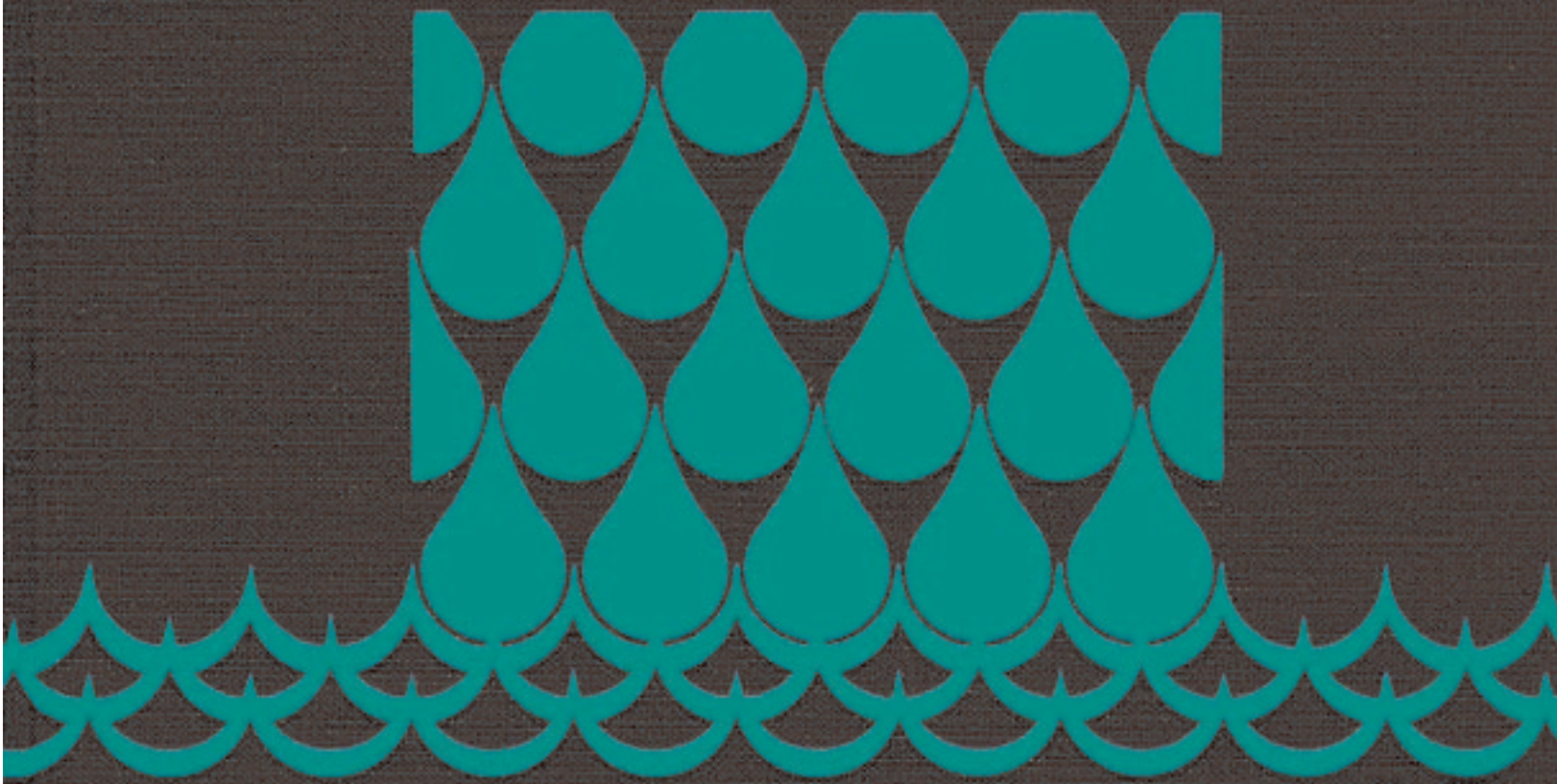
THE INDIANA WATER RESOURCE



RECOMMENDATIONS FOR THE FUTURE

The Indiana Water Resource

Recommendations For the Future

GOVERNOR'S
WATER RESOURCE STUDY COMMISSION,
STATE OF INDIANA

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The Honorable Otis R. Bowen, M.D.
Governor
The State of Indiana
206 State House
Indianapolis, Indiana 46204

