SLOPE OF LAND SURFACE

By Mark T. Duigon

EXPLANATION

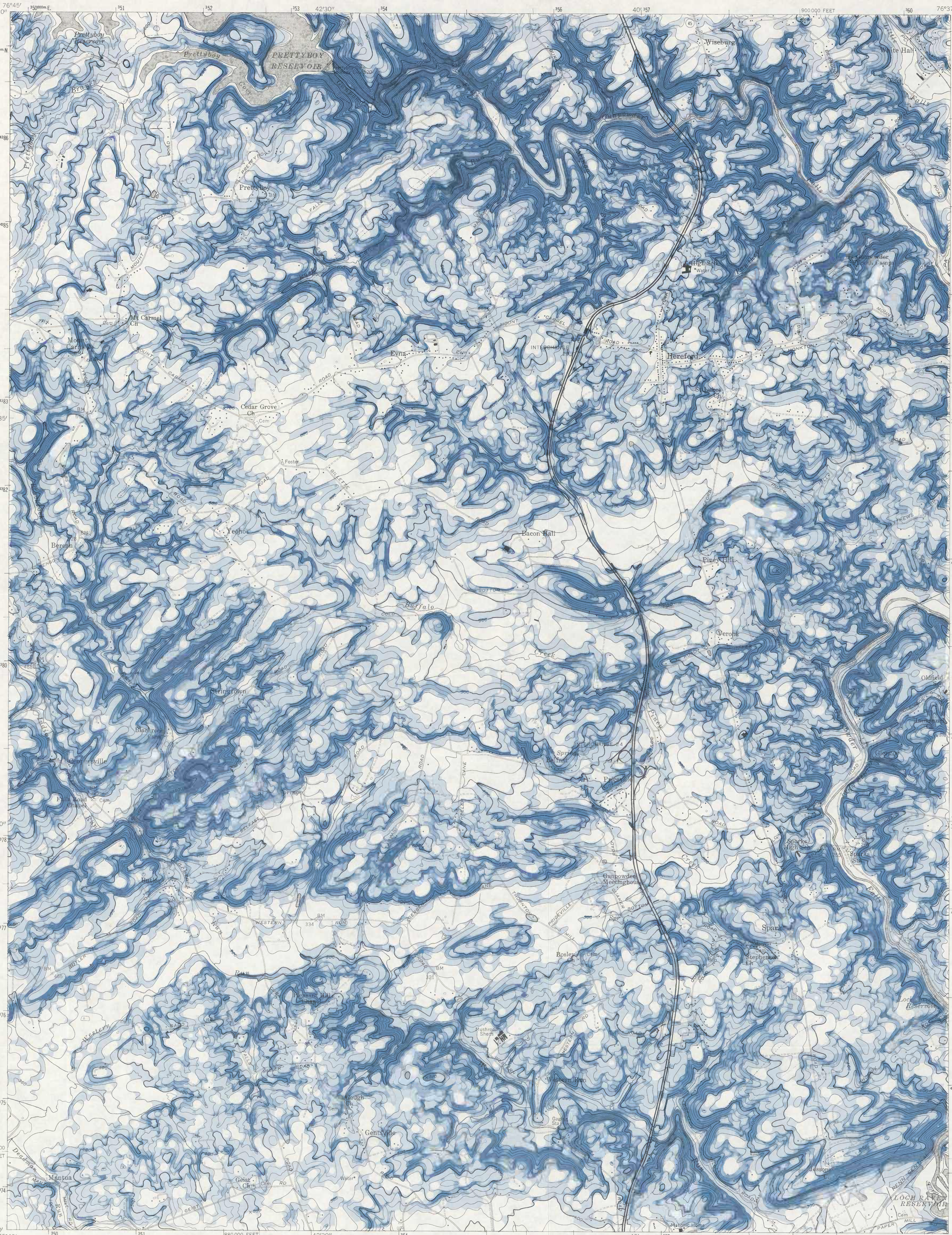
This map shows the slope of the land surface in the Hereford quadrangle with the slopes grouped into categories. The map was prepared from a 1:24,000-scale topographic contour plate using a semi-automatic photomechanical process. In this process, a device measures the distance between adjacent lines and for the contour interval provided, calculates the slope between the lines. Narrow summits or depressions and similar features may be falsely mapped due to the bending of a line upon itself. Likewise, equal but adjacent contours produce overestimated slopes. Widely separated contour lines may result in an averaging of the intervening slopes. However, these limitations are only of small extent and do not seriously affect the use of the map. The slope categories which relate to those in the Baltimore County Soil Survey were selected for their relevance to current and contemplated Baltimore County planning regulations.

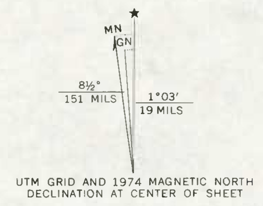
Prepared in cooperation with the
United States Geological Survey
and the
Baltimore County Department of
Planning and Zoning

Maryland Geological Survey

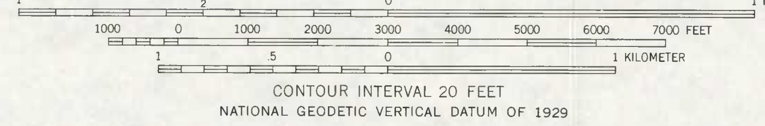
MAP 1. SLOPE OF LAND SURFACE

Quadrangle Atlas No. 18





SCALE 1:24 000

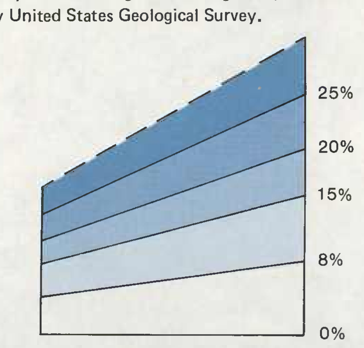


CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1981

QUADRANGLE LOCATION

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



Maryland Geological Survey

MAP 3. DEPTH TO WATER TABLE

Quadrangle Atlas No. 18

DEPTH TO WATER TABLE

By Mark T. Duigon

EXPLANATION

This map shows the distance from the land surface to the water table (top of the zone of saturation). The map is based on drillers' well-completion reports supplemented by soils maps and observations of springs, swamps, and other natural features. The map shows that the water table is generally shallowest near streams and along valley floors, and deepest under summits of hills and ridges.

The position of the water table is not constant but responds to various stresses, chiefly precipitation and evapotranspiration. The water table is usually highest during the spring and deepest in late summer. Precipitation tends to raise the water table, but much of this water may be removed by evapotranspiration before reaching the zone of saturation. This removal of water is most noticeable during the growing season. Fluctuations in the flow of springs may indicate changes in the position of the water table. A spring which usually flows all year may cease to discharge during a prolonged drought because the water table has declined to some point below the spring mouth. The map presented here is generalized, showing average depths to the water table.

Figure 1 shows a 19-year record of water levels in well BA-CE 21 measured periodically by the U.S. Geological Survey. This well, located near Jacksonville, Md., shows the seasonal variations that are characteristic of most wells. It also shows variations in annual mean levels.

A discharging well produces a lowering of the water table (drawdown), but, in this region, the effect is usually restricted to the immediate vicinity of the well and as soon as the pump is shut off, the water level begins to return to its former level. The amount of drawdown varies considerably, depending on pumping rate, duration of pumping, and the hydrologic properties of the aquifer.

In some areas, rainwater infiltrating the ground encounters an impermeable barrier and saturates the soil above it, while the material below the barrier remains unsaturated. The surface of such a saturated zone is known as a perched water table. In the Piedmont, such perced zones are not as extensive as the main water table and are usually temporary. They are not shown on this map.

