HYDROGEOLOGIC ATLAS WESTMINSTER QUADRANGLE CARROLL COUNTY, MARYLAND

INTRODUCTION AND MAP 1. SLOPE OF LAND SURFACE

Maryland Geological Survey

Quadrangle Atlas No. 9

HYDROGEOLOGY

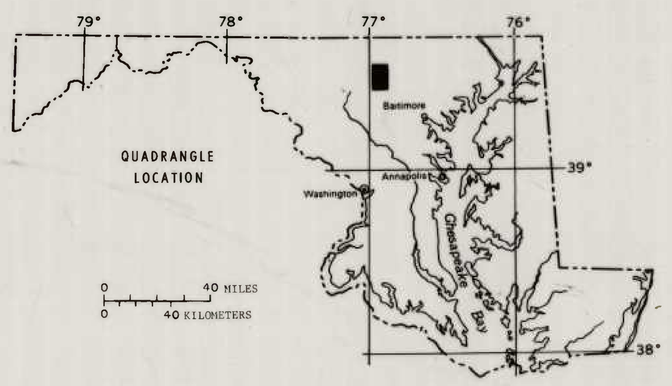
by

Edmond G. Otton and others

INTRODUCTION

This atlas describes the geology, hydrology, and mineral resources of the Westminster 7 ½-minute quadrangle in central Carroll County, Maryland. It is intended for use by County, State, and Federal officials, as well as planners, engineers, developers, and others who are concerned with potential environmental problems and land-use planning and decisions. Land use in the quadrangle is urban, suburban, and agricultural, with substantial housing developments present near the main transportation corridor to Baltimore, U.S. Route 140. Vehicle transportation is also served by Maryland Routes 32, 97, and 27. A branch line of the Western Maryland RR formerly provided a rail link to Baltimore City for Westminster, New Windsor, and other towns farther west. The climate is typical of the humid Piedmont region of Maryland where the average annual precipitation is 43 inches per year. The precipitation is distributed throughout the year, but is somewhat greater in the spring than in the fall.

The Westminster quadrangle is drained by tributaries of the Patapsco River, chiefly the north and east branches. The topography is hilly to undulating, and the maximum relief is nearly 600 feet.



HYDROLOGY

Precipitation amounts to about 43 inches annually. It recharges the local ground-water reservoirs, which consist of the voids and pores in the weathered rock (saprolite) and the fractures and joints in the unweathered rock. Ground-water runoff in the form of seeps and springs sustains the flow of streams during dry periods. The water table marks the top of the zone of saturation in these rocks. It rises and falls in response to changes in rates of ground-water recharge and discharge. Where the rocks in the saturated zone yield water to wells and springs, they are called aquifers. Some of the Piedmont crystalline rocks, such as marble or gneiss, are more productive aquifers than other rocks, such as schist or phyllite. The yield of individual wells depends on their topographic position (valley sites are more productive), the nature and thickness of the weathered zone, and the extent and degree of fracturing of the rocks. Most of the ground water is of satisfactory chemical quality for ordinary uses, but some is moderately hard or midly acidic.

GEOLOGY

The Westminster quadrangle lies within the Piedmont physiographic province. It is underlain chiefly by metamorphosed sedimentary rocks of early Paleozoic age. The reader is referred to Cleaves, Edwards, and Glaser (1968) for additional information on the geology. Currently (1979), detailed geologic mapping on the scale of 1:24,000 is under way in Carroll County by the Maryland Geological Survey. When available, these maps will form the basis for a revision of the geology.

The crystalline rocks of the quadrangle are mantled by soil and weathered rock (saprolite). In some places, as along the walls of stream valleys, the saprolite is thin or absent and in other places well records and borings show it may be as much as 100 feet thick; its average thickness is about 30 to 40 feet.

REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geol. Survey.

Ferris, J. G., Knowles, D. B., Brown, R. H., and Stallman, R. W., 1962, Theory of aquifer tests: U.S. Geol. Survey Water-Supply Paper 1536-E, 174 p.

Meyer, Gerald, 1958, The ground-water resources *in* The water resources of Carroll and Frederick Counties: Maryland Dept. Geology, Mines and Water Res. 1/ Bull. 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geol. Survey Inf. Circ. 16, 24 p.

Nutter, L. J., and Otton, E. G., 1969, Ground-water occurrence in the Maryland Piedmont: Maryland Geol. Survey Rept. Inv. 10, 56 p.

Otton and others, 1975, Cockeysville quadrangle: geology, hydrology, and mineral resources: Maryland Geol. Survey Quad. Atlas No. 3, 8 maps.

Stose, A. J., and Stose, G. W., 1944, Geology of the Hanover-York district, Pennsylvania: U.S. Geol. Survey Prof. Paper 204, 84 p.

______ 1946, Geology of Carroll and Frederick Counties, *in* The physical features of Carroll and Frederick Counties: Maryland Dept. Geology, Mines and Water Res. 1/, p. 11-128.

University of Maryland, Maryland State Roads Commission, U.S. Bureau of Public Roads, 1963, Engineering soil map of Carroll County (1 sheet).

U.S. Department of Agriculture, Soil Conservation Service, 1969, Soil survey, Carroll County, Maryland, 92 pages, 55 photomaps, 1 index.

______ 1971, Soils and septic tanks: 12 p.

U.S. Public Health Service, 1967 rev., Manual of septic-tank practice: 92 p.

1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

MAPS INCLUDED IN THE ATLAS

Map 1. Slope of land surface, by Photo Science, Inc.

Map 2. Depth to the water table, by Edmond G. Otton.

Map 3. Availability of ground water, by Edmond G. Otton.

Map 4. Constraints on installation of septic systems, by Edmond G. Otton.

Map 5. Location of wells, springs, and test holes, by John T. Hilleary and Edmond G. Otton.

LIMITATIONS OF MAPS

All the maps of this Atlas represent some degree of judgment and interpretation of available data. The boundaries depicted on maps are not to be construed as being final, nor is the information shown intended to supplant a detailed site evaluation by a specialist in these fields.

SLOPE OF LAND SURFACE

Prepared by

Photo Science, Inc.

EXPLANATION

Four slope-area categories are shown on this map by three types of shading and by the absence of shading for the terrain category having a slope of 0 to 5 percent. Terrain having the maximum slope (greater than 25 percent) currently (1978) exceeds the maximum land slope permitted for the installation of domestic sewage-disposal systems (septic tanks) by the Carroll County Health Department. Intermediate terrain categories are useful in planning certain construction activities involving local roads and drains.

This map was prepared using topographic contour negatives by a process developed by the U.S. Geological Survey, Topographic Division. The process uses a semiautomated photomechanical process, which translates the distance between adjacent contours into slope data. The slope zones on the map are unedited. Proximity of the same contour or absence of adjacent contours may produce false slope information at small tops and depressions, on cuts and fills, in saddles and drains, along shores of open water, and at the edges of the map.

