Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY, LEXINGTON

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

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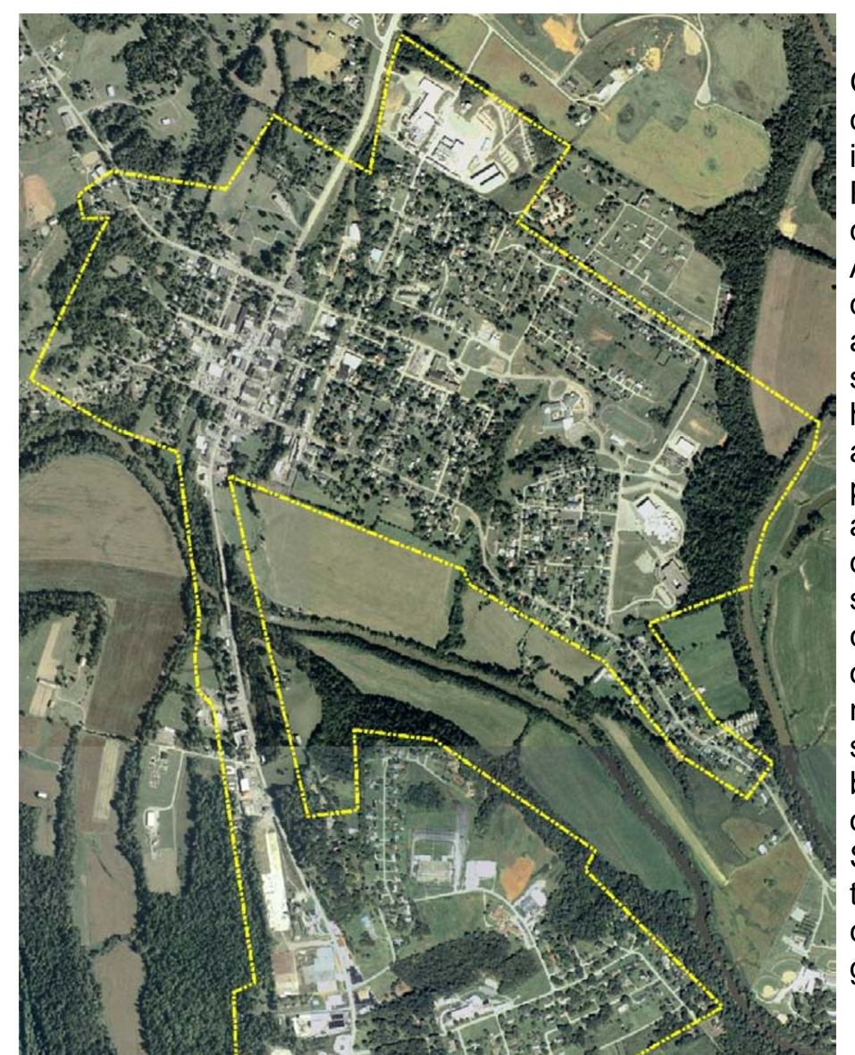
MAP AND CHART 160
Series XII, 2007

Historic Green County Courthouse

The former Green County courthouse, known as the oldest existing courthouse west of the Allegheny Mountains, was built of local limestone and completed in 1803. Green County, an area of 289 square miles in the Mississippian Plateaus Region, was formed in 1793. The highest elevation, 1,045 feet, is less than a mile south of where Ky. 61 crosses the Larue County line. The lowest elevation, 490 feet, is where the Green River leaves the county. The county population of 11,931 in 2005 was 3.6 percent greater than that of 2000. Photo by Dan Carey, Kentucky Geological Survey.



Greensburg

Greensburg (left), the county seat, was designated in 2004 as a Preserve America community. Preserve America communities demonstrate that they are committed to preserving America's heritage while ensuring a future filled with opportunities for learning and enjoyment. This designation provides strong incentives for continued preservation of the city's cultural and natural heritage resources. Photo (2004) by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Natural Resources

Timber and timber products, such as produced by the lumber mill above and cedar mill below, contribute to the Green County economy. Photos by Dan Carey, Kentucky Geological Survey.

