

# **Kentucky Interagency Groundwater Monitoring Network**

## **Annual Report**

**July 2006–June 2007**

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# **Kentucky Interagency Groundwater Monitoring Network Annual Report July 2006–June 2007 Executive Summary**

In 1998, the Kentucky General Assembly directed the Kentucky Geological Survey to establish a long-term groundwater monitoring network that would characterize the quality, quantity, and distribution of Kentucky's groundwater resources. This was necessary because although groundwater is an essential natural resource, the amount and quality of groundwater throughout Kentucky are not adequately known. Improved information about groundwater quality and availability is essential to help locate water supplies in areas where adequate surface water is not available or where supplemental water supplies are needed, to help define regions where groundwater is particularly vulnerable to nonpoint-source contamination, and to assist cities and industries in planning water-use and waste-disposal practices that most economically meet environmental-protection regulations and water-quality standards. The Kentucky Geological Survey was also charged with annually reporting network activities to the Governor's Office and the Legislative Research Commission. This report summarizes activities that occurred during the 2006–2007 fiscal year.

From July 2006 through June 2007, 23 major data-collection programs were under way, and seven regional groundwater characterization reports were completed. Groundwater information was communicated to scientific and regulatory communities and to the public through presentations, publications, and postings on Web sites. Quarterly meetings of the Interagency Technical Advisory Committee on Groundwater provided an opportunity to coordinate groundwater-related efforts and share information among agencies. Exchange of groundwater data, including electronic transfer between State and university databases, has proceeded through close cooperation between the Kentucky Division of Water and the Kentucky Geological Survey.

Since the Groundwater Monitoring Network was established, significant progress has been made toward collecting and reporting groundwater-quality data and improving interagency cooperation. Important work remains, however. Among the major issues still to be addressed are:

- determining how large an area is represented by a particular well or spring.
- establishing new monitoring sites in areas that are currently not represented
- optimizing the sampling frequency to account for natural variations in different groundwater flow systems throughout the state
- monitoring the rate of intrusion of nonpoint contaminants into groundwater systems
- standardizing reporting information about sampling methods, field measurements, and sample-site descriptions
- developing a water-level monitoring network to track long-term land use and climate effects on groundwater supplies
- standardizing sampling and reporting procedures to promote data sharing
- facilitating electronic data sharing
- providing public access to groundwater-quality data via interactive Web sites
- investigating the occurrence of bacteria and other pathogens in regional groundwater flow systems
- establishing the amount of pharmaceutical and personal-care product chemicals in water systems
- determining and evaluating pesticides of interest in groundwater
- increasing the use of isotopes, caffeine, and other tracers to indicate contaminant sources and groundwater ages and flow rates
- determining the role of groundwater on the low-flow quality and quantity of water in streams as

related to water-quality standards and designated uses.

The Kentucky Interagency Groundwater Monitoring Network will continue to address these issues. Significant advances require improved staffing and funding, however. Most of the progress made has been the result of substantial agency com-

mitment of State executive budget funds, one-time grants to the Kentucky Division of Water Groundwater Branch and the Kentucky Geological Survey, and voluntary cooperation between agencies. Implementing an effective groundwater monitoring plan requires sustained, recurring funding to maintain a long-term effort.

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## Introduction

Kentucky groundwater is used extensively for domestic, agricultural, commercial, and industrial purposes. It is also essential to the health of surface-water ecosystems because groundwater feeds rivers, lakes, and wetlands. Monitoring the quality of this critical resource and protecting it from contamination are important to the future of water resources in the commonwealth and to its citizens.

Information provided by the Kentucky Division of Water indicates that 185 public water systems use groundwater to serve nearly 1.3 million people, and approximately 400,000 citizens rely on springs and wells for domestic water supplies. This dependence on groundwater resources will increase into the foreseeable future. Many public water-supply systems are considering switching from surface-water to groundwater sources because the required treatment and monitoring are less extensive and less expensive. Currently, Louisville, Hardinsburg, Salyersville, and the Greater Fleming Regional Water Supply are either considering switching to groundwater sources or are supplementing surface-water supplies with groundwater. Furthermore, many people who now rely on wells or springs for private domestic water supplies will remain dependent on groundwater because of the high cost of extending public water-supply systems to rural areas, and because groundwater supplies are abundant in some parts of the commonwealth.

Significant quantities of groundwater are used for commercial and industrial applications, crop irrigation, livestock watering, mining, and thermoelectric power generation. Groundwater also sustains valuable ecosystems by providing base flow to streams, lakes, and wetlands. This is particularly important during droughts such as

those that occurred in 1999, 2005, and 2007. In the absence of rain, groundwater base flow is the only natural source of water to maintain streamflow and lake levels, and to preserve riparian and wetland ecosystems.

Recognizing the importance of groundwater, the 1998 Kentucky General Assembly directed the Kentucky Geological Survey to establish a long-term, interagency groundwater monitoring network to characterize the quality, quantity, and distribution of groundwater in Kentucky (Kentucky Revised Statutes 151.620 and 151.625). The major goals of the Interagency Groundwater Monitoring Network are to (1) collect groundwater data, (2) characterize groundwater quality, (3) distribute groundwater information, (4) improve coordination between agencies that collect groundwater data, and (5) facilitate sharing of groundwater data (Interagency Technical Advisory Committee on Groundwater, 1996).

