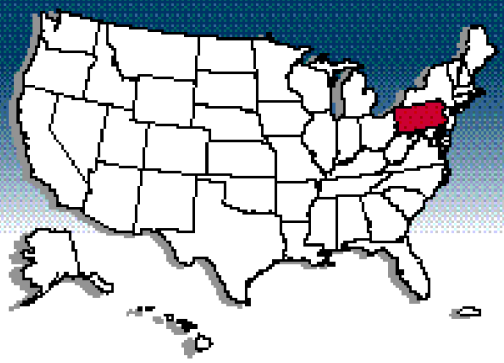
U.S. Geological Survey Programs in Pennsylvania



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

The U.S. Geological Survey (USGS) is involved in mapping and studying land, mineral, biological, and water resources and determining the risk from earthquakes and other natural hazards, which are of importance to the citizens of Pennsylvania. This Fact Sheet describes how the USGS is addressing some of the major environmental issues in Pennsylvania, which include availability of mineral resources; contamination of the environment by hazardous wastes; effects of coal mining, oil and gas production, and agriculture on the environment; nutrient input to streams and estuaries; and adequacy of good-quality water supplies. Information on acquiring the thousands of map, book, and aerial photographic products of the USGS also is given.

Mineral-Resource Information

The USGS Mineral Resource Data System (MRDS) is a digital data base that contains information from more than 110,000 sites nationwide and worldwide. The MRDS provides information on the occurrence of minerals and related data to Federal and State agencies, industry, and the public. The MRDS contains information on about 800 sites in Pennsylvania that relates mostly to deposits of iron, limestone, sand, and gravel.

Mineral-Resource Assessment

The USGS is completing a prototype quantitative national assessment of mineral resources for five commonly used metals—gold, silver, copper, lead, and zinc. The assessment lists significant known deposits, identifies areas with mineral potential, and estimates the quantity of each metal present. As a complement to the national assessment, the USGS is conducting a more-comprehensive regional assessment of the metallic- and industrial-mineral resources in the Eastern United States. As part of this regional work, the USGS is preparing an inventory of known mineral resources in Pennsylvania and is assessing the potential for undiscovered mineral resources. This work involves compilation of digital geological, geophysical, geochemical, and mineral-deposit data. Products include traditional maps and digital (CD–ROM) data sets.

Continuous-Type Natural Gas Accumulation

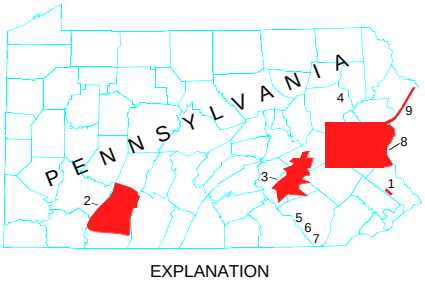
A natural gas accumulation of regional dimensions may be present in Lower Silurian sandstone reservoirs in northwestern Pennsylvania, eastern Ohio, western New York, and western West Virginia. This continuous-type accumulation is at the edge of largely depleted oil and natural gas fields in central and east-central Ohio. The reservoirs of the continuous-type accumulation are at greater depth, are less permeable, and yield less gas per well than reservoirs in discrete-type accumulations. However, reservoirs in the continuous-type accumulation probably are gas saturated, and nearly all wells completed in this accumulation should be productive after hydrofracturing. Several tens of trillions of cubic feet of gas may be recoverable from the accumulation. The USGS has begun a multi-year investigation to increase understanding of the nature, size, and origin of the accumulation.

Contamination of Water by Hazardous Wastes

The USGS, in cooperation with the U.S. Department of Defense and the U.S. Environmental Protection Agency (USEPA), has studied hazardous wastes in ground water at numerous sites in Pennsylvania. For example, the USGS recently completed a study at a Superfund site at Warminster in Bucks County (fig. 1, site 1) to determine the distribution, transport, and fate of volatile organic compounds (VOC's). Several methods were used to investigate the geohydrology of the site, including borehole geophysical logging, measurement of vertical borehole flow, isolation of specific zones in the borehole for depth-discrete hydraulic testing and water-sample collection, drilling, coring, installation of monitor wells, and continuous water-level monitoring.

