Eastern Kentucky Seismic Monitoring

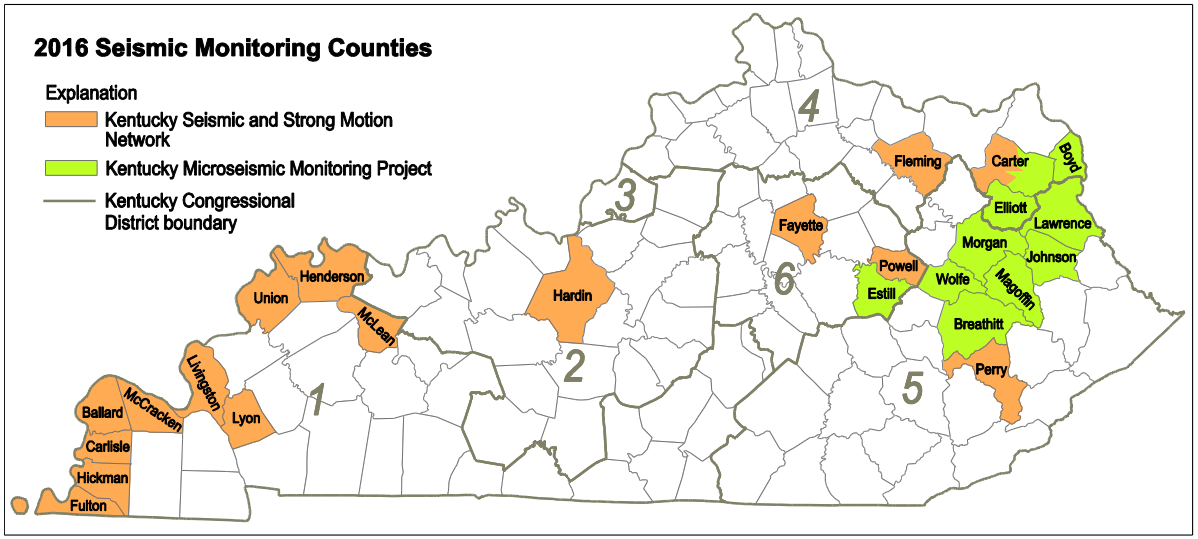
As part of the Eastern Kentucky Microseismic Monitoring Project, KGS has installed 12 sensitive seismometers to augment the pre-existing regional seismic network.

These seismometers can detect extremely small seismic events, below the level felt by humans. Determining the level of natural microseismic activity is important in identifying whether human activity, such as underground wastewater disposal or fracking, might induce earthquakes in Kentucky. The oil and gas exploration company Cimarex Energy and the instrumentation company Nanometrics, along with the Earth and Environmental Sciences Department at UK, are partnering with KGS. Each of the new stations operates autonomously, powered by solar-charged batteries and communicating wirelessly over cellular networks, allowing real-time data analysis at KGS. Recordings are displayed on the KGS website.

The microseismic network will also allow early identification of human-induced seismic activity, helping to establish characteristics that differentiate manmade from natural events, so that necessary steps can be taken to prevent larger events from occurring.

For more information on earthquakes and geologic hazards, please visit www.uky.edu/KGS/geologichazards .

Collectively, the new seismic and groundwater monitoring networks and other KGS research programs will help ensure that Kentucky's water, land, and mineral resources are protected and wisely used and managed for all present needs as well as for future generations.



