Proceedings

1995 Governor's Conference On the Management of the Illinois River System

Fifth Biennial Conference
October 10-11, 1995
Hotel Père Marquette
Peoria, Illinois

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Elizabeth D. Wagner, Editor
Institute for Environmental Studies

Issued as **Special Report No. 22**
Water Resources Center
Institute for Environmental Studies
University of Illinois at Urbana-Champaign
1101 W. Peabody Dr., Urbana, IL 61801
(217) 333-0536

Photographs by Jon Hubbert, Natural Resources Conservation Service, Department of Agriculture.
Printed with financial support from the Illinois Department of Natural Resources.
(450/ February 1996) Printed on recycled paper.

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Ruth Ballowe and Michael Reuter,
The Nature Conservancy
Nani Bhowmik, Misganaw Demissie and David Soong,
Illinois State Water Survey
John Braden and Harini Narayanan,
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Michael Platt and Holly Thome
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Proceedings

Opening Address

Robert W. Frazee

University of Illinois Cooperative Extension Service
East Peoria Extension Center, 727 Sabrina Drive, East Peoria, IL 61611

Good Morning and Welcome! At this time I would like to convene this Opening Session of the 1995 Governor's Conference on the Management of the Illinois River System. I am Bob Frazee, an Extension Educator specializing in Natural Resources Management for the University of Illinois and a co-chair for this conference. This morning as I mingled with people in the hallways, it was exciting to be a part of the interest and enthusiasm that is being generated by holding this fifth biennial conference on the Illinois River System. I am very pleased to report, that as of a few minutes ago, we now have over 250 individuals registered for this conference. In looking over the registration list, we have a very diverse group of participants in terms of their backgrounds and the groups and agencies they represent. This is great! With this diversity in mind, I would like to encourage each of you, throughout this two-day conference, to actively seek out individuals with different opinions and viewpoints on river management. Share your thoughts and concerns with each other, open your mind to new perspectives, and explore the opportunity for compromise.

The Illinois River has been a river of extremes throughout the 20th century. It has flourished as one of the country's best fresh-water fisheries; and it has also been given up as dead, the victim of severe pollution. However, the Illinois River has been making another comeback in the past decade, and this is the focus for our 1995 Governor's Conference on the Management of the Illinois River System.

The theme, appropriately enough, is: "The Illinois River: Past, Present, and Future." During the next two days, our conference speakers will be addressing water-quality issues and programs, progress that has occurred to date, and future plans that will influence the river and its watershed into the 21st century.

The Illinois River System is indeed our state's most important inland water resource. It is part of the seventh largest river system in the world, draining nearly 18.5 million acres in three states. As each of us in this room must acknowledge, the Illinois River System is in jeopardy. Only through efforts like this conference, will solutions to the river's problems be found.

The Governor of Illinois, Mr. Jim Edgar, recognizes the tremendous importance of the Illinois River System to our state and further realizes that it also provides Illinois with a key environmental challenge. Consequently, the 1995 Conference on the Management of the Illinois River System has been designated a Governor's Conference. A special Governor's proclamation has been issued to emphasize our state's commitment to conscientiously manage this important

natural resource for the benefit of future generations. This is on display in the foyer and will also be printed in the Conference Proceedings. Unfortunately, Governor Jim Edgar is unable to attend this Illinois River Conference due to his direct involvement in a special two-week European trade mission.

Two years ago, following the 1993 Illinois River Conference, a statewide planning committee was formed to begin making plans for the conference convening here today. These committee members, who are listed on pages 28 and 29 of the Abstracts and Speaker Information Booklet, can be identified by the blue committee ribbon on their name tags. I feel these individuals have done an outstanding job of developing the program and making the necessary arrangements. Would these planning committee members please stand and be recognized.

I am also pleased to announce that we have over 50 co-sponsoring agencies and organizations who have assisted in promoting this conference and are committed to protecting and preserving the Illinois River System. They are listed on page 28 of the Abstracts and Speaker Information Booklet. We welcome each of you and thank you for helping to make this conference a success!

This year, we are especially indebted to several state agencies for providing significant contributions to enhance the quality of this conference. The Illinois Department of Natural Resources is to be commended for providing a grant to help defray the cost of printing both the Abstract and Speaker Information Booklet and the Conference Proceedings. Each registered participant will receive a copy of the Conference Proceedings through the mail in approximately three months. I would like to draw your attention to a change in your conference agenda. This evening, the Conference Reception scheduled from 5:30 to 7:00 p.m. will not be held in the LaSalle Room as printed in the program, but instead it will be located in the Cotillion Room, which is the same place where today's lunch is being served. This year we are especially pleased to be celebrating the 100th anniversaries of the Illinois State Water Survey and the Illinois Natural History Survey's Stephen A. Forbes Biological Station. The purpose of this reception is to formally recognize and applaud the contributions of these two agencies towards the long-term management of the Illinois River System.

At this time, I would like to specifically recognize the efforts of several individuals who have made significant contributions to the organization of this conference. First is the co-chair of this conference, Roberta Parks or better known to many of us as "Rob." Rob is Senior Vice-President of Governmental Relations for the Heartland Partnership and will be chairing the conference sessions tomorrow. Roberta, thank you for the excellent leadership you have provided to this conference.

Next, I would like to recognize the Heartland Water Resources Council of Central Illinois, which has been serving as the local administrative entity for handling the many arrangements necessary to make this a successful conference. Mike Platt is the Executive Director and Wendy Russell is the Office Manager for the Heartland Water Resources Council. Please join me in thanking Mike and Wendy for their efforts in organizing this conference. While you are at this conference, if you should have questions or need local information, the members of the Heartland

Water Resources Council will be pleased to help you, and they can be identified by the special ribbon on their name tags.

The third individual I would like to formally recognize is Jon Hubbert, District Conservationist with the Peoria County Natural Resources Conservation Service. Jon was responsible for organizing the Pre-Conference Conservation Tour that was held yesterday afternoon. This tour provided an excellent opportunity for participants to see, first-hand, the many conservation practices which are being applied to agricultural and urban land throughout the Illinois River Watershed. Thank you, Jon, for an outstanding tour.

The fourth individual I would like to recognize is David Soong, Hydrology and River Mechanics Leader for the Illinois State Water Survey, who has taken the responsibility for organizing our Exhibit and Display Room. The Exhibit Room is located immediately to your right and will be the site for the refreshment breaks and tomorrow's continental breakfast. On pages 22 - 27 of your program booklet is a listing of the Exhibitor Abstracts. We encourage each of you to take time during the conference to visit the displays and to learn about the many diverse projects that are occurring throughout the Illinois River System.

Throughout our two-day conference, please refer to the Abstract and Speaker Information Booklet for the agenda and for more complete information regarding the speaker's topic and personal background. On behalf of the planning committee, I hope that you will find this conference to be exciting, informative, stimulating, and enjoyable.

At this time, it is my pleasure to introduce to you, Mr. James A. Maloof, Mayor of the City of Peoria. Mr. Maloof will welcome you to this friendly Tri-County area, situated midway on the Illinois River between Chicago and Grafton.

Thank you, Mr. Maloof, for this cordial welcome. It is now my pleasure to introduce the Moderator for our Opening Session, Colonel Charles S. Cox. Colonel Cox is the District Engineer and Commander for the Rock Island District of the United States Army Corps of Engineers. Colonel Cox will provide us with an overview of the Corps of Engineers priorities associated with the Illinois River and will introduce the Keynote Speaker for our Opening Session.

Sharing the Challenge: Floodplain Management Into the 21st Century

Brigadier General Gerald E. Galloway, Jr., U.S.A. (Ret.)

Industrial College of the Armed Forces
Fort Lesley J. McNair, Washington, D.C. 20319-6000

It is a great pleasure for me to be here and to be part of this important gathering. I appreciate Colonel Cox's kind remarks and the efforts of the Rock Island District to be part of the Illinois team. I'm here to talk about flooding. I want to talk to you about sharing, partnerships, and responsibilities that go with floodplain management and where they should rest, and to tell you a little bit about the study that we did as a result of the floods that occurred in the Mississippi Basin in 1993.

As nature would have it, floods have occurred all over the world since 1993. We have seen heavy floods in Georgia and Florida; we've seen floods in Texas; we've seen floods again and again in California and throughout Europe, and once again back in the Midwest of the United States.

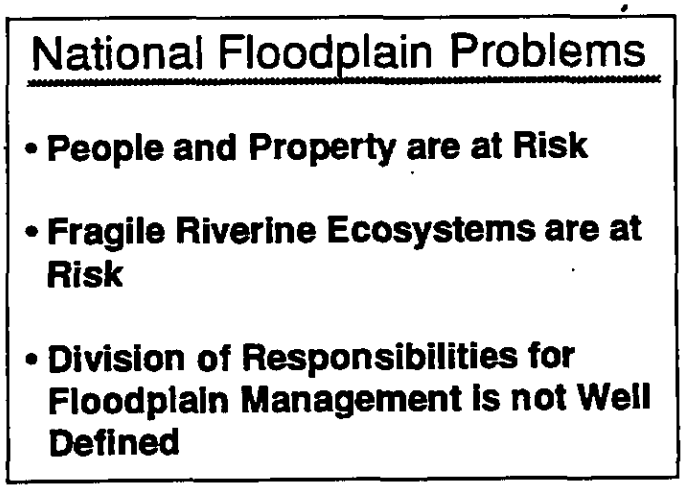

Figure 1

We all are familiar with flood scenes like this of Jefferson City, Missouri, the state capital. It was cut off in 1993 from the northern part of the state. The airfield was under water. The State Capitol looks out over the flooded Missouri River.

We recognize trauma. We see individual homes that have been inundated. We recognize those hardy souls that say, "Not to worry, we'll protect ourselves," but sometimes that doesn't work.

As you all know, even the best laid plans can go asunder. We all sympathized and struggled as we watched people fighting levees, trying to hold them.

So flooding is a major and a significant problem in this country (Figure 1). As a result of the 1993 floods, the White House looked around asking, haven't we invested a considerable amount of money, from 1917, in part from 1928 with the lower valley of the Mississippi, and from 1936 on a national basis in floodplain management. And what has happened since then? We have had some successes, yet we still have a number of people and a lot of property still at risk. What should we do about it? We've also, as part of this process of working in the river valleys, working along side the rivers, damaged some of our fragile ecosystems. And, who is in charge? What federal agency? What state agency? What is the responsibility of local government for floodplain management?

So the White House decided it would be important to form a team to examine the subject. We brought together 31 individuals representing various federal agencies and were given a charter: "Go out and find out why the flood of '93 occurred," (Figure 2).

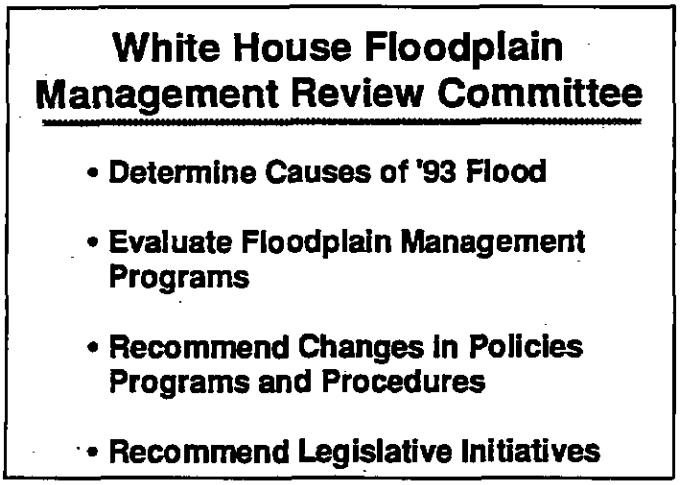

Figure 2

As you may recall, in the spring and on through the summer of 1993, everyone was on the television giving reasons why the floods had occurred. Then, how did the floodplain management programs that we've had over these years work? What changes should there be in these programs? Should there be some legislative initiatives?

Let me jump to the conclusions. Our committee concluded that the 1993 flood was a significant hydrometeorological event. It rained a lot. That is really the answer. If you would just look at this picture of the imagery of the soil wetness index developed by NOAA from the middle of July — this tells it all. Look out there in western Iowa and southern Minnesota and what do you see? It appears there was a sixth Great Lake out there in Iowa. It rained and rained and rained, and then it continued to rain. Those of you who farm the land understand. The rain fills every little pore in the soil. It fills every ditch. The ditches fill every little creek. Every creek

fills every river, and it all flows downhill to the big rivers. That lake is not in the floodplains of the Missouri and the Mississippi. The floodplains fill when all of that rainfall ends up in the rivers and the rivers then rise.

We also concluded that major floods will continue to occur. Now you can say, "That's a blinding flash of the obvious." But, there are a lot of people who said at the time, "Do not say that. That will make people nervous. That will make people very concerned because they understood it was a 500-year flood and we don't want them to think another one might come sooner than 500 years." After the 1995 Mississippi River rose, a man in Missouri said, "I must be 800 years old because we've had a 500- and a 300-year flood in the last two years." It is important for the nation to recognize that we do not know everything about hydrology. Our rainfall records — our stream records — are very limited in comparison to records of the Nile River. So when somebody tells you that this was a 100-year flood, they are simply making an educated guess based on the hydrologic records we have. It is important for people to recognize that floods will continue to occur.

Flood costs were extensive. You all recognize that. The $16 billion for the flood of 1993 was a tremendous economic cost to the nation. But, far greater than that to many people, those people who worked and lived on the land, was the loss of the ability to farm, the long term damage to property, and the trauma of homes inundated for 60, 90 or 120 days. We have begun to see instances of spousal and child abuse. These secondary effects can't be measured in economic terms, but we know they are there. On the positive side, a lot of the work that was accomplished by the Corps of Engineers, the Soil Conservation Service, the National Flood Insurance Program (the land controls that were part of that program) did in fact prevent considerable damage. Nineteen billion dollars in damages were prevented by the projects that were in place — the reservoirs, levees, and watershed programs. This investment paid handsome dividends in many places.

We have asked "Did levees cause the flood of 1993?" The answer is no. The rain caused the flood of 1993. The levees protected St. Louis, Kansas City, Hannibal and many, many farm communities. They raised the levels of the water in some areas, but those areas generally were protected by levees. When levees overtopped, and, for all practical purposes this occurred along the entire lower Missouri River, the amount of flood storage created was minimal. Changes made in the peak hydrograph were minimal. That says, during big rainfall events, levees are a wash. They protect the people who are behind them and they do not cause significant damage to those not protected.

Some of the levees that broke were poorly sited, inadequately maintained and were not part of the federal program. In the lower Mississippi Valley of the United States, most levees that protect the lower valley states from the onslaught of the Mississippi River are under federal control. In the upper valley there are 8,000 miles of levees, only 2,000 miles of which are under strict federal control. The remainder are part of a loose amalgam of levees where one may impact on the other without any control. So there were a lot of problems with the local levee system in the Upper Mississippi Basin.

Our fourth level conclusion notes that we have, in fact, lost a lot of wetlands in this country over the last 150 years. I say, over 150 years, because I don't want everyone to ask, "Did we do it?" The loss has been taking place since settlement began in the Midwest. People cleared the state of Illinois and cleared Indiana, and cleared parts of Iowa. They filled prairie potholes. They wanted dry land. This increased the amount of runoff. We also lost a lot of fish and wildlife habitat. Clearing the land also increased the amount of sediment going into our rivers. Wetland restoration and upland treatment are significant virtues. They help prevent our losses. However, they were not significant in reducing the impact of the 1993 flood. Had there been more areas restored into wetlands or had there been more upland treatment, we probably would have seen the same downstream flood results. There was too much rain. For the more frequent floods such as the 25-year and the 10-year floods, upland treatment and wetland restoration can make a significant difference. And those are the floods that create tremendous economic losses. There is a lot to be said for watershed management and wetland restoration.

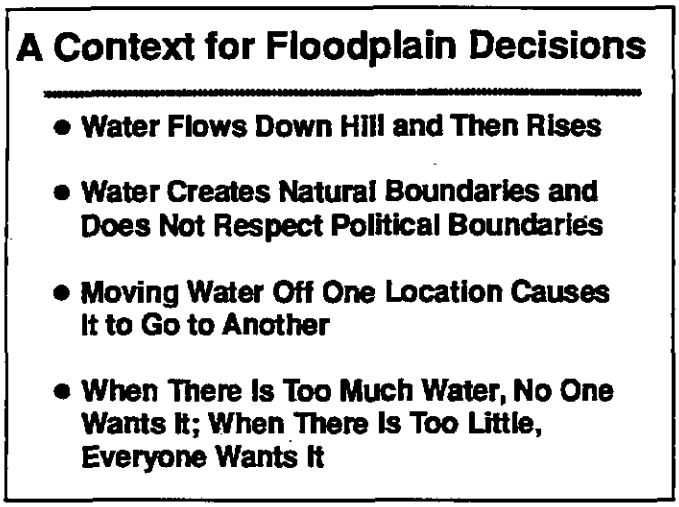

Figure 3

I would toss out these rules as very important (Figure 3). Now they may look a little bit humorous, but it's amazing the number of people who don't recognize that when it does rain in Iowa, the waters are going to show up in Missouri and in Illinois. Water does rise. There are natural boundaries created by rivers. Water does not understand political boundaries. Today, we have too much water; tomorrow, we have not enough water. How do we handle a battle among the states? Who should control the water?

We also found that in the Upper Mississippi Basin, we don't really have an overall plan (Figure 4). The efforts we have underway have not been well coordinated.

Our report set forth two fundamental principles. The first and most important one, and perhaps the most relevant to what we're doing here today is that responsibility for floodplain

management must be shared by all levels of government (Figure 5). Fundamental land use decisions must be made at the state and local level. That's the way the Constitution has it. Responsibility for sharing the cost must be borne, not only by the federal and the state

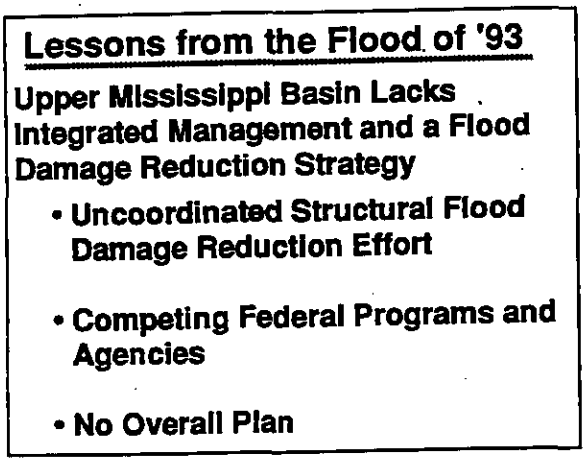

Figure 4

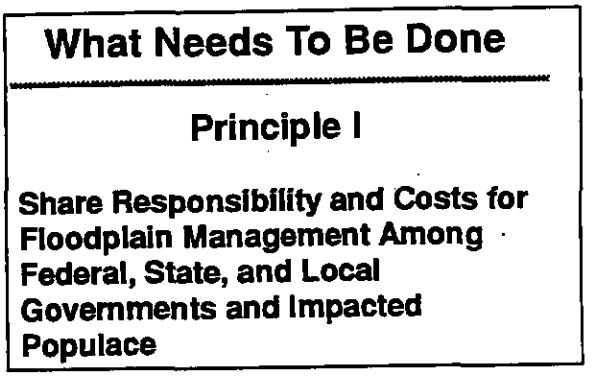

Figure 5

government, but by those people who are at risk in the floodplain. It takes a team effort to have effective floodplain management. The federal government cannot dictate what should be done in the community or in the state. Everyone must work together. And very clearly, as we looked through this, we found that, in many cases, the state was the missing link. A lot of programs directly linked the federal government with the local government and with individuals, but kept the state out of the process. Many states needed to take a more responsible approach to floodplain management.

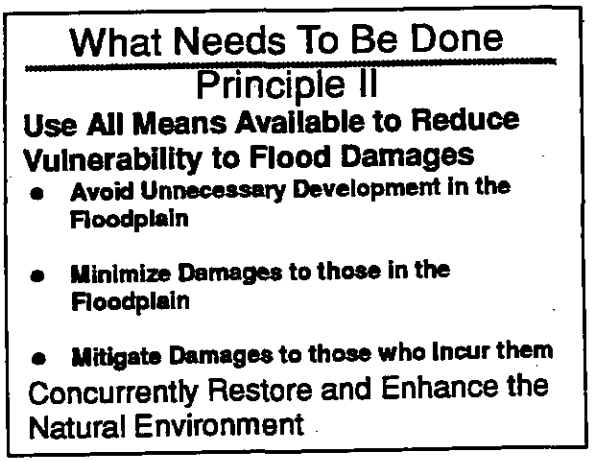

Figure 6

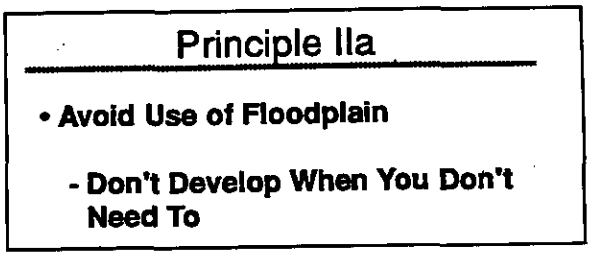

Figure 7

The second principle notes that we have a toolbox full of instruments that will allow us to do effective floodplain management (Figure 6). You will deal with many of these during the

conference. You are going to fill your tool box. We have got to take all of the tools out the box and put them all to work.

The first rule is, don't build in a floodplain if you don't need to (Figure 7). Quite obviously there are activities that occur in the floodplain that require the use of the floodplain, farming, transportation, recreation. We didn't propose moving New Orleans, or moving St. Louis or moving Kansas City — that doesn't make sense. There is a lot of development being contemplated today for the floodplain. It does not make sense to build something in the floodplain when you could build it somewhere else and it wouldn't be subject to the risks of living in the floodplain. So stay out of the floodplain when you don't need to be in the floodplain.

Second, if you are going to be in the floodplain minimize the damages that will occur to the people and activities that are there (Figure 8). Every single place we went with our study team we heard the same thing — catch the water where it lands. Do upland treatment. Do watershed programs. Hold the water as much as you can on the upstream land and then release it slowly. That will help the people who are downstream — wherever downstream they may be — New Orleans, St. Louis, or Hannibal.

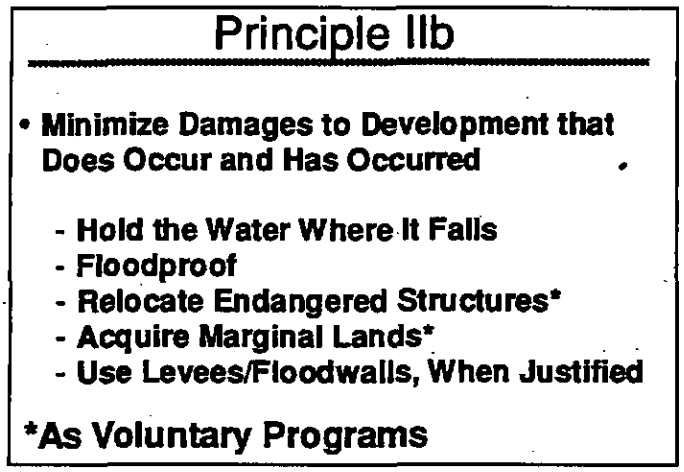

Figure 8

If you can't capture the water on the land, then go to floodproofing. Protect the structure in some way so that when water does rise, it will not be damaged. And then voluntarily relocate people who are at risk. In 1992, had we said this in a group like this, you probably would have shouted, "Get the tar and feathers ready." But, people have thought about relocation. Since the flood of '93, in the Midwest, over 8,200 homes have been voluntarily relocated. A great success story. In the town of Arnold, south of St. Louis, 88 homes were relocated after 1993; when the 1995 flood came, the old home sites were under water. Relocation saved nearly a million dollars by having those people out of the floodplain. People are anxious to relocate. And who is relocating? The poor. The elderly. Those who can't afford other alternatives. It makes sense. In one case, an entire community, Valmeyer, Illinois, moved out of harms way. Lastly, build levees

and floodwalls to protect those who must remain in the floodplain when it makes economic, environmental, social and engineering sense to do so.

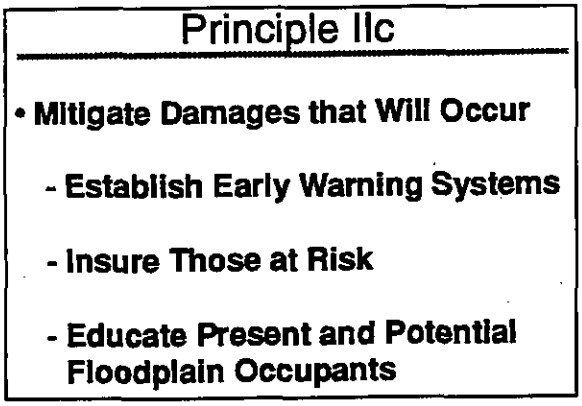

Figure 9

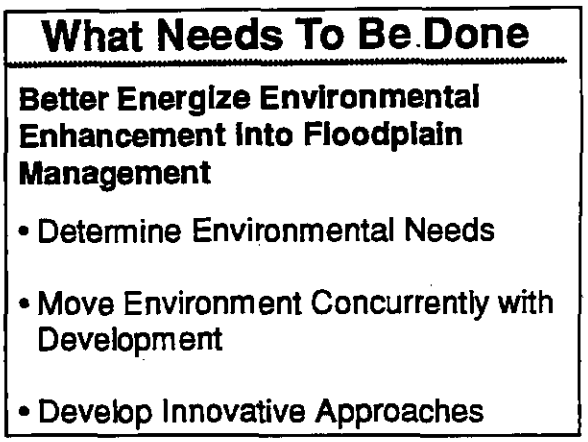

Figure 10

At a third level, we need to mitigate damages that do occur (Figure 9). We do it by telling people floods are coming! That also makes a lot of sense and there are a lot of programs that do this. Having a more effective insurance program (I'll tell you a little bit more about this in a minute) is a must. Last, but not least, is the need for education. It's amazing the number of people who will still argue about why we are still having floods this year when we had a flood last year. It was a 100-year flood, and it should be 100 years before we have the next flood. If we could convince people that the 100-year flood is in fact a 1 percent probability flood, that you have a 1 percent probability of such a flood every single year, they might understand that they really are at risk. In the life of a 30-year mortgage, you've got a greater than 1 in 4 chance of having your home flooded. People need to understand that. We've got to start with young people and have them make wise decisions from the very first day they get into the economic world, and that makes economic sense.

What needs to be done? We need to take care of the natural environment and figure out what are the shortfalls (Figure 10). Take care of environmental mitigation as we develop. And, we need to get some innovation in the way we design our projects. You can make a difference.

More natural areas are needed (Figure 11). We need the opportunity to acquire some land. We don't want to take the land — we do not suggest taking the land from anybody. Right now the Corps of Engineers is limited to immediate repair of the structures that were damaged in a flood. We are suggesting that we need some flexibility to allow the Corps to purchase or obtain an easement on damaged land. We also need more coordination of federal programs. At one point in time, three agencies were out bidding against each other for a particular piece of land in the Missouri bottoms. Again, it doesn't make sense. We all ought to be on the same sheet of music in acquiring land. The bottom line remains a willing seller. The Board of Commissioners from Union County, Illinois, wrote to the Senate, "Please help us. We've got 35,000 acres of marginal land. It is always flooded. Can't you acquire this and put it to some natural resource use?" Since

the flood of '93, 100,000 acres have been acquired in fee or easement from voluntary sellers or lessors, and we have 60,000 acres waiting to be acquired. People want to move out of marginal lands. It is not a call by the federal government to take over the land. People want to do this.

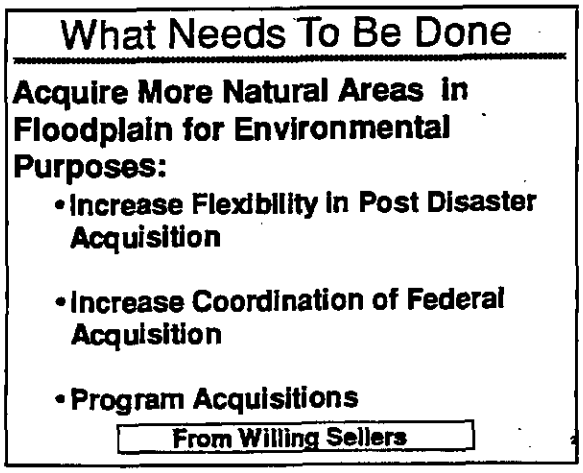

Figure 11

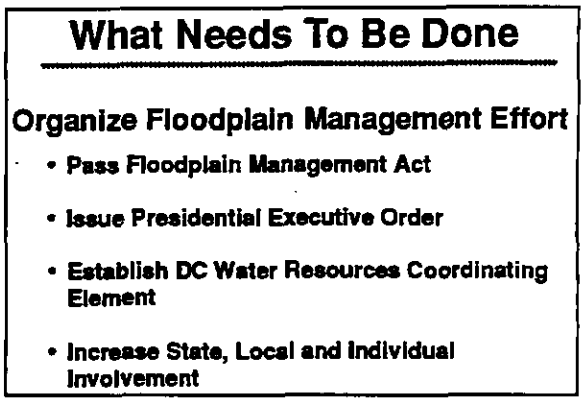

Figure 12

We're not very well organized for floodplain management (Figure 12). We need some type of document, a floodplain management act, that defines the responsibilities at the state level, the federal level, the local level, and for the individual. What is the individual supposed to be doing?

We need an Executive Order that says to federal government activities, "You must set the example. Don't build something in the floodplain. Don't support a housing development that is in the floodplain."

We need some sort of a coordinating element in Washington to pull together all the different agencies, and get them at the same table to talk about the water issues, the very issues you'll be spending the next couple of days discussing. And in those areas where we have multiple state involvement, we need to have some sort of a basin coordination. State A has a very strict law — you may not build a levee if it is going to cause more than a tenth of an inch rise in the rivers upstream. State B, directly across from A, has no such law. Anybody can build a levee and push all the water over onto State A. That doesn't make sense. We've got to identify those problems and find a coordinating mechanism and solve them.

We are not making full use of the tools that are available to us (Figure 13). Structural and nonstructural approaches both have a place in our tool kit. We've got to revise the Principles and Guidelines, the federal rules that govern the NRCS, the Corps of Engineers, the Bureau of Reclamation, and TVA. These rules are focused on economic return. We know the vitality of our nation's infrastructure, the vitality of the farming community, the vitality of an entire state may depend on a project, and it may not be as economically as feasible as we would like. However, it may be justified if you consider the total entire benefit-cost to the nation. Social benefits can certainly fit in the equation in a proper benefit-cost analysis.

We need to do more collaborative planning and more watershed planning. We've got to get everybody at the table. It is important that those who are going to be affected by a project be there at the beginning of the planning for the project. What we've seen is one agency, or one group, waiting until they have finished their project planning to ask for comments. If we would all start together and work together from the very beginning, we could, in fact, solve some of these problems. And, there needs to be more focus in the federal government on watershed planning.

The National Flood Insurance Program has some problems (Figure 14). Fortunately many of the more fundamental problems have been addressed. The flood insurance program was rewarding people who just ignored it. The flood insurance program is supposed to say that if you live in the floodplain, if you're at risk, you ought to have responsibility for obtaining insurance for your property. We were paying people who ignored this rule, the same amount after a flood as those people who had purchased insurance. We've said that we need to increase the waiting period — people could buy insurance five days prior to a flood. It's now going to be 30 days under a 1994 reform. People must be given the opportunity, once they've been flooded, to elevate their structures or to make them less flood-prone, to mitigate future damages. And, we've got to make those people who are lending money to people in the floodplain comply with the rule that says that mortgages/homes should have flood insurance.

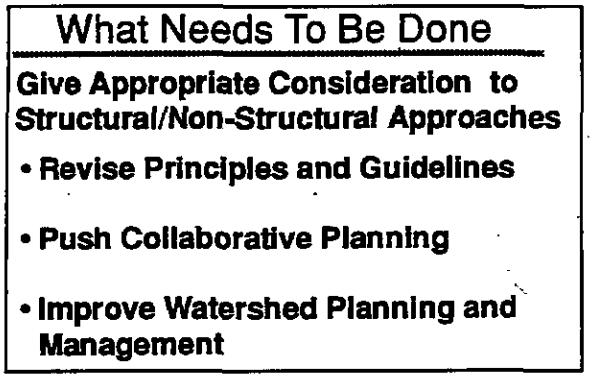

Figure 13

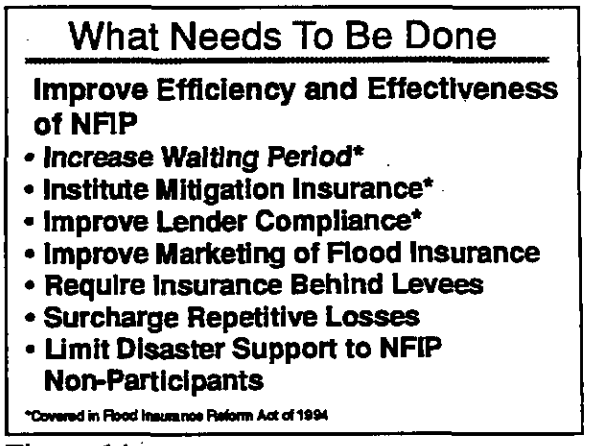

Figure 14

What was not in the 1994 Flood Insurance Reform Act were requirements for better marketing of flood insurance, finding some way not to pay people who didn't buy insurance the same amount as those people who did, and finding a way to charge people who are repetitively flooded a higher rate than those who have never been flooded. When somebody is paid to replace their property eight times, it doesn't make sense. If you were paying into a car insurance pool and you were paying the same amount as someone whose car had crashed eight times, it wouldn't make sense to you. It doesn't make sense in flood insurance. And lastly, where someone is not

protected by a levee to the standard project flood level, that's the biggest flood that we can imagine, they should have insurance. They should have insurance to remind them that they are at risk.

Those of you who are from the Upper Mississippi know your problems. The Upper Mississippi needs better management (Figure 15). If we are going to be successful in watershed planning, if we are going to be successful in any water resource activities, we've got to address our problems in a way that puts the state, federal and local governments together. We also need appropriate federal support for major maintenance and revitalization.

The last recommendation deals with technology. Everyone needs access to U.S. technology (Figure 16). The geographic information system world — a computer that displays basic maps with overlays of soils and overlays of watersheds, overlays of rivers, everything that you want to know about a particular piece of land — is a feasible world. Lots of people are gathering data. We discovered, however, that different federal and state agencies gather data to different standards. It is very difficult to make these data come together. We need a program, coordinated by the United States Geological Survey, to acquire data and make data available to you, the people who need the data, on a day to day basis. We've got a tremendous amount of capability in our overhead remote sensing platforms to find out what's going on in the river basins. We can quickly create better hydraulic models and get very accurate information as to what's going on in a given watershed. What is the impact of a new rainfall? How is what goes on in this watershed going to affect another watershed? The federal government should invest in these programs.

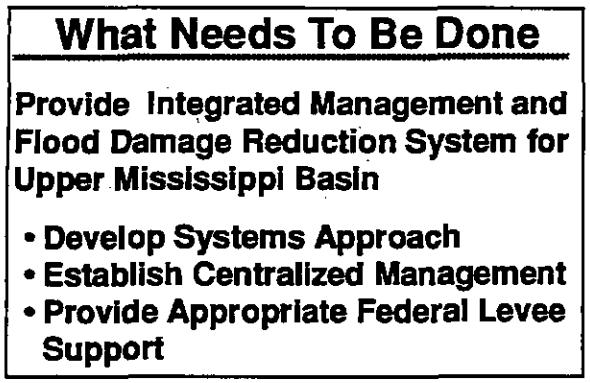

Figure 15

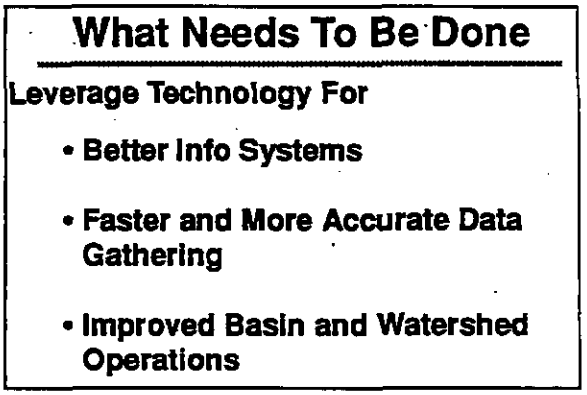

Figure 16

The bottom line (Figure 17). Our report did not say get everybody out of the floodplain. The report says the floodplain is a wonderful place for certain activities. Some of our best food and fiber production comes out of the floodplains of the United States. There are ports, there are cities that will always remain in the floodplain. We do, however, need to be smart in how we operate in the floodplain. We've got to think together. We've got to work together. We've got to use the complete toolbox. And, we can't forget the environment.

What's happened since the report was issued? I mentioned the Flood Insurance Reform Act (Figure 18). Agencies have made changes in their programs in response to the nearly 95 recommendations in our report. The White House Floodplain Management Task Force also is reviewing these recommendations and we expect the Task Force to make some additional recommendations.

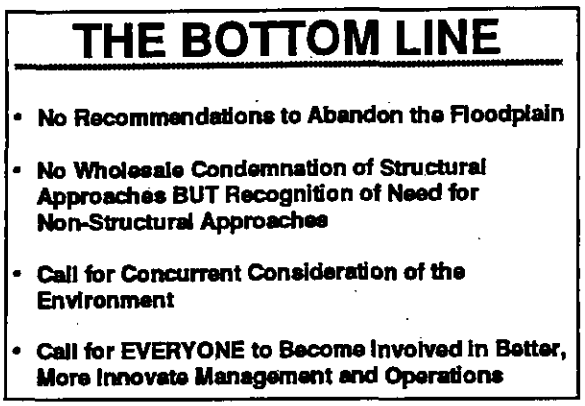

Figure 17

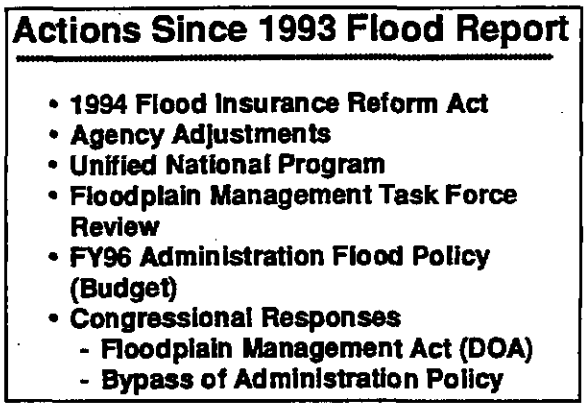

Figure 18

The 1995 Administration budget for FY 96 proposes that only when flood flows are greater than 50 percent interstate, will the federal government be a participant in flood control. And the cost share, even then, would be flipflopped to 25 percent federal, 75 percent local — a big change. Since this was placed in the budget in January, the Administration is reconsidering the proposal. The Congress has essentially ignored the proposal.

Figure 19

You should be aware of several actions now underway (Figure 19). The Corps of Engineers has just completed a Floodplain Management Assessment. This document builds on our study and lessons learned in 1993. The Corps is also working on a study of the future of navigation on the Mississippi and the Illinois. You need to be part of this effort. You also should be aware of and involved in the Environmental Management Program, being conducted jointly by the Corps and the Department of the Interior.

The Corps is also taking comments on plans to revise the schedule of releases from the major reservoirs on the Missouri River. Get involved.

Also as we speak, states are making adjustments to their floodplain management programs. Again there is plenty of room for you to become involved, for you to participate.

Ladies and gentlemen, I would hope that during this conference you would find time, among the many issues to consider, to discuss the issue of floodplain management. It is your responsibility. It is the President's responsibility. It is the Governor's responsibility. If we all work together, there is a lot that can be done. We are dealing with the fundamentals of how we live. We are dealing with the fundamentals of nature. Putting these all together can result in a success story. Continuing to work our separate ways will certainly never get us where we want to go.

Thank you very much for your attention. I wish you all a great conference.

Navigation on the Illinois

Donald R. Vonnahme and Bruce Barker

Illinois Department of Natural Resources, Office of Water Resources
Springfield, Illinois

NAVIGATION IN THE CANAL ERA

Steamboats arrived on the Illinois River with the first settlements in the early 1830's. The first steam locomotive in Illinois arrived by steamboat in 1839 at Naples where it went into service on the state-operated Northern Cross Railroad connecting the river landing with Springfield. Construction was underway on the Illinois and Michigan Canal, but financing problems delayed completion until 1848. That same year the Galena and Chicago Union, Illinois' second railroad, began serving territory west of the city. Thereafter, the railroads rapidly expanded and improved trackage, equipment, and service as the countryside developed and revenues increased.

The Illinois and Michigan Canal though well built and comparatively deep had small locks. The unprotected earth banks could not tolerate the higher speeds of steam propelled barges. Saddled with huge bonded indebtedness and managed by the bondholders' trustees, the canal could not be improved and increasingly lost competitive advantage to the railroads. But the greatest limitation on use of the canal as a through waterway to Lake Michigan was the Illinois River itself. The river was shallower than the canal. Cargo had to be transferred between canal boats and light draft river steamers. During extreme low water even the lightest steamers couldn't operate on the river making delivery very unreliable for shippers.

By scraping together small sums from state appropriations along with small federal appropriations the canal commission and the Corps of Engineers slowly constructed four locks and dams on the Illinois River to insure reliable depth. Henry lock and dam was completed in 1872, Copperas Creek lock and dam in 1877, LaGrange lock and dam in 1889, and Kampsville lock and dam in 1893. The few canal boats remaining were fitted with steam engines and could easily navigate the Illinois River. While the depth and reliability of the Illinois River now exceeded that available on the upper Mississippi River, the old canal between Chicago and Peru was hopelessly obsolete. Illinois River traffic increased, but traffic and revenues on the canal continued to decline.

The state constitution prohibited state appropriations to aid the canal. Only a federal takeover could provide the funds necessary to build a larger waterway. During the last 20 years of the 19th Century, the federal government took over numerous state waterways and abolished tolls. Attempts were made to give the Illinois and Michigan Canal to the federal government. The Corps of Engineers advised the Congress that expense couldn't be justified.

LAKES-TO-GULF WATERWAY

Following the disastrous typhoid and cholera epidemic of 1885 which killed about 12% of the people in Chicago, a city commission on drainage and water supply recommended diverting sewage diluted with lake water through a new, large canal into the Illinois River. The project was authorized by the legislature in 1889 and flow first passed through the canal in January 1900. A powerhouse and lock connecting the Chicago Sanitary and Ship Canal with the Illinois and Michigan Canal at Lockport was completed in 1907. Even before construction started the new canal was seen as the first and most expensive segment of an entirely new waterway system between Lake Michigan and the Mississippi River. The waterway plan was further developed by the Internal Improvement Commission which reported to the state legislature in 1907. The commission recommended construction of four locks and dams on the Des Plaines and Illinois Rivers to provide slackwater navigation between Utica and Lockport. Hydroelectric powerplants at the dams using up to 14,000 cubic feet per second of lake diversion would generate revenue to retire state bonds. If the state completed the next most expensive segment, it was believed the federal government could be persuaded to take over and finish the waterway system.

The Illinois Waterway was envisioned to be the first segment of a new deep waterway system which would allow ships to navigate between the Gulf of Mexico and the Great Lakes. Waterway competition would compel railroads to lower freight rates. The idea of a magnificent lakes-to-gulf waterway captured public imagination throughout the Mississippi River basin. Governors and state delegations in Congress from every basin state pressured the Corps of Engineers to think big. Favorite slogans were: "River regulation is rate regulation; river improvement is rail improvement." Congressman Henry T. Rainey of Carollton, Illinois was a prime leader of the movement and personally campaigned throughout the state with a slide show depicting a lakes-to-gulf waterway. In November 1908 the people of Illinois approved an amendment to the constitution authorizing the state to construct the four locks and dams with the proceeds of a $20 million bond issue. With this victory political pressure intensified on the Corps of Engineers and the Congress to improve the Illinois River from Utica to Grafton and to improve the Mississippi River, especially the portion between Cairo, Illinois and St. Louis. Lake diversion was touted as a cheap means of providing deep channels without locks and dams and with minimal dredging.

MAJOR ISSUES ARISE

Just as public support for a lakes-to-gulf waterway was peaking, major questions arose to attack the fundamental assumptions of the waterway plan. Among these questions were: is dilution a safe and effective means of sewage disposal? who should develop hydropower on public waterways? are the Illinois and Des Plaines Rivers public (navigable) streams? can water be diverted from the Great Lakes without permission from Congress? will lake diversion cause significant lowering of lake levels? what kinds of cargo vessels are best suited to inland waterways? what kinds of cargoes will move on inland waterways? These were important technological, constitutional law, and public policy questions for which no sure answers existed. Each had to be answered definitively before the waterway could be built.

FIRST ECONOMY LIGHT AND POWER CASE

Following the Illinois Waterway referendum the attorney general moved to challenge the authority of the Economy Light and Power Company to build a private hydropower dam at the junction of the Des Plaines, Kankakee, and Illinois Rivers. This was the dam site proposed to be used for the waterway, the site of the present Dresden Island dam. The main question hinged on whether or not the Des Plaines and Illinois Rivers were navigable streams. The Illinois Supreme Court was not persuaded with the evidence of past use presented in the trial but gave great weight to the evidence the streams had not been used commercially in anyone's living memory. They decided in 1909 the streams were not navigable and, therefore, were susceptible to private control. The United States Supreme Court denied a writ of error in 1913 on the reasoning that if the streams weren't navigable, there was no federal question.

This was a severe setback to the state waterway plan. The state would have to purchase the beds of the streams as well as the power rights and other water rights riparian owners might claim. It also seemed to wreck any hope of a federal takeover because the federal government only had authority over navigable streams.

Fortunately, the Corps of Engineers had a different view of the navigability question. The rivers and harbors acts of 1889 and 1899 had given the Corps regulatory control over the navigable waters of the United States. No project could be built on a navigable stream without a Corps permit. The Corps was not ready to concede that the Illinois and Des Plaines Rivers weren't navigable. With the backing of President Taft in 1911 the Corps changed its view from a long string of negative reports and from that time forward became a strong supporter of the waterway as a cooperative state-federal project. They encouraged the state to proceed and develop construction plans for the locks and dams between Lockport and Utica.

STATE WATERWAY PLANS

No state agency had been empowered to implement the Illinois Waterway referendum. In 1915 the legislature created the Illinois Waterway Commission and authorized it to construct the waterway between Lockport and Utica using proceeds from the $20 million bond issue. The commission without any surveys or engineering quickly prepared a plan and submitted it to the Corps of Engineers for approval. The Corps rejected the plan because the locks were too small, the channels too narrow, and the project too dependent on lake diversion (over which the Corps was asserting federal control). Some of these problems could only be corrected by changing state law.

State government was thoroughly reorganized in 1917. All boards, commissions, and special offices were abolished and their powers and duties were consolidated into a system of code departments. The powers and duties of the Illinois Waterway Commission, the Rivers and Lakes Commission, and the Illinois and Michigan Canal Commission were assigned to the newly created Department of Public Works and Buildings, Division of Waterways. Mortimer Barnes was employed as chief engineer. He discovered nothing had been done on waterway plans since the

unsuccessful commission attempt in 1915. But resumption of waterway planning work was interrupted by World War I. The transportation infrastructure of the nation was strained to the breaking point by the war mobilization effort. The federal government nationalized the railroads and even tried to revitalize moribund canals and waterways. The Illinois and Michigan Canal was renovated with federal funds. While the war effort was over quickly, the transportation crisis showed the vulnerability of national defense dependent on a single mode of transportation. From that time forward the federal government assumed a strong role in building highway, water, and air transportation systems.

In 1919 the legislature passed a new Illinois Waterway Act that removed the earlier objections of the Corps of Engineers. New plans were prepared and submitted to the Corps for a permit. Meanwhile the Corps had moved to prevent the Economy Light and Power Company from proceeding with its dam project without a Corps permit. The power company protested the streams were not navigable, the Corps said they were, and the whole matter moved to the U.S. Appellate Court which agreed with the Corps (1919).

The Corps of Engineers and the state could not agree on the channel depth to be provided in the state project. Barge flotillas, not self-propelled ships, were the most likely vessels to use the waterway. The existing federal authorized channel below Utica was 7 feet deep, but this was clearly inadequate for the kind of waterway being planned by the state and the Corps. Finally a compromise was reached: excavate the channels 10 feet deep in rock sections since these channels would be difficult to deepen later. Excavate earth sections to 8 feet deep and deepen later if necessary. Lock chambers would be 110 feet wide by 600 feet long, the same size being constructed on the Ohio River. The first state construction contract was awarded for Marseilles lock late in 1920.