The General Assembly also established an Interagency Technical Advisory Committee on Groundwater to assist the Kentucky Geological Survey in the development, coordination, and implementation of a groundwater monitoring network (KRS 151.629). The committee is composed of members from the following agencies and organizations:

- Kentucky Department for Environmental Protection
- Kentucky Department for Natural Resources
- Kentucky Department for Surface Mining Reclamation and Enforcement
- Kentucky Department of Agriculture, Division of Pesticide Regulation
- Kentucky Department of Mines and Minerals
- Kentucky Division of Conservation
- Kentucky Division of Environmental Health and Community Safety

- Kentucky Division of Forestry
- Kentucky Division of Waste Management
- Kentucky Division of Water
- University of Kentucky, Kentucky Geological Survey
- University of Kentucky, College of Agriculture
- University of Kentucky, Kentucky Water Resources Research Institute
- U.S. Geological Survey, Louisville office

The 1998 legislation directed the Kentucky Geological Survey to provide an annual summary of groundwater monitoring activities to the governor and the Legislative Research Commission. This is the seventh annual report of the Kentucky Interagency Groundwater Monitoring Network. Previous reports are posted at [www.uky.edu/kgs/water/gnet/](http://www.uky.edu/kgs/water/gnet/).

## 2006–2007 Activities and Accomplishments

Brief summaries of work performed by the ITAC agencies during the 2006–2007 fiscal year are given below. Activities are organized to show how the major goals of the network are being addressed. Additional information regarding these projects can be obtained by contacting the responsible agency.

### Groundwater Data Collection

Collecting and analyzing water samples from wells and springs, measuring water levels in wells, and mapping recharge and discharge areas of karst systems provide the basic data needed to determine current groundwater quality, detect changes over time, and evaluate hydrogeologic hazards. Two types of groundwater data-collection programs were conducted during the reporting period. Site-specific studies are designed to evaluate the effects of particular land uses or unique hydrologic conditions, or the quality of unregulated public water supplies such as roadside springs. Statewide and watershed-based monitoring programs were conducted to determine regional groundwater quality and to determine whether nonpoint-source chemicals such as sewage, pesticides, fertilizers, and volatile organic compounds have invaded the groundwater system. These regional studies are

conducted in one or more of the basin management units (Table 1, Fig. 1) that were established by the Kentucky Division of Water (1997).

**Table 1.** Major river watersheds that make up the Kentucky basin management units.

Basin Management Unit	Watershed
1	Kentucky River
2	Salt River and Licking River
3	Upper Cumberland River, Lower Cumberland River, Tennessee River, Jackson Purchase Region
4	Green River, Tradewater River
5	Big Sandy River, Little Sandy River, Tygarts Creek

### Kentucky Division of Water Groundwater Branch

The Groundwater Branch is the primary source of new groundwater-quality data throughout the state. During the 2006–2007 fiscal year, DOW staff collected

- 134 samples from 62 wells and springs for the Ambient Groundwater Monitoring Program
- 36 samples from four sites for the South Elkhorn Creek Nonpoint Source Project
- 90 samples from 10 sites for the Green River Nonpoint Source Project
- 20 samples from 20 sites for the Elkhorn Creek Nonpoint Source Project
- 16 samples from six sites for the Pesticide Memorandum of Agreement Project
- 39 samples from 39 sites for special assistance or in response to complaints.

All samples were analyzed at the Kentucky Division of Environmental Services laboratory. Results were entered into the Division of Water's groundwater-quality database and subsequently copied to the Kentucky Groundwater Data Repository at the Kentucky Geological Survey.

### U.S. Geological Survey

**Water-Quality Assessment in the Upper Sinking Creek Basin, Breckenridge County.** The U.S. Geological Survey, in cooperation with the Kentucky



