GIS in Kentucky

What is a GIS?

A GIS (Geographic Information System) is any system capable of capturing, storing, analyzing, and displaying geographically referenced information; that is, data identified by location. Your brain working with a map is a GIS. Computer hardware and GIS software are part of a GIS that provides tools for visualizing, exploring, querying, editing, and analyzing information linked to geographic locations.

Universities and local, state, and federal agencies all participate in a Kentucky GIS system that is distributed across the Commonwealth, sharing data, expertise, and resources. The KYGEONET at the Kentucky Division of Geographic Information and the Water Resources Information System at the Kentucky Infrastructure Authority are examples of sites that help to collate and distribute data.

How does a GIS work?

The power of GIS comes from its ability to relate different information in a spatial context and to reach a conclusion about this relationship. Where are the sinkholes in relation to the proposed highway location? Where is the unstable shale in relation to the proposed development? Where are the water sources that might be impacted by the chemical spill? This is accomplished by using a location reference system, such as latitude and longitude, to understand the spatial relationships in our environment. GIS can reveal and communicate important new information that leads to better decision making.

GIS data types

Data for a GIS is either vector or raster. Vector data—represented by points, lines, and polygons—is used to represent features such as schools (points), roads (lines), and farm fields (polygons). A record in an attribute table is associated with each vector element (Fig. 1). For example, a record associated with a polygon representing the soil at a particular location could include fields for soil name, drainage characteristics, flood frequency, farmland category, erodibility factor, septic suitability, and many more. Vector data may be generated by digitizing existing map data (Fig. 2) or going outside with a Global Positioning System unit to determine the latitude and longitude at a location of interest (Fig. 3.). Raster data is represented by a grid of uniform cells. Raster may be a grid of elevation points, aerial photos of your town, or satellite land cover imagery. Figures 4 and 5 illustrate the two types of data.

FID	Shape	PWSID	OWNER	PURPOSE	STATUS	SIZE	TRAIRUSE	YEARCON	MATERIAL
0	Polyline	KY1070308	SIMPSON COUNTY WATER DISTRICT	BOTH	IN SERVICE	4	FINISHED	1972	UNKNOWN
1	Polyline	KY0710707	SOUTH LOGAN WATER ASSOCIATION	DISTRIBUTION	IN SERVICE	6	FINISHED	2004	PVC
2	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	6	FINISHED	1980	UNKNOWN
3	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	6	FINISHED	1990	UNKNOWN
4	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	6	FINISHED	1960	UNKNOWN
5	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	6	FINISHED	1960	UNKNOWN
6	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	4	FINISHED	1969	UNKNOWN
7	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	4	FINISHED	1997	PVC
8	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	8	FINISHED	1991	PVC
9	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	2002	PVC
10	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	12	FINISHED	1998	PVC
11	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	4	FINISHED	1974	PVC
12	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1974	PVC
13	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1996	PVC
14	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1997	PVC
15	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	4	FINISHED	1997	PVC
16	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1974	PVC
17	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	4	FINISHED	1999	PVC
18	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1997	PVC
19	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	OUT OF SERVICE	6	FINISHED	1996	PVC
20	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	6	FINISHED	1974	PVC
21	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	4	FINISHED	1990	UNKNOWN
22	Polyline	KY0050490	CAVE CITY WATER SYSTEM	DISTRIBUTION	IN SERVICE	4	FINISHED	1990	UNKNOWN
23	Polyline	KY1140487	WARREN COUNTY WATER DISTRICT	DISTRIBUTION	IN SERVICE	4	FINISHED	1991	PVC

Figure 1. Section of an attribute table for water line data. Each row (record) is associated with a section of pipe. Each column (field) contains data for a particular attribute of the pipes, such as year constructed.

Figure 2 (left). A cartographer (map maker) uses a digitizer to electronically capture data from a paper map. The digital data will be used with GIS computer software to perform spatial analyses.

Figure 3 (right). A geologist uses a hand-held GPS (Global Positioning System) unit to receive satellite signals that allow him to determine the latitude, longitude, and elevation at the Tipton Ridge Quarry in Estill County. That information will be incorporated into the statewide GIS quarry database.

Figure 4. Vector (polygon) representation of soils in Bath County.

Figure 5. Raster (grid cell) representation of soils in Bath County.