CONVERSION FACTORS

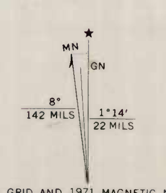
In this Atlas, figures for measurements are given in English units. The following table contains the factors for converting these units to metric (System International or SI) units:

ENGLISH UNIT	SYMBOL	EQUIVALENT (Multiply by)	METRIC UNIT (unit)	SYMBOL
Inches	(in)	25.4	Millimeters	(mm)
Feet	(ft)	0.3048	Meters	(m)
Miles	(mi)	1.609	Kilometers	(km)
Square miles	(mi^2)	2.590	Square kilometers	(km^2)
U.S. gallons	(gal)	3.785	Liters	(L)
U.S. gallons per minute	(gal/min)	0.06309	Liters per second	(L/s)
U.S. gallons per minute per foot	[(gal/min)/ft]	0.207	Liters per second per meter	(L/s/m)

Topography from aerial photographs by stereophotogrammetric methods. Aerial photographs taken 1943
Culture revised by the Geological Survey 1953

Polyconic projection. 1927 North American datum
10,000-foot grid based on Maryland coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue

Prepared by Photo Science, Inc., Gaithersburg Maryland, utilizing contour negatives furnished by United States Geological Survey.



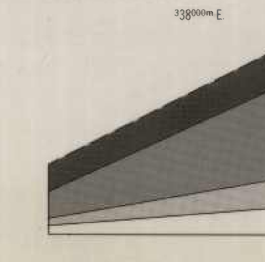
UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

Slope zones photomechanically generated from 20-foot contour lines.

QUADRANGLE LOCATION



1979

DEPTH TO THE WATER TABLE

by
Edmond G. Otton

EXPLANATION

This map shows the approximate depth to the top of the permanent zone of saturation (water table), as indicated by well and spring records (Meyer, 1958). However, in large part, control for the areas underlain by a shallow water table (0 to 10 feet) was based on an analysis of the drainage network on the topographic quadrangles. Control for areas having depths to the water table of 35 feet or greater was based largely on well records and on an analysis of topographic features as they reflect variations in the position of the water table. In some places, temporary perched zones of saturation may occur above the levels indicated on the map.

Ground-water levels, as measured in wells, fluctuate both seasonally and over longer periods in response to changes in frequency and amounts of infiltrating precipitation. Ground-water levels also fluctuate in response to withdrawal from wells, but in the Westminster quadrangle the effect of pumping from domestic wells is not widespread, such effects normally being confined to a few tens of feet from each well. The greatest fluctuation in the water table occurs beneath hills and uplands and the smallest in valleys and swales.

In general, ground-water levels are lowest in the fall and early winter and highest in late winter and spring, but in some years lows and highs may deviate from this pattern. Long-term annual fluctuations may also occur. The duration and magnitude of these fluctuations are shown by a statistical analysis of the 29-year record of the water level of observation well HO-BD 1 at Slacks Corner in Howard County (fig. 1). This well, 48 feet deep and ending in schistose or gneissic rocks, is 3 miles south of Carroll County and 12 miles south of the boundary of this map. The following graphic analysis of the water level in this well shows that annual cycles of high and low water levels occurred during 1946-74. These levels are the result of cyclic periods of precipitation in the Maryland Piedmont. The figure also shows that a relatively dry period in the mid-1960's was followed by a wet period in the early 1970's, climaxed by the water year 1972-73, the wettest year on record in Maryland.

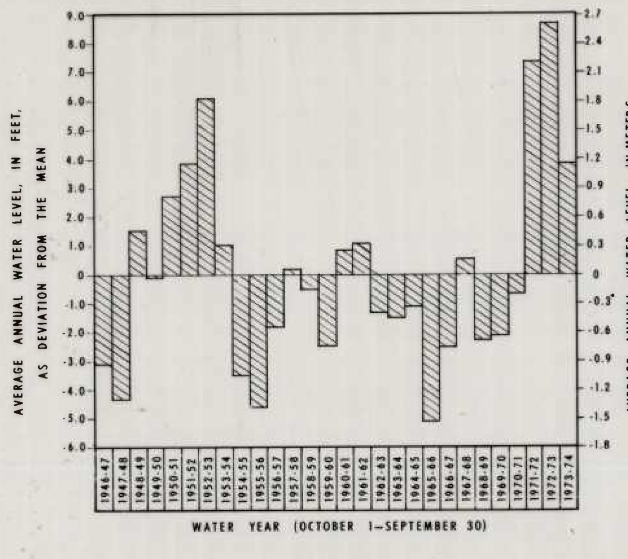


Figure 1. Mean annual water level during 1946-74 in observation well HO-BD 1 at Slacks Corner.

Figure 1A, a stage-duration graph on well HO-BD 1, shows that the static water level fluctuated through a range of 16 feet during the period of record, but 60 percent of the time the level fluctuated through a range of 6 feet.

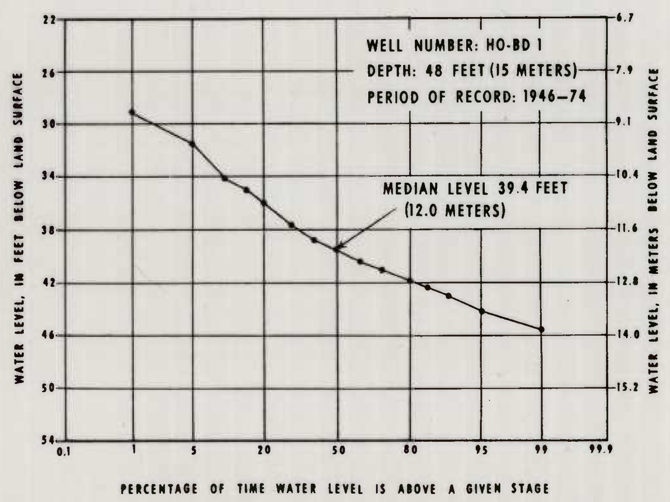


Figure 1A. Stage-duration graph of the water level in well HO-BD 1.

The magnitude of possible fluctuations in ground-water levels are shown by the record of observation well CL-BF 1 at Hampstead, Md., 1.3 miles east of the boundary of the Westminster quadrangle. During the 28-year period, 1946-73, the nonpumping water level in this well fluctuated throughout a range of 23.9 feet. The well is situated on a hilltop and yields water from schistose crystalline rocks. Figure 2 is a stage-duration analysis of 280 water-level measurements over the period of record.

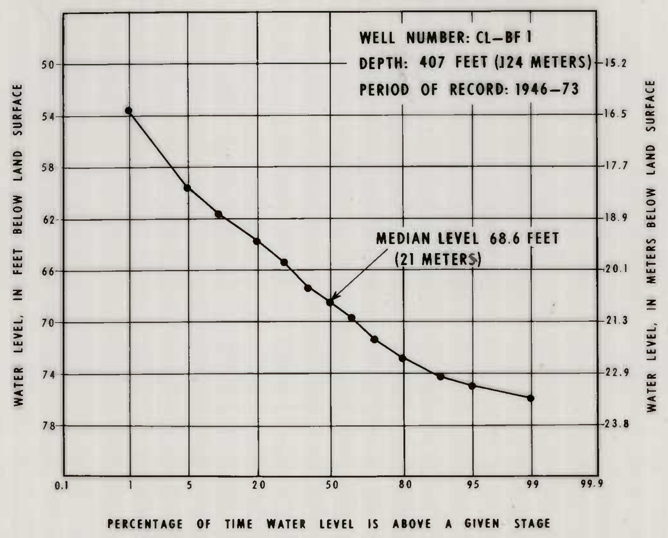


Figure 2. Stage-duration graph of the water level in an observation well at Hampstead.