In 1921 the United States Supreme Court upheld the decision that the Des Plaines and Illinois Rivers were navigable streams based on evidence of historical commercial usage. This decision established the historical test for navigability as a part of the law of navigable waters. The court said such streams need governmental protection because times and conditions may change so that it is worthwhile to invest public funds to make them navigable again. Of course this was exactly the case with the Des Plaines River. It had been last navigated for commercial purposes in 1825 by the American Fur Company. Now, nearly 100 years later the state and federal governments were about to create a modern waterway. Two years later in *DuPont v. Miller* the Illinois Supreme Court adopted the new test and acknowledged its error in the first Economy Light and Power case. Land rights acquired by the power utility were now useless and were sold to the state for the waterway project.

FEDERAL ROLE

Congressional authorization of the federal part of the Illinois Waterway was delayed by the lake diversion controversy litigation in the United States Supreme Court. Finally, in 1927 Congress authorized a federal 9-foot channel from Grafton to Utica knowing it would not work without substantial lake diversion but refusing to authorize any diversion. The Supreme Court

decree in April 1930 limited lake diversion to 1500 cubic feet per second plus domestic pumpage (then as now about 1700 cubic feet per second) after January 1, 1938. State construction had proceeded briskly but it now appeared the balance of the $20 million bond issue, about $7,500,000, was not enough to complete the five locks and four dams and connecting channels. With the diversion issue now settled by the Court, Congress acted quickly and approved federal takeover of the Illinois Waterway on July 3, 1930. The legislation authorized the diversion allowed by the Court to be used for navigation. Construction resumed in 1931 under Corps of Engineers supervision. The state used the balance of the bond issue to construct highway bridges across the waterway.

The waterway opened for traffic in 1933 still using the old locks on the Illinois River. But this was a big enough improvement to immediately spark interest with shippers. Commonwealth Edison began shipping coal from Havana to Chicago experimentally. This was quickly followed by major investments in coal loading and unloading docks. Grain shipments expanded quickly. The last impediments to modern barge transportation as we know it today were removed in 1939 when new federal dams and locks at Alton, LaGrange, and Peoria replaced the old locks and dams.

THE WATERWAY TODAY

Illinois Waterway quickly became one of the most important commercial waterways in the United States. Not surprisingly the capacity of the 1930's locks is nearly reached today, and plans are underway for additional 1200-foot long locks. Because of its waterways and Lake Michigan, Illinois regularly ships and receives over one hundred million tons of waterborne cargo every year. Illinois ranks third among the fifty states, behind Alaska and Louisiana, in domestic waterborne commerce. Two objectives of the planners at the turn of the century have been realized: Lake Michigan is preserved as a pure water source and waterway commerce thrives. Other objectives were not realized or shown to be false. Certainly the idea of diverting sewage diluted with lake water created huge environmental and legal problems that everyone soon regretted. Water quality has improved greatly in recent decades through massive investment in sewage treatment and sidestream aeration, but much of the environmental damage related to siltation cannot be reversed soon. Lake diversion though greatly reduced and intensely managed under state control remains a permanent legal and political issue with the Great Lakes states and Canadian provinces.

ILLINOIS WATERWAY CHRONOLOGY

1900 Chicago Sanitary and Ship Canal opens.

1905 Act creates state Internal Improvement commission to report on waterway.

1907 Internal Improvement Commission proposes waterway between Lockport and Utica using the Des Plaines and Illinois Rivers, four dams, powerhouses. Open channel navigation below Utica predicated on 14,000 cfs of lake diversion. Chicago Sanitary and Ship Canal connected by a lock at Lockport to the Upper Basin of the Illinois and Michigan Canal at Joliet.

1908 Statewide referendum authorizes $20 million bond issue after Congressman Rainey gives 200 speeches around the state. Federal government is expected to provide major financing.

1909 Illinois Supreme Court decides the Illinois River and Des Plaines River are non-navigable in Economy Light and Power case.

1911 Rivers and Lakes Commission created to implement Rivers, Lakes and Streams Act. President recommends Board of Engineers negotiate a cooperative plan with Illinois to improve navigation between Lockport and mouth of Illinois River.

1913 U.S. Supreme Court denies writ of error in Economy Light and Power case.

1915 Act creates Illinois Waterway Commission and authorizes construction of waterway between Lockport and Utica. Corps refuses a permit: locks are too small, channel is too narrow, too dependent on lake diversion.

1917 Illinois Waterway Commission, Rivers and Lakes Commission, and Illinois and Michigan Canal Commission abolished and succeeded by Department of Public Works and Buildings, Division of Waterways. Mortimer Barnes hired as chief engineer. United States takes over the railroads to overcome transportation crisis during World War I.

1918 I&M Canal rehabilitated with federal funds to aid war effort.

1919 New Illinois Waterway Act overcomes objections of Corps. New state plans submitted for permit. U.S. Appellate Court decides Des Plaines and Illinois Rivers are navigable in *Economy Light and Power Company v. United States.*

1920 Corps permit granted for channel 8 feet deep in earth and 10 feet deep in rock with locks 110 feet by 600 feet. State construction begins on Marseilles Lock.

1921 U.S. Supreme Court upholds decision that Des Plaines and Illinois Rivers are navigable in *Economy Light and Power v. United States.*

1922 Calumet-Sag Channel opened providing alternate route from Sanitary and Ship Canal to Lake Michigan at Calumet Harbor.

1923 In *DuPont v. Miller,* Illinois Supreme Court endorses federal standards for navigability stated in Economy Light and Power case.

1927 Congress authorizes federal channel between Utica and mouth but refuses to authorize lake diversion.

1930 U.S. Supreme Court decides diversion case, *Wisconsin v. Illinois,* and limits diversion to 1,500 cfs plus domestic pumpage after January 1, 1938. Congress authorizes federal takeover of Illinois Waterway project and completion by Corps of Engineers. Congress authorizes diversion allowed by Supreme Court for navigation.

1931 Construction resumes under Corps supervision. State constructs highway bridges.

1933 First traffic through completed waterway.

1939 Completion of Alton, LaGrange, and Peoria dams completes waterway to present dimensions. Chicago Lock completed and Chicago River mouth closed by Chicago Sanitary District to prevent backflows to the lake.

1965 Thomas J. O'Brien Lock and Dam completed by Corps of Engineers on Calumet River. Calumet-Sag Channel widening completed by Corps of Engineers.

1967 U.S. Supreme Court limits Illinois diversion to 3,200 cfs.

1977 First state order allocating lake diversion among units of local government.

1980 U.S. Supreme Court modifies diversion accounting.

1984 Corps of Engineers take over control of Chicago Lock.

1986 Corps of Engineers authorized to take over diversion measurement and accounting.

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Illinois Possesses Unique Knowledge About Its Weather and Climate

Stanley A. Changnon

Chief Emeritus and Principal Scientist
Illinois State Water Survey
2204 Griffith Drive, Champaign, IL 61820

ABSTRACT

Illinois is the only state to have made a sizable investment in a group to gather data and produce information about the state's atmospheric resources. Scientists at the Water Survey have conducted a broad program of research, data collection, and services focusing on weather and climate since 1947. One element of this effort has been to measure, describe, and explain every facet of Illinois' weather and climate, especially climatic extremes such as floods and droughts and the state's various forms of severe weather including flash-floods, tornadoes, and winter storms. Developed largely through federal grants, the program has tackled major issues: weather modification, acid rain, accidental changes in weather and storminess due to cities, and global climate change. We have tested weather modification techniques, evaluated the state's nine cloud-seeding projects, and investigated the effects of changed weather on the state. Attention to such diverse issues has necessitated a large staff with diverse skills, who are qualified to attract federal funds to support 85% of our studies. Investigations of global climate change have included the potential water resource and agricultural impacts, as well as involvement in the development of state and national policies.

Even with this heavy focus on applied research, the Survey's atmospheric program has also maintained a major services component. State-of the-science computer technology and vast historical records provides Illinois citizens easy access to thousands of climate products from the Midwestern Climate Center, assisted by the State Climatologist. Outreach has included more than 3,800 publications, numerous workshops, and staff involvement on various state and national panels and committees.

As a result of these extensive weather-climate studies and services, representing a five-decade commitment to atmospheric research, Illinois knows more about its atmospheric resources than any other state. Further, Illinois has skilled scientists capable of addressing existing and emerging atmospheric issues that affect Illinois, the Midwest, and the nation. Illinois citizens and managers in business and government can make informed decisions about weather-sensitive issues with the assurance that they have better information available than exists anywhere else in the world.

INTRODUCTION

Atmospheric sciences endeavors at the Illinois State Water Survey began with a small meteorology group formed in 1947. The establishment and sustainment of an atmospheric sciences research group at a state-supported institution are unique — no other comparable research institution exists anywhere in the United States. Furthermore, by any measure, the atmospheric sciences program at the Water Survey has been extremely productive and has made major contributions to furthering the nation's understanding of the atmosphere and its importance to the state and nation. Illinois possesses more data and information about its weather and climate than any other comparable area in the world. This review has served as a useful tool for analyzing the history of the atmospheric program and to speculate on future program directions. Ignoring the past merely creates the potential for not learning from it.

To understand how the group developed, grew, and succeeded requires knowledge of the Survey's place in two institutional domains: Illinois state government and the University of Illinois. The Water Survey was formed in 1895 with the mission "to study and report on the state's water resources." Although the organization was physically housed at the University of Illinois, the Water Survey was funded by state appropriations separate from those of the university. In 1917 the Water Survey and its two sister scientific Surveys were formally established as state agencies within the Illinois Department of Registration and Education. It is significant that the Surveys were mandated by the legislature to be located on the University of Illinois campus, a scientific advantage, and further the staff were employees of the Board of Natural Resources and Conservation, which is appointed by the Governor, thereby establishing the institutional framework necessary to ensure a staff of qualified scientists and engineers.

Interactions with the University of Illinois have been of critical importance to the atmospheric sciences program for several reasons. First, hundreds of grants and contracts, the key to the group's survival and development, were and are handled by the university. Such a close affiliation allows atmospheric scientists access to university facilities, computers, and allied equipment required for many research tasks. The University of Illinois also formed an atmospheric sciences research group in 1965 to exploit the university's computer prowess, and there have been many useful interactions. In fact, three Survey staff have even become adjunct professors of the department. Strong ties with the Geography Department and the College of Agriculture have also developed, involving their staff and graduate students in Water Survey weather research.

In its early decades (1895-1930), the Water Survey was essentially a water quality-chemistry institution, but by the late 1920s, a program in hydrology was also emerging. There were extensive water resource studies during the 1930s, and by 1940, the Water Survey had two groups, a Chemistry Section and an Engineering (hydrology) Section, both geared to data collection, analyses, and services. When the new meteorology group of four staff members was formed in 1947, the Water Survey had 18 staff members, an annual state budget of $51,000, and offices and laboratories in a university building.

The five decades beginning in the mid-1940s have witnessed a revolution in American science that greatly changed the Water Survey. World War II advanced science and technology light years ahead, and as the sciences grew, so too did the Water Survey. Under the far-sighted leadership of Chief Arthur M. Buswell (1920-1957), the meteorology group began climatic studies and investigations of radar-rainfall relationships, and with growth became the Survey's third scientific section in 1953. Under the growth-oriented leadership of Chief William C. Ackermann (1958-1979), the Meteorology Section expanded significantly and became the Atmospheric Sciences Section with 70 staff members and an annual budget of $2.3 million by 1975.

Most of the financial resources for atmospheric sciences have come from external grants and contracts (largely federal agencies), not state funds. The long-term ratio of support for atmospheric endeavors shows 85% from grants and contracts and 15% from state funds. In 48 years, the atmospheric program has garnered $63 million in external funds. This situation has required that the group perform high-quality, competitive scientific research and services to address national as well as state issues. For example, from 1947 to 1965 the meteorology group was heavily involved in the nation's efforts in radar-rainfall research, a major issue for national defense agencies. When weather modification became a new focus of the federal atmospheric research during the 1960s and 1970s, the meteorology group played a significant role. As inadvertent weather and climate change became national issues during the 1970s, the expanding program took on these issues too. Because of the funding situation, the atmospheric sciences endeavors were more oriented to research (both basic and applied) than the provision of services.

Analysis of the evolution of the scientific program since 1947 shows the endeavors ultimately embraced nine major areas of atmospheric research, or major programs. Program areas and the year that each research program began follow:

- Measurement of precipitation 1947
- Hydrometeorological studies 1948
- Climate research and services 1952
- Cloud physics and mesoscale meteorological research 1958
- Weather modification 1960
- Inadvertent weather and climate modification 1961
- Atmospheric chemistry 1964
- Impacts of weather and climate 1965
- Assessment of research and government weather policies 1970

Each program area consisted of four or more "themes" or sub-program areas. For example, the Survey's 1960-1995 program in planned weather modification consisted of major efforts in 1) rain modification experimentation, 2) design and evaluation of weather modification projects, 3) study of hail suppression and other forms of weather modification, 4) assessment of programs and governmental policies affecting weather modification, and 5) the study of the physical and socioeconomic impacts of weather modification. To handle the diversity of its many projects, the Water Survey's atmospheric group has included a talented staff with expertise in civil and

electrical engineering, meteorology (and its many specialty areas), climatology, geography, agriculture, chemistry, physics, computer science, and statistics.

ACHIEVEMENTS: UNIQUE INFORMATION AND SERVICES

This assessment focuses on those achievements that have particular relevance for Illinois and the Midwest. Research and informational services fell within three broad categories: the Illinois weather and climate, major national atmospheric issues, and applications of information and data collection.

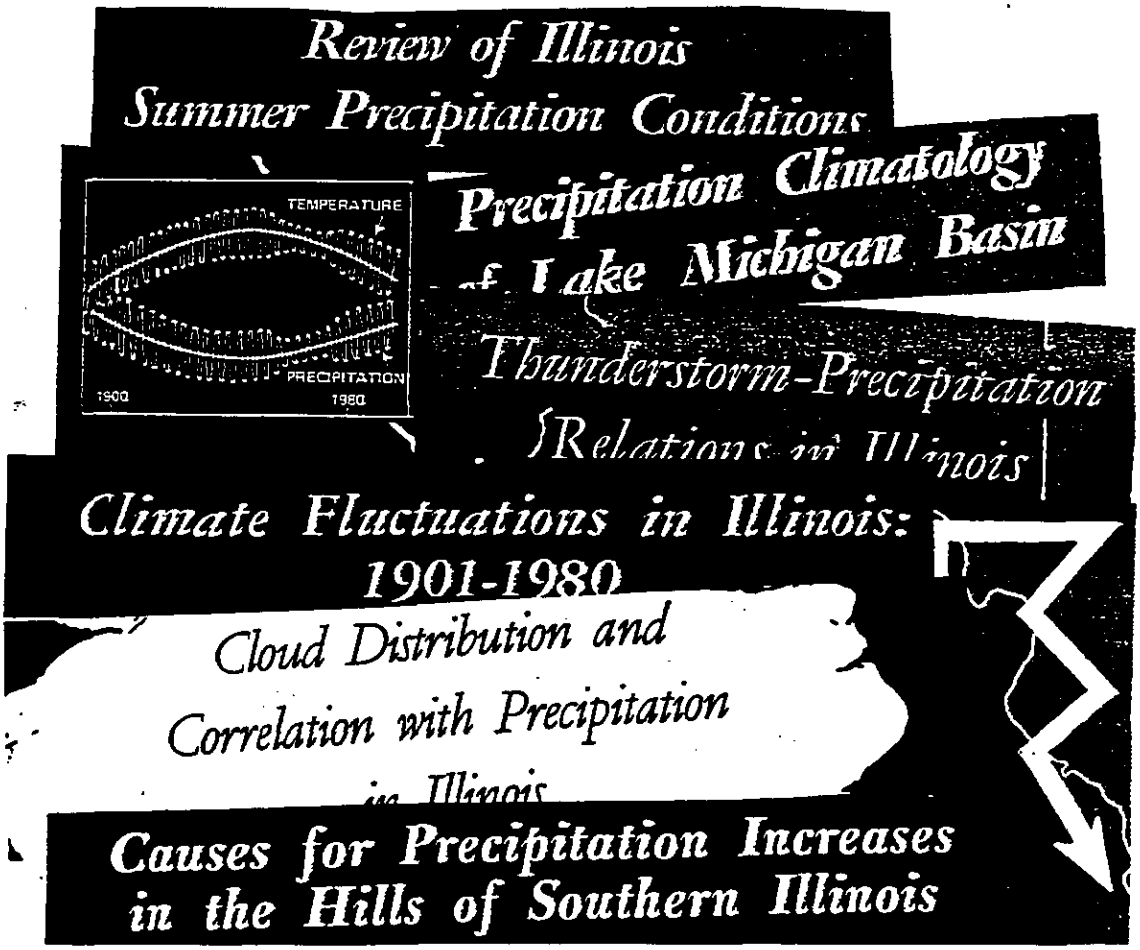

Figure 1. Titles of publications describing and explaining the climate of Illinois.

Illinois Weather and Climate

For nearly 50 years research at the Water Survey has been directed to various studies of the weather and climate of Illinois. Figure 1 lists several of these studies, which illustrate various space and time descriptions of the climate (e.g., review of summer precipitation conditions), the climate of specific locations such as the Lake Michigan basin, and major factors

affecting climate (clouds, thunderstorms, hills, and Lake Michigan). The emphasis has always been on defining the hydrologic cycle and hence on clouds, precipitation, and storm conditions.

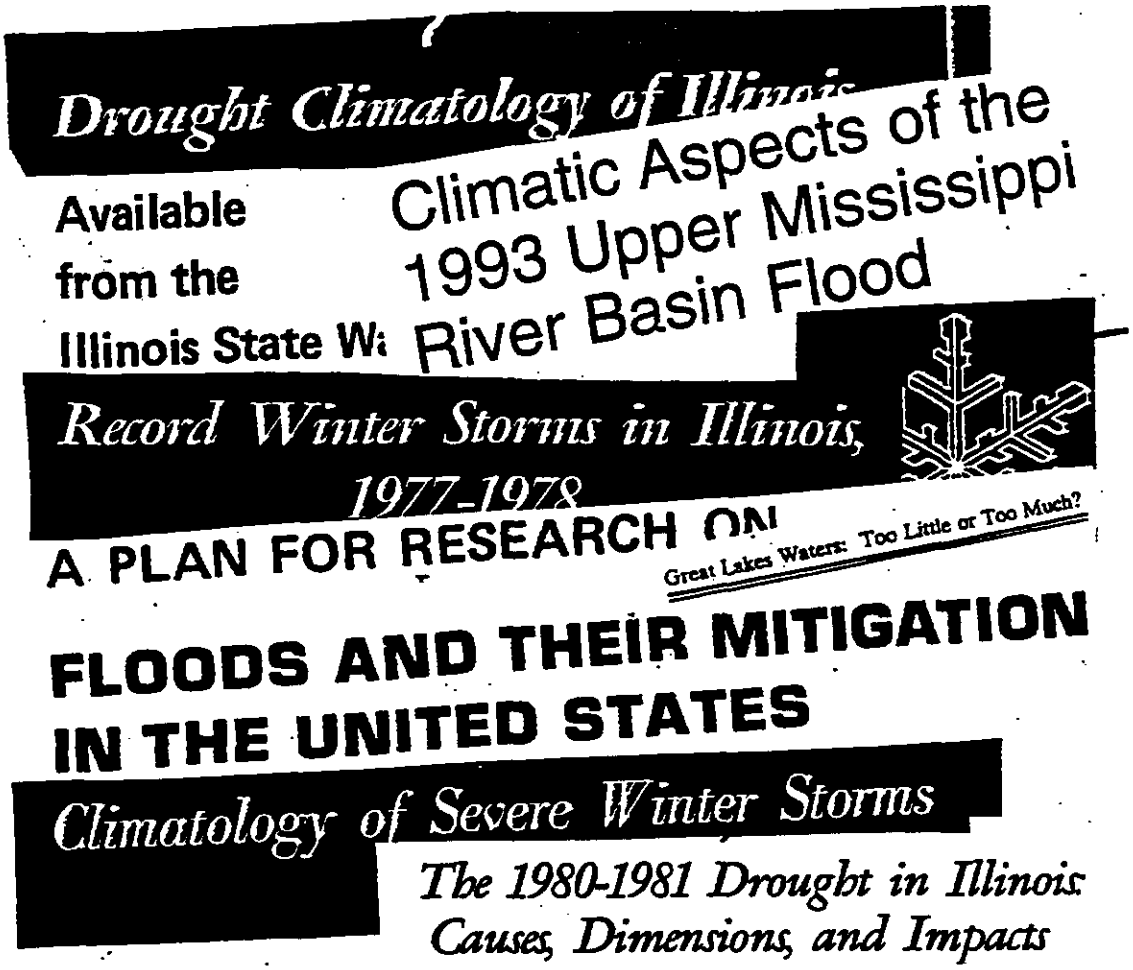

Figure 2. Titles of publications about extremes of climate in Illinois.

Special emphasis in research on the state's climate has concerned measuring and explaining climate extremes or periods of abnormal weather that persist within a time frame ranging from a few months up to ten years. The titles of selected Survey reports (Figure 2) illustrate the attention given to defining the climatology of these extremes (e.g., the climatology of droughts), and to describing specific events (the drought of 1980-1981). Survey expertise has been solicited for projects with a national implication, not just for the state and the Midwest. For example, we recently completed a two-year assessment to prepare a national plan of flood research at the request of the National Science Foundation.

A thorough investigation of an area's climate is incomplete without extensive studies of severe weather events, and Illinois certainly has its share in all seasons. Studies of hail and Illinois tornadoes (Figure 3) began in the 1950s and have continued over the years to include definition of all aspects of damaging winds, winter storms, and lightning. Great attention has been

given to the study of severe local rainstorms, and numerous post-storm field studies were done. As a result, Illinois design engineers have access to more information about flash-flood producing events than exists anywhere else in the nation.

Figure 3. Titles of Survey publications concerning severe weather in Illinois.

Issues of State and National Importance

By the late 1960s changing sources of federal funds for weather research and changes in leadership of the atmospheric sciences group ushered in a new era of research planning and identification of new, relevant research themes that focused on major issues of state and national importance. These issues included planned weather modification, inadvertent weather modification, acid rain, and climate change. Undergirding these topics was ongoing research in several program areas (hydrometeorology, climatology, cloud physics, and instrument development). In 1971 the study of weather and climate impacts became a new area of interdisciplinary research.

Purposeful weather modification and its potential for enhancing water resources and reducing severe weather has been a major issue and area of investigation and service ever since Water Survey Chief Arthur Buswell decided to have the Survey help Lester Pfister in his development of a cloud-seeding project to make rain on his seed farms in 1947. Although facilities and staff were assembled by 1948, no cloud seeding was attempted. Some of the ensuing key activities in the weather modification field are reflected in the titles presented in Figure 4. Major federal

funding has supported this work for over 25 years. Our expertise in rain measurements and statistics helped us become national leaders in the evaluation of weather modification, a thorny issue. We pioneered studies of two issues: can the weather in Illinois be modified, and should it be modified? Our results to date suggest that under certain cloud conditions rain can be enhanced, and that if organized and conducted properly, added rain can benefit crop production. Major laboratory and field projects delved into how to enhance warm season rainfall.

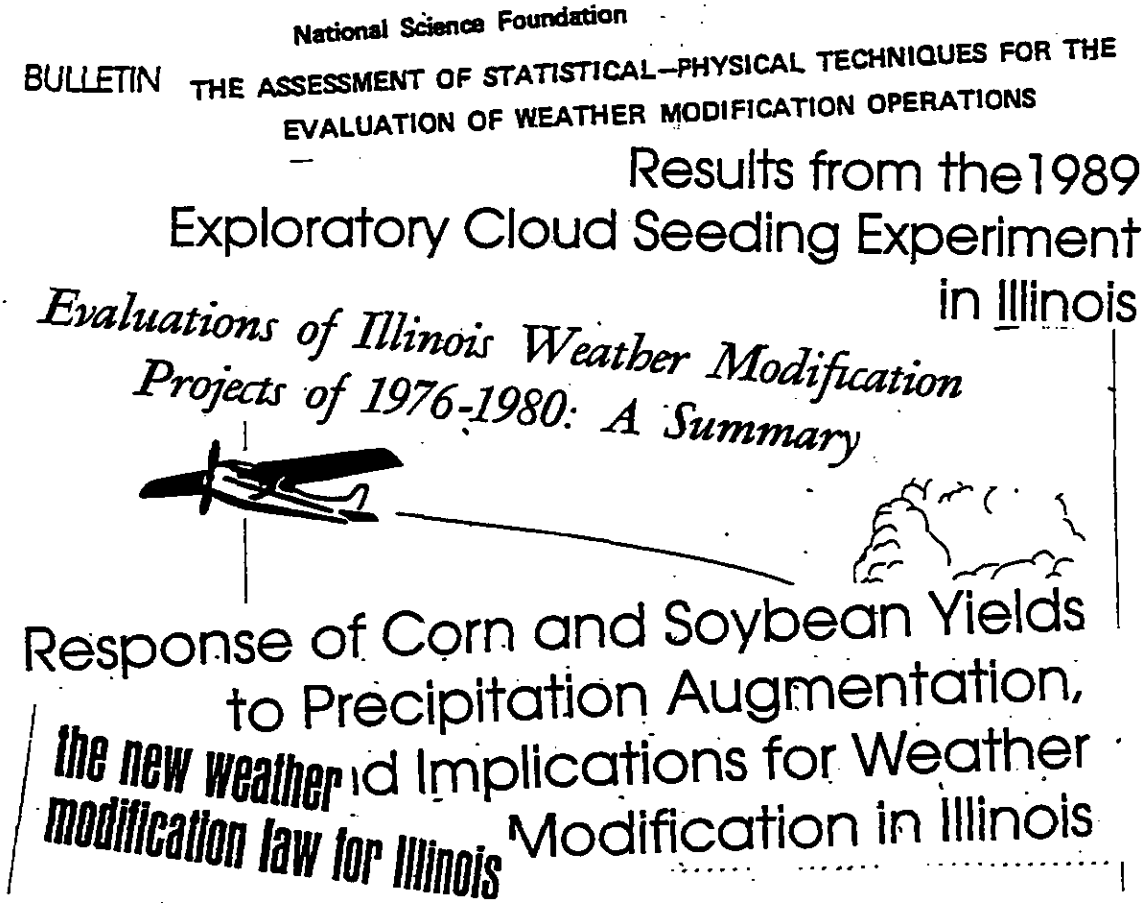

Figure 4. Titles of publications about planned weather modifications.

We have exhaustively studied the effects of changed rainfall on Illinois' water resources and agriculture. This research led us to work with the Illinois Farm Bureau in the 1970s to develop a law for the use and control of weather modification projects in Illinois. This has long been considered the nation's "model" state law, and has been followed in several other states.

When Survey scientists discovered the "La Porte Anomaly" in the 1960s, they found that northwestern Indiana had been receiving 25% more summer rainfall and storm activity as a result of the influence of the Chicago metropolitan area on the atmosphere. This launched a major program addressing inadvertent weather modification (Figure 5) with the principal focus on how large cities like Chicago and St. Louis alter clouds and precipitation over them and many miles

downwind. We have also investigated atmospheric changes caused by large cooling towers and lakes and by jet aircraft flying over the Midwest. Our atmospheric chemists also got involved in one of the major national issues of the 1970s and 1980s, acid rain. We performed major research studies, collected rainfall data, and are the home of the nation's central analytical laboratory to which all U.S. rainwater samples are still brought and analyzed.

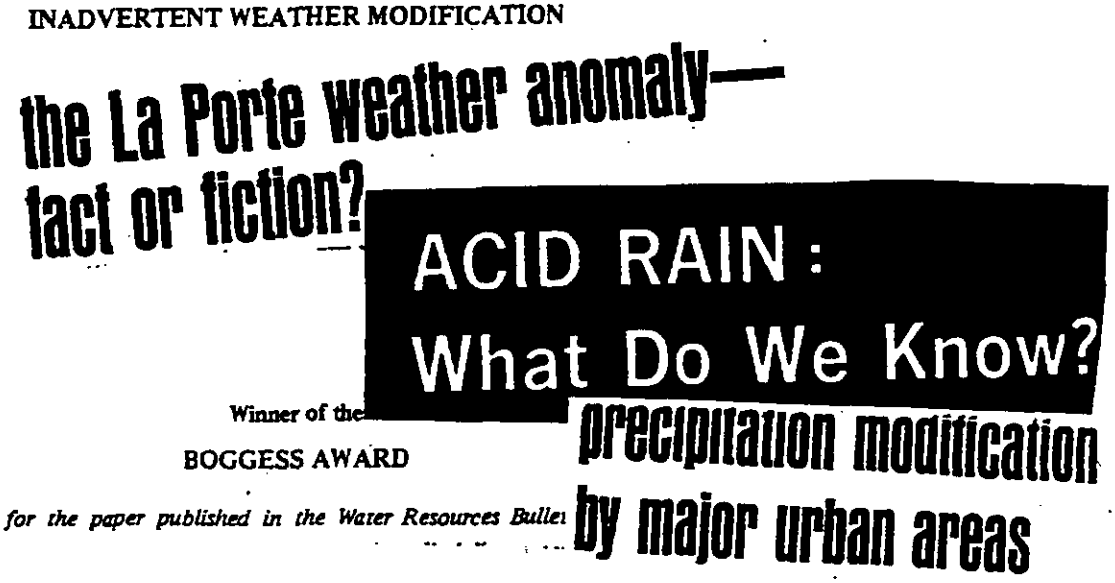

Figure 5. Titles of publications concerning inadvertent weather modification.

Establishment of the Institute of Natural Resources in 1979 changed the institutional environment of the Water Survey and the orientation of certain atmospheric programs. This brought our meteorologists into more direct involvement with state government agencies and issues such as acid rain. It also gave access to state research funds distributed by the Department of Energy and Natural Resources (DENR), including funds "to establish a major program in climate research" in 1979. This launched a greater effort in climate change research, an emerging national issue in the 1980s.

Figure 6 presents titles of several Survey studies relating to climate change. Actually, our studies of climate change began well before it was a "fashionable" topic with various analyses of changes in air and soil temperatures done in the early 1960s. Involvement in the climate change issue has been wide ranging and also includes considerable involvement with policy issues at the state and federal levels. We joined with the Canadian and U.S. governments in organizing and hosting a major international symposium on the Great Lakes in 1989, leading to other projects. Many studies have estimated the effects of a changed climate on Illinois' agriculture and water resources. Much of what is currently known about climate change in Illinois was summarized in a report prepared in 1994 for the Illinois Global Climate Change Task Force appointed by Governor Edgar.

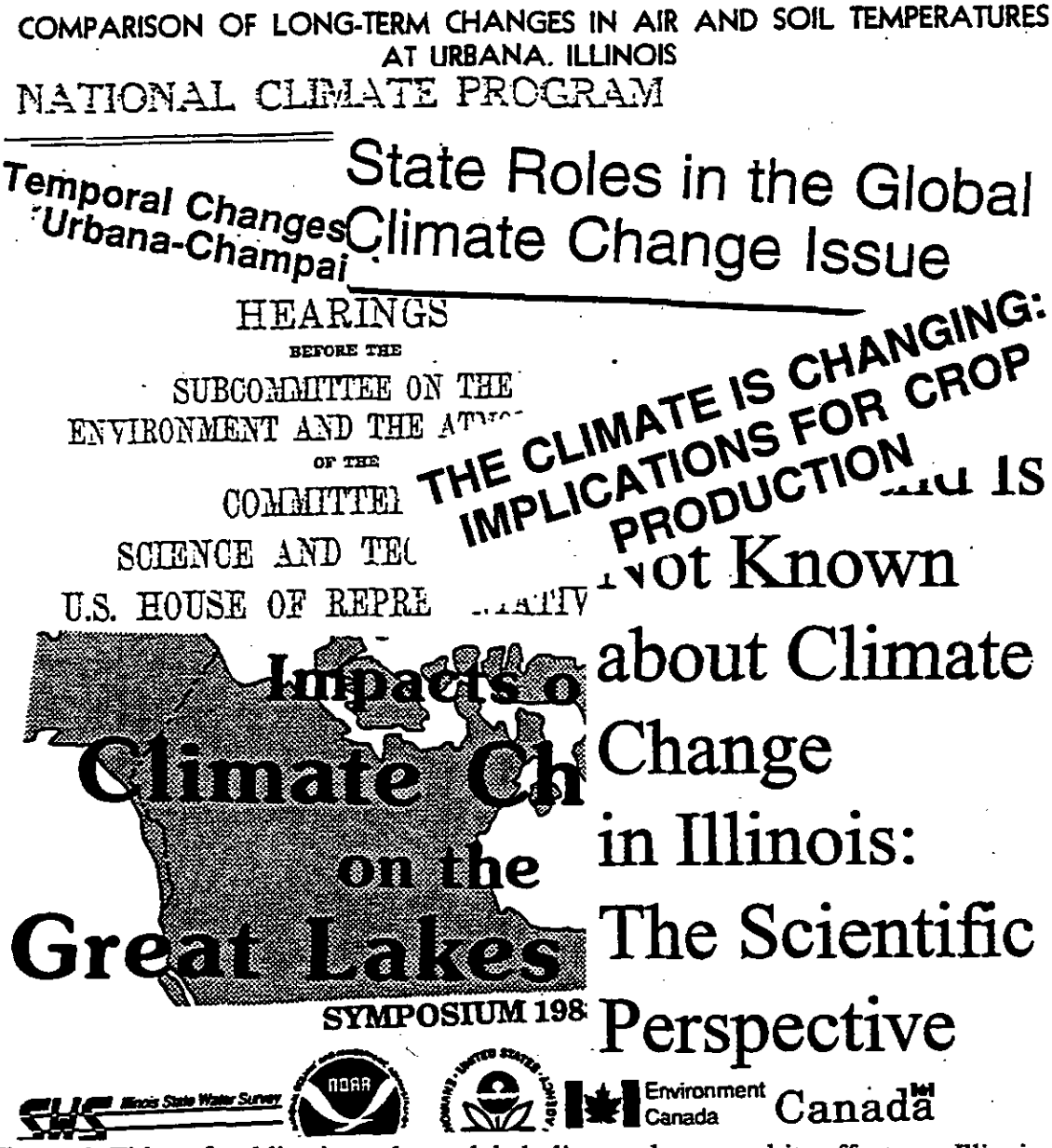

Figure 6. Titles of publications about global climate change and its effects on Illinois.

Services: Applications of Information and Data Collection

The Atmospheric Sciences program has long used printed publications to disseminate information and hence provide services to Illinois. As shown in Figure 7, we have also written articles for magazines and trade journals to make our findings and issues available to the user public. Workshops such as the one in 1994 on the new climate forecasts serve as another medium, as does the news media. In response to the nation's call for improved climate services and applied research the Survey developed and promoted the concept of a national network of

six regional climate centers, now established and a part of National Weather Service. The Survey is home to one of the centers, the Midwestern Climate Center, which has a computer-based, telephone-accessed climate information system (MICIS) that provides anyone in Illinois (with a PC) with easy, inexpensive access to a myriad of climate products. Included among the products are weekly updated maps of soil moisture and estimates of corn and soybean yields throughout the growing season. The system's regional soil moisture model was valuable in ascertaining the likelihood of flood conditions in the post-flood months of 1993-1994.

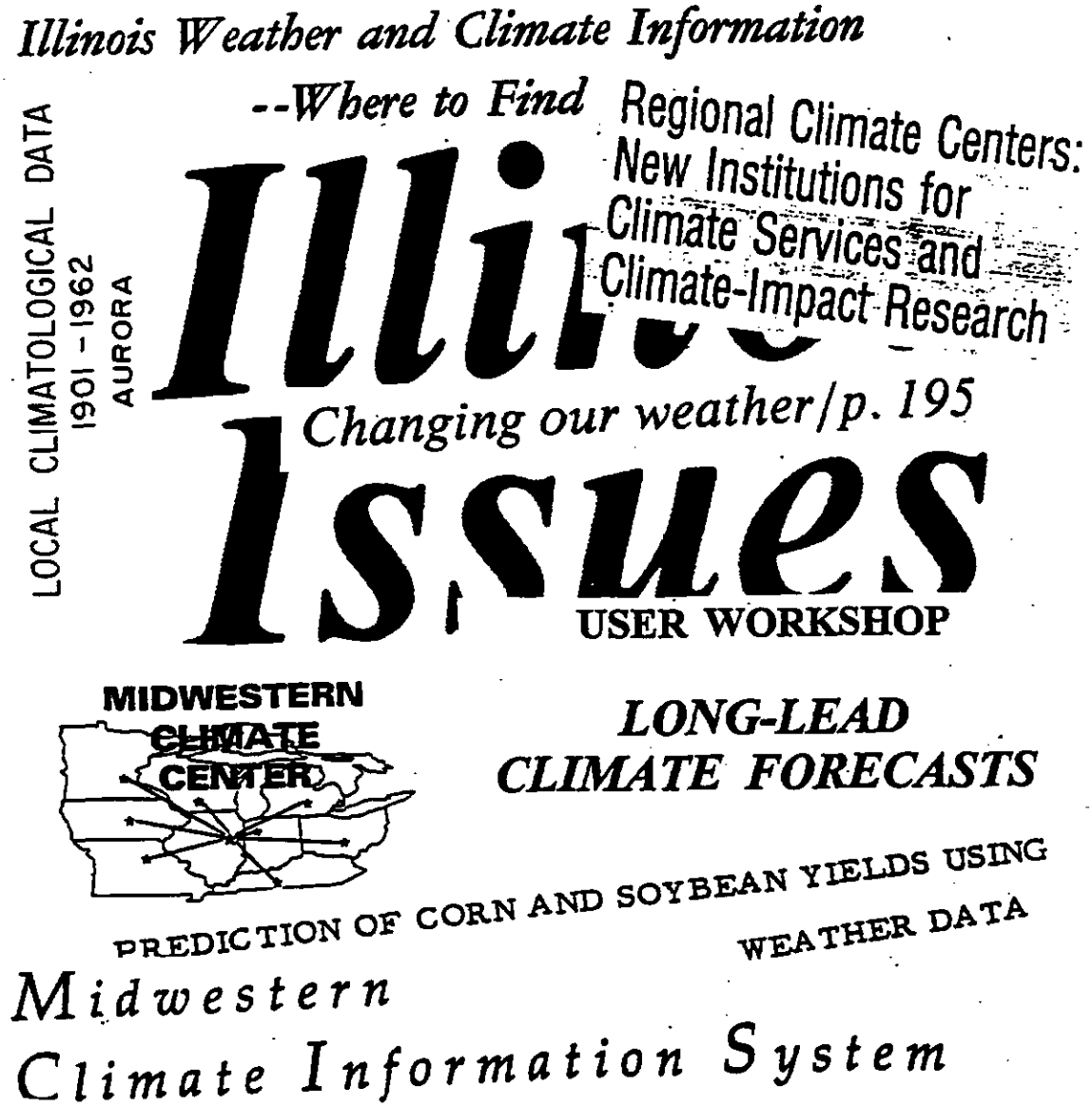

Figure 7. Titles of publications relating to services in providing data and information.

A long-running area of service-oriented research dealt with providing users with design-related information. Much attention has been given, as shown in Figure 8, to rainfall design

information, an area of Survey expertise. Other studies were aimed at providing design information for the construction industry and agriculture. Reaction to the energy problems of the 1970s led to design-oriented studies for wind and solar energy in Illinois. Our climatological expertise resulted in many studies of long-range climate forecasting, and MICIS will soon present climate-based outlooks of the hydrological conditions on the Great Lakes, an effort done in concert with Great Lakes Environmental Laboratory.

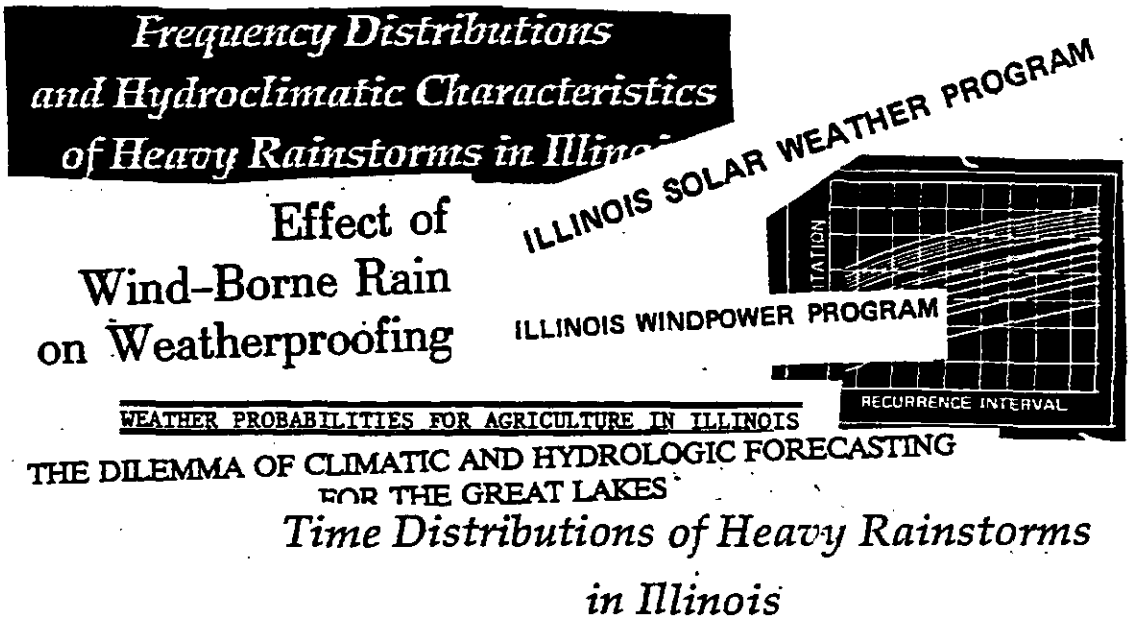

Figure 8. Titles of publications providing information for design-related applications.

Interwoven in our outreach efforts were many studies of relationships between weather/climate and water resources, agriculture, and other weather-sensitive endeavors. Publication titles indicate some of these studies (Figure 9). The precipitation-low streamflow study in the 1960s defined a new relationship predictive method and won for us the prestigious Robert Horton Award from the American Geophysical Union. We received more than $2 million in grants from the National Science Foundation to develop and successfully test a rainfall prediction system for Chicago, a national demonstration project involving our weather radars and raingages. Climatic studies such as the one completed in 1994 help us explain the abnormally high frequency of flood-producing rainstorms in the Chicago region in the past 25 years. Another area of major applications research since the 1960s has addressed weather-crop relations in Illinois through modeling and field measurements, and we are in the eighth year of an experiment on the University of Illinois' farms to more clearly define how various temperature and moisture conditions during the growing season affect corn and soybean production.

We recently completed an extensive analysis of the 1995 heat wave at Chicago explaining how it occurred and why so many died from heat stress. We have long received support from the weather insurance industry to conduct research on severe weather risks and crop-weather relationships.

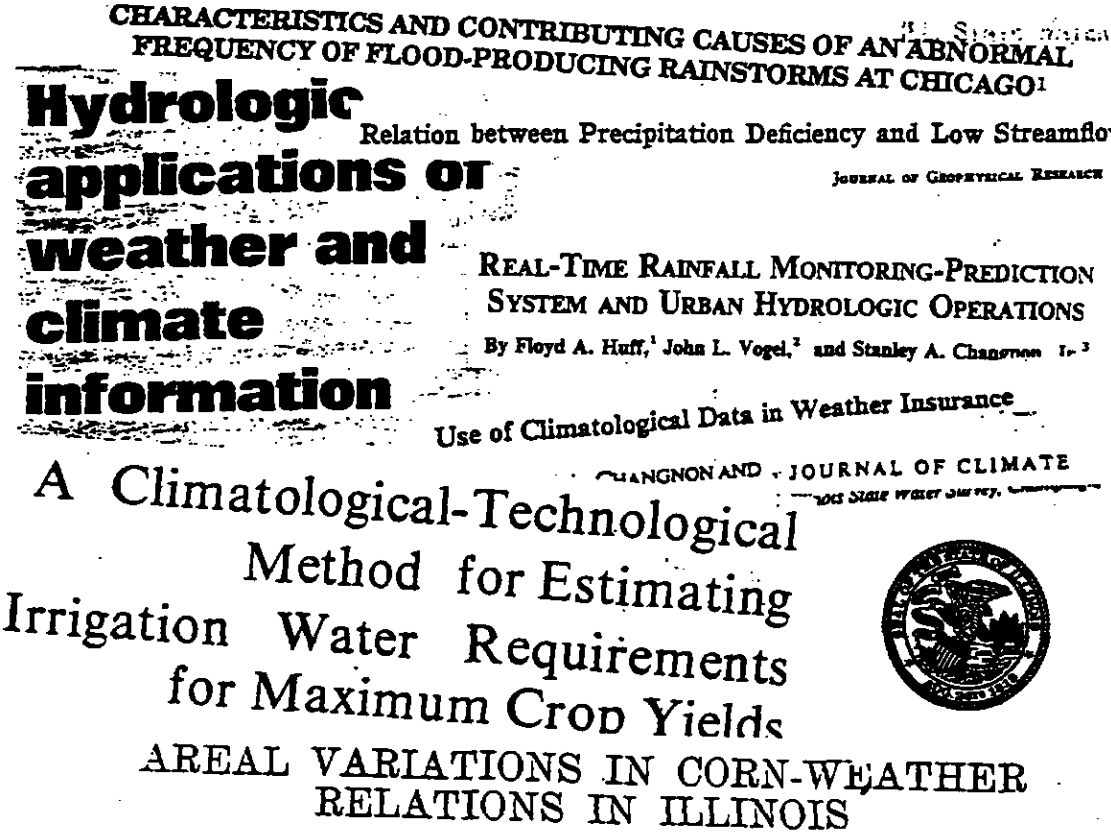

Figure 9. Titles of publications describing applications of information and operational systems.

Last but not least has been the enormous data collection effort during the 48-year atmospheric program. Efforts began in 1948 to collect massive amounts of data on convective rainfall using both weather radars and networks of dense raingages. Over the past four decades the Survey has had one or more raingage networks in operation somewhere in Illinois (Figure 10). We tested and operated 12 different weather radars and built data assembly systems. The new NEXRAD radars being installed across the nation are modeled after the innovative doppler radar designed in 1970, built, and operated by Survey engineers in conjunction with scientists at the University of Chicago. In the DENR environment, even more attention was given to data collection, which allowed us to establish the Illinois Climate Network, 20 completely automatic weather stations scattered across the state. The Survey has organized seven major national field projects concerning specialized weather studies and has participated in several other projects. To handle long-term field projects at sites remote from Champaign-Urbana, facilities such as buildings, radar towers, and special instruments were built. Survey staff built a major facility at Pere Marquette State Park that was used from 1971-1976, and one near Joliet that was used from 1976-1980. Major sites of other field instrumentation include an atmospheric chemistry sampling-monitoring facility at Bondville, the famed Urbana weather station (which has been existence since 1888), and the 20 sites of the Illinois Climate Network across Illinois.