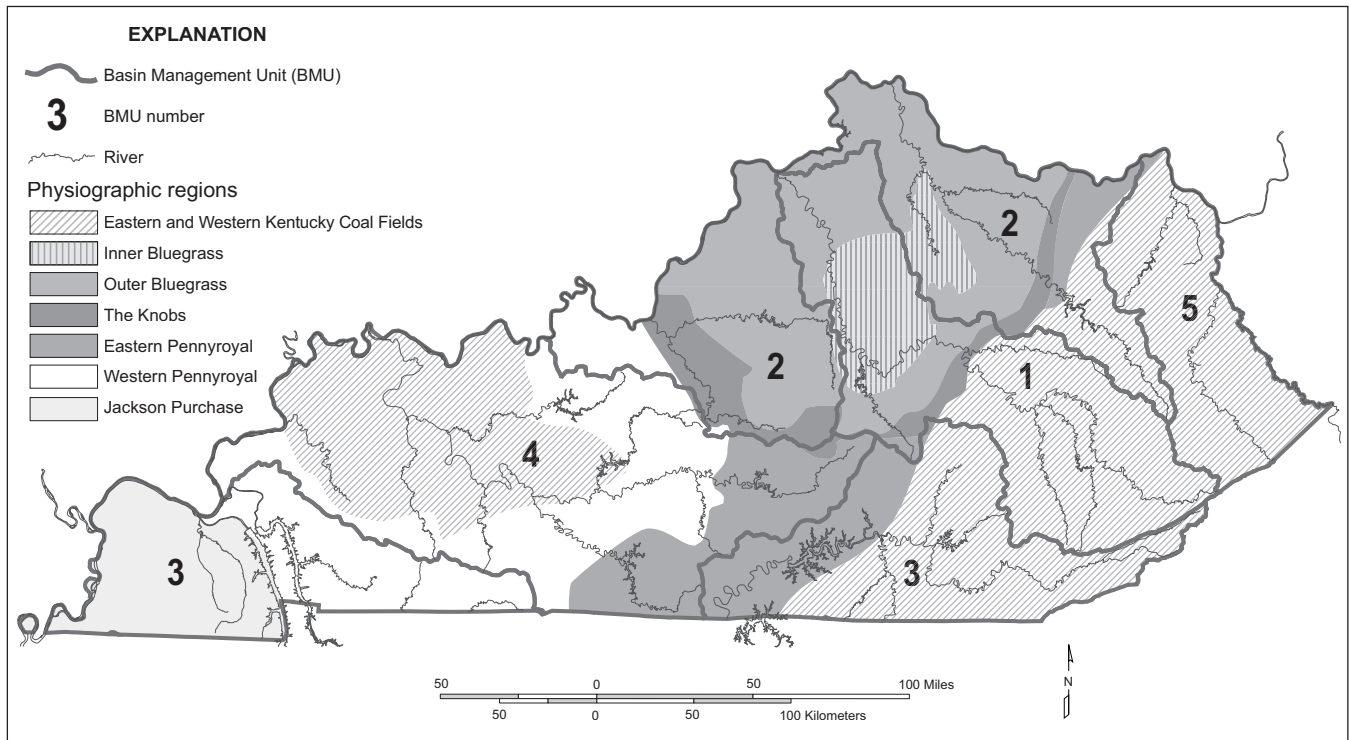


Figure 1. Locations of major rivers, basin management units, and physiographic regions in Kentucky.

Department of Agriculture-Technical Support Branch, has completed 3 years of water-quality sampling in the upper Sinking Creek Basin. This study evaluated the karst groundwater system in the upper Sinking Creek Basin by collecting pesticide, nutrient, streamflow, precipitation, and sediment data from 2004 to 2006. Pesticide, nutrient, and suspended sediment samples were collected in 2004, 2005, and 2006 at two Sinking Creek main-stem sites, four springs, and one karst window. Findings from the study will be published in a USGS Scientific Investigations Report in late 2007. The USGS report also will discuss the development of a water-quality runoff model that simulates groundwater/surface-water interactions in the upper Sinking Creek Basin. This work is funded by a one-time grant from the U.S. Environmental Protection Agency, administered by the Kentucky Division of Water's Nonpoint Source Section.

**Louisville Water Company, Ohio River Alluvial Aquifer, Jefferson County.** The USGS, in cooperation with the Louisville Water Company, maintains a network of 18 water-level observation wells in the northeastern part of the Ohio River al-

luvium in Jefferson County. Seven of the wells are equipped with continuously recording pressure transducers that measure depth to water and water temperature. Water-level measurements are taken at the other nine observation wells on a quarterly basis. These data are assisting the Louisville Water Company's efforts to design and implement river-bank infiltration using a network of water-supply wells constructed to draw and naturally filter river water through the sand and gravel aquifer near the B.E. Payne Treatment Plant.

**Kentucky Abandoned Landfills.** The USGS continues to provide technical assistance to the Kentucky Division of Waste Management, Solid Waste Branch Closure Section for the assessment of abandoned landfills. During the report period, USGS completed site characterization at abandoned landfills in Bardwell and Cadiz. Groundwater-level and temperature monitoring has continued at a third site in Owensboro.

**Regional Karst Hydrology Initiative Project.** The USGS Ground-Water Resources Program is involved in a regional study of the karst aquifers in



Kentucky, Alabama, Illinois, Indiana, and Tennessee. During the first phase of the project, a special emphasis was placed on developing geographic information systems technology to improve the utilization and integration of karst geospatial and time-series data, and on new methods to improve the estimation of karst water budgets. A number of spring basins in Kentucky, including the McCracken Spring Basin in Meade County, the Graham Springs Basin in Warren and Edmonson Counties, and a spring basin at the UK Agricultural Research Farm in Woodford County, are being used as demonstration sites for these efforts. Various available data about karst springs in other parts of Kentucky are also being collected and synthesized, along with spring data from the other states, as part of the regional study. Additional information about the project can be obtained via the Internet at [ky.water.usgs.gov/projects/cjt\\_karst/](http://ky.water.usgs.gov/projects/cjt_karst/).

