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ELKHART RIVER BASIN INDIANA

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Prepared by: State of Indiana
 Department of Natural Resources
 Department of Commerce
 State Board of Health

U.S. Department of Agriculture
 Soil Conservation Service
 Forest Service
 Economic Research Service

U.S. Department of Interior
 Geological Survey

U.S. Army Corps of Engineers
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Great Lakes Basin Commission

August 1976



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REPORT ON
WATER AND RELATED LAND RESOURCES

ELKHART RIVER BASIN

INDIANA

Prepared by

STATE OF INDIANA

Department of Natural Resources
Department of Commerce
State Board of Health

UNITED STATES DEPARTMENT OF AGRICULTURE

Economic Research Service
Forest Service
Soil Conservation Service

U.S. DEPARTMENT OF THE INTERIOR

Geological Survey

U.S. ARMY CORPS OF ENGINEERS

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PREFACE

The Elkhart River Basin Study was requested by the Indiana Department of Natural Resources in May 1969 after having received letters of support for such a study. These letters were from local officials in the four counties involved. In June 1969, the Soil Conservation Service requested authority for the U.S. Department of Agriculture to participate in the study. The request was supported by U.S. Congressmen representing the area. In July 1970, USDA received authorization to share responsibility of the study with the State of Indiana.

The nature and scope of this study dictated that study activities be pursued consistent with policy and procedures of participating federal, state and local agencies. To assure compatibility with objectives of citizens within the Basin, the Citizens' Advisory Group, representing local individuals, organizations and units of government was organized as part of the study structure. The Citizens' Advisory Group participated in seven (7) public meetings within or near the Basin. These meetings provided opportunities for the citizens to express opinions or ideas and provide information about resource problems and needs within the Basin. These public meetings were sponsored by the Coordinating Committee which consists of the heads of participating state and federal agencies.

In addition to the public meetings, representatives of participating federal agencies exchanged information and coordinated their work among themselves and with appropriate state agencies. This process resulted in the formulation of alternatives to meet identified needs.

Periodic meetings of task forces which consisted of representatives of the federal and state agencies and the Citizens' Advisory Group, were held to assemble and exchange pertinent data and to review progress of the study. These meetings were held throughout the study in an effort to insure that consideration would be given to views of the state and local units of government, as well as individual citizens and organizations.

Comments and suggestions received from federal, state and local agencies and from individuals and organizations in regard to the Preliminary Draft Report of November 1974 and the Final Draft Report of May 1975 have been considered. Appropriate changes have been incorporated in this report which identifies the water and related land resources within the region and the problems or need associated with those resources. The actions listed in the various alternatives should be considered opportunities for development. This report does not lead directly to implementation. It does provide a framework of compatible actions which can be implemented as programs and/or resources become available and local support is evident. The identified actions will become a reality only with local leadership and local decisions that the Basin's resources should be utilized for the betterment of the human and natural environment.

ELKHART RIVER BASIN

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I. SUMMARY

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CHAPTER I. SUMMARY

A. Objective and Scope of Study

The Elkhart River Basin Study was authorized for cooperative Federal-State technical assistance to the Basin residents, due to a keen interest of local and state authorities in consolidating planning efforts to analyze the water and land related resources of the area. The study provides physical and economic information about the Basin, including problems and needs, identification of alternative projects and programs to meet those needs, evaluation of alternatives, and the application of multiple-objective planning within the limitations of the data available.

This report is not intended to be an all-encompassing problem-solving effort. Rather, to the extent that data were available, alternative actions are provided to help meet major problems which require cooperative effort among local, state and/or federal agencies and the Basin residents. The alternatives show ways in which requirements for water and land-related goods and services can be provided, as well as meeting specific demands for satisfying environmental quality considerations. Recommendations for development are included to show how different actions for different purposes can be compatible. However, each recommended action can be implemented independently without jeopardizing the feasibility or practicality of other actions.

B. Size and Location of the Basin

The Elkhart River Basin comprises approximately 700 square miles of north-central Indiana, and is part of the St. Joseph River Basin, most of which lies in the State of Michigan. The Elkhart River Basin lies within the boundaries of four Indiana counties - Elkhart, Kosciusko, LaGrange and Noble.

C. Problems and Needs

Proper use and management of land for sustained agricultural production is a basic need in the conservation, development, and utilization of land and water resources. About 272,900 acres of agricultural land need adequate treatment with conservation practices. Some land use changes should be considered, primarily a conversion to permanent cover of grass and trees on steep to rolling cropland.

Flooding occurs along most of the Elkhart River main channel and its tributaries affecting about 21,600 acres, but there are few concentrated areas which suffer extensive flood damage. Flooding does occur around many natural lakes and causes damage to existing developments.

Soil erosion is relatively low; however, there are isolated areas where erosion is considered severe. Sediment problems in the Basin do not appear to be as severe as adjoining areas which have higher suspended load discharge in the streams.

The installation of adequate drainage systems is needed on about 34,000 acres of cropland, many of which are situated on individual farms. These areas are situated in small "land-locked" depressions, in low, wet muck areas, or in fields along streams.

There are identified needs for increased recreational opportunities in the Basin, particularly those activities which are considered land-based. Canoeing is the only water-based activity for which an immediate need exists. The Basin is rich in natural water areas and prime wetlands. There is an identified need to protect and maintain the wildlife and/or fish habitat on much of these areas.

D. Findings and Conclusions

In accordance with "Principles and Standards for Planning Water and Related Land Resources" ^{1/} alternatives were developed to satisfy problems and needs identified with the National Economic Development and Environmental Quality objectives. These are identified as Alternate A and Alternate B, respectively, and are discussed in Chapter IX and summarized in Tables IX-2 and IX-3. Elements from those two alternatives were combined to form Alternate C, which includes specific recommended actions to help meet both objectives.

The recommendations for development are discussed in Chapter IX, summarized in Tables IX-4, IX-5 and IX-6, and are itemized below by general categories.

1. Channel work for flood control and increased recreation at the outlets of two natural lakes - Adams (0.3 mile) and Knapp (0.6 mile).
2. On-farm resource management systems to adequately treat 25,800 acres of cropland for drainage.
3. Channel work for flood control and drainage in parts of Turkey Creek (6.7 miles) and Solomon Creek (4.6 miles).
4. Channel work for flood control and drainage on 2.2 miles of Carrol Creek and 2.7 miles of Wagner Court Ditch.
5. Riverside recreation development along Elkhart River between Elkhart and Goshen for public recreational use (12 miles - 620 acres).

^{1/} Water Resources Council, "Principles and Standards for Planning Water and Related Land Resources", Federal Register Vol. 38, No. 174, Part III, Sept. 10, 1973, effective Oct. 25, 1973.

6. Establish environmental corridors along 27 miles (1120 acres) of the Elkhart River and lower Turkey Creek between Goshen and the junction of North Branch and South Branch, along 6 miles (220 acres) of lower North Branch, and along 15 miles (550 acres) of South Branch for protection of the natural and aesthetic qualities of the stream systems.
7. Develop an abandoned railroad right-of-way between Kendallville and Wolcottville for public recreational uses (9 miles - 110 acres).
8. Develop about 1,600 acres of county parks near or adjacent to existing water areas to satisfy a variety of recreational needs.
9. Accelerate the land treatment program by installation of conservation measures to reduce erosion, improve drainage of cropland, and adequately treat about 206,000 acres.
10. Implement land use changes on 23,500 acres of cropland so the land can be managed within its capabilities or limitations for erosion control and economic stability.
11. Establish program to protect the natural, aesthetic, and wildlife values of about 25,000 acres of classified wetlands.
12. Establish program to protect, enhance and maintain the wildlife and fisheries habitat along about 170 miles of stream.
13. Amend or adopt flood plain zoning ordinances, building codes and similar land use control ordinances in seven jurisdictions: Elkhart, Kosciusko, LaGrange and Noble Counties, and the cities of Elkhart, Goshen and Ligonier.

The total estimated average annual beneficial monetary effects of elements satisfying the National Economic Development objective in the NED account of Alternate C are about \$1,230,000, while the total adverse monetary effects are about \$842,000. The total average annual adverse monetary effects of elements satisfying the Environmental Quality objective in the NED account are about \$1,818,000.

When monetary effects are considered in the Regional Development account of Alternate C, the total estimated average annual beneficial effects to the region (state and local) for the NED objective are about \$2,704,000, while the total adverse effects are about \$732,000. Total adverse effects to the region for the Environmental Quality objective are about \$2,297,000. The net monetary effect on the nation for the NED objective is a negative \$1,585,000, while the net effect for the EQ objective is a positive \$479,000.

The recommended accelerated land treatment program has an estimated installation cost of about \$4,315,000, including technical assistance from existing USDA programs.

The recommendations for development, if implemented, would provide about 560 temporary jobs for installation of plan elements, about 11 permanent seasonal jobs in the recreation sector, and about 40 permanent jobs in the agricultural and operation and maintenance areas.

Physical and social effects of Alternate C are summarized in the Environmental Quality and Social Well-Being accounts in Table IX-4. Almost 53,000 acres of flood prone and wetland areas would be dedicated to agricultural, natural or recreational uses. Riparian wildlife and fishery habitat would be maintained on about 255 miles of stream. The application of conservation measures would be accelerated on about 206,000 acres of agricultural land. Smaller land areas will have temporary or permanent land use changes. Over 490,000 recreation visits are projected for the rural and urban population of the Basin.

In addition to the elements in Alternate C, additional recommendations are included in Chapter IX which support the continuation of existing programs or initiation of action under existing authorities.

The following Table I-1 summarizes monetary, physical and social effects of the various categories of elements in Alternate C, as well as relate the elements to program opportunities which may exist. Chapter X provides further discussion of opportunities for development as they relate to USDA, state and local programs or to the need for program development.

TABLE I - 1: SUMMARY OF RECOMMENDATIONS FOR DEVELOPMENT AND PROGRAM OPPORTUNITIES
Elkhart River Basin, Indiana

OPPORTUNITIES FOR DEVELOPMENT	NATIONAL ECONOMIC DEVELOPMENT				ENVIRONMENTAL QUALITY BENEFICIAL AND ADVERSE EFFECTS	REGIONAL DEVELOPMENT				SOCIAL WELL-BEING BENEFICIAL AND ADVERSE EFFECTS	PROGRAM OPPORTUNITIES			
	ANNUAL BENEFICIAL EFFECTS (\$1,000)		ANNUAL ADVERSE EFFECTS (\$1,000)			ANNUAL BENEFICIAL EFFECTS (\$1,000)		ANNUAL ADVERSE EFFECTS (\$1,000)			U S D A	O T H E R		
	REGION	NATION	REGION	NATION		REGION	NATION	REGION	NATION					
Channel Work Adams Lake 0.3 mi. Knapp Lake 0.6 mi. Turkey Creek 2.0 mi. Davison Ditch 4.7 mi. Solomon Creek 4.6 mi. *Carrol Creek 2.2 mi. *Wagner Court Ditch	Flood Prevention Drainage Recreation	7.3 43.1 3.3 53.7	Installation Land Rights OM&R	26.4 7.1 5.0 38.5	1. Stabilize lake level. 2. Eliminate flooding of 13 houses. 3. Improve operation of septic tanks 4. Reduce flooding on 230 lawns and/or gardens. 5. Sustain recreation use of lake through summer months by providing an additional 3285 activity days. 6. Reduce bank erosion on 12.2 miles of stream. 7. Disrupt aquatic ecosystem on 12.2 miles of stream. 8. Continued maintenance on 12.2 miles of riparian wildlife habitat. 9. Add 102.5 acres of permanent wildlife cover. 10. Provide permanent easement on 29.5 acres of wildlife habitat. 11. Destroy 36 acres of riparian wildlife habitat.	Income Flood Prevention Drainage Recreation Wages & Salaries Indirect & Induced	7.3 61.1 3.3 20.2 29.1 121.0	-18.0 -20.2 -29.1 -67.3	Installation Land Rights OM&R	26.4 7.1 5.0 38.5	1. Create 7.0 low to medium income jobs and 5.0 higher income jobs for one (1) year. 2. Create 5.1 low to medium income permanent jobs. 3. Provide 75% flood damage reduction to Solomon Creek, Turkey Creek and Davison Ditch. 4. Provide 50% flood damage reduction on Adams Lake and Knapp Lake. 5. Reduce frequency and duration of standing water on septic systems at lake cottages. 6. Provide 3285 additional annual activity days of recreation at a natural lake.	2 - PL 83-566 watersheds identified but small enough for local action. Farmers Home Administration (FmHA) loans PL-74-46 Soil Conservation Service (SCS) Technical Assistance for Drainage. Agricultural Stabilization and Conservation Service (ASCS) cost sharing based on annual program provisions	Indiana Department of Natural Resources (IDNR) - lake outlet control County Drainage Boards - channel work	
On-farm resource management systems on 25,800 acres of cropland	Drainage	503.8 503.8	A. Installation OM&R	395.4 24.2 419.6	1. Provide potential for increased agricultural nutrient contribution to streams.	Drainage Indirect & Induced	809.8 370.8 1180.6	-306.0 -370.8 -676.8	Installation OM&R	395.4 24.2 419.6	1. Create 20.4 low to medium income permanent jobs for region residence. 2. Create 178 low to medium income jobs and 44 higher jobs for one (1) year.	PL 74-46 SCS Technical Assistance for Drainage ASCS Cost sharing based on annual program provisions. FmHA loans	County Drainage Board - major drainage systems. Soil and Water Conservation Districts	
Recreation Riverside development 12 miles-620 acres Abandoned railroad R/W 9 miles-110 acres County parks 1600 acres	Recreation	533.0 533.0	Installation Land Rights OM&R	109.9 137.4 136.9 384.2	1. Preserve 620 acres of floodplain for natural or recreational uses 2. Provide 1130 acres of protected area for wildlife. 3. Maintain 17 miles of stream in its natural condition. 4. Disrupt tranquility of rural environment by providing public access and recreation activities for 390,990 recreation visits. 5. Reduce erosion on 400 acres. 6. Extends public access to 17 miles of stream for canoeing and fishing. 7. Change 2330 acres from private to public ownership 8. Provide recreation opportunities for four urban centers and the rural residents. 9. Remove 400 acres from cultivation. 10. Continued maintenance on 17 miles of riparian wildlife habitat and 510 acres of wildlife habitat. 11. Replace 214 acres of wildlife habitat with public recreational facilities.	Recreation Wages & Salaries	533.0 120.0 653.0	-120.0 -120.0	Installation Land Rights OM&R Induced(land rights)	50.4 59.5 68.7 68.7 136.9 17.8 273.8	59.5 68.7 -17.8 110.4	1. Create 6.8 low to medium income permanent jobs for region residents. 2. Create 9.0 low to medium income seasonal permanent jobs for region residents. 3. Create 55.5 low to medium income jobs and 16.0 higher income jobs for one (1) year. 4. Provide restricted use and development of flood prone areas, thereby reducing risk of loss of life. 5. Create 390,990 annual recreation visits for a mix of rural and urban population.	1 - RC&D project FmHA loans Cooperative Extension Service (CES) Technical assistance	IDNR - Land & Water Conservation Fund Program IONR - Trails Program County, City and Town Park and Recreation Boards U.S. Housing and Urban Development (HUD) - Community Development Act Conservancy Districts Federal revenue sharing with local units of civil government
Accelerated Land Treatment Program to reduce erosion and adequately treat: 152,050 acres cropland 22,400 acres grassland 30,980 acres forestland	NOTE: Accelerated land treatment program not evaluated in monetary terms		Installation including technical assistance = 4,314.9 capital cost		1. Reduce erosion and sedimentation on 205,430 acres. 2. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off. 3. Decrease agricultural nutrient contribution to streams. 4. Increase quantity and improve quality of wildlife habitat. 5. Temporary disruption of aesthetic quality and temporary increase in fire hazard from TSI practices.	NOTE: Accelerated land treatment program not evaluated in monetary terms.			Installation including technical assistance = 4,314.9 capital cost			1. Create 5.4 low to medium income permanent jobs for region residents. 2. Create 198 low to medium income jobs and 49 higher income jobs for one (1) year.	PL 74-46 SCS technical and cost sharing assistance 2 - PL 83-566 Watersheds(as above) 1 - RC&D Project FmHA loans Forest Service State & Private Forestry Technical Assistance ASCS cost sharing based on annual program provision CES Technical and Information Assistance	IDNR Forestry Technical Assistance Program IONR Fish and Wildlife Technical Assistance Program Soil and Water Conservation Districts
Change 23,500 acres of Class IV, VI, VII & VIII cropland to non-cropland			Installation for alternate uses Land Rights	220.1 1,043.5 1,263.6	1. Reduce erosion and sedimentation by converting 18,800 acres of Class IV cropland to permanent cover of grass and 4,700 acres of Class VI, VII and VIII cropland to permanent cover of trees 2. Improve water quality by reducing erosion and nutrient contribution from 23,500 acres presently in cropland. 3. Net decrease of agricultural nutrient contribution to streams. 4. Improve wildlife habitat on 18,800 acres for species favoring grass environment and 4,700 acres for species favoring forest environment. 5. Improve riparian fish and wildlife habitat.	Erosion control (land use adjustment)	574.3 574.3	-574.3 -574.3	Installation for alternate uses Land rights Induced (land rights)	220.1 1043.5 654.8 1918.4	-654.8 -654.8	(Region) = -1,344.1 (Nation) = 80.5	PL 74-46 SCS Technical Assistance Forest Service State & Private Forestry Technical Assistance 1 - RC&D Project ASCS cost sharing based on annual program provisions	IDNR Forestry Technical Assistance Program Soil and Water Conservation Districts

TABLE I - 1(cont): SUMMARY OF RECOMMENDATIONS FOR DEVELOPMENT AND PROGRAM OPPORTUNITIES
Elkhart River Basin, Indiana

OPPORTUNITIES FOR DEVELOPMENT	NATIONAL ECONOMIC DEVELOPMENT				ENVIRONMENTAL QUALITY BENEFICIAL AND ADVERSE EFFECTS	REGIONAL DEVELOPMENT						SOCIAL WELL-BEING BENEFICIAL AND ADVERSE EFFECTS	PROGRAM OPPORTUNITIES	
	ANNUAL BENEFICIAL EFFECTS (\$1,000)		ANNUAL ADVERSE EFFECTS (\$1,000)			ANNUAL BENEFICIAL EFFECTS (\$1,000)			ANNUAL ADVERSE EFFECTS (\$1,000)				U S D A	O T H E R
							REGION	NATION		REGION	NATION			
Environmental Corridors Elkhart River and Lower Turkey Creek 27 miles - 1120 acres North Branch 6 miles - 220 acres South Branch 15 miles - 550 acres	Recreation Flood Prevention	133.4 1.0	Installation Land Rights OM&R	10.9 111.4 36.8	1. Protect 1890 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 1890 acres protected area for wildlife. 3. Maintain 56 miles of stream in its natural condition. 4. Disrupt tranquility of rural stream corridors by providing public access and recreation activities for 99,360 recreation visits. 5. Reduce erosion on 60 acres. 6. Extend public access to 29 miles of stream for canoeing and fishing. 7. Remove 60 acres from crop production. 8. Change 1890 acres from private to public ownership. 9. Provide recreation opportunities for two urban centers and rural residents. 10. Temporary disruption of aquatic ecosystem on 20 miles of stream. 11. Continued maintenance on 56 miles of riparian wildlife habitat. 12. Replace 28 acres of wildlife habitat with public recreational facilities.	Recreation Flood prevention Wages & Salaries	133.4 1.0 30.2	-30.2	Installation Land Rights OM&R	5.0 55.7 36.8	5.9 55.7	1. Create 1.8 low to medium income permanent jobs for region residents. 2. Create 2.0 low to medium income seasonal permanent jobs for region residents. 3. Create 7.1 low to medium income jobs for one (1) year. 4. Provides restricted use and development of flood prone areas, thereby reducing risk of loss of life. 5. Creates 99,360 recreation visits for a mix of rural and urban population.	FmHA loans 1 - RC&D Project	IDNR Fish and Wildlife Technical Assistance with cost sharing through federal grants County Park and Recreation Boards IDNR-Natural Streams Program IDNR-Land and Water Conservation Fund Program Local Land Zoning Ordinances
		134.4		159.1					97.5	61.6				
		Net Beneficial Effects = -24.7												
Protect 25,000 acres of classified wetlands			Land Rights Property tax loss	347.3 2.5	1. Protect 25,000 acres of classified wetlands and their related habitat.				Land Rights Property tax loss	236.8 2.5	110.5	1. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the wetlands.	Water Bank Program	IDNR Fish and Wildlife Technical Assistance Program IDNR Wetlands Acquisition Program Local Land Zoning Ordinances
				349.8						239.3	110.5			
		Net Beneficial Effect = -349.8												
Protect, improve and maintain riparian habitat on 170 miles of small streams			Installation Land Rights OM&R	3.3 18.2 17.0	1. Improve stream fisheries and riparian wildlife habitat on 92 miles of stream. 2. Temporary disruption of aquatic ecosystem on 92 miles of stream. 3. Protect and maintain stream fisheries and riparian wildlife habitation on 170 miles of stream and 310 acres.	Wages & Salaries	5.2	-5.2	Installation Land Rights OM&R	3.3 18.2 17.0	38.5	1. Create 0.4 low to medium income seasonal permanent jobs for region residents. 2. Create 2.1 low to medium income jobs for one (1) year. 3. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.		IDNR Fish and Wildlife Technical Assistance Local Land Zoning Ordinances
				38.5						38.5				
		Net Beneficial Effect = -38.5												
Floodplain management program	Flood prevention	4.6	Flood hazard analyses Implementation Administration	3.5 1.2 2.0	1. Preserve 21,600 acres of floodplain for agricultural, natural or recreational uses.	Flood prevention Wages & Salaries	4.6 1.0	-1.0	Flood hazard analyses Implementation Administration	1.2 2.0	3.5	1. Create 0.1 low to medium income permanent jobs for region residents. 2. Allow planned development of flood prone areas at the land use intensity compatible with state law.	5 - PL 83-566 SCS Flood Hazard Studies	Plan Commissions Park and Recreation Boards County Commissioners Cities and Towns
		4.6		6.7						3.2	3.5			
		Net Beneficial Effect = -2.1												
Basin Total**		1,229.5		2,660.0						2,704.3	-1,474.8		PL 74-46 SCS Technical Assistance for land treatment and drainage ASCS cost-sharing based on annual program provisions FmHA loans Forest Service State and Private Forestry Technical Assistance PL 83-566 SCS Small Watersheds - 2 each SCS Flood Hazard Studies - 5 each 1 - RC&D Project Water Bank Program CES Technical and Information Assistance	Department of Natural Resources County and Local: Commissioners Drainage Boards Park & Recreation Boards Soil and Water Conservation Districts Plan Commissions Conservancy Districts Other Federal - HUD - Community Development Act
		Net Beneficial Effect = -1,430.5												
*Effects of these units not reflected in this summary. For further explanation, see Section IX-A, page IX-3														
**Totals differ slightly from Table IX-5 due to rounding.														

II. INTRODUCTION

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CHAPTER II. INTRODUCTION

This report on the Elkhart River Basin is the result of a cooperative Type IV interagency study of the Basin's water and related land resources. The report discusses the availability of the water and related land resources to meet the present and future needs of the Basin, and presents alternative plans for achieving orderly and beneficial utilization, development and conservation of these resources.

A. Purpose of Study

The purpose of the study is to evaluate the water and related land resources, identify problems associated with their use and development, determine present and future needs for resource development, and propose alternative plans for the orderly development of these resources. The items appraised include flooding, watershed protection (land treatment), soil erosion and sedimentation, drainage, irrigation, water supply and water quality, fish and wildlife, and outdoor recreation. Opportunities for development were evaluated in physical, economic and environmental terms, simultaneously.

B. Authority for Study

Authority for USDA participation is the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 83-566, as amended). The Secretary of Agriculture is authorized to cooperate with other federal, state, and local agencies in this investigation of watersheds, rivers, and other waterways to develop coordinated programs. The State of Indiana is authorized to participate through the Indiana Flood Control Act, Chapter 318, Acts of 1945, as amended.

C. Nature of Study

The study included an evaluation of the importance of agriculture and related economic activities in the Basin, the State of Indiana and the nation. Aspects analyzed and projected include land use, output of agricultural products, agricultural employment, and expected shifts of agricultural land to other uses. Projections were made of the need for developing water and related land resources for food production, rural and municipal water supply, and outdoor recreation.

Resource developments required to meet short and long range needs were identified. An early action plan was developed to meet projected needs for the year 1990. Opportunities for meeting long range projected needs for 2020 were considered in lesser detail.

Opportunities and solutions were identified that can be carried out by private groups and individuals, and by the U.S. Department of Agriculture and other federal, state and local agencies under existing authorities, and those activities that should be developed under amended or new authorities. The impact of the proposed programs upon physical, economic, social and environmental factors was evaluated.

Two physical study areas have been used in the analysis and report. The Elkhart River Basin Economic Area includes all of Elkhart, LaGrange, Kosciusko and Noble Counties. The Elkhart River Basin, or Basin, contains only the watershed (hydrologic drainage area) of the Elkhart River. Total area of the Economic Area is 1,795 square miles while the Basin encompasses about 700 square miles. The Economic Area is a geographic base more suitable for discussion of historical, demographic and economic data and future projections. Most basic economic data is available on a county basis.

Basic data pertaining to physical characteristics is more readily obtainable for the Basin area.

D. Description of the Basin

The Elkhart River Basin, comprising approximately 700 square miles in north-central Indiana, is a part of the St. Joseph River Basin. It occupies a portion of Land Resource Areas 98 and 111, the Southern Michigan Drift Plain and the Indiana and Ohio Till Plain, respectively. Topography is flat to strongly rolling. There are numerous natural lakes in the Basin, many of which are in series along the major tributaries.

The 1970 population was 129,295, of which approximately one-half were rural residents. The largest city, Elkhart 1/ had a population in 1970 of 43,152.

Agriculture continues to be an important economic activity in an area where industrial and business growth has been rapid in recent years. General farms are the most common with corn, soybeans, wheat and hay being the principal crops. Many farms also produce livestock, dairy and poultry products. Farm ownership is held by owner-operators to a greater extent than is average for Indiana.

Recreation and tourism are economically important to the area. Many lakes are used extensively for water sports and fishing. Cabins and houses often exist near the shorelines of the lakes. Extensive wetlands are valuable wildlife habitat.

E. Sponsoring and Cooperating Agencies Participating in Study

The U.S. Department of Agriculture participated in accordance with the Memorandum of Understanding among the Economic Research Service (ERS), the Forest Service (FS), and the Soil Conservation Service (SCS), dated February 2, 1956, and revised April 15, 1968. The State of Indiana participated in this study through the Department of Natural Resources, the Department of Commerce, and the State Board of Health. Other participating agencies included the U.S. Geological Survey, the Great Lakes Basin Commission, and the U.S. Army Corps of Engineers.

1/ Partially located in the Basin

F. How Study was Made

A Plan of Work for this study was prepared by the participating agencies of both the U.S. Department of Agriculture and the State of Indiana. The Plan of Work outlined a study structure which consisted of the USDA Field Advisory Committee, Coordinating Committee, Plan Formulation Subcommittee, Public Information Subcommittee, and seven task forces. Interested local citizens and organizations participated as an Advisory Group.

1. The Field Advisory Committee (FAC) guided and coordinated the Department of Agriculture survey activities. This Committee was composed of the State Conservationist, Soil Conservation Service, Indianapolis, Indiana; the Leader, North Central Resource Group, Economic Research Service, East Lansing, Michigan; and the Field Representative, River Basin Survey, Forest Service, Carbon-dale, Illinois. The State Conservationist, SCS, served as chairman of the FAC and by virtue of this chairmanship, he was a member of the Coordinating Committee.

Each of the involved Department of Agriculture agencies was designated responsibility for aspects of the survey which were within their respective capabilities.

2. The Coordinating Committee consisted of representatives from the following agencies:

- Department of Natural Resources, State of Indiana (Chairman)
- Department of Commerce, State of Indiana
- Indiana State Board of Health
- U.S. Dept. of Agriculture, Field Advisory Committee Chairman
- U.S. Department of the Interior, Geological Survey
- Great Lakes Basin Commission
- U.S. Army Corps of Engineers, Detroit District

The Coordinating Committee gave general direction to the study.

3. Membership of the Plan Formulation Subcommittee consisted of representatives from:

- Soil Conservation Service, USDA (Chairman)
- Economic Research Service, USDA
- Forest Service, USDA
- Indiana State Board of Health
- Bureau of Water and Mineral Resources, State of Indiana
- Bureau of Land, Forest and Wildlife Resources, State of Indiana
- Department of Commerce, State of Indiana
- Great Lakes Basin Commission

The Plan Formulation Subcommittee served the function of establishing schedules, reviewing progress, and coordinating study activities. Task force co-chairmen normally attended the Subcommittee meetings to present data developed by the task forces. The Subcommittee developed and evaluated alternative plans and made recommendations to the Coordinating Committee.

4. The Public Information Subcommittee was responsible for the preparation and dissemination of all news releases. Subcommittee members were assigned from the following agencies:

Soil Conservation Service, USDA (Co-chairman)
Dept. of Natural Resources, State of Indiana (Co-chairman)
Department of Commerce, State of Indiana
Indiana State Board of Health
Cooperative Extension Service, Purdue University

This Subcommittee was responsible for the collection of pictures, color slides, visual aids and other information. The Subcommittee also prepared a condensed (summary) version of this report.

5. The task forces were comprised of specialists from several agencies and interested members of the Advisory Group. Task forces were charged with the responsibility of investigating problems and needs within their assigned areas and reporting to the Plan Formulation Subcommittee. Following is a listing of the seven task forces, the agencies that provided representatives, and a brief description of the general assignments:
 - a. Task Force #1, Economic and Demographic, Co-chaired by representatives of Economic Research Service, USDA, and Department of Natural Resources, State of Indiana. This task force developed data for the projection of population, employment, income and land use. These projections were used by other task forces to determine requirements for the conservation, utilization and management of water and related land resources.
 - b. Task Force #2, Hydraulics and Hydrology, Co-chaired by representatives of Soil Conservation Service, USDA, and Department of Natural Resources, State of Indiana. This group inventoried data on streams, lakes and ground water for use in analyzing flooding, water supply, water quality, recreation, and related fish and wildlife resources. The hydrologic effects of project proposals were studied and these results made known to other study participants.
 - c. Task Force #3, Fish and Wildlife, Co-chaired by representatives of Soil Conservation Service, USDA, and Department of Natural Resources, State of Indiana. This task force inventoried fish and wildlife resources. Studies were conducted on the utilization of these resources. Estimates were prepared on future demands, and the effects of considered land and water resource development plans were analyzed.

- d. Task Force #4, Environmental and Recreational, Co-chaired by representatives of Department of Natural Resources, State of Indiana, and Soil Conservation Service, USDA. The existing land and water oriented recreation resources and facilities were inventoried. Future outdoor recreation needs were determined and used in making estimates of the Basin needs for water and related land resources required to satisfy these demands.

Adverse environmental sites were inventoried. Historical, archaeological and natural sites were listed with associated needs and potentials for their preservation, protection and enhancement.

Proposed land and water resource projects were studied by this task force in view of determining their effects upon the environmental and recreational values in the Elkhart River Basin.

- e. Task Force #5, Water Supply and Water Quality, Co-chaired by representatives of Soil Conservation Service, USDA, and Indiana State Board of Health. This group compiled the requirements for all water uses. Inventories were compiled on water quality related data. The task force considered various alternative means for meeting the water supply needs. This task force was also responsible for preparing the data on electric power generation in the Basin.
- f. Task Force #6, Land Resources, Co-chaired by representatives of Soil Conservation Service, USDA, and Department of Commerce, State of Indiana. This task force obtained and analyzed data regarding existing land use, future demands for land and the effects of resource development plans upon the land. Mineral resources data were obtained and analyzed by this task force.
- g. Task Force #7, Flood Damage Reduction, Co-chaired by representatives of Department of Natural Resources, State of Indiana, and Soil Conservation Service, USDA. Responsibilities of this group included: delineating flood plains, establishing current and projected average annual flood damages, and studying alternative plans and programs for flood damage reduction and drainage improvement.

In addition to the co-chairmen, the task forces included up to ten additional members. These members were drawn from the agencies named above, and in addition, the Forest Service, USDA; Purdue University; Indiana University; and the Agricultural Research Service, (USDA) were represented.

6. The Advisory Group was comprised of people with varied occupations, including representatives of special interest groups; soil, water, fish and wildlife, and recreation enthusiasts; university employees; and county officials. Many of these people are residents of the Elkhart River Basin and volunteered to serve in consultant capacities with task forces. This group supplied local input to the study at the

Coordinating Committee meetings as well as through task force activities.

The study participants utilized available published and unpublished data as indicated in the bibliography and developed additional data as needed. The Elkhart River Basin was divided into seven hydrologic units for purpose of studying water problems. Field reconnaissance, interview and engineering surveys were conducted. Maps were prepared to show general soil association; ground-water availability; ground-water level; hydrologic stations; wildlife habitat classification; fishery habitat classification; flood plains; and recreation, historic, scenic, and natural areas.

G. Use That Can be Made of Report

This report will be used by the State of Indiana in the formulation of the Elkhart River Basin portion of the State Water Plan. The survey will assist the U.S. Department of Agriculture in making the most effective use of its land and water conservation and development programs. It will also serve as a guide in coordinating water and related land resource development programs and projects of local, state and federal agencies, and private groups and individuals. The identification of problems, needs and opportunities presented in this report can be one of the tools used in planning for optimum water and related land resource development. Planners can avoid conflicts by considering the data and information presented.

The basic data collected and used in this study are on file at the Soil Conservation Service, Suite 2200, 5610 Crawfordsville Road, Indianapolis, Indiana 46224; U.S. Forest Service, Forestry Science Laboratory, Southern Illinois University, Carbondale, Illinois 62901; Economic Research Service, 1405 South Harrison Road, East Lansing, Michigan 48823; and State of Indiana, Department of Natural Resources, State Office Building, 100 North Senate Avenue, Indianapolis, Indiana 46204.

H. Acknowledgements

In addition to the agencies actively participating, cooperation, data and assistance were provided by the following, to whom appreciation is hereby expressed:

- U.S. Department of Agriculture
 - Agricultural Stabilization and Conservation Service
 - Farmers Home Administration
 - Statistical Reporting Service
 - Extension Service
 - Agricultural Research Service

- U.S. Department of the Interior
 - Bureau of Outdoor Recreation
 - Fish and Wildlife Service

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

State Agencies
Indiana State Highway Commission

Other
Soil and Water Conservation Districts
Purdue University
Indiana University
County Officials
Local Residents
South Bend (Ind.) Audubon Society

III. ENVIRONMENTAL SETTING - BASIN RESOURCES

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CHAPTER III.

ENVIRONMENTAL SETTING-BASIN RESOURCES

A. Physical Data

1. Location, Size, Cities, Population, and Relation to Other River Systems.

The Elkhart River Basin is located in northeastern Indiana, 130 miles north of Indianapolis, and encompasses about 447,360 acres (about 700 square miles) in parts of four counties (Elkhart, Kosciusko, LaGrange, and Noble). Drainage flows are predominately westward and north-westward. The Basin extends about 40 miles in an east-west direction and from approximately 13 miles in a north-south direction near its center to as much as 20 miles at the east and west ends of the Basin. (see Plate 1).

Principal cities and towns and the 1970 population for each are: Elkhart 43,152 1/; Goshen 17,171; Kendallville 6,838; Nappanee 4,159 1/; Ligonier 3,034; Syracuse 1,546; Albion 1,498; Rome City 1,354; Milford 1,264; and Wolcottville 915. Basin population is 129,295 of which approximately one half are rural residents.

Adjacent river systems are: the St. Joseph River Basin to the north, the Maumee River Basin to the east, the Tippecanoe River Basin on the south, and the Kankakee River Basin on the west.

In addition to the Elkhart River Basin as described above, the four-county area of Elkhart, Kosciusko, LaGrange, and Noble is used in this report. This four-county area is referred to as the Elkhart River Basin Economic Area (Plate 1) or the Economic Area, and comprises 1,165,200 acres (see Table III-1). The use of the Economic Area is necessary because a large part of the basic information for this study is available only on a county basis.

2. Soil and Water Resource Problems

Proper use and management of land for sustained agricultural production is a basic need in the conservation, development, and utilization of land and water resources. Some land use changes should be considered, primarily a conversion to permanent cover of grass and trees on steep to rolling cropland.

Flooding occurs along most of the Elkhart River main channel and its tributaries, but there are few concentrated areas which sustain extensive flood damage. Flooding does occur around many natural lakes, and causes damage to existing developments.

Soil erosion is relatively low; however, there are isolated areas where erosion is considered severe. Sediment problems in the Basin do not appear to be as severe as adjoining areas which have higher suspended load discharge in the streams.

1/ Part of these cities lie outside of the Basin boundary.

TABLE III - 1: LAND DISTRIBUTION
Elkhart River Basin and Economic Area, Indiana

Land Use	Economic Area <u>1/</u>		Basin <u>2/</u>	
	Acres	Percent <u>3/</u>	Acres	Percent <u>4/</u>
<u>Inventory</u>				
Cropland	776,261	66.6	303,060	67.8
Pasture	102,545	8.8	32,790	7.3
Forest	100,932	8.7	41,310	9.2
Other	53,869	4.6	28,130	6.3
Sub-Total	1,033,607	88.7	405,290	90.6
<u>Non-Inventory</u>				
Urban and Built-up	106,843	9.2	31,700	7.1
Small Water Areas <u>5/</u>	8,250	0.7	1,710	0.4
Sub-Total	115,093	9.9	33,410	7.5
Inland Water <u>6/</u>	16,500	1.4	8,660	1.9
Total	1,165,200	100.0	447,360	100.0

Source: Indiana Soil and Water Conservation Needs Inventory (1968) and Bureau of Census.

1/ Total area of Elkhart, Kosciusko, LaGrange and Noble Counties.

2/ Total hydrologic (watershed) drainage area of the Elkhart River.

3/ Percent of total Economic Area.

4/ Percent of total Basin.

5/ Areas less than 40 acres and streams less than one-eighth mile wide.

6/ Areas larger than 40 acres and streams greater than one-eighth mile wide.

Drainage needs exist on numerous cropland areas, many of which are situated on individual farms. These occur in small "land-locked" depressions, in low, wet muck areas, or in fields along streams.

There are identified needs for increased recreational opportunities in the Basin, particularly those activities which are considered land-based. Canoeing is the only water-based activity for which an immediate need exists. The Basin is rich in natural water areas and prime wetlands. There is an identified need to protect and maintain the wildlife and/or fish habitat on much of these areas.

3. Land Resource Base

The Elkhart River Basin Economic Area encompasses approximately 1,165,200 acres or nearly five percent of the State of Indiana. Land available for agriculture and forestry production reflects the importance of these land uses in the area. About 1,033,607 acres or almost 89 percent of the total area is utilized for agriculture and forestry. Cropland comprises 776,261 acres, pastureland 102,545 acres, forest land 100,932 acres, and other agricultural land 53,869 acres as shown in Table III-1. Over 94 percent of Noble County is classified as currently being utilized for agriculture and forestry, whereas only 83 percent of Elkhart County is classified as being utilized for agricultural purposes.

The remaining 131,593 acres are classified as being utilized for non-agriculture purposes. Urban and transportation acreage of 106,843 acres is the largest land use category in the non-agricultural use. Elkhart County is the most urban-oriented county with 46,844 acres, or over 15 percent of the county being classed as being used for urban or transportation uses. Another 3,600 acres of Elkhart County is in water areas. When combined, the urban and transportation, in addition to the water area, account for over 38 percent of the non-agricultural land use in the Economic Area. Kosciusko County has the most water area with 14,400 acres or over 53 percent of the water area in the Basin.

The 48 conterminous states of the United States have been divided into 156 major land resource areas. A land resource area (LRA) is a large geographic unit of land with similar characteristics of soil, climate, geology, vegetation, topography, and agricultural development. These areas are comprised of lands which are similar with regard to the types and severity of soil management problems encountered. Contracts between land resource areas are usually, but not always, distinct and readily discernible.

These 156 major land resource areas have been grouped into 20 land resource regions. The major consideration in this grouping has been to retain as much similarity as possible in the general characteristics of agriculture within each region.

The Elkhart River Basin includes portions of two land resource areas which are in two different land resource regions. Land Resource Area 98,

Southern Michigan Drift Plain, bisects the Basin on a north-south axis and comprises slightly less than half the Basin area. It is a part of the Lake States Fruit, Truck and Dairy Region. The eastern half and northwestern corner of the Basin are in Land Resource Area 111, Indiana and Ohio Till Plain, which is a part of the Central Feed Grains and Livestock Region.

Within these two land resource areas the soils of the Elkhart Basin have been grouped into 11 soil associations. These soil associations, along with brief descriptions, are shown on the General Soils Map, Plate 3. Soil associations are delineated on the basis of the predominant soils and their characteristics. There are, of course, usually several other soils mapped within each association.

A further means by which soils are grouped and categorized is the capability classification system. In this system soils are grouped according to their potential and limitations for agricultural production. It is a method whereby soils can be grouped and recommendations made in regard to their use, treatment, and management. The capability classification system consists of three major categories: (1) capability class; (2) capability sub-class; and (3) capability unit.

a. Land Capabilities

The broadest category in the classification system places all soils in one of eight capability classes which are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, and are defined as follows:

- Class I - Soils with few limitations that restrict their use.
- Class II - Soils with moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Class III - Soils with severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV - Soils with very severe limitations that restrict the choice of plants, require very careful management, or both.
- Class V - Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland or wildlife food and cover.
- Class VI - Soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

- Class VII - Soils with very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.
- Class VIII - Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

The capability classes are further divided into sub-classes based on the principal limiting problem. They are designated by adding a small letter "e", "w", "s", or "c" after the capability class numeral.

The letter "e" indicates that the main limitation is risk of erosion; "w" shows that excess water in or near the soil surface interferes with plant growth or cultivation; "s" indicates that the soil is limited mainly because it is shallow, droughty, or stoney and "c" is used in some parts of the country (not the Elkhart Basin) where the climate is a limiting factor. In capability Class I there are no sub-classes because these soils have few, if any, limitations.

Capability units are the most detailed grouping in the classification system. The soils in any one capability unit are similar enough to be suited to the same crop and pasture plants, to require similar management, and to be similar in productivity and other responses to management. They are usually designated by adding an Arabic numeral after the capability class and sub-class designations as IIe6 or IIIw6. Class I soils may be divided into capability units even though they have no capability sub-class designation; e.g. I-1 and I-2.

b. Land Use by Capability Class

Table III-2 shows the present major land use by capability class for the Elkhart River Basin. Only a little more than 2 percent of the area, or 8,650 acres, is Class I land. There are 5,540 acres of Class I cropland, all of which are suited for a wide range of plants and requires only good management for sustained intensive cultivation.

Class II land is predominant and comprises 192,290 acres or approximately 60 percent of the Basin area, accounting for over 63 percent of the Basin cropland. For use as cropland, these soils require conservation practices such as residue management and annual cover crops on the 83,200 acres of "e" sub-class soils and the 14,330 acres of "s" sub-class soils, and adequate drainage on the 94,760 acres of "w" soils, which are presently in cropland.

Approximately 27 percent of the area consists of Class III soils which accounts for a corresponding portion of the Basin cropland acreage. The 47,510 cropland acres in Class III soil with an erosion

TABLE III-2: MAJOR LAND USE BY CAPABILITY CLASS 1/
Elkhart River Basin, Indiana

Land Use	Soil Class			
	I	II	III	IV
	Acres <u>2/</u>	Acres	Acres	Acres
Cropland	5,540 (1.83)	192,291 (63.45)	81,716 (26.96)	18,806 (6.21)
Pastureland	430 (1.31)	19,138 (58.37)	8,099 (24.70)	1,472 (4.49)
Forest land	1,588 (3.84)	22,292 (53.96)	9,167 (22.19)	3,955 (9.57)
Other	1,095 (3.89)	10,213 (36.30)	10,719 (38.10)	2,078 (7.39)
Total	8,653 (2.13)	243,934 (60.19)	109,701 (27.07)	26,311 (6.49)

Land Use	Soil Class			
	VI	VII	VIII	Total
	Acres	Acres	Acres	Acres
Cropland	3,617 (1.19)	873 (.29)	215 (.07)	303,058
Pastureland	1,987 (6.06)	574 (1.75)	1,088 (3.32)	32,788
Forest land	2,944 (7.13)	---	1,363 (3.30)	41,309
Other	1,898 (6.75)	395 (1.40)	1,737 (6.17)	28,135
Total	10,446 (2.58)	1,842 (.45)	4,403 (1.09)	405,290

Source: Indiana Soil and Water Conservation Needs Inventory (1968)

1/ Does not include non-inventories acreage: federal non-cropland, water areas, urban built-up - 42,070 acres.

2/ Figures in parenthesis refer to the percentage of major land use within capability class.

hazard ("e"sub-class) show a strong need for contour farming, stripcropping, terraces, and diversions along with conservation cropping systems.

There are 25,280 acres of IIs soils in cropland, more than half of which need annual cover crops, crop residue management, or sod in the rotation and grassed waterways. The IIIw soils in cropland comprise 8,920 acres and need improved drainage in addition to conservation cropping systems for more efficient agricultural production.

Class IV soils comprise about 6 percent of the Basin area and a corresponding percentage of the Basin cropland. There are 15,835 acres of these soils with an erosion hazard in cropland on which the major needs are strip-cropping, terraces, diversions, and in some cases a change to permanent cover of grass or trees. There are 2,970 cropland acres of IVw soils which need drainage improvement and conservation cropping systems in order to efficiently remain in crop production.

There is no Class V land in the Basin.

About 3 percent of the Basin area is Class VI land, which is only slightly more than 1 percent of the cropland. The 2,540 cropland acres of VIe soils are in need of a land use conversion to permanent cover of grasses or trees.

There are 1,080 acres of VIw soils in cropland which need improved drainage or a change to a less intensive land use, either pasture or forest land.

Less than one-half of 1 percent of the Basin area is in Class VII land which comprises less than 1 percent of the Basin cropland. These areas comprise 873 acres of cropland, all of which are subject to severe erosion.

Class VIII lands comprise slightly more than 1 percent of the Basin area and less than one-tenth of 1 percent of the Basin cropland. Only 220 acres is in cropland, all of which are "w" soils and need to be changed to permanent cover of grasses or trees.

c. Soils

The General Soils Map (Plate 3) gives a visual reference to the variations of soils and associated geology. Opposite the General Soils Map is an interpretive Plate 2 (Soil Interpretations) that refers to the soils in the Basin.

Each of the soil associations in the Basin are described below:

(1) Oshtemo-Fox Association

Nearly level and sloping well drained, loamy soils formed in outwash sand and gravel.

The landscape consists of outwash plains, terraces and valley trains that are predominately nearly level with long narrow slopes on terrace breaks. This association occupies about 22 percent of the Basin.

The Oshtemo soils are nearly level to strongly sloping and well drained. They have a surface layer of dark grayish-brown sandy loam and a subsoil that is dark brown sandy loam and loamy sand.

Fox soils are nearly level to strongly sloping and well drained. They have a surface layer of dark grayish-brown loam and a subsoil that is dark brown clay loam and gravelly clay loam.

(2) Morley-Blount-Rawson Association

Sloping, well drained, clayey Morley, nearly level and somewhat poorly drained clayey Blount formed in glacial till and sloping, moderately well drained, loamy Rawson formed in outwash or lake-deposited sand and silt.

The landscape consists of a glacial moraine that is gently rolling. This association occupies about 13 percent of the Basin.

Morley soils are gently sloping to strongly sloping and moderately well drained. They have a surface layer of very dark grayish-brown and grayish-brown silt loam and a subsoil that is mostly dark yellowish-brown and brown clay and is mottled in the lower part.

Blount soils are nearly level and somewhat poorly drained. They have a surface layer of very dark grayish-brown and dark grayish-brown loam or silt loam and a subsoil that is mostly dark brown and dark grayish-brown mottled silty clay and clay.

Rawson soils are gently sloping to moderately sloping and moderately well drained. They have a surface layer of dark brown loam and a subsoil that is dark brown sandy clay loam in the upper part and brown clay that is mottled in the lower part.

(3) Blount-Haskins-Pewamo Association

Nearly level, somewhat poorly drained, clayey Blount and very poorly drained, clayey Pewamo formed in glacial till and somewhat poorly drained, loamy Haskins formed in outwash or lake-deposit sand and silt.

The landscape consists of a glacial moraine that is gently rolling with some depressional areas near drainage ways. This association occupies about 0.5 percent of the Basin.

Blount soils are nearly level and somewhat poorly drained. They have a surface layer of very dark grayish-brown and dark grayish-brown loam or silt loam and a subsoil that is mostly dark brown and dark grayish-brown, mottled silty clay and clay.

Haskins soils are nearly level and somewhat poorly drained. They have a surface layer of dark grayish-brown loam and a subsoil that is brown and grayish-brown sandy clay loam in the upper part and grayish-brown mottled clay in the lower part.

Pewamo soils are depressional and nearly level and very poorly drained. They have a surface layer of very dark gray silty clay loam and a subsoil that is mostly dark gray or grayish-brown mottled silty clay or silty clay loam.

(4) Riddles-Miami-Fox-Crosby Association

Sloping, well drained, loamy Riddles and Miami and nearly level, somewhat poorly drained, clayey Crosby formed in glacial till and sloping well drained loamy Fox formed in outwash sand and gravel.

The landscape consists of glacial moraines and till plains, kames, kame moraines, and valley trains that are rolling or hummocky with nearly level areas at the lower elevation. This association occupies about 49 percent of the Basin.

Riddles soils are gently sloping to strongly sloping and well drained. They have a surface layer of dark grayish-brown sandy loam and a subsoil that is mostly dark brown sandy clay loam in the upper part and brown and dark yellowish-brown in the lower part.

Miami soils are gently sloping to strongly sloping and well drained. They have a surface layer of dark grayish-brown loam and a subsoil that is dark brown clay loam.

Fox soils are gently sloping to strongly sloping and well drained. They have a surface layer of dark grayish-brown loam and a subsoil that is dark brown clay loam and gravelly clay loam.

Crosby soils are nearly level and somewhat poorly drained. They have a surface layer of dark grayish-brown silt loam and a subsoil that is yellowish-brown mottled clay loam.

(5) Fulton-Bono-Rimer-Lenawee Association

Nearly level, somewhat poorly drained, clayey Fulton and loamy over clayey Rimer and very poorly drained clayey Bono and Lenawee all formed in lake deposits.

The landscape consists of a glacial lake plain that is dominantly nearly level with occasional slight rises. A few sloping areas in the landscape are near deeply dissected streams. This association occupies about 1 percent of the Basin.

Fulton soils are nearly level and are somewhat poorly drained. They have a surface layer of dark grayish-brown silty clay loam and a subsoil that is mostly grayish-brown mottled silty clay.

Bono soils are nearly level and very poorly drained. They have a surface layer of black silty clay loam and a subsoil that is dark gray silty clay.

Rimer soils are nearly level and somewhat poorly drained. They have a surface layer of dark grayish-brown loamy fine sand and a subsoil that is dark brown and grayish-brown mottled loamy fine sand and fine sandy loam in the upper part and dark grayish-brown clay in the lower part.

Lenawee soils are nearly level and very poorly drained. They have a surface layer of very dark brown silty clay loam and a subsoil that is dark grayish-brown and grayish-brown mottled silty clay loam.

(6) Volinia-Dickinson Association

Nearly level, well drained, loamy soils formed in outwash sand and gravel.

The landscape consists of glacial outwash plains and terraces that are dominantly nearly level with occasional slight rises. This association occupies about 3 percent of the Basin.

The Volinia soils are nearly level and well drained. They have a surface layer of very dark brown loam and a subsoil that is dark yellowish-brown clay loam in the upper part and dark brown in the lower part.

The Dickinson soils are nearly level and well drained. They have a surface layer of very dark brown fine sandy loam and a subsoil that is dark brown and dark yellowish-brown fine sandy loam.

(7) Miami, Gravelly Substratum Phase Association

Nearly level and sloping, well drained, loam over sandy soils formed in glacial till and the underlying outwash sand and gravel. The landscape consists of glacial moraines and outwash plains that are rolling with nearly level areas at the lower elevations. This association occupies about 1 percent of the Basin.

The Miami, gravelly substratum phase soils are nearly level to moderately sloping and well drained. They have a surface layer of dark grayish-brown loam and a subsoil that is dark brown clay loam.

(8) Carlisle-Linwood-Tawas-Edwards Association

Nearly level, very poorly drained, organic soils formed in shallow to deep organic deposits.

The landscape consists of bogs, depressions or broad depressed flats in lake plains, outwash plains, till plains and glacial moraines. This association occupies about 3 percent of the Basin.

Carlisle soils are depressional, nearly level, and very poorly drained. They have greater than 50 inches of black and dark reddish-brown muck.

Linwood soils are depressional, nearly level, and very poorly drained. They have between 16 and 50 inches of black muck over silt loam.

Tawas soils are depressional, nearly level, and very poorly drained. They have between 16 and 50 inches of black muck over sand or loamy sand.

Edwards soils are depressional, nearly level, and very poorly drained. They have between 16 and 50 inches of black muck over marl.

(9) Homer-Sebewa-Guilford Association

Nearly level, somewhat poorly drained, loamy Homer and very poorly drained, loamy Sebewa and Guilford formed in outwash sand and gravel.

The landscape consists of outwash plains, lake plains, terraces and valley trains that are nearly level with many broad depressions and occasional slight rises. This association occupies about 3 percent of the Basin.

Homer soils are nearly level and somewhat poorly drained. They have a surface layer of dark grayish-brown silt loam and a subsoil that is brown, grayish-brown, and gray mottled clay loam, sandy clay loam and gravelly clay loam.

Sebewa soils are nearly level and are poorly and very poorly drained. They have a surface layer of black loam and a subsoil that is dark gray and grayish-brown, mottled clay loam and gravelly clay loam.

Gilford soils are nearly level and very poorly drained. They have a surface layer of black fine sandy loam and a subsoil that is gray mottled sandy loam.

(10) Brookston-Crosby Association

Nearly level, very poorly drained, loamy Brookston and somewhat poorly drained, clayey Crosby formed in glacial till.

The landscape consists of a glacial till plain that is nearly level with many slight rises. This association occupies about 4 percent of the Basin.

Brookston soils are depressional, nearly level, and very poorly drained. They have a surface layer of very dark gray silty clay loam and a subsoil that is dark gray mottled silty clay loam in the upper part and gray mottled clay loam in the lower part.

Crosby soils are nearly level and somewhat poorly drained. They have a surface layer of dark grayish-brown silt loam and a subsoil that is yellowish-brown mottled clay loam.

(11) Warsaw-Elston Association

Nearly level, well drained loamy soils formed in outwash sand and gravel.

The landscape consists of an outwash plain that is nearly level. This association occupies about 0.5 percent of the Basin.

Warsaw soils are nearly level and well drained. They have a surface layer of very dark brown loam and a subsoil that is dominantly brown sandy clay loam.

Elston soils are nearly level and well drained. They have a surface layer of very dark brown sandy loam and a subsoil that is dark brown sandy loam in the upper part and loamy sand in the lower part.

Detailed soil maps, useful in intensive planning, are available for much of the Elkhart River Basin. Soil surveys have been completed in Noble and Elkhart Counties. Soil surveys are being conducted in Kosciusko and LaGrange Counties with an established date for completion.

d. Geology, Physiography, and Topography

The Basin is characterized by a thick mantle of unconsolidated glacial deposits overlying shale, limestone, and dolomite bedrock. The glacial deposits, known collectively as glacial drift, range in thickness from about 100 feet in the vicinity of Elkhart to nearly 500 feet at the extreme eastern boundary of the Basin. These glacial deposits are primarily responsible for the present landscape.

The Basin is primarily within the Steuben Morainal Lake Area, a complex topographic and physiographic area. This area consists of a complex array of glacial materials including ground-moraine and end-moraine till, lacustrine (lake) deposits, outwash deposits of sand, gravel and silt, and ice-contact stratified drift (see Plate 4). The variety of topographic features is a direct result of these glacial deposits which are typical of the near-ice, ice disintegration environment.

The topography of the Basin may be characterized as nearly level to strongly sloping. Local relief of 100 to 150 feet is not uncommon,

and in some places, exceeds 200 feet. The altitude ranges from about 730 feet above mean sea level at the mouth of the Elkhart River to approximately 1,060 feet (MSL) near the Noble-LaGrange County line at the northeastern Basin boundary.

There are approximately 379,000 acres of mineral soils which occur on the slopes ranging from nearly level to strongly sloping. The remaining 26,290 acres consist of organic soils which occur on nearly level to depressional topography.

Surficial bedrock beneath the glacial drift consists predominantly of shale with some limestone or dolomite (Plate 5). Devonian-Mississippian shales crop out beneath the drift across the northern part of the Basin. Devonian shale with some limestone crops out across the southern part of the Basin. Limestone and dolomite of Devonian age crops out at the bedrock surface in two small areas in the extreme southern part of the Basin and underlies the Devonian and Mississippian shales throughout the Basin. Over 2,000 feet of predominantly limestone, dolomite, and shale of Ordovician and Silurian age underlie the units described above.

e. Mineral Resources

The production of mineral resources has come from the glacial drift deposits of the Basin. Sand, gravel, peat, and marl have been the principal commodities produced in the past. Specific information on mineral production in Indiana is contained in "Bureau of Mines Minerals Yearbook", published annually by the U.S. Department of the Interior. Additional information is available in published and non-published form from the Indiana Geological Survey, Bloomington.

Sand and gravel are the only mineral resources currently produced. In 1970, sand and gravel was produced in all four counties of the Basin.

Peat and marl are two mineral commodities that have declined in importance. Although numerous inactive or abandoned pits or unworked deposits are located throughout the Basin, no production was reported in any of the four counties for 1970. 1/

f. Climatological Data

The climate of the Elkhart River Basin is classed as humid continental. Frequent changes in the weather occur, both from day to day and from season to season. This Basin is in the path of cold air moving out of Canada and warm, moist gulf air

1/ "The Mineral Industry of Indiana" preprint from the 1970 Bureau of Mines Yearbook, U.S. Department of the Interior.

from the south. Frequent eastward passage of cyclonic storms across the Basin cause moderate cloudiness and windiness. Tornadoes can and do occur in the area. See Plate 6 (Hydrologic Data Network) for location of the weather stations.

Summer weather is moderately warm and humid. The freeze free period of a typical year extends from May 1 through October 10 for an average of about 160 days. Winter weather brings severe cold with several days of subzero expected each winter. Snowmelt rarely causes flood flow in Basin streams. Specific climatic data is discussed in the following paragraphs.

(1) Precipitation

Mean Annual. Precipitation, including snowfall, varies from year to year, as well as seasonally within any year. The average annual precipitation for the Elkhart Basin is about 35.0 inches. Table III-3 presents mean annual precipitation data for stations in or near the Basin.

