THE NATION'S WATER RESOURCES 1975-2000

Volume 4: Upper Mississippi Region

Second National
Water Assessment
by the
U.S. Water Resources Council

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Foreword

The Water Resources Planning Act of 1965 (Public Law 89-80) directs the U.S. Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. In 1968, the Water Resources Council reported the results of its initial assessment. The Second National Water Assessment, a decade later, provides a comprehensive nationally consistent data base for the water resources of the United States. The results of the Second National Water Assessment were obtained by extensive coordination and collaboration in three phases.

Phase I: Nationwide Analysis

The Council member agencies researched, analyzed, and prepared estimates of current and projected water requirements and problems and the implications of the estimates for the future.

Phase II: Specific Problem Analysis

Regional sponsors, one for each of the 21 water resources regions, surveyed and analyzed State and regional viewpoints about (1) current and future water problems, (2) conflicts that may arise in meeting State and regional objectives, and (3) problems and conflicts needing resolution.

Phase III: National Problem Analysis

The Council conducted this final phase in three steps: (1) An evaluation of phases I and II, (2) an analysis that identified and evaluated the Nation's most serious water resources problems, and (3) the preparation of a final report entitled "The Nation's Water Resources--1975-2000."

The final report of the Second National Water Assessment consists of four separate volumes as described below. These volumes can assist Federal, State, local, and other program managers, the Administration, and the Congress in establishing and implementing water resources policies and programs.

Volume 1, Summary, gives an overview of the Nation's water supply, water use, and critical water problems for "1975," 1985, and 2000 and summarizes significant concerns.

Volume 2, Water Quantity, Quality, and Related Land Considerations, consists of one publication with five parts:

Part I, "Introduction," outlines the origin of the Second National Water Assessment, states its purpose and scope, explains the

numerous documents that are part of the assessment, and identifies the individuals and agencies that contributed to the assessment.

Part II, "Water-Management Problem Profiles," identifies ten general water problem issues and their implications and potential consequences.

Part III, "Water Uses," focuses on the national perspectives regarding existing ("1975") and projected (1985 and 2000) requirements for water to meet offstream, instream, and flow-management needs. State-regional and Federal perspectives are compared.

Part IV, "Water Supply and Water Quality Considerations," analyzes the adequacy of fresh-water supplies (ground and surface) to meet existing and future requirements. It contains a national water budget; quantifies surface- and ground-water supplies, reservoir storage, and transfers of water within and between subregions; describes regional requirements and compares them to supplies; evaluates water quality conditions; and discusses the legal and institutional aspects of water allocation.

Part V, "Synopses of the Water Resources Regions," covers existing conditions and future requirements for each of the 21 water resources regions. Within each regional synopsis is a discussion of functional and location-specific water-related problems; regional recommendations regarding planning, research, data, and institutional aspects of solving regional water-related problems; a problem-issue matrix; and a comparative-analysis table.

Volume 3, Analytical Data, describes the methods and procedures used to collect, analyze, and describe the data used in the assessment. National summary data are included with explanatory notes. Volume 3 is supplemented by five separately published appendixes that contain data for the regions and subregions:

Appendix I, Social, Economic, and Environmental Data, contains the socioeconomic baseline ("1975") and growth projections (1985 and 2000) on which the water-supply and water-use projections are based. This appendix presents two sets of data. One set, the National Future, represents the Federal viewpoint; the other set, the State-Regional Future, represents the regional sponsor and/or State viewpoint.

Appendix II, Annual Water Supply and Use Analysis, contains baseline water-supply data and baseline and projected water withdrawal and water-consumption data used for the assessment. Also included are a water adequacy analysis, a natural flow analysis, and a critical-month analysis.

Appendix III, Monthly Water Supply and Use Analysis, contains

monthly details of the water-supply, water-withdawal, and water-consumption data contained in Appendix II and includes an analysis of monthly water adequacy.

Appendix IV, Dry-Year Conditions Water Supply and Use Analysis, contains both annual and monthly baseline and projected water-withdrawal and water-consumption data for dry conditions. Also, a dry conditions water-adequacy analysis is included.

Appendix V, Streamflow Conditions, contains detailed background information on the derivation of the baseline streamflow information. A description of streamflow gages used, correction factors applied, periods of record, and extreme flows of record, are given for each subregion. Also included is the State-Regional Future estimate of average streamflow conditions.

Volume 4, Water Resources Regional Reports, consists of separately published reports for each of the 21 regions. Synopses of these reports are given in Volume 2, Part V.

For compiling and analyzing water resources data, the Nation has been divided into 21 major water resources regions and further subdivided into 106 subregions. Eighteen of the regions are within the conterminous United States; the other three are Alaska, Hawaii, and the Caribbean area.

The 21 water resources regions are hydrologic areas that have either the drainage area of a major river, such as the Missouri Region, or the combined drainage areas of a series of rivers, such as the South Atlantic-Gulf Region, which includes a number of southeastern States that have rivers draining directly into the Atlantic Ocean and the Gulf of Mexico.

The 106 subregions, which are smaller drainage areas, were used exclusively in the Second National Water Assessment as basic data-collection units. Subregion data point up problems that are primarily basinwide in nature. Data aggregated from the subregions portray both regional and national conditions, and also show the wide contrasts in both regional and national water sources and uses.

The Second National Water Assessment and its data base constitute a major step in the identification and definition of water resources problems by the many State, regional, and Federal institutions involved. However, much of the information in this assessment is general and broad in scope; thus, its application should be viewed in that context, particularly in the area of water quality. Further, the information reflects areas of deficiencies in availability and reliability of data. For these reasons, State, regional, and Federal planners should view the information as indicative, and not the only source to be considered. When policy decisions are to be made, the effects at State, regional, and local levels should be carefully considered.

In a national study it is difficult to reflect completely the regional variations within the national aggregation. For example, several regional

reviewers did not agree with the national projections made for their regions. These disagreements can be largely attributed either to different assumptions by the regional reviewers or to lack of representation of the national data at the regional level. Therefore, any regional or State resources-management planning effort should consider the State-regional reports developed during phase II and summarized in Volume 4 as well as the nationally consistent data base and the other information presented in this assessment.

Additional years of information and experience show that considerable change has occurred since the first assessment was prepared in 1968. The population has not grown at the rate anticipated, and the projections of future water requirements for this second assessment are considerably lower than those made for the first assessment. Also, greater awareness of environmental values, water quality, ground-water overdraft, limitations of available water supplies, and energy concerns are having a dramatic effect on water-resources management. Conservation, reuse, recycling, and weather modification are considerations toward making better use of, or expanding, available supplies.

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Description

The Upper Mississippi Region encompasses the drainage area of the Mississippi River upstream from the mouth of the Ohio River exclusive of the area drained by the Missouri River. Basically, this region extends in a north-south direction for about 700 miles from a point about 70 miles south of the Canadian Border to Cairo, Illinois, as shown in Figure 7-1. On an east-west basis, the region spans 500 miles reaching from near South Bend, Indiana, to Big Stone Lake, South Dakota.

The Mississippi River originates at Lake Itasca in northern Minnesota and flows southward toward the Gulf of Mexico following a winding course along a valley created by an earlier glacial stream. The region's total surface area equals approximately 180,670 square miles (about 115.6 million acres)[1] and includes parts of the following States: Illinois (about 23 percent of the region); Indiana (1 percent); Iowa (22 percent); Minnesota (25 percent); Missouri (8 percent); South Dakota (1 percent); and Wisconsin (20 percent). About 4,200 square miles (about 2.69 million acres) of this total area is water surface most of which is found in the numerous lakes and reservoirs located in Minnesota and Wisconsin. Total surface area in the region's reservoirs is slightly over 1,700 square miles (about 1.09 million acres). Cropland, pasturelands, and forests are important in the Upper Mississippi Region. Together, cropland and pastureland uses account for almost two-thirds of the regional surface area. Forests cover over one-fifth of the surface area (see Figure 7-2).

Geology

The geologic history of the Mississippi River above Cairo, Illinois, differs considerably from the portion below Cairo. Above Cairo, the river was greatly affected by Pleistocene glaciation which covered most of the region and resulted in the river's being shoved back and forth as the ice sheets moved from east to west and west to east. Consequently, glacial debris buried large parts of the river's former valley, forcing it to incise a new one in glacial deposits or drift ranging from a thin veneer to several hundred feet in thickness. Generally, most of the region's surface is covered with windblown silt as much as 300 feet thick in some locations.

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[1] This is the sum of the areas of counties used to approximate the hydrologic area of the region. Land-use and other socioeconomic data are related to this area. The drainage area within the hydrologic boundary is 190,170 square miles.

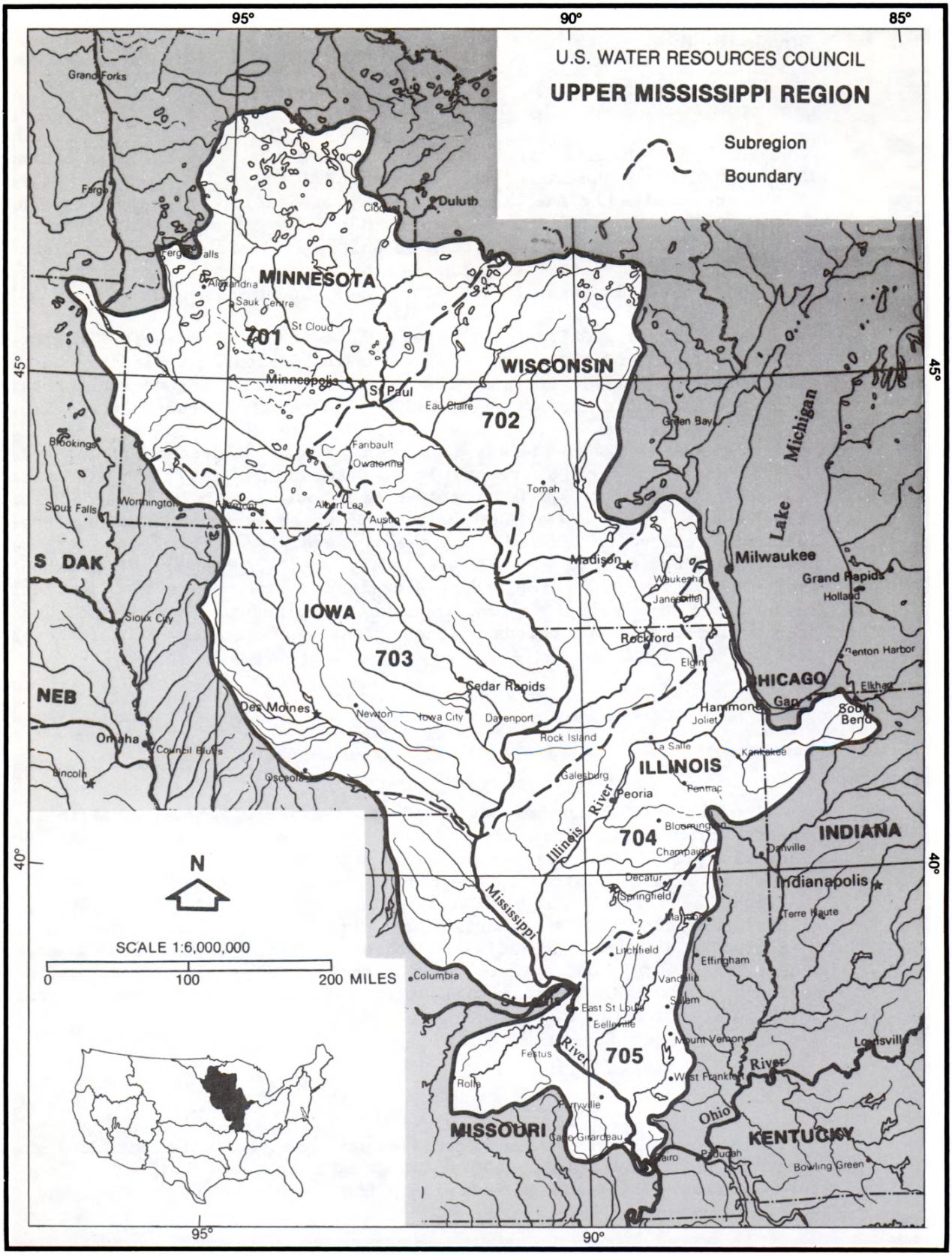

Figure 7-1. Region Map

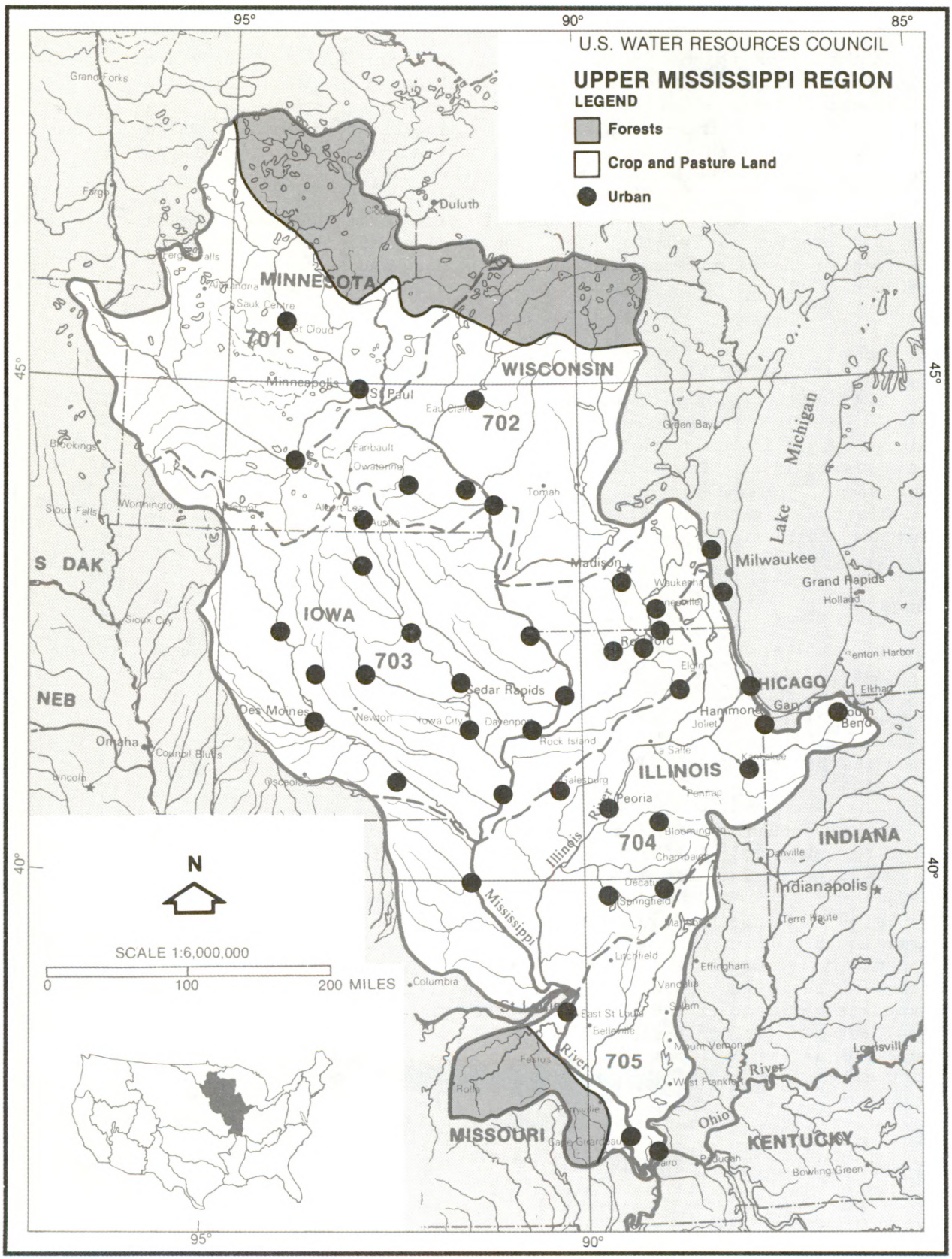

Figure 7-2. Present Land Use

In the northern part of this region, the Superior Upland is underlain by an igneous-metamorphic rock complex which is part of the Canadian Shield. These rocks are Precambrian in age and extend southward beneath the overlying rocks to the Ozark Plateau. Basically, these rocks form a basin in which a thick sequence of sediments, including sandstone, limestone, and shale, were deposited in the basin throughout Paleozoic time.

During subsequent Mesozoic and Cenozoic times, this area was above sea level and erosion was commonplace. Some sedimentation occurred during this time in the encroaching seas at the southern and western portion of the basin.

Topography

Most of this region's topography is the result of glaciation which has produced a gently rolling terrain with a progressively less well-developed drainage system to the north. Elevations range from about 300 to 2,100 feet above sea level. Thousands of lakes characterize this region's headwaters area. The southern part of this region and other areas not altered by glaciation are extensively dissected by streams, creating numerous escarpments and bluffs.

Climate

The climate within the Upper Mississippi Region is of the humid continental type. The average annual precipitation varies from 20 inches in the north to 48 inches in the south. In the southern part of the region, precipitation is about evenly distributed between summer and winter months. In the north, there is more precipitation during the growing season than in the winter. Periodic droughts and floods occur throughout the region.

Average annual temperatures range from 39°F in the northern part of the region to 59°F in the southern part. There is about a 3°F change per 100 miles of latitude. Winters are severe in the northern part, with subzero temperatures common. The average monthly temperature for July is 67°F in northern Minnesota and 80°F in southern Illinois; the average monthly January temperatures for the same areas are 5°F and 35°F, respectively. Frost-free periods vary from 90 days in the northeastern portion of the region to 210 days in the most southerly portions. The Great Lakes serve to extend the frost-free period in the area bordering them. Between the north-south extreme of the region lies the fertile area known as the Corn Belt. The frost-free period here is from 150 to 180 days.

People and the Resources

Basic to any identification of a region's problems and its critical water- and related land-resource needs is a comprehensive and coordinated analysis of the current and future resource uses as well as resource management and conservation activities. To facilitate the identification of problems, estimates of population, economic growth, water- and land-resource use, and other parameters were made for three time periods (1975, 1985, and 2000) as explained elsewhere in the national assessment report. These data were prepared at the national, regional, and subregional level of geographic detail and represent two viewpoints: National and State-regional. Subareas are county boundary approximations of one or more Water Resource subregions. As Figure 7-1 indicates, the Upper Mississippi Region is divided into five subregions. The national viewpoint, referred to as the National Future (NF), was prepared jointly by the U.S. Water Resources Council staff and Federal agencies represented on the Council's National Programs and Assessment Committee, whereas the State-regional viewpoint, referred to as the State-Regional Future (SRF), was prepared jointly by the Upper Mississippi River Basin Commission and its member agencies. A comparison of these two viewpoints and discussion, to the extent possible, of the basic differences between the two sets of data is included at the end of this section.

Population

Most of this region's residents are historically linked to rural families, communities, commerce, and social life. However, widespread migration from the rural areas to the cities has resulted in the urbanization of large areas of the region. The region's current (1975) population was estimated to be about 13.4 million (NF) of which 65 and 35 percent lived in urban and rural areas, respectively. The following is a breakdown of this region's population by State. These figures reflect data developed by State-regional sources.

State	Percent of population
Illinois	27
Indiana	-
Iowa	18
Minnesota	25
Missouri	17
South Dakota	-
Wisconsin	13

This region's major urban centers include the St. Louis (population, 2.4 million) and Minneapolis-St. Paul (population, 2.0 million) metropolitan areas. Together these two metropolitan areas comprise about one-third of the region's total population. Other large urban centers and their populations are as follows: Madison, Wisconsin (173,258); Cedar

Rapids (110,642), Des Moines (200,587), Waterloo (75,533), and Davenport (200,587), Iowa; and Rockford (147,370) and Peoria (126,963), Illinois.

The National Future projects a regional population of 15.8 million in the year 2000, an 18 percent increase over 1975. While the national projections for total population are quite comparable with the State-regional projections, the national projections assume that a smaller share of the region's total population will reside in the standard metropolitan statistical areas. By 2000, this difference is estimated at about 5 percent.

Economy

The economy of the Upper Mississippi Region is quite diversified and varies considerably from one location to another. In the far northern segments of the region in Minnesota and Wisconsin, mining and pulp and paper production are major industries. Agriculture and agriculture-related industries contribute heavily to the economy of much of the region, primarily southern Minnesota and Wisconsin as well as most of Iowa and Illinois. Coal and petroleum production are important industries in central and southern Illinois. The St. Louis and Minneapolis-St. Paul metropolitan areas are major U.S. centers for wholesale and retail trade, services, and diversified manufacturing. Manufacturing accounts for slightly over 28 percent of this region's earnings. Earnings in certain manufacturing sectors include: food and kindred products, $2.5 billion; paper and allied products, $900 million; and chemical and allied products, $800 million. Total manufacturing earnings were estimated by the NF to be $18,480 million in 1975. "Other" earnings shown in Table 7-1 represent almost 64 percent of the region's total 1975 earnings and include the following categories: wholesale and retail trade; government; service; transportation, communications, and public utilities; contract construction; and finance, insurance, and real estate. Selected earnings data in Table 7-1 are derived from National Future projections. Per capita income in this region is projected (NF) to increase from $6,218 in 1975 to $12,529 by 2000.

This region's total employment in 1975 was 5,615,000, of which approximately 70 percent was in the noncommodity-producing group and the remaining 30 percent was in the commodity-producing group. Within the commodity-producing group, approximately 80 percent of those employed were engaged in manufacturing, whereas the remainder were engaged in nonmanufacturing commodity production, chiefly agricultural production. Within the manufacturing sector, the fabricated metals, nonelectrical machinery, and food and kindred products industries are major employers. By 2000, total employment in this region is expected to reach approximately 7,202,000.

All earnings categories in this region are projected to have increased earnings by the year 2000. Manufacturing is expected to remain the leader with slightly over 26 percent of the total earnings. However, the greatest relative increase in earnings will be in services; finance, insurance, and real estate; and government.

Table 7-1.--Upper Mississippi Region earnings--1975, 1985, 2000
(million 1975 dollars)

Earnings sector	1975	1985	2000
Manufacturing	18,481	26,084	40,235
Agriculture	4,646	4,638	5,461
Mining	414	459	585
Other	41,759	61,780	105,690
Total	65,300	92,961	151,971

Natural Resources

This region's natural vegetation consists primarily of forests in the northwest and southwest, grasses in the east and west, and an intermingling of grasses and forests in the central portion of the region. Major forest types include the elm-ash-cottonwood, maple-birch, oak-hickory, aspen-birch, and white-red-jack pine. Forest and woodlands account for about 21 percent of the total surface area. There is very little remaining native prairie, and over 55 percent of the total area of the region is devoted to cropland uses. Primary crops include corn, hay, oats, and soybeans. Urban areas make up a relatively small proportion (less than 2 percent) of the total surface area (see Table 7-2).

Table 7-2.--Upper Mississippi Region surface area and 1975 land use

Surface area or land-use type	1,000 acres	Percentage of total surface area
Surface area		
Total	115,631	100.0
Water	2,687	2.3
Land	112,944	97.7
Land use		
Cropland	64,062	55.4
Pasture and range	11,644	10.1
Forest and woodland	24,473	21.2
Other agriculture	3,643	3.1
Urban	2,151	1.9
Other	6,971	6.0

Agriculture

The cropland base in the Upper Mississippi Region currently is about 64.1 million acres. About 85 percent of the total cropland acreage is cropland harvested. It is projected that total cropland will increase

only slightly (4 percent) between 1975 and 2000. Cropland harvested is projected to increase by about 14 percent during this period. Irrigated farmland is not extensive and accounts for less than 1 percent of the total cropland (see Table 7-3).

Table 7-3.--Projected changes in cropland and irrigated farmland in the Upper Mississippi Region--1975, 1985, 2000
(1,000 acres)

Land category	1975	1985	2000
Total cropland----------	64,062	64,310	64,687
Cropland harvested----------	54,396	62,316	61,825
Irrigated farmland----------	204	307	434

Energy

Total power generation from this region's 78 steam-electric powerplants was over 112,000 gigawatt-hours (gWh) in 1975. About one-half of these plants use once-through water cooling systems. Seventy-one of these plants were fossil fueled and seven were nuclear. As of 1970, there were 52 licensed hydroelectric power projects in the region, but they supplied only 1 percent of the total power generated. Total power generation in this region has been projected to reach about 667,000 gigawatt-hours annually by 2000. Of this amount, approximately three-fourths is projected to be produced by nuclear-fueled plants (See Table 7-4). However, the Department of Energy has projected an energy generation scenario based on the assumption that synthetic fuels can be developed from existing resources (coal) and become a significant part of this region's energy-producing structure. If the development of synthetic fuels becomes economically and environmentally feasible, the nuclear share of this region's total power generation could be reduced from about 500,000 gigawatt-hours to somewhere between 60,000 to 100,000 gigawatt-hours in the year 2000.

Table 7-4.--Upper Mississippi Region electric power generation--1975, 1985, 2000
(gigawatt-hours)

Fuel source	1975	1985	2000
Fossil----------	87,825	125,908	156,084
Nuclear----------	24,879	122,255	509,195
Conventional hydroelectric power--	1,247	1,450	1,450
Total generation----------	113,951	249,613	666,729

This region's principal coal deposits are located in the State of Illinois, and of the 40 to 50 coal deposits scattered throughout this State, only about four are major producers. Much of the coal mined in Illinois is consumed in the State for the production of electrical energy and metallurgical use. Smaller reserves of coal are found in

Iowa and Missouri; however, these reserves have undergone only limited development. Petroleum, natural gas, and natural gas liquids are also found in southern Illinois.

Navigation

The Mississippi River from St. Louis to the head of navigation above Minneapolis-St. Paul (730 river miles) and the entire Illinois Waterway (291 river miles) have been developed for navigational purposes through channelization and the installation of a series of locks and dams. Below St. Louis to the mouth of the Ohio River, the Mississippi River is an open river with dredging to maintain authorized navigable depths. The lower 50 miles of the Kaskaskia River has also been channelized for navigational purposes. In addition, the St. Croix River (25 river miles) and Minnesota River (15 river miles) are navigable within the backwater pools of the Mississippi River. Figure 7-3 delineates the region's navigation system.

The Upper Mississippi is a key element in the Nation's inland waterway system. This system's role in the United States domestic transportation system is the long distance movement of bulk commodities. Grain, coal, iron ore, iron and steel, and miscellaneous materials comprise the downbound traffic on the Mississippi River. The upbound traffic consists of coal, petroleum, and industrial and agricultural chemicals as well as other miscellaneous bulk commodities.

According to recent statistics compiled under the State-Regional Future, the Upper Mississippi Region's navigation system transported approximately 94 million tons of freight in 1975. This is projected to nearly double by the year 2000. Current data indicate that, generally, except for lock and dam 26, the region's existing waterway system (including channel depth and other locks and dams) is not being utilized to full capacity and will be adequate to meet the region's needs for water commerce in the near future. The present structure at lock and dam 26, now being utilized near capacity with excessive traffic delays, is inadequate to pass existing traffic safely and efficiently. Locking facilities on the Illinois River will be inadequate for expected growth in commercial navigation by the year 2000. Other components of the navigation system, such as harbors and fleeting areas, are now operating at or near full capacity and are likely to be expanded according to need.

Environmental Resources

Prior to settlement by white people, the Upper Mississippi Region contained vast areas of forests and wetlands supporting a varied wildlife population. Following this settlement, vast forests were cleared and thousands of acres of wetlands were drained to facilitate development. In the process, the wildlife balance shifted from a forest-game species toward farm species. Elk, bear, moose, cougar, wolves, and other residents of the heavy forest were gradually replaced by deer, cottontails, mourning doves, and other species--all animals that can exist in harmony

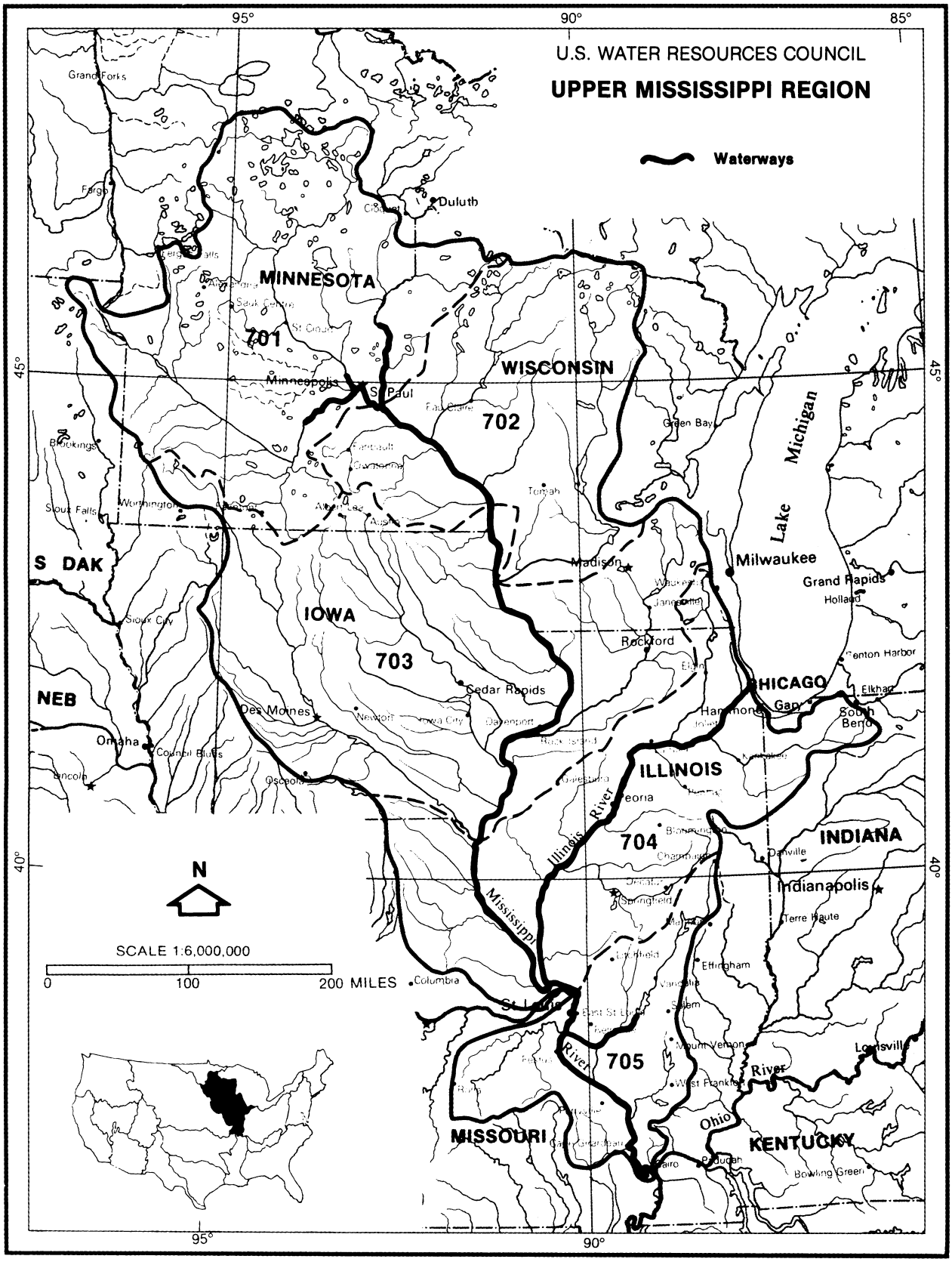

Figure 7-3. Navigation System

with man's activities. Pheasants and Hungarian partridge were introduced successfully and joined such native species as the quail, sharp-tailed grouse, and prairie chicken. In many parts of the region, farm game now receives most of the hunting pressure.

However, large areas of forestland supporting a great variety of wildlife still exist in the Upper Mississippi Region. These areas are found in the northern portion of the region in Minnesota and Wisconsin and in the southern portion of the region in Missouri and Illinois. Valuable waterfowl habitat also still exists in the region. The sloughs and backwaters of the Mississippi River are excellent waterfowl production areas and abundant populations migrate throughout this area. Great abundances of natural lakes and streams still provide an excellent habitat for a variety of gamefish. Muskellunge, trout, northern pike, walleye, bass, and many other species of gamefish are still found in these waters.

The stress of urban living and its accompanying economic affluence have caused increasing numbers of people to turn to open spaces for wholesome outdoor recreation. The enthusiasm for boating, camping, hiking, fishing, and picnicking is creating a substantial impact on this region's water and related land resources. The region has many interesting places to visit that offer relaxation and in which the region's residents have a deep sense of pride.

Commercial resorts have developed throughout the region on natural and manmade bodies of water. There are about 2.7 million acres of water surface in the region. Of this, an estimated 0.8 million acres of water surface area were deemed to be available and of suitable quality for water-based recreational purposes in 1970. Water-based recreation includes all activities which are water-related or enhanced by water, including swimming, canoeing, sailing, boating, water skiing, picnicking, camping, nature walks, and hiking. Approximately 2.7 million acres of water surface area, including streams and rivers, provide this region with excellent sport fishing habitats.

Currently, almost 1.2 million acres (1960 data) of Bureau of Outdoor Recreation (BOR) Class I and II are available to meet demands for land-based recreation uses. BOR Class I lands are high-density recreation areas or areas which are intensively developed and managed for mass use, such as playgrounds and urban parks. BOR Class II lands are general outdoor recreation areas or areas subject to substantial development for a wide variety of recreational uses such as State parks and recreation areas. Land-based recreation activities include horseback riding, hiking, outdoor play, snow skiing, and sledding. Total land area available and suitable for hunting purposes is estimated at about 107.6 million acres. This figure assumes that all lands, except urban and built-up areas, are potential hunting areas or resources. It must be recognized, however, that large portions of this land area are basically unusable for hunting purposes due to posting by landowners as well as farmstead and other rural developments.

Estimated demands (SRF) in activity-days for recreation, fishing, and hunting in 1975 and 2000 are listed in the following chart:

Category	1975	2000
	(million days)	
Recreation-days		
Water-based	184.5	284.3
Land-based	351.5	511.5
Fisherman-days	45.0	52.2
Hunter-days	16.5	18.9

Water- and related land-resource requirements (in acres) to meet the foregoing demands are summarized below:

(NF Estimates)

	1975	2000
	(thousand acres)	
Water surface area needs	509	783
Developed land area needs	23	33

As the foregoing figures indicate, this region's water and related land resources are not adequate to meet the existing (1975) demands. This is complicated by the fact that many of the region's recreational resources are not readily accessible to the region's residents, particularly those living in the metropolitan areas such as Minneapolis-St. Paul and St. Louis.

One wilderness area has been designated in the region and several potential wilderness areas have been identified. The St. Croix and the lower St. Croix have been designated and preserved as national scenic rivers. Another 16 streams have been identified as potential wild or scenic rivers.

Thirteen national wildlife refuges are located in the region. The two largest refuges, Mark Twain and Upper Mississippi, extend for 560 miles along the Mississippi River bottomlands and provide 268,000 acres of wildlife habitat. The Mississippi Flyway and parts of other important bird migration routes cross the region. There are 1,600 miles of nationally significant fishing streams within the region. In 1975, four species of wildlife in the region had been designated as endangered. These are the Indiana bat of the midwest and eastern United States; the Gray bat of the midwest and southeast; the eastern timber wolf of the Lake Superior area of Michigan, Wisconsin, and Minnesota; and the eastern cougar of the east and midwest.

