Fact Sheet

United States Geological Survey
Programs in Tennessee

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

Evaluation of Earthquake Hazards in the Central Mississippi River Valley

The largest earthquakes known to have occurred within the interior of the United States struck the central Mississippi River Valley during winter 1811–12. The quakes were centered in the New Madrid, Missouri, region and were felt as far away as Quebec. This region continues to have the highest level of seismicity in the country east of the Rocky Mountains. A critical aspect for determining regional earthquake hazards for this area is the development of an accurate chronology of past large earthquakes.

The U.S. Geological Survey (USGS) is funding a research team of consulting geologists and University of Memphis geologists who are investigating dates of prehistoric movement on the Reelfoot Fault near Tiptonville, northwestern Tennessee (fig. 1). The scarp caused by this fault forms the western shore of Reelfoot Lake, which was created by the great New Madrid earthquakes of 1811–12. The team's trenching studies have confirmed earlier work by the USGS suggesting that movement along the fault resulted in two strong earthquakes within 2,000 years before 1811. The most recent data indicate that the dates of the earthquakes are about 900 and 1400. These dates are consistent with evidence for dates of past earthquakes found by other researchers working in nearby Arkansas and Missouri.

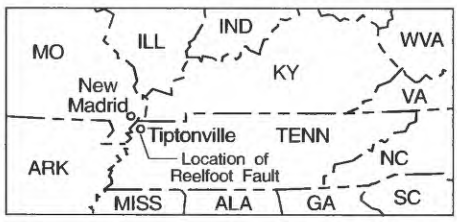

Figure 1. Location of earthquake research study.

Memphis Area Hydrogeology

The metropolitan area of Memphis, with a population of more than 800,000, relies on ground water for municipal water supply. Almost 200 million gallons of water are pumped daily from the Memphis aquifer to meet public, industrial, and commercial demand. The USGS, in cooperation with Shelby County and the city of Memphis, has conducted many studies to help define the geology and hydrology of the complex aquifer system underlying the greater Memphis area and to help maintain the generally high quality of water.

A recently completed investigation of ground-water quality in the Memphis area included a well field in the western part of the city. Intermittent sampling of wells at this site since 1972 has shown a degradation in the quality of water from some of the wells, which is of concern because it may indicate that contamination from surface sources is possible. Drilling of a test hole just west of the well field revealed that the protective clay deposit that separates the shallow aquifer from the underlying Memphis aquifer is absent, and a comparison of constituents in water samples from the two aquifers indicated that younger, more mineralized water in the shallow aquifer was flowing downward to the Memphis aquifer. With knowledge of the source of the inferior quality water and the reason for entry into the deeper part of the aquifer system, water managers will be able to reduce the deterioration in water quality by adjusting pumping patterns at the well field.

Assessment of Mineral Resource Potential in Southeastern Tennessee

Economic growth and development in Tennessee depend on the availability of local sources of minerals and materials used in construction, industry, and manufacturing and for maintaining and upgrading the State's infrastructure. In 1993, the USGS published an inventory of known mineral resources in the 8,027-square-mile area of the Chattanooga 1- by 2-minute quadrangle in southeastern Tennessee and maps showing potential areas for undiscovered deposits. Five tracts were delineated that are favorable for the occurrence of mineral resources, including metals, industrial minerals, and fuels. Construction and industrial materials, especially limestone, dolomite, sand, and gravel, were shown to have the greatest potential for increased development to meet current needs and the requirements of future population growth, industrial expansion, and new markets. The report and maps will assist Federal and State land-management agencies, land-use planners, industry, and local governments in ensuring that adequate supplies of these minerals remain available and in promoting resource development at the lowest possible cost.

Index of Subjects

Estimating the Chemical Quality of Storm Runoff in Larger Cities

Recent amendments to the Clean Water Act require that cities with populations of more than 100,000 estimate quan-

tities and mean concentrations of several constituents in storm runoff from urban areas to receiving streams. Cities are required to provide the estimates and to implement potentially expensive mitigation methods if estimated loads exceed U.S. Environmental Protection Agency limits to obtain a permit under the National Pollution Discharge Elimination System (NPDES). Models may be used to derive the estimates.

