INDIANA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER
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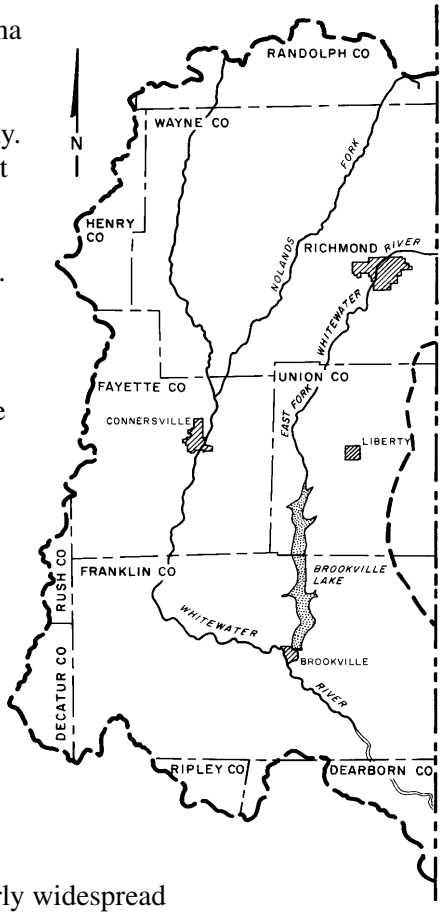
WATER RESOURCE AVAILABILITY IN THE WHITEWATER RIVER BASIN, INDIANA - EXECUTIVE SUMMARY

In response to legislative directives contained in the 1983 Water Resource Management Act, the Indiana Department of Natural Resources, Division of Water published a report describing the availability, distribution, quality, and use of surface water and ground water in the Whitewater River Basin, Indiana.* The second in a series of 12 regional investigations, this report provides hydrologic data and related information for planners, government officials, and others interested in the state's water resources. The following is a summary of that report. The full report can be obtained from the Indiana Department of Natural Resources, Division of Water. For ordering information, please see the instructions printed at the end of this summary.

The Whitewater River Basin drains 1329 square miles in southeast Indiana and 145 square miles in southwest Ohio (figure 1). About 2 miles east of the Indiana-Ohio state line, the Whitewater River joins the Miami River, which empties into the Ohio River at the intersection of Indiana, Ohio, and Kentucky. The Whitewater River Basin in Indiana encompasses parts of 10 counties, but 82 percent of the land area lies within Wayne, Fayette, Union, and Franklin Counties. Although the Whitewater River basin includes portions of Indiana and Ohio, the discussion below will focus on the Indiana portion of the basin.

Figure 1. Location of the Whitewater River Basin



SOCIOECONOMIC SETTING

More than half of the 1980 basin population of 145,500 resided in Wayne County, particularly in and near Richmond, the basin's largest city. Nearly a third of the basin population resided in Fayette, and Franklin Counties.

The recent decrease in Wayne County's population is expected to continue through at least the year 2000 as Richmond's population continues to decline. Moderate increases in population are projected for Franklin and Union Counties. An increase in population is also projected for Fayette County; however, provisional estimates show a decline in population since 1980.

Manufacturing, wholesale-retail trade, services, and government constitute the Whitewater Basin's four largest non-farm employment classes and account for three-fourths of the total earnings. Farm employment exceeds non-farm employment in Union and Franklin Counties. Farm earnings in the basin are highest in Union County.

Cropland, the major land use in the Whitewater River Basin, is particularly widespread in Union and Wayne Counties. The largest tracts of forestland occur in southern Fayette and western Franklin Counties, where erosive soils and hilly terrain limit the availability of prime cropland. Residential and commercial development is primarily concentrated in and near the cities of Richmond and Connersville, which together comprise 40 percent of the basin's total population.