Although most of the region's environmental resources are privately owned and/or managed, the States and the Federal Government are playing an increasing role in natural resources management and protection. All States in the region now have established centralized State regulatory programs for the administration and enforcement of water-quality standards. Most States have established flood-plain management statutes and are currently administering flood-plain management programs. In addition, the

States also regulate hunting and fishing to protect each State's fishing and hunting resources. The Federal Government, however, plays a less direct role in regulating water and related land resources in the area. While Federal agencies are directly involved in the management and preservation of some of this area's valuable natural resources through public ownership, their basic role is that of cooperating with and providing assistance to State and local agencies and the general public relative to the management, protection, and enhancement of the area's valuable natural resources.

For the most part, neither the States nor the Federal Government are large landowners in the Upper Mississippi Region. However, the U.S. Forest Service manages large tracts of forestland in the far northern and southern portions of the region. Major Federal management units in the region include the following:

- National forests--Mark Twain, Shawnee, Chequamegon, Nicollet, and Chippewa National Forests.
- National wildlife refuges--Crab Orchard, Clarence Cannon, Mark Twain, Chautaugua, Trempealeau, Necedah, Sherburne, Rice Lake, and Upper Mississippi National Wildlife Refuges.
- Jefferson National Expansion Memorial
- Lincoln Home National Historic Park
- Effigy Mount National Monument
- St. Croix National Scenic Riverway

State ownership is distributed chiefly among numerous State parks and forests as well as wildlife management areas in Iowa, Minnesota, and Wisconsin; Conservation Area and Preserves in Illinois; and State Wildlife Areas in Missouri. Table 7-5 presents a listing of areas of critical environmental concern by State. Specific areas of environmental concern listed in this table were identified according to the particular attributes (wild and scenic river, wetland habitat, etc.) and concerns (pollution, residential development, etc.) of the areas. A complete explanation of Table 7-5 follows:

- Numbers in Column 1 indicate the source of information used from the list below in designating each area of critical environmental concern.

  1. Statewide Comprehensive Outdoor Recreation Plans for each State.
  2. Upper Mississippi River Comprehensive Basin Study.
  3. Islands of America, Bureau of Outdoor Recreation, 1970.
  4. National Register of Natural Landmarks, Federal Register, Volume 38, Number 171, September 5, 1973.
  5. Wisconsin Scientific Areas, Scientific Area Preservation

Council, Wisconsin Department of Natural Resources, 1973.
6. Bureau of Outdoor Recreation, Unpublished Reports and Studies.

- NA - Information concerning the size of certain areas was not available.

- Roman Numerals - Describe the environmental attribute(s) of each area of critical environmental concern identified in the region as follows:

  I Federal Wild and/or Scenic River (pursuant to Section 3(a), Public Law 90-542, as amended by Public Law 93-621).

  II State Wild and/or Scenic River (pursuant to State legislation).

  III Potential wild and/or scenic river (pursuant to Section 5(a) or 5(d) of Public Law 90-542, as amended by Public Law 93-621, SCORP's Framework Level A and River Basin Level B Studies).

  IV High-value recreation beach or shoreland.

  V Unique water or water-related recreation area such as:
  wetland (marsh, swamp, or bog)
  island (high recreation value and of a fragile environmental nature)
  scientific water-related study area
  waterfall
  spring
  gorge
  canyon

  VI Flood-plain recreation area

  VII Open space, scenic, or natural area.

  VIII High-value general recreation area.

- Letters - Describe the nature of the concern for each area of critical environmental concern as follows:

  A Residential development
  B Commercial development
  C Industrial development
  D Agricultural development
  E Mining and related energy resource development
  F Dams and irrigation projects
  G Navigation projects
  H Channelization projects
  I Water level fluctuations
  J Water pollution
  K Sedimentation

L Erosion
M Nuisance vegetation
N Weed growth
O Eutrophication
P Adequate public areas
Q Adequate streamflows
R Overuse (recreation)

Table 7-5.--Areas of critical environmental concern, Upper Mississippi Region

Source	Name	Size	Descriptor	
			Attribute	Concern
Minnesota				
4	Itasca Natural Area	1,452 Acres	V	A,B
3	Leech Lake Islands	39 Miles	V	A,P
1	Willow River	92 Miles	III,V	A
1	Crow Wing River	102 Miles	V,VIII	A,B,R
1	Brainerd-Mille Lacs Lake Area	NA	VIII	A,R
1	Pine River	31 Miles	VIII	A
1	Kettle River	52 Miles	III	A
3	Big Island in St. Croix River	410 Acres	V	R
1	Snake River	76 Miles	III	A,B
1	St. Croix and Namekagon Rivers and Tributaries	252 Miles	I,II	A,R
1	Loon Lake	2,400 Acres	V	A,J,P
1	Big Marine Lake	1,100 Acres	VII	A,J,P
1	Oneka Lake	1,000 Acres	VII	A,J,P
1	Linwood Lakes	1,200 Acres	VII	A,J,P
1	Lino Lakes	2,500 Acres	VII	A,J,P
1	Otter Lake	700 Acres	VII	A,J,P
1	Rice Creek and Rush Lake	450 Acres	VII	A,J,P
1	Grass Lake and Vadnais Lake	3,000 Acres	VII	A,J,P
1	Lake Elmo	2,000 Acres	VII	A,J,P
1	Pigs Eye Lake	1,000 Acres	VII	A,J,P
1	Spring Lake	1,750 Acres	VII	A,J,P
1	Chub Lake	1,500 Acres	VII	A,J,P
1	Cedar and Sand Lakes	2,500 Acres	VII	A,J,P
1	Murphy and Honrahan Lakes	126 Acres	VII	A,J,P
1	Anderson Lakes	700 Acres	V	A,J,P
1	Carver Park	3,200 Acres	VII	A,D
1	Lake Waconia	1,000 Acres	VII	A,J,P
1	Ferndale Marsh	30 Acres	V	A
1	Mud Lake and Oak Lake	1,300 Acres	VII	A,J,P
1	Diamond Lake	1,000 Acres	VII	A,J,P
1	Niger Lake	4,000 Acres	VII	A,J,P
1	Run River	69 Miles	III	A
1	Upper Mississippi River	370 Miles	III	A,B,C,F,G, H,J,K,L,P
1	North Fork of the Crow River	90 Miles	III	A,J,K,L
1	Rockville Tamarack Bog	32 Acres	V	A
1	Ancient River Warran Channel	NA	V	A,D
1	Crow River (South Fork)	NA	III	A,J,C,J,P
1	Minnesota River	289 Miles	III	A,B,C,D,G, J,K,L,M,N
1	Cottonwood River	54 Miles	VIII	A,D,J,K,L,
1	Watonwan River	NA	VIII	A,D,J,K,L
1	Blue Earth River	NA	VIII	A,D,J,K,L
1	Heron Lake	8,251 Acres	V,VIII	A,M,N,O

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
1	Des Moines River	53 Miles	III	A,J
1	Mississippi River Shoreline, Coulees, and Bluffs	NA	VIII	A,F,G,H,J, L,P
5	Nelson-Trevino Bottoms	3,740 Acres	V	G
3	Mississippi River Islands in MN	2,928 Acres	V	G
1	Cannon River	73 Miles	III	A,D
1	Zumbro River	NA	III	A,D
1	Root River	NA	III	A,J
South Dakota				
1	Ancient River Warren Channel	NA	V	A,D
Wisconsin				
3	Big Island in St. Croix River	410 Acres	V	R
1	St. Croix and Namekagon Rivers and Tributaries	252 Miles	I,II	A,R
1	Lake Region-Burnett and Washburn Counties			
1	Wilton Bog	NA	V	A
1	Kinnickinnic River Canyon	NA	V	A,J,P
1	Apple River Canyon	NA	V	A,J,P
5	Washburn County Pine	120 Acres	VII	A,D
5	Dory's Bog	40 Acres	V	A,I
1	Trout Streams on Tributaries to Red Cedar, St. Croix, and Namekagon Rivers	NA	V	A,R
1	Sawyer County Lake District including the Chippewa Flowage	NA	VIII	A
1	Rusk/Chippewa County Lake District	NA	VIII	A
1	Vilas-Oneida Lakes Complex	NA	VII,VIII	A,O,P
1	Powell Spring Bog	NA	V	
5	Bittersweet Lakes	223 Acres	V	A
5	Finnerud Pine Forest	120 Acres	V	
1	Flambeau River	NA	II	A,J
1	Chippewa County Terminal Moraine-Kettle District	NA	V	
1	Pine River Dells	NA	V	
1	Chippewa River and Shoreline	NA	III,VIII	A,J,K,L,P
1	Mississippi River Shoreline, Coulees, and Bluffs	NA	VIII	A,F,G,H,J, L,P
5	Nelson-Trevino Bottoms	3,740 Acres	V	G
5	Tiffany Bottoms Wilderness	402 Acres	V	

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
1	Outliners (Clark/Jackson County)	NA	V	
5	Tamarack Creek Bog	130 Acres	V	
1	Meadow Valley and Necadah Game Area	NA	V,VIII	
5	Blackhawk Island	245 Acres	V	
1	Wisconsin Dells Area	NA	V,VIII	R
3	Mississippi River Islands in Wisconsin	471 Acres	V	G
5	Pine Glen	120 Acres	V	
1	Baraboo Range	NA	V	
1	Lost Lake	NA	VII	A
3	Wisconsin River Islands	1,293 Acres	V	
1	Lower Wisconsin River: Coulees, Bluffs, and Ridges	NA	III,VII	A,J
1	Twin Bluffs	NA	VII	
1	Sand County Lakes Area	NA	VIII	A,J
1	Castle Rock-Petenwill Flowage Complex	NA	V	
1	Kickapoo River and Valley	NA	VII	A,K,L
1	Pier Spring Woods	NA	VII	
1	Black River and Shoreline	NA	VII,VIII	A,J,L,P
1	LaCrosse River	NA	VII	A,L
1	Krenz Woods (Marathon County)	NA	VII	
1	Eau Claire River	NA	VIII	A
1	Yellow River	NA	V	A
1	Trempealeau River	NA	VII	A,P
1	Red Cedar River	NA	V	A
1	Blue Hills	NA	VII	
1	Terminal Moraine-Kettle Lake Region (Barron County)	NA	VII	
1	Trout Streams Tributary to the Wisconsin, Mississippi, and Chippewa Rivers	NA	V	A,C,D,L
5	Flambeau River Hemlock Hardwoods	360 Acres	VII	
5	Black Tern Bog	26 Acres	V	
5	Trout Lake-Conifer Swamp	15 Acres	V	
5	Escanaba Lake Hemlocks	130 Acres	VII	
5	Plum Lake-Star Lake Hemlock	475 Acres	VII	
5	Rice Lake-Thunder Lake Marsh	250 Acres	V	
5	Gobler Lake	470 Acres	V	
5	Parfrey's Glen	89 Acres	VII	
5	Ableman's Gorge	7 Acres	V	
5	Honey Creek Natural Area	130 Acres	VIII	
5	Eau Claire River Dells	40 Acres	V	
5	Goose Pond	55 Acres	VII	

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
5	Hub City Bog	55 Acres	VII	
1	Fish Lake	252 Acres	VII	A,J
1	Madison Lake Area	18,657 Acres	VII	A,J,N,O
1	Lake Koshkonong	10,480 Acres	VII	A,J,P
6	Rock River	NA	III	A,J
1	Sugar River	NA	VII	A,J
1	Turtle Creek	NA	VII	A,J
1	Pecatonica River	NA	VII	A
6	Tributary Trout Streams to the Wisconsin, Pecatonica, Mississippi, and Sugar Rivers in Grant and Iowa Counties	NA	V	D,H,K
1	Ripley, Blue Spring, and Lower Spring Lakes	659 Acres	V	A,P
5	Waterloo Fen and Springs	78 Acres	V	A,P
5	Bean Lake	120 Acres	V	A,P
5	Waubesa Wetlands	129 Acres	V	D,I,O
5	Avon Bottoms	40 Acres	VII	
5	Cross Plains Unit-Ice Age National Scientific Preserve	NA	VII	
Iowa				
1	Cheever Lake, Eagle Lake, East Swan Lake, Four Mile Lake, Grass Lake, and Iowa Lake	1,648 Acres	VII	A,J
1	Ingham High, Turtle, Ryan, Twelve Mile, and West Swan Lakes	4,545 Acres	VII	A,J
1	Cunningham Slough	362 Acres	V	D,H,K
1	Blue Wing Marsh	160 Acres	V	D,H,K
1	Five Island Lake	1,111 Acres	VII	A,J
1	Lost Island, Rush, Silver, and Virgin Lakes	2,700 Acres	VII	A,J
1	Union Slough	2,078	V	D,H,K
1	Goose Lake	111 Acres	VII	A,J
1	Iowa Lake Slough	126 Acres	V	D,H,K
1	Schwab Marsh and State Line Marsh	265 Acres	V	D,H,K
1	Harman Lake	72 Acres	VII	A,J
1	Myre Slough	430 Acres	V	D,H,K
1	Rice Lake Area	702 Acres	VII	A,J
1	Brights Lake and Silver Lake	461 Acres	VII	A,J
1	Elm Creek Area	1,553 Acres	V,VII	A,J
1	Crystal Lake	283 Acres	VII	A,J

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
1	Eagle Lake	21 Acres	VII	A,J
1	Zerbal Slough	130 Acres	V	A,H,K
1	Ventural Marsh	473 Acres	V	D,H,K
1	Clear Lake	3,643 Acres	VII	A,J
1	Mallard Marsh	227 Acres	V	D,H,K
1	West Twin Lake	109 Acres	V	A,J
1	Coldwater Cave	NA	V	
6	Upper Iowa River	NA	III	J
1	Duck Lake	200 Acres	VII	A,J
1	Mud Hen Lake	164 Acres	VII	A,J
1	Lansing Big Lake	679 Acres	VII	A,J
1	Fallow Springs	NA	V	
1	Andros Hollow	NA	V	
1	Mississippi River Shoreline, Coulees, and Bluffs	NA	VII,VIII	A,J
3	Mississippi River Island in Iowa	4,595 Acres	III	G
1	Goose Lake	887 Acres	VII	A,J
1	Bear Creek	NA	V	
1	Harrahs Lake	80 Acres	VII	A,J
2	Upper Mississippi River	NA	V,VII	F,G,H,J
1	Weise Slough	1,550 Acres	V	D,H,K
1	Paradise Lake	192 Acres	VII	A,J
1	Muscatine Slough	1,790 Acres	V	D,H,K
1	Klum Lake	258 Acres	VII	A,J
1	Cone Marsh	421 Acres	V	D,H,K
1	Lake Odessa	2,000 Acres	VII	A,J
1	Huron Slough	120 Acres	VII	D,H,K
1	Lake Darling	302 Acres	VII	A,J
1	Swan Lake	44 Acres	VII	A,J
1	Skunk Cabbage Bog	NA	V	D,H,K
1	Muskrat Slough	366 Acres	V	D,H,K
1	Palo Marsh	113 Acres	V	D,H,K
1	Hanging Bog	17 Acres	V	
1	Peat Meadow	NA	V	D,H,K
1	Goose Pond	NA	V	A,J
1	Otter Creek Marsh	3,009 Acres	V	A,H,K
1	Diamond and Ponderosa Lakes	1,196 Acres	VII	A,J
1	Miami Lake	142 Acres	VII	A,J
1	Lake Wapello	287 Acres	VII	A,J
1	Hendrickson Marsh	525 Acres	V	D,H,K
1	Pine Lake	160 Acres	VII	A,J
1	Fallen Rock Area	100 Acres	V	
1	Goose Lake	887 Acres	V	A,J
1	Little Wall Lake	273 Acres	VII	A,J
1	Beeds Lake	319 Acres	VII	A,J
1	Big Wall, Elm Cornelia, and Morse Lakes	1,740 Acres	VII	A,J

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
1	Lizard Lake	268 Acres	VII	A,J
1	North and South Twin Lakes	569 Acres	VII	A,J
1	Swan Lake	130 Acres	VII	A,J
1	Kiawa and Tomahawk Marshes	79 Acres	V	D,H,K
1	Black Hawk Lake	957 Acres	VII	A,J
1	Storm Lake	3,079 Acres	VII	A,J
1	Pickerel Lake	175 Acres	VII	A,J
1	Little Clear Lake	187 Acres	VII	A,J
Illinois				
1	Spring Lake	560 Acres	V	A,J
6	Kishwaukee River	NA	III	A,J
6	Rock River	NA	III	A,J
6	Apple River	NA	III	A,J
4	Mississippi Palisades	NA	V	A
1	Goose Lake Prairie	1,513 Acres	V	A,D,J
2	Upper Mississippi River	NA	V,VII	F,G,H,J
1	Sugar River	NA	VII	A,J
1	Pecatonica River	NA	VII	A
6	Kankakee River	NA	III	
6	Fox River	NA	III	J
6	Vermilion River	NA	III	J
6	Mackinaw River	NA	III	J
4	Allerton Natural Area	NA	V	
3	Illinois River Islands	5,825 Acres	V	G
2	Mississippi River	NA	VIII	F,G,H,J,K
3	Mississippi River Islands in Illinois	4,501 Acres	V	G
6	Kaskaskia River	NA	III	J,K,L
6	Shoal Creek	NA	III	J,K,L
6	Big Muddy Creek	NA	III	J,K,L
1	Burnham Island	NA	V	G
4	Horseshoe Lake Nature Preserve	NA	V	
Indiana				
1	Bird Marsh	64 Acres	V	D,H,K
1	Beaver Lake Nature Preserve	640 Acres	V	
6	Kankakee River	NA	III	
Missouri				
4	Mark Twain and Cameron Coves	NA	V	
3	Mississippi River Islands in Missouri	2,781 Acres	V	G

Table 7-5.--Areas of critical environmental concern (continued)

Source	Name	Size	Descriptor	
			Attribute	Concern
1	Burnham Island	NA	V	G
3	Mississippi River Islands in Missouri	2,781 Acres	V	G
2	Lower Meramec River	NA	II	A,B,J
1	Courtouis River	NA	III	J
1	Huzzah River	NA	III	J
1	Upper Meramec River	NA	III	A,D,J
2	Mississippi River	NA	VIII	F,G,H,J,K

Available Water Supplies and Use

The availability of surface-water and ground-water resources varies considerably from one location to another in the Upper Mississippi Region. In most of Minnesota and Wisconsin, water resources are quite abundant and are generally more than sufficient to meet needs. However, in other locations water resources in drought periods can be quite limited, providing only enough water to sustain relatively small communities and industries requiring only limited quantities of water.

Surface-water Resources

The inland water surface area in the Upper Mississippi Region is estimated to be approximately 4,200 square miles. Approximately three-fourths of the surface-water area is found in the numerous lakes and reservoirs located in Minnesota and Wisconsin. Total surface area in reservoirs in the region is about 1,700 square miles.

The mean monthly outflow in the region varies from 204,000 mgd in April to 67,900 mgd in December. The mean annual discharge is 187,220 cfs or 121,000 mgd. Figure 7-4 illustrates current streamflows in the Mississippi River by subregions as they actually occur, that is, after average withdrawals and consumptive use. Streamflow data shown in this figure reflect the importation of approximately 2.1 bgd of water from Lake Michigan in the Chicago metropolitan area to the Illinois River in subregion 704 and inflow from the Missouri River (Subregion 1011) in Subregion 705.

The quality of surface water in the region varies according to flow conditions, proximity to populated areas, and other factors. Water quality problems in the region stem from both point and nonpoint pollution sources. Point sources of pollution can be found near many of the region's major urban centers and stem from industrial and municipal waste discharges. Nonpoint pollution problems resulting from agricultural runoff are quite severe in the region's major crop and livestock-producing areas. High turbidity resulting from erosion and flooding also poses a significant problem. Acid-mine drainage problems are also becoming severe in the region's coal-producing areas in Illinois. Eutrophication and aquatic weed growth problems are significant throughout the region in the late summer and fall.

Ground-water Resources

Ground water represents a major source of water for municipal, industrial, agricultural, and other water uses in the Upper Mississippi Region. In 1975, an estimated 2,366 mgd of water was withdrawn from ground-water sources for all uses in the region. This total ground-water use represents approximately 19 percent of total water withdrawals. Large quantities of ground water can be found in the unconsolidated glacial sediments located in the region. These sediments are especially excellent ground-water sources along several of the region's major rivers where

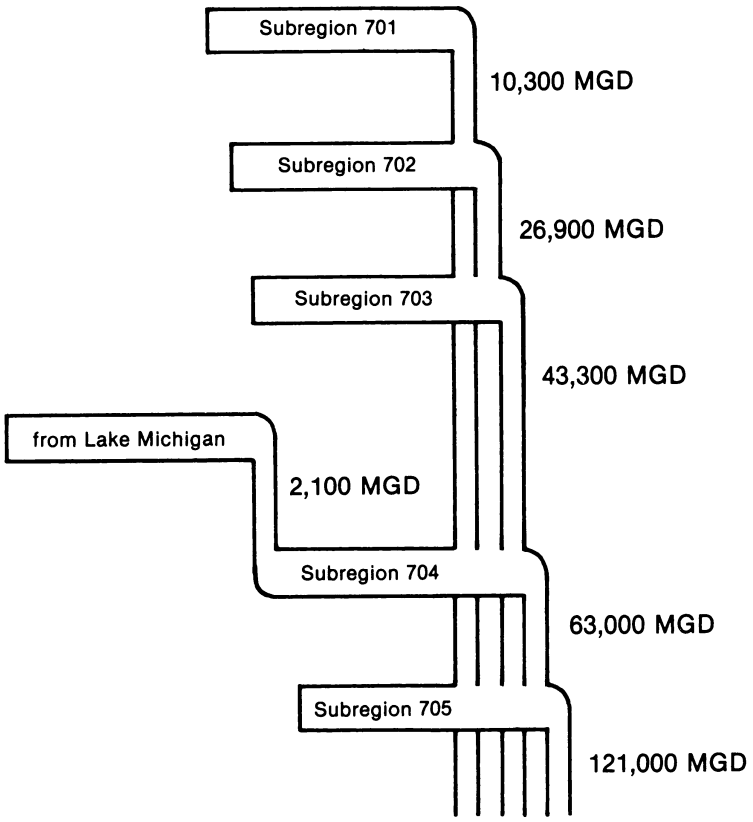

Figure 7-4. Streamflow

ground-water yields are usually 40 to 500 gallons per minute (gpm) and, in many places, more than 500 gpm. Bedrock aquifers also provide major ground water resources in the region. The most notable of these bedrock aquifers are the Jordan-Prairie du Chien and Mt. Simon-Hinckley Aquifers in the northern parts of the region and the Cambrian-Ordovician and Silurian-Devonian aquifers found in the central and southern portions of the region. Ground-water quality is generally good and suitable for most uses. However, locally high concentrations of dissolved solids and iron, and excessive hardness problems exist in the region. Figure 7-5 geographically portrays the major productive aquifers in the Upper Mississippi Region.

Water Withdrawals

Total water withdrawn from streams and ground water in 1975 was estimated at just over 12.4 bgd. Of this amount, irrigation accounted for about 2 percent of these withdrawals. However, this percentage is

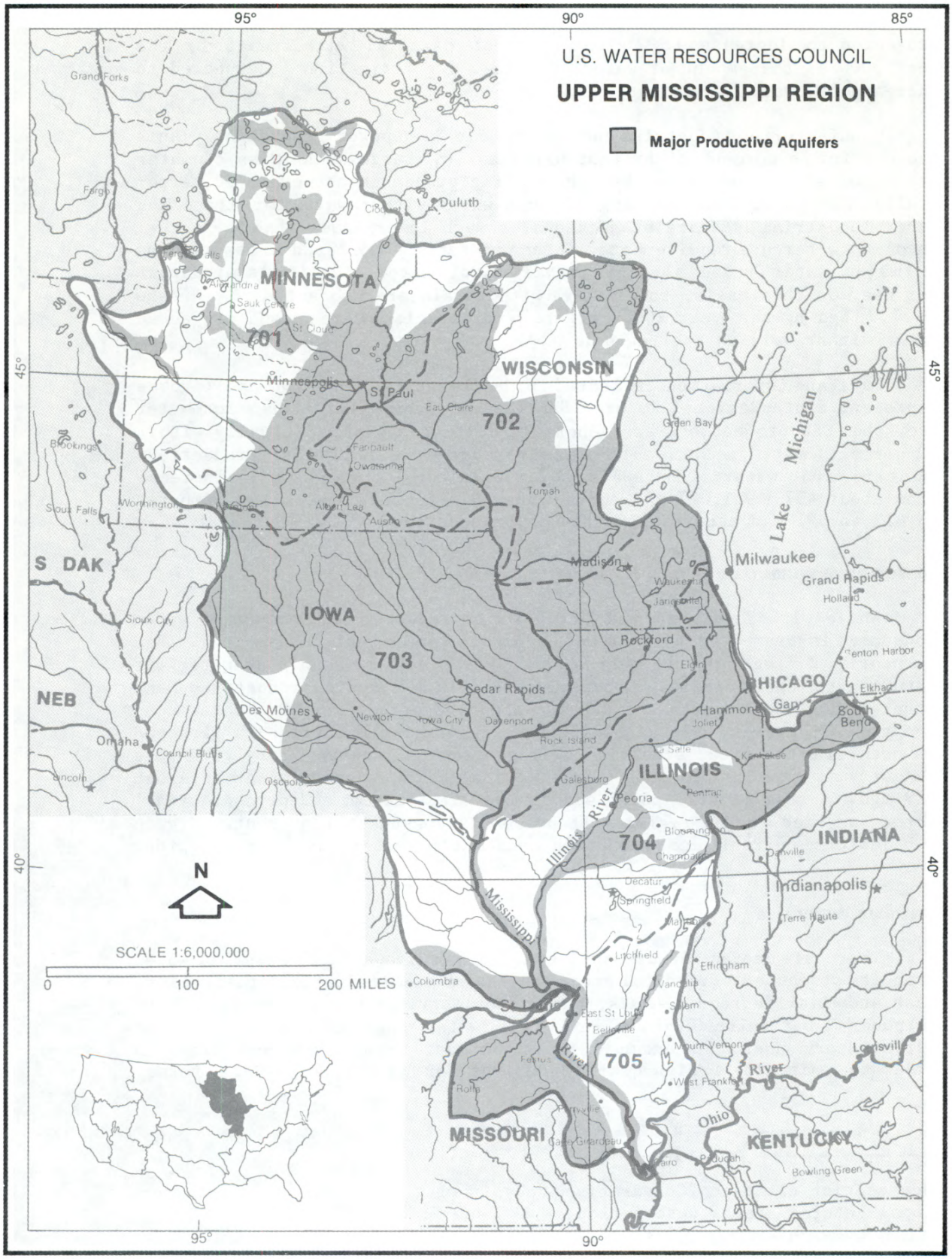

Figure 7-5. Major Aquifers

projected to increase to about 5 percent of total withdrawals by the year 2000 as the amount of water withdrawn for irrigation is expected to increase by over 100 percent.

Manufacturing industries and thermal electric power generation plants account for 78 percent of present withdrawals. Large quantities of water are required because once-through cooling processes are employed, especially for powerplant cooling. Future water withdrawals for these and other industrial uses are projected at a much lower level than the actual in-plant water-use requirements. These projections are based on assumptions of major water reuse through recycling of water once it is withdrawn for use. On this basis, total water withdrawals are projected to decrease to 7.9 bgd by the year 2000. Figure 7-6 depicts current and projected water withdrawals in the region.

Data and information reflected in the foregoing narrative and figures represent State-Regional Future (SRF) data.[1] Except for irrigation water use, the SRF projections are generally quite comparable (usually within 10 percent) with the National Future (NF) projections. The SRF projections indicate that water withdrawals for agricultural purposes will increase from about 497 to 1,027 mgd during the 1975-to-2000 time frame compared to 422 to 691 mgd according to the NF projections.

Consumptive Water Use

While withdrawals are projected to be reduced, the amount of water consumed is projected to increase from a 1975 amount of about 1.1 bgd to nearly 2.7 bgd in the year 2000. Water consumed is that water not returned to the streams. Domestic uses, manufacturing industries, and other miscellaneous uses account for about 52 percent of 1975 water consumption. However, the major increase in water consumption is expected to occur in the steam electric power generation industry. By 2000 this industry is expected to consume over 8 times its current amount of about 129 mgd. Steam elecric power generation will consume 40 percent of all water consumed in the region. It presently consumes 11 percent. Figure 7-6 depicts current and projected consumptive water use in the region.

Instream Water Use

There are many water uses which do not require actual removal of water from its streambed. Principal among these uses are recreation, navigation, fish and wildlife requirements, and hydroelectric power generation. These purposes do require minimum levels of water quantity and quality for satisfactory use. For example, a stream must provide minimum flows in order to maintain a high-quality habitat for its aquatic life forms.

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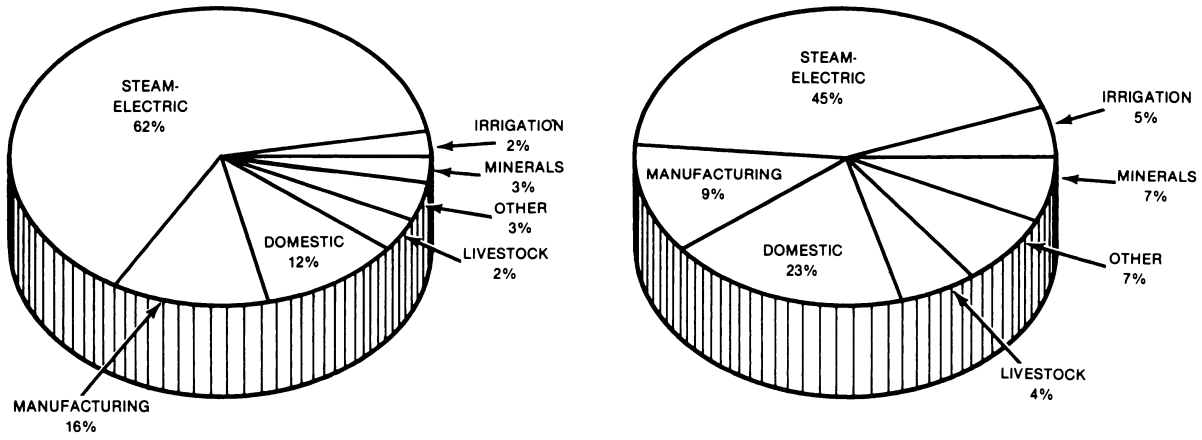
[1] See section entitled "Comparative Analysis of the National and State-Regional Futures" for a description of SRF and NF data.

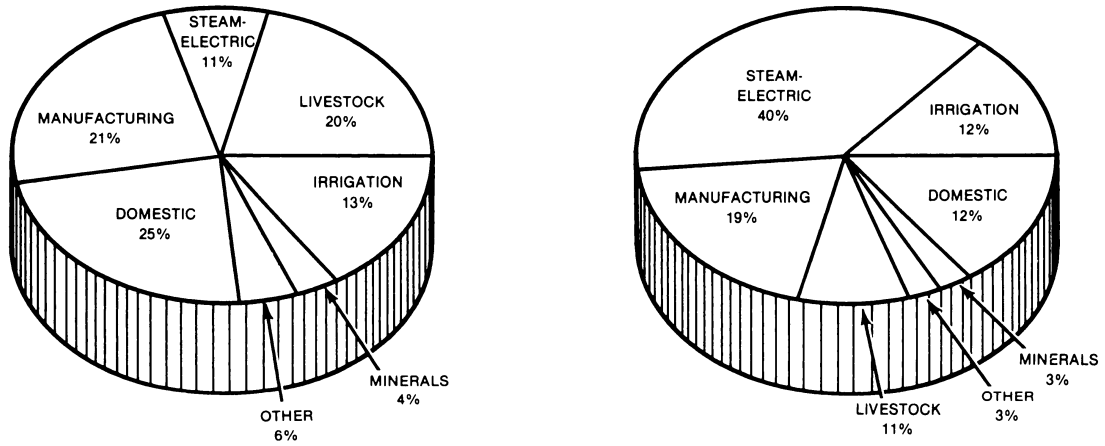
ANNUAL FRESHWATER WITHDRAWALS



1975
Total Withdrawals — 12,401 MGD

2000
Total Withdrawals — 7,910 MGD

ANNUAL FRESHWATER CONSUMPTION



1975
Total Consumption — 1,145 MGD

2000
Total Consumption — 2,688 MGD

Figure 7-6. Withdrawals and Consumption

A comparison of instream flow requirements in the Upper Mississippi Region with streamflows indicates that, on a gross basis, most instream needs are met under average streamflow conditions. However, streamflows on many smaller tributary streams are characterized by extreme low-flow and, at times, no-flow conditions in late summer, fall, and winter months resulting in a poor-quality stream fishery and restricted usability for recreation purposes.

Water Resource Supply/Demand Adequacy Analysis

The Upper Mississippi Region is one of the foremost areas of the world in terms of the quantity and quality of water and land resources available. A comparison of current annual use with available supplies illustrates this. Total 1975 withdrawals (12,401 mgd) average about 9 percent of total natural streamflow in an average year (135,057 mgd). Total losses, consumptive use (1,145 mgd) plus reservoir and farm/stock pond evaporation (43 mgd) are only about 10 percent of total withdrawals or less than 1 percent of total streamflow. This is without consideration of the vast ground-water supplies available. With future withdrawals decreasing because of reuse and future consumptive use expected to increase 2.3 times the 1975 level, there would appear to be little strain on the region's water resources in the future. By 2000, the water consumption will be about 2 percent of total annual streamflow.

However, while these overall annual figures show no water shortage in the region, they can be very misleading. A stream in the uppermost western part of a watershed can present very real problems for users during the drier months of the year. A local source anywhere in the region can fail to meet the needs of a large metropolis or major water-using plant. Such localized problems are identified in the individual problem area summaries at the end of this chapter. The water is available in the region, particularly in the southern half, but its use requires facilities and management to provide it where it is needed.

Comparative Analysis

Table 7-6 compares the National Future (NF) and State-Regional Future (SRF) estimates of streamflows and water needs in the Upper Mississippi Region.

NF and SRF estimates of total withdrawals show close similarity. Two internal discrepancies exist, however, in the agriculture and domestic categories. The SRF projections for irrigation water requirements are consistently larger than those of the NF, while SRF projections for domestic use are smaller then the corresponding NF figures. There is excellent agreement between NF and SRF on consumptive-use data for 1975. The total estimates become more discrepant in future years. SRF irrigation and domestic use projections again vary quite markedly from the NF data.

