Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY

MAP AND CHART 81
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Generalized Geologic Map for Land-Use Planning: Jefferson County, Kentucky

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Acknowledgments

Geology adapted from Bhattarai (2001), Nelson (2002a-e), Nelson and Sparks (2002a-c), and Zhang (2002a-c). Thanks to Paul Howell, U.S. Department of Agriculture--Natural Resources Conservation Service, for pond construction illustrations. Sinkhole data from Paylor and others (2004).

For Planning Use Only

This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. The properties of thick soils may supercede those of the underlying bedrock and should be considered on a site-to-site basis. At any site, it is important to understand the characteristics of both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, 859.257.5500. For more information, and to make custom maps of your local area, visit our Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Pond Construction

Successful pond construction must prevent water from seeping through structured soils into limestone solution channels below. A compacted clay liner, or artificial liner, may prevent pond failure. Getting the basin filled with water as soon as possible after construction prevents drying and cracking, and possible leakage, of the clayey soil liner. Ponds constructed in dry weather are more apt to leak than ponds constructed in wet weather. Illustration by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

A pond liner consisting of clayey soil is placed in loose, moist layers and compacted with a sheepsfoot roller. A geotechnical engineer or geologist should be consulted about the requirements of a specific site. Other leakage prevention measures include synthetic liners, bentonite, and asphaltic emulsions. The U.S. Department of Agriculture—Natural Resources Conservation Service can provide guidance on the application of these liners to new construction, and for treatment of existing leaking ponds. Photograph by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

Dams should be constructed of compacted clayey soils at slopes flatter than 3 units horizontal to 1 unit vertical. Ponds with dam heights exceeding 25 feet, or pond volumes exceeding 50 acre-feet, require permits. Contact the Kentucky Division of Water, 14 Reilly Rd., Frankfort, KY 40601, telephone: 502.564.3410.

Groundwater

The alluvium along the Ohio River is the best source of groundwater in the county. Many properly constructed drilled wells will produce over 1,000 gallons per minute from the alluvium; most wells in alluvium will produce enough for a domestic supply at depths of less than 100 feet. In the main sections of the larger creek valleys, and on broad ridges in the central part of the county, most drilled wells will produce enough water for a domestic supply at depths of less than 100 feet. Some wells located in the smaller creek valleys and in some broad ridges in southwestern and central Jefferson County will produce enough water for a domestic supply, except during dry weather. In the upland areas of eastern Jefferson County, most drilled wells will not produce enough water for a dependable domestic supply, although some wells along drainage lines may meet domestic needs, except during dry weather.

Water is hard or very hard but otherwise of good quality. Groundwater in upland areas may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

For more information on groundwater in the county, see Carey and Stickney (2001).