*Indiana Department of Natural Resources (Clendenon, C.J., ed.), 1988, Water resource availability in the Whitewater River Basin, Indiana: Division of Water, Water Resources, Assessment 88-2

PHYSICAL ENVIRONMENT

The northern third of the Whitewater River Basin lies within the Tipton Till Plain and has nearly flat to gently rolling topography characterized by morainal deposits of Wisconsinan age. The southern two-thirds of the basin lies within the Dearborn Upland and is dominated by dissected upland plains and narrow ridges. Near the basin's northeastern boundary, land surface elevation often exceeds 1,200 feet m. s. l. along the crest of the Knightstown Moraine. In the extreme southeastern part of the basin, land surface elevation is approximately 500 feet m. s. l. where the Whitewater exits Indiana. Maximum local relief can exceed 400 feet where bedrock ridges border the lower Whitewater River valley. The Wisconsinan glacial boundary, which extends through Franklin and southwest Fayette Counties, divides the Whitewater River Basin into two geologically distinct portions. North of this glacial boundary, bedrock is covered by variable but often thick layers of tills, lacustrine clays, and sands and gravels. The only bedrock exposures occur along some of the larger river valleys, particularly the East Fork Whitewater River. South of the Wisconsinan boundary, thin layers of residuum and/or pre-Wisconsinan tills overlie the bedrock surface, which is commonly exposed along valley sides. Outwash deposits within the valleys of the Whitewater River and its major tributaries are thicker south of the Wisconsinan glacial boundary, but are more laterally extensive to the north (figure 2).

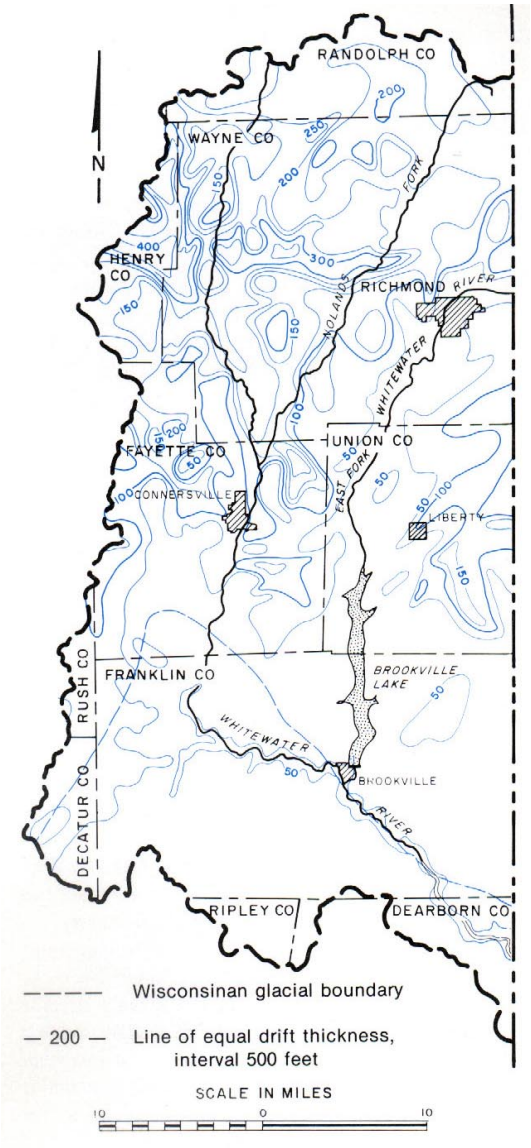


Figure 2. Drift thickness
(Modified from Gray, 1983)

Limestones and dolomites of Silurian age underlie the western, northern, and northeastern portions of the Whitewater River Basin. Ordovician limestones and shales underlie the basin's central part. Bedrock elevation ranges from more than 1050 feet m.s.l. in the northeastern part of the basin to about 450 feet m.s.l. where the Whitewater River exits Indiana. A large buried bedrock valley in western Wayne County and eastern Henry County is filled with up to 300 feet of glacial sediment.

SURFACE-WATER HYDROLOGY

Normal annual temperatures within the Whitewater Basin range from 50ºF in northern areas to 52ºF in the south. Normal annual precipitation ranges from 38 inches in the north to 40 inches in the south. Evapotranspiration annually consumes from 27 to 28 inches of water. The amount of precipitation available on a monthly and seasonal basis is generally abundant, but extended periods of dry weather can sometimes occur.

Drainage in the Whitewater River Basin is well developed, particularly in southern areas where glacial deposits are older or absent. Principal streams are entrenched in glacial drift in northern parts of the basin, and are cut into bedrock in southern areas. Channel slopes of the Whitewater River and its east fork are among the highest for major Indiana rivers.

