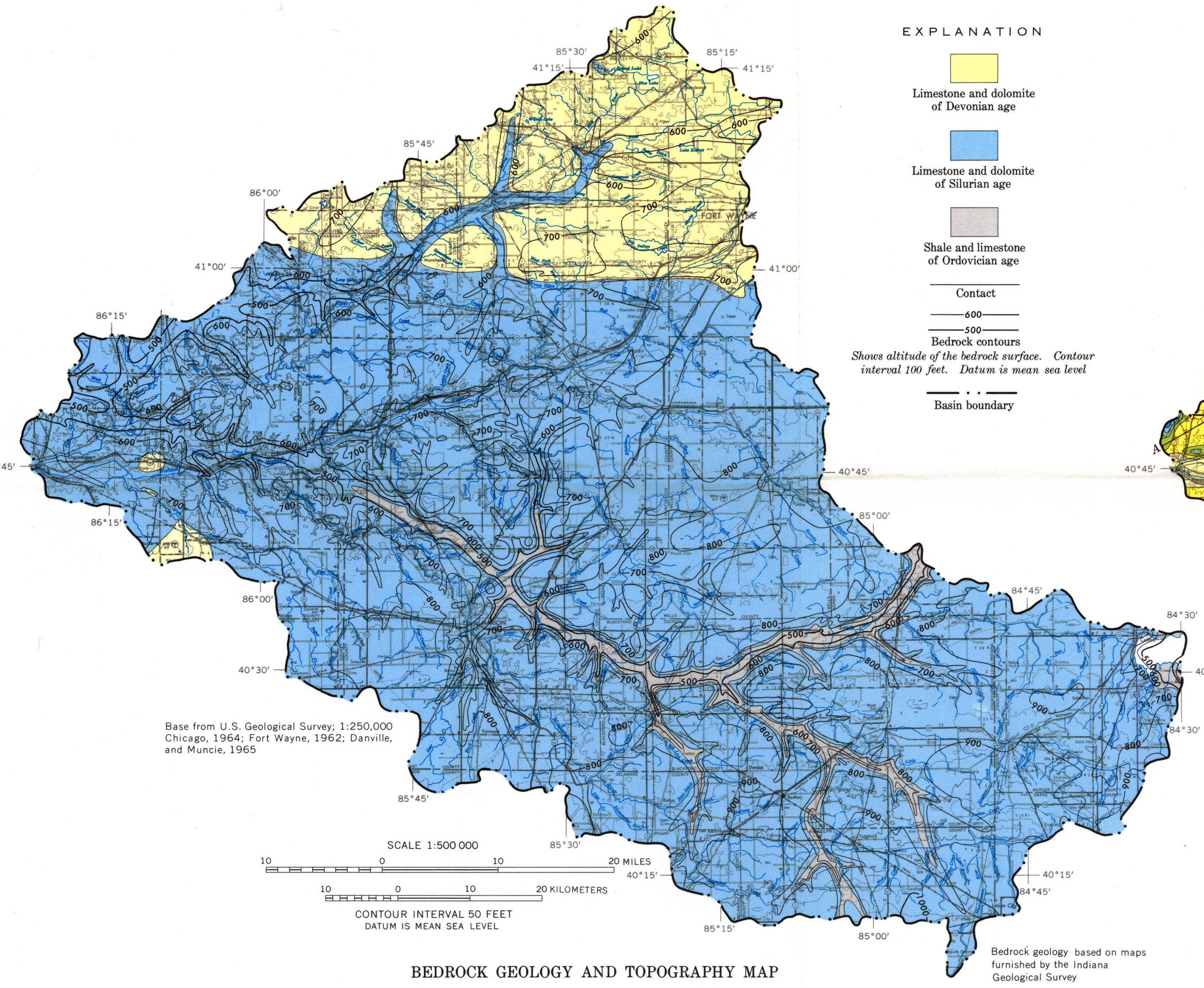
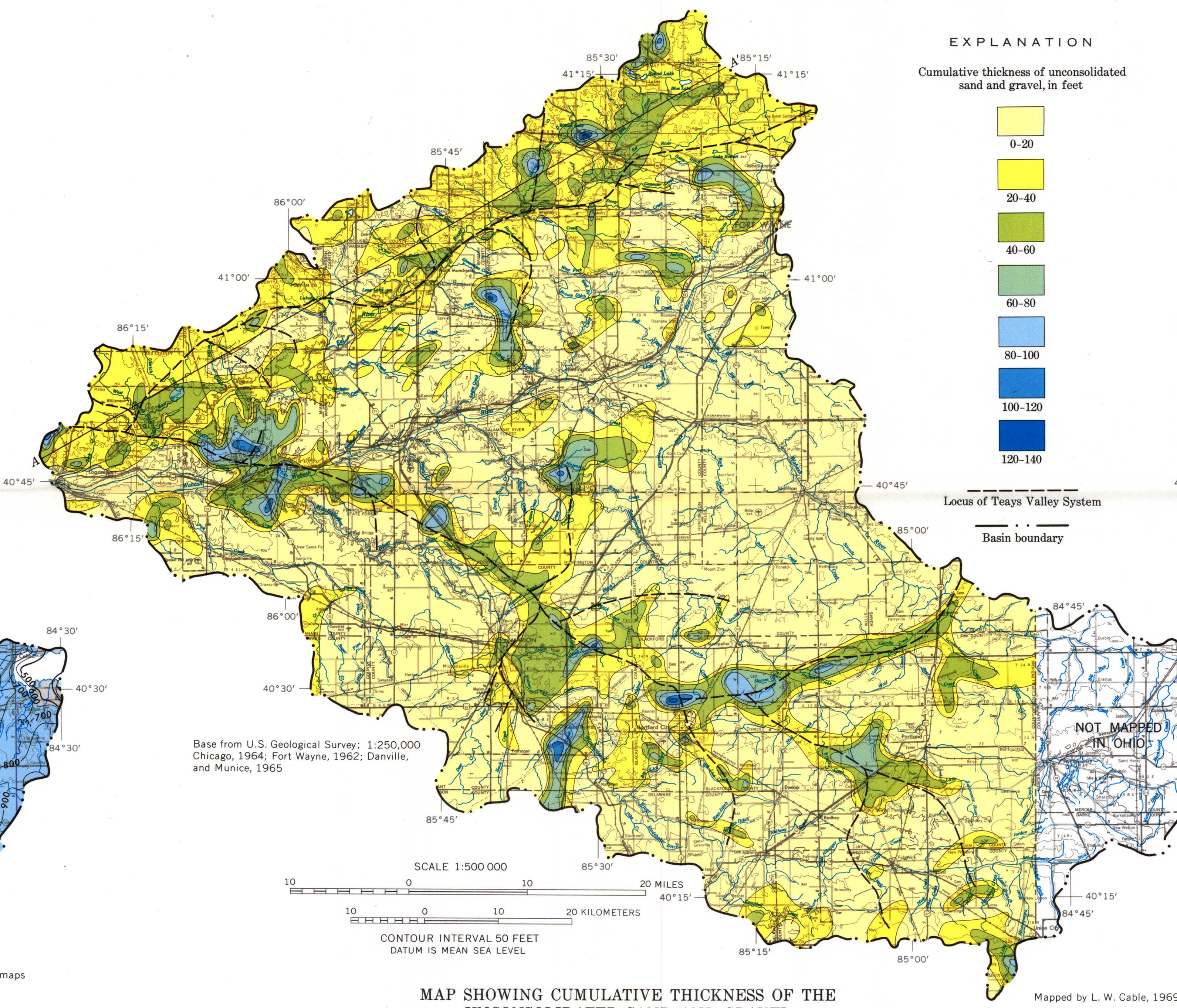
PREPARED IN COOPERATION WITH THE
INDIANA DEPARTMENT OF NATURAL RESOURCES