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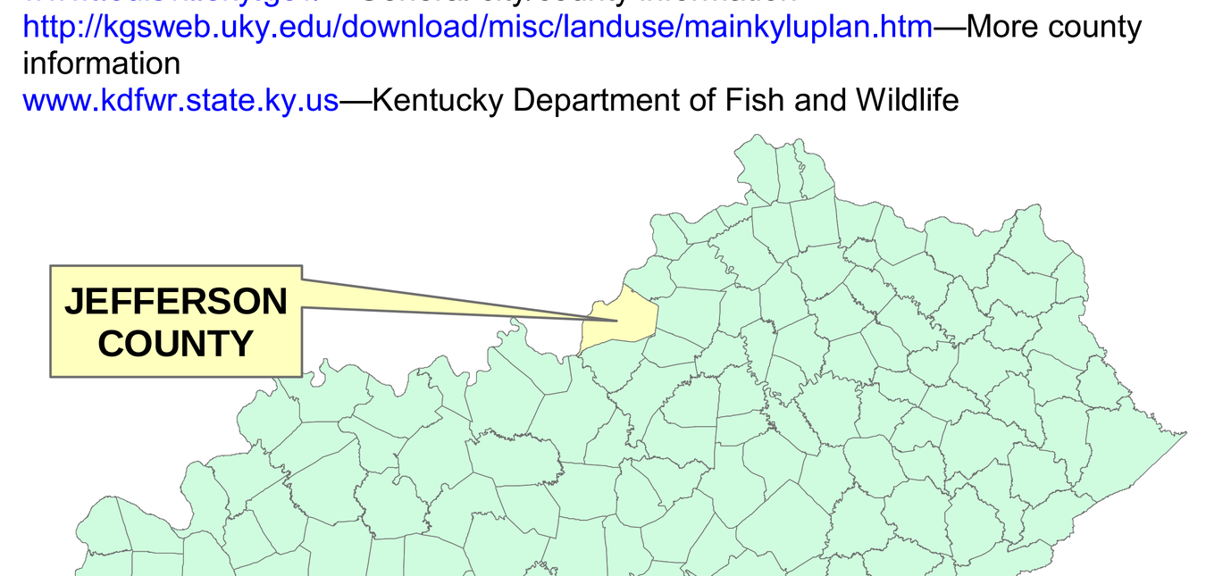
Additional Planning Resources

Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Jefferson County:

ces.ca.uky.edu/jefferson/—University of Kentucky Cooperative Extension Service
www.kineticnet.net/kyrcd/kh.html—Kentucky Resource Conservation and Development
www.kipda.org/Home/Default.asp—KIPDA Area Development District
www.thinkkentucky.com/edis/cmnty/cw091/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21111.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21111.html—U.S. Census data
www.louisvilleky.gov/—General city/county information
http://kgsweb.uky.edu/download/misc/landuse/mainkyluplan.htm—More county information
www.kdfwr.state.ky.us—Kentucky Department of Fish and Wildlife

