

WATER CONSERVATION

Statement of the Problem

Increasingly, the public is warned that the nation's water shortage will soon not only rival the energy crisis, but in fact surpass it. Water has been traditionally used in this country as though the supply is inexhaustible. But recently, Americans are beginning to grasp the nature of the water shortage problem.

In most years the volume of water available surpasses water use. The problem is the imbalance of water resources throughout the country and even in the State of Illinois, where lack of adequate ground water resources threaten public water supplies in a number of central and southern Illinois counties during drought conditions.

The greatest concern of all to water resource experts is that our vast underground reserves of water, in some cases built up over thousands of years, have been seriously depleted in a few decades. While the water resources are produced as precipitation, much of it either evaporates immediately or runs off, unused, to the oceans. By the year 2000, some say that there will be parts of the country where water supplies are so depleted, farming may never be possible again. The nation's water outlook is hauntingly reminiscent of the oil outlook ten years ago as are the possibilities to make the same mistakes.

Energy and water shortages are closely linked. A limiting factor in irrigation tends to be the high cost of electricity to run the pumps as the water table declines. Livestock farmers have faced economic disaster as wells run dry and alternative sources become nonexistent.

As Americans have discovered the hidden energy costs in various products, they are beginning to discover the hidden water costs. It requires about 15,000 gallons of water to grow a bushel of wheat, 60,000 gallons to manufacture a ton of steel and 120 gallons to produce one egg. Actually, water is priced far below its cost, but it is usually very unpopular to raise water rates, which could help reduce water usage.

The nation will have to make expensive and painful decisions over the next few years to deal with water shortage problems, including the replacement of leaking water mains, state buy-out and retirement of farmland in certain parts of the country, the possible installation of systems to recycle water, and the use of technology to scan acreage from the air to determine which fields need water and which don't. While measures such as these may help the country and the State to stretch its water supplies, everyone will have to accept the fact that the era of cheap water is over.

While a number of steps have been taken by the State with respect to water conservation issues, most of these efforts have been drought related. There is a need at this point to build on these drought-related efforts and expand them so that water conservation is practiced as a matter of course by

industry, government, businesses, and individuals. It is important that the State take the initiative in such endeavors due to the nature and widespread geographical locations of water shortages. While there is a lack of consensus on the exact role that the State should play in water resource regulation, there would probably be no conceptual problems with a state educational and assistance role in the area of water conservation. During the fall of 1980, the State Water Plan Task Force held a series of public forums around the State to obtain the public views about water resource concerns and priorities. Out of 18 critical water resource issues, water conservation was rated overall as the third most critical. Based on the reactions obtained at these forums, it would seem that the public may be ready to support more concerted programs in the area of water conservation.

Ongoing Programs

As noted in the previous section, most of the state's efforts in the water conservation area have related to recent droughts in Illinois. Examples of some of the water conservation activities and programs that have been developed by the State include the following:

Department of Commerce and Community Affairs (DCCA) - Brochures and other materials related to water conservation have been developed and made available to communities throughout the State.

Workshops have been provided upon request to interested groups.

Local governments have been assisted in coordinating water conservation programs.

A videotaped film has been produced on the water conservation measures taken in Eldorado to serve as an instructional film for other communities faced with drought.

Staff members have participated in radio talk shows on the subject of water conservation and news releases have been prepared.

Division of Water Resources, Department of Transportation - An educational packet of materials was developed for use during drought periods.

Water conservation pamphlets and related materials have been distributed to communities on the Chicago metropolitan area to help them stretch existing supplies and to identify alternative sources of water.

Capital Development Board - The Capital Development Board is currently pursuing the use of water conservation devices in new construction and retrofitting with respect to several upcoming development projects for which the Capital Development Board is responsible.

Water Resources Commission - The Commission is currently preparing a packet of water resources related materials that it will send to every local government and school district in the State. The packet will contain posters and water saving tips, as well as other water conservation items.

While all of these efforts have been and are being effective to some degree in helping the State's communities save water, as yet no overall program has been designed to help insure that water conservation will become a continuing every day concern. In order for this to occur, much more will need to be done to provide the framework and the tools required to insure that future water shortages do not work undue economic or physical hardships on communities, businesses, and farmers. In addition to an overall water conservation program framework, there is a need for an analytical evaluation of water usage with a consequent evaluation of various water conservation strategies linked to water usage. It is not possible, due to time and staff constraints, to undertake such an evaluation as a part of this plan component. However, it is suggested that such an effort be undertaken as soon as possible.

As part of the state's ongoing efforts to develop water conservation programs, appropriate officials in affected states should be contacted in order to learn from their successes and/or failures.

Other than the need for more analytical data on water usage, there appear to be no serious data gaps with respect to some of the types of programs that need to be developed relative to a statewide water conservation program. The major issues are of an organization and political nature and what is needed most is commitment and dedication.

Options and Recommendations for Policy and Programs

While certain components of a well developed water conservation program are in place (e.g., brochures, technical assistance personnel, videotape, etc.), there are a number of other activities that need to be considered. Essentially, and with a strong emphasis on public education, the basic components of an ongoing water conservation program should include:

Public education

Marketing of water conservation devices

Revision of plumbing codes

Consultation with industry

Pilot projects at state institutions, public housing authorities, etc.

Data collection on water use

Close working relationship with local governments, housing authorities, community action agencies and other organizations interested in water conservation.

Training of water plant operators in water conservation techniques.

Where appropriate, requiring water conservation measures as part of Pollution Control Board variance proceedings.

Among the activities listed above, there clearly is a wide range of levels of state initiation and participation possible. Although benefit/cost implications of these levels are not available, informed judgement is that all of the activities would yield a high return for the State.

Work Plan for 1981 and Beyond

A detailed and reasonable program has been developed by the Task Force which could be completed by June 1982, and would have a total cost in the order of \$100,000. About half of this would be required in the Public Education activity, and nearly one quarter each in Revision of Plumbing Codes and Consultation with Industry. Other activities would have nominal cost. For each activity, the lead and supporting State agencies are identified, as are the principal beneficiaries and possible conflicts.

Recommended activities are summarized in the following paragraphs.

Public Education - Educating the various publics about the benefits and methods of water conservation is perhaps the most important element of the program, since, by and large, most citizens still take water for granted. Education on the importance of water should begin in the early grades. An

option here is the expansion of the educational packet developed by the Department of Transportation during the last drought. By working with such groups as the Illinois Association of School Administrators, suitable curriculum supplements can be developed and school officials can learn how they too can save water through retrofitting their institutions.

DCCA intends to continue efforts to promote water conservation through the newspapers and radio talk shows. These efforts have been fairly successful in drought areas and efforts are being made to raise public consciousness about the issue in the metropolitan areas. Public service announcements have been written for radio and await agency approval. Television spots should be developed, also.

Consumer, civic and labor oriented magazines provide important potential forums for water conservation education as well as general interest magazines. Another option would include the production of appropriate articles for these magazines.

Marketing of Water Conservation Devices - There is a need to rigorously market water related retrofit devices to specific targets as well as the general public. The key options here are (a) working with such organizations as the Plumbing Manufacturers' Institute and appropriate trade associations in attempt to get them involved in promoting the sale and distribution of water conservation devices; (b) getting a major retailer to feature special sections in its stores where water conservation devices can be promoted; and (c)

developing and providing articles for various trade publications on the subject of water conservation, and (d) through water conservation programs of municipal and private water companies.

Revision of Plumbing Codes - Drawing upon the positive results generated by plumbing code changes in the State of California and closer to home in DuPage County, DCCA should, along with the Illinois Department of Public Health, recommend new plumbing code guidelines. Local governments would be encouraged to revise their existing codes so that low-flow toilets, showerheads and aerators become a regular feature in new construction. These requirements should eventually have the effect of stimulating the market for these products and increasing their availability in hardware, and home center retail stores.

Consultation With Industry - In addition to the options mentioned under Marketing of Water Conservation Devices, there is a need for the State to consult with industries to learn about successful water conservation experiences. Such information can be useful as the State meets with industries that may not be making full use of possible conservation techniques. Other options in this area include conferences, and development of materials for trade journals.

Pilot Projects at State Institutions - Since the cost of retrofitting most buildings for water conservation is considerably less than the amount of savings realized within a year, it is recommended that the Illinois Capital Development Board target those institutions which use the largest amount of water for conservation efforts. Preliminary discussions have been held with

respect to this option and follow-up is needed. Targets would most likely include state correctional and mental health centers. The results of retrofitting should be closely monitored with the long-range goal of retrofitting all state buildings. By getting its own house in order, the state's leadership on this issue gains authority and cost cutting is particularly welcomed by taxpayers in these inflationary times.

Close Working Relationships With Local Governments and Agencies - In addition to the program proposal relating to local plumbing code revisions, the state should maintain a close working relationship with local groups with respect to water conservation issues. Options include: (a) holding workshops where water conservation ideas and experiences can be exchanged; (b) assessment of communities' experiences in adopting uniform or inverse block rates to conserve water; and (c) an annual competition to select the communities with the best water conservation programs; (d) encouraging communities to design in excess capacity when developing new, or enlarging existing, water systems; and (e) working with communities in helping them set-up committees to ensure that actual water costs including maintenance and planned expansion are being charged and not subsidized by other arms of local governmental bodies.

Training Water Plant Operators in Water Conservation Techniques - The Environmental Resource Training Center at Southern Illinois University - Edwardsville provides training programs for water plant operators. The operators receive training in various aspects of managing and maintaining public water systems. In addition to the current curriculum, it is recommended that coursework be added relative to water conservation practices

and techniques. This should prove most helpful over time to communities during water shortage periods as well in helping to prevent future water shortage problems.

Data Collection on Water Use - To measure the effectiveness of a well-developed water conservation program, data on water use from different communities and for different uses must be available. Therefore, a continuing water use inventory program is essential in Illinois.

SUMMARY OF RECOMMENDATIONS FOR WATER CONSERVATION

The Task Force Recommends:

- A sustained and coordinated program to promote water conservation in Illinois.
- Education, as the most important element of the recommended program, to be carried out through the schools and the various media for which specific material will be prepared.
- Marketing of water conservation devices by working with appropriate trade associations and retailers.
- Revision of plumbing codes to be recommended for new construction.
- Successful industrial experience be exchanged, pilot projects at State institutions be proposed, and a close program relationship maintained with local governments and agencies.
- That the curriculum for water plant operators be enlarged to encompass water conservation practices.
- That the effectiveness of water conservation programs be monitored through a water use inventory program.

