Mar 20th, 3:10 PM

Session 1C (Source Water Protection)

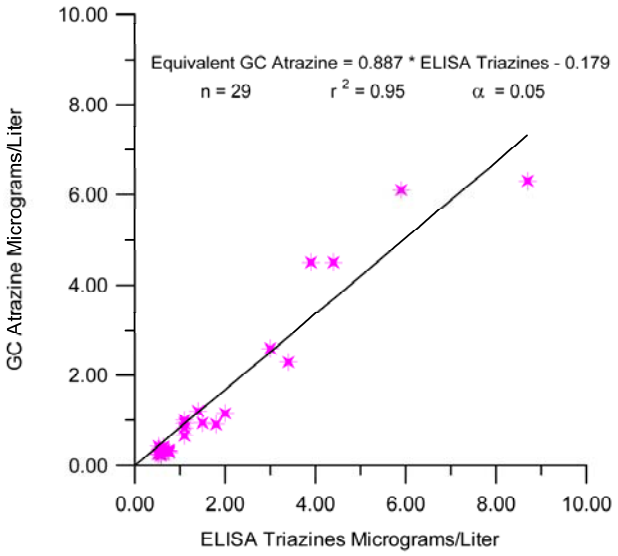
Kentucky Water Resources Research Institute, University of Kentucky

THE PLEASANT GROVE SPRING NONPOINT-SOURCE POLLUTION STUDY: REVIEW OF AN UNDERUSED DATA SET

James C. Currens, M.S., P.G.
Kentucky Geological Survey, University of Kentucky
504 Rose St., 228 Mining and Mineral Resources Building
Lexington, KY 40506-0107
859-323-0526
currens@uky.edu

Younger researchers in Kentucky may not be familiar with the karst groundwater-quality work done at Pleasant Grove Spring in Logan County nearly 30 years ago (Currens, 1999, 2005). The location was chosen to monitor water quality during the adoption of best management practices intended to protect groundwater from pollutants generated by modern agriculture. The study determined the basic hydrogeology, springshed boundaries, fundamental groundwater-quality parameters, and the measured flux of pollutants. Ninety-two percent of the 4,069-hectare springshed is used for agriculture. During the 1990-91 water-year, reconnaissance samples were collected and the karst hydrogeology was mapped. The second year, instrumentation was installed in the springshed where natural features allowed access to resurging groundwater. In the 1992–1994 water years, water-quality sampling was conducted before BMPs were put in place. Water-quality monitoring and sampling was continued through November 1998.

The data set is large and contains water-quality analyses for 1,226 samples from Pleasant Grove Spring, 174 samples from George Delaney swallow hole, and Upper Pleasant Grove Creek, and 398 samples from Leslie Paige karst window. Spring Valley karst window, the Canyon karst window, and other topical sites were sampled less frequently. The data set also contains quality-control and precipitation samples. The discharge data include rating curves for six locations (Pleasant Grove, Spring Valley, Leslie Paige, George Delaney, and Upper Pleasant Grove Creek); stage data were recorded every 10 minutes. The discharge records cover May 1992 through November 1998. The Pleasant Grove Spring discharge record is nearly 100 percent complete between those dates and includes more than 341,000 records. The Leslie Paige karst window stage record is 84 percent complete and has nearly 281,000 observations.



Cross plot of triazine determinations by ELISA (Immunoassay) versus atrazine by gas chromatograph (GC).

Water samples were analyzed using two constituent lists: a comprehensive group that included major ions as well as nutrients and pesticides measured by both gas

chromatograph and immunosorbent assay, and a "base" flow list limited to nitrate and four pesticides measured by ELISA. Bacteria samples were also collected. The figure above illustrates the precision of the results from ELISA analyses for triazines and gas chromatograph analysis of atrazine, one of the pesticides that make up the triazines group. The linear regression is remarkable in that the correlation coefficient is 0.95.

The pre- and post-BMP water quality was statistically evaluated by comparing the annual mass flux, annual descriptive statistics, and population of analyses for the two periods. Nitrate-nitrogen concentration was essentially unchanged. Pre-BMP nitrate-nitrogen concentration averaged 4.65 mg/L, and post-BMP average was 4.74 mg/L. Total suspended solids concentration decreased slightly, whereas orthophosphate concentration increased slightly. The pre-BMP median total suspended solids concentration was 127 mg/L, and post-BMP was 47.8 mg/L. The pre-BMP median triazine concentration measured by ELISA was 1.44 μg/L and the post-BMP was 1.48 μg/L. However, increases in atrazine-equivalent flux and triazine geometric averages were not statistically significant. Fecal streptococci counts were reduced post-BMP. Pre-BMP median bacteria counts were 418 colonies per 100 ml for fecal coliform and 540 col/100 ml for fecal streptococci. The median fecal coliform count increased to 432 col/100 ml after BMP implementation, but the median fecal streptococci count decreased to 441 col/100 ml.

