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

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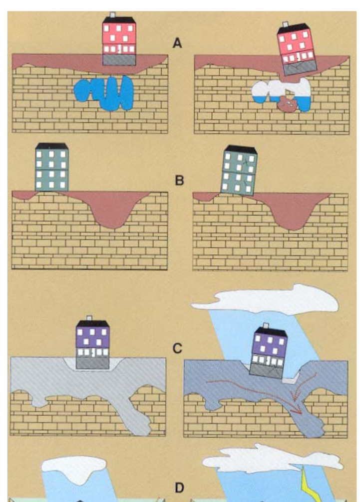
For Planning Use Only

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.

Acknowledgments

Geology adapted from Crawford (2003), Criss (2003), Hosey (2003a-d), Lambert (2003), Mullins (2003), Nelson (2003a-f), Robinson (2003), Smith (2003a-b), and Toth (2003a-b). 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 Jim Currens, Kentucky Geological Survey, for sinkhole illustration. Mining data from the Kentucky Mine Mapping Information System (2005).Thanks to Jay Stone, Christian County Agriculture and Natural Resource Agent; and Eric Steidl, Rogers Group Hopkinsville Aggregate.

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).

Sinkholes

Sinkholes are common karst features throughout Christian County. Sinkholes commonly form under or adjacent to houses as small openings, 3 to 4 feet in diameter, as seen above. Without proper management, these sinkholes can form depressions that are tens of feet in diameter. Photograph by Glynn Beck, Kentucky Geological Survey.

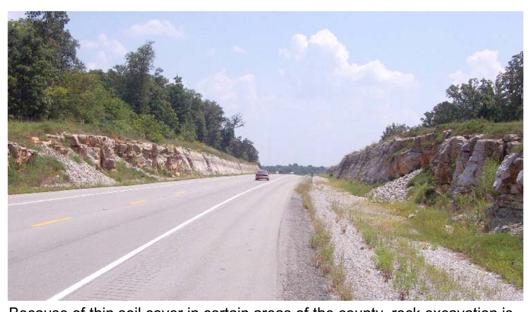
Mineral Resources

Limestone is an abundant rock in Christian County. One of several active quarries in the county, the Rogers Group Hopkinsville Aggregate Quarry, shown above, produces approximately 1.5 million tons of crushed stone per year. Photo by Glynn Beck, Kentucky Geological Survey.

Agriculture

Agriculture is a major part of the Christian County economy. According to the 2002-2003 Kentucky Agricultural Statistics Service, 136,577 acres (30 percent) of the 462,201 land acres available were planted in corn, soybeans, and tobacco. Photo by Glynn Beck, Kentucky Geological Survey.