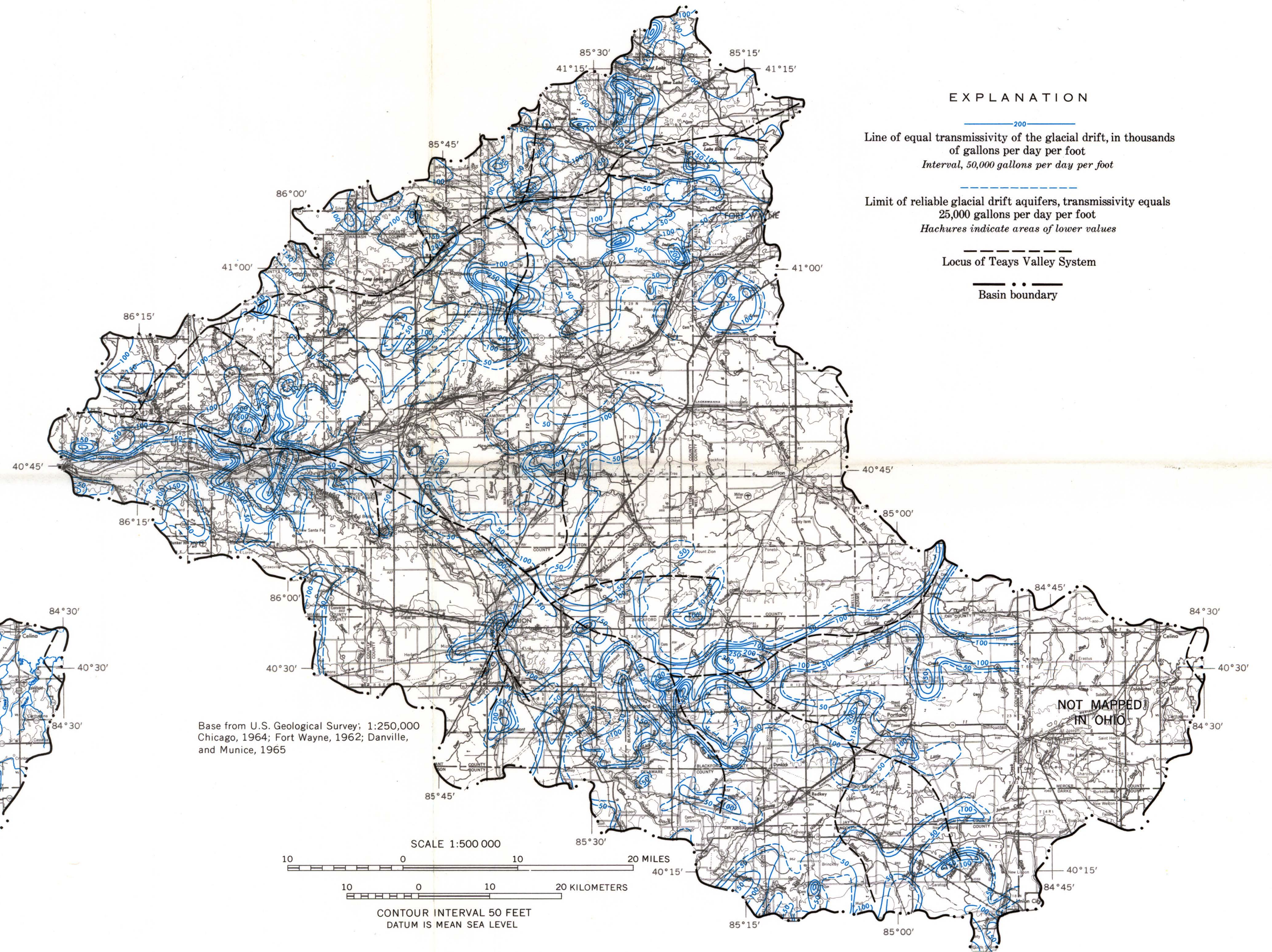
# GROUND WATER




BEDROCK GEOLOGY AND TOPOGRAPHY MAP




MAP SHOWING CUMULATIVE THICKNESS OF THE UNCONSOLIDATED SAND AND GRAVEL

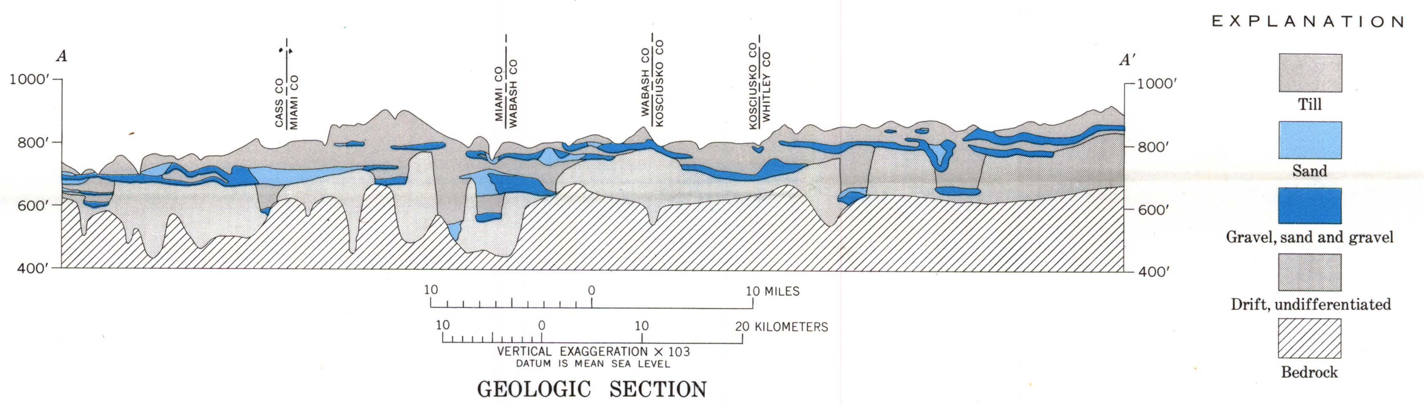



MAP SHOWING ESTIMATED TRANSMISSIVITY OF THE UNCONSOLIDATED AQUIFER SYSTEM

## BEDROCK GEOLOGY AND TOPOGRAPHY

The bedrock surface is the lower geologic boundary of the unconsolidated ground-water reservoir. Beneath the bedrock surface lies the consolidated rocks containing water that is hydraulically connected to that in the overlying Quaternary deposits. The number and degree of interconnection of the water-bearing openings in the bedrock aquifers differ widely, resulting in variations of transmissivity.

The bedrock underlying the basin is of Ordovician, Silurian, and Devonian age (see bedrock geologic map). The rock of Ordovician age that is at the bedrock surface in the preglacial valleys is mostly shale, and generally will yield very little water to wells. Limestone and dolomite of Silurian and Devonian age comprise the bedrock surface throughout most of the basin. These rocks contain solution channels that yield as much as 400 gpm (gallons per minute) to wells. The regional transmissivity of these rock aquifers is estimated to be about 9,000 gpd per foot (Watkins and Rosenshein, 1963).




GEOLOGIC SECTION

## UNCONSOLIDATED AQUIFER SYSTEM

The unconsolidated deposits of sand and gravel range in cumulative thickness from less than 20 feet to slightly more than 140 feet (see cumulative thickness map). Data used in determining thickness of sand and gravel units were obtained from well drillers' records.

The data available were not adequate for mapping individual aquifers in the subsurface, therefore, the more generalized approach of mapping cumulative aquifer thickness was taken. For those areas of the basin that have no logged wells to bedrock, an estimate was made of the amount of aquifer material in the unlogged vertical section based on the logged part. The geologic section illustrates a generalized interpretation of the arrangement and distribution patterns of these sand and gravel units.

