Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY, LEXINGTON

MAP AND CHART 82
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Generalized Geologic Map for Land-Use Planning: Hardin County, Kentucky

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Acknowledgments

Geology adapted from Bhattarai (2001a-d), Conley (2002a-d), Crawford (2001, 2002a-c), Johnson (2001a, b, 2002a , b), Nelson (2001), Nelson and Sparks (2002), and Toth (2001, 2002, 2004). Sinkhole data from Paylor and others (2004). Thanks to Paul Howell, U.S. Department of Agriculture--Natural Resources Conservation Service, and Jim Currens, Kentucky Geological Survey, for photos and illustrations. Thanks to Richard Smath, Kentucky Geological Survey, for information on tar-sands.

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. Alluvium	Fair to good foundation material; easily excavated.	Slight limitations. Easy to excavate. Refer to soil report for further information (Arms and others, 1979).	Moderate to severe limitations. Check area to determine if flood prone. Basements can be wet.	Slight to moderate limitations. Refer to soil report (Arms and others, 1979).	Slight to moderate limitations. Refer to soil report (Arms and others, 1979).	Slight limitations. Refer to soil report (Arms and others, 1979).	Check to see if area is flood prone. If not, slight limitations based on type of structures necessary. Refer to soil report (Arms and others, 1979).	Check to see if area is flood prone. If not, slight limitations based on type of structures necessary. Refer to soil report (Arms and others, 1979).	Severe limitations. Leaky reservoir material. Refer to soil report (Arms and others, 1979).	Severe limitations. Leaky reservoir material. Refer to soil report (Arms and others, 1979).	High groundwater table possible. Moderate to severe limitations. Refer to soil report (Arms and others, 1979).
2. Limestone	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures and 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 likely. Locally, upper few feet may be rippable. Sinks common and caves possible. Local drainage problems.	Slight limitations. Local drainage problems from seeps or springs; sinks common and caves possible.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable.Sinks common. Local drainage required.	Severe to moderate limitations, depending on activity and topography.	Slight limitations, depending on type of facilities or activities.	Severe limitations. Leaky reservoir; locally, conditions may be favorable. Sinks possible.	Severe limitations. Possible leaky reservoir rock.	Severe limitations. Rock excavation.
3. Limestone, dolomite, and shale	Fair to good foundation material; difficult to excavate.	Severe to moderate limitations. Impermeable rock; locally fast drainage through fractures and sinks to groundwater table. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Rock excavation likely, Local drainage problems. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation possible. Sinks common; local drainage problems. Possible groundwater contamination.	Severe to slight limitations, depending on activity and topography. Possible steep, wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep, wooded slopes.	Severe to moderate limitations; reservoir; may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.
4. Sandstone	Fair to good foundation material; difficult to excavate.	Severe limitations. Thin soils possible.	Severe to moderate limitations. Rock excavation likely; locally, upper few feet may be rippable. Steep slopes possible.	Severe limitations. Rock excavation likely; locally, upper few feet may be rippable. Possible steep slopes.	Moderate limitations. Rock excavation likely. Steep slopes possible.	Severe limitations. Rock excavation likely. Steep slopes possible.	Severe to slight limitations, depending on activity. Possible steep slopes.	Slight to moderate limitations. Possible steep slopes.	Moderate limitations; requires liner material. Permeable rock.	Moderate to severe limitations. Difficult to excavate.	Moderate to severe limitations. Highly variable amount of rock and earth excavation. Steep slopes possible.
5. Sandstone and shale	Good to excellent foundation material; moderately difficult to excavate.	Severe limitations. Impermeable rock.	Severe to moderate limitations. Rock excavation possible. Poor drainage.	Slight to moderate limitations. Rock excavation likely. Local seeps. Subgrade may require drainage.	Slight limitations. Local seeps.	Slight limitations. Rock generally rippable in shallow cuts. Local seeps.	No limitations.	No limitations.	Slight limitations. Most favorable sites are in this unit. Locally, impermeable rock may be thin and underlain by fissured limestone.	Slight limitations.	Moderate limitations. Highly variable amount of rock and earth excavation.
6. Shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations. Depending on activity.	Severe to slight limitations, depending on activity and topography.	No limitations. Impermeable rock.	Severe limitations. Poor strength and stability.	Moderate limitations. Highly variable amount of rock and earth excavation.
7. Shale, sandstone, and limestone	Fair to good foundation material; difficult to excavate.	Severe limitations. Thins soils and impermeable rock.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Steep slopes possible.	Severe to moderate limitations. Rock excavation may be required.	Severe to slight limitations, depending on activity. Possible steep slopes.	Slight limitations. Reservoir may leak where rocks are jointed.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe to moderate limitations. Thin soils and possible rock excavation.

