Virginia Water Central

Virginia Water Resources Research Center Blacksburg, Virginia June 2009 (No. 49)

Larvae and pupae of the mosquito *Aedes vexans* fill a puddle in a tire track on the Virginia Tech campus, June 10, 2009. Inset shows larva (left) and pupa (right). Virginia's very wet spring provided many such mosquito habitats in ruts, depressions, tires, cans, and other places. For more on mosquitoes, please see the Science Behind the News article. For fewer mosquitoes, don't allow water to collect and stand in containers or structures! *Water Central* thanks Sally Paulson, Virginia Tech Entomology Department, for identifying the mosquito species.

IN THIS ISSUE

VirginiaTech
Invent the Future

S^2 on H_2O

Mountaintop Removal Mining and Southwestern Virginia's Streams

By Stephen Schoenholtz, Director
Virginia Water Resources Research Center

Coal mining plays an integral role in the economy and culture of the Appalachian coalfields in Virginia as well as in Kentucky, Ohio, Pennsylvania, Tennessee, and West Virginia. The coal industry has always provided both promise and peril to the local communities in this region, and nearly half of the nation's electricity currently comes from coal. In recent years, developments in mining technology and economics have led to an increased use of the practice of mountaintop-removal mining in the Appalachian region, which involves removing the tops off mountains to expose underlying coal seams. Impacts of this practice, however, include eliminating forests and generating so-called "valley fills": filling headwater streams with the displaced rock, soil, and other debris that was blasted away to expose the coal.

The Obama administration recently announced steps that may change or potentially ban mountaintop-removal mining in order to protect water resources. In March, the U.S. EPA halted several mountaintop mining permit applications in order to review the water-resources impacts of such permits. In June, the Obama administration announced an unprecedented interagency action plan to reduce environmental impacts of mountaintop coal mining. These and other developments—such as climate-change legislation now in the Congress—have increased the focus on issues related to coal mining, including U.S. dependence on foreign oil, jobs, electricity prices, environmental impacts, and community impacts. With so much at stake, there is a pressing need to base policy decisions on sound science, including an improved understanding of the impacts of mountaintop-removal mining on water resources.

To this end, the Virginia Water Resources Research Center has embarked on two new research projects in headwater streams affected by coal mining in southwestern Virginia. One project, funded by the Virginia Department of Environmental Quality, the Virginia Department of Mines, Minerals and Energy, and Virginia Tech's Powell River Project, is investigating associations between total dissolved solids (TDS) and aquatic benthic macroinvertebrates (insects and other organisms that live on stream bottoms). High levels of TDS are often found in stream water originating from areas exposed to coal mining, and benthic macroinvertebrates are a key indicator of stream health. A second project, funded by Virginia Tech's Institute for Critical Technology and Applied Science and the Powell River Project, is evaluating measurements of hydrological and ecological functions in streams undergoing restoration activities following coal-mining impacts. Efforts to restore stream structure and function following coal mining are relatively recent (mostly within the past five years), and many questions have been raised as to effectiveness of these practices. Both of these research efforts are aimed to provide objective scientific information to policy makers and to those involved in the debate surrounding mountaintop-removal mining. [*Ed. note*: A review of recent regulatory developments related to mountaintop mining is on page 28 of this *Water Central*.]

TEACHING WATER
Especially for Virginia's K-12 teachers

This Issue and the Virginia Standards of Learning

Below are suggestions for Virginia Standards of Learning (SOLs) that may be supported by items in this issue. The SOLs listed below are from Virginia's 2003 Science SOLs and 2001 Social Studies SOLs. Abbreviations: BIO = biology; ES=earth science; GOV = Va. and U.S. government; LS = life science; WG = world geography.

Newsletter Section	Science SOLs	Social Studies SOLs
Feature: Recreational Water Quality	6.5, 6.7, LS.12, ES.9, ES.11, BIO.9	WG.2, GOV.8, GOV.9
Science: Mosquitoes and Water	3.8, 4.5, 6.5, 6.7, 6.9, LS.5, LS.7, LS.9, LS.10, BIO.5, BIO.7, BIO.9	WG.2, WG.7
Water Status (precipitation, groundwater, stream flow, and drought)	4.5, 4.6, 4.8, 6.5, 6.7, LS.7, LS.12, ES.7, ES.9, ES.13	WG.2

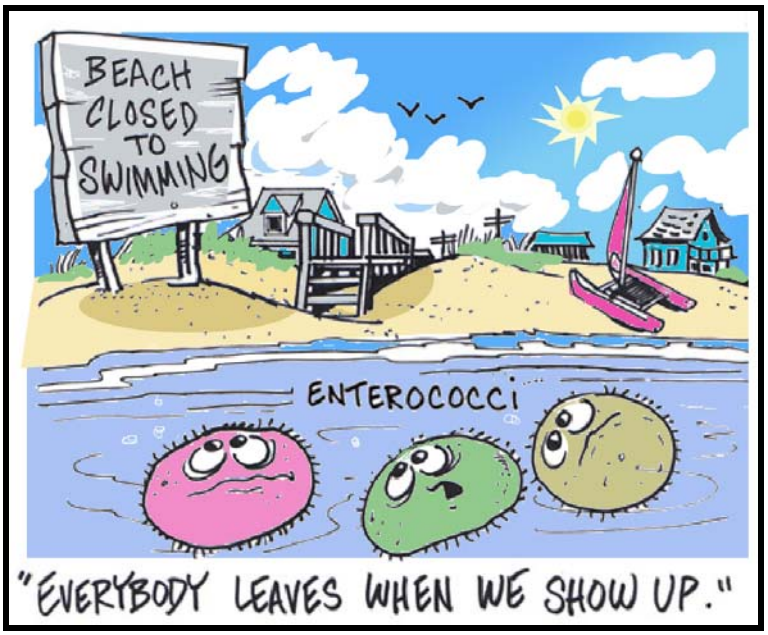
FEATURE ARTICLE

Resources for Recreational Water Quality

By Jane Walker, research associate at the Virginia Water Resources Research Center.

[Ed. note: The article was originally published in May 2009 in Water Center's online feature, "The Water Cooler," available at www.vwrrc.vt.edu/watercooler_may09.html. The cartoon was originally published in "Beaches and Bacteria" in the August 2004 issue of *Virginia Water Central*. All Web sites listed were functional in this article were functional as of 7/2/09.]

During this season of warm weather and outdoor water recreation, it is particularly important to know and follow healthy behaviors when in contact with water bodies. The federal Centers for Disease Control and Prevention (CDC) defines "recreational water illnesses" as those caused by ingesting, inhaling vapors of, or having contact with contaminated water in swimming pools, water parks, spas, interactive fountains, ponds, lakes, rivers, or oceans.[1] This article identifies sources of information on how recreational water users can avoid water-borne illnesses.



Beach Monitoring Activities and Advisories in Virginia

Bacteria levels in Virginia's beach waters are monitored at 44 public beaches on the Chesapeake Bay and Atlantic Ocean during the swimming season (May-September). The Virginia Department of Health's (VDH) "Beach Monitoring" Web site, at www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring/, has information about current swimming advisories and monitored beaches in Virginia, beach advisory and monitoring data, links to local beaches, local health department contacts for beach monitoring, and more.

To help protect your health, the VDH Beach Monitoring Web site recommends that you take these simple steps:

- Observe swimming advisories and do not enter the water at a beach under an advisory;
- Swim well away from fishing piers, pipes and drains, as well as water flowing from storm drains onto a beach;
- Do not dispose of trash, pet waste, or dirty diapers on a beach.

[1] Centers for Disease Control and Prevention, "Notice to Readers: Recreational Water Illness Prevention Week: May 18-24, 2009," online at www.cdc.gov/mmwr/preview/mmwrhtml/mm5818a8.htm (accessed May 21, 2009).

"Beaches and Bacteria" from *Virginia Water Central*

This article, published in the August 2004 issue (issue #31) of *Virginia Water Central*, provides information about the causes of beach closures, the regulations and legislation behind them, and the role of bacteria in beach water-quality monitoring. To read this article online, please go to www.vwrrc.vt.edu/pdfs/newsletter/031Aug2004onecol.pdf; the article is on pages 11-16 of the issue. If you do not have Internet access, please contact *Water Central* at (540) 231-5463 to request a photocopy.

Topics covered by the article:

- The Beaches Environmental Assessment and Coastal Health (BEACH) Act;
- Virginia's bacteria standards;
- The types of indicator organisms monitored at Virginia's beaches;
- How people responsible for beach closures/advisories decide what is safe;
- The difference between a beach advisory and a beach closure;
- What it means to close a beach preemptively;
- Bacteria Source Tracking.

"Safely Enjoying Virginia's Natural Waters" from the VDH

This VDH brochure focuses on Virginia's natural waters—its ocean waters, bays, rivers, streams, and lakes. The brochure describes water quality as it relates to recreational activities and addresses such questions as the following:

- What kinds of organisms are present in natural waters and what are the sources of these organisms?
- Why should we avoid natural waters after a heavy rain?
- What are the health risks associated with recreating in natural waters?
- How is the health risk from natural waters determined?

In addition, the brochure provides advice on ways to recreate safely in natural waters. The brochure is available online at www.vdh.virginia.gov/Epidemiology/DEE/BeachMonitoring/ (a Spanish version is also available at that link). [*Ed. note: Virginia Water Central* has reproduced this brochure, in English and Spanish, in this issue's "Water Quality and You" section.]

Swimming and boating are inviting summer activities on many Virginia water bodies, such as the James River shown above. Please be sure to stay safe while you have fun!

Regulations for Public Pools and Spas in Virginia

The VDH's Web page, "Swimming Pool Regulations Governing the Posting of Water Quality Results" (available at www.vdh.virginia.gov/EnvironmentalHealth/Food/Regulations/PostingWaterQuality/index.htm) provides access to the chapter in the *Virginia Administrative Code* (12 VAC 5-462-10 *et seq*.) that governs the posting of water quality results for public swimming pools and spas. The purposes of the regulation are the following:

- Ensure that owners or operators of all public swimming pools post daily water quality test results and water quality standards so that users are informed of pool conditions that affect the public health, welfare, and safety.
- Guide the owner or the agent in the requirements necessary to ensure safe pool maintenance including pH level, disinfectant type and concentration level, and water temperature.
- Establish the recommended standards for the safe and sanitary maintenance of public swimming pools, including the safe levels for pH, chlorine, bromine, and water temperature for spas.

The table below documents the minimum and maximum free chlorine and bromine residuals, pH values, and water temperatures that are to be maintained in Virginia's public pools and spas (**ppm** stands for parts per million.)

Water Quality Standards for Public Pools and Spas in Virginia (12 VAC 5-462-290)

POOLS	**MINIMUM**	**MAXIMUM**
Free Residual Disinfectant: Chlorine	1.0 ppm*	3.0 ppm
Free Residual Disinfectant: Bromine	2.0 ppm	4.0 ppm
pH	7.2	7.8
Temperature	None	104°F / 40°C (heated pools only)
SPAS		
Free Residual Disinfectant: Chlorine	2.0 ppm	10.0 ppm
Free Residual Disinfectant: Bromine	2.0 ppm	10.0 ppm
pH	7.2	7.8
Temperature	None	104°F / 40°C (heated pools only)

***ppm = parts per million.

Source: Va. Department of Health, "Swimming Pool Regulations Governing the Posting of Water Quality Results, www.vdh.virginia.gov/EnvironmentalHealth/Food/Regulations/PostingWaterQuality/index.htm (accessed 7/1/09).

Healthy Swimming Information from the Centers for Disease Control

The CDC's "Healthy Swimming" Web site, available at www.cdc.gov/healthyswimming/, has information for swimmers, pool operators, public health professionals, and travelers (also available in Spanish).

Water-quality topics covered on the site include the following[2]:

Healthy Swimming A-Z Index;
Water-associated Illnesses A-Z Index;
Recreational Water Illnesses: What, Where, How, Why, Who, How to Prevent;
Health-promotion and Illness-prevention Materials (brochures, fact sheets, podcasts, posters, videos/TV);
Training and Education (for pool operators and health inspectors)
Design and Operation Guidelines;
Disinfection and Remediation Guidelines;
Outbreak Response;
Ocean, Lake, and River Swimming;
Disease Tracking/Surveillance; and
Resources by State.

[2] The site also provides information on other aspects of water safety, including preventing drowning, safe boating, preventing electrocutions in or around pools; and guidelines for preventing harmful effects from sun exposure.

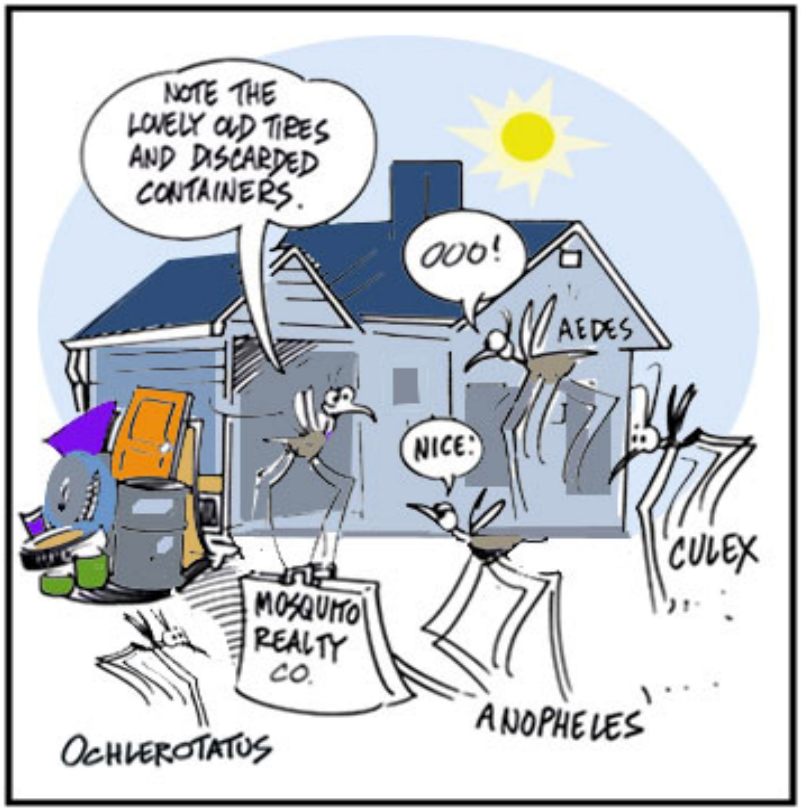
SCIENCE BEHIND THE NEWS

Mosquitoes and Water

By Alan Raflo, David Gaines, and Eric Day.

David Gaines is State Public Health Entomologist for the Virginia Department of Health. Eric Day manages the Insect Identification Lab for the Department of Entomology at Virginia Tech.

[*Ed. note:* This article was originally published in the March 2003 issue of *Virginia Water Central*. The following version was reviewed and updated by the authors in June 2009. All Web sites listed were functional as of 7/3/09.]



"Loudoun County mosquitoes test positive for malaria," Associated Press, 9/30/02.
"Dead birds at MCV are tested; West Nile Virus raises concern for human ills," *Richmond Times-Dispatch*, 10/3/02.
"Gloucester man dies from Eastern Equine Encephalitis," Associated Press, 9/26/03.
"Beach officials warn mosquito-borne EEE virus is more active," *Virginian-Pilot*, 9/9/06.
"West Nile season mildest in 7 years," *Richmond Times-Dispatch*, 9/26/08.
"West Nile found in mosquitoes across Fairfax County," *Richmond Times-Dispatch*, 6/9/09.
"Mosquito populations soar after weeks of wet weather," *Virginian-Pilot*, 6/19/09.

Since the summer of 2002, mosquitoes have often been in the news. Much of the coverage has been due to the spread of **West Nile virus** (WNV) in the United States and Virginia. WNV is a **pathogen** (a disease-causing organism) that can be transmitted by certain species of mosquitoes. Starting in August 2002, the number of reported cases of the disease steadily increased in Virginia and in many other states. In the 10 years since WNV's introduction into the Unites States (as of June 2009), the federal Centers for Disease Control in Atlanta had recorded 28,963 human cases of the disease in 47 states and the District of Columbia, including 1,131 fatalities. In Virginia, a total of 78 WNV cases have been reported since 2002, with five fatalities.

But West Nile virus is not the only mosquito-borne disease of concern to Virginia. The **La Crosse encephalitis** virus has infected an average of about two persons per year (mostly children under the age of 15

years) in Virginia since 1995. La Crosse encephalitis mostly occurs in the mountain regions of Virginia and may be fatal, but also may cause learning disabilities or even retardation in afflicted children. The **Eastern equine encephalitis** virus periodically causes a fatality (five fatalities in the past 30 years) in Virginia's coastal regions. In the past decade Virginia has had two outbreaks of mosquito-transmitted **malaria**, as well as numerous imported cases of malaria and **dengue fever** that could potentially be picked up and transmitted by mosquito species found in Virginia. Finally, Virginia has had one case of **chikungunya fever**, a newly emerging mosquito-borne viral disease which has spread widely across Africa and Asia in the past few years and which caused a major disease outbreak in northern Italy in 2007.

This article aims to help you be better informed about and prepared for mosquitoes. The article describes how mosquitoes are connected to water resources, what Virginia localities do to control mosquitoes, and what citizens can do to reduce their potential for exposure to these widespread, annoying, and sometimes dangerous insects.

Life Cycles Tied to Water

A bit of scientific classification is necessary to make distinctions among the many kinds of mosquitoes, their habits, and their impacts.[3] Mosquitoes are, of course, insects, and they are grouped with other insects whose *adults have only two wings* in the insect **order** called Diptera ("di-" meaning two and "ptera" from the Greek word for wing). This order contains the insects known as the "true flies" (the word "mosquito" is the diminutive form of the Spanish and Portuguese word "mosca," meaning "fly.") Within this order, mosquitoes are classified as a separate **family**, Culicidae. The next major classification level under family is a **genus**, and within a given genus are one or more **species**; later we will focus on several mosquito genera (plural of genus) and species that are particularly important in Virginia.

Like many other familiar insects, mosquitoes undergo a life cycle known as **complete metamorphosis**, including **egg**, **larva** (plural "larvae"), **pupa** (plural "pupae") and **adult** stages.[4] *All mosquitoes require a water habitat for their larvae and pupae.* One Virginia entomologist described the variety of breeding habitats used by mosquitoes as follows:

> "Mosquito larvae can live in almost every type of still-water habitat [including natural habitats such as] woodland pools, marshes, swamps, ponds, lakes, and backwaters and pools of streams and rivers, [as well as human-created habitats such as] automobile tires and food and beverage containers."[5]

Other authors add this description of mosquitoes' habitat versatility:

> "Great swarms may be produced from practically all sorts of still water, fresh and brackish, foul or clear; water in tin cans, car and airplane tires, hoof prints, tree holes, [and] deposits in leaf cups; [and] the margins of streams rivers, lakes, and water impoundments."[6]

Temporary habitats like water-filled containers can provide breeding habitat for mosquitoes because a *mosquito's life cycle is typically short*. In warm weather, the cycle runs from only a few days to two weeks, with usually 7 to 10 days a typical period (although it may span several months in some species and some circumstances). A short life cycle also makes possible several generations per year (as in most species).

Let's look more closely at the stages of the mosquito life cycle, beginning with the most familiar stage, the adults.

Adult. Using their brushy antennae to detect sound, male mosquitoes are attracted to females for mating by the sound of females' beating wings. In the mosquito species that are of most importance to humans—the species that bite humans and economically valuable animals—fertilized eggs require a protein found in blood to grow and develop properly.[7] Accordingly, females need a *blood meal before egg laying* (females eat nectar or plant juices for other activities) (Males do not have mouthparts adapted for blood feeding, so males do not bite.)

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[3] About 3000 mosquito species occur worldwide, according to Robert Harwood and Maurice James, Entomology in Human and Animal Health (New York: Macmillan), p. 171.

[4] Butterflies and moths provide a familiar example of complete metamorphosis in insects, with larvae known as caterpillars and pupae of many species encased in a silken cocoon.