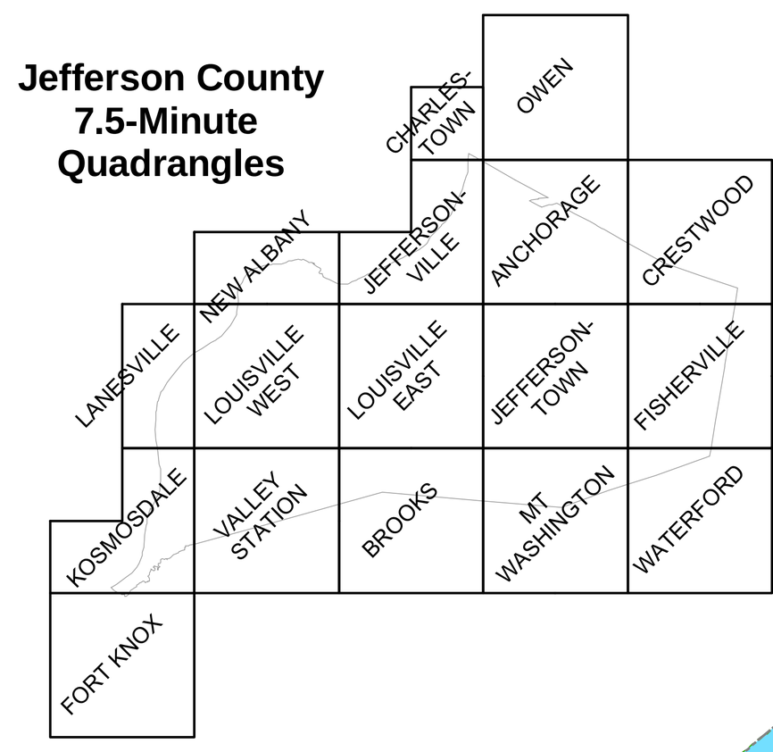


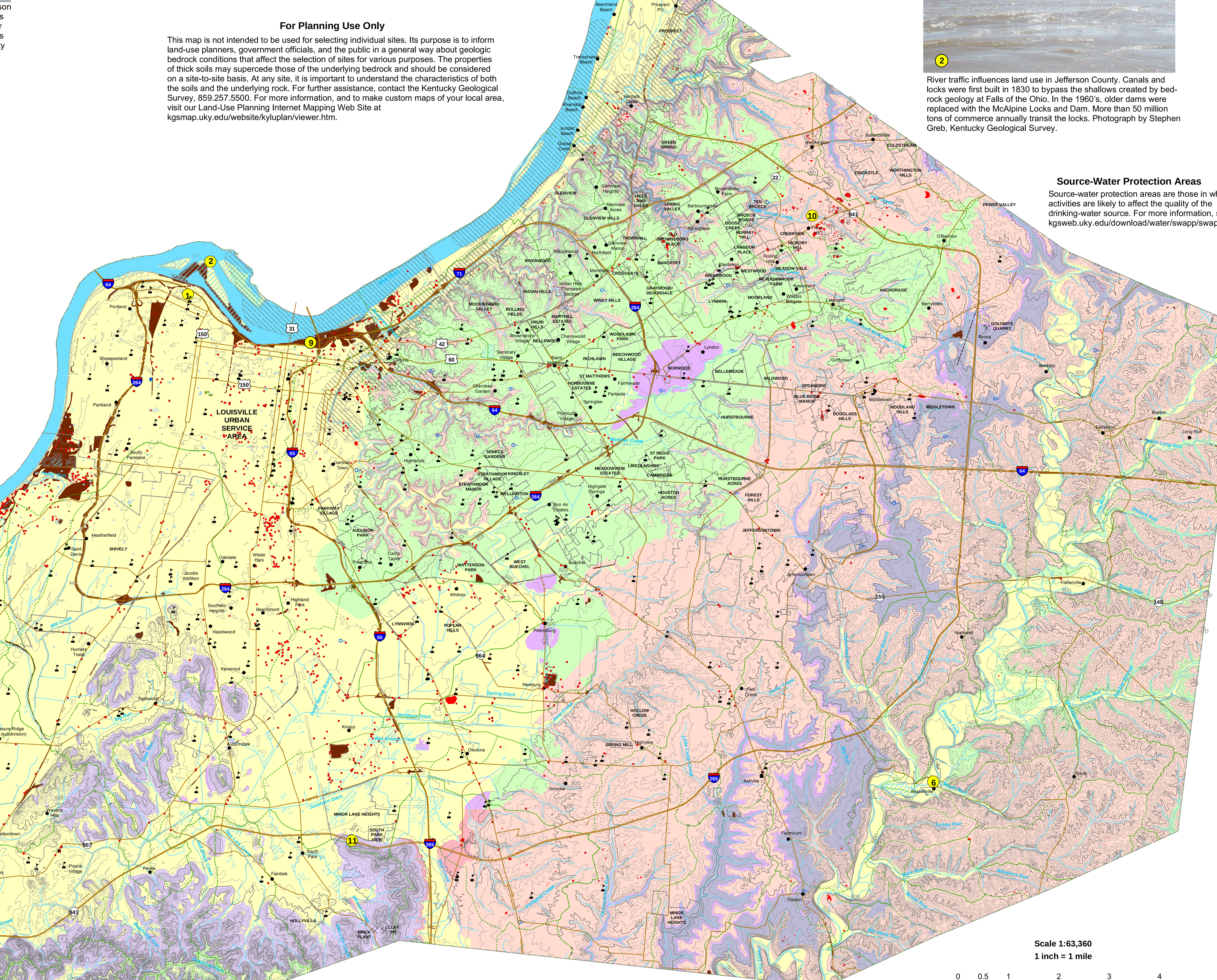
Situated on the Ohio River, Louisville is the county seat of Jefferson County, and was founded by George Rogers Clark in 1778. Lewis and Clark's Corps of Discovery to the American West began their voyage here, at the nearby Falls of the Ohio (which Louisville was known as during its early history). Louisville is the 16th largest city in the United States. Photograph by Stephen Greb, Kentucky Geological Survey.