Dear Governor Bowen:

The Governor's Water Resource Study Commission presents herewith its second phase report, *The Indiana Water Resource: Recommendations for the Future.*

During the past three years the Commission has held fourteen formal meetings, together with the more than thirty public meetings in various areas of the state. In addition the staff, comprised of personnel from the Department of Natural Resources and the State Board of Health, analyzed every aspect of the water resource. These findings are published in the first phase report, *The Indiana Water Resource: Availability, Uses, and Needs.*

The culmination of the previous three years work is presented in this second report. The issues, conflicts, and existing and potential problems associated with the utilization of the water resource through the year 2000 are identified. In addition, an evaluation is made as to the adequacy of the current system of policy, law, and management to meet the needs during this period. It was through this analysis that the deficiencies in the present management system to deal with current and anticipated resource conflicts surfaced.

The Commission's objective is to develop recommendations for the solution of these current and forthcoming management and resource problems. The general public participated in more than fifteen meetings, where their opinions of five management options were solicited. The Commission developed its conclusions and recommendations for an integrated management system based upon the input from these public meetings and the findings of an expert staff.

The Commission transmits this report to you with the earnest hope that it, together with the *Availability, Uses, and Needs* report, will contribute to the wise use of our water resource.

Respectfully submitted,

William J. Watt,
Chairman

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Map of Indiana showing the location of the eighteen study regions of the Governor's Water Resource Study Commission.

Introduction

The Governor's Water Resources Study Commission was created by Governor Otis R. Bowen on July 10, 1977, pursuant to Executive Order 11-77. The basic task of the Commission, as set forth in the order, is as follows:

> The Commission shall develop recommendations for an integrated system of policy, law, and management to provide the essential framework within which the human, social, and economic water needs of the people of Indiana may be satisfied in a timely and equitable manner. The Commission's recommended water policy shall be based upon a comprehensive examination of water availability, law, management, and present and projected human, social, and economic needs.

At its first meeting on September 22, 1977, the Commission adopted the following statement of its general goal, objective, scope, and plan of study.

Goal To establish a comprehensive water program for Indiana; that is, an integrated system of policy, law, institutions, and management to provide the essential framework within which the human, social, and economic water needs of the people of Indiana may be satisfied in a timely and equitable manner.

Objective To develop a recommended water program for Indiana, based upon a comprehensive study of water availability and quality; present and projected human, social, and economic uses and needs; and laws, institutions, and management programs.

Scope The investigation and study will give consideration to:

1) All forms of the water resource in Indiana (surface, ground, and atmospheric) and their availability and quality.
2) The present and projected human, social, and economic uses and needs.

3) The definition of the general nature and types of problems to be reasonably anticipated in meeting the various uses and needs for water.

4) The determination of the measures and actions needed to provide a sound basis for meeting those needs.

5) The adequacy of existing policies, laws, institutions, and programs to serve as a basis for solving those problems.

6) The development of recommendations for new and/or amendatory policies, laws, institutions, and programs.

General Plan of Study

The course of investigation was divided into two phases. The first phase included the: 1) development and implementation of a strong public involvement program; 2) determination of the availability and quality of the water resource of the state, including surface, ground, and atmospheric water; 3) assessment of the nature, extent and magnitude of excess water conditions; 4) an inventory of the current development and use of water in the state; 5) projections of the future uses and needs for water for all purposes for a period extending to the year 2000; and 6) compilation of existing water resource policies, laws, institutions, and management programs at both state and local levels, together with applicable existing federal policies, laws, institutions, and programs as they relate to the ability of state and local governments to solve water resource problems.

The second phase included an 1) analysis of water resource availability and quantity versus present and projected water uses and needs to the degree necessary to define the general nature and types of actions and measures necessary to meet those needs; 2) analysis of the adequacy of existing state and local policies, laws, institutions, and programs, considered in the light of federal aids or constraints, to address defined problems; and 3) development of recomendations for new and/or amendatory policies, laws, institutions, and programs to provide an effective water program in Indiana.

The results of the first phase are published in a report entitled *The Indiana Water Resource: Availability, Uses and Needs.* Frequent reference is made to that document in this report. Such references are cited in the form (IWR: AUN, page number).

