close correlation between concentrations of total organic carbon (TOC) and most trace metals at the sinkhole and the spring stations suggests that these constituents are transported together.

A report was published in 1988 summarizing the data collected during the first 6 months of the investigation. The project leader is hydrologist Anne Hoos, assisted by hydrologic technician Jerry Garrett.

**IMPACT ON GROUND-WATER QUALITY OF BLASTED-IN SUBSURFACE SEWAGE SYSTEM FIELD LINES**

Almost one-third of the population of Tennessee is served by subsurface sewage disposal systems, which are the largest contributors of wastewater to the ground. This problem is likely to be more significant in subdivided tracts in suburban areas, especially where field lines have been installed in blasted rock. The U.S. Geological Survey, in cooperation with the Tennessee Department of Health and Environment, Division of Construction Grants and Loans, is undertaking an investigation to establish the nature and degree of relation between ground-water contamination and blasted-in field lines. Ground water samples were collected at two test sites; one control site, where the subsurface is suitable for a septic system, and an experimental site, where the field lines have been blasted-in. Initial results indicate high levels of bacteria (fecal coliform) at discharge sites downgradient from blasted-in systems. Other constituents indicative of septic effluent have been below levels of adverse impact. A dye-trace study is planned at the experimental site to determine the degree of connection between blasted-in septic systems and ground water.

This study is being conducted by hydrologist Dorothea Hanchar.

*Block diagram showing flow of field line effluence from subsurface sewage system into blasted rock, to household well, and to nearby creek in subdivision using individual well-septic systems.*
CHARACTERIZATION OF INFLOW OF PESTICIDES AND NUTRIENTS FROM STORM RUNOFF INTO REELFOOT LAKE, WEST TENNESSEE

Reelfoot Lake, in West Tennessee, is one of the most important natural resources in the State. The lake and surrounding forests are a key tourism and recreation area in West Tennessee and has been a traditional commercial fishery. Intensive agricultural activity in the area surrounding Reelfoot Lake, and storm runoff from tributaries result in the discharge of fertilizer and pesticide residues into the lake. The annual budget of nutrients and pesticides entering the lake from these sources, and the extent of contribution by storms, have not been adequately defined.

The U.S. Geological Survey, in cooperation with the Tennessee Department of Health and Environment, Division of Construction Grants and Loans, began an investigation in October 1987 to study the impact of agricultural activities on runoff into Reelfoot Lake. The 2-year investigation includes measurement of streamflow and collection and analysis of water samples from three tributaries (North Reelfoot Creek, South Reelfoot Creek, and Running Slough) to the lake during base flow and storms. Samples are analyzed for sediment concentration, nutrients, and triazine herbicides.

Specific objectives of the investigation are to:

1. Identify variation in concentrations of nutrients and pesticides relative to seasonal effects and discharge for storm events, and
2. Estimate the annual nutrient and pesticide loading for the three tributaries.

Samples collected in the first year of the investigation during base flows and winter storm events show that most of the nitrogen is in the form of organic nitrogen. Concentrations of most triazine pesticides were below the limits of analytical detection. The exception was atrazine, for which concentrations for these samples were as high as 1.6 micrograms per liter. In water samples collected during spring and summer storm events, most nitrogen occurred in the form of ammonia. Concentrations of atrazine and alachlor were as high as 57 and 45 micrograms per liter, respectively.

A report was published in 1988 presenting data collected during the first 6 months of the investigation. A final report summarizing data and interpretations of the study will be completed in 1989. The project leader is hydrologist Anne Hoos, assisted by hydrologic technician Jerry Garrett.
RECONNAISSANCE OF THE IMPACT OF AGRICULTURAL CHEMICALS ON GROUND-WATER QUALITY

During 1988, the U.S. Geological Survey, in cooperation with the Tennessee Department of Health and Environment, Division of Construction, Grants, and Loans, conducted an investigation to determine the contribution of chemicals in agricultural runoff to ground water. Shallow wells at three sites were sampled for nitrogen species and pesticides. Sampling sites, located in Shelby, Lake, and Haywood Counties, were chosen as representing the three major agricultural practices of West Tennessee (corn, soybeans, and cotton). All wells were located near fields under active cultivation of these crops.