Karst Geology

The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snow-melt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum), such as occurs in units 2 and 3 on this map. Sinkholes are depressions on the land surface where water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits that are large enough for a person to enter.

Jefferson County 7.5-Minute Quadrangles



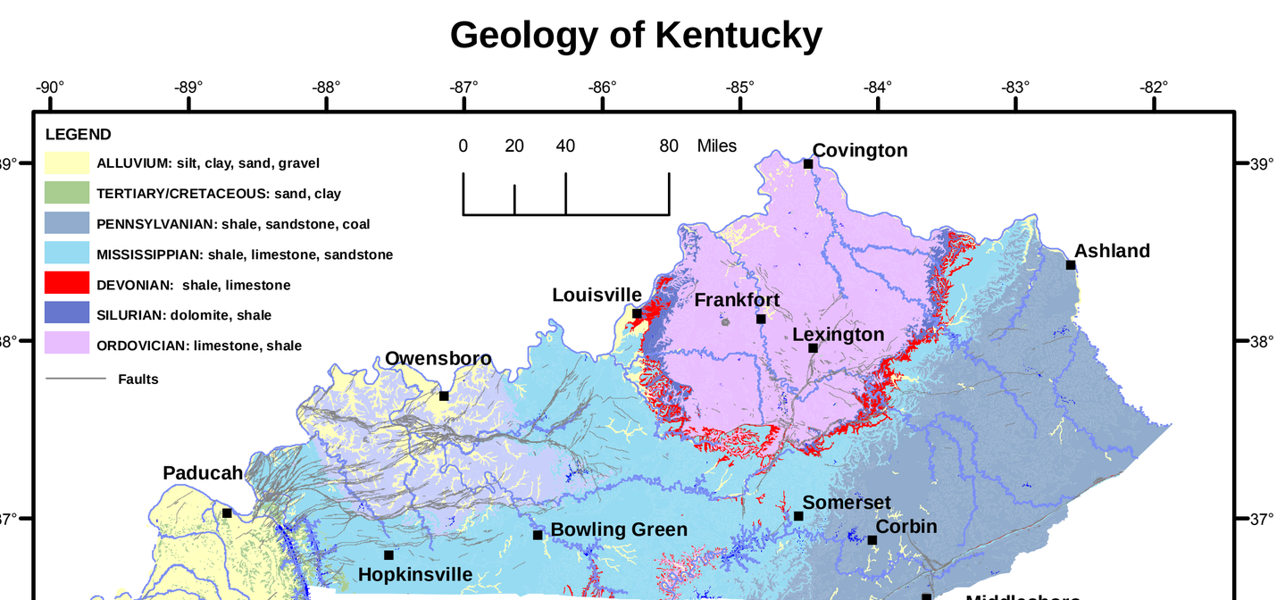


Source-Water Protection Areas

Source-water protection areas are those in which activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

Scale 1:63,360
1 inch = 1 mile
0 0.5 1 2 3 4 Miles

Geology of Kentucky



Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call:

Public Information Center
859.257.3896 or
877.778.7827 (toll free)

View the KGS World Wide Web site at:
www.uky.edu/kgs

PLANNING DEFINITIONS

FOUNDATION AND EXCAVATION

The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

LIMITATIONS

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal of difficulty or expense.

Moderate—A moderate limitation is one that can normally be overcome but the difficulty and expense are great enough that completing the project is commonly a question of feasibility.

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

LAND USES

Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the natural soil.

Residences—Ratings are made for residences with and without basements because the degree of limitation is dependent upon ease and required depth of excavation. For example, excavation in limestone has greater limitation than excavation in shale for a house with a basement.