To provide appropriate basic data for stormflow-quality models for Nashville, Knoxville, and Chattanooga, the USGS, in cooperation with the governing bodies of these cities, collected and analyzed samples of storm runoff from watersheds in each city. Analysis of model results showed that the tested models overestimated loads and concentrations in storm runoff for these cities because of characteristics of the data bases used for calibration. Models would likely produce similar results for many other cities. To provide more accurate values, the USGS developed methods for adjusting selected models with the local data. The results have provided city engineers and planners with four detailed model-adjustment procedures and information on selecting which procedure to use based on exploratory analysis of the local data base. The procedures have potential for use nationwide. Cities that use these procedures may derive smaller and more accurate estimates of loads in nonpoint-source runoff and thus be able to implement less costly mitigation measures to meet the NPDES requirements.

Geologic Mapping

Since 1993, the USGS, in cooperation with the National Park Service, has been conducting bedrock, surficial, and geochemical studies of four 7.5-minute quadrangles in the Great Smoky Mountains National Park. Results of the investigation are being placed in digital files that can be accessed by computers having geographic information system (GIS) software. GIS provides an efficient method for storing and manipulating large amounts of data. The digital data base for the 520,004-acre region will be used to help manage the Nation's most-visited National Park.

Additionally, the USGS, in cooperation with the Tennessee Department of Environment and Conservation, the U.S. Army Corps of Engineers, the Tennessee Valley Authority, and the U.S. Soil Conservation Service, converted existing geologic maps for 368 7.5-minute quadrangles in Tennessee to GIS coverages. Most of the area is in the central part of the State. The GIS coverages will be widely used for local and regional studies and for management purposes.

National Mapping Program

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. Contour lines are used to depict the elevation and shape of terrain. Tennessee is covered by 803 maps at this scale, which are useful for scientific investigations, civil engineering studies, land-use planning, natural-resource monitoring, and other technical applications. In addition to these uses, these maps have long been favorites with the general public for outdoor purposes, including hiking, camping, exploring, and back-country fishing expeditions.

Collection of Hydrologic Data

The USGS collects hydrologic data in Tennessee in cooperation with numerous Federal, State, and local agencies. Activities include the continuous measurement of streamflow at 121 gaging stations; the monitoring of ground-water levels statewide; analyses of the physical, chemical, and biological characteristics of surface and ground waters; compiling and updating records of water use; participating in the national baseline network, water-quality network, and atmospheric deposition programs; and providing operational support for USGS scientists conducting hydrologic studies.

Uses of the data are many. To cite some examples, instantaneous satellite-transmitted data that describe river flow and rainfall at distant points are used to manage and operate the reservoir systems on the Tennessee and the Cumberland Rivers, to respond quickly to conditions that cause floods, and, for certain cities and towns along rivers, to determine permissible windows of time for waste disposal. The longer term record of data developed by the USGS (figs. 2, 3) is used for designing bridges, culverts, dams, and other structures near rivers; managing development of river flood plains; determining flood-insurance rates; determining trends in water availability and quality; projecting and planning for future water demand; and conducting interpretive studies that provide information used for making decisions about water-related problems that may affect many thousands of people.

Coal Availability

The continued availability of environmentally acceptable and reliable energy sources is an important issue for Federal, State, and local planners. Conventional Federal and State coal-resource estimates do not account for the restrictions to mining now imposed by environmental and

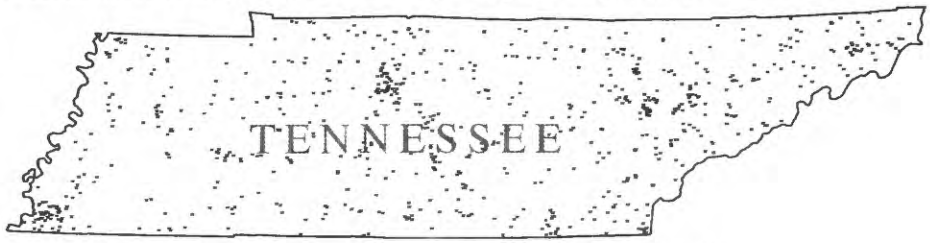

Figure 2. Stations where streamflow data have been or are being collected.

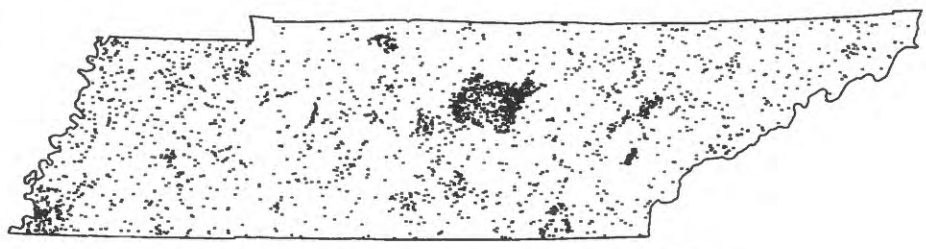

Figure 3. Stations where water-quality data have been or are being collected.

social concerns that, in effect, can result in an overestimation of mineable reserves. These restrictions could limit mining in a coal-producing area or, because of higher mining and transportation costs, could affect costs associated with electric power generation. Consequently, a cooperative program between the USGS and the Tennessee Division of Geology was initiated in 1992 to identify and delineate major restrictions to mining and to estimate the amount of remaining coal available for development under these constraints. Coal availability studies represent a national geographic-information-system-based effort to collect, analyze, and depict data that characterize the relation between restrictions to mining and development of this resource.

