

Kentucky Interagency Groundwater Monitoring Network

Annual Report

July 2008–June 2009

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Kentucky Interagency Groundwater Monitoring Network Annual Report July 2008–June 2009 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 (Interagency Technical Advisory Committee, 1996). These activities are conducted in coordination with the Interagency Technical Advisory Committee, composed of representatives from 15 State and Federal agencies and the University of Kentucky. The Kentucky Geological Survey is also charged with reporting network activities on an annual basis to the governor's office and the Legislative Research Commission. This report summarizes activities during the 2008–09 State fiscal year.

From July 2008 through June 2009, 24 data collection programs were under way, and eight major groundwater characterization reports were published. Groundwater information was communicated to the scientific and regulatory communities and to the public through 13 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 11 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 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 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 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 amounts and effects of pesticide metabolites in groundwater

- Increasing the use of stable isotopes, caffeine, and other tracers to indicate contaminant sources and quantify groundwater ages and flow rates
- Quantifying the role of groundwater on the quality and quantity of water in streams as related to water-quality standards, total maximum daily loads, and designated uses.

The Kentucky Interagency Groundwater Monitoring Network will continue to address these issues. Significant 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 Branch, the Kentucky Division of Pesticide Regulation, 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.

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.

Information provided by the Kentucky Division of Water indicates that more than 300,000 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 considering 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.

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. The 1998 General Assembly 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.

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 tenth annual report of the Kentucky Interagency Groundwater Monitoring Network. Previous reports are posted at www.uky.edu/KGS/water/gnet/.

2008-09 Activities and Accomplishments

Brief summaries of work performed by the ITAC agencies during the 2008-09 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.

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 (1997) 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 used by the public, such as roadside springs.

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 maintains an active groundwater sample collection and analysis program. The following projects have been active during the report period.

Ambient Groundwater Monitoring Network. Regularly scheduled sampling continued for the statewide Ambient Groundwater Monitoring Network. This fiscal year 123 samples were collected from 55 sites (wells and springs) across the state. Groundwater-quality data were provided to numerous persons through information requests. Data were also included in statistical analyses for regional and watershed-based groundwater assessments.

Pesticides Memorandum of Agreement Project. This project with the Department of Agriculture is composed of 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 network sites are submitted to the Department of Agriculture annually.

Complaint Sampling. The Division of Water responds to complaints about groundwater and conducts investigations as requested by the general public. In this fiscal year the Division collected 24 samples from 24 sites in response to complaints. The majority of these samples are collected by personnel from Kentucky Division of Water regional offices.

Nonpoint-Source Groundwater Assessments. The Division currently has five active nonpoint-source projects in various phases, from reconnaissance and site selection to drafting final reports.

Groundwater Quality Assessment in the South Elkhorn Creek Watershed. This project is nearing completion, and a draft report has been submitted for internal review. A summary presentation has been made at water resource conferences.

Sample results indicate definite nonpoint-source impacts to groundwater from *E. coli*, pesticides, total suspended solids, nitrate (as