**Maxey Flats Low-Level Radioactive Waste Repository, Fleming and Rowan Counties.** The USGS continues to provide technical assistance to the Environmental and Public Protection Cabinet–Division of Waste Management in regard to closure of the Maxey Flats Repository. The USGS maintains continuous water-level data recorders in 15 monitoring wells at the site. Five of these wells are also sampled semiannually for tritium activity. Water levels are measured periodically in 14 other monitoring wells. Of these, two wells are sampled quarterly for tritium, and the remaining 12 are sampled annually.

**Groundwater-Level Data Collection.** The USGS collects real-time continuous water-level measurements from an observation well in Graves County that is included in the USGS National Ground-Water Climate Response Network—a network of wells intended to monitor the effects of droughts and other climate variability on the nation’s groundwater resources. The water-level data for this well can be accessed via the Internet at [groundwaterwatch.usgs.gov/](http://groundwaterwatch.usgs.gov/) or [ky.water.usgs.gov/](http://ky.water.usgs.gov/). Two observation wells in downtown Louisville are maintained by the USGS and are used to collect continuous water-level data from the Ohio River alluvial aquifer. These data, historical water-level data from other observation wells, and additional information about the activities of the

USGS–Kentucky Water Science Center, are available at [ky.water.usgs.gov/](http://ky.water.usgs.gov/).

**Well-Integrity Survey of Abandoned Gas Wells near West Point.** Abandoned and unrecorded natural-gas wells may act as conduits for the contamination of groundwater supplies by oil- and gas-field brines and other pollutants. The casings of abandoned wells may develop leaks, which, if not properly plugged, can allow pollutants to reach freshwater aquifers that supply drinking water. Such is the situation in the Fort Knox well field near West Point. Many of the drinking-water supply wells for Fort Knox have chloride concentrations in excess of the secondary maximum contaminant level of 250 mg/L, with some as high as 800 mg/L. The USGS, in cooperation with the U.S. Army Corps of Engineers and the army installation at Fort Knox, is currently conducting a gas-well inventory and assessment to determine if any of the abandoned wells are likely sources of chloride in water-supply wells.

**Kentucky Department of Agriculture Sinking Creek Basin Project.** The Kentucky Department of Agriculture, in cooperation with the USGS, has been sampling surface water and karst springs in the Sinking Creek Basin in Breckinridge and Meade Counties for the past 2 years to evaluate relations between pesticides, nutrients, streamflow, sediment, and precipitation. The data from this monitoring project will be used to develop and apply a rainfall-runoff model to predict saturation excess and infiltration of surface runoff. Atrazine and simazine were the most frequently detected pesticides. Twenty-four percent of atrazine samples collected in April, May, and June exceeded the MCL of 3.0 ppb. The median atrazine concentration was higher in 2005 than in 2004 for samples collected in April, May, and June. A summary report of pesticide, nutrient, and suspended-sediment results from 2004 and 2005 is available online at [ky.water.usgs.gov](http://ky.water.usgs.gov/).

**Little River Monitoring Project.** The Kentucky Department of Agriculture, in cooperation with the USGS, studied seasonal and spatial variables involving pesticides and nutrients in the Little River Basin in western Kentucky. The Department of Agriculture will recommend the application

of additional best management practices based upon the USGS's data analysis and findings. A USGS Scientific Report indicated that herbicides were detected more frequently than insecticides or fungicides. Fifteen of 24 pesticides detected in the basin were herbicides. Atrazine exceeded the MCL in 17 percent of the samples, and simazine exceeded its MCL in 2 percent of the samples.

**Rough River Project.** This project is coordinated by Western Kentucky University in cooperation with the Department of Agriculture, local partners in Grayson County, and the University of Kentucky's Agriculture Extension, which is responsible for educational outreach. This project has been important in documenting the runoff of atrazine into the Rough River through the use of stratification monitoring.

**Atrazine Research.** Syngenta Corp. and the Department of Agriculture's Pesticide Workgroup have been working for several years with small watersheds monitoring community water systems. The most responsive system has been Marion Community System in Crittenden County, in which atrazine levels have been reduced using the Corn Growers Association's assistance involving local farmers in an "Atrazine Free" effort. This is primarily a surface-water program, but the results have important implications for shallow groundwater quality. It has expanded to other community systems in which the workgroup is evaluating pesticide detections on an ongoing basis. Data are coming from Marion in Crittenden County, Webster County community system, and Leitchfield community system in Grayson County. Recently, Syngenta's monitoring program has expanded to simazine in the Livermore community system in McLean County. The effort is examining both raw and finished water in public water-supply systems.

### **Division of Mine Reclamation and Enforcement**

Water samples are routinely collected and analyzed in response to mining-related complaints and inquiries. Approximately 10 to 15 percent of the complaints are eventually linked to mining activities, while the rest are typically attributed

to well construction, well maintenance, or other site-specific conditions and activities.

