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

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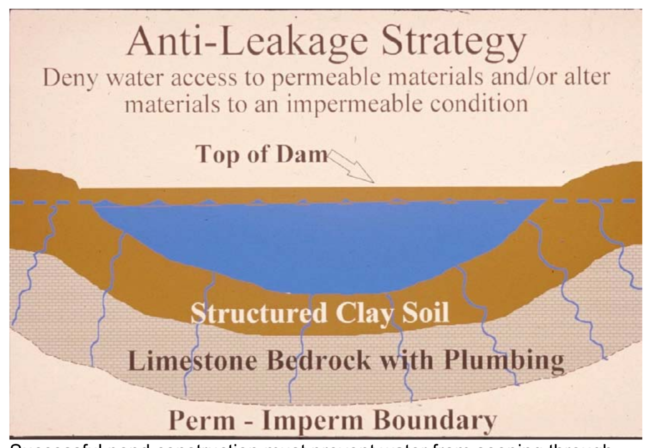
Taylor County Courthouse at Campbellsville

Taylor County, an area of 270 square miles in the Pennyrile Region, was formed in 1848. The terrain varies from hilly in the east to gently rolling in the west. Alluvial valleys are broad and flat. The highest elevation, 1,200 feet, is on a ridge near the junction of Taylor, Marion, and Casey Counties. The lowest elevation, 570 feet, is where the Green River leaves the county. The 2005 population of 23,726 was 3.5 percent greater than that of 2000. Photo by Dan Carey, Kentucky Geological Survey.

Green River Lake

Green River Lake in Taylor and Adair Counties provides 8,210 acres and 250 miles for shoreline for water sports, fishing, swimming, and camping. It also provides water to the Campbellsville Municipal Water System. Photo by Dan Carey, 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.

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.

New pond underlain by limestones and shales of units 4 and 5. Taylor County is blessed with an abundance of water. Photo by Dan Carey, Kentucky Geological Survey.

Campbellsville University

Over 2,000 students from 35 countries attend Campbellsville University. Photo by Dan Carey, Kentucky Geological Survey.

Limestone, Siltstone, and Shale–Unit 5

Limestone (unit 5) provides soils for a strong agriculture and attractive sites for homes and industry. Thoughtful planning can reduce conflicting interests. Photos by Dan Carey, Kentucky Geological Survey.

Siltstone and Shale–Unit 4

This roadcut along Ky. 70 reveals the siltstones and shales of the 350-million-year-old Mississippian Fort Payne Formation (unit 4). Photo by Dan Carey, Kentucky Geological Survey.

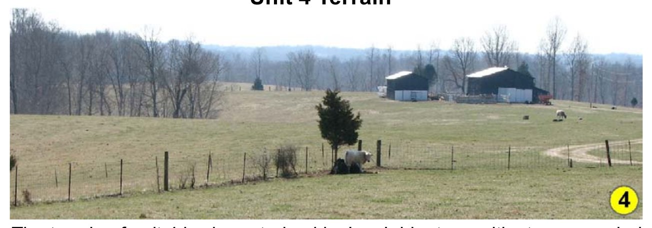
Shale–Unit 4

Roadbed built on shale (unit 4) requires additional support. Photo by Dan Carey, Kentucky Geological Survey.

Site 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).

Unit 4 Terrain

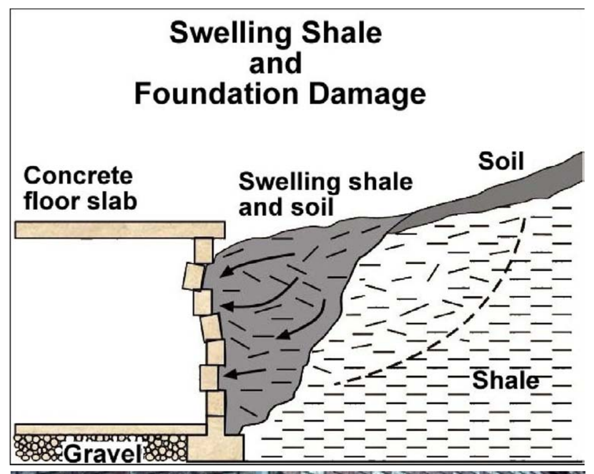


The terrain of unit 4 is characterized by level ridgetops with steep, wooded hillsides. Unit 4 is relatively flat when adjacent to alluvial (unit 1) valleys. Photo by Dan Carey, Kentucky Geological Survey.