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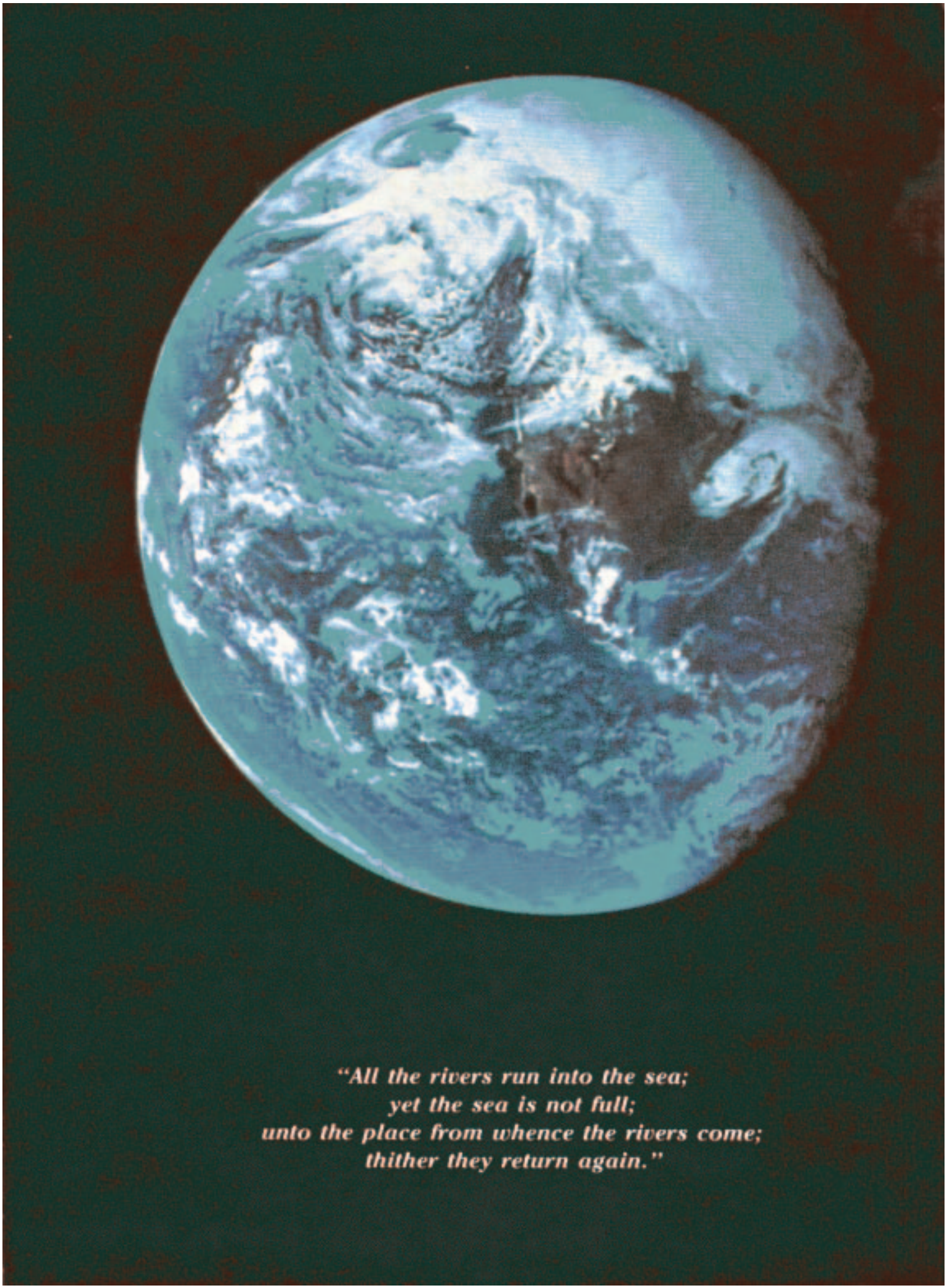
The Indiana Water Resource



"All the rivers run into the sea;
yet the sea is not full;
unto the place from whence the rivers come;
thither they return again."

