9 Commercial and Recreational Navigation

Iowa is fortunate that it is bordered by two major rivers, the Mississippi and the Missouri. These two rivers provide water for many beneficial uses including navigation, commercial river transportation, and recreational boating. This report examines the needs and conflicts associated with these two navigation uses. The overall goals of this important beneficial-use category are (1) to enhance economic development by using commercial river transportation for economic efficiency and, (2) to enhance the quality of the border river corridors for recreational boating and other uses, by the management, conservation, restoration, or improvement of the quality of natural and cultural resources and ecological systems.

This report examines the Mississippi and Missouri Rivers where navigation for commercial and recreational purposes interface. Because the streams differ in physical characteristics and traffic volumes, this report on navigation is divided into two parts; the first part deals with the Mississippi River, and the second with the Missouri River.

Mississippi River
The Resource

The Upper Mississippi River navigation project (St. Louis to Minneapolis) made possible low-cost water transportation to and from Iowa's eastern border. The navigational system, constructed and maintained by the U.S. Army Corps of Engineers, consists of a series of locks and dams, wing-dams, and levees.

Iowa has 11 locks and dams along its eastern border (Figure 9-1), beginning with Lock and Dam No. 9 near Harper's Ferry and ending with Lock and Dam No. 19 at Keokuk. The locks and dams are located in fairly straight stretches of the river at irregular intervals varying from 5.5 to 49.2 miles. The average pool length is 25 miles. The dams provide more stable pool levels and associated depths of flow for commercial navigation, and offer year-round slack water pools for pleasure boating, fishing, swimming, and waterfowl hunting. The authorized nine-foot channel for navigation is maintained by the Corps through the dredging of shallow areas; the shoaling is caused by the river as it deposits silt and sand in undesired areas in the main channel.

The information presented in this chapter is based on the comprehensive "Task Force Report on Commercial and Recreational Navigation," prepared by and filed with the Iowa Natural Resources Council.

Mississippi River at McGregor / W. E. Akin

There are 63 barge terminals operating on the Mississippi River along Iowa's border (Figure 9-2). Grain, coal, and petroleum are the principal commodities shipped and received at Iowa terminals. Most grain is collected from interior Iowa shipping points and barged to New Orleans. A major portion of the coal is inbound and received by power plants adjacent to the Mississippi. The terminals handling inbound petroleum are located mainly in the metropolitan areas of the Quad Cities.

Besides the benefits to commercial interests, the federal land acquired for the project and the construction of the locks and dams have provided a vast resource base for recreation and fish and wildlife interests. There are eight federal fish and game refuges and 16 state game management areas totaling 226,000 acres along the Upper Mississippi River. Along the Iowa shoreline, there are 58 public boating access areas available to make the 184,000 acres of water area accessible to Iowans for boating and recreational use (Figure 9-3). A side benefit of the Corps' dredging operations is the creation of sandy islands that form some of the most widely used recreation areas along the river. However, detriments include sedimentation and loss of backwater areas essential to fish and wildlife.

Resource Considerations and Problems

Commercial Use

The Upper Mississippi River has long been one of the nation's leading waterways in terms of annual traffic and importance to the surrounding area. Between 1955 and 1975, freight traffic in the Rock Island District (which extends from Guttenburg, Iowa, to Hannibal, Missouri,) grew from 7.7 to 24.5 million tons, representing a 3.3 percent average annual growth rate (Table 9-1.) Grain and related commodities are becoming the largest commodity group on the river, attributable for the most part, to growing U.S. exports of agricultural commodities and the establishment of post-war government food programs. Waterborne movement of coal also experienced a steady increase and is expected to increase even more in the future because of national energy policies. Although petroleum tonnage doubled during this period, it did not keep pace with other commodities.

In 1975, 8.6 million tons of commodities were handled at Iowa terminals (Table 9-2). Most commercial users of the Mississippi River are located within 150 miles of the river and two-thirds of this volume is transported by truck.

Approximately 47 percent of the total tonnage through Iowa barge terminals is grain or grain products. Coal and petroleum accounted for about 25 percent of the total tonnage originating and terminating at Iowa barge terminals during 1974 and 1975.

Prospective Traffic

The Upper Mississippi River Comprehensive Basin Study (UMRCBS) developed low, medium, and high range projections of total commerce for 1980, 2000, and 2020. The projections include the section of the Mississippi from Cairo, Illinois to Minneapolis, Minnesota. Figure (9-4) shows that actual waterborne commerce has exceeded even the high growth range of the UMRCBS projections from 1965 to the present, and that grain is projected to be the most important commodity shipped by barge.

The future of bulk commodity movements on the Upper Mississippi is difficult to predict since national policy and regional marketing patterns will affect commodities handled by barge. Export demand for grains will significantly affect transportation needs. The U.S. exports about 20 percent of its corn, 50 percent of its soybeans, and two-thirds of its wheat. It appears that downstream movement of western coal will increase. The complex system of rates and costs between transportation modes will be important in determining how commodities move.

The Mid-America Ports Study, funded by 17 states (including Iowa) and the Maritime Administration, reports river traffic will double by the year 2000. The study will provide traffic predictions for river segments when it is completed in 1979.

Lock and Dam Maintenance

The present system of locks and dams must be maintained in quality operational condition because of their tremendous economic importance to Iowa. The U.S. Army Corps of Engineers operates and maintains the 9-foot channel on the Upper Mississippi River. A breakdown at one lock could cause traffic delays along the entire waterway; therefore, they must be kept in quality operational condition.

Channel Maintenance

Dredging is necessary at problem areas to maintain the authorized 9-foot channel. However, recent dredging and dredge disposal practices have been criticized because of their adverse effect on the surrounding natural environment. The loss of productive fish and wildlife habitat can be partially attributed both to the direct effects of initial dredge material placement and the indirect effects resulting from secondary movement of the material. The Great River Environmental Action Team (GREAT) has been studying the impacts of navigation channel maintenance on the resources of the Upper Mississippi River. GREAT is studying the possible beneficial uses of dredged material. Through implementing GREAT's recommendations, the Corps of Engineers has been minimizing the adverse environmental impacts of dredging.

Increasing the Capacity of the Waterways System

Commercial navigation growth places demand on the Upper Mississippi 9-foot channel project in addition to system maintenance. The continuing trend toward larger, more efficient tows and increased traffic requires continuing waterway improvements.

To accommodate future increases in the capacity of the waterways system, a number of nonstructural and structural alternatives should be considered. Improved efficiency at the locks would increase the capacity of the system. Efficiency methods to be analyzed include: traffic control scheduling, use of helper boats at locks, and improved scheduling of equipment to avoid movement of empty barges. Extension of the navigation season, another nonstructural alternative, also would increase the capacity of the system. However, there are problems associated with winter navigation related to the natural ecosystem, the activities of man, and equipment problems with breaking ice. The Corps of Engineers is restudying some possible alternatives and the environmental impacts of an extended season.

Replacement of locks with improved facilities has been cited as a means of accommodating future increases in traffic. One important prospect, Lock and Dam 26, has been disputed. The Inter-Agency Resource Council, made up of the heads of various Iowa agencies dealing with natural resources and members of the Governor's staff, investigated and studied the Lock and Dam 26 project and concluded that:

> The proposed replacement of Lock and Dam No. 26 is in the best interest of Iowa and that a recommendation should be made to Congress for authorization and funding, and wishes to add further that it is opposed to increasing the navigation channel depth from 9 to 12 feet.

This represents Iowa's position, and it was distributed through the Governor's office to appropriate state and federal agencies and to Iowa's Congressional delegation.

Environmental Concerns of Increasing Waterways Systems

There is a need to document the adverse environmental effects of increased traffic. For example, the detrimental effects of increased channel usage on aquatic life due to pollutants may be less than previously believed because of aeration resulting from barge movement, and the fact that many pollution problems may have been caused by industrial wastes that are now being treated before discharge to the river. Any decision to support or oppose a project that might increase traffic should be based on both sound environmental and economic considerations.

Terminal and Fleeting Areas

Mississippi River commerce projections indicate a need for improved harbor facilities and fleeting areas. The Iowa Department of Transportation recognizes the need to assist local, private, and governmental organizations in formulating plans for ports, terminals, and other river related facilities which should reduce overall shipping costs. The criteria for selecting port development areas include: 1) Present economic effect on the area, 2) accessibility to supporting transportation systems, 3) efforts already undertaken in attaining financing of viability studies, 4) environmental impact, and 5) physical characteristics of the river.

Adequate fleeting areas and terminals are important to commercial navigation; hopefully, with proper planning, new facilities can be accommodated. One alternative is to keep certain areas free for commercial development and retain others for recreational and fish and wildlife purposes. Another alternative is to make a coordinated effort to shift non-river businesses from

FIGURE 9-1 Locks and Dams on Upper Mississippi River

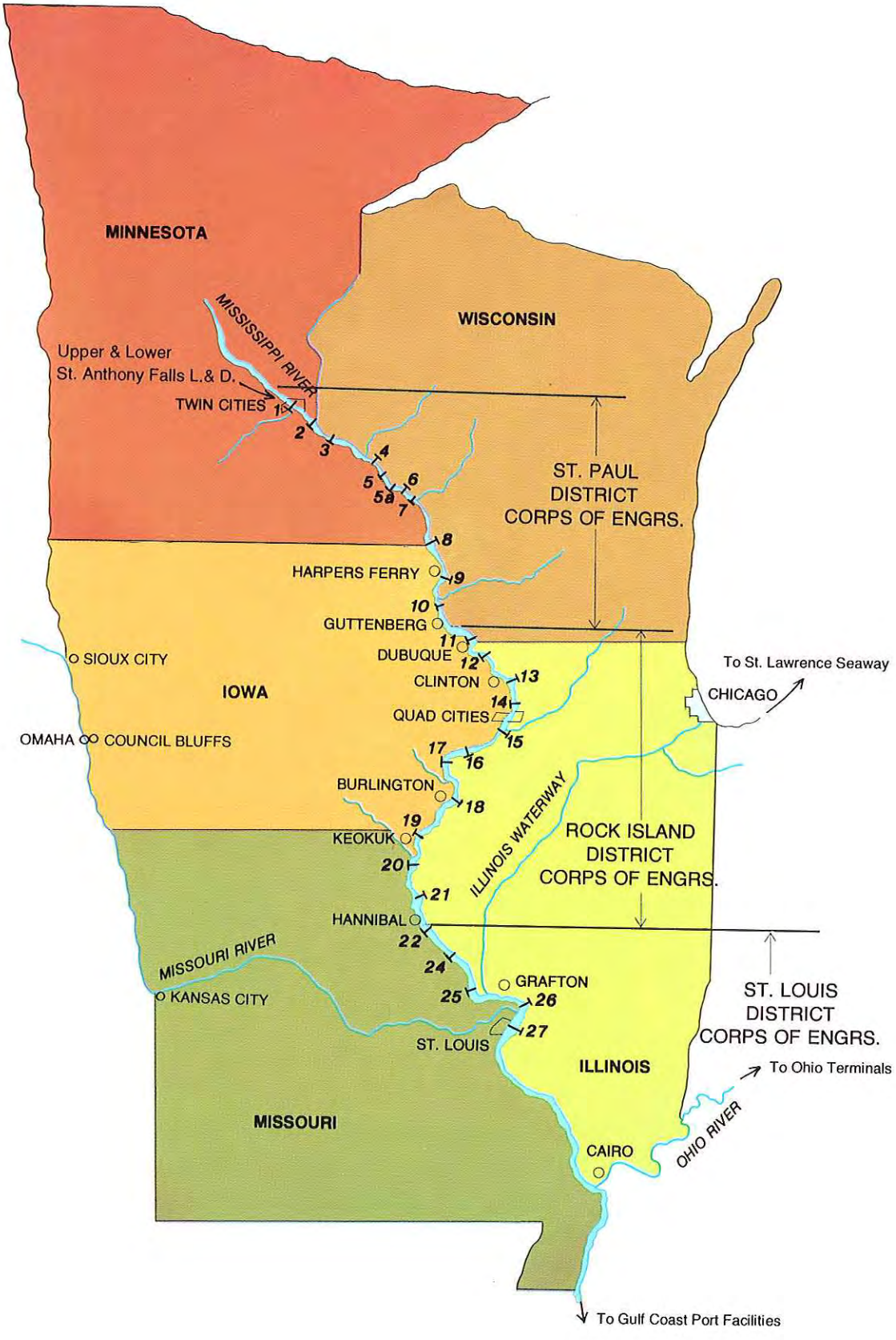
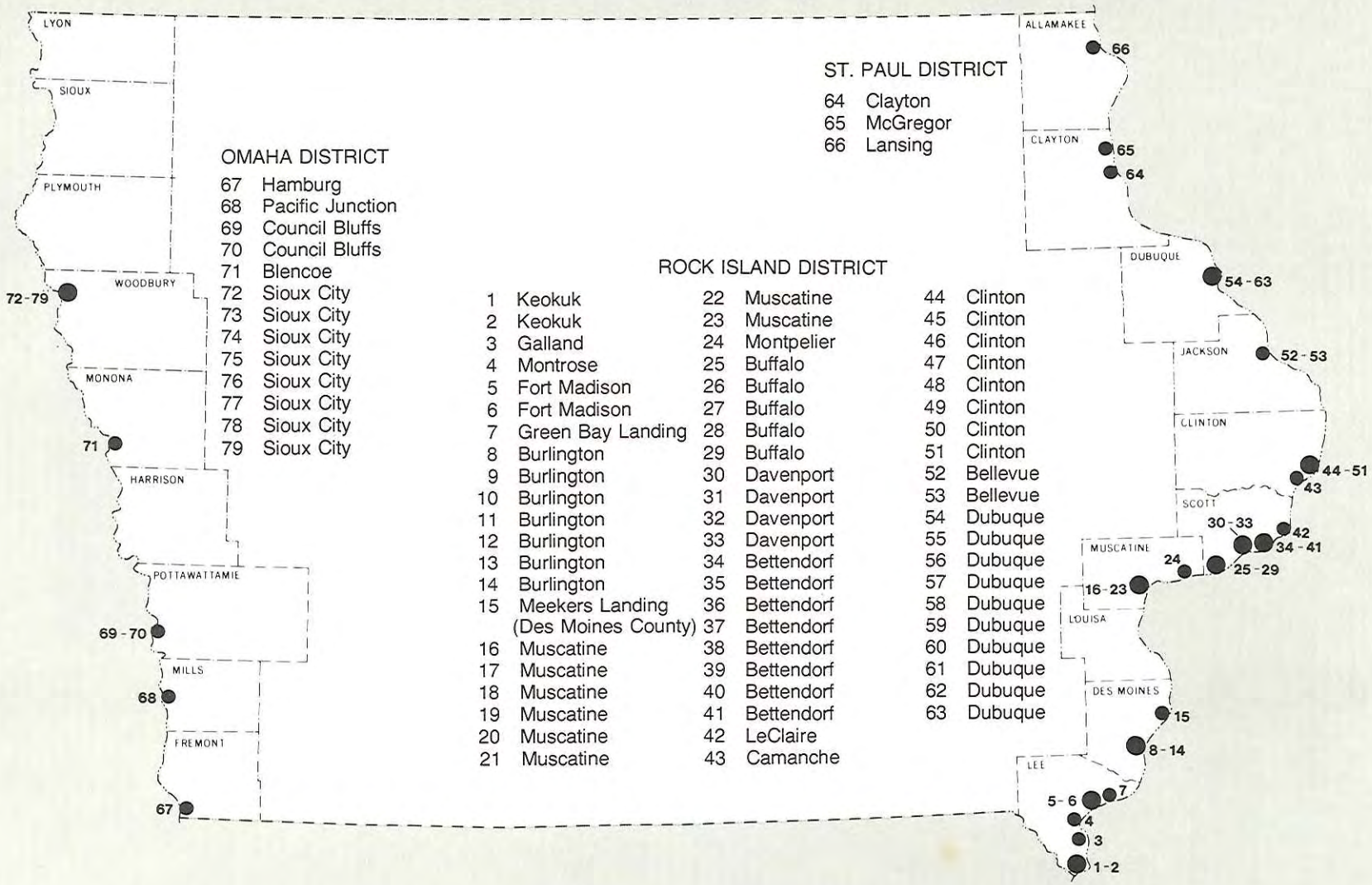


FIGURE 9-2 Location of the Barge Terminals Along the Border Streams



OMAHA DISTRICT

67 Hamburg
68 Pacific Junction
69 Council Bluffs
70 Council Bluffs
71 Blencoe
72 Sioux City
73 Sioux City
74 Sioux City
75 Sioux City
76 Sioux City
77 Sioux City
78 Sioux City
79 Sioux City

ST. PAUL DISTRICT

64 Clayton
65 McGregor
66 Lansing

ROCK ISLAND DISTRICT

1 Keokuk
2 Keokuk
3 Galland
4 Montrose
5 Fort Madison
6 Fort Madison
7 Green Bay Landing
8 Burlington
9 Burlington
10 Burlington
11 Burlington
12 Burlington
13 Burlington
14 Burlington
15 Meekers Landing (Des Moines County)
16 Muscatine
17 Muscatine
18 Muscatine
19 Muscatine
20 Muscatine
21 Muscatine
22 Muscatine
23 Muscatine
24 Montpelier
25 Buffalo
26 Buffalo
27 Buffalo
28 Buffalo
29 Buffalo
30 Davenport
31 Davenport
32 Davenport
33 Davenport
34 Bettendorf
35 Bettendorf
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39 Bettendorf
40 Bettendorf
41 Bettendorf
42 LeClaire
43 Camanche
44 Clinton
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FIGURE 9-3 Mississippi River Access Areas

	Map No.	Name of Area	Public Access	Private Access
ALLAMAKEE COUNTY	1	New Albin	●	
	2	Lansing Harbor		●
	3	Sweeney's Livery		●
	4	Public Ramp	●	
	5	Verdon's Boat Rental		●
	6	S & S Rentals		●
	7	Water Patrol Station	●	
	8	Babes		●
	9	Delphey's Marina		●
	10	Riverview		●
	11	Doc's Dok		●
	12	Boardman Marina		●
	13	Taylors		●
	14	Wine's Cabins		●
	15	Hartman's		●
	16	Nobles Island	●	
CLAYTON COUNTY	1	Marquette Dock		●
	2	Marquette Ramp	●	
	3	Pink Elephant		●
	4	Boatels		●
	5	Mississippi Marina		●
	6	McGregor City Ramp	●	
	7	Art's Landing		●
	8	Sny Magill	●	
	9	Public Ramp	●	
	10	Bill's Landing		●
	11	Public Ramps (2)	●	
	12	Winegar's		●
	13	Fisheries Man. Station	●	
	14	Kenney's		●
	15	Benskin		●
	16	Camp Hide-A-Way		●
	17	Earthhams		●
DUBUQUE COUNTY	1	Anthonys—Wahpeton		●
	2	Finleys Landing	●	
	3	Mud Lake	●	
	4	Dubuque Dock Comm.	●	
	5	Dubuque Marina		●
	6	River View Park	●	
	7	Massey Slough	●	
	8	Nita-Ho Valley		●
JACKSON COUNTY	1	Spruce Creek Harbor	●	
	2	Doc's Marina		●
	3	Ike's Landing	●	
	4	Bellevue	●	
	5	Point Pleasant	●	
	6	Shady Haven		●
	7	Waters Station	●	
	8	Pleasant Creek	●	
	9	Fish Lane Landing	●	
	10	Ditch Landing	●	
	11	Smith Creek Landing	●	
	12	Pipeline Landing	●	
	13	Esmay Slough	●	
	14	Sabula Public Use	●	
	15	Ehis Harbor		●
	16	Lower Sabula	●	

	Map No.	Name of Area	Public Access	Private Access
CLINTON COUNTY	1	Bulger's Hollow	●	
	2	Boyd's Marina		●
	3	Clinton Mun. Boat Ramp	●	
	4	Stan's Marina		●
	5	Latika Marina		●
	6	Riverview	●	
	7	Anchorage	●	
	8	Clinton Mun. Boat Ramp	●	
	9	Camanche Harbor		●
	10	Camanche	●	
	11	Rock Creek	●	
	12	Hansen's Dock	●	
SCOTT COUNTY	1	State Conservation Com.	●	
	2	Al's Boat Dock		●
	3	Princeton Public Area	●	
	4	LeClaire Legion		
	5	LeClaire Public Access	●	
	6	Green Gables		●
	7	Lock No. 14 Access	●	
	8	Bettendorf Access	●	
	9	Davenport Public Ramp	●	
	10	Credit Island	●	
	11	West Lake	●	
	12	Grantville Marina		●
	13	Buffalo Public Access	●	
	14	Buffalo Shores Access	●	
MUSCATINE COUNTY	1	Montpelier	●	
	2	Shady Creek	●	
	3	Fairport Landing		●
	4	Ikes	●	
	5	Water Patrol Station	●	
	6	Muscatine Boat Harbor		
	7	Muscatine Pow. Bt. Club		
	8	Muscatine Public Ramp	●	
LOUISA COUNTY	1	Kilpeck	●	
	2	Big Timber Access	●	
	3	Toolesboro	●	
	4	Ferry Landing	●	
DES MOINES COUNTY	1	Public Ramp (4th Pump. Sta.)	●	
	2	Coleman Marina		●
	3	Tama Beach	●	
	4	Meyers Marina		●
	5	Yetter Marina		●
	6	Burlingtong Boat Storage		●
	7	Municipal Dock (N.)	●	
	8	Municipal Dock (S.)	●	
	9	Cascade Boat Club		●
LEE COUNTY	1	River View Marina	●	
	2	Riverview Park	●	
	3	Keokuk Boat Launch	●	
	4	Langford's Marina	●	
	5	Keokuk Yacht Club		●
	6	Art's Gas Dock		●
	7	Keokuk Municipal	●	

riverfront land to provide those businesses needing terminal and fleeting space with river access or to shift this land into receational use.

User Fees

The National Water Commission pointed out that the present cost-sharing policy is one of the major deficiencies in the inland waterway program. Waterway improvements, operation, and maintenance costs traditionally have been borne by the Federal government. However, many people feel that the policy should be adjusted so those who directly benefit from low cost transportation facilities pay.

The Iowa Department of Transportation investigated the question of user fees. They reviewed the Corps of Engineers accounting records to determine the costs of operating and maintaining a 300-mile section of the Mississippi River. The DOT analyzed the accounts and separated costs into channel and lock maintenance components. They concluded that a system of user charges based on a fuel tax and locking fee, computed from actual Corps data, is realistic.

There is some real concern over the possible adverse effects of a user charge on Iowa. The Iowa Development Commission feels that a user charge should be opposed because it might increase barge rates. Higher transportation rates may be reflected in lower crop prices and higher fertilizer costs to Iowa farmers. Higher coal, oil, and utility prices also may be experienced. A balanced transportation system including associated, equitable rate schedules and/or appropriate user fees for all modes is needed.

Any decision on user fees for navigation will ultimately be made by the United States Congress. Studies, like the Iowa Department of Transportation's, will provide the information necessary to make an informed decision.

River Tolerance Index

To assist in managing our rivers and related resources, the feasibility of developing a simulation model should be investigated. Such a model would continually examine the rivers' numerous uses, their interaction, and their effects. The system could consider levels of commercial and recreational traffic, other beneficial uses of water, air and water quality standards, and economic factors, such as costs of lock delays for commercial tows. This would permit a river tolerance index to be assigned to a specific reach, as an indication of the amount of commercial and recreational navigation growth that could be allowed if selected environmental impact levels are not to be exceeded. The Department of Transportation envisions that this system would alert Iowa to potential river navigation and environmental problems and conflicts.

Recreational Use

The Mississippi River is probably Iowa's single largest water oriented recreational asset. In 1976, over 11 million user days were recorded in the 11 pools that border Iowa. Pool No. 13 in the Clinton-Quad Cities area experienced the heaviest use pressure in 1976 with more than three million user days. Previous to 1976, Pool No. 19 in the Burlington-Ft. Madison-Keokuk area experienced

TABLE 9-1 Summary of Barge Commodity Transport, 1955-1975, Rock Island District

Year	Coal	Petroleum	Grain	All Others	Total
1955	2,161,943	2,800,230	1,248,541	1,513,131	7,723,845
1960	3,542,159	3,021,800	2,235,042	1,764,535	10,653,536
1965	4,606,210	2,720,880	4,907,250	2,128,265	14,362,605
1970	6,401,355	2,708,721	9,022,300	4,278,094	22,410,470
1975	4,932,500	2,100,053	12,054,324	5,418,246	24,505,123

TABLE 9-2 Summary of Barge Commodity Transport, 1975, Mississippi River Volume and Distribution at Iowa's Barge Terminals

	VOLUME		DISTRIBUTION (%)		
COMMODITY	Tons	Percentage Of River Movement	Transported By Truck	Transported By Rail	Produced or Consumed at Terminal
Grain	4,135,500	48	79.7	20.0	0.3
Coal	1,225,000	14	3.7	0	96.3
Petroleum	1,076,400	13	96.2	0	3.8
Other	2,116,500	25	58.0	11.0	31.0
TOTAL	**8,553,400**	**100**	**65.5**	**12.4**	**22.1**

the heaviest use pressure of all Iowa pools. The pools with the least use were numbers 10 and 15, the latter being in the heavily industrialized Quad City vicinity.

Besides supporting heavy use for recreational boating, the river attracts many other outdoor enthusiasts. Camping was the favorite activity of most (55 percent) of the users. Fishing (50 percent) was the second most participated-in activity, and boating and waterskiing were third (32 percent). Minor activites include picnicking, swimming, sightseeing, and both waterfowl and wildlife hunting.

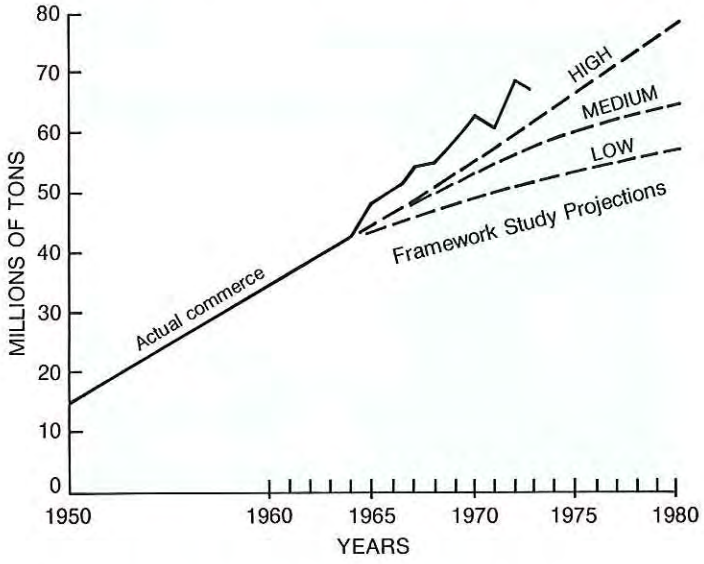
A Corps of Engineers' survey showed that 45 percent of the users travel less than 25 miles to use a pool; 15 percent travel between 26 and 50 miles. According to the 1970 Participation Survey of Iowans, 55 percent of the people boating on the Mississippi River are on their vacations, while 40 percent are on a 1-day outing and about 5 percent are on an overnight trip.

In 1976, 57,000 pleasure craft locked through the 11 locks which border Iowa, which is 32 percent of the total lockages. Lockage trends are not well established for the entire river or at individual facilities. Lack of established trends probably indicate a number of factors are involved in determining recreation lockage. Over two-fifths of all recreation craft using the locks are of the runabout class; about one-third are some type of cruiser with overnight facilities; and nearly 16 percent are of the houseboat class. Few fishing boats (3 percent) are presently using the locks; most put in at a local access and fish within that specific pool.

Prospective Traffic

The vast recreation boating potential (184,410 acres along Iowa's eastern border) of the Mississippi must be shared with residents of the bordering states. Projections of the demand for both Iowa and the total region are shown in Figure 9-5. Iowans represent approximately 39 percent of the total boating demand. On a peak day in 1975, Iowans needed between 30 and 62 thousand acres for boating on the Mississippi River. The total region's demand for boating acres could equal the supply by 1979, according to GREAT space standards. If the Iowa

FIGURE 9-4 Total Waterborne Commerce—Upper Mississippi River



Source: Upper Mississippi River Basin Commission. 1975. Decision Oriented Information Base, p. 45.

Commodity	1960-64 Average	1980 High	2000 High	2020 High
Selected Grains	10.1	25.0	45.0	75.0
Bituminous Coal	6.3	10.5	13.5	15.0
Petroleum and Petroleum Products	11.6	10.7	19.3	28.7
Cement, Stone, Sand and Gravel	4.2	7.6	11.2	13.9
Industrial Chemicals and Sulphur	2.2	6.3	15.5	31.5
Agricultural Chemicals	1.2	8.0	17.5	28.0
Iron Ore and Iron and Steel	2.6	5.6	10.1	15.0
Other and Miscellaneous	2.0	4.3	7.9	12.9
Total	40.2	78.0	140.0	220.0

Source: U.S. Army Engineer Division, North Central, 1970. Upper Mississippi River Comprehensive Basin Study, Appendix J.

Conservation Commission (ICC) space standards are used, then the supply will not be fully utilized until after 2020. The realistic demand for boating acres will probably be somewhere between these two sets of projections. There undoubtedly will be tremendous pressure on specific segments of the river, especially those reaches of the river near urban areas.

Recreational Boating Access

The lack of adequate recreational access is creating a bottleneck in meeting increased boating demand. The river manager can either distribute use by providing more access points or by enlarging and improving existing access sites. The ICC is looking toward the provisions of a combination of high-density and low-density recreational use which would be located near urban areas and would be designed to accommodate high-use pressure while the more environmentally fragile areas would be designed to accommodate only limited use.