[5] J. Reese Voshell, Jr., *A Guide to Common Freshwater Invertebrates of North America* (Blacksburg, Va.: McDonald and Woodward, 2002), p. 415.

[6] Harwood and James, *Entomology in Human and Animal Health*, p. 169.

[7] In one subfamily of mosquitoes, the eggs do not require blood for development, so adult females feed only on flowers.

Two groups of mosquitoes—classified as **subfamilies**—have blood-feeding females. One is the Culicinae, containing most of the U.S. mosquito species and particularly the important genera *Aedes* and *Culex*. The other is the Anophelinae, containing in the United States only one, very important genus, *Anopheles*. In most species, the female feeds on blood of mammals or birds, but some species will select fish, amphibians, reptiles, or the larvae of other insects. Most species feed on animals other than humans, but some species do prefer humans.

Egg. Females lay eggs either singly or in groups (called "rafts") of up to several hundred. In some species, females lay their eggs either directly onto the surface or along the edges of pools or other quiet water. Other species, however, lay their eggs in various kinds of areas that will become covered by water *at some later time*, either from rainfall, tides, or flooding. (Some species, for example, lay their eggs in tree holes that will eventually fill with rainwater.) Some species in the genus *Aedes* lay eggs during summer and fall; the eggs remain under snow for the winter and hatch when melted snow provides suitable habitat for the larvae. The eggs of floodwater species do not necessarily hatch all at once. Although typically most will hatch with the first flooding, some remain until later submergences (with some species even taking as long as four years of intermittent flooding before hatching).

Eggs of some species can survive for months or even years; this requires that they be kept moist in some species, but other species have eggs that can survive for months even in dry conditions.[8]

Larva. Mosquito eggs hatch into larvae, known as "wrigglers" because of their active movement pattern. Larvae go through several periods, called **instars**, as they grow and prepare to enter the pupa stage. Larvae in the two blood-feeding subfamilies develop in about seven days (in Culicinae) or a bit longer (in Anophelinae), if conditions such as temperature and food supply are suitable. Larvae of other species, however, may take several months to develop.

Pupa. Ultimately a larva forms a pupa, a non-feeding stage. Mosquito pupae, compared to the pupae of some other kinds of insects (butterflies and moths, for example), are relatively active. When disturbed, mosquito pupae descend in a rolling fashion from the surface to deeper water, hence the name "tumblers." As with larvae, the length of the pupa stage varies among species from two days to about two weeks, but the typical duration is two to three days.

And Back to Adult. At the end of the pupa state, a new adult emerges. During normal summer activity, adult males live up to one week, females two to four weeks. While many species survive the winter in the egg stage, some species overwinter as adults.

The Next Time a Mosquito Lands on Your Arm…

…you might take a few seconds to see if you can determine its classification group. The two subfamilies of blood-feeding mosquitoes can be distinguished by the *adults' resting position*. Species in the Anopholinae group typically rest with their body and *proboscis* (the needle-like mouthpart used for piercing flesh and sucking blood) in nearly a straight line at an angle to the surface (somewhat the appearance of standing on its head). Species in the Culicinae group typically rest with their body parallel to the surface but the proboscis bent toward the surface. For a good illustration of this difference, see p. 267 of *A Field Guide to the Insects*, by Donald Borror and Richard White (Houghton Mifflin, 1970) or another general reference on mosquitoes.

Impacts of Mosquitoes

In the 1979 book *Entomology in Human and Animal Health*, authors Robert Harwood and Maurice James devote 65 out of 463 pages to mosquitoes, more space than to any other single group of insects. This was for good reason:

> "Mosquitoes are the most prominent of the numerous kinds of bloodsucking arthropods[9] that annoy man, other mammals, and birds…Losses resulting from lowered productivity of industries concentrating on outdoor activities are frequently considerable because of mosquito annoyance…These losses must be added to widespread suffering and death due to mosquitoes as vectors of pathogens causing disease."[10]

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[8] Eggs of *Aedes aegypti*, which transmits yellow fever, can survive up to a year under dry conditions, according to Harwood and James, *Entomology in Human and Animal Health*, p. 183

[9] Arthropods are a large group of animals, including insects, spiders, and crustaceans, which have in common these key features: no backbone (invertebrate), an external skeleton, and jointed limbs.

[10] Harwood and James, *Entomology in Human and Animal Health*, p. 169.

Mosquito annoyance is, of course, familiar to anyone who has been bitten, harassed by persistent whine, or driven from a recreation area. Less familiar, perhaps, are the many ways that these insects, when in great numbers, can annoy animals; examples include disruption of bird nesting, effects on migratory activities of reindeer and caribou, reduced weight gain in livestock, and reduced milk production by dairy cows.[11] The following quote about *Aedes nigromaculis*, a species found in the western and central United States, captures the essence of mosquito annoyance:

"Swarms of these fierce daytime biters may bring recreational activities and normal behavior of livestock to a virtual standstill."[12]

The impacts of mosquitoes as annoying little creatures or as annoying huge swarms are considerable. But even more crucial is the role of mosquitoes as a disease **vector**, that is, as a route for the transmission of disease-causing organisms. We turn now to that unpleasant topic.

Mosquitoes and Disease

Several factors make mosquitoes highly effective vectors of human disease: they breed abundantly; they are easily infected by one or more pathogens; their bodies provide favorable conditions for pathogen development; they feed readily on humans; they invade human homes; and their normal life span allows time both for pathogens to develop and for the insects to feed on humans repeatedly.[13]

Mosquitoes are vectors of three general kinds of pathogens:

- single-celled animals (or Protozoa), particularly the four species of *Plasmodium* that cause malaria;
- immature forms of parasitic worms known as **filarial worms**, which cause serious diseases of the human lymph system; and
- viruses, including those that cause yellow fever, various types of encephalitis, West Nile disease, and many others.

Tropical areas of the world endure much more mosquito-transmitted disease than do more temperate areas. Malaria, yellow fever, and filarial worms remain serious problems for large parts of the world, but in the United States malaria appears only sporadically, while neither yellow fever nor filariasis occur here.[14] (Please see the accompanying box on the next page, "Malaria in Virginia.")

Other mosquito-borne diseases, however, especially the viral diseases, do cause problems in the continental United States. Mosquito-borne disease is due *primarily* (but not completely) to species within three mosquito genera: *Aedes*, *Anopheles*, and *Culex*. We offer some basic information about these mosquitoes here, and the next section will include information about particular species of importance in Virginia.[15]

- ***Aedes.*** This genus once contained about half of all North American mosquito species, but recently the majority of these species have been moved into a new genus known as *Ochlerotatus*. In Virginia, 21 of the 25 species classified in the *Aedes* genus are now classified as *Ochlerotatus* species. Breeding areas for different species include salt marshes, floodplains, snowmelt, tree holes, water from irrigation, and containers and other human-generated habitats. Most species bite in the evening, but some bite during the day. *Aedes aegypti* is the carrier of yellow fever; several species transmit other viral diseases.

Continued after box on next page

[11] Ibid.

[12] Ibid., p. 180.

[13] Harwood and James, *Entomology in Human and Animal Health*., p. 197.

[14] For many years after European colonization, both malaria and yellow fever were serious problems in North America. As recently as the 1930s there were several million malarial cases in the continental United States. Yellow fever, transported to the Americas along with its mosquito vector (*Aedes aegypti*) in slave ships in the 1500s, affected large parts of this country until successful mosquito-eradication efforts were completed in the early 1900s.

[15] The information about these genera comes mainly from Harwood and James, *Entomology in Human and Animal Health*, pp. 177-198.

Malaria in Virginia, From Time to Time

To persist in an area, the single-celled *Plasmodium* organisms that cause malaria need a "reservoir"—that is, a host organism where populations of the parasite survive over time. In many parts of the world, infected monkeys, apes, and humans serve as reservoirs, but in North America the only significant reservoirs are 1) infected humans who have come from countries where malaria is endemic, or 2) *Anopheles* mosquitoes that have bitten such people. In the United States, most of the locally transmitted malaria cases involve the pathogen *Plasmodium vivax,* which can lie dormant in an infected person who shows no symptoms (an "asymptomatic carrier"). Because no symptoms arise, such a person may never realize they carry the pathogen and consequently never seek treatment to remove it. (Other malarial pathogens, such as *P. falciparum,* cause such severe illness that infected persons quickly seek treatment.) Mosquitoes that bite a carrier can then become infected with the malaria parasite and transmit the pathogen to other people who then develop symptoms of the disease.

In July 1998, a woman in Westmoreland County became ill and was determined to have been infected with *P. falciparum* malaria. As she had never traveled outside the United States and no other explanation could be found for her infection, it became evident that she had contracted malaria from the bite of a *local* mosquito. It was subsequently hypothesized that the mosquito had been infected by feeding on someone from a group of Haitian migrant workers who had resided on a nearby farm (*P. falciparum* malaria is endemic in Haiti). In spite of efforts to locate the source of the malaria, no infected worker was ever located.

In late summer 2002, three people in a Loudoun County neighborhood contracted malaria (one of the patients lived across the street from a residence frequented by the second and third patient). Two of the patients became ill in August 2002 and the third patient became ill in March 2003. It was later determined that the third patient had spent time at the residence visited by the second patient during the previous August and that the third patient had a delayed onset of malaria. All three patients were found to have been infected with the same variety ("strain") of *P. vivax* from Latin America (the Centers for Disease Control used samples from all patients to compare the genetic "fingerprint" of the pathogens). The neighborhood where the malaria was contracted is heavily populated with immigrants from El Salvador (malaria occurs in the most southern parts of Mexico and many Central American countries). This neighborhood is adjacent to a creek, and drought conditions in summer and fall 2002 had dried this creek down to a series of stagnant pools that were breeding large numbers of *Anopheles quadrimaculatus*, a vector of malaria.

Source: David Gaines, Virginia Department of Health/Office of Epidemiology, June 2009.

Continued from page 9

•***Anopheles.*** The genus contains nearly 400 species worldwide but only about 15 species in North America. Breeding habitat varies considerably, even among species that are very similar physically. Different species transmit malaria in different regions: *Anopheles quadrimaculatus* in the eastern, central, and southern parts of the United States; *Anopheles freeborni* in the southwestern United States; and many other species in other parts of the world. The preferred breeding habitat for *Anopheles quadrimaculatus* includes clean, still water with floating vegetation or debris, some sunlight, and some shade.

•***Culex.*** The genus contains the common house mosquito, *Culex pipiens*, found worldwide and capable of transmitting encephalitis as well as other diseases, including dog heartworm. Females of this species will lay eggs in all kinds of still water and human-made containers; good breeding conditions can produce huge numbers.

Mosquitoes in Virginia: Important Virginia Species and Their Impacts

Of 166 North American species of mosquitoes, at least 57 species are currently known to occur in Virginia, and 25 species occur commonly, according to the Virginia Mosquito Control Association. Among the more common species, seven have greater potential for disease transmission than other mosquito species (Table 1, next page).

Table 1. "Top Seven" Potential Mosquito Disease Vectors in Virginia.

Species	Diseases Transmitted	Special Problems
Aedes albopictus	West Nile virus, La Crosse encephalitis, eastern equine encephalitis, dengue fever, & chikungunya	Most common container breeder found around homes; daytime biter; will enter homes and bite indoors at night.
Aedes vexans	West Nile virus, & eastern equine encephalitis	Very common evening biter; bites during daylight hours during the fall months.
Anopheles quadrimaculatus	Malaria	Will enter homes and bite indoors at night.
Culex erraticus	West Nile virus	Second most likely human biting *Culex* species to be infected with West Nile virus in Virginia.
Culex pipiens	West Nile virus & St. Louis encephalitis	Very common container breeder found around homes; will enter homes and bite indoors at night.
Culex salinarius	West Nile virus, St. Louis encephalitis, eastern equine encephalitis	Will enter homes and bite indoors at night.
Ochlerotatus triseriatus (formerly *Aedes triseriatus*)	La Crosse encephalitis & West Nile virus	Container breeder; daytime biter found around homes; passes La Crosse virus to its offspring trans-ovarially (via eggs).

Source: David Gaines, Virginia Department of Health/Office of Epidemiology, June 2009.

Found statewide, six of the seven species can carry one or more viral diseases—specifically West Nile disease, La Crosse encephalitis, St. Louis encephalitis, and eastern equine encephalitis—and one can carry malaria. Various other mosquito species also can carry viral diseases, but the seven listed in Table 1 pose special problems. First, they are common, or at least locally common. Second, they are more likely than other species to be infected with their associated pathogens. Third, several behavioral habits of species on this list increase their chances of interacting with humans: three species are daytime biters, three breed in containers which are commonly found around homes, and four species will enter homes and bite people while indoors at night. Finally, one species passes on its viral pathogen to a significant number of its offspring trans-ovarially (directly to the eggs).

Beneficial Aspects of Mosquitoes

While most mosquito larvae feed upon debris or microscopic organisms in water or sediments, some species (found in two genera, *Toxorhynchites* and *Psorophora*) eat other mosquito larvae. Other benefits include mosquito larvae serving as a food source for fish and other aquatic insects; adult mosquitoes being used for food by various birds and other insects, such as dragonflies; and adults helping to pollinate flowers in which they seek nectar. One might also make a case that mosquitoes' blood-feeding activity (and the resulting disease) has broad ecological or evolutionary importance—but that's a case for another day.

Mosquito Control

Large-scale mosquito control[16] has been the focus of extensive research resulting in comprehensive manuals on the subject. Three approaches are widely used: eliminate breeding areas by various environmental modifications; apply chemicals to water surfaces to kill larvae or pupae; or spray insecticides to kill adults. A less common approach is to use natural predators of mosquitoes, either by *adding a predator* like the Mosquitofish (*Gambusia affinis*) to a water body or by *modifying a habitat* to enhance native predators like birds or other insects. The accompanying box (next page), "Wetlands and Mosquitoes," provides an example of this latter approach.

[16] Recognizing a worthy foe, professionals in mosquito control often refer to their field as mosquito *abatement*, an acknowledgment that actual "control" of mosquitoes is often not feasible.

Wetlands and Mosquitoes—Good, Bad, or It Depends?

One debate within the world of mosquito control concerns the impact of wetlands. In many cases in the past, people viewed marshes and other wetlands only as barriers to agriculture or development and as mosquito nurseries to boot. Since at least the 1980s, however, the beneficial ecological and water-quality aspects of wetlands have received widespread attention. In contrast to temporary mosquito-breeding habitats such as water-filled tires or containers, wetlands—while certainly providing breeding areas for mosquitoes—can at the same time provide habitat other than just still water, habitat that can support dragonflies, damselflies, and other insects that may prey upon mosquitoes.

Some communities have used enhancement of fairly large areas of marsh habitat to increase populations of mosquito predators. New Jersey uses a technique of Open Marsh Water Management, which seeks to eliminate breeding depressions and increase natural predators, without use of insecticides. One example from the Cape May Mosquito Extermination Commission: in 1969 the commission implemented the method on a 548-acre marsh, and 25 years later the marsh still had not needed maintenance, cleaning, or pesticides. Use of this method saved the locality an estimated $669,000 over the 25 years.

Source: Indiana Department of Natural Resources, "Did You Know?...Healthy Wetlands Devour Mosquitoes," fact sheet located at http://www.in.gov/dnr/fishwild/files/hlywet.pdf.

For more on mosquito-control practices in wetlands, please see *Best Management Practices for Mosquito Control and Freshwater Wetlands Management*, online at http://www.rci.rutgers.edu/~insects/fresh.htm; or contact the New Jersey State Mosquito Control Commission, CN 400, Trenton, NJ 08625-0400; (609) 292-3649.

Control methods are most effective when adequate *monitoring* of mosquito populations occurs. Monitoring (or "surveillance") involves being aware of environmental conditions that affect mosquitoes and using sampling techniques to determine the presence and abundance of mosquito species.

Let's look now at some large-scale mosquito-control efforts in Virginia.

Mosquito-control Efforts in Virginia

Co-author David Gaines, of the Virginia Department of Health's Office of Epidemiology, coordinates a program to inform Virginia localities about mosquito issues and appropriate control approaches. Below, Mr. Gaines summarizes large-scale mosquito-control efforts in Virginia. His comments cover the local responsibility for mosquito control in Virginia, his program's educational efforts, typical control practices in Virginia, and an example of a less-typical control practice being tried in the state.

On local responsibility: The *Code of Virginia* requires that all mosquito control be funded and managed as a part of local government. No state funds support mosquito surveillance or control and currently no federal funds are available for control. Most control programs in the state are mosquito-control districts run by local mosquito-control commissions. There are also a number of programs run by county or city public works programs and a few programs run by county or city health departments.[17]

On the state-level program: The VDH Office of Epidemiology's program focuses on promoting surveillance for mosquito-borne viral diseases and mosquito-control programs to health departments or local governments statewide. The program's entire budget comes from a grant from the Centers for Disease Control for West Nile virus surveillance and public education. The VDH's promotion campaign has mostly consisted of regional presentations for government officials on West Nile virus, mosquito biology, mosquito surveillance, and the technical and material requirements for implementing a mosquito-control program.

[17] Alexandria, Chesapeake, Fairfax County, Hampton, Henrico County, Newport News, Norfolk, Portsmouth, Prince William County, Suffolk, Virginia Beach, and York County all have full-time mosquito-control programs with surveillance, control, and public education. The following localities have part-time programs:, Buena Vista, Chincoteague, Courtland, Gloucester County, Lexington, West Point and a number of smaller towns on the Eastern Shore. Fairfax County uses a mosquito control contractor.

The VDH's efforts stress the need for surveillance: local governments need a surveillance program to identify and quantify their local mosquito problem areas before they can plan and invest in a control program. After that, the surveillance program should provide a way of appropriately targeting control measures.[18]

On typical mosquito-control practices: Most mosquito-control efforts in Virginia consist of the following (listed from first to last in order of effort and budget): maintaining drainage ditches, larviciding (applying pesticides to water to kill larval mosquitoes), and fogging (using air-borne aerosol insecticides to kill adult mosquitoes). Most of Virginia's established control programs are located in the Hampton Roads region, where terrain is flat and poorly drained and ditches are an important part of floodwater management. The Hampton Roads region has relatively large urban and suburban human populations and without mosquito control large numbers of people would be exposed to the mosquitoes breeding in water accumulations on the flat terrain. There are also several control programs in the more heavily urbanized counties and cities of northern Virginia and in the Richmond area; these non-coastal, urban programs mainly use larvicides targeted at stormwater drainage systems.

On other control approaches used in Virginia: The York County Mosquito Control Program has a Mosquitofish (*Gambusia affinis*) hatchery to produce fish for use in their control program. The Virginia Department of Game and Inland Fisheries (DGIF) imposes restrictions on the use of Mosquitofish, including requiring that Mosquitofish not be stocked in water bodies that provide habitat for game fish.[19] Counties that want to use Mosquitofish must first provide DGIF with a list of the locations where they plan to use the fish. After review of the proposed sites, DGIF decides whether or not to issue a use permit to that county. The VDHs' Office of Epidemiology considers Mosquitofish an appropriate option in places such as stormwater management ponds, backyard ornamental pools, and animal-watering troughs.

Reducing Your Exposure to Mosquitoes

In Virginia, mosquitoes are active generally from March to November, that is, when daytime temperatures are consistently above 50 degrees F (depending on one's location within the state). During that time, a variety of actions can help you reduce your exposure to mosquitoes. Such actions are generally of two kinds: 1) those that help prevent bites from existing mosquitoes; and 2) those that reduce mosquitoes' breeding areas (based on the aquatic life of mosquito larvae and pupae). The lists below compile mosquito-avoidance recommendations from the following sources:
Centers for Disease Control, at http://www.cdc.gov/ncidod/dvbid/westnile/prevention_info.htm;
Virginia Mosquito Control Association, at http://www.mosquito-va.org/; and
Virginia Department of Health. at http://www.vdh.virginia.gov/Epidemiology/DEE/Vectorborne/WestNile/.