Both views of the future must be considered in decisions and future

Table 7-6.-- Socioeconomic and volumetric data summary: the Upper Mississippi Region

Category	1975		1985		2000	
	NF	SRF	NF	SRF	NF	SRF
SOCIOECONOMIC DATA (1000)						
Total population	13,387	13,228	14,408	14,096	15,822	15,716
Total employment	5,615	5,615	6,325	6,325	7,202	7,202
VOLUMETRIC DATA (mgd)						
-Base conditions-						
Total streamflow	135,057	NE	135,057	NE	135,057	NE
Streamflow at outflow point(s)	121,000	117,279	113,867	NE	111,234	NE
Fresh-water withdrawals	12,401	12,352	10,386	10,380	7,910	7,905
Agriculture	422	497	566	899	691	1,027
Steam electric	7,644	7,644	6,347	6,347	3,537	3,537
Manufacturing	2,030	2,283	886	974	728	795
Domestic	1,450	1,073	1,609	1,182	1,808	1,400
Commercial	515	515	552	552	603	603
Minerals	333	333	417	417	533	533
Public lands	2	2	3	3	4	4
Fish hatcheries	5	5	6	6	6	6
Other	0	0	0	0	0	0
Fresh-water consumption	1,145	1,153	1,604	1,821	2,688	2,908
Agriculture	383	441	513	779	627	888
Steam electric	129	129	352	352	1,079	1,079
Manufacturing	240	259	309	338	506	552
Domestic	282	213	302	224	324	237
Commercial	63	63	67	67	74	74
Minerals	46	46	58	58	74	74
Public lands	2	2	3	3	4	4
Fish hatcheries	0	0	0	0	0	0
Other	0	0	0	0	0	0
Ground-water withdrawals	2,366	2,127	NE	1,698	NE	1,718
Evaporation	43	2,468	45	2,468	46	2,468
Instream approximation						
Fish and wildlife	110,750	110,750	110,750	110,750	110,750	110,750

NE - Not estimated.

plans concerning water-related problems. The amount of water required to meet the SRF projected irrigation needs is much greater than that required by the NF projections. Local decisions will be made on irrigation development, and its impact on the water supplies will be local. On a regionwide basis, the amounts of water involved in irrigation in either case are only a small percentage of available water.

Severe Water-Related Problems

Although the region's total water supply and use situation is excellent, there are many water-related problems which, from the State-regional viewpoint, are affecting the lives and environment of the region's residents and deserve serious and early consideration for resolution. These problems have been identified and described by those State and Federal agencies participating in this region's 1975 assessment activities.

Water Quality

Throughout the Upper Mississippi Region, water quality is a major problem. Point and nonpoint pollution problems were identified in site-specific areas in nearly all of the individual problem areas delineated during the Specific Problem Analysis portion of the 1975 assessment. The major causes of poor water quality in designated areas of the region include:

- Industrial wastes from the following sources and/or areas:
  1. The Minneapolis-St. Paul metropolitan area.
  2. The Illinois River, which receives extensive wastes from the Chicago metropolitan area and other urban areas.
  3. The Mississippi River below St. Louis to the Ohio River where waste discharges from petroleum refining, chemicals, and primary metals manufacturers are commonplace.
  4. The pulp and paper industry, which is projected to increase substantially during the next 25 years.
- Inadequate municipal waste treatment facilities, especially in the larger urban centers such as Minneapolis-St. Paul and St. Louis.
- Nonpoint sources or those originating from broad areas that do not have any system for the collection and treatment of polluted water as it flows to the streams. Major nonpoint sources of pollution in the region include agricultural lands, construction sites, and coal-producing areas.

The most severe example of adverse urban impact on water quality is the reach of the Mississippi River below the Minneapolis-St. Paul area. Effluent from a metropolitan sewage treatment plant depletes oxygen and increases levels of nitrogen and ammonia in the stream. Combined with the nutrient and organic load in the stream, these have frequently caused severe algae growth problems. Ambient total algae and nitrogen production had annual mean values for 1975 of over 10,000 algae cells/ml and over 2.00 mg nitrogen/l in much of the region. The nearby portion of the Minnesota River is also degraded with high coliform levels. High turbidity, however, tends to check algae growth.

Coliform levels in the Mississippi River below Minneapolis and in the Minnesota River are consistently high. Total coliform has been measured in the Mississippi River at 200 counts/100 ml near St. Anthony and 17 million counts/100 ml below the Minneapolis-St. Paul treatment plant. Albert Lea Lake in Minnesota has coliform counts so high that no body contact with water is permitted. High coliform counts in the Mississippi River at Dubuque, Iowa, have forced the closing of beaches. Coliform levels in the tributaries are generally low. However, violations of fecal coliform standards occur near the mouths of most Wisconsin tributaries in a significant number of samples.

In addition to high coliform counts around urban centers there are high counts of phenols, ammonia, nitrates, and other toxic substances. Annual mean values for total heavy metals are high along most of the Upper Mississippi River and exceed 100 micrograms per liter along the Mississippi River in subregions 0703, 0704, and 0705.

Toxic substances, mainly ammonia and potassium, high biological oxygen demand, and high turbidity, are responsible for the disappearance of the fingernail clam, for lesser amounts of emergent aquatic vegetation, and for changes in the fish population in the Illinois River. Some of the discharges from the St. Louis area, when mixed together, form new and very exotic toxic substances. A hazard to human health exists. Habitat destruction by pollution has eliminated the commercial fishing industry, and substantially reduced sport fishing, in the 50-mile reach of the Mississippi River below St. Louis.

Heat given off by power generation and industrial cooling will no longer be discharged to streams and lakes by 2000 if the expected recycling of water powerplants occurs. However, chemical problems associated with recycling must also be considered.

Acid-mine drainage problems exist in the region's coal-producing areas in the Illinois, Kaskaskia, and Big Muddy River Basin. Acid-mine drainage from producing and abandoned coal mines and roads constructed from mine wastes has resulted in the destruction of fish and wildlife habitat and severe impairment of water quality. The estimated cost for controlling water pollution resulting from mine drainage in Illinois to meet the requirements of Public Law 92-500 is $346 million.

The implementation of water quality improvements scheduled in response to Public Law 92-500 should resolve many of these water quality problems. These improvements have been accepted as part of the future in projections made for this study. Failure to achieve these improvements could allow water quality problems of major consequence to continue and further intensify in this region.

Another problem issue identified in many of the problem areas outlined in this region is that of poor ground-water quality. High concentrations of dissolved solids, iron, manganese, and nitrates as well as occasional bacterial pollution are characteristic of the ground-water resources in many of the intensified problem areas. Generally, the ground-water quality deteriorates as the depth of the aquifer increases.

Water Quantity

The availability of surface-water and ground-water resources varies considerably from one location to another in the Upper Mississippi Region. In most of Minnesota and Wisconsin, water resources are quite abundant and generally more than sufficient to meet needs. However, in other locations water resources in drought periods can be quite limited, providing only enough water to sustain relatively small communities and industries requiring only small quantities of water. In general, the same can be stated for instream uses; that is, on a gross basis it appears that streamflows are quite adequate to meet instream needs. However, streamflows on many smaller tributary streams are characterized by extreme low-flow and, at times, no-flow conditions even during normal years, resulting in a poor quality stream fishery and restricted usefulness for recreation purposes.

Major potential water supply problems have been identified in the Twin Cities, Peoria-Pekin, and St. Louis areas as well as the Chicago metropolitan area. In these areas, locally high withdrawal and consumptive use demands during drought periods could create serious water supply and instream flow problems.

Inadequate stream depths and surface water area for recreation purposes, including fishing and hunting, have also been identified as significant problem issues in many parts of this region. While many parts of the region are characterized by extensive water resources, these resources in many places are not readily accessible to the region's residents due to a lack of public access or because of the travel distance required to reach the resource. This situation has prevented the maximum use of existing recreation resources even though there is a heavy demand for recreation opportunities. The public problem is especially significant in the backwater areas of the Mississippi River. As time progresses, the problem will continue to become more critical throughout the region due to increased demands for water-based recreation and fishing resulting from population growth, increased leisure time and affluence, etc.

Flooding

In almost every problem area delineated in this region, numerous urban and nonurban areas and large rural areas, including agricultural lands and roads, are subject to frequent, and often severe, flooding. Over the years, flood stages and damages in several of the identified problem areas have been increasing due to continued development of and encroachment onto the flood plain. Another flood-related problem issue in several areas is that of sheet-water flooding or excess wetness conditions on agricultural land areas which inhibit or restrict the efficient use and management of the region's prime agricultural land areas.

This region currently experiences average annual flood damages of about $235 million (1975 dollars). Without any future flood-control action, damages are projected to reach $380 million by the year 2000. If flood-plain regulation and structural measures are installed at levels consistent with past trends, the increase in damages would be reduced to $302 million.

Erosion and Sedimentation

Another major problem issue in this region is that of sheet, gully, and streambank erosion along with the associated sedimentation damages to rural properties, agricultural and recreation lands, and environmental resources. Erosion problems are especially severe due to the highly erosive character of the loess soils and glacial ridges combined with increased flooding and changing shoreland uses as well as more intensive development of flood-plain areas. High suspended sediment concentrations resulting from erosion in agricultural areas and construction zones pose major problems to the use of the riverine resources for recreation, navigation, and fish and wildlife uses. Heavy bedload sediment results in shoaling of the navigation channels on the Mississippi and Illinois Rivers, thus necessitating maintenance dredging of the channel for navigation purposes. Deposition of the dredged materials in sloughs, backwater areas, wetlands, fish and wildlife habitat, etc., poses serious environmental problems. However, considerable progress is being made through the commission's GREAT (Great River Environmental Action Team) River Study of the Mississippi River Main Stem to find new and more acceptable uses for these materials as well as a method for disposing of these materials in a manner which is both economically and environmentally feasible. High turbidity and suspended sediment concentrations also pose problems for municipal, industrial, agricultural (including commercial fisheries), recreation, and environmental uses.

Currently, sediment loads in the Mississippi River at St. Paul, Minnesota, are 500 tons per day, while at St. Louis, Missouri, below the mouth of the Missouri River, the average daily sediment load is 500,000 tons. The combined sediment and industrial waste accounts for most of the 289.0 billion tons of total suspended solids (TSS) generated annually. Under best available technology application in accordance with Public Law 92-500, a slight reduction in the amount is projected by the year 2000.

From 10 to 60 percent of the 544.0 million-ton soil losses incurred annually from cropland erosion reaches the river. In addition to cropland, sediment is produced from 50,000 acres upon which new development is taking place, from southern Illinois streams diverted to strip mine coal beneath them, and from streambank erosion aggravated by currents, winds, and river craft.

For purposes of this assessment it was assumed that erosion rates would not exceed twice the tolerable soil loss rate (T-Value). However, when the erosion rate exceeds the T-Value for a given soil, the productive capacity of that soil is being depleted. In light of the existing erosion rates throughout much of this region and the projections for erosion rates to continue above the tolerable soil loss level, the erosion problem is considered to range from severe to extremely severe throughout the region. Improving soil conservation practices and stopping the use of cropland with excessive erosion problems will negate what otherwise would be higher soil losses resulting from intensive cropland use.

Land-use Conflicts/Changes

A major problem issue in the Upper Mississippi Region is that of changing land uses and conflicts between competing land uses. Conversion of shoreland and flood-plain areas to agricultural, residential, and other land uses has accelerated flooding and erosion problems and contributed to increased degradation of water quality and loss of forestland. Emerging land-use conflicts are centered primarily around the location and placement of dredged materials and the drainage of agricultural land areas characterized by excess wetness, which inhibits or restricts normal agricultural land uses and urban sprawl.

Resource Management and Conservation

Institutional and physical management problems pervade all of the individual problems and problem areas along the Upper Mississippi River corridor and its many tributaries. The various interests affecting these rivers and streams have different objectives and desires and also affect the rivers in different ways. Navigation requires dredging, filling, locking, and pooling. Recreation requires access, quality environment, and health and safety measures. Fishermen require access, high quality habitat, fish, and the time and quiet to pursue them. Travelers and inhabitants deserve an opportunity to view the river and to have attractive riverscapes to enjoy. Industries require the water for domestic and commercial uses, firefighting, maintenance of parks, and cleaning of streets.

Many of these uses impact on the streams by degradation of water quality and the environment. Others cause streambank erosion, excessive noise, and fluctuation of streamflow. The potential for conflict is obvious and compromises and controls must be developed.

A major step toward the management of this important river system was taken with the establishment of the Upper Mississippi River Basin Commission in 1972. This commission is made up of Federal agency and State representatives with a chairman appointed by the President. The commission, working closely with the States and local interests, has been involved in, and instituted, several study programs including the development of a commission plan (the comprehensive coordinated joint plan, CCJP) aimed at the optimum management and conservation of the water and related land resources in the Upper Mississippi Region. The Commission is also involved in another study, the Great River Environmental Action Team (GREAT) study of the Upper Mississippi River Main Stem from Minneapolis-St. Paul, Minnesota, to Cairo, Illinois. This study is designed to develop an overall management strategy for the optimum use of the river's total resources.

There are many obstacles to the preparation of a management strategy equitable to all interests. Although the Commission has the responsibility to plan and coordinate, it must rely upon individual agencies and units of government to implement its recommended plans and programs. Many of these agencies and units of government operate under narrow author-

ities and have limited sources of funds for their projects and programs. Only extensive collaboration among many individuals and interests can effectively accomplish the wise management of the river system.

Individual Problem Areas

Through the specific problem analysis (SPA) portion of the national water assessment, the Upper Mississippi River Basin Commission identified a total of 37 water and related land resource problems which are perceived to be severe from the State/regional viewpoint in the Upper Mississippi Region. All but two of these problem areas, Problem Area Numbers 06 and 13, are now in existence or will become severe during the 1975-to-1985 time frame. Problem Areas 06 and 13 are projected to become severe during the 1985-to-2000 time frame. Figure 7-7a shows the general location of these problem areas. Figure 7-7b provides a comparison of the various problem issues identified in the region by (1) Federal agency representatives during the nationwide analysis and (2) the Upper Mississippi River Basin Commission during the specific problem analysis. Table 7-7 identifies each problem area by name and urgency and indicates the States involved.

This section contains a brief geographic description of the region's individual problem areas and a summary of the basic problem issues which now exist or are expected to occur within each problem area by the year 2000. Among the basic problem issues identified are two institutional and financial problem issues which are common to all problem areas. These common problem issues can generally be stated as follows:

1. Current institutional arrangements and policies for controlling flood-plain development, reducing erosion and sedimentation, reducing point and nonpoint sources of pollution, power plant siting, and protecting and enhancing the area's recreation and environmental resources are oftentimes ineffective due to inadequate funding, incentives coordination, and enforcement and/or public awareness of existing Federal, State, and local programs.

2. Current legislation regarding (1) the definition of navigable waters and the U.S. Army Corps of Engineers role in implementing the provisions of Section 404 of Public Law 95-500 and (2) the matter of Federal vs. State jurisdiction over the utilization of all water resources found beneath the surface or on Indian reservations needs to be clarified and resolved if we are to achieve the wise and orderly development of our water and related land resources.

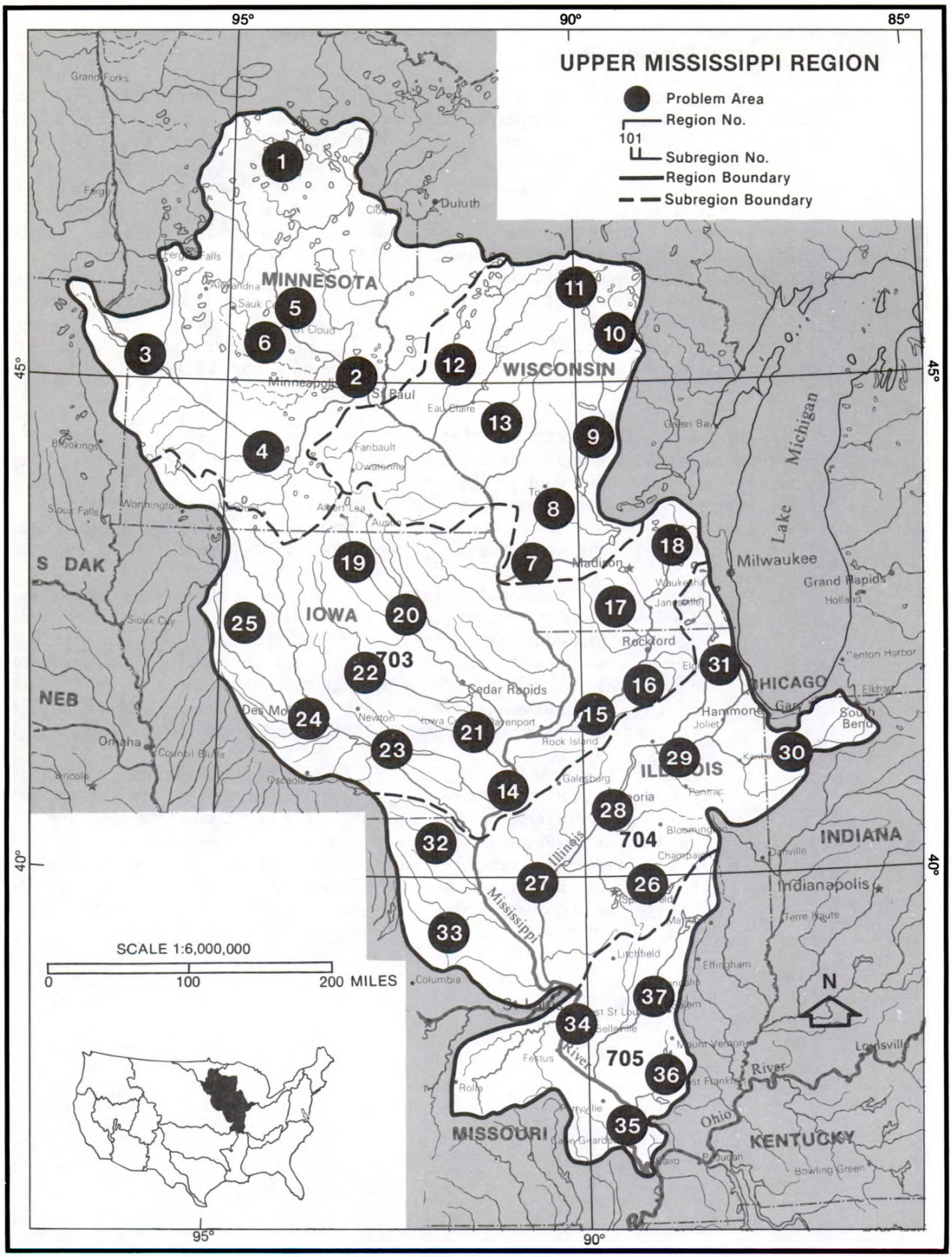


Figure 7-7a. Problem Map

UPPER MISSISSIPPI REGION (7)

PROBLEM MATRIX

Problem area		Problem issues O= Identified by Federal Agency Representatives X= Identified by State-Regional Representative														
		Water quantity				Water quality				Related lands						
No. on map	Name	Fresh surface	Ground	Marine and estuarine	Surface/depth	Fresh surface	Ground	Marine and estuarine	Surface/depth	Flooding	Drainage	Erosion and sedimentation	Dredge and fill	Subsidence	Water related use conflicts	Other
Subregion 701	Mississippi Headquarters	O			O	O					O	O	O		O	
Area 1	Mississippi River Headwaters, Minnesota	X								X		X			X	
2	Minneapolis – St. Paul S.M.S.A., Minnesota	X	X		X	X	X			X	X	X	X		X	
3	Upper Minnesota River Basin, Minn. and S. Dak.	X	X			X	X			X	X	X			X	
4	Lower Minnesota River Basin, Minnesota	X	X			X				X	X	X	X		X	
5	Clearwater River Basin, Minnesota					X						X				
6	Crow River Basin, Minnesota									X		X				
Subregion 702	Black-Root-Chippewa-Wisconsin					O				O		O	O		O	
Area 7	Upper Miss. River Mainstem, Ill., Iowa, Minn. & Wisc.					X				X		X	X		X	
8	Lower Wisconsin – LaCross River Basin, Wisconsin				X	X	X			X		X			X	
9	Central Wisconsin River Basin, Wisconsin	X	X			X	X			X		X			X	
10	Upper Wisconsin River Basin, Wisconsin					X	X			X		X			X	
11	Upper Chippewa River Basin, Wisconsin					X						X			X	
12	Lower Chippewa River Basin, Wisconsin					X				X		X			X	
13	Black, Buffalo, and Trempealeau River Basins, Wis.		X				X			X		X				
Subregion 703	Rock-Mississippi-Des Moines				O	O				O		O	O		O	
Area 14	Middle Mississippi River Mainstem, Ill., Iowa & Mo.					X				X	X	X	X		X	
15	Lower Rock River Basin, Illinois				X	X				X	X	X	X			
16	Kishwaukee River Basin, Illinois		X			X				X	X	X	X		X	
17	Pecatonica River Basin, Illinois & Wisconsin				X	X				X	X	X	X		X	
18	Upper Rock River Basin, Illinois & Wisconsin		X		X	X	X			X		X			X	
19	Upper Cedar River Basin, Iowa and Minnesota	X	X			X	X			X		X				
20	Middle Cedar River Basin, Iowa	X	X			X				X		X			X	
21	Lower Iowa – Cedar Rivers, Iowa					X	X			X		X				
22	Middle Iowa River, Iowa					X	X			X		X				
23	Skunk River Basin, Iowa	X	X		X	X				X		X				
24	Middle Des Moines River, Iowa		X		X	X	X			X		X			X	
25	Upper Des Moines River Basin, Iowa & Minnesota	X	X		X						X	X			X	
Subregion 704	Salt-Sny-Illinois	O	O		O	O	O			O	O	O	O		O	
Area 26	Sangamon River Basin, Illinois	X	X		X	X	X			X		X				
27	Lower Illinois River & Tributaries, Illinois	X	X			X	X			X		X	X			
28	Middle Illinois River & Tributaries, Illinois	X	X			X	X			X		X	X	X		
29	Upper Illinois River & Tributaries, Illinois		X			X	X			X		X	X			
30	Kankakee River Basin, Illinois & Indiana					X	X			X		X	X		X	
31	Fox River Basin, Illinois & Wisconsin	X	X			X	X			X		X			X	
32	Fabius River Basin, Missouri	X	X		X	X	X			X		X			X	
33	Salt River Basin, Missouri	X	X		X	X	X			X		X			X	
Subregion 705	Lower Upper Mississippi	O	O		O	O	O			O		O	O		O	
Area 34	St. Louis S.M.S.A., Illinois & Missouri	X	X		X	X	X			X		X	X		X	
35	Lower Mississippi River Basin, Illinois & Missouri					X	X			X		X	X		X	
36	Big Muddy River and Tributaries, Illinois		X			X	X			X		X				
37	Kaskaskia River Basin, Illinois		X			X	X			X		X	X		X	

Figure 7-7b. Problem Matrix

Table 7-7
Problem area rating
Upper Mississippi Region

Problem area Name (State involved)
PROBLEM AREAS OF MAJOR URGENCY
Upper Mississippi River Main Stem (Illinois, Iowa, Minnesota, and Wisconsin)
Middle Mississippi River Main Stem (Illinois, Iowa, and Missouri)
St. Louis SMSA (standard metropolitan statistical area) (Illinois and Missouri)
Lower Mississippi River Basin (Illinois and Missouri)
Kaskaskia River Basin (Illinois)
Sangamon River Basin (Illinois)
Middle Illinois River and Tributaries (Illinois)
Upper Illinois River and Tributaries (Illinois)
Fox River Basin (Illinois and Wisconsin)
Upper Rock River Basin (Illinois and Wisconsin)
Minneapolis-St. Paul SMSA (Minnesota)
Upper Minnesota River Basin (Minnesota and South Dakota)
Lower Minnesota River Basin (Minnesota)
Middle Cedar River Basin (Iowa)
Middle Des Moines River (Iowa)
PROBLEM AREAS OF MAJOR/MODERATE URGENCY
Big Muddy River and Tributaries (Illinois)
Lower Illinois River and Tributaries (Illinois)
Kankakee River Basin (Illinois and Indiana)
Lower Rock River Basin (Illinois)
Pecatonica River Basin (Illinois and Wisconsin)
Lower Wisconsin-LaCrosse River Basin (Wisconsin)
Central Wisconsin River Basin (Wisconsin)
Lower Chippewa River Basin (Wisconsin)
Upper Cedar River Basin (Iowa and Minnesota)
Lower Iowa-Cedar Rivers (Iowa)
Middle Iowa River (Iowa)
Skunk River Basin (Iowa)
Fabius River Basin (Missouri)
Salt River Basin (Missouri)
Upper Des Moines River Basin (Iowa and Minnesota)
PROBLEM AREAS OF MODERATE/MINOR URGENCY
Kishwaukee River Basin (Illinois)
Upper Wisconsin River Basin (Wisconsin)
Upper Chippewa River Basin (Wisconsin)
Mississippi River Headwaters (Minnesota)
Clearwater River Basin (Minnesota)
Crow River Basin (Minnesota)
Black, Buffalo, and Trempealeau River Basins (Wisconsin)

Individual Problem Areas

Problem Area : Upper Mississippi River Main Stem Area

WRC REGION: 7 SUBREGION: 702 and 703

STATES: Illinois, Iowa, Minnesota, and Wisconsin PROBLEM AREA NO.: 7

The Upper Mississippi River Main Stem Problem Area includes the Mississippi River and immediate drainage area from the southern limits of the Quint Cities SMSA north to the southern limits of the Minneapolis-St. Paul SMSA. The area includes Scott, Clinton, Jackson, Dubuque, Clayton, Muscatine, and Allamakee Counties (Iowa); Whiteside, Carroll, Jo Daviess, and Rock Island Counties (Illinois); Pierce, Grant, Crawford, Vernon, LaCrosse, Trempealeau, Buffalo, and Pepin Counties (Wisconsin); and Houston, Winona, Wabasha, and Goodhue Counties (Minnesota). The problem sites are Winona, Minnesota; LaCrosse and Prairie du Chien, Wisconsin; Dubuque and Clinton, Iowa, and the Quint Cities SMSA. The topography can generally be described as rugged with steep bluffs often rising sharply from the river's banks. Surface-water and ground-water resources are quite plentiful. Unconsolidated deposits underlying the long narrow strip of the Mississippi River are generally capable of yielding greater than 500 gpm to individual wells.

Water Issues

- o There are localized point sources of pollution at major urban centers from municipal and industrial waste discharges and from sewage wastes from pleasure and work boats. High turbidity results from erosion and natural runoff and from the addition of domestic sewage from municipal and industrial sources. Significant nonpoint pollution problems stem from agricultural land runoff resulting in high chemical (TDS) and bacterial concentrations, nutrient levels, and lake eutrophication. Two large lakes (greater than 100 acres), totalling 1,050 acres in Grant County, Wisconsin, are classified as very eutrophic. This represents one-third of the large lakes in the Wisconsin portion of the analytical area. Potential water quality problems are associated with runoff from lead and zinc mines in southwestern LaFayette and southeastern Grant Counties in Wisconsin. There is serious PCB contamination of fish habitat areas in Lake Pepin. Some concern has also been expressed about the deterioration of ground-water quality in the fractured and cavernous limestone areas of southeastern Minnesota. Sinkholes complicate the problem.

Related Land Issues

- o Urban flood damages are major in the following cities in the problem area (from north to south):

  Minnesota: Hastings, Red Wing, Frontenac, Lake City, Read

Landing, Wabasha, Winona, Homer, LaMoille, Dresbach, and La-Crescent.

Wisconsin: Prescott, Trenton, Bay City, Maiden Rock, Stockholm, Deer Island, Alma, Buffalo City, Cochrane, Fountain City, Trempealeau, Onalaska, North LaCrosse, LaCrosse, Stoddard, Genoa, DeSoto, Ferryville, Lynxville, Prairie du Chien, Brice's Prairie, and Cassville.

Illinois: East Dubuque, Savanna, Fulton, Albany, Cordova, East Moline, Moline, and Rock Island.

Iowa: Dubuque (flood damages in Dubuque have been substantially reduced by completion of a flood-control project), Bellevue, Sabula, Clinton, LaClair, Bettendorf, and Davenport. Major flood damages occur to agricultural lands between Guttenberg, Iowa, and the Quint Cities. Moderate flood damages occur to recreation lands and facilities, particularly marinas and boat landings. Nine flood-prone communities in the three Wisconsin counties bordering the Mississippi River do not have flood-plain ordinances. Four others are not enrolled under the Federal Flood Insurance Program although they do have ordinances.

- Erosion damages are significant along the Mississippi River and adjacent lands. The highly erosive character of the loess soils and glacial ridges combined with increased flooding and changing shoreland uses have accelerated these erosion problems. Heavy bedload sediment results in shoaling of the navigation channel, requiring maintenance dredging for navigation purposes. Sediment inflicts major damage in and along the Mississippi River to fish and wildlife habitat and recreation water areas. In the Wisconsin portion of the Upper Mississippi River Main Stem Analytical Area, 804,135 acres or 57 percent of the land area needs soil conservation treatment; 109,650 acres or 7.7 percent of the total acreage is classified as "critical" (soil losses are in excess of 20 tons per acre).

- Dredged materials and natural siltation are deposited in sloughs, backwater areas, wetlands areas, fish and wildlife habitat, and in rivers and streams. Land-use conflicts associated with the location and placement of dredged materials are emerging.

- Development of an intensive, high-value agriculture in the flood plain has led to a significant decrease in the forestland resource and increased the potential for agricultural flood damages in these flood-plain areas. In addition, structures which constrict the floodway contribute to increased flood heights for the same discharge flood, and any additional development in the watershed creates impervious surfaces which increase runoff. This is particularly apparent at Alma, Genoa, and Cassville, Wisconsin.

- Land use conflicts and changes are resulting from the alteration of the natural setting of the Mississippi River Valley to facilitate agricultural and urban uses.

Adverse Effects

- Use of surface water as a potable water supply for domestic and livestock uses is restricted. Treatment is required prior to its use as a municipal water supply.

- Average annual urban and rural flood damages are estimated to be $195,760 per mile by 1980 (1975 Dollars). Flood damages reduce property values, curtail agricultural and industrial production in flood-plain areas, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, increased maintenance costs of public and private property, deterioration of recreation lands and facilities, and loss of productive agricultural topsoils with a corresponding decrease in agricultural production.

- Further shoaling of the navigation channel results in continued costs for dredging operations. Reduction in commercial navigation may result from the siltation and filling in of the navigation channel. Channel maintenance costs are directly attributable to the deposition of streamborne sediments. Average annual dredging volume in Pools 3 through 10 during the period from 1956 to 1970 equaled about 1,151,900 cubic yards. Another 1,016,000 cubic yards was dredged annually from Pools 11 through 22 during the same period. By 1973, about 2,060 acres of land had been created by deposition of dredged materials in Pools 3 through 10.

- Erosion and flooding problems are accelerating as a result of flood-plain and shoreland developments.

- Quantity and quality of recreation opportunities are declining due to pollution and destruction of natural water and land habitat. Primary contact recreation use of the Mississippi River between Hastings and Lake City and immediately downstream from the following urban areas is severely impaired: Winona, Minnesota; LaCrosse and Prairie du Chien, Wisconsin; and Clinton, Dubuque, and Quint Cities, Iowa. High fecal coliform counts in the Bad Axe and Grandplatte Basins make water unsuitable for body-contact recreation uses. Recreation values are impaired on 1,050 acres of lakes within the Wisconsin portion of the analytical area due to eutrophication or other problems.

- Fish and wildlife habitat and wetlands are being reduced, and steambanks, scenic amenities, and other environmental resources are being degraded.

- Tourism potential and associated economic benefits associated with tourism are being suppressed by water quality problems.

Problem Area : Middle Mississippi River Main Stem Area

WRC REGION: 7 SUBREGIONS: 703 and 704

STATE: Illinois, Iowa, and Missouri PROBLEM AREA NO.: 14

The Middle Mississippi River Main Stem Problem Area includes the Mississippi River and immediate drainage area from the northern limits of the St. Louis SMSA up to the southern limits of the Quint Cities SMSA. The area encompasses about 2,800 square miles and includes portions of Lincoln, Pike, Ralls, Marion, and Lewis and Clark Counties in Missouri; Calhoun, Pike, Adams, Hancock, Henderson and Mercer Counties in Illinois; and Lee, Des Moines and Louis Counties in Iowa. The problem area has a population of approximately 330,000 people and its largest cities are Hannibal, Missouri; Burlington, Fort Madison, and Keokuk, Iowa; and Quincy, Illinois. The topography of the problem area can generally be described as rugged with steep bluffs. Flood plains along the Main Stem vary in width up to 10 miles, thus affording excellent alluvial soils for agricultural truck farming. Both ground-water and surface-water resources are quite plentiful. The recharge capacity of the Mississippi River bed is capable of producing high ground-water yields in excess of 500 gpm.

Water Issues

- Localized point sources of pollution at major urban centers stem from industrial and municipal waste discharges. High turbidity, attributable to suspended and colloidal matter, results from erosion and flooding.

- There are locally high concentrations of bacteria and nutrients stemming from point and nonpoint pollutants throughout the problem area. Eutrophication and aquatic growth problems are emerging in late summer and fall months.

Related Land Issues

- Urban flood damage are major in the following cities: Burlington, Fort Madison, and Keokuk (Iowa); New Boston, Keithsburg, Dallas City, Niota, and Quincy (Illinois); and Canton, LaGrange, Hannibal, and Louisiana (Missouri). Major flood damages occur to agricultural and rural properties, especially in the flood-plain areas adjacent to the river. Moderate flood damages occur to power-generating facilities and recreation lands and facilities.

- Streambank erosion problems along the Main Stem are accelerated by flooding and changing land uses. Heavy bedload sediment, resulting in shoaling of the navigation channel, requires extensive maintenance dredging. Major sediment damage occurs in and along the Mississippi River to fish and wildlife habitat. The average daily sediment load of the Mississippi River at Hannibal, Missouri, is over 70,000 tons per day.

- Dredged materials and natural siltation are deposited in sloughs, backwater areas, wetlands areas, fish and wildlife habitat, and rivers and streams.

- Development of an intensive, high-value agriculture in the flood plain has increased the potential for flood damage. Streambank erosion that affects this intensive agriculture becomes an immediate and severe problem. Conversion of shoreland areas to agricultural, residential, and other land uses results in a decrease in forest areas, loss of wildlife habitat, and increased flooding and erosion problems.

Adverse Effects

- Use of surface water as a potable water supply for domestic and livestock uses is restricted. Treatment is required prior to its use as a municipal water supply.

- Average annual urban flood damages are estimated to be $26,670 per mile by 1980 (1975 dollars). Property values will be reduced; agriculture, industrial operations, and power production will be curtailed; and recreation lands and facilities will deteriorate.

- Commercial fishing resources will deteriorate further due to destruction of fish habitat.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and degradation of productive agricultural acreages. The sediment load in the Mississippi River is also a significant factor in the loss or degradation of fish, migratory bird, and fur-bearing animals habitat areas.

- Further shoaling of the navigation channel results in continued costs for dredging operations. Siltation and filling in of the navigation channels may result in reduced commercial naviation. Channel maintenance costs are directly attributable to the deposition of streamborne sediments.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. Erosion is accelerating and flooding problems are becoming intensified as a result of this flood-plain and shoreland development.

- Recreation opportunities are diminishing in quantity and quality due to pollution and destruction of natural water and land habitat. Primary-contact recreation in the Mississippi River is severely impaired immediately below the following urban areas: Burlington, Fort Madison, and Keokuk, Iowa; Quincy, Illinois; and Hannibal, Missouri.