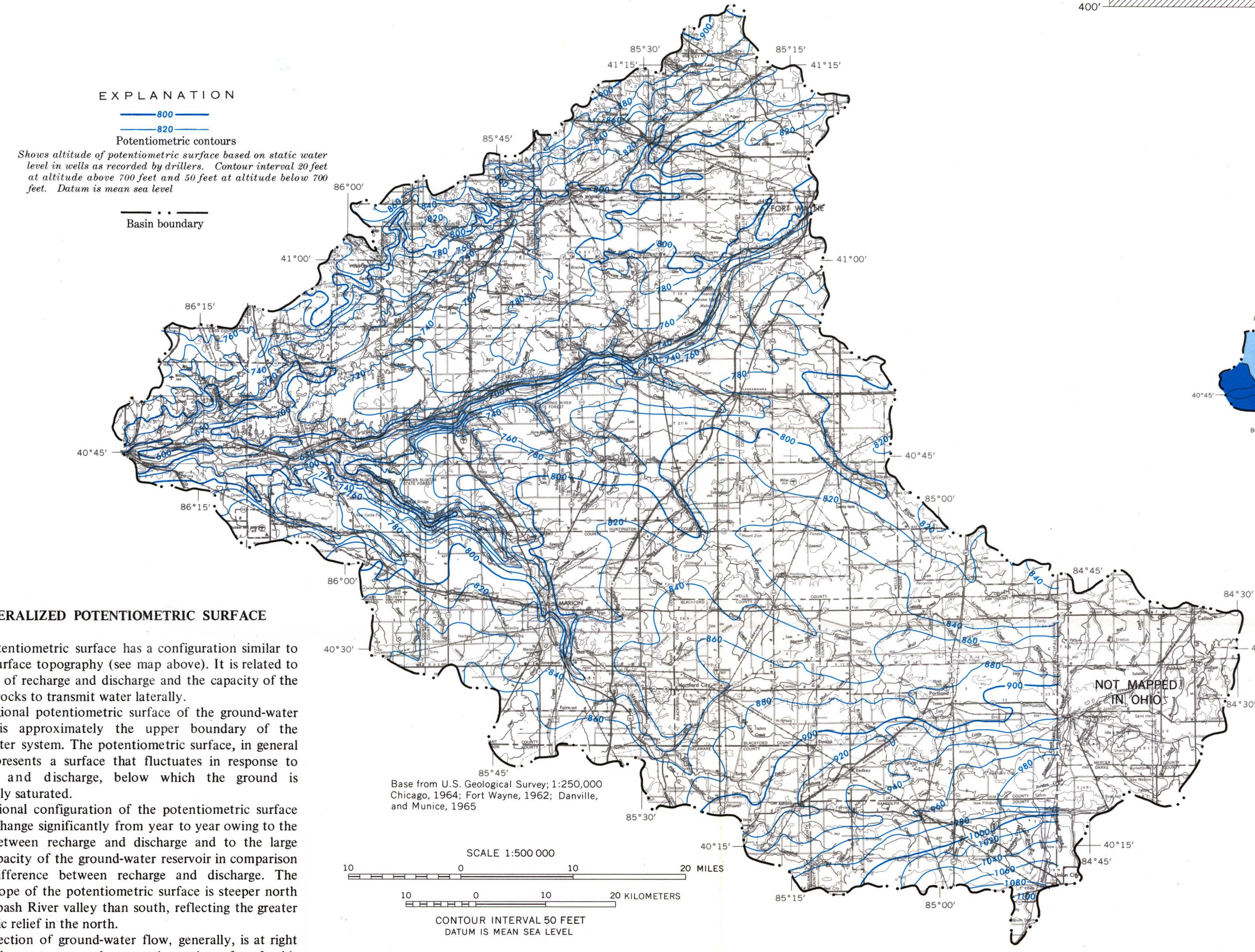
The estimated transmissivity of the cumulative sand, and sand and gravel units in the unconsolidated aquifer system ranges from less than 25,000 to slightly in excess of 350,000 gpd per foot (see transmissivity map). (Transmissivity is equal to the product of the hydraulic conductivity and aquifer thickness.) Hydraulic conductivity values were assigned only to lithologic types considered permeable enough to have aquifer potential and were based on particle size. Both transmissivity, which is a measure of the ability of the ground-water reservoir to transmit water, and potentiometric gradient are used in determining the amount of water moving through the ground-water system. The data presented here are intended for planning purposes only; additional data are necessary for the estimation of yields at specific sites.

The unconsolidated deposits in the basin may be subdivided on the basis of ground-water availability. About 50 percent of the basin is characterized by a relatively thin drift cover on bedrock with no significant unconsolidated aquifers (transmissivity values are less than 25,000 gallons per day per foot). This is probably the least desirable area in which to attempt to develop high-yield wells. Wells in this area are usually finished in limestone or dolomite rock.

About 35 percent of the basin is characterized by drift containing sand and gravel aquifers which tend to be thin, discontinuous, and generally of limited area extent (transmissivity values range from 25,000 gpd per foot to 100,000 gpd per foot). In order to get high yields in this area the wells would probably have to be opened to bedrock as well as to the available sand and gravel aquifers.

The remaining 15 percent of the basin is characterized by drift containing thick and extensive sand and gravel aquifers (transmissivity values range from 100,000 gpd per foot to slightly in excess of 350,000 gpd per foot). Thickness and transmissivity of the unconsolidated aquifer represents composite values. Therefore, for maximum yield the wells in this area should be constructed with several screens separated by casing to coincide with the aquifer and non-aquifer material.

The latter area generally includes the Teays Valley which was the principal drainage system in this region prior to glaciation. The Teays Valley is filled with predominantly silts, sands, and gravels, and is potentially one of the principal sources for large development of ground water.




