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Generalized Geologic Map for Land-Use Planning: Lexington and Fayette County, Kentucky

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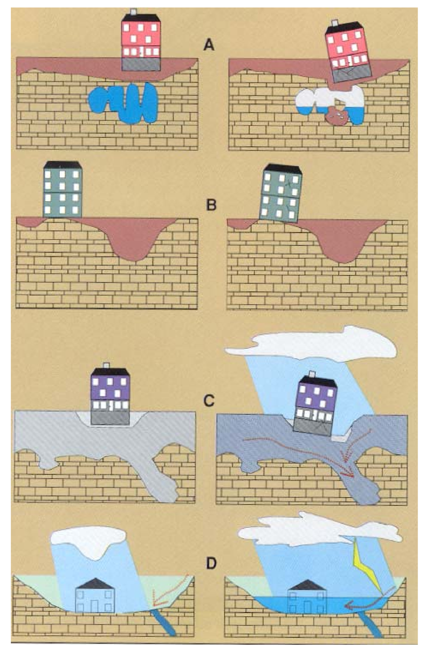
Construction on Limestone Terrain



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).

Sinkhole Flooding

Flooding in a karst basin. Sinkhole swallets and solution channels are not large enough to carry off the water after a large storm. The problem is exacerbated by development. Often the only solution is to relocate the homes out of the karst floodplain. Photograph courtesy of Jim Rebmann, Lexington-Fayette Urban County Government.

Cover-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. Photograph courtesy of Jim Currens, Kentucky Geological Survey.

Attempt to fill in a cover-collapse sinkhole in Fayette County. Photograph courtesy of Leslie Russo, Kentucky Geological Survey.

EXPLANATION

- School
- Spring
- Water Wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
  - Agriculture
- Identified sinkholes
- Mapped sinkholes
- Railroad
- Watershed boundary
- Concealed geologic fault
- Geologic fault
- Source-water protection area boundary, zone 1
- Royal Spring aquifer protection area
- Urban service boundary
- Artificial fill
- Public lands
- Designated flood zone (FEMA, 2003)*
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2004)
- Active quarry

50-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.

Groundwater

In the North and South Forks of Elkhorn Creek, Hickman Creek, and Boone Creek and their major tributaries, most drilled wells 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 and western two-thirds of the county and in the upper reaches of the creek valleys in the eastern third will produce enough water for a domestic supply except during dry weather. In the upland areas of the eastern third of Fayette County (about 10 percent of the county), most drilled wells will not produce enough water for a dependable domestic supply unless they are drilled along drainage lines, in which case they may produce enough water except during dry weather.

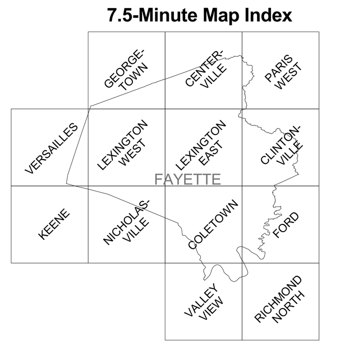
Throughout the county groundwater is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

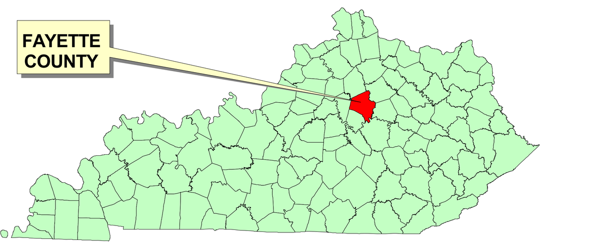
For more information on groundwater in the county, see Carey and Stickney (2005).

For Planning Use Only

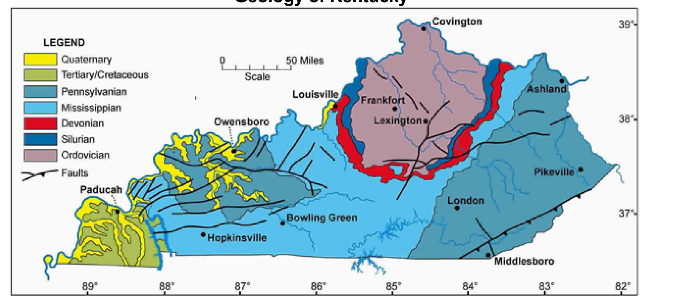
This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. For further assistance, contact the Kentucky Geological Survey, Geologic Hazards Section, 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.