*These clay shales may swell when wet and shrink when dry, and are susceptible to landslides.

PLANNING TABLE DEFINITIONS

FOUNDATION AND EXCAVATION

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

LIMITATIONS

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

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

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

LAND USES

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

Residences—Ratings are made for residences with and without basements because the degree of limitation is dependent upon ease and required depth of excavation. For example, excavation in limestone has greater limitation than excavation in shale for a house with a basement.

Highways and streets—Refers to paved roads in which cuts and fills are made in hilly topography, and considerable work is done preparing subgrades and bases before the surface is applied.

Access roads—These are low-cost roads, driveways, etc., usually surfaced with crushed stone or a thin layer of blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin base is used. The degree of limitation is based on year-around use and would be less severe if not used during the winter and early spring. Some types of recreation areas would not be used during these seasons.

Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be core drilled to determine presence of caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

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

Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

Reservoir embankments—The rocks are rated on limitations for embankment material.

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

Groundwater

In karst areas, such as Hardin County, stormwater runoff can flow underground through large solution channels. This groundwater flow does not follow the topography of the surface, and water from one watershed may flow underground and reappear in an adjacent watershed. A knowledge of the groundwater flow, gained through dye-trace studies, is required to manage stormwater and to protect water quality and drinking-water sources.

In northern Hardin County nearly all drilled wells in the alluvium of the Ohio River valley are adequate for domestic use; many wells yield several hundred gallons per minute. Compound horizontal wells set in the alluvium may yield 5,000 gallons per minute, which is sufficient for a community or industrial use. In the Rough River lowlands of southwestern Hardin County, most drilled wells are adequate for a domestic supply. Depths of drilled wells range from 60 to 300 feet. In much of central, eastern, and northern Hardin County, except in the lowlands of the major creeks and rivers, about three-quarters of the wells drilled yield enough water 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 a few wells meet the supply needs for domestic use.

Springs with flows ranging from a few gallons per minute to 3,128 gallons per minute are found throughout the county. Many of the springs are of the depression type, and yield more than 100 gallons per minute when pumped. For more about the groundwater resources of the county, see Carey and Stickney (2001).

Mapped Surface Faults

Faults are common geologic structures across Kentucky, and have been mapped in many of the Commonwealth's counties. The faults shown on this map are part of the Pennyrile Fault System, which is not considered to be active. Earthquake damage in Hardin County is still a possibility, however. Soil creep, slumps, and landslides along steep slopes may occur from erosion or ground motion associated with a strong earthquake. Areas associated with alluvium (unit 1) are subject to liquefaction during a strong earthquake.

Faults may be associated with increased fracturing of bedrock in the immediately adjacent area. This fracturing may influence slope stability and groundwater flow in these limited areas.

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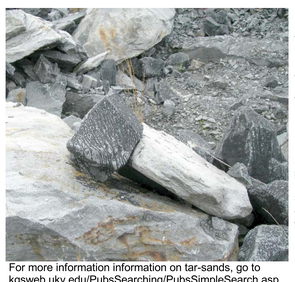
Public Information Center
859.257.3896 or
877.778.7827 (toll free)