Much smaller fluctuations in ground-water levels occur in valleys and lowlands. Analysis of the record of observation well BA-EC 43 along a stream valley near Pikesville in Baltimore County showed a range of the nonpumping water level of 3.4 feet during 1956-73 (Otton, 1975). Similar ranges in ground-water levels in valley and lowland areas may be expected in the Westminster quadrangle. Figure 3 is a stage-duration graph of approximately 200 water-level measurements in well EC 43 during the period of record.

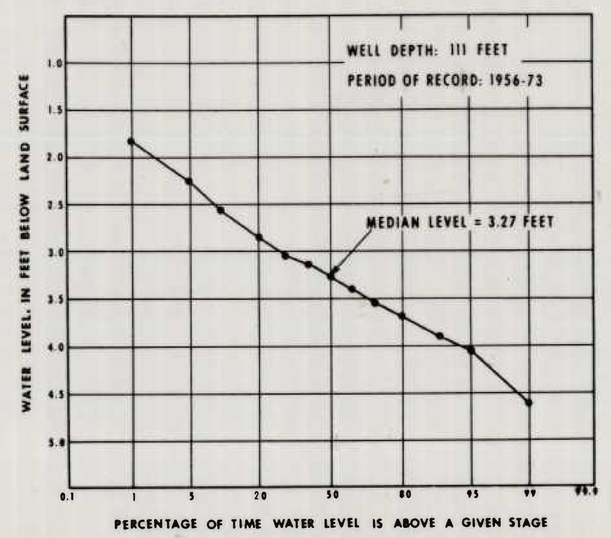


Figure 3. Stage-duration graph of the water level in an observation well near Pikesville in Baltimore County.

REFERENCES

Meyer, Gerald, 1958, The ground-water resources *in* The water resources of Carroll and Frederick Counties: Maryland Dept. of Geology, Mines and Water Res. 1/ Bull. 22, p. 1-228.

Otton and others, 1975, Cockeysville quadrangle: geology, hydrology, and mineral resources: Maryland Geol. Survey Quad. Atlas No. 3, 8 maps.

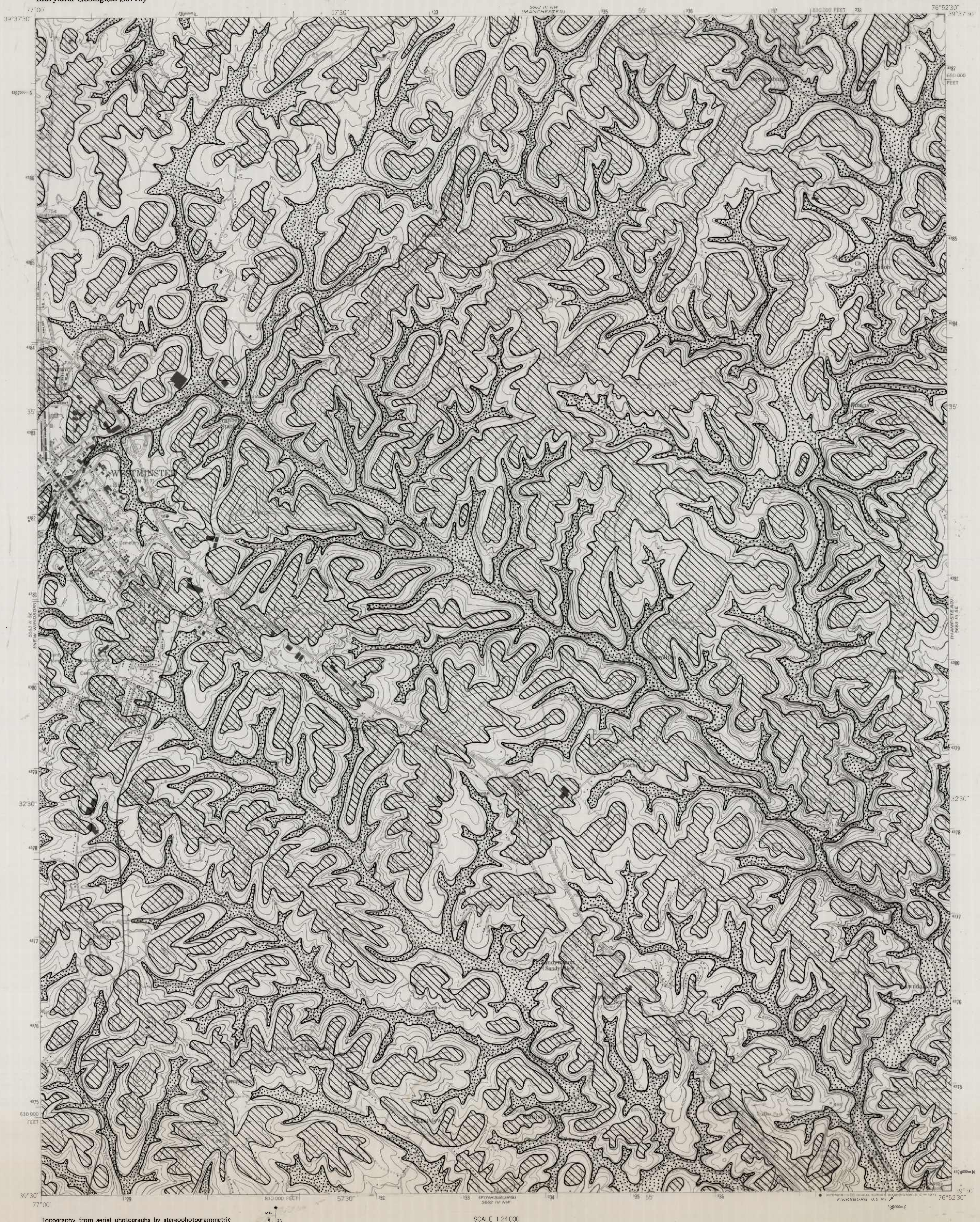
1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

APPROXIMATE DEPTH TO WATER, IN FEET (METERS) BELOW LAND SURFACE

0 - 10 feet (0 - 3 meters)	10 - 35 feet (3 - 11 meters)	Greater than 35 feet (Greater than 11 meters)

MAP 2. DEPTH TO THE WATER TABLE

Maryland Geological Survey Quadrangle Atlas No. 9



Topography from aerial photographs by stereophotogrammetric methods. Aerial photographs taken 1943.
Culture revised by the U.S. Geological Survey 1953 (photorevised 1971).