In the fall of 1995, approximately 72 percent of the watershed was enrolled in BMPs sponsored by the U.S. Department of Agriculture's Water Quality Incentive Program. Among the BMPs available, record-keeping was the most widely used (2,365 ha), followed by conservation cropping sequence (2,046 ha) and crop residue use (1,839 ha). The application of conservation cover crops, pasture management, and nutrient management were the next most used practices (average of 300 ha), and the practices most likely to benefit the groundwater. Other practices used were conservation tillage, filter strips, grasses and legumes in rotation, livestock exclusion, pasture planting, pest management, and waste utilization. The BMPs were only partially successful because the types available and the rules for participation resulted in less effective BMPs being chosen.

An example of potential uses of the data from the Pleasant Grove Study is a project conducted in 2007. Austin Peay State University secured a grant from the Kentucky nonpoint-source program to implement a stream restoration project on Pleasant Grove Creek from Pleasant Grove Spring to the Red River, a tributary of the Cumberland River.
(http://www.redriverwatershed.org/pleasant%20grove.htm last visited Jan. 24, 2017).

References Cited

Currens, J.C., 1999, Mass flux of agricultural nonpoint-source pollutants in a conduit-flow-dominated karst aquifer, Logan County, Ky.: Kentucky Geological Survey, ser. 12, Report of Investigations 1, 151 p.

Currens, J.C., 2005, Changes in groundwater quality in a conduit-flow-dominated karst aquifer as a result of best management practices: Kentucky Geological Survey, ser. 12, Report of Investigations 11, 62 p.

KENTUCKY'S SOURCE WATER PROTECTION PROGRAM

Robert J. Blair, P.G.
Kentucky Division of Water
300 Sower Boulevard, Frankfort, KY 40601
(502)782-6893
robert.blair@ky.gov

During the late 1990s and early 2000s the Kentucky Source Water Protection programs were developed with the implementation of the Wellhead Protection Program (WHPP) and Source Water Assessment and Protection Program (SWAPP) for drinking water systems. Kentucky's SWAPP was the first in the country to be approved by EPA. While these programs have sometimes worked in tandem, the programs have been administered by different groups within the Division of Water (DOW). The WHPP, required by state regulation, provides for phased plan development and 5-year updates. The SWAPP is also required by regulation, but does not carry similar provisions for regular updates.

There are approximately 400 community drinking water systems in Kentucky, serving roughly 95% of the state's population. Recent national and local events have exposed potential threats to drinking water quality and increased public awareness of protecting drinking water supplies. The DOW has recently combined the WHPP and SWAPP programs under a single Source Water Protection (SWP) program, administered by the Watershed Management Branch. SWP personnel are focused on evaluating and improving the program and have identified four avenues of program advancement. The first is through evaluating current SWP plans and prioritizing their updates based on need and potential outcomes. The next is to identify partnerships and encourage stakeholder collaboration. DOW has also developed an assistance program that provides funding for SWP projects conducted by water systems and/or the entities that they serve. The last is SWP promotion through meetings and conferences across the state to inform stakeholders and the general public. Utilizing these initiatives and stakeholder feedback, DOW will develop an effective SWP program focused on assistance and implementation.

NOTES

ASSISTANCE PROGRAM FOR SOURCE WATER PROTECTION: SUCCESS IN KENTUCKY

Laura A. Norris and Allan D. Shingleton
Kentucky Division of Water
Watershed Management Branch
300 Sower Blvd.
Frankfort, KY 40601
(502)-782-7029
laura.norris@ky.gov

Source water protection is a dynamic approach to guarding public health by protecting drinking water supplies. However, water systems often have limited control of the activities occurring within their source water protection areas. An effective means to reduce water treatment costs and safeguard water supplies is to protect and improve the contributing area.

Planning source water protection is the first step to ensure safe drinking water. However, strategies with a high likelihood of implementation will create the most positive impact. In order to assist public water suppliers with their protection measures, the Kentucky Division of Water has developed the Source Water Protection Assistance Program (SWPAP). The program is designed to provide communities with funding to develop and implement projects within a one-year time frame. Eligible activities include those projects that lead to a reduced risk of degradation or contamination of the drinking water source and must provide long-term benefits to source water quality.

SWPAP began in 2014 and has since funded diverse and creative projects across the Commonwealth. The number of applications and competition for funding has steadily increased and this is expected to continue. Many projects were completed in a short period of time such as plugging unused water wells or public education events. Other projects have been more in depth, such as implementation of Best Management Practices around a reservoir to reduce the nutrient load, or surveying unused septic systems within a Wellhead Protection Area. Regardless of whether the project is strictly planning, implementation, or a combination of both, the overall goal is to positively impact the quality and quantity of the public drinking water supply. The efforts made by the water systems and entities they serve continue to indicate an optimistic future for Source Water Protection in Kentucky.

NOTES