Water-Resources Investigations in Tennessee: Programs and Activities of the U.S. Geological Survey, 1992-94

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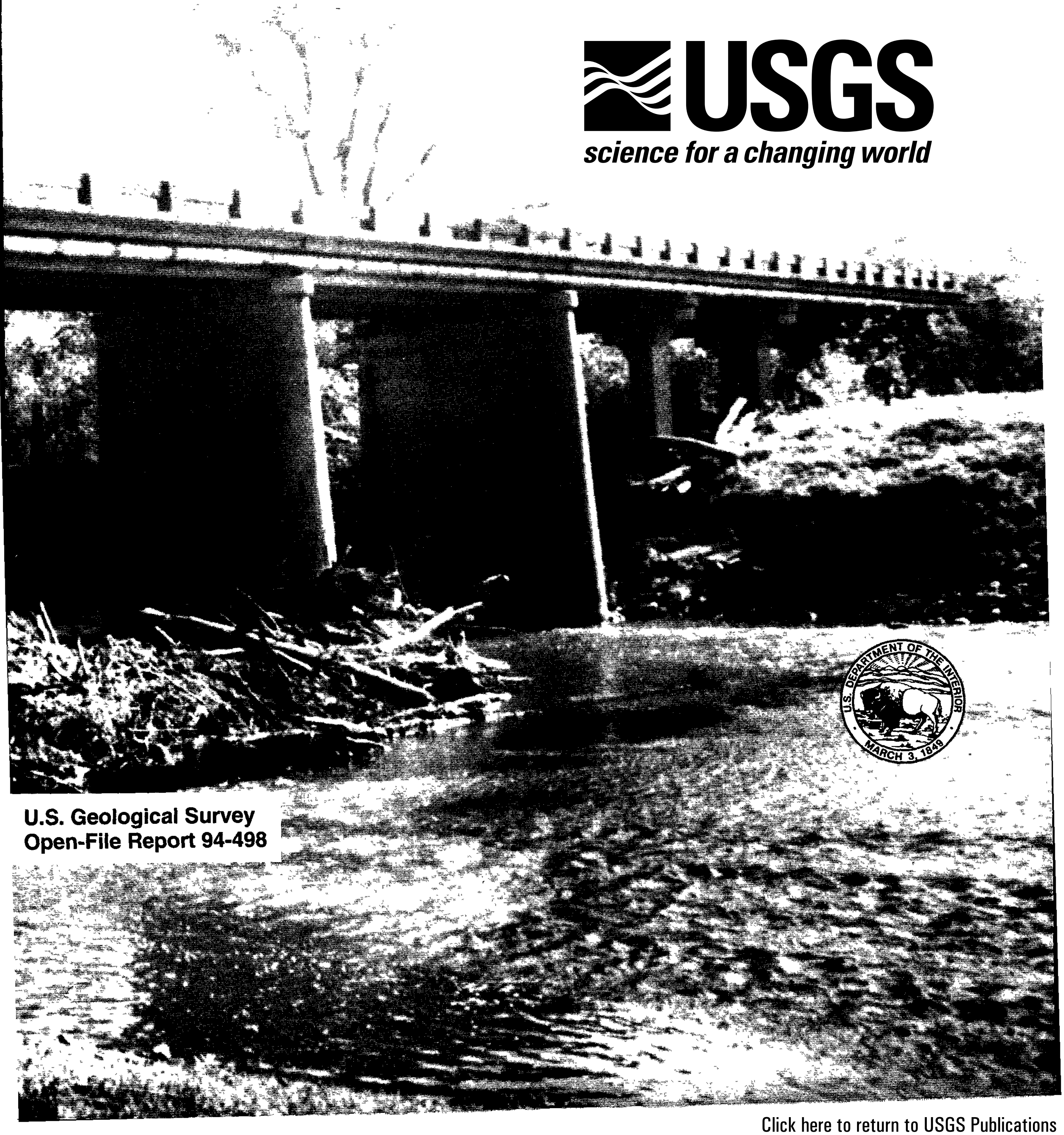


U.S. Geological Survey
Open-File Report 94-498

Quality of Ground Water in Grainger County, Tennessee

Ground water is the principal source of domestic water supply for about 75 percent of the residents of Grainger County and is an important source of irrigation water supply for vegetable producers in the county. To address concerns about ground-water quality, the USGS, in cooperation with Grainger County, collected and analyzed water samples from 35 wells during summer 1992. The primary objective was to determine whether pesticides, certain metals, nitrogen (from septic-tank effluent, animal waste, and fertilizers), and bacteria were present in ground water at concentrations sufficient to warrant concern.

Analyses of samples from the 35 wells showed that:

- No organic pesticides were detected at concentrations greater than the State's primary maximum contaminant level for public water-supply systems.

- Iron concentrations exceeded the State's secondary maximum contaminant level in samples from six wells; manganese concentrations exceeded that threshold in samples from seven wells.

- Nitrite and nitrate concentrations were less than the primary maximum contaminant levels in samples from all wells.

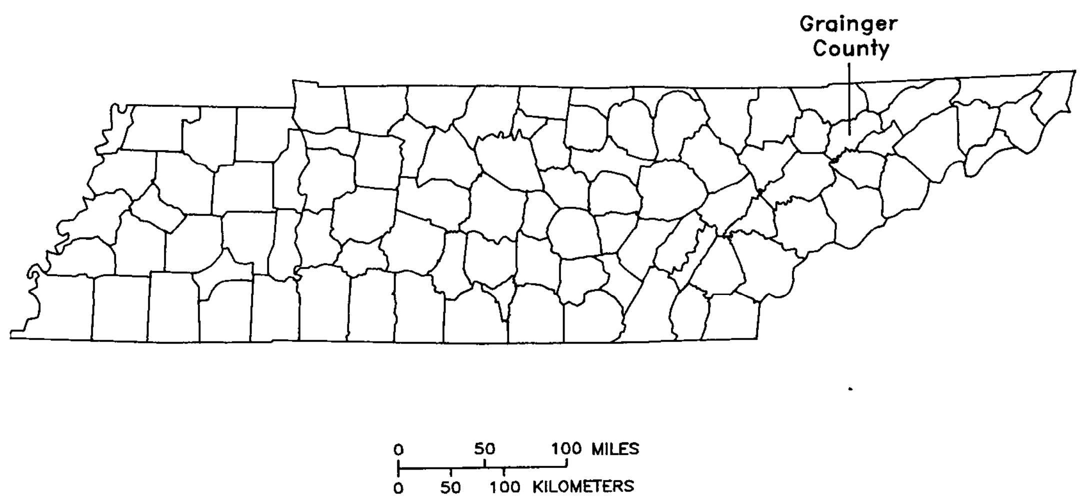
- Fecal coliform bacteria colonies exceeded the State's maximum contaminant level in samples from 15 wells. The geographic distribution of these samples did not indicate clustering in any specific area.

- Methylene blue, a compound found in many household soaps and detergents, was detected in trace amounts in 23 wells.

Jess D. Weaver of the District office was in charge of the investigation.

PUBLICATION

Weaver, J.D., Patel, A.R., and Hickey, A.C., 1994, Ground-water quality for Grainger County, Tennessee: U.S. Geological Survey Open-File Report 93-365, 14 p.



Location of study area in Grainger County, Tennessee.

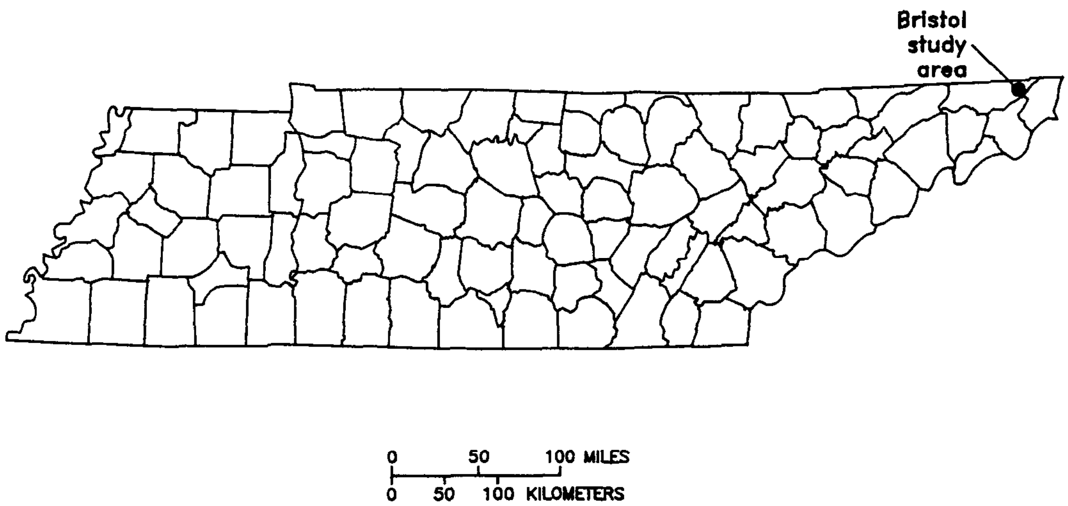
Water Quality of an Intermittent Stream near Bristol, Tennessee

The USGS, in cooperation with the U.S. Department of the Navy, has investigated the water quality of an intermittent stream draining a small disposal area at a Naval Weapons Industrial Reserve Plant (NWIRP) in Bristol, Tennessee. The NWIRP-Bristol has been in operation since 1954. The purpose of this investigation was to document the water quality of the stream draining the disposal area during low-flow conditions and following storms both before and after remedial measures at the disposal area were implemented.

Four surface-water sites were selected for sampling locations. Two are background sites located on small streams with a drainage area and geologic setting similar to that of the disposal-area stream. Water quality of these two streams is unaffected by industrial or other anthropogenic factors and is representative of the ambient surface-water quality in the Bristol area. The other two sites are located at the disposal area. One site is upstream and the second site is downstream of the disposal area.

