2005

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

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Acknowledgments

Geology adapted from Hettinger (2001), Nelson (2001a-f, 2002), and Thompson (2001a-b). Mapped sinkholes from Paylor and others (2004). Thanks to Jim Currens, Kentucky Geological Survey, for karst illustrations. Thanks to Paul Howell, U.S. Department of Agriculture-Natural Resources Conservation Service, for pond illustrations.

Kentucky State Capitol at Frankfort

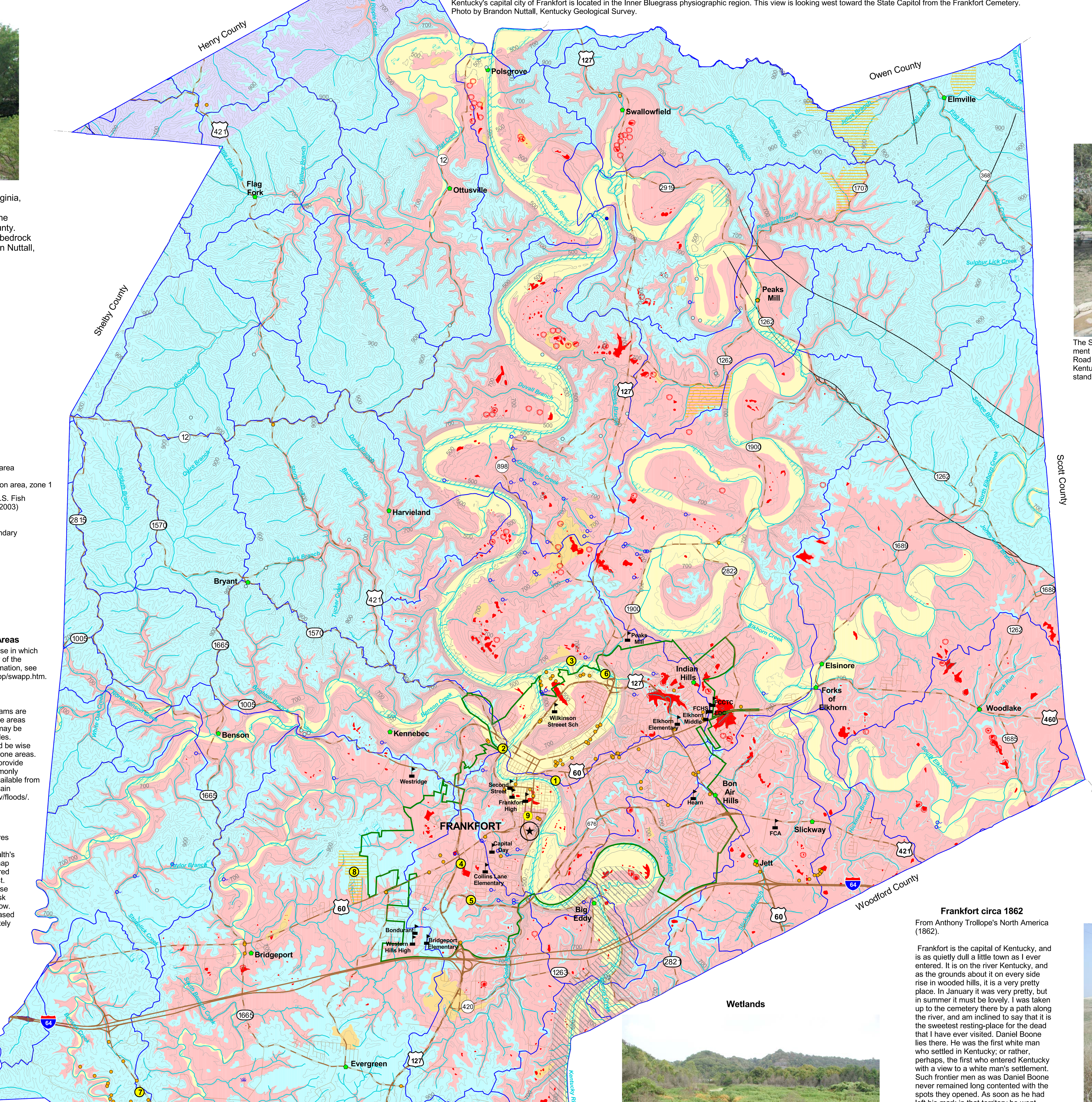
Franklin County, 210 square miles in the Bluegrass Region of Kentucky, was formed in 1794. It was named for Benjamin Franklin. The county seat of Frankfort was established in 1786 as Frankfort, Virginia, and became the capital of the new state of Kentucky in 1792. Tourist information is available from www.visitfrankfort.com. Elevations in Franklin County range from 455 feet, the normal pool level of the Kentucky River at Lock and Dam No. 4, to 930 feet on Union Ridge near the eastern edge of the county. The 2004 population of the county was 48,142, one percent higher than the population in 2000. The bedrock of the county is 450-million-year-old limestone and shale of the Ordovician Period. Photo by Brandon Nuttall, 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 the characteristics of both the soils and the underlying rock. For further assistance, contact Bart Davidson, Kentucky Geological Survey, 859.257.5500 x162. 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.