Maximum and Minimum Annual. Extreme values of annual precipitation recorded at two long term gages are 21.7 inches in 1934 at Albion and 50.3 inches in 1954 at Goshen College.

Monthly Distribution. The average monthly precipitation for selected gages is presented on Table III-3 and Figure III-1. The greatest precipitation normally occurs in summer months and the least in the winter months.

(2) Snowfall

Snowfall in the Elkhart Basin may be heavy and will vary from year to year. The mean annual snowfall is about 25 inches and usually occurs from November through April. Data on Table III-4 and Figure III-2 indicate that the heaviest snow usually falls in December or January.

(3) Evaporation

Evaporation and transpiration are important to low flow characteristics and the depletion of water in storage, from both reservoirs and ground-water aquifers. Table III-5 and Figure III-3 show the recorded Class A Pan evaporation for March through November for the Kendallville gage.

(4) Temperature

Mean Annual. The average annual temperature for the Elkhart Basin is about 50 degrees Fahrenheit. Mean daily maximum and minimum temperatures are about 61 degrees and 40 degrees

TABLE III - 3: MEAN MONTHLY AND YEARLY PRECIPITATION
Elkhart River Basin, Indiana

MONTH	GOSHEN					KENDALLVILLE GAGE 13 YEARS RECORD
	ELKHART 10 YEARS RECORD	LAGRANGE GAGE 10 YEARS RECORD	COLLEGE GAGE 45 YEARS RECORD	ALBION GAGE 44 YEARS RECORD		
January	2.09	2.30	1.95	1.98	2.62	
February	1.84	2.57	1.63	1.42	2.15	
March	1.88	2.50	2.57	2.33	2.55	
April	3.66	4.26	3.54	2.95	3.98	
May	3.44	3.34	3.58	3.23	3.61	
June	3.55	3.76	3.60	3.82	4.35	
July	4.06	4.15	3.16	3.19	4.10	
August	4.23	3.76	3.21	3.14	3.61	
September	2.38	2.54	3.16	3.00	3.05	
October	3.39	3.15	2.99	2.86	3.29	
November	2.29	2.69	2.35	2.50	2.82	
December	1.72	2.09	1.95	2.03	2.17	
MEAN ANNUAL	34.53	37.11	33.69	32.45	38.30	

Note: Source materials for climatological data in this report are:

- (1) for precipitation, temperature, snowfall and evaporation data;
(a) Climatography of the U.S., NOAA (National Oceanic and Atmospheric Administration) publications #11-10 and #86-10 (summaries of data for 1931 - 1960).
- (b) Climatological Data for Indiana, NOAA (Data for 1961 - 1970).
- (2) for flood and drought information;

Water Resources Data for Indiana, U.S. Geological Survey.

FIGURE III-1 MONTHLY PRECIPITATION
Elkhart River Basin, Indiana

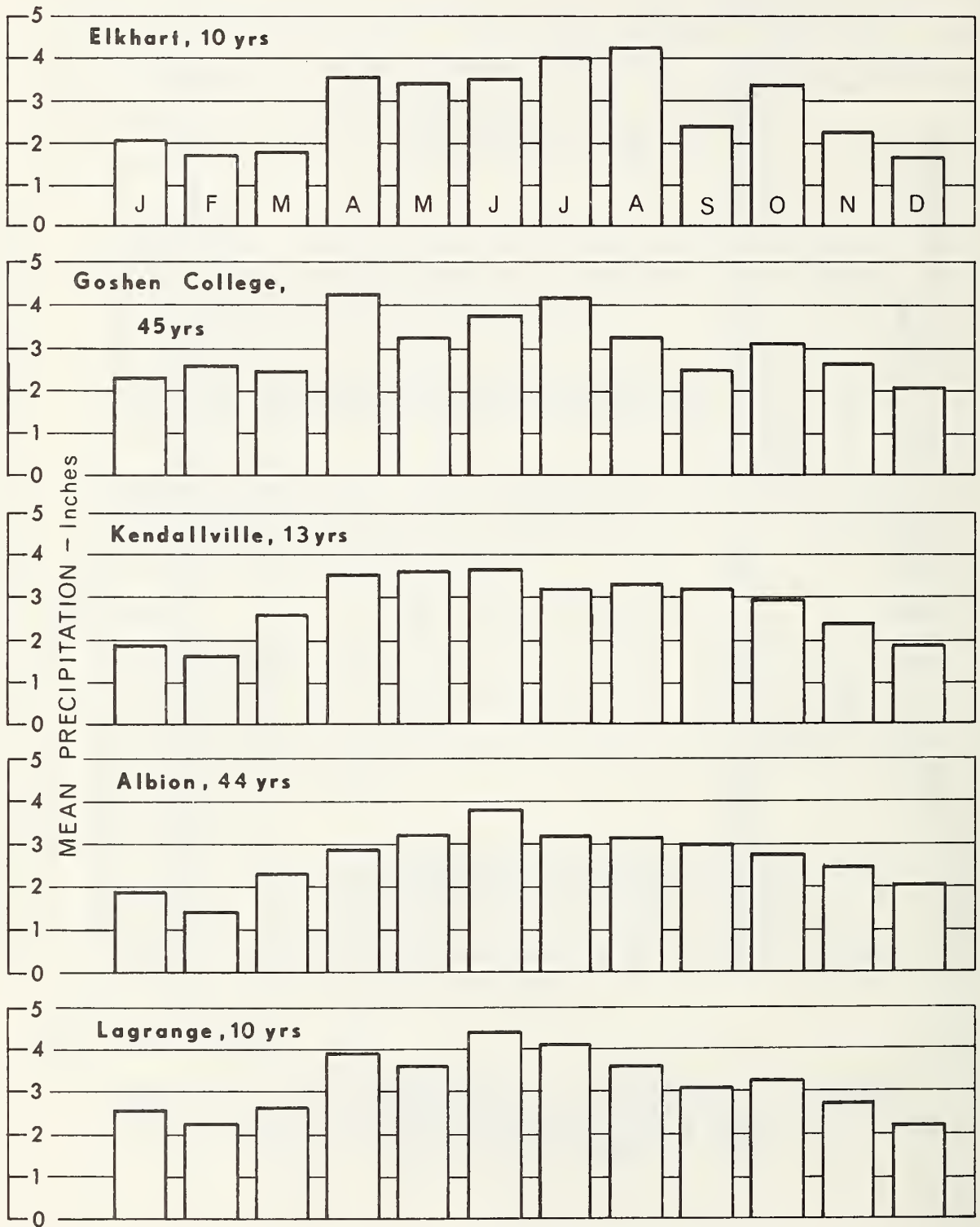


TABLE III-4: MEAN SNOWFALL
Elkhart River Basin, Indiana

MONTH	GOSHEN	
	COLLEGE GAGE 44 YR. RECORD (Inches)	ALBION GAGE 41 YR. RECORD (Inches)
JAN	5.9	7.0
FEB	4.8	5.0
MAR	4.1	4.0
APR	1.3	1.1
MAY	.2	T <u>1</u> /
JUN	T <u>1</u> /	.0
JUL	T <u>1</u> /	.0
AUG	.0	.0
SEP	.0	T <u>1</u> /
OCT	.2	.3
NOV	2.6	2.9
DEC	5.5	6.0
MEAN ANNUAL	24.6	26.3

1/ T - Trace

TABLE III-5: MEAN EVAPORATION
Elkhart River Basin, Indiana

MONTH	KENDALLVILLE GAGE 13 YEARS RECORD (Inches)
JAN	---
FEB	---
MAR	3.30
APR	5.10
MAY	6.27
JUN	7.83
JUL	8.00
AUG	7.17
SEP	5.91
OCT	3.92
NOV	2.07
DEC	---

TABLE III-6: DROUGHTS
Elkhart River Basin, Indiana

STATION	ANNUAL PRECIPITATION		DROUGHT YEAR	DRY MONTHS
	MEAN (Inches)	RECORD LOW (Inches)		
LAGRANGE	37.11	25.60	1953	APRIL-DEC
KENDALLVILLE	38.30	27.64	1953	FEB, SEPT-DEC
GOSHEN COLLEGE	33.69	24.08	1934	FEB, MAY, JULY, AUG, OCT
SOUTH BEND	35.83	25.85	1956	SEPT, OCT
ALBION	32.45	23.98	1953	AUG-DEC
ELKHART	34.53	26.76	1953	SEPT-DEC

FIGURE III-2 MEAN SNOWFALL
Elkhart River Basin, Indiana

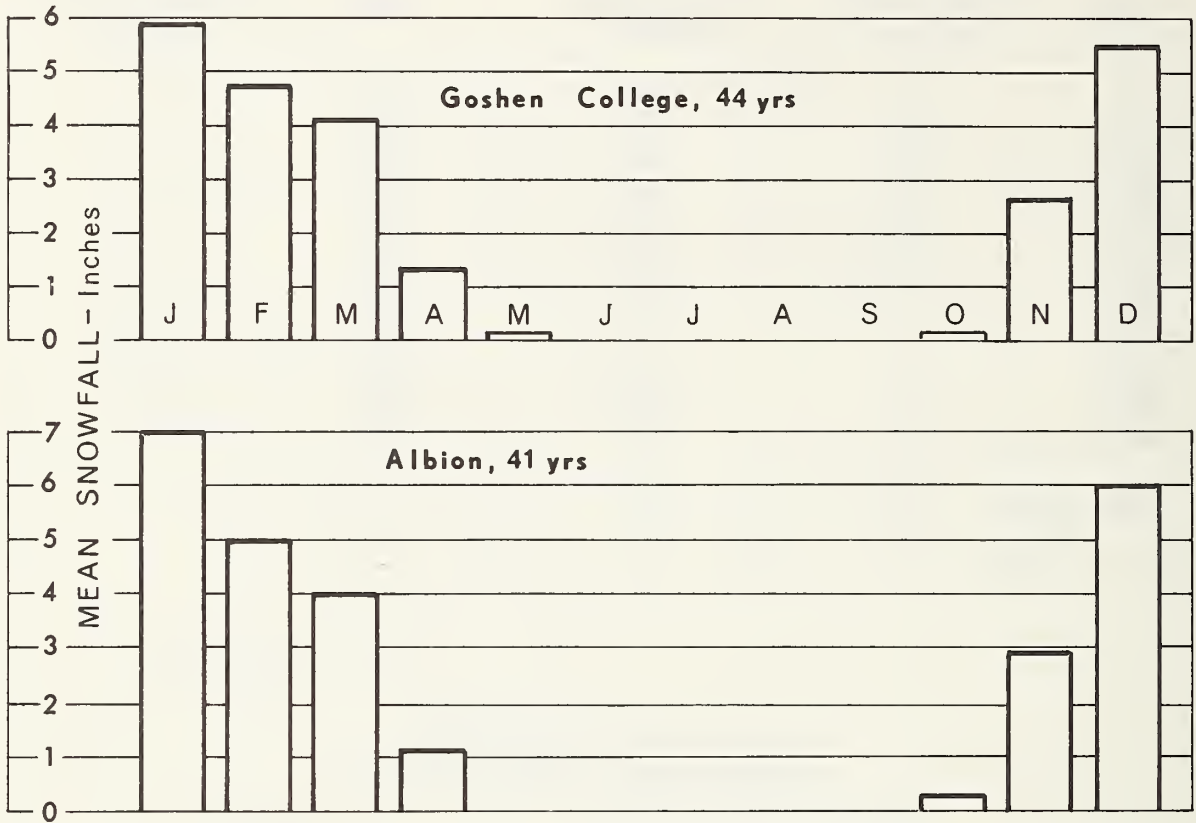
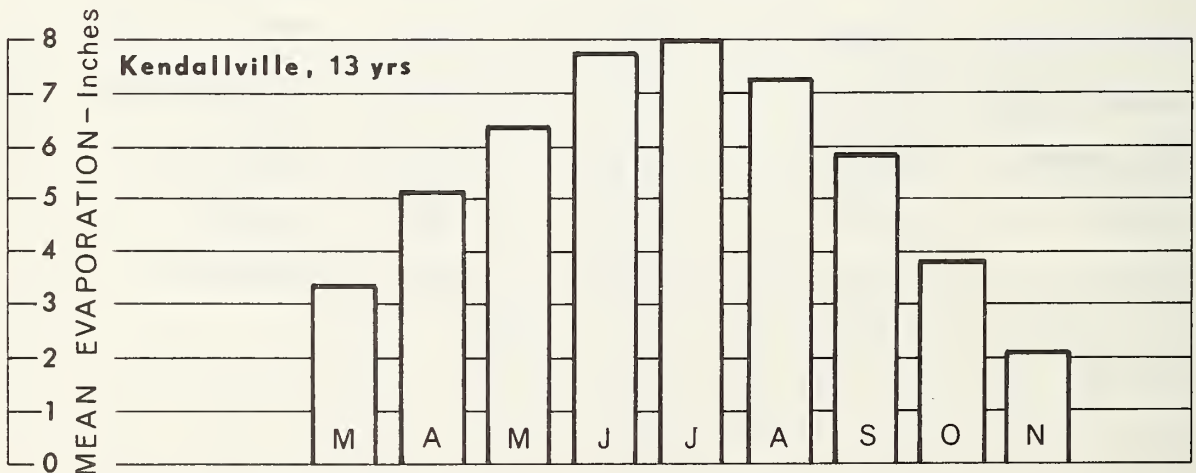


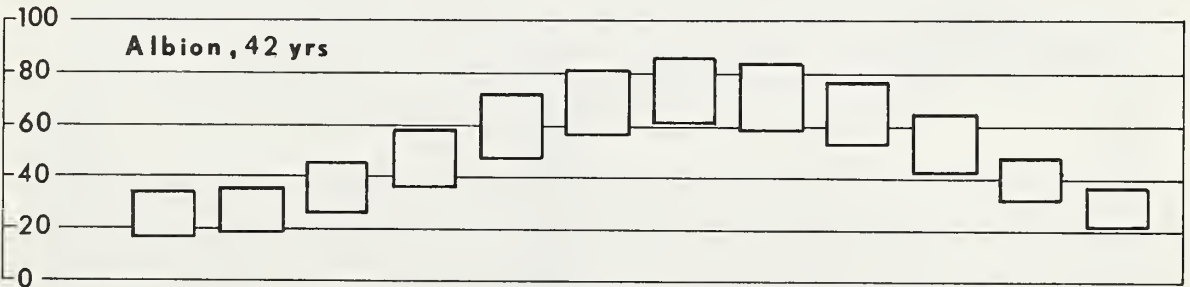
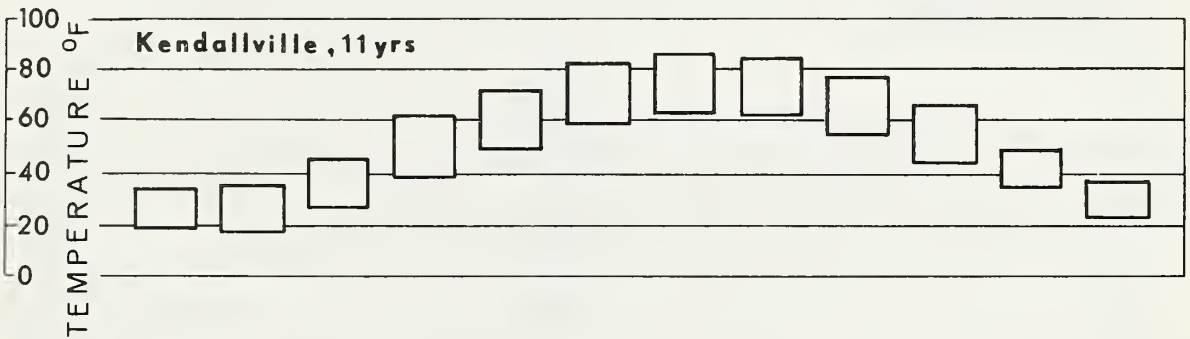
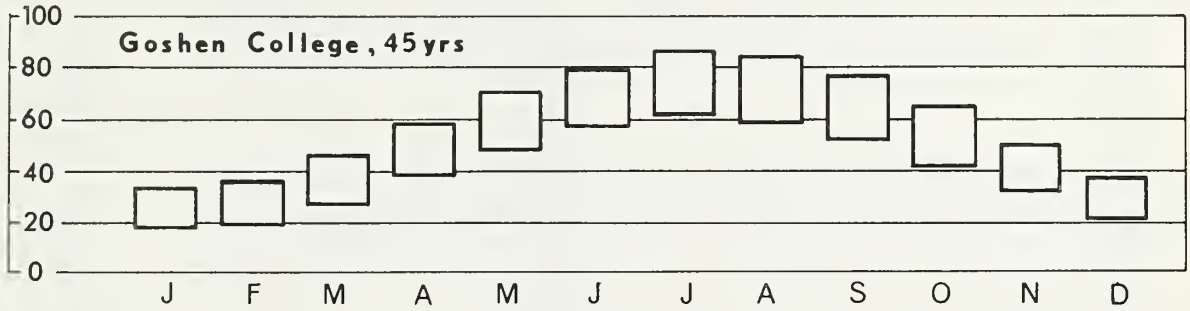
FIGURE III-3 MEAN EVAPORATION
Elkhart River Basin, Indiana



Class A Pan Evaporation
No record for Jan., Feb. and Dec.

FIGURE III-4 MEAN MONTHLY TEMPERATURES

Elkhart River Basin, Indiana



LEGEND



-  — Mean Daily Maximum
-  — Mean Daily Minimum

TABLE III - 7 MEAN MONTHLY TEMPERATURES
Elkhart River Basin, Indiana

GOSHEN COLLEGE GAGE
45 YEARS RECORD

	<u>MEAN DAILY</u> <u>MAX °F</u>	<u>MEAN DAILY</u> <u>MIN °F</u>
	+	
JAN	33.5	16.8
FEB	36.2	19.2
MAR	46.2	26.5
APR	59.7	36.8
MAY	70.8	46.5
JUN	79.1	56.7
JUL	85.6	60.7
AUG	84.2	58.9
SEP	76.5	52.0
OCT	64.8	41.3
NOV	48.6	30.9
DEC	36.2	20.6

KENDALLVILLE GAGE
11 YEARS RECORD

JAN	34.4	19.9
FEB	37.6	21.8
MAR	45.3	26.7
APR	61.0	39.3
MAY	72.1	49.0
JUN	81.9	58.9
JUL	85.5	62.6
AUG	83.8	61.0
SEP	76.6	53.5
OCT	65.8	43.3
NOV	48.2	31.9
DEC	36.9	22.5

ALBION GAGE
42 YEARS RECORD

JAN	32.7	16.7
FEB	35.5	18.6
MAR	45.5	26.4
APR	58.8	37.2
MAY	72.0	47.0
JUN	80.1	57.3
JUL	84.6	60.9
AUG	82.8	59.1
SEP	76.0	52.4
OCT	63.9	41.4
NOV	47.3	30.6
DEC	35.6	20.9

Fahrenheit, respectively.

Monthly Distribution. The average monthly temperature for January is about 26 degrees Fahrenheit and for July 74 degrees Fahrenheit. Graphical presentation of annual and monthly temperature data is shown in Figure III-4 and Table III-7.

Extremes. The lowest recorded temperature was -25 degrees Fahrenheit at the Goshen College gage, and the highest recorded temperature was 111 degrees Fahrenheit at the Albion gage.

(5) Droughts

Dry periods may be caused by the lack of precipitation, excessive evaporation caused by high temperature and dry winds, or untimely distribution of a normally sufficient amount of rain.

Droughts are usually local in nature and largely dependent upon soil characteristics. Crops are seldom ruined, but an economic loss may occur due to reduced yields. Evaporation and transpiration often exceed precipitation in the growing season. Table III-6 shows dry periods of record that have occurred in the Elkhart Basin.

(6) Floods

Using the United States Geological Survey gage on the Elkhart River at Goshen as a guide, the flood of records for the Basin probably occurred in 1950. Large discharges at the Goshen gage have occurred in 1943, 1950, 1951, and 1955 producing 5,090 cfs., 5,440 cfs., 5,260 cfs., and 5,260 cfs., respectively.

4. Land Use and Related Plant Community

The predominant land use in the Basin is cropland which comprises approximately 75 percent of the land area. The row crops of corn and soybeans are predominant, comprising an estimated 68 percent of the cropland. Rotation hay and pasture: primarily alfalfa and red clover in combination with various grasses such as bromegrass, orchardgrass, fescue, and timothy are grown on approximately 15 percent of the cropland. Small grains, primarily wheat and oats, are grown on 16 percent of the cropland. Miscellaneous crops: primarily potatoes, popcorn, and vegetables are grown on the remaining 1 percent of the cropland.

Approximately 41,310 acres (10 percent) of the land is forested. Ninety-seven percent of this area is classified as commercial forest land, i.e., land which is either producing or capable of producing crops of industrial wood and is not withdrawn from timber utilization. The remainder is classified as non-commercial forest land -- either unsuitable for timber growing because of low productivity or because of legal reservations for recreation or other non-timber uses.

With the exception of a small acreage of Christmas tree plantations and some small scattered tracts of planted pines, the primary forest type in the Basin is Northern Hardwoods. The principal timber types in this forest type in the order of their magnitude of occurrence are oak-hickory, maple-beech-birch, elm-ash-cottonwood, pin oak-maple-tamarack, aspen-birch, and pine.

The stand size classes are: 55 percent sawtimber, 19 percent poletimber, 22 percent seedlings and saplings, and 4 percent unstocked.

Grazing damages of varying intensity are occurring on approximately 22 percent of the commercial forest land while damages from erosion, wild-fire, insects, and disease are practically non-existent.

Approximately 8 percent of the area is grassland. The unimproved pastures consist mainly of bluegrass. Improved pastures are established generally as combinations of legumes and grasses which tend to become primarily grasses as the sod becomes more dense and the legumes are crowded out. The more common legumes and grasses include alfalfa, birdsfoot, trefoil, ladino clover, red clover, Kentucky bluegrass, orchardgrass, Reed canary-grass, smooth brome grass, tall fescue, and timothy.

Approximately 7 percent of the Basin land area is in Other land which includes land in farms as well as land not in farms. The land in farms includes farmsteads, farm roads, feed lots, ditch banks, fence and hedge rows. Other land not in farms includes rural non-farm residence lots, investment tracts, and marshes not used for grazing, and similar areas.

The major portion of this Other land is in marshes and is described more fully in Section III-A-7, "Kind and Location of Wetlands". Vegetation in the shallow marshes includes grasses, sedges, smartweed, goldenrod, aster, cattail, and bur reed. Deep marsh vegetation consists mainly of spatterdock and water lily, cattail, bulrushes, spikerushes, various aquatic grasses. Dogwood, willow, buttonbush, blueberry, winterberry, and chokeberry comprise the primary vegetation in the shallow shrub swamps. Deep shrub swamp vegetation includes buttonbush, blueberry, winterberry, chokeberry, dogwood, and willow.

5. Surface Water Resources

a. Streams

The Elkhart River is the outlet for surface water from the Basin. This stream is fed by tributaries whose flow characteristics are perennial by nature, due in part to a substantial contribution from ground-water reservoirs. The main stem of the Elkhart River is formed by the confluence of the North Branch Elkhart River and the South Branch Elkhart River at a point about 3.5 miles east of Ligonier, Indiana. Both branches are streams which exhibit substantial low flow discharges and corresponding temperate peak

discharge. The Elkhart River flows northwestward to the point of discharge into the St. Joseph River at Elkhart, Indiana.

The drainage area of the North Branch is about 163 square miles, and that of the South Branch about 114 square miles. Stream gradient averages 2.8 feet per mile in the main stem above Goshen, Indiana, and 3.9 feet per mile in the North Branch above Cosperville, Indiana.

Knowledge of stream flow characteristics came from stream gage studies of the North Branch near Cosperville, the Elkhart River at Goshen, and the St. Joseph River at Elkhart. While the latter gage record is for the total St. Joseph River Watershed at Elkhart, comparison of this record with the two Elkhart River Basin gages shows similar flow duration and volume frequency characteristics. This is indicative of homogeneity in stream flow traits throughout a large area of northeastern Indiana and southern Michigan. Two stream gages with insufficient record for statistical analyses (established 1969) are located on Forker Creek near Burr Oak and Turkey Creek at Syracuse. In future years, after several years of records have accumulated, these two additional gages will enhance the knowledge of stream flow in this Basin.

The natural stream system in the upper basin is largely comprised of channels connecting the many natural lakes. These channels are inherently shallow streams meandering through marsh lands. Individual stream channels more removed from lakes have been straightened and deepened to facilitate improved drainage of adjacent fields. Principal tributary systems in which this type of channel work has been done are Yellow Creek, Leedy Ditch, Rock Run, Turkey Creek, Solomon Creek, Long Ditch, and Dry Run. No channel work has been done to the North Branch, South Branch, or main stem of the Elkhart River. The Elkhart River was modified at three locations in Elkhart County by placement of dams to provide a head of water for electric power. The largest of these dams is at Goshen where the dam creates a 150 acre lake known as the Goshen Dam Pond. The other dams are of such low height that the pool upstream of each dam is contained within the river banks. Hydroelectric power is no longer produced. The dams, pools, and canals are now property of the Elkhart County Park and Recreation Board and are available for public use.

In addition to marsh lands along the rudimentary streams between lakes, extensive marsh lands are found along the South Branch and along the lower end of Turkey Creek.

The Turkey Creek marsh is partially a result of the outlet being restricted by the Goshen Dam Pond which pools water in the most downstream reach of Turkey Creek. The other factor contributing to this marsh is that the dredging of Turkey Creek did not continue downstream through the last mile of the creek. The South Branch

marsh exists principally because this channel is very shallow with a nearly flat stream gradient. The overbank lands lie so low in comparison to the outlet channel that drainage for agricultural purposes has never been attempted. These wetlands are considered valuable wildlife habitat.

The Mallard Roost Public Fishing Site is owned and maintained by the State of Indiana within the South Branch marsh.

b. Lakes

An important characteristic of the Elkhart River Basin is the large number and variety of natural lakes. These lakes lie principally in Noble, LaGrange and Kosciusko Counties. Total surface area of lakes in the Basin is about 11,000 acres. There are 109 lakes over 10 acres in size with a combined total surface area of 10,219 acres.

Lake size ranges from unnamed, insignificant areas upward to Lake Wawasee, by far the largest lake in the Basin, with a surface area of 3,060 acres. There are no other natural lakes in this Basin with surface areas exceeding 500 acres. Two artificial lakes, Goshen Dam Pond and Sylvan Lake, have 150 and 575 surface acres, respectively. Waterlines of several of the natural lakes are stabilized by low head control dams at the outlet.

The cumulative water surface area of all the lakes represents about two (2) percent of the entire Elkhart River Basin. The deepest lakes are Adams Lake, Dallas Lake and Oliver Lake in LaGrange County which have depths of nearly 100 feet. Most other lakes are considerably more shallow.

The economic impact of the lakes exceeds their proportionate area. Many lakes are used extensively for water sports, fishing and swimming. Wildlife habitat is enhanced by the large areas of marsh adjacent to many of the lakes. Residential development pressures are felt along many waterfronts. Cabins and houses form continuous lines of development near many shorelines. A large number of the more substantial houses are occupied the year around. Youth camps are situated near a few of the larger lakes.

Commercial enterprises to supply the needs of lake residents and others who use the lakes are located throughout the Basin. These businesses add considerable to the economic life of the Basin.

Regulatory authority for lake use and development is vested in county and state governments. Efforts are being put forth to protect the natural environmental values of the lakes and adjacent land areas. However, poor water quality, excessive eutrophication or other problems currently exist at some lakes.

c. Water Quality

The quality of a body of water is defined in terms of the physical, chemical, biological, and bacteriological characteristics of the water and stream bed. These natural characteristics in turn are influenced by the geology and climate of the area, stream flows, land run-off, and various types of water discharges. The significance of these characteristics and their variations depend on the water uses under consideration.

At the present time, there is a water quality monitoring station in the watershed located on the Elkhart River at East Jackson Street in Elkhart. The station was instituted in January 1973, as part of the Indiana Water Quality Monitoring Program and consists of bi-weekly sampling. The 1973 data from this station indicate generally good quality water (see Fig. III-5). An abnormally high biological oxygen demand in August and a high phosphorus reading in February are the only significant deviations from normal. Since 1970, 12 pollution surveys have been conducted within the Elkhart River Basin and 39 biological or limnological surveys have been performed on the Basin lakes and streams. These data are currently being analyzed by the Indiana State Board of Health and will be evaluated in the "Water Quality Management Plan - St. Joseph River Basin". The completion date for this report is scheduled for 1976. Because of this pending "Water Quality Management Plan", a special analysis of these water quality data was not attempted for this Type IV study.

6. Ground-Water Resources

The Elkhart River Basin is situated in an extensively glaciated portion of the state that bears heavily upon the ground-water availability of the area. The major aquifers and aquifer systems 1/ are exclusively in deposits of sand and gravel of glacial origin, and other sources of ground-water are only slightly used. Major sand and gravel aquifers are present in the valleys of the Elkhart River, Solomon and Turkey Creek, and within and below the main body of glacial drift. See Plate 7, Ground-Water Availability Map.

Some deep bedrock aquifers are available; however, because of their greater depth, limited supplies, and general lack of good quality water, they are seldom used. In many areas these aquifers are covered by a thick shale cap and downward movement of water to these sources is restricted.

Glacial deposits cover the entire area, and thickness in excess of four hundred feet are noted locally. Much of the Basin is underlain by glacial deposits to a depth of 250 - 300 feet and contain the significant aquifers of sand and gravel.

Well yields in the Basin are generally good to excellent and supplies of at least 250 gallons per minute (gpm) can be obtained in most areas.

1/ Aquifer systems - The unitizing of water-bearing formation of a similar or common water-yielding characteristic into a single definable unit.

FIGURE III- 5 SUMMARY OF WATER QUALITY DATA,
ELKHART RIVER WATER QUALITY MONITORING STATION,
ELKHART, INDIANA - 1973
Elkhart River Basin, Indiana

Constituent or Characteristic	Minimum	Maximum	Average
Water temp. (°C)	1.	25.	16.
pH, Laboratory	7.0	8.2	7.7
Specific Conductance (micromhos/cm)	450.	740.	600.
Ammonia as N	.10	.60	.24
Arsenic	.010-	.010-	.010-
Biological Oxygen Demand	1.0	20.0	3.3
Cadmium	.010-	.010-	.010-
Chlorides	10.	22.	18.
Chromium (Hexavalent)	.010-	.010-	.010-
Copper	.020	.190	.062
Dissolved Oxygen, Field	7.1	13.3	9.3
Lead	.020	.060	.030
Manganese	.030	.170	.084
Nickel	.020	.110	.040
Nitrates as N	.3	2.1	1.1
Phosphorus	.10	1.3	.23
Suspended Matter	4.	24.	10.
Sulfates	39.0	69.0	56.0
Zinc	.04	.68	.14
Fecal Coliform (number/100 ML)	20.	4100.	1517.
Mercury (parts per billion)	.100	1.100	.192

Milligrams per liter

Note: Parameter values with a (-) sign following the number indicates that the observed value was less than the number indicated.

Source: Unpublished data - Surveys Section, Division of Water Pollution Control, Indiana State Board of Health.

While these areas are generally favorable, the map defining the groundwater availability should not be used to locate specific wells, but to serve in indicating the general potential of the areas and the overall capability of the aquifers to supply water of a given quantity. The areas, while varying within the Basin, can be expected to fall within the parameters defined.

a. Ground-Water Availability

Ground-water supplies are generally good to excellent in much of the Elkhart River, Solomon Creek and Turkey Creek. Elsewhere, major aquifers or aquifer systems are present in the glacial drift sequence that are capable of supplying up to 1,000 gpm to properly constructed wells. Wells with capacities of at least 250 gpm can be obtained in most areas. See Ground-Water Availability Map, Plate 7.

Irrigation is practiced in several areas, but is confined primarily to the Elkhart River, Solomon Creek and Turkey Creek valleys. These areas are underlain by highly permeable deposits of sand and gravel and well yields in excess of 1,000 gpm are noted. The saturated sand and gravel deposits extend to over 70 feet below the land surface. Substantial increases in irrigation are anticipated in these areas.

Some areas of locally limited water supplies are noted in the Basin and more intensive management practices may be required in the future in these sectors, particularly if larger volumes of water are required. A systematic program of testing and development may be required in these areas particularly at the southeast edge of Elkhart, near Kendallville, and in portions of the general area near Nappanee.

Ground-water conditions in the Basin are depicted on the "Ground-Water Availability Map" and while these supplies are generally favorable, the map should not be used to locate specific wells, but to indicate the general development potential of the areas and the expected capability of the aquifers to supply water of a given quantity to large diameter wells.

b. Water Level Map

Ground-water levels are generally near the surface in much of the Basin, averaging about 25 feet below the ground level; however, there are areas near Kendallville and Nappanee where water levels are quite deep, approaching 100 feet or more. The Ground-Water Level Map (Plate 8) depicts the elevation of the ground-water surface throughout the Basin, and defines those areas where

flowing wells are known to be present.

Many of the aquifers are under artesian pressure, being confined by glacial till (hardpan) or lake clays; and when wells encounter these water-bearing zones, the water is under sufficient pressure to rise well above the aquifer. Several prominent areas of flowing wells are noted in the Basin; however, most water levels of artesian aquifers are below the prevailing ground surface.

Water table (unconfined water-level) aquifers are found in the valleys of the Elkhart River, Solomon Creek and Turkey Creek. These aquifers are in the valley-train deposits of sand and gravel, and water levels are free to rise or fall depending upon the prevailing climatic or water level pattern.

In these valleys water levels are near the land surface and usually exist at an elevation above the prevailing stream or river level. This relationship is present in much of the Basin; and exclusive of limited areas, the streams receive water from the ground-water aquifers. These streams are referred to as gaining streams or effluent streams because of the water they receive from the ground due to the higher head and hydraulic gradient of the aquifers discharging into the waterway.

Throughout the Basin the divides of the surface-water drainage and under-ground water generally coincide, and the divides are sufficiently small as to place the divides at virtually the same position.

c. Surface - Ground-Water Inter-Relationship

The relationship between surface and ground-water in the Elkhart Basin is not well understood; however, it is apparent from stream flow data and the available information compiled on the ground-water hydrology that these systems are intimately connected, and most of the streams receive substantial portion of their flow from the ground-water reservoirs. In some segments of the Basin ground-water contribution to the overall flow probably exceeds the 60 percent flow duration. In addition, it is apparent from the map prepared on the ground-water levels that sub-surface diversion may be occurring between hydrologic sub-areas (Plate 12), particularly in the area of the South Branch of the Elkhart River and Solomon Creek, south of Albion.

Low-flow characteristics of the various streams are also a direct reflection of the adjacent aquifer systems and wide ranges in the low flows are anticipated. Turkey Creek near Milford exhibits a high low-flow discharge as compared to other portions of the Basin, and it is expected that variation above and below this mean would occur in other parts of the Basin as the local conditions affect them.

d. Ground-Water Quality

Data on ground-water quality is limited to the chemical analysis performed on raw and treated water of the eleven municipally owned drinking water systems in the Basin. Each of these communities utilizes ground water as its source of supply. Selected chemical characteristics of these sources, as listed in Table III-8 were compiled from the records of the Indiana State Board of Health.

This Table has been arranged to indicate the drinking water quality with relation to certain elements listed in "U.S. Public Health Service Drinking Water Standards - 1962". These include the basic chemicals that determine water quality with respect to palatability and appearance.

Table III-8 lists the communities, with line "A" denoting raw water quality and the range of the test results for the various characteristics and chemicals. Line "B" indicates the range of these same chemicals for the treated water. No treatment of the water supply (other than chlorination) is practiced where line "B" is blank.

This Table indicates that ground-water is generally moderately hard with iron and manganese present in most sources. The presence of such chemicals is not necessarily harmful to humans, but locally may cause some dissatisfaction with such untreated water supplies.

Ground-water resources available to all public water supplies in the Elkhart River Basin appear to be adequate for their present and future requirements. While the quality may not always be desirable to meet the standards, it is possible to correct deficiencies with treatment and continue to utilize this resource. Rural ground-water sources are found to contain most of the same chemical characteristics found in the public supplies.

7. Kind and Location of Wetlands

In the Elkhart Basin, the remaining marshes and swamps are only vestiges of those acreages once present in the area. Even today, however, no other basin in Indiana can equal this Basin in number and acreage wetlands.

These wetlands are regarded as one of the more characteristic and outstanding natural resources of the Elkhart Basin. With over 75,000 acres of marshes and swamps in the Economic Area, wetlands seem to appear almost anywhere and everywhere. However, they occur in greater frequency in three large general areas. The first of these includes the entire Elkhart River drainage of LaGrange County and an equal area to the immediate south in Noble County near Kendallville and Rome City. The second major area, entirely in Noble County, is roughly bordered by Highways 5, 6, 9, 33 and 8.

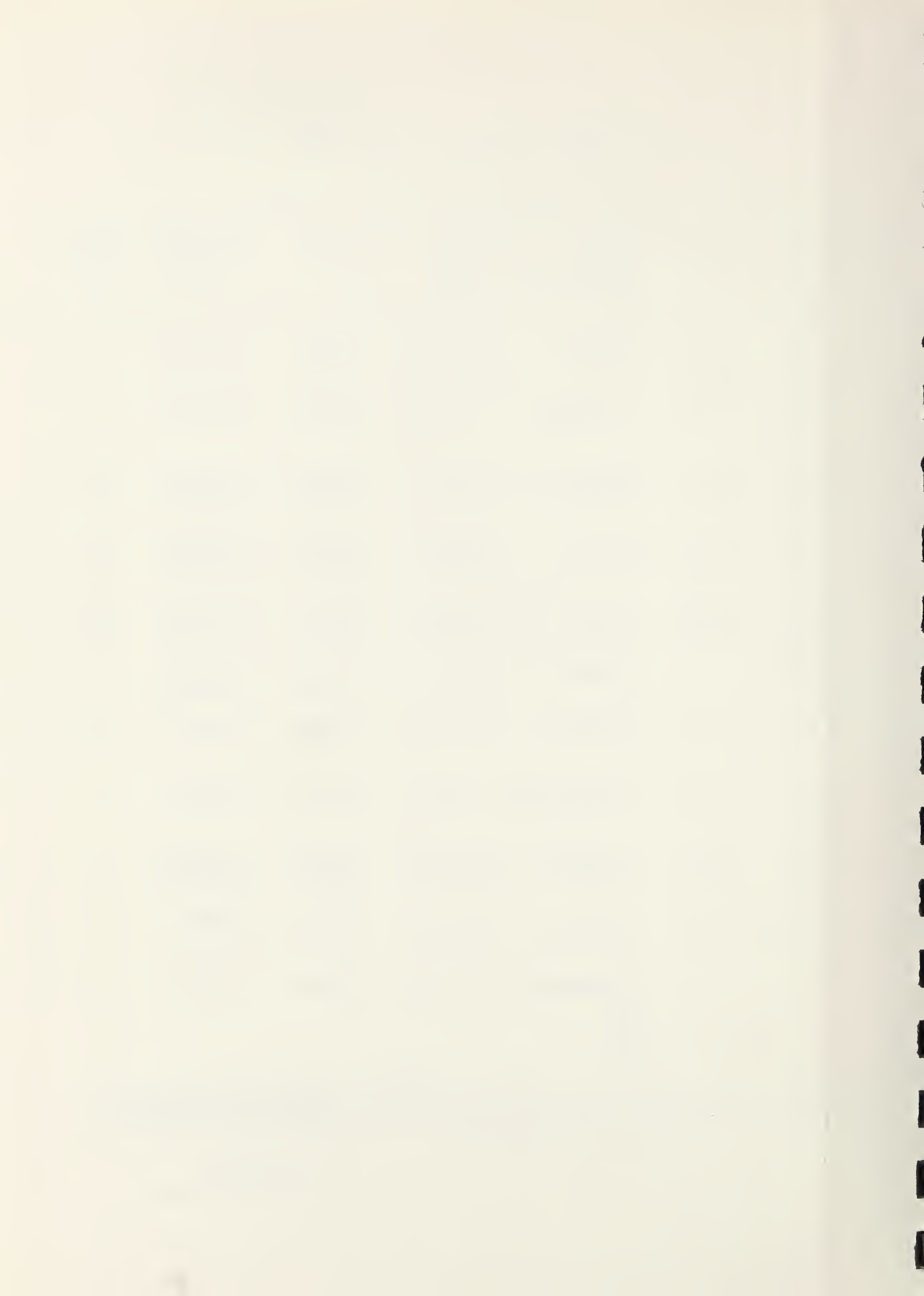
TABLE III-8: QUALITY OF GROUND WATER

Elkhart River Basin, Indiana

Communities		pH	Alkalinity as CaCO ₃	Chlorides as Cl (250)	Fluorides as F (1.0)	Magnesium as Mg	Manganese as Mn (0.05)	Nitrates as N (10)	Sodium as Na	Sulfates as SO ₄ (250)	Hardness as CaCO ₃	Color Units (15)	Turbidity Units (5)	Iron as Fe (0.3)	Calcium as Ca	Potassium as K
Albion	A <u>1/</u>	7.5-8.0	294-312	1-2	0.8-1.0	26-28	0-0.03	0.1-0.5	11-19	0-29	272-330	<5	4-10	0.7-2.0	66-85	1-2
	B <u>2/</u>	7.8-8.2	296-316	1-4	0.7-1.0	8-9	0- 0.02	0.3-0.4	12-110	0-29	85-332	5	0.5-0.6	0.05-0.1	20-21	1
Cromwell	A	6.9-7.3	282-285	2	0.2-0.3	24-25	<0.05	0.1	3-4	46-54	332-340	0	20	2.3-3.0	92-94	1
	B															
Elkhart	A	7.2-8.1	170-280	5-13	0-0.2	16-35	0.05-0.23	<0.1-0.6	5-10	29-130	200-405	<5-5	0.4-20	0.06-1.7	54-105	1-2
	B	7.8-8.0	202-264	8-9	0.9-1.0	21-33	0.01-0.04	<0.1-0.2	6-7	24-100	238-372	<5	0.6-1.0	0.1-0.2	60-95	2
Goshen	A	7.6-8.1	216-260	2-22	0-0.2	19-27	0.05-0.2	0-<0.1	3-9	25-54	264-308	5	3-15	0.9-1.6	69-83	1-2
	B	7.6-7.9	246-248	23	0.1-0.6	25	0.05-0.07	0.1	6-10	47	296-310		0.1	0.1-0.3	83	1
Kendallville	A	7.4-7.9	302-350	8-41	0.2-0.4	19-38	0.1-0.2	0.2-0.4	10-31	47-180	326-532	<5-5	1-15	1.3-3.1	96-150	2-3
	B	7.5-7.7	292-322	12-24	0.7-1.3	6-12	0.02-0.05	0-0.5	130-165	54-95	68-114	5	0.1-0.8	<0.06-0.2	18-26	<1-2
Ligonier	A	7.5-7.9	276-308	<1-2	0.1-0.2	28-62	0.03-0.05	0-0.1	3	50-60	342-370	0-45	2-20	1.1-1.7	90-100	1
	B	7.6-8.1	298-302	3	0.1-1.2		<0.02	0	3	54	351-370		0.1-0.4	<0.30-0.1		
Milford	A	7.3-7.9	234-274	9-22	0-0.1	24-26	0.05-0.11	0.7-22.	6-9	60-73	318-400	0	0.5-5	0.1-1.1	74-117	2-12
	B															
Millersburg	A	7.1-7.2	302-311	1-2	0.1	31	0.06	0.1	8-9	13-14	310-318	0-45	3-5	1.0-1.8	74-77	1.2
	B															
Nappanee	A	7.3-7.6	334-344	1-3	0.3-0.5	28-34	<0.02-0.1	0.2-0.4	9-15	<1-5	320-343	<5-5	3-15	1.5-2.3	78-82	1-2
	B	7.5-7.6	338-340	2	1.0-1.3	27	<0.02-0.04	0.4	10-12	< 1	330-332		1.0	0.1	84	1
Syracuse	A	6.7-6.9	288-296	1-5	0.3	26-29	<0.02	0.3-0.4	8-17	<1-25	262-322	5	0.7-2	0.9-2.6	62-81	1-2
	B															
Wolcottville	A	7.0-7.6	284-297	<1-3	0.3-0.4	21-23	0.04-0.05	<0.1-0.4	3-7	11-18	292-300	<5	0.6-15	0.06-3.1	80-84	<1-2
	B															

Source: Public Water Supply Data from Indiana State Board of Health, 1964-1972.
 Figures in parentheses refer to limits described in U.S. Public Health Service Drinking Water Standards, 1962
 All columns except pH, color, and turbidity are expressed in milligrams per liter.

1/ Raw Water
2/ Finished Water



The smallest of the major areas is the eastern one-third of that part of Kosciusko County in the Elkhart Basin. In the Basin, other significant groupings and individual wetlands occur, but these are the main areas of concentration.

Wetlands are classified according to the criteria in the United States Department of the Interior Publication Wetlands of the United States, Fish and Wildlife Circular 39. Briefly, a description of the wetland types occurring is:

Type 3. Shallow Marsh: This is an area where the soil is normally waterlogged during the growing season. It is often covered with as much as six inches of water. Typical vegetation consists of grasses, sedges, smartweed, goldenrod, and aster; and in wetter areas, cattail and bur reed.

Type 4. Deep Marsh: Here the soil is covered with six inches to 3 feet of water during the growing season. The vegetation is mainly yellow and white water lily, cattail, bulrushes, spikerushes and various aquatic grasses.

Type 5. Open Water. Water is of variable depth. The vegetation, if any is present, is predominantly submergent.

Type 6. Shrub Swamps: Here the State of Indiana classification varies from type 6 wetland in Circular 39, which includes all shrub swamps. This type was important enough in Indiana to split into type 6³ and type 6⁴ classification.

Type 6³. Shallow Shrub Swamp: The soil is normally waterlogged during the growing season - often as much as six inches of standing water is present. The principal vegetation is dogwood and willow with lesser amounts of buttonbush, blueberry, and chokeberry.

Type 6⁴. Deep Shrub Swamp: Similar to the 6³, except water is from six inches to three feet during the growing season. The predominant vegetation is usually buttonbush or, less commonly, a mixture of blueberry, winterberry, and chokeberry. Dogwood and willow can also occur.

About 61 percent of all wetland acreage is open water (Type 5). The second most important type is the shallow marsh (Type 3) which comprises about 14 percent of the Economic Area wetlands. The type 3 area is extremely important because it not only has a high value for the wetland-oriented wildlife but, as the driest of the wetlands considered, it often provides a critically needed habitat for more upland species.

The type 3 wetland is generally a more stable habitat than, for example, are the pheasant's normal haunts. If, due to fall plowing, fence row clearing, heavy snows, or other reasons, the pheasant's usual home is unavailable, the shallow marsh and its rank vegetation often supply an emergency habitat.

The similar type, the shallow shrub swamp (Type 6³), varies from the type 3 by possessing primarily woody rather than herbaceous cover. This type comprises about 11 percent of the total wetland acreage. The remaining wetland types, deep marshes (Type 4) and deep shrub swamps (Type 6⁴), account for 10 and 4 percent respectively.

Table III-9 shows the number and acreages of wetlands in the Economic Area.

TABLE III - 9: NUMBER AND ACREAGE OF WETLANDS BY CLASSIFICATION TYPE
Elkhart River Basin (Economic Area), Indiana

Wetland Type	Number of Wetlands	Total Acreage	Ave. Size in Acres	Percent of the Total Number of Wetlands in the Basin	Percent of the Total Wetland Acreage in the Basin
3	860	10,770	12	23	14
4	512	7,240	14	13	10
5	1,344	45,800	34	36	61
6 ³	684	8,420	12	18	11
6 ⁴	372	3,100	8	10	4
Total	3,772	75,330	20	100	100

B. Economic Data

Most of the data presented in this section are based upon the Elkhart River Basin Economic Area. The use of the Economic Area is necessary because the majority of basic information used in this study is available only on a county basis. In subsequent sections of this report some basic data have been disaggregated to the Basin (hydrologic area). Additionally, different base periods have been used in some instances. Therefore, direct comparison of certain values between sections of the report is not always possible.

1. Land Ownership

Most farmers are owner-operators, as shown in Table III-10. The number classified as full owners have averaged about 70 percent for the 1954 and 1969 time period, whereas, only 63 percent of the farm operators in the state were full owners. The trend has been toward more full and part owners. Tenant farmers decreased from 1,770 in 1954 to only 659 in 1969. In 1969, approximately 91 percent of the farms in the Area were fully or partially owned by the operator compared to 88 percent of the farms in Indiana.

2. Farm Enterprises - Types, Size and Number

Technological advances and the influence of urban expansion have resulted in changes in farm and land use patterns in the Elkhart Economic Area. Improved varieties of seed, large machinery, increased use of fertilizer and chemicals, and improved management practices have allowed the individual producer to expand production by being able to operate a larger acreage and produce more per acre.

Within the Economic Area the total number of farms has decreased from 9,150 in 1954 to only 6,947 in 1969, shown in Table III-11.

Livestock production farms are the most predominant type of farming operation, accounting for 39 percent of the total commercial farms in the Area. Dairy farms are concentrated in Elkhart and LaGrange Counties and represent about 24 percent of the farms, and seem to be maintaining this position. In contrast, the number of farms classified as general decreased from 985 in 1959 to only 302 farms in 1969. It is noteworthy that of all Indiana farms over 19 percent of the poultry farms, 18 percent of all dairy farms, and over 10 percent of the general farms are located in the Elkhart River Basin Economic Area.

Census data for 1969 show about 66 percent of the farm operators worked off-farm during the year, with over 50 percent working off-farm more than 100 days during the year. The trend in off-farm work by farmers is becoming more pronounced each year.

TABLE III - 10: FARM TENURE, BY COUNTY, 1969
 Elkhart River Basin (Economic Area), Indiana

COUNTY	ALL FARM OPERATORS	FULL OWNERS	PART OWNERS	ALL TENANTS
Elkhart	1,926	1,301	430	195
Kosciusko	2,038	1,421	447	170
LaGrange	1,466	1,032	276	158
Noble	1,517	1,091	290	136
Total	6,947	4,845	1,443	659

TABLE III - 11: NUMBER OF FARMS, BY COUNTY, 1954 - 1969
 Elkhart River Basin (Economic Area), Indiana

COUNTY	1954	1959	1964	1969
Elkhart	2,853	2,166	2,905	1,926
Kosciusko	2,598	2,272	2,052	2,038
LaGrange	1,710	1,550	1,412	1,466
Noble	1,989	1,734	1,518	1,517
Total	9,150	7,722	7,887	6,947

Source: U. S. Census of Agriculture

The reduction in farm numbers has been reflected by a corresponding increase in the size of the remaining farms. Average farm size in the Economic Area increased from 113 acres in 1954 to almost 137 acres in 1969. Census data show that the number of farms of 1,000 acres or more has increased from 3 to 17 in the 1954-1969 time period. During the same time, the number of farms of 100 acres to 999 acres decreased from 4,270 units to 3,346 operating units. Farms under 100 acres also decreased from 4,876 in 1954 to 3,584 in 1969.

3. Crops and Yields

The Basin is located in the northeastern dairy and general type-of-farming area. 1/ Mixed livestock, dairy, and cash grain farming are the major farming enterprises. This rather diversified agricultural economy results in numerous crops being grown, in contrast to parts of the nation where agriculture is essentially a "one crop" enterprise. Corn, which is primarily harvested for grain (with some silage), soybeans, wheat, hay (alfalfa and clover-grass mixtures), and oats are the primary crops, accounting for approximately 97 percent of the cropland acreage.

The major crop is corn, which accounts for about 47 percent 2/ of the crop acreage in the Economic Area. Yields during the period 1954-1970 ranged from 56 bushels per acre in 1959 to 82 bushels in 1968. 3/

Soybeans, currently the second most important crop, have shown tremendous increases during the past 15-20 years. The acreage of soybeans in the Economic Area increased from about 25,000 acres in 1954 to more than 100,000 acres in 1969. Soybean yields during the 1954-1970 period ranged from 19.6 bushels per acre in 1957 to 32.1 bushels in 1968.

Hay crops constitute the third largest crop grown. Alfalfa and clover are the major legumes which are generally grown with grasses such as bromegrass, orchard grass, and timothy harvested either as hay or rotation pasture. Alfalfa and clovergrass mixtures were grown on about 65,000 acres in 1969, a decrease of 50 percent from the more than 130,000 acres grown in the Economic Area in 1954. Hay yields during this period have ranged from 1.66 tons per acre in 1954 to 2.82 tons in 1969.

The most important small grain produced is wheat. In the Economic Area, it still ranks fourth in acreage despite a decline from 80,000 acres in 1954 to about 50,000 acres in 1969 and 1970. In the late 1940's wheat acreage in the Area exceeded 100,000 acres. Yields during the period from 1954 to 1970 ranged from 25.9 bushels per acre in 1959 to 38.6 bushels in 1966.

1/ Purdue University, Agri. Experiment Station, A map of Indiana Soils (Indiana Type-of-Farming Areas).

2/ U.S. Dept. of Commerce, Bureau of the Census, Census of Agriculture, 1969.

3/ U.S. Dept. of Agriculture, Statistical Reporting Service, Purdue University, Agri. Exp. Station, Ind. Crop & Livestock Statistics, Annual Crop Summary, 1954-1970.

Oats, the other significant small grain, is the fifth important crop in terms of acreage. The acreage of oats produced in the Economic Area has decreased greatly, from more than 100,000 acres in 1954 to approximately 25,000 acres in 1969. Yields during this period ranged from 33 bushels per acre in 1954 to 65 bushels in 1968.

Several other miscellaneous crops are grown throughout the Basin in small acreages. These crops include popcorn, vegetables, potatoes, grass silage, and sorghum.

Approximately 0.53 million cubic feet of industrial wood products was produced from the forest land of the Basin in 1970. These products included pulpwood, sawlogs, veneer logs, fuelwood, fence posts, and other industrial products. Practically all this output was produced from hardwood timber. Projections indicate that by the year 2020 approximately 1.55 million cubic feet of industrial wood products will come from the Basin's forest land. (Table III-12)

TABLE III-12: PRODUCTION OF INDUSTRIAL WOOD PRODUCTS
FROM ROUNDWOOD 1970, 1980, 1990, 2000, and 2020 ^{1/}
Elkhart River Basin, Indiana

	1970	1980	1990	2000	2020
	(Thousand cubic feet)				
Production of Industrial Wood	533	781	1,065	1,371	1,548

^{1/} USDA Forest Service Resource Bulletin NC-7, 1969

4. Land Values

The average value of land and buildings in the Economic Area was \$389 per acre in 1969 ^{1/}, as compared to \$205 in 1954. This amounts to an increase of 90 percent over the 15-year period, or approximately 6 percent per year.

Comparable figures for the State of Indiana show an increase from \$194 per acre in 1954 to \$406 per acre in 1969. This indicates that land values in the Basin have been increasing, but at a slightly slower rate (6 percent annually) than the state as a whole (7-1/3 percent annually).

Land values in flood plain areas vary greatly due mainly to location and flood hazard. Flood plain land values vary from \$150 to \$500 ^{2/} per acre in agricultural areas, with the great variation due mainly to flood frequency, land use, and soils. The inventory data cited above shows average land values estimated at

^{1/} U.S. Dept. of Commerce, Bureau of the Census, 1969 Census of Agriculture.

^{2/} Source: Soil Conservation Service field inventory data.

\$385 per acre, which correlates closely with the \$389 value in the Census of Agriculture.

Land values in urban areas are extremely high, especially in Elkhart and Goshen, where the demand for land for such development is great. Land values for non-agricultural development vary greatly based on size, location, zoning, and various other factors.

5. Accessibility to Roads and Markets

Accessibility to roads and markets is generally adequate to meet the needs of the farm and non-farm population of the Basin. The location of the Basin, in the midst of several major population centers and the nearness to major national transportation routes, has resulted in the highly productive agricultural sector.

Marketing facilities in the Basin consists of local livestock auctions, grain elevators and livestock buying stations. The Basin is also near the Fort Wayne and Toledo central livestock markets. Marketing facilities are generally adequate; however, in recent years the shortage of railroad cars for the transportation of agricultural products has created some problems.

6. Socio-economic Conditions

The Economic Area was originally subdivided according to the rectangular survey system which established townships containing 36 or less square miles. The township was therefore the smallest unit of rural government and formed the basis for the establishment of school districts. More recently, consolidation has led to the merger of township and small town schools into county school systems.

Churches have been important since establishment of the early social structure of the Area. They were usually established soon after settlement and were of the faith of the predominance of the early settlers.

The major town in each county was usually designated as the county seat and became the business and cultural center of the county. Industrial and residential development generally was drawn to these communities.

The railroads and improved transportation facilities helped some communities to grow and expand more rapidly than others. These factors have also lessened the ties of the essentially close knit social patterns which have been common throughout rural communities in the past.

C. Fish and Wildlife Resources

The Elkhart River, its two main branches, and its tributaries were surveyed for fishing and hunting utilization, wildlife production, and vegetative characteristics during the summer of 1972. The survey involved

the streams and ditches shown on the habitat maps (Plates 9 and 10). The study investigated 33 streams and ditches in the four counties drained by the Elkhart River system. The Elkhart River, South Branch and North Branch were considered three separate waterways. The total includes six tributaries which flow through two counties and one (Turkey Creek) which flows through three counties. Of these 33, 16 are in Elkhart County, 6 in Kosciusko County, 3 in LaGrange County, and 16 in Noble County.

This Basin contains possibly the greatest variety of wildlife and fisheries resources in Indiana. Results of the survey indicate a wide variety of wildlife species. Of the 52 mammal species and 336 species of birds recorded in recent years for Indiana, 43 and 261, respectively, have been seen in the Elkhart River Basin.

Trapping is generally good to excellent for muskrats and mink, but beavers are not found in the area. Raccoons are hunted heavily and are plentiful throughout the Basin.

Fishing is generally good, and trout stocking is extensive, both in the Basin's tributaries and in the lakes through which some of the tributaries flow.

1. Habitat Quantity and Quality

The Basin contains large areas of high-quality marsh, which includes Indiana's prime waterfowl breeding grounds. This is Indiana's "Prairie Pothole Region".

Much of this area is high-intensity agricultural land and, at many bridges, the adjacent land on all four corners is in corn or soybeans. Cover provided by an overgrown ditch represents an invaluable break for wildlife in the cultivated-crops monoculture.

The streams and ditches that do not support fishing pressure, nevertheless are important for wildlife. They provide watering areas for wildlife, and their banks provide nesting habitat for song birds and small mammals. They are also utilized by waterfowl for raising broods, and for cover and resting areas during migration.

