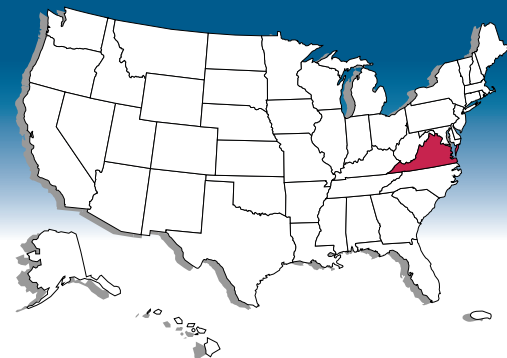




# U.S. Geological Survey Programs in Virginia



U.S. Department of the Interior ■ U.S. Geological Survey

For more than 100 years the U.S. Geological Survey (USGS) has provided earth science information to help others understand and manage the Nation's energy, land, mineral, biological, and water resources. Such information is used in many decisions regarding management and optimum use of Virginia's natural resources and to address major environmental, economic, and health issues, such as contamination of the environment by hazardous wastes, adequacy of suitable-quality water supplies, nutrient input to streams and estuaries, distribution of coal and mineral resources, and effects of urban development and agriculture on the environment.

## Hydrologic and Geologic Hazards

Virginia's hydrologic and geologic hazards have included floods, droughts, and landslides. The USGS, in cooperation with the Federal Emergency Management Agency, is currently conducting geologic mapping and evaluation of landslides, debris-flows, and flood effects caused by flash flooding in summer 1995 in the Blue Ridge Province of Madison County and other parts of the Shenandoah Valley region (fig. 1). Specific sites of future potential damage from debris flows and flooding are being identified, as well as alternatives for mitigation of debris-flow hazards.

Much of the hydrologic data collected by the USGS is provided continuously (real-time data) to resource managers, planners, and forecasters for predicting and minimizing the impacts of natural hazards. These data are obtained at hydrologic monitoring stations equipped with telephone lines or satellite transmission equipment. The National Weather Service uses the real-time data from USGS streamgaging stations to forecast streamflow conditions on major rivers and smaller streams in densely populated areas. Real-time hydrologic data also are used to minimize hazards caused by low-flow or drought conditions. Numerous reservoirs in Virginia currently are managed on

the basis of real-time streamflow conditions to ensure adequate water supply at municipal intakes and to maintain minimum in-stream flows for preservation of fish and wildlife habitat.

As part of the U.S. National Seismograph Network, the USGS supports a regional seismic network with a station at the Virginia Polytechnic Institute and State University in Blacksburg. The national network, which consists of more than 1,750 stations, is designed to provide rapid notification of seismic events to emergency services personnel; a consistent archive of standardized, high-quality, and nationwide seismicity data; and a national data base for public information on earthquakes.

## Water-Data Networks

In virtually all parts of Virginia, the quantity, quality, and distribution of water are critical to the State's economy, public health and welfare, and resource management. Public protection from floods and droughts, multiple use of limited water resources, and effects of land and water use on water quality are among the typical issues.

### Index of Subjects

- Hydrologic and Geologic Hazards
- Water-Data Networks
- Water Supply, Availability, and Development
- Human and Environmental Influences on Water Quality
- Regional Environmental Assessments
- Biological Studies in the Potomac and Appalachian Regions
- Mineral and Energy Resources
- Geologic Mapping
- Topographic Mapping
- Earth-Science Information

The USGS, in cooperation with other Federal, State, and local agencies, operates and maintains long-term and continuous hydrologic data-collection networks with the Virginia Department of Environmental Quality. The statewide networks consist of monitoring sites at which surface- and ground-water and water-quality data are collected and recorded. The data are collected and processed by using nationally standardized techniques and special-purpose instrumentation, including satellite telemetry, multiparameter water-quality sensors, global positioning systems, and water-level sensors. The data, which are stored in computer files,



Figure 1. Flood effects in Shenandoah National Park in summer 1995.

are available either through the Internet or annual publications.

In Virginia, streamflow is recorded continuously at more than 160 streamgaging stations, and peak flows are monitored at more than 45 crest-stage sites (fig. 2). Streamflow data are used extensively by the general public; industry; Federal, State, and local agencies; and utility companies to make a wide variety of decisions, including those regarding safe river-rafting conditions, selection of future water supplies, flood control and warning systems, bridge and culvert design, management and operation of reservoirs and hydroelectric powerplants, and permits for water use and discharge of treated wastewater.