7.5-Minute Map Index





Geology of Kentucky



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

The Horse Capital of the World

Lexington is known as The Horse Capital of the World. The phosphatic limestones underlying the Inner Bluegrass create a gently rolling topography and fertile soils that provide the foundation for the strong agricultural and thoroughbred horse industries. The Kentucky Horse Park will host the 2010 Alltech Fédération Equestre Internationale World Equestrian Games, bringing $150 million to the community. Photo by Dan Carey, Kentucky Geological Survey.

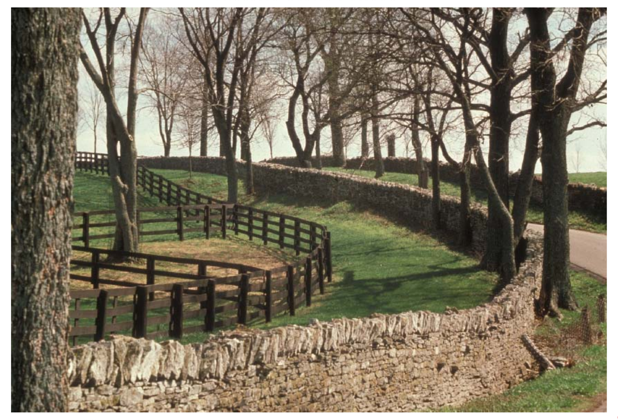
Keeneland

Keeneland is world-renowned for its thoroughbred racing and sales. Photo by Jim Rebmann, Lexington–Fayette Urban County Government, Division of Planning.

Tobacco

Annual burley tobacco production, once the backbone of Bluegrass farming, has dropped from 480 million pounds to less than 140 million pounds in recent years. Photo by Jim Rebmann, Lexington–Fayette Urban County Government, Division of Planning.

Historic Stone Fences



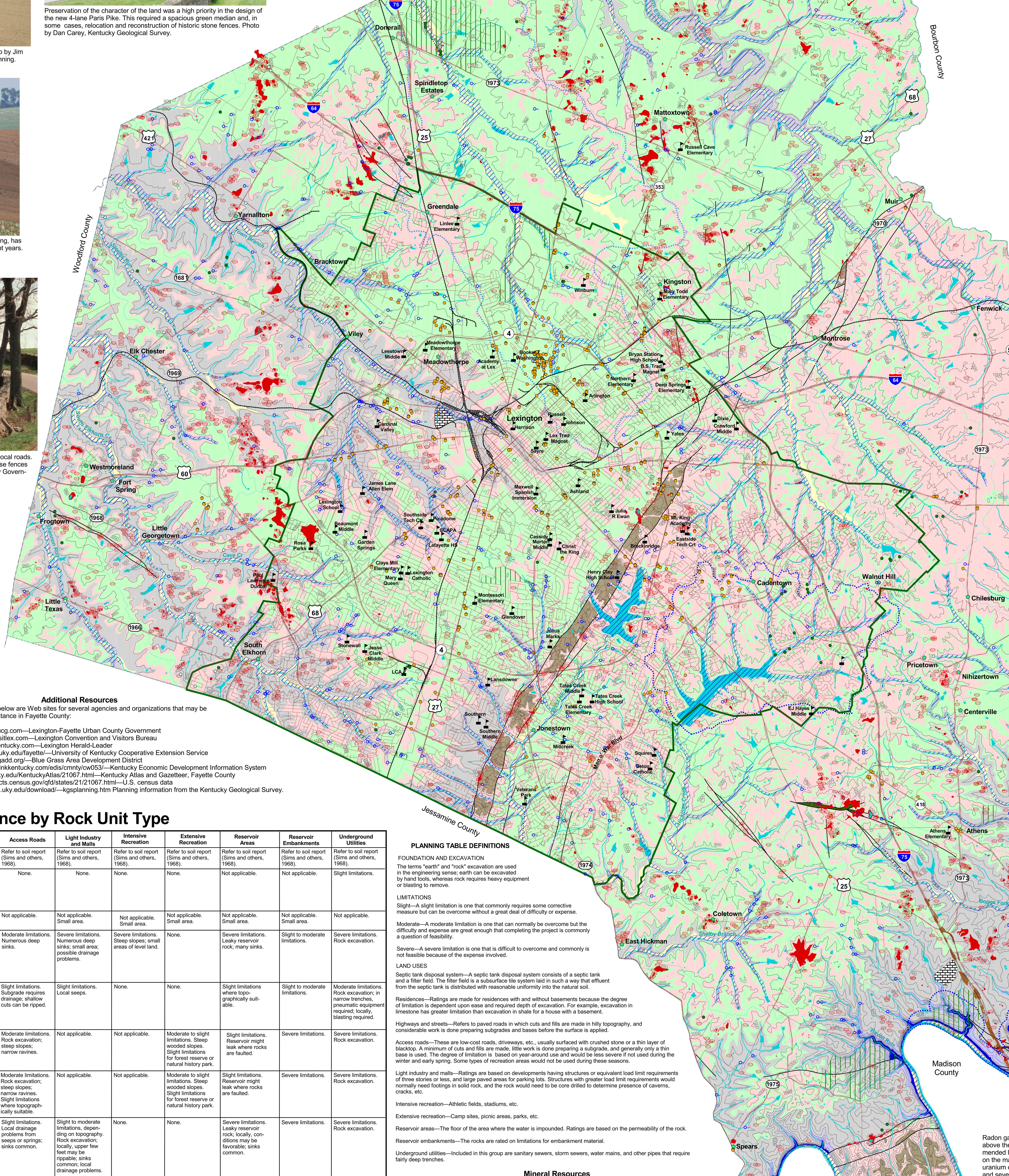
There are 38 miles of historic stone fences in the public right-of-way along local roads. The fences were made from local limestone. A local ordinance protects these fences from destruction. Photo by Jim Rebmann, Lexington-Fayette Urban County Government, Division of Planning.