Kentucky's Capital City

Kentucky's capital city of Frankfort is located in the Inner Bluegrass physiographic region. This view is looking west toward the State Capitol from the Frankfort Cemetery. Photo by Brandon Nuttall, Kentucky Geological Survey.



EXPLANATION

- School
- State Capital
- Water Wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
  - Spring
  - Wet area
- Sinkhole
- Mapped sinkholes
- Wildlife management area
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Artificial fill
- Incorporated city boundary
- Watershed divide
- Fault
- Concealed fault

40-foot contour interval

- Picture location

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.

Flooding

Alluvium and low-lying areas along streams are subject to flooding. Construction in these areas should be protected from flooding and may be restricted by floodplain construction codes. Researching local flooding history would be wise prior to initiating construction in flood-prone areas. Soil scientists and engineers may also provide guidance. The depth of flooding is commonly underestimated. Flood information is available from the Kentucky Division of Water, Floodplain Management Branch, www.water.ky.gov/floods/.

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.

Kentucky River Flooding

Flooding of the Kentucky River is a relatively common occurrence in Frankfort. Here, the confluence of Benson Creek with the Kentucky River is shown at flood stage on June 1, 2004. The old iron bridge over Benson Creek is now a foot bridge for a river walk. Photo by Brandon Nuttall, Kentucky Geological Survey.

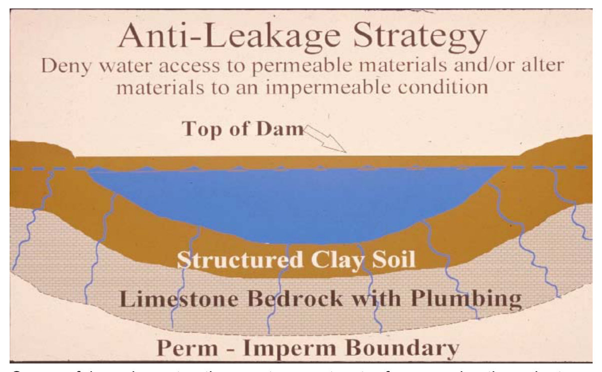
Kentucky River at Low Water

The same view as picture 2a, 1 year later on June 6, 2005, at summer pool. Photo by Brandon Nuttall, Kentucky Geological Survey.

Flood Protection

This flood control levee is located near the Jones Run Pumping Station in Frankfort. The view is to the south, with the Kentucky River to the right (west) and the Cove Spring Park Nature Preserve Wetland Area (picture 13) to the left (east). Photo by Brandon Nuttall, Kentucky Geological Survey.

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. (Photo 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 Road, Frankfort, KY 40601, telephone: 502-564-3410.

Groundwater Resources

In the valley bottoms of the Kentucky River, Elkhorn Creek, and their major tributaries, most drilled wells will produce enough water for a domestic supply at depths less than 100 feet. Wells located in the smaller creek valleys throughout the county and the uplands of the southeastern part of the county will produce enough water for a domestic supply except during dry weather. In other upland areas (about 40 percent of the county), most drilled wells will not produce enough water for a dependable domestic supply. Wells along drainage lines in this area may produce enough water except during dry weather. Groundwater throughout the county is hard or very hard, and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet. For more information about groundwater in the county see Carey and Stickney (2001).

