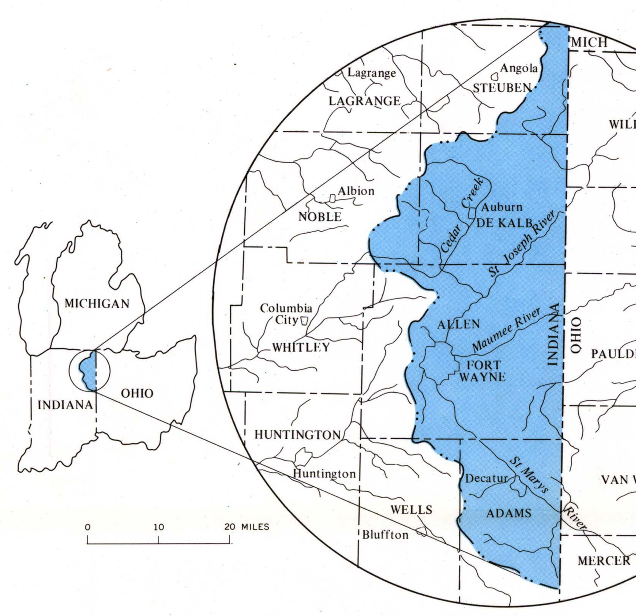
PHYSICAL SETTING



LOCATION MAP

INTRODUCTION

The Maumee River basin is one of the 18 watersheds in the State of Indiana as defined by the Indiana Water Resources Study Committee in 1956. This report presents general information on streamflow characteristics, ground-water availability, and quality of water in the Indiana part of the basin. The emphasis is on the regional rather than the specific approach to the basin's water resources. Therefore, the information should be used for regional planning and not for design purposes.

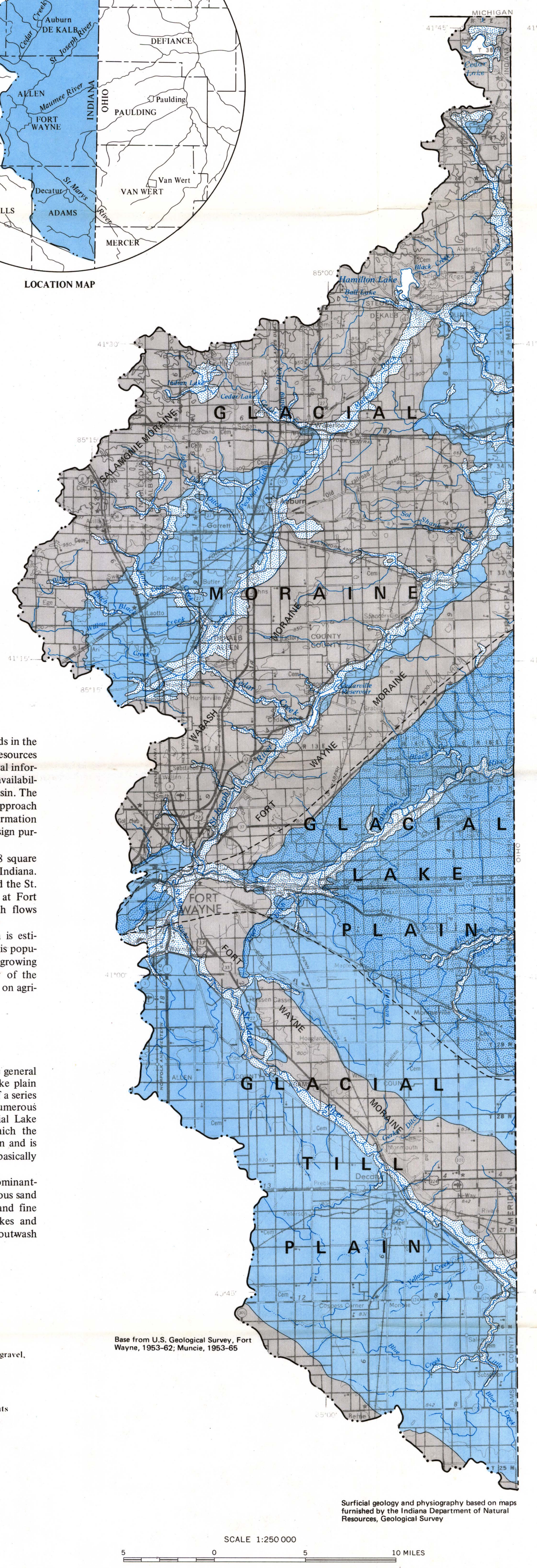
The Maumee River and its tributaries drain 6,608 square miles, of which 1,283 square miles are in northeast Indiana. The St. Joseph River flows south out of Michigan and the St. Marys northwest out of Ohio. The two rivers join at Fort Wayne, Indiana to form the Maumee River, which flows northeast through Ohio to Lake Erie.