Sampling was initiated in 1992 and continued through 1994 under various flow conditions. The samples were analyzed for major constituents, trace metals, volatile organic compounds, semivolatile organic compounds, and pesticides.

Jess D. Weaver of the District office coordinated the sampling efforts.



Location of the Bristol, Tennessee, study area.

Water-Quality Variability in the Clinch-Powell Rivers in East Tennessee

The USGS, in cooperation with the Tennessee State Planning Office, has conducted a reconnaissance investigation to define water-quality variability of the Clinch and Powell Rivers in East Tennessee. The quality of water in these rivers may be threatened by acid mine drainage, nutrients from agricultural runoff and waste-water discharge, and sediment from accelerated erosion of disturbed land. There also is evidence that the mussel population of these rivers has been in decline over the past decade, which might be due to deteriorating water quality or to other factors.

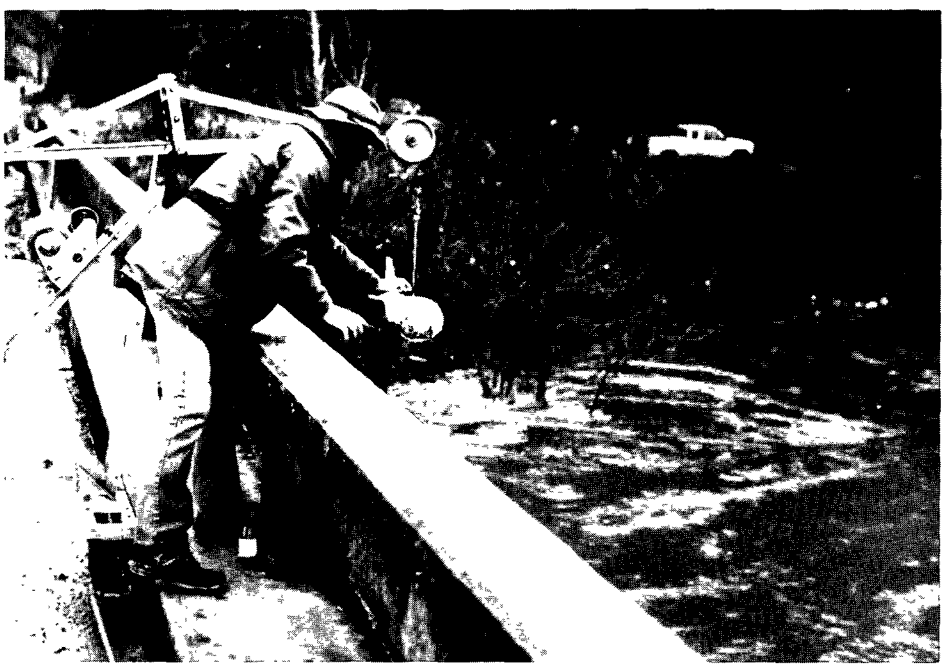
The objectives of the project were to collect water-quality and suspended-sediment data over a range of flow conditions. The project was designed to:

- Define the variability in concentrations of suspended sediment, bacteria, nutrients, common ions, selected trace metals, and to make field determinations of specific conductance, pH, and dissolved oxygen for a range of water-discharge conditions, particularly during periods of high flow; and

- Estimate annual loadings of suspended sediment, nutrients, and other constituents in the two basins.

Several sets of samples have been collected under variable flow conditions at two sites near the Tennessee-Virginia State line. Preliminary results indicate that the suspended-sediment concentration and bacterial content of the water are highest during periods of stormflow.

The project is directed by Jess D. Weaver of the District office.



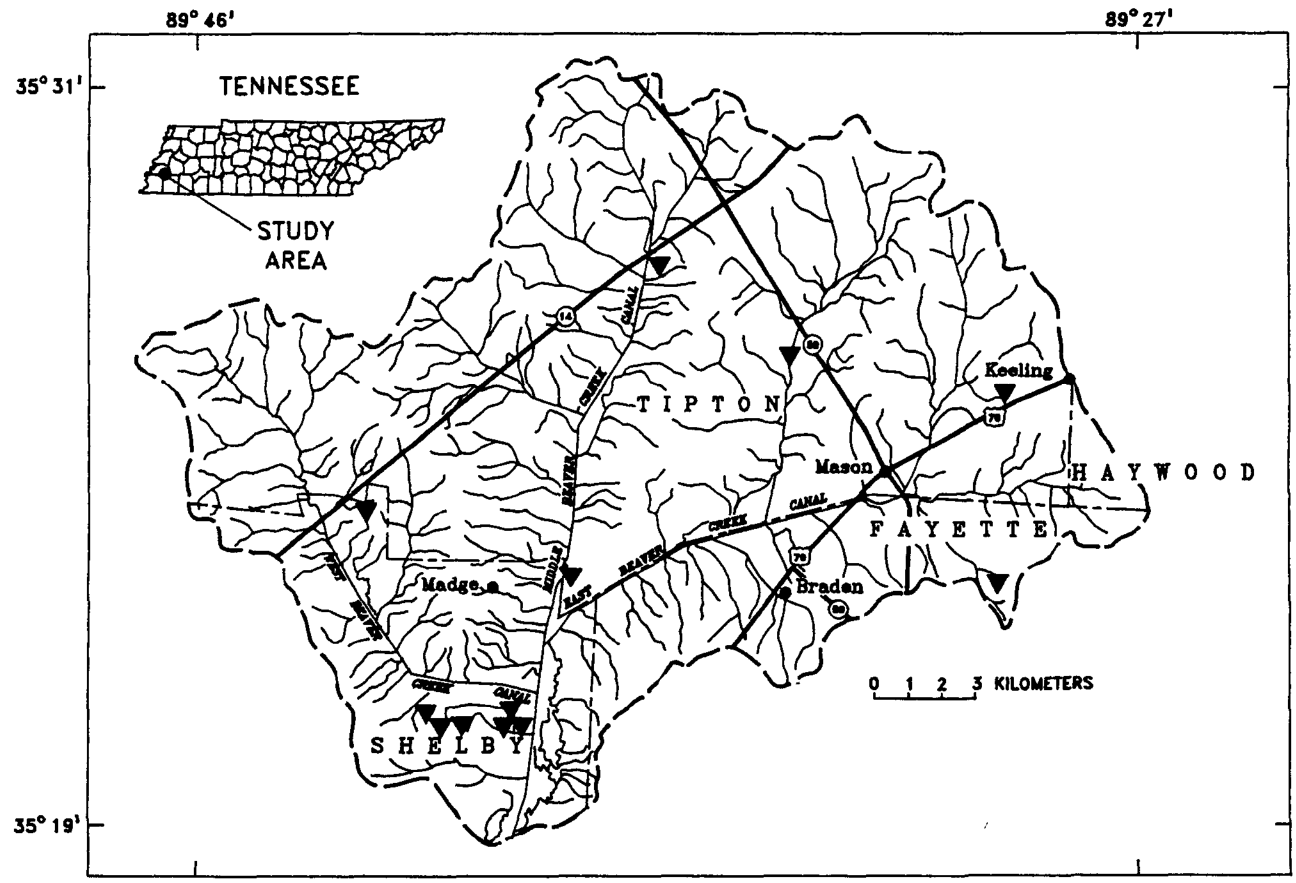
Suspended-sediment sample collection from the Powell River at Alanthus Hill, Tennessee.

Evaluation of Agricultural Nonpoint-Source Pollution in the Beaver Creek Drainage Basin, West Tennessee

Agricultural activities are recognized as a major cause of nonpoint-source pollution. In 1990, the USGS began a comprehensive long-term research program to assess the effect of agricultural practices in the Beaver Creek watershed, West Tennessee, on the quality of both surface water and ground water. This watershed was selected as typical of many in the mid-South region. The program is being conducted in cooperation with the Tennessee Department of Agriculture, U.S. Department of Agriculture, Soil Conservation Service (now Natural Resources Conservation Service), Tennessee Association of Soil Conservation Districts, Shelby County Conservation District, Tennessee Department of Environment and Conservation, Water Environment Federation, Clemson University, Memphis State University (now the University of Memphis), and University of Tennessee Agricultural Extension Service.

Objectives of the program are to:

- Evaluate currently accepted monitoring strategies to assess agricultural nonpoint-source pollution and develop new strategies as needed,
- Evaluate the nature and extent to which agricultural activities affect the quality of surface and ground water in the Beaver Creek watershed,
- Identify and quantify the processes and factors that control the transport of pollutants from agricultural fields, and



Location of surface-water monitoring stations in the Beaver Creek watershed.

- Assess the effectiveness of agricultural conservation practices (commonly referred to as best management practices) at the field and the watershed levels.

Surface-water-quality monitoring stations have been established in the watershed; 10 gages were in use at the end of 1994. Data collected at these sites are being used in paired watershed, trend, and upstream-downstream analyses. Transport of agrichemicals in the soil profile has been evaluated in five agricultural fields under different tillage practices. Soil samples were collected in three transects from four depths every 15 days during the growing season. The samples were analyzed for nitrogen and phosphorus species, selected pesticides and their metabolites, pH, organic matter content, and cation exchange capacity. Laboratory experiments to evaluate the behavior of applied agrichemicals in the soil under controlled conditions have been conducted. Occurrence and distribution of agrichemicals in the water-table aquifer have been assessed by establishing and sampling a network of shallow wells. The ground-water network included 75 domestic wells and 10 observation wells that were sampled five times a year. In addition, the assimilative capacity of natural and artificial wetlands for agricultural runoff is being evaluated.

Monitoring activities are scheduled through 1996. W. Harry Doyle, Jr. of the Memphis Subdistrict office is the project chief.