Foundation and Excavation



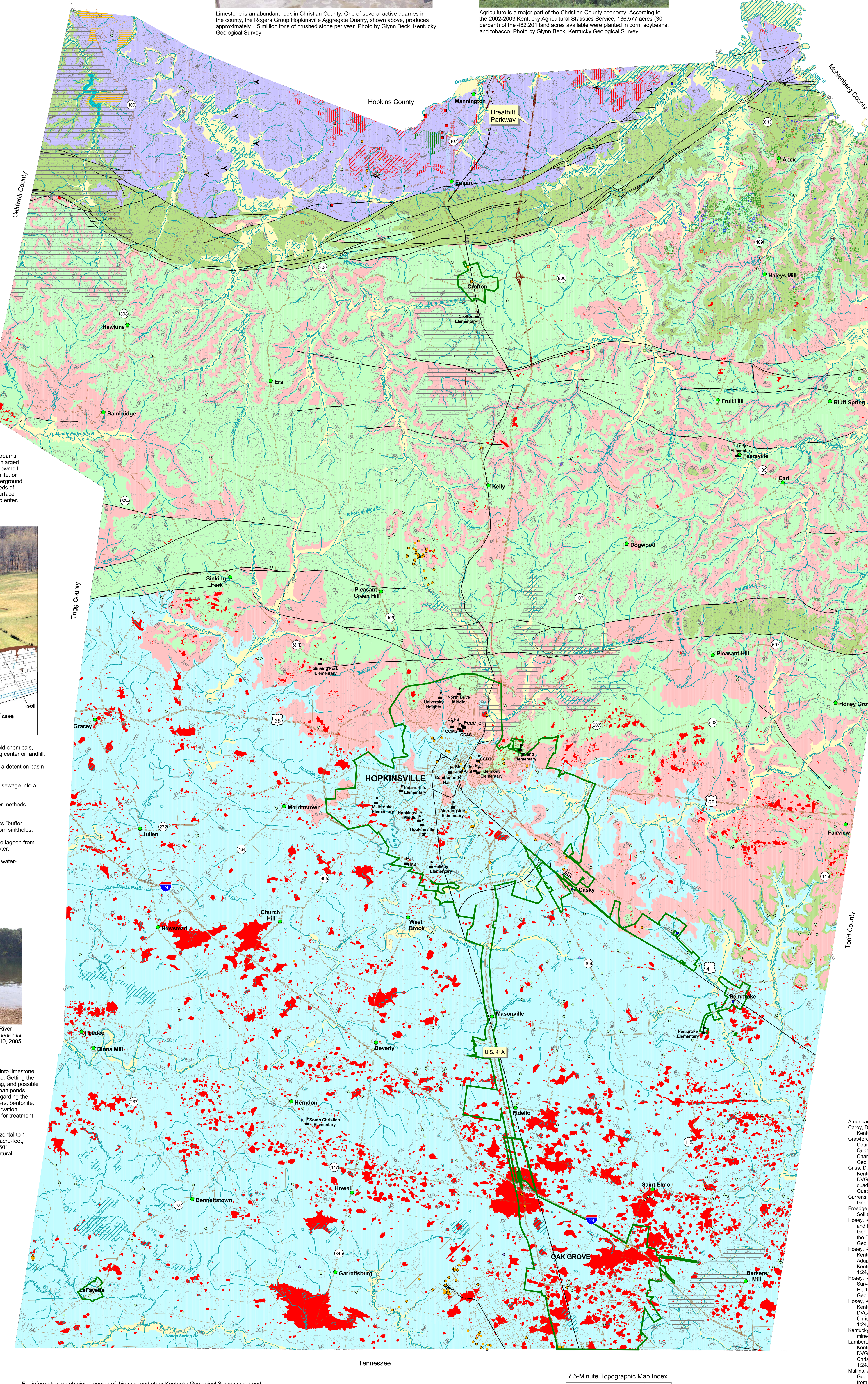
Because of thin soil cover in certain areas of the county, rock excavation is required during road and other types of construction. Photo by Glynn Beck, Kentucky Geological Survey.

Subdivision Development

The population of Christian County grew 5 percent between 1990 and 2000 (2000 U.S. Census data). Conversion of land to residential use is growing throughout the county. Photo by Glynn Beck, Kentucky Geological Survey.

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.



EXPLANATION

- School
- Urban service boundary
- Source-water protection area
- Wetlands > 1 acre, (U.S. Fish and Wildlife Service, 2003)
- Wildlife management area
- Artificial fill
- Surface mining
- Underground mining
- Mining
- Sinkholes
- Railroad
- Concealed faults
- Faults

Water Wells
- Domestic
- Heat pump
- Industrial
- Irrigation
- Livestock
- Monitoring
- Public
- Unknown

