Kentucky Geological Survey
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY

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

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Acknowledgments

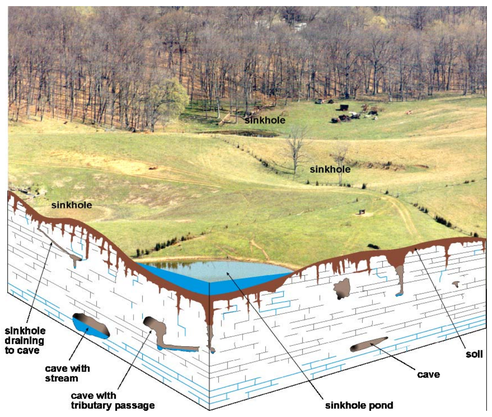
Geology adapted from Crawford (2003), Hosey (2003), Johnson (2003), Lambert (2003), Mullins (2003), Nelson (2003a-f), and Wilhelm (2003). Mapped sinkhole data from Paylor and others (2004). Thanks to Jim Currens, Kentucky Geological Survey, for karst diagram (2001). Sinkhole data from Paylor and others (2004).Thanks to Curt Judy, Todd County Agriculture and Natural Resources agent, for photo assistance.

MAP AND CHART 109
Series XII, 2005

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)

Sudden-Collapse Sinkholes

Sinkholes are common karst features throughout Todd County. Sinkholes often 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. Photo by Glynn Beck, Kentucky Geological Survey.

Foundations and Excavation

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

Flooding

Localized flash flooding can occur throughout Todd County and should be considered during any type of land-use planning, such as home construction. Photo by Glynn Beck, Kentucky Geological Survey.

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 presence of caverns, cracks, etc.

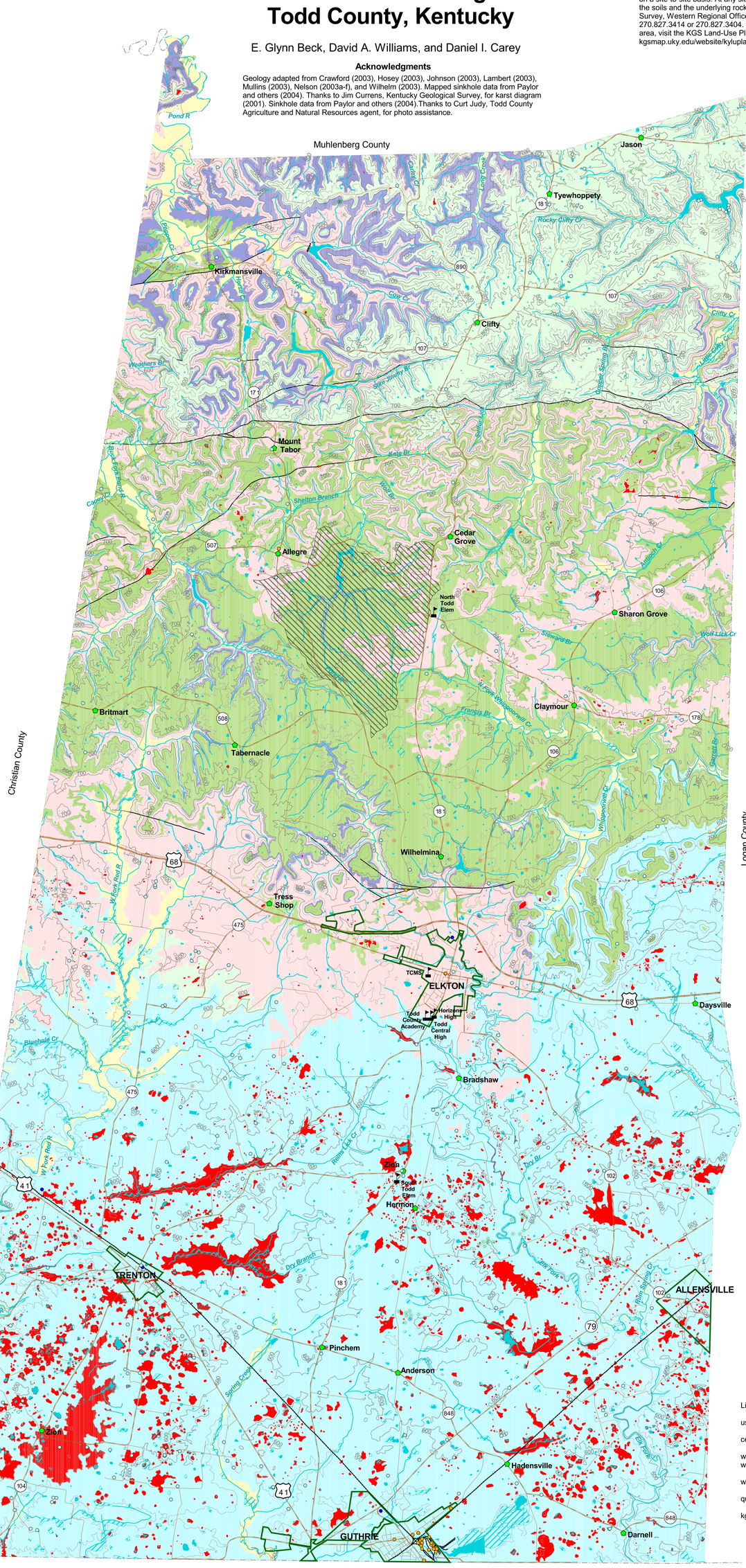
Intensive recreation -- Athletic fields, stadiums, etc.