Private boating sites (access ramps, harbors, marinas, etc.) open for public use should be encouraged to meet a portion of the demand. But, private development should be coordinated with a total resource management plan so as to protect environmentally fragile areas. These private operations provide both a service to the recreational user and income to the state in the form of taxes. Small Business Administration loans, guidance and informational services from public recreation agencies,and prudent business management techniques are methods to increase the viability of private operations. The public sector must thoroughly explore the implications of the expansion of public facilities and not jeopardize a viable private operation that is currently serving access needs in a satisfactory manner.

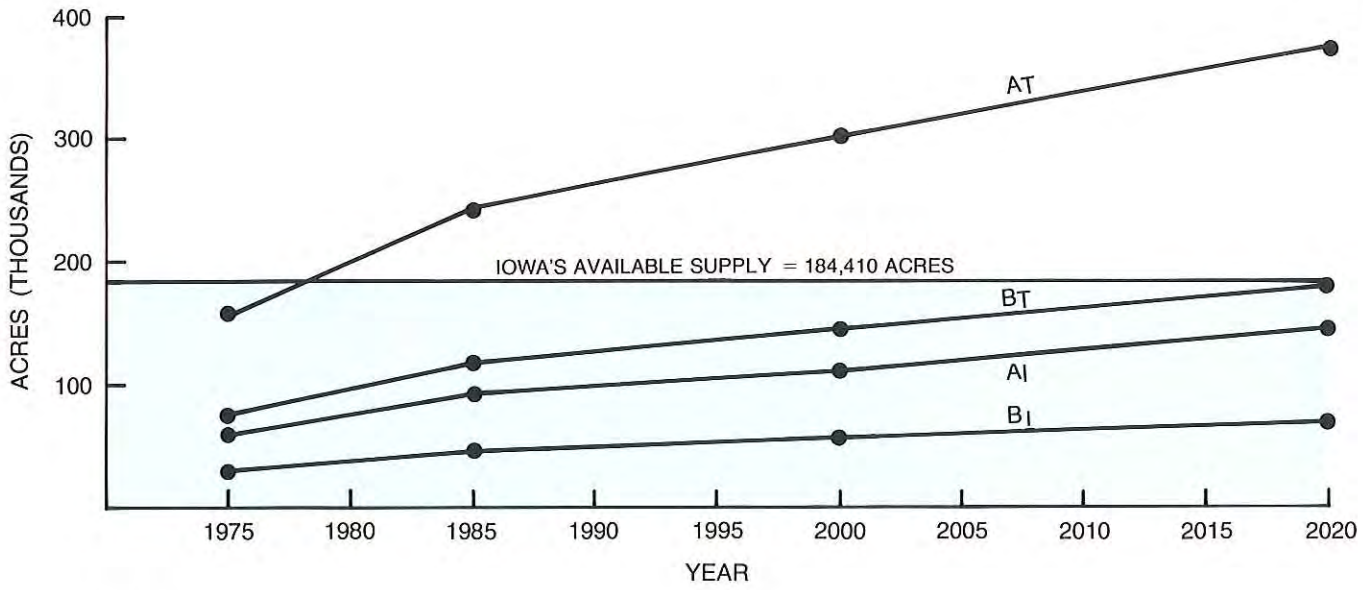
Navigation and Recreational Boating Support Facilities

Another public need is for a system of sanitary sewage dumping stations, for both commercial and recreational traffic along the river. Currently, there is a definite lack of dumping stations which encourages dumping of wastes in the river. The Corps of Engineers' authorization does not include recreation enhancement solely for recreational needs. This prevents it from doing certain activities solely for recreation. Its authorization should be expanded to include recreation enhancement such as replenishing beaches, active management of recreation sites, dredging access sites, and side-channel openings for recreational boating and for enhancing the fisheries of backwater areas.

Commercial-Recreational Conflicts

Direct conflicts between recreational and commercial vehicles are not presently a serious problem on the Upper Mississippi River. Because the navigational pools are large and sufficient, water is available for recreational

FIGURE 9-5 Projected Demand for Boating on the Mississippi River



KEY

- A_T Total Demand Based on Great River Environmental Team's Outdoor Recreation Space Standards
- B_T Total Demand Based on Iowa Conservation Commission's Outdoor Recreation Space Standards
- A_I Iowa's Demand Based on Great River Environmental Action Team's Outdoor Recreation Space Standards
- B_I Iowa's Demand Based on Iowa Conservation Commission's Space Standards

Note: Total Demand is based on U.S. Army Corp of Engineers Statistics and includes recreational boaters from the entire region. Iowa's demand is based on Iowa Conservation Commission Survey of recreational use by Iowans.

boating outside of the main channel marked for commercial barge traffic. The one area on each pool where this does not hold true is near the locking facility at each dam. All traffic locking through is funneled into a confined area where maneuvering time and space are limited. The recreational boat must respect the operational requirements of the cumbersome commercial tows. In turn, the tows must respect the prime recreational use areas and operate their craft in a safe and prudent manner.

The respect for smooth traffic flows derives from experience on the river. A void exists for the novice to the river. This knowledge can best be disseminated to the recreationalist through education. Some states are now implementing mandatory boat operator's safety certification for boat operation within their state. Iowa should investigate these programs and develop a mandatory boat operator's safety certification to address these educational needs for safe boating operation.

A Congressional Resolution adopted April, 1974, authorized the Upper Mississippi River Recreational Craft Locks Study to explore this conflict and recommend alternative modes of providing pool-to-pool access for recreation boats. Both structural and nonstructural alternatives will be considered in providing more efficient lockages. The lack of established trends indicates that a number of factors affect recreation lockage on the Upper Mississippi River. Each pool and each lock and dam have a specific character that calls for individual solutions.

Conclusions and Recommendations

The Future of Commercial Navigation

Conclusions

Using water transportation to move bulk commodities benefits Iowa. River transport is particularly beneficial for hauling grain, petroleum, coal, and other bulk commodities. However, river transport must mesh with other modes. The Iowa Department of Transportation's goal is a balanced transportation system, using the best advantages of rail, highway, water, air, and pipelines. It must be recognized that the Mississippi River is a multi-purpose river, interstate in character, and serves many people in many ways. The feasibility of developing a simulation model to examine the interaction and effects of the river's numerous uses should be investigated.

Recommendations

Iowa should continue to depend on the Federal Government to finance the maintenance of the navigation routes on the Mississippi River. These routes include both the Upper and Lower Mississippi River and the interconnected waterways leading to the Great Lakes, the Ohio River, and other tributary streams, and to the

Channel stabilization on the Missouri River *Corps of Engineers*

Towboat and barges, Mississippi River *Iowa Development Commission*

intra-coastal waterway system. In Iowa, a reasonable, coordinated interagency approach to planning should be supported. All agencies concerned with water and related resources must be actively represented in all regional planning efforts affecting the state. Iowa agencies, with interagency framework, should consider and evaluate all Federal proposals so the state's interests are cared for.

The Iowa Department of Transportation should develop a river tolerance index to assist in managing the river and related resources. This index should serve as a guide in solving conflicts and establishing planning priorities.

Twelve-Foot Channel

Conclusion

The Corps' 1973 12-foot channel study concluded that the costs of a 12-foot channel on the Mississippi River upstream of Grafton, Illinois, would exceed the benefits based upon current traffic projections. The study recommended there be no further study of a 12-foot channel at this time, and that the 9-foot navigation channel be continued.

Recommendation

Due to the tremendous and unassessed environmental impact and the unsound economics of a 12-foot channel on the Upper Mississippi, Iowa should oppose any proposal to increase the channel depth from 9 to 12 feet on the Upper Mississippi River. The state should continue to lend its support to the maintenance of the 9-foot channel, by the Federal Government. Maintenance should include the replacement of specific locks and dams when physical conditions indicate they have aged and deteriorated beyond normal repair capability. Also, replacement should be carried out only after comprehensive analysis is made of all needs and problems associated with that facility.

Extended Navigation Season

Conclusions

The U.S. Army Corps of Engineers' Phase I report on navigation concluded in September, 1973, that an extension of the navigation season to 52 weeks to Burlington, Iowa and 40 weeks to Cassville, Wisconsin warranted further study. The Corps has reactivated the year-round navigation study and is using the Phase I report as their starting point. Their current work effort will concentrate on environmental concerns that cannot be answered with existing information. There are problems associated with winter navigation related to both the natural ecosystems and to the activities of man. During winter, ice jams can cause water level fluctuations which might freeze furbearers out of their dens or block the head of a slough causing deoxygenation. Year-round navigation would mean an open channel which would prohibit the movement of wildlife across natural ice bridges. The commercial and recreational fisherman could, moreover, experience unsafe shelf ice and limited access to some areas.

Recommendation

There are some serious, unanswered environmental and engineering questions about extending the navigation season; therefore, Iowa should insist that the environmental and economic impacts be carefully evaluated and reviewed before the proposed extensions are presented to the state for its approval.

Channel Maintenance

Conclusions

Dredging is necessary to maintain adequate depths for navigation. The dredged material disposal sites created by the placement of dredged material consist of more than 95 percent sand from some of the most widely used recreation areas along the shores of the Upper Mississippi River. Recently, dredging and dredged material disposal practices have been criticized because of their adverse effect on the surrounding natural environment. The loss of productive fish and wildlife habitat can be partially attributed both to the effects of initial dredge material placement and to indirect effects resulting from secondary movement of the material causing sedimentation of the backwater sloughs and wildlife areas. Currently, the Corps cannot consider recreation or fish and wildlife enhancement as a project purpose. Getting this authorization would allow the Corps to consider the recreation potential of dredged material disposal sites and also give them the responsibility for protecting and improving fish and wildlife habitat.

The Great River Environment Action Team (GREAT) is developing a plan to help maintain the river's future multi-purpose qualities. One of the major objectives of the study is to minimize the impacts of navigation channel maintenance on the resources of the Mississippi River. Recommendations for upcoming dredging seasons are developed by the team. These recommendations are then approved by the Upper Mississippi River Basin Commission and sent to the appropriate Army Corps District Engineer for consideration and implementation.

Recommendation

A program for achieving improved dredging and dredge disposal practices should be developed so that a nine-foot channel depth can be maintained while minimizing adverse environmental impacts. Iowa should support and encourage the U.S. Coast Guard efforts to shift markers to allow the navigation channel to shift naturally. Iowa should insist that the U.S. Army Corps of Engineers dredge according to GREAT's recommendations, wherever and whenever possible. The state's resource agencies should expand their participation in GREAT so that GREAT's results will better reflect Iowa's interest. Cities and counties located along the river and the public in general should be encouraged to become involved in GREAT. Iowa should push to get the Corps' authorization changed so that recreation and fish and wildlife enhancement also become project purposes.

Resource Use

Conclusions

Future projections of commerce on the Mississippi River waterway system indicate improved harbor and fleeting areas will be needed. However, there are concerns over the adverse effects to fish and wildlife and to the visual appreciation of the river.

Wise land use would prohibit use of the corridor, especially the portion susceptible to flooding, for non-compatible development. Land use regulations may minimize one person's adverse impact on another. Key recreation, fish and wildlife areas should be acquired, but Iowa will have to depend on land use regulations to protect the open space views for the major portion along the river.

Recommendations

An overall total river development plan is needed. This would include identifying sites suitable for fleeting areas and terminal development ahead of time and incorporating them into a total river development plan so that site selection and review will not be on a piecemeal basis.

Powered houseboat on Mississippi River, Lansing *J. Sherman*

One alternative to the problem of increased riverfront development that should be explored is to shift nonriver business from riverfront land to provide those businesses needing terminal and fleeting space with river access.

As part of developing a detailed plan, the state should conduct a resource analysis of the Mississippi River Corridor. This would include identification of such things as fragile environmental areas, and other areas that can accommodate certain types and degrees of development. With this type of information available, the state would be able to take the lead in developing and implementing an overall river plan to guide the growth, use, and development of the river corridor. Land use regulations will have to be an integral part of such a plan.

The feasibility of developing a simulation model (as explained previously) that would continually examine the numerous uses of the river, their interaction, and their effects, needs to be investigated in the immediate future. Its implementation is considered to be a key part of developing a river plan for the future.

Recreation Boating Access

Conclusions

Many areas along the Mississippi River have the capacity for absorbing large amounts of increased recreational activity. The vast expanses of public land and water join to form the basis for those activities. Currently, the problem of failing to meet a portion of the increased water-based recreation demands is attributed to the lack of access and supportive parking areas. Much of the projected increase for boating and recreation activities can be accommodated with renovation and expansion of existing access areas. The expansion and renovation of the public areas may be more easily accomplished than improving the private sector facilities due to the fact that no operational profit must be realized to construct the facility. But, it must be recognized that the private sector provides both a service to the public and income to the state in the form of taxes. The public sector should not expand into areas where there is a viable private operation serving public access needs.

Recommendations

An access development program is needed, beginning with studies to show where new access sites are needed and where existing sites should be expanded or renovated.

Encouragement in the form of guidance and information from the Iowa Conservation Commission, and financial assistance from the Small Business Administration (SBA) program, should be provided to the private sector for promoting private recreational development along the Mississippi River.

Recreational Boating Support Facilities

Conclusion

Along the Mississippi River, adequate facilities are deficient at many boating access sites. Adequate facilities make the recreational experience more enjoyable. These support facilities include camping, picnicking, sanitation areas (pump-out stations), potable water, and trash collection points. This type of recreational development would be practical where access is available for a maintenance vehicle. The Corps of Engineer's authority to actively manage recreational areas and provide facilities is limited. It can only provide a 50-50 cost share if a project is sponsored by a state or local agency. This does not include any funds for operation and maintenance which is the responsibility of the sponsoring agency.

Recommendation

The state should give high priority to providing improved access with adequate support facilities above Locks Nos. 9 and 13 and below Lock and Dam No. 10. Recreational facilities are deficient and should be provided in Pools 9, mid-10, near Clinton, near Davenport, below Muscatine, in Pool 18, and in Pool 19. A system of sanitary sewage dumping stations are needed for both commercial and recreational traffic along the entire river. Also, the state should recommend to Congress that the Corps of Engineers be given the authority to provide recreation enhancement such as replenishing beaches, active management and maintenance of recreation sites, dredging access sites, and opening of side channels for recreation boating and habitat restoration.

Commercial-Recreation Conflict

Conclusions

The size of the river makes it a place where all can navigate in relative safety. The towboats run only in the deep water channel while the recreational boater has water available outside of the marked channel. Congestion which causes delays in locking is the major conflict between recreation and commercial boats. Delays cause lost time and unsafe boating conditions. Most of the problems result from poor communication, inexperienced boaters, excessive drinking, and poor or non-existent tie-up facilities. The Recreational Craft Locks Study by the Corps of Engineers is to determine where an independent means of moving recreational boats from pool to pool is desired, needed, and can be justified.

Canoeing on the Upper Iowa River
Iowa Conservation Commission

Recommendations

The state should cooperate in the Recreation Crafts Locks Study and should support reasonable alternatives for each pool.

The state should develop a mandatory boating certification program that addresses the educational needs for safe boating operation. This program would particularly apply to the border streams, but is also needed statewide. The state needs more Water Officers to provide better patrol, enforcement, assistance, and public relations for the Mississippi River.

The Missouri River
The Resource

The Missouri River Stabilization and Navigation Project, authorized by the River and Harbor Act of 1945, provides for a continuous nine-foot navigation channel, 300 feet wide, from Sioux City, Iowa, to its confluence with the Mississippi. This is a distance of 735 miles, 179 miles of which are along the western boundary of Iowa (approximately 14,000 surface water acres). This project is an open river regulation project which uses the energy of the flowing water to maintain the channel in an alignment fixed by means of dikes and revetments. With the river banks permanently secured in the desired alignment, the scouring action of the flowing water on the riverbed rather than on the banks is expected to maintain the desired channel width and depth. The main stem dams on the Missouri River are part of the total system, providing as part of the multipurpose benefits the provision for maintaining navigational flows by water releases from the six main stem reservoirs in Montana, North Dakota, South Dakota, and Nebraska.

In addition to providing for navigation, this project was designed to stop bank erosion and meandering. The completed stabilization works will prevent the annual destruction of more than 9,000 acres of farmland and eventually will open up an additional 188,000 acres of new land to agriculture. The project has also provided flood protection to urban communities. The economic value of the land adjoining the river has increased as a result of the project, thus, gaining tax revenues for local governments.

Unfortunately, these construction efforts to provide a nine-foot navigation channel have left the Missouri River with about half of its original water surface and half of the mixture of aquatic and wildlife habitats it once contained. Within Iowa, the length of the river has been reduced 35 miles since stabilization and navigation work was begun. The average current velocities of three to six feet per second make the river treacherous for boating, swimming, and water-skiing. The project has created a bottom of fine shifting sand which leaves the habitat impoverished; few feed resources other than microinvertebrate drift remain. The most fertile areas for fishing now occur near the tips of the channel dikes where deep eddies and adjacent shallow water form resting and feeding areas for fish. This project has resulted in the riverbed degrading anywhere from two to six feet from Sioux City to Council Bluffs, causing many problems with low water levels in the oxbow lakes and damage to foundations of bridges.

FIGURE 9-6 Missouri River Access Areas

County	Map No.	Name of Area	State Access	County Access	Private Access
FREMONT		None			
MILLS		None			
POTTAWATTAMIE	1	Longs Landing		●	
	2	Wilson Island	●		
HARRISON	1	Western Iowa Fish & Wildlife Club			●
	2	Tyson Bend	●		
	3	Remington Boat Launch		●	
	4	Little Sioux Delta	●		
	5	Deer Island	●		
MONONA	1	Huff Access		●	
	2	Middle Decatur Bend		●	
	3	Louisville Bend	●		
	4	Sunset Island	●		
	5	Lighthouse Marina			●
WOODBURY	1	Synder Bend		●	
	2	Weedland Access	●		
	3	Chris Larsen, Jr. Marina			●
	4	Sioux City Boat Club			●
PLYMOUTH	1	Millsite Access	●		
	2	Big Sioux Park		●	

TABLE 9-3 Missouri River Navigation and Bank Stabilization Project Freight Traffic for Selected Years, 1955-1974 (1,000's of short tons)

Code	Commodity Group	1955	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
01	Farm Products	121.2	1,150.6	1,399.9	1,670.8	1,553.1	1,145.6	857.0	1,059.0	1,247.9	1,115.2	816.5	1,215.4
	Corn	12.7	59.5	107.1	79.9	55.7	3.4	104.7	143.8	83.8	21.7	230.4	313.5
	Wheat	90.2	649.1	929.3	1,154.5	1,103.8	801.7	510.4	669.0	885.9	764.6	452.4	761.7
	Sorghum Grains	1.5	216.9	83.7	247.8	344.8	274.9	162.8	33.0	119.5	233.5	0	6.7
14	Nonmetallic Minerals	417.5	1,487.2	2,585.1	2,181.8	2,400.7	2,930.3	3,199.1	2,869.5	2,990.4	2,544.1	2,911.7	3,430.2
20	Molasses and Kindred	74.7	46.2	295.3	270.3	291.5	350.4	332.2	370.3	474.0	482.0	253.3	429.0
	Food	74.7	46.2	113.3	139.6	144.7	181.2	184.2	169.0	197.2	228.5	102.3	140.5
26	Pulp and Paper	0	0	2.4	5.2	6.2	8.2	13.8	16.7	15.4	18.4	5.0	6.2
28	Chemicals	1.4	29.4	79.8	167.1	254.8	347.2	432.1	526.2	586.3	491.5	307.6	452.7
29	Petroleum	7.6	17.2	119.8	106.7	103.3	69.2	46.9	50.4	59.3	78.0	78.6	83.6
32	Stone, Clay, and Glass	0	0	97.2	133.8	122.4	133.1	145.3	157.7	162.5	184.4	138.4	161.6
33	Primary Metals	188.8	164.0	58.5	90.5	80.4	62.3	70.9	57.8	79.3	46.6	52.7	55.8
41	Waterway Materials	2,290.7	4,045.8	3,005.5	3,312.8	1,836.5	1,660.0	1,880.8	2,377.2	1,855.9	2,178.2	1,802.0	1,831.1
	All Other Freight	37.8	8.5	82.3	9.2	10.3	18.2	23.1	34.4	12.6	44.3	4.9	7.3
	TOTAL	**3,139.7**	**6,948.9**	**7,725.9**	**7,948.2**	**6,659.2**	**6,724.6**	**7,001.1**	**7,519.2**	**7,483.7**	**7,182.8**	**6,370.8**	**7,673.1**
	Total without sand and gravel and waterway materials	**435.5**	**1,440.9**	**2,271.6**	**2,453.6**	**2,566.5**	**2,257.3**	**2,127.3**	**2,462.5**	**2,791.9**	**2,654.4**	**1,817.4**	**2,576.1**

Source: Waterborne Commercial Statistics, various years.

The Fish and Wildlife Coordination Act of 1958 and Section 207 of the Flood Control Act of 1962 authorized the Corps of Engineers to plan and develop recreation areas and access points. Recreation development in Iowa has been proposed at eight public use areas, three of which have been completed, on a cost-sharing basis. There are 14 public boating access sites along Iowa's 179 Missouri River miles (Figure 9-6).

Grain and fertilizer products are the principal commodities shipped and received at Iowa barge terminals along the Missouri River. Most of the grain is exported to New Orleans while fertilizer products are imported. During 1975, seven barge terminals operated along Iowa's western border; six of these are located in Council Bluffs and Sioux City.

Resource Considerations and Problems

Commercial Use

Navigation on the Missouri is still in its infancy as compared to other inland waterways. In 1974, traffic generated by the Missouri River accounted for only 2.3 percent of the total tonnage on the Mississippi River system.

Table 9-3 summarizes all water borne traffic movement on the Missouri River for selected years between 1955 and 1974. While navigation was available west of Kansas City by 1955, it was 1965 before traffic achieved full initial development. Farm products are the most important in terms of tonnages; however, the overall pattern shows little, if any, change suggestive of growth. The most notable characteristic is the easily apparent wide variety of change in the historical record. In 1972, corn shipments totaled only 21.7 thousand tons but two years later, they reached 313.5 thousand tons. More than a million tons of wheat were shipped in 1966 and 1967 compared to only 450 thousand tons in 1973.

The reasons for these variations may, in large part, be due to forces external to the transportation savings available on the water. This would include price shifts, production levels, shifts in domestic and export demands, and changes in costs of alternative modes of transportation.

In 1975, 306,600 tons of freight were handled at Iowa barge terminals along the Missouri, which was only 3.5 percent of the total handled at all Iowa barge terminals (Table 9-4). The largest percentage (88.4 percent) of the total volume shipped by barge along the Missouri is transported to the river by truck while the remaining volume (11.4 percent) is transported by rail.

On a ton-mile basis, approximately 71 percent of the movement takes place between Kansas City and the mouth, 26 percent between Kansas City and Omaha, and 3 percent between Sioux City and Omaha. The low ton miles of movements along Iowa is due to the short haul between Sioux City and Omaha. In 1977, this segment handled 15.8 percent of the Missouri River tonnages.

Prospective Traffic

The Missouri River Basin Commission points out that long-range projects on this waterway are risky and subject to considerable change as the future unfolds.

A consulting report, prepared for the Corps of Engineers, reviewed all the previous shipment projections to determine their accuracy. While each set of projections used different methodologies and historical data bases, they all exhibit a bias toward change and growth which is inherent in any projection effort. It is doubtful that any of the techniques used could have been made sufficiently sensitive to incorporate those factors that have, in reality, resulted in an overall limited growth record over the past 10 years.

The study came up with two alternatives that they consider as a reasonable basis for future economic estimates. Table 9-5 displays the projection for 1985 for each scenario by major commodity groups. The "No Growth" alternative is projected to be 2.67 million tons while the "Constant Share" alternative is projected to be 3.61 million tons annually. The Iowa DOT supports the "Constant Share" scenario as the most likely projection. The Missouri River Basin Commission projects a growth of over five million tons by year 2000. The problem is that industry has not yet fully utilized the present capacity of the system.

Water Use-Main Stem Reservoirs

In the future (it is not known when), the capacity of the system may be reduced because upstream water demands from the main stem reservoirs will deplete downstream releases. The Missouri River Basin Commission has stated that increased industrial and agricultural use of water from the upstream reservoirs could adversely affect downstream water users and shorten the navigation season. The state of Iowa should maintain a strong interest in the allocation of the water resources of the Missouri River Basin so that the state receives its proportionate share for its own water supply needs and instream uses.

Dredging

Dredging of the navigation channel may have adverse

TABLE 9-4 1974 and 1975 Tonnage Through All Iowa Barge Terminals Located Along the Missouri River

YEAR	COMMODITIES (TONS)				ORIGINATE (TONS)	TERMINATE (TONS)	TOTAL (TONS)
	GRAIN	COAL	PETROLEUM	OTHER			
1974	207,778	0	8,000	172,274	226,066	161,986	388,052
1975	78,405	0	0	228,200	104,366	202,239	306,605
± % Change	-62.3%	0.0%	-100.0%	+32.5%	-53.8%	+24.9%	-21.0%

Source: Iowa Department of Transportation. Iowa Barge Terminal Study, 1975, p. 15.

TABLE 9-5 Missouri River Navigation and Bank Stabilization Project Projected 1985 Commodity Flows (1,000 tons)

Code	Commodity Group	"No Growth"	"Constant Share"
01	Farm products	1190	1540
14	Non-metallic minerals (other than sand & gravel)	175	220
20	Food and kindred	460	530
26	Pulp and paper	15	30
28	Chemicals	510	850
29	Petroleum	75	100
32	Stone, clay, and glass	170	210
33	Primary metals	60	100
	All other freight	20	30
	TOTAL	**2,675**	**3,610**

environmental effects; however, since 1964, all requirements for dredging have been below St. Joseph, Missouri. Thus, Iowa has not had to contend with dredging and dredge disposal problems along its western border.

Environmental Effects of the Missouri River Project

There are attempts being made to mitigate some of the environmental effects of the project. In 1975, both the Kansas City and Omaha District office of the Corps of Engineers initiated construction of notches in a number of existing dikes that will permit an amount of water to flow behind the dikes. The purpose of the openings is to reduce the adverse effects of reduced water surface area and to increase the diversity of aquatic habitat in the Missouri River. An interagency task force is monitoring the effects of this project.

Under the authority of the Fish and Wildlife Coordination Act of 1958, the Corps of Engineers has initiated an investigation of the fish and wildlife impact that has accrued since 1954 due to the construction of the bank stabilization and navigation project. Losses of recreation potential are not in the authorization. Also, degradation of the riverbed is not being considered because it was not in the authorization.

The Fish and Wildlife Service, in cooperation with the adjoining states' fish and wildlife agencies, is making a similar investigation and will furnish the Corps of Engineers with a report of their investigation and their recommendations for mitigative measures. The report of the Missouri River Division of the Corps is scheduled to be completed in 1978. It will be processed to Congress if the Corps' recommendations include the need for acquisition of lands, or to the Office of the Chief of Engineers if measures which do not require acquisition of additional land are recommended. The compensation efforts will concentrate on minimizing the adverse effects of reduced water surface, loss of diversity of aquatic habitat, and the loss of riverine vegetation.

According to the Iowa Governor's Inter-Agency Resources Council, the number one priority of Iowa is the initiation of the necessary hydrological modeling studies on the entire river to determine both the aggradation and degradation rates (future river hydrology) with a subsequent program for problem resolution, whether it be for allowing continued change, stabilizing change, or reversing the trends. The number two priority is the documentation of the natural resource losses (both land and water-oriented) to the states adjoining the river beginning with the earliest manipulations by the Corps of Engineers on the Missouri River. Iowa's Inter-Agency Resources Council strongly feels that unless the present study efforts on mitigation and the Metropolitan Sioux City and Missouri River Study include an interim report on degradation that it will be an inadequate effort and a disservice to the public. The study efforts spent on other elements may tend to be premature and possibly misdirected. The state's position on fish and wildlife losses and general mitigation efforts cannot be determined until the results of the degradation study are known.

TABLE 9-6 Missouri River Water-Related Recreation Demand (ASA 09) (100's of activity days)

Activity	1975	1985	2000
Camping	2,484.6	2,989.5	3,669.6
Picnicking	5,047.7	5,483.2	6,048.9
Fishing	2,693.8	2,829.1	3,083.1
Swimming	3,099.2	3,281.2	3,585.8
Power Boating	1,673.8	1,822.9	2,027.5
Water-Skiing	431.5	539.6	686.9
Canoeing and Sailing	—	—	—
TOTAL	**15,403.3**	**16,945.5**	**19,101.8**

Source: Missouri River Basin Commission. 1975. Water and Related Resources in the Missouri River Basin.

Recreational Use and Prospective Recreation Boat Traffic

The Missouri River Basin Commission has developed a set of recreation projections for Aggregated Sub Area-09 which is composed of 11 counties in Nebraska, five in Missouri, four in Kansas, and 22 in Iowa. This includes all counties along the state's western border except Lyon and Sioux. Demand projections for six recreational activities for the years 1975, 1985, and 2000 were estimated (Table 9-6).

In this area, picnicking was the most popular recreational activity in 1975 and it is projected to remain the most participated-in activity. In 1975, swimming was the second most popular activity along the Missouri and it was closely followed by fishing and camping. By 2000, days spent camping are projected to surpass days spent swimming. This demand pattern may reflect the actual recreational preferences of this geographic area, or it may only reflect the current availability of recreational opportunities, now limited for fishing, waterskiing, swimming, and camping.