Siltstone and Shale (Unit 2)

Thick beds of shale separated by erosion-resistant siltstone, exposed at this roadcut on Ky. 88, lie at the bottom of unit 2. Photo by Dan Carey, Kentucky Geological Survey.

Energy Resources

Since exploration began in 1915, the county has produced millions of barrels of oil. Natural gas has also contributed to the local economy. Photo by Dan Carey, Kentucky Geological Survey.

Radon

Radon gas can be a local problem, in some areas exceeding the U.S. Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter. Limestones of unit 2, in particular, may contain high levels of uranium or radium, parent materials for radon gas. 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, and the remedy may simply be additional ventilation of the home.

Radon Risk If You've Never Smoked (U.S. Envorinmental Protection Agency, 2005)

Radon Level	If 1,000 people who never smoked were exposed to this level over a lifetime*...	The risk of cancer from radon exposure compares to**...	WHAT TO DO:
20 pCi/L	About 36 people could get lung cancer	35 times the risk of drowning	Fix your home
10 pCi/L	About 18 people could get lung cancer	20 times the risk of dying in a home fire	Fix your home
8 pCi/L	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix your home
4 pCi/L	About 7 people could get lung cancer	The risk of dying in a car crash	Fix your home
2 pCi/L	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	About 2 people could get lung cancer	(Average indoor radon level)	(Reducing radon levels below 2 pCi/L is difficult.)
0.4 pCi/L		(Average outdoor radon level)	

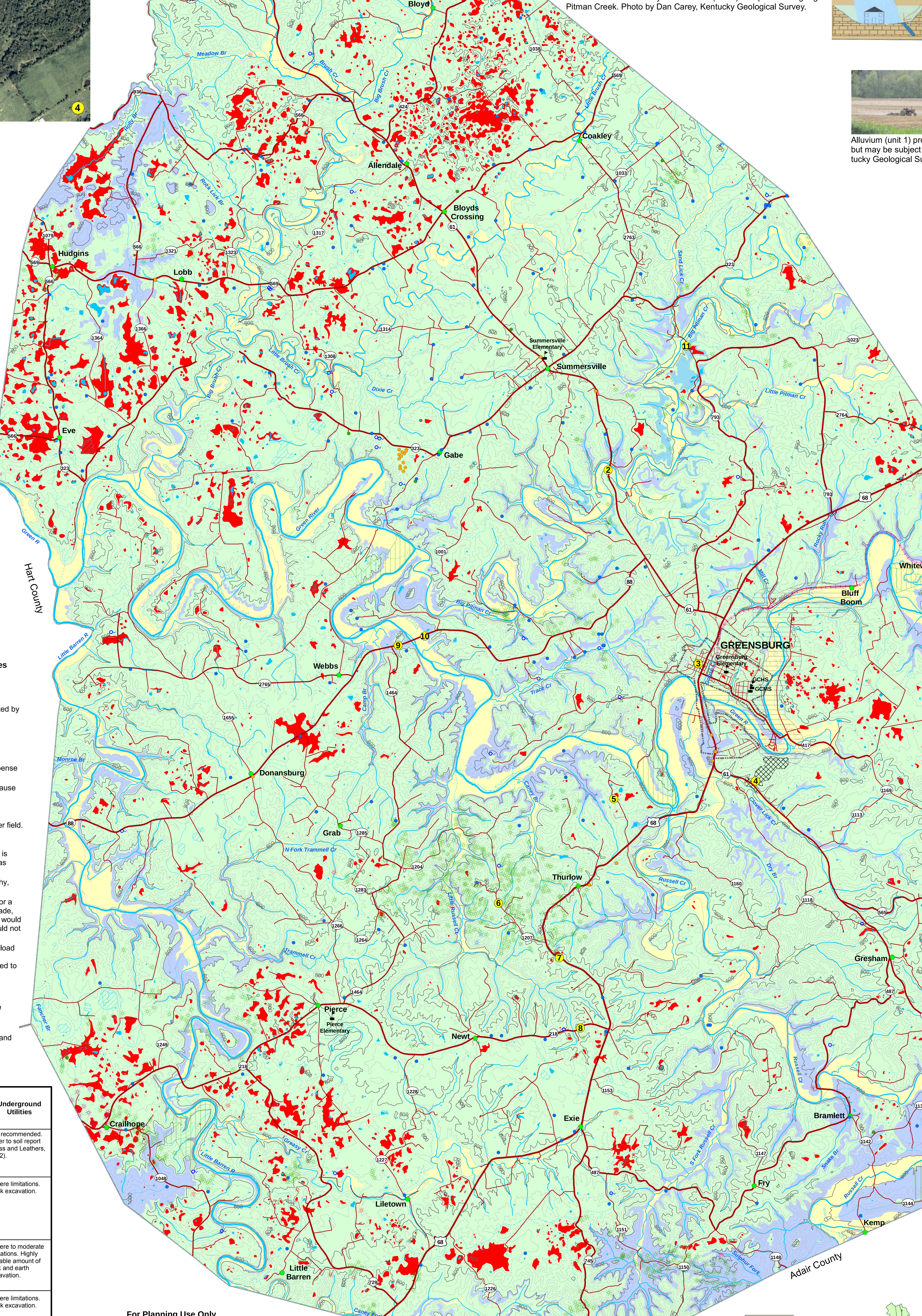
Note: If you are a former smoker, your risk may be higher.
* Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.