Borehole geophysical logs were used to construct a map of the underground rock layers at the site. Borehole television surveys (fig. 2) were used to help understand the geophysical logs and to locate smooth sections of the boreholes where packers could be inflated. Aquifer-isolation tests were run in six boreholes by inflating rubber-bladder packers above and below a water-bearing

Index of Subjects



EXPLANATION

1 Warminster
2 Stonycreek River Basin
3 Swatara Creek Basin
4 Old Forge borehole
5 Lake Clarke
6 Lake Aldred
7 Conowingo Reservoir
8 Allentown quadrangle
9 Delaware Water Gap National Recreation Area

Figure 1. Locations of selected USGS studies.

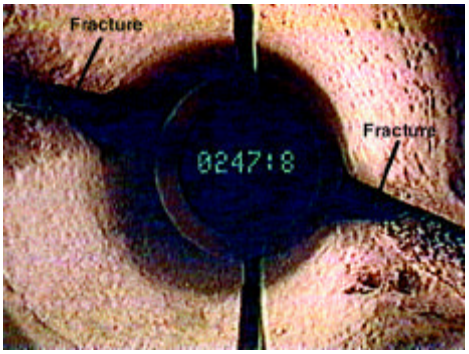


Figure 2. Photograph from a borehole television survey showing a water-producing fracture 247.8 feet below land surface.

fracture. By placing a pump between the packers, hydraulic testing was conducted, and a water sample for laboratory analysis was collected. Elevated quantities of several VOC's were detected in most water samples.

The downward hydraulic head gradient at the site, which was partly the result of the pumping of nearby public supply wells, caused the downward vertical migration of VOC's deeper into the aquifer through three wells with open-hole construction in the main contamination area. The VOC's then moved outward into the aquifer at different depths in response to the pumping of nearby wells and natural hydraulic gradients. The results of this study are enabling the USEPA to evaluate and improve the remedial activities at the site.

Discharges From Coal Mines

Acidic drainage from abandoned and active coal mines has affected more than 2,400 miles of streams and associated ground water in Pennsylvania. Increased concentrations of sulfate and metals in mine drainage make the water unfit for most uses and are toxic to aquatic organisms. To assist State, Federal, and local agencies in their efforts to remediate and improve utilization of affected waters, the USGS has documented the extent and severity of surface-water and ground-water contamination associated with bituminous coal mining in western Pennsylvania and anthracite coal mining in eastern Pennsylvania and has evaluated the effects of mining and reclamation practices and water-treatment methods on water quality. These studies have been supported by the USEPA, the Office of Surface Mining, the Pennsylvania Topographic and Geologic Survey of the Department of Conservation and Natural Resources (PaDCNR), the Pennsylvania Department of Environmental Protection (PaDEP), the Philadelphia Water Department, the Somerset County Conservation District, coal companies, and The Pennsylvania State University.

In the Stonycreek River Basin in Somerset and Cambria Counties (fig. 1, site 2), 270 discharges from coal mines were precisely located, sampled, and prioritized (ranked) with respect to their loading on the receiving stream, and 37 streamwater sites were sampled during base-flow conditions. A ranking index was developed for all streams in six subbasins of the Stonycreek River Basin that were moderately to severely affected by discharges from coal mines. This ranking provides a basis for selecting the sites for remediation that will provide the greatest improvement in stream quality at the least cost.

In the Swatara Creek Basin in Schuylkill County (fig. 1, site 3), mine-drainage treatment systems are being evaluated to improve understanding of the treatment process, so that PaDEP can design cost-effective treatment systems to protect water quality in a proposed reservoir. At the opening to the Orchard Mine, three 80-foot-long limestone drains were constructed in parallel; access points in the drains enable collection of water, gas, and rock samples. As water flows through the drains, concentrations of alkalinity and calcium increase; concentrations of acidity and dissolved and suspended iron and aluminum decrease; and concentrations of sulfate, magnesium, manganese, and trace metals are unchanged. Water at the inflow was very acidic; at the outflow it was nearly neutral.

A USGS study of large discharges from mines in the anthracite coal fields shows that many mines discharge water with increased concentrations of aluminum, calcium, cobalt, iron, lithium, magnesium, manganese, nickel, strontium, zinc, and sulfate. From 1975 to 1991, the acidity of water discharged from most mines in this region decreased and concentrations of iron, manganese, and sulfate decreased. Figure 3 shows the decrease in iron concentration in water from the Old Forge borehole (fig. 1, site 4), which is a major discharge point in the Northern Anthracite Field. Borehole discharge ranges from about 4 to 400 cubic feet per second, but discharge does not appear to have any long-term trend. Changes in the exposed surface area of limestone drains caused by dissolution and, possibly, coating of sulfide minerals probably account for most of the improvement in water quality with time that has been observed at many mines in the anthracite region. This study provides the data that PaDEP can use to plan remedial activities and to determine the effects of new mining on water quality.