Environmental Effects of an Abandoned Wood-Preservative Plant

A facility for impregnating wood with preservatives that was operated near Jackson for about 50 years was closed and abandoned in 1981. Plant operations resulted in the soils, ground water, and nearby streams becoming contaminated with significant levels of wood-preserving chemicals, including creosote, a cancer-causing substance. The USGS, in cooperation with the U.S. Environmental Protection Agency, conducted an investigation to determine toxicological effects of the spills and leakages on nearby streams, to identify and delineate the extent of contaminants in off-site ground water, and to assess the potential for transport of contaminants to wells used for water supply within a 2-mile radius of this Superfund site.

The study showed that a small creek along the western site boundary contained four wood-preserving compounds. The concentration of one of them was greater than the State's criterion maximum for fish and aquatic life. Fish contained small concentrations of creosote compounds. Bottom sediment—important to aquatic life—of the creek and the receiving river to the southwest contained large concentrations of numerous organic chemicals associated with plant operations. Elutriates of the sediment were slightly to highly toxic to various aquatic organisms. Most of the organic-compound contaminants detected in ground water were in samples from wells that tap the shallow aquifer. Concentrations were below the State's primary contaminant levels for drinking water. Low concentrations of six organic compounds were detected in wells screened in the deeper aquifer, including wells operated by the city of Jackson, but none of the compounds that commonly characterize contamination from wood-preserving processes were detected. This implies that the compounds identified were from a source other than the abandoned plant.

Earth Observation Data

Through its Earth Resources Observation Systems Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover the entire State. Aerial photographs of some sites go back about 40 years. Satellite images dating from 1972 can be used to study changes in regional landscapes. The USGS is providing technical support in the use of a statewide block of Landsat satellite image data acquired recently. State resource-management agencies are using the satellite data as a cost-effective source for interpreting land-cover characteristics.

Investigation of Channel-Scour at Bridge Sites

The scouring or erosion of river channels by flowing water is a natural process that often is increased, sometimes greatly, by man's activities. Severe scour can result in undercutting the footings of bridge structures, causing bridge failure. Scour is a suspected cause of the bridge failure that resulted in the loss of several lives at the U.S. Highway 51 crossing of the Hatchie River in western Tennessee in 1989.

To provide information on channel-scour potential statewide, the USGS, in cooperation with the Tennessee Department of Transportation (TDOT), evaluated stream-channel characteristics at nearly 4,000 bridge sites over a 3-year period after the Hatchie River tragedy. Information from the site assessments was used to develop indexes for observed scour and potential scour at the sites. These indexes, together with structural characteristics and highway-use data, were used by the TDOT to synthesize a ranking index for prioritizing bridge-site inspection plans and repair work. Additionally, the methods developed during this study allow for the identification of stream reaches where changes in channel-management practices, such as the dredging or straightening of channels, may result in potentially dangerous responses at bridge sites downstream. The methods developed in Tennessee by the USGS are being used in channel-scour studies nationwide.

National Coal Resources Data System State Cooperatives

Standardized current information on the location, quantity, and quality of the coal resources of the United States is needed to provide the basis for optimum energy development and utilization policies. A joint venture between the USGS and State Geological Surveys was initiated in 1975 to develop the National Coal Resources Data System (NCRDS). Under this arrangement, the USGS provides the central computer hardware, software, and analytical capabilities, and the USGS and the States create and use the data bases. Currently, cooperative projects are ongoing with 22 States, which represent 98 percent of current U.S. coal production.

A cooperative project between the USGS and the Tennessee Division of Geology was started in 1979 to collect, evaluate, and correlate drill hole, mine, and outcrop data; encode and enter geologic and geochemical data into the NCRDS; and access NCRDS data bases and software to generate new maps, reports, and resource assessments. The continued data collection and support of the NCRDS data bases provides baseline information that can be accessed for annual State resource updates and recast to meet new needs.

