

# **Kentucky Interagency Groundwater Monitoring Network**

## **Annual Report**

**July 2009–June 2010**

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# **Kentucky Interagency Groundwater Monitoring Network Annual Report July 2009–June 2010 Executive Summary**

Kentucky's citizens, businesses, industries, and ecosystems depend on adequate supplies of clean groundwater. Regional and temporal variations in groundwater quantity and quality are not adequately known, however. For this reason, the 1998 Kentucky General Assembly directed the Kentucky Geological Survey to establish a long-term groundwater monitoring network (KRS 151.620 and 151.625). The network collects groundwater data, characterizes groundwater quality, distributes groundwater information, improves coordination between agencies that use groundwater data, and facilitates data sharing. These activities are conducted in coordination with the Interagency Technical Advisory Committee (ITAC), composed of representatives from 15 State and Federal agencies and the University of Kentucky. The duties and responsibilities of this committee include

- Developing a plan to coordinate agencies for overall characterization of the state's groundwater
- Reviewing the data-entry process to ensure that all groundwater data collected are placed into the Kentucky Groundwater Data Repository
- Establishing a long-term groundwater monitoring plan for the commonwealth
- Recommending priorities for the state's groundwater research needs
- Annually reviewing and evaluating groundwater data collection and analysis.

The Kentucky Geological Survey is also charged with annually reporting network activities to the governor's office and the Legislative Research Commission. This report summarizes activities during the 2009-10 State fiscal year.

From July 2009 through June 2010, 23 data-collection programs were under way, and seven major groundwater characterization reports were published. Groundwater information was commu-

nicated to the scientific and regulatory communities and to the public through nine presentations and publications, as well as postings on Web sites. Quarterly meetings of the Interagency Technical Advisory Committee provided an opportunity to coordinate groundwater-related efforts and share information among agencies. Exchange of groundwater data, including electronic transfer of analytical results between Division of Water and Kentucky Geological Survey databases, has proceeded through close cooperation between the Kentucky Division of Water and the Kentucky Geological Survey.

The Kentucky Interagency Groundwater Monitoring Network has been in existence for 12 years. During this time, significant progress has been made. Important work remains, however. Among the critical issues facing Kentucky are:

- Determining recharge areas for sampled wells and springs so water supplies can be protected
- Establishing monitoring sites in areas that are currently not monitored or where groundwater demand is expected to increase
- Optimizing the sampling frequency to account for natural variations in groundwater flow systems throughout the state
- Monitoring the rate of intrusion of nonpoint-source contaminants into groundwater systems so that effective prevention and remediation can be implemented
- Establishing standard procedures for assessing whether compromised well integrity is allowing surface contamination to reach groundwater supplies
- Standardizing reporting of information about sampling methods, field measurements, and sample-site descriptions to promote data sharing

- Developing a water-level monitoring network to track long-term land-use and climate effects on groundwater supplies
- Standardizing reporting procedures and database structures to facilitate electronic data sharing
- Providing increased public access to groundwater-quality data in order to increase awareness
- Determining sources and amounts of bacteria and other pathogens in both local and regional groundwater flow systems
- Investigating the amount of pharmaceutical and personal-care-product chemicals in water systems
- Evaluating amount and effects of pesticide metabolites in groundwater
- Increasing the use of stable-isotope, caffeine, and other tracers to indicate contaminant

sources and quantify groundwater ages and flow rates

- Quantifying how groundwater affects the quality and quantity of water in streams in terms of water-quality standards, total maximum daily loads, and designated uses.

The Kentucky Interagency Groundwater Monitoring Network will continue to address these issues. Progress has been hampered by staff and funding limitations, however, which are increasing. Recent advances have been the result of substantial agency commitment of State executive budget funds; one-time, competitive grants to the Kentucky Division of Water's Groundwater Section and the Kentucky Geological Survey; and voluntary cooperation between agencies. An effective groundwater monitoring network requires sustained, recurring funding to maintain the long-term effort.

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## Introduction

Groundwater is used extensively throughout Kentucky for domestic, agricultural, commercial, and industrial purposes. Because of its connection with rivers, lakes, and wetlands, groundwater is also essential to the health of surface-water ecosystems. Determining the quality of this resource and protecting it from contamination are important to the future of the commonwealth and its citizens. The Kentucky Interagency Groundwater Monitoring Network was established in 1998 by the Kentucky General Assembly to increase knowledge and awareness of groundwater resources. For 12 years, the network has met its obligation of collecting and interpreting data, communicating findings, sharing data, and promoting interagency cooperation. Previous annual reports for the network are posted at [www.uky.edu/KGS/water/gnet](http://www.uky.edu/KGS/water/gnet).

Information provided by the Kentucky Division of Water indicates that more than 400,000 citizens rely on water from private wells and springs for drinking, cooking, and washing. Public water systems serving more than 1.25 million people also rely on groundwater as a source of drinking water. This dependence on groundwater resources will continue and may increase for economic reasons. Many public water-supply systems are consider-

ing switching from surface-water to groundwater sources because the required treatment and monitoring are less extensive and less expensive. Recently, the cities of Louisville, Hardinsburg, and Salyersville, and the Greater Fleming Regional Water Supply were considering either switching to groundwater sources or supplementing surface-water supplies with groundwater. Furthermore, many people who now rely on private wells or springs for domestic water supplies will remain dependent on groundwater because of the cost of extending public water-supply systems to rural areas and because groundwater supplies are more than sufficient in some areas 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 moderate to severe droughts, such as those that occurred in 1999-2001, 2005-06, and 2007-08. In the absence of precipitation, groundwater base flow is the only source of water to maintain stream flow and lake levels, and to preserve riparian and wetland ecosystems.