The Water Resource

General Characteristics and Summary

In the general sense, the amount, physical availability, and mode of occurrence of the water resource is the result of a combination of natural forces and factors that are not subject to substantial alteration by man. It then follows that the State of Indiana must accept this natural regime and formulate its water resource policies and practices in harmony with those natural forces and factors that determine the availability of the water resource. The following discussion of general characteristics concerning precipitation, soil moisture, ground water, and surface water is summarized from the report *The Indiana Water Resource: Availability, Uses, and Needs.*

Precipitation

Although water moves through the closed hydrologic cycle, it is convenient to regard precipitation as the source of supply for Indiana's water. Precipitation on Indiana is a function of the world climate and, more particularly, of the continental climate. Its overall type, amount, and distribution is governed by natural forces beyond the substantial control of man, either now or foreseeably. This is not to say that there are not areas in which local influences exist; for example, those resulting from heat and particulate emmissions from some metropolitan centers and from weather modification efforts. The long-term average precipitation regime for Indiana is such that the supply is well distributed throughout the year and, on an average annual basis, the state receives an ample supply of water. However, despite the overall favorable precipitation supply, as depicted by both long-term annual and monthly averages, there are substantial, sometimes critical, and generally unpredictable variations as to periods of both excess and deficiency. Because precipitation is the source of supply, these variations have direct and relatively immediate impacts. The degree of impact caused by these variations in precipitation depends upon the nature (excess or deficiency), areal extent, duration, and time of occurrence of the precipitation event. Since these variations do occur

and are not subject to substantive control or even advance prediction, it follows that they must be recognized and incorporated in the water resource planning, development, and management process.

Soil Moisture

The general climatic regime of the state, including its length of growing season, and its favorable precipitation, both in amount and time distribution, together with a high proportion of fertile and productive soils, makes Indiana one of the leading states in agriculture. The term *soil moisture* is used to describe that water held or contained within the soil profile. Soil moisture is the source of supply that supports vegetation, including crops. The availability of soil moisture to vegetation, especially during the critical growing season, is dependent directly on precipitation, and is therefore subject to variations in precipitation. Periods of substantial deficiency in precipitation can and do result in loss or reductions in crop yields. The phenomena of precipitation deficiencies during the growing season is responsible for the expanding practice of agricultural irrigation in those areas where suitable soils and available water supplies exist. Periods of excess precipitation may result in excessive soil moisture, and are particularly detrimental to those soils having either poor internal drainage characteristics or that have not been provided with adequate drainage facilities, or both. The impacts resulting from excess soil moisture may be no less severe in terms of effects upon crop yields and consequent economic loss than those from periods of deficient supply.

Ground Water

Ground water is defined as water that occurs in those unconsolidated and bedrock formations which, because of their physical characteristics, are capable of absorbing, storing, and transmitting water. Such formations are known as aquifers. The source of supply to ground water, commonly called recharge, is that portion of the precipitation that infiltrates through the soil profile and migrates under the influence of gravity into the aquifer.

As noted previously, precipitation is subject to substantial variations in time, space, and amount. It therefore follows that ground-water recharge is subject to the same variability. In addition, ground-water recharge is generally limited during the growing season when most of that precipitation which enters the soil profile is utilized by vegetation through the process of evapotranspiration. Recharge is also limited when the ground is frozen.

Thus ground-water availability depends upon the presence and relative capability of the aquifers; upon precipitation with all its attendent variations as a source of supply; and upon the capacity of the overlying soils to absorb precipitation. Further, and unlike natural streamflow, ground-water availability is influenced by the volume of water stored in the aquifer. Such storage is a function of the porosity, permeability, areal extent, and saturated thickness of the aquifer. The role of aquifer storage is substantially comparable to that of surface water impoundments, where stored water serves as the supply during periods when the rate of use exceeds streamflow.

Surface Water

Surface water is defined as water in streams, lakes, and reservoirs. It has three components of supply: (1) the portion of precipitation that falls directly upon the lake or stream, (2) diffused surface water, and (3) the ground-water contribution to streamflow. As will be noted in the following discussion, each of these supply components is either directly or ultimately reflective of precipitation.

The portion of precipitation that falls directly upon the lake or stream is self-explanatory. Obviously, such supply occurs only during precipitation events, and depends upon the amount of precipitation and the areal extent of the stream or lake upon which it falls. On an average annual basis, precipitation upon a body of water is approximately equal to its evaporation.

