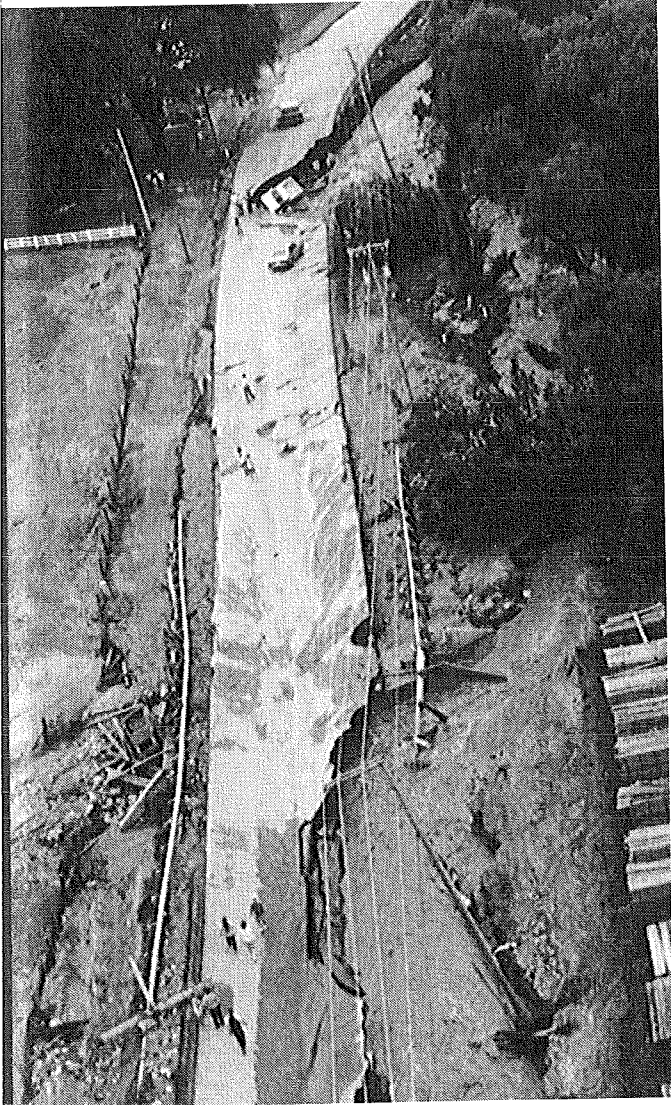


# The Floods Of 1993



## The Wisconsin Experience

Wisconsin Department of Natural Resources  
December 1993

# THE FLOODS OF 1993

## THE WISCONSIN EXPERIENCE

Covering The Following River Basins:

Illinois-Fox, Rock, Fox, Wolf, Wisconsin, Black, Chippewa,  
Mississippi, Yahara, Pecatonica, Baraboo/Devils Lake

Prepared by:

Bureau of Water Regulation & Zoning  
Wisconsin Department of Natural Resources

*Gary Heinrichs, Editor (608) 266-3093*

**Cover Photos:** Left - Highway 113, south of Devil's Lake, felt the brutal power of the July 17-18th flooding event. Top Right - 90 homes damaged in the Grove area of Black River Falls during the June 20th flooding event. Bottom Right - Downtown Darlington under water after the July 5-6th flood.

## TABLE OF CONTENTS

INTRODUCTION .....	1
ILLINOIS-FOX RIVER .....	11
ROCK RIVER .....	15
FOX/WOLF RIVER .....	17
WISCONSIN RIVER .....	21
BLACK RIVER .....	25
CHIPPEWA RIVER .....	29
MISSISSIPPI RIVER .....	33
PECATONICA RIVER .....	41
YAHARA RIVER .....	47
BARABOO RIVER .....	49

### FIGURES

- FIGURE 1:       DECLARED COUNTIES IN WISCONSIN
- FIGURE 2:       TOTAL DAMAGES IN WISCONSIN
- FIGURE 3:       PUBLIC SECTOR DAMAGES
- FIGURE 4:       UTILITY DAMAGES
- FIGURE 5:       JUNE 1 - JULY 31 PRECIPITATION
- FIGURE 6:       FLOODING EVENTS STATEWIDE
- FIGURE 7:       PEAK STAGES/DISCHARGES SUMMARY
- FIGURE 8:       MIDWEST WEATHER PATTERNS
- FIGURE 9:       DAM FAILURE SUMMARY



## INTRODUCTION

---

Major flooding struck the upper Midwest during the spring and summer of 1993. The magnitude of the disaster - to people, property, business, agriculture and the environment - was unmatched by any other flood in United States history. Damages will exceed \$12 billion - at least \$930 million in Wisconsin. Damaged highways and rail lines disrupted transportation. The Mississippi and Missouri Rivers were closed to shipping. millions of acres of farmland were under water for weeks during the growing season, and severe erosion, siltation, well pollution, chemical and effluent spills, and other environmental damages are a lasting legacy of the flood.

In Wisconsin, 86% of the damages (\$800 million) was related to agriculture. Cool, wet weather in 1992 combined with over \$125 million in winterkill losses and a very wet spring made this one of the most disastrous periods in state agricultural history - and then came the floods! Homeowners were also hurt badly. At least 4,700 homes were damaged by the floods, 2500 people were evacuated, and damages may exceed \$46 million (5% of total damages). This does not include the costs of temporary housing and meals, evacuation activities, or damaged personal possessions. Private business losses exceeded \$31 million (3.3%), much of it related to shutdowns and

damages to goods and supplies stored in basements. Public damages reached \$43.6 million (4.7%), including roads, bridges, buildings, dams and levees. Utilities claimed \$9.2 million in damages (1%). Over 4,000 individuals and private businesses have filed damage claims. Claims submitted by municipalities and non-profit organizations total 650. (See charts.)

To date, much of the federal assistance applied for is still pending for review or disbursement. Of the \$17.5 million requested in federal assistance for individual and family grants, public assistance, and hazard mitigation, \$4.9 million has been granted. Of the \$46 million requested for repairing homes, \$3.1 million has been granted. Some homeowners have decided to relocate because they can't afford to rebuild to present floodplain development standards, flush polluted wells, or replace failed septic systems. In other communities, floodplain development standards have been attacked as a roadblock to rebuilding structures, thus threatening these areas with recurrent flooding and similar damages in the future.

Beyond the well-publicized toll the floods exacted on people, businesses and agriculture, there were other equally devastating effects. It is projected that flooding and excessive rains have cost Wisconsin millions in

lost tourism revenue, \$577,000 in additional staff for public health services, \$921,000 in unemployment claims for displaced workers, and \$425,000 for National Guard and Conservation Corps services. In addition, the losses due to crops not planted, livestock damage, winterkill, damage to farm facilities, and lost business revenue may never be accurately calculated. Where reliable figures are available, aggregate totals and damages by category are charted in this report.

The Soil Conservation Service estimated that 804,800 acres of state farmland has suffered severe (>10 tons/acre) erosion due to the flooding. Damages to erosion control structures were reported statewide and the wet weather has prevented construction of planned conservation practices. Wisconsin has received \$250,000 from SCS in federal Emergency Watershed Protection funds for stabilizing stream banks, removing debris and sediment, restoring watercourses, and other activities to prevent secondary flooding and further damage. It will cost an estimated \$11 million to implement all the land treatment practices needed to correct erosion damage.

## ***WHAT CAUSED THE FLOODING?***

The flooding in Wisconsin resulted from three principal factors:

- Heavy rains and flooding in fall '92, with some areas receiving as much as 8 inches of rain in one day.

- Saturated soil conditions around the state through winter '92-'93 as a result of the fall flooding.
- Unusually high precipitation throughout the spring and summer '93. (See precipitation maps.)

The fall '92 flooding culminated with a storm event on September 14-18 that dropped rain at a rate exceeding 2 inches an hour in much of the state. The flooding was caused by a stalled cold front over Illinois that trapped low pressure weather systems, causing unusually high precipitation events behind the front. Rainfall amounts for the week ranged from 6-8 inches, with 11 inches reported in Sauk County.

The worst hit areas were near the Baraboo, Trempealeau, Kickapoo, Black and Pine rivers. River levels 3 to 6 feet above flood stage were reported in many areas and hundreds of people were evacuated. Farmers - already suffering from poor crop growth due to the cool summer - could not harvest crops because of wet conditions. Ironically, a 4-inch rain forced officials to cancel the last two days of Farm Progress Days near Eau Claire for the first time in the show's history. A presidential declaration authorized assistance to 10 counties in southern and western Wisconsin. Damages were estimated at more than \$18 million. The 10 counties were Buffalo, Crawford, Jackson, Juneau, Pepin, Pierce, Richland, Sauk, Trempealeau, and Vernon.

By spring '93, the saturated soil conditions combined with heavy rains to cause widespread flooding on rivers throughout southern and southeastern

Wisconsin. Because of the typically low flows and wide floodplains on these rivers, damage was mostly confined to low-lying fields and roads, although the Fox River in Kenosha County flooded over 160 homes.

Unfortunately, the wet spring was just the beginning of a prolonged weather pattern that brought record rainfalls, river flows, and flood damages to a nine-state area in the upper Mississippi River drainage basin. The phenomenon is common, but the duration wasn't.

In early June, a weather pattern developed that was characterized by a strong low-pressure system over the western U.S. and a large high-pressure system in the southeast. The jetstream dipped south in the western states and flowed northeasterly across the upper Midwest. The southeastern high blocked the eastward movement of storms, thus creating a convergence zone between the warm, moist flow from the Gulf of Mexico and the much cooler and drier air from Canada, which resulted in thunderstorms. This pattern persisted through July.

As a result, the upper Midwest within this zone was deluged with rain while the eastern U.S., under the influence of the high-pressure system, was very hot and dry. Slight movements in the atmospheric pattern determined the timing and location of the excessive rainfall throughout the Midwest.

The persistence of this weather pattern caused unusually large amounts of rain to fall over the upper Midwest. These large accumulations and the wetter-than-usual spring produced flooding throughout the upper Mississippi River basin. Cumulative totals of 20-

40 inches for the first seven months of the year were typical, putting totals 150-200% above normal. As an example, Madison recorded above average precipitation for each of the first seven months of the year, with June being almost 200% of normal and July 300% of normal.

In Wisconsin, the most severe, widespread flooding began after the rainfall event of June 17-18, which produced totals of 2-7 inches throughout much of the southern and western part of the state. Runoff from this storm caused flooding on the Black, Chippewa, Eau Claire, Trempealeau, Buffalo, Kickapoo, Wisconsin and Mississippi rivers. Several dams and levees failed, hundreds of people were evacuated, and hundreds of millions of dollars in damages resulted. Succeeding rainfalls caused serious damages in the Pecos basin, the Yahara basin, and - in an extreme example of localized flooding - the Baraboo River/Devil's Lake flash flood event of July 17-18. By August, floodwaters had mostly receded around the state, except for parts of the lower Rock River. The stalled weather pattern reverted to more normal conditions.

As communities throughout the state move into the post-disaster period and begin the recovery process, it is important to acknowledge the lessons learned from the 1993 floods and what steps may be taken in the future to mitigate flood losses. Floodplain management's primary objective of protecting life, health and property must always be upheld. Properly addressing the following issues is an important step in that direction.

# WHAT HAVE WE LEARNED?

---

## ***FLOODPLAIN MAPPING***

This may have been the most costly lesson the floods of '93 taught us. A young boy was killed in the Baraboo area when an unnamed (and unstudied) tributary of the Baraboo River flooded and washed away the car he was riding in. As disturbing as this event was, it is even more sobering to fully grasp how far we have to go in completing this most critical activity. There are hundreds of similar tributaries that are unstudied and have the potential to unleash the same destruction as occurred in Baraboo.

In Black River Falls, the area known as the Grove was severely flooded when a levee washed out and was overtopped. This area was not mapped as floodplain because the old federal mapping standards dictated that all areas behind the levee were removed from the floodplain if the levee was at least built to the 100-year flood level. Wisconsin standards would have required the levee be at least 3 feet above the 100-year level, but the state was not aware that the levee existed. Thus, most homeowners in the Grove did not have flood insurance, no floodproofing measures had been enacted, and private and taxpayer dollars had been spent to improve these structures without protecting them from floods. Area residents believed the levee would protect them and were bitterly disappointed - and very angry - when it didn't.

Better coordination with local and county officials will be crucial in prioritizing and mapping these flood-prone areas. Even then, proper elevation of roads and structures, proper sizing of culverts, and thorough emergency action plans will be necessary to avert such tragic events in other areas.

## ***DEBRIS BLOCKAGE***

This was a major factor statewide, most notably at the Hatfield Dam where three of the 10 tainter gates were inoperable and two others were unusable partly because of debris blockage. Aerial photographs showed massive amounts of flotsam and jetsam piled up behind the dam, including piers, logs, boats and rafts. It is especially a problem in areas with low bridges, undersized culverts, or intense development. The problems associated with debris blockage certainly justify the use of the 2 foot freeboard standard for floodplain development.

## ***HYDRAULIC MODELS***

There were some problems with inadequate/inaccurate hydraulic models, primarily on the Wisconsin, Black and Eau Claire Rivers. Older studies which predicted a certain flood height based on the measured flows proved to be out of date or inaccurate. Unfortunately, these problems aren't evident until a flooding event occurs, which may be too late to prevent damages. A comprehensive inventory of outdated studies needs to be

completed along with a list of priorities for updated modeling and maps.

## ***WEATHER REPORTING***

There were problems with inaccurate flood predictions - either duration, severity, or time of occurrence. It was especially apparent along the Mississippi River where several rivers that contributed to the main channel flows were not reported. Better coordination between the state and local emergency government officials, and the NWS is necessary to provide more timely and accurate flood warnings. Also, better reportage of rainfall amounts for statewide weather reporting stations is critical.

## ***LEVEES***

The failure of the levee at Black River Falls, which inundated 90 homes in the Grove area and forced the evacuation of over five hundred people, underscores the value of state minimum standards for floodplain development. Older levees such as this, which do not meet the current standard requiring protection 3 feet above the 100-year flood, must be identified, upgraded, and all areas behind these levees mapped as floodplain. In this case, the department was unaware of the levee and thus did not enforce the standards. The Portage levee suffered several minor breaches which were successfully repaired, but damages would have been worse with higher flows. Better coordination with local officials to identify and mitigate sub-standard levees is necessary to avoid any more events like the Grove.

## ***WASTEWATER TREATMENT PLANTS***

The record rains and storm events strained the capacity of more than 20 municipal wastewater treatment plants in southwestern Wisconsin, causing hundreds of thousands of gallons of untreated sewage to be discharged directly into rivers and streams. Many of the plants received two to three times the normal amounts. The good news is that overall, the state's standards for siting and floodproofing plants worked. Plants in Arcadia and Portage were relocated and experienced no problems. Portage's old site was completely under water and would have caused massive water pollution. Hatfield and Fort Atkinson built new plants above the regional flood elevation and remained operational. Baraboo's plant remained fully operational during the flash flood event. Poorly sited and marginal plants throughout the state must take an example from these success stories and take the necessary steps to avoid costly damages and avert a water pollution disaster during the next flood.

## ***WATER SUPPLY SYSTEMS***

The inundation of the Des Moines filtration plant which cut off the supply of clean water for over 250,000 citizens for nearly a month focused attention on the vulnerability of public water supply systems and how entire cities can be inconvenienced for weeks or months. Flooded wells almost always become polluted and must be pumped, purged and chlorinated before being used again. Although state standards require the entire system to be floodproofed and regularly



inspected, there were several instances where the failure of storm sewers or - in one case, a levee - shut down one or more wells in a community. However, compared to the 1978 flood when numerous systems were shut down, floodproofing and relocation efforts undertaken by local governments in compliance with state well standards resulted in very few problems this year. Still, storm sewer failures and similar problems need to be closely monitored and mitigated to protect this most precious resource.

## ***ANTECEDENT SOIL MOISTURE***

Perhaps the most misunderstood and least publicized factor in the 1993 floods was antecedent soil moisture. Since television and newspapers rely heavily on visuals to tell the story of a disaster, most media coverage focused on riverine flooding, flash flooding, dam breaks, and levee failures. This is understandable from the lay person's viewpoint because it is much easier to see, accept and understand surface flooding. Raging rivers, clogged dams, flooded homes and floating cars are more interesting than soil moisture levels, soil type analysis, soil depth to bedrock, and soil drainage patterns.

Yet, the importance of publicizing and educating people about this major contributor to the flooding is critical. In areas such as the pothole lakes region of Waushara County, the Fox/Wolf River/Lake Winnebago basin area, and the Lower Wisconsin River Valley, high groundwater tables and high antecedent soil moisture levels combined to create the majority of the flooding problems. It is imperative that

people understand the differences between riverine and groundwater flooding, especially the concept that floodplain management programs will not solve all types of flooding problems. It is also important for communities to regulate development in areas where high ground water occurs. Regulations can prohibit basements and require elevation of first floors at least 2 feet above natural ground.

## ***BASEMENT COLLAPSE***

Residents of the Grove in Black River Falls found out what happens when you pump the water out of the basement while there is still high groundwater outside the structure. As water is pumped out, an imbalance in pressure is created between the basement space and the outside soil. The higher pressure on the outside collapses the basement walls. Since the water damage has already occurred to contents of the basement, the prudent course is to wait until outside groundwater is lowered sufficiently to eliminate any pressure imbalances. Another implication is that for structures on the fringes of the 100-year floodplain, natural or artificial changes made since the area was studied could raise the 100-year flows, so it is a good idea to properly floodproof the basement and purchase flood insurance with the expectation that a flood exceeding the 100-year event is possible.

## ***LANDFILLS/HAZARDOUS WASTE SITES***

Wisconsin regulations prohibit the siting of landfills and hazardous waste sites in a floodplain. This means all mapped

floodplains, not just the 100-year floodplain. Even then, development in the floodplain since it was studied may raise the flows, so the best course is to site these facilities far outside the floodplain. Also, there are many unlicensed facilities out there which follow no regulations, are managed by irresponsible people, and pose many environmental hazards during a flood event. Tire dumps, auto salvage yards, and small scrap metal recyclers are some of the problem categories. Fluids such as oil, anti-freeze and battery acid may be stored in improperly sealed containers. Old lead-acid batteries may be loosely stacked on the ground. Shredded tire piles may be carelessly placed outside. Better coordination with DNR and local solid waste managers is necessary to identify, monitor and regulate these facilities.

## ***PROPANE TANKS***

Floating propane tanks are a disaster waiting to happen. Floating bombs might be a more accurate description. Propane tanks, along with any other flammable, corrosive, explosive, buoyant, or otherwise potentially dangerous container should always be anchored and elevated above the 100-year flood level. However, a legally non-conforming structure that is not properly elevated may have dangerous tanks associated with it that are also not properly elevated. During the Black River Falls flood, at least one floating propane tank was reported in the Grove along with one tank anchored to the Hatfield Dam that was being violently jarred, creating a very dangerous situation. Reports of floating tanks along the Mississippi River were also made. Communities should prohibit all

such tanks in floodplain areas or maintain an up-to-date inventory of dangerous tanks in floodplain areas to insure they are properly anchored and elevated and to better prepare for implementation of emergency action plans during a flooding event.

## ***FLOODPLAIN MANAGEMENT***

Wisconsin's nationally recognized floodplain management program, innovative local initiatives and prudent action by private property owners and businesses limited damages in our state. Relocation programs in Soldiers Grove and Prairie du Chien took hundreds of structures out of the floodplain that had been severely damaged in previous floods. In Eau Claire a pumping station installed to alleviate flooding in low-lying areas of the Third Ward was very successful. In Richland Center, five homes in an area that participated in a SCS floodproofing program were not damaged while five others in the same area that did not participate were damaged. In Necedah, all but two structures in the community's floodplain have been relocated in recent years. The city of Darlington is working on a plan to relocate businesses in the floodplain and floodproof others that are historically significant.

The experiences of these communities in mitigating flooding problems, protecting life, health and property, minimizing business and personal inconveniences, and bettering the economic, social and cultural quality of life in their respective areas need to be shared with all residents of the state. State regulations and assistance programs establish the framework for

equitable and effective floodplain management programs, but the experiences of citizens, business owners and local officials in implementing these programs provides the best testimony of their value to all of us.

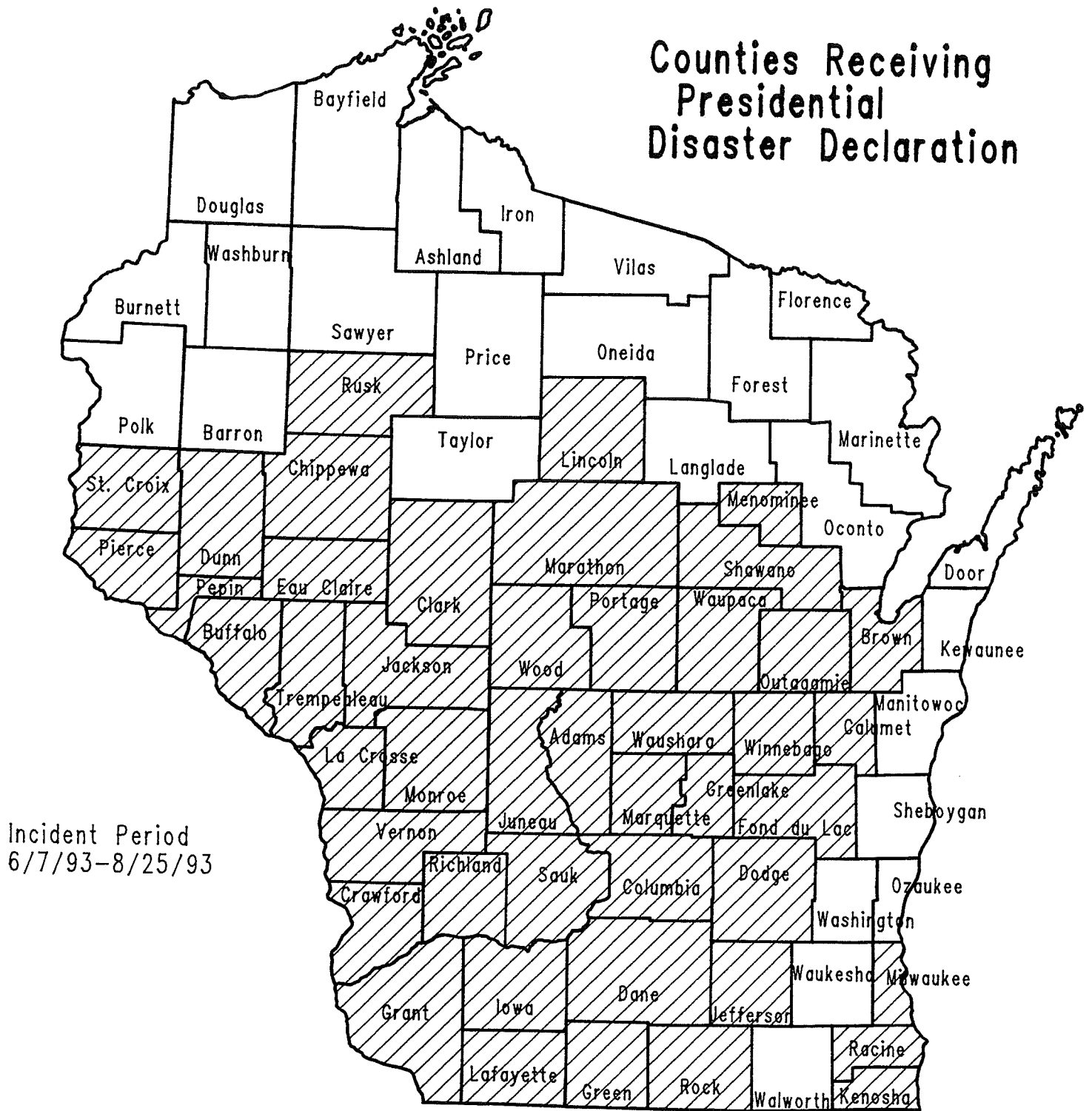
## WHAT HAPPENS NOW?

---

In the aftermath of the flooding, people understandably are still focused on rebuilding, replacing and renewing their personal lives, their economic livelihoods and the communities they live in. Total relocation (like Soldier's Grove, WI) is proposed by several communities in the nine Midwest flooded states. Acquisitions and relocations of structures in the floodway, floodproofing, rebuilding of levees, and elevating structures are being discussed by several communities in Wisconsin. Many communities have put plans on hold until financing and logistical arrangements can be worked out.

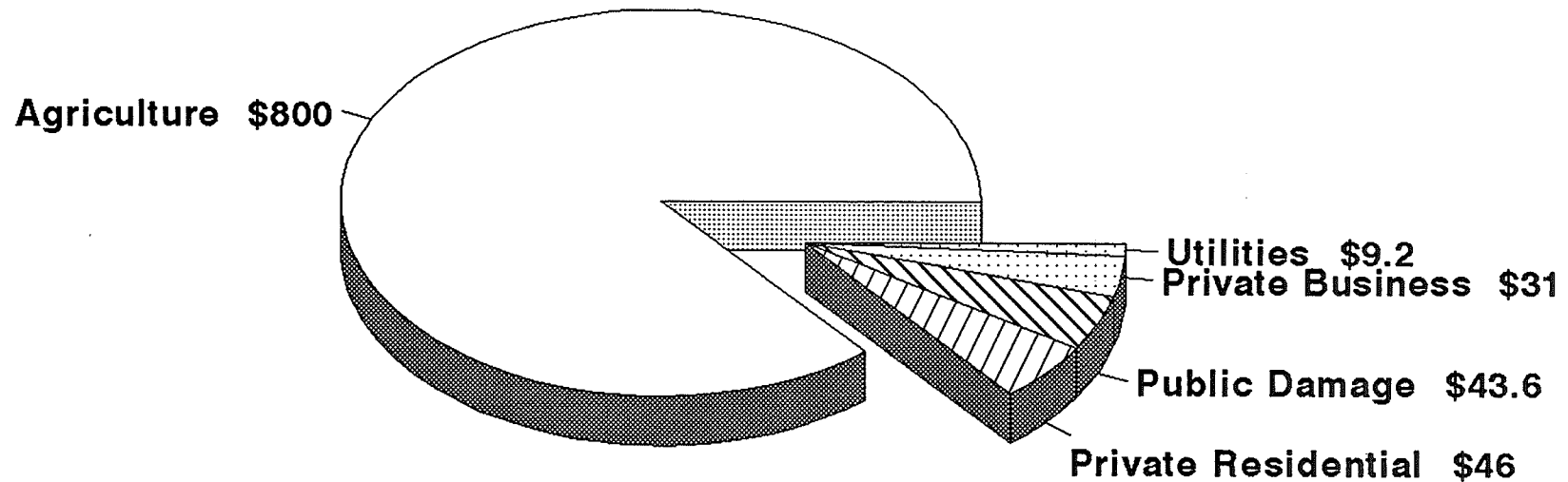
One difficulty is the complexity and (sometimes) contradictory intentions of the myriad of federal and state assistance programs available. For many programs, the focus is on rebuilding to standards that may not prevent future flood damage. For others, questions of eligibility related to participation in the National Flood Insurance Program have come up. Taken together, it is clear that these various programs will need to work on improved coordination, more timely delivery and more harmonious objectives in promoting sound floodplain management. Listed below are some of the critical tasks this agency will address in the coming months:

- Reviewing short term mitigation options for communities affected by flooding: acquisitions and relocation, floodproofing, elevation of structures.
- Reviewing federal and state floodplain management standards and programs for feasibility, compatibility and effectiveness.
- Assisting communities in developing and implementing long-term mitigation plans.
- Evaluating available federal and state funding programs for mitigation and suggestions for improvements.
- Strengthening emphasis on technical assistance, information and training for local officials.
- Implementing more effective flood loss reduction programs through cooperative agreements with the Wisconsin County Code Administrators, Wisconsin Counties Association, Wisconsin Towns Association, League of Wisconsin Municipalities, Wisconsin Alliance of Cities, and other groups interested the issue.