The 1998 legislation also established the Interagency Technical Advisory Committee to assist the Survey in the development, coordination, and implementation of a groundwater monitoring network (KRS 151.629). The following agencies and organizations were asked to appoint a representative to the Interagency Technical Advisory Committee:

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

## 2009-10 Activities and Accomplishments

Brief summaries of work performed by the ITAC agencies during the 2009-10 State fiscal year are presented herein 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.

The Interagency Technical Advisory Committee met twice during the 2009-10 fiscal year (July 14, 2009, at the Kentucky Geological Survey Well Sample and Core Library in Lexington, and October 13, 2009, at the Kentucky Division of Forestry in Frankfort). These meetings served as opportunities for networking and information sharing. In addition, all committee members were invited to the Donald C. Haney Distinguished Lecture at the Kentucky Geological Survey on April 7, 2010. David R.

Wunsch, state geologist and director of the New Hampshire Geological Survey, presented "The Making of a National Ground Water Monitoring Network." Dr. Wunsch, previously an employee of the Kentucky Geological Survey and a former ITAC participant, is active with the National Ground Water Association and other water-related organizations involved in efforts to establish a national groundwater monitoring network.

Statewide and regional ambient monitoring programs evaluated groundwater that is not affected by point-source contamination, and determined whether nonpoint-source chemicals such as sewage, pesticides, fertilizers, and volatile organic compounds have affected groundwater quality. These large-scale studies are conducted in basin management units (Fig. 1), which were established by the Kentucky Division of Water and include one or more major river watersheds. Site-specific studies were conducted in smaller watersheds or other, more restricted regions. These more specific studies were designed to evaluate the effects of particular land uses or unique hydrologic conditions on the quality of unregulated water supplies, such as roadside springs, used by the public.

## Groundwater Data Collection

Drilling wells, collecting and analyzing water samples, measuring water levels in wells, and mapping recharge and discharge areas of karst systems provide the fundamental data needed to determine current groundwater quality, detect changes over time, and evaluate hydrogeologic hazards.

### *Kentucky Division of Water– Groundwater Section*

The Groundwater Section of the Kentucky Division of Water's Watershed Management Branch maintains an active groundwater-sample collection and -analysis program. The following projects have been active during the report period.

**Ambient Groundwater Monitoring Program.** Regularly scheduled sampling continued for the statewide Ambient Groundwater Monitoring Program. This fiscal year 111 samples were collected from 55 sites (wells and springs) across the state. Groundwater-quality data were provided to numerous persons through information requests.