Diffused surface water is defined as the portion of precipitation that falls at rates in excess of the infiltration capacity of the land surface and flows vagrantly over the land surface to find its way to a watercourse. The term diffused surface water indicates its intermittent and transient character. It is directly dependent upon precipitation and upon its time and mode of occurence, intensity, duration and areal extent. Diffused surface water is not directly available for use, but is the major source of supply to surface water.

The ground-water supply component to surface water results from aquifer discharge into streams and lakes. Its relative contribution to surface water is reflective of ground-water availability. The effects of variations in precipitation, while very real, are delayed and muted with respect to the ground-water contribution to streamflow because of the modifying effect of ground-water storage.

Thus, water in watercourses is primarily dependent upon the components of diffused surface water and ground-water discharge. Diffused surface water contributes approximately seventy to seventy-five percent of the average annual surface water yield on a statewide basis. As noted, the diffused surface water supply is intermittent, of short duration, highly variable in amount as to a specific event and generally unpredictable as to specific time of occurrence. Diffused surface water is almost entirely responsible for the high degree of variability in natural streamflows.

Of vital importance is the fact that the streamflow resulting from the diffused surface water component occurs as sporadic medium to high flow events of relatively short time duration. Further, these flows pass through the stream system and outside the boundaries of the state in a matter of a few days to a few weeks. Thus, in the natural system, these flows are available for use only intermittently and for short time spans. On the other hand, the ground-water contribution is the basic source of supply to the low flow regime, thereby sustaining those flows that are present on a more or less continuing basis.

Conclusion

On the basis of the foregoing general characteristics of the water resource, the Commission concludes that:

> *Indiana has a single water resource. It is composed of the inter-related elements of atmospheric moisture, precipitation, soil moisture, evapotranspiration, diffused surface water, surface water (water in lakes and watercourses), and ground water.*

SUMMARY OF WATER AVAILABILITY

Recognizing that the water resource and its availability in time, mode of occurrence, quantity, and geographic location is subject to the operation of the general principles and characteristics noted in the previous section, it is desirable to summarize in general terms the availability of water throughout the state.

Precipitation

As stated, precipitation is the source of supply for Indiana's water resource. The gross long-term supply of water, in the form of precipitation, amounts to a statewide annual average of 38 inches per year, ranging from 36 inches in the north to 44 inches in southern Indiana. Approximately 26 inches is returned to the atmosphere through direct evaporation and transpiration by vegetation. The remaining 12 inches represents the long-term average annual net supply of the water resource. Approximately 8.4 to 9.0 inches of the net supply is diffused surface water, while the remaining 3.0 to 3.6 inches constitutes recharge to the ground-water system and is eventually contributed to streamflow. The net annual supply of the water resource ranges from 10 to 18 inches from northern to southern Indiana (IWR: AUN, p. 26).

Ground Water

In general, the ground water resource of northern Indiana can be classified as being good to excellent, and exclusive of areas bordering Lake Michigan, eastern Allen County, Benton, southern Lake, Jasper and western White Counties, properly constructed individual well yields of from 200 to 2,000 gallons-per-minute can be expected in most areas. Major areas of availability are found in the Silurian-Devonian bedrock aquifer system, in inter-till sand and gravel aquifers, and in sand and gravel deposits along the St. Joseph, Elkhart, Pigeon, Fawn, Eel, and Tippecanoe River valleys (IWR: AUN, p. 34).

In the central portions of the state, ground-water conditions range from fair to good, with properly constructed individual well yields in the range of 100 to 400 gallons-per-minute. Both outwash sands and gravels and limestone and dolomite bedrock are utilized. Major ground-water sources are found in the valleys of the West Fork of the White, Whitewater, Eel, and Wabash Rivers and in portions of the valleys of Eagle, Fall and Brandywine Creeks and Blue River (IWR: AUN, p. 34).

Large areas of the southern part of the state are particularly lacking in ground water and only limited amounts, generally less than 10 gallons-per-minute, are available. The major sources in this area of the state are confined to the valleys of the Ohio, Wabash, Whitewater and Eel Rivers and the White River and its East and West Forks (IWR: AUN, p. 34).

