

INTRODUCTION

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This report describes the availability, distribution, quality, and use of water in the St. Joseph River basin in northeastern Indiana. It is intended to provide the user with a background of hydrologic information that may be applied to water-related problems. Data used in the report were, for the most part, obtained from the files of Federal and State agencies; however, some new data were collected during the investigation.

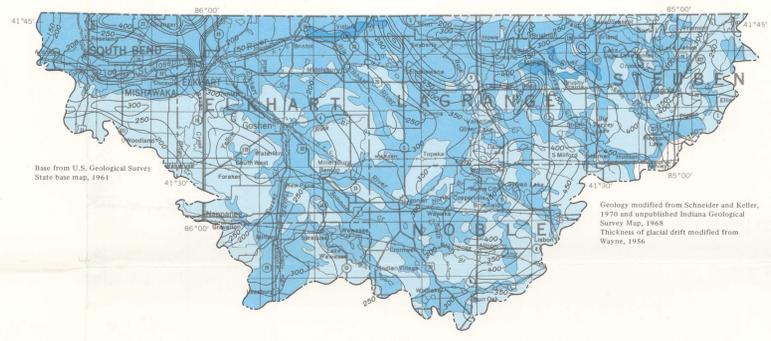


THE ST. JOSEPH RIVER BASIN IN INDIANA HAS AN AREA OF 1,624 SQUARE MILES. The entire river system, draining 4,590 square miles, is located in northeastern Indiana and southwestern Michigan.

WATER FACTS

- Unconsolidated glacial deposits as thick as 450 feet underlie the basin. Sand and gravel units within these deposits are the major sources of ground water. Few wells have penetrated to the Devonian and Mississippian shale beds that underlie the glacial deposits.
- Precipitation, the ultimate source of most water in the basin, averages 34.6 inches annually in the study area. This is about 2,690 mgd (million gallons per day).
- Average streamflow originating within the study area totals about 840 mgd (10.8 inches annually), of which approximately 670 mgd (80 percent) is derived from ground-water seepage into the streams. The natural ground-water movement within the basin is toward the St. Joseph River.
- Evapotranspiration, averaging 23.8 inches per year (1,850 mgd) in Indiana, is the largest single water use in the basin.
- About 5,000,000 million gallons of fresh water is in storage within the aquifers.
- About 74 million gallons of water was used on an average day in 1967. Slightly more than 86 percent of this amount was ground water.
- All public water systems utilize ground water; they distributed about 40 mgd in 1967.
- The water table is, in general, a subdued replica of the land surface. The altitude of the water table is highest in the eastern part of the basin and decreases toward the St. Joseph River. Seasonal water-level fluctuations are generally less than 10 feet, except where affected locally by pumping.
- Ground water throughout is of the calcium magnesium bicarbonate type, is very hard, and has a high iron content. Except for the iron content, which commonly exceeds the U.S. Public Health Service (1962) recommended limit, and the high hardness, ground water is of good chemical quality for most uses.
- Ground water is available from sources within the basin to supply all foreseeable demands. Farsighted planning, wise management, and efficient design of wells and well fields will be needed to solve problems that will accompany increased water withdrawals.
- The average surface-water discharge from the basin is 2,020 mgd or 3,130 cfs (cubic feet per second).
- The maximum observed discharge (18,400 cfs) in the basin occurred on the St. Joseph River at Elkhart on April 5, 1950.
- On the average, a discharge of about 1,300 cfs can be expected to be equalled or exceeded about 90 percent of the time on the St. Joseph River at Elkhart. A discharge of 140 cfs can be expected to be equalled or exceeded 90 percent of the time on the Elkhart River at Goshen.