Raven Run

Raven Run Creek. Raven Run is a unique, 470 acre nature sanctuary dedicated to preserving the natural beauty of the Kentucky River Palisades and early Kentucky history. Over 10 miles of hiking trails provide access to streams, meadows and woodlands characteristic of the area. Numerous 19th century remnants of early settlers, as well as over 600 species of plants, allow visitors to become acquainted with and appreciate the natural world. Raven Run also accommodates over 200 species of birds throughout the year. Photo by Jim Rebmann, Lexington–Fayette Urban County Government, Division of Planning.

Preserving the Character of the Land

Preservation of the character of the land was a high priority in the design of the new 4-lane Paris Pike. This required a spacious green median and, in some cases, relocation and reconstruction of historic stone fences. Photo by Dan Carey, Kentucky Geological Survey.



Additional Resources

Listed below are Web sites for several agencies and organizations that may be of assistance in Fayette County:

www.lfucg.com—Lexington-Fayette Urban County Government
www.visitlex.com—Lexington Convention and Visitors Bureau
www.kentucky.com—Lexington Herald-Leader
ces.ca.uky.edu/fayette/—University of Kentucky Cooperative Extension Service
www.bgadd.org/—Blue Grass Area Development District
www.thinkkentucky.com/edis/cmnty/cw053/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21067.html—Kentucky Atlas and Gazetteer, Fayette County
quickfacts.census.gov/qfd/states/21/21067.html—U.S. census data
kgsweb.uky.edu/download/—kgsplanning.htm Planning information from the Kentucky Geological Survey.