Table 9-6 shows a demand increase of 48 percent for camping, 20 percent for picnicking, 14 percent for fishing, 16 percent for swimming, 21 percent for power-boating, and 59 percent for waterskiing from the year 1975 to 2000.

A 1975 Participation Survey of Iowans showed that Iowans enjoyed boating on the Missouri River 97,131 user days in 1975. Fishing was the second most popular water-oriented activity as Iowans spent 46,724 user days on the Missouri River in 1975. More than 16,000 Iowans went swimming in the Missouri River in 1975.

Along Iowa there are approximately 14,000 acres of surface water available for use by Iowans but only half of these are deemed usuable for recreation because of treacherous current. Only half of this usable supply is realistically available to Iowans because Nebraska potentially exerts an equal demand. This leaves about 3,500 acres of boating water for Iowans. On a peak day in 1975, Iowans needed between 2,000 and 4,000 acres (the difference depends on which standards are used) for boating on the Missouri River (Figure 9-7). Boating demand is projected to increase 55 percent by 1985 to between 3,000 and 6,200 acres. The GREAT Outdoor Recreation space standards show that demand has already exceeded supply in 1975, but according to the ICC's space standards, the supply will not be exceeded until after 1997. The actual demand for boating acres will probably be somewhere between these two sets of projections.

Coal barge on the Mississippi River
Iowa Development Commission

Recreational Boating Access

There are several ways to meet the demand for boating. The most obvious ways are to increase both available supply and access. Public access should be increased in the most recreationally deficient areas of Council Bluffs, Sioux City, and south of Council Bluffs to the Missouri border, by using a combination of acquisition of sites, purchase of easements, and expansion and renovation of existing public access sites. Another way to increase access is to encourage the private sector by providing guidance, informational assistance, and loans. Along with this, the public sector should not expand into an area that already has a viable private operation.

The amount of available supply could be increased by widening the channel and slowing down the current, making the river safer for recreation. Other alternatives include the construction of low-head dams, the construction of new off-channel impoundment structures, or pumping of additional water supplies into, or dredging, oxbows. Currently, an oxbow lake study sponsored by the Conservation Commission is addressing the relationship of the oxbow lakes to the river's alluvial aquifer to help determine the feasibility of dredging and supplemental pumping. The state should look into the possibility of reclaiming some old oxbow lakes presently unusable for recreation. This approach could be used by the Corps of Engineers in mitigating some of the recreation and fish and wildlife losses.

Conclusions and Recommendations

The Future of Commercial Navigation

Conclusions

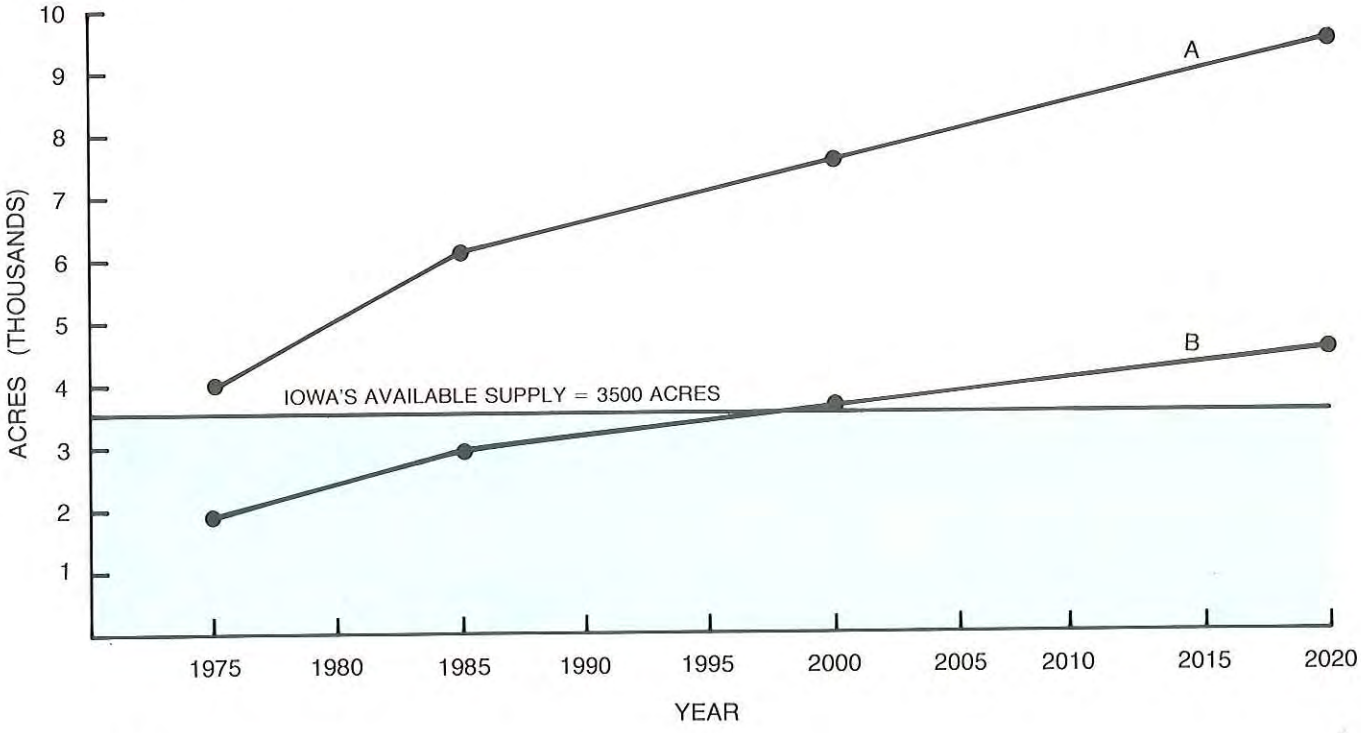
Using water transportation to move bulk commodities benefits Iowa. River transport is particularly beneficial for hauling grain, petroleum, coal, and other bulk commodities. However, river transport must mesh with other modes. The Iowa Department of Transportation's goal is a balanced transportation system, using the best advantages of rail, highway, water, air, and pipelines. It must be recognized that the Missouri River is a multi-purpose river, interstate in character, serving many people in many ways.

Recommendations

Iowa should continue to depend on the Federal Government to finance the maintenance of the navigation routes on the Missouri River, as was stated previously for the Mississippi River. A reasonable, coordinated interagency approach to planning and development should be supported. All agencies concerned with water and related resources must be actively represented in all regional

A Mississippi River towboat passing the Dubuque Commercial Harbor *Iowa Development Commission*

FIGURE 9-7 Projected Demand for Boating on the Missouri River Along the Iowa Border



KEY

A. Iowa's Demand based on Great River Environmental Action Team's Outdoor Recreation Space Standards

B. Iowa's Demand Based on Iowa Conservation Commission Outdoor Recreation Space Standards

planning efforts affecting Iowa. Iowa should consider and evaluate all Federal proposals so our interests are met. Iowa supports the continuance of the nine-foot naviagation channel on the Missouri River, provided the channel degradation problems now occurring upstream of Omaha can be resolved satisfactorily.

Water Use-Main Stem Reservoirs

Conclusions

Commercial navigation is not a consumptive user of water, but it does require a minimum flow in order to provide a satisfactory nine-foot channel with nominal dredging. With present stream flow depletions, inflows to the reservoir system are sufficient to support these minimum navigation flows in about three out of four years without any loss of storage water. The Missouri River Basin Commission stated that increased industrial and agricultural use of water from the upstream reservoirs could adversely affect downstream water users and shorten the navigation season.

Recommendations

The State of Iowa should maintain a strong interest in the allocation of the water resource of the Missouri River Basin so that we receive our proportionate share for our own water supply needs and instream uses including navigation. Development of an allocation plan may be needed, and should receive attention by the Missouri River Basin Commission and its member states and federal agencies.

Iowa should also support multi-agency efforts to determine the effects of reservoir management and channel modification on the river alluvial aquifer system and adjacent land use implications. Reasonable mitigation measures should be implemented.

Commercial-Recreational Impacts

Conclusions

The Missouri riverbed has degradated from two to six feet from Sioux City to Council Bluffs. The Corps indicates the riverbed may drop another four to six feet in the Sioux City area. This degradation causes problems with surface water intakes and low water levels in the oxbow cutoff lakes. Lower water levels result in a smaller area being available to boating, and boats no longer get into and out of the river during low flows. Lowering of groundwater levels will also adversely affect irrigation and municipal withdrawal from wells. Lower water levels, channel straightening, and the stabilization structures have reduced habitat for both fish and wildlife.

Recommendations

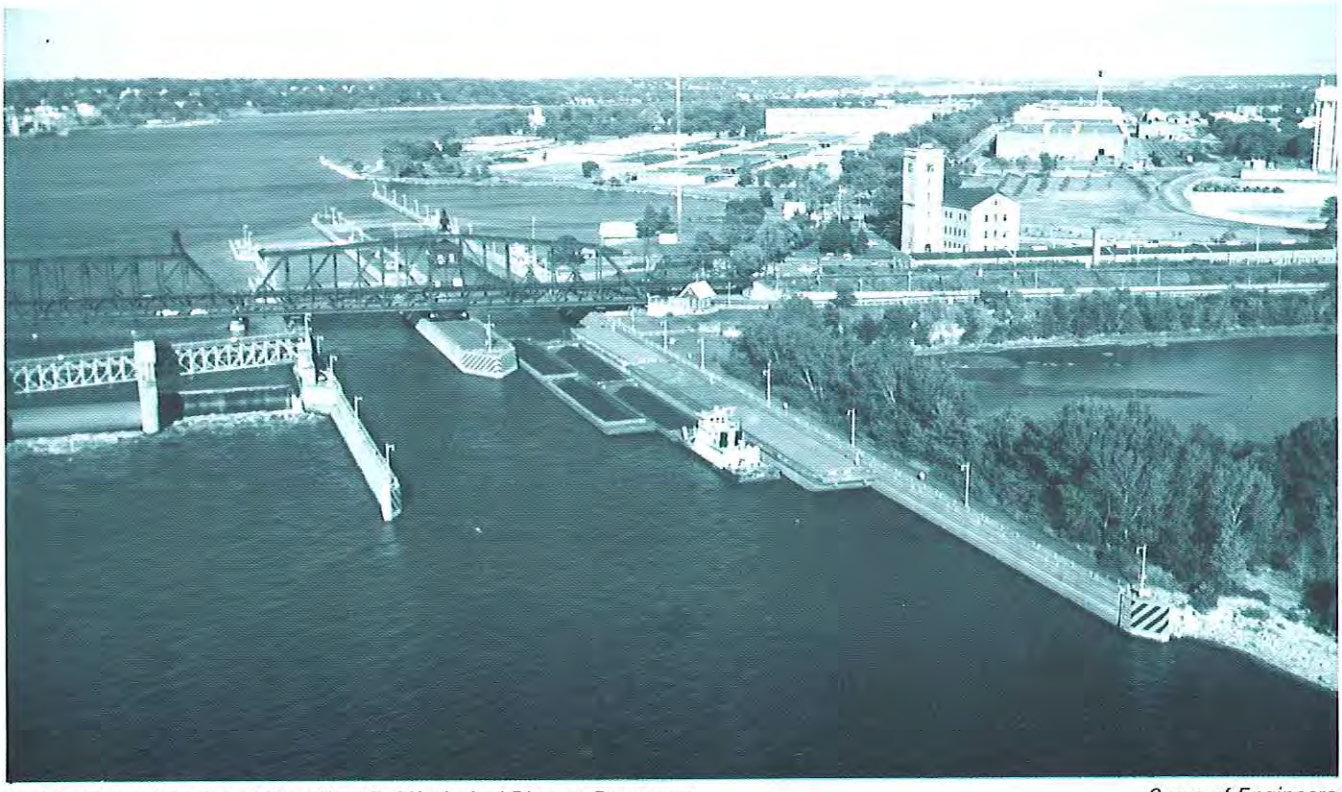
Support should be given to multi-agency efforts to determine the effects of reservoir management and channel modification on the alluvial aquifer and adjacent land use implications, and to implement mitigation measures.

Methods to improve recreational navigation use of the Missouri oxbow lakes should be developed and implemented, to reduce the user dependency on the river with its attendant swift current and boat safety problems.

River Corridor

Conclusions

The impact of unrestricted land use along the Missouri Corridor has serious implications for the recreationalist. Land use planning may be necessary to protect the open spaces and natural areas compatible to outdoor recreation along the Missouri.



Locking through Lock and Dam No. 15, Mississippi River at Davenport *Corps of Engineers*

Recommendations

A comprehensive, detailed resource plan for the Missouri River Corridor is needed. The state should conduct a resource analysis of the Missouri River Corridor, which would include identification of such things as fragile environmental areas, and areas that can accommodate certain types and degrees of development. With this type of information available, the state would be able to take the lead in developing an overall river plan to guide the growth, use, and development of the river corridor. Land use policies and use restrictions will have to be an integral part of such a plan.

Recreational Boating Access

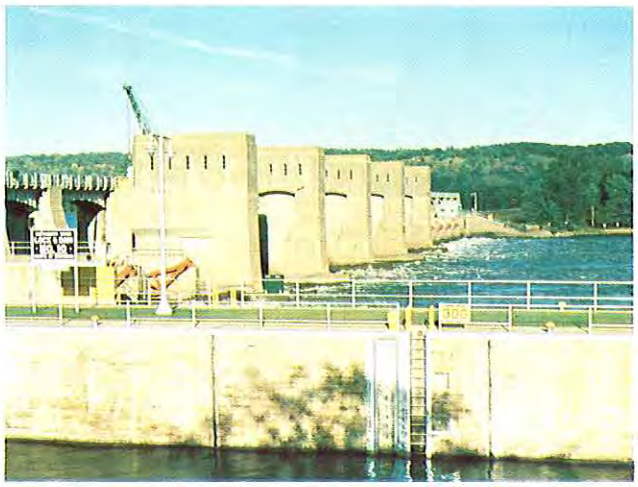
Conclusions

The Missouri River bottom land is extensively farmed. Because of the farming value of this land, there is almost no public land adjoining the river. This creates a significant barrier to public use. Currently, there are only 14 public and 4 private access sites along Iowa's 179 river miles. To date, private ventures have not faired well but they may have future potential. These private operations provide both a service to the recreational user and tax income to Iowa. The public sector should not expand into an area where there is a viable private operation serving public access needs.

Recommendations

As part of the state's outdoor recreation program, access and facilities should be provided in recreationally deficient areas. The metropolitan areas of Council Bluffs and Sioux City and the counties south of Council Bluffs to the Missouri border are the most critical areas and should be given top priority. Increased recreational boating demand should be met by using a combination of acquisition of sites, purchase of easements, and expansion and renovation of existing access sites. New, flat areas may ultimately be needed to satisfy the demand for water-oriented recreational facilities.

Encouragement in the form of guidance and information from the Iowa Conservation Commission and financial assistance from the Small Business Administration (SBA) program should be provided to the private sector for private recreation development along the Missouri River.



Lock and Dam No. 10, Guttenberg
Iowa Development Commission

Commercial-Recreational Conflicts

Conclusions

Direct conflicts between recreational and commercial vehicles are minute due to the low volumes of commercial and recreational traffic on the Missouri River. The educational process concerning the maneuvering time and space of commercial tows is needed for all recreational boaters to gain a respect for their limitations.

Recommendations

The state should develop a mandatory boating certification program that addresses the educational needs for safe boating operations.

Iowa farm scene, Clayton County

W. E. Akin

10 Agriculture

Iowa is primarily an agricultural state with an orientation toward both field crop and livestock production. The crops produced respond well to the soils. The temperate climate usually provides favorable growing conditions for both plants and animals. Large scale livestock production is dependent on the availability of an adequate feed supply.

The continued demand for farm products is expected to maintain pressure for high levels of crop and animal production in the United States, and on Iowa farmers to help meet that demand. With increased future demands for production, pressures on interrelated land and water resources can be expected to increase. Possible changes in agriculture in the years ahead must be evaluated so that desirable alternatives related to water resources can be encouraged and problems associated with undesirable changes can be minimized.

The Resource

Iowa has approximately 36 million acres within its boundaries. Since 1950, the acreage in farms has remained a bit over 34 million acres, or about 94 percent of the state. The acres harvested have generally ranged slightly above 22 million acres, or about 60 percent of the state.

Table 10-1 shows the relative importance of Iowa's agriculture among the states in both crop and livestock production. Among the 50 states, Iowa ranks near or at the top in a variety of key agricultural indicators.

Changes Since 1950

Since 1950, new techniques, new equipment, and relatively high profits have brought about rapid and significant changes in farming. Fewer and larger farms, fewer people living on farms, increasing costs, higher yields, and higher product prices are only a few of the changes that have been, and are currently, taking place. Major changes in the past 25 years in Iowa's crop production are shown in Table 10-2. Total acres in harvested crops did not show an appreciable change during this period, but the number of acres in different crops have changed significantly.

Total acres in row crops, corn, and soybeans increased from 11.7 million acres in 1950 to 20.2 million in 1975. Corn acres increased from 9.8 million to 13.2 million acres, and soybeans from 1.9 million to near 7 million acres. These figures indicate the pressure Iowa farmers are putting on the soil's resources. Erosion has always been a problem in the prairie states, but it is being accelerated as more areas of row crops are planted on steeper, unprotected slopes, resulting in greater movement of both soil and water from the land.

The information presented in this chapter is based on the comprehensive "Task Force Report on Agriculture," prepared by the Iowa Department of Soil Conservation and filed with the Iowa Natural Resources Council.

Acres planted to different crops by farmers are largely determined by the profitability of the crops, though most farmers show a marked preference for, and are equipped to produce, corn and soybeans. Improved crop varieties and management techniques and increased use of fertilizer, have increased the yield potential of most crops. Amounts and seasonal distribution of rainfall, however, are the final determinants of yield levels.

Livestock production is a large user of water in the state. Table 10-3 shows the total number of livestock and poultry for selected years from 1950 to 1975. The number of beef cattle increased substantially during the 25-year period. While the number of swine marketed varied over shorter time periods, the longer range trend was stable. The number of chickens and turkeys have been generally stable since 1965.

Nearly 50 percent of the dairy cattle are found in the northeastern part of the state. Beef cattle tend to be concentrated across the central and southwestern areas. The heaviest concentrations of market cattle are found in the central and western districts. The fewest numbers of market hogs are found in the southern part of the state, with the largest numbers in the northeast, east central, and northwestern sectors. Turkey production is primarily located in the central, southeast, northwest, and west central parts of the state.

Cost of Production

As farmers have become more efficient in their operations and have produced higher yields, it becomes more difficult and more costly to increase crop yields to even higher levels. From the mid-1950s until 1969, crop production remained relatively stable though it varied from year to year. It was during this span of years that much new agricultural technology was tested and adapted and larger equipment was put into use. This came about in part because of larger acres farmed and in part in an effort to achieve more timely operations. Costs of inputs increased significantly from 1969 to 1972, but from 1972 to 1977, costs of producing crops in Iowa more than doubled.

Resource Considerations and Problems

Iowa has established itself as a leading agricultural state as shown by its ranking among states in acres and production of field crops and numbers of livestock produced and fed. Considering this fact, there is a potential for certain water related problems:

—Crop yields and total production are highly weather dependent and can be altered significantly only with irrigation development beyond a level that appears possible at this time.

—With more than 22 million acres in row crops, significant water and wind erosion will occur unless adequate runoff and erosion control measures are applied. The sediment movement also

will result in the loss of applied agricultural chemicals, including fertilizer elements, from farm fields.

—The large numbers of livestock will require a continuous source of water of an acceptable quality.

—When applied to fields, animal wastes create potential surface water contamination problems even with careful management.

Water For Crop Production

Water availability for crop production is determined, in large measure, by precipitation and soil moisture reserves. Water use by crops is related to the various stages of plant development and atmospheric conditions which influence evapotranspiration rates.

Using average precipitation and water use data during the growing season for each major crop, the calculated water use for selected crops indicates that corn uses 1.5 inches more water than falls as precipitation during the growing season; soybeans, 2.2 inches more; sorghum, 1.3 inches more; and alfalfa hay, 2.2 inches more; while oats use 0.5 inches less (Figure 10-1). The precipitation deficit must be supplied by subsoil moisture reserves.

Iowa's soil depends to a large degree on nongrowing season precipitation for moisture recharge. Soil moisture constitutes a water reserve for plant growth, especially during the high water demand months of July and August. Corn, soybeans, sorghum, and perennial hay crops use soil moisture to a depth of five feet or more; oats to at least three feet. Medium and moderately fine-textured soils can hold about two inches of plant-available moisture per foot of soil profile, whereas coarse-textured soils may hold less than 1/2 inch per foot of profile.

Air temperature can be a limiting factor in crop or animal production in Iowa. Temperatures above 85-90° F reduce both plant and animal production efficiencies. Excessive temperatures during the pollination stage cause severe plant stress and yield reductions.

As a consequence of Iowa's dependence upon precipitation and the soil moisture reserve for agricultural production, problems of water shortages for agriculture include two major areas of concern. First, there is a continuing need for improved efficiency in soil moisture conservation practices for extensive areas of the state, and soil moisture recharge. Adequate soil moisture allows high crop yields even with periods of below normal rainfall, as was the case in 1976. Second, weather variability

TABLE 10-1 Iowa's Position as an Agriculture State

	1965	1970	1971	1972	1973	1974	1975
Crops							
Corn for Grain (BU)	2	1	1	1	1	1	2
Corn for silage (TONS)	3	3	3	2	2	2	1
Soybeans (BU)	2	2	2	2	2	2	2
Oats (BU)	4	5	5	5	4	2	3
All Hay (TONS)	4	4	5	6	5	5	4
Total Crops as Harvested (Acres)	—	1	1	1	1	1	1
Numbers of Livestock							
All Cattle and Calves	2	2	2	2	2	2	2
Milk Cows 2 years +	5	6	7	6	8	7	7
Beef Cows 2 years +	8	8	7	7	7	7	5
All Hogs	1	1	1	1	1	1	1
Sheep and Lambs on Feed	2	3	3	5	6	7	12
Cattle and Calves on Feed	1	1	1	2	2	2	2
All Chickens Raised	4	—	—	—	—	—	10
All Turkeys	5	7	7	7	7	5	7
Cash Receipts from Farm							
Crops	6	4	3	3	3	3	4
Livestock	1	1	1	1	1	1	1

Source: Iowa Annual Farm Census and Iowa Agricultural Statistics

TABLE 10-2 Changes in Iowa Agriculture 1950-1975

	1950	1955	1960	1965	1970	1975
Acres in Farms	34,800,000	34,900,000	34,700,000	34,600,000	33,400,000	34,200,000
Acres per Farm	169	179	190	219	237	251
Acres in Harvested Crops	22,326,000	22,874,000	22,894,000	20,294,000	20,428,000	22,143,000
Acres in corn	9,798,000	10,767,000	12,607,000	10,457,000	10,717,000	13,150,000
Av. Yield per acre in corn	48.5	48.5	63.5	82.0	86.0	90.0
Selling Price	1.52	1.44	.97	1.13	1.25	2.40
Acres in Soybeans	1,930,000	2,261,000	2,599,000	4,850,000	5,680,000	6,970,000
Av. Yield per acre in soybeans	22.7	20.0	25.5	26.0	32.5	34.0
Selling Price	2.64	2.64	2.13	2.61	2.82	4.55
Acres in Oats	6,520,000	5,798,000	4,100,000	1,999,000	1,711,000	1,500,000
Av. Yield per acre in oats	41.5	44.5	42.0	52.5	55.0	53.0
Selling Price	.79	.58	.60	.65	.64	1.45
Acres in Cultivated Forage	3,737,000	4,006,000	3,492,000	3,038,000	2,460,000	2,450,000
Av. Yield per acre in hay	1.75	1.74	2.32	2.35	2.77	2.82
Selling Price	16.60	16.20	14.50	21.80	20.00	50.00
Acres in Pasture	9,730,000	9,200,000	8,160.000	7,753,000	7,256,000	(3)

Source: Iowa Annual Farm Census and Iowa Agricultural Statistics, Statistical Reporting Service, USDA

[1] Corn Harvested for All Purposes
[2] Corn Harvested for Grain
[3] Not Available

TABLE 10-3 Numbers of Livestock and Poultry in Iowa With Projections (in thousands)

Livestock Groups	1950	1955	1960	1965	1970	1975	2000	2020
Dairy Cows (1)	1,194	1,122	943	827	508	405	300	250
Dairy Calves (2)	1,122	1,055	905	777	478	381	282	235
Beef Cows (1)	588	1,018	993	1,287	1,582	1,835	2,500	2,500
Beef Calves (2)	541	937	914	1,184	1,455	1,688	2,300	2,300
Cattle Marketed (1)	2,545	3,687	3,958	4,841	4,945	4,270	5,000	5,500
Sows-Spring Farrow (1)	2,198	1,649	1,458	1,333	1,663	1,380	2,000	1,500
Hogs Marketed (1)	16,770	19,133	18,457	19,081	20,029	17,816	28,000	24,000
Sheep-Breeding Stock (2)	534	718	820	652	483	370 (3)	250	200
Sheep & Lambs Marketed (1)	1,164	1,509	1,758	1,372	848	381 (3)	300	300
Chickens & Broilers (3)	38,154	29,325	21,758	14,086	16,550	14,290	18,000	20,000
Turkeys (3)	2,438	3,534	6,859	6,467	4,107	6,363	7,500	9,000
Horses	—	—	—	—	175	200	400	400

Source: Iowa Annual Farm Census Reports and Iowa Agricultural Statistics, Iowa Department of Agriculture and Statistical Reporting Service - USDA Duncan, E. R., Adaptations from existing and calculated data

Notes: (1) Meat Animals - Statistical Reports - Annual USDA Crop Reporting Board - Statistical Reporting Service
(2) Calculations (Dairy Cows x .94 = Calves) (Sheep, Breeding Stock. Lambs - .13) (Beef Cows x .92 = Calves)
(3) Projections for this study based on expert opinion and judgment

is the major cause of fluctuations in production of crops. There is a need to develop accurate seasonal, annual, and long range weather forecasting techniques, and to devise methods of responding to such changes which will moderate or modify the undesirable impacts of weather variability upon agricultural production.

Irrigation Water Use

Irrigation is not a common practice in agricultural crop production in the state. While irrigation may increase yields in years of limited or poorly distributed rainfall, the increases in yield from irrigation in most years may not justify the cost.

There were a total of some 1,430 irrigation permits in Iowa as of the end of 1977. About 700 irrigation application permits were also pending. Well irrigation permits numbered 790, mostly located in the Missouri River bottom land area. The remaining sources were primarily streams. By the end of 1977,approximately 230,000 acres of land had been approved for agricultural and related irrigation purposes, less than one percent of the agricultural land in crop and forage production.

Research on crop response to irrigation in Iowa was conducted largely in the 1950s. Results showed that when crop season (April-September) precipitation was 16 inches or less, considerably below average for any area of the state, favorable responses from irrigation were obtained. Crop production and irrigation technology have improved since that time and higher yields as well as higher responses are now possible. In dry years, due largely to moisture stress conditions, responses to irrigation tend to be larger, but actual yields remain much below those in years with favorable weather.

Soils with different surface and subsurface textures respond quite differently to irrigation. Before installing an irrigation system, a detailed soil survey should be made of the property to determine probable crop response to irrigation. Fixed and variable costs for center pivot irrigation systems have been estimated. In 1977, average annual costs for center pivot irrigation were estimated to be $88 per acre. Added crop yields from irrigation must generate at least this much income to break even. Average production costs for non-irrigated corn have been estimated to be $242 per acre per year. To profitably irrigate the same land would require a gross income of $330 per acre annually. This amount represents a 165 bushel average yield at $2.00 per bushel.

In addition, irrigation can consume several times as much energy as other field operations. However, irrigation may make the difference between a good crop and no crop. Long-range planning for irrigation must weigh water and energy requirements against food production needs.

Drainage of Agricultural Lands

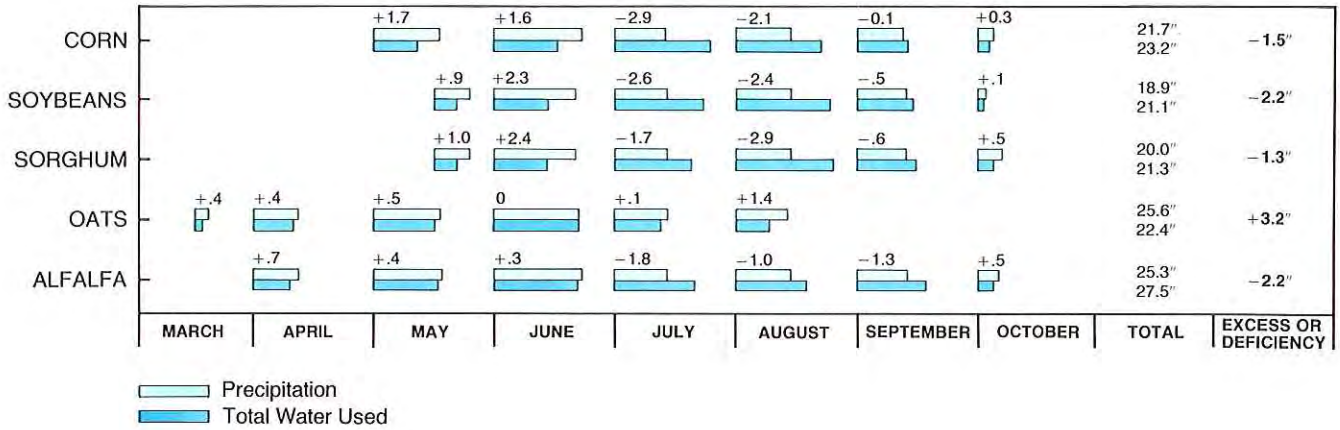
Agricultural drainage is defined as the removal and disposal of excess water from agricultural land either by surface or subsurface means. Principal sources of excess water may be precipitation, snowmelt, over-irrigation, overland flows, floodwater, underground seepage, and uncontrolled artesian flow from deep aquifers. Artificial drainage systems supplement natural drainage in many areas of the state. Excess water is a problem on agricultural land when it interferes with farm operations and plant growth, resulting in reduced crop yields, lower crop quality, and increased production costs.