PUBLICATIONS

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Fielder, A.M., Roman-Mas, Angel, and Bennett, M.W., 1994, Reconnaissance of ground-water quality at selected wells in the Beaver Creek watershed, Shelby, Fayette, Tipton, and Haywood Counties, West Tennessee, July and August 1992: U.S. Geological Survey Open-File Report 93-366, 28 p.

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_____1994, Transport and degradation of aldicarb in the soil profile: a comparison of conventional tillage and non-tillage, *in* Pederson, G.L., ed., National Symposium on Water Quality, Chicago, 1994, Proceedings: American Water Resources Association, p. 31-42.

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Roman-Mas, Angel, and Mattraw, H.C., Jr., 1994, Assessment of agricultural nonpoint-source pollution and best management practices in West Tennessee: U.S. Geological Survey handout (unnumbered), 1 p.

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Smink, J.A., Roman-Mas, Angel, and Klaine, S.J., 1994, An experimental wetland to treat cropland runoff, *in* 15th Annual Meeting, Society of Environmental Toxicology and Chemistry, Oct. 30 - Nov. 3, 1994, Denver, Abstracts: Society of Environmental Toxicology and Chemistry, p. 32.

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Williams, S.D., and Roman-Mas, Angel, 1994, Relation between nitrate concentrations and potential nitrate sources of water-table aquifers in the Beaver Creek watershed, West Tennessee: a statistical analysis, *in* Pederson, G.L., ed., National Symposium on Water Quality, Chicago, 1994, Proceedings: American Water Resources Association, p. 43-50.

Quality of Storm Water in Relation to Land Use for Urban Areas in Tennessee

Cities with a population of more than 100,000 are now required by U.S. Environmental Protection Agency (USEPA) regulations to control the quality of storm-water discharges within their boundaries and to obtain a Federal permit under the National Pollution Discharge Elimination System (NPDES) as evidence of compliance. Cities must provide the USEPA with estimates of the quantities and mean concentrations of several constituents in storm runoff to receiving streams in order to obtain a permit.

To provide data needed by Nashville, Knoxville, and Chattanooga, the USGS, in cooperation with the governing bodies of these cities, measured discharge and characterized storm-runoff quality at selected watersheds in each city during one to three major storms. The watersheds selected were representative of the primary land uses in each metropolitan area. The USGS also characterized rainfall in each city, another requirement for the NPDES permit, on the basis of existing data.

The project was completed under the direction of Anne B. Hoos of the District office.

Validation of Factor-Adjustment Procedure in Weighting Regional Models of Urban-Runoff Quality with Local Data

The issuance of a National Pollution Discharge Elimination System permit first requires an estimate of storm-runoff loads in urban areas to streams. City engineers or planners can make estimates by applying linear regression models that were developed and calibrated with data for certain cities. They also have available a small data base of local storm-runoff quality (also required by USEPA regulations), which relates to their own city. To help improve the accuracy of the estimates, a USGS project developed and tested statistical methods for combining, or weighting, the predictions from the regression models with information from the local data base, and derived expressions for calculating variance of prediction and confidence intervals for the 'weighted' predictions. Four procedures for adjusting the regression models were tested and validated. For many cities, the procedures can result in smaller estimates of load and possibly a need for less costly mitigation measures for compliance with the USEPA limits.

The project was funded by USGS Office of Surface Water and was conducted by Anne B. Hoos of the District office.

PUBLICATION

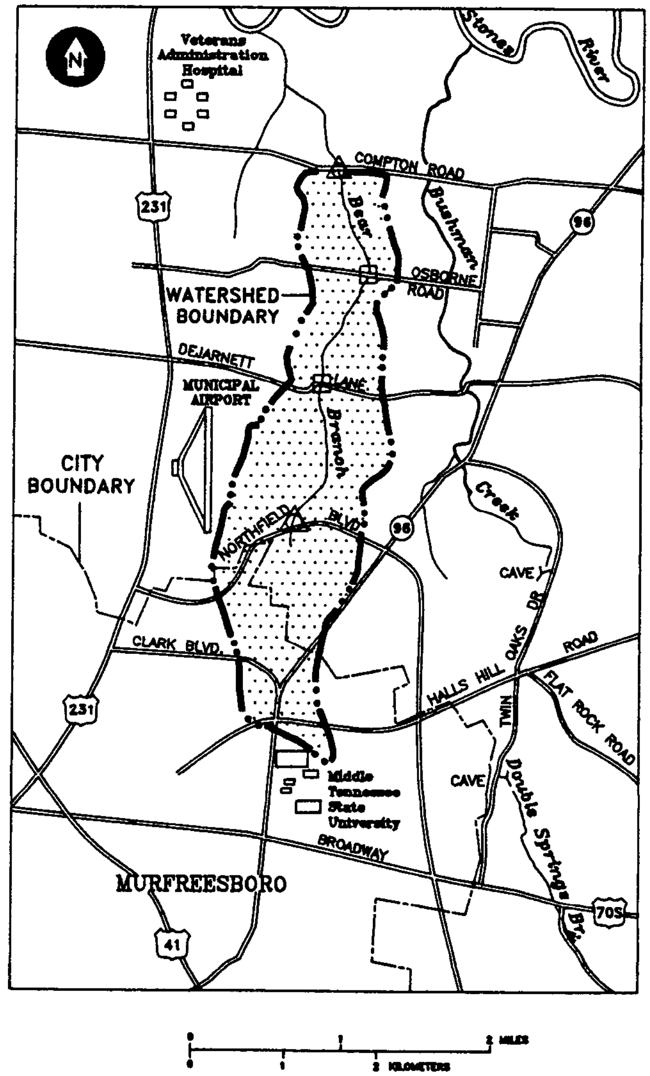
Hoos, A.B., and Sisolak, J.K., 1993, Procedures for adjusting regional regression models of urban-runoff quality using local data: U.S. Geological Survey Open-File Report 93-39, 39 p.

Application of the Distributed Routing Rainfall Runoff Model, DR$_3$M, to Bear Branch Watershed, Murfreesboro, Tennessee

The USGS, in cooperation with the City of Murfreesboro, calibrated the USGS Distributed Routing Rainfall Runoff Model, DR$_3$M, to the 2.8-square-mile Bear Branch watershed in northern Murfreesboro. DR$_3$M uses kinematic wave theory to route excess rainfall overland and through a branched system of stream channels. It also can simulate the effect of detention storage. The model was calibrated using information from two rain gages, two stream gages, and two crest-stage gages that operated in the watershed from March 1989 through July 1992. The calibrated model was used to define flood characteristics and long-term flood frequencies for conditions in the watershed as of 1993.

The calibrated model provides planners and engineers of the City of Murfreesboro with a valuable tool to study the effects of future changes in land use on the flood characteristics and the flood-frequency relation of the Bear Branch watershed. The ability of the model to simulate detention storage will be valuable in the development of plans to manage and reduce flood damage in the watershed. The calibrated model applies specifically to the Bear Branch watershed; however, the techniques used in the study are transferable to other watersheds where observed rainfall and streamflow data are available.

The investigation was conducted by George S. Outlaw of the District office.



EXPLANATION

○ PARTIAL–RECORD STREAMFLOW

△ RAINFALL GAGE

□ CREST–STAGE GAGE

Location of watershed and data-collection points for Bear Branch.

Seepage and Spring Inventory Reconnaissance and Base-Flow Measurements at the Oak Ridge Reservation, Oak Ridge, Tennessee

The USGS, in cooperation with the U.S. Department of Energy, conducted an inventory of seeps and springs and made base-flow measurements of them on about 16,000 acres of the Oak Ridge Reservation (ORR). The information from this project will aid Oak Ridge National Laboratory's Environmental Restoration Program, Groundwater Operable Units Remedial Investigation in developing a better understanding of the interaction between ground water and surface water on the ORR.

The first part of the study included about 4,300 acres near Oak Ridge National Laboratory (ORNL). In March and April 1993, all tributaries in each of the 18 basins of this area were followed to their source, and the locations of springs, seeps, and stream-measuring sites to be used in the investigation were assigned unique identification numbers. A total of 821 sites were identified during this reconnaissance. About 60 percent of the sites were mapped to an accuracy of within 3 to 5 meters of actual location using a global positioning system (GPS). The other 40 percent of the sites were mapped by measuring the distances from GPS points or other control points.

A high base-flow seepage investigation was conducted from April 29 to May 3, 1993, and from May 7 to May 10, 1993. Discharge measurements or estimates of discharge were made at all sites having flowing water at this time. Specific conductance, temperature, and pH of the water were also measured. About 27 percent of the sites that were identified during the reconnaissance were dry during the high base-flow seepage investigation.

The low base-flow seepage investigation was conducted from August 8 through August 10, 1993, and consisted of revisiting and measuring the seeps and springs that were flowing during the high base-flow seepage investigation. About 68 percent of the sites revisited were dry during the low base-flow seepage investigation.

The second and third parts of the study were performed during 1994. Similar efforts were made to locate seeps and springs and measure base flow on about 7,100 acres near the K-25 plant and 4,600 acres near the Y-12 plant. The number of sites identified in each area totalled 400 and 700, respectively.

The project was performed under the direction of Gregory C. Johnson of the Knoxville Subdistrict office.