Low stream flows are moderately sustained along the principal streams, where ground-water discharge from outwash deposits accounts for about 55 percent of the total runoff (figure 3). In general, the degree of ground-water contribution appears to be greatest in northern areas of the basin, particularly along the Whitewater River and its major tributaries in Wayne County, where outwash deposits are laterally extensive and occasionally quite thick.

In southern areas of the Whitewater River Basin, stream flow in the mainstem Whitewater River is well sus-

tained by ground-water discharge from thick outwash sands and gravels. However, tributary streams generally cease flowing during dry periods because of minimal ground-water seepage from thin, clayey tills.

Middle Fork Reservoir, Lake Santee, and Whitewater Lake are the major manmade impoundments in the Whitewater River Basin used for recreation or for recreation and public water supply. Brookville Lake, the basin's largest reservoir, is used for flood control, recreation, and water supply. The reduction of flood peaks downstream of Brookville Lake has prevented more than $2.5 million in flood damages sine 1974.

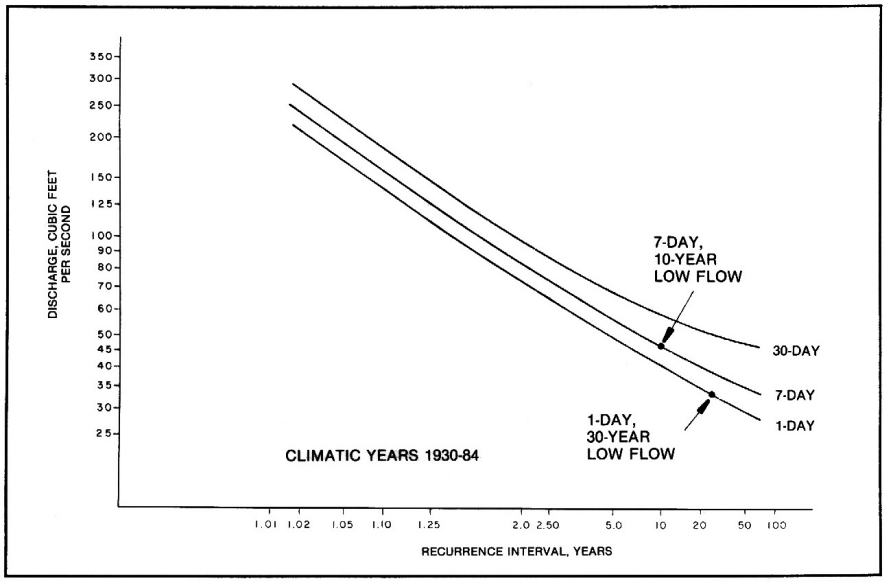


Figure 3. Low-flow frequency curves, Whitewater River near Alpine

The operation of Brookville Lake dam significantly reduces downstream flood discharges and also modifies seasonal flows. Downstream flows in autumn are higher than normal during reservoir drawdown. In contrast, downstream flows in spring are lower than normal as the reservoir level is increased to summer pool. Daily stream flows will reflect scheduled as well as occasional operations at the dam, and hence can sometimes be excessively high or low.

SURFACE-WATER QUALITY

Water quality is generally good in the Whitewater River and its east fork. At the stream quality gage on the Whitewater River downstream of Brookville, however, violations of the bacterial standard for recreational uses have frequently been recorded. Only occasional violations have been recorded along other reaches. A 28-mile segment of the Whitewater River in Franklin County has been recommended for inclusion in Indiana's Natural, Scenic, and Recreational Rivers System.

Middle Fork Reservoir and Brookville Lake are two moderately eutrophic lakes of good water quality. Iron and manganese concentrations are occasionally high, but nutrient levels are low and concentrations of toxic substances are negligible. Although Whitewater Lake has recently experienced an improvement in overall water quality, a siltation problem remains.