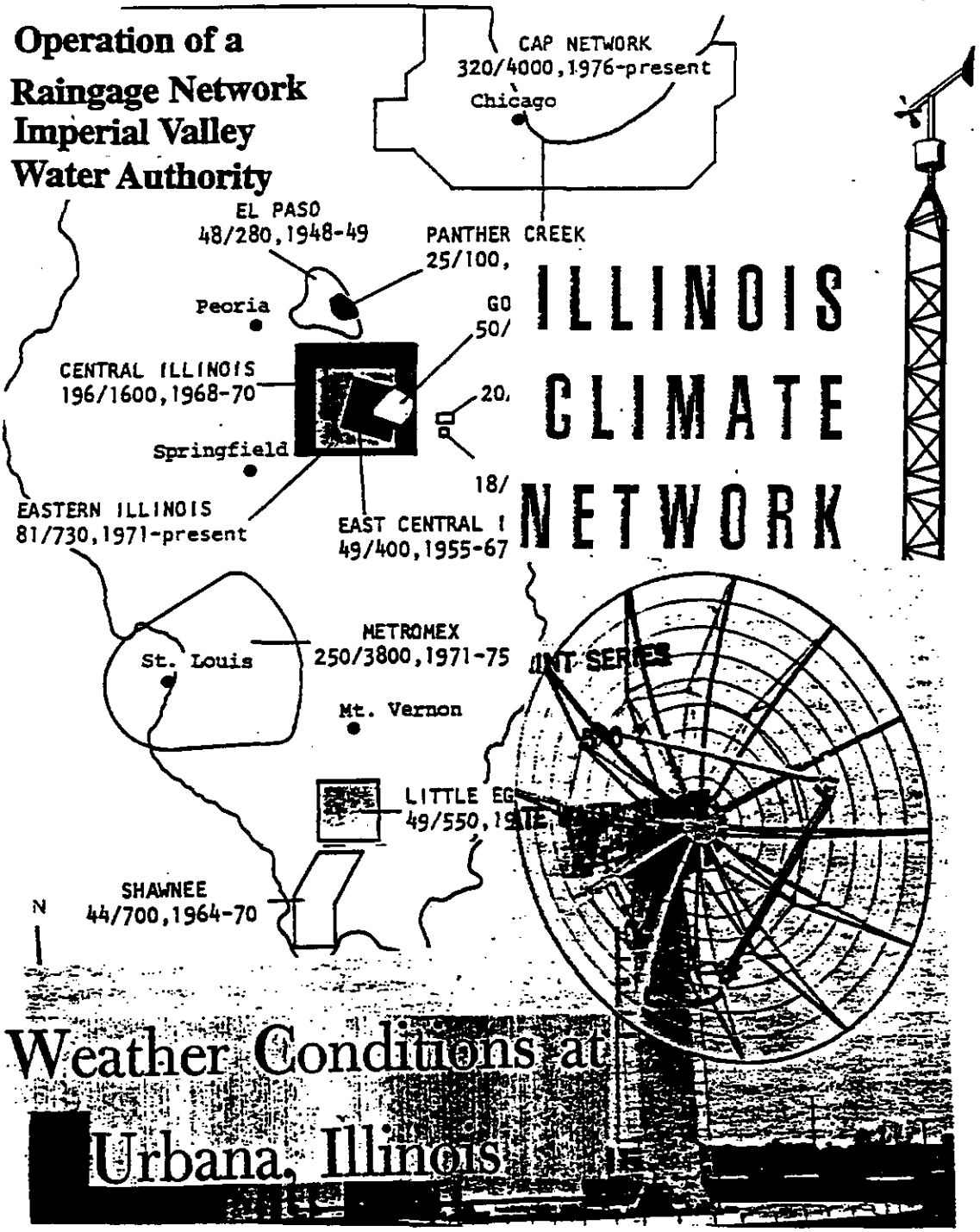

Figure 10. Titles of publications based on data collection efforts.

SUMMARY

The 48-year history of the Survey's weather group reveals amazingly diverse scientific endeavors, constantly shifting to meet new challenges. The hundreds of projects embraced every major function that an atmospheric sciences group can address. These have included: 1) basic and applied research; 2) data collection, evaluation, and storage; 3) large and small field projects; 4) instrument design, development, and testing; and 5) a service program featuring publications and responsiveness to the needs of the public and hundreds of specialized users of weather and climate information. The programs and needs have been actively promoted through the scientific community and through interactions with state and federal government bodies.

In the 1970s, 1980s, and 1990s, Water Survey atmospheric scientists have been involved in several state issues. We have served on the Illinois Weather Modification Control Board, the Illinois Water Plan Task Force, and the Governor's Task Force on Energy. Survey scientists were concerned about global climate change and worked with members of the General Assembly and the Illinois Farm Bureau to establish an Illinois Task Force for Global Climate Change, established by the General Assembly in 1991. We serve as the science advisor to the Task Force. These types of direct interactions with state and national policy development led to changes in emphasis on Survey atmospheric programs. There was more focus on air quality and atmospheric chemistry, and on climate change, and on enhancing climate information-services.

Today the atmospheric sciences group continues its mix of services, applied and basic research, and data collection. With funding heavily dependent on external sources, the significant ongoing changes in the federal government represent a major problem. We face potential major losses of support for programs in atmospheric chemistry, weather modification, and climate services-research. Future support seems likely to dwindle and new themes of interest will develop relating to man's continuing insult to the atmosphere and the need to achieve sustainable development. As primarily an applied research group, it appears the atmospheric sciences group will have to seek more support from the private sector to assist them in the design and operations of weather-sensitive systems. Another recent change is the new Department of Natural Resources, which includes the Scientific Surveys, and its objectives will certainly affect the atmospheric sciences. Change is the name of the future.

The state's $11 million investment in the atmospheric sciences program over the past 48 years has paid off handsomely in attracting huge amounts of federal funding (nine dollars for each state dollar invested). Most importantly, this investment has provided Illinois with unique knowledge about its weather and climate. The state uses this information time and time again to enhance its economy and to improve environmental management. From my perspective, the key achievement has been the creation and sustainment of a state-sponsored atmospheric sciences research group that has attained national and international recognition within a unique institution. A special national award given to the Survey by the American Meteorological Society in 1976 recognizes this achievement for the "initiation, support and successful completion of imaginative research in applied meteorology including storms, rainfall and hail, weather modification, and hydrometeorology problems."

A Century of Water Resources Research at the Illinois State Water Survey: Meeting the Challenge

Mike Demissie, Vernon Knapp and Adrian Visocky

Illinois State Water Survey
2204 Griffith Drive, Champaign, Illinois 61820-7495

ABSTRACT

In 1895, the 39th General Assembly appropriated $5,000 to the University of Illinois for the purposes of surveying the waters of Illinois. With this modest appropriation, chemistry professor Arthur William Palmer started "the chemical survey of the waters of the state" that gave birth to the Illinois State Water Survey, which has been conducting scientific studies of the water resources of Illinois for a century. No other state can match the resulting water resources data and knowledge and the extent to which it has been used to provide the scientific and engineering basis for solving complex water resources problems throughout Illinois. Over the years the water resources issues that drive data collection and research have varied and gotten more complex. With each challenge the Water Survey has responded by collecting the appropriate data and providing state-of-the-art scientific analysis to planners, decision makers, and the general public. Throughout this period, the Water Survey has played a pioneering role in many scientific and engineering analyses of water resources problems in Illinois and the United States.

WATER RESOURCES RESEARCH AT THE WATER SURVEY

The initial impetus to start the Water Survey came from the typhoid epidemics that had swept through the United States in the nineteenth century and the concern for the safety of drinking water supply sources in Illinois. In 1895, the Illinois General Assembly appropriated $5,000 to the University of Illinois for the purposes of surveying the waters of Illinois to ensure a safe and adequate water supply for the citizens of Illinois. In the first 15 months of its existence the Survey, under the leadership of Professor Arthur William Palmer, analyzed the chemistry of 1,787 water samples from 156 towns in 68 different counties of Illinois. These efforts gradually expanded to include investigations into the quality and quantity of water from streams and ground-water sources throughout the state.

In 1917, the Water Survey was transferred from the University of Illinois to the State Department of Registration and Education with the directive to "... investigate and study the natural resources of the state...to the end that the available water resources of the state may be better known." With such a broad mandate, the Water Survey has completed major studies concerning the water resources of Illinois and has met the challenges of changing and complex issues over the past century. Water Survey scientists and engineers started the inventory of municipal ground-water supplies and the survey of surface waters including sedimentation

surveys of lakes and reservoirs. They also developed and used advanced computers and software to model and solve complex problems in ground-water and surface water resource evaluation.

In response to the recurring droughts and water supply shortages in the 1930's and 1950's, the Water Survey completed a statewide inventory of potential reservoir sites, developed methods to reduce evaporation losses from reservoirs and to estimate reservoir capacity losses due to sedimentation, and completed the analysis of expected low flows in streams during droughts.

In addition to the long-term mission of data collection and research, the Water Survey has served the State by providing the expertise necessary for major projects related to Lake Michigan water allocation and diversion issues, Upper Mississippi River basin management issues, and site selection for the Superconducting Super Collider in the 1980's and the Low-Level Radioactive Waste disposal site in the 1990's.

Even though the main mission of the agency has remained the same, Water Survey scientists and engineers have always attempted to advance the scientific methods of water resources investigations and to anticipate and meet future problems. Because of their enthusiastic search for more and better data, scientific methods, and improved techniques, over the years the Water Survey has been involved in resolving many of the water resources issues in the state. Water resources research at the Water Survey has traditionally been grouped into two major areas: surface water and ground water. Since most of the data collection techniques and analytical procedures are different for surface and ground-water studies, the evolution of each field of study at the Water Survey is presented separately.

EVOLUTION OF SURFACE WATER RESEARCH AT THE WATER SURVEY

Hydrologic investigations at the Water Survey have always reflected immediate water resources concerns of Illinois. For much of the history of the Water Survey, the primary concern has been public water supply, i.e., finding abundant supplies of good quality for the people of the State. During the first half of this century, the study of surface water resources was particularly influenced by water supply inadequacies experienced during major droughts.

When the Water Survey was formed in 1895, public water supply systems were just coming into existence throughout the State. Individuals in all but the larger communities still obtained their water from shallow ground-water wells. Many of these wells went dry for the first time during the drought of 1893-1895, and the people of Illinois realized they had to search elsewhere for reliable sources of water. Wells in the northern portion of the state were drilled to deeper aquifers. The ground-water yield was unable to supply the water needs of the southern third of Illinois and some other areas that required large quantities of water so many communities began to withdraw and treat water from streams.

By the end of the next two droughts during 1900-1901 and 1913-1914, it was apparent that the growing need for water surpassed the capability to sustain flow in many smaller streams. Over the years, fewer than ten smaller communities had built reservoirs by impounding streams,

and it wasn't until after the 1913-1914 drought that this practice started to become a more common method to remedy water supply shortages. Between 1915 and 1930, 24 water supply reservoirs were built, many of them in southern Illinois where water supply shortages were most extreme.

It was also at this time that the Water Survey began collecting more comprehensive data on public water supplies. Most of the early data concerning public water supply came from site inspections for specific systems that had experienced quality problems. Starting in 1914, the Water Survey became more actively involved in the investigation of all public water supplies to assure that citizens had an abundant supply of pure water. Over time, data were collected for all Illinois water supply systems, describing the sources of water supply, well yields, potential surface water sources, and experiences in water shortages. An inventory of existing ground-water supply systems was first published in 1925. The first inventory on surface water supplies, published in 1937, focused heavily on potential surface water supplies (all lakes and potential reservoir sites in Illinois) along with information on existing systems. During the 1940's and 1950's the statewide inventories would be expanded significantly to address the rapidly increasing water needs for industrial and irrigation uses. The inventory for existing and potential reservoir sites was updated in the early 1960's.

Although surface waters were increasingly being used for public water supply, there was very little existing data to indicate the magnitude of low flows in streams during drought. These data would also be necessary in determining the size of impounding reservoirs built. A cooperative agreement begun in 1906 between the U.S. Geological Survey (USGS) and the University of Illinois Engineering Experiment Station provided for flow quantity and quality measurements for several Illinois streams. But this short-lived monitoring program lapsed prior to the 1913-1914 drought. In 1914 the Water Survey and the USGS entered into an agreement to renew the streamgaging activities, a cooperative program that has continued uninterrupted to this day.

Since most surface water supplies were developed with incomplete data on low flows in streams, they were not fully prepared for the impacts of major droughts such as those that occurred in 1930-1931 and 1953-1956. Forty of the 58 surface water supply systems in the State experienced shortages during the 1930-1931 drought, as did 53 of the 98 systems that existed during the 1950's drought. Following the 1930-1931 drought the study of surface and ground-water quantity became the primary immediate concern of the Water Survey. Between 1930 and 1940, the USGS and the Water Survey expanded their cooperative agreement to substantially increase the number of gages throughout the State. By 1940 the emphasis on streamgaging had grown to such an extent that 20 percent of the Water Survey budget went toward the program. With the increased support came greater emphasis on monitoring streams near existing water supply reservoirs and on smaller watersheds similar in size to those where reservoirs existed. The streamgaging program continued to increase with additional cooperation from other state and federal agencies, and 125 streamgages were in operation by 1950.

Each of the major droughts also marked a resurgence in the building of new water supplies, principally the impoundment of streams. Forty-eight reservoirs were built between 1931 and 1950, and 36 additional reservoirs were built after the 1950's drought. From one perspective, it was perhaps necessary to experience these droughts before sufficient information was available to define the range of flow conditions needed for use in hydrologic design. The 1953-1956 drought was the drought of record for more than two-thirds of all Illinois streams, and low flows measured during that drought are still used today as the yardstick when studying water supply issues.

The first reservoir sedimentation survey by the Water Survey was conducted on Lake Decatur in 1931 and 1932. Subsequent surveys on Lake Decatur and numerous other lakes were used to estimate sedimentation rates for various regions in the State. The Water Survey published the first eight investigations of this type between 1947 and 1952.

Many other investigations on the hydrologic design for impounding reservoirs, lake evaporation, and water budget studies of watersheds and reservoirs emerged from the Water Survey starting in the mid-1950's, and to a great degree built the hydrologic reputation that the Water Survey maintains to this day. Bulletin 51, *Low Flows of Illinois Streams for Impounding Reservoir Design*, in particular, was a landmark study that combined all of the various aspects of water supply hydrology that had been the focus of Water Survey activities for decades.

By the late-1960's, most public water supply systems had been upgraded, and the impact of drought became a less critical matter. The emphasis of hydrologic investigations now shifted to a broad range of other water resources issues, including water resources planning and management, the effects of watershed and rainfall characteristics on runoff and flooding in urban areas, river hydraulics, and environmental quality. Several studies examined optimal operation of two large, multipurpose reservoirs on the Kaskaskia River, Lake Shelbyville, and Carlyle Lake.

Investigations were also taking advantage of the growing computer technology. The ILLUDAS Urban Watershed Model, developed at the Water Survey, was one of the first computer models developed for stormwater modeling in urban watersheds. Computers would also become essential to process the large amounts of data and detailed equations that had become commonplace in most hydrologic and hydraulic research. Methods for the analysis and management of floods and floodplain management were developed or examined, including regional analysis of flood frequency distributions, development of unit hydrographs for ungaged streams, and algorithms to convert storm rainfall to surface runoff.

The Water Survey has paid special attention to the Illinois River since the early days when Professor Palmer collaborated with Professor Stephen A. Forbes of the Natural History Survey by analyzing the chemical quality of the Illinois River at the Havana field station on the Illinois River. Professor Palmer had already started reporting a significant increase in the pollution of the Illinois River in 1897. The Water Survey has collected and analyzed water samples from the Illinois River ever since to document the status of the river. Starting in the mid-1970's the major issue for the Illinois River has become the excessive sedimentation in bottomland lakes and the

degradation of aquatic habitats. The Water Survey has conducted numerous sedimentation surveys and studies along the Illinois River to assess the existing conditions of the lakes and to predict the future fate of these lakes and habitats under different land-use and management practices. The Peoria Lake area has been intensively investigated by the Water Survey, which has resulted in a number of reports and very useful data for the whole Illinois River valley.

As a result of the Water Survey's extensive experience in collecting and analyzing data from a large river such as the Illinois River, the Water Survey was recognized as an expert in field data collection from large rivers and became an important player in the evaluation of the impacts of recreational and navigation traffic in the Upper Mississippi River System. New data collection techniques were developed by the Water Survey to measure changes in velocity, pressure, sediment concentrations, and wave heights due to river traffic.

In recent years the Water Survey has been actively conducting comprehensive watershed studies to evaluate the influence of land-use practices on soil erosion, sedimentation, streamflow, and water quality. Studies have been conducted for small watersheds such as the Blue Creek and Highland Silver Lake watersheds and for larger watersheds such as the Kankakee River, Lake Springfield, Cache River, Lake Decatur, and Vermilion River watersheds. The cumulative results of watershed studies will enable state, regional, and local agencies to develop best management practices to reduce erosion and improve water quality.

The Water Survey has continued to issue reports on important hydrologic events and their impacts on the State's water resources. Several documents were published detailing various aspects of the droughts of 1980-1981 and 1987-1989, as well as their impacts on water supply, agriculture, navigation, and the environment. Most recently, the 1993 Flood of the Mississippi River brought into focus the need to examine the use and management of the State's floodplain areas and the potential impacts of human activities and climatic change on floodwaters. The resulting impact of the flood on the river's sediments and chemical constituents were also investigated.

EVOLUTION OF GROUND-WATER RESEARCH AT THE WATER SURVEY

Early efforts at ground-water data collection at the Water Survey were sporadic in nature and often consisted of site visits to municipalities in response to a request related to some problem with one or more aspects of their water supply. The Water Survey also encouraged municipalities to make periodic measurements of water levels in their own wells and to report these to the Survey. Ground-water quality data were also often collected in this manner, with water samples being collected in the field by Water Survey representatives and returned to the Survey chemistry laboratory for analysis.

Perhaps the first systematic ground-water data collection at the Water Survey occurred in 1934 as part of a Depression-era Civil Works Administration project supervised by the Survey. Private wells were inventoried and their water levels measured over a large portion of Illinois. Later, in the 1940's and 1950's, efforts of a routine nature got underway, usually involving the

periodic (monthly) measurement of water levels in a statewide network of observation wells. Measurements were taken in wells located both in areas of significant ground-water use and in areas remote from ground-water withdrawals, in order to monitor ground-water fluctuations induced by pumpage as well as those that are seasonal in nature. Ground-water pumpage data were obtained by telephone, letter, and personal contact with municipalities and industries and, therefore, depended on the goodwill and cooperation of these entities.

As all of these data were compiled, they gradually accumulated into a significant amount of information that eventually was tapped by researchers to supplement their studies of local and regional aquifers. Early examples of such studies were the Bulletin 21 and 40 series, which reported on the public ground-water supplies across the State. This series was later improved on as the Bulletin 60 series, which compiled such information for municipalities within each county. Other examples were the field studies of ground-water development in the Metro-East area of East St. Louis, the Peoria area, Champaign-Urbana, and several areas of northeastern Illinois.

Coop Report 1, published in 1959, was the first cooperative ground-water report between the State Water and Geological Surveys, describing the ground-water resources in the eight-county area around Chicago. The study was undertaken in response to the rapidly growing ground-water development in the deep bedrock aquifers and the consequent sharp decline of water levels. Information gathered over the previous two decades was supplemented with data from the first mass measurement of water levels in hundreds of deep wells. That information was obtained by postcard mailings to municipalities and industries, requesting water-level data from the well operators. Subsequent mass measurements were conducted in later years by Water Survey staff.

The pumping tests on production wells and aquifer tests on observation wells are other data collection activities that have undergone significant changes over the years. Methods of determining water levels in wells with emphasis on well yield tests were introduced in the 1920's. Until perhaps ten years ago these tests usually were of relatively short duration (3 to 8 hours). Well and aquifer yields were estimated by a simple long-term extrapolation of the time-drawdown data. Later, as analytical equations were described in the literature and a methodology was developed for data analysis, well and aquifer yields were determined with more detail and sophistication. Under water-table conditions, for example, aquifer tests gradually were extended in duration to 24 hours to allow for the effects of delayed gravity drainage to dissipate. At present, in areas where nearby boundaries are suspected, aquifer tests are typically conducted for up to seven days and occasionally for as many as 30 days.

Instrumentation for measuring ground-water levels and well discharge rates evolved slowly over the years, but advances have been rapid in the computer age. Early measurements of well discharge rates during pumping tests, for example, were made with meters, weirs, or pipe-discharge formulas. These methods were gradually replaced with orifice tubes or orifice buckets constructed and calibrated by the Water Survey. An orifice tube uses a piezometer tube to register the hydraulic head at the discharge end of a pipe fitted with a calibrated orifice plate, while an orifice bucket uses a piezometer to determine the head above the calibrated openings in the bottom of the bucket. Calibration curves then provide the discharge rate. In recent years

instrumentation developed by industry includes sonic and propeller-driven devices, both of which send analog signals to a computer, which then converts the signals to discharge units. Water levels typically have been measured with steel tapes marked with chalk or with electric droplines (devices that register contact with the water surface through a light signal or buzzer). To some extent these devices are still used, especially as an adjunct to modern, electronic equipment. For long-term monitoring of wells, water-level recorders attached to floats were used to collect continuous ink traces of water levels over time. The computer age has now brought us pressure transmitters that send milliamp electric signals to a computer, which converts the signals to depths of submergence of the pressure device with time. Measurement frequency is virtually continuous and can be varied at will, and the data can be downloaded onto office computers for manipulation and analysis with software programs.

With some notable exceptions (Peoria, the Havana Lowlands, and the American Bottoms), aquifer studies through perhaps the 1960's were of the desktop variety, using information that had been routinely collected and stored in Water Survey files, along with previously published reports. The information available for these studies often was supplemented with additional data derived from limited field work. Gradually, however, the emphasis shifted to more intensive field-based investigations so that, at present, much of the information collected for ground-water studies is on-site, new data. Observation well networks frequently are developed in a study area by inventorying existing private wells for later use in mass measurements of water levels. Where geologic control is lacking, boreholes are drilled at selected sites to determine the nature, thickness, and areal extent of geologic materials, particularly in glacial deposits. The Geological Survey often cooperates with the Water Survey in obtaining detailed borehole information by conducting downhole geophysical logging.

Aquifer modeling, the basis for most aquifer studies, has undergone enormous changes. The standard modeling technique of the late 1950's and the 1960's was the conceptual model, linked to an appropriate analytical model, based on the concept of idealized aquifers. Aquifer boundaries were simulated by combining image-well theory and the principle of superposition with idealized, "infinite aquifers". In the late 1960's and much of the 1970's electric analog models were used by the Water Survey to study aquifer situations (boundaries and layers) that were too large or complex to be handled by analytical models. These devices used the analogy between the flow of electricity through resistors and capacitors with the flow of ground water through aquifers. Analogs gradually, in turn, gave way to digital computer models, which now are the standard of the industry for very complex aquifer systems. Today, computer models, some of which were developed at the Water Survey, are used to estimate long-term yield and predict the effects of various scenarios of ground-water development in complex aquifers and to determine capture zones of individual wells or well fields for aquifer protection purposes.

Beginning about the 1970's and continuing to the present, the impetus for ground-water data collection has increasingly come from events and issues that are of importance locally and statewide. Droughts, for example, frequently spur communities with surface-water supplies to request assistance in conducting a search for supplemental ground-water sources, especially in cases where rapid growth in projected water demand is occurring. For example, the drought of

1988-1989 led the city of Decatur to investigate ground-water possibilities in the Mahomet aquifer and ultimately to construct an eight-well emergency well field with a design capacity of 25 million gallons per day near the DeWitt-Macon County line. The Water Survey was asked to collect and analyze the data from the aquifer testing that was conducted at the well field site. The drought also provided the impetus for the town of Normal, the city of Bloomington, and McLean County to form a Long-Range Water Plan (LRWP) Steering Committee to investigate supplemental ground-water sources to meet projected future water needs. The LRWP committee has funded an ongoing study by the Water Survey and the Geological Survey of the ground-water potential in the sand and gravel resources of the Sankoty-Mahomet aquifer system in western McLean and eastern Tazewell Counties. This multi-year study includes extensive test drilling, geophysical logging, aquifer mapping, and aquifer testing.

Examples of issue-driven data-collection efforts are also numerous. When the issue of Lake Michigan allocations for public water supplies came to prominence in the 1970's, the Water Survey provided information concerning the major aquifers in northeastern Illinois in testimony before the U.S. Supreme Court. The Scientific Surveys were also heavily involved in collecting and providing geohydrologic information for the State in its quest to have the U.S. Department of Energy locate the Superconducting Super Collider, a high-energy physics research facility, in Illinois in the late 1980's. Recent ground-water investigations by both Surveys were critical to the effort to locate a repository for low-level radioactive waste. A massive drilling and aquifer testing program conducted near Martinsville (Clark County) determined the unsuitability of that proposed site for the repository. A new screening investigation by the Surveys is now underway to select ten potential sites for more detailed study.

Ground-water data collection has not been limited to quantitative studies. The very beginnings of the Water Survey were for the purpose of surveying the quality of surface water across Illinois. Later, however, this activity was extended to provision of chemical analyses of ground-water samples collected from private, municipal, and industrial wells. Gradually, municipal supplies were regulated by the Illinois Environmental Protection Agency (IEPA), which required routine water sampling. Ground-water samples are still often collected by Water Survey staff, however, during the course of testing newly constructed municipal wells. The Water Survey water-quality database contains approximately 50,000 records of chemical analyses from samples analyzed at the Water Survey laboratories and the IEPA laboratories. Some of these analyses date back to the early part of the century, but most analyses are from 1970 to the present. Before 1987, most analyses addressed inorganic compounds and physical parameters. Since then many organic analyses have been added to the database from the IEPA Safe Drinking Water Act compliance monitoring program.

Legislation passed by the Illinois Legislature during the 1980's to protect ground-water resources has been a primary driving force in ground-water quality studies conducted by the Water Survey. Major regional ground-water quality assessments have been or are being conducted in the Rockford and Peoria areas, the Metro-East area around East St. Louis, and in McHenry County. In addition, several state and federally funded investigations have been made or are underway to determine the extent of pesticide contamination in shallow aquifers in Illinois.

Severe reductions in the State budget over the last ten years have cut staff size at the Water Survey and forced many of the staff to switch to grant and contract funding. As a result, significant effort and attention is now given to projects that are sponsor driven. The realities of recent State budgets dictate that large-scale ground-water data collection will not likely be funded by the Legislature but will be sponsored by other entities (water authorities, local government, etc.) that have an interest in particular areas of Illinois.

CONCLUSION

The Water Survey is still dealing with some of the old issues, trying to resolve current problems, and preparing for the future by investigating issues such as the impacts of potential changes in the global and regional climate, environmental protection policies related to point and nonpoint source pollution, and watershed and ecosystem management. It is already apparent that water-related problems and difficult environmental and ecological issues will continue to occupy the Water Survey for yet another century, if not longer.

Forbes Biological Station Commemorates 100 Years of Research

S.P. Havera and K.E. Roat, Illinois Natural History Survey

Forbes Biological Station, P.O. Box 590, Havana, IL 62644

ABSTRACT

One hundred years of continuous research has been conducted on the Illinois River from the Illinois Natural History Survey Stephen A. Forbes Biological Station near Havana. Established by Forbes in 1894, the station was the first inland aquatic biological station in America equipped for continuous investigations and the first in the world to undertake the serious study of the biology of a river system.

The original station consisted of three rented rooms in Havana, a working library of 120 volumes, and a chartered cabin boat stationed on Quiver Lake. The station now occupies a well-equipped, two-story office building and a wet laboratory on Chautauqua National Wildlife Refuge and a leased building in Havana. Station scientists have investigated river pollution and contamination, fishes, mussels, other aquatic organisms, navigation, floodplain ecology, sedimentation, vegetation, wetlands, mammals, waterfowl, and other avifauna. The long-term studies conducted at the station provide a unique opportunity for comparison of river conditions before and after human interference. Investigations have provided information for a multitude of scientific publications and technical reports, and the findings have significantly benefited the scientific community, the citizens of Illinois, and the natural resources of our nation.

The most challenging aspiration of the current staff is to restore a part of the Illinois Valley to some semblance of its pristine condition as one of the most remarkable and productive river systems in North America, and to return to the river at least part of the floodplain that was taken from it.

FORBES BIOLOGICAL STATION ESTABLISHED

The Forbes Biological Station reached a milestone in 1994 when 100 years of continuous research had been conducted on the Illinois River from the station located near Havana. Stephen A. Forbes, founding chief of the Illinois Natural History Survey and considered by some as the "Father of Ecology", believed that "the study of local faunas and floras is likely to grow, and to dominate largely the work of many of our younger biologists ... and will come to require more or less independent biological stations for its complete realization" (Forbes 1910:1). In 1894, Forbes established a biological research station at Havana on the backwaters of the Illinois River. It was the first inland aquatic biological station in America equipped for continuous investigation and the first in the world to undertake the serious study of the biology of a river system.

Forbes selected Havana as the site because the bluffs and clean, hard beaches along the eastern shores of the river and the abundance of pure, cold spring water provided good working and camping conditions. The initial appropriation from the State legislature for establishment of the station was $1,800. The first station consisted of three rented rooms in Havana, a working library of 120 volumes, and a chartered cabin boat stationed on Quiver Lake. Fieldwork on the Illinois River was conducted from the boat equipped with seines, dredges, surface nets, plankton apparatus, and other collecting equipment. It also carried microscopes, preservation reagents, a number of breeding cages for aquatic insects, and aquaria. Somehow it also managed to provide a kitchen and sleeping accommodations for four.

In 1895, the Illinois legislature appropriated $2,500 for further equipping the station and $3,000 per annum for expenses. With these funds, a 60-foot houseboat was built in Havana from plans drawn under Forbes' direction. This floating biological laboratory arrived at the station in September of 1896. With no power of its own, it was towed by a 25-foot steamer, the Illini. The houseboat proved to be a comfortable and efficient laboratory for as many as 15 workers and had the very great advantage of mobility. According to Forbes, the station differed from most American freshwater stations in that its equipment was all afloat, and readily moveable from place to place; it was devoted to investigation only, and not to teaching; it was in operation throughout the year instead of being limited to the vacation season; it was devoted to a study of the biology of a river system instead of a lake; and it was supported directly by appropriations from the treasury of the State.

Forbes believed strongly that classroom and laboratory work should be integrated, and his feeling on this point may have influenced the University of Illinois to require field experience at a biological station before granting a graduate degree in zoology. In addition, summer school biology students at the University were required to spend ten days of field work in zoology, botany, and entomology at the Havana station.

EARLY AQUATIC RESEARCH

Water samples were collected regularly from six points on the Illinois River and three points on connecting lakes and analyzed by Arthur W. Palmer in conjunction with the State Water Survey, which had been founded in 1895. Much of Palmer's work at the Havana site was the result of a widespread typhoid epidemic in 1893 and the belief that it originated in contaminated water supplies. Palmer's work had significant impact on sewage disposal in small towns.

Charles A. Kofoid, director of the Havana station from July of 1895 through December of 1900, had as his major area of investigation the plankton of the Illinois River. Altogether he published nearly 1,000 pages on the subject.

When Forbes looked back on the research conducted at the station from its genesis to 1903, he noted that over 6,000 collections had been made — about 500 were fishes, some 2,000 were plankton collections, and a variety of aquatic forms accounted for another 3,500. Weekly water samples had been analyzed for a consecutive period of three and a half years. In addition to local

collections, boatside samples had been taken from longitudinal sections that totaled 450 miles on the Illinois River and 316 miles on the Mississippi between St. Louis and Quincy.

In 1903, Robert E. Richardson, an aquatic biologist, joined the staff of the State Laboratory and was asked to take charge of the station at Havana and the fish collections. He was to remain a part of the staff for the next 30 years, conducting extensive studies of the bottom fauna of the Illinois River during a period that coincided with severe changes in the biology of the river. Before the turn of the century, the Illinois had been a relatively undisturbed river receiving limited amounts of organic pollution from a few towns along its banks. By 1900, however, Chicago was growing rapidly, and disposal of sewage and organic waste materials had become a problem. In 1900 the flow of the Chicago River was reversed, and water from Lake Michigan was sent southward to transport sewage and organic wastes through a diversion channel into the Des Plaines River, a headwater stream of the Illinois. Consequently, the Illinois River began to receive a heavy load of organic pollutants and up to 10,000 cubic feet per second of Lake Michigan water, including lake water that had been withdrawn for industrial and municipal purposes and was now being discharged. During the same period about half of its 400,000-acre floodplain was being leveed, cleared, and drained for agricultural purposes.

Forbes and Richardson had collected bottom fauna in the Illinois River prior to 1900, and Richardson continued to do so after the Lake Michigan diversion. With his assistant, Henry C. Allen, Richardson virtually lived afloat during 1909 and 1910, intensively studying breeding grounds to learn the fate of fish eggs and fry. At Chillicothe and Hennepin, the river appeared nearly normal, but pollution upriver became progressively worse. Organic waste from Chicago continued to increase, and maximum pollution occurred between 1915 and 1920. Based upon his studies of bottom fauna, Richardson calculated a reduction of 34.5 million pounds in the weight of bottom organisms from Chillicothe to LaGrange. Because the organic pollutants served as fertilizer to plant life, the fish yield from the lower Illinois increased from 11.5 million to 24 million pounds from 1900 to 1908. Fish yield declined to 4 million pounds by 1921, a result of increased pollution and the extensive leveeing and drainage of bottomland lakes.

Continuous collections at the station made possible the first edition of The Fishes of Illinois in 1908. This book, a joint endeavor by Forbes and Richardson, had been conceptualized by Forbes in 1876, when he studied fishes in the Illinois River, before the station opened. A second edition was issued in 1920, and the book remained a unique publication for more than 40 years.

By 1927, the staff of the Survey had published twenty articles, more than 1,850 pages, on the biology of the river. These benchmark publications had a profound effect on the study of aquatic biology throughout the nation, and similar investigations were initiated at other sites.

One of the most important studies implemented by William C. Starrett, director of the Havana station from 1948 to 1972, was an annual electrofishing survey of the Illinois River. Begun in 1959, the survey continues to be updated. This long-term monitoring of the fish populations in the Illinois River has provided a baseline for documenting changes in number,

distribution, and species of fishes as the river system continually sustains changes brought about by natural processes and human activity.

NORTH AMERICAN BENTHOLOGICAL SOCIETY

The Midwest Benthological Society was founded at the Havana station in 1953 with Starrett as one of its 13 charter members. Now numbering over 1,200 members, the organization is known as the North American Benthological Society.

WILDLIFE RESEARCH

Wildlife research at the Survey began in the 1870s when Forbes investigated the food habits of birds. His insightful ideas concerning predation, density-dependent and density- independent factors in wildlife populations, census techniques, and population management were consistent with many of the principles that came to be associated with modern wildlife biology. Not until the 1930s, however, was wildlife research fully recognized in the Survey's program.

In recognition of the importance of waterfowl to Illinois, the Survey employed Arthur S. Hawkins and Frank C. Bellrose to initiate a waterfowl research program in 1938. Wood duck studies were also begun in 1938 with the collection of preliminary information on nesting biology. In 1939, the first successful nesting box for the wood duck was constructed from rough-cut lumber, thus beginning the nesting box studies that continue as part of the Survey's waterfowl program.

One of the best wildlife data sets ever compiled in North America had its genesis in 1938 when Bellrose censused waterfowl during the fall migration in selected bottomland lakes in the Illinois Valley. Ground counts were continued during the early 1940s until the fall of 1948 when aerial censuses of the Illinois River floodplain were begun. These weekly aerial counts are still conducted each fall. The massive amount of data provided by years of censusing has vastly improved our understanding of the chronology of migration, the effects of refuges, the value of wetlands, and the distribution of waterfowl in Illinois.

The first permanent structure for the field station was completed on Chautauqua National Wildlife Refuge in early 1940 at a cost of $9,000, a mile or so from the site on Quiver Lake where Forbes had established the station in 1894. In January of 1940, Hawkins, Bellrose, and John M. "Frosty" Anderson moved into the newly completed building to begin what would become one of the most productive waterfowl research programs ever conducted at the field station. The next year Jessop B. Low joined the waterfowl staff, and studies of ducks in the Illinois Valley proliferated. In spite of World War II, a number of benchmark studies in the biology of waterfowl were produced, and their findings did much to advance the art of waterfowl management.

Harry G. Anderson documented the diet of 17 species of waterfowl in Illinois, and Bellrose suggested how research findings could be used to establish Illinois duck seasons. The program

to band waterfowl, begun by "Frosty" Anderson in the fall of 1939, expanded rapidly and continued through 1952. Over 75,000 ducks, mostly mallards, were banded at four localities in Illinois. These bandings generated important information about migration behavior, the mortality of ducks, and the reporting rates on banded ducks.

Following an extensive die-off of mallards in January of 1947 and another the following year, the Survey began an investigation of the effects of lead shot on waterfowl that was to span a period of more than forty years. This and subsequent studies conducted at the Havana station were instrumental in developing a federal program for the elimination of lead shot in the sport hunting of waterfowl, a program that was implemented nationwide in the 1991 hunting season.

Bellrose worked with the survey for more than 50 years. His studies of the wood duck, waterfowl migration, and lead poisoning are considered landmarks in the field. Another landmark in Bellrose's career was the publication of Ducks, Geese and Swans of North America, an updated edition of the 1942 classic by Francis H. Kortwright. Bellrose's edition sold more than 300,000 copies and was recognized by The Wildlife Society as the best book publication of 1977. Bellrose was director of the station from 1972 until he retired from the Natural History Survey in 1982; however, he continued to work along with colleague, Dan Holm, on their recently published book, Ecology and Management of the Wood Duck.

CURRENT RESEARCH

Research is currently directed by two scientists: Stephen P. Havera and Richard E. "Rip" Sparks. Sparks, an aquatic biologist at the station since 1972, has added to our understanding of the effects of chemical contaminants on aquatic organisms, soil erosion and sedimentation as factors in stream pollution, and the ecological impacts of barge-fleeting and river navigation. Current studies include investigations of native and exotic zebra mussels and floodplain ecology. Havera, a wildlife biologist who joined the Survey in 1972 and the station in 1978, has been director of the station since 1982. His research interests include animal ecology, physiology, nutrition, and population-habitat relationships. He has studied agriculture, sedimentation, wetlands, waterfowl, tree squirrels, cottontail rabbits, bald eagles, and eastern bluebirds. Havera has completed a comprehensive book manuscript on waterfowl in Illinois.

Until an addition was built in 1988, the building on Chautauqua Refuge housed up to 20 full-time and seasonal employees. New construction was funded by a grant from the National Science Foundation and by the Capital Development Board of the State of Illinois. As part of the fiftieth anniversary of the original building, the station was officially named the Stephen A. Forbes Biological Station in May 1989. Today, the station has expanded to include a leased building located in Havana and a total of approximately 30 full- and part-time employees.

The foresight of Stephen A. Forbes in establishing a biological station on the Illinois River has made possible many significant contributions to an understanding of the river ecosystem. Forbes' goals for the station included "a comparison of present conditions with those of the former time" (1910:6). He intended "to study the river as a unit with reference particularly to its

economic values, its protection, and its improvement; to work out the details of its biological regimen by a separate study of special problems; and to carry on comparative studies between the Illinois, the Mississippi, and the Missouri, all readily accessible from the station" (Forbes 1910:6). These goals remain valid today.

The staff at the Forbes Biological Station plan to continue work in three areas of demonstrated competence: river and wetland ecology, population studies of aquatic organisms and migratory birds, and toxicological and habitat studies to determine why certain populations have declined. In addition, they hope to make significant contributions in areas receiving national and international attention: the functions and values of wetlands, biodiversity, ecosystem management, floodplain management, and restoration.

The current staff is dedicated to the investigation of the properties and functions of the Illinois and Mississippi rivers and the plants and animals associated with and dependent upon these wetlands. Their mission is to document the changes in those rivers, the reasons for those changes, and the results of those changes. Their most challenging aspiration is to restore a part of the Illinois Valley to some semblance of its pristine condition as one of the most remarkable, beautiful, and productive river systems in North America, and return to the river at least part of the floodplain that was taken from it.

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Economic Impact of the Illinois River on River Communities

David R. Allardice

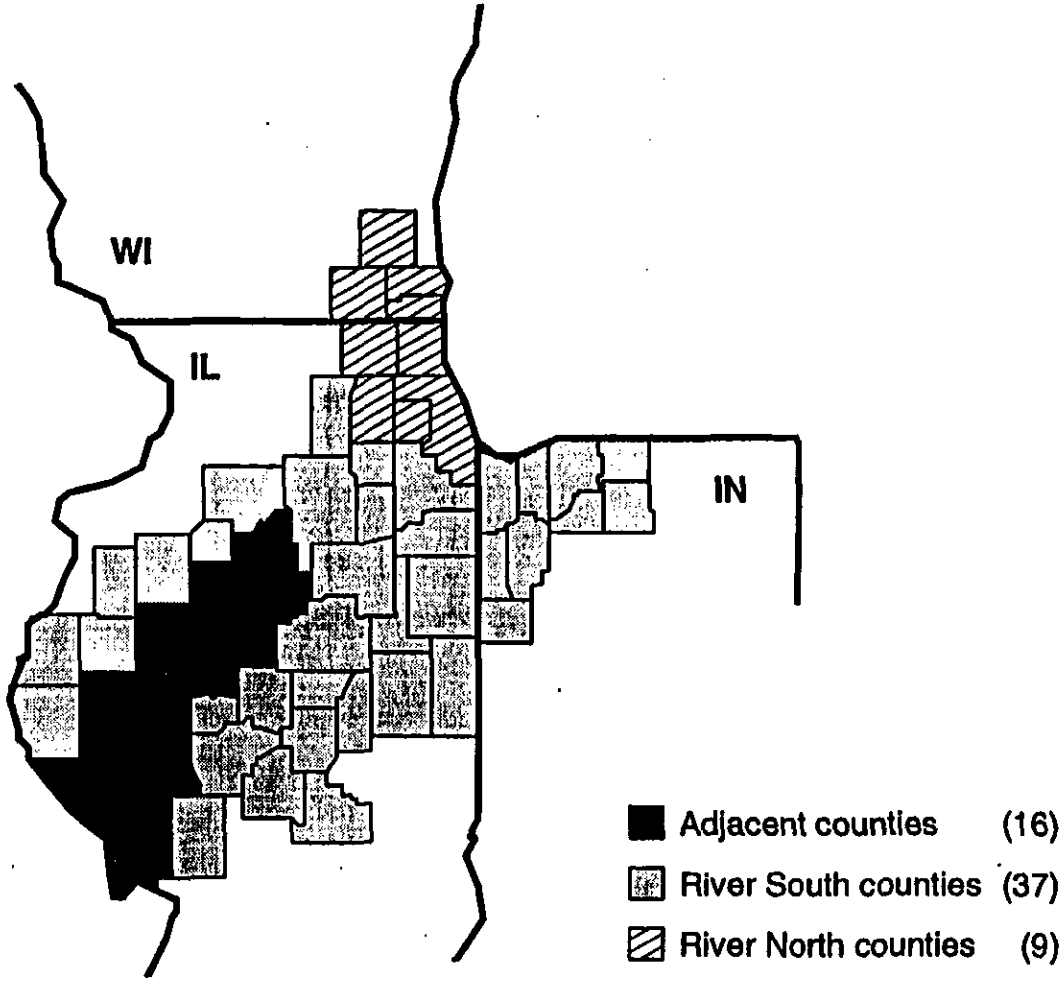
Federal Reserve Bank of Chicago-Detroit
160 West Fort Street, Detroit, MI 48226-3217

The text of Dr. Allardice's presentation is not available in written form. The outline of his presentation appears below, and the supporting figures and tables are reproduced on the following pages.

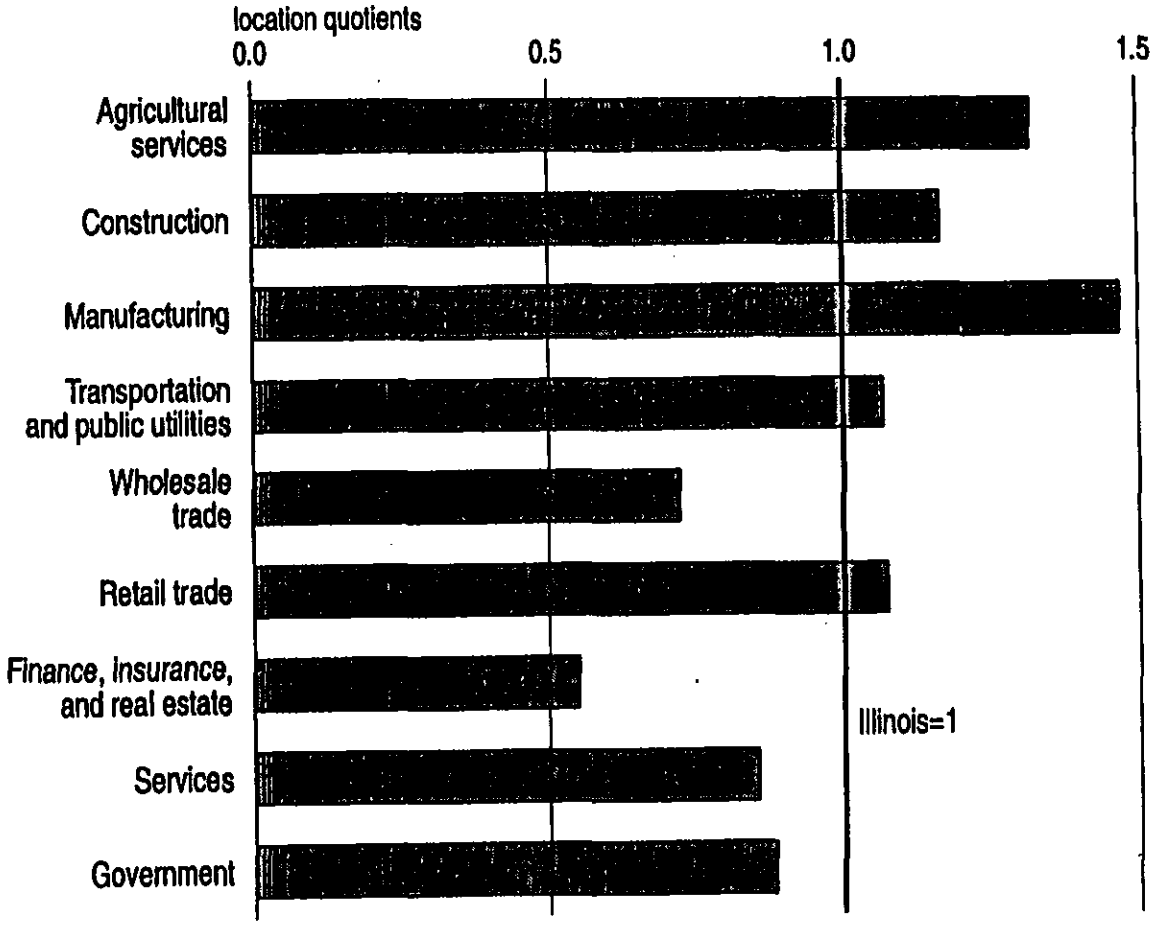
FACTORS SHAPING THE ILLINOIS RIVER COUNTIES ECONOMY

- DOMESTIC FACTORS
  - Economic restructuring
  - Demographic trends
  - Environmental policies
  - Infrastructure developments
  - Changes in agricultural policies
- INTERNATIONAL FACTORS
  - Changes in world markets
  - Growth in world population and food needs

The Illinois River drainage basin counties



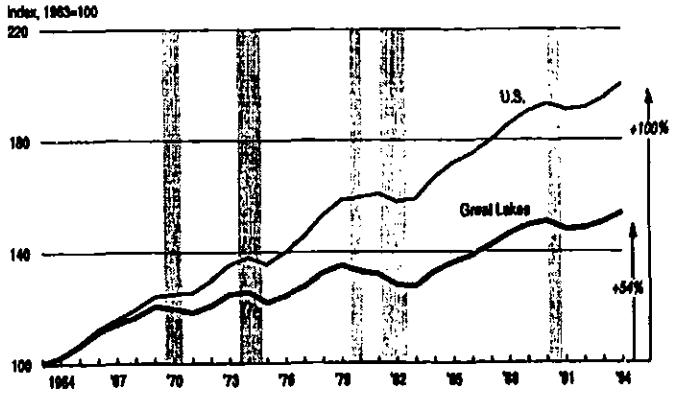
Adjacent river counties personal income by industry



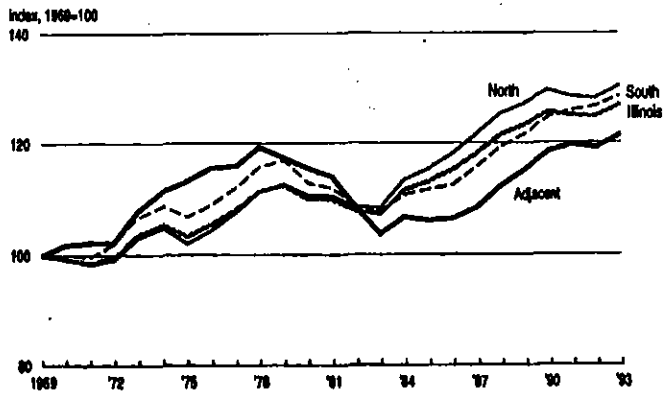
Total employment

Great lakes has undergone a structural change over the last 20 years.

Great Lakes and U.S.



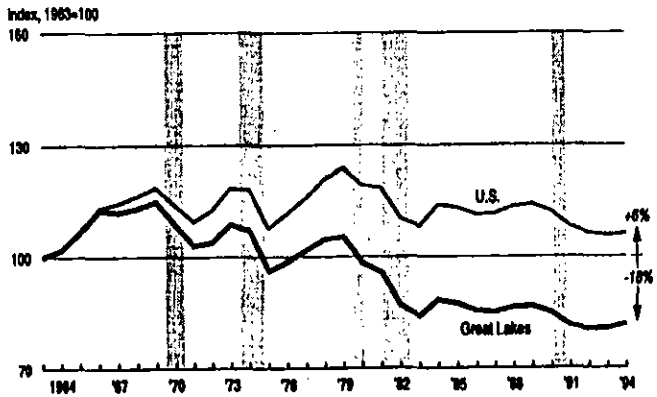
Illinois River counties



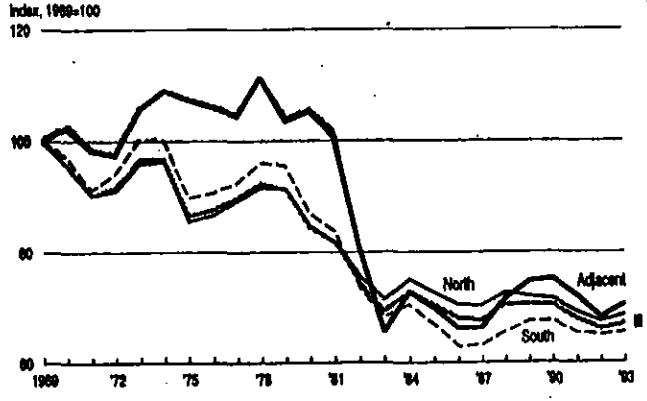
Manufacturing employment

Manufacturing employment has borne the brunt of structural change.

