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Abridged Report  
**Specific Problem Analysis**  
**1975 National Assessment of Water and Related Land Resources**  
Missouri Region



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Missouri River Basin Commission  
August 1977

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## Introduction

This abridged report summarizes the activities of the Missouri River Basin Commission during the 1975 National Assessment of Water and Related Land Resources. This 3-year effort resulted in presenting 18 recommendations (see p. 15) concerning the major problems and issues associated with water and related land resources and confronting the Missouri River Basin to the U.S. Water Resources Council, Washington, D.C.

The Missouri River Basin Commission is the principal agency for the coordination of Federal, State, interstate, local and non-governmental plans for the development of water and related land resources in the area served by the Missouri River and its tributaries. The Commission's Chairman is appointed by the President; its Vice-Chairman is elected from among State members. Commission headquarters are located at Suite 403, 10050 Regency Circle, Omaha, Nebraska 68114.

MRBC members are Colorado; Iowa; Kansas; Minnesota; Missouri; Montana; Nebraska; North Dakota; South Dakota; Wyoming; Department of Agriculture; Department of the Army; Department of Commerce; Energy Research and Development Administration; Environmental Protection Agency; Federal Power Commission; Department of Health, Education and Welfare; Department of Housing and Urban Development; Department of the Interior; Department of Transportation; Yellowstone River Compact Commission; and Big Blue River Compact Administration. Canada is an observer.



*Wild Missouri River in Montana*

## The National Assessment

The 1975 National Assessment of Water and Related Land Resources is being conducted by the U.S. Water Resources Council, Washington, D.C. This is the second such assessment, the first having been completed in 1968. Broad objectives of the current assessment are to (1) identify and describe existing and emerging needs and problems at national, regional, State, and subregional levels; (2) relate these needs and problems to the adequacy of water and related land resources to meet the requirements and goals of the people for the proper conservation, development, use, and management of these resources, both now and for the foreseeable future; and (3) identify specific geographic areas with complex problems which require more detailed investigations and planning.

To accomplish the objectives of the assessment, three major activities were identified—nationwide analysis, specific problem analysis, and national priorities analysis. The nationwide analysis is being accomplished by Federal agencies under guidance of the U.S. Water Resources Council. This activity includes development of estimates, using nationally consistent criteria, of socio-economic characteristics, water withdrawals, water consumption, and water supply availability for 106 separate aggregated subareas (ASA's). Estimates were made for 1975 and then projected to the years 1985 and 2000 and serve as one basis for identifying and describing severe and urgent water-related problems. Specific problem analysis activities were undertaken by regional sponsors for the 21 major water resource regions of the Nation. The purposes of the national priorities analysis are to articulate from the national viewpoint, priorities for resolving identified water-related problems, to prepare a national assessment report which contains both the national and State/regional viewpoints, to formulate conclusions, and to make recommendations

concerning the Federal role in helping to resolve the high-priority problems.

Publication of the National Assessment Report by the Water Resources Council is scheduled for completion the latter part of 1977.

### Missouri Region Role

The regional sponsor for the Missouri Region or Missouri River Basin is the Missouri River Basin Commission. The Commission was established in 1972 by the President at the request of the Governors in the region. It is comprised of a Chairman appointed by the President, the 10 States in the region, 10 Federal agencies with substantial interest in water and related land resources, and 2 interstate compact agencies.

The MRBC regional sponsor role in the national assessment effort involved four distinct, but related, activities for the Missouri Region: (1) identification of water and related land resource problems and problem areas; (2) present and future uses and associated problems and issues relevant to water and related land resources, including socio-economic characteristics, water withdrawals, water consumption, and water availability for 11 separate aggregated subareas (ASA's); (3) identification of potential study areas; and (4) specific problem analysis summary report of water and related land resources. The 11 ASA's of the Missouri Region are shown on Figure 1. The Summary Report, Technical Memorandum No. 4, includes a description of the National Assessment process, a description of the Missouri Region, comparisons of water use estimates, identification of severe water and related land problems, conclusions, and recommendations.