- Mine shaft
- Mine adit

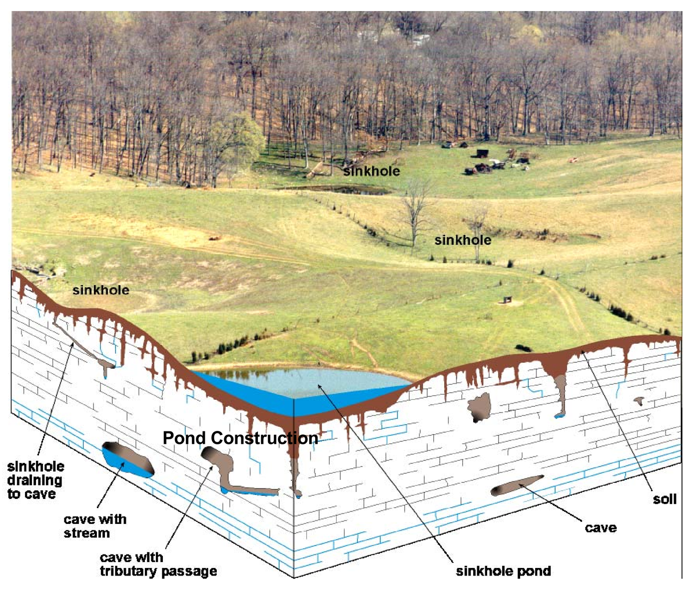
Oil and Gas Wells
- Gas well
- Oil and gas well
- Oil well
- Class II injection well

50-foot contour interval

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.

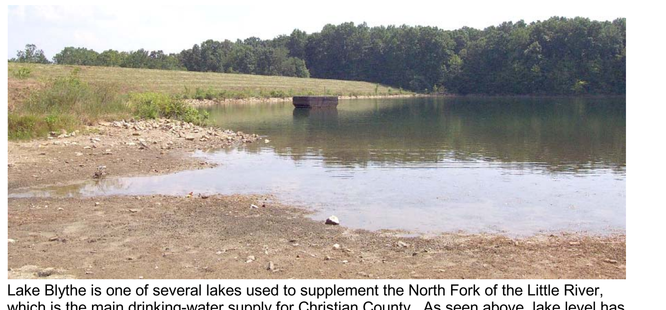
See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass "buffer strips." This will filter runoff flowing into sinkholes and also keep tilled areas away from sinkholes.

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)

Water Supply



Lake Blythe is one of several lakes used to supplement the North Fork of the Little River, which is the main drinking-water supply for Christian County. As seen above, lake level has dropped considerably because of drought conditions. Picture was taken on August 10, 2005. Photo by Glynn Beck, 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.

Groundwater

In the southern half of Christian 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 of the West Fork of the Red River, the Little River, and its major tributaries, most wells are inadequate for domestic use unless the well intercepts a major solution opening in the limestone; in that case, the yield could be very large. Groundwater in the northern half of the county is not as prevalent as in the southern half, except in the area west of U.S. 41 between Hopkinsville and Crofton. Most drilled wells in the west-central section of the county that obtain water from fault zones are adequate for a domestic supply and sometimes yield up to 100 gallons per minute. Most wells in the rest of the northern half of the county are inadequate for a domestic supply. Some wells in sandstone formations yield enough water for a domestic supply. Springs with flows ranging from a few gallons per minute to 3,000 gallons per minute are found in the county. Minimum flows generally occur in early fall, maximum flows in late winter. For more information on groundwater in the county, see Carey and Stickney (2001).

Geologic Hazards

The most prominent geologic hazard for Christian County is the karst development in the southern part of the county. Sinkholes shown in red on the map are the surface expression of solution cavities such as caves and flow channels in the thick limestone (unit 6) underlying the surface. 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. Groundwater supplies may be polluted if waste is improperly dumped into sinkholes, which ultimately affects surface water.

None of the faults in Christian County are considered to be active; however, the proximity of the New Madrid and Wabash Valley Seismic Zones does call for precautions to be taken for earthquake damage mitigation.

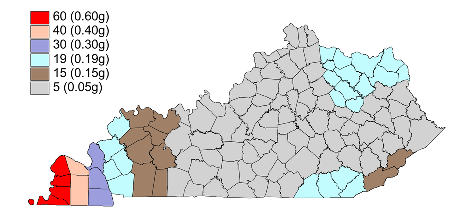
There are some underground coal mines beneath parts of northern Christian County in unit 2. Particular care should be taken when building in areas underlain by deep mines. Mine subsidence insurance is available in Kentucky.

Flooding may be a problem in Christian County, especially along major streams. Urban development often exacerbates flooding, and therefore potential flooding should always be considered in urban development plans. Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Steep slopes are present in parts of northern Christian County. 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.