Samples were collected in January, February, and June 1988. Results from pesticide analyses showed concentrations were below analytical detection limits for triazine herbicides (used on all crop types to control grasses), and organophosphorus insecticides (used for the control of the boll weevil, and sampled for in Haywood County only). Results from nutrient analyses indicated a wide range of concentrations for nitrogen constituents. Relatively high concentrations of total nitrite plus nitrate (NO₂ + NO₃ as nitrogen) were detected in some of the wells sampled. These concentrations did not exceed the Federal or State standards for drinking water of 10 milligrams per liter of nitrite plus nitrate. The measured concentrations are indicative of the occurrence of nitrogen in ground water as a result of agricultural activities.

As a result of the project, one or more wells at each site are under consideration for inclusion in a long-term, statewide monitoring network for ground-water quality. A water-resources investigation report documenting the results of the study is in preparation. Hydrologist Dorothea Hanchar directed the project.
HYDROGEOLOGY AND DELINEATION OF WELLHEAD-PROTECTION AREAS AT JACKSON, TENNESSEE

An investigation of the hydrogeology of the Jackson area, in West Tennessee as part of a local wellhead-protection program, was initiated by the U.S. Geological Survey in cooperation with the Jackson Utility Division (JUD) in 1988. The project is a continuation of a pilot investigation of the Jackson area begun in 1987 for the development of wellhead-protection areas for the two municipal well fields by the City of Jackson. The initial investigation included a preliminary assessment of the local hydrogeology, ground-water quality, and potential sources of contamination.

The purpose of the current phase is to describe in further detail the hydrogeology of the Jackson area. The detailed data will be used by the JUD to define short- and long-term threats to the quality of ground water, and adopt strategies to protect municipal supplies. Project tasks include:

- Mapping the lithology and geometry of the aquifers and confining layers in detail
- Mapping the configuration of the water-table and potentiometric-surfaces
- Mapping directions of ground-water flow
- Delineating areas of ground-water recharge and discharge
- Simulating the ground-water flow system
- Delineating areas that contribute ground water to the municipal wells

Potential sources of ground-water contamination were determined during the pilot investigation. During 1988 and early 1989, maps of subsurface geology and lithology, constructed on a regional scale by other investigators, were refined using additional local information from drillers' logs and borehole geophysical logs. Nearly 100 domestic and industrial wells were selected for water-level measurements, to be conducted in the spring of 1989. Stream discharge at numerous sites also was measured.

A finite-difference, ground-water flow model will be calibrated to average hydrologic conditions. An analytical program in the model will be used to estimate zones of ground-water contribution to wells in the municipal well fields. The project is directed by hydrologist Zelda Bailey.
GEOGRAPHIC INFORMATION SYSTEM INVENTORY
FOR THE STATE OF TENNESSEE

Within the last 4 years, the number of computerized Geographic Information Systems (GIS) within Tennessee has increased rapidly. In order to examine the present status of GIS efforts, the Tennessee State Planning Office, the Tennessee Comptroller of the Treasury, and the USGS entered into a cooperative agreement to collect information about mapping usage, computer equipment, GIS software, and existing digital data. The objectives of the project were to:

- Conduct an inventory of existing mapping coverage, location-specific data bases, available transformation software, and transfer techniques that exist at various state, federal, county, and municipal agencies
- Create a computer data base of the results of the survey
- Develop suggested standards for digitized data
- Describe, in general, communications techniques that can be used to transfer data from one computer system to another
- Create a map coverage of Tennessee and the 7.5-minute quadrangle maps within the State and program retrieval of existing map coverage for each
- Publish the results of the project

Typical GIS coverages.
The project was completed in October, 1988. The following are the summarized results:

- 263 agencies were inventoried
- 139 maintained one or more computers
- 4,741 computerized data coverage existed for areas within Tennessee
- 120 location-specific data bases were available
- 25 GIS systems were in operation

A data base called the GIS Inventory data base was completed for storage of the data. The data were entered into the data base and were cross-referenced by county, 7.5-minute quadrangle, and hydrologic unit code. A map coverage for each cross-referenced geographic unit was created for identification of existing coverage for that area.