The results of the survey were summarized and discussed by counties. A discussion of each of the four counties follows:

Noble County - Pheasant hunting is best in the valley of the South Branch of the Elkhart. Pheasants are plentiful in the prairie area north of Kendallville, and are also in the Chain O'Lakes State Park area. Quail hunting is considered very good throughout the county. Rabbits and squirrels are found in concentrations sufficient to support hunting in all areas. Deer is plentiful throughout the valley of the South Branch of the Elkhart.

Diamond Lake (Sec. 31 & 32, T35N, R9E and Sec. 5 & 6, T34N) is the only source of regular smallmouth bass production in Noble County. The 12 lakes in the Chain O'Lakes account for the best fishing in Noble County and is comparable to that in any other area of the state.

Elkhart County - The marshes are prime waterfowl reproduction areas. Turkey Creek supports marshes and swamps along the lower one-third of its length in this county, and most of these hold water throughout the summer. Trapping is extensive on nearly every tributary of the river in this county and on the marshes supported by the system. Waterfowl hunting is heavy.

The Elkhart River is considered one of the top fishing streams in Indiana. Fishing on the river is generally good throughout the river in Elkhart County. The confluence with the St. Joseph River is heavily fished, particularly for channel and blue catfish. Smallmouth bass, rock bass, and crappie fishing is good from Elkhart to Goshen. Much of the fishing is done from the bridges in Goshen and Elkhart, but many fishermen float the river between the two cities. Northern pike and largemouth bass are found from Goshen upstream to State Road 33. This stretch of the river, because of frequent deep pool areas is also noted for rock bass, bluegill, and crappie. Smallmouth bass fishing from State Road 33 upstream into Noble County is excellent.

Kosciusko County - There is very little pheasant hunting and hunting for rabbit and quail is only fair. Adjacent land on the tributaries surveyed is predominately farmland, and where woods are present, squirrel hunting is only fair. Fishing is rated as poor to fair in the Kosciusko County streams.

LaGrange County - North Branch and Little Elkhart Creek are fished heavily for trout. Rock bass and smallmouth bass are also caught. Most fishing is done at road crossings, because the stream is generally too deep for wading. Wildlife habitat is generally poor on adjacent lands except in those areas where wetlands occur. Stream banks are generally vegetated well enough to support songbirds and other small forms of wildlife.

Plates 9 and 10 show wildlife and fishery habitat classifications for streams and ditches included in the survey.

2. Access

Access to streams, lakes, and other desirable wildlife areas vary from poor to excellent throughout the Basin. Noble and LaGrange Counties have few problems provided permission is requested from the landowners; however, access in Kosciusko County is generally poor.

In the developed areas of Elkhart County, particularly in the suburban build-up of Goshen and Elkhart, access is limited to city and county park sites and bridges. Elsewhere, access is generally good with a few areas having no access.

3. Rare and Endangered Species

The survey of fish and wildlife resources indicated a wide variety of wildlife species in the Basin, with seven bird and mammal species being listed as rare and endangered.

Of the existing mammals, two species (star-nosed mole and badger) are considered peripheral species. This is one whose occurrence in Indiana is at the edge of its natural range and should be considered rare or endangered within the area, although not in its range as a whole. Special attention is necessary to assure its retention in the Indiana fauna. Another species, the Indiana bat is considered endangered nationwide. An endangered species is one whose prospects of survival and reproduction are in immediate jeopardy. It must have help or extinction will probably follow.

Peripheral listings are difficult for bird species because of their mobility; however, 2 species (bald eagle and peregrine falcon) are considered endangered nationwide. The sandhill crane is listed as rare. A rare species is one not presently threatened with extinction but occurs in such small numbers that it could be endangered if its environment worsens. A fourth species, the osprey, is considered of undetermined status. It is indicated as possibly rare or endangered, but precise information is lacking and more study is needed.

4. Pollution Influence

Pollution influence on fish and wildlife resources is limited to seasonal sediment problems associated with runoff from adjacent farmlands on the North and South Branches of Elkhart River and some point sources. Areas affected by point sources include Turkey Creek by pollution from Syracuse and a tributary from Rome City which carries organic waste loads.

D. Recreation Resources

1. Existing and Potential Resources

Recreation resources were inventoried to determine features that might influence people to visit a given recreation area or facility, and to provide a basis for determining recreational needs for the Basin. Table III-13 is a summary of the resource features that attract recreational participants to the Elkhart Economic Area, and also shows areas where potential development may be considered.

TABLE III-13: RECREATION FEATURES THAT ATTRACT RECREATIONAL PARTICIPANTS 1/

Elkhart River Basin (Economic Area), Indiana

County	Park & Gen. Recreation	Fishing or Hunting	Historic and Memorial	Vacation Center	Natural Area	Spec. Sports	Play Area	Special Feature	Number of Facilities	
Elkhart	19	4	--	--	1	25	71	5		
Kosciusko	31	16	--	13	--	15	28	14		
LaGrange	21	29	--	13	2	9	37	2		
Noble	18	11	2	1	3	11	26	5		
Total	89	60	2	27	6	60	162	26		

1/ Source: Shaping the Future, Indiana Department of Natural Resources, August 1969, Appendix I.

Table III-14 includes a listing of some of the parks in the Basin and part of the facilities they provide. This summary is an indication of the many outdoor recreational opportunities available in the Basin.

2. Effect of Water Quality and Pollution

The natural stream system and the many natural lakes offer a variety of recreational opportunities in the Basin. Recreation potential of some of the streams have been reduced due to their use as outlets for sewage treatment facilities. Residential developments on many of the lakes have created potential water quality problems. Where eutrophication and other problems exist, aesthetic values are reduced and potential for some recreational activities is affected.

3. Public Accessibility and Facilities Provided

Recreation facilities can be better utilized when their distribution coincides with that of the population and its recreational interests. The mobility of people has made it possible for a recreation area to serve persons from outside the area as well as local residents. A summary of recreation areas and the scope of area they serve (Recreation Service Area) is shown in Table III-15. Development of facilities is based on an examination of demands, accessibility, and type of resources available. An inventory of developed recreational facilities is shown in Table III-16.

There are approximately 50 publicly owned recreational areas located within the Elkhart River Basin. Most of these are operated by municipal or county governmental agencies; however, there are three state-operated recreational areas. These are the Tri-County Fish and Wildlife Area with 3,437 acres, the Chain O'Lakes State Park with 2,678 acres, and the Wawasee State Fishing Area with 9 acres.

Public access sites make considerable acreage available to the citizens and visitors. A very real advantage is the presence of many natural lakes, some of which are still open to the public.

Camping facilities are very widely offered. There are at least 20 areas with commercial tent and trailer spaces available. Some 1,100 acres are devoted to this use. Services range from the most sophisticated amenities to one area providing primitive camping.

Several other types of outdoor recreation are available. Winter sports are possible over a moderately long season. Unorganized recreational opportunities are also found in visits to farm friends, or by pleasure walks through privately-owned woodlands, with previous permission of the owner. Driving along wooded side roads reveals wildflowers, birds, and occasional wild animals in their natural settings.

TABLE III - 14: OUTDOOR RECREATION OPPORTUNITIES 1/

Elkhart River Basin, Indiana

NAME	LOCATION (COUNTY)	ACRES	TENT		ELEC- TRICITY	WATER SEWER	PICNIC TABLES	RECREA- TION			SWIM- MING POOL	OTHER SWIM- MING	FISH- ING	BOAT- ING	PLAY- GROUND
			SPACES (No.)	TRAILER SPACES (No.)				FLUSH TOILETS	SHOWERS	CAFE- SNACK BAR					
Chain O'Lakes	Noble	2,678	360	360	x	x	x	x	x	x	x	x	x	x	x
Ox Bow Park	Elkhart	200	20	29			x							x	x
Bixler Lake City Park	Noble	220	50	30	x	x	x	x ⁴	x			x	x	x	x
Twin Pines	Elkhart	1	58	58	x	x	x					x			
Yankee Trails Park	LaGrange	22	20	20	x	x	x	x		x	x	x	x	x	x
Gordon Big Long Lake Campground	LaGrange	50	250	200	x	x	x	x		x	x	x	x	x	x
North Shore Campground	LaGrange	15	52	52	x							x	x	x	x
Turtle Bay Campground	Kosciusko	4	24	24	x	x	x	x	x			x	x	x	x
Lakeview Campsites	Kosciusko	6	50	30	x	x	x	x	x			x	x	x	x
Dunlap Campground	Noble	5	50	50	x	x	x	x	x			x			x

1/ Source: Rand McNally's Campground and Trailer Park Guide, 1973

'TABLE III - 15: INVENTORY OF PRESENT RECREATIONAL AREAS, BY RECREATION SERVICE AREA, 1969 1/
Elkhart River Basin (Economic Area), Indiana

County	Recreation Service Area 2/-							Total
	National or Multi-State	Regional	County	Community, City or Town	Neighbor- hood	Block Total Lots	Transient Road- side Parks	
Elkhart	--	12	14	36	58	1	4	125
Kosciusko	20	56	2	30	6	--	3	117
LaGrange	9	58	5	39	1	--	1	113
Noble	3	35	7	24	6	1	1	77
Total	32	161	28	129	71	2	9	432

1/ Source: Shaping the Future, Indiana Department of Natural Resources, August 1969, Appendix 1.

2/ Geographic area that serves as the primary source of recreation users for a specific site.

TABLE III - 16: INVENTORY OF PRESENT RECREATIONAL FACILITY DEVELOPMENT, 1969 ^{1/}
 Elkhart River Basin (Economic Area), Indiana

COUNTY	PICNIC AREAS	CAMPING AREAS	GOLF COURSES	SKI SLOPES	HUNTING AREAS	Number			
						FOOT	BICYCLE	HORSE	CANOE
----- Miles -----									
Elkhart	28	5	7	6	-	3	2	-	-
Kosciusko	28	27	6	-	3	1	-	1	-
LaGrange	31	28	2	-	3	15	-	7	-
Noble	27	22	2	-	1	14	1	5	38
Total	114	82	17	6	7	33	3	13	38

^{1/} Source: Shaping the Future, Indiana Department of Natural Resources, August 1969, Appendix I.

4. Present Utilization

Utilization of most recreational facilities in the Economic Area is at or near maximum. Ocular examination of campgrounds, parks, picnic areas, and other facilities reveals the intensity of use and the overuse during peak use periods. Reservations are required for some recreational facilities. Studies show a shortage of many recreational facilities in the Area including picnic tables, campsites, playfields, hunting areas, bicycle, hiking and horseback riding paths, nature walks, and canoeing trails.

A camping survey conducted by the Department of Natural Resources indicated the greatest complaints from campers were the conditions found in the campground. This condition will exist when the carrying capacity of the facility has been exceeded. Construction of parks has not kept up with demand, resulting in overcrowded conditions and detrimental effects to the existing facilities.

E. Natural and Historical, Archeological, and Scenic Areas

A natural area is described as an area of land and/or water, whether in public or private ownership, which either retains or has re-established its natural character (although it need not be undisturbed), has unusual flora or fauna, or has biotic, ecological, scenic, geologic, or paleontological features of scientific or educational value. Nature preserves are similar areas which have been formally dedicated for full protection by action of the Indiana Natural Resources Commission.

In order to facilitate the establishment of priorities for the preservation of natural areas, inventories of these natural areas have been compiled. Table III-17 contains a listing and short description of ten recognized natural areas within the Elkhart River Basin. Other historic and scenic areas are identified on Plate II (Environmental and Recreation Map).

The Elkhart River Basin is of importance archeologically because some of the earliest records for the American Indian involve groups in the southern Great Lakes area. Although present archeological data are incomplete, there is sufficient information available to emphasize the importance of the region. At the present time, only two sites within the Economic Area are on record in the files of the Glenn A. Black Laboratory of Archaeology at Indiana University. Both are in Kosciusko County. One was an excavated glacial kame (Late Archaic) site on the shore of Lake Wawasee, and the other involves a number of Middle Woodland burials associated with copper artifacts which were accidentally uncovered near Ridenger Lake. Several mounds and numerous village sites have been reported in Noble County, although no systematic study of the area has been made. Early newspaper accounts record a few burial mounds and artifacts in LaGrange County. Although no specific sites have been recorded for Elkhart County, innumerable newspaper accounts attest to the frequent discovery of artifacts.

TABLE III - 17: INVENTORY OF NATURAL AREAS 1/
Elkhart River Basin, Indiana

COUNTY	DESCRIPTION	MAP 2/ KEY NO.	TYPE 3/ ACREAGE	COUNTY	DESCRIPTION	MAP 2/ KEY NO.	TYPE 3/ ACREAGE
Elkhart	PARSON'S SWAMP WOODS. (NE 1/4 Sec. 21, T36N, R6E). A swampy area along the Elkhart River just below Goshen Dam Pond. It contains an unusual variety of plants and birds, and is used considerably by Goshen College. The area is in private ownership.	1	A-T-Sc 17	Noble	MERRY LEA NATURE AND RELIGIOUS CENTER. (W 1/2, Sec. 17, N 1/2 Sec. 18, T33N, R9E). An area of sandy uplands, swales, swamps and bogs including extensive frontage on Bear and High Lakes. Owned by the Merry Lea Foundation.	4	A-T-E 150
KOSCIUSKO	WYLAND LAKE. (NW 1/4, SE 1/4, Sec. 2 T33N, R7E). A ten acre, 38 foot deep natural lake perched high on the watershed. There is a narrow rim of emergent vegetation bordering an upland woods. The area is within the Tri-County State Fish and Wildlife area.	2	A 20		EDNA W. SPURGEON NATURE PRESERVE. (N 1/2, SW 1/4, Sec. 18, T35N, R9E). Marked nature trails traverse a beech-maple forest on the rolling terrain in this area in the region locally known as "The Knobs". This area is owned and managed by Acres, Inc., a not-for-profit preservation organization with headquarters in Ft. Wayne, Indiana.	5	PR-T 65
	GRIDER'S WOODS NATURE PRESERVE. (SW 1/4, SE 1/4, Sec. 36, T34N, R7E). This small nature preserve includes an oak-hickory stand and features a self-guiding nature trail. It is located within the Tri-County Fish and Wildlife Area and managed by the Indiana Department of Natural Resources, Division of Fish and Wildlife.	3	T 10		LLOYD W. BENDER NATURE PRESERVE. (SE 1/4, Sec. 22, SW 1/4, Sec. 23, NW 1/4, Sec. 26, T34N, R9E). This area fronts the South Branch of Elkhart River and contains a wide variety of vegetative types. Owned by Acres, Inc.	6	T-A 60
LaGrange	QUOG LAKE. (W 1/2, SW 1/4, Sec. 18, T36N, R10E). This 30 acre lake is nearly surrounded by a quaking bog. The shoreline is dominated by marsh and swamp vegetation. An oak-hickory woods adjoins the low ground.	7	A-T 100		GENE STRATTON PORTER STATE MEMORIAL WOODS. (NE 1/4, NE 1/4, Sec. 22, T35N, R10E). This area on Sylvan Lake has extensive wildflower gardens and old trees, and features one of the homes of the renowned author and naturalist. It is operated by the Division of Memorials and Museum, Indiana Department of Natural Resources.	9	T 6
	OLIN LAKE AND BROWARD WOODS. (SE 1/4, Sec. 20, T36N, R10E). This marl lake area includes a narrow tomarack-red osier dogwood swamp adjoining a beech-maple woods on the south side. Purdue University owns a portion of the north shore; the south side is owned by G. E. Broward.	8	A-T 180		LONDIDAW. (NE 1/4, SE 1/4, Sec. 27, T35N, R11E). This area is a fine example of a glacial kettle hole and esker. It contains open water and a boggy shoreline bordered by a second growth forest. Acres, Inc. has established nature trails in the area.	10	E 25

1/ Includes nature preserves as indicated in description.
2/ Refer to Plate _____, Environmental and Recreation Map.
3/ A -- Aquatic Biological
T -- Terrestrial Biological
PR -- Perceptive Recreational
E -- Educational
SC -- School (elementary and secondary local)

Source: Lindsey, A., Schmelz, D., and Nichols, S., 1966
Natural Areas in Indiana and their Preservation, Indiana
Natural Areas Survey, Dept. of Biological Sciences, Purdue
Univ., Lafayette, and files of Indiana Dept. of Natural
Resources, Division of Nature Preserves.

F. Soil, Water and Plant Management

1. Land Use Trends

Land use changes throughout the Basin have been gradual and have not been the result of any sudden or drastic causative factors. During the past two decades there has been a gradual but continued decline in the acreage of land in farms. 1/ From 1954 to 1959, land in farms in the Elkhart Basin decreased by about 8 1/2 percent. This has in turn resulted in decreases in cropland (5 percent) and pastureland.

A decrease in forest land and increases in "Other Land" and "Urban and Built-Up" lands also occurred. Much of this was a result of forest land going into non-agricultural development in and around the major growth centers of Elkhart and Goshen.

These data reflect the changes which are constantly taking place as the agricultural land base is undergoing change with respect to land use. Marginal and submarginal cropland is transferring to forest land, pasture, and "Other Land" uses. Forest land in turn is transferring to "Urban and Built-up" and in some instances to cropland as farmers attempt to attain larger, more economical operating units.

2. Land Treatment Program

The application of needed conservation measures is an important factor in the management of the Basin's land and water resources. Such a program will provide for the proper use and treatment of the land for sustained agricultural and forest production within the inherent capability of the soil.

a. Status

The Indiana Soil and Water Conservation Needs Inventory (1967) indicates that 58,910 acres, or 19.4 percent of the Basin's 303,060 acres of cropland are adequately treated by land treatment measures aimed at conserving soil and water. Treatment is adequate on only 10,790 acres of the 149,965 acres of soils with a predominant erosion hazard ("e" subclass).

b. Degree of Land, Labor, and Capital Commitment Within Problem Areas

Capital requirements have expanded greatly for most agricultural uses, especially during the past two decades. This is reflected by recent census data on value of land and building plus other farm expenditures.

1/ Source: U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1954, 1959, 1964, 1969

Total investment in land and buildings in the Economic Area was about 369.5 million dollars in 1969. This is an average of about \$53,000 per farm, or \$390 per acre. The large increase in this investment is shown in contrasting values for 1954 of \$23,000 per farm and \$205 per acre.

Other sizeable investments in agriculture include machinery, equipment, livestock, fertilizer, and grain stocks. These investments have also increased significantly in recent years as mechanization has increased and farm owners and operators have substituted capital for labor.

The extent to which drainage had played a part in the development of the Economic Area is exemplified by the following data from the 1960 Census of Drainage 1/: (1) Nearly 90 percent of the land in farms and 77 percent of the land area is in drainage projects; (2) the cost of drainage works and services from 1950-1959 was \$637,700 of which 28.3 percent was for new drainage works and 71.7 percent was for maintenance, operation, repair, and administration. These cost data exclude privately-owned drainage projects of less than 500 acres.

The extent of capital expenditure by individual landowners for on farm drainage installations is estimated to be in excess of 2.9 million dollars in the Basin area. This is based on the amount of drainage practices reported in the SCS records and reports and average cost of installation.

3. Soil and Water Conservation Districts

The four counties in the Basin all have soil and water conservation districts which have been in existence for periods of time ranging from 16 to 32 years. These districts, established under state law as local units of government, are involved with all water, land, and associated resource problems within their boundaries. Their main objectives are to have complete soil and water conservation plans in effect on all lands and assist in the solutions to land and water problems throughout the districts.

a. District Cooperators, Basic Plans and Areas Planned 2/

A total of 3,252 landowners have become cooperators with their local soil conservation districts in the four Basin counties. These agreements encompass a total of 438,952 acres. It is estimated that 1,300 of these cooperators including 175,580 acres within the Basin boundaries.

Basic conservation plans have been prepared on 293,712 acres for 2,239 cooperators within the four Basin counties. It is estimated that 900 cooperators whose land encompass 117,500 acres

1/ U.S. Census of Agriculture, Drainage of Agricultural Lands, 1959

2/ As of July 1, 1972, from SCS records and reports.

TABLE III-18: LAND TREATMENT MEASURES APPLIED
 (As of 6-30-72)
 Elkhart River Basin, Indiana

Land Use	Practice	Unit	Amount in Basin	Estimated Application Cost (Dollars)
Cropland	Conservation Cropping System	Acres	145,000	
	Land Adequately Treated <u>1/</u>	Acres	120,700	
	Crop Residue Management	Acres	131,500	
	Minimum Tillage	Acres	64,800	
	Contour Farming	Acres	5,240	
	Diversion <u>1/</u>	Feet	95,100	
	Stripcropping	Acres	1,100	
	Terrace, Gradient	Feet	3,360	
	Terrace, Parallel	Feet	3,020	
	Drainage Main or Lateral	Feet	1,080,000	
	Drainage Field Ditch	Feet	17,300	
	Subsurface Drain	Feet	5,912,000	
	Land Smoothing	Acres	170	
	Open Channel	Feet	470	
	Pumping Plant for Water Control	No.	1	
Structure for Water Control	No.	4		
Grassed Waterway or Outlet	Acres	160		
Subtotal cropland				3,030,000 <u>2/</u>
Grassland	Pasture & Hayland Management	Acres	11,800	
	Pasture & Hayland Planting	Acres	16,870	
	Spring Development	No.	20	
Subtotal Grassland				1,031,000
Forest Land	Tree Planting	Acres	1,930	
	Woodland Improved Harvesting	Acres	5,400	
	Woodland Improvement	Acres	920	
Subtotal Forest Land				244,000
Other Land	Wildlife Wetland Management	Acres	3,470	
	Wildlife Upland Management	Acres	5,300	
	Wildlife Watering Facility	No.	12	
Subtotal Other Land				1,015,000
Multiple	Pond	No.	330	
	Grade Stabilization Structure	No.	75	
	Critical Area Planting	Acres	420	
Subtotal Multiple				638,000
Grand Total				5,958,000

1/ Occurs in more than one land use

2/ Does not include cost of annual recurring practices

are within the Basin area. These plans document the recommendations and decisions of landowners relative to the conservation use and treatment of soil and water resources of each individual land unit.

b. Practices Applied

The specific conservation measures which have been applied to this date by landowners and operators in the Basin are many and varied. This would be expected in any area of this size having such variation in soils, topography and natural features.

The more prominent erosion control practices include crop residue management, contour farming, diversions, pasture and hayland planting, and tree planting. Table III-18 lists the conservation practices and amounts applied in the Basin as of July 1, 1972.

4. Other Programs Affecting Adequacy of Land Management

The current annual levels of forest management assistance given landowners in the Economic Area are listed in Table III-19. The Indiana Department of Natural Resources, Division of Forestry, anticipates this annual level of accomplishment will be continued under their existing going programs.

TABLE III-19: CURRENT ANNUAL LEVELS OF FOREST MANAGEMENT ASSISTANCE
Elkhart River Basin (Economic Area), Indiana

Practice	Number Landowners	Acres
Classified Forest <u>1/</u>	33	680
Forest Management Plans	31	680
Timber Marking	6	146
Timber Stand Improvement	3	30
Tree Planting	2	15

1/ As of June 1973 a total of 3,400 acres, on 165 individual ownerships, has been placed in the "classified" forest program.

In addition, the Division of Forestry utilization and marketing program is active in the Basin. For example, during the spring of 1972, a lumber grading short course sponsored by the Division and the U.S. Forest Service was attended by several sawmill operators or owners from the Basin. This course was directed toward improved efficiencies at the sawmills.

G. Electric Power Generation and Supply

One critical criterion being used in the site selection of electric power generating plants is low-flow stream conditions. The average annual 7 day 1-in-10 year low-flow discharge of the Elkhart River at Goshen, Indiana, is 76 cfs. The flow in the Elkhart at Goshen is considered to be sufficient to support one steam-electric generating unit of the 500 megawatts (MW) capacity range, providing reservoir storage or an alternate source is available to the plant for make-up water during periods when stream flow is below a certain minimum (7 day 1-in-10 year low-flow plus 20 percent or 91 cfs).

The Elkhart River, which is a tributary to the St. Joseph River, flows into the St. Joseph River at Elkhart, Indiana. At Elkhart, the average annual 7 day 1-in-10 year low-flow of the St. Joseph River is 760 cfs, and using current power plant siting criteria, the flow in the St. Joseph River is considered to be capable of supporting at least one 2,000 MW steam-electric generating plant in addition to the two electric generating plants already in existence in Indiana along reaches of the St. Joseph River provided reservoir storage or an alternate source is available to the plant for make-up water during periods when stream flow is below a certain minimum (7 day 1-in-10 year low-flow plus 20 percent or 912 cfs). One of the currently existing plants, a hydroelectric plant, has an approximate capacity of 4 MW while the other, a steam-electric plant, has an approximate capacity of 1,500 MW. It should be recognized that there are other limiting factors to power plant sitings other than a stream's low-flow condition. More in depth information relative to Indiana's electric power generation industry is available in the Indiana Department of Natural Resources State Water Plan Section.

Within the Elkhart River Basin there are no municipally owned electric generating companies. Electric power customers in this Basin purchase their power from either an investor-owned electric utility or a Rural Electric Membership Cooperative (REMC), dependent upon where the customer resides. The REMC provides electric service primarily to the rural-farm customer, while customers living in cities-towns are generally provided electric service by the investor-owned utilities - Northern Indiana Public Service Company (NIPSCO), Indiana-Michigan Electric Company (I&M), and Public Service Company of Indiana, Inc. (PSI). Throughout most of the Basin the service areas of the REMCs and the investor-owned utilities overlap. Customers living in the municipal areas of the Basin are served almost entirely by I&M and NIPSCO. Approximately 60 percent of the Elkhart River Basin lies in the service area of I&M, and the remaining 40 percent lies in the service area of NIPSCO.

The REMC in this part of Indiana purchase the power it sells to its customers from the investor-owned utilities. Besides purchases being made from I&M and NIPSCO, the Kosciusko County REMC purchases some of its power from PSI. Approximately 60 percent of the Basin area is served by four REMCs which are the LaGrange County, Noble County, Whitley County, and Kosciusko County REMCs.

Customers in the remaining 40 percent of the Basin, which are not served by a REMC are generally served by the investor-owned utility in whose service area they reside.

IV. ECONOMIC DEVELOPMENT AND PROJECTIONS

- | | |
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CHAPTER IV.

ECONOMIC DEVELOPMENT AND PROJECTIONS

A. Historical Development

The Elkhart River Basin is located in Indiana's northern counties of Elkhart, Kosciusko, LaGrange, and Noble. The first settlers arrived around 1828-1829 when the territory was occupied by Indians. Most of the land was either forested or in native grass, and from the time of settlement to the present, agricultural related industry has been of prime economic importance. These counties were formally established through legislative action in the following years: Elkhart, 1830; LaGrange, 1832; and Kosciusko and Noble, 1836. During the first two decades after settlement the people were dependent almost entirely upon agricultural crops and livestock for their livelihood and material advancement.

Prior to the legal creation of the four counties, several small communities had begun to develop throughout the Basin. These communities, along with several trading posts, developed mainly along the rivers transecting the area. The rivers served as the primary means of early transportation and were also the primary sources of power. Community growth often was related to the prominence of the rivers next to which a community was located. Elkhart, for example, was founded two years later than Goshen, the county seat, but had more rapid growth because of its more favorable position at the confluence of the Elkhart River, St. Joseph River, and Christiana Creek where water power was abundant. Other communities in the Basin anticipated substantial economic growth with the development of the Wabash-Erie Canal and the development of a river highway system. Most of the small communities along the Elkhart River anticipated this economic growth, particularly after the spring of 1844 when the first steamboat moved up the Elkhart River to commence hauling grain, livestock, and timber supplies back down the St. Joseph River to the Great Lakes. Then in October 1851, the first railroad train rolled into the city of Elkhart. It was this emergence of the railroad transportation system that caused the decadence of the Wabash-Erie Canal and waterways as a primary means of commercial transportation. With the development of the railroad, commercial goods from the eastern seaboard could be transported into northern Indiana and the Elkhart River Basin. No longer would communities and people living in the Basin have to be self-sustaining.

In addition to the grist mills and sawmills which could be found in several locations throughout the Basin, work shops and factories began to emerge in the 1850's, particularly in the city of Elkhart. By 1928, the agricultural industry in the Basin was feeling the impact of farm youths leaving to work in the factories of the growing communities, and by 1937, Elkhart County had grown to be the seventh largest county in the state in population and assessed valuation. No other community in the Basin has grown in economic importance as much as Elkhart, which today is known for its production of band and musical instruments;

mobile home trailers; and pharmaceuticals, chemicals and allied products. Goshen has the second greatest economic base of the cities and towns in the Elkhart River Basin. Some of the more prominent industries found in Goshen are those associated with mobile home products, molded rubber, kitchen and bathroom cabinets, ladder and outdoor furniture, farm equipment, plumbing equipment, electroplating, and automotive assembly.

In other Basin communities, such as Nappanee, furniture and woodworking are the primary industry. Plastics, electronics, and automotive manufacturing are found in Albion while paper table products, molded rubber goods, metal castings, and power tools are manufactured in Ligonier. In Syracuse, there is substantial production of travel and mobile home products, aluminum fishing and pleasure boats, and molded rubber products.

Water resources development in the Basin has centered primarily around these urbanized areas, which are characterized by high population concentrations and which are the hubs for the Basin's industrial activities. Data and information about the current and future municipal, industrial, and agricultural water use in the Basin are included in Section V.

B. General Description

The population figures in this report include the entire county if a portion of it is located within the hydrologic boundary of the Basin. Therefore, the entire population of Elkhart, Kosciusko, LaGrange, and Noble Counties is included. This four-county area will hereinafter be referred to as the Economic Area.

1. Population and Population Characteristics

During the last several decades Indiana's population increased at approximately the same rate as that of the nation. The population of the Economic Area, however, has increased at a faster rate than the state, with a 63 percent gain in the 1940 to 1970 time period. The Elkhart Economic Area population from 1940 to 1970 is shown by county and place of residence in Table IV-1. Total population has increased during each ten-year period since 1940. The proportion of the total population categorized as urban and rural non-farm has also increased. By 1970, the proportion of population classified as urban had increased to over 43 percent with 99,460 persons residing in urban sectors.

The rural non-farm sector 1/ of the population, however, recorded the largest percentage as well as the largest number increase. The population increased 188 percent from 32,361 in 1940 to 93,180 in 1970. A substantial proportion of this increase can be attributed to the growth of small towns and unincorporated areas on the urban fringe which have not been incorporated into areas classified as urban.

1/ Includes communities and towns of less than 2,500 population not engaged in agriculture.

TABLE IV - 1. HISTORICAL POPULATION BY COUNTIES
Elkhart River Basin (Economic Area), Indiana

Year	Urban	Farm	Rural Non-Farm	Total	Population	Percent			Total	Population
						Urban	Farm	Rural Non-Farm		
-----Number-----										
<u>Elkhart County</u>										
1940	47,837	14,340	10,457	24,797	72,634	65.9	19.7	14.4	34.1	100.0
1950	52,042	12,145	20,325	32,470	84,512	61.6	14.4	24.0	38.4	100.0
1960	57,887	10,437	38,466	48,903	106,790	54.2	9.8	36.0	45.8	100.0
1970	79,223	11,339	35,967	47,306	126,529	62.8	9.3	27.9	37.2	100.0
<u>Kosciusko County</u>										
1940	6,378	13,429	9,754	23,183	29,561	21.6	45.4	33.0	78.4	100.0
1950	6,625	11,415	14,962	26,377	33,002	20.1	34.6	45.3	79.9	100.0
1960	7,234	9,245	23,894	33,139	40,373	17.9	22.9	59.2	82.1	100.0
1970	10,365	7,991	29,771	37,762	48,127	21.5	15.5	63.0	78.5	100.0
<u>LaGrange County</u>										
1940	-	9,314	5,038	14,352	14,352	-	64.9	35.1	100.0	100.0
1950	-	8,347	7,000	15,347	15,347	-	54.4	45.6	100.0	100.0
1960	-	7,781	9,599	17,380	17,380	-	44.8	55.2	100.0	100.0
1970	-	7,950	12,940	20,890	20,890	-	36.8	63.2	100.0	100.0
<u>Noble County</u>										
1940	5,431	10,233	7,112	17,345	22,776	23.8	44.9	31.3	76.2	100.0
1950	6,119	8,478	10,478	18,956	25,075	24.4	33.8	41.8	75.6	100.0
1960	9,360	6,774	12,028	18,802	28,162	33.2	25.3	41.5	66.8	100.0
1970	9,872	6,991	14,519	21,510	31,382	31.5	22.2	46.3	68.5	100.0
<u>Elkhart Economic Area</u>										
1940	59,646	47,316	32,361	79,677	139,323	42.8	34.0	23.2	57.2	100.0
1950	64,786	40,385	52,765	93,150	157,936	41.0	25.6	33.4	59.0	100.0
1960	74,481	34,572	83,652	118,224	192,705	38.7	17.9	43.4	61.3	100.0
1970	99,460	34,288	93,180	127,468	226,928	43.8	15.1	41.1	56.2	100.0

Source: U. S. Census of Population 1940, 1950, 1960 and 1970.

The rural farm population has decreased from 47,316 in 1940 to 34,288 in 1970. Factors contributing to this decline include the substitution of capital for labor, increases in farm efficiency, and the lure of attractive off-farm employment opportunities. A similar decline in the rural farm population was recorded throughout the state and nation.

The total population in the Economic Area is expected to increase from 226,928 in 1970 to 297,100 in 1990, 337,700 in 2000, and 436,700 in 2020 (Table IV-2). The rural farm population, however, will continue to decline but at a slower rate than in the past. Continued increases in the urban and rural non-farm sectors are expected to more than offset this loss. Population in the rural non-farm sector is projected to increase to 152,000 by 1990 with a further increase to 193,200 by 2020. Increased population in the rural non-farm sector is expected to continue to be centered in small towns, unincorporated areas, and near the many lakes and recreational facilities.

The majority of the rural non-farm population increase is projected to occur in Kosciusko and Noble Counties. Population in the urban sector is expected to continue to increase to 145,100 in 1990 and to more than double by 2020 with 243,500 classified as living in urban places. More than 80 percent of the urban increase is projected to take place in Elkhart County. The 2020 urban population of Elkhart County is expected to be 196,800 or 76 percent of the county population.

TABLE IV - 2. 1970 AND PROJECTED POPULATION
Elkhart River Basin (Economic Area), Indiana

Population Category	1970	1990	2000	2020
Urban	99,460	145,100	174,300	243,500
Rural				
Farm	34,288	27,700	25,500	22,100
Non-farm	93,180	124,300	137,900	171,100
Total Population	226,928	297,100	337,700	436,700

Source: U.S. Census of Population. OBERS, 1/ Series "C" Population Projections.

The more recent Series "E" projections indicate that population growth in the Basin will not be as rapid as indicated above. Basin population, based upon Series "E", is projected to increase to about 260,000 by the year 1990, and to about 294,000 by the year 2020.

1/ U.S. Department of Commerce and U.S. Department of Agriculture, 1972 OBERS projections of economic activity in the United States, Volume 1 (Concepts, Methodology and Summary Data) prepared for U.S. Water Resources Council, Sept. 1972, 109p. OBERS is an acronym for Office of Business Economics (OBE - currently known as the Bureau of Economic Analysis, U.S. Dept. of Commerce) and the Economic Research Service (ERS), U.S. Dept. of Agriculture.

2. Social Structures and Institutional Arrangements

The political structure of the Elkhart Economic Area is typical of the rectangular land division system in having governmental authority vested in towns and cities, in addition to county and township governmental units. Most of the governmental units have planning and zoning commissions and other regulatory agencies. However, their major activity is planning in response to the increased population pressures and related economic problems.

Over 60 thousand persons were enrolled in public and private schools in the Economic Area in 1970. Schools vary in size from small in the rural areas to those which are much larger in the more urban or consolidated school districts. Many of the rural students are transported to centrally located elementary and secondary schools in the larger towns. Ancilla Domini College, Goshen College, and Grace College and Seminary offer the opportunity for higher education. Goshen College, located at Goshen, is the largest with an enrollment of 1,202 persons in 1970.

3. Employment and Economic Activity

Employment is an important indicator of comparability between areas. Generally an area's economic situation is determined by the type and number of persons employed. Employment in the Economic Area can be classified as basic or non-basic. Basic employment includes work involved in producing goods for export (agriculture, mining, and manufacturing). Non-basic employment is the production of goods for consumption or use within the area. Trades, services (transportation, communication, finance, insurance, real estate, government, utilities, and personal and professional services), and construction are included in non-basic employment.

Employment in the Economic Area is characterized by a decline in the relative importance of the agricultural sector and an increase in manufacturing, and trades and services (Table IV-3). In 1940, over 25 percent of the employed persons were engaged in agriculture as compared to less than 5 percent in 1970. Thus, the employment pattern has followed other areas of the state by utilizing less employees in agriculture and a larger share of the work force in manufacturing and trades and services. Employment in manufacturing has increased from 30 percent of the work force in 1940 to over 47 percent in 1970. Manufacturing firms numbered 458 for the Basin in 1960. However, by 1970, the number had increased to 687 or a 50 percent increase when compared to the 1960 base period. Elkhart County accounted for 162 of the 229 manufacturing firms increase. An example of the importance of industry in the area is reflected in the employment growth of the transportation equipment industry. Employment in the transportation equipment industry increased from 233 in 1940 to 10,795 by 1970.

TABLE IV - 3. HISTORICAL AND PROJECTED EMPLOYMENT, 1940-2020

Elkhart River Basin (Economic Area), Indiana

Employment Category	1940	1950	1960	1970	1980	1990	2000	2010	2020	
										<u>Employees</u>
<u>Basic Activities</u>										
Agriculture, Forestry, Fisheries	12,152	10,941	7,618	4,376	3,000	2,700	2,300	2,000	1,700	
Mining	47	65	65	141	100	100	100	100	100	
Manufacturing	14,598	22,458	30,179	44,322	45,100	48,400	54,900	62,500	69,200	
Total Basic	26,797	33,464	37,862	48,839	48,200	51,200	57,300	64,600	71,000	
<u>Non-Basic Activities</u>										
Contract Construction	1,900	2,970	2,934	4,079	4,900	6,200	7,700	9,700	11,600	
Transportation & Comm.	3,300	4,532	4,026	4,048	3,600	3,900	4,300	4,800	5,300	
Wholesale & Retail Tr.	6,787	9,628	12,367	16,548	18,500	21,700	26,400	31,700	35,900	
Finance, Insurance and Real Estate	751	1,112	1,612	2,483	2,500	2,700	3,100	3,700	4,200	
Services	7,233	8,759	11,959	16,563	18,400	21,800	26,900	32,500	38,000	
Government	1,000	1,278	1,622	1,776	2,700	3,400	4,100	4,600	5,000	
Total Non-Basic	20,971	28,279	34,520	45,497	50,600	59,700	72,500	87,000	100,000	
Non-Classified	742	779	2,568	--	8,300	8,600	9,400	10,400 ⁴	12,000	
Total All Industries	48,510	62,522	74,950	94,336	107,100	119,500	139,200	162,000	183,000	

Source: U.S. Census of Population 1940, 1950, 1970 and OBERS Series "C" Population Projections.

Table IV-3 shows the projected employment by major industries. The significant point of this tabulation is the expected change in employment in the area from a basic to a non-basic employment pattern. In the basic sector, future employment in agriculture is expected to continue to decrease from the present 4.6 percent to 2.2 and 0.9 percent in 1990 and 2020, respectively. However, employment in manufacturing is expected to increase to 48,400 in 1990 and 69,200 in 2020.

The non-basic employment sector is expected to increase to 59,700 in 1990 and to 100,000 in 2020. Major industries expected to employ over 85 percent of the workers are the contract construction, wholesale and retail trade and services.

Employment, sales, and the market value of all agricultural products are also measures of economic activity. Sales tax collections in the Economic Area totaled \$7,143,881, or over 3 percent of the state total collections for fiscal 1969-1970. About 58 percent of the collection was obtained in Elkhart County. Wholesale trade sales for the Economic Area increased from \$211,829,000 in 1963 to \$322,716,000 in 1967. Retail trade sales for the same period increased 28 percent from \$271,978,000 to \$349,716,000. Sales of agricultural products contribute significantly to the economy. While many of the crops produced in the Basin might appear insignificant in national scope their production is vital to the local producers and to the local economy. Market value of all agricultural products sold increased from \$81,512 in 1964 to \$110,055,000 in 1969.

4. Income

Income is one of the best indicators of economic activity and prosperity of an area. Areas of low income are usually associated with a low level of education, a high rate of unemployment, and out-migration. Young, better educated individuals in the labor force are mobile, and are more likely to migrate to areas offering better employment opportunities and higher rates. In 1970, 7 percent of the families in the Economic Area had annual incomes of \$3,000 or less.

The general income levels are shown in Table IV-4. Income is higher than in most areas of the state due to the type of employment opportunities available in the area.

The median family income varied considerable among the counties. The most urbanized county, Elkhart, had the largest median family income (\$11,043), whereas LaGrange County---the most rural in the area---recorded the lowest median income with only \$9,474.

TABLE IV - 4. INCOME CHARACTERISTICS BY COUNTY, 1970
Elkhart River Basin (Economic Area), Indiana

Income	Elkhart	Kosciusko	LaGrange	Noble
<u>All Levels</u>				
Families	32,968	12,850	5,083	8,206
With Female Head	2,753	803	250	527
Median Income	\$11,043	\$ 9,675	\$ 9,474	\$ 9,484
Mean Income	\$12,439	\$10,374	\$ 9,804	\$ 9,958
Per Capita	\$ 3,557	\$ 3,052	\$ 2,554	\$ 2,809
<u>Less Than Poverty</u>				
Families	1,661	1,023	598	591
Percent of Total	5	8	11.8	7.2
Mean Size of Family	3.56	3.14	4.19	3.48
With Female Head	595	216	64	81
Mean Income	\$ 1,771	\$ 1,587	\$ 1,925	\$ 1,847

Source: U. S. Census of Population, 1970

TABLE IV - 5. PROJECTED PER CAPITA AND TOTAL INCOME
Elkhart River Basin (Economic Area), Indiana

Year	Per Capita Income (Dollars)	Total Personal Income (Million Dollars)
1970	\$ 3,242	\$ 736
1980	4,650	1,220
1990	6,010	1,790
2000	8,120	2,740
2010	10,710	4,130
2020	14,060	6,140

In 1970, the Economic Area had a total of 59,107 families, of which 4,233 were classified as having incomes below poverty level. Families in this category ranged from 5 percent in Elkhart County to 11.8 percent in LaGrange County. The income of rural families having incomes below poverty level (\$3,000 or less) tended to be higher than their urban counterparts. Over 42 percent of all low income families are located in Elkhart County, of which almost 600 have females as heads of the households.

Projected per capita and total income are presented in Table IV-5. Per capita income is expected to almost double by 1990. Total personal income is expected to more than double by 1990 and increase to over eight times the 1970 level by 2020. The rapid increase in total personal income is the result of the increased per capita income as well as increased population.

5. Current Growth Characteristics

The Elkhart Economic Area's economy, like many other areas of the United States, may be characterized by a decline in the relative importance of the agricultural sector and an increase in the manufacturing, trade, and service sectors. Despite the natural advantages favoring growth in the agricultural sector, the area has followed the change of other developing areas by utilizing a larger share of the work force for manufacturing; wholesale and retail trade; and service occupations, while agriculture and related employment has declined in importance. Agricultural activity has not decreased as fast as the average for the state, but employment in manufacturing and the wholesale and retail trade sectors have increased at a faster rate. At the present time, the percentage of work force employed in manufacturing is approaching the average of the state.

During the projection time period, wholesale and retail trade and the service sectors are expected to have increasing importance in the total economy. This will be due largely to their more rapid expansion than the other sectors of the economy. Increased leisure time, specialization of occupation, disposable income and mobility will be responsible for creating an increased demand for services.

6. Urban Centers and Their Influence

The influence of the adjacent metropolitan centers is reflected in the growth as well as economic activity. The Economic Area is located between the South Bend and Fort Wayne Standard Metropolitan Statistical Areas (SMSA's). Many persons residing in the area commute daily to their respective places of employment in the urban centers. In addition, cities and towns in the area provide many of the raw materials that are utilized in the final manufacture of goods in the metropolitan centers. Along with being the center of largest employment and economic influence, these metropolitan areas are centers of major needs for water, land resources, recreation, and transportation facilities.

7. Land Use

Current and projected land use by major land use and inventory and non-inventory acreages are shown for the Economic Area and the River Basin in Table IV-6 and IV-7, respectively. Land available for agriculture and forest production within the Economic Area is expected to decrease by 25,835 acres by 1990, decreasing further by 51,024 acres between 1990 and 2020. Non-agricultural land is expected to increase from the present 115,093 acres to 140,928 acres in 1990 with an additional increase to 191,952 acres in 2020.

The projected 2020 land use within the Basin shows a decrease of 29,370 acres of land available for agricultural and forestry purposes (Table IV-7). However, during this period cropland is expected to increase by 16,325 acres. Urban and built-up land will nearly double by 2020, increasing from the present 31,700 acres to 61,070 acres.

Elkhart County is an excellent example of the strong competition for land between agricultural and forestry usage and commercial development. As land prices and taxes increase, the land historically used for agriculture in the Basin shifts to higher use values. In Elkhart County, the average value of agriculture land increased from \$300 in 1959 to almost \$500 per acre in 1969. During the same period, urban or built-up land increased by 9,000 acres.

8. Transportation

Transportation facilities in the Economic Area include airlines, buses, trucks, railroads, and an adequate highway system. Goshen and Elkhart have airports providing commercial flights and air transportation service. In addition, there are three other public owned airports, plus four privately operated fields.

Railroads serving the area include Penn Central, Baltimore and Ohio, and Norfolk and Western. Freight service is provided in the area, but there is no passenger service. Commerce in the Economic Area is also transported by trucking services. Passenger service by bus is available in some of the major towns, but many of the rural communities have no public transportation.

Major highways are U.S. 6, an east-west highway, and U.S. 33, a southeast to northwest route. Most communities and towns are connected by hard-surface roads. Total mileage of roads and streets is 4,866.

C. Agriculture and Related Economic Activity

1. Major Crop Enterprises

Crop production in the Elkhart River Basin serves as one of the major sources of agricultural receipts as well as input to the livestock industry. Feed grains including corn, corn silage, and oats are grown more extensively than all other crops combined. The major portion of the production is marketed as feed inputs for the livestock industry. Food grains, such as soybeans and wheat, are another important source of income.

TABLE IV-6. PROJECTED INVENTORY AND NON-INVENTORY LAND
Elkhart River Basin (Economic Area), Indiana

Year - County	Non-Inventory <u>1/</u>	Inventory <u>2/</u>
-----Acres-----		
1969 <u>3/</u>		
Elkhart	49,144	250,356
Kosciusko	26,590	317,710
LaGrange	27,506	214,994
Noble	11,853	250,547
Total	115,093	1,033,607
1990		
Elkhart	64,596	234,904
Kosciusko	31,955	312,345
LaGrange	29,535	212,965
Noble	14,842	247,558
Total	140,928	1,007,772
2020		
Elkhart	97,016	202,484
Kosciusko	40,727	303,573
LaGrange	33,007	209,493
Noble	21,202	241,198
Total	191,952	956,748

1/ Includes: Federal non-cropland, urban and built-up, and small water areas.

2/ Includes: Cropland, pastureland, forest land, and other land.

3/ Indiana Soil and Water Conservation Needs Inventory (1968)

TABLE IV-7. CURRENT AND PROJECTED MAJOR LAND USE
1968 1/, 1990 and 2020
Elkhart River Basin, Indiana

Land Use	1968	1990	2020
-----Acres-----			
<u>Inventory</u>			
Cropland	254,605	273,980	270,930
Pastureland	32,790	31,480	29,850
Forest Land	41,310	38,850	35,720
Idle Cropland	48,455	19,710	11,290
Other	28,130	28,130	28,130
Sub-Total	405,290	392,150	375,920
Non-Inventory			
Urban and Built-up	31,700	44,840	61,070
Total Basin <u>2/</u>	436,990	436,990	436,990

1/ Source: Indiana Soil and Water Conservation Needs Inventory, 1968

2/ Does not include water areas - 10,370 acres.

Current normal 1/ and projected crop acreages are shown in Table IV-8. There are 335,850 acres of land available for agricultural use. Corn for grain is the predominant crop. It is grown on nearly 94,000 acres and accounts for over 37 percent of all cropland harvested. In addition, nearly 8,000 acres of corn are harvested for silage. The continued demand for soybean and soybean by-products has resulted in a noticeable increase in the acreage utilized for soybean production. Currently, almost 45,000 acres of cropland are devoted to soybean production.

Wheat remains a major crop in the Basin with over seven percent of the crop harvested acreage. Nearly 17,000 acres are in oats, barley and other small grains grown for livestock feed.

Hay is the major source of roughage for livestock. Currently, over 27,000 acres are utilized for hay production. Alfalfa and alfalfa mixtures account for over 71 percent of the hay production. Relatively small acreages of seeds, potatoes, and vegetables are grown in the Basin. The major specialty crop is popcorn; however, there has been a decrease in cropland utilized for this purpose.

Pastureland encompasses 32,790 acres or almost 10 percent of the land presently available for agricultural production.

1/ Current normal represents cropland and pastureland acreage and production in an average year using current production technology. In this report, current normal is based upon 10-year period 1963-1972. The normalization process removes abnormalities caused by weather, other hazards, and farm programs which make a single year unreliable for a land use and production base.

TABLE IV - 8. CURRENT NORMAL AND PROJECTED ACREAGE OF PRINCIPAL CROPS
Elkhart River Basin, Indiana

Crop	Current	1990	2020
	Normal	-----Acres-----	
Corn for Grain	93,578	119,240	128,450
Corn for Silage	7,954	8,590	8,780
Soybeans	44,993	63,620	64,910
Wheat	21,849	15,680	12,430
Alfalfa Hay	26,644	26,060	23,220
Other Hay	10,626	9,110	7,060
Small Grain	17,009	14,000	12,500
Cropland/Rotation Pasture	30,072	16,460	12,660
Vegetables	1,880	880	790
Idle	48,455	20,050	11,420
<u>Total Cropland</u>	303,060	293,690	282,220
Improved Pasture	32,147	30,860	29,270
Permanent Pasture	643	620	580
<u>Total Pasture</u>	32,790	31,480	29,850

The projected acreage of corn for grain and silage is 127,830 acres in 1990 and 137,230 acres in 2020. This represents over 46 percent and 50 percent, respectively, of the cropland available for production in the Basin. Table IV-8 shows the current normal and projected acreages of major crops. Soybeans are projected to require 63,620 acres in 1990 and 64,910 acres in 2020. The total acreage devoted to wheat, other small grain production, cropland and/or rotation pasture, idle cropland, vegetable production and permanent pasture is expected to decline.

However, analysis of the more recent OBERS Series "E" projections indicate that the total projected acreage utilized for agricultural production will increase, resulting in a more rapid decline of idle cropland through the projection period. Therefore, based upon the Series "E" projections additional resource development will be necessary in order for the Basin to meet its share of agricultural production.

2. Major Livestock Enterprises

Livestock and livestock products are of major economic importance to the Elkhart River Basin. Historically, a major portion of total farm sales have been derived from livestock enterprises. Cattle and hog numbers are increasing. In contrast, dairy cows, and sheep numbers have been decreasing. Milk production per cow has been increasing, thus milk production has remained nearly constant. Poultry production has been expanding; however, broiler production varies widely from year to year depending mostly on the prevailing price.

3. Volume and Value of Production

Current normal and projected crop production for the Basin are shown in Table IV-9. Corn for grain production is expected to increase most with a 147 percent increase by 2020. However, soybean production is projected to increase the largest percentage by 1990 with an 83 percent increase. Corn for silage, hay and pasture production are expected to increase at a slower rate. Wheat is the only major crop expected to decrease in production during the projection time period.

The baseline level of projected major livestock and livestock production is shown in Table IV-9. Beef and veal production is expected to increase 50 percent by 1990 and to more than double by 2020. Pork production is projected to increase more than 50 percent by 1990 and 115 percent of current normal production by 2020. Poultry production is also expected to increase. Milk production is projected to decrease 3 percent in the Basin by 2020. However, lamb and mutton is expected to decrease the most with a 22 percent decrease by 1990 and a 33 percent decrease by 2020.

The projected increase in value of production from current normal to 1990 is a little over \$28 million for the Basin, and a further increase of \$27 million is expected by 2020 as shown in Table IV-10. A major proportion of the increase is due to expected increases in beef and pork production. It should be noted that not all the value calculated was added or originated in the Basin. With feeder livestock, the total value was added to the Basin total if the animals were finished for market without taking into account the value and growth added elsewhere if the animals were in shipments such as feeders.

4. Employment and Income

Estimated agricultural employment in the Basin is 1,650 persons. The proportion of farm operators who work off the farm has been increasing over the years. In 1970, over 66 percent of all farm operators reported working off the farm, with a majority reporting 100 or more days of work off the farm. However, a significant number of employees classified as non-agricultural workers contribute to the agricultural labor force. The trend of fewer farm operators, more farm operators working off the farm, and a significant contribution of farm labor from persons classified as workers in other sectors of the economy is

expected to continue during the projection time period. Workers classified as agricultural employees are projected to decrease to 1,425 persons in 1990, and to further decrease to 1,150 persons in 2020.

TABLE IV-9. CURRENT NORMAL ^{1/} AND PROJECTED PRODUCTION OF HARVESTED MAJOR CROPS, LIVESTOCK, POULTRY AND DAIRY PRODUCTS BY TYPE
Elkhart River Basin, Indiana

Crop	Units	Current	1990	2020
		Normal	-----1000's-----	
Corn for Grain	Bu	7,625	13,650	18,850
Corn for silage	Tons	180	178	203
Soybeans	Bu	1,200	2,200	2,900
Wheat	Bu	767	750	720
All Hay	Ton	95	131	140
All Pasture	AUD's	6,837	7,873	8,102
Beef and Veal	Lbs	20,300	30,600	45,400
Pork	Lbs	38,900	58,500	83,700
Lamb and Mutton	Lbs	900	700	600
Broilers	Lbs	5,700	11,800	18,300
Turkeys	Lbs	5,700	6,900	10,900
Milk	Lbs	124,200	122,300	120,400
Eggs	Doz	13,400	19,100	21,800

^{1/} Current normal represents cropland and pastureland acreage and production in an average year using current production technology. In this report, current normal is based upon 10-year period 1963-1972. The normalization process removes abnormalities caused by weather, other hazards, and farm programs which make a single year unreliable for a land use and production base.

Farm income consists of farm marketing, rental value of farm dwellings, government payments, and recreational income. Income from farm marketings is the income derived from the sum of the commodities produced less the value of crops utilized by livestock multiplied by the current normal price. Current normal value of farm marketing totals \$59.1 million and is the principal contributor to farm income. Other sources of income account for only \$2.2 million or about 4 percent of total farm income.

The current normal total income value less estimated production expenses yield an estimated net of \$21.8 million. Projected total income is expected to increase to over \$118 million by 2020, whereas net income is expected to more than double to \$42.3 million by 2020 as shown in Table IV-10.

TABLE IV-10. CURRENT NORMAL AND PROJECTED AGRICULTURE INCOME
Elkhart River Basin, Indiana 1/

	Current Normal	1990	2020
(Thousands of Dollars)			
Value of Production	59,097.6	87,195.7	114,510.0
Other Receipts	2,224.9	3,282.7	4,357.7
Total	61,322.5	90,478.4	118,867.7
Total Expenses	39,529.4	58,323.7	76,592.4
Net Income	21,793.1	32,154.7	42,275.3

1/ Agricultural Price Standards (Normalized Prices) - U.S. Water Resources Council, 1974

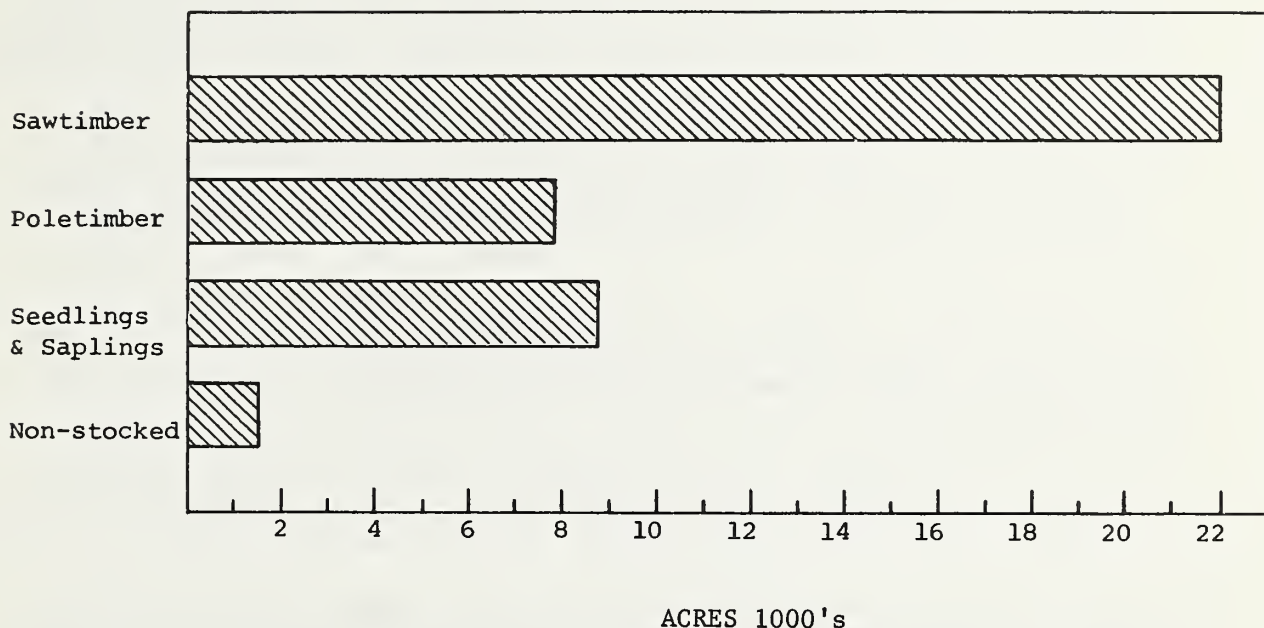
D. Forest Resources and Related Economic Activity

1. Extent and Nature of Resources

Forest land occupies 41.3 thousand acres of the Basin. Of this amount 40.1 thousand acres are classed as commercial forest land and 1.2 thousand acres are non-commercial forest land.

About 1.5 thousand acres of the Basin's commercial forest land are classed as non-stocked. Figure IV-1. This includes idle farmland reverting to forest but still in brush transition stage and stands of trees that are too poor in quality because of fire damage or other abuse. The distribution of the remaining forest land is: 22.0 thousand acres, sawtimber; 7.8 thousand acres, poletimber; and 8.8 thousand acres of seedling and sapling size stands.