Mineral Resources

Limestone from the Fort Payne Formation (unit 4) is extracted for construction aggregate at this quarry south of Greensburg. Photo above by Dan Carey, Kentucky Geological Survey. Aerial photo below (2004) by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Radon Ventilation

Ventilation system removes radon from the basement area of this home. Photo by Dan Carey, Kentucky Geological Survey.



Scale = 1: 48,000
1 inch = 3/4 mile
0 0.5 1 2 3 4 Miles

LAND-USE PLANNING TABLE DEFINITIONS

FOUNDATION AND EXCAVATION

The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

LIMITATIONS

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal of difficulty or expense.

Moderate—A moderate limitation is one that can normally be overcome but the difficulty and expense are great enough that completing the project is commonly a question of feasibility.

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

LAND USES

Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.

Residences—Ratings are made for residences with 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 the 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.

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Planning Guidance by Rock Unit Type

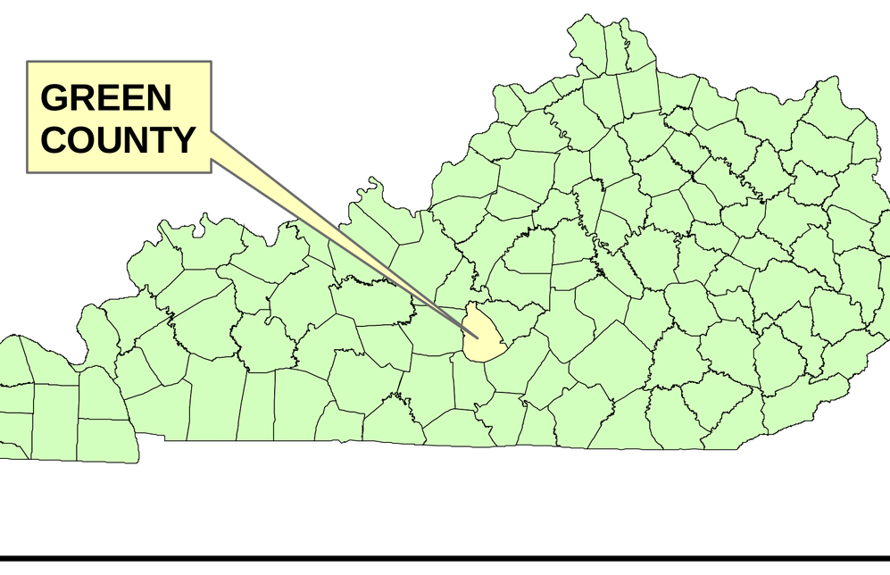
Rock Unit	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel (alluvium)	Fair foundation material; easy to excavate.	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Ross and Leathers, 1982).	Water in alluvium may be in direct contact with basements. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Refer to soil report (Ross and Leathers, 1982).	Slight to moderate limitations. Refer to soil report (Ross and Leathers, 1982).	Slight to moderate limitations. Avoid construction in floodplain. Refer to soil report (Ross and Leathers, 1982).	Refer to soil report (Ross and Leathers, 1982).	Refer to soil report (Ross and Leathers, 1982).	Refer to soil report (Ross and Leathers, 1982).	Not recommended. Refer to soil report (Ross and Leathers, 1982).	Not recommended. Refer to soil report (Ross and Leathers, 1982).
2. Limestone, siltstone, and shale	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. 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 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 common. Local drainage problems.	Slight to moderate limitations, depending on activity and topography.	Slight to moderate limitations, depending on activity and topography.	Severe limitations. Leaky reservoir rock; locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky rock. Locally, conditions may be favorable.	Severe limitations. Rock excavation.