Great Lakes and U.S.



Illinois River counties



Employment growth in Illinois River counties

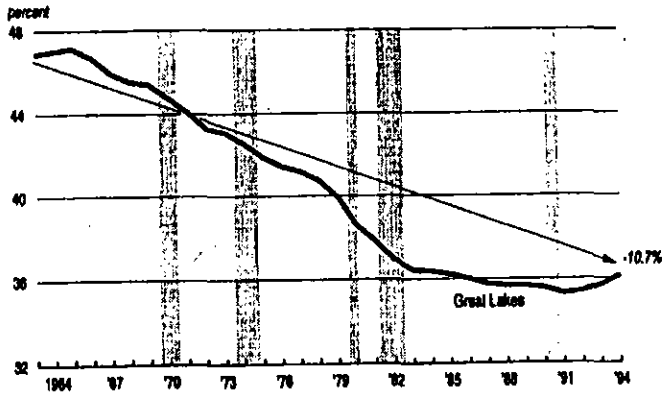
Rank	County	Employment Growth (1969-93)	Region # (1, 2, or 3)
1	DU PAGE	286.81	3
2	WAUKESHA	173.55	3
3	PORTER	123.79	2
4	MCHENRY	121.54	3
5	JASPER	91.20	2
6	LAKE	85.69	3
7	WALWORTH	81.71	3
8	MCLEAN	80.72	2
9	MARSHALL	79.57	2
10	GRUNDY	72.04	2
11	WOODFORD	64.55	1
12	DE WITT	61.39	2
13	KANE	59.72	3
14	WILL	56.59	2
15	BROWN	53.32	1
16	MACOUPIN	48.45	2
17	SANGAMON	48.10	2
18	KENDALL	43.53	2
19	MCDONOUGH	43.51	2
20	KENOSHA	42.41	3
21	STARKE	41.06	2
22	DE KALB	38.61	2
23	RACINE	38.57	3
24	SCOTT	36.19	1
25	JERSEY	35.93	1
26	ST. JOSEPH	35.31	2
27	CHAMPAIGN	34.06	2
28	SHELBY	33.46	2
29	MENARD	30.78	2
30	LIVINGSTON	29.80	2
31	NEWTON	27.84	2
32	BUREAU	27.21	2
33	KANKAKEE	25.75	2
34	PUTNAM	23.73	1
35	IROQUOIS	23.35	2
36	LA PORTE	22.83	2
37	TAZEWELL	22.41	1
38	PEORIA	21.93	1
39	CASS	21.58	1
40	CHRISTIAN	21.56	2
41	MARSHALL	19.16	1
42	MORGAN	17.39	1
43	HANCOCK	15.90	2
44	ADAMS	15.04	2
45	BENTON	15.03	2
46	LOGAN	15.02	2
47	SCHUYLER	11.98	1
48	WARREN	10.65	2
49	MASON	9.90	1
50	LA SALLE	9.55	2
51	MACON	9.09	2
52	CALHOUN	8.74	1
53	FULTON	8.21	1
54	COOK	6.79	3
55	STARK	6.58	2
56	KNOX	6.27	2
57	PIKE	5.09	1
58	FORD	1.40	2
59	GREENE	0.95	1
60	PIATT	-0.27	2
61	LAKE	-1.47	2
62	VERMILION	-4.83	2

COUNTY CODES: (1) Adjacent (2) River basin south (3) River basin north

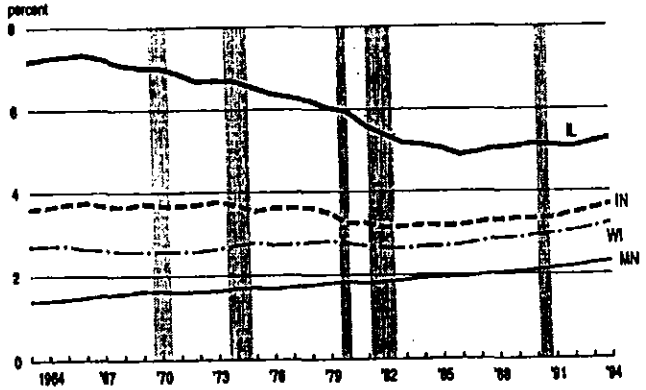
Share of U.S. manufacturing employment

Geographic redistribution of industries has been away from Great Lakes region.

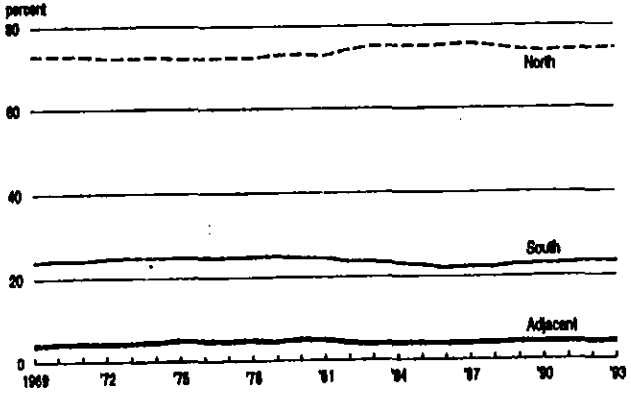
Great Lakes



Western Great Lakes



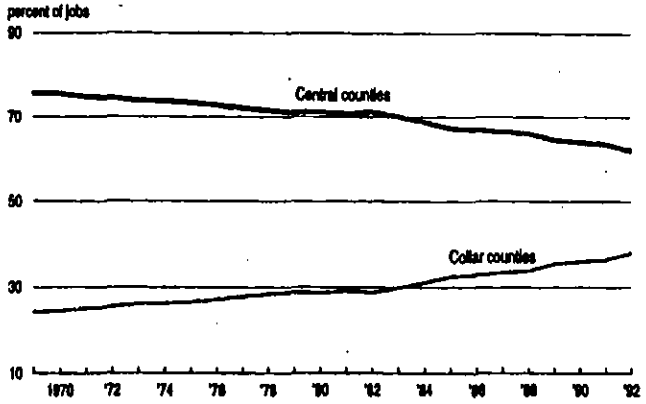
Illinois River counties



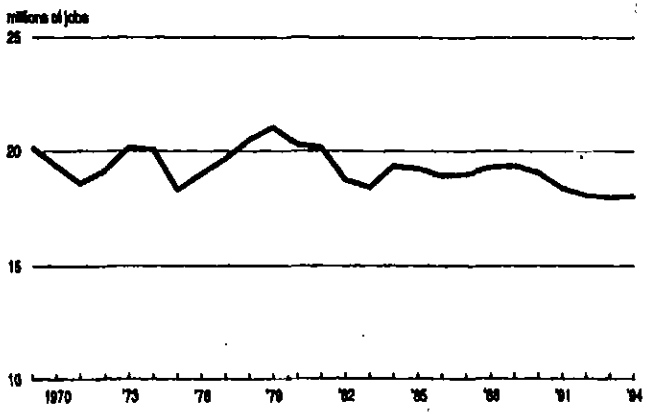
Manufacturing jobs in central and collar counties

Within metro areas of the Great Lakes, manufacturing jobs continue to suburbanize. Overall, the number of jobs in manufacturing has been stagnant. Many more of the jobs are white-collar or require higher education.

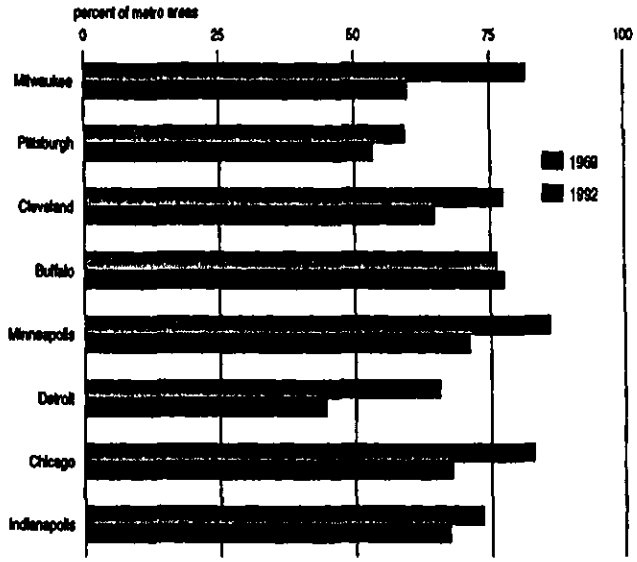
Share of total metro manufacturing jobs



Total U.S. manufacturing jobs

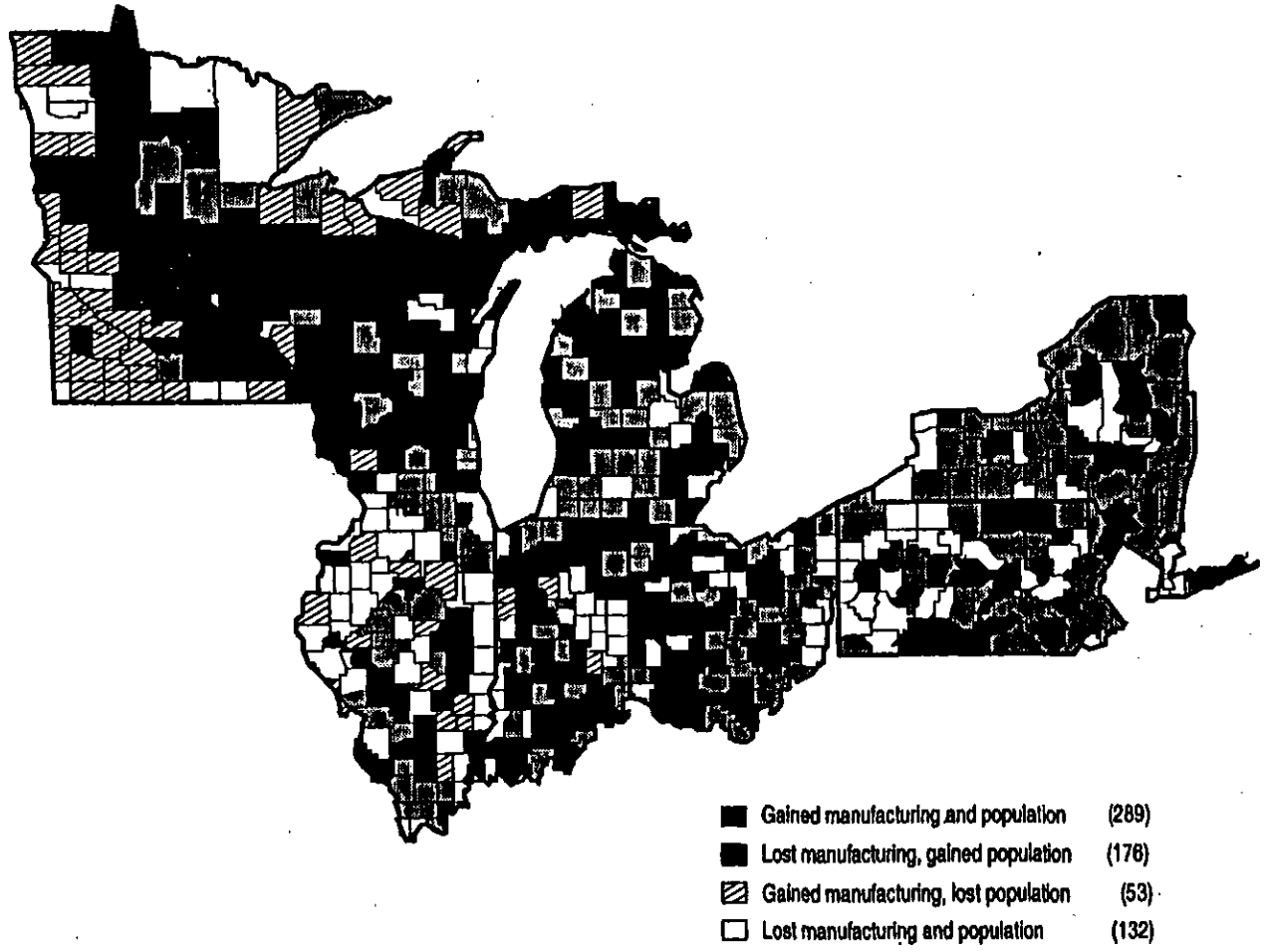


Central county share of manufacturing jobs

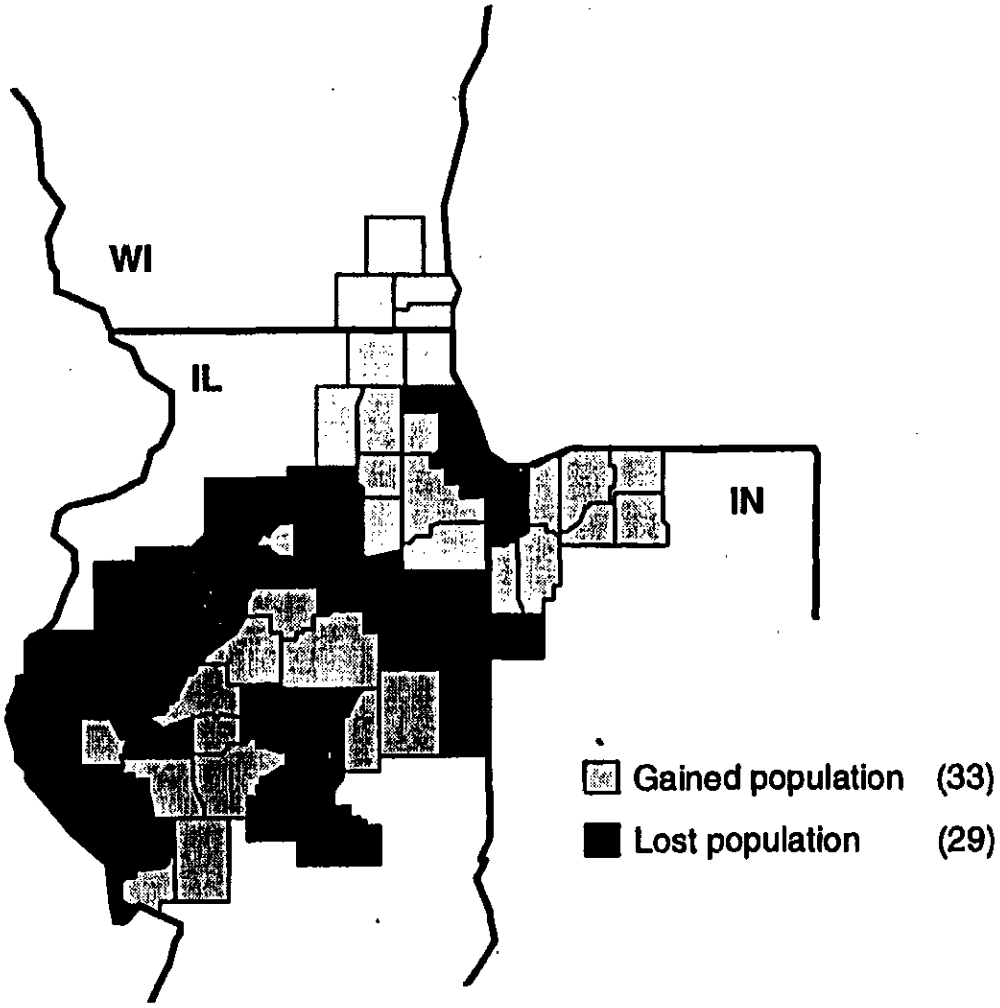


County patterns of employment and population growth—1969-93

Generalizations concerning the geography of manufacturing jobs do have some exceptions . . .in some instances, perhaps concerted public policy actions can make a difference.

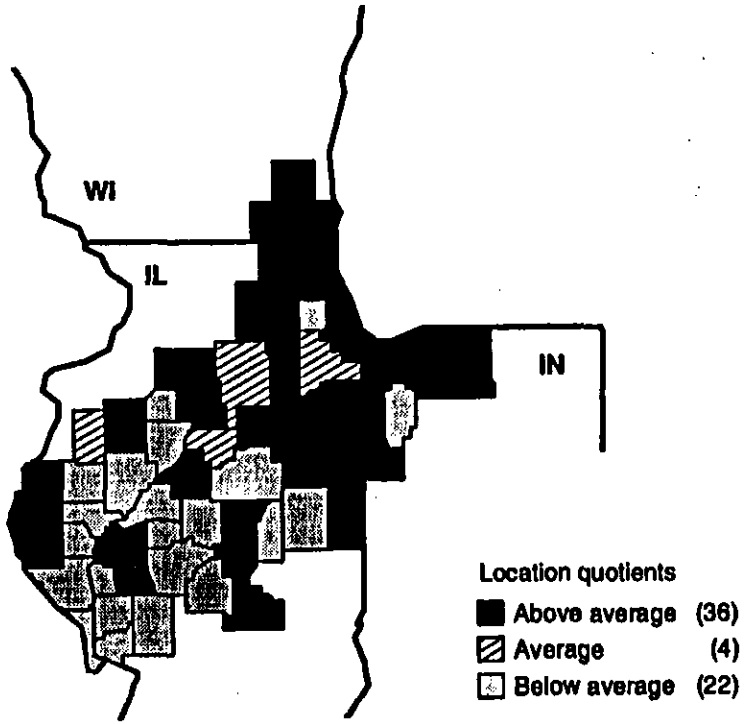


Illinois River counties population change, 1969-93

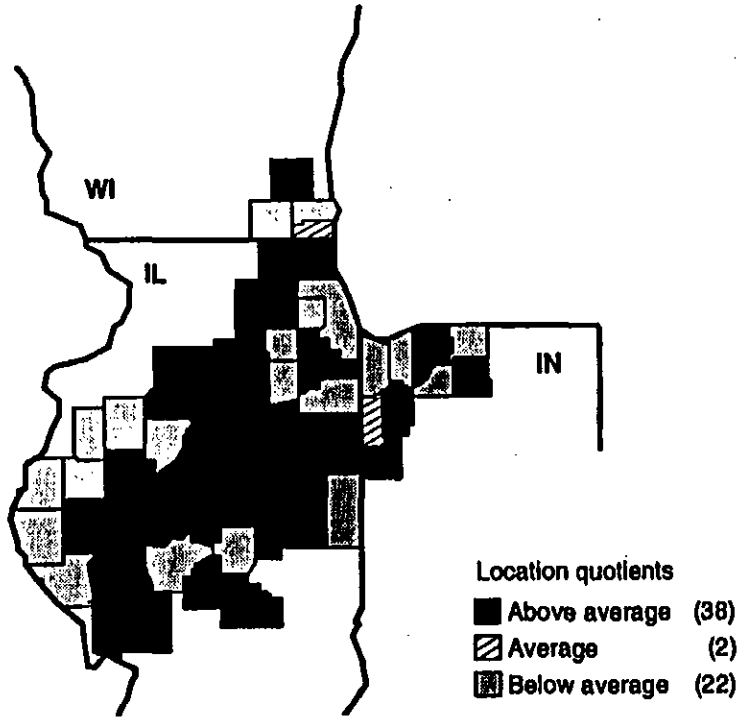


Employment concentration

Manufacturing

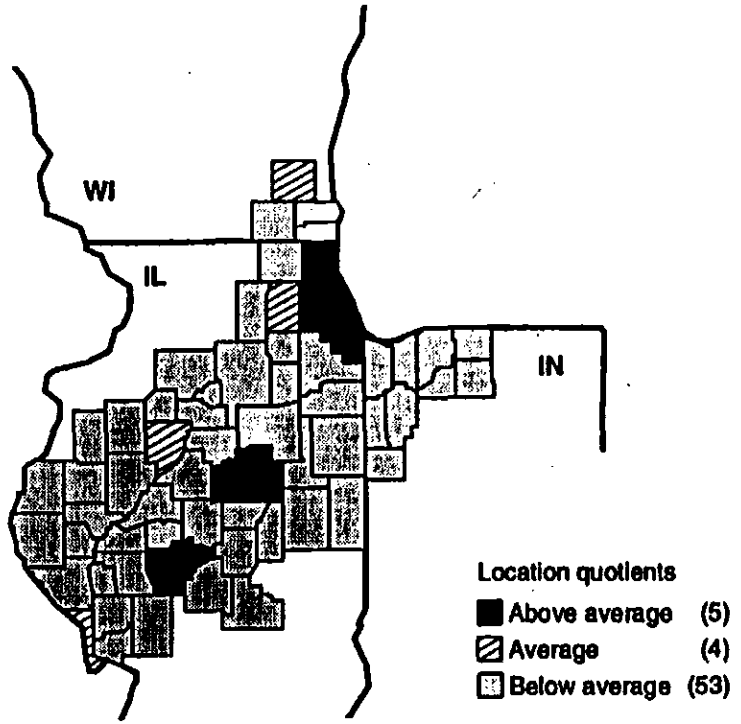


Agricultural services

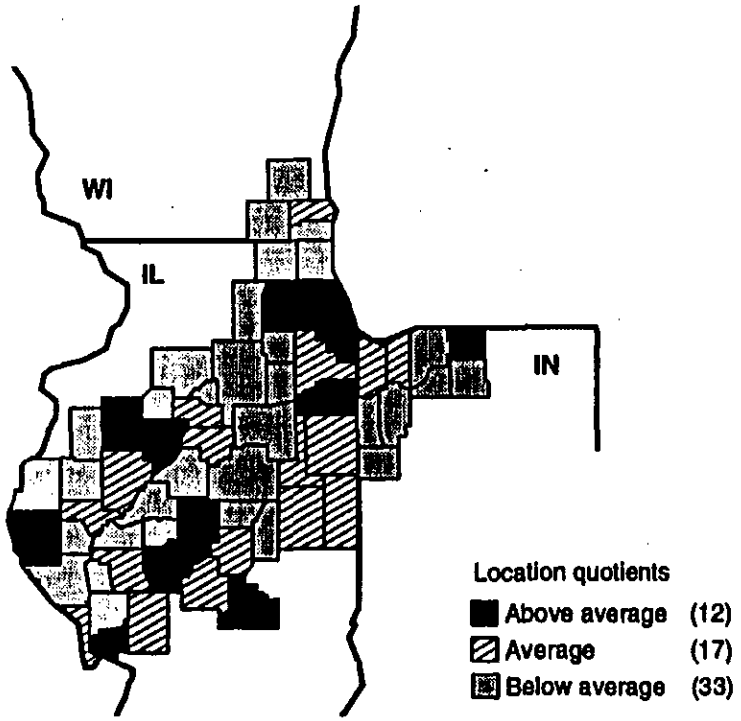


Employment concentration

Finance, insurance, and real estate

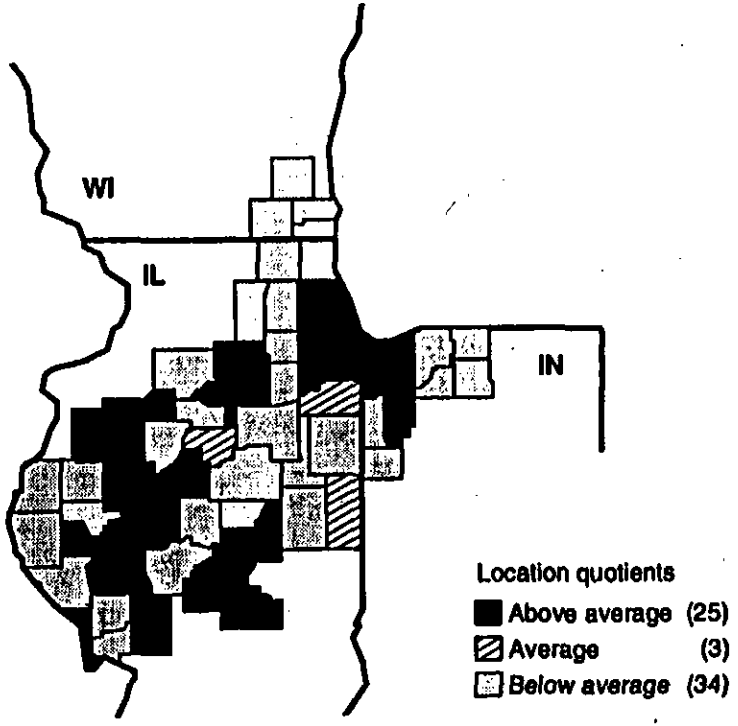


Service employment

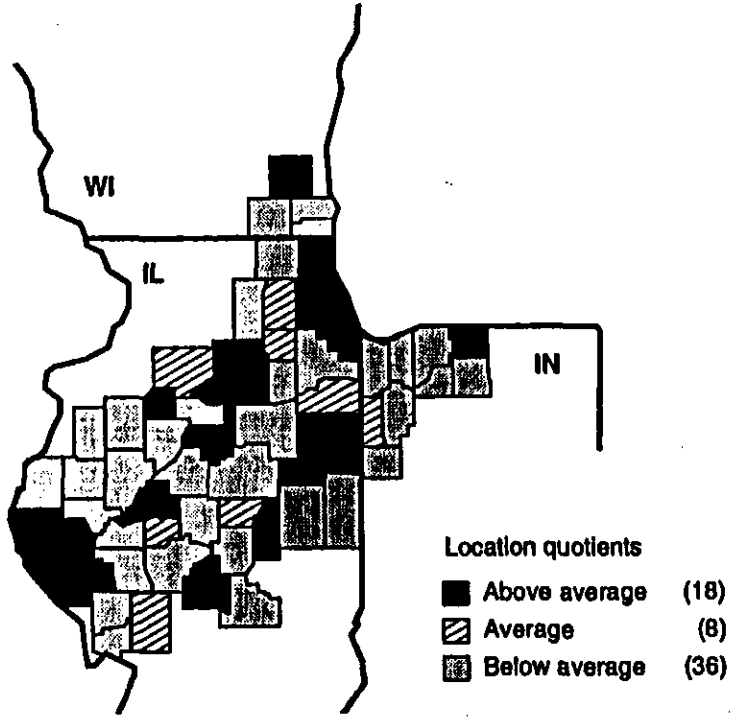


Employment concentration

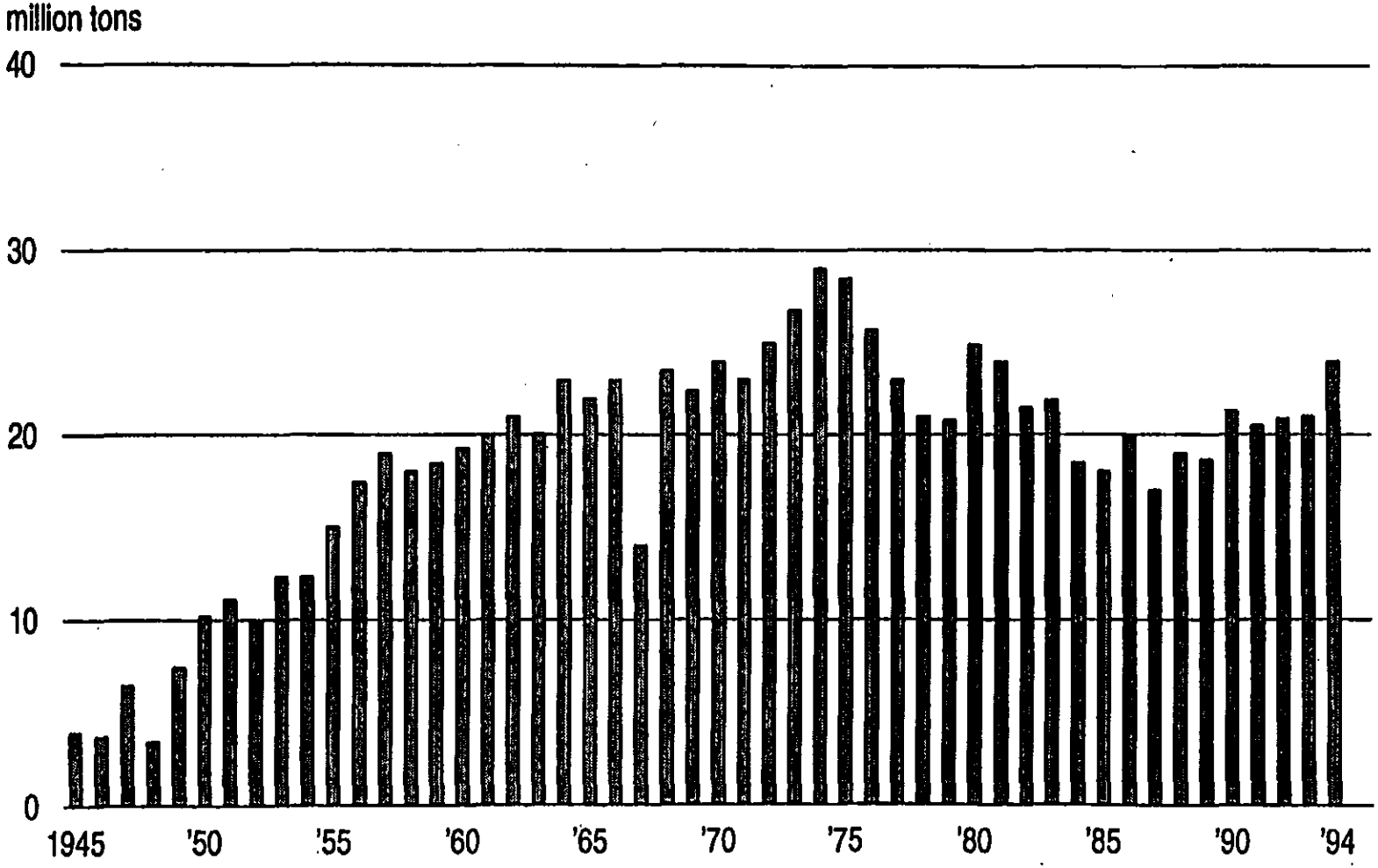
Transportation and public utilities



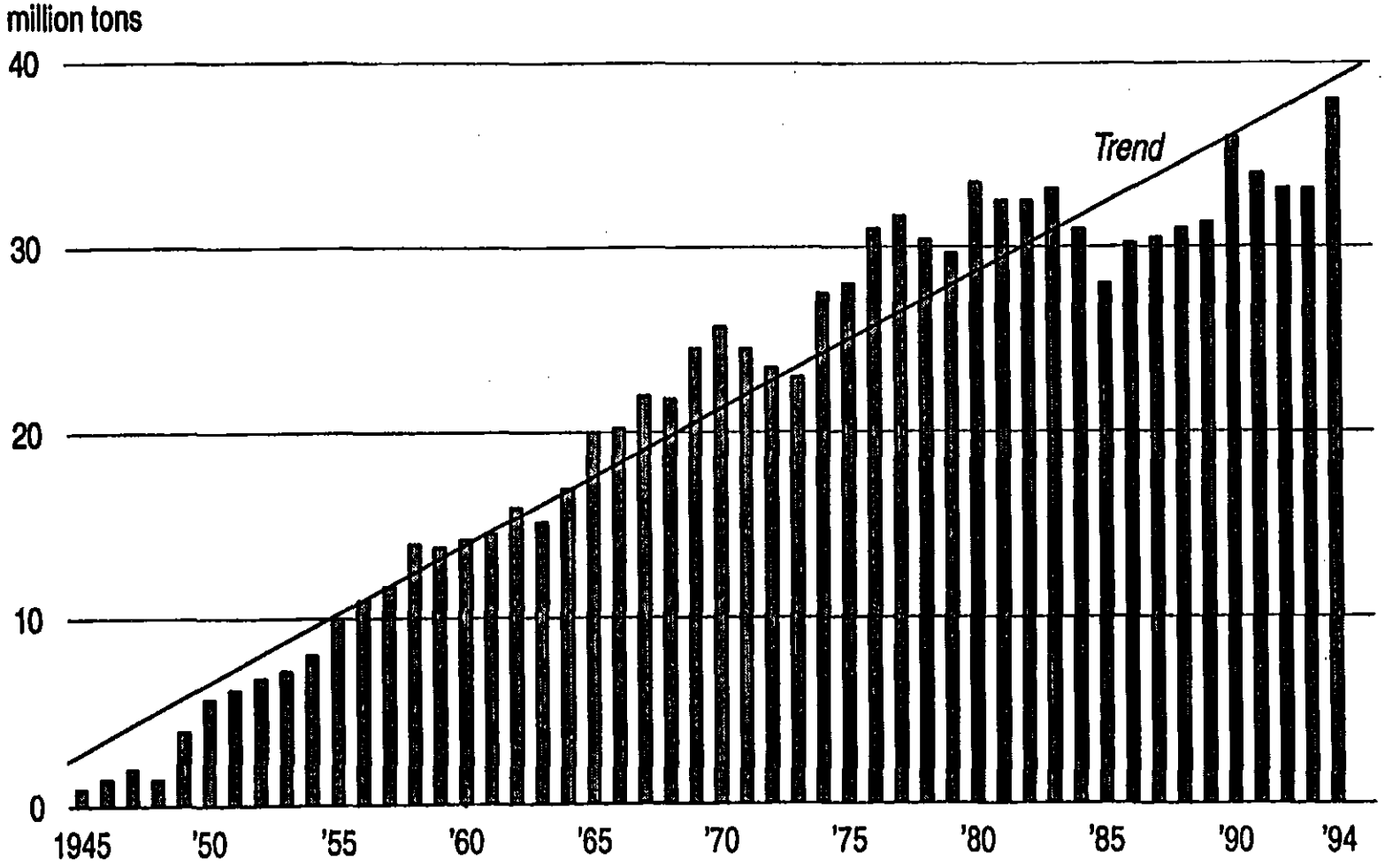
Wholesale trade



Illinois River traffic at Marseilles



Illinois River traffic at LaGrange



An "NRI Snapshot" of Resource Conditions In the Illinois River Drainage Basin

Robert McLeese, State Soil Scientist

USDA, Natural Resources Conservation Service
1902 Fox Drive, Champaign, Illinois 61820

INTRODUCTION

The National Resources Inventory (NRI) provides information on the status, condition, and trends of land, soil, water, and related resources on the nation's nonfederal land. (Alaska is excluded from the inventory.) The 1992 NRI is the fourth in a series of inventories conducted by the U.S. Department of Agricultures' Natural Resources Conservation Service (NRCS). The 1992 NRI provides a nationally consistent database that was constructed specifically to estimate 5- and 10-year trends from 1982 to 1992.

Data for the 1992 NRI were collected for more than 800,000 locations in the United States. The data are statistically reliable for national, regional, state, and substate analysis.

This paper presents national, state, and river basin results from the 1992 NRI for selected data elements. Included are statistics for land cover/use, prime farmland, erosion estimates, wetlands, and conservation treatment needs.

BACKGROUND

For 50 years, NRCS has conducted periodic inventories of the Nation's soil and water resources. The earliest efforts in the 1930's and 1940's were reconnaissance studies. The 1958 and 1967 Conservation Needs Inventories were the agency's first efforts to collect data nationally from scientifically selected sample field sites.

The Rural Development Act of 1972 authorized the National Resources Inventory activities within NRCS. It directs the Secretary of Agriculture to carry out a land inventory and monitoring program and to report on the condition of soil, water, and related resources at not less than 5-year intervals. NRI's were conducted in 1977, 1982, 1987, and 1992.

DATA COLLECTION

The 1992 NRI data collection effort in Illinois began in the fall of 1991 and concluded in the summer of 1993. Data was collected on 8300 primary sample units (PSU). Each PSU is a 160 acre quarter section and contains three points where information was gathered.

Most of the 1992 sample points were part of the 1982 inventory and were field-visited at that time. Only a portion were revisited in 1992. Remote sensing techniques were used to gather much of the data in 1992.

Many types of data are collected by the NRI process. They can be organized into ten general categories:

soil characteristics and interpretation
earth cover
land cover and use
erosion
land treatment
vegetative conditions
conservation treatment needs
extent of urban land
habitat diversity
cover maintained under CRP

THE ILLINOIS RIVER DRAINAGE BASIN

The major river basins of Illinois are:

Great Lakes (Lake Michigan)	78,000 acres
Wabash River	5.6 million acres
Ohio River	1.5 million acres
Mississippi River (direct tributaries)	5.9 million acres
Rock River	3.4 million acres
Upper Illinois River	4.3 million acres
Lower Illinois River	11.4 million acres
Kaskaskia River	3.7 million acres

Combined, the Upper Illinois and the Lower Illinois comprise >40% of the state's land area. While they are the focus of this paper, national and state data are also presented.

NRI SUMMARY

Who Owns The Land?

Federal land totaled 408 million acres in 1992 — 21% of the Nation's total (+1% from 1982).

520,000 acres of Illinois' 36,060,800 acres were owned by the U.S. Government in 1992 (+6% from 1982).

There are approximately 62,000 acres of federal land in the Illinois River Basin, representing only 0.4% of the basin's 15.7 million acres.

Where is Uncle Sam's Land?

88% of the federal land is in the 11 western states. Nevada has more federal land than any other state with 60 million acres (85% of the state). Illinois ranks 36th.

In Illinois, 50% of the federal land is in the Upper Mississippi's direct tributaries, Kaskaskia River and Big Muddy River Basins. Thirty percent is in the Ohio River Basin. Only 12% of the federal land in the state is in the Illinois River Basin.

What's Growing on the Land?

America's nonfederal land is about equally divided among cropland (26%), forest (27%), and rangeland (27%), with less amounts of pasture land (8%), and "other" land (12%). The category "other" land includes 92 million acres of urban and built-up land and also includes rural transportation, minor use areas (farmsteads, pits, quarries), CRP acreage, and small water areas.

Land use in Illinois:
- crop land 67% (24.1 million acres)
- forest land 9% (3.4 million acres)
- pasture land 8% (2.7 million acres)
- other land 16% (5.8 million acres which includes 3.1 million urban and built-up).

From 1982 to 1992 cropland acreage is down 628,000 acres (2.5%); urban and built-up acreage is up 240,000 acres (8%).

24.1 million acres of cropland ranks Illinois fifth nationally behind Texas, Kansas, Iowa, and North Dakota.

3.1 million acres of urban and built-up land ranks Illinois eighth nationally behind Texas, California, Florida, Michigan, Ohio, North Carolina, and Pennsylvania.

Land use in the Lower Illinois Basin in 1992:
- cropland 75% (8.5 million acres)
- forest land 8% (954,000 acres)
- pasture land 8% (920,000 acres)
- other land 9% (1.1 million acres which includes 594,000 acres urban and built-up).

From 1982 to 1992 cropland acreage is down 86,000 acres (1%), forest land up 4,000 acres, and pasture land down 72,000 acres. "Other" land acreage is up 153,000 acres.

Land use in the Upper Illinois Basin in 1992:
cropland 59% (2.5 million acres)
forest land 3% (134,000 acres)
pasture land 5% (199,000 acres)
other land 33% (1.4 million acres which includes 1.2 million acres urban and built-up).

From 1982 to 1992 cropland acreage is down 70,000 acres (3%), forest land down 27,000 acres, and pasture land down 39,000 acres. "Other" land acreage is up 136,000 acres.

Where is the Prime Farmland?

Prime farmland is rural land with the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oil seed crops, and is available for these uses.

The belt of four states extending from Ohio, Indiana, and Illinois, to Iowa are the only states in the Nation in which more than half of the rural land is prime farmland.

The 334 million acres of prime farmland in the U.S. in 1992 was down 6 million acres from 1982.

In Illinois 66% of the total rural land (21 million acres) is prime farmland (down 1% from 1982). Illinois ranks third behind Texas and Kansas. 89% of cropland is prime (ranks Illinois first).

In the Lower Illinois Basin 68% of the total rural land is prime farmland. Prime farmland acreage of 7.8 million acres was 30,000 acres less than in 1982.

In the Upper Illinois Basin, 56% of the total rural land is prime farmland. Prime farmland acreage of 2.4 million acres was 98,000 acres less than in 1982.

Where is Irrigated Cropland?

More than 62 million acres of U.S. cropland — 16% of the total — were irrigated in 1992. (Less than a 1% increase from 1982). Eighty-five percent of that is west of the Mississippi River. Texas, California, and Nebraska lead the Nation.

202,000 acres were irrigated in 1992 in Illinois, a 15% increase from 1982.

In the Lower Illinois Basin there were 108,000 acres of irrigated cropland in 1992, a 32% increase from 1982.

In the Upper Illinois Basin there were 81,0000 acres of irrigated cropland in 1992, a 2% increase from 1982.

Water Erosion on the Slide

Erosion rate by water on U.S. cropland has been reduced by 24% in the last 10 years. The average annual sheet and rill erosion rate declined from 4.1 tons/acre in 1982 to 3.1 tons/acre in 1992.

Erosion on Illinois cropland was reduced by 31% from 1982 to 1992, dropping from 6.3 tons/acre to 4.3 tons/acre.

In the Lower Illinois Basin the erosion rate dropped from 6.1 tons/acre to 4.1 tons/acre in the 10-year period 1982-92.

In the Upper Illinois Basin the erosion rate dropped from 4.4 tons/acre in 1982 to 3.1 tons/acre in 1992.

Soil Loss — More Work Needed

In 1992, 2.1 billion tons of U.S. cropland soil was lost to erosion, compared to 3.1 billion tons in 1982.

Forty-five percent of cropland erosion occurred in six states, Texas, Minnesota, Iowa, Montana, Kansas, and Illinois.

In Illinois, in 1992, 103 million tons were lost. 156 million tons were lost in 1982.

Thirty-five million tons of soil were lost from the Lower Illinois River Basin's cropland in 1992, down 17 million tons from 1982.

In the Upper Illinois River Basin, 8 million tons of soil were lost in 1992, down 3 million tons from 1982.

In 1982, 14.7 million acres of Illinois cropland were eroding at less than T. That acreage increased to 17.7 million acres in 1992, leaving 6.4 million acres of cropland with an erosion rate greater than T.

Conservation Practices

Conservation tillage systems were used on about 48% (11.1 million acres) of Illinois' cropland in 1992, compared to 33% of the 1982 cropland.

2.9 million acres in the Lower Illinois and 1.3 million acres in the Upper Illinois were in a conservation tillage system. This is a 50% increase in the Lower Illinois and a 20% increase in the Upper Illinois since 1982.

The acreage of other conservation practices (diversions, filter strips, grade stabilization, grassed water ways, and woodland improvement) in the Upper and Lower Illinois River Basins has also increased since 1982.

Conservation Treatment Needs

Erosion control is still needed on 1.4 million acres of cropland in the Upper Illinois and on 2.7 million acres in the Lower Illinois.

73,000 acres of cropland need drainage improvement in the Lower Illinois, while 257,000 acres in the Upper Illinois need some drainage work.

CRP Benefits

Illinois has approximately 822,000 acres enrolled in the Conservation Reserve Program (CRP) through the 12th sign-up. Some of the soil loss reduction in Illinois and across the country can be attributed in part to this program.

Through the 11th sign-up about 101,000 acres and 8,500 acres were enrolled in CRP in the Lower and Upper Illinois River Basins, respectively.

Grasses and legumes accounted for more than 90% of the contracted practices. Small acreages were contracted for trees and wildlife.

Agriculture Wetland Loss is Down

Wetland losses due to agriculture continued during the 1980's but at a much slower rate than in previous years.

Wetland losses in the U.S. during the 1982-92 period were about 31,000 acres per year — about one-fifth the annual loss estimated by Fish and Wildlife Service for the period 1974-83 and less than 10% of the losses estimated for 1954-74.

The rate that Illinois is losing wetlands is also on the decline. While the 1992 NRI results do indicate a loss of wetlands, the amount and rate is less than what was expected. Wetland acreage decreased 33,400 acres from 1982 to 1992. There are about 1.9 million acres of wetland in Illinois.

The Lower Illinois River Basin saw a 12,000 acre decrease to 478,000 acres.

The Upper Illinois River Basin saw a 9,000 acre decrease to 298,000 acres.

TRENDS IN THE TRENDS

Cropland acreage is decreasing while urban and built-up acreage is increasing.

Prime farm land acreage is decreasing.

Irrigated cropland acreage is increasing.

Water erosion is on the slide.

More and more cropland is eroding at less than T.

Use of conservation tillage systems and other conservation practices is on the rise.

CRP is responsible for significant soil loss reductions.

While the soil loss rate in the Illinois River Basin is less than the state average, more work is needed.

The rate of wetland loss is on the decline.

Illinois T by 2000 Transect Survey, 1995 Results

Chet Boruff

Illinois Department of Agriculture
Division of Natural Resource and Agricultural Industry Regulation
State Fairgrounds, Springfield, IL 62794-9281

In the early 1980's, Illinois set for itself the goal of achieving T by 2000. "T" is the factor representing tolerable soil loss in the universal soil loss equation. The T factor, which may vary with individual soil types, represents the level at which soil erosion can occur and be replaced by natural soil-building processes. The goal of achieving T by the year 2000 is a recognition that in order to maintain long term productivity and to alleviate soil sedimentation problems, valuable Illinois topsoil needs to be held in place. Over the past decade, a strong soil and water conservation partnership, including the Illinois Department of Agriculture, USDA Natural Resource Conservation Service (Soil Conservation Service), local soil and water conservation districts, and many other partners, have worked to achieve this important goal. Good progress towards achieving T by 2000 has been made, thanks to strong promotional efforts, conservation compliance provisions of the USDA farm program, improved farm equipment and pesticides, and producer recognition that topsoil is a valuable resource.

Progress towards achieving T by 2000 has been measured by making use of periodic inventories by USDA called Natural Resource Inventories (NRI). NRIs, conducted every five years, have shown Illinois to be making steady progress in achieving T by 2000. However, the data collected is only significant at the state level.

The Illinois Department of Agriculture (IDOA) recognized the need to be able to accurately assess T by 2000 progress on a county-by-county basis, and in 1993, formed a team made up of various conservation partners to develop a method for gathering soil loss data at the county level. This team developed a method now called the T by 2000 Transect Survey. The Transect Survey was conducted statewide in 1994 and 1995 and has proven to be an accurate and cost-effective method of gaining this important information.

Local soil and water conservation district staff members take the initiative in developing and beginning the transect process. A predetermined route is mapped out criss-crossing the county, or transecting the county, in a uniform and orderly manner. Along this route, a survey team stops at ½-mile intervals to observe and record data from farm fields on both sides of the road which would be used in determining the T value at that particular site. Factors such as slope, residue, planting techniques, and crop, are recorded on computer entry sheets and other pertinent factors are noted as well. Typically, in each county the team will record data from 450-550 fields. Statewide, the database for the Transect Survey includes over 54,000 data points. In subsequent years, the team will travel the same route and stop at the same data points. Over a period of time,

the survey will allow county conservation partners to assess trends using this statistically accurate data. Statewide, IDOA has used the transect data to determine what areas of the state are close to achieving T by 2000 and which others may need additional resources to achieve the goal. The State of Illinois has taken a leadership role in developing and using the Transect Survey for statewide use, and recently received national recognition for the development of this program.

The T by 2000 Transect Survey has proven to be very successful and has given numerous benefits to local soil and water conservation districts and conservation policymakers. By using transect data, the Illinois Department of Agriculture has been able to pinpoint financial resources available through Conservation 2000 to those areas of most need. It also allows the department to make estimates on future financial needs to achieve the goal of T by 2000. Locally, soil and water conservation district board members and staff have been able to develop programs tailored specifically for local needs and conditions. In most cases, data collection is done by a transect team of three to five people, and in many cases, local farm organization leaders, NRCS personnel, Cooperative Extension representatives, farm broadcasters, and others have assisted SWCD board members and staff in data collection. As a result, this activity has strengthened partnerships at the local level and allowed for increased awareness and communication in soil and water conservation programs.

Transect survey data from 1994 and 1995 shows that Illinois is making steady progress in achieving T by 2000. The following table will show the progress Illinois has made towards achieving its goal. In 1994, 74% of the state's farmland was at "T" and in 1995, 77% had reached this level. Another key factor to note is the amount of farmland at soil loss levels only 1-2 tons per acre over "T". With minor adjustments in residue management, crop rotation, or planting techniques, this next increment could quickly be brought to "T". In 1994, 12% of Illinois crop acres were at this next level and in 1995, it was 11%. The transect survey also gives us data regarding tillage techniques or the adaptation of no-till planting. The use of no-till to plant Illinois soybeans has shown steady increases and contributes greatly to the reduction of soil erosion. No-till corn has shown increases but not to the same degree. In 1995, wet soil conditions may have caused some corn producers to use some type of tillage rather than planting no-till. For the first time, the transect data allows soil conservation technicians the ability to assess trends in tillage and residue management and pinpoint local recommendations based on this annual data.