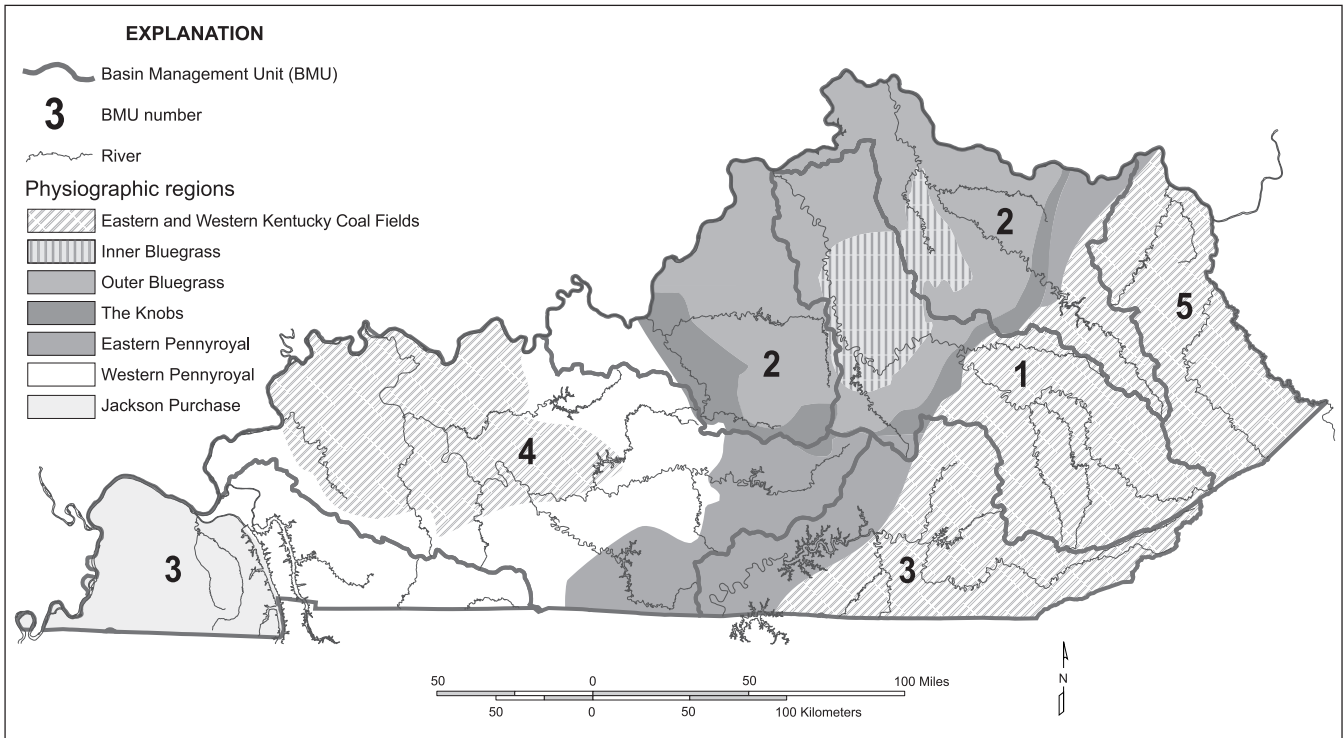


Figure 1. Major rivers, basin management units, and physiographic regions in Kentucky.

N), orthophosphate (as P), and total phosphorus. Potential nonpoint-source impacts were noted for chloride. There seems to be little or no correlation between land-use types (agricultural versus urban or residential) and overall groundwater quality.

Twelve tracer tests were recovered during this study, which allowed two additional karst groundwater basins to be delineated and for previously unknown hydrogeologic connections to be made within groundwater basins. These data, in combination with previous tracer data, were used to assess USGS hydrologic unit code delineations for surface watersheds. Deviation of karst groundwater basin margins from topographic watershed divides have serious implications for hydrologic modeling, total maximum daily loads, and emergency responders.

Groundwater Quality Assessment in the Sinking Creek and Beargrass Creek Watersheds. The report for this project is currently being written. 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 in Jefferson County have been presented at water resource conferences.

Integrated Surface-Water and Groundwater Assessment of Large Springs in the Green River Basin. The report for this project is also being written. 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 Plateaus Region were monitored for 1 year. Data obtained were sufficient to assess these springs and to have them listed on the 2008 Integrated Report-305(b)/303(d).

Nine of the 10 springs assessed in the Green River Basin were designated as not supporting primary contact recreation and one spring was designated as partially supporting. Five of these springs fully supported aquatic life use, and the other five springs partially supported it.

The final report for this project will discuss each spring assessment relative to the primary contact recreation and aquatic life use standards

set forth in 401 KAR 10:031. The report will also include findings for biological population assessments and tracer tests conducted to delineate and refine these identified karst groundwater basins. The final report should be submitted in October 2009. Results of this study have been presented at water-resource conferences.

Basin Management Unit 5 (Elkhorn Creek Subbasin) Groundwater Study. 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 tests for iron-related bacteria, sulfate-reducing bacteria, and slime-forming bacteria. A preliminary draft is in progress.

Western Pennyrile Karst Study. Work on this project began in late fall of 2008. Field reconnaissance and a hydrogeologic inventory as preparation for tracer tests are currently being conducted throughout the study area. Following completion of the tracer tests and delineation of karst groundwater basins, monitoring sites will be chosen. This project will incorporate the integrated surface-water and groundwater assessment approach.

