Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY, LEXINGTON

MAP AND CHART 130
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Generalized Geologic Map for Land-Use Planning: Grayson County, Kentucky

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Acknowledgments

Geology adapted from Conley (2002a,b), Hawkins (2002), Johnson (2002), Mullins (2002a-d), Plauche (2002). Smith (2002a,b), Thompson and Toth (2002), and Toth (2002a-e). Mapped sinkhole data from Paylor and others (2004). Thanks to Richard Smath, Kentucky Geological Survey, for information on tar-sands.

Grayson County Courthouse at Leitchfield

Grayson County, 504 square miles in the Western Kentucky Coal Field, was established in 1801. The 2004 population of 25,004 was 4 percent greater than in 2000. The highest point in the county, 963 feet, is on Buzzard Ridge, about 3.5 miles southwest of Millerstown. The lowest elevation, 395 feet, is where Rough River leaves the county. Rough River Dam State Resort Park offers fishing, boating, and golfing. The 5,800-acre Nolin Lake, with its 200 miles of shoreline, also provides for water recreation and outdoor activities. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone Ridges

Erosion-resistant sandstones (units 2, 3, 4) cap the ridges in many areas of the county. Junction Road follows such a ridge and provides this scenic vista looking north along Ky. 79 in the upper Pleasant Run Valley. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone and Limestone

Sandstone (unit 3) overlies limestone (unit 6) in this roadcut along the Western Kentucky Parkway. A thin layer of shale separates the two. Photo by Dan Carey, Kentucky Geological Survey.

Rough River Lake

The low winter pool on Rough River Lake reveals some interesting subterranean features along the shore. Photo by Dan Carey, 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 the Kentucky Geological Survey, Western Regional Office, 1401 Corporate Court, Henderson, KY 42420, phone 270.827.3414 or 270.827.3404. For more information, and to make custom maps of your area, visit the KGS Land-Use Planning Internet Mapping Web site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