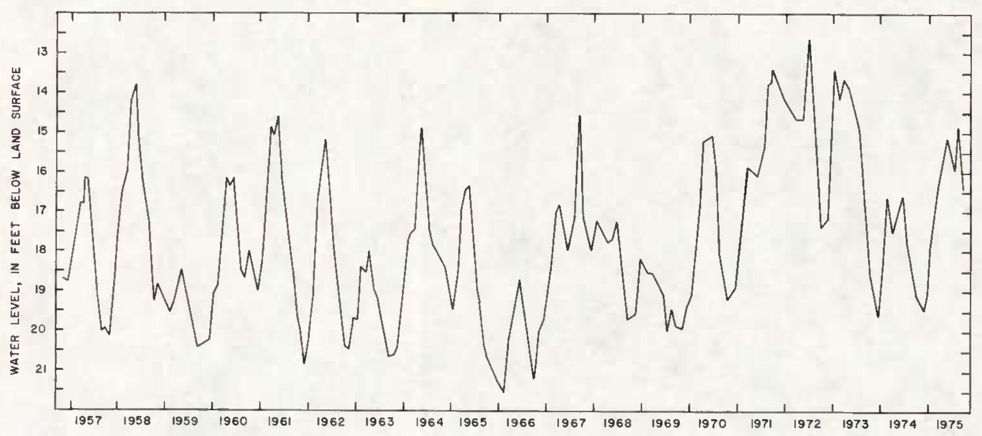


Figure 1. -- Hydrograph for well BA - CE 21, Jacksonville.

APPROXIMATE DEPTH TO WATER TABLE
IN FEET BELOW LAND SURFACE

Less than 10 Feet

10 - 35 Feet

Greater than 35 Feet

Topography from aerial photograghs by photogrammetric methods 1944. Aerial photographs taken 1943. Culture revised by the Geological Survey 1958. Photorevised 1974.

UTM GRID AND 1974 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1981

QUADRANGLE LOCATION

Prepared in cooperation with the United States Geological Survey and the Baltimore County Department of Planning and Zoning

LOCATIONS OF WELLS AND SPRINGS

By

Mark T. Duigon and John T. Hilleary

EXPLANATION

Information for some of the wells on this map (comprising an earlier inventory) is tabulated in the Maryland Geological Survey Basic Data Report No. 1 (Laughlin, 1966). Supplementary wells are tabulated in this report. The supplementary well information has been entered in the National Water Data Storage and Retrieval System (WATSTORE) of the U.S. Geological Survey.

Since 1945, the State of Maryland has by law required a permit to drill a water well. The numbers corresponding to the permit applications are included in the well-data tabulations. Since 1973, metal tags bearing State permit numbers have been affixed to the well casings. Much of the well data collected for this report is contained on well-completion forms which the driller must submit to the State upon completion of the well.

Wells are identified in a State-wide numbering system. Each county is set up with a grid system based on every fifth minute of latitude and longitude. Each square of the grid is lettered by row and column. Thus, well BA-BC 123 is the 123rd well inventoried in the second row from the north, third column from the west, in Baltimore County.

O 123

WELL AND NUMBER

Ó 24

SPRING AND NUMBER

REFERENCE

Laughlin, C. O., 1966, Records of wells and springs in Baltimore County, Maryland: Maryland Geological Survey Water Resources Basic Data Report No. 1, 406 p.