Extensive recreation -- Camp sites, picnic areas, parks, 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.



EXPLANATION

- School
- Urban service boundary
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Artificial fill
- Sinkholes
- Concealed fault
- Fault

Water Wells
- Domestic
- Monitoring
- Public

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

50-foot contour interval

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.

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.

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call:

Public Information Center
859.257.3896
877.778.7827 (toll free)

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

Groundwater

In the southern half of Todd 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 Elk and West Forks of the Red River and along Spring Creek, 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 south. Most wells in the north are inadequate for a domestic supply. Some wells in sandstone formations do 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 (2004).

7.5-Minute Topographic Map Index

HALEYS MILL	KIRKMANSVILLE	ROSEWOOD
HONEY GROVE	ALLEGRE	SHARON GROVE
PEMBROKE	ELKTON	OLMSTEAD
TRENTON (HAMMACKSVILLE GQ)	GUTHRIE	ALLENSVILLE

Additional Planning Resources

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

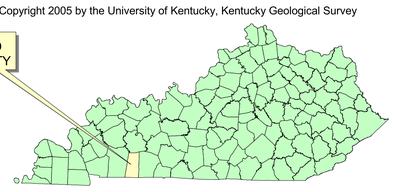
ces.ca.uky.edu/todd/—University of Kentucky Cooperative Extension Service
www.peadd.org/—Pennyrile Area Development District
www.thinkkentucky.com/edis/cmnty/cw071/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21219.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21219.html—U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm—Planning information from the Kentucky Geological Survey

N

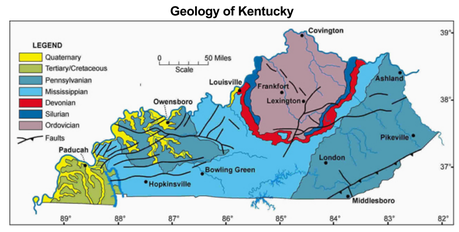
Scale 1:63,360

1 inch equals 1 mile

1 0 1 2 3 Miles



Geology of Kentucky



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

Geologic Hazards

The most prominent geologic hazard for Todd County is the karst development on the terrain underlain by thick limestone, units 5 and 6. Sinkholes, shown in red on the map, are the surface expression of solution cavities such as caves and flow channels. Karst can be particularly hazardous if not treated properly during urban development. Significant damage can occur if sinkholes open beneath a structure, and flooding can worsen if subsurface channels through sinkholes and caves are plugged or impaired. Groundwater supplies may be polluted if waste is improperly dumped into sinkholes, which ultimately affects surface water.