EXPLANATION

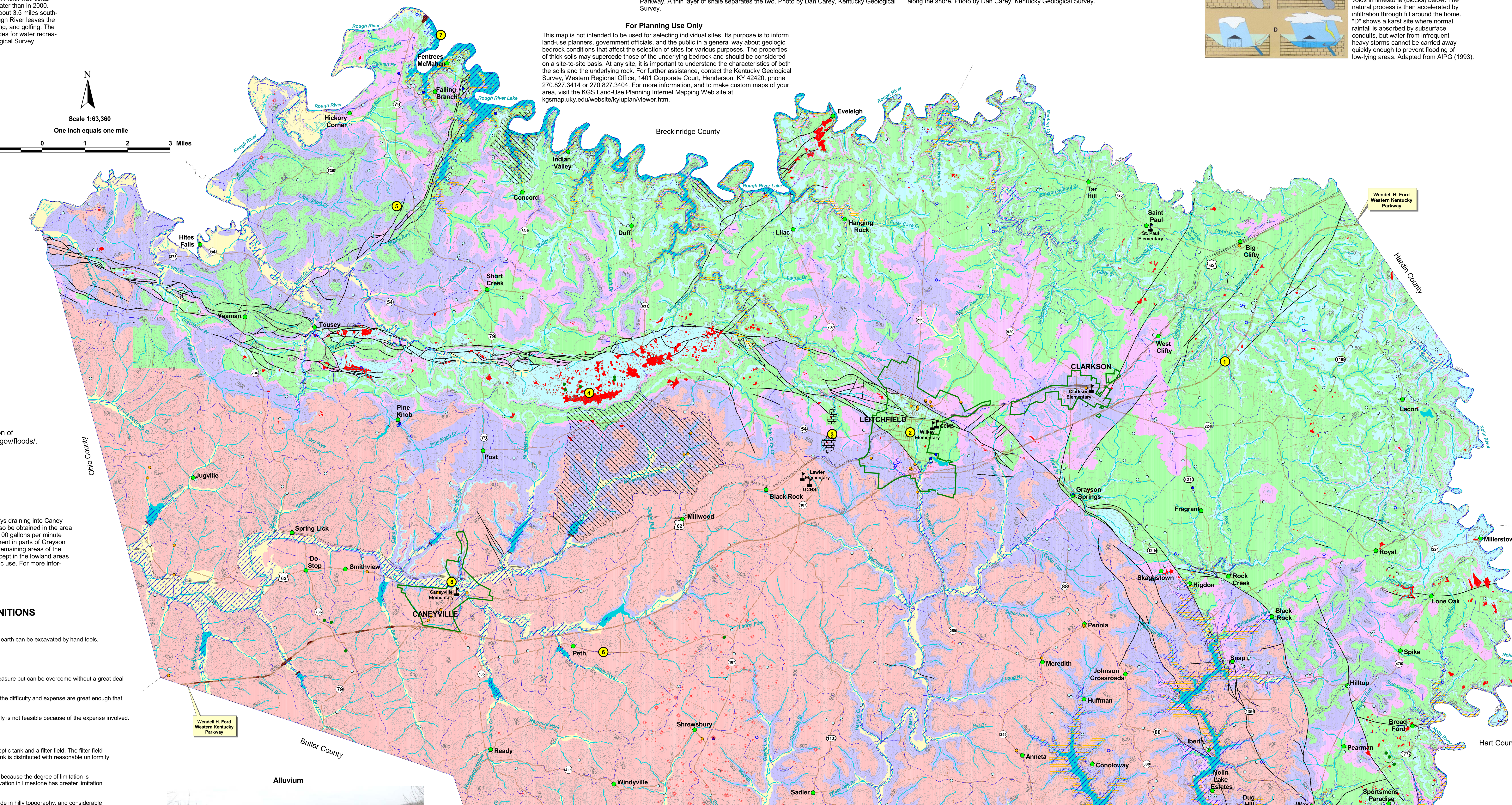
- School
- Urban service boundary
- Watershed divide
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Designated flood zone* (FEMA, 2005)
- Wildlife management area
- Limestone quarry
- Sinkholes
- County line
- Railroad
- Concealed fault
- Fault
- Water Wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
- Spring
- Oil and Gas Wells
  - Gas well
  - Oil and gas well
  - Oil well
- 40-foot contour interval
- Photo location

Scale 1:63,360

One inch equals one mile

1 0 1 2 3 Miles

*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

Most drilled wells in the lowlands along the Rough River and the valleys draining into Caney Creek are adequate for a domestic supply. Domestic supplies may also be obtained in the area extending 10 miles east and west from Leitchfield. Yields as high as 100 gallons per minute have been reported from wells penetrating fault zones that are prominent in parts of Grayson County. Depths of adequate wells range from 100 to 300 feet. In the remaining areas of the county, only a few wells yield enough water for a domestic supply, except in the lowland areas bordering streams, where yields are sometimes adequate for domestic use. For more information on groundwater in the county, see Carey and Stickney (2005).

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.

Alluvium

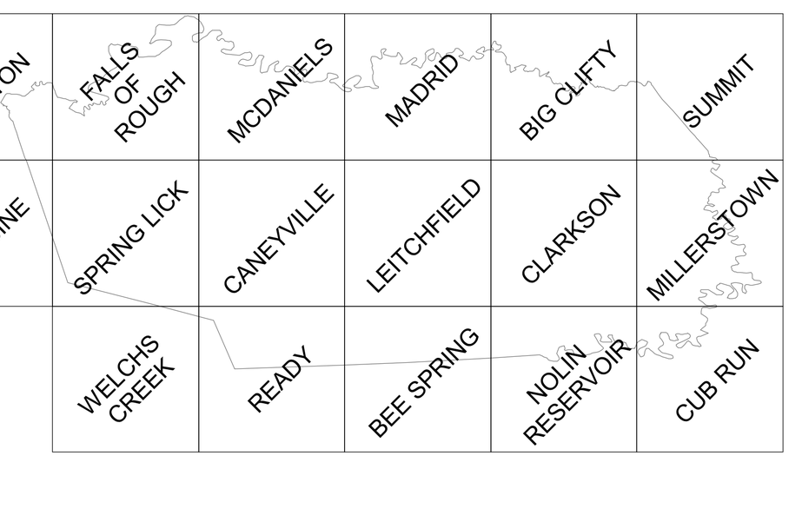
Standing water in this bottomland along Caney Creek near Caneyville is indicative of the limitations on construction in areas of alluvium (unit 1). Photo by Dan Carey, Kentucky Geological Survey.