Surface Water

The availability of surface water is a complex subject and, with respect to any given type and amount of use, must ultimately be addressed in a local or site-specific sense. Overall, it has been noted that the long-term average annual runoff

for the state is about 12 inches, with a range from 10 to 18 inches from north to south. This, combined with inflows from interstate streams and that available from Lake Michigan and the Ohio River, represents the sum total of the available water resource.

Examination of the data from stream gaging stations with a reasonable period of record indicates average annual flows of about 460,000 to 610,000 gallons-per-day-per-square-mile of drainage area occur in those streams within the Upper Mississippi drainage basin; from 470,000 to 690,000 in the Great Lakes basin; from 500,000 to 860,000 in the Wabash River basin; and from 659,000 to 850,000 in the Ohio River drainage (exclusive of the Wabash basin). It should be noted that, because of generally increasing precipitation from north to south, watersheds in southern Indiana have higher overall basin yields than those in northern Indiana.

However, the total yield of a watershed is only one of the important parameters. Equally important, from the standpoint of the availability and utility of natural streamflow, is the distribution of flow throughout the year. Since the low flows are derived basically from the ground-water supply, the more favorable flow distribution is found in those areas possessing the best ground-water characteristics. Thus, streams in the ground-water rich areas of extreme north-central Indiana have higher and more dependable sustained flows than those in the ground-water poor regions of southern Indiana.

Two special cases of surface water availability are the Ohio River and Lake Michigan. The Ohio River constitutes the 357 mile southern boundary of the state, involving twelve counties. The average flow of the Ohio River is 73,680 million-gallons-per-day at Louisville. Low flows of the Ohio River are augmented by an extensive system of reservoirs in the upriver watershed.

A portion of Lake, Porter and LaPorte Counties lies in Lake Michigan, and hence Indiana has the use of that water, at least within that portion of the state lying within the Lake Michigan drainage basin. The capability of the lake to supply water within that area poses no physical limitations to use.

In summary, the long-term supply of surface water in Indiana is very substantial. However, individual streams may experience wide fluctuations in flow. As a result, many withdrawal uses, depending largely upon the rate of withdrawal and the degree of dependability required, can be met only by the use of supplemental storage.

Water Quality

The chemical quality of the ground water in the state is generally good, meeting most of the basic requirements for household, municipal, industrial and irrigation uses. However, these waters are normally hard, exceeding 180 parts-per-million in most cases. Some form of iron or manganese treatment is required in many areas.

Surface water quality is managed by the Indiana Stream Pollution Control Board pursuant to both federal and state law. Water quality standards are based upon the seven day, once in ten year low flow of the receiving stream. With the exception of accidental spill events, direct discharges during extreme precipitation events by communities having combined sewage and storm-water drainage systems, and stream segments immediately downstream from the outfalls of the major wastewater

treatment plants, most of the surface waters of Indiana are within the water quality standards. Therefore water quality does not usually pose any limitations to the availability of the resource for withdrawal uses.

Conclusions

With respect to availability, the Commission concludes that:

(1) The overall availability of the water resource is both substantial and adequate. It is, however, characterized by a high degree of variability in mode of occurrence, in geographic location and in availability with respect to time.

(2) Water resource planning and management are necessary to overcome the problems of variability so as to enable the resource to meet present and projected needs.

EXISTING WATER RESOURCE UTILIZATION

It is useful and convenient to classify the utilization of the water resource into the two broad categories of instream uses and withdrawal uses. Instream uses are defined as those that utilize water in place in streams, lakes and reservoirs. Hence such uses involve only the surface water component of the water resource, not ground water. Instream uses consist generally of commercial navigation, hydroelectric power generation, recreational boating, fish and wildlife habitat, swimming, wastewater assimilation, and general environmental and aesthetic values. In addition, streams serve the major instream functions of drainage and the discharge of flood waters. Withdrawal uses are defined as those uses which involve the physical removal of water from its ground or surface source. Examples of such withdrawals include those for the purpose of municipal, industrial and rural water supplies, irrigation and the generation of energy. Withdrawal uses may be classified further as to consumptive and non-consumptive uses. Consumptive uses are those which, because of evaporation, transfer out of the basin of origin, incorporation into manufactured products, or other processes, preclude the return of some or all of the withdrawn water to its source. Non-consumptive uses, as the term implies, are those in which the withdrawn water is returned to the source of supply essentially undiminished in volume.