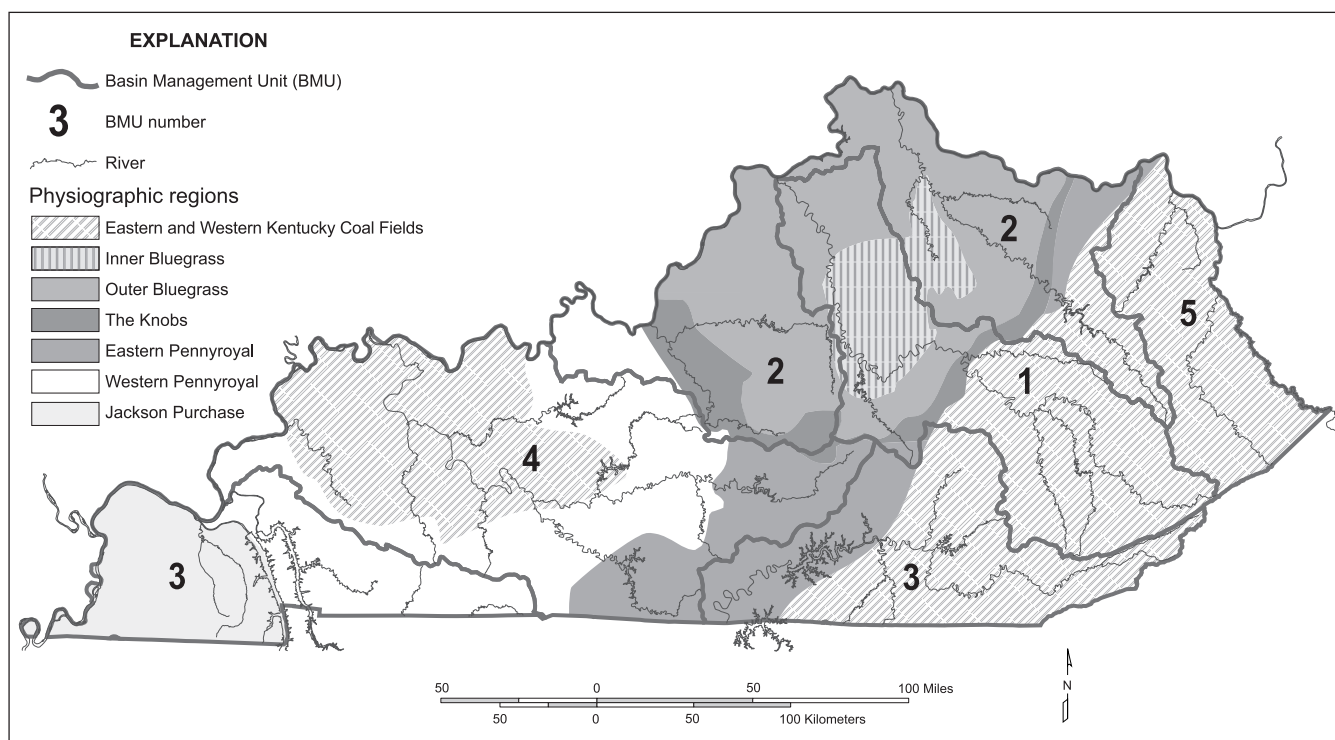


Figure 1. Major rivers, basin management units, and physiographic regions in Kentucky.

Data were also included in statistical analyses for regional and watershed-based groundwater assessments.

**Pesticides Memorandum of Agreement Project (Pest MOA).** The Pest MOA with the Department of Agriculture covers four permanent sampling sites (three springs and one well) in western Kentucky. Each site was sampled quarterly for a total of 16 samples throughout the fiscal year. Pesticide data from these sites and the Ambient Groundwater Monitoring Program sites are submitted to the Department of Agriculture annually.

**Complaint Sampling.** The Division of Water responds to complaints about groundwater and investigates as requested by the general public. This fiscal year, the division collected 28 samples from 28 sites in response to complaints. The majority of these samples are collected by personnel from the division's regional offices.

**Nonpoint-Source Groundwater Assessments.** The division currently has four active nonpoint-source projects in various phases from drafting final re-

ports to study-area reconnaissance and site selection.

**Groundwater Quality Assessment in Sinking Creek and Beargrass Creek Watersheds (NPS0303).** This project is currently in the report-writing phase. Groundwater-quality monitoring and tracer tests have been completed. Parts of the report have been completed, but data have not been statistically analyzed. Aspects of this project relating to groundwater infiltration of the sanitary sewer system in the Beargrass Creek Watershed, Jefferson County, have been presented at water-resources conferences and to a community watershed group.

**Integrated Surface-Water and Groundwater Assessment of Large Springs in the Green River Basin (NPS0503).** This project is also in the report-writing phase. Groundwater-quality monitoring and tracer tests have been completed. An integrated approach was used to assess groundwater resources, according to surface-water protocols, in an attempt to better define the nexus between the two systems. Ten large springs in the Mississippian Plateau Region were monitored for one year. Data



obtained were sufficient to assess these springs and to have them listed on the 2008 Integrated Report-305(b)/303(d).

The final report for this project will discuss each spring relative to the primary contact recreation and aquatic life use standards set forth in Kentucky Administrative Regulations 401 KAR 10:031. The report will also include findings for biological population assessment, and tracer tests conducted to delineate and refine identified karst groundwater basins. Results of this study have been presented at water-resources conferences.

**Basin Management Unit 5 Elkhorn Creek Subbasin Groundwater Study (NPS0604).** This project is focused on assessing groundwater quality of domestic-use wells along Elkhorn Creek in southeastern Pike County and northeastern Letcher County. All chemical water-quality samples have been collected and analyzed. Each well used in this study will be sampled for total coliform and *E. coli* bacteria. Biological activity reaction tests will also be collected for each well, including iron-related bacteria, sulfate-reducing bacteria, and slime-forming bacteria. Preliminary work on the draft report is currently in progress.

**Western Pennyroyal Karst Study (NPS0704).** Work on this project began in late fall of 2008. Tracer tests have been conducted throughout the study area. Following completion of the tracer tests and delineation of several karst groundwater basins, monitoring sites will be chosen. An integrated surface-water/groundwater assessment will be done.

**Special Projects.** The division conducted 18 tracer tests for karst mapping projects and groundwater technical assistance. Sixteen county health departments were also assisted with dye traces as part of localized contaminant investigations.

The division is currently conducting a pilot study on the feasibility of adding karst data to the USGS's National Hydrography Dataset. The dataset was designed to incorporate groundwater flow data. The Kentucky Geological Survey and Kentucky Division of Water have compiled and digitized karst flow data for more than half of the karst regions in Kentucky. Incorporating previously omitted subsurface flow data into the

dataset will provide several benefits, primarily: (1) demonstration of local deviation of karst drainage from topographic watershed divides, (2) establishment of a baseline for mapping karst features and groundwater flow paths within the state, and (3) improvement of accuracy and applicability of information used for hydrologic modeling, research, and field investigation.

### **U.S. Geological Survey**

**Louisville Water Co., Ohio River Alluvial Aquifer, Jefferson County.** The U.S. Geological Survey, in cooperation with the Louisville Water Co., maintains a network of 24 water-level observation wells in the northeastern part of the Ohio River alluvium in Jefferson County. Ten 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 14 observation wells on a quarterly basis. These data assist the Louisville Water Co.'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 Payne water-treatment plant.