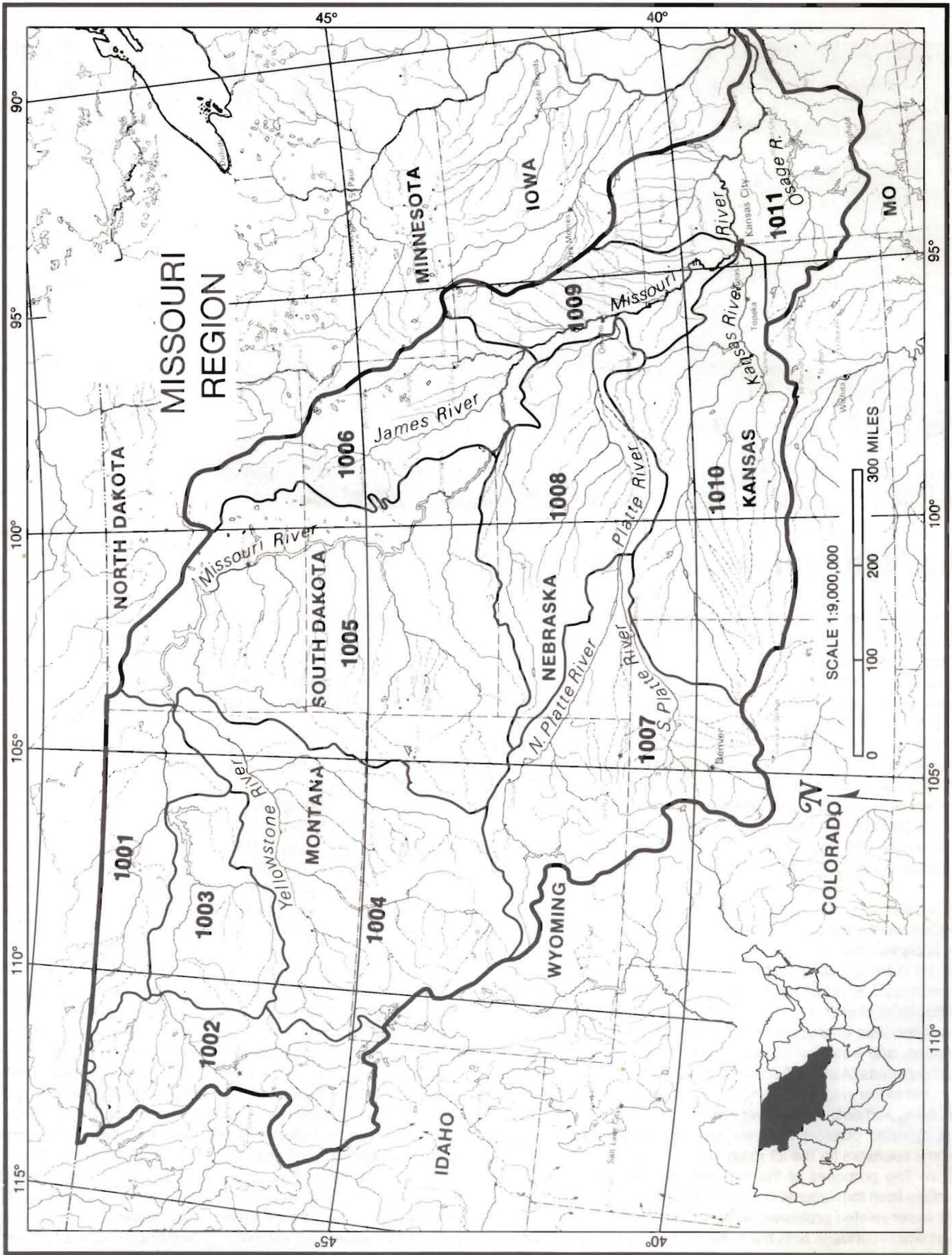


Figure 1  
 AGGREGATED SUBAREAS 1975 NATIONAL WATER ASSESSMENT

## The Missouri Region

The Missouri Region, largest of the Nation's 21 major water resource regions, is often characterized as the area of the Great Plains which comprises about 86 percent of the region's land area; however, its western boundary or divide is the Rocky Mountain system with many peaks surpassing 14,000 feet in elevation and in the southeast is the scenic Ozarks area with its forested hills and clear streams. Rising here and there from the plains are unique areas like the Badlands, the Black Hills and the Sand Hills of Nebraska. The region encompasses over 15 percent of the land area of the Nation's 48 contiguous states but has only 4 percent of its people. The Missouri River rises high in the Rocky Mountains, then flows generally southeastward, joining the Mississippi River near St. Louis. It includes all or parts of 10 States—Montana, Wyoming, North and South Dakota, Colorado, Nebraska, Minnesota, Iowa, Kansas, and Missouri. Because Indian reservations and Federal lands comprise a large part of the Missouri River Basin lands, a map showing generalized land ownership status in 1965 is shown on Figure 2. Although not current, the map serves to illustrate the extent of water problems associated with these large land holdings as discussed later in this report.

The spring and early summer mountain snowmelt provides most of the streamflow for the western streams, since the average annual precipitation over most of the western plains area is less than 16 inches. Moving eastward through the region, this average gradually increases to over 40 inches in the southeast extremities. The averages are misleading, since the region suffers from periodic droughts and, at the other extreme, periodic flooding causes widespread damage. Winters are relatively long and cold while summers are hot and dry. Winds in the plains area are the rule rather than the exception. Strong winter winds accompanied by snow sometimes create blizzard conditions dangerous to both man and livestock. When hot winds prevail during the dry summer, they may destroy crops and desiccate rangeland within a few days.

People have been moving from the rural areas to the larger cities in and outside the region. Although total population of the region has been increasing, the rate of increase has been below the national average. Most of the people live in the southern part of the region, which has the three largest metropolitan centers of Denver, Kansas City, and Omaha-Council Bluffs. The plains area is generally thinly populated as indicated by about one-half the area having population densities of fewer than 5 people per square mile.

Agriculture and its related activities dominate the region's economy; however, manufacturing and other commodity-producing industries play a very important role in many parts, particularly in the larger cities. Mining currently constitutes only a minor part of the total region economy, but the vast coal resources in Montana, Wyoming, and North Dakota are becoming increasingly important to the region and the Nation in meeting burgeoning energy requirements. Tourism has been growing and, unless limited by the specter of oil scarcities, will probably continue to increase in importance.

About 92 percent of the region's area of 328.5 million acres is used for agricultural purposes. In the western or more arid parts, pasture and rangeland dominate, while croplands are more prevalent in the eastern more humid part. The number of acres under irrigation has been increasing. The 10 basin States estimated that 11.5 million acres were being irrigated in 1975, of which less than 10 percent is in Federal Reclamation projects.



North Dakota wheat harvest

## Water Resources, Development and Utilization

The Missouri Region, in general, has adequate surface and ground water resources to meet current and projected needs. However, the water is not always available at the point of need in the quantity or of the quality desired. Wide precipitation fluctuations result in even more extreme variations in streamflow. Many of the western streams with their origin in the Rocky Mountains usually carry considerable amounts of water in the spring and early summer from the mountain snowmelt, but flows greatly diminish in the late summer, fall, and winter. Where reservoirs have been built, they usually provide adequate carryover storage for the intended purposes, capturing the excess streamflows for use in times of need.

The widespread occurrence of ground water within the region has enabled development, particularly for agriculture, remote from perennial streams. Ground water is used for irrigation, municipal, industrial, mining, rural domestic, and livestock purposes. About 87 percent of the reported 9.8 million acre-feet of ground water withdrawals was used for irrigation. Although the ground water resources of the region are immense, knowledge concerning the quantity and quality of the water in many of the aquifers is lacking. The large amounts of ground water being pumped from the Ogallala formation in western Nebraska and Kansas and eastern Colorado and falling water tables indicate that water is being pumped from this aquifer at a rate faster than the rate of recharge or replenishment. Although ground water is used extensively throughout the region, this resource has been barely tapped in many areas, particularly in the upper States.

Public Law 92-500 dictates the region's water quality objectives. In general, it can be assumed that municipal, industrial, and feedlot wastes will be appropriately treated as required. At this time, there are no known feasible means of controlling water quality problems resulting from farm and ranch operations and other nonpoint sources. One of the more significant stream pollutants throughout much of the region is sediment resulting from sheet, gully, and streambank erosion. Early explorers and settlers often referred to the Missouri River as the "Big Muddy."

Although water resource development programs in the Missouri Region began over 100 years ago, it was not until 1944, with Congressional authorization of the Pick-Sloan comprehensive development plan, that major multiple-purpose water resource developments were initiated by the Federal Government. Currently there are six large multiple-purpose reservoirs on the main stem of the Missouri River with nearly 75 million acre-feet of storage space, or over three times the average annual river flow at Sioux City, Iowa; over 100 major tributary reservoirs with over 25,000 acre-feet of storage capacity in each; and about 1,400 other reservoirs with capacities of less than 25,000 acre-feet each. The tributary reservoirs provide a total of over 37 million acre-feet of storage capacity, nearly all of which serves multiple-purpose functions, including flood control, municipal and industrial water supply, irrigation, hydroelectric power, navigation, water quality improvement, fish and wildlife propagation and enhancement, and recreation. Since the 1971 Missouri Basin Inter-Agency Committee Framework Report, construction has been initiated or completed on 12 additional major Federal reservoirs which have a total storage capacity of over 2 million acre-feet. In addition, numerous P.L. 566 watershed projects, which include many smaller single- and multiple-purpose reservoirs, have been completed or are under construction. It was estimated that in 1975 there were over 365,000 stockwater ponds in the region.

There are about 120 local flood-protection projects in the region, most of which are at the cities and communities, consisting primarily of levees and channel improvements. These, together with upstream watershed projects, provide varying degrees of flood protection to well over 3 million acres of developed and agricultural lands, leaving about 13 million acres subject to periodic flooding.

The Missouri River from Sioux City, Iowa, to its confluence with the Mississippi River near St. Louis provides an 8-month navigation season from March through November, the ice-free period. The banks of this 732-mile stretch of the river have been stabilized by rock revetments to provide open river navigation of 9-foot depth. The stabilization works serve a dual purpose of preventing the river from meandering through its 1.8 million acres of broad valley lands, thus protecting the many improvements constructed in and across the river valley as well as permitting extensive farming of the rich alluvial lands. Flows needed for navigation are maintained by a system of six large main stem reservoirs.

#### Water Uses

Irrigation is by far the largest water use in the region, accounting for 90 percent of all water consumed for various purposes. The 10 States estimated that 11.5 million acres irrigated in 1975 consumed a total of about 16.1 million acre-feet of water, much of it from ground water sources. Other uses for municipal and industrial, rural domestic, manufacturing, mining, livestock, and steam electric power generation purposes accounted for the remaining consumption of 1.5 million acre-feet. It was estimated that these consumptive uses depleted streamflows throughout the region by about 15.5 million acre-feet. These estimates of

water consumption and streamflow depletions are considered to be excessive by some of the region's water experts who have followed development of the water resources for many years.