- Deterioration and reduction of fish and wildlife habitat and wetlands continues. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : St. Louis SMSA Area

WRC REGION: 7 SUBREGION: 705

STATES: Illinois and Missouri PROBLEM AREA NO.: 34

Problem Area 34 consists of the St. Louis SMSA in central Missouri and southwest Illinois. The problem area covers approximately 4,100 square miles and includes all of Madison and St. Clair Counties and the city of St. Louis in Missouri. The area has a population of about 2.5 million and its major city is St. Louis. Major rivers in the problem area are the Mississippi, Meramec, Bourbeuse, Big, Kaskaskia, and lower Missouri Rivers. The topography of the Missouri portion of the area is generally characterized as hilly with steep, well-defined river valleys. The topography of the Illinois portion of the area is generally characterized as flat flood-plain areas rising to flat plateau areas. Ground-water resources in the area are generally quite plentiful with pockets of deficiency problems. Unconsolidated deposits of sand and gravel are capable of yielding greater than 500 gpm to individual wells. Ground-water yields west of the Mississippi River Valley are also quite adequate; however, ground-water problems arise at several locations in the problem area. Surface-water resources are also generally ample. The major rivers in the problem area have well-sustained flows, even during drought periods; however, they are susceptible to local low-streamflow problems due to extremely high consumptive demands. Streamflows of several of the small tributaries to the major river corridors are quite variable with a potential for local low-streamflow problems in the more densely settled areas.

Water Issues

- Localized water quality problems throughout the St. Louis area result from discharges of municipal and industrial wastes and urban storm-water runoff. Severe taste and odor problems occasionally affect water supplies derived from the Meramec River during times of high streamflow. High concentrations of bacteria and nutrients, excess turbidity, high coliform counts, and high biochemical oxygen demands occur throughout the metropolitan area and stem from point and nonpoint pollution. Large amounts of nutrients, including nitrogen and phosphorus, enter the area's

hydrologic system as a result of storm-water runoff and may cause eutrophication problems.

- Ground-water supply problems occur east of the Mississippi River Valley in the Illinois portion of the St. Louis SMSA. Future surface-water supply problems are forecast for southern Jefferson County in Missouri.

- Shallow ground-water supplies are contaminated in localized areas with bacteria, and with nitrates and other chemicals, particularly in northern Jefferson County and in the East St. Louis area. Inadequate solid and liquid waste disposal systems and improperly constructed wells result in the contamination of these shallow ground-water supplies. Ground-water intrusion is also a problem as a result of both natural and man-induced causes (pumping). Consequently, many areas are forced to utilize highly mineralized water supplies to meet their needs.

- Fluctuating ground-water levels cause extensive damage to sub-structures of urban and industrial properties in the East St. Louis area.

- The need for the rehabilitation, replacement, modification, and modernization of Lock and Dam 26 has caused some controversy. Locking facilities for commercial navigation are currently inadequate.

- Flat-water recreation opportunities are lacking in Missouri near the St. Louis SMSA.

Related Land Issues

- Major urban flood damage problems in the St. Louis metropolitan area occur as a result of prolonged high water levels on the major rivers and flash floods on the smaller tributaries. Floods regularly cause extensive flood damage to recreation facilities and recreation and environmental resources. Rural properties and agricultural lands on the periphery of the metropolitan area sustain severe flood damages. The man-induced changes in the river cross-section, including flood-plain development, have created stages which are much higher now than in the past for given flood discharges.

- Significant sheet, gully, and streambank erosion are sustained by rural and urban properties, agricultural and recreation lands, and by environmental resources throughout the metropolitan area. Erosion problems are especially severe in the periphery areas which are experiencing rapid urban development. Significant sediment damage along the Mississippi River Main Stem, the Missouri, Meramec, Bourbeuse and Big Rivers, and the Lower Meramec Basin are about 2,000 tons per square mile, and in the lower Kaskaskia Basin, about 1,600 tons per square mile (both from a 1,000 square-mile

watershed). Sediment loads transported by the Main Stem average about 500,000 tons per day at St. Louis.

- Heavy bedload sediment causes shoaling of the navigation channel requiring maintenance dredging for navigation purposes. Dredged materials are deposited in sloughs, backwater areas, wetlands areas, fish and wildlife habitat, and rivers and streams.

- Conversion of shoreland areas to agricultural and urban uses results in a decrease in forest areas, loss of wildlife habitat, and potential flooding and erosion problems.

Adverse Effects

- There are restrictions on use of surface- and ground-water supplies for domestic and livestock needs and for certain manufacturing processes, primarily food processing industries. Treatment is required to make the water suitable for use.

- There is a potential deficiency in ground-water supplies in the far eastern segments of the St. Louis SMSA. In St. Charles, St. Louis, and Jefferson Counties, a lack of natural, sustained low flows on many smaller tributary streams may make it necessary to utilize storage reservoirs if year-round surface water supplies are required. However, extensive water treatment would be required to make this water suitable for use.

- By 1980, rural and urban flood damages are expected to reach an annual average of $23,600 per mile along the Kaskaskia River; $6,280 per mile along Silver Creek; $723,600 per mile along Richland Creek in Belleville, Illinois, and $15,800 per mile in downstream areas; $26,700 per mile on the lower Meramec River; $4,750 per mile along the Big River; $9,500 per mile along the Bourbeuse River; and $7.5 million per mile along the Mississippi River Main Stem from river mile 170 to 203 (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities. Flooding along small urbanized streams in the area causes major economic losses. For example, Moline Creek, which has a total drainage area of only about 25 square miles, averages more than $766,500 in damages from a 10-year frequency flood and more than $2,299,500 from a 50-year frequency flood.

- Further deterioration of the commercial fishing resource will occur due to destruction of fish habitat.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and degradation of productive agricultural acreages leading to decreased agricultural production.

- Further shoaling of the navigation channel incurs continued costs for dredging operations. Sedimentation and filling in of the navigation channel could reduce commercial navigation. Channel maintenance costs are directly attributable to the deposition of streamborne sediment. Navigation plays a major role in the economic viability of the upper Midwest. There are constraints at existing locks and at Dam 26 on existing and potential commercial navigation.

- Valuable recreation land is being lost to agricultural and urban development in flood-plain and shoreline areas. Accelerated erosion and increased flooding problems result from this flood-plain and shoreland development. In addition, scattered urban development in the high-growth fringe areas of the St. Louis SMSA has resulted in the proliferation of privately operated waste treatment facilities, these facilities contributing substantial quantities of partially treated water effluents to several of the area's smaller streams, creating pollution problems.

- Recreation opportunities have been reduced in quantity and quality in the St. Louis area due to pollution and destruction of natural water and land habitat. The lack of adequate water-oriented recreation facilities in the urban area has resulted in a large, unsatisfied recreation demand.

- Fish and wildlife habitat and wetlands areas are deteriorating and being reduced; streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Lower Mississippi River Basin

WRC REGION: 7 SUBREGION: 705

STATES: Illinois and Missouri PROBLEM AREA NO.: 35

The Lower Middle Mississippi River Basin Problem Area includes the Mississippi River and immediate drainage area including the lower Cache Basin, from Cairo, Illinois, up to the southern limits of the St. Louis SMSA. The problem area encompasses approximately 2,100 square miles and includes portions of Cape Girardeau, Perry, St. Genevieve, and Scott Counties in Missouri, and Alexander, Jackson, Monroe, Pulaski, Randolph, and Union Counties in Illinois. The area has a population of about 150,000 people, and its largest cities are Cairo, Illinois, and Cape Girardeau, Missouri. The area's topography can generally be described as rugged with steep bluffs often rising sharply from the river's bank. Surface-water and ground-water resources are quite plentiful. Ground-water yields in the Mississippi River flood plain will generally range from 500 to 1,000 gpm to individual wells.

Water Issues

- Water quality problems exist on the Cache River near Jonesboro,

Illinois; Cape Cinque Hommes River near Perryville, Missouri; Hubble Creek near Jackson, Missouri; and the Main Stem of the Mississippi River. These stem from municipal, industrial, and agricultural waste pollutants. Nonpoint pollution problems throughout the problem area are caused by pesticide, fertilizer, and animal waste runoff. High concentrations of nutrients and bacteria, high turbidity, and high biochemical oxygen demands throughout the problem area stem from point and nonpoint pollution sources. Eutrophication problems are common on the Mississippi River Main Stem in late summer and fall months.

- There are high concentrations of dissolved solids, iron, and manganese in the ground-water resources of the Cache River Basin.

Related Land Issues

- Urban flood damages are major in St. Genevieve, St. Marys, and Cape Girardeau, Missouri and Kaskaskia, Illinois. Rural properties and agricultural lands are also severely damaged by floods. Flood damages to recreation lands and facilities are moderate.

- Severe sheet, gully, and streambank erosion affects rural properties, agricultural and recreation lands, and environmental resources.

- Extensive sediment damage occurs on the Mississippi River Main Stem. Sediment loads transported by the Lower Mississippi River Main Stem exceed 500,000 tons per day.

- Heavy bedload sediment causes shoaling of the Mississippi River navigation channel requiring maintenance dredging for navigation purposes. Dredged materials are deposited in sloughs, backwater areas, wetland areas, fish and wildlife habitat, and rivers and streams.

- Shoreland and flood-plain areas are being converted to agricultural and urban uses resulting in the depletion of forest areas, loss of wildlife habitat, and potential flooding and erosion problems.

Adverse Effects

- Use of surface- and ground-water supplies for domestic purposes and livestock is restricted. Only limited use can be made of surface-water resources for certain manufacturing purposes, primarily food processing industries, due to excessive turbidity and sediment concentrations and inadequate water quality.

- Average annual urban and rural flood damages for 1980 are estimated at $70,520 per mile along the Mississippi River and $12,260 per

mile along the Cache River. Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- o Commercial fishing resources are deteriorating due to destruction of fish habitat.

- o Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages.

- o Further shoaling of the navigation channel results in continued costs for dredging operations. Siltation and filling in of the navigation channel may reduce commercial navigation.

- o Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas.

- o Fish and wildlife habitat and wetlands are deteriorating and being reduced. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Big Muddy River and Tributaries Area

WRC REGION: 7 SUBREGION: 705

STATE: Illinois PROBLEM AREA NO.: 36

The Big Muddy River and Tributaries Problem Area in south-central Illinois includes the entire Big Muddy River Basin which drains to the Mississippi River. The problem area encompasses approximately 2,200 square miles and includes major portions of Jackson, Williamson, Perry, Jefferson, and Franklin Counties. The area has a population of about 165,000 people, and its largest city is Carbondale. The topography of the area ranges from gently rolling to hilly country in the north and east to a relatively flat relief in the southern and western parts of the basin. Ground-water resources, except for the southwestern portion of the basin in the Mississippi River flood plain, are quite deficient. Except for this southwestern portion of the basin, there is little chance of obtaining significant ground-water supplies for municipalities or large water-using industries.

Surface-water resources are quite variable. During periods of high streamflows, flood damages occur; during low streamflows, many water uses cannot be accommodated.

Water Issues

- o Water quality problems, resulting from high concentrations of municipal, industrial, and agricultural waste pollutants, exist

on Beaucoup Creek near DeQuoin, Casey Fork near Mount Vernon, Middle Fork near West Frankfort, Lake Creek near Johnston City, Hurricane Creek near Herrin, Crab Orchard Creek near Marion and Carbondale, and on the Big Muddy River near Benton and Murphysboro. Acid-water drainage from active and abandoned coal mining areas is a critical problem on Pond Creek. High concentrations of bacteria and nutrients stem from point and nonpoint pollution throughout the problem area. Eutrophication and aquatic growth problems are emerging at several locations in the Big Muddy Basin.

- Ground-water supplies are not sufficient for municipalities, large water-using industries, and agricultural uses especially in the northern and eastern portions of the basin. Ground-water supplies contain significant concentrations of dissolved solids, iron, and manganese.

Related Land Issues

- Floods damage the Carbondale, Murphysboro, and West Frankfort urban areas. Rural properties and agricultural lands are severely damaged by floods along the Middle Fork and Little Muddy River, Beaucoup Creek, and upstream areas above Crab Orchard Reservoir.

- Severe streambank, gully, and sheet erosion damages rural properties, agricultural and recreation lands, forest areas, coal-mining areas, and environmental resources. Significant sediment damage occurs throughout the Big Muddy Basin. Sediment yields are greater than 500 tons per square mile from the entire area.

- There are land subsidence problems in Franklin, Perry, and Jackson Counties.

Adverse Effects

- Ground-water supplies for large scale, municipal, industrial, agricultural, and mining uses are insufficient in the northern and eastern portions of the Big Muddy Basin.

- Use of surface water and ground water as a potable water supply for domestic needs and livestock and as a suitable water supply for food processing industries is restricted. Surface water is characterized by excess turbidity and high concentrations of nutrients and suspended sediment. Ground-water resources contain high concentrations of dissolved solids, iron, and manganese.

- Annual urban and rural flood damages are estimated for 1980 at $4,600 per mile on the Big Muddy, $3,070 per mile along the upstream areas above Crab Orchard Reservoir and along the Middle Fork River, and $1,530 per mile along the Little Muddy and Beaucoup Rivers (1966 prices and conditions). Floods reduce property values and curtail agricultural and industrial production.

- Erosion and sedimentation decrease property values in rural areas and cause deterioration of recreation lands and facilities and loss of productive agricultural acreages. Strip mine and coal production areas are also degraded by erosion and sedimentation, resulting in decreased production. Property values are reduced and productive agricultural lands are lost to land subsidence.

- Recreation uses involving whole-body water contact are severely impaired on Beaucoup Creek near Du Quoin, Casey Fork near Mount Vernon, Middle Fork near Frankfort, Lake Creek near Herrin, Crab Orchard Creek near Marion and Carbondale, and on the Big Muddy River near Benton and Murphysboro.

- Fish and wildlife habitat and wetlands are being reduced. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Kaskaskia River Basin Area

WRC REGION: 7 SUBREGION: 705

STATE: Illinois PROBLEM AREA NO.: 37

The Kaskaskia River Basin Problem Area, which lies in south-central Illinois, includes the Kaskaskia River and its tributaries which drain to the Mississippi River. The problem area encompasses approximately 3,500 square miles and includes all of Bond and Fayette Counties and portions of Montgomery, Clinton, Randolph, Marion, Shelby, and Moultrie Counties. The area has a population of about 175,000 people and its largest cities are Fayetteville, Centralia, Vandalia, and Greenville. The topography of the Kaskaskia basin ranges from generally hilly terrain in the southwest to nearly level land in the northeastern portion of the area. The availability of ground water in the basin varies considerably from one location to another. Generally, in the lowlands of the Kaskaskia River and its major tributaries, ground-water yields are ample. However, in the upland areas, ground-water resources are quite limited, requiring extensive test drillings to locate water-yielding beds. Surface-water resources are subject to large fluctuations in streamflow.

Water Issues

- Present ground-water yields in the uplands of the Kaskaskia Basin provide only enough water to sustain limited water withdrawal demands except in the Wisconsin Drift above Shelbyville. Large, concentrated demands on local ground-water supplies in these upland areas could create a serious ground-water supply problem. Future water requirements for coal production alone are projected to nearly double between 1975 and 2000. Ground-water supplies in these upland areas could create a serious ground-water supply problem. Future water requirements for coal production alone are projected to nearly double between 1975 and 2000. Ground-

water supplies taken from bedrock aquifers yield brackish and saline waters suitable for most water withdrawal purposes. Yields from glacial drift and alluvial aquifers are characterized by high concentrations of bicarbonate, iron, and dissolved solids.

- Locally high consumptive demands during drought periods may cause serious local streamflow problems in much of the problem area.

- There are water quality problems on the Kaskaskia River at Shelbyville Reservoir and Carlyle Reservoir stemming from wastes from upstream municipal waste treatment plants. Other water problems at Litchfield, Hillsboro, and Breese along Shoal Creek stem from high concentrations of municipal and agricultural waste pollutants. Nonpoint pollution throughout the problem area stems from agricultural land runoff and acid-mine drainage. High concentrations of bacteria and nutrients and high biochemical oxygen demand throughout the problem area stem from point and nonpoint pollution. There are eutrophication problems in Carlyle and Shelbyville Reservoirs.

Related Land Issues

- Floods damage the urban area of Vandalia and cause severe damages to rural properties and agricultural lands along the Kaskaskia River and Shoal and Crooked Creeks. Moderate flood damages affect recreation lands and facilities.

- Significant sheet, gully, and streambank erosion occurs on rural properties, in coal mining areas, on agricultural and recreation lands, and to environmental resources. Sediment damages are significant throughout the problem area. Over a 10 square-mile area, sediment loads range from a maximum of 9,500 tons per square mile to a minimum of 950 tons per square mile. The suspended sediment concentration frequently reaches several thousand parts per million.

- Conversion of shoreland areas to agricultural and urban uses results in a decrease in forest areas, loss of fish and wildlife habitat, and an increase in flooding and erosion problems. There is conflict between agricultural, mining, urban, and environmental interests over the use of the basin's water and related land resources.

Adverse Effects

- Ground-water supplies are deficient for large-scale water uses in the upland areas of the Kaskaskia River Basin. Conflicts are emerging between agricultural, mining, urban, and environmental interests over the use of the limited water supplies in the problem area.

- There are restrictions on the use of surface water and ground

water as potable water supplies for domestic and livestock uses as well as for food processing industries and petroleum production, which requires both potable and saline water in its operation. Treatment is required before they can be used as potable water supplies.

- Annual urban and rural flood damages are estimated to reach $23,600 per mile in 1980 along the Kaskaskia River up to the north end of Carlyle Reservoir, $32,960 per mile between Carlyle and Shelbyville Reservoirs, $7,820 per mile along Shoal Creek, and $7,820 per mile along Crooked Creek (1975 Dollars). Floods reduce property values, curtail agricultural and industrial production, and cause continued deterioration of recreation lands and facilities.

- Fish and wildlife habitat is being destroyed and water quality is being severely impaired as a result of drainage from active and abandoned coal mines and from roads constructed from mine wastes. The estimated cost for controlling water pollution from mine drainage in Illinois to comply with Public Law 92-500 is $530 million.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, loss of productive topsoil resources resulting in decreased agricultural production, and degradation of strip-mine and coal-producing stress resulting in decreased production. Lakes and streams are becoming filled with sediment as a result of erosion. Counties in the Kaskaskia River Basin Area with 60 percent or more of the tilled agricultural land area requiring soil conservation practices include the following: Washington (64 percent); Bond (62 percent); Montgomery (70 percent); and Shelby (60 percent).

- Recreation uses involving whole-body water contact on the Kaskaskia River and Shoal Creek are being severely impaired. Recreation lands are being lost to agricultural development in floodplain and shoreland areas. High-quality hunting areas are being reduced due to reduction in wildlife habitat. Eutrophication problems in late summer and fall months restrict use of the area's lakes and reservoirs.

- Deterioration and reduction of fish and wildlife habitat and wetlands as well as degradation of streambanks, scenic amenities, and other environmental resources are ongoing problems.

Problem Area : Sangamon River Basin Area

WRC REGION: 7 SUBREGION: 704

STATE: Illinois PROBLEM AREA NO.: 26

The Sangamon River Basin Problem Area lies in central Illinois. It

includes the Sangamon River and its tributaries which drain to the Illinois River. The problem area encompasses approximately 4,400 square miles and includes all of Dewitt, Logan, and Menard Counties, and portions of Cass, Christian, McLean, Macon, Mason, Piatt, and Sangamon Counties. The area has a population of about 425,000, and its largest cities are Bloomington, Decatur, and Springfield. The Sangamon River has its headwaters in McLean County and flows southeasterly for 50 miles and then turns south and west, flowing towards its confluence with the Illinois River in Cass County. The topography of the basin is characterized by a gently rolling plain. Ground-water resources vary according to location. Generally, yields are quite adequate in the northern portions of the basin and throughout the basin in the river valleys and bedrock valleys. Yields in other areas in the southern portion of the basin are generally deficient. Surface-water resources are also quite variable. The Sangamon River generally has a good, sustained flow; however, several of its tributaries have minimum daily flows near zero in late summer and fall months.

Water Issues

- Large concentrated demands on surface and ground water in the southern portion of the basin, especially at Decatur and Springfield, could create a serious water supply problem. Consumptive demands which are locally high during drought periods may cause serious local streamflow problems in these areas.

- There are water quality problems on Sugar Creek below Bloomington, on the Flat Branch and South Fork Rivers, and on the Sangamon River below Decatur stemming from high concentrations of municipal, industrial, and agricultural waste pollutants. There are nonpoint pollution problems throughout the problem area due to pesticide, fertilizer, and animal waste runoff. High concentrations of bacteria and nutrients and high biochemical oxygen demands throughout the problem area are caused by point and nonpoint pollution. Eutrophication problems are serious in the basin, especially in Lake Decatur, Lake Springfield, and Taylorville Lake Reservoirs.

- Significant hardness and high iron concentrations in surficial aquifers restrict their use as potable water supplies. Yields from the deeper aquifers contain higher concentrations of minerals, and the quality of water in these deeper aquifers deteriorates with increasing depth.

Related Land Issues

- Urban flood damages are moderate in Decatur and in several smaller urban areas. Flood damages to rural properties and to agricultural lands are severe, especially along the Sangamon River, Salt Creek, South Fork River, and Sugar Creek. Flood damages to recreation lands and facilities are moderate.

- Severe sheet, gully, and streambank erosion damages rural proper-

ties, strip-mine areas, agricultural and recreation lands, and environmental resources. Sediment damages are significant throughout the problem area. Representative annual sediment yields in the basin are about 1,100 tons per square mile (10 square-mile drainage area).

Adverse Effects

- Use of surface water and ground water as potable water supplies for domestic purposes and livestock is restricted. In addition, use of surface water for industrial processing is restricted due to excessive turbidity and sedimentation. There are potential deficiencies in suitable ground water for food processing industries.

- There are potential deficiencies in surface-water and ground-water supplies for all uses in the southern portion of the basin, especially in the Decatur and Springfield areas.

- Annual urban and rural flood damages for 1980 are estimated at $29,120 per mile along the Sangamon River (river miles 0-131), $26,060 per mile along the South Fork River, and $12,260 per mile along Sugar Creek (1975 prices and conditions). Flooding reduces property values, curtails agricultural, industrial, and power production, and causes deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, loss of productive agricultural acreages and decreased agricultural production, and erosion of strip-mine and coal-producing areas, which restricts production.

- Recreation involving whole-body water contact is severely impaired on Sugar Creek below Bloomington, on the Flat Branch and South Fork Rivers, and on the Sangamon River below Decatur.

- Continued deterioration and reduction of fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other environmental resources are ongoing problems.

Problem Area : Lower Illinois River and Tributaries Area

WRC REGION: 7 SUBREGION: 704

STATE: Illinois PROBLEM AREA NO.: 27

The Lower Illinois River and Tributaries Problem Area, which lies in west-central Illinois, includes the lower 130 miles of the Illinois River and its drainage area, excluding the Sangamon River Basin. The problem area encompasses 5,100 square miles and includes all of Brown,

Jersey, McDonough, and Schuyler Counties, and portions of Adams, Cass, Fulton, Greene, Hancock, Knox, Macoupin, Mason, Morgan, and Scott Counties. The area has a population of about 275,000 people and its largest city is Jacksonville. The topography of the area is characterized by a gently rolling plain. The Illinois River Valley is characterized by flat bottoms which exceed 8 miles of width in certain areas. The width of the stream varies from about 700 feet to approximately 1,400 feet near its confluence with the Mississippi River. Ground-water resources are generally quite adequate. Ample supplies of ground water are available from both surficial and bedrock aquifers. Surface-water resources are also quite adequate. The Illinois River Main Stem has high sustained flows throughout the year due to flow regulation, base flow from ground sources, and inflow from the major tributaries.

Water Issues

- There is a potential water supply problem along the La Moine River.
- Water quality problems on Killjordan Creek near Macomb, Macoupin Creek near Carlinville, and Mauvaise Terre Creek near Jacksonville stem chiefly from upstream municipal and industrial waste discharges. Severe water quality problems on the entire stretch of the Illinois River stem from upstream municipal and industrial waste discharges and from excessive pesticide, fertilizer, and animal waste runoff in rural areas. There are nonpoint pollution problems throughout the problem area. High concentrations of bacteria and nutrients and high biochemical oxygen demands throughout the problem area result from point and nonpoint pollution. Eutrophication and excessive aquatic growth problems are especially severe in the lower Illinois River in late summer and fall months. Thermal pollution problems on the Illinois River stem from cooling water discharges from steam-electric power plants.
- Ground-water supplies from surficial aquifers have high concentrations of iron, significant hardness problems, and high concentrations of dissolved solids. Yields from the deeper aquifers are also mineralized and the quality of water in these aquifers deteriorates with increasing depth.
- Adequate locking facilities to provide for expected growth in commercial navigation are lacking.

Related Land Issues

- Moderate urban flood damages occur in several smaller communities along the Illinois River. Rural properties and agricultural lands along the Illinois, Spoon, and LaMoine Rivers suffer severe flood damages. Flood damages to recreation lands and facilities are moderate.
- Severe sheet, gully, and streambank erosion affects rural prop-

erties, strip mine areas, agricultural and recreation lands, and environmental resources. There is significant sediment damage throughout the problem area which is especially severe in and along the Illinois River. Representative yields from the very erosive bluff areas along the Illinois River Main Stem are about 8,000 tons per square mile. Yields from the remainder of the problem area are about 1,000 tons per square mile per year (10 square-mile drainage area).

- Heavy bedload sediment results in shoaling of the Illinois River navigation channel requiring maintenance dredging for navigation purposes.

Adverse Effects

- Use of surface water and ground water as potable water supplies for domestic purposes and livestock is restricted, as is use of surface water for industrial processing and cooling purposes. This is due primarily to excessive turbidity and sedimentation. There are potential deficiencies in suitable ground water for food-processing industries.

- Average annual urban and rural flood damages estimated for 1980 are $42,920 per mile along the Illinois River ($68,220 per mile along the lower 80 miles), $21,460 per mile along the Spoon River, and $15,330 per mile along the LaMoine River (1975 prices and conditions). Flooding results in reduction in property values, curtailed agricultural and industrial production, and deterioration of recreation lands and facilities.

- Further deterioration of the commercial fishing resource is occurring due to destruction of fish habitat.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, loss of productive agricultural acreages, and erosion of strip-mine and coal-producing areas which restricts coal production.

- Further shoaling of the Illinois River navigation channel results in continued cost for dredging operations. Commercial navigation is reduced as a result of the siltation and filling in of the navigation channel.

- Recreation uses involving whole-body water contact are severely impaired on Killjordan Creek near Macomb, Macoupin Creek near Carlinville, Mauvaise Terre Creek near Jacksonville, and the entire stretch of the Illinois River.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Middle Illinois River and Tributaries Area

WRC REGION: 7 SUBREGION: 704

STATE: Illinois PROBLEM AREA NO.: 28

The Middle Illinois River and Tributaries Problem Area in central Illinois includes 50 miles of the Main Stem of the Illinois River (river miles 130 to 180), and its immediate drainage area, including the lower two-thirds of the Mackinaw River. The area encompasses approximately 1,800 square miles and it includes all of Peoria, Tazewell, and Woodford Counties. The area has a population of about 350,000 people, and its major cities are Peoria, Pekin, East Peoria, and Morton. The topography of the area is characterized by a gently rolling plain. Ground-water resources in the problem area are generally quite plentiful. A large supply of ground water is available from both surficial and bedrock aquifers. Surface-water resources are also quite plentiful. The Illinois River Main Stem has high sustained flows throughout the year due to flow regulations, base flow from ground-water sources, and inflow from major tributaries, such as the Mackinaw River. However, locally high consumptive demands during late summer and fall months could create potential water supply problems, especially in the Peoria-Pekin Area.

Water Issues

- Locally high consumptive demands during late summer and fall months could create a potentially serious water supply problem in the Peoria-Pekin area.

- Water quality problems along the Illinois and Mackinaw Rivers are due to high concentrations of municipal, industrial, and agricultural waste pollutants. Wastes from metropolitan areas compound water quality problems on the Illinois River. Nonpoint pollution problems throughout the problem area stem from agricultural land runoff. High concentrations of bacteria and nutrients and unsatisfactory dissolved oxygen levels throughout the area stem from point and nonpoint pollution. Eutrophication problems occur in late summer and fall months.

- Significant hardness and high iron concentrations in surficial aquifers restrict their use as potable water supplies. Yields from the deeper aquifers contain higher mineral concentrations, and the quality of water in these deeper aquifers deteriorates with increasing depth.

- There is a lack of adequate locking facilities to provide for expected growth in commercial navigation.

Related Land Issues

- Urban flood damages are moderate in the Peoria-Pekin area. Flood

damages to rural properties and to agricultural lands along the Illinois and Mackinaw Rivers are severe. Flood damages to recreation lands and facilities are moderate.

- Excessive sheet, gully, and streambank erosion damages rural properties, strip-mine areas, agricultural and recreation lands, and environmental resources. Significant sediment damage occurs in and along the Mackinaw River and drainage area. Sediment damage in and along the Illinois River is severe. Typical sediment yields in the central portion of the river area are 1,000 tons per square mile (from a 10 square-mile drainage area).

- Heavy bedload sediment results in shoaling of the Illinois River navigation channel, requiring maintenance dredging for navigation purposes. Dredged material disposal impacts on biological communities.

- Conversion of shoreland areas to agricultural and urban uses results in the decrease of forest areas, loss of fish and wildlife habitat, and an increase in flooding and erosion problems. There is conflict between agricultural, coal-mining, urban, and environmental uses of the problem area's land resources.

Adverse Effects

- Use of surface water and ground water as potable water supplies for domestic purposes and livestock is restricted, as is use of surface water for industrial processing and cooling purposes. This is due primarily to excessive turbidity and hardness. There are potential deficiencies in suitable ground water for food processing industries. Treatment is required prior to its use as a municipal and industrial water supply.

- There are potential deficiencies in ground-water and surface-water supplies for all uses during drought periods in the Peoria-Pekin area. At present, approximately 865 mgd is withdrawn from the Illinois River in Peoria and Tazewell Counties alone. Low streamflow conditions could restrict these water withdrawal needs.

- Average annual flood damages are estimated for 1980 at $44,000 per mile along the Illinois River and $15,800 per mile along the Mackinaw River (1975 dollars). Floods cause reduction in property values, curtailed agricultural and industrial production, and deterioration of recreation land and facilities.

- Further deterioration of the commercial fishing resource is occuring due to destruction of fish habitat.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, degradation of productive agricultural

acreages, and erosion of strip-mine and coal-producing areas, restricting production. Counties in the problem area with 60 percent or more of tilled agricultural land requiring treatment measures include: Peoria (74 percent); Tazewell (71 percent); and Woodford (75 percent).

- o Further shoaling of the Illinois River navigation channel is occurring, resulting in continued costs for dredging operations. Commercial navigation is being reduced by the sedimentation and filling in of the navigation channel. Existing locks constrain the expected growth in commercial navigation.

- o All recreation uses in the problem area are severely impaired, especially those involving water-contact types of recreation. Siltation, urban storm runoff, and eutrophication problems restrict recreation use of the area's lakes.

- o Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. Increased flooding and erosion problems result from this flood-plain and shoreland development.

- o Deterioration and reduction of fish and wildlife habitat and wetlands continues. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Upper Illinois River and Tributaries Area

Note: Since the Chicago metropolitan area was not included in the Upper Mississippi Region for the purposes of the 1975 assessment, this problem area does not include discussion of problem issues concerning the Chicago metropolitan river system which drains into the Illinois River.

WRC REGION: 7 SUBREGION: 704

STATE: Illinois PROBLEM AREA NO.: 29

The Upper Illinois River and Tributaries Problem Area in north-central and central Illinois includes the Illinois River and its drainage area above Woodford and Peoria Counties (river miles 180 to 273). The problem area encompasses approximately 3,400 square miles and includes all of LaSalle, Marshall, and Putnam Counties, and portions of Bureau, Livingston, Ford, and McLean Counties. The area has a population of about 225,000 people, and its largest cities are Ottawa, Pontiac, LaSalle, Peru, and Streator. The Illinois River is formed by the confluence of the Kankakee and Des Plaines Rivers which is located about 9 miles upstream from Morris, Illinois. From there it flows 273 miles in a westerly and then southwesterly direction to the Mississippi River at Grafton, Illi-

nois. The topography of the problem area is characterized by a gently rolling plain. Ground-water resources are generally quite plentiful. A large supply of ground water is available from both the alluvium and glacial deposits along and near most of the Illinois River and from the deeper Cambrian-Ordovician aquifer. Surface-water resources are also ample. The Illinois River has high sustained flows throughout the year due to flow regulation, base flow from ground sources, and inflow from its major tributaries.

Water Issues

- There are potential ground-water supply problems for domestic uses due to declining ground-water levels.

- Water quality problems on the Vermilion and Illinois Rivers stem from high concentrations of municipal, industrial, and agricultural waste pollutants. Waste loads from the Chicago SMSA adversely affect the Illinois River by seriously decreasing dissolved oxygen levels. Nonpoint pollution problems throughout the problem area stem from agricultural runoff. Excessive concentrations of bacteria and nutrients as well as severe biochemical oxygen demands, especially in the northern segments of the Illinois River, come from point and nonpoint pollution sources. There are significant eutrophication and aquatic growth problems.

Related Land Issues

- Urban flood damages are major in Streator, Pontiac, and Mendota. Significant flood damage occurs to rural properties and to agricultural lands, especially along the Vermilion River above Hauder's ford (mile 67) and, to a lesser degree, along the Illinois river. Utilities along the Vermilion River and recreation lands and facilities along both the Illinois and Vermilion Rivers suffer moderate flood damages.

- Severe sheet, gully, and streambank erosion damages rural properties, strip-mine areas, agricultural and recreation lands, and environmental resources. There are significant sediment damages in the northwestern and western portions of the problem area, especially in and along the Illinois River. Representative sediment yields from this area are about 1,100 tons per square mile per year (10 square-mile drainage area).

- Heavy bedload sediment causes shoaling of the Illinois River navigation channel, requiring maintenance dredging for navigation purposes. Dredged material disposal impacts on biological communities. There is a lack of adequate locking facilities to provide for expected growth in commercial navigation.

Adverse Effects

- Use of surface water and ground water as potable water supplies for domestic purposes and livestock is restricted, as is use of surface water for industrial processing and cooling purposes. This is due primarily to excessive turbidity and hardness. At present, approximately 735 mgd is withdrawn from the Illinois and Vermilion Rivers in Grundy, LaSalle, and Putnam Counties. There are potential deficiencies in suitable ground water for food processing industries. Treatment is required prior to use of surface water and ground water for municipal and industrial purposes.

- There are potential future water supply problems in the basin as a result of the loss of artesian pressure in the Cambrian-Ordovician aquifer. Withdrawals since 1958 have exceeded the practical sustained yield of the Cambrian-Ordovician aquifer with the result that ground-water users continue to mine water and to borrow water from future generations. By the end of 1966, the upper units of the aquifer were already being dewatered in many areas. If the distribution of pumpage remains the same and pumpage continues to increase as indicated by recent trends, the principal water-yielding units of the aquifer will be partially dewatered in many areas much sooner than previously anticipated. Pumping levels exceeded 1,000 feet below the surface in a few wells in 1971, and such levels will be common within the next 5 years.

- Urban and rural flood damages occur along the Illinois and Vermilion Rivers. Floods reduce property values; curtail agricultural, industrial, and power production; and cause deterioration of recreation lands and facilities.

- Commercial fishing resources are deteriorating due to destruction of fish habitat.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, degradation of productive agricultural acreages resulting in decreased agricultural production, and erosion of strip-mine and coal-producing areas, restricting production. Sedimentation and filling in of lakes and streams occur as a result of a lack of erosion control. Counties in the problem area with 60 percent or more of tilled agricultural land requiring treatment measures include: Grundy (66 percent), LaSalle (77 percent), Livingston (71 percent), Marshall (79 percent), and Putnam (74 percent).