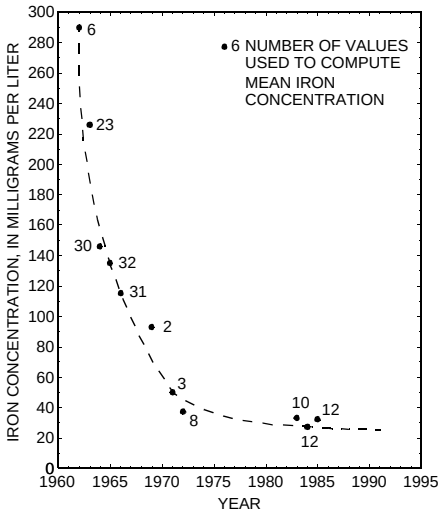


Figure 3. Annual mean iron concentration in water discharged from the Old Forge borehole, Northern Anthracite Field, northeastern Pennsylvania, from 1962 to 1991.

Sediment in the Lower Susquehanna River

Many State and Federal agencies are involved in a major effort to protect and improve water quality in the Chesapeake Bay. The USGS has undertaken several studies to support this effort.

The Susquehanna River drains 27,510 square miles in New York, Pennsylvania, and Maryland and is the largest contributor of sediment to the upper Chesapeake Bay. Data collected by the USGS and the Susquehanna River Basin Commission have shown that, in an average year, streams in the Basin transport 150 pounds per acre of sediment from forested land, 1,100 pounds per acre from cropland, and 2,200 pounds per acre from areas that are undergoing development. During an average year, the Susquehanna River transports about 3.3 million tons of sediment, but only 0.89 million tons enters the Chesapeake Bay.

Three large hydroelectric dams span the lower Susquehanna River. Safe Harbor (Lake Clarke) and Holtwood (Lake Aldred) are in southern Pennsylvania, and Conowingo (Conowingo Reservoir) is in northern Maryland about 10 miles upstream from the Chesapeake Bay (fig. 1, sites 5, 6, 7). The reservoirs behind the dams have trapped large quantities of sediment, nitrogen, and phosphorus and kept the sediment and nutrients from reaching the Bay. In fall 1990, sediment stored in the three reservoirs was about 260 million tons. About 33 percent of the sediment in the three reservoirs is sand and coal. The sediment in the reservoirs contained about 814,000 tons of organic nitrogen, 98,900 tons of ammonia (as nitrogen), and 226,000 tons of phosphorus.

Lake Aldred and Lake Clarke reached equilibrium with incoming river sediment by 1910 and 1950, respectively, and have no capacity to store additional sediment. The original (1928) capacity of the reservoir formed by Conowingo Dam was about 300,000 acre-feet. USGS studies show that by 1990, deposition of sediment reduced the capacity to 196,000 acre-feet. When

Conowingo Dam was completed in 1928, the reservoir ranged from 100 feet deep just above the dam at Holloway's Run to about 60 feet deep at Broad Creek. Surveys by the USGS in 1993 indicated depths of about 62 feet just above the dam and about 22 feet at Broad Creek (fig. 4). Once the average depths in the reservoir are reduced to about 55 feet just above the dam and to about 15 feet at Broad Creek, the reservoir will no longer accumulate sediment. Conowingo Reservoir will probably reach equilibrium and cease to accumulate sediment in the next 20 or 30 years. As the capacity of Conowingo Reservoir to store additional sediment decreases, the loads of sediment, nitrogen, phosphorus, and metals that reach the Chesapeake Bay from the Susquehanna River will increase. Because this may adversely affect habitat in the Bay, understanding the effect that reservoir filling will have is of critical importance for planning the actions that need to be taken to protect the Bay.

National Water-Quality Assessment Program

The National Water-Quality Assessment (NAWQA) Program involves studies of 60 major hydrologic basins of the United States. It is designed to describe the status and trends in the quality of the Nation's surface-water and ground-water resources and identify the natural and human factors that affect the water quality. The NAWQA Program includes four river basins in Pennsylvania. The Lower Susquehanna and the Potomac River Basin studies began in 1991. The Ohio River Basin (Allegheny and Monongahela Rivers) study began in 1994. A NAWQA Program study of the Delaware River Basin is scheduled to begin in 1997 (fig. 5).