The electric power industry, one of the fastest growing industries of the region, supplies power from a variety of generating plants. In 1975, the total installed capacity in the region was 23,611 megawatts which generated 92,201 gigawatts of electrical energy of which over 20 percent was produced by conventional hydroelectric power installations. The installed capacity is more than adequate to meet the region's demands and some power is being exported to areas of need. The scheduled or planned additional capacity to be in service by 1984 is more than ample to meet the expected increases in power demand. By the year 2000 the expected net energy requirement will be nearly 450,000 gigawatt-hours, or a 5-fold increase from 1975. The water consumed in the cooling process required for steam electric plants was estimated to be 68,000 acre-feet in 1975 and is expected to increase to 637,000 acre-feet by the year 2000. It is estimated that about 75 percent of the additional capacity would be supplied by coal-fired steam plants.

The States' estimate of nearly 11.5 million acres of land irrigated in 1975 is expected to increase to about 14.2 million acres by 1985 and to 17.4 million acres by 2000. Irrigation uses are expected to remain at about 90 percent of all water used in the region. The total water withdrawals and consumptive uses by major purposes and as estimated by the States, except for steam electric which were furnished by the Federal Power Commission, are shown in Table 1.

**TABLE 1**  
**Water Uses in the Missouri Region**  
**for 1975, 1985, and 2000**  
**as Estimated by the States**  
 (thousand acre-feet)

Use	1975	1985	2000
		<b>Withdrawals</b>	
Domestic <sup>1</sup> .....	1,415	1,866	2,302
Manufacturing .....	727	1,019	1,306
Mining .....	351	381	468
Irrigation .....	31,389	37,688	43,226
Livestock .....	488	650	817
Steam Electric .....	5,560	8,190	6,098
<b>TOTALS .....</b>	<b>39,930</b>	<b>49,794</b>	<b>54,217</b>

		<b>Consumption</b>	
Domestic <sup>1</sup> .....	601	778	931
Manufacturing .....	217	376	568
Mining .....	127	131	154
Irrigation .....	16,053	20,351	25,331
Livestock .....	480	643	815
Steam Electric .....	75	242	645
<b>TOTALS .....</b>	<b>17,553</b>	<b>22,521</b>	<b>28,444</b>

<sup>1</sup>Includes both central and noncentral systems and commercial and institutional uses.

The Missouri River Basin Comprehensive Framework Study (FS) published in 1971, contains estimates of water uses and their estimated depletion effects on streamflows at Sioux City, Iowa, and for the entire basin. These estimates and the State/Regional Future (SRF) for irrigated areas, irrigation withdrawals, irrigation consumptive use, and the estimated depletions and residual flows for 1975 and 2000 are shown in Tables 2 and 3.

**TABLE 2**  
Estimated Irrigated Area and Average Annual  
Irrigation Withdrawals and Consumptive Use

	Irrigated Area (thousand acres)		Average Annual Irrigation Withdrawals <sup>1</sup> (thousand acre-feet)		Average Annual Irrigation Consumptive Use <sup>1</sup> (thousand acre-feet)	
	1975	2000	1975	2000	1975	2000
<b>Upstream of Sioux City, Iowa</b>						
SRF	3,686	5,623	15,317	20,555	7,233	10,560
FS	3,120	4,547	7,867	11,989	4,913	6,927
<b>Missouri Region</b>						
SRF	11,463	17,402	31,389	43,226	16,053	25,331
FS	8,864	13,407	18,692	27,614	12,400	18,900

<sup>1</sup>As supplied from both surface and ground water sources.

**TABLE 3**  
Missouri River Estimated Average Annual  
Streamflow Depletions and Residual Flows  
(million acre-feet)

	Estimated Depletions		Residual Flows	
	1975	2000	1975	2000
<b>Upstream of Sioux City, Iowa</b>				
SRF	9.7	14.6	18.6	13.7
FS	7.8	11.7	20.5	16.6
<b>Missouri Region</b>				
SRF	15.5	22.4	49.5	42.6
FS	13.8	21.1	51.5	44.2

### Severe Water and Related Land Problems

The 1975 National Water Assessment effort in the Missouri Region involved identification of severe and urgent water and related land problems and issues as well as grouping them into appropriate areas for further analysis. The areas thus identified were examined as to the severity and urgency of the problems and issues, whether there was a recently completed study of the area or an ongoing study which is addressing the problems and issues, and whether appropriate studies are scheduled or programmed. This examination and screening process of the 58 problem areas identified revealed that none of the areas warranted recommendation for undertaking comprehensive studies immediately. The problems and issues in 16 areas were considered to be neither severe nor urgent, 22 areas were deemed to be adequately covered by recently completed or ongoing studies, and the remaining 10 areas are scheduled for appropriate studies.

Since there are many broad major problems and issues in the region, attention was directed toward those warranting or being in need of further action. Most of these surfaced in one or more of the problem areas and the others had been identified in the Framework Study or had been discussed at MRBC meetings. These 19 broad major water-use problems are presented in the ensuing paragraphs.

### Indian Water and Related Land Resources Problems and Federal Reserved Water Rights

The problem of uncertainties in the application and quantification of Indian water rights has long been considered one of the most pressing for the region. There are 23 Indian reservations in the region containing about 12 million acres of land. Although the total Indian land area comprises but 4 percent of the total area of the region, these lands are a significant part of the land area in the 4 upper States, comprising 15 percent of Montana, 8 percent of Wyoming, 6 percent of North Dakota, and 20 percent of South Dakota. Nearly all of the water flowing into the upper Missouri River is also contributed by these 4 States. The 6 large main stem dams operated by the Corps of Engineers and several not quite so large tributary reservoirs operated by the Bureau of Reclamation and Corps of Engineers regulate the upper basin flow for hydropower production and flood control and downstream needs for navigation, water quality, water supply, and other purposes, as well as utilization of the reservoirs for recreation, fish, and wildlife. It can readily be seen that the unknown and unquantified Indian water claims could have a serious impact on other water uses, not only of the Missouri River main stem, but for the tributaries as well.

The problems associated with reserved water rights for Federal lands are similar to those of the Indian lands—they are unquantified and relatively unknown as to location of intended water use. Although about 45 million acres, or about 14 percent of the total region, are in Federal ownership, current total water use on these lands is quite small. The Bureau of Land Management and the Forest Service manage about 38 million acres primarily for outdoor recreation, range, timber, watershed, and fish and wildlife habitat.

The large Federal land holdings pose particularly vexing problems for all western States, but particularly in the Missouri Region. Although there is little development and current water use on most Federal lands in the region is small, added uses may not conform with the State water-right structures and there could be a cloud on the validity of State-granted rights. Thus, there is a need for a determination concerning the Federal reserved water doctrine and means should be developed to quantify the water-use requirements of reserved lands so that other water rights can be safely and firmly established and water resource planning can proceed in a meaningful and rational manner. Several court suits concerning specific Federal land areas, currently in the process of adjudication, may result in clarifying a determination of reserved water rights on Federal lands.

With an uncertain future associated with Indian water rights, water resource planners are currently faced with the difficult

situation of not knowing how much water is or will be available for purposes outside the Indian reservations. There is a pressing need to determine the Indian and Federal reserved water rights and the quantification of these rights. There is great reluctance among some of the Federal agencies and some of the States involved to undertake this study at this time because of the fear that it might prejudice the outcome of judicial proceedings. On the other hand, there is considerable support for a study of Indian and Federal reserved water rights, which would improve knowledge and the basis for negotiated answers in the event the courts are requested to adjudicate these rights.

The MRBC has established an ad hoc committee to address these and similar or related problems and to recommend a course of action or study to be undertaken by the Commission. Because of the many problems of attempting to outline completely a study of this nature at this time, it was decided that the committee will continue to function so that the problems will continue to be addressed and evaluated. The committee will then be in position to make periodic reports to MRBC, develop timely proposals to study, and make future recommendations as appropriate.