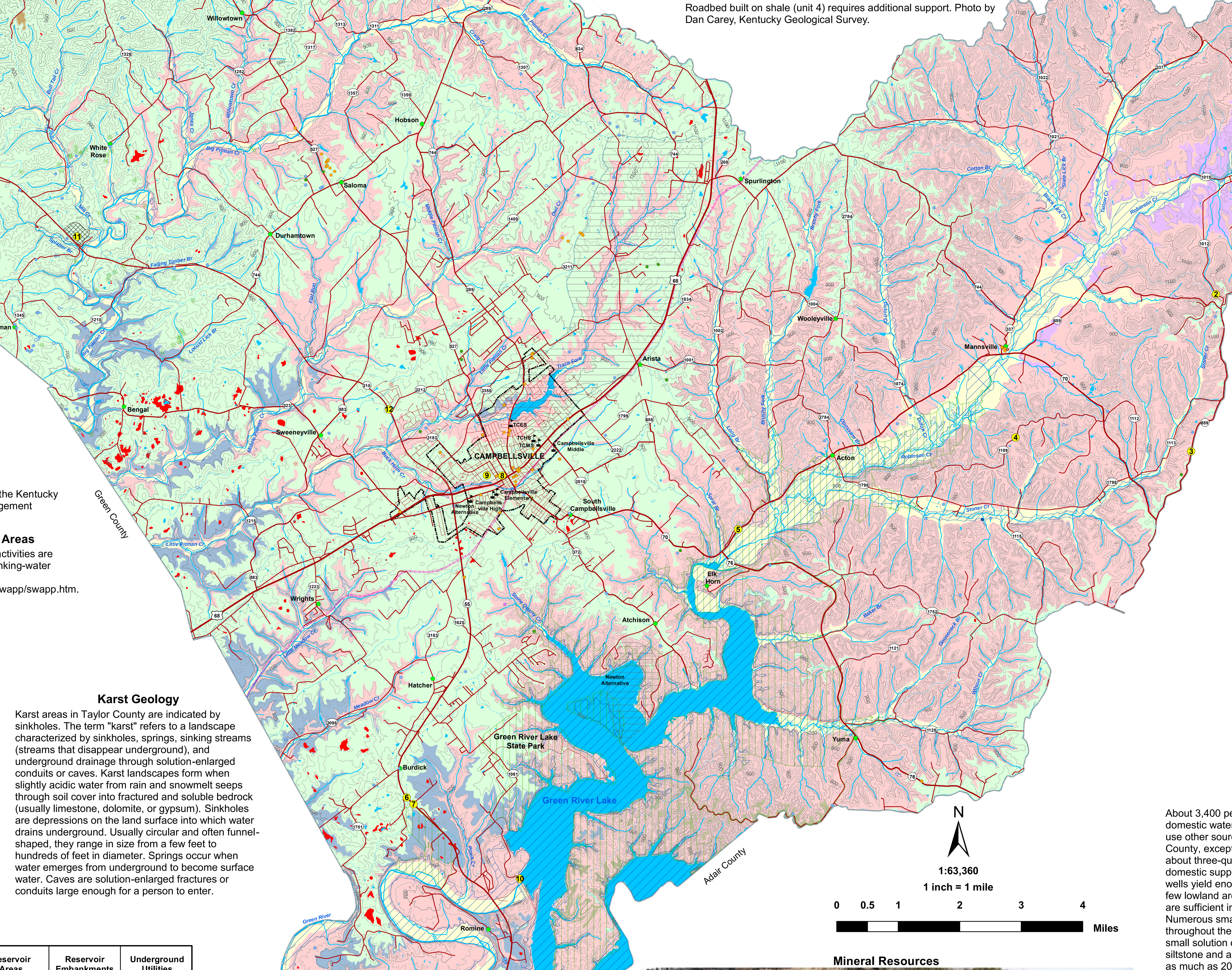
Swelling and Shrinking Shales

A problem of some concern in Taylor County is the swelling of some of the clay minerals in shale units 4, 6, and 8. The process is exacerbated when the shale contains the mineral pyrite (fool's gold). Pyrite is a common mineral and can be found distributed throughout the black shale, although it is not always present and may be discontinuous both laterally and horizontally. In the presence of moisture and oxygen, pyrite oxidizes and produces sulfuric acid. The acid reacts with calcium carbonates found in water, the rock itself, crushed limestone, and concrete. This chemical reaction produces sulfate and can form the mineral gypsum, whose crystallization can cause layers of shale to expand and burst, backfill to swell, and concrete to crack and crumble. It can heave the foundation, the slab, and interior partitions resting on it, and damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky. During times of drought, these same shales may shrink, causing foundations to drop.