- Destruction of fish and wildlife habitat and severe impairment of water quality occur as a result of mine drainage from producing and abandoned coal mines and from roads constructed from mine wastes.

- Recreation uses involving whole-body water contact are severely impaired on the Vermilion River, as are all recreation uses on the Illinois River. Eutrophication problems in late summer and fall months restrict use of the area's lakes.

- Further shoaling of the Illinois River navigation channel results in continued costs for dredging operations. Commercial navigation is reduced as a result of the sedimentation and filling in of the navigation channel. There are constraints at existing locks for expected growth in commercial navigation.

- Deterioration and reduction of fish and wildlife habitat and wetlands continues. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Kankakee River Basin Area

WRC REGION: 7 SUBREGION: 704

STATES: Illinois and Indiana PROBLEM AREA NO.: 30

The Kankakee River Basin Problem Area in northwest Illinois includes the Kankakee River and its tributaries which drain to the Illinois River. The problem area encompasses approximately 4,300 square miles. It includes all of Jasper, Newton, and Stark Counties and portions of Lake, La Porte, Marshall, and Porter Counties in Indiana, and all of Grundy and Kankakee Counties and portions of Iroquois, Livingston, and Will Counties in Illinois. The area has a population of about 325,000, and its largest cities are Kankakee, Illinois, and La Porte and Valparaiso, Indiana. The Kankakee River originates near South Bend, Indiana, and flows southwesterly to Kankakee, Illinois, and then northwesterly to its confluence with the Des Plaines--a total distance of 130 miles. The topography of the Kankakee River Basin is characterized by a gently rolling terrain. Ground-water resources are quite plentiful throughout the basin. Yields of 1,000 to 2,000 gpm are common in wells less than 150 feet deep in the unconsolidated sand and gravel deposits in the Kankakee River Valley. Surface-water resources are also quite ample. The Kankakee River has an average discharge to the Illinois River of approximately 4,400 cfs.

Water Issues

- There are water quality problems on Travis Ditch near La Porte, Indiana, on the Kankakee River below its confluence with Travis Ditch, and on the Iroquois River. These problems stem from high concentrations of municipal, industrial, and agricultural waste pollutants. Nonpoint pollution problems throughout the problem area result from agricultural land runoff. High concentrations of bacteria and nutrients and high biochemical oxygen demands throughout the problem area are due to point and nonpoint pollution. Eutrophication problems occur in late summer and fall months.

- High concentrations of iron and dissolved solids as well as hardness are characteristic of the area's ground-water supplies.

Related Land Issues

- Major urban flood damage occurs in Plymouth and Knox, Indiana, on the Yellow River, and in Watseka, Illinois, on Sugar Creek. Severe flood damages occur to rural properties and to agricultural lands, and are especially severe in the flood-plain areas along the Kankakee, Yellow, and Iroquois Rivers. Recreation lands and facilities suffer moderate flood damages.

- There is extensive drainage and filling of wetlands and small lakes and ponds to facilitate agricultural land uses.

- Significant sheet, gully, and streambank erosion damages rural and urban properties and agricultural lands. Moderate sediment damages occur throughout the Kankakee Basin. Representative yields are about 70 tons per square mile per year (from a 10 square-mile drainage area). Sediment loads in the Kankakee River become considerably higher during high streamflow conditions.

- There are existing and emerging land-use conflicts between agricultural, recreation, and urban land uses in the northern portions of the area adjacent to the Chicago SMSA.

Adverse Effects

- Use of surface water and ground water as potable water supplies for domestic purposes and livestock is restricted. Adequate treatment would make available water supplies more desirable for domestic purposes.

- Annual urban and rural flood damages are estimated for 1980 at $7,820 per mile along the Iroquois River, $10,270 per mile along the Yellow River, and $31,430 per mile along the Kankakee River from miles 48 to 127 (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and degradation of productive agricultural land areas, resulting in decreased agricultural production. Sixty-nine percent of the tilled agricultural land in Iroquois County requires additional land treatment to reduce erosion and sedimentation.

- Recreation uses involving whole-body water contact on Travis Ditch, on the Kankakee River below its confluence with Travis Ditch, and on the Iroquois River could be impaired.

- Recreation lands are being lost to agricultural and urban development in flood-plain, shoreland, and forest areas. Erosion and flooding problems are accelerating as a result of this agricultural and urban development. High quality hunting areas are being reduced due to continued drainage and filling of wetland areas.

- Deterioration and reduction of fish and wildlife habitat and wetlands continues. Streambanks, scenic amenities, and other environmental resources are being degraded.

Problem Area : Fox River Basin Area

WRC REGION: 7 SUBREGIONS: 703 and 704

STATES: Illinois and Wisconsin PROBLEM AREA NO.: 31

The Fox River Basin Problem Area lies in north-central Illinois and southeast Wisconsin. The majority of the problem area is located within the Chicago metropolitan area, and it is presently experiencing considerable urban development. The problem area encompasses approximately 2,600 square miles and includes portions of DeKalb, Kane, Kendall, LaSalle, and McHenry Counties in Illinois, and portions of Kenosha, Racine, Walworth, and Waukesha Counties in Wisconsin. The area has a population of about 800,000 people and its largest cities are Aurora and Elgin, Illinois, and Waukesha, Wisconsin. The topography of the area can be characterized as a gently rolling plain. The Fox River, unlike most rivers, is characterized by a broad valley and wide channel in its upper portion, the portion that flows through Kendall County. Ground-water resources in the area are generally quite plentiful; however, large, concentrated demands on these resources have resulted in gradual lowering of the ground-water levels. The streamflow of the Fox River is quite variable, with large fluctuation in flows.

Water Issues

- Surface-water resources of the Fox River can only provide a limited quantity of water for municipal, agricultural, and industrial water withdrawal usage.

- Water quality problems on the Fox River result chiefly from upstream municipal and industrial waste discharges at Elgin, Aurora, and Waukesha. There are 37 major sources of pollution in the Fox River system in Wisconsin. Nonpoint pollution problems in the western and southern portions of the area stem from agricultural land runoff. There are high concentrations of bacteria, especially coliform bacteria, nutrients, and high biochemical oxygen demands in the entire Fox River stemming from point and nonpoint pollution. Overloads of bacteria and nutrients have accelerated eutrophication problems. In the Wisconsin portion of the analytical area, 28 lakes, totalling 15,948 acres, have one or more of the following problems affecting recreation use: weeds, algae,

fish kills, and/or pollution. Fourteen of these lakes, totalling 11,545 acres, are classified as eutrophic or very eutrophic.

- Projected demands for ground water will exceed ground-water potential. The deeper bedrock aquifer is presently being pumped in excess of its recharge capacity, and further heavy concentrated pumpage will result in a significant dewatering of this aquifer. Heavy pumpage from surficial aquifers in the sand and gravel deposits along the Fox River Valley could result in the serious interception of the base flow of the Fox River.

- Both surficial and bedrock aquifers have serious hardness and iron content problems. The quality of water in the bedrock aquifer is generally unacceptable for use.

Related Land Issues

- Urban and rural properties and agricultural lands along the Fox River suffer major flood damages. Ice jams cause flooding at Dayton. Recreation lands and facilities experience moderate flood damages. Eleven flood-prone communities in the two Wisconsin counties do not have flood-plain ordinances.

- Significant gully, sheet, and streambank erosion damages rural and urban properties and agricultural and recreation lands. Sedimentation along the Fox River damages fish and wildlife habitat. These erosion and sedimentation problems are being intensified by land-use changes. In the Wisconsin portion of the analytical area, 269,152 acres of land area, or 38 percent of the land area, needs soil conservation treatment. Four percent of this area, or 29,395 acres, has critical problems (losses exceeding 20 tons per acre per year).

- Much of the area's recreation and environmental land resources is being converted to urban uses. The shorelines of most lakes in the area are entirely surrounded by cottages, homes, and resorts. The population of the Wisconsin portion of the area is projected to increase 90 percent (171,000 persons) between 1970 and 1990.

Adverse Effects

- There are restrictions on the use of surface-water and ground-water supplies as potable water supplies for domestic purposes and livestock as well as certain manufacturing uses, primarily food processing industries. Treatment is required prior to use as municipal water supplies.

- There are potential deficiencies in surface-water and ground-water supplies in the urbanizing area of the Fox River Basin. Ground-

water withdrawals since 1958 have exceeded the practical sustained yield of the Cambrian-Ordovician aquifer with the result that ground-water users continue to mine water and to borrow from future generations. By the end of 1966, the upper units of the aquifer were already being dewatered in many areas. If the distribution of pumpage remains the same and pumpage continues to increase as indicated by recent trends, the principal water-yielding units of the aquifer will be partially dewatered in many areas much sooner than previously anticipated. Pumping levels exceeded 1,000 feet below the surface in a few wells in 1971, and such levels will be common within the next 5 years. If this aquifer becomes significantly dewatered, it may be necessary to develop and desalt the brackish water stored in the Mt. Simon Aquifer in order to meet the water needs of the area. In Wisconsin, potential surface-water deficiencies occur mainly in the Des Plaines River Basin and other eastern Fox River subbasins.

- Continued urban and rural flood damages along the Fox River reduce property values, curtail manufacturing and agricultural production, and cause deterioration in recreation lands and facilities. Thirty-seven percent of the cropland (622,300 acres) in the Fox River Basin is characterized by excess water conditions which inhibit land preparation (tilling and seeding) and harvesting operations.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and degradation of valuable agricultural land areas, resulting in decreased agricultural production. In the Wisconsin portion of the Fox River Basin, 140 miles of streambanks are characterized by moderate or severe bank erosion. Sedimentation of many of the lakes and streams in the basin has resulted in a serious reduction in the fish-carrying capacity of the area's surface waters. In addition, this problem has resulted in the filling of stream channels and, as a result, has increased flood problems.

- Recreation uses involving whole-body water contact are severely impaired on segments of the Fox River. In late summer, fall, and winter months especially, the streamflow is not sufficient for assimilation of wastes. Recreation use of the basin's lakes is restricted due to algae blooms in late summer and fall months.

- Valuable recreation lands and environmental resources are being lost to urban development in flood-plain, shoreland, and forest areas. This urban development results in an increase in flooding and erosion problems.

- Deterioration and reduction of fish and wildlife habitat and wetlands is an ongoing problem (over 60 percent of the original wetlands have been destroyed, and the quality of those remaining--53,000 acres in large wetlands--is severely reduced by partial

drainage, livestock pasture, and other encroachments). Streambanks, scenic amenities, and other environmental resources are being degraded, and the natural setting of the Fox River Valley is being altered.

Problem Area : Lower Rock River Basin Problem Area

WRC REGION: 7 SUBREGIONS: 703 and 704

STATE: Illinois PROBLEM AREA NO.: 15

The Lower Rock River Basin Problem Area lies in north-central and northwest Illinois. It includes the Rock River drainage area from just south of Rockford, Illinois, to its confluence with the Mississippi River at Rock Island, Illinois. It also includes the Green, Rock Creek, and Elkhorn River Basins. The area encompasses approximately 2,600 square miles and includes portions of Rock Island, Whiteside, Henry, Lee, Bureau, Carroll, and Ogle Counties. The problem area has a population of approximately 300,000 people, and its largest cities are Rock Island, Moline, and Sterling. The topography of the area ranges from a nearly level to slightly rolling plain in the northern and central segments, to a rugged terrain with fairly steep slopes in the southern and western segments of the area near the Mississippi River. Ground-water and surface-water resources are generally quite plentiful throughout the problem area.

Water Issues

- o High concentrations of organic and inorganic materials in solution or suspension in the Rock River and tributaries cause high biochemical oxygen demand, high bacterial counts, high concentrations of nutrients, and eutrophication problems. It has been estimated that 331.5 mgd of water is withdrawn for all uses from the Rock River in Illinois.

- o Stream depths and surface-water acreage are inadequate to meet the recreation needs of the area's residents.

Related Land Issues

- o Urban flood damages are severe in Geneseo, Dixon, Sterling, Hillsdale, Green Rock, Moline, Milan, and Coal Valley. Urban flood damages at Rock Island are still significant; however, a flood control project, now largely completed, has substantially reduced flood damages. Extensive flood damage occurs to rural properties and to agricultural lands. Recreation lands and facilities suffer moderate flood damages.

- o Wetlands and small lakes and ponds are being drained and filled to facilitate agricultural development.

- Severe bank, gully, and sheet erosion damages agricultural and recreation lands and environmental resources. There are extensive sediment damages throughout the problem area. Representative yields are about 1,100 tons per square mile of drainage area.

Adverse Effects

- Use of surface water as a potable water supply for domestic purposes and livestock and for industrial processing and cooling is restricted by excessive turbidity and sedimentation. Treatment is required prior to its use as a potable water supply.

- Annual urban and rural flood damages are estimated to reach $42,460 per mile by 1980 along the lower 50 miles of the Rock River (1975 dollars). Major urban damage areas along the Lower Rock River during the 1973 flood included: Erie ($910,762); Hillsdale ($539,460); and Moline-East Moline ($2,788,700). In these three urban areas alone, 886 residential properties and 45 commercial and industrial properties were adversely affected.

- Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages and decreased agricultural production. Counties in the Lower Rock River Basin with 60 percent or more of tilled area requiring soil conservation practices include: Carroll (72 percent), Lee (66 percent), and Ogle (71 percent).

- Recreation uses involving whole-body water contact on the Lower Rock River are severely impaired. Recreation uses of many of the area's lakes are restricted by sediment and eutrophication problems. There is a lack of sufficient surface-water resources to meet the recreation demands of the area's residents.

- High-quality hunting areas are being reduced by continued drainage and filling of wetland areas.

- Continued deterioration and reduction of fish and wildlife habitat and wetlands as well as the degradation of streambanks, scenic amenities, and other environmental resources is occuring as a result of erosion, sedimentation, and drainage problems.

Problem Area : Kishwaukee River Basin Area

WRC REGION: 7 SUBREGION: 703

STATE: Illinois PROBLEM AREA NO.: 16

The Kishwaukee River Basin Problem Area lies in north-central Illinois. The Kishwaukee River Basin drains to the Rock River in southern Winnebago County just south of Rockford, Illinois. The area encompasses approximately 1,200 square miles, and it includes portions of Boone, DeKalb, Winnebago, Kane, and McHenry Counties. The problem area has a population of approximately 150,000 people, and its largest city is DeKalb. The topography of the area can be characterized as a broad alluvial plain covered with loess deposits and glacial drift. The ground-water and surface-water resources are quite sufficient and the Kishwaukee River can be characterized as having a good sustained flow.

Water Issues

- Municipal and industrial pollution occurs on the South Branch of the Kishwaukee River below DeKalb and on the East and South Branches of the Kishwaukee near Sycamore. Nonpoint stream pollution results from overland runoff from agricultural land. Lake eutrophication and high nutrient contents stem from point and nonpoint pollution.

Related Land Issues

- Major urban flood damages occur in DeKalb, Sycamore, and Belvidere. Rural flood damages occur along both branches of the Kishwaukee River.

- Wetlands and small lakes and ponds are being drained and filled to facilitate agricultural and urban development.

- Conversion of shoreland areas to agricultural and urban uses results in a decrease in forest areas. Land-use conflicts are emerging between agricultural, urban, and recreation uses of the basin's land resources.

Adverse Effects

- Average annual urban and rural flood damages estimated for 1980 are $6,200 per mile (miles 130 to 160) along the Kishwaukee River (1967 dollars). Floods reduce property values, curtail industrial production, and cause deterioration of recreation lands and facilities.

- Recreation uses involving whole-body water contact are severely impaired on the South Branch of the Kishwaukee River and on the East and South Branches of the Kishwaukee near Sycamore. Use of many of the area's lakes is restricted by eutrophication and urban storm runoff problems.

- Recreation lands are being lost to urban development in floodplain and shoreland areas. Increased flooding problems result

from this shoreland and flood-plain development. High-quality hunting areas are being reduced by drainage and filling of wetland areas.

- o There is continued deterioration and reduction of fish and wildlife habitat and wetlands, and degradation of streambanks, scenic amenities, and other environmental resources as a result of water quality, flooding, drainage, filling, and land-use problems.

- o Potential deficiencies in municipal water supplies result from the loss of artesian pressure in the Cambrian-Ordovician aquifer. Withdrawals since 1958 from this aquifer in the Chicago area have exceeded the practical sustained yield of the Cambrian-Ordovician aquifer with the result that ground-water users continue to mine water and borrow water from future generations. By the end of 1966, the upper units of the aquifer were already being dewatered in many areas. If the distribution of pumpage remains the same and pumpage continues to increase as indicated by recent trends, the principal water-yielding units of the aquifer will be partially dewatered in many areas much sooner than previously anticipated. Pumping levels exceeded 1,000 feet below the surface in a few wells in 1971, and such levels will be common within the next 5 years.

Problem Area : Pecatonica River Basin Area

WRC REGION: 7 SUBREGION: 703

STATES: Illinois and Wisconsin PROBLEM AREA NO.: 17

The Pecatonica River Basin Problem Area lies in north-central Illinois and south-central Wisconsin. The Pecatonica River drains to the Rock River and includes the Sugar River drainage area. The problem area encompasses approximately 2,100 square miles and it includes all of Green County in Wisconsin, portions of Iowa, Dane, Lafayette, and Rock Counties in Wisconsin, and Winnebago and Stephenson Counties in Illinois. The area has a population of approximately 125,000 people, and its largest cities are Freeport, Illinois, and Darlington, Wisconsin. The topography of the area varies from rolling hills with wide level valley floors in the east, to a more rugged topography with steep-walled valleys and high relief in the western segments. Ground-water and surface-water resources are plentiful. The Pecatonica River itself is fairly large and has a good sustained flow.

Water Issues

- o Water quality problems include: industrial waste pollution from dairy plants and cheese factories, municipal waste pollution from sewage treatment facilities in urban areas along the Pecatonica and tributaries, and nonpoint pollution stemming chiefly from animal waste runoff from agricultural land areas and potential drainage

from mining areas, particularly in southwest Iowa County, Wisconsin. Moderate dissolved oxygen and fecal coliform and nutrient levels stem from municipal, industrial, and agricultural pollution. Specific water quality problem areas include Brewery Creek below Mineral Point, Honey Creek near Monroe, and the West Branch of the Sugar River below Mt. Horeb.

- Stream depths and surface water are inadequate to meet the recreation needs of the area's residents.

Related Land Issues

- Urban areas suffering flood damage include Darlington, Wisconsin, and Freeport, Winslow, and McConnell, Illinois. Extensive agricultural flood damage occurs to rural properties and cropland and pastureland. Flood risks in several locations in the problem area, especially near the confluence of Otter Creek and the Pecatonica River, are among the highest in Wisconsin due to low infiltration and limited surface storage. Thirteen flood-prone communities in the two Wisconsin counties do not have flood-plain ordinances, and five of these same communities are not enrolled in the Federal Flood Insurance Program. Two of the noninsured communities have not even prepared maps of their flood-prone areas. Green County does not have a county flood-plain ordinance.

- Wetlands are being drained and filled to facilitate agricultural development. Wetland drainage activities have diminished considerably in the past 15 years; however, wetland drainage continues at the rate of about 1 percent per year.

- Gully, streambank, and sheet erosion damages valuable agricultural and recreation land and other land resources. The streambanks and flood-plains of most of the streams in the problem area consist of easily eroded silty material, and local erosion is severe. Sediment damages to agricultural lands and recreation and other resources are significant. Average annual sediment yields are among the highest in the State. Sediment concentrations reach several thousand parts per million during high streamflow in several of the area's streams. In the Wisconsin portion of the analytical area, 377,948 acres, or 48 percent of the land acreage, needs soil conservation treatment; 99,735 acres, or 12 percent of the total acreage, is classified as critical (soil losses exceed 20 tons per acre).

- Conversion of shoreland areas to agricultural and urban uses results in the depletion of forest areas and acceleration of flooding and erosion problems. Lack of sufficient access to much of the problem area's water resources severely limits water-based recreation activities.

Adverse Effects

- Average annual urban and rural flood damages are estimated for 1980 at $7,820 per mile along the Sugar River and $11,800 per mile along the Pecatonica River (1975 dollars). Floods reduce property values and curtail agricultural and industrial production.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration in quality of recreation waters and water-based facilities, and degradation of productive agricultural acreages resulting in decreased agricultural production.

- Recreation uses involving whole-body water contact are severely impaired on Brewery Creek below Mineral Point, Honey Creek near Monroe, and the West Branch of the Sugar River below Mt. Horeb. Recreation use of Decatur and Yellowstone Lakes and the Albany Millpond is restricted due to algae and aquatic weed growth problems. These lakes total 708 acres.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. High-quality hunting areas are being reduced due to continued drainage and filling of wetland areas.

- Lack of sufficient public access areas, campsites, boat ramps, picnic areas, and nature trails restricts recreation use of the area's surface-water resources.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other environmental resources as a result of water quality, erosion, sedimentation, drainage, filling, and land-use problems.

Problem Area : Upper Rock River Basin Area

WRC REGION: 7 SUBREGIONS: 702 and 703

STATES: Illinois and Wisconsin PROBLEM AREA NO.: 18

The Upper Rock River Basin Problem Area in south-central Wisconsin and north-central Illinois includes that section of the Rock River Basin at and above Rockford, Illinois. It also includes the Turtle, Yahara, and Crawfish River Basins. The area encompasses approximately 3,000 square miles and includes all of Jefferson and Dodge Counties, Wisconsin; parts of Columbia, Dane, Rock, Walworth, Waukesha, and Washington Counties, Wisconsin; and Winnebago and Boone Counties, Illinois. The problem area has a population of approximately 750,000 people, and its largest cities are Madison, Janesville and Beloit, Wisconsin, and Rockford, Illinois. The

topography of the area is characterized by rolling to hilly terrain with extensive marshes and shallow lakes. Surface- and ground-water resources are generally quite plentiful; however, the Rock River and its tributaries are subject to large variations in flow.

Water Issues

- There is the possibility of low streamflow conditions on the Rock River and drawdown of Lake Koshkonong due to the proposed development of the Koshkonong nuclear generating plant. Low streamflow creates problems on the Yahara River between Lake Monona and its confluence with Badfish Creek.

- Severe water quality problems in many rivers and large lakes throughout the Basin stem from municipal and industrial (food and kindred products industries) waste discharges, urban and agricultural runoff, and malfunctioning of individual sewage disposal systems. Low dissolved oxygen and high coliform counts are prevalent on numerous stream reaches, including Badfish Creek near Madison; Beaver Dam River; Oconomowoc River; Allen Creek near Evansville; Turtle Creek near Delavan; South Branch Rock near Waupun; and Rock River near Watertown, Jefferson, Janesville and Beloit (Wisconsin) and Rockford (Illinois). Nutrient levels are among the highest in Wisconsin and have resulted in excessive algae and aquatic plant growths, especially in lakes. There are 28 lakes greater than 99 acres in the analytical area. Twenty-six of these lakes, totalling 43,935 acres, are characterized by one or more of the following problems: weeds, algae, winterkill of fish, or pollution. Twenty of these lakes (41,349 acres) are classified as very eutrophic.

- Poor recharge of the Platteville-Galena Aquifer where it underlies Maquoketa Shale may require a shift to surface water or use of another recharge system in the Rockford metropolitan area after 1980.

- High concentrations of nitrates in private wells in Columbia and Dane Counties (Wisconsin) are attributed to intensive farming and fertilizer application. High dissolved solid levels in wells in Rock (Wisconsin) and Winnebago (Illinois) Counties stem chiefly from chemical pollution from landfills located in the area's gravel pits. Bacterial pollution of private wells is due to malfunctioning septic systems, especially in Dodge and Rock Counties in Wisconsin. Forty-one percent of 251 wells surveyed in Columbia County had nitrate levels above the safe limit of 10 mg/liter. Similar problems are evident in Dane County. Fourteen areas, predominantly in Dodge County, experience serious septic system problems, with potential for contaminating ground water. Approximately 46 percent of the wells in western Beloit Township and 20 percent of the wells surveyed in Rock County were found bacterially unsuitable as potable water supplies.

Related Land Issues

- Major urban flood and storm drainage cause damages in Beloit, Fort Atkinson, Janesville, Jefferson, Watertown, Hutisford, Columbus, and Horicon in Wisconsin and South Beloit, Loves Park, and Rockford, Illinois. Significant flood damages afflict rural properties and pasturelands in the basin, especially along the Crawfish River. Thirty-two communities in the four Wisconsin counties in the analytical area do not have flood-plain ordinances and six of these communities plus two others are not enrolled under the Federal Flood Insurance Program. Jefferson County has not prepared maps of flood-prone areas.

- There is extensive drainage and filling of wetlands to facilitate agricultural and urban development.

- Gully and streambank erosion problems due to easily eroded silty soils are increased by flooding and changing land uses. In the Wisconsin portion of the analytical area, 873,598 acres or 41 percent of the land acreage needs soil conservation treatment; 279,044 acres, or 13 percent of the total acreage, is classified as critical (soil losses exceeding 20 tons per acre). Sediment damages to recreational and environmental resources are significant and are especially severe in river delta areas at Lake Koshkonon, Lake Beaver Dam, and Lake Sinissippi. Turbidity is a problem on the Rock, East Branch Rock, Crawfish, Rubicon, and Beaver Dam Rivers.

- There is intensive urban development of flood-plain areas, especially in major urban centers along the Rock River. Valuable forest resources are being lost to agricultural and urban developments. Drainage of wetlands and stripping of shoreland vegetation to facilitate agricultural and urban land uses could destroy valuable environmental resources. The population of the area is expected to increase significantly in the next 15 years and elimination of these valuable lands and waters for recreation would severely deplete the area's much needed recreational and environmental resources. Population is expected to increase 28 percent (156,854) between 1970 and 1980, and another 32 percent (229,400) between 1980 and 1990.

Adverse Effects

- Costs are incurred on a continuing basis for replacing and/or correcting polluted wells in order to provide potable water supplies for domestic and livestock uses and to provide safe water supplies for food processing industries.

- There is a potential deficiency in ground water for municipal uses in the Rockford metropolitan area. Heavy pumpage from deep wells in the Rockford area has resulted in a serious lowering of aquifer water levels of 50 to 100 feet during the years 1966 to 1971.

- Annual urban and rural flood damages are estimated to reach $7,820 per mile by 1980 along the Crawfish River, and $3,220 per mile by 1980 along the Rock River between Rockford, Illinois, and Janesville, Wisconsin, (1975 dollars). During the 1973 flood, 1,421 residential properties and 218 commercial and industrial properties were adversely affected in these five urban areas alone. Property values and industrial production have been reduced. Agricultural production has been curtailed as a result of excess wetness conditions on agricultural land areas which inhibit normal seeding and tillage operations.

- Continued erosion and sedimentation decreases property values in urban and rural areas, causes deterioration in quality of recreation waters and water-based facilities, and degrades productive agricultural acreages resulting in decreased agricultural production. Gully erosion damages were recently estimated at $180 per square mile in the Upper Rock Basin. Sediment yields range from 22 to 88 parts per million (ppm).

- Recreation uses involving whole-body water contact are severely impaired on the Rock River between Janesville, Wisconsin, and Rockford, Illinois. Recreation values on 43,935 acres of lakes are impaired due to eutrophication or other problems.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas and residential development of ridge and wooded areas. Increased flooding and erosion problems result from this agricultural and urban development. Reduction in the availability of high quality hunting areas is due to continued drainage and filling of wetland areas. Over 1 percent of Rock County's wetlands are being drained yearly.

- There is a lack of sufficient surface-water resources and facilities to meet the recreation needs of the area's residents. Current estimates indicate that 56,000 acres of surface water are needed by 1980 to meet these needs, including those of the Pecatonica River Basin which is not in this problem area. Deficiencies are especially significant in Dodge County along the Niagara Escarpment where there is a lack of canoe or nature trails, vistas (scenic areas), and public boat-launching facilities. In Jefferson County, public access to lakes is inadequate. Access to Crawfish River is inadequate.

- Deterioration and reduction of fish and wildlife habitat and wetlands as well as degradation of stream banks, scenic amenities, and other environmental resources is continuing.

Problem Area : Lower Wisconsin-LaCrosse River Basin Area

WRC REGION: 7 SUBREGIONS: 702 and 703

STATE: Wisconsin PROBLEM AREA NO.: 8

The Lower Wisconsin-LaCrosse River Basin Problem Area lies in southwest Wisconsin. This problem area includes the lower Wisconsin River Basin just below Portage and the Kickapoo and LaCrosse River Basins. The area lies predominantly in Monroe, Vernon, Richland, and Crawford Counties and partially in Columbia, Dane, LaCrosse, Iowa, Grant, and Sauk Counties. The problem area has a population of approxiamtely 193,000 people, and its largest city is Richland Center. The topography of the area is generally that of an upland plain dissected by valleys. Most of the problem area lies in the rugged, driftless area of Wisconsin and contains few lakes. Both surface- and ground-water supplies are quite plentiful. Maximum ground-water yields are more than 1,000 gpm.

Water Issues

- Point sources of pollution stem from municipal sewage treatment plants and dairy plants. Nonpoint pollution results from agricultural land runoff and erosion. Specific streams and/or stream reaches showing pollution include the main stem Wisconsin River for a number of miles below Portage, and below the Kickapoo River confluence to the mouth of the river; positions of the Kickapoo and Baraboo Rivers; and the Pine River. The Pine River below Richland Center, Spring Creek below Lodi, and the lower LaCrosse River also have seriously polluted segments. Malfunctioning of septic systems is a problem in 14 communities plus several communities around Lake Wisconsin. Increased nutrient content and eutrophication problems exist as a result of nonpoint and point sources of pollution. Sixteen lakes totaling 12,913 acres have one or several of the following problems: weeds, algae, fish winterkill, and/or pollution. Lakes in the worst condition are Lake Wisconsin, Lazy, Park (Columbia County) and Redstone (Sauk County). These lakes total 10,015 acres. The average condition of lakes in these counties is eutrophic, except in Iowa and Monroe Counties where lakes average close to eutrophic, and Columbia County where average conditions are very eutrophic.

- There is a shortage of surface water to meet the recreation needs of the area's residents.

- Ground-water pollution problems in Columbia County stem from geologic conditions, crowding of septic systems, and intensive agricultural practices. Excessive nitrate concentrations are found in over 40 percent of wells surveyed in the county.

Related Land Issues

- Extensive urban flood damages occur along the Kickapoo River at Steuben, Gay Mills, Soldiers Grove, Viola, LaFarge, Ontario, and Norwalk and at Richland Center on the Pine River. Major flood damages afflict high-value agricultural crops along the Kickapoo, LaCrosse, and Wisconsin Rivers. Twenty-three flood-prone communities in the seven-county analytical area do not have flood-plain

ordinances and six of these communities plus five others are not enrolled in the Federal Flood Insurance Program. Columbia County has not prepared maps of flood-prone areas. Monroe County has neither a county ordinance nor maps of flood-prone rural areas.

- Severe gully and streambank erosion problems stem from steep topography and easily transported soils. Flooding intensifies these erosion problems. There is extensive cutting of evergreen shelter belts to accommodate spray irrigation of sandy soils in the Wisconsin River Valley (primarily in Sauk and Iowa Counties). High-flow sediment yields of several thousand parts per million on the Kickapoo River at LaFarge have discharged up to 4 to 5 feet of sand on the flood-plain. Streamflows on many of the area's smaller streams are characterized by heavy sediment loads. Forty-one percent of the total land acreage (1,372,945 acres) in the analytical area need soil conservation treatment; 116,346 acres or 3.5 percent of the total acreage is classified as critical (losses in excess of 20 tons per acre). There is increased probability of wind erosion from irrigated sandy soils due to a lack of shelter belts.

- Rapid population expansion in rural areas and villages within commuting distance of Madison has altered wild scenic areas, including wildlife habitat, and increased the already serious erosion and sedimentation problem.

Adverse Effects

- The cost of providing clean and safe ground water as a potable water supply for domestic and livestock uses is increasing. Well pollution problems in Columbia City pose threats to human health.

- Extensive flood damages occur along the Wisconsin, Kickapoo, and LaCrosse Rivers. Flood damages have been projected to average $48,750 per mile by 1980 along the lower 50 miles of the Wisconsin River (1975 dollars). Floods reduce property values and curtail agricultural and industrial production.

- Erosion and sedimentation damages decrease property values in urban and rural areas, cause deterioration of recreation waters and water-based facilities, and reduce valuable topsoil resources in agricultural areas resulting in decreased agricultural production.

- Recreation uses involving whole-body water contact is severely impaired on the Pine River below Richland Center, Spring Creek below Lodi, and on the lower 16 miles of the LaCrosse River. Recreation values on 12,425 acres of lakes are impaired by eutrophication or other problems. Fishing in the Wisconsin River is restricted due to eutrophication or because of mercury contamination in fish. Fish in this stretch of river generally contain an average of above 0.5 ppm of mercury (and up to 1.01 ppm),

and fishermen are advised to limit consumption to one meal of fish per week. Buffalo fish in Lake Wisconsin tend to contain elevated levels of PCB's, some up to 9 ppm.

- o There is a lack of sufficient surface-water area to meet the recreation demands of the area's residents.
- o Recreation lands are being lost to agricultural and residential development in flood-plain, shoreland, and forest areas. An increase of erosion and flooding problems results from this development.
- o There is continued deterioration and reduction of fish and wildlife habitat and wetlands plus degradation of shoreland areas, scenic amenities, and other environmental resources. The natural setting of the Wisconsin River Valley is being further altered.

Problem Area : Central Wisconsin River Basin Area

WRC REGION: 7 SUBREGION: 702 and 703

STATE: Wisconsin PROBLEM AREA NO.: 9

The Central Wisconsin River Basin Problem Area includes that section of the Wisconsin River Basin from just north of Stevens Point south to the mouth of the Baraboo River just below Portage. It also includes the Baraboo and Lemonweir River Basins. The area lies predominantly in Wood, Portage, Juneau, and Adams Counties and partially in Monroe, Sauk, and Columbia Counties. The problem area has a population of approximately 200,000 people, and its largest cities are Stevens Point, Wisconsin Rapids, Marshfield, Baraboo, and Portage. The topography of the area ranges from nearly level to a gently undulating plain. Except for one area in Wood County near Marshfield, ground-water resources are quite plentiful. In the Marshfield area, surface- and ground-water resources are not as plentiful because of rapid surface-water runoff and only semipermeable glacial till over impermeable crystalline rock. Ground-water yields to wells in this area are generally less than 40 gpm.

Water Issues

- o Surface- and ground-water resources are insufficient for water supply needs in the Marshfield area.
- o Water quality problems in the Wisconsin River and Mill Creek stem from high concentrations of municipal, industrial (chiefly paper and pulp mill wastes), and agricultural waste pollutants which cause low dissolved oxygen values. Algae blooms and eutrophication create problems in Lake Wisconsin. During the summer months, severe oxygen depletion occurs below Biron for 12 to 34 miles. In winter, dissolved oxygen (DO) deficiency results in fish

kills in the Petenwell Reservoir where DO levels start dropping in January and remain near zero until the ice breaks up in mid-April. There is often no dissolved oxygen between Wausau and the Petenwell Dam in winter. Sludge banks formed from paper mill pollution in former years will continue to deplete DO for about 10 years after suspended solids discharges are reduced. (Most suspended solids are now removed from paper mill discharges.) Twenty-four lakes (each greater than 99 acres and including the Wisconsin River flowages) totalling 48,700 acres have one or more of the following problems that affect recreation use: weeds, algae, fishkill, and/or pollution. Fourteen of these lakes totalling 44,344 acres are classified as eutrophic or very eutrophic. Lake pollution is most severe in Juneau County.

