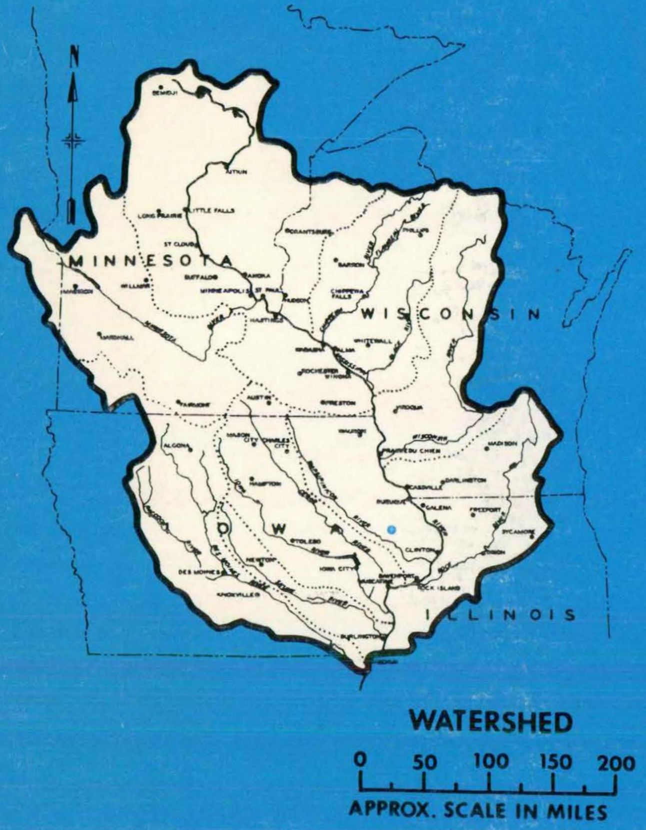
MISSISSIPPI RIVER
FLOOD PLAIN INFORMATION

Mile 549.4 To Mile 608.5



REACH COVERED BY THIS REPORT

PREPARED FOR THE:

IOWA NATURAL RESOURCES COUNCIL

ILLINOIS DEPARTMENT OF TRANSPORTATION

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

BY CORPS OF ENGINEERS, U.S. ARMY

ROCK ISLAND DISTRICT, ILLINOIS

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PREFACE

This report defines the area which is subject to flooding by the Mississippi River in part of Jo Daviess County, Illinois, all or part of Clayton, Dubuque and Jackson Counties, Iowa, and a part of Grant County, Wisconsin. The area covered includes the communities of East Dubuque, Illinois; North Buena Vista, Dubuque, and Bellevue, Iowa; and Cassville, Wisconsin. Urban properties are residential, commercial, and industrial. Property in the unincorporated area is mostly agricultural. Both urban and rural property have suffered moderate to severe damage by floods in 1951, 1952, 1965, 1969, and 1973. Open spaces in the flood plains of major communities which are now under pressure for future development are extensive while those in the smaller communities and rural areas are limited. Although large floods have occurred in the past, studies indicate that even larger floods are possible.

This report has been prepared to present flood potential and flood hazard knowledge which is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding in the study reach and identifies those areas that are subject to possible future floods. Special emphasis is given to these floods through maps, photographs, profiles, and cross sections. The report does not provide solutions to flood problems; however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of the loss problems. It will also aid in the identification of other flood damage reduction techniques such as works to modify flooding and adjustments, including flood proofing, which might be embodied in an overall Flood Plain Management (FPM) program. Other FPM program studies--those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings--could also utilize this information.

This report was prepared at the request of the State of Iowa with support from the State of Illinois and the State of Wisconsin by Owen Ayres and Associates, Inc., Eau Claire, Wisconsin, for the Rock Island District, Corps of Engineers under continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended.

Assistance and cooperation of the Illinois Department of Transportation, Division of Waterways, the Iowa Natural Resources Council, the Wisconsin Department of Natural Resources, the U.S. Geological Survey, the U.S. Weather Bureau (E.S.S.A.), and private citizens in supplying useful data and photographs for the preparation of this report are appreciated.

Additional copies of this report can be obtained from the Illinois Department of Transportation, the Iowa Natural Resources Council, and the Wisconsin Department of Natural Resources. The Rock Island District, Corps of Engineers, upon request, will provide limited technical assistance in the interpretation and use of the data presented herein.

BACKGROUND INFORMATION

Settlement

The Louisiana Purchase of 1803 gave the United States control over both banks of the Mississippi River. In 1805, Lieutenant Zebulon Pike, under orders from the Government, came up the river to discover its source and to select locations for United States outposts. Pike, in command of 20 soldiers, left St. Louis on August 9, 1805. On August 27, 1805, the party arrived at the mouth of the Rock River and landed on the Illinois side of the Mississippi.