The ground-water data network in Virginia consists of more than 250 wells at which water levels are measured at least twice each year. These data are used to document natural changes in water levels in aquifers and to monitor long-term water-level declines that result from pumpage.

## Water Supply, Availability, and Development

The availability of high-quality ground and surface waters for private, municipal, industrial, and agricultural uses has been and will continue to be of utmost importance



Figure 2. Measurement of surface-water flow from a cable suspended above a stream.

within Virginia. Many USGS activities are directed at hydrologic and geologic issues associated with water supply.

The USGS, in cooperation with the Virginia Department of Environmental Quality, collects, compiles, and manages site-specific and aggregated water-use estimates. The water-use information is published every 5 years.

The USGS, in cooperation with the Virginia Department of Environmental Quality and the Hampton Roads Planning District Commission, evaluates the effects of ground-water pumpage on the availability of local and regional water resources in the Coastal Plain of Virginia. The assessment is based on a digital ground-water flow model that is integrated with spatial data maintained in a geographic information system (GIS). The model and GIS are used to help evaluate permit requests to withdraw ground water from the Coastal Plain aquifers. The information is critical for maintaining a sustainable supply of freshwater to meet the continuing population growth and increased demands for freshwater.

## Human and Environmental Influences on Water Quality

Information on the status, trends, and causes of water-quality conditions in the State is vital to decisionmakers who set priorities, regulations, and policies for the optimum management of water resources. Scientific information about how, when, and where chemicals enter water supplies can help managers tailor protection strategies. An understanding of human and environmental influences on water quality is useful to identify quickly and efficiently locations throughout the State that are most vulnerable to contamination, to identify priority aquifers and streams that require protection, and to devise appropriate and cost-effective watershed-management strategies.

The Chesapeake Bay, which is one of the largest estuaries in the world and home to more than 2,700 species of plants and animals, is a major economic and recreational resource in Virginia. In 1987, the Governor of Virginia signed the Chesapeake Bay Agreement, which commits Federal, State, and other agencies to work toward improving the quality of water in the Bay and to reduce controllable nutrient input to the Bay by 40 percent by 2000.

USGS information is provided to managers and scientists to evaluate the need for pollution-control practices, policies, and

strategies in the Chesapeake Bay watershed. The USGS has worked with the Virginia Department of Environmental Quality since 1988 to determine the amounts of nutrients and suspended solids that enter the Bay from five major tributaries in Virginia and to assess whether water-quality conditions are changing over time. In addition, the USGS has recently initiated a 5-year baywide ecosystem assessment on ground-water/surface-water relations, living resources, and topographic and geologic processes that affect water quality in the Bay.

The ecosystem assessment will be coordinated with other relevant and ongoing activities to document and further understand conditions in and processes that affect the Bay watershed. One activity involves a USGS study conducted with the Accomack-Norhampton Planning District Commission, which evaluates geohydrologic and chemical processes that affect agricultural nonpoint-source contamination. These processes, which govern how nitrate and other contaminants move in the ground water and ultimately discharge to estuaries on the Eastern Shore, can be applied to many other areas within the Chesapeake Bay region. An understanding of these processes helps water-resource planners and managers, and the agricultural community to develop effective crop-management practices to control nonpoint-source contamination in ground water.

The USGS is currently evaluating the quality of water in major aquifers of the Coastal Plain that are used for water supply in the heavily urbanized Hampton Roads area of Virginia. This effort is coordinated with the Hampton Roads Planning District Commission and the Virginia Department of Environmental Quality and includes an assessment of the spatial distribution of saltwater and the rate of movement of saltwater into fresh ground-water supplies. Geologists from the USGS and the Virginia Department of Environmental Quality are currently assessing the role of a giant meteorite impact, which occurred 35 million years ago in the Chesapeake Bay region, on the location and extent of the salty water in the freshwater aquifers.

The city of Newport News and the USGS are assessing the quality and quantity of streams and associated reservoirs to optimize water-supply strategies. Ongoing USGS efforts include analysis of organic material and chemical constituents in selected reservoirs and associated watersheds and assessment of factors, including hydrology, land use, wetland environments, and seasonality,

that affect distribution of the organic material.

The USGS, in cooperation with the Virginia Department of Conservation and Recreation, Division of Natural Heritage, is evaluating hydrologic and geochemical processes in protected wetlands in the North Landing River Basin. Knowledge of the hydrologic interaction between agricultural uplands and associated wetland ecosystems, as well as site-specific hydrologic and geochemical processes that occur within the ecosystems, is needed to manage this natural preserve effectively.