**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 Groundwater Climate Response Network – a nationwide network of long-term observation 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 at [groundwaterwatch.usgs.gov](http://groundwaterwatch.usgs.gov) or [ky.water.usgs.gov](http://ky.water.usgs.gov). Two additional long-term observation wells located in downtown Louisville are also 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 oil and

gas field brines and other pollutants to contaminate groundwater supplies. The casings of abandoned wells may eventually 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, Ky. Many of the drinking-water supply wells for Fort Knox have chloride concentrations in excess of secondary maximum contaminant levels of 250 mg/L; some are as high as 1,900 mg/L. The USGS, working in cooperation with the U.S. Army Corps of Engineers and the Army installation at Fort Knox, is presently conducting a geophysical and hydrogeologic investigation of the Ohio River alluvial aquifer at the Fort Knox well field to identify abandoned or improperly plugged oil and gas exploration wells that may be contributing brine contamination to the freshwater aquifer and to characterize the migration and dispersion of chlorides.

### ***Kentucky Department of Agriculture***

The Kentucky Department of Agriculture-Technical Support Branch continued to receive monitoring data from the Division of Water under its memorandum of agreement. The memorandum covers 16 samples yearly from four sites. It is supplemented by the Division of Water's Ambient Groundwater Monitoring Program.

### ***Kentucky Geological Survey***

**Identifying Raw-Water Supplies.** The Water Resources Section is helping small Kentucky communities look to groundwater sources for public water supplies. Work continued in eastern Kentucky with the city of Campton in Wolfe County to develop a future water plant by testing production and quality of groundwater supplies. An aquifer test was completed for the city. Hydraulic and water-chemistry data were used by the city's consulting engineer to successfully apply for funds to build a new water-treatment plant.

**Cumberland Gap Tunnel.** A joint report by the Kentucky Transportation Center and the Kentucky Geological Survey was written for the Kentucky Transportation Cabinet. Groundwater chemical data and ground-penetrating radar readings were used to delineate the cause of pavement subsid-

ence in the tunnel. Continuation funds through 2014 were received to determine the rate at which the roadbase aggregate is being dissolved by the groundwater flow system entering the bottom of the tunnel.

**Nutrient Study.** The Water Resources Section completed a project funded by the Division of Water to sample nutrients and provide field measurements for streams throughout eastern Kentucky. The Division of Water chose 29 sites that would be sampled a total of five times during high- and low-flow events. KGS sampled the streams and provided the division with discharge records, which the Division of Water will analyze.

**Cane Run Watershed.** The Lexington-Fayette Urban County Government is under a consent decree with the U.S. Environmental Protection Agency to improve the natural water quality within its jurisdiction. KGS is working in cooperation with the University of Kentucky's College of Agriculture to monitor the underground conduit through which the Cane Run watershed usually flows from Lexington to Royal Spring, the major water supply for Georgetown, in Scott County. This watershed is the focus of an EPA grant to mitigate poor water quality. Electrical-resistivity and spontaneous-potential geophysical logs were used to help pinpoint the location of the active conduit at the Kentucky Horse Park, where monitoring wells were drilled into the conduit; water flow and chemistry will be monitored in the coming year. In addition, further geophysical studies and exploratory drilling will be conducted on College of Agriculture farm lands in the vicinity of Berea Road and at North Farm in Lexington to locate the conduit for monitoring purposes.

**Selenium Concentrations in the Aquatic Environment.** A draft report featuring analysis of selenium for 13 surface-water sites in the Eastern Kentucky Coal Field was completed and delivered to the Kentucky Division of Water, the funding source for the study. This reconnaissance collected 37 water samples, 25 sediment samples, and 29 fish-tissue samples, for which seven forms of selenium were analyzed. Sites were selected where selenium concentration in strata were expected to be high; these sites included active, reclaimed, and abandoned

surface coal mines, roadcuts, and undisturbed land. The Division of Water has reviewed the draft report, and both agencies are working on modifications for a final report.

**Karst Activities.** In cooperation with the Division of Water, KGS staff completed and released the karst groundwater basin map for the Tell City 30 x 60 minute quadrangle. Work continued on developing maps of the probability of occurrence of cover-collapse sinkholes. Statistical analyses are being used to link geologic strata to the occurrence of sinkholes and the probably that sinkholes will occur in the future. A paper was submitted on these findings to the *Journal of Cave and Karst Studies*.

A significant amount of time and effort was spent on various activities to locate the main-stem conduit for the Royal Spring karst aquifer in the vicinity of the Kentucky Horse Park. This included conducting specialty groundwater tracing experiments, electrical-resistivity experiments, and drilling 17 holes. The conduit was found from a combination of data from the electrical-resistivity logs, fundamental hydrogeologic techniques, and a conceptual model that explains the results of both the recent drilling and previous attempts to locate the conduit. Each hole drilled, regardless of what it found, was an essential piece of the puzzle.