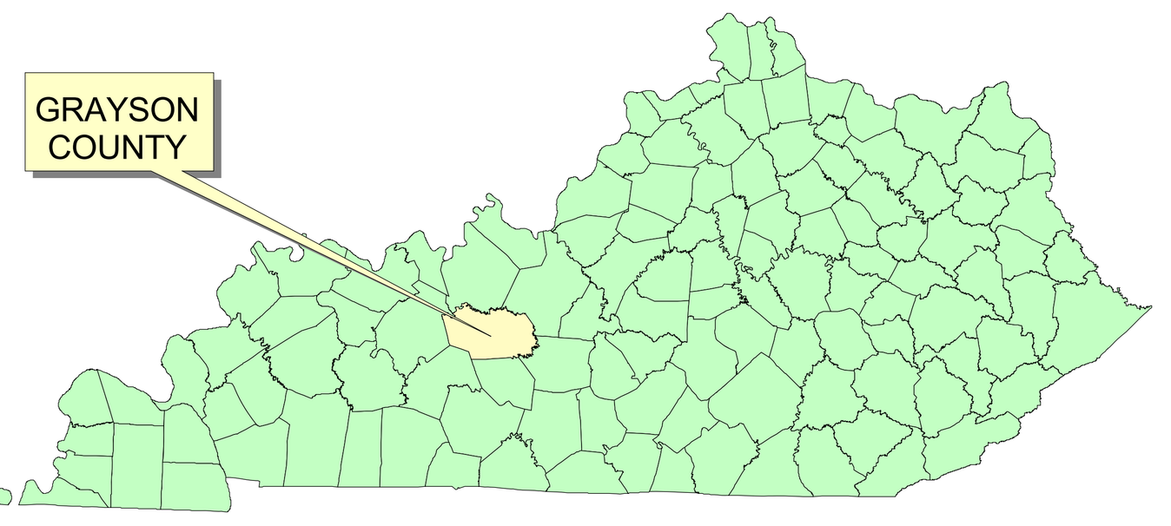
Planning Guidance by Rock Unit Type

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 (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).	Refer to soil report (Whitaker and others, 1972).
2. Shale, siltstone, sandstone, limestone, coal, underclay	Fair to good foundation material. Difficult excavation. Shales may contain expanding clay minerals.*	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable.*	Moderate limitations. Rock excavation.	Severe limitations. Rock excavation; locally, upper few feet may be rippable.*	Slight to moderate limitations.	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.*	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of soil and rock excavation.
3. Sandstone	Fair to good foundation material. Difficult excavation.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Moderate limitations. Permeable rock.	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of soil and rock excavation. Steep slopes.
4. Sandstone, siltstone, limestone, shale	Fair to good foundation material. Difficult excavation. Shales may contain expanding clay minerals.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of soil and rock excavation.
5. Limestone and shale	Fair to good foundation material. Difficult excavation. Shales may contain expanding clay minerals.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of soil and rock excavation.
6. Limestone	Excellent foundation material. Difficult excavation.	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 possible. Drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required.	Slight limitations. Local drainage problems from seeps or springs. Sinks possible.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Local drainage problems.	Slight to severe limitations. Steep slopes.	Slight to moderate limitations.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky rock.	Severe limitations. Rock excavation.

* Coal beds and underclays should not be used for foundations or reservoir embankments because of the presence of expanding pyrite in coal and underclays and the weakness of underclay when it becomes wet.