GENERAL HYDROLOGY



EXPLANATION
 Dune sand
 Valley train and outwash plain sediments; mostly sand and gravel
 Ground and end moraine; mostly till
 Line of equal thickness of glacial drift. Interval is 50 feet
 Basin boundary

THE BASIN IS UNDERLAIN BY UNCONSOLIDATED GLACIAL DEPOSITS THAT CONTAIN THE PRINCIPAL AQUIFERS. Most of the basin is underlain by 200 to 400 feet of glacial drift, which generally thickens from west to east. Sand and gravel units within the drift are major sources of ground water; these units are usually thicker and more continuous in preglacial valleys.
 The greater part of the basin is characterized by many moraine lakes and outwash plains. In parts, the moraine topography consists of kame complexes, with small basins, lakes, and peat bogs. Channels of former melt-water streams, small lacustrine plains, and former lake beds are common.
 The northwestern part is a low, poorly drained area, with a variety of glacial and preglacial features, including sandy lacustrine plains, valley trains, outwash plains, and dunes.

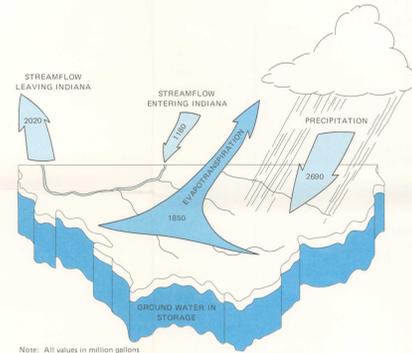
GEOLOGY



EXPLANATION
 Coldwater Shale
 Mostly gray shale
 Ellsworth Shale
 Green shale with black shale in lower part
 Antrim Shale
 Black shale with gray shale and limestone in lower part
 Traverse and Detroit River Groups
 Mostly limestone and dolomite
 Contact
 650
 Bedrock contour
 Shows altitude of bedrock surface. Contour interval is 50 feet. Datum is mean sea level.
 Basin boundary

DEVONIAN AND MISSISSIPPIAN SHALE BEDS UNDERLIE THE GLACIAL DEPOSITS, AND ARE CONSIDERED TO BE THE BASE OF THE GROUND-WATER RESERVOIRS. The bedrock surface is probably gently rolling, with entrenched valleys; however, owing to the thickness of drift, few wells have penetrated to bedrock. The shale bedrock dips gently northward toward the Michigan basin. An abrupt bedrock escarpment in the northeast corner of the basin forms a small area where the drift thins abruptly to about 100 feet. Because it transmits water poorly, shale is generally not a good aquifer; however, small amounts of water may be obtained locally where dense shale has been fractured.

WATER BUDGET

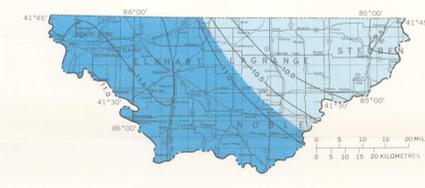


AN ESTIMATED 3,870 MILLION GALLONS OF WATER ENTERS THE BASIN EACH DAY. Of this, 2,020 million gallons (52 percent) replenishes the ground- and surface-water supply; the remainder is returned to the atmosphere through evapotranspiration. About 5,000,000 million gallons of fresh water is in storage within the aquifer underlying the basin.



EXPLANATION
 Average annual precipitation for area is 34.6 inches
 Average annual precipitation more than 34.6 inches
 Average annual precipitation less than 34.6 inches
 Line of equal average precipitation. Interval 0.5 inch
 Basin boundary

PRECIPITATION, THE LARGEST SOURCE OF WATER IN THE STUDY AREA, AVERAGES 34.6 INCHES EACH YEAR OR ABOUT 2,690 MILLION GALLONS EACH DAY. The precipitation is well distributed throughout the year, and the average for each month ranges from 2 to 4 inches.