# WISCONSIN DAMAGE ESTIMATES In Millions

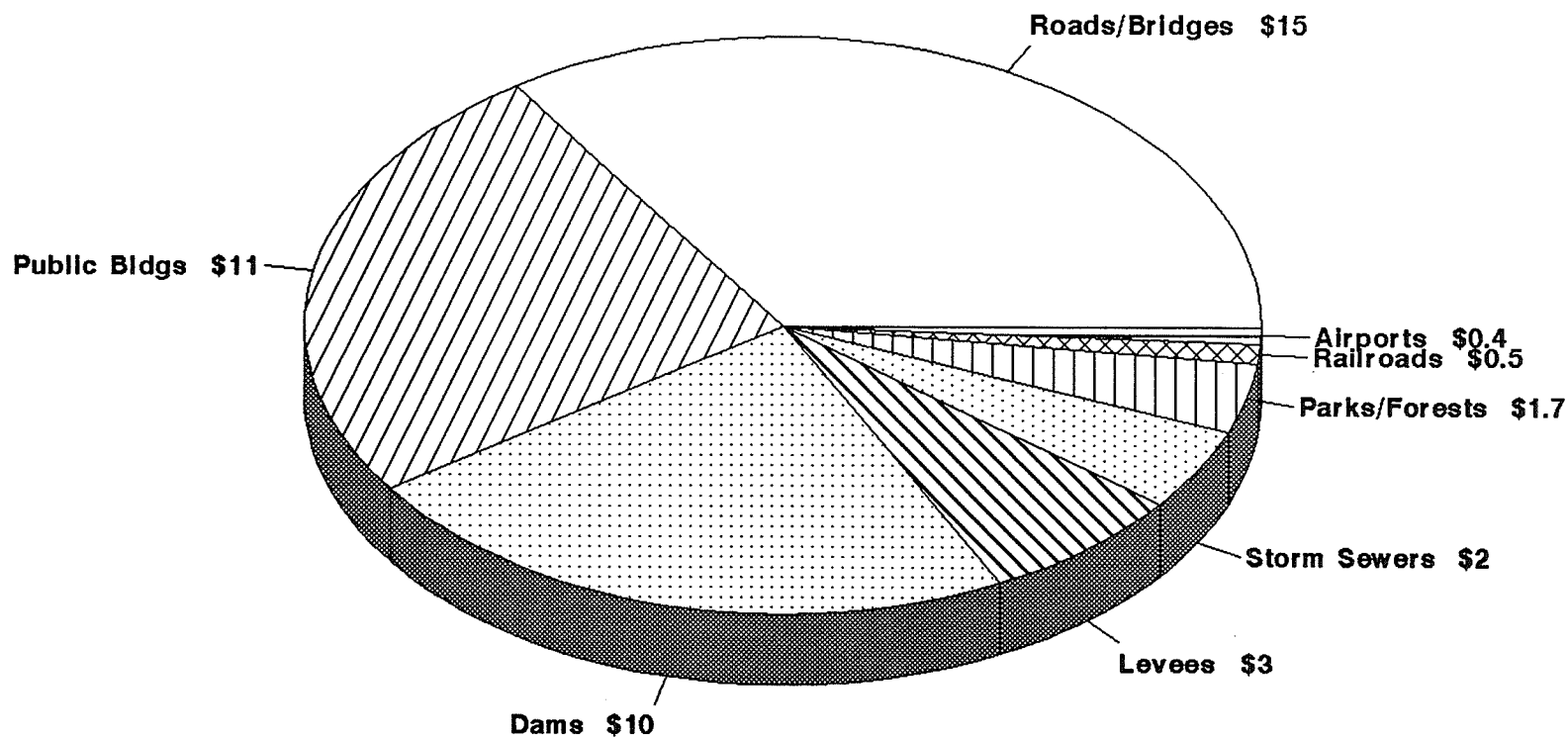
---



**Total of \$929.8 Million**

# PUBLIC DAMAGES FURTHER BROKEN DOWN In Millions

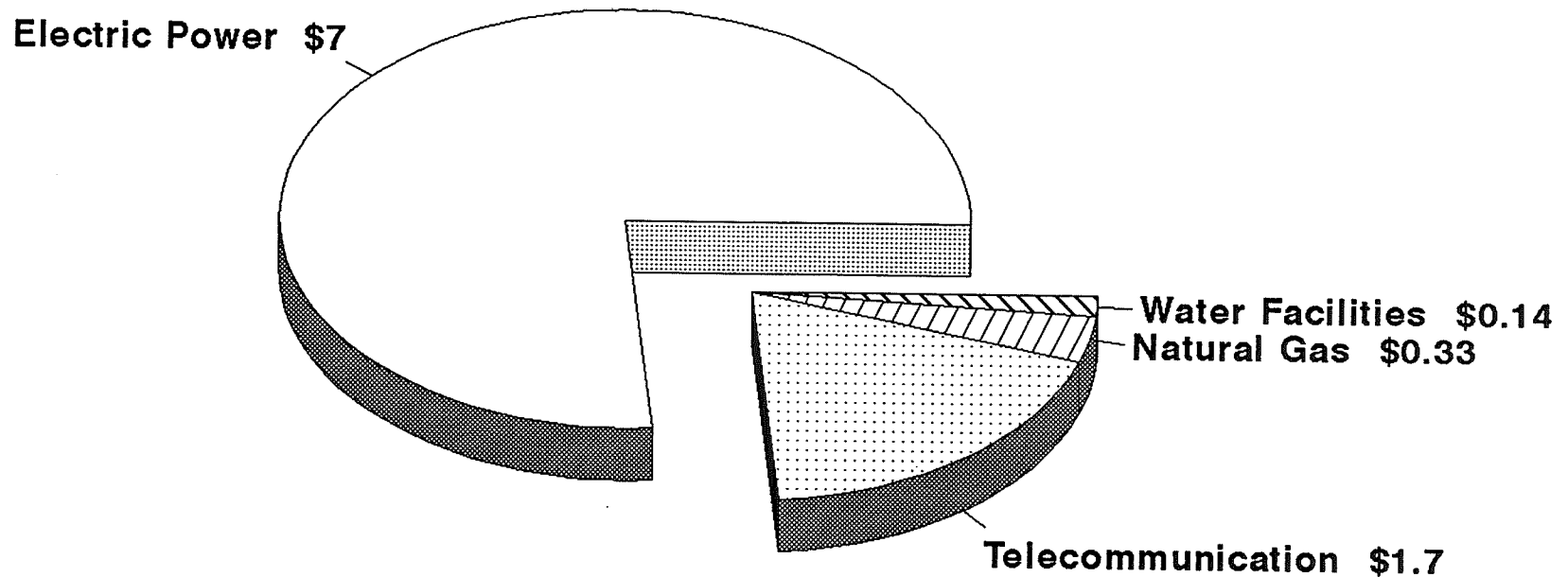
---



Total of \$43.6 Million

# UTILITIES DAMAGES FURTHER BROKEN DOWN In Millions

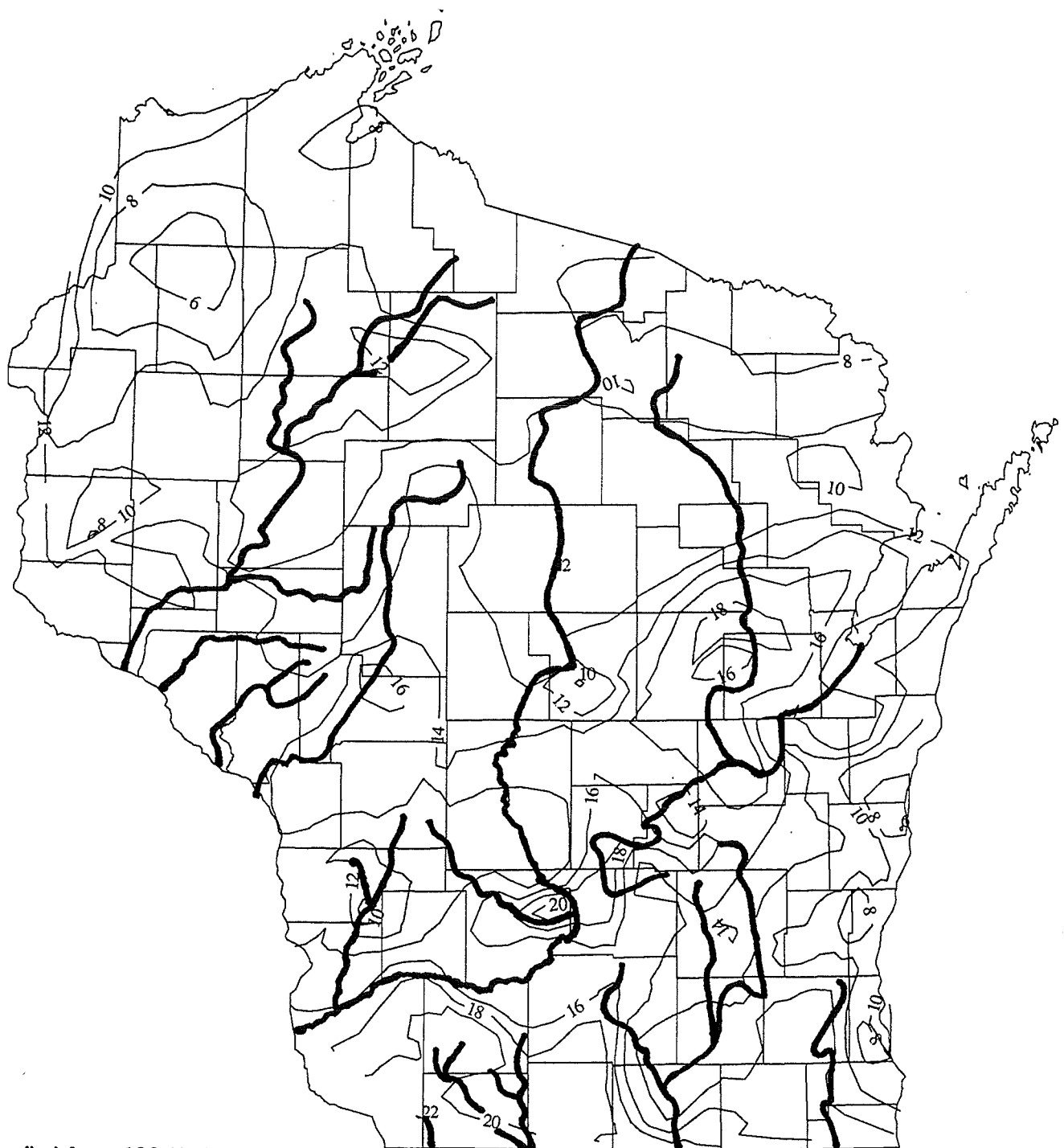
---



**Total of \$9.2 Million**



### Agregate Rainfall (inches) June and July, 1993



Compiled from 199 National  
Weather Service Reporting Stations

# Recurrence Intervals for Flooding Events in WI April - August 1993

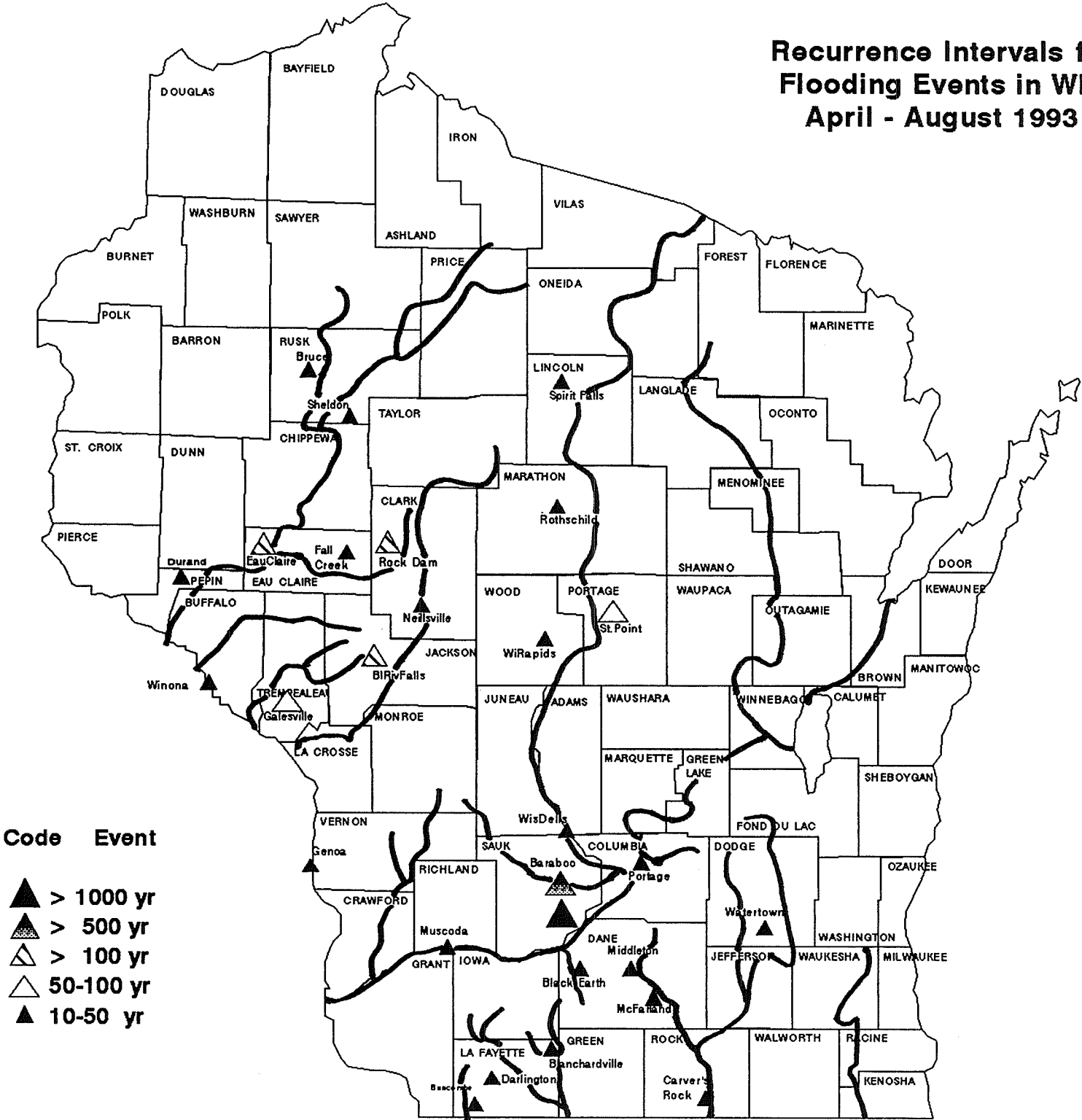


FIGURE 6

Table 1. Summary of peak stages and discharges at selected streamflow-gaging stations in the upper Mississippi River Basin [mi<sup>2</sup>, square miles; ft, feet; ft<sup>3</sup>/s, cubic feet per second; >, greater than]

Site number	Station number	Station name	Drainage area (mi <sup>2</sup> )	Flood data						
				Flood of June–August 1993				Previous maximum discharge		
				Peak stage (ft)	Peak discharge (ft <sup>3</sup> /s)	Date	Recurrence interval range (years)	Peak stage (ft)	Maximum discharge (ft <sup>3</sup> /s)	Date
21	05360500	Flameau River near Bruce, Wis.	1,860	10.11	16,500	06/21	10– 50	10.90	17,600	<sup>3</sup> 04/1986
22	05362000	Jump River at Sheldon, Wis.	576	13.20	16,400	06/21	10– 50	18.80	46,000	08/1941
23	05369500	Chippewa River at Durand, Wis.	9,010	15.76	90,100	06/23	10– 50	18.40	123,000	<sup>3</sup> 04/1967
24	05381000	Black River at Neilsville, Wis.	749	19.28	30,300	06/20	10– 50	23.80	48,800	09/1938
25	05382000	Black River near Galesville, Wis.	2,080	16.64	64,000	06/21	> 100	<sup>4</sup> 15.46	65,500	<sup>3</sup> 04/1967
26	05393500	Spirit River at Spirit Falls, Wis.	81.6	7.4	2,700	06/21	10– 50	10.00	4,180	09/1942
27	05398000	Wisconsin River at Rothschild, Wis.	4,020	27.48	44,400	06/21	10– 50	<sup>5</sup> 18.46	49,200	04/1965
28	05404000	Wisconsin River near Wisconsin Dells, Wis.	8,090	18.16	59,100	06/24	10– 50	23.83	72,200	09/1938
29	05405000	Baraboo River near Baraboo, Wis.	609	22.78	6,360	07/18	10– 50	<sup>6</sup> 17.50	7,900	03/1917
30	05406500	Black Earth Creek at Black Earth, Wis.	45.6	6.13	1,320	07/06	10– 50	6.58	1,750	07/1954
31	05407000	Wisconsin River at Muscoda, Wis.	10,400	10.35	59,600	06/25	10– 50	<sup>4</sup> 11.48	80,800	09/1938
32	05414820	Sinsinawa River near Menominee, Ill.	39.6	13.18	11,300	07/05	(> 50)–100	13.34	11,600	06/1969
33	05415000	Galena River at Buncombe, Wis.	125	16.7	16,000	07/06	10– 50	19.57	29,700	06/1969
34	05418500	Maquoketa River near Maquoketa, Iowa.	1,553	32.59	38,000	07/06	10– 50	<sup>5</sup> 24.7	48,000	06/1944
35	05420500	Mississippi River at Clinton, Iowa.	85,600	<sup>2</sup> 22.98	245,000	<sup>3</sup> 07/05	10– 50	24.65	307,000	04/1965
36	05422000	Wapsipinicon River near DeWitt, Iowa.	2,330	12.86	24,100	07/09	10– 50	14.19	31,100	06/1990
37	05427948	Pheasant Branch at Middleton, Wis.	18.3	8.92	<sup>1</sup> 746	07/06	10– 50	8.54	516	<sup>3</sup> 03/1975
38	05429500	Yahara River near McFarland, Wis.	327	<sup>6</sup> 6.75	615	07/25	10– 50	<sup>2</sup> <sup>6</sup> 6.33	867	<sup>3</sup> 04/1959
39	05431486	Turtle Creek at Carvers Rock Road near Clinton, Wis.	199	10.38	5,580	06/30	10– 50	<sup>7</sup> 12.85	16,500	04/1973
40	05432500	Pecatonica River at Darlington, Wis.	273	18.22	12,400	07/06	10– 50	20.71	22,000	07/1950
41	05433000	East Branch Pecatonica River near Blanchardville, Wis.	221	16.54	6,560	07/06	10– 50	15.74	11,700	02/1948

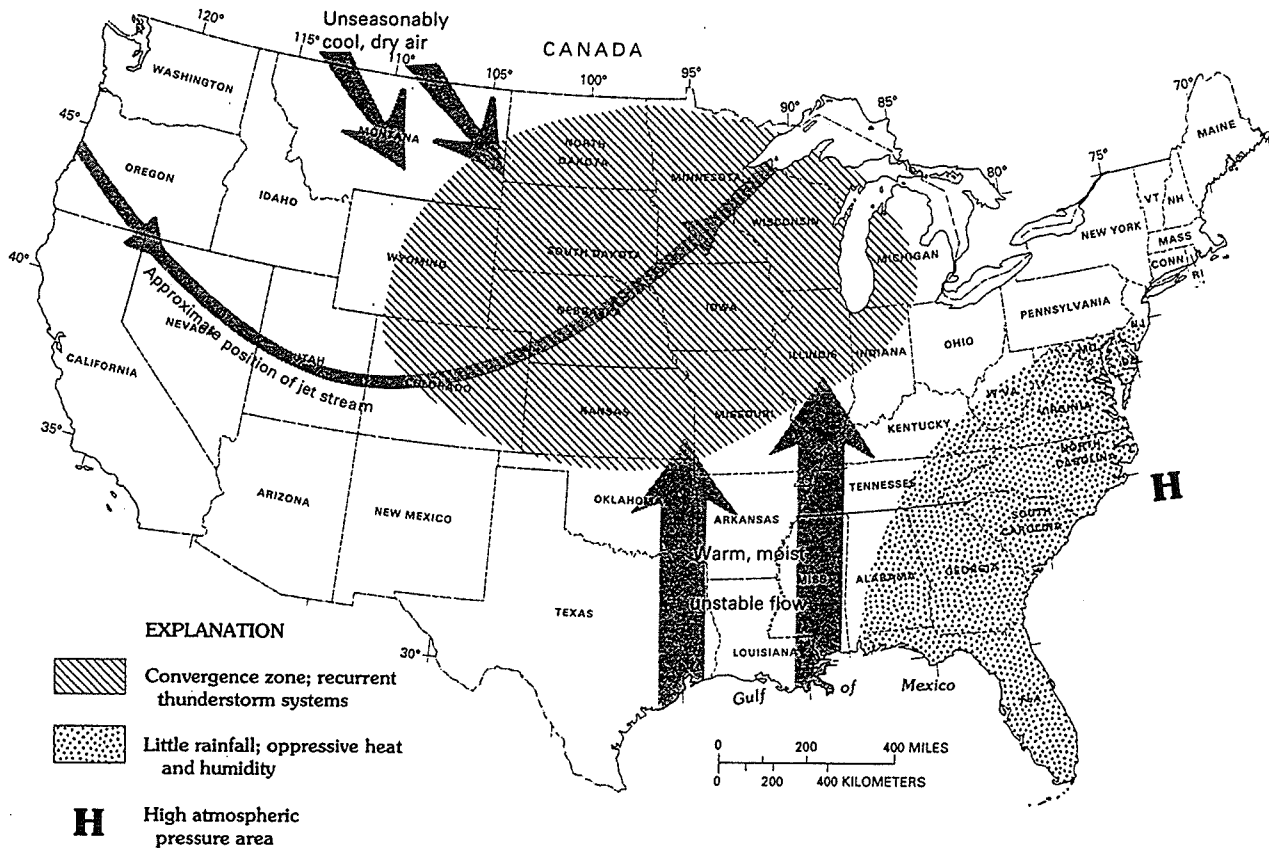


Figure 2. Dominant weather patterns over the United States for June through July 1993 (from National Weather Service, 1993).

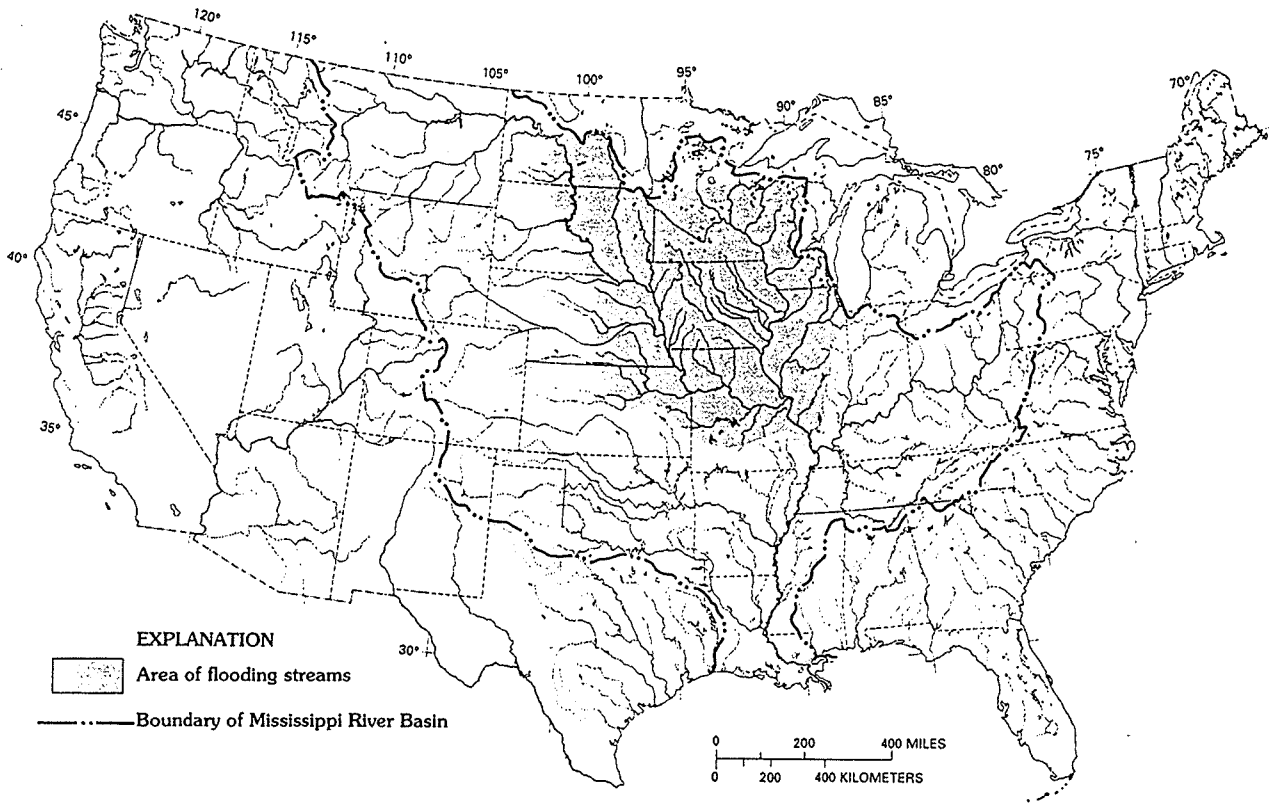


Figure 1. Mississippi River Basin and general area of flooding streams, June through August 1993 (from Parrett and others, 1993).