### **Alternative Uses of Water**

As water use in the Missouri Region increases, competition for the remaining available supplies will intensify. Some of the tributary basins already are short of water, the available water having been overappropriated. In the upper South Platte River Basin in Colorado, some cities and industries have purchased irrigation water rights to satisfy their needs. Serious questions have been raised concerning the construction of thermal power plants in some localities, the extent of their water use, and their effects on downstream flows. Potential water use for transporting coal by slurry pipelines has generated much controversy. The viability of some Federal irrigation projects has been questioned, particularly as to whether projected water supplies are available and adequate to satisfy proposed needs. Additional questions are being raised concerning the adequacy of some existing streamflows to maintain fisheries, riverine recreation, and wetlands used by migrating waterfowl. Thus, competition for available water supplies in some areas is already intense. The future appears to be one of growing competition with more disagreements and contentions.

Another area of some concern relates to existing Federal projects and programs. Questions have been raised, for instance, as to whether some existing Federal reservoir projects are best fulfilling the needs of the region. A number of these projects were conceived, authorized, and constructed a number of years ago to satisfy needs as perceived at that time. Do these projects best serve current needs or have needs changed? Would the project purposes, water allocations, and project operations be the same today as when the projects were built? Although environmental quality has always been of concern to water resource planners, there has been increasing emphasis placed on environmental concerns. Many Federal, State, and local laws and policies concerning water resource developments also have changed. It appears that it would be appropriate to undertake a systematic review of existing projects, which may be accomplished as a part

of a larger study which assesses current and projected water uses and needs.

Concern for water availability and uses reaches every area of the region. What happens upstream affects the downstream areas. Some river systems are covered by an international treaty, interstate compacts, and court decrees; however, while these are significant, they represent only a relatively small portion of the total region. For the large remaining areas not thus covered, any State could conceivably use all of the water flowing into or through its State, although this appears to be unlikely. Nevertheless, there is concern about recent estimates of accumulated water use in many parts of the region and an even greater concern as to what the future may bring. The recent drought situation has accentuated this concern.

The Governors of the 10 basin States are enough concerned so that a conference meeting to discuss critical water issues in the Missouri River Basin was held in St. Paul, Minnesota, on August 3-4, 1976. They unanimously adopted the following resolution:

That the Missouri River Basin Commission implement on an annual basis a meeting that would involve the Governors of the basin similar to our involvement in this August 3-4, 1976, Missouri River Basin Governors conference meeting.

The second such conference was held in Omaha, Nebraska, on May 3-4, 1977, and a third meeting is scheduled to be held in Montana in 1978. With this expressed concern and the desire of the Governors to meet annually, it is evident that the water resources of the Missouri River Basin are in need of critical examination and study. We need to know where we are, where we intend to go, and what we are willing to do about it.

### **Current Water Supply Availability and Use**

The problems associated with differing estimates of current water supply availability and use are closely akin to those discussed in the previous section, "Alternative Uses of Water." While the "need to know where we are" aspects could be undertaken in the broader study of alternative uses of water, it is imperative that studies be undertaken as soon as possible to determine water availability, current uses, effects on streamflow, total water management, etc., and to arrive at determinations acceptable to the States and the Federal agencies concerned. There is too much at stake to delay these determinations. Federal laws and policies require that agencies operating Federal reservoirs perform these operations in accordance with the authorizing legislation and, in the case of hydropower, to set power rates at a level adequate to cover operation and maintenance costs and to repay investment costs over a specified number of years. To perform these assigned tasks in an acceptable manner, the Federal agencies need to have reliable estimates of probable amounts of water currently available and those likely to be available for both the short-term and the long-term future. In order to properly manage its waters, each State needs to know how much water is currently used and that available prior to embarking upon planning for its future.



## Water for Energy

Probably the most widely discussed topic in the Nation today is energy. Water is an important component of energy production. Today's electric power industry could not function without adequate quantities of water for cooling purposes. If synthetic gas and oil are to be produced from coal, water will be a necessary component of the process. Hydropower, although only a small but important part of total energy production, is completely dependent on water. Water will play an important role in our energy growth, although to what extent is difficult to estimate. Water use estimates for existing electric power plants and projections of future water use for 1985 and 2000 are available. These estimates have been generally accepted throughout the region; however, future water needs for other types of energy production are dependent on an uncertain future. Initial estimates of water requirements for energy production were never great compared to available supplies, and more recent estimates have tended to forecast even lesser amounts of water requirements. At this writing, there is no unified national energy policy; however, it appears that the national policy now taking shape would place greater emphasis on the use of coal and less reliance on the use of natural gas and oil, with primary emphasis on conservation measures and improved energy use efficiencies.

The large deposits of low sulphur coal lying close to the earth's surface in the Northern Great Plains of the region have received considerable attention. Mining of this coal has been increasing at a steady rate. Future increases are greatly dependent on such matters as national energy policies, economics, changing technologies, and environmental and social concerns. An MRBC-funded Level B study covering the Yellowstone River Basin and adjacent coal area is currently scheduled for completion late in calendar year 1977. The study is examining the critical issues confronting this 127,000-square mile area in southeastern Montana, northeastern Wyoming, and southwestern North Dakota. Potential energy and agricultural developments would place large water consumption demands upon the study area's water supplies. Maintenance of stream flows to meet esthetic, environmental, and recreation potentials is the major nonconsuming water demand. Agriculture and energy will compete to a degree with each other for water, but primary competition will be between those uses that divert and consume the water against those uses that require water to be left in the streams. Crossing all of the potential water use demands are the questions of reserved water rights for the large areas of federally owned lands and of Indian water rights in the area and the manner in which they may affect the future uses of water supplies. The major question to be answered is: "Will the water supply be adequate in quantity and quality to meet the forecasted demands while maintaining the quality of life and social well-being of all the people?"

There are a number of widespread concerns regarding the use of Missouri Region waters to support energy development initiatives. Some of the more probable impacts on the water resource base include the basic concerns associated with water depletion, alteration of streamflow patterns, transregion diversions related to coal slurry pipelines, water quality deterioration, destruction or alteration of established aquatic ecosystems, limi-

tations on water-use options, and alteration of aquifer integrity including surface-ground water interchange. However, it does not appear that water availability would be a limiting factor, although adequate water quantities may not always be available at site-specific locations. Assuming that energy developments in this area would require as much as 500,000 acre-feet annually, this would be only about 6 percent of the average annual amount of water currently flowing in the Missouri River below its confluence with the Yellowstone River and less than 3 percent of the average annual flow at Sioux City, Iowa.



*Ft. Calhoun nuclear power plant near Omaha*

## Ground Water and Surface Water Interrelationships

Ground water hydrology is one of the more difficult components of total water resource management and planning. While there is considerable knowledge concerning ground water resources in some areas of the region, there is a notable lack of information on other areas. The interrelationships of ground water with surface waters are even more complex than either resource taken alone. Although it is generally acknowledged that, for most areas, there is an interrelationship, the extent or effects are not well understood. Available information shows that in some areas ground water levels are declining and pumpage rates exceed aquifer recharge rates. In most areas, infiltrating precipitation is the only source of replenishment to the aquifer. In other areas, stream channels intercept aquifers and there may be an interchange of water depending on the local relationships of water levels, soils, rock formations, etc. It is becoming increasingly apparent that the total water supply, both ground and surface, should be viewed as a single resource. More and better knowledge is needed on the extent and quality of underground water supplies and aquifer recharge rates. Determinations need to be made as to the interrelationships of surface and ground waters, e.g., how does increased ground water use affect surface waters and how does increased surface water use affect the quantity and quality of ground water supplies. We need to know whether there is a time lag before the effects show up, and whether this can be measured in days, months, or years. Because of variances, study areas need to be established and special study criteria unique to each area need to be determined.