3. Slumped sandstone, conglomerate, and shale	Fair to good foundation material; difficult to excavate.	Severe limitations. Impermeable rock.	Severe to moderate limitations. Difficult excavation; locally, upper few feet may be rippable.	Severe to moderate limitations. Difficult excavation; locally, upper few feet may be rippable.	Moderate limitations. Difficult excavation; locally, upper few feet may be rippable.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations, depending on activity and topography.	Slight to moderate limitations, depending on activity and topography.	Moderate limitations. Reservoir may leak where rocks are fractured.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe to moderate limitations. Highly variable amount of rock and earth excavation.
4. Limestone and siltstone	Good to excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Danger of groundwater contamination.	Severe limitations. Rock excavation may be required.	Severe limitations. Rock excavation. Possible steep slopes.	Severe to moderate limitations. Rock excavation. Possible steep slopes.	Slight to moderate limitations, depending on topography. Rock excavation. Local drainage problems.	Slight to severe limitations, depending on activity and topography.	Slight to severe limitations, depending on activity and topography.	Moderate to severe limitations. Reservoir might leak where rocks are fractured.	Moderate to severe limitations. Reservoir might leak where rocks are fractured.	Severe limitations. Rock excavation.
5. Shale and siltstone	Fair to poor foundation material; easy to moderately difficult to excavate. Possible expansion of shales.	Severe limitations. Low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Slight to severe limitations, depending on activity and topography. Strength, slumping, and seepage problems.	Slight to moderate limitations, depending on activity and topography.	Slight limitations. Reservoir may leak where rocks are fractured. Most ponds on shale are successful.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength, wetness.
6. Gravel (high-level deposits)	Good foundation material; easy to excavate.	Severe to moderate limitations. Possible groundwater contamination.	Slight limitations.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Not recommended. Pervious material.	Not recommended. Pervious material.	Slight limitations.

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 supersede those of the underlying bedrock and should be considered on a site-to-site basis. At any site, it is important to understand the characteristics of both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, 859.257.5500. For more information, and to make custom maps of your area, visit the KGS Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