1993 DAM FAILURE SUMMARY

*During the winter, the following dam washed out:*

*Partridge Lake Dam, Juneau County*

*In spring, the following dams washed out or were damaged by high water:*

*Wright Dam, Iowa County*

*Lake Emily Dam, Dodge County*

*Gooseville Dam, Sheboygan County*

*Cox Hollow Dam, Governor Dodge State Park, Iowa County*

*Briggsville Dam, Marquette County*

*Waterford Dam, Racine County*

*Lowell Dam, Dodge County*

*The following dams overtopped:*

*Upper Watertown Dam, Jefferson County*

*Hebron Dam, Jefferson County*

*Due to the flooding period in June the following dams washed out:*

*Rock Dam Lake Dam, Eau Claire County - washed out embankment & road*

*Hatfield Dam power canal dike, Jackson County*

*ASP Cranberry, Jackson County - 2 dikes*

*Roberts Cranberry, Jackson County - 4 dikes*

*Cambria Dam, Columbia County*

*Bass Lake Dam, Waupaca County*

*Several other dams were damaged during this period:*

*Jordan Dam, Columbia County - emergency repairs to prevent embankment failure*

*Humbird Dam, Clark County - completely washed out the embankments around the cutoff walls*

*Fairchild Dam, Eau Claire County - dike overtopped and road washed out*

*Lake Eau Claire Dam, Eau Claire County - deep sluice gate broken in attempt to open*

*Blair Dam, Trempeleau County - Slow gate operation caused downstream road embankment to erode*

*Dells Dam, Augusta, Eau Claire County - damage to water wheel*

*Packers Bay Dam, Marquette County - embankment overtopped*

*Shopiere Dam, Rock County - emergency repairs were required to fill embankment breach*

*Reservoir/Dummy Dams, Oconto County - failure to fully operate gates caused lake to bypass through low area causing road damage*

*Upper Appleton, Outagamie County - high head caused grout patch to fail resulting in severe seepage through a rock rubble wall*

*Auld & Rohrer, Waupaca County - contractor breached embankment to prevent spillway construction from failing*

*Fox Lake Dam, Dodge County - embankment problems related to seepage at old tree roots*

*Other results of the flooding include:*

- *Construction on dams was halted at Dairyland and Ladysmith due to high water.*

- *The necessity for increased numbers of inspections of dams which have been threatened this spring and summer. Once the water recedes, dam owners will see problems which are not visible due to the high water.*

- *The lack of information and notification from cranberry growers regarding the condition and operation of their dams.*

- *Many dams have sustained unreported damage. The damage may not be noted until a subsequent inspection takes place or when the weakened structure is again stressed by flooding.*

*As you can see, many dams around the state were stressed this year. Almost none of these dams provided any foreshadowing that they were on the verge of failing. Once again, if your dam is located in an area of the state which was subjected to high quantities of rain this year, you should inspect your dam this fall to ensure its stability for spring snowmelt and higher flows.*





## ILLINOIS-FOX RIVER

---

The Illinois Fox River has its source near Menomonee Falls and travels generally southward, draining areas of Waukesha, Walworth, Racine, and Kenosha counties before emptying into the Illinois River in Illinois, which is a tributary to the Mississippi River.

At the town of Wheatland, the Fox and its tributaries have a drainage area of 822 square miles. Near the village of Silver Lake, the drainage area increases to 865 square miles, and at the state line, the area is 871 square miles. The predominant land use of the contributing drainage area is agricultural, mostly corn and soybeans.

After four years of low precipitation and emergency drought conditions, southeastern Wisconsin experienced a very wet spring and summer with precipitation levels several inches above normal. There was 7.71 inches of rain during April 1993, with average monthly summer levels of about 6 inches. Groundwater levels, well below average for the past four years, were restored. In spring and summer of 1993, the water table was above the normal. Most of the streams were running bank full with overtopping into some overbank areas.

Between April 8-21, rain fell nine of the 14 days in the Kenosha area, including a 2 inch event on April 20. As a result there were lots of areas of minor flooding. However, the Illinois Fox River did receive more extensive flooding with many homes and roads inundated with the flood waters.

In late April 1993, the Illinois Fox River in Kenosha County rose to flood levels. The flood damage was limited to areas south of STH 50. Roughly 200 homes were impacted in the town of Wheatland and the villages of Silver Lake and Wilmot. There was also a very small portion of the town of Salem impacted. Kenosha County declared a state of emergency and recommended evacuation. The flood emergency lasted more than a week. The Coast Guard, Kenosha County Sheriff's Department, town of Wheatland Fire Department and DNR Conservation Wardens assisted in the evacuation of impacted residents. The Kenosha County Emergency Services estimates that 50% of the impacted homes were actually evacuated after the order of emergency.

About 160 homes were flooded prior to the crest. Most of these homes also had one or two accessory structures in the rear of the property. There were several sheds that floated away and clogged up the CTH F bridge. These sheds were ultimately destroyed by the forces of the river.

In the town of Wheatland, CTH W was overtopped at one location, while six major roads were closed to traffic. Major portions of western Silver Lake were inundated and ordered evacuated. After the flood crest, the CTH F bridge became clogged with several obstructions and impeded the flow of the river. In the village of Wilmot, the public access was closed. Several homes along 306th Court were flooded during the event.

Flow data from the gaging station at Wilmot (05546500) indicates that the peak level was approximately a 10-15 year event. It must be noted that in 1992, the Wilmot dam failed and there is an adjustment to be made to the flow data. The information used for this report is raw and has not been adjusted; however, for purposes of comparison it should be sufficient.



$Q_{10} = 4650$  cfs from FIS

$Q_{peak} = 4990$  cfs from gage

The peak occurred on April 22, with flows greater than 4000 cfs from April 21-26. See USGS Flow Report for April and May 1993.

Flooding also occurred 32 river-miles upstream in the city of Waukesha, primarily overland with little structural flooding. This drainage area is significantly smaller with a watershed area of 126 square miles. There was 6.45 inches of rain in April observed at the Waukesha station. Flow gage information from USGS (station 055438300) was compared with the Waukesha FIS.



$Q_{10} = 1690$  cfs FIS

$Q_{peak} = 1490$  cfs gage

In Kenosha County, damages to residential structures was estimated between \$200,000 - \$250,000. This figure does not include vehicles, boats, lawn mowers, sheds, and other accessory items damaged by the flooding. If these items were included, the damage totals would be closer to \$500,000. Most wells in the area were inundated and air was blasting out. While many of the wells were non-

compliant with the well codes and did not meet floodplain standards, the health danger from flooding was relatively low.

While the Illinois Fox River received the most attention due to the number of structures involved, the Southeast experienced flooding in other areas. At Johnsonville, the Sheboygan River was lapping at the base of the Johnsonville Sausage meat processing plant. In Thiensville and Mequon, several streets were closed to vehicular traffic due to the high water of the Milwaukee River. While no one was evacuated, several homes in Mequon were accessible only by boat.

Along Pike Creek near Kenosha, roughly 160 cars at a car dealership storage terminal suffered water damage from the overflowing stream. As a result of the mold and moisture damage, the company decided to destroy the vehicles.

In a related event, the bluffs along Lake Michigan in southern Ozaukee County and northern Milwaukee County faced severe slumping and erosion due to the large storm runoff. Roughly 20 property owners have applied to the Department to repair the deteriorating bluff.

## CHRONOLOGY

### THURSDAY, MARCH 25

Choked by rapidly melting snow and recent rains, the Fox River overtopped its banks, flooding low-lying areas in western Kenosha County. Although flooding is common in this area, the velocity and fast rise of the waters

concerned even long-time residents. "The water came up so fast, what with the rain and melting snow, but I think if we don't get more rain, it should crest by tomorrow," said Mary Jo Joerndt. Other residents noted that if the dam at Wilmot had not been removed, the flooding could have been a lot worse.

## SATURDAY, MARCH 27

The Fox River rose another foot Friday afternoon, forcing authorities to barricade a number of streets and causing residents to boat to their homes. More than 80 homes in the Oakwood Shores subdivision were surrounded by water Friday, double the number from Wednesday. Local residents believe the river crested late Friday and should start receding today. Frank Livermore, who lives in the subdivision, commented that "things don't look too bad right now, but if we get rain this weekend, we will be in a world of hurt."

## THURSDAY, APRIL 15

Persons living along the Fox River are breathing a little easier this week as flood waters finally began receding. A month after the river first overtopped its banks, six streets in the Oakwood Shores subdivision remained closed, but should be reopened soon. Residents noted that the river usually recedes within a week of cresting, and the duration of this event was unusually long.

## TUESDAY, APRIL 20

Spurred by 24 hours of steady rain, the flooded Fox River surged more than a foot to near record levels today.

Many residents of Shorewood Acres and Oakwood Shores, south of Highway 50, spend the day moving furniture and vehicles and preparing to evacuate as the river continued to rise about an inch an hour. One resident said the water was already above the foundation of his house and had risen 18 inches in the past two days. The Kenosha wastewater treatment plant pumped a record 80 million gallons Tuesday, breaking the previous record of 74 million set last Thursday.

## WEDNESDAY, APRIL 21

A state of emergency was declared today for flooded areas in the towns of Salem, Wheatland and the village of Silver Lake. Approximately 150 homes are affected and residents were asked to evacuate. Utilities were being shut off at residences and the local fire departments were evacuating some people by boat. The river was still rising today and is not expected to crest until Thursday at 7.8 feet, 15 inches above flood stage.

## FRIDAY, APRIL 23

The Fox River receded 2 inches today from Thursday's crest of 7.8 feet, but was still 13 inches above flood stage. The chief concern was forecasts calling for heavy rains through Saturday that could push river levels even higher. The boating ban on the stretch between Highways F and 50 continued.

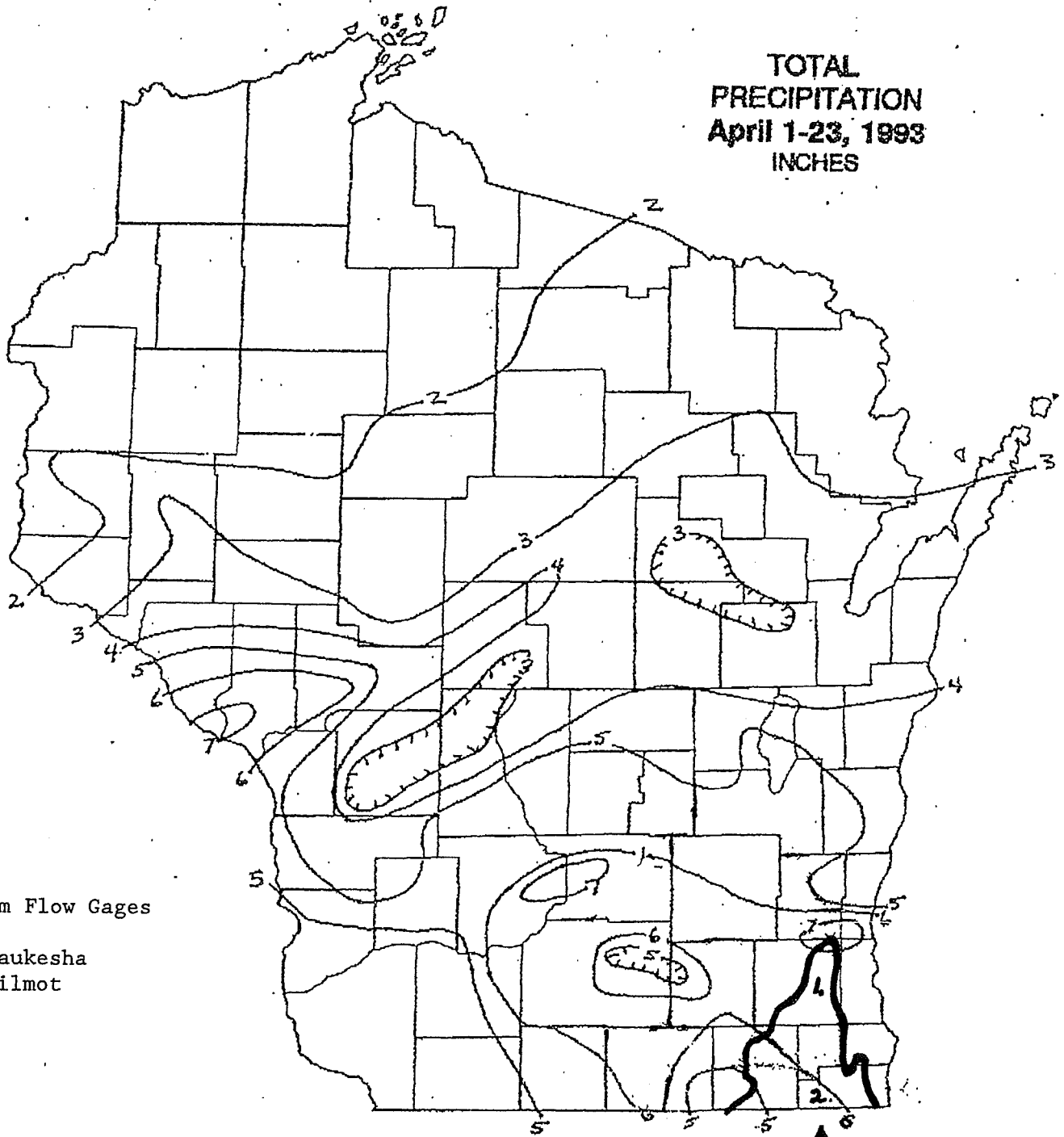
## SATURDAY, APRIL 24

The combination of unexpected dry weather today and a further drop in river levels to 7 feet brought relief to Kenosha County residents. Officials



believe that most evacuated residents will be allowed to return home within two days and that the state of emergency will be lifted by Tuesday.

**TOTAL  
PRECIPITATION  
April 1-23, 1993  
INCHES**



Stream Flow Gages

- 1) Waukesha
- 2) Wilmot

FOX RIVER BASIN  
-ILLINOIS- ↑

STATE CLIMATOLOGIST

GEOLOGICAL & NATURAL HISTORY SURVEY

UW-EXTENSION



# ROCK RIVER

The Rock River watershed drains a large area of south central Wisconsin, flowing southerly to the Illinois border. The contributing basin is relatively flat with a large amount of floodplain storage, with floods usually related to high volumes of flow caused by extended precipitation, snow melt or both.

Spring 1993 flows were higher than normal due to both factors. During the period of April 1-23, precipitation was again above normal (see attached isohyet map). This precipitation along with snow melt combined to create the resultant high flows.

Precipitation during the months of March and April was above normal. Snow cover had also been above average. Spring snow melt combined with the 5-7 inches of rain which fell across the basin during the first three weeks of April contributed to the flooding along the Rock River.

Although the amount of flooding varied, saturated soil conditions and the extended precipitation events kept the river above flood stage for extended periods of time. Although the recurrence intervals for this flood were less than a 20 year event for the most part, the length of time that it remained above flood stage along with the uncertainty of additional rainfall made the event appear considerably more severe.

Flood frequency varied by location. The following table summarizes the actual flows and the expected frequency at selected gage points. Cubic feet per second (C.F.S.) is a measure of flow. As a comparison, 7.5 gallons per second is equal to 1 c.f.s. Frequency refers to flood heights compared to the 100-year flood elevation level.



## FREQUENCY SUMMARY

<u>Gage Number</u>	<u>Location</u>	<u>Date</u>	<u>Gage Ht.</u>	<u>Discharge</u>	<u>Frequency</u>
#05425500	Watertown	4/20	6.03 ft.	4,700 CFS	29 Yr.
#05427570	Indianford	4/25	15.85 ft.	10,200 CFS	22 Yr.
#05430500	Afton	4/23	11.44 ft.	10,800 CFS	11 Yr.

## CHRONOLOGY

### FRIDAY, APRIL 16

The weather service issued a flood warning for the areas of Jefferson and Rock counties adjacent to the Rock River through Sunday, as the swollen river caused lowland flooding in those areas. All floodgates on the Jefferson dam were opened. The Watertown dam was sandbagged because high waters were overflowing the east wing wall. The river was 2 feet over its banks in Fort Atkinson, flooding back yards and several roads. In Janesville, the river overflowed its western bank in Riverside Park. The river was expected to crest at 11 feet on Sunday.

### TUESDAY, APRIL 20

Water levels along the Rock River in Jefferson County were almost up to the 1986 levels, but still 2 feet below the big flood of 1979. Homes and businesses in the Blackhawk Island/Lake Koshkonong area were pumping basements and piling sandbags in anticipation of higher flows. "We are monitoring the Rock and Crawfish and they are still below the 1979 flood stage by a couple of feet," said Becky Heinz, emergency government program assistant. "That flood crested on April 1. We are really pretty late in the spring with this one." Officials were watching dams throughout the watershed as the river system passed along runoff from the recent rain and snowfalls. Sandbagging operations were underway at the Lake Emily Dam near Fox Lake; the Beaver Dam River at Lowell; and on the east bank of the Rock River at the Jefferson Dam.

### THURSDAY, APRIL 22

Flood warnings have been extended until Friday for the Rock River in Jefferson and Rock counties, which was still rising and causing widespread lowland flooding. Levels at Afton were at 11.24 feet Wednesday, up from 11.1 feet on Tuesday. Flood stage is 9 feet. The river at Afton, south of Janesville, is expected to crest Friday around 11.8 feet. The river crested at 6.03 feet at Watertown on Tuesday, and fallen to 5.76 feet on Wednesday. Flood stage is 6 feet. Levels continued rising on the Crawfish, up to 8.96 feet from 8.87 feet yesterday. Flood stage is 9 feet.

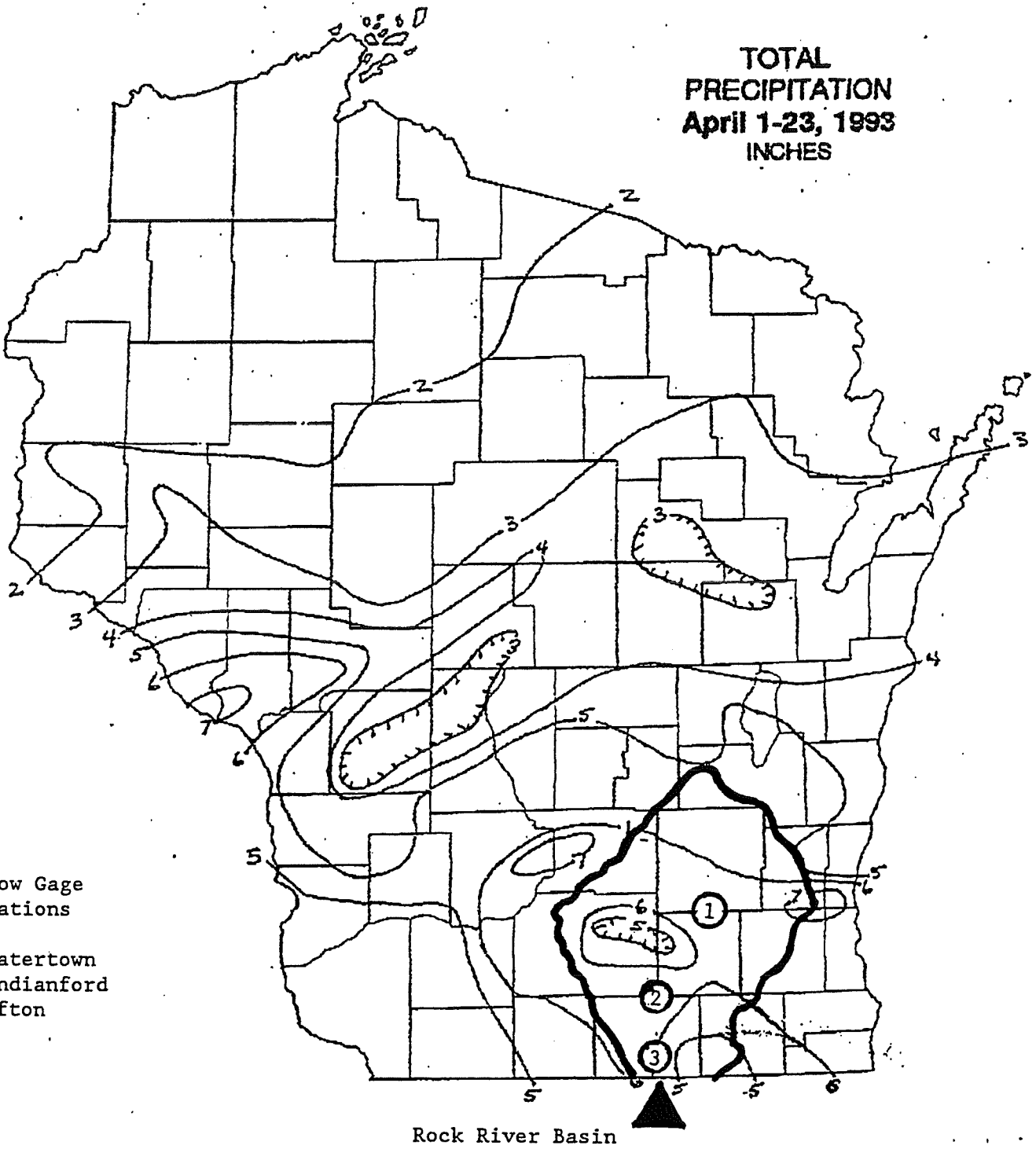
### MONDAY, APRIL 26

River levels remain high around the state but most have crested and are starting to drop. The Rock River is dropping slowly at Afton, Indianford and Watertown. The Crawfish River dropped, but is still above flood stage.

### FRIDAY, JULY 30

High waters on the Rock River near Fort Atkinson still plague residents of Blackhawk Island. This summer the river rose to its highest July level since records were first kept in 1933. With levels only going down a half-inch daily, problems such as submerged roads, docks, and basements have meant daily inconveniences for island residents. Shoreline erosion has been worsened by speeding boats, and mail service has been interrupted.

**TOTAL  
PRECIPITATION  
April 1-23, 1993  
INCHES**



Flow Gage  
Stations

- 1. Watertown
- 2. Indianford
- 3. Afton

Rock River Basin



# FOX AND WOLF RIVERS

The Fox and Wolf Rivers form a major watershed in east central Wisconsin, flowing northeast and southeast respectively until converging at the Lake Winnebago basin and then flowing north to Green Bay. The contributing basin is relatively flat with a large amount of floodplain storage, with floods usually related to high volumes of flow caused by extended precipitation, snow melt or both.

1993 flows were higher than normal due to precipitation that averaged 40 per cent above average. During the period of June 16-21, precipitation was again above normal (see attached isohyet map). This precipitation along with snow melt combined to create the resultant high flows.

Precipitation during the months of April, May and early June was considerably above normal. Saturated soil conditions were not uncommon. Rainfall during the period of June 16-21 ranged from over 4 inches in the north portion of this watershed to less than 3 inches in the south. This basin was not subjected to the much higher precipitation events which occurred to the west.

The amount of flooding varied along both rivers, but most areas had less than 10 year events with several slightly higher. Damages were lower than in basins with higher precipitation levels. Flood frequency varied by location. The following table summarizes the actual flows and the expected frequency at selected stream gage points:



## FREQUENCY SUMMARY

<u>River</u>	<u>Gage Number</u>	<u>Location</u>	<u>Date</u>	<u>Gage Ht.</u>	<u>Discharge</u>	<u>Frequency</u>
Wolf	#04074950	Langlade	6/20	9.83 ft.	1,770 CFS	5 Yr.
Wolf	#04077400	Shawano	6/21	11.88 ft.	3,880 CFS	18 Yr.
Wolf	#04079000	New London	6/25	12.25 ft.	9,980 CFS	6 Yr.
Fox	#04073500	Berlin	4/24	14.65 ft.	4,680 CFS	5 Yr.
Fox	#04084500	Wrightstown	7/08	- ft.	18,700 CFS	9 Yr.

## CHRONOLOGY

### THURSDAY, APRIL 22

The National Weather Service issued a flood warning through Friday for Winnebago and Green Lake counties along the Fox River. A hazardous water conditions advisory has been issued for the lower Fox from Menasha to Green Bay. The Fox - currently at 14.41 feet - should crest at Berlin Friday at 14.5 feet. Flood stage is 12 feet. River flows at Kaukauna have reached 14,308 c.f.s. The normal flow is about 5,000. The Wolf River at New London is also continuing to rise and hit 8.76 feet today. Flood stage is 9 feet.

### MONDAY, APRIL 26

The Fox River at Berlin is unchanged at 14.57 feet, 2.57 feet above flood stage, but should start falling today. Minor flooding was reported along the Wolf Rivers. Levels are dropping, but are still above flood stage.

### FRIDAY, JUNE 18

The De Pere dam on the Fox River was opened today for the first time since 1960 to accommodate flood water after overnight storms dumped 2 inches of rain in Green Bay. The dam was passing 125,000 gallons of water per second, about five times the normal volume for this month. All nine dams in the lower Fox were running at nearly 100% capacity. Basement flooding, sewer backups and flooded roads were reported in the area. Two apartment buildings in Neenah were flooded with up to 4 feet of water on the first floor, damaging most furnishings and appliances. Several families required

emergency shelter. Local hardware stores reported a run on sump pumps. "A lot of people are coming in to buy them. Some people have put one in each corner of the house. Others are sinking well points near the foundation of their homes, the water table is just that high," said store owner Larry Callahan.

### SUNDAY, JUNE 20

The Fox River was rising today, threatening the Berlin area. The river is expected to crest at 13.5 feet on Tuesday. In New London, the Wolf River is expected to crest at the 9 foot flood stage on Tuesday. Fox River flows at Kaukauna are at 14,158 c.f.s., compared to the average June flow of 3,296. The Appleton area received 6.38 inches of rain for the first 17 days of June, compared with an average of 3.6 inches for the entire month.

### SATURDAY, JUNE 26

Tributaries of the Wolf River are completely backed up in Outagamie County, and ten thousand sandbags are being placed in preparation for the river's expected cresting on Wednesday, June 30. Winnebago County reported flooding in the towns of Wolf River and Menasha, and the Eureka Dam area.