1. Protecting Oneself from Mosquito Bites

- Install or repair window and door screens.
- If possible, avoid outdoor activity at dawn and dusk—the times when mosquitoes bite most actively.
- If possible, wear a long-sleeved shirt and long pants when outdoors.
- Wear light-colored, loose-fitting clothing—mosquitoes are attracted to dark objects and can more easily reach your skin through tight clothing.
- When outdoors with an infant in a high-mosquito area or at peak biting times, place mosquito netting over the infant's carrier.
- If you use a mosquito repellent (or *any* insecticide), read and follow the manufacturer's *directions for use*, printed on the product. Mosquito repellents approved for use on skin by the CDC and the U.S. EPA include one of the following three active ingredients: Picardie, oil of lemon eucalyptus, or DEET.
- Apply *sparingly* to exposed skin an insect repellent containing the compound DEET. Adults should use a product with no more than 50 percent DEET (VDH recommendation); children, one with no more than 10-30 percent DEET (American Academy of Pediatrics recommendation, at CDC Web site). The CDC notes that a higher percentage of DEET in a repellent increases the length but not the degree of protection (and concentrations higher than 50 percent do not increase the length of protection).
- *Do not* use a DEET-containing product if you are pregnant, nor on infants.

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[18] In Virginia localities with formal mosquito programs, surveillance activities include the use of traps that catch females seeking a place to lay eggs, light traps baited with carbon dioxide for monitoring adults, dip-sampling into water for monitoring larvae, and monitoring of landing rates on humans (the latter technique is not widely used).

[19] Restrictions are placed on the use of the Mosquitofish because of the potential for populations of this fish to increase or to spread to other locations and displace other species (particularly game species).

- *Do not* apply repellent near eyes or mouth, nor to children's hands (as they may apply it to their eyes or mouth).
- With repellents in a spray container, *do not* spray repellent to the face. Spray on hands, then apply to face.
- *Do not* apply an insect repellent over cuts or other open wounds, nor on sunburned or irritated skin.
- After your outdoor activity, wash off insect repellent.
- Repellents containing either permethrin or DEET can be applied to clothing. If you spray clothing, it is not necessary to spray repellent containing DEET on the skin under the clothing. *Do not* apply a repellent containing *permethrin* to exposed skin.

2. Reducing Mosquito-Breeding Areas

- Remove unneeded outdoor items that can collect water, such as old tires and plastic containers.
- Drill holes in tires being used for playground equipment.
- Store bottles and other containers being saved for recycling in a covered trash can or sealed bag.
- Cover garbage cans.
- Once or twice a week, empty outdoor items that can collect water: plant pots, pet food and water dishes, birdbaths, wading pools, swimming pool covers, buckets, barrels, cans, wheelbarrows, toys, boats.
- Adjust tarps over firewood, grills, boats, swimming pools, straw, or other items to prevent pooling of water. If it is not possible to prevent pooling, remove the water once or twice a week.
- Check for water-holding items under your house, in shrubbery, or in other hard-to-see places.
- Clean out rain gutters clogged with debris.
- Keep swimming pools clean and chlorinated.
- Remove standing water that may collect on a flat roof.

Mosquito breeding: A densely concentrated mass of *Aedes vexans* larvae and pupae in a small puddle in Blacksburg, Va., on 6/23/09.

No Mosquitoes in the Air Without Water Somewhere

In the 1976 short film "Kudzu" by Marjorie Anne Short, a man speaks a memorable line about three things he hates: "Kudzu, skeeters, and city livin'." Many people love city life, and not everyone is familiar with the woes of the invasive plant Kudzu, but few would disagree with putting "skeeters"—mosquitoes, that is—on their "I hate" list. As we have seen, the summertime annoyance most Virginians experience from a few kinds of mosquitoes is but a sample of the disturbance and disease that dozens of species cause worldwide.

We'll never like mosquitoes, but we'll probably always have to live with them. Mosquitoes are unavoidable wherever there is still water and warm temperatures, and control practices can eradicate mosquitoes only in limited areas.

Faced with such a prolific and persistent pest, we have the powerful tool of knowing what kinds of aquatic habitats mosquitoes use for breeding and how residential practices affect the supply of mosquito-breeding areas. Water-collecting items filled by warm-season rains make lovely nurseries for mosquito larvae; emptying such items within a few days will help send the "skeeters" elsewhere.

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Voshell, J. Reese, Jr. *A Guide to Common Freshwater Invertebrates of North America*. Blacksburg, Va.: McDonald and Woodward, 2002.

For More Information

Federal Centers for Disease Control and Prevention/National Center for Infectious Diseases

"Mosquito-borne Diseases" is available at www.cdc.gov/ncidod/diseases/list_mosquitoborne.htm. To request information by phone from the CDC, call (toll-free) 800-CDC-INFO (800-232-4636); TTY: (888) 232-6348, or e-mail cdcinfo@cdc.gov.

Virginia Department of Health's Office of Epidemiology/Division of Environmental Epidemiology

1) Their main page for "Vector-borne Disease" is at http://www.vdh.virginia.gov/epidemiology/DEE/Vectorborne/.
2) "Frequently Asked Questions" about mosquitoes is available online at www.vdh.virginia.gov/epidemiology/DEE/Vectorborne/mosquitofaq.htm.
3) "Asian Tiger Mosquitoes Cause the Most Mosquito Bites in Virginia," available at www.vdh.virginia.gov/news/Alerts/MosquitoAwarenessWeek/index.htm, describes the habits of this species that breeds in containers and bites during the day.
4) "Mosquitoes, West Nile Virus, and Procedures Used for Mosquito Surveillance and Control," available at www.vdh.virginia.gov/epidemiology/DEE/Vectorborne/WestNile/vdhwnvcontrol.htm , is a slide presentation with details on mosquito biology, the species involved in West Nile Virus transmission, and control procedures.

The phone number for the Office of Epidemiology in Richmond is (804) 864-7905; e-mail: epi-comments@vdh.virginia.gov. For general information about mosquitoes in any Virginia locality, contact the local Health Department office, listed in your local phone book.

Virginia Mosquito Control Association

This non-profit association's Web-site, www.mosquito-va.org , includes information about mosquito-borne diseases and control practices; common mosquitoes in Virginia with illustrations and basic facts; links to mosquito-control groups in other states; and the organization's newsletter, *Skeeter*. The organization is available by phone at (252) 771-5221.

VIRGINIA WATER STATUS REPORT

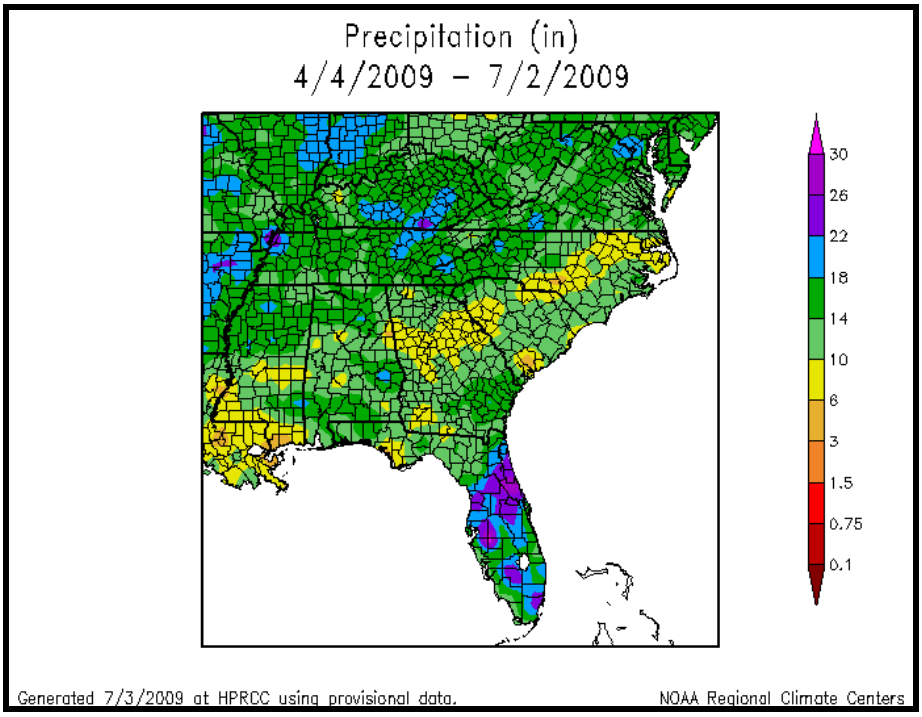
This section of *Water Central* presents recent and historical data on Virginia's precipitation, groundwater levels, stream flow, and occurrence of drought conditions. All Web sites mentioned were functional on 7/3/09.

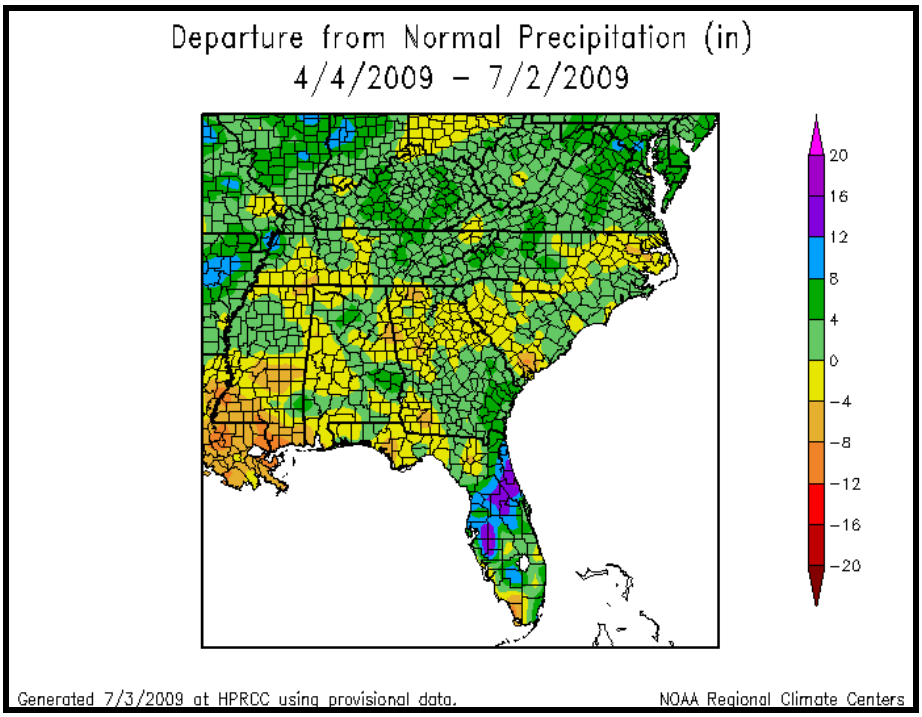
Precipitation in Virginia, July 2008-June 2009

The chart below shows precipitation (in inches) over the last 12 months at nine National Weather Service (NWS) observation sites in or near Virginia. The upper number for each entry is the **total precipitation** for the respective site and month (with yearly total at the bottom of the chart), including the equivalent amount of water contained in any snowfall or other frozen precipitation. These values were found at the "Climate" sections of NWS Web sites, as follows: www.weather.gov/climate/index.php?wfo=mrx for the Tri-cities Airport in Tennessee, about 20 miles from Bristol, Va.; www.weather.gov/climate/index.php?wfo=rnk, for Blacksburg, Danville, Lynchburg, and Roanoke; www.weather.gov/climate/index.php?wfo=lwx, for Washington-Dulles; and http://mi.nws.noaa.gov/climate/index.php?wfo=akq, for Norfolk and Richmond. The lower number in each entry (in parenthesis) is the **average precipitation** for the locality and month (again, with the average yearly total at the bottom of the chart), over the period 1971—2000, according to the National Climatic Data Center, *Climatography of the United States No. 81* (available online at http://cdo.ncdc.noaa.gov/climatenormals/clim81/VAnorm.pdf). RL and RH mean record low or high, respectively, for that month. The amounts listed here are classified by the Weather Service as *provisional* data and are subject to revision; the National Climatic Data Center maintains any edited and *certified* data that are available.

	Bristol (Tri-Cities, Tenn., Airport)	Blacks-burg (Va. Tech Airport)	Danville (Airport)	Lynchburg (Regional Airport)	Norfolk (Internat. Airport)	Richmond (Byrd Intern. Airport)	Roanoke (Woodrum Airport)	Wash.-Dulles Airport
Jul. 2008	4.69 (4.21)	4.88 (4.17)	4.00 (4.44)	1.07 (4.39)	5.19 (5.17)	4.05 (4.67)	3.67 (4.00)	2.18 (3.57)
Aug. 2008	2.99 (3.00)	3.28 (3.68)	6.92 (3.54)	2.73 (3.41)	0.67 (4.79)	5.73 (4.18)	4.65 (3.74)	2.48 (3.78)
Sep. 2008	2.53 (3.08)	1.99 (3.39)	6.67 (4.08)	2.28 (3.88)	9.41 (4.06)	5.94 (3.98)	2.20 (3.85)	7.18 (3.82)
Oct. 2008	1.01 (2.30)	1.04 (3.19)	0.94 (3.71)	2.09 (3.39)	1.47 (3.47)	1.32 (3.60)	1.87 (3.15)	1.31 (3.37)
Nov. 2008	2.09 (3.08)	1.95 (2.96)	3.54 (3.07)	3.94 (3.18)	5.32 (2.98)	3.51 (3.06)	1.92 (3.21)	2.01 (3.31)
Dec. 2008	4.41 (3.39)	3.43 (2.87)	3.81 (3.16)	3.48 (3.23)	3.83 (3.03)	4.07 (3.12)	2.25 (2.86)	2.63 (3.07)
Jan. 2009	5.67 (3.52)	3.60 (3.37)	3.01 (4.03)	3.13 (3.54)	1.82 (3.93)	1.49 (3.55)	2.72 (3.23)	2.64 (3.05)
Feb. 2009	2.24 (3.40)	1.96 (3.02)	0.97 (3.41)	1.14 (3.10)	1.26 (3.34)	0.74 (2.98)	1.22 (3.08)	0.35 (2.77)
Mar. 2009	2.21 (3.91)	4.58 (3.83)	4.37 (4.25)	3.23 (3.83)	5.28 (4.08)	4.26 (4.09)	3.47 (3.84)	2.41 (3.55)
Apr. 2009	2.72 (3.23)	2.98 (3.83)	2.45 (3.83)	2.87 (3.46)	2.28 (3.38)	2.56 (3.18)	3.20 (3.61)	4.11 (3.22)
May 2009	4.58 (4.32)	9.54 (4.39)	6.56 (3.96)	7.04 (4.11)	4.77 (3.74)	3.71 (3.96)	6.87 (4.24)	**10.26 RH** (4.22)
Jun. 2009	3.57 (3.89)	4.06 (3.93)	4.83 (3.50)	3.71 (3.79)	5.81 (3.77)	4.32 (3.54)	4.54 (3.68)	6.69 (4.07)
Period Total	38.71 (41.33)	43.29 (42.63)	48.07 (44.98)	36.71 (43.31)	47.11 (45.74)	41.70 (43.91)	38.58 (42.49)	44.25 (41.80)

For a more visual presentation over a wider area, the two graphs below—from the National Oceanic and Atmospheric Administration's (NOAA) Southeast Regional Climate Center, located at the University of North Carolina in Chapel Hill—show the total precipitation (in inches; top graph) over the past three months and the departure from normal (in inches above or below normal; bottom graph) over that period. Note that the values represented by a given color differ between the two graphs. T*hese data are provisional.* These graphs were taken from http://www.sercc.com/climateinfo/precip_maps on 7/3/09.





More Virginia climate information and data are available from the University of Virginia Climatology Office, online at http://climate.virginia.edu. To contact the office in Charlottesville, phone (434) 924-0548 or send e-mail to climate@virginia.edu.

Groundwater Levels at Selected Virginia Wells, July 2009

As of July 6, 2009, the Virginia Active Water Level Network—maintained by the U.S. Geological Survey (USGS) and available online at http://groundwaterwatch.usgs.gov/StateMaps/VA.html—provided access to groundwater levels at 492 wells in 65 Virginia counties and cities. At 85 of these observation wells in 38 localities, *real-time data* (updated every 5 to 60 minutes) were being recorded. The table below shows the July 5 daily average level from real-time wells in 19 localities. These readings are *provisional* (i.e., subject to revision). All measurements are in **feet below the land surface**, rounded to the nearest 0.1 foot; **a smaller value means wetter conditions, while a larger value means drier conditions.** The table also shows levels reported in previous issues of *Water Central*, plus the median July level, the deepest (driest) level, and the shallowest (wettest) level (all for each well's period of record). Historical information on groundwater is also available from the USGS' annual reports of groundwater; annual reports for Water Years (October through September) 2002 to 2008 are available online at http://wdr.water.usgs.gov/; for previous years, check your local library.

Well (Local #)	7/5/09 Level	4/8/09 Level	1/6/09 Level	July Median	Record Deepest (Driest)	Record Shallowest (Wettest)	Period of Record
Accomack (66M 19 SOW 110S)	9.2	8.8	8.8	9.6	11.3 (Nov. 1981)	7.4 (Nov. 2006)	Since Sep. 1978
Buckingham (41H 3)	22.0	24.0	26.4	20.6	36.7 (Jan. 2002)	7.4 (Apr. 1973)	Since Mar. 1971
Clarke (46W 175)	35.8	39.9	38.4	37.1	45.7 (Sep. 2002)	23.5 (Sep. 2003)	Since Mar. 1987
Fairfax (52V 2D)	13.0 (7/4/09)	12.9	15.5	14.2	24.9 (Dec. 1998)	6.5 (Mar. 1984)	Since Oct. 1976
Frederick (46X 110)	37.4	43.6	41.2	36.6	47.9 (Jun. 2006)	18.2 (Sep. 2004)	Since Nov. 2002
Hanover (53K 19 SOW 080)	19.3	15.8	18.3	19.1	22.9 (Aug. 1984)	5.1 (Aug. 2004)	Since Jan. 1978
Loudoun (49Y 1 SOW 022)	58.9	58.0	60.3	59.5	66.5 (Oct. 2008)	48.0 (June 1972)	Since Nov. 1963
Montgomery (27F 2 SOW 019)	2.3	3.6	6.3	5.1	7.3 (Dec. 1969)	< 0.0 (Mar. 1993)	Jul. 1953, then since Apr. 1969
Northampton (63H 6 SOW 103A)	7.5	7.1	7.3	6.7	10.0 (Oct. 2002)	0.8 (Aug. 2004)	Since Sep. 1977
Orange (45P 1 SOW 030)	21.9	25.5	28.4	25.5	39.0 (Aug. 2002)	11.8 (Apr. 1973)	Since Feb. 1965
Prince William (49V 1)	9.3	7.8	8.8	10.5	13.1 (Sep. 1991)	6.6 (May 2008)	Since Nov. 1968
Roanoke City (31G 1 SOW 008)	18.9	18.8	18.7	18.1	19.3 (Jun. 1987)	12.4 (Feb. 1986)	Since Aug. 1966
Rockbridge (35K 1 SOW 063)	23.5	23.6	27.0	24.5	30.4 (Sep. 2002)	14.3 (Apr. 1987)	Feb. 1964, then since Jun. 1972
Rockingham (41Q 1)	67.8	79.7	83.4	68.3	99.0 (Oct. 2002)	57.7 (Feb. 1998)	Since Aug. 1970
Suffolk (58B 13)	7.9	6.2	8.2	10.0	13.4 (Jan. 1981)	0.0 (Feb. 2008)	Since Mar. 1975
Surry (57E 13 SOW 094C)	8.0	7.4	8.2	9.2	11.2 (Dec. 1981)	3.9 (May 1980)	Since Jul. 1978
Virginia Beach (62B 1 SOW 098A)	4.2	2.4	6.8	4.5	12.0 (Sep. 1980)	0.9 (Aug. 2004)	Since Jun. 1979
Westmoreland (55P 9)	3.4	0.3	8.5	7.3	12.8 (Dec. 1988)	< 0.0 (Jun. 2009)	Since Jul. 1977
York (59F 74 SOW 184C)	9.7	5.7	8.5	10.3	14.1 (Jan. 2002)	0.9 (Nov. 2006)	Since Jun. 1990

Stream Flow in Virginia, May-July 2009

The graphs on this page, from the U.S. Geological Survey's (USGS) "WaterWatch—Current Water Resources Conditions" Web site (http://water.usgs.gov/waterwatch/?m=real&r=va&w=real%2Cplot, 7/6/09), compare recent Virginia stream flow to historical records.