Anyone planning construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.



Some shales, and the soils derived from them, swell when exposed to water or air. These swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams, roads). Photo by John Kiefer, Kentucky Geological Survey.



EXPLANATION

School

Water wells
- Public
- Domestic
- Agricultural
- Monitoring
- Industrial

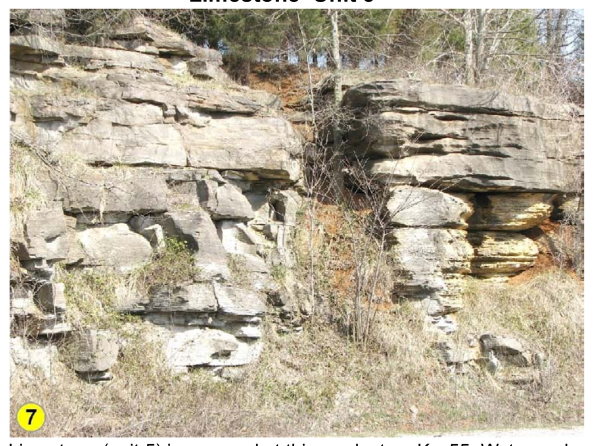
Spring
Gas well
Oil well
Incorporated city boundary
Public lands
Source-water protection area, zone 1
Designated flood zone (FEMA, 2004)
Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
Watershed boundaries
Quarry
Mapped sinkhole
Geologic fault
40-foot contour interval
Photo location

*Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Source-Water Protection Areas

In source-water protection areas, activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

Limestone–Unit 5



Limestone (unit 5) is exposed at this roadcut on Ky. 55. Water and soil seeps into cracks and crevices and dissolves the limestone. This is the process of sinkhole formation in karst areas. Photo by Dan Carey, Kentucky Geological Survey.

Karst Geology

Karst areas in Taylor County are indicated by sinkholes. 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.

Radon Ventilation

Ventilation system removes radon from the basement area of this home built on black shale. 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. The shales of unit 8 and limestones of unit 5, 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

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.

Black Shale–Unit 8

The New Albany Shale (also called the Chattanooga and Ohio Shale) (unit 8) is the most prominent shale in Kentucky. It is brownish-black, silty, pyritic, bituminous, and carbonaceous. It contains enough organic matter to burn. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

About 3,400 people in Taylor County rely on private domestic water supplies: 2,200 use wells and 1,200 use other sources. In the western half of Taylor County, except in the lowlands of Big Pitman Creek, about three-quarters of the wells yield enough for a domestic supply. In the rest of the county, very few wells yield enough for a domestic supply, except in a few lowland areas bordering streams, where yields are sufficient in a few wells for domestic use. Numerous small springs and seeps are found throughout the county; most springs discharge from small solution openings and joints in limestone or siltstone and are supported by shale layers. Flows are as much as 20 gallons per minute, but most have minimum flows of less than 1 gallon per minute.

For more information on groundwater in the county, see Carey and Stickney (2004).

Mineral Resources

Nally & Gibson excavates the St. Louis and Salem Limestones (unit 5) for construction aggregate and agricultural lime in this quarry off of Ky. 210. Photo by Dan Carey, Kentucky Geological Survey.