### TUESDAY, JULY 6

Flooded streets and basements were reported in much of Brown, Calumet, Dodge and Fond du Lac counties, and Neenah, Appleton and Green Bay. The Fox River over flowed its banks in the Berlin area. A man drowned in the Fox

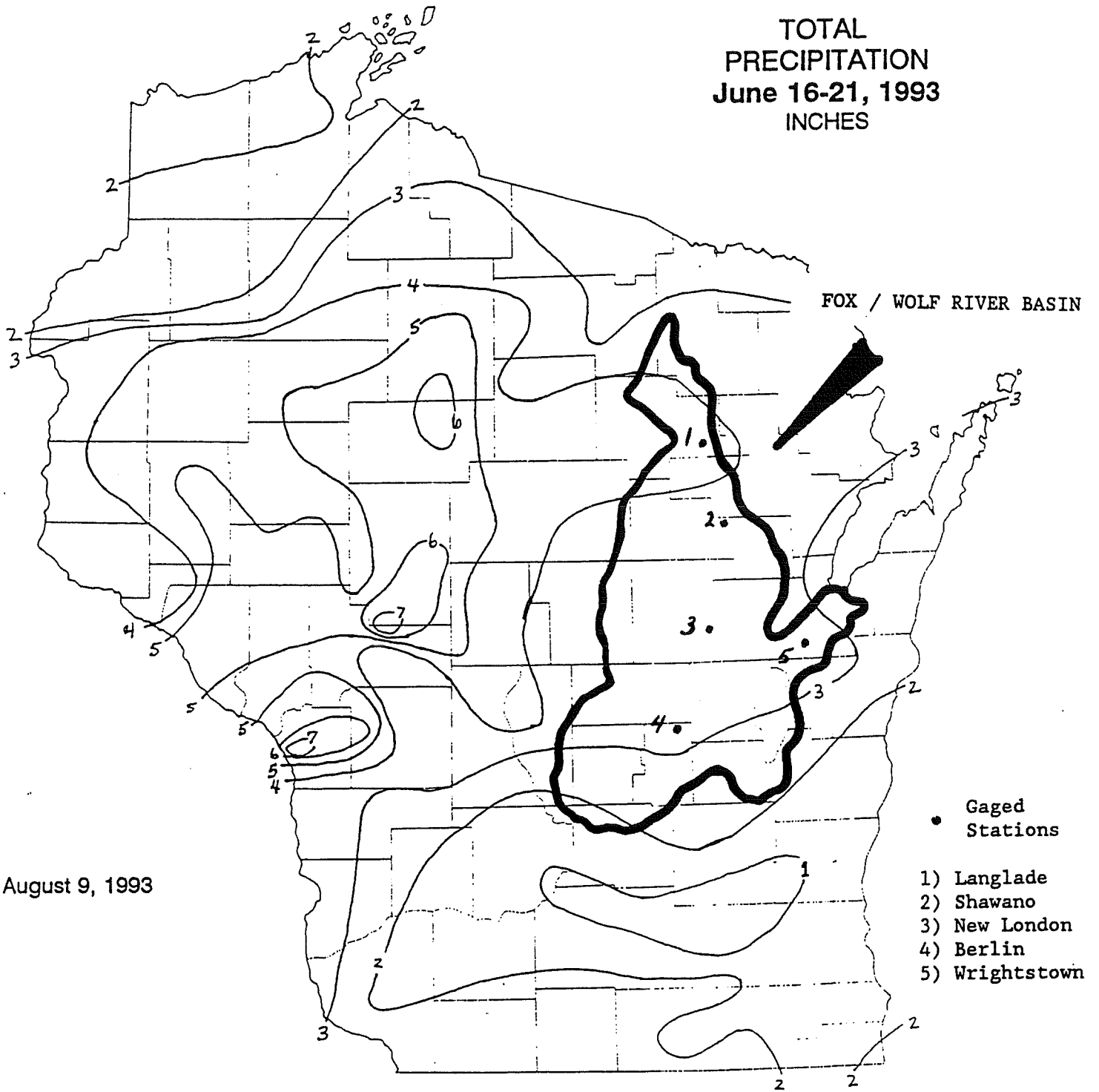
River southwest of Berlin after his canoe overturned.

## WEDNESDAY, JULY 21

Flood warnings remained in effect for the Fox River in Green Lake and Winnebago counties as levels were still 2 feet above flood stage.



TOTAL  
PRECIPITATION  
June 16-21, 1993  
INCHES





## WISCONSIN RIVER

---

The Wisconsin River is a major watershed that dissects the state north to south, draining approximately 12,000 square miles. Nearly the entire river is controlled with dam structures. The Wisconsin Valley Improvement Company operates 21 reservoirs near the headwaters for maintaining uniform year-round flows. Significant flow regulation is also provided by hydroelectric dams at the Du Bay, Petenwell, and Castle Rock Reservoirs.

Spring flows were above normal due to precipitation levels 40% above average. Between June 16-21, precipitation was again well above normal (see attached isohyet map) for the basin and the rest of the state. Flooding began in the upper river reaches near Merrill on June 21. As the peak moved downstream, it gained strength from rainfall-induced tributary inflows. Event frequencies varied due to inflow levels and reservoir operations. The peak flowed past Muscoda June 27 toward the confluence with the Mississippi River.

Precipitation during the months of April, May and early June was considerably above normal. Saturated soil conditions were common. Precipitation in the upper half of the basin ranged between 2-6 inches for June 16-21. High antecedent moisture conditions and high precipitation levels caused the flooding conditions along the river.

The severity of flooding varied considerably along the river. The upper stretches had only minor flooding with few damaged areas. The intensity increased in the Stevens Point -

Wisconsin Rapids area (some elevations were recorded in excess of the 100 year FIS elevation), yet damages were still relatively minor.

Downstream from Wisconsin Rapids, the Petenwell and Castle Rock Reservoirs were drawn down prior to the peak's arrival, creating additional storage which helped attenuate flows and lowered discharges downstream. Even with these measures, Portage had the third highest flooding event on record.

The DNR began patrolling the three state-controlled levees (Caledonia, Lewiston, and Portage) near Portage on June 19. The river stage at this point exceeded 17 feet. When the river exceeded 19 feet, two-a-day patrols were begun. Emergency levee repairs were completed by the DNR as sand boils and other weak spots appeared. At one point the newly constructed plug near the mouth of the Portage Canal began to overtop and slough off on the downstream side. Sand bagging and placement of rip rap material over filter fabric solved the problem. Only minor evacuations were necessary, but a much larger evacuation would have occurred if the recorded river stages had exceeded 20 feet. It was later learned that because of a change in the local gage's location and an error made in establishing the datum of that gage, stages had exceeded the 20 foot limit but were not recorded as such and thus did not trigger the evacuation process. As the peak continued downstream, dropping water levels along with a

decrease in local inflows further reduced the severity of the flooding.

The following table indicates the progression of the severity and timing of the peak flow.

### Wisconsin River - 1993 Flood - NWS Gage Record Summary

<u>Date</u>	<u>Merrill</u>	<u>Rothschild</u>	<u>Stevens Pt.</u>	<u>Wis. Rapids</u>	<u>Pentenwell</u>
6/18	9,000 cfs	14,500 cfs	16,200 cfs	15,300 cfs	20,300 cfs
6/19	8,300 cfs	20,300 cfs	25,600 cfs	31,400 cfs	26,000 cfs
6/20	12,100 cfs	25,000 cfs	34,900 cfs	41,700 cfs	36,500 cfs
6/21	19,100 cfs	41,000 cfs	54,700 cfs	51,100 cfs	48,400 cfs
6/22	18,900 cfs	39,400 cfs	61,300 cfs	64,500 cfs	53,000 cfs
6/23	13,800 cfs	26,100 cfs	43,300 cfs	53,000 cfs	45,500 cfs
6/24	11,200 cfs	14,900 cfs	29,000 cfs	34,300 cfs	43,500 cfs
6/25	-	-	-	-	-
6/26	8,500 cfs	10,900 cfs	14,400 cfs	16,400 cfs	13,800 cfs
6/27	7,300 cfs	9,300 cfs	14,200 cfs	14,700 cfs	10,600 cfs
6/28	5,800 cfs	7,400 cfs	10,700 cfs	10,700 cfs	12,600 cfs
6/29	5,100 cfs	6,900 cfs	9,800 cfs	9,800 cfs	12,700 cfs
6/30	4,700 cfs	6,200 cfs	8,600 cfs	8,600 cfs	9,700 cfs

<u>Date</u>	<u>Castle Rk.</u>	<u>Wis. Dells</u>	<u>Portage</u>	<u>P. Du Sac</u>	<u>Muscoda</u>
6/18	24,000 cfs	26,500 cfs	14.68 ft	23,700 cfs	26,300 cfs
6/19	27,200 cfs	31,200 cfs	15.90 ft	30,800 cfs	24,600 cfs
6/20	39,900 cfs	42,400 cfs	16.60 ft	34,500 cfs	27,500 cfs
6/21	55,400 cfs	43,500 cfs	17.74 ft	43,000 cfs	31,300 cfs
6/22	54,400 cfs	44,500 cfs	19.03 ft	56,400 cfs	54,300 cfs
6/23	54,400 cfs	55,400 cfs	19.73 ft	61,500 cfs	- cfs
6/24	54,300 cfs	59,650 cfs	19.89 ft	66,800 cfs	- cfs
6/25	- cfs	59,500 cfs	20.20 ft	71,000 cfs	57,100 cfs
6/26	22,600 cfs	43,500 cfs	19.22 ft	68,400 cfs	59,600 cfs
6/27	12,400 cfs	19,000 cfs	16.38 ft	48,000 cfs	59,600 cfs
6/28	13,900 cfs	17,300 cfs	14.05 ft	22,200 cfs	55,300 cfs
6/29	14,000 cfs	16,200 cfs	14.12 ft	19,700 cfs	42,200 cfs
6/30	13,900 cfs	16,300 cfs	14.15 ft	20,700 cfs	26,200 cfs

Flood frequencies varied by location. The following table summarizes the actual flows and the expected frequency at selected points:



## FREQUENCY SUMMARY

<u>Community</u>	<u>Date</u>	<u>Gage Ht.</u>	<u>Discharge</u>	<u>(100 Yr)</u>	<u>Frequency</u>
Merrill	6/21	12.20	19,100 cfs	(32,000)	6 Yr.
Rothschild	6/21	-	41,000 cfs	(64,000)	6 Yr.
Stevens Point	6/22	-	*61,300 cfs	(63,100)	67 Yr.
Wis. Rapids	6/22	12.00	64,500 cfs	(76,000)	25 Yr.
Wis. Dells	6/24	-	59,650 cfs	(82,000)	17 Yr.
Portage	6/25	794.14	-	(795.3)	~ 25 Yr.
Prairie du Sac	6/25	-	71,000 cfs	(86,000)	20 Yr.
Muscoda	6/26	-	59,600 cfs	(80,000)	11 Yr.

\* Discharge is approximate due to backwater at the dam structure affecting the rating curve, per Consolidated Water Power Company. Emphasis should be placed on flows at Wisconsin Rapids.

## CHRONOLOGY

### THURSDAY, APRIL 22

Water continued to rise on the lower part of the Baraboo River in Sauk and Columbia counties, reaching 17.7 feet near Baraboo, up from 16.01 feet Tuesday. Flood stage is 16 feet. The Kickapoo at Steuben rose from 11.3 feet Tuesday to 11.47 feet Wednesday. Flood stage is 12 feet and the river is expected to continue to rise.

### MONDAY, APRIL 26

The flood warning for the Baraboo River continues with the river down slightly, but still 3 feet above flood stage. Minor flooding was reported along the Kickapoo River. Levels are dropping, but the river is still above flood stage.

### SUNDAY, JUNE 20

The Portage area was under a flood warning, as the river rose to 16.3 feet and is expected to crest at 19.5 feet Wednesday. Flood stage is 17 feet.

The lowlands between the river and Long Lake, south of Portage, are completely flooded. Many lake residents have moved out, but some are undaunted. "Our neighbors never stay too long and it's very peaceful," according to long-time lake resident Gil Hollander. "There ain't a helluva lot to do when you can only walk on your deck. It's just like living on an island." If the river reaches 20 feet, the city will issue an evacuation order, according to Tim Carlin, county emergency government director. "They don't have to leave," he said. "It's just a precautionary measure. Unless it's a life or death situation, we can't force them to leave." Up river, Merrill reported the river was over its banks. Flood warnings were issued for Stevens Point.

### MONDAY JUNE 21

The river neared flood stage as flows continued to climb. Flows on the river at Wisconsin Rapids were at a twenty-year high Monday of 60,000 cfs, compared to a normal June flow of

5,700, and a rate of 62,000 in March, 1973. The flood stage for the river is 64,000 cfs or 12 feet. The river was at 11.76 feet Monday morning. DNR engineers were planning to continue monitoring the Portage levee as water levels crept up slowly.

### WEDNESDAY, JUNE 22

The Wisconsin River crested at 19.5 feet at Portage today, flooding low-lying areas. No evacuations were necessary. A drunk in Wisconsin Rapids was charged with disorderly conduct and obstructing an officer after he was rescued from the swollen river while trying to swim across it on a bet.

### THURSDAY, JUNE 24

Heavy rain fell in Portage, where the Wisconsin River had crested yesterday at 19.5 feet, and was expected to drop back to 17 feet by noon Saturday. Prairie du Sac Dam operators increased flow to 70,600 cfs. 10,000 is considered normal. Upstream dam operators are reporting flow levels down from yesterday. Some light rain is expected in the western part of the state Friday, but after that dry conditions are predicted through Tuesday.

### SATURDAY, JUNE 26

Dry conditions lessened flooding threats for most Wisconsin rivers. The Wisconsin River at Portage remained slightly above flood stage, but is expected to drop 2 feet by noon today. A campground along the river near Sauk City was forced to evacuate residents from trailers, while further downriver County Highway Y and

Highway 130 were closed. At Snuffy's Campsite off U.S. 12 near Sauk City, only a few summer residents remained in their trailers last night. Roy Aeschbach, one of the hardy souls, joked that "I want to stick around here until I get evacuated. I'm staying until the big one goes." The "big one" is the Prairie du Sac dam, which is currently passing a flow of 70,600 c.f.s., compared to a normal June flow of 10,000.

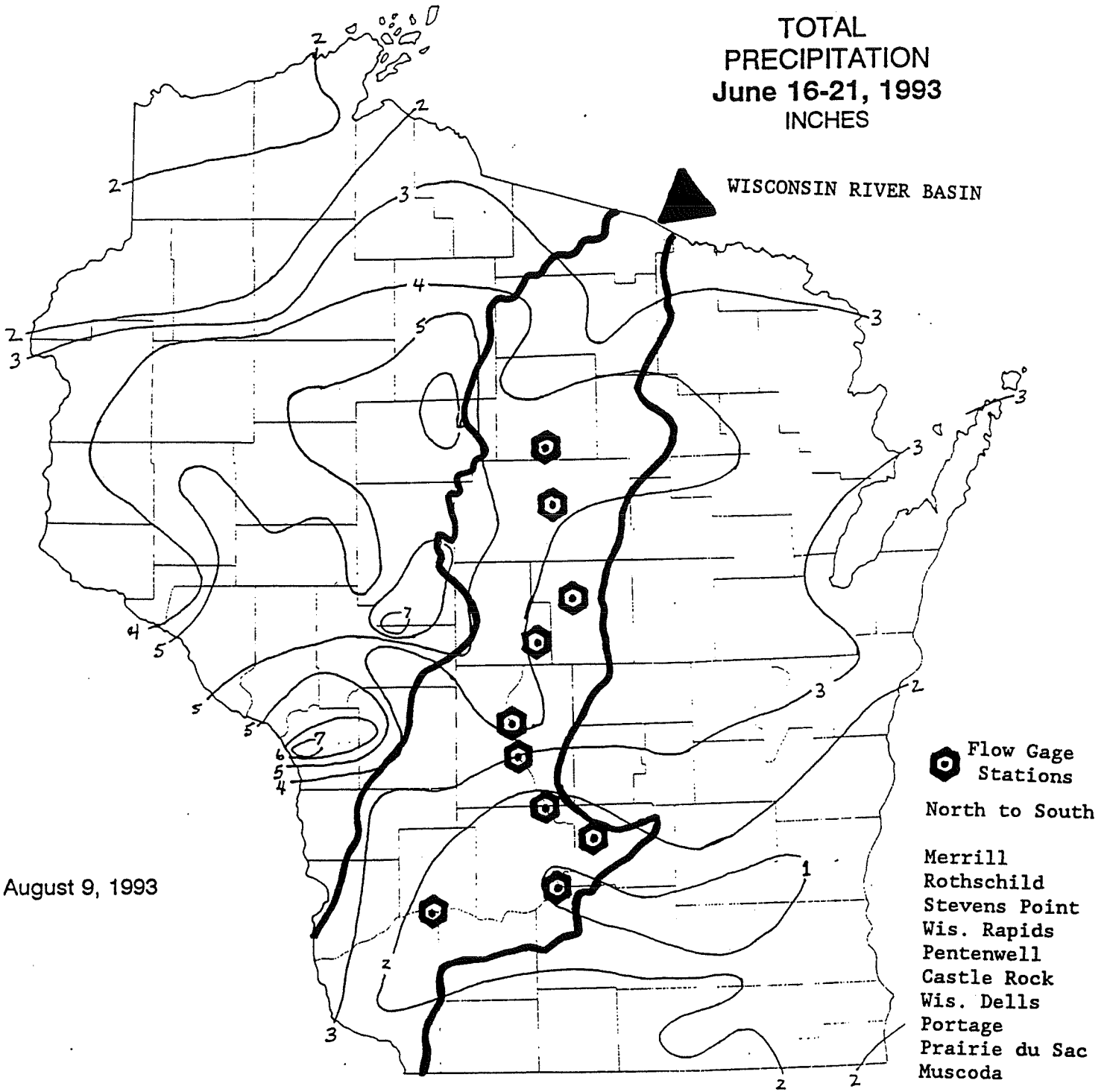
### THURSDAY, JULY 1

The Wisconsin River continued to fall rapidly at Portage. Flood losses in Juneau County will total at least \$3 million, the majority in crop damage. Some roads were closed and minor damage to businesses and residences occurred. Levels on the Petenwell and Castle Rock flowages were raised 6 inches above normal summer highs to minimize flooding in downstream areas and to accommodate flow increases of up to 1000%.

### MONDAY, AUGUST 2

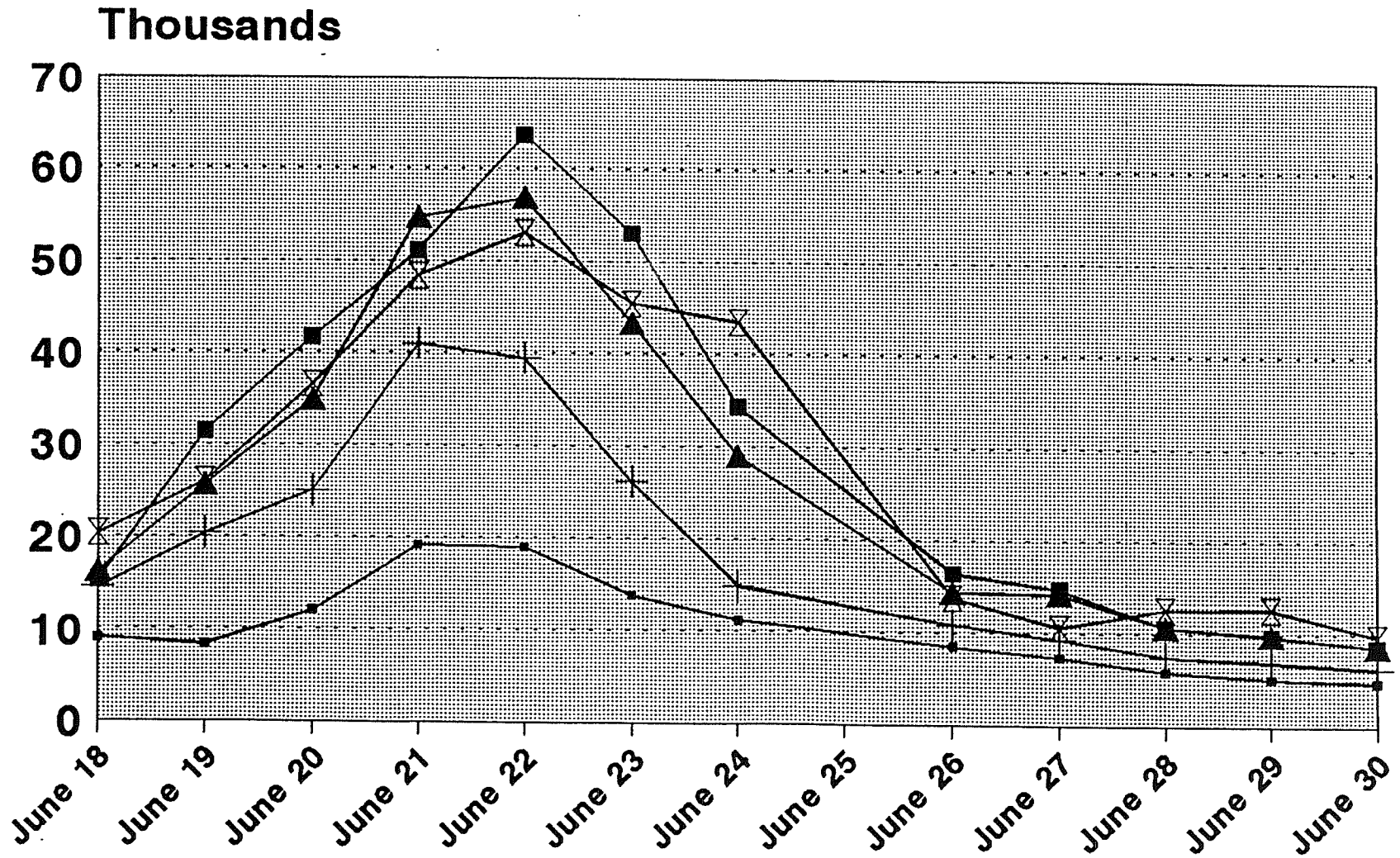
Compared to much of the state, north central Wisconsin has seen below-normal precipitation levels recently. From Wisconsin Rapids north, July rain totals are up to an inch below normal, sparing the area from major flood woes. Flows in the Wisconsin River at Eagle River are 79% of normal while Muscoda is at 230%. 79% of cropland in the area is reported to have adequate moisture while only 21% has a surplus.

**TOTAL  
PRECIPITATION  
June 16-21, 1993  
INCHES**



# Wisconsin River - 1993 Flood - NWS Gage Record Summary

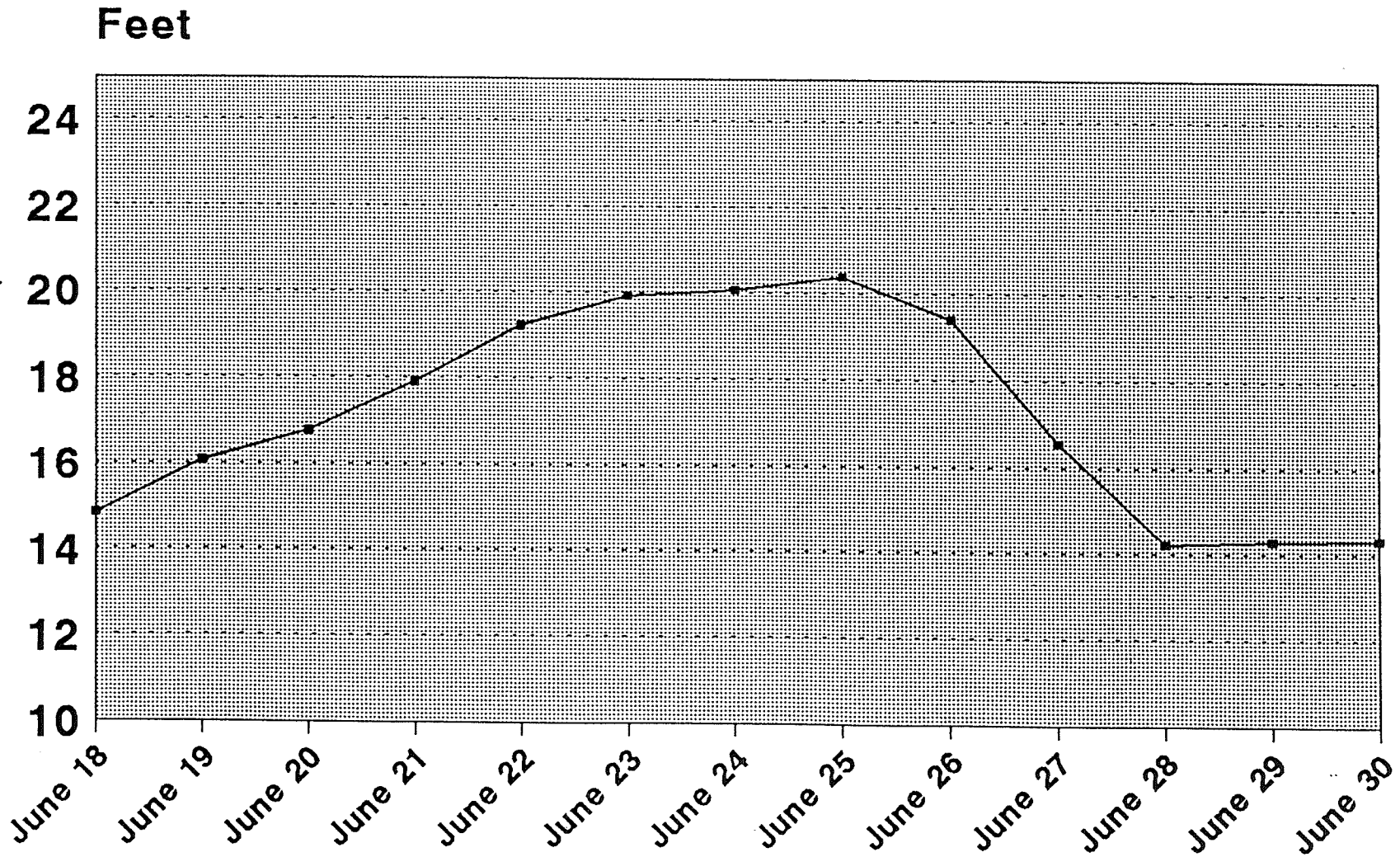
Daily Flow Readings (CFS) Merrill, Rothschild, Stevens Pt, Wis.Rapids, Pentenwell



—■— Merrill + Rothschild ▲ Stevens Pt —■— Wis.Rapids —x— Pentenwell

# Wisconsin River - 1993 Flood - NWS Gage Record Summary

Daily Flow Readings (FOOT) for Portage

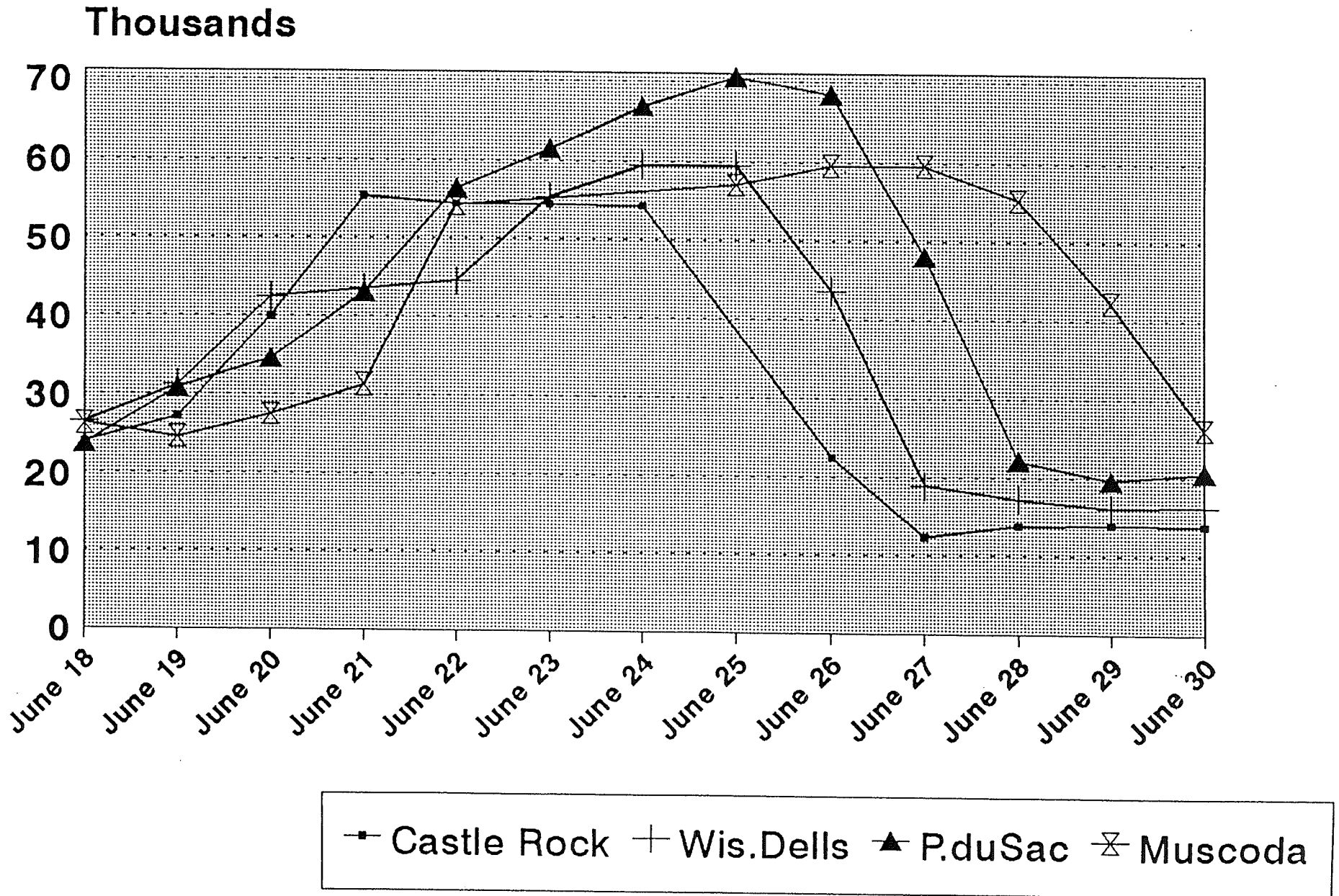


■ Portage



# Wisconsin River - 1993 Flood - NWS Gage Record Summary

Daily Flow Readings (CFS) Castle Rk, Wis.Dells, P.duSac, Muscoda





## BLACK RIVER

---

Heavy rains June 17-19 caused significant flooding on the Black River on Sunday, June 20. Late Sunday morning, a portion of the embankment on the power canal between Hatfield and Black River Falls failed. At approximately 2:00 pm, the levee protecting a portion of Black River Falls called the Grove began to fail due to overtopping. Approximately 90 structures were damaged in the Grove, some with flood waters reaching the ceiling on the first floor. Streets, storm sewers, sanitary sewers, water mains and utilities were damaged and need to be replaced.