The data in the graphs come from 104 sites that have at least 30 years of records. Each graph uses a "**stream flow index**," which measures how a site's average stream flow *over 24 hours* (the **average daily stream flow**) compares to the historical average stream flow *for that same site and date*. The graphs show a further average: the stream flow index averaged *over all monitoring stations*.

Index values (1-7 on the vertical axis in the graphs) mean the following:

Values indicating dry conditions:

1 = average daily flow is record low for that date;
2 = average daily flow is in the lowest 10 percent of historical values for that date;
3 = average daily flow is in the lowest 25 percent of historical values for that date, but exceeds the lowest 10 percent.

Value indicating "normal" flow:

4 = average daily flow exceeds the lowest 25 percent of historical values for that date, but is less that the highest 25 percent of values.

Values indicating wet conditions:

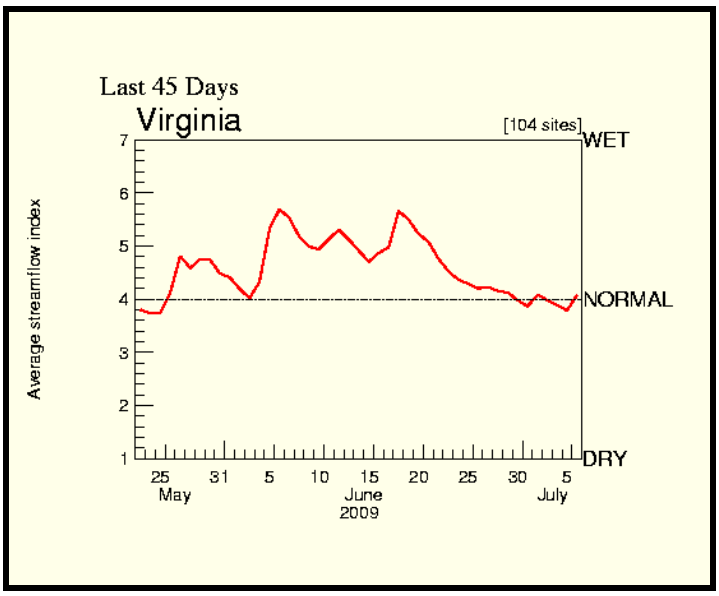
5 = average daily flow exceeds 75 of historical values for the date, but is lower than the highest 10 percent of values.
6 = average daily flow exceeds 90 percent of historical values for that date;
7 = average daily flow for the graphed date is record high for that date.

Gaps in the data: Data are not plotted for days when less than two-thirds of the sites report data (due to equipment or weather problems), because a statewide average on those days may misrepresent actual conditions.

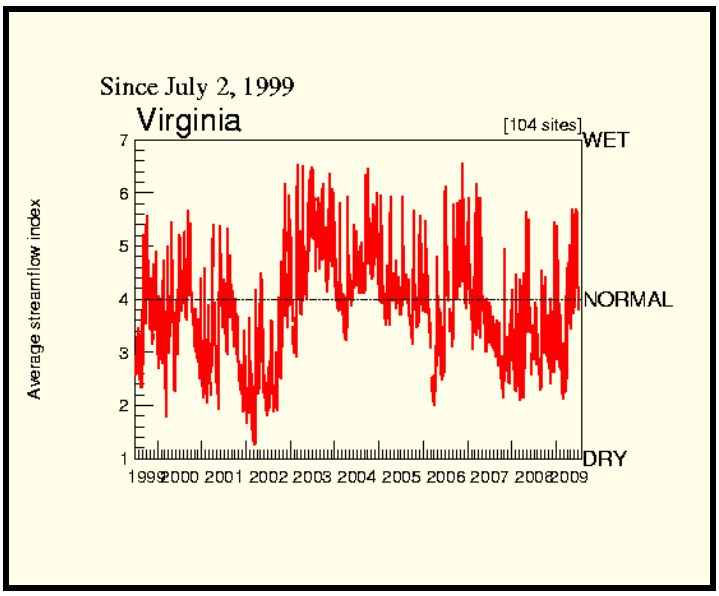
A USGS **map of current stream flow conditions** (with links providing access to details for each measuring station) compared to historical flows is available online at http://water.usgs.gov/waterwatch/?m=real&r=va. This Web site also has maps that show average flows over the previous 7-, 14-, and 28-day periods.

Average Daily Stream Flow Index, Compared to the Historical Average for the Date

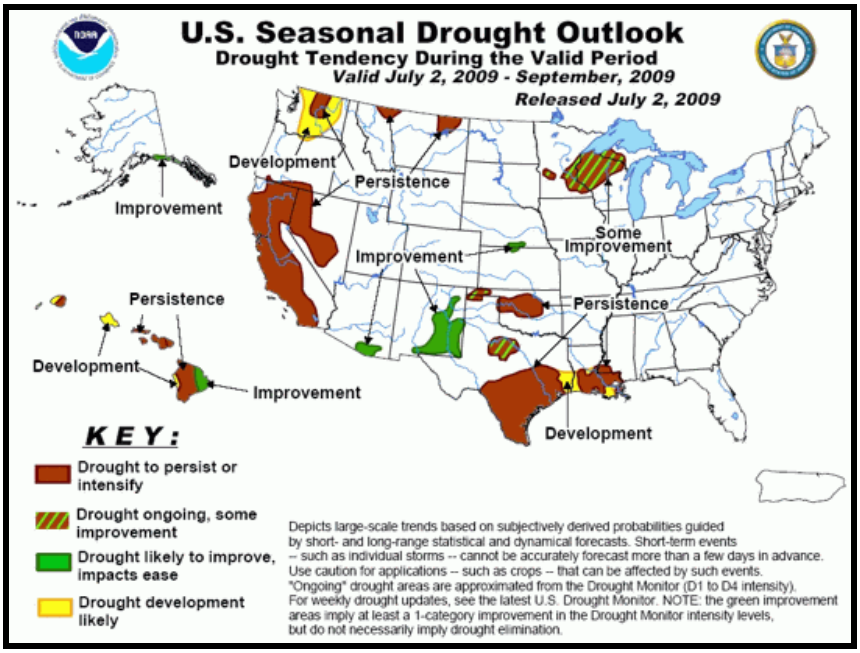
For May 22—July 5, 2009



For July 1999—July 2009



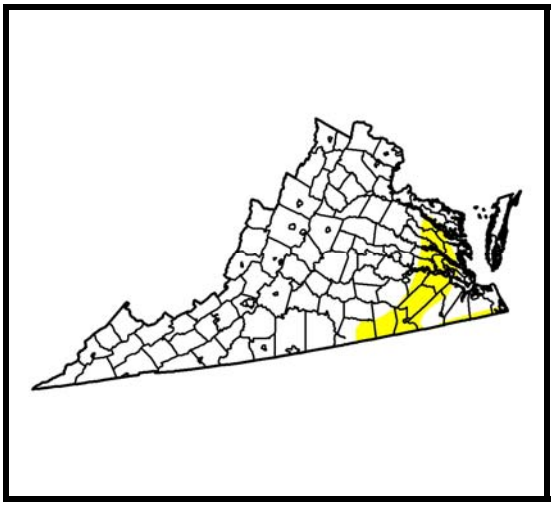
Drought Update



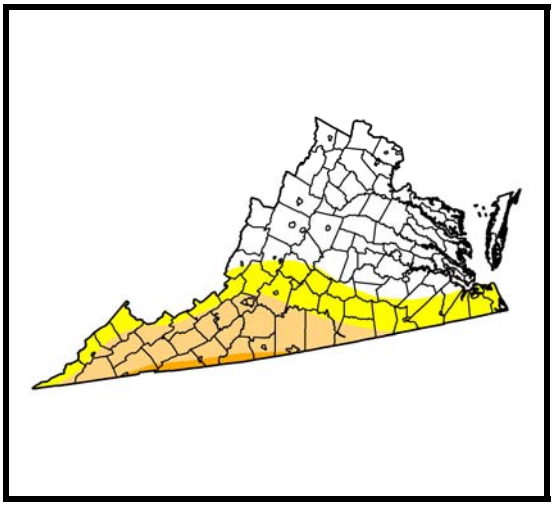
The national drought outlook for July-September 2009, according to the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center Web site, www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html, accessed 7/5/09.

From the U.S. Drought Monitor: Virginia Conditions Now and One Year Ago

The U.S. Drought Monitor, available online at www.drought.unl.edu/dm/monitor.html, is a weekly nationwide drought assessment by federal agencies and state climatological centers. The following graphs show Drought Monitor assessments of Virginia conditions on June 30, 2009, compared to July 1, 2008. Note that as of late June Virginia had only a small area of abnormal dryness, a big improvement over the same time in 2008.



June 30, 2009



July 1, 2008

= D0 Abnormally Dry | = D1 Moderate Drought | = D2 Severe Drought | = D3 Extreme Drought | = D4 Exceptional Drought

Source: Images taken from archive of U.S. Drought Monitor, www.drought.unl.edu/dm/archive.html, 7/5/09. Author: Rich Tinker, NOAA, for both images.

The Drought Monitor also gives *percentages* of the country, of regions, and of individual states classified in the drought categories. The following table shows how much of the country and of Virginia received different Drought Monitor ratings in recent months and one year ago. Note that in May Virginia became almost drought free (with only 0.3% of the state rated as abnormally dry); this was the first time since December 2006 that the Drought Monitor had indicated Virginia as essentially drought free.

Drought Monitor Report Date	Percentage of area rated "abnormally dry" (D0) or worse	Percentage of area rated "severe drought" (D2) or worse
6/30/09	US = 31%; VA = 9%	US = 5%; VA = 0%
5/26/09	US = 28%; VA = 0.3%	US = 5%; VA = 0%
4/28/09	US = 39%; VA = 85%	US = 7%; VA = 0%
3/31/09	US = 42%; VA = 90%	US = 7%; VA = 0%
7/1/08	US = 40%; VA = 49%	US = 10%; VA = 2%

From the Virginia Drought Monitoring Task Force

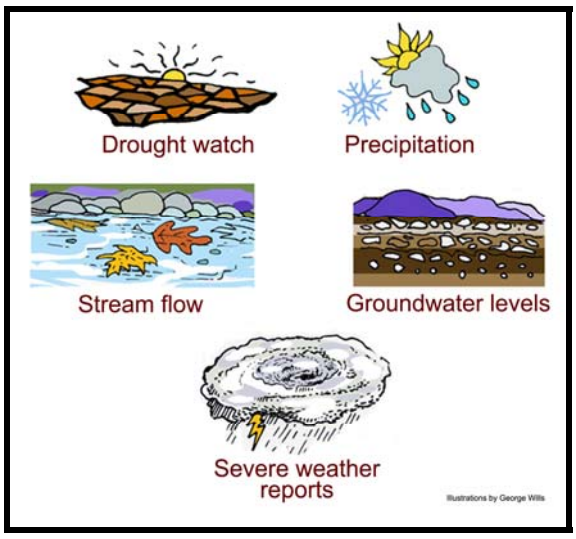
As of July 5, 2009, no reports had been issued from the Virginia Drought Monitoring Task Force since May 21, 2009, as a result of the substantial rains in the state in May and June. Reports from the Task Force since February 2002 are available online at www.deq.virginia.gov/waterresources/drought.php.

Other Useful Sources of Information Online

- Virginia Forestry Department list of burn bans: http://www.dof.virginia.gov/fire/burn-bans.shtml.
- Virginia Department of Environmental Quality water-conservation tips: www.deq.virginia.gov/waterresources/waterconservation.html.

Don't Forget the Water Center's Online Water Status Page!

The Water Center's online "Water Status Information" area has links to current and historical information on drought, groundwater, precipitation, stream flow, and severe weather. Look for the image below, at www.vwrrc.vt.edu/water_status.html.



Gaging station on the James River at Scottsville, Va. (Fluvanna County), February 2009.

IN AND *OUT OF* THE NEWS
Newsworthy Items You May Have Missed

The items in this section are based on information in the source(s) indicated in parentheses at the end of each item. Most of this issue's items were reported between April 7 and July 2, 2009. Except as otherwise noted, all localities mentioned are in Virginia and all dates are in 2009. All Web sites listed were functional as of July 6, 2009. Frequently used abbreviations: DEQ = Virginia Department of Environmental Quality; EPA = U.S. Environmental Protection Agency; SWCB = Virginia State Water Control Board; VIMS = Virginia Institute of Marine Science; VMRC = Virginia Marine Resources Commission.

Focus on Virginia's Water Resources and the 2009 American Recovery and Reinvestment Act

The 2009 American Recovery and Reinvestment Act (the 2009 federal stimulus package) authorized $4.9 billion for Virginia through Fiscal Year 2011. According to the Virginia's Web site for its use of federal stimulus funds (http://stimulus.virginia.gov), the state received funding requests for over $465 billion for 9160 projects. As of June 2009, the state had allocated and authorized $3.1 billion to 1195 projects. Projects directly related to water and other natural resources make up a relatively small portion of this total; projects under the Natural Resources Secretariat, for example, have been allocated about $86 million so far.

This focus section presents several snapshots of how federal stimulus funds are being used for water-related projects in Virginia.

•In April, the State Water Control Board (SWCB) approved the **list of wastewater projects** to receive federal stimulus funds through Virginia's Clean Water Revolving Loan Fund. A total of $76.9 million in grants were awarded to 27 projects. The Virginia Department of Environmental Quality (DEQ) evaluated 294 requests, for more than $1.3 billion, before submitting a recommendation to the SWCB. Lynchburg received the largest award, $25 million for three combined-sewer overflow projects (projects to eliminate connections between the sanitary sewer system and the stormwater system, which can lead to sewer overflows during heavy rains.) The second largest award, $10 million, went to Alleghany County for wastewater-treatment plant improvements. According to DEQ's news release, "specific criteria were used in DEQ's analysis, including anticipated environmental benefits, financial hardship, and ability to begin the projects in the near future. A locality's unemployment rate also was a consideration." (Va. DEQ news release, 4/27/09; *Lynchburg News & Advance*, 4/27/09; and *Richmond Times-Dispatch*, 4/27/09)

Among the list of SWCB-approved projects are several **"green infrastructure" projects** to develop alternative energy or to reduce use of energy, water, or other resource. Here are two examples. 1) The **Augusta County** Service Authority (ACSA) will receive $364,964 in 2009 federal stimulus funds towards the purchase of **solar panels** to generate electricity for heating, lighting, and small pumps at eight sewer lift stations and 11 wastewater-treatment plants. 2) The **City of Hopewell** will receive $600,000 to help pay for an estimated $1.2 million project to determine the feasibility of using **algae to take nitrogen from wastewater and then to produce a biofuel and fertilizer.** The work will occur at the Hopewell Regional Wastewater Treatment Facility, and tests are expected to begin in summer or fall 2009. (*Staunton News-Leader*, 5/20/09; and *Hopewell News*, 5/5/09)

•The **Powell River watershed in Lee County** will receive $380,000 in federal stimulus funds for mitigating damage from acid drainage or erosion problems from abandoned mines that do not fall under the 1977 Surface Mining and Reclamation Act. The Powell River watershed has been identified by the U.S. EPA as one of the country's most biologically diverse areas, due to the presence there of rare mussel and fish species. The funds are part of $84.8 million provided by the U.S. Department of Agriculture for 53 watershed-restoration projects nationwide. (*Kingsport [Tenn.] Times News*, 4/18/09

•The **Hampton Roads area will receive $21 million from the U.S. Army Corps of Engineers** for bridge construction, wetlands restoration, dredging of Lynnhaven Inlet and the Pagan River, and several projects at Norfolk Harbor and Craney Island. (*Virginian-Pilot*, 5/1/09)

•The **U.S. Fish and Wildlife Service's (FWS) fish hatchery in Charles City County** will receive $175,000 for long-deferred repairs to its water-supply system. Overall, federal progams or facilities in Virginia will receive $43 million in stimulus funds from the U.S. Department of the Interior (the home department of the FWS). (*Richmond Times-Dispatch*, 6/22/09)

•The U.S. Commerce Department is providing $2 million for a **habitat-restoration project for eight coastal bays on Virginia's Eastern Shore**. The project will create 24 acres of oyster reefs and 100 acres of submerged aquatic vegetation beds, and will release over two million adult and juvenile Bay scallops into existing vegetation beds. The Eastern Shore project is one of 50 approved habitat-restoration projects, out of over 800 proposed to Commerce Department. (*Virginian-Pilot*, 7/1/09) (For a related development, please see the Lynnhaven River Symposium item in the Aquatic Systems section below.)

Other Virginia News

Aquatic Systems, Water Quality, and Restoration (including Chesapeake Bay)

•On April 8, the U.S. EPA included the **former Peck Iron and Metal site** (a scrap metal business from the 1940s to the 1990s) along Paradise Creek (an Elizabeth River tributary) in Portsmouth as one of 13 sites nationwide being recommended for **addition to the National Priorities List** (the Superfund list). Tests between 2004 and 2007 indicated contamination of the site from pesticides, PCBs, other organic chemicals, and lead. A sixty-day comment period followed the recommendation. Three other active Superfund sites are in Portsmouth, and nine others are in South Hampton Roads. (*Virginian-Pilot*, 4/9/09)

Elsewhere on the Elizabeth River: Work began in June to **remove creosote-contaminated sediments from the Elizabeth near Money Point**. For many years the river has been polluted by material that came from industrial operations at the site, particularly from a fire in the 1960s. Contaminated sediments will be taken to a landfill or to an incinerator, and clean sand will be placed at the site, followed by planting of marsh vegetation and placement of an artificial oyster reef. (*Virginian-Pilot*, 7/2/09)

•On April 6, Virginia, Maryland, and the U.S. Army Corps of Engineers announced a **new strategy for oyster restoration** in the Chesapeake Bay, which does *not* include non-native ("Asian") oysters. On March 24, the Virginia Seafood Council had announced that it was abandoning its efforts to introduce non-native oysters into the Bay. (*Virginian-Pilot*, 4/7/09)

•On May 11, Lynnhaven River Now (a non-profit group in Virginia Beach) organized the **first symposium on the Lynnhaven River with its associated Broad Bay and Linkhorn Bay**. At the symposium, the U.S. Army Corps of Engineers outlined its plans for restoration of the river system, based on six years of study (at a cost of $3.2 million, paid for by the Corps and the City of Virginia Beach). The plans include work to restore wetlands, replant submerged aquatic vegetation, remove sediment, reconnect 20 man-made lakes to the river's tidal flow, and possibly establish a new population of scallops. Implementation will require funding from Congress or the City; no work is expected before 2014. (*Virginian-Pilot*, 5/12/09)

•Despite significant restoration efforts since the 1980s—including breaching dams and stocking hatchery-raised fish—**American Shad numbers in the James River and other Virginia and East Coast rivers have decreased** in recent years. In 2007, the Atlantic States Marine Fisheries Commission said that East Coast American Shad stocks were at an all-time low. Similarly, the number of American Shad observed going through the Bosher's Dam fish passage in the James near Richmond has decreased since 1998, with 2008 having the lowest count. Fisheries scientists can't explain the American Shad declines or simultaneous *increases* in populations of Hickory Shad. (*Richmond Times-Dispatch*, 5/25/09)

•Scheduled to leave **Fort Monroe in Hampton** in 2011, the U.S. Army is working to clean several contaminated areas on the 570-acre facility, including a former landfill, a former medical and dental clinic, and the moat surrounding the fort. The estimated cost of the clean-up is $100 million, down from the $240 million that the Army estimated in 2005, when it announced the eventual closing of the fort. (Associated Press, in *Richmond Times-Dispatch*, 5/25/09)

•A May 2009 report by the Nature Conservancy, *Shellfish Reefs at Risk—A Global Analysis of Problems and Solutions*, asserts that 85 percent of the **natural oyster reefs worldwide** have been lost. Chesapeake and Delaware Bays were two of the estuaries examined; the Virginia Institute of Marine Science (VIMS) was a study collaborator. A fact sheet and the full report are available at http://www.nature.org/initiatives/marine/shellfish/. (*Asbury Park (N.J.) Press*, 5/25/09)

•On June 1, the U.S. EPA announced 24 **Chesapeake Bay Stewardship Fund grants** in Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia. Virginia will receive $2.4 million, with grants ranging from $200,000 to $800,000. (*Richmond Times-Dispatch*, 6/2/09)

•In June, the Va. DEQ released for public comment the Total Maximum Daily Load (TMDL) **study of impairments in the South River** (a tributary of the South Fork Shenandoah River) near Waynesboro, including mercury contamination from the city's former DuPont rayon plant. Some 100,000 pounds of mercury were put into the river or its floodplains, according to a study in the 1980s. The DEQ TMLD report indicates that reducing current mercury levels by 99 percent is necessary for the river to meet water-quality standards, and this reduction will take many years, more research, new technologies for removal, and millions of dollars. (*Waynesboro News Virginian*, 6/12/09)

In more positive news along the South River: On April 17, the **second annual Coldwaters Summit** was held in Waynesboro to show landowners, conservationists, and local officials how to improve and protect water quality in the South River watershed. Since 2008, the summit has brought a water-protection aspect to the long-running Virginia Fly Fishing Festival. (*Waynesboro News Virginian*, 4/18/2009)

•**Chesapeake Bay Blue Crab developments**: In April, government officials reported that the most recent winter Blue Crab survey indicated more than a 40-percent population increase, from 280 million to over 400 million. At its May 2009 meeting, the Virginia Marine Resources Commission (VMRC) voted unanimously to continue major Blue Crab-harvesting regulations implemented in 2008, while easing certain aspects. The continued regulations include the following: a 15-percent reduction, compared to 2007, in the number of crab pots allowed; and prohibition on winter dredging for hibernating females (starting in December). Modified regulations include the following: extending the crabbing season about a month longer than in 2008, to November 21 for females and November 30 for males; and removing the 2008 ban on recreational crabbing licenses, for a season from June 1-Sept. 15 (the VMRC had previously said it would allow recreational crabbing when the spawning-age crab population again reached 200 million, which it did in the most recent survey earlier this year). (*Richmond Times-Dispatch*, 4/17/09; *Virginian-Pilot*, 4/29/09 and 5/27/09; and *Washington Post*, 5/27/09. For a previous *Water Central* item: June 2008, p. 18.)