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

The Knobs

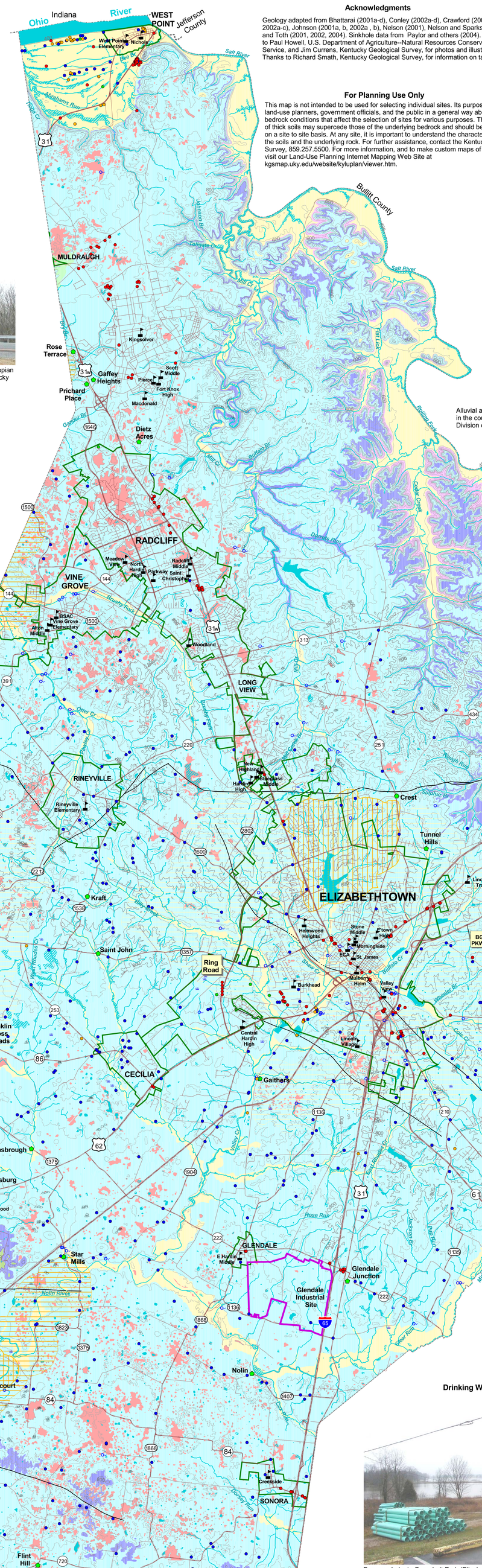
Approaching Hardin County from the east on the Blue Grass Parkway, the transition from the Mississippian Plateau physiographic region into the Knobs Region is very noticeable. Photo by Jack Stickney, Kentucky Rural Water Association.

Tar-Sands in Western Kentucky

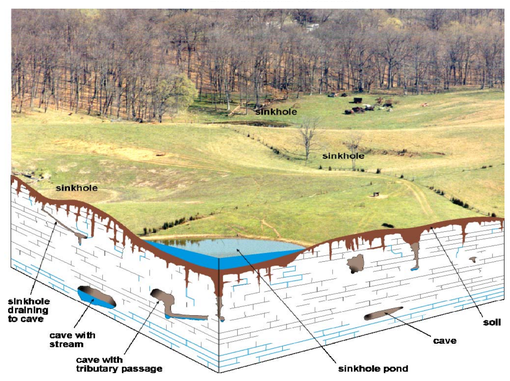


Investigations by the Kentucky Geological Survey have confirmed that major tar-sand resources are present in western Kentucky (Noger, 1999). In-place resources are calculated to be in excess of 3 billion barrels. The principal formations that contain tar-sand deposits (also referred to as asphaltic sandstones, 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 southwestern Hardin County, tar-sands may be present in unit 4. Photo by Randy Bruner.

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



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)

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, 859.257.5500. For more information, and to make custom maps of your local area, visit our Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Flooding

Alluvial areas may be subject to flooding. For information on flooding in the county, contact the Flood Plain Management Branch, Kentucky Division of Water, 502.564.3410.