The flooding in Hatfield and Black River Falls can be traced to a storm over the Black River basin from June 16-21, 1993. The storm was created by two low pressure areas interacting with a stationary front stretched across central Wisconsin. The rainfall in the hardest hit areas fell in two distinct periods, as each low approached. Significant precipitation occurred early on the morning of the 17th, with a respite on the 18th. A slow-moving low pressure center caused the heaviest rainfall amounts on the evening of the 19th in central Wisconsin. For the 24-hour period beginning Saturday morning, approximately 3.5 inches of rain fell. The 100-year 24-hour rainfall for this area is just under 6 inches; however this does not account for antecedent soil moisture. A significant portion of the basin had rainfall totalling more than 5 inches, with a few scattered locations recording over 6 inches of rain from June 16-21. This rain fell on already saturated ground caused by

wet spring conditions and the rainstorm of June 7-9, which dropped up to 3 inches of rain in the vicinity of Black River Falls. Another 1-2 inches of rain fell at many locations on June 13-14. Unofficial reports show that from June 1-20, approximately 16 inches of rain fell in the basin.

The total drainage area of the Black River is 2,340 square miles. The dam at Hatfield creates a one thousand acre impoundment called Lake Arbutus. The drainage area above the Hatfield dam is 1,290 square miles. Normal pool elevation is 885 MSL. Hatfield Hydro went from one tainter gate open at noon on Thursday to all of the operable tainter gates (7 of 10) open at 4:13 am on Friday, June 18th. From then until 3:00 am on Saturday, the water level dropped about a foot. The water then began rising again. Elevation was kept below the maximum summer elevation of 885 MSL by opening trip gates and stop logs. Between the time of the last elevation reading on Saturday at 8:30 pm and the first elevation reading Sunday at 3:04 am, pool elevation rose 1.5 feet. Pool elevation peaked at 10:30 am at 889.5 and began dropping at 2:30 pm Sunday. Water flowing around the dam caused a breach in the canal that Hatfield Hydro indicates occurred at 10:30 am. The levee protecting the Grove was overtopped at 1:45 pm Sunday, flooding 90 homes to an average depth of 5.5 feet.

Black River Falls is bracketed by gages at Neillsville and Galesville. The flow at Neillsville was 30,300 cfs (24 yr event) while the flow at Galesville was 64,000

cfs (88 year event). Flow was peaking in Neillsville at the same time Lake Arbutus was the highest. This was caused by heavy localized rainfall in the Lake Arbutus area and by a substantial accumulation of debris at the Hatfield Dam, reducing its outflow capacity.

High water marks in Black River Falls indicate that the flood waters reached elevation 762.5 MSL (2.3 feet above the 100-Year flood elevation of 760.2 MSL) on this portion of the Black River. The levee protecting the Grove was not built to today's standards which require 3 feet of freeboard above the regional flood elevation or a levee height equal to the 500-year flood elevation - whichever is greater. In addition, the levee was not constructed to today's structural standards and had not been properly maintained to prevent trees and brush from covering the levee.

## CHRONOLOGY

### SUNDAY, JUNE 20

A state of emergency was declared in Jackson and Clark counties as the Black River, swollen by 8 inches of rain in five days, flooded much of Black River Falls and Hatfield, forcing the evacuation of over 500 people and inundating 90 homes. An earthen levee collapsed and flooded low-lying areas of Black River Falls. "It's very bad," said Al Spaulding, county emergency government director. "All the roads are washed out. We're sending workers in by boat to evacuate hundreds of people." More than 200 hundred National Guard troops were dispatched to the area and police were patrolling downtown, urging residents to move out.

The river was at 19.24 feet Sunday, 1.24 feet above flood stage. I-94 was closed in the area for seven hours as engineers inspected the dam and bridges for weaknesses. The Hatfield Dam was weakening Sunday night and reportedly lost about 50 feet of spillway. If the dam broke, a 20 to 25-foot wall of water could rush through Black River Falls. A National Guard spokesman commented that "I saw the river from the air. To say the river is swollen would be an understatement. It's churning rapidly - moving muddy brown water and lots of it."

Jerry Hansen was planning to celebrate Father's Day in his new dream home on the banks of the Black River. Instead, he and his children spent the day moving out all his belongings. "His house is under water now," said Hansen's daughter, Susanne Goldsmith. "We haven't even wished him a happy Father's Day." The house was not insured for flood damage.

### MONDAY, JUNE 21

Flood waters which began to retreat late Sunday night continued to ease off Monday after one of the worst floods in local memory. Municipal water pumps and sewage treatment operations were shut down in Black River Falls. Gas service to 180 homes and businesses was also shut off. Some of the estimated 500 - 700 residents who were evacuated Sunday were allowed to return briefly to assess damages. National Guard troops removed sandbags and reopened traffic, although more rain is expected by Wednesday. At a school, displaced residents waited out the evacuation over sandwiches and coffee. "I lived in

Florida," said Harriet LaFleur. "I lived through hurricanes and monsoons, this doesn't bother me at all. I just go to the shelter."

The flooding came after days of heavy rain filled the Black River and on Sunday threatened the Hatfield Dam at the southern tip of Lake Arbutus. The dam held, but one section of the structure's top layer broke, according to the Division of Emergency Government. Water stood 2 feet deep in downtown Black River Falls on Sunday afternoon, but was gradually pumped out and nearly eliminated by today. Relief workers set up several evacuation centers to feed and house residents, but by late Sunday had closed all but one center.

## TUESDAY, JUNE 22

A DNR inspection of the Hatfield Dam found a hole about 8 feet deep and 4 to 6 feet across on the east side of its trip gate, posing a significant threat to nearby communities. If the erosion continues to occur, the entire lake body could be released. The report found that three of the dam's 10 gates are not operable and two others are clogged with debris.

Residents evacuated from Hatfield and North Bend were allowed to return to their homes as floodwaters receded. Black River Falls residents had limited access, but could not move back in. Initial damage reports were \$11 million. The section closest to the levy, called the Grove, was hardest hit. As residents surveyed the damage, the news that most residents didn't have flood insurance and that homeowners insurance wouldn't cover the damages

began to circulate. Compounding the fears were concerns that the damage was so localized that the federal government will not find it bad enough to step in with any kind of disaster aid. "Some little horse---- town like this might not qualify for federal disaster aid," said Fred Goettl of the Jackson Bank.

And there was plenty of bitterness leveled at local and state emergency officials, who some felt focused their attention and their sandbags on the business end of town while leaving homeowners to fend for themselves. "It's one of those situations where, after they saved Main Street, then they tried to figure out what to do about the rest of us," said Eugene Boisen, who wondered why they weren't given time to save what they could. "We could have moved all this stuff out of here," he said, "but this is the part of town nobody has any respect for. It's mostly old people, not considered No. 1."

## WEDNESDAY, JUNE 23

Preliminary flood damage estimates soared past \$50 million, including \$36 million in Jackson County, \$6 million of which is crop damage. Workers used clay, filter cloth and sandbags to fill the hole in the Hatfield Dam, but the DNR said it is a temporary solution and more heavy rains could cause another breach. Lake Arbutus continues to be drawn down to relieve the pressure on the dam. Emergency Government Director Al Spaulding said there have been problems with the dam since February. When asked if the dam was structurally sound, he replied, "it depends on your definition of structurally sound."

Hatfield resident Ed Mazola, who estimated that he suffered more than \$20,000 damage to his home and property, said, "This feels like a nightmare. One that could have been prevented." James and Carol Hauri, who live just 15 feet off of Arnold Creek, which runs into the Black River, said they warned dam operators of the problems. "The time to open the gates is early to make more room for the water," said James Hauri. "Just the 30% may have helped. They don't know how to take care of the water levels. After living here 18 years, I can say that you have to get ready ahead of time." He added that it is possible there would have been some flooding even with the gates open. "There was an awful lot of water. People who have lived here 30 years haven't seen this much water," he said.

repairs and have the dam inspected by July 9.

#### THURSDAY, JUNE 24

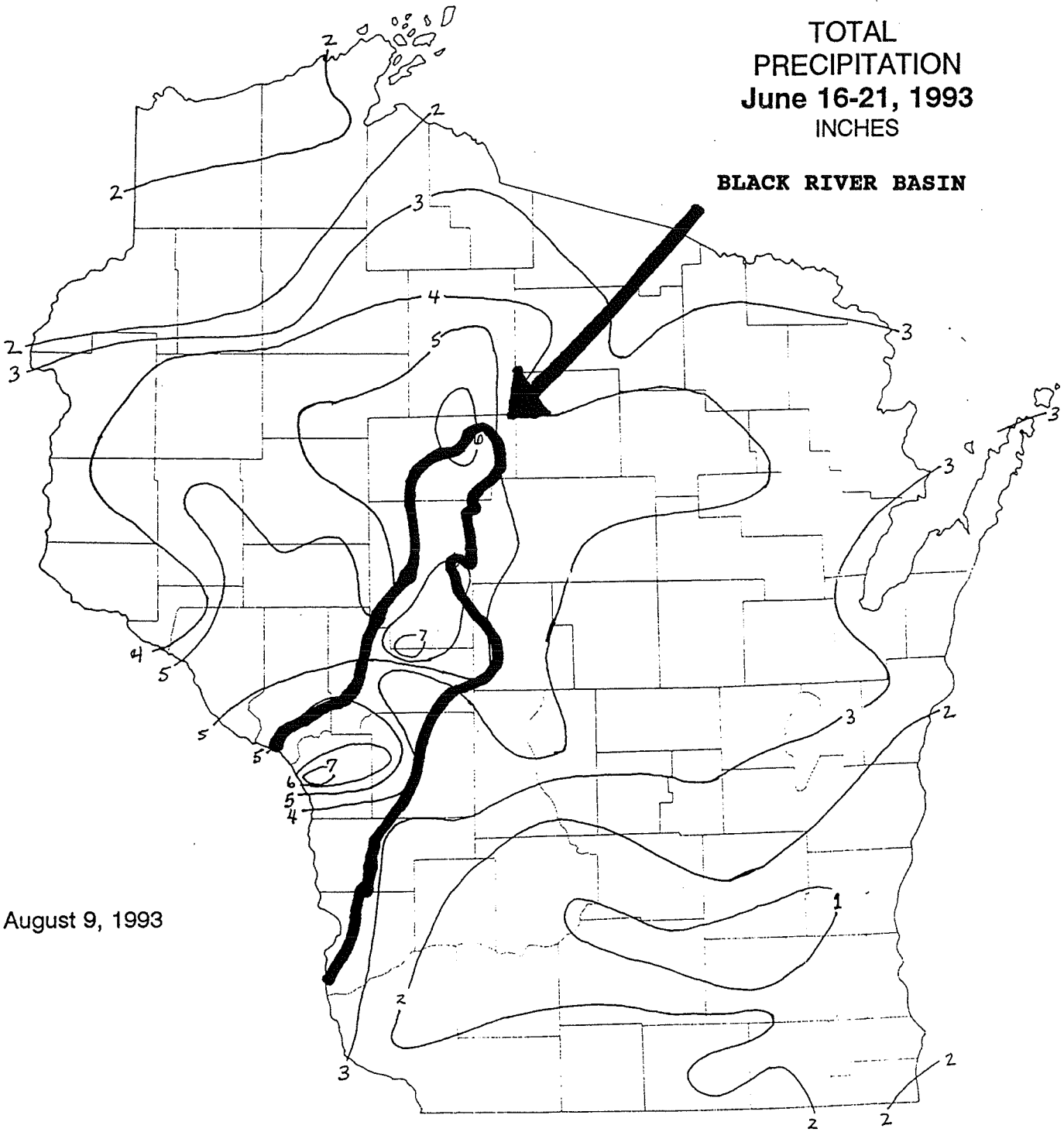
Water levels inside the Hatfield Dam along the Black River dropped 4 feet in the past 24 hours. Three floodgates that were inoperable had new chains installed and were opened this morning. A barge and crane will begin removing debris from the dam Friday. Some light rain is expected in western Wisconsin Friday, but after that dry conditions are predicted through Tuesday.

#### SATURDAY, JUNE 26

Damages for Black River Falls reached \$21 million and 100 homes are still uninhabitable. A spokeswoman for the Red Cross said that 383 Black River Falls families were affected by the flood. The Federal Energy Regulatory Commission has ordered the owners of the Hatfield Dam to make immediate

TOTAL  
PRECIPITATION  
June 16-21, 1993  
INCHES

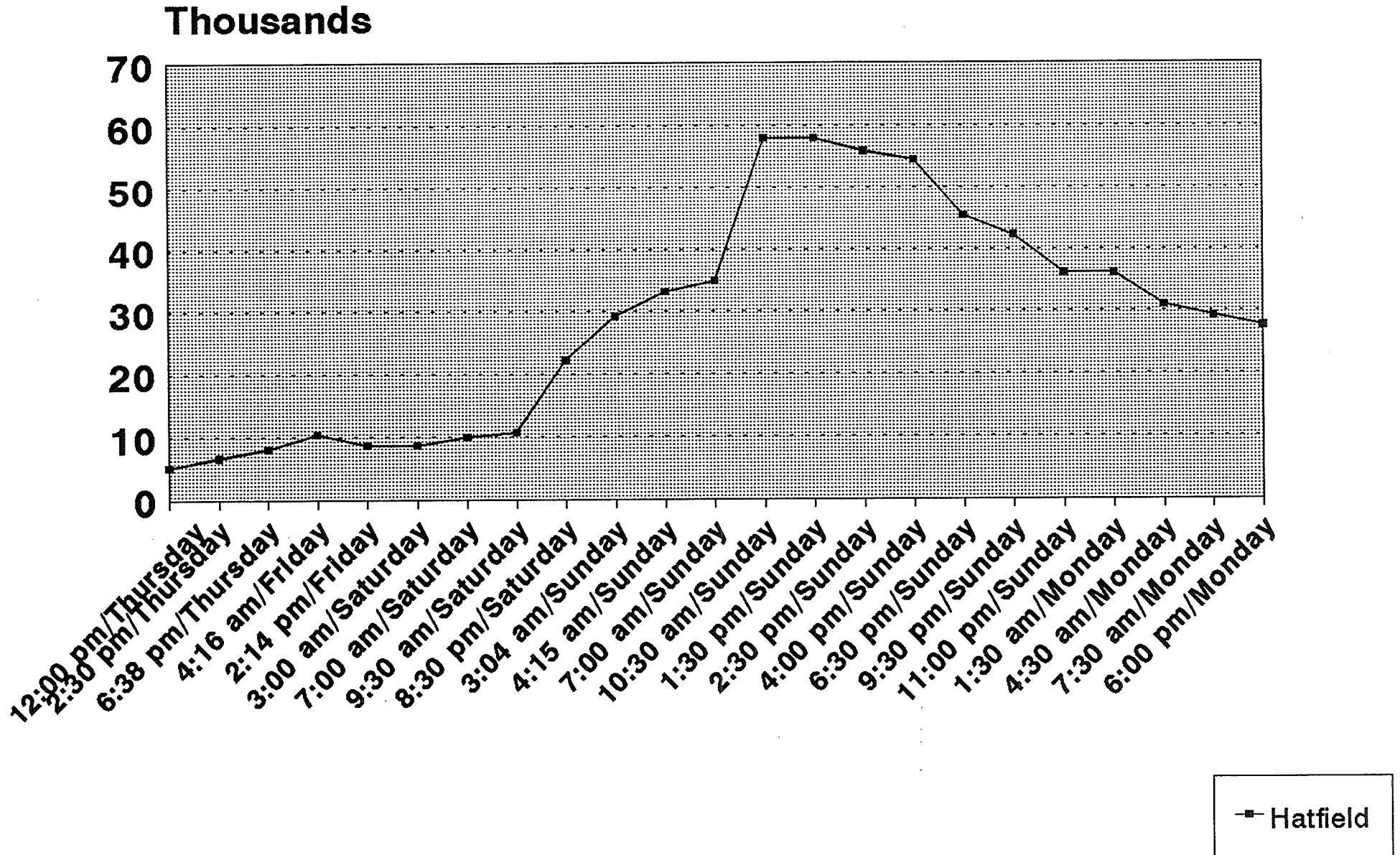
BLACK RIVER BASIN



August 9, 1993

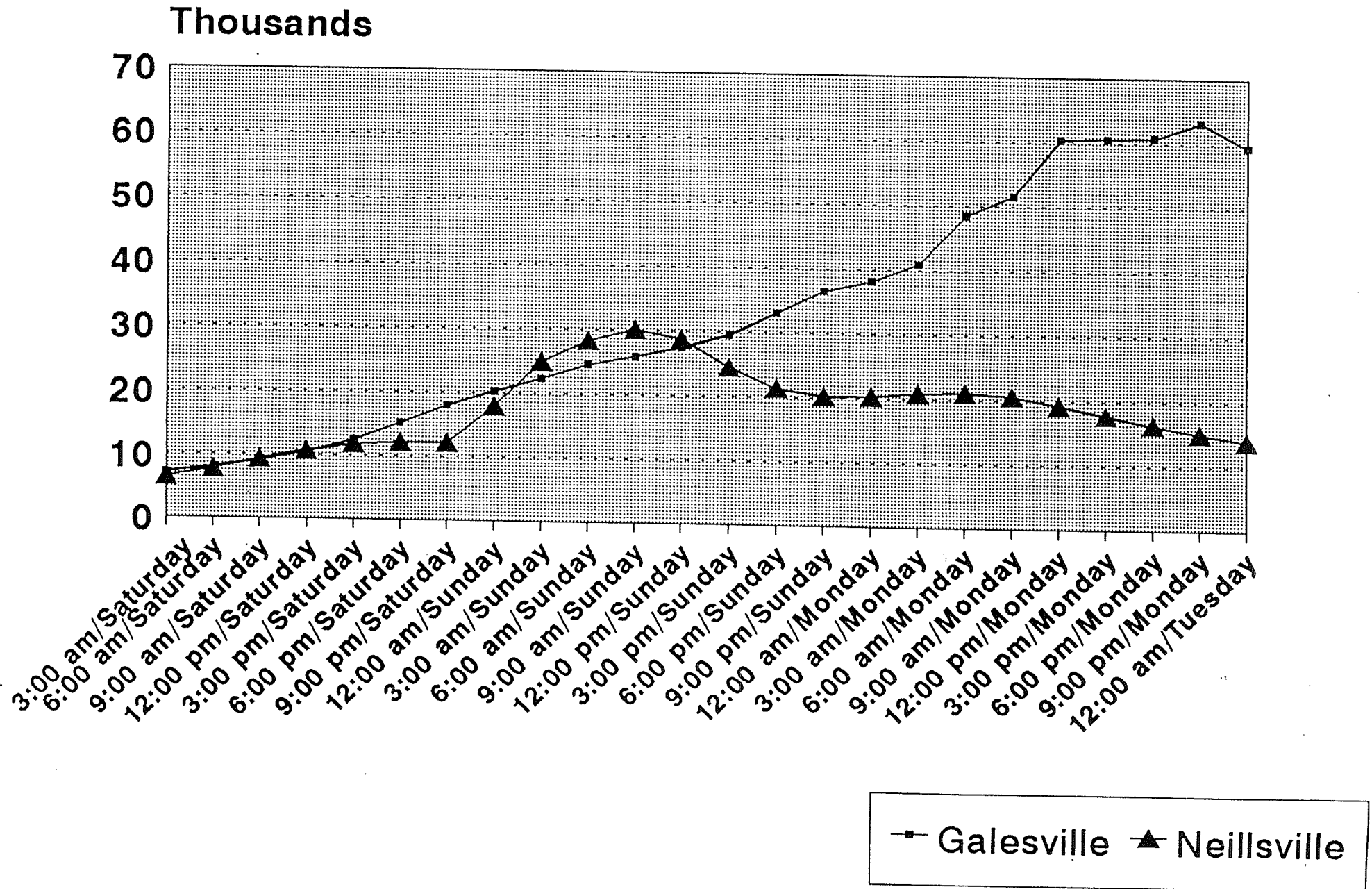
# Hatfield Dam - 1993 Flood Summary- Outfall Summary

Hourly (CFS) June 17-21, 1993



# Neillsville and Galesville - 1993 Flood Summary - Gage Record Summary

Hourly Flow Readings (CFS) June 19-21, 1993







# CHIPPEWA RIVER

The most significant flooding in the Chippewa River basin occurred on the Eau Claire River, when heavy rains on Friday and Saturday, June 18-19, caused flooding on the upper reaches of the East Branch Sunday morning, peaking in the City of Eau Claire on Tuesday, June 22nd. Flood elevations at or above the 100-year flood elevations were recorded at Rock Dam Lake, Lake Eau Claire, Lake Altoona and in the city of Eau Claire. The Eau Claire River flooding can be traced to a storm over the Black River basin from June 16-21, 1993, which is described in that report.

The total drainage area of the Chippewa River is 9,010 square miles, while the drainage area of the Eau Claire sub-basin is 816 square miles. Flash flooding washed out numerous road crossings in the Eau Claire River basin. The dramatic

event occurred on Hay Creek (61 square mile drainage area) early Sunday morning when the Rock Dam failed, releasing a peak flow of 5,000 cfs over a six hour period. The impoundment overflowed an earthen section of the dam about 100 feet south of the main dam structure and eroded a 25 foot deep, 200 foot wide opening through the roadway that crosses Hay Creek just downstream from the dam. Three campground roads at Rock Dam Lake were washed out during this event, temporarily stranding people in the campground.

While regional flood elevations were exceeded on Rock Dam Lake, Lake Eau Claire and Lake Altoona, none of the gaging stations on the Eau Claire or Chippewa rivers reached 100-year flows. The following table summarizes the actual flow and expected frequency at the gage locations:



## FREQUENCY SUMMARY

<u>Gage Number</u>	<u>Location</u>	<u>Peak Stage</u>	<u>Peak Discharge</u>	<u>Recurrence Interval</u>
Chippewa R. 05365500	Chippewa Falls	19.84 ft.	60,300 cfs	8
Chippewa R. 05365500	Durand	15.76 ft.	90,100 cfs	21
Eau Claire R.	Fall Creek	19.37 ft.	25,200 cfs	34

## CHRONOLOGY

### SUNDAY, JUNE 20

The Chippewa River, 3.5 feet over its banks and still rising, flooded parts of downtown Chippewa Falls and Eau Claire. Bridge Creek overflowed its banks in Augusta, flooding most homes and businesses south of the creek and the wastewater treatment plant. The Stone Street bridge was threatened. High waters in the Dells mill pond swept the water wheel from the side of the Mill Pond Museum. The nearby Lake Eau Claire dam peaked Sunday at 10 feet over normal summer levels. Augusta Mayor Romane Woodford said people should be careful around bridges and swollen streams. "Sunday an Amish buggy got swept away by water covering a road. That current is often much stronger than it looks." Catawba received 6.5 inches of rain in a 24 hour period Sunday.

In Osseo, Lake Martha overflowed its banks, inundating Seventh Street and the golf course, and had officials worrying whether the dam adjacent to Highway 53 might burst. The heavy rains flooded downtown businesses and homes alike, overburdened the sanitary sewer system and caused residents to boil their water. Sandbag crews worked nonstop to contain the rising lake. Since the annual "Lake Martha Days" celebration was cancelled by the flood, the Optimists Club donated its lefse busse and the Lions Club donated charcoal chicken dinners to the sandbaggers. "That's where small towns shine way above big towns, everybody turned out and lots of people shovelled," Greg Gregerson of the Osseo Police said.

### MONDAY, JUNE 21

Dozens of rivers across the state were over flood stages Monday night, and more rain is expected later in the week. The weather service issued flood warnings for the lower portion of the Chippewa River, already 3 feet over flood stage, from Chippewa Falls to the river's mouth. The Eau Claire River, a tributary of the Chippewa, is near flood stage.