**Public Health and Groundwater Quality.** In conjunction with the University of Kentucky College of Public Health, Glynn Beck continues work on health-related water studies in western Kentucky. In early 2009, a doctoral candidate in public health mailed out a health questionnaire to 551 households that use groundwater for their domestic water supply. This study seeks to determine if there are links between the health of those families and elevated nitrate concentrations and the presence of bacteria (total coliform and *E. coli*) in the well water. Approximately 39 percent of the households responded to the survey. Data from the survey are currently being compiled, and interpretations should be completed by the end of 2010.

**Assessment of CO<sub>2</sub> Injection on Local Groundwater Quality.** Glynn Beck monitored shallow groundwater for three carbon storage projects overseen by the Energy and Minerals Section at KGS. One project, in Hancock County, investigated

the feasibility of injecting CO<sub>2</sub> into deep saline aquifers. The second project, in Hopkins County, researched the feasibility of injecting CO<sub>2</sub> into an oil-producing formation to enhance oil recovery while also storing carbon dioxide. A third project, which is scheduled to begin in October 2010, in Henderson County, will investigate the feasibility of a “huff and puff” injection scenario. The shallow groundwater was sampled to characterize the local water quality and assess any changes in quality that may be associated with CO<sub>2</sub> injection. Groundwater sampling in Hancock County will continue through 2012, in Hopkins County through March 2011, and in Henderson County through 2011.

**Analysis of Formation-Water Chemistry in the Appalachian and Illinois Basins of Kentucky.** Marty Parris and colleagues at the Kentucky Geological Survey are evaluating archived formation water-chemistry data collected mostly from oil wells in the Appalachian and Illinois Basins of Kentucky. The formation waters are mostly nonpotable and salinities can range up to 300,000 mg/L of total dissolved solids. Samples were collected from Precambrian through Pennsylvanian reservoirs, spanning a depth of 2,000 to -8,000 ft (sea-level reference). The formation-water chemistry data include major cations and anions, and important administrative data, such as well location and the depth and stratigraphic interval from which the water sample was collected. The distribution of solutes within a stratigraphic and depth context is being used to analyze basin hydrostratigraphy. The chemistry data are also used as inputs for CO<sub>2</sub> solubility models for carbon sequestration studies.

**Unregulated Drinking-Water Initiative.** The Water Resources Section is working on a joint project, along with several other states and the Centers for Disease Control and Prevention in Atlanta. The CDC has initiated a nationwide project to create a database on unregulated drinking-water sources that are not covered by the Safe Drinking Water Act. These sources consist primarily of groundwater wells and springs. This database will contain water-well and water-quality data that can be accessed by researchers and public-health professionals to identify and remediate health issues associated with drinking unregulated well water. The CDC used the Kentucky Groundwater

Data Repository database framework to assist in designing a data-collection tool for the national database.

## Distribution of Groundwater Information

One of the most important functions of the Groundwater Monitoring Network is translating analytical data from water-level measurements and groundwater analyses into readily available, useful information and presenting it to the public. During the 2009-10 fiscal year, groundwater information was communicated via short reports, oral and poster presentations at meetings and conferences, and posting on Web sites.

### Publications

- Beck, E.G., Dinger, J.S., Grove, J.H., and Pena-Yewtukhiw, E.M., 2010, Assessment of row crop, alfalfa, and pasture field practices on groundwater quality in an upland bedrock setting, Henderson County, Kentucky: Report of soil- and water-quality data: Kentucky Geological Survey, ser. 12, Information Circular 19, [kgs.uky.edu/kgsweb/olops/pub/kgs/water/IC19\\_12/IC19\\_12.pdf](http://kgs.uky.edu/kgsweb/olops/pub/kgs/water/IC19_12/IC19_12.pdf) [accessed 09/28/2010].
- Beck, E.G., Dinger, J.S., Pena-Yewtukhiw, E., and Grove, J.H., 2010, Soil- and groundwater-quality data for an abandoned cattle and hog feedlot in Henderson County, Kentucky: Kentucky Geological Survey, ser. 12, Information Circular 20, [kgs.uky.edu/kgsweb/olops/pub/kgs/water/IC20\\_12](http://kgs.uky.edu/kgsweb/olops/pub/kgs/water/IC20_12) [accessed 09/28/2010].
- Blair, R.J., Ray, J.A., Webb, J.S., Blanset, J.M., and Goodmann, P.T., 2009, Assessment of nonpoint source impacts on groundwater quality in South Elkhorn Creek Basin, central Kentucky: Kentucky Division of Water, grant NPS0204, 85 p.
- Davidson, B., 2009, Groundwater data on the Web: Search engines for the Kentucky Groundwater Data Repository[abs.]: Kentucky Water Resources Annual Symposium, Abstracts with Programs, p. 79.
- Pena-Yewtukhiw, E.M., Grove, J.H., Beck, E.G., and Dinger, J.S., 2009, Effect of soil and absence/presence of an abandoned feedlot on determining the area sourcing nitrate to a contaminated domestic well: *Soil Science Journal*, v. 174, no. 1, p. 56-64.
- Reed, T.M., McFarland, J.T., Fryar, A.E., Fogle, A.W., and Taraba, J.L., 2010, Sediment discharges during storm flow from proximal urban and rural karst springs, central Kentucky, USA: *Journal of Hydrology*, v. 383, p. 280-290.
- Zhu, J., Paylor, R., Currens, J.C., and Dinger, J.S., 2009, Geophysical methods for locating karst conduits in Cane Run watershed, central Kentucky: *Eos*, v. 90, no. 52, Fall Meeting Supplement, Abstract H43C-1048.