7.5-Minute Quadrangle Map Index

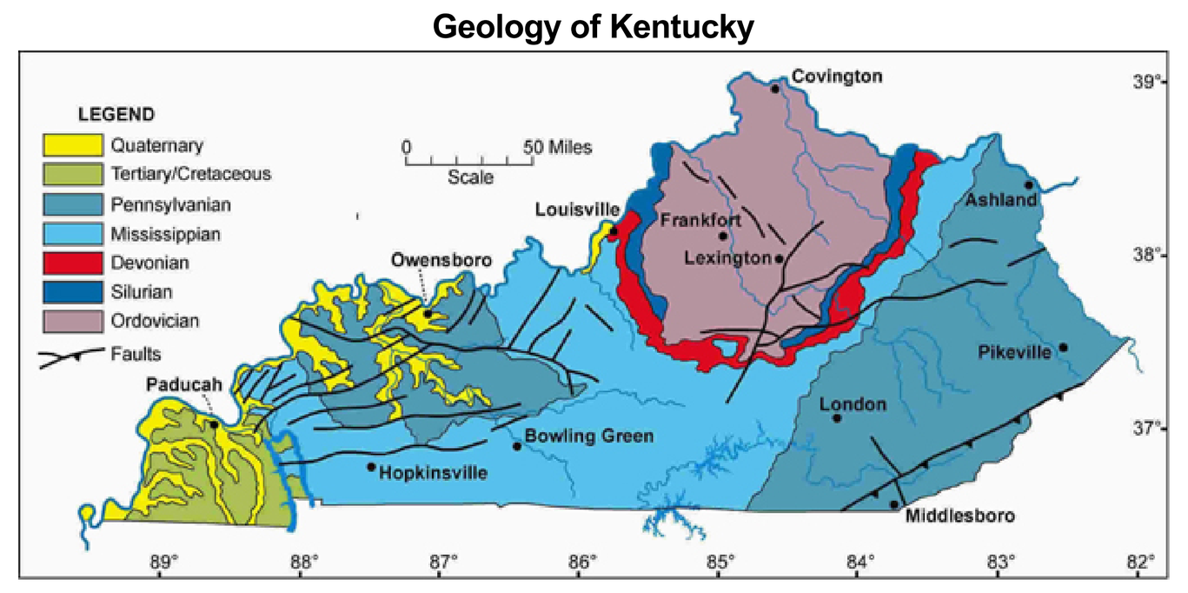




Ponds and Detention Basins

New basin in unit 2. Most ponds on unit 2 are successful. Photo by Dan Carey, Kentucky Geological Survey.

Geology of Kentucky



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

Mineral Resources

Ragland Quarry Inc. mines deep beneath the surface west of Leitchfield to produce 300,000 tons of limestone per year for crushed stone, asphalt, and lime. Photo by Dan Carey, Kentucky Geological Survey.

Energy Resources

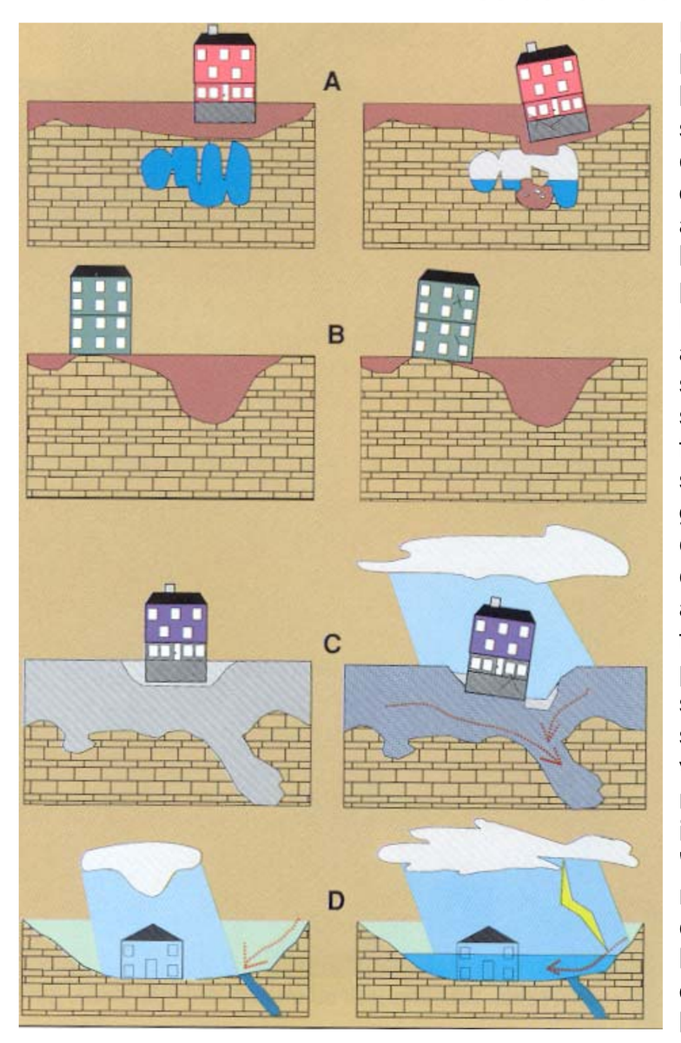
The Shrewsbury Gas Field in south-central Grayson County is one of the more productive fields in western Kentucky. Wells penetrate 1,200 to 1,700 feet into the Devonian-age New Albany Shale.