FIGURE IV - 1. COMMERCIAL FOREST AREA BY STAND-SIZE CLASS, 1967
Elkhart River Basin, Indiana



Sawtimber stands are defined as stands at least 10 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber or poletimber trees and with sawtimber stocking at least equal to poletimber stocking. Poletimber stands are at least 10 percent stocked with growing-stock trees, and with half or more of this stocking in sawtimber and/or poletimber trees and with poletimber stocking exceeding that of sawtimber. Seedlings and sapling stands are at least 10 percent stocked with growing-stock trees and with seedlings and/or saplings comprising more than half of the stocking.

The area of commercial forest land by major types is shown in Table IV-11.

TABLE IV - 11. AREA OF COMMERCIAL FOREST LAND BY MAJOR FOREST TYPE, 1968
Elkhart River Basin, Indiana

Forest Type	Acres (Thousand Acres)
Northern Pines	(insignificant)
Oak - Hickory	17.5
Pin Oak - Maple - Tamarack	0.7
Elm - Ash - Cottonwood	9.2
Maple - Beech - Birch	12.4
Aspen - Birch	0.3
Total All Types	40.1

Source: North Central Forest Experiment Station, St. Paul, Minnesota

These major forest types are defined as:

Northern Pines - forest in which white, red and jack pines, singly or in combination, comprise a plurality of the stocking. In Indiana, this type occurs principally as plantations. Large, native white pine can be found scattered throughout the area as single trees or as small groups of trees. Common associates include sugar maple, hickory, yellow-poplar, and ash.

Oak - hickory, forest in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking. Common associates include yellow-poplar, elm, maple, black walnut, black locust, and catalpa.

Pin Oak, Maple - Tamarack, bottomland forests in which pin oak, soft maple and tamarack, singly or in combination, comprise a plurality of the stocking. Common associates include cottonwood, willow, ash, elm, and hackberry.

Elm - ash - cottonwood, lowland forests in which elm, ash, cottonwood, or soft maple, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, and beech.

Maple - beech - birch, upland forests in which hard maple or beech, singly or in combination, comprise a plurality of the stocking. Common associates include elm, basswood, and soft maple.

Aspen - birch, forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. Common associate is soft maple.

The forest lands of the Basin support nearly 37 million cubic feet of growing stock timber volume. 1/ This volume is predominately in hardwood species with softwood representing less than one percent of the total (Table IV-12). About eighty percent of this volume consists of high value hardwoods such as white oak, ash, hard maple, and walnut. These are in high demand for veneer, furniture, gunstock manufacture and similar products. The remaining hardwood volume is in species such as red oak; soft maple; beech; and cottonwood used primarily for pallet stock, blocking, and lumber.

Growing stock volumes of live, sound trees in Indiana have shown an increase of nearly 25 percent during the period 1950 to 1967. 2/ The primary reason for this increase in growing stock inventory is the continuing surplus of net annual growth over timber removals. The limited and sporadic market for poletimber size trees for use in the pulpwood markets is the main reason growing stock removals have not been higher. Improved technology in the use of small hardwoods for pulp is expected in the near future and this may

1/ Volume of sound wood in merchantable trees.

2/ USDA Forest Service Resource Bulletin NC-7, 1969.

lessen the gap between growing stock and removals. The Elkhart River Basin has shown a slight decrease in cubic feet of growing stock during this same period of time. The timber removals are still below the net annual growth figures but not nearly as much as the state average. Average annual timber removals are also less than the average annual allowable cut. 1/ Annual allowable cut is the volume that could be cut while bringing the forest to a more productive condition and improving the distribution of age classes and species composition. It assumes an equal level of management regardless of ownership and that level of management will be similar to that applied on national forest land. While allowable cut is only a guide, it does balance timber removals against levels of cutting desired for a forest not fully managed. Under a fully managed condition for timber production, growth and cut would be equal.

The rate of growth and cut is highest in northern Indiana, despite the fact that nearly 80 percent of the state timber volume is in the south. Northern Indiana's growing stock inventory is 22 percent of the state total, but its removal and growth are 34 and 36 percent, respectively, of the total.

2. Current and Projected Growth

The production of industrial wood 2/ in the Basin is expected to increase from about 0.53 million cubic feet in 1970 to 1.55 million cubic feet by the year 2020. This projected increase assumes improved harvesting techniques, utilization of material not now salvaged or removed from the forest, increased supply of growing stock generated by improved management, and a reduction in losses caused by insects and diseases.

Currently, there are good markets for all size and species of trees except for the poletimber and smaller. The largest user of raw forest products is the lumber mill. Here, everything from lumber to pallet stock is produced and in some cases, high grade veneer logs are graded out and sent to other markets. Several "blocking" plants operate sporadically throughout the area. Northern Indiana is also a good producer of high-quality veneer-grade walnut as well as lumber-grade and gun-stock grade walnut. Most of this material is processed outside the Basin.

Black Walnut deserves special mention because of its high value and short supply of large diameter trees in Indiana and throughout its entire range. Between 1950 and 1967, black walnut growing-stock volume on commercial forest land remained surprisingly constant. Volume losses in the larger diameter groups were more than offset by gains in the smaller diameter group. Sawtimber volume of walnut also increased slightly. A substantial gain was made in the 11.0 to 14.9 inch diameter group, but all classes showed losses. 1/

1/ USDA Forest Service Resource Bulletin NC-7, 1969.

2/ Industrial wood is logs, bolts or other roundwood sections cut from trees for industrial consumer use.

TABLE IV - 12. NET VOLUME OF GROWING STOCK AND SAWTIMBER ON COMMERCIAL FOREST LAND BY SPECIES GROUP, 1970
Elkhart River Basin, Indiana

Species	Growing Stock (Million Cubic Feet)	Sawtimber (Million Board Feet)
Softwoods	0.187	0.249
White Oak Group	4.966	13.157
Red Oak Group	7.542	19.413
Hickory	3.389	5.761
Hard Maple	2.864	7.449
Soft Maple	1.881	4.344
Beech	1.195	3.789
Ash	3.149	6.966
Cottonwood	2.345	7.181
Yellow Poplar	0.951	2.583
Sycamore	1.251	4.093
Other	6.934	12.960
All Species	36.654	87.945

Source: North Central Forest Experiment Station, St. Paul, Minnesota.

The demand for veneer-quality and sawlog-quality black walnut will increase in the future, making this species one of the most prized and highest priced species in the country. Because of this, walnut will undoubtedly be managed much more intensively in the future than it has in the past.

Although, to a lesser degree, this same reasoning holds true for many other hardwood species found in the Basin. Demand for hardwood sawtimber is expected to triple between 1962 and 2000. ^{2/} It is imperative, therefore, that landowners in the Basin initiate good forest management on their forest lands if they are to take advantage of the anticipated improved markets and higher prices to be paid for high-quality hardwoods.

^{2/} USDA Forest Service - Timber Trends in the United States Forest Service Rep. 17, 235 p., 1965.

3. Employment and Income in Primary Processing and Related Trade and Service Industries

Currently in the Elkhart River Basin there are about 77 active wood-using industries. Included are about 19 sawmills and one veneer and plywood plant engaged in primary manufacturing. An estimated 3,242 persons are employed in timber-based manufacturing (Table IV-13), generating an average annual payroll of \$15,944,000. Study projections indicate an increase in numbers employed through 1980, then a decrease through the year 2020. Income through payrolls is projected to increase throughout the study period. The decrease in numbers employed after 1990 will be caused by improved technology in milling processes requiring fewer employees per unit of output. This will require more specialized employees and hence higher payrolls.

Greater demand in the future will generate higher prices paid for standing timber and this, together with less rigid product specification and improved utilization, will increase the profitability of timber growing, harvesting and manufacturing.

4. Capital Investment

Capital investment and operating costs for the forest products industry are increasing. This increase is attributed to the continuing efforts of mills to improve utilization of raw materials, meet requirements for improved pollution control imposed through regulatory activities, and new mill construction.

TABLE IV - 13. EMPLOYMENT AND INCOME IN PRIMARY AND SECONDARY FOREST PROCESSING 1972, 1980, 1990, 2000, 2020
Elkhart River Basin (Economic Area), Indiana

	<u>1972</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2020</u>
No. of Employees					
Primary Mfg.	305	392	384	376	283
Secondary Mfg.	<u>2937</u>	<u>4162</u>	<u>4107</u>	<u>4059</u>	<u>3065</u>
Total	<u>3242</u>	<u>4554</u>	<u>4491</u>	<u>4435</u>	<u>3348</u>
(Thousand Dollars)					
Total Income					
(Employees)					
Primary Mfg.	1,500	2,229	2,715	3,178	3,552
Secondary Mfg.	<u>14,444</u>	<u>23,661</u>	<u>29,032</u>	<u>34,302</u>	<u>38,469</u>
Total	<u>15,944</u>	<u>25,890</u>	<u>31,747</u>	<u>37,480</u>	<u>42,021</u>

Source: Indiana Department of Natural Resources

E. Outdoor Recreation and Related Economic Activity

Table IV-14 shows an inventory of the designated recreation land and water areas in the Economic Area. Outdoor recreation utilizes 24,958 acres of land and water, or about two percent of the area. Distribution of this total shows 17,014 acres, or 68 percent, are administered by public agencies while the remaining 7,944 acres are administered by private owners, but for general public use. The related economic activity associated with recreation facilities provided on these acreages is important to the area.

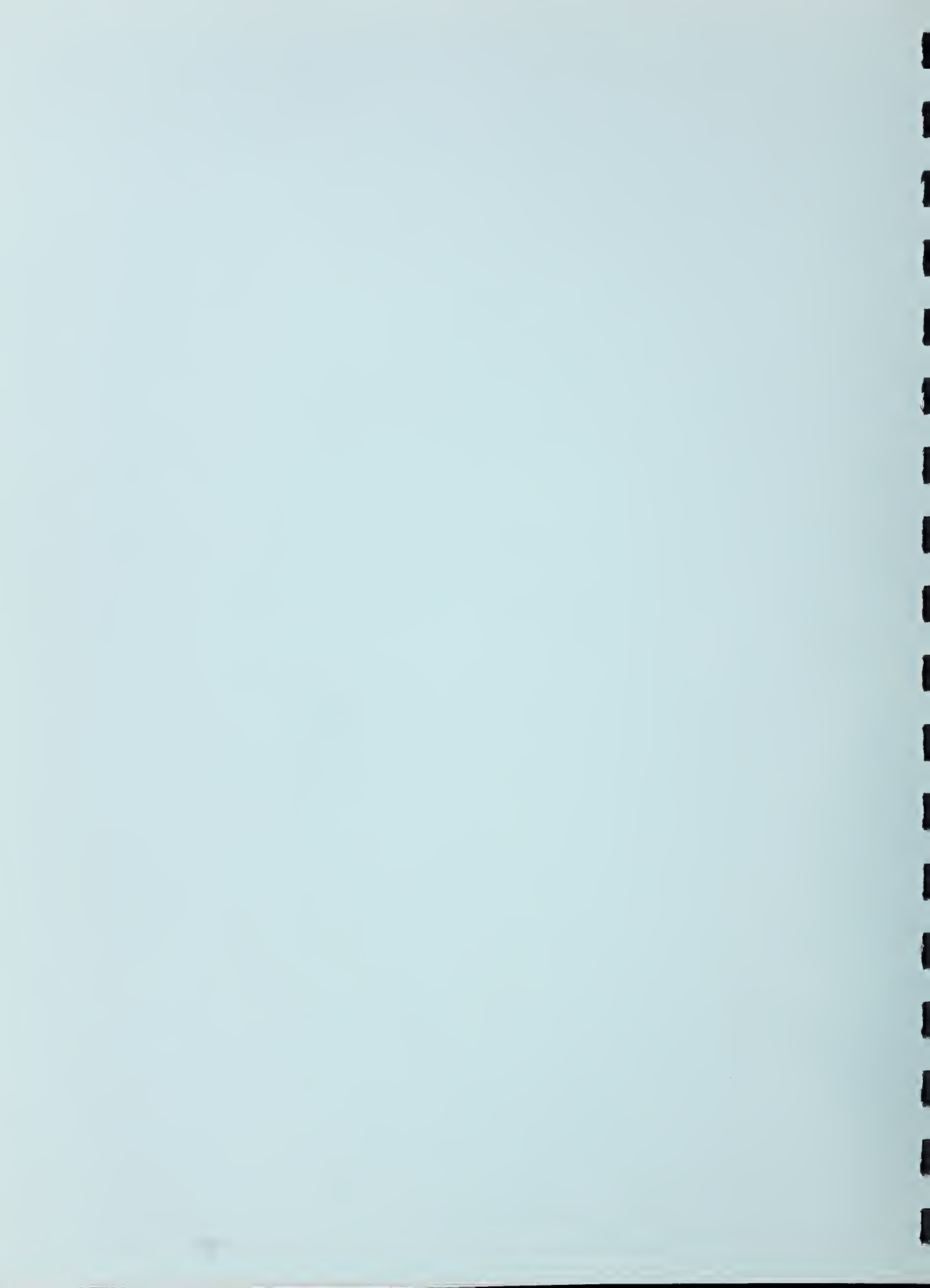
TABLE IV - 14. INVENTORY OF DESIGNATED RECREATIONAL LAND AND WATER AREAS
Elkhart River Basin (Economic Area), Indiana

County	Land Area	Lakes	Streams	Wetlands	Total
-----Acres-----					
Elkhart					
Public	1,235	7	1	-	1,243
Other	1,354	2	-	-	1,356
Kosciusko					
Public	2,613	600	-	80	3,293
Other	1,499	4	-	900	2,403
LaGrange					
Public	5,884	481	90	2,118	8,573
Other	2,694	25	8	20	2,747
Noble					
Public	3,543	305	1	56	3,905
Other	1,298	5	-	135	1,438
Sub-Total					
Public	13,275	1,393	92	2,254	17,014
Other	6,845	36	8	1,055	7,944
Total	20,120	1,429	100	3,309	24,958

Source: Shaping the Future, Indiana Department of Natural Resources, August 1969. Appendix I.

V. PROBLEMS AND NEEDS FOR DEVELOPMENT OF WATER AND RELATED LAND RESOURCES

A. Land Treatment	V - 1
B. Floodwater Damage	V - 7
C. Lake Problems	V - 11
D. Erosion Problems	V - 14
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CHAPTER V.

PROBLEMS AND NEEDS FOR DEVELOPMENT OF WATER AND RELATED LAND RESOURCES

A. Land Treatment 1/

Proper use and management of the land for sustained agricultural and forest production is a basic need in the conservation, development, and utilization of land and water resources. The characteristics of the various soils must serve as a guide in developing broad land use plans and in assisting individual landowners in making proper land management decisions.

1. Types of Problems and Need for Land Treatment

Approximately 150,000 acres of the Basin's 303,060 acres of cropland are subject to erosion problems. About 139,000 acres of cropland are currently in need of treatment for control of sheet erosion. Nearly 40,000 acres of cropland are located on areas having unfavorable soil conditions, primarily droughtiness. These problems are distributed throughout the Basin. Table V-1 summarizes the area affected by these problems within each land capability class. There are nearly 108,000 acres of cropland which have a dominant problem of excess water.

Treatment is currently adequate on 58,910 acres (19.4 percent) of the total cropland in the Basin (303,060 acres). Proper management practices such as crop residue, annual cover crops, and sod in the crop rotation can meet the treatment needs on nearly 143,000 acres (more than 58 percent of the 244,150 cropland acres needing treatment). Mechanical practices such as contour farming and stripcropping, and the use of terraces or diversions are needed on 53,000 acres of cropland or 22 percent of the area needing treatment. Slightly more than 34,000 acres, representing 14 percent of the cropland treatment needs, have a predominant need for an adequate drainage (on-farm resource management) system for the removal of excess surface or internal water.

1/ Data within this section based upon Indiana Soil and Water Conservation Needs Inventory (1968), and the 1969 U.S. Census of Agriculture - Indiana.

TABLE V - 1. PREDOMINANT CROPLAND HAZARDS BY LAND CAPABILITY CLASS
Elkhart River Basin, Indiana

Land Class	Dominant Hazard (Acres)				Total Area
	Erosion	Droughtiness	Excess Water	None	
I	-	-	-	5,540	5,540
II	83,200	14,330	94,760	-	192,290
III	47,510	25,280	8,920	-	81,710
IV	15,840	-	2,970	-	18,810
VI	2,540	-	1,080	-	3,620
VII	870	-	-	-	870
VIII	-	-	220	-	220
TOTAL	149,960	39,610	107,950	5,540	303,060
Area					
Adequately	10,790	17,380	26,950	3,800	58,910
Treated <u>1/</u>	(7.2%)	(43.9%)	(25.0%)	(68.6%)	(19.4%)

Source: Indiana Soil and Water Conservation Needs Inventory (1968)

There are approximately 2,410 acres (7.3 percent) of grassland which are adequately treated; a total of 29,740 acres (90.7 percent) are in need of treatment. An additional 640 acres (2.0 percent) is not feasible to treat based on a reasonable return on the investment. The predominant treatment need is for improvement of plant cover on 18,240 acres (55.6 percent) of the grassland. This treatment generally involves the application of minerals, weed control, and other mechanical measures as needed to obtain a satisfactory stand of grasses. After the stand is improved or restored, adequate plant cover can be maintained by applying recommended management practices and following recommended grazing systems. Table V-2 indicates the current treatment needs for grassland in the Elkhart River Basin.

1/ Land on which the current conservation treatment is adequate to meet the conservation problems.

TABLE V - 2: TREATMENT NEEDS FOR GRASSLAND
Elkhart River Basin, Indiana

Treatment Needed		Percent of Grassland
None, treatment is adequate	2,410	7.3
Not feasible to treat	640	2.0
Protection from overgrazing	2,950	9.0
Improvement of plant cover	18,240	55.6
Brush control and improvement of plant cover	640	2.0
Reestablishment of vegetative cover	4,350	13.3
Reestablishment of vegetative cover and brush control	3,550	10.8

Source: Indiana Soil and Water Conservation Needs Inventory (1968)

Treatment is currently adequate on 7,931 acres (19.2 percent) of the total forest land in the Basin (41,310 acres). Proper management practices such as timber stand improvement, protection from grazing, improved harvesting practices, and protection from insect, disease and fire damage can meet the treatment needs on nearly every acre of forest land whether the need be for timber production, recreation, or wildlife habitat improvement. These treatment needs currently exist on approximately 33,400 acres of forest land.

Study projections indicate a net loss of forest land from the years 1967 thru 2020 of approximately 13 percent (Table V-3). This amounts to the loss of an estimated 5,500 acres of forest land to other uses by the year 2020. Most of this loss is expected to be the conversion of forest land to pasture. The remaining is projected to be converted to urban use, cropland, and road and utility rights-of-way.

TABLE V - 3: ACRES OF COMMERCIAL AND NON-COMMERCIAL FOREST LAND FOR 1967 and 1970 and PROJECTIONS THRU 2020
Elkhart River Basin, Indiana

	-----Thousands-----					
	1967	1970	1980	1990	2000	2020
Total Forest Land	41.3	41.0	39.9	38.9	37.9	35.8
Commercial Forest land	40.1	39.8	38.8	37.8	36.8	34.7
Non-Commercial Forest land	1.2	1.2	1.1	1.1	1.1	1.1

This is a significant loss, considering the scarcity of the resource (less than 10 percent of the total area) and the need for this type of land use in satisfying the recreational needs of the Basin's ever-increasing population.

Grazing control is needed on over 17,800 acres of forest land, and timber stand improvement is needed on 19,300 acres.

Insect and disease damage, which is only a minor problem on the forest land, will be further reduced by maintenance of current information, and by detection and control programs.

Forest fires are not a serious threat to planned programs for forest land management and treatment. Fire prevention and control measures under the Cooperative Forest Fire Control Program and cooperative agreement with local fire departments are adequate to meet state and program goals. Maintenance of going programs will insure adequate protection of the forest land from fire.

Multiple-use management of the Basin's forest land needs to be accelerated to help fulfill the ever-increasing demands on this shrinking resource. Not enough is known of the potentials or limitations of multiple-use. A great deal needs to be learned about the extent to which different uses or intensities of uses are or are not compatible and also about management techniques that can foster optimum production of each use while protecting the values of other uses. There is, of course, a limit to the amounts and kinds of goods and services which any given unit of land can yield. As pressure for production from the land increases, it becomes imperative that sound land management give emphasis to the multiple uses of land. Under proper management, landowners can produce timber crops, enhance recreation, improve wildlife habitat, and improve water quality. Environmental or open space corridors along the Basin streams should be maintained and enhanced where possible. Benefits would include recreation, fish and wildlife, water quality, and timber production.

In summary, land treatment to reduce erosion and improve production efficiency is needed on 272,900 acres of agricultural land. This includes about 139,000 acres of cropland which have a need for control of sheet erosion. In addition, about 34,000 acres of cropland have a need for adequate drainage (on-farm resource management) systems.

2. Need for Land Use Adjustments

There are 13,500 acres (4.5 percent) of the cropland in the Basin which need a change to permanent cover of grass or trees. This need occurs primarily on cropland in Capability Classes IVe and VIe. Table V-4 summarizes the cropland acreage which needs a change in land use to permanent cover.

TABLE V - 4: CROPLAND ACREAGE, BY CAPABILITY CLASS, WHICH NEEDS
CONVERSION TO PERMANENT COVER
Elkhart River Basin, Indiana

<u>Capability Class & Sub-Class</u>	<u>Cropland Acres Needing Land Use Change</u>
IIe	180 <u>1/</u>
IIw	390 <u>1/</u>
IIIe	2,080
IVe	7,250
VIw	430
VIe	2,540
VIIe	430
VIIIw	220
	<u>13,520</u>

Source: Indiana Soil and Water Conservation Needs Inventory (1968)

1/ Consists of numerous small areas which must be managed in accordance with capability class of larger adjacent area.

The land use changes discussed previously have all been those recommended from cropland to a less intensive use such as the permanent cover provided by grassland or forestland. There are 2,020 acres of Class I land now in non-cropland uses which have capability for use as cropland. This consists of 430 acres of grassland and 1,590 acres of forest land. The net effect, if all these land use changes are made, would be a decrease of 11,500 in the total acreage of cropland in the Basin.

The 1,590 acres of forest land on Capability Class I land are mostly in small isolated tracts scattered throughout the Basin. Although this is prime agricultural land, it is also good from the standpoint of timber production and offers an excellent alternative of keeping the land in production pending the time it might be needed for additional agricultural production.

3. Effects of Economic Conditions on Landowners and Operators

Numerous factors have had an effect on economic conditions which influence decisions of landowners and operators. Among these factors, the following are of major significance in the Elkhart River Basin: (1) advances in agricultural technology; (2) the influence of urban expansion (primarily in Elkhart County), (3) the increasing utilization of recreational opportunities provided by the Basin's numerous lakes, and (4) national economic policy.

Technological advances in agricultural crop production have resulted in greater efficiency, but at the same time have required significantly higher inputs of capital. Improved varieties of seed, larger machinery, and increased use of fertilizer and chemicals in conjunction with improved management practices have enabled individual farmers to expand production by operating larger acreages and increasing yield.

Farm size in the Economic Area increased 20 percent from 1954 to 1969 to an average size of 137 acres, which is 20 percent below that of the State of Indiana. While the size of farm increased, the number of farms decreased by 24 percent from 9,150 to 6,950 during the same period. The below average farm size is partly a result of part-time farmers who supplement their farm income by working off the farm. Industries located at Elkhart, Goshen, Kendallville and Nappanee offer the greatest opportunities for off-farm employment within the Basin while other significant employment opportunities are offered in the nearby communities of South Bend, Mishawaka, Fort Wayne, Auburn, Warsaw, and Plymouth.

Demands for land for urban development have not been great in the past, and have increased at a rate considerably less than the state as a whole. The Goshen-Elkhart area, however, is growing steadily and has the potential of critical problems on land use changes if proper emphasis is not placed on future land use planning.

Although the demand for land for urban development is increasing at a rate less than the state average, it does have an impact on the forest land. This is particularly true in the single family development rather than the sub-division or group type developments.

Improved markets in terms of reliability and prices paid to landowners for forest products has created an increased interest in forestry by landowners and operators in the Basin. This interest has manifested itself in improved forest management of existing stands and in establishment of some walnut plantations for the multiple goals of producing nuts, saw timber, and veneer quality timber. Markets for low quality timber in the pallet and blocking industries also permit landowners to upgrade their forest stands

and receive an interim return by removing and selling the less desirable or lower quality trees while releasing the more desirable species and size trees.

As the demand for land-based recreation increases, this too will have an impact on forest land. This impact could result in a loss of acreage to open space activities or a change from timber production to recreational use. This change to recreational use would of course create a new source of income for the forest land owners involved.

Any negative impact on forest land area brings about a corresponding negative impact on wildlife through the reduction or elimination of forest cover and associated habitat. Improved forest and wildlife habitat management can offset some of this direct loss.

B. Floodwater Damage

1. Nature and Extent of Damage, Land Use, Limitations, People and Properties Affected

The Elkhart River Basin was divided into seven hydrologic sub-areas for purposes of relating water damage to hydrologic units. These subareas are identified by major tributaries and the main stem of Elkhart River, as shown in Table V-5 and Plate 12.

TABLE V - 5: IDENTIFICATION OF HYDROLOGIC SUBAREAS
Elkhart River Basin, Indiana

<u>Tributary Name</u>	<u>Drainage Area</u>	
	<u>Sq. Mi.</u>	<u>Acres</u>
South Branch Elkhart River	114	72,960
North Branch Elkhart River	163	104,320
Yellow Creek	33	21,270
Rock Run Creek	43	27,810
Turkey Creek	183	117,120
Solomon Creek	46	29,350
Main Stem Elkhart River (including minor tributaries)	<u>116</u>	<u>74,530</u>
TOTAL	<u>698</u>	<u>447,360</u>

TABLE V - 6: AREA FLOODED BY LAND USE
Elkhart River Basin, Indiana

Hydrologic Subarea	Land Use <u>1/</u>				Other Land	Total	Percent of Hydrologic Subarea
	Cropland	Grassland	Forest land				
Main Stem Elkhart River	731 (17)	558 (13)	1,010 (24)	1,932 (46)	4,231	5.7	
S. Branch	1,337 (22)	997 (16)	470 (8)	3,329 (54)	6,133	8.4	
N. Branch	1,843 (28)	1,133 (17)	604 (9)	3,097	6,677	6.4	
Yellow Creek	243 (46)	101 (19)	106 (15)	77 (15)	527	2.5	
Rock Run Creek	203 (45)	35 (8)	22 (5)	190 (42)	450	1.6	
Turkey Creek	762 (27)	202 (7)	497 (17)	1,389 (49)	2,850	2.4	
Solomon Creek	545 (73)	19 (3)	109 (15)	72 (9)	745	2.5	
Total Basin	5,664 (26)	3,045 (14)	2,818 (13)	10,086 <u>2/</u> (47)	21,613		

1/ Areas shown in acres; figures in parentheses indicate percentage of area flooded.

2/ Includes 7,816 acres of wetlands found mostly in North Branch, South Branch, Turkey Creek, and Main Stem - primarily involving Types 3, 4, 5, 6³ and 6⁴.

Flooding occurs along most of the Elkhart River main channel and its major tributaries. The most significant flooding occurs on the Main Stem Elkhart River, North Branch, South Branch, and Turkey Creek. The total area subject to flooding is about 21,600 acres, as listed in Table V-6 and shown on the Elkhart Flooded Area Map, Plate 13 1/. This represents about five (5) percent of the total Basin.

Land use in flood problem areas, as shown in Table V-6, is of low agricultural intensity, as signified by the 26 percent in cropland. The wetlands, part of other land, occupy about 36 percent of the flooded area, and are marshy or swamped areas under permanent vegetation. Two noteworthy areas of wetlands include the Main Stem Elkhart River and lower Turkey Creek immediately upstream from Goshen Dam Pond at Goshen in Elkhart County, and the Main Stem, lower North Branch, and South Branch just upstream from Ligonier in Noble County.

Areas affected by flooding are primarily agricultural, with damages occurring to crops and other agricultural property. The estimated average annual flood damage to cropland is \$44,965 and \$6,077 to pasture. Monetary flood damage to forest land and other land is considered negligible since these areas contain primarily water-tolerant vegetation.

Urban flood damages occur primarily to scattered residences and businesses. There appears to be no great concentration of damages. Many low value houses are involved, primarily among the developments around existing lakes. Inventory reports show that 137 residences, 23 businesses, and 4 industries are damaged from flooding. The frequency of damage along major streams is estimated to be about once in ten years in most areas. Stage-frequency studies have been made on fifteen (15) lakes with gages. Lake levels rise about 2-3 feet above the legal levels (established by court action) after a 100-year frequency storm. Other flood damages are to on-farm fences and various county roads.

There are about 2,820 acres of forest land situated primarily along the major drainage and classified as flood plain forest. Restrictions to use in this forest system are associated with management problems such as timing of harvest and not with species site problems. The species occurring in this forest condition are adapted to these sites and would be damaged if the water levels were altered. This same holds true for the areas used primarily for wildlife and recreation in these wet soil conditions.

1/ Plate 13 depicts the areas known to have a flood hazard. The frequency of recurrence is variable by location.

2. Frequency and Seasonal Occurrence of Floods

For this discussion of floods the Main Stem Elkhart River and its two principal tributaries, the North Branch and South Branch, will be considered.

Peak Flow - Frequency. Study of flood flows in the North Branch and in the Main Stem Elkhart River can best be done by analyzing the stream gages at Cosperville and Goshen, respectively. At the Cosperville gage, records for the year 1948 through 1969 were studied while at Goshen the years 1932 through 1969 were studied. The South Branch has no stream gage from which to study the flow record but can be studied effectively by analyzing the North Branch gage. Thus, the Cosperville gage shows the characteristics of the upper Basin area drained by both branches of the river while the Goshen gage indicates flow conditions along the Main Stem.

Minor flood problems of the nuisance type occur in the Elkhart River Basin along these streams on the average of between one and two times per year. Stage-fluctuation among floods of varying frequencies show comparatively very small range in vertical change. Flood peaks and flood stages are tempered by the soils and topography of the Basin. Much of the Basin soil is well to excessively well drained as regards to its property of allowing water to percolate downward rapidly. The Basin area includes many lakes over a wide range in surface area and depth. Many small drainage areas contribute to depressed lands that have no surface outlets to streams. Much of the major stream system flow finds its source from either ground water or the lakes. Stream gradients, in the upper Basin especially, are relatively flat. Thus, the streams are not subject to rapid and excessive rises, nor to extremely low rates of flow.

Reference to Table V-7 indicates the comparison of discharge and elevation between floods of widely varying return periods for the two stream gages referred to above.

TABLE V - 7: STREAM GAGE COMPARISON
Elkhart River Basin, Indiana

Item	Stream Gage	
	North Branch at Cosperville (134 Sq. Mi.)	Elkhart River at Goshen (594 Sq. Mi.)
100-year discharge - cfs	920	6450
2-year discharge - cfs	430	2800
ratio 100-yr cfs/2-yr cfs	2.14	2.30
100-yr elevation - msl-ft	890.8	781.1
2-year elevation - msl-ft	888.2	776.5

The ratios above are among the lowest for Indiana streams. In summary, the basin streams do not build high peak discharges for their respective drainage areas.

Seasonal Occurrence: Seasonal occurrence of floods in the Elkhart River Basin was studied by analyzing all peak flow events above the peak base of 1,800 cfs at the Goshen stream gage on the Elkhart River.

It is apparent that winter and spring are the seasons when most big flows occur. In fact, only 11.1 percent of all large flows occur during June through November, or 18.9 percent during May through November, as shown in Table V-8.

Based upon the usual characteristic of smaller drainage areas being subject to more summertime floods, somewhat more summer flooding may occur in the upper Basin. The magnitude of this increase is unknown.

TABLE V - 8: SEASONAL ANALYSIS OF ELKHART RIVER HIGH FLOWS
AT GOSHEN 1/
Elkhart River Basin, Indiana

<u>Month</u>	<u>No. of High Flows</u>	<u>Percent of Total</u>
Jan.	7	10.9
Feb.	13	20.3
Mar.	10	15.6
Apr.	15	23.4
May	5	7.8
June	1	1.6
July	3	4.7
Aug.	1	1.6
Sept.	0	0
Oct.	2	3.2
Nov.	0	0
Dec.	<u>7</u>	<u>10.9</u>
	64	100.0

1/ Record for years 1932-1969

C. Lake Problems

A survey of the natural lakes and a few man-made lakes in the Elkhart River Basin was conducted by the Flood Damage Reduction Task Force. The survey took the form of a questionnaire sent to county surveyors, conservation officers, conservationists, and personnel from the Lakes and Streams Section of the Division of Water, Indiana Department of Natural Resources. The survey concerned problems relating to high water, outlet capacity, low water, septic tank problems, weed and algae prob-

lems, crowded conditions, quality of fishing, presence of wetlands, uses of the lake and the presence of a lake owner's association. One hundred and nine lakes between 10 and 3,060 acres were surveyed.

Fifty-seven lakes (52 percent) had weed and algae problems. Fourteen lakes (13 percent) had noticeable problems with a septic tank. Ninety lakes (83 percent) had some wetland resources worthy of consideration. Forty lakes (37 percent) might profit from some form of lake surface management such as zoning of restricted hours. This assessment came from the evaluation of the responses to questions about conflicting uses and crowded conditions.

All available inventory data on each of these 109 lakes have been compiled in tabular form as basic data for the Basin study. The inventory data is divided into three sections - physical data, shoreline characteristics, and water characteristics.

There is much variation between lake communities, and both informational and resource management programs need to be adapted to the specific needs of each community. It cannot be assumed that problems in one community will be the same as those in another. There would appear to be two major classes of factors which cause lake problems: (1) those associated with the physical, chemical and biological nature of the lake ecosystem and (2) those associated with the people living in the lake community. Identical aquatic ecosystems could have entirely different problems because of the difference in the opinions and needs of the people living around the lake. A combination of the ecological and sociological approaches in analyzing the lake problems appears to hold promise.

There are several lakes or chains of lakes which have flooding problems due to fluctuating water stages or outlet conditions. These lakes are discussed below and may be located on Plate 1.

1. Lake Wawasee and Lake Syracuse in Kosciusko County

The problems associated with these lakes deal with undesirable high stages due to the restricted capacity of Turkey Creek below the dam in Syracuse. Careful operation of the control structure at Syracuse is now required to minimize damages to low-lying properties around the lakes.

2. Dallas, Hackenburg, Messick, Westler, and Witmer Lakes (Indian Lakes Chain) in LaGrange County.

These lakes are now experiencing undesirable high stages due to the restricted outlet channel capacity. These lakes outlet into the North Branch of the Elkhart River over a control structure which is owned and maintained by the Department of Natural Resources. Due to the restriction in outlet channel capacity, this control structure becomes "drowned out" during times of excessive runoff. Much of the existing lakeshore development around Dallas and Hackenburg Lakes lies on lands which are too low with respect to normal lake surface, thereby subjecting lake cottages to flood water damage and hampering septic system operations.

3. Adams Lake in LaGrange County

About three houses and 140 lawns and gardens are damaged from undesirable high stages due to inadequate outlet channel capacity and improper control structure. The control structure is located about 1,000 feet downstream from the main body of the lake. This portion of the outlet is choked with sediment and grown up with trees and aquatic vegetation.

4. Hindman, Moss, Knapp, Little Bause and Harper Lakes (Knapp Lake Chain) in Noble County

These lakes experience undesirable ranges in stage due to restricted outlet channel capacity and lack of a control structure. In particular, the existing development of Knapp Lake is too low. Approximately 10 houses and 90 lawns and gardens are damaged from flooding. Because the upper reach of this stream is located in an extensive marsh, the best site for a control structure would be at a point immediately upstream from Gordy Lake.

5. Muncie Lake and Williams Lake in Noble County

The high water problem on these lakes is two-fold. The outlet channel on Williams Lake is restricted, and the flow through the South Branch of the Elkhart River is sluggish, causing backwater problems. The outlet channel on Williams Lake could be improved to eliminate high water problems caused by localized short duration storms.

6. Waldon, Tamarack, Jones, and Steinbarger Lakes (West Lakes Chain) in Noble County

The new control structure which has been built and is operated by the Department of Natural Resources has helped to eliminate the low water stages from this lake chain. However, the outlet of this chain is the North Branch of the Elkhart River,

which has an inadequate capacity to move high flood flows downstream.

D. Erosion Problems

Soil erosion is one of the problems relating to the proper and efficient use of the land resources of the Basin. Excessive erosion reduces the capability of the land to produce crops, and results in a general deterioration of the land resource base. The erosion process also represents the source of sediment that causes additional damage to land, open ditches, channels, and roads. In excessive concentrations, sediment has a detrimental effect on the quality of surface waters in streams and lakes.

About 45 percent 1/ (196,500 acres) of the Basin has a dominant hazard or problem 2/ of soil erosion. Approximately 150,000 acres of cropland have a dominant erosion problem or hazard and only 10,790 acres have received adequate treatment for control of erosion. The remaining 139,000 acres may be characterized as having a current erosion problem and a corresponding need for erosion control treatment. Table V-1 illustrates the distribution of erosion hazard soils by land capability classes for cropland. There are no widespread erosion problems on the grasslands under its present use; however, some of these areas would be susceptible to serious erosion under more intensive use, such as cropland.

There are several types of soil erosion in the Basin; however, the frequent, intense thunderstorm rainfall occurring in a region with such a large percentage of cropland, establishes sheet erosion as the most widespread and severe. Soils are described as having an erosion problem when the losses result in a depletion of the soil resource. The maximum amount of soil loss that can be tolerated without depleting the resource is referred to as the soil loss tolerance and is usually expressed in tons per acre. Most of the erosion hazard soils within the Basin have soil loss tolerances ranging from 2 to 3 tons per acre annually. Computations of sheet and rill erosion in the Elkhart Basin reveal an average annual soil loss of 2.2 tons per acre.

Cropland within the Basin averages about 2.6 tons per acre; pasture land averages about 0.21 tons per acre annually. Although the average is relatively low, soil losses exceed 3 tons per acre annually on nearly one-third of the Basin's cropland.

- 1/ Indiana Soil and Water Conservation Needs Inventory (1968)
2/ Susceptibility to erosion is the dominant problem or hazard in the use of the soils. Erosion susceptibility and past erosion damage are the major factors for placing soils in this category.

Conservation treatment to reduce the soil loss from the area is needed. These soil loss values are determined on the basis of average management practices, taking into consideration the rainfall erosion potential, soil type and the gradient and length of slope. Wind erosion, a form of sheet erosion, is not a widespread problem, although it is a potentially severe problem on some sandy and organic soils.

There are 18, 990 acres of forest land occurring on soils with erosion hazards.

The average basic erosion rate for the forest land in the Basin is 0.21 tons per acre per year. This indicates that erosion problems on forested acres are negligible. Proper forest management, which includes protection from fire and grazing, will maintain this good condition.

One factor that accounts for the relatively low average soil loss is the high percentage of soils which have relatively flat slopes and low runoff potential. Approximately 20 percent of the Basin soils (15 percent of the cropland) are characterized by very gentle slopes and low runoff (high infiltration) potential.

Gully erosion, although locally a serious problem, is not a major problem widespread throughout the Basin. Damages that may result from gully erosion include destruction of the land by the creation of a void where the gully is formed; depreciation of the land adjacent to the gully; and damage to roads, railroads, bridges, culverts, building foundations, fences and field crossings. The gullies are also a hazard to the farm operators and their livestock. The extent and severity of gully erosion in the Basin was judged not great enough to warrant special studies or monetary evaluation of damages. Questionnaires completed by local soil conservationists indicate that severe gully problems are restricted to local, widely scattered areas, and that potentially moderate gully erosion problems are limited to less than 20 percent of the Basin's soils.

Streambank erosion is not a widespread or severe threat to the productive land base of the Basin, due principally to relatively low flood stages and low velocities of the Elkhart River and major tributaries. Some streambank erosion does occur locally on some of the Basin's streams. However, in general, streambank erosion was judged not to be severe enough to warrant further study pertaining to possible economic justification of special "project type" treatment measures such as riprap or grade control structures.

Erosion damage from flood plain scour is minimal in this Basin. The relatively low flood flow velocities and the lack of well-defined and confined flood plains results in low out-of-bank flood flow velocities and consequently, the opportunity for widespread scour is not great. Nevertheless some scour does occur in local areas.

Erosion is a potentially severe problem on new construction areas, livestock feedlots, and on unvegetated roadside banks and ditches. Disturbed and non-vegetated areas that are cleared and graded for urban and commercial developments are particularly subject to severe erosion. Erosion control on these areas is needed throughout the Basin.

E. Sediment Problems

The sediment problems in the Elkhart Basin do not appear to be as severe as in some adjoining areas. Suspended sediment records are available for only one location within the Basin. The average annual suspended sediment discharge as reported by the U. S. Geological Survey 1/ for the Elkhart River at Goshen, Indiana, is about 30 tons per square mile. This compares with 209 tons per square mile for the Wabash River at Bluffton, Indiana, and 52 tons per square mile for the Tippecanoe River at Ora, Indiana. The Elkhart River suspended load values are the lowest of 35 stations which were reported in the U. S. Geological Survey report. The Elkhart River suspended load data may not be truly indicative of the sediment yield from individual hydrologic subareas because the station is below (downstream from) the Goshen Dam Pond, which traps some of the sediment, thus partially explaining the low sediment loads at that point.

In addition, the relatively low sediment yield in the Elkhart Basin can be partially explained by a number of other factors including the topography, stream flow characteristics, and the soils. Gentle slopes and pervious soils cause a larger percentage of precipitation to infiltrate the soil which results in less direct runoff, lower velocities of stream flow, and a lesser capability of the stream flow to pick up and transport the sediment particles. The Elkhart Basin, by virtue of a relatively large percentage of gentle slopes and pervious soils, is characterized by streams with relatively low flow velocities and low flood stages, and thus, less capability to transport the sediment loads. Many streams flow through series of small natural lakes. Additionally, during periods of base runoff when the streamflows are maintained largely by ground water effluent, the sediment concentrations are relatively low and change little from day to day. Thus, the relatively low sediment concentrations in the Basin can be partially attributed to the fact that a substantial portion of the annual Elkhart Basin streamflow is from ground water sources.

Soil loss and sediment produced from forest land is insignificant. The basic erosion rate, or amount of soil particles displaced, is extremely low and the filtering action of ground cover within forest stands keep this displaced soil relatively close to its source. In other words, even though some soil particles are moved, they are quickly trapped by the litter on the soil surface and do not leave the area in the form of suspended sediment.

1/ Johnson, L.E. 1971, Continuing Sediment Investigations in Indiana, U.S. Dept. of Interior, Geological Survey, open file report, Indianapolis.

Despite the relatively low sediment yield, the Basin is not totally free of sediment problems and associated damages. Suspended sediment in the form of fine silts and clays creates a turbidity of the water which reduces the aesthetic quality of the water and decreases its value for recreational purposes, particularly where stream flow enters the many natural lakes of the Basin.

The deposition of the suspended load or bed load material may also cause additional damage. There are locally significant damages which result from the accumulation of sediment in channels, thus reducing the capacity of the channel to carry runoff and increasing the possibilities of flooding. Sediment accumulations in channels have blocked a few tile drain outlets and surface drainage ditches, and have caused a general raising of the water table in adjacent land.

Direct monetary evaluation of channel filling and related sediment damages has not been attempted. This type of damage is very closely related to floodwater damages and to drainage problems. The joint floodwater damages and drainage problems discussed on the following pages may be attributed in part, in some locations, to sediment accumulation in stream channels.

Infertile overwash damage occurs when relatively infertile sediment is deposited over productive soils. It usually occurs on bottomland soils and takes the form of overbank deposits. The damaging materials are usually infertile sands or gravels. Although not uncommon in some parts of the Basin, this type of sediment damage is not considered to be of major proportions within the Basin.

F. Drainage Problems and Needs

Most drainage hazards to cropland are related to soil types which trap excess rainfall on or near the surface of areas near drainageways. Lack of adequate surface drainage appears to be the major factor related to these drainage needs. Most major channels are now adequate in depth and capacity for proper subsurface drainage; however, many tributary channels and lateral ditches are too shallow or marginal for good drainage outlets.

Cropland areas having drainage hazards are well distributed throughout the Basin. The most prominent wet areas are those which are permanently or frequently in a swamped condition, and are related to the Elkhart River main channel, and the lower reaches of North Branch, South Branch and Turkey Creek. Many of these wet areas are also subject to flooding. The total identified joint flood-drainage hazard area involves about 21,600 acres, of which 26 percent are in cropland.

In addition to the joint flood-drainage hazard areas, related drainage hazards are found on about 25,780 acres located near major watercourses and bordering the areas subject to surface flooding. Table V-9 shows these drainage hazard areas by hydrologic subarea and land use. Drainage problem areas are classified into two major categories.

1. Interdependent - areas which depend upon improvement of an adjacent open channel for adequate depth and capacity for gravity discharge of water or upon pumps where a gravity outlet is impractical.
2. Non-interdependent - areas which already have adequate open channel gravity outlets for water removal but require on-site improvements such as tile and/or surface drains.

Numerous cropland areas with drainage needs exist throughout the Basin, and can be classified in both the interdependent and non-interdependent categories.

Some of these are small "land-locked" depressional areas, or other areas situated on individual farms not associated with or adjacent to streams or lakes. Some of the drainage hazard areas are associated with excessively wet soils such as mucks. The exact location of all areas with drainage needs has not been determined.

Additional studies were conducted in Noble County to analyze the relative significance of all types of drainage needs within the Basin. Noble County was selected because: (1) most of its land area lies within the Elkhart Basin, (2) the county contains all types of water hazard areas, both adjacent to the streams and in isolated depressional and on-farm locations, and (3) landowners and operators have shown an interest in identifying all needs for agricultural development in the area.

Field interviews were conducted with 74 owners or operators representing 12,136 acres or about five (5) percent of Noble County. Areas identified as having flood and/or drainage (wetness) hazards represented about 31 percent of the sample area. Corresponding data from the CNI 1/ for Noble County indicates that about 33 percent of the cropland and 35 percent of the total inventory land have a wetness hazard. In the Elkhart River Basin portion of Noble County, CNI data identifies a wetness hazard on about 31 percent of cropland and 34 percent for all inventory land. In the total Elkhart River Basin, these relationships correspond to about 33 percent "wetness" hazard for cropland and 34 percent for all inventory land.

The CNI data indicate that predominately wet areas of inventoried land in the Basin total about 154,000 acres, including

1/ Indiana Soil and Water Conservation Needs Inventory - 1968

TABLE V - 9: DRAINAGE HAZARD AREAS ASSOCIATED WITH MAJOR STREAMS
Elkhart River Basin, Indiana

Hydrologic Subarea	Land Use (Acres) ^{1/}				Total
	Cropland	Grassland	Forest Land	Other Land	
Main Stem Elkhart River	1,251	778	1,122	2,300	5,451
S. Branch Elkhart River	7,588	2,015	1,568	8,605	19,776
N. Branch Elkhart River	5,152	1,897	1,300	6,021	14,370
Yellow Creek	243	101	106	77	527
Rock Run Creek	1,325	114	36	360	1,835
Turkey Creek	2,484	543	631	1,526	5,184
Solomon Creek	1,244	64	144	107	1,559
GRAND TOTAL	19,287	5,512	4,907	18,996 ^{2/}	48,702

^{1/} Includes about 21,600 acres identified as having flooding problems.

^{2/} Includes about 14,600 acres of wetlands found mostly in North Branch, South Branch, Turkey Creek and Main Stem Elkhart River - - primarily involves Types 3, 4, 5, 6³, and 6⁴.

all interdependent and non-interdependent drainage problem areas. Approximately 108,000 acres with a wetness hazard are in cropland, 14,000 in grassland, 17,000 in forest land and 15,000 in other land (includes wetlands discussed above). The wetness hazard, however, is considered a problem only to the cropland areas, since much permanent vegetation is composed of water tolerant species. Elkhart County and Noble County have most of the "wet" soils within the Basin with 44 percent and 40 percent, respectively, while 11 percent are in Kosciusko County and 5 percent are in LaGrange County.

The Noble County Study attempted to find signs of changes in land use patterns attributed to excess water. Results show that cropland acres have reduced from 51 percent to 34 percent of the sample area during the last 20-40 years. There was a corresponding increase in other land (primarily wildlife wetlands) from 28 to 42 percent of the sample area. This could be indicative of a gradually deteriorating drainage condition of land for agricultural uses. Removal of excess water by installation of surface drains and/or tile appears to be the predominant need for most wet cropland areas. The relative importance of these marginal agricultural lands in meeting demands for food and fiber within the Basin, is discussed in Chapter VII.

Although approximately 17,000 acres of forest land is in subclass "w" (wet soils), need for drainage is not critical on these areas. The species occurring on these soils are adapted to this condition and a change in seasonal high water tables brought about through drainage would have a detrimental impact on this resource. Many of these wet forest stands occur in depressional areas and swampy situations which act as natural filters for water flowing into or through them. A reduction of this natural filter system would permit more sediment to reach the water courses than is now occurring.

G. Irrigation

Irrigation in the Basin is not a very significant crop production practice, when the acreage irrigated is compared to the total cropland acreage. In 1969 only 31 producers in the Basin utilized irrigation in the production of crops and only 1,587 acres were irrigated. By 1990 irrigated cropland is expected to increase to 2,300 acres and by 2020 to 3,700 acres. These increases are expected to occur mostly on sandy soils such as Soil Association No. 1 (page III-7) and well-drained muck soils on which a majority of the truck and speciality crops will be grown. These soils are considered to be best adaptable to methods of sprinkler and sub-surface irrigation. Soil Association No. 1 (Oshtemo-Fox) comprises nearly 22 percent of the Basin.

Weather conditions in the area are such as to create the assumption that irrigation could be beneficial to more acres of crop production. Weather causes droughty conditions in some years and supplemental irrigation during these periods would be a profitable practice. However, during most years, the rainfall is adequate and supplemental irrigation could only result in a small increase in crop yields.

From a national viewpoint the development of irrigation is not needed for the Basin to produce its share of projected food and fiber demands. However, irrigation of some speciality and field crops is expected to continue during the projection time period. The water requirement for irrigation is expected to be only 1,456 acre feet per year by 1990 and 2,352 acre feet per year in 2020.

H. Present and Projected Water Use and Water Quality

1. Municipal and Industrial Water Use and Projected Needs

a. General Statements

Eleven of the 18 communities in the Elkhart River Basin have public water supplies providing water for domestic, commercial, and industrial purposes. These municipally supplied communities range in population from rural Cromwell, population approximately 500, to urban Elkhart, population approximately 43,000. Recent water use figures range from 74 to 298 gallons per capita per day (gpcd) with a median figure of approximately 109 gpcd. Each municipality utilizes ground water as the current source of water for the populus, with certain of the municipalities having potential access to surface water sources, if required.

Industry in the Elkhart River Basin is concentrated in the Goshen and Elkhart communities with minor concentration in the Kendallville and Ligonier communities. Recorded data of the public water supplies in the Basin show that these particular communities have higher per capita water usages than those principally rural in nature. To this extent, communities were treated differently and different projection methods applied. The projected figures reflect the water demand for the included municipalities. These values represent increases from 26 to 72 percent over the 1970 per capita water usage figures, depending on the municipality's degree of industrialization.

The method used to project municipal-industrial water demands in the Elkhart River Basin consisted of (1) categorizing Basin communities as either being industrialized or non-industrialized, (2) establishing a relationship between historical community population and historical community

water use using a least square method, and then (3) using this relationship to project water demand in each category. The degree of industrialization of a community was considered to be a critical factor because industrialized communities have characteristically higher per capita water usage demands than non-industrialized communities of comparable population. The parameter of water recycling was forecasted to significantly affect the water demand projections in the later years of the projection period.

b. Discussion of Specific Communities

Tables V-10 and V-11, respectively, show recent and projected population, gross water pumpage, and per capita water use for industrial and non-industrialized communities in the Elkhart River Basin. In examining the gross water pumpage projections, two items should be noted. First, the gross water pumpage figures represent the demands from natural sources and not the total water usage. Total water usage is defined as the total amount of water used for domestic, commercial, and industrial purposes including the use of recycled water. Second, the water demand projections beyond the year 1990 were expected to be influenced by an increase in the amount of water being recycled; hence, recycling is expected to cause a diminishment in the rate of increase in water demand beginning near the year 1990. A general relationship depicted by these tables is that communities with large populations generally have a higher per capita water usage than communities of smaller population. This is evident when comparing the pumpage data of Goshen and Kendallville to those of Albion and Milford.

In applying the methodology, it was found that the pumpage data from the communities of Syracuse and Millersburg were either erratic or inadequate to facilitate making water demand projections. The industrialized community of Syracuse had recorded pumpage data which appeared to be erratic with respect to the population served. The non-industrialized community of Millersburg did not have pumpage data which were recorded daily. Water demand projections were therefore not made for either of these two communities; however, further research showed that the present water sources for Syracuse and Millersburg will be sufficient to supply their projected populations.

Study of the water supplies for other communities in the Basin indicates that ground-water supplies are capable of meeting projected needs with the possible exception of Kendallville and Nappanee.

TABLE V - 10: RECENT AND PROJECTED POPULATION, GROSS WATER PUMPAGE AND PER CAPITA WATER USE DATA FOR INDUSTRIALIZED COMMUNITIES WITH PUBLIC WATER SUPPLIES ^{1/}
Elkhart River Basin, Indiana

Community	1970	1990	2020
Elkhart			
Population served	43,152	50,300	54,100
Gross Pumpage, mgd	7.029	9.406	11.091
Per Capita usage, gpcd	163.0	187.0	205.0
Goshen			
Population served	17,171	21,200	26,800
Gross pumpage, mgd	2.280	3.668	5.440
Per capita usage, gpcd	132.8	173.0	203.0
Kendallville			
Population served	6,838	8,500	9,700
Gross pumpage, mgd	1.120	1.207	1.523
Per Capita usage, gpcd	163.8	142.0	157.0
Ligonier			
Population served	3,034	3,600	4,300
Gross pumpage, mgd	0.330	0.446	0.598
Per capita usage, gpcd	108.8	124.0	139.0

^{1/} Data provided by the State Water Plan Section, Indiana Department of Natural Resources. Base data from the Indiana State Board of Health

Water management personnel of these two communities need to undertake deliberate planning and water development efforts to assure their municipalities of adequate water supplies. The Kendallville condition is considered to be the more urgent of the two.

TABLE V - 11: RECENT AND PROJECTED POPULATION, WATER PUMPAGE AND WATER USE
 DATA FOR NON-INDUSTRIALIZED COMMUNITIES WITH PUBLIC WATER SUPPLIES 1/
 Elkhart River Basin, Indiana

Community	1970	1990	2020
Albion			
Population served	1,498	1,600	1,700
Gross pumpage, mgd	0.121	0.171	0.223
Per capita usage, gpcd	80.8	107	131
Cromwell			
Population served	475	500	600
Gross pumpage, mgd		0.042	0.064
Per capita usage, gpcd		84	106
Milford			
Population served	1,264	1,600	2,000
Gross pumpage, mgd	0.112	0.171	0.274
Per capita usage, gpcd	88.6	107	137
Nappanee			
Population served	4,159	5,200	6,100
Gross pumpage, mgd	0.429	0.718	1.055
Per capita usage, gpcd	103.2	138	173
Wolcottville			
Population served	915	1,100	1,400
Gross pumpage, mgd	0.058	0.109	0.178
Per capita usage, gpcd	74.3	99	127

1/ Data provided by the State Water Plan Section, Indiana Department of Natural Resources. Base data from the Indiana State Board of Health.

2. Rural Water Use and Projected Needs

Water is utilized in the rural sector of the Basin area for many purposes including domestic uses, irrigation, livestock consumption, sanitation, crop spraying and insect control.

There are no accurate records available on rural water uses in the Basin area. The quantity of water used has been estimated from secondary data relating to population, livestock numbers, crop acreage and estimated water requirements. Present and projected rural water requirements and consumptive use are shown in Table V-12. The widespread availability of generally acceptable quality ground-water explains the dependence upon ground-water as probably the most important source of rural water needs.

a. Rural Domestic

The rural domestic water requirements are based upon rural population and a per capita use rate. The rural population considered for this determination consists of the total population of the Basin area less the total population supplied by municipal water systems. A use rate of 60 gallons per capita day (gpcd) was assumed for the 1970 population and increased to 75 gpcd for the year 2020. Rural domestic water requirements are projected to increase significantly from about 3.2 millions of gallons per day (mgd) in 1970 to 8.6 mgd by 2020.

Ground-water has been the principal source for rural domestic use and it appears that nearly all of the future needs will be supplied from this source of supply. Rural water systems in this Basin area are not in great demand because of the widespread availability of ground-water. With the possible exception of relatively small scattered areas, ground-water sources are expected to be adequate to meet the projected rural domestic demands.

TABLE V - 12: RURAL WATER USE AND PROJECTED REQUIREMENTS
Elkhart River Basin, Indiana

	Requirement			Consumption 2/		
	Present 3/	1990	2020	Present 3/	1990	2020
	Values in millions of gallons per day (mgd)					
Rural Domestic 1/	3.2	5.3	8.6	0.5	0.8	1.3
Livestock	2.7	3.8	5.3	2.4	3.4	4.8
Irrigation	0.7	1.3	2.1	0.5	1.0	1.6
Total	6.6	10.4	16.0	3.4	5.2	7.7

1/ Does not include communities that have central water service.

2/ Consumptive use or that portion of the water withdrawn that is no longer available due to loss either through evaporation or transpiration or otherwise removed from the Basin area's environment.

3/ Irrigation data is 1967 base; others are 1970 base.

b. Livestock

The present and future needs for livestock water are dependent on existing and projected livestock numbers. Water use requirements and consumptive rates were developed for various livestock categories and adjusted for the projection periods. The requirements for the Basin are estimated to increase from 2.7 mgd in 1970 to about 5.3 mgd by 2020. Consumptive use rates are estimated to increase from 2.4 mgd in 1970 to 4.8 mgd by the year 2020 (See Table V-12).

Ground-water and surface-water sources are both utilized to meet the livestock water requirements. There are more than 800 ponds within the Basin, many of which serve the principal purpose of storage for livestock water. The generally widespread availability of good quality ground water is conducive to its use for livestock water. Both surface and ground water sources will continue to be important in satisfying the livestock water requirements.

c. Irrigation Water

The requirements for irrigation water in the Basin is relatively minor in comparison to the total rural water use and projected needs as shown on Table V-12. Future irrigation water needs are expected to occur mostly on sandy soils and well-drained muck soils which are well-suited to sprinkler or subsurface irrigation systems. The water requirements are expected to increase from 0.7 mgd (784 acre feet/year) in 1967 to 1.3 mgd (1,456 acre feet/year) in 1990, and 2.1 mgd (2,352 acre feet/year) by the year 2020. The increased acreage of irrigation is expected to occur in areas with suitable soils and adequate supplies of ground water.