### Presentations

- Blair, R.J., and Goodmann, P.T., 2009, Integrated surface- and groundwater assessments in karst regions of Kentucky: Southeastern Water Pollution Biologists Association Conference, Frankfort, Ky., October 21.
- Davidson, B., 2009, Groundwater data on the Web: Search engines for the Kentucky Groundwater Data Repository: Kentucky Water Resources Annual Symposium, Lexington, Ky., March 2.

### Web Site Information

The Kentucky Geological Survey provides online access to information about water wells and springs at [kgs.uky.edu/kgsweb/DataSearching/Water/WaterWellSearch.asp](http://kgs.uky.edu/kgsweb/DataSearching/Water/WaterWellSearch.asp). These data are useful to the public, well drillers, consultants, and researchers. KGS also maintains a Web site for the Kentucky Interagency Groundwater Monitoring Network ([www.uky.edu/kgs/water/gnet](http://www.uky.edu/kgs/water/gnet)), which contains links to current and previous annual reports of the network and 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 the present at [www.uky.edu/kgs/water](http://www.uky.edu/kgs/water).

Statewide groundwater data in the Kentucky Groundwater Data Repository can be accessed at [kgs.uky.edu/kgsweb/DataSearching/watersearch.asp](http://kgs.uky.edu/kgsweb/DataSearching/watersearch.asp). The two main search engines cover water wells and springs and groundwater-quality data. Several alternatives are available for

viewing groundwater information on both interactive and static maps, and for creating graphical representations of groundwater-quality data.

The Kentucky water-well and spring search engine was accessed by the public 4,809 times during fiscal year 2009-10, and 526 downloads were made. It is the second most popular search engine on the KGS Web site after that for oil and gas records. Users can search for wells or springs by county, 7.5-minute quadrangle, or a radius from a user-provided latitude/longitude location. Resulting data can be displayed on maps or downloaded for use in GIS packages.

The Kentucky groundwater-quality data search engine was accessed by the public more than 1,390 times during fiscal year 2009-10, and 273 downloads were made. Users can select from 38 parameters of interest in five major categories: water properties, volatile organic compounds, nutrients, pesticides, and inorganic solutes. Resulting data can be downloaded, displayed on maps, or used to generate graphs comparing groundwater-quality data by physiographic region or watershed basin.

For more information on groundwater-quality or water-well and spring data, contact the Survey at (859) 323-0524.

## Interagency Coordination

Cooperation among agencies and research organizations that collect, analyze, and use groundwater data reduces monitoring costs, improves program efficiency, and promotes data sharing. The Kentucky Interagency Technical Advisory Committee on Groundwater provides a forum for organizations that participate in ITAC to meet quarterly and discuss groundwater issues.

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 a drilling site in Salyersville, 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. KGS staff have been meeting with County Extension Service agents and Area Development District staff throughout the commonwealth to promote awareness of hydrogeologic issues. Many of the ITAC agencies are also members of the Kentucky Agricultural Water Quality Authority, or cooperate with the authority and participate in their 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 interested in groundwater resources.

## Groundwater Data Sharing

Sharing 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, agricultural 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 Division of Water's Groundwater Section since 1992. There has also been a high level of collaboration and data sharing between KGS and the Groundwater Section during the reporting period, as the agencies are jointly reporting on groundwater quality throughout the state. During 2009-10, electronic data files of water-well, spring, and groundwater-quality data were transferred from the Division of Water to the Kentucky Geological Survey, and have been uploaded to the Kentucky Groundwater Data Repository. The Kentucky Geological Survey completed a restructuring of the database in early 2010 to mirror the schema of the Division of Water database, thereby making data transfers more seamless and efficient. Uploads from the Division

of Water will occur on a monthly basis in late 2010, allowing end-users to access the most recent well and spring data available.

## Other Activities

ITAC agencies are involved in many activities primarily concerning surface-water quality and public education about water resources. Although these projects do not directly address issues raised by the 1998 Kentucky General Assembly, they are important contributions because of the close interconnection of groundwater and surface-water systems in Kentucky.

### **University of Kentucky Environmental and Natural Resource Issues Task Force**

**The Kentucky Well Education Web Site.** The Kentucky Well Education Web site ([www.ca.uky.edu/downwell](http://www.ca.uky.edu/downwell)) is a joint project between the Environmental and Natural Resource Issues Task Force and the Kentucky Geological Survey. The Web site contains information on well types and construction, along with simplified descriptions of Kentucky Division of Water regulations about general well construction and specific types of wells. The Web site provides video and photographic examples of problems that may occur in wells and gives advice on solutions. Treatment methods to make groundwater potable are discussed; this section will be expanded in fall 2010. Links to information on geology and its impact on groundwater are provided through KGS, and will be expanded in fall 2010 as a result of interest shown by the U.S. Geological Survey. This site is maintained by Tyler Henningsen, ENRI assistant.

