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Water, Water, Everywhere
Minnesota Flooding 1993

Many Minnesota residents have a new appreciation for the words in this report's title, taken from "The Rime of the Ancient Mariner," by Samuel Taylor Coleridge.

The ancient mariner was becalmed on a ship in the middle of the ocean because he had killed an albatross -a symbol of good luck to sailors. Minnesota did not look like an ocean in 1993,but it did temporarily have many more lakes, wetlands and streams. No albatrosses were killed, but many Minnesota residents had a terrible run of bad luck. Minnesota was, however, much better off than some neighbors to the south.

What Happened...

The 1993 spring flood season started normally, with scattered minor flooding in parts of southern and western Minnesota. This situation changed rapidly.

- On May 6 and 7 the "Mother's Day Storm" hit the Marshall area in southwestern Minnesota, depositing up to 10 inches of rain.
- President Clinton declared nine counties in southwestern Minnesota as a disaster area on June 11, 1993, as a result of the May storms.
- In June and July additional thunderstorms caused extensive flooding in many parts of the state (see figure 1).
- By August 25, 1993, when the Federal Emergency Management Agency (FEMA) finally declared the disaster over, 57 of Minnesota's 87 counties had been included in the disaster declaration (figure 2).

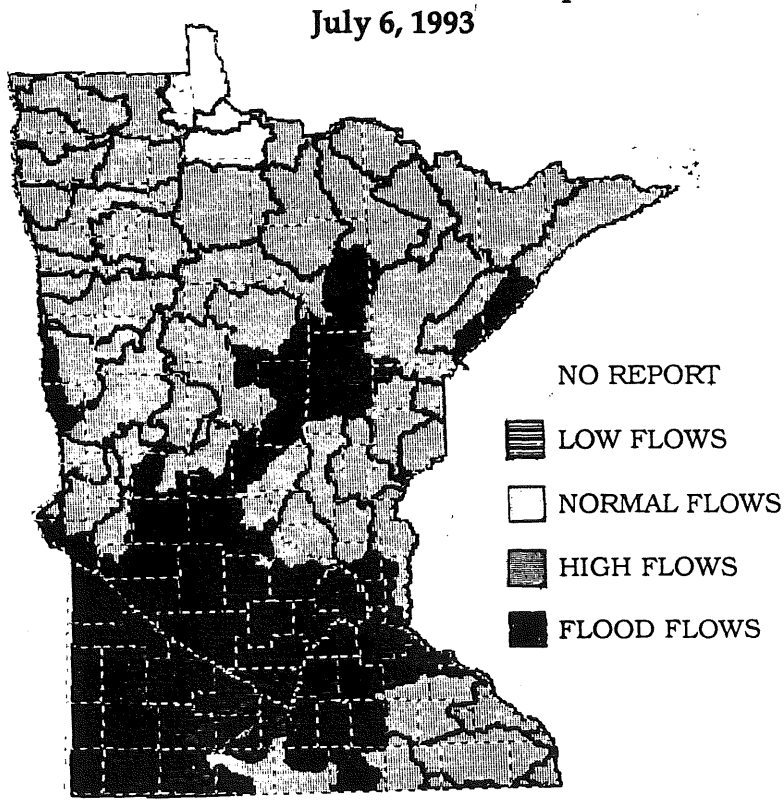
Flooding affected approximately 6.7 million acres of agricultural land, causing more than $1 billion in agricultural damage. Individual, family and business losses are estimated at $115 million. Damage to public facilities are estimated at $52 million.

This report covers several aspects of the 1993 floods in greater detail:

- A look at patterns of rainfall and large thunderstorms
- A summary of peak flows at various locations
- A brief examination of the impacts of wetland drainage on the 1993 floods
- A description of the damages caused by the floods
- An analysis of the flood recovery efforts

The 1993 floods had serious impacts on almost all of Minnesota. Looking to the future, it is critical that we use this experience to prepare for similar or even worse flood events in the future. Responsible efforts for improvement will take the coordinated efforts of businesses, individuals, and government at all levels.

Figure 1. **Minnesota Stream Flow Report**
July 6, 1993



High Flows are greater than the July Q25. Normal Flows are between July Q25 and Q75. Low Flows are below the July Q75. Critical Flows are below the Annual Q90. Flood Flows are greater than the highest monthly Q10.
This report is based on provisional data.