3. Water Quality in Streams

a. General

There are many point and non-point discharge sources which contribute to the pollution of waterways within the Elkhart River Basin. These sources are industrial waste water, municipal waste water, semi-public waste water, agricultural (confined feeding operations and fertilizer runoff), septic tanks, salt storage areas, sanitary landfills, haulers of chemical and petroleum products, pesticides, and insecticides (spraying operations).

All but three sewered municipalities in the Elkhart River Basin provide sewage treatment facilities. Of the 13 municipalities providing sewage treatment, 10 have secondary treatment and 6 have phosphorus removal facilities. Table V-13 lists the municipal waste water treatment needs for the Basin.

TABLE V - 13: MUNICIPAL WASTE-WATER TREATMENT NEEDS:
 INDIANA WATER QUALITY STANDARDS
 Elkhart River Basin, Indiana

<u>Municipality</u>	<u>Treatment Required</u>
Albion	Advanced Waste Treatment or Controlled Discharge
Millersburg	Sewage Treatment Facilities
Rome City	Sewage Treatment Facilities
Syracuse	Plant Expansion, Advanced Waste Treatment

There are 23 industries in the Elkhart River Basin which operate waste-water treatment facilities. Five of these industries provide treatment facilities with soil absorption of the effluent, and, therefore, have no outlet to the receiving stream. Eight of the industries discharge waste-water directly into a municipal sewage treatment plant. The remaining ten industries discharge waste-water through their own treatment facilities into a waterway.

There are 125 agricultural feedlot facilities presently in operation within the Elkhart River Basin. These operations include poultry, farrowing sows, nursery and finishing hogs, dairy cows, beef cattle, and ducks. The distribution (by county) of these feedlots is summarized below:

Elkhart	(12)
Kosciusko	(55)
LaGrange	(32)
Noble	(16)

The number of these operations is continually increasing and, therefore, additional manpower will be required by the State Board of Health if proper surveillance is to be maintained for continued protection from this type of pollution.

The Basin contains numerous lakes with varying degrees of development. Many of the lakes were developed before adequate zoning ordinances were adopted by the local zoning board or before zoning boards were established. This has resulted in many small and poorly planned lots which create problems relating to adequate sewage waste disposal. Most, if not all, sewage disposal systems consist of septic tanks which frequently discharge directly into the lakes. Much effort is expended by state and county health departments in locating and correcting faulty or improperly installed disposal systems. There has never been an organized effort to collect all available lake water quality data into one formal condition of lakes within the Elkhart River Basin. Therefore, at the present time, it

would not be possible to make any definitive statements concerning the water quality trends for any specific lake. However, based upon communication received from area residents, there are apparent indications that problems exist in some lakes relative to algal growth, aquatic weeds, and undesirable fish populations.

These problems are caused by the natural and/or artificial addition of nutrients and other processes of the natural aging of the lake. In addition a fact that must be emphasized is that the presence of these problems do not necessarily indicate that the established water quality criteria are being violated.

In order to satisfy the need for additional information a major lake survey program was initiated in 1973. These surveys will be performed by both the Indiana State Board of Health and the National Eutrophication Survey.

b. Effects of Runoff from Agricultural Land

The potential deterioration of water quality in streams and lakes due to rural sources is complex and varied. These sources may include runoff from cultivated land, feedlots, and individual homesteads. The latter category may contribute directly or indirectly, through ineffective septic systems or through the discharge of sewage. The relative impact of each of these sources in a given area depends on a host of factors.

Runoff from cultivated land may affect water quality through: (1) the discharge of sediment (sedimentation and turbidity problems) and sediment borne pollutants (nutrients and pesticides), and (2) the discharge of dissolved pollutants in runoff water. Nutrient removal by runoff varies considerably depending on topography, hydrologic conditions, fertilizer and management practices and the geochemical properties of the prevalent soil. No systematic study of the relative influence of each of these factors on the nutrient content of runoff has been conducted, although extensive information is available in regard to the expected soil losses under various conditions.

In view of the relative minor variation in relief within the Elkhart River Basin, one might assume nutrient enrichment of open water by runoff to be of minor significance. Suspended load values as measured for 1973 at the East Jackson Street monitoring station on the Elkhart River at Elkhart, Indiana, are rather low 4-24 ppm (parts per million) according to unpublished data from the Surveys Section, Division of Water Pollution Control, Indiana State Board of Health. Phosphate levels at this station varied from

0.1 to 1.3 ppm during this period with the majority of the data points around 0.2 ppm. Nitrate levels (reported as nitrogen) during this period ranged from 0.3-2.1 ppm with an annual average of 1.1 ppm. The relatively low sediment and nutrient levels cited refer to the combined load discharged by urban, suburban and rural districts. No breakdown has been made as to the relative contribution of each source. It would seem, therefore, that runoff from cultivated land might be, at the most, a contributing factor to nutrient enrichment of streams, particularly in the watersheds of the upper tributaries to the Elkhart River, where surface relief is more pronounced. No information is available concerning the nutrient discharge by the various sources into existing natural lakes within the Basin.

4. Ground-Water Quality

Table III-8 indicates that the quality of ground-water that serves as the source for municipal supplies in eleven Basin communities is generally acceptable with the exception of moderate hardness and the presence of iron and manganese. Proper treatment can improve the quality to overcome objections and meet the Drinking Water Standards. The degree of treatment provided varies among the individual communities. As noted from Table III-8, the Kendallville supply has been made more acceptable by softening and iron removal treatment. Albion, Elkhart, Goshen, Ligonier and Nappanee have also provided iron removal treatment. Elkhart, Kendallville, Ligonier and Nappanee standardize the fluoride content of their water between 1.0 and 1.5 milligrams per liter as part of a program to reduce dental caries.

The Cromwell, Milford, Millersburg, Syracuse and Wolcottville water supplies are untreated except for chlorination. These towns have chosen not to sophisticate their water by treatment to reduce the iron, even though the iron content is higher than the Public Health Drinking Water Standards. The Milford and Wolcottville water supplies also exceed the standard for manganese in drinking water. Milford has one well that is high in nitrates.

Ground-water in the communities without public water supply systems and in the rural areas generally is moderately hard and contains appreciable amounts of iron, some manganese, and even hydrogen sulphite in isolated areas. These elements, although they are not necessarily harmful to humans, are undesirable from an aesthetic viewpoint and can be reduced by adequate treatment.

I. Recreation

1. Availability of Existing Resources to the General Public

Table IV-14 presented an inventory of designated recreation land in the Economic Area by county and ownership. Access is available to these lands and their distribution makes them readily accessible to all residents in the Area. In addition, non-designated existing recreational resources have varying degrees of access which are dependent upon owner attitudes. The latter areas are not considered stable recreational resources since their availability may change at any time. Additional designated recreation areas are needed to meet present and future recreation demands.

2. Problems with Water Quality and Sediment in Lakes, Streams, and Ponds with Recreation Potential

The aesthetic quality and value for recreational purposes of stream and natural lake waters are reduced by turbidity created by suspended sediment and organic matter. Weed and algae problems are prevalent in over 50 percent of the lakes 10 acres or larger in size. Septic tank discharge problems have been noted on some lakes from residential development on their shorelines. Water quality of Turkey Creek and a tributary from Rome City is affected by urban pollution and discharges from sewage treatment facilities.

3. Relation of Present and Future Population to Needs for Additional Development

The Economic Area has a rural population of 56 percent. Future projections indicate by the year 2020 the Area will have become more urbanized with rural population decreasing to 44 percent. Table IV-2 shows the relationship between urban and rural population.

Recreation facilities must be patterned to meet the needs of the population. As population changes from rural to urban, there will also be a change in the type of recreational facilities required. Recreational facilities that are more intensively developed are generally planned as population density and intensity of land use increase.

The need for recreational facilities is determined by an analysis of the population resources and their related socio-economic factors pertaining to recreation. Urban-rural distribution, age, income levels, education, type of employment, social status, leisure time, and travel habits are some of the factors which affect participation in any given recreational activity. Availability and quality of both resources and facilities are also important factors.

These factors and their effect must be determined in order to predict future demands for various types of recreational facilities.

Ownership of potential recreational land and water areas affect the amount and type of recreational facilities available. An inventory of existing designated recreational land and water areas indicated a total of 17,014 acres in public ownership and 7,944 acres in other ownership.

As population and related recreational demands change, development of recreational resources will need to change accordingly. Both private and public development will be required, and a change in ownership from private to public may be necessary to meet the demands.

4. Needs for Additional Recreational Development

Existing data on the number of people outside the Economic Area utilizing recreational facilities in the Area are not available to establish a trend. Also, adequate data are not available on people living in the Area that go outside the Area for recreational activities. Reports have indicated that a larger percentage of people utilizing recreational facilities within the Area live in the Area. Therefore, no allowance has been made for recreational demand that would result from persons living outside the Area. All of Elkhart, Kosciusko, LaGrange, and Noble Counties are included in the current and future recreational facilities, demands, and needs.

Sixteen recreational activities were considered in the study. These include picnicking, camping, golf, snow skiing, bicycling, horseback riding, hiking, nature walks, playfields, driving for pleasure, swimming, fishing, boating (except sailing), water skiing, canoeing, and hunting. To determine the demand of these recreational activities, a participation rate for each activity was computed.

Participation rates used in this study are 1973 rates from the Indiana Department of Natural Resources, Division of Outdoor Recreation, adjusted from Planning and Development Regions to the Economic Area by a weighted average based on the population for each time period. These rates are shown in Table V-14.

Demand projections for each of the 16 recreational activities are expressed as activity days. Activity day is defined as a statistical unit of recreation used by one person in pursuit of a single activity for all or part of one 24-hour period. The demand for each activity was computed by multiplying the related participation rate and projected population for each time period.

TABLE V - 14: PRESENT AND PROJECTED DEMANDS FOR LAND AND WATER BASED RECREATIONAL ACTIVITIES
Elkhart River Basin (Economic Area), Indiana

Activity	Existing Activity Days(1970) <u>1/</u>	1970		1980		1990		2000		2010		2020	
		Rate ^{2/}	Demand ^{3/}	Rate ^{2/}	Demand ^{3/}	Rate ^{2/}	Demand ^{3/}	Rate ^{2/}	Demand ^{3/}	Rate ^{2/}	Demand ^{3/}	Rate ^{2/}	Demand ^{3/}
<u>Land Based</u>													
Driving for Pleasure	0	1.84	417.5	1.84	480.6	1.85	549.6	1.84	621.4	1.84	710.1	1.84	803.5
Picnicking	1383.1	3.63	823.7	3.63	948.2	3.64	1081.4	3.61	1219.1	3.61	1393.1	3.60	1572.1
Camping	1036.8	3.78	857.8	3.78	987.3	3.79	1126.0	3.77	1273.1	3.78	1458.7	3.77	1646.4
Golfing	219.7	0.77	174.7	0.77	201.1	0.77	228.8	0.77	260.0	0.77	297.1	0.77	336.3
Snow Skiing	86.4	0.06	13.6	0.061	15.9	0.06	17.8	0.06	20.3	0.062	23.9	0.06	26.2
Playfields	290.0	2.64	599.1	2.63	686.9	2.64	784.3	2.63	888.2	2.62	1011.1	2.62	1144.2
Bicycling	101.2	1.16	263.2	1.15	300.4	1.16	344.6	1.15	388.4	1.15	443.8	1.14	497.8
Horseback Riding	17.3	0.71	161.1	0.71	185.5	0.71	210.9	0.71	239.8	0.71	273.9	0.71	310.1
Hiking	93.2	2.15	487.9	2.14	558.9	2.15	638.8	2.13	719.3	2.13	821.9	2.12	925.8
Nature Walks	0	1.89	428.9	1.88	491.1	1.89	561.5	1.88	634.9	1.87	721.6	1.87	816.6
Hunting	90.6	0.83	188.4	0.83	216.8	0.83	246.6	0.83	280.3	0.84	324.2	0.83	362.5
<u>Water Based</u>													
Swimming	6480.0	4.56	1034.8	4.57	1193.7	4.58	1360.7	4.58	1546.7	4.58	1767.2	4.58	2000.1
Fishing	1728.0	1.17	265.5	1.17	305.6	1.18	350.6	1.17	395.1	1.17	451.5	1.17	510.9
Canoeing	69.1	0.41	93.0	0.41	107.1	0.41	121.8	0.41	138.5	0.41	158.2	0.41	179.0
Boating <u>4/</u>	542.7	1.30	295.0	1.30	339.6	1.31	389.2	1.30	439.0	1.30	501.7	1.30	567.7
Water Skiing	148.1	0.45	102.1	0.447	339.6	0.45	133.7	0.45	152.0	0.447	172.5	0.45	196.5

1/ Available activity days (thousands) based on existing facilities and standards for recreational activities.
2/ Seasonal recreation participation rates. Rates are number of occasions of participation by all ages of the population.
3/ Activity days (thousands).
4/ Does not include sailing.

The recreational activities are divided into two categories, land based and water based activities. Land based activities consist of driving for pleasure, picnicking, camping, golfing, snow skiing, playfield, bicycling, horseback riding, hiking, nature walks, and hunting. Water based activities consist of swimming, fishing, canoeing, boating (except sailing), and water skiing. Table V-14 shows the present and projected demands for land and water based recreational activities.

a. Standards

Recreation standards are used to relate supply to demand and needs for recreational facilities. Limited resources and capital at times make it impossible to attain certain desirable standards that are necessary to maintain quality recreational facilities.

Standards used for the Economic Area are from the Indiana Outdoor Recreation Plan (1970).

(1) Standards for Land and Water Based Recreational Activities.

Table V-15 lists the standards used for each recreational activity considered in the Area.

(2) Driving for Pleasure

It is difficult to equate demand to supply for this activity. Therefore, a standard has not been used for this activity. Road standards, zoning, maintaining existing visual assets, and other factors have an effect on this activity.

b. Needs

The recreational needs for the Economic Area were developed using the relationship between the demand projections, assumed standards, and existing supply of acreage and facilities for each specific activity. These needs represent the additional land and water area required to satisfy the outdoor recreational demands.

Projection of recreational needs assumes that resources are available and facilities will be provided. However, if resources are not available or facilities provided, one or more of the following can be expected to occur: (1) part of the demands would be shifted to adjacent areas; (2) a change to other outdoor recreational activities; (3) projected demand may decrease to reduce overcrowding; or (4) part of the demand may be changed to indoor recreational activities.

TABLE V - 15: STANDARDS FOR LAND AND WATER BASED RECREATIONAL ACTIVITIES 1/

Elkhart River Basin, Indiana

Activity	Unit	Standard
<u>Land Based</u>	<u>Daily</u>	
Picnicking	Capacity/Acre	200 - Urban
		96 - Suburban
	Tables/Acre	64 - Rural
		20 - Urban
Camping	Daily Capacity/Acre	12 - Suburban
	Campsites/Acre	8 - Rural
		36
Golf	Daily Capacity/Acre	9
	Acres/Hole	27.3
Snow Skiing	Daily Capacity-Persons/Slope	8.5
	Acres/Slope	150
Playfields	Daily Capacity/Field	2.5
		140 - Urban
		200 - Suburban
	Acres/Field	200 - Rural
		5 - Urban
Bicycling	Daily Capacity/Mile of Trail	10 - Suburban
		10 - Rural
		800 - Urban
		300 - Suburban
Horseback Riding	Daily Capacity/Mile of Bridle Trail	200 - Rural
		80 - Urban
		40 - Suburban
		40 - Rural
Hiking	Daily Capacity/Mile of Trail	240 - Urban
		120 - Suburban
		60 - Rural
Nature Walks	Daily Capacity/Mile of Trail	320 - Urban
		240 - Suburban
		160 - Rural
Hunting	Daily Capacity/Acre	0.2
<u>Water Based</u>		
Swimming	Daily Capacity/Swim Unit	400
Fishing	Daily Capacity/Acre of Water	2
Boating	Daily Capacity/Acre of Water	0.75
Water Skiing	Daily Capacity/Acre of Water	0.5
Canoeing	Daily Capacity/Mile of Canoe Trail	
		48

1/ Source: Shaping the Future, The Indiana Outdoor Recreation Plan (1970).

Driving for pleasure does not have a projected need due to the lack of a use standard. However, it is an important activity and has related resources such as lakes, scenic vistas, historical spots, forests, parks, parkways, streams, and scenic roads.

Water based activities have three basic needs: (a) sufficient quantity; (b) public access to water; and (c) water of suitable quality.

Table V-16 shows the present resources and those required for projected land and water based recreational activities.

J. Fish and Wildlife

1. Relation of Changed Land Use and the Loss of Wildlife Habitats

The natural condition of the Economic Area consisted of dry prairie, wetland, and two forest types: Oak-Hickory and Beech-Maple. As the Area began to be settled, the woodlands were cleared and the meadows plowed. Today about 90 percent of the total Area is utilized for agriculture and forest.

Results of land use changes have been a loss in the natural wildlife habitat resource. Quantity and quality of wildlife habitat has been reduced, with resultant changes in species and quantity of wildlife. Some studies have been made but they are not adequate in number over a sufficient period of time to make a quantitative comparison of the quantity, quality, and location of wildlife habitat and species. However, the Area does represent possibly the greatest variety of wildlife and fisheries habitats in Indiana.

Urban and built-up areas have increased over the years. Future projections indicate the Area will become more urbanized, with the competition for land becoming greater between the agriculture and forestry usage and commercial development. As these changes take place, additional loss of wildlife habitat will occur.

2. Endangered Species 1/

The Elkhart Basin contains a wide variety of wildlife species, with 43 mammal and 336 bird species having been seen in the Basin. Of this number, only seven species have been listed as rare, endangered, or of undetermined status. Listed as rare is the sandhill crane while endangered species include the Indiana bat, bald eagle and Peregrine falcon, all of which are considered endangered nationwide. The star-nosed mole and badger which are peripheral species and the osprey which is of undetermined status, all must be considered rare or endangered for Indiana.

1/ Rare and Endangered Species, BSF&W, IDNR, Purdue U., Ball State U. etc. Adhoc Committee

TABLE V - 16: PRESENT RESOURCES AND ADDITIONAL NEEDS FOR LAND AND WATER BASED ACTIVITIES
Elkhart River Basin (Economic Area), Indiana

Activity	Units	Existing Supply 1970				Additional Needs 1/				
		1970	1980	1990	2000	2010	2020			
<u>Land Based</u>										
Picnicking Tables	Acres No.	440 2,510	0 549	0 1,052	0 1,393	0 1,938	17 2,496			
Camping Campsites	Acres No.	800 4,000	0 2,860	68 3,820	182 4,840	326 6,140	470 7,430			
Golfing 9-hole Courses 18-hole Courses	Acres No. No.	1,900 4 13	0 0 0	78 1 0	348 3 1	669 3 3	1,008 3 4			
Snow Skiing Slopes	Acres No.	40 15	0 0	0 0	0 0	0 0	0 0			
Bicycling	Miles	10	19	23	26	30	34			
Hiking	Miles	30	146	166	184	210	234			
Horseback Riding	Miles	10	96	109	124	142	161			
Nature Walks	Miles	0	67	76	84	94	106			
Hunting	Acres	11,700	16,300	20,200	24,500	30,200	35,100			
Playfields	Acres	363	494	610	733	880	1,038			
<u>Water Based</u>										
Swimming	Acres	90	0	0	0	0	0			
Boating 2/	Acres	20,100	0	0	0	0	1,026			
Fishing	Acres	24,000 3/	0	0	0	0	0			
Water Skiing	Acres	8,230	0	0	214	1,353	2,687			
Canoeing	Miles	40	22	30	40	52	64			

1/ Need figures are cumulative.

2/ Does not include sailing.

3/ Surface area; existing water quality not considered.

For all seven of these bird and mammal species, public awareness of their precarious status and preservation of their existing habitats are the greatest needs.

3. The Effects of Flooding, Sediment Deposition, and Water Quality

The effect of flooding in the Elkhart River Basin must definitely be regarded as an asset to the area's fish and wildlife resources. The flooding that does occur along with the poor drainage of many areas accounts for both quantity and quality of remaining habitat by restricting more intensive development. Forms of wildlife and vegetation occur in the "flood-areas" that are not only capable of surviving high water, but probably are highly dependent upon it.

The problem of sediment and water quality as occurring today also has little or no significant effects on plant and wildlife populations. These problems, however, have had an adverse effect on some species of fish, such as smallmouth bass and trout, that are highly intolerant of these conditions.

Water quality (disregarding sediment content) within the Basin is generally good in so far as fish and wildlife needs are concerned, except for lakes and reaches of streams below the larger communities. In these areas, fisheries population are generally degraded due to municipal and industrial discharges.

The water quality condition primarily affecting fish populations is sediment. With only a few exceptions, such as Clock and Carroll Creeks, the streams of the Basin at some time and in some reaches carry high sediment loads. The main reason this condition and other water quality problems are not more widespread is the existence of the natural "biological waste treatment complex" of the wetland and other overflow lands.

4. Need for Additional Fish and Wildlife Habitat

The fish and wildlife habitat need of the Elkhart Basin is not for additional areas, but is for the preservation and proper maintenance of existing areas. Both in acreage and habitat types, the Basin represents a rich fish and wildlife resource. It is adequate for the present and future needs of the resource if protected and improved by elimination of existing fisheries water quality problems.

5. Access

The public utilization of fish and wildlife resources will foreseeably become a problem and a need for both consumptive and non-consumptive uses. Limited problems of public access will grow in the face of increasing urbanization and other development. This will be compounded if decreases or degradations of existing fish and wildlife resources is permitted.

VI. PLANNING OBJECTIVES, METHODOLOGY AND ASSUMPTIONS

- | | |
|---------------------------------|--------|
| A. Relationship to Type I Study | VI - 1 |
| B. Objectives | VI - 1 |
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CHAPTER VI. PLANNING OBJECTIVES, METHODOLOGY, AND ASSUMPTIONS

A. Relationship to Type 1 Study

The Elkhart River Basin is a tributary of the St. Joseph River which outlets into Lake Michigan at Benton Harbor, Michigan. As such, it comprises a portion of the Great Lakes Basin and was therefore a part of the area included in the Great Lakes Basin Comprehensive Framework (Type I) Study. The St. Joseph River comprises a portion of the Lake Michigan Southeast Planning Sub-area (2.3) which is one of four sub-areas into which the Lake Michigan Plan area was divided. The Comprehensive Framework Study, which provides a broad framework plan for water and related land resources is essentially complete.

The Elkhart River Basin comprises an area of about 700 square miles as compared to 298,000 square miles in the entire Great Lakes drainage. It is readily apparent that even though basic planning assumptions were similar, the Elkhart River Basin Study has been directed toward the solution of problems which are more regional and localized in nature than was possible in the Great Lakes Type I Study. Due to the much smaller scope of the study area, more detailed studies of problems, projected needs, and potential solutions were possible. This is one of the primary purposes for conducting Type IV studies such as the Elkhart River Basin Study in areas on which Type I Framework Plans such as the Great Lakes have been prepared.

B. Objectives

Plans for the use of the water and land resources are directed toward improvement in the quality of life through contributions to the objectives of national economic development and environmental quality. The beneficial and adverse effects on each of these objectives are evaluated and displayed in Chapter IX as to their impact on the nation and the region (state and local). The planning effort is directed toward the best use of water and related land resources, as they relate to existing and projected problems and needs, and toward identification of alternative methods or programs of action which can be used to improve the public decision-making process.

Existing or projected problems and needs expressed by the Basin residents and indicated through collection of basic data demonstrate the need for a consolidated effort in planning and implementing actions for the best resource management and use. Solutions to many of the identified problems and needs will require multi-governmental actions, and their resolution will require cooperation by many levels of government and private interests. The identification of some of these governmental entities and the programs or assistance available is part of the objective of this study.

Beneficial and adverse effects of alternative solutions are measured in both monetary and nonmonetary terms in Chapter IX. The priorities and preferences of the various groups and individuals affected by recommended action will vary, and accordingly, there will likely not be full agreement among all affected on whether certain effects are beneficial or adverse. However, the recommended plan represents an implicit expression of those actions considered to be the priorities and preferences of the study group and the citizen's Advisory Group.

C. Procedures and Assumptions

1. Study Approach

A look to the future, a specific statement of goals, and a plan of action are essential to any water resource program. For the Elkhart River Basin Study, the initial questions were: What and where are the needs? What are the possible solutions? How can the solutions be implemented?

To adequately respond to these questions and many more, a plan of study considered a complete investigation of needs and potentials for development of all purposes of water and related land resources in the formulation of a detailed framework plan. A determination of the needs and potentials to serve the comprehensive objectives requires participation by federal, state, and local agencies whose inherent interests and responsibilities are involved. These agencies cooperated with the Elkhart River Basin Coordinating Committee in the formulation and evaluation of plans of improvement to the extent their respective interests were affected.

The study was approached in two phases. The initial phase was directed toward the identification of resource problems and determination of present and future resource development needs. The second phase was concerned with the formulation of alternative plans of improvements to solve the identified problems and meet the present and future resource development needs compatible with the basin development concept.

2. Planning Assumptions

The comprehensive nature of this investigation required, for purposes of practicality, several basic assumptions. For example, it was assumed that for the period of this study, the federal, state and local interests in water resource development will remain unchanged. Assumptions falling into a general category applicable to many of the study inputs are discussed in the following sub-paragraphs. Assumptions which are limited to a particular subject are discussed in the appropriate chapters.

Economic Activity: The projections of economic activity in the Basin are based primarily on the OBERS 1/ projections of regional economic activity in the United States. The OBERS Series C (moderate growth rate) projections used in this study are based on a set of assumptions which represent those conditions believed to have the greatest probability of occurrence in the long run. The projections, therefore, represent estimates that would result if all assumed conditions materialize. These general assumptions are:

- (1) Growth of population will be conditioned by a decline of fertility rates from those of the 1962-1965 period.
- (2) Nationally, reasonably full employment, represented by a 4 percent unemployment rate, will prevail at the points for which projections are made; as in the past, unemployment will be disproportionately distributed regionally, but the extent of disproportionality will diminish.
- (3) No foreign conflicts are assumed to occur at the projection dates.
- (4) Continued technological progress and capital accumulation will support a growth in private output per manhour of 3 percent annually.
- (5) The new products that will appear will be accommodated within the existing industrial classification system, and, therefore, no new industrial classifications are necessary.
- (6) Growth in output can be achieved without ecological disaster or serious deterioration, although diversion of resources for pollution control will cause changes in the industrial mix of output.

1/ U.S. Department of Commerce and U.S. Department of Agriculture, 1972 OBERS projections of economic activity in the United States, Volume 1 (Concepts, Methodology and Summary Data) prepared for U.S. Water Resources Council, Sept. 1972, 109p. OBERS is an acronym for Office of Business Economics (OBE - currently known as the Bureau of Economic Analysis, U.S. Dept. of Commerce) and the Economic Research Service (ERS), U.S. Dept. of Agriculture.

The Elkhart River Basin projections are based upon the following additional assumptions:

- (1) Most factors that have influenced historical shifts in regional "export" industry location will continue into the future with varying degrees of intensity.
- (2) Trends toward economic area self-sufficiency in local-service industries will continue.
- (3) Workers will migrate to areas of economic opportunities and away from slow-growth or declining areas.
- (4) Regional earnings per worker and income per capita will continue to converge toward the national average.
- (5) Regional employment/population ratios will tend to move toward the national ratio.

Regional assumptions (4) and (5) are corollaries of assumption (3). They are in the nature of central tendencies only. In some circumstances they may be counterbalanced by other forces. The migration of retired people to attractive retirement areas without regard to economic opportunity there, is an example of this counter-effect.

The population was projected by attributing to the Basin a future share, based upon established trends, of national population growth as estimated by the U.S. Dept. of Commerce, Bureau of Economic Analysis, Series "C", moderate growth rate. These Series "C" projections were used in conjunction with the Indiana State Water Plan population projections.

Related Lands: The related lands under consideration in this study are defined in the Water Resource Council Guidelines. Related land is that land on which projected use and/or management practices may significantly affect the runoff pattern or quality of the water resource to which it relates, and land that is significantly affected by existing or proposed measures for the management, development or use of the water resource to which it relates.

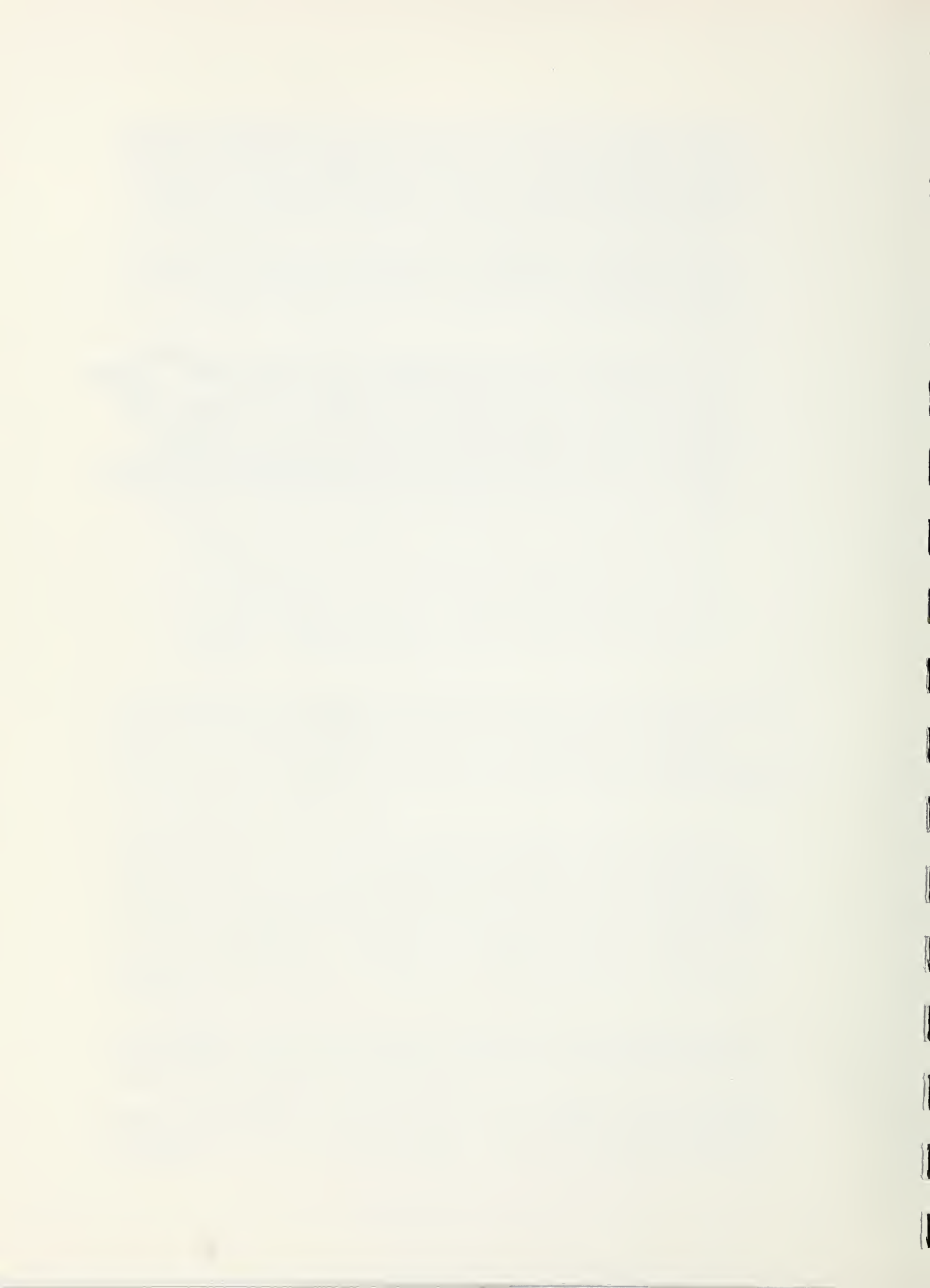
Technological Advances: Future advances in technology were taken into account for projections for municipal and industrial water supply and agricultural production.

Project Potentials: It was assumed that elements of all on-going programs would be utilized to meet some of the growing needs of the Basin.

Price Levels: Price levels prevailing in January 1972 were used for evaluating the present and future benefits and costs. The beneficial effects from agricultural production were evaluated on the basis of current normalized prices.

Interest Rate: An interest rate of 5 7/8 percent was used in the monetary evaluation of beneficial effects and in amortizing estimated capital costs for installation of recommended actions.

Benefits: The aim of water resource projects and programs is to satisfy the human environment - the human needs. Capital goods and services are produced to achieve this goal. These goods and services have value in accordance with demand for them and their relative scarcity. Thus the net monetary benefits in this report represent the estimated increase in value of goods and services of a project expected for a period under study from which losses, if any, have been deducted.



VII. EVALUATION OF RESOURCE CAPABILITY AND OPPORTUNITIES

A. Resource Land Use, Treatment, and Development	VII - 1
B. Flood Prevention, Erosion and Sediment	VII - 2
C. Water Supply Development	VII - 3
D. Recreation and Open Space	VII - 4
E. Fish and Wildlife	VII - 5
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CHAPTER VII. EVALUATION OF RESOURCE CAPABILITY AND OPPORTUNITIES

This section of the report relates primarily to the physical capabilities of the Basin to supply the needed water and related land resource development. It is not aligned toward specific programs or projects. The process of framing alternative plans to meet the current and projected needs for resource development necessarily requires an evaluation of the full physical capabilities of the Basin. Such an evaluation establishes the maximum development capacity within which plans may be formulated for practical and efficient solutions to current and future identified needs.

More specifically, this section deals with the availability of land, as related to present and projected requirements for alternate levels of development. Land treatment is presented in terms of total needs as determined in the Conservation Needs Inventory. Although these are considered to be immediate needs, it must be recognized that their application is dependent to a great extent on the preference and financial resources of individual landowners. Other types of developments including agricultural drainage, flood prevention, and water supply are presented in terms of their physical capacity to solve the problems and to meet the identified need.

A. Resource Land Use, Treatment, and Development

The Basin's land base is sufficient to permit a rather wide range in land use adjustments. The agricultural land base is adequate to absorb the projected increase in urban and built-up land requirements along with land for associated recreational and transportation facilities. Reductions in the agricultural land base (inventory land) from urban expansion are projected to be approximately 13,000 acres by 1990 and nearly 30,000 acres by 2020, as shown in Table IV-7. Advances in agricultural technology which result in increased yields on the land remaining in agricultural production will more than offset these losses.

The opportunities for installation of land treatment measures on agricultural lands are very great. More than 80 percent of the Basin's cropland, or 244,150 acres, is in need of some type of treatment, as indicated by the Conservation Needs Inventory (1968). This includes 13,520 acres currently in cropland which need a change in land use to permanent cover of grass or trees. These acreages represent the total potential for treatment of agricultural lands. Although adequate treatment of all agricultural lands would be desirable, it is not realistic to plan for 100 percent accomplishment of this goal. In addition, lands projected to change to non-agricultural uses, such as urban and built-up and other uses must be deducted from the agricultural land base.

It is estimated that the acreage of cropland and pastureland adequately treated will increase from the present 61,320 acres to 169,750 acres by the year 1990, or from 18 percent to 52 percent. These percentages reflect the projected decrease in cropland and pastureland from 335,850 acres in 1968 to 325,170 acres in 1990, due primarily to the increase in urban and built-up areas.

Opportunities for adequate treatment and management of the Basin's forest resources exist on 33,410 acres of the 41,310 acres of forest land. Currently only 7,900 acres or 19 percent of the forest land is adequately treated.

It is estimated that the acreage of forest land which is adequately treated will increase to 28,900 acres or 74 percent by 1990, and to 31,900 acres or 89 percent by 2020. These percentages reflect projected decreases in forest land acreages to 38,850 acres in 1990 and 35,720 acres in 2020, as shown in Table IV-7.

Hunting, hiking, horseback riding, camping, picnicking and nature walking are recreation activities where forest land can be a source of supply. Table III-16 presented an inventory of present recreational facility development, part of which is supplied by forest land. The supply figures represent only those areas which are designated or otherwise set aside to satisfy recreation uses. Because of the dispersed nature of hunting, nature walking, hiking, and horseback riding, such activities are not restricted to areas which must be set aside for specific purposes. Nearly every acre of forest land has the potential for some type of recreation use. The two major factors which restrict uses on forest land are access to the areas for use and the quality of the recreation experience being sought. Access in the context of this discussion means the availability of the land to the general public, and not the road systems needed to get to the access.

B. Flood Prevention, Erosion, and Sediment

There are ten (10) identified reservoir sites in the Basin, none of which offer potential for use in reducing flood damages. Most of the sites have physical limitations in available storage or water-holding potential and in their proximity to high flood damage areas. There was no identified potential for these sites in serving other component needs of the Basin; therefore, none of the sites is recommended for development.

Of the 109 natural lakes in the Basin over 10 acres in size, many have undesirable water level fluctuations during periods of high rainfall. Some of these lakes have extensive residential developments, with some houses located very close to normal lake levels. Relief from damages caused by high lake levels can be attained by modifying the outlet channel of some lakes. Other lakes can be stabilized by modifying existing outlet control structures, or by construction of new ones.

Major channel modification was considered for flood control; however, the present flood damages along major tributaries and the main channel do not support extensive channel work. Selected tributaries with high concentration of cropland offer some potential for channel work in conjunction with drainage needs.

The adoption or amendment of flood plain zoning ordinances is recommended for the entire Basin. This nonstructural method for flood protection is perhaps the single most important and versatile tool for reducing future flood damages. In Indiana, effective flood plain zoning is a cooperative effort of the state and local government.

The potential for reducing soil erosion in the Basin is significant. This reduction can be accomplished by improved land use and by the application of needed land treatment measures, including erosion control practices. The conversion of about 12,500 acres of cropland with a severe erosion hazard to a permanent cover of grass or trees will reduce the estimated average annual gross erosion on these acres from nearly 7 tons per acre to less than 1 ton per acre. In addition, the application of recommended land treatment measures can reduce the gross erosion on the remaining cropland from the estimated average annual loss of about 2 1/2 tons per acre to less than 1 1/2 tons per acre. Much of this reduction can be accomplished by cropland management practices, including improved crop rotations, crop residue use and the use of minimum tillage methods.

In addition to protecting the soil resource base, the potential reduction in soil erosion will reduce problems related to sedimentation. Probably the most important impact would be a decrease in the rate of sedimentation in the drainage channels. Such a reduction would result in a decrease in the operation and maintenance costs of the open ditch drainage systems. Another significant impact would be a reduction in turbidity of the Basin's stream and lake waters. In addition, the potential for pollution of the surface waters by agricultural nutrients and pesticides would be reduced.

C. Water Supply Development

Water supply developments for municipal and industrial as well as agricultural and other rural uses will primarily involve utilization of the ground water resource. Although it was not practical to evaluate the full ground water resource potential for this study, ground water supplies are generally good to excellent in much of the Elkhart River Basin (Plate 7). Wells with capacities of at least 250 gallons per minute can be obtained in most areas. However, some areas of locally limited supplies are noted and management practices will be required in the future for

these sectors, particularly if larger volumes of water are required. A program of testing and development will be required in these areas, particularly at the southeast edge of Elkhart, near Kendallville, and in portions of the general area near Nappanee.

Ground water has been the principal source for rural domestic use. With the possible exception of relatively small, scattered areas, ground water sources are expected to be adequate to meet the projected rural domestic needs.

Similarly, ground water will continue to be a significant source of water for livestock. Ground water supplies are believed to be adequate to meet the increased needs for irrigation water, provided that the increased irrigation acreage is planned for areas with good ground water supplies as well as adequate soils.

While the quality of ground water may not always be desirable, or meet the drinking water standards, it should be possible to treat the deficiencies and continue to use the resource.

D. Recreation and Open Space

The Elkhart Basin has many natural resources that will provide opportunity for recreational development. Distribution of these resources throughout the Basin makes it possible to provide recreational opportunities where the people live. Well planned development of available resources will satisfy many of the recreation demands of the Economic Area.

1. Land Based

There is currently 20,120 acres of designated recreational land within the Economic Area. This is about 72 percent of the present needs, (27,900 acres) and only 38 percent of the projected needs for the year 2020 (53,500 acres). The largest area requirement is for hunting, which comprise about 87 percent of the present and future needs (24,300 and 46,800 acres respectively).

Riverside recreational developments or corridors along the major streams in the Basin can be utilized as a major resource to satisfy many of the land based recreational activities, such as bicycling, hiking, picnicking and others. Some change in land use may be required in some areas where recreational development will occur. Cropland can be used to satisfy a portion of the hunting demands, providing access is made available.

2. Water Based

The Economic Area contains many water areas which offer opportunities for recreational development. Inventoried Type 5 wetlands total about 45,800 acres and presently there is about 1,530 acres of designated recreational water areas in the Economic Area.

Seventy percent of the Type 5 wetlands are less than five acres in size, while in the Basin there are 109 lakes with 10 acres or more containing a total of 10,190 acres.

The various designated and undesignated water areas satisfy all the present recreational demands except canoeing. The main stem of Elkhart River and Turkey Creek provide canoeing opportunities to satisfy existing and some of the future demands. Although the Basin has an ample supply of water areas, due to the small size of many of these areas they are not capable of supplying all the specific recreation demands. Sufficient water areas are available to meet fishing demands; however, water quality needs to be improved in some areas to provide for a more desirable species of fish.

E. Fish and Wildlife

Cropland, forest land, and pastureland all provide food and cover for wildlife, although some are available only on a seasonal basis. A variety of habitat is provided along the streams and the approximate 75,000 acres of classified wetlands in the Economic Area. These wetlands vary in size and type and therefore offer habitat to a wide variety of wildlife species.

Water resources of the Basin are sufficient to supply fishery needs and water quality is satisfactory for the production of warm water fish. Water quality needs to be improved in areas where pollution occurs to enable the production of a larger variety of desirable fish species.

Acreage and type of fish and wildlife habitat are adequate in the Basin. Additional areas will not be needed provided preservation and proper maintenance of the existing resources occur.

F. Drainage

There is potential for channel modification for drainage in many Basin areas - main channel, tributary and on-farm. These areas have an identified need for drainage to aid agricultural crop production on existing cropland. Over 34,000 acres are so identified, most of which will require individual on-farm action. There are two (2) selected areas, Solomon Creek and Turkey Creek-Davison Ditch, which are recommended for group or drainage board action due to their size and number of beneficiaries.

The potential for large-scale drainage measures (channel work) was evaluated for the South Branch main channel, the Carroll Creek area south of Muncie Lake, and the Wagner Court Ditch-Turkey Creek area at the south Elkhart County line. These evaluations did not show net beneficial effects in terms of economic efficiency. There remains,

however, potential for alternative corrective actions for the drainage problems in those and other areas. Pump drainage, selective channel excavation and debris removal, or tile and open ditch installation appear to be practical alternative solutions to many of the identified drainage problems on existing cropland.

G. Irrigation

There are approximately 75,000 acres of land in the Basin with soil conditions that are suitable for irrigation. The Ground Water Availability Map (Plate 7) indicates that in general, well yields in much of the Basin range up to 500 gallons per minute or more. The major ground water sources are along Coppes Ditch and Turkey Creek, along Solomon Creek and along the Elkhart River downstream from its junction with Solomon Creek. It should be re-emphasized that the planning of large scale irrigation projects should include adequate evaluation of the physical resources at each specific site. Such evaluation must include the suitability of soils and an analysis of the water withdrawal rates versus recharge rate of the aquifer(s) involved.

Limited supplies of surface water are available in many areas. Potential reservoir storage sites are limited in many areas by topographic and geologic conditions. Rainfall patterns and amounts are adequate for most years; therefore, large scale irrigation projects are not expected to develop. Ground water supplies should be adequate for expected future irrigation needs, provided the irrigation projects are planned on the basis of specific investigations of the soil and water resources.

H. Water Quality

The greatest potential for improving water quality in most streams and lakes is through control of pollutants at their source. Adequate treatment of wastewater from municipal, industrial and commercial facilities must be accomplished in order to achieve the full potential for improving the Basin's waters. Likewise, effective erosion control measures applied to the land would reduce the sediment load in streams. The proper use of fertilizers, insecticides, and herbicides would further reduce the possibility of contamination of Basin waters.

The potential for maintaining and improving the quality of the Basin's water resources lies largely in the availability of adequate stream pollution control laws and regulations and their enforcement. In that regard, the Indiana Stream Pollution Control Board, under the present Indiana Stream Pollution Control Law (Chapters 214, Acts of 1943, as amended, and the Environmental Management Act, PL-100) has the authority to control and prevent pollution in the waters of the state.

SPC (Stream Pollution Control) 1R-3 established standards of water quality for the waters of the entire state. All waters, based on the use concept, will be required to meet the standards for the appropriate public and industrial water supply, aquatic life, recreational and agricultural uses. Compliance with these standards will enhance the quality of water within this Basin. The minimum weekly flow, which occurs once in 10 years, will be used in applying these standards. It is recognized that the all-time minimum of flow will be less, but will occur only a very small percentage of the time. During these periods, only minimum damage to stream will result. The Board plans to require compliance with coliform standards for recreation during the recreational season of April through October, inclusive, and year around for water supply. But, it must be recognized that there are uncontrollable sources of coliform pollution other than sewage treatment plant effluents, such as storm water runoff.

Table VII-1 describes the implementation plan for municipal wastewater treatment facilities. The accomplishment of this schedule would be a significant achievement toward developing the potential for improving the quality of the Basin's waters.

In order to maintain the acceptable lake water quality conditions, several general recommendations have been suggested for implementation in all basins within the state. The implementation of these recommendations would require additional state laws and/or regulations and local ordinances. These recommendations represent a potential for meeting lake water quality needs and are summarized below:

- a. The construction of new municipal or industrial waste treatment facilities which would discharge directly to any lake within the Basin should not be permitted.
- b. All existing direct discharges into the lakes within the Basin should be eliminated. If this activity is not possible or practicable, then advanced waste treatment including nutrient removal should be provided.
- c. All waste treatment facilities of significant size utilizing discharges to any tributary of a lake within the Basin should also provide nutrient removal facilities.
- d. A program should be initiated to ultimately provide sewer systems to serve all lakes which have significant shoreside development. In the interim, a program to check and correct malfunctions in the individual septic tank disposal systems around lakes should be undertaken.

TABLE VII - 1: MUNICIPAL IMPLEMENTATION PLAN FOR WATER QUALITY STANDARDS
Elkhart River Basin, Indiana

Municipality	Start of Construction	Completion of Construction	Treatment Required
Albion	December 31, 1976	December 31, 1977	Advanced waste treatment or controlled discharge
Millersburg	December 31, 1976	December 31, 1977	Sewage treatment facilities
Rome City	December 31, 1976	December 31, 1977	Sewage treatment facilities
Syracuse	December 31, 1975	December 31, 1976	Expansion

- e. Further channeling, extension of shorelines or dredging should be restricted unless it can be demonstrated that the ecological impact of proposed projects will be negligible.
- f. Restrict future development of remaining vacant land surrounding the lakes to single family dwellings or cottages except in the case where a developer is willing to provide a sewer system and the type of treatment previously discussed.
- g. Initiate a program to encourage the use of agricultural practices that would minimize sediment transport to the lakes or their tributaries. In the event the program fails, the implementation of some kind of land use zoning should be investigated.

I. Archeological, Historical, Scenic, or Unique Areas

The full archeological importance of the Basin is unknown. At the present time nearly 900 different sites have been recorded for Indiana; however, only two sites have been recorded for the Elkhart River Basin Economic Area. Although archeological data are incomplete, there is sufficient information to emphasize the importance of the region.

Recording of historical and scenic areas in the Basin has been limited. Of the areas that have been recorded, many deal with local history or interest and would add little to the overall history of the Basin or be of interest to people on a Basin wide level.

The natural areas of the Basin diminished as the competition for land grew. It is imperative that the limited number of areas that remain be considered for preservation. The ten identified natural areas in the Elkhart Basin, shown in Table III-17, have been assigned a priority rating for preservation by the Division of Nature Preserves, Indiana Department of Natural Resources.

VIII. EXISTING PROJECTS AND PROGRAMS

A. USDA Programs	VIII - 1
B. Other Federal Programs	VIII - 3
C. State Agencies	VIII - 4
D. Local and Other Agencies	VIII - 15

TABLE VIII - 1: AGENCY ACTIVITIES IN WATER RESOURCE
 PLANNING AND DEVELOPMENT
 Elkhart River Basin, Indiana

	Agency	Activity	
	Corps of Engineers-----		A - Basic Data B - Studies and Research C - Finance, Operation, or Construction D - Regulation A, B, C, D
FEDERAL	Department of Agriculture -----		A, B, C, D
	Agricultural Stabilization and Conservation Service -----		A, C
	Farmers Home Administration -----		C
	Extension Service -----		A, B
	Forest Service -----		A, B, C
	Economic Research Service -----		A, B
	Soil Conservation Service -----		A, B, C
	Rural Electrification Administration -----		C, D
	Department of Housing and Urban Development -----		C
	Department of the Interior -----		A, B, C
Bureau of Outdoor Recreation -----		A, B, C	
U. S. Fish and Wildlife Service -----		A, B	
U. S. Geological Survey -----		A, B	
Environmental Protection Agency -----		A, B, D	
STATE	Department of Commerce -----		A, B, C
	Department of Natural Resources -----		A, B, C, D
	Environmental Management Board -----		D
	State Board of Health -----		A, B, D
	Stream Pollution Control Board -----		A, B, C, D
	Indiana University -----		A, B
	Purdue University -----		A, B
	LOCAL	Conservancy Districts -----	
Soil and Water Conservation Districts -----			A, B
Water, Sewage and Solid Waste Districts -----			A, B, C
Planning and Zoning Agencies -----			A, B, D
Counties, Cities and Towns -----			A, B, C, D

VIII. EXISTING PROJECTS AND PROGRAMS

The many state and federal agencies supply services to meet resource conservation needs in the Basin. Although the programs of these agencies are comprehensive, the present level of operation in manpower and funding is below present development requirements. Discussion of these programs follows:

A. USDA Programs

The PL-46 Program includes activities authorized in 1935 under the Soil Conservation Act (Public Law 74-46). The Soil Conservation Service under PL-46 carries on a broad program of soil and water conservation operations including direct technical assistance to landowners and operators and technical services to other agencies and organizations.

The primary job of the Soil Conservation Service is to provide technical assistance to Soil and Water Conservation Districts in helping landowners and operators, individually or in groups, do conservation work on the land. Such work is basic to, and is a necessary foundation for, watershed protection and other soil and water conservation activities in both rural and urban areas. Related activities include soil surveys and soil investigations, helping find and improve plant materials for conservation uses, and providing technical services in connection with other USDA programs involving financial or other assistance in conservation work.

Assistance to Soil and Water Conservation Districts and other qualified Sponsors is also available for developing group action programs through the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended). Applications and project plans must be approved by the state and federal government. No applications have been submitted from the Elkhart River Basin.

In 1962, Congress passed the Food and Agriculture Act (Public Law 87-703) which authorized the organization of resource conservation and development areas. This program authorizes technical, financial, and loan assistance to legal sponsors in approved areas where acceleration of going resources conservation programs will increase economic opportunity for local people. Resource conservation and development areas provide local leadership with the opportunity to coordinate and use local, state, and federal facilities more fully in developing and carrying out a plan of action for the orderly conservation improvement, development and wise use of natural resources. An application is now being prepared for the Potawotomi RC&D area, which includes that part of the Elkhart Basin located in Elkhart and Kosciusko Counties.

The Agricultural Stabilization and Conservation Service program has provided cost-sharing to farmers in implementing soil, water, woodland, and wildlife conservation practices on farmlands now in agricultural

production. The program also provides aerial photos for conservation work and planning assistance for land treatment, residential and industrial development, and emergency measures for natural disasters.

Credit assistance is available from the Farmers Home Administration. This includes: (1) farm ownership loans, (2) farm-operating loans, (3) farm emergency loans, (4) loans for housing, both rural and urban, (5) loans for grazing associations, (6) loans to develop rural recreation enterprises and (7) watershed loans. Loans for water and waste disposal systems are available for rural districts or towns and villages. Water and sewer planning grants have been provided to Kosciusko, La-Grange and Noble Counties to develop comprehensive plans (now completed). Elkhart County already has a comprehensive plan which meets FmHA criteria for loan eligibility.

The Extension Service is part of the cooperative extension service partnership. Three levels of government - federal, state, and county - share in financing, planning, and carrying out extension educational programs. Extension Service acts as the education agency of the U. S. Department of Agriculture and the land grant universities. Extension specialists work with other agencies to provide local people information relating to soil and water conservation programs, and to provide technical assistance in analyzing recreational needs and developments. This work has been an integral part of USDA since 1914, when the Smith-Lever Act became law.

Cooperative federal-state forestry programs active within the Basin include: forestation, forest management, insect disease control, and fire control. The various services of these programs are provided by the U. S. Forest Service in cooperation with the Indiana Department of Natural Resources, Division of Forestry. Technical assistance is available for approved forest practices installed on private land. The U. S. Forest Service is cooperating with the state and other related agencies in multiple-purpose planning of public use areas.

Over 85 percent of the forest land is in private ownerships, most of which are in small holdings. Forestry programs in which the state and the U. S. Forest Service cooperate are largely directed to helping these small, private landowners plant, grow, and protect or market their timber. Many cooperative programs are well established and represent some progress. During 1972, seventy-five (75) landowners received management planning assistance under cooperative forestry programs involving a total of 1,651 acres. These programs also provide technical assistance for urban and environmental forestry.

The Economic Research Service provides economic analyses of the effects of alternative resource uses on various aspects of the nation's agricultural life including food supplies and costs, farm income, and the costs of government programs. The principal effort concerning the

economic analysis of water and related land resource use is carried on by the Natural Resource Economic Division of the Economic Research Service. Economic analysis and projections are carried on in river basin planning with research also conducted concerning water rights, water quality, watershed program analysis, outdoor recreation, land tenure and income distribution, rural zoning and other land use controls.

The Rural Electrification Administration was created by Executive Order 7037 on May 11, 1935, and currently operates under authority of the Rural Electrification Act of May 20, 1936, as amended. It administers loan programs for rural electrification and rural telephone service. Loans are made to finance electric distribution, transmission, and generation facilities to bring initial and continued adequate electric service on an area coverage basis to persons in rural areas who do not have central station service. Loans are also made to finance facilities to furnish and improve telephone service in rural areas on an area coverage basis.

The Rural Electrification Act, as amended, establishes the interest rate on all REA loans at 2 percent, and fixes the permissible loan repayment period at a maximum of 35 years. An application is approved by REA only after legal, engineering, economic, and financial studies. Funds are obligated by a loan contract and the borrower gives a note, mortgage and, in some cases, other security. Funds are advanced as needed for carrying out the construction.

REA furnishes its borrowers with technical assistance in engineering, accounting, and operations in support of the security of the government loans. REA also assists its borrowers in initiating projects to stimulate economic development in the areas they serve. Each Rural Electric Membership Cooperative (REMC) in Kosciusko, LaGrange and Noble Counties have active loans with REA.

B. Other Federal Programs

The U. S. Army Corps of Engineers, Detroit District, has authority to plan and construct major reservoirs and local protection measures for flood control, and to improve navigation. Past studies have indicated such major improvements are not currently feasible within the Basin. The Corps of Engineers maintains an on-going program to review periodically the needs for planning and implementation of major flood control and navigation measures.

The Corps of Engineers' authority for rivers and harbors dates back to 1824. Their scope of, and requirements for, water resource projects have developed through a long series of River and Harbor and Flood Control Acts. Responsibilities have been added by statute in the fields of flood control, hydroelectric power, municipal and industrial water supply, recreation, and planning for all functions of water resources development.

The U. S. Department of the Interior provides assistance to state and local and federal agencies through technical assistance by the U. S. Fish and Wildlife Service, and financial and technical assistance by the Bureau of Outdoor Recreation.

The Great Lakes Basin Commission was formed in 1967 under the authority of the Water Resources Planning Act of 1965 (Public Law 89-80). The Commission is empowered to both conduct and coordinate water and related land resources planning within those portions of the Great Lakes States - Michigan, Wisconsin, Indiana, Minnesota, Ohio, Illinois, Pennsylvania and New York - which are drained by the St. Lawrence River system, including the Great Lakes, their tributaries and the tributaries of the St. Lawrence River which are located within the United States.

The Commission's specific responsibilities are to serve as the principal agency for coordination of all plans for development of water and related land resources in the basin, and to prepare a comprehensive plan and recommend long-range schedules of priorities for the collection and analysis of basic data and for investigation, planning and construction of projects.

C. State Agencies

There are several departments and agencies of state government which have vested interests in or are concerned with some phase of water management. Only those which have a major input into the Basin Study are discussed below:

1. Department of Natural Resources

The Department of Natural Resources is assigned the responsibility of managing the natural resources of Indiana. Using the findings of research by professional personnel in many fields, the Department endeavors to carry out conservation programs which will make the wisest use of the resources. At the same time it tries to meet the tremendous demands of public use.

Indiana's Department of Natural Resources came into being on July 1, 1965. Formation of the Department was primarily a reorganization, combined with a merger of the former Indiana Flood Control and Water Resource Commission, the State Soil and Water Conservation Committee, the Recreation Council of the State Board of Health 1/, and the Department of Conservation.

Under the Director of Natural Resources, two bureaus, each headed by a Deputy Director, were formed. The Bureau of Land, Forest and Wildlife Resources contains all the land-holding divisions, such as Forestry, Fish and Wildlife, Parks, Museums and Memorials, Reservoir Management, Nature Preserves, and the Division of Out-

1/ The Recreation Council of the State Board of Health was abolished by Acts of 1969, Chapter 297.

door Recreation, Engineering and Planning, Reclamation, and Entomology. Under the Bureau of Water and Mineral Resources are the Division of Water, the Geological Survey, Soils, and Oil and Gas Division, and the State Soil and Water Conservation Committee and State Water Plan Section.

The Division of Forestry has primary responsibility for the protection, management, and utilization of the forest resources of the state and for statewide fire protection on both state and private forest lands. The Division provides technical advice and assistance to private woodland owners and primary wood using industries. The Reforestation Section is responsible for the production and distribution of tree seed and seedlings for reforestation and reclamation work on both state and private lands.

The Division program includes the operation and management of about 140,000 acres of forest lands in thirteen state forests, the operation of two forest nurseries and the sale and distribution of planting stock. Also, the Division provides technical assistance to woodland owners and primary wood using industries through thirteen service forestry districts; maintains fire patrol flights to cover five fire districts as a fire detection system; and administers the provisions of the Act regulating surface mining. The Division also provides technical assistance in woodland management on Public Law 566-(Small Watershed) Projects.

Programs designed to assist forest land owners and operators in proper management and protection of their forest land are presently available in the Basin area. The Cooperative Forest Management Program is a cooperative effort between the Indiana Department of Natural Resources, Division of Forestry and the U. S. Forest Service to provide advice and other technical assistance to landowners in proper management techniques, availability of markets, timber marking, and other aspects of good forest management.

Protection from fire is provided through a cooperative effort between the Division of Forestry and the U. S. Forest Service (Cooperative Forest Fire Control Program) and agreements between the Division of Forestry and local fire department in the Basin area.