SUPPLEMENTAL RECORDS OF WELLS, HEREFORD QUADRANGLE

LOCAL NUMBER	STATE PERMIT NUMBER	OWNER	CONTRACTOR	DATE COMPLETED	ALTITUDE OF LAND SURFACE (FEET)	DEPTH OF WELL (FEET)	FINISH	DEPTH CASED (FEET)	CASING DIAMETER (INCHES)	PRINCIPAL AQUIFER	WATER LEVEL (FEET)	DRAW-DOWN (FEET)	DISCHARGE (GALLONS PER MINUTE)	DATE DISCHARGE MEASURED	PUMPING PERIOD (HOURS)	SPECIFIC CAPACITY (GPM/FT)	USE OF WATER	USE OF SITE	TYPE OF LIFT
BA BC 195	BA-73-3502	WISNER, JAMES R	WM C JAMES	10/13/1976	675	118.00	X	72	6	300PLGV	40.00	--	10	10/13/1976	6.0	--	H	W	S
BA BC 215	BA-73-4895	HILSE, MABE	G EDGAR HARR	01/16/1978	710	175.00	X	85	6	300PLGV	45.00	29	16	01/16/1978	4.0	0.5	H	W	S
BA BC 216	BA-73-4549	SELLERS, JOHN A	WM C JAMES	08/21/1977	740	245.00	X	42	6	300PLGV	39.00	92	2.0	08/24/1977	6.0	0.0	H	W	S
BA BC 217	BA-73-4509	SIMMONS, DAN	EARL JONES	06/23/1977	730	100.00	X	24	6	300PLGV	26.00	12	20	06/23/1977	6.0	1.7	H	W	S
BA BC 218	BA-73-3735	LOGSEON, JOSEPH	A C REIDER	02/03/1977	580	153.00	X	19	6	300PRTB	51.00	36	2.0	02/03/1977	6.0	0.1	H	W	S
BA BC 219	BA-73-4007	RUHL, JAMES	G EDGAR HARR	03/24/1977	630	150.00	X	20	6	300PLGV	48.00	5	9.0	03/24/1977	6.0	1.8	H	W	S
BA BC 220	BA-73-4011	RUSSO, RICHARD T	WM C JAMES	03/11/1977	510	120.00	X	--	--	300PRTB	D	--	0.00	03/11/1977	--	0.0	--	Z	--
BA BC 221	BA-73-4011	RUSSO, RICHARD T	WM C JAMES	03/11/1977	510	320.00	X	--	--	300PRTB	D	--	0.00	03/11/1977	--	0.0	--	Z	--
BA BC 222	BA-73-4011	RUSSO, RICHARD T	WM C JAMES	03/11/1977	510	125.00	X	--	--	300PRTB	D	--	0.00	03/11/1977	--	0.0	--	Z	--
BA BC 223	BA-73-4011	RUSSO, RICHARD T	WM C JAMES	03/11/1977	510	125.00	X	33	6	300PRTB	30.00	8	3.0	03/11/1977	6.0	0.4	H	W	S
BA BC 224	BA-73-1234	LATTIN, FRANK G	WM C JAMES	03/20/1974	740	200.00	X	23	6	300PLGV	35.00	51	3.0	03/20/1974	6.0	0.1	H	W	S
BA BC 225	BA-73-1232	HILSE, RUSSELL E	WM C JAMES	03/15/1974	660	200.00	X	21	6	300PRTB	40.00	70	3.0	03/15/1974	6.0	0.0	H	W	S
BA BD 201	BA-73-2800	LAND DEVELOP	W W REICHART	02/26/1976	550	100.00	X	22	6	300PLGV	30.00	18	8.5	02/26/1976	6.0	0.5	H	W	S
BA BD 202	BA-73-3453	LAND DEVELOP CORP	W W REICHART	10/04/1976	560	100.00	X	50	6	300PLGV	40.00	10	8.0	10/04/1976	6.0	0.8	H	W	S
BA CC 225	BA-66-0466	HEBB, DONALD	WATER INC	08/31/1966	400	195.00	X	--	--	300CCKV	4.00	190	0.25	08/31/1966	1.0	0.0	U	U	--
BA CC 226	BA-66-0466	HEBB, DONALD	WATER INC	08/31/1966	420	135.00	X	24	6	400BLMR	17.00	16	20	08/31/1966	2.5	1.3	H	W	S
BA CC 227	BA-73-0442	ESHMAN, CHARLES	G EDGAR HARR	02/27/1973	520	300.00	X	31	6	400BLMR	30.00	260	2.0	02/27/1973	6.0	0.0	H	W	S
BA CC 228	BA-73-1201	SCHMUFF, THOMAS	WM C JAMES	03/04/1974	665	110.00	X	20	6	300PNRN	40.00	20	8.0	03/04/1974	6.0	0.4	H	W	S
BA CC 229	BA-73-3369	GRISWALD, JACK	G EDGAR HARR	08/20/1976	395	225.00	X	40	6	400BLMR	14.00	196	2.0	08/20/1976	6.0	0.0	H	W	S
BA CC 230	BA-73-3444	LOCH HILL CONST	G EDGAR HARR	10/19/1976	555	150.00	X	44	6	400BLMR	12.00	28	8.0	10/19/1976	6.0	0.3	H	W	S
BA CC 231	BA-73-3970	COSSENTINO, FRANK	WM C JAMES	02/24/1977	525	145.00	X	42	6	400BLMR	41.00	21	3.0	02/24/1977	6.0	0.1	H	W	S
BA CC 232	BA-73-4133	JACOBSON, NICHOLAS	W W REICHART	05/16/1977	490	100.00	X	41	6	400BLMR	25.00	--	10	05/16/1977	6.0	--	H	W	S
BA CC 233	BA-73-4752	BAKER, MARGARET	WATER INC	09/14/1977	410	202.00	X	50	6	400BLMR	15.00	3	3.0	09/14/1977	6.0	1.0	H	W	S
BA CC 234	BA-72-5148	MACKENZIE, CLARK F	WATER INC	11/29/1977	390	172.00	X	31	6	400BLMR	40.00	20	5.0	11/29/1977	6.0	0.3	M	W	S
BA CC 235	BA-73-4769	FITCHETT, THOMAS C	WM C JAMES	08/23/1977	670	245.00	X	72	6	300PNRN	70.00	41	3.0	08/23/1977	6.0	0.1	H	W	S
BA CC 236	BA-73-4769	FITCHETT, THOMAS C	WM C JAMES	08/23/1977	670	220.00	--	--	--	300PNRN	--	--	0.00	08/23/1977	--	--	--	Z	--
BA CC 237	BA-73-5541	DUNKIN, TERRY	G EDGAR HARR	04/03/1978	570	325.00	X	105	6	300STRS	126.00	74	3.0	04/03/1978	6.0	0.0	H	W	S
BA CC 238	BA-73-0892	BROWN, WILLIAM R	G EDGAR HARR	09/06/1973	670	150.00	X	48	6	300PNRN	25.00	13	15	09/06/1973	6.0	1.2	H	W	S
BA CC 239	BA-73-4745	MCKEE, DAVID	WM C JAMES	08/19/1977	665	245.00	X	28	6	300PNRN	45.00	117	2.0	08/19/1977	6.0	0.0	H	W	S
BA CC 240	BA-73-4717	LINKOWICH, CHARLES	A C REIDER	09/06/1977	650	180.00	X	49	6	300PNRN	37.00	12	2.0	09/06/1977	6.0	0.2	H	W	S
BA CC 246	BA-73-1601	KIDDER, JEROME	G EDGAR HARR	08/02/1974	345	200.00	X	40	6	300CCKV	30.00	2	10	08/02/1974	6.0	5.0	H	W	S
BA CC 247	BA-73-4968	KNIGHT HOMES	DANA KYKER	09/18/1978	670	225.00	X	60	6	300STRS	70.00	20	3.0	09/18/1978	6.0	0.2	H	W	S
BA CC 248	BA-73-2282	HANN, ROBERT L	WATER INC	08/11/1975	520	100.00	X	52	6	300MBAB	35.00	25	9.0	08/11/1975	6.0	0.4	M	W	S
BA CC 250	BA-73-5743	SCOTT, JAMES	C C CAMBELL	06/06/1978	600	245.00	X	43	6	300PRTB	30.00	12	8.0	06/06/1978	6.0	0.7	H	W	S
BA CD 203	BA-73-3599	CHER CHRIS CONS	G EDGAR HARR	10/29/1976	560	100.00	X	40	6	300STRS	38.00	22	4.0	10/29/1976	6.0	0.2	H	W	S
BA CD 204	BA-73-2892	SHIMER, JIM	A C REIDER	06/19/1976	505	163.00	X	110	6	300STRS	28.00	132	5.0	06/19/1976	6.0	0.0	H	W	S
BA CD 205	BA-73-1547	BLAZUCKI, J A	EARL JONES	07/08/1974	550	100.00	X	31	6	300STRS	27.00	48	11	07/08/1974	6.0	0.2	H	W	S
BA CD 206	BA-73-1061	BOWSER AND RYAN	DANA KYKER	11/19/1973	520	130.00	X	45	6	300STRS	50.00	70	6.0	11/19/1973	7.0	0.1	H	W	S
BA CD 207	BA-73-4687	JOYCE, PAUL H	W W REICHART	09/07/1977	390	425.00	--	--	--	400BLMR	--	--	0.00	09/07/1977	--	--	--	Z	--
BA CD 208	BA-73-4687	JOYCE, PAUL H	W W REICHART	09/07/1977	390	200.00	--	--	--	400BLMR	--	--	0.00	09/07/1977	--	--	--	Z	--
BA CD 209	BA-73-4687	JOYCE, PAUL H	W W REICHART	09/07/1977	390	200.00	--	--	--	400BLMR	--	--	0.00	09/07/1977	--	--	--	Z	--
BA CD 210	BA-73-4687	JOYCE, PAUL H	W W REICHART	09/07/1977	360	250.00	X	23	6	400BLMR	35.00	190	2.3	09/07/1977	6.0	0.0	H	W	S
BA CD 211	BA-73-5726	EARLY AMER BLDR	MD DRILLING	07/05/1978	450	167.00	X	20	6	400BLMR	55.00	31	2.0	07/05/1978	6.0	0.1	H	W	S
BA CD 212	BA-73-5725	EARLY AMER BLDR	MD DRILLING	07/05/1978	440	165.00	X	18	6	400BLMR	55.00	35	2.0	07/05/1978	6.0	0.1	H	W	S
BA CD 213	BA-73-5640	VOSS, KATIE	G EDGAR HARR	07/26/1978	350	270.00	--	--	--	400BLMR	--	--	0.00	07/26/1978	--	--	--	Z	--
BA CD 214	BA-73-5640	VOSS, KATIE	G EDGAR HARR	07/26/1978	330	120.00	X	20	6	400BLMR	8.00	4	2.0	07/26/1978	6.0	0.5	H	W	S
BA CD 216	BA-73-5914	GRIMES, ERNEST	MARYLAND DLG	07/31/1978	470	128.00	X	43	6	400BLMR	20.00	1	6.0	07/31/1978	6.0	6.0	H	W	S
BA CD 226	BA-73-5914	GRIMES, ERNEST	WATER INC	07/31/1978	430	128.00	X	45	6	300PRTB	20.00	1	6.0	07/31/1978	6.0	6.0	H	W	S

FINISH CODES

X OPEN HOLE

PRINCIPAL AQUIFER CODES

300PLGV PLEASANT GROVE SCHIST
300PRTB PRETTYBOY SCHIST
300CCKV COCKEYSVILLE MARBLE
400BLMR BALTIMORE GNEISS
300PNRN PINEY RUN FORMATION
300STRS SETTERS FORMATION
300MBAB METAGABBRO AND AMPHIBOLITE

WATER USE CODES

H DOMESTIC
U UNUSED

SITE USE CODES

W WITHDRAWAL
Z DESTROYED
U UNUSED

LIFT TYPE CODES

S SUBMERSIBLE

SUPPLEMENTAL RECORDS OF SPRINGS, HEREFORD QUADRANGLE

NUMBER	OWNER	ALTITUDE	TOPOGRAPHIC SETTING	AQUIFER	YIELD	DATE	TEMPERATURE	PH	USE OF WATER
BA-CC 241	-	345	S	300CCKV	15	03/02/1979	10	8.8	U
BA-CC 242	Virdin, E.C.	540	S	400BLMR	2	03/02/1979	10	6.1	U
BA-CC 243	Murkland, R.C.	520	S	300CCKV	10	03/02/1979	6	6.0	U
BA-CC 244	Cassidy, F.E.	575	S	300PNRN	5	03/02/1979	5	5.8	U
BA-CC 245	Assoc. Prof. Loyola College	390	S	400BLMR	10	03/02/1979	6	6.1	U
BA-CC 249	Eney, H.V.	540	W	300PRTB	1	04/21/1979	-	-	-
BA-CD 217	Matthews, Margaret	390	S	400BLMR	3	03/02/1979	7	6.8	U

TOPOGRAPHIC SETTING CODES

S Hillside
W Upland draw

AQUIFER CODES

300CCKV Cockeysville Marble
400BLMR Baltimore Gneiss
300PNRN Piney Run Formation
300PRTB Prettyboy Schist

WATER USE CODES

U Unused

Maryland Geological Survey

MAP 2. LOCATIONS OF WELLS AND SPRINGS

Quadrangle Atlas No. 18

Topography from aerial photographs by photogrammetric methods 1944. Aerial photographs taken 1943. Culture revised by the Geological Survey 1958. Photorevised 1974.