Scale 1:48,000
2.25 0 2.25 4.5 Miles
1 inch equals 3/4 mile

Planning Guidance by Rock Unit Type

Rock Unit	Karst Potential	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation (ballfields, playgrounds, etc.)	Extensive Recreation (hiking trails, nature preserves, etc.)	Reservoir Area	Reservoir Embankments	Underground Utilities
1. Alluvium	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock.	Fair foundation material; easy to excavate. Seasonal high water table, subject to flooding. Also refer to soil report (McDonald and others, 1985).	Severe limitations. Seasonal high water table subject to flooding. Refer to soil report (McDonald and others, 1985).	Severe limitations. Seasonal high water table subject to flooding. Refer to soil report (McDonald and others, 1985).	Severe limitations. Seasonal high water table subject to flooding. Refer to soil report (McDonald and others, 1985).	Severe to moderate limitations. Seasonal high water table subject to flooding. Refer to soil report (McDonald and others, 1985).	Severe limitations. Seasonal high water table subject to flooding. Refer to soil report (McDonald and others, 1985).	Moderate to slight limitations, depending on activity and topography. May be subject to flooding. Refer to soil report (McDonald and others, 1985).	Slight limitations, depending on activity and topography. May be subject to flooding. Slight limitations for nature or forest preserves. See soil report (McDonald and others, 1985).	Pervious material. Seasonal shallow water table. May be subject to flooding. Refer to soil report (McDonald and others, 1985).	Severe to slight limitations. Unstable steep slopes. Refer to soil report (McDonald and others, 1985).	Slight limitations. Generally favorable except for seasonal high water table and subject to flooding. See soil report (McDonald and others, 1985).
2. High-level gravel deposits	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock.	Fair foundation material; easy to excavate.	Severe to slight limitations, depending on amount of soil cover.	Moderate to slight limitations, depending on degree of slope.	Features generally favorable.	Features generally favorable, depending on degree of slope.	Features generally favorable, depending on degree of slope.	Moderate to slight limitations, depending on activity and topography. Possible steep, wooded slopes.	Slight limitations, depending on activity and topography. Possible steep, wooded slopes. Slight limitations for nature or forest preserves.	Pervious material.	Severe to slight limitations. Unstable steep slopes.	Slight limitations.
3. Limestone and shale	High to medium.	Good to excellent foundation material; difficult to excavate.	Severe to slight limitations, depending on amount of soil cover and depth to impermeable rock.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Possible rock excavation. Local drainage problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Possible rock excavation. Possible steep slopes. Slight limitations with suitable topography.	Severe to slight limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Moderate to slight limitations. Rock excavation may be required.	Slight limitations, depending on activity and topography. Possible steep, wooded slopes. No limitations for nature or forest preserves.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.
4. Limestone	High.	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table. Danger of groundwater contamination.	Severe limitations. Rock excavation may be required.	Severe limitations. Possible rock excavation. Possible steep slopes.	Severe to moderate limitations. Possible rock excavation. Possible steep slopes and narrow ravines.	Slight to moderate limitations, depending on topography. Possible rock excavation. Sinks common. Local drainage problems.	Moderate 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. No limitations for nature or forest preserves.	Severe to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.
5. Shale and limestone	Medium to low.	Fair to good foundation material; difficult to excavate.	Severe to slight limitations, depending on amount of soil cover and depth to impermeable rock.	Severe to moderate limitations. Rock excavation may be required.	Moderate to severe limitations. Possible rock excavation. Possible steep slopes.	Moderate limitations. Rock excavation likely. Local drainage problems. Sinks common.	Severe to slight limitations, depending on topography. Possible rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Moderate to slight limitations, depending on activity and topography. Possible steep, wooded slopes.	Slight limitations, depending on activity and topography. Possible steep, wooded slopes.	Slight to moderate limitations.	Slight to moderate limitations.	Severe to moderate limitations. Possible rock excavation.