Because hydrologic data form a framework upon which management decisions are based, the adequacy of data networks for ongoing water management purposes was assessed. Based upon a Division of Water review, data collected from climatic stations and observation wells in the Whitewater River Basin are sufficient for water management needs. The establishment of stream gaging stations on either Greens Fork or Nolands Fork, Salt Creek or Pipe Creek, and the Middle Fork of the East Fork Whitewater River upstream of Middle Fork Reservoir should be considered, primarily to provide data for regional hydrology. In addition, reinstatement of the Richmond gage as a partial-record station could provide low-flow data for an urban river reach. Stations currently operating on Little Williams Creek at Connersville, Whitewater River near Economy, and Whitewater River near Hagerstown are recommended for discontinuation between 1988 and 1990 because of sufficient record.

GROUND-WATER HYDROLOGY

Ground water in the Whitewater River Basin is available from glacial deposits and from bedrock (figure 4). Of the six aquifer systems identified in the basin, the Whitewater Valley System is by far the most productive. Well yields of 500 gpm can be expected throughout most of this system, which occupies the valley of the Whitewater

River and its major tributaries.

The sand and gravel outwash deposits comprising the Whitewater Aquifer system may reach 100 feet in thickness, but thicknesses of 25 to 75 feet are typical. These outwash sands and gravels contrast sharply with the clay-dominated aquifer systems.

The Wayne-Henry Aquifer System is the second most productive unconsolidated system. The principal aquifers are intratill sand and gravel lenses which are confined by clay or till sequences. Aquifer materials can reach 40 feet in thickness, but are generally 10 feet thick or less. Most wells in the Wayne-Henry System produce less than 15 gpm, but yields of 150 gpm have been reported.

West and South of Richmond, a fairly consistent intratill sand and gravel zone has been delineated within the Wayne-Henry Aquifer system. This zone is usually about 5 feet thick, and most wells produce at least 10 gpm.

Ground-water supplies are limited in the Fayette-Union and Dearborn Aquifer Systems, which are comprised of clay-rich till sequences of Wisconsinan and pre-Wisconsinan age, respectively. Intratill sand and gravel lenses are generally less than 4 feet thick in the Fayette-Union System, and less than 2 feet thick in the Dearborn System. Most wells in the two systems produce only 2 to 3 gpm; however, yields of 10 gpm can typically be expected in part of northeastern Union County, where sand and gravel zones are more abundant and slightly thicker. Dry holes are fairly common in the Dearborn System, which has the most limited ground-water resources of the unconsolidated aquifer systems in the Whitewater River Basin.

Silurian limestone and multiple layers of Ordovician limestone and shale are used as a ground-water source where glacial aquifers are absent. The best Silurian bedrock production is along the basin's northern boundary, where yields of 30 to 60 gpm are common. Farther south, well yields decrease to 10 gpm or less. Wells completed in Ordovician bedrock generally produce less than 8 gpm, and dry holes are fairly common.