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1981

Prepared in cooperation with the United States Geological Survey and the Baltimore County Department of Planning and Zoning

Maryland Geological Survey Quadrangle Atlas No. 18

MAP 4. AVAILABILITY OF GROUND WATER

AVAILABILITY OF GROUND WATER

By Mark T. Duigon

EXPLANATION

The ground-water availability units presented on this map are based on statistical evaluation of reported specific capacities (discharge, in gal/min, divided by drawdown, in ft) of wells grouped by geologic units. [The geologic units correspond to the mapping units of the Geologic Map of Baltimore County (Crowley, 1976)]. Because specific capacity depends in part on length of the pumping test, only wells that have been tested for a 3-hour-minimum duration were included in the analyses. The groups were tested for significant (95-percent confidence level) differences using the Kruskal-Wallis and Wilcoxon nonparametric tests (Sokol and Rohlf, 1969; Rohlf and Sokol, 1969). The results suggest the presence of three units. These units are described below.

GEOHYDROLOGIG UNIT 1, not present in this quadrangle, is composed of Coastal Plain sediments.

2

CEOHYDROLOGIC UNIT 2: This unit occurs in two small areas in the Hereford quadrangle. In the southwest corner it is underlain by the massive metadolostone member of the Gockeysville Marble. In the southeast corner it is underlain by the layered metadolostone member of the Gockeysville Marble. Because of insufficient data in this area, well data from areas underlain by these rock units elsewhere in Baltimore Gounty were used for statistical analyses.

Reported yields of 16 wells range from 5 to 60 gal/min; the median yield is 10 gal/min. Mean yield is 17 gal/min. Figure 1 shows distribution of well yields calculated from specific capacities and assumed 50 ft drawdown. Specific capacities range from 0.11 to 1.67 (gal/min)/ft. The median is 0.65 (gal/min)/ft and the mean is 0.67 (gal/min)/ft. Well depths range from 50 to 242 ft below land surface. Median depth is 110 ft.

Wells drilled in unit 2 will generally be adequate for domestic use and, with proper construction and design, may serve for some municipal, commercial, or certain industrial supplies.

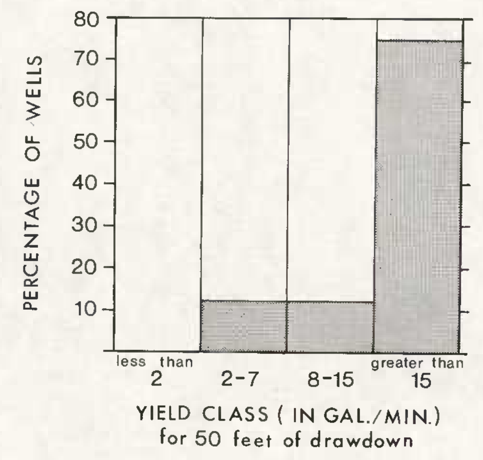


Figure 1. -- Distribution of well yields, Geohydrologic Unit 2 (16 wells).

3

GEOHYDROLOCIC UNIT 3: This unit covers the greatest area in the Hereford quadrangle. It is composed of several formations, mostly schist and gneiss with areas of marble, ultramafic rocks, and quartzite.

Reported yields of 782 wells in the Hereford quadrangle and nearby areas range from 0 to 117 gal/min. Median yield is 6 gal/min and mean yield is 8.5 gal/min. Figure 2 shows distribution of well yields calculated from specific capacities. Specific capacities range from 0.00 to 7.0 (gal/min)/ft. Median specific capacity is 0.14 (gal/min)/ft; the mean is 0.38 (gal/min)/ft. Well depths range from 36 to 525 ft below land surface; the median depth is 150 ft.

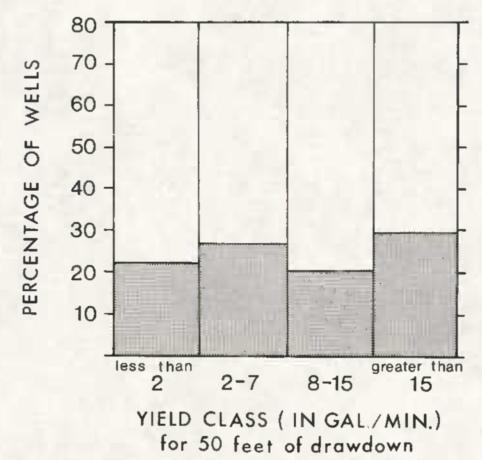


Figure 2. -- Distribution of well yields, Geohydrologic Unit 3 (782 wells).

4

CEOHYDROLOGIG UNIT 4: This unit occurs in several areas scattered about the middle of the quadrangle. It is underlain by the garnet-staurolite, the garnet-kyanite, and the garnet-staurolite-kyanite facies of the Loch Raven Schist. These facies are biotite-plagioclase-muscovite-quartz schists characterized by those accessory minerals.

This is the least productive unit with the reported yields of 144 wells ranging from 0 to 60 gal/min. The median well yield is 5 gal/min, and the mean is 6 gal/min. Figure 3 shows distribution of well yields calculated from specific capacities. The specific capacities range from 0.0 to 6.0 (gal/min)/ft and the median is 0.06 (gal/min)/ft. Mean specific capacity is 0.20 (gal/min)/ft. Well depths range from 60 to 600 ft below land surface. Median depth is 203 ft.

The risk of being unable to obtain a well adequate for domestic use on the first attempt is rather high [21 percent of reported yields were less than 2 gal/min, considered adequate for domestic use; 40 percent have specific capacities less than 0.04 (gal/min)/ft]. Wells are generally deeper in this unit, and therefore more expensive. Homes in this unit may require specially designed water-supply systems and conservation methods. The likelihood of obtaining a well capable of meeting requirements greater than for domestic use is very low.

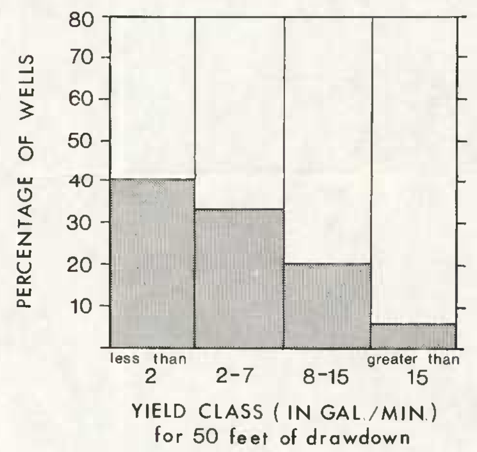


Figure 3. -- Distribution of well yields, Ceohydrologic Unit 4 (144 wells).

SUMMARY

Records of 942 wells were analyzed in order to determine well-yield characteristics of the geologic units present in the Hereford quadrangle. For wells located within the boundaries of the Hereford quadrangle, reported yields of 217 wells ranged from 0 to 100 gal/min. The median is 5 gal/min and the mean is 7.3 gal/min. Values for upper and lower quartiles of reported yield are 10 and 2 gal/min, respectively. Of these wells, 23 percent were reported to yield less than 2 gal/min. Specific capacities range from 0.00 to 6.1 (gal/min)/ft. Median specific capacity is 0.12 (gal/min)/ft; the mean is 0.32 (gal/min)/ft. Figure 4 is a specific-capacity cumulative frequency graph for each of the three units. Depths of the wells range from 50 to 432 ft below land surface. Median depth is 157 ft.

Because most of the wells inventoried are domestic wells, the statistics may underestimate the actual potentials of the geohydrologic units. The comparisons do indicate relative differences in well yields. Variability within each group is somewhat large. Selection of a well site in any group should include study (especially in the field) of additional factors such as topography and surface expression of fracture zones, in order to maximize the probability of selecting the optimum site.

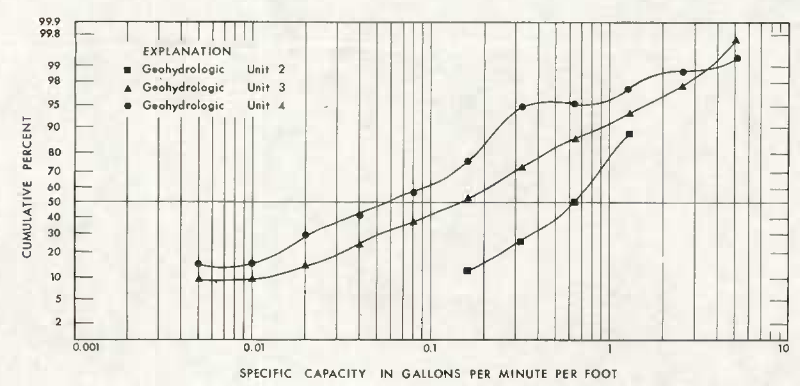


Figure 4. -- Cumulative frequencies of specific capacities of wells in the three Hydrogeologic Units.