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

MARYLAND
QUADRANGLE LOCATION

1979

DRAWING NUMBER
westminster Map 3
PLAN HOLD

AVAILABILITY OF GROUND WATER

by Edmond G. Otton

NATURE OF OCCURRENCE

Ground water in Carroll County occurs chiefly in fractures and other voids in the crystalline rocks; some ground water is present also in the residuum (decomposed rock) or saprolite, which forms a mantle of variable thickness over most of the bedrock. The source of all the water in the rocks is local precipitation amounting to 43 inches per year.

Downward-moving water fills the voids and fractures in the rocks and their residuum forming a zone of saturation at variable depths beneath land surface. The upper surface of the zone of saturation is the water table, or potentiometric surface. This irregular surface fluctuates with time in response to changes in the rate of replenishment of the saturated zone and to changes in the rate of removal of water from the zone. Water is removed from the saturated zone by gravity flow to nearby streams, by pumping from wells, and by evapotranspiration where the root zone of vegetation is sufficiently close to the saturated zone. Water is added to the zone chiefly from infiltrating local precipitation.

Where the rocks in the saturated zone are capable of yielding water to wells and springs, they are termed aquifers. Aquifers differ widely in their ability to yield water. In the Piedmont region, some rocks appear to be better aquifers than others, depending in part on the nature and extent of their interconnected fractures and voids. Figure 1 is a generalized model showing ground-water occurrence and movement in the Piedmont region.

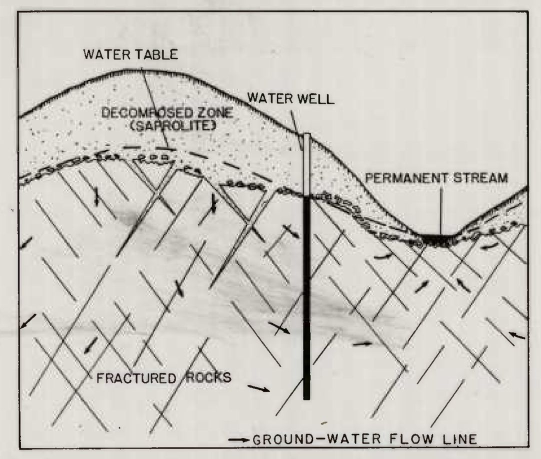


Figure 1. Occurrence and movement of ground water in Piedmont terrain.

The yields of individual wells in the Westminster quadrangle depend on factors such as topographic position of the well, nature and thickness of the saprolite, and extent and degree of fracturing of the rocks at the well site. In general, the fractures and voids in the rocks disappear with increasing depth. An analysis of the depth of water-yielding fractures, as reported by drillers for 100 wells in the Westminster and Winfield quadrangles, indicates that most of the ground water occurs in the uppermost 75 to 100 feet. In fact, 68 percent of the water-yielding fractures occur in the uppermost 100 feet of the rocks. Figure 2 shows the occurrence of water-yielding fractures in depth intervals down to 425 feet, the greatest depth at which any fracture was reported.

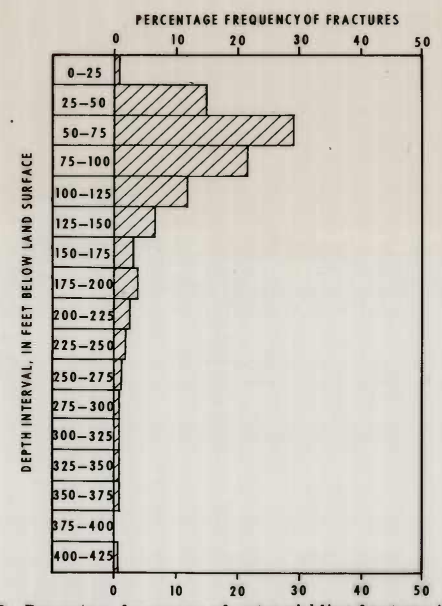


Figure 2. Percentage frequency of water-yielding fractures in drilled wells in the Westminster and Winfield quadrangles.

Unfractured and unweathered metamorphic rocks are essentially impermeable. Crystalline rocks containing several intersecting fractures are more permeable and accordingly are more likely to yield larger supplies of water to wells. Therefore, the distribution of fractures is a major factor governing the availability of water in these rocks. An analysis of topography on maps and aerial photographs shows linear features which may identify major zones of rock fracturing. The orientation of many valleys and stream channels seems to be controlled by the zones of rock fracturing. Wells drilled in such zones may be expected to have above-average yields. The presumed existence of such fracture zones, or lineaments, is shown on the accompanying map by the straight lines following the trend of numerous water courses.

SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geol. Survey.

Ferris, J. G., Knowles, D. B., Brown, R. H., and Stallman, R. W., 1962, Theory of aquifer tests: U.S. Geol. Survey Water-Supply Paper 1536-E, 174 p.

Meyer, Gerald, 1958, The ground-water resources *in* The water resources of Carroll and Frederick Counties: Maryland Dept. of Geology, Mines and Water Res. Bull. 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geol. Survey Inf. Circ. 16, 24 p.

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Stose, A. J., and Stose, G. W., 1946, Geology of Carroll and Frederick Counties *in* The physical features of Carroll and Frederick Counties: Maryland Dept. of Geology, Mines and Water Res., p. 11-128.

EXPLANATION

Linear features which may be related to zone of rock fracturing.

The rocks of the Westminster quadrangle are divided into two geohydrologic units according to their water-yielding characteristics. Although these units are part of a larger areawide classification scheme, the well statistics given are based entirely on data from the Westminster and adjacent quadrangles. The mapped geohydrologic units are numbered in the order of their decreasing productivity as a source of water, based on the mean reported specific capacities of drilled wells. Thus, wells in Geohydrologic Unit 2 are more productive than wells in Unit 3. Geohydrologic Unit 1, underlain by Coastal Plain sediments, is absent from the Westminster quadrangle, but is present east of the Fall Line, about 20 miles east of the quadrangle. The stratigraphic nomenclature follows the usage of the Maryland Geological Survey.

2

GEOHYDROLOGIC UNIT 2: Area underlain by the Bachman Valley Formation, chiefly green to grayish-green phyllite with interlayered marble which, in places, weathers to form long narrow valleys. The marble is white, gray to blue or purplish with some dolomite layers. These rocks form two northeast-trending bands which extend into the Manchester quadrangle to the north and extend westward into the New Windsor quadrangle. The rocks also contain green schist, which may be locally vugular as a result of the leaching of interspersed calcite. In places, the marbles are deeply weathered. Unit 2 includes rocks mapped as the Sams Creek Metabasalt and the Wakefield Marble on the geologic map of Maryland (Cleaves and others, 1968).

A narrow valley, underlain by marble, extends northeastward from Westminster along the Western Maryland RR tracks. Meyer reports (1958, p. 117 and 157) that three of the most productive wells in Carroll County (CL-CE 2, -CE 3, and -CE 4) are within a few hundred feet of each other in this valley. Yields of these wells ranged from 470 to 550 gal/min when tested in 1948. Because of their anomalously high yields and specific capacities, these wells are not included in the statistics given below.