A water-resources investigations report containing the summarized results of the project, general standards for digitized data, communication techniques for transfer of data, and an appendix containing guidelines for initiating a GIS is in review. Bill Barron, hydrologist, is the project chief.
SEDIMENT DEPOSITION AT WETLANDS NEAR BRIDGE CROSSINGS

The U.S. Geological Survey, in cooperation with the Tennessee Department of Transportation (TDOT), is investigating the impact of highway crossings on sediment deposition at wetlands in West Tennessee. The 10 sites selected represent bottomland-hardwood forests and cypress-tupelo swamps along broad flood plains, common in the Gulf Coastal Plain. Highway crossings generally consist of fill material across flood plains with relief openings across main and overflow channels. The principal concern of TDOT is to determine if highway crossings have wide-spread effects on sedimentation processes and ecology of wetlands.

The study uses an interdisciplinary approach and includes techniques of hydrology, sedimentology, dendrochronology, geomorphology, and ecology. Dendrogeomorphic analysis provides the principal data for documentation of sediment deposition. The technique uses historic rates of deposition obtained by excavation of buried trees, which are then aged through tree-ring dating. This information allows for determination of rates of sediment accretion and for evaluation of spatial and temporal variation in sedimentation. Additionally, flow and sediment modeling are used to evaluate potential for deposition and to investigate cause and effect relations. In areas found to have altered sedimentation rates, the impact on wetlands ecology is evaluated. Ecological techniques include growth-trend analysis of tree-core samples and ecological analysis of vegetation-plot data. The 3-year study, scheduled for completion in 1990, is directed by Dr. Cliff Hupp, botanist.

Sampling layout at Big Sandy River at State Route 69, West Tennessee.
BOTANICAL TECHNIQUES USED FOR FLOOD-FREQUENCY INVESTIGATION

The Geomorphic-Ecological Research Unit of the Tennessee District is involved in developing a new method for estimating flood frequency on Tennessee streams. The project, in cooperation with TDOT, is concerned with improving flood-frequency estimates on gaged and ungaged streams using dendrogeomorphic techniques. The method utilizes tree-ring anomalies that indicate flood damage within riparian trees to develop a flood record. Dendrochronologic identification of anomalies indicates the year of occurrence of a flood. A magnitude may be determined from the elevation of the sample. The information learned from trees will reveal historic flood data as far back as the oldest trees. Age of riparian trees usually surpasses the length of systematic record. Historic years of occurrence provided by this method can be used to extend the total years of record for a gaged stream or create an indirect flood record for an ungaged stream. Extended length of record will decrease the standard error involved in flood-frequency estimation. The standard method used by the U.S. Geological Survey in flood-frequency estimation uses systematic gage record, a method which can not be used on ungaged streams. Standard estimates for ungaged streams are determined by use of regional equations which have a high standard error in respect to individual streams. Dendrogeomorphically reconstructed flood history on gaged or ungaged streams is being used most efficiently. Results have improved the degree of confidence placed on a data set and allow for the development of accurate flood-frequency determination at ungaged sites. The project leaders are Dr. Cliff R. Hupp, botanist, and Bradley A. Bryan, hydrologist.

Example of (a) cross section and (b) core sample of a 13-year-old tree.
DOCUMENTATION OF MILLINGTON FLOOD

In cooperation with Shelby County and the City of Millington, Tennessee, the U.S. Geological Survey has completed a project to document the flood of December 25, 1987, in the city and the northern part of the county. The data collected indicates that the flood on the Loosahatchie River had a recurrence interval in excess of 75 years, while the peak discharge on Big Creek was almost twice the discharge of the 100-year flood. For North Fork Creek, the flood was about equal to a 100-year flood.

The documentation of the flood included:

- Data on rainfall that caused the flood
- Flood profiles for the streams involved
- Computation of peak discharges and frequencies
- Delineation of flooded areas and flood depths in Millington

The data will be published as a hydrologic atlas for use by local officials in planning for future flood-protection measures, zoning, and updating of flood-insurance studies.

The project chief was Jim Lewis, hydrologic technician from the Knoxville Subdistrict office.