Earthquake Hazard Information

Peak ground acceleration at the top of rock that will probably occur in the next 500 years in Kentucky



Although we do not know when and where the next major earthquake will occur, we do know that an earthquake will cause damage. Damage severity depends on many factors, such as earthquake magnitude, the distance from the epicenter, and local geology. Information on earthquake effects is obtained by monitoring earthquakes and performing research. Such information is vital for earthquake hazard mitigation and risk reduction.

The most important information for seismic-hazard mitigation and risk reduction is ground-motion hazard. One way of predicting ground-motion hazard is by determining the peak ground acceleration (PGA) that may occur in a particular timeframe. The map above shows the PGA at the top of bedrock that will likely occur within the next 500 years in Kentucky (Street and others, 1996). It shows, as expected, that PGA would be greatest in far western Kentucky near the New Madrid Seismic Zone. Ground-motion hazard maps for the central United States and other areas are available from the U.S. Geological Survey. These maps are used to set general policies on mitigating damage. For example, maps produced by the USGS in 1996 were used to determine seismic design in building codes. For additional information pertaining to earthquake hazards, visit the Kentucky Geological Survey Web site at www.uky.edu/KGS/geologichazards/geologichazards.html.

Tennessee

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.

N
Scale 1:63,360
1 inch equals 1 mile
2 0 2 4 Miles

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.

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 foundation material; easy to excavate. May be subject to high water table and flooding. Also refer to soil report (Froedge, 1980).	Severe limitations. May be subject to high water table and flooding. Refer to soil report (Froedge, 1980).	Severe limitations. May be subject to high water table and flooding. Refer to soil report (Froedge, 1980).	Severe limitations. May be subject to flooding. Refer to soil report (Froedge, 1980).	Severe to moderate limitations. May be subject to high water table and flooding. Refer to soil report (Froedge, 1980).	Severe limitations. May be subject to flooding. Refer to soil report (Froedge, 1980).	Slight to moderate limitations, depending on activity and topography. May be subject to flooding. Refer to soil report (Froedge, 1980).	Slight limitations, depending on activity and topography. May be subject to flooding. Refer to soil report (Froedge, 1980).	Pervious material. Seasonal shallow water table. May be subject to flooding. Refer to soil report (Froedge,1980).	Severe to slight limitations. Unstable steep slopes. Refer to soil report (Froedge, 1980).	Slight limitations. Generally favorable except for seasonal high water table and subject to flooding. Refer to soil report (Froedge, 1980).
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; steep slopes.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable; steep slopes.*	Moderate limitaions. 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.	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.	Moderate limitations. Highly variable amount of soil and rock excavation. Steep slopes.
4. Sandstone, siltstone, thin 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.	Moderate limitations. Highly variable amount of soil and rock excavation.
5. 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.	Slight to severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation.
6. Limestone prone to karst development	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.	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 Topographic Map Index

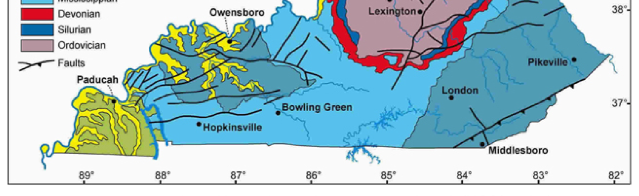
DAWSON SPRINGS	SAINT CHARLES	NORTON-VILLE	GRAHAM
DAWSON SPRINGS SW	DAWSON SPRINGS SE	CROFTON	HALEYS MILL
GRACEY	PLEASANT GREEN HILL	KELLY	HONEY GROVE
CALEDONIA	CHURCH HILL	HOPKINS-VILLE	PEMBROKE
ROARING SPRING	HERNDON	OAK GROVE	TRENTON

Additional Planning Resources

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

www.christiancounty.org—Christian County
ces.ca.uky.edu/christian/—University of Kentucky Cooperative Extension Service
www.peadd.org/—Pennyrile Area Development District
www.thinkkentucky.com/edis/cmnty/cw020/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21047.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21047.html—U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm—Planning information from the Kentucky Geological Survey

Geology of Kentucky



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

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