The Military outposts were the beginnings of permanent settlements along the Mississippi River. Fort Edwards opposite the mouth of the Des Moines River was established in 1815, just a year before Colonel William Lawrence and the Eighth Regiment of U.S. Regulars built Fort Armstrong at Rock Island.

There were no permanent settlers in Iowa at that time nor were there until 1833. Although Julien Dubuque staked out his "Mines of Spain" in 1796, the settlement at Dubuque was not permanent. Five years after Pike explored the Upper Mississippi in 1805, Dubuque died. In the years that followed, the Fox Indians reclaimed the mining settlement and drove off all white men who sought to work Dubuque's mines.

In 1823, the Virginia made the first steamboat voyage on the Upper Mississippi. Navigation was extremely important to settlement of the frontier area since the settlers depended on the steamboats for both freight and passenger service.

Historical information describing the settlement of individual communities can be found in most public libraries in the local communities.

The Stream and Its Valley

The Mississippi River headwaters begin in northern Minnesota at Lake Itasca southwest of Bemidji.

Major tributaries upstream from the study reach include: The Minnesota River in southwestern Minnesota and eastern South Dakota; the St. Croix, Chippewa, Black, and Wisconsin Rivers in Wisconsin; the Cannon, Zumbro, and Root Rivers in southeastern Minnesota; and the Turkey, and Upper Iowa Rivers in northeastern Iowa. Pertinent drainage areas of the Mississippi River within the study reach are shown in Table 1.

TABLE 1

DRAINAGE AREAS

Stream	Location	Miles Above Ohio River	Drainage Area sq. mi.
Mississippi River	Lock & Dam 12	556.7	82,400
	Gordon's Ferry	566.2	82,100
	Lock & Dam 11	583.0	81,600
	Cassville	606.3	80,900
Galena River	Mouth	564.9	205
Little Maquoketa River	Mouth	586.4	156
Platte River	Mouth	588.3	338
Grant River	Mouth	593.2	316
Turkey River	Mouth	608.0	1,696

One of the first detailed descriptions of the Upper Mississippi River and its valley was recorded by Major General G. K. Warren in his report to the House of Representatives (Executive Document No. 58, 39th Congress, 2nd Session, January 1867) regarding surveys of the Upper Mississippi River and its tributaries. Following are excerpts from Warren's Report:

"As one travels up the Mississippi River from LeClaire, at the head of the upper rapids (Rock Island), to Fulton and Lyons, some twenty miles, he sees the banks which rise above the bottom lands slope gently back to the prairie lands of Iowa and Illinois. .... at Fulton and Lyons, these high lands become more steep and naked rocks project from their sides, and here the banks reach an elevation of 120 feet (above the valley floor) at points about 4,000 feet apart on opposite sides. Above Fulton and Lyons the bluffs stand farther apart: They generally remain steep, often precipitous, and their elevation gradually increases from 150 feet at first to 400 feet in the neighborhood of Prairie du Chien. They maintain this height to above Lake Pepin, then declining again somewhat toward St. Paul. From the highest bluffs, the prairie level extends out to the horizon.

"This wide cut or chasm of the Mississippi has a direction nearly northwest from Fulton and Lyons to St. Paul.... Its width just above St. Paul is about one-half mile, at Lake Pepin about five or six miles, and generally varies from one and a half to five miles down to Fulton and Lyons. These are nearly the widths of the river at its highest floods, where artificial works have not been made to contract it.

"The bottom lands of the Mississippi are now overflowed to the depth of from six to twelve feet, and are also from six to twelve feet above the low stages, the river ranging from high to low water about eighteen feet. These bottoms are generally covered with trees, such as cottonwood, elm, linn, willows, and vines of various kinds.

"The Mississippi, in its floods, covers all the bottom lands to the depth of six to twelve feet and flows through the forests .... When within the banks formed by the bottom lands, the river is almost entirely free from those sweeping bends and returning folds that characterize the Minnesota and lower Mississippi below the junction of the Ohio .... The river, however, does not long remain on one side of the valley before it gradually makes its way among its islands to the opposite bluff, usually forming, in the crossing, places of difficult navigation at low stages. At these crossings there is a greater slope, an increased velocity and width, a diminished depth, and more changing sand bars. One of the most notable features of the Upper Mississippi is the multiplicity of the islands which everywhere exist, in all possible sizes, and the great variety of their shapes, as well as that of the lakes found in the islands and bottom lands. The extreme gentleness of the current, which at low water averages about one and a half mile an hour, and rarely exceed three miles in the swiftest places, also attracts one's first attention .... Our levels show the slope to be only on the average about four-tenths to six-