Approximately 165 forest land owners have placed a total of 3,400 acres in management under the classified forestry program. The main objective of this program is to encourage better private forest land management and protection. The incentives for landowners to classify their lands and practice better management are the reduction of the assessed value of classified lands to \$1.00 per acre and continual technical advice and assistance.

The Division of Fish and Wildlife is responsible for the protection, management, control, and enhancement of all non-domestic populations of fish and wildlife within this state. This includes non-game

species as well as sport or game species. It is also responsible for providing for hunting, fishing and related outdoor recreation activities on public and private lands; providing for fish and wildlife habitat improvement and protection; establishing fish and wildlife regulations; and carrying out scientifically sound fish and wildlife propagation, management and research programs.

To minimize the problems in the management of fish and wildlife resources, a research program is carried on to provide better guidance. Fisheries research has included inventory surveys of a number of lakes and streams. The Division operates eight fish hatcheries to provide fish to stock new lakes, reservoirs, and state-owned lakes. Game research is aimed at improving game management practices. A Game Management Program is carried out to provide more and better habitat for wildlife. The Farm Game Habitat Restoration Program furnishes seed, seedlings and grain to aid rural landowners in wildlife development plans.

The U. S. Fish and Wildlife Service, U. S. Department of the Interior, provides technical assistance to the Division, and other state and federal agencies, in analyzing fish and wildlife needs and recommending programs for protection and enhancement of fish and wildlife habitat.

The Division acquires and operates lands and waters for fish or game management, outdoor activities, public fishing and hunting and for flora and fauna preservation. Properties now owned and managed by the state within the Basin are: Tri-County State Fish and Wildlife area, Mallard Roost Fish and Wildlife area, Wawasee State Fishing area, and numerous public fishing sites at the natural lakes.

The Division of Outdoor Recreation is dedicated to enhancing the outdoor recreation opportunities in Indiana through the provision of financial and technical assistance and recreation resource planning. This is accomplished by administering the following programs:

- a. Land and Water Conservation Fund Program. This program provides over four million dollars annually for the acquisition and/or development of recreation facilities on both the local and state levels.
- b. Outdoor Recreation Planning Program. The Division is constantly involved in the recreation planning process updating outmoded plans, working to implement existing plans, and assisting local agencies in recreation planning. Special studies such as: Off Road Vehicle Study, Abandoned Railroad Rights-of-Way Study, and Scenic Streams Study, among others are being accomplished periodically.

- c. A-95 Review Program. The Division serves as a clearinghouse for all comments on federal aid applications by other divisions. These comments are consolidated into one Department statement for each application.
- d. Environmental Impact Statement Review. The Division also serves as a clearinghouse for all comments on Highway Environmental Impact Statements. Differences between divisions are arbitrated and a consolidated Department statement is prepared.
- e. Trails and Rivers Implementation Program. The Division has been assigned the responsibility of implementing and coordinating the development of an Indiana trails system and the Natural, Scenic, and Recreational River System in Indiana.

The Division of Entomology as the principal plant regulatory agency of Indiana is charged with the responsibility of preventing the introduction and spread of insect pests and plant diseases. Japanese beetle, gypsy moth and others are cooperative plant protection and quarantine programs with the U. S. Department of Agriculture, but nursery licensing and inspection, apiary inspection and the soybean cyst nematode quarantine are independent state operations.

Division responsibilities also include formulation of rules and regulations for the guidance of inspectors in making inspections and investigation; regulation of all shipments of nursery stock into the state; and formulation and enforcement of necessary plant quarantine regulations; all subject to the approval of the Governor.

The primary purpose of the Division of State Parks is to preserve outstanding examples of Indiana's natural and scenic heritage. Secondly, and complementary to its primary responsibility, the Division is to provide associated quality outdoor recreational opportunities. To carry out these responsibilities, the Division manages 22 properties which include one state beach, seventeen state parks, and five state recreation areas.

An act passed by the 1967 General Assembly created a Division of Nature Preserves within the Indiana Department of Natural Resources, for the purpose of establishing a state system of these areas. It provided for their acquisition, control, use, management, and protection.

Acquisition is directed toward the purchase of certain key tracts that are in danger of being lost by timber cutting, mining, or other exploitation. Acreage will include the natural tract and a sufficient buffer zone.

Development expenditures involve fencing, concrete boundary markers, signs and outside parking lots and roads. Nature preserves are for walking only.

To date, 24 nature preserves containing 5,011 acres, have been dedicated by the Natural Resources Commission. These vary in sizes from 1,530 acres in Dunes Nature Preserve in the Indiana Dunes State Park to Grider Nature Preserve with 10 acres in Tri-County State Fish and Wildlife area. Seventeen are located on properties under the jurisdiction of the Department of Natural Resources; four are owned by Acres, Inc.; two by the Nature Conservancy and one by St. Joseph County Park and Recreation Board.

The Division of Water has primary responsibility for basin and project planning, and for the regulatory, construction and administrative phases of the water resource functions of the Department. These responsibilities include studies and investigations needed to develop projects wherein state participation is warranted and justified in order to obtain multiple-purpose development of specific small watershed and reservoir projects, and to solve specific flood control and water resources problems.

The planning program of the Division includes cooperation with state and federal agencies in investigation and planning for flood control and water resources development and planning for flood plain regulation.

The regulatory program of the Division includes review and approval or disapproval of the construction of any works in the floodways of the rivers and streams of the state; review, coordination and approval of plans and specifications for all works of any nature for flood control in the state; making engineering inspections of and enforcing proper maintenance and repair of dams, levees and floodwalls, and mediating disputes between users of surface water in any watershed area.

It also includes the review of petitions for the formation of conservancy districts; establishment of average normal water levels of natural lakes and the review and approval or disapproval of the alteration of the bed or shore line of public freshwater lakes; enforcement of laws which control removal of sand, gravel and minerals from navigable streams and from Lake Michigan; licensing of water well drillers; and issuing permits to oil operators for use of potable ground water for water-flood operations.

The construction program of the Division includes the construction or supervision of construction of dams, spillways and control works necessary to maintain the average normal level of natural and artificial lakes; planning, design and construction of flood control

and water resources projects, including multiple-purpose reservoirs; and acquisition of land needed for multiple-purpose reservoirs.

Other activities of the Division are the administration of the Flood Control Revolving Fund; development and administration of contracts for the provision of certain minimum quantities of streamflow or for the sale of water; administration of the water resources development fund, established for the purpose of developing reservoirs for water supply; administration of the statute providing for advance acquisition of reservoir sites for storage of water; administration of state contributions connected with federal multiple-purpose reservoirs; administration of State Grant Funds for the construction of multiple-purpose reservoirs in small watershed projects; and administration of the cooperative stream gaging and ground water programs, the cooperative lake level gaging station program and the cooperative lake mapping program with the U. S. Geological Survey.

The State Water Plan Section is responsible for coordination of the development of a State Water Plan for the timely conservation, utilization and management of water and related land resources, so formulated as to provide the means for satisfying the state's needs for water during the foreseeable future. The Plan will constitute one element of the Comprehensive State Plan for the physical, social and economic development of the state now being coordinated by the Department of Commerce.

The programs and activities of the Section and the cooperating agencies are to evaluate and appraise the surface and ground water resources of the state in terms of location, quantity and quality; evaluate and appraise existing water resources developments; develop both medium and long-range population and economic projections and translate these projections into requirements for water for all beneficial purposes; and develop and propose a plan of action, with appropriate alternatives, for the timely development and management of Indiana's water and related land resources to meet indicated needs.

The Division of Geological Survey has the responsibility to locate and describe the state's mineral resources; to determine the mineralogic and chemical composition of these deposits and their suitability for particular industrial uses; to provide other state agencies with the geologic and geophysical information that they may require to preserve in accessible form selected oil well samples, cores, electrical and other logs and mineral records and analyses; and to do basic scientific research on all phases of the geologic information that will increase the utilization of Indiana's mineral resources.

The programs of the Geological Survey include investigations of the mineral resources of the state; geochemical analysis of all geologic formations; geophysical surveys in connection with dam and spillway sites and with mapping thickness of potential aquifers. A major geologic mapping program has involved the preparation of regional geologic maps that show bedrock and surficial materials.

The State Soil and Water Conservation Committee is responsible for seeing that county soil and water conservation districts are organized throughout the state, and that these districts carry out their operations in accordance with the law. In addition to assisting local district supervisors to perform their duties, it is also responsible for maintaining permanent records for each district, making supervisor appointments, overseeing elections, securing Oath of Office from each supervisor, training supervisors and keeping them informed.

The purpose of the State Committee is to organize, guide and support the local soil and water conservation districts. To accomplish this, the Committee: (1) assists interested local groups in organizing new districts, (2) helps districts plan and revise their long-range programs, (3) assists supervisors with their districts' administrative, management and operational responsibilities, (4) stimulates interest and activity on the part of district supervisors, (5) assists in development of public appreciation of the problems and importance of conserving resources, (6) helps districts with their conservation education program, (7) provides conservation information to news media throughout the state, (8) apportions the state funds for district program needs, and (9) facilitates the acceleration of small watershed planning by transferring state appropriated funds to the U. S. Soil Conservation Service under a trust fund agreement.

2. State Board of Health

The State Board of Health was established in 1891 to provide an agency responsible for safeguarding the health and life of the citizens of the state. The Board must review and approve all plans for water supply improvements prior to construction and it has the authority to confer with local officials and agencies on their future needs; participate in the evaluation of existing and future sources of water supply; and supervise all municipal, county and other water supply systems. It has similar authority with respect to planning, construction and operation of all sewage systems and sewage treatment plants and plants for industrial waste treatment and disposal.

The programs and activities of the State Board of Health concerning water supply, water resources and water pollution control are best described under the division responsible for carrying them out.

The Division of Sanitary Engineering has primary responsibility for matters relating to the health and sanitary aspects of public water supplies, certain semi-public water supplies and sewage treatment facilities and solid waste disposal. The Division program includes review and approval of plans for public and certain semi-public water supplies, advice and recommendations concerning standards for design, construction and operation of the facilities; insuring that all public and semi-public water supplies produce water meeting the bacteriological and other health-related standards set forth in the latest Public Health Service Drinking Water Standards; and advising and assisting other state, interstate and federal agencies in studies of, and programs for water supply development.

Plans for semi-public wastewater treatment which discharge to streams are reviewed, summarized and presented, with recommendation; to the Stream Pollution Control Board for their approval or disapproval.

The Division of Water Pollution Control has the main responsibility for furnishing technical assistance to and staff for the Stream Pollution Control Board. The Division was created under a re-organization of the Board of Health in 1968. Plans for municipal and industrial wastewater treatment facilities are reviewed, summarized and presented, with recommendations, to the Stream Pollution Control Board for their approval or disapproval. Field activities, including inspection and assistance in the operation of wastewater treatment plants, collection of data required for determination of pollution and operation of the water quality monitoring network and stream sampling, are carried on by the appropriate sections. Liaison internally within the Division and with other state, federal and local agencies and groups concerning water supply, water pollution and water resources is carried on under Special Projects.

3. Stream Pollution Control Board

The Stream Pollution Control Board which was established in 1943, has broad powers to control and prevent pollution of water in Indiana by substances injurious to public health, industry or wildlife. It is designated as the agency to represent the state in the federal water pollution control program, and it reviews plans and specifications for pollution abatement facilities and assigns priorities to municipalities for federal aid.

The primary objective of the Board is to control and prevent the pollution of surface and ground waters within the state, in accordance with state statutes, interstate compacts and federal laws. This is accomplished by eliminating existing pollution of

waters in Indiana, by requiring adequate treatment prior to discharge for all wastes from new outlets; and by urging adequate expansion of existing waste treatment facilities as the need arises due to population growth and industrial expansion.

4. Environmental Management Board

The Environmental Management Board was established by an act of the 1972 Legislature to provide for evolving policies for comprehensive environmental development and control on a statewide basis; and to unify, coordinate and implement programs to provide for the most beneficial use of the resources of the state and to preserve, protect and enhance the quality of the environment so that, to the extent possible, future generations will be insured clean air, clean water and a healthful environment.

This Board shall develop and maintain a current long-term comprehensive program for the state for the development and control of the total environment to insure the best possible air, water and land quality. It shall evolve standards and develop and adopt regulations to assure the accomplishment of the comprehensive long-term program; conduct a program of continuing surveillance and inspection of refuse disposal sites, public water supplies, actual or threatened sources of environmental pollution by contamination, radiation, odor or noise; encourage and assist local units of government in the developing of programs and facilities for air, water, radiation, odor, and noise pollution control, water and wastewater treatment, water resource development and solid waste disposal.

The Stream Pollution Control Board and Air Pollution Control Board are continued as now established and retain their powers and duties. The establishment of priorities and coordination of the functions and services of these agencies are now conferred on this Board.

This Board also is vested with the powers and duties formerly exercised by the State Board of Health under the Refuse Disposal Act, the Wastewater Treatment Control Act, the Water Resources Research Act and the Sanitary Water Supply Act.

The Stream Pollution Control Board is hereby designated as the solid waste agency for the state for all purposes of the Federal Solid Waste Disposal Act.

Each agency, department and institution of the state shall report to the Board any plans or activities which may affect the environment of the state. The Board shall review such reports and coordinate the programs which may affect the environment.

If the Board finds that local governmental units have not developed plans which provide for adequate water supply, air, water, or wastewater treatment or solid waste disposal facilities, the Board or an agency may hold a public hearing and if the facts support such conclusion, the Board may order the affected local governmental units to proceed to form regional water, sewage, air, or solid waste district as may be necessary.

The Board at any time, may by resolution approved by its members, transfer any duties or powers vested in it to the Stream Pollution Control Board or Air Pollution Control Board.

5. Department of Commerce

The present rights and obligations of the Department of Commerce are set forth in the Acts of 1965, Chapter 262, as amended. The Department serves as the official State Planning Agency of the state and it has the power to negotiate with the federal government or any of its agencies to secure a planning grant(s) for the initial phase of the development of a statewide planning program. In addition, the Department is responsible for the development and promotion of programs designed to make the best use of the resources of the state so as to assure a balanced economy and continuing economic growth for Indiana. To achieve such purposes the Department may:

- a. assemble and disseminate information concerning the resources of the state and their availability for the development of industrial and commercial activities,
- b. prepare and activate plans for the development, expansion and use of the resources of the state,
- c. cooperate with federal, state and local governments and agencies in the coordination of programs to make the best use of the resources of the state,
- d. encourage and foster research and development activities, including industrial parks, and
- e. receive and accept grants, gifts and other things of value on behalf of the state.

The Department's structure was changed in 1973 to give greater emphasis to economic development. The new structure includes three departments, known as "groups", covering: economic development, planning and research, and public information.

The Economic Development group has four divisions, each designed to promote and develop Indiana's business climate through the

location of new industry and expansion of existing industry within the state. The four divisions are: The Agricultural and Rural Development Division, the State Office of Minority Business Enterprise, the Industrial Development and Promotion Division, and the International Trade Division.

The State Planning Services Agency maintains two divisions, planning and economic research. The Planning Division provides local planning assistance to counties, cities, and towns. In addition, the Planning Division also prepares studies in areas of land use, transportation, housing, recreation, and environmental management through its State Planning Section. This Division works with city, area and regional plan commissions in developing comprehensive plans for local areas. There are a traditional variety of land use planning, resulting in regulations of use of land to insure balanced and compatible future development patterns. Comprehensive plans have been developed for the counties of Elkhart, LaGrange, and Noble, and for the Basin cities or towns of Elkhart, Goshen, Millersburg, South Milford, Wolcottville, Albion, Kendallville, Rome City, Wawaka, and Cromwell. The Economic Research Division provides economic analysis for planning - related problems, and educational services to inform state and local officials and private citizens on federal and state planning programs.

The Public Information group functions as the public relations arm of the Department, and has three divisions: tourism promotion, information, and publications. These divisions provide information and promotional programs for development of tourism, establishment of better consumer-merchant relationship, and general dissemination of information in the areas of responsibility shared by the Department of Commerce.

6. Purdue University

The Natural Resources Research Institute was established in July 1964 as an administrative unit of Purdue University to provide scientific leadership and coordinated management for all University, interdisciplinary research and educational programs concerned with the preservation, conservation, development and utilization of the state's most important basic natural resources - water, land and the atmosphere.

The Institute has general jurisdiction over three associated research centers known as the: (1) Water Resources Research Center, (2) Land Resources Research Center, and (3) Atmospheric Resources Center. The Water Resources Center serves to coordinate and expand research programs dealing with all phases of present and future water problems. At present the University has on-going research in this field.

The off-campus teaching arm of the University is the Cooperative Extension Service. The principal areas of educational effort dealing with water use and management are in the Department of Agricultural Engineering, Agronomy, Forestry and Conservation and Agricultural Economics.

7. Indiana University

A Water Resources Research Center, to integrate the diverse water research activities of Indiana University and to coordinate them with water programs of state and federal agencies, other academic institutions, and private organizations was established as an interdisciplinary component of the University in June 1963. Emphasis is placed on water problems peculiar to the midwest, and the Center helps to identify and define those areas in which current research is deficient, and to stimulate and initiate new research programs in critical areas.

The Center for Outdoor Recreation Research of the Department of Recreation and Park Administration in the School of Health, Physical Education, and Recreation, conducts special research studies on topics pertaining to outdoor recreation, leisure time, recreation resource allocation, and other related subjects. The Center is available to conduct specific studies upon request by both public and private agencies.

D. Local and Other Agencies

There are several types of special purpose districts that may be established in Indiana to handle various water management problems. Their areas of jurisdiction and responsibility are usually tailored to specific objectives.

The following paragraphs discuss local entities which may be effective in dealing with water and related soil resources in the Basin.

1. Conservancy Districts

Under the provisions of the Indiana Conservancy Act, Acts of 1957, Chapter 308, as amended, local landowners may petition the circuit courts for the establishment of conservancy districts that have the necessary legal authority and fund raising powers to construct, operate and maintain works of improvement for solving water management and water resources problems. Conservancy districts may be formed to accomplish one or more of the following purposes:

- a. flood prevention and control,
- b. improve drainage,
- c. provide for irrigation.

- d. provide for water supply, including treatment and distribution for domestic, industrial and public use,
- e. provide for the collection, treatment and disposal of sewage and other liquid wastes produced within the district,
- f. develop forests, wildlife areas and parks and recreational facilities where feasible in connection with beneficial water management,
- g. prevent the loss of top soil from injurious water erosion,
- h. storage of water for augmentation of streamflow and,
- i. operation, maintenance and improvement of any existing works of improvement for water-based recreational purposes, or other work of improvement which could have been built pursuant to any of the above purposes.

The program and operation of the conservancy district may be financed by special benefit taxes levied on real property, the collection of assessments from lands which may receive exceptional benefits, the receipt of funds from federal or state government, the receipt of revenue from the sale of services or property, the collection of assessments for maintenance and operation of the works of improvement and borrowing from private or public sources. The Flood Control Revolving Fund, as mentioned previously, is one source of monies available to conservancy districts.

2. Soil and Water Conservation Districts

Soil and Water Conservation Districts are established under the provisions of Acts of 1965, Chapter 171, as amended, to encourage the development, improvement and conservation of lands and water. The Board of Supervisors, assisted by technicians of the U. S. Soil Conservation Service, promotes the use of proper land treatment practices and sound farming techniques by the local landowners. They have active interests in the federal watershed protection and flood prevention program, and they have authority to construct water control and management works; however, the district does not have eminent domain, taxing or assessment powers. All four counties have active soil and water conservation districts.

Prior to 1965, soil conservation districts were established under the provision of Acts of 1937, Chapter 232, as amended. This Act was superseded by the Soil and Water Conservation Districts Act of 1965.

3. Regional Water, Sewage and Solid Waste Districts

Under the provisions of the Acts of 1969, Chapter 244, any area situated in any unincorporated part of one or more contiguous

counties or in one or more municipal corporations, or both, may be organized as a regional water, sewage and solid waste district for one or more of the following purposes:

- a. to provide a water supply for domestic, industrial and public use to users within and without the district,
- b. to provide for the collection and disposal of storm and sanitary sewage and other liquid waste within and without the district,
- c. to provide for the collection and disposal of solid waste and refuse within and without the district.

The authority for the district is vested in a board of trustees which manages and conducts the affairs of the district. The board of trustees may make and enforce rules and regulations necessary to accomplish the purposes of a district which are not inconsistent with the laws of the State Board of Health or the Stream Pollution Control Board. Before taking effect, all rules and regulations, issue of bonds and proposed rates of the district are subject to approval by the Public Service Commission of Indiana. Before plans for the proper purification, filtration and distribution of water or proper collection and treatment of sewage are placed in effect they must be filed with the State Board of Health of the Stream Pollution Control Board, which may approve or reject any provisions of the plans pertaining to water supply, sewage and solid waste.

4. Planning and Zoning Commissions

Planning and zoning commissions - municipal, county and regional - are concerned with the orderly development of land. The use of lands that are subject to flooding can be controlled through zoning and other regulations that prescribe how such areas may be used or developed to minimize the loss of life and property damage from flooding. Proper drainage and adequate sanitation facilities are also of concern to plan commissions.

5. Counties, Cities and Towns

County commissioners, city councils and town boards can pass ordinances regarding water, sewage and general health which designate the health officer having jurisdiction as the enforcing agent. In addition, the local health departments are an important part of water resources development because they have authority to enforce Indiana State Board of Health laws, rules and regulations at the local level.

6. County Drainage Boards

The Indiana Drainage Code, Acts of 1965, Chapter 305, as amended, created in each county in the state a county drainage board for the purpose of construction, reconstruction and maintenance of all legal drains in the county. Board membership consists of the county commissioners and the county surveyor, ex-officio in each county; however, in all counties having a city of the first class, the city engineer and the county surveyor shall be voting members of the county drainage board.

Whenever construction or reconstruction of a legal open drain is proposed, the Department of Natural Resources is to be notified. Before a drain under the jurisdiction of a drainage board can be included in the final plan of a conservancy district, and when plans show that any legal drain will come within 300 feet of a levee, written approval of the Department is required. Whenever anyone desires to connect a drain carrying liquid wastes into a legal drain, written approval must be obtained from the Stream Pollution Control Board.

7. Park and Recreation Boards

The Indiana Park and Recreation Law allows city and county governments to create park and recreation boards. Such boards have been created in all four counties of the Basin. These boards are: Elkhart County and LaGrange County, and the cities of Elkhart, Goshen, Nappanee, Bristol, LaGrange, Kendallville, and Warsaw. These boards have the authority to develop and implement county or city recreation plans.

IX. FORMULATION AND EVALUATION OF ALTERNATIVE SOLUTIONS AND ENVIRONMENTAL ASSESSMENT OF RECOMMENDATIONS FOR DEVELOPMENT

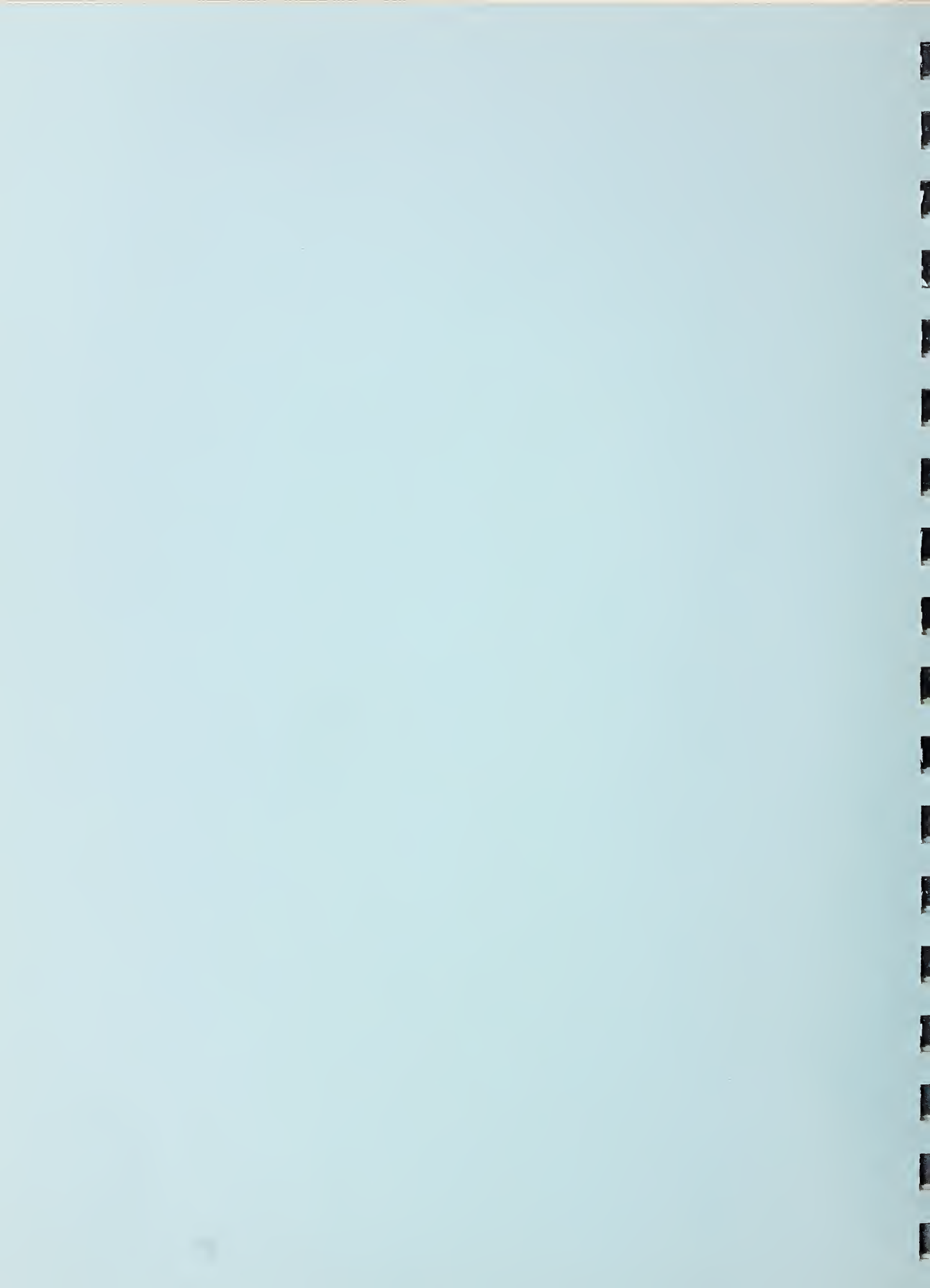
- A. National Economic Development Objective IX - 2**

- B. Environmental Quality Objective IX - 12**

- C. Recommendations for Development IX - 20**

- D. Environmental Assessment of Recommended Actions IX - 29**

- E. Additional Recommendations for On-going Programs IX - 31**



CHAPTER IX.

FORMULATION AND EVALUATION OF ALTERNATE SOLUTIONS AND ENVIRONMENTAL ASSESSMENT OF RECOMMENDATIONS FOR DEVELOPMENT

The formulation and evaluation of opportunities for development in this Basin were guided by the USDA Procedures for Planning Water and Related Land Resources, in accordance with the Water Resources Council's "Principles and Standards for Water and Related Land Resources Planning." The Water Resources Council, an independent executive agency of the U.S. Government, is composed of representatives of federal departments and commissions engaged in water resources planning and development. Under the "Principles and Standards," the overall purpose of water and related land resources planning is to promote the quality of life through contributions to the following objectives:

1. enhancement of the National Economic Development (NED) by increasing the output and value of the nation's goods and services and improving national economic efficiency; and
2. enhancement of Environmental Quality (EQ) by the management, conservation, preservation, creation, restoration or improvement of the quality of certain natural and cultural resources and ecological systems.

Several alternative plan elements for the use of water and related land to solve identified problems and meet identified needs of the Basin residents were evaluated. Each plan element was considered from the standpoint of its contribution to one or both of the primary objectives.

Utilizing the Principles and Standards, three alternatives (sets of plan elements) were developed. The plan elements were first assigned to either the NED objective or the EQ objective (the land treatment was assigned to both) to form the "alternate" aligned with the respective objectives. These are labeled Alternate A - National Economic Development (NED) and Alternate B - Environmental Quality (EQ). Alternate A contains those planning elements which, if implemented, would have economic returns (beneficial effects) that exceed the costs (adverse effects), in terms of a national viewpoint. Alternate B contains those planning elements designed to enhance the natural environment of the Basin. Alternate C - Recommendations for Development combines the planning elements contained in Alternates A and B and represents the suggested planning elements and actions which the Coordinating Committee is presenting to the local citizens for their consideration.

The components of each alternative are displayed, in terms of their effects, by four specific accounts. The NED account displays the dollar benefits (beneficial effects) and costs of development (adverse effects). As expected, the plan development to maximize such benefits (Alternate A) performs far better in that respect than the environmentally oriented

plan (Alternate B). The EQ account evaluates the effects of the planning elements on the quality of the environment in qualitative and, where possible, quantitative terms.

The Regional Development (RD) account evaluates the economic impact of each "alternative" on the immediate area as distinguished from the nation. Regional development, although not identified as a major objective, is extremely important to the Basin residents. These residents recognize that development within a very small area of the Basin will have a minor impact on national income; however, the local economy is dependent upon continued utilization of the agricultural resources available and upon future conservation and development of those resources. The RD account compares impacts on income, employment, and the quality of services from both the regional and national viewpoint. Because several of the planning elements would probably be financed, in part, by federal monies (which would not then be available for use elsewhere in the nation), the RD account indicates the distribution of the monetary benefits between the region and the rest of the nation.

The Social Well-Being account (SWB) evaluates such social considerations as security of life, health and safety, personal income distribution, and regional employment and population distribution including number of jobs.

The following pages contain a more specific discussion of the planning elements as assigned to the major objectives and included in the various "alternates." The environmental assessment of Alternate C is discussed and comparison tables are provided to assist the reader in determining the relative merits of the three alternatives.

A. National Economic Development Objective

Component needs identified with the NED objective are in four (4) general categories:

1. Flood damage reduction on 21,600 acres.
2. Improve efficiency in production by agricultural drainage on (on-farm resource management) 34,000 acres of cropland.
3. Accelerated land treatment to reduce erosion and increase production efficiency on 272,900 acres of cropland, grassland and forest land.
4. Additional outdoor recreation opportunities for 374 miles of trails, 60 acres of camping, 30 miles of canoeing, 78 acres of golfing, 610 acres of playfields, and 20,200 acres of hunting.

Elements assigned to the NED objective to help satisfy the identified component needs are:

1. Outlet channel work (0.3 mile) at Adams Lake for flood control and increased recreation.
2. Outlet channel work (0.6 mile) at Knapp Lake for flood control and increased recreation.
3. On-farm resource management systems to adequately treat 25,800 acres of cropland for drainage.
4. Channel work on 2.0 miles of Turkey Creek and 4.7 miles of Davison Ditch for flood control and drainage.
5. Channel work on 4.6 miles of Solomon Creek for flood control and drainage.
6. Channel work on 2.2 miles of Carrol Creek and 2.7 miles of Wagner Court Ditch for flood control and drainage.^{1/}
7. Riverside recreation development along Elkhart River between Elkhart and Goshen for public recreational use (12 miles - 620 acres).
8. Recreation development on abandoned railroad right-of-way between Kendallville and Wolcottville (9 miles - 110 acres).
9. About 1,600 acres of county parks near or adjacent to existing water areas to satisfy a variety of recreational needs.
10. Accelerated land treatment program which includes installation of conservation measures to reduce erosion and adequately treat over 206,000 acres.

These elements are summarized in Table IX-2 as Alternate A - National Economic Development.

Additional natural lakes may need outlet channel work for flood control as development increases or as problems are better defined.

Many areas of cropland are recognized as having severe drainage problems which are localized to one or a very few landowners. These areas should be given priority when considering continuation of agricultural production; however, they should be pursued through individual and/or small group effort. Increased efficiency in production by agricultural drainage at existing levels of output contribute substantially to the national economic development. The

^{1/} Not included in Table IX-2. See page IX-4 for further explanation.

installation of these recognized resource management systems for drainage will help satisfy needs expressed vocally by many Basin residents. Pumping many of these small drainage problem areas is a viable alternative which should be pursued through individual or group effort.

Additional channel segments were analyzed to determine their feasibility for reducing major flood and drainage problems on agricultural lands. The Elkhart River main channel, North Branch and South Branch have definitive flooded areas and adjacent areas on which drainage is restricted. Analysis of these areas indicates that the amount of cropland affected and the potential for reduction of estimated annual damages to agricultural production will not support major channel work for flood control and drainage purposes. The South Branch was analyzed in detail because it has a larger area flooded in proportion to its length. The analysis was made without current policy constraints on draining of classified wetland. Work analyzed included provisions for adequate depth and capacity for agricultural drainage and a 1-year level of flood protection. Land now too wet to farm was assumed to be converted to productive cropland. The total annual benefits for the South Branch channel work were \$237,480 compared to \$280,730 annual cost.

In addition to the South Branch analyses were made on the Carrol Creek area (west of Muncie Lake) in Noble County, and on the Wagner Court Ditch area in Elkhart County (south of U.S. 6 and tributary to Turkey Creek). Annual benefits^{1/} to Carrol Creek were \$1,650 compared to \$1,870 annual cost. Annual benefits to Wagner Court Ditch were \$13,050 compared to \$21,690 annual cost. In both cases, additional local or regional benefits from increased crop production would accrue and would provide net beneficial effects. However, because OBERS^{2/} series "C" projections indicate the Basin can meet its share of national needs for agricultural products without additional developments, the Carrol Creek and Wagner Court Ditch areas were not initially included among the plan elements for the NED alternative. More recent analyses, based upon Series E projections, indicate that the region's share of national needs for food and fiber will not be exceeded by including these two tributaries for development. Benefits from these potential projects are now considered eligible for inclusion in the NED alternative. Therefore, the projects are now included in alternatives A (NED) and C, although Tables IX-2, IX-4, and I-1 do not reflect their effects.

1/ Includes efficiency benefits only (excludes increased crop production benefits).

2/ U.S. Water Resources Council, 1972 OBERS Projections - Economic Activity in the U.S., Washington, D.C., September 1972. Based on the SERIES "C" Projected National Population, Bureau of the Census, 1967.

The riverside and abandoned railroad recreational developments and park areas are recommended to help meet identified needs for additional recreation opportunities and to provide varying intensities of use for a variety of activities. The recreational developments are intended for public utilization of linear area and will involve no existing cropland. The park areas will involve an estimated 400 acres of present cropland; however, the locations and installation of such parks will require local action and decisions.

The riverside recreational development between Goshen and Elkhart is recommended to satisfy a variety of recreation activity needs between the two population centers in Elkhart County. The recreation development along the railroad would (should the railroad's petition for abandonment be approved) utilize an existing resource for identified public needs for trails and camping sites. The development of county parks is a recognized need in the state recreation plan. The selection of areas and types of facilities for such parks are decisions for local officials and citizens. All three recommendations for creating recreation opportunities are considered contributory to the NED objective, due to their potential for generating recreation visits and monetary benefits to the nation and region.

Land treatment measures are conservation practices which are needed to protect the basic soil resource and provide optimum returns within the physical constraints of soils, topography, and past management.

The early action land treatment program consists of those measures needed to adequately treat 75 percent of the land by 1990. Table IX-1 shows the estimated accomplishments and costs for this recommended accelerated land treatment program. Benefits from this program were not evaluated in monetary terms; however, physical and social benefits are included in Table IX-2. The total capital cost, including technical assistance, for the accelerated program is shown by footnote on the NED and RD accounts on Table IX-3. Drainage systems, normally included in the land treatment program, are included in the element for on-farm resource management systems.

TABLE IX - 1. ACCELERATED LAND TREATMENT PROGRAM-ACCOMPLISHMENTS BY 1990 1/
Elkhart River Basin, Indiana

Conservation Treatment Practices	Acres Needing Treatment <u>2/</u>	Acres to be Treated	Cost (\$1,000)
Cropland			
Crop Residue Management	53,740	40,250	140.8
Sod in Rotation	89,220	66,900	-
Contour Farming	19,410	14,600	29.2
Stripcropping, Terracing or Diversions	33,870	20,200	2,306.5
Permanent Cover	13,520	10,100	572.5
Technical Assistance			720.2
Grassland			
Protection Only	2,950	2,200	5.5
Improvement Only	18,240	13,700	411.0
Brush Control & Improvement	640	500	25.0
Reestablish Vegetative Cover	4,350	3,300	132.0
Reestablish with Brush Control	3,555	2,700	135.0
Technical Assistance			25.2
Forest land <u>3/</u>			
Management Plans	36,000	10,200	25.5
Timber Stand Improvement	19,300	3,200	112.0
Forest land Grazing Control	17,800	17,800	427.2
TOTAL - Early Action Program			5,067.6

1/ To serve the NED objective

2/ Based on Indiana Soil and Water Conservation Needs Inventory - 1968

3/ Costs include technical assistance

TABLE IX - 2: ALTERNATE A - NATIONAL ECONOMIC DEVELOPMENT
 NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	<u>Measures of Effects 1/</u> (Average Annual)	<u>Measures of Effects 2/</u> (Average Annual)
Beneficial Effects:		
A. The value to users of increased outputs of goods and services		
1. Flood prevention	7,290	
2. Drainage	546,900	
3. Recreation	536,330	
Total beneficial effects	1,090,520	
Components		
Adverse Effects:		
A. The value of resources required for implementation of elements		
1. Multipurpose channel work		
Installation		13,910
Land Rights		7,100
OM&R		5,020
2. On-farm resource management systems		
Installation		405,340
OM&R		26,700
3. Recreation and Environmental Areas		
Installation		109,890
Land Rights		137,320
OM&R		136,850
Total adverse effects		842,130
Net beneficial effects		248,390

1/ Accelerated land treatment program not evaluated in monetary terms.
 Total installation cost estimated to be \$5,067,600.
2/ Installation costs amortized for 100 years @ 5 7/8 percent interest, except on-farm resource management systems which are amortized for 50 years @ 8 percent interest.

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TABLE IX - 2 (cont.): ALTERNATE A - NATIONAL ECONOMIC DEVELOPMENT
ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>	<u>Components</u>	<u>Measures of Effects</u>
Beneficial and adverse effects:			
A. Areas of natural beauty	<ol style="list-style-type: none"> 1. Preserve 620 acres of floodplain for natural or recreational uses. 2. Provide 1130 acres of protected area for wildlife 3. Maintain 17 miles of stream in its natural condition. 4. Disrupt tranquility of rural environment by providing public access and recreation activities for 390,990 recreation visits. 	C. Biological resources and selected ecosystems.	<ol style="list-style-type: none"> 1. Disrupt aquatic ecosystem on 12.2 miles of stream. 2. Continued maintenance on 29,2 miles of riparian wildlife habitat. 3. Establish 102.5 acres of permanent wildlife cover. 4. Protect permanent easement on 29.5 acres of existing wildlife habitat. 5. Increase quantity and improve quality of wildlife habitat through land treatment program. 6. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices. 7. Change 26 acres of riparian wildlife habitat to open channel or grass. 8. Replace 214 acres of wildlife habitat with public recreation facilities.
B. Quality considerations of water, land and air resources	<ol style="list-style-type: none"> 1. Stabilize two lake levels. 2. Improve operation of septic tanks at two lakes. 3. Reduce bank erosion on 12.2 miles of stream. 4. Decrease agricultural nutrient contribution to streams. 5. Extend public access to 17 miles of stream for canoeing and fishing. 6. Change 2330 acres from private to public ownership. 7. Adequately treat about 206,000 acres to reduce erosion and increase production efficiency of agricultural land. 8. Remove 400 acres from crop production. 9. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off. 	D. Irreversible or irretrievable commitments of resources.	None

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TABLE IX - 2 (cont): ALTERNATE A - NATIONAL ECONOMIC DEVELOPMENT

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/		Income: Adverse effects: A. The value of resources contributed from within the region to achieve the outputs 1. Multipurpose channel work Installation Land Rights OM&R 2. On-farm resource management systems Installation OM&R 3. Recreation Areas Installation Land Rights OM&R B. Losses in output resulting from external diseconomies, associated with land rights required for recreation.	Measures of Effects	
	Region (Average Annual)	Rest of Nation (Average Annual)		Region (Average Annual) 2/	Rest of Nation
A. The value of increased output of goods and services to users residing in the region.					
1. Flood prevention	7,290	-	13,910	-	
2. Drainage	870,930	-324,030	7,100	-	
3. Recreation	536,330	-	5,020	-	
4. Additional wages and salaries accruing to the region from implementation of the plan.	140,200	-140,200	405,340	-	
			26,700	-	
			50,380	59,510	
			68,660	68,660	
			136,850	-	
			17,760	-17,760	
Total beneficial effect	399,850	-399,850	731,720	110,410	
	1,954,600	-864,080	1,222,880	-974,490	

1/ Accelerated land treatment program not evaluated in monetary terms.
Total installation cost estimated to be \$5,067,600.
2/ Installation costs amortized for 100 years @ 5 7/8 percent interest, except on-farm resource management systems which are amortized for 50 years @ 8 percent interest.

TABLE IX - 2 (cont): ALTERNATE A - NATIONAL ECONOMIC DEVELOPMENT

REGIONAL DEVELOPMENT ACCOUNT

Components Employment Beneficial effects:	Measure of Effects	Rest of Nation	Components Employment Adverse effects:	Measures of Effects	
				Region	Rest of Nation
A. Increase in number and types of jobs					
1. Agricultural employment	23.4 man-years in agricultural production	-			
2. Land treatment installation	93 skilled jobs for 1 year 188 semi-skilled jobs for 1 year 188 unskilled jobs for 1 year	- - -			
3. Land treatment OM&R	7.5 permanent semi-skilled jobs	-			
4. Recreation Service Sector	5 permanent seasonal semi- skilled jobs 4 permanent seasonal un- skilled jobs	- -			
5. Project construction	21 skilled jobs for 1 year 32.2 semi-skilled jobs for 1 year 29.3 unskilled jobs for 1 year	- - -			
6. Project OM&R	2.8 permanent semi-skilled jobs 4.0 permanent unskilled jobs	- -			
Total beneficial effect	4.0 permanent seasonal un- skilled jobs 114.0 skilled jobs for 1 year 220.2 semi-skilled jobs for 1 year 217.3 unskilled jobs for 1 year 33.7 permanent semi-skilled jobs 4.0 permanent unskilled jobs 5.0 permanent seasonal semi- skilled jobs	- - - - - - -			

SOCIAL WELL-BEING ACCOUNT

Components

Beneficial and adverse effects:

A. Real income distribution

Measures of Effects

1. Create 37.7 low to medium income permanent jobs for region residents
2. Create 9 low to medium income permanent seasonal jobs for region residents
3. Create 551.5 jobs for 1 year
4. Create regional income benefit distribution of \$1,954,600 by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
Less than 3000	7	2
3000 to 10000	40	76
More than 10000	53	21

5. Local costs to be borne by region total \$731,720 with distribution by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Contributions in Class
Less than 3000	7	1
3000 to 10000	40	49
More than 10000	53	50

B. Life, health and safety

1. Provide 50 percent flood damage reduction to two lakes.
2. Provide 1-year level of protection to two streams.
3. Reduce frequency and duration of standing water on septic systems at lake cottages.
4. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.

C. Recreational opportunities

1. Provide 3285 additional activity days of recreation at two natural lakes.
2. Create 391,040 recreation visits for a mix of rural and urban population.

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B. Environmental Quality Objective

Component needs identified with the EQ objective are in five (5) general categories:

1. Accelerated land treatment to reduce erosion and increase production efficiency on 272,900 acres of cropland, grassland and forest land.
2. Protection and management of about 3,000 acres along about 30 miles of existing major streams.
3. Protection of about 50,000 acres of existing classified wetlands.
4. Protection and improvement of about 170 miles of fisheries and riparian wildlife habitat.
5. Management of flood prone areas on about 21,600 acres.

Elements assigned to the EQ objective to help satisfy the identified component needs are:

1. Change 23,500 acres of Class IV, VI, VII AND VIII cropland to non-cropland for reduction of erosion and sedimentation, and for adequate treatment of land within its capability.
2. Accelerate the land treatment program by installation of conservation measures to reduce erosion and adequately treat over 205,000 acres.
3. Protect 25,000 acres of classified wetlands^{1/} (Types 3,4,5,6³ and 6⁴) in their natural state.
4. Establish environmental corridors along 27 miles (1,120 acres) of the Elkhart River and lower Turkey Creek between Goshen and the junction of the North and South Branches, along 15 miles (550 acres) of the South Branch, and along 6 miles (220 acres) of the North Branch for protection of the natural and aesthetic qualities of the stream systems.
5. Establish program for protection and maintenance of 78 miles of stream fisheries and wildlife habitat classified as fair to excellent (in addition to areas in item 4 above).
6. Initiate active program of stream fisheries and riparian wildlife habitat improvement on 92 miles of stream (in addition to areas in items 4 and 5 above).

^{1/} As defined in USDI Fish and Wildlife Service Circular No. 39

7. Amend or adopt flood plain zoning ordinances, building codes, and similar land use control ordinances in the following seven jurisdictions: Elkhart, Kosciusko, LaGrange, and Noble Counties, and the cities of Elkhart, Goshen and Ligonier.

These elements are summarized in Table IX-3 as Alternate B - Environmental Quality. The accelerated land treatment program aimed specifically at environmental quality includes consideration of changes in land use from cropland to permanent cover on the more erosive soils. Such conversion of land use would eliminate the need for special erosion control measures such as strip-cropping, terracing, and diversions on those converted acres. On-farm drainage needs are not included in satisfying the environmental quality objective. The exclusion of drainage and certain erosion control measures from the land treatment program will reduce the total estimated cost for the early action program from \$5,067,600 for the NED objective to about \$4,314,900 for the EQ objective. The accelerated land treatment program also improves the productive capacity of cropland which is less erosive and less costly to protect.

The protection of classified wetlands is recommended in recognition of these unique natural areas which total about 50,000 acres within the Basin. They are more prevalent within this region than perhaps any other in Indiana. The habitats provided by these wetlands provide abundant shelter and food for a variety of wildlife. The method of protection or preservation of these wetlands will depend upon coordinated efforts and interests of local, state and federal agencies, and landowners affected. Both voluntary effort and local initiative must be present for a program of this nature to be successful.

The environmental corridors for the North Branch, the South Branch, and the Elkhart River above Goshen are recommended for protection of the natural and aesthetic qualities of the linear areas along the stream courses. The areas should be developed or left in a condition that can enhance man's environment by maintaining or creating scenic beauty, wildlife habitat, natural areas, open space, and recreational opportunities. They differ from the riverside recreational development for the NED objective in that less public use is proposed. Recreational activities are limited to canoeing, hiking, use of nature trails, primitive camping and picnicking. The stream channels will require limited debris and sandbar removal to provide for continuous canoe passage. This channel work will provide a minimal amount of flood damage reduction. Specific locations for debris and sandbar removal have not been identified as part of the study. Reconnaissance of the channels and reports from local officials indicate the need for such work. On-site investigations and decisions by local sponsors and officials should dictate the type and intensity of corridor development and related channel work.

The Division of Fish and Wildlife, Indiana Department of Natural Resources, has categorized all streams in the Basin as to their relative value for riparian wildlife habitat and fishery habitat. The recommendations for preservation and/or enhancement of the 170 miles of stream are to assure continuation of desirable wildlife and fisheries habitat. There is no intent to imply public use and/or ownership for these areas. The implementation of these recommendations will require technical and financial assistance from state and/or federal agencies charged with these responsibilities. Implicit in these recommendations is the cooperation by landowners along these streams and their willingness to recognize the value of the riparian habitat. No land purchase or use of cropland is intended with this element.

The nonstructural approach to flood plain management is recommended as a means of maintaining land uses compatible with the hazard involved. Acceptable uses of such areas are considered to be agricultural, recreational, or natural and scenic. The relatively low intensity of present development in the flood prone areas provides opportune timing for initiating local controls on land use in flood hazard areas. Existing state rules and regulations for floodways and floodway fringe areas should become part of any local ordinance governing land use and development in these areas. The nonstructural method of flood plain management is considered a viable means of preventing future flood damages which might occur if improper development takes place.

TABLE IX - 3: ALTERNATE B - ENVIRONMENTAL QUALITY

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

<u>Components</u>	<u>Measures of Effects</u> <u>(Average Annual)</u>	<u>1/</u>	<u>Components</u>	<u>Measures of Effects</u> <u>(Average Annual)</u>	<u>2/</u>
Beneficial Effects:					
A. The value to users of increased outputs of goods and services			A. The value of resources required for implementation of elements		
1. Flood prevention	5,630		1. Fishery and wildlife habitat protection		
2. Recreation	133,410		Installation	3,250	
			Land Rights	18,240	
			OM&R	17,000	
			2. Environmental Areas		
			Installation	10,870	
			Land Rights	111,400	
			OM&R	36,780	
			3. Erosion control (land use adjustment)		
			Installation	220,090	
			Land Rights	1,043,460	
			4. Classified wetlands protection		
			Land Rights	347,350	
			Property tax loss	2,500	
			5. Floodplain management program		
			Flood-prone area identification	3,540	
			Program implementation	1,180	
			Program administration	2,000	
Total beneficial effects		139,040	Total adverse effects		1,817,660
			Net beneficial effects		-1,678,620

1/ Accelerated land treatment program not evaluated in monetary terms.
Total installation cost estimated to be \$4,314,900.
2/ Installation costs amortized for 100 years @ 5 7/8 percent interest.

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TABLE IX - 3(cont): ALTERNATE B - ENVIRONMENTAL QUALITY
ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>	<u>Components</u>	<u>Measures of Effects</u>
Beneficial and adverse effects:			
A. Areas of natural beauty	<ol style="list-style-type: none"> 1. Preserve 22,900 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 3310 acres of protected area for wildlife. 3. Maintain 56 miles of stream in its natural condition. 4. Disrupt tranquility of rural environment by providing public access and recreation activities for 99,360 recreation visits. 5. Protect and improve stream fisheries and riparian wildlife habitation on 92 miles of stream. 	C. Biological resources and selected ecosystems.	<ol style="list-style-type: none"> 1. Temporary disruption of aquatic ecosystem on 112 miles of stream. 2. Continued maintenance on 226 miles of riparian wildlife habitat. 3. Improve wildlife cover on 18,800 acres for species favoring grass and 4,700 acres for species favoring forest environment. 4. Protect 25,000 acres of classified wetlands and their related habitat. 5. Increase quantity and improve quality of wildlife habitat through land treatment program.
B. Quality considerations of water, land and air resources.	<ol style="list-style-type: none"> 1. Decrease agricultural nutrient contribution to streams. 2. Extend public access to 29 miles of stream for canoeing and fishing. 3. Change 1890 acres from private to public ownership. 4. Reduce the average annual gross erosion rate for the Basin from 2.2 tons/acre/year to 1.7 tons/acre/year. 5. Remove 23,560 acres from crop production. 6. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off. 	D. Irreversible or irremediable commitments of resources.	<ol style="list-style-type: none"> 6. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices. 7. Replace 28 acres of wildlife habitat with public recreation facilities.
			None

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TABLE IX - 3(cont): ALTERNATE B - ENVIRONMENTAL QUALITY
REGIONAL DEVELOPMENT ACCOUNT

Components		Measures of Effects <u>1/</u>		Measures of Effects <u>2/</u>	
	Income:	Region (Average Annual)	Rest of Nation	Region (Average Annual)	Rest of Nation
Beneficial effects:					
A. The value of increased output of goods and services to users residing in the region.					
1. Flood prevention		5,630	-		
2. Erosion control (land use adjustment)		574,340		3,250	
3. Recreation		133,410	-574,340	18,240	
4. Additional wages and salaries accruing to the region from implementation of the plan.		36,390	-36,390	17,000	
Income:					
Adverse effects:					
A. The value of resources contributed from within the region to achieve the outputs.					
1. Fishery and wildlife habitat protection					
Installation				3,250	
Land Rights				18,240	
OM&R				17,000	
2. Environmental areas					
Installation				5,000	5,870
Land Rights				55,710	55,690
OM&R				36,780	
3. Erosion control (land use adjustment)					
Installation				220,090	
Land Rights				1,043,460	
4. Classified wetlands protection					
Land Rights				236,840	110,510
Property tax loss				2,500	
5. Floodplain management program					
Flood-prone area identification				-	3,540
Program implementation				1,180	
Program administration				2,000	
B. Losses in output resulting in external diseconomies, associated with alternate use of land					
		749,770	-610,730	654,750	-654,750
Total beneficial effect					
				2,296,800	-479,140
Total adverse effects					
				-1,547,030	-131,590
Net beneficial effects					

1/ Accelerated land treatment program not evaluated in monetary terms.
Total installation cost estimated to be \$4,314,900.
2/ Installation costs amortized for 100 years @ 5 7/8 percent interest.

TABLE IX - 3(cont): ALTERNATE B - ENVIRONMENTAL QUALITY

REGIONAL DEVELOPMENT ACCOUNT

Components Beneficial effects:	Measures of Effects		Components Adverse Effects	Measures of Effects	
	Region	Rest of Nation		Region	Rest of Nation
A. Increase in number and types of jobs.					
1. Land treatment installation	49 skilled jobs for 1-year 99 semi-skilled jobs for 1 year 99 unskilled jobs for 1-year				
2. Land treatment O&M&R	5.4 permanent semi-skilled jobs	-			
3. Recreation Service Sector	2.0 permanent seasonal semi skilled jobs	-			
4. Project Construction	9.2 semi-skilled jobs for 1-year	-			
5. Project O&M&R	2.2 permanent semi-skilled jobs	-			
Total beneficial effect	7.6 permanent semi-skilled jobs 2.0 permanent seasonal semi- skilled jobs 49 skilled jobs for 1-year 108.2 semi-skilled jobs for 1-year 99 unskilled jobs for 1-year				

TABLE IX - 3(cont): ALTERNATE B - ENVIRONMENTAL QUALITY

SOCIAL WELL-BEING ACCOUNT

Components

Beneficial and adverse effects:

A. Real income distribution

Measures of Effects

1. Create 7.6 low to medium income permanent jobs for region residents
2. Create 2.0 low to medium income permanent seasonal jobs for region residents
3. Create 256.2 jobs for 1 year
4. Create regional income benefit distribution of \$749,770 by income class as follows:

<u>Income Class</u> <u>(dollars)</u>	<u>Percentage of</u> <u>Adjusted Gross</u> <u>Income in Class</u>	<u>Percentage</u> <u>Benefits</u> <u>in Class</u>
Less than 3000	7	4
3000 to 10000	40	66
More than 10000	53	30

5. Local costs to be borne by region total \$2,296,800 with distribution by income class as follows:

<u>Income Class</u> <u>(dollars)</u>	<u>Percentage of</u> <u>Adjusted Gross</u> <u>Income in Class</u>	<u>Percentage</u> <u>Contributions</u> <u>in Class</u>
Less than 3000	7	4
3000 to 10000	40	47
More than 10000	53	49

B. Life, health and safety

1. Allow planned development of flood-prone areas at the land use intensity compatible with state law.
2. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.

C. Recreational opportunities

1. Create 99,360 recreation visits for a mix of rural and urban population.
2. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

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C. Recommendations for Development 1/

The recommendations for development contained in the preliminary draft report (November 1974) were reviewed by representatives of the Citizens Advisory Group at a Plan Formulation meeting in July 1974. Those representatives present expressed need for additional recommendations, particularly in draining and reclaiming wetland areas along the North and South Branches of the Elkhart River, but there were no strong objections to including the elements found in the preliminary draft report. On the basis of that review, all viable elements to meet the NED and EQ objectives were included in Alternate C and presented in the preliminary draft report. The element relating to accelerated land treatment measures for erosion control was the only one duplicated in formulating alternatives to meet the needs of the NED and EQ objectives.

Subsequent reviews of the preliminary draft report revealed local dissatisfaction with the recommendations for development contained in Alternate C. Most comments expressed concern about possible public ownership and use of streams and that drainage needs had not been considered properly. Those views were expressed in a public meeting on January 8, 1975, and through letters of comment. Additional discussion of drainage problem potentials has been included in this report under section V-F and in discussion of the NED objective in section IX-A. Further clarification of environmental corridors is included under discussion of the EQ objective (section IX-B).

Consensus was not reached by the entire study group - federal, state and local agencies, and citizens' advisory groups - on those actions which should be recommended for development in the Basin. Alternate C represents that combination of actions or recommendations for development, any one of which can be supported by some of the study participants. All elements in Alternate C, which are summarized in Table IX-4: Recommendations for Development, are consistent with state and federal planning policies and procedures.

The elements included in Alternate C are identical to those previously described under the NED objective (IX-A) and the EQ objective (IX-B). Therefore, specific discussion of those elements is not repeated here.

All elements need not be implemented immediately. Alternate C recognizes those elements which are compatible with each other and which can be installed as programs and/or resources become available. Any one element can be implemented at any time without jeopardizing the feasibility or practicality of other elements.

1/ Viable opportunities identified which help satisfy needs outlined in this study.

In order to provide the reader additional information to judge the relative merits of the alternatives studied, a summary comparison of Alternates A, B, and C is provided on Table IX-5. The capability of alternatives to satisfy identified component needs is presented in Table IX-6.

TABLE IX - 4: ALTERNATE C - RECOMMENDATIONS FOR DEVELOPMENT

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual)	Adverse Effects: A. The value of resources required for implementation of elements	Measures of Effects (Average Annual) 2/
			NED EQ
Beneficial Effects:			
A. The value to users of increased outputs of goods and services			
1. Flood prevention	12,920	Installation	13,910
2. Drainage	546,900	Land rights	7,100
3. Recreation	669,740	OM&R	5,020
		2. On-farm resource management systems	
		Installation	405,340
		OM&R	26,700
		3. Fishery and wildlife habitat protection	
		Installation	3,250
		Land Rights	18,240
		OM&R	17,000
	1,229,560	4. Recreation and Environmental Areas	
Total beneficial effects		Installation	109,890
		Land Rights	137,320
		OM&R	136,850
		5. Erosion control (land use adjustment)	
		Installation	220,090
		Land Rights	1,043,460
		6. Classified wetlands protection	
		Land Rights	347,350
		Property tax loss	2,500
		7. Floodplain management program	
		Flood-prone area identification	3,540
		Program implementation	1,180
		Program administration	2,000
		Total adverse effects	842,130
		Net beneficial effects	387,430

1/ Accelerated land treatment program not evaluated in monetary terms.
Total installation cost estimated to be \$4,314,900.
2/ Installation costs amortized for 100 years @ 5 7/8 percent interest,
except on-farm resource management systems which are amortized for
50 years @ 8 percent interest.