Highways and streets—Refers to paved roads in which cuts and fills are made in hilly topography, and considerable work is done preparing subgrades and bases before the surface is applied.

Access roads—These are low-cost roads, driveways, etc., usually surfaced with crushed stone or a thin layer of blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin base is used. The degree of limitation is based on year-around use and would be less severe if not used during the winter and early spring. Some types of recreation areas would not be used during these seasons.

Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be core drilled to determine presence of caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

Extensive recreation—Camp sites, picnic areas, parks, etc.

Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

Reservoir embankments—The rocks are rated on limitations for embankment material.

Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

Planning Guidance by Rock Unit Type

Rock Unit	Karst Potential Rating	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Silt, sand, and gravel	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock.	Fair foundation material. Easy to excavate.	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Zimmerman, 1966).	Water in alluvium may be in direct contact with basements. Refer to soil report (Zimmerman, 1966).	Slight limitations. Refer to soil report (Zimmerman, 1966).	Slight to moderate limitations. Refer to soil report (Zimmerman, 1966).	Slight to moderate limitations. Avoid construction in floodplain. Refer to soil report (Zimmerman, 1966).	Refer to soil report (Zimmerman, 1966).	Refer to soil report (Zimmerman, 1966).	Refer to soil report (Zimmerman, 1966).	Not recommended. Refer to soil report (Zimmerman, 1966).	Not recommended. Refer to soil report (Zimmerman, 1966).
2. Limestone	High.	Good to excellent foundation material. Difficult excavation.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Rock excavation. Possible steep slopes. Slight limitations with suitable topography.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
3. Limestone, dolomite, and shale	High.	Fair to good foundation material. Difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table, with possible contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Rock excavation likely. Local drainage problems. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Sinks common.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
4. Dolomite	Medium.	Excellent foundation material. Difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table, with possible contamination.	Moderate to severe limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Severe to moderate limitations. Rock excavation. Possible steep slopes and narrow ravines.	Moderate to slight limitations, depending on topography. Rock excavation. Local drainage problems. Sinks common.	Moderate to slight limitations, depending on activity and topography. Possible wooded slopes.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
5. Siltstone and shale	Low.	Fair to good foundation material. Moderately difficult to excavate.	Moderate to severe limitations. Impermeable rock. Possible thin soils.	Moderate to severe limitations. Rock excavation; locally, upper few feet may be rippable.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir may leak where rocks are fractured.	Moderate limitations.	Moderate limitations. Possible rock excavation.
6. Shale*	Low.	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations. Depending on activity.	Severe to slight limitations, depending on activity and topography.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Possible rock excavation.
7. Shale and limestone	Medium.	Fair to good foundation material. Difficult to excavate.	Severe to moderate limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Possible groundwater contamination.	Moderate to severe limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Possible drainage and slumping problems in shale. Sinks common and caves possible.	Moderate limitations. Rock excavation likely. Local drainage problems. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation possible. Sinks common. Local drainage problems. Possible groundwater contamination.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Sinks common.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
8. Siltstone, dolomite, and limestone	Medium.	Fair to good foundation material. Difficult to excavate.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures and sinks to water table, with possible contamination.	Moderate to severe limitations. Rock excavation may be required.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.

*These clay shales may swell when wet and shrink when dry, and are susceptible to landslides.

Water Quality

River traffic influences land use in Jefferson County. Canals and locks were first built in 1830 to bypass the shallows created by bedrock geology at Falls of the Ohio. In the 1960's, older dams were replaced with the McAlpine Locks and Dam. More than 50 million tons of commerce annually transit the locks. Photograph by Stephen Greb, Kentucky Geological Survey.

Construction Materials

The Kosmos Cement Plant was founded in 1905, and the nearby community of Kosmosdale (formerly Riverview) was named after the plant. About 720,000 tons of cement are produced by the plant annually. Photograph by Bart Davidson, Kentucky Geological Survey.