## Interbasin and Interstate Water Transfers

Interbasin water transfers or diversions have always been viewed with considerable trepidation, and, when State lines are involved, fears become magnified. Consequently, while many diversions have been proposed, only a few have been adopted for implementation.

Droughts, with their accompanying low streamflows and diminishing ground water supplies, usually result in those suffering from a lack of rainfall and short water supplies casting covetous aspirations for diversions from those areas and streams with a seemingly more plentiful water supply. Consequently, there is much discussion about interbasin water transfers but, so far, little legislative action has resulted to permit their realization. Two of the more serious current proposals are (1) for diversion of Oahe Reservoir water by pipeline to western South Dakota for municipal and industrial needs and possible irrigation use and extending to the coal fields in northeastern Wyoming for energy needs, and (2) slurry pipelines to transport coal long distances beyond the confines of the Missouri River Region, which also have the potential for intermediate deliveries.

Interbasin water transfers within the confines of State boundaries is in itself usually quite complex, involving legal questions and policy issues as well. Taking water from a basin in one State and transferring it for use in another basin of a different State is even more complex. Interbasin transfer of waters may, in the future, fulfill needs considered to be dire enough so that the States may be willing to approach the subject with considerably less apprehension. Certainly, this option should be kept open, since it may prove to be the only viable solution to a particularly vexing problem in certain instances.

### Legal, Policy, and Institutional Problems

If there were no competition for available water supplies or if everyone had an ample supply of water, there would be no legal, policy, or institutional problems. To overcome some of these deficiencies and water supply limitations, water storage reservoirs have been constructed, water is being imported and exported, interstate compacts have been negotiated, and other innovative measures have been undertaken. Some of the past actions have not been tested concerning their legality and it is quite evident that there are a host of upcoming actions which will be subject to adjudication through the court systems.

The Flood Control Act of 1944 authorized construction of five large Missouri River main stem reservoirs, numerous tributary reservoirs, and other water resource development projects. The plan for development of the reservoirs and associated developments originally referred to as the Pick-Sloan Plan is now designated the Pick-Sloan Missouri Basin Program. Most of the reservoirs have been constructed and are in operation. As competition for use of available water supplies has increased so have questions and arguments pertaining to jurisdictional control. This is particularly evident concerning jurisdiction over water impounded in the federally constructed reservoirs. Jurisdictional questions were raised by several of the States in commenting on



**Fort Randall Dam and Lake Francis Case, South Dakota**

an extension of the existing Memorandum of Understanding between the Secretary of the Interior and the Secretary of the Army concerning water marketing for industrial purposes from the six Missouri River main stem reservoirs.

Although there are no active formal water compact negotiations underway for division of interstate surface waters, there are indications that requests may be forthcoming to clarify or renegotiate some existing compacts. Some States feel that existing compacts have provisions which do not properly or adequately fulfill current water needs. An example is the Yellowstone River Compact, approved October 30, 1951, which has a provision that the signatory States (Wyoming, Montana, and North Dakota) must consent to any proposed diversion of waters outside the Yellowstone River Basin. Thus, if Wyoming's share of Yellowstone River water were to be proposed for use outside this basin, e.g., for development of coal fields situated elsewhere than in the Yellowstone basin, the diversion would require the unanimous consent of the compacting States.

Recent large increases in ground water use in many areas of the Missouri Region and elsewhere have raised questions concerning the need for new or revised State laws governing the use and management of ground waters.

The western States in the region have experienced a recent significant increase in requests for adjudication of water rights and related problems, which is probably the result of increasing water use, competition for available water supplies, and recent drought conditions. It is also becoming increasingly apparent that either the Federal judicial or legislative process or both must be called on to settle some of the impending water problems facing the Missouri Region. Among these important issues are such matters as Indian water rights, Federal reserved rights, water use for interstate coal slurry pipelines, regional water allocations, and, of course, many others. What is important in these issues is to determine the quantities of water involved, the existing water rights both active and otherwise, how much water is or would be depleted from the streams and ground water reservoirs, and how much is or will be available for future uses. Planning for water resource development needs or for reservation for instream flow needs or other purposes is very difficult without quantification of water allocations to various purposes and locations. Since the States will be considerably affected, they will need to participate extensively in any studies or determination.

Legal, policy, and institutional arrangements concerning water resources should be reviewed periodically to determine if they are a part of the problem, if they are outdated, or if changes would improve problem resolution agreement with other congressional actions which authorized and funded for construction numerous water resource development projects. Some past Federal actions have resulted in considerable uncertainty and a waste of funds. A cohesive Federal policy concerning water resources development is needed. The States need to know the direction of Federal policies, and what cost-sharing and other basic arrangements to expect.

### Funding Arrangements (Cost-Sharing)

Funding arrangements or cost-sharing for development and operation and maintenance of water resource projects generally means how much will be supplied by the Federal Government and how much or what part from non-Federal sources. Historically, the Federal Government has provided most of the waterway improvements for navigation. In the Missouri Region, most of the other improvements or developments prior to World War II were accomplished by local entities. All of the major projects and programs and most others since World War II have been financed by the Federal Government, with appropriate repayment by non-Federal entities for many of the services provided. The obvious reason for this is that the Federal Government was the only source with the capability and capital to undertake such projects and programs.

The evolution of the Federal laws, policies, administrative procedures, and cost-sharing requirements for Federal water resource developments has spanned many years and the projects and programs involve many departments, agencies, and bureaus. While there is some overlapping of responsibilities and there are inconsistencies in some cost-sharing responsibilities in some programs, the overlaps and inconsistencies are comparatively minor for a program which has been evolving over a long period of years and covers the entire Nation with its diverse water problems.

The involvement of the Federal Government in water resources planning and development in the West resulted largely from a desire to settle and develop this part of the Nation, and the obvious inability of others to undertake comprehensive coordinated development projects and to provide the large capital required for their implementation. Generally, the States and others have only limited capabilities and financial resources to undertake projects requiring a large capital investment. Comprehensive coordinated planning and development of projects and programs to satisfy water resource needs, particularly those involving large areas and large projects, often go beyond State lines. It is quite obvious that Congress recognized this need in evolving the Federal laws, policies, and administrative procedures which resulted in assigning various responsibilities to various Federal agencies and in appropriating funds to carry out the various programs. If the Nation wishes to continue to develop its water resources to meet its needs, the Federal Government is the only entity with the authority, capabilities, and financial resources to do

so, although some States are taking steps to participate financially with local entities.

### Instream Flow Needs

Within the limits of their natural occurrences, the flows available for instream use are dependent on State laws and water rights, interstate compacts, Supreme Court decrees, and international treaties and on the magnitude of uses developed thereunder. There are only 2 states in the Missouri Region, Colorado and Montana, which currently give legal recognition to instream flow needs for fish and wildlife, although Kansas has procedures whereby establishment of minimum flows can be accomplished. A number of other States have considered such legislation. Water uses in the more arid parts of the region are largely controlled by existing water rights held by irrigators, cities and industry, and many of the tributary streams are already overappropriated. While most States recognize the desirability of maintaining instream flows for fish, wildlife, recreation, and other uses, currently these are recognized as being only incidental uses subordinate to those established previously under State water right laws. There are currently no Federal laws requiring or establishing minimum streamflows. Recent congressional acts concerning the preservation of rare and endangered species and where significant Federal actions are involved, may preclude Federal actions where significant changes in streamflows would have adverse effects on preservation of these species.