Instream Uses

Indiana is served by two of the major inland waterway systems of the United States, the Great Lakes-St. Lawrence River system and the Ohio-Mississippi Rivers system. Both serve to provide Indiana industries and farmers with access to efficient, low-cost transportation.

The northwest Indiana heavy industrial complex was located primarily because of the availability of water transportation and access to a very large and dependable supply of water. In addition to the essentially industrial Indiana, Gary and Buffington Harbors, the Port of Indiana in Porter County provides the state with one of the newest and most modern general cargo port facilities on the Great Lakes system. Michigan City harbor is now primarily used for fishing and recreational craft.

The Ohio River navigation system provides Indiana shippers access to a waterway system serving most of the central and south-central United States, including ports on the Gulf of Mexico. The Ohio River system has recently been improved with new locks and dams suited to modern navigation. The two new Indiana ports under development at Jeffersonville and Mount Vernon are expected to provide outstanding facilities for Indiana shipping, both imports and exports.

A very minor amount of hydroelectric power is generated in Indiana. The largest and only modern plant is that of Public Service Indiana, located in the Markland Dam on the Ohio River in Switzerland County with a capacity of 81 megawatts. The Indiana and Michigan Electric Company has two small plants on the St. Joseph River in St. Joseph and Elkhart Counties totalling 7.7 megawatts. The Northern Indiana Public Service Company has two small plants on the Tippecanoe River in White County totalling 17.6 megawatts.

Recreational boating, including such related activities as fishing, pleasure cruising, skiing, and canoeing, is very popular in Indiana. An estimated twenty-six percent of the population participate in boating, nine percent in skiing, eight percent in canoeing, and forty-five percent in fishing. A total of 169,620 boats were registered in Indiana in 1979. This does not include canoes and other small craft not subject to registration. It should be noted that only the few large rivers of the state and those lakes and reservoirs more than 300 acres in size are available for power boating in the normal sense of that term. Canoeing is not nearly so restricted in the sense of area and depth limitations, but because of seasonal flow characteristics, is generally feasible only on the larger creeks in addition to the waters available to power boating.

The major recreational activities, fishing and hunting, are based in whole or in part upon the fishery and the riparian habitat. The fishery is, of course, dependent upon the aquatic habitat provided by streams and lakes. Its quality is a function of water availability and quality, cover, and the food chain. Lakes and streams in Indiana typically support populations of warm water fish and the food chain necessary to sustain those populations. The best aquatic habitat is found along the major streams, with the smaller streams seemingly more sensitive to the impacts of land use. However, some small waterways in the forested areas of south-central Indiana and in the Pigeon and Elkhart River basins of north-central Indiana provide aquatic habitat of high quality.

The Indiana fishery has been enhanced by the introduction of salmon in Lake Michigan, intensive management practices, the creation of new lakes, and by generally improving water quality. The fishery resource attracts more than one million fishermen to make some 34 million fishing trips per year.

The riparian habitat along streams serves to help support both upland game and seasonal waterfowl. There are an estimated 200,000 acres of wetland remaining in the state. These are predominately located in the northern two tiers of counties and in a narrow band along the Ohio River, with some scattered areas along the Wabash River. The open-water types, comprising about fifty percent of the total, possess the highest fishery value, while shallow marshes, accounting for about twenty percent of the total, possess the highest wildlife values.

A very important instream use is that for wastewater assimilation. All streams serve this function with respect to non-point sources of pollution. A great many others serve as the receiving waters for municipal and industrial discharges. Although current water quality management programs have a goal of zero discharge of pollutants, that objective will not be reached in the foreseeable future, if ever, although vast strides have been made in relation to past practices. It is reasonable to assume that there will always be a residual pollutant discharge, together with that from non-point sources, which the stream will have to receive. Assimilative capacity is a function of streamflow. Hence the better the flow characteristics of the stream, the better it is equipped to handle the pollution load imposed upon it.

In summary, instream uses play a vital role for a variety of purposes. The ability of the stream to sustain these uses is a function of streamflow, especially during the low-flow regime.

Withdrawal Uses

A statewide summary of water withdrawals and consumptive uses for major purposes is shown in Table 1.