### TUESDAY, JUNE 22

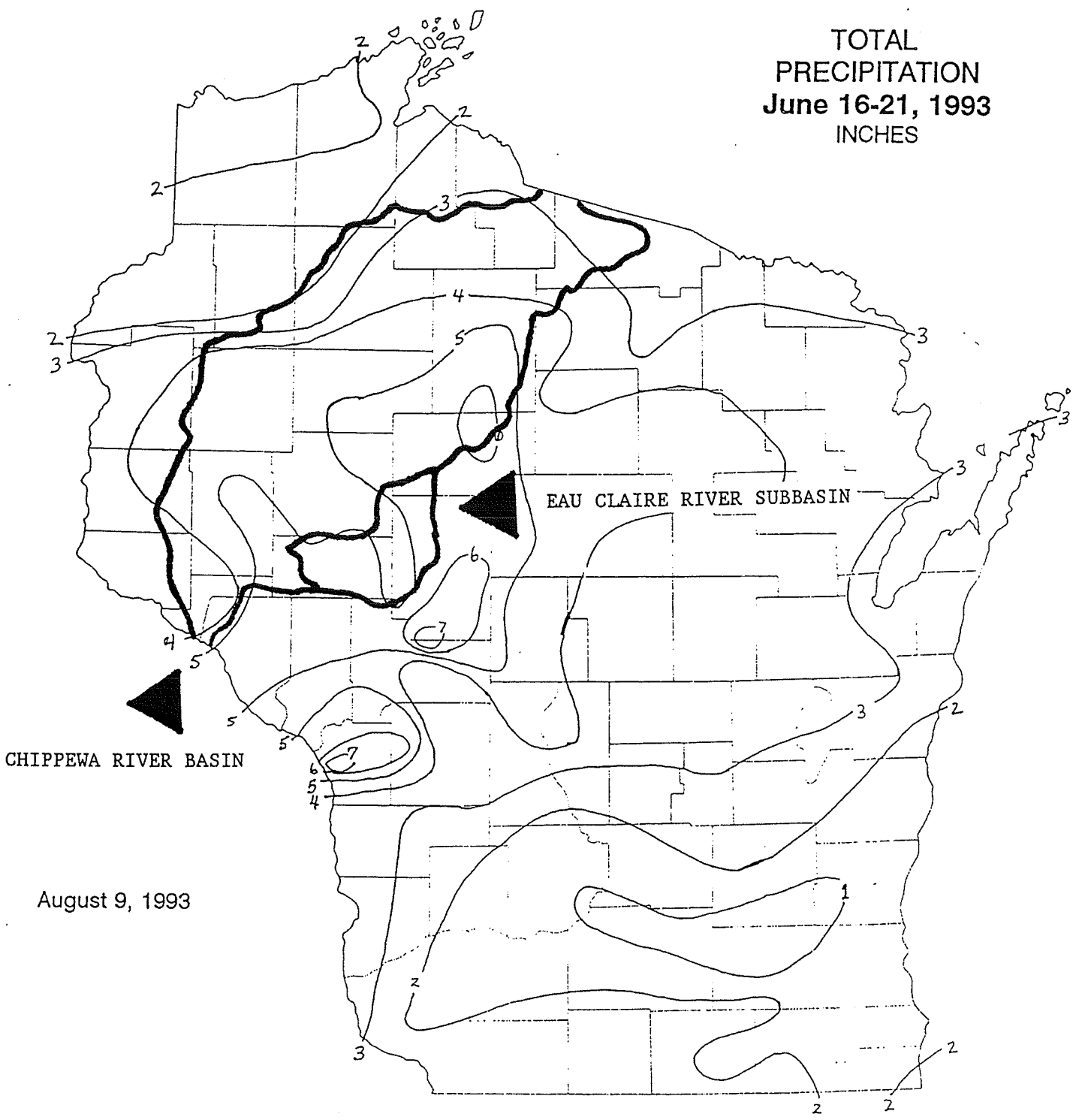
In Eau Claire, the Madison Street bridge over the Chippewa River remained closed. The river crested Monday at 6 feet over flood stage. In Durand, the Chippewa River had risen to 15.7 feet - the highest level since the record flood of 1967 - and was still rising, flooding low-lying areas. Six hydroelectric dams on the Chippewa River and two on the Red Cedar River were being closely monitored due to discharge amounts 10 times the norm and the highest river levels since 1941. Clark County officials estimated \$450,000 to \$500,000 in road damage, including 200 feet of road that was washed away in Rock Dam. Trempealeau County reported \$65,000 in damages. Thunderstorms will be moving into western Wisconsin tonight and will cover the state by Thursday.

### WEDNESDAY, JUNE 23

Total damages in Clark County were estimated at \$14.7 million, much of it in crop damage. Trempealeau County reported \$2.8 million so far, most of it to 180 homes. Eau Claire County reported more than \$5 million in damages, while ten people were left

homeless, 250 people were evacuated and two dozen homes and businesses were destroyed or damaged due to flooding. The state closed portions of recreational trails in western Wisconsin, including the Chippewa River Trail in Eau Claire and the Buffalo River Trail in Trempealeau County.

TOTAL  
PRECIPITATION  
June 16-21, 1993  
INCHES





## MISSISSIPPI RIVER

---

The flooding on the Upper Mississippi River Basin ranged from a 10-year event at Prescott to a 30-year event at Lock and Dam #11. Spring flooding was predicted in the National Weather Service Spring Flood Outlook issued on March 26, 1993. "The outlook advises that with present snow melt alone there is minor to moderate flood potential on the Mississippi River Basin tributaries and mainstem, as well as in the Great Lakes drainage basin. The potential would become moderate to major if above normal precipitation is received in the remainder of the melt period." This warning proved prophetic as upper air currents stalled over the Upper Mississippi drainage basin, producing from 125% to 200% more rainfall than normal over portions of Minnesota and Wisconsin from January through July 1993.

The combination of saturated soil conditions and above average June rainfall resulted in flooding. The rainfall of June 17-18 caused flood flows along the Upper Mississippi equivalent to 10-40 year occurrence intervals. The highest stage elevations were recorded from June 25 to July 1, 1993.

Following this summary the report details preliminary stage elevation datum provided by the Army Corps of Engineers, which is summarized from recorded stages along the Mississippi River from June 1 to July 31, 1993. U.S.G.S. stream gage information for tributaries is also referenced. This information will be applied to individual counties from Pierce to Grant.

Actual dam operational procedures were not included in this report and flood control operations presumably would have a significant impact on the timing and calculation of peak flows in certain situations.

Each county summary will include the following information:

- List and location of gages along the Mississippi River.
- Approximate peak stage elevations, peak flows, time of peak stage elevation, and stage elevation occurrence intervals.
- Identification of major contributing watersheds in Wisconsin.

At the end of this chapter a list of Mississippi River gage stage elevations and how they relate to the starting and 100-year stage elevations will be presented. All elevations used in this chapter are based on the 1912 adjustment of Mean Sea Level and preliminary information which is used as general indications of peak elevations and timing of peak elevations. Attached appendixes include stage and flow hydrographs, and Corps of Engineers river profiles which contain peak flood level data.

### ***PIERCE COUNTY***

Pierce County experienced 15-25 year flood occurrence levels. The major contributing drainage basin was the

Minnesota River, which crested on 6/24 near Jordan, Minnesota and provided 90% of the flow recorded on the Mississippi River at St. Paul, which peaked on 6/27. The St. Croix River combined with the Mississippi at Prescott, Wisconsin. While certain locations in the basin received considerably more, the St. Croix and Mississippi River basins received an average of 4-10 inches of rainfall during June 1993.

## **GAGES**

U.S.G.S gage# 05330000 at Jordan peaked on 6/24 at 92,000 c.f.s., which is a 50-100 year event on the Minnesota River.

U.S.G.S. gage# 05331000 at St. Paul peaked on 6/26 at 104,000 c.f.s., which is a 10-50 year event on the Mississippi River.

The Prescott, WI gage peaked on 6/28 at 5:00 a.m. The peak elevation of 687.69 feet was a 15-25 year event.

The Lock & Dam #3 gage peaked on 6/28 at 12:00 p.m. The peak elevation of 683.24 feet was a 15-25 year event.

The Red Wing gage peaked on 6/28. The peak elevation of 680.4 feet was a 15-20 year event.

## **PEPIN COUNTY**

The Lake City gage peaked at 12:00 a.m. on 6/27, which is a 10-year event. There are no significant additional drainage areas contributing to the flood flows in Pepin County.

## **BUFFALO COUNTY**

The stages in Buffalo County corresponded to approximately a 10-25 year event. The June 17-20 storm, combined with saturated soil conditions, produced the peak elevations, although the Chippewa River Basin runoff apparently caused the peak stages ahead of the attenuated peak flow coming down the Mississippi. The combination of peak flows helped extend the duration of the peak stages along the Mississippi River to the Illinois border.

## **GAGES**

U.S.G.S. gage# 05369500 on the Chippewa River at Durand peaked on 6/23 at 90,100 c.f.s., which was a 10-50 year event. This contributed to an early peak on the Mississippi River from the Buffalo County line downriver.

The Wabasha, MN gage peaked at approximately 7:00 p.m. on 6/25. The peak elevation of 675.34 was between a 10-25 year event.

The Lock & Dam #4 gage peaked at approximately 8:00 p.m. on 6/25. The peak elevation of 671.65 (168,000 c.f.s.) was between a 10-25 year event.

The Lock & Dam #5 gage peaked at approximately 12:00 p.m. on 6/26. The peak elevation of 662.77 (168,000 c.f.s.) was between a 10-25 year event.

The Lock and Dam #5a gage peaked at approximately 4:00 p.m. on 6/26. The peak elevation of 658.81 (178,000

c.f.s.) was between a 10-50 year event.

## ***TREMPEALEAU COUNTY***

The stages in Trempealeau County corresponded to a 15-30 year event. The county received 8-10 inches of rain during June with 5-7 inches between June 16-21. The Trempealeau River basin and other drainage areas contributed to a peak Mississippi River stage that arrived almost four hours before the Lock and Dam #5a peak upstream.

### **GAGES**

U.S.G.S. gage #05379500 on the Trempealeau River at Dodge peaked on 6/22 at 5130 c.f.s. This corresponded to a 2-5 year event.

The Lock and Dam #6 gage peaked at 12:00 p.m. on 6/26. The peak elevation of 650.35 (189,000 c.f.s.) was between a 15-30 year event.

## ***LA CROSSE COUNTY***

The Black River significantly affected local flooding by emptying into the Mississippi five days before the peak flow arrived. This prolonged flooding conditions in the county. A more descriptive analysis of the Black River basin is contained in a separate chapter of this report.

### **GAGES**

U.S.G.S. gage# 05381000 on the Black River near Galesville peaked on 6/21 at 64,000 c.f.s. This corresponded to an 88 year event.

The Lock and Dam #7 gage peaked at 4:00 p.m. on 6/26. The peak elevation of 643.76 (182,000 c.f.s.) was between a 15-30 year event.

The Lacrosse gage peaked at approximately 8:00 a.m. on 6/27. The peak elevation of 640.99 was between a 15-30 year event.

## ***VERNON COUNTY***

### **GAGES**

The Lock and Dam #8 gage peaked at approximately 8:00 a.m. on 6/28. The peak elevation of 634.75 (179,500 c.f.s.) was between a 20-35 year event.

## ***CRAWFORD COUNTY***

While Crawford County didn't receive rainfall comparable to other areas, upper drainage basin runoff produced stages approaching a 50 year event.

### **GAGES**

The Lansing, IA gage peaked at approximately 6:00 a.m. on 6/30. The peak elevation of 630.5 was between a 20-40 year event.

The Lock and Dam #9 gage peaked at approximately 8:00 a.m. on 6/30. The peak elevation of 629.52 was between a 20-40 year event.

The McGregor, IA gage peaked at approximately 10:00 p.m. on 6/29. The peak elevation of 627.28 was between a 20-40 year event.

## **GRANT COUNTY**

The Wisconsin River drainage basin contributed to the Mississippi flood flow at the northern edge of Grant County. A more detailed report on the Wisconsin River is included in a separate chapter in this report.

### **GAGES**

U.S.G.S. Gage #05407000 at Muscoda peaked on 6/25 at 59,600 c.f.s.

The Clayton, IA gage peaked at approximately 12:00 a.m. on 6/29. The peak elevation of 623.76 was between a 20-50 year event.

The Lock and Dam #10 gage peaked at approximately 4:00 a.m. on 6/30. The peak elevation of 620.67 (238,000 c.f.s.) approached a 50 year event.

The Lock and Dam #11 gage peaked on 7/1. The peak elevation of 611.19 (241,000 c.f.s.) approached a 50 year event.

The Dubuque, IA gage peaked on 7/1. The peak elevation of 609.31 approached a 50 year event.

### **CHRONOLOGY**

#### **TUESDAY, JUNE 22**

At La Crosse, where the flood stage is 12 feet, the Mississippi rose to 13.39 and is expected to crest at 13.6 feet Wednesday. Elsewhere along the Mississippi, 90 people fled low-lying homes near Lock and Dam 6 at Trempealeau. The river is expected to crest there today after rising another 2 to 4 feet. Thunderstorms were

expected to move into far western Wisconsin Tuesday night and spread across the state by Thursday.

#### **THURSDAY, JUNE 24**

The governor declared a state of emergency in 24 more counties in western and southern Wisconsin as strong thunderstorms hit the flood-stricken area. National Guard troops were on alert due to the threat of more flooding. Prairie du Chien kept watch on the rising Mississippi River as water up to 2 feet deep flooded some streets. No damage was reported.

#### **SATURDAY, JUNE 26**

Dry conditions lessened flooding threats for most Wisconsin rivers, but the Mississippi was still rising Saturday and causing problems from Minnesota to Illinois. The river is expected to crest 7 feet above flood stage Sunday in St. Paul and up to 6 feet above bank full in Dubuque by Tuesday. In Pierce County, at least 100 residents on Trenton Island were evacuated and four businesses were closed as the water climbed toward 3 feet above flood stage. All trailers were removed from the Island Campground area as the river rose nearly 5 feet above some nearby back yards. Authorities were enforcing a no-wake speed on the river to protect properties. 215 miles of the river from Bellevue, IA, south to Alton, IL, were closed to barge traffic Friday and another 230 miles north of Bellevue is expected to close today. The closure could cause grain prices paid to farmers to fall while raising prices for foreign customers. Most grain companies stopped loading barges yesterday and won't resume operations for two to six



weeks. The river at Prairie du Chien is 3 feet above flood stage and is expected to rise another 18 inches before cresting Monday. While no evacuations have been ordered, many roads and basements have flooded. The grain terminal has shut down and may be closed through July 4th. The Villa Louis historic site has been sandbagged and closed to visitors since Thursday.

## SUNDAY, JUNE 27

The Mississippi River rose a foot in 24 hours (and still rising) at Prairie du Chien and was at 21.6 feet, more than 5 1/2 feet above flood stage. A crest of 21.8 feet is expected Tuesday. The river is expected to crest more than 3 feet above flood stage at Trenton Island on Wednesday. The lock at Red Wing closed Saturday and the Alma lock might follow suit. 20 residents in La Crosse County reported flooded basements after the river crested at 14.1 feet Saturday. Normal level is 12 feet. "Right now it's holding at about 14 feet, but that can change because rain is expected Tuesday," an official said.

## MONDAY, JUNE 28

Rising waters on the Mississippi River brought state-of-emergency declarations from the governor for Grant, Crawford, St. Croix, and Vernon Counties, raising the number of counties placed on emergency status since June 21 to 30. 25 homes in Prairie du Chien and dozens outside the city limits have been evacuated. The river is expected to crest today at 22 feet, 6 feet above flood level, the second worst flood in city history

behind the 100-year flood of 1965, which crested at 25.4 feet. "We've got water coming across the road," said Duane Burgus of Sieg Auto Parts. "The last time water got this high was in 1965. There was 3 feet of water at the front of the store." Burgus rents a home about 600 feet from the river and the structure is swamped with at least 4 feet of water. It takes a half-mile boat ride to get to the property these days, and Burgus expects he won't be able to move back into the home for at least two weeks.

The flooding, spurred by up to 10 inches of rain in a week, has stranded more than 50 towboats and many barges since most locks were closed Friday between St. Paul and St. Louis. The Mississippi is the nation's central corridor for grain bound for overseas markets. A spokesman for the towboat industry said operators were losing \$1 million a day while the river was shut down. Recreational boating has also ceased due to fast currents and debris - including whole trees, picnic tables, piers, and dead deer. "I don't know of anybody who would go out there," said Bob Bochmore, who rents boats at an inland lake. "There's too much crap floating in the river and it's flowing too fast." High water crested at St. Paul Saturday, but the river was rising rapidly at Rock Island, Ill. It was at 18.5 feet Sunday, 3.5 feet above flood stage. The river was still 2 feet above flood stage at La Crosse.

## TUESDAY, JUNE 29

Prairie du Chien residents barricaded homes and businesses with more than 20 thousand sandbags as the

Mississippi River crested today at 21.9 feet, inundating low-lying areas with up to 4 feet of water. The normal level for June is 7 to 9 feet. Dozens of basements were flooded and more damage is expected as weather forecasters are predicting 1 to 2 more inches of rain will fall by Saturday. The hardest hit area was around North Main and North First streets, where the only way to get around was by boat. More than 150 volunteers filled more than 20,000 sandbags in an effort to prevent further damages. Most of the rain predicted for the weekend should fall south of town, but if it moves north the area could experience a second crest. Area residents who had been through previous floods remained philosophical. Veronica Duffy, who had two sump pumps going in her basement, remembered that the '65 flood had covered her first floor. "You acquire lakefront property awfully fast when the river comes up," she said.

Numerous roads in Grant County were reported closed due to high waters on the Mississippi River and several tributaries. In the town of Paris, West Lane was covered by 1/2 feet of water after the Mississippi and Platte rivers overflowed their banks. Local residents report that it is the highest levels since 1965. In Cassville, most low-lying areas were under one to two feet of water. A resort in the Bagley area relocated 62 travel trailers because of high water. Lock and Dam 11 at Dubuque, with a flood stage of 17 feet, is expected to crest Wednesday at 23.5 feet. Thunderstorms are forecast for the area through Saturday.

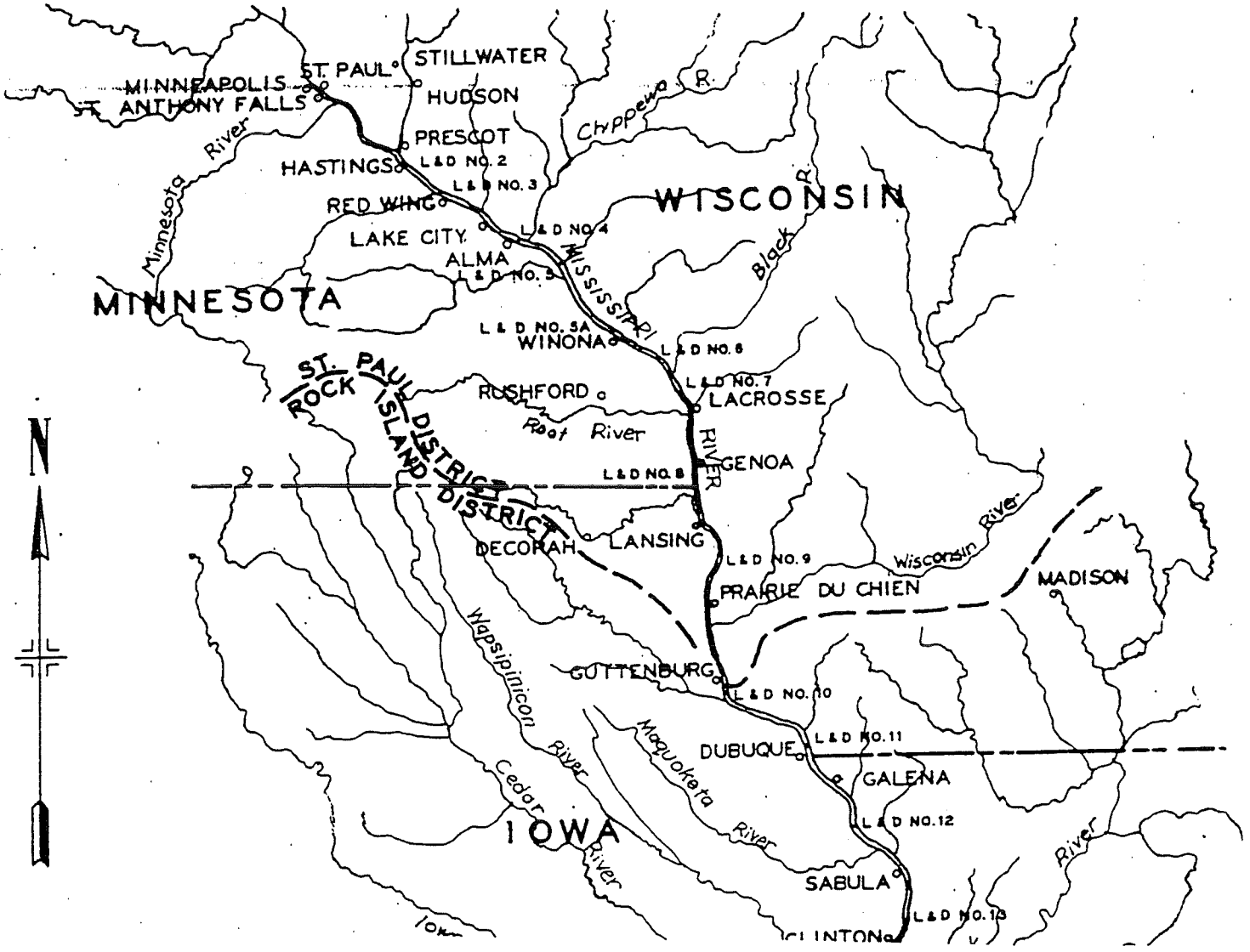


## Observed upper Mississippi high water levels for June and July 1993.

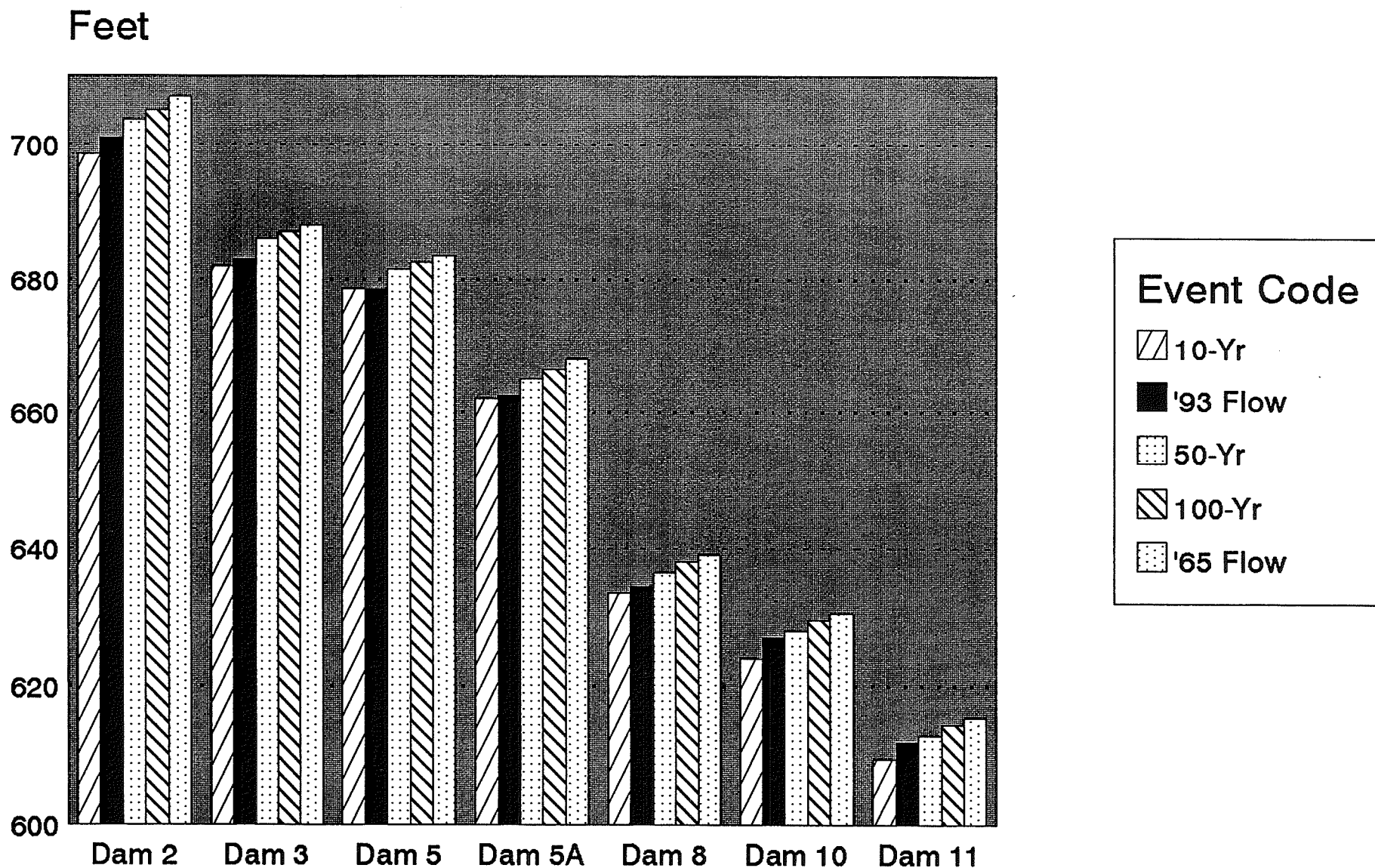
GAGE LOCATION	JUNE 1 EL. 1912 DAT	1993 PEAK EL. 1912 DAT	RISE IN EL. (ft)	DATE OF PEAK	100 YR. EL. 1912 DAT	1993 PEAK EL. BELOW 100 YR.
S. St. Paul	690.5	701	+ 10.5	6/27/93	705.2	- 4.2
Lock & Dam #2	686.5	690.26	+ 3.76	6/27/93	695	- 4.74
Dam #2 T.W.	681.2	689.2	+ 8.0		694.1	- 4.9
Prescott	680.9	687.69	+ 6.79	6/28/93	691.6	- 3.91
Lock & Dam #3	675.2	683.24	+ 8.04	6/28/93	687.1	- 3.86
Dam #3 T.W.	674.8	682.3	+ 7.5		686.6	- 4.3
Red Wing (Trenton Island)		680.4		6/28/93	684.4	- 4.0
Lake City	672.2	678.55	+ 6.35	6/27/93	682.4	- 3.85
Wabasha	670.1	675.34	+ 5.24	6/25/93	679	- 3.66
Lock & Dam #4	666.3	671.65	+ 5.35	6/25/93	674.2	- 2.55
Dam #4 T.W.	664.2	670.8	+ 6.6		675	- 4.2
Alma	663.2	668.38	+ 5.18	6/25/93		
Lock & Dam #5	659.3	662.77	+ 3.47	6/26/93	667.6	- 4.83
Dam #5 T.W.	655.2	662.1	+ 6.9		666.6	- 4.5
Winona	649.0	656.65	+ 7.65	6/26/93	660.4	- 3.75
Lock & Dam #5a	650.8	658.81	+ 8.01	6/26/93	662.8	- 4.01
Dam #5a T.W.	650.4	658.2	+ 7.8		662.4	- 4.2
Lock & Dam #6 Trempealeau	644.5	650.35	+ 5.85	6/26/93	653.7	- 3.35

GAGE LOCATION	JUNE 1 EL. 1912 DAT	1993 PEAK EL. 1912 DAT	RISE IN EL. (ft)	DATE OF PEAK	100 YR. EL. 1912 DAT	1993 PEAK EL. BELOW 100 YR.
Dam #6 T.W.	643.4	649.8	+ 6.4		652.4	- 2.6
Dakota	640.4	645.3	+ 4.9	6/26/93	648.2	- 2.9
Lock & Dam #7	638.8	643.76	+ 4.96	6/26/93	647.2	- 3.44
Dam #7 T.W.	636.3	643.1	+ 6.8		646.4	- 3.3
Lacrosse	634.8	640.99	+ 6.19	6/27/93	643.6	- 2.61
Brownsville	631.7	636.34	+ 4.64	6/27/93	639.2	- 2.86
Lock & Dam #8	629.8	634.75	+ 4.95	6/28/93	638.1	- 3.35
Dam #8 T.W.	627.4	633.8	+ 6.4		637.3	- 3.5
Lansing	622.0	630.5	+ 8.5	6/30/93	633.8	- 3.30
Lock & Dam #9	619.9	629.52	+ 9.62	6/30/93	632.8	- 3.28
Dam #9 T.W.	619.5	628.9	+ 9.4		632.2	- 3.3
McGregor Prairie Du Chien	617.1	627.28	+ 10.18	6/29/93	629.8	- 2.52
Clayton	614.0	623.76	+ 9.76	6/29/93	625.8	- 2.04
Lock & Dam #10	611.2	620.67	+ 9.47	6/30/93	622.8	- 2.13
Dam #10 T.W.	610.8	620.2	+ 9.4		622.2	- 2.0
Lock & Dam #11	602.93	611.19	+ 8.26	7/1/93	613.4	- 2.21
Dam #11 T.W.	599.0	610.52	+ 11.52	7/1/93	613.0	- 2.48
Dubuque	598.42	609.31	+ 10.89	7/1/93	611.3	- 1.99

# Mississippi River Gage Stations



# Mississippi River Stage Data





## PECATONICA RIVER

---

The Pecatonica River is a large watershed located in southwestern Wisconsin. The basin lies in the eastern edge of the driftless area north of the Wisconsin - Illinois state line in Green, Iowa, and Lafayette Counties.