The USGS is actively involved with addressing Virginia's concerns about urban development and its effect on water quality. The USGS, in cooperation with the Virginia Department of Transportation (VDOT), is evaluating the effectiveness of stormwater-management facilities in controlling increases in highway runoff and associated chemical constituents caused by expanded highways. The USGS is also working with the VDOT and the Virginia Polytechnic Institute and State University to assess the hydrology and effectiveness of reconstructed wetlands in Manassas. Benefits of natural stream restoration techniques, retention ponds, and other best-management practices on stream-water quality in a heavily urbanized area in Prince William County are being investigated by the USGS, in cooperation with 15 local, State, and Federal agencies.

Migration of toxic contaminants at hazardous-waste sites is a continued concern throughout Virginia. The USGS, in cooperation with the U.S. Environmental Protection Agency, Virginia Department of Environmental Quality, and various military branches of the U.S. Department of Defense, is evaluating migration of toxic contaminants at hazardous-waste sites and military installations in Virginia. Detailed descriptions of geohydrologic settings, water quality, and rates and directions of ground-water and contaminant flow are provided by the USGS. These descriptions help others to evaluate and optimize potential remedial actions at hazardous-waste sites.

## Regional Environmental Assessments

Since 1986, the USGS has conducted a nationwide assessment of water-quality conditions in streams and ground water known as the National Water-Quality Assessment (NAWQA) Program. Five major river or aquifer systems in Virginia are studied in the

NAWQA program. These systems are located in the Potomac River Basin, the Albemarle-Pamlico drainage basin, the Kanawha-New River Basin, the Upper Tennessee River Basin, and the Delmarva Peninsula. The long-term goals of the NAWQA Program are to describe the status and trends in the quality of surface- and ground-water resources and to identify the natural and human factors that affect their quality. Communication and coordination with local and State water-resource officials are key components of the national program.

The USGS is working with the National Park Service to protect and preserve the natural and cultural resources within Shenandoah National Park. Geologists are mapping surficial deposits and overburden, and hydrologists are assessing quantity and quality of ground water and springs. The geologic and hydrologic information is presented in general interest publications and exhibits, and is useful to understand, preserve, and manage the Park's natural ecosystem, as well as to provide adequate and high-quality water supplies to 2 million visitors each year.

## Biological Studies in the Potomac and Appalachian Regions

The USGS Biological Resources Division (BRD, formerly the National Biological Service) provides information on water quality, fisheries, acid rain, and priority species in Virginia. Senior biologists provide expertise and technical assistance in biological collections and interpretation of data in three NAWQA study areas, including the Potomac River basin, the Albemarle-Pamlico drainage basin, and the Upper Tennessee River Basin. BRD biologists are also involved in studies on the passage of fish, such as striped bass, through the Little Falls Dam on the Potomac River, in collaboration with the U.S. Army Corps of Engineers, National Park Service, the U.S. Fish and Wildlife Service, and State agencies. BRD is also studying the effects of acid rain and habitat degradation in the Appalachian region and, with the assistance of the Southern Appalachian Man and the Biosphere Program, is developing a system for sharing this information with local communities.

The Virginia Cooperative Fish and Wildlife Research Unit is located on the Virginia Polytechnic Institute and State University campus in Blacksburg. Unit scientists conduct research throughout the State on fishery issues, habitat modification, and endangered

species in conjunction with State and Federal agencies. Many of their efforts focus on freshwater mussel ecology and restoration.

## Mineral and Energy Resources

The USGS Mineral Resource Data System (MRDS) is a digital data base of more than 110,000 mineral sites worldwide and provides mineral-related information to other Federal, State, and local agencies; industry; and the general public. The MRDS contains information on about 1,400 sites in Virginia that focuses mostly on occurrences of iron, gold, manganese, copper, and sand and gravel. This information has been developed in cooperation with the Virginia Department of Mines, Minerals, and Energy (DMME), Division of Mineral Resources.

Scientists at the USGS are conducting geophysical studies, such as aeromagnetic and aerial gamma-ray spectrometer surveys, that provide important information for assessing mineral-resource potential. The surveys provide data about the characteristics of rocks near the Earth's surface and help distinguish rock units that are deeply weathered. These data are useful for determining the geologic framework of a region and also can be used to assess natural radiation hazards. Digital geophysical data sets for Virginia are being compiled by the USGS, in cooperation with the DMME, Division of Mineral Resources, and Mary Washington College.

