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

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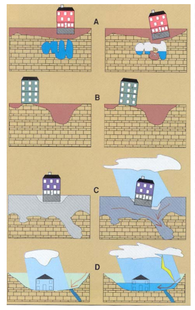
Construction on Karstic Limestone



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).

Sinkhole Flooding

Flooding in a large karst basin. Sinkhole swallets and solution channels are not large enough to carry off the water from this large storm. The problem is exacerbated by development. Often the only solution is to relocate the home out of the karst floodplain. Photo by Jim Currens, Kentucky Geological Survey.

Sudden-Collapse Sinkhole

Sinkhole cover collapse. After perhaps years of slow settlement, soils over bedrock solution channels collapse rapidly and wash out, leaving sinkholes such as this. This phenomenon occurs throughout the Inner Bluegrass karst landscape. Photo by Jim Currens, Kentucky Geological Survey.

Attempt to fill in a cover-collapse sinkhole in Fayette County. Photo by Leslie Russo, Kentucky Geological Survey.

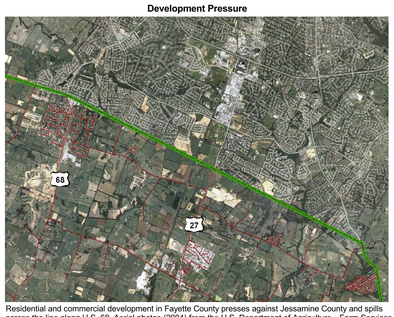
For Planning Use Only

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 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.

Acknowledgments

Geology adapted from Carey (2000), Ciszak (2000a-c), Nelson (2000a, b, 2001), and Thompson (2000). This publication is adapted from Johnson and Hopkins (1966). Identified sinkholes are from the U.S. Department of Agriculture—Natural Resources Conservation Service, Soil Survey Geographic database (SSURGO). Mapped sinkhole data from Paylor and others (2004). Thanks to Leslie Russo and Jim Currens, Kentucky Geological Survey, for photos. Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base map data.

Development Pressure



Residential and commercial development in Fayette County presses against Jessamine County and spills across the line along U.S. 68. Aerial photos (2004) from the U.S. Department of Agriculture—Farm Services Administration, National Agricultural Imagery Program.

Residential–Commercial Development

Brannon Crossing off U.S. 27 is a 92-acre mixed-use development with more than 800,000 square feet of retail, office and mixed-use space. 1,600 residential homes are planned for adjacent properties. Photo by Dan Carey, Kentucky Geological Survey.

Urban Residential Community

The Reserve at Hager Place and the Crossings at Hager Place are urban residential communities within the city of Nicholasville. Photo by Dan Carey, Kentucky Geological Survey.

Limestone—Unit 6

Areas underlain by limestones of unit 6 provide fertile soils for agriculture and desirable sites for development. Thoughtful planning can minimize conflicting interests. Photo by Dan Carey, Kentucky Geological Survey.

Radon

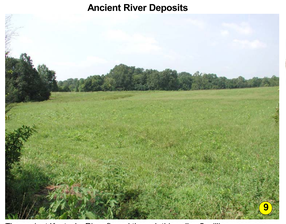
Radon gas can be a local problem, although it is not widely distributed in Kentucky in amounts above the Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter. Unit 7 on the map, the Tanglewood Limestone, may contain high levels of uranium or radium, parent materials for radon gas. The Tanglewood and several other limestones in the state contain apatite, a phosphate mineral. Uranium is sometimes part of the apatite crystal structure, and when the limestone weathers away the phosphates containing uranium can become concentrated in the soil and ultimately give rise to high levels of radon. A few areas of high radon concentrations are known in the Bluegrass Region. Homes in these areas should be tested for radon, but the homeowner should keep in mind that the threat to health results from relatively high levels of exposure over long periods of time, and the remedy may simply be additional ventilation of the home.