Location of the Millington study area.
The APRASA (Appalachian Valleys-Piedmont Regional Aquifer-System Analysis) is one of 28 studies across the United States authorized by the U.S. Congress as a result of the drought of 1977. The purpose of each federally funded study is to define the regional hydrology and geology and to establish a framework of background information on geology, hydrology, and water chemistry of the Nation's important aquifer systems. The APRASA study area covers 145,000 square miles and is occupied by 26 million people. Surface-water resources have been well allocated in the most populated areas, but are now over stressed. Increasing emphasis is being given to additional development of the ground-water resources. The Tennessee District is responsible for the Valley and Ridge part (45,000 square miles) of the APRASA.

Accomplishments during 1988 include fully staffing the APRASA headquarters office in Richmond, Va. Seven districts, Alabama, Georgia, South Carolina, North Carolina, Tennessee, Virginia, and West Virginia, are compiling data and converting the data into machine-readable formats. Three other districts Maryland, Pennsylvania, and New Jersey are extracting and interpreting data in available computer files. A draft of the planning report which defines the problems in the study area and describes the objectives and approaches of the study is being revised. A report on the discharge of large springs in Tennessee is in review. In the Valley and Ridge province the hundreds of geologic units are being identified as principal aquifers, minor aquifers, and nonaquifers. Interpretation of chemical quality of water in the aquifers has just begun. Discussions are underway to identify the typical hydrogeologic settings and ground-water flow systems that characterize the study area. The project leader for the Valley and Ridge part of the APRASA is E.F. "Pat" Hollyday. The project is scheduled for completion in 1992.
WAYNE COUNTY LANDFILL INVESTIGATION

In 1987, the U.S. Geological Survey, in cooperation with the Tennessee Department of Health and Environment, Division of Superfund, initiated an investigation of the hydrogeology of the Wayne County landfill and adjoining area. The objectives of the project included:

- Determination of potential pathways of contaminants from the landfill to nearby surface and ground waters.
- Determination of water-quality conditions in ground water underlying the landfill, in leachate emanating from it, and in nearby streams.
- Determination of the nature and extent of contaminants, if any, in water and fauna in streams adjoining the site.

During 1988, drilling of 16 observation wells was completed. Preliminary characterization of the chemistry of leachate in seeps on the slopes of the landfill was completed. Samples were also collected from streams adjacent to the site. Samples of aquatic organisms in these streams were collected for preliminary analyses of contaminants in animal tissue.

Late in 1988 the project was temporarily halted while funding was obtained to complete the final phases. The project was re-activated in June 1989. A new schedule was prepared to complete sampling from wells, biological monitoring, interpretation of the data, and report preparation. Hydrologists Roger Lee and Arthur Bradfield assisted by hydrologic technician N. Carolyn Short is in charge of the project. The project is scheduled for completion in April 1990.

Location of Wayne County landfill study area.
HYDROGEOLOGY IN THE VICINITY OF THE Y-12 PLANT
AT THE OAK RIDGE RESERVATION

Several hazardous-waste disposal sites where contaminants may be leaching into ground and surface water are located in Bear Creek Valley, within the Oak Ridge Reservation. An investigation of Bear Creek Valley and Union Valley conducted in cooperation with the U.S. Department of Energy began in 1984. The objectives of the investigation of the hydrogeology were to:

- Formulate an understanding of the ground-water flow system.
- Determine the potential extent of contaminant migration.

Project tasks included:

- Assessment and use of existing geologic and hydrologic data.
- Installation of well clusters on the hydrologic boundaries of the valley.
- Collection of surface-water flow and water-quality data.
- Description of ground-water flow based on potentiometric and geochemical interpretations.
- Analysis of hydraulic-conductivity data by statistical and regression-model techniques.
- Simulation of ground-water flow system using a three-dimensional flow model.