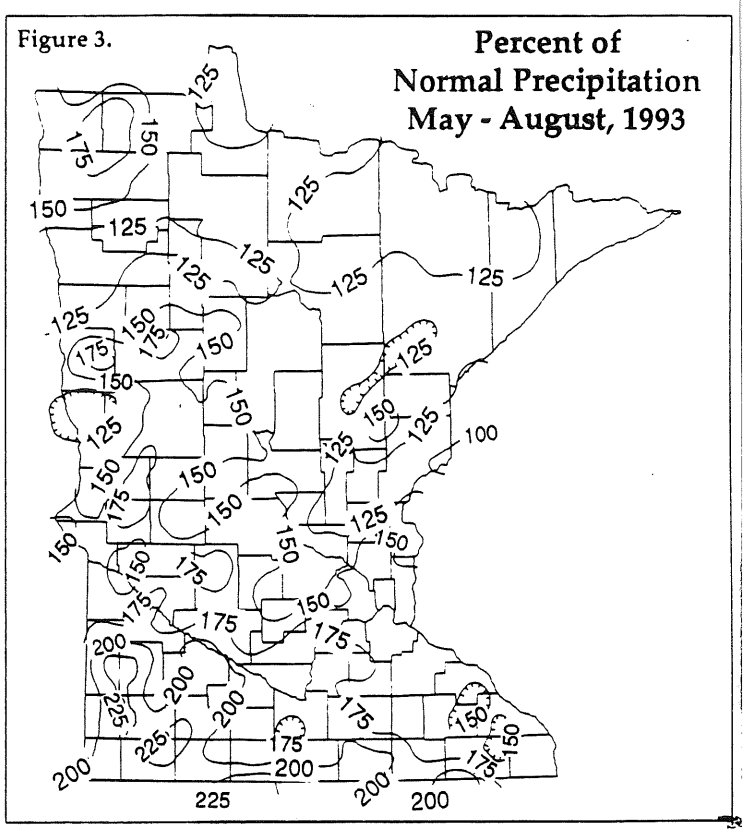
Climatic Factors

May through August 1993 were the wettest summer months in Minnesota's recorded climate history. The rainfall that affected nearly all of the Midwest left many Minnesota locations with rainfall totals exceeding 200 percent of the average summer rainfall; the equivalent of nearly two summers of rainfall (figure 3). Almost half of Minnesota ranked at or above the 99th percentile for May through August rainfall (figure 4). A value above the 99th percentile means that all-time rainfall records were broken or nearly broken for May through August, which occurred at many locations around the state (table 1).

The thunderstorms began in early May in southwestern Minnesota. Heavy rains before Mother's Day weekend led to significant urban and rural flooding in the Marshall and Pipestone areas. During May heavy rains and wet soils delayed or eliminated the planting of crops.

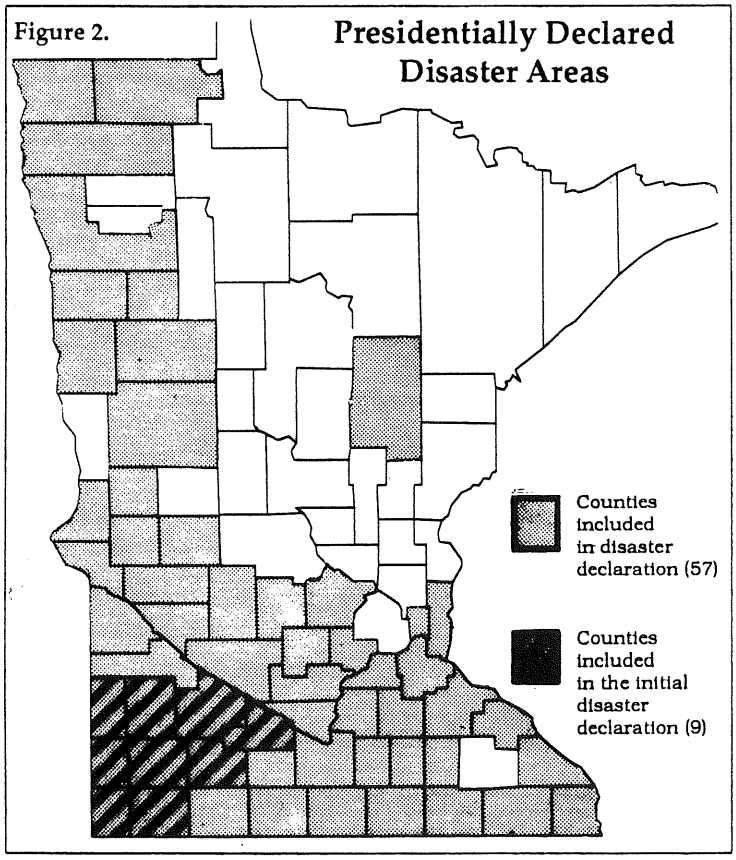
The heavy rains continued through June, drenching some parts of southern Minnesota with more than 15 inches. The largest rainfall event during the month was the storm that struck southern Minnesota on June 16th and 17th.

