LAND RESOURCE ANALYSIS MAPS OF KNOX COUNTY

Knox County has a 1972 population in excess of 270,000. The Metropolitan Planning Commission (1968) projects an increase in population to approximately 360,000 by 1990. As the population grows and favorable areas like west Knox County approach their limit of development, more and more marginal land will be utilized. In order to utilize the existing land resources safely and efficiently, and in order to maintain a suitable environmental quality, knowledge concerning the physical environment and its limitations should be readily available to planners and decision makers. To provide some of these data, a series of maps, I–767, summarizing current knowledge about critical aspects of the physical environment has been prepared.

GLOSSARY

CALCAREOUS – Rocks containing some calcium carbonate ($CaCO_3$).

CALCITE – A mineral composed of calcium carbonate ($CaCO_3$).

DOLOMITE – A mineral composed of calcium magnesium carbonate [$CaMg(CO_3)_2$]. The name is also applied to a rock composed chiefly of calcium magnesium carbonate.

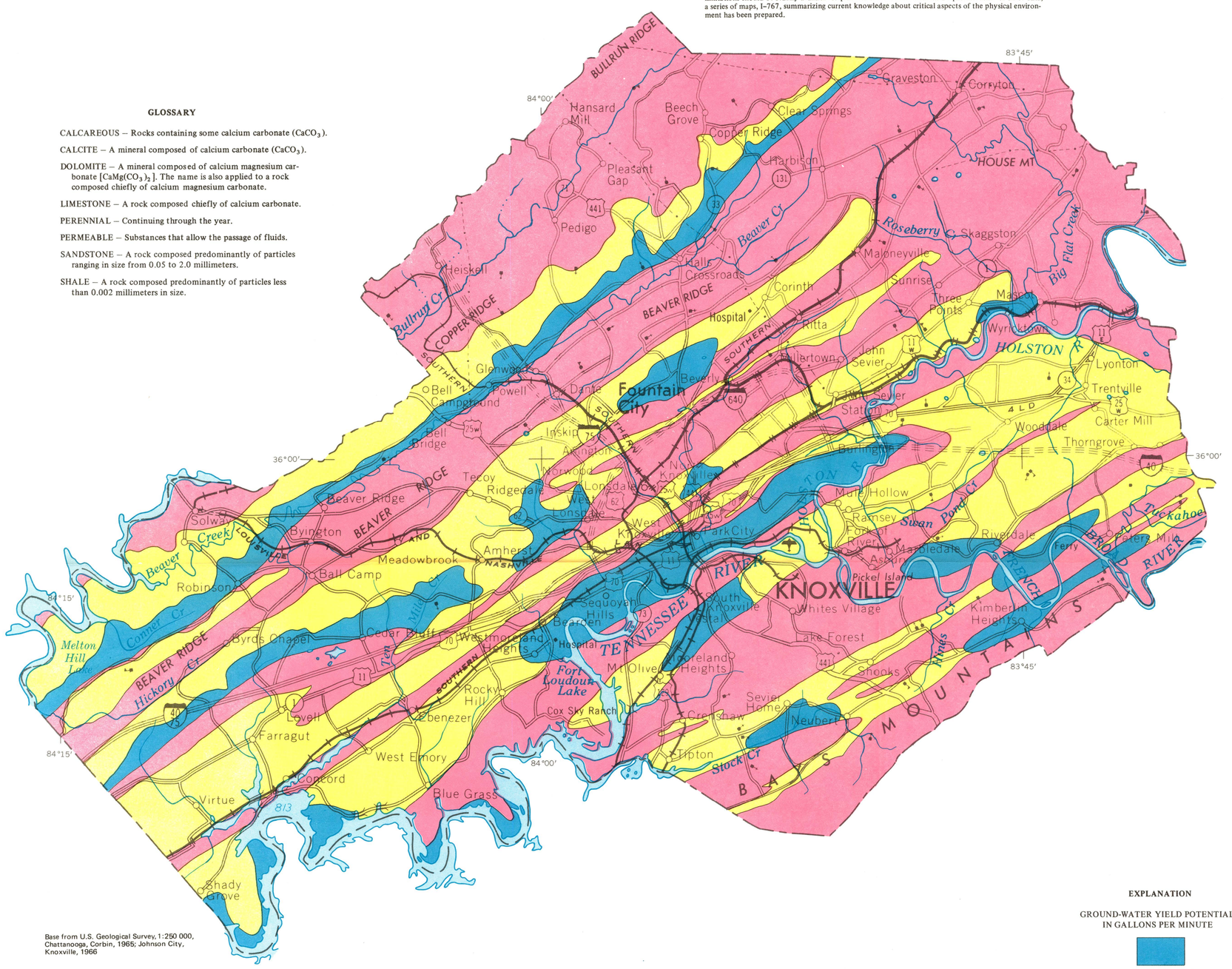
LIMESTONE – A rock composed chiefly of calcium carbonate.