Water Quality

The Floyds Fork Creek drainage basin in east-central Jefferson County contains a mapped wetland area. Water-quality issues in the rural parts of Jefferson County differ from those in the metropolitan Louisville area because fertilizers and pesticides applied to crops, and nitrates from cattle operations, can affect groundwater from domestic (private) water wells. Photograph by Bart Davidson, Kentucky Geological Survey.

In metropolitan areas where residential construction is common, care must be taken to ensure that septic systems are correctly installed to avoid polluting streams and groundwater. In Jefferson County, this involves recognition of Quaternary sediments near the river and karst geology in the eastern and central part of the county. Photograph by Bart Davidson, Kentucky Geological Survey.

EXPLANATION

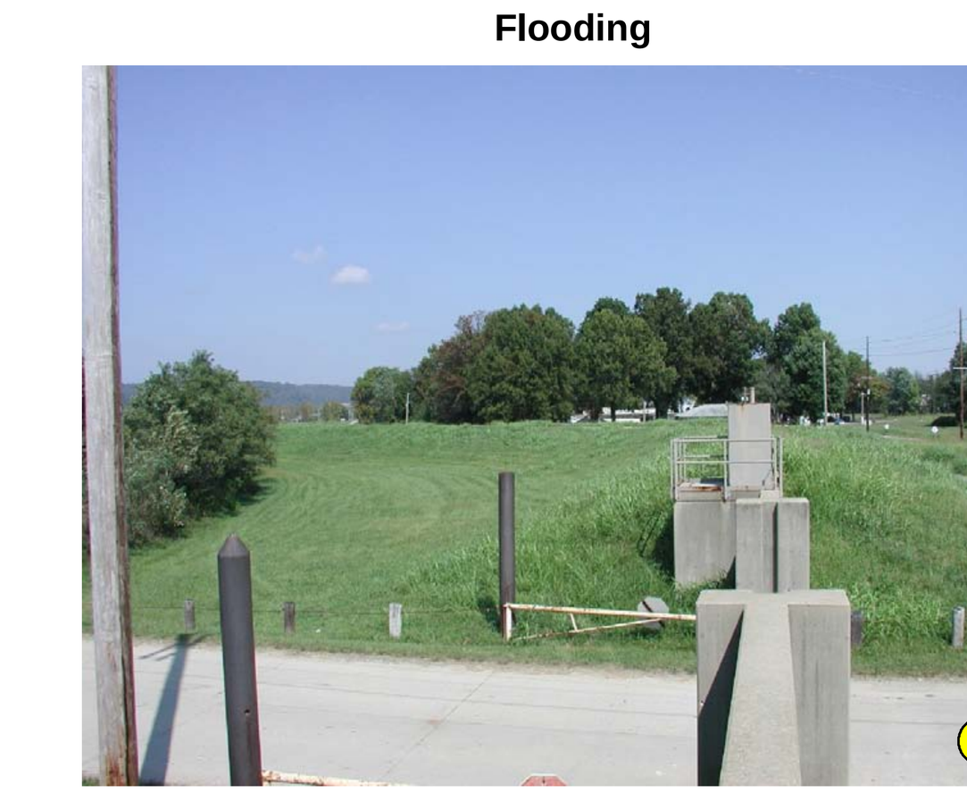
- School
- Mineral resource operations
- Water wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
  - Springs
- Concealed fault
- Wetlands > 1 acre (U.S. Fish & Wildlife Service, 2003)
- Urban Services Boundary
- Watersheds
- Wildlife management areas
- Source-water protection areas, zone 1
- Artificial fill
- Sinkholes
- 20-foot contour interval
- Photograph location