### **Kentucky Geological Survey**

**Groundwater Sampling in the Jackson Purchase Region and Western Kentucky Coal Field.** During the 2006–2007 fiscal year, 156 domestic water wells were sampled in the Jackson Purchase Region. All wells were sampled for major anions, metals, and field parameters, and 64 wells were sampled for total coliform and *E. coli*. To better determine the possible sources of nitrate to the shallow groundwater system, three wells were sampled for nitrogen isotopes and 126 were sampled for caffeine. Funding was provided by the University of Kentucky College of Agriculture's SB-271 program and an NSF EPSCoR grant. Caffeine analyses were paid for by the Kentucky Division of Water.

In 2001, 519 cubic yards of organic-rich soil were removed from an abandoned dairy feedlot in Henderson County. Since remediation, one domestic well and seven feedlot monitoring wells have been sampled monthly for nitrate-N, chloride, and sulfate to determine if concentrations in groundwater are decreasing over time. Data collected during the report period indicate that nitrate and chloride concentrations beneath the feedlot have decreased significantly. Funding for this research was provided by the University of Kentucky College of Agriculture's SB-271 program.

**Community Water Resource Projects.** KGS Water Resources Section staff completed the final report for a hydrology study of karst-related flooding in the city of Radcliff, funded by the U.S. Army Corps of Engineers. Dye traces, water-flow measurements, and water-level changes were used to determine the sources and amount of water flowing through the karst terrain, and to determine the intake capacity of a swallow hole draining the study area. The city then contracted with KGS to map all the karst groundwater basins in Radcliff through dye tracing, to help the local government comply with EPA water-quality standards.

Water Resources Section members were also involved in developing public water supplies from groundwater resources for the communities of Evarts and Wallins (Harlan County), Campton (Wolfe County), and Hindman (Knott County) in

the Eastern Kentucky Coal Field. With funding from the Kentucky Infrastructure Authority, KGS staff sited new well locations, conducted pumping tests, and sampled and evaluated groundwater quality in cooperation with the Kentucky Rural Water Association.

**Cumberland Gap Tunnel.** The Cumberland Gap Tunnel Authority contracted with KGS to conduct testing and analyses to help determine the causes of subsidence of sections of the roadbed. The tunnel is a 4,600-foot section of U.S. 25E passing under the Cumberland Gap National Historic Park just south of Middlesboro at the southeastern border of Kentucky with Virginia and Tennessee. A series of investigations, including dye tracing, groundwater-velocity measurements, downhole packer tests, analyses of water samples collected from the groundwater system, and physical observations of the bedrock and the limestone gravel forming the roadbase material beneath the tunnel pavement were completed. Results from these investigations indicate that groundwater is dissolving the limestone gravel roadbase. KGS continues to be part of a team including the Kentucky Transportation Center at the University of Kentucky and State and Federal highway administrations that are advising the Tunnel Authority on developing solutions for the problem, including replacing the limestone gravel with granite aggregate and installing a new groundwater handling system under parts of the roadway.

**Selenium in Surface Waters in the Eastern Kentucky Coal Field.** KGS is assisting the Kentucky Division of Water in a study of selenium in surface water draining from surface coal mines and other construction that disrupts the land surface in the Eastern Kentucky Coal Field. The EPA has determined that elevated selenium concentrations can be detrimental to aquatic life and terrestrial animals consuming aquatic life. With the help of KGS, the Division of Water will sample both water and aquatic life in streams that drain certain stratigraphic intervals in the coal field. Approximately 15 sites will be sampled in the coming year and analyzed by the Kentucky Division of Technical Services and laboratories capable of determining the species of selenium in both stream water and body mass of aquatic life.

## Groundwater-Quality Characterization

Uninterpreted results of data collection programs are of limited value to most citizens, agencies, and organizations concerned with regional groundwater quality and supply. Placing results of such investigations into the context of natural conditions, regional variations in bedrock type and land use, potential impact of human activities, and the possible impacts on human health is therefore an important activity of the Kentucky Interagency Groundwater Monitoring Network. Major reports completed during the fiscal year are:

- Cumbie, D.H., Dinger, J.S., and Webb, S.E., 2006, Groundwater and surface-water monitoring at Robinson Forest: Report of water-quality data: Kentucky Geological Survey Open-File Report OF-06-01, [www.uky.edu/KGS/water/OF-06-01](http://www.uky.edu/KGS/water/OF-06-01) [accessed 08/30/2007].
- Currens, J.C., Paylor, R.L., and Spears, A., 2006, Hydrogeology of karst related flooding, Happy Valley karst valley (Quiggins swallow hole), Radcliff, Hardin County, Kentucky: Final report prepared under contract with the U.S. Army Corps of Engineers for the city of Radcliff, USACOE Project W912SU-05-P-0105, 59 p., 1 plate.
- Davidson, B., and Fisher, R.S., 2006, Groundwater quality in Kentucky: Barium: Kentucky Geological Survey, ser. 12, Information Circular 11, 4 p.
- Dinger, J.S., Cumbie, D.H., and Davidson, B., 2006, Assessing water-supply potential of abandoned underground coal mines in eastern Kentucky: Kentucky Geological Survey, ser. 12, Report of Investigations 12, 33 p.
- Fisher, R.S., and Davidson, B., 2007, Groundwater quality in Kentucky: Iron: Kentucky Geological Survey, ser. 12, Information Circular 13, 4 p.
- Fisher, R.S., Davidson, B., and Goodmann, P.T., 2007, Regional groundwater quality in watersheds of the Upper Cumberland, Lower Cumberland, and Lower Tennessee Rivers, and the Jackson Purchase Region (Kentucky basin management unit 3): Kentucky Geological Survey, ser. 12, Report of Investigations 15,



[www.uky.edu/KGS/water/RI\\_15/](http://www.uky.edu/KGS/water/RI_15/) [accessed 08/30/2007].