Groundwater Protection Plan Program. The Groundwater Protection Plan Program is operated out of the Groundwater Section. It was established in 1994 by 401 KAR 5:037 in response to requirements of the Clean Water Act. These regulations require persons or entities who conduct activities with the potential to pollute groundwater to develop a groundwater protection plan. Since the spring of 2008, renewed efforts have been made to educate the public about this program. To this end, attention has been refocused on providing groundwater protection plan training through presentations and forums within various State government agencies, especially those that have direct contact with the public, to raise awareness of this program.

Certified Drillers Program. Regulations for water-well drillers' certification and well construction

practices and standards were revised and filed with the Legislative Research Commission. The certification regulation was revised, construction standards for water-supply wells were updated, and a separate regulation was written for monitoring-well construction practices. In addition, a more comprehensive definitions regulation that reflects professional and technical changes within the profession was written. The new regulations can be viewed through the Division Web site, www.water.ky.gov/gw/gwtech/gwdrill/.

Special Projects. The Division conducted 20 dye traces for karst mapping projects and groundwater technical assistance. We also assisted nine county health departments with dye traces for localized contaminant investigations.

Personnel from the Groundwater Section assisted the Division of Mining Reclamation and Enforcement with a dye-trace study to determine potential groundwater impacts of a proposed quarry in Todd County near Cooksey Spring. Based on the results of the tracer test, the Division of Mining Reclamation and Enforcement has required the quarry owners to conduct further subsurface investigation to provide proof that quarry operations will not adversely affect groundwater in the area.

U.S. Geological Survey

Louisville Water Company, Ohio River Alluvial Aquifer, Jefferson County. The USGS, in cooperation with the Louisville Water Company, 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 is measured quarterly at the other 14 observation wells. These data help the Louisville Water Company design and implement riverbank 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.

Maxey Flats Low-Level Radioactive Waste Repository, Fleming and Rowan Counties. USGS continues to provide technical assistance to the Division of Waste Management in regard to oversight of the closure of the Maxey Flats repository.

Continuous water-level data were collected from June 30, 2008, through July 8, 2009, in 15 monitoring wells at the site. Five of these wells are also sampled semiannually for tritium concentrations.

Groundwater-Level Data Collection. 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 via the Internet at groundwaterwatch.usgs.gov/ or ky.water.usgs.gov/. Two additional long-term observation wells in downtown Louisville are also maintained by USGS and 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 the USGS Web site at 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 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. 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; some are as high as 800 mg/L. 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 Kentucky Geological Survey continued studies of groundwater for public water supplies for small communities and rural neighborhoods. The Survey continued to work with the city of Evarts, Harlan County, to develop groundwater supplies by testing the water quality in two newly drilled wells and analyzed general groundwater conditions for future planning. An aquifer test was completed for the city of Campton, Wolfe County. The hydraulic and chemistry data were used by a consulting engineer to complete the successful application for funds to build a new water-treatment plant. Both the Evarts and Campton sites target sandstone units of Early Pennsylvanian age. Remotely sensed data and field observations were used to site new wells in fracture zones that tend to produce more groundwater than surrounding areas. KGS conducted a pumping test for a new municipal well in Greenville, Muhlenberg County, at a depth of approximately 850 feet. Hydraulic analyses and quality data were collected and reported to a consulting engineer. KGS continues to provide information to the city of Marion, Crittenden County, and their consulting engineer concerning the use of abandoned, underground fluorspar mines as potential water supplies. In addition, KGS assisted the city of Sturgis, Union County, by sampling a monitoring well installed to assess the groundwater quality of a proposed municipal well site.

Groundwater Conditions in the Cumberland Gap Tunnel. KGS, in coordination with the Cumberland Gap Tunnel Authority, the Federal Highways Administration, the Kentucky Transportation Cabinet, the University of Kentucky Transportation Center, and Vaughn and Melton Engineers Inc., completed installation of 23 new monitoring wells in the tunnel and completed one round of sampling the

quality of 50 wells to further delineate a problem with dissolution of the limestone aggregate road-base in certain areas in both the northbound and southbound tunnel bores. Remediation measures are being considered by the Kentucky Transportation Cabinet.