In the early 1900s, drainage of agricultural land was pursued as an activity being in the general public's interest. During this period, drainage practices included installing tile and ditch drainage systems, widening and straightening existing streams, and constructing levees to protect adjacent lowlands. In recent years, new products and methods of installation have been developed. However, such methods still involve underground tile, ditching, and channelization of watercourses. The systems selected are usually related to overall cost-effectiveness.

At present, most agricultural drainage districts are concentrated in the northcentral part of the state on nearly level terrain. Drainage districts are also found on the bottomlands of the Missouri and Mississippi Rivers, and individual drainage districts are located throughout the state. With the exception of the Iowa-Cedar Rivers Basin Study area, there has been no recent comprehensive inventory of drainage districts in the state. This lack of information hinders the factual analysis of statewide agricultural drainage problems.

The 1970 Iowa Conservation Needs Inventory indicated that approximately 3-1/2 million acres, or 13 percent of Iowa's cropland, needed additional drainage

FIGURE 10-1 Precipitation and Estimated Water Use for Various Crops—Central Iowa



for more efficient crop production. These acres generally are concentrated in the north central part of the state in the upper reaches of the Des Moines, Iowa, and Cedar River basins.

The findings of the Iowa-Cedar 1975 Drainage Report may also have a general application to the Des Moines River Basin and other similar areas. Most of these drainage districts were located in the northern part of the basin. It was estimated that over 50 percent of the drainage districts studied had inadequate tile main systems, including mains in poor condition due to crushed or partially blocked tile, inadequate size, inadequate depth, and inadequate outlets. In addition, there are legal, institutional, and funding problems associated with developing or redeveloping drainage systems.

It is important that drainage systems be planned and developed on a watershed, rather than a piecemeal basis, since each watershed is unique. A well designed and constructed drainage system for an entire watershed will not increase downstream peak flows.

Projections for Crop Production and Irrigation

Past trends in crop acres and yields were considered in developing future acres and yields. During the 25-year period 1950-1975, total quantities of harvested crops in Iowa increased substantially, while the total acres in crops remained slightly over 22 million. Corn acreage increased nearly three million acres to about seven million and yields increased about 30 percent. Acreage in oats declined from about seven million acres to 1.5 million.

There are two major areas of uncertainty for making the needed projections: (1) How will the relative profitability of these crops change from 1977 to 2000 and from 2000 to 2020, and (2) what quantity and quality of land will be removed from agricultural use in Iowa during the same periods.

If severe environmental controls are implemented, the total acreage of row crops may need to increase in order to maintain total production under large government subsidies.

The demands for crops determine the prices received for the crops regardless if these are world or just natural demands. Profitability is determined by what is left for the producer after costs of production are deducted from gross income.

The problem of energy availability must be solved within the next quarter century if present energy use levels on farms are to be maintained. If energy conservation takes the form of higher prices, there will be a direct increase in production costs. If it takes the form of reduced availability of energy, significant changes in machinery efficiency and farming practices will be required. Such changes do not seem probable by 1985, but could appear by the year 2000.

A variety of projections have been made to the year 2020 by U.S.D.A.'s Economic Research Service in cooperation with other agencies. These projections are referred to as the "OBERS Projections," and they are revised from time to time as new information becomes available. These projections are widely used and reported, and certain information from the OBERS Projections was used in projecting Iowa crop yields and acreages for this study. Table 10-4 presents the acres and yields for selected major crops in Iowa as projected in selected OBERS reports to the year 2020.

A best judgment at this time would be that the OBERS Projections, primarily based on economic demand rather than resource availability as shown in Table 10-4, are too optimistic for the years 2000 and 2020.

Laying tile to drain agricultural land
Soil Conservation Commission

Additional acres may be irrigated in Iowa, but these acres are not expected to influence the total number of acres in row crops, nor are they expected to bring "new acres" into production. The availability of water for irrigation is a primary requirement and a limiting factor.

Table 10-4 compares the OBERS' yield projections and those obtained from a survey of 15 agronomists working in Iowa. The agronomists' figures are five-year averages straddling each of the years indicated. Based on the survey analysis, in comparison with the OBERS' projections, the agronomists' projections are considered to be more realistic estimates of future yields.

Projections for future irrigated acres are associated with projected crop yields and acres, weather, production costs, and water availability. In addition, projections for agricultural irrigation in Iowa are based on the following general assumptions:

- —Climatic conditions will remain normal when compared to the 1941-1970 period, and deviations from normal will follow past experiences.
- —Crop yields will increase at an irregular, modest rate so that yields will be 30 to 40 percent higher in 2020 than in 1975.
- —Exports of grains and oil seeds will continue, but at a somewhat lower rate than in the mid-1970s.
- —Canada, Australia, and especially Brazil and Argentina will increase their grain production, so more will be available for export.
- —Developing nations will continue to improve their production of cereal grains, but most will not become self-sufficient.
- —Livestock/feed relationships will continue to be relatively favorable with the usual year-to-year variations.
- —The world population growth rate will continue to be above two percent per year and the United States' growth rate will continue at about 1.2 percent per year.
- —Energy will become more costly and supplies will not meet needs based on 1977 use rates.
- —Point and nonpoint source pollution control standards will be established, and farmers will be obligated to reduce erosion to a level less than that presently occurring.

These assumptions reflect a moderate view for the next half century, with continued need for an agricultural production level that will keep Iowa a leading agricultural state. It is assumed that Iowa's production will be achieved with slightly fewer farm operators and more hired labor.

Costs of producing crops and livestock are expected to continue to increase slowly, as will the prices of crops and livestock produced. Profit margins will be small enough so that there will be an increasing premium on efficiency.

Higher yields will result from the development of improved water-use-efficient crop varieties, wider adoption of improved crop management practices, and the use of fewer acres of the most marginal land for cultivated crops. These projected yield levels would maintain the production of corn at more than one billion bushels per year, soybeans at more than 400 million, and hay production at about 18 million tons. Oat acreage is projected to drop below one million acres, primarily as a companion crop for legume seedings.

Irrigation costs are expected to continue to increase and energy needed to operate irrigation systems will receive closer attention. While supplies of energy appear adequate for the next few years, most authorities agree that supplies are finite and are being depleted. In the period to 2000, it is reasonable to assume that some form of energy supply rationing will be instituted. It is also reasonable to believe that if energy supplies do become limited, irrigated production of feed grains would not have a high priority for available energy supplies.

Under Iowa conditions, and at present cost/price relationships, irrigation for corn production appears profitable in western Iowa only when growing-season rainfall is less than 80 percent of normal. Profitability is the most important irrigation consideration, but not the only one. Irrigation also can be considered as a form of yield insurance, though the cost may be quite high.

Considering the available evidence and the stated assumptions, there appears to be marginal economic justification for expansion of irrigation for grain production in Iowa. There is, however, a backlog of irrigation system commitments, very active sales efforts, and unusually favorable water availability in the Missouri River bottom which will result in a short-run increase in permit requests.

After 1980, particularly if energy supplies become more costly or difficult to obtain, it is very doubtful if the number of irrigation permit requests will continue its present steep upward trend.

The Iowa Natural Resources Council has indicated that the past and present irrigation situation and future trends are about as follows:

Year	Authorized Permits	Acres Irrigated	Acre-Feet of Water Used or Authorized
1969	649	93,200	99,300
1976	837	131,300	146,000
1977	1,429	230,000	280,000
2000	4,000	740,000	740,000

These figures suggest that demands for irrigation water and acres irrigated may show an increase of about five times between 1976 and 2000. Much of the 2000 demand is likely to be on the Missouri River bottoms. In the longer run from 2000 to 2020, there would be little apparent justification for irrigating additional acres of feed grain crops.

It is possible that there could be a shift from irrigated grain production to irrigated sugar beet, vegetable, and sweet corn production. While weather conditions are not completely favorable to vegetable and sugar beet production, selective use of soils could make the irrigated production of these crops highly competitive. In such cases, use of existing irrigation facilities probably would change, and a major expansion of new systems would be unlikely.

Conflicts between water for irrigation and other uses are not expected to be a significant problem in the major river valleys where adequate volumes of water are available from alluvial sand and gravel aquifers. The major problem is in the upland areas where available water resources for all competing water uses are limited. Priorities for water use in these areas should still be a matter for early consideration by the Iowa Natural Resources Council. It is doubtful that irrigation will be given high priority in upland areas.

Water for Livestock

While Iowa, in general, has an abundance of water, the state does have cyclical periods when conditions may be too wet or too dry. Inadequate water for livestock production during long periods of below-normal rainfall is frequently a problem in western and south central Iowa. Adequate water of suitable quality must be available on a continuing basis for efficient livestock production. While

TABLE 10-4 Projected Crop Yield For Iowa With Sources Compared

CROP	1975	1985		2000		2020	
		OBERS	Agronomists Survey	OBERS	Agronomists Survey	OBERS	Agronomists Survey
Corn - Bu/Acre	90	132	108	155	119	185	129
Oats - Bu/Acre	51	65	65	73	75	84	87
Sorghum - Bu/Acre	62	105	85	127	93	155	106
Soybeans - Bu/Acre	34	38	37	42	45	47	56
Hay - Tons/Acre	3.0	3.4	3.7	4.0	4.3	4.6	5.3

Source: Duncan, E. R., Adaptations from existing and calculated data.
Note: Agronomists' estimates based on five-year averages for dates shown. (March 1977)

water intake by livestock may come from several sources (plants, etc.), this study is primarily concerned with drinking water.

Several factors influence the amount of drinking water taken in by livestock and poultry. These include kind, size, sex, age, work or state of production, type of ration, amount of feed intake, air and water temperaure, physical forms of feed, and availability and quality of water. Water use by livestock, other than that required for drinking, is affected by different types of livestock operations and techniques. The quality of water in Iowa, with present demand, is such that it is not a deterrent to water intake by livestock. Under usual weather conditions, the quantity of water presently available to livestock does not pose a problem. With extended periods of low rainfall, shallow wells and small impoundments are not sufficient to meet demands. If demands are significantly increased, both quantity and quality of water supplies may require a distribution of types of livestock different from the distribution patterns of 1975.

Livestock and poultry water use estimates are shown in Table 10-6. These figures are premised on moderate temperatures and general availability of water. The totals may be somewhat high for Iowa conditions due to "other uses," particularly for dairy cows. Spillage, amounting to 10 percent for animals and 15 percent for poultry, is included in "other uses," as is waste removal, etc.

The 1975 livestock water use is estimated to be approximately 135 million gallons per day, or over 49 billion gallons per year. The highest water use demand for livestock is in the northwestern part of the state where rainfall is lowest, where there are very few impoundments, and essentially all water needs are supplied by wells. Many of these wells are shallow and have low capacity. As a result, water shortages for livestock do occur and are a recurring intermittent problem. Several rural water districts have been established in the northwest which have livestock water supplies incorporated as part of the system.

Livestock Projections and Future Use

Several different methods may be used to project future numbers of livestock and related water requirements. For purposes of this study, projections to the year 2020 are based upon an extension of past trends modified by empirical judgments regarding probability of future events.

The following general assumptions were made:

—Real personal disposable income in constant dollars will increase at the rate of about four percent annually.

—There will be only modest product substitution from food sources other than livestock.

—Exports of feed grains and oil seeds will continue at a somewhat lower rate than in the mid-1970s.

—World population growth will continue about 2 percent per year, and U.S. population growth at about 1.2 percent.

—Developing nations will improve their production of cereal grains, but most will not become self-sufficient.

—Countries such as Canada, Australia, Brazil, and Argentina will increase their feed grain production. Yields will increase faster than in the United States because they are starting at a lower base.

—Livestock/feed relationships will continue to be relatively favorable, with usual year-to-year variations.

TABLE 10-5 Estimated Water Use by Livestock Gallons Per Day

Livestock Groups	Drinking	Other Uses	Total/Day
Dairy Cows	20.0	12.0	32.0
Dairy Calves (under 1 year)	3.9	1.4	5.3
Beef Cows	7.5	.7	8.2
Beef Calves (under 1 year)	3.9	.4	4.3
Grain-fed Cattle Marketed	7.2	.8	8.0
Sows	4.8	1.0	5.8
Market Hogs	1.9	.7	2.6
Stock Sheep	.6	.1	.7
Sheep & Lambs Marketed	.6	.1	.7
Chickens - Layers	6.5/100	1.0/100	7.5/100
Broilers and Others	3.0/100	.5/100	3.5/100
Turkeys	11.0/100	1.0	1.1
Horses	10.0	—	10.0

Source: Adapted from Livestock Water Use, USDA - SCS - Special Projects Division for Water Resources Council, July 1975.

—The percent of feed grains fed to livestock in Iowa will not increase beyond the 1970s level, and may even decrease, but due to probable feed grain yield increases, the total tonnage fed to livestock may increase.

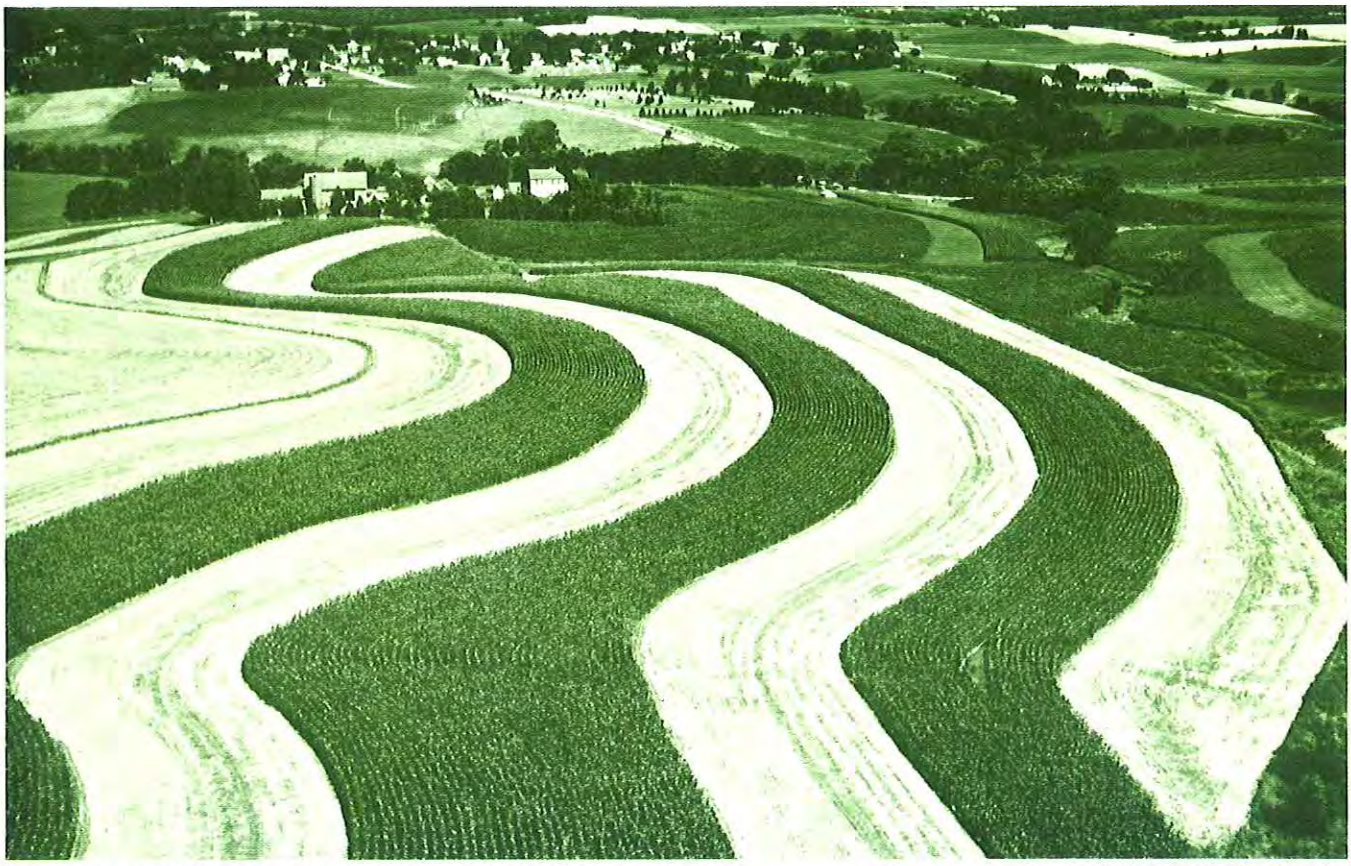
—Farmers will continue to be highly responsive to income opportunities in livestock production.

There are increasing concerns about feeding a rapidly expanding world population and some experts believe that feed and food grains might better be eaten directly rather than processed through livestock. However, Americans like meat, expecially red meat, and will not give it up easily though they may accept a somewhat lower quality. A large percentage of the meat protein produced comes from roughages and other products not readily consumed by humans. It is the general assumption of this study that meat production will continue increasing moderately in future years, with a corresponding increased need for water of acceptable quality.

Livestock census data were tabulated in order to visualize the trend of the past 26 years. This trend provides an indication of a direction for the future, although modifications may take place due to the many factors that influence farmers to produce livestock or livestock products. Expert opinions were obtained by survey from professionals in animal science and related fields. The composite opinions of these experts, with knowledge of past patterns and anticipated new technology and its acceptance, are reflected in the livestock numbers shown in Table 10-3, projected to the years 2000 and 2020. While the experts surveyed had doubts about the actual projected numbers to the year 2000, they expressed confidence in the direction of the projections.

Based on the livestock projections for 2000 and 2020, Table 10-6 shows a realistic estimate of projected livestock numbers and resulting future water needs. These calculations show an estimated need for 25 to 30 percent more water for future livestock production by the year 2020, with an increase from about 135 million gallons per day (151,000 acre-feet per year) in 1975 to approximately 180 million gallons per day (200,000 acre-feet per year) in the year 2000 and about 170 million gallons per day (189,000 acre-feet per year) in the year 2020.

There is little reason to believe that the location of dairy herds, now largely in northeast Iowa, will change significantly in the future. If distribution changes are made in the relative numbers of beef cows in different parts of the state, it appears that northwest, central, and east central Iowa would lose in favor of southwest, south central, and southeast Iowa. The pattern of distribution of market cattle in western and central Iowa is not expected to change significantly in the years ahead. Increases in market hogs are projected largely in north central and central Iowa. Increases in numbers of chickens and turkeys may well take place in the northeast, south central, and southeast parts of the state. The number of horses in Iowa is almost totally determined by income and amount of leisure time. A statewide distribution pattern was not developed.



Contour farming, Clayton County *Soil Conservation Service*

TABLE 10-6 Water Requirements For Iowa Livestock With Projections

Livestock Groups	Water Use per Animal (gallons)	1975		2000		2020	
		Numbers (000)	Gal/Day	Numbers (000)	Gal/Day	Numbers (000)	Gal/Day
Dairy Cows	32.0	405	12,960	300	9,600	250	8,000
Dairy Calves	5.3	381	2,019	282	1,495	235	1,246
Beef Cows	8.2	1,835	15,047	2,500	20,500	2,500	20,500
Beef Calves	4.3	1,688	7,262	2,300	9,890	2,300	9,890
Marketed Cattle	8.0	4,270	34,160	5,000	40,000	5,500	44,000
Sows	5.8	1,380	6,877	2,000	11,600	1,500	8,700
Marketed Hogs	2.6	17,816	46,322	28,000	72,800	24,000	62,400
Stock Sheep	.7	370	259	250	175	200	140
Marketed Sheep & Lambs	.7	381	267	300	210	300	210
(1) Chickens-Layers & Broilers	5.0/100	14,290	715	18,000	90	20,000	100
Turkeys	1.1	6,363	6,999	7,500	8,250	9,000	9,900
Horses	10.0	200	2,000	400	4,000	400	4,000
Total Gallons/Day			**134,884**		**178,610**		**169,086**
Total/Year in Acre Feet			**151,000**		**200,000**		**189,000**

Source: Duncan, E. R., based on calculations from projected animal numbers.

Note: (1) For purposes of these calculations, chickens are combined and an intermediate use figure is used (5.0/100).

Both quality and quantity of water appears satisfactory in Iowa for present and projected livestock production. However, deeper wells and larger impoundments will be necessary to ensure adequate water supplies in periods of low rainfall, especially in western and south central Iowa. These water supplies may be quite costly to develop.

Soil Conservation

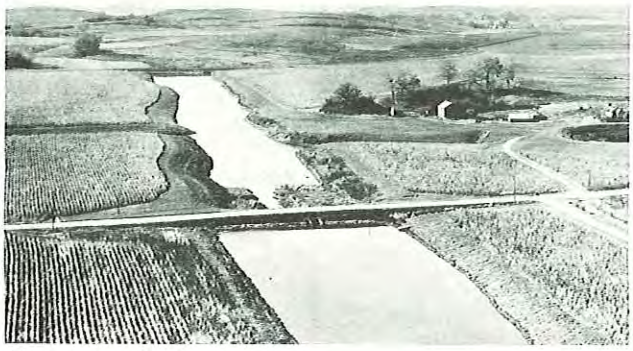
According to the National Inventory of Soil and Water Conservation Needs (Table 10-7, 10-8, 10-9), Iowa had nearly 24 million acres of Class I, II, and III cropland in 1967, which represents 10, 7, and 6 percent respectively of those three classes of land in the United States. The following outline describes these land classification categories.

Land Capability Classification

A. Land suited for cultivation and other uses including pasture, range, woodland, or wildlife.
   - Class I — These soils have few or no conditions that limit their use. They can be safely cultivated without special conservation treatment.
   - Class II — These soils have some natural condition that limits the plants they can produce or that calls for some easily applied conservation practice when they are cultivated.
   - Class III — These soils have more serious or more numerous limitations than those in Class II. The limitations may be natural ones, such as steep slope, sandy or shallow soil, or too little or too much water. Or, the limitation may be erosion accelerated by the way the land has been used. Thus, they are more restricted in the crops they can produce or, when cultivated, require conservation practices more difficult to install and maintain.
   - Class IV — These soils have very severe limitations that restrict the plants they can grow or the number of years they will produce a cultivated crop. When cultivated, they require very careful management. In humid areas, they are suitable for occasional, but not regular, cultivation; in subhumid and semiarid areas, crops fail in low-rainfall years.

B. Land generally not suitable for cultivation but suitable for other uses.
   - Class V — These soils have little or no erosion hazard but have some condition, impractical to remove, that limits their use largely to pasture, range wood production, recreation, water supply, or wildlife food and cover.
   - Class VI — These soils have severe limitations that make them generally unsuited for cultivation and restrict their use to pasture, range, wood production, recreation, water supply, or wildlife food and cover with careful management.
   - Class VIII — These soils and land forms have limitations that prevent their use for commercial plant production and that restrict their use to recreation, water supply, or wildlife food and cover with careful protection.

A gully in Woodbury County before treatment
Soil Conservation Service



The same gully after treatment
Soil Conservation Service

Probable Consequences of Intensive Cultivation

Soil erosion is not unique to modern times and modern agriculture. The Missouri River was called the Big Muddy by the first explorers and early trappers. This was long before cultivation became a factor. Hundreds of similar examples can be cited, but this does not excuse the continuing problem. With the increasing population in the United States and in the world, long-term measures to control water runoff and erosion are essential so that increased food production can be continued.

Since the 1930s, millions of dollars have been spent in Iowa alone, directly and indirectly, by government and individuals to control soil erosion. Nonetheless, as a result of intensive cultivation and the use of modern large scale equipment, erosion may be more serious today than it was 50 years ago. Gully erosion is most obvious in western and southern Iowa. The fact that gully erosion dissects fields and causes hazards to man and machines often brings about active interest in its control. Sheet erosion, even on gentle slopes, creates different problems. As water moves from the fields, it carries not only the soil particles but also organic materials, fertilizer nutrients, and other chemicals. As the sediment, nutrient,

TABLE 10-7 Iowa Irrigated and Nonirrigated Cropland; Acres in 1967, by Land Capability

Land Capability Class and Subclass	In Tillage Rotation									Orchards Vine-yards & Brush Fruits	Open Land Formerly Cropped	Total Cropland
	Field Crops				Rotation Hay and Pasture	Hayland	Conser-vation Use	Tempo-rarily Idle	Total			
	Row	Close Grown	Summer Fallow	Total								
I	2,709,573	188,023	0	2,897,594	321,697	12,030	393,295	7,534	3,632,150	0	1,859	3,634,009
II	8,437,255	369,599	406	9,307,260	1,568,601	42,527	1,478,583	16,396	12,413,267	1,540	9,528	12,424,435
E	4,025,259	490,656	203	4,516,118	855,637	18,422	666,232	5,593	6,062,002	1,536	1,415	6,064,957
W	4,255,082	352,622	203	5,607,907	670,885	23,269	765,303	10,194	6,077,558	4	7,490	6,085,052
S	156,719	26,321	0	183,040	41,688	836	46,611	609	272,734	0	619	273,403
C	195	0	0	195	391	0	437	0	1,023	0	0	1,023
III	4,282,133	706,620	0	4,985,753	1,674,513	89,573	1,118,721	23,320	7,694,880	690	5,782	7,901,352
E	3,619,339	660,018	0	4,279,357	1,591,561	87,111	939,535	11,196	6,908,760	690	4,742	6,914,192
W	607,087	43,353	0	650,440	72,194	2,413	156,945	11,674	893,666	0	826	894,492
S	55,707	3,249	0	58,956	10,758	49	22,241	450	92,454	0	214	92,668
I-III	15,428,961	1,764,240	406	17,193,607	3,564,811	144,130	2,990,599	47,250	23,940,897	2,230	17,169	23,959,796
IV	651,345	151,396	0	802,741	456,902	36,849	265,302	6,473	1,568,267	184	5,611	1,574,062
E	515,202	127,570	0	642,772	393,394	35,652	219,577	5,809	1,295,204	184	4,919	1,300,307
W	36,215	5,506	0	41,821	23,766	0	12,359	0	78,446	0	0	78,446
S	99,828	18,320	0	118,148	39,742	1,197	32,866	2,664	194,617	0	692	195,309
I-IV	16,080,306	1,915,636	406	17,996,348	4,021,713	180,979	3,255,901	53,723	25,508,664	2,414	22,780	25,533,858
V	74,765	8,594	0	83,359	19,625	6,185	24,851	4,791	138,811	0	205	139,016
W	74,765	8,594	0	83,359	19,625	6,185	24,851	4,791	138,811	0	205	139,016
VI	204,921	47,870	0	252,791	183,537	18,268	106,180	4,096	564,872	252	3,048	566,172
E	194,589	44,813	0	239,402	172,625	18,046	99,110	4,096	533,279	252	2,898	536,429
S	10,332	3,057	0	13,389	10,912	222	7,070	0	31,593	0	150	31,743
VII	67,074	16,184	203	83,461	59,604	18,027	49,681	2,152	212,925	231	4,119	217,275
E	53,023	13,566	203	66,792	52,095	12,148	46,149	1,519	178,703	231	3,909	182,843
W	4,624	103	0	4,727	203	416	208	633	6,187	0	210	6,397
S	9,427	2,515	0	11,942	7,306	5,463	3,324	0	28,035	0	0	28,035
V-VII	346,760	72,648	203	419,611	262,766	42,480	180,712	11,039	916,608	483	7,372	924,463
TOTAL	**16,427,066**	**1,988,284**	**609**	**18,415,959**	**4,284,479**	**223,459**	**3,436,613**	**64,762**	**26,425,272**	**2,897**	**30,152**	**26,458,321**

Source: USDA, Inventory of Soil and Water Conservation Needs, 1967; Statistical Bulletin No. 461, January 1971.

and chemically enriched water moves into bodies of water, ecological and health problems may arise. These frequently impair water areas for recreational use and for fish and wildlife habitat, and degrades water quality for human and industrial use. Increased cost of water treatment may be experienced by municipal and industrial water users.

Sediment, nutrient, and chemically enriched water runoff is considered to be "nonpoint source" water pollution. Examples of nonpoint sources include runoff resulting from precipitation and snowmelt; pollution not traceable to a discrete identifiable source, such as a facility or industrial process; and pollution generally best controlled by planning and management techniques rather than by end-of-pipe treatment. Statewide nonpoint source control planning is in progress as a part of the statewide water quality management process. The basic objectives of nonpoint source pollution studies are to: (1) Assess location and degree of nonpoint pollution problems in Iowa, (2) determine causal factors which contribute to nonpoint pollution, (3) suggest feasible control alternatives—technically, economically, and socially—for nonpoint pollution problems, and (4) use publicly supplied information to augment the first three objectives. The paramount charge of nonpoint source pollution planning is to interface public information and attitudes with technical measures designed to reduce nonpoint source water quality problems. The results of this planning effort will be to recommend nonpoint source pollution control alternatives and necessary procedures for implementation, which should be incorporated into the State Water Quality Management Plan.

There seems little question but that public pressure will be brought to bear on individuals and groups responsible for different forms of pollution, including agriculturally-related nonpoint sources. Both public and private costs to achieve suitable measures of control will be high. The U.S. Soil Conservation Service estimates of soil conservation practice needs and associated costs for Iowa will be just short of $2 billion (Table 10-9). These estimates are based on reducing soil losses to the limits already established by Iowa's soil conservation districts.