The U.S. Department of the Interior, Fish and Wildlife Service, recently established an office in Fort Collins, Colorado, which is called the Cooperative Instream Flow Service Group. Its purpose is to assess instream flow needs and to provide information to assist biologists and recreation planners in establishing instream



Fly fishing near Augusta, Montana

flow requirements and management strategies for riverine and stream environments. Previous instream flow requirement estimates have been based largely on judgment. The Cooperative Instream Flow Service Group will attempt to develop scientific bases for determining instream flow needs to maintain fisheries, recreation, wildlife, and ecosystems. It is quite apparent that there will be continuing problems concerning those desiring to divert streamflows for beneficial consumptive uses and those desiring to increase streamflows or maintain them at current levels.

Instream flow needs to meet withdrawal and consumptive water use needs for municipal and industrial purposes, mining, land irrigation, livestock, and thermal electric power generation, and for hydroelectric power operations and inland navigation have long been recognized. Minimum streamflows to maintain stream fisheries, wildlife, and ecosystems, to provide continuing or greater recreation enjoyment, and for esthetic purposes have only recently come under serious discussion but are gaining in recognition. There is a need to continue and, perhaps, increase the funding level of the recently initiated studies to make assessments of instream flow needs, to establish scientific bases for instream flow requirements, and to establish management strategies. These studies are needed to provide a better knowledge base on which decisions can be made on controversies concerning water uses and water resource developments versus conservation policies and needs and maintenance of ecosystems.

#### **Water Related Recreation Needs**

The State/Regional Future (SRF) estimates of water-related outdoor recreation demands were based on data and information contained in the State Comprehensive Outdoor Recreation Plan (SCORP) reports. Due to a lack of uniformity of data and information presented in the SCORP reports, it was difficult to prepare uniform data at the ASA level for recreation participation estimates, particularly by uniform activity classifications. While some of the SCORP reports included data on water and land areas available for recreation, others did not. One general conclusion that could be drawn from reviewing these reports is that there is a lack of adequate water and related land areas near most of the large urban centers and cities in the region to meet outdoor recreation needs.

Numerous tributary streams in the Missouri Region are naturally intermittent and provide little or no opportunity for recreation enjoyment. On the other hand, there are many streams with adequate base flows which would provide excellent opportunities for development of recreation areas in a riverine environment to meet local recreation needs. In many cities and towns, development of flood plain areas for recreation provides opportunities for wise use of these areas. Existing reservoirs provide additional opportunities for expanding facilities and areas and to provide access to meet increasing recreation needs. In some instances, water supply reservoirs and some reservoirs on private lands which are closed to the public could be opened and access and recreation facilities provided for public enjoyment.

The nonuniformity of the State-prepared SCORP reports is a problem when attempting to determine the adequacy of water-oriented recreation opportunities available or in determining the inadequacy of available water and land areas and facilities. There is a need to establish uniform criteria and procedures in defining recreation opportunities and needs, evaluating recreation benefits, and assembling associated recreation data and information.



*Sailboating on North Dakota reservoir*

#### **Environmental Concerns and Issues**

The problems of the need for quantification of instream flow needs for fisheries, wildlife, and ecosystem preservation have been discussed previously and water quality problems are discussed in a later section. As the uses of and competition for available surface water supplies have increased, so have concerns about the amounts of water left in the streams. Man's use of water to increase crop production, to satisfy municipal and industrial needs, and for other purposes has greatly reduced the streamflows in many areas of the region. In many instances, water stored in upstream reservoirs is regulated to augment low streamflows. There are choices to be made such as whether to curb man's use of water, mandate certain minimum streamflows, or to provide upstream reservoir storage so that low streamflows can be augmented.

The Missouri Region, bounded on the west by the Rocky Mountains, with large expanses of prairie lands, low population densities, and a diverse climate, affords many opportunities for wild and scenic river and primitive recreation area designations. As each of these potentials is studied in detail, consideration will need to be given to its effects on residents of the area and whether it is in the best interests of the region and the Nation to set these areas aside for control and limited use for environmental protection or preservation.

Today's environmental concerns and issues include all of man's activities. Expanding cities continue to take land out of agricultural production or land which could be used for some other purpose. Inadequately treated municipal and industrial waters pollute our streams and, in some instances, our ground water. Man's use of the land to grow the food and fiber needed to feed and clothe the people of our Nation and the world affects the land and water and even the air. It affects naturally occurring animals, birds, and plants. Irrigation water used to increase crop production and other water uses deplete the stream and ground water in storage. The arguments and contentions concerning man's effect on his environment rage on and on. Scientists cannot agree on many of the short- and long-range effects on the environment or what the effects on projected lifestyles will be. One thing is certain, the interactions and complexities are too great for man to fully comprehend and evaluate using only limited available knowledge.

The available water resources are more or less finite although the amount of water available varies over wide limits from year to year and month to month. Primary concerns are for the extremes, or what balance to seek in storing excess waters for use during periods of shortages to attain higher degrees of utilization in fulfilling our growing needs or to be satisfied with water supplies remaining as provided by nature. Since every action involves environmental changes, and it is obvious that human needs are going to continue to expand, the planning of water and related land resource developments should proceed with the best evaluations possible of alternative uses and for both beneficial and adverse effects. Just as adequate housing for protection against nature's elements is fundamental to mankind's well-being so are efforts to improve on nature's way of providing inadequate precipitation and water availability or, at times, too much.

### Navigation Flow Requirements

The Missouri River navigation project extends 732 miles from Sioux City, Iowa, to the mouth of the river near St. Louis, Missouri. It is an open river channel of 9-foot depth with the banks secured by stabilization structures. A system of six large main stem reservoirs regulates the river flow to provide water for several purposes, including an 8-month navigation season during the ice-free season from April through November.

The upstream reservoir storage system provides a capacity equal to about three times the average annual flow at Sioux City. Because the amount of water available and the depletions above Sioux City are under contention, so is the present average annual

flow at Sioux City. Nevertheless, it is probably somewhere around 19 to 22 million acre-feet annually. To maintain adequate streamflows to meet downstream water quality requirements and M&I needs and for an 8-month navigation season requires about 15 to 16 million acre-feet annually. Projections of possible depletions and residual water supplies indicate these average annual flows will probably be available through the year 2000 except during extended drought periods such as occurred from 1930-1941. Because of increasing upstream depletions, inflows into the reservoir system would fall considerably below the average during extended drought periods. The first requirement in releases would be to maintain adequate streamflows for water quality and M&I needs. With increased depletions beyond the year 2000 there may not always be enough water for a full 8-month navigation season. What the effect of a shortened navigation season, occurring several years in a row, on shippers and on the barge lines operating on the Missouri River would be is difficult to assess. However, it probably would reduce the total river tonnage shipped and it would dampen the interest of shippers and barge line owners in the maintenance of Missouri River navigation. Because of the slope of the Missouri River and its high sediment loads, and based on current technology, a system of locks and dams which would reduce the water requirement would be very costly and currently is not considered to be a viable solution.



Towboat Yankton arriving Nebraska City

### Land Conservation and Erosion Control

The Missouri River Basin Comprehensive Framework Study Report stated that about 45 percent of the 324.7 million acres of basin lands has been adequately managed or treated by needed vegetative and mechanical practices. It should be safe to assume that some, although probably quite limited, progress in land conservation on the remaining 55 percent has been made although to what extent was not ascertained during this national assessment. While most Federal lands are adequately treated or managed, well over 50 percent of the lands in private ownership are in need of land conservation treatment or improved management practices. Without assistance from U.S. Department of Agriculture

programs, it is highly doubtful that much progress would be made in bringing about conservation practices on private lands.