Meanwhile, 58 Virginia watermen who were prevented by Virginia regulations from a 2008-09 winter dredging season for Blue Crabs participated in a **state program to recover "ghost" crab pots**—those pots lost by watermen and remaining on the bottom of the Bay, posing a threat to Bay creatures. VIMS has estimated that some 20 percent of pots set are eventually lost; research has also estimated that 60,000 crabs per year are captured in lost pots in just the York River. This is the only recovery program of this kind on the East Coast (a similar program is conducted in Hawaii's Pacific waters). The Virginia watermen—who were paid $300 per day and compensated for fuel out of $1.3 allocated for this year by the VMRC—recovered 8,600 pots and 61 abandoned nets, containing some 5,000 animals. (Associated Press, as published in *Virginian-Pilot*, 5/11/09)

On May 19, the U.S. Commerce Department approved Virginia's plans for using an additional $7.5 million in federal Chesapeake Bay **Blue Crab fishery disaster funds**. The money will allow Virginia to continue through 2010 its program of hiring out-of-work watermen to collect marine debris from the Bay (as described above), and to begin a crabbing-license buyback program from crabbers who agree to quit the business. The funds approved on May 19 are part of $10 million authorized for Virginia under the disaster declaration ($10 million was also authorized for Maryland). Also on May 19, Virginia and Maryland learned that both states are eligible for $5 million for Blue Crab programs under the federal Omnibus Appropriations Act of 2009. (*Virginian-Pilot*, 5/20/09)

Boats and Ships

•Mathews County is trying to preserve the **205-year-old New Point Comfort Lighthouse**. The 63-foot lighthouse is the third-oldest still standing in the Chesapeake Bay and, according to county research, the tenth-oldest in the United States. The county is seeking VMRC permission to build a rock wall around the lighthouse's base to protect it from erosion, and the New Point Comfort Lighthouse Preservation Task Force is seeking to change the structure's status on the National Historic Register from statewide significance to national significance, which could help fund-raising efforts. (*Daily Press*, 6/18/09)

Dams

•On April 30, the last scheduled public hearing was held on Appalachian Power Company's (APCO**) relicensing application for its Smith Mountain hydroelectric power facilities**, which includes Smith Mountain Lake and Leesville Lake, both on the Roanoke River. APCO's current license was issued when the facility was built in 1960 and expires in March 2010. In April the company released a draft environmental impact study that covers plans for recreation, navigational aids, and debris management. Speakers at the public hearing expressed concern over sediment build-up that, coupled with low water levels during dry weather, has reduced water access and affected both recreational boating and boating businesses. The Federal Energy Regulatory Commission (FERC) is expected to have a final version of the environmental impact study ready for action by August. As part of the federal relicensing process, APCO in 2008 applied for a state water-release permit; that permitting process generated considerable controversy over the amount of water to be maintained in the reservoirs vs. how much water is released downstream to the Staunton River (a section of the Roanoke River). (*Roanoke Times*, 5/1/09. For additional background on these issues, see the Va. DEQ's 9/25/08 memorandum on APCO's water protection permit, online at http://www.deq.state.va.us/export/sites/default/waterresources/pdf/Memo_to_the_SWCB.pdf.)

•Following the June 6 drowning of an **experienced boater who was swept over a low-head dam** on the Blackwater River in Franklin County, the county board of supervisors began considering three options for reducing the danger of the dam: removing the dam, developing an instream park, or "facing" the dam, which involves placing obstructions to reduce the hydraulic pull of the dam. (*Roanoke Times*, 6/17/09)

Education

•In April, the VIMS began its first six-month **Oyster Aquaculture Training program** with four interns who will learn about all aspects of raising oysters. The VIMS program is a response to recent growth in oyster aquaculture in Virginia, including an increase in the sale of farmed oysters from 843,000 in 2005 to 4.8 million in 2007, according to a 2008 survey by the Sea Grant Marine Advisory Program at VIMS. (*William and Mary News*, 6/11/09)

•In May, the National Science Foundation announced a **$2.6-million grant to Christopher Newport University** in Newport News for university faculty to work with five local high schools, the City of Newport News, and the Hampton Roads Planning District Commission on an urban **stormwater monitoring and education** project. The city will use data gathered by the faculty and students to help in managing stormwater going into the James River and Chesapeake Bay. (*Daily Press*, 5/6/09)

•June 2009 will mark the second year of **Rappahannock Community College's (RCC) marine trades program**, offered at the community college's campus in Glenns (Gloucester County) and at Northern Neck Technical Center in Warsaw (Richmond County). As of fall 2008, about 40 students were enrolled in the program to learn about small motors, engine theory, regulations for marine mechanics, boat business operations, and other areas. The RCC program is one of only four training centers recognized by the American Boat and Yacht Council certification process. (V*irginia Marine Resource Bulletin*, Fall/Winter 2008)

Energy Use and Developments/Climate Change Developments

•On April 17, the Virginia Supreme Court ruled that the State Corporation Commission's June 2008 approval of the **coal-fired power plant by Dominion Virginia Power in Wise County** did *not* violate the federal Constitution's Interstate Commerce clause, because the action did not *require* Dominion to use Virginia coal as opposed to coal from other states. The lawsuit had been brought by Southern Environmental Law Center on behalf of four groups. (*Richmond Times-Dispatch*, 2/26/09 and 4/17/09. Previous *Water Central* item: April 2008, p. 27.)

•In May, government officials, potential investors, scientists, and equipment manufacturers gathered for a conference on the **potential for wind-energy facilities off the coast of Virginia Beach**. The conference was prompted in part by a study released in February 2009 that indicated such a project could be feasible. The Virginia Coastal Energy Research Consortium is leading the efforts to develop the project. Another wind-energy development in Virginia Beach is the City's work to develop a local ordinance to allow wind mills in residential areas. Meanwhile, in June a Chesapeake couple installed **one of the first residential wind-energy units in Virginia**, using two 30-foot tower-type turbines (resembling large egg-beaters) rather than the more familiar propeller-blade type of turbine. The City of Chesapeake does not yet have a wind-turbine ordinance, but the couple was able to get a permit for the turbines as an "accessory structure." (*Virginian-Pilot*, 5/16/09 and 6/21/09)

•A facility being constructed by Rockingham Memorial Hospital in Harrisonburg is expected to be **Virginia's first "green" hospital**, that is, the first to receive a Leadership in Energy and Environmental Design (LEED) silver certification. The project's "green" features include using methane from a local landfill for power, installing energy-efficient lighting and water-saving fixtures, recycling construction debris, and preserving wetlands on the property. (*Harrisonburg Daily News-Record*, 6/3/09)

•By the end of June, Waste Management, Inc. expected to be generating enough **electricity from methane at the Middle Peninsula Landfill and Recycling Center in Gloucester** to power several thousand homes. The methane, from decomposing trash, has previously been burned off and not used for power generation. Waste Management, which rents the facility from Gloucester County, will sell the power to Dominion Virginia Power. Waste Management runs two other trash-to-power operations in Virginia, in Hampton and King George County, and similar operations are in place or are being considered at several other Virginia landfills. (*Daily Press*, 5/26/09)

•Here are some recent developments regarding **Old Dominion Electric Cooperative's (ODEC) proposed Cypress Creek coal-fired plant in Surry County.** An April report by Massachusetts-based Synapse Energy Economics, questioned the cost estimates and the need for the plant; ODEC disputed the Synapse report. In June, the Virginian-Pilot reported that a number of environmental groups have come to the area to oppose the plant, and that the U.S. Army Corps of Engineers will do an environmental impact study to determine whether to grant a permit for the project, which would affect some of the 430 acres of wetlands on the proposed site (the Corps has regulatory authority over wetlands under the jurisdiction of the federal Clean Water Act). In July, the Dendron Town Council was scheduled to begin consideration of ODEC's rezoning request to allow the plant to be built on the proposed site. Here is some **background on the proposed plant**: the estimated cost is $4 to 6 billion; capacity could be as much as 1,500 megawatts, making it Virginia's largest coal-fired power plant (for comparison, the new plant being built in Wise County has 585-megawatt capacity); construction could employ 2,400 to 2,600 workers; permanent jobs are estimated to be 225; the plant would use water from the James River, requiring a new pipeline; it would also use biomass for 2 to 3 percent of the fuel stock; the estimated annual emissions are 3,685 tons of sulfur dioxide, 3,085 tons of nitrogen oxides, 2,722 tons of particles, and 118 pounds of mercury; 2016 is ODEC's target for beginning operations; and ODEC has said 50 federal, state, and local permits will be needed. (*Richmond Times-Dispatch*, 5/17/09; *Style* [Richmond], 6/23/09; *Virginian-Pilot*, 6/14/09)

•On June 26, the U.S. House of Representatives' voted 219 to 212 to approve the **American Clean Energy and Security Act of 2009**, which would establish a **cap-and-trade program for carbon emissions** and has many other provisions (the bill has 553 sections). Rep. Rick Boucher (Va.-9th), who represents Virginia's coal-mining areas, was a key participant in negotiations in the Energy and Commerce Committee, which passed the bill on May 21. For online access to the full bill, summaries of the bill, and a record of House actions, visit http://thomas.loc.gov/ and search for bill number H.R. 2454. (*E&E Daily* at http://www.eenews.net/, 6/26/09; and *Roanoke Times*, 5/22/09)

Fishing and Fisheries

•Here is an update on the **chronic fish kills in the Shenandoah River and James River basins**: About 10 to 20 percent of fish sampled in the James River in 2009 have been dead or have had the lesions previously associated with fish kills in these river systems, compared to about 30 to 40 percent observed in previous sample years. no evidence of the problems has been seen this year below Buchanan on the James, whereas the problem in previous years has been seen as far downstream as Lynchburg. Occurrence of the problems in 2009 on the Shenandoah has been comparable to past years, but Va. Dept. of Game and Inland

Fisheries officials are relieved the problem hasn't been worse, because wet conditions such as occurred in spring 2009 have seemed to produce more problems in years past. (*Lynchburg News & Advance*, 7/4/09)

Meanwhile, in a recent study by U.S. Geological Survey researchers at the Leetown Science Center in West Virginia, male fish injected with estrogen were found to have lower levels of the hormone hepcidin, which is thought to be involved in immune responses. The results are evidence that the **appearance of intersex characteristics in fish may be linked to vulnerability to diseases**. Researchers are investigating these issues in response to the appearance of intersex characteristics (such as egg production in male Smallmouth Bass) and to the chronic fish kills in the Potomac/Shenandoah watershed. The study by L. S. Robertson, L. R. Iwanowicz, and J. M. Marranca is in the June 2009 issue of *Fish and Shellfish Immunology*. (Associated Press, 6/8/09)

And in another item on **emerging contaminants**: On April 15, the U.S. EPA announced that it will require pesticide manufacturers to test 67 chemicals to determine if they can disrupt animals' endocrine systems. The testing, required initially by the provisions of the 1996 Food Quality Protection Act, is to begin in summer 2009. (*Washington Post*, 4/16/09)

•On May 23, the City of Hampton opened a new $4.1 million **public fishing pier at Buckroe Beach**. This is the first large, publicly available pier in the city since two piers were destroyed by Hurricane Isabel in 2003. (*Daily Press*, 5/20/09)

Groundwater

•Since early spring 2009, the **Loudoun County** Planning Commission has been working to develop an ordinance for a **Limestone Overlay Zone**. Potential water-quality impacts are one of the chief concerns with development in the county's karst areas—that is, areas with limestone bedrock, where groundwater can be particularly susceptible to pollution from surface activities. The county area under consideration for the overlay zone is the U.S Rt. 15 corridor north of Leesburg. (*Leesburg Today*, 5/27/09)

•As of June 2009, **Albemarle County had 34 cases of leaking underground petroleum storage tanks**, the highest number of any locality covered by the Virginia DEQ's Valley Regional Office, which is handling some 200 such cases. Factors leading to the relatively high number of Albemarle cases include its population density, the area's geology, a high number of residences built in the 1960s and 1970s with heating-oil tanks that may now be leaking, and a high number of small stores/gas stations that have relatively old tanks. Prospective home buyers are largely responsible for investigating whether a property might have been at or near the site of a former storage tank. More information about the DEQ's petroleum program is available at www.deq.virginia.gov/tanks/homepage.html, by contacting your regional DEQ office, or by phoning the central office for the petroleum program at (804) 698-4010. (*C-ville*, 6/30/09)

•On June 16, the **Eastern Shore of Virginia Groundwater Committee** held a public event to kick off its work to develop a new plan to guide local decisions that affect groundwater. The plan, which will update a 1992 version, will examine all potential water sources in the Shore counties of Accomack and Northampton and will consider several current issues, including recharge capacity compared to existing or predicted use, existing and potential nitrate contamination, and saltwater intrusion. (*Eastern Shore News*, 6/20/09)

•The **possible contamination of groundwater from coal-combustion by-products** (fly ash) used under Chesapeake's Battlefield Golf Club course continues to be in the news. Here is some **background**: Starting in 2002, some 1.5 million tons of ash from Dominion Virginia Power's Deep Creek Power Plant were used in building the golf course. Starting in March 2008, a series of *Virginian-Pilot* articles described the use of the ash and alleged impacts on nearby groundwater. In August 2008, Dominion offered to provide up to $6 million to extend water-supply lines to the area near the golf course. Now, here are some **recent developments**. On March 26, a lawsuit was filed on behalf of 400 Chesapeake residents against Dominion over alleged impacts to groundwater from the fly ash. In May, the *Virginian-Pilot* reported that a 2001 study indicated that placing the coal fly ash under the golf course might cause groundwater contamination; the report was not known publicly until the lawsuit was filed. In June, the U.S. EPA completed a draft report on possible contamination from fly ash at the golf course. (*Virginian-Pilot*, 5/3/09 and 6/7/09)

Land Use

•On May 21, Gov. Kaine's office announced that Virginia and the Nature Conservancy have purchased 4**,188 acres of land in the Dragon Run watershed**, a swampy, biologically rich area forming the border between the counties of Essex and King and Queen, and flowing into the Piankatank River (the Piankatank

is a Chesapeake Bay tributary). The Smithsonian Institution has identified Dragon Run as one of the most important ecological areas in the Bay watershed. The state land will become part of a state forest; the land retained by the Conservancy will be protected from development. About 8,200 acres of land have now conserved in the 90,000-acre Dragon Run watershed. (*Daily Press*, 5/22/09)

•With a $50,000 U.S. Department of Agriculture grant plus funds from other sources, the non-profit organization **Green Infrastructure Center in Charlottesville will conduct a year-long project to inventory the "green infrastructure" of Accomack County**: the water resources, habitats, parks, forests, wetlands, and other natural features that support air, land, and water quality and habitat. The completed inventory and accompanying maps will be available to help county citizens and elected officials to develop policies or strategies for guiding development and other land uses. The Center has also participated in inventories in five other Virginia areas. (*Eastern Shore News*, 5/27/09)

•In June, the Wintergreen Resort and the Wintergreen Nature Foundation in Nelson County announced that the Resort will give 1**,400 acres around the 3000-foot-high Crawford Knob** to the Foundation so that the land can be placed in a conservation easement. (*Charlottesville Daily Progress*, 7/1/09)

Laws & Regulations

•On April 27, the Virginia DEQ presented to the SWCB a proposed regulation that would require **buyers of poultry litter to document when and where they used the material**, as a way to track potential impacts on the Chesapeake Bay watershed from nutrients in the litter. The SWCB approved a 60-day public comment period on the proposal. (*Harrisonburg Daily News-Record*, 5/8/09)

•In May, Virginia Del. Albert Pollard's office began a service of **sending weekly text messages about state regulations** to the cell phones of Virginia watermen. Del. Pollard, who represents parts of King George, Lancaster, Northumberland, Richmond, and Westmoreland counties, sees this as a more effective and immediate way than computer communications to reach people working on the water. The messages will be based on information from the Virginia Marine Resources Commission and the Potomac River Fisheries Commission. (*Fredericksburg Free Lance-Star*, 5/7/09)

Mining

•Here is a review of some recent legal and regulatory **developments regarding the mountaintop (also called "mountaintop removal") method of coal mining**, with its accompanying "valley fills" (placement of the removed soil and rock into nearby hollows or valleys, many of which had perennial or intermittent streams): 1) On March 24, the U.S. EPA decided to stop a large number of permits being sought for mountaintop mining while the agency reviews the environmental impacts of the method. 2) On April 27, U.S. Interior Secretary Ken Salazar announced that he has asked the U.S. Justice Department to overturn a regulation, and send it back to the EPA, that was completed near the end of the Bush administration affecting Clean Water Act application to mountaintop mining and valley fills). 3) In May, the U.S. Army Corps of Engineers suspended a permit sought by A&G Coal Company for a proposed mountaintop/valley fill coal mine on 1,300-acre site in Wise County. The Corps letter stated that the suspension would allow the agency to review concerns raised by the U.S. EPA over the mining method. 4) On June 11, the Obama administration announced policy changes in federal oversight of the mountaintop/valley fill method of coal mining. The agreement among federal agencies (U.S. EPA, the Interior Department, and the U.S. Army Corps of Engineers), coordinated by the White House Council on Environmental Quality, aims to require more environmental review of projects, reassert federal authority to monitor state regulators, and ensure buffers between streams and placement of fill material. For more details on these developments, please see the U.S. EPA Web site "Mid-Atlantic Mountaintop Mining," at http://www.epa.gov/region3/mtntop/. (*Wall Street Journal*, 4/28/09; *Bristol Herald Courier*, 5/8/09; and *Washington Post*, 6/11/09)

•On May 21, a Virginia Coal and Energy Commission (VCEC) subcommittee approved the final draft of a plan to study **proposed uranium mining in Pittsylvania County**. This followed the May 7 submission by the National Research Council of a recommended study plan. The subcommittee voted to make public health and safety the first item in the list of study priorities, followed by social and economic impacts. The National Academy of Sciences is to oversee the study. The study plan and other information about the VCEC uranium mining are available at http://dls.state.va.us/groups/cec/Uranium/meetings.htm. (*Lynchburg News & Advance*, 5/13/09 and 5/22/09)