Four data reports and three interpretive reports have been published, and two additional interpretive reports are in the process of publication. The project report summarizes the hydrogeologic findings of the study and presents the results of the ground-water flow modeling and geochemical analyses. The project was directed by Zelda Bailey (geologist) assisted by Roger Lee (geochemist) and Dr. Joseph Connell (engineer).
OTHER ACTIVITIES

GROUND-WATER INFORMATION UNIT

In 1989, the U.S. Geological Survey organized a "Ground-Water Information Unit" in the Tennessee District. The objectives of this support unit are to ensure maximum utilization of ground-water data collected in Tennessee and to provide diverse support for all ground-water activities in the District. Specific functions of the unit are:

- Storage of new ground-water data
- Cleanup and maintenance of ground-water data bases
- Assistance to personnel in retrieving and plotting data
- Answering information requests from cooperators, officials, and the public

A computerized data base maintained by the Tennessee District as part of the National Ground-Water Information System operated by the USGS, currently contains information on over 2,600 ground-water sites in Tennessee. Data from the District's data base can be output directly as tables and hydrographs, or to the Geographic Information System (GIS) for graphical and statistical analyses.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

The GIS in the Tennessee District has been operational for about 1 year. During this preceding year various coverages have been assembled, and software support has been developed to facilitate project work. Interfaces between GIS and U.S. Geological Survey data bases were developed. The following are 1988 highlights of goals achieved:

1. The following coverages were acquired or developed:
   a. Hydrography coverages for the State at 1:100,000 scale. These coverages have polygon, line, and point features that represent lakes, streams, springs, and gaging stations.
   b. Transportation coverages for the State at 1:100,000 scale.
      (1) Roads and trails divided into five different categories;
      (2) Railroads
      (3) Pipelines, transmission lines, and miscellaneous transportation.
   c. Land use and land cover coverage for the State at 1:250,000 scale. This coverage is divided into 9 general categories that are further subdivided into 37 sub-categories. The several categories include Urban, Agricultural, Forest, Water and so forth
   d. County outline coverage at 1:250,000 and 1:2,500,000 scale.
   e. Statewide streams, geology, and hydrologic units at a 1:2,500,000 scale.
   f. Topographic coverage with 20- and 100-foot contour intervals for the Oak Ridge Reservation.
COMPUTER SECTION AND ACTIVITIES

The Computer Unit of the Tennessee District continued to improve and to expand its capabilities in support of programs and cooperators. During 1988, the following milestones were accomplished:

1. A 16-channel multiplexor replaced an 8-channel multiplexor in the Knoxville and Memphis Subdistrict Offices, and each was placed on a dedicated phone line. This provided faster communications from the field office to the main computer in Nashville. An additional 16-channel multiplexor was added at the District Office to accommodate additional terminals.

2. Several new computer peripherals were purchased:
   a. A Macintosh II system was installed in the Publications Section for more efficient graphics production.
   b. Two AST Premium 286 personal computers were added to assist and enhance report typing and desktop publishing.
   c. All of the personal computers in the Hydrologic Investigations Section were connected to a print-sharing device connected to a laser printer.
   d. A GIS workstation was installed consisting of an Altek digitizer and a Tektronix 4207 graphics terminal.
   e. A CD ROM drive was installed including an optical disk containing a file of the WRSIC abstracts and USGS's historical streamflow data.
   f. A 36" X 48" Calcomp digitizer was procured for use with computerized drafting software in the Publications Section.

3. Data processing in the sediment laboratory in the Nashville Subdistrict was computerized.

4. Computing capabilities in the Investigation Section were enhanced by the installation of state-of-the-art word processing, statistics, and graphics programs.

5. Data coverage in the GIS system were expanded and applications in several surface and ground-water projects were developed.

The computer staff currently consists of Bill Barron, site manager; Joe Connell, GIS Administrator; Leticia Ables, computer operator; and Charlie McCoy, programmer trainee.
REGIONAL PUBLICATION CENTER

The Tennessee District operates a Regional Publication Center and Clearinghouse in support of projects within the District and the 10 other states in the Southeastern Region. Barbara Balthrop is the Chief of the Publication Center. The following is a list of the Center's accomplishments during 1988 and its goals for 1989.

Accomplishments for 1988:

- Acquisition of two personal computers and graphics software for production of publication-quality illustrations for reports
- Upgrade of personal computer used for desktop publishing

Goals for 1989:

- Acquire advance training for personnel preparing computer graphics
- Compile and publish the National Computer Technology Meeting proceedings for Headquarters
RECENT PUBLICATIONS

The Tennessee Center prepared for publication 4 Water-Resources Investigations Reports, 12 Open-File Reports, 21 journal articles, abstracts, and symposia articles, and the annual data report. The Tennessee Center also compiled and printed a publication for the First Tennessee Hydrology Symposium containing 36 abstracts, along with printing 11 out-of-District reports, and 5 bi-monthly bulletins. Currently, there are approximately 25 reports in various stages of preparation.