The basin is comprised of two large sub-basins. The western lobe is the Pecatonica River with a drainage area of 524 square miles at the confluence with the East Branch Pecatonica River, which has a drainage area of 419 square miles. Six miles downstream of the confluence at the Illinois - Wisconsin state line, the drainage area is 1035 square miles. The basin is oriented mostly north to south with steep unglaciated tributary valleys. The main channels of the two major sub-basins are flat meandering streams in broad flat valley floodplains.

Three USGS gaging stations are located on the river. The gages are located at Darlington on the upper west branch, Blanchardville on the east branch, and Martintown at the state line below the confluence of the two sub-basins.

Two floods occurred on the Pecatonica in the summer of 1993. The first lesser flood event occurred at the end of June. The second larger flood occurred in early July. The major concentration of flood damage, other than agricultural flood damage, occurred in Darlington. Lesser flood damage occurred in Blanchardville and Martintown. The following discussion is a chronology of storms and resultant flooding in the Pecatonica basin.

The two storm patterns that produced significant rainfall in the basin occurred less than one week apart. Continuous wet conditions through the spring and early summer produced saturated soil conditions. As a consequence, any significant storm event produced heavy runoff and flooding conditions.

The first flood on the Pecatonica was caused by a storm on June 30th in which an average of 2.5 inches of rain fell over the western sub-basin. The upper end of the east branch received significantly less rainfall. The greatest rainfall was concentrated in Rock County along the state line. The rain over the western sub-basin caused a routinely high flood stage in Darlington. The second and larger storm event - with 5 to 7 inches of rain - occurred over the July 4th weekend, causing major flooding in the entire basin.

Three USGS gaging stations located in the basin are used to document the flooding events along the Pecatonica River. The gages are:

- Pecatonica at Darlington, No. 5432500, D.A. = 273 sq. mi.
- E. Branch Pecatonica near Blanchardville, No. 543300, D.A. = 221 sq. mi.
- Pecatonica at Martintown, No. 5434500, D.A. = 1034 sq. mi.

The first flood on June 30th, which produced 2.5 inches of rain, was a

minor event compared to past floods. Minor flooding occurred in Darlington along with some agricultural and roadway damage. A tabulated record of gage heights and comparison with past floods is given below.

The more severe flood occurred one week later as the result of a major storm over the July 4th weekend. 5 to 7 inches of rain fell over a two day period. As a result of this storm and already saturated soil conditions, major flooding occurred over the entire basin of the Pecatonica River. A levee along the East Branch in Blanchardville was threatened. Action was taken to shore up the levee and was successful. However, downtown businesses were still flooded due to flood water backing up from downstream of the levee. A few homes along the river in Martintown were also flooded.

The most significant flood damage occurred in Darlington. Several blocks of the downtown area were evacuated. The fire station was flooded as well as several businesses in the downtown area. An oil company with large stores of petroleum and gas in the floodplain on the northwest side and the sewage treatment plant on the southeast side were environmental concerns. Fortunately, no major incidents occurred. The flood stages were significantly higher than the earlier flood. A comparison of the two is given below, as well as a relationship to past floods along the Pecatonica.





## HISTORY OF MAJOR FLOOD EVENTS

GAGE	LOCATION	DATE	GAGE HEIGHT	DISCHARGE CFS	FREQUENCY
5432500	Darlington	7/16/50	20.71	22,000	NA
		4/1/59	17.16	10,700	NA
		6/30/69	19.16	16,000	NA
		6/29/90	19.80	18,300	NA
		6/30/93	14.43	NA	NA
		7/6/93	18.25	12,000	22
543300	Blanchardville	2/28/48	15.74	11,700	NA
		7/17/50	15.73	7,150	NA
		4/1/59	15.61	9,680	NA
		6/30/90	14.05	2,540	NA
		6/30/93	10.89	NA	NA
		7/6/93	16.59	6,800	13
5434500	Martintown	2/29/48	20.24	13,400	NA
		4/3/59	20.23	14,200	NA
		3/24/75	20.57	12,900	NA
		7/1/90	20.98	12,000	NA
		7/8/93	20.36	NA	NA

The high awareness of flooding along the Pecatonica River is due to the frequent and predictable flood damage that occurs in the City of Darlington. As seen in the table above, only three years ago, in 1990, Darlington had experienced an even worse flood. A flood warning and evacuation plan is in effect for the Pecatonica River system and has been put to the test this year. Without it, considerably more damage and endangerment of life and property would result.

## CHRONOLOGY

### FRIDAY, MARCH 26

Pecatonica River is at 13 feet, 2 feet over flood stage, flooding farm fields and low-lying roads.

### FRIDAY, APRIL 16

The Pecatonica River produced minor flooding in Green and Lafayette counties. The river level was at 10.69 feet in Martintown and was expected to rise to 13 feet by Sunday.

### THURSDAY, APRIL 22

The Pecatonica River was 12.98 feet at Martintown, down from 13.05 feet Tuesday. Flood stage is 11 feet.

### MONDAY, APRIL 26

Minor flooding was reported along the Pecatonica River. The river is dropping, but is still above flood stage.

### SUNDAY, JUNE 20

In the Martintown area, the Pecatonica River was over its banks.

### SUNDAY, JUNE 27

A flood warning remained in effect for the Pecatonica River with levels a half foot above flood stage, but the river is expected to begin dropping soon.

### WEDNESDAY, JUNE 30

The Pecatonica River at Darlington crested at 15.5 feet today, flooding

roads in low-lying areas, but later receded to 13.75 feet. Flood stage is 20 feet. No was damage reported in the city.

### TUESDAY, JULY 6

Record-breaking rainfalls in southwestern Wisconsin Monday contributed to what the governor termed "the largest disaster we've faced in Wisconsin for a long time and maybe the worst ever." Damages may total more than \$200 million. Dane and Iowa counties were added to the other 33 Wisconsin counties declared in a state of emergency due to flooding in the last month. Madison received 3.75 inches of rain, exceeding the city's normal July total of 3.39 inches.

About a third of downtown Darlington was closed today after 6 to 7 inches of rain raised levels on the Pecatonica River by 9 feet to a crest of 18.6 feet, 7.6 feet over flood stage. The river completely covered the Main Street bridge, cutting off travel between the north and south sides of town. Firefighters spent much of the morning ferrying people to each side in a boat. Ironically, the fire department was under three feet of water. Business owners, veterans of two major floods in three years, had started hauling inventory out of their stores Monday. "There were people loading things on horse trailers," said Traci Heffran, owner of the Country Cafe. "People just came down and helped them take as much as they could haul."

In Blanchardville, the river easily crested a dike and flooded some downtown areas with a foot or more of water. Access via Highway 78 was

cut off by high waters. McKellar Park downtown resembled a lake and some kids treated it as such by going for a dip. No residents were evacuated, but several businesses were closed. "I've never seen anything like it," said Ruth Engstad who runs the local Chevrolet dealership with her husband Orville. The Engstads had to move six antique cars parked in a garage several blocks from the river that they thought was safe from flooding.

In Belmont, rains caused Bonner's Creek to swell to more than 200 feet wide in some areas, washing away thousands of dollars worth of lumber and building supplies from Nodolf Lumber, Inc. In Gratiot, the river crested up to the sides of the main street area, forcing at least one business to evacuate. The VFW park was covered with 5 feet of water. The fire department has been pumping out resident's basements for the past two days.

LaFayette County Emergency Services Director F. John Reichling has estimated that there is roughly \$2.5 million worth of crop damage in the county and probably another three-quarters of a million or more in damages to roads. He estimates another \$200,000 in damages to businesses.

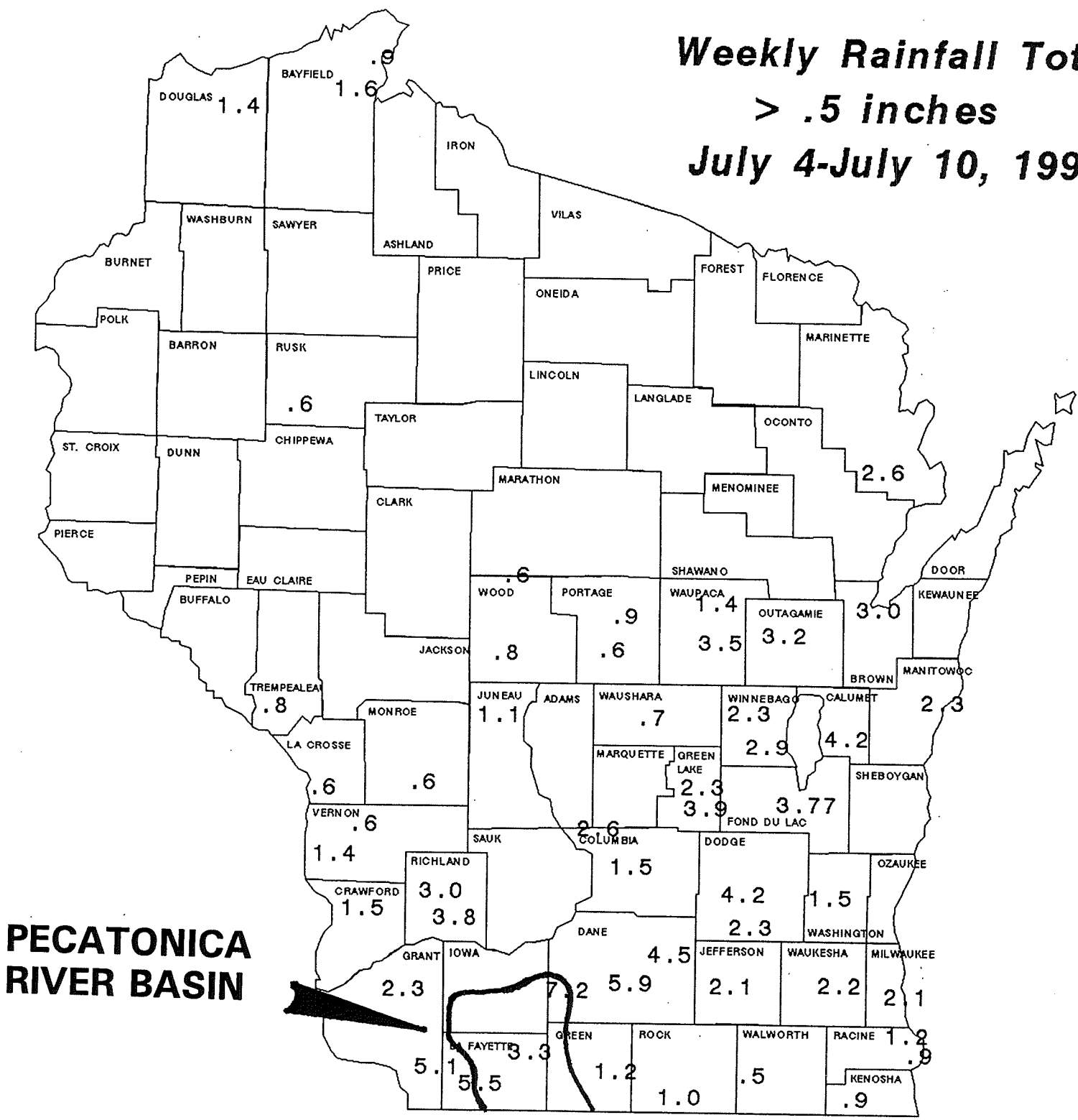
In Iowa County, Highways 39 and 191 near Hollandale were closed. Half the roads in the southern half of the county were closed Tuesday and three-fourths of them sustained damage, according to Sheriff Thomas De Voss. "This is something that came very quickly and people just weren't ready for it," he said. "The creeks and rivers rose

rapidly and there wasn't a lot that could be done."

## WEDNESDAY, JULY 21

Hundreds of thousands of gallons of untreated sewage have been dumped directly into rivers and streams by more than 20 municipal treatment plants across a five-county area in southwestern Wisconsin during the past three weeks of flooding. All but three of the plants in Grant, Iowa, Green, Richland and Lafayette counties are now back to normal operations. Dodgeville, Brodhead and Cassville are still diverting some sewage. Many of the plants are getting two to three times their normal amounts of sewage.

# Weekly Rainfall Totals > .5 inches July 4-July 10, 1993



**PECATONICA  
RIVER BASIN**





# YAHARA RIVER BASIN (MADISON LAKES)

The Yahara River drainage basin has an area of 537 square miles that includes four major lakes: Mendota, Monona, Waubesa and Kegonsa. Mendota, Waubesa and Kegonsa have control structures operated by Dane County. All four lake levels exceeded the normal maximum elevations for substantial periods during the summer of 1993, resulting in flooding of lake front property.

A very wet spring caused the flooding. The attached diagram shows that the basin received 1.5 to 2 times the normal precipitation in April and May.

Dane County began opening the gates on the control structures in the fall of 1992 to lower the lakes levels for the winter. The following table provides the target operating lake elevations and regional flood elevations.

## LAKE ELEVATIONS

<u>Lake</u>	<u>Winter Min.</u>	<u>Summer Min.</u>	<u>Summer Max.</u>	<u>RFE</u>
Mendota	848.2	849.6	850.1	851.7
Monona	842.1	844.7	845.2	847.7
Waubesa	841.9	844.5	845.0	847.4
Kegonsa	842.25	843.0	843.5	844.1

The summer maximums on all lakes were exceeded due to the abnormal rainfall. The attached charts show the actual monthly minimum and maximum levels for each lake. The lake levels are reduced during the winter to reduce ice damage to the shoreline. The control structures at Waubesa and Kegonsa were opened completely on Nov. 23, 1992, creating free flow conditions from Monona through Kegonsa. The county then operated the gates at Tenney Locks to maintain the required 5 foot elevation difference between Mendota and Monona.

In March, the Lake Waubesa dam gates were closed to bring the levels up to

summer minimums. Rising lake levels in March forced the county to begin pulling stop logs at the Lake Waubesa dam. In early June, when the lake approached maximum summer elevations, the remaining logs were pulled creating free flow conditions. Heavy rainfall (one-third the yearly average) from June 29 - July 10 caused lake levels to rise dramatically.

While regional flood elevations were exceeded on Mendota and Kegonsa, the available storage capacity prevented peak flows on the Yahara River from exceeding the 100-year event. The following table summarizes

the actual flow and expected frequency at gage locations on the Yahara River:



## FREQUENCY SUMMARY

<u>Gage Number</u>	<u>Location</u>	<u>Peak Stage</u>	<u>Peak Discharge</u>	<u>Recurrence Interval</u>
05429500	McFarland	6.75 ft.	615 cfs	13 years

## CHRONOLOGY

### THURSDAY, JUNE 24

A state of emergency was declared in 24 more counties in western and southern Wisconsin as strong thunderstorms hit the flood-stricken area. National Guard troops were on alert due to the threat of more flooding. Heavy rain fell in the Portage/Madison area, where the Wisconsin River had crested yesterday at 19.5 feet, and was expected to drop back to 17 feet by noon Saturday.

### TUESDAY, JULY 6

Record-breaking rainfalls in southwestern Wisconsin Monday contributed to what the governor termed "the largest disaster we've faced in Wisconsin for a long time and maybe the worst ever." Damages may total more than \$200 million. Dane and Iowa counties were added to the other 33 Wisconsin counties declared in a state of emergency due to flooding in the last month. Madison received 3.75 inches of rain, exceeding the city's normal July total of 3.39 inches.

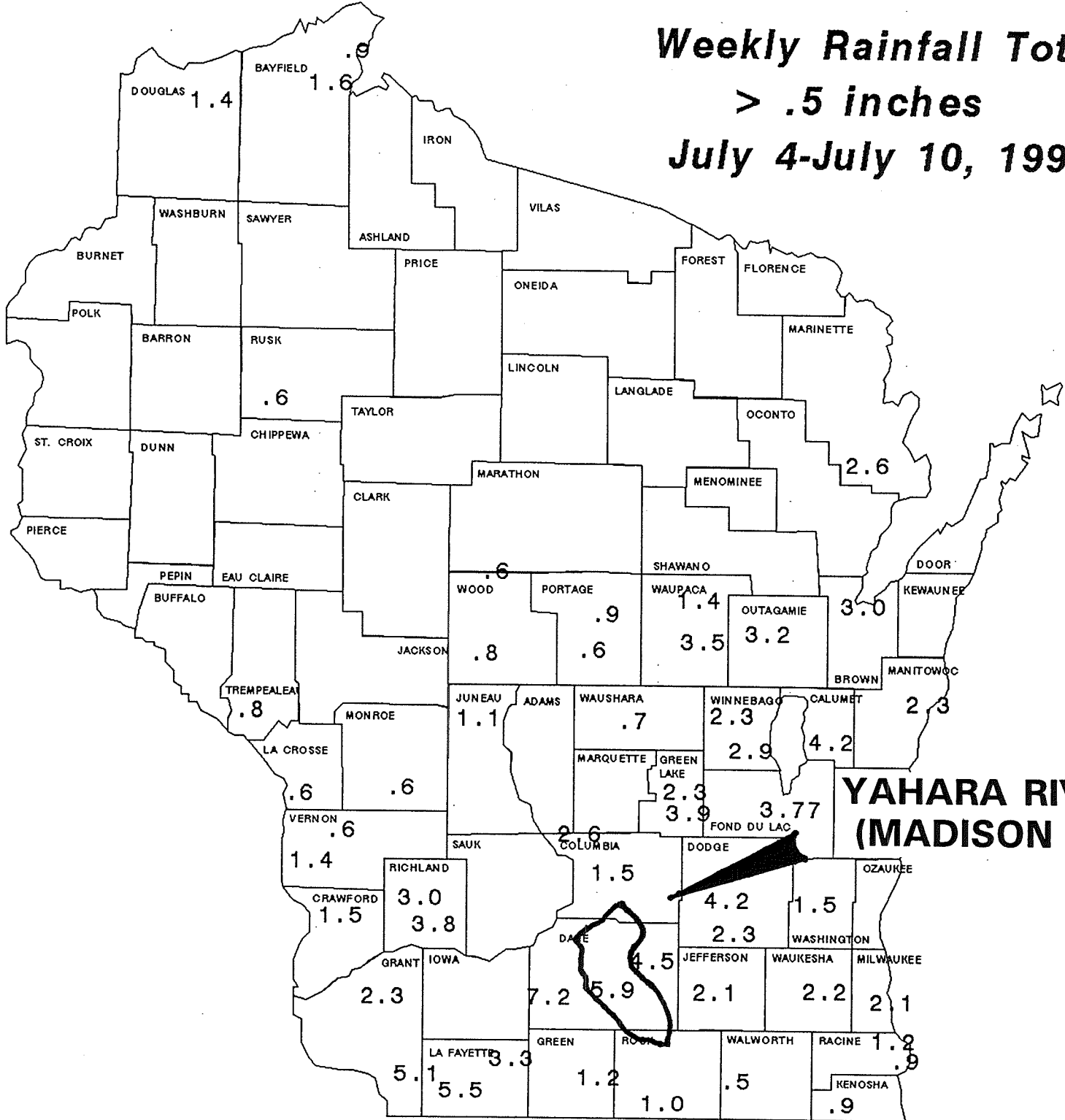
### FRIDAY, JULY 16

Floods have caused over \$400,000 in damages to nine state airports, including the Dane County Regional Airport and Wittman Field in Oshkosh, site of the Experimental Aircraft Association Fly-In Convention. In Dane County, high water forced officials to impose a 300 foot no-wake zone along shorelines of the Yahara chain of lakes. Local water ski shows were canceled as a result of the action.

### SUNDAY, JULY 25

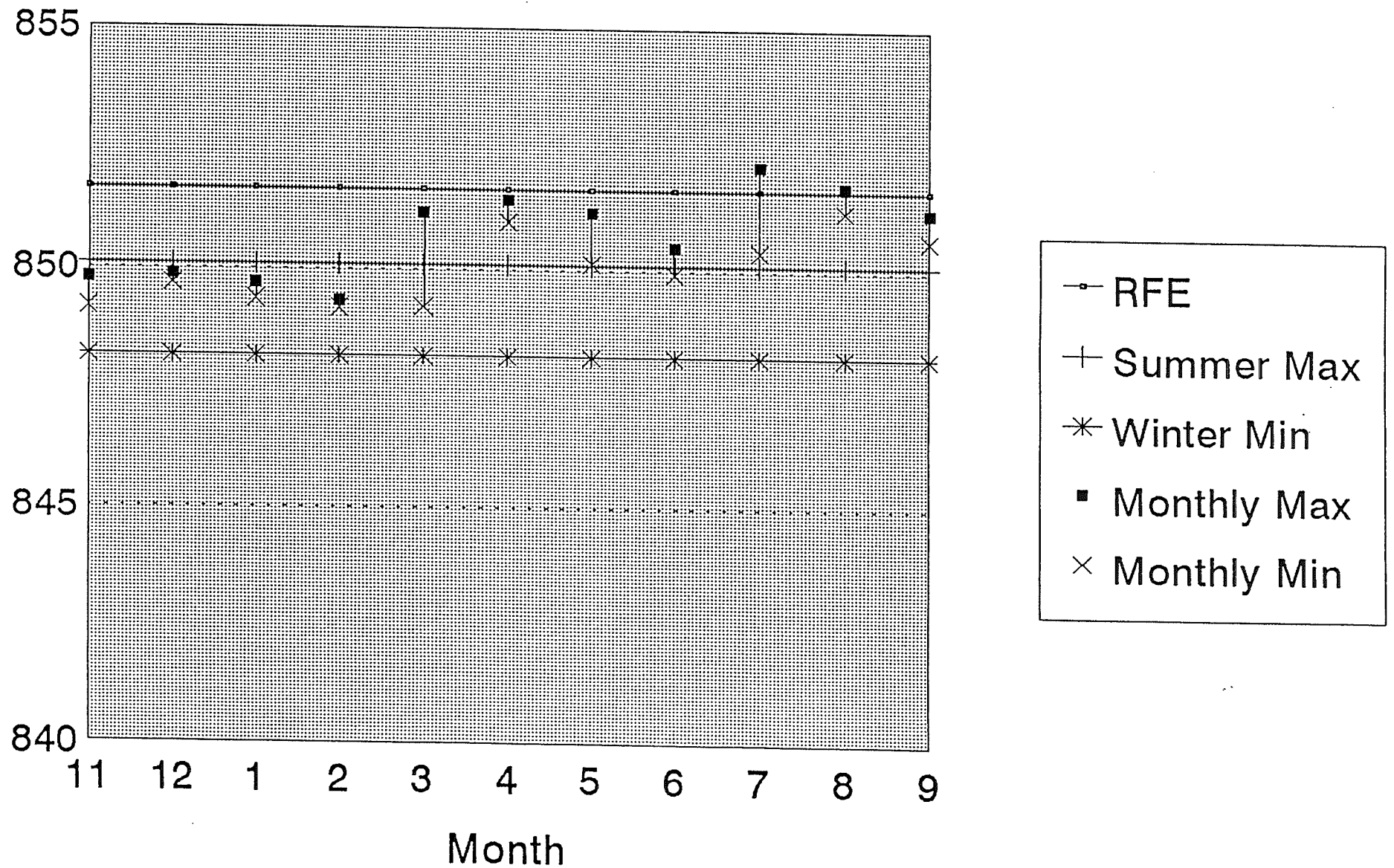
More than an inch of rain fell in the Madison area early Sunday, causing Badfish Creek to overflow its banks, which contributed to basement flooding in the village of Oregon. Damages were estimated at \$130,000 to 15 homes in a two block area.