Figure 3.



This "Father's Day Storm" dropped 4 or more inches of rain across much of the Minnesota River basin. Since the ground was already saturated and river levels were already high, the rain caused widespread flooding.

Figure 2.



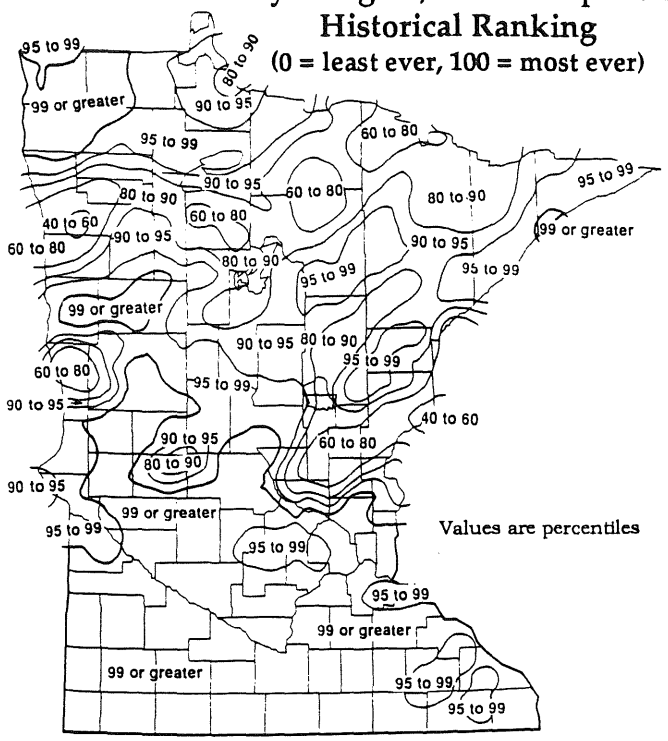
Flooding in southern Minnesota marked the beginning of what was to become a natural disaster throughout the Midwest. During July the heavy rains continued in southern Minnesota, but also spread into the northwestern parts of the state. The Moorhead area and many communities in Clay and Becker counties encountered severe flooding from thunderstorms on July 15 and 16. The summer's largest rainfall event occurred on August 15 and 16 along a line from New Ulm to Austin. A large area received more than 4 inches; eight inches or more of rain fell in Freeborn and Mower counties.

The same atmospheric conditions that led to the heavy rains across the state caused extraordinarily low evaporation rates. Cloudy, cool weather along with high relative humidity dramatically reduced the atmosphere's ability to evaporate water from the earth's surface. For the first time since such records have been kept, precipitation totals exceeded evaporation values for the May through August period. The lack of evaporation exaggerated an already serious situation.

Figure 4.

May - August, 1993 Precipitation Historical Ranking

(0 = least ever, 100 = most ever)



This map depicts where the May to August, 1993 precipitation totals fall in the context of history (100 years of climate data). A value of 99 or greater means the May to August all-time rainfall record was nearly matched or broken. A value of 90 means that greater amounts would only be expected one out of ten years.

Table 1.