Webb, S.E., Cumbie, D.H., Dinger, J.S., and Russo, L.K., 2006, Water-quality and -quantity data for abandoned underground coal mines in eastern Kentucky: Kentucky Geological Survey, ser. 12, Information Circular 15, [www.uky.edu/KGS/water/IC\\_15/](http://www.uky.edu/KGS/water/IC_15/) [accessed 08/30/2007].

## Distribution of Groundwater Information

One of the most important functions of the Groundwater Monitoring Network is converting raw data from water-level measurements and sample analyses to understandable, useful information. During the past fiscal year, groundwater information was communicated via presentations at meetings and conferences and placement on Web sites.

### Publications

Blacketter, L.L., Fannin, H.B., Beck, E.G., and Kotter, D., 2007, Environmental monitoring and assessment of arsenic metal in groundwater samples from Ballard, Carlisle, and Graves Counties, Kentucky [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 17.

Crain, A.S., 2007, Water quality in the karst terrane of the Sinking Creek Basin, Kentucky, 2004–06 [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 39–40.

Currens, J.C., Dinger, J.S., Paylor, R.L., Gadbois, C., and Spears, A., 2006, Results of the groundwater tracer tests conducted within the Cumberland Gap Tunnel: Contract report for Tunnel Management Inc. for the Cumberland Gap Tunnel Authority, 34 p. and disk of databases.

Daugherty, S.D., and Dinger, J.S., 2007, Land-use effects on water quality within lower Howard Creek watershed, southwestern Clark County, Kentucky [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 21–22.

Davidson, B., and Fisher, R.S., 2007, Kentucky groundwater-quality search engine [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 37–38.

Dinger, J.S., and Currens, J.C., 2006, Description of cores, downhole video logs, and straddle packer tests in the Cumberland Gap Tunnel integrated with geotechnical observations by Bhate Engineering Corporation: Contract report for Tunnel Management Inc. for the Cumberland Gap Tunnel Authority, 80 p.

Fisher, R.S., and Davidson, B., 2007, Kentucky groundwater-quality mapping service [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 35.

Fleck, A., 2007, Shaker prosperity traced to perennial springs: *Land, Air & Water*, v. 18, no. 3, p. 5.

Kotter, D., Beck, E.G., Doss, P., Thompson, S., and Fannin, H., 2007, Environmental monitoring and assessment of the groundwater quality in Calloway County, Kentucky [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 19.

Vendrell, P., Dozier, M., Beck, E.G., Branch, B., Dennis, S., and Kizer, M., 2007, Southern region down-well camera team [abs.]: U.S. Department of Agriculture–Cooperative State Research, Education, and Extension Service 2007 National Water Quality Conference, [www.usawaterquality.org/conferences/2007/2007\\_Abtracts\\_PDF/Posters/Rural%20Environmental%20Protection/Vendrell.pdf](http://www.usawaterquality.org/conferences/2007/2007_Abtracts_PDF/Posters/Rural%20Environmental%20Protection/Vendrell.pdf) [accessed 09/04/2007].

Wendroth, O., Shuai, X., Walton, J., Dinger, J., Currens, J., Edwards, D., Coyne, M., Grove, J., and Higgins, S., 2007, Salt movement through the vadose zone of a karst soil—First experiences with a transfer function approach [abs.]: Kentucky Water Resources Research Institute Annual Symposium, Abstracts with Program, Lexington, Ky., March 26, p. 41–42.

### Presentations

Beck, E.G., 2006, Collaborative assessment of agricultural practices on Kentucky's groundwater

