Department of Natural Resources

MARYLAND GEOLOGICAL SURVEY

Kenneth N. Weaver, Director

QUADRANGLE ATLAS NO. 13

LINEBORO QUADRANGLE: HYDROGEOLOGY

By

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and John T. Hilleary

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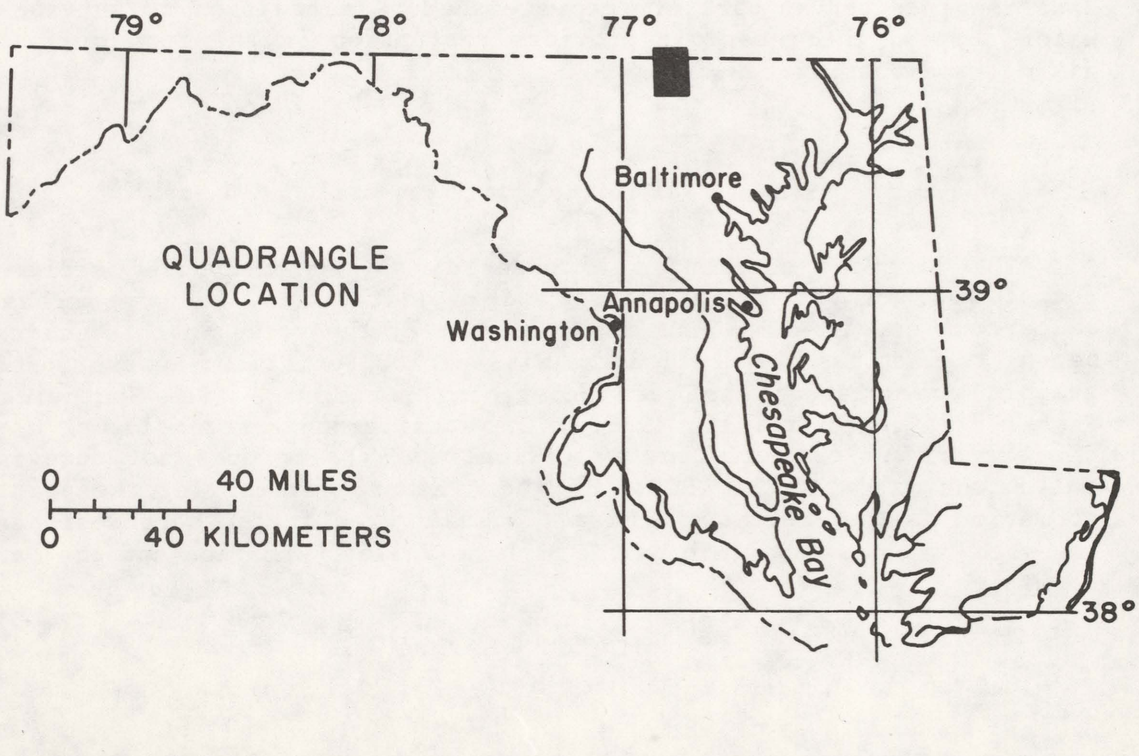
INTRODUCTION

This atlas describes the hydrogeology of the Lineboro 7 1/2-minute quadrangle in northwest Baltimore County and northeast Carroll County, Maryland. The northern quarter of the quadrangle extends into York County, Pennsylvania. The York County portion has not been included in this study.

The information contained herein is intended for use by planners, health officials, developers, environmental consultants, and the public, who are concerned with the interaction between ground water and development and land use.



The climate of this area is temperate, with an average annual temperature of 52°F, and an average annual precipitation of 44 inches (Vokes and Edwards, 1974, p. 20, 28).

The Lineboro quadrangle lies within the eastern division of the Piedmont physiographic province. The area exhibits the rolling topography typical of that province. Along major streams, and part way up their tributaries, many valleys are steep-sided. Except for a small area southwest of Maryland Highway 30, drainage is to Gunpowder Falls. Geologic structure (joint systems) controls the drainage pattern to an extent. Magnitudes and frequencies of stream discharges are described by Walker (1971), using U.S. Geological Survey stream-gage data. There are no stream gages in the Lineboro quadrangle; however, Walker presents a method for estimating stream characteristics at ungaged locations based on basin characteristics whose relations to discharge have been determined at sites where long-term records exist. The nearest U.S. Geological Survey stream gage is located one-half mile south on Georges Run at Armacost, in the adjacent Hampstead quadrangle.

Land in the area is used largely for agriculture and woodland; major crops are corn and wheat. In recent years, several housing developments have been built to accommodate the expanding population, which includes migration from urban areas.