Regional Aquifer-System Analysis Program

The goals of the USGS Regional Aquifer-System Analysis (RASA) Program are to define the regional geology and hydrology of the major aquifer systems throughout the United States and to establish a framework of information that can be used for regional assessments of the ground-water resource and for supporting detailed local studies. The information is greatly needed for water-resource management during periods of drought. Of the 28 aquifer systems across the United States identified for study, 2 include parts of Tennessee (fig. 4).

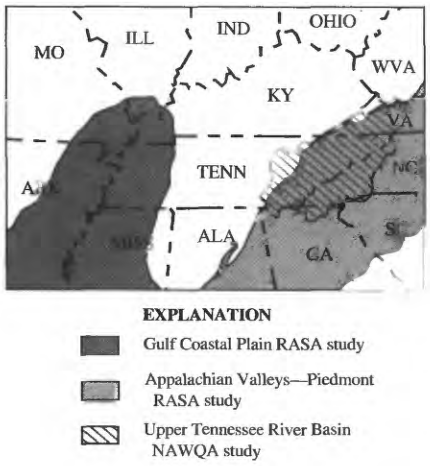

Figure 4. Location of Regional Aquifer-System Analysis and National Water-Quality Assessment studies that include Tennessee.

The Gulf Coastal Plain RASA study includes the area from western Tennessee and Kentucky to States bordering the Gulf of Mexico. The study has significantly advanced knowledge of the geologic framework, ground-water-flow patterns, and water quality of the major aquifers throughout this region. Of importance to Tennessee, the study has helped define characteristics of three major aquifers underlying the western part of the State. The development of a computer model that simulates regional ground-water flow has enabled local water managers to locate new well fields and to manage them to minimize the interaquifer transfer of water of undesirable quality.

The Appalachian Valleys–Piedmont RASA includes 10 States from Pennsylvania to Alabama. In much of eastern Tennessee and parts of the other States, large supplies of ground water, such as those needed for municipal use, are difficult to locate. Study of the geology, stream records, and well records enabled delineation of five hydrogeologic terranes in the region on the basis of magnitude of probable yields to wells. The statistical approach to defining ground-water occurrence and potential for development allows water utilities and others to seek water in the more favorable terranes and provides information on the probable range in yields to wells before drilling is attempted. The study also included a compilation of chemical data that has provided information on variations in the quality of ground water in the region.

National Water-Quality Assessment Program

Long-term goals of the National Water-Quality Assessment Program are to describe the status and trends in the quality of a large, representative part of the Nation's surface and ground waters and to identify the natural and human factors that affect the quality of these resources. Information produced is expected to be used by policymakers and managers at the local, State, and national levels.

The upper Tennessee River basin study unit, which is 1 of 60 hydrologic systems included in the Program, includes parts of Tennessee, North Carolina, Virginia, and Georgia (fig. 4). Assessment activities began in 1994. Study of the lower Tennessee River basin study unit, which includes parts of Alabama, Tennessee, and Kentucky, is scheduled to begin in 1997.

Cooperative Programs

The USGS cooperates with about 50 local, State, and Federal agencies in Tennessee. Cooperators typically include city and county governments, water-utility districts, soil conservation districts, and Federal and State agencies. Cooperative activities include water-resources-data collection, interpretive water-availability and water-quality studies, mineral-resource appraisals, and geologic and topographic mapping. Activities with State and local agencies usually are funded on a matching-funds basis. Some of the cooperators not mentioned elsewhere in this Fact Sheet, include the Tennessee Division of Water Management; the Wildlife Resources Agency; the Tennessee Department of Agriculture; the University of Memphis; Hamilton County; the cities of Dickson, Crossville, Franklin, Murfreesboro, Alcoa, and Johnson City; and the U.S. Departments of Energy and Transportation; the U. S. Army; the U.S. Navy; and the U.S. Air Force. Space does not permit a complete listing.

The USGS provides support to the Water Resources Research Center, which conducts a program of research, education, and information and technology transfer.

For more information contact any of the following:

For water information
District Chief
810 Broadway, Suite 500
Nashville, Tennessee 37203
(615) 736-5424

For map information
Chief, Mapping Applications Center
567 National Center
Reston, Virginia 22092
(703) 648-6002

For geologic information
Assistant Chief Geologist
953 National Center
Reston, Virginia 22092
(703) 648-6660

National Earthquake Information Center
Denver Federal Center, Mail Stop 967
Denver, Colorado 80225
(303) 273-8500

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.

U.S. GPO 647-311

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-042-95