Cane Run Watershed. In 2006, the Kentucky Division of Water named Cane Run watershed one of four focus watersheds for clean-up under the State's nonpoint-source pollution program. This watershed begins in Lexington (Fayette County) and ends in Scott County where Cane Run discharges into North Elkhorn Creek. Because of karst bedrock, Cane Run only flows during times of sufficient rainfall, usually in the spring of the year. The remainder of the time, most water is recharged to an underground conduit system that leads from Lexington to Royal Springs, the major water supply for Georgetown, Scott County. The Kentucky Geological Survey is leading an effort to locate sites to monitor the underground conduit. Electrical-resistivity and spontaneous-potential geophysics are being used to help pinpoint the location of the active conduit at three locations. Additional monitoring wells will be drilled in the future at selected sites. This work is being carried out in cooperation with the University of Kentucky College of Agriculture and Department of Earth and Environmental Sciences.

Selenium Concentrations in the Aquatic Environment. In cooperation with the Kentucky Division of Water, which is providing funding, the Kentucky Geological Survey is developing a database of selenium concentrations in water and fish tissue from the Eastern Kentucky Coal Field. The operating hypothesis is that groundwater moving through bedrock and areas of coal-mine spoil dissolves selenium initially concentrated in the coals during their formation. The groundwater eventually discharges to surface waters, where selenium may metabolize and bioaccumulate into toxic forms and concentrations in the food chain. Thirteen sites were sampled in 2007 and 2008: 37 water samples, 25 sediment samples, and 29 fish tissue samples, for which seven forms of selenium were analyzed, along with standard chemical analyses to help define the hydrogeochemical environment. Data interpretation and statistical analyses began

in February 2009 and are continuing. Development of a report on the data began in June 2009.

Karst Activities. KGS staff completed a project for the Transportation Cabinet to assess the potential consequences of routing overland runoff from one karst groundwater basin to another along the extension of the Edward T. Breathitt Pennyriple Parkway, southern Christian County. In cooperation with the Division of Water, the karst groundwater basin map for the Tell City 30 x 60 minute quadrangle was completed and will be released soon.

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 model karst ordinance for guiding development in terrain has been completed and delivered to over 70 Kentucky fiscal courts and planning agencies.

Health Conditions Associated with Domestic Well Water Use. This work examines the health of citizens in western Kentucky who rely on groundwater for their drinking-water supply. Results from a survey designed to record health conditions will be combined with water-quality data. The resulting data set will be analyzed for health effects related to nitrate-nitrogen, herbicides, and bacteria in the drinking water. In April 2009, 550 well owners were asked to complete the health survey. As of July 1, 2009, 25 percent of the well owners have responded. A second mailing occurred in July. This project began in May 2008 and runs until January 2010. It is a joint project between the University of Kentucky College of Public Health and the Kentucky Geological Survey.

Assessment of CO₂ Injection on Local Groundwater Quality. Two carbon sequestration projects are under way in the state, both of which require monitoring shallow (less than 200 feet below land surface) groundwater. One project, in Hancock County, investigates the feasibility of injecting CO₂ into deep (more than 8,000 feet below land surface) saline aquifers. The second project, in Hopkins County, investigates the feasibility of injecting CO₂ into an oil-producing formation to enhance

recovery. The sampling will characterize the local groundwater quality and assess any changes in quality that may be associated with CO₂ injection. Groundwater sampling associated with both projects is expected to continue through 2012.

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 2008-09 fiscal year, groundwater information was communicated via short reports, oral and poster presentations at meetings and conferences, and placement on Web sites.

Publications

- Beck, E.G., Parris, T.M., and Williams, D.A., 2009, Western Kentucky deep saline reservoir CO₂ storage test: Preliminary environmental assessments and monitoring: Kentucky Water Resources Research Institute annual symposium, Program and Abstracts, p. 51-52.
- Currens, J.C., and Paylor, R.L., 2009, Mapping karst groundwater basins along the E.T. Breathitt Pennyryle Parkway, Christian County: Final report by Kentucky Geological Survey submitted to Kentucky Transportation Cabinet, Division of Drainage Design, 17 p.
- Currens, J.C., Paylor, R.L., and Crawford, M.M., 2009, Karst potential and development indices: Tools for mapping karst at the regional scale: Proceedings, International Congress of Speleology, v. 1, p. 425-430.
- Davidson, B., 2009, Groundwater data on the Web: Search engines for the Kentucky Groundwater Data Repository: Kentucky Water Resources Research Institute annual symposium, Program and Abstracts, 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. 74, no. 1, p. 56-64.

Ray, J.A., Moody, J.R., Blair, R.J., Currens, J.C., and Paylor, R.L., in press, Mapped karst groundwater basins in the Tell City and part of the Jasper 30 x 60 minute quadrangles: Kentucky Geological Survey, ser. 12, Map and Chart 192, scale 1:100,000.