Urban Hydrology for Johnson City, Tennessee

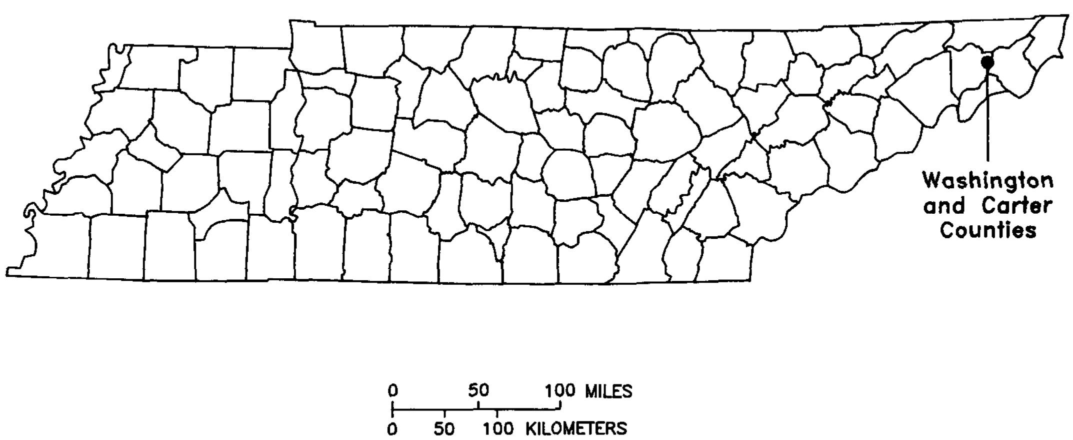
Urban development in and surrounding Johnson City in Washington and Carter Counties, Tennessee, has increased steadily over the past two decades. Associated with this urbanization are increases in impervious areas, storm-sewer developments, and stream-channel modifications, causing significant increases in the magnitude and frequency of flooding. The effect of increased flooding can be minimized if the changes caused by urbanization are considered in the planning and design of buildings and drainage structures. Towards this goal, the City of Johnson City plans to use rainfall-runoff models of five basins to predict the hydraulic effects of specific options in urban development, such as regulations controlling density of developments, amount of impervious surfaces, setbacks from streams, and site design. In addition to use for land-use planning, the calibrated rainfall-runoff models also will be useful in designing urban drainage systems.

In 1990, the USGS, in cooperation with Johnson City and the Tennessee Valley Authority (TVA), initiated a 5-year hydrologic and hydraulic investigation of the Johnson City area which includes the following:

- Collection of rainfall and runoff data,
- Calibration of a basin streamflow model,
- Construction of observed and computed flood profiles, and
- Determination of flood magnitude-frequency relations.

The basins being studied are the Brush Creek, Cobb Creek, Knob Creek, Catbird Creek, and Sinking Creek basins that drain much of Johnson City. A network of 10 streamflow gages and 6 rainfall gages transmit data by radio on a real-time basis to a computer in the Johnson City Public Works Department office. This system allows users to observe rainfall intensities and streamflow of the major creeks at points throughout the city as storms are happening. Crest-stage gages have been installed at 18 sites to provide additional flood-profile information. The data produced are also recorded on USGS data loggers and archived. The archived data will be used in hydraulic analyses of the basins and for programming and calibrating the rainfall-runoff models.

Gregory C. Johnson of the Knoxville Subdistrict office is leading the field work and surface-water analyses for the USGS, and Chris Hughes is leading the modeling effort for TVA. Steve Ellis, Assistant City Engineer for Johnson City, provides coordination for the project.



Location of Johnson City urban hydrology study area, Washington and Carter Counties, Tennessee.

Hydrologic Regime of Wetlands at Arnold Air Force Base, Tennessee

Wetlands are vitally important to the nation's water supply. Among the many economic and public-health benefits of wetlands, one of the most important is the recharge of ground-water systems. In limestone regions, such as the Highland Rim of Tennessee, recharge often occurs rapidly through sinkholes that are connected to cavities in the bedrock. Because surface flow concentrates around these sinkholes, they have potential to introduce surface pollutants directly into the ground water.

Arnold Air Force Base, near Manchester, Tennessee, contains approximately 619 acres of wetlands, many of which contain large and active sinkholes. These areas play a critical role in recharging the ground-water system of the base and surrounding communities. The wetlands also support a number of rare plant and animal species and abundant wildlife. Two of the sites, Sinking Pond and Goose Pond, are Registered Natural Landmarks. Despite the acknowledged hydrologic and ecological importance of these sites, little is known about how water moves through them. In particular, detailed information is needed on the flooding tolerances and requirements of rare plants and on the rates, locations, and processes of ground-water recharge.

In cooperation with the U.S. Air Force, the USGS is conducting a study of the wetlands on Arnold Air Force Base.

The study objectives include:

- Defining spatial and temporal patterns of flooding in areas that support rare plants;
- Evaluating the spatial patterns, rates, and processes of ground-water recharge in sinkhole wetlands; and
- Identifying the geologic and other environmental factors that control the distribution and hydrology of wetlands on Arnold Air Force Base and surrounding areas.

These objectives have been met by monitoring precipitation, surface-water stages, and ground-water levels, and by mapping and correlating hydrologic features, geology, topography, vegetation, and soils. The data collected are currently being analyzed and interpreted.

The project is directed by William J. Wolfe of the District office.

A seasonally flooded stand of willow oaks and overcup oaks in the interior of Sinking Pond, on Arnold Air Force Base.

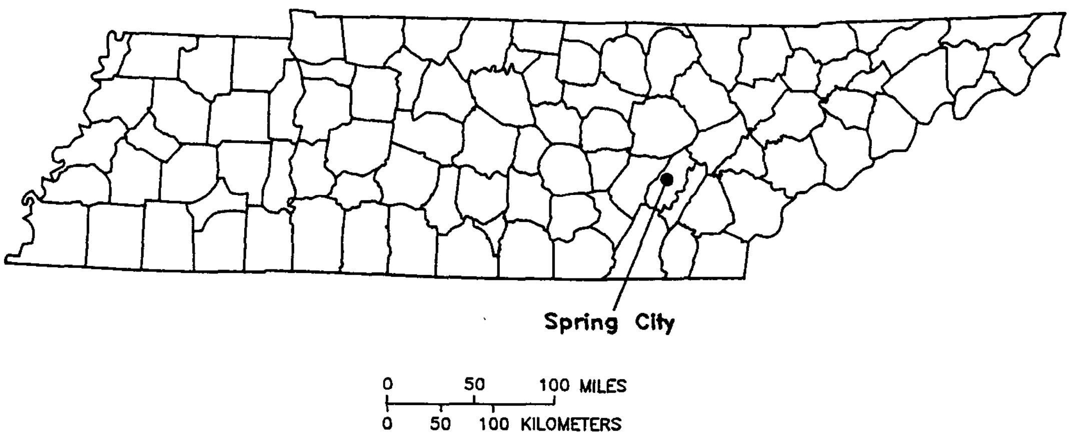
Wetlands Monitoring at Spring City, Tennessee

Part of a natural wetland at Spring City, in Rhea County, was disturbed by the construction of a highway access ramp. To compensate for the destroyed wetland, the Tennessee Department of Transportation (TDOT) excavated an adjacent area to create a constructed wetland. The USGS, in cooperation with the TDOT, monitored the water surfaces at the two sites and collected other data from December 1991 to November 1992 as part of a study of wetlands hydrology. The data will be evaluated by the TDOT to determine if the constructed wetland has hydrologic properties similar to the natural wetland.

Recorders on five 6-inch-diameter wells, approximately 5 feet deep, provided continuous water levels in the two wetland areas. The continuous data allowed determination of periods of wetland inundation. Water levels also were monitored at 20 shallow 2-inch-diameter wells at 6-week intervals to provide synoptic data and a more detailed profile of the water surface in the wetlands.

In addition to monitoring water levels in the wetlands, rainfall and streamflow were measured. A recording rain gage was installed in the constructed wetland. These data were used to correlate rainfall to water-surface elevation changes in the wetlands. A continuous-stage recorder was installed on Town Creek, which forms the southeastern boundary of the wetlands. The creek stage information was recorded to determine what effect a flood might have on the wetlands if such an event occurred during the study period.

Gregory C. Johnson of the Knoxville Subdistrict office was project chief of the study.



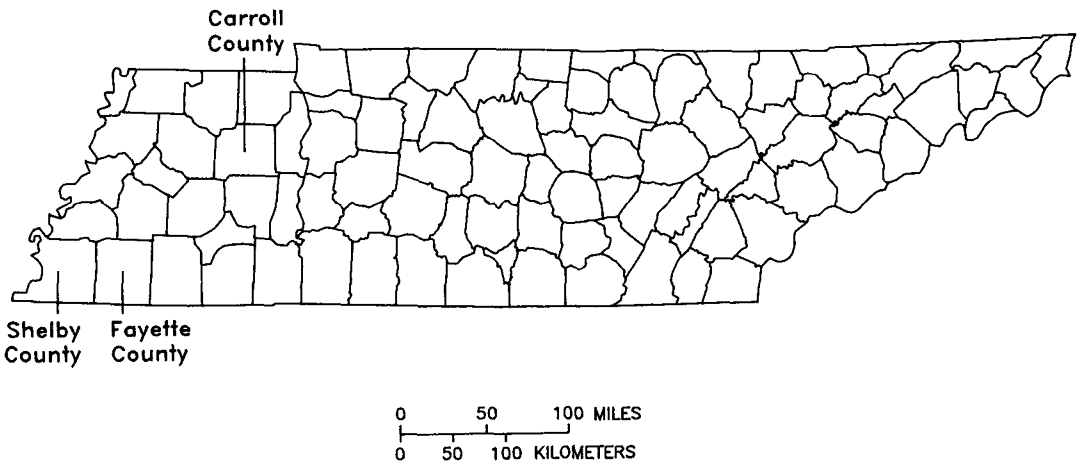
Location of the Spring City wetlands monitoring project, Rhea County, Tennessee.

Wetland Restoration Studies, West Tennessee

In cooperation with the Tennessee Department of Transportation (TDOT), the Tennessee District of the U.S. Geological Survey is carrying out multidisciplinary investigations at three wetland restoration sites. The sites are located in Shelby, Fayette, and Carroll Counties. Monitoring of conditions at these sites began in June 1993 and is ongoing.