The USGS is completing a quantitative national assessment of mineral resources for five commonly used metals—gold, silver, copper, lead, and zinc. The assessment lists and quantifies significant known deposits and identifies areas with mineral potential. Tracts outlined in Virginia may contain undiscovered deposits of copper, lead, and zinc and two types of gold deposits.

As part of its mineral-resource assessment program, the USGS, State resource agencies, and universities are assessing the potential for undiscovered industrial polymetallic resources offshore of the Atlantic Coast (from Florida to Maine) on the basis of geological, geophysical, and geochemical studies. Information in digital and paper form assists Federal and State land-management agencies, regional planners, industry, and local governments in ensuring adequate supplies and optimal management of these important minerals.

The USGS, in cooperation with the DMME, Division of Mineral Resources, is characterizing the quality of coal resources

on public and private lands. The information is useful to regulatory agencies, land-management agencies, industrial interests, and academic researchers.

Acid mine drainage in Contrary Creek in Louisa County is being investigated by the USGS, the U.S. Army Corps of Engineers, the National Park Service, and the DMME, Division of Mineral Resources. Specifically, scientists from the cooperating agencies are investigating relations between different iron precipitates in neutral and acidic parts of the creek and water chemistry. Such relations may help in the development of a cost-efficient tool to assess accurately the acidity and water quality of other streams in Virginia and throughout the Nation.

## Geologic Mapping

State agencies currently cooperate with the USGS on digital topographic and geologic data collection, as well as traditional map-revision activities. For example, the USGS cooperates with and provides data to the DMME, Division of Mineral Resources, which has recently completed the new "Geologic Map of the State of Virginia." Geologic mapping is currently in progress in the Piedmont and the Coastal Plain of southern Virginia, in cooperation with the DMME, Division of Mineral Resources. These maps provide information needed for construction of highways, bridges, and industrial sites; evaluation of sites of environmental contamination; and identification of sources of construction materials. Geologic mapping completed in northern Virginia addresses multiple land-use and environmental issues in areas of metropolitan growth. One of the Nation's first radon-risk maps, which is based on the geologic mapping, was completed recently for Fairfax County. Computer models developed by the USGS that combine geologic, land-use, and environmental data are used by Loudoun County to screen potential landfill sites.

Geologic mapping also is conducted with National Cooperative Geologic Program funds to increase the coal mine data base. This information can be used for permitting and reclamation of coal mines, coal reserve and coal-quality studies, and engineering studies related to subsidence and underground mine development.

## Topographic Mapping

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map repre-

sents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. The maps are used extensively for civil engineering, land-use planning, natural-resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor recreation. The State of Virginia is covered by 815 maps at this scale. Digital elevation models are available for about 99 percent of the State.

The National Mapping Program fosters partnerships with State and Federal agencies to improve the effectiveness of its data-collection activities, to maximize resource sharing, and to enhance the availability of timely and accurate data to the general public. The USGS cooperates with the DMME, Division of Mineral Resources, on the acquisition of statewide aerial mapping photography through the National Aerial Photography Program. Initial overflights were completed in spring 1994. These photographs are used to revise maps and to produce digital orthophotoquads, which are digitized aerial photographs with displacement caused by camera tilt and terrain relief removed. Digital orthophotoquads combine the image characteristics of a photograph with the geometric qualities of a map.

## Earth-Science Information

Earth Science Information Centers (ESIC's) provide information about USGS programs, products, and technological developments to the public. The ESIC in Charlottesville was established under a cooperative agreement with the DMME, Division of Mineral Resources. An ESIC also is located at the USGS National Center in Reston. As part of a national ESIC network, these offices provide information on cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, aerial photography, and land use.

Virginia is the home of the USGS Headquarters at the National Center in Reston. The National Center supports almost 2,000 employees and contractors who seek answers to many earth science questions that face the Nation and who produce scientific reports, maps, and digital products. The National Center also houses the USGS Visitors Center, where more than 10,000 people visit each year to learn about aerial photography, floods, dinosaurs, volcanoes, earthquakes, water quality, and how USGS maps are made.

# For More Information

USGS State representative  
3600 West Broad Street, Rm 606  
Richmond, VA 23230  
(804) 278-4750  
Fax: (804) 278-4759  
Email: [dc\\_va@usgs.gov](mailto:dc_va@usgs.gov)

Additional earth science information can be found by accessing the USGS Home Page on the World Wide Web at <http://www.usgs.gov/>

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

The **USGS** provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, biological, and land resources. We help find the natural resources needed to build tomorrow and supply the scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by natural and human activities. The results of our efforts touch the daily life of almost every American.

U.S. Geological Survey  
Fact Sheet FS-046-96