COMPARATIVE RISK CHART for RADON LEVELS

Radon Level pCi/L	Estimated Fatal Lung Cancers/1000	Comparable Exposure Levels	Comparable Risk Estimate
200	440 - 770	1,000 times average outdoor level	More than 60 times non-smoker risk
100	270 - 630	100 times average outdoor level	Four packs/day smoker or 20,000 chest X-rays/yr
40	120 - 380	100 times average outdoor level	Two-pack/day smoker
20	60 - 210		
10	30 - 120	10 times average indoor level	One pack/day smoker
4	13 - 50	10 times average outdoor level	Five times non-smoker risk
2	7 - 30		
1	3 - 13	Average indoor level	Non-smoker risk of fatal lung cancer
0.2	1 - 3	Average outdoor level	20 chest X-rays/yr

EPA recommends action be taken if indoor levels exceed 4 picocuries per liter, which is 10 times the average outdoor level. Some EPA representatives believe the action level should be lowered to 2 picocuries per liter; other scientists dissent and claim the risks estimated in this chart are already much too high for low levels of radon. The action level in European countries is set at 10 picocuries per liter. Note that this chart is only one estimate; it is not based upon any scientific result from a study of a large population meeting the listed criteria. (from the U.S. Environmental Protection Agency)

Ancient River Deposits

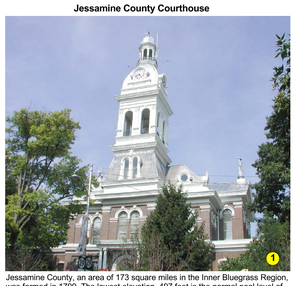


The ancient Kentucky River flowed through this valley 5 million years ago, depositing silt, sand, and gravel, until geologic forces lifted the land and changed the course of the river. Photo by Dan Carey, Kentucky Geological Survey.

Rural Residential Development

Small, rural residential developments are scattered throughout northern Jessamine County. Development on units 6, 7, and 8 must be handled with care to prevent unanticipated sinkhole flooding and associated damages. Groundwater pollution is also a concern in areas where public sewer is not available, and on-site wastewater treatment systems must be properly designed, built, and maintained. Photo by Dan Carey, Kentucky Geological Survey.

Jessamine County Courthouse



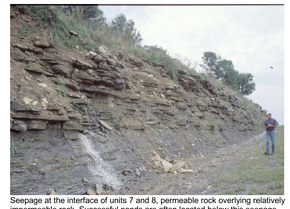
Jessamine County, an area of 173 square miles in the Inner Bluegrass Region, was formed in 1799. The lowest elevation, 497 feet is the normal pool level of the Kentucky River where it leaves the county near Brooklyn Bridge. The highest elevation is 1,072 feet on a ridge just west of the railroad about 3 miles north of Nicholasville. The 2005 population of 42,965 was 40.9 percent greater than in 1990. Photo by Dan Carey, Kentucky Geological Survey.

Residential Drainage

An uplifting experience that will not be appreciated! Left: All is well in this newly built home until water from percolation, drains, lawn sprinklers, leaking sewers, or water mains soaks swelling soil beneath the foundation. Right: With time, expanding soils exert several tons per square foot of pressure on the foundation and shallow pilings. Without remedial measures, the house will actually become deformed, and shatter masonry and windows. Remedies vary from mere maintenance that keeps drainage away from the house to expensive reconstruction of foundations. Prior site planning that takes geology into account is always preferable to dealing with problems after a structure is built. From AIPG (1993).

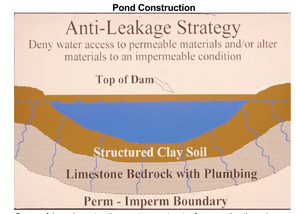
Seepage

Seepage at the boundary between overlying permeable and underlying impermeable rocks. Often not evident during dry-weather construction, it can produce a variety of problems, including foundation disturbance, flooding, soil movement, wet basements, and failure of onsite wastewater treatment systems. These problems are common with construction on backfilled steep slopes. (photo by Paul Howell)