Tar-Sands in Western Kentucky

Investigations by the Kentucky Geological Survey have confirmed that major tar-sand resources are present in western Kentucky (Noger, 1999). In-place resources are calculated to be in excess of 3 billion barrels. The principal formations that contain tar-sand deposits (also referred to as asphaltic sandstones, heavy-oil deposits, or bitumen-impregnated sandstones) are the Kyrock, Bee Springs, Tar Springs, Hardinsburg, and Big Clifty Sandstones. Some of these may occur in Logan, Warren, Butler, Edmonson, Hart, Grayson, Breckinridge, and Hardin counties. In Grayson County, tar-sands may be present in unit 3. Photo by Randy Bruner.

For more information information on tar-sands, go to kgsweb.uky.edu/PubsSearching/PubsSimpleSearch.asp, keyword= tar sands.

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).

Geologic Hazards

The most common geologic hazard for Grayson County is flooding. Areas underlain by alluvium, unit 1 on the map, are often subject to flooding. Urban development can exacerbate flooding, and therefore the potential for flooding should always be considered in urban development plans. Areas of steep-walled drainage, such as that formed in terrain underlain by units 3 and 4, are conducive to flash flooding, especially in developed areas. Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

The Rough Creek Fault Zone passes through the middle of Grayson County from west to east. None of the faults in Grayson County are considered to be active. The proximity of active seismic zones such as the New Madrid and Wabash calls for precautions to be taken for earthquake damage mitigation, however. The presence of thick alluvium, which normally has a high groundwater table, should also be treated with special concern because of the possibility of augmented shaking and liquefaction during a strong earthquake. In addition, alluvium often contains high amounts of clay minerals that can give a soil a high shrink/swell capacity.