FLOOD DAMAGE MITIGATION

Statement of the Problem

Introduction - Flooding has long been a serious water resource problem within the State of Illinois. The State's first water plan published in 1967 recommended that Illinois Government immediately turn its attention to the worsening flood problems of the State. A report by the Illinois Economic and Fiscal Commission stated in 1974 that "flooding appears to be the major problem in water resource management in Illinois. Discussions with State water officials revealed consensus on this point, and it was confirmed by a survey of local governmental units with water management responsibilities".

A review of the table below shows how the State has responded, on the average, to urban flood damages over the last 15 years.

STATE FLOOD DAMAGES VS. EXPENDITURES

<u>YEAR</u>	<u>AVERAGE ANNUAL DAMAGES (MILLIONS OF \$)</u>	<u>RATIO OF DAMAGES TO STATE EXPENDITURES</u>
1966	30	26:1
1974	100	21:1
1980	300	100:1

A review of this table shows that for the 10-year period from the mid-sixties to the mid-seventies average annual flood damages within the State more than tripled and in the 6-year period from 1974 to 1980 estimated damages again tripled. Studies of rain-produced floods reveal no marked increase in this period, indicating the increased loss is largely a result of more floodplain development. State expenditures on the other hand, have clearly not kept pace with the increasing magnitude of average annual flood damages. It can be seen that during the mid-sixties annual damages were outpacing annual expenditures by a factor of 26 to 1. Annual damages are now outpacing expenditures by a factor of 100 to 1.

The floods experienced statewide during the summer of 1981 are a current reminder of the seriousness of flooding within the State. Through the last two weeks of June and first week of July, cities and farms in all regions of the State were impacted significantly by flooding. Numerous municipalities in southern Cook County in the Northeastern Illinois portion of the Little Calumet River Basin suffered over 64 million dollars in damages from one flood event. The City of Joliet in Will County suffered over 20 million dollars in damages while over 400 homes were evacuated. During this flood disaster, curfews had to be set, the National Guard called in, plus thousands of volunteers were required to aid in the cleanup.

Serious flooding was also experienced during this time period in Aurora and Morris in N.E. Illinois, Mt. Carroll in N.W. Illinois, Carthage in W. Central

Illinois, Elkhart in Central Illinois, Colp in S. Central Illinois, and Eldorado in S.E. Illinois. Eldorado experienced severe flooding after barely recovering from a serious water supply shortage caused by a drought event. Over one thousand homes had to be evacuated statewide during this three week period due to flooding.

Urban Flood Control - Urban floods now cause an estimated \$300 million in average annual flood damages within the State of Illinois. This estimate of damages has more than tripled in the last six years and will continue to grow at an unacceptable rate as long as unwise and irresponsible developments continue to occur in flood prone areas.

While flood damages mount annually, a backlog of more than \$250 million of first costs in needed cost-effective flood control projects has accumulated. This \$250 million is the minimum funding needed for flood control projects through 1995 if a responsible effort is to be undertaken to reduce the annual economic losses occurring within Illinois due to flooding.

Further, since 1975 the State has undertaken a responsible program to assure that only flood free developments are placed on flood prone lands in urbanizing land areas. Since this program was initiated only six urbanizing watershed areas have come under this program, the last being initiated over two years ago. Without continued growth in this program in a responsible and timely manner, average annual flood damages from new developments within Illinois will continue to rise.

Rural Flood Control - Recent estimates identify that annually there is more than \$50 million in agricultural flood damages incurred throughout the State. At the rate of current Federal flood control programs and practices, such damage will not be significantly reduced. Most of the proposals for dealing with severe agricultural damage have been examined and many projects have been identified. In some cases, planning has begun, but few structural projects have been implemented. The three primary problems determined previously as relating to rural flood control projects are as follows:

- 1) that Federal agencies responsible for planning and implementation of rural flood control programs move very slowly in their responsibilities,
- 2) the State of Illinois has little influence in promoting agricultural flood protection projects; and,
- 3) local governmental units in special districts which sustain the important local sponsor role for all agricultural projects are at a disadvantage when dealing with the large and "professional" Federal agencies working on rural flood control projects.

These three problems indicate that an effective State rural flood control program is dependent upon active leadership by the state itself. Without that leadership there is a lack of meaningful state priorities for funding and

technical assistance. There is also the lack of effective coordination between the Federal, State and local government units involved. The State must have the capability to intervene on behalf of both the Federal bureaucracy and the local project sponsors to facilitate effective coordination and communications. There also could be a need for State financial assistance on some projects.

Urban Storm Water - Flooding caused by inadequate drainage is a further problem causing increased damages and hardships in many municipalities statewide. Although the causes and solutions of inadequate stormwater drainage and management are generally quite different than those of overbank flooding described previously, the damages are nevertheless, just as real.

Compatible solutions to the implementation of proper urban drainage problems are also lacking from a statewide perspective. Increasing urbanization throughout the State has led to a corresponding increase in stormwater runoff, and often to increased stormwater induced property damages. Existing design procedures vary among municipalities and counties and often lead to locally expedient solutions which are detrimental to downstream areas.

Responsibilities for improper drainage have become fractionalized and, in many cases, affected citizens are left with neither answers nor solutions to their problems. In addition, the effects of future upstream developments are frequently not considered in the design of local systems. The State's role in strengthening the ability of local governments to solve urban drainage and related flood problems must be increased.

Ongoing Programs

Ongoing State programs for flood damage mitigation are explained in detail in the Agency Appendix A of this annual report. A brief summary of these programs are included here.

The Division of Water Resources (DWR) has authority through the Flood Control Act of 1945 (Ill. Rev. Statutes Ch. 19, Sec. 126) to participate in the improvement of the rivers of the State for the purpose of regulating and controlling flood and low water flows. The criteria followed by the Division relating to flood control project planning and implementation are as follows:

- 1) Assurance that most severely damaged areas receive priority consideration and assistance from State and Federal sources. There is currently a \$250 million backlog of capital costs for such projects.
- 2) State water resource and flood control projects be designed to maximize economic efficiency at minimal environmental impact.
- 3) State expenditures result in maximum benefits for the least possible cost.
- 4) Local interest and investment of funds be required as evidence of involvement in any project.

As a part of the State's flood control planning responsibilities, DWR provides support to other Federal and State agencies for the collection and storage of stream flow and flood related hydrologic data. The Division and the Water Survey cost share with the U. S. Geological Survey for a statewide stream gaging network.

The State Water Survey operates a storage and retrieval system for flood discharges and floodplain information. Hydrologic research has led to improved methods and criteria relating to flood hydrograph determination and dam safety evaluation. Atmospheric studies of flood-producing rainstorms focus on three areas: field studies of flood events, design research for flood frequencies in Illinois, and on rainstorm forecasting research and operations. A 4-year development project for forecasting and monitoring heavy rains in the Chicago area using radar has just ended.

DWR also has jurisdictional and supervisory authority to control activities within the floodways and floodplains of the State. This program is conducted as authorized under the Rivers and Lakes Act of 1911 (Ill. Rev. Statutes Ch. 19, Sec. 52-78). As of this year, only six urbanizing watersheds have come under the full supervisory authority of this program.

DWR also provides flood mitigation assistance under the Local Floodplains Programs Section of the Division. This Section fulfills the role of State Coordinating Agency for the National Flood Insurance Program. This Section, therefore, provides advice and information concerning the flood insurance

program as well as technical assistance for floodproofing and urban stormwater management programs. The Water Survey, with DWR support, provides technical assistance to 150 small communities and rural areas that have flooding problems, but did not receive flood insurance studies.

The Illinois Department of Agriculture is the lead State agency for rural flood control projects within Illinois. The program of the Department includes the review of the program authorities of the Army Corps of Engineers, review of all rural flood control projects currently and previously under consideration, development of a working relationship with the Army Corps of Engineers, state agencies and local project sponsors, and the development of a uniform system for project review, plus a re-evaluation of the Watershed Protection and Flood Prevention Act of 1954 (P.L. 566).

Another State agency active in flood damage mitigation activities is the Illinois Emergency Services and Disaster Agency. This agency bears complete responsibility for the total coordination of manpower and resources from State and Federal agencies in time of a major flood emergency and disaster. Through this responsibility, the entire complement of emergency assistance functions are carried out such as the provision of shelter, medical assistance and rescue assistance.

Numerous Federal agencies also conduct various forms of flood damage mitigation programs.

The Watershed Protection and Flood Prevention Act (P.L. 566) authorizes the USDA Soil Conservation Service to cooperate with local organizations to carry out, maintain, and operate works of improvement for flood protection. Under this program, numerous watershed projects have been planned statewide in both urban and rural areas. The implementation of these programs, though, has been painstakingly slow.

The U.S. Army Corps of Engineers, through a series of River, Harbor, and Flood Control Acts, also has been authorized to plan and construct necessary measures for flood control and navigation. The activities of this agency must be increased within the State in order for Illinois to receive its fair share of the Federal flood control dollar.

The National Flood Insurance Act of 1968 and the flood disaster protection act of 1973 created a Federally subsidized flood insurance program which is administered by the Flood Insurance Administration of the Federal Emergency Management Agency. The 1968 Act made this Federally subsidized insurance available to citizens in communities that adopt regulations controlling floodplain development. There are currently 700 local governmental units within the State of Illinois in this program, and as of June 1979, 38,000 flood insurance policies were in force within the State. These numbers again show not only the seriousness of flooding within the State, but also the value of this insurance program.

Numerous Federal agencies also provide various forms of assistance following flood disasters in the forms of grants, direct assistance or low interest loans. Participation in the flood insurance program by communities in identified flood hazard areas is required in order for these communities to remain eligible for continued Federal flood relief assistance.

Options and Recommendations for Policies and Programs

In review of the statewide flood damage problems and related issues, the State Water Plan task Force will present policies and programs based on the following conclusions and recommendations:

Floods are not subject to complete control but their damaging effects can be mitigated in many cases in a cost effective fashion.