The availability of waterpower and clean water from Gunpowder Falls led to the establishment of some of Maryland's first papermills by William Hoffman (Seitz, 1946). In 1893, after 117 years of operation, the papermills closed. Several years later the property was turned over to Baltimore City for the creation of a water-supply reservoir. Prettyboy Dam was completed in 1933 and was named for a tributary of the Gunpowder Falls near the dam site. The Prettyboy Branch received its name from a horse that drowned in the stream (Seitz, 1946, p. 53). The height of the dam crest above the streambed is 130 feet. The reservoir floods 1,500 acres at crest elevation and has a capacity of about 20 billion gallons. Baltimore City owns approximately 7,380 acres of land adjoining the reservoir, and this land is protected as part of the watershed. In addition to serving as a water supply, the reservoir provides recreation in the form of fishing, hiking, and boating.

GEOLOGY

The Lineboro quadrangle is underlain by metamorphosed sedimentary rocks, most of which are schist and phyllite, and, in some areas are calcareous or, locally, pure marble. Most of the rocks in this quadrangle belong to what has been called the Wissahickon Formation; however, stratigraphic nomenclature has been undergoing revision. (See Southwick and Fisher, 1967; and Crowley, 1976.) The stratigraphic nomenclature used in this report is that of Crowley (1976a, 1976b) and does not necessarily follow the usage of the USGS. In the Lineboro quadrangle, the principal formation is the Prettyboy Schist. A small area in the northwest part of the study area is underlain by the Bachman Valley Formation and the Marburg Formation.

Mantling these crystalline rocks is a variable thickness of overburden consisting of weathered rock (saprolite) and alluvium deposited by streams along their flood plains. The nature and thickness of the overburden depend upon such factors as the type of rock from which it was derived and its topographic position. In some places rock that is only slightly weathered is exposed, while in other areas saprolite thickness exceeds 100 feet. Overburden is generally thinner beneath steeper slopes, due to erosion. Because well drillers usually set casing 1 or 2 feet into fresh rock, depth of casing is usually a good indication of overburden thickness (Nutter and Otton, 1969, p. 15).

A variety of soils has developed in response to factors such as climate, biota, topography, parent material, and time. The various soil types have been mapped and studied by the U.S. Department of Agriculture, Soil Conservation Service (Matthews, 1969, Reybold and Matthews, 1976).

HYDROLOGY

In the Piedmont province, ground water occurs chiefly in fractures in crystalline metamorphic rocks. Water moves along these fractures; intersecting fractures provide a larger network for ground-water movement. Fractures tend to become tighter with increased depth (LeGrand, 1954), thereby decreasing the rate at which water can flow. Also, the number of fractures encountered decreases with increased depth. This decrease in fracture frequency and openness usually limits the depth to which water wells can be drilled economically. Davis and Turk (1964) present a method for determining the optimum depths of wells, considering both hydrologic and economic factors.

Most of the ground water is stored in the pore spaces of unconsolidated material that overlies the fractured rock. This overburden is considered too unsatisfactory to be developed as a water supply because of its commonly low permeability and the susceptibility of contamination to wells drilled in this material. Overburden serves as a storage reservoir for the underlying rock aquifer; however, the rate at which water can be pumped from a well depends on the hydrologic properties of the rock itself.

The overburden provides renovation for downward-percolating water. The rock fractures have little renovation capacity. If contaminated water infiltrates the fractures, it can travel significant distances without adequate purification.

The primary criterion for choosing successful well locations is topography. Wells in valleys and draws tend to have greater yields, whereas those on hilltops are generally deeper and less productive. This may be caused by the decrease in number of fractures with depth; the water table is closer to the land surface in valleys and draws and therefore more intersecting fractures are filled with water; however, under hilltops, only the deeper, more widely separated fractures contain water. Another factor is the tendency of stream valleys to follow zones of rock weakness, which may in some cases correspond to zones of multiple fractures. And finally, topography can help concentrate recharge.

Rock type may have an effect on well yields. The strength and mineralogy of a rock unit affect the rock's permeability by influencing the way in which fracturing develops and weathering occurs.

An analysis of linear features aids in selecting optimum well sites. In some places, these features, called lineaments, are related to zones of more intense fracturing. These features are identified by linear segments of stream channels, linear soil or vegetation tonal patterns, and alinement of some geologic features. They can be seen on topographic maps and aerial photographs, but need to be field-checked for verification. Although fractures can occur anywhere, the probability of drilling a well that will intersect at least one water-bearing fracture is increased by choosing a site that is suspected of being in a zone of greater fracture density.

MAPS INCLUDED IN THIS ATLAS

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

1. Slope of the Land Surface, by Photo Science, Inc.

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

3. Depth to the Water Table, by Mark T. Duigon and Edmond G. Otton.

4. Availability of Ground Water, by Edmond G. Otton and 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 meant to substitute for detailed onsite investigations where required. The boundaries may not be exact because of the scale of the maps, data quality, geographical distribution, and judgment required for interpolation and extrapolation.

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.)	25.4	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]

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