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. Seasonal high water table. Subject to flooding.	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Ross and Leathers, 1982).	Water in alluvium may be in direct contact with basements. Seasonal high water table. Subject to flooding. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Refer to soil report (Ross and Leathers, 1982).	Moderate to slight limitations. Avoid construction in floodplain. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Possible flooding. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Possible flooding. Refer to soil report (Ross and Leathers, 1982).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Ross and Leathers, 1982).	Fair stability. Fair compaction. Piping hazard. Refer to soil report (Ross and Leathers, 1982).	Slight limitations. Seasonal high water table. Refer to soil report (Ross and Leathers, 1982).
2. Gravel (terrace 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.
3. Limestone, dolomite	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 possible. Drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Local drainage problems.	Moderate limitations. Rock excavation.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Local drainage problems.	Moderate to slight limitations, depending on slope.	Moderate to slight limitations, depending on slope.	Severe limitations. Leaky reservoir rock; locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky rock.	Severe limitations. Rock excavation.
4. Limestone, shale**, siltstone, sandstone	Fair to good foundation material; difficult to moderately difficult to excavate. If clay shale unit encountered, see unit 8.	Moderate to severe limitations. Impermeable rock.	Severe limitations. Rock excavation. If clay shale unit encountered, see unit 8.	Severe limitations. Rock excavation. If clay shale unit encountered, see unit 8.	Severe to moderate limitations. Rock excavation. If clay shale unit is encountered, see unit 8.	Slight to moderate limitations, depending on topography. Rock excavation. If clay shale unit encountered, see unit 8.	Slight to moderate limitations, depending on activity and topography. If clay shale unit is encountered, see unit 8.	Slight to moderate limitations, depending on activity and topography. If clay shale unit is encountered, see unit 8.	Moderate limitations. Reservoir may leak where rocks are fractured. If clay shale unit is encountered, see unit 8.	Moderate limitations. Reservoir may leak where rocks are fractured. If clay shale unit is encountered, see unit 8.	Severe limitations. Rock excavation. If clay shale unit encountered, see unit 8.
5. Limestone, siltstone, shale	Good to excellent foundation material; moderately difficult to difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to groundwater table; danger of contamination.	Severe to moderate limitations. Rock excavation may be required.	Slight to moderate limitations. Rock excavation. Local drainage problems, especially on shale. Sinks possible.	Slight limitations. Rock excavation. Local drainage problems. Sinks possible.	Moderate to slight limitations. Rock excavation. Local drainage problems; possible groundwater contamination. Sinks possible.	Slight to moderate limitations, depending on activity and topography.	Slight limitations, depending on activity and topography.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky reservoir rock.	Severe to moderate limitations. Rock excavation.
6. Sandstone, shale*	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.	See unit 7 for sandstone, unit 8 for shale.
7. Sandstone	Excellent foundation material; difficult to excavate.	Moderate to severe limitations. Impermeable rock.	Severe limitations. Rock excavation.	Severe limitations. Rock excavation.	Severe limitations. Rock excavation.	Severe limitations. Rock excavation.	Severe to moderate limitations, depending on activity and topography.	Severe to slight limitations, depending on activity and topography. Slight limitations for forest preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation.
8. Shale*	Fair to poor foundation material; easy to moderately difficult to excavate. Possible expansion of shales. Plastic clay is particularly poor foundation.	Severe limitations. Low permeability.	Severe limitations. Low strength, slumping, and seepage problems. Possible shrinking and swelling of shales.	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.	Severe to slight limitations, depending on activity and topography. Strength, slumping, and seepage problems.	Moderate to slight 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.

* See discussions of swelling shales and soils and slope stability.
** Clay shales may be present, particularly in the lower part of the unit in the Robinson Creek watershed above Stoner Creek. See unit 8.

Acknowledgments

Geology adapted from Lambert (2006), Murphy (2006a-d), and Petersen (2006a-e). 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.

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.

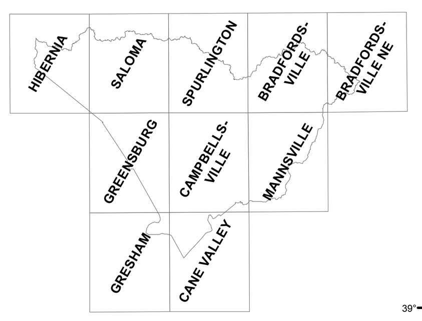
Extensive recreation—Camp sites, picnic areas, parks, etc.

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.

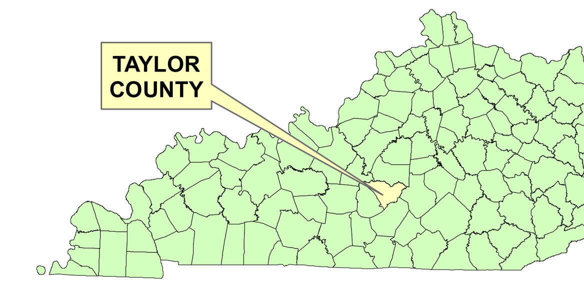
Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

7.5-Minute Quadrangle Map Index

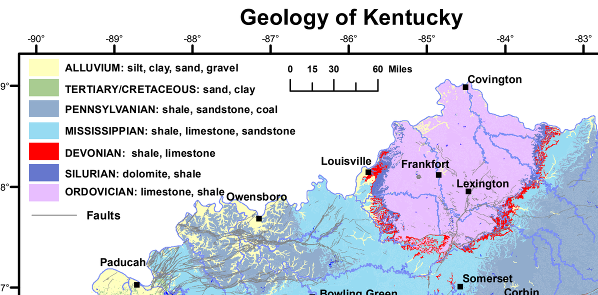


For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 859.257.3896 or 877.778.7827 (toll free)

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



Geology of Kentucky



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

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.

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