EXPLANATION
 Average annual runoff for area is 10.8 inches
 Average annual runoff more than 10.8 inches
 Average annual runoff less than 10.8 inches
 Line of equal average runoff. Interval 0.5 inch
 Basin boundary

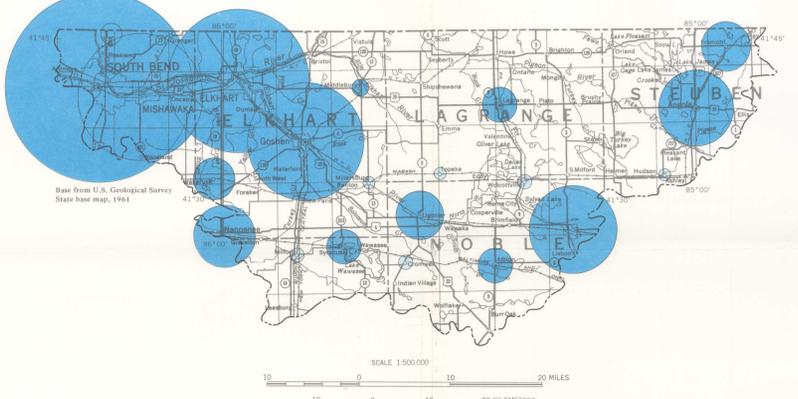
RUNOFF FROM WITHIN THE BASIN IN INDIANA AVERAGES 10.8 INCHES EACH YEAR, OR ABOUT 840 MILLION GALLONS EACH DAY. Eighty percent, or about 670 mgd, is derived from ground-water seepage into streams. Some ground-water seepage can be intercepted by installation and pumping of new wells. The large ground-water contribution to runoff is related to: (1) the slow velocity of overland flow associated with low topographic relief, giving water time to percolate into the ground-water system, and (2) the ease of water movement through the sand and gravel in the glacial deposits. After collecting the 840 mgd of runoff from the basin, the St. Joseph River flows from Indiana into Michigan at about 2,020 mgd.



EXPLANATION
 Average annual evapotranspiration for area is 23.8 inches
 Average annual evapotranspiration more than 23.8 inches
 Average annual evapotranspiration less than 23.8 inches
 Line of equal average evapotranspiration. Interval 0.5 inch
 Basin boundary

EVAPOTRANSPIRATION, WHICH REDUCES THE AMOUNT OF WATER AVAILABLE FOR MAN'S USE, AVERAGES 23.8 INCHES EACH YEAR, OR ABOUT 1,850 MILLION GALLONS EACH DAY. It is the largest single water use in the basin.

WATER USE



EXPLANATION
 Average daily municipal water use. Size of circle indicates quantity with drawn as measured on the scale. Ground water is the sole source of supply
 Basin boundary

ABOUT 74 MILLION GALLONS OF WATER IS USED ON AN AVERAGE DAY IN THE ST. JOSEPH RIVER BASIN IN INDIANA. All but approximately 10 million gallons is ground water. All public water supplies come from ground-water sources. The greatest demand is in the heavily populated manufacturing centers of Elkhart, Goshen, and South Bend. Nearly half (186,000) the area's population of 406,000 is concentrated in these areas. Agricultural activities in the central part of the basin and recreational facilities being developed around the many small lakes in the eastern part have a more modest need for water.

Predicted water needs can be obtained from ground-water sources within the basin. Of the productive aquifers that underlie most of the basin, valley-train and outwash sand and gravel aquifers provide consistently high well yields. On the average, about 670 million gallons of ground water enters the streams each day from the aquifers underlying the St. Joseph River basin in Indiana. An additional 5,000,000 million gallons of fresh water is stored within the aquifers. Total ground-water withdrawals in the study area average less than 10 percent of the amount being discharged into the streams. By the year 2020, about 20 percent of the amount now being naturally discharged probably will be pumped from the aquifers on an average day.

AVERAGE WITHDRAWALS, IN MILLION GALLONS PER DAY (1967 DATA)

Source	Public water supplies*	Self-supplied industrial use	Rural		Total	Percent
			Domestic	Stock		
Ground water	39.81	14.80	6.85	2.33	63.79	86.3
Surface water	9.20	.36	.58	10.14	13.7
Total...	39.81	24.00	7.21	2.91	73.93	100.0

*Number of public water supplies: 26
 Population served: 260,500
 Average daily per capita use (public water supplies): 155 gallons
 Average daily per capita use (public water supplies, Indiana): 139 gallons

Data compiled from U.S. Geological Survey, Indiana Department of Natural Resources, and Indiana State Board of Health records.

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