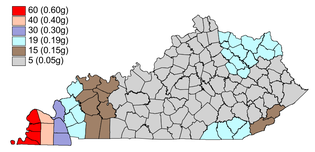
None of the faults in Todd County are considered to be active; however, the proximity of active seismic zones such as the New Madrid and Wabash does call for precautions to be taken for earth-quake damage mitigation.

Flooding may be a problem in Todd County, especially along major streams. Urban development often exacerbates flooding, and therefore potential flooding should always be considered in urban development plans. Areas of steep-walled drainage such as that formed in terrain underlain by units 2, 3, 4, and 7 are conducive to flash flooding, especially in developed areas. Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Steep slopes are present, especially along streams, in areas underlain by units 2, 3, 4, and 7 in the northern part of Todd 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



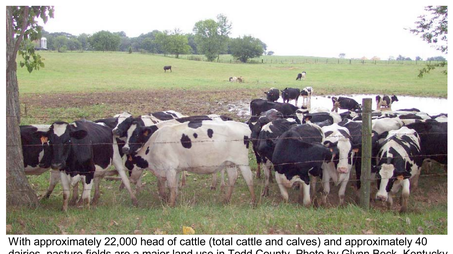
Although we do not know when and where the next major earthquake will occur, we do know that an earthquake will cause damage. Damage severity depends on many factors, such as earthquake magnitude, the distance from the epicenter, and local geology. Information on earthquake effects is obtained by monitoring 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

Agriculture

Agriculture is a major part of the Todd County economy. According to the 2003-2004 Kentucky Agricultural Statistics Service, 89,775 acres (37 percent) of the 241,280 acres available were planted in corn, soybeans, and tobacco. Photo by Glynn Beck, Kentucky Geological Survey.

Pasture Land



With approximately 22,000 head of cattle (total cattle and calves) and approximately 40 dairies, pasture fields are a major land use in Todd County. Photo by Glynn Beck, Kentucky Geological Survey.

Poultry Production

There are approximately 30 chicken houses in Todd County; most are breeder houses. Chicken litter associated with these operations is used as a substitute for synthetic fertilizers on row crops. Proper nutrient management is extremely important to ensure that local soil and water resources are not impaired. Photo by Glynn Beck, Kentucky Geological Survey.

Ecoregions

Todd County lies primarily within two ecoregions. Northern Todd is in the Crawford–Mammoth Cave Uplands ecoregion. Southern Todd is in the Western Pennyroyal Karst Plain ecoregion (Woods and others, 2002). The boundary between these two regions is very abrupt, as seen above. The tree-covered hill represents the uplands ecoregion, and the gently rolling cornfield represents the plain ecoregion. Photo by Glynn Beck, Kentucky Geological Survey.

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Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic Tank Disposal System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Alluvium	Fair to good foundation material; easily excavated.	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).	Refer to soil report (Haagen, 1987).
2. 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. Generally forms steep slopes, especially along drainages.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable; generally forms steep slopes, especially along drainages.	Moderate limitations. Rock excavation. Generally forms steep slopes, especially along drainages.	Moderate limitations. Rock excavation; Generally forms steep slopes, especially along drainages.	Severe limitations. Generally forms steep slopes, especially along drainages.	Slight to moderate limitations.	Moderate limitations. Permeable rock.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation. Generally forms steep slopes, especially along drainages.
3. 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.
4. Limestone, shale: karst development possible	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.
5. 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.
6. Sandstone, siltstone, 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.
7. Gravel	Fair to good foundation material on hilltops, poor foundation material on hillslopes; easily excavated.	Slight to moderate limitations. Variable thickness and permeability.	Moderate to severe limitations.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Moderate to severe limitations.	Moderate to severe limitations.	No limitations.

* Generally forms steep slopes along drainages, but in upland areas usually forms rolling terrain.