EXPLANATION

- School
- Eroded area
- Rock outcrop
- Wet area
- Quarry

Water Wells

- Domestic
- Industrial
- Monitoring
- Public

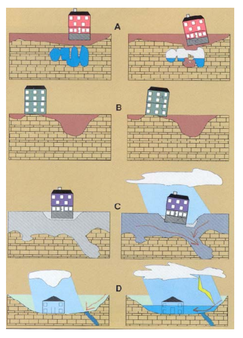
- Wetlands (1-acre or larger)
- Source-water protection area--Zone 1
- Source-water protection area--Zone 2
- Groundwater protection zone
- Watershed boundary (HUC 14)
- Artificial fill
- Incorporated city boundary
- Concealed fault
- Fault
- (84) Mapped sinkholes

50-foot elevation contour interval

Source-Water Protection Areas

Source-water protection areas are areas in which activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/misc/swapp.pdf.

Residential Construction

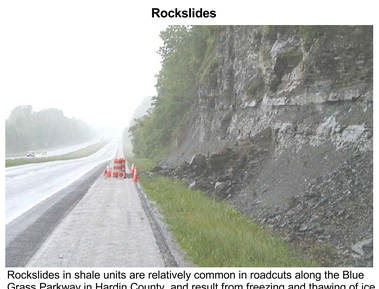


Limestone terrain can be subject to subsidence hazards, which usually can be overcome by prior planning and site evaluation. "A" shows construction above an open cavern, which later collapses. This is one of the most difficult situations to detect, and the possibility of this situation beneath a structure 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 an infrequent heavy storm cannot be carried away quickly enough to prevent flooding of low-lying areas. Adapted from AIPG (1993).

Logging

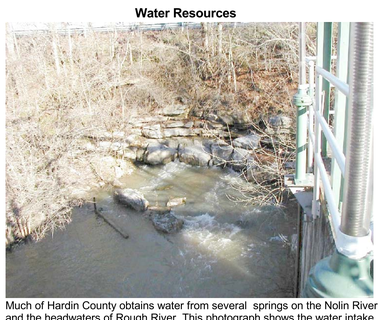
Logging has become a more common activity in Hardin County as woodlands mature. Logging can have a serious impact on water quality if best management practices are not followed. Photo by Jack Stickney, Kentucky Rural Water Association.

Rockslides



Rockslides in shale units are relatively common in roadcuts along the Blue Grass Parkway in Hardin County, and result from freezing and thawing of ice in fractures in the rock. Photo by Jack Stickney, Kentucky Rural Water Association.

Water Resources



Much of Hardin County obtains water from several springs on the Nolin River and the headwaters of Rough River. This photograph shows the water intake equipment for Hardin County Water District No. 2 at White Mills Spring in southwestern Hardin County. Photo by Jack Stickney, Kentucky Rural Water Association.

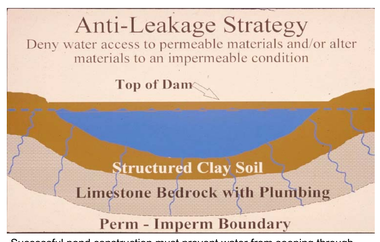
Tar Sands

Naturally occurring petroleum can be found in some sandstone outcrops in Hardin County. These are called "tar sands" and occur in the Hardinsburg Sandstone. Photo by Jack Stickney, Kentucky Rural Water Association.

Fort Knox

Hardin County is the home of Fort Knox, a major military training center and the home of the U.S. Treasury's Fort Knox Bullion Depository. The depository is constructed of granite, concrete, and steel and is not open to the public. It has safeguarded the Magna Carta, the British Crown Jewels, the Declaration of Independence, and the Constitution since its construction in 1936. Photo by Jack Stickney, Kentucky Rural Water Association.

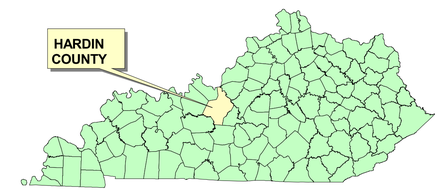
Pond Construction



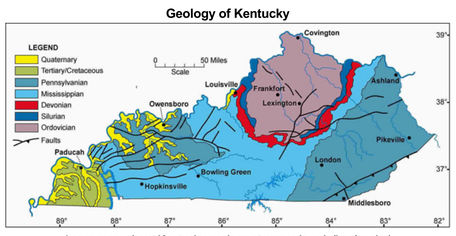
Successful pond construction must prevent water from seeping through structured soils into limestone solution channels below. A compacted clay liner, or artificial liner, may prevent pond failure. Getting the basin filled with water as soon as possible after construction prevents drying and cracking, and possible leakage, of the clayey soil liner. Ponds constructed in dry weather are more apt to leak than ponds constructed in wet weather. Illustration by Paul Howell, U.S. Department of Agriculture--Natural Resource Conservation Service.