Water and Seismic Monitoring Networks in Kentucky

Kentucky Geological Survey, University of Kentucky

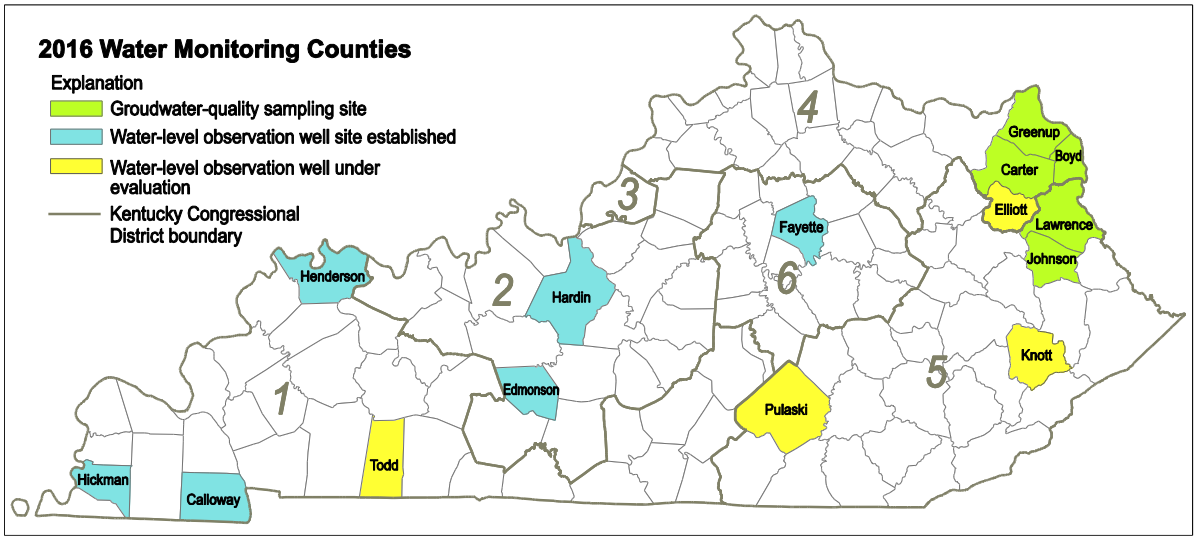
UNIVERSITY OF KENTUCKY
Kentucky Geological Survey
www.uky.edu/KGS

The Kentucky Geological Survey is installing advanced monitoring networks across the commonwealth to ensure that new energy and agricultural development has no adverse effects on the environment. These monitoring networks are designed to provide important baseline data on:

- ***Seismic activity***, particularly microearthquakes like those linked to oil and gas activity elsewhere
- ***Groundwater levels***, to allow tracking and assessment of groundwater recharge and availability
- ***Groundwater quality and dissolved gas contents***, prior to significant unconventional oil and gas development

Kentucky Groundwater Monitoring

Concerns about potential impacts of drought and increasing groundwater withdrawals for agricultural and energy-extraction industries have made monitoring groundwater quantity and quality throughout Kentucky a high priority. KGS is establishing a new long-term water-level observation network as part of a State-mandated groundwater monitoring program. In 2016, KGS began work needed to establish 15 observation wells at selected critical locations throughout Kentucky. At present, KGS has established nine observation wells in six counties, and existing wells located in four other counties



are under evaluation. Additional well sites are anticipated in other counties before the end of 2016. Data collected from the KGS observation well network will improve water resource managers' ability to track changes in groundwater availability, predict the occurrence and potential severity of droughts, and assess the impacts of changes in groundwater conditions on Kentucky's freshwater aquifers and surface streams.

In addition to the groundwater-level observation network, KGS is collecting baseline groundwater-quality data from five counties in eastern Kentucky in the Berea Sandstone and Rogersville Shale unconventional resource area. Samples from domestic water wells are being analyzed for inorganic and organic constituents and dissolved gases. Approximately 50 wells will be analyzed in this study. The project is also testing new well-sampling protocols that will be recommended for future use by industry. This dataset will be important as a reference to infer potential impacts of future unconventional oil and gas development on groundwater quality. For more information on water resource research at KGS, please visit www.uky.edu/KGS/water .

The groundwater-quality monitoring project was funded by a grant from the Research Partnership to Secure Energy for America, in collaboration with the Environmentally Friendly Drilling Systems consortium (www.efdsystems.org).

At the Kentucky Geological Survey, our mission is to increase knowledge and understanding of the mineral, energy, and water resources, geologic hazards, and geology of Kentucky for the benefit of the commonwealth of Kentucky and the nation.