Wetlands

The wetland pictured here is part of the Cove Spring Park Nature Preserve Wetland Area, located in a meander cutoff of the Kentucky River near Frankfort. For many years this area was the habitat of beavers, whose dam impounded water from Cove Spring and permanently flooded the area. The beavers were removed in the interest of flood and mosquito control, and the area is being restored to an ephemeral ponded wetland. Photo by Brandon Nuttall, Kentucky Geological Survey.

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.

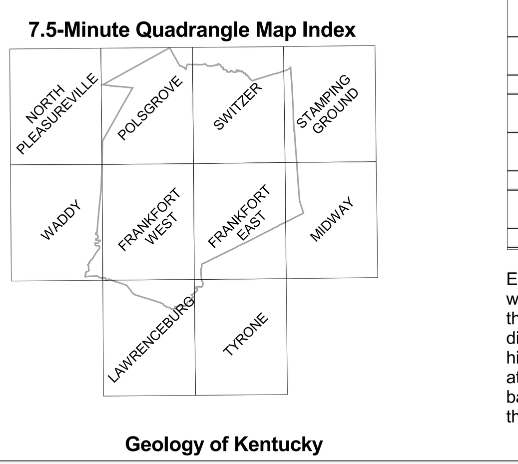
Extensive recreation--Camp sites, picnic areas, parks, etc.

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

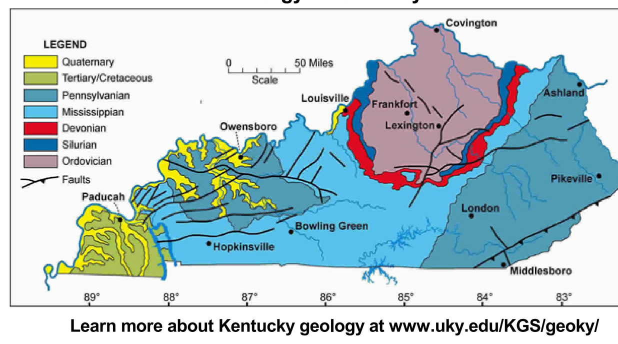
Reservoir embankments--The rocks are rated on limitations for embankment material.

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

7.5-Minute Quadrangle Map Index



Geology of Kentucky



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

Frankfort circa 1862

From Anthony Trollope's North America (1862).

Frankfort is the capital of Kentucky, and is as quietly dull a little town as I ever entered. It is on the river Kentucky, and as the grounds about it on every side rise in wooded hills, it is a very pretty place. In January it was very pretty, but in summer it must be lovely. I was taken up to the cemetery there by a path along the river, and am inclined to say that it is the sweetest resting-place for the dead that I have ever visited. Daniel Boone lies there. He was the first white man who settled in Kentucky; or rather, perhaps, the first who entered Kentucky with a view to a white man's settlement. Such frontier men as was Daniel Boone never remained long contented with the spots they opened. As soon as he had left his mark in that territory he went again further west over the big rivers into Missouri, and there he died. But the men of Kentucky are proud of Daniel Boone, and so they have buried him in the loveliest spot they could select, immediately over the river. Frankfort is worth a visit, if only that this grave and graveyard may be seen. The legislature of the State was not sitting when I was there, and the grass was growing in the streets. (Kentucky Atlas & Gazetteer)

Karst Geology

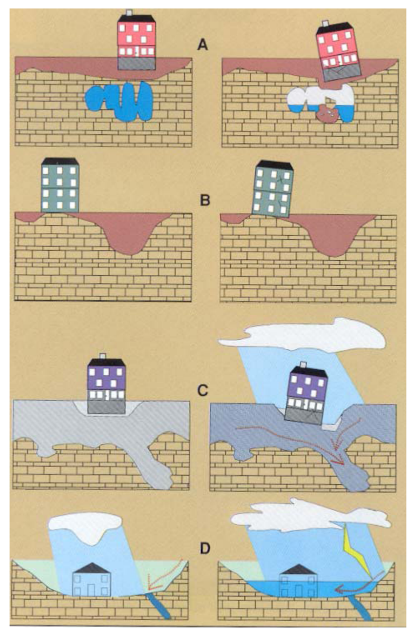
The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum).

Sinkholes are depressions on the land surface into which 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 large enough for a person to enter.