**Home and Environment Extension Bulletin Series.** Home and Environment Extension Bulletin Series (HENV) is a newly established series of bulletins that provides homeowners with science-based information about their homes and home environment. Long-version bulletins, short-version bulletins, and radio scripts will be developed for the topics listed below. The 3- to 5-page long-version bulletin is more detailed, whereas the 1- to 2-page short-version bulletin is condensed to main

points about the topics. The radio scripts are for Extension agents to provide to their clientele.

*HENV Series Numbering System:*

- 100's – reduce, reuse, recycle, hazardous waste, compost, etc.
- 200's – stormwater (rain barrels, rain gardens, artificial drains, wetlands, etc.)
- 300's – chemical issues at home (radon, lead, arsenic, chromium, mercury, etc.)
- 400's – landscaping issues (tree throw, soil compaction, lawn management, etc.)
- 500's – rural wastewater issues (septic systems, cluster systems)
- 600's – drinking water (wells to water softeners)
- 700's – energy (green living, CFL's, appliances)

The following publications are currently in development:

- *Building a Rain Barrel* (HENV-200)
- *Building a Rain Garden* (number to be assigned)
- *Rainwater Harvesting Systems and Cisterns* (number to be assigned)
- *Household Waste Management: Reuse* (HENV-101)
- *Household Waste Management: Reduce* (number to be assigned)
- *Household Waste Management: Recycle* (number to be assigned)

Additional publication (not included in HENV Series):

- *Riparian Buffers: A Livestock Best Management Practice for Water Quality* (ID-175), available online at [www.ca.uky.edu/agc/pubs/id/id175/id175.pdf](http://www.ca.uky.edu/agc/pubs/id/id175/id175.pdf)

**ENRI Web Site.** The ENRI Web site ([www.ca.uky.edu/enri](http://www.ca.uky.edu/enri)) contains information on groundwater (e.g., publications, radio scripts, activities). In addition, the site has information on watersheds, stormwater, nutrient management, the Kentucky Agriculture Water Quality Act, and the Kentucky Water Awareness Month packet. An Upcoming Events page provides information on current events such as Groundwater Awareness Week and Kentucky Water Awareness Month. The site is maintained by Ashley Osborne, ENRI Extension associate.

**ENRI Quarterly Newsletter.** The ENRI Newsletter ([www.ca.uky.edu/enri/newsletter.php](http://www.ca.uky.edu/enri/newsletter.php)) is distributed to County Extension agents and other natural-resource professionals throughout Kentucky. Newsletters contain information about current research, resources (e.g., new publications, training, etc.), and events. Newsletters are coordinated by Ashley Osborne, ENRI Extension associate.

**Consumer Radio Tips.** The following 60-second radio scripts were recorded by the University of Kentucky Agricultural Communications Service:

- Fats, Oils, and Greases (FOG's)
- Groundwater Awareness Week
- Kentucky Water Awareness Month
- Storm vs. Sanitary Sewers
- Septic Systems
- Soil Tests
- Native Plants
- What Is Karst?
- Farm Dumps

These scripts were developed and recorded by Amanda Gumbert, UK water-quality liaison, and Ashley Osborne, ENRI Extension associate.

**"See Blue Go Green" Web Site.** The "See Blue Go Green" Web site ([www.ca.uky.edu/gogreen](http://www.ca.uky.edu/gogreen)) contains information for all Kentuckians regarding topics such as drinking water, stormwater, wastewater, water quality, etc. The site includes publications, fact sheets, radio scripts, displays, lesson plans, activities, and links. It is maintained by Ashley Osborne, ENRI Extension associate.

**Kentucky Water Awareness Month Packet.** Each May, citizens across Kentucky celebrate Water Awareness Month. This program first began in 1996 as an educational tool of the University of Kentucky Cooperative Extension Service to promote water awareness. Program materials are developed by a committee at the state level, and distributed (via listserv) to each of the 120 County Extension offices. Counties across the commonwealth participate in activities such as after-school programs, environmental day camps, and homemaker club meetings. The 2010 Kentucky Water Awareness Month materials are available online at [www.ca.uky.edu/enri/kwam2010.php](http://www.ca.uky.edu/enri/kwam2010.php), and include a calendar, flyer, and several fact sheets, radio scripts, and activities. The

packet is coordinated by Ashley Osborne, ENRI Extension associate.

**4-H<sub>2</sub>O Ambassador Program.** Kentucky partnered with several states in EPA Regions 4 and 6 to develop the 4-H<sub>2</sub>O Ambassador Program. This program addresses concepts related to watershed education. The program committee has developed curriculum units, each of which focuses on a specific question related to water quality and watersheds. Each unit includes hands-on activities (e.g., chemical, physical, and biological water analysis). These curriculum units were piloted in fall 2009, spring 2010, and summer 2010 in Kentucky and Georgia. The curriculum will be revised in fall 2010. Hands-on training sessions will be offered in 2011. This program is coordinated by Ashley Osborne, ENRI Extension associate.

**Cane Run Watershed Project.** The University of Kentucky has led watershed-based planning, monitoring, and educational efforts as part of the Cane Run Watershed Assessment and Restoration Project. This project is coordinated by Amanda Gumbert, UK water-quality liaison.