TABLE 1

The 1977 water withdrawals and consumption rate in millions-gallons-per-day

Water Use	Withdrawal	Consumption*
Public Water Supply	353	68
Industrial Self Supply	3,456	146
Rural Water Supply	147	147
Irrigation	196	196
Energy	9,492	48
Coal Processing	9	9
Oil Well Injection	1	1
Total	13,854	615

* Does not include water considered as consumed due to the transfer out of the basin of origin.

The largest single water withdrawal use in Indiana, about 9.5 billion-gallons-per-day, or almost sixty-nine percent of the total withdrawal, is for electric power generation. Once-through cooling, the typical practice for all plants constructed prior to recent imposition of thermal standards, requires vast quantities of water. Withdrawals of 300 million-gallons-per-day (mgd) or more are common. Because of these high intake requirements, all of the generating stations in Indiana use surface water. All large plants are located along major rivers having good rates of sustained flow. These large plants are located along the Wabash River downstream from Attica, on the White River and its West Fork, on the Kankakee River, on the Ohio River, and on the shore of Lake Michigan. The largest number of plants are found along the Ohio River.

The second largest category of withdrawal uses is that for self-supplied industrial water. This use totals 3.4 billion-gallons-per-day, or approximately twenty-five percent of the total withdrawals. Importantly, about 3.1 billion-gallons-per-day, or some eighty-nine percent of self-supplied industrial water, is utilized by the heavy industrial complex in north-western Indiana and is withdrawn from Lake Michigan. As might be expected, the remaining 364 mgd of self-supplied industrial withdrawals are primarily (seventy-eight percent)

centered in and around South Bend, Fort Wayne, Lafayette, Anderson-Muncie, Indianapolis and Terre Haute. With the exception of the north-west area, the major source of self-supplied industrial withdrawals is ground water.

The third largest category of withdrawals, consisting of 553 mgd (or about four percent of the total withdrawals) is for public water supply. Approximately fifty-one percent of the water distributed by the public water supply utilities is withdrawn from surface water sources. The remaining forty-nine percent is withdrawn from ground water. Usually, only those utilities with limited access to adequate quantities of ground water rely upon surface sources. Thus the majority of utilities withdraw water from aquifers (IWR: AUN p. 54). However, the four largest utilities in the state, serving the Indianapolis, Gary-Hobart, Fort Wayne, and Evansville areas, obtain at least ninety-five percent of their supply from surface sources.

The principal areas using surface sources are extreme north-west Indiana (Lake Michigan), Fort Wayne (St. Joseph River), Evansville-Mount Vernon (Ohio River), Indianapolis and Muncie (West Fork White River and tributaries), and a relatively large area in south-central Indiana where ground water is very limited.

A large number of rural water systems have been constructed in the approximate southern one-third of the state since 1960 (IWR: AUN p. 55). These systems, while capable of supplying only domestic household needs, are very popular in this area of general ground-water deficiency, replacing unreliable wells and cisterns. These systems are generally supplied from a public water supply utility or from wells in one of the major river valley aquifers.

The most rapidly increasing withdrawal use is for agricultural irrigation, with some 64,400 acres irrigated in 1977. In Indiana, irrigation is practiced on coarser grained, reasonably well drained soils that do not hold soil moisture well. This causes deficient soil moisture during the peak growing season of July and August, adversely affecting agricultural yields. Irrigation is a seasonal water use that varies from year to year depending upon the amount and distribution of rainfall during the growing season. Those soils which produce increased yields from irrigation are found in northern Indiana in the Kankakee River Valley and along the St. Joseph and Elkhart Rivers. There is also a corridor of suitable soils along the Wabash River, the Blue River, and both forks of the White River (IWR: AUN p. 59). Water for irrigation is withdrawn either from wells or from nearby surface streams, depending upon local water availability. In the flat, sandy soils of the Kankakee valley a special form of irrigation known as water table control is practiced by controlling the elevation of water in drainage ditches in or adjacent to irrigated fields. Irrigation is also practiced on small acreages of specialty crops throughout the state and on golf courses. It should be noted that irrigation withdrawals usually coincide with the periods of declining streamflows and ground-water levels. The drier the agricultural season, the greater the demand for irrigation withdrawals.

Some water is developed in the state on an individual basis for rural residential use and livestock watering. In most cases, ground water is the source for these individually small household uses, with numerous ponds serving livestock.