Flooding is one of the most consistently destructive natural hazards in the State of Illinois and the upward trend in these damages is continuing at an alarming rate.

The upward trend in the costs of flood damages can be moderated through a comprehensive State program directed towards the implementation of structural plans and floodplain controls that are economically, environmentally, and socially cost effective.

Flood hazard mitigation strategies should reflect mixes of structural and nonstructural approaches appropriate to the specific flood hazard area.

Project benefits from structural flood control measures must be preserved through implementation of accompanying floodplain control measures.

Because continuing building in the floodways of the State causes increases in damages to existing property, State and local controls must prohibit any such developments that will increase flood elevations on adjacent or nearby property unless legal steps are taken to protect affected property owners.

State management of Federal flood control programs must be enhanced in order to maximize the potential Federal involvement in flood damage mitigation programs.

Based on the above conclusions, the State Water Plan Task Force makes the following policy and program recommendations:

SUMMARY OF RECOMMENDATIONS FOR FLOOD DAMAGE MITIGATION

The Task Force Recommends:

Urban Flood Control

- The State must direct an increased level of resources towards an accelerated construction program for the backlog of flood control projects presently planned.
- State and local governments must strengthen their floodplain control programs in order that the increases in flood damages caused by new and unwise developments are eliminated.

Rural Flood Control

- The State must maintain a strong coordination program with local, State and Federal agencies for the implementation of needed rural projects. Increased staffing will be required as the number of projects and level of required coordination increases.

Urban Stormwater Management

- The State must provide an increased level of technical assistance to local governments in order to strengthen their ability to solve urban drainage and related flood problems.
- Improved storm and flood forecasting systems and warning procedures are needed. A radar and satellite-based forecast system developed for the Chicago Metropolitan Area needs to be used in a long term demonstration project.

Work Plan for 1981 and Beyond

The Work Plan of study relating to the continued program refinement of this issue has been developed by co-lead agencies of the Division of Water Resources, Department of Agriculture, and State Water Survey. As part of this program refinement, a unified state agency floodplain control program will be evaluated within the next two years.

Urban Flood Control - During the remainder of 1981, State Water Plan activities will concentrate on improving the management and efficiency of the existing floodplain control program. Key management issues and objectives will be identified and addressed through a series of special studies and programs. The relative efficiency of the construction application and review process will be evaluated in order to reduce processing times and shift workload distribution to the more critical and significant floodplain control cases.

During the first half of 1982, efforts will be directed towards the development of a detailed ten-year urban flood problem mitigation program. These efforts will detail an optimum design and construction program for the current backlog of projects now waiting for implementation up through the year 1995. Further efforts during the first half of this year, will concentrate on a public waters identification program and related issues. The second half of this year's efforts will concentrate on a detailed overall review of the effectiveness and appropriate level of the existing floodplain control program. Benefits and costs of public protection through such controls will be evaluated.

During 1983, it is anticipated that all studies relating to the unified floodplain control issue will be completed to a level where consideration can be given to developing options for resolving identified competing and/or conflicting programs for floodplain land use and development.

Rural Flood Control - Activities underway during 1981 are as follows:

- 1) review existing programs and authorities,
- 2) contact potential local sponsors and interests, and
- 3) develop a project screening and prioritization criteria.

In 1982, activities of the first half year will be directed towards final implementation of a State rural flood control program.

Urban Stormwater Management - Three separate efforts will be initiated during 1981. A technical advisory committee will be organized for the purpose of developing a stormwater management pamphlet and model ordinance for local governmental use. The development of a more detailed technical assistance program will start through the review of the draft national manual. A cooperative State-Federal research investigation of impacts within an urbanizing watershed will continue. Hopefully, funding will be provided by the state and metropolitan agencies to initiate the radar-satellite forecasting project in the Chicago and St. Louis metropolitan areas.

In 1982, the pamphlet and ordinance are scheduled for completion the first half of the year. A program for distribution will be initiated. Work will continue on the development of the technical assistance manual and participatory State program.

COMPETITION FOR WATER

Statement of the Problem

Illinois has historically been classified or assumed to be a water rich state. Planners, developers, business interests and governmental entities have long presumed that except for rare drought events, the availability of a dependable water supply source is a given, and therefore, not a factor which might limit or modify future plans and decisions.

Recent events regarding proposals for implementing new and major consumptive uses of water within the state have raised concerns among water interests and professionals as to the impacts of these new demands on the currently available regional supplies.

The potential for major energy related water consumptive developments being implemented within the state will increase as the nation works towards a goal of energy independence. Illinois coal resources are considered as a valuable long term energy supply for the nation. Development of these coal reserves could potentially result in the placement of numerous coal gasification facilities within the state. These facilities are major consumptive users of water with demands as large as a modern power plant or city the size of Peoria.

Proposals are also being considered for the development of coal slurry pipelines which would transport Illinois Coal to other regions of the nation. These pipelines can also be major consumptive users of water that effectively export large quantities of water along with the coal resource.

As of 1980, irrigation was being used on only 140,000 acres of Illinois cropland, but its use has been growing at the rate of about 15% annually. Irrigation can be a major consumptive user of water whose demands increase significantly during the dryest times of the year. A recent study of water demands in the Little Wabash Basin has concluded that a slight increase above prevailing commodity prices could result in basin wide irrigation withdrawals approaching the median flow during the growing season.

Recent studies of public and industrial water supplies in the Chicago Metropolitan Area have determined that groundwater withdrawals from the deep sandstone aquifers are at a level which is three times the natural recharge rate of the groundwater source. This example of regional competition for a limited resource is being addressed through the state's authority to allocate nearby Lake Michigan water to communities in competition for the groundwater resource.

Increased concerns are also being expressed by environmental, recreational and other interests for consideration to be given to the protection of minimum instream flows necessary for public health and safety, water quality, navigation, and fish and wildlife considerations.

It is clear that the issue of competition for water is complex. It is also seen that the State is not in a position to address completely the complex issues involved at this time.

Public and private interests can increase conflicts for water or reduce the conflicts through their programs and activities. Some programs may simultaneously increase and decrease conflicts in different ways. Competition can be increased by declining water supplies or by increasing demand. Decreased competition can come about by decreasing demand or increasing supplies.

Both supply and demand can be characterized by the quantity needed over time, water quality, and the location of the supply and demand.

Quantity - The absolute amount of water available is a function of the minimum and maximum at a given point in time. Averages of available water for example, become meaningless if water for a public water supply were only available for six months of a year. Every demand has a quantity/time character and most supplies also have a quantity/time character which may be out of phase.

Quality - Water can be considered available only if its quality is suitable for the intended use or it can be treated at a reasonable cost.

Location - If supplies of suitable quality are readily available in the quantity/time required for a particular use, but are located far from the location of use, needs are not satisfied. In this case, the supply should be considered not to be available (or available at increased transport costs).

In order to characterize supply and demand and be able to answer allocation problems, two types of information and data are needed. One type is the definition of the basic water resource such as how much water is available, how dependable is it, its quality, and its location. In a similar vein current demands need to be quantified and demands for future uses must be projected.

The second type of data and information needed addresses management issues such as better management of lakes and streams, structural changes, and types of conservation measures available.

Water resource conflicts (or competitive situations) are now generally addressed on a limited or ad hoc basis. This has and probably will continue to result in future alternatives and options of the State and local areas being closed out. Actions today affect tomorrow's options. It is necessary to examine the effect of various problem solutions on the future availability of water resources.

Summary of Problem Statement - Due to the potential for major energy related water consumptive developments, increased irrigation potential, and water supply demands, it is apparent that new as well as existing future demands for public and industrial water supply may very well stress regional water supply resources to a limit where the resource is inadequate for all demands within the region. The potential for competition among demands and regional economic

hardships are problems that public and private interests alike cannot ignore. At this time, the appropriate role and response of government to competition for water on a regional basis is ill defined. The State must, therefore, develop more data and information and begin to address the issue of competition before it occurs. This will enable the State to examine impacts of potential decisions in order that desirable options are not closed out in the future.

Ongoing Programs

Various agencies within the State of Illinois have authorities and programs relating to water supply and its development and regulation. No one agency at this time has either adequate information or programs to address regional water supply competition in a statewide manner, but on-going efforts are grouped in three major categories as follows.

(1) PROGRAMS TO EVALUATE THE ISSUE

Division of Water Resources - The Division of Water Resources (DWR) through its Planning and Research Section has two major efforts underway to address this component of competition for water.

Through the use of data supplied by the Illinois Environmental Protection Agency (IEPA) and the State Water Survey (SWS), a detailed inventory and

review of public and industrial water supply demands and resource availability for both surface and groundwater supplied systems is being conducted. These inventories will be completed in the fall of 1981.

The Planning and Research Section is also conducting a major instream flow quantification assessment with the cooperation of the Illinois Department of Conservation. This statewide assessment is initially concentrating on fishery needs but will expand into assessing recreation, water quality, and navigation requirements as further information is developed. This statewide evaluation is scheduled for completion in 1985.

Illinois Department of Agriculture - The Illinois Department of Agriculture does not have an established program to deal with or to promote the use of irrigation. The Department does, however, support the use of irrigation as a tool for production agriculture.

The Department has coordinated the development of the irrigation issue through a group composed of 10 varied irrigation interests. The work group has established a list of short, medium, and long-term irrigation needs, which have been placed into a priority ranking. This list will serve as a basis for the Water Plan Task Force to consider programs and activities.

Department of Energy and Natural Resources - Divisions of the Department have a number of programs which aid in assessing the basic water resources of the state and which help mitigate problems or enhance the water resources.

The State Geological Survey, in addition to conducting basic research on the hydrogeology of the state and performing contract research for State agencies, has been conducting research on the impact of surface coal mining on the geologic materials and ground water in different geologic settings in Illinois. This work has taken place at abandoned surface mines and should be expanded to active mine sites. Preliminary results of the current study were published in May of 1981.

The State Water Survey, in addition to conducting extensive hydrologic research, conducts water quality and toxicological studies, cooperative programs with the U.S. Geological Survey which define demand by user sector, ground water resource evaluation studies, ground water monitoring programs, as well as contract studies with other State agencies. Collectively, these programs define the basic water resources of the State. Climatological work at the Water Survey is also an essential part of defining water input and distribution over time for the State. Past work dealing with the evaluation of potential reservoir sites and existing strip mine lakes has aided in the definition of alternatives.