Consistent study designs are achieved by dividing the Basins into subunits on the basis of physiography, lithology of bedrock, and land use. By using standardized methods of sampling and data analysis, results are comparable among different river basins and subunits.

The primary focus of the Lower Susquehanna and the Potomac River Basin studies has been on the occurrence of nitrogen, phosphorus, and herbicides. The concentrations of nitrogen and herbicides indicate that the streams and ground water in each of the subunits have different sources of these contaminants and different degrees of water-quality problems. For example, concentrations of nitrate nitrogen in streams and ground water from agricultural subunits underlain by limestone bedrock are significantly higher than average values from the other subunits with less agricultural land use. In addition to water quality related to agriculture, such important issues as bacteria and radon concentrations in water from rural wells and the concentrations of VOC's have been addressed in these studies.

The USGS, in cooperation with several other Federal agencies, is acquiring satellite-image data for the entire United States to provide current information on land use. These data are used by the NAWQA Program projects to help determine the effects of land use on water quality.

Figure 5. Locations of National Water-Quality Assessment Program study units.

Geologic and Hydrologic Mapping

Bedrock and surficial geologic maps and hydrologic maps are prepared by the USGS. These maps are essential for studies of water contamination, resource availability, environmental effects of mineral extraction, hazard mitigation, and land-use management.

The USGS, in cooperation with the Pennsylvania Topographic and Geologic Survey and Bloomsburg University, is preparing surficial and bedrock geologic maps of the Allentown 1:100,000 quadrangle and component 1:24,000 quadrangles (fig. 1, site 8). These maps and derivative products are being used by the Lehigh–Northampton County Joint Planning Commission to develop wellhead-protection strategies. The USGS also is cooperating with the National Park Service in the Delaware Water Gap National Recreation Area (fig. 1, site 9) by supplying and interpreting geologic data for public outreach, training of park rangers, and park management.

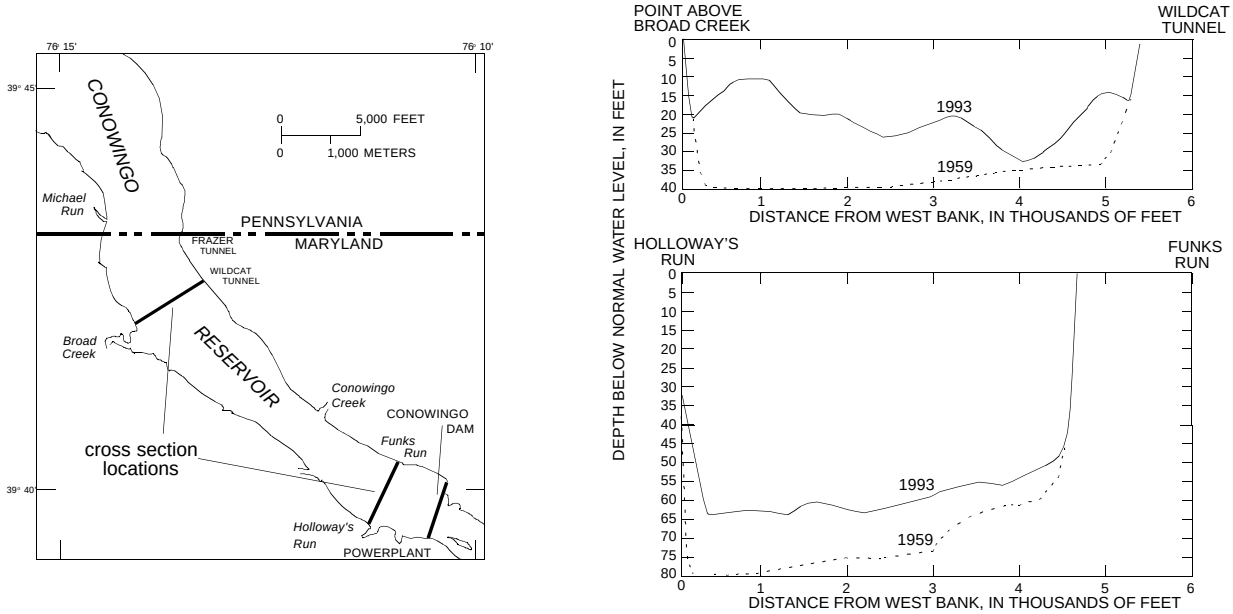


Figure 4. Depth to bottom sediments at two cross sections in Conowingo Reservoir, 1959 and 1993. (Data for 1959 were collected by the Johns Hopkins University.)