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



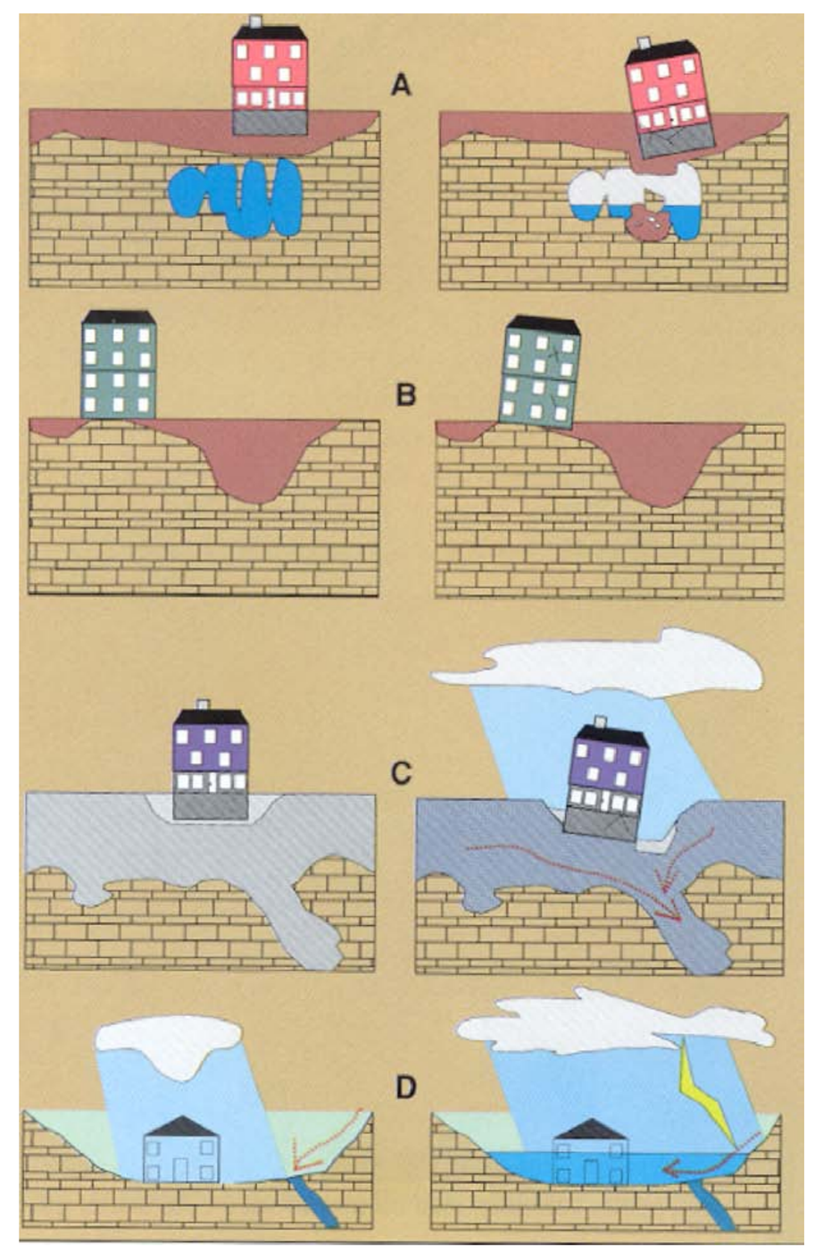
Limestone and Shale Terrain

The terrain of unit 2 varies from hilly to gently undulating sinkhole plains, depending on the thickness and frequency of shale beds in the underlying limestone. This scene looks toward Greensburg from the southwest. Photo by Dan Carey, Kentucky Geological Survey.

Limestone (Unit 4)

Limestone in the Fort Payne Formation (unit 4) is exposed along Big Pitman Creek. Photo by Dan Carey, Kentucky Geological Survey.

Construction on Karst



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).

Alluvium (Unit 1)

Alluvium (unit 1) provides rich soils for agriculture and level land for development, but may be subject to drainage problems and flooding. Photo by Dan Carey, Kentucky Geological Survey.

Shale and Siltstone (Unit 5)

Shale of unit 5 is exposed in this roadcut south of Big Pitman Creek. Photo by Dan Carey, Kentucky Geological Survey.