○ Well with reported yield less than 2 gal/min.

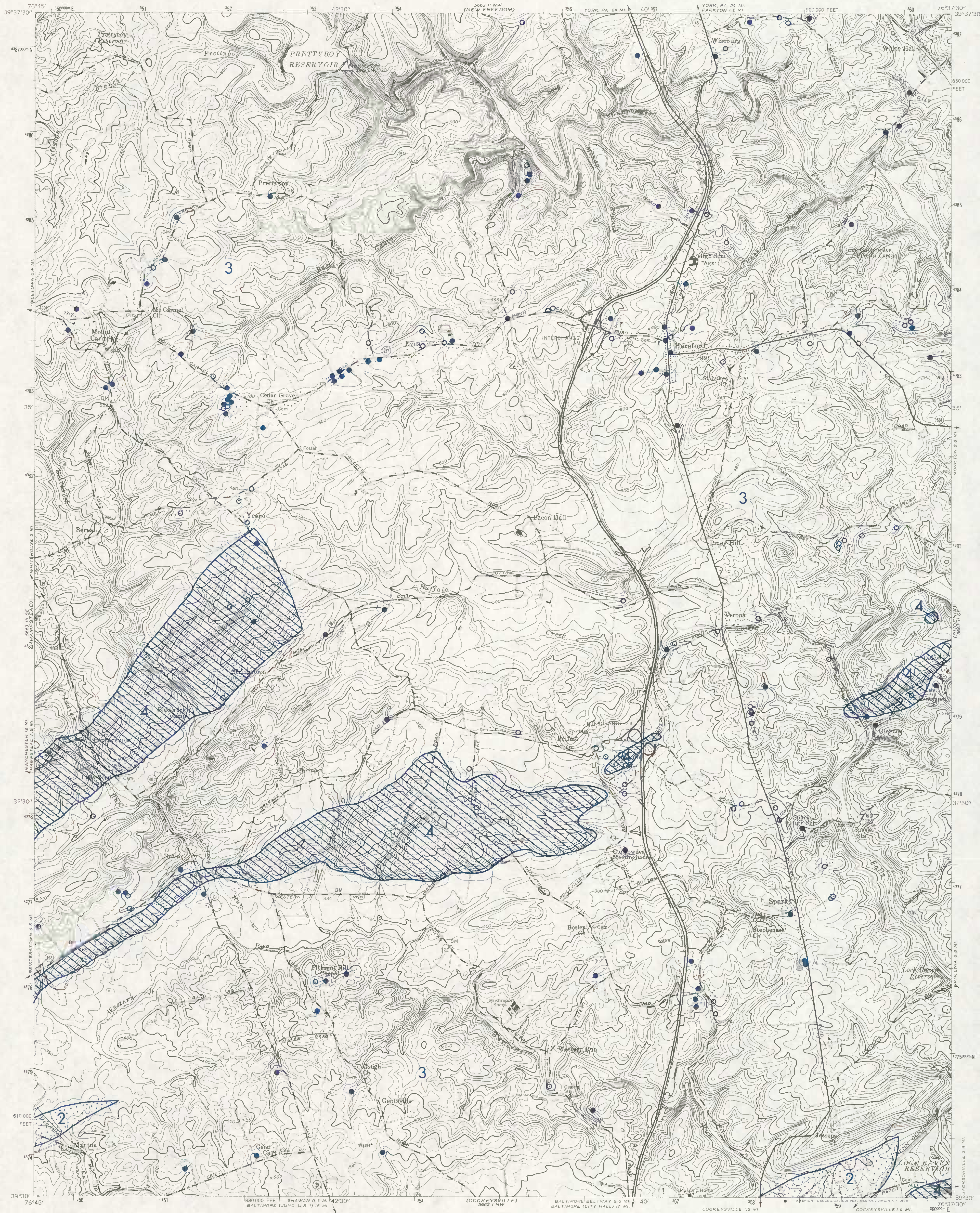
● Well with reported yield greater than 15 gal/min.

REFERENCES

Crowley, W. P., 1976, The geology of the crystalline rocks near Baltimore and its bearing on the evolution of the eastern Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 27, 40 p.

Rohlf, F. J., and Sokol, R. R., 1969, Statistical tables: San Francisco, W. H. Freeman, 253 p.

Sokol, R. R., and Rohlf, F. J., 1969, Biometry: San Francisco, W. H. Freeman, 776 p.



Topography from aerial photographs by photogrammetric methods 1944. Aerial photographs taken 1943. Culture revised by the Geological Survey 1958. Photorevised 1974.

Prepared in cooperation with the United States Geological Survey and the Baltimore County Department of Planning and Zoning

Maryland Geological Survey

MAP 5. GEOHYDROLOGIC CONSTRAINTS ON SEPTIC SYSTEMS

Quadrangle Atlas No. 18

GEOHYDROLOGIC CONSTRAINTS ON SEPTIC SYSTEMS

By Mark T. Duigon

INTRODUCTION

Where centralized sewage systems are not available, wastes from individual homes must be disposed of in comparatively small areas within the lot. These wastes are composed of many different substances, including urine, fecal matter, laundry detergents and cleaning compounds, and food scraps--all transported out of the house as a slurry by mixing with large quantities of water. These substances must be reduced in quantity or deactivated; otherwise, harmful conditions may become established in the environment and perhaps adversely affect the water-supply system.

The usual sewage disposal method is to pipe the slurry into a septic tank which separates the liquid from solids and greases, and partially decomposes some of the waste material. The effluent is then directed into a seepage pit or tile field for distribution into the soil. As the effluent percolates downward toward the water table, the soil filters and absorbs most deleterious substances.

Careful construction and maintenance of disposal systems are essential. Although it is recognized that these systems have a limited life span, failure is often accelerated by negligent construction and lack of periodic maintenance. Systems operating according to different principles may be more effective, but if not maintained properly, they may lose their effectiveness and fail more readily than conventional systems. (See, for example, Warshall, 1979, p. 24-25).

CONSTRAINT FACTORS

1. Flood hazard: Disposal systems do not drain properly when flooded and may be physically damaged. Contamination of surface water is possible when flood waters mix with effluent, and can spread to ground-water supplies.

2. Shallow water table: If effluent enters the ground-water system before it has passed through enough soil for adequate renovation, it is very likely to contaminate the system. Baltimore County requires a separation of 4 ft from the base of the seepage system to the water table.

3. Depth to bedrock: Fractures in bedrock act as ground-water conduits, and renovation of effluent is not effective. Therefore, a sufficient thickness of unconsolidated material between the base of the seepage system and the bedrock surface is required.

4. Slope: Steep slopes generally have a fairly thin soil cover and are likely to allow effluent to emerge at the surface. Baltimore County allows a maximum slope of 25 percent. Sternberg (written commun., 1974) concluded that, where the slope exceeds 20 percent, effluent will come to the surface downhill of a drain field regardless of soil type or depth of trenches. Slope categories for this map were obtained from Map 1.

5. Infiltration rate: This factor affects the design of the disposal system. If infiltration is too slow, drainage will be sluggish and effluent may back up through the plumbing system. If too fast, renovation will be inadequate. In Maryland, the infiltration rate is evaluated at the site by a percolation test [1/].

Most of these factors are individually evaluated and tabulated by the U.S. Department of Agriculture, Soil Conservation Service (Reybold and Matthews, 1976) for each of the mapping units of the county soil surveys. These evaluations, in addition to field observations by the author, other information in this atlas, and consideration of percolation tests by county officials, provide the basis for the categories shown on this map. This map cannot substitute for onsite evaluations, as discussed in the section, Limitations of Maps.

1/ The percolation test in Baltimore County consists of digging at least two holes to bedrock or as deep as the backhoe will dig (about 16 ft). This is to determine if the water table or bedrock surface is high. A lateral extension of the first hole is dug to an approximate depth of 5 ft (initially), and, at the bottom, a 1x1x1-ft hole is hand-dug. This small hole is filled with water to a level of 7 inches. The level is allowed to drop 1 inch and then is timed as it drops a second inch. The test is considered successful if the level takes from 2 to 30 minutes to drop the second inch. If the test fails, it is repeated at a greater depth or at another location. A proposed building lot must have a successful percolation test before a building permit will be issued, if sewage is to be disposed onsite. The testing health official also notes any other factors that may affect operation of the disposal system, such as impermeable layers.