The State Natural History Survey through its regular program and contract work for State and Federal agencies deals with aquatic habitat and indigenous aquatic life which has defined the use requirements for maintaining aquatic life. This helps define the point where competition may occur. Lake management and related research leads to mitigation measures which can reduce conflict.

The Resource Development Division has conducted a three part study of hydropower potential in the State during 1981. The studies were conducted in coordination with the Surveys and other State agencies and were designed to avoid adverse environmental impacts of hydropower development. This design resulted in the conclusion that sites should only be developed where impoundments or structures currently exist.

Illinois Environmental Protection Agency - The IEPA through its groundwater and surface water monitoring programs accumulates a massive amount of data on water quality. Work contracted out as part of water quality standards development has addressed base flow conditions, temporal variations of stream flow and aquatic organisms needs. As part of an application for the permanent program of the Resource Recovery and Conservation Act groundwater data including definition of aquifers (location and quality) is being assembled from the State Geological and Water Surveys.

(2) PROGRAMS TO REDUCE OR MITIGATE CONFLICTING DEMANDS

Division of Water Resources - The allocation of Lake Michigan Water required a comprehensive program to identify demands and supplies on a regional basis pursuant to a 1967 U.S. Supreme Court Decree limiting water diversion from Lake Michigan. Due to this decree, the Illinois General Assembly passed legislation requiring the DWR to apportion the Lake Michigan diversion, to

make suggestions and recommendations for control and regulation of the diversion, to devise and develop a continuing program for apportionment of water from the lake, to make competing claims a matter of record, and to require that all feasible means reasonably available to the state and its subdivisions are employed to manage and conserve the water resources of the region and the use of water therein in accordance with the best modern scientific knowledge and engineering practice.

The allocation of water from Lake Michigan is now an ongoing program of DWR and many solutions adopted as part of this program may be of use in other areas of the state as required.

DWR also manages state owned water supply storage in four major multi-purpose reservoirs located in Southern Illinois. These reservoirs are Carlyle, Shelbyville, Rend, and Kinkaid. The sale and allocation of water supply from these sources should be effectively used to avert some demand conflicts in the regions in which these reservoirs are located.

(3) PROGRAMS WHICH INCREASE DEMAND

While no program is designed to increase conflicts, a program may lead to future conflicts if it is not coordinated with other interests. In general, the area of economic development leads to more demand; and, local, regional and State economic development programs all have aspects of demand promotion. Two specific programs are discussed below.

Synfuels Development - Such projected development can require massive amounts of water in some regions of the State. In addition to consumptive use of water for conversion processes, cooling water and use of water by increased work forces and secondary development in the area of synfuel plants all add to the potential for future conflicts. The Illinois Department of Energy and Natural Resources, in cooperation with the Department of Commerce and Community Affairs, are the primary agencies dealing with synfuels development.

Irrigation - The promotion of irrigation as a cost-effective means to increase production can affect future water use in certain basins in Illinois. Full irrigation potential may not be realized in some basins where other demands may supercede. This has not been assessed at this time. The University of Illinois has been active in assessing irrigation potential, along with the State Water Survey.

Options and Recommendations for Policy and Programs

The problem statement section indicates that potential regional competition situations in time and place will be defined after projected demands are compared with regional supplies. The development of alternative solutions for reducing or eliminating these conflicts should help define the appropriate roles, if any, various levels of government should take in regard to such conflicts. Once these roles are selected, the State Water Plan can define the goals and objectives, policies, programs and necessary budgetary support for state action. This information will be available for the State Water Plan in the fall of 1983.

At this time, although some generic types of solutions to regional conflict situations can be described. These solutions attempt to reduce conflict by adjusting the supply versus demand function to either increase supply or reduce demand.

Supply Development - In a general sense, the most obvious and safest solution to a water shortage induced by competition is supply development. However, this solution does have some limitations. The lead time for planning, selecting, designing, financing, and constructing a water supply project may require many years. This type of solution is, therefore, never applicable during an ongoing drought, although it may be the best long-term means for reducing or eliminating the impacts of competition which significantly increase during a drought event.

Another limitation to supply development is that in some basins the entire regional supply may become exhausted. In this case, only some type of inter-basin transfer can augment supply if such transfers are legally implementable.

The economics and financing of water supply development projects can also be limiting. The economics of a project could result in the cost of water supplied being at a level where existing and/or projected users are unwilling to pay for water from the supply. The financing of a project by a municipal type water utility may be limited due to the position of general bond obligations and the alternative of revenue bonds may not be possible due to a historically inadequate system of unrealistically low rate structures.

Demand Modification - Various alternative measures can be designed to modify the demands on a water resource in an area of inadequate supply. Some of these measures are water conservation, responsible demand siting, and demand allocation.

Water Conservation is a separate issue of the State Water Plan. The implementation of a localized, regional or statewide water conservation program will surely reduce demand. This can be accomplished if necessary through either a voluntary program stressing information and technical assistance or programs involving various forms of mandatory conservation.

Various alternatives can also be designed to serve the purpose of steering major uses away from potential areas where shortages would develop due to their presence.

In areas where shortages and resulting conflicts are caused by increasing demands from many smaller water supply users the alternative of supply allocation can be applied to limit demands. This could also be a type of voluntary or mandatory program depending on the severity of the forecasted shortage.

With respect to irrigation, an in-depth study of the potential development which would include climate change, soil conditions, economic factors, and water supplies is needed before the competition can be accurately

anticipated. Of particular importance is a need to perform a climatic study of variations in weather conditions that affect water demands for irrigation from year to year. These types of design and development studies are prerequisites before the impact of irrigation can be adequately assessed. Water use studies and projections are integral to assess the demands.

SUMMARY OF RECOMMENDATIONS FOR COMPETITION FOR WATER

The Task Force recommends:

- An intense 3-year study to identify on a regional basis the water supplies and the future demands related to energy, irrigation, urban, industrial and other demands.

Work Plan for 1981 and Beyond

There are a number of data gaps which exist in Illinois Water Resources which are not addressed in the work plan because of a lack of fiscal resources. Some examples include better definition of groundwater quality trends and verification of the causes of such trends.

The work plan for the future is organized in three major steps.

Scenario Development - In order to determine if, when, and where future conflicts will arise, the development of forecasts of supply and demand on a

unit/demand basis and the development of scenarios by location and timing is necessary. This includes:

- a. Development of forecasts for energy, irrigation, urban and industrial uses and other demands by September 1982.
- b. Development of scenarios includes alternative futures and evaluating alternatives by an interagency group which considers all demands and supplies. This is scheduled for completion in September 1983.

An output of this step will be an assessment of where probable conflicts, if any, will arise, how long the conflicts will persist, when they are likely to occur, and where.

Problem Redefinition - The current Water Plan assumes that there will be problems in the future. The output from supply and demand forecasts will either refute or refine that assumption. If the output suggests that problems are real, data deficiencies will be identified for specific areas and prioritized. This is programmed for completion in the spring of 1984.

Development of Evaluation and Institutional Mechanisms to Address Conflicts - Based on the output of Step 2, the types of data deficiencies and conflicts and timing will lead to a long-term method of coordination on water resource issues to avoid conflicts. Solutions for a variety of problems at a variety of levels of government and private interests will be explored. This is planned for completion in the fall of 1984.

AQUATIC AND RIPARIAN HABITAT

Statement of the Problem

Illinois possesses a variety of aquatic environments, including major rivers and their tributary streams; marshes, swamps and other wetlands; and many types of confined or impounded waters from natural glacial and backwater lakes to gravel and strip mine pits, and from dammed streams (channel dams) and watershed ponds to main stream reservoirs. Associated with each of these natural and artificial aquatic environments are specialized animal and plant communities which depend on the existence of the often complex array of habitat types which occur in, along and adjacent to these water areas for their continued survival. The development of management strategies for these aquatic systems demands both knowledge of and attention to the physical, chemical and biological factors which interact to support each aquatic and riparian ecosystem.

As with upland terrestrial environments, the ecotone or transition zone between various aquatic environments or between the shoreline water dependent or riparian habitats and the drier upland environments is often the most biologically productive. Man's interaction with the aquatic and riparian environment is for the most part also concentrated in the ecotone. Nowhere are the lines of conflict between the natural and man-made environments so

clearly drawn than at the water's edge. To support his ever-growing economic needs, man continually modifies those aquatic systems upon which he depends for survival. Society's perceived needs cause people to bulldoze streamside forests, strip bank vegetation, artificially change channel alignments, mine flood plains and streamside rock outcrops, and dam streams to create artificial impoundments.

Natural and artificial lakes are also subjected to a variety of impacts: many lake shorelines are artificially filled to create sites for homes; productive in-shore habitats are covered with thick blankets of sand to create artificial beaches; lakeside septic systems and watershed fertility leaches into the lake water enriching it and causing accelerated eutrophication. Poor watershed land management and in-lake wave wash on unprotected shorelines deliver silt to the lakes which reduces volume and covers productive bottom. Wetlands are filled and drained and used as trash dumps.

Much work is necessary to solve these problems. This section addresses the initial important step of establishing an effective state government planning process which will eventually lead to resolution of the problem of degradation of the state's aquatic and riparian habitats. As with any logical planning process, the goals and objectives of the effort must first be defined. Then information needs are identified and data are collected, assembled in a usable form and analyzed. Finally, alternate strategies for problem resolution are developed to achieve the objectives based on the analyzed information.

Proceeding in this manner, first, the state's goal in the management of all natural resources is conservation, that is, wise use. The term "wise use" as applied here embodies two primary concepts. First, the state wishes to protect the integrity of the resource base and insure its existence for use by future generations. Second, the state desires to allow for reasonable balanced consumptive and non-consumptive uses of these resources by its present citizenry. To achieve the goal of wise use, strategies for the management of aquatic and riparian habitats must be based upon a knowledge of Illinois' consumptive needs for these resources, sound ecological principles, and adequate resource information.