- resources: SB-271 panel discussion meeting, Lexington, Ky., October 3.
- Beck, E.G., 2006, Groundwater quality in the Jackson Purchase: Jackson Purchase Area Development District Water Management Council meeting, Mayfield, Ky., October 11.
- Beck, E.G., 2006, Well camera for domestic wells: District 7 County Extension Service agents quarterly meeting, Princeton, Ky., November 8.
- Beck, E.G., 2006, Well camera use and groundwater quality in the Jackson Purchase Region, Kentucky: Texas A&M Well Camera Team training course, College Station, Tex., October 30–November 1.
- Beck, E.G., 2007, EPSCoR environmental initiative: Building environmental research and education through ERTL: American Association for the Advancement of Science panel review, Lexington, Ky., January 22.
- Crain, A.S., 2007, Water quality in the karst terrane of the Sinking Creek Basin, Kentucky, 2004–06: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 26.
- Daugherty, S.D., and Dinger, J.S., 2007, Land-use effects on water quality within lower Howard Creek watershed, southwestern Clark County, Kentucky: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 26.
- Davidson, B., and Fisher, R.S., 2007, Kentucky groundwater-quality search engine: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 26.
- Dinger, J.S., 2007, Karst in Floyds Fork watershed: Floyds Fork Watershed Planning Committee, University of Louisville, Shelbyville campus, Louisville, Ky., February 23.
- Dinger, J.S., 2007, Karst in general: Floyds Fork Watershed Planning Committee, University of Louisville, Shelbyville campus, Louisville, Ky., February 23.
- Dinger, J.S., 2007, Karst occurrence and issues in the Floyds Fork watershed: Floyds Fork Technical Advisory Committee to 319(h) project, Louisville, Ky., June 12.
- Dinger, J.S., 2007, Public policy of water resources in Kentucky: Kentucky Geological Survey annual meeting, Lexington, Ky., April 20.
- Fisher, R.S., and Davidson, B., 2007, Kentucky groundwater-quality mapping services: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 26.
- Kotter, D., Beck, E.G., Doss, P., Thompson, S., and Fannin, H., 2007, Environmental monitoring and assessment of the groundwater quality in Calloway County, Kentucky: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 26.

### **Web Site Information**

Making groundwater data easily available to the public and other agencies and organizations is increasingly important. KGS has developed both tabular- and map-based groundwater-quality search capabilities this year. These new capabilities complement the established but regularly updated search engines for water well and spring records ([kgsweb.uky.edu/DataSearching/Water/WaterWellSearch.asp](http://kgsweb.uky.edu/DataSearching/Water/WaterWellSearch.asp)) and locations ([kgsmap.uky.edu/website/KGSWater/viewer.asp](http://kgsmap.uky.edu/website/KGSWater/viewer.asp)), karst potential ([kgsmap.uky.edu/website/KGSGeology/viewer.asp?LayoutID=31](http://kgsmap.uky.edu/website/KGSGeology/viewer.asp?LayoutID=31)), and ongoing water-resources research projects ([www.uky.edu/KGS/water/](http://www.uky.edu/KGS/water/)).

The tabular data search ([kgsweb.uky.edu/DataSearching/Water/WaterQualSearch.asp](http://kgsweb.uky.edu/DataSearching/Water/WaterQualSearch.asp)) allows users to select an area of interest and then obtain water-quality records for 38 common water-quality properties and nonpoint-source chemicals. Results can be displayed either for each sample or summarized for each well or spring. It is also possible to limit results by time period; that is, all data, data collected before or after a particular date, or over a user-determined interval. Associated files provide information about the analyte, natural and contaminant sources, and potential health effects of the analyte in drinking water.

A map-based search capability ([kgsmap.uky.edu/website/KGSWaterQual/viewer.asp](http://kgsmap.uky.edu/website/KGSWaterQual/viewer.asp)) provides the same sort of data but in a spatial context, giving online users the ability to display groundwater-quality data on a variety of base maps. This search type is particularly useful to those wishing to view groundwater quality in relation to hydrologic, geologic, geographic, or cultural features.

Groundwater publications are being made available on Web sites to increase accessibility. KGS

maintains and regularly updates a Web site for the Kentucky Interagency Groundwater Monitoring Network ([www.uky.edu/kgs/water/gnet/](http://www.uky.edu/kgs/water/gnet/)). This site contains maps and data summaries of nitrate, fluoride, arsenic, mercury, and selenium concentrations; maps of pH and hardness; a location map showing wells and springs that have been analyzed for various water-quality parameters; and previous network annual reports. The site also has links to the Web sites of the ITAC agencies and organizations. KGS has compiled information about hydrology, geology, topography, water supply, and water quality from maps, reports, and data collected from 1940 to 2000 and posted them for public access at [www.uky.edu/KGS/water/library/webintro.html](http://www.uky.edu/KGS/water/library/webintro.html). KGS has also completed maps of water wells and springs for all the 30 x 60 minute quadrangles in Kentucky. These water-well and spring maps are now available online at [kgsweb.uky.edu/PubsSearching/PubsSimpleSearch.asp](http://kgsweb.uky.edu/PubsSearching/PubsSimpleSearch.asp).

Other ITAC agencies, particularly the Division of Water, are increasingly using Web sites to post groundwater information ([www.water.ky.gov/gw/](http://www.water.ky.gov/gw/)). From this main page, users can obtain information about groundwater databases and well records ([www.water.ky.gov/gw/gwdb/](http://www.water.ky.gov/gw/gwdb/)), groundwater protection ([www.water.ky.gov/gw/gwprotection/](http://www.water.ky.gov/gw/gwprotection/)), monitoring and assessment programs ([www.water.ky.gov/gw/monitoring/](http://www.water.ky.gov/gw/monitoring/)), and technical assistance ([www.water.ky.gov/gw/gwtech/](http://www.water.ky.gov/gw/gwtech/)).