The USGS assists TDOT in identifying potential restoration sites, assessing the difficulty of restoring wetland hydrology, and developing a restoration plan that has a high likelihood of achieving desired restoration objectives. Hydrologic conditions at the sites selected are monitored continuously to evaluate existing conditions and changes produced by application of the restoration plan. Geomorphic and biological techniques are used to enhance the cost-effectiveness of surface-water and ground-water monitoring.

The project chief is Timothy H. Diehl of the District office.



Location of Shelby, Fayette, and Carroll Counties, Tennessee.

Assessment of Scour at Bridges

The USGS and the Tennessee Department of Transportation (TDOT) have cooperatively assessed interactions between channel and bridge characteristics that can cause the scouring of channels at bridges. Sejvere scour can result in undercutting the footings of bridge structures, causing bridge collapse. From 1989 to 1992, almost 4,000 bridge sites were inspected and the data produced were placed in digital files linked to a geographic information system with mapping capabilities. Indexes for potential and observed scour were developed with additional information provided by the TDOT. These indexes have been used by the TDOT as an aid in organizing bridge-site repair plans. The TDOT and USGS have developed techniques for estimating trends in scour potential through exploratory data-analysis techniques. Plotting of specified data, such as bed-material type, provides the ability to visually determine sites where scour may be severe. Additionally, these techniques can identify stream reaches where changes in channel management or land use may result in potentially dangerous geomorphic responses. The techniques developed in this project are being used in channel-scour studies in other States.

Bradley A. Bryan of the Knoxville Subdistrict office was the project chief of this investigation.

Bare bank and leaning tree are indicators of high-flow impact and channel migration in vicinity of State Highway 15, Little Swan Creek, Lincoln County, Tennessee.

Debris Accumulation at Bridges

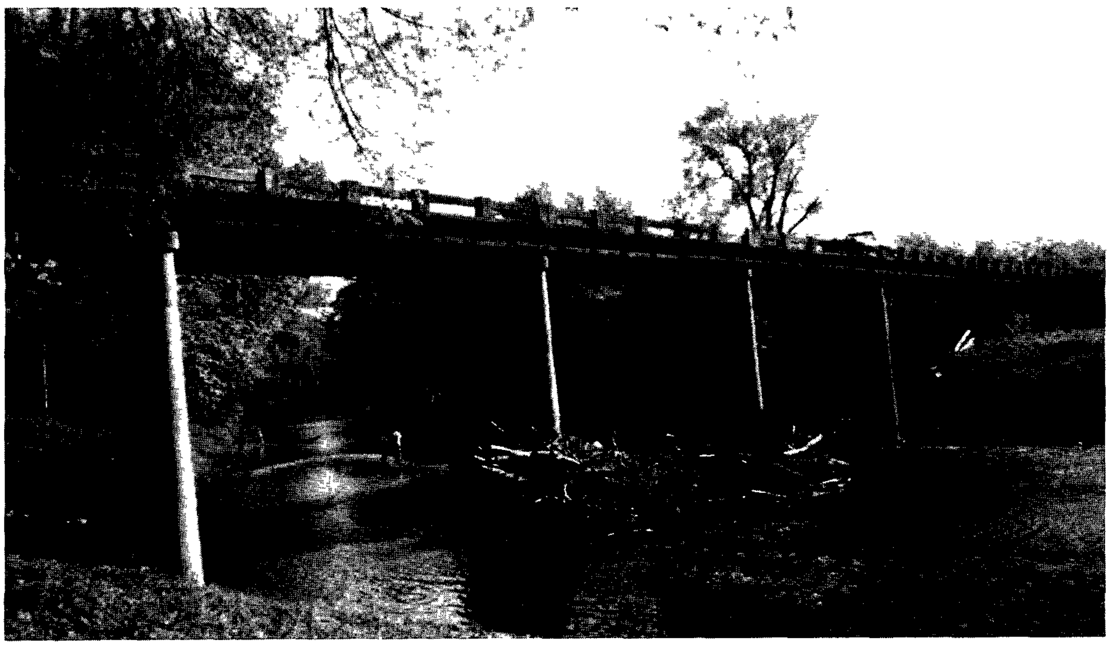
Large woody debris, much of which is made up of entire tree trunks with attached root stubs, is common in rivers that flow between wooded banks. The accumulation of debris at bridges causes maintenance problems, contraction and local scour, and bridge failures. The USGS, in cooperation with the Federal Highway Administration, is investigating the causes and effects of debris accumulation at bridges nationwide.

This project incorporates three interdependent approaches to understanding debris accumulation:

- A statistical study of data relevant to debris accumulation;
- A more detailed study of factors contributing to debris accumulation at selected bridges where debris has blocked much of the river channel; and
- A descriptive study of debris production, transport, and trapping in one or two study reaches.

Accomplishments during 1992-94 include combining bridge inspection data from several States into a single digital data base, the development of response forms on which highway engineers can describe debris accumulations, identification of several bridges in the Mississippi Valley with large, recurrent debris accumulations, and a pilot study of debris production and transport potential in a small Cumberland River basin near Franklin, Tennessee.

Timothy H. Diehl of the District office is the project chief.



Debris accumulation at bridge over the Harpeth River at Sneed Road near Bellvue, Tennessee.

PUBLICATION

Diehl, T.H., and Bryan, B.A., 1993, Supply of large woody debris in a stream channel, *in* Shen, H.W., Su, S.T., and Feng, Wen, eds., Hydraulic Engineering '93 Conference, San Francisco, 1993, Proceedings: American Society of Civil Engineers, v.1, p. 1055-1060.

Sedimentation and Surface-Water Flow Patterns near the Tigrett Wildlife Management Area, Dyer County, Tennessee

The Tigrett Wildlife Management Area and nearby areas along the North Fork Forked Deer River in Dyer County typify drainage conditions along channelized streams in West Tennessee: expanding ponds, dead or dying timber, and tributary flooding. Two issues raised by these conditions are (1) the hydrologic effects of historical sedimentation and (2) the hydrologic interaction of different parts of the flood plain and its margins. In cooperation with the Tennessee Wildlife Resources Agency, the USGS conducted a study to evaluate hydrologic conditions in and near the Tigrett Wildlife Management Area. The study results provided environmental decision makers with a scientific basis for choosing among several management options for the Wildlife Management Area. The major conclusions were:

- 5 to 12 feet of sediment were deposited on the flood plain between 1830 and 1930;
- Ponds in the flood plain are gradually being drained by head cuts in both banks of the North Fork Forked Deer ditch; and
- Ponding along several tributaries reflects conditions in the tributary basins and does not depend on flood-plain ponding.

The principal investigators were William J. Wolfe and Timothy H. Diehl with assistance from Bradley A. Bryan.

PUBLICATION

Wolfe, W.J., and Diehl, T.H., 1993, Recent sedimentation and surface-water flow patterns on the flood plain of the North Fork Forked Deer River, Dyer County, Tennessee: U.S. Geological Survey Water-Resources Investigations Report 92-4082, 22 p.

A formerly buried cypress stump excavated by channel erosion in the Tigrett Wildlife Management Area. Note the numerous small roots along the sides of the stump and the young birch growing on its top.

Digital Data Acquisition and Development of Geographic Information System Coverages for Wells and Springs Used for Public Water Supply in Tennessee

About 51 percent of Tennessee residents depend on ground water for domestic water supply. In some parts of the State, potential exists for surface or near-surface contaminants to enter aquifers resulting in the degradation of ground-water quality. Susceptibility to degradation is greatest for unconfined aquifers and aquifers in areas where sinkholes or other karst-related surface-drainage features occur.

During 1991-92, the USGS, in cooperation with the Tennessee Department of Environment and Conservation, Division of Water Supply, developed digital files (termed "coverages") that can be used to estimate the potential for ground water in Tennessee to become degraded by contaminants. The coverages include:

- principal surficial aquifers in the State
- karst-hazard assessment
- location of wells and springs used for public supply and rates of ground-water withdrawal
- location of hazardous-waste sites inventoried under the Comprehensive Environmental Response Compensation Liability Act
- location of hazardous-waste sites inventoried under the Resource Conservation and Recovery Act

Additionally, two coverages were acquired:

- county boundaries and names
- population density, by county

A geographic information system (GIS) was used to develop each coverage. Coverages of different features can be overlain, and the computing capabilities of the GIS used to derive information that relates to the potential for ground-water contamination.

The project was completed under the direction of Joseph F. Connell and William R. Barron, Jr., of the District office.

PUBLICATION

Connell, J.F., and Barron, W.R., Jr., 1993, Digital data acquisition and development of geographic information system coverages for use with the public water-supply wells and springs in Tennessee: U.S. Geological Survey Water-Resources Investigations Report 92-4178, 28 p.

Conversion of Geologic Quadrangle Maps to Geologic Coverages

The USGS, in cooperation with the Tennessee Department of Environment and Conservation, U.S. Army Corps of Engineers, Tennessee Valley Authority, and U.S. Soil Conservation Service (now the Natural Resources Conservation Service), converted information on 368 geologic maps of 7 1/2-minute quadrangles in Tennessee to digital files. The files can be accessed by computers equipped with geographic information system (GIS) software. GIS technology provides managers, scientists, engineers, and others with an efficient manner for storing and manipulating large amounts of data and providing derivative maps of selected types of information at any desired scale. Most of the area included in this project is in Middle Tennessee with lesser amounts in the eastern and western parts of the State.

The project was under the direction of Joseph F. Connell of the District office.

PUBLICATION

Connell, J.F., Barron, W.R., Jr., and Mitchell, R.L., III, 1994, Conversion of geologic quadrangle maps to geologic coverages: U.S. Geological Survey Open-File Report 94-359, 23 p.