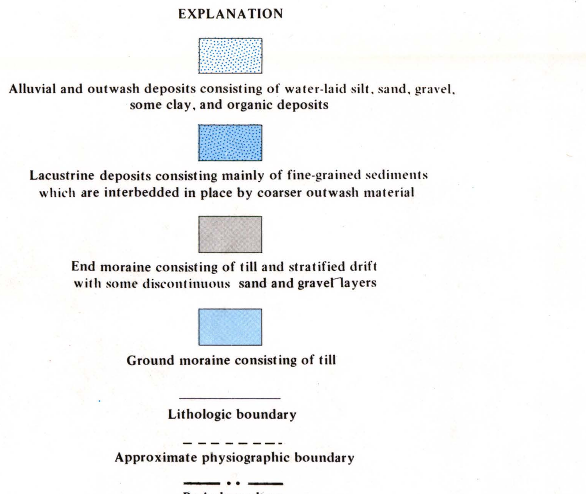
The population of the Indiana part of the basin is estimated to be about 336,000. Nearly 60 percent of this population live in the vicinity of Fort Wayne, which is a growing industrial and manufacturing center. The economy of the basin outside the Fort Wayne area is based primarily on agriculture.

PHYSICAL DESCRIPTION

The Maumee River basin in Indiana includes three general physiographic areas—a glacial moraine, a glacial lake plain and a glacial till plain. The moraine area is made up of a series of moraines characterized by knolls and sags and numerous lakes. The lake plain, which was formed by Glacial Lake Maumee, is almost featureless. The channel in which the Maumee River flows is 25 to 40 feet below the plain and is without floodplain or terrace. The glacial till plain is basically a modified moraine and is flat over a wide area.

The surficial materials covering the basin are predominantly till or lake sediments which, except for discontinuous sand and gravel layers, are for the most part clay rich and fine grained. Adjacent to many of the present-day lakes and streams are coarse-grained materials of alluvial and outwash origin.





SURFICIAL GEOLOGIC AND PHYSIOGRAPHIC MAP

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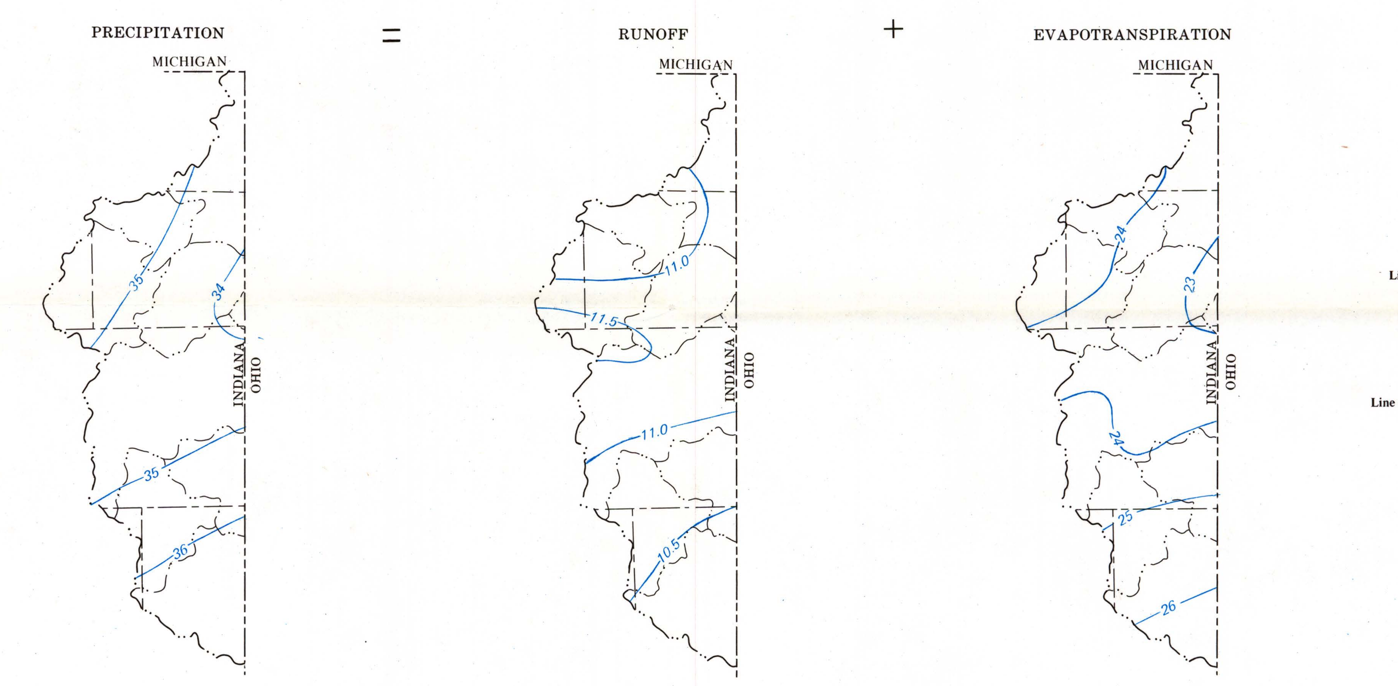
WATER BALANCE