Gully erosion, Scott County
Soil Conservation Service

TABLE 10-8 Comparison of Irrigated and Nonirrigated Cropland in Iowa and the United States in 1967, by Land Capability

Land Capability Class & Subclass	U.S.	Iowa	Iowa as Percent of U.S.
	(1000 acres)		
I	36,276	3,634	10
II	187,258	12,424	7
E	90,330	6,065	7
W	57,410	6,058	10
S	19,108	273	1
C	20,410	1,023	5
III	141,710	7,901	6
E	80,308	6,914	9
W	33,889	894	3
S	14,927	93	1
C	12,585	—	—
I-III	365,244	23,959	7
IV	49,740	1,574	3
E	35,969	1,300	4
W	6,289	78	1
S	6,574	195	3
C	907	—	—
I-IV	414,983	25,534	6
V	2,076	139	7
E	1	—	—
W	1,890	139	7
S	96	—	—
C	89	—	—
VI	16,325	568	3
E	12,116	536	4
W	817	—	—
S	3,219	32	1
C	174	—	—
VII	4,105	217	5
E	1,988	183	9
W	142	6	4
S	1,948	28	1
C	27	—	—
V-VII	22,506	924	4
VIII	94	—	—
E	3	—	—
W	43	—	—
S	48	—	—
TOTAL	**437,583**	**26,458**	**6**

Source: USDA, National Inventory of Soil & Water Conservation Needs, 1967, Statistical Bulletin No. 461, January 1971.

Conclusions and Recommendations

Water for Agricultural Production

Conclusion

Vegetation in Iowa, including crop, pasture and forage production, and timber and woodlands growth, draws its moisture from the soil profile. The evapotranspiration process, whereby this water stored in the soil profile is utilized in plant growth, is an essential part of the hydrologic cycle in Iowa. Precipitation is the source of water for replenishment of the soil moisture reserves, through infiltration of water through the ground surface and into the soil profile. Approximately 20 inches of water, in equivalent depth of precipitation (acre-inches per acre), are required each season to produce an optimum yield of corn; slightly less is needed for soybeans. Agriculture will continue to depend in large part on these natural processes for the water needed to produce its agricultural crops.

Recommendations

Agriculture in Iowa should continue in its crop, pasture, forage, and timber producing regions to have first priority for precipitation and the soil moisture resources. Continued recognition should be given to the need for adequate precipitation and the need for accurate, long-range weather forecasting.

Support should be continued and be increased as necessary to carry out the functions of the office of the state climatologist. An adequate precipitation and climatological station network should continue to be a high priority, in coordination with other state and federal agencies. Studies needed to further develop forecasting techniques should be implemented by the state climatologist in cooperation with climatologists at the state universities and with other appropriate local, state, and federal agencies.

Conservation tillage practices, crop varieties, and rotations that will encourage infiltration of precipitation (rainfall and snowmelt) into the ground to replenish the soil moisture should be an integral part of the agricultural water management program for the state. Increased attention to and support of the soil conservation districts and the state universities' extension programs should be provided.

Research should continue in plant-water relationships and demands, particularly where water shortages and droughts are recurring problems. The loss of yields due to water stress should be studied in detail, in relationship to temperature stress and other weather variables. The need to develop drought-resistant crop varieties should be explored further.

TABLE 10-9 Estimated Soil Conservation Practice Needs and Costs for Iowa - 1976

Practices for Cropland	Acres (000)	Cost $ (000)
Stripcropping	635	3,175
Terracing	6,192	1,640,880
Grade Stabilization Structure	27	94,150
Grassed Waterway	109	51,775
Farm Pond	54	81,750
Contouring	15,500	NC(1)
Conservation Tillage	15,500	NC
Practices for Pastureland		
Land Conversion	660	46,200
Critical area Planting	78	23,550
Grassland Management	1,300	NC
Practices for Woodland		
Woodland Improvement	83	5,000
Woodland Management	2,950	NC
TOTAL COSTS	**XXX**	**$1,946,480**

Source: Soil Conservation Service, USDA

Note: (1) No Cost

Water for Crop Production

Conclusion

Generally, the major crops grown in Iowa use more water during the growing season (April-September) than is available from precipitation. This soil moisture deficit is made up by the utilization of the soil moisture reserve, which comes from precipitation recharge during the nongrowing season. It is this subsurface reserve that is especially important for plant growth and development during the high-water demand months of July and August. Poor agricultural management practices may increase runoff and reduce needed replenishment of subsurface moisture.

Recommendations

Agricultural land management practices that reduce runoff and preserve and replenish soil moisture should be implemented; such management practices should include measures that increase infiltration rates and increase surface retention allowing additional time for infiltration.

Farm operations should use water conservation management practices to assure the best crop yields within described precipitation probabilities.

Crop breeding should be directed toward producing plant varieties that utilize water more efficiently and better resist drought conditions.

Weather Variability/Weather Modification

Conclusion

Weather variability is the major cause of seasonal fluctuations in food production. Short-term weather fluctuations, within a season or over a period of years, seriously reduce agricultural production. Accurate weather information and interpretation is necessary to anticipate and minimize the disastrous effects of drought, flood, extreme heat, cold, storms, and climatic changes upon the agricultural economy.

Weather modification for agriculture includes both altering the micro-climate, by planting windbreaks, and

modifying mesoscale cloud and storm systems for hail suppression or for increasing precipitation. Cloud seeding has been developing through the past three decades and has been at least partially successful under certain specified conditions. The economic returns for agriculture could be substantial even if small increases in precipitation can be produced. As yet, most successes are reported in mountainous areas and winter storm systems, while results continue to be inconclusive for growing season precipitation increases for the plains states, including Iowa.

Recommendations

The Office of the State Climatologist should assist in and sponsor research urgently needed for developing more accurate medium and long-range weather forecasts for use in long-term agricultural decision making. Statistical climatic analyses should relate the effects of weather and climatic fluctuations upon the agricultural economy in terms of food production, energy consumption, and water usage.

Studies of historical weather variability should be completed to better define climatic trends, fluctuations, cycles, and extreme values that affect agriculture.

Continued and strengthened support for the state's climatological network is recommended. The need for adequate data requires a climatological network for acquiring all agriculturally essential elements, e.g., temperature, precipitation, wind, evaporation, soil moisture, solar radiation, and soil temperature, to be operated in a manner that will ensure homogenous and adequate regional information. The agricultural community should be provided with climatic assessments presenting the cumulative summary effects upon agriculture and issued in a timely manner.

The adoption of a state experimental weather modification program is recommended. The basic needs of agriculture relative to weather modification should be identified and research inaugurated relative to those needs. Those weather modification methods proven by research should be integrated into programs that will consistently benefit agriculture.

An appropriate state resource agency should be designated to monitor weather modification activities. This would include analyzing precipitation amounts, both seeded and unseeded areas, and clouds and storm systems. Legislation should be enacted to authorize the agency to carry out a program to coordinate the activities

Silt accumulation upstream of Upper Iowa River Dam *Soil Conservation Service*

of county weather modification boards established under Chapter 361 of the **Iowa Code**, and to coordinate fully with federal weather modification regulatory agencies to issue permits, monitor chemicals used, and to determine if specific weather modification projects are serving the best interests of the state.

Supplemental Irrigation

Conclusion

Supplemental irrigation can be used in some areas of the state, to augment natural rainfall at critical times during the growing season and to replenish soil moisture during nongrowing periods. The demand for irrigation water is likely to increase in the future. The geographical limits of areas of potential benefit and areas of water availability are not clearly defined, but preliminary judgment would indicate western Iowa should have a high priority for water supply and irrigation studies.

Recommendations

The geographical areas of benefit, the availability of water for irrigation purposes, and the water use efficiency of irrigation systems should be more clearly established with western and northwestern Iowa receiving first consideration for agricultural water supply and irrigation studies. The total costs and benefits associated with potential irrigation areas should be more clearly defined.

As new information becomes available, technical and educational assistance related to irrigation should be provided by appropriate state, federal, and private agencies and organizations; such assistance would include data and information on water availability, water quality, cost/benefit, and management practices.

Physical, legal, social, and institutional arrangements should be established and implemented for the best utilization of surface and groundwater supplies in order to minimize the effects of drought upon agricultural crop production. Responsibilities should include determination of well spacing, withdrawal limits, priorities, etc., in accordance with established guidelines.

For the present and near future, the development of individual farm irrigation systems should be funded from private sources. Public funding and incentives for irrigation should be considered only at such times in the future when governmental aid in the production of food and fiber is recognized as being in the general public interest.

Agricultural Land Drainage

Conclusion

In the north central areas of the state, inadequate drainage of agricultural cropland is a problem. Excess water is a nuisance when it results in reduced crop production and quality, increased costs, and planting and harvesting delays, and decreased farm profits. An extensive number of drainage district mains are in poor condition or are of inadequate size. There are additional legal, institutional, and funding problems in constructing, or reconstructing, drainage mains.

Recommendation

Physical, legal, institutional, and funding arrangements related to the construction or reconstruction of agricultural drainage systems should be analyzed and modified if needed. The role of the conservancy districts in modernizing the existing drainage statutes should be studied in detail.

Agricultural drainage systems should be planned and constructed, or reconstructed, on a watershed basis.

Water Availability for Livestock

Conclusion

Water for livestock will continue to be a major rural water consuming sector. The demand for water for livestock is likely to show modest increases in future years. Where existing livestock water supply problems are minimal, future supplies can be expected to remain adequate. However, there may be problems associated with individual operations.

Tile drainage of agricultural land *Soil Conservation Service*

In some parts of the state, groundwater supplies for livestock are not considered adequate in either quantity or quality. The geographical limits of adequate groundwater supplies are not clearly defined.

Recommendations

Studies should be directed to delineate more clearly the areas of inadequate water availability for livestock, and the extent of the need for alternative sources of water supplies—such as reservoirs.

Studies should be continued in the overall feasibility of rural agricultural water distribution systems.

As appropriate, state technical and educational assistance should be provided for the development of a rural agricultural water distribution system to serve areas where livestock water supplies are inadequate or unsuitable. Planning assistance is the first priority need, followed by construction funding assistance from local, state, and federal sources. Such assistance should include information related to water availability and quality, management practices, and cost/benefit analyses.

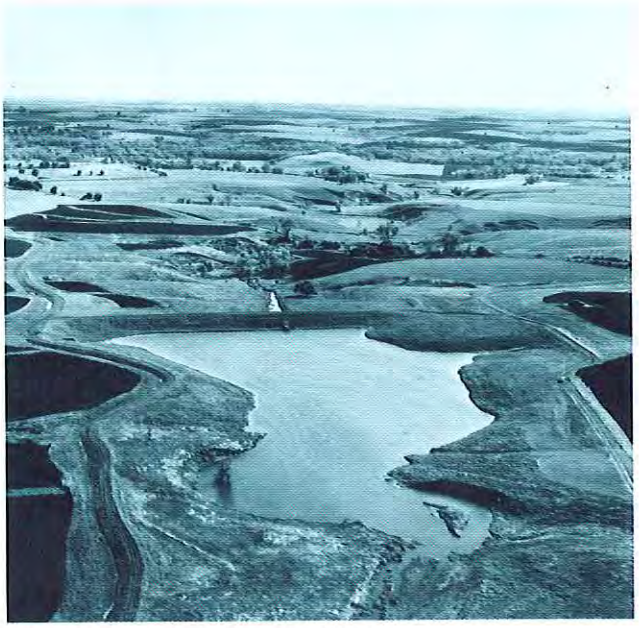
Soybeans on terraces, Wayne County Soil Conservation Service

Soil Conservation

Conclusion

Soil erosion is a significant part of the agriculturally-related water problem. Agricultural runoff can transport significant pollutant substances, principally sediment, nutrients, and chemicals. All of these substances, except agricultural chemicals, are natural components of the environment, and become pollutants when they exceed levels which impair the beneficial uses of water. The protection of Iowa's soil through permanent soil conservation practices, e.g., terraces, erosion control structures, grassed waterways, etc., is fundamental to the future well-being of Iowa and Iowa's water resources.

On many types of soils and under certain slope conditions, conservation tillage methods are acceptable means of maintaining soil losses within acceptable limits. Such reduced tillage methods leave sufficient erosion-retarding crop residue on the surface of the field.



Watershed structure, Cherokee County Soil Conservation Service

Recommendations

The state soil conservation program should be strengthened. Agricultural land in the state should be protected and utilized in accordance with its capabilities. Permanent soil and less intensive cropping patterns, and properly managed pasture, should be adopted to bring soil losses within acceptable limits. Increased state funding of cost-share assistance for such practices is recommended.

Incentive programs should be considered as a means of encouraging permanent soil conservation practices; such incentives might include tax credits, preferential agricultural land assessment, low interest loans, and additional grants.

Governmental actions should be considered that encourage conservation tillage methods through incentives and regulatory requirements. The feasibility of financial incentives for conservation tillage methods should be analyzed as a means of achieving acceptable soil loss limits.

On-going research and educational programs, illustrating and documenting conservation tillage methods as a part of good agricultural management practices, should be continued and intensified.

Agricultural management decisions should consider the impact of agricultural chemicals on water runoff. Agricultural chemicals should be applied at rates and at times that minimize associated nonpoint pollution.

Technical research and education programs should be continued and intensified as a part of the total effort directed at soil conservation and erosion control technology.

Nonpoint Pollution Control Planning

Conclusion

A nonpoint pollution control planning study is now in progress in the state. This study is a part of a larger federally funded program related to statewide water quality, as authorized in P.L. 92-500. The objectives of the nonpoint portion of the program include (1) an assessment of the magnitude and location of nonpoint

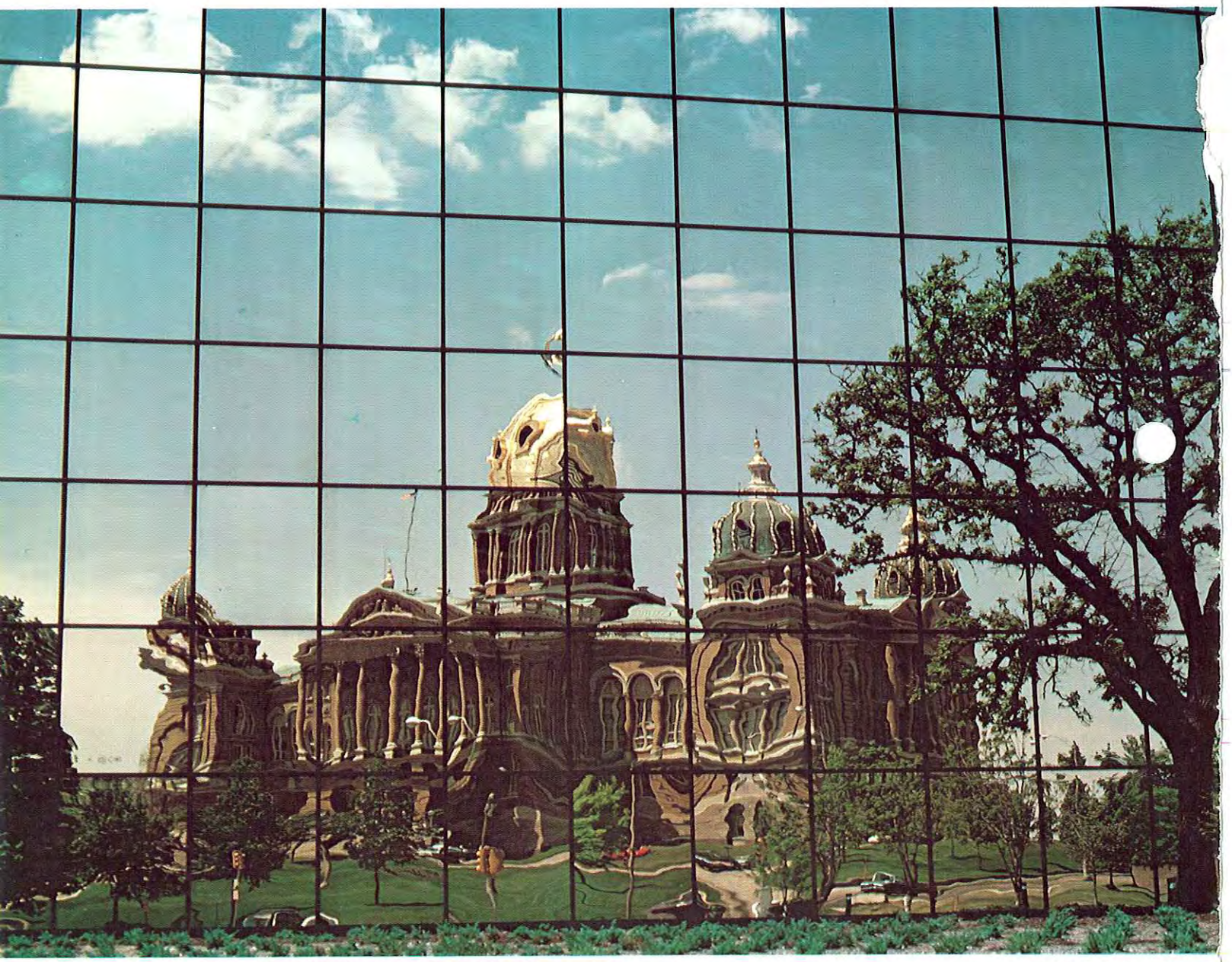
water pollution problems within the state, (2) the determination of the causal factors and processes that contribute to nonpoint pollution problems, (3) suggested feasible control alternatives for nonpoint pollution problems, (4) the utilization of public participation to actively aid in supplementing and executing the previous objectives.

The major work product of the study will be the development and recommendation of nonpoint pollution control alternatives, and necessary procedures for implementation. The results of the nonpoint pollution planning will become part of the State Water Quality Management Plan.

Recommendations

As information becomes available, appropriate recommendations obtained from the 208 nonpoint source pollution study should be appendaged to the state water framework report.

Watershed treatment, Woodbury County *Soil Conservation Service*



Iowa State House reflected in Henry A. Wallace Building *W. E. Akin*

11 Law and Government

With the coming of age of the "multi-use" concept in water resource planning, a need has emerged to analyze the legal-institutional arrangements that implement water resource programs to determine whether they are efficiently and equitably administered. This analysis is a necessary first step in development of a comprehensive state plan for the beneficial use and allocation of its water resources among competing uses.

The objective of this summary is first, to present an overview of the institutional arrangements created under Iowa law to manage various aspects of the state's water resources; and secondly, to highlight substantive state laws that play a key role in its management. Following this overview of Iowa's law and government for water resource management is a set of conclusions and recommendations taken from the Task Force Report on Iowa Law and Government Affecting Water Resource Management.

Iowa's Governmental Arrangements for Water Resource Management

The governmental arrangement for water resource management in Iowa is comprised of over thirty agencies at the state, county, municipal, and special-purpose district levels of government. These agencies administer numerous and often interdependent programs which are briefly outlined below. A summary matrix of these programs and the agencies that administer the programs is provided in Figure 11-1.

State Level

While there are numerous state agencies having water resource management programs, five agencies carry the primary responsibility for this management: the Iowa Natural Resources Council (INRC), the Department of Soil Conservation (DSC), the Department of Environmental Quality (DEQ), the Iowa Conservation Commission (ICC), and the Iowa Geological Survey (IGS). The internal organizational structure of these agencies is illustrated in Figure 11-2.

The State Comptroller's Office classifies these agencies, as well as several others, by function as "natural resource" agencies for budgetary purposes. Table 11-1 provides a breakdown of the general fund appropriations among various functional agency classes by the 67th General Assembly for fiscal year 1978. As the table indicates, natural resource management programs comprise less than 2 percent of all general fund appropriations. Table 11-2 provides a further breakdown of general fund appropriations within the natural resource functional classification for each agency.

The INRC water resource programs focus on flood plain management, regulation of water withdrawals and use, and water resource planning and coordination. Specific activities engaged in by the INRC include establishing flood plain encroachment limits; issuing flood plain construction permits; regulating the construction and operation of flood control projects and milldams; regulating the alternation of water levels behind dams; processing applications and issuing permits for diversion, storage, and withdrawal of water for uses subject to the permit system; preparing and updating a water plan for control, utilization, and protection of the state's water resources; coordinating federal water resource projects with state, county, and local needs; and regulating oil and gas well drilling and the use of water in the drilling process.

The DSC administers the state's surface mined land reclamation program, assists the state's six conservancy districts (CD's) and 100 soil conservation districts (SCD's) in the administration of soil erosion abatement programs, and engages in nonpoint source water pollution abatement planning in cooperation with DEQ and EPA. The surface mine reclamation program involves enforcement of mining operation procedures that minimize soil erosion and water pollution. The CD programs include preparing a comprehensive plan for the protection of soil and water resources; constructing and operating improvements to implement this plan; and coordinating the soil erosion programs of other counties, cities, and special purpose districts. The SCD programs, which are administered by the 100 SCD's with DSC technical and administrative assistance, include preparing plans for the prevention of soil erosion and flood damage; establishing erosion control demonstration projects; distributing educational material; financing and constructing soil erosion and flood prevention practices (cost-share); and establishing and enforcing soil loss limits.

The DEQ administers the state's air, land, and water pollution control and abatement programs. The water pollution control program includes regulating point source dischargers and animal feeding operations; regulating the construction, operation, maintenance, and financing of municipal wastewater disposal systems; setting and enforcing water quality, effluent, and pretreatment standards; setting detergent labeling standards; and developing comprehensive plans for pollution abatement, including nonpoint source abatement planning required under section 208 of the Federal Water

The information presented in this chapter is based on the "Task Force Report on Iowa Law and Government Affecting Water Resource Management," prepared by and filed with the Iowa Natural Resources Council.

FIGURE 11-1 Agency-Program Matrix of Iowa's Water and Related Land Resources

INSTITUTION / WATER RELATED ACTIVITY	Water Withdrawal, Diversion	Water Level and Flow	Public Water Supply	Agricultural Chemical Use	Discharge into Water	Sewage Disposal	Solid Waste Disposal	Commercial Feedlots	Other Water Quality	Dams / Water Impoundments	Farm Ponds	Reservoirs	Flood Plain Activities	Drainage	Soil Conservation	Mining	Oil and Gas Wells	Water Wells	Weather	Electric Power	Piers and Docks	Dredging, Gravel Removal	Shoreline Alteration	Roads and Bridges	Fish and Game	Parks and Outdoor Recreation	Navigation	Scenic, Landscape Preservation	Zoning	Water and Related Land Planning
STATE AGENCY:																														
Iowa Natural Resources Council	R[1]	R[2]	R[3]		R[4]			R[5]	R[6]	R[7]	R[8]	R[7]	R[9]	R[10]			R[11]	R[1]		R[1]	R[9]	R[9]	R[9]	R[9]			R[12]	N[13]	R[14]	R[15]
Department of Environmental Quality			R[16]	R[17]	R[18]	R[19]	R[20]	R[21]	R[22]	R[23]				R[24]	N[25]	R[22]		R[16]		R[26]	R[22]	R[22]	R[22]	R[22]						R[27]
Department of Soil Conservation									N[28]					R[29]	R[30]	R[31]						R[31]	R[30]					R[31]		N[32]
Iowa Geological Survey	N[33]	N[33]	N[33]		N[33]										N[33]	N[34]	R[35]	N[36]	N[33]											N[33]
Iowa Conservation Commission										R[37]	N[42]	R[39]			N[38]						R[39]	R[40]	R[39]	R[41]	R[42]	R[43]	R[44]	N[45]	N[45]	N[46]
Department of Health			R[47]			R[47]								R[47]																
Department of Agriculture				R[48]															N[49]											
Iowa Commerce Commission			R[50]						R[50]											R[51]										R[52]
Department of Transportation														N[53]	R[54]								R[54]	R[55]		N[56]	N[57]	N[56]		N[58]
Iowa Development Commission																										N[59]				
Energy Policy Council																N[60]	N[60]			N[60]										N[60]
Office for Planning and Programming																														N[61]
Executive Council												N[62]								R[63]						N[64]				
State Hygienic Lab									N[65]																					
Historic Department																												N[66]		N[66]
Mississippi Parkway Planning Commission																								N[67]		N[67]				N[67]
State Extension						N[68]	N[68]	N[68]	N[68]		N[68]			N[68]	N[68]															N[69]
SPECIAL PURPOSE DISTRICTS:																														
Conservancy District									N[70]	N[70]			N[70]	N[70]	N[70]															N[71]
Soil Conservation District									N[72]	N[72]			N[72]	N[72]	R[72]								N[72]							N[73]
Drainage or Levee Districts						N[74]				N[75]			N[75]	N[75]	N[75]								N[76]							
Erosion and Flood Control										N[77]			N[77]	N[77]	N[77]	N[77]							N[77]							
County Agricultural Extension District					N[78]	N[78]	N[78]		N[78]		N[78]		N[78]	N[78]	N[78]								N[78]							
Rural Water District	N[79]	N[79]	N[79]							N[79]		N[79]						N[79]												N[82]
Benefited Water District	N[80]	N[80]	N[80]							N[80]		N[80]						N[80]												N[82]
Sanitary District	N[81]	N[81]				N[81]																								N[82]
Metropolitan or Regional Planning Commission																														N[82]
COUNTY			R[83]			R[84]	R[85]						R[86]	R[87]	N[86]	N[86]			N[88]				N[86]	N[89]	N[90]	N[90]		N[90]	N[91]	N[92]
MUNICIPAL	←														R[93]															→

KEY

R— Agency has regulatory power over private sector actions involving the water related activity.

N— Agency has power to implement programs involving the water related activity.

The numerical superscripts to "R" and "N" refer to footnotes citing pertinent Iowa Code sections. The footnotes are part of the Law and Government Task Force Report, but they have been omitted from the Framework Study due to their length.

Pollution Control Act. In addition to pollution control, DEQ also administers a public water supply program that involves the setting of safe drinking water standards; regulating construction, operation, and maintenance of public water supply and distribution systems; and preparing a safe drinking water emergency plan for the state. Other DEQ programs indirectly affecting water quality include regulatory programs relating to sanitary landfill projects, spill prevention and cleanup of hazardous materials, land application of residual wastes, and the sale, use, and disuse of agricultural chemicals, including fertilizers and pesticides.

The ICC administers the state outdoor recreation, fish and wildlife programs and regulates construction on the beds of the state's meandered streams. The outdoor recreation programs include acquisition, development, and operation of state parks, waters, forests, recreational areas, and preserves; preparation of an outdoor recreation plan; designation of scenic rivers; supervision of the county conservation boards; and regulation of recreational navigation. The fish and wildlife programs include establishment and enforcement of sport and commercial fish and game laws; operation of fisheries and game farms; and acquisition and maintenance of fishing, game management, and hunting areas.

The IGS is unique among the state's water resource agencies. Unlike the above mentioned agencies, IGS is not required to regulate, develop, or manage any natural resources. Instead, IGS is authorized to engage in natural resource research and data-collection. In this capacity, the IGS provides extensive technical assistance to other agencies and the public. In particular, IGS provides significant technical support services relating to water availability and water quality needed by the INRC and the DEQ in administering their various water related programs. Private well drillers also rely heavily on IGS data. Some of the research and data-collection activities the IGS engages in include monitoring, in cooperation with the U.S. Geological Survey, stream flows for quantity and quality; preparing the basic water availability data for the INRC's **Water Plan '78**; investigating the state's underground water supplies; mapping of flood plains with sophisticated aerial photography; studying the economic feasibility of irrigation and coal mining in Iowa; assisting DEQ in establishment of geological criteria for selection of sanitary landfill sites; and investigating thermal water pollution.

Besides the above five agencies, other state agencies with less extensive responsibility in water resource management include the Iowa State Commerce Commission, Department of Health, Department of Transportation, Department of Agriculture, Iowa State Historical Department, Energy Policy Council, Iowa Development Commission, Office for Planning and Programming, Executive Council, Department of Public Defense, Mississippi Parkway Planning Commission, Inter-Agency Resource Council, and various research and service institutes affiliated with the state university system.

The Iowa State Commerce Commission (ISCC) is responsible for regulating the service and rates charged by non-exempt public utilities that furnish water by a piped distribution system for compensation. Rural water districts and municipal water utilities are exempt from this regulation.

The Department of Health regulates the construction and alteration of individual, private sewage disposal systems, and promulgates and enforces a state plumbing code applicable to all buildings within a city. The plumbing code specifies minimal construction requirements for both the sewage disposal and water supply systems of a building.

The Iowa Department of Transportation (IDOT) affects water resources when constructing roads, rest areas, culverts, and bridges near or over streams. The Department's river transportation diversion explores the feasibility of developing river transportation and port facilities that can be integrated with other modes of transportation.

The Department of Agriculture, in cooperation with DEQ, regulates pesticides and fertilizers, major sources of water pollution. This regulatory program includes licensing pesticide dealers and commercial applicators, and registering pesticides before they can be distributed and sold. The Department also has a weather and climate section that is authorized to collect and disseminate weather data and establish voluntary weather stations.

The Iowa State Historical Department, through its Division of Historical Preservation, identifies and documents historic properties, prepares a state preservation plan, and develops and researches sites of historic, architectural, and archaeological value. Since human settlement patterns in both prehistoric and historic times are highly correlated with the presence of water, the Division's activities inevitably affect water resource development as it identifies and recommends management efforts for culturally important sites that are often located near streams and lakes.

The Energy Policy Council is authorized to evaluate alternative energy sources and the environmental impact of using each source in the course of studying and recommending a state energy policy. Since large quantities of water are needed in coal gasification operations and by electric power stations for cooling and operating various air pollution control processes, and by coal companies to wash coal mined in Iowa which has a high sulfur content, the Council's energy policies could have significant influence on future demand for each development of water resources.