Percent of Acres Planted No-Till
(Statewide)

Crop	1994	1995
Soybeans	29%	33%
Corn	20%	17%

Transect data shows that statewide trends are mirrored in the counties representing the Illinois River Basin. Steady progress has been made toward reducing and preventing soil runoff from agricultural fields which may contribute to sedimentation to the Illinois River and its tributaries. The data has also allowed policymakers to pinpoint those areas in the basin where financial resources can be best spent.

The survey is scheduled to be repeated in the spring of 1996 in an effort to continue to track Illinois' progress toward the goal of reaching T by 2000. The process has been refined as ways to improve the data collection are identified. It is very likely that the data collection process can be automated by use of laptop computers, GPS, and GIS as hardware and software becomes affordable and available. The data which has been collected is available to other agencies and projects dealing with natural resource programs where this site-specific data could be used. As an example, data points included within a multi-county watershed program could identify areas of specific need and chart progress of watershed planning efforts.

No-Till in the Illinois River Watershed

Robert W. Frazee

University of Illinois Cooperative Extension Service
East Peoria Extension Center, 727 Sabrina Drive, East Peoria, IL 61611

No-till farming is a rapidly expanding practice throughout the Illinois River Watershed. The Conservation Technology Information Center (CTIC) defines no-till as being "a tillage system where the soil is left undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disc openers, in-row chisels or roto-tillers".

The quality of the Illinois River and its associated watershed has benefited greatly from the adoption of no-till farming practices by farmers and landowners. Research and field applications have shown that no-till can provide significant economic advantages to farmers while at the same time enhance the quality of the natural resources of the watershed. All of our earth's natural resources, including the soil, water, plants, animals, and the air, can benefit directly from the adoption of no-till farming practices.

Significant natural resource benefits attributed directly to no-till farming include: major reduction in soil erosion; increased water infiltration/reduced water runoff and resulting sedimentation; moisture conservation during drought periods; enhanced habitat and wildlife populations; high yield potential from all major crops; improved soil quality as it relates to higher organic matter content, improved soil texture, and better microbiological populations; and improved air quality due to reduction of the concentration of CO_2 in the atmosphere. Research has also documented that these benefits are cumulative in nature when no-till farming is practiced on a long-term, continuous basis.

There are twenty-two counties in the State of Illinois that directly border the Illinois River as it stretches from Alton, IL to Lake Michigan. These counties include Calhoun, Jersey, Greene, Pike, Scott, Morgan, Brown, Cass, Schuyler, Mason, Fulton, Tazewell, Peoria, Woodford, Marshall, Putnam, Bureau, LaSalle, Grundy, Will, Cook, and DuPage (Figure 1). There are actually portions of fifty-five counties that are included in the entire Illinois River Watershed. However, since tillage data is only collected on a county-wide basis and not on an individual farm basis, it is not possible at this time to include only land that drains directly into the Illinois River Basin and not into other watersheds. Also, land that is closer to a river or stream may actually contribute greater sediment loads from soil erosion. This greater sediment loading is often due to the fact that a significant portion of the land immediately adjacent to the Illinois River is comprised of steeper sloping, bluff land with higher soil erosion rates. Also, shorter distances for sediment transport are involved. Consequently, for comparative purposes for this paper, I will be referring to the land that comprises the twenty-two counties immediately adjacent

to the Illinois River as the Illinois River Watershed. For the remainder of this paper, I will be showing the trends that have occurred over the past ten years relative to the adoption of no-till farming practices by farmers in the Illinois River Watershed.

During the past ten years, corn has been the leading agricultural crop produced in the Illinois River Watershed, as well as the state as a whole. However in the early 1980's, no-till was in the experimental/demonstration phase of adoption and was just beginning to be used by farmers (Table 1). In 1984, only 5% of the corn acres in the Illinois River Watershed were planted by no-till methods (approximately 117,000 acres). No-till corn acres expanded to 11% in 1989 (approximately 238,000 acres), and to 19% on approximately 424,000 acres by 1994. The adoption of no-till by corn farmers in the Illinois River Watershed has proceeded at a pace similar to that which has occurred throughout the entire state during this period of time.

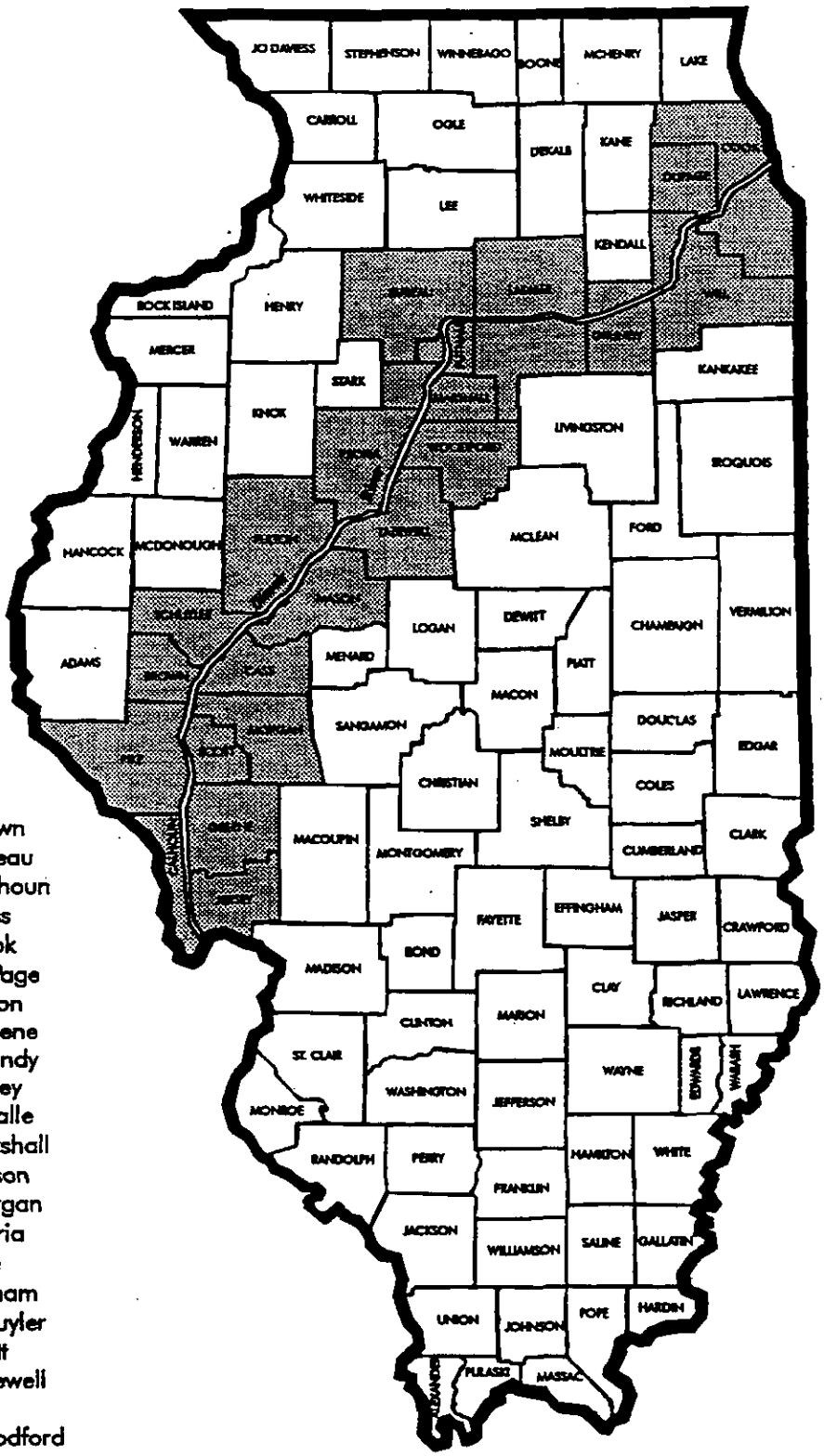
Soybeans are the second largest cash crop for farmers in the Illinois River Watershed as well as in the state. Historically, farmers were reluctant to plant their soybean fields to no-till due to difficulties in being able to get good weed control and to be able to achieve a good stand. This changed drastically when agri-business infused new technology into the marketplace by developing herbicides and drills/planters designed specifically for no-till soybeans. With the availability of this new technology, farmers soon found it to be easier to plant no-till soybeans than no-till corn (Table 2). In 1984 only 2% of the Illinois River Basin's soybeans were planted using no-till methods (approximately 40,000 acres). By 1989, 139,000 acres of no-till soybeans were being planted in the Illinois River Basin, comprising 8% of the planted acres. However during the next five years, as farmers quickly adopted new no-till soybean technology, no-till soybean acreage in the Illinois River Watershed mushroomed to over 635,000 acres. By 1994, over 37% of the watershed's soybeans were planted utilizing no-till methods, which surpassed the state's average of 29%. This is extremely rapid adoption of a new agricultural practice by farmers in a very short period of time!

Although corn and full-season soybeans are the two predominant crops grown in both the Illinois River Basin and in the state, there are also several other crops grown with significant acreage. These include winter wheat, oats, grain sorghum, forages, and double-crop soybeans. No-till farming methods have been adopted for use with these crops as well, although their total acreages are substantially smaller. Collectively, the acreages of corn, soybeans, and these crops comprise the category of "All Cropland" as reported in Table 3. In 1984, 5% of all the cropland in the Illinois River Watershed was planted using no-till methods on approximately 219,000 acres. This grew to 10% of the cropland acreage in 1989. By 1994, the use and adoption of no-till had snow-balled by farmers in the watershed to encompass over 1,163,000 acres or more than 27% of the planted crop acreage.

During the First Conference on the Management of the Illinois River System held in 1987, soil erosion and sedimentation were identified as the number one problem impacting the Illinois River System. Statistics compiled by the CTIC report that no-till farming in the Illinois River Watershed has grown from approximately 5% of the basin's total cropland acreage in 1984 to over 27% in 1994. These statistics are very encouraging as they indicate that farmers in the

Illinois River Watershed are currently applying no-till farming practices to a significant number of their cropland acres and at a pace slightly ahead of the state average. According to a survey conducted in 1994, approximately one-third of Illinois farmers were utilizing no-till as a part of their farming operation. By the year 2000, it is projected that over 50% of the total Illinois cropland acreage will be planted utilizing no-till farming methods. This scenario imparts tremendous "Good News!" to everyone interested in using, protecting, and preserving the quality of the Illinois River and its watershed for the future.

In conclusion, I feel no-till farming is a win-win situation for the farmer and landowner, as well as for the quality of the natural resources throughout the Illinois River Watershed. Farmers and landowners benefit through improved productivity and profitability accompanying an enhanced soil resource for the long-term. Society benefits from no-till farming because the end result extends the life, quality, and diversity of the Illinois River and its associated watershed.



1. Brown
2. Bureau
3. Calhoun
4. Cass
5. Cook
6. DuPage
7. Fulton
8. Greene
9. Grundy
10. Jersey
11. LaSalle
12. Marshall
13. Mason
14. Morgan
15. Peoria
16. Pike
17. Putnam
18. Schuyler
19. Scott
20. Tazewell
21. Will
22. Woodford

Figure 1. The twenty-two counties immediately adjacent to the Illinois River.

TABLE 1. Summary of Corn Acres for 1984, 1989, and 1994: How Much No-Till?

County	Total 1984 Corn Acres	Total 1984 NoTill Acres	Percent NoTill	Total 1989 Corn Acres	Total 1989 NoTill Acres	Percent NoTill	Total 1994 Corn Acres	Total 1994 NoTill Acres	Percent NoTill
Brown	33,000	1,500	5%	35,000	7,000	20%	38,339	15,154	40%
Bureau	290,000	6,000	2%	250,000	35,000	14%	263,000	60,500	23%
Calhoun	20,000	1,000	5%	18,250	1,825	10%	18,366	3,673	20%
Cass	83,000	6,000	7%	72,000	10,000	14%	74,686	34,355	46%
Cook	36,440	1,300	4%	16,000	1,500	9%	6,505	1,084	17%
DuPage	20,000	1,600	8%	9,000	900	10%	6,700	1,300	19%
Fulton	137,000	3,000	2%	110,000	4,000	4%	150,000	27,000	18%
Greene	94,000	19,250	20%	90,000	7,000	8%	100,067	15,580	16%
Grundy	114,000	1,680	1%	82,372	16,500	20%	110,355	24,278	22%
Jersey	39,800	3,000	8%	49,700	10,500	21%	50,560	13,146	26%
LaSalle	317,600	7,579	2%	290,000	7,845	3%	280,356	39,643	14%
Marshall	95,057	10,000	11%	90,000	9,900	11%	92,822	9,100	10%
Mason	100,000	7,200	7%	105,000	17,500	17%	116,184	29,046	25%
Morgan	120,000	10,500	9%	117,000	24,000	21%	125,000	25,000	20%
Peoria	124,184	3,200	3%	110,000	12,000	11%	108,875	28,307	26%
Pike	124,860	12,000	10%	120,000	20,000	17%	117,639	17,595	15%
Putnam	40,000	4,000	10%	35,510	3,906	11%	38,547	7,343	19%
Schuyler	58,700	1,000	2%	47,515	7,500	16%	59,858	11,398	19%
Scott	40,200	2,500	6%	46,854	9,500	20%	48,755	8,300	17%
Tazewell	172,800	4,000	2%	144,800	5,500	4%	150,678	25,615	17%
Will	156,100	9,000	6%	145,000	19,000	13%	129,440	19,418	15%
Woodford	150,000	1,800	1%	135,560	7,200	5%	130,960	7,857	6%
IL. River Watershed	2,366,741	117,109	5%	2,119,361	238,076	11%	2,217,692	424,692	19%
Entire State Total	11,206,272	711,809	6%	10,477,740	897,414	9%	11,188,418	2,077,214	19%

* Data obtained from Conservation Technology Information Center (CTIC) , West Lafayette, IN

TABLE 2. Summary of Soybean Acres for 1984, 1989, and 1994: How Much No-Till?

County	Total 1984 Soybean Acres	Total 1984 NotIll Acres	Percent NotIll	Total 1989 Soybean Acres	Total 1989 NotIll Acres	Percent NotIll	Total 1994 Soybean Acres	Total 1994 NotIll Acres	Percent NotIll
Brown	33,000	500	2%	35,000	10,500	30%	40,298	29,605	73%
Bureau	130,000	1,000	1%	150,000	18,000	12%	151,500	65,100	43%
Calhoun	9,000	1,000	11%	11,000	220	2%	13,230	2,646	20%
Cass	70,000	1,000	1%	71,000	10,000	14%	63,324	34,195	54%
Cook	28,495	200	1%	14,000	1,500	11%	6,363	1,591	25%
DuPage	18,800	300	2%	6,000	500	8%	4,100	1,300	32%
Fulton	101,000	400	0%	100,000	4,000	4%	130,000	55,900	43%
Greene	91,000	9,900	11%	91,000	6,500	7%	76,105	21,855	29%
Grundy	83,000	48	0%	116,604	11,000	9%	90,921	38,187	42%
Jersey	60,000	400	1%	50,200	4,000	8%	43,476	17,825	41%
LaSalle	227,000	1,604	1%	222,400	13,000	6%	219,103	63,000	29%
Marshall	63,000	100	0%	68,000	3,000	4%	74,414	26,263	35%
Mason	100,000	1,500	2%	95,000	500	1%	96,850	48,425	50%
Morgan	124,000	0	0%	114,000	24,000	21%	123,000	47,970	39%
Peoria	68,607	450	1%	67,500	3,000	4%	84,639	34,804	41%
Pike	107,000	20,000	19%	115,000	2,300	2%	92,663	21,948	24%
Putnam	24,300	80	0%	26,800	1,072	4%	27,163	6,924	25%
Schuyler	56,700	150	0%	52,000	7,800	15%	58,488	18,118	31%
Scott	38,653	300	1%	49,000	3,000	6%	40,268	14,500	36%
Tazewell	101,000	400	0%	117,800	6,800	6%	113,743	31,985	28%
Will	140,000	800	1%	127,000	4,500	4%	75,702	22,712	30%
Woodford	100,000	80	0%	105,520	4,800	5%	115,328	31,138	27%
IL. River Watershed	**1,774,555**	**40,212**	**2%**	**1,804,824**	**139,992**	**8%**	**1,740,678**	**635,991**	**37%**
Entire State Total	8,892,399	185,198	2%	8,938,033	469,761	5%	9,186,856	2,658,363	29%

* Data obtained from Conservation Technology Information Center (CTIC), West Lafayette, IN

TABLE 3. Summary of All Crop Acres for 1984, 1989, and 1994: How Much No-Till?

County	Total 1984 All Crop Acres	Total 1984 NoTill Acres	Percent NoTill	Total 1989 All Crop Acres	Total 1989 NoTill Acres	Percent NoTill	Total 1994 All Crop Acres	Total 1994 NoTill Acres	Percent NoTill
Brown	74,300	7,000	9%	86,225	22,725	26%	84,290	48,561	58%
Bureau	449,500	7,200	2%	412,000	54,500	13%	421,200	127,900	30%
Calhoun	48,245	7,300	15%	45,350	5,681	13%	42,052	7,953	19%
Cass	172,820	10,400	6%	157,800	23,100	15%	151,574	75,806	50%
Cook	72,865	1,500	2%	35,050	3,000	9%	16,862	2,675	16%
DuPage	41,600	1,900	5%	17,100	1,400	8%	12,300	2,600	21%
Fulton	283,500	5,900	2%	238,700	9,000	4%	292,200	88,710	30%
Greene	228,730	36,630	16%	212,100	15,400	7%	200,300	47,060	23%
Grundy	205,940	1,728	1%	199,791	27,650	14%	203,762	62,465	31%
Jersey	139,400	9,800	7%	132,470	20,400	15%	118,855	40,362	34%
LaSalle	566,569	9,383	2%	532,300	22,845	4%	510,329	104,244	20%
Marshall	168,482	10,100	6%	168,400	12,900	8%	175,658	35,959	20%
Mason	269,323	13,200	5%	258,350	18,000	7%	273,886	92,730	34%
Morgan	280,320	12,150	4%	250,900	49,550	20%	264,550	79,700	30%
Peoria	218,693	3,850	2%	205,550	18,000	9%	213,570	72,793	34%
Pike	322,620	55,000	17%	278,330	30,050	11%	239,589	51,334	21%
Putnam	68,400	4,080	6%	67,865	4,978	7%	69,232	14,854	21%
Schuyler	139,000	1,450	1%	115,015	20,200	18%	133,937	34,975	26%
Scott	106,018	3,650	3%	108,259	13,500	12%	97,749	25,630	26%
Tazewell	300,850	5,200	2%	289,170	13,800	5%	285,493	61,200	21%
Will	324,775	9,800	3%	315,300	25,850	8%	216,645	42,842	20%
Woodford	264,270	2,060	1%	248,030	12,100	5%	260,591	43,511	17%
IL. River Watershed	4,746,220	219,281	5%	4,374,055	424,629	10%	4,284,624	1,163,864	27%
Entire State Total	23,741,915	1,618,596	7%	22,333,737	1,958,358	9%	22,645,399	5,527,034	24%

* Data obtained from Conservation Technology Information Center (CTIC), West Lafayette, IN

Mitigative Management

Andrew C. French

U.S. Fish and Wildlife Service
Illinois River National Wildlife and Fish Refuges
19031 E. County Road 2105N, Havana, IL 62644

Efforts should emphasize the restoration of historic segments and enhancement of faltering components rather than protecting areas that are functioning and are not truly threatened. Restoration and enhancement of ecosystem components could assemble the elements necessary to revive the historical ecosystem structure and function.

Water drives the system. The frequency, depth, timing, and duration impact the physical and biotic features of the floodplain. Plant and animal species have evolved to depend on the pristine structure and function of the river-floodplain relationship. Each plant community has a specific moisture tolerance and occupies a particular niche which is tremendously influenced and even dictated by the water regime. Human modifications to the structure of the floodplain (navigation projects, agricultural development in the watershed, and the diversion of Lake Michigan waters) will change the floodplain function and the hydrology of the river-floodplain relationship. A change in the hydrology will generate a visible response in plant and animal species composition, distribution, and abundance.

Plant communities are important to fish and wildlife on a seasonal basis. If the ecosystem structure is altered and hydrology changes and does not permit the existence of a certain plant community or access for fish or wildlife to a plant community, the system breaks down. Species diversity and abundance decline as does ecosystem structure and function.

Ecosystem Management does not mean "hands off"; it means working with erosion, sedimentation, and the flood cycle in an attempt to manage and guide them to approximate the former natural process (Aquatic Ecology Technical Report, 1993). Habitat restoration, enhancement, or management projects which reestablish or simulate the "natural" flood cycle benefit numerous species of plants and animals.

Fish and wildlife managers frequently strive to approximate the historic hydrograph using some form of water "control" to mimic the dry cycle. Traditionally, a lesser amount of attention has consciously been given to the ecological opportunities and benefits associated with the entire flood cycle. However, substantial opportunities and benefits have been realized incidental to the primary focus of traditional initiatives.

There are unique nuances in each system (natural or induced) that impact ecosystem structure, function, and determine the hydrologic regime. A strategy to achieve a desired solution will need

to be custom designed to mitigate the human induced forces to successfully approximate the natural hydrologic regime and habitat conditions. Before we begin the restoration process we need to have an understanding of the physical environment and the biotic communities occupying the area, the hydrologic regime, the physical and chemical characteristics of the soils and substrate, and the potential for the area to support fish, wildlife, and plant communities.

Native fish, wetland dependent wildlife, and plant communities readily respond to a natural or simulated water regime in a terrestrial or aquatic environment. Using the structure and function of an ecosystem or the water regime of a healthy river-floodplain relationship as a guide, resource stewards can perpetuate native fish, wetland dependent plant communities and wildlife populations. If the critical points of the flood cycle are present (natural or managed) in spite of all the changes to the floodplain, fish, wildlife, and plant communities will benefit.

Management efforts that impact the flood cycle and cause the hydrology to deviate from the normal (historic) range should be reconsidered. Human induced alterations to the flood cycle should be mitigated to facilitate a "natural" river-floodplain relationship. As ecosystem system structure and function is restored to a point within the range of normal, the need for mitigative management of ecosystem components will diminish.

Human activities have initiated the decline of species diversity and abundance as well as ecosystem structure and function. Natural processes will not occur unless the human activities which destabilized the system are mitigated. The structure and function of the ecosystem has been changed; therefore, the natural process has been altered and even eliminated. As it pertains to the river-floodplain relationship, water does not course through the system as it did 100 years ago.

As resource stewards we must consider and understand the structure and function of the ecosystem and be prepared to mitigate those forces which cause the process to falter. Efforts to promote the ecosystem will not be the same in each location because the human induced impacts will vary. It could take many years to restore the structure and function of selected focus areas. Our management actions may be high input in some places and low in other areas. In any scenario our efforts should not exceed the forces that destabilized ecosystem synchrony.

This past summer the U.S. Fish and Wildlife Service implemented a cost share program that was designed to enhance wetlands, promote the natural management of sediment, and increase native floodplain plant communities along the Illinois River on private land. As a part of the Illinois River Floodplain Private Lands Initiative (Initiative), the Illinois River National Wildlife and Fish Refuges identified projects and contributed funds to wetland enhancement projects along the Illinois River and the tributaries which benefit fish, waterfowl, other migratory birds, and resident wildlife. Twenty landowners who own 2,091 acres of land in 13 counties in Illinois participated in the Initiative which contributed to the Upper Mississippi River and Great Lakes Joint Venture.

Dedicated partners who could tolerate a few "strings" which did not affect how they used their area were paid up to two-thirds of the cost of approved wetland enhancement projects. In

return, they committed to managing their area to mimic the natural flood cycle to promote native plant communities in lieu of corn, buckwheat, and Japanese millet. These conditions were outlined in a Cooperative Agreement and a site specific Management Plan. This was an overt attempt to capitalize on our mutual interest in waterfowl for their benefit as well as fish, other migratory birds, resident wildlife, and native plant communities.

It has been said that the three most important elements in real estate are: location, location, and location. The Illinois River has all three of these. Based on research conducted by Frank Bellrose beginning in the 1940's, waterfowl during the fall migration would generally turn east near Rock Island, Illinois, and follow the "Illinois River Flyway". The Illinois River (38,000 acres) and backwater areas (67,000 acres) occupy about 105,000 acres of the floodplain area. About 47,000 acres are in Federal (17,000 acres) and State (30,000 acres) ownership, and about 34,000 acres are owned by private sporting clubs. Another 190,000 acres have been leveed, cleared, and drained for agricultural production. The balance is unprotected bottomland and farmland, as well as urban and industrial areas. Private sporting clubs create an excellent opportunity to enhance shorebird, wading bird, waterfowl, and other migratory bird habitat on private land.

Residents often lament about fishing and waterfowl hunting excursions of a bygone era and attribute the diminished quality of a local tradition on the sediment laden water and the lack of aquatic plants. Agriculture, navigation, and the diversion of Lake Michigan water set the stage for the modern condition of the Illinois River; however, there are significant resource benefits that we can capture if we look to the natural flood cycle for guidance. Sediment has forever been a part of a system that was managed naturally during the dry summer period. Historically, the Illinois River swelled in the spring with a torrent of sediment laden water from the watershed; water spilled over the banks and sediment was deposited as the water ambled along the gradual course of the floodplain. As the water receded during the summer, sediment could naturally dry and compact; organic material would break down and annual plant communities would flourish. During the fall the water would gradually rise and provide access for fish and waterfowl to the bounty of the summer growing season. The roots and decaying plant material would provide a consolidated substrate for spawning fish and fuel for an explosion of high protein invertebrates in the spring.

As an example, the Wasenza Pool and Kikunessa Pool of Chautauqua Refuge account for 5 percent (3,600 acres) of the backwater areas and seasonal floodplain wetland habitat areas within the Illinois River floodplain, however, they provided resting and feeding habitat for as much as 61 percent of the waterfowl on the Illinois River and 49 percent of the waterfowl using the Illinois reach of the Mississippi River and Illinois River combined during the 1994 fall migration. Prior to managing the area to promote native plant communities, the peak waterfowl populations were significantly lower in 1992 with only 29 percent of the Illinois River population and 19 percent when combined with the Illinois segment of the Mississippi River population (Illinois Natural History Survey).

The Illinois River is a treasure and as a team we have the ability to significantly enhance its intrinsic natural values.

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Sustainable Farming Systems: Implications for the Illinois River Valley

Richard E. Warner

Department of Natural Resources and Environmental Sciences
University of Illinois at Urbana-Champaign
W-503 Turner Hall, 1301 W. Gregory Drive
Urbana, IL 61801

INTRODUCTION

The Illinois River is among the most famous tributaries in North America, and we know much about its historic and current conditions. In spite of our knowledge and concern, some of the most treasured facets of human and natural resources have diminished and/or their future seems uncertain. What can be realistically accomplished in reversing the seeming uncertain future of farm-related employment, shrinking rural population, dwindling local economies, and the compromised natural resource base? Why have we been unable to reverse some of these trends, given that we have considerable knowledge and desire to make such changes? Have the polices, practices, and forces at work helped or hindered what is optimal for the region? What human and natural-related dimensions should be promoted and/or preserved?

The question of what we promote, and how we go about it, is especially critical to this region of the state. Based on this and previous such conferences, there is a desire to improve the conservation of natural resources, preserve critical ecosystem processes, strengthen economic enterprises related to these resources, diversify local economies, provide for thriving rural communities, and ensure a strong agriculture. These issues parallel a growing state and national effort to develop farming systems and related economies that are — for lack of a better term — sustainable.

At present, sustainable agriculture is more of a question or ideal than a widely agreed upon set of practices. An inherent part of this question is, why has there been so little experimentation and attempt to engender policies and practices that recognize and take advantage of unique cultural and natural resources of a given region? The short answer is that the momentum of forces operant on a world and national scale over recent decades have become increasingly important, and they have tended to minimize local innovation and adaptation. These factors are discussed here in the categories of (1) global factors that affect the use of land and water resources, and their implications for the future; (2) the overwhelming influence that federal policies and programs bear on agriculture that is practiced in this country; and (3) issues relevant to sustainable farming systems and communities in the Illinois River region.

GLOBAL FACTORS

The problems of the Illinois River are not unique. Throughout the world aquatic habitats are experiencing sedimentation and other pollution at unprecedented rates, as well as draining of bottomland lakes, desiccation of tributaries, damming of rivers, channelization of streams, over-exploitation of fisheries, and competition of native flora and fauna by exotics. It is likely that the pressure to intensively farm the Illinois River Valley will increase with human numbers, as land and water resources degrade throughout much of the world, and economic linkages at the global scale continue to strengthen the demand for farm commodities grown here. It is not simply the projected increase in demand for food. First, most of the major tributaries of the world are experiencing much greater sediment loads than those of the Midwestern United States; by comparison the problems of the Illinois River look relatively tolerable. Second, the rate of degradation of land resources in food, fiber, and wood production, if unchecked, will severely limit the productive capacity of many regions of the world within our lifetime. Hence, global links will increasingly pressure the Midwestern bread basket to produce at maximum short-term capacity.

FEDERAL POLICIES AND LAND USE

Although agricultural land use in the Illinois River Valley increasingly has a global dimension, farm- and community-level trends have been overwhelmingly influenced by various farm policies and programs of national scope. Federal policies over many decades have featured relatively few farm commodities, now with a limited array of agronomic technologies and other practices applied on the land.

The range of realistic opportunities for generating income on the farm has likewise become quite restricted. Although economies of scale are inherently important, federal policy greatly affects the relative advantages of cost and other efficiencies of scale. Over the past century, for example, returns to farm producers and related local services and industries have been an ever-shrinking portion of the agricultural sector. The factors driving the trends described in Figure 1 have largely caused the depopulation of the rural (farm) Midwest.

Often times such sustained policy directions have unexpected consequences. The federal highway system is a striking example of a sustained action by government with widespread ramifications. A huge federal investment has created a travel system that is very efficient in terms of rate of travel for vehicular traffic, but very inefficient in terms of costs to society per person (or goods) per mile traveled. The tipping of the transportation scale by federal policy has eliminated or minimized other forms of transportation that may have been cheaper, more energy efficient, and could perhaps have been sustained without the same magnitude of public investment. Likewise, there was little expectation in the early 1900's that federal farm policy would cause an exodus off of the farm and out of rural communities (Fig. 1). Has the emphasis of relatively few commodities and associated technologies minimized the ability to develop creative land use practices that could better accommodate regional needs and resources — perhaps even at less cost?

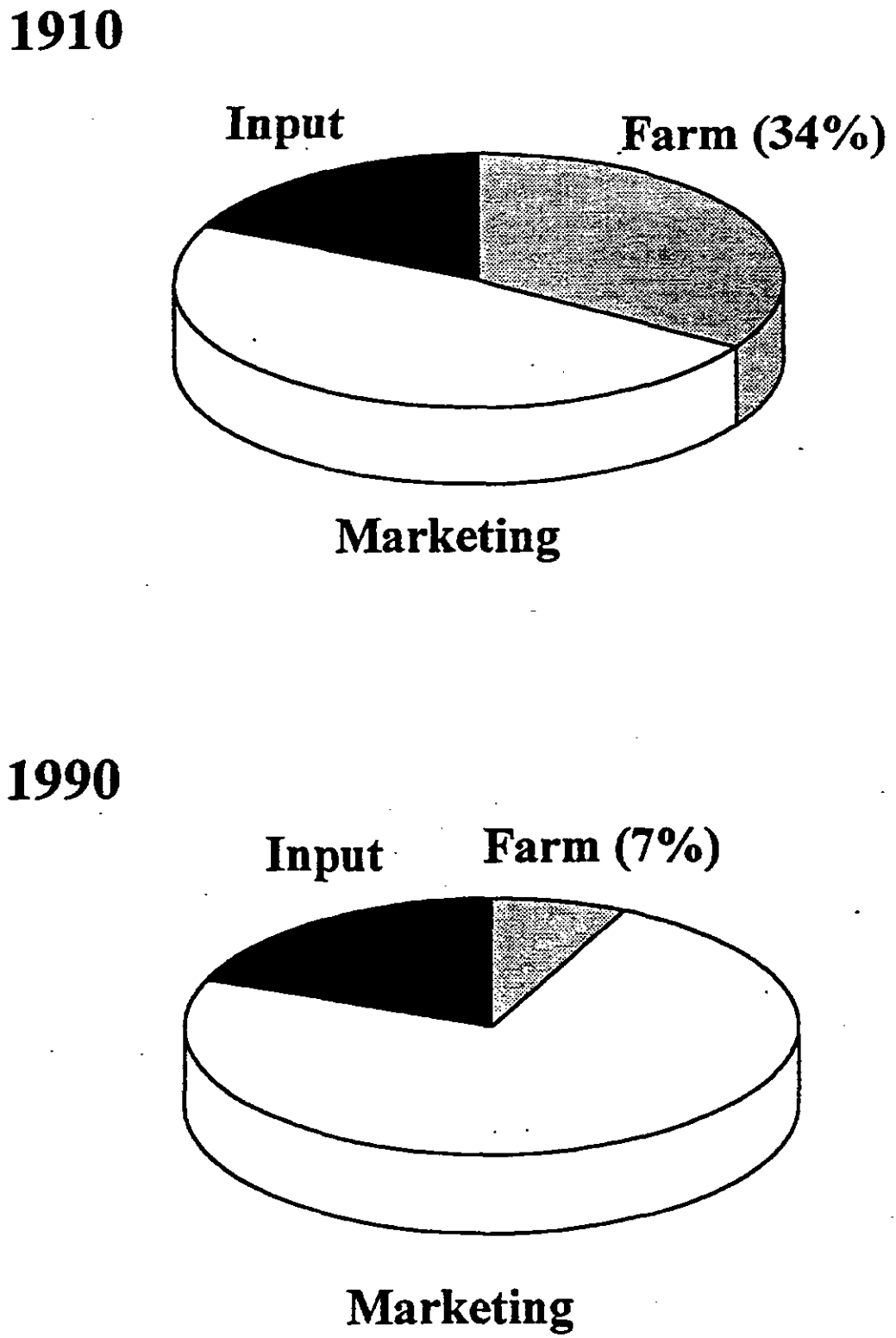

Figure 1. The portion of agricultural income generated by the input, marketing, and farm sectors in the United States, 1910 vs. 1990 (after Smith 1992).

SUSTAINABLE FARMING SYSTEMS AND COMMUNITIES

Throughout the United States, few regions have mustered the political will and other resources to protect natural resources and sustain locally thriving rural communities, where it was necessary to more than marginally redirect agriculture. There are relatively few commodities and practices that seem like plausible options. The limited range of options reflects the effects of federal policies and global forces.

The Illinois River is no exception. Although the river valley region has unique soils and other natural resources, and is prone to soil and water quality problems, land use is virtually indistinguishable from most of Illinois (Table 1). Conservation programs in agriculture have become so generalized that they typically do not effectively target many areas such as the Illinois River watershed, where the need is great. The recent Conservation Reserve Program (CRP), for example, has been of marginal benefit in the river valley because national guidelines are not sufficiently flexible to take many of the more erodible soils in the watershed out of production. The percent of farmland in CRP in counties along the river is on average no different than for other regions of Illinois (Table 1).

Thus, many of the forces at work at national and global scales have minimized regional variations in how land resources are used, and work against engendering economies and land use practices that are out of well established and narrow norm of practices. For these reasons, issues of sustainability and diversity in farming have to be addressed at the federal as well as at state and local levels. From the federal standpoint, there is no clear signal that policy-makers are seriously considering issues of sustainability in rural America. However, in spite of minuscule federal support, questions of future sustainability are being considered in Illinois. Progress along these lines is relevant to the future of the Illinois River valley.

THE MOVE TOWARD SUSTAINABLE FARMING SYSTEMS IN ILLINOIS

Sustainable Agriculture Committee

In January of 1990 the Sustainable Agriculture Act was signed in Illinois, putting in place an Illinois Sustainable Agriculture Committee (ISAC) to provide an appropriate focus and identify sources of funding for relevant projects. The ISAC first submitted recommendations to the 88th Illinois General Assembly regarding the fostering of sustainable agriculture in the state. The committee has pursued legislation to fund sustainable agriculture activities (e.g., by modest fees on fertilizer sales and/or pesticide registrations), but to date legislation has not been passed.

The ISAC has identified several guiding principles and goals for managing agroecosystems in a sustainable fashion in Illinois, including (a) encourage the prudent use of renewable and/or recyclable resources; (b) protect the integrity of natural systems so that natural resources are continually regenerated; (c) improve the quality of life of individuals and communities; (d) ensure profitability in farming; and (e) engender a land ethic that considers that long-term good of all members of the land community (Warner 1994).

Table 1. Average statistics that reflect land use in the Illinois River Valley and for the state as a whole.

	Year	
	1964	1987
% cropland diverted from production:		
River valley[1]	6	13
Illinois[2]	6	15
% cropland receiving commercial fertilizer:		
River valley	35	46
Illinois	36	49
% cropland receiving herbicides:		
River valley	20	50
Illinois	17	50
% cropland planted by no-till methods 1987:		
River valley	N/A	6
Illinois	N/A	7
% cropland classified as highly erodible:		
River valley		17
Illinois		23
Average farm size (acres):		
River valley	248	320
Illinois	227	323

[1]River valley refers to the average of 20 counties in closest proximity to the Illinois River.

[2]Illinois refers to the average of all 102 counties.

Illinois Sustainable Agriculture Network

In January of 1992 the Illinois Sustainable Agriculture Network (ISAN) was formed, initially with funding through a grant from the USDA Sustainable Agriculture Research and Education Program (SARE), the Illinois Department of Energy and Natural Resources, and the University of Illinois, Urbana-Champaign (UIUC). The ISAN has emphasized fostering and linking farmer-managed and community-based sustainable agriculture groups in Illinois with the UIUC College of Agricultural, Consumer, and Environmental Sciences, and other public agencies, in a statewide participatory research and education network.

Thus, the sustainable agriculture movement in Illinois is closely associated with farmer-based groups and their alliances. In addition to the ISAN, the Illinois Sustainable Agriculture Society (ISAS) serves as an umbrella organization providing administrative support for regional sustainable agriculture groups (Figure 2).

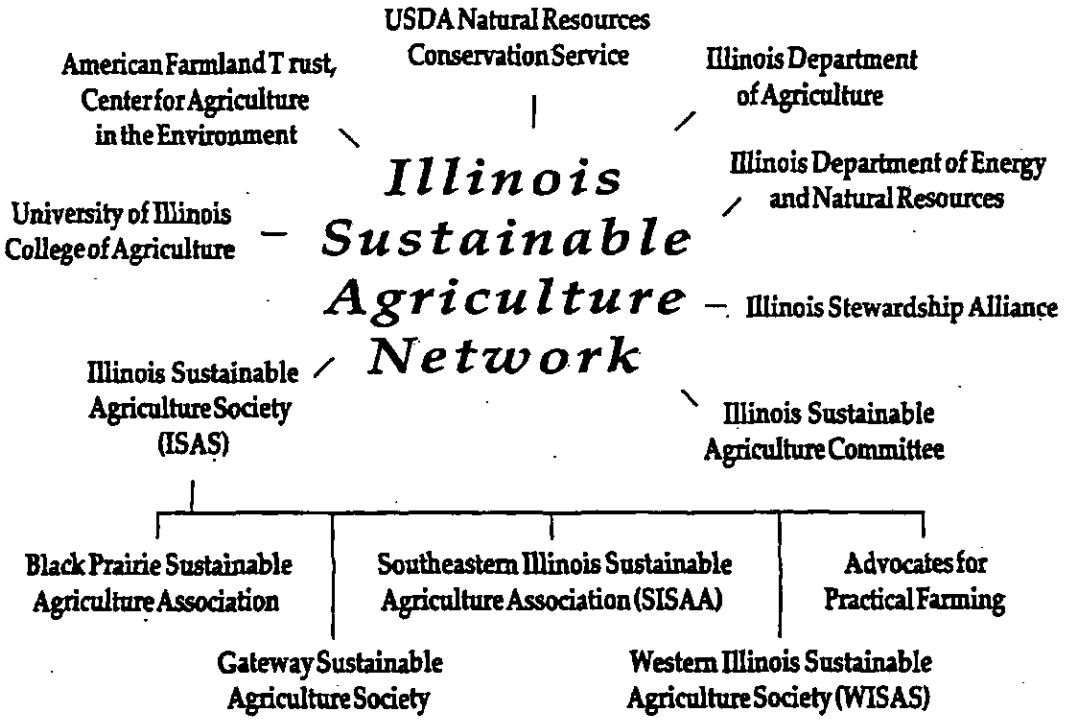

Figure 2. The Illinois Sustainable Agriculture Network and its partner organizations (after Warner 1994).

Sustainable Farming Systems and the Land Grant Institution

Some of the research and extension initiatives at the UIUC in recent years that are relevant to the Illinois River watershed include:

- A study of social and cultural factors affecting sustainable farming systems and the barriers to adoption;
- Evaluation of N fertilizer rate, planting date, tillage, and winter cover crops in a summer feed grain/soybean production system in central and southern parts of the state;
- On-farm adaptation of integrated crop and livestock systems;
- An on-farm research program working with approximately 70 farmers each year, to address farm-level adaptations of sustainable farming practices initiated by producers;
- Use of lower-than-label rates of insecticide to control corn root worms;
- A cooperative project with Purdue University (SARE funds) to evaluate sustainable vegetable production systems, and other research projects regarding vegetable cropping systems;
- Research pertaining to continuous and rotational grazing by cows of grass-legume mixtures;
- An experimental swine rearing facility developed as a model low-input sustainable system that also solves air quality and manure disposal problems;
- Food sciences studies of renewable fuels, biodegradable membranes, value-added chemicals, water recycling, and pesticide detection technologies; and
- A program to train extension personnel in issues and practices pertaining to the adoption of relatively sustainable farming practices.

Future Directions

The various partnering organizations in Illinois are emphasizing development of research and educational capacities in sustainable agriculture around the following tenets and goals:

a. The research agenda must be flexible and have the capacity to change with emerging technologies, farm policies and programs, funding opportunities, etc.;

b. Research in sustainable agriculture will tend to be issue or problem oriented, often requiring relatively rapid responses by interdisciplinary teams; the traditional "linear" model for research, where basic inquiry slowly progresses over time to applied research, will need to be replaced by a paradigm where numerous research and education functions occur along parallel time lines;

c. Scientists, educators, and students need to be encouraged to think in terms of systems approaches and team efforts to address sustainable agriculture;

d. The research agenda for sustainable agriculture should include integrated studies of alternative agricultural enterprises and market development, new crops, new uses for traditional crops, economic and sociological perspectives, and emphasis of natural resources;

e. Research and education in sustainable agriculture must be closely linked; new and efficient ways of networking and communicating research findings must be developed;

f. More adequate funding and general public support is needed if sustainable agriculture is to be aggressively approached; and

g. Groups under the sustainable agriculture umbrella have diverse needs and interests; state and federal agencies must, therefore, carefully contemplate how to contribute toward the stability, development, and focus of this movement.

SUMMARY

In conclusion, the visibility, needs, and opportunities of the Illinois River watershed are unique within the state, if not the Midwest. It is an ideal region to feature practices that ensure that the natural resources, economic, and cultural resources thrive into the next century. We are beginning to ask appropriate questions, develop a vision for sustainability, and establish the partnerships needed to move toward a viable future for the watershed. However, current national and global forces are tending to minimize the opportunity to capitalize on the unique aspects of the region. A change in direction will require that (1) in the near future the appropriate questions and priorities regarding sustainability are addressed; and (2) a shared vision develops among stakeholders and

agencies that can facilitate change. Along these lines, we can participate in a course of change that can be a model for the nation.

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Building Successful Partnerships and Volunteer Support for Scientific Studies of Sedimentation in the Kankakee River System

Bill Byrns

Research Director, The Alliance to Restore the Kankakee River
360 Holly Drive, Bradley, Illinois 60915

ABSTRACT

Early in 1991, after decades of growing concern about the sedimentation of the Kankakee River, community leaders met with representatives of the Kankakee County Soil and Water Conservation District (KCS&WCD) to seek scientific answers to the community's concerns. By mid-year the Kankakee County Soil and Water Conservation District entered into a cooperative agreement with the United States Geological Survey to conduct a series of sedimentation studies of the Kankakee River. The Alliance to Restore the Kankakee River (ARK) was formed to meet the financial and supportive needs of this project.

ARK is a community-based coalition of agricultural, business, civic, environmental, governmental and recreational interests. ARK has raised over $125,000 (as of 5/95) toward meeting the $217,000 local share of the 4-year cooperative agreement between USGS and KCS&WCD. The USGS project is threefold: (1) to determine the long-term sedimentation rate in the floodplain; (2) to determine a suspended sediment budget for the central portion of the Kankakee River basin, and (3) to investigate changes in channel geometry over the past several decades from the dam in Kankakee, Illinois to the Indiana state line. ARK aids this effort by bringing together a number of diverse groups and building partnerships to work toward a common goal. ARK has also mobilized a local volunteer corps of data collectors to staff three of six USGS suspended sediment stations on the Kankakee and Iroquois Rivers. Each volunteer station represents a significant cost saving over the three year duration of the suspended sediment data collection project.

Bridging obstacles has been the goal of ARK's project. Community-based partnerships have helped raise funding and public awareness of environmental issues. Recruiting local volunteers has helped cut project costs and allowed the scientific teams to concentrate on fieldwork and data analysis.

BACKGROUND

In June of 1977, Governor Jim Thompson commissioned a special Kankakee River Basin task force to report on concerns by basin residents and to develop solutions for the problems of the river. The task force produced a final report in April of 1978 that

contained 11 working papers reporting on the river's ecosystem, sedimentation, water quality, flood characteristics, natural areas, recreation, public water needs, nuclear power generation, navigation, the role of public agencies and future growth for the basin.

The Governor's task force report contained a wealth of scientific information concerning the Kankakee River Basin. The working papers in the task force report produced more in-depth studies of the hydrology, hydraulic and sediment transport in the Kankakee basin. These studies were published in 1980, 1981 and 1983 by the Illinois State Water Survey. The 1980 report by Dr. Nani G. Bhowmik et al. recommended an extended sediment data collection program extending over a period of the next five to 15 years to provide a solid baseline of data for a complete analysis of the sediment transport of the river. Unfortunately, no further in-depth studies of the river were conducted.

Over the intervening years, local concern grew about the sedimentation of the river. In 1986, local members of the Illinois General Assembly appointed a new Kankakee River Commission to study ways to correct flooding, erosion and sedimentation in the Kankakee River. The commission reported in 1989 that a "Kankakee River Basin Conservancy District" should be formed to provide local funding and oversight for river-related issues. The proposal to create a new local taxing authority, however, was defeated that year.

The people of the Kankakee River Basin had defeated creation of a new local taxing authority — never a popular idea at best — but the concern over the river remained strong.

Sandbed Deposition Result of Indiana Channelization

That concern was focused when a 1991 article in the Illinois State Water Survey journal, ***Currents***, cited channelization of the river in Indiana as the major source of the excessive amounts of sand found in the Illinois portion of the Kankakee River. Dr. Bhowmik was quoted as saying, "Sandbars begin forming near the state line where the straight river channel from Indiana meets the naturally meandering river in Illinois. This is where the sand is slowed and begins to accumulate." In his earlier reports, Dr. Bhowmik had described some of these sandbars as being a half-mile to a mile long and moving an inch a day depending on the stream flow. Dr. Bhowmik estimated that "it can take as long as 20 to 30 years for a sandbar to move through the system." A 1991 Indiana Kankakee River Sediment Study summary report by Engineers Jon D. Stolz and Christopher B. Burke observed that "the Kankakee River system is currently one with significant sedimentation problems within Indiana. A major sediment contributor within the Kankakee is the watershed inflow via tributaries."

GRASSROOTS ALLIANCE

The creation of the grassroots Alliance to Restore the Kankakee River in 1991 represented a new approach toward seeking action on the Kankakee River. At the request

of a local environmental organization, the Northern Illinois Anglers' Association, representatives from the Kankakee County Soil and Water Conservation District outlined ways that a cooperative program of scientific studies might be possible with the USGS.

Funding was to be the main issue. The local KCS&WCD simply could not accept the burden of a long-term matching funds program. USGS representatives met with KCS&WCD and other community leaders to outline a series of studies that would draw upon previous work by the State of Illinois and produce new data on sedimentation in the Kankakee River. Once approved the project became eligible for federal matching share funding with the local cooperative partner. The promise seemed worth the effort and a new coalition — ARK — was formed to provide an independent source of funding for a cooperative agreement between the KCS&WCD and USGS.

