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Generalized Geologic Map for Land-Use Planning: Larue County, Kentucky

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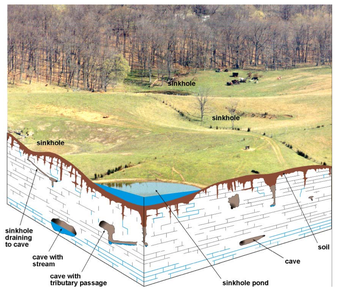
Acknowledgments

Geology adapted from Crawford (2004a-b), Johnson (2004a-e), Nelson (2004), Petersen (2004a-c), Thompson (2004), and Toth (2004). Sinkhole data from Paylor and others (2004). Karst illustration from Currens (2001).

Environmental Protection



Never use sinkholes as dumps. All waste, but especially pesticides, paints, household chemicals, automobile batteries, and used motor oil, should be taken to an appropriate recycling center or landfill.

Make sure runoff from parking lots, streets, and other urban areas is routed through a detention basin and sediment trap to filter it before it flows into a sinkhole.

Make sure your home septic system is working properly and that it's not discharging sewage into a crevice or sinkhole.

Keep cattle and other livestock out of sinkholes and sinking streams. There are other methods of providing water to livestock.

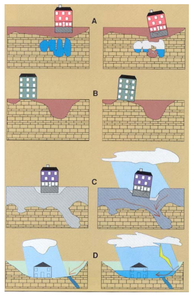
See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass buffer strips. This will filter runoff flowing into sinkholes and also keep tilled areas away from sinkholes.

Construct waste-holding lagoons in karst areas carefully, to prevent the bottom of the lagoon from collapsing, which would result in a catastrophic emptying of waste in the groundwater.

If required, develop a groundwater protection plan (410KAR5:037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

Residential Construction

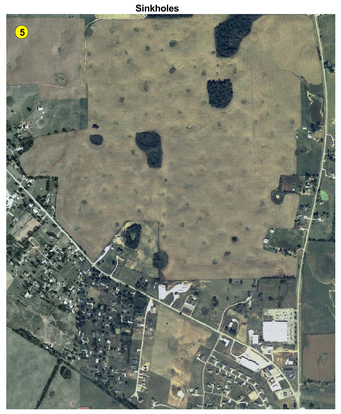


Limestone terrain can be subject to subsidence hazards, which usually can be overcome by prior planning and site evaluation. "A" shows construction above an open cavern, which later collapses. This is one of the most difficult situations to detect, and the possibility of this situation beneath a structure warrants insurance protection for homes built on karst terrain. In "B," a heavy structure presumed to lie above solid bedrock actually is partially supported on soft, residual clay soils that subside gradually, resulting in damage to the structure. This occurs where inadequate site evaluation can be traced to lack of geophysical studies and inadequate core sampling. "C" and "D" show the close relationship between hydrology and subsidence hazards in limestone terrain. In "C," the house is situated on porous fill (light shading) at a site where surface and groundwater drainage move supporting soil (darker shading) into voids in limestone (blocks) below. The natural process is then accelerated by infiltration through fill around the home. "D" shows a karst site where normal rainfall is absorbed by subsurface conduits, but water from infrequent heavy storms cannot be carried away quickly enough to prevent flooding of low-lying areas. Adapted from AIPG (1993).

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 snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). 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.

Sinkholes



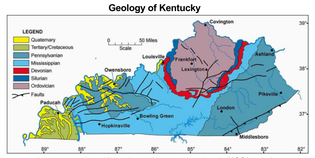
Sinkholes dimple the karst landscape on unit 2 between Ky. 210 and Ky. 1607 north of Hodgenville. Development in karst areas requires careful planning to prevent pollution of groundwater and drinking-water sources. Aerial photo (2004) by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Groundwater Availability

In the western and central two-thirds of Larue County, except in the lowlands of the Nolin River and its major tributaries, about three-quarters of the wells yield enough water for a domestic supply. In the rest of the county, very few wells yield enough water for a domestic supply, except in a few lowland areas bordering streams. Springs with flows ranging from a few gallons per minute to 1,330 gallons per minute are found throughout the county. Many of the springs are of the depression type, and yield more than 100 gallons per minute when pumped.

For more information on groundwater in the county, see Carey and Stickney (2005).