Tennessee Coordinated Ground-Water Data Base

The USGS and the Tennessee Department of Environment and Conservation (TDEC) have coordinated their ground-water data bases on one computer platform. Three TDEC State data bases (Water Wells, Public Water Supply, and Monitor Wells) and three USGS data bases (State Water Use Data System, Ground Water Site Inventory, and Digital Well Coverages) were transferred to work stations for use as a common data base system. Among the benefits of the coordinated data base are that data accessibility to both agencies has been greatly improved, the speed of input and retrieval of data has been significantly enhanced, the data are readily transferrable to coverages under geographic information systems, and the overall management of ground-water resources in the State has been facilitated.

The project was under the direction of David C. Greene of the District office with assistance from Joseph F. Connell.

OTHER ACTIVITIES

Outreach

USGS employees of the District office and three Subdistrict offices in Tennessee have presented numerous talks and seminars on various aspects of hydrology to the students and faculty of several schools and universities in the State. The list of schools includes the University of Tennessee, Middle Tennessee State University, Memphis State University (now the University of Memphis), Christian Brothers University, Rhodes College, and the Memphis College of Art. Seminars, frequently with hands-on demonstrations, also have been given to teacher groups, high school students, and students in elementary schools. Talks on hydrology also have been presented to non-academic organizations such as the Tennessee Association of Utility Districts, Fort Campbell Environmental-Quality Officers, and various Chambers of Commerce. The Beaver Creek project has been of particular interest to several organizations outside Tennessee. This project has been the subject of talks at the National Academy of Sciences, the National Cotton Council, Texas Farm Bureau, and Arkansas Nature Conservancy.

To encourage young people to consider careers in science, representatives of the Tennessee District have attended "career day" at several colleges to discuss the work of the USGS. Special efforts have been made to attract students of minority groups.

During part of 1992, the Tennessee District was host to two visiting scientists from Spain who came to learn new hydrologic methods. They participated in the Cave Springs, Appalachian Valleys-Piedmont Regional Aquifer System Analysis, and Beaver Creek projects.

The Tennessee District was a co-sponsor of the Fifth Tennessee Water Resources Symposium in 1992, the First Annual Tennessee Students Symposium on Water Resources in 1993, and the American Water Resources Association Annual Spring Symposium in 1994. These meetings are intended to provide a forum for the exchange of water-resources information and ideas among scientists and others within the state. Additionally, the USGS has provided financial support each year to the Tennessee Water Resources Research Center.

Geophysical Logging

The Tennessee District of the USGS conducts an active program of geophysical logging in cooperation with Memphis Light, Gas and Water Division (MLGW) and in support of other ground-water investigations across the State. Geophysical logs can provide valuable information on the geologic and hydrologic conditions at a well. These logs can be used to identify changes in lithology, determine the occurrence and depth of fractures and solution openings intercepted by a well, determine the porosity of the formation, measure ground-water temperature and specific conductance at depth, and determine directions of water flow within the borehole.

Test wells drilled by MLGW are logged by the USGS to provide information on the Memphis aquifer and the Fort Pillow aquifer in Shelby County. The Tennessee District has a geophysical logging unit in Memphis to support the cooperative work with MLGW. This logging unit can run caliper, natural gamma, and electric logs to depths of about 2,500 feet below land surface.

The USGS also has a regional geophysical logging unit in Atlanta that has been used in Tennessee to provide additional logging capabilities. The regional logger can run density, neutron porosity, sonic velocity, acoustic televiewer, long and short normal resistivity, focused resistivity, spinner flow meter, and heat-pulse flow meter logs as well as the standard caliper, natural gamma, and electric logs.

District Drilling Capabilities

A CME 55 drill rig is stationed at the Memphis Subdistrict to support USGS drilling activities in the Tennessee District. The rig can be used to drill in unconsolidated soils to a depth of about 150 feet. Capabilities of the drilling operations include hollow- and solid-stem augering, mud-rotary drilling, and split-spoon sampling. The drill rig significantly improves the Tennessee District capabilities to install monitoring wells in a cost-efficient and timely manner. For example, the CME 55 drill rig was used to install 36 monitoring wells at a U.S. Environmental Protection Agency Superfund site in Jackson, Tennessee, where the soils were highly contaminated with organic chemicals. Installation of deep monitoring wells and wells in consolidated formations are contracted out using a competitive-bidding process.

Drilling operations are directed by Larry B. Thomas of the Memphis Subdistrict office. He is assisted by W. Kevin Kelly, Amy M. Fielder, and Randy Thomas, also of that office.

Geographic Information System Capabilities

Geographic information system (GIS) is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information. Information is derived from numerous sources such as digital elevation models, studies of aquifers, and maps of roads, hydrography, vegetation, karst areas, and land use. These data bases are managed and manipulated to provide base maps and analyses for both project work and cooperators' needs.

The Tennessee District has several Statewide data bases at varying scales obtained through national and Statewide mapping efforts. In addition, data bases for more local areas have been created at relatively large scales to meet specific project needs. One of the recently added data bases, developed in cooperation with other government agencies, incorporates information on geologic maps for 368 of all 811 7½ minute quadrangles included within or partly within the State.

Recent Publications

The Tennessee Publications Center prepared 30 Water-Resources Investigations Reports; 18 Open-File Reports; 33 journal articles, abstracts, and symposia articles; and 2 annual data reports for publication in 1992-94. The Publications Center also compiled and printed two book reports presenting the program with 45 abstracts for the Fifth Tennessee Hydrology Symposium and the program with 39 abstracts for the National Computer Technology Meeting. It also printed 10 reports from other Districts and Headquarters and 1 periodic bulletin, and made the third printing of the "Standards for Illustrations in Reports of the U.S. Geological Survey, Water Resources Division." Currently, approximately 50 reports are in various stages of preparation.

Recently published reports are:

Bailey, Z.C., 1993, Hydrology of the Jackson, Tennessee, area and delineation of areas contributing ground water to the Jackson well fields: U.S. Geological Survey Water-Resources Investigations Report 92-4146, 54 p.

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Balthrop, B.H., and Baker, E.G., compilers, 1992, U.S. Geological Survey national computer technology meeting: Program and abstracts, Norfolk, Virginia, May 17-22, 1992: U.S. Geological Survey Open-File Report 92-64, 41 p.

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Bazemore, D.E., Hupp, C.R., and Diehl, T.H., 1991, Wetland sedimentation and vegetation patterns near selected highway crossings in West Tennessee: U.S. Geological Survey Water-Resources Investigations Report 91-4106, 46 p.

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Carmichael, J.K., and Bennett, M.W., 1993, Reconnaissance of quality of water from farmstead wells in Tennessee, 1989-90: U.S. Geological Survey Water-Resources Investigations Report 92-4186, 43 p.

Connell, J.F., and Barron W.R., Jr., 1993, Digital data acquisition and development of geographic information system coverages for use with the public water-supply wells and springs in Tennessee: U.S. Geological Survey Water-Resources Investigations Report 92-4178, 28 p.

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Fielder, A.M., Roman-Mas, Angel, and Bennett, M.W., 1994, Reconnaissance of ground-water quality at selected wells in the Beaver Creek watershed, Shelby, Fayette, Tipton, and Haywood Counties, West Tennessee, July and August 1992: U.S. Geological Survey Open-File Report 93-366, 28 p.

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APPENDIX 1

Active Recording Surface-Water Stations in Tennessee as of 9/30/94

Station No.	Name	Drainage area (mi²)	Lat	Long	Date began
	CUMBERLAND RIVER BASIN				
03312255	Salt Lick Cr at Red Boiling Springs	12.6			1992
03409500	Clear Fork near Robbins	272	362318	843749	1930
03409700	East Branch Bear Creek near Oneida	--	363242	842919	1994
03409710	Unnamed tributary to East Branch Bear Creek near Oneida	--	363252	842948	1994
03414500	E Fork Obey River nr Jamestown	202	362458	850135	1942
03416000	Wolf River near Byrdstown	106	363337	850423	1942
03417500	Cumberland River at Celina	7,307	363315	853052	1922
03418070	Roaring River above Gainsboro	210	362104	853245	1974
03421000	Collins River near McMinnville	640	354232	854346	1925
03422500	Caney Fork near Rock Island	1,678	354826	853744	1911
03424730	Smith Fork at Temperance Hall	214	360514	855429	1991
03425000	Cumberland River at Carthage	10,690	361453	855719	1922
03425400	Cumberland River at Hunters Point	11,107	361757	861549	1986
03426385	Mansker Crk above Goodlettsville	--	362020	864304	1993
03427500	East Fork Stones River nr Lascassas	262	355506	862002	1951
03428200	W Fork Stones River at Murfreesboro	128	355410	862548	1972-82, 1986
03428500	West Fork Stones River near Smyrna	237	355625	862754	1965
03430118	McCrory Cr at Ironwood Dr, at Donelson	7.31	360908	863901	1977
03430147	Stoners Creek nr Hermitage	20.6	361140	863628	1992
03430550	Mill Creek near Nolensville	40.5	360033	864206	1992
03431000	Mill Creek near Antioch	64.0	360454	864050	1953-75, 1991
03431062	Mill Creek trib. at Glenrose Ave., at Woodbine	1.17	360702	864337	1977
03431300	Browns Creek at State Fairgrounds at Nashville	11.18	360747	864540	1964-75, 1993
03431490	Pages Branch at Avondale	2.01	361222	864624	1977
034315005	Cumberland River at Woodland St. at Nashville	12,860	361002	864635	1992
03431599	Whites Creek near Bordeaux	51.3	361303	864913	1993
03431700	Richland Creek at Charlotte Ave. at Nashville	24.3	360904	865116	1964-1990, 1993
03431800	Sycamore Creek near Ashland City	97.2	361912	870304	1961
03432350	Harpeth River at Franklin	191	355514	865156	1974
03432400	Harpeth River below Franklin	210	355653	865254	1986
03433500	Harpeth River at Bellevue	408	360316	865542	1920
03434500	Harpeth River near Kingston Springs	681	360719	870556	1925
03435000	Cumberland River below Cheatham Dam	14,163	361926	871332	1954