**Weekly Rainfall Totals  
> .5 inches  
July 4-July 10, 1993**



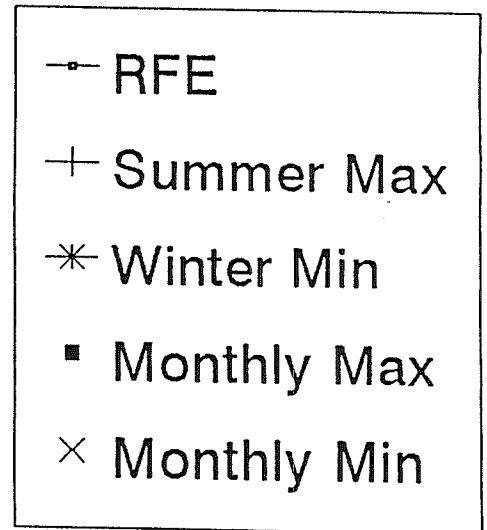
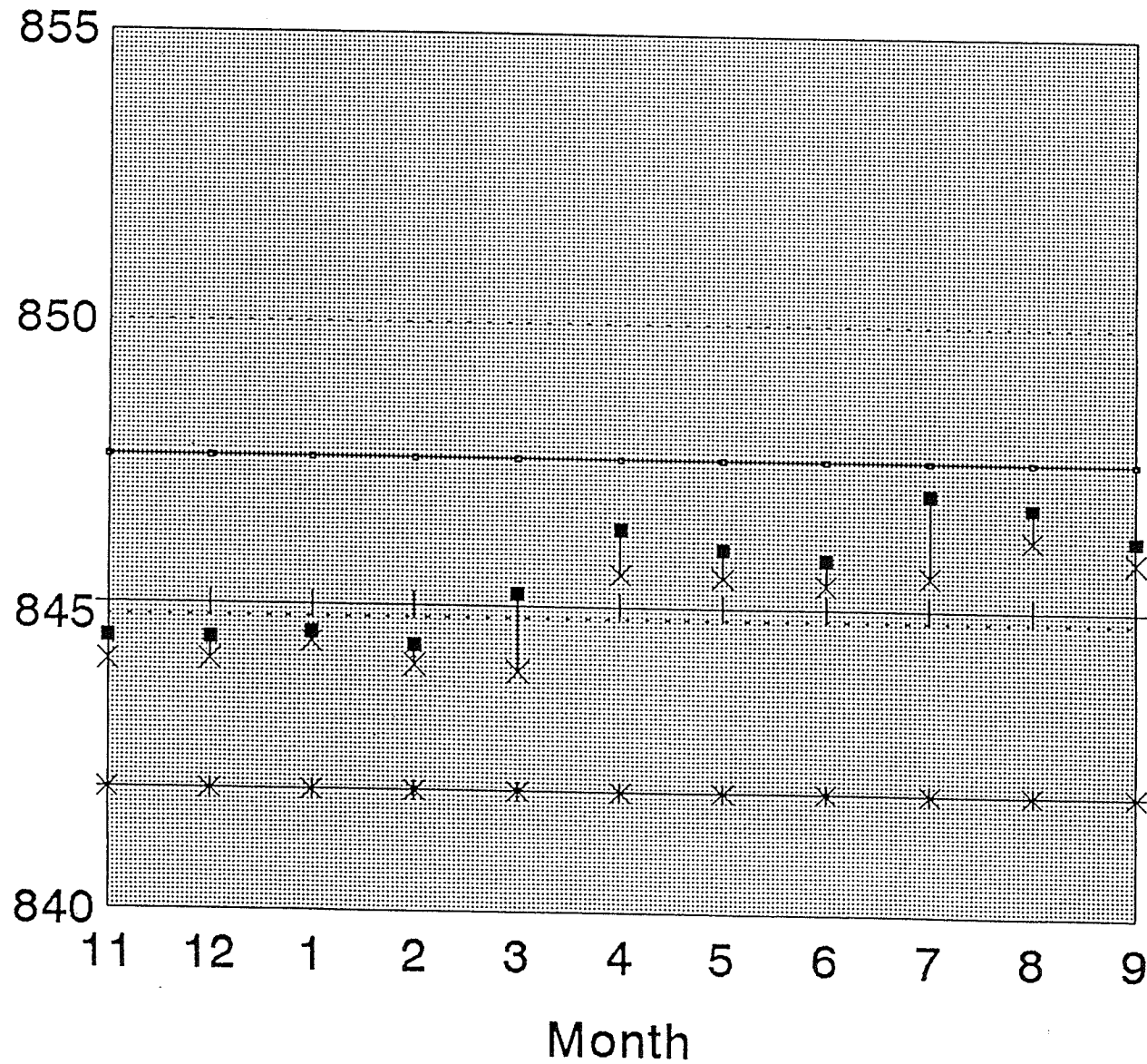
**YAHARA RIVER BASIN  
(MADISON LAKES)**

# Lake Mendota

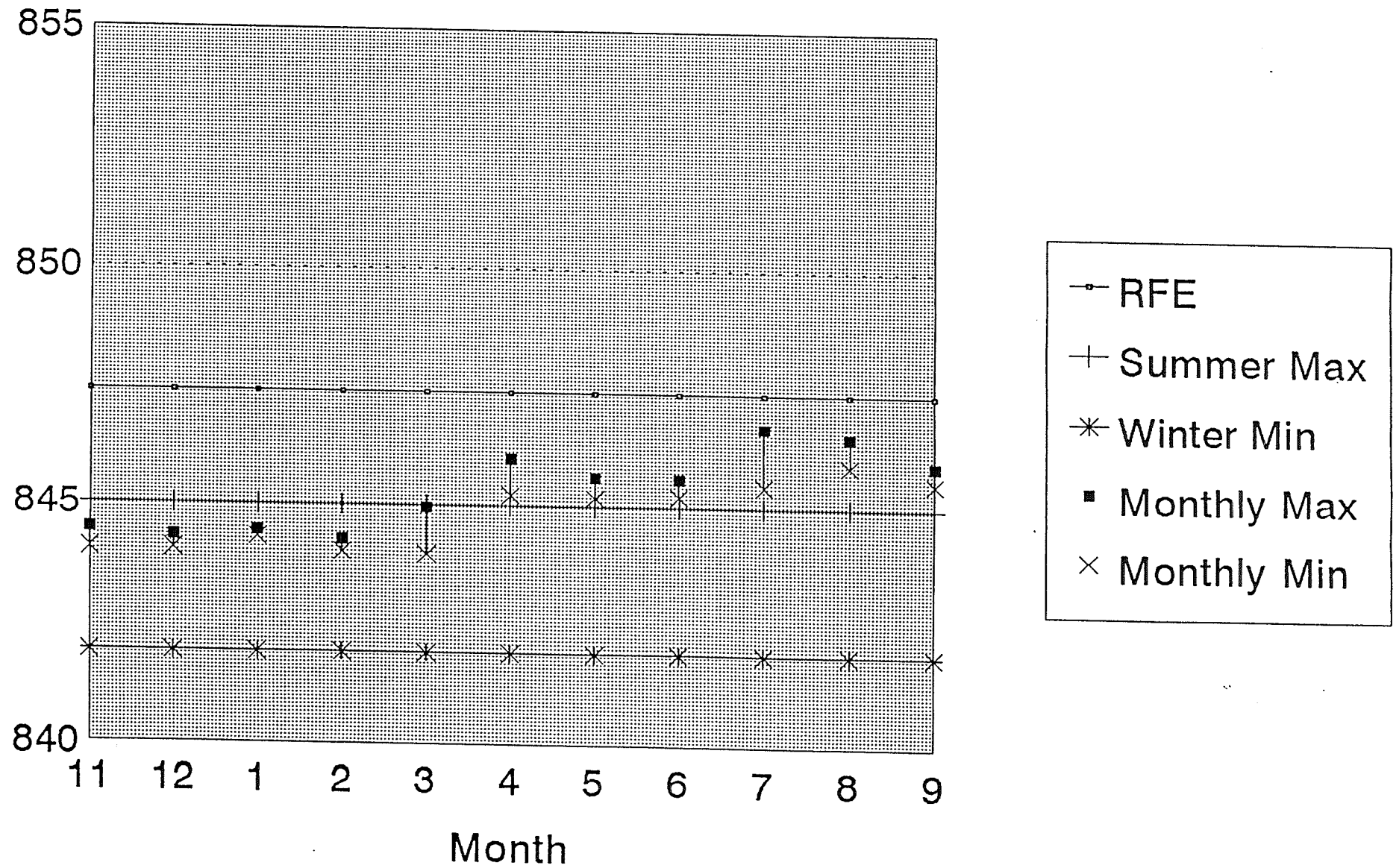




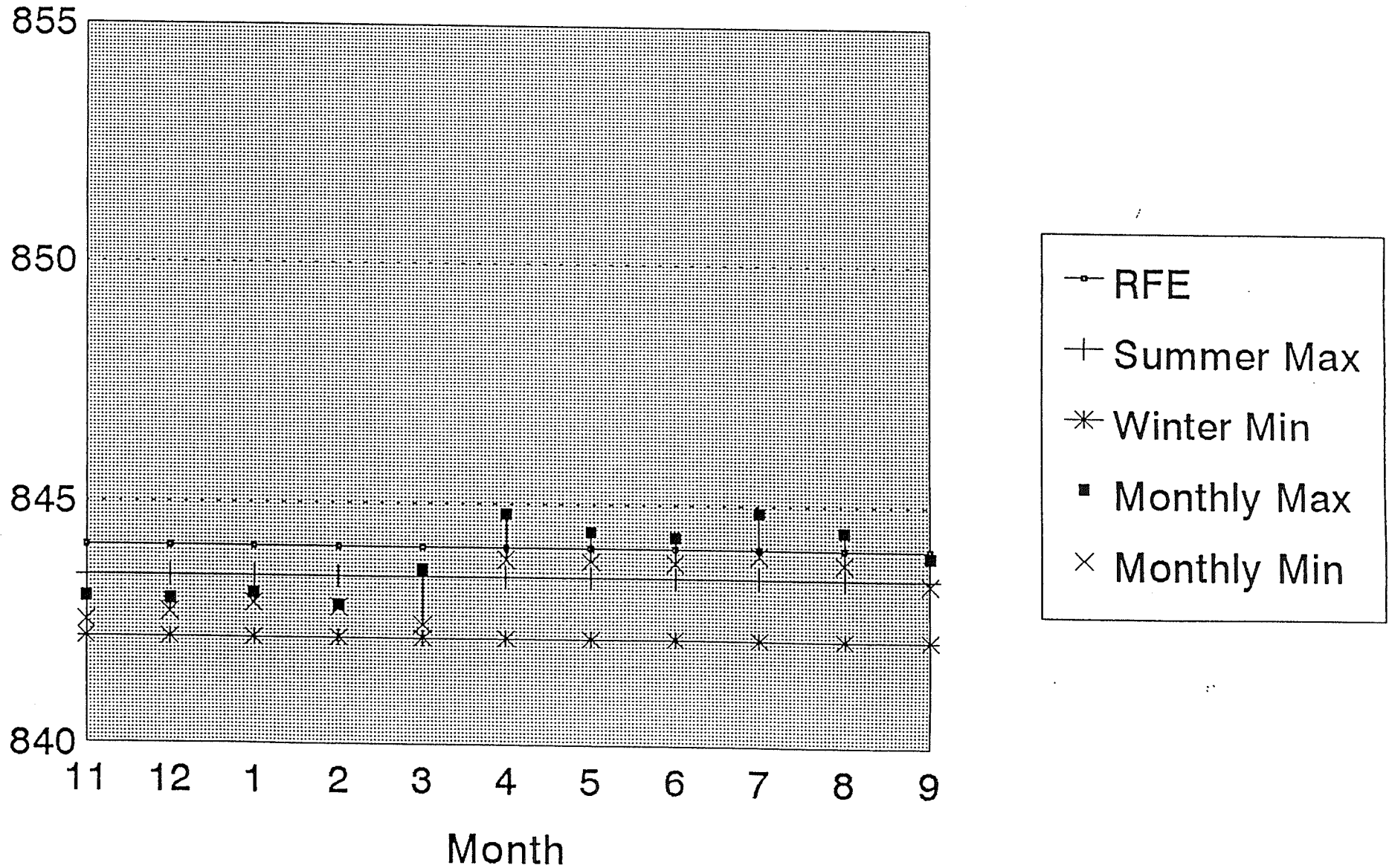
# Lake Monona



# Lake Waubesa



# Lake Kegonsa





## BARABOO RIVER

---

On Saturday evening, July 17, 1993, an intense storm centered itself just south of Baraboo, WI. The storm covered a small area as shown on the isohyet map of the event. Flooding caused by this precipitation varied considerably by basin. The storm's center remained relatively stagnant, producing an extreme intensity and volume of precipitation. Flood levels were dependent on the basin location relative to the storm center as well as individual basin parameters such as drainage area, slope, soil conditions, land use, etc. The worst flooding occurred just south of Baraboo on two small, steep tributaries to the Baraboo River. One death occurred and damages were extensive.

Above normal precipitation occurred over much of Wisconsin during the months of April, May, June and early July. Saturated soil conditions were not uncommon. The precipitation gage at the Baraboo sewage treatment plant registered a total of 6.13 inches from July 1-17. According to eye witness reports, precipitation began to fall after 8:00 p.m. on July 17. The first hour was "just sheets of rain". It then tailed off, but still rained very hard until about 12:00 pm, with much lighter rain after that. According to reports from the Wisconsin State Climatologist Office, rainfall near the storm center was in excess of 12 inches and fell over a duration of approximately 3 hours.

This event greatly exceeded the expected 100 year precipitation event of 3.6 inches (as derived from the "Rainfall Frequency Atlas of the United

States - Technical Paper 40" prepared by the Department of Commerce). This report indicates a probable maximum event of 24 inches over a 6 hour duration for a 10 square mile basin. Based on the difference in rainfall and duration, the recorded precipitation fell only slightly short of this extreme event.

Due to the localized distribution of precipitation, the smaller sub-basins near the center felt the greatest impacts. In particular, this included two unnamed tributaries to the Baraboo River just south of Baraboo.

The western tributary drainage area includes Devil's Lake State Park. The 370 acre lake impoundment was already at high levels and did not have enough capacity to store the 12 inch event. The lake overflowed at the north end into the adjacent stream which drains the remainder of the upper basin. These combined flows then built up behind two 72-inch corrugated metal pipes under Highway DL until the adjacent railway grade gave way.

This washout reacted similar to a dambreak and the resulting rapid increase in elevation caused much of the damage to the north, including Devi-Bara Lodge. The flows were then compounded with local runoff and continued downstream to the Hein-Werner building. At this point the original stream was conveyed via twin 48 inch concrete pipes under the road as well as the manufacturing building. The capacity of these pipes was insufficient and flows occurred both

around and through the building to the confluence with the Baraboo River.

The eastern tributary has a drainage area of 4.7 square miles which is somewhat less than the Devil's Lake Tributary. Under normal conditions it crosses back and forth under Highway 113 through concrete box culverts. During this event the stream took a more direct path adjacent to the highway, causing washouts to the highway along with driveways, building foundations, etc. A couple of vehicles fell into these washouts and resulted in one fatality. The stream sheet flowed downstream from about Highway W to the confluence with the Baraboo River. Sedimentation was a major problem in this area with the original channel completely filled in. Other tributaries mainly to the west also received substantial damage with a number of bridge and road washouts.

The Baraboo itself had large variations in flood elevations. These variations were caused by the spiked peaks from the in-flowing local tributaries, the limited volume of runoff associated with these peaks, the basin size differential, the timing of the peaks, and the large storage capacity of the Baraboo floodplain. These factors allowed the peak flows from the in-flowing tributaries to be effectively attenuated. Peak flows along the Baraboo were high near the confluences but decreased substantially downstream.

The DNR did a hydrologic analysis using the HEC 1 program to model the flooding events that took place. Sub-basins in the vicinity of Baraboo were input separately with emphasis placed on the basins where the most damage

occurred and the most information was available. As expected, frequencies varied basin by basin as well as within the larger basins.

Numerous assumptions are made using this model. In this case, parameter adjustments were possible due to the number of surveyed high water marks, stream gage readings obtained from the USGS, and their continuous flow meter at Highway X approximately 5 miles downstream of Baraboo. This type of information increases the probable validity of the model. Frequency results for selected points taken from this model are listed on the following table:



## **APPROXIMATE FLOOD FLOW AND FREQUENCY**

- 1) Seeley Creek at the confluence - 2,400 CFS - < 10 Year
- 2) Skillet Creek at the confluence - 5,500 CFS - > 1000 Year
- 3) Devils Lake Tributary at the confluence - 9,800 CFS - > 1000 Year
- 4) Hwy 113 Tributary at the confluence - 6,100 CFS - > 1000 Year
- 5) Baraboo River upstream of North Freedom - 850 CFS - < 2 Year
- 6) Baraboo River within West Baraboo - 6,500 CFS - 10 Year
- 7) Baraboo River just downstream of the Devil's Lake Tributary - 12,800 CFS - 500 Year

8) Baraboo River just downstream of the HWY 113 Tributary - 17,100 CFS - > 500 Year

9) Baraboo River at the USGS gage (HWY X) - 6,700 CFS - 20 Year

\* See attached location map.

## CHRONOLOGY

### SATURDAY, JULY 17

A torrential thunderstorm hit the Baraboo area Saturday night, washing away cars, roads, bridges and buildings, and resulting in one death. Officially, 7.78 inches of rain fell in three hours, but 10 to 12 inches were reported in the area. The Baraboo River rose by 10 feet in five hours and is at 22.75 feet - 6.75 feet above flood stage. Three of Baraboo's four drinking wells were knocked out by the flood. Numerous highways were closed in Sauk County and more than 2,300 campers were evacuated Sunday morning.

On Saturday night, Ryan P. Long, 12, of Woodstock, IL, drowned when the car he was riding in was overturned by flash flooding and he was carried downstream to his death. Ryan was with his brothers Christopher, 21, and Douglas, 30, when their car was swept off Highway 113 north of Devils Lake State Park. Both brothers were treated for injuries and released.

The Governor called in 200 National Guard troops and 200 members of the Wisconsin Conservation Corps to help with cleanup. Several businesses suffered extensive damage from the waters and mud and have closed

temporarily until assessments can be done. Baraboo police reported rescuing several people from rooftops and cars in the area. There was standing water 3 to 5 feet deep throughout the city.

At the Hein-Werner Corp., parking lots collapsed into huge craters, numerous doors were blown out, a forklift ended up in an outside culvert, and a 30-foot semitrailer was washed down the culvert and through a tunnel and landed 75 yards behind the building. No one can find the truck that went with the trailer. "I couldn't believe it," said Tim Deppe of the moment he arrived at the site. "I still can't believe it." One state official estimated the damage at \$1.5 million, but Deppe laughed when he heard the figure.

Devils Lake State Park was closed due to extensive flooding in the campgrounds and road washouts. "We have made over 200 phone calls this morning to tell people with reservations for this week not to come," said Timothy Miller, park superintendent. "This is the first time to my knowledge that the park has ever closed due to bad weather." 28 people inside the bar at the nearby Devi-Para resort formed a human chain to escape the five feet of water that flooded the building. Sauk County was declared a disaster area in June for residential flooding and it is expected that financial assistance will also now be available for public works projects due to the latest event.

### MONDAY, JULY 19

The DNR announced today that Devils Lake State Park will be closed for at least a week due to high-water damage from the storm on Saturday that

dumped at least 5 inches of rain in the area. The lake, which has no outlet, overflowed its north bank into an unnamed tributary of the Baraboo River. The resulting floodwaters, estimated at up to eight feet high, caused much of the downstream damage in the area. The lake is more than 10 feet above normal and 18 inches over the previous high. Within the park boundaries, damage was reported to a concession stand in North Beach, numerous hiking trails, campgrounds, picnic grounds, roads, parking lots and trees. Damages in the county are estimated at \$8 million to \$10 million, including \$2.3 million for roads, \$345,000 for private residences, and at least \$100,000 at Devils Lake State Park.

In Baraboo, local businesses are predicting shutdowns ranging from one day to a year due to the heavy flooding. Resorts, stores, manufacturers, a printing company, an auto dealer, a railroad, a cable company and a school bus company were among those affected by the flood. Most of the business owners did not have flood insurance. One commented, "We never considered flood insurance. We're not near a lake, and a stream nearby (which flooded) only has water in it in the spring. The Baraboo River is half a mile away." Damages to businesses have not been tallied, but the Devi-Bara Resort estimates it will be over \$250,000, while Farm and Fleet is claiming over \$2 million in damaged merchandise and Hein-Werner is over \$1.5 million.

### WEDNESDAY, JULY 21

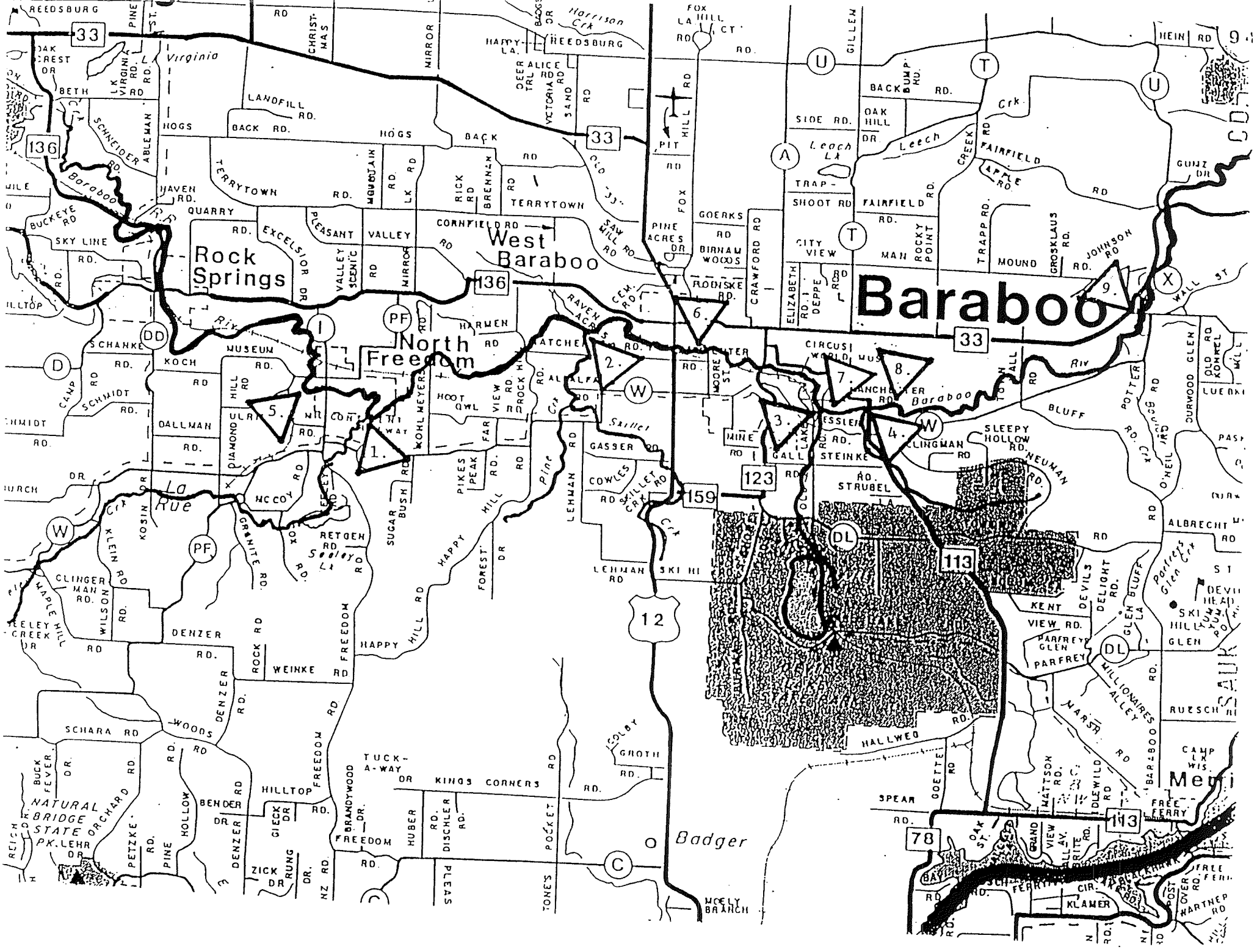
Public water was being restored to Baraboo, with three of four city wells

back in service. But because of diminished pumping capacity, residents are being asked to restrict water usage to two-thirds of normal. Clean-up efforts continued at Devil's Lake State Park, along with repair efforts on Highways 113 and DL. Flood warnings remained in effect for the Baraboo River downstream from Baraboo, which is still 3 feet above flood stage.

### FRIDAY, JULY 23

Devils Lake State Park is scheduled to reopen Monday, but officials caution that activities will be limited because of continued high water. Beaches are still closed, some hiking trails are still washed out and a concession stand was damaged. Crews are still cleaning up debris and rebuilding roads and rail lines in the Baraboo area. The flood warning for the Baraboo River was canceled as the river's level fell to 14.74 feet.

v:\perm\wz993fld.ggh



Rock Springs

North Freedom

West Baraboo

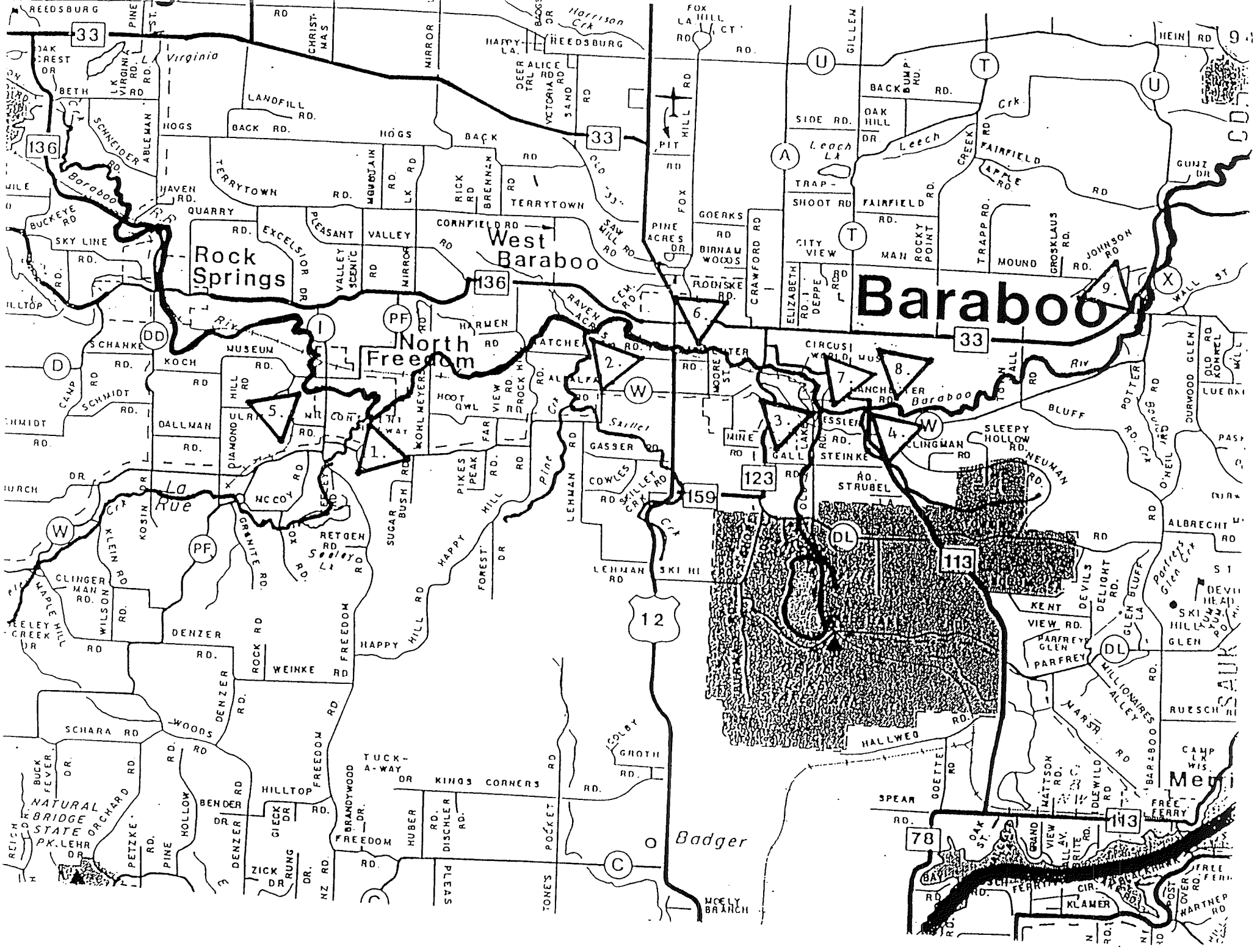
Baraboo

Meni

Badger

Sauk

CD.





RAINFALL FOR 24 HOURS  
ENDING 7AM SUNDAY  
JULY 18, 1993