Geology of Kentucky

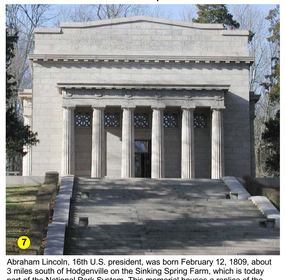


Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Larue County Courthouse at Hodgenville

Larue County, 263 square miles in the Pennyrile Region of Kentucky, was formed in 1843. The population in 2004 was 13,485, about 5,400 households. The City of Hodgenville and Larue County Water District No. 1 provide drinking water to nearly two-thirds of the households. Public sewer service is provided to one-fourth of the households, those in and near Hodgenville. Photo by Dan Carey, Kentucky Geological Survey.

Lincoln's Birthplace



Abraham Lincoln, 16th U.S. president, was born February 12, 1809, about 3 miles south of Hodgenville on the Sinking Spring Farm, which is today part of the National Park System. This memorial houses a replica of the original log cabin. Photo by Dan Carey, Kentucky Geological Survey.

Upland Limestone

Limestone (unit 3) topography and soils provide for upland agriculture. Photo by Dan Carey, Kentucky Geological Survey.

Alluvial Valley

Alluvium (unit 1) in the broad Rolling Fork River Valley in northern Larue County. Photo by Dan Carey, Kentucky Geological Survey.

EXPLANATION

- School
- Severely eroded area
- Rock outcrop
- Wet area
- Mine or quarry
- Spring
- Gas well

Water wells
- Domestic
- Monitoring
- Public
- Water service
- Sewer service
- Watershed boundary
- Fault
- Mapped sinkholes
- Designated flood zone* (FEMA, 2005)
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Incorporated city boundary
- Source water protection area—zone 1
- Gas field
- 4 Photo location
- 20-foot contour interval

*Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

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.

Mapped Surface Faults

Faults are common geologic structures across Kentucky, and have been mapped in many of the Commonwealth's counties. The faults shown on this map represent seismic activity that occurred several million years ago at the latest. There has been no activity along these faults in recorded history. Seismic risk associated with these faults is very low. Faults may be associated with increased fracturing of bedrock in the immediately adjacent area. This fracturing may influence slope stability and groundwater flow in these limited areas.

LARUE COUNTY

7.5-Minute Map Index

N

Scale 1:48,000

1 inch equals 3/4 mile

2 0 2 4 Miles

Agricultural Resources

Unit 2 limestone provides productive soils for an agricultural economy. Photo by Dan Carey, Kentucky Geological Survey.