APPENDIX 1--Continued

Active Recording Surface-Water Stations in Tennessee as of 9/30/94--Continued

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
03436100	Red River at Port Royal	935	363317	870831	1961
03436500	Cumberland River at Clarksville	16,000	363228	872204	1924-44, 1986
03436690	Yellow Creek at Ellis Mills	103	361839	873315	1980
03437000	Cumberland River at Dover	16,530	362926	875020	1986
	TENNESSEE RIVER BASIN				
03455000	French Broad River near Newport	1,858	355854	830940	1900
03465500	Nolichucky River at Embreeville	805	361035	822727	1920
03465830	Muddy Fork near Leesburg	--	361759	823336	1994
03466098	Jockey Creek near Mt. Bethel Church near Limestone	--	361406	823848	1994
03466228	Sinking Creek at Afton	13.7	361155	824431	1977
03466825	Lick Creek Near Holland Mill	--			
03469175	Little Pigeon River above Seviersville	184	355155	833201	1988
03486305	Sinking Creek at Sinking Creek Road at Johnson City	4.10	361649	822205	1992
03486311	Sinking Creek at Highway 67 at Johnson City	7.29	361841	821948	1991
03486312	Catbird Creek at Miami Dr at Johnson City	2.91	361845	821932	1990
03486485	Brush Creek at State of Franklin Road at Johnson City	4.05	361808	822253	1991
03486494	Brush Creek at Johnson City	9.58	361915	822101	1991
03486508	Brush Creek at Piney Grove at Johnson City	14.0	362053	821909	1991
03486657	Knob Creek at Claude Simmons Road at Johnson City	3.15	361952	822529	1991
03486659	Knob Creek Tributary at Knob Creek Road at Johnson City	1.97	362026	822433	1991
03486665	Knob Creek at Wayfield Drive at Johnson City	11.4	362211	822213	1991
03486670	Cobb Creek at East Oakland Avenue at Johnson City	3.75	362124	822529	1991
03491000	Big Creek near Rogersville	47.3	362534	825707	1957
03491544	Crockett Creek below Rogersville	4.67	362247	830248	1989
03495547	Love Creek at I-40 at Knoxville	8.01	360039	835036	1990
03497300	Little River above Townsend	106	353952	834241	1963
03498500	Little River near Maryville	269	354710	835304	1951
03498850	Little River near Alcoa	300	354832	835536	1987
03528000	Clinch River above Tazewell	1,474	362530	832354	1918
03536320	White Oak Creek near Melton Hill	1.31	355556	841820	1987
03536380	Whiteoak Creek near Wheat	2.10	355530	841852	1987
03536440	Northwest Tributary near Oak Ridge	.67	355518	841913	1987
03536450	First Creek near Oak Ridge	0.33	355521	841910	1987

APPENDIX 1--Continued

Active Recording Surface-Water Stations in Tennessee as of 9/30/94--Continued

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
	TENNESSEE RIVER BASIN				
03536550	Whiteoak Creek bl Melton Valley Drive near Oak Ridge	3.28	355510	841902	1985
03538231	E. FK. Poplar Cr at Y-12 at Oak Ridge	.81	355911	841502	1993
03538235	E. FK. Poplar Cr at Bear Creek Road at Oak Ridge	1.69	355948	841425	1993
03538256	Bear Creek at Bear Creek Road near Oak Ridge	.42	355817	841649	1994
03538260	Bear Creek at County Line nr Oak Ridge	1.57	355726	841803	1993
03538270	Bear Creek at St. Hwy. 95 nr Oak Ridge	4.34	355614	842022	1959-64, 1985-93
03538600	Obed River at Crossville	12.0	355727	850300	1992
03540500	Emory River at Oakdale	764	355859	843329	1927
03543500	Sewee Creek near Decatur	117	353453	844453	1934
03563000	Ocoee River at Emf	524	350548	843207	1913
03564500	Ocoee River at Parksville	595	350548	843915	1911-16, 1921
03565428	Oostanaula Creek near Sweetwater	--	353014	842947	1994
03565430	Oostanaula Creek below Johnson Branch near Athens	--	352814	843312	1994
03566000	Hiwassee River at Charleston	2,298	351716	844507	1898-1903, 1914-40, 1963
035661285	North Mouse Creek near Rocky Mount Hollow near Athens	--	352655	843923	1963,1994
03567500	South Chickamauga Creek nr Chickamauga	428	350051	851235	1928-78, 1980
03568000	Tennessee River at Chattanooga	21,380	350512	851643	1874
03571000	Sequatchie River near Whitwell	402	351222	852948	1920
03578455	Bradley Cr Trib. at AEDC nr Manchester	--	352327	860216	1993
03578600	Brumalow Cr at AEDC nr Manchester	--	352220	860233	1993
03578970	Rowland Cr at AEDC nr Manchester	--	352211	860332	1993
03579620	Rock Creek at Tullahoma	12.3	352134	861247	1992
03584500	Elk River near Prospect	1,784	350139	865652	1904-08, 1919
03588500	Shoal Creek at Iron City	348	350127	873444	1925
03593500	Tennessee River at Savannah	33,140	351329	881526	1930
03597210	Garrison Fork above L&N Railroad at Wartrace	85.5	353042	861926	1990
03597590	Wartrace Creek below County Road at Wartrace	35.7	353138	862025	1990
03597860	Duck River at Shelbyville	425	352851	862745	1992
03598000	Duck River near Shelbyville	481	352849	862957	1934
03598173	Fall Creek near Deason	--	353501	862917	1994
03598179	Fall Creek near Halls Mill	--	353309	863214	1994
03598250	N Fork Creek near Poplins Crossroads	71.9	353506	863545	1994

APPENDIX 1--Continued

Active Recording Surface-Water Stations in Tennessee as of 9/30/93--Continued

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
	TENNESSEE RIVER BASIN				
03599500	Duck River at Columbia	1,208	353705	870156	1905-08, 1920
03600088	Carters Creek at Butler Rd at Carters Creek	20.1	354302	865945	1986
03602219	Piney River at Cedar Hill	46.6	355943	872622	1988
03603000	Duck River above Hurricane Mills	2,557	355548	874435	1925
03604000	Buffalo River near Flat Woods	447	352945	874958	1920
03604400	Buffalo River near Lobelville	702			
03605078	Cypress Creek at Camden	27.3	360249	880433	1992
03607225	Holly Fork Creek at Noble	--	362101	881346	1994
03607232	Beaverdam Creek at Sulfur Well Road at Noble	--	362011	881110	1994
	OBION RIVER BASIN				
07024305	Beaver Creek at Huntingdon	55.5	355956	882601	1962
07026040	Obion River at U.S. Highway 51 near Obion	1,875	361427	891303	1929-58, 1966
07027000	Reelfoot Lake near Tiptonville	240	362109	892507	1940
	HATCHIE RIVER BASIN				
07029500	Hatchie River at Bolivar	1,480	361631	885836	1929
	LOOSAHATCHIE RIVER BASIN				
07030240	Loosahatchie River near Arlington	262	351837	893823	1969
07030241	E Beaver Creek canal tributary at Tritt Farm near Keeling	.044			
07030242	E Beaver Creek canal tributary at Williams Farm near Belmont	.168			
07030246	Middle Beaver Creek near Gainesville	--	352339	893829	1994
070302481	W Beaver Creek canal tributary at Moffatt Farm near Madge	.105			
07030249	Middle Beaver Creek canal tributary at Wilson Farm near Madge	.660			
07030250	Beaver Creek near Arlington	148	351911	893929	1994
	WOLF RIVER BASIN				
07031650	Wolf River at Germantown	699	350659	894805	1970-86, 1991
	NONCONNAH CREEK BASIN				
07032200	Nonconnah Creek near Germantown	68.2	350259	894908	1969

APPENDIX 1--Continued

Active Crest-Stage Stations in Tennessee as of 9/30/93

[#, Operated as a continuous-record gaging station]

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
	CUMBERLAND RIVER BASIN				
03409000	White Oak Creek at Sunbright	13.5	361438	844014	1934, 1955-82, 1985
03418201	Doe Creek at Gainesboro	5.72	362123	853920	1978
03421200	Charles Creek near McMinnville	31.1	354300	854605	1955
03424900	Mulherrin Creek near Gordonsville	26.9	361128	855711	1982, 1986
03425045	Peyton Creek at Monoville	44.7	361837	855921	1986
03425365	Second Creek near Walnut Grove	3.47	362401	861248	1986
03426800	East Fork Stones River at Woodbury	39.1	354941	860436	1962-89#, 1990
03426874	Brawleys Fork below Bradyville	15.4	354444	861014	1983
034269424	Reed Creek near Bradyville	3.52	354444	861231	1983
03427690	Bushman Creek at Pitts Lane Ford near Compton	9.67	355308	862047	1989-92#, 1993
03428043	Lytle Creek at Sanbyrne Drive at Murfreesboro	17.6	354938	862328	1978
03430118	McCrory Creek at Ironwood Drive near Donelson	7.31	360907	863902	1977-94
03430400	Mill Creek at Nolensville	12.0	355732	864031	1965
03431040	Sevenmile Creek at Blackman Road at Nolensville	12.2	360421	864400	1965
03431060	Mill Creek at Thompson Lane, near Woodbine	93.4	360704	864308	1965
03431120	West Fork Browns Creek at General Bates Drive, at Nashville	3.30	360629	864707	1965
03431240	East Fork Browns Creek at Baird-Ward Printing Company, at Nashville	1.58	360633	864600	1965
03431340	Browns Creek at Factory Street, at Nashville	13.2	360826	464531	1965
03431550	Earthman Fork at Whites Creek	6.29	361555	864951	1965
03431573	Ewing Creek at Richmond Hill Drive at Parkwood	2.17	361350	864628	1976
03431575	Ewing Creek at Brick Church Pike at Parkwood	3.02	361358	864654	1976
03431578	Ewing Creek at Gwynwood Drive near Jordonia	9.98	361358	864732	1976
03431581	Ewing Creek below Knight Road, near Bordeaux	13.3	361355	864814	1976
03431677	Sugartree Creek at YMCA Access Road, at Green Hills	1.51	360613	864912	1976
03431679	Sugartree Creek at Abbott Martin Road, at Green Hills	2.19	360623	864917	1976
03432470	Murfrees Fork above Burwood	7.43	354858	865720	1986
03432925	Little Harpeth River at Granny White Pike, at Brentwood	22.0	360130	864909	1978