Projections

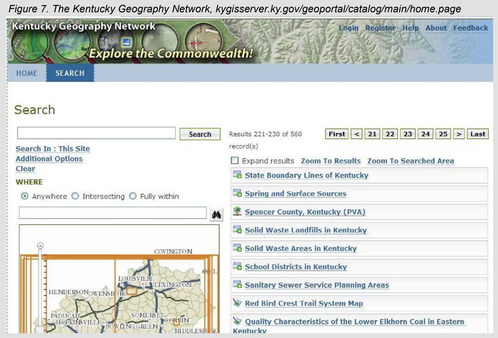
With maps and GIS, information from the three-dimensional curved surface of the Earth is displayed on a two-dimensional flat surface. This necessarily entails some distortion. Imagine trying to cut a basketball and stretch it out on a flat surface. Depending on the purpose of the map, some distortions are acceptable and others are not. Some projections minimize distortions in area, others minimize distortions in shape, direction, or distance. Projections commonly used are: western Kentucky, Universal Transverse Mercator (UTM) Zone 16 (west of longitude 84); eastern Kentucky UTM Zone 17 (east of longitude 84); and statewide, the Kentucky State Plane Single-Zone. A comparison of the Geographic Coordinate System (GCS) projection and the Kentucky State Plane Single-Zone projection is seen in figures 5 and 6.

Figure 5. Geographic Coordinate System Projection

Figure 6. Kentucky State Plane Single-Zone Projection

Figure 24. Slope data derived from the 10-meter dem data clearly reveals the different regions of Kentucky.

Figure 7. The Kentucky Geography Network, kygisserver.ky.gov/geoportal/catalog/main/home.page



Kentucky Data

The nationally recognized Kentucky Geography Network (Fig. 7), developed and maintained by the Kentucky Division of Geographic Information, currently provides access to 560 GIS data sets and products—GIS data layers, aerial and satellite imagery, digital elevation models, maps. The Kentucky Geography Network is a cooperative venture, with GIS data contributors from federal, state, and local agencies, universities, Area Development Districts, and others.

Vector Data

Available Kentucky GIS vector data includes cities, towns, and counties, highways, roads, and streets (Fig. 8), railroads (Fig. 9), airports (Fig. 10), soils (Fig. 11), geology (Fig. 12), sinkholes (Fig. 13), streams (Fig. 14) and water bodies, flood areas, water quality, watersheds, watershed protection areas, groundwater data, waste management (Fig. 15), utilities (Fig. 16) , oil and gas (Fig. 17), coal, mineral resources, ecoregions, state and national parks, wetlands (Fig. 18), wildlife management areas (Fig. 19), fishing (Fig. 20), boating, and hunting, wild and aquatic life, conservation areas, trails and recreation areas, libraries, schools (Fig. 21), groundwater dye traces, feedlots, census data, PVA parcels, industrial sites, and more.

GIS allows us to quickly and easily calculate and summarize the physical characteristics of the data. How many miles of water line are in Pike County? How many acres of prime farm land are in Christian County?

Figure 8. Highways, roads, streets.

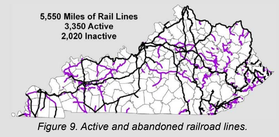


Figure 9. Active and abandoned railroad lines.

Figure 10. Airports

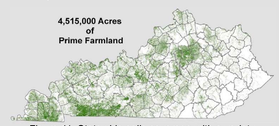


Figure 11. Statewide soils coverage with a variety of attributes such as farmland classification.

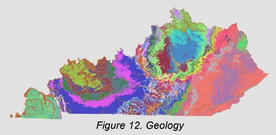


Figure 12. Geology

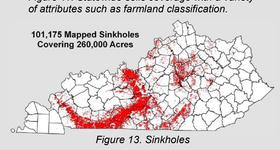


Figure 13. Sinkholes

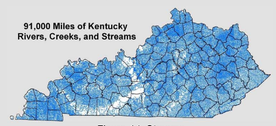


Figure 14. Streams

Figure 15. Landfills

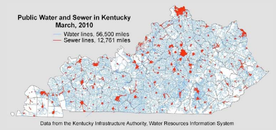


Figure 16. Water and sewer lines

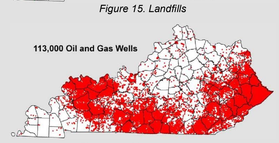


Figure 17. Oil and gas wells

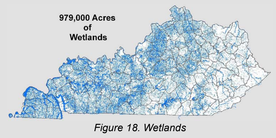


Figure 18. Wetlands

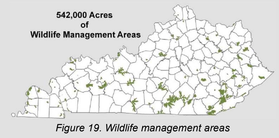


Figure 19. Wildlife management areas

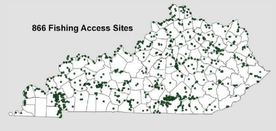


Figure 20. Fishing access sites

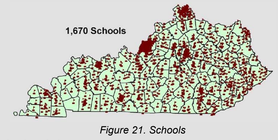


Figure 21. Schools

Raster Data

Available Kentucky raster data (represented by images, grids, aerial photos) includes land cover (Fig. 22), digital elevation models (Fig. 23, 24, 25), aerial photography (Fig. 26) with resolution down to 0.5 foot, topographic and geologic maps, historic maps, wetlands maps, landslide maps, and land use planning maps.