May thru August Rainfall Totals Selected Cities

(Values are in inches)

Location	1993	Normal	All-Time Rank
Austin	32.34	16.03	1st
Detroit Lakes	25.42	13.84	2nd
Fairmont	35.62	15.58	1st
Faribault	26.67	15.52	2nd
Gaylord	29.50	15.54	1st
Marshall	29.94	13.07	1st
Mpls./St.Paul	22.38	14,59	3rd*
Morris	22.40	13.13	2nd
Willmar	27.45	15.42	1st
Worthington	32.73	13.92	1st

*using the modern data set

- Stream flows in the Redwood River approached the 100-year flood level following the storms in early May. The mid-June storms resulted in approximately a 30-year flood event on the Redwood River.

A 100-year flood has a 1 percent chance of occurring in any given year. A 10-year flood has a 10 percent chance of occurring in any given year. While the odds are against it, large floods like a 100-year flood can and do occur in consecutive years and can even occur more than once in a single year.

Entering the fall of 1993, soil moisture was at or near saturation for nearly all of Minnesota. After soil freezes, the soil moisture remains generally unchanged through the winter season. Although this is just one factor that could affect spring flooding in 1994, it does indicate that spring flooding could once again be a possibility.

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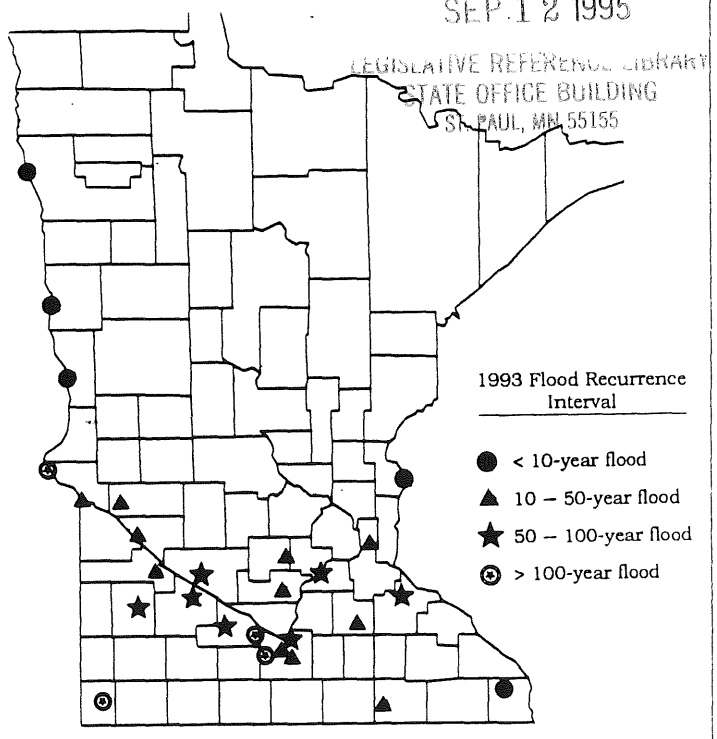
Figure 5.



Streamflow Factors

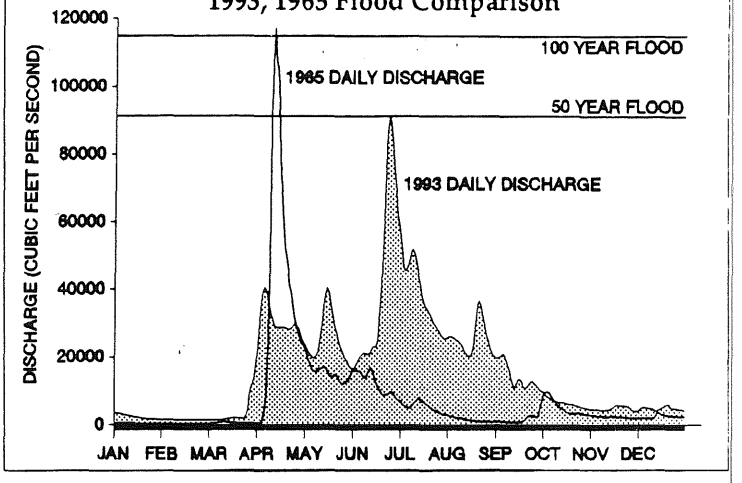
The severity of flooding varied considerably.