Reports Published


Administrative services to the Tennessee District headquarters and field offices are provided by a unit of four employees directed by Nancy Tedder, Administrative Officer. Personnel management, payroll, training, procurement, inventory control, budgeting, and accounting services are efficiently handled through computerized systems.
APPENDIX 1

Active Recording Surface-Water Stations in Tennessee as of 3/1/89

[mi², square miles; Lat, latitude; Long, longitude]

<table>
<thead>
<tr>
<th>Station No.</th>
<th>Name of Drainage Area</th>
<th>Drainage Area (mi²)</th>
<th>Lat</th>
<th>Long</th>
<th>Date began</th>
</tr>
</thead>
<tbody>
<tr>
<td>03408500</td>
<td>New River at New River</td>
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</tr>
<tr>
<td>03409500</td>
<td>Clear Fork near Robbins</td>
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<tr>
<td>03414500</td>
<td>E Fork Obey River nr Jamestown</td>
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<tr>
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<tr>
<td>03417500</td>
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<tr>
<td>03417600</td>
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<tr>
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<tr>
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<td>640</td>
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<td>03422500</td>
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<tr>
<td>03426800</td>
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<td></td>
<td>262</td>
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<td>128</td>
<td>862548</td>
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<td>237</td>
<td>862754</td>
<td>1965</td>
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<td>03430118</td>
<td>McCrory Cr at Ironwood Dr, at Donelson</td>
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<td>7.31</td>
<td>863901</td>
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<td>03431000</td>
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<td>64.0</td>
<td>864050</td>
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<td>03431062</td>
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<td>1.17</td>
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<tr>
<td>03431490</td>
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<td>2.01</td>
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<td>03431700</td>
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<td>97.2</td>
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<td>191</td>
<td>865156</td>
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<tr>
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<td>Harpeth River below Franklin</td>
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<td>865254</td>
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<td>03433500</td>
<td>Harpeth River at Bellevue</td>
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<td>865542</td>
<td>1920</td>
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<td>681</td>
<td>870556</td>
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<td>03435000</td>
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<td>14,163</td>
<td>871332</td>
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<td>14,421</td>
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## APPENDIX 1---Continued

Active Recording Surface-Water Stations in Tennessee as of 3/1/89---Continued

<table>
<thead>
<tr>
<th>Station No.</th>
<th>Station Name</th>
<th>Drainage Area (mi²)</th>
<th>Lat</th>
<th>Long</th>
<th>Date Began</th>
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<tr>
<td>03436000</td>
<td>Sulphur Fork Red River near Adams</td>
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### CUMBERLAND RIVER BASIN---Continued

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<td>03538225</td>
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### Active Recording Surface-Water Stations in Tennessee as of 3/1/89--Continued

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<th>Long.</th>
<th>Date Began</th>
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<td>851235</td>
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<tr>
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<td>851643</td>
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<td>03580995</td>
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<td>865652</td>
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<td>350354</td>
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<td>352849</td>
<td>862957</td>
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<tr>
<td>03600088</td>
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<td>354302</td>
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### Active Recording Surface-Water Stations in Tennessee as of 3/1/89—Continued

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<th>Longitude</th>
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<td>Piney River at Cedar Hill</td>
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<td>03602500</td>
<td>Piney River at Vernon</td>
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<td>03603000</td>
<td>Duck River above Hurricane Mills</td>
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<td>03604500</td>
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<td>707</td>
<td>354846</td>
<td>874751</td>
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### OBION RIVER BASIN

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<td>360705</td>
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<td>North Reelfoot Creek at State Hwy 22 nr Clayton</td>
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<td>Running Slough near Ledford, Ky.</td>
<td>10.8</td>
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<td>Reelfoot Lake near Tiptonville</td>
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<td>S.F. Forked Deer River at Jackson</td>
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### LOOSAHATCHIE RIVER BASIN