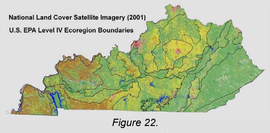


Figure 22.

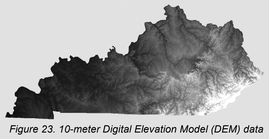


Figure 23. 10-meter Digital Elevation Model (DEM) data

Figure 26. Surface mining near Eolia in Letcher County. Photo by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program (2004).

Using GIS

GIS can combine vector and raster data together in ways that allow us to see and understand in new and different ways the spatial relationships of the place where we live (Fig. 27). We can sit at a computer and answer a variety of questions, for example, if I build my house in this part of the county, what are the soils and underlying rocks? Will they provide a suitable foundation? Is the area on public water? Are the soils and geology suitable for a septic system if not on public sewer (Fig. 28)? Are their geologic hazards I should be aware of, say, flooding or unstable slopes (Fig. 29)?

GIS gives anyone the capability of quickly and cost-effectively producing maps that visually communicate spatial relationships and issues. These maps can be used by local officials, planners, developers, homeowners, teachers, and anyone interested learning more about the place where they live, work, and play. One picture is worth a thousand words.

Examples of the use of Geographic information system (GIS) technology in Kentucky include: scientific investigation—examining the relationship between underlying rock and landslides; resource management—utilizing Kentucky's Water Resource Information System; development planning—GIS was used to create land-use planning maps for every county in Kentucky.

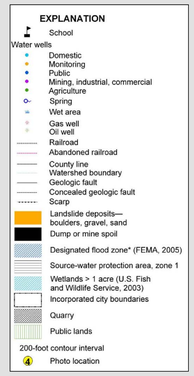


Figure 27. Legend (above) for Letcher County Land Use Map shown below

Figure 28.

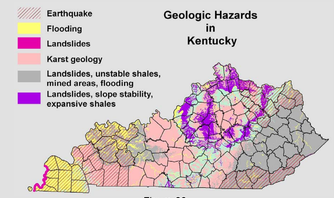
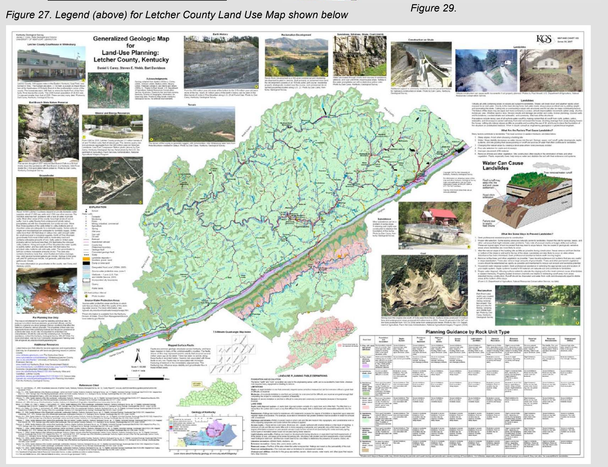


Figure 29.



GIS in the classroom

GIS and GIS data allow Kentucky students and teachers to develop maps for their classrooms (Fig. 30). Maps relating earth science in Kentucky were generated using GIS and are now in over 1,000 classrooms in 400 schools (Fig. 31). Watershed maps generated with GIS can be easily adapted to show student activities in the field (Fig. 32).

Figure 30. Mill Creek Elementary School Watershed

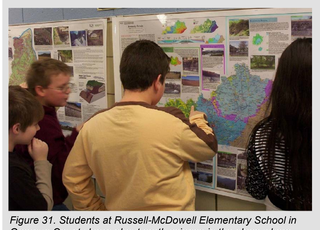
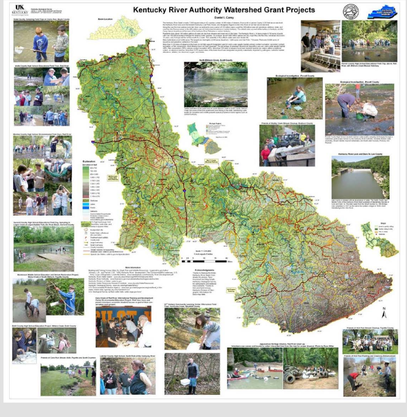


Figure 31. Students at Russell-McDowell Elementary School in Greenup County learn about earth science in the place where they live using maps created with a GIS system.