WELL YIELDS AND DEPTHS: The rocks in unit 2 comprise the most productive aquifer in the quadrangle. The best wells apparently penetrate thin zones of marble in phyllite. The reported yields 1/ of 14 wells range from 1 to 150 gal/min; the mean yield is 21 gal/min. The most productive well, CL-CE 49, is in Westminster. The well was drilled to a depth of 200 feet in 1946. Figure 3 shows the distribution of wells by yield classes and adequacy categories. About 14 percent of the wells are inadequate for most purposes and 36 percent of the best wells are adequate for many industrial and municipal purposes.

The depths of 25 wells range from 22 to 885 feet and average 204 feet. The deepest well, CL-CE 4, was drilled in 1938 in the search for ground water at a packing plant in Westminster.

WELL SPECIFIC CAPACITIES: Reported specific capacities 2/ of 14 wells range from 0.01 to 3.3 (gal/min)/ft and average 0.4 (gal/min)/ft. Well CL-CE 49 has the maximum specific capacity, based on a 6-hour yield test.

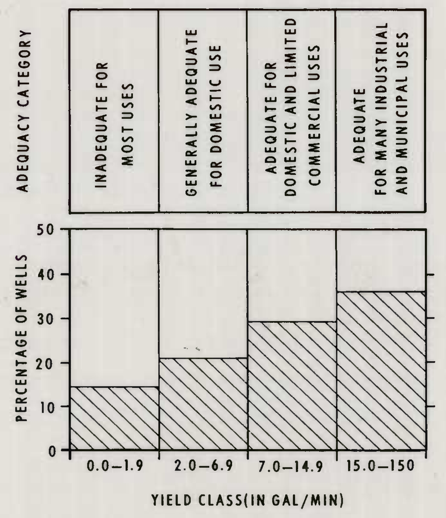

Figure 3. Yield class graph for Geohydrologic Unit 2 in the Westminster quadrangle.

3

GEOHYDROLOGIC UNIT 3. Area underlain by the Prettyboy Schist, a green to greenish-gray rock (in fresh exposures) with variable amounts of quartz, quartzite, and muscovite. Locally, the unit contains calc-schist. In the northeast corner of the quadrangle a prominent, narrow strike valley occurs which may be underlain by micaceous marble. This valley is tentatively mapped as Geohydrologic Unit 2. Unit 3 includes a part of the areas shown on the geologic map of Maryland (Cleaves and others, 1968) as the Wissahickon Formation (undivided). The thickness of the saprolite is variable, ranging from zero to 90 feet.

The most productive wells are obtained where they are located along major fractures, faults, or joint planes, or at the intersection of two or more of these features. Indirect evidence suggests that large and small streams flow chiefly along the zones of fractured rock. Hence, wells drilled in or near these stream valleys may yield two to three times above the average for the unit. The assumed trace of these fractures is shown by straight lines on the map.

WELL YIELDS AND DEPTHS: Unit 3 contains only moderately productive aquifers capable of yielding domestic water supplies in most localities. The reported yields 1/ of 85 wells in the quadrangle range from 0 to 35 gal/min. The most productive well, CL-CE 102, is 143 feet deep and was tested at 35 gal/min for 3 hours in 1973. This well is near Fenby in the southwest part of the quadrangle.

Figure 4 shows that 21 percent of the wells are inadequate for most uses (yield less than 2 gal/min) and 18 percent of the wells yield 15 gal/min or more. The remaining 61 percent of the wells are in the two intermediate yield classes. Of course, the yields of all crystalline-rock wells may decline during sustained periods of no ground-water recharge, due to the low storage capacity of the rocks. The depths of 100 wells range from 50 to 580 feet and average 198 feet.

WELL SPECIFIC CAPACITIES: Reported specific capacities of 85 wells range from 0.0 to 0.6 (gal/min)/ft of drawdown and average 0.1 (gal/min)/ft 2/. The maximum value (0.6 (gal/min)/ft)) is from well CL-CF 64, located 1 mile south of Hoffmans Mill.

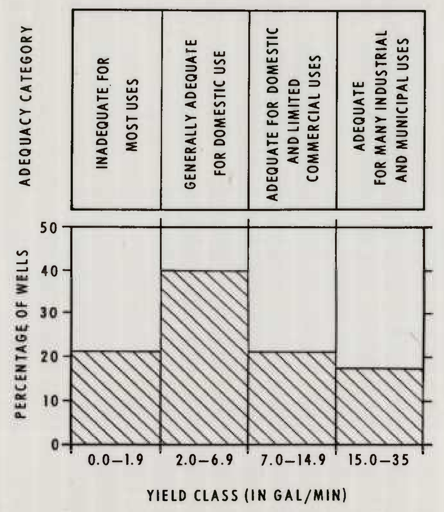

Figure 4. Yield class graph for Geohydrologic Unit 3 in the Westminster quadrangle.

1/ Only wells for which the driller reported a yield test of 2 hours duration, or longer, were used in this analysis.

2/ Specific capacity of a well is the yield per foot of drawdown of the water level in the well. No time period is, however, specified for the measurement of this variable, which is commonly expressed in gallons per minute per foot of drawdown ((gal/min)/ft). For many domestic wells, the period of measurement ranges from 2 to 6 hours. Analysis includes only wells having a yield test of 2 hours duration, or longer.

SUMMARY OF GEOHYDROLOGY

In summary, the reported yields of 99 wells in both geohydrologic units in the Westminster quadrangle range from 0 to 150 gal/min, exclusive of three exceptional high-capacity wells near Westminster. The depths of 125 wells in both units range from 22 to 885 feet and average 200 feet. Specific capacities of both units range from 0.0 to 3.3 (gal/min)/ft. The above data have an inherent sampling bias as most of the wells included are for domestic use and are not always tested for their maximum yield. Furthermore, such wells are commonly located on hilltops or other upland areas where geohydrologic conditions are suboptimal for maximum well yields.

MAP 3. AVAILABILITY OF GROUND WATER

Maryland Geological Survey
Quadrangle Atlas No. 9

Topography from aerial photographs by stereophotogrammetric methods. Aerial photographs taken 1943.
Culture revised by the U.S. Geological Survey 1953 (photorevised 1971).

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

MARYLAND
QUADRANGLE LOCATION

1979

MAP 4. CONSTRAINTS ON INSTALLATION OF SEPTIC SYSTEMS

Maryland Geological Survey
Quadrangle Atlas No. 9

CONSTRAINTS ON INSTALLATION OF SEPTIC SYSTEMS

by

Edmond G. Otton

EVALUATION OF UNITS

The three areas, or units, shown on this map differ in their degree of limitation for domestic liquid-waste disposal systems because of differences in soil and subsoil infiltration characteristics, land slope, depth to water table, flood hazard, and the existence of a thin or rocky soil mantle over bedrock at various places.