The Iowa Development Commission is charged with promoting development of the state's agricultural, industrial, and recreational opportunities. These opportunities are partially a function of existing and future water resources.

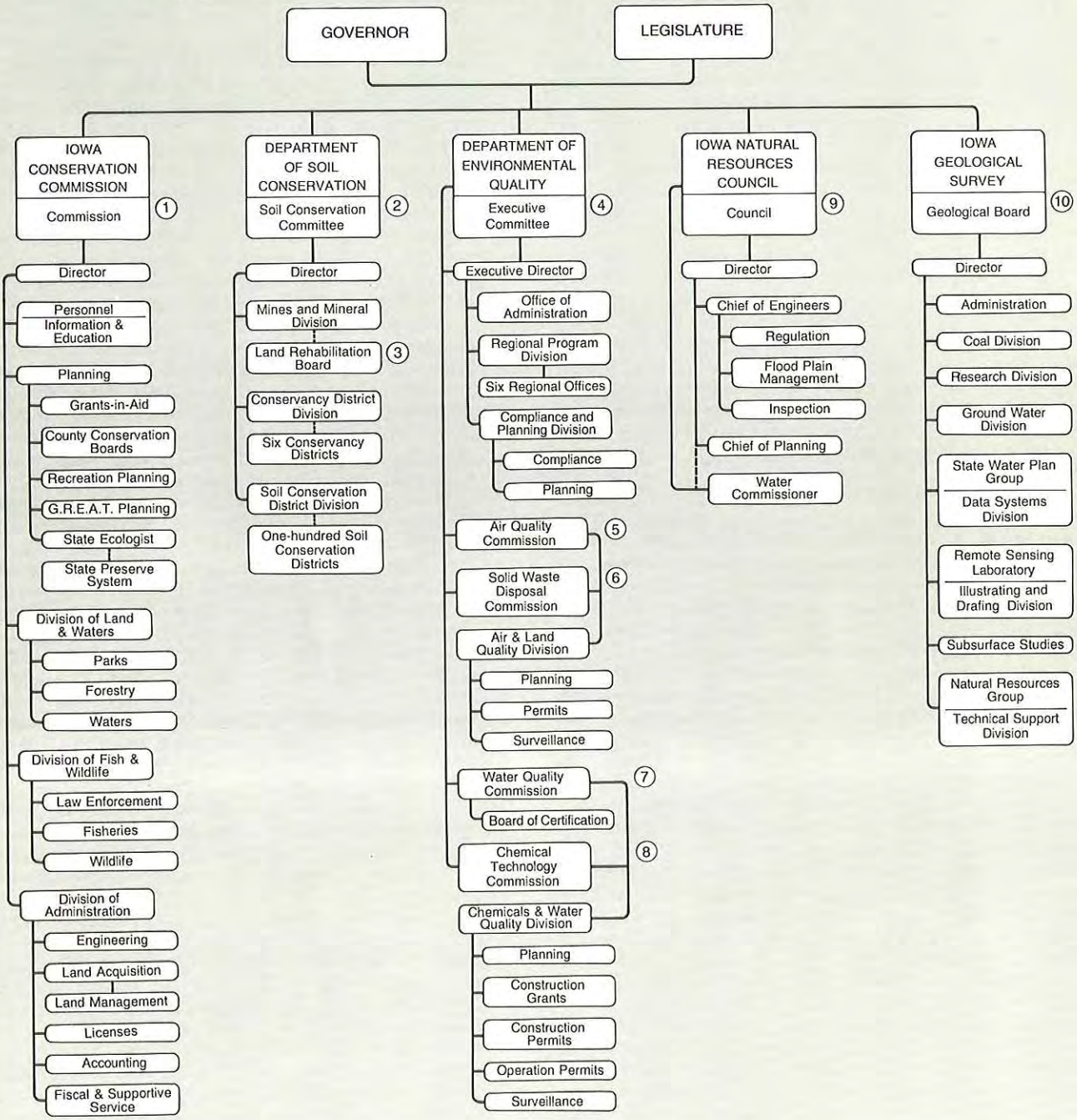
The Office for Planning and Programming (OPP) has no substantive program relating to water resources, but it is authorized to function as a facilitator for and coordinator of government programs at the federal, state, and local levels. It has also studied land use regulations of state and local units of government.

The Executive Council is authorized to provide flood disaster aid to any governmental subdivision that is unable to meet its governmental responsibilities due to flood damage. It must also approve the construction, operation, and maintenance of hydroelectric plants.

The Department of Public Defense includes an Office of Disaster Services, which is responsible for preparing and administering the state's disaster services and emergency planning affairs. Disasters, such as floods and droughts, are handled by this office. Pursuant to the Governor's 1977 drought disaster emergency proclamation, this office worked with the INRC in processing emergency water permits.

The Inter-Agency Resources Council is an informal organization consisting of department heads from the following agencies: Governor's Office, Department of Agriculture; State Archaeologist, Conservation Commission, Energy Policy Council, Iowa Natural Resources

FIGURE 11-2 Organizational Structure of Iowa's Five Agencies Having Primary Responsibility for Water Resource Management



1. The Conservation Commission consists of seven citizens knowledgeable in conservation matters who are appointed by the Governor with the approval of two-thirds of the Senate. No more than four may be of the same political party when appointed.
2. The State Soil Conservation Committee consists of six farmers, one city representative and one mining representative who are all appointed by the Governor with Senate confirmation, and five ex officio nonvoting members.
3. The Land Rehabilitation Board serves in an advisory capacity to the Department of Soil Conservation and consists of a geologist, forester, agronomist, two surface mine operators, and representatives of the Soil Conservation Committee and the Iowa Natural Resources Council.
4. The Executive Committee consists of the chairpersons of the four department commissions and six nonvoting ex officio members.
5. The Air Quality Commission consists of one farmer, one manufacturer and two electors of the state, who are all appointed by the Governor with two-thirds Senate approval, and the president of the Iowa Medical Society.
6. The Solid Waste Disposal Commission consists of one farmer, one manufacturer and two electors of the state, who are all appointed by the Governor with two-thirds Senate approval, and the president of the Iowa Engineering Society.
7. The Water Quality Commission consists of one farmer, one manufacturer and two electors who are all appointed by the Governor with two-thirds Senate approval, and the chairperson of the Iowa Development Commission
8. The Chemical Technology Commission consists of a chemical manufacturer and a farmer, who are appointed by the Governor with two-thirds Senate approval, and seven ex officio members.
9. The Iowa Natural Resources Council consists of nine voting members appointed by the Governor with two-thirds Senate approval, and one nonvoting ex officio member representing the Department of Environmental Quality.
10. The Iowa Geological Board consists of the Governor, Auditor of the State, presidents of Iowa State University, and The University of Iowa and president of the Iowa Academy of Science.

--- Denotes an administrative or coordinating relationship.

Council, Department of Soil Conservation, Department of Environmental Quality, Iowa Geological Survey, and Department of Transportation. Other state agencies are called upon if the Council's agenda topic requires their attendance. The purpose of the council is to address issues of inter-agency and state concern to promote departmental coordination and solidarity of a state position or attitude.

The Mississippi Parkway Commission serves in an advisory capacity to the DOT and the Conservation Commission on the construction of the Great River Road, a scenic and recreational highway that parallels the Mississippi River, the state's single most important water resource.

There are many research and service institutes affiliated with the state university system that study water related problems. The University of Iowa houses the Institute of Hydraulic Research and the State Hygienic Laboratory, as well as the offices of IGS. The Institute of Hydraulic Research does basic and applied research in the area of fluids. The Hygienic Laboratory provides laboratory and data collection support for the water quality programs of the Department of Health and DEQ.

Iowa State University, the state's land grant college, houses the Iowa State Water Resources Research Institute (ISWRRI), the University Extension Service, the Agricultural and Home Economics Experimental Station, and the Engineering Research Institute. The university also offers M.S. and Ph.D. programs in water resources. ISWRRI is partly funded by the federal government to engage in water resource research and training. The Extension Service, through its Cooperative Extension Service branch, offers conferences, consultations, and activities relating to such topics as animal waste management, wildlife conservation, zoning, recreational development, and pesticide application. The Agricultural Experimental Station conducts basic and applied research on a wide range of agricultural topics many of which directly or indirectly influence the state's waters. The Engineering Research Institute conducts research relating to sanitary engineering and other engineering problems.

County Level

County government is vested with various duties and powers directly or indirectly affecting water resources. Many of these powers are vested in the county board of supervisors, while others are vested in administrative subunits of the county, such as the county conservation board, the county board of health, the zoning commission, or the weather modification board.

County involvement in flood and soil erosion control programs can take several forms. The county board of supervisors may establish and manage soil conservation and flood control districts, and provide funding to soil conservation districts for watershed projects. The county supervisors may also construct, operate, and maintain flood and soil erosion control programs on their own lands and zone non-urban flood plains with the approval of the INRC.

The county supervisors are also involved with drainage matters. They may establish and manage drainage and levee districts and are the initial arbitrators of individual drainage right disputes when one landowner needs a drainage outlet across another's land and the parties cannot agree as to compensation. In cities, a county board of health is responsible for enforcing the Department of Health's plumbing code which places certain restrictions on the exterior surface and subsurface drainage of buildings. County road construction activities also have direct effects on watercourse drainage patterns.

County conservation boards, which have been created pursuant to local voter approval in all counties except Allamakee, are authorized to provide programs for public recreation and natural resource conservation. The programs include comprehensive planning, and the establishment and maintenance of parks, preserves, forests, museums, conservation and wildlife areas, playgrounds, and other recreational areas. The State Conservation Commission must approve the acquisition of land and general development plans when costs exceed $2500.

County programs affecting water quality relate primarily to the regulation of solid waste and sewage disposal. All counties, via their county health boards, must establish alone or jointly with a city, a sanitary disposal site for solid wastes in accordance with DEQ regulations. The county health boards also enforce the Department of Health's State Plumbing Code regulations for individual private water disposal systems. The county supervisors also oversee the establishment of sanitary districts created in the county, and may even establish sewage disposal systems that are funded by user fees and revenue bonds issued against them.

County water supply programs are limited to supervision of the establishment of benefited water districts and rural water districts, and to the county board of health's enforcement of the State Plumbing Code regulating urban water supply systems.

A county weather modification board may be established in counties to investigate, develop, and administer an artificial weather modification program. Funds for the program can be raised by a special two cent per acre tax levy on the county's agricultural land, provided a majority of the voters approve the levy at a general or special election.

Besides the above county programs affecting water and land related resources, counties are authorized to engage in a number of more general land use controls which also affect water resource development. These controls include zoning and subdivision ordinances and building and housing codes. When properly used, these controls provide significant opportunity for integrated management of water and land related resources.

Municipal Level

In November, 1968, Iowa voters approved a state constitutional amendment granting municipalities broad home rule powers. Under home rule, a municipality can exercise any power, other than a taxing power, if it relates to local affairs and government and is not inconsistent with the laws of the General Assembly. The fact that the **Iowa Code** does not explicitly authorize a city to exercise a certain power does not, in itself, invalidate the exercise of that power. Of course, the General Assembly has concurrent and superior power over a city's local affairs and may preempt a given field if it so desires. Thus, the net effect of the home rule amendment is that a city may engage in almost any water resource program subject to the following three limitations: (1) the activity must be financed only from specially authorized taxes; (2) the activity is consistent with existing state law, and (3) the activity relates to local affairs.

Since the home rule amendment does not give a city the power to levy a tax at its discretion, the General Assembly retains significant control over a city's capacity

to deliver services. Various provisions of the **Code**, however, authorize municipal taxation that can be used to fund water resource projects. These authorized taxes include a general fund tax, a debt service fund tax, special assessments, user fees, a capital improvement tax, a sanitary disposal planning tax, various bridge taxes, improvement district taxes, and a levee improvement tax.

The second limitation placed on municipal home rule—that the activity be consistent with state law—does not necessarily bar a city from engaging in water related activities that other governmental units also engage in. Thus, cities have historically provided water supply, drainage, and sewage disposal services and developed water resources for recreational purposes.

The final limitation placed on home rule—that the activity relate to local affairs—precludes cities from engaging in activites of a statewide concern. The only way to determine whether something is local is to seek a judicial decree. To date, the Iowa Supreme Court has found, among other things, sewage collection and disposal a local concern and has generally construed what constitutes a local concern broadly.

Special-Purpose District Level

The **Iowa Code** authorizes the creation and operation of numerous special-purpose districts. Eight such districts have programs affecting water resource management. These include: conservancy districts (Chapter 467D), soil conservation districts (Chapters 455, 456-467), soil erosion and flood control districts (Chapter 467C), county agricultural extension districts (Chapter 176A), rural water districts (Chapter 357A), benefited water districts (Chapter 357), and sanitary districts (Chapter 358). Each district has its own policy mandates, procedure for formation, administrative and funding powers, personal jurisdiction, and authorized activities. The enabling acts should be consulted for particulars.

The six conservancy districts cover the entire state with boundaries running along the watershed lines of six major state river basins. These districts, assisted by the Department of Soil Conservation, are authorized to engage in soil conservation planning and to construct soil erosion and flood control works. Because of funding limitations and the absence of district taxing powers, the conservancy district programs have been limited to planning activities.

The state's one hundred soil conservation districts cover the entire state and are also authorized to construct and operate soil erosion and flood control works. In addition, the districts set and enforce acceptable soil loss limits on various types of soil. Mandatory compliance with these limits is required only if the state or some other party provides 75 percent of the funds needed to halt the excessive erosion. Subdistricts of a soil conservation district may be formed by the landowners of a watershed for the purpose of implementing particular soil erosion and flood control practices. These subdistricts have the authority to levy an annual tax to finance their operations.

Drainage and levee districts may be formed by local landowners for the purpose of building drainage structures, although the districts may also construct soil erosion and flood control structures. In general, the drainage district laws are complex, poorly organized, and in need of revision.

A soil conservation and flood district is similar to drainage districts in purpose for creation, operation, and function, except that a county board of supervisors may establish these districts to handle surface mine erosion problems, and their formation must be approved by the local soil conservation district, the INRC, and the ICC.

TABLE 11-1 67th General Assembly Appropriations from the General Fund for FY 1978* and Governor's Recommendation for FY 1979 by Agency Function**

Agency Function	1978 FY		Gov. Rec. for FY 1979	
	Appropriation	Percentage	Appropriation	Percentage
State Departments	74,800,075	5.35	83,938,750	5.61
Education	717,998,167	51.42	776,441,519	51.85
Human Resources	266,988,047	19.12	283,347,006	18.92
Transportation and Law Enforcement	28,890,720	2.06	31,477,470	2.10
Natural Resources	17,833,051 (24,063,051)+	1.27 (1.72)+	22,115,601 (28,365,601)++	1.48 (1.90)++
Miscellaneous Tax Credits, Aids, Inc. Offsets, and Tax Refunds	289,580,077 (283,350,077)+	20.74 (20.29)+	300,014,486 (293,764,486)++	20.04 19.62 ++
TOTAL General Fund Appropriations	**1,396,090,137**	**100**	**1,497,334,832**	**100**

*Source: Exhibit D from "State of Iowa General Fund Statement, July, 1977" prepared by the State Comptroller (dated October 12, 1977).

**Source: Exhibit D of Governor's Budget Supplement to the Second Session of the 67th General Assembly (dated January 11, 1978).

+Percentage Adjusted to reflect DEQ sewage grant aid of $2,000,000 and DSC conservation cost share of $4,230,000 inclusion in Natural Resource category and exclusion from Miscellaneous Tax Credit and Aids category.

++Percentage Adjusted to reflect DEQ sewage grant aid recommendation of $2,000,000 and DSC conservation cost share recommendation of $4,250,000 inclusion in Natural Resource category and exclusion from Miscellaneous Tax Credit and Aids category.

The one hundred county agricultural extension districts engage in educational programs relating to agriculture, home economics, and rural and community life. Many of their topics deal with water resource management problems.

Rural water districts may be created by landowners to provide an adequate supply of water for domestic purposes when they are not served by a city water system and cannot feasibly obtain adequate water supplies from private wells. Benefited water districts, in contrast, are authorized to provide a public water supply for domestic, fire, and other uses with the legislative intent being that the districts utilize a municipal water supply source if possible.

Sanitary districts are authorized to construct and operate sewage and industrial waste disposal systems. This includes trunk sewage lines, waste treatment plants, and auxiliary equipment.

Iowa's Water Resource Management Laws

The governmental arrangements discussed in the first part of this report are responsible for implementing a group of substantive laws that defines various rights of the public and the private landowners to use the state's water resources. These laws relate to the following four functional areas of regulation: (1) water use and quantity control; (2) water quality control; (3) drainage; and (4) stream and related shoreline use.

Water Use and Quantity Control Laws

Two basic archetype legal systems exist in the United States for governing the type and quantity of water use —the doctrine of riparian rights and the doctrine of prior appropriation. The riparian doctrine prevails in 31 more-humid eastern states, while the prior appropriation doctrine prevails in 17 more-arid western states. The touchstone of the riparian system is the concept that water use rights usually are associated with the ownership of the land. In contrast is the prior appropriation's concept that water use rights depend on making a timely claim to water use for beneficial purpose.

Iowa historically has been associated with those states employing the riparian doctrine to allocate water. However, the Supreme Court has not ruled on certain aspects of that doctrine, and in 1957, the Legislature passed a law requiring the issuance of a permit for most uses of water in excess of 5,000 gallons per day. As a result, Iowa now has a legal system for allocating water that is a hybrid lying somewhere between the riparian and prior appropriation systems. The riparian doctrine still applies to the extent a particular use is not subject to the permit system's regulatory scheme.

The following discussion of Iowa's water use and quantity control laws will focus first on the common law riparian doctrine as articulated by the Iowa Supreme Court; then consideration will be given to the nature and scope of the statutory water permit system.

Common Law Water Rights and the Riparian Doctrine

Under common law, the principles regulating the allocation of water varied, depending on the source of withdrawal and the nature of the water use. Water taken from lakes and surface or underground streams was subject to one allocation scheme, while water taken from a percolating groundwater source (i.e., an aquifer) was subject to another scheme.

In the case of lake and surface or underground stream withdrawals, water used for "natural" purposes had superiority over water used for "artificial" purposes. Water uses for ordinary domestic and livestock purposes were considered natural; and other water uses, such as those for municipal supply, industrial, and irrigation purposes, were considered artificial. Between competing users for natural purposes, the party controlling the water source had superiority. Between competing users for artificial purposes, each had a right to "reasonable use" of the stream's flow. This reasonable use test considered the size and capacity of the stream, the wants and needs of all the riparian landowners, the character of the soil, and any other factors relevant to the use of water. A "wasting" use of water was prohibited.

In contrast, the allocation scheme for water taken from percolating groundwater sources was much simpler: water from these sources could be taken for any beneficial use and in any quantity regardless of the effects on others provided there was no wasting. Unfortunately, this doctrine developed during an era when little was known of groundwater hydrology and its relationship to surface water. It is questionable whether modern courts would follow this crude rule of allocation. In any event, the landowner withdrawing water from an aquifer had greater use rights at common law than did one withdrawing water from a stream; but there was less probability of legal recourse for impairment of an aquifer source than for impairment of a stream source.

Besides the fundamental rule for water allocation between competing users, courts have had to develop ancillary principles that also influence water allocation. The common law of many states prohibits the use of water on lands that are outside either the stream's watershed or the original tract of land abutting the stream. The Iowa Supreme Court has not yet passed on this issue. Such limitations are undesirable since the most beneficial use of water often is not tied to such parcels of land.

Another common law principal relates to ownership of the water. No riparian can lay claim to water; title is held by the state and the landowner merely has certain rights to use that water. Because of the usufructuary nature of these rights, it is unclear to what extent state interference with them is a "taking" of property for which compensation is required. However, the Iowa Supreme Court has noted that governmental rights over water resources are more substantial than that over other natural resources.

Water Permit System

Under the water permit system authorized by Chapter 455A of the **Code**, a person desiring to withdraw quantities of water in excess of 5,000 gallons per day for uses other than those exempt by statute* must obtain a permit from the Iowa Natural Resources Council prior to withdrawal of the water. Unfortunately, many of the exempt water uses are designed to accommodate special interests and have no rational basis within the context of an overall regulatory scheme for allocating water.

Prior to the issuance of a water permit, the water commissioner must hold a hearing on the permit application. The duration of the permit cannot exceed ten

* *The use of water for ordinary household and livestock watering purposes are exempt. Other exemptions are listed on page 193.*

years, with the exception that permits for storage of water may be granted for the life of the structure. If there is a change in the quantity or source of withdrawal or in the use of the water, then a new permit must be obtained. While a permit is generally irrevocable, the Council may modify or cancel it in a number of situations.

All water permits are appurtenant to the land. Thus, they can be transferred only when the land on which the water withdrawal point is located is also transferred.

The Council has a mandate to consider a broad range of criteria before issuing a permit. These criteria include: (1) the declared policies and principles of beneficial use set forth in Chapter 455A; (2) the effect on the natural flow and the established average minimum flow; (3) effects on landowners whose water use might be altered; (4) effects on landowners with prior, superior, or vested rights; (5) effects on the public interests; (6) effects on water quality; (7) effects on navigability; and (8) compatibility with the state water framework study.

While Chapter 455A does not explicitly require the Council to establish a priority system for allocating water, these criteria implicitly suggest that the Council has such authority. Following the 1976-1977 drought period, the Council recognized a serious need for creating a priority system. As water demands grow, it appears inevitable that some sort of water priority scheme will be needed. Without such a priority system, water users will lack the certainty needed for investment in water-dependent activities. The Council has begun to implement a priority system on an aquifer-by-aquifer basis where stresses on the supply source have occurred.

A number of problems plague the water permit program. First, the INRC faces a serious backlog of water permit applications, resulting from increased interest in irrigation during the drought of 1976-1977. Without increased staffing, this backlog cannot be reduced in the near future. A possible means proposed by the Council for funding an expanded water permit program is to charge a water user fee based on consumption, or an increased filing fee. With such charges, the water permit program would both allocate water more efficiently and be a self-supporting administrative program.

A second problem with the water permit system is the confusion generated by the use of terms such as "prior", "superior", and "vested" rights in Chapter 455A. The use of these terms should be clarified.

A final problem affecting the water permit system is a lack of adequate penalities to defer illegal water withdrawals. Under present law, the fine for illegal water withdrawals is $100, plus $100 a day for each day that such violation continues after conviction. This fine schedule has not proved to be a significant deterrent to irrigators during the recent 1976-1977 drought. Legislation is needed to remedy the problem.

Water Quality Control Laws

The Department of Environmental Quality (DEQ) is the state agency with primary responsibility for water quality control. Pursuant to the mandate of the Federal Water Pollution Control Act, as amended, and the EPA regulations, DEQ sets ambient water quality standards for all Iowa waters and effluent standards for all "point source" discharges, including municipal discharges. Effluent dischargers must obtain a permit from DEQ. DEQ also enforces a nondegradation policy that provides for maintaining the existing quality of a stream's water where its quality exceeds the requirements of the ambient water quality standards. Exceptions to the nondegradation policy can be made only if DEQ determines through the continuing planning process that there is a need to lower the water quality because of a necessary and justifiable need for economic or social development.

Besides regulating discharges, DEQ oversees the financing, construction, and operation of waste treatment disposal systems and public water supply and distribution systems. DEQ, in cooperation with the Department of Soil Conservation, is also charged to develop plans for abating nonpoint source pollution.

The INRC also has authority to consider water quality matters when issuing water permits. A permit can be denied by the Council if it feels the proposed water use will result in water pollution.

Besides the government programs for regulating water quality, a riparian has a right under the common law to be free of an unreasonable impairment of his use of a stream's flow by upstream riparians. The enforcement of riparian rights, however, is left to the individual landowners, who must initiate civil litigation if necessary.

Drainage Laws

There are three major drainage law sources—the common law, Chapter 465, and the drainage and levee district laws. The Iowa common law provides that a lower landowner cannot complain of an upper landowner's drainage activities, unless the discharge resulting therefrom is so greatly increased that substantial injury results to the lower landowner. This is known as the "reasonable use" rule.

Chapter 465 provides a procedure whereby drainage disputes among landowners are resolved. If the dispute cannot be resolved, a condemnation proceeding may be initiated before the county board of supervisors to construct drainage ditches across private land for the benefit of private landowners.

The drainage and levee district laws provide for the formation and operation of special-purpose districts for the purpose of constructing drainage, soil erosion, and flood control improvements. These districts are usually locally governed and provide for district taxing powers.

Stream and Related Shoreline Use Laws

Numerous statutes and common law doctrines affect the use of streams, lakes, and related shorelines. These include laws relating to the ownership and use of a streambed, or lakebed, the use of flood plains, and local land use.

Floodwall along Mad Creek, Muscatine
Corps of Engineers

TABLE 11-2 The 67th General Assembly Appropriations to State Natural Resources Agencies

State Agency	(1) General Fund Appropriation	(2) Percent of Total General Fund Appropriations	(3) Percent of General Fund Appropriated to Natural Resource Agencies	(4) Trust and Revolving Fund Appropriations [d]	(5) Total Departmental Appropriations [e]	(6) Percent of Total Departmental Appropriations To Natural Resource Agencies [f]
ICC	5,536,562	.39	23.00	7,245,456	12,782,018	38.68
DSC	6,716,602 [g]	.48	27.91	—	6,716,602	20.33
Dept. of Agriculture	3,577,245	.25	14.86	1,729,324	5,306,569	16.06
DEQ	3,922,224 [g]	.28	16.29	—	3,922,224	11.87
IDC	1,823,918	.13	7.57	—	1,823,918	5.52
IGS	1,147,650	.08	4.76	—	1,147,650	3.47
Fair Board	580,800	.04	2.41	—	580,800	1.75
INRC	521,857	.03	2.16	—	521,857	1.57
EPC	210,193	.01	.87	—	210,193	.63
Hoover Foundation	20,000	—	.08	—	20,000	.06
Miss. River Parkway Comm.	6,000	—	.02	—	6,000	.01
TOTAL	**24,063,051**	**1.72**	**100**	**8,974,780**	**33,037,831**	**100**

(a) Source: Pages 20-22 of Schedule D-1, "Iowa General Fund Statement, July 1, 1977", prepared by the State Comptroller (dated 10/12/77) (hereinafter referred to as 1977 General Fund Statement).
(b) Total General Fund appropriations for fiscal year 1977-1978 is $1,396,090,137. See Exhibit D, 1977 General Fund Statement.
(c) (Col. 1) $24,063,051 × 100%
(d) Source: Comptroller's Office
(e) Col. (1) + Col. (4)
(f) Col. 5 $33,037,831 × 100%
(g) Figures adjusted to include $2,000,000 appropriated to DEQ for sewage works construction and $4,230,000 appropriated to DSC for conservation cost share.

Bed Ownership and Use

Streambed and lakebed ownership and use rights hinge on whether the stream or lake is "meandered" or "navigable". Meandered streams and lakes are those whose boundaries were surveyed out by the original government survey and whose beds were subsequently retained by the federal government when conveying the original government patent to adjacent lands. The state owns the bed of a meandered stream or lake up to the "ordinary high water" (OHW) mark, which has been judicially defined as the point on a bank reached by floodwaters in a normal flood below which the soil is unfit for vegetation or agricultural purposes. This definition of OHW mark is difficult to apply and should be redefined by statute. Portions of 14 Iowa rivers are meandered for a total distance of about 1,637 miles. Figure 7-4 depicts those streams that are meandered.

Whether a stream is "navigable" depends on what test of navigability is used. Under federal common law, a stream is navigable if it was once used for commerce, is presently being used for commerce, or could be used for commerce in the future after reasonable improvements are made. Iowa received title to the bed of these streams to the OHW mark upon its admission to the Union.

Many state courts have adopted navigability tests broader in scope than the federal test. The U.S. Supreme Court appears to have deferred to the property law of the states for determination of whether post-statehood grants and patents by the federal government include the conveyance of beds of streams that are nonnavigable under the federal test. Such federal deferrence is not surprising, given the historic role of the state courts in determining water and property rights. Thus, the General Assembly or the Iowa courts could probably adopt a liberal navigability definition and delineate what use rights the public and adjacent landowners have in the stream.

Flood Plain Regulation and Management Programs

There are numerous statutes regulating various types of flood plain activities. Chapter 455A, the most comprehensive of these statutes, authorizes the INRC to issue permits for any flood plain construction and to set floodway encroachment limits where it deems necessary to do so. The Council may prohibit flood plain construction if it finds the construction will have an adverse affect on the following: the efficiency and capacity of the floodway; the control, development, protection, allocation, or utilization of water resources; or the state water framework study. Unauthorized construction may be abated as a nuisance, and unauthorized construction detected within a year of construction is deemed a nuisance for abatement purposes.

The Council's flood plain encroachment limits are designed to allow a reasonable use of the flood plain while minimizing property damage from flooding. Counties and cities can also set floodway encroachment limits and flood plain ordinances. These regulations, however, must be approved by the Council.

The Conservation Commission administers a more limited flood plain regulation program based on its jurisdiction over meandered or navigable waters. A permit is required from the Commission prior to construction on the surface or beds of these waters up to the ordinary high water mark.

The Council is also responsible for regulating all dams placed on the flood plain whether for flood control or power generation purposes. Pending federal legislation that authorizes funds for states with qualifying dam safety programs could be a major source of new revenue for an expanded state dam inspection and control program.

Local Land Use Controls

The above discussion has focused on laws designed to handle specific and narrowly-focused types of water

Mississippi River flood, Davenport, April, 1951 *Corps of Engineers*

resource management problems relating to streambed and shoreline use. In contrast, general land use control laws, such as zoning and subdivision laws, are more comprehensive in focus than this type of problem-oriented legislation; hence, the land use control laws provide greater opportunity for integrated development of water and related land resources. Implementation of these controls are the responsibility of the counties and cities. However, it appears that many rural counties and the smaller cities do not have land use control laws because they are politically unpopular.