- Lake-level fluctuations create problems in Adams County.

- High capacity municipal water supply wells located along rivers near Stevens Point and Port Edwards face the possibility of contamination due to increased ground-water recharge from the Wisconsin River.

Related Land Issues

- Floods damage urban areas on the Wisconsin River at Stevens Point, Wisconsin Rapids, and Nekoosa; on the Lemonweir River at Mauston and New Lisbon; on the Baraboo River at Baraboo; and on the Yellow River at Pittsville and Necedah. Fifteen flood-prone communities in the analytical area do not have floodplain ordinances. Eight of these communities are not enrolled under the Federal Flood Insurance Program. Juneau County has not prepared maps of flood-prone areas.

- Major flood damages afflict rural properties including railroads, roads and bridges, high value crops, and commercial forest areas along the Lower Baraboo and Wisconsin Rivers.

- There are moderate bank and gully erosion problems, increased by flooding and recent construction, in the high-growth communities of Stevens Point and Marshfield as well as Adams and Portage Counties. There are severe erosion problems on the eastern shores of Castle Rock and Petenwell Lakes. Thirty-one percent of the land acreage (594,207 acres), in the analytical area, needs soil conservation treatment; 42,274 acres, or 2 percent of the total acreage, is classified as critical (soil losses exceeding 20 tons per acre).

- Conversion of shoreland and flood-plain areas to agricultural, residential, and other land uses results in increased flooding and erosion problems, and degradation of valuable fish habitat and scenic values along the Baraboo and Wisconsin Rivers.

- Access to the Lemonweir River is inadequate.

Adverse Effects

- Costs to provide clean and safe surface water and ground water as potable water supplies for domestic and livestock uses will be high. Aquifers providing water supplies for 26,600 people may become contaminated.

- There is deficiency in water supply for all uses in the Marshfield area in Wood County due to rapid surface-water runoff and low ground-water yields. Expansion of agricultural production is limited.

- Annual urban and rural flood damages continue along the Wisconsin, Baraboo, Lemonweir, and Yellow Rivers. Damages along the Wisconsin River (miles 100 to 150) are projected for 1980 at just over $12,570 per mile (1975 dollars). Floods reduce property values and curtail agricultural and industrial production.

- Continued erosion damages result in decreased property values in urban and rural areas, deterioration of recreation waters, and loss of productive agricultural acreages and decreased agricultural production. The eastern shores of Castle Rock and Petenwell Flowages (50 miles) erode 6 to 10 feet yearly in places. Sixty miles of trout streams in Portage County require extensive management to alleviate bank deterioration.

- Recreation uses involving whole-body water contact are severely impaired on the Wisconsin River above Wisconsin Rapids and on Mill Creek and the Yellow River due to mercury contamination. Fish in this reach of the river contain an average of about 0.5 ppm of mercury (up to 2.36 ppm), and fishermen are advised to limit consumption to one meal of fish per week. In large lakes 46,614 acres of surface water are impaired for recreation due to eutrophication or other problems.

- Recreation lands are being lost to agricultural and residential development in flood-plain and shoreland areas. Acceleration of erosion and flooding problems results from this flood-plain and shoreland development. Public access to rivers, especially the Lemonweir River, is inadequate.

- Degradation of fish and wildlife habitat and scenic amenities due to pollutional effects that generally extend for 80 miles but at times for the entire length (140 miles) of the Wisconsin River Main Stem.

Problem Area : Upper Wisconsin River Basin Area

WRC REGION: 7 SUBREGION: 702

STATE: Wisconsin PROBLEM AREA NO.: 10

The Upper Wisconsin River Basin Problem Area in north-central Wiscon-

sin includes the entire Wisconsin River Basin above Stevens Point. The area lies predominantly in Marathon, Lincoln, and Oneida Counties and partially in Portage, Wood, Taylor, Price, Langlade, and Vilas Counties. The problem area has a population of approximately 190,000 people, and its largest cities are Wausau, Tomahawk, Merrill, Antigo, and Rhinelander. The topography of the problem area ranges from nearly level to a gently undulating plain. In Vilas and Oneida Counties, numerous lakes and swamps dot the plain. Drift hills extend east and west across the central part of the problem area. Surface- and ground-water resources are quite plentiful. In the northern segment of the problem area, ground-water yields to wells are as high as 1,000 gpm.

Water Issues

- There are water quality problems in the Wisconsin River below Rhinelander stemming from high concentrations of industrial (chiefly pulp and paper mills), municipal, and agricultural waste pollutants which cause severe eutrophication and algae bloom problems. There is often no dissolved oxygen in the winter months between Wausau and DuBay Dam, and in the summer, there is severe DO depletion below Rhinelander for 8 to 18 miles and below Brokau, for 30 to 50 miles. Most of the suspended solids and low dissolved oxygen can be attributed to former and/or present discharges from pulp and paper mills. At Hat Rapids Dam, 22 percent of samples in 1975 violated fecal coliform standards. Although the average condition of lakes in these counties (except for Marathon) was not eutrophic, 72 lakes totalling 41,599 acres have one or several of the following problems which affect recreation use: weeds, algae, fishkill and/or pollution. Some 30 of these lakes, totalling 13,490 acres, are classified as eutrophic or very eutrophic. Fifteen areas in Marathon, Langlade, Oneida, Price, and Lincoln Counties have private septic system problems.

- High capacity wells adjacent to rivers near Antigo, Brokaw, Rothschild, and Wausau are experiencing increased recharge from the Wisconsin River or a tributary, thereby increasing the possibility for contamination of these communities' municipal water supplies.

Related Land Issues

- There are urban flood problems in Tomahawk, Merrill, Wausau, Rothchild, Brokaw, and Schofield. Six flood-prone communities in the analytical area do not have flood-plain ordinances, and three of these communities, plus three others, are not enrolled under the Federal Flood Insurance Program. Neither Marathon nor Vilas Counties have final maps of flood-prone areas, and Vilas County has neither a county ordinance nor Federal Flood Insurance.

- Moderate gully and streambank erosion problems are increasing because of flooding and land-use changes. In the analytical

area, 382,197 acres, or 14 percent of the land acreage, needs soil conservation treatment. About 1 percent of this acreage, 20,537 acres, is classified as critical (soil losses exceeding 20 tons per acre).

- Conversion of shoreland areas of lakes and rivers to residential, agricultural, and other land uses results in increased flood damages and additional erosion and water quality problems. Land and water problems could arise from anticipated large-scale mining efforts in Oneida County.

Adverse Effects

- The increased cost of providing clean and safe surface water and ground water as potable water supplies for domestic and livestock uses is increasing.

- Continuation of major urban flood problems results in the reduction of property values and curtailed industrial production. Average annual flood damages for the Wisconsin River above mile 250 (above Stevens Point) are $88,600 (1975 dollars). Damages caused by the the 1941 flood were $812,950.

- Continued erosion damages result in decreased property value in urban and rural areas, deterioration of recreation waters and water-based facilities, and degradation of productive agricultural land, resulting in decreased agricultural production.

- Sport fish consumption is curtailed due to mercury contamination. Fish contain an average of about 0.5 ppm of mercury (and up to 0.97 ppm) in that reach of the Wisconsin River below Rhinelander. Fishermen are still advised to limit consumption to one meal of fish per week, although contamination is decreasing due to pollution abatement.

- Severe impairment of recreation uses in 110 miles of the Upper Wisconsin River Main Stem continues. Swimming is prohibited entirely in dam pools near Wausau, Mosinee, and Tomahawk, and it is limited near Merrill and Rhinelander. Recreation values of 41,599 acres of lakes is impaired because of eutrophication and other problems.

- Valuable recreation and environmental resources are being lost to agricultural and residential development in flood-plain and shoreland areas. Increased flooding and erosion problems result from this flood-plain and shoreland development.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands and degradation of shoreland areas, scenic amenities, and other environmental resources. The natural setting of the Wisconsin River Valley is being further altered.

Problem Area : Upper Chippewa River Basin Area

WRC REGION: 7 SUBREGION: 702

STATE: Wisconsin PROBLEM AREA NO.: 11

The Upper Chippewa River Basin Problem Area lies in north-central Wisconsin. It covers approximately 6,000 square miles and includes that section of the Chippewa River Basin above Holcombe to the Wisconsin/ Michigan border. The area lies predominantly in Rusk, Sawyer, and Price Counties and partially in Iron, Ashland, Taylor, and Chippewa Counties. The problem area has a population of approximately 65,000 people, and its largest cities are Ladysmith and Park Falls. The topography of the area is a nearly level to gently undulating plain with many lakes, swamps, and peat bogs. Surface- and ground-water resources are quite plentiful with ground-water well yields ranging from 500 to 1,000 gpm.

Water Issues

- o There are point sources of pollution from paper mills on the Flambeau River below Park Falls (high suspended solids, locally high concentrations of paper and pulp residues, sludge deposits, and high biochemical oxygen demand [BOD] contents). Additional point sources of pollution come from sewage treatment plants on various tributary streams.

- o Eutrophic conditions are found in 20 lakes, each over 100 surface acres in size, in the problem area. Weed, algae, and fishkill are common problems in several other lakes.

Related Land Issues

- o Bank erosion is a problem in the southern portions of the area, especially during high streamflow conditions along the Upper Chippewa River in Sawyer County. Localized sedimentation problems occur in the southern portion of the problem area.

- o Potential land and water problems are associated with large-scale copper mining in Sawyer and Rusk Counties.

Adverse Effects

- o Continued erosion and sediment damages decrease property values in rural areas, cause deterioration of recreation lands and facilities, and result in loss of productive agricultural acreages and decreased agricultural production.

- o Use of the Flambeau River below Park Falls for recreation is impaired.

- o There is continued deterioration and reduction of fish and wildlife habitat and wetlands, including degradation of streambanks, scenic amenities, and other environmental resources. The natural setting of the Chippewa River Valley is being altered.

Problem Area : Lower Chippewa River Basin

WRC REGION: 7 SUBREGION: 701 and 702

STATE: Wisconsin PROBLEM AREA NO.: 12

The Lower Chippewa River Basin Problem Area, which lies in west-central Wisconsin, covers about 3,000 square miles. It includes the entire Chippewa River Basin below Holcombe, Wisconsin. Major tributaries in the problem area are the Red Cedar and Eau Claire Rivers. The area lies predominantly in Chippewa, Eau Claire, Dunn, Baron, and Pepin Counties and partially in Taylor, Clark, St. Croix, Pierce, and Buffalo Counties. The problem area has a population of approximately 240,000, and its largest cities are Eau Claire, Chippewa Falls, and Menomonie. The topography of the problem area ranges from a nearly level to a gently undulating plain with sandy soils in the north and east, to a river-dissected upland with highly eroded glacial drift deposits in the south and west. Surface- and ground-water resources are quite plentiful.

Water Issues

- o Heavy bedload sediment results in high turbidity and total dissolved solids (TDS) levels throughout the problem area. At Chippewa Falls Falls on the Chippewa River, 13 percent of samples in 1976 violated D.O. standards.

- o Algae growth and/or weed growth problems exist in 12 large lakes totalling 7,607 acres (each more than 100 acres in surface area), including Lake Altoona, Lake Menomin, Lake Tainter, and six lakes in Baron County. These lakes are considered eutrophic or very eutrophic. These problems are caused primarily by agricultural runoff.

Related Land Issues

- o There is the risk of floods of damaging proportions to rural and urban properties, including recreation areas such as boat landings and resort areas. Such floods result from rapid snowmelt, increased at times by spring rains, and from rapid runoff following intense summer rainstorms. Urban areas subject to flooding include: Cornell, Chippewa Falls, Eau Claire, and Durand (on the Chippewa River); Cadott (Yellow River); Colfax (Red Cedar River); and areas above Spring Valley on the Eau Galle River. Eighteen flood-prone communities in the analytical area do not have flood-plain ordinances, and five of the communities are not enrolled under the

Federal Flood Insurance Program. Barron County has not prepared maps of its rural flood-prone areas.

- Severe bank erosion, sedimentation, and turbidity problems exist in and along the Chippewa River below Eau Claire, Wisconsin. Severe shoaling of the Mississippi River navigation channel below its confluence with the Chippewa River results from this heavy bedload sediment from the Chippewa River. The natural shoreline and wetland areas along the lower Chippewa River are rapidly being inundated by shoaling sands and gravels. Thirty percent of the total land acreage (693,636 acres) in the analytical area needs soil conservation treatment; 49,621 acres or 2 percent of the total area is classified as critical (soil losses exceeding 20 tons per acre).

- Stripping of shoreland vegetation for urban and agricultural uses has accelerated the erosion and sedimentation problem on the Chippewa River. This problem is especially severe in the Eau Claire-Chippewa Falls area.

- Public access to the Chippewa River is inadequate.

Adverse Effects

- Average annual urban and rural flood-water and sediment damages are estimated for 1980 at $11,800 per mile along river miles 0 to 80 of the Chippewa River and $5,060 per mile along river miles 80 to 110 of the Chippewa (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause continued deterioration of recreation lands and facilities.

- Severe bank erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, and loss of valuable topsoil resources, resulting in decreased agricultural production.

- Further shoaling of the Mississippi River navigation channel below its confluence with the Chippewa River results in continued costs for dredging operations.

- Periodic low streamflow levels and sedimentation on the Chippewa River restrict boating recreation to canoeists and occasional fishermen and reduce the river's fishing and sightseeing potential. This lack of boating recreation and related tourist activities suppresses tourism potential and economic benefits associated with these activities.

- Recreation uses in 17 lakes totalling 10,906 acres are impaired because of one or more of the following problems: weeds, algae, winterkill of fish, and pollution.

- Valuable recreation lands and environmental resources are being

lost to agricultural and urban development in flood-plain and shoreland areas. Erosion and flooding problems are increasing as a result of this agricultural and urban development. Public access to the Chippewa River is inadequate.

- Fishing in the Chippewa River north of the Chippewa/Eau Claire County line is restricted due to mercury contamination which has averaged 0.6 ppm in fish (at times as high as 4.89 ppm). Fishermen are still advised to limit consumption of fish to one meal per week, although contamination is declining with pollution abatement.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands as well as degradation of streambanks, scenic amenities, and other environmental resources. The natural setting of the Chippewa River Valley is being altered.

Problem Area : Upper Mississippi River Headwaters Area

WRC REGION: 7 SUBREGION: 701

STATE: Minnesota PROBLEM AREA NO.: 1

The Upper Mississippi River Headwaters Problem Area, in north-central Minnesota, encompasses about 6,400 square miles and covers the northern one-third of the headwaters drainage basin of the Mississippi River from just below Brainerd to just above Winnibigoshish Reservoir. The area lies predominantly in Cass, Aitkin, Crow Wing, and Clearwater Counties. The population of the problem area is approximately 120,000, and its largest cities are Bemidji, Brainerd, and Grand Rapids. The topography of the problem area consists of hilly to rolling glacial moraines broken by level areas of outwash, undulating till prairies, and glacial lake basins. More than four-fifths of this densely timbered area is forests or lakes. Both ground-water and surface-water resources are plentiful with ground-water well yields ranging from 500 gpm (gallons per minute) to 1,000 gpm.

Water Issues

- There is a point source of organic waste pollution near Grand Rapids on the Main Stem which results in the discoloration of lakes and streams and low dissolved oxygen levels. Eutrophication problems exist in many lakes in the region between Bemidji and Cass Lake.

- Waste-water treatment is inadequate in Bemidji, Brainerd, Grand Rapids, and other areas.

Related Land Issues

- Major urban flood damages occur in Brainerd and Aitkin. Extensive flood damages also afflict agricultural and recreation lands, especially in the vicinity of Aitkin and Winnibigoshish, Luck, and

Pokegama Reservoirs. Principal crops damaged are potatoes, corn, and hay. Commercial forest areas are inundated.

- Severe bank erosion and recession of the sandy shorelines is characteristic of much of the area. Bank erosion, caused chiefly from wave action and ice movement, occurs during flooding. There is localized, heavy bedload sediment, especially in areas adjacent to eroding shorelines.

- Conversion of shoreland areas to urban and residential uses results in the depletion of forest areas and acceleration of flooding and erosion problems.

Adverse Effects

- Urban and nonurban flood damages are estimated for 1980 at $33,730 per mile (1975 dollars). Floods reduce in property values, curtail agricultural, industrial, and forestry production, and cause deterioration of recreation lands and facilities.

- Further erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss in productive agricultural acreage and decreased production.

- Recreation involving whole-body water contact is severely impaired below Grand Rapids on the Mississippi River.

- There is continued deterioration and reduction of fish and wildlife habitat; degradation of streambanks, scenic amenities, and other environmental resources; and alteration of the natural setting of the Mississippi River headwaters area.

Problem Area : Minneapolis-St. Paul SMSA Area

WRC REGION: 7 SUBREGION: 701

STATE: Minnesota PROBLEM AREA NO.: 2

The Minneapolis-St. Paul SMSA covers about 2,800 square miles and includes all of Hennepin, Ramsey, Dakota, Washington, Scott, Carver, and Anoka Counties. The area's population is approximately 2,000,000 people, and its largest cities are Minneapolis, St. Paul, and Bloomington. Major rivers in the problem area are the Mississippi, Minnesota, St. Croix, Rum, and Crow. The topography in the problem area is irregular, varying from nearly level to a gently rolling outwash plain. There are many lakes, both large and small, in the area. Surface- and ground-water resources in the area are generally plentiful; however, locally high consumptive demands, especially during drought periods, may cause serious local surface- and ground-water supply problems.

Water Issues

- There is a potential deficiency in surface water resources during late summer, fall, and winter months for municipal and industrial water needs. Streamflow and surface depth are inadequate in the Mississippi, St. Croix, and Minnesota Rivers during these late summer, fall, and winter months for commercial navigation purposes. This requires extensive maintenance dredging.

- Major municipal and industrial organic waste pollution occurs on the Main Stem of the Mississippi River in the Metropolitan area. Biological waste pollution from animal waste and land runoff creates problems along the Minnesota, Crow, and Rum Rivers. Thermal pollution from fossil-fueled electric power plants occurs on the Minnesota and Mississippi Rivers.

- Fluctuating lake levels are often associated with ground-water withdrawals.

- There is a potential deficiency in ground-water supplies for rural, municipal, and industrial uses. Ground-water well contamination in rural areas stems from malfunctioning of onsite waste disposal units.

Related Land Issues

- Major urban flood damages occur in Afton, Bayport, St. Croix Beach, Stillwater, and St. Mary's Point on the St. Croix River; Anoka, Champlin, Dayton, Fridley, Hastings, Inver Grove, Lilydale, Minneapolis, New Brighton, and St. Paul on the Mississippi; and along the Minnesota, Crow, and Rum River valleys. Floods damage high-value vegetable crops in the Crow River Basin and corn, oats, and hay in the Rum River Basin. Flood-water and sediment damages afflict urban and nonurban recreation lands and facilities.

- There is extensive drainage of wetlands to facilitate agricultural and urban development.

- Scattered streambank erosion problems are accelerated by flooding and changing land use. Significant sheet and gully erosion problems occur in the rural portions of the metropolitan area. Localized heavy bedload sediment results in shoaling of the navigation channel on the Mississippi, Minnesota, and St. Croix Rivers.

- Natural shoreline areas are being converted to agricultural, urban, and other land uses.

Adverse Effects

- There is a lack of sufficient surface- and ground-water supplies

to meet projected municipal and industrial water use demands. In rural areas, use of ground water as a potable water supply is restricted.

- Annual urban and rural flood damages are estimated for 1980 at $44,460 per mile along the Mississippi River (river mile 815 to 900); $13,800 per mile along the St. Croix River (river mile 0 to 50); and $7,660 per mile along the Lower Minnesota River (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages and decreased agricultural production.

- Further shoaling of the navigation channel is occurring, resulting in continued costs for dredging operations. Reduction in commercial navigation could result from the siltation and filling in of the navigation channel.

- Whole-body water contact recreation is restricted on the Mississippi River, especially in late summer, fall, and winter months.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. High-quality hunting areas are being reduced by continued drainage and filling of wetlands.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands plus degradation of streambanks, scenic amenities, and other environmental resources. The Minnesota, Rum, Crow, and Mississippi Rivers are experiencing further shoaling, and their scenic and natural settings are being altered.

Problem Area : Upper Minnesota River Basin Area

WRC REGION: 7 SUBREGION: 701

STATES: Minnesota and South Dakota PROBLEM AREA NO.: 3

The Upper Minnesota River Basin Problem Area in west-central Minnesota and northeast South Dakota includes the Minnesota River and its drainage area north and west of mile 200, or north and west of Redwood Falls. The problem area encompasses approximately 8,000 square miles and includes all of Yellow Medicine, Chippewa, Lac Quie Parle, Swift, and Big Stone Counties in Minnesota; portions of Lincoln, Lyon, Redwood, Renville, Stevens, Pope, Douglas, and Kandiyohi Counties in Minnesota; and Grant, Roberts, and Marshall Counties in South Dakota. The area has a population of approximately 160,000 people, and its largest cities are Redwood Falls, Granite Falls, Marshall, Montevideo, and Ortonville--all in Minnesota. The topography

of the problem area varies from low, rolling hills and outwash plains in the west and southwest, to steep hills and lake-dotted moraines in the northern part of the area. Ground-water yields vary considerably in the area. Above Montevideo some wells have yielded as much as 1,500 gpm, although average yields are considered to be 5 to 10 gpm. In the Granite Falls area, the scarcity of ground water forces the city to obtain its water supply from the Minnesota River. Surface-water resources are quite variable with large fluctuations in streamflow.

Water Issues

- There are deficiencies in surface-water and ground-water supplies for municipal purposes in the Granite Falls area. High concentrations of sulfates, iron, and manganese exist in ground-water supplies.

- There are water quality problems on the South Fork of the Whetstone River, Pomme de Terre River, Canby Creek, West Branch of the Lac Quie Parle River, Chippewa River, and the Main Stem of the Minnesota River. These are due to municipal, industrial, and agricultural waste pollutants. Nonpoint pollution problems throughout the upper Minnesota River Basin stem from pesticide, fertilizer, and animal waste runoff. High concentrations of nutrients, chiefly nitrogen and phosphorous compounds, result from point and nonpoint pollution. There are severe algae bloom problems in Big Stone Lake.

Related Land Issues

- Major urban flood damages occur in Canby, Dawson, Granite Falls, Marshall, Montevideo, and Ortonville in Minnesota, and in Big Stone City in South Dakota. Severe flood damages afflict rural properties and agricultural lands throughout the Upper Minnesota River Basin. Recreation lands and facilities along the Minnesota River experience moderate flood damages.

- There is extensive drainage and filling of wetlands, lakes, and ponds to facilitate agriculture.

- Significant streambank and gully erosion damages rural properties, agricultural and recreation lands, and environmental resources. Significant sediment damage occurs throughout the problem area and stems chiefly from soil erosion along several of the small tributaries of the Minnesota River.

- Much of the area's valuable recreation land and environmental resources is being converted to agricultural and urban land uses.

Adverse Effects

- There are deficiencies in surface- and ground-water supplies for

municipal purposes in the Granite Falls area.

- Use of ground water as a potable water supply for domestic purposes and livestock is restricted. Untreated ground-water supplies contain high concentrations of sulfates, iron, and manganese.

- Rural and urban flood damages are a continuing problem along the Main Stem of the Minnesota River and along several tributaries. Average annual flood damages along the Minnesota River are estimated for 1980 at about $115,000 per mile (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages and decreased agricultural production.

- Recreation involving whole-body water contact is severely impaired on the Chippewa and Redwood Rivers.

- Recreation lands are being lost to agricultural and urban development in flood-plain, shoreland, and forest areas. High quality hunting areas are being reduced as a result of continued drainage and filling of wetland areas.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands, and degradation of streambanks, scenic amenities, and other environmental resources. The natural setting of the Minnesota River Valley is changing.

Problem Area : Lower Minnesota River Basin Area

WRC REGION: 7 SUBREGION: 701

STATE: Minnesota PROBLEM AREA NO.: 4

The Lower Minnesota River Basin Problem Area in south-central Minnesota includes the Minnesota River and its drainage area from below the Redwood Falls area to the Twin Cities SMSA. The area encompasses approximately 6,500 square miles and includes all of Brown, Watonwan, Nicollet, Sibley, Blue Earth, and Faribault Counties and portions of Redwood, Cottonwood, Renville, LeSueur, Waseca, and Martin Counties. The problem area has a population of approximately 225,000 people, and its largest cities are Mankato, North Mankato, St. Peter, Fairmont, New Ulm, and LeSueur. The topography of the problem area varies from a tableland, rising several hundred feet above the river in the southern portion of the area, to a hilly moraine contour in the northern portion of the area above the Minnesota River. The lower Minnesota River Basin above Mankato is one of the best areas in Minnesota for obtaining ground water from shallow sand and gravel aquifers, especially along the river valleys. It is also

one of the most favorable areas for developing deep wells. Average yields range from 500 to 2,000 gpm. West of Mankato several wells yield more than 300 gpm; however, the average yield is about 10 gpm. As in the upper Minnesota River Basin, surface-water resources are quite variable, and there are large fluctuations in streamflow.

Water Issues

- Water supply problems could occur at New Ulm and Mankato. Locally high consumptive demands during low-flow periods in late summer and fall may cause serious local streamflow problems in the problem area.

- There are water quality problems on the Cottonwood and Blue Earth Rivers, Center and Plum Creeks, an unnamed tributary to the LeSueur River, Watonwan River, and the Minnesota River below Mankato. These problems stem from high concentrations of municipal, industrial and agricultural waste pollutants in these locations. There are high bacteria counts and low dissolved oxygen levels at these locations during periods of low flow. Nonpoint pollution problems throughout the area stem from agricultural land runoff. High nutrient counts, chiefly nitrogen and phosphorus compounds, and heavy sediment loads stem from land runoff and municipal and industrial waste pollution.

Related Land Issues

- Major urban flood damages occur in Springfield, New Ulm, St. Peter, LeSueur, Judson, Henderson, and Madelia. Severe flood damages afflict rural properties and agricultural lands along the lower Minnesota River and tributaries.

- There is extensive drainage and filling of wetlands, lakes, and ponds to facilitate agricultural development.

- Significant streambank and gully erosion damages rural properties, agricultural and recreation lands, and environmental resources. Significant sediment damage occurs throughout the problem area and stems chiefly from soil erosion along several of the small tributaries of the Minnesota River. Sediment yields exceeding 100,000 tons per day were calculated at Mankato.

- Much of the area's valuable recreation lands and environmental resources is being converted to agricultural and urban land uses.

Adverse Effects

- There is a potential deficiency in surface-water and ground-water supplies for large scale municipal, industrial, and agricultural

uses in the New Ulm and Mankato areas.

- Use of surface water as a potable water supply for domestic purposes and livestock and as a suitable water supply for food processing industries is restricted. Untreated ground-water supplies contain high concentrations of sulfates, iron, and manganese. Treatment is required prior to its use as a municipal or industrial water supply.

- Average annual rural flood damages (1975 dollars) are estimated to reach $184,000 per mile by 1980 near Mankato along the Minnesota River and an average of over $38,300 per mile by 1980 along the entire lower 200 miles of the Minnesota River. There is extensive flood damage along several of the tributaries. Floods reduce property values, curtail agricultural and industrial production, and cause further deterioration of recreation lands and facilities. Flood damages are especially severe in the flood-plain areas of the Minnesota River where floods on these bottomlands have caused severe loss of productive agricultural soils. Approximately 75 percent of the total flood-plain area of the Minnesota River Basin is used for agricultural purposes, and damages to crops and farm properties are substantial throughout this flood-plain area.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of valuable topsoil resources, resulting in decreased agricultural production. Removal of suspended sediment is required prior to the use of surface waters for municipal and industrial purposes.

- Recreation involving whole-body water contact is severely impaired on the Cottonwood, Blue Earth, Watonwan, and Minnesota Rivers below Mankato. Use of many of the area's lakes for recreation is restricted due to algae blooms in late summer and fall months.

- Recreation lands are being lost to agricultural and urban development in flood-plain, shoreland, and forest areas. Erosion and flooding problems are accelerating as a result of this flood-plain and shoreland development. High quality hunting areas are being reduced by continued drainage and filling of wetland areas.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other environmental resources. The natural setting of the Minnesota River Valley is being altered.

- Failure to resolve institutional issues may result in continued loss of confidence and faith in these public agencies and a resultant lack of public acceptance of agency plans for solving water and related land resource problems.

Problem Area : Upper Cedar River Basin Area

WRC REGION: 7 SUBREGION: 703

STATES: Iowa and Minnesota PROBLEM AREA NO.: 19

The Upper Cedar River Basin Problem Area in north-central Iowa and south-central Minnesota includes the drainage area of the Cedar River just north of Cedar Falls. The drainage areas of the Winnebago, Shell Rock, and Little Cedar Rivers are included in the Cedar River Basin. The problem area encompasses approximately 3,700 square miles, and it includes all of Floyd, Cerro Gordo, and Worth Counties and portions of Butler, Franklin, Mitchell, Winnebago, and Bremer Counties in Iowa and portions of Mower and Freeborn Counties in Minnesota. The area has a population of approximately 200,000 people, and its largest cities are Austin and Albert Lea, Minnesota, and Mason City, Iowa. The topography of the area is generally a gently rolling prairie with isolated lakes, swamps, and bogs. Ground-water and surface-water resources are generally ample for the majority of the problem area. However, in the urban areas of Austin, Albert Lea, Forest City, and Mason City, existing ground-water supplies and variable streamflows may not be sufficient to meet the local water demand in the near future.

Water Issues

- Locally high consumptive demands during late summer, fall and winter months may cause local streamflow and water supply problems at Mason City and Forest City, Iowa, and at Albert Lea and Austin, Minnesota.

- Water quality problems on the Cedar River below Austin, Shell Rock River below Albert Lea, and on the Winnebago River below Mason City and Forest City stem from high concentrations of municipal, industrial (meat packing industries), and agricultural waste pollutants. Nonpoint pollution problems throughout the problem area are due to pesticide, fertilizer, and animal waste runoff. High concentrations of total nitrogen and phospates arise from point and nonpoint pollution problems. Eutrophication and excessive algae bloom create problems in several of the lakes in the basin, especially Albert Lea Lake.

- Large concentrated demands on local ground-water supplies pose potential water supply problems in Austin, Albert Lea, Mason City, and Forest City. High concentrations of iron, dissolved solids, and excessive hardness create problems in the ground-water resources of much of the basin.

Related Land Issues

- Major urban flood damages occur in Charles City, Mason City, Waverly, and Greene, Iowa, and in Austin, Minnesota. Flood damages to rural properties and agricultural lands are extensive along both the Iowa

and Cedar Rivers. Moderate flood damages occur on recreation lands and facilities.

- o There is streambank, gully, and sheet erosion damage throughout the upper Cedar Basin. Environmental resources in the area suffer significant sediment damage. Sediment yields in the Upper Cedar River Basin average about 200 tons per square mile per year.

- o Use of untreated ground water as a potable water supply for domestic purposes and livestock and as a suitable water supply for food processing industries is restricted due to excessive iron and dissolved solids concentrations.

- o There are potential deficiencies in surface-water and ground-water supplies for large scale municipal and agricultural withdrawal uses.

- o Average annual urban and rural flood damages are estimated for 1980 at $227,100 along the Cedar River above Cedar Falls; $292,200 for the Shell Rock River; and $522,000 for the West Fork of the Cedar River (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- o Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages and decreased agricultural production.

- o Recreation involving whole-body water contact is severely impaired below Austin on the Cedar River, below Albert Lea on the Shell Rock River, and below Mason City and Forest City on the Winnebago River.

- o There is continued deterioration and reduction **27** fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Middle Cedar River Basin Area

WRC REGION: 7 SUBREGION: 703

STATE: Iowa PROBLEM AREA NO.: 20

The Middle Cedar River Basin Problem Area lies in east-central Iowa. It includes the Cedar River and its immediate drainage area from just north of Cedar Falls to just south of Cedar Rapids. The problem area encompasses approximately 1,200 square miles, and it includes portions of Black Hawk, Benton, Linn, and Buchanan Counties. The area has a population of approximately 300,000 people, and its largest cities are Cedar Rapids, Cedar Falls, and Waterloo. The topography of the area is generally a rolling prairie with surface elevations less than 150 feet above the Cedar River. Streams in this area are generally in steeper valleys,

although wide flood plains are sometimes developed. Ground-water resources in the area are quite abundant and are the major source of municipal and industrial supplies. Surface-water resources are also ample; however, flows are quite variable.

Water Issues

- Locally high consumptive demands during late summer, fall, and winter months may cause local streamflow and water supply problems at Cedar Rapids and Waterloo.

- Water quality problems on the Cedar River below Waterloo and Cedar Rapids stem from municipal, industrial, and agricultural pollutants. Nonpoint pollution problems throughout the problem area stem from agricultural runoff. High concentrations of nitrogen and phosphates result from point and nonpoint pollution. Eutrophication and excessive aquatic weed growth create problems throughout the problem area.

- Large concentrated demands on local ground water supplies pose potential water supply problems in Waterloo and Cedar Rapids. There are high concentrations of iron and excessive hardness problems in the ground-water resources of much of the basin.

- There is a lack of sufficient surface-water area for many water-related recreation activities.

Related Land Issues

- Major urban flood damages occur in Waterloo and Cedar Rapids. Flood damages to rural properties and to agricultural lands are severe along the Cedar River between Waterloo and Cedar Rapids. Recreation lands and facilities suffer moderate flood damages.

- Streambank, gully, and sheet erosion damages occur throughout the area. Sediment damages are significant, especially in the Cedar Rapids area. Localized sediment yields in the problem area vary from approximately 200 tons per square mile near Waterloo to approximately 650 tons per square mile near Cedar Rapids (on a 10 square-mile area).

- Conversion of shoreland and flood-plain areas to agricultural and urban uses results in a decrease in the area's limited forest resources and acceleration of flooding and erosion problems.

Adverse Effects

- There are potential deficiencies in surface-water and ground-water supplies for large scale municipal, industrial, and agricultural withdrawal uses. The development of additional sources of water

supply may be required in the Waterloo and Cedar Rapids Areas.

- Average annual rural and urban flood damages are estimated for 1980 at $69,100 per mile along the Cedar River in the problem area (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and degradation of productive agricultural acreages, decreasing agricultural production. The Cedar River downstream from its confluence with the West Fork River transports an annual sediment load of approximately 9.8 million tons, of which 9.1 million tons is attributed to soil loss from cropland areas. Land treatment costs to reduce gross sediment loss in the area by 20 to 30 percent would amount to an annual cost of between $3.80 and $6.10 per ton of sediment retained on the land.