Presentations

- Blair, R.J., and Goodmann, P.T., 2008, 2009, Integrated surface- and groundwater assessments in karst regions of Kentucky: Groundwater Protection Council annual symposium, Cincinnati, Ohio, Sept. 23, 2008; Mid West Groundwater Conference, Dubuque, Iowa, Sept. 29, 2008; Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 2, 2009.
- Jackson, D.A., 2009, Summary of changes to 401 KAR Chapter 6 (Driller Regulations): Kentucky Groundwater Association Annual Water Well Drillers Workshop and Conference, Louisville, Ky., March 5-6.
- Keefe, P.K., 2009, Groundwater protection plans: Kentucky Water Resources Research Institute annual symposium, Lexington, Ky., March 2.
- Lyne, K.L., and Blair, R.J., 2008, Efficiently locating and repairing damaged sewer lines in a karst terrane: Groundwater Protection Council annual symposium, Cincinnati, Ohio, Sept. 23; Mid West Groundwater Conference, Dubuque, Iowa, Sept. 29.
- Ray, J.A., Blair, R.J., and Webb, J.S., 2008, Karst groundwater infiltration of the sanitary sewer within the Beargrass Creek watershed, Jefferson County, Kentucky: Groundwater Protection Council annual symposium, Cincinnati, Ohio, Sept. 23; Mid West Groundwater Conference, Dubuque, Iowa, Sept. 29.
- Takacs, K.G., Beck, E.G., and Parris, T.M., 2009, Sugar Creek CO₂-EOR project: Kentucky Oil and Gas Association annual meeting, Lexington, Ky., June 10, 2009.

Web Site Information

The Kentucky Geological Survey provides online access to information about water wells and springs at kgs.uky.edu/kgsweb/DataSearching/watersearch.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/), 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/.

Statewide groundwater data in the Kentucky Groundwater Data Repository can be accessed at 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 6,368 times during fiscal year 2008-09, and 639 downloads were made. It is the second most popular search engine on the KGS Web site after oil and gas records. Users can search for wells or springs by county, 7.5-minute quadrangle, or by 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 over 3,100 times during fiscal year 2008-09, and 161 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/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 that have interests 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 Groundwater Branch

since 1992. There has also been a high level of collaboration and data sharing between KGS and the Groundwater Branch during the reporting period, as the agencies are jointly reporting on groundwater quality throughout the state. During 2008-09, electronic data files of water-well, spring, and groundwater-quality data were transferred from the Division of Water to the Kentucky Geological Survey, and are in the process of being uploaded to the Kentucky Groundwater Data Repository.

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

ENRI Web Site. The ENRI Web site (www.ca.uky.edu/ENRI/) contains information (e.g., publications, radio scripts, activities) on groundwater. In addition, the site includes information on watersheds, stormwater management, nutrient management, and the Kentucky Agriculture Water Quality Act, as well as 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) is distributed to County Extension agents and other natural-resource professionals throughout Kentucky. Newsletters include 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:

- Storm Drain Awareness
- Rain Barrel/Stormwater Prevention
- Proper Disposal of Pharmaceuticals
- Kentucky Water Awareness Month
- Auto Pollution and Eco-Friendly Travel
- Recycling Used Oil
- Safe Chemical Storage
- What Is a Watershed?
- Farm Dumps
- Sinkholes
- Integrated Pest Management
- Filter Strips
- Atrazine Use and Pollution Prevention
- Diagnosing Septic System Problems with Turfgrass
- Avoiding Soil Compaction on Septic Systems
- Caring for a Septic Tank

These scripts were developed and recorded by Amanda Gumbert, UK water quality liaison; Brad Lee, extension water quality specialist; and Ashley Osborne, ENRI extension associate.

“See Blue Go Green” Web Site. The “See Blue Go Green” Web site (www.ca.uky.edu/gogreen/) contains information for all Kentuckians regarding “green” topics (e.g., 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. May is Water Awareness Month in Kentucky. This program first began in 1996 as an educational tool of the University of Kentucky Cooperative Extension Service. Program materials are developed by a committee at the state level, and distributed as packets to each of the 120 County Extension offices (www.ca.uky.edu/ENRI/kwam.php).