Planning Guidance by Rock Unit Type

Rock Unit	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. Clay, silt, sand, and gravel	Fair to good foundation material; easy to excavate. Seasonal high water table; subject to flooding.	Severe limitations. Seasonal high water table; subject to flooding. Refer to soil report (Arms and others, 1979).	Severe limitations. Seasonal high water table; subject to flooding. Refer to soil report (Arms and others, 1979).	Severe limitations. Seasonal high water table; subject to flooding. Refer to soil report (Arms and others, 1979).	Severe limitations. Seasonal high water table; subject to flooding. Refer to soil report (Arms and others, 1979).	Severe limitations. Seasonal high water table; subject to flooding. Refer to soil report (Arms and others, 1979).	Slight to severe limitations, depending on type of activity. Subject to flooding. Refer to soil report (Arms and others, 1979).	Slight to moderate limitations, depending on type of activity. Subject to flooding. Refer to soil report (Arms and others, 1979).	Pervious material. Seasonal high water table. Refer to soil report (Arms and others, 1979).	Fair stability. Fair compaction characteristics. Refer to soil report (Arms and others, 1979).	Slight limitations. Generally favorable except for seasonal high water table and possible flooding. Refer to soil report (Arms and others, 1979).
2. Limestone, dolomite, and shale	Good to excellent foundation material; moderately difficult to difficult excavation.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to groundwater table; danger of contamination.	Severe to moderate limitations. Rock excavation may be required.	Slight to moderate limitations. Rock excavation. Local drainage problems, especially on shale. Sinks common.	Slight limitations. Rock excavation. Local drainage problems. Sinks common.	Moderate to slight limitations. Rock excavation. Local drainage problems; possible groundwater contamination. Sinks common.	Moderate to slight limitations, depending on activity and topography.	Slight limitations, depending on activity and topography.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky reservoir rock.	Severe to moderate limitations. Rock excavation.
3. Limestone	Excellent foundation material; difficult excavation.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to groundwater table; danger of contamination.	Severe to moderate limitations. Rock excavation may be required. Possible radon occurrence.	Moderate to severe limitations. Rock excavation. Possible steep slopes.	Slight to moderate limitations. Rock excavation. Possible steep slopes.	Slight to severe limitations, depending on topography. Rock excavation. Sinks possible. Local drainage problems. Possible groundwater contamination.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky reservoir rock.	Severe limitations. Rock excavation.
4. Shale*, siltstone, and limestone	Fair to poor foundation material; easy to moderately difficult excavation. Possible expansion of shales. Plastic clay is particularly poor foundation.	Severe limitations. Locally fast drainage through fractures to groundwater table; possible contamination.	Moderate to severe limitations. Rock excavation may be required. Possible radon occurrence. Plastic clay is particularly poor foundation.	Moderate limitations. Rock excavation. Local drainage problems. Clay shale is poor foundation and will not hold up in high-angle roadcuts.	Moderate limitations. Rock excavation. Possible steep slopes. Severe limitations on clay shale; poor foundation and will not hold up in high-angle roadcuts.	Slight to severe limitations depending on topography. Rock excavation. Local drainage problems. Possible shale expansion. Clay shale very poor foundation.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Slight limitations. Reservoir may leak where rocks are jointed or fractured. Clay shale provides excellent seal.	Slight to moderate limitations. Reservoir may leak where rocks are fractured. Clay shale provides excellent seal, but tends to slump.	Severe to moderate limitations. Possible rock excavation.
5. Sandstone and shale	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils.	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. 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 limitations. Reservoir may leak where rocks are jointed or fractured.	Moderate limitations. Reservoir may leak where rocks are jointed or fractured.	Severe to moderate limitations. Thin soils. Possible rock excavation.
6. Dolomite	Excellent foundation material; difficult excavation.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to groundwater table; danger of contamination.	Severe limitations. Rock excavation may be required.	Severe limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation. Possible steep slopes and narrow ravines.	Slight to moderate limitations, depending on topography. Rock excavation. Sinks possible. Local drainage problems.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Slight to moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe limitations. Rock excavation.

* Instability of slopes cut in this material can be a serious construction problem. This material tends to slump and slide down slopes when weakened by successive saturation and drying, freezing and thawing.

Land-Use Planning Table 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 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.

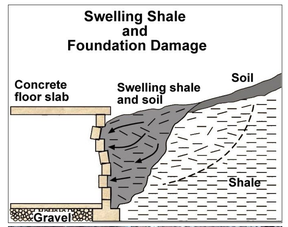
Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

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.

Swelling and Shrinking Shales

A problem of considerable concern in this area is the swelling of some of the clay minerals in shale units 4 and 5. Expanding shale can cause backfill to swell, and concrete to crack and crumble. It can heave the foundation, the slab, and interior partitions resting on it, and damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky. During times of drought, these same shales may shrink, causing foundations to drop. Anyone planning construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.



Some shales, and the soils derived from them, swell when exposed to water or air. these swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams,aroads). Photo by John Kiefer, Kentucky Geological Survey.

Construction on Unit 4

Construction on steep slopes of unit 4, where shale is more predominant, may create slides and instability, and requires careful management of drainage. Photo by Dan Carey, Kentucky Geological Survey.

Shales of Unit 4

Shales in unit 4 will expand and shrink, and landslides and slumps are common, particularly in cuts on steep slopes. Clay shales shown here make a poor foundation material. Ponds on shales are generally successful. Photo by Dan Carey, Kentucky Geological Survey.

Otter Creek Valley

Looking west from Ky. 467 down the valley of the East Fork of Otter Creek, underlain by limestones of units 2 and 3 in eastern Larue County. Photo by Dan Carey, Kentucky Geological Survey.

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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 Larue County:

ces.ca.uky.edu/larue/—University of Kentucky Cooperative Extension Service
www.kinetionet.net/kyrcd/lincoln.html—Lincoln Resource Conservation and Development Council Inc.
www.ltadd.org/—Lincoln Trail Area Development District
www.thinkkentucky.com/edis/cmnty/cw041/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21123.html—Kentucky Atlas and Gazetteer, Larue County
quickfacts.census.gov/qfd/states/21/21123.html—U.S. census data
kgsweb.uky.edu/download/kgsplanning.htm—County planning information from the Kentucky Geological Survey