The following graph shows the range in constraints of the various units for use as a disposal medium:

MAXIMUM CONSTRAINTS	MARGINAL TO VARIABLE CONTRAINTS		MODERATE CONSTRAINTS
I	II	III	IV

FACTORS GOVERNING THE EVALUATION

1. Soil and subsoil infiltration rates were determined chiefly on the basis of several hundred percolation tests 1/ conducted by sanitarians of Carroll County, under standardized procedures established by the Maryland Department of Health, and by more than 100 tests conducted by the U.S. Geological Survey.

2. Land slopes were obtained from a machine-generated slope map, prepared by Photo Science, Inc. Maryland Department of Health regulations (July 1964, Section 1, definitions, part 1.9) do not permit, as of 1977, the installation of underground domestic sewage disposal systems where the slope of the land surface is in excess of 25 percent. Steep slopes are considered to be a major contributing cause of failure of underground disposal systems (U.S. Public Health Service, 1967, p. 18 and U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 8).

3. The 10-foot depth to the water table used as a constraint in this report is the sum of three component factors. These are: (a) The recommended depth of drain tile fields is at least 3 feet below the land surface (U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 3); (b) a minimum depth of 4 feet between the base of the tile field (absorption trench) and the underlying water table is recommended (U.S. Public Health Service, 1967, p. 11); and (c) a 3-foot additional depth is suggested to allow for seasonal variations in position of the water table, which commonly fluctuates through at least a 3-foot range in Piedmont valleys.

4. Most valleys in the Westminster quadrangle are subject to periodic flooding. Floods would cause uncontrollable dispersal of sewage and possible physical damage to the disposal system.

5. Where bedrock crops out or occurs near the land surface, the construction of underground disposal systems is not feasible. Hence, the existence of rock is an obvious terrane constraint.

REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968 Geologic map of Maryland: Maryland Geol. Survey.
Meyer, Gerald, 1958, The ground-water resources *in* The water resources of Carroll and Frederick Counties: Maryland Dept. of Geology, Mines and Water Res. 2/ Bull. 22, p. 1-228.
University of Maryland, Maryland State Roads Commission, U.S. Bureau of Public Roads, 1963, Engineering soil map of Carroll County (1 sheet).
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______1971, Soils and septic tanks: 12 p.
U.S. Public Health Service, 1967 rev., Manual of septic-tank practice: 92 p.

1/ The standard percolation test conducted in the Maryland Piedmont counties (1977) is performed as follows: a 2- to 3-foot wide pit is dug to the depth to be tested, and a 1-foot square hole is hand-excavated on the floor of the pit. The 1-foot hole is filled with water, and the time required for the water to drop the second inch of a 2-inch decline is measured. To be rated as "passing" or successful, the rate of drop of the water level must be between 2 and 30 minutes per inch. Declines of the water level at rates too fast or too slow are the basis for rejection of the unit of land sampled by the test. Also, the presence of shallow ground water or rock ledges is an additional basis for rejection of the test site. Where clayey or other nearly impervious materials are encountered in a test pit, the actual test may not be performed, based on the judgment of the sanitarian conducting the test.

2/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

MAP UNITS

I

UNIT I. Includes low-lying valley-bottom areas where the depth to the permanent water table ranges from 0-10 feet and areas where the slope of the land surface exceeds 25 percent. Unit I is underlain by stream alluvium, colluvium, and rocky land consisting of the various crystalline rock formations present in the quadrangle, chiefly the Prettyboy Schist, a gray to green muscovite-chlorite schist. Near the surface the grayish rocks oxidize to a tan to brown color. The depth of overburden on the steep rocky slopes generally ranges from 0 to 5 feet. The depth of alluvium in the larger stream valleys ranges from a few feet to 25+ feet.

The terrain in unit I is characterized by steep-sided valley slopes, commonly rocky, and by flat, poorly drained, valley bottoms. subject to periodic flooding.

Relatively few percolation tests have been made in unit I, but the soil and subsoil along the valley bottoms appear to be relatively impermeable. These bottoms are underlain mainly by Hatboro, Codorus, and Baile soils, consisting chiefly of silt loam and some gravelly loam. The steep hillsides are underlain by Mt. Airy and Glenelg soils. Figure 1 shows the approximate mean percolation rates for three depth categories in unit I, based on 33 tests in valley alluvium in various areas in central Carroll County. In only two tests were measured percolation rates less than 30 minutes per inch. Both tests were in the depth interval from 6 to 9 feet. However, the number of tests run in unit I is not sufficient for a meaningful appraisal of it.

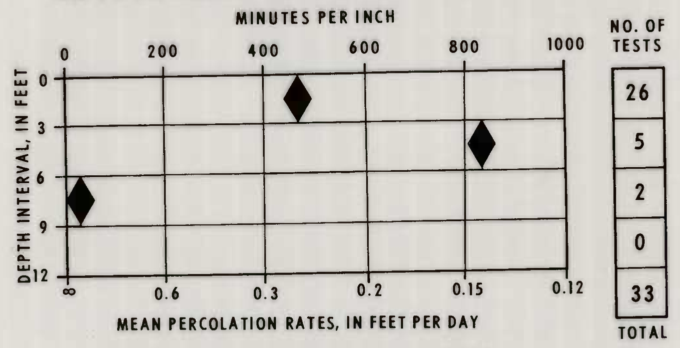


Figure 1. Mean percolation rates in Unit I.

II

UNIT II. Includes areas underlain by maroon to reddish-brown shale and siltstone with some sandstone, comprising the New Oxford Formation. This unit has relatively thin soil and subsoil having low percolation rates, especially where shale and siltstone are the underlying rocks. Unit II is not present in the Westminster quadrangle, but is present in the New Windsor and Littlestown quadrangles immediately to the west and northwest.

III

UNIT III. Includes two separate areas totalling approximately 3 square miles, chiefly in the northwest part of the quadrangle. The largest area, about ¾-mile wide, extends northeast from Westminster along Cranberry Branch. The unit is underlain by the Bachman Valley Formation consisting of bluish-gray phyllite and phyllitic greenstone. Narrow bands and lenses of white to reddish, impure marble occur within the wider bands of phyllite.

Both the phyllite and the marble weather to greater depths than the surrounding rocks. Depths of weathering range from a few to more than 100 feet. Depth to the water table in unit III is commonly between 10 and 35 feet, subject, of course, to normal seasonal fluctuations. Slopes of the land surface are usually less than 15 percent and may commonly be less than 10 percent. Topography is generally more subdued than in unit IV.

Soils in the unit are of the Mt. Airy-Linganore association, consisting of well-drained, nearly level to steep, channery soils that are moderately deep to deep (U.S. Dept. of Agriculture, 1969). Figure 2 shows that the lowest infiltration rates (longest times) occur in the two depth intervals from 0-3 feet and from 3-6 feet. The highest infiltration rates (shortest times) occur in the two depth intervals from 6 to 12 feet. Most of the disposal systems in unit III, therefore, are at a depth of 6 to 12 feet where the phyllitic, channery zones permit rapid, downward movement of liquid effluent. These zones are generally unfavorable for satisfactory renovation of the effluent and can create conditions favoring pollution of the water in nearby wells.