MAP UNITS

UNIT I: Disposal facilities constructed in this unit face a high probability of failure. This unit generally occurs adjacent to streams and lakes, where the water table is shallow and flooding can be a hazard. Other constraining factors are land slopes exceeding 25 percent and the presence of soils of low permeability (less than 0.63 in./hr, equivalent to greater than 95 min/in.). This unit includes soils developed on alluvium and subject to flooding, such as the Codorus silt loam and Hatboro silt loam. It also includes steep Manor soils and thin, stony Mt. Airy soils.

UNIT II: Conditions in this unit are not as severe as in Unit I, but they may work in combination to adversely affect disposal systems. Because of its variability and marginality, onsite evaluation is of particular importance. Major soils in this unit are Manor and Glenelg soils having moderate (15 to 25 percent) slopes. Some soils that formed over carbonate rocks (Conestoga and Hagerstown soils) are included because of their areal variability. Also included are areas of scattered outcrops and stony soils and land which has been modified and, hence, is highly variable. Depths to water table and bedrock vary; for example, depth to bedrock beneath Conestoga soils is reported as 4 to 10 ft.

UNIT III: Conditions in this unit are generally most favorable for installation of disposal systems. Onsite inspection is still required to determine the characteristics of particular sites. The unit generally covers well-drained interfluvial areas dominated by Chester, Manor, and Glenelg soils having slopes less than 15 percent. Permeability varies (0.63 to 6.3 in./hr or 95 to 9.5 min/in.), but is generally adequate. The water table and bedrock are generally at depths greater than 10 ft from land surface.

SELECTED REFERENCES

Baker, F. G., 1978, A model for planning and location of on-site waste disposal systems: Water Resources Bulletin 14, no. 1, p. 144-156.

Bender, W. H., 1971, Soils and septic tanks: U.S. Department of Agriculture, Soil Conservation Service, Agriculture Information Bulletin 349, 12 p.

Bouma, Johann, 1971, Evaluation of the field percolation test and an alternative procedure to test soil potential for disposal of septic tank effluent: Soil Science Society of America Proceedings, v. 35, no. 6, p. 871-875.

Coulter, J. B., Bendixen, T. W., and Edwards, A. B., 1961, Study of seepage beds: Report to the Federal Housing Administration (revised): Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, 62 p.

Derr, B. D., Matelski, R. P., and Petersen, G. W., 1969, Soil factors influencing percolation test performance: Soil Science Society of America Proceedings, v. 33, p. 942-946.

Healy, K. A., and Laak, Rein, 1973, Factors affecting the percolation test: Journal Water Pollution Control Federation, v. 45, no. 7, p. 1508-1516.

______1974, Site evaluation and design of seepage fields: American Society of Civil Engineers, Journal Environmental Engineering Division, v. 100, no. EE5, Proceedings Paper 10882, p. 1133-1146.

Huddleston, J. H., and Olson, G. W., 1967, Soil survey interpretation for subsurface sewage disposal: Soil Science, v. 104, no. 6, p. 401-409.

Johnson, D. E., 1978, Selecting sewerage systems to fit site conditions and budget: Civil Engineering, v. 48, no. 9, p. 90-93.

McGauhey, P. H., and Winneberger, J. H., 1964, Studies of the failure of septic tank percolation systems: Journal Water Pollution Control Federation, v. 36, no. 5, p. 593-606.

Miller, J. C., 1972, Nitrate contamination of the water-table aquifer in Delaware: Delaware Geological Survey Report of Investigations No. 20, 36 p.

Morris, J. G., Newberry, R. L., and Bartelli, L. J., 1962, For septic tank design, soil maps can substitute for percolation tests: Public Works Journal, v. 93, no. 2, p. 106-107.

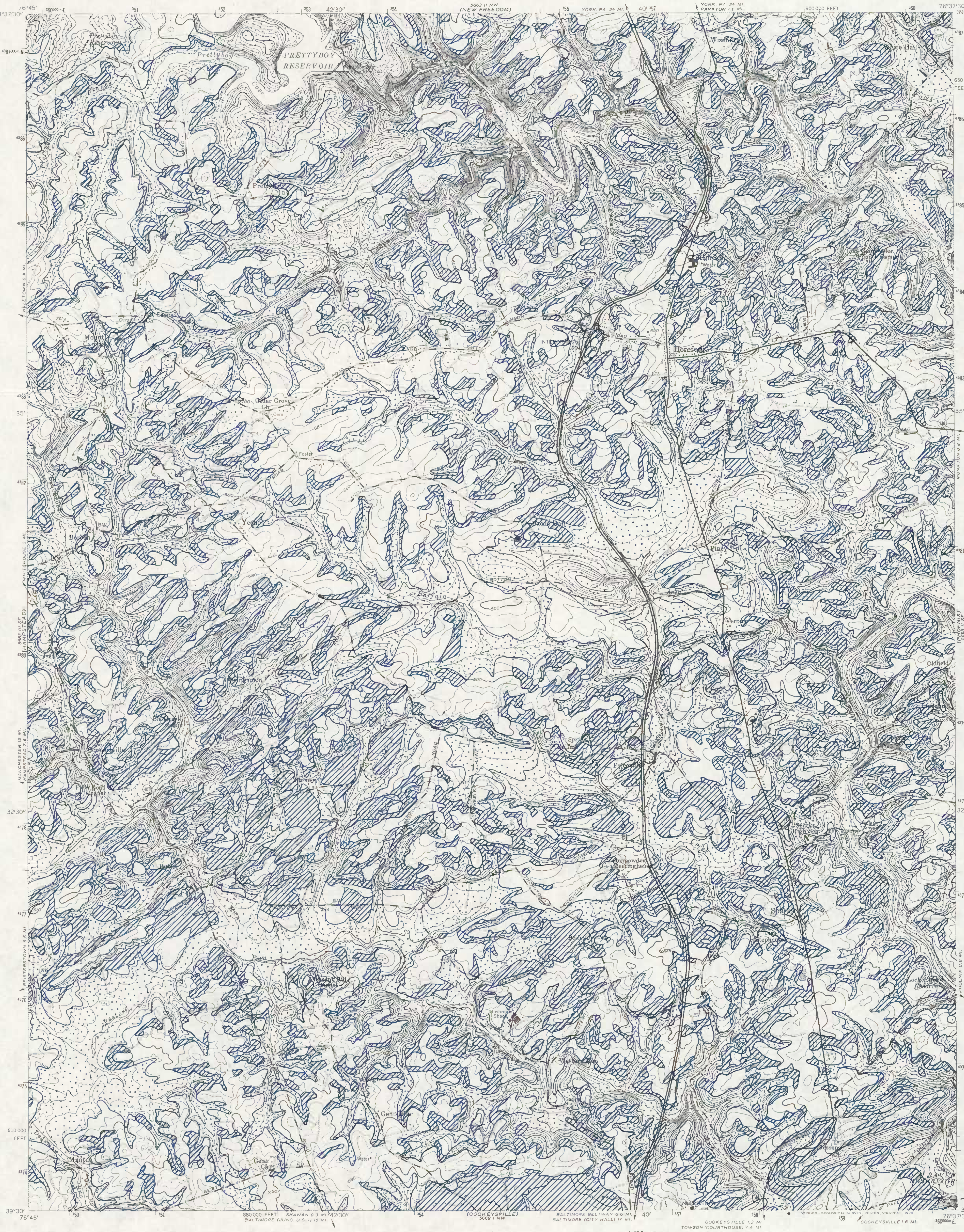
Reybold, W. U., III, and Matthews, E. D., 1976, Soil survey of Baltimore County, Maryland: U.S. Department of Agriculture, Soil Conservation Service, 149 p.

U.S. Department of Health, Education, and Welfare, Public Health Service, 1967, Manual of septic-tank practice (revised): Publication No. 526, 92 p.

Viraghaven, T., and Warnock, R. G., 1976, Ground-water quality adjacent to a septic tank system: American Water Works Association Journal, v. 68, no. 11, p. 611-614.

Warshall, Peter, 1979, Septic tank practices: Garden City, New York, Anchor Press/Doubleday, 167 p.