Planning Guidance by Rock Unit Type

Map 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 (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).	Refer to soil report (Sims and others, 1968).
2. High-level gravel deposits	Good foundation material. Easily excavated.	Slight to moderate limitations. Variable thickness and permeability; underlain by impervious rock.	Slight limitations.	None.	None.	None.	None.	None.	Not applicable.	Not applicable.	Slight limitations.
3. Fault breccia	Good foundation material. Easily excavated.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable. Small area.	Not applicable. Small area.	Not applicable. Small area.	Not applicable. Small area.	Not applicable. Small area.	Not applicable.
4. 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.	None.	Moderate limitations. Numerous deep sinks; rock excavation; possible drainage problems.	Moderate limitations. Numerous deep sinks.	Severe limitations. Numerous deep sinks; small area; possible drainage problems.	Severe limitations. Steep slopes; small areas of level land.	None.	Severe limitations. Leaky reservoir rock; many sinks.	Slight to moderate limitations.	Severe limitations. Rock excavation.
5. 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.	None.	None.	Slight limitations where topographically suitable.	Slight to moderate limitations.	Moderate limitations. Rock excavation; in narrow trenches, pneumatic equipment required; locally, blasting required.
6. Dolomite	Excellent foundation material. Difficult to excavate.	Not applicable.	Not applicable.	Severe limitations. Rock excavation; steep slopes.	Moderate limitations. Rock excavation; steep slopes; narrow ravines.	Not applicable.	Not applicable.	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.
7. Limestone	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of groundwater contamination.	Not applicable.	Severe limitations. Rock excavation; steep slopes.	Moderate limitations. Rock excavation; steep slopes; narrow ravines. Slight limitations where topographically suitable.	Not applicable.	Not applicable.	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.
8. Limestone, irregularly bedded	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of groundwater 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.	None.	None.	Severe limitations. Leaky reservoir rock; locally, conditions may be favorable; sinks common.	Severe limitations.	Severe limitations. Rock excavation.
9. Limestone, evenly bedded	Excellent foundation material. Difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures; danger of groundwater 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; local seepage problems.	None.	None.	Severe to moderate limitations. Leaky reservoir rock; locally, conditions may be favorable; solution channels common.	Severe limitations.	Severe limitations. Rock excavation.
10. Shale and limestone 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 in shallow cuts; local seeps.	None.	None.	Slight limitations. Most favorable sites are in this unit; locally, impermeable rock and underlain by fissured limestone.	Slight limitations.	Moderate limitations. Highly variable amount of rock and earth excavation.

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 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.

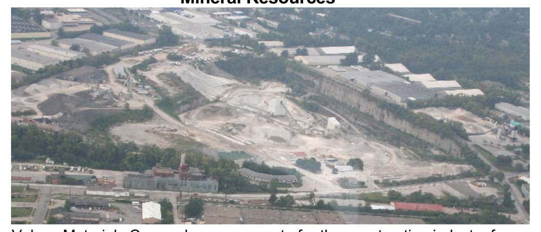
Extensive recreation—Camp sites, picnic areas, parks, etc.

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.

Mineral Resources



Vulcan Materials Co. produces aggregate for the construction industry from this limestone (unit 7) mine at the corner of Manchester and S. Forbes in Lexington. Photo by Jim Rebmann, Lexington-Fayette Urban County Government, Division of Planning.

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

Publications Sales Office
859.257.3896

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

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.

Radon

Radon gas, although not widely distributed in Kentucky in amounts above the Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter, can be a local problem. Unit 9 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 locally contain the phosphate mineral apatite. Uranium is sometimes part of the apatite structure, and when the limestone weathers away the phosphates containing uranium become concentrated in the soil and ultimately can give rise to high levels of radon. A few areas of high radon concentrations have been recorded in the Bluegrass Region. 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.

Acknowledgments

Geology adapted from Ciszak (2000), Curl (2001), Murphy (2001), Nelson (2000a-d, 2001a-c), Thompson (2000), Yang (2001) and Zhang (2001). This publication is adapted from Johnson and Hopkins (1966). Locations of urban service boundaries, streets, rails, and major sinkholes provided by the Lexington-Fayette Urban County Government's Geographic Information System department. Other sinkholes from the U.S. Department of Agriculture—Natural Resources Conservation Service, Soil Survey Geographic database (SSURGO). Thanks the LFUCG—Division of Planning for data and review.

Rural Residential Development

An army of new residential homes advances on the horizon beyond horse farms off Ky. 1681. Photo by Dan Carey, Kentucky Geological Survey.

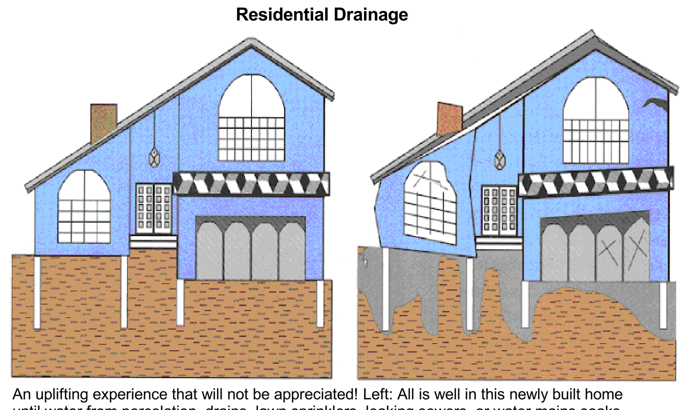
Purchase of Development Rights

Farmland east of Lexington protected through the Purchase of Development Rights (PDR) program. The landowner sells the development rights in perpetuity for the difference between the agricultural use value and the future development value. The PDR program encourages rural preservation and planned growth by reserving large contiguous rural areas. The goal of the PDR program is to purchase 50,000 acres by the year 2020. Photo by Dan Carey, Kentucky Geological Survey.