Thirty ARK Organizations Represent 100,000 Basin Residents

ARK launched its mission with a core group of 30 organizations representing agricultural, business, civic, environmental, governmental, and recreational organizations and agencies. The alliance would serve as the fund raising arm of the partnership with USGS and as a support liaison to the Survey providing volunteer data collectors and logistic assistance as needed for the field studies. Today ARK represents over 100,000 people in the Kankakee River Basin in Illinois.

The alliance started with one simple goal, to raise the local share — $217,000 — of a five-year USGS study of the Kankakee River. To meet that goal meant that the coalition would have to reach deep into the community's pocketbooks to meet the local funding obligation. It would also have to bridge obstacles and form partnerships between groups that had previously been at cross purposes in the past.

BUILDING PARTNERSHIPS

Right from the start, ARK faced its first challenge. The pro-active environmental group that had spearheaded the early days of the USGS proposal needed to form a much broader base with support from all parts of the community. ARK was the vehicle to bring those groups together to work toward a common goal, preservation and eventual restoration of the river.

To accomplish that task required ARK to occasionally serve as mediator between member groups that had disagreed in the past to maintain the common cause of the alliance.

The earlier efforts to create a Kankakee River Basin Conservancy District had divided many of the environmental and recreational groups on one hand from local county governmental leaders and the agricultural community on the other. Agricultural leaders had been particularly vocal in warning about the dangers in creating a new local taxing

authority when the river conservancy district was proposed. Now these leaders joined in common cause with some of their old opponents to fight a new enemy, the gradual sedimentation of the river system.

Two other old adversaries, the Northern Illinois Anglers' Association (NIAA) and the Kankakee Metropolitan Wastewater Utility also found ways to bridge a troubled history and work together as partners in the new alliance. NIAA helped infuse ARK with early start-up funding, provided organization leadership and a locally respected environmental ally. NIAA would also provide ARK with two of its three presidents. Kankakee Metro would provide the third president to the growing organization as well as being a respected governmental agency concerned with the protection of the river and its resources. Metro also helped draw additional support for ARK from the business and industrial community.

USGS STUDY DEFINED

The USGS project has three main goals: 1) to estimate the long-term sedimentation rate in the floodplain; 2) to determine a suspended sediment budget for the central portion of the Kankakee River Basin, and 3) to investigate changes in channel geometry over the past several decades from the dam in Kankakee, Illinois to the Indiana state line. Of these three projects, the longest term — and most costly — would be the three-year suspended sediment budget project that collects suspended sediment data from six USGS gauging stations on the Kankakee and Iroquois River in Illinois and Indiana. To save costs, ARK organized volunteers to staff at least three of the stations. Volunteer data collectors, trained by USGS personnel and supervised by ARK, save approximately $1,000 per station, per year in project costs. The volunteers monitor gauging stations on the Kankakee River at Momence and on the Iroquois River at Iroquois and at Chebanse. The remaining three stations — the Kankakee River at Shelby, Ind., the Singleton Ditch near Schneider, Ind. and the Kankakee River at Wilmington — are staffed by paid USGS collectors.

Dendrogeomorphic Study Published

The USGS recently published the results of its first study of the Kankakee River, "A Dendrogeomorphic Estimate of Changes in Sedimentation Rate Along the Kankakee River Near Momence, Illinois." The report made estimates of the long-term changes in the sedimentation rate by using a dendrogeomorphic technique comparing tree age and net sedimentation depths at several locations in the Kankakee River floodplain in the Momence Wetlands west of the Indiana state line. The age of the tree was determined by counting tree rings. The amount of sediment deposition over the tree's original lateral roots was also measured. The age of the tree is an estimate of the time during which the sediments accumulated. Data was collected at six sites, five in backwater areas away from the main channel and one on a natural sand levee near the river. The report found that "results of the dendrogeomorphic study indicate that there was a greater sedimentation rate in the Kankakee River floodplain after 1950 than before 1950. At one site, an

erosional event appeared to result in a subsequent increased sedimentation rate." The report also noted that both precipitation and streamflow have increased in the Kankakee River Basin over the past 75 years. Lastly, the report found that the percentage of sediment load transported as bedload remained constant (about 28 percent) at Kankakee River at Shelby, Ind. whereas the percentage increased with streamflow at Singleton Ditch at Schneider, Ind.

Other Studies Forthcoming

Two other reports from the USGS study are forthcoming. They include a channel geometry-cross sectional survey of the Kankakee River in the Momence Wetlands area and in the Six-Mile Pool reach and the three-year suspended sediment budget report. The cross sectional report is expected to be ready this fall and the sediment budget report is expected in mid-1996.

ARK has struggled in many ways to change the public perception of river protection. ARK began stressing the positive benefits of the river that provides economic resources and a dependable potable water supply to the thousands who use its watershed. The river is ranked among the top three aquatic ecosystems in Illinois for species diversity and environmental quality by the Illinois Natural History Survey and annually draws over 1.5 million people to its shores adding tourism dollars to the benefits provided by the river. Most importantly, ARK has placed the responsibility for river protection in the hands of the local community and the community has responded.

FROM CHICKEN DINNERS TO CORPORATE APPEALS

ARK's fundraising efforts have taken many forms. Individual donations and fundraising dinners play a role as do major events such as the ARK/GNB Clean River Bass Tournament and the Kankakee River Valley Fishing Derby. GNB, Inc. of Kankakee, a battery manufacturer, also operates a community car and boat battery recycling program that returns $2 per battery to the Alliance. ARK has also organized a multi-year corporate appeals program to provide stable funding over the four-year life of the current USGS studies. At present, the bulk of the ARK fundraising has been limited to the Kankakee metropolitan area. ARK is beginning to reach out to the other communities within the Kankakee River Basin that includes Kankakee and Iroquois County and portions of Will and Grundy Counties.

Having established a record of success ARK is now exploring grants for future river protection and restoration efforts. Part of that effort will be the continual need to educate people on watershed issues and to continue to build partnerships that can seek local solutions to watershed programs.

ARK has also worked with U.S. Senator Paul Simon and Congressman Thomas Ewing to seek answers to the sedimentation issue. Both have pledged to support a bill

authorizing a U.S. Army Corps of Engineers study of the Kankakee River Basin. ARK has also monitored the efforts by the State of Indiana in addressing their flood control problems on the Kankakee River. Part of Indiana's approach includes land acquisition of riverine wetlands along the Kankakee River as part of the Grand Kankakee Marsh Restoration Project. The project has particular significance to ARK because a relatively undisturbed portion of the Grand Marsh — known as the Momence Wetlands — still exists along the Kankakee River just west of the Indiana line.

Ultimately ARK believes that answers to the problems of the river will be solved on both sides of the state line. River systems do not easily conform to political or geographic boundaries. River systems are dynamic hydrological systems and must be addressed as such. The USGS study, which was ARK's first step towards seeking answers to the Kankakee puzzle, sought out a federal agency that can operate effectively to address questions along the river in both states. Further ARK efforts will also have to focus on a basin-wide approach and building partnerships — not just between local groups but between the states themselves. This will be part of the challenge in the future.

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AmeriCorps and the Illinois RiverWatch Network

Dana Curtiss

Illinois Department of Energy and Natural Resources
325 W. Adams, Suite 300, Springfield, IL 62705

Established in April 1993 under an initiative of Lieutenant Governor Bob Kustra, the IllinoisRiverWatch Network is a partnership among Illinois citizens to monitor, restore and protect the state's rivers and streams. Part of the AmeriCorps National Service Network, the Illinois RiverWatch Network meets a number of environmental protection and education needs. As *Citizen Scientists*, RiverWatch volunteers conduct stream habitat assessments and sample and identify aquatic macroinvertebrates. Citizen Scientists not only learn about the ecology of river systems but have a direct role in monitoring the health of their local rivers or streams. The RiverWatch Network is coordinated through the Illinois Department of Natural Resources (DNR).

The primary objectives of the Illinois RiverWatch Network are to establish an extensive statewide monitoring network, inform and educate the public about aquatic resources, and create pro-active groups who will be stewards of and advocates for Illinois' rivers and streams. Key aspects of the program include outreach to existing community groups, businesses, and schools; environmental education for members of the general public (adults and children); and community action on local river issues, including stream cleanup, habitat assessment and biological monitoring. As a statewide affiliation of existing and newly formed river organizations, the RiverWatch Network provides opportunities for citizens to participate in a broad range of watershed monitoring activities.

The AmeriCorps National Service Program was established by President Clinton in 1993 to provide service opportunities to individuals of all ages and backgrounds to help meet local education, public safety, human and environmental needs. AmeriCorps Members commit to a one year term of service in return for an educational award to help finance their college education or vocational training, or to pay back their student loans after successful completion of service. AmeriCorps follows in the tradition of the Civilian Conservation Corps, the GI Bill, and the Peace Corps. It is based on the simple idea that those who take responsibility for their community ought to be rewarded with opportunity.

A recent GAO report assessed the benefits of AmeriCorps. Cited in the report are numerous examples of AmeriCorps programs nationwide that have made significant contributions to the quality of our nation's environment. Examples include: planting of 212,500 trees, restoration and stabilization of 27 miles of stream banks, restoration of 320

acres of natural area, and removal of 12 tons of trash from an urban stream. The Illinois RiverWatch Network has met similar goals throughout the state.

Despite these accomplishments, both houses of Congress have voted to terminate funding for National Service after the second year of the program. Federal funding for all the AmeriCorps programs constitutes less than one-half of one percent of each federal budget dollar. President Clinton has vowed to veto any bill that eliminates AmeriCorps funding. However, the outcome is uncertain, since the legislation affecting AmeriCorps funding is part of a larger appropriation bill.

Much of what the Illinois RiverWatch Network has accomplished in 1995 is due in part to the support received under the AmeriCorps National Service Program. AmeriCorps funding supports a statewide network of AmeriCorps Members who serve as regional facilitators for the program. These individuals are based at numerous community colleges where they carry out recruitment, training and coordinating at the local level. Since January 1995, the RiverWatch Network has trained over 500 Citizen Scientists to monitor 106 sites on 97 different streams. The contribution of volunteers has resulted in a significant increase in the total number of streams assessed statewide. Data collected by Citizen Scientists is currently under review at the Illinois Natural History Survey with a report due by the Department of Natural Resources in December.

AmeriCorps program support for the Illinois RiverWatch Network has already begun to demonstrate that National Service is an important asset for environmental programs. It has the power to enhance state and local resources and to involve the public in activities that educate and advocate individual responsibility and activism.

The AmeriCorps Program's current funding situation threatens to eliminate the benefits realized by National Service opportunities. AmeriCorps has only had a single year to demonstrate its benefits. Before Congress acts to deny future national service funding, there must be ample time to determine the benefits relative to the costs of the program.

To learn more about the AmeriCorps Program, contact the National and Community Service Coalition at 202/822-9450. For information about the Illinois RiverWatch Network contact the Department of Natural Resources, Division of Energy and Environmental Assessment at 424 S. Second Street, Springfield, IL 62701-1787.

Mackinaw River Partnership

Mary Jo Adams

Mackinaw River Partnership
Horton 227-G, HPR-5120
Normal, IL 61790

Good morning. My name is Mary Jo Adams, and I am here representing the Landowner Committee of the Mackinaw River Project. I am a lucky person. Not only do I own land along the Mackinaw River (I can't imagine living anywhere else in Central Illinois), but I feel lucky to be able to work with a dynamic and diverse group of people who have chosen to become involved with the project.

The Mackinaw River is a "jewel" of a stream in Central Illinois. Right now, it is particularly lovely with the changing fall colors. But it has its ugly side also, sometimes hidden, like buried tires and refrigerators, or obvious, like the brown, swirling muddy torrent seen during flooding. The Mackinaw River runs for 129 miles, from Sibley to the Illinois River three miles south of Pekin. It drains an area of 744,000 acres. Of this, all but about 3000 acres (DOC and Parklands Foundation) is in private ownership.

The Landowner Committee of the Mackinaw River Project, which was formed by interested and committed landowners from throughout the watershed, is working with The Nature Conservancy to develop a watershed management plan which will strive to create a better balance between the human and natural communities that share this wonderful place we call our homes. The project is unique because it is quite actively involving landowners throughout the entire planning process. We, the landowners, those of us who live in, who work in, and whose knowledge of the river is incredibly diverse get to craft a management plan for ourselves, and will not be forced to accept some plan that was designed by well-meaning, but less intimately connected outsiders. We are working directly with The Nature Conservancy on this project. The Conservancy is providing the scientific information upon which we will base our decisions. We, the landowners, will try to develop a management plan to address the problems identified by the scientists. Part of our challenge will be to look at the river in a new and different way. All of us have a tendency to look at the river in slightly different ways. For years, farmers have worked to reduce soil erosion. While we have done a good job of minimizing soil loss due to run-off, we find that controlling the river itself is impossible.

Rivers are dynamic, fluctuating systems. They change. Some of us have attempted to prevent this change by trying to contain and control the river with levees or ditches. This has often made the problem worse. Over the years, people have also increased run-off through unregulated building or road construction, or increased drainage in uplands or

wetlands. This has caused flooding to worsen even more. The issue of flooding is where the human and natural communities can find some common ground, because flooding causes problems for both. And so we will attempt to find some solutions which will work to our mutual advantage.

Those of you who like to talk about preserving the environment need to remember that there are people who live in the communities and land along the river. Many of our ties to the land and river go back many, many generations. Farmers are tired of hearing how they are the only ones responsible for damaging land and ruining rivers. Very few farmers would intentionally harm something that is going to be the foundation for their livelihood. If farmers have caused problems, it is usually because they have not fully understood the full nature of their impacts on the environment. Most of us do care.

Through the Mackinaw River Project, we will hopefully find ways to live more compatibly with the natural systems around us, as long as we feel that our hopes and fears and our personal rights are being respected by those of you who are inclined to concern yourself with just the ecological aspects (animals, fish, plants, etc.) of the river. We must stretch our vision of stewardship to extend beyond the borders of our farmland. We must look at the river as an entire entity, and not focus only on our tiny pieces of it. We must consider ourselves as many links in a diverse chain, a chain that can only be strong if it is well-connected. Lasting solutions to the problems facing our river community will be found within those of us who are firmly rooted, just like a tree which must be firmly rooted into the bank of the river into a vision of the communities themselves.

Fox Waterway Agency

Karen C. Kabbes, P.E., Executive Director
Fox Waterway Agency, 45 S. Pistakee Lake Road, Fox Lake, IL 60020

Since the late 1800s the Chain of Lakes and Fox River of Lake and McHenry Counties has been a popular tourist destination point. Vacationers have come to fish, boat, hunt and in the past, see the "world famous lotus beds". However, years of intense recreational use of the combination of shallow and deep lakes and area development and river resulted in concerns about the impact of siltation and water quality.

The result is the Fox River and Chain O'Lakes are experiencing the same issues as other parts of the Illinois River system, sedimentation, erosion and water quality concerns and the associated potential impacts on recreation and recreational navigation. To deal with these issues the Fox Waterway Agency, a special purpose unit of local government, was created.[1] Created by state statutes and local referendum the agency is funded by a boat user fee. The Agency's charge is to improve and maintain the waterway system for a number of purposes, including recreation, flood control, water quality and tourism.

The system currently consists of over 30 miles of river, 7600 acres of lakes and more than 100 contiguous public access channels. The first state sponsored improvements in the system date back to the 1930s when a lock and dam was built at McHenry. Since the 1940s, the state dredged a number of channels to connect the shallow wetland lakes and deep glacier lakes to create a "chain". Numerous developers have developed the system of over 100 contiguous public secondary channels connecting residential neighborhoods to the waterway to create the waterway system we have today.

The waterway area is currently undergoing redevelopment but visitors can still see along the shores a number of old buildings. Interspersed between more modern buildings are such structures as an old Victorian hotel that is now a residence, the Minneola Hotel, the largest wood frame structure in the State of Illinois, former haunts of Al Capone, and several old boating, fishing and hunting clubs.

The Agency's current user fees range from $10 to $50 per year and generate approximately $700,000 per year in revenue. That revenue is used to fund a ten person staff that performs a number of administrative and field activities including:

- placing navigational aids,
- removing debris in the navigation channels,
- channel dredging,
- water quality demonstration projects, and
- publication of a boating map.

To conduct the dredging operations the Agency has used a state owned small dredge and an amphibious backhoe.

A Corps of Engineers Environmental Impact Statement on boating impacts (May, 1994)[2] clearly documented the significant role boats played in re-suspending fine grain sediment in the shallow boat channels and the need to dredge boating channels in the system to a significant minimum depth. A 1988 study suggests the Agency would need to remove 600,000 cubic yards of sediment throughout the system to maintain boating channels that are 100 feet wide and six feet deep. The same study references the fact that the system receives 40,000 - 60,000 cubic yards of sediment every year from watershed runoff.

Current Agency projects include a IEPA 319 grant to demonstrate to area property owners biotechnical bank protection methods. The Agency is also assisting in fish stocking, mussel relocation for dredging projects and reconstruction of eroded wetlands through the use of dredge materials.

Fortunately, Lake County, Illinois has a county-wide storm water and erosion control program. McHenry County is expected to create a county-wide program soon. Wisconsin is working on a non-point pollution control project in the watershed in their state. Recent changes in state law will allow the Agency to take a watershed approach and raise user fees to address concerns.

The Agency is working to educate users and property owners on water quality issues. The Agency also is working with the Corps of Engineers on modifications to both the McHenry Stratton dam and Algonquin dam and attempting to assure the dams are operated to minimize flood damage and maximize water quality benefits and fish and wildlife habitat. Hopefully, the lasting result of our efforts will allow area visitors to enjoy the scenic beauty and natural resources of the lakes and river for generations to come.

[1] 615 ILCS 90/7.1.

[2] U.S. Army Corps of Engineers - Final Environmental Impact Statement - Summary, Vol. 1 to 3, Appendices A and B, May, 1994.

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Peoria Wilds — the Role of Volunteers in Stewardship Efforts

Chris Ryan

Volunteer, Peoria Wilds Project
915 Commerce Bank Building
Peoria, Illinois 61602

INTRODUCTION

Hello, my name is Chris Ryan, and I am a volunteer in the Peoria Wilds project which is part of the volunteer stewardship network sponsored by the Nature Conservancy. I would like today to explain to you briefly what it is that volunteers do within the Peoria Wilds project, why we do it, and suggest where I believe volunteers and professionals can benefit each other in connection with efforts to restore the health and integrity of the Illinois River Ecosystem.

PEORIA

The Oak Hickory Bluff forest along the Illinois River between Peoria and Chillicothe is one of the largest remnant forest ecosystems left in Illinois north of the Shawnee National Forest. In late 1989, the Nature Conservancy brought a field representative to the Peoria area to assist in the formation of a volunteer stewardship network, and to encourage stewardship activities in this area. The basis for this effort was the fact it had become clear through inventories and the work of local naturalists in the Peoria Park District that oak and hickory regeneration was low or even absent due to fire suppression and encroachment by fire intolerant species such as maple and elm.

The early efforts of the original band of volunteers coordinated by the Conservancy Field Office focused on removing these encroaching species to simply allow light to reach the forest floor. Workers removed brush at the Singing Woods site which is a 1,000 acre continuous preserve held by the Peoria Park District. Photographs taken at Robinson Park in 1989 and in 1992 show the dramatic results of three years worth of restoration efforts.

In addition to the goal of restoring light to the forest floor, the volunteers focused on preservation of hill prairies which harbor various plant species which were certainly uncommon, and in some cases even endangered including such species as Blazing Star, Schreber's Aster, purple Prairie Clover and Hills Thistle. These plants commonly are found in hill prairies which dot the bluffs at sites such as Camp Wakonda, which has recently been taken over by the Park District from the Boy Scouts.

1992 — CHANGE OF COURSE

In 1992, the local volunteer stewardship network was led along the standards which were traditionally utilized by the Nature Conservancy in preservation of valuable, biologic sites. This system treated each site individually with the steward reporting directly to the local landowner, which in this case would have been the Peoria Park District. Through the efforts of Michael Reuter, who at that time was the local field representative, the focus of restoration efforts by the volunteers began to shift to accommodate the entire bluff ecosystem. A steering committee was formed to work with the individual site stewards to create more comprehensive restoration efforts between sites, and in the community at large. This led to the formal formation of the Peoria Wilds Group in 1993 with a common steering committee and, of course, a logo.

This allowed the volunteers to present a common and easily identifiable image to the public for all of the restoration efforts being undertaken in the Peoria area. As a result, we were able to attract large corporations such as Cilco and their employees to assist in organized work days sponsored by the corporations. Cilco workers received instructions on various tasks including brush carrying and brush cutting from the steward at the Singing Woods site (Bill Allen). Additionally, the volunteers took on greater public involvement. As an example, a site known as Big Hollow was being subjected to development. Volunteers removed a variety of prairie plants from the area for transplantation to other sites prior to development.

Volunteers also commenced an annual Fall Festival called Autumn in the Oak Woodlands which has drawn a wide range of members of the general public who were exposed to trail walks explaining the difference between the current landscape, and the landscape as it exists today due primarily to fire suppression and development. The public received some early instruction in plant identification and Dale Goodner of the Peoria Park District explained how to look cool while walking through the woods with a stick.

Perhaps more importantly, the Peoria Park District as the major owner of ecologically important sites in the area began a great expansion of stewardship activities. These included a vast increase in the size and number of burn units and allowing volunteers greater control over the burns themselves. There was also an increase in monitoring and seed collecting as well as a major migratory bird study at the Singing Woods site, sponsored by the U.S. Fish and Wildlife Service, the Peoria Park District, and various other state and federal agencies.

Additionally, the Nature Conservancy received an award in 1994 in sponsorship of the Peoria Park District as the Park District's Volunteer of the Year award. While the official designation indicated that the Peoria Wilds project contributed 6,000 man hours to restoration work on District's property, it was admitted by various Park District officials that the figure could well have been closer to 10,000 hours as many of the volunteer hours are not clearly tracked or reported. I myself can verify that many of the

hours of the Steering Committee, including myself, are not specifically reported, and I would suggest to you that 6,000 represents only the actual hands-on work done on the sites as reported by the stewards to the local Conservancy office.

LANDOWNER INVOLVEMENT

Beginning in the fall of 1993, the landowners began to recognize that it was impossible for the entire ecosystem to be adequately protected by the efforts of the Park District staff, and volunteers of Peoria Wilds alone. There were clearly insufficient funds available from any source to purchase or protect sensitive areas, and the entire bluff area was and continues to be under severe pressure from development. It was discussed among the volunteers and the local Conservancy office that perhaps getting private landholders along the bluff area more involved in and aware of restoration efforts would lead to a greater level of protection while remaining consistent with the Nature Conservancy's non-confrontational approach. It was felt that a voluntary landowner registry program sponsored by the Peoria Wilds project in conjunction with the Peoria Park District as a public agency and the Nature Conservancy as the private agency would be an excellent way to convey the message of restoration to landowners and ease development pressure that might otherwise occur.

Clearly, one of the events that greatly fostered promulgation of the landowner registry program was the Georgetowne project. The Georgetowne subdivision is located in the heart of the bluff just south of Cedar Hills Drive in Peoria. It is approximately 40 acres of prime woodland which has been subdivided with high end residential real estate with lots of 5 acres or more. The homeowners met with Michael Reuter and me in the fall of 1993, and after discussing the matter among themselves agreed to allow the volunteer network to provide them with supervision in restoring and maintaining the woodlands which surrounded their homes. This led to a burn conducted within the subdivision in the fall of 1993 with the ubiquitous Michael Reuter providing instruction on the use of a drip torch and Dr. Michael Cashman, a local gastroenterologist putting the drip torch to good use. The burn was successful, and in most cases the burn lines were extended to the edge of the blue grass yard adjacent to these six and seven figure homes.

Needless to say, we are very, very excited by this project which has continued annually since 1993. We believe that the Georgetowne project can provide a model of compromise between woodland development and ecosystem management which not only encourages landowner involvement, but hopefully encourages greater sensitivity and development by increased lot size and more intelligently placed drainage systems.

In fact, Dr. Hank Stone, who is a member of the local Nature Conservancy Regional Board, assisted in the initial Georgetowne burn, and was so excited by the results that he insisted we return to his house and burn his front yard the next day. His front yard consists of approximately 14 acres along Route 29 which he has replanted with a variety of flood plain prairie species. I hasten to add that the first year growth, much to Dr.

Stone's dismay, appeared initially to be nothing but foxtail. However, I assure you that site today has shown extreme improvement due to annual burning, and I encourage you to drive by his house which is adjacent to Detweiler Park on Route 29 this coming Spring and Summer and view it for yourself as an example of what can be done with urban or quasi-urban prairie restoration.

In addition, at approximately the same time Peoria Wilds Registry Program was being formed, the local Conservancy office was successful in reaching an agreement with Priscilla Sours to be the first member of the registry program. Her property is approximately 40 acres and contains numerous hill prairie sites which are equal to that of nature preserves in the area.

I am also greatly happy to report that after a meeting less than one month ago with a group of homeowners adjacent to the Singing Woods site, four homeowners with approximately 40 acres have agreed to become new members of the registry program and are already working with Bill Allen in planning appropriate restoration and stewardship efforts on their property which will be performed in cooperation with efforts at the Singing Woods site. Additionally, we have recently received calls from a number of homeowners including those representing a large subdivision known as Lake of the Woods which is very close to the Georgetowne Subdivision. These homeowners, while by and large having lot sizes much smaller than the Georgetowne property have large backyards adjacent to ravine and slope areas, and they have expressed a great interest in the Peoria Wilds project and what can be done cooperatively to assist in management of these areas.

COMMON GROUND

Based on these and other efforts, the Peoria Wilds project was recently named a model project by the Illinois River Valley partnership sponsored by Lt. Governor Kustra's office in conjunction with their liaison, Gretchen Bonfert, whom many of you may know. Some of you involved in the Illinois River project may be asking yourselves what does restoration of woodlands along the bluff have to do with problems facing the Illinois River ecosystem.

I would suggest to you the obvious answer is the issue of erosion.

Any volunteer who has worked at sites such as Robinson Park or Singing Woods can tell you of seeing eroded areas such as these in Singing Woods in 1990. I can safely say, it is the belief of every volunteer involved in this project who have been out to these work sites and worked in any of the subdivisions including Georgetowne, that these ravines and streams running through the woodlands and the bluffs of the Peoria Wilds area are feeding massive amounts of sedimentation into the feeder creeks which flow into the Illinois River and the Peoria Lakes. I believe this belief will be borne out by the

discussion you will hear later from Don Roseboom who has in fact been measuring erosion through woodland and farmland areas.

I can certainly tell you that it is these ravines that initially brought the Georgetowne homeowners to call us, the Lake of the Woods homeowners to call us, and is the source of most of our current homeowner contact, and I can tell you that while we can talk about biodiversity and saving habitats, there is nothing that focuses the attention of a homeowner better than watching these ravines creeping six feet per year closer to their backyards and their homes.

CONCLUSION

In conclusion, our volunteer force is eager to work further in the area of controlling erosion in our woodlands. However, all that we do is based on scientific evidence rather than our personal feelings. We need assistance in quantifying the amount of woodland erosion we are seeing with our naked eyes. We need to scientifically quantify which of the problems I have outlined above are causing the most significant amount of erosion, and whether restoration or other methods are more effective in combating these problem areas. I am asking you on behalf of the volunteer network of Peoria Wilds to consider focusing your scientific efforts in this area which we believe is not receiving the attention it arguably deserves. As I mentioned earlier, Peoria Wilds contains a number of highly motivated, knowledgeable and energetic volunteers who are willing to devote in excess of 10,000 or more man hours to this project at a cost and benefit ratio that I challenge you to match anywhere else.

If you can find a way to steer your scientific efforts towards addressing the problems involved in woodland and forest erosion, I guarantee that the volunteers of Peoria Wilds will take those efforts and run with them in a way that will achieve quantifiable, measurable results. If you are not involved in a field or area which will assist the research in this area of the Illinois River System, I strongly urge you to consider utilizing volunteers in your research and restoration efforts, as you cannot find a better value elsewhere.

Are Erosion Control Programs Reducing Sedimentation?

D. P. Roseboom and R. Sinclair, Illinois State Water Survey,
Gary Eicken, Illinois Environmental Protection Agency,
Pat Woods, Pike County Soil and Water Conservation District

Illinois State Water Survey, Box 697, Peoria, IL 61652

INTRODUCTION

Nonpoint source (NPS) pollution is the diffuse, intermittent runoff from various watershed landuses. Precipitation creates surface water runoff, which carries pollutants from their respective landuse to the receiving streams and lakes. The watershed yield of each pollutant is dependant upon the concentration of pollutant in the water runoff and the amount of water runoff. In Illinois, 90 percent of assessed lake acres have been impaired by nonpoint pollution — usually sedimentation and nutrients.

Illinois landuse sources of NPS pollution are agriculture, construction erosion, urban runoff, hydrologic modifications, and mineral extraction. Lake Pittsfield lies in western Illinois, which has the highest instream sediment yields in Illinois (Bonini, et al., 1983). Western Illinois has been designated in the critical sediment producing area of the Mississippi River basin by the Soil Conservation Service (Crews, 1983).

Under the Illinois EPA and Region V of the USEPA, the Clean Lakes Program granted the City of Pittsfield a Phase I diagnostic/feasibility study to develop a lake restoration program for Lake Pittsfield. The Phase 1 report indicated that sediment was the primary pollutant. Region V was reluctant to grant Phase II lake restoration funds without concurrent Section 319 nonpoint pollution control funding to limit watershed sources of sediment.

The Pike County Soil and Water Conservation District (SWCD) applied for 319 funding to reduce the rate of sediment delivery from the watershed. The SWCD has proposed the construction of a large sediment retention basin (SRB) with 90 percent trap efficiency at the upper end of Lake Pittsfield. In addition, 37 smaller sediment retention basins have been proposed in the upper watershed pending landowner approval. In addition, a Water Quality Incentive Project (WQIP) through the Agricultural Stabilization and Conservation Service will attempt to reduce NPS pollution through the use of incentive payments to secure changes in land management systems in an environmentally and economically sound manner. The management practices include conservation tillage, livestock exclusion, filter strips, wildlife habitat, and a landowner educational program.

The Pike County SWCD has been heavily involved in the reduction of erosion and sedimentation since the creation of Lake Pittsfield in 1961. When early lake sedimentation

surveys indicated an annual sedimentation rate of 6 tons of sediment per acre per year, the SWCD began an aggressive erosion control program. In 1979 with funding Agricultural Stabilization and Conservation Service, the SWCD began a Special Water Quality Project by installing Best Management Practices (BMP's) throughout the watershed. The list of BMP's included terraces, no-till cultivation, contour plowing, and water control structures.

The Special Water Quality Project enlisted the Illinois EPA and Illinois State Water Survey to monitor water quality improvements in Lake Pittsfield and within the Blue Creek tributary. With early lake sedimentation surveys by the City of Pittsfield, the Illinois State Water Survey has been able to determine the rate of lake sedimentation by lake surveys in 1974, 1979, and 1985.

With the new 319 program of sediment retention basin (SRB) construction, the Illinois State Water Survey has instated another water quality monitoring program for Lake Pittsfield and Blue Creek under the USEPA's National Monitoring Program. The monitoring program not only provides long-term monitoring of the large sedimentation basin effectiveness but also gives direction on the watershed installation of SRB's in the upper subwatersheds.

The Lake Pittsfield's monitoring program also includes sediment yield determinations of Blue Creek subwatersheds, GIS determination of watershed landuses and BMP implementation, a lake sedimentation survey, and lake water quality analysis. The monitoring program is scheduled to cover an eight year sampling period.

WATERSHED MONITORING

Nonpoint source (NPS) pollution is carried by the diffuse, intermittent runoff from various watershed landuses. The watershed yield of each pollutant is dependant upon the concentration of pollutant in the water discharge and the amount of water discharge. The water discharge results from unsteady state flood flows as represented by quickly ascending limb and slowly descending limb of the flood hydrograph. Both the rate of floodwater discharge and pollutant concentrations vary rapidly over the duration of the flood event.

In small watersheds, the short duration of flood events causes extreme difficulty in determining the stage-discharge curve and sediment yield for watershed sampling stations (Wallings, 1977). Even when rating relationships are differentiated by season and stage (flow), errors in the estimation of monthly loads could vary by +900 percent and -80 percent. Errors from sediment rating curves can be almost unlimited for flashy streams with low quality discharge records and for which sediment is only collected once or twice per day (Colby, 1956).

The Lake Pittsfield watershed monitoring program established a series of stream sampling and flow gaging stations. Four ISCO automatic samplers (B, C, D, and H) were constructed on the main channel of Blue Creek. The B ISCO sampler has a dopler flow meter to measure stream flow during lake backwater episodes. Another ISCO sampling Station (I)

was constructed on a large ravine system on the lake bluffs. The G sampling station, present in the 1980-1982 Lake Pittsfield monitoring study (Lee et al, 1983), was abandoned after the park road culverts were repeatedly washed out.

With a relatively short time frame of 2-3 years to provide project managers with an evaluation of subwatersheds with the greatest sediment delivery, an intensive program of flood event sediment sampling began with the establishment of staff gages on stream stations in the fall of 1992. As rapidly as the ISCO samplers could be obtained and installed, the sampling network was formed in late 1992 and 1993. Sampling station construction was slowed by the large number of flood events monitored in 1993.

Methodology

The concentrations and watershed yield of sediment were determined by an intensive sampling schedule during flood events. Normal stream flows were sampled on a biweekly basis. However, stream sampling was intensified during the spring season when stream samples and flow measurements at B and C Stations were taken every 3.5 days in accordance with the USEPA National Monitoring Program.

Stream samples were analyzed gravimetrically after being dried at 105 degrees C following the specified EPA methodology (USEPA, 1983). Flow measurements were performed in accordance with U.S. Geological Survey procedures (Rantz, 1982). When combined with flow gaging at individual flood stages, the cross-sectional areas are utilized to determine the flow in cubic feet per second (cfs) at each measured stage in the flood hydrograph. With an adequate distribution of flow measurements over the hydrograph, the stage discharge curve is determined for each stream station.

As major stream sampling sites, stream flow measurements were focused on Stations C, D, and I and therefore these stations have the first tabulated stage-discharge curves.

At each stream station, the sediment yield for each flood event is calculated by use of the following equations:

Determination of Sediment Yields During High Flow Events

$$Yi = (qi)\ (ti)\ (ci)$$

$$Yt = Yi + Yi+1 + ...Yn$$

where Yi = yield during discrete sample collection, qi = flow during discrete sample collection, ti = time interval of discrete sample collection which is equal to one-half the time since previous discrete sample plus one-half the time to the next discrete sample, ci = concentration of chemical in discrete sample, Yt = sum of interval yields representing discrete samples during the high flow event and n = number of discrete samples.

At the time of sampling, stream flows were determined from stage discharge curves, which correlated the measured stream discharges (flow) with stream stage heights. Discrete water samples were collected throughout the stream hydrograph during each runoff event. The depth integrated samples and ISCO automated samples were taken by project personnel during each runoff event.

During rapid fluctuations of stream discharge, sediment yield was determined by a series of water samples taken during the rise and fall of flood waters in the stream channels. Each discrete water sample represented the water quality of the stream for a specified period of time, when the stream was at a specified stage and water velocity. Each discrete sample was analyzed. The stream yield of sediment for each period of time was the product of the time period in minutes, the stream flow in cubic feet per second, and the concentration of sediment in the stream at that time. During a high stream flow event, the quantity of sediment carried by the stream is the sum of sediment loadings for each time period sampled.

Table 1 illustrates sediment concentrations and yield for June 19th flood. Note that sediment yield for the flood is the summation of the individual samples of stream flow and sediment concentrations over the duration of flood flow. The accuracy of the sediment yield calculation increases as the number of sediment samples and stream flow measurements increase.

Since 1993, rainfall produced 32 stream sampling events which generated 2550 storm event sediment samples. The relatively large number of high stream flows allowed plotting of the station stage-discharge curves for the C, D, and I ISCO sampling stations. With the stage-discharge curve and sediment concentrations, the surface runoff and sediment yield was calculated for each flood event monitored. Table 2 summarizes the flood discharges and sediment yields at Stations C and D since November of 1992.

For the subwatershed above Station D, sediment delivery was only 3.4 tons per acre over the entire 1993-1994 sampling period. Between sampling Stations C and D, the C subwatershed had a much higher sediment yield of 10.9 tons per acre. While the relatively flat D subwatershed was 70 percent rowcrop, the steeper topography of the C subwatershed allowed only 32 percent rowcrop landuse. If rowcrop landuse (507 acres) was the dominant sediment source (70 percent of total sediment yield) in the C subwatershed, then C rowcrop lands would have had an average sediment delivery rate of 23.7 tons per acre since 1993.

Sediment transport from the C subwatershed was 7.2 tons per acre-ft of floodwater discharge, while only 3.4 tons of sediment per acre-ft of floodwater was transported from the D subwatershed. These facts indicate that higher sediment delivery rates from the steeper C subwatershed was not the result of significantly higher water discharge rates. Based upon both tons of sediment per acre-ft of floodwater discharge and tons of sediment per acre of watershed, sediment basins in the C subwatershed will have half the effective lifetime of the sediment basins in the D subwatershed.

Sediment delivery from 5 storms (4 in the fall of 1993 and 1 in April of 1994, Table 3) represented 55 percent of the sediment delivery from all 32 storm events since November of 1992. The sediment delivery was twice as large from the April storm event (11.6 tons per acre-ft) as from the September floods (6.0 tons per acre-ft) in the C subwatershed. Sediment yields from the D, H, and I subwatersheds indicate a doubling of sediment delivery from the April storm when compared to the large September storms. Setaside acreage were plowed up during the fall and spring when the USDA moved to increase crop production. Much of the setaside acres were steep marginal lands, which had not been in production for many years.

The high sediment delivery of the April storm is significant. There were no large spring storm events (> 3 inches) between 1979 and 1993, when the sedimentation rate in Lake Pittsfield dropped by 50 percent. Five large spring storms occurred at Pittsfield between 1960 and 1979.

The summations of sediment yields and floodwater discharges for all five flood events (Table 4) again reveal the doubling of sediment delivery from the C subwatershed on a tons/acre basis when compared with both the D and I subwatersheds. The C subwatershed also had twice the sediment delivery rate when based upon tons of sediment per acre-ft of floodwater discharge. The sediment delivery rates will be utilized to evaluate the effectiveness of sedimentation retention basin to reduce sedimentation of Lake Pittsfield in upstream subwatersheds.

The large April 11th storm was composed of 3 separate thunderstorm cells, which passed over the watershed in 24 hours. Each thunderstorm cell generated hydrographs with differing sediment and water discharges relationships. The first hydrograph with the smallest peak flow had the greatest peak sediment discharge because of high sediment concentrations. The later thunderstorm cells produced greater floodwater discharges with smaller sediment discharges. Many of the largest storms, which produce the greatest percent of sediment delivery from watersheds, are composed of multiple cells moving across the landscape at different times during the event.

Such variation indicates the large number of event samples necessary to accurately evaluate the effectiveness of watershed management strategies on pollutants such as sediment, when pollutant concentrations and yields varies so widely during the flood event. This difficulty is compounded by the infrequent and limited time periods at which the pollutants are being transported from subwatershed into the stream channel.

The effectiveness of the large sediment retention basin at B is being evaluated by the standardized National Nonpoint Monitoring Program. Following the upstream-downstream monitoring plan, the sediment yield relationship between the sediment basin outflow at B is evaluated against the basin inflow at C before and after basin construction. Two years of monitoring in 1993 and 1994, will determine the preconstruction relationship.

Additional storm event monitoring will supplement the National Monitoring effort. Such event sampling compares the sediment yields between the C and B Stations by allowing for time of travel in sample selections for regressions. In addition, the dopler flow meter at the B ISCO Station will allow event sediment calculations during lake backwater episodes with the equivalent accuracy of upstream stations. Backwater during high lake water stages do not allow accurate flow measurement from a stage-discharge curve during the falling limb of large flood hydrographs at B.

For the short duration floods, landuse along the stream corridor will influence sediment concentration in the smaller discharge volumes more heavily than storms with greater volumes of runoff. The placement of swine in the stream riparian areas creates large areas of very erodible soils. The sediment concentrations in the rising limb of the flood hydrograph are increased by the soil disturbing activities of swine concentrations adjacent to Blue Creek. With larger amounts of flood runoff, the severely disturbed riparian soils would contribute a smaller portion of sediment yield. Both cattle and swine are confined to smaller areas in the spring and summer when crops are growing.

Precipitation

Rain gages have been established at C and H ISCO sampling stations and an additional raingage was positioned at the Water Treatment plant near Station A. The rankings of 1993 and 1994 rain events by precipitation amounts with previous years are shown in Table 5.

Precipitation records indicate that 1993 would rank as the second highest year in inches of precipitation since construction of Lake Pittsfield (Table 5). With the annual precipitation record, are the results of four lake sedimentation surveys. The 1992 lake sedimentation survey found an extremely low sedimentation rate of 0.7 tons per acre per year for the 1985-1992 period. However in all years between 1985 and 1992, the annual precipitation totals were below the average annual amount of 39.2 inches. This is when the drought of 1989 forced the City of Pittsfield to reevaluate the water storage capacity of Lake Pittsfield and the economic consequences of sedimentation. It should also be noted that no large spring storm events occurred since 1979 until the April 11th storm in 1994. This spring storm had twice the sediment yield of the large September storms which are characteristic of all large storms between 1979 and 1994.

The 1985 lake sedimentation survey (Bogner, 1986) occurred after implementation of BMP soil conservation practices in 1979-1981. Precipitation for this period was much greater and resulted in an average sediment yield of 3.3 tons/acre in Lake Pittsfield. This sedimentation rate was only 57 percent of the lake sedimentation rate prior to the installation of BMP's in 1979.

The 1993 sediment yield of 4.9 tons/acre for Station C is similar to the sediment yield (5.7 tons/acre) for Station C in 1981 (Lee et al, 1982). The 1981 and 1993 monitoring periods represent the fourth and second rankings of greatest annual precipitation. In 1980,

Lee (et al. 1982) found a 0.9 tons of sediment/acre in the watershed above Station C, which is very similar to the 0.7 tons per acre found in Lake Pittsfield during the 1985-1992 monitoring period. Also in 1980, annual precipitation was only 25.74 inches, which is similar to annual precipitation amounts in the 1985-1992 time period. Roseboom (1986, 1990) found similar sediment yields for flood events in western Illinois watersheds. Watershed sediment yields from stream event sampling and lake sedimentation rates are very similar during both wet and dry years.

Table 1. Tabulation of Discharge and Sediment Yield at C During the June 19th Flood

Station	Date	Time	Gage Ht.	Discharge CFS	TSS mg/L	Time/hrs. Duration	Yield Tons	Discharge Acre-ft.	Sample Num.
C	6/19/93	1608	1.4	17.5	5874	2.13	24.6	3.1	1217
C	6/19/93	1816	2.4	43.5	6186	1.10	33.3	4.0	1218
CI	6/19/93	1820	2.7	55.6	4032	0.16	4.0	0.7	1287
CI	6/19/93	1835	4.9	204.4	10386	0.25	59.6	4.2	1288
CI	6/19/93	1850	6.2	342.1	14576	0.25	140.1	7.1	1289
CI	6/19/93	1905	6.8	418.2	11018	0.25	129.5	8.6	1290
CI	6/19/93	1920	6.8	418.2	6797	0.25	79.9	8.6	1291
C	6/19/93	1933	6.9	431.6	6016	0.13	37.9	4.6	1219
CI	6/19/93	1935	6.7	405.0	4465	0.14	28.5	4.7	1292
CI	6/19/93	1950	6.5	379.2	3799	0.25	40.5	7.8	1293
CI	6/19/93	2005	6.3	354.2	4520	0.25	45.0	7.3	1294
CI	6/19/93	2020	6.0	318.5	4214	0.25	37.7	6.6	1295
CI	6/19/93	2035	5.6	273.9	6392	0.25	49.2	5.7	1296
CI	6/19/93	2050	5.2	232.9	6236	0.19	31.0	3.7	1297
C	6/19/93	2058	5.2	232.9	5640	0.13	19.2	2.5	1220
CI	6/19/93	2105	4.6	177.8	5544	0.93	103.1	13.7	1298
C	6/19/93	2250	2.5	47.3	2402	1.75	22.4	6.8	1221
Total						8.66	885.5	99.7	

Table 2. Sediment Yield and Discharge Pittsfield Lake C and D Subwatersheds 1993 - 1994

	C Subwatershed	D Subwatershed
Acres	1567	1756
Rowcrop Land use 1993	32%	70%
Pasture Woodland 1993	63%	30%
Sediment Yield (tons)	17,139	7,664
Discharge ac-ft	2369	2273
Sediment Yield per acre (tons/acre)	10.9	4.4
Discharge/acre inches of runoff (ac-ft/acre)	18.1 1.51	15.5 1.29
Sediment yield per ac-ft of discharge (tons/ac-ft)	7.2	3.4

Table 3. Sediment Yield per Discharge of 5 Storm Events in 4 Subwatersheds*

Subwatershed Rain Event	Rain	Tons of Sediment per Acre-ft of Discharge I	H	D	C
9/2/93	(2.7")	3.9	-	3.5	6.0
9/15/93	(4.5")	3.1	-	2.5	6.0
9/22/93	(2.6")	1.3	3.2	3.4	6.1
11/17/93	(2.2")	1.8	2.3	2.5	2.1
4/12/94	(4.2")	6.2	7.2	6.1	11.6

* These 5 storm events delivered 50% of the sediment yield of all 32 storm events during 1993-1994 monitoring period.

Table 4. Summation of Sediment Yields and Discharges from Lake Pittsfield Subwatersheds during 5 Storm Events*

Subwatersheds	I	D	C
Acres	390	1756	1567
Rowcrop coverage			
Sediment yield (tons)	952	4046	8781
Sediment yield/acres (tons/acre)	2.4	2.3	5.6
Discharge (ac-ft)	257	1159	1175
Discharge/acre	0.66	0.66	0.74
(inches of runoff)	7.9	7.9	8.9
Sediment yield per discharge (tons/ac-ft)	3.7	3.5	7.5

* Storms of 9/2/93, 9/15/93, 9/22/93, 11/17/93, and 4/11/94 generated 50% of Watershed Sediment Yield

Table 5. Rankings of Annual Precipitation and Lake Sedimentation Rates

	Year	Precipitation (inches)	Rank	
	1960	34.07		
	1961	49.04	5	
	1962	31.94		
	1963	28.15		
	1964	32.18		
	1965	43.21		
	1966	32.58		
	1967	48.36	7	
	1968	37.00		
	1969	46.61	8	
	1970	58.92	1	
	1971	32.69		6 of the 10 years with greatest
	1972	28.24		rainfall occur
	1973	53.88	3	
1974 Lake sedimentation	1974	43.98	9	
survey-5.9 tons/acre/yr	1975	41.22		
	1976	25.97		
	1977	40.51		
	1978	34.42		
1979 Lake sedimentation	1979	32.16		Began BMP installation in
survey-5.8 tons/acre/yr	1980	25.74		watershed
	1981	49.92	4	
	1982	46.46	10	3 of 10 years with greatest
	1983	33.92		rainfall occur
	1984	40.38		
1985 Lake sedimentation	1985	48.60	6	
survey-3.3 tons/acre/yr	1986	33.81		
	1987	30.12		
	1988	30.28		All years below average rainfall
	1989	23.93		
	1990	32.12		
	1991	29.09		
1992 Lake sedimentation	1992	35.41		
survey-0.7 tons/acre/yr	1993	54.24	2	Watershed monitoring at C -
	1994	36.42		4.9 tons/acre
	Total	1,325.57		
	Average	37.87		

Great Rivers Confluence

Sarah F. Perkins

Great Rivers Land Preservation Association
P.O. Box 821, Alton, IL 62002

INTRODUCTION

The Alton Lake Heritage Parkway Commission along with other citizens' organizations and local, state, and federal agencies are working together to ensure the long term survival of the ecological integrity, esthetic quality, and economic health of the confluence area of the Illinois, Mississippi, and Missouri Rivers. This paper focuses on the work being done in the Alton Lake Heritage Corridor which borders a 22 mile stretch of the Illinois and Mississippi Rivers. While the importance of this area is without question and has been recognized as such by environmentalists for some time, the State of Illinois has recently recognized the value of this region and included this area in the Illinois River Strategy Project.

BACKGROUND

Between upper Mississippi River mile 203.5 and Illinois River mile 6.0, an area, including the confluence of the Illinois and Mississippi Rivers, there is a combination of natural and cultural characteristics that brings a unique richness to this part of the state of Illinois and makes this region significant to the adjoining ecosystem. It is this fusion of scenic beauty, ecological, historical, cultural, recreational, and commercial aspects of the Mississippi and Illinois river valleys that is unsurpassed anywhere else along the Mississippi and Illinois waterways. This rich landscape is the focus of the beginning stages of the Great Rivers Confluence project.