APPENDIX 1--Continued

Active Crest-Stage Stations in Tennessee as of 9/30/93

[#, Operated as a continuous-record gaging station]

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
	CUMBERLAND RIVER BASIN				
03434590	Jones Creek near Burns	13.3	360615	871905	1984
034350021	Bartons Creek near Cumberland Furnace	22.29	361502	872000	1984
034351113	Honey Run Creek below Cross Plains	25.8	363231	864214	1986
03435770	Sulphur Fork Red River above Springfield	65.6	363047	865144	1975
03435930	Spring Creek tributary near Cedar Hill	1.40	363208	865926	1986
03436505	Cummings Creek nr Dotsonville	2.65	362918	872806	1984
03436700	Yellow Creek near Shiloh	124	362055	873220	1957-80#, 1982
	TENNESSEE RIVER BASIN				
03461230	Caney Creek near Cosby	1.62	354703	831211	1967
03465607	Cherokee Creek near Embreeville	22.9	361224	822923	1984
03465780	Clear Fork near Fairview	10.5	361933	823347	1983
03466890	Lick Creek near Albany	172	361454	825534	1984
03467480	Bent Creek at Taylor Gap	2.18	361408	830641	1986
03467992	Carter Branch near White Pine	4.25	360705	831855	1986
03467993	Cedar Creek near Valley Home	2.01	360803	831847	1986
03467998	Sinking Fork at White Pine	6.38	360721	831744	1986
03470215	Dumplin Creek at Mt. Hareb	3.65	360459	832551	1986
03476960	Indian Creek at Childress	6.79	362538	821554	1983
03478615	Evans Creek near Blountville	2.50	363119	821812	1983
03487550	Reedy Creek at Orebank	36.3	363342	822736	1963-89#, 1990
03490522	Forgey Creek at Zion Hill	0.86	362912	825308	1986
03491540	Robertson Creek near Persia	14.6	362024	830227	1986
03494990	Flat Creek at Luttrell	22.4	361145	834444	1986
03519610	Baker Creek tributary near Binfield	2.10	354156	840246	1966-77, 1979
03519640	Baker Creek near Greenback	16.0	354021	864628	1965-75#, 1976
03527800	Big War Creek at Luther	22.3	362718	831429	1986
03528390	Crooked Creek near Maynardville	2.23	361556	835025	1986
03534000	Coal Creek at Lake City	24.5	361314	840927	1932-34#, 1955
03535180	Willow Fork near Halls Crossroads	3.23	360559	835427	1967
03555900	Coker Creek near Ironsburg	22.4	351305	842028	1983
03566420	Wolftever Cr nr Ooltewah	18.8	350343	850359	1964-1989#, 1990
03566599	North Chickamauga Creek at Greens Mill, near Hixson	99.5	351030	851340	1925, 1944, 1953-56,
03569168	Stringers Branch at Leawood Drive, at Red Bank	1.54	350700	851728	1980

APPENDIX 1--Continued

Active Crest-Stage Stations in Tennessee as of 9/30/93

[#, Operated as a continuous-record gaging station]

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began
	TENNESSEE RIVER BASIN				
03571500	Little Sequatchie River at Sequatchie	116	350747	853510	1925, 1929-30, 1932-34#, 1944, 1951-54, 1965, 1979
03571730	Standifer Branch at Jasper	15.3	350422	853656	1982
03571800	Battle Creek near Monteagle	50.4	350803	854615	1955
03583300	Richland Creek near Cornersville	47.5	351910	865220	1962-68#, 1969
035944242	Owl Creek at Lexington	2.50	353826	882213	1984
03597300	Wartrace Creek above Bell Buckle	4.99	353745	862122	1966
03602170	West Piney River at Hwy 70 nr Dickson	2.16	360521	872812	1984
03602500	Piney River at Vernon	193	355216	873005	1925-93#, 1994
03604090	Coon Creek above Chop Hollow, near Hohenwald	6.02	353519	874109	1967
03604580	Blue Creek near New Hope	13.2	360352	873858	1984
03605555	Trace Creek above Denver	31.9	360308	875427	1963-88#, 1989
03605880	Cane Creek at Stewart	4.12	361909	875021	1984
	OBION RIVER BASIN				
07024225	Neil Ditch near Henry	4.07	361019	882333	1984
07024370	Little Reedy Creek near Huntingdon	0.91	355544	882950	1984
07024500	South Fork Obion River near Greenfield	383	360705	884839	1929-89#, 1990
07025500	North Fork Obion River at Union City	480	362359	885943	1929-66, 1967-71, 1989-93#, 1994
07028505	North Fork Forked Deer River at U.S. Highway 45W Bypass at Trenton	73.9	355858	885549	1987
07029090	Lewis Creek near Dyersburg	25.5	360314	892142	1955-78, 1980-83, 1985
07030100	Cane Creek at Ripley	33.9	354525	893305	1957-62#, 1963-70, 1986-88#, 1989

APPENDIX 2

Active ground-water network in Tennessee as of 9/30/94

Station No.	Local well No.	Lat	Long	Date began
	RECORDER--60-MINUTE PUNCH INTERVAL			
360835086441100	Dv:L-10	360835	864411	1985
350234085181200	Hm:G-36	350234	851812	1981
351428085003600	Hm:O-15	351428	850036	1975
360020087573300	Hs:H-1	360020	875733	1962
353839089493500	Ld:F-4	353839	894935	1966
354223088380200	Md:N-1	354223	883802	1949
360543084343101	Mg:F-5	360543	843431	1984
360521085432601	Pm:C-1	360521	854326	1968
353922083345600	Sv:E-2	353922	833456	1979
350514089553700	Sh:K-75	350514	895537	1948
350735089593300	Sh:P-76	350735	895933	1928
350900089482300	Sh:Q-1	350900	894823	1940
350344090130000	Ar:H-2	350344	901300	1983
350432090015100	Sh:J-126	350432	900151	--
350124090072200	Sh:J-140	350124	900722	--
350002090054400	Sh:J-1	350002	900544	--
350914090010600	Sh:O-212	350914	900106	--
3511000895236	Sh:P-185	351100	895236	--
3514390895723	Sh:P-113	351439	895723	--
3508100894308	Sh:R-31	350810	894308	--
3507240895556	Sh:K-76	350724	895556	--
3509100900151	Sh:O-170	350910	900151	--
350811089430901	Sh:R-30	350811	894309	1940
3506580895601	Sh:K-45	350658	895601	--
	TAPE DOWN			
352226089330101	Fa:R-1	352226	893301	1949
352226089330102	Fa:R-2	352226	893301	1949
351435090005200	Sh:O-1	351435	900052	1940
352112089571200	Sh:U-1	352112	895712	1946
352112089571300	Sh:U-2	352112	895713	1953
355505086541100	Wm:M-1	355505	865411	1950
350958090173800	Ar:C-1	350958	901738	1983
351349090062800	Ar:O-1	351349	900628	1983

APPENDIX 3

Water-quality and suspended-sediment stations

[Q, chemical; B, bacteriological; S, sediment]

Station No.	Name	Drainage area (mi^2)	Lat	Long	Date began	Data type
	CUMBERLAND RIVER BASIN					
03417500	Cumberland River at Celina	7,307	363315	853052	1992	Q
03418420	Cumberland River below Cordell Hull Dam	8,095	361712	855627	1980	Q
03425000	Cumberland River at Carthage	10,690	361453	855719	1975	Q,B,S
03426310	Cumberland River at Old Hickory Dam (Tailwater)	11,673			1979	Q
03428200	W Fork Stones River at Murfreesboro	177	355410	862548	1986	Q
03435000	Cumberland River below Cheatham Dam		361926	871332	1993	Q
	TENNESSEE RIVER BASIN					
03497300	Little River above Townsend	106	353952	834241	1964-82, 1986	Q,B,S
03578455	Bradley Creek Trib at AEDC near Manchester	--	352327	860216	1993	Q
03578600	Brumalow Cr at AEDC nr Manchester	--	352220	860233	1933	Q
03578970	Rowland Cr at AEDC nr Manchester	--	352211	860332	1993	Q
03593005	Tennessee River at Pickwick Landing Dam	32,820	350354	881508	1975	Q,B,S
03597860	Duck River at Shelbyville	425	352851	862745	1991	Q
03600085	Carters Creek at Petty Lane near Carters Creek	16.6	354340	865920	1986	Q,B,S
03600086	Carters Creek Trib near Carters Creek	2.94	354334	865920	1986	Q,B,S
03600088	Carters Creek at Butler Road at Carters Creek	20.1	354303	865945	1986	Q,B,S
03604000	Buffalo River near Flat Woods	447	352945	874958	1964	Q,B,S
	OBION RIVER BASIN					
07026040	Obion River at US Highway 51 near Obion	1,875	361427	891303	1975	Q,B,S
	HATCHIE RIVER BASIN					
07029500	Hatchie River at Bolivar	1,480	361631	885836	1964, 1968, 1977	Q,B,S

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