A basic requirement for widespread attainment of land conservation is the proper use and management of all cropland, pasture and range, forest and woodland, and other agricultural lands for safe and continuous production without deterioration. In the eastern part of the region, water erosion is the dominant problem on croplands, with sheet and gully erosion being the major hazards to tilled soils with slopes exceeding 2 percent. Vegetated waterways, terraces, contour farming, strip cropping, proper use of crop residues, adequate use of fertilizers, and conversion of marginal croplands to permanent vegetation are the major treatments needed to control water erosion and provide protection to croplands. Some agricultural lands with excess water are in need of drainage. In the western and northern parts of the region, both wind and water erosion are dominant problems on croplands.

Agriculture is the principal industry of the region; hence, the primary interest of basin residents is in the land and its productivity. While historically most of those farming the land were concerned primarily with the current year's crops and gave little thought to the long-term future conditions of their land, education and concerns for the future have brought about changed attitudes and outlooks. Today, although not yet universal, there is widespread interest in land treatment and management practices to allow for safe and continuous production without causing land deterioration. Improved management practices are easily understood and can be instituted by individuals with only limited guidance needed; however, watershed improvements, such as those provided for under Public Law 566, require planning and technical study by trained individuals. Also, the laying out of contours, terraces, and gully erosion controls exceeds individual capabilities.

#### **Streambank Erosion and Channel Aggradation and Degradation**

Streambank and gully erosion are relatively serious problems throughout most of the Missouri Region, resulting in many acres of lost land annually and affecting numerous individual land owners. Streambank erosion preventive measures are costly, and in most instances, are not economically feasible using current evaluation procedures and usually involve natural environmental controversy. Critical problems occur at many of the bridge crossings, particularly during high flood flows. These high flows often cause erosion around bridge abutments and cut through streambanks thus undercutting highway approaches. Bank deterioration has occurred immediately below many of the large dams and is particularly serious below the Garrison and Gavins Point Dams on the Missouri River. The most extensive erosion problems occur in ASA's 1004, 1005, 1009, 1010, and 1011 with the average annual dollar damage being greatest in ASA's 1009 and 1010. Channel aggradation and degradation are also problems at many locations throughout the region, affecting the water intakes of many municipalities, power plants, industry, and irrigators.

It is estimated that streambank erosion, measured in 1967 dollars, causes damages of nearly \$7 million annually. It is also estimated that there are over 2 million acres subject to gully erosion damage causing annual damages, in 1967 dollars, of almost \$32 million. Since a large part of these damages represents the permanent loss of valuable land, it is obvious that measures should be taken or accelerated to prevent these losses.



*Streambank erosion on Iowa river*

#### **Flooding Problems and Flood Plain Management**

Much has been written concerning ever increasing flood damages despite large public expenditures for flood protection projects. Following the trend of increasing annual flood damages, Congress has instituted a National Flood Insurance Program in an effort to reduce annual disaster assistance outlays through the increased availability of flood insurance. This program includes extensive mapping programs of flood plains and classification of flood-prone areas to assist local interests in the control of developments permitted in the flood-prone areas. Studies by the Corps of Engineers and the Soil Conservation Service currently consider all manner of possible means to reduce or control floods and flood damages. These include structural measures (upstream reservoirs, levees, floodwalls, channel improvements, and flood proofing of buildings); nonstructural methods such as flood plain management (zoning and regulation), evacuation, improved river forecasting, and community preparedness.

In the Missouri Region, flood damage estimates were inventoried by the Soil Conservation Service for drainage areas of less than 400 square miles and by the Corps of Engineers for the remaining areas. The estimates made reflect a continuation of recent trends of Federal appropriations for structural measures and recent trends of flood plain regulation. The estimates show that, using 1967 dollars, the average annual damages in the

region for 1975 were about \$228 million, which are estimated to increase to about \$233 million by 1985 and to about \$270 million by 2000. Over 45 percent of the annual damages occurs in ASA 1011 which can be attributed to the greater amount of development and more frequent flooding because it is in the more humid part of the region. These estimates reveal that flooding is a major problem throughout much of the region. Numerous cities and communities have severe flood problems and large agricultural areas are subject to frequent flooding.

Since there are many remaining severe flooding problems in the region, water and related land resources development planning should consider all means, including structural solutions, whereby flood damages can be reduced. Since flood control, flood protection, and national flood insurance are all Federal programs, it is obvious that any measures which would result in annual benefits or reduction of annual flood losses greater than the annual cost of the Federal programs should be undertaken. Efforts should also be made to improve river forecasting and flood warning systems so as to reduce damages, reduce or eliminate lives lost, and reduce human suffering from major and flash floods.

#### **Municipal and Industrial Water Needs**

The Safe Drinking Water Act of 1974 authorizes the Environmental Protection Agency to regulate the contaminant levels in public water systems and to promulgate national primary standards for drinking water, which includes all public systems with 15 or more connections and serving 25 or more persons, excluding systems used primarily for storage. The States were offered primary enforcement but not all accepted, and EPA has assumed enforcement in those States. Many small communities in the region do not have readily available water supply sources which can pass standard public health requirements nor do they have the financial means whereby acceptable water supplies can be obtained. Without considerable Federal assistance, it is highly doubtful whether many of these communities will ever have acceptable public water supplies.

There are many communities and even several large cities in the region with inadequate sources of water supplies to meet these current and projected needs. The recent drought has affected many areas. Many communities and livestock raisers, particularly in the Dakotas, were forced to haul in water supplies. Many others instituted water rationing to conserve available supplies. The far-below-normal winter snowpack in the Rocky Mountains and subnormal runoff caused great concern, particularly in some areas of Colorado where water rationing and water use restrictions have been invoked.

Studies are underway and some have been completed on tentative schemes to supply water to a number of communities in eastern South Dakota. Similar studies are programmed for western South Dakota. Numerous studies have been made and others are underway to consider alternative schemes to supply water for the cities and communities along the Front Range area of the Rocky Mountains in Colorado. Many communities in northwestern Missouri, southwestern Iowa, and southeastern Ne-

braska obtain their water from shallow aquifers which tend to dry up or nearly so during extremely dry periods. While rural water districts are meeting some of the needs, many others are needed; but in the more thinly populated areas, these types of solutions are far too costly.

#### **Water Quality and Low Streamflow Augmentation**

Overall, the water quality objectives for the Missouri Region are dictated by Public Law 92-500. Section 101(a)(2) states: "...it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water shall be achieved by July 1, 1983." In general, it can be assumed that effluents from municipalities, industries, and feedlots, while currently causing some degradation immediately downstream from outfalls, will be appropriately treated as required by P.L. 92-500.

At this time, there are no known feasible means of controlling quality problems caused by farm and ranch operators, although increasing emphasis is being placed on management of irrigation water use and on education and training in the prudent use of farm chemicals. It may be possible to reduce somewhat the salinity of irrigation return flows in some areas, although to what extent is not now determinable. One of the more significant stream pollutants throughout most of the Missouri Region is sediment resulting from sheet, gully, and streambank erosion. This problem is most prevalent throughout ASA 1009 and the northern part of ASA 1011 in northwestern Missouri and southwestern Iowa. Although improvements in land conservation practices, controlled grazing, taking some lands out of cultivation, and installing control structures will probably lessen the pollution, stream sediment will always be a major problem. Also, there are no apparent feasible solutions to the water quality problems caused by other naturally polluting areas, such as the Badlands of South Dakota in ASA 1005 and salt water intrusion from many areas.

The amount of data available concerning the quality of surface waters in the region is somewhat less than desirable. More sampling stations and a reliable method to transmit the available data are needed to provide better coverage. Records at existing stations are not available for a period long enough to define accurately the changing quality of water. Data concerning the biological quality of surface waters are particularly deficient.