- Recreation involving whole-body water contact is severely impaired below Cedar Rapids and Waterloo on the Cedar River. Use of the area's lakes is restricted because of eutrophication problems in late summer and fall months. Fishing opportunities are limited in the Cedar River as a result of high concentrations of pesticides found in fish.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. Acceleration of flooding and erosion problems occurs as a result of this agricultural and urban development.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Lower Iowa-Cedar Rivers Area

WRC REGION: 7 SUBREGION: 703

STATE: Iowa PROBLEM AREA NO.: 21

The lower Iowa-Cedar Rivers Problem Area in southeast Iowa includes the drainage area of the Cedar River just below Cedar Rapids, Iowa, and the lower 100 miles of the Main Stem of the Iowa River. The problem area encompasses approximately 1,700 square miles, and it includes portions of Cedar, Muscatine Muscatine, Louisa, Johnson, Linn, and Washington Counties. The area has a population of approximately 125,000 people, and its largest city is Iowa City. The topography of the problem area is generally characterized by gently rolling prairie. In Louisa and Muscatine Counties adjacent to the Mississippi River, the area's streams have cut deeply into this gently rolling topography and wide flood plains are common. Ground-water and surface-water resources are quite abundant in this area; however, streamflows for the Iowa

and Cedar Rivers are quite variable. Maximum flows can be many times the average or minimum flows.

Water Issues

- Water quality problems on the Iowa River below Iowa City stem from municipal, industrial, and agricultural pollution. Nonpoint pollution problems on both the Cedar and Iowa Rivers result from pesticide, fertilizer, and animal feedlot waste runoff. High concentrations of total nitrogen and phospates, stemming from point and nonpoint pollution, result in lake eutrophication and excessive algae blooms and aquatic growths.

- Excessive hardness and high concentrations of iron occur in groundwater resources.

Related Land Issues

- There are urban flood problems in Iowa City. Extensive flood damages occur to rural properties and to agricultural lands along both the Iowa and Cedar Rivers. Recreation lands and facilities suffer moderate flood damages.

- Severe streambank, gully, and sheet erosion damage occurs throughout the problem area. There are also extensive sediment damages in the area. Average sediment yields are about 650 tons per square mile annually (on a 10 square-mile area). The total sediment load at Iowa City on the Iowa River in 1966 was 463,379 tons.

Adverse Effects

- Use of surface water as a potable water supply for domestic purposes and livestock and as a suitable water supply for industrial processing and cooling purposes is restricted, primarily by excessive hardness and iron content problems.

- Average annual flood damages are estimated at $7,660 per mile along the Iowa River and $12,300 per mile along the Cedar River in the problem area (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas and deterioration of recreation lands and facilities.

- Recreation involving whole-body water contact is severely impaired below Iowa City on the Iowa River.

- There is continued deterioration and reduction of fish and wild-

life habitat and wetlands, and degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Middle Iowa River Area

WRC REGION: 7 SUBREGION: 703

STATE: Iowa PROBLEM AREA NO.: 22

The Middle Iowa River Problem Area includes the Iowa River and drainage area from just north of Marshalltown to the western edge of the Coralville Reservoir in Iowa County. The area encompasses approximately 1,600 square miles and includes portions of Tama, Marshall, Benton, Poweshiek, and Iowa Counties. The problem area has a population of approximately 90,000 people, and its largest city is Marshalltown. The topography of the area reflects a gently rolling prairie land with surface elevations of less than 150 feet above the streams. Ground-water resources in the problem area are quite abundant. Surface-water resources are also abundant; however, streamflows on the Iowa River are quite variable, with maximum flows often many times that of average or minimum flows.

Water Issues

- o There are water quality problems on the Iowa River below Marshalltown stemming from high concentrations of municipal, industrial and agricultural waste pollutants. Nonpoint pollution problems throughout the problem area stem from agricultural land runoff. High concentrations of nitrogen and phosphates result from point and nonpoint pollution, leading to lake eutrophication and excessive algae blooms and aquatic growths.

- o Excessive hardness due to high concentrations of iron occurs in ground-water resources.

Related Land Issues

- o Major urban flood damages occur in Marshalltown and Tama. Severe flood damages afflict rural properties and agricultural lands along the Iowa River. Recreation lands and facilities suffer moderate flood damages.

- o There are severe streambank, gully, and sheet erosion damages and extensive sediment damages throughout the problem area. Average sediment yields are about 650 tons per square mile per year, and concentrations exceed several thousand parts per million during high streamflow conditions.

Adverse Effects

- o Use of surface water as a potable water supply for domestic purposes

and livestock and as a suitable water supply for industrial processing and cooling purposes is restricted, primarily because of excessive turbidity and sedimentation. Cost of water treatment for municipal and industrial supplies taken from surface-water resources is increasing. Use of untreated ground water as a potable water supply is restricted because of excessive hardness and iron content problems.

- Average annual urban and rural flood damages are estimated for 1980 at $20,400 per mile along the Iowa River (miles 160 to 231) (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause continued deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, loss of resevoir storage, and loss of productive topsoil on agricultural lands, resulting in decreased agricultural production. Eighty-seven percent of the Iowa River Basin's agricultural land has problems that restrict its use and/or create a need for measures to preserve the resource. Proposed treatment practices have been shown to reduce gross sediment loss by 20 to 30 percent at an annual unit cost of between $3.80 and $6.10 per ton of sediment retained on the land.

- Recreation involving whole-body water contact is severely impaired below Marshalltown on the Iowa River. Excessive algae blooms in Coralville Reservoir restrict its use for recreation during the late summer and fall months.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands as well as degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Skunk River Basin Area

WRC REGION: 7 SUBREGION: 703

STATE: Iowa PROBLEM AREA NO.: 23

The Skunk River Basin Problem Area, which lies in central and east-central Iowa, includes the Skunk River and its drainage area from just north of Ames, Iowa, to its confluence with the Mississippi River just south of Burlington, Iowa. The area encompasses about 4,400 square miles and it includes portions of Story, Hamilton, Jasper, Polk, Mahaska, Poweshiek, Keokuk, Washington, Jefferson, Henry, and Des Moines Counties. The problem area has a population of approximately 260,000 people, and its largest cities are Ames, Oskaloosa, Fairfield, and Burlington. The topography of the Skunk River Valley ranges from a narrow shallow plain above Ames, to a fairly wide plain below Ames. In Henry County, the river enters a narrow, steep-walled valley until just below Augusta where the valley becomes wide and merges with the flood plain of the Mississippi

River. Ground-water resources range from 500 to 1,000 gpm in areas immediately adjacent to the Skunk River, to 100 gpm in localized areas. Surface-water resources vary considerably as the Skunk River does not always have a good sustained flow. Extremely low flows have occurred in the river during extended droughts.

Water Issues

- Streamflows are not sufficient for recreation purposes. There is a lack of adequate waste-water treatment for waste assimilation purposes during low-flow periods in late summer and winter months.

- Surface- and ground-water resources may not be sufficient to meet projected water requirements in Ames.

- Chemical pollution has caused water quality problems on the Skunk River below Ames. Domestic, commercial, and industrial waste discharges from the Ames area are imposing a waste load on the river which is greater than the river can assimilate. Other water quality problems exist on Cherry Creek below Fairfield and on a small creek below Oskaloosa. There are nonpoint pollution problems on the Skunk River in Jefferson, Washington, and Henry Counties arising from agricultural land runoff. Stream and lake eutrophication problems, turbidity, and high nutrient levels throughout the problem area stem from point and nonpoint pollution.

Related Land Issues

- Major urban flood damages occur in Ames and Augusta. Flood damages to rural properties and agricultural lands along the Skunk River are extensive. Recreational lands and facilities experience moderate flood damages.

- Severe bank, gully, and sheet erosion inflicts damage on rural properties and agricultural and recreational lands. Sediment damages are extensive throughout the Skunk River Basin. In the lower two-thirds of the problem area, sediment yields are greater than 500 tons per square mile (on an average 10 square-mile area).

Adverse Effects

- Use of surface water as a potable water supply for domestic purposes and livestock and as a suitable water supply for industrial processing is restricted primarily by excessive turbidity and sedimentation. In addition, during periods of low streamflow, the river is characterized by high bacterial counts, nutrient levels, and low dissolved oxygen levels. As a result, treatment is required prior to its use as a municipal and industrial supply.

- There are potential deficiencies in surface water and ground water

for municipal needs in the Ames area. The alluvial aquifer from which Ames draws its municipal supply is estimated to have a sustained yield of only 10 mgd. The development of additional sources of water supply may be required.

- Average annual urban and rural flood damages are estimated for 1980 at $7,820 per mile (miles 0 to 90) and $11,800 (miles 91 to 180) per mile along the Skunk River (1975 dollars). Average annual damages for the entire basin were estimated at $3,203,500 in 1970 and are projected to be $4,284,900 in 1982 (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, and loss of valuable topsoil resources resulting in decreased agricultural production. It was estimated that implementation of land treatment measures to reduce surface runoff and to limit soil losses to levels established by soil conservation districts would cost about $2.6 billion. Major treatment measures required under this program would include strip-cropping and terracing ($1,265 million) and grade stabilization ($978.0 million).

- Recreation uses involving whole-body water contact are severely impaired below Ames on the Skunk River and on the Skunk River in Jefferson, Washington, and Henry Counties. Use of the area's lakes is restricted because of eutrophication problems. There is a severe lack of sufficient surface water to meet the recreation demands of the area's population.

- Deterioration and reduction of fish and wildlife habitat and wetlands and degradation of streambanks, scenic amenities, and other valuable environmental resources are ongoing problems.

Problem Area : Fabius River Basin Area

WRC REGION: 7 SUBREGION: 704

STATE: Missouri PROBLEM AREA NO.: 32

The Fabius River Basin Problem Area in northeastern Missouri and southeastern Iowa includes the North, Middle, and South Fabius Rivers and their drainage areas which drain to the Mississippi River. The problem area encompasses approximately 1,400 square miles and includes portions of Clark, Knox, Lewis, Marion, Schuyler, and Scotland Counties in Missouri and a portion of Davis County in Iowa. The area has a population of about 30,000 people, and its largest cities are Monticello and Canton. The topography of the basin is generally level prairie to rolling country with long, narrow, and deep river valleys. Ground-water resources are quite limited in the basin. Ground water in quantities adequate for

municipal or industrial supply is generally limited to the sand and gravel along the Mississippi River. Surface-water resources are quite variable. For example, streamflows on the North Fabius River at Monticello have fluctuated from 20,700 cfs to zero. Critical low flows generally occur in the late summer and early fall.

Water Issues

- Surface-water resources in low flow periods can generally provide only enough water to sustain relatively small communities and industries requiring limited qualtities of water. Ground water in quantities adequate for municipal, agricultural, and industrial supply is generally limited to the unconsolidated sands and gravels along the Mississippi River.

- There is not sufficient surface water for water-related recreation activities, especially in late summer, fall, and winter months.

- Large amounts of nutrients, including nitrogen and phosphorus, enter the area hydrologic system as a result of storm-water runoff and may cause eutrophication problems.

- Limited ground-water supplies from consolidated aquifers are highly mineralized and unacceptable for domestic and livestock uses. Ground water from glacial drift in northern Scotland and Clark Counties has a high iron content and frequently a high nitrate content.

Related Land Issues

- Rural properties and agricultural land sustain major flood damages, especially along the North Fabius River. Recreation lands and facilities suffer moderate flood damages.

- Severe sheet, gully, and streambank erosion damage rural properties and agricultural and recreation lands. Excessive turbidity and significant sediment damages in the Fabius Basin, especially in the lower half of the basin, are about 1,100 tons per square mile. Annual yields in the lower half are extremely high, averaging 1,700 tons per square mile (10 square-mile area). Sediment loads on the Fabius River reach several thousand parts per million during high streamflow periods.

- Potential water impoundments will pose conflicts for future land uses.

Adverse Effects

- Use of surface water as a suitable water supply for domestic pur-

poses and livestock and as a suitable water supply for industrial processing is restricted primarily by mineralization, excess turbidity, and sedimentation. Ground water from consolidated aquifers is unacceptable for most water withdrawal uses.

- Rural flood damages are estimated for 1980 at an annual average of $6,130 per mile along the North Fabius River; $770 per mile along the Middle Fabius River; and $1,530 per mile along the South Fabius River (1975 dollars). Floods reduce property values, curtail agricultural production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages which decrease agricultural production.

- Recreation involving whole-body water contact is severely impaired on the north and south forks of the South Fabius River below Edina and on an unnamed tributary to the North Fabius River near Memphis. Surface-water area is not sufficient to meet the recreation needs of the area's population.

- Deterioration and reduction of fish and wildlife habitat and wetlands as well as the degradation of streambanks, scenic amenities, and other environmental resources are ongoing problems.

Problem Area : Salt River Basin Area

WRC REGION: 7 SUBREGION: 704

STATE: Missouri PROBLEM AREA NO.: 33

The Salt River Basin Problem Area in northeastern Missouri includes the Salt River and its tributaries, which drain to the Mississippi River. The problem area encompasses approximately 2,600 square miles and includes portions of Adair, Audrain, Macon, Monroe, Pike, Ralls, Randolph, and Shelby Counties. The area has a population of approximately 75,000 people, and its largest cities are Mexico, Vandalia, and Centralia. The topography of the basin ranges from a gently rolling plain in the upstream end of the basin to a more broken and hilly landscape in the central and lower portions. Ground-water resources are generally quite plentiful in the southern portion of the problem area and along the Mississippi River. However, in the northern segments of the area, aquifer yields are very limited. Surface-water resources are quite variable, as streamflows tend to fluctuate considerably. For instance, the Salt River streamflow has varied from a maximum flow of 107,800 cfs during flood stages to no-flow conditions.

Water Issues

- Present surface-water resources can only provide limited quantities

of water for withdrawal purposes, especially in later summer and fall months. Ground-water yields from the glacial till are insufficient for water supply purposes in the northern portions of the Salt River Basin.

- There is insufficient surface water for water-related recreation activities, especially in late summer, fall, and winter months.

- Large amounts of nutrients, including nitrogen and phosphorus, entering the area's hydrologic system as a result of stormwater runoff, may cause eutrophication problems.

- There are high concentrations of dissolved solids, iron, nitrates, and high bacteria counts in ground-water resources. Ground water from consolidated aquifers is highly mineralized and unacceptable for most water withdrawal use.

Related Land Issues

- Major urban flood damages occur at Mexico and New London. Severe flood damages afflict rural properties and agricultural lands, especially along the lower 100 miles of the Salt River. Recreation lands and facilities suffer moderate flood damages.

- Significant gully, sheet, and streambank erosion damages rural properties, agricultural and recreation lands, and environmental lands and resources. Streambank erosion problems become acute along many of the smaller tributaries during flash floods. Sediment damages are severe in the problem area, especially in the lower reaches of the Salt River where sediment loads reach several thousand parts per million. Sediment loads in the upper reaches average about 900 tons per square mile per year (from a 10 square-mile area).

- There are conflicts between agricultural, mining, recreation, and environmental uses of the basin's land resources. These conflicts will become more acute if water supplies diminish further.

Adverse Effects

- Restricted use of surface water as a suitable water supply for domestic purposes and livestock and as a suitable water supply for industrial processing is due primarily to mineralization, excess turbidity, and sedimentation. Ground water from consolidated aquifers is unacceptable for most water withdrawal uses.

- Surface-water and ground-water supplies are insufficient for large-scale water withdrawal uses, especially in the northern segments of the Salt River Basin where aquifer yields are quite limited and surface-water resources are highly variable.

- Annual urban and rural flood damages are estimated for 1980 at $13,800 per mile along the Salt River below the Clarence Cannon Reservoir; $7,660 per mile along the South Fork of the Salt River; $6,130 per mile along the Middle Fork of the Salt; and $4,600 per mile along the North Fork of the Salt River (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreation lands and facilities, and loss of productive agricultural acreages, which decreases agricultural production.

- Recreation uses, especially those involving whole-body contact, of the basin's water resources are severely impaired in late summer, fall, and winter months. There is a lack of sufficient surface water to meet the recreation needs of the area's population.

- Recreation lands are being lost to urban, mining, and agricultural development in shoreland, flood-plain, and forest areas.

- Deterioration and reduction of fish and wildlife habitat and wetlands and the degradation of streambanks, scenic amenities, and other environmental resources are ongoing problems.

Problem Area : Clearwater River Basin Area

WRC REGION: 7 SUBREGION: 701

STATE: Minnesota PROBLEM AREA NO.: 5

The Clearwater River Basin Problem Area lies in central Minnesota. The Clearwater River rises in Meeker County, flows through Stearns and Wright Counties, and enters the Mississippi River near the town of Clearwater. The problem area encompasses approximately 183 square miles and includes portions of Meeker, Stearns, and Wright Counties. The area has a population of about 6,500 people, and its principal communities are Annandale, Kimball, South Haven, and Watkins. The topography of the area is dominated by rolling glacial moraines. The western portion of the watershed is composed of morainal hills which have a high clay content. The area to the east is flatter and is characterized by more porous, sandy soils. The elevation ranges from 1,150 feet in the west to 940 feet at the Mississippi River to the east. Ground-water resources in the basin are generally quite ample. The watershed lies almost entirely in glacial drift over igneous and metamorphic rocks. The Clearwater River is characterized by low- or no-flow conditions at times. The upper reaches of the river receive little flow from lakes or ground water during summer months, and its tributaries are often dry. Records indicate that the streamflow of the river at the inlet to Clearwater Lake is about 60 cfs during summers of normal rainfall.

Water Issues

- o There is insufficient streamflow during the late summer and fall months to sustain a quality stream fishery.

- o Severe eutrophication, algae bloom, and aquatic weed growth are problems in Clearwater Lake, Lake Louis, Lake Maria, and Lake Caroline. These problems stem from point and nonpoint sources of pollution. Considerable nutrient accumulation and oxygen depletion problems occur in Clearwater Lake during the late summer months. There are high concentrations of nitrates and phosphorus in the Clearwater River. Nutrient levels in the Clearwater River reach excessive proportions during low-streamflow periods.

Related Land Issues

- o Rural properties and agricultural lands suffer moderate erosion damage. Significant streambank erosion damages are in evidence along Clearwater Lake during high water level periods. Representative sediment yields are about 60 tons per square mile from a ten square-mile drainage area.

Adverse Effects

- o Recreation involving whole-body water contact is severely impaired on Lake Mana, Lake Caroline, Lake Louisa, Clearwater Lake, and the Clearwater River.

- o Reduction in value of lakefront properties results from water quality and erosion problems.

- o Agricultural lands deteriorate as a result of sheet and gully erosion.

- o Deterioration and reduction of fish and wildlife habitat plus the degradation of streambanks, scenic amenities, and other valuable environmental resources are ongoing problems.

Problem Area : Middle Des Moines River Basin Area

WRC REGION: 7 SUBREGION: 703

STATE: Iowa PROBLEM AREA NO.: 24

The Middle Des Moines River Basin Problem Area lies in central and south-central Iowa. It includes the Des Moines River and its immediate drainage area from mile 330 (just above Fort Dodge) to mile 77 (just below Ottumwa). The area encompasses approximately 3,000 square miles and includes portions of Boone, Dallas, Green, Humboldt, Mahaska, Marion, Monroe, Polk, Wapello, Warren, and Webster Counties. The area has a population of about 450,000 people, and its largest cities are Des Moines,

Fort Dodge, and Ottumwa. The Des Moines River rises in the south-central portion of Lyon County, Minnesota, and flows in a southerly direction, entering Iowa at the northwestern corner of Emmet County. After entering Iowa, the River flows in a southeasterly direction 535 miles to its confluence with the Mississippi River a few miles below Keokuk, Iowa. Above Des Moines, the valley of the river is quite narrow. From Humboldt to Des Moines, the hills on either side of the river are high and steep, while below Des Moines the valley becomes wider and is bounded by rounded bluffs. Ground-water resources in the problem area are generally adequate to meet present and future needs. Sufficient quantities of ground water may be obtained from shallow to moderately deep unconsolidated deposits and from moderately deep consolidated formations. The Des Moines River and its tributaries are characterized by great variations in flow. Streamflow records show that the Des Moines River and tributaries have sustained low flows, and serious flooding frequently occurs in the problem area.

Water Issues

- Streamflows are insufficient during the late summer, fall, and winter months to maintain quality recreation and environmental uses.

- Water quality problems exist on the Boone River below Webster City and on the Des Moines River below Fort Dodge and Des Moines. These stem from high concentrations of municipal, industrial, and agricultural waste pollutants. Nonpoint pollution throughout the problem area stems from agricultural and land runoff. There are high concentrations of bacteria and nutrients and locally high biochemical oxygen demands throughout the problem area which stem from point and nonpoint pollution problems. Excessive turbidity problems in the lower half of the problem area arise chiefly from animal feedlot and agricultural land runoff. There are Eutrophication problems in the area's lakes, streams, and reservoir areas. Thermal pollution problems stemming from fossil fueled steam electric power facilities occur on the Des Moines and Lower Raccoon Rivers.

- There are potential deficiencies in ground-water supplies for future municipal and industrial water requirements. These water supply problems are especially significant in the southern portion of the problem area where ground water is highly mineralized and yields are low. In Ottumwa, excessive pumpage from the Jordan-Sandstone Aquifer has resulted in a loss of pressure head of 100 feet in 70 years.

- Ground-water supplies taken from unconsolidated aquifers have locally high concentrations of total dissolved solids, iron, and excessive hardness problems. At times, total dissolved solids concentrations exceed drinking water standards.

Related Land Issues

- Major urban flood damages occur in Webster City on the Boone River and in Fort Dodge, Ottumwa, and West Des Moines on the Des Moines River. Rural properties and agricultural lands along the Boone, Des Moines, and Raccoon Rivers suffer severe flood damage. Recreation lands and facilities experience moderate flood damages.

- Severe sheet, gully, and streambank erosion damages rural properties and agricultural and recreation lands. Erosion damage is especially severe in the lower half of the problem area. Extensive sediment damage is especially severe in the lower half of the problem area where representative sediment yields are 1,100 tons per square mile per year (from a 10 square-mile drainage area). Sediment loads in the middle Des Moines River increase to several thousand parts per million during high streamflow.

- Conflicts exist between agricultural, urban, recreation, and environmental interests over the conversion of the area's recreation and environmental land resources to urban and agricultural uses.

Adverse Effects

- Use of surface water as a potable water supply for domestic purposes and livestock and as a suitable water supply for industrial processing and cooling purposes is restricted primarily because of excessive turbidity and sedimentation. Use of untreated ground water as a potable water supply for domestic purposes and livestock is also restricted. Treatment is required prior to its use as a municipal and industrial water supply.

- There is a lack of sufficient ground-water supplies for municipal and industrial needs in many parts of the problem area.

- Average annual urban and rural flood damages are estimated for 1980 at $7,820 per mile along river miles 77-114 of the Des Moines River; $94,400 per mile along river miles 197-214 and $15,800 per mile along river miles 266-300 of the Des Moines River (1975 dollars). Average annual damages along the Raccoon River as well as Walnut and Jordan Creeks in the Des Moines Area are $803,400 (1975 dollars). For the entire Des Moines Basin, average annual damage figures were estimated at $3,073,700 (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreation lands and facilities.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation lands and facilities, and loss of valuable topsoil resources resulting in decreased agricultural production. Gully erosion alone adversely affected 2,530 acres in the Des Moines River Basin in 1966 causing damages estimated at $1,465,600. The Des Moines River also trans-

ports an average sediment load of 23,000 tons daily. This excessive sediment load creates serious problems in the use of surface water for water supply purposes.

- Recreation involving whole-body water contact is severely impaired on the Boone River below Webster City and below Fort Dodge and at Des Moines on the Des Moines River. Use of many of the area's lakes and reservoirs for recreation is restricted because of eutrophication problems in late summer and fall months.

- Recreation lands are being lost to agricultural and urban development in flood-plain and shoreland areas. Flooding and erosion problems are accelerating as a result of this development. High-quality hunting areas are being lost because of destruction of wildlife habitat.

- There is continuing deterioration and reduction of fish and wildlife habitat and wetlands as well as degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Upper Des Moines River Basin Area

WRC REGION: 7 SUBREGIONS: 701 and 703

STATES: Iowa and Minnesota PROBLEM AREA NO.: 25

Problem Area 25 in north-central Iowa and southwestern Minnesota includes the Des Moines River and its drainage area above mile 400 or just above Palo Alto County in Iowa. The area encompasses approximately 1,700 square miles, and it includes portions of Cottonwood, Jackson, Marin, Murray, and Nobles Counties in Minnesota and Emmet County in Iowa. The area has a population of about 50,000 people, and its largest cities are Esterville, Iowa, and Jackson and Worthington, Minnesota. The topography of the area is characterized by low rolling hills and outwash plains. The Des Moines River Valley itself is quite narrow. Surface-water resources in the area are generally quite limited. The upper Des Moines River and its tributaries are characterized by extreme low-flow conditions in late summer, fall, and winter months, and the river is quite shallow for the majority of the year. Ground-water resources may be obtained from shallow to moderately deep unconsolidated deposits and from moderately deep consolidated formations. However, in certain locations, ground water is not economically available in adequate quantity or quality. Difficulties encountered by the city of Worthington in locating an adequate water supply emphasize the general lack of readily accessible large aquifers in the upper Des Moines Basin.

Water Issues

- Streamflows are insufficient during the late summer, fall, and winter months to maintain quality recreation and environmental use.

- In many parts of the upper Des Moines River Basin, ground water is not available in adequate quantity for large-scale municipal, agricultural, and industrial uses. Surface-water resources are capable of providing only enough water to sustain limited domestic, agricultural, and industrial demands.

- There are water quality problems in Okabena Creek near Worthington and on the Des Moines River below Esterville stemming from high concentrations of municipal, industrial, and agricultural waste pollutants. Nonpoint pollution problems throughout the problem area stem from pesticide, fertilizer, bacteria, and nutrients, as well as from locally high biochemical oxygen demands in the problem area. There are eutrophication problems in many of the area's shallow lakes and streams.

- Locally high concentrations of total dissolved solids, iron, and excessive hardness problems occur in ground-water supplies taken from unconsolidated aquifers. At times, total dissolved solids concentrations exceed drinking water standards.

Related Land Issues

- Wetlands, small lakes, and ponds are being drained to facilitate agricultural development.

- Significant sheet, gully, and streambank erosion damages occur in the upper Des Moines Basin. Erosion damages are especially severe along the bluff areas along the basin's major rivers and tributaries. Sediment damages are significant in and along the basin's major rivers and tributaries. Representative sediment yields from the bluff areas of the Des Moines River are about 400 tons per square mile per year (from a 10 square-mile drainage area).

- Conflicts exist between agricultural interests and recreation and environmental needs over the use of the area's land resources. Much of the problem area's recreation and environmental land resources is being converted to agricultural uses.

Adverse Effects

- Use of ground water as a potable water supply for domestic purposes and livestock is restricted.

- There is a lack of sufficient ground water and surface water for large-scale water needs in many areas in the upper Des Moines River Basin.

- Recreation lands are being lost to agricultural development in flood-plain and shoreland areas. High-quality hunting areas are being reduced by continued drainage and filling of wetland areas and small lakes.

- Continued erosion and sediment damages result in decreased property values in urban and rural areas, deterioration of recreation land and facilities, and loss of productive agricultural acreages and decreased agricultural production.

- Recreation activities involving whole-body water contact are severely impaired below Estherville on the Des Moines River and on Okabena Creek near Worthington.

- There is continued deterioration and reduction of fish and wildlife habitat and wetlands plus degradation of streambanks, scenic amenities, and other environmental resources.

Problem Area : Crow River Basin Area

WRC REGION: 7 SUBREGION: 701

STATE: Minnesota PROBLEM AREA NO.: 6

Problem Area 6 in central Minnesota encompasses the drainage area of the Crow River, including both the North and South Forks of the Crow which drain to the Mississippi River. The area encompasses approximately 2,300 square miles and includes portions of Kandiyohi, McLeod, Meeker, Renville, Stearns, and Wright Counties. The problem area has a population of about 100,000 people. Its largest cities are Willmar and Hutchinson. The topography of the basin is characterized by a gently rolling till plain or till prairie. Nearly all of the area is farmland, and about three-fourths of the farm area is cropland. Ground-water resources are quite plentiful. Both the surficial and bedrock aquifers yield large quantities of water of excellent quality for municipal and industrial uses. Streamflows of the major rivers in the basin are quite variable. Both the North and South Forks of the Crow River experience wide fluctuations in streamflow.

Water Issues

- There are water quality problems on the Crow River Main Stem and the South Fork of the Crow River below Hutchinson stemming from high concentrations of municipal, industrial, and agricultural waste pollutants. Significant nonpoint pollution problems occur throughout the Crow River Basin and stem from pesticides, fertilizer, and animal waste runoff. High concentrations of bacteria and nutrients cause locally high biochemical oxygen demands throughout much of the problem area. These stem from point and nonpoint pollution. Eutrophication is a problem in many of the basin's lakes.

Related Land Issues

- Major urban flood damages occur in Dayton along the Crow River

Main Stem and in Hutchinson along the South Fork of the Crow River. Severe flood damages afflict rural properties and agricultural lands along both forks of the Crow River and the Crow River Main Stem.

- Moderate sheet, gully, and streambank erosion damages rural properties and agricultural and recreation lands. Sediment damages occur throughout the problem area. Representative yields are about 60 tons per square mile per year (from a 10 square-mile drainage area).

Adverse Effects

- Use of surface water as a potable water supply for domestic purposes and livestock and as a suitable water supply for food processing industries is restricted.

- Rural and urban flood damages occur along both forks of the Crow River Main Stem. Average annual damages along the South Fork of the Crow River are estimated to be $7,660 per mile by 1980 (1975 dollars). Floods reduce property values, curtail agricultural and industrial production, and cause deterioration of recreational lands and facilities.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreational lands and facilities, and loss of productive agricultural acreages.

- There is severe impairment of recreational uses involving whole-body contact with water on the Crow River Main Stem and the South Fork of the Crow below Hutchinson.

- Deterioration and reduction of fish and wildlife habitat and wetlands plus degradation of streambanks, scenic amenities, and other environmental resources is an ongoing problem.

Problem Area : Black, Buffalo, and Trempealeau River Basins Area

WRC REGION: 7 SUBREGION: 702

STATE: Wisconsin PROBLEM AREA NO.: 13

Problem Area 13 in west central Wisconsin includes the entire drainage area of the Black, Buffalo, and Trempealeau Rivers. The problem area encompasses approximately 3,600 square miles and includes portions of Buffalo, Clark, Jackson, LaCrosse, Monroe, Taylor, Trempealeau, and Wood Counties. The area has a population of about 100,000 people. Its largest city is Black River Falls. The topography of the problem area varies from a level to gently undulating glaciated plain with widespread swamps in the northern and northeastern parts of the area, to an unglaciated topography with narrow steep-sided ridges and narrow valleys in the western and southern parts, including all of the Trempealeau and Buffalo Basins.

Generally, surface- and ground-water supplies are adequate, but ground water is more difficult to obtain in the northern and central portions of the problem area.

Water Issues

- o There are water quality problems on the upper segment of the Black River near Medford stemming from high concentrations of waste pollutants and low base-flow conditions. Localized water quality problems occur elsewhere in the problem area, resulting in nutrient levels high enough to cause excessive aquatic growths. Municipal waste treatment plants at Neillsville and Black River Falls are significant point sources of pollution. Moderately high coliform counts occur in areas near sewage treatment plant outfalls. Five communities have septic system problems which may result in water pollution. Nonpoint pollution problems stem from agricultural runoff. In the analytical area, eleven lakes totalling 4,455 acres have one or several of the following problems: weeds, algae, winterkill, and/or pollution. Six of these lakes totalling 1,025 acres are classified as eutrophic or very eutrophic.

- o Most wells in the upper portions of the problem area (north of Lake Arbutus and south of Owen) yield less than 5 gpm; some yield less than 1 gpm. These yields are inadequate for municipal supplies and barely adequate for private domestic use.

- o Ground water is hard to very hard in much of the problem area, especially in the lower portions of the area. There are high concentrations of calcium, magnesium, and bicarbonates in these groundwater supplies. There is excessive iron in the sandstone aquifer which supplies most wells.

Related Land Issues

- o Major urban flood damages occur in Arcadia, Black River Falls, and in several other small communities along the Black, Buffalo, and Trempealeau Rivers. Frequent and severe flood damages occur at Owen on the Poplar River. Clark and Taylor Counties and twenty-six floodprone communities in the analytical area do not have floodplain ordinances. Six of these communities and Taylor County are not enrolled under the Federal Flood Insurance Program. Jackson County has not prepared maps of its rural flood-prone areas.

- o Severe flood damages afflict rural properties and agricultural lands along both the Buffalo and Trempealeau Rivers and along the lower 50 miles of the Black River.

- o Significant sheet, gully, and streambank erosion damages rural properties, agricultural lands, and environmental resources. Erosion damage is especially significant in the southern and western

portions of the problem area. Extensive streambank erosion results from the sandy soils in the Buffalo and Trempealeau Basins. In the analytical area, 1,003,493 acres or 34 percent of the land acreage need soil conservation treatment. One and a half percent of the total acreage, or 44,085 acres, is classified as critical (losses in excess of 20 tons per acre).

- There are high sediment yields in the sandy, rugged Trempealeau and Buffalo Basins and in the extensively farmed Black River Basin north of Neillsville. Sediment yields in the problem area are about 700 tons per square mile per year (10 square mile drainage area) and 400 tons per square mile (1,000 square mile drainage area) in the Buffalo and Trempealeau Basins and the lower 40 miles of the Black River Basin.

Adverse Effects

- Use of untreated ground water as a potable water supply for food processing industries is restricted. Treatment is required for iron removal and softening.

- There are deficiencies in ground water for large-scale rural and municipal demands in the northern and central portions of the Black River Basin.

- Average annual urban and rural flood damages are estimated for 1980 at $18,860 per mile along the Trempealeau River, $3,220 per mile along the Buffalo River from its mouth to near Gilman, and $65,600 in Owen along the Poplar River (1975 dollars). Property values are reduced and agricultural production is curtailed.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreational waters and water-based facilities, and loss of productive agricultural acreages, especially in the heavily farmed area north of Neillsville and in the Buffalo and Trempealeau River Basins.

- There is impairment of whole-body contact recreation activities due to high coliform-count levels near Medford, Neillsville, and Black River Falls on the Black River (1975 to 1985 time frame only). The recreational value of 4,455 acres of lakes is impaired due to eutrophication.

Summary

The Upper Mississippi Region has ample land and water resources to provide for an expanding economy with a quality environment. Its gently rolling terrain and thousands of lakes are a product of glaciers of thousands of years ago. Rainfall is generally adequate for crops and water supply throughout the region. It is cold in the winter and hot in the summer with an excellent growing season which extends from April and May to September and October. Natural resources include a large central area of prime agricultural land; forests to the north and south; water, coal, petroleum, and other minerals; natural gas; and fish and wildlife.

The society of the region is an urban-rural one. While there are major metropolitan centers, there are also innumerable small towns and many people living on farms, in the lake country, and in the forests. The region has a thriving and diversified economy. Its agriculture is important to the nation's food supply. Many people are employed in service industries. The largest employer is manufacturing which produces many different products. The population, employment, and economy are expected to grow, but at a lesser rate than that of the country as a whole.

Many rivers course through the region in a general north-south direction. The Mississippi River bisects the area providing a political boundary, a navigation route, and water for municipalities, industries, and recreation. Streams tributary to the Mississippi River drain most of Minnesota, Wisconsin, Illinois, and Iowa; a significant portion of Missouri; and small areas in Indiana, Michigan, and South Dakota. Large amounts of water are stored or flowing in the ground under a large part of the region. The lakes, rivers, and natural land area provide opportunities for many pleasant outdoor activities.