Water Awareness Month activities include after-school programs, environmental day camps, and homemaker club meetings. In March 2009, packets were distributed and included radio scripts and short media articles, fact sheets, activities, and brochures on stormwater management, proper disposal of pharmaceuticals, and saving money by saving water. Many materials included in the 2009

packet are available online at www.ca.uky.edu/ENRI/kwam2009.php. The packet is coordinated by Ashley Osborne, ENRI extension associate.

4-H₂O Ambassador Program. Kentucky partnered with several states in EPA Regions 4 and 6 to develop the 4-H₂O 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 will be piloted in fall 2009 and spring 2010. The program is coordinated by Ashley Osborne, ENRI extension associate.

Cane Run Watershed Project. The University of Kentucky has led educational efforts as part of the Cane Run Watershed Assessment and Restoration Project. Educational efforts have included the facilitation of the Cane Run Watershed Council, which meets on a quarterly basis. A listserv for the group has been developed, and is used for information exchange among the watershed stakeholders. The group allows for public involvement in the watershed-based plan development process.

Other activities include:

- Watershed signs installed in four city parks in the Cane Run watershed
- Stream clean-ups with Lexmark during Earth Week activities
- Trash pickup in the Green Acres subdivision of Lexington by 13 student volunteers as part of UK's For Unity and Service in Our Neighborhoods (FUSION) project
- Development of a watershed Web site (www.canerunwatershed.org)
- Watershed tours of Cane Run for UK Natural Resources Conservation and Management program courses, watershed professional development training for teachers, and others
- Coordination with Kentucky Water Resources Research Institute's Water Pioneers program to conduct a case study on Cane Run

Kentucky Division of Forestry

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

For the fiscal year of July 1, 2008, to June 30, 2009, 5,159 harvest inspections were performed, resulting in 486 enforcement actions. A BMP monitoring study from a recent statewide survey indicated that 68 percent of the applicable BMP's were implemented on the sites examined.

The Kentucky Division of Forestry's Stewardship Program is also proactively involved with mitigating water-quality concerns by providing technical assistance to practice plans for riparian buffer development under the auspices of the U.S. Department of Agriculture-Natural Resources Conservation Service's Conservation Reserve Program. Riparian buffer development is also a major component of the Conservation Reserve Enhancement Program in the Green River watershed, in which the Kentucky Division of Forestry continues to play a key role. In this targeted project area, the Division of Forestry completed 58 practice plans involving 247 acres for fiscal year 2008-09.

The Division of Forestry is also beginning to promote the new "agroforestry" concept of strategically incorporating trees into the agricultural landscape to protect water resources and meet landowner objectives. This integrated watershed approach is very effective in promoting water quality, and can be economical for the landowner when implemented.

Mitigating stormwater issues is a component of the Division of Forestry's Urban Forestry Program. The Division's urban forestry specialists educate community leaders about the many benefits of trees in an urban setting, one of which is phytoremediation (or the use of trees to decontaminate soils or water). Urban forestry specialists within the Division are also involved in the local Cane Run Focus Watershed Management Group, addressing water-quality concerns for that important urban landscape of the Bluegrass Region.

Division of Forestry personnel are assigned to work collaboratively with the local groups in four of the five 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. This past fiscal year the Technical Support Section of the Division of Mine Reclamation and Enforcement conducted a normal number of investigations. An extended drought in eastern Kentucky ended in December 2008. Wells that had been dewatered or partially dewatered began to recharge, and the proportion of water-quality complaints to dry-well complaints increased dramatically. The instances of methane production from domestic water wells in the Eastern Kentucky Coal Field associated with lowered groundwater levels declined from the previous year, but several cases were still reported.

The Division received 72 requests for inspection related to groundwater issues, and of the 53 investigations closed during the 2008-09 fiscal year, 15 found that groundwater quality or quantity had been affected by mining operations. The remaining investigations resulted in a finding of no impact or impacts by natural causes.

Summary

The Kentucky Interagency Groundwater Monitoring Network was established by the Kentucky General Assembly to increase knowledge and awareness of groundwater resources. For 11 years, the Network has met its obligation of collecting and interpreting data, communicating findings, sharing data, and promoting interagency cooperation. Significant progress has been made over this period, particularly over the past fiscal year; however, critical questions remain to be addressed.

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.

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.
- Kentucky Division of Water, 1997, Kentucky watershed management framework: Kentucky Division of Water, 53 p.