Precipitation, runoff and evapotranspiration are the principal variables that define the water-balance equation for the basin. Two other variables in the water-balance equation, underflow and change in storage are omitted because: (1) the amount of underflow is considered insignificant (less than 0.1 inch per year), and (2) although basin storage changes between years, the change in storage over the long-term period of record is considered to be zero. The average annual precipitation map represents the areal distribution of precipitation based on the U.S. Weather Bureau normals for 1931–60. The runoff lines represent the distribution of streamflow within the basin for the 1947–68 period of record. The average annual precipitation in the basin for this period was about 36.2 inches, nearly the same as the 1931–60 normal value of 35.7 inches. The difference between the average precipitation and average yearly runoff of 11.1 inches is estimated as the average annual evapotranspiration (about 25 inches per year).

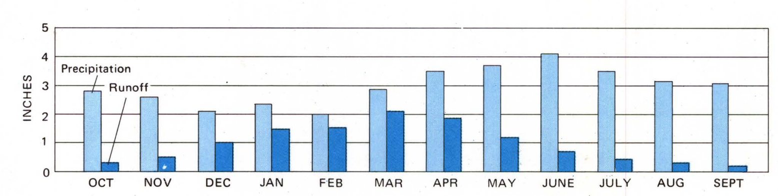


Although the average annual precipitation is 35.7 inches, yearly values varied from 27.0 inches (1963) to 50.9 inches (1950).

Average annual runoff for the 1947–68 period was 11.1 inches per year. Yearly values ranged from about 4.7 inches (1963) to about 22.9 inches (1950).

Evapotranspiration is the least variable factor in the water-balance equation. Yearly values varied from about 19 inches (1961) to about 28 inches (1950). Evapotranspiration in the northern part of the basin is less than in the southern part because precipitation is less.

MAPS SHOWING THE AVERAGE ANNUAL WATER BALANCE



GRAPH SHOWING THE MONTHLY DISTRIBUTION OF AVERAGE ANNUAL PRECIPITATION AND AVERAGE ANNUAL RUNOFF

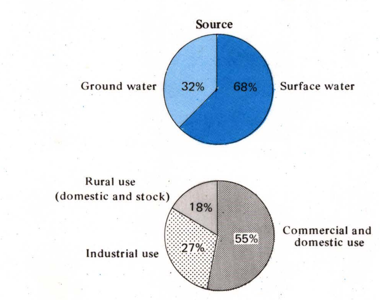
The within year distribution of precipitation is fairly uniform in the basin; however, the distribution of runoff is much more variable because of seasonal variations in rates of evaporation, plant growth, and recharge to the water table.