Figure 32. Student field trip activities along streams in the Kentucky River Basin are illustrated on this poster generated with GIS (right).



Kentucky Division of Geographic Information
gis.ky.gov

University of Kentucky
Kentucky Geological Survey
www.uky.edu/KGS

GIS on the Internet

Internet GIS map services provide information on communities, development planning, transportation, water resources, energy, geology, mineral resources, and recreation.

Basemaps:
- The Commonwealth Map - Base Map (KYGDI)
- The National Map Viewer (USGS)
- Incorporated Cities (KYDGI)
- Geodetic Control in Kentucky (KYDGI)
- + DEM Downloads (KYDGI)

Geology:
- KGS Geologic Map Information Service (KGS)
- KGS Lithologic Map (KGS)
- Core and Sample Holdings Map (KGS)
- Download Georeference Geologic Map (KGS)

Energy:
- *+ non-mining energy related information*
- Coal Information Map (KGS)
- Oil and Gas Wells Map (KGS)

Mining:
- Available Coal Mine Maps / Active Mines (KMMI)
- Known Coal Mined Out Areas / Historical Mines (KMMI)
- Surface Mining Information (KDNR-DSMRE)

Water:
- Flood Prone Areas (KYDGI)
- Groundwater Map Service (KGS)
- Groundwater-Quality Map Service (KGS)
- Hydrology of Kentucky (USGS)
- Karst Potential Map (KGS)
- KY e-Clearinghouse Mapping Portal (WRSI)
- KY Watershed Watch Sampling Map/Database (KRWW)
- Proposed Water Infrastructure Projects (WRIS)
- Surface Mine Water Monitoring Data (KDNR-DSMRE)
- Wastewater Mapping Portal (WRSI)
- Water Infrastructure (WRIS)
- Watershed Viewer (EPPC-GIS)

Transportation:
- Active Six Year Plan Projects (KYTC)
- HIS Interactive Planning Map (KYTC)

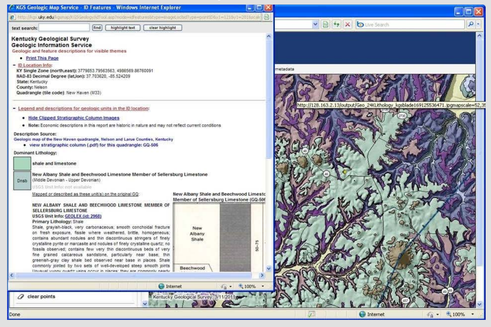
Land-Use Planning:
- *+ services that are specifically directed towards land-use planning*
- Land-Use Planning (KGS)

Counties:
- *(data may be limited to the specific county only)*
- Barren County PVA (KYDGI)
- + Boone County
- Caldwell County PVA (KYDGI)
- Hardin County PVA (KYDGI)
- + Lexington-Fayette County
- Nelson County PVA (KYDGI)
- Pendelton County PVA (KYDGI)
- Spencer County PVA (KYDGI)
- Trimble County PVA (KYDGI)
- Wayne County PVA (KYDGI)
- Webster County PVA (KYDGI)

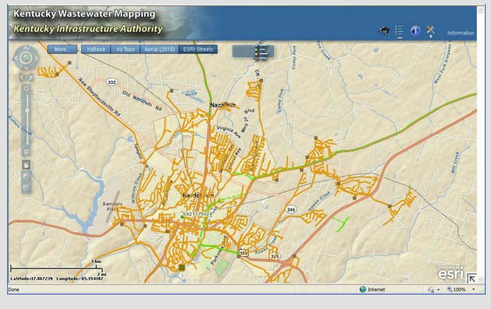
Recreation:
- Hunting and Fishing Access Sites (KYFWIS)
- State Parks (KYPARKS)
- Trails (KYDGI)

Information About Recreational Activities in Kentucky on the Internet

Information About Kentucky's Natural Resources on the Internet



Planning and Development Information on the Internet



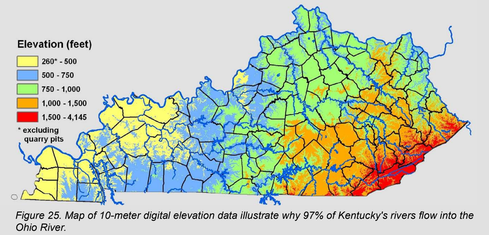


Figure 25. Map of 10-meter digital elevation data illustrate why 97% of Kentucky's rivers flow into the Ohio River.