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TABLE IX - 4(cont): ALTERNATE C - RECOMMENDATIONS FOR DEVELOPMENT

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects	Components	Measures of Effects
Beneficial and adverse effects:			
A. Areas of natural beauty	<p>1. Preserve 23,520 acres of floodplain for agricultural, natural or recreational uses.</p> <p>2. Provide 4,440 acres of protected area for wildlife.</p> <p>3. Maintain 73 miles of stream in its natural condition.</p> <p>4. Disrupt tranquility of rural environment by providing public access and recreation activities for 490,350 recreation visits.</p> <p>5. Protect and improve stream fisheries and riparian wildlife habitation on 92 miles of stream.</p>	C.	<p>1. Temporary disruption of aquatic ecosystem on 124.2 miles of stream.</p> <p>2. Continued maintenance on 255.2 miles of riparian wildlife habitat.</p> <p>3. Improve wildlife cover on 18,800 acres for species favoring grass and 4,700 acres for species favoring forest environment.</p> <p>4. Establish 102.5 acres of permanent wildlife cover.</p> <p>5. Assure permanent easement on 29.2 acres of existing wildlife habitat.</p> <p>6. Protect 25,000 acres of classified wetlands and their related habitat.</p> <p>7. Increase quantity and improve quality of wildlife habitat through land treatment program.</p> <p>8. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.</p> <p>9. Replace 242 acres of wildlife habitat with public recreation facilities.</p> <p>10. Change 26 acres of riparian wildlife habitat to open channel or grass.</p>
B. Quality considerations of water, land and air resources.	<p>1. Decrease agricultural nutrient contribution to streams</p> <p>2. Extend public access to 46 miles of stream for canoeing and fishing.</p> <p>3. Change 4,220 acres from private to public ownership.</p> <p>4. Reduce bank erosion on 12.2 miles of stream.</p> <p>5. Adequately treat about 206,000 acres to reduce erosion and increase production efficiency of agricultural land.</p> <p>6. Remove 23,960 acres from crop production.</p> <p>7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.</p> <p>8. Stabilize two lake levels.</p> <p>9. Improve operation of septic tanks at two lakes.</p>	D.	<p>None</p>
			<p>Irreversible or irretrievable commitments of resources.</p>

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TABLE IX - 4 (cont): ALTERNATE C - RECOMMENDATIONS FOR DEVELOPMENT

REGIONAL DEVELOPMENT ACCOUNT

Components Employment Beneficial effects:	Measures of Effects		Components Employment Adverse effects:	Measures of Effects	
	Region	Rest of Nation		Region	Rest of Nation
A. Increase in number and types of job					
1. Agricultural employment	23.4 man-years in agricultural production jobs	-			
2. Land treatment installation	93 skilled jobs for 1 year 188 semi-skilled jobs for 1 year	-			
3. Land treatment OM&R	188 unskilled jobs for 1 yr. 7.5 permanent semi-skilled jobs	-			
4. Recreation Service Sector	7 permanent seasonal semi-skilled jobs 4 permanent seasonal unskilled jobs	-			
5. Project construction	21 skilled jobs for 1 year 41.4 semi-skilled jobs for 1 year 29.3 unskilled jobs for 1 yr.	-			
6. Project OM&R	5 permanent semi-skilled jobs 4.0 permanent unskilled jobs	-			
Total beneficial effect	4.0 permanent seasonal unskilled jobs 114.0 skilled jobs for 1 year 229.4 semi-skilled jobs for 1 yr. 217.3 unskilled jobs for 1 year 35.9 permanent semi-skilled jobs 4.0 permanent unskilled jobs 7.0 permanent seasonal semi-skilled jobs	-			

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TABLE IX - 4(cont): ALTERNATE C - RECOMMENDATIONS FOR DEVELOPMENT

SOCIAL WELL-BEING ACCOUNT

Components

Beneficial and adverse effects:

A. Real income distribution

Measures of Effects

1. Create 39.9 low to medium income permanent jobs for region residents
2. Create 11 low to medium income permanent seasonal jobs for region residents
3. Create 560.7 jobs for 1 year
4. Create regional income benefit distribution of \$2,704,370 by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
Less than 3,000	7	3
3,000 to 10,000	40	72
More than 10,000	53	25

5. Local costs to be borne by region total \$3,028,520 ^{1/} with distribution by income as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Contributions in Class
Less than 3,000	7	4
3,000 to 10,000	40	47
More than 10,000	53	49

^{1/} Includes environmental quality objective costs of \$2,296,800.

B. Life, health and safety

1. Provide 50 percent flood damage reduction to two lakes.
2. Provide 1-year level of protection to two streams.
3. Reduce frequency and duration of standing water on septic systems at lake cottages.
4. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
5. Allow planned development of flood-prone areas at the land use intensity compatible with state law.

C. Recreational opportunities

1. Provide 3,285 additional activity days of recreation at two natural lakes.
2. Create 490,400 recreation visits for a mix of rural and urban population.
3. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

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TABLE IX - 5: SUMMARY COMPARISON OF ALTERNATIVES

Accounts	Elkhart River Basin, Indiana			
	Alternate A National Economic Development	Alternate B Environmental Quality	Alternate C Recommendations	Difference (Alternate C minus Alternate B (Shown))
A. National Economic Development				
Beneficial effects (\$)	1,090,520	139,040	1,229,560	+1,090,520
Adverse effects (\$)	842,130	1,817,660	2,659,790 1/	+842,130
Net Beneficial Effects (\$)	248,390	-1,678,620	-1,430,230	+248,390
B. Environmental Quality				
Beneficial & Adverse Effects				
1. Areas of Natural Beauty				
a. Protect areas for wildlife, natural, agricultural, or recreational uses.	1,750 acres	26,210 acres	27,960 acres	+1,750 acres
b. Maintain streams in their natural condition.	17 miles	56 miles	73 miles	+17 miles
c. Protect and improve stream fisheries and riparian wildlife habitat.	-	170 miles	170 miles	+170 miles
2. Quality Considerations of Water, Land and Air Resources.				
a. Reduce streambank erosion	12.2 miles	-	12.2 miles	+12.2 miles
b. Provide public access to streams	17 miles	29 miles	46 miles	+17 miles
c. Change land from private to public uses	2,330 acres	1,890 acres	4,220 acres	+2,330 acres
d. Reduce soil loss	85,150 acres	85,150 acres	85,150 acres	-
e. Remove land from crop production	400 acres	23,560 acres	23,960 acres	+400 acres
3. Biological Resources and Selected Ecosystems.				
a. Disrupt aquatic ecosystem	12.2 miles	112 miles	124.2 miles	+12.2 miles
b. Maintain riparian wildlife habitat	29.2 miles	226 miles	255.2 miles	+29.2 miles
c. Establish or improve wildlife cover	102.5 acres	23,500 acres	23,602.5 acres	+102.5 acres
d. Protect wildlife and wetland habitat	29.5 acres	25,000 acres	25,029.5 acres	+29.5 acres
e. Change riparian wildlife habitat to open channel or grass	26 acres	-	26 acres	+26 acres
f. Replace wildlife habitat with public recreation facilities	214 acres	28 acres	242 acres	+214 acres
C. Regional Development				
1. Income				
Beneficial effects (\$)	1,954,600	749,770	2,704,370	+1,954,600
Adverse effects (\$)	731,720	2,296,800	3,028,520 2/	+731,720
Net Beneficial Effects (\$)	1,222,880	-1,547,030	-324,150	+1,222,880
2. Employment				
Permanent	37.7 jobs	7.6 jobs	39.9 jobs	+32.3 jobs
Seasonal	9.0 jobs	2.0 jobs	11.0 jobs	+9.0 jobs
Temporary (1-year)	551.5 jobs	256.2 jobs	560.7 jobs	+305.5 jobs
D. Social Well-Being				
1. Employment (See C 2 above)				
2. Regional income and costs (See C 1 above)				
3. Provide agricultural flood protection (1 year)	968 acres	-	968 acres	+968 acres
4. Provide recreational opportunities for rural and urban population of region	391,040 rec. visits	99,360 rec. visits	490,400 rec. visits	+391,040 rec. visits

1/ Includes \$1,817,660 for Environmental Quality

2/ Includes \$2,296,800 for Environmental Quality

TABLE IX - 6: CAPABILITY OF ALTERNATIVES TO SATISFY COMPONENT NEEDS
Elkhart River Basin, Indiana

OBJECTIVES		ALTERNATIVES - COMPONENT NEEDS PROVIDED AND REMAINING									
		Component		A (NED)		B (EQ)		C (Recommendations)			
Description	Unit	Needs (Early Action - 1990)	Quantity	Provides	Remaining	Provides	Remaining	Provides	Remaining	Remaining	
NED 1. Flood Damage Reduction from channel work	Acres	\$ Annual Damage	21,600	970	20,630	-0-	21,600	970	20,630	20,630	
2. Drainage - Improved Farming Efficiency	Acres		51,000	7,300	43,700	1,000 1/	50,000	8,300	42,700	42,700	
3. Accelerated Land Treatment	Acres		34,000	27,700	6,300	-0-	34,000	27,700	6,300	6,300	
Sheet Erosion Control	Acres of Cropland		139,000	85,150	53,850	85,150	53,850	85,150	53,850	53,850	
Adequate Treatment	Acres		272,900	206,000	66,900	206,000	66,900	206,000	66,900	66,900	
4. Outdoor Recreation	Acres for Camping		68	34	34	8	60	42	26	26	
	Miles of Trails		374 2/	37	337	21	353	58	316	316	
	Acres of Playfields		610	40	570	-0-	610	40	570	570	
	Miles of Canoeing		30	17	13	29	1	46	-16	-16	
	Acres for Golfing		78	306	-228	-0-	78	306	-228	-228	
	Acres for Hunting		20,200	-0-	20,200	-0-	20,200	-0-	20,200	20,200	
EQ 1. Accelerated Land Treatment - Sheet Erosion Control	Acres of Cropland		139,000	85,150	53,850	85,150	53,850	85,150	53,850	53,850	
Adequate Treatment	Acres		272,900	206,000	66,900	206,000	66,900	206,000	66,900	66,900	
2. Protect & Manage Areas	Acres		3,000	620	2,380	1,890	1,110	2,520	480	480	
Along Existing Major Streams	Miles		60	12	48	48	12	60	-0-	-0-	
3. Protect Existing Classified Wetlands	Acres		50,000	-0-	50,000	25,000	25,000	25,000	25,000	25,000	
4. Protect and Improve Fisheries and Riparian Wildlife Habitat	Miles		170	-0-	170	170	-0-	170	-0-	-0-	
5. Management of Flood Prone Areas	Acres		21,600	-0-	21,600	21,600	-0-	21,600	-0-	-0-	

1/ In addition \$4,600 of future flood prevention from floodplain zoning is attributable to Alternate B.

2/ Includes: Bicycling - 23 miles, Bridle - 109 miles, Nature - 76 miles, and Hiking - 166 miles.

D. Environmental Assessment of Recommended Actions

Tables IX-2, IX-3, and IX-4 summarize the effects of each set of alternatives in economic, physical, and social terms, and Tables IX-5 and IX-6 provide comparisons of the recommended actions with the NED and EQ alternatives. The summaries under the various accounts provide the aggregate effects in physical and monetary terms. The effects noted in the environmental quality and social well-being accounts provide concise, objective environmental assessments of each alternative.

Further discussion will deal only with those elements in Alternate C recommended for development.

1. Environmental Impact of Recommended Actions

The environmental quality account on sheet 2 of Table IX-4 provides a summary of environmental impacts of the recommended actions if full implementation occurs.

2. Beneficial Effects of Recommended Actions

The beneficial effects are numerous; therefore, the reader is referred to Table IX-4, sheet 2 of 5 (Environmental Quality Account) where all physical effects are listed. Beneficial effects are all those not listed in item 3 below.

3. Adverse Effects of Recommended Actions

- a. Disrupt tranquility of rural environment by providing public access and recreation activities for 490,350 recreation visits.
- b. Extend public access to 46 miles of stream for canoeing and fishing.
- c. Temporary disruption of aquatic ecosystem on 124.2 miles of stream.
- d. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
- e. Replace 242 acres of wildlife habitat with public recreation facilities.
- f. Change 26 acres of riparian wildlife habitat to open channel or grass.

4. Alternates to Recommended Actions

Alternatives considered in meeting component needs to satisfy the NED and EQ objectives are discussed under previous portions of this chapter and are displayed in Tables IX-2, IX-3, and IX-4. Comparisons are presented in Tables IX-5 and IX-6. The effects of a "no action" alternative can be quantified by referring to the Component Needs (Early Action - 1990) on Table IX-6. Those quantities reflect remaining needs if no recommendations for development are implemented.

5. Short-Term vs. Long-Term use of Resources

Current trends do not indicate rapid change in land use unless specific project-type action stimulates such a change. Flood prone areas and other areas at or near stream channels are now used for limited agricultural activity, while most uses are for natural or aesthetic purposes. Areas surrounding natural lakes are being developed slowly with both seasonal and permanent residences.

The development of county parks would affect an estimated 400 acres of cropland. This estimate is speculative until local decisions are made for implementation of such parks. An additional 1,200 acres of other land use would be utilized for the remainder of the county park areas.

Recommended recreation or corridor developments along streams would involve about 2,500 acres, none of which are now developed or used for agricultural production. About 240 acres of wildlife habitat would be replaced with recreation facilities. Other recommended recreation and corridor developments are not expected to change land uses.

The projected uses of land with development of recommendations in this report are considered generally compatible with existing plans for land use in the Basin, with one major exception. The recommendation for conversion of 23,500 acres of cropland to grassland and forest land would result in a reduced net return to the landowners on a short-term basis. Accelerated land treatment on more productive lands would enhance the land resource base and provide continued long-term production. This action would assure adequate cropland to meet projected demands for agricultural production in the Basin. Continued application of conservation measures to the land will assure a fertile resource base for future generations.

There have been no planned water resource projects in the Basin, nor are there any current applications for such projects.

The recommended actions will have a significant impact on protection and retention of existing resources, with only slight changes to improve public access to those resources.

6. Irreversible and Irretrievable Commitments of Resources

Land use changes considered detrimental to the natural environment are indicated in Table IX-4, Environmental Quality Account. About 242 acres of wildlife habitat would be replaced with recreation facilities and 26 acres of riparian wildlife habitat would be changed to open channel or grass with implementation of recommended flood prevention and recreation measures. Local decisions which would lead to development of recommended actions would not preclude optional use of the areas involved at any time in the future, should circumstances dictate the need for such changes.

E. Additional Recommendations for On-going Programs

In addition to the recommended elements to meet the NED and EQ objectives, there are several on-going programs which should be continued, or authorized programs which should be initiated in the best interests of Basin residents. These additional recommendations are for action by state and/or local government and are not classified as new planning elements for project action. They are:

1. The Indiana Department of Natural Resources should continue their program of analyzing natural lake levels and the need for control structures and/or outlet channel work.
2. County drainage boards should accelerate implementation of their authority under the 1965 Indiana Drainage Law, as amended, in order to aid numerous landowners who have small isolated areas that need channel deepening for an adequate outlet.
3. Implement the Federal Flood Insurance Program in all areas of the Basin. Several eligible jurisdictions within the Basin are now participating.
4. Establish water quality monitoring station on Mallard Roost to aid in providing continued water quality.
5. Increase utilization of the ground water resource with additional wells and expanded distribution system to meet projected demands of nearly 22 mgd for municipal and industrial water supply.
6. Refine water processing in municipal systems to meet the desires of the people.

7. Increase utilization of the ground water resource to meet projected demands for rural water.
8. Implement compliance schedules to meet municipal, industrial, and semi-public wastewater treatment needs, and implement a continuing development program to improve and protect surface water quality.
9. Continue and expand the surveillance necessary to effectively control and improve water quality.
10. Maintain enforcement of State Board of Health water quality standards.
11. Analyze lake developments and the necessity or advisability of central sewage disposal systems.
12. Expand the National Eutrophication Survey to study the trophic nature and water quality of all public lakes and reservoirs of significant size in Indiana.
13. Complete acquisition of Tri-County and Mallard Roost Fish and Wildlife areas.
14. Continue and complete inventories and fish management plans for public areas.
15. Complete inventories and fish management plans on streams.
16. Continue to acquire natural areas and preserves in accordance with their established priority rating.
17. Continue survey of important archaeological sites and record them in the files of the Glenn A. Black Laboratory of Archaeology at Indiana University.

**X. POTENTIAL FOR DEVELOPMENT
OF RECOMMENDATIONS**

A. USDA Programs X - 1

B. Other Programs X - 2



CHAPTER X. POTENTIAL FOR DEVELOPMENT OF RECOMMENDATIONS

A. USDA Programs

1. Land Treatment Program Under PL-46 and Other Related Authorities

The need for accelerated land treatment has been identified and recommended for the Basin. Technical assistance can be provided by SCS under the authority of PL-46 to individuals or groups of landowners and operators in both rural and urban areas. Such assistance is coordinated by local soil and water conservation districts under authority of state law. Related activities include cost-sharing provisions available through ASCS to cooperating farmers in implementing soil, water, woodland, and wildlife conservation practices on farmland now in agricultural production.

The recommended accelerated land treatment program to meet resource conservation needs amounts to about 75 percent of total identified needs. Technical and financial assistance available through SCS and ASCS will serve as stimuli in moving the program forward.

2. Cooperative State-Federal Forestry Programs

The Cooperative Forest Management Program involves the U.S. Forest Service and the Division of Forestry, IDNR, in providing advice and other technical assistance for approved forest management practices on private lands. This program will be valuable in meeting the need to convert land use from cropland to forestland on those areas which have excessive erosion or are otherwise more suited to the growth of forest products.

3. Potential PL-83-566 Watershed Projects

Although assistance is available through SCS under the Watershed Protection and Flood Prevention Act (PL-83-566), no applications have been submitted from the Elkhart River Basin. The possibilities identified in this study include the Solomon Creek and Turkey Creek areas; however, the relatively small extent of work needed to solve flood and drainage problems in those areas, lends itself to local action by the county drainage board.

4. Resource Conservation and Development Areas

An application is now under consideration for the Potawotomi Resource Conservation and Development Area, under the authority of PL-87-703, which provides for technical, financial and loan assistance to legal sponsors in approved areas where acceleration of going resource conservation programs will increase economic opportunity for local residents. The Potawotomi application would include Elkhart County and Kosciusko

County portions of the Basin. Assistance under this program can help meet the identified needs for recreational development in environmental corridors and park systems, and assist in implementing the accelerated land treatment program.

5. Rural Development Programs

Credit assistance is available from the Farmers Home Administration through loans for farm ownership, farm emergencies, housing, grazing associations, rural recreation and watersheds. Such assistance serves as the impetus to apply proper conservation measures to the land and use the land within its capabilities. The Extension Service specialists work with other agencies to provide information relating to soil and water conservation programs and technical assistance in analyzing recreational needs and developments.

B. Other Programs

1. Other Agency Programs

The Division of Fish and Wildlife, IDNR, administers funds available through the U.S. Fish and Wildlife Service for purchase and management of classified wetlands. This program and a similar program carried out by the Division will help meet the recommended action to protect certain classified wetlands.

The Division of Outdoor Recreation, IDNR, administers grant funds available from the Bureau of Outdoor Recreation for acquisition and/or development of recreational facilities. This program is a source of aid in implementing the environmental corridors and parks recommended for the Basin.

The Division of Water, IDNR, administers the regulatory authority of the Natural Resources Commission for all flood control works in the state, regulation of construction in floodways, and approval authority over local flood plain management ordinances. Minimum standards for flood plain management are now in effect and can be adopted by local ordinance. Implementation of this minimum standard in the Basin would help reduce the hazard to future life and property.

The Division of Water is actively evaluating the need for outlet control structures at natural lakes. The channel work recommended at Adams Lake and Knapp Lake will be done in conjunction with scheduled construction of control structures at those lakes.

The Elkhart, LaGrange, Kosciusko, and Noble County Soil and Water Conservation Districts are actively promoting the on-going program of installing needed conservation measures on individual farms. The SWCDs will support the recommended acceleration of land treatment measure installation.

County drainage boards have full authority to assist landowners with major open channel drainage measures, and should be considered the primary

source of assistance in accelerating the installation of needed drainage systems in the Basin.

The State Board of Health and the Stream Pollution Control Board are actively involved in a number of programs to maintain and improve the quality of water in the Basin. The Stream Pollution Control Board now conducts stream surveys in various waters within the state as part of its data collection program. Likewise, samples are collected from 86 stations in Indiana streams and lakes.

Chapter 273, Acts of 1967, requires the classification of wastewater treatment plants and certification of plant supervisors. The frequency of inspections of wastewater treatment facilities by representatives of the Board has been increased and will be increased even more to insure compliance with the standards. The prompt and regular submission of monthly operational reports will be required of the treatment plant personnel for purposes of evaluating the effluent quality. Furthermore, where practicable, the Board will require a downstream sampling program at the larger facilities.

The National Pollutant Discharge Elimination System (NPDES) permit program is a federally required program for the issuance of permits for all point discharges into waterways within the State of Indiana. The program was initiated on October 18, 1972, as part of the Federal Water Pollution Control Act Amendments of 1972.

The Stream Pollution Control Board Regulation SPC 15 gives the state authority to issue permits for all point discharges. Discharge permits which will satisfy both the NPDES and SPC 15 discharge requirements will be issued.

The Environmental Protection Agency has established an intensive survey (National Eutrophication Survey) to identify the water bodies in the United States which have potential or actual eutrophication problems due to phosphorus from municipal sources. Seven lakes within the Basin are included in the survey. Results of the survey are an integral part of an Environmental Protection Agency control program to assist state and local governments, through construction grants, in reducing phosphates to the extent necessary to protect water quality by means of municipal waste treatment. Under this control program, 80-98 percent phosphate removal may be provided at municipal treatment plants, where required.

In addition to the federally sponsored National Eutrophication Survey, the Indiana State Board of Health - Division of Water Pollution Control plans a 5-year study which will provide information regarding the trophic nature of all public lakes and reservoirs of significant size in the state. While many of the methods employed are similar to those used by the National Eutrophication Survey, the surveys will not initially involve the collection of more than one set of samples from each lake or its tributaries. In addition, it will not be possible to conduct algal assays of the lake water at this time; however, the surveys will identify those public lakes and reservoirs

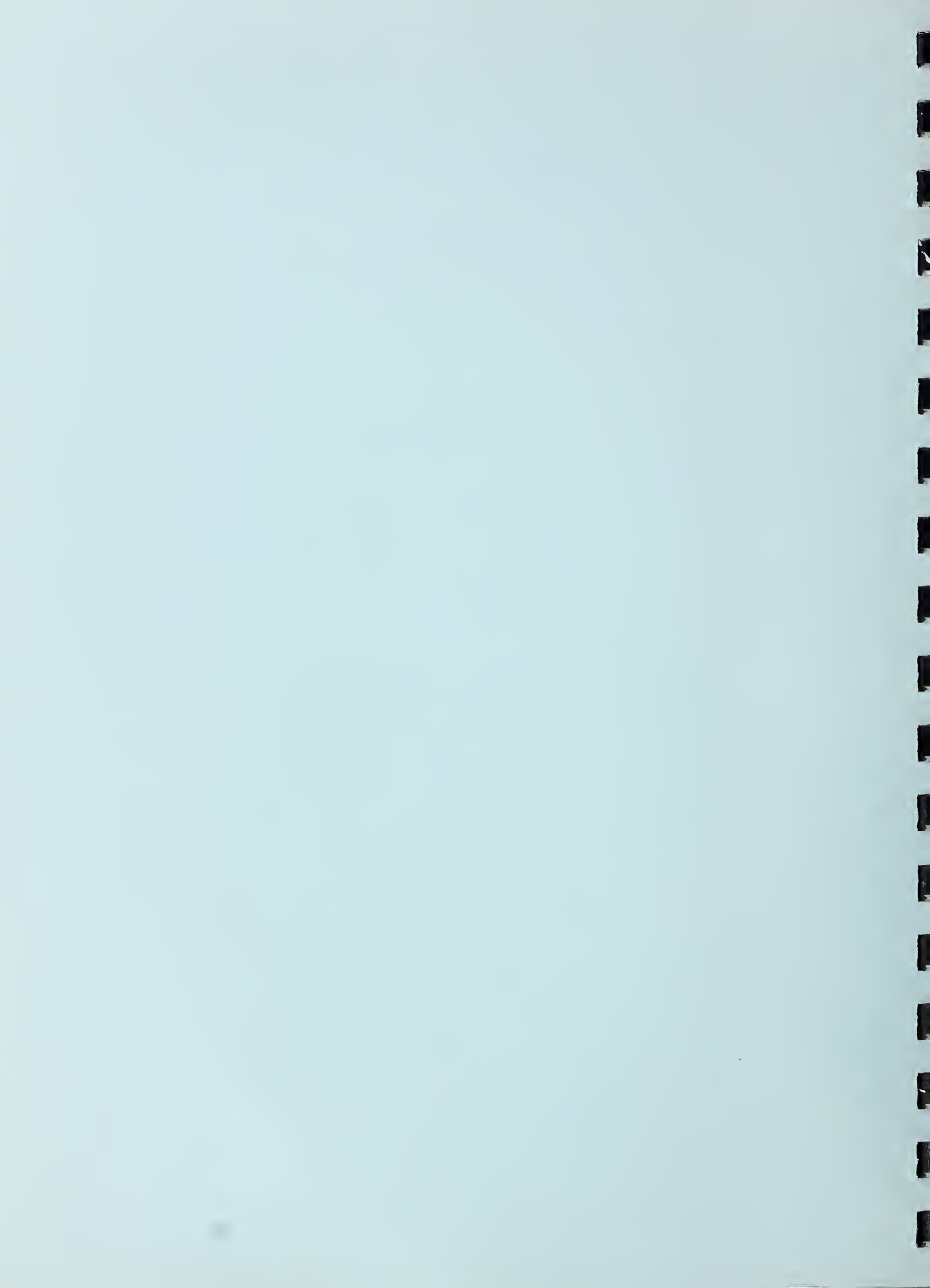
which are apparently being enriched at an excessive rate. All lakes will be identified relative to their unique character or special ecological significance. Following the collection and analyses of a sufficient quantity of survey data, the water quality criteria and plan of implementation will be reevaluated using the new information.

2. Projects Needing Further Coordination

The recommended environmental corridors provide a unique combination of providing public use of the major streams while meeting part of the need for nonstructural flood control measures. Making such public corridors a reality will require a coordinated effort among local agencies and with individual landowners. The city and county park and recreation boards, plan commissions, governing councils, and other special districts will need to consider carefully the extent and use of such corridors, and enact ordinances to assure proper development, operation, and maintenance of the areas.

Classified wetlands are a unique natural resource of this Basin, but the protection of those areas for future generations to enjoy will require careful consideration of the present landowners and the impact of purchase or long-term lease on adjacent lands. A new program similar to the Classified Forest Program should be considered as one method of implementing this recommendation for the Basin.

GLOSSARY



GLOSSARY

1. Accelerated Land Treatment

The installation of land treatment (See LT) at an earlier date, or more rapid rate, than would be effected under existing programs and conditions. This term may be used to refer to the additional land treatment accomplished in a particular time frame or by a given date, as compared with the norm.

2. Activity Day

An activity day is "any part of a day in which the person engaged in the activity one or more times".

3. Average Annual Benefits

The mean yearly advantage during the evaluation period. Does not consider costs.

4. Average Annual Costs

The mean yearly expense during the evaluation period.

5. Comprehensive River Basin Studies

Studies to provide a guidance for state, federal, and local interest to conserve, develop, and utilize their water and related land resources in an efficient and timely manner. Their objectives are to enhance national economic development and to enhance the quality of the environment.

6. Recreation Demand

The desire of people to participate in recreational activities. The recreation demands are projected through the use of participation rates, as developed in 1973 by the Indiana Department of Natural Resources, Division of Outdoor Recreation.

7. Environmental Corridors

Linear areas reserved for managed use and left in or developed to a condition that can enhance man's environment by maintaining or creating scenic beauty, wildlife habitat, natural areas, open space, recreational opportunities, flood hazard reduction, water quality improvement and other desirable features in total or in any part.

8. Environmental Quality

This objective reflects society's concern and emphasis for the natural environment and its maintenance and enhancement as a source of present enjoyment and a heritage for future generations. Components of the Environmental Quality objective may include areas of natural beauty; quality of water, land and air; biological resources and ecosystems; geological, archeological, and historic resources.

9. Flood Hazard Area

Those flood plains which have not been adequately protected from flooding either by structural or non-structural means.

10. Flood Plain

The area adjoining a river, stream, or lake which has been or may hereafter be covered by flood water.

11. Floodway

The channel of a river or stream and those portions of the flood plains adjoining the channel, which are reasonably required to efficiently carry and discharge the peak flood flow of the regional flood of any river or stream.

12. Floodway Fringe

Those portions of the flood hazard areas lying outside the floodway.

13. Land Treatment (LT)

The application of conservation management and practices on areas of cropland, pastureland, forestland, and other land. Land treatment includes land use planning, as well as the installation of engineering and agronomic measures with the intent of conserving and improving the soil resource.

14. National Economic Development (NED)

Increases or decreases in the Nation's productive output. Beneficial effects are increased goods and services and improvements in economic efficiency. Adverse effects are the value of resources required or displaced by the plan.

15. Natural Areas

This consists of areas of unique natural conditions with little developed facilities. Areas are selected for designation, on the basis of the resource rather than on the utilization for recreation purposes.

16. Nature Preserves

Natural areas that preserve a single unique geologic feature or extensive ecological communities.

17. Natural Streams

Those streams in an unaltered and unpolluted condition.

18. Need

Need is the difference between demand and supply when demand is greater than supply.

19. OBERS

U. S. Department of Commerce and U. S. Department of Agriculture, 1972 OBERS projections of economic activity in the United States, Volume 1 (Concepts, Methodology and Summary Data) prepared for U. S. Water Resources Council, Sept. 1972, 109p. OBERS is an acronym for Office of Business Economics (OBE - currently known as the Bureau of Economic Analysis, U. S. Dept. of Commerce) and the Economic Research Service (ERS), U. S. Dept. of Agriculture.

20. On-Farm Resource Management

Land treatment measures for drainage on existing cropland (required in addition to project structural measures to achieve agricultural potential of an area).

21. Participation Rate

The participation rate is the result of one person participating in one activity for at least one-half hour of any one day.

22. Principles and Standards

Principles - provide the broad policy framework for planning activities and include the conceptual bases for planning.

Standards - provide for uniformity and consistency in comparing, measuring, and judging beneficial and adverse effects of alternative plans.

23. Recreation Areas

Such areas as scenic, hunting and fishing, national and state forests, parks, monuments, refuges, drives, and campgrounds.

24. Regional Development (RD)

Increases or decreases in the Region's production output. The Region encompasses all areas that will be physically affected by the plan and all contiguous counties that will incur significant economic effects. See NED.

25. Social Well-Being

Effects which are integrally related to the basic values and goals of society, and which are usually not subject to monetary evaluation. These include effects on real income; security of life, health, and safety; educational, cultural, and recreational.

LIST OF PLATES

PLATE

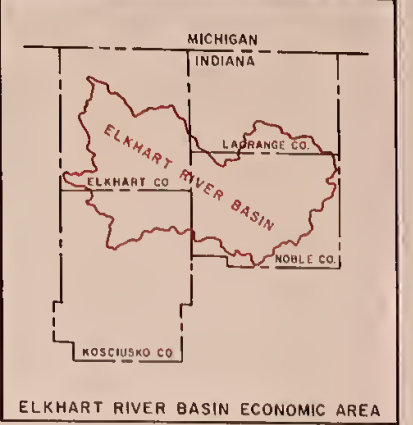
- 1 General Location Map
- 2 Soil Interpretations
- 3 General Soils Map
- 4 Generalized Surficial Geologic Map
- 5 Bedrock Geology Map
- 6 Hydrologic Data Network
- 7 Ground-Water Availability Map
- 8 Ground-Water Level Map
- 9 Riparian Wildlife Habitat
- 10 Stream Fisheries Habitat
- 11 Environmental and Recreational Map
- 12 Hydrologic Subareas
- 13 Flooded Area Map





LEGEND

BASIN BOUNDARY	STREAM
COUNTY BOUNDARY	LAKE
COUNTY SEAT	U.S. HIGHWAY
TOWN	STATE HIGHWAY



SOURCE: SCS DRAWING 5, R-28, 896(4-25-75)
AND INFORMATION FROM FIELD TECHNICIANS.
POLYCONIC PROJECTION

ELKHART RIVER BASIN
INDIANA
COMPREHENSIVE BASIN STUDY
GENERAL LOCATION MAP
U.S. DEPARTMENT OF AGRICULTURE JUNE 1975
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA - Department of Natural Resources
PLATE 1 5-9-75
5, S-35, 243

ELKHART RIVER BASIN, INDIANA

ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES

SOIL ASSOCIATION	SOIL SERIES AND PERCENT OF ASSOCIATION		DWELLINGS		WASTE DISPOSAL		LOCAL ROADS, STREETS AND PARKING AREAS	SUITABILITY AS A SOURCE OF			RECREATION		INTENSIVE CROPPING	WOODLAND PRODUCTIVITY
	SOIL SERIES	PCT	WITH BASEMENTS	WITHOUT BASEMENTS	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS		SAND	GRAVEL	ROADFILL	CAMP AND PICNIC AREAS	PLAYGROUNDS & ATHLETIC FIELDS		
1	OHSTEMO FOX MINOR	70 8 22	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	SLIGHT SLIGHT	GOOD GOOD	GOOD GOOD	GOOD GOOD	SLIGHT SLIGHT	SLIGHT MODERATE: 1	FAIR FAIR	GOOD GOOD
2	MORLEY BLOUNT RAWSON MINOR	50 30 10	MODERATE: 5 SEVERE: 3 MODERATE: 5	MODERATE: 5 MODERATE: 3,5 MODERATE: 5	SEVERE: 2 SEVERE: 2,3 SEVERE: 2	MODERATE: 1 SLIGHT MODERATE: 1	SEVERE: 5,6 SEVERE: 5,6 SEVERE: 5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR POOR POOR	SLIGHT MODERATE: 3 SLIGHT	MODERATE: 1,2 MODERATE: 2,3 MODERATE: 1,2	FAIR FAIR GOOD	GOOD FAIR GOOD
3	BLOUNT MASKINS PEWAMO MINOR	40 20 20 20	SEVERE: 3 SEVERE: 3 SEVERE: 3	MODERATE: 3,5 MODERATE: 3,5 SEVERE: 3	SEVERE: 2,3 SEVERE: 2,3 SEVERE: 2,3	MODERATE: 3 MODERATE: 3 SEVERE: 3	SEVERE: 5,6 SEVERE: 5,6 SEVERE: 3,5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR POOR POOR	MODERATE: 3 SEVERE: 3 SEVERE: 3	MODERATE: 2,3 MODERATE: 2,3 SEVERE: 2,3	FAIR GOOD GOOD	FAIR FAIR FAIR
4	RIDDLEES MIAMI FOX CROSBY MINOR	28 25 20 7	MODERATE: 5 MODERATE: 5 SLIGHT SEVERE: 3	MODERATE: 5 MODERATE: 5 SLIGHT MODERATE: 3,5	MODERATE: 2 MODERATE: 2 SLIGHT SEVERE: 2,3	MODERATE: 1,7 MODERATE: 1,7 SEVERE: 7 MODERATE: 3	SEVERE: 5,6 SEVERE: 5,6 SEVERE: 5,6 SEVERE: 5,6	UNSUITED UNSUITED GOOD UNSUITED	UNSUITED UNSUITED GOOD UNSUITED	POOR POOR GOOD POOR	SLIGHT SLIGHT SLIGHT MODERATE: 3	MODERATE: 1 MODERATE: 1 MODERATE: 1 MODERATE: 3	GOOD GOOD FAIR GOOD	GOOD GOOD GOOD FAIR
5	FULTON BOND RIMER LENAWEE MINOR	25 25 20 10 20	SEVERE: 3,5 SEVERE: 3,5 SEVERE: 3,5 SEVERE: 3	SEVERE: 3,5 SEVERE: 3,5 SEVERE: 3,5 SEVERE: 3	SEVERE: 2,3 SEVERE: 2,3 SEVERE: 2,3 SEVERE: 2,3	MODERATE: 3 SEVERE: 3 MODERATE: 3,7 SEVERE: 3	SEVERE: 5,6 SEVERE: 3,5 SEVERE: 5,6 SEVERE: 3,5,6	UNSUITED UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED UNSUITED	POOR POOR POOR POOR	MODERATE: 3 SEVERE: 3 SEVERE: 3 MODERATE: 3	SEVERE: 2,3 SEVERE: 2,3 SEVERE: 3 MODERATE: 2,3	FAIR GOOD FAIR GOOD	FAIR FAIR FAIR FAIR
9	VOLINTA DICKINSON MINOR	62 20 18	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	SLIGHT SLIGHT	GOOD POOR	GOOD UNSUITED	GOOD GOOD	SLIGHT SLIGHT	SLIGHT SLIGHT	FAIR FAIR	NO DATA AVAIL. FAIR
7	MIAMI GRAVELLY SUBSTRATUM MINOR	60 40	MODERATE: 5	MODERATE: 5	MODERATE: 2	SEVERE: 1,7	SEVERE: 5,6	UNSUITED (sand will occur within 4 to 8 ft.)	UNSUITED (gravel will occur within 4 to 8 ft.)	POOR	SLIGHT	MODERATE: 1	GOOD	GOOD
8	CARLISLE LINWOOD TAWAS EDWARDS MINOR	50 20 15 10 5	SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6	SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6	SEVERE: 3 SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3,7 SEVERE: 3,7 SEVERE: 3,7 SEVERE: 3,7	SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6	UNSUITED UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED UNSUITED	POOR POOR POOR POOR	SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6	SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6 SEVERE: 3,5,6	GOOD GOOD GOOD GOOD	POOR POOR POOR POOR
9	HOMER SEBENA GILFORD MINOR	35 35 15 15	SEVERE: 3 SEVERE: 3 SEVERE: 3	MODERATE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 7 SEVERE: 3,7 SEVERE: 3,7	MODERATE: 3 SEVERE: 3 SEVERE: 3	GOOD FAIR FAIR	GOOD FAIR UNSUITED	FAIR POOR GOOD	MODERATE: 3 SEVERE: 3 SEVERE: 3	MODERATE: 3 SEVERE: 3 SEVERE: 3	FAIR GOOD GOOD	FAIR FAIR POOR
10	BROOKSTON CROSBY MINOR	45 45 10	SEVERE: 3 SEVERE: 3	SEVERE: 3 MODERATE: 3,5	SEVERE: 2,3 SEVERE: 2,3	SEVERE: 3 MODERATE: 3	SEVERE: 3 SEVERE: 5,6	UNSUITED UNSUITED	UNSUITED UNSUITED	POOR POOR	SEVERE: 3 MODERATE: 3	SEVERE: 3 MODERATE: 3	GOOD GOOD	FAIR FAIR
11	WARSAW ELSTON MINOR	60 20 20	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	SLIGHT SLIGHT	GOOD POOR	GOOD UNSUITED	GOOD GOOD	SLIGHT SLIGHT	SLIGHT SLIGHT	FAIR FAIR	NO DATA AVAIL. FAIR

EXPLANATION OF COLUMNS IN THE TABLE

SOIL ASSOCIATION:
THE NUMBERS AND COLORS IN THIS COLUMN CORRESPOND WITH THE NUMBERED SOIL ASSOCIATIONS (GENERAL SOIL AREAS) ON THE GENERAL SOIL MAP OF THE ELKHART RIVER BASIN. EACH SOIL ASSOCIATION IS NAMED FOR THE MAJOR SOILS.

SOIL SERIES & PERCENT OF ASSOCIATION:
THIS COLUMN SHOWS THE APPROXIMATE PERCENT OF EACH MAJOR SOIL IN EACH ASSOCIATION, AND THE TOTAL PERCENT OF ALL THE MINOR SOILS.

DWELLINGS - WITH BASEMENTS:
RATINGS ARE FOR UNDISTURBED SOILS THAT ARE EVALUATED FOR SINGLE FAMILY DWELLINGS AND OTHER STRUCTURES WITH SIMILAR FOUNDATION REQUIREMENTS. EXCLUDED ARE BUILDINGS OF MORE THAN THREE STORIES AND OTHER BUILDINGS WITH FOUNDATION LOADS IN EXCESS OF THOSE EQUAL TO THREE STORY DWELLINGS. NO SPECIFIC BEARING STRENGTH IS ESTIMATED OR IMPLIED.

DWELLINGS - WITHOUT BASEMENTS:
THE SAME QUALIFICATIONS AS GIVEN ABOVE FOR DWELLINGS WITH BASEMENTS APPLY HERE EXCEPT THAT SEASONAL HIGH WATER TABLES ARE NOT AS RESTRICTIVE.

WASTE DISPOSAL - SEPTIC TANK ABSORPTION FIELDS:
RATINGS ARE FOR SMALL, SUB-SURFACE TILE ABSORPTION FIELDS AND DO NOT INCLUDE ALTERNATIVE SYSTEMS.

WASTE DISPOSAL - SEWAGE LAGOONS:
RATINGS ARE FOR SMALL LAKES USED TO HOLD SEWAGE FOR THE TIME REQUIRED FOR BACTERIAL ACTION.

LOCAL ROADS, STREETS, & PARKING AREAS:
RATINGS ARE FOR IMPROVED ROADS AND STREETS HAVING SOME KIND OF ALL-WEATHER SURFACING, COMMONLY ASPHALT OR CONCRETE, AND ARE EXPECTED TO CARRY AUTOMOBILE TRAFFIC ALL YEAR.

SUITABILITY AS A SOURCE OF:
SAND - THIS COLUMN PROVIDES GUIDANCE ABOUT WHERE TO LOOK FOR SAND. SOIL RATED "GOOD" CONTAINS A SOURCE OF CLEAN SAND. "FAIR" INDICATES SAND WITH SOME FINE MATERIAL. "POOR" INDICATES SAND WITH FINE MATERIAL COSTLY TO REMOVE. UNSUITED INDICATES SAND IS NOT AVAILABLE.
GRAVEL - THE PURPOSE OF THIS COLUMN IS TO PROVIDE GUIDANCE ABOUT WHERE TO LOOK FOR GRAVEL. THE EXPLANATION OF THE RATINGS FOR "SAND" (ABOVE) APPLY ALSO TO "GRAVEL".
ROADFILL - REFERS TO SOIL MATERIAL MOVED FROM ITS ORIGINAL LOCATION AND USED IN ROAD CONSTRUCTION. GENERALLY IT SERVES AS THE SUBGRADE OR FOUNDATION FOR THE ROAD. THE WHOLE SOIL, TO A DEPTH OF 6 FEET, IS GIVEN ONE RATING, ASSUMING IT WILL BE MIXED IN HANDLING.

RECREATION - CAMP AND PICNIC AREAS:
RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR TENTS AND SMALL CAMP TRAILERS AND THE ACCOMPANYING ACTIVITIES OF OUTDOOR LIVING AND FOR PARK-TYPE PICNIC AREAS.

RECREATION - PLAYGROUNDS AND ATHLETIC FIELDS:
RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR PLAYGROUNDS FOR BASEBALL, FOOTBALL, VOLLEYBALL, AND OTHER SIMILAR ORGANIZED GAMES. THESE AREAS ARE SUBJECT TO INTENSIVE FOOT TRAFFIC.

INTENSIVE CROPPING:
THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS TO PRODUCE SUSTAINED CORN YIELDS UNDER HIGH LEVELS OF MANAGEMENT.

WOODLAND PRODUCTIVITY:
THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS FOR THEIR PRIMARY ADAPTED SPECIES.

GENERAL SOIL MAP

THE GENERAL SOIL MAP OF THE ELKHART RIVER BASIN IN INDIANA SHOWS 11 MAIN PATTERNS OF SOILS CALLED SOIL ASSOCIATIONS. EACH ASSOCIATION CONTAINS A FEW MAJOR SOILS AND SEVERAL MINOR SOILS, AND IS NAMED FOR THE MAJOR SOILS. THE SOILS IN ONE ASSOCIATION MAY BE IN ANOTHER, BUT IN A DIFFERENT PATTERN.

THE GENERAL SOIL MAP IS USEFUL TO PEOPLE WHO WANT A GENERAL IDEA OF THE SOILS, WHO WANT TO COMPARE DIFFERENT PARTS OF THE RIVER BASIN OR WHO WANT TO KNOW THE LOCATION OF LARGE TRACTS THAT ARE SUITABLE FOR A CERTAIN KIND OF FARM OR NON-FARM LAND USE. SUCH A MAP IS NOT SUITABLE FOR PLANNING THE MANAGEMENT OF A FARM OR FIELD, OR FOR SELECTING THE EXACT LOCATION OF A ROAD, BUILDING OR SIMILAR STRUCTURE BECAUSE THE SOILS IN ANY ONE ASSOCIATION USUALLY DIFFER IN SLOPE, DEPTH, DRAINAGE, OR OTHER CHARACTERISTICS THAT AFFECT MANAGEMENT.

DETAILED SOIL MAPS AND INFORMATION ON SOILS AND SPECIFIC USES IS AVAILABLE FOR MUCH OF THE AREA ENCOMPASSED BY THE ELKHART RIVER BASIN. FOR THIS DETAILED INFORMATION, PLEASE CONTACT THE FIELD OFFICE OF THE SOIL CONSERVATION SERVICE IN THE INDIVIDUAL COUNTIES CONCERNED.

SOIL INTERPRETATIONS

THE INTERPRETIVE TABLE TO THE LEFT, ENTITLED "ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES", PROVIDES SOIL INTERPRETATIONS FOR 12 SPECIFIC USES FOR EACH OF THE 11 SOIL ASSOCIATIONS SHOWN ON THE GENERAL SOIL MAP OF THE ELKHART RIVER BASIN. THE APPROXIMATE PERCENT OF THE ASSOCIATION OF EACH MAJOR SOIL AND THE TOTAL PERCENT OF ALL OF THE MINOR SOILS IS GIVEN. ESTIMATED LIMITATIONS OR SUITABILITY FOR EACH OF THE MAJOR SOILS FOR EACH OF THE 12 USES IS GIVEN IN TERMS OF SLIGHT, MODERATE, OR SEVERE LIMITATIONS OR GOOD, FAIR, POOR OR UNSUITED SUITABILITY. BESIDE EACH OF THE RATINGS THE LIMITING SOIL PROPERTIES OR FEATURES ARE GIVEN BY LISTING ONE OR MORE NUMBERS. THESE NUMBERS CORRESPOND WITH THOSE LISTED IN THE "KEY TO PRINCIPAL SOIL LIMITATIONS", AT THE BOTTOM OF THE TABLE. SOILS RATED AS SLIGHT ARE ESTIMATED TO HAVE NO PRINCIPAL SOIL LIMITATIONS AND ARE NOT REFERENCED TO THE KEY.

SOIL LIMITATION CLASSES

SOILS RATED AS "SLIGHT" HAVE FEW OR NO LIMITATIONS FOR THE USE. SOILS RATED AS "MODERATE" HAVE LIMITATIONS WHICH REDUCE TO SOME DEGREE THEIR DESIRABILITY WHEN USED FOR THE PURPOSE BEING CONSIDERED. THEY REQUIRE SOME CORRECTIVE MEASURES. SOILS RATED AS "SEVERE" HAVE UNFAVORABLE SOIL CHARACTERISTICS THAT SEVERELY RESTRICT THEIR USE AND DESIRABILITY FOR THE PURPOSE. A SEVERE RATING DOES NOT MEAN THE SOIL CANNOT BE USED FOR A SPECIFIC USE. IT DOES INDICATE PROBLEMS DURING OR AFTER APPLICATION OF THE USE, UNLESS SPECIAL DESIGN, ENGINEERING OR OTHER CORRECTIVE MEASURES ARE USED TO OVERCOME THE LIMITATIONS. COSTS ARE USUALLY GREATER THAN ON SOILS RATED SLIGHT OR MODERATE, AND MANY TIMES COSTS ARE PROHIBITIVE.

SOIL SUITABILITY RATING

"GOOD", "FAIR", "POOR" AND "UNSUITED" ARE TERMS USED TO RATE SOILS AS A SOURCE OF SAND, GRAVEL AND ROADFILL. SOILS RATED AS "GOOD" HAVE QUALITIES SUCH THAT THEY CAN BE CONSIDERED AS A SUITABLE RESOURCE MATERIAL. SOILS RATED "FAIR" HAVE SOME PROBLEMS IN THE MATERIAL THAT MAKE THEM LESS DESIRABLE. SOILS RATED AS "POOR" HAVE PROBLEMS THAT GREATLY LIMIT THEIR SUITABILITY AS A SOURCE. SOILS RATED AS "UNSUITED" ARE PHYSICALLY UNFIT, OR IT IS NOT PRACTICAL TO PROCESS THE MATERIAL.

WHERE USED FOR "INTENSIVE CROPPING", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING SUSTAINED CORN YIELDS OF 110 TO 155 BUSHELS OF CORN PER ACRE UNDER HIGH LEVELS OF MANAGEMENT. "FAIR" INDICATES SOILS THAT WILL PRODUCE 70 TO 110 BUSHELS OF CORN AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 70 BUSHELS OF CORN PER ACRE.

WHERE USED FOR "WOODLAND PRODUCTIVITY", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING GREATER THAN 335 BOARD FEET PER ACRE PER YEAR FOR ADAPTED TREE SPECIES. "FAIR" INDICATES SOILS THAT WILL PRODUCE 260 TO 335 BOARD FEET AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 260 BOARD FEET PER ACRE PER YEAR.

COLORS CIRCLES

THE COLORED CIRCLES SHOW THE PROPORTIONATE EXTENT, OR RELATIVE PERCENTAGE, OF THE LIMITATIONS OR SUITABILITY OF EACH SOIL ASSOCIATION AS A WHOLE FOR A SPECIFIED USE.

- INDICATES SLIGHT OR NO LIMITATIONS OR GOOD SUITABILITY
- INDICATES MODERATE LIMITATIONS OR FAIR SUITABILITY
- INDICATES SEVERE LIMITATIONS OR POOR SUITABILITY
- INDICATES THAT A PART OR ALL OF THE ASSOCIATION IS UNSUITED FOR THAT USE.
- MINOR SOILS, BECAUSE OF THEIR COMPLEXITY, WERE NOT RATED

KEY TO PRINCIPAL SOIL LIMITATIONS

1. EXCESSIVE SLOPE FOR INTENDED USE 2. SLOW PERMEABILITY 3. SEASONAL HIGH WATER TABLE 4. FLOOD HAZARD 5. POOR STABILITY 6. ADVERSE SOIL TEXTURE 7. EXCESSIVE PERMEABILITY

**ELKHART RIVER BASIN
INDIANA**

COMPREHENSIVE BASIN STUDY

SOIL INTERPRETATIONS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1975

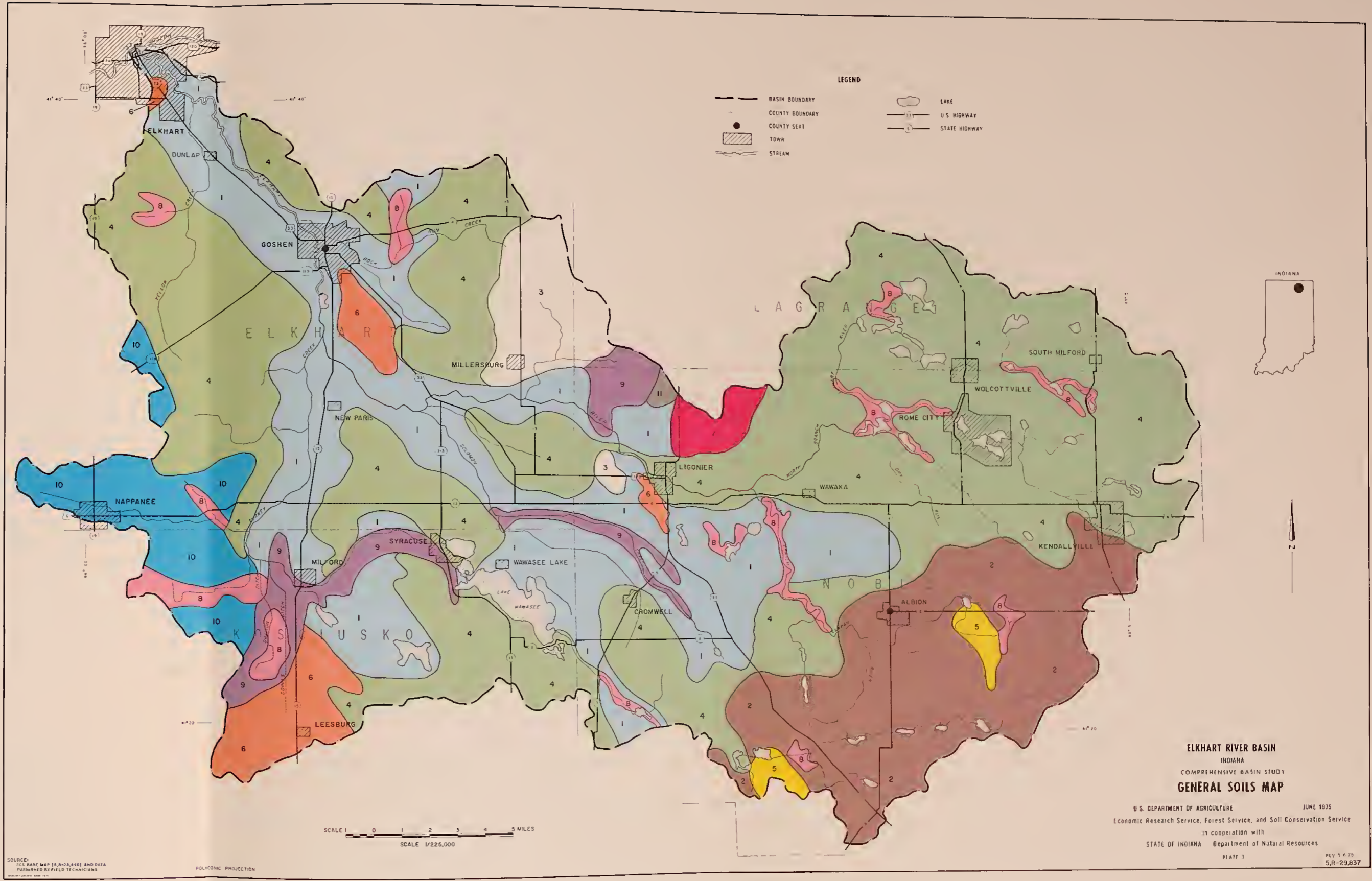
Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

STATE OF INDIANA - Department of Natural Resources

LEGEND

- 1 Oshtemo-Fox association: Nearly level and sloping, well drained, loamy soils formed in outwash sand and gravel.
- 2 Morley-Blount-Rawson association: Sloping, well drained, clayey Morley, nearly level, and somewhat poorly drained clayey Blount formed in glacial till and sloping, moderately well drained, loamy Rawson formed in outwash or lake-deposited sand and silt.
- 3 Blount-Haskins-Pewamo association: Nearly level, somewhat poorly drained, clayey Blount and very poorly drained, clayey Pewamo formed in glacial till and somewhat poorly drained, loamy Haskins formed in outwash or lake-deposited sand and silt.
- 4 Riddles-Miami-Fox-Crosby association: Sloping, well drained, loamy Riddles and Miami and nearly level, somewhat poorly drained, clayey Crosby formed in glacial till and sloping well drained loamy Fox formed in outwash sand and gravel.
- 5 Fulton-Bono-Rimer-Lenawee association: Nearly level, somewhat poorly drained, clayey Fulton and loamy over clayey Rimer and very poorly drained, clayey Bono and Lenawee all formed in lake deposits.
- 6 Volinia-Dickinson association: Nearly level, well drained, loamy soils formed in outwash sand and gravel.
- 7 Miami, gravelly substratum phase association: Nearly level and sloping, well drained, loamy over sandy soils formed in glacial till and the underlying outwash sand and gravel.
- 8 Carlisle-Linwood-Tawas-Edwards association: Nearly level, very poorly drained, organic soils formed in shallow to deep organic deposits.
- 9 Homer-Sebewa-Gilford association: Nearly level, somewhat poorly drained, loamy Homer and very poorly drained, loamy Sebewa and Gilford formed in outwash sand and gravel.
- 10 Brookston-Crosby association: Nearly level, very poorly drained, loamy Brookston and somewhat poorly drained, clayey Crosby formed in glacial till.
- 11 Warsaw-Elston association: Nearly level, well drained loamy soils formed in outwash sand and gravel.