In recognition of a need for local land use controls, the General Assembly requested local government officials to study land preservation policy alternatives and to submit their recommendations in 1979. The relationship between state and local governments with regards to land use controls, and whether zoning should be mandatory, will be major issues that the Legislature must face in the years ahead.

Conclusions and Recommendations

Governmental Arrangements

Inter-agency Program Coordination

Conclusion

The five state agencies responsible for water resource management in Iowa administer many similar and interdependent programs. Closer inter-agency coordination of these programs, by means of incorporating multiple agency objectives into a program and sharing information, personnel, equipment, and funds for program implementation, would result in more efficient resource utilization.

Recommendation

Institutional arrangements that facilitate greater program coordination should be created. Alternative ways through which coordination may be achieved include the following: (1) reorganization of present programs among state agencies; (2) formal creation of an inter-agency council, consisting of the directors of the five natural resource agencies (i.e., INRC, DEQ, ICC, IGS, DSC), whose function would be to achieve greater coordination of program adminstrative support, and to coordinate resource planning, data collection, inspection, and monitoring activities among the several agencies; (3) coordination of agency planning programs; and (4) creation of a state resource data bank under centralized management for assimilation of natural resource information that all agencies provide source information or actual data input to and can take data output from. The last option, a central water resource data bank, is already being developed on a pilot project scale by IGS. This project, called the Iowa Water Resources Data System (IWARDS) is being prepared as part of the state water planning process. If fully implemented, the IWARDS project could function to coordinate the data collection activities of the federal and state agencies, special-purpose districts and local units of govenment.

Reorganization of Natural Resources Agencies

Conclusion

Significant attention has been given in recent years to the issue of how to reorganize Iowa's natural resource agencies for the purpose of increasing administrative efficiency. In particular, the INRC has been singled out for abolishment with its programs to be dispersed among other agencies. Unfortunately, this proposal, as well as other reorganization proposals, has not been based on a comprehensive study of Iowa's existing governmental arrangements for natural resource management.

Recommendation

Reorganization of natural resource agencies for the purpose of increasing administrative efficiency is a laudable objective that the Governor, Legislature, and state agencies should support. However, before any reorganization proposal is finally adopted, a careful study should be made of alternative reoganizational proposals to determine the consequences that each proposal would have for realizing administrative efficiency, for implementing effective programs, and for altering the basic relationship the public would have with the proposed agency.

Such a study should, among others, consider with regards to each proposal, the following: (1) whether the public will have fewer opportunities and forums before which relief can be sought from agency action adversely affecting them; (2) whether the public's contact with agency personnel will be farther removed from the decision-maker; (3) whether interprogram policy conflicts will be resolved before a public policy-making body open to the public or out-of-public view within an internal agency structure; (4) whether fewer agency personnel will have an opportunity to review projects with resultant decreased probability of full articulation of all perspectives; (5) whether some programs will be slighted in the budget process of the new agency; (6) whether the vesting of certain "regulatory" programs with "development" programs will create a conflict of interest among agency personnel; and (7) whether there is a serious commitment to the funding necessary to ensure effective program inplementation.

Only after these and other questions have been answered, can a rational choice be made among the many reorganization proposals.

Legal Assistance for State Agencies

Conclusion

The Attorney General's Office provides legal services for all the natural resource management agencies. While this centralization of legal services has certain administrative efficiencies, several problems exist with the arrangement. First, by denying the agencies in-house counsel, the attorney representing the agency does not

have the opportunity to develop as extensive an understanding of agency operations or expertise in the laws administered by the agency, as might be the case if more responsibility rested in the agency. Second, the natural resource agencies are experiencing a chronic backlog of cases waiting prosecution by the Attorney General's Office and are unable to set priority for prosecution of these cases on which the development and implementation of agency policy often depends.

Finally, the necessity of agency reliance on the Attorney General's Office for legal advice often puts the Attorney General in a potential conflict of interest situation, due to the fact that the office must provide legal advice to the agencies and at the same time represent the Legislature, its committees, and the public's interest. Conflict of interest situations that can arise include those where an agency action is being investigated by a legislative committee, where two agencies are in dispute over jurisdictional reach, where a legislator seeks an attorney general's opinion on the propriety of an agency action, where the Attorney General objects to a proposed agency rule under the Administrative Procedure Act, and where the public's rights under the Open Meeting Law or the Administrative Procedure Act are at issue.

Recommendation

There are two options available for alleviating the present problems associated with delivery of legal services to the natural resource agencies. The first option is to require the Attorney General to locate personnel in the various agency offices with their salaries budgeted through the agency. This practice has already been allowed with some state agencies. The second option is to exempt the agency from the provisions of the **Code** that requires agency reliance on the Attorney General for legal services. The resource agencies prefer the latter alternative.

Well Regulation

Conclusion

The state lacks a comprehensive well regulation program. Such a program is needed to reduce the pollution of underground water by poorly constructed, located, and maintained wells. It would also generate useful data on Iowa geological formations and water supplies that would be beneficial to existing programs administered by DEQ, INRC, and IGS.

Recommendation

The Department of Health because of its county coordination potential should be authorized to regulate the construction, operation, and abandonment of water wells. Such regulation could require the following: registration of all existing and future wells, well drillers, and pump installation contractors; permits for pump installation and well construction or alteration; the filing of well completion reports; and the development of standards for well construction, pumping equipment, and pump installation. The Model Water Act, which has been adopted in a number of other states, provides an example of legislation that could be enacted.

Weather Modification

Conclusion

Under present law, counties may establish weather modification boards authorized to develop a weather modification program. This institutional arrangement is inadequate for a number of reasons. First, the county is not the best geographic unit of government for developing a weather modification program because weather patterns are often regional and cloud seeding could benefit or adversely affect a number of counties at one time. Secondly, it is inefficient to have the counties establish duplicate programs when a single program could achieve the same result. Third, the present arrangement creates the opportunity for intercounty hostility and accusations of "rain-theft". Finally, the federal government may pass legislation that, among other things, will require central state coordination of weather modification activities.

Recommendation

The weather section of the Department of Agriculture should be given the authority to assist, coordinate, and approve county weather modification programs. It should also be authorized to develop and implement a state level weather modification program involving the licensing of weather modification operators and the regulation of material used, and to act as liaison with the federal government on weather modification projects. Any weather modification program should be developed in cooperation with all resource agencies.

Common Law Water Rights

Codification of Water Rights

Conclusion

The common law of water rights is not uniform among the states. The Iowa Supreme Court has adopted some of the more generally accepted principles and rejected or not addressed other principles. As a result, there is little certainty as to exactly what the state's water rights law is for those water uses not subject to the water permit program. Often it is assumed the common law of other states would also be applied in Iowa. Frequently, this is unwarranted or undesirable from an efficient water allocation policy perspective.

Recommendation

The common law of water rights should be codified in conjunction with the existing water use permit system

Discharge from Coralville Reservoir
Corps of Engineers

administered by INRC under Chapter 455A. Those principles of the common law which the Iowa Court has not ruled on, should be explicitly incorporated or rejected in the course of the codification.

Water Transfers to Nonriparian Lands

Conclusion

The common law of many states prohibits the use of riparian waters on nonriparian lands that are outside either the stream's watershed or the original tract of land abutting the stream. The Iowa Court has not passed on this issue. Such limitations on the transfer of water are not desirable since the most efficient or socially beneficial use of water may require water transfer to other locations.

Recommendation

The transfer of water to nonriparian lands for uses not subject to the water permit system should be explicitly authorized by law, but made subject to INRC approval under the water permit program. This approval should be made contingent on a finding that the protected flow set by INRC and the rights of riparian landowners to use of water for household and ordinary livestock watering purposes are not adversely affected by the transfer of water to nonriparian lands.

Underground Water Classifications

Conclusion

The Iowa common law distinguishes between water in an underground watercourse and underground percolating water. The landowner has only reasonable use rights in water taken from an underground watercourse; while the landowner's only restriction on use of percolating water is that it be devoted to a beneficial purpose. There is no technical reason in Iowa for continuing this distinction for waters not regulated by the water permit program. The distinction was made at a time when little knowledge of groundwater hydrology existed.

Recommendation

Legislation should be enacted to abolish the common law distinction between underground watercourses and underground percolating water and to make all underground water uses not regulated by the INRC water permit system subject to allocation under a "reasonable use" criterion similar to that applied under common law for allocating water from streams.

Water Permit System

Comprehensive Water Use Recording

Conclusion

The following uses, among others, are exempt for the water permit system created by Chapter 455A:

(1) Beneficial uses of border river surface flow;
(2) Beneficial uses (other than industrial uses) within the territorial boundaries of municipal corporations existing on May 16, 1957;
(3) Beneficial industrial uses within the territorial boundaries of municipal corporations existing on May 16, 1957, where the industrial user has its own supply of water and its use has not increased by more than three percent over the highest beneficial use prior to May 16, 1957;
(4) Municipal corporation uses (or those of a person supplying a municipal corporation) where such uses have not increased by the greater of one hundred thousand gallons, or three percent, whichever is greater, per day than the highest per day beneficial use prior to May 16, 1957; and
(5) Uses involving diversion of water or other material from the surface directly into any underground watercourse or basin, where such diversion existed prior to May 16, 1957, and does not create waste or pollution.

Pumping water for irrigation
Soil Conservation Service

Because of these exceptions, the water permit system does not provide a complete record of many major water uses. Without such a record, the assessment of the effect of a pending water permit application on existing uses is more speculative, and it is more difficult to determine how much water is pumped from the various groundwater formations or streams and rivers of the state. A primary objective of the water permit system should be to obtain and update a comprehensive inventory of all water use. The exceptions also prevent an equitable allocation of water under the permit system in times of water shortage, since the exempt users can continue to pump large quantities of water when regulated users are requested to curtail pumpage.

Recommendation

Other than water uses (i) for less than 5,000 gallons per day, (ii) for ordinary household purposes, and,(iii) for watering an ordinary number of livestock, all present exemptions to the water permit system should be phased into the permit system. These exempt water users should be given a one-year period in which to register with the INRC their water use and other data that the water commissioner deems necessary. The Council would, immediately upon registration, issue a temporary water permit good for a five-year period. During this 5-year period, the newly registered water uses could, at any time, make application for a standard 10-year water permit. After the 5-year period had run its course, all of the above-mentioned exempt water users would be subject to the standard water permit procedures. With this phase-in procedure, all large water users can be brought under the permit system without straining the agency's permit processing capabilities.

User Fee and Water Resource Management Fund

Conclusion

Historically, water has been used and allocated outside of a pricing mechanism characteristic of the free enterprise market. A pricing mechanism facilitates

efficient resource allocation in two ways: (1) it reflects the cost of alternative products and services that would otherwise be available to the consumers, which provides an incentive for them to increase their consumptive demand only if benefits exceed real costs; and (2) it informs the producer of the consumer's relative desire for a commodity, which indicates the extent to which resources should be devoted to capital improvements for expanded production.

Since water use is not affected by a market pricing mechanism, the efficient allocation of water is not being realized. The existing permit system cannot be used to approximate a market system because a user fee cannot be levied. As a result, water permit applicants tend to request permits for quantities of water in excess of actual need and applicants have little motive to implement water conservation practices. (Irrigators, in particular, tend to request permits for excessive quantities of water.) State imposition of some type of a user fee would result in a more efficient allocation of water than presently exists because it would, at least, establish a rudimentary pricing system.

Another problem associated with an administrative permit system for allocating water is its dependency on state appropriations as its primary funding source. Few other revenue sources are available. A significant ancillary benefit of imposing a user fee is that it would also create a revenue source which could be used to fund the permit system, and other water resource management programs supporting the permit system.

Recommendation

The INRC should be authorized to increase the permit application fees on the basis of quantity and type of use, or to charge a user fee for every acre-foot of water authorized for withdrawal under a permit. A user fee could be levied on the basis of either the quantity of consumptive use, nonconsumptive use, or a combination thereof. Because consumptive uses are unavailable for subsequent reuse, any user fee levied could be directly proportional to the amount of the consumptive use. This would encourage more efficient use of water, as well as provide a revenue source for water resource management programs. Suggested user fee levels would be well below the actual economic value of the water; thus, they would not be a major burden on permittees who are presently enjoying free use of state owned water.

The fund generated by the collection of application fees or user charges could be managed by the INRC for the following purposes: (1) financing the operation of the water rights division of the INRC, consisting principally of the office of the Water Commissioner; (2) funding the state portion of cost share for the installation, operation, maintenance, and repair of the official stream gaging station network within the State of Iowa, in cooperation with state and federal agencies, and as determined necessary by the INRC for water management purposes; (3) installing, operating, and maintaining a system of groundwater observation wells to monitor water levels in the aquifers of the State of Iowa, in cooperation with other state and federal agencies, to the extent deemed necessary for water management purposes; and (4) assisting in conducting a statewide groundwater exploration program and related water availability studies in cooperation with other state and federal agencies.

An alternative to the user charge concept is a higher one-time water permit application fee. A permit application fee schedule could be tied to the consumptive or nonconsumptive nature of the water use and the duration of the permit. Such a schedule could provide for a base processing fee that is nonrefundable in addition to the administration fee that is refunded if the permit is denied.

Dredging on the Des Moines River *Iowa Conservation Commission*

Penalties for Illegal Water Withdrawal

Conclusion

During the 1977 summer drought period, there were several cases of illegal water withdrawals by irrigators. Known violators were ordered to cease and desist from pumping prior to issuance of a water permit, but many continued to illegally irrigate knowing they could only be fined $100. Some irrigators even stated that the fine was negligible in comparison to the value of being able to irrigate.

Recommendation

The maximum fine for illegal withdrawals of water should be raised from $100 to $1,000 per offense. Such willful violation should also be made a permissible criteria for denying a subsequent or pending water permit request by the offender. Continuing water withdrawal violations should be punishable on a $100/per day basis from the time that the offender is notified by the INRC that the withdrawals are illegal.

Priority of Water Use

Conclusion

Many criteria for issuing water permits can be found in Chapter 455A. These criteria implicitly suggest that the INRC has the authority to formulate priorities for allocating water among classes of competing uses, both in times of water shortage and in the long run. Such a priority system, which could be based on type of use, time of use initiation, or a combination of both, is essential in times of water shortage for efficient water allocation. A priority system would provide greater certainty as to available water supplies over the long run—an important factor in business investment decisions. The INRC recognizes the need for developing such a system by agency rule. Implementation of a priority system requires accurate groundwater quantity data that is not yet available or only recently acquired. However, where the data exists, priority rules should be promulgated.

Recommendation

The INRC should establish and implement a priority system by administrative rule for issuing water permits and, subsequently, restricting permitted water uses in times of shortage. A water conservation plan, designed to eliminate nonessential water uses during drought periods and applicable to every water permit holder by class of permit, should be a major component of the priority system. The priority system should also reflect the fact that water is not uniformly distributed across the state, and it should be applied separately to each major aquifer unit for groundwater, and to each conservancy district or subdistrict unit for surface waters.

Vested Rights

Conclusion

The common law is unclear as to the extent to which water use rights are so fundamental that state interference with them is a "taking of property" for which compensation is required. Chapter 455A, the water rights statute, incorporated this ambiguity by use of vague provisions referring to "prior", "superior", and "vested" rights.

Recommendation

Legislation should be passed that gives the individual landowner a right appurtenant to property ownership to use water for domestic or household purposes (e.g., cleaning, washing, and cooking), and for supplying an ordinary number of livestock. These uses would be the only rights considered "vested" on the rationale that under common law these uses were given priority over other uses in times of water shortage, and are presently unaffected by the water permit system. All other uses of water should be made subject to the water permit system (see recommendation regarding comprehensive water recording) and the reasonable regulations made by the INRC in administering the system.

Drainage Laws—Recodification

Conclusion

The drainage laws relating to the formation and operation of drainage and levee districts are needlessly complex and repetitive due to numerous amendments over the years. The common law of private drainage rights also remains largely uncodified.

Recommendation

The drainage and levee district laws of the state should be rewritten so as to reduce their complexity and length. The common law of drainage rights should also be codified and the relationship of these rights delineated, vis-a-vis drainage district and conservancy district programs. A conservancy district management system for handling multi-county drainage problems should also be considered.

Public and Private Rights To Use Streams

Conclusion

The rights and duties of the public and private landowners relating to use of the state's streams is laden with uncertainty. For example, there is no definitive case law indicating what streams are "navigable" under a state test of navigability, what uses of them are permissible, and who owns the bed of these streams. Likewise, the judicial definition of "ordinary high water mark", which is used to define the boundaries of state owned beds, is laden with ambiguity.

Because of the increased pressure for water-oriented recreation in recent years, a trend expected to continue into the future, delineation of public and private rights to streambed use is needed. In particular, the rights and duties of landowners to fence across streams, vis-a-vis the public right to float on these streams, must be addressed. If legislation is not enacted soon to clarify this area of the law, judicial proceedings will eventually be instituted by private parties to define the rights of the public and adjacent landowners in various streams. At that point, legislative options may be foreclosed. A legislative solution is more desirable because the courts can only fashion a decree enforceable against the litigating parties. Since the courts have only limited resources for enforcing or monitoring any decrees they make, these limitations could distort any decree issued by the courts. In addition, numerous litigation costs would be avoided in the long run by a statutory resolution of this problem.

Recommendation

Legislation clearly defining public and private use rights in the state's streams should be passed. "Navigable streams" and "ordinary high water mark" should be

Locust Street Bridge, Des Moines River, Des Moines *W. E. Akin*

defined and a clear delineation made of the rights and duties of landowners and the public in these streams. Riparian landowners' rights and duties relating to fencing should also be specifically addressed. The Iowa Conservation Commission should be authorized to regulate fences strung across streams defined as navigable, and to provide technical and financial assistance for those portions of fences that allow passage of water recreation craft. Funding for this program could come from an increase in boat regulation fees.

Flood Plain Regulation and Management

Mandatory City and County Flood Plain Zoning

Conclusion

Under existing Iowa law, there are no provisions to require cities and counties to adopt flood plain management regulations. As a result, few cities and counties have passed flood plain regulations, even when detailed flood plain information has been made available at the expense of federal or state agencies. The financial sanctions of the National Flood Insurance Program, as well as the associated availability of low cost flood insurance, have provided a significant impetus to cities and counties to adopt flood plain management regulations and are a condition of eligibility for the program.

Recommendations

The state should support the National Flood Insurance Program and strengthen the existing state program by enacting legislation that would require cities and counties to adopt and enforce flood plain management regulations within a specified period of time after adequate flood plain information is available from state or federal sources.

Builder Liability for Unauthorized Flood Plain Construction

Conclusion

The INRC flood plain regulations are being extensively violated. It is unclear whether section 455A.33 authorizes the INRC to hold builders, as well as landowners, liable for violations of the flood plain construction permit requirement. If builders were subject to liability, greater compliance with flood plain regulations would result.

Recommendation

Section 455A.33 should be amended to require contractors and builders, as well as landowners, to obtain a flood plain construction permit prior to construction. The builder should be made jointly and severely liable with the landowner for flood plain regulation violations.

Easement Powers

Conclusion

Under present law, it is unclear whether the Iowa Conservation Commission can take an interest in land of less than fee title (i.e., an easement) by condemnation for programs other than those associated with the Great River Road Project. Prior Attorney General opinions held that the Commission could not, but more recent changes in the **Code** definition of "land" suggests a different result. The Commission needs such easement condemnation powers in order to deal more equitably with all persons in the concerned area, and to initiate multi-use of unique lands by local farmers while still preserving the scenic and

recreational values of the land from destruction by incompatible development. Easements prohibiting flood plain construction would also enhance INRC programs.

Recommendation

The Conservation Commission should be clearly authorized by statute to take use easements of less than fee title by condemnation when voluntary easement purchases cannot be made.

Legislation should allow the Commission to consolidate all property valuation proceedings for a given geographic area. County assessors should be required to revalue their property tax assessments on property subject to an easement to the extent the property's fair market value is affected by the easement.

Great River Road Program

Conclusion

The Mississippi River shoreline is experiencing intense development pressure both on the flood plain and the adjacent blufflands. This development is often randomly scattered and poorly planned, with resultant degradation of the area's scenic character.

Recommendation

The state Great River Road project should receive greater attention in its relationship with the multi-state-federal Great River Environmental Action Team (GREAT) program. The Great River Road project should emphasize the acquisition of conservation areas, scenic overlooks, and scenic easements whose location and anticipated use is integrated with the GREAT management plan presently being developed for the Mississippi River flood plain.

Land Use Controls—County Subdivision Powers

Conclusion

A county's statutory basis for imposing subdivision regulations is ambiguous and may prove to be inadequate for comprehensive regulation of subdivisions and clustered residential developments outside of cities, where the failure to install collective sewage disposal systems often leads to deterioration of the quality of groundwater with subsequent pollution of water supply systems.

Recommendation

Legislation should be enacted that gives a county comprehensive rural subdivision regulation powers. In particular, the county board of supervisors should be given power to establish sanitary districts for rural housing clusters and subdivisions to deal with the associated waste collection and treatment in advance of development.

Iowa State House, Des Moines *W. E. Akin*

Iowa farm pond

Iowa Development Commission

Directions 12 For the Future

New Perspectives

WATER PLAN '78 completes the Framework Study and sets the stage for the future. This 3-year study, like its predecessor inventories by the INRC in the 1950's, has shown that Iowa normally has a good supply of water available for its beneficial user groups, but droughts and floods cause severe impacts. Overdevelopment has occurred in some localities, leading to conflicts between users, causing local and regional inadequacies of supply, or reducing water levels in groundwater formations to adversely affect others. Managing Iowa's surface and groundwater resources will depend on achieving a balance among (1) supply availability, (2) demands of users, and (3) wise use and conservation policies.

Iowa has not neglected its water and related natural resources—one administrative program or another has evolved to provide some measure of policy declaration and program coverage in all the recognized beneficial use and water resources management categories. However, some policies and programs are weak, some are ineffective, a few are diluted among too many agencies, and most suffer from too-little funding to achieve a balance with other state programs. Less than two percent of the state's annual budget is allocated to the development, allocation, utilization, conservation, and protection of all the state's natural resources, including land and water. This has resulted in local users depending on a combination of private and local funds, some type of direct or indirect rates and/or user charges, and an increasing dependence on federal funding and related development and regulatory programs.

Water Plan '78 is designed to strengthen the state's role in managing one of its most important resources—water. This very closely follows current changes in Federal policy. In June 1978, President Carter submitted to Congress new water policy initiatives aimed at:

- improving the planning process and the efficient management of water resources, preventing waste and permitting development that is cost effective, safe, and environmentally sound;
- providing increased emphasis on water conservation;
- placing increased attention on environmental quality;
- enhancing federal-state cooperation and improving state water resources planning;
- recognizing that the states should continue to have primary authority and responsibility for water management within their borders;
- giving the states increased input with respect to federal water policy and project development;
- requiring more state financing and participation in federal programs and project development in that state, as a tradeoff for state management responsibility.

Iowa, in completing the Framework Study, has in large part already studied and accepted these revisions, and is ready to meet new challenges, which are posed at both state and national levels. **Water Plan '78** provides a policy background and program elements for an implementation phase, and directs attention to the need for additional, detailed project planning to solve water problems facing the state and its residents. Planning for the 1980-2000 period is of the greatest importance, meshing with the **Iowa 2000** studies.

This final chapter will summarize those policies and water plan elements essential to the state water plan, outline the program alternatives necessary for moving ahead in the implementation phase, address deficiencies where project attention deserves first priority, and provide an insight to resource agency organizational structures and funding needs for the future.

Iowa's Water Policy

The basic statements of policy contained in Chapter 455A, **Code of Iowa**, are summarized as follows, to represent **Water Plan '78's** water policy for Iowa:

(1) that the water resources of the state be put to beneficial use to the fullest extent of which they are capable;
(2) that the waste or unreasonable use, or unreasonable methods of use of water be prevented;
(3) that the conservation of the state's waters be exercised with a view to assuring the reasonable and beneficial use thereof in the interest of the people;
(4) that the public and private funds for the promotion and expansion of the beneficial use of water resources shall be invested to the end that the best interests and welfare of the people are served;
(5) that the state's water resources agency shall have the duty and authority to establish and enforce an appropriate comprehensive state-wide program for the control, utilization, and protection of the surface and groundwater resources of the state;
(6) that the protection of life and property from floods, the prevention of damage to lands therefrom, and the orderly development, wise use, protection, and conservation of the water resources of the state through the considered and proper use thereof by beneficial user groups is of paramount importance to the welfare and prosperity of the people of the state;
(7) that the comprehensive, statewide plan for the control, utilization, and protection of the water resources of the state shall include all uses and developments of water resources, and shall provide for the optimum control, protection, development, allocation, and utilization thereof;
(8) that the plan shall give consideration specifically

to the needs of domestic households, municipal corporations, agriculture, industry, fish and wildlife, recreation, health, pollution control, and allied matters (including energy production and border river navigation) as they relate to water resources and flood control; further, that the use of water for domestic purposes (drinking water and ordinary household use) and for ordinary numbers (family-farm sustenance) of poultry, livestock, and domestic animals shall have priority over other uses with a balancing of priorities among other users in a regional and/or groundwater aquifer sense;

(9) that water occurring in any underground basins (aquifers) or in any watercourse, or other natural body of water of the state, is declared to be public water and public wealth of the people of the state of Iowa and subject to beneficial use in accordance with the statutory provisions (and departmental rules and procedures) for regulated and unregulated uses;

(10) that no use of water shall be authorized that will impair the effect of pollution control laws as they apply both to the surface waters and the groundwater aquifers of the state, or impair or deplete the established average minimum in-stream flow (protected low flow).

All proposed actions affecting water and related natural resources shall be measured against the full context of these collective policy statements. The goals of the state water plan were listed in Chapter 1, along with the scope and content of the Framework Study. These goals lend further substance to the Iowa water policy expressed above and have multiple objectives. Within a strong quality-of-life preservation and environmental enhancement theme, conflicts can and will arise. It is believed that these can best be resolved, as illustrated in the Framework Study, by establishing statement criteria and standards, including evaluation procedures for analyzing alternatives, and then applying these to each specific program proposal, or project development as it is planned and implemented. Balancing these conflicts, within a statewide framework, will provide the necessary give and take permitting development where absolutely necessary and justified, but preserving unique or sensitive resources and enhancing environmental quality as the normal practice. This is the method recommended for use in subsequent phases of water planning and development. Hopefully, this should eventually evolve into a state-mandated requirement for environmental assessment and preparation of environmental impact assessments for all significant proposed developments, both for programs and for project formulations.

Basic Elements of the Iowa Water Plan

Based upon the policy statements listed above, the state water plan for Iowa shall include fundamental statewide programs for collectively achieving the control, development, allocation, utilization, and protection of the state's water resources (and related land and other natural resources). This shall be accomplished by incorporating therein current and future programs for the following water management categories (as discussed in Chapter 1), representing beneficial use and protection sectors of the state's economy:

(1) community and industrial water use
(2) agricultural water use
(3) recreational and fish and wildlife water use
(4) energy production water use
(5) border-river navigation water use
(6) flood plain management and protection
(7) water quality control and environmental protection

Short programs to be included in the state water plan are:

(1) climatological and hydrologic basic data systems, cooperative with the existing federal government programs.
(2) Iowa's water data system (IWARDS) for data identification, storage, retrieval, and analysis.
(3) related socio-economics, demographic, legal and institutional planning, development and enforcement programs.
(4) Iowa's administrative water code, the water rights allocation system, with its permit requirements for regulated uses as currently administered by the Iowa Natural Resources Council.
(5) continued short-term applied studies and/or research, and long-term fundamental research, using the expertise of the resource agencies and universities in a coordinated program.

These primary and support programs represent the heart of the state water plan. Current statutes and state programs serve as the basic implementation level for coordinating day-by-day operational activities. The program changes and recommendations proposed in Chapters 3 through 11 serve as **Water Plan '78's** recommendations for accomplishing a second implementation phase, to refine and strengthen this basic framework into an action-level state water plan. Completing this implementation phase would bring the state's total water management program to a higher plateau, and thereafter serve as a strong, statewide coordinated resource and comprehensive water plan for the benefit of all Iowans. Development, utilization, protection, and regulatory programs lead to project formulation, including development, construction, operation, and management phases.

A myriad of water resources projects have been constructed to support these primary beneficial use and protection categories. They have been constructed by or through individuals or corporations, local governmental units, state agencies, and the federal government. All become operational elements in a state water plan. New projects in the future should be reviewed carefully to assure that they conform to revised and restructured resource programs as the implementation phase proceeds.

Remaining sections of this concluding chapter will review briefly the future trends in each of the primary beneficial use and/or protection sectors of the plan, and a collective outlook on the support groups, agency reorganization, and funding alternatives.

Community-Industrial Water Use

The highest priority given to water in Iowa is for domestic household use in which drinking water is essential to life. Beyond this, a collective picture for municipal, commercial, industrial, other miscellaneous uses, and regional-rural systems evolves. Water supply, treatment, and distribution for meeting the needs of this beneficial use group has largely been left to the individual water supply units at the local level. Many individual systems are noted for poor water quality, with bacterial and nitrate problems predominating. Aging community systems are of national and state concern, and refurbishing is a key need in many communities. Many industries have found scale economies in joining with municipal systems.