## **Kentucky Groundwater Data Repository**

In 2006–2007, personnel from the Water Resources and Geospatial Analysis Sections at KGS enhanced and streamlined searching capabilities for Kentucky groundwater-quality data. In addition to obtaining updates of groundwater-quality data from the Division of Water, KGS staff systematically standardized the reporting names and concentration units of 38 parameters in five major categories (water properties, volatile organic compounds, nutrients, pesticides, and inorganic solutes) to facilitate data searches. Users can now select individual or multiple parameters of interest, view search results, and download the data for use in spreadsheets or other software packages.

## **Interagency Coordination**

Cooperation among agencies and research organizations that collect, analyze, and use groundwater data is essential to reduce monitoring costs, improve program efficiency, and promote data sharing. The Kentucky Interagency Technical Advisory Committee on Groundwater provides a forum for agencies and organizations to meet and discuss groundwater issues.

Cooperation and interaction within the ITAC agencies and between ITAC agencies and other groups and organizations is routine. Many programs benefit from the Division of Water's willingness to collect and analyze groundwater samples to support various projects. Recent examples include the Division of Water coordinating with the Kentucky Geological Survey to collect groundwater samples at the Salyersville drilling site, and the Division of Water's regular sampling of Royal Spring, the focus of a Kentucky Geological Survey travel-time study. The Division of Water also samples groundwater and surface water for nonpoint-source constituents in support of projects for the Division of Pesticide Regulation. The Division of Water and the Kentucky Geological Survey regularly answer inquiries from the public and communicate with staff of the Kentucky Rural Water Association. The Kentucky Geological Survey has been meeting with County Extension Service agents and Area Development Districts throughout the commonwealth to promote awareness of hydrogeologic issues. Many of the ITAC members are also members of the Kentucky Agricultural Water Quality Authority, or cooperate with the authority and participate in its meetings. Members of both the Division of Water and the Kentucky Geological Survey regularly participate in meetings of State and Federal agencies and citizens' groups that have interests in groundwater resources.

## **Groundwater Data Sharing**

Sharing groundwater data is an essential function of the Interagency Groundwater Monitoring Network. Data transfers between agencies provide each group access to a larger database than any agency could develop independently, thereby improving evaluations of groundwater quality and suitability for various uses, threats to groundwater quality, and the effects of mining, logging, agricul-



tural practices, urbanization, waste disposal, and oil and gas production. Sharing data also reduces the overall expense and increases the efficiency of monitoring efforts.

Data have been transferred electronically between the Division of Water groundwater database and the Kentucky Groundwater Data Repository, and between the Kentucky Geological Survey analytical laboratory and the Groundwater Branch, since 1992. There has also been a high level of collaboration and data sharing between the Kentucky Geological Survey and the Groundwater Branch during the reporting period, as the agencies are jointly reporting on groundwater quality throughout the state.

## Future Activities

Preparing and distributing reports that summarize the results of groundwater investigations in terms that are readily understood by the public will remain an important function of the Kentucky Interagency Groundwater Monitoring Network. It is essential that the data being collected be presented to legislators, regulatory agencies, and the public in a useful, understandable fashion.

In addition to improved communications of the information being gathered, the following activities are urgently needed:

- determining how large an area is represented by a particular well or spring
- establishing new monitoring sites in areas that are currently not represented
- optimizing the sampling frequency to account for natural variations in different groundwater flow systems throughout the state
- monitoring the rate of intrusion of nonpoint contaminants into groundwater systems
- standardizing reporting information about sampling methods, field measurements, and sample-site descriptions
- developing a water-level monitoring network to track long-term land use and climate effects on groundwater supplies
- standardizing sampling and reporting procedures to promote data sharing
- facilitating electronic data sharing
- providing public access to groundwater-quality data via interactive Web sites

- investigating the occurrence of bacteria and other pathogens in regional groundwater flow systems
- establishing the amount of pharmaceutical and personal-care product chemicals in water systems
- determining and evaluating pesticides of interest in groundwater
- increasing the use of isotopes, caffeine, and other tracers to determine contaminant sources, groundwater ages, and flow rates
- determining the role of groundwater on the low-flow quality and quantity of water in streams as related to water-quality standards and designated uses.

## Summary

The Kentucky Interagency Groundwater Monitoring Network was very active during the reporting period. Programs to collect statewide ambient groundwater-quality data, as well as to investigate specific problems of karst hydrology and aquifer sensitivity, nonpoint-source contamination of groundwater supplies, and the effects of agricultural practices on groundwater resources were completed or are in progress.

Most of the activities conducted during the reporting period were largely investigations of identified or suspected groundwater-quality problems, and were possible only because the agencies involved were able to obtain funding from outside sources. As noted in previous annual reports, the availability of these funds is decreasing. A stable source of recurring funding is essential if groundwater issues are to be addressed on a proactive basis, which will best serve the needs of citizens, resource managers, and environmental regulators.

## References Cited

- Interagency Technical Advisory Committee on Groundwater, 1996, Framework for the Kentucky Groundwater Monitoring Network: A report of the Interagency Technical Advisory Committee: University of Kentucky, Kentucky Water Resources Research Institute, 29 p.
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