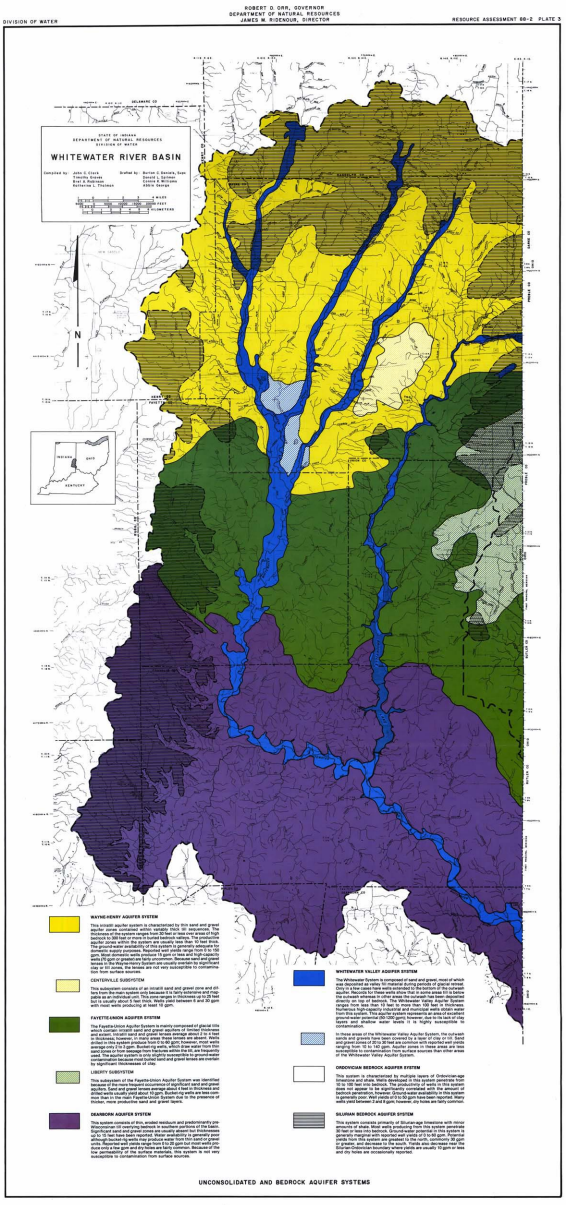


Figure 4. Aquifer systems.
(**click here to enlarge**)

GROUND-WATER QUALITY

Ground water throughout the Whitewater River Basin is characterized by high alkalinity, high hardness, and mostly basic pH. Ground water generally meets standards for public supply; however, iron concentrations commonly exceed the secondary drinking water standard of 0.3 mg/l. Total dissolved solids concentrations exceeded the secondary limit of 500 mg/l in half of the wells sampled in the Ordovician Aquifer System. The primary drinking-water standard for nitrate (as nitrogen) of 10 mg/l was exceeded in three wells in the Whitewater Valley System and one well in the Ordovician System (figure 5).

The Wayne-Henry, Fayette-Union, and Silurian Aquifer Systems have the three highest median iron values and the three lowest median nitrate values. The Dearborn System has the lowest median values of alkalinity, calcium, magnesium, hardness, and total dissolved solids, whereas the Ordovician System has the highest median values of these constituents. In addition, the Ordovician System has the highest median chloride and sodium values. The

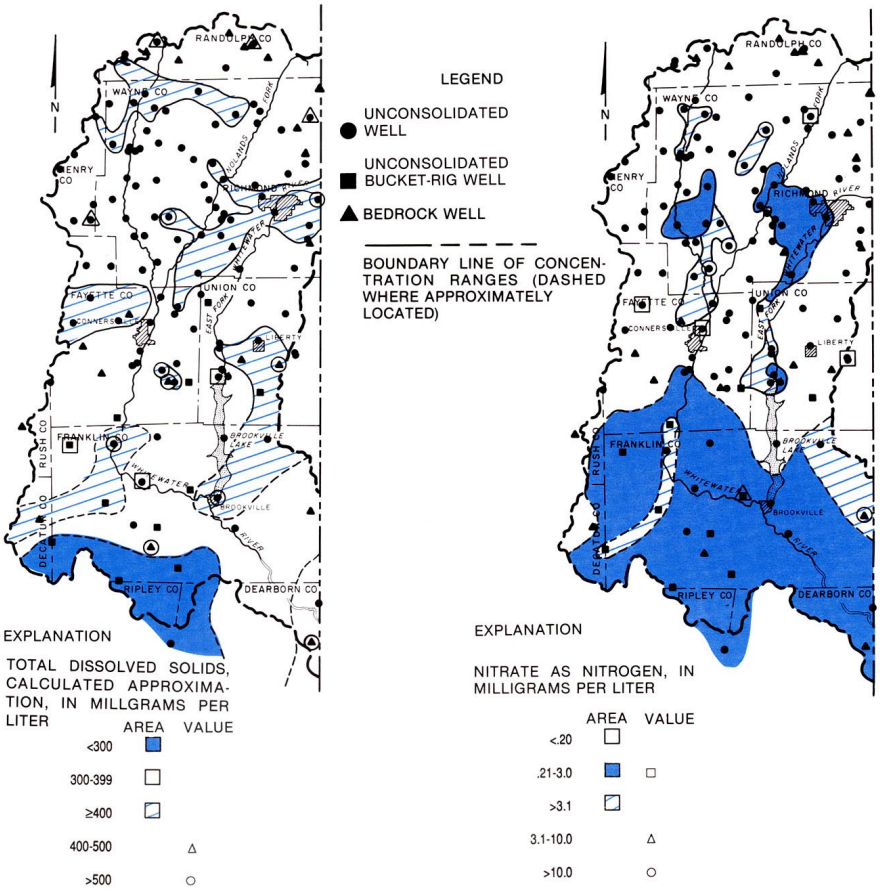


Figure 5. Generalized areal distribution of total dissolved solids and nitrate concentrations

Dearborn System and Whitewater Valley System have the two lowest median iron values and the two highest median nitrate values. The Whitewater System also has the highest median value of sulfate.