Salato

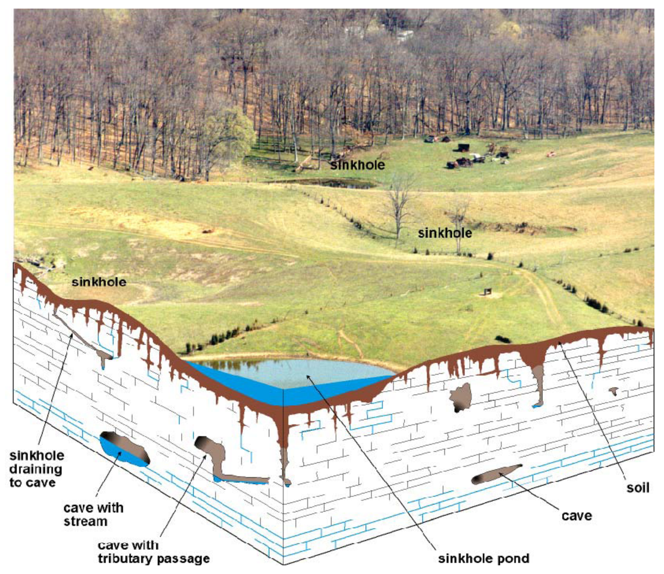
The Salato Wildlife Education Center, managed by the Kentucky Department of Fish and Wildlife Resources, is located at Number One Game Farm Road on U.S. Highway 60 east of Frankfort. The center is a showcase of Kentucky's diverse ecosystems. Note the black bear to the right of the view stand. Photo by Brandon Nuttall, Kentucky Geological Survey.

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 an infrequent heavy storm cannot be carried away quickly enough to prevent flooding of low-lying areas. Adapted from AIPG (1993).

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 into the groundwater.

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

(From Currens, 2001)

Sinkholes

A natural sinkhole near Frankfort at Hudson Hollow Road. Road construction in this vicinity has altered underground drainage, causing flooding to the area and nearby neighborhoods. Trees and debris can be seen in the opening of the sinkhole. Photo by Brandon Nuttall, Kentucky Geological Survey.

This constructed sinkhole at Hudson Hollow is adjacent to the natural sinkhole shown in picture 4a, and is used to control flooding during heavy rains. The underground system was built with two constructed swallets to redirect groundwater flow toward the Kentucky River. Photo by Brandon Nuttall, Kentucky Geological Survey.

This outflow gate for the constructed underground drainage system shown in picuture 4b is located at the intersection of the East-West Connector and Collins Lane in Frankfort. The constructed underground drainage system exceeds 1 mile in length. Photo by Brandon Nuttall, Kentucky Geological Survey.

Waste Management

The Benson Valley Area Landfill of Franklin County, as seen from Ky. 151. Landfill sites must be carefully considered and extensively monitored to avoid contamination of local groundwater aquifers. Photo by Brandon Nuttall, Kentucky Geological Survey.

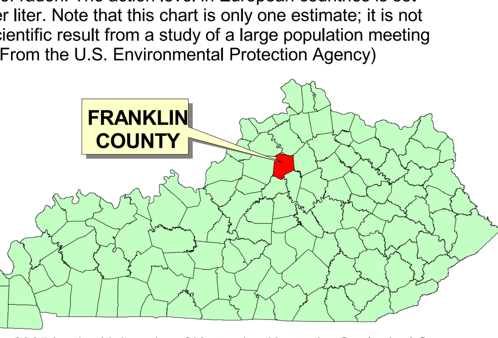
Radon

Radon gas, although not widely distributed in Kentucky in amounts above the U.S. Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter, can be a local problem. Units 3, 4, and 5 may have high levels of radon. Homes in these areas should be tested for radon, but the homeowner should keep in mind that the health threat 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 pack/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)



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

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Other Resources for Franklin County

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

ces.ca.uky.edu/franklin/--University of Kentucky Cooperative Extension Service (agriculture agents)
www.kineticnet.net/kyrcd/tbred.html--Kentucky Resource Conservation and Development
www.bgadd.org/counties/franklin.htm--Bluegrass Area Development District
www.thinkkentucky.com/edis/cmnty/cmntyindex.htm--Detailed county statistics
www.uky.edu/KentuckyAtlas/21073.html--Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21073.html-- U.S. census data