Activities in the Cane Run watershed include:

- Continued facilitation of the Cane Run watershed council
- Participation in stream cleanups with Lexmark during Earth Week activities and with UK student volunteers
- Removal of invasive species at Coldstream Park as part of UK's For Unity and Service In Our Neighborhoods (FUSION) project with 13 student volunteers
- Enhancement of a watershed Web site ([www.canerunwatershed.org](http://www.canerunwatershed.org))
- Tours of the Cane Run watershed for UK Natural Resources Conservation and Management program courses, watershed professional development training for teachers, and State/Federal/local agencies
- Coordination with Kentucky Water Resources Research Institute's Water Pioneers program to conduct an educational case study on Cane Run

- Implementation of a watershed-based plan, including the installation of a stream buffer at the Kentucky Horse Park
- Cooperation with the development of the Legacy Trail to install educational signs referencing the Cane Run watershed and related issues
- Acquisition of additional funding for stream-buffer and water-quality research within the Cane Run watershed.

### **Additional Programs**

- Displayed information on the Kentucky Agriculture Water Quality Act at the Kentucky Division of Conservation/Kentucky Department of Fish and Wildlife Resources Wild Game Dinner
- Presented information to Southern States Field Technicians on Kentucky Agriculture Water Quality Act, riparian buffers, and Web soil survey
- Displayed information on the Kentucky Agriculture Water Quality Act at the Wolfe County Farm and Home Night
- Presented Kentucky Agriculture Water Quality Act materials at the University of Kentucky's Field Day in Princeton
- Led UK student volunteers in enhancing stream buffers as part of FUSION
- Displayed Kentucky Agriculture Water Quality Act materials at a Boyd County Woodland Owners short course
- Presented updated Agriculture Water Quality Act and nutrient management information at the Agribusiness Association of Kentucky's annual meeting
- Worked with Division of Conservation staff to continue work on a 319(h) project to address the effectiveness of the Kentucky Agriculture Water Quality Plan, including survey tool development/review and county meetings
- Presented nonpoint-source pollution information for the Robinson Scholar's Academic Explorers program to 58 students
- Served on a water-quality discussion panel for UK's Sustainability Showcase, and discussed the Kentucky Agriculture Water Quality Act
- Coordinated Project Learning Tree and Project Water Education for Teachers Training for educators in collaboration with the Kentucky

Division of Forestry. Theme of training was Protection of Groundwater Through Urban, Agricultural and Environmental Planning.

### ***Kentucky Division of Forestry***

The primary objective of the Kentucky Division of Forestry's Timber Harvest Compliance Program is to protect water quality from nonpoint-source pollution by using best management practices in commercial timber-harvesting operations. This program enforces the minimum performance standards of BMP's mandated by the Agriculture Water Quality State Plan.

For the State fiscal year of July 1, 2009, to June 30, 2010, a total of 5,284 harvest inspections were performed, resulting in 495 enforcement actions. A BMP monitoring study from a recent statewide survey indicated that 68 percent of the applicable BMP's were implemented at the sites examined.

The Kentucky Division of Forestry's Stewardship Program is also proactively involved with mitigating water-quality concerns by providing technical assistance in practice plans for riparian-buffer development within the auspices of the USDA Natural Resources Conservation Service-Conservation Reserve Program. Riparian buffer development (CP-22) is a major component of the Conservation Reserve Enhancement Program within the Green River watershed, in which the Kentucky Division of Forestry continues to play a key role. Within this watershed, the Division of Forestry completed six practice plans involving 18 acres. Statewide, 27 additional practice plans were completed, encompassing 328 acres for the fiscal year.

The Division of Forestry is also addressing water quality by promoting the agriforestry concept of strategically incorporating trees into the agricultural landscape to protect water resources. This integrated watershed approach is very effective in promoting water quality, and many times is economical to the landowner.

Mitigating stormwater issues is a component of the Division of Forestry's Urban Forestry Program. The division's urban forestry specialists are educating community leaders about the many benefits of trees in an urban setting; one example is phytoremediation, or the use of trees to decontaminate soils or water. Urban forestry specialists



are also involved in the local Cane Run focus watershed management group, by addressing water-quality concerns in that important urban landscape in the Bluegrass Region.

Division of Forestry personnel have been assigned to work collaboratively with local groups in four of the five Kentucky Division of Water focus watersheds.

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

Water samples are collected during the investigation of possible mining-related impacts to groundwater in both the Eastern and Western Kentucky Coal Fields. The 2009-10 fiscal year was relatively normal for the Technical Support Section of the Division of Mine Reclamation and Enforcement as far as the number of investigations conducted. DMRE received 102 requests for inspection concerning mining and water issues, and 119 investigations were closed during the 2009-10 fiscal year; 31 were related to diminished quality, 46 to diminished quantity, and six to both. In addition to these, 14 investigations concerned groundwater

seepage or slide-related issues, and the remaining 22 investigations were not related to groundwater. Sixteen investigations found that groundwater quality or quantity had been adversely affected by mining operations, and eight investigations found that mining operations had had an impact on the hydrologic balance, causing landslides of varying magnitudes. All other investigations resulted in a finding of impacts by natural causes or of no impact at all.

### **Funding**

Most of the activities during the reporting period were 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 proactively, which will best serve the needs of citizens, resource managers, and environmental regulators.