Hamburg Place

One of the most historic farms in the Bluegrass, Hamburg Place Farm, has been converted into a commercial and residential center. 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).

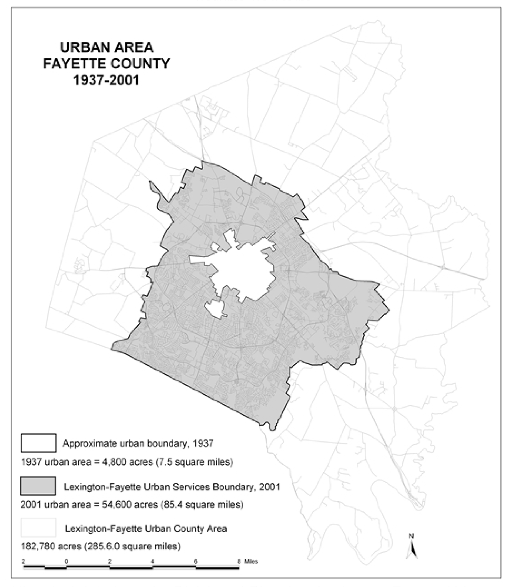
Limestone—Shale Interface

Seepage at the boundary between overlying permeable limestone and underlying impermeable shale. 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. Photograph by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

Urban Service Area Boundary

In 1958, Lexington became the first U.S. city to establish an urban service boundary. Outside the boundary, intensive development is not allowed. The urban service boundary has expanded since its inception; 47,000 acres of farmland were lost between 1964 and 2002, most during 1992-2002. Photo by Jim Rebmann, Lexington–Fayette Urban County Government, Division of Planning.

Urban Growth

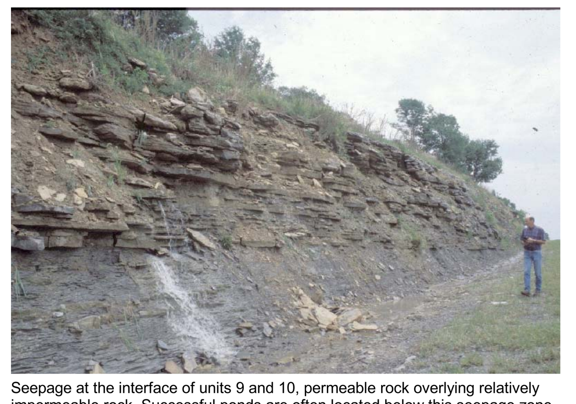


Historical data from the Division of Planning, Lexington–Fayette Urban County Government.

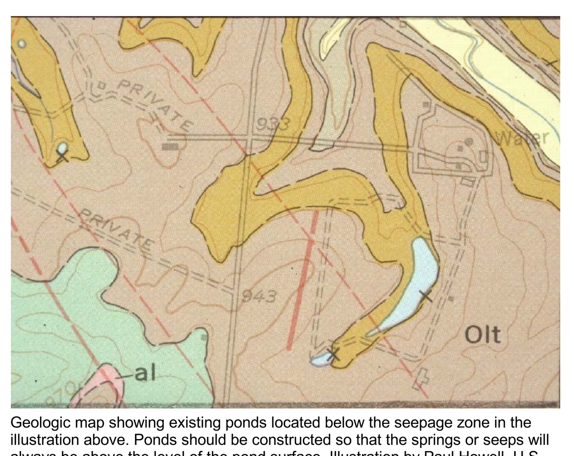
Pond Construction

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 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. Illustration by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.



Seepage at the interface of units 9 and 10, permeable rock overlying relatively impermeable rock. Successful ponds are often located below this seepage zone, as shown on the map below. Photograph by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.



Geologic map showing existing ponds located below the seepage zone in the illustration above. Ponds should be constructed so that the springs or seeps will always be above the level of the pond surface. Illustration by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

Swans and ducks enjoy a farm pond at the Kentucky Horse Park. Photo by Jim Rebmann, Lexington-Fayette Urban County Government.

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Scale 1:48,000

1 inch equals 3/4 mile

2 0 2 4 6 Miles