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<td>Loosahatchie River near Arlington</td>
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<td>351037</td>
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<tr>
<td>070303573</td>
<td>Loosahatchie River at North Watkins Street, at Memphis</td>
<td>728</td>
<td>351515</td>
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### WOLF RIVER BASIN

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<td>709</td>
<td>350758</td>
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<td>07031740</td>
<td>Wolf River at Hollywood St., at Memphis</td>
<td>788</td>
<td>351116</td>
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## Active Recording Surface-Water Stations in Tennessee as of 3/1/89—Continued

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<td>350432</td>
<td>900355</td>
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NONCONNAH CREEK BASIN
### APPENDIX 1--Continued

Active Crest-Stage Stations in Tennessee as of 3/1/89

[mi², square miles; Lat, latitude; Long, longitude; *, Operated as a continuous-record station]

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<th>Station Name</th>
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<td>Charles Creek near McMinnville</td>
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<td>Mulherrin Creek near Gordonsville</td>
<td>1982, 1986</td>
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<td>03425357</td>
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<td>Darwin Branch tributary at Hartsville</td>
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<td>Spencer Creek near Lebanon</td>
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<td>03426874</td>
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<td>Reed Creek near Bradyville</td>
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<td>17.6</td>
<td>Lytle Creek at Sauberry Drive at Murfreesboro</td>
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<td>03430400</td>
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<td>Mill Creek at Nolensville</td>
<td>1965</td>
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<td>Mill Creek near Antioch</td>
<td>1954-61*, 1962-63, 1964-75*, 1976</td>
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<td>12.2</td>
<td>Sevenmile Creek at Blackman Road at Nolensville</td>
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<td>03431060</td>
<td>93.4</td>
<td>Mill Creek at Thompson Lane, near Woodbine</td>
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<td>East Fork Browns Creek at Baird-Ward Printing Company, at Nashville</td>
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<td>2.17</td>
<td>Ewing Creek at Richmond Hill Drive at Parkwood</td>
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<td>3.02</td>
<td>Ewing Creek at Brick Church Pike at Parkwood</td>
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**CUMBERLAND RIVER BASIN--Continued**

**TENNESSEE RIVER BASIN**

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APPENDIX 1—Continued

Active Crest-Stage Stations in Tennessee as of 3/1/89—Continued

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OBION RIVER BASIN
## APPENDIX 1--Continued

Active Surface-Water Low-Flow Stations in Tennessee as of 3-1-89

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### Active Surface-Water Low-Flow Stations in Tennessee as of 3-1-89--Continued

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<td>351613</td>
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<td>03599970</td>
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<td>03599980</td>
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<td>03600085</td>
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<td>865919</td>
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<td>03600086</td>
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<td>354334</td>
<td>865919</td>
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APPENDIX 1--Continued

Active Surface-Water Low-Flow Stations in Tennessee as of 3-1-89--Continued

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<td>870033</td>
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<td>870736</td>
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<td>03600370</td>
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<td>Leipers Creek at Williamsport</td>
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<td>354143</td>
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<td>03601100</td>
<td>Big Bigby Creek at Needmore</td>
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<td>353243</td>
<td>871405</td>
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<tr>
<td>03602194</td>
<td>West Piney River below State Highway 48 near Dickson</td>
<td>25.7</td>
<td>360043</td>
<td>872633</td>
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<tr>
<td>03602209</td>
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<td>872638</td>
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<tr>
<td>03602230</td>
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<td>355711</td>
<td>872753</td>
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<tr>
<td>03602265</td>
<td>Piney River at Pinewood</td>
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<td>03604750</td>
<td>Birdsong Creek at Holladay</td>
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<td>355253</td>
<td>880839</td>
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<td>03606330</td>
<td>Big Sandy River at Westport</td>
<td>110</td>
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OBION RIVER BASIN

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<td>07025190</td>
<td>Mud Creek near Sharon</td>
<td>45.6</td>
<td>361559</td>
<td>885005</td>
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<td>362646</td>
<td>882757</td>
<td>1958-61, 1964, 1975-78, 1980</td>
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<td>07026090</td>
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<td>891103</td>
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<td>07026100</td>
<td>Reeds Creek near Trimble</td>
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<td>07027280</td>
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HATCHIE RIVER BASIN