WATER USE

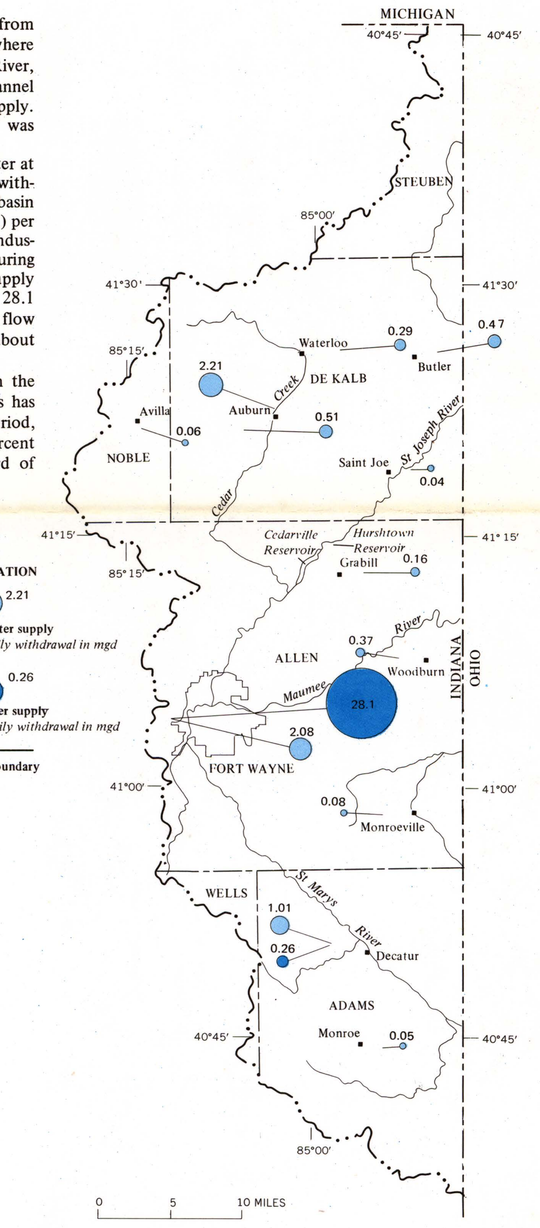
Water supplies in the basin are obtained primarily from ground-water sources except in the Fort Wayne area where the municipal supply is furnished by the St. Joseph River, which is regulated by Cedarville Reservoir. The off-channel Hurshtown Reservoir is available for additional water supply. More than half of the total water withdrawn in 1967 was used for commercial and domestic purposes.

The map indicates the average daily withdrawal of water at selected localities in the basin; the figures include water withdrawn for public supplies and industry. Total use in the basin for 1967 was approximately 34,600 gallons per day (gpd) per square mile. The use in Allen County, the most highly industrialized area, was about 73,400 gpd per square mile. During 1967, average daily use of surface water for public supply and industrial uses for the city of Fort Wayne was about 28.1 million gallons per day (mgd). The 7-day 10-year low flow for the St. Joseph River (including Cedar Creek) is about 26.8 mgd.

As an example of the growing demand for water in the basin, the amount furnished for public water supplies has increased about 42 percent since 1959. Over the same period, the population served has increased about seven percent (based on data published by the Indiana State Board of Health).

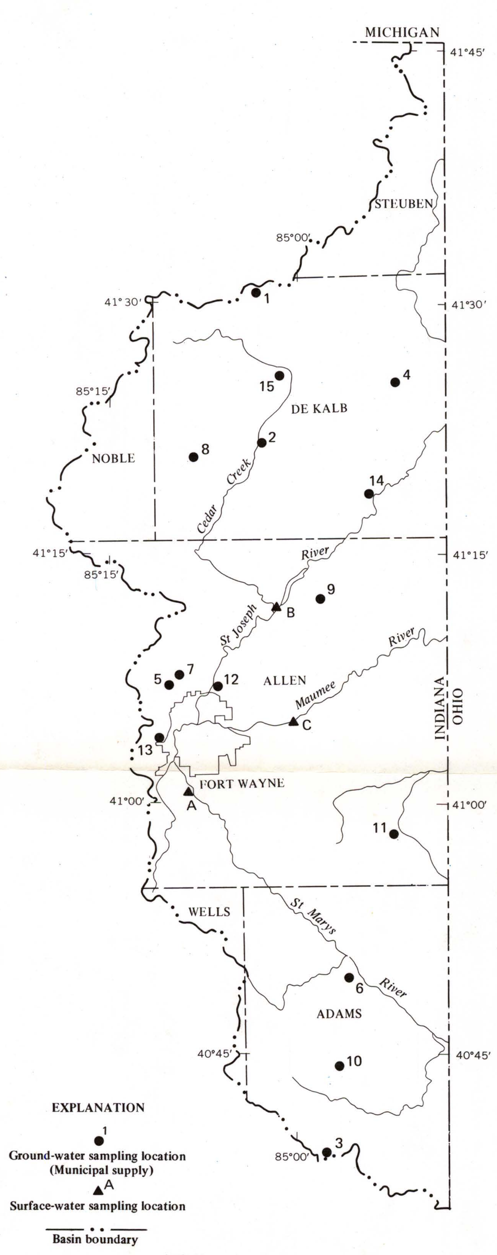


DIAGRAMS SHOWING SOURCE AND USE OF WATER IN THE MAUMEE BASIN (1967). AVERAGE DAILY WATER USE IN THE BASIN (INDIANA) IS 44.4 MILLION GALLONS PER DAY