Various state agencies and academic institutions have over the past hundred years been collecting information on Illinois' aquatic resources, often with little or no coordination. These data sets today reside the length and breadth of Illinois in isolated repositories. In some cases, little or no information exists concerning a given aquatic or riparian habitat due to the lack of sufficient study in the past. Such is the case with wetlands and riparian vegetation. In contrast, streams and natural and artificial lakes have been the recipient of much study by a variety of agencies and individuals. However, this wealth of information is scattered statewide, and is presently not available in a form usable for statewide policy and program planning.

The complexity of the aquatic and riparian habitat issue is great and the development of implementable solutions requires equally complex strategies for

each of the following sub-elements: information system development, program coordination, and the instream flow requirements of aquatic organisms.

Ongoing Programs

The Physical Aspect - By statute, the Illinois Department of Transportation, Division of Water resources (DWR) has permitting review power over construction in and along Illinois rivers, lakes, and streams. In 1974, their review power was extended to include construction activities within the 100 year regulated flood plain. The DWR is also responsible for water navigation systems at the state level and has regulatory responsibility over the activities of organized drainage districts.

The Illinois Department of Agriculture (IDOA) is responsible for developing and implementing a statewide erosion and sedimentation control program and for local Soil and Water Conservation Districts, which are its primary arms for program delivery along with the University of Illinois' Agricultural Research Station and Extension Service.

For the past 10-16 years, the State Water Survey has been assessing the behavior and characteristics of glacial lakes and man-made impoundments. During more recent years, demonstration projects have been undertaken to evaluate the cost and effectiveness of various in-lake treatment processes. The results of this work, in combination with Illinois Environmental Protection Agency (IEPA) water quality evaluations and Department of

Conservation (DOC) and Illinois Natural History Survey (INHS) biological data, has relevance for lake management decision making.

DWR and the Illinois Geological and Water Surveys all collect information and carry out and fund studies designed to provide information on Illinois' stream resources.

The Chemical Aspect: The Illinois Environmental Protection Agency, through both State statute and federal designation, is the agency charged with maintaining the water quality of both the State's surface and ground waters. IEPA permits the construction and operation of municipal and industrial waste treatment plants and various outfalls, sets water quality standards for chemical and bacterial concentrations and assures the purity of potable water supplies. IEPA also has responsibility for area and statewide water quality planning and acts as a pass-through agency for several federal grant programs related to water pollution control. The IEPA maintains the Illinois Water Quality Network, a series of over 200 water sampling stations on Illinois streams and this year has inaugurated, with volunteer assistance, a water sampling network on 100 public lakes in Illinois.

The Biologic Aspect: The Illinois Department of Conservation is charged, through several State statutes, with the perpetuation of Illinois' natural heritage of animal and plant species. Over the past forty years, the DOC has developed a variety of programs designed to address the above responsibilities as they relate to the aquatic environment. Furbearer and waterfowl

populations are monitored, and refuge and nesting areas are acquired and created. Wildlife biologists also provide technical assistance to other public agencies and private groups on furbearer and waterfowl management. Management related research through the INHS and the State universities is conducted on water dependent species. Pristine wetland environments are acquired or given statutory protection through designation as state nature preserves. DOC fisheries biologists have for the past thirty years provided technical assistance on all aspects of lake, pond, and stream management. In the 1960's, the DOC's fisheries personnel carried out, in cooperation with the Illinois State Museum and the INHS, extensive statewide surveys which culminated in the development of updated reference collections and books on the distribution of Illinois' aquatic plant, mussel, and fish species. The DOC now has special project staffs assigned to the management of the fish populations of Lake Michigan, the three Corps of engineers reservoirs: Carlyle, Rend, and Shelbyville; rivers and streams; and all other Illinois surface waters.

The Impact Analysis Section of the DOC's Division of Planning, with input from DOC field biologists, annually reviews thousands of permit applications and other water development related proposals, provides assessments of the potential environmental impact of the proposed actions and makes recommendations for project alternatives and impact mitigation or, in certain cases, project elimination.

The Illinois Department of Energy and Natural Resources (DENR), through the wildlife, faunistic and aquatic sections of the Illinois Natural History Survey, has carried out research on the biologic aspects of surface water management for nearly 100 years. The DENR's State Water and Geologic Surveys both also carry out studies and research which assist in the understanding of the chemical and physical aspects of Illinois' water resources. The DENR itself funds selected independent research projects designed to collect information on and develop solutions for many water resource problems.

Options and Recommendations for Policy and Programs

In this Section, the issue of aquatic and riparian habitat is addressed through three component sub-issues.

Computerized Resource Information System - The issue is not the collection of new resource information, since Illinois has for over 100 years been doing just that. Rather, the more pressing need is to organize existing natural and cultural resource information in a systematic way so that it can be readily accessed for use in statewide resource decision making. Until this existing resource information is brought together from its existing repositories, Illinois' governmental agencies will continue to be unaware of the full existence and availability of State resource information. This will continue to foster the duplication of data gathering efforts and, therefore, the needless spending of limited State and local funds, while already existing data is underutilized.

In recent years, several Illinois agencies have begun to develop isolated and somewhat parallel resource information systems to serve their information needs. The Illinois Geologic Survey has computerized considerable information concerning the occurrence in Illinois of mineral resources. The Illinois Environmental Protection Agency has for the past two decades collected and computerized monthly information on the levels of the various chemical and bacteriological constituents of Illinois' stream waters, as well as occurrence and abundance information on stream invertebrate life. The IEPA has recently begun to collect water quality information on certain lakes in the state and has begun placing this information into a computerized data management system. The Illinois DOC, the Illinois Natural History Survey and the Illinois State Water Survey together have over 100 years of historical resource information which, if brought together in an organized fashion, could be utilized in the resource decision processes by all levels of government.

The Illinois Natural Areas Inventory, completed for the DOC in 1978, identified over 1000 remnants of the natural ecosystems which characterized the Illinois landscape prior to colonization by Europeans and has allowed the state to focus its protection efforts on the most critical sites. The recently initiated Statewide Streams Inventory has as its primary goal the development of an organized set of physical, chemical and biological data on each stream in the state for use in future resource allocation decision making.

Not yet included in water resource information system's development are natural and man-made impoundments, except for the preliminary work initiated

by IEPA, and information concerning the location, size and resource characteristics of Illinois' marshes, swamps and other wetlands. Another important addition to a resource information system would be geographic information on the extent of various soil types and the distribution of prime agricultural lands.

Because of the constant developmental pressures placed on State resources, Illinois can ill afford to delay in the decision to institutionalize interagency coordination and cooperation in resource data base development and management. A computerized statewide water resource information system should be developed, made available for use by all levels and branches of government, and the information maintained in a current, accurate status.

The options of reducing current activities or maintaining the status quo have been examined, evaluated, and rejected.

Program Coordination to Manage Illinois' Impoundments, Streams, and Wetlands -

Many in-lake and watershed activities adversely affect Illinois' impoundments, and only recently have the State and federal agencies responsible for the various facets of impoundment management begun to coordinate their programs in this field, stimulated by the passage of the Clean Water Amendments to the Federal Water Pollution Control Act, redirection of the SCS small watershed program under PL-566, and the 1978 amendments to the Illinois Soil and Water Conservation District Act. The recently established Watershed Priority Committee under the direction of IDOA has as its goal to channel local, State and federal program responses to erosion and sedimentation control to those watersheds exhibiting the most critical need for resolution.

Diagnostic studies need to be completed on many of Illinois' important natural and artificial lakes to provide the data base for the development of feasible and affordable approaches to solving the many physical, chemical and biological problems which limit their ability to sustain native fauna and flora and their potential for full recreational use and utility for water supply, cooling and other beneficial uses. Detailed depth contour maps are needed for major State and public lakes to assist in the development of management recommendations. Occurrence information on the various aquatic organisms which inhabit Illinois' water areas is also needed. The productive in-shore habitats need to be cataloged so that adequate protection can be given to important refuge and spawning areas. Data on dam structural soundness is also important to insure the public's health and safety. The cooperative in-lake and watershed demonstration projects aimed at developing and testing innovative and affordable impoundment rehabilitation techniques, specific to Illinois, are an important and commendable development.

Various Illinois statutes mandate the protection of natural faunal and floral resources, the maintenance of surface water quality, and the permitting of construction in and along streams. These statutes, however, do not recognize the importance of preserving and protecting the State's streams and wetlands and their associated riparian zones as valuable natural resources. For example, State law governing the permitting of construction activities in and along streams does not specifically recognize ecological concerns as a viable reason for permit denial.

There has never been an assessment of the magnitude of the impact of man's activities on Illinois' streams, making a determination of the cumulative

effect of these actions on the stream systems impossible. Illinois' wetland resources have been largely ignored in the land management decision process. The development of the state for urban, industrial and agricultural uses over the past 160 years has left less than fifty thousand scattered acres of wetlands.

Although a variety of joint agency study efforts have been completed and are underway, there are no overall State goals and objectives for managing stream and related resources. Also, the role of the State resource surveys relative to the development of plans and priorities for water resource management is not well defined. The role of these research arms of Illinois state government as a full partner in water resource management needs to be better defined and a mechanism developed to insure future research-management coordination.

A reduction of current activities or a continuation of these at current levels would fail to achieve reasonable program coordination among the numerous agencies involved.

Information Base and Policy for In-Stream Flow Reservation - Among our growing needs for municipal, industrial and irrigation water supplies, the life support needs of aquatic organisms relative to water flow, velocity, temperature and other factors, as well as the complexities of the aquatic food chains and their relationship to in-stream parameters have been largely ignored in decision making. As a result, in Illinois there presently is no state policy, statute authority or data base to balance in-stream and off-stream use of water. However, there is currently under development a data

base designed to provide information on the in-stream flow needs of Illinois' streams as natural systems.

In view of the recognized needs to establish in-stream requirements and the progress being made in current pilot studies, the Task Force concludes that neither a reduction or continuation of activity at the present level will meet the State's need.

SUMMARY OF RECOMMENDATIONS FOR AQUATIC AND RIPARIAN HABITAT

The Task Force Recommends:

- That a computerized water resource information system be established and maintained to organize existing natural and cultural resource information for cost-effective statewide resource decision making.
- That the various studies and implementation programs for the management of Illinois' impoundments, streams, and wetlands be coordinated and prioritized.
- An amendment to "An Act in Relation to Rivers, Lakes, and Streams" which allows appropriate consideration of environmental concerns in water resources planning and permitting be developed.
- That completion of the statewide in-stream flow data base be accelerated, and regulatory goals and objectives with respect to in-stream flow reservations be considered and discussed with the interested public.