Wright, F. B., 1977, Rural water supply and sanitation (3rd ed.): Huntington, N.Y., Robert E. Krieger Publishing Company, 305 p.



Topography from aerial photograghs by photogrammetric methods 1944. Aerial photographs taken 1943. Culture revised by the Geological Survey 1958. Photorevised 1974.

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Prepared in cooperation with the United States Geological Survey and the Baltimore County Department of Planning and Zoning

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

QUADRANGLE ATLAS No. 18

HEREFORD QUADRANGLE: HYDROGEOLOGY

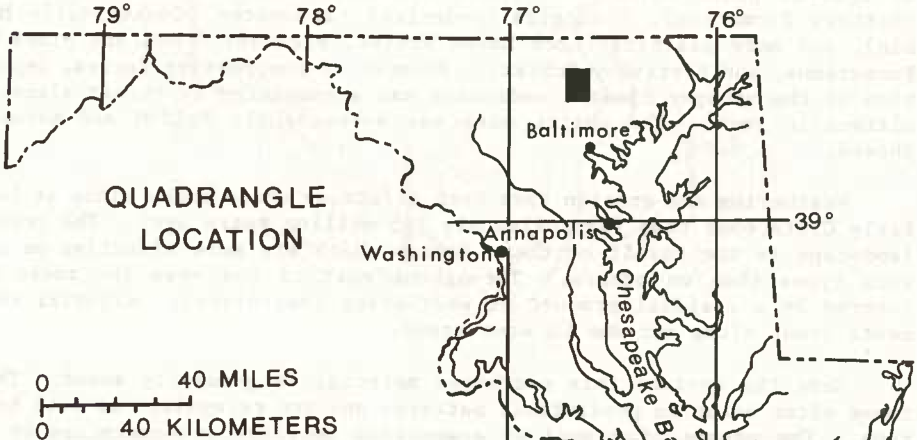
By Mark T. Duigon and John T. Hilleary

INTRODUCTION

This atlas describes the hydrogeology of the Hereford 7 ½-minute quadrangle in north-central Baltimore County, Maryland (fig. 1). The information contained herein is intended for use by planners, health officials, developers, environmental consultants, and anyone else concerned with baseline hydrogeologic data pertaining to development.

The Hereford quadrangle lies within the eastern division of the Piedmont physiographic province. The land surface is mostly undulating. Some stream valleys are deeply dissected, and are controlled by major joint trends. Other valleys underlain by relatively soluble carbonate rock are broad.

The climate of this area is humid temperate, with an average annual temperature of 53°F and an average annual precipitation of 44 in. (Vokes and Edwards, 1974).



Tributaries of Gunpowder Falls drain the entire area. Portions of two reservoirs are within the mapped area--Prettyboy Reservoir in the northwest, and Loch Raven Reservoir in the southeast. Both are formed by dams on Gunpowder Falls. Prettyboy Reservoir controls flow to Loch Raven Reservoir which contributes to the Baltimore Metropolitan Water Supply.

A permanent gaging station located at Western Run Road monitors discharge from Western Run which drains into Loch Raven Reservoir. Low flows were estimated for Blackrock Run (near Coopersville) based on correlation of measured discharges with the continuous record of Western Run (Walker, 1971).

York Road (Md. Rte. 45), paralleled by Interstate 83, runs north-south through the quadrangle area. These roads have encouraged residential development to meet the needs of workers in the Baltimore area, but agriculture remains important in the area. Corn is the chief crop; livestock consists mainly of dairy cattle and horses. Some commercial and light industrial development has occurred primarily along York Road.

GEOLOGY AND SOILS

The stratigraphic nomenclature used in this report is that proposed by Crowley (1976) and does not necessarily follow the usage of the USGS. The nomenclature differs primarily in the subdivision of formations.

The Baltimore Gneiss, the oldest rock in the Hereford quadrangle, is considered to be a mass of volcaniclastic rocks that was deposited and metamorphosed in Precambrian time. In this area it consists of dark and light layers of biotite-microcline-quartz-plagioclase gneiss. This unit forms a basement upon which marine sediments were deposited during periods of crustal plate movement. These sediments were composed of clastics (Setters Formation), biologically-derived carbonates (Cockeysville Marble), and more clastics (Loch Raven Schist, Pleasant Grove and Piney Run Formations, and Prettyboy Schist). Because of compressive forces, deposition of the younger clastic sediments was accompanied by thrust slices of ultramafic rock. The entire mass was subsequently folded and metamorphosed.

Weathering and erosion have been affecting these rocks since at least Early Cretaceous time (approximately 135 million years ago). The present landscape is the result of these forces which are more effective on some rock types than on others. Throughout most of the area the rocks are covered by a residual product of weathering (saprolite). Alluvial sediments occur along streams in some areas.

Near the surface this weathered material is generally zoned. These zones often occur in predictable patterns and are recognized as soil horizons. The nature of a soil at a specific locality is determined by the combined effects of various "factors of soil formation" (Jenny, 1941):

$$s = f\ (cl, o, r, p, t, \ldots)$$

This equation states that the characteristics of a given soil (s) are a function of climate (cl), biological activity (o), topography (r), parent material (p), time since the process began (t), and other factors. In the Hereford area, parent material and topography are the most variable factors and have resulted in the formation of quite different soils.

The predominant soil series are the Manor and the Glenelg Series. These soils, along with Chester, Elioak, and Mt. Airy soils, are found on ridgetops and upper slopes and are underlain by schist, quartzite, and gneiss. In the marble valleys, Baltimore, Conestoga, and Hagerstown soils dominate. Throughout the area, Codorus, Hatboro, and Melvin soils occupy floodplains, whereas Glenville and Baile soils occupy draws and heads of drainageways. Other soil series occur to a lesser extent. Differences in properties among these soils affect their suitability for different land uses. The Baltimore County Soil Survey (Reybold and Matthews, 1976) provides greater detail on the distribution and properties of these soils.

HYDROLOGY

Ground water in the Piedmont province occurs chiefly in fractures and joints in the crystalline metamorphic rocks and in the pore spaces of the overlying unconsolidated material (fig. 2). Intersecting fractures allow greater areal movement of ground water. Fractures tend to become fewer in number and the voids formed by the fractures tend to become narrower with increased depth (LeGrand, 1954); consequently, the amount of water and the rate at which it can flow decrease with increased depth.

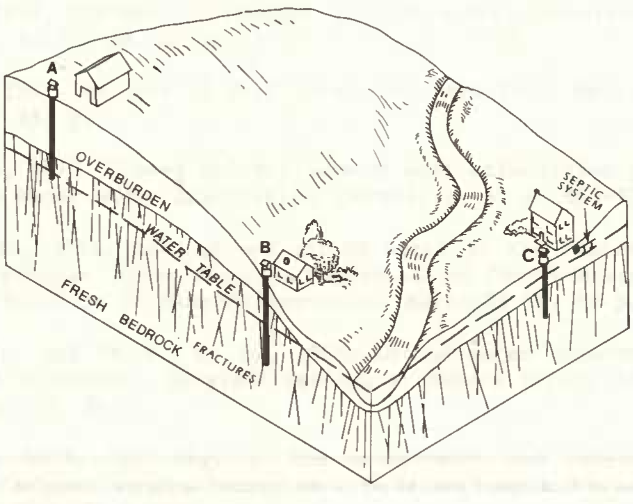


Figure 2. -- Wells in the Maryland Piedmont. Well A may go dry during a drought as the water table is lowered. Well B intersects more interconnecting fractures and is assured a good supply , even if the water table is lowered. Well C yields a sufficient amount of water but is subject to contamination from the septic system located up-gradient.

The water pumped from a well comes from storage in the fractures and in the pore spaces of the overlying material. The amount of water a well can discharge is governed by the number and interconnection of water-bearing fractures that the well intersects, the openness of the fractures, and the amount of water available from storage. Some wells are supplied by fractures that intersect sources of recharge such as nearby streams, and can supply greater amounts of water.