EXPLANATION

School
Gas well
Oil well
Enhanced recovery well
Gas injection or storage well
Water wells
Domestic
Monitoring
Industrial
Agricultural
Spring
County line
Watershed boundary
Abandoned railroad
Public lands
Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
Incorporated city boundaries
Source-water protection area, zone 1
Mapped sinkhole
Quarry
40-foot contour interval
Photo location

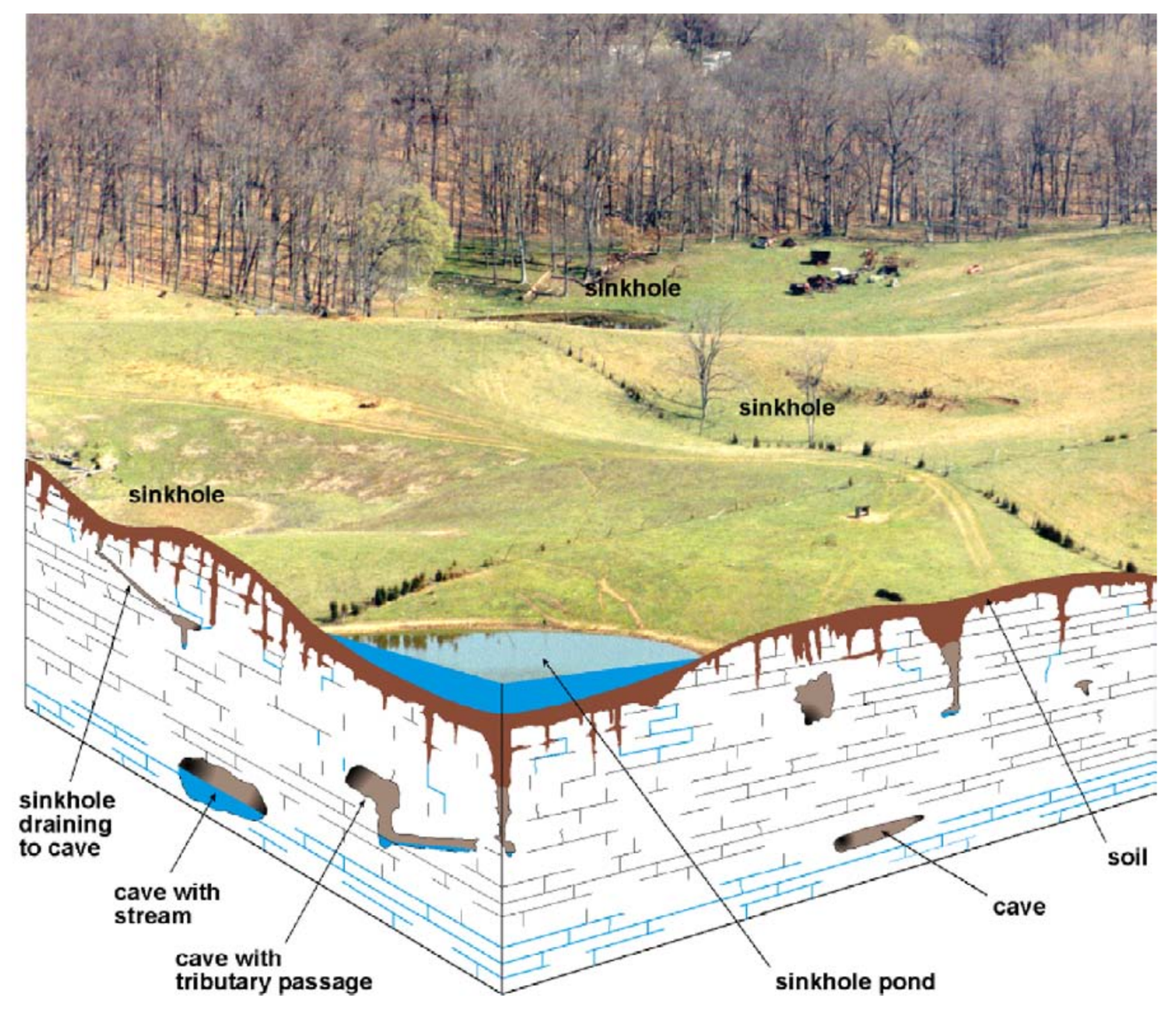
Source-Water Protection Areas

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.