While it appears that practically all point sources will be treated by 1983 to meet the prescribed requirements of P.L. 92-500, the region will still have water quality problems resulting from nonpoint sources. Also, in some areas, it is doubtful that the low, erratic streamflow can adequately assimilate even properly treated wastes. Particularly in those areas and possibly in other areas where advanced treatment would prove to be quite costly, consideration should be given to reservoir storage to augment low streamflows where this proves to be the only viable or most economical alternative.

## Growth-No Growth

Like many parts of the Nation, many areas of the Missouri Region and some segments of the population have voiced a preference for a "no-growth" policy, although most States encourage industrial expansion and associated growth. Many ranchers, farmers, and others living in the coal-field areas of Wyoming, Montana, and North Dakota oppose development of the coal fields, not only because of the land disruption but because of the influx of people and expressed fears of attendant social prob-



*Modern Denver*

lems. They would prefer a status quo to protect their current life styles. Some interests in the Rocky Mountain Front Range area in Colorado oppose further development because of strains being placed on the environment and particularly the available water supplies. While the most often expressed fears concerning environmental disruptions are those which would result from increased developments, many fears are related to increasing water uses. Increased water needs of many areas can be met only by additional reservoir storage and water diversion, or some other manmade provisions. Additional reservoir storage and water diversions always cause concern and protests from those concerned with environmental issues. If there is to be growth, the needs of the additional people will have to be met by some means but the solutions will not be easy.

## Discussion

While it may be quite difficult to formulate, to the satisfaction of all concerned, plans to study many of the major problems and issues, the mere fact that the problems persist indicates the need to make extensive efforts to initiate appropriate studies. Hopefully, through the coordinated efforts of the Federal agencies, States, and others, all facets of the problems and issues can be surfaced and appropriate resolutions devised. At least, by the

process of appropriate studies, alternative solutions could be devised from which selections could be made. Where agreement among concerned interests cannot now be reached for the undertaking of certain studies, these studies should not be delayed interminably lest interests outside the region step in and impose unwanted resolutions.

It was planned that the MRBC would update the Missouri River Basin Comprehensive Framework Report and that this effort would be meshed with the 1975 National Water Assessment efforts. In November 1976, MRBC agreed to prepare a Comprehensive Coordinated Joint Planning Report (CCJP). Since the CCJP would include a baseline record of resources, projects, programs, and a continuous planning process, this will serve to update the Framework Report. Consequently, there currently are no Level A studies contemplated and none is needed at this time. MRBC completed a Level B study on the Platte River Basin in Nebraska in 1976. The Level B study covering the Yellowstone River Basin and adjacent coal area is scheduled for completion late in 1977. Funds have been appropriated to initiate a Level B study of the Missouri River Basin in Montana in fiscal year 1978. No other Level B studies are contemplated at this time; however, several subregional analyses are scheduled, beginning with the James River Basin in the Dakotas in FY 1978. There are numerous Level C and other studies covering entire tributary river basins, significant parts of river basins, metropolitan areas, other areas, and projects currently underway or programmed.

The CCJP process, report, and recommendations will provide background information; the basis for study, program, and project needs; and directions for the future. It is a dynamic process with the supporting data updated progressively and the report to be updated biennially. It will provide the information needed to point out the deficiencies and to show where greater emphasis is needed in basic data collection and planning-related research programs. It will point out those areas where regional, river basin, special, or other types of studies or programs are needed and the relative importance or need for each. The CCJP process provides a systematic approach to determining the areas where subregional analyses are needed and methods whereby the relative importance of each can be determined, including scheduling and budgeting recommendations. It also provides a process whereby the need and relative importance of implementation studies, programs, and projects can be determined. With the establishment of the CCJP process and biennial reporting, the MRBC members will be able to select those studies, programs, and projects which are directly needed and to seek their implementation on a systematic basis and in a timely manner commensurate with the capabilities of the States and Federal agencies.



# Recommendations

The Missouri River Basin Commission recommends that:

1. The ongoing studies of water and related land resource problems and needs being accomplished by the Federal agencies be completed as expeditiously as possible.
2. For those States which have not completed State water plans, that these be completed as soon as practicable and that, where completed, the plans be continually updated; that the funds to the States being provided under Title III of P.L. 89-80 be increased to enhance their capabilities to complete and continually update State water plans and to participate as partners with the Federal Government in water resources planning activities.
3. A study to determine current water uses and availability, both surface and ground water, be undertaken immediately; that study participants include representation from the Bureau of Reclamation, the Corps of Engineers, and appropriate States; and that funding for the Bureau of Reclamation's Total Water Management Studies, which relate to current water uses, be accelerated.
4. A study of problems and issues associated with water and related land resources for Indian and Federal lands and related matters be undertaken under the auspices of MRBC at the earliest date deemed appropriate.
5. A study of projected water needs, impacts, alternative water uses, and water pricing and marketing, including institutional arrangements, be undertaken under the auspices of MRBC at the earliest date deemed appropriate, the institutional aspects to be undertaken when all States have completed a State water plan.
6. The follow-on studies to be recommended in the ongoing Level B study of the Yellowstone River Basin and adjacent coal area be funded, undertaken, and completed as expeditiously as possible.
7. Where the use of ground water is significantly affecting the ground water resource and streamflows, and, particularly where such use is threatening water using developments and investments, that studies be undertaken in selected areas to be determined through the CCJP process and report and the annual MRBC prioritizing process and report.
8. Studies by the Bureau of Reclamation, the Department of Agriculture and others of current water use for irrigation for Federal and non-Federal projects and private developments be accelerated to improve efficiencies of water use and thus conserve available supplies; and that existing irrigation developments be rehabilitated and upgraded where needed to become more efficient and conserve water use.
9. The studies initiated by the U.S. Fish and Wildlife Service concerning instream flow need determinations to maintain stream fisheries, wildlife, and ecosystems, to provide greater recreation enjoyment, and for esthetic reasons be accelerated through increased funding.
10. Steps be taken by the Bureau of Outdoor Recreation to establish uniform criteria for use by the States and Federal agencies in defining recreation opportunities and needs, the evaluation of recreation benefits, and associated recreation data and information.
11. Funding for the land conservation and management programs of the USDA and the PL-566 watershed projects of the States and USDA be accelerated.
12. To reduce the large annual losses of valuable lands, funding of programs of the U.S. Soil Conservation Service and the Corps of Engineers to control and prevent streambank and gully erosion be accelerated; and that current justification procedures for undertaking these programs be modified.
13. Programs of the U.S. Soil Conservation Service, the Corps of Engineers, and the Department of Housing and Urban Development to reduce flood losses in both urban and rural areas and to improve the National Weather Service and local flood warning systems be accelerated or instituted as appropriate.
14. Programs of the National Farmers Home Administration, Department of Agriculture, and other Federal agencies to provide water supplies of adequate quantity and quality for numerous small communities throughout the Missouri Region be accelerated.
15. Particularly in those areas where advanced treatment would be costly and low-flow augmentation is needed to improve water quality, consideration be given to reservoir storage to augment low streamflows where this proves to be the only viable or the most economical alternative.
16. The establishment of an appropriate centralized water and related land resources data bank be investigated through MRBC's comprehensive planning program.
17. The CCJP process and biennial report, including the associated annual prioritization process, be used as a guide for determining needs for basic data, planning-related research, studies of water and related land resource problems and potential resolutions, other water related programs, and water resource project or program implementation.
18. Federal and other funding to the Environmental Protection Agency, U.S. Geological Survey, and other agencies involved in the collection of water quality data be increased.

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Montana Department of Highways, pp. 1, 9

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