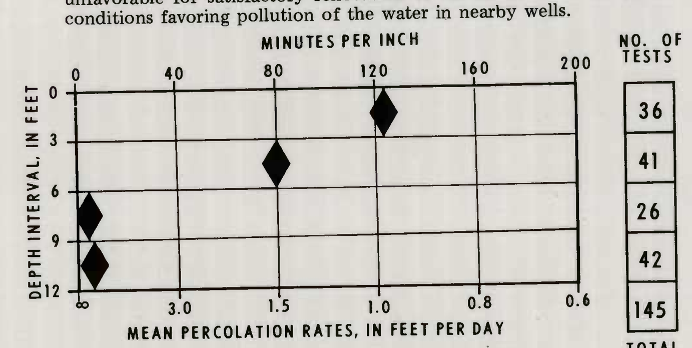


Figure 2. Mean percolation rates in Unit III.

IV

UNIT IV. Includes the major part of the upland, interstream areas of the quadrangle. Underlain by the Prettyboy Schist, consisting of a complex series of schist and interlayered quartz and quartzite. The unweathered schist is grayish-green to gray, well foliated, and poorly jointed.

Depth of weathering, based on 30 well logs, ranges from 7 to 112 feet and averages 40 feet.

Soils in unit IV include the Mt. Airy-Linganore association and the Glenelg-Chester-Manor association, well-drained, micaceous, deep soils over schist (U.S.D.A., 1969, General Soils Map). In some of the Mt. Airy and Linganore Soils, the depth to bedrock ranges from 1 to 3 feet and in these localities underground disposal systems are not feasible.

Figure 3 shows the infiltration rates of the soils in unit IV by depth intervals. Unit IV differs from units I and III in that the infiltration rate of the soil in the depth interval 3 to 6 feet averages 17 minutes per inch (7 feet per day) in contrast to an average rate of 80 minutes per inch (1.5 feet per day) for the equivalent depth interval in unit III. Infiltration rates in the depth interval 6 to 12 feet are approximately the same in units III and IV. Because most of the sewage disposal systems in Carroll County are seepage pits ending in the depth interval from 6 to 12 feet, the high rates of infiltration (20 to 25 feet per day) permit passage of the effluent into the underlying rock aquifers with little opportunity for renovation and purification, especially where vertical crevices or other openings exist.

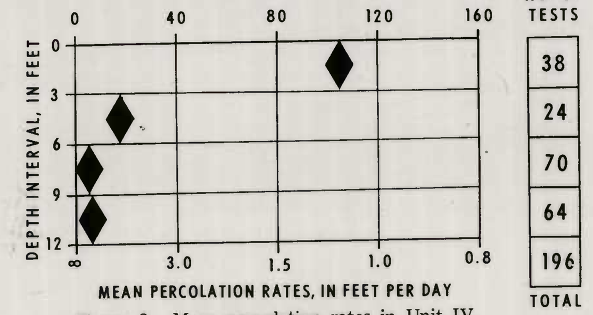
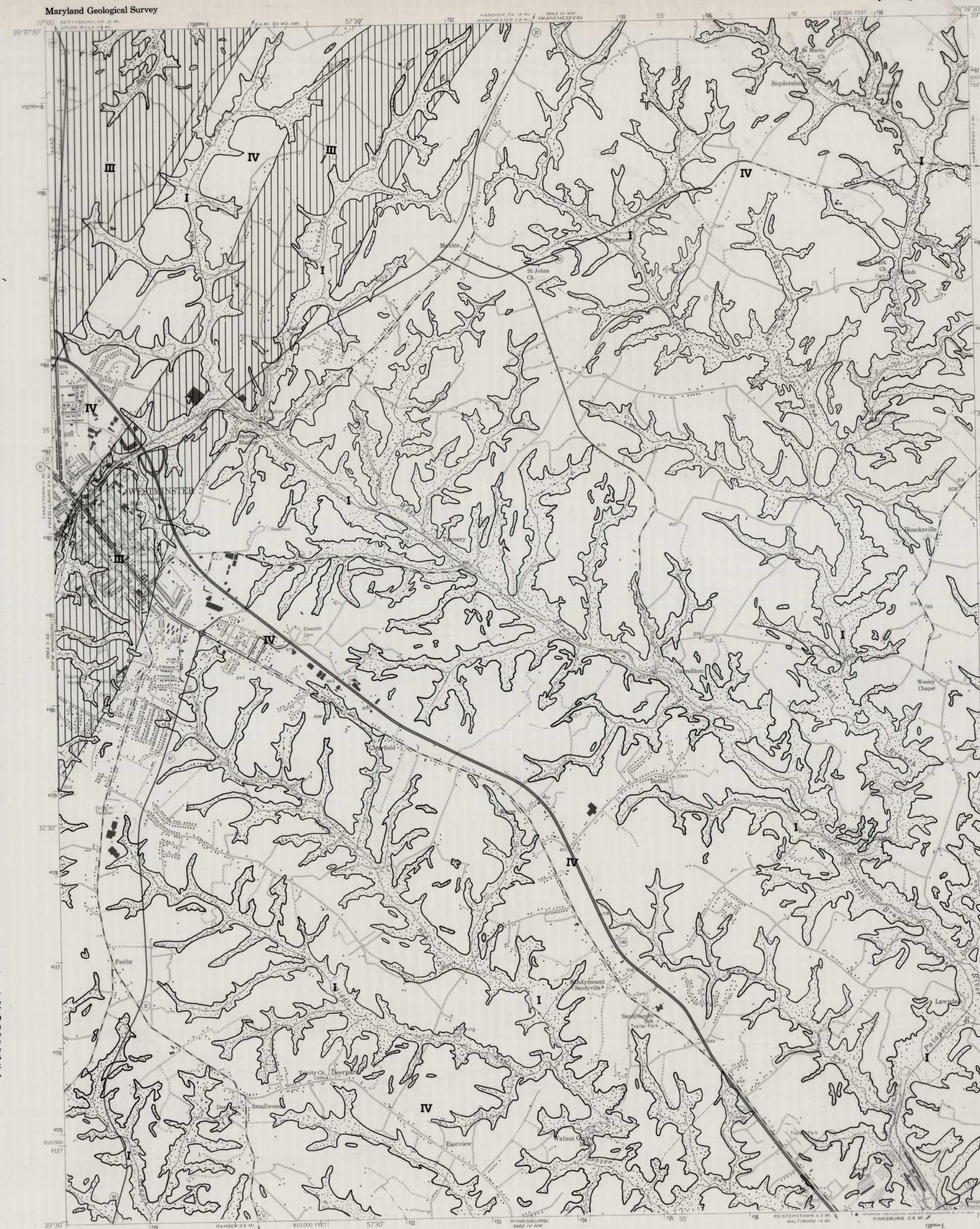


Figure 3. Mean percolation rates in Unit IV.



Topography from aerial photographs by stereophotogrammetric methods. Aerial photographs taken 1943.
Culture revised by the U.S. Geological Survey 1953 (photorevised 1971).