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APPENDIX 2

Active ground-water network in Tennessee as of 3/1/89

[Lat, latitude; Long, longitude]

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<td>360835</td>
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<td>350234085181200</td>
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<td>350234</td>
<td>851812</td>
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<td>850036</td>
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<td>854326</td>
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<td>353922</td>
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APPENDIX 3

List of water-quality and suspended-sediment stations

[mi², square miles; Lat, latitude; Long, longitude; Q, chemical; B, bacteriological; S, sediment]

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<td>10,690</td>
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<td>1979</td>
<td>Q</td>
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<td>1975</td>
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## INDEX

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<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Administrative Services Section</td>
<td>44</td>
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<tr>
<td>Appalachian Valleys-Piedmont Regional Aquifer System Analysis</td>
<td>36</td>
</tr>
<tr>
<td>Blasted-in subsurface sewage system field lines</td>
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</tr>
<tr>
<td>Botanical techniques</td>
<td>34</td>
</tr>
<tr>
<td>Burial grounds at the Oak Ridge Reservation</td>
<td>18</td>
</tr>
<tr>
<td>Computer Section</td>
<td>40</td>
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<tr>
<td>Contamination potential of the Memphis Sand aquifer</td>
<td>22</td>
</tr>
<tr>
<td>Effects of urbanization on flood-peak discharges in Murfreesboro, Tennessee</td>
<td>10</td>
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<td>Hydrologic Data Section</td>
<td>1</td>
</tr>
<tr>
<td>Hydrologic Investigations Section</td>
<td>8</td>
</tr>
<tr>
<td>Impact from urban runoff on ground-water quality</td>
<td>26</td>
</tr>
<tr>
<td>Impact of agricultural chemicals on ground-water quality</td>
<td>29</td>
</tr>
<tr>
<td>McNairy-Nacatoch aquifer in West Tennessee</td>
<td>20</td>
</tr>
<tr>
<td>Millington flood</td>
<td>35</td>
</tr>
<tr>
<td>Organochlorine pesticides in ground water</td>
<td>19</td>
</tr>
<tr>
<td>Other activities</td>
<td>39</td>
</tr>
<tr>
<td>Radionuclides in ground water from Hickman and Lewis Counties, Tennessee</td>
<td>17</td>
</tr>
<tr>
<td>Recent publications</td>
<td>42</td>
</tr>
<tr>
<td>Regional Publication Center</td>
<td>41</td>
</tr>
<tr>
<td>Scour investigation at bridges throughout Tennessee</td>
<td>13</td>
</tr>
<tr>
<td>Sediment chemistry at Reelfoot Lake</td>
<td>12</td>
</tr>
<tr>
<td>Sediment deposition at wetlands near bridge crossings</td>
<td>33</td>
</tr>
<tr>
<td>Soil-gas analysis</td>
<td>14</td>
</tr>
<tr>
<td>Storm runoff into Reelfoot Lake, West Tennessee</td>
<td>28</td>
</tr>
<tr>
<td>Surface-water monitoring network</td>
<td>2</td>
</tr>
<tr>
<td>Surface-water stations (as of 3/1/89)</td>
<td>45</td>
</tr>
<tr>
<td>Suspended-sediment network</td>
<td>5</td>
</tr>
<tr>
<td>Water-quality and suspended-sediment stations</td>
<td>58</td>
</tr>
<tr>
<td>Water-quality in the Clinch and Powell Rivers, East Tennessee</td>
<td>17</td>
</tr>
<tr>
<td>Water-quality network</td>
<td>4</td>
</tr>
<tr>
<td>Water quality of farmstead wells in Tennessee</td>
<td>11</td>
</tr>
<tr>
<td>Water-use program</td>
<td>6</td>
</tr>
<tr>
<td>Wayne County landfill</td>
<td>37</td>
</tr>
<tr>
<td>Webb Creek area, Sevier County</td>
<td>25</td>
</tr>
<tr>
<td>Y-12 Plant at the Oak Ridge Reservation</td>
<td>38</td>
</tr>
</tbody>
</table>