Solid Waste Management

• In spring 2009, the Upper Tennessee River Roundtable continued **two ongoing efforts to reduce trash problems in southwestern Virginia watersheds**. First, the Keep Southwest Virginia Beautiful program received grants from Keep American Beautiful for campaigns to reduce cigarette litter in Abingdon, Clintwood, Gate City, Grundy, Norton, and Wise. The Roundtable campaigns concentrate both on cleaning up existing cigarettes and on raising public awareness that cigarette butts actually are litter. The second effort is a project to locate and map illegal dumpsites in the watershed; the most recent project, in March 2009, mapped over 90 sites in Tazewell County. Mapping the dumpsites has allowed the Roundtable and other partners to target clean-up efforts. (*Upper Tennessee River Roundtable Newsletter*, Spring 2009)

•On May 15, the board of the **Southeastern Public Service Authority (SPSA) approved a plan to recover from $240 million in debt**. SPSA provides solid waste services to Virginia Beach, Norfolk, Chesapeake, Portsmouth, Suffolk, Franklin, Isle of Wight County, and Southampton County. The plan includes a loan from the City of Virginia Beach, a credit line from Wachovia Bank, refinanced bonds from the Virginia Resources Authority, and a $170/ton landfill tipping fee (the highest in the United States; two years ago, SPSA's fee was $57/ton). (*Virginian-Pilot*, 4/23/09 and 5/15/09)

•What solid-waste issue does the densely populated and high-powered city of **Washington, D.C**., have in common with the rural southeastern Virginia county of **Isle of Wight**? Both localities recently have focused on **plastic bags**. In Washington, on June 2 the city council passed the Anacostia River Cleanup and Protection Act, which imposes a five-cent tax to discourage use of non-reusable bags—plastic and paper—at businesses; the businesses keep one cent while four cents goes into a fund for cleaning up the river. In Isle of Wight, the county received a $28,000 grant from the Virginia DEQ to start a pilot program for recycling plastic bags and educating citizens on the potential impacts of discarded bags. In recent years the county has become concerned particularly with damage to agricultural equipment from discarded plastic bags. (*Daily Press*, 5/27/09; and *Washington Post*, 6/3/09)

Spills

•On May 27, the U.S. Chemical Safety Board (CSB) released its final report on the November 12, 2008, **collapse of a fertilizer-storage tank at Allied Terminals in Chesapeake**, which injured two workers and resulted in a spill of over two million gallons of liquid fertilizer, some of which reached the Elizabeth River. The report said the Virginia should regulate inspection and maintenance of above-ground tanks that contain *non-combustible* liquids (underground tanks, and above-ground tanks containing *combustible* material, both fall under existing regulatory authority). According to CSB, 17 states have such regulations. Chesapeake officials said they intend to seek General Assembly legislation that would authorize the City to regulate such tanks along the Elizabeth. The report also said that the company did not have adequate procedures for inspecting welds (faulty welds were previously identified as the cause of the collapse) or for re-filling tanks after major tank modifications. (*Virginian-Pilot*, 5/28/09).

Stormwater Management

•Mill Dam Creek, a tributary of the Lynnhaven River in Virginia Beach, exemplifies the many streams in Virginia that have **bacterial contamination problems resulting largely from stormwater runoff**. The city's stormwater permit administrator has estimated that the creek, which has very high bacterial readings, is impacted by 40-50 stormwater outfalls. City officials are working with scientists from the University of North Carolina to track the sources of the bacteria. (*Virginian-Pilot*, 4/14/09)

•From late June to mid-July, the Virginia Department of Conservation and Recreation (DCR) held five public hearings around the state on **proposed changes to the state's Stormwater Management Program Permit Regulation**. The proposed changes address criteria for water quality and quantity, procedures for local stormwater-management programs, and the administration and schedule of fees. Among the proposed changes are a reduction in the amount of phosphorus allowed to run off a construction site, an increase in the amount of rainfall that must be managed, and new recommended best management practices (BMPs). The public comment period on the proposed changes ends August 21. More information about these regulations is available at www.dcr.virginia.gov/soil_and_water/stormwat.shtml, or phone the DCR's central office at (804) 786-2064. (*Harrisonburg Daily News-Record*, 7/1/09)

Wastewater

•The **Town of Culpeper's $27-million wastewater-treatment plant upgrade** should be completed by October 2009. When completed, the 6-million-gallon-per day plant will meet nutrient requirements that Chesapeake Bay watershed localities must meet by 2010. (*Culpeper Star-Exponent*, 4/8/09)

•In June, the town council in **Elkton (Rockingham County) was considering a 45-percent increase in water and sewer rates**. The Town plans to apply to borrow $3.4 million in an interest-free loan from the Virginia DEQ for wastewater-treatment plant improvements. The Town is under a consent decree to make improvements, estimated currently at $2.8 million; the improvements would also increase the system's capacity. To receive the DEQ loan, the Town would be required to raise sewer rates enough to cover the debt payments. (*Harrisonburg Daily News-Record*, 6/8/09 and 6/19/09; and *Valley Banner*, 5/22/09)

Meanwhile, also in Elkton wastewater affairs: On June 29 the **Chesapeake Bay Foundation (CBF) filed suit** in Richmond Circuit Court against the nutrient-discharge allowance approved by the SWCB in April for the **Merck Company's Stonewall pharmaceutical plant** in Elkton. CBF is asserting that if Merck's allocation is increased, a comparable decrease should occur elsewhere in the Shenandoah-Potomac river basin. This follows the April 2009 approval by the SWCB of an increase (as of 2011) for the Merck plant's nutrient-discharge allowance, from the current permit limit of 14,619 pounds of nitrogen and 1,096 pounds of phosphorus to 43,835 pound of nitrogen and 4,384 pounds of phosphorus. (In 2007, Merck discharged 110,700 pounds of nitrogen, according to the Va. DEQ.) In exchange for the permitted nutrient discharge, Merck must purchase nutrient credits from other wastewater dischargers who are below their permitted limits, or put money into a state fund for reducing nutrients from nonpoint sources, such as agriculture. Merck is also required to spend $16 million to improve nutrient removal at the Stonewall plant. (*Harrisonburg Daily News-Record*, 5/2/09; and *Waynesboro News Virginian*, 6/30/09)

Water Supply and Conservation

•On April 15, the **Fluvanna County Board of Supervisors approved the formation of a joint water authority with Louisa County**; Louisa's board approved the arrangement on April 6. Since 2003, the counties have been considering a pipeline for three-to-six million gallons/day of water from the James River that would serve Fluvanna on its way to a terminus in Louisa; the project is estimated to cost $45-50 million. Some Fluvanna County residents, concerned about the joint authority's expected powers and the cost of the proposed project, had requested a public referendum on the issue. (*Charlottesville Daily Progress*, 4/16/09)

•In May, the counties of Henrico and Powhatan announced that they will no longer be partners in the proposed **Cobbs Creek reservoir**. Under discussion and negotiation since 2002, the proposed reservoir would cover about 1,100 acres, store water pumped from the James River during high flows, and cost about $200 million. Goochland County is a fourth partner in the project. According to Henrico's deputy county manager for community relations—who said there is still a possibility of resuming negotiations—Cumberland was asking for about $32 million more (over 50 years) than Henrico and Powhatan are willing to pay in return for having the reservoir in Cumberland (and take on the associated environmental effects and other impacts. The Powhatan County Board of Supervisors chair said that another conflict is whether Cumberland County or the regional authority (which would own the reservoir) would manage the reservoir's watershed. (*Richmond Times-Dispatch*, 5/29/09. For a previous *Water Central* item: Sep. 2008, p. 11.)

•Here is an update on **water-supply planning in the Albemarle-Charlottesville area**: A June report by a team of engineers for the Rivanna Water and Sewer Authority (RWSA) asserted that the cost of a new dam to increase the size of the Ragged Mountain Reservoir could be reduced below the nearly $57 million estimate given after investigations found fractures in the bedrock that would be under the dam's foundation. When the Ragged Mountain option was initially approved in Albemarle and Charlottesville as the key to a long-term water supply increase, the project's estimate was about $37 million. The higher dam-project cost estimate gave new impetus to advocates for dredging the South Fork Rivanna River Reservoir. In March, following a January presentation of study by a task force on dredging South Fork, the Charlottesville City Council called for an examination of the cost of doing so. On May 18, the Charlottesville City Council voted to fund a study of dredging South Fork. On June 15, the RWSA executive director said that the Authority is continuing both to examine the costs of the dam project and the feasibility of South Fork dredging. (*Charlottesville Daily Progress*, 5/19/09 and 6/16/09. Previous *Water Central* item: Sep. 2008, p. 12)

•The long history of **Newport News' proposed King William Reservoir** took significant turns in spring 2009. On March 31, U.S. District Judge Henry Kennedy, Jr., ruled that the U.S. Army Corps of Engineers and the U.S. EPA erred in granting a permit in November 2005 for the 13-billion-gallon reservoir project. On April 30, the City of Newport News announced that was suspending all work towards its years-long effort to get approval for and build the proposed reservoir. On June 1, the U.S. Department of Justice filed a notice of intent to appeal the March 31 U.S. District Court ruling (the appeal was filed with the U.S. Court of Appeals for the District of Columbia Circuit). The permit remains suspended, pending the possible appeal. (*Daily Press*, 5/1/09, 5/29/09, and 6/2/09; and *Virginian-Pilot*, 5/2/09).

Wetlands

•Kevin DuBois, an environmental specialist with the Norfolk Environmental Commission, was one of 43 nominees across the country for a **National Wetlands Award**, an annual recognition administered by the Environmental Law Institute in Washington, D.C. (*National Wetlands Newsletter*, May-June 2009)

Out of Virginia

Chesapeake Bay States

•In April, the Maryland General Assembly passed legislation (S.554) to require **nitrogen-removal technology on all new or replacement septic systems** in critical areas within 1000 feet of the Chesapeake Bay. The state estimates that 50,000 residences could be affected. (*Washington Post*, 4/19/09)

•In a settlement with 13 environmental groups who challenged the **Maryland Department of the Environment's (MDE) 2008 general permit for construction-related stormwater runoff**, MDE has agreed to tighten requirements in the general permit process, require individual permits for projects over 150 acres, and allow more public comment on individual permits. (*Baltimore Sun*, 5/22/09)

•**The Maryland Grow Oysters project**, through which citizens and organizations volunteer to grow baby oysters in cages until the oysters can be placed on reefs in sanctuaries, will increase from the 850 cages in one river in 2008 to 5,000 cages in 11 streams and rivers in 2009. The program is coordinated by the Maryland Department of Natural Resources. (*Washington Post*, 6/16/09)

•President Obama's May 12, 2009, Executive Order on a larger federal role in protecting and restoring the Chesapeake Bay is apparently the **first official inclusion of Delaware as a full partner in Chesapeake restoration efforts**, according to one editorial. Delaware has the headwaters of the Choptank River, Nanticoke River, and several other Bay tributaries. (*Delaware News Journal*, 5/18/09)

•Exploration for and recovery of **natural gas from the Marcellus shale formation** in Maryland, New York, Ohio, Pennsylvania, and West Virginia continues to generate news, particularly in Pennsylvania and New York. Important issues include the large number of wells being drilled or planned, the potential economic returns, road and community impacts, water use, and potential water-quality impacts from chemicals in water injected underground in the hydraulic-fracturing method of extracting the gas. "Natural Gas Quest: All About Drilling in New York and Pennsylvania," a Web site from the *Press and Sun-Bulletin* of Binghamton, N.Y., provides access to background resources about the Marcellus formation and the drilling process, along with dozens of news articles on the topic. (*Binghamton Press and Sun-Bulletin* Web site, http://www.pressconnects.com, accessed 6/16/09)

Elsewhere

•In January, the U.S. Court of Appeals for the Sixth Circuit, in the case of *National Cotton Council of America v. U.S. EPA*, found invalid the EPA's rule that had exempted **pesticide applications**—if conducted according to the federal Insecticide, Fungicide, and Rodenticide Act—from the requirement for a discharge permit under the federal Clean Water Act. (*National Wetlands Newsletter*, Mar.-Apr. 2009)

•At almost ten times the size of the Florida Everglades, the **Pantanal wetland in Brazil** is the world's largest freshwater wetland. The Pantanal is facing pressure from two rapidly growing Brazilian industries: beef exporting, which increased three-fold between 2003 and 2008 (estimates are that each head of cattle requires 2.5 acres of pasture); and the pig-iron smelting industry, which has increased six-fold since 2003 (this industry uses trees from the area for charcoal). (*National Wetlands Newsletter*, Mar.-Apr. 2009)

Final Words

•"I applaud the president for taking the initiative. But it doesn't solve the problem. …The problem as I see it is the simple fact that you cannot have a healthy Bay until you limit nitrogen and phosphorous discharges. The six states in the Chesapeake watershed and the District of Columbia have agreed that you cannot have a have a healthy Bay unless you limit nitrogen to 170 million pounds and phosphorous to 12.4 million pounds a year."[20] Tayloe Murphy, a former member of the Virginia House of Delegates and former Virginia secretary of natural resources, commenting on the May 12 Executive Order by President Obama on an increased role for the federal government in restoration of the Chesapeake Bay. (*Fredericksburg Free Lance-Star*, 5/16/09)

•"We consume massive quantities of water to generate energy, and we consume massive quantities of energy to deliver clean water. Many people are concerned about the perils of peak oil—running out of cheap oil. A few are voicing concerns about peak water. But almost no one is addressing the tension between the two: water restrictions are hampering solutions for generating more energy, and energy problems, particularly rising prices, are curtailing efforts to supply more clean water." Michael E. Webber, associate director of the Center for International Energy and Environmental Policy at the University of Texas at Austin. ("Energy vs. Water: Why Both Crises Must be Solved Together," *Scientific American*, Oct. 2008)

•"We have something even more special here in the [Shenandoah] Valley; our farmland can support rain-fed agriculture. Our food production here is not dependent on irrigation water from deep wells or dams. There aren't very many places like that in the world." Robert Whitescarver, a district conservationist with the Natural Resources Conservation Service in Verona (Augusta County), in a commentary about conflict in Virginia between growth and agricultural land preservation. (*Staunton News Leader*, 5/24/09)

•"They all know that one thing they can do is go home and tell people (about the environment) and now they have a vehicle, the rain barrels, to discuss it. And if the questions come, they can really educate others." Carrie Lewis, 5th-grade teacher at Dearington Elementary School in Lynchburg, referring to her students' year-long math/science lessons using water quality as a theme for illustrations and exercises. The year culminated in the students making rain barrels from old pickle barrels. (*Lynchburg News & Advance*, 6/11/09)

•"I was just going to work this morning and I saw the tent set up and said, 'Should I go to work or volunteer? Aw, heck, I'm going to volunteer and spend the day on the river with the dog.'" Herbert Joyner, referring to his decision to forego his regular job one day in June to join about 1000 other volunteers participating in the 10th Annual James River Regional Cleanup. (*Richmond Times-Dispatch*, 6/14/09)

For more water-related news and resources, categorized by topic, please visit the *Virginia Water Central* News Grouper, at www.vwrrc.vt.edu/va_water_grouper.html.

[20] According to the Chesapeake Bay Program (http://www.chesapeakebay.net/status_pollutants.aspx?menuitem=19795, 5/26/09), an estimated 291 million pounds of nitrogen and 13.8 million pounds of phosphorus reached the Bay in 2008. According to the *Annapolis Capital*, 5/23/09, the Bay states' goal is to reduce the nitrogen input to 175 million pounds annually; an interim goal for 2011 (set at the 2009 Chesapeake Bay Executive Council meeting) is 243.6 million pounds annually. Virginia contributes about 27 percent of nitrogen, Maryland 21 percent, and Pennsylvania almost 40 percent.

SPECIAL NEWS ITEM: WATERSHED ROUNDTABLES ROUND-UP

In this section, *Water Central* will present occasional updates from Virginia's watershed "roundtables"—forums within Virginia's major river basins where various groups and individuals can share information, perspectives, and activities on water resources. Any opinions expressed in these updates are not necessarily those of the Virginia Water Resources Research Center. Following is the June 25, 2009, update.

Introducing the Virginia Watersheds Alliance

By Llyn Sharp

In 2005, a network of individuals representing the watershed roundtables for major watersheds in the Commonwealth formed the Virginia Watersheds Alliance (VaWA).

The goals for VaWA include sharing visions, resources, expertise, and strategies among member roundtable organizations so that the organizations may better fulfill their roles. VaWA is also a forum for articulating and presenting statewide concerns to decision-makers.

VaWA has prepared a statement supporting a water policy update for the Commonwealth. This will be presented to the Kaine administration as well as carried forward in the transition to the new administration next year.

Previous efforts by the leaders involved in VaWA have shown that sustained efforts to develop relationships among stakeholders in water issues can lead to collaborative approaches to complex problems. Thoughtful and committed work among organizations can make a meaningful impact on the stewardship of the Commonwealth's water resources.

Watershed Roundtables in VaWA

As of June 2009, there are 13 major watershed roundtables participating in VaWA: Albemarle-Chowan River, Big Sandy River, Eastern Shore, Hampton Roads, Middle James River, New River, Potomac River, Rappahannock River, Shenandoah River, Upper James River, Upper Roanoke River, Upper Tennessee River, and York River & Small Coastal.

Recognition of Virginia roundtables started in 1996 through a Virginia Department of Conservation and Recreation initiative to provide watersheds a regional forum to discuss water issues. The primary objective of a roundtable is to develop relationships among diverse stakeholders such that they may collaborate with, learn from, and inform each other while effectively acting to address local water issues. Stakeholders include agencies, local government, business, industry, environmental groups, education, and committed citizens.

Each roundtable serves its local watershed through a combination of meetings, projects, and actions that best suit its circumstance; however, each roundtable agrees to operate in a manner that allows it to remain welcoming, neutral, and representative in order to encourage relationships and collaboration. Roundtables strive to enroll the most diverse stakeholder group as is possible and reasonable for a specific meeting, project, or activity.

A Web portal connects to participating watershed roundtables at http://www.vawatersheds.org. The site includes an interactive map showing the area covered by each roundtable. Clicking on an individual roundtable area identifies the localities and the major rivers in the area and provides links to contacts and organizations in the area.

For More Information

For more information about individual roundtables or the Virginia Watersheds Alliance (of Roundtables, please see the Web site at http://www.vawatersheds.org/, or contact the following:

Bruce Lundeen, Shenandoah Valley Pure Water Forum Executive Director
James Madison University, MSC 4903
800 S. Main Street
Harrisonburg, VA 22807
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E-mail: bruce@purewaterforum.org.

WATER QUALITY and YOU/ LA CALIDAD de AGUA y USTED

In this section, *Water Central* offers suggestions for how individuals can help maintain and improve the condition of Virginia's waters and aquatic habitats. Unless otherwise noted, you are welcome to reproduce and distribute items in this section, but please retain the credits to the original source(s). All Web sites mentioned were functional as of 7/3/09. A Spanish translation begins on the following page. *Para información en español, por favor vea la página proxima.*

Safely Enjoying Virginia's Natural Waters

[*Ed. note:* The following text is from a May 2004 Virginia Department of Health brochure, located online at http://www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring/ .]

What You Should Know

The quality of Virginia's natural waters, including ocean, bays, rivers, streams, and lakes, is monitored regularly. There are a number of factors—including naturally occurring organisms, rainwater runoff, and human impacts—that make it impossible to guarantee that any natural body of water is free of health risks. Most of the organisms in Virginia's recreational waters probably do not cause human illness or are in such low levels [that] they will not make anyone sick, but there is no way to be sure. Because natural bodies of water—especially rivers—are so changeable, officials can only make general statements about the health risk of certain bodies of water; they cannot say exactly what the condition of a specific body of water is at any particular time.

Where Do Organisms Found in Water Come From?

All natural waters contain algae, bacteria, viruses and parasites. These microbiological organisms come from plants, animals and sometimes, humans. Agricultural and urban runoff and improperly or partially treated sewage contribute to microbiological pollution. Water flow, temperature, level of acidity, chemical composition, amount of organic material, and especially what runs into or is dumped into the water influence how many and what kinds of organisms are present.