Water is withdrawn from the streams and ground for many uses. The largest of these withdrawals is for cooling steam electric power plants. Only about 9 percent of this withdrawn water was consumed in 1975. Consumptive use of water is projected to increase to 2.3 times the 1975 amount by the year 2000. At the same time, withdrawals of water are projected to decrease by over 36 percent. Expanded pollution abatement programs will require cities and industries to change their pattern of water use. Much of the water withdrawn from streams and the ground will be reused or recirculated instead of discharged directly to the receiving stream. However, the overall gross water supply situation in this region is excellent.

Despite the generally favorable situation with respect to water and related land resources in this region, severe water and related land resources problems exist in many areas. Failure to resolve these problems will have serious implications for the localities involved, the State, the region, and, in some cases, the Nation. The most severe of these problems are those associated with water quality, erosion and sedimentation, flooding, land-use conflicts, local water supply and instream flow inadequacies, drainage, and navigation and dredging.

The severity and urgency of water-quality problems in the Upper Mississippi Region generally are greatest near the metropolitan areas and in the downstream areas. Erosion and sedimentation also tend to be more severe in the downstream portions of the region. Flood damage occurs throughout the region and principally along the main streams and in the upstream watersheds. Urban, industrial, and agricultural development of flood plains has led to an increase in the value of property subject to floods and thereby an increase in flood damages. With the exception of temporary and scattered water supply problems during the late summer, fall, and winter months--particularly during drought periods--lack of water is not a severe problem. However, portions of the region are experiencing serious water supply shortages in rural areas. Land-use issues such as the draining and filling of wetlands and the placement of dredged materials along navigation routes are significant problems. A major regional and national problem issue is the controversial need for rehabilitation, replacement, modification, and modernization of existing navigation works. Construction and maintenance of these works is often attacked as being environmentally damaging and an unfair Federal subsidy to the barge industry.

Conclusions and Recommendations

While the initial or overriding purpose of the Second National Water Assessment was to identify and describe the Nation's severe water-related problems from the national and State/regional viewpoint, one of the major assessment products was the development of basic conclusions and recommendations for resolving each region's critical water resources needs and problems. More specifically, conclusions and recommendations reflecting both the State-regional and national viewpoints were to be developed in each of the following categories:

- Needs for planning studies (Table 7-8).
- Needs for further research and data collection including those program modifications which are necessary to provide adequate information and data to support further planning activities and an improved assessment process (Table 7-9).
- Needs for changes in existing institutional or legal arrangements, water policies, and water-related programs.
- Delineation of the Federal role in helping to resolve each region's water-related problems.

It should be noted that the conclusions and recommendations delineated on the following pages reflect only the consensus of the Upper Mississippi River Basin Commission members. They are not official recommendations which have been formally approved or adopted by either a State or Federal agency governing body such as a State Department of Natural Resources, a State Legislature, the Federal Executive Branch, including the Office of Management and Budget, or the Congress. The conclusions and recommendations presented below in Tables 7-8 and 7-9 indicate what needs to be done in several major problem categories in various parts of the region, and which agencies, Federal or State, should lead the efforts for meeting each identified need. Certain ongoing planning studies relevant to "Needs for Planning Studies" are included to encourage continued administrative and financial support. Wherever the lead agency for the resolution of a particular need is unknown, a dash has been used to denote this. A list of abbreviations used in identifying the suggested lead agency follows:

BLM	-	Bureau of Land Management
COE	-	Corps of Engineers
EWGCC	-	East-West Gateway Coordinating Council
GERPDC	-	Greater Egypt Regional Planning and Development
HUD	-	Housing and Urban Development
IADEQ	-	Iowa Department of Environmental Quality
IADSC	-	Iowa Department of Soil Conservation

ILDOT	-	Illinois Department of Transportation
ILEPA	-	Illinois Environmental Protection Agency
ISU	-	Iowa State University
MNDNR	-	Minnesota Department of Natural Resources
MNEA	-	Minnesota Energy Agency
MNPCA	-	Minnesota Pollution Control Agency
MODNR	-	Missouri Department of Natural Resources
NDSHD	-	North Dakota State Health Department
NDSU	-	North Dakota State University
NDSWC	-	North Dakota State Water Commission
SCS	-	Soil Conservation Service
SIMRPC	-	Southwest Illinois Metropolitan and Regional Planning Commission
UIL	-	University of Illinois
UMN	-	University of Minnesota
UMO	-	University of Missouri
UMRBC	-	Upper Mississippi River Basin Commission
USDA	-	United States Department of Agriculture
USDI	-	United States Department of Interior
USDOT	-	United States Department of Transportation
USGS	-	United States Geological Survey
UW	-	University of Wisconsin
WDNR	-	Wisconsin Department of Natural Resources

Table 7-8.--Needs for Planning Studies

Water Quality Planning Needs	Federal	State	Suggested Lead Agency
o Fox River Water Quality Study. Determine the quality of the Fox River's water with respect to acceptability as a public water supply source at Aurora and vicinity, i.e., the area below the Chain of Lakes Region.			-
o Aquifer Water Quality Determination for Barium - and Radioactivity. Identify those aquifers, mainly in northern Illinois, which contain barium and radioactivity levels in excess of the Illinois standards, and determine the extent of these aquifers within the State of Illinois.			-
o Post-Facto Reservoir Study. Post construction impacts on Shelbyville and Carlisle Reservoirs.		X	ILDOT
o Areawide Waste Treatment Management Studies. Development of action plans and regulatory programs to meet the 1983 Water Quality Goals of Public Law 02-500 (Section 208) in the following areas: East St. Louis, Southern Illinois, and St. Louis.		X	SIMRPC GERPDC EWGCC
o Waste-water Treatment Facilities Detailed Plans. Steps 1 and 11 detailed plans and specifications for waste-water treatment works in UMRBC States.		X	ILEPA IADEQ MNPCA MODNR WDNR
o Statewide Water Quality Management Plans. Plans to provide the water quality assessment and program management information necessary to make centralized, coordinated, water-quality management decisions in UMRBC States (Section 208 of Public Law 92-500).		X	ILEPA IADEQ MNPCA MODNR WDNR
o Environmental Concerns of Management of Lakes and Reservoirs. Special studies to analyze the effects of runoff with related pollutants in light of increased use and construction of artificial lakes.		X	IADEQ All States
o Nonpoint Pollution Sources. Studies to determine the effectiveness of water pollution control programs to develop and implement alternative methods of treatment to control nonpoint source pollution (Section 208 of public Law 92-500).		X	All States

	Federal	State	Suggested Lead Agency
o Environmental Impact of Growth. Special studies concenring the relationship between economic growth and development and the effects of such growth on water quality.		X	WDNR All States
o Publicly Owned Shoreland Study. Special study to rank accessibility of the lakes and streams for the purpose of determining actions needed to achieve water-quality standards.		X	WDNR
o Use of EPA's Strategy Environmental Assessment System Model. Study to predict economic, environmental, and social consequences of alternative water-quality standards.		X	WDNR All States
Water Supply and Hydrology Planning Needs			
o Illinois Small Community Water Supply Program. Development of a State program to provide adequate water supplies ast reasonable rates to small communities in central and southern Illinois experiencing chronic water supply shortages for municipal purposes.		X	-
o East St. Louis Metropolitan Ground-water Study. An examination of the ground-water supply in the East St. Louis area outside of the American Bottoms and the identification of a program for alleviating water supply shortages.			-
o Alternate Water Supply Source for West Central Illinois. A number of public water supplies in west central Illinois utilize well water which is high in total dissolved solids. Alternate water supply sources are needed or the application of methods to reduce the total dissolved solids contents in existing water supplies. This study's purpose would be to locate better quality water supplies or develop a plan, e.g., regionalization, to provide esthetically acceptable water supplies to communities.			-
o Study of Ground-water Problems. Develop a framework for ground-water management programs in Minnesota and Wisconsin.		X	MNDNR WDNR
o Basic Data File for Well Records. Study to develop a user-oriented, automatic retrieval system for Wisconsin well records.	X		USGS

	Federal	State	Suggested Lead Agency
o Hydrology of Lakes in Wisconsin. Studies to classify lakes in Wisconsin.	X		USGS
o Studies to define low-flow characteristics of streams at gaged and ungaged stations in the region.	X		USGS
o East St. Louis and Vicinity, Illinois, Groundwater Flood Damages. A study to determine and evaluate methods to reduce flood damages associated with high water tables in the area.	X		COE
o Development of a Hydrologic Model for the Twin Cities Artesian Basin. Develop a three dimensional digital hydrologic model of the Twin Cities (7 County Metropolitan Statistical Area) Artesian Basin in Minnesota.	X		USGS
Transportation Planning Needs			
o Coal Transportation Policy Development in Minnesota. A special study for storage and transfer of coal.		X	MNEA
o Investigation of remedial works to restrict shoaling conditions at ferry landings on the Mississippi River.	X		COE
o Special study to determine how the navigation system of the Upper Mississippi River relates to all other modes of transportation.	X		COE
o Guidewall extension of Lock No. 3 on the Mississippi River to allow tows more distance to aline with the lock chamber.	X		COE
o Wilds Bend Cutoff. Development of a Mississippi River navigation improvement plan.	X		COE
o Additional research and planning needed to resolve the conflicts associated with the development of shipping terminals on the Mississippi River and the effect of this terminal development on adjacent wetlands.	X	X	-
Fish-Wildlife/Recreation Planning Needs			
o Design for Conservation. Develop plans for (1) natural areas, (2) waterfowl areas, (3) lake development, (4) stream access and frontage, (5) warm-water fisheries, and (6) development of recreational facilities in Missouri.		X	MODNR

	Federal	State	Suggested Lead Agency
o Kettle River and Upper Mississippi River Wild and Scenic River Studies. Planning for the preservation of the Upper Mississippi and Kettle Rivers in Minnesota.	X		USDI
o Harriet Island Harbor. A recreation craft harbor to be completed by accomplishing some bank protection and other minor work.	X		COE
o Upper Mississippi River Recreational Craft Locks Study. A study of ways to provide independent passage of recreational craft at Mississippi River locks and dams.	X		COE
o Minnesota Valley National Wildlife and Recreation Area. A plan for the creation of a 17,500 acre refuge and recreation area.	X		USDI
o Lower Wisconsin Wild and Scenic River Plan. Preservation plan for the lower Wisconsin River Basin.	X		USDA
o State cooperative programs for the acquisition and management of fish and wildlife areas. Study and protection of endangered species.	X	X	USDI
o Review of all major Federal projects for evaluating impacts of fish and wildlife resources.	X		USDI
o Comprehensive Planning Projects. Categorical Grants-In-Aid to States for the preparation and use of comprehensive Fish and Wildlife Service Guidelines to Federal aid programs.	X		USDI
Preservation of Environmental Quality Planning Needs			
o Study of Wetland Values. Special study to obtain information on the value of wetlands for maintaining water quality, controlling floods, and providing recreational activities in Wisconsin.		X	WDNR
o Reclamation of strip-mine areas in the Big Muddy River Basin.	X		COE
o Upper Mississippi Wilderness Area. A plan for the creation of a wilderness area on the Upper Mississippi River.	X		USDI

	Federal	State	Suggested Lead Agency
o Conduct economic appraisals of mineral potential on areas proposed for inclusion in the National Wilderness System in Wisconsin.	X		USDI
Flood Damage Reduction and Watershed Protection Planning Needs			
o Illinois Storm-water Drainage Manual. Develop a State manual for use by municipalities in their design, approval, and regulation of stormwater drainage.		X	-
o Illinois Erosion and Sedimentation Inventory. Statewide erosion rate and sedimentation study providing a data base for potential control of primary nonpoint sources of pollution in Illinois streams.		X	-
o Collection and mapping of flood inundation data and identification and labeling of flood-prone areas on topographic maps. Studies of flood frequency for highway culvert design in Illinois.	X		USGS
o Study to determine the impacts of urbanization on watersheds in Illinois.	X		COE
o Cooperative studies to evaluate agricultural and related resources and consideration of alternative solutions to problems in the Iowa/ Cedar, Southern Iowa, Southern Minnesota, Des Moines, and Wisconsin River Basin.	X		USDA
o Minnesota River Basin Study. An overall basin study to determine the best plan for development and management of all water-related resources in the basin.	X		COE USDA
o Small watershed planning (Public Law 83-566) for watershed protection and flood prevention in the following watersheds: Illinois - Mad River, Zuma Creek, South Quincy, Rocher Modoc, Long Point Slough, Bay CreekPike, Upper Big Muddy, Cypress Creek; Iowa - Cylinder Creek, Doon Creek, Buffalo Grove, Sand Cove, Prairie Creek, West Branch Iowa River, Morlee, West Buttrick, Honeycomb, Union, Lost Nation, Buffalo Bill, Ralston Creek, German Creek, White Breast Creek, Soap Creek, Cedar Creek, Indian Creek; Minnesota - Yellow Bank River, CobbFlorida, Upper Yellow Medicine, Tyler, Three Mile Creek, Des Moines River, Jack Creek, Okabena Creek, Heron Lake, South Fork of Watonwan, Spring Creek, Harkeom Creek South Zumbro, Turtle Creek, Cedar Valley,	X		USDA

	Federal	State	Suggested Lead Agency
Thompson Valley; Missouri - Upper Fabius, Little Wyaconda, Troublesome Creek, Lower Fabius, Wyaconda, Honey-Sugar Creek, Little Fabius, North River, Middle Fork of Salt, Crooked, and Otter Creeks, Pike-Spencer Creek, Perugue; and Wisconsin - Pine River, Furnace Hill.			
o Resource Conservation and Development (RC & D) Planning via the Resource Conservation and Development Act in the following areas: Illinois - Blackhawk Hills, Prarie Hills, Shawnee, and Two Rivers; Iowa - Upper Exploreland, Pathfinder, Chariton Valley, Geode Wonderland; Minnesota - Wes Min, Headwaters, Arrowhead, Onanegozie, Hiawatha Valley; Wisconsin - Pri-Ru-Ta, River Country, Lumberjack, Coulec, Goldenlands, Southwestern Wisconsin.	X		USDA (SCS)
o A review of the operation and management of the existing and/or new headwaters reservoirs in northern Minnesota with a view to obtaining the greatest possible benefit.	X		COE
o Preliminary or feasibility studies to evaluate flood control and flood-related problems in the following areas: South Fork of the Sangamon River, Crooked Creek, Miller City, Richland Creek, and Chouteau Island in Illinois; the Mississippi River, Old Channel, Mile 111 to 117, in Missouri and Illinois above the Missouri River, Plattin Creek Basin, Missouri; the St. Croix River at Stillwater, Minnesota; Chippewa River; and on the Wisconsin River at Portage, Wisconsin. Advanced engineering and design planning for flood control purposes throughout the basin.	X		COE
Comprehensive and Multifaceted Planning Needs			
o State Comprehensive Water and Land Resources Plans. Comprehensive plans for the management of each State's water and related land resources.		X	-
o Great River Environmental Action Teams (GREAT's I, II, and III): Continuation of a program designed to develop a river management plan for the upper Mississippi River which incorporates total river resource requirements. Major emphasis will be placed on the development of environmentally sound dredging practices.	X	X	COE & USDI

	Federal	State	Suggested Lead Agency
o Upper Mississippi River Main Stem Level B Study: Initiation of a comprehensive evaluation of water and related land resources.	X	X	UMRBC
o Comprehensive Coordinated Joint Plan (CCJP) and Priorities Reports: Development of a plan to assure coordination and integration of private interest, local government, Federal agency, and nongovernmental plans. The priorities report establishes the frameworks and priorities of such studies as are necessary in the preparation of the CCJP and for implementation of projects and programs which are part of the recommendations.	X	X	UMRBC
o More interagency special planning and implementation studies (short, medium and longrange) designed to minimize the effects of use conflicts between fish and wildlife resources and man's developments to be initiated and coordinated in a manner similar to GREAT Program.	X	X	-
o Additional research and planning is needed to more adequately evaluate the adverse and beneficial effects of expanded coal development in Illinois.			-

Table 7-9.--Modified and/or Further Research, Data Collection

	Federal	State	Suggested Lead Agency
Water Quality			
o Continued studies are needed to determine efficient means of sludge disposal that will result in minimal impacts on the total environment (Section 208 of Public Law 92-500).	X	X	-
o Studies are needed to determine whether or not mercury, lead, zinc, cadmium, nickel, antimony, chromium, strontium, cobalt, selenium, and possibly other elements or compounds can be magnified or multiplied	X	X	-

	Federal	State	Suggested Lead Agency
through the food chain, and, by this mechanism, built up within the aquatic environment to levels that might effect other creatures in the food chain. Studies are needed to determine what levels of these known toxic materials in bottom sediments constitute a threat to the aquatic environment. In addition, further studies are needed to determine the effects of dredging and prop wash and resultant turbidity on the distribution of these heavy metals in the water.			
o Data collection is needed to determine reaeration rates and travel times below sewage treatment plants using tritium and krypton tracers.	X	X	USGS
o A State program should be developed and implemented to inventory and monitor nonpointsource water pollution problems and achievements.		X	-
o Emphasis on research and professional training in solid waste management should be increased so that the high quality programs now in existence throughout the Nation will continue. The Federal Government should be encouraged to continue and increase support for these programs. In addition, State government and industry should closely examine training and research needs with the universities and should explore possible areas of program support.	X	X	-
o Stream assimilative studies and waste load allocations should be completed in basin States as soon as possible on all water quality governed segments so that the findings can be evaluated and used in establishing effluent limitations to meet applicable water-quality standards.	X	X	-
o Efforts should be made to secure continued support for lake quality research and demonstration (Section 314 of the Clean Lakes Program). The value of the lake resources to the region, past successes, and vast opportunities to be realized by continued research and demonstration strongly justify long-term support for these programs.	X	X	-
o Research and development of low-cost wastewater treatment and on-site disposal systems in problem soils should be continued and expanded. Likewise, emphasis should focus on nutrient control in treatment systems in nearlake environments.	X	X	-

	Federal	State	Suggested Lead Agency
o The surveillance program for thermal pollution at industrial and powerplant sites should be expanded. Likewise, environmental radioactivity surveillance should also be expanded at nuclear plant sites.	X	X	-
o A research and data collection program should be established and implemented to evaluate the hazards of abandoned wells and to properly seal these wells to prevent ground-water contamination.		X	-
o The scope of periodic chemical examination of public water supplies should be broadened to include the following organic compounds: phenolic materials, herbicides, pesticides, polychlorinated biphenyls and naphthalenes, and other organic compounds that form complexes with chlorine which are suspected carcinogens.	X	X	-
o A research study should be conducted on sources and methods of removal of specific types of taste and odor problems that occur in private wells.		X	-
Water Supply and Hydrology			
o Basic data collection should be expanded to provide better estimates of low-streamflow characteristics at all sewage effluent and industrial out-fall sites in the region.	X	X	-
o Data-gathering network should be expanded to collect more information on flow characteristics of small streams and on regulated streams in the region.	X	X	-
o Mathematical tools should be developed to synthesize from other measurable characteristics, such as geology and geomorphology, data on streamflow characteristics for streams where flow data are not available.	X	X	-
o Mathematical models should be developed of entire river systems, including quantity as well as other surface- and ground-water parameters that affect flow.	X	X	-
o Work in the monitoring of lake volume and area should be expanded and should relate lake stage fluctuation to hydrologic factors.	X	X	-
o Effects of urbanization and other developments on surface-water quantity should be analyzed.	X	X	-

	Federal	State	Suggested Lead Agency
o Data collection and surface- ground-water studies of wetlands should be expanded.	X	X	-
o Comprehensive stream-gaging and information collection systems for hydrologic areas in the region should be developed.	X	X	-
o Further data collection and analysis is needed to maintain an inventory of municipal watersupply facilities and water use in the basin states.		X	-
o The series of State and county ground-water inventory studies should be accelerated.	X	X	-
o The development of data storage and retreival systems should be accelerated to provide a common base of information on all State agencies collecting and using ground-water as well as other resource data.		X	-
o Digital model studies of principal aquifers should be made in all heavily industrialized and urbanized areas of the region.	X	X	-
o The present ground-water quality monitoring system should be expanded to more adequately define the baseline quality against which any change, such as could result from pollution, could be measured.		X	-
o An accelerated topographic mapping program should be instituted. Modern mapping would be a valuable aid to ground-water studies as well as many other aspects of environmental research and management.	X		USGS
o Studies are needed in areas of abnormally high (and rising) water tables to relate normal fluctuations of the water table to fluctuations of annual precipitation.	X	X	-
o Detailed ground-water studies are needed in areas where excessive pumping has greatly lowered the water table, causing local wells to go dry.			
o Data collection and analysis is needed to define the natural quality of ground water (aerially and with depth) in the region's major aquifers with respect to recharge, chemical composition, and direction and rate of movement.	X	X	-

Recreation/Fish and Wildlife/Preservation of Environmental Quality	Federal	State	Suggested Lead Agency
o Basic data collection to provide up-to-date information on the extent, location, and types of wetlands and establishment of a program to improve wetland mapping to strengthen the regulation of wetland alteration.	X	X	USDI All States
o Data collection and research to measure changes in population levels of migratory birds including mortality and survival rates of selected migratory game birds.	X		USDI
o Evaluation of the implications of waterfowl migration patterns and populations along 250 miles of the Mississippi and Illinois Rivers.	X		USDI
o Identification of islands for which validity of Federal ownership under public domain status can be based.	X		BLM
o Continued support for cooperative Federal-State fish and wildlife surveys and research.	X	X	USDI All States
o Further research and data collection to determine:	X		USDI
- A basinwide baseline inventory of fish and wildlife resources.			
- Instream flow requirements for fish and wildlife.			
- Water-quality requirements for fish and wildlife.			
- Habitat requirements for fish and wildlife.			
o Additional research and data collection to evaluate the adverse effects to backwater and wetland habitat as a result of the construction of channelization wing dikes and revetments. Such research and data collection on the Mississippi River could include a time series study of both area and volumetric changes in the backwater areas outside of the navigation channel (the distance between wing-dike ends).	X		-

	Federal	State	Suggested Lead Agency
o A uniform, statewide recreation and open space base data file in the State outdoor recreation planning process as a service for local recreation planning.		X	-
o A preliminary survey dealing with cultural resource identification, definition of cultural resource types, and the management of valuable cultural resources.			-
Flood Damage Reduction and Watershed Protection			
o Preparation of detailed soil maps and interpretations for counties lacking such information in the basin States.	X		USDA
o Collection of detailed flood-hazard data for the National Flood Insurance Program.	X		HUD
o Collection of data on small area floods at selected bridge sites.	X		USGS
o Data collection to provide flood-frequency data and a means of estimating the magnitude of floods of various frequencies on drainage basins of less than 20 square miles.	X	X	USGS WDNR
Other (Multifaceted)			
o Expansion of water resources research projects in the basin States.		X	ISU, UIL UMN, UMC
o Information search and summary of mineral resources on Indian lands.	X		USDI
o Development of regional environmental information needs regarding stream alteration practices and the siting, construction, and operation of powerplants.	X		USDI
o Each State should assess its programs involving water-use information to identify data limitations. States should document cases of fragmented data collection, identify areas of incomplete data, and evaluate accessibility of information.		X	-

- Each State should develop techniques to maximize water-use data availability and improve data collection.
- Future efforts should be made to improve the water-use information related to navigation and hydroelectric power generation.

Federal	State	Suggested Lead Agency
	X	-

Changes in Institutional Arrangements, Water Policies, Water-related Programs

Water Issues

- Strong land-use and zoning laws are necessary to prohibit development in locations where sewage treatment facilities must discharge to streams which are water-quality limited.
- Where physically and economically practicable, joint treatment of municipal and industrial wastes is desirable. However, in instances where the nonavailability of grant money may seriously jeopardize the abatement of water pollution or where separate treatment lends itself readily to internal closeup and/or recycling of industrial effluents, industry should be encouraged to provide its own treatment.
- Ground-water quality studies should be coordinated with hydrogeologic studies to be better able to manage the ground-water resource. Extend the regular chemical examination of public supplies to include supplies in compliance with the Safe Drinking Water Act, Public Law 93-523.
- Passage of legislation in Wisconsin should be pursued which would establish environmental fees needed to administer water pollution control programs such as those for permits issued pursuant to Chapter 147 and approvals issued pursuant to Section 144.04 of the Wisconsin Statutes.
- Steps should be taken to insure that State lake renewal and protection programs are coordinated with other water quality management programs in each State to maximize potential benefits from the various programs. In addition, education programs should be expanded to inform elected representatives, citizens, and concerned groups of procedures and actions that are useful in developing effective lake management and protection programs.

- There is a need for increased State funding for State health agencies to be staffed adequately with technically trained personnel to more effectively review plans, inspect, and consult on private domestic sewage treatment and disposal systems to protect the public health. In addition, there is need for continued research into on-site disposal systems to make them more economical, reduce flow, operate on smaller land area, apply to unsewered villages and developments, and analyze land-use and ground-water impacts.

- In Wisconsin: (1) obtain additional State and Federal funding for PCB field investigations and laboratory support; increase the performance and level of activity in that State's Toxic and Hazardous Spill Program; and (3) adopt legislation authorizing the certification of pesticide applications.

Water Supply

- A means of coordinating the ground-water quality and quantity monitoring programs of the various State and Federal agencies and implementation of a data processing record system should be sought.

- The frequency of inspecting public water supplies should be increased to insure adequate facilities and operational procedures in order that customers receive the highest quality water on a continuous basis.

- Additional trained staff and analytical equipment should be provided at the State level so that special study capability can be improved to meet the challenge of better defining contaminants in drinking water.

- Where applicable, State statutes should be amended to provide for State authority to require joint or regional public water supply systems as considered needed in the interest of efficient and economical water supply development and use. Implementation of areawide water supply planning and the institutional arrangements to carry out the plan would need to be included in the statutory authority.

- A program of proper well abandonment in municipalities having public water supply systems should be effected. In addition, State statutes should be modified to prescribe State control over the construction of exploratory, prospecting, dewatering, and similar drillholes and the proper filling of such holes when their use has been completed, with the view of protecting the aquifers of the States.

Fish and Wildlife/Recreation

- Federal and State agency water policies and water-related programs should be examined and changed, if needed, to more adequately consider the needs of fish and wildlife resources.

- Expansion of the present role of the U.S. Fish and Wildlife Service should be considered. By increased funding and manpower to facilitate more adequate planning participation and planning assistance, greater grants and funding of research and data gathering, and greater funding for both Federal and State land acquisition can take place.

- State and Federal Agencies should cooperate with local communities and Indian Tribes in gaining access to recreation funding assistance; funding for local recreation planning should be increased; and the percent of Land and Water Conservation funds allocated to urban recreation needs should be increased.

- States should be encouraged to adopt legislation for regulating recreation use of surface waters to minimize conflicts among recreators and between recreators and shoreline residents. In addition, States should be encouraged to consider adopting similar measures for preventing overuse of recreation lands and facilities if such measures are necessary to protect each State's resource base and the opportunity for quality recreation experiences for each State's residents.

- In Wisconsin: (1) Amend the gas tax law to appropriate those taxes which originate from gasoline sales to boaters to water recreation improvements. Efforts should also be initiated to improve the State's boating laws. Present needs are primarily to provide additional funding and aids for water safety and enforcement, public access and harbors of refuge, and lake and stream improvement. (2) Adjust the source of operations funds to allow the expansion of non-revenue producing programs such as the naturalist and cultural program and non-revenue producing properties such as the State park trails. (3) Appropriation of additional funds for more environmental awareness programs with schools, groups and visitors.

Preservation of Environmental Quality

- State regulations for the protection and maintenance of the inland lakes and rivers of the basin are encouraged for those States lacking such regulatory authority.

- Understanding and general awareness of long-term public values in wetland conservation could be improved by accelerating public information programs in this area. Protection of broad public

values and the need for protection of specific wetlands should be incorporated in accordance with local, State, and national goals and priorities.

- The States should be encouraged to make provisions for the reclamation of permanently closed mining facilities.

- State and Federal agencies are encouraged to more frequently use scenic easements along with their various land acquisition programs to protect the scenic portions of the region.

- Protection and management of the basin's scientific and natural areas should be improved through (1) increasing public awareness of the values of these resources, (2) classification of such areas according to fragility and restricting use of those areas least tolerant of public use, (3) increasing public acquisition, and (4) encouraging land-use legislation to prevent degradation of these resources prior to acquisition and to limit encroachment in buffer areas.

- Wisconsin Statutes dealing with instruction in the conservation of natural resources should be updated to reflect a broader, total environmental viewpoint. The Wisconsin Administrative Code, where it pertains to existing environmental education statues, needs a similar revision.

- In Wisconsin, it is recommended that Chapters 30 and 31, Wisconsin Statutes, insofar as they relate to the Water Regulation Program, be rewritten to incorporate a statutory definition of public waters, navigability, and ordinary high-water mark (lake, stream, Great Lakes, etc.). Legislation is needed to protect wetlands adjacent to navigable waters that are above the ordinary high watermark.

Flood Damage Reduction and Watershed Protection

- Augment the Federal-local technical assistance programs with State funds to increase State Soil and Water Conservation Agency staff, thereby increasing technical assistance to landowners who wish to carry out basic soil and water conservation plans.

- Provide for State financial support to accelerate the current soil survey program.

- Develop effective soil and water conservation district sediment control programs for urban and incorporated areas.

- Continue State financial support for research to develop low cost sewage disposal systems for use on problem soils which will not support presently designed and State approved systems, and also allow for utilization of the continuing State appropriations on other related research projects.

- Encourage the acquisition of flood data and topographic mapping on a river basin approach instead of the present segmented approach. The cost per river mile would be materially reduced over the present system.

- Accelerate the mapping of flood plains and the preparation of flood-plain management plans.

- Improve flood damage reduction information and monitoring systems.

Water Issues

- All States in the basin should become "Agreement States" under the Nuclear Regulatory Commission to provide for more complete surveillance of radioactive substances used in the States.

- A coordinated regulatory approach to hazardous waste management is needed which will lead to development of hazardous waste management systems that are acceptable to both man and environment. These management systems include waste classifications, labeling, reporting, storage, collections, transportation, processing, and land disposal. Legislation should be developed to insure safe and effective hazardous waste controls and economical and efficient waste management systems. In addition, State legislative action is needed to continue and expand programs for solid waste management planning.

- Continued development and incorporation of animal waste regulations into State and county sanitary codes, zoning ordinances, and health codes is needed to complement other programs such as cost-sharing, education, and technical assistance to farmers to help alleviate agricultural waste disposal problems.

Other (Multifaceted Needs)

- The various State Legislatures in the region should be urged to give careful consideration to funding requests for the development of statewide water plans. In addition, it is urged that the various State water-planning agencies be strengthened and assigned sufficient personnel to effectively carry out their various water-related responsibilities.

- The appropriations under Title III of the Water Resources Planning Act should be increased to keep up with inflation and to allow expansion of the States' participation in water and related land resources.

- River Basin Commission studies should be designed in a format which makes them easier to update, eliminates collection of unnecessary data, makes data available in a format useful to various governmental planning needs, and facilitates early and meaningful participation by the public.

- Support for, and participation in, the GREAT Program should be encouraged among all State agencies with an interest in any of the five key concerns in the Mississippi River, namely, (1) fish and wildlife, (2) flood-plain management and land use contracts, (3) commercial navigation and bulk commodity transportaton, (4) water quality, and/or (5) recreation.

- There is a need for reexamination and revision of the existing Level B Study Program (Section 209 of Public Law 92-500) in order to more adequately reflect State goals and objectives and to modify State financial and institutional requirements.

- Regional and local governments, private enterprise, concerned citizens, and special interest groups and individuals should become more actively involved in River Basin Commission planning programs with the goal of making plans more acceptable and likely to be implemented.

- The comprehensive planning process should be strengthened at both the State and regional levels by formalizing the procedures for joint participation and for expanded citizen and public official involvement.

- Efforts to collect, analyze, and disseminate resource information should be coordinated to avoid duplication and maximize usefulness. Priority should be given to data-collection programs which fill data gaps for the most pressing land resource decisions.

- In Wisconsin, a cooperative program should be established between the Wisconsin Department of Natural Resources (DNR), the Wisconsin Public Service Commission, and the U.S. Geological Survey to develop a coordinated water-use information system. In this regard, a coordinating committee made up of representatives from these three agencies should be established to direct the implementation of expanded data collection and exchange techniques. The Wisconsin DNR should serve as the central agency for such a coordinated system.

- Reflecting back on the experiences gained during the 1975 Assessment effort suggests several changes which should be considered for implementation in future assessment efforts if the results and findings are to be of maximum value and utility to decisionmakers. These suggested changes include the following:

    1. State, Federal, and regional agencies should be directly involved in the preparation and development of assessment plans of study, work statements, guidelines, etc., rather than simply reviewing and commenting on prepared materials only.

    2. All assessment data should be provided not only at the region or subregion level of detail, but also at the State level of the region or subregion.

3. Future assessments need to continue emphasizing the importance of consistency and uniformity in the procedures and methodology being used to identify and describe each region's severe water-related problems.

4. Additional manpower and funds are needed at the national, State, and regional level to produce high quality, credible, assessment products in a timely manner.

5. Future assessment efforts should begin by preparing a set of uniform base maps for each of the Nation's Water Resources Council subregions.

6. All resource demand, supply, and need scenarios, such as the National and State-Regional Futures, should be accompanied by clear, concise statements outlining the basic methodologies and assumptions utilized in preparing those materials.

Federal Role in Regional Problems

- The Federal Government should continue to expand its efforts to provide for quality outdoor recreation opportunities. The Federal Land and Water Conservation Fund, already hard-pressed to provide for potential requests, must be expanded. Appropriations at authorized levels are recommended. Additionally, the Contingency Reserve Fund should be significantly expanded.

- Establish with certainty future levels of funding for construction of municipal waste treatment plants. Continuity in the Federal grant program is essential to assure needed cooperation of communities in completing the many stringent planning and design requirements.

- Federal funding of State administrative programs (in water quality) needs to be increased if further authority is to be delegated to the States.

- A National Steering Committee should be formed to encourage and coordinate States' efforts in developing a water-use information system.

- The priority of water-use information at the State level should be improved with a cooperative funding program spearheaded by the U.S. Geological Survey. The National Steering Committee (referred to in a previous recommendation) should encourage State/Federal matching funds for implementation and operation.

- Federal funding should be increased in order to step up progress in completing soil, water resources, and geological surveys for the entire State of Wisconsin and presenting information in report form.

- The central and regional offices of HUD should take a more active role in the policy and technical work of framework studies, permanent river basin commissions, and the Water Resources Council. The present commitment of resources by HUD to these roles does little more than establish HUD's presence. With sufficient resources, however, HUD can make substantial contributions in terms of the planning process and its own programs.

- HUD should encourage its constituents, in particular its State, regional, and local 701 grant recipients, to take a more active part in the work of permanent commissions and framework study efforts. This may require additional funding and more definitive guidelines from HUD to the grant recipients.

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[1] The Washington staff of the Federal agencies was augmented by field office staff who participated with Washington offices or through the Regional Study Teams.
[2] Several States had representatives on more than one Regional Study Team. Contributions of those not named were greatly appreciated.

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Authorization

The United States Water Resources Council was established by the Water Resources Planning Act of 1965 (Public Law 89-80).
The purpose of the Council is to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the Federal government, States, localities, and private enterprises with the cooperation of all affected Federal agencies, States, local government, individual corporations, business enterprises, and others concerned.