Power Production

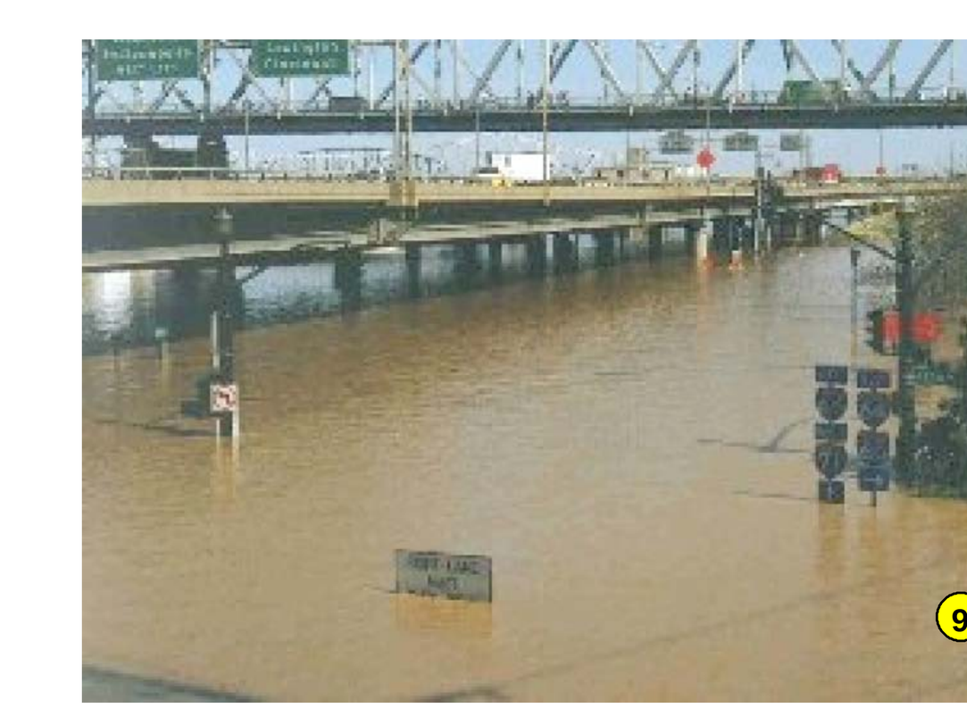
Large cities such as Louisville require great amounts of electricity. Louisville Gas and Electric's Mill Creek Power Station on the Ohio River is a 1600 megawatt coal-fired plant. The flue-gas desulfurization unit at the plant produces half a million tons of gypsum annually as a byproduct that is shipped by barge to a wallboard plant. Photograph by Bart Davidson, Kentucky Geological Survey.

A sister power station to Mill Creek, the Cane Run Power Station burns 1.3 million tons of coal per year, all shipped by rail. The plant produces gypsum as a byproduct that must be disposed of in environmentally safe landfills. Photograph by Stephen Greb, Kentucky Geological Survey.

Flooding



A 29-mile-long system of floodwalls, gates, pumping stations, and levees allows for multiple land uses in the Louisville metropolitan area. The flood walls were constructed following a 1937 flood when the river crested at 85.4 feet. Ohio River flood stage at McAlpine Dam is 55 feet, and the flood walls that protect the city are constructed for a river height of 88.5 feet. This gate and berm (above) are located near Kosmosdale. The photo below shows the flood of 1997 in Louisville. Photographs by Bart Davidson (above) and Stephen Greb (below), Kentucky Geological Survey.



Growth of the metropolitan Louisville area has been accompanied by alteration of the existing landscape. In this example, retaining walls have been built along a drainage area for flood control adjacent to extensive development. In metropolitan areas, care must be taken to maintain water quality and control stormwater runoff from surrounding parking lots. Photograph by Bart Davidson, Kentucky Geological Survey.

Slope Stability

Drainpipes and limestone riprap are used along the shale slopes of the Muldraugh Escarpment to help prevent water infiltration and subsequent slope instability onto the Gene Snyder Expressway. Photograph by Bart Davidson, Kentucky Geological Survey.