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.

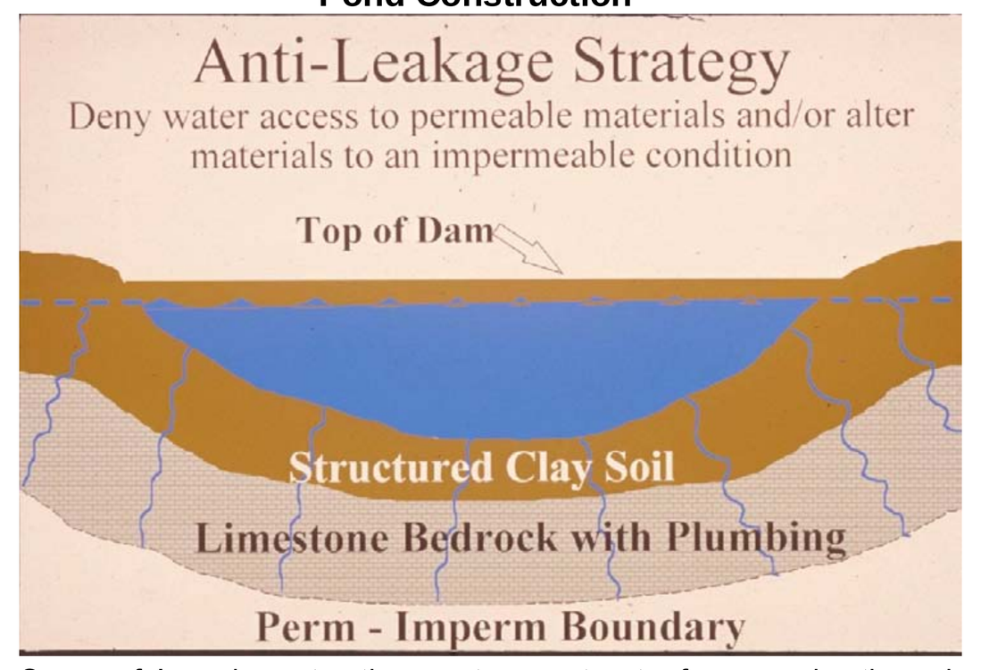
Environmental Protection



- 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 water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

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.

Limestone (Unit 2)

The Salem Limestone (unit 2) resists erosion in this small stream at Ky. 2762. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

About 500 people in Green County rely on private domestic water supplies: about 300 use wells and 200 use other sources. In the limestone-rich area of Green County, more than three-quarters of the drilled wells in the uplands are adequate for a domestic supply. Yields as high as 50 gallons per minute have been reported from wells penetrating large solution channels. In the low-lying areas in the Green and Barren River Valleys, only a few wells yield enough water for a domestic supply. Springs with flows ranging from a few gallons per minute to 318 gallons per minute are found in the county. Minimum flow generally occurs in early fall, maximum flows in late winter.

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

Additional Planning Resources

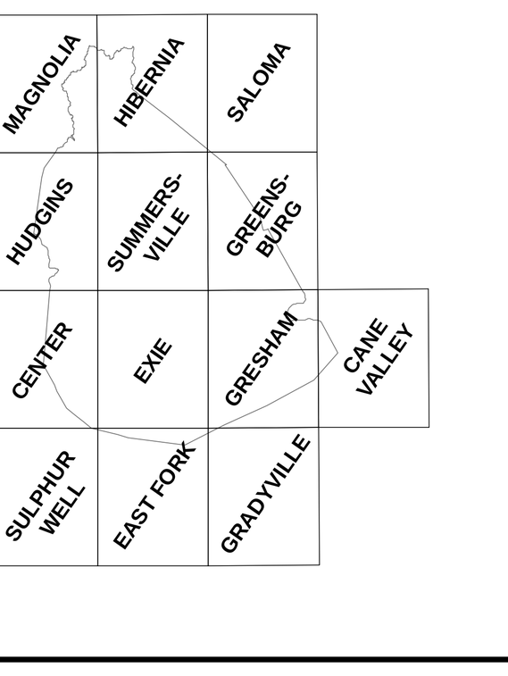
Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Green County:

www.greensburgky.com/—Greensburg Chamber of Commerce
ces.ca.uky.edu/green/—UK Cooperative Extension Service
www.lcadd.org/—Lake Cumberland Area Development District
www.thinkkentucky.com/edis/cmnty/cw/cw061/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21087.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21087.html—U.S. Census data
www.bae.uky.edu/ext/Residential/Radon/QandA.htm—Radon in the home
kgsweb.uky.edu/download/misc/landuse/mainkyluplan.htm—Planning information from the Kentucky Geological Survey

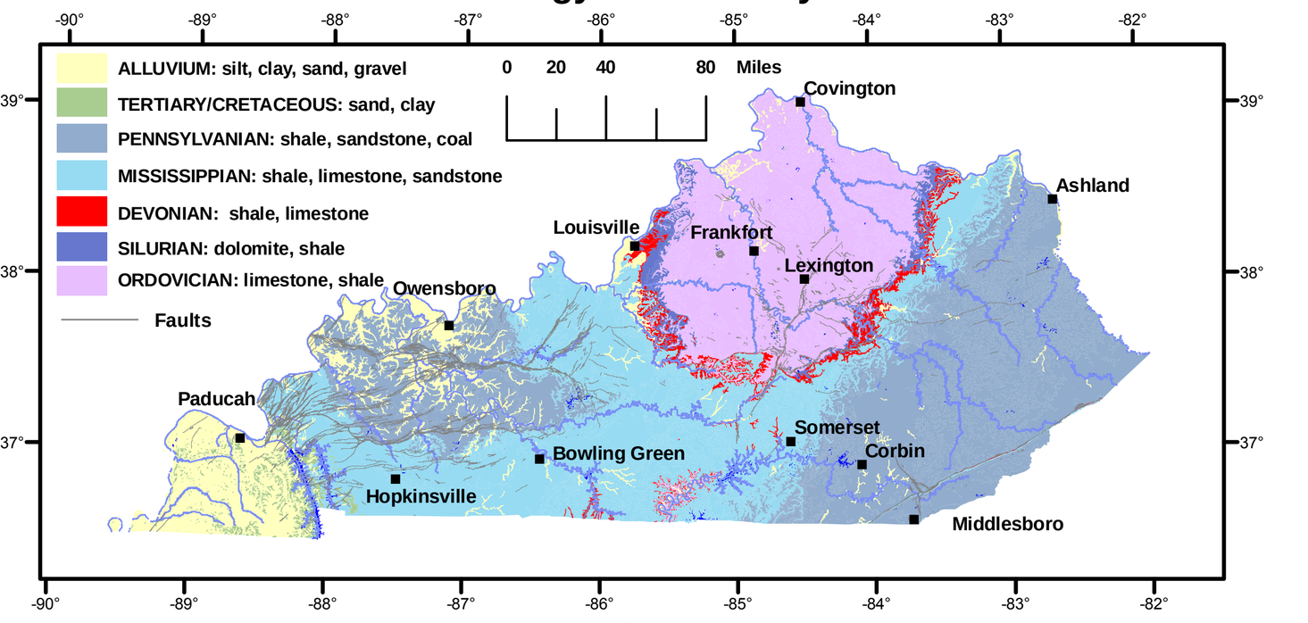
Acknowledgments

Geology adapted from Petersen (2004, 2006a-e), Thompson (2004a, b), Crawford (2006), Lambert (2006), and Murphy (2006a-c). Mapped sinkholes from Paylor and others (2004). Thanks to Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service, for pond construction illustration. Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base-map data.

7.5-Minute Quadrangle Map Index



Geology of Kentucky



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