Seepage at the interface of units 7 and 8, permeable rock overlying relatively impermeable rock. Successful ponds are often located below this seepage zone. Ponds should be constructed so that the springs or seeps will always be above the level of the pond surface. Photo by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

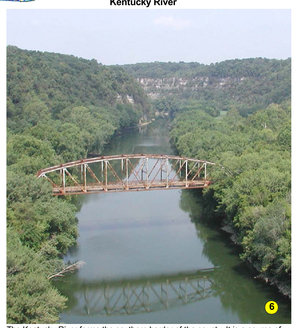
Pond Construction



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. A geotechnical engineer or geologist should be consulted regarding 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.

Dams should be constructed of compacted clayey soils at slopes flatter than 3 units horizontal to 1 unit vertical. Ponds with dam heights exceed-ing 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. Illustration by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

Kentucky River

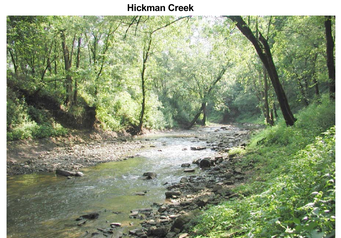


The Kentucky River forms the southern border of the county. It is a source of drinking-water and provides boating, swimming, and fishing recreation. The limestones of unit 6 form the Kentucky River palisades, which support the highest concentration of rare plant species in the Bluegrass Region. The valley walls, almost vertical, rise 400 or more feet above the stream. Photo by Dan Carey, Kentucky Geological Survey.

Alluvium

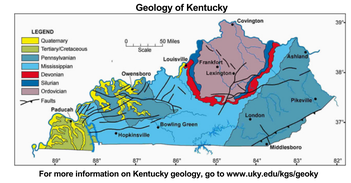
Alluvium, such as that seen here along Hickman Creek, provides soils for hay and row crops. Photo by Dan Carey, Kentucky Geological Survey.

Hickman Creek



Hickman Creek just above its mouth at the Kentucky River. The creek drains western Jessamine and southern Fayette counties over limestones of unit 4 and can be polluted by development. Photo by Dan Carey, Kentucky Geological Survey.

Geology of Kentucky



For more information on Kentucky geology, go to www.uky.edu/kgs/geoky

Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic Tank Disposal System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Alluvium	Fair to good foundation material. Easily excavated.	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).	Refer to soil report (McDonald and others, 1983).
2. High-level (ancient) river deposits	Good foundation material. Easily excavated.	Slight to moderate limitations. Variable thickness and permeability; underlain by impervious rock.	Slight limitations.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Not applicable.	Not applicable.	Slight limitations.
3. Dolomite and shale	Good foundation material. Moderately difficult to difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; and sinks to water table; possible groundwater contamination.	No limitations.	Moderate limitations. Numerous deep sinks; rock excavation; possible drainage problems.	Moderate limitations. Numerous deep sinks.	Severe limitations. Numerous deep sinks; small areas of possible drainage problems.	Severe limitations. Steep slopes; small areas of level land.	No limitations.	Severe limitations. Leaky reservoir rock; many sinks.	Slight to moderate limitations.	Severe limitations. Rock excavation.
4. Siltstone	Good foundation material. Moderately difficult to difficult to excavate.	Severe limitations. Impermeable; joints tight.	Severe limitations. Rock excavation; poor drainage.	Slight to moderate limitations. Subgrade requires drainage; rock excavation.	Slight limitations. Subgrade requires drainage; shallow cuts can be ripped.	Slight limitations. Local seeps.	No limitations.	No limitations.	Slight limitations where topographically suitable.	Slight to moderate limitations.	Moderate limitations. Rock excavation; in narrow trenches, pneumatic equipment required; locally, blasting required.
5. Limestone	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of ground-water contamination.	Severe limitations. Rock excavation; steep slopes.	Severe limitations. Rock excavation; steep slopes.	Moderate limitations. Rock excavation; steep slopes; narrow ravines. Slight limitations where topography-ically suitable.	Severe limitations. Rock excavation; steep slopes.	Severe limitations. Steep slopes; small areas of level land.	Moderate to slight limitations. Steep wooded slopes. Slight limitations for forest reserve or natural history park.	Slight limitations. Reservoir might leak where rocks are faulted.	Severe limitations.	Severe limitations. Rock excavation.
6. Limestone, irregularly bedded	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of ground-water contamination.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable; sinks common; drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable; sinks common; local drainage problems.	Slight limitations. Local drainage problems from seeps or springs; sinks common.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable; sinks common; local drainage problems.	No limitations.	No limitations.	Severe limitations. Leaky reservoir rock; locally, conditions may be favorable; sinks common.	Severe limitations.	Severe limitations. Rock excavation.
7. Limestone, evenly bedded	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of ground-water contamination.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable; solution channels common; local seepage problems.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable; solution channels common; local seepage problems.	Slight limitations. Local drainage problems.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable; solution channels common; local seepage problems.	No limitations.	No limitations.	Severe to moderate limitations. Leaky reservoir rock; locally, conditions may be favorable; solution channels common.	Severe limitations.	Severe limitations. Rock excavation.
8. Shale and lime-stone, interbedded	Good to excellent foundation material. Moderately difficult to difficult to excavate.	Severe limitations. Impermeable rock.	Slight to moderate limitations. Earth and rock excavation; poor drainage.	Slight to moderate limitations. Earth and rock excavation; local seeps; subgrade requires drainage.	Slight limitations. Local seeps.	Slight limitations. Rock generally rippable; shallow cuts; local seeps.	No limitations.	No limitations.	Slight limitations. Most favorable sites are in this unit; locally, impermeable rock and underlain by fissured lime-stone.	Slight limitations.	Moderate limitations. Highly variable amount of rock and earth excavation.