Work Plan for 1981 and Beyond

For each of the component sub-issues discussed above, work plans for the recommended options are outlined as follows:

Computerized Resource Information System - By the beginning of 1982 the DENR will convene a work group to identify data availability and needs.

During 1982, local agencies and private users will be surveyed to determine their needs and interest in participating. The scope for the Information System will then be completed and presented to the Task Force. During mid-year, the data formats and procedures will be completed, and during the final quarter, the system will be activated.

Program Coordination to Manage Illinois' Impoundments, Streams, and Wetlands -

During 1981, the Water Plan Task Force will consider and adopt a uniform stream indexing system and a systematic approach for prioritizing applications for diagnostic study, research, and implementation of solutions for impoundments, streams, and wetlands. Concurrently, a technical work group will develop language for an amendment to "An Act in Relation to Rivers, Lakes and Streams".

During the first quarter of 1982, the work group will develop a statement of goals and prioritized objectives and operating procedures for the future development and management of impoundments, streams, and wetlands. This will be considered and adopted by the Water Plan Task Force in mid-year, and then incorporated into an interagency agreement.

Information Base and Policy for In-Stream Flow Reservation - During the remainder of 1981, a technical work group will begin development of procedures to determine protected flows.

During early 1982, work on the protected flow methodology will be completed. During April-May, this will be applied to the completed basin, and the results publicized. Further implementation steps will then be determined.

WATER-BASED RECREATION

Statement of the Problem

Any discussion of water-based recreation is inextricably tied to the subject of aquatic and riparian habitat considered in the immediately previous section, because the quality of a recreational experience is both dependent on and enhanced by the environmental quality of the setting in which it occurs.

In Illinois, as elsewhere, a major factor in decisions on the location of recreation facilities has been the proximity of surface water or the potential to create a water body. However, because of Illinois' geologic history, natural water bodies are lacking on a statewide basis and are not sufficient to meet the recreation needs of Illinois' population centers. While one of the primary factors in the establishment and growth of Illinois' major urban centers was the nearness of Lake Michigan or a river suitable for a drinking water supply, power generation and transportation, most communities over the ensuing years have tended to expand away from these water bodies toward the adjoining upland.

Over the past thirty years as society's affluence and leisure time have increased, attention has once again been drawn to the State's rivers, lakes and streams as important resources for recreation. Illinois' water areas in

the early 1900's were primarily the domain of hunters, trappers, anglers and water-borne commerce. Since the early 1950's interest and participation in other water-based recreational pursuits has dramatically increased.

Recreational boating, including canoeing, sailing and water skiing, has become a major industry in Illinois and the United States. Swimming and sunbathing, once pursuits of the affluent, have become national pastimes. Fishing for sport is now "big business", as is waterfowl hunting. In response to these trends, governments at all levels now provide an ever increasing array of recreational services and have instituted a variety of regulations to both protect the water resource base and mediate the often conflicting desires for water use.

As recreational water use increased in popularity, people have increasingly sought to live near the water. This migration back to the water was seldom preceded by proper land use planning. Illinois' northeastern glacial lake district has changed from a summer resort mecca to a series of compacted shoreline communities. These lakes are now so congested that quality recreational experiences are a dream of the past. Throughout the state many association or subdivision and water supply lakes have been developed, which, in most cases, except for a narrow band of common land along the shore, are ringed by private residences and cottages.

During the 1940's a plank in Governor Green's successful platform was: "A state lake for every county." For years after the Green administration, Illinois' concern was to construct impoundments with little or no regard to

the stream resources and associated amenities which were lost. The upsurgence of the environmental movement in the late 1960's has rekindled awareness of the importance of the nation's rivers and streams as major recreational and environmental resources to be protected and wisely used.

Ongoing Programs

The Illinois Department of Conservation (DOC) and the Cook County Forest Preserve District are the largest recreational water managers in Illinois. Many park districts, conservation districts, and some city and village governments also own and maintain water areas and associated recreational facilities. The DOC provides technical fisheries and general lake management assistance to all water owners, as well as fish for stocking purposes. In recent years, it has accepted recreational management responsibility for several power company cooling lakes and the three U.S. Corps of Engineers flood control reservoirs: Carlyle, Rend, and Shelbyville Lakes. Through the State Boating Act mandated Local Boating Assistance Program, the DOC assists local governments in the development of boat access sites on Illinois' public rivers, lakes and streams, as well as on Lake Michigan. The Department trains local volunteers to provide Boat Use Safety Courses statewide, and, in cooperation with the U.S. Coast Guard and county sheriff departments, carries out boat safety inspections and provides water safety patrols. DOC Law Enforcement Officers annually inspect and license all rental boats in Illinois to increase the safety of users.

The Illinois Department of Public Health has established rules and regulations for the operation of swimming beaches and pools, and regulates sanitary facilities for outdoor recreation areas including water areas. Some County Public Health Departments have also adopted water quality and operational requirements for beaches. Lakeside homes are inspected to determine the condition of their waste water facilities. The Illinois Environmental Protection Agency certifies drinking water supplies and has established more stringent water quality standards for recreational water areas.

Options and Recommendations for Policy and Programs

The DOC is in the process of developing by November 1982 an updated Statewide Comprehensive Outdoor Recreation Plan (SCORP) which will address Illinois' pressing outdoor recreation concerns. Among the topics under study is Water-Based Recreation. There is also a direct relationship between several of the actions proposed under the Aquatic and Riparian Habitat, Integration of Water Quality and Quantity Management, and Erosion and Sediment Control issues of the State Water Plan and the Water-Based Recreation issue. For example, those actions which reduce pollution and sedimentation directly and positively affect the potential of water areas to provide a quality environment for recreation.

Several sub-issues are involved in addressing water-based recreation:

Information on Magnitude of Existing Recreational Use of Illinois' Surface Waters and Potential for Increased Use - The Department of Conservation has carried out numerous angler catch studies, although these types of studies have seldom been carried out on other public and association or private water areas. The DOC also carries out tri-annual statewide licensed angler surveys to provide current management decision information on the use of the state's fisheries resources and the needs and desires of Illinois' angling public. To date, in Illinois, no attempt has been made to determine the magnitude and diversity of recreational water use by power boaters, water skiers, canoeists, sailors and swimmers, or to determine the recreational carrying capacities of lakes and streams.

Information on recreational water use is important to both DOC and IEPA in developing management strategies and approving access site development applications for individual water areas and in establishing water quality standards for various chemical constituents of both lake and stream environments. Knowing which reaches of a given stream are utilized for various recreational activities is also necessary information for determining instream flow reservations.

The IEPA has begun the process of cataloging information on the recreational activities carried out on the 350 impoundments it recently surveyed and on certain streams. However, this process needs to be extended to include important association, club, private and commercial waters, and on recreationally significant streams. For enlightened environmental impact

analysis and management decision making to occur, accurate relevant statewide water resource and recreational use information must be both available and organized to allow efficient analysis. Much information concerning the use of Illinois waters for various recreational activities exists in both published reports and as unpublished field data in the field office files of the DOC's Divisions of Fish and Wildlife Resources and Law Enforcement. Until this existing data base is organized in an accessible format, its utility in statewide project prioritization and funding is minimal. Further, it is difficult to determine where to place further data collection emphasis and where to target research efforts until the magnitude and reliability of existing information is known. The organization of existing recreational use information as well as the development of a methodology to determine acceptable use levels will be included in a Scope of Work for the "Water Resource Information System" proposed under the Aquatic and Riparian Habitat issue. The recommended approach and work plan for this sub-issue is the same as that proposed for impounded waters and streams under the Aquatic and Riparian Habitat issue.

Rights of the Public to Utilize Illinois' Natural Water for Recreation

Purposes and to Regulate that Use - The interpretation of Riparian Doctrine as applied to Illinois' waters by past case law is ambiguous and leaves many questions unanswered pertaining to the public's right to utilize surface waters for recreational purposes. At the same time, the DOC is increasingly requested to provide access to various streams for canoe use.

Thirty-one Illinois streams were declared navigable waters by the recent federal court decision on a waterway permit matter involving the Mackinaw River near Peoria. However, the question remains whether these streams are actually legally available for recreational use or only for commercial navigation. Also, the Illinois Fish Code directs the State of Illinois to protect and insure the survival of the fish and other aquatic organisms which inhabit the waters of the state. However, riparian case law seems to establish that only the riparian landowner may take these species for consumptive purposes.

Adjoining states have interpreted the same Riparian Doctrine much more broadly in relation to the public's rights to access and use water areas for recreation purposes. Illinois' case law seems to indicate that the ownership of the beds of non-navigable streams was transferred from the State to the riparian owner, but neither this transaction nor the determination of how certain water areas were determined to be navigable can be documented. As the DOC makes decisions to fund local requests for access site development and to develop State canoe trail facilities, and as IEPA determines water quality standards for individual stream reaches for recreational and other uses, they need a clear determination of the public's legal rights to use and their responsibilities to manage these resources and commit state funds for this purpose. Also needed is a determination of the extent of riparian landowner liability where public use occurs on an adjacent navigable stream.

In light of the above uncertainties and their important policy and program implications, DOC and IEPA along with the Department of Commerce and Community

Affairs, the Department of Agriculture, and the Division of Water Resources will constitute a work group to clarify the access and use issue in conjunction with other water law issues. A scenario for resolving the recreational use issue will be developed, coordinated by the State Water Plan Task Force (SWPTF) and cooperatively implemented.

Work Plan:

Calendar 1982

- January-February - DOC develops tentative course of action and assembles appropriate background information.
- March - DOWR, DOA, IEPA, DCCA and DOC meet to discuss proposal and reach agreement on proceeding.
- April - Present proposal to SWPTF for discussion and concurrence to proceed.