- The flood flows along the Minnesota and Mississippi rivers and their tributaries were generally less than 100-year flood events (figure 5). The Minnesota River peaked at approximately a 50-year flood level; the Mississippi River at St. Paul peaked at about a 20-year flood level.
- Peak flows along the Red River occurred during spring runoff; the summer flooding was generally less than a 10-year flood event.
- The city of Marshall was affected by some of the heaviest rainfall and most severe flooding.

The news media talked a lot about the "record" flooding occurring in the Midwest. There were record-setting floods in some states to the south, but in Minnesota, while flooding was severe, it did not break any records.

The highest recorded flooding along the Minnesota River occurred during the spring of 1965. The 1993 summer flood did not reach the peak levels attained during the 1965 flood, but was unusual for different reasons. The flooding came very late in the year, most major floods in Minnesota occur in the spring as a result of snowmelt and rainfall; the total volume of water discharged during the summer was greater than any previous flood period in recorded history; and the length of the flooding (lasting from May through August) far exceeded previous floods (figure 6).

Figure 6. Minnesota River at Jordan
1993, 1965 Flood Comparison



Wetland Factors

Flood control is frequently cited as an important wetland function, and in many cases it is important. The summer-long flooding in 1993 has focused attention on the role that wetlands and wetland drainage may have played in extending the duration and intensifying the severity of the flooding.

Drainage systems affect peak flows on smaller rivers systems. The most visible effects of drainage occur during the more frequent flood events, such as the two-year to 10-year floods.

Drainage systems reduce flooding within a local project area, but often at the expense of downstream areas. Drainage can reduce and even eliminate the ability of a wetland to temporarily retard flood runoff; channelization generally will increase the speed at which water enters downstream rivers. Drainage can also provide an outlet to confined wetland basins allowing runoff to enter into a river system where it might not have gone before drainage systems were installed.

The impact of wetland drainage on the 1993 flood events is much less certain simply because the effects of wetland drainage on large river systems such as the Minnesota or Mississippi are not well understood. The lack of good long-term flow and precipitation records and the other hydrologic factors that affect the magnitude of flooding in a large watershed have made any conclusive studies impossible.

The impact of wetland drainage during the floods of 1993 was probably minimal in the Minnesota and Mississippi river basins because of the large volume of rainfall and runoff, the long duration of the flooding, and the fact that many drained wetlands still provided a significant amount of flood storage.

Flood Damage

The 1993 flooding in Minnesota did not break any records in terms of flooding, but it did break records in terms of the cost of damages. In Minnesota, the cost of damage will exceed $1.2 billion, mainly due to tremendous agricultural damage. Most previous large floods in Minnesota occurred in early spring, after which farmers were able to plant some type of crop. In 1993, the late start and long duration of flooding meant that many farmers were never able to plant a crop in the first place. If they did, many fields were flooded later on with no chance to replant to salvage a crop.

These factors help to explain the $1 billion agricultural losses in Minnesota in 1993. The actual long-term cost may, in fact, be far greater. In 1994, it may again be difficult for some farmers to get crops planted because of continuing wet soil conditions. There are also long-term losses to communities and businesses in Greater Minnesota caused by the loss of farm income.

Individual, family and business losses are currently estimated at $115 million. These losses are difficult to measure because some people do not report losses. Even when losses are reported, the various assistance programs available from federal, state, local and private organizations rarely compensate people for 100 percent of their losses.

The National Flood Insurance Program (NFIP) probably provides the most direct form of compensation for flood losses to homes and businesses. Unfortunately, only a small percentage of floodplain residents purchased flood insurance. Statewide, only about 25 percent of the people who should have flood insurance actually have it.