A clayey soil pond liner is placed in loose, moist layers and compacted with a sheepsfoot roller. 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. Photo by Paul Howell, U.S. Department of Agriculture--Natural Resource Conservation Service.

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.



Geology of Kentucky



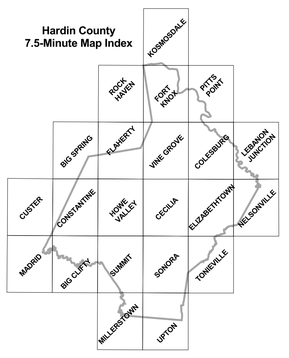
Learn more about Kentucky geology at www.uky.edu/kgs/geoky/

Additional Planning Resources

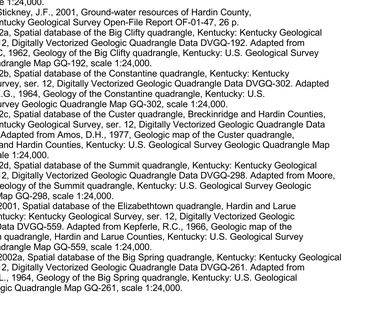
Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Hardin County:

www.hccoky.org—Hardin County Clerk
www.thenewsenterprise.com/—The News-Enterprise
www.elizabethtownky.org—Elizabethtown
www.hcky.org—Hardin County government
www.hardin.k12.ky.us/—Hardin County schools
ces.ca.uky.edu/hardin/—University of Kentucky Cooperative Extension Service
www.kineticnet.net/kyrcd/lincoln.html—zzLincoln Resource Conservation and Development Council Inc.
www.ltadd.org/—Lincoln Trail Area Development District
www.thinkkentucky.com/edis/cmnty/cw041/ Detailed County Statistics
www.uky.edu/KentuckyAtlas/21093.html Kentucky Atlas and Gazetteer, Hardin County
quickfacts.census.gov/qfd/states/21/21093.html US Census data
kgsweb.uky.edu/download/kgsplanning.htm—County planning information from the Kentucky Geological Survey

Hardin County 7.5-Minute Map Index

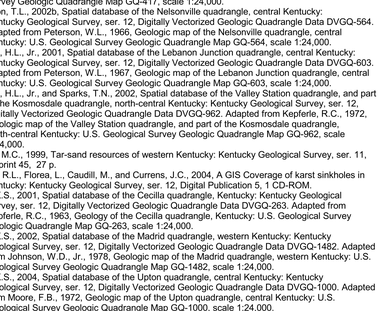


Drinking Water



Freeman Lake in Greenbelt Park (Elizabethtown) was formerly used as a water reservoir for the city. Photo by Jack Stickney, Kentucky Rural Water Association.

Sinkholes

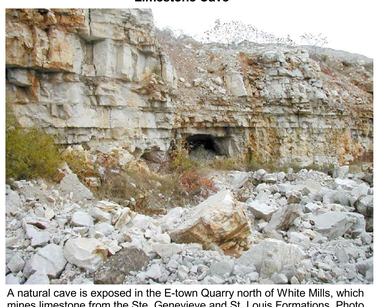


Karst (sinkholes, underground streams, springs, and caves) is prevalent in Hardin County. This is an example of a cover-collapse sinkhole, where an opening to a sinkhole has developed when the soil plug to the sinkhole collapsed. It has been filled with rocks to allow drainage. Photo by Jack Stickney, Kentucky Rural Water Association.

Groundwater

Pirtle Spring supplies much of the raw water for Hardin County Water District No. 1. Photo by Jack Stickney, Kentucky Rural Water Association.

Limestone Cave



A natural cave is exposed in the E-town Quarry north of White Mills, which mines limestone from the Ste. Genevieve and St. Louis Formations. Photo by Jack Stickney, Kentucky Rural Water Association.

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