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.

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. The term "rippable" means excavating rock using a ripper attachment on a bulldozer.

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 cavern, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

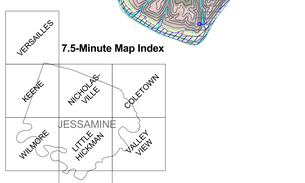
Extensive recreation—Camp sites, picnic areas, parks, etc.

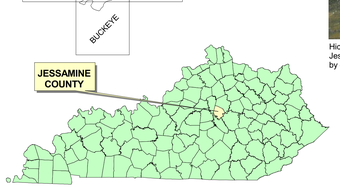
Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

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.

7.5-Minute Map Index





N
Scale 1:42,000
1 inch equals 2/3 mile
2 0 2 Miles

Groundwater

In karst areas such as Jessamine County, stormwater runoff can flow underground through large solution channels. This groundwater flow does not follow the topography of the surface, and water from one watershed may flow underground and reappear in an adjacent watershed. A knowledge of the groundwater flow, gained through dye-trace studies, is required to manage stormwater and to protect water quality and drinking-water sources. For more about dye traces in the area, contact the Kentucky Geological Survey.

In the Kentucky River, Hickman Creek, Jessamine Creek, and their major tributaries, most wells drilled in the valleys will produce enough water for a domestic supply at depths of less than 100 feet. Wells located in the creek valleys and the uplands of the northern two-thirds of the county will produce enough water for a domestic supply except during dry weather. In the uplands of the southern third of Jessamine County, which encompasses only 15 percent of the county, most drilled wells will not produce enough water for a dependable domestic supply. Some wells drilled along drainage lines in this area may produce enough water for a domestic supply except during dry weather.

Throughout the county, groundwater is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet. For more about the groundwater resources of the county, see Carey and Stickney (2005).

EXPLANATION

- School
- Water Wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
  - Agriculture
- Spring
- Rock outcrop
- Sinkhole
- Railroad
- Watershed boundary
- Concealed geologic fault
- Geologic fault
- Urban Service Boundary
- Source-water protection area, zone 1
- Flood zones (FEMA, 2005)
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Limestone quarry
- Mapped sinkholes
- Photo location

10-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. From more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

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