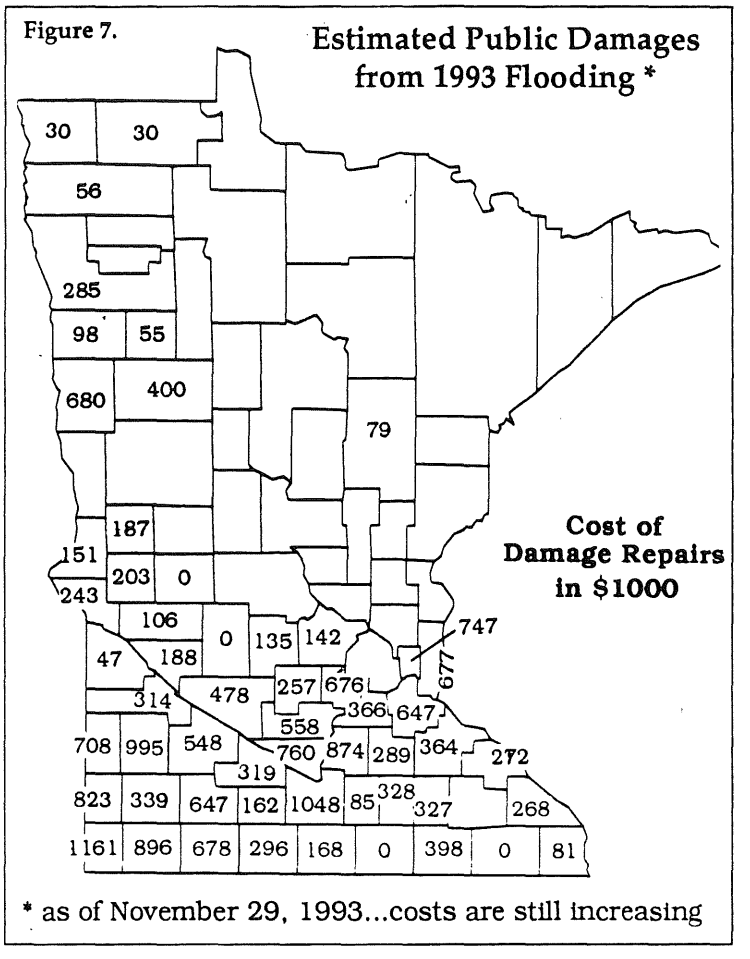
The NFIP reported that there were only 258 claims in 1993 for damage to homes and businesses. The amount paid on the claims averaged $6060.

Some losses to individuals, families and businesses from floods may not be compensated at all because of varying eligibility requirements.

Damage to public facilities such as roads, bridges, culverts, dams, buildings, trails, parks, debris removal and clean-up totalled about $52 million. These damages are easier to inventory. Federal programs, in particular, are in place to help compensate for these losses following a Presidential Disaster Declaration.

There was more than $1 million in damage to facilities managed by the Minnesota Department of Natural Resources. This damage included roads, trails and public accesses, debris clean-up and removal, and one dam failure. As might be expected, the areas with the largest public damages are the areas that had large storm events or are located along the major rivers (figure 7).

Figure 7.



* as of November 29, 1993...costs are still increasing

Assistance from the federal government will cover 90 percent of the repair or replacement costs for public damage following the 1993 floods. The state of Minnesota will provide an additional 5 percent of the repair costs to local governments, following legislative approval in early 1994.

Damage Averted

The damage caused by the 1993 floods was much less (other than agricultural damage) than might have been expected because of several programs.

• **National Flood Insurance Program (NFIP).** When a city or county joins the NFIP, it agrees to regulate new construction of homes and businesses in the floodplain in order to protect them from damage during a potential 100-year flood event. In return the NFIP makes flood insurance available for homes and businesses in these communities. Some communities have been participating in the NFIP for 15 to 20 years, so damage in these communities was less than expected. They may actually have been reduced further from other mitigation activities that the communities have undertaken.

• **Federal Assistance programs.** There are a number of these programs that assist in the construction of flood-control projects. The U.S. Army Corps of Engineers estimates that permanent flood control projects implemented by the Corps prevented almost $118 million in damage in Minnesota during 1993. Flood control projects have also been implemented by the Soil Conservation Service through its P.L. 566 watershed protection program.

• **State Assistance programs.** Local governments have received assistance in flood-control measures from the DNR's flood hazard mitigation program. Construction of floodwater impoundments in the upper portion of the Minnesota River Basin has been part of the Board of Water and Soil Resources Area II flood control program.

Some local government units have also implemented their own flood-control projects. Together these programs plus efforts of individuals made significant contributions in reducing damages from the 1993 floods.

Future Flood Damages

Now that the 1993 floods are over, how can areas flooded in 1993 be protected from future floods? In the past this has been a haphazard process. This year, all state and federal agencies with post-flood recovery programs are coordinating their efforts through the Minnesota Long-Term Grants Coordination Group, under the auspices of Gov. Arne Carlson's Disaster Task Force. This group has screened 238 proposals from local governments totalling $65 million for flood recovery projects.