The Great Rivers confluence is a significant riverine ecosystem not only in the State of Illinois, but for the country. This area holds one of the largest forest systems in the State north of Shawnee National Forest. Many areas along the bluffs have been cited in the Illinois Natural Areas Inventory as having both high quality and significant natural areas. This area is adjacent to the U.S. Army Corps' Riverland project, the nation's largest wetland reconstruction project. The project also borders part of the Mark Twain National Wildlife Refuge south of Grafton, IL. The corridor provides a natural link between riverine ecosystems of the Mississippi and Illinois Rivers and terrestrial ecosystem. This area is also home to federally and state listed endangered and threatened species including the American Bald Eagle, Western Ground Plum, and species of river mussels. In addition, the area is rich with archaeological sites dating back to 9,000 B.P. (before present). In addition to the natural features, there are also businesses within the Corridor, which reflect the river community and recreational uses of the river.

This area is also unusual because of the presence of a roadway, The Alton Lake Heritage Parkway, that runs between the 150 foot limestone bluffs and the river giving travelers easy access to the river and to magnificent views of the surrounding landscape. The Parkway has been designated as a scenic byway.

The Mississippi and Illinois River, the Parkway, and the surrounding landscape are known as the Alton Lake Heritage Corridor. The Corridor is rich in both archaeological and historic resources. For well over 10,000 years the bountiful natural environment of the Illinois and Mississippi valleys has attracted a wide array of prehistoric human settlements. The area around the confluence of the Mississippi and Illinois rivers north of Alton is justly known as the "Crossroads of Prehistoric America," and the central Mississippi Valley north and south of Alton has been characterized as the "Nile of North America" (Center of American Archeology). The density and diversity of archaeological sites in this area is not exceeded in any area of North America north of the Valley of Mexico. By the time of Christ, the area thrived with the villages of Woodland Indians, whose population in the lower Illinois Valley exceeded that of the present day. By A.D. 1000, a prehistoric city with monumental earthworks had sprung up at Cahokia, just south of Alton, that housed some 10,000-20,000 aboriginal residents.

The coming of the Europeans brought explorers such as Lewis and Clark and Fathers Marquette and Joliet to these waters. The paddle wheelers and steam boats of the 1800s brought both people and goods up and down the river stopping at places like Clifton Terrace and the Elsah sandbar for refueling. The beauty of the area has inspired writers and artisans alike such as Frederick Oaks Sylvester, Kathryn Cherry, Henry Lewis, J.B. Blair, James Green, John and Dicey Madson, and Arthur Towata. In addition, each year there are hundreds of artists who come to this area to paint and sketch the striking landscape.

In addition to the natural features of the Confluence area, the Corridor has great recreational potential as it is within a 45 mile radius of a major metropolitan area (St. Louis). The landscape also includes extensive agricultural lands and several rural communities.

The tremendous size and complexity of this area and the relatively unspoiled and unique nature of the macrosite make this a large scale ecosystem of great value and in need of comprehensive management and conservation.

THE GREAT RIVERS CONFLUENCE PROJECT

The Great Rivers Confluence project involves an unusual collaborative effort of citizen volunteers, non-government organizations and local, state, and federal agencies. The collaborative effort to thoughtfully manage the visual and ecological integrity of this area officially began just over four years ago with the Alton Lake Heritage Parkway Law (P.A. 86-1489, as amended), which created the Alton Lake Heritage Parkway Commission. The Project is an endeavor to coordinate the efforts of interested groups and government agencies to bring stewardship to this area which allows people and the river landscape to interact in a way that will enhance both.

At this time, there are two coordinating entities: the Alton Heritage Parkway and the Great Rivers Land Preservation Association, which grew out of the initial work of the Commission. Volunteer citizens constitute the body of both organizations.

Alton Lake Heritage Parkway Commission

The Illinois General Assembly, in 1991, officially recognized this remarkable section of the river as the Alton Lake Heritage Parkway (ALHP), extending 22 miles from the western city limits of Alton, Illinois to Pere Marquette State Park, excluding the town of Grafton. The General Assembly also made provisions for a commission of appointed representatives from townships, towns, and counties adjacent to the Parkway, to develop a land management plan for protection and for future development of the Parkway corridor and its great treasure of resources which have regional and national significance.

Recognizing the significance of the area and the interrelationship of the Parkway with the surrounding landscape, the Alton Lake Heritage Parkway Advisory Commission designated the Alton Lake Heritage Corridor for the area surrounding the Alton Lake Heritage Parkway. The Corridor allows for the preservation and interpretation of large landscapes and their resources through partnerships of local governments, state governments, federal agencies, and private interest. The Alton Lake Heritage Corridor is a structure to recognize, organize, and protect the area's natural, cultural, recreational, and economic attributes. Coordinating private efforts with local, state and federal government efforts is a method of perpetuating important values, stimulating the local economy and improving the quality of life through a cooperative public and private decision-making effort. Such an approach is the only way to ensure that the area's enormous potential survives, as the health of the Corridor reflects the health of the economy dependent upon it.

With input and assistance from several local, state, and federal sources including the U.S. National Park Service, the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Illinois Department of Conservation, Center for American Archaeology, Illinois Historic Preservation Agency, Illinois Natural History Survey, and the Illinois Department of Transportation, as well as with input from local college and university professors, the Alton Lake Heritage Commission developed a master plan for the Corridor. The Land Management Plan was received by the Illinois General Assembly in November 1992 and was unanimously approved.

The goals of this master plan include providing a coordinated plan for the management and development of the Alton Lake Heritage Parkway which will:

- protect significant land areas through cooperative public and private efforts;
- provide a structure to recognize, organize, and protect the area's natural, cultural, recreational, historical, and economic attributes; and
- protect important values, while stimulating the local economy, and improving the quality of life.

The Alton Lake Heritage Parkway Advisory Commission was re-formed as the Alton Lake Heritage Parkway Commission. The Commission now facilitates and coordinates both governmental and private management efforts for the implementation of the land management plan.

Part of the initial work of the Alton Lake Parkway Commission included over 40 community meetings held throughout the project area. Citizens were invited to come to the meeting to hear about the project and to give their input. The National Park Service provided training for volunteer meeting facilitators. Data from these town meetings were then analyzed to determine both concerns the citizens might have and to determine what direction the citizenry thought was important to take.

From these public meetings and from work carried out by the Commission over a two year period, several recurring issues emerged:

- preserve the visual integrity of the corridor;
- control commercialization along the corridor;
- coordinate management of the corridor locally with assistance from local, state, and federal agencies;
- ensure rights of property owners along the Parkway;
- evaluate economic impacts locally from planned uses (uses should not erode the local tax base);
- address public access and recreation opportunities along the corridor;
- provide education and information opportunities locally and for visitors to the Corridor area.

With this information, the Commission developed a management plan for the Corridor and is now in the process of facilitating the implementation of the plan. Figure 1 shows the primary organizations which have been instrumental thus far in moving forward with the plan.

The Alton Lake Heritage Parkway Commission has accomplished the following:

- Conducted over 40 public community meetings with facilitators trained by the U.S. National Park Service to elicit the input of the region's citizens.
- Inventoried and mapped resource data using natural and cultural history experts.
- Commissioned a landscape architect to do a visual analysis of the Corridor.
- Produced and presented a Land Management plan to the Illinois General Assembly in November of 1992.
- Obtained official federal designation of the Alton Lake Heritage Parkway as a Scenic Byway, and thereby accredited the parkway and positioned it for assistance on many projects.
- Helped create a liaison with the St. Charles Greenway Network, the Charbonier Preservation Association, another organization interested in the flood plain located in Missouri on the Florissant bluffs.
- Joined a cooperative effort at obtaining wetlands at the confluence of the Mississippi and Missouri Rivers.

- Began a working partnership with many organizations such as The Nature Conservancy, The Nature Institute, The Illinois Nature Preserves Commission, The American Farmland Trust, The Trust for Public Land, the State of Illinois with the Illinois Department of Transportation as the lead agency, and other federal and state agencies.
- Received grants from the McKnight Foundation, the Alton Community Service League, from another local funding source, and from the Federal Highway Administration (FHWA).
- Obtained a Scenic Byway Grant (FHWA) with a State matching grant for the acquisition and development by the IL Department of Transportation of property at Clifton Terrace to be used as a bicycle access site.
- Submitted an application for the Dunce House and Eastman Barn at Pere Marquette State Park to the National Register of Historic Places for inclusion in the register.
- Expedited the giving of $200,000 of in-kind community services toward the formation and implementation of the Land Management Plan.

Great Rivers Land Preservation Association

The Great Rivers Land Preservation Association (GRLPA) is a nonprofit, charitable land trust chartered in 1992. The main goal of GRLPA is to obtain and steward scenic easements along the Mississippi and Illinois Rivers and bluffs from Alton, Illinois to Pere Marquette State Park. Its mission is to be a non-governmental, local land trust association that holds scenic conservation easements as well as promotes and carries out efforts that will permanently protect the natural and historical resources of the Alton Lake Heritage Corridor and surrounding areas. The GRLPA serves as a bridge between private and public sectors to preserve and enhance the area through private contribution, including scenic easements and land grants.

The basis of the work of GRLPA is to integrate the needs of both private and public interests, to the benefit of all, in protecting this unique ecological area of the Corridor. GRLPA is working with the Illinois Department of Conservation, Illinois Nature Preserves Commission, and the U.S. Army Corps of Engineers on issues of public access to the rivers, rest areas, and natural areas. The goal of this organization is to protect, conserve, and enhance a landscape which reflects the natural scenic, ecological, and historical character on both sides of the Mississippi River and Illinois River confluence area including riparian, wetland, oak/hickory forest, and prairie habitats as well as Native American and other historical sites. This landscape would integrate both ecological integrity and human use compatible to the area.

The major part of the Confluence Project undertaken by the GRLPA has been coordinating the scenic easement surveying with the Illinois Department of Transportation and landowners along the Corridor. The boundary line of the viewshed has now been permanently monumented.

Currently, the land trust is working with over 330 landowners along the viewshed Corridor to obtain scenic easements. While the easements may have some variation to fit a landowner's particular situation, in general the easements include the following conditions:

- no new buildings extending above the tree line can be constructed within the viewshed;
- color of exteriors of buildings within the viewshed are to be compatible with the natural surroundings;
- vegetation within the viewshed is to be native plantings;
- trees within the viewshed may not be removed except if the tree is blocking the homeowner's view.

In this beginning time period, the land trust has obtained voluntary easements thus far from landowners. It is our expectation that many more will be obtained during this next year.

In its three year history, the Great Rivers Land Preservation Association has accomplished the following:

- Assisted in obtaining the dedication of the Mississippi Sanctuary and a portion of the Oblate Father's property as an Illinois Nature Preserve.
- Facilitated the IDOT's viewshed survey crew in locating the GRLPA's survey disks which permanently monument the boundary line of the Viewshed.
- Obtained 6 scenic easements.
- Achieved Forest Legacy designation from the U.S. Department of Agriculture for 20,000 acres of riverine forest and oak-hickory bluff forests.
- Established a joint headquarters at Lewis and Clark Community College.
- Received grants from McKnight Foundation, the Environmental Support Center, the St. Louis Community Foundation, and from a local funding source.
- Received over 60 donations from Friends of GRLPA.
- Accepted title for two parcels of undeveloped property donated by the Morrissey Corporation.
- Accepted title for the undeveloped Rosenberg Property.

Piasa Creek Watershed Conservancy

The Piasa Creek Watershed Conservancy (PCWC) was established in 1993 to address water concerns in the Piasa Creek Watershed. Piasa Creek is the major creek and drainage system within the Corridor. The watershed covers 65 square miles including portions of Madison, Jersey and Macoupin Counties. The PCWC was initiated when it became clear that the confluence of the Piasa Creek and the Mississippi River had a significant visual and ecological impact on the Corridor. The Conservancy began with a grant from the American Farmland Trust to begin to work with farmland owners in the watershed to develop land management practices that would not degrade the watershed.

The Conservancy has initiated meetings with farmland owners with property adjacent to the Creek to begin dialogue and problem solving to correct practices which damage the riparian area. The watershed is primarily farmland, subject to chemical runoff from cultivated fields and to erosion from soil runoff from adjacent fields. The Creek also flows through a town.

To date the Conservancy has accomplished the following:

- Hired a tri-county water coordinator with salary paid by the American Farmland Trust.
- Helped establish a resource partnership for the tri-county Piasa Creek Watershed to identify problems and make recommendations for improving water quality.
- Urged buy-outs in the flood damaged portions of the corridor along the river, including Grafton and Piasa Creek and the Harbor Dell Trailer Park.
- Published a brochure on the Piasa Creek Watershed.
- Assembled a watershed steering committee composed of land owners and officials to further study problems and solutions.
- Interacted with a network of governmental agencies and community organizations to begin a watershed resource plan including preparation for an Environmental Protection Agency Grant.
- Began formulating a concept of developing the Piasa riparian corridor into the Piasa Greenway, a process which involves changing a U.S. Army Corps of Engineer policy of private-exclusive leasing of federal lands for cabin homes in the flood plain to true public use as a greenway.
- Initiated an effort to collect information about the cultural and natural history of the Piasa Watershed.
- Focused public awareness on the need to attend to the health of the Piasa Creek Watershed.

All parties concerned by this area agree that there is much more to do. The work has expanded to include organizations and agencies in Missouri to work on that side of the river Corridor. Efforts are being made to provide green, open space in the Missouri Bottoms to allow for recreation opportunities for citizens as well as space for the Mississippi and Missouri Rivers to flood while decreasing economic loss to the area.

It is our hope that the Rivers Confluence Project can serve as a role model for other conservation efforts which meld private, public, corporate, public, and governmental interests. Protecting and managing watersheds, especially major watersheds like the Missouri, Mississippi and Illinois Rivers is complicated business. But, we are finding that through coordinating the work of the private, public, and government sectors, more sound strategies can be made and action taken that will ensure the health of these systems for generations to come.

Figure 1

Organizations Implementing the Alton Lake Heritage Parkway Commission Management Plan

Great Rivers Land Preservation Association	Piasa Creek Water Conservancy	The Nature Conservancy	Other Group Affiliations and Partnerships
Landowners along the Viewshed	Piasa Creek Partnership	Macrosite	Illinois Department of Transportation
Subdivision Associations	SIUE	Illinois River Strategy Project	Illinois Department of Conservation
Interested Individuals	Principia College		The Nature Institute
	BSA Camp Warren Levis		P.R.I.D.E.
			American Farmland Trust
			Illinois Nature Preserve Commission
			The Nature Conservancy
			Trust for Public Lands

Lt. Governor's Illinois River Initiative

Karen A. Witter

Department of Natural Resources, Lincoln Tower Plaza
524 South Second Street, Springfield, IL 62701-1787

I am pleased to be here to talk about the Lt. Governor's Illinois River Strategy Team. The Lt. Governor launched this initiative in 1994 to follow on from a working group convened by Department of Agriculture Director Becky Doyle and then the Department of Conservation (now Department of Natural Resources) Director Brent Manning.

When the initiative was launched, Lt. Governor Bob Kustra highlighted the importance of the Illinois River:

"Despite a century of alterations, the Illinois River retains approximately half of its floodplain and a flood pulse, and therefore is one of only three large river floodplain ecosystems in the United States recommended for restoration by the National Research Council Committee on Restoration of Aquatic Ecosystems (1992)." He also indicated that, "We must find ways to preserve those parts of the Illinois River system that are in good shape and promote processes that will allow the ecosystem to maintain, repair and rejuvenate itself."

Last fall, the Lt. Governor announced the formation of the Illinois River Strategy Team, which is a panel of agriculture, conservation and business leaders. The Team is counseled by a technical group, the Ecology and Economics Advisory Committee. At the same time, Lt. Governor Kustra cited the importance of citizen involvement in this effort saying "That's why I'm also forming the Illinois River Valley Partnership which will include any citizen or organization that would like to be kept informed about this initiative as well as participate and offer suggestions." To date, nearly 150 entities have signed on.

Overall the goal is to link all the local, state-federal efforts to protect and improve the river, while taking a long-term, systems approach. The brochure for this conference indicates a system approach to river management will be emphasized throughout this conference. That is critical to the future of the Illinois River.

Last night a reception was held marking the 100th anniversary of the State Water Survey and of the Natural History Survey's Stephen A. Forbes Biological Station. Forbes was the founding Chief of the Natural History Survey.

A 1914 quote from Forbes follows:

"To the experienced student of river biology, the river system itself comes to have the aspect of a huge, complex, sensitive, active living organism, of telescopic size and microscopic composition; with its periods of origin, of growth, of development, and of transformation; its peculiarities of structure as related to its environment; its powers of appropriation, metabolism and excretion; its laws of physiological action and of personal behavior; its conditions of health and of disease; its beneficent and its malevolent relations to the welfare of man; and the more completely one succeeds in unraveling the structure and analyzing the activities of this living leviathan, the more clearly he sees that it must be studied as a whole for an understanding of any of its parts, and studied in each of its parts for an adequate understanding of the whole."

Through the work of the Illinois River Strategy Team, both the whole and the parts will be examined.

There are two phases to this initiative:

Phase I - selection of innovative and reproducible model projects that can be repeated throughout the Illinois River Valley.

Phase II - development of an ecosystem recovery plan — essentially an integrated management plan for the Illinois River system.

As a first step, during the Fall of 1994, the technical committee and the strategy team developed a vision for this initiative. The vision of the Illinois River Strategy Team is a naturally diverse and productive Illinois River Valley that is sustained by natural ecological processes and managed to provide for compatible social and economic activities. The Team and committee also developed guiding principles and criteria for model projects which provide direction to applicants and frame the decision-making for model project selection.

GUIDING PRINCIPLES

1. Promote compatible social and economic activities that enhance the integrity of natural ecological systems which sustain the Illinois River Valley.

2. Efforts must be based on planning and grassroots coalition building that includes local citizens and all levels of government.

3. Both the public interest and private property rights must be recognized, and all actions must strive to maintain a balance between the two.

4. All actions must appropriately reflect scientific and economic data, as well as possess practical applications.

5. Efforts should focus on areas that currently possess the highest ecological integrity and hold the greatest potential for recovery. It also must be recognized that great benefits to the system may arise from addressing stresses in highly altered areas.

6. Priority should be given to voluntary and incentive based actions.

7. The strategies developed should be consistent with other ecosystem based management strategies that are being developed at the local, state and regional levels; as well as serve as a template on a broader scale with the ecological and economic needs of the upper Mississippi River Basin.

8. Efforts should capture the natural and free energies of the system.

9. It must be recognized that economic and environmental sustainability are directly linked with ecosystem health.

10. All efforts must be based on the recognition of the importance of ecological phenomena.

CRITERIA

1. Replicable and transferable.
2. Socioeconomic impacts are favorable and the project has regional and local support.
3. Promotes natural and sustainable ecosystem structure and function.
4. Improves water and sediment regimes.
5. Enhances important natural resource values.
6. Fulfills the guiding principles.
7. High promotional and educational value.

The first part of 1995 was spent evaluating the 48 proposals that were submitted in response to a solicitation. There are two categories of recognition: model projects and model approaches.

Projects are comprehensive efforts involving watershed management planning, evaluation of causes and solutions to problems impacting the Illinois River, as well as restoring the ecosystem, with monitoring to evaluate progress. Model Approaches are specific actions that can be implemented in a portion of a watershed and that contribute to improving the health of the river system.

Last month, Lieutenant Governor Kustra held a press conference to announce the first round of models identified by the Illinois River Strategy Team. He also presented a directory of model projects for the expressed purpose of enabling others in the watershed to become aware and be able to reach to the contact persons to learn more about the efforts that are applicable to their portion of the watershed.

Ten model projects and Five Model Approaches are identified in the directory, which I'll summarize briefly. The sites are beginning from the northeastern corner of the state, and continuing downstream.

The projects are located up and down the Illinois River. You have heard about a number of them from speakers in the previous panel. They include: Chain O'Lakes, Tyler Creek, Urban Watershed Planning in Northeastern Illinois, Kendall County Soil & Water Conservation District, Mackinaw River Watershed, Urban Stream and Bluff Erosion Control-Heartland Water Resources Council, Blalock Creek, Peoria Wilds, Rice Lake, Chautauqua National Wildlife Refuge, Prairie Hills Resource Conservation & Development, Inc., Upper Sangamon River Watershed, Site M and Great Rivers Confluence.

All of these projects represent positive activities in the watershed. They all have strong partnerships, local involvement, and address the guiding principles.

As for Phase Two, we are just now exploring how to go about what the Lt. Governor Kustra describes as "a full ecosystem restoration plan for the entire river system, in which we will examine the economic constraints or benefits and consider alternative management strategies for ecosystem recovery and sustainability."

SUMMARY OF MODEL PROJECTS

1. Chain O'Lakes and Fox River, in Lake County. This Model Project offers a beneficial use of sediment dredged from the waterway. Areas were identified that were historically known to be wetlands, but have been altered. These areas will be restored to wetlands, providing wildlife habitat and retaining sediment. Containment dikes will be created around these areas using an experimental fabric, with dredge material pumped in for wetland restoration.

2. Model Approach to planning to protect and restore a tributary, Tyler Creek. (A portion of this creek in Kane county is channelized, another segment flows through crop land, and the segment with the richest aquatic resources is in a highly urbanized area). The Openlands Project, a not-for-profit organization, is conducting a demonstration project involving officials from three municipalities along the creek, and representatives of county government and the forest preserve district. They meet monthly to explore the environmental and economic issues and pressures in the area. The products from this demonstration project will include a report for each participating unit of local government, describing short and long term strategies to achieve the protection and/or restoration of the water quality and biological integrity of Tyler Creek.

3. Urban Watershed Planning in NE Illinois, in Cook County, Northeastern Illinois Planning Commission. This model project is a manual to be prepared that will empower landowners, organizations, and public jurisdictions by providing clear information regarding low-cost techniques for improving environmental conditions along stream-based greenways. It will specifically address concerns, such as stream maintenance, bank stabilization, stream and

wetland protection ordinances, riparian buffer restoration, aquatic habitat, and incorporation of trails.

4. Kendall County Soil and Water Conservation District: Model Approach to revegetate the banks of a tributary, Aux Sable Creek, to reduce sedimentation (Kendall and Grundy). The initiative includes a proposed effort to vegetate 75-100 percent of the creek bank within a five year period. The area to be replanted would be approximately 100 feet in width along the creek. Several sites along the Aux Sable Creek will be monitored to gain information concerning non-point source contributions of sediment.

5. Mackinaw River Watershed, in Tazewell, Woodford and McLean counties, proposed by Illinois Chapter of The Nature Conservancy. This model project is a large sub-basin of the Illinois River, which has a diversity of fish and mussel species in its high quality segments, and significant erosion, flooding and sedimentation problems in its lower reaches. This is a public-private partnership for river protection and restoration based on scientific study of the river's dynamics and surveying social and economic concerns of the landowners.

6. In Peoria, Woodford, Tazewell counties, units of local government are focusing on an erosion control ordinance. Erosive forces contributing sediment is one of the most critical problems in the Illinois River watershed. Consequently, the Tri-County Regional Planning Commission is being recognized for their regional collaboration in a Model Approach for developing locally developed tools to reduce erosion related to development.

7. In Peoria County, the Urban Stream and Bluff Erosion Control Model Approach, being conducted by the Heartland Water Resources Council is recognized. Due to previous success stabilizing areas along Big Hollow Creek, now landowners are working with the Council to obtain the resources to stabilize highly erodible sites along a tributary to the creek.

8. Reconstruction of Floodplain Adjacent to Peoria Lakes, Woodford County. Landowners in a 240-acre portion of the watershed of Blalock Creek are being assisted by the Heartland Water Resources Council in seeking public funds to reduce the sediment being delivered to the Illinois River. This model project seeks to reconstruct natural floodplain values along lower Blalock Creek by reestablishing bottomland hardwoods and wetlands.

9. Peoria Wilds, Peoria County. The oak-hickory bluff forests along the Illinois River at Peoria are the focus of this Model Project designed to preserve habitat for threatened and endangered species, and also reduce soil erosion, through voluntary preservation and management to mimic natural forces such as prescribed burning.

10 and 11. Rice Lake Complex is a Model Project in Fulton County, where the Illinois Department of Natural Resources and the Corps of Engineers collaborate in the Environmental Management Program. Chautauqua National Wildlife Refuge, in Mason County, U.S. Fish and Wildlife Service, is one of the Illinois River National Wildlife and Fish Refuges. The primary purpose of these model projects is habitat improvement for migratory waterfowl and

shorebirds, using the one-year and ten-year event levees to simulate the natural processes of the Illinois River to create high quality wetland habitats. At Chautauqua, the levees are set back, away from the river, enlarging the naturally fluctuating floodplain area. At both Rice Lake and Chautauqua, the flood/dry cycle, as well as the use of native vegetation in floodplain restoration and bank stabilization improves the sediment regime of the river.

12. Prairie Hills Resource Conservation and Development, Inc.: Model Approach for landowner involvement in watershed management planning for the Spoon River (Fulton, Knox, Peoria, Stark, McDonough, Henry, Warren, Bureau, and Marshall). Following regional public meetings in the watershed, a Spoon River Watershed Development Action Team was formed. The Team meets on a regular basis to address issues such as water supplies, soil erosion, compatible recreation and tourism, and riparian management. The team will identify and evaluate challenges and opportunities, develop goals, secure funding and compete for grants, and strive to improve the watershed of the Spoon River.

13. Upper Sangamon River Watershed Management, in Macon County, proposed by the City of Decatur. This model project involves farmers in the watershed of Lake Decatur voluntarily, with incentives, altering agricultural practices. To solve the regulatory problem of high nitrate levels, the City of Decatur and the Illinois Environmental Protection Agency entered into an agreement to use an innovative watershed management approach over a number of years — instead of expanding their water treatment facility or securing an alternative water source.

14. Site M-Riparian Corridor Restoration/Stream Stabilization, in Cass County, proposed by the Illinois Department of Natural Resources. This 16,000-acre site encompasses the majority of the watersheds of two creeks which are tributaries to the Illinois River. In this model project, the watersheds of Cox Creek and Panther Creek will be evaluated to determine their historical conditions, as well as what are the upstream and downstream causes of streambank erosion, to determine the appropriate restoration methods. Restoration methods can also be compared on the two creeks, providing the opportunity to present demonstration projects to the public.

15. Great Rivers Confluence, in Calhoun, Jersey, Madison, and Macoupin counties, proposed by the Great Rivers Land Preservation Association, Inc. In this model project, the scenic vistas, upland forests, and rare plants and animals along the southern reaches of the Illinois River are being preserved through the voluntary actions of landowners, local and regional organizations, and local, state and federal government partnerships.

Time did not allow for these projects to be described in detail. The information is provided here for informational purposes. Acknowledgment is given to Gretchen Bonfert for providing this information. Ms. Bonfert is assisting the Lt. Governor's office with the Illinois River Strategy Team.

Multi-Objective Watershed Planning: the Butterfield Creek Experience

Peggy A. Glassford, Village of Flossmoor, Illinois
Dennis W. Dreher, Director of Natural Resources,
Northeastern Illinois Planning Commission,
222 South Riverside Plaza, Suite 1800, Chicago, IL 60606
Robert M. Bartels, Consoer Townsend Envirodyne Engineers, Inc.

Presented by Tom Price, Senior Engineer, NIPC

ABSTRACT

Butterfield Creek drains a watershed area of 26 square miles in southern Cook County, Illinois. It is plagued by problems which are common in urbanizing areas, including increased flooding, severe channel erosion, water quality impairment, aesthetic degradation, and an overall loss of beneficial recreational uses. To address these problems, the communities in the watershed banded together in the mid-1980s to form the Butterfield Creek Steering Committee. The Committee recognized that the best course of action for addressing its myriad problems was to take a comprehensive watershed planning approach.

The Committee, with the assistance of an environmental planning consultant, the Northeastern Illinois Planning Commission, and the Illinois Department of Natural Resources, has recently completed *A Vision for Butterfield Creek*. This plan provides a concept for not only reducing the aforementioned problems but also for converting the stream corridor to a recreational and aesthetic amenity for local communities. The plan identifies conceptual plans for restoration of degraded stream channels, for enhancing the flood storage and habitat functions of degraded regional wetlands, for developing stream-based recreational and trail opportunities, and for accommodating new development in an environmentally conscious, cost-effective manner. Important themes of this plan include restoration of native vegetation in riparian zones and linking the stream to existing and planned trail systems via an integrated greenway.

BACKGROUND

In the early 1980s, the Butterfield Creek watershed experienced several large flood events which filled both the flood prone areas and the local government board rooms to overflowing. Political pressure to end flooding led to the formation of a local steering committee whose focus was to get state and federal assistance to dam, divert or detain the stormwater.

The last 10 years has taught everyone involved many lessons in the complex world of stormwater management. Local officials and floodplain residents began with a hope that somebody else would provide a relatively quick solution with lots of money. The reality has been a study in self-help and intergovernmental cooperation with very limited funding. The Butterfield

Creek story is a series of multi's: multi-community, multi-agency, multi-objective. What was learned can be applied by others in their watershed.

The Butterfield Creek watershed is a 6735 hectare (26-square mile) area located approximately 48 kilometers (30 miles) south of Chicago, Illinois. Portions of eight communities are located in this watershed. Approximately 60% of the watershed is developed with typical suburban land use, 23% is still being used for agricultural production, and 15% is in public open space or is currently vacant waiting for construction of new developments.

Historically, the creeks draining the upper portions of the watershed were part of a wide, prairie wetland. As the creek proceeded downstream, the terrain became steeper and the channel was much more defined. As farmers settled, farm tiles were installed, the upstream portions were drained, and the waters were carried away in small manmade channels. Early urban development was concentrated in the downstream portion of the watershed, primarily on the higher elevation lands and along the floodplain of Butterfield Creek. By 1980, new development had crowded out onto the natural floodplains and into wetlands and other natural storage areas through use of both drainage and fill.

These changes resulted in higher peak flows during storm events and significantly higher damages to the developed properties. The downstream communities were very concerned about what would happen when additional development occurred on the undeveloped land upstream.

SEARCHING FOR SIMPLE SOLUTIONS

The Butterfield Creek Steering Committee (BCSC), representing seven communities of the watershed and Cook County, was formed in 1983. The first action of the Committee was to request the state and federal governmental agencies to stop the flood damages. The U.S. Soil Conservation Service (now Natural Resources Conservation Service, or NRCS) and the Illinois Department of Transportation, Division of Water Resources (now Illinois Department of Natural Resources, Office of Water Resources, or OWR), provided the first interagency cooperative response by conducting a study of flooding and flood damages in the watershed. Structural solutions were to be evaluated as part of the study and the local communities waited to see if these agencies would solve their problems.

In April of 1987, the NRCS presented preliminary results of the floodplain management study to the BCSC and local citizens. The results presented were very disappointing to all in attendance. While substantial flood damages were identified, they were scattered and many different measures would be needed to significantly reduce the damages. The benefit/cost ratio for these upstream structures did not meet Federal or State criteria for the expenditure of their funds to solve the problems.

Although the NRCS floodplain management study (NRCS, 1987) did not result in funding to solve the flood problem, it did identify three very important facts about the watershed. First, the current flood insurance maps for Butterfield Creek were inaccurate — the recalculated 100-

year flood level was as much as 0.76 meters (2.5 feet) higher in some locations. Second, most detention standards for new development, in force in 1987, would not prevent increased flood damages in downstream areas (Bartels, 1987). Finally, the study identified the significant areas of natural storage in the upstream watershed would go up by at least 50% and possibly by as much as 500%.

TACKLING THE COMPLEX

Recognizing their vulnerability, downstream communities requested, through the BCSC, the cooperation of all communities of the watershed in addressing the flood problems. If flooding could not be easily stopped, at least they could work together to plan and control their future before more of the watershed developed and flood damages increased. Recognizing that a commitment to help each other would benefit both upstream and downstream communities, all involved communities agreed to continue the BCSC efforts. Although there were no easy answers, it was understood that all seven communities, along with Cook County, were impacted by what happened in the watershed and along Butterfield Creek.

Organizing and staffing the BCSC was an immediate problem; fortunately, the Northeastern Illinois Planning Commission (NIPC), a regional planning agency for the six-county area of northeastern Illinois, agreed to provide basic help with agendas, mailings, minute taking, and some engineering evaluations. The OWR agreed to provide a liaison to the Committee. Depending upon the particular need, the U.S. Army Corps of Engineers, the NRCS, the U.S. Environmental Protection Agency (USEPA), the U.S. Fish and Wildlife Service, and the Federal Emergency Management Agency (FEMA) all agreed to provide future assistance. With multiple communities and multiple agencies around the table, the group began to tackle the complex task of watershed management.

WATERSHED PLANNING ACTIVITIES

Goal Setting

Goal setting proved a critical juncture for the Committee. This was when the participants discussed and concluded that flooding problems and environmental concerns were inextricably connected and that in order to tackle one, the other must be considered. Thus, the goals became multi-objective:

1. Reduce flooding and minimize streambank erosion in the Butterfield Creek drainage basin.
2. Protect the storm and floodwater capacities of natural detention areas and protect wetlands for their resource management benefits.
3. Preserve additional public open space to increase recreational opportunities (including trail facilities), to protect and enhance natural resource benefits, and to improve the environment within communities and neighborhoods.

4. Improve the maintenance of streams in order to maximize natural water resource benefits and the aesthetics of stream corridors.
5. Improve the quality of water in Butterfield Creek and its tributaries.
6. Achieve a mutually supportive, basin-wide management and regulatory framework for development activities affecting Butterfield Creek watershed.

Develop Stormwater and Floodplain Management Regulations

Having agreed to goals, the Committee's next step was to create a model stormwater and floodplain management code for the communities. A state statute was passed in 1988 that mandated new floodplain regulations. This created an opportune time to review current ordinances and at the same time address some of the issues raised by the NRCS study of the watershed. It was concluded that any code developed by the BCSC would address all issues of stormwater management. The village engineer for one of the downstream communities worked with the NIPC staff to develop the Model Code (BCSC, 1990).

Highlights of the Model Code are:

- The storage capacity of those all important natural storage areas identified in the NRCS study will be maintained.
- Detention requirements for new development were significantly strengthened. Release rates must meet 100-year storm limits of 0.0105 cubic meters per second per hectare (0.15 CFS per acre) and two-year storm limits of 0.0028 cubic meters per second per hectare (0.04 CFS per acre). The two-year requirement is to prevent increased erosion of downstream channels.
- The adverse water quality effects of new development are addressed by: requiring effective erosion and sediment control, encouraging "natural" drainage practices, and requiring detention basin designs which enhance pollutant removal.
- The regulatory floodplains have been expanded to coincide with those defined in the NRCS study.
- Very limited uses in the floodway, allowing only public flood control, public recreation and open space, crossing roads and bridges.
- Fees are allowed in lieu of detention for small developments where small individual detention basins for every site are not reasonable. This will require careful planning to create centralized detention at the needed locations.
- New developments along streams are required to have 22.8 meter (75-foot) setbacks with a 7.6 meter (25-foot) vegetated buffer strip along the stream.
- Site permits are required for all development. Development is defined as "any manmade change to real estate". This regulation includes the grading of all private property including residential.
- All regulations related to stormwater management are consolidated into this one code.

To date, five of the seven communities on the BCSC have adopted the Model Code. These five include all of the communities located in the upper portions of the watershed.

With stronger regulations adopted, the residents of the watershed threatened by floods have been given some insurance against worsened flood conditions in the future.

Flood Hazard Mitigation Plan

In order to establish priorities for reducing flood hazards in the watershed, NIPC officials prepared options for Committee evaluation. This effort was funded by FEMA through OWR, and the final product was a Flood Hazard Mitigation Plan (Price and Dreher, 1991) in which known mitigation options are described and recommendations for action are outlined. These recommendations are now before the policy boards of the watershed communities. It is hoped that each community will adopt the Hazard Mitigation Plan.

THE MULTI-OBJECTIVE APPROACH: A PLAN FOR ACTION

Discussions at the BCSC meetings in 1991 pointed out the need to develop an Action Plan. This plan, completed in 1992, combines the twin goals of mitigating flood hazards and protecting the watershed environment. The committee members divided the Action Plan into logical categories with members of the Committee taking leadership for a specific category. Highlights of the plan and accomplishments to date are as follows.

Natural Storage Acquisition/Greenway Planning

A major element of the action strategy is preservation, and possible enhancement, of the upstream natural storage areas. Public ownership of this land would meet the primary objective of flood control, but it could also satisfy other objectives such as passive recreation, preservation of open space and, in some cases, habitat restoration.

A key question is who will provide the funding? The open space benefits and some recreation advantages would primarily go to the community where the land is located. The flood storage benefits would accrue to both the community where the site is located and to downstream communities.

Recognizing these mutual advantages, the watershed committee united behind an effort to secure funding for the acquisition of the natural storage areas. Short on funds, but long on cooperative and informed member communities, the Committee worked with state agencies to tie down $250,000, which had previously been allocated for flood control, for land acquisition. The Village of Matteson, in which the principal natural storage areas reside, is currently pursuing the arduous task of identifying land parcel owners and negotiating land purchases and/or donations.

Part of the land targeted for acquisition lies within a greenway recently designated in the Northeastern Regional Greenways Plan developed and adopted by NIPC in cooperation with the Openlands Project, a private open space advocacy organization. It is hoped this will facilitate the obtaining of additional funds to purchase the land identified.

Water Quality Management Projects

The water quality, aquatic habitat, and aesthetic conditions of Butterfield Creek are all degraded. Because there are no significant wastewater discharges to the creek, it was easy to conclude that identified problems are caused by "nonpoint" sources of pollution. With funding from USEPA, the watershed was thoroughly evaluated and a preliminary nonpoint source management plan (Dreher et al, 1992) was developed. The study concluded that the major sources of stream degradation were urban runoff and stream channelization, with additional contributions coming from problem septic systems and illicit wastewater connections to storm sewers.

Many of the actions recommended were also included in the Flood Hazard Mitigation Plan (Price & Dreher, 1991). It identified the need for stringent controls on development similar to those in the Model Code (BCSC, 1990) with some enhancements. The plan recognized that public awareness and access must be improved; it specifically recommended the acquisition of riparian open space and the expansion of a streamside trail network.

Recognizing that implementation of this plan could be enhanced by timely demonstration projects, USEPA funded two activities to demonstrate innovative, multi-purpose design of stormwater facilities. The first demonstration was aimed at designing and constructing a wetland biofilter to remove sediment-related pollutants from a mixed use development, thereby protecting an adjacent lake/wetland system. The second demonstration involved the retrofitting of an existing, single-purpose detention basin to improve its ability to remove runoff pollutants and to control erosion-causing storm flows. Both of these demonstration projects addressed maintenance, public education, and aesthetics as critical elements to their long-term success and acceptability by local officials, developers, and residents.

In response to severe channel erosion problems, the Illinois Department of Conservation provided funding for a project to demonstrate effective, low-cost streambank stabilization using a technique called brush layering. Brush layering utilizes naturally occurring, dormant willow posts to stabilize stream banks via their dense root structures and by deflecting erosive flows away from the bank. This demonstration was intended to show property owners a way to inexpensively protect their own streambanks — creating an aesthetically pleasing landscape while preventing their property from literally being carried away by floodwaters.

Floodproofing

The most cost-effective method identified in the NRCS study (NRCS, 1987) to reduce flood damages in the Butterfield watershed was floodproofing of floodprone properties. This solution, however, is dependent on acceptance by the private property owner and is sometimes difficult to sell. The Committee, using a model created by OWR, decided to promote the advantages of floodproofing through an educational open house at which local governments and agencies set up informational tables to inform homeowners. OWR planned this event which was attended by nearly 300 people. An interesting highlight of the "Floodproofing Open House" was the presentation by contractors of their floodproofing methods and equipment.

Homewood, a member community of the BCSC, is demonstrating its conviction to this element of the Action Plan. The village is preparing a pilot program under which eight floodprone homes will be elevated a maximum of 0.61 meters (two feet), above the established flood protection elevation. In addition to the house elevation program, eleven homes with basements or lower levels were identified as eligible for a special floodproofing program through the village.

Participating homeowners will be required to pay the first $1,500 towards the cost of elevating or floodproofing. The village will pay for the remaining portion. It is estimated that the total cost of elevating one home will be about $25,000. Having participated in the decision-making and planning process that produced the floodproofing recommendation, homeowners are anxious to have the work begin.

Public Education

The Committee plans a series of educational efforts working with schools and libraries. Already completed is the first of three planned videotapes. The Committee member working on this project convinced the local cable TV company to produce the first fifteen minute video which introduces the Committee and its work. The video was first broadcast to the concerned communities in February, 1993.

A VISION FOR BUTTERFIELD CREEK

The culmination of the watershed planning efforts of the Steering Committee was the recent completion of *A Vision for Butterfield Creek.* This plan was completed with the assistance of an environmental planning consultant, the Northeastern Illinois Planning Commission, and the Illinois Department of Natural Resources. This plan provides a concept for not only reducing identified flooding and water quality problems but also for converting the stream corridor to a recreational and aesthetic amenity for local communities. The plan identifies strategies and techniques for restoration of degraded stream channels, for enhancing the flood storage and habitat functions of degraded regional wetlands, for developing stream-based recreational and trail opportunities, and for accommodating new development in an environmentally conscious, cost-effective manner. Important themes of this plan include restoration of native vegetation in riparian zones and linking the stream to existing and planned trail systems via an integrated greenway.

THE BUTTERFIELD CREEK EXPERIENCE AS A MODEL

The projects completed to date speak for themselves; some could be used in other watersheds, some are unique to this stream corridor. Beyond the projects, however, it is felt there are four universally applicable lessons one can learn from the Butterfield experience. The first is that streams do not respect geographic or political boundaries. Stormwater management must have the cooperation of all the watershed communities in order to solve problems. Demonstrating a united effort also makes it much easier to get outside help.

The second lesson is that help is available. While the State and Federal agencies often receive criticism because of their regulatory responsibility, they are a resource of knowledgeable and dedicated people who really want to help solve problems. The residents of the Butterfield Creek watershed have been blessed with the help of many agencies. The agencies cannot do everything but, if the local governments are willing to work with what is possible, much can be accomplished.

The third lesson is that it is important to know what can be done and what can't be done. The communities and residents of the watershed had to accept that there would be no quick fix for the flooding problems. They had to recognize the need to help themselves and that it would take years of hard work to show any significant results.

Finally, efforts to manage stormwater can also provide a means to protect the environment and provide recreation when a holistic approach is used to find a solution. A multi-objective approach is critical.

Butterfield Creek, like all streams, bears the imprint of its watershed. Every activity on the land draining into the stream impacts the stream's flow characteristics. Flooding, erosion and environmental degradation are the creek's reaction to poor watershed planning. It is the hope of the Butterfield Creek Steering Committee that the waters of their creek will one day bear the positive imprint of the coordinated planning effort they are doing today.

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Coordinated Resource Management: Shunning the Three "Shuns"

Herb Manig

Public Policy Division, American Farm Bureau Federation
225 Touhy Avenue, Park Ridge, IL 60068

What Is the Problem?

In this era of heightened environmental awareness, increasing demands are being made of finite natural resources. All too often these demands for use and nonuse evolve into disputes among the competing interests. And, as one would expect of competitive people, they want their side in the dispute to prevail. What then are the methods of choice? There are three: legislation, regulation and litigation.

Typical of contests, there are winners and there are losers. Seldom are both sides satisfied with a new statute, a court decision or additional regulations.

Is There a Way to Shun the Three "Shuns?"

Some dispassionate reflection might cause one to wonder whether there is a better way; a way to avoid legislation, regulation and litigation; a way that could result in improved resource management with the least conflict among users, owners and public agencies.

Over a number of years, in a growing number of instances, Coordinated Resource Management (CRM) has shown it can be a better way.

What Is CRM?

CRM is a process that brings together all the parties having an interest in a specific natural resource issue for the purpose of achieving consensus regarding the management of that resource. It has been sufficiently utilized, monitored and studied over time so that a body of knowledge has been developed that can assist others.

What Are the Basic Premises of CRM?

CRM was born out of the realization that there are no natural resource problems per se; there are people problems. People are the ones having problems with resource use or preservation.

Whether or not it was formally recognized, leaders in the evolution of CRM employed the behavioral sciences to resolve the conflicts over natural resources. The importance of perception, attitudes, beliefs, learning, motivation, group process, organization behavior, and communication

became paramount to the attainment of cooperation. It was realized that people needed and wanted to participate in the resource decisions that affected them.

These CRM leaders developed the philosophy that "sensitive issues are poor tools to build relationships, whereas strong relationships are powerful tools to resolve sensitive issues." A favorite CRM slogan is, "None of us knows as much about something as all of us."

When Does CRM Become Necessary?

CRM leaders suggest that CRM becomes necessary when competition for allocation of resources is accelerating, when misinformation and misunderstanding about resource cause-and-effect relationships are increasing, when multiple land ownerships and jurisdictions are increasing, and when resources are managed in a confusing framework of overlapping and sometimes contradictory laws.

Where Is CRM Applicable?

Although CRM can be applied wherever a natural resource issue exists, it is most applicable and appropriate at the local level with local persons involved.

Do Government Agencies Recognize the Use of CRM?

There are four primary sources of authority for CRM:

1. The Administrative Dispute Resolution Act of 1990 which authorizes and encourages federal agencies "to use mediation, conciliation, arbitration, and other techniques for the prompt and informal resolution of disputes..."

2. Section 12 of the Public Rangelands Improvement Act of 1978 which directed the Secretaries of Agriculture and Interior to experiment with incentives to create better stewardship of the land.

3. A Memorandum of Understanding (MOU) between the Extension Service, Natural Resources Conservation Service, Forest Service and Bureau of Land Management.

4. MOUs developed by state governments that provide authority to their agencies to work with federal agencies and private parties in a CRM process.

How Can a State Organize Itself for Developing a Memorandum of Understanding?

A common approach is to develop three tiers of administration:

1. A Technical Review Team (TRT) is the most frequently used tier, and it functions at the most local level; i.e., farm unit, small watershed, etc. The TRT is the basic building block

of CRM resource planning and conflict resolution. Here TRT participants must have an intimate knowledge of the target resource. This can best be obtained from on-the-ground experiences.

2. A Steering Committee (SC) can be used to embrace a larger area of the community; i.e., multiple watersheds, several farms, a county, a soil and water conservation district, etc. The SC can provide assistance and supervision to several TRTs under its jurisdiction.

3. A State Executive Committee (SEC) is comprised of the heads of participating federal and state agencies, as well as heads of other appropriate organizations such as general agriculture organizations, commodity groups, conservation groups, sportsmen clubs, etc.

Does CRM Have Any "Rules" That Should Be Followed?

Over the years, the "science" of CRM has evolved to the point that students of CRM agree that there are four cardinal rules:

1. Participation in CRM is voluntary, and the process by which recommendations and decisions are reached is through consensus-building. Unlike a system that uses voting procedures that result in win-lose decisions, the process of consensus-building strives to consider all points of view, and does not move forward until all participants are ready to proceed. Because this requires a special sensitivity on the part of the CRM group leader, a trained facilitator is often utilized.

2. All participants must be committed to the success of the CRM process. Organizations or agencies having a seat at the table, particularly at the Steering Committee level, should send a representative who has the authority to act in behalf of that group. That representative should refrain from using substitutes.

3. All interested parties or interests should be given the opportunity to participate. Excluding an interested party invites attack on the work of the CRM group. Yet the CRM group should have some semblance of balance. For example, if a particular point of view is held in common by several groups, the groups may need to nominate one or two who can speak for all of the groups rather than expect that each group is entitled to have a representative at the table.

4. Participants in a CRM process should express needs, not positions. The expression of positions is akin to drawing a line in the sand, and may lead to confrontation rather than consensus. A statement of needs invites group focus on potential solutions, and is more conducive to an atmosphere promoting cooperation and creativity.

There are a few other principles that also should be noted:

1. A CRM process stands a better chance of succeeding if it is initiated, accepted and supported by affected resource users.

2. Resource needs that have been agreed upon should be placed in priority order.

3. Management objectives should be developed that are measurable and attainable.

4. After developing management objectives, a plan of implementation should be developed.

5. An evaluation or monitoring mechanism should be established so that progress toward objectives can be determined.

6. Participants should constantly strive for teamwork throughout the CRM process.

What Are Some Roadblocks to a Successful CRM Process?

A new CRM group might have a participant who has a hidden agenda, and seeks to undermine the process. When the rest of the participants realize what is happening, they usually coalesce against the disruptive person leaving that individual isolated with little or no influence.

Another problem that has occurred in the past is the agency official who feels that his/her resource management prerogatives are threatened by a process that involves competing interests. An unwillingness to cooperate and become part of the team can lead to frustration of the entire effort.

Sometimes organizations having a representative serving as a CRM participant seek to unduly influence that person. National counterparts of local organizations have even sought to overturn the local organization's "signoff" of a CRM group's management plan recommendation.

At this time, interpretation by some of the Federal Advisory Committee Act has cast a cloud on the legality of using CRM where federal officials are involved. Statutory clarification may be needed to resolve this.