Topographic Mapping

The National Mapping Program of the USGS strives to ensure the availability of map data in graphic and digital forms to the public through timely data collection and revision procedures.

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map represents 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. Pennsylvania is covered by 876 maps at this scale. About 90 percent of Pennsylvania is covered by digital elevation model (DEM) data and work is in progress to complete the coverage. Among other uses, DEM's have been used to construct hydrologic models, determine landslide probability, and assist in forest fire control.

The USGS, in cooperation with PaDCNR, completed statewide aerial photographic coverage between 1992 and 1994 that is being used to prepare digital orthophotoquads (DOQ). A DOQ is derived from digitized aerial photographs, with displacement caused by camera tilt and terrain relief removed. It combines the image characteristics of a photograph with the geometric qualities of a map. They are becoming increasingly useful in geographic information system databases, where they are used in combination with other data. DOQ's have been completed for 10 counties and are being prepared for 18 counties (fig. 6). The USGS, in cooperation with PaDEP, was preparing statewide 1:24,000-scale digital raster graphic (DRG) coverage during 1995. A DRG is a scanned image of a topographic map that retains the positional accuracy of the map in raster format. A DRG can be the basic reference layer for a geographic information system, thus allowing digital spatial data to be overlaid or integrated with a high degree of accuracy. The USGS and PaDEP are cooperating on the production and demonstration of a spatial data set of the Lake Erie shoreline to be used for coastal zone management. This data set is available on CD–ROM and includes DRG's, DOQ's, DEM's, and digital line graphs.

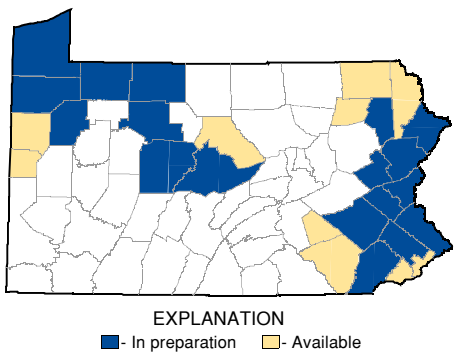


Figure 6. Digital orthophotoquad coverage for Pennsylvania.

An Earth Science Information Center operated by the Pennsylvania Topographic and Geologic Survey in Harrisburg, provides information on such earth science topics as cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, aerial photography, and land use. The Center is operated in cooperation with the USGS and is supported by the USGS with reference materials, technical assistance, training and outreach activities, and access to USGS data bases.

Collection of Hydrologic Data

The USGS, in cooperation with more than 30 local, State, and Federal agencies, collects streamflow, ground-water, and water-quality data at sites throughout Pennsylvania. Many of these data-collection sites are equipped with data-collection platforms that use radio and satellite relay technology to provide near-realtime data to the users. These data are helpful for day-to-day administration and management of water resources, determining the extent and severity of droughts, characterizing and predicting conditions during floods, and monitoring the effects of human activities on water resources, among other uses.

Cooperative Programs

The USGS cooperates with more than 30 local, State, and Federal agencies in Pennsylvania. Cooperators include State agencies, counties, municipalities, basin commissions, water authorities, universities, and other Federal agencies. Cooperative activities include water-resources data collection, interpretive water-availability and water-quality studies, mineral-resource assessments, mapping, and studies of channel instability and scour at more than 16,000 highway bridges over water. When local or State agencies are involved, activities typically are funded by USGS and cooperating agencies on a 50–50 matching basis. In addition to the agencies already mentioned, the USGS in Pennsylvania cooperates with the U.S. Army Corps of Engineers, the Chester County Water Resources Authority, the Delaware River Basin Commission, and the Pennsylvania Department of Transportation, to name only a few.

The USGS provides support to the Environmental Resources Research Institute of the Pennsylvania State University, which conducts a program of research, education, and information and technology transfer.

For More Information

USGS State representative
840 Market Street
Lemoyne, PA 17043-1586
(717) 730-6900
Fax: (717) 730-6997
Email: dc_pa@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
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