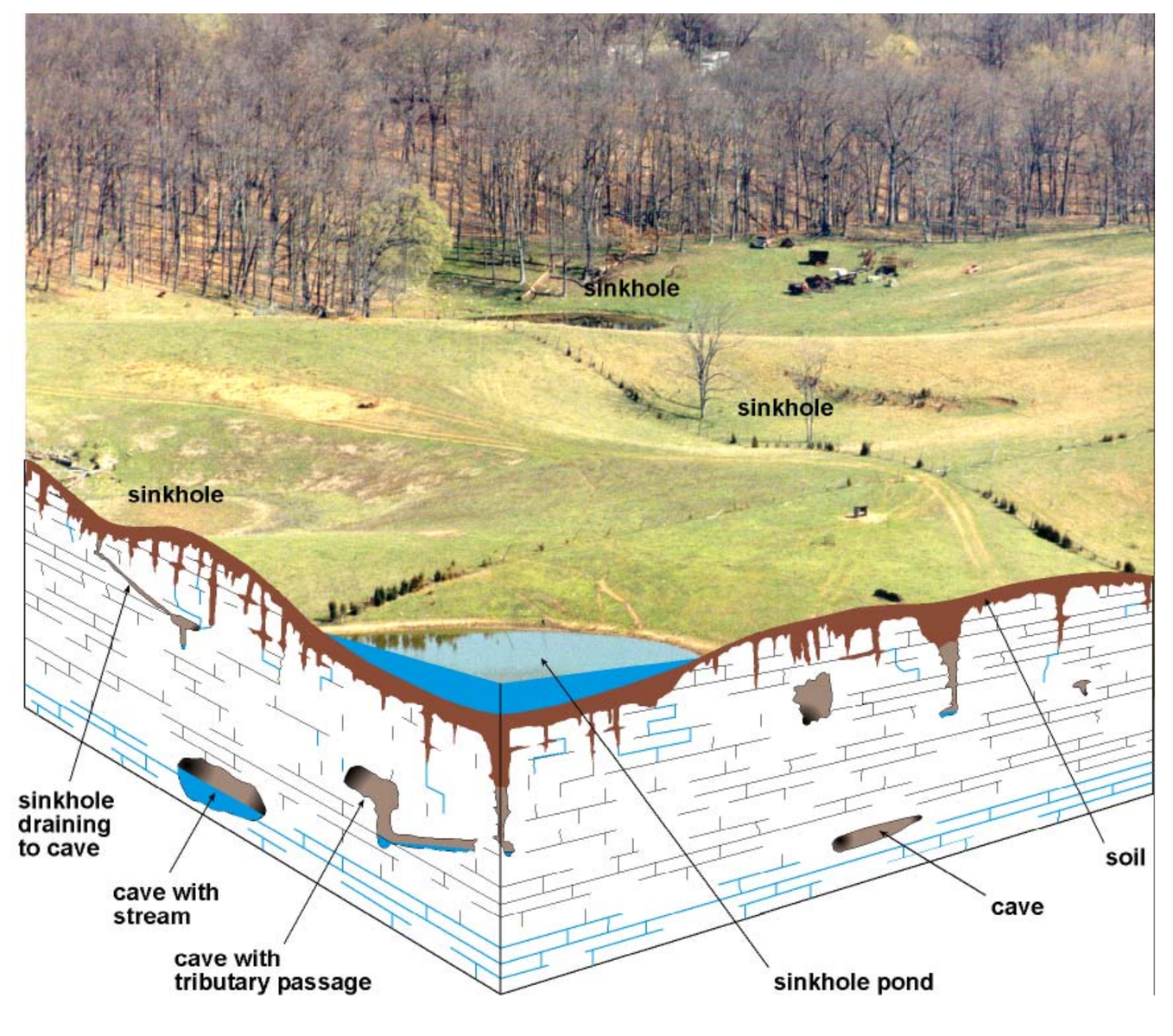
Steep slopes are present, especially along streams in areas underlain by units 3 and 4. Steep slopes can develop soil creep and landslides if not properly treated during development. Proper engineering techniques should be followed when developing on hillsides, and care should be taken not to affect property above and below a development site on a hillside.

Karst development contained within the faulted area of central Grayson County underlain by thick limestone, unit 6 on the map, is a significant geologic hazard. Sinkholes, shown in red, are the surface expression of solution cavities such as caves and flow channels. Karst can be particularly hazardous if not treated properly during urban development. Significant damage can occur if sinkholes open beneath a structure, and flooding can worsen if subsurface channels through sinkholes and caves are plugged or impaired by development and by diversion of surface-water runoff into sinkholes from large hard surfaces such as parking lots. Groundwater supplies may become polluted if waste is improperly dumped into sinkholes, and this will ultimately affect surface water.

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.

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)

Sinkholes

Sinkholes dominate the limestone (unit 6) landscape in the Rough Creek Fault Zone. This pair lie along the aptly named Sinks Road that traverses the area. Photo by Dan Carey, Kentucky Geological Survey.

Additional Planning Resources

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

ces.ca.uky.edu/Grayson/ University of Kentucky Cooperative Extension Service
www.ltadd.org/ Lincoln Trail Area Development District
www.thinkkentucky.com/edis/cmnty/cw010/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21085.html Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21085.html U.S. census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 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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