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL

MARYLAND
QUADRANGLE LOCATION

1979

PLAN HOLD
DRAWING NUMBER
Westminster Map 4
PLAN HOLD CORPORATION IRVINE CALIFORNIA

MAP 5. LOCATION OF WELLS, SPRINGS, AND TEST HOLES

Maryland Geological Survey

Quadrangle Atlas No. 9

LOCATION OF WELLS, SPRINGS, AND TEST HOLES

by John T. Hilleary and Edmond G. Otton

EXPLANATION

Information for wells and test holes shown on the map is on file with the U.S. Geological Survey, Towson, Maryland, and the Maryland Geological Survey, Baltimore, Maryland. Logs and well-construction records are available for most wells and test holes shown.

Well-numbering system: The wells and springs shown on the map are numbered according to a coordinate system in which Maryland counties are divided into 5-minute quadrangles of latitude and longitude. The first letter of the well number designates a 5-minute segment of latitude; the second letter designates a 5-minute segment of longitude. These letter designations are followed by a number assigned to wells chronologically. This letter-number sequence is the quadrangle designation, which is preceded by an abbreviation of the county name. Thus, well CL-CE 20 is the 20th well inventoried in quadrangle CE in Carroll County. In reports describing wells in only one county, the county prefix letters are frequently omitted from the well number. However, the numbering system currently in use (1977) differs slightly from that used in earlier published reports, such as Meyer (1958). In the 1958 report, well CL-CE 20 was designated as Car-Ce 20. The discontinuance of the use of lower-case letters in the well designation was necessitated by the change in 1970 to a computer storage and retrieval system for well information.

Miscellaneous shallow boreholes or auger test holes are designated by a number preceded by a "T". These holes are numbered chronologically within each 7½-minute quadrangle. Geologic and hydrologic records for them were obtained from various local concerns and agencies, chiefly county and State highway departments.

Water wells drilled in Maryland since 1945 also have a number (not shown on this map) assigned by the Maryland Water Resources Administration. This number consists of a two-letter county prefix (for example, CL for Carroll County) followed by a two-digit number indicating the State fiscal year in which the permit was issued (for example, -72 for the 1972 fiscal year). A four-digit chronologic sequence number follows the the State fiscal year in which the permit was issued (for example, -72 for the fiscal year designation. Thus, well CL-72-0010 is the 10th well permit issued for Carroll County during the 1972 fiscal year.

Records of wells, springs, and boreholes shown on the map are in the Selected References, or are in the files of the District office of the U.S. Geological Survey at Towson, Maryland.

o 10

WATER WELL AND LOCATION NUMBER

ó 4

SPRING AND LOCATION NUMBER

● T5

AUGER OR TEST HOLE AND NUMBER

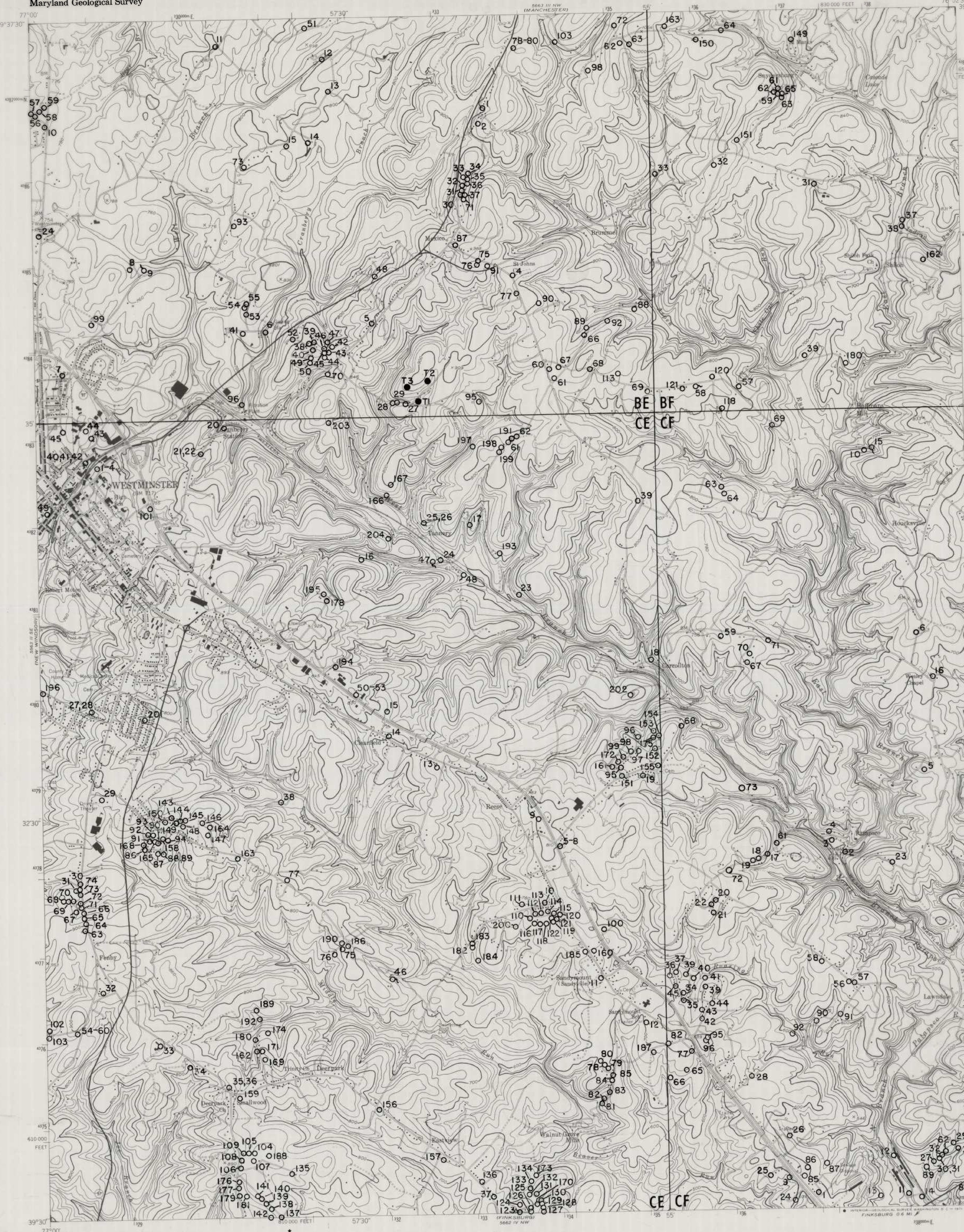
SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic Map of Maryland: Maryland Geol. Survey, scale 1:250,000.

Meyer, Gerald, 1958, The ground-water resources *in* The water resources of Carroll and Frederick Counties: Maryland Dept. of Geology, Mines and Water Resources 1/ Bull. 22, p. 1-228.

Stose, A. J., and Stose, G. W., 1944, Geology of the Hanover-York district Pennsylvania: U.S. Geol. Survey Prof. Paper 204, 84 p.

1/ Name of this agency changed to Maryland Geological Survey in 1964.



Topography from aerial photographs by stereophotogrammetric methods. Aerial photographs taken 1943. Culture revised by the U.S. Geological Survey 1953 (photorevised 1971).

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