POTENTIOMETRIC SURFACE MAP

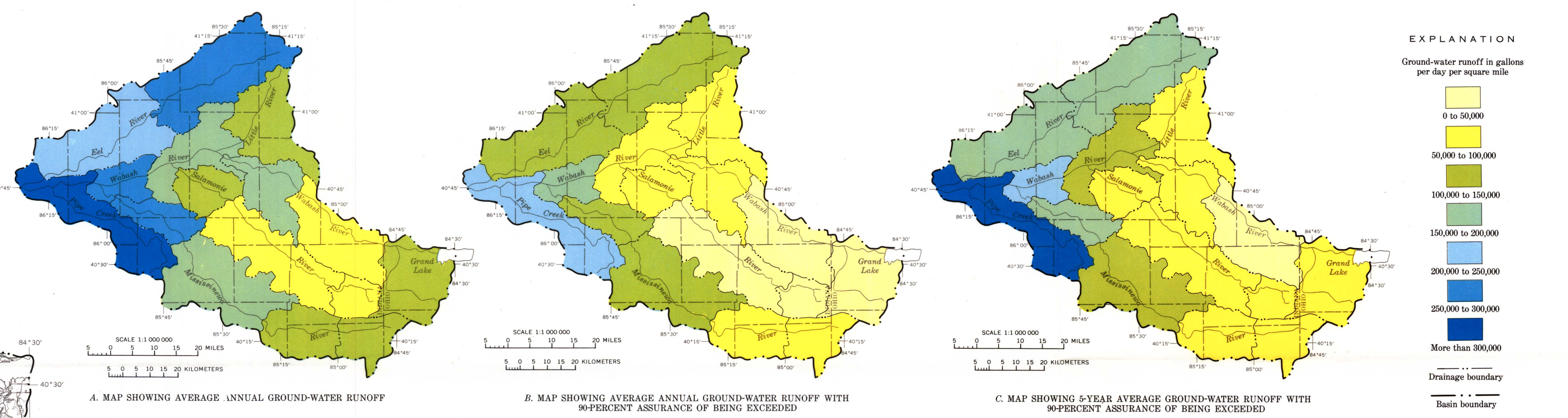
## GENERALIZED POTENTIOMETRIC SURFACE

The potentiometric surface has a configuration similar to the land-surface topography (see map above). It is related to conditions of recharge and discharge and the capacity of the saturated rocks to transmit water laterally.

The regional potentiometric surface of the ground-water reservoir is approximately the upper boundary of the ground-water system. The potentiometric surface, in general terms, represents a surface that fluctuates in response to recharge and discharge, below which the ground is permanently saturated.

The regional configuration of the potentiometric surface does not change significantly from year to year owing to the balance between recharge and discharge and to the large storage capacity of the ground-water reservoir in comparison to the difference between recharge and discharge. The regional slope of the potentiometric surface is steeper north of the Wabash River valley than south, reflecting the greater topographic relief in the north.

The direction of ground-water flow, generally, is at right angles to the contours on the potentiometric surface. In this basin most ground-water runoff occurs near the source of recharge.




*A.* MAP SHOWING AVERAGE ANNUAL GROUND-WATER RUNOFF

*B.* MAP SHOWING AVERAGE ANNUAL GROUND-WATER RUNOFF WITH 90-PERCENT ASSURANCE OF BEING EXCEEDED

*C.* MAP SHOWING 5-YEAR AVERAGE GROUND-WATER RUNOFF WITH 90-PERCENT ASSURANCE OF BEING EXCEEDED

GROUND-WATER RUNOFF MAPS

## GROUND-WATER RUNOFF

Ground-water runoff to streams is the natural output from the ground-water system after evapotranspiration losses are satisfied. The average annual ground-water runoff represents an approximation of the potential for development from ground-water sources; however, large development of ground water will reduce the natural ground-water runoff to streams. Geologic and hydrologic factors are major constraints limiting the feasibility of local development.

The average ground-water runoff from the basin is estimated, on the basis of analysis of streamflow records, to be 662 mgd or 175,000 gpd per sq mi (gallons per day per square mile). The average ground-water runoff from smaller basins (map *A*) ranges from 69,000 to 429,000 gpd per sq mi. The smaller basins are defined by the intervening surface drainage between gaging stations, and thus do not necessarily reflect geologic controls. The runoff values shown on map *A* have about a 50-percent probability of being exceeded in any year.

The estimated runoff with a 90-percent assurance of being exceeded in any year is indicated on map *B*, and the average runoff for a 5-year period with a 90-percent assurance of being exceeded is shown on map *C*.

# WATER RESOURCES OF THE UPPER WABASH RIVER BASIN, NORTHEASTERN INDIANA

By
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