Access to Illinois Water Areas for Recreation - With the passage of the Illinois Boat Safety and Registration Act in the early 1960's, it became the DOC's responsibility to insure adequate public access to the navigable waters of the state. Over the past twenty years the DOC has developed and assisted in the development of nearly 200 lake and stream access sites. While this represents a substantial accomplishment, these access sites are located

primarily on the Mississippi, Ohio, Illinois, Rock, and Sangamon Rivers and Lake Michigan. Other recreationally significant water areas, such as the Mackinaw, Spoon, and Embarrass Rivers have little or no access. This uneven distribution of public access has occurred because: 1) there are urban centers located along the larger rivers with park districts able to assume management responsibility for the sites once construction is complete, 2) the DOC's Local Boating Assistance Program presently allocates funds based solely on unsolicited applications from potential local sponsors, a cursory determination of the need for the site and the physical acceptability of the location. In addition, the boating act only provides for the registration of motorized craft and sailboats over twelve feet in length. The State Boating Fund then is supported by these registration fees and marine lubricant and motor fuel tax monies. Therefore, while limited general revenue funds can be used, the DOC has no dependable funding source for developing access to streams which are either too shallow or narrow for effective motor boat use, but offer excellent canoe trail potential.

As a part of the FY '82 work plan for the Comprehensive Streams Inventory, data will be collected on the location, ownership and availability for public use of existing access sites. In addition, the boating and canoeing public will be surveyed during FY '82 to determine their concerns as users and where they feel access is insufficient. The DOC will then, as a part of the development of the 1982 SCORP Policy Plan, set priorities for stream reaches, based upon an analysis of access needs and the legality of public navigation, and actively seek local sponsors for site development and maintenance.

Illinois citizens will then be assured that their Boating Act funds are being utilized to solve the most critical access problems. An additional important benefit of this access site analysis will be the availability of locational information for use during flooding and other emergency situations. To facilitate ready access to this information, the DOC will produce a statewide access directory and distribute it to law enforcement officials and the boating public.

Revitalization, Renewal, and Protection of Illinois' Culturally, Recreationally and Economically Significant Urban Waterfronts - Illinois' largest urban centers are located adjacent to large rivers or Lake Michigan. Early development along these waterfronts was primarily oriented toward commercial, industrial and cargo handling activities. With the decline in the use of our waterways as the primary means of transporting goods to distant markets, the vitality of the urban waterfront decreased. Today many of the nation's waterfront factories, and docking facilities are being refurbished as apartments, condominiums, office and commercial buildings, and the associated riverbank and lakefront lands are being converted to public parks and promenades. Old waterside rail spurs are being developed into urban foot and bicycle trails which cross the water body on once derelict railway trestles or antiquated iron truss bridges. The revitalization of urban waterfronts direct urban attention toward the protection of the adjacent lake or stream and its utilization as a base for active and passive recreation. These types of activities are already beginning in Illinois along the Chicago River in Chicago, at Peoria on the Illinois River, and elsewhere. This is the best

type of urban renaissance because it can concurrently preserve culturally significant structures, provide jobs, increase innercity commercial activity, stimulate tourism, and generally improve the quality of life for the urban dweller.

At present, the DOC is involved in these activities peripherally through the provision of technical assistance. Federal grants which were once the primary funding sources are generally no longer available. New methods must be found to stimulate and assist these renewal efforts. The Department of Commerce and Community Affairs (DCCA) through its combined roles of liaison to local governments, state tourism coordinator, and as a stimulator of Illinois commercial and industrial activity is uniquely suited to provide joint leadership with the DOC in the development of a State response to this issue.

In light of the opportunity for State leadership to stimulate local activities, it is recommended that DOC, DCCA, IEPA, and DWR jointly develop a scope of work for a statewide analysis of the location and condition of Illinois' urban waterfronts. The study would also recommend how best to channel state government activity to provide necessary assistance to local agencies and would examine alternative funding strategies. The study would be funded in part by the DOC portion of Illinois WRC-Title III grant funds. Subsequently, the Water Plan Task Force and an active local waterfront action group will sponsor a statewide "Urban Waterfront Renewal Workshop" to explore funding mechanisms, and imaginative renewal planning and generally heighten the public's awareness of the need for and utility of these efforts.

Following these steps, a state policy statement on Urban Waterfront Renewal will be developed which recommends the proper roles for the appropriate State agencies.

SUMMARY OF RECOMMENDATIONS FOR WATER-BASED RECREATION

The Task Force Recommends:

- That information on the magnitude of existing and potential for water-based recreation locations be cataloged to guide management strategies for recreational carrying capacities, for approving access site development, for in-stream flow requirements, and for water quality standard setting.
- The public rights to use natural water for recreation be clarified for various purposes including the provision of access sites.
- A State-wide analysis of urban waterfronts for recreation and commerce be conducted to identify how the State can assist local agencies in their renewal activities.

Work Plan for 1981 and Beyond

A. Calendar 1981:

November-December - Joint work group develops scope of work for the "Waterfront Study".

B. Calendar 1982:

April - Review proposals, select contractor, and begin study.

May - Hold Urban Waterfront Renewal Workshop.

August-September - Begin to draft State Policy on Urban Waterfronts.

ATMOSPHERIC CHANGES AND MANAGEMENT ISSUES

Atmospheric changes are altering the quantity and the quality of the waters of Illinois. Some changes are slow, others rather sudden, and many are just being realized by scientists and the public. The atmospheric changes are due to natural fluctuations in climate and also to man's influence on the atmosphere. There are two emerging capabilities to deal with these changes, weather modification and climate prediction.

The atmospheric concerns relate to three issue areas:

- A) climate change and prediction of future climate conditions,
- B) inadvertent weather and climate modification; and,
- C) planned weather modification.

All are at the margin of developing knowledge and public awareness, but the state must play a major role if they are to be addressed to benefit our water resources. Each of these is treated as a separate, but related sub-issue.

Detailed plans of future efforts including manpower and funding needs, and of agency responsibilities have been developed. These are not all presented here because of space limitations, but can be supplied by the Water Survey.

CLIMATE CHANGE AND PREDICTION OF FUTURE CLIMATE CONDITIONS

Statement of the Problem

The quality and quantity of Illinois' water resources are irrevocably linked to and dependent upon the climate. Precipitation contributes all of the water available to Illinoisians. However, not all of this water falls on the state; some of it is hundreds of years old and buried in the ground, and some originates elsewhere and flows to the state in major rivers. The amount of water that escapes from Illinois in the form of evaporation and transpiration is also significant, and this evapotranspirative loss is dependent on the humidity, temperature and winds, and other major features of the climate of Illinois. The ability of the atmosphere to carry and then deposit natural and anthropogenic pollutants also represents a major factor affecting the quality of the State's waters.

As a result, climate is an integrator and a controller of the state's water resources on all time and space scales. Hence, changes in climate can be of importance to Illinois' waters and its major uses, human consumption, crop growth, and energy production.

Climate is not static, as many perceive, and is constantly varying over time scales ranging from a few years, to decades, to centuries. If we look back at what has happened in Illinois in the past 140 years, we see that we are now in a period of declining temperatures and fluctuating but heavier precipitation. Since we will be dealing in the future with a climate different than that of the past 60 years, we will experience events for which our current water systems have not been designed or developed.

Proper assessment of the current climate, including its trends, changes in its variability from year to year, or alterations in extremes of weather, is integral to the planning and management of water. Water is intimately linked to agriculture and energy since both are great consumers of water. Climate's affect on Illinois' water resources is most easily visualized by the dramatic impacts on both floods and droughts. A change to more of these, or to more extremes of wet and dry conditions, would be of singular consequence to the state's economy and institutions.

The race to keep pace with these climate-related water problems and to seek their solutions, requires consideration of the climatic factors of today, and the knowledge of the shifts and trends that are developing. Means for the state government and climate-sensitive industry to adjust to future climate extremes basically fall in three classes:

- 1) reduced and delayed services and more difficult management (reaction approach);
- 2) allowance for greater flexibility in budgeting of personnel and materials to handle the unknowns (surplus management approach); or
- 3) use of long-term climate predictions in planning, budgeting, and operations (planning approach). Climate prediction offers a chance to act, not react, to future atmospheric vagaries. This sub-issue area addresses climate variations, their impacts, and what should be done to ameliorate their effects on the water resources of Illinois.

Ongoing Programs

There are three general program activities in Illinois including collection of climate data, climate-change research, and an education-information program. The collection of data is largely the responsibility of the National Weather Service (NWS) and the Illinois State Water Survey (ISWS). The NWS operates 5 stations where all weather conditions are measured continuously, and 95 substations manned by volunteers where daily precipitation and temperature is measured. These stations are the state's basic climatic network and are keys to monitoring changing climate. The ISWS has operated a series of special weather networks in various locations around the state to collect data on the smaller scale variations in climate. In 1981, the ISWS also

installed 6 special climate stations to measure weather conditions not being measured by NWS and seen as vital to water resources (soil moisture, solar radiation, atmospheric deposition, winds, and precipitation).

Two of the primary problems in the existing collection of data to monitor climate and its changes relate to federal reductions in support. The NWS is reducing its support of climatic measurements as well as support of the dense networks needed for studies of variability. Monitoring climate change requires high quality data, collected in the same undisturbed location with long-term operations. Long-term historical records represent a legacy calling for a state commitment to maintain their operations.

Another area of climate efforts relates to research. Research dealing with climate change and climate prediction is being federally funded and conducted at the ISWS and at the University of Illinois, Northern Illinois University, and the University of Chicago. All are slated to terminate by 1983, as are the ISWS federally-supported studies of climate change. Research on climate prediction, supported by federal agencies and private companies, plus monitoring of the on-going conditions, faces an uncertain funding future beyond 1983.

The ISWS generates publications and conducts workshops that relate to climate, and other Illinois researchers yield scientific reports. The

level of educational and climate awareness activities is less than required for informed decisions about an important and complex subject.

Options and Recommendations for Policy and Programs

The goal of state policies relating to climate, climate change, and climate prediction is to improve the resilience of our water resources to climatic impacts. There are five recommended action options which build upon existing agency strengths and which have great potential for efficiency in the use of our water resources.

Awareness that Climate Change is a Problem - Most decision makers are not now aware of and adjusting to the existence nor degree of climate change and its impacts on the waters of Illinois. One of the actions to pursue is:

- 1) a program of research to better define the climate-society interactions, and
- 2) to launch a more ambitious program of information dissemination about these interactions to improve awareness.