Why Avoid Natural Water After a Heavy Rain?

During a heavy rainfall, pollution from the land washes into rivers, lakes, and streams and eventually winds up in our coastal waterways. Pet, livestock, and wildlife wastes, [as well as] untreated waste water from sewage treatment plants that are overloaded by an excess of rain water, can all end up in natural waters used for recreation and [then can] pose risks to human health.

How is Health Risk from Natural Waters Determined?

Because testing water for bacteria, viruses, and parasites that cause illness is difficult, time-consuming, and costly, two bacteria have been selected to use as **indicators** of possible contamination from human waste. National standard tests for *E. coli* and enterococci (a *group* of bacteria) indicate the level of possible contamination from human waste. Non-disease causing bacteria can also come from animals or multiply readily in certain types of water, so high levels of these indicator bacteria do not necessarily mean the water is unsafe. Likewise, water that tests negative for indicator bacteria could contain disease-causing organisms. In general, the higher the indicator level, the more likely it is that harmful bacteria are present, increasing the risk that people will become ill from the water.

What Are the Risks?

The most common waterborne illnesses are gastrointestinal and may cause vomiting, diarrhea, or nausea. These illnesses result from swallowing water contaminated by disease-causing microbiological organisms. Less commonly, skin, ear, and eye infections can result from contact with contaminated water. Although recreational water users may inadvertently swallow water, deliberately drinking from rivers, streams, or lakes is *never* recommended.

People who have a weakened immune system may get sick from much lower levels of harmful organisms than healthy people, and should avoid any contact with natural bodies of water. Some waters may be contaminated with toxic substances. The risk of illness is greater for persons eating fish from those waters than it is for swimmers. The Virginia Department of Health (VDH) issues fish-consumption advisories when levels of contaminants found in fish exceed safe levels and [those advisories recommend] that people limit or eliminate consumption of certain types of fish from those waters. Warning signs and brochures on fishing regulations provided by the Department of Game and Inland Fisheries notify the public of fishing advisories.

What You Can Do To Protect Yourself

•Look for posted signs and follow the advice on them.
•Do not swim in water that looks stagnant or muddy or [that] smells unpleasant.
•Try to avoid swallowing river, stream, or lake water.
•People who have a weakened immune system should avoid contact with natural bodies of water.
•Prevent direct contact between broken skin and recreational water.
•Avoid swimming [for] several days after a heavy rainfall.
•Do not drink alcoholic beverages or use drugs when swimming or boating.
•Avoid areas where you may become trapped in rocks or debris by fast-flowing water.
•Avoid flood waters, [which] can carry hidden debris and cause injury.
•Do not add to the risk; use appropriate toilet facilities.

For more information, contact your local health department or the regional Virginia Department of Environmental Quality office serving your area, or visit the VDH Web site at http://www.vdh.virginia.gov/epidemiology/.

En Español

En esta sección, *Water Central* le ofrece sugestiónes de como individuales pueden mantener y mejorar la condición de las aguas y los habitats acuáticos de Virginia. Aprovechese de repdroducir y distribuir esta pagina, pero por favor retenga los credítos a los originales. Todos los sitios de Web mencionados funcionaban el 3 Julio 2009.

Como Disfrutar de las Aguas Naturales de Virginia Sin Peligros

[La información siguenta proviene de una folleta de mayo 2004 de la Virginia Department of Health (el Departamento de Virginia de Salud), en el Internet a http://www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring/. La traducción es de la folleta original.]

Lo que debe saber

La calidad de las aguas naturales de Virginia, incluyendo el mar, las bahías, los ríos, riachuelos, y lagos, es revisada de manera regular. Una serie de factores—incluyendo organismos que ocurren naturalmente, residuos de las lluvias, y el impacto humano—hacen imposible garantizar que toda masa de agua está libre de riesgos para la salud. La mayoría de los organismos en las aguas recreativas de Virginia probablemente no producen enfermedades en humanos, o están presentes en niveles tan bajos que son incapaces de producir una enfermedad en las personas; pero no hay manera de garantizar esto. Debido a que las masas de agua naturales—específicamente los ríos—cambian tanto, los organismos oficiales sólo pueden hacer declaraciones generales sobre los riesgos para la salud de ciertas masas de agua. Los organismos oficiales no pueden decir con exactitud cual es la condición de una masa de agua específica en un momento determinado.

¿De dónde provienen los organismos que se encuentran en las aguas?

Todas las aguas naturales contienen algas, bacterias, virus, y parásitos. Estos microbios provienen de las plantas, animales, y algunas veces de los humanos. La infiltración de las aguas residuales de la agricultura y las zonas urbanas, y las aguas negras parcialmente tratadas, contribuyen a la polución de carácter microbiano. La corriente del agua, la temperatura, el nivel de acidez, la composición química, la cantidad de material orgánico, y especialmente lo que drena en estas aguas o se desecha en las mismas, influyen en la cantidad y los tipos de organismos presentes.

¿Por que debo evitar las aguas naturales después de lluvias copiosas?

Durante las lluvias copiosas, la polución de los campos es arrastrada hacia los ríos, lagos, y riachuelos y con el tiempo alcanza las aguas costeras. Los desechos de mascotas, ganado, y vida salvaje, y las aguas de desecho de las plantas de tratamiento que se ven sobrecargadas por un exceso de agua de lluvia, pueden alcanzar las aguas naturales usadas con fines recreativos y ocasionar riesgos a la salud humana.

¿Cómo se determinan los riesgos de salud de las aguas naturales?

Debido a que realizar pruebas del agua para detectar bacterias, virus, y parásitos que causan enfermedades, es difícil, toma mucho tiempo y es muy costoso; se han seleccionado dos bacterias para usarlas como **indicadores** de possible contaminación por desechos humanos. Las pruebas nacionales estándar para detectar *E. coli* y enterococos (un *grupo* de bacterias) indican los niveles de posible contaminación por desechos humanos. Las

bacterias que no provocan enfermedades también pueden provenir de animales o multiplicarse rápidamente en ciertas aguas; de manera que niveles elevados de estas bacterias indicadoras, no necesariamente significan que las aguas son peligrosas. De la misma manera las aguas cuyas pruebas arrojan resultados negativos; podrían contener organismos que causan enfermedades. En general, mientras más alto sea el nivel de indicadores, la probabilidad de que hayan bacterias nocivas es mayor, aumentando el riesgo de que las personas se enfermen a causa del agua.

¿Cuáles son los riesgos?

Las enfermedades más comunes transmitidas por el agua son las gastrointestinales y pueden producir vómitos, diarrea, o nauseas. Estas enfermedades son producto de tragar agua contaminada por microbios que causan enfermedades. Menos comunes son las infecciones de la piel, oídos, y ojos, producidas por el contacto con aguas contaminadas. Aunque los usuarios las aguas recreativas pueden tragar agua sin darse cuenta, tomar agua deliberadamente de ríos, riachuelos, o lagos no es recomendado. Las personas que poseen un sistema immune débil, pueden enfermarse con niveles más bajos de organismos nocivos que las personas sanas, y deben evitar el contacto con masas de agua naturales. Algunas aguas pueden estar contaminadas con sustancias tóxicas. El riesgo de contraer una enfermedad es mayor para las personas que consuman pescados capturados en esas aguas que para las personas que nadan en las mismas. El Departamento de Salud de Virginia (VDH) publica advertencias para el consumo de pescado cuando los niveles de contaminantes en los peces exceden los niveles de seguridad y recomienda que las personas limiten o no consuman ciertos tipos de pescados provenientes de esas aguas. Los letreros de advertencia y los folletos de regulaciones de pesca, provistos por el Departamento de Caza y Pesca, notificará al público sobre advertencias de pesca.

Lo que puede hacer para protegerse

- Observe si hay letreros y siga los consejos que allí aparecen.
- No nade en aguas que parezcan estancadas o enlodadas o que tengan un mal olor.
- Trate de evitar tragar agua de ríos, riachuelos o lagos.
- Las personas con un sistema immune débil, deben evitar el contacto con masas de agua naturales.
- Prevenga el contacto directo entre la piel rota y las aguas recreativas.
- Evite nadar hasta varios días después de lluvias copiosas.
- No consuma bebidas alcohólicas o drogas cuando nade o navegue.
- Evite áreas donde pueda verse atrapado en rocas o escombros, debido a corrientes de agua rápidas.
- Evite aguas de inundaciones, pueden llevar escombros escondidos y lesionarle.
- No aumente el riesgo; use instalaciones sanitarias adecuadas.

Para más información, póngase en contacto con el departamento de salud de su localidad o la oficina del departamento regional de Calidad Ambiental que atiende a su localidad; o visite la página Web en http://www.vdh.virginia.gov/epidemiology/.

Avoid contact with natural waters until several days after high flows./Evite contacto con las aguas naturales hasta varios días después de lluvias copiosas. *Photo by Alan Raflo.*

VIRGINA GOVERNMENT WATER ISSUES OVERVIEW

This section lists water issues under current consideration (study or regulation) by state boards, commissions, or agencies in Virginia. Information in this issue is based on public meetings listed **April 20—July 6, 2009,** on the **Virginia Regulatory Town Hall** Web site, at www.townhall.state.va.us/L/meetings.cfm. The Town Hall site posts agendas of upcoming meetings and minutes of past meetings held by Virginia's boards, commissions, and departments; also, the Town Hall site includes various water-related meeting on relatively local issues that are *not listed here*, such as water-treatment plant permit hearings or meetings about specific scenic rivers. Unless otherwise noted, all contact people listed in this section are Virginia state employees. To find the e-mail address any state employee, go online to www.employees.state.va.us/directory-search.cfm. You can also request state employee phone numbers by calling (800) 422-2319. All Web sites listed in this section were functional as of 7/8/09.

Total Maximum Daily Load (TMDL) Processes

Under the federal Clean Water, when a water body fails (with a certain frequency) to meet state water-quality standards, the water is to be designated as "impaired," requiring development of a total maximum daily load (TMDL). A TMDL *study* identifies the pollutant source(s) causing the impairment and determines how much of the pollutant(s) the water can receive (the "load") and still meet standards. A TMDL *implementation plan* (required by Virginia law) maps a process for reducing the pollutant load to the TMDL level. Many Virginia TMDLs are underway, each involving many public meetings. The table below lists those where public meetings were held during the period noted above. Information on the status of all TMDLs in Virginia is available online at www.deq.state.va.us/tmdl/.

Location	Water(s) & Impairment	Larger Watershed(s)	Most Recent Meeting Date	For More Information
Arlington County	Four Mile Run (tidal portion) for bacteria	Potomac River	6/15/09	Katie Conaway
Augusta County	Long Glade Run, Mossy Creek, and Naked Creek for bacteria, and Mossy Creek for aquatic life (benthic) impairment	South River/ Shenandoah River	6/18/09	Tara Sieber
Charles City County	Morris Creek for bacteria	Chickahominy River/James River	5/20/09	Margaret Smigo
Arlington and Fairfax counties and cities of Alexandria and Falls Church	Cameron Run, Holmes Run, and Hunting Creek for bacteria	Potomac River	6/30/09	Katie Conaway
James City County	Mill Creek and Powhatan Creek for bacteria	James River	6/18/09	Jennifer Howell
Lee County	Straight Creek and tributaries (Baileys Trace, Ely Creek, Gin Creek, Lick Branch, Puckett Creek, and Stone Creek) for bacteria	Powell River/Tennessee River	5/26/09	Shelley D. Williams
Northampton County	Mill Creek for aquatic life impairment (low oxygen) and Oyster Harbor for shellfishing impairment.	Atlantic Ocean	4/30/09	Jennifer Howell
Northumberland County	Fountain Cove and Bridgeman, Cod, Cubitt, Hack, Hull, Presley, and Rogers creeks, all for bacteria	Potomac River	624/09	Margaret Smigo
Page and Rockingham counties	South Fork Shenandoah River for bacteria and aquatic life (benthic) impairment	Shenandoah River/Potomac River	5/18/09	Robert Brent
Richmond County	Richardson and Totuskey creeks for bacteria	Rappahannock River	5/6/09	Margaret Smigo

Other Topics Under Current Consideration

The following lists topics considered in public meetings held during the period noted at the beginning of this section. The focus of this section is topics of broad or statewide concern; generally, meetings about individual permits or strictly local issues are not included. Items are listed alphabetically by topic, followed by the agency or group coordinating state study or action and then a contact name. Agency Abbreviations: DCR = Dept. Conservation and Recreation; DEQ = Dept. Environmental Quality; DGIF = Dept. Game and Inland Fisheries; DMME = Dept. Mines, Minerals and Energy; SWCB = State Water Control Board; VDH = Department of Health. "VAC" numbers indicate the *Virginia Administrative Code* section for a particular regulation; you can access and search the VAC at http://legis.state.va.us/Laws/AdminCode.htm. "NOIRA" stands for Notice of Intended Regulatory Action.

Biosolids Permits—1) 6/11/09 public meeting on application by Nutri-Blend, Inc., to land-apply biosolids on approximately 3587 acres in Campbell County. Public comment period: 6/12/09 to 7/13/09. More information: Kevin A. Crider. 2) 6/15/09 public meeting on application by Synagro Central, Agri-Services Corporation, and Recyc Systems, Inc., to land-apply biosolids on approximately 6633 acres in Fauquier County. Public comment period: 6/16/09 to 7/15/09. More information: Beth Biller. 3) 6/16/09 public meeting on application by Nutri-Blend, Inc., to land-apply biosolids on approximately 4412 acres in Charlotte County. Public comment period: 6/16/09 to 7/17/09. More information: Kirk A. Batsel.

Biosolids Regulations (9 VAC 25-20, 25-31, and 25-32)—SWCB's advisory committee on biosolids regulations met 4/21/09 (financial subcommittee) and 5/22/09 (full committee). The SWCB published a Notice of Intended Regulatory Action (NOIRA) in the June 23, 2008, *Virginia Register* about several possible amendments to the biosolids regulations. More information: William K. Norris.

Coal Combustion By-products Regulation (9 VAC 20-85)—Advisory Committee meetings: 4/29/09, 5/19/09, and 6/11/09. The DEQ has established this advisory committee to review and make recommendations on the entire regulation, including location restrictions, design and construction requirements, operations, closure, testing of the materials prior to placement, a public-notice component, and other topics that may be brought up during the public comment period. DEQ expects that a rulemaking will be initiated to amend the regulation. More information: Melissa Porterfield.

Coal Mining-related Water Permits—6/2/09: Public hearing on Curley Hollow Solid Waste Management Facility permit in Wise County. This permit is for disposal of fossil fuel combustion products from the Virginia City Hybrid Energy Center (new coal-fired power plant); leachate collection and groundwater monitoring are part of the permit; the public comment period ran April 24-June 17, 2009. More information: Dallas R. Sizemore.

Mined Land Reclamation—Dept. of Mines, Minerals and Energy's (DMME) **Orphaned Land Advisory Committee** met 5/27/09. The advisory committee helps he DMME's Division of Mineral Mining set priorities for orphaned land sites to be reclaimed with money from the Orphaned Land Fund. More information: Allan Bishop, DMME. The DMME's **Abandoned Mined Land Advisory Committee**, which helps with *coal-mining* abandoned lands, met 6/3/09. More information: Roger L. Williams.

Natural Gas and Surface Owner Rights—DMME public education meetings: 6/1, 6/4, and 6/9/09. DMME held these townhall-style meetings in response to citizen questions and concerns regarding natural gas development and surface owner rights in Virginia. Topics included the history of state rules and regulations governing natural gas extraction, how wells are located and drilled, options for participating in a lease agreement, and others. More information: Mike Abbott.

Recycling—DEQ's Recycling Markets Development Council meeting: 6/3/09. More information: Michael Ward, Virginia Petroleum Council, (804) 225-8248 or m.ward7@verizon.net.

Solid Waste Management and Groundwater—6/2/09: Public hearing on a draft permit for BFI Waste Systems of Virginia for a permit modification at the Old Dominion Landfill in Henrico County. The public comment period began May 3 and ended June 17, 2009. More information: Donald H. Brunson.

Scenic Rivers—Goose Creek advisory committee meeting, 5/13/09. More information: David C. Dowling.

State Parks—Public meetings on park master plans: Occoneechee State Park in Mecklenburg County, 6/4/09. More information: John R. Davy.

Stormwater Best Management Practices (BMPs)—Virginia Stormwater BMP Clearinghouse Committee meeting: 6/11/09. The BMP Clearinghouse Committee, coordinated by the Va. DCR and the Virginia Water Resources Research Center, is working to develop a publicly accessible Web site that will serve as Virginia's reference site for stormwater BMPs. More information: David Dowling.

Stormwater Management Regulations (4 VAC 50-60)—Public hearings on proposed amendments: 6/30/09, 7/1/09, 7/7/09, 7/9/09, and 7/14/09. Amendments are proposed for Parts 1, 2, 3, and 13 of the Virginia

Stormwater Management Program Permit Regulations to address criteria for water quality and quantity, criteria and procedures for local stormwater-management programs, and the administration and schedule of fees. The public comment period runs 6/22/09 to 8/21/09. More information: David Dowling.

Stormwater Nutrient Offsets from Construction Activities—Stormwater Offsets Workgroup meetings: 6/3/09 and 6/25/09. This workgroup was created to help develop guidance to implement HB 2186 (2009 Virginia General Assembly), which allows the use of offsets to achieve required nutrient reductions for stormwater discharged from construction sites. The guidance will be developed for the Chesapeake Bay watershed. More information: David C. Dowling.

Water-quality standards (9 VAC 25-260) triennial review (remaining issues)—Advisory committee meetings: 4/29/09, 5/26/09, and 6/17/09. According to the Regulatory Town Hall notice: "At its October 16-17, 2008, meeting, the SWCB approved changes to the Virginia Water Quality Standards regulation as part of the triennial review of the standards. Due to the scientific complexity behind the numeric criteria for several toxic pollutants, the Board also directed staff to reconvene the triennial review advisory committee to consider updates to aquatic life criteria for ammonia, copper, cadmium, cyanide, and lead in 9 VAC 25-260-140, and consider the need for a prohibition of any new or expanded mixing zones for persistent bioaccumulative toxic substances in 9 VAC 25-260-20." The advisory committee was to meet monthly with DEQ staff through June 2009. More information: Alex Barron.

Regular Meetings of Statewide Boards and Commissions

Marine Resources Commission—Meets monthly; most recent meeting: 6/23/09. More information: phone (757) 247-2200, TDD (757) 247-2292; main Web page: www.mrc.virginia.gov/index.shtm.

State Water Control Board—Meets quarterly; most recent meeting: 4/27-28/09; SWCB meeting minutes are available at the Regulatory Town Hall Web site, http://www.townhall.state.va.us/L/meetings.cfm (click on "Past Year" to access meeting minutes from the past 12 months). More information: Cindy Berndt.

Board of Health's water-related committees:

1) **Onsite Sewage Handling and Disposal Engineering Design Review Panel**—Most recent meeting: 3/10/09. More information: David S. Tiller.

2) **Onsite Sewage Handling and Disposal Appeals Review Board**: Most recent meeting: 4/1/09. More information: Donna Tiller.

Cave Board— Meet three times per year; most recent meeting: 4/18/09. More information: phone (804) 786-7951; Web site: www.dcr.virginia.gov/natural_heritage/cavehome.shtml.

Chesapeake Bay Local Assistance Board—Meets March, June, September, and December. Most recent meeting: 6/16/09 (Policy Committee and full board). More information: phone (800) CHESBAY; Web site: www.dcr.virginia.gov/chesapeake_bay_local_assistance/board.shtml.

Game and Inland Fisheries Board—Meets bimonthly; most recent meeting: 6/25/09 (Wildlife and Boat Committee). More information: Beth B. Drewery; Web site: www.dgif.virginia.gov/about/.

Gas and Oil Board—Meets monthly; most recent meeting: 6/16/09. More information: Davis Asbury; Web site: http://www.dmme.virginia.gov/divisiongasoil.shtml.