To obtain a successful well, the bore must intersect suitable water-bearing fractures, and selection of a well site should maximize the probability of drilling through fractures. Some rocks tend to fracture more readily than others; some rocks tend to weather more readily, thereby enlarging fracture voids. In the Hereford area some rock units tend to yield greater amounts of water, but the variability within the rock type is great. An analysis of topography can increase the chances of obtaining a successful well. Wells located in valleys and draws tend to have greater yields than wells located on hill summits. Another related method of selecting the optimum site for a well is analysis of linear features. In some cases these features, called lineaments, are related to zones of more intense fracturing. They can be indicated on topographic maps and aerial photographs, but should be verified in the field. They are identified by linear segments of stream channels, linear soil or vegetational tonal patterns, and alinement of some geologic features. Although fractures can occur anywhere, the chances of drilling a well that will intersect at least one, and perhaps several, are increased if selection is made of a site that is suspected of being in a zone of greater fracture density.

The generalized pattern of water circulation is known as the hydrologic cycle (fig. 3). The hydrologic cycle is the network of circulation and storage that water may follow as it is recycled through the earth and atmosphere. Net gains and losses to the system are negligible, although water may be temporarily detained in a storage component such as a reservoir or in the ground. The hydrologic cycle in a particular region can be quantitatively evaluated by use of the hydrologic budget:

$$P = R + ET + \Delta S$$

where

P = precipitation,

R = runoff,

ET = evapotranspiration, and

ΔS = change in storage.

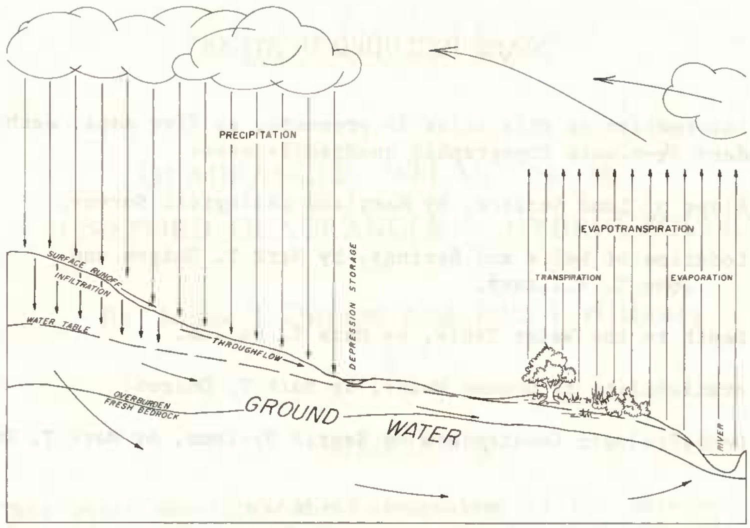


Figure 3. -- The hydrologic cycle.

Precipitation is the source of water in the Piedmont. Some of this water falls directly into streams, flows over the land surface and into streams, or enters the ground but exits into streams after only a short time in the ground. Other portions of precipitation are returned to the atmosphere as water vapor (evapotranspiration). If these outputs are not balanced by the precipitation, there will be a change (positive or negative) in the amount of water stored in the aquifers.

Water quality is affected by the substances with which the water comes into contact. Ground water usually dissolves some of the minerals present in the rock or soil through which it passes. The intended use determines the suitability of water from a particular source: Water that is fit to drink may not be suitable for cerain industrial or commercial applications, such as in steam boilers. Water supplied to homes by individual wells in the Hereford area generally requires no treatment, although in some cases, particularly where the water is from the Cockeysville Marble, a softener may be desired to alleviate hardness. In some areas underlain by schist or phyllite, the water is slightly acidic and may accelerate corrosion of plumbing. Contaminated water discharged by septic-tank disposal systems is generally renovated by passing through a sufficient thickness of overburden. Rock fracture systems have little renovation capacity. Wells must be properly sealed and located a sufficient distance from waste disposal systems to prevent contaminated water from passing unrenovated into the fracture system supplying water to the well.

MAPS INCLUDED IN ATLAS

The information in this atlas is presented as five maps, each prepared on a standard 7½-minute topographic quadrangle base:

1. Slope of Land Surface, by Maryland Geological Survey.

2. Location of Wells and Springs, by Mark T. Duigon and John T. Hilleary.

3. Depth to the Water Table, by Mark T. Duigon.

4. Availability of Ground Water, by Mark T. Duigon.

5. Geohydrologic Constraints on Septic Systems, by Mark T. Duigon.

LIMITATIONS OF MAPS

These maps are designed for broad planning purposes and are not intended to substitute for detailed on-site investigations where required. Boundaries may not be exact because of map scale, data quality and distribution, and judgment required for interpolation.

CONVERSION OF MEASUREMENT UNITS

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

Inch-pound Unit	Symbol	Multiply by	For Metric Unit	Symbol
inch	(in.)	25.40	millimeter	(mm)
foot	(ft)	0.3048	meter	(m)
mile	(mi)	1.609	kilometer	(km)
gallon	(gal)	3.785	liter	(L)
gallon per minute	(gal/min)	0.0631	liter per second	(L/s)
gallon per day	(gal/d)	0.0438	cubic meter per second	(m^3/s)
gallon per minute per foot	[(gal/min)/ft]	0.2070	liter per second per meter	[(L/s)/m]

SELECTED REFERENCES

Baltimore County Office of Planning and Zoning, 1970, Western Run Watershed, plan for 2020: Baltimore County Technical Report, 40 p.

Crowley, W. P., 1976, The geology of the crystalline rocks near Baltimore and its bearing on the evolution of the eastern Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 27, 40 p.

Davis, S. N., and Turk, L. J., 1964, Optimum depth of wells in crystalline rocks: Ground Water, v. 2, no. 2, p. 6-11.

Dingman, R. J., Ferguson, H. F., and Martin, R. O. R., 1956, The water resources of Baltimore and Harford Counties: Maryland Department of Geology, Mines and Water Resources [1/] Bulletin 17, 233 p.

Ellis, E. E., 1906, Occurrence of water in crystalline rocks: U.S. Geological Survey Water-Supply Paper 160, p. 19-28.

Hem, J. D., 1970, Study and interpretation of the chemical characteristics of natural water (2nd ed.): U.S. Geological Survey Water-Supply Paper 1473, 269 p.

Higgins, M. W., 1972, Age, origin, regional relations, and nomenclature of the Glenarm Series, central Appalachian Piedmont: A reinterpretation: Geological Society of America, Bulletin, v. 83, p. 989-1026.

Higgins, M. W., and Fisher, G. W., 1971, Further revision of the stratigraphic nomenclature of the Wissahickon Formation in Maryland: Geological Survey of America, Bulletin, v. 82, p. 769-774.

Hunt, Joel, 1978, How much is enough? A minimum well formula: Water Well Journal, v. 32, no. 2, p. 53-55.

Jenny, Hans, 1941, Factors of soil formation: New York, McGraw-Hill Book Company, 281 p.

Koenig, Louis, 1960, Survey and analysis of well stimulation performance: American Water Works Association Journal, v. 52 p. 333-350.

LeGrand, H. E., 1954, Geology and ground water in the Statesville area, North Carolina: North Carolina Department of Conservation and Development, Division of Mineral Resources, Bulletin 68, 68 p.

Nutter, L. J., and Otton, E. G., 1969, Ground-water occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 10, 56 p.

Poth, C. W., 1968, Hydrology of the metamorphic and igneous rocks of central Chester County, Pennsylvania: Pennsylvania Geological Survey Bulletin W25, 69 p.

Reybold, W. U., III, and Matthews, E. D., 1976, Soil Survey of Baltimore County, Maryland: U.S. Department of Agriculture, Soil Conservation Service, 149 p.

Southwick, D. L., and Fisher, G. W., 1967, Revision of stratigraphic nomenclature of the Glenarm Series in Maryland: Maryland Geological Survey Report of Investigations No. 6, 19 p.

Stewart, G. W., 1974, Hydraulic fracturing of drilled water wells in crystalline rocks of New Hampshire: New Hampshire Department of Resources and Economic Development, 161 p.

Summers, W. K., 1972, Specific capacities of wells in crystalline rocks: Ground Water, v. 10, no. 6, p. 37-47.

Wright, F. B., 1977, Rural water supply and sanitation (3rd ed.): Huntington, N.Y., Robert E. Krieger Publishing Company, 305 p.

Vokes, H. E., and Edwards, Jonathan, Jr., 1974, Geography and geology of Maryland (revised): Maryland Geological Survey Bulletin 19, 242 p.

Walker, P. N., 1971, Flow characteristics of Maryland streams: Maryland Geological Survey Report of Investigations No. 16, 160 p.

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