Wayne County has been designated by the Indiana Department of Environmental Management as a geographic area where ground-water protection may be most needed. Detectable levels of at least one volatile organic compound were found by the U. S. Environmental Protection Agency in six public water supplies in the Whitewater River Basin.

WATER USE AND PROJECTIONS

The 44 high-capacity water withdrawal facilities registered in the Whitewater River Basin reported a total average use of nearly 12 mgd of ground water and nearly 5 mgd of surface water in 1986. Public supply utilities accounted for about 85 percent of the water withdrawn, and self-supplied industries accounted for approximately 15 percent. Total estimated water withdrawals from small-capacity, non-registered facilities averaged about 4 mgd for domestic self-supplied uses, and 2 mgd for livestock uses.

More than three-fourths of the basin's water usage for public supply occurs in Richmond and Connersville. Withdrawals for public water supply are projected to increase in all basin counties except Fayette, where a two percent decrease is projected from 1985 to the year 2000.

Ground water is the source of all public supply withdrawals in the Whitewater River Basin except in eastern Wayne County, where Middle Fork Reservoir provides about 60 percent of Richmond's water supply needs. In a unique situation involving water supply at Brookville Lake, water used by the Franklin County Water Association is derived from two wells located on the Fairfield causeway; hence, the utility's water withdrawals are categorized as ground-water withdrawals. A water supply contract with the Indiana Department of Natural Resources, however, considers this use to be met by surface water from Brookville Lake.

About 60 percent of the water withdrawn by industries is derived from ground water. Three-fourths of the registered industrial water usage occurs in Wayne County, primarily in and near Richmond. Although sand and gravel operations within the basin account for more than half of the water withdrawn by industries, the greatest percentage in water use is projected for primary metal production.

Only one agricultural irrigator is registered in the Whitewater River Basin. The potential for increased agricultural irrigation is limited in most of the basin by moderate to steep slopes, unsuitable soils, and variability of water supply; however, some areas in the major stream valleys may be suitable for irrigation development.

WATER AVAILABILITY AND DEVELOPMENT

The most dependable water supplies for current and future development are available in the valleys of the Whitewater River and its major tributaries. Outwash sand and gravel deposits underlying these valleys serve as a ground-water source for about three-fourths for the registered withdrawal facilities and comprise about 90 percent (11 mgd) of reported ground-water use. The permeable sand and gravel deposits designated as the Whitewater Valley Aquifer System have an estimated recharge rate several times that of the intratill aquifer systems.

Most registered facilities with surface intakes withdraw water from excavations near the major streams. The Whitewater River or reservoirs on its tributaries could supply additional surface water for future development.

Middle Fork Reservoir's dependable yield of 5.3 mgd corresponding to its present total storage capacity exceeds the demand of 3.8 mgd projected for Richmond's surface-water needs in the year 2000. If additional surface-water supply were to be required, the installation of Tainter gates could increase the reservoir yield to 8.3 mgd. The construction of a reservoir on the West Fork of the East Fork Whitewater River, although more costly, could also provide an additional supply of surface water for the Richmond vicinity.

Although Batesville's present water supply capacity of approximately 2 mgd exceeds the projected demand of 1.5 mgd for the year 2000, the construction of a reservoir on Salt Creek could provide an additional supply for Batesville and nearby areas. Batesville, which lies outside the Whitewater River Basin boundary, currently supplies water to Oldenburg, which lies just inside the boundary.

Brookville Lake is by far the largest but least used reservoir supply in the basin. The U. S. Army Corps of Engineers estimates the water supply capability of Brookville Lake to be 90.5 mgd. Although six registered wells utilized for public supply are located on or near the Fairfield and Dunlapsville causeways, no registered facilities currently withdraw water directly from the lake. Brookville Lake therefore remains a largely underutilized source of water supply.

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