The Framework Study shows that the following problems need immediate attention:

(1) Water storage impoundments are needed to increase water supply availability in central, southern, and western Iowa, where groundwater supplies are limited for the quantities needed, or the quality is poor. Serious shortages developed in Polk and Story counties in 1977, for example, and many southern Iowa communities having water supply impoundments suffered both in the droughts of the 1950s and 1970s. More state assistance in water supply source development—both surface and groundwater—is a key alternative to a do-nothing level or to leave it to local water units to find and develop their own sources. Many smaller communities and rural residences will benefit from the economics of regional-rural systems, particularly in having an improved and acceptable water quality.

(2) Implementation of the federal drinking water standards is an identified role for the state. It brings to the forefront a need for designated water supply division status within state government (one of the resource agencies), with increased responsibility for guiding and assisting these local water supply units. Alternatives include state cost-sharing in planning phases and in developing supply sources and impoundments, or loans and/or grant assistance. Additional coordination and review of the regional-rural systems that are rapidly gaining popularity would be another function. A water conservation program would be the responsibility of this division also.

(3) Providing additional safety and protection of individual and community water supplies using groundwater sources involves better well construction and pump installation procedures. A county-state monitoring program is being recommended collectively by the state's resource agencies, including education and licensing provisions for well drillers and pump installers.

Agricultural Water Use

Agriculture, with intensive-use cropland utilizing over half the land area of the state, has first claim to the state's precipitation, through plant growth and transpiration of soil-moisture water. Framework studies of the severe droughts of the 1950s and the 1970s have illustrated that moisture shortages are most critical in eastern and northwestern Iowa and on the sandier soils. Irrigation may be profitable in these areas. Specialty crops also deserve irrigation attention. Otherwise, precipitation is sufficient in most years to leave supplemental irrigation of doubtful long-term economic value. Livestock watering remains an essential water need for agriculture, and regional-rural systems have provided better quality and more reliable quantity aspects.

Soil erosion and sediment problems, agriculture chemicals, and livestock waste residues make agriculture a full participant in the state's water quality control program. **Water Plan '78** summarizes these urgent needs:

(1) Water allocation policies should acknowledge that supplemental irrigation where water supplies are available, should have a high priority in (a) western and northwestern Iowa, (b) on the sandier, alluvial soils of the state, or (c) for speciality crops needing a supplemental water safeguard. Otherwise, the practice of supplemental irrigation should not be encouraged pending additional physical and economic research studies. In western and northwestern Iowa, where groundwater supplies are insufficient to meet this large consumptive demand, further development may depend on storage or water transfer economics.

(2) Weather modification has received increased attention at the federal level. Iowa could benefit in two ways: reduced severe weather impact including hail and wind, and increased rainfall during droughts. However, many problems are foreseen. A state evaluation and monitoring program, with an alternative of licensing or registration requirements, should be established within the Office of the State Climatologist, Iowa Department of Agriculture.

(3) An increased emphasis on non-point source pollution control and implementation of a sound program for Iowa is considered a must. The Departments of Soil Conservation and Environmental Quality are currently developing such an action program. Key provisions and alternatives include education, regulation, tax incentives and/or penalties, public cost sharing, and demonstration projects for best management practices. The best alternative appears to be to establish several key demonstration watershed projects for initial implementation. It is suggested that at least one watershed of those lying upstream of the state natural lakes and/or artificial lakes, or municipal water supply impoundments in each of the six Conservancy Districts be used as a demonstration site.

Recreational and Fish and Wildlife Water Use

Water-oriented recreational use has been on the increase since the close of World War II. Immediate high use is experienced whenever water facilities, particularly flat-water areas, are opened to the public, as evidenced this year at the Saylorville Reservoir and Big Creek Lake projects at Des Moines. Greater use of the streams for fishing, boating, canoeing, and rafting also is in evidence. Growing energy problems will make recreational water use in Iowa of greater importance in the future as travel becomes more and more expensive. At the same time, appropriate attention is needed to preserve wetlands and for fish and wildlife propagation needs.

Junction of South Fork with Iowa River
Iowa Historical Museum

The following high-priority needs are recognized in **Water Plan '78**:

(1) Several flat-water area deficiences are noted in the Framework Study. The intensive use at the Saylorville Reservoir complex illustrates this growing interest and demand. Studies have indicated that the following criteria could be used as a responsible goal for the planning period 1980-2000.

Regional Scope	Flat-water area needs— acres of water area
Statewide	40 acres per 1,000 population
Regional (16 economic regions)	20 acres per 1,000 population
County (99 counties)	10 acres per 1,000 population

Discounting the rapidly-flowing Missouri River, there are over 110,000 acres of flat-water area available for use in Iowa. Three of the state's larger metropolitan areas—Council Bluffs, Sioux City, and Waterloo—are located in flat-water deficient regions. These deserve attention during the planning period 1980-2000, once the Brushy Creek, Big Creek, and Volga Lake state projects are completed and multipurpose projects now being planned with the Soil Conservation are constructed. Several counties also are deficient in flat-water area availability. Multipurpose water use facilities may be a realistic alternative to single purpose projects, if coordination of state and federal agencies can be achieved among the state resource agencies, the county conservation boards, and municipalities in these counties. Continued management and operation of the state's water areas also are important, as will be the further development of lake restoration and improved management programs where needed and economically justifiable. Improved boating laws for powered craft must be included in the lake management program.

(2) The scenic river and/or protected river waters programs of the Iowa Conservation Commission are key alternatives to the continued lack or unavailability of stream access by the public. It is suggested that one or more rivers be selected in each of the six Conservancy Districts for immediate evaluation and program formulation and implementation. Suggestions gleaned from the framework studies include:

Conservancy District	River or Reach of River
Northeastern Iowa	Upper Iowa River, Volga River
Iowa-Cedar	Portions of Iowa and Cedar Rivers, perhaps major tributaries thereof
Des Moines	Portions of the Raccoon, Boone and Des Moines Rivers
Skunk	Portions of the Upper South Skunk River and downstream portions below Mahaska-Henry County line
Southern Iowa	Portions of the Grand and Chariton Rivers
Western Iowa	Portions of the Little Sioux River and selected tributaries

The Big Sioux River and the Shellrock River are two additional potential scenic river candidates, but their inclusion and/or consideration will depend on correcting the interstate pollution problems arising principally at Sioux Falls, South Dakota, and Albert Lea, Minnesota.

The ability to manage such scenic river corridors poses real problems to be resolved, including access, scenic easements, land acquisition, funding, and control of overuse and undue stress on the environment. A comprehensive program, however, is a recognized state need.

(3) Wetland preservation is a key element in the state's water plan. The do-nothing alternative will lead to continued loss to agricultural cropland. The strengthened program recommended in the Framework Study would consist of an inventory in each county, evaluation of priorities, and a cost-sharing program (state-federal-local) to acquire sites. Tax incentives or tax relief is an alternative tool to use as an option until public acquisition can be achieved. The county conservation boards can assist the Iowa Conservation Commission, if a cooperative program is developed and funded.

Electrical Energy Production

The ever-increasing need for electricity places a heavy demand on the water resources of the state. Most of the present demand is met by steam-electric generating plants, with hydroelectric plants playing a very minor role. The water requirement for cooling the condensers of the steam-electric plants constitute the largest gross demand for water in Iowa and in the nation, except for the natural transpiration of water by growing crops and other vegetation. Fortunately, the condenser flows are largely nonconsumptive, that is, little water is lost by evaporation. Once-through cooling systems lose from one to two percent of the water used because of increased temperature in the return flows to the streams. However, once-through cooling is practical only on the border rivers where stream volume is sufficient to dilute the increased temperature of the return flows. Closed-cycle systems will be required at future generating plant sites in Iowa's interior streams. These streams require less total water intake than the once-through systems, but consumptive use is greater requiring from two to four percent of the gross condenser cooling requirement as "make-up" water to replace tower evaporation losses and supply "blowdown" to dilute mineral buildup. These requirements will place stresses on the natural stream flows during drought periods at those sites on interior Iowa streams.

Water Plan '78 considers that:

(1) In the future, to meet energy needs, surface-water storage reservoirs will be needed to augment stream flow in the interior streams.

Multiple purpose reservoir development and use for key water supply purposes is becoming a recognized need. The potential exists for combining municipal and regional-rural water supply, outdoor recreation and water for energy demands. Site exploration and evaluation should be a combined private-state-federal responsibility in this program, which needs further consideration for implementation in coordination with

the Iowa Commerce Commission and the Energy Policy Council. The smaller plants, with less than 100 megawatts capacity, can continue to rely on groundwater sources, where available. The ability to use the border rivers for once-through cooling needs to be maintained, providing thermal and other water quality standards can be maintained.

(2) The state has an interest also in the continued hydroelectric production of electricity. The principal source of value to the state, particularly in northwest Iowa, is the hydropower being developed and marketed from the Federal Missouri River main stem dams and powerhouse generating units. The renegotiating of service contracts, coming up sometime in the next few years, will be an essential factor in state water planning to protect the state's interest in a regional resource.

Continued production of hydroelectric power at existing sites within the state or on the border rivers, where economically feasible, is also encouraged. Participation in available Federal Department of Energy low-head hydroelectric power studies and demonstration projects is also recommended, as an alternative to additional steam electric or gas turbine development and production.

Navigation-River Transportation

Iowa's border rivers—the Mississippi and Missouri Rivers—serve as recreational areas as well as providing important transportation routes for waterborne commerce. Since the Iowa Department of Transportation (IDOT) was created, increasing attention has been given to the development of these aspects of the rivers. But continued multi-agency coordination, both state and federal, is needed in view of the interstate nature of the valuable river corridor resources of each border river. Additional recreational participation, with other river basin commissions as well as other federal agencies is a continued need. **Water Plan '78** recognizes these important planning elements:

(1) Continued revision and expansion of the GREAT I and GREAT II programs (Great River Environmental Action Teams) should be a part of the state water planning implementation phase, for the Mississippi River. There is a real and economic need for maintaining and modernizing the Upper Mississippi River lock and dam system for the benefit of Iowans. Making the development and use agency (IDOT) an equal partner in this planning role with the state conservation-environmental agencies and the Corps of Engineers is a recognized need. Further expansion of the dredge disposal review authority and inclusion of barge terminal site evaluation methodology is a future alternative. Expanded planning and programming for the entire river corridor should be coordinated through the Upper Mississippi River Basin Commission.

(2) An evaluation program to review the Missouri River Navigation and Bank Stabilization Project should be completed within a two-year period. The channel degradation problem is considered to be extremely serious, and its impacts should be summarized quickly, so that initial remedial measures can commence under Federal Programs of the Army Corps of Engineers.

Covered bridge, a heritage from Iowa's past
Iowa State University

Flood Plain Management

More and more attention is being given at both state and federal levels of governments to the need for controlling flood plain occupancy and development as a major means of reducing future flood damages. As a result, nonstructural regulatory programs will carry greater weight in the future than the usual structural methods of achieving solutions. Iowa's flood plain management program, which began in earnest in 1957, is capable of solving Iowa's problems if adequately supported and given an expanded role. Much has been accomplished already as a part of state water planning. Participation by the state in a flash flood warning system, in flood emergency disaster assistance programs, and related relief measures are also ongoing. Accomplishments also include local flood protection engineering works, where economically justified, and major and minor flood control reservoir construction. The program achievements include the strong nonstructural regulatory program administered under current state law by the Iowa Natural Resources Council. Continued emphasis on each facet is recommended.

Important revisions for **Water Plan '78** are summarized below:

(1) Enhancing the nonstructural flood plain management program should have highest priority in this sector of the state's water plan. Controlling future development and limiting or preventing unwise, intensive urban uses of the flood plains (especially in newly urbanizing areas) is the recommended alternative. Strengthening the criteria by which flood hazard risk is evaluated is part of this alternative. Moving from the present 100-year flood frequency (one percent chance annual occurrence) to the INRC regional flood (less than 0.2 percent chance annual occurence) is recommended. Further expansion of the program to achieve greater coordination and participation of communities and counties, and with the continued coordination of federal agencies is also recommended as a first priority and urgent need.

(2) Two types of flood plain occupancy problems deserve special evaluation and program development. The first is the problem of flash floods

impacting on built up areas along smaller tributaries in the major river valleys. Every major city in Iowa has at least one flash flood problem area. A special program is proposed to come to grips with just what to do—what is an acceptable, long-term solution among many alternatives. The second is the problem of private agricultural levees. To date, the Iowa Natural Resources Council has balanced a farmer's need for protection against the adverse effect on others by granting a low-level of protection but with adequate levee setbacks. Yet problems remain, particularly in a social-equity sense. A demonstration study for a reach of one of Iowa's rivers is recommended followed by statewide application and new program formulation and implementation.

(3) An urban stormwater management program is a key recommendation of the state water plan. Stormwater retention in urbanizing areas is one objective; providing a flow pathway for floods exceeding the usual design capacity of curbs, gutters, and storm sewers is a second. Control of soil erosion and sedimentation problems during urban construction phases is a third. The goal is to achieve control over planned or newly developing areas first, then review older built-up areas. Applications of principles and criteria, and necessary control regulations, would be alternative levels of program administration. These would be evaluated and reported as this program is formulated by the Iowa Natural Resources Council.

Water Quality Control

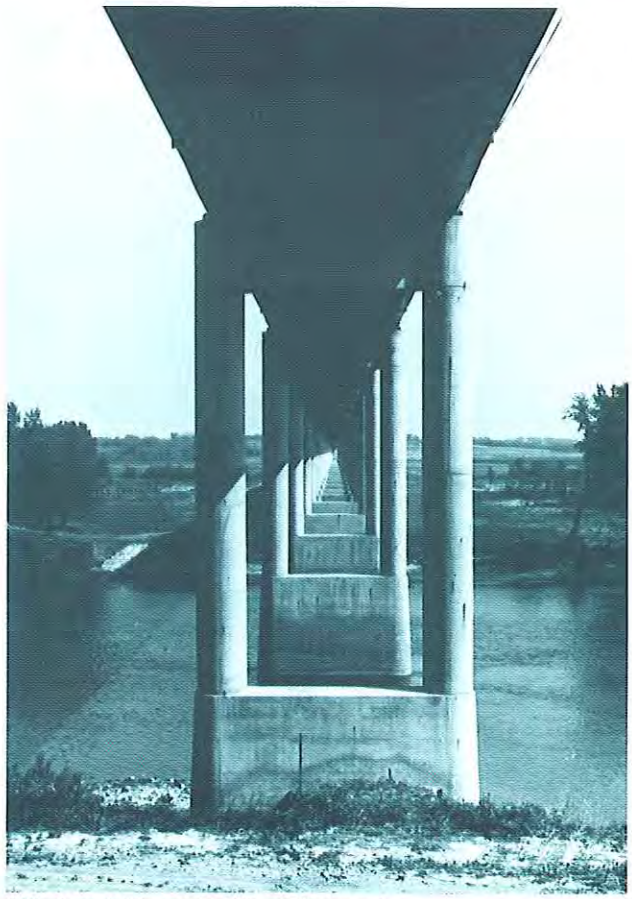
Every beneficial user group subsequently becomes a problem in the waste residue arena of pollution control. There are no "clean hands" at this point. Therefore, the water quality management plans of the Iowa Department of Environmental Quality are to be reviewed and upon acceptance will be made part of the state water plan. Of importance are both the point-source pollution control and the nonpoint source pollution control programs. Two major programs need continued attention:

(1) Continued implementation and operation of the state's point-source control program is recommended. Of particular importance will be industrial waste treatment, and on-site industrial cleanup for these industrial systems discharging to a municipal waste water collection system and waste treatment facility. Alternatives for the future include increasing the state's cost sharing of municipal plan construction costs (currently 5%); additional tax incentives or penalties for industries and cities not meeting standards; and the degree to which tertiary, advanced waste treatment processes are required in addition to primary and secondary treatment. Bringing the livestock feedlot units under more adequate control is an associated point-source pollution control need. A long-term goal, through education, funding, and regulation is to have runoff from all feedlots controlled, and residues placed to land application or disposal.

(2) Completing current studies and implementing an adequate non-point source pollution program for the state represents the greatest challenge of all proposed pollution control programs. The framework studies have shown that non-point source pollution is by far the greatest pollution problem facing the state. Currently being evaluated by the Departments of Soil Conservation and Environmental Quality, implementation and control measures are being considered. Key alternative features in achieving a successful program must include: control of rural and urban non-point pollution sources, including agriculture, forest, construction, transportation, residential, commercial and industrial areas; control of soil erosion and sediment, along with chemicals and nutrients, as key materials impacting the water resource and the environment; include and consider both surface and groundwaters; utilize education, training, conservation tillage practices, tax incentives or penalties, and alternative control and regulatory measures. A substantial amount of time and effort will be required to achieve meaningful results, but support of the executive, legislative, and judicial arms of the State and Federal government will be needed. Additional specific legislative attention will be required during the next one or two biennial periods.

Other Support Groups

Adequate support and funding will be needed for each program (see page 200 for listing) to carry out the



Mile-long bridge at Red Rock Reservoir
Iowa Development Commission

policies and goals of **Water Plan '78**. Additional support for the basic data systems and water allocation programs is a needed alternative to the past status-quo. The need for resource agency enforcement attorneys is also apparent.

Iowa's administrative water permit system will continue to serve as the foundation for water use allocation in the state. The 5,000 gallon per day non-regulated exemption adequately protects the minor uses for each farmstead, rural residence or individual, small community user. Withdrawal of larger quantities should be monitored in the water management program of the INRC. Removal of exemptions to communities and industries presently in the law is a key need for attention by the legislature. Improvements have been enacted in each of the last two years by the legislature. The Council rules and regulations, now being implemented through the hearing process, will strengthen the allocation program. Priorities by region and aquifer are being considered and implemented. Additional technical and economic evaluation may be needed to further improve the permit system. These will be recommended and carried out through the continuing planning process, as a follow-up to **Water Plan '78**.

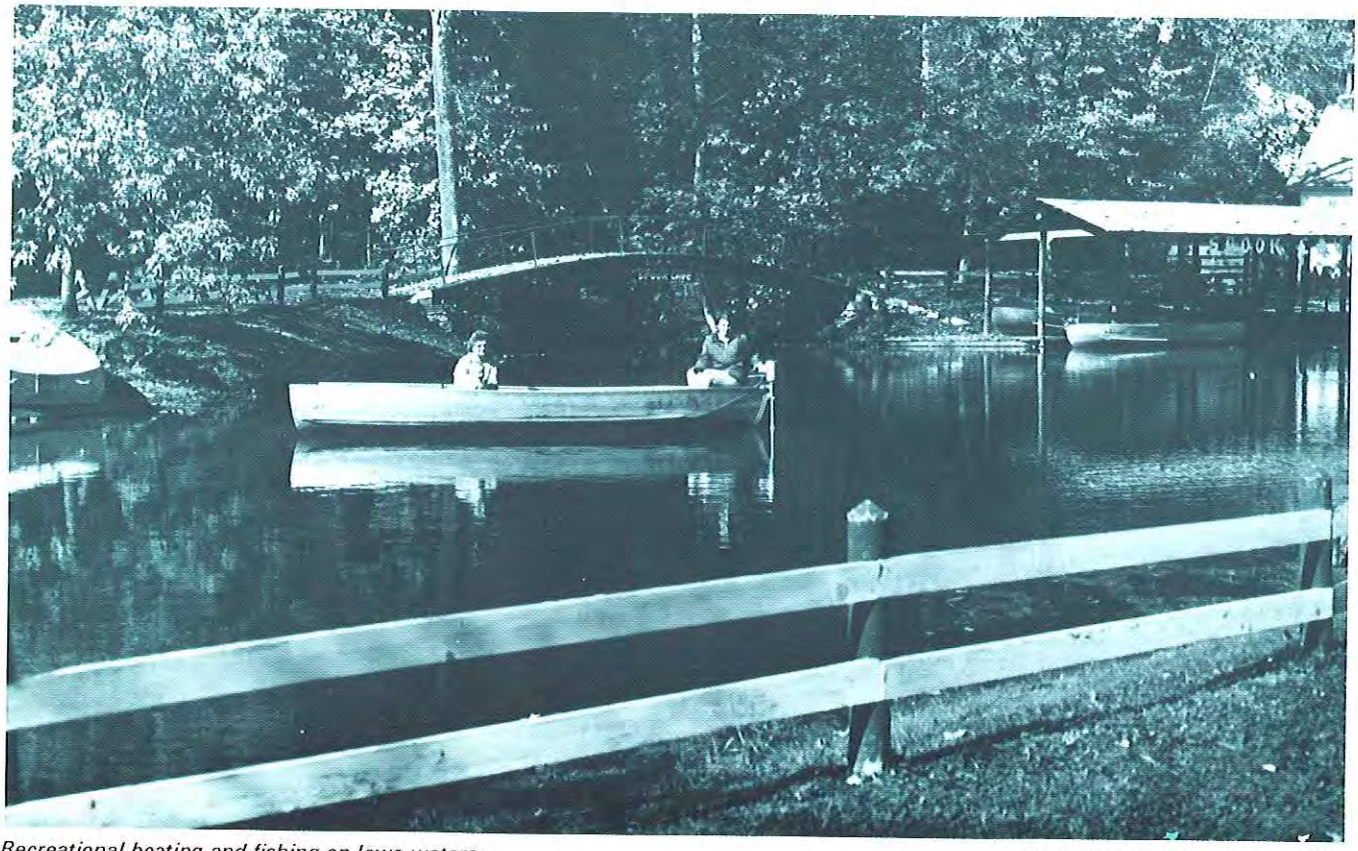
State Agency Reorganization

Five state agencies have carried the primary responsibility for resource development, use, conservation, and protection. In Iowa these are the INRC, IGS, ISCC, DSC, and the DEQ, the latter having 4 divisional agencies. The Iowa Senate this last session studied the alternatives available in reorganizing the resource agencies into one or more larger units. SF 2216 was passed by the Senate, but was not considered by the House. Additional consideration is expected in the next General Assembly.

In **Water Plan '78**, the objectives of additional reorganization and alternatives have been stated and reviewed, at least briefly. The primary objectives should be:

(1) To achieve larger, stronger, more effective units of government which can command more attention and action.
(2) To give such reorganized units a stronger role in resource development, utilization, allocation, conservation, and protection of the state's natural resources, including water.
(3) To retain the responsiveness and sensitivity to the people of Iowa that is needed in resource use and protection.
(4) To provide an increased budget, including operational funds and capital improvements needs, capable of solving more adequately and rapidly the state's water and related natural resource problems.
(5) To create an agency structure which can accept the land use policy structure now being formulated, and also accept, revise, and make the state's drainage statutes effective on a conservancy district and/or subdistrict basis.

It is believed that the environmental protection and regulatory activities of the Iowa-DEQ, as waste residue impact monitors, should be kept separate from the development, allocation, and beneficial use groups and related state agencies. This provides the necessary adversary role between resource user and environmental protector; yet some reorganization might improve that



Recreational boating and fishing on Iowa waters *Iowa Development Commission*

role within a given restructured resource unit, as a stronger entity commanding a larger voice for the public.

Water Plan '78 recommends additional interim study of SF 2216 of the 67th General Assembly; further, that all alternatives be included in a comprehensive study, including future budgetary needs.

Funding Needs

Water Plan '78 would not serve its purpose without a concluding section on funding needs for resource development, allocation, utilization, conservation, and protection. As stated in the introduction, less than 2% of the state's annual budget ($20,000,000 of almost $1,000,000,000) is allocated to the state's resource agencies, including capital improvement expenditures. This is far overshadowed by funds spent for education, welfare, and transportation.

A key recommendation is a request for additional funds for increased operational budgets and capital improvements in the resource category of the state budget. It is tentatively estimated that implementing **Water Plan '78** in all aspects will require a doubling of the current budget allocation for natural resources. This should be accomplished within a 5-year period. At least 50 percent of this increase would be directed to one form or another of capital improvements or local program and project assistance; the remainder would be for state agency support and operations. More detailed estimates, for the period 1980-2000, must be prepared as a follow-up study (suggested for **Water Plan '80**).

How and where to obtain additional funds will be an important subject, in view of current state and national attitudes. Coordination of funding sources will become important in the future, among local, county, regional, state, and federal levels of government.

Alternative funding sources have been given some initial consideration. Sources include:

(1) Permit fees.
(2) User charges or fees.
(3) User supported programs (at local, or state, or federal level, or a combination of all).
(4) The state's General Fund
(5) Special funds
(6) Additional funds for increased state taxes, either individual income, corporate income, sales or special excise taxes, as placed in the State's General Fund and allocation to agencies based on need and priority.
(7) Establishment of selected loan or grant programs.
(8) Other

It is expected that a combination of these eventually will evolve to support an expanded role of the state's resource agencies and the state water plan as it reaches an increased implementation level. The resource agencies will plan to cooperate with the executive and legislative arms of the state government in developing a funding plan which will become part of the state water plan in the implementation phase.

Conclusion—Continued Water Planning

Water Plan '78 has completed its initial objectives, in presenting a policy and program formulation to the state water plan. Further development of the state's future water resources management program depends on implementing these policy and program recommendations. Future projects, development, formulation, and implementation of detailed programs will be accomplished in subsequent phases, with Phase II being the initial implementation phase.

To accomplish this detailed specific project or program level planning the Iowa Natural Resources Council, with the concurrence of the Governor's Interagency Resource Council and the Rock Island District Corps of Engineers, is promoting a Corps of Engineers Level C study of every river basin in the state. This study would be on the implementation level, and would identify all problem areas and offer project or program solutions, with an analysis of the beneficial and adverse impacts of such solutions. Utilizing this approach, an explicit state water implementation plan could be accomplished in a maximum of eight years.

For the state to independently accomplish a plan of such detail in the desired frame, a substantial increase in state funding of water planning would be required. It is doubtful that funding of the magnitude required would be acceptable to the General Assembly. The current proposed expenditure by the Federal Government for this project is on the order of eleven million dollars.

The current proposal places the state in a leadership role with full participation in the analysis of problems and development of alternative solutions, and not in the review and comment role that has caused problems in the past. The state resource agencies have agreed to expend a concerted effort on this particular phase of water resource planning.

Once the completion of this study is achieved, the state water planning effort can be greatly reduced to a simple biennial review and updating program.

It is further recommended, under a continuous planning concept, that a **Water Plan '80** be scheduled, prepared and presented for the next biennium, following the 1978-1980 biennial period, to report on progress and further development of the state's water plan. Key subject content for **Water Plan '80** will be:

(1) Progress in implementing **Water Plan '78** recommendations, particularly legislative response and action.
(2) Concentrate on funding alternatives and needed budgetary levels for implementing the required programs.
(3) Reorganization of the state's resources agencies, including achieving regional and local pathway for effective arrangement and operation of resource agency activities.

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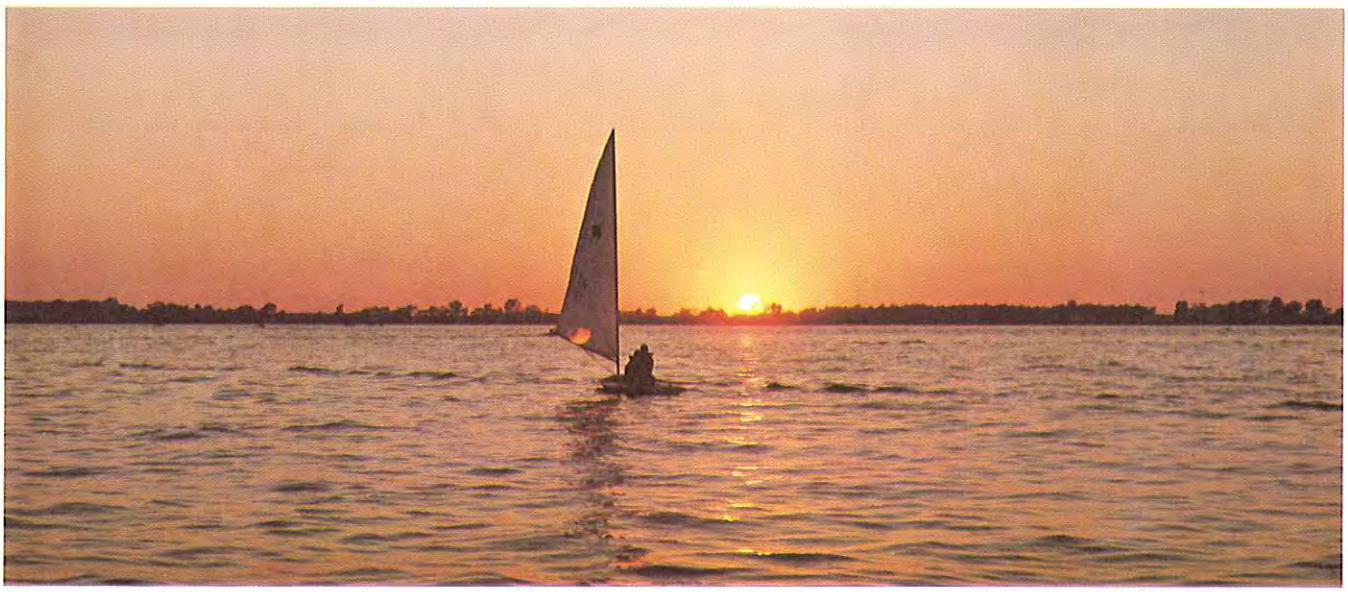
(4) Revised, more satisfactory state-federal relationships and accomplishments in water project planning formulation, and construction.
(5) A special review of regional, interstate water and related resource problems, particularly with the Missouri and Upper Missouri River Basin Commissions, for water quantity, and water quality and water allocation aspects.

This completes **Water Plan '78**. Its future success depends upon the attention and support which will be afforded it by the Governor, the Iowa General Assembly, the individual resource agencies, other local, county and regional governmental units, and the people of Iowa.



Sailing at sunset, Clear Lake *Iowa Conservation Commission*