What Was the Catalyst for CRM?

The development and use of CRM evolved in the western states during the 1950s. Problems of competition for natural resources became more intense out West because of the many and varied opportunities for resource use/extraction, and because of the complex pattern of land and resource ownership. For example, half the land surface of a state might be owned by federal government, with its lands being managed by the Bureau of Land Management (Department of the Interior), Forest Service (Department of Agriculture), Department of Defense, and Fish and Wildlife Service (Department of the Interior). Privately owned lands may have the minerals under

the surface owned by others. The water may be owned by the state with use of it regulated under state law. The wildlife running across private and public land alike is owned/managed by the state. The presence of tribal lands and lands owned by the state itself added to the complexity. Clearly this was a recipe for potential chaos and conflict.

Can CRM Be Used in Nonwestern States?

CRM can be used wherever there is a need to develop common goals and cooperative efforts regarding a natural resource management. The use of CRM is expanding outside of the West as CRM's effectiveness becomes more widely recognized. Events that produce conflicts in the West are fairly common throughout the country. The traditional users of natural resources are still a factor; i.e., farming/ranching, timbering, mining, and oil and gas exploration/production. But over the years, increasing competitive pressures have come from hunting, fishing, boating and river rafting, camping, hiking, mountain biking, off-the-road vehicles, wilderness area designations, preservation of wetlands, wild and scenic river designations, riparian area protection, watershed conservation measures, big game herd expansion, endangered species recovery plans, small game and other wildlife protection, demands for increased biological diversity, ecosystem management initiatives, mechanisms to protect aesthetics such as viewsheds, growing towns, increasing numbers of rural residents and burgeoning numbers of tourists. No wonder more statutes are passed, regulations spew forth and court dockets are clogged.

Where Can More Information on CRM Be Obtained?

A document published in June, 1993 entitled, "Coordinated Resource Management Guidelines," is available from the Society for Range Management, 1839 York Street, Denver, CO 80206, phone (303) 355-7070. The Society can assist in providing CRM workshops for those interested. A state CRM workbook published in 1991 is available from the Wyoming Department of Agriculture, 2219 Carey Ave., Cheyenne, WY 82002, phone (307) 777-7321.

The general topic of environmental conflict resolution is discussed in the book, "Environmental Disputes, by James E. Crowfoot and Julia M. Wondolleck, 1990, Island Press.

Economic Problems Facing Illinois River System Cities

Norman Walzer

Director, Illinois Institute for Rural Affairs
Western Illinois University
1 University Circle, Macomb, IL 61455-1390

Rural Illinois encountered significant economic problems during the 1980's as did much of the rural Midwest. Consolidations of agriculture, economic stagnation in many midwestern metropolitan centers, and competition from offshore locations all caused population outmigration in rural areas. While the U.S. population grew 9.8 percent during the 1980's, Illinois increased only 0.03 percent. Further examination shows that the population in metropolitan areas in Illinois increased 1.2 percent, compared with a decline of 5.59 percent in nonmetropolitan areas. Of the 76 nonmetropolitan counties in 1980, 72 had declined in population by 1990. Especially hard hit were small cities with more than 75 percent of those with fewer than 10,000 population losing population in the 1980's.

The 1990's offer some indications of a reversal in the fate of downstate communities. Since the figures for the 1990's are only estimates, one can not be certain of their accuracy and, thus, whether the first half of this decade truly indicates a reversal. Nationwide, nearly two-thirds of the rural counties gained population between 1990 and 1994. Unfortunately for the Midwest, the greatest gainers are in the West. The North Central states, especially those which rely on agriculture, did not fare as well. Retirement and recreation counties, in particular, gained relative to other counties.

Even more significant is the restructuring occurring in the rural Midwest. Overall, many manufacturing jobs have left, especially in metropolitan areas, and have been replaced with services. While manufacturing has been relatively stable in rural Illinois, agricultural employment has been replaced with services in many instances. These employment shifts have often brought about reductions in incomes for people displaced by job changes.

This paper examines several major issues faced by rural communities in the Illinois River Valley (IRV). The paper has three main sections. First, population changes between 1980 and 1994 are examined by county and city size group. Second, the effects of the employment restructuring, especially on rural counties, are shown. Third, attitudes of residents in the IRV[1] area are examined to determine their outlook on the future. Finally, we examine what communities can do to improve the future prospects.

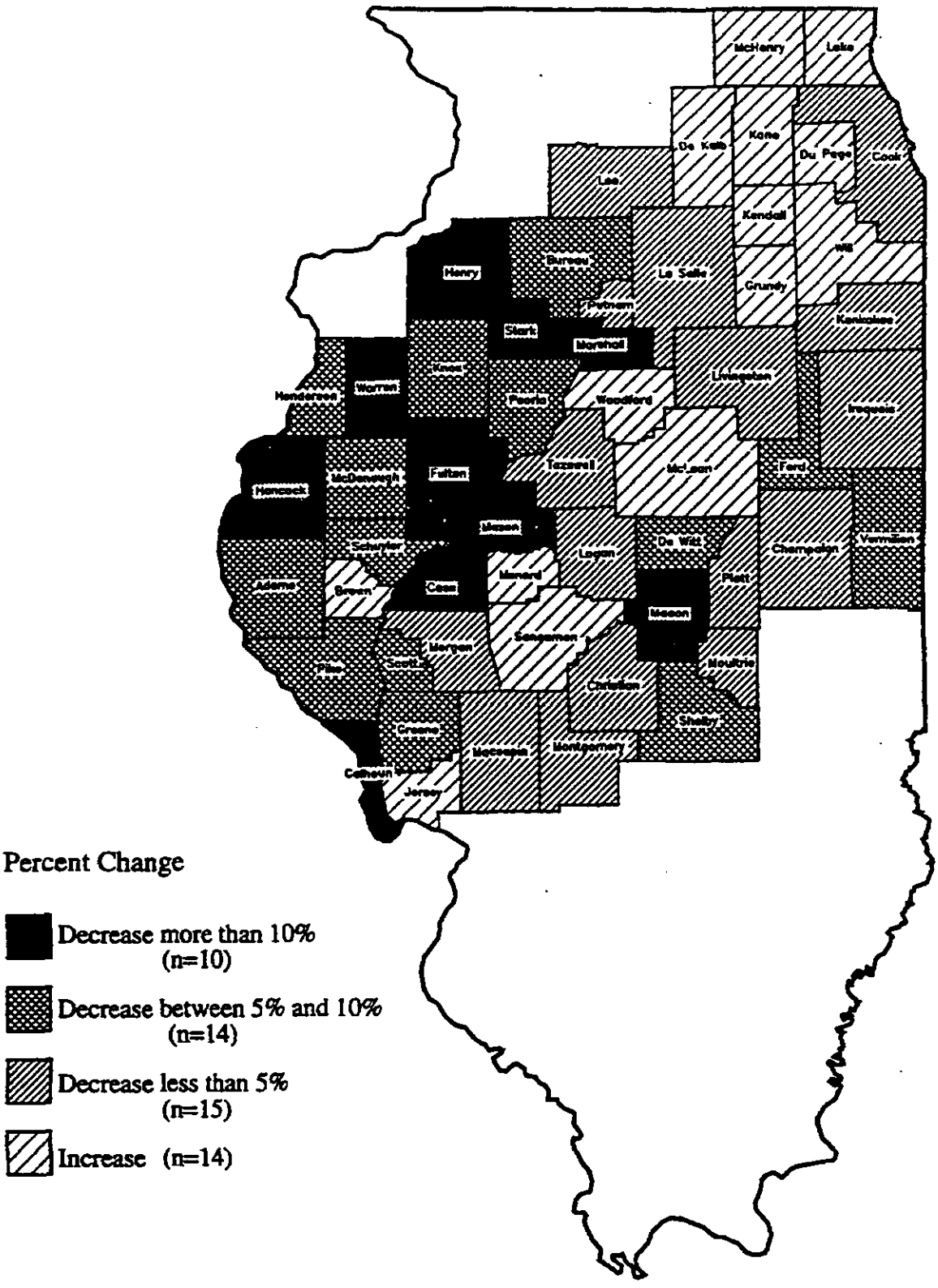


Figure 1. Population Change, 1980-1994.[2]

SOCIOECONOMIC TRENDS

The population trends between 1980 and 1994 (Figure 1) clearly show that counties in the IRV fit into two basic groups. First, counties in the northwestern portion had significant population declines throughout the period. Second, counties in the northern, southern, and eastern portions have fared much better, mainly because they are more closely linked with metropolitan populations. The expansion in the collar counties and the area surrounding Bloomington-Normal accounts for much of the prosperity in these regions. In the western area, much of the economic base is agriculture. Also, metropolitan centers such as Peoria and the Quad Cities did not fare well economically during this period. Business losses as well as advancements in manufacturing productivity reduced the number of employees.

Within the IRV, for most size classifications, more than half of the cities reported population declines during the 1980's. The only size group in which fewer than half (45.3 percent) of the cities did not report a decline was between 10,000 and 19,999. In general, the probability of reporting a decline is inversely related to population size. Specifically, 86.9 percent of the smallest cities (less than 500 population) had declines, compared with 50.0 percent of those larger than 49,999 in this category.

A more detailed examination of population changes in the IRV region compared with the state of Illinois does not show statistically significant differences, after variations among counties have been considered. This results partly because the IRV counties are such a large portion of the state. Not only are 54 counties included in the study area but many are relatively large.

The region also does not differ markedly from the remainder of Illinois in other population characteristics. For instance, the elderly (age 65 and older) were 12.5 percent of the population in Illinois, compared with 12.2 percent in the IRV. No noticeable differences exist in per capita income levels — an estimated $17,998 statewide and $17,290 in the region in 1994. Likewise, the growth rates in the region and statewide are similar.

Significant differences are found, however, in the level of unemployment. The IRV counties had an average unemployment rate of 5.8 percent in 1994, compared with 6.6 statewide. The main explanation is the greater presence of metropolitan centers and overall greater prosperity in northern and central Illinois, than in southern and western, or even eastern, Illinois.

Thus, the IRV communities/counties closely match the state as a whole, with the possible exception of unemployment levels in which case the IRV counties are in relatively better condition.

ECONOMIC RESTRUCTURING

While IRV communities do not differ noticeably from other counties in Illinois, the entire state has experienced a decline in manufacturing employment in the past 15 years with many of the jobs replaced by service workers. Generally, service employment is of two types: producer

services and consumer services. The former includes those workers who provide services directly to businesses including such groups as accountants, engineers, and lawyers. This class typically earns relatively high salaries with good employee benefits.

The other group of service employees is more directly tied with consumers. These include employees in fast food restaurants and some retail employees — auto repair and dry cleaning establishments to name several. Widespread variations exist within each of these groups, but generally producer services pay more than consumer services.

From a locational perspective, producer services typically gravitate toward large cities and consumer services tend to locate in more rural areas. The outcome, of course, is that wages earned by rural residents are often less than in urban areas. Also true, however, is that within the producer service categories rural workers typically earn less for the same job than urban workers. Thus, the growth in service employment has disadvantaged rural communities and residents in two ways: the greater preponderance of consumer services in rural and the disparity in earnings by producer service workers between urban and rural.

The importance of the restructuring from manufacturing to services is highlighted by a comparison of earnings in the two occupational classifications. Within the IRV, manufacturing employees earned an average of $18,754 in 1992, compared with an average of $9,142 in the services classification. This last figure includes both producer and consumer services so it overstates rural communities and understates urban centers. Even though these are very gross figures, it suggests that, within the region, a shift from a manufacturing job to a service job could mean a decline of $6,912 in earnings, not an insignificant amount. For rural parts of the IRV, a shift from agricultural services to consumer services probably does not affect earnings that much, however. For instance, the average earnings of service workers stated above ($9,142) compares with an average earnings of agricultural workers of $8,800. Given that the $9,142 includes producer services as well as consumer services, it definitely overstates the earnings of service workers in rural areas which could make the shifts from agricultural services to consumer services almost trivial in wage differences.

Growth in service employment, both absolutely and relatively, is expected for the foreseeable future. Most likely, this trend will continue to disadvantage rural communities. Earnings in rural areas will remain much lower than in metropolitan areas and probably will increase less rapidly. This metropolitan/nonmetropolitan disparity will exist within the IRV.

ATTITUDES OF RURAL RESIDENTS

In light of the socioeconomic profile and conditions in the IRV, it is important to understand the attitudes of rural residents regarding issues and concerns in their communities and how they perceive the next five years. The data base for this analysis is the Annual Illinois Rural Life Panel (IRLP), sponsored by the Governor's Rural Affairs Council. This panel has been conducted for six years, starting in 1989. The IRLP is a sample of approximately 2,000 rural residents throughout Illinois. The panel was selected to include all ages and walks of life. It contains

approximately one-half males and one-half females. The questions posed to the panel include a wide variety of policy issues to obtain input on issues facing local and state governments.

Quality of Life

Two sets of questions are of special interest in understanding citizens' perceptions of the future for their region. Respondents were asked in 1990 and 1993 how the quality of life had changed for their families and/or their community during the previous five years. They also were asked about their expectations for the quality of life in the next five years. Because of the depth of the data base, profiles can be generated by age and sex. However, due to space limitations, detailed comparisons are not made here.

Consistent with prior discussions, panelists in the IRV mirrored rural attitudes statewide (Table 1)[3]. When asked how the quality of life in their community had changed in the five years prior to 1990, an average of 29.1 percent of IRV respondents reported that it had become somewhat or much better. This compares with an average of 30.0 percent statewide. Slightly fewer (26.9 percent) reported that the quality of life had become somewhat or much worse. Thus, respondents were almost balanced between those who reported that conditions had improved and those who thought they had worsened.

More troubling is the revelation that the percentage who think that conditions in their community had improved between 1990 and 1993 decreased from 29.1 percent to 26.9 percent and those who thought conditions had worsened went from 26.9 percent to 30.8 percent. This is true not only for the region but statewide as well.

Another interesting finding involves differences in attitude regarding quality of life for their family compared with their community. Nearly half (46.8 percent) in 1990 thought that quality of life for their family had improved but these figures dropped substantially by 1993 to 38.2 percent. Likewise, in 1990, 13.6 percent of respondents thought that conditions had become somewhat or much worse for their family and by 1993 the figure was 20.5 percent.

One significant explanation for the reported changes in attitudes may be differences in the business cycle. By 1990, the national economy had undergone a period of unprecedented economic expansion and conditions in rural areas had improved. Many displaced farmers had found alternative employment. Immediately prior to 1993, however, the national economy had experienced a major recession.

Table 1. Feelings About the Quality of Life in Rural Illinois

Item	IRV 1990	IRV 1993	State of Illinois 1990	State of Illinois 1993
			Percent	
During the past five years, has the quality of life in your community . . .				
become somewhat or much better	29.1	26.9	30.0	28.2
remained the same	44.1	42.3	43.0	40.7
become somewhat or much worse	26.9	30.8	27.0	31.1
During the past five years, has the quality of life for your family . . .				
become somewhat or much better	46.8	38.2	48.0	37.9
remained the same	39.7	41.3	37.0	40.5
become somewhat or much worse	13.6	20.5	15.0	21.5
In the next five years, will the quality of life for families in your community . . .				
become somewhat or much better	33.1	25.2	33.0	24.7
remained the same	46.5	43.7	45.0	44.8
become somewhat or much worse	20.4	31.2	22.0	30.6
In the next five years, will the quality of life for your family . . .				
become somewhat or much better	45.7	34.4	46.0	33.7
remained the same	43.8	43.4	43.0	44.4
become somewhat or much worse	10.5	22.2	12.0	21.9
In the next five years, will the overall economic prospects for rural Illinois families . . .				
become somewhat or much better	22.4	19.2	22.0	18.2
remained the same	38.2	33.4	38.0	32.6
become somewhat or much worse	39.4	47.4	39.0	49.3
Has your financial situation today compared with a year ago . . .				
become somewhat or much better	34.4	28.1	33.5	26.3
remained the same	45.0	43.9	44.7	43.7
become somewhat or much worse	20.6	28.0	21.8	30.0

1990 Survey: IRV Watershed Region, n=1,388; State of Illinois, n=2,681.
1993 Survey: IRV Watershed Region, n=1,246; State of Illinois, n=2,343.

Source: Illinois Rural Life Panel Summary Report, Spring 89/90, Vol. 1, Issue 1 and Illinois Rural Life Panel Winter Survey, Illinois Institute for Rural Affairs, 1993.

When asked about the overall economic prospects for rural Illinois, during the next five years, IRV residents were much more positive in 1990 than in 1993. In the former survey, 22.4 percent reported that the overall economic prospects would become somewhat or much better; however, in the 1993 survey, the figure had decreased to 19.2 percent. At the other extreme, 39.4 percent in 1990 thought that overall economic prospects would decline compared with 47.4 percent in 1993. Thus, it appears that nearly half of the respondents in the IRV were concerned about the overall economic prospects for rural Illinois families and communities.

What is Needed?

Respondents in the 1994 Illinois Rural Life Panel were asked to indicate the three most important changes that would improve the quality of life in their community and the three changes which are of least priority (Table 2). The sample sizes are small for this question but respondents in the IRV are similar to those statewide, once again.

Table 2. Improvement of Quality of Life

Item	IRV		State of Illinois	
	Highest Priority	Lowest Priority	Highest Priority	Lowest Priority
	Percent			
Which of the following would improve the quality of life in your community? (check three highest and lowest priorities)				
Bring in new business	73.9	2.2	73.1	2.5
More job opportunities	67.6	2.5	65.7	2.5
More activities for young	40.5	4.5	39.6	6.1
Retain old businesses	38.0	3.6	37.6	4.7
Improve local roads	27.6	11.5	28.8	11.0
Improve water/sewage	22.7	11.7	20.3	13.4
Recreational opportunities	16.2	16.9	15.2	16.4
More local housing	14.6	18.4	15.0	19.1
Downtown beautification	13.9	28.5	14.6	29.2
Public transportation	13.9	31.0	15.3	30.3
Better local housing	13.7	10.1	11.5	9.6
Elder care facilities	12.8	9.7	11.6	10.3
Improve/develop parks	10.3	30.8	10.2	29.2
Better interstate access	8.3	42.0	8.7	39.5
Child care facilities	7.6	11.2	8.5	10.8
Better telephone service	4.5	35.3	5.6	31.7

IRV Watershed Region, n=445; State of Illinois, n=836.

Source: Illinois Rural Life Panel Winter Survey, Illinois Institute for Rural Affairs, 1994.

By far, the most important change to improve quality of life would be to bring in new businesses as reported by 73.9 percent of the IRV respondents. Only 2.2 percent reported that this as a low priority. The next important response was to create more job opportunities as reported by 67.6 percent of respondents.

The third most important change is more opportunities for young people, reported by 40.5 percent. Loss of youth has been a major concern for many years and providing both jobs and entertainment opportunities is important.

Surprising is the finding that better interstate access was considered a low priority by 42.0 percent of respondents in the region and 39.5 percent across the state. This finding is partly tempered by whether an area already has access to interstates. Much of the IRV, except in the western portion, has access to Interstates 74, 55, and/or 80 so additional access may not be as important as additional jobs. Also, improvements in the physical appearance of the downtown and parks/recreation were rated relatively low (13.9 percent and 10.2 percent, respectively) as a way to improve the quality of life. Nearly one-third rated them specifically as low priority. This is not to say, however, that respondents are not interested in expanding employment or the number of stores in the downtown as will be seen in the next section.

What Should be Done Next?

Knowing the attitudes of residents in rural communities about the future is important, but equally important is knowing developments that they would like, or not like, to see between 1995 and 2000. As one might expect, the projects are closely aligned with the identified areas that would improve quality of life. Most important was downtown revitalization (having every store front occupied) with 93.7 percent reporting this type of project (Table 3). The central business district is a constant reminder of what many cities had been in the past and there is often a wish to return to those times. In many small communities this is not likely to occur, however, especially with the growth of regional shopping centers. At the very least, revitalizing and maintaining downtowns will require more jobs with better salaries in the community.

Respondents would like to see more vocational training opportunities, closely followed by more adult education opportunities. The importance of continuing and vocational education stems from the needs for better skills created by the economic restructuring. As noted previously, many residents who undergo an employment change find that they must accept lower wages to find new employment. Many of these jobs require skills that job-seekers, especially in rural areas, do not currently have. Vocational and adult education is crucial to success in the economic changes currently underway. Also considered important is greater use of telecommunications in local businesses, schools, and government. Presumably, residents see the benefits of distance learning opportunities for bringing specialized classes to schools as well as in adult education opportunities.

Building a factory ranked third in importance (85.8 percent) and, again, this corresponds to the interest among residents in jobs. Development of new recreational facilities (83.0 percent), also a job creation venture, ranked almost as important as a new factory. Recreational facilities provide entertainment opportunities as well as creating jobs. Especially interesting is that only 16.0 percent wanted a new prison constructed in or near their community and 84.0 percent reported that they did not want to see such an institution created. This is slightly above the state population as a whole.

Table 3. Community Development

Item	IRV		State of Illinois	
	Would Like	Would Not Like	Would Like	Would Not Like
	Percent			
Developments you would or would not like to see occur in or near your community during the next five years:				
Downtown revitalization (every store front occupied)	93.7	6.3	93.0	7.0
Development of more vocational training opportunity	90.1	9.9	89.6	10.4
Construction of new factory	85.8	14.2	87.8	12.2
Development of new recreational facilities	83.0	17.0	82.6	17.4
Development of more adult education opportunities	82.8	17.2	83.2	16.8
Construction of retirement housing	82.6	17.4	83.6	16.4
Improved use of telecommunications by local businesses, schools, and government	82.5	17.5	82.4	17.6
Development of new tourist attraction(s)	69.7	30.3	71.3	28.7
Construction of new subdivision	68.8	31.2	68.2	31.8
Opening of a new medical clinic	63.6	36.4	66.8	33.2
Opening of a new nursing home	62.9	37.1	64.9	35.1
Development of inter-city bus or rail service	40.0	60.0	39.7	60.3
Opening of a new fast food establishment	41.2	58.8	41.5	58.5
Construction of new prison	16.0	84.0	19.3	80.7

IRV Watershed Region, n=1,037; State of Illinois, n=1,888.

Source: Illinois Rural Life Panel Winter Survey, Illinois Institute for Rural Affairs, 1995.

More retirement housing also was reported as a priority by a large number of respondents (82.6 percent). Once again, this type of project offers additional economic opportunities in the region but also meets a growing social concern. As the average age of population increases, more retirement housing will be needed. Some communities currently are experiencing a relative housing shortage and more high quality retirement housing could open up older homes for beginning families in the community. A much lower number, but still more than two-thirds (68.8 percent), would like to have a new subdivision built which again speaks to the need for high quality housing in many areas.

SUMMARY

Communities in the IRV, in general, are doing as well as, or better than, the statewide population in Illinois. This region has excellent transportation facilities and contains several key metropolitan areas to provide growth. The collar counties around Chicago have expanded markedly and much of this growth spills over to surrounding rural areas.

However, residents of the IRV communities still feel a need for additional economic expansion. The economic structuring going on throughout Illinois has replaced many manufacturing jobs with lower paying service jobs. Within rural areas, even the producer services jobs pay substantially less than those in metropolitan areas. Thus, there is a call for additional factories, downtown revitalization, and other income-generating efforts.

So, how will these projects get implemented? Since 1980, with the reduction of Federal involvement in local and state activities and cutbacks in funding available for some programs, the overriding message is that local public officials and community leaders must assume responsibility for the future of their communities. For certain, state and Federal programs can help, but, most often, the initiative must be taken locally.

Within the IRV, there are numerous examples of these efforts. The Triangle of Opportunity including Danvers, Hopedale, Minier, Mackinaw, Atlanta and Tremont has joined to expand its economic opportunities. Working with the Mapping the Future of Your Community Program sponsored by Lt. Governor Bob Kustra and DCCA, the Illinois Institute for Rural Affairs helped them create strategic plans for their communities and the region. Many projects have been implemented across Illinois by cities using the Mapping program.

Other communities in IRV are participating in the Illinois Main Street Program to undertake downtown revitalization efforts. These efforts, started by the Governor's Rural Affairs Council and Lt. Governor Bob Kustra, can go a long way in increasing the viability of downtowns and in fostering shopping in communities in the region.

Increased use of telecommunications in businesses, schools, and government is a high priority for respondents in the IRV and the Distance Learning Foundation, managed by the Governor's Rural Affairs Council, provides funding for schools to upgrade their equipment and curriculum to include the latest technology. Some of these facilities also are used for adult education. Private groups, such as Ameritech, have worked with the Distance Learning Foundation and universities to provide classes and other facilities to struggling downstate schools.

These efforts represent solutions to current concerns and they have been successful but additional support is needed. Most important, however, is that community leaders take the initiative to get started, and many have already done so.

Notes

[1] If any part of the county was included in the IRV, then the entire county has been included because of an inability to split county information.
[2] Bureau of Economic And Business Research, 1992 Illinois Statistical Abstract, Urbana-Champaign, IL: Bureau of Economic and Business Research, College of Commerce and Business Administration, University of Illinois, Urbana-Champaign, Table 1-1.
[3] In 1990, there were 1,388 respondents in the IRV compared with 2,681 statewide; while in 1993, there were 1,246 respondents from the IRV in a total of 2,343 statewide.

Riverfront Development in Peoria

James Baldwin

Vice-President, Caterpillar Inc.
Chairman, Peoria Riverfront Development Commission
City Hall Building, 419 Fulton Street
Peoria, IL 61602-1276

James (Jim) Baldwin, as Chairman of the Peoria Riverfront Development Commission, presented a video which depicts the past, present, and future plans for the Peoria riverfront. It described a series of projects, which include public parks and private investments in restaurants, brew pub, dinner theaters, indoor ice and soccer facilities, as well as outdoor entertainment areas. The overall plan, which began in January 1995, is ongoing, but with major portions of the project completed in the next five years. The purpose of making the presentation at the 1995 Governor's Conference on the Management of the Illinois River System was to point out the need to save the Illinois River and Peoria Lake. The citizens of the Peoria area expect nothing less in the future.

Closing Address

Roberta M. Parks

Senior Vice President, Government & Community Relations
Heartland Partnership, 124 SW Adams, Suite 300
Peoria, IL 61602

Once again, I have the opportunity to be the last person you hear from at the Governor's Conference on the Management of the Illinois River System. I have been very impressed over the last day and a half at the quantity and quality of the information that has been shared with all of us. The breadth of the information has been significant. Whether you are a professional in the area of conservation management or are a Ph.D. level researcher or are a lay person who just happens to have an abiding interest in the river, there was something for you in this conference.

We are very sorry that Lt. Governor Kustra was unable to join us today. That sometimes happens when key elected officials are invited as keynote speakers. The Lt. Governor asked that we express his apologies for being unable to join us today. There is no doubt of his commitment to the future of the river. That has been witnessed from his past participation in this conference and his leadership of the Illinois River Strategy Team. We hope that you found the video presentation "Choking on Silt" instructive and insightful. Our thanks to H. Wayne Wilson for allowing us to use it at the last moment.

I do need to take a couple of minutes to express some well deserved "thank yous". First, and foremost, I want to thank my co-chair, Bob Frazee. I suspect that the planning committee thinks they are stuck with a rather unusual duo with Bob and me as the co-chairs. As I have mentioned several times before, our styles are rather different. But nevertheless, I think we make a decent team. That is primarily because Bob is the politest, most laid back man I have ever met. I doubt that anyone would say the same about me! Anyway, Bob, it has once again been a treat working with you.

I would also like to thank the entire planning committee for their valuable assistance in putting this conference together. They willingly gave us their time, their ideas and their contacts. What you have seen yesterday and today is a result of all of that. Most specifically, I want to thank the co-chairs of each of the sessions. So thanks to Nani, Gary, Steve, Gary, Mike, Mike, Jim, and Nancy. Thanks also to David Soong for coordinating the exhibits, Jon Hubbert for the pre-conference tour, John Braden and his staff for editing the abstract and proceedings and to DNR for printing them. Last but not least, both Bob and I want to thank Mike Platt and Wendy Russell from Heartland Water Resources Council for their hard work on this conference. Bob and I get the limelight and Mike and Wendy do a great deal of the work.

At each conference, I try to remember why I am willing to do this job. And really each year, I come to the same conclusion. The Illinois River is my responsibility — but really it is all of our responsibility. Each of us, from whatever perspective we come, have a connection to and responsibility for the river. It is wholly contained within the boundaries of our state. It provides us with economic opportunities, recreational opportunities, habitat enhancements, drinking water, contemplative vistas and much, much more. If we can't or won't take care of the Illinois River, then no one will.

All of you have shown your commitment to the Illinois River — by what you do every day as a professional or what you do in your "spare time" as a volunteer. You have shown that commitment by coming to this conference. For that, I thank you and ask that you keep it up. There is much work yet to do to make sure that the Illinois River is as much of a resource and asset to the next generations as it is to us.

Thank you for being a part of the 1995 Governor's Conference on the Management of the Illinois River System. Meeting adjourned.

Stephen A. Forbes Biological Station

The Illinois Natural History Survey's Forbes Biological Station was officially opened by Dr. Stephen A. Forbes, founding chief of the Survey on 1 April 1894. It was the first inland aquatic biological station in the country manned and equipped for continuous investigations, and the first to dedicate itself to the study of a major river system. Initially established with a $1,800 appropriation from the legislature, the first station consisted of three rented rooms in Havana, a 120-volume library, and a chartered cabin boat moored on Quiver Lake. In 1895, a 60-ft houseboat that was to serve as a floating laboratory was built in Havana from plans drawn under Forbes' direction. The boat gave the station mobility and year-round operation.

In 1903, Forbes noted that over 6,000 collections of fishes, plankton, and a variety of aquatic forms had been made since the station's opening. Weekly water samples had been analyzed for a consecutive period of 3 ½ years. In addition to local collections, boatside samples had been taken along 450 miles of the Illinois River and 316 miles of the Mississippi River. *The Fishes of Illinois,* a joint endeavor in 1908 by Forbes and aquatic biologist Robert E. Richardson, remained a unique publication for 40 years.

Wildlife research at the survey began in the 1870s when Forbes investigated the food habits of birds. In 1938, wildlife research was fully recognized in the Survey's program when Arthur S. Hawkins and Frank C. Bellrose were employed to initiate a waterfowl research program. The first permanent structure for the field station was completed on Lake Chautauqua in early 1940, and Hawkins and Bellrose moved into the new building to begin what would become one of the most productive and important waterfowl research programs ever conducted at a field station. Dr. Bellrose's studies of the wood duck, waterfowl migration, and lead poisoning are considered landmarks in the field. His award-winning publication of *Ducks, Geese and Swans of North America* has sold more than 300,000 copies. Bellrose collaborated on another book, *Ecology and Management of the Wood Duck*, published in 1994.

One of the most important studies implemented by Dr. William C. Starrett, who worked at the station from 1948 to 1972, was an annual electrofishing survey of the Illinois River. Begun in 1959, the survey continues to be updated and provides a baseline for documenting changes in number, distribution, and species of fish populations as the river system continually sustains changes. Starrett and 12 other aquatic biologists established the North American Benthological Society in the conference room of the station in 1953. Membership in that society now numbers over 1,800.

Research at the station is currently directed by Dr. Stephen P. Havera and Dr. Richard E. Sparks. Sparks, an aquatic biologist at the station since 1972, has added to our understanding of the effects of chemical contaminants on aquatic organisms, soil erosion and sedimentation as factors in river pollution, and floodplain ecology. Havera joined the Survey in 1972 and the station in 1978. He is an animal ecologist whose research interests include populations,

physiology, nutrition, agriculture, and wetlands. Havera recently completed a comprehensive book on waterfowl in Illinois.

The station was officially named the Stephen A. Forbes Biological Station in May 1989. The staff continues to work in three areas of demonstrated competence: (1) river and wetland ecology, (2) population studies of migratory birds and aquatic organisms, and (3) toxicological studies. The researchers' findings make significant contributions to national and international issues, such as the functions and values of wetlands, biodiversity, ecosystem management, and floodplain ecology and restoration.

One Hundred Years of Research, Data Collection, and Public Service by the Illinois State Water Survey

The Water Survey was founded in 1895 as a unit of the University of Illinois Department of Chemistry. Its original mission was to survey the waters of Illinois to trace the spread of waterborne disease, particularly typhoid. In its first fifteen months of operation, the Water Survey responded to public requests for chemical analyses of 1,787 water samples from 156 towns in 68 Illinois counties. In its initial stages the Water Survey also addressed the health and safety of public water supplies, water softening methods, sewage and wastewater treatment, and the establishment of sanitary standards for drinking water.

In 1917 the Water Survey was transferred to the Illinois Department of Registration and Education. At that time, the Board of Natural Resources and Conservation, composed of eminent scientists and professionals selected by the governor, was formed to guide its activities. This Board is still in operation and provides overall guidance to the Water Survey. Scientific investigations were expanded including the state's first inventory of municipal ground-water supplies, water levels in wells, yield testing, and the establishment of an ongoing survey of the state's surface water.

During World War II, Water Survey chemists worked on the detection of chemical warfare agents in water as well as an expansion of the radar meteorology to measure rainfall and track severe storms. The State Climatologist's position was also transferred to the Water Survey. Population growth in the late 1950s and 1960s created the need for expanded water resources, and the Water Survey worked to identify and increase usable water supplies. Studies addressed reservoir development and maintenance, lake sedimentation, new methods for evaluating wells and aquifers, and the effects of future development. An evaluation of the State's principal ground-water resources was also done.

In the late 1970s and early 1980s the Water Survey's programs on large rivers such as the Illinois and Mississippi (including sedimentation problems) expanded. This also included Peoria Lake and the other 60-plus backwater lakes along the Illinois River. These research and public service activities have been supported by various state and federal agencies. The Water Survey staff is now recognized as one of the major expert groups in the country to work on large rivers.

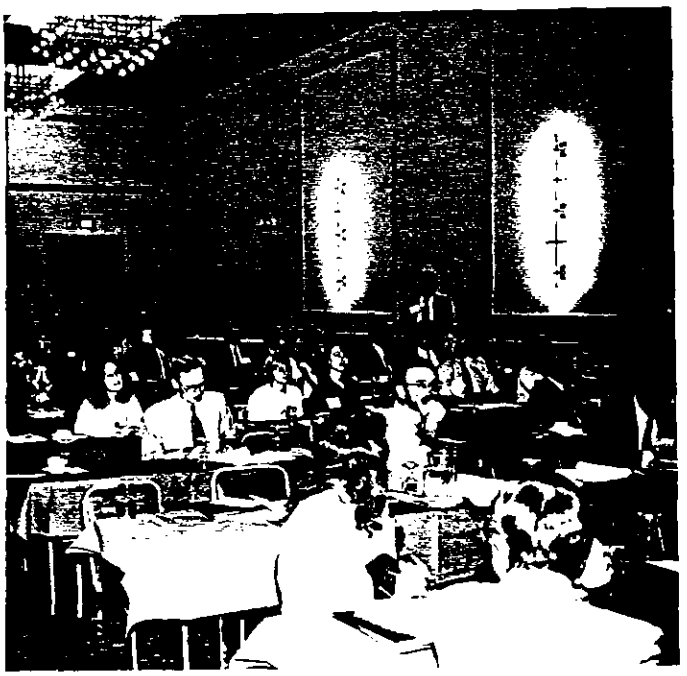
Support for scientific programs includes a state appropriation and income from grants and contracts with state agencies, municipal groups, universities, private organizations and businesses, and federal agencies. The Water Survey cooperates with all agencies concerned with the water and weather of Illinois.

Water Survey activities are now conducted under three scientific and one administrative division. The scientific divisions are: Hydrology, Chemistry, and Atmospheric Sciences. These three divisions address all aspects of water in its various states.

As of July 1, 1995, the Water Survey is a part of the newly formed Department of Natural Resources. The current staff is composed of 235 employees, including 130 professional scientists and engineers, 75 technical and support staff, and 30 university students, as well as visiting professional scientists. The Water Survey staff has the vision and wisdom to address the water-related problems of the future and serve the citizens of the state in a befitting manner.

Appendices

Photographs



Above left: More than 250 people attended the fifth biennial conference on managing the Illinois River. Pictured at left are conference co-chairs, Roberta M. Parks and Robert W. Frazee holding the Executive Proclamation that reaffirms Governor Edgar's commitment to improving the Illinois River. Pictured below is Brent Manning, Director of the Department of Natural Resources, presiding over the session devoted to the past.

Below: Dr. David Allardice from the Federal Reserve Bank delivers a keynote address describing the factors influencing the economy of the Illinois River drainage basin.
Bottom: Keynote speaker Brigadier General Gerald Galloway, Jr. presents the findings of the Floodplain Management Review Committee that was formed as a result of the historic flood of 1993.

1995 marked the 100th anniversaries of the Illinois State Water Survey and the Stephen A. Forbes Biological Station. At the reception honoring both institutions, former Chief John O'Connor (Illinois State Water Survey, left) and Richard Sparks (Forbes Biological Station, right) share reminiscences.

Students present water quality data they have collected throughout Illinois as part of the Illinois Middle School Groundwater Project.

Contributing lively discussions to the conference were 26 groups that exhibited displays for the poster sessions.

Appendix B

Poster Session Participants

Illinois State Water Survey, Organizer

Dickson Mounds Museum
Elan Engineering Corporation
Heartland Water Resources Council
Illinois American Water Company
Illinois Audubon Society
Illinois Department of Agriculture
    Bureau of Soil and Water Conservation
Illinois Department of Natural Resources
    Division of Fisheries
    Illinois Natural History Survey
    Illinois State Museum
    Illinois State Water Survey
Illinois Farm Bureau
Illinois Middle School Groundwater Project and Illinois River Project
Marshall-Putnam Soil and Water Conservation District
The Nature Conservancy
The Openlands Project
Prairie Rivers Resource Conservation and Development
Tri-County Regional Planning Commission
Tri-County Riverfront Action Forum
United States Army Corps of Engineers, Rock Island District
United States Fish and Wildlife Service
United States Geological Survey
University of Illinois
    Illinois-Indiana Sea Grant Program
    Water Resources Center
Upper Mississippi River Conservation Committee
USDA Soil Conservation Service

Appendix C

Participants

Alvarado, Marla
Illinois RiverWatch Network

Ash, Jim
Clark Engineers MW, Inc.

Atherton, Sue
Illinois - American Water

Austen, Doug
Illinois Department of Natural Resources

Austin, Tom
USDA-FSA

Barber, Ben
Illinois RiverWatch Network

Behrends, Marty
Peoria County

Berry, Rodney
A.D.M.

Bhowmik, Nani
Illinois State Water Survey

Blanchar, James
U.S. Army Corp of Engineers
Rock Island, Illinois

Bock, Allen
University of Illinois

Bonfert, Gretchen
Green Strategies

Boruff, Chet
Illinois Department of Agriculture

Boyle, John
CHZM Hill

Braden, John
University of Illinois
Water Resources Center

Brandon, Alice
Illinois RiverWatch Network

Bromberg, Mel
University of Illinois
Cooperative Extension Service

Brown, Holly and 6 students
Pekin Broadmoor School

Brown, Marvin
USDA Natural Resources
Conservation Service

Brown-Ahrends, Jane
The Nature Conservancy

Bruce, Debbie
Illinois Department of Natural Resources

Bruyn, Rodger
Bureau County Farm Bureau

Butler, Colleen
Tri-County Regional Planning Commission

Byrns, Bill
ARK (Alliance to Restore Kankakee River)

Caldwell, Joy
Office of Congressman Ray LaHood

Chamberlain, Joe
Ivy Club

Changnon, Stan
Illinois State Water Survey

Cima, John
Environmental Science & Engineering

Clair, Mike
Ottawa Plant Food

Clark, Gary
Illinois Department of Natural Resources

Cochran, Mike
Illinois Department of Natural Resources

Cole, Margaret
Illinois Department of Natural Resources

Comerio, John
Illinois Department of Natural Resources

Cox, Charles
U.S. Army Corp of Engineers
Rock Island, Illinois

Cox, Michael
U.S. Army Corp of Engineers
Rock Island, Illinois

Creutzburg, Brian
Illinois RiverWatch Network

Curtiss, Dana
Illinois RiverWatch Network

Daugherty, Jim
University of Illinois
Cooperative Extension Service

Delaney, Robert
NBS, EMTC

Demissie, Mike
Illinois State Water Survey

Donoho, Kevin
USDA Natural Resources
Conservation Service

Douglas, John
Growmark

Eddings, Leonard
Agseeds

Edgcomb, Tom
LaSalle County Farm Supply

Edwards, Randy
USDA Natural Resources
Conservation Service

Ehnle, Kurt
Soil/Water Conservation District

Eichelkraut, Richard
Izaak Walton League

Eicken, Gary
Illinois Environmental Protection
Agency

Enstrom, Chris
Illinois RiverWatch Network

Erickson, Mary Alice
Office of Congressman Ray
LaHood

Erickson, Nancy
Illinois Farm Bureau

Fandel, Pete
University of Illinois
Cooperative Extension Service

Fehr, Doug
Heartland Farm Bureau

Fielder, Rick
Hydrolab

Flattery, Tom
Illinois Department of Natural
Resources

Ford, John
USDA Natural Resources
Conservation Service

Foree, Buck
Illinois RiverWatch Network

Frazee, Bob
University of Illinois
Cooperative Extension Service

Frye, Rich
LaSalle County Farm Supply

Fuller, Carol
Illinois Environmental Protection
Agency
Community Relations

Fuller, Michelle
Illinois RiverWatch Network

Ganschow, Randy
Meriden Grain Co.

Gates, David
U.S. Army Corp of Engineers
St Louis, Missouri

Gentry, David
Growmark Inc.

Georgi, Michelle
Illinois Natural History Survey
Forbes Biological Station

Gill, Cliff
Soil and Water Conservation
District

Gittinger, Jack
LZT Associates

Goettel, Robin
Illinois - Indiana Sea Grant

Gorman, Betty
Soil and Water Conservation
District

Gough, Steve
Steve Gough & Associates

Gries, Amy
Illinois RiverWatch Network

Grodjesk, Ken
Pekin Broadmoor School

Groschen, George
U.S. Geological Survey

Gulso, Alan
Department of Agriculture

Hardy, Leland
USDA Natural Resources
Conservation Service

Harris, Mitchell
U.S. Geological Survey

Hartzold, Sharon
USDA Natural Resources
Conservation Service

Havera, Steve
Illinois Natural History Survey

Hendrickson, Harry
Illinois Department of Natural
Resources

Henry, Bob

Hilsabeck, Rob
Illinois Department of Natural
Resources

Hine, Chris
Illinois Natural History Survey
Forbes Biological Station

Hobbs, Frank
Senior Master, PAR-A-DICE
Riverboat Casino

Horn, Shonnon
Illinois Department of Natural
Resources

Horner, Rod
Illinois Department of Natural Resources, Fisheries

Hubbell, Mavin
Illinois Department of Natural Resources

Hubbert, Jon
USDA Natural Resources Conservation Service

Hunsley, Tom
Growmark Inc.

Ingram, Wayne
Environmental Science & Engineering

Jacob, Mark
USDA Natural Resources Conservation Service

Jacobs, Bob
A.D.M.

Janssen, Arlan
Soil and Water Conservation District

Janssen, Greg
Tazewell County Cooperative Extension

Johnson, Alice
Soil and Water Conservation District

Johnson, Gary
U.S. Geological Survey

Johnson, Mark
Northern Illinois Water Corporation

Kabbes, Karen
Fox Waterway Agency

Kaiser, Jeff
Zeneca Ag Products

Kammueller, James
Illinois Environmental Protection Agency

Keefer, Laura
Illinois State Water Survey

King, Robin
U.S. Geological Survey

Kinney, Bart
CIBA

Kirchhofer, Patrick
Peoria County Farm Bureau

Kitchen-Maran, Kay
USDA Natural Resources Conservation Service

Knapp, Vernon
Illinois State Water Survey

Kraft, Jackie
McLean County Soil and Water Conservation District

Kramer, Gary
Caterpillar Inc

Krapf, Tom
USDA Natural Resources Conservation Service

Lambie, Pete
Woodford County Board

Lane, Phil
Clark Engineers MW, Inc.

Lawfer, Pat
Illinois Agri-Women

Lerczak, Thomas

Lewis, Bill
USDA Natural Resources Conservation Service

Leyland, Marilyn
Caterpillar Inc.

Lubinski, Ken
NBS, EMTC

Mair, Erica
Office of the Governor

Manig, Herb
American Farm Bureau Federation

Marlin, John
Hazardous Waste Research & Information Center

Mason, Joe
Illinois Bureau of the Budget

Mathis, Bill
Bradley University

McConkey, Sally
Illinois State Water Survey

McCoy, Melissa
Illinois Riverwatch Network

McCully, Doyle
U.S. Army Corps of Engineers
Rock Island, Illinois

McGuire, Lon
U.S. Army Corps of Engineers
Rock Island, Illinois

McLeese, Bob
USDA Natural Resources Conservation Service

McMahon, Jim
The Nature Conservancy

Meinen, Don
Tri-County Riverfront Action Forum Inc.

Merna, Carol
Office of Congressman Ray LaHood

Mick, Jim
Illinois Department of Natural Resources

Miller, Don
G & J Fertilizer

Mills, Mike
VanDiest Supply Co.

Myers, Lori
Illinois RiverWatch Network

Neagele, Deanna and 24 students
Ottawa Marquette High School

Nelson, Matt
The Nature Conservancy

Nevling, Lorin
Illinois Natural History Survey

Newman, Debbie
Illinois Audubon Society

O'Connor, John
Illinois State Water Survey

Olmstead, Cynthia
The Nature Conservancy

Parks, Roberta
Heartland Partnership

Pescitelli, Steve
Illinois Department of Natural Resources

Pfiefle, Gary
USDA Natural Resources Conservation Service

Phelps, Bob
Lake Wildwood Association

Pittman, Dave
Peoria Park District

Platt, Michael
Heartland Water Recources Council

Prickett, Tom
Thomas A Prickett & Associates Inc

Rader, Jeannine
Illinois RiverWatch Network

Ray, Lyle
Illinois Environmental Protection Agency

Retzer, Michael
The Nature Conservancy

Reuter, Michael
The Nature Conservancy

Robinson, Gilbert
Caterpillar Inc

Robinson, Jean Ann
Grundy County

Rodsetter, John
Illinois State Water Survey

Ropp, Gordon
Office of the Secretary of State

Ropp, Roberta

Rudin, Diane
The Nature Conservancy

Russell, Wendy
Heartland Water Resources Council

Rutherford, Jim
McLean County Soil and Water Conservation District

Schwarz, Dick
Illinois - American Water Company

Shane, Philip
Illinois Corn Grower Assoc.

Shereck, Erin
Illinois RiverWatch Network

Shipman, Kay
FarmWeek

Shoemaker, Kenn
USAED, R.I.D. Il Waterway Project Office

Shurts, John
Growmark Inc

Silverthorn, Dan
West Central Building Trades

Simonart, Marie
Caterpillar Inc.

Simpson, Doug
Woodford County Farm Bureau

Sinclair, Dorothy
Tri-County Riverfront Action Forum Inc.

Siwicke, Georgeann and 6 students
East Peoria High School

Skalak, Jerry
U.S. Army Corp of Engineers
Rock Island, Illinois

Snyder, Skip
Illinois Riverfront Development Corporation

Solecki, Mary Kay
Illinois Nature Preserves Commission

Soong, David
Illinois State Water Survey

Sparks, Richard
Illinois Natural History Survey

Spencer, Chuck
Illinois Farm Bureau

Stahl, Jana
Illinois Department of Natural Resources

Stout, Glenn
International Water Resources Association

Strom, Jan
Thermogas

St. John, Kim
USDA Natural Resources
Conservation Service

Suits, Barry
Northern Illinois Water
Corporation

Sulaski, David
Office of Lt. Governor

Sutton, Barry
LaSalle County Farm Supply

Szafoni, Robert E.
Illinois Department of Natural
Resources

Taylor, John
Illinois Valley Flood Control
Association

Terrio, Paul
U.S. Geological Survey

Traeger, Barb
Illinois Department of
Transportation

Van Winkle, Steve
City of Peoria

Vonnahme, Donald
Office of Water Resources
Illinois Department of Natural
Resources

Wagner, Elizabeth
University of Illinois
Water Resources Center

Walzer, Norman
Illinois Institute for Rural Affairs

Waugh, Fred
Illinois RiverWatch Network

Webber, Fran and 6 students
East Peoria Central Junior High
School

Weyhrich, Jeff
Mason County Farm Supply

Wieland, Brian
Crop Pro-Tech

Wilkinson, Christina
WIRL Farm Director

Williams, Bob
Rivers Project

Williams, Bob
LaSalle County Farm Supply

Witter, Karen
Illinois Department of Natural
Resources

Wozniak, Julie
Commonwealth Edison Company

Yetter, Aaron
Illinois Natural History Survey
Forbes Biological Station