One of the sub-groups created by this process is concentrating on mitigation and flood control opportunities resulting from the 1993 flood (table 2). These projects will reduce or eliminate future flood damages in areas where projects are implemented. The top priority of this sub-group is to coordinate grants and assistance to acquire homes and businesses located in frequently flooded areas so that they will not be flooded in the future.

Nine acquisition or relocation projects are currently being considered or implemented. These projects are in Springfield, Austin, Rockford, East Grand Forks, Delano, Waterville, and Norman, Mower and LeSueur Counties. These projects, if completed, will result in the removal of 84 homes and 12 businesses from floodplain areas.

Proposals for projects other than acquisition or relocation projects are also being dealt with. But it is of primary importance to fund projects that will remove structures from flood-prone areas before more floods occur. Many other projects are being studied, but for some it will take a long time to identify final solutions, and others are very expensive. These projects will be implemented as additional funding becomes available from local, state and federal sources.

Lessons Learned from the 1993 Floods

The 1993 floods provided an opportunity to examine the effectiveness of managing floodplains and fighting floods. A number of observations follow.

- The 1993 floods in Minnesota were not unique. They were unusual, but not so much from the magnitude of the flooding as from the duration of the flooding and the time of year that it occurred. Bigger floods can, and eventually will, occur in Minnesota.

- The flood-fighting efforts of individuals and local governments were, for the most part, excellent. The floods did remind many communities that it is necessary to have emergency plans in place for floods and other disasters.

Table 2. **Mitigation/Flood Control Sub-Group**

Mitigation/Flood Control Alternatives	Funding Sources: Limited	Funding Sources: Principal Federal-State	Tech. Assist./ Support Agency	Regulatory Agency
Major Flood Control - levees - retention - reservoirs	DTED EDA[3] FEMA/ DEM	SCS DNR COE	USFWS	MSHS USFWS DNR COE, PCA
Community Flood Control Studies - COE's Section 205/Section 14,etc. - neighborhood/ community study - studies for improvement to infrastucture - SCS-PL 566	HUD EDA[3]	COE DNR SCS		
Other Flood Control - culvert downsizing/retention - neighborhood retention - elevate structures - acquisition/relocation - floodproof structures - lift stations/pumps - channel repair [4] - channel improvement/maintenance[4] - backwater valves/elev. of utilities	EDA[3] COE[1] SCS[2]	FEMA/ DEM DTED DNR MnHFA	USFWS COE	MSHS PCA DNR COE USFWS
Flood Forecasting/Warning	EDA[3] NWS COE[1] SCS[2]	FEMA/ DNR DEM	USGS COE	

• Floodplain management zoning ordinances adopted by local governments under state and federal regulations were effective in preventing flood damage when the ordinances were aggressively administered. Without good administration of floodplain zoning ordinances for the past 20 years, there would have been many more homes and businesses affected throughout Minnesota.

• Flood-control projects and flood hazard mitigation projects that were designed and implemented in a reasonable manner reduced or prevented significant flood damage. It did not matter whether the projects were implemented at the local, state or federal level. A number of agricultural and urban levees, home acquisition or relocation programs, impoundments, high-flow diversions, and storm water management systems were effective in reducing or preventing flood damage. Problems that occurred with flood-control projects in states south of Minnesota should not be used to condemn all flood-control projects.

• The rain and river gauging systems that were in place when the flooding began were invaluable for predicting peak flood levels on rivers. There were some watersheds where additional gauges would help; there were several instances where more rainfall and river gauges should be incorporated as parts of local flood warning systems.

• Many former wetlands that were drained by drain tile for agricultural purposes did actually provide a significant amount of flood water storage. The drain tile outlets were blocked by high water in drainage ditches or streams, or by sediment, and effectively stored flood waters. Some of these former wetlands still are storing water from the floods. Many of these former wetlands should be permanently returned to a wetland condition rather than allowing agricultural drainage to resume. As a result of the flooding, there are numerous opportunities to restore or acquire wetlands to help reduce future damage as well as provide many other public benefits.