PERENNIAL – Continuing through the year.

PERMEABLE – Substances that allow the passage of fluids.

SANDSTONE – A rock composed predominantly of particles ranging in size from 0.05 to 2.0 millimeters.

SHALE – A rock composed predominantly of particles less than 0.002 millimeters in size.



Base from U.S. Geological Survey, 1:250 000, Chattanooga, Corbin, 1965; Johnson City, Knoxville, 1966

SCALE 1:125 000

5 4 3 2 1 0 5 MILES

5 4 3 2 1 0 5 10 KILOMETERS

REFERENCES CITED

Harris, L.D., 1972, Distribution of sedimentary rocks in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 C.

Harris, L.D., and Kellberg, J.M., 1972, Overburden related to type of bedrock and engineering characteristics of the bedrock, Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 J.

Metropolitan Planning Commission, 1968, General plan 1990, Knoxville, Knox County, Tennessee: Knoxville, Tenn., Metropolitan Planning Commission, 1 sheet, scale 1 inch = approx. 1 mile.

EXPLANATION

GROUND-WATER YIELD POTENTIAL, IN GALLONS PER MINUTE

Greater than 100

25 to 100

Less than 25

CONDITIONS THAT AFFECT GROUND-WATER AVAILABILITY IN KNOX COUNTY

Knox County is underlain by a variety of consolidated sedimentary rocks, including dolomite, limestone, shale, and sandstone (Harris, 1972). These rocks are not permeable enough to allow water to move freely through them or porous enough to allow water to be retained within them. Thus, ground-water yield is dependent upon the widespread presence of natural openings between individual rock layers and the presence of high-angle fractures or breaks that cut through the layers. In order to obtain water from bedrock, a well must penetrate one or more of these openings below the water table (the surface below which openings in the rocks are filled with water). There is no direct way to identify the presence of large water-bearing openings other than by drilling, but knowledge of the geology and water-bearing characteristics, probable thickness of saturated weathered material, and topography can be used to delineate areas potentially favorable for large-yield wells. On this basis, and using available well records, a very generalized map showing ground-water yield potential for Knox County was prepared. The yield potentials shown are based on the assumption that well locations will be selected carefully and that as many as three test holes may be necessary to obtain one well having at least the potential yield shown. Because of the large variation in conditions that affect ground-water availability from place to place within each area, some wells will yield much less than the potential amount shown, others much more.

Large well yields in the county are obtained from areas underlain by limestone, dolomite, and calcareous shale. Because limestone and dolomite are composed of minerals (calcite and dolomite) that are soluble in ground water charged with weak naturally-produced organic acids, the original openings in these rocks can be and have been enlarged to form interconnected channelways. Similarly, the solvent action of ground water enlarges fractures in calcareous shale, but because the volume of soluble minerals is small, the water-bearing system is more restricted than it is in limestone and dolomite. Noncalcareous sandstone and shale do not contain readily soluble minerals, consequently water-bearing openings in these rocks are small and not enlarged by circulating ground water. For this reason maximum yields of wells in sandstone and shale are not as high as those obtained from calcareous rocks.

Well yields are related to the configuration of the land surface, the type and thickness of weathered material overlying bedrock, and the number, size, depth, and extent of interconnected water-bearing openings penetrated. Large sustained yields are more likely to be obtained from wells in topographically low areas underlain by calcareous shale, limestone, or dolomite, where the conditions for solution and enlargement of openings are more favorable. Ground water is stored in the weathered material overlying bedrock and is slowly fed into and through the water-bearing openings in the bedrock to a pumping well. Where a thick blanket of weathered material (Harris and Kellberg, 1972) overlies an interconnected channelway, large sustained yields are possible. Where a thin blanket of weathered material overlies bedrock, large yields generally are not available for long periods of time. Water-bearing openings in Knox County are common to depths of 250 feet, less common at depths of 250 to 350 feet, and rare below 350 feet. Although sizeable openings have been penetrated by wells at depths of 600 feet or more, few wells obtain significant amounts of water below 350 feet. Therefore, a new drilling site seems more likely to produce water than continued drilling below 350 feet.

Wells drilled in limestone or dolomite near perennial streams may have high sustained yields because pumping the well induces infiltration of water through the streambed and into the ground-water system. If the water from the stream passes through a few feet of soil material it may be filtered enough to be free of disease-producing bacteria, but if there is no filtration the water will require treatment. In any case, a new well should be sterilized, pumped until clear, and the water analyzed for indications of disease-producing bacteria before being used for human consumption.

GROUND-WATER YIELD POTENTIAL IN KNOX COUNTY, TENNESSEE

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