Monitoring and Research of Climate Change - A key input to all action options is knowledge of the types of climatic changes deduced from monitoring, and of causes and impacts of changes from research. These two activities are the heart of the information, planning, and decision process. These efforts are viewed as a joint activity of the state and

federal government. Federal support, which has been predominate, is decreasing and the amount of state support should increase to sustain the effort.

Direct Access to Quality Climatic Data and Predictions: Climate

Information Center - The diverse application of climate data (soil moisture, rainfall, snow melt, temperature extremes, etc.) and of predictions of climate (for months, seasons, and years ahead) have a wide variety of applications in water design, assessment of events, and operational issues. The primary action option for state institutions and businesses is to have climate data and predictions easily accessible in computer format at a state-operated climate center. Development of a centralized data bank and related information with real time access by climate-sensitive users is seen as an extremely profitable endeavor.

The installation of a data base-information system at the Illinois Climate Center, already established at ISWS should be a state task. Data must be constantly collected, verified and entered in the data bank, clearly state activities.

Developing Plans for Climatic Extremes - The climate will bring more or less frequent climatic extremes such as droughts and floods. Contingency plans relating to such events must be developed for more effective assistance in the management of water systems. Included should be disaster relief plans for short-term climatic changes (like droughts,

floods, and heat and cold waves), and plans for economic and institutional conversions related to the longer-term changes such as ever colder temperatures and higher precipitation. Development of these contingency plans is seen as a state activity, to be done jointly by involved State agencies through a Climate Detection and Assistance Board.

Implementation of Preventive-Adjustment Activities - A follow-on aspect of contingency planning for climatic extremes is implementation of action responses. This includes establishment of warning systems for droughts, heat waves, floods, and cold waves, dissemination of forecasts of future climate abnormalities, development of new control works, etc. These will benefit the public but primarily local and state governments and climate-water sensitive industry and commerce. The warning adjustment function is highly dependent on the monitoring function and research products, and is viewed as the responsibility of ISWS. A means of warning dissemination should be devised involving primary users.

Work Plan for 1981 and Beyond

The efforts in the next two years will include sustainment of two existing programs including:

- 1) data collection efforts of the NWS and ISWS, and
- 2) climate change and predictive research of the ISWS and state universities

Increased state support will be needed as federal support continues to decline.

New activities to be accomplished in the next two years, given added state and private support is available, include:

- 1) educational-information project launched and completed;
- 2) establishment of the Climate Data and Prediction Center; and
- 3) identification of climate change monitoring and warning activities at the Illinois Climate Center

Policy-related activities to be launched include 1) development of state policies about climate change (interstate and international arrangements), and 2) the establishment of the Climate Detection and Assistance Board.

B. INADVERTENT WEATHER AND CLIMATE MODIFICATION

Statement of the Problem

Settlement in Illinois, begun in earnest 170 years ago, gradually began to alter the climate of the state. The changes of land use, prairie and woods to row crops and cities, have altered the earth-atmosphere

radiation and moisture balances. In addition, the combustion of fossil fuels have added heat, gases, and particles to the atmosphere. These changes collectively affect the weather and in turn have altered the climate everywhere in the state. These man-induced climate changes are becoming sufficiently large to be evident in the quantities and qualities of our water resources.

Every aspect of the urban climate differs from that of adjacent rural climates. In and well beyond (east) large cities like St. Louis and Chicago, it is warmer, stormier, rainier, and less humid than in other rural areas west of these cities. Elsewhere in Illinois it is cloudier, with fewer temperature extremes and poorer visibility, and more polluted by haze than it would be without man's presence. The waste heat of cooling towers and cooling lakes of our utilities and industries produce clouds and make fog, and our high flying jet aircraft create clouds that reduce sunshine, evaporation, and radiation. The magnitudes of our climatic conditions have been significantly changed by man.

Man has also altered the quality of certain climatic conditions. The various man-made pollutants including rain-caused eroded soil and windblown dust, both due to heavier rains and improper soil management, often mix with the clouds and rain and fall to earth in potentially harmful forms. Acid rain is just one of these impacts. The many gases released including CO₂ produce a range of air quality concerns including a reduction of the earth's protective ozone layer and increased global temperatures.

A particular area of concern is the material being deposited on the surface of Illinois, including acid rainfall. The sources, transport, transformation, and deposition of pollutants, plus their impacts on the water resources of Illinois largely represent a major and potentially serious unknown. The effects of acid precipitation are estimated to be numerous, but the scientific evidence to quantify such estimates is largely lacking. The most obvious conceptualized effects include:

- 1) increased pollution of water resources,
- 2) corrosion of building materials and statuary,
- 3) alteration of natural ecosystems (especially lake and stream systems), and
- 4) adverse impacts on agricultural and forest crops

While much research is underway, none of these impact areas has been documented scientifically to directly respond adversely to precipitation chemical quality. The effects of pollutants deposited in non-rain conditions are ill-defined but appear potentially serious.

Formidable scientific questions must be addressed to assess the magnitude of the acid rain and dry deposition issues. Among these are:

- 1) what is the current trend of precipitation acidity?,

- 2) what is the response of natural precipitation chemistry to increased fossil fuel consumption? and,
- 3) what is the response of Illinois waters, soils, weather and agriculture to pollutant deposition?

The scientific community agrees that meaningful answers to key questions about acid rain, including what causes it, what is the trend, and what are the impacts, will come only after more data are collected. The list is long but the questions are critical.

Man-made changes in climate, in the net, affect the state's major supply of water: the precipitation, both as to its amount and its quality. Several of the altered climate conditions also affect the rate of outgoing moisture through altering evaporation. Some of the important specific effects relating to water include acidic pollutants in rainfall and their effects on water supply, increased soil erosion due to heavier rainfall rates and higher winds, and the complex secondary impacts these produce. For example, these two issues affect the state's productivity by forcing higher pollutant removal costs for coal thereby reducing the level of coal development, as reflected in the nation's acid rain concerns. The added erosion due to higher rain rates and winds reduces the potential for higher crop yields. A key aspect of the inadvertent modification area relates to state awareness and action. There is a strong necessity for a 3-pronged state initiative:

- 1) to sustain a critical level of research;
- 2) to ensure the monitoring and data collection to measure the magnitude of the problems;and
- 3) to launch an educational effort so the public can understand and government react wisely to issues like acid rainfall, carbon dioxide, and soil erosion that are partially or largely, a result of man's influence on the atmosphere.

The potential for conflicts relating to inadvertent weather and climate change is considerable. These focus on questions of causation of heavy rains and acid rains, and span the scale from local (urban) to international conflicts.

Ongoing Programs

The Illinois State Water Survey (ISWS) has pioneered in studies of inadvertent weather and climate modification. The National Atmospheric Deposition Program concerned with acid rain and composed of 90 stations, with 6 in Illinois, utilizes the ISWS expertise and facilities as the Central Analytical Laboratory for the nation.

Recently completed studies including those on the atmospheric effects of waste heat from cooling lakes and towers have led to an adequate

definition of their influence on the atmosphere. The studies of urban effects on weather and climate have been extensive and the most definitive in the world. Current research is completing the measurement of the effects of Chicago on precipitation, both over the city and over Lake Michigan which serves as the state's principal water source.

Another on-going program relates to studies of regional inadvertent modification. These include data collection and research dealing with:

- 1) the effect of jet-induced contrails on cloudiness in Illinois and the Midwest,
- 2) releases of gases and particulates to the atmosphere, and
- 3) the sources, transport, and deposition of man-made pollutants including acid rain. The sources, transport, transformation, and deposition of pollutants, plus their impacts on the water resources of Illinois largely represent a major and a potentially serious unknown cycle receiving concentrated study.

There is very little research or study of the effects of CO₂ and particulates on climate, and in turn on our water resources. These remain as major gaps in our knowledge.

Options and Recommendations for Policy and Programs

The goal of state policy relating to inadvertent weather and climate modification is to understand the changes caused by Illinois and their impacts, and to establish policy positions and regulations regarding unfavorable modification for the benefit of Illinois and the nation. The implications of possible interstate and international atmospheric transport of materials and climate changes produced by Illinois are enormous. Illinois must be prepared to justify its current economic status and future growth in the face of potential degradation of climates beyond its borders. Because of the lack of scientific certainty in some of these areas, several programmatic options stand before Illinois.

Research and Monitoring - Research here includes data collection and monitoring, as well as defining regional climate changes due to jet aircraft. The studies of effects of CO₂ and particulates on climate have just begun and will require at least 10 years to resolve. The third key research area relates to atmospheric chemistry including acid rain. This area will require 10 years to achieve major answers. These research efforts will be pursued by ISWS and state universities.

Awareness and Response - Two major metropolitan areas of Illinois, and adjacent suburban and rural areas representing 5% of Illinois land and 70% of the state's population, experience major man-induced weather and climate changes. These produce a myriad of impacts, and mostly major

local problems for the water resources of these populous areas. Little if anything is consciously being done by local, state, or regional officials to either manage the climate anomalies or to adjust to their impacts. The institutional means for identifying these problems, for designing facilities to address them, and to operate water systems in an optimal way are not in existence. Hence a public and institutional problem-recognition effort is recommended. This effort could be a function of the Climate Detection and Assistance Board.

A follow-on action should be the launching of an information effort primarily to educate urban and regional planning groups, federal agency staffs, leaders of major cities, and state agencies. This program would present results about inadvertent modification and potential interpretation of the actions to be taken. New regulations will likely evolve including new designs for sewer and storm drain systems.

Work Plan for 1981 and Beyond

Research dealing with urban effects on precipitation will be completed in 1982. Research and data collection for atmospheric chemistry involving the source, transport and deposition of various pollutants will continue. A third on-going area involves research related to the effect of jets on cloud cover.

These project areas are being largely performed by the ISWS and largely supported by federal funds with expected terminations in 1983-1984. Only marginal support is available for initiating studies of large-scale particulates or CO₂ influence on Illinois climate.

Efforts are being made by the ISWS to inform decision makers about inadvertent climate modification and effects on water resources. These include workshops and scientific reports. Development of state policies on the issues raised by inadvertent weather and climate modification should be evolved in the next 3 years.