SOURCE:
SCS BASIC MAP (S, R-29,636) AND DATA
FURNISHED BY FIELD TECHNICIANS

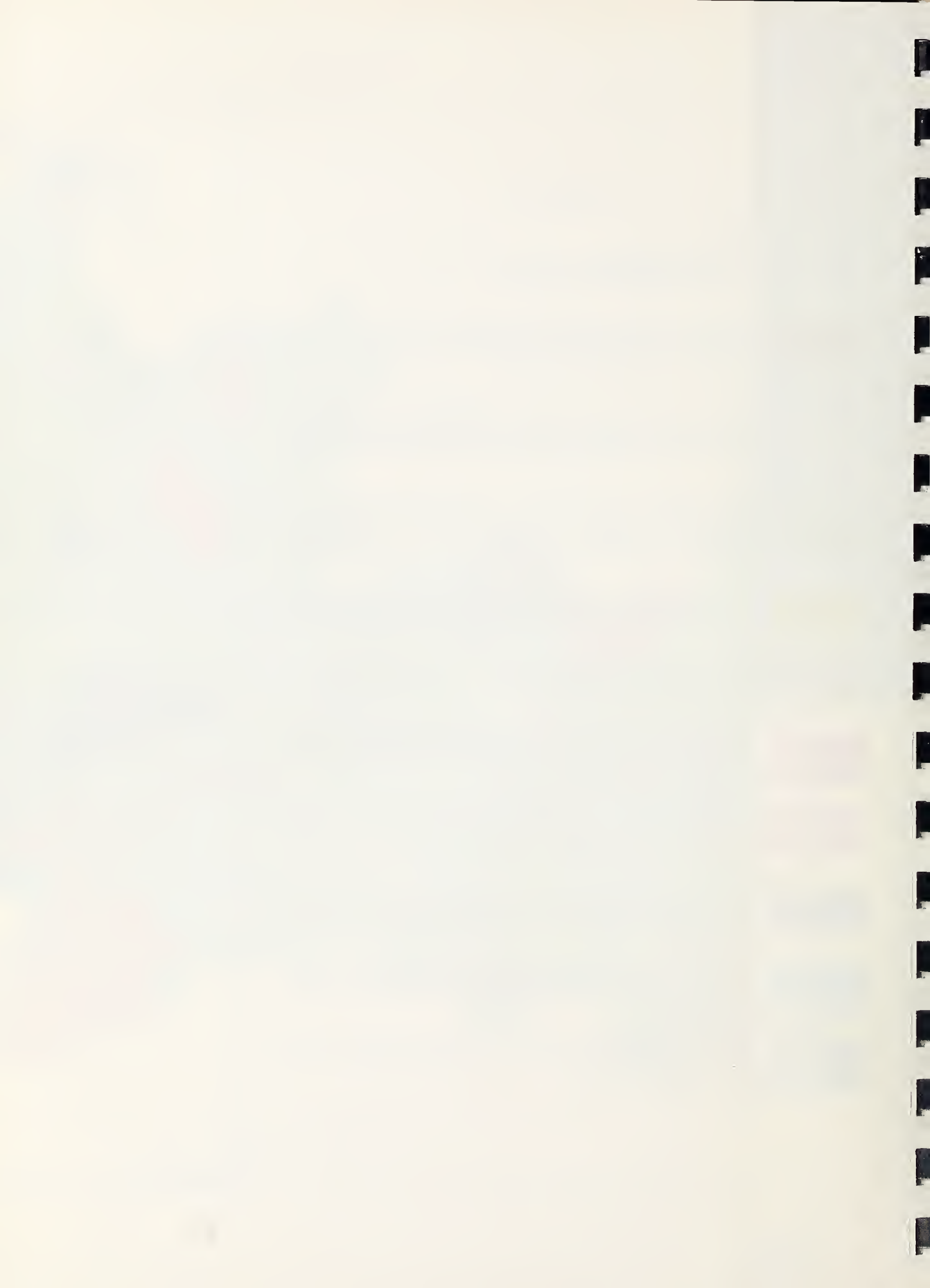
POLYCONIC PROJECTION

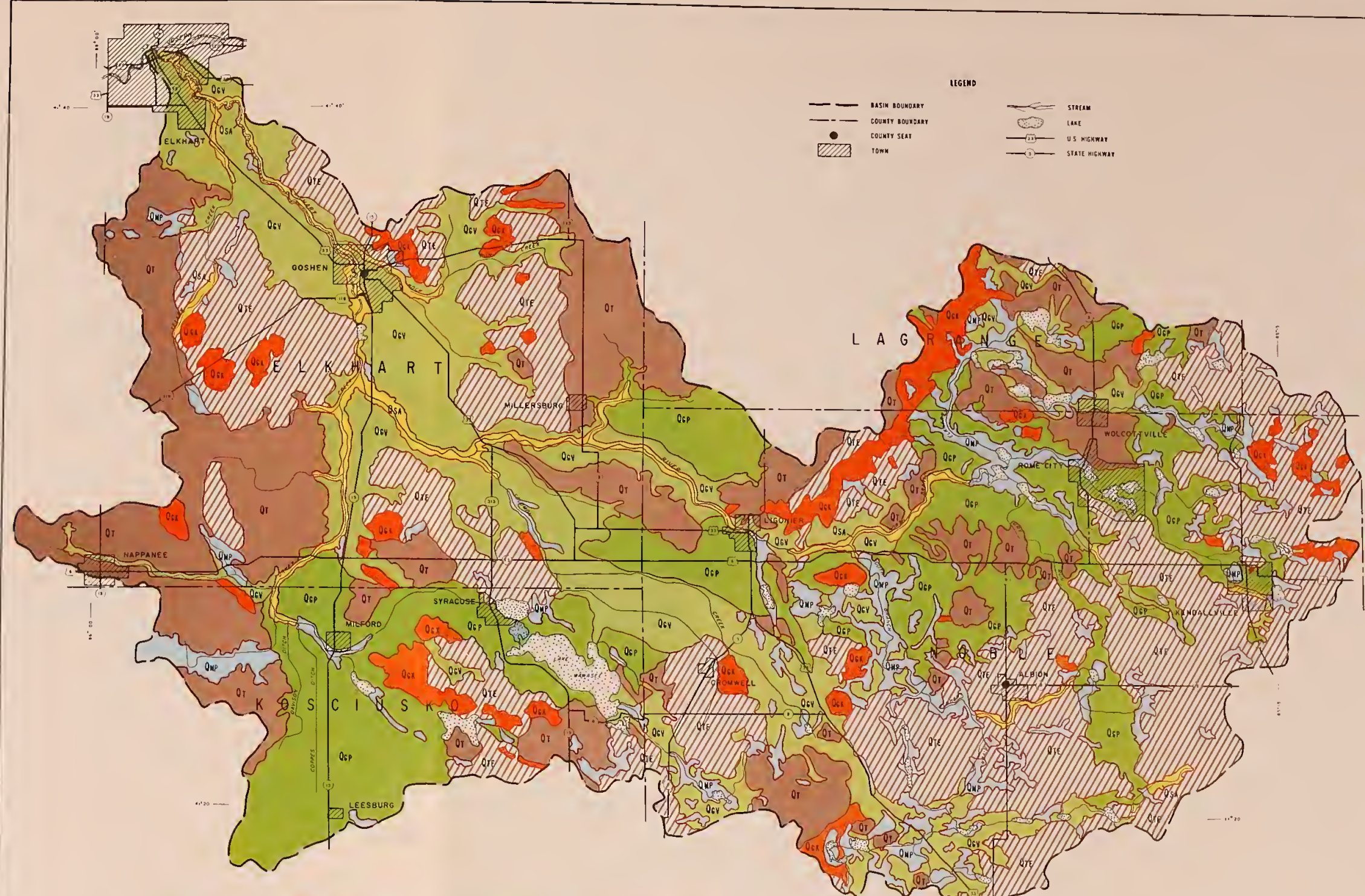
SCALE 1" = 5 MILES
SCALE 1/225,000

ELKHART RIVER BASIN
INDIANA
COMPREHENSIVE BASIN STUDY
GENERAL SOILS MAP

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA Department of Natural Resources

JUNE 1975
REV. 5-4-75
5R-29,637





- LEGEND**
- BASIN BOUNDARY
 - - - COUNTY BOUNDARY
 - COUNTY SEAT
 - ▨ TOWN
 - STREAM
 - LAKE
 - U.S. HIGHWAY
 - STATE HIGHWAY

EXPLANATION

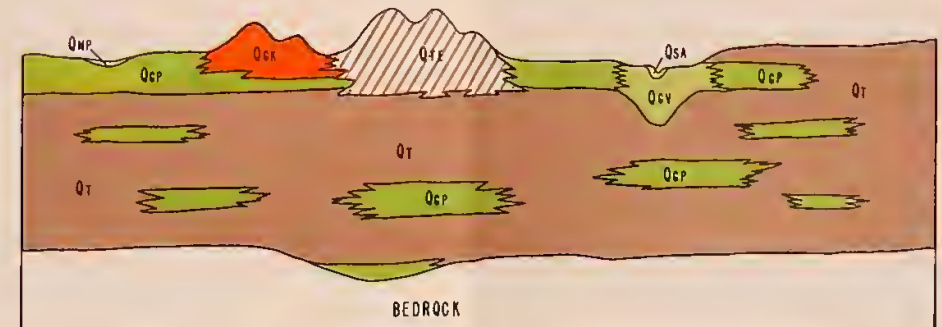
- QcV / QcP DUTWASH DEPOSITS OF SAND, GRAVEL, AND SILT. QcV, VALLEY-TRAIN DEPOSITS; QcP, OUTWASH-PLAIN DEPOSITS.
- QT / QTE GLACIAL TILL WITH SOME ICE-CONTACT STRATIFIED DRIFT. GROUND MORaine (QT) DEPOSITS ARE TOPOGRAPHICALLY LOWER THAN THE MORE HUMMOCKY OR RIDGELIKE END-MORaine (QTE) DEPOSITS
- QSA ALLUVIUM - RECENT STREAM DEPOSITS OF SILT, SAND, AND GRAVEL.
- QMP PALUDAL (MARSH) AND LACUSTRINE (LAKE) DEPOSITS - MUCK, PEAT, AND MARL (NUMEROUS SMALL AREAS NOT SHOWN).
- QcK ICE-CONTACT STRATIFIED GLACIAL DRIFT IN KAMES AND KAME MORAINES. MAINLY GRAVEL, SAND, AND SOME SILT.

NOTE: THE UNITS AND BOUNDARIES SHOWN HEREON HAVE BEEN GENERALIZED TO BETTER CONFORM TO THE PURPOSES AND SCALE OF THE MAP.

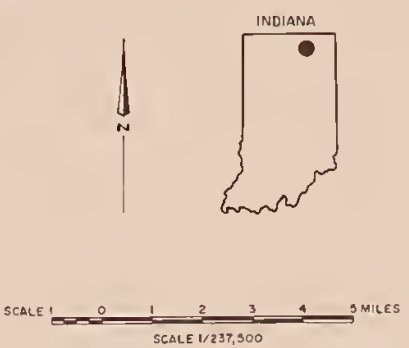
MAP MODIFIED FROM:

JOHNSON, G. H., AND KELLER, S. J., 1972, GEOLOGIC MAP OF THE 1° X 2° FT WAYNE QUADRANGLE, INDIANA, MICHIGAN, AND OHIO, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 8.

SCHNEIDER, A. F., AND KELLER, S. J., 1970, GEOLOGIC MAP OF THE 1° X 2° CHICAGO QUADRANGLE, INDIANA, ILLINOIS, AND MICHIGAN, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 4.



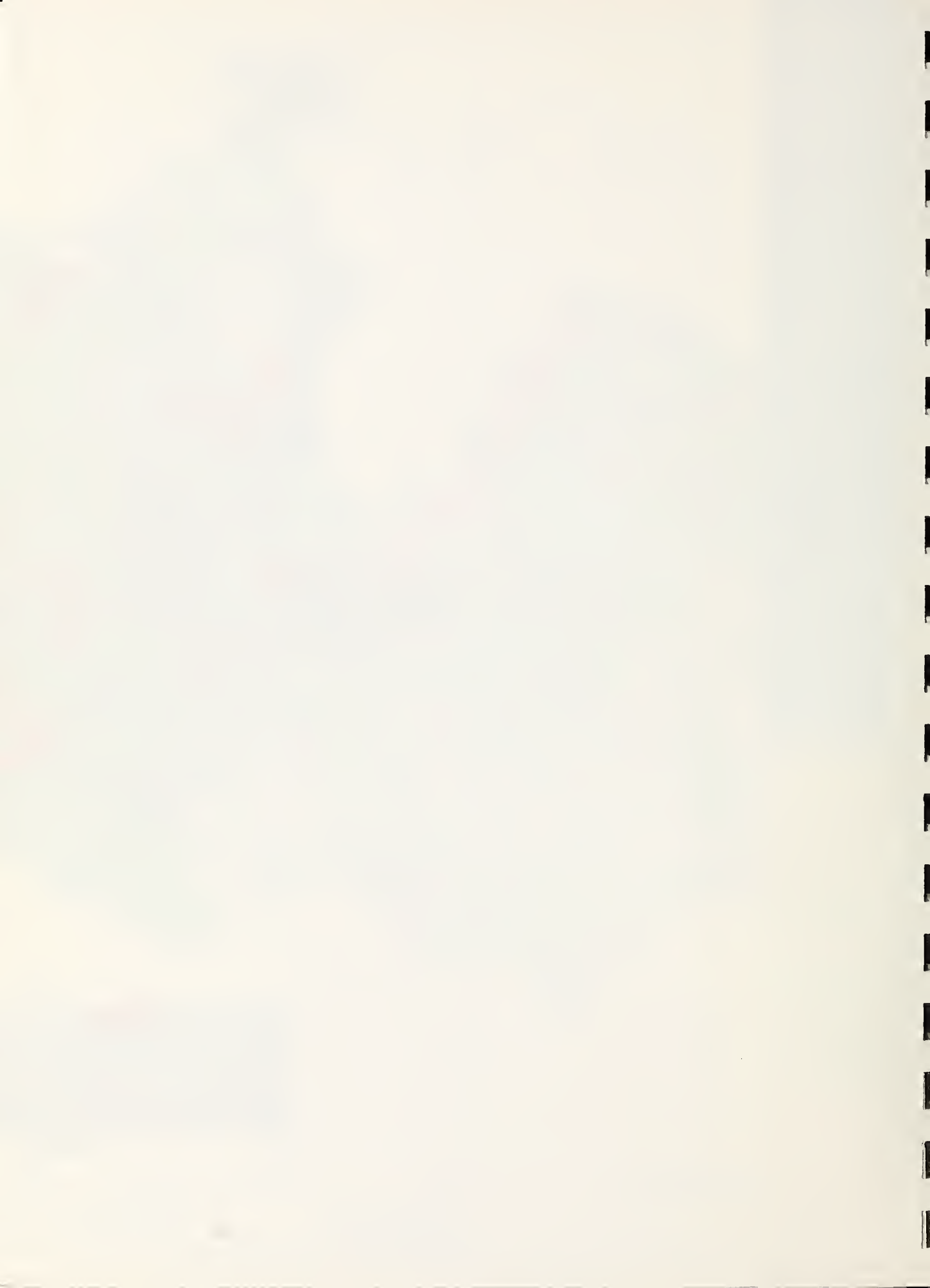
SCHMATIC SECTION SHOWING RELATIONSHIPS OF UNCONSOLIDATED DEPOSITS

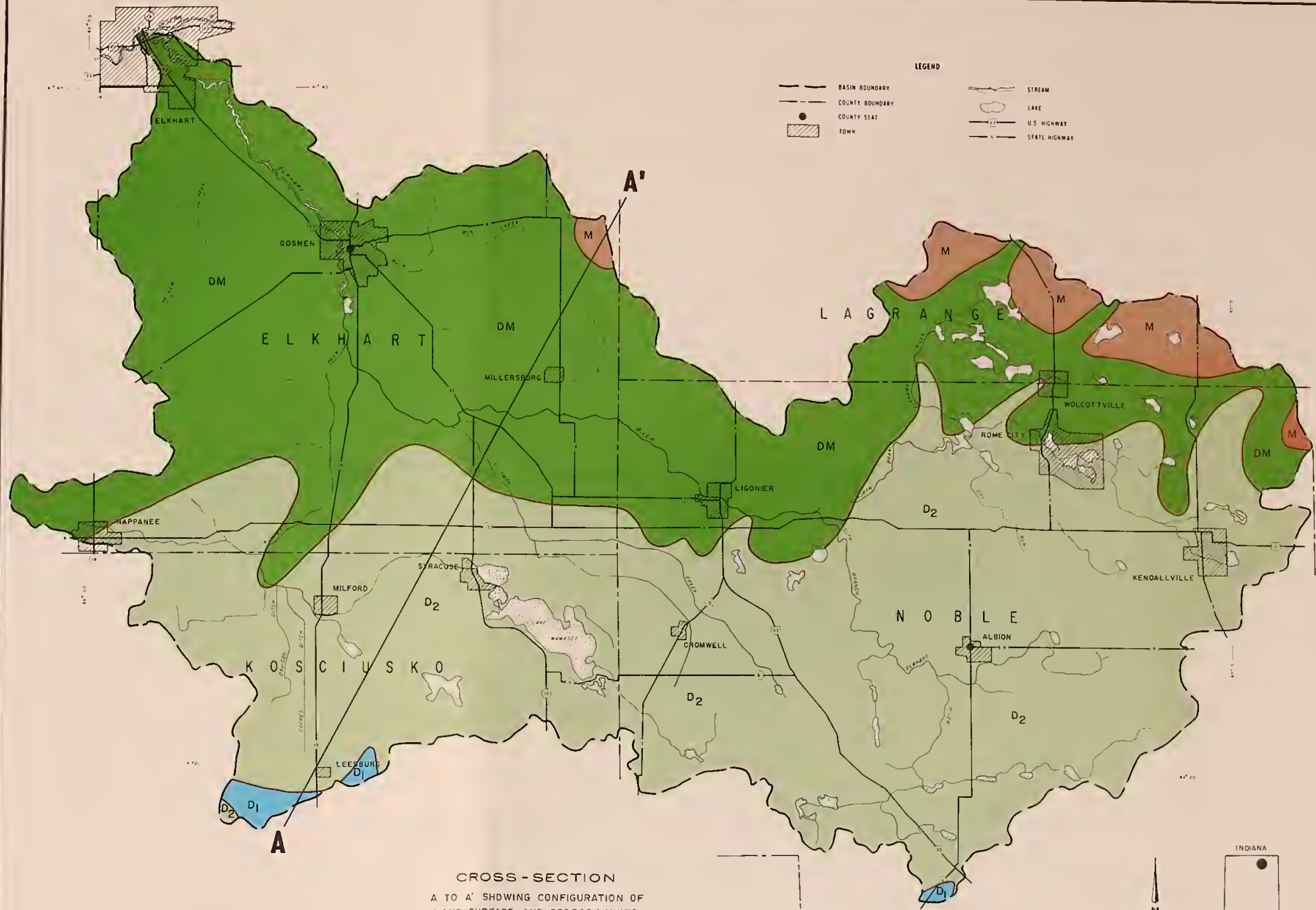


ELKHART RIVER BASIN
INDIANA
 COMPREHENSIVE BASIN STUDY
GENERALIZED SURFICIAL GEOLOGIC MAP
 U.S. DEPARTMENT OF AGRICULTURE JUNE 1975
 Economic Research Service, Forest Service, and Soil Conservation Service
 in cooperation with
 STATE OF INDIANA - Department of Natural Resources

SOURCE
 SCS DRAWING NUMBER S-R-28896-1
 AND INFORMATION FROM FIELD
 USDA SCS LINCOLN, NEBR. 1975

POLYCONIC PROJECTION





LEGEND

- - - BASIN BOUNDARY
 - - - COUNTY BOUNDARY
 • COUNTY SEAT
 ▨ TOWN

~~~~~ STREAM  
 ○ LAKE  
 - - - U.S. HIGHWAY  
 - - - STATE HIGHWAY

**EXPLANATION**

MISSISSIPPIAN

M  
COLDWATER SHALE  
MOSTLY GRAY SHALE

DEVONIAN AND MISSISSIPPIAN

DM  
SUNBURY AND ELLSWORTH SHALES  
GREEN SHALE WITH BLACK SHALE IN THE UPPER AND LOWER PARTS

DEVONIAN

D<sub>2</sub>  
ANTRIM SHALE  
BLACK SHALE WITH GRAY SHALE AND LIMESTONE IN THE LOWER PARTS

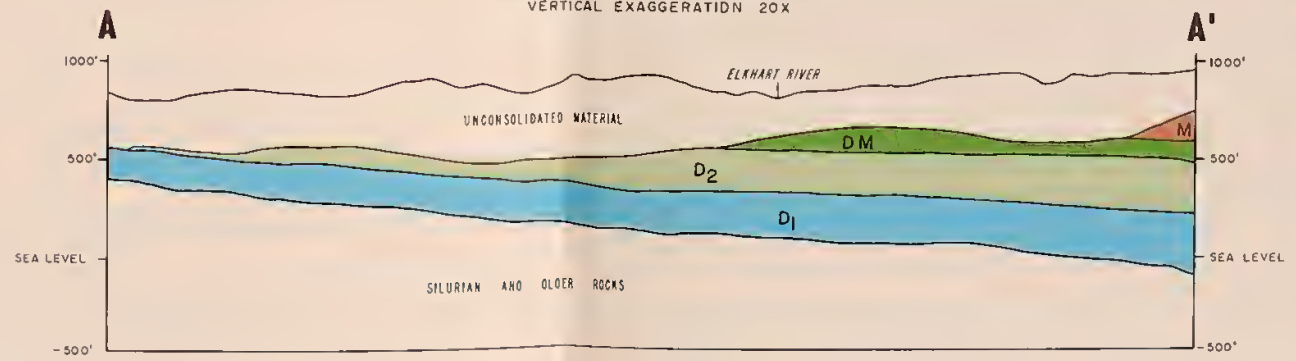
D<sub>1</sub>  
TRAVERSE AND DETROIT RIVER FORMATIONS  
MOSTLY LIMESTONE AND DOLOMITE

GEOLOGY MODIFIED BY THE INDIANA GEOLOGICAL SURVEY FROM:

JOHNSON, G. H., AND KELLER, S. J., 1972, GEOLOGIC MAP OF THE 1° X 2° FT. WAYNE QUADRANGLE, INDIANA, MICHIGAN, AND OHIO, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 8

SCHNEIDER, A. F., AND KELLER, S. J., 1970, GEOLOGIC MAP OF THE 1° X 2° CHICAGO QUADRANGLE, INDIANA, ILLINOIS, AND MICHIGAN, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 4.

**CROSS-SECTION**  
 A TO A' SHOWING CONFIGURATION OF  
 LAND SURFACE AND BEDROCK UNITS  
 VERTICAL EXAGGERATION 20X



SCALE 1 0 1 2 3 4 5 MILES  
 SCALE 1/250,000

POLYCONIC PROJECTION

**ELKHART RIVER BASIN**  
 INDIANA  
 COMPREHENSIVE BASIN STUDY  
**BEDROCK GEOLOGY MAP**

U.S. DEPARTMENT OF AGRICULTURE JUNE 1975  
 Economic Research Service, Forest Service, and Soil Conservation Service  
 in cooperation with  
 STATE OF INDIANA · Department of Natural Resources

SOURCE  
 SCS DRAWING 5-R-26896 2  
 & INFORMATION FROM FIELD  
 USDA SCS LINCOLN, NEB. 1975

PLATE 5

REV 5-6-75  
 5,S-32,046





- LEGEND**
- BASIN BOUNDARY
  - - - COUNTY BOUNDARY
  - COUNTY SEAT
  - ▨ TOWN
  - ~ STREAM
  - LAKE
  - 33 — U.S. HIGHWAY
  - 15 — STATE HIGHWAY
  - RAILROAD
  - ▲ STREAM GAGE
- WEATHER STATIONS**
- PRECIPITATION ONLY, NONRECORDING
  - PRECIPITATION AND TEMPERATURE, NONRECORDING
  - PRECIPITATION AND TEMPERATURE, RECORDING AND NONRECORDING
  - PRECIPITATION, TEMPERATURE, EVAPORATION, NONRECORDING

**ELKHART RIVER BASIN**  
 INDIANA  
 COMPREHENSIVE BASIN STUDY  
**HYDROLOGIC DATA NETWORK**

U.S. DEPARTMENT OF AGRICULTURE      JUNE 1975  
 Economic Research Service, Forest Service, and Soil Conservation Service  
 in cooperation with  
 STATE OF INDIANA - Department of Natural Resources

SCALE 1/200,000  
 0 1 2 3 4 5 MILES

SOURCE  
 SCS DRAWING S,R-28,896 AND INFORMATION  
 FROM FIELD TECHNICIANS POLYGONIC PROJECTION



# EXPLANATION

## AREA IN WHICH YIELDS OVER 500 GALLONS PER MINUTE CAN BE DEVELOPED

WATER SUPPLIES IN THIS SECTION ARE OBTAINED PRIMARILY FROM WELLS COMPLETED IN DEPOSITS OF OUTWASH SAND AND GRAVEL ASSOCIATED WITH THE MAIN TRIBUTARY AND STREAM VALLEYS. THE WELLS ARE GENERALLY OF SHALLOW DEPTH (20 TO 50 FEET), EXCEPT WHERE MUNICIPAL AND INDUSTRIAL WELLS PENETRATE THE SURFACE OUTWASH DEPOSITS TO OBTAIN WATER FROM THE DEEPER BURIED SAND AND GRAVEL AQUIFERS. THE UPPER SAND AND GRAVEL AQUIFER IS USUALLY SEPARATED FROM THE DEEPER SAND AND GRAVEL ZONES BY A THICK GLACIAL TILL (CLAY HARD-PAN) DEPOSIT. WELLS IN THIS AREA RANGE IN YIELD FROM 5-1500 GALLONS PER MINUTE (GPM), WITH SEVERAL IRRIGATION AND MUNICIPAL WELLS HAVING RECORDED YIELDS OF 500-1000 GPM EACH. WELLS IN THE AREA VARY IN DEPTH FROM 20 TO OVER 175 FEET.

## AREAS IN WHICH WELL YIELDS UP TO 500 GALLONS PER MINUTE CAN BE DEVELOPED

WELLS IN THIS AREA GENERALLY ARE OF MODERATE DEPTH (40 TO 125 FEET), OBTAINING WATER FROM DEPOSITS OF SAND AND GRAVEL OCCURRING AT OR NEAR THE LAND SURFACE AND FROM SAND AND GRAVEL AQUIFERS WITHIN AND BELOW THE DEEPER DEPOSITS OF GLACIAL TILL OR LAKE-BED DEPOSITS. OUTWASH-PLAIN DEPOSITS OF SAND AND GRAVEL, LAKE-BED DEPOSITS AND CLAY BEGS PREDOMINATE IN THE AREA. WELL SUPPLIES IN THESE SECTIONS ARE GENERALLY OF GOOD CAPABILITY WITH INDIVIDUAL WELL YIELDS RANGING UP TO 1000 GPM.

THICK DEPOSITS OF DRY SAND AND GRAVEL ARE FOUND NEAR THE SURFACE UNDER MUCH OF THE AREA. WATER LEVELS ARE GENERALLY DEEPER THAN IN OTHER PARTS OF THE BASIN, AND WATER SUPPLIES ARE OBTAINED FROM THE LOWER PORTION OF THE SURFACE SAND AND GRAVEL AND FROM DEEPER SAND AND GRAVEL AQUIFERS WITHIN AND BELOW THE THICK GLACIAL TILL SEQUENCE WHICH GENERALLY UNDERLIES THE AREA. WELL DEPTHS IN THIS SECTION GENERALLY RANGE FROM 50 TO 175 FEET. MAXIMUM WELL YIELDS RANGE UP TO 500 GPM.

WELL SUPPLIES IN THIS AREA ARE OBTAINED PRIMARILY FROM INTER-TILL AND DEEPLY BURIED SAND AND GRAVEL AQUIFERS. LOCALLY SOME THICK SAND UNITS ARE PRESENT THAT MAY OFFER INCREASED POTENTIAL FOR LARGER VOLUMES OF WATER; HOWEVER, MUCH OF THE AREA IS UNDERLAIN BY THICK GLACIAL TILL DEPOSITS AND WELL YIELDS MAY BE LIMITED. WELL DEPTHS RANGE FROM LESS THAN 30 TO OVER 200 FEET. WELLS SUPPLYING UP TO 500 GPM HAVE BEEN NOTED AND LARGER YIELDS ARE POSSIBLE IN SOME AREAS.

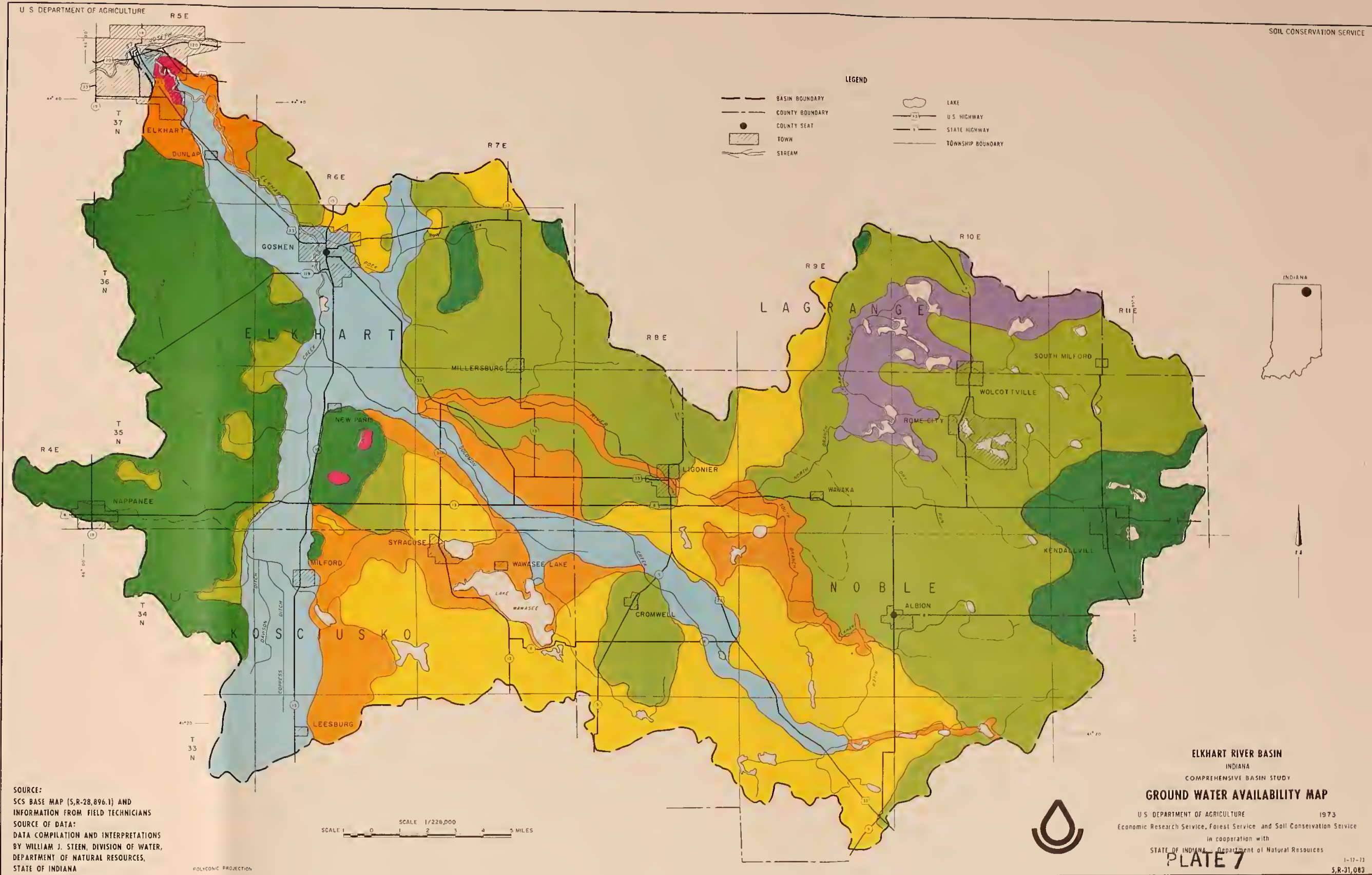
MUCK, MARL, AND LOCALLY THICK SAND DEPOSITS OCCUR NEAR THE SURFACE IN THIS AREA AND OVERLIE A THICK GLACIAL TILL SEQUENCE CONTAINING UNITS OF SAND AND GRAVEL. WELL DEPTHS ARE QUITE VARIABLE RANGING FROM LESS THAN 30 TO OVER 250 FEET. LOCALLY SOME WELLS PENETRATE 100 FEET OR MORE OF FINE SAND BEFORE ENCOUNTERING A SUFFICIENTLY COARSE SAND OR GRAVEL ZONE. MAXIMUM WELL YIELDS ARE NOT WELL-DEFINED BECAUSE OF INSUFFICIENT DATA.

## AREA IN WHICH WELL YIELDS UP TO 250 GALLONS PER MINUTE CAN BE DEVELOPED

GLACIAL TILL PLAIN AREA. THIN INTER-TILL SAND AND GRAVEL AQUIFERS PREDOMINATE IN THIS REGION. THE THICK GLACIAL TILL DEPOSITS WHICH UNDERLIE THE AREA CONTAIN SOME LOCALLY THICKER SAND DEPOSITS; HOWEVER, MOST WATER-BEARING ZONES ARE FIVE FEET IN THICKNESS OR LESS. OCCASIONAL DRY HILLS OR AREAS OF LIMITED SUPPLIES ARE NOTED. WELL DEPTHS ARE VARIABLE RANGING FROM 30 TO OVER 400 FEET. WELL YIELDS UP TO 600 GPM HAVE BEEN RECORDED, BUT YIELDS OF 250 GPM OR LESS CAN BE ANTICIPATED.

## AREA IN WHICH WELL YIELDS UP TO 50 GALLONS PER MINUTE CAN BE DEVELOPED

AREA OF LOCALLY LIMITED WATER SUPPLIES. THICK TILL DEPOSITS OCCUR BENEATH THE AREA WHICH CONTAIN LITTLE OR NO WATER-BEARING ZONES. IN THE VICINITY OF ELKHART, THIN OUTWASH SAND AND GRAVEL OVERLIES THE TILL DEPOSITS AND MAY OFFER SOME POSSIBILITIES FOR LIMITED WATER NEEDS. WELL DEPTHS VARY FROM 25 TO OVER 200 FEET.



SOURCE:  
SCS BASE MAP (S,R-28,896.1) AND  
INFORMATION FROM FIELD TECHNICIANS  
SOURCE OF DATA:  
DATA COMPILATION AND INTERPRETATIONS  
BY WILLIAM J. STEEN, DIVISION OF WATER,  
DEPARTMENT OF NATURAL RESOURCES,  
STATE OF INDIANA

SCALE 1" = 5 MILES  
SCALE 1/228,000



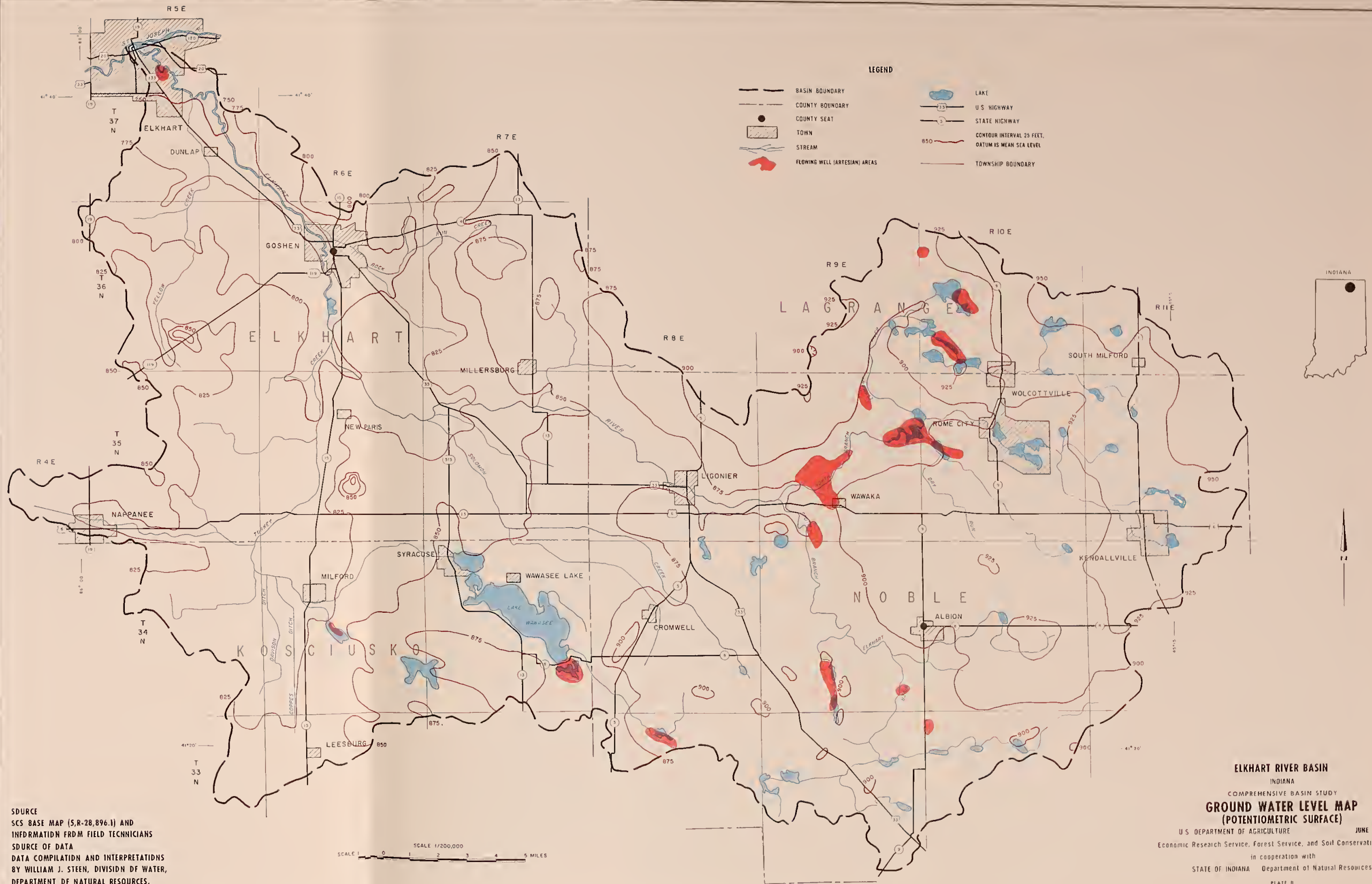
ELKHART RIVER BASIN  
INDIANA  
COMPREHENSIVE BASIN STUDY  
GROUND WATER AVAILABILITY MAP

U.S. DEPARTMENT OF AGRICULTURE 1973  
Economic Research Service, Forest Service and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA, Department of Natural Resources

PLATE 7

1-17-73  
S,R-31,083





SOURCE  
 SCS BASE MAP (S,R-28,896.1) AND  
 INFORMATION FROM FIELD TECHNICIANS  
 SOURCE OF DATA  
 DATA COMPILATION AND INTERPRETATIONS  
 BY WILLIAM J. STEEN, DIVISION OF WATER,  
 DEPARTMENT OF NATURAL RESOURCES,  
 STATE OF INDIANA POLYCONIC PROJECTION

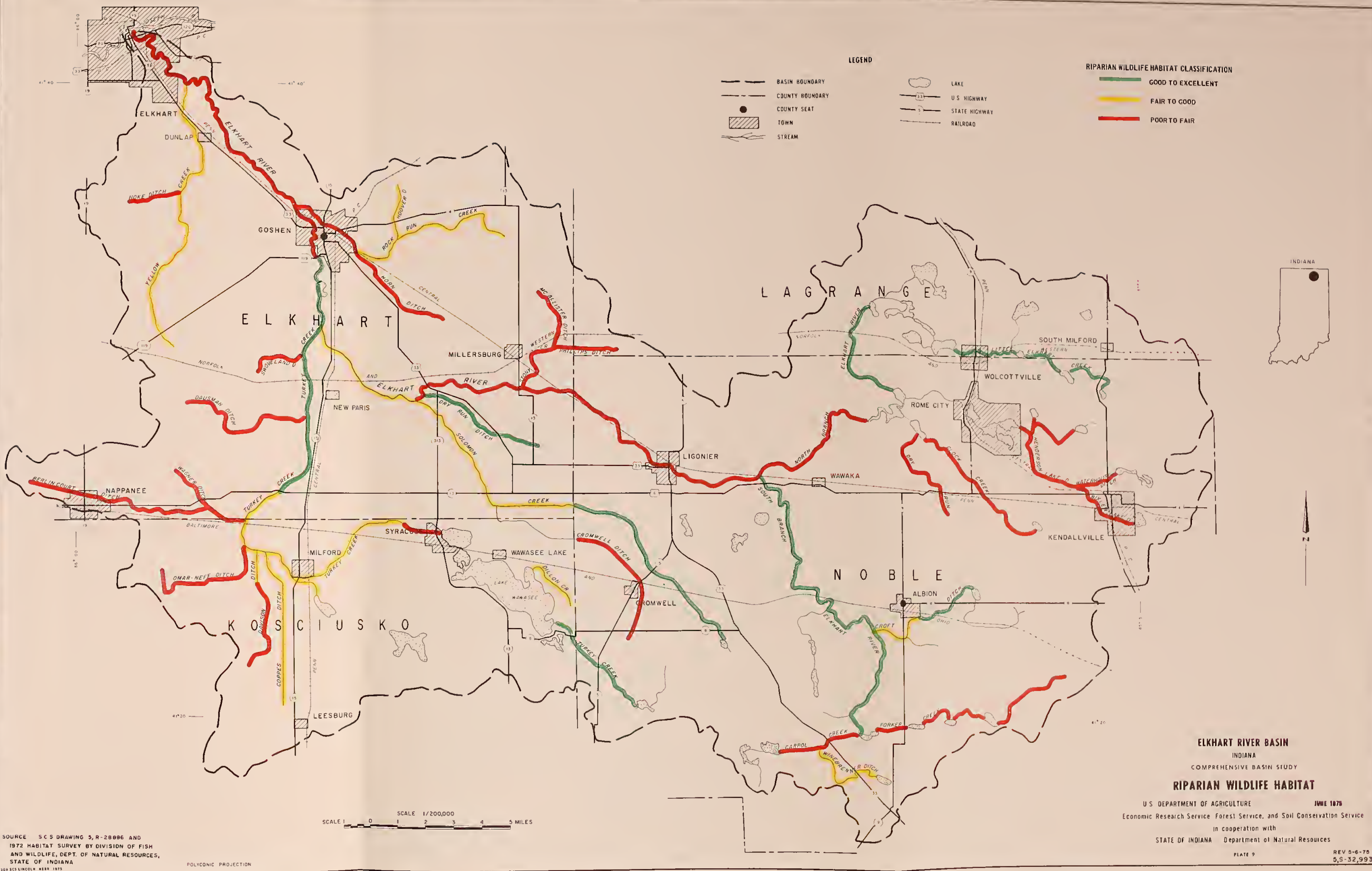
SCALE 1:200,000  
 SCALE 1 0 1 2 3 4 5 MILES

**ELKHART RIVER BASIN**  
 INDIANA  
 COMPREHENSIVE BASIN STUDY  
**GROUND WATER LEVEL MAP**  
 (POTENTIOMETRIC SURFACE)

U.S. DEPARTMENT OF AGRICULTURE JUNE 1975  
 Economic Research Service, Forest Service, and Soil Conservation Service  
 in cooperation with  
 STATE OF INDIANA Department of Natural Resources







**LEGEND**

- BASIN BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN
- STREAM
- LAKE
- U.S. HIGHWAY
- STATE HIGHWAY
- RAILROAD

**RIPARIAN WILDLIFE HABITAT CLASSIFICATION**

- GOOD TO EXCELLENT
- FAIR TO GOOD
- POOR TO FAIR

SOURCE SCS DRAWING 3, R-28986 AND 1972 HABITAT SURVEY BY DIVISION OF FISH AND WILDLIFE, DEPT. OF NATURAL RESOURCES, STATE OF INDIANA

POLYCONIC PROJECTION

SCALE 1/200,000  
SCALE 0 1 2 3 4 5 MILES

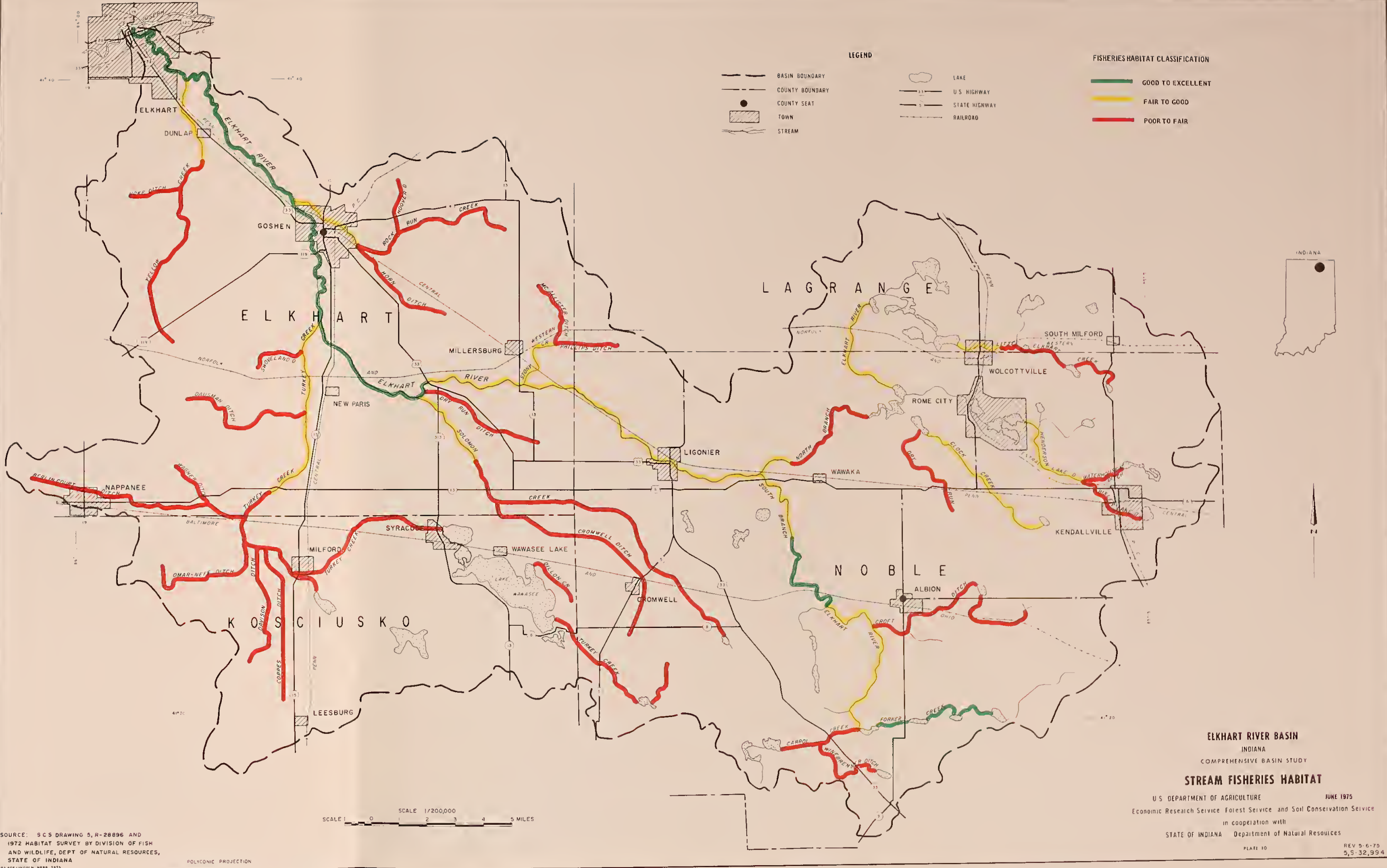
**ELKHART RIVER BASIN**  
INDIANA  
COMPREHENSIVE BASIN STUDY  
**RIPARIAN WILDLIFE HABITAT**

U.S. DEPARTMENT OF AGRICULTURE  
Economic Research Service, Forest Service, and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA, Department of Natural Resources

PLATE 9

REV 5-6-75  
5,9-32,993





**LEGEND**

- BASIN BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN
- STREAM
- LAKE
- U.S. HIGHWAY
- STATE HIGHWAY
- RAILROAD

**FISHERIES HABITAT CLASSIFICATION**

- GOOD TO EXCELLENT
- FAIR TO GOOD
- POOR TO FAIR

SOURCE: SCS DRAWING 5, R-28896 AND 1972 HABITAT SURVEY BY DIVISION OF FISH AND WILDLIFE, DEPT. OF NATURAL RESOURCES, STATE OF INDIANA

POLYCONIC PROJECTION

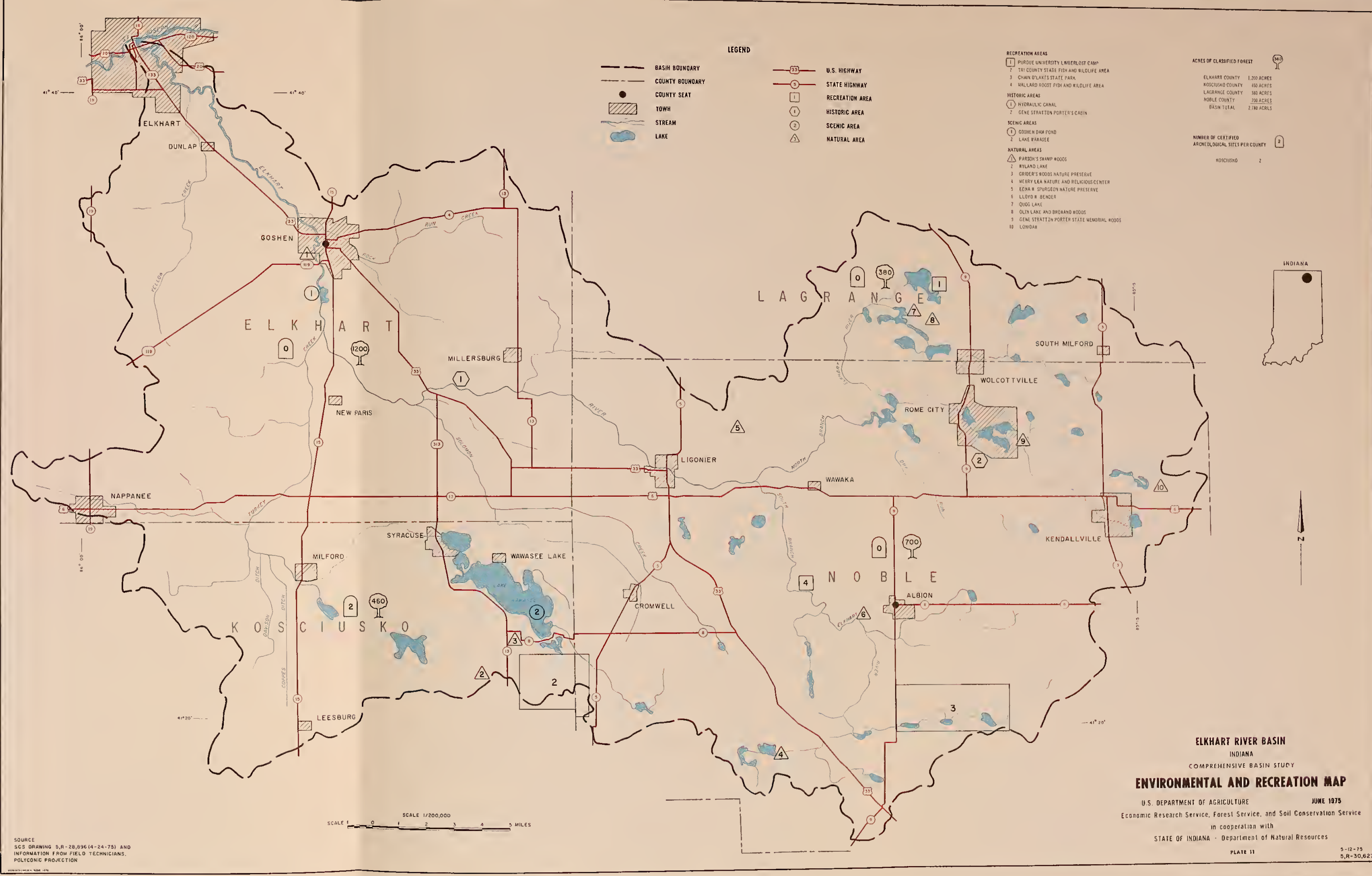
SCALE 1/200,000  
SCALE 0 1 2 3 4 5 MILES

**ELKHART RIVER BASIN**  
INDIANA  
COMPREHENSIVE BASIN STUDY  
**STREAM FISHERIES HABITAT**

U.S. DEPARTMENT OF AGRICULTURE  
Economic Research Service Forest Service and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA Department of Natural Resources

PLATE 10  
JUNE 1975  
REV 5-6-75  
5,5-32,994





**LEGEND**

- BASIN BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN
- STREAM
- LAKE
- U.S. HIGHWAY
- STATE HIGHWAY
- RECREATION AREA
- HISTORIC AREA
- SCENIC AREA
- NATURAL AREA

- RECREATION AREAS**
- 1 PURDUE UNIVERSITY LUMBERLOST CAMP
  - 2 TRI COUNTY STATE FISH AND WILDLIFE AREA
  - 3 CHAIN O'LAKES STATE PARK
  - 4 MALLARD ROOST FISH AND WILDLIFE AREA
- HISTORIC AREAS**
- 1 HYDRAULIC CANAL
  - 2 GENE STRATTON PORTER'S CABIN
- SCENIC AREAS**
- 1 GOSHEN DAM POND
  - 2 LAKE WAWASEE
- NATURAL AREAS**
- 1 PARSON'S SWAMP WOODS
  - 2 RYLAND LAKE
  - 3 GRIDER'S WOODS NATURE PRESERVE
  - 4 MERRY LEA NATURE AND RELIGIOUS CENTER
  - 5 EDNA W. SPURGEON NATURE PRESERVE
  - 6 LLOYD W. BENDER
  - 7 QUOG LAKE
  - 8 OLIN LAKE AND BRORAND WOODS
  - 9 GENE STRATTON PORTER STATE MEMORIAL WOODS
  - 10 LONIDAR

**ACRES OF CLASSIFIED FOREST**

|                    |                    |
|--------------------|--------------------|
| ELKHART COUNTY     | 1,200 ACRES        |
| KOSCIUSKO COUNTY   | 460 ACRES          |
| LAGRANGE COUNTY    | 380 ACRES          |
| NOBLE COUNTY       | 700 ACRES          |
| <b>Basin Total</b> | <b>2,740 ACRES</b> |

**NUMBER OF CERTIFIED ARCHEOLOGICAL SITES PER COUNTY**

|           |   |
|-----------|---|
| KOSCIUSKO | 2 |
|-----------|---|



SCALE 1/200,000  
SCALE 1 0 1 2 3 4 5 MILES

SOURCE  
SCS DRAWING 5,R-28,896(4-24-75) AND  
INFORMATION FROM FIELD TECHNICIANS.  
POLYCONIC PROJECTION

**ELKHART RIVER BASIN**  
INDIANA  
COMPREHENSIVE BASIN STUDY  
**ENVIRONMENTAL AND RECREATION MAP**  
U.S. DEPARTMENT OF AGRICULTURE  
Economic Research Service, Forest Service, and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA - Department of Natural Resources  
JUNE 1975  
PLATE 11





**LEGEND**

- BASIN BOUNDARY
- - - COUNTY BOUNDARY
- COUNTY SEAT
- ▨ TOWN
- ~ STREAM
- ◐ LAKE
- MAIN STEM ELKHART RIVER
- YELLOW CREEK
- ROCK RUN CREEK
- TURKEY CREEK
- SOLOMON CREEK
- NORTH BRANCH ELKHART RIVER
- SOUTH BRANCH ELKHART RIVER



**ELKHART RIVER BASIN**  
INDIANA  
COMPREHENSIVE BASIN STUDY  
**HYDROLOGIC SUBAREAS**

U.S. DEPARTMENT OF AGRICULTURE  
Economic Research Service, Forest Service, and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA Department of Natural Resources

JUNE 1975

PLATE 12

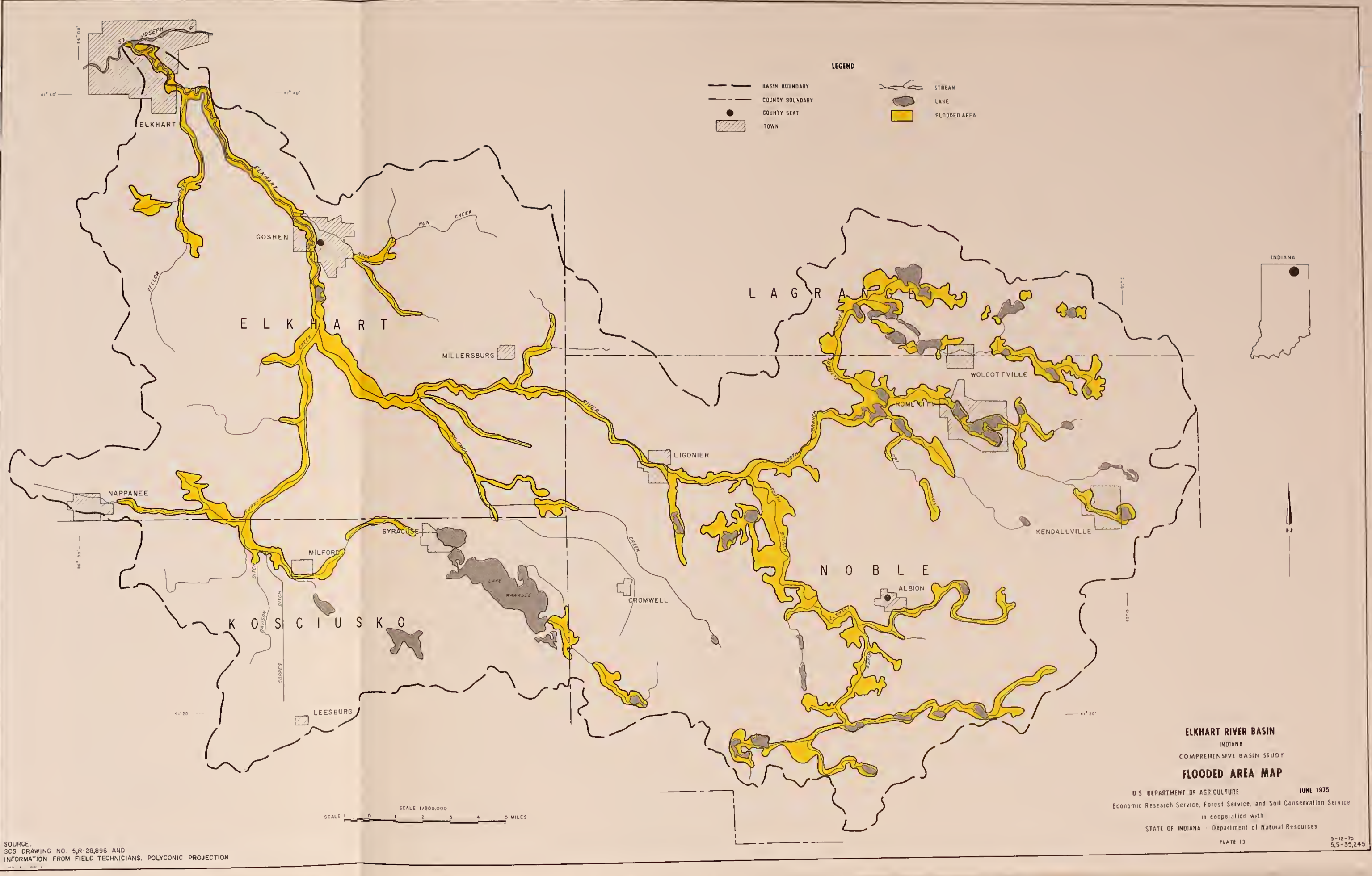
5-12-75  
5S-35,246

SOURCE: SCS DRAWING NO. 5-R-28,896 AND INFORMATION FROM FIELD TECHNICIANS. POLYCONIC PROJECTION

SCALE 1" = 200,000  
0 1 2 3 4 5 MILES







**LEGEND**

- BASIN BOUNDARY
- - - COUNTY BOUNDARY
- COUNTY SEAT
- ▨ TOWN
- STREAM
- LAKE
- FLOODED AREA

**ELKHART RIVER BASIN  
INDIANA  
COMPREHENSIVE BASIN STUDY  
FLOODED AREA MAP**

U.S. DEPARTMENT OF AGRICULTURE  
Economic Research Service, Forest Service, and Soil Conservation Service  
in cooperation with  
STATE OF INDIANA - Department of Natural Resources

JUNE 1975

PLATE 13

5-12-75  
5,5-35,245

SOURCE:  
SCS DRAWING NO. 5,R-28,896 AND  
INFORMATION FROM FIELD TECHNICIANS. POLYCONIC PROJECTION

SCALE 1" = 200,000'  
0 1 2 3 4 5 MILES