Groundwater Protection Steering Committee—Meets third Tuesday of odd-numbered months; most recent meeting: 3/17/09. More information: Mary Ann Massie; Web site: www.deq.virginia.gov/gwpsc/.

Land Conservation Foundation—Meets about three times per year; most recent meeting: 3/27/09. More information: phone (804) 786-3218; Web site: www.dcr.virginia.gov/virginia_land_conservation_foundation/index.shtml.

Licensing and Regulation Boards—Licensing boards for engineers, geologists, onsite sewage system professionals, soil scientists, waste-management facility operators, waterworks and wastewater works operators, and wetland delineators are under the Dept. of Professional and Occupational Regulation; phone (804) 367-8500, TDD (804) 367-9753; Web site: www.dpor.virginia.gov/dporweb/boards.cfm.

Outdoors Foundation—Meets at least quarterly; most recent meetings: 4/1/09; 5/21/09. More information: Bobbie Cabibbo at (540) 327-7727; Web site: www.virginiaoutdoorsfoundation.org.

Scenic River Advisory Board—Meets at least two times a year. Most recent meeting: 5/14/09. More information: Lynn Crump, DCR, (804) 786-5054 or lynn.Crump@dcr.virginia.gov; Web site: www.dcr.virginia.gov/recreational_planning/srmain.shtml.

Soil and Water Conservation Board—Meets bimonthly; most recent meeting: 5/21/09. More information: DCR (804) 786-1712; Web site: http://www.dcr.virginia.gov/soil_and_water/vs&wcb.shtml.

Waste Management Board—Meets about three times per year. More information: contact: Dept. of Environmental Quality, (800) 592-5482; Web site: www.deq.virginia.gov/cboards/homepage.html#waste.

N O T I C E S

If you would like to receive e-mail notifications about meetings, reports, and other items related to water quality and water monitoring, you may do so by joining the Virginia Water Monitoring Council; contact Jane Walker at (540) 231-4159 or janewalk@vt.edu.

All Web sites listed in this section were functional as of July 8, 2009.

DEQ Citizen Monitoring Grant Schedule for FY 2010

On June 8, the Virginia Department of Environmental Quality (DEQ) announced the following schedule for Fiscal Year 2010 grants under its Citizen Monitoring Grant program:
6/29/09: Request for FY 2010 Grant Proposals released;
8/31/09: Deadline for submitting proposals to DEQ for review;
10/30/09: Grants announced and contracts mailed to awardees;
11/30/09: Signed contracts due to DEQ to begin award payment process;
1/1/10-12/31/10: FY 2010 grant project term;
2/1/10: Draft Quality Assurance Project Plan (QAPP) submitted to DEQ (if applicable);
12/31/10: Final QAPP submitted to DEQ (if applicable);
2/28/11: Final reports due.

For more information on this program, contact Stuart Torbeck, DEQ Water Quality Data Liaison at (804) 698-4461 or cstorbeck@deq.virginia.gov; Web site: http://www.deq.virginia.gov/cmonitor/grant.html.

Volunteer Precipitation Monitoring

The Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) is a non-profit, community-based network of volunteers who measure and map precipitation (rain, hail and snow). The network originated with the Colorado Climate Center at Colorado State University in 1998 and has expanded to over 12,000 observers in 39 states. The national Web site is http://www.cocorahs.org/; the Virginia Web page http://www.cocorahs.org/State.aspx?state=VA. People interested in signing up as monitors can do so at the national home page or by contacting regional coordinators. Virginia's regional coordinators are the following:

Northern Region: Dennis Miller, National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Md.: dennis.miller@noaa.gov.

Eastern Region : Mike Montefusco, National Weather Service (NWS) in Wakefield; (757) 899-4200 or michael.montefusco@noaa.gov.

Western Region: Dennis Sleighter and Anita Silverman, NWS in Blacksburg; (540) 552-0084; or e-mail to dennis.sleighter@noaa.gov or anita.silverman@noaa.gov.

Far Western Region: Craig Carpenter**,** NWS in Morristown, Tenn.: craig.carpenter@noaa.gov.

Water Quality in the Lynchburg Area

The Freshwater Ecology Laboratory at Lynchburg College is in its seventh year of studying the water quality of the Blackwater River watershed in Lynchburg and in Bedford and Campbell counties. Reports since 2003 are available online at http://lasi.lynchburg.edu/shahady_t/public/Research/Blackwater%20Ivy/Blackwater.htm. For more information, contact Thomas Shahady at (434) 544-8545 or shahady@lynchburg.edu.

Carbonate Aquifer Groundwater Report

Factors Affecting Water Quality in Selected Carbonate Aquifers in the United States, 1993–2005 (117 pages) is a 2009 report from the U.S. Geological Survey's National Water Quality Assessment Program. The report examined water quality in 12 carbonate aquifers, including the Valley/Ridge and the Piedmont/Blue Ridge aquifers located partially in Virginia. The report (SIR 2008-5240) is available online at http://pubs.usgs.gov/sir/2008/5240/; a limited number of print copies are available from the Pennsylvania Water Science Center, (717) 730-6946 or jbricker@usgs.gov.

Northern Snakehead Web Site

Nicholas LaPointe, a Ph.D. student in Virginia Tech's Fisheries and Wildlife Sciences Department, has developed a Web site on the Northern Snakehead, a non-native fish that was found in the Potomac River in 2004. Besides basic information on the fish, the site will include Mr. LaPointe's research results on the species life history, habita, feeding, and behavior. The site is www.fishwild.vt.edu/snakeheads/index.html.

Marine Debris Booklet

The *Educator's Guide to Marine Debris* (44 pages) from South Carolina Sea Grant, has information and middle-school level lessons on marine debris on the southeastern U.S. and Gulf coasts. Available online at www.scseagrant.org/content/?cid=153, or contact SC Sea Grant at (843) 953-2078.

Montana State University Student Video on Amphibians

The April 2009 issue of *Montana Water News* reports that Jennifer Grace, a graduate film student at Montana State University, won a Student Emmy for her 17-minute children's film, "Frog, Chemical, Water, You," about worldwide amphibian declines and environmental toxins. Ms. Grace made the film for exhibit at the Smithsonian Institution's National Zoo. The video can be viewed at http://www.lifeonterra.com/results.php?creator=Jennifer Grace.

Water Levels in Major Rivers

A comprehensive study of global stream flows from 1948 to 2004 reveals that many world rivers have decreased flows. The Columbia, Colorado, and Mississippi are among the rivers studies. The study was published in May 2009 in the *Journal of Climate*. For more information: www.nsf.gov/news/news_summ.jsp?cntn_id=114600&govDel=USNSF_51.

Drinking Water Facts from U.S. EPA

Did you know that the United States has approximately 52,000 community water systems, but just eight percent of those systems (4,132) serve 82 percent of the people? This and other drinking water information is available in the EPA publication *Factoids: Drinking Water and Ground Water Statistics for 2008*. The publication (EPA 816-K-08-004; November 2008) and those from previous years are available online at http://www.epa.gov/safewater/databases/sdwis/howtoaccessdata.ht.

Aquatic Invasive Species Monitoring

The Spring 2009 issue of *The Volunteer Monitor* focuses on methods for monitoring and preventing the spread of aquatic invasive species, such as the Zebra Mussel, Purple Loosestrife, European Naiad, Water-milfoil, and many others. The newsletter is available online at www.epa.gov/owow/monitoring/volunteer/issues.htm, or contact the editor at (415) 334-2284 or ellieely@earthlink.net.

Water and Cities

The Water Environment of Cities (2009; 375 pages), by Larry Baker, of the University of Minnesota's Water Resources Center, examines urban water budgets, groundwater management, urban water infrastructure, urban streams, water management institutions and law, water in urban planning, and water economics. The book is published by Springer (www.springer.com).

A Global Look at Water Law

The Evolution of the Law and Politics of Water (2009; 416 pages) examines the history and current status of water laws and policies throughout the world. Ordering information is at www.springer.com/law/environmental/book/978-1-4020-9866-6.

New Scientific Journal on Desalination

In November 2009, the International Desalination Association will publish the first issue of *Journal of Desalination and Water Reuse*, a peer-reviewed publication on desalination science and technical matters. For more information about the new journal: Leslie Merrill at lmerrill@idadesal.org; Web site: www.idadesal.org.

What if a Bird Sings and No One Hears It?

This is the title of a May 11, 2009, essay by Sam Hamilton, the Southeast Regional Director for the U.S. Fish and Wildlife Service (FWS). On June 9, Mr. Hamilton was nominated by President Obama to be the head of FWS. His essay argues the health of bird populations, habitats, and other natural features depends on younger Americans becoming more aware of nature. The short essay is online at www.fws.gov/southeast/news/2009/r09-025.html.

Energy and Climate Notices

•On January 16, the U.S. EPA released a 786-page, three-year study (co-authored by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration) on potential **climate change impacts on the mid-Atlantic coast** (New York, New Jersey, Delaware, Maryland, D.C., Virginia, and North Carolina). The full report and summaries by state are available online at http://sealevelreport.com/.

•**"Portfolio Manager"** from the U.S. EPA allows water utilities to track energy use and associated carbon emissions. The program also offers wastewater treatment plant managers to compare their plant's energy use with other peer plants. The program is available at www.energystar.gov/index.cfm?c=water.wastewater_drinking_water.

•The March 2009 issue of *Natural Hazards Observer* focuses on **connections between natural hazards and climate change**. Feature articles examine the potential for collaboration between natural hazards researchers and climate change researchers, the potential benefits of long-term flood insurance policies, and how climate change may affect human conflicts. The issue also contains a useful one-page summary of climate change ("Climate Change for the Compleat Idiot"). Available online at www.colorado.edu/hazards/; or contact the Natural Hazards Center in Boulder, Colorado, at (303) 492-6818 or hazctr@colorado.edu.

•**Carbon sequestration on public lands:** *Framework for Geological Carbon Sequestration: Report to Congress* is a June 2009 report from the U.S. Department of Interior on the technical and legal issues involved in using public lands for underground sequestration (long-term storage) of carbon dioxide generated by energy production. The report is online at www.doi.gov/news/09_News_Releases/EISA_Sec._714_Report_to_Congress_V12_Final.pdf.

•***Global Climate Change Impacts in the United States***: This annual report by the U.S. Global Change Research Program integrates information available on the current climate situation and predicted impacts. The report (196 pages) and various aids for examining key findings (including a 20-page summary brochure) are available at the program's Web site, www.globalchange.gov.

Upcoming Conferences and Workshops

Please also see the Water Center's "Quick Guide to Water-related Meetings and Conferences in Virginia," on our Web site at www.vwrrc.vt.edu/VAConfQuickGuide.html.

Events In Virginia

Aug. 14, Ferrum College: **Roanoke River Watershed Conference**. Organized by the Upper Roanoke River Roundtable and Ferrum College. More information: Maureen Castern at mcastern@verizon.net; Web site: http://www.upperroanokeriver.org/rivercurrents.shtml.

Aug. 15, VFW grounds, Front Royal: **On the River '09 Festival.** Organized by the Friends of the Shenandoah River. More information: Karen Andersen, (540) 665-1286, or friendsofshenandoahriver@gmail.com.

September-October, statewide: **Virginia Waterways Cleanup**, in conjunction with the **International Coastal Cleanup**. Organized by Clean Virginia Waterways. More information: (434) 395-2602 or cleanva@longwood.edu; Web site: http://www.longwood.edu/cleanva/iccva.htm.

Sept. 9-10, Hampton: **Virginia Environmental Education Conference.** Organized by the Virginia Department of Environmental Quality and the Hampton Roads Alliance for Environmental Education. More information: http://www.vanaturally.com/eeconference09.html.

Sep. 17-20, Cape Charles and surrounding area: **17th Annual Eastern Shore Birding and Wildlife Festival.** Organized by the Eastern Shore of Virginia Chamber of Commerce. More information: (757) 787-2460; Web site: www.esvachamber.org/festivals/birding/.

Oct. 15-16, Richmond: **Virginia Water Research Conference–Water Resources in Changing Climates. PLEASE SEE OUR CONFERENCE NOTICE ON PAGE 44.**

Events Elsewhere

Aug. 4-6, Prestonsburg, Ky.: **Forestry Reclamation Approach in Action.** 3rd annual conference of the Appalachian Regional Reforestation Initiative. Includes field tours of coal-mining operations, a stream-reconstruction project, and a reforestation project. More information: Renee Williams at (859) 257-7597 or rdwill5@uky.edu; Web site: http://arri.osmre.gov/Events/AN_CONF/MLRC2009.details.htm.

Aug. 11-12, Johnstown, Penn.: **Mid-Atlantic Invasive Plant Conference.** Organized by the Mid-Atlantic Exotic Pest Plant Council'. More information: Steve Young at steveyoung@aol.com; Web site: www.ma-eppc.org.

Sep. 30-Oct. 2, Atlanta, Ga.: **Southeast Stormwater Association Annual Conference.** More information: Danielle Hopkins at (850) 561-0904 or danielleh@ksanet.net; Web site: www.seswa.org/conferences.asp.

Oct. 9-11, Shepherdstown, W. Va.: **Chesapeake Watershed Forum.** Organized by the Alliance for the Chesapeake Bay. More information: Lou Etgen at (410) 377-6270 or letgen@acb-online.org; Web site: www.acb-online.org/ChesForum2009.cfm.

Oct. 22-23, Charleston, S.C.: **Hurricane Hugo 20th Anniversary Symposium on Building Safer Communities.** Organized by the Applied Technology Council. More information: (650) 595-1542; Web site: www.atcouncil.org.

Also Out There…

(Brief descriptions of some interesting items *Water Central* has recently discovered.)

•"**The Use of Aquatic Insects to Assess the Effectiveness of Stream Restoration in North Carolina**," in the March 2009 issue of NWQEP Notes from North Carolina State University, discusses the relatively new field of using biological monitoring to evaluate stream-restoration projects. The publication is available online at www.bae.ncsu.edu/programs/extension/wqg/issues/notes131_aquatics.pdf, or contact the editor at (919) 515-3723 or notes_editor@nscu.edu.

•"**Recession Could Mean Greater Accountability for Chesapeake Bay Restoration**." Written by graduate journalism students in the Washington Program at Northwestern University's Medill School for Journalism, this article offers a good review of recent reports on conditions in the Bay and recent political and economic developments in the Bay restoration effort. *Medill Reports Washington*, 4/16/09; Northwestern University, Evanston, Ill.; online at http://news.medill.northwestern.edu/washington/news.aspx?id=126277.

•And for more on **Bay restoration accountability**: *An Accountability Mechanism for the Chesapeake Bay—Interview Findings* presents comments from 11 state and federal officials who have been involved with the U.S. EPA's Chesapeake Bay Program (including Jeff Corbin in the Virginia Secretary of Natural Resources' office) on how to improve the accountability of the Bay Program. A summary of and link to the 18-page report are online at www.progressiveregulation.org/chesbay.cfm; or contact the CPR in Washington, D.C., at (202) 747-0698 or info@progressivereform.org.

•From Sea Grant programs in Virginia and South Carolina come two recent articles on **preparation for, and response to, severe coastal storms**:

1)"Forecasting the Rising Tide," in the Spring 2009 issue of *Virginia Marine Resource Bulletin* from Virginia Sea Grant, describes research at the Virginia Institute of Marine Science to improve predictions of storm surges. Available online at http://web.vims.edu/adv/pubs/bulletin.html, or contact Va. Sea Grant at (804) 684-7167 or vsgpubs@vims.edu.

2) "Disaster Resilience: 20 Years After Hugo," in the Spring 2009 issue of *Coastal Heritage* from South Carolina Sea Grant, examines the effects of the past 20 years of hurricanes on building practices, communications, and other storm-preparation and -response factors in South Carolina and other southeastern states. Available online at www.scseagrant.org/Sections/?cid=82, or contact S.C. Sea Grant at (843) 953-2078 or annette.dunmeyer@scseagrant.org.

Correction from a Previous *Water Central*

April 2009 issue (issue #48): The article on the 2009 Virginia General Assembly omitted HJ 819, recognizing the 40th anniversary of the Virginia Scenic Rivers Program.

AT THE WATER CENTER

To reach the Virginia Water Resources Research Center: phone (540) 231-5624; FAX (540) 231-6673; e-mail water@vt.edu; Web site www.vwrrc.vt.edu.

New Publication on Water and Energy Use

Younos, T., C. Grady, T. Chen and T. Parece 2009. Conventional and Decentralized Water Infrastructure: Energy Consumption and Carbon Footprint. In the proceedings of the American Water Resources Association' s 2009 spring specialty conference, "Managing Water Resources and Development in a Changing Climate," May 4-6, 2009, Anchorage, Alaska. ISBN: 1-882132-79-3.

New Water Center Publication on Stormwater

Implementing Watershed-Based Green Infrastructure for Stormwater Management: Case Study in Blacksburg, Virginia (SR45-2009), by Meredith P. Warren, Tamim Younos, and John Randolph, is now available at the Water Center's Web site, at www.vwrrc.vt.edu/special_reports.html.

William R. Walker Award Winner

Congratulations to John Petrie, the recipient of the 2009 William R. Walker Graduate Fellowship. John is a Ph.D. student in the Civil and Environmental Engineering Department at Virginia Tech. The Walker Fellowship, established to honor the late Bill Walker, the Water Center's founding director, is awarded annually to an individual preparing for a professional career in water resources.

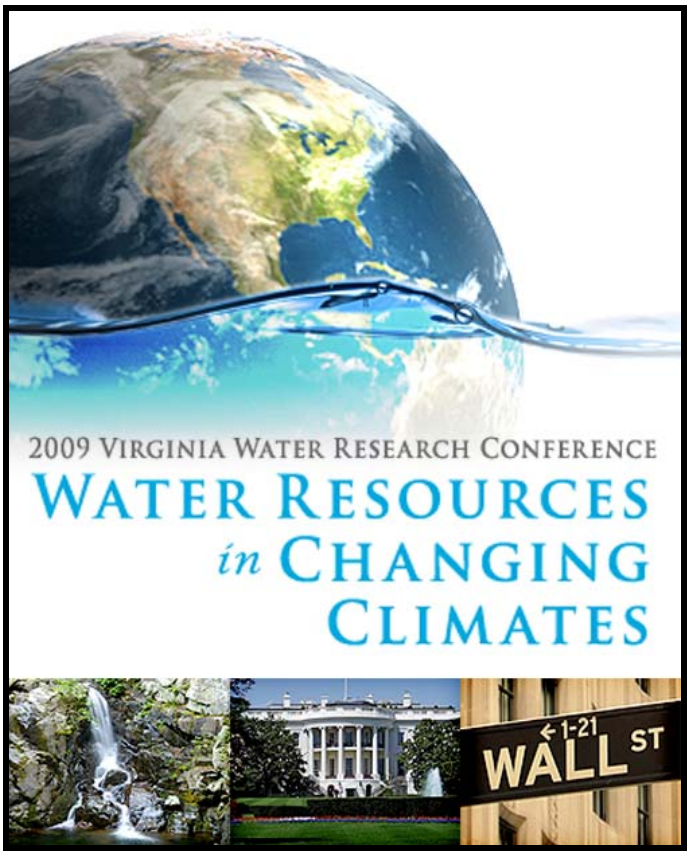
2000 VIRGINIA WATER RESEARCH CONFERENCE

In October, the Virginia Water Resources Research Center and the Rice Center for Environmental Life Sciences at Virginia Commonwealth University will present "Water Resources in Changing Climates," a research conference to address environmental, political, and economic changes faced by stakeholders, researchers, and managers of water resources.

Special keynote speakers include Preston Bryant, Virginia secretary of natural resources and Virginia Burkett, chief scientist for global change research at the U.S. Geological Survey.

The conference will be **October 15-16, 2009**, at the Trani Center for Life Sciences on Virginia Commonwealth University's Monroe Park Campus in Richmond, Virginia. Lodging is available at the DoubleTree Hotel Richmond Downtown at the special rate of $89 plus tax per room per night (good through September 23, 2009).

More information and registration is available online at www.vwrrc.vt.edu/2009conference.html, or contact Jane Walker at (540) 231-4159 or janewalk@vt.edu.



Virginia Water Central

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