• The long duration of flooding stressed the entire system for fighting and recovering from the floods. Agencies at all levels of government were having problems staffing all activities related to dealing with and recovering from floods. Those activities included: assistance in flood fighting, closing roads, providing additional security to flooded areas, delivering pumps and sandbags, conducting aerial reconnaissance, staffing the Minnesota Duty Officer program, briefing local officials about public assistance and hazard mitigation programs, conducting preliminary damage assessments, participating on the interagency hazard mitigation team, participating on the Governor's Disaster Task Force, coordinating disaster recovery and flood hazard mitigation assistance, and staffing damage survey report teams, Disaster Field Office, and the Emergency Operations Center. Assistance was maximized through cooperation among all levels of government.

• Individuals, businesses and local governments would have had difficulty recovering from the 1993 floods on their own. Large amounts of state and federal assistance were needed for damage repair and flood hazard mitigation activities. These funds are needed during or immediately after the conclusion of a flood to take advantage of the limited "window of opportunity" to implement flood-damage reduction measures, such as acquisition or relocation projects.

• State and federal funding agencies for disaster recovery and hazard mitigation activities for the first time acted in a well-coordinated manner to assure that available funds went where they were most needed. Because of the positive experience working together during the 1993 floods, all of the agencies will be more willing and ready to closely coordinate their activities during and after the next flood.

Conclusion...

The 1993 floods in Minnesota could have been worse in terms of both peak flows and damage. Only one thing is certain: Larger floods can and will occur in the future. The key to flood hazard mitigation is to continue to reduce flood damages even when dealing with larger floods. Teamwork is necessary to recover from the devastating effects of the 1993 floods. It is important to expand and improve on the programs and projects that were effective in reducing 1993 flood losses. It is also important to look for new flood damage reduction programs that were not in place, or not fully implemented, during the 1993 floods. With individuals, businesses and all levels of government working together, it is possible to gradually eliminate some types of flood damage and to continue to reduce the devastating public and private effects of future floods.

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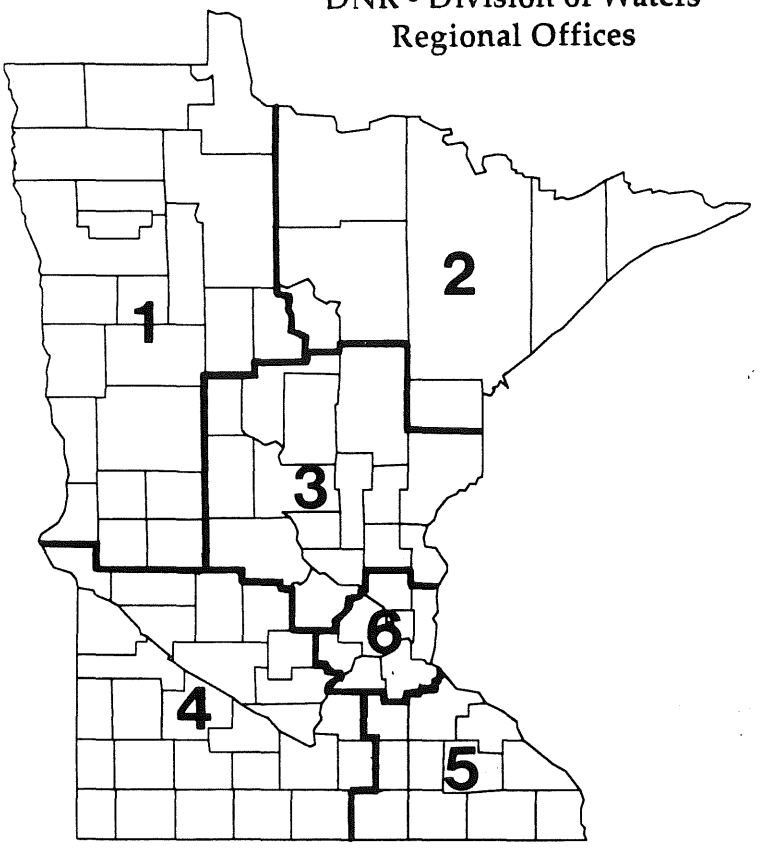

For additional information and assistance, contact the appropriate Regional Office or the Division of Waters in St. Paul.

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Bemidji, MN 56601
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Region 2 1201 East Highway 2
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(218) 327-4416

Region 3 1601 Minnesota Drive
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