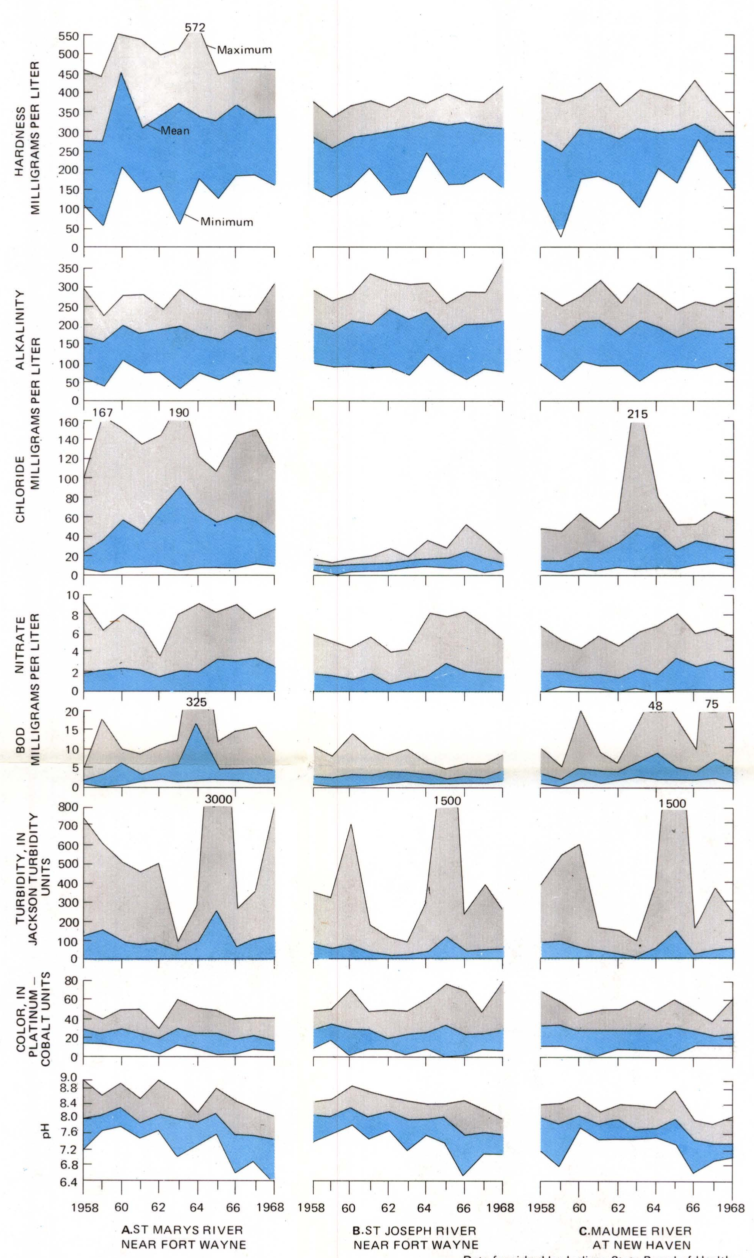


MAP SHOWING THE AVERAGE ANNUAL WATER BALANCE

WATER QUALITY



MAP SHOWING LOCATION OF SAMPLING POINTS FOR WATER QUALITY



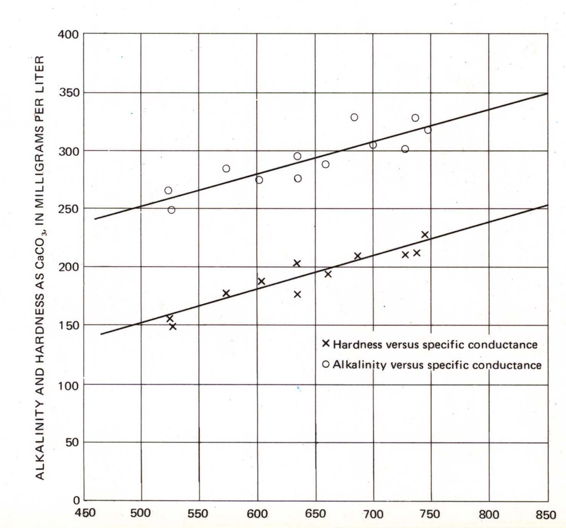
GRAPHS SHOWING MEANS AND EXTREMES OF SELECTED QUALITY PARAMETERS OF STREAMFLOW

SURFACE WATER

Surface-water supplies are subject to pollution by waste discharges from industry, commercial establishments, and municipalities, and from land runoff. Therefore, these water supplies are monitored to determine the adequacy, trend, and change in quality of the streamflow.

Data from water samples collected and analyzed by the Indiana State Board of Health were compiled to show the monthly variation in chemical quality. The water samples were analyzed for additional quality constituents but not all these constituents were used in comparing the quality of water from the three sampling sites.

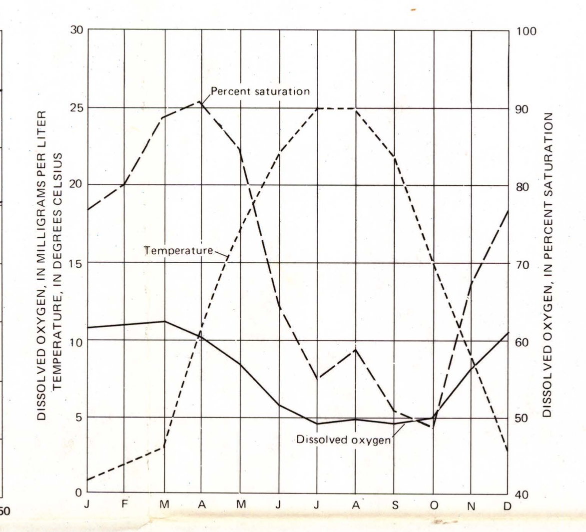
Surface water in the Maumee River basin tends to be less mineralized than ground water. As indicated graphically, the waters are predominantly basic, hard to very hard, and exhibit considerable variation in turbidity. Water from the St. Marys River is higher in hardness and chloride content than that from the St. Joseph River. This is an influence of ground-water runoff and is due principally to the difference in aquifer material through which the water moves. The quality of the stream water at New Haven reflects the effect of mixing of the water from these two major tributaries plus effluent from the Fort Wayne area.



GRAPH SHOWING THE RELATIONSHIP OF SPECIFIC CONDUCTANCE TO HARDNESS AND TO ALKALINITY OF WATERS FROM THE MAUMEE RIVER NEAR NEW HAVEN, INDIANA

SPECIFIC CONDUCTANCE

The linear relationship of specific conductance to hardness and alkalinity is shown graphically for water samples from the Maumee River at New Haven. The data used to plot the relationship were published by the Indiana State Board of Health for the period 1958–68. Water samples from this station represent a composite of nearly all the water flowing in the streams of the basin. Therefore, the linear regression lines of specific conductance versus hardness and alkalinity can be used to estimate basin-wide the change in hardness and alkalinity with a unit change in specific conductance. They also can be used to estimate hardness and alkalinity of water in the basin streams when the specific conductance is known.



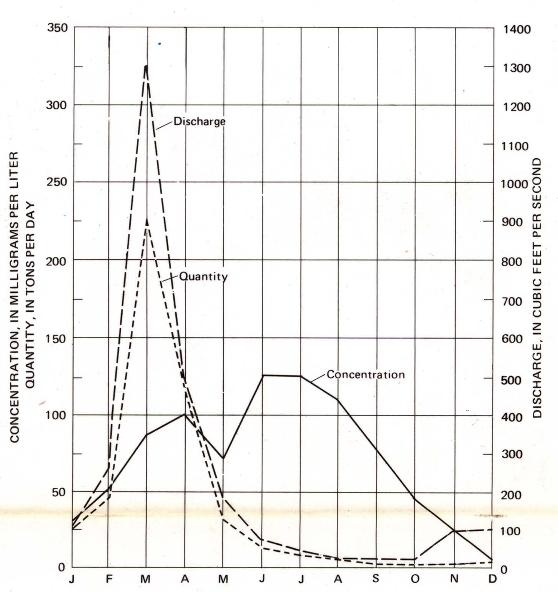
GRAPH SHOWING MONTHLY AVERAGE DISSOLVED OXYGEN, PERCENT SATURATION OF DISSOLVED OXYGEN, AND TEMPERATURE OF WATER FLOWING IN THE MAUMEE RIVER AT NEW HAVEN (1958–68)

DISSOLVED OXYGEN

The minimum allowable dissolved oxygen concentration for the Maumee River in Indiana has been established at four milligrams per liter (mg/1) (Indiana Stream Pollution Control Board, 1970) which, during critical summer conditions, is comparable to 62.5 percent oxygen saturation. This criterion was set to meet requirements of normal water uses including the protection of fish and wildlife common to the waters of the basin.

The solubility of atmospheric oxygen in fresh water under one atmosphere of pressure ranges from 14.6 mg/1 at 0°C to about 7 mg/1 at 35°C. The low solubility of oxygen is a major factor that limits the purification capacity of natural waters and necessitates treatment of wastes to remove oxygen consuming pollution matter before discharging to receiving streams.

Because rates of biological oxidation increase with temperature, the critical conditions related to dissolved oxygen deficiency occur during the summer months of low streamflow when temperatures are high and solubility of oxygen is at a minimum. Under these conditions, the maximum dissolved oxygen level in streams is about 8 mg/1.



GRAPH SHOWING MONTHLY SUSPENDED SEDIMENT AND DISCHARGE FOR SAINT MARYS RIVER NEAR FORT WAYNE. THESE VALUES OCCURRED OR WERE EXCEEDED 50 PERCENT OF THE TIME (1953–67)

SUSPENDED SEDIMENT

The State of Indiana and later the U.S. Geological Survey operated a daily suspended sediment station on the St. Marys River near Fort Wayne from 1953 to December 1967 (letter A on map). Daily sampling showed that the river carries an average sediment load of about 15,000 tons per year. The area drained above the sampling point is approximately 762 square miles. Thus the 15,000 tons of sediment is equivalent to about 19½ tons per square mile. The average amount of sediment carried past this sampling point is nearly 60 pounds per minute.

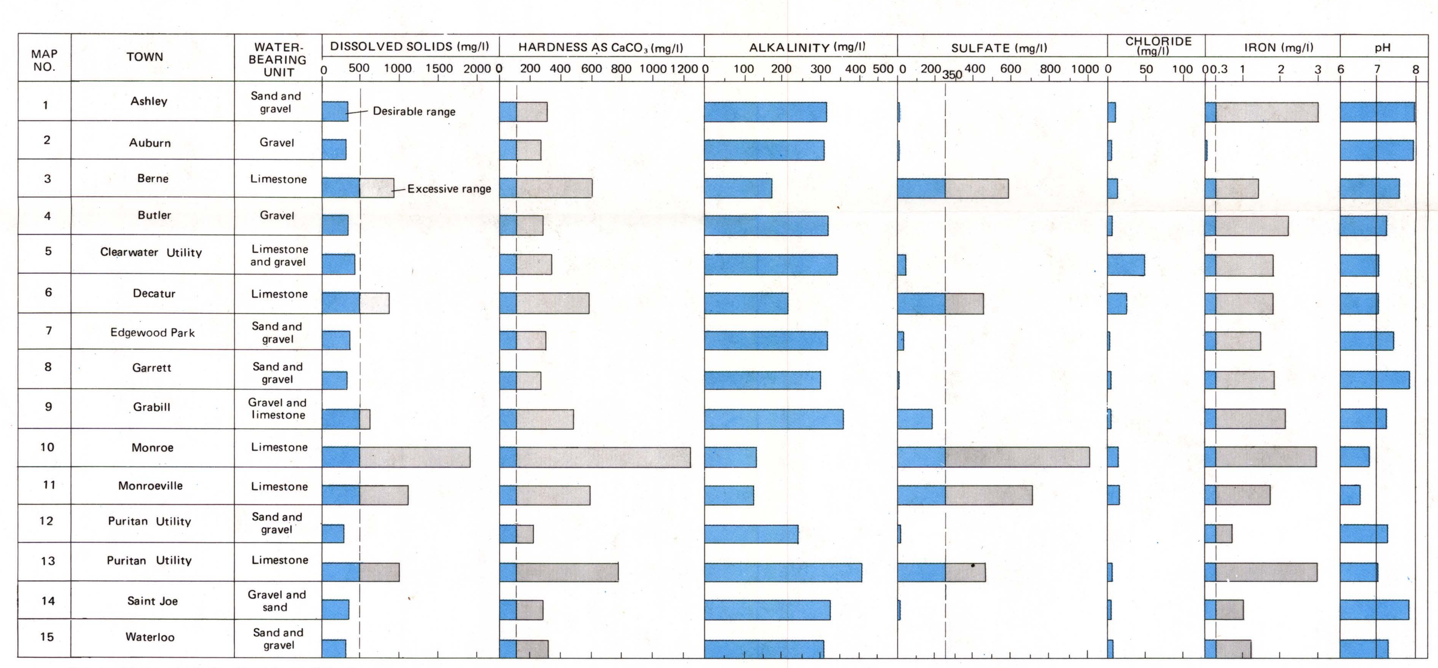


DIAGRAM SHOWING QUALITY OF WATER FROM MUNICIPAL WELL SUPPLIES

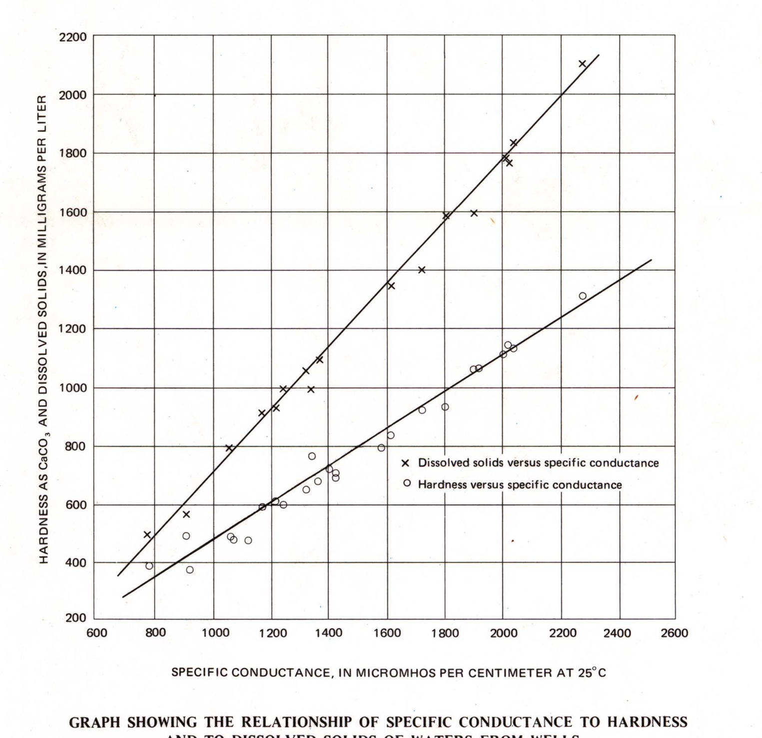
GROUND WATER

Representative chemical analyses of water from municipal wells are shown graphically and their locations are indicated on the accompanying map. Also presented is the desirable range of some of the constituents as recommended in the U.S. Public Health Service's "Drinking Water Standards", 1962

Water in the aquifers of the basin is characterized by a high hardness and iron content and a wide range in dissolved solids. The water is a calcium-magnesium bicarbonate type. Concentrations of other constituents are generally low except for sulfate, which in places may comprise a significant part of the dissolved-solids content. This is particularly true of the consolidated aquifers, which yield water that is generally high in sulfate because of the presence of relatively soluble sulfur-bearing minerals such as gypsum and pyrite. Variations in the dissolved-solids content and the chemical character of the water are related to the length of time the water has been in the aquifer, and to variations in chemical composition of the aquifer material through which the water has moved. The occasional presence of high sulfate in water from unconsolidated aquifers may be caused by the upward leakage from bedrock formations.

ESTIMATING HARDNESS AND DISSOLVED SOLIDS

One characteristic of water that can be rather easily determined is its specific electrical conductance. Although there is no exact relationship between specific conductance and dissolved solids, specific conductance is a fairly accurate indicator of dissolved mineral content. It also can be used to estimate the hardness of water. The linear relationship between these parameters is shown graphically by plotting specific conductance versus dissolved solids and hardness. The linear regression line can be used to estimate dissolved solids and hardness in water from wells in the basin over the range shown.



GRAPH SHOWING THE RELATIONSHIP OF SPECIFIC CONDUCTANCE TO HARDNESS AND TO DISSOLVED SOLIDS OF WATERS FROM WELLS

WATER RESOURCES OF THE MAUMEE RIVER BASIN, NORTHEASTERN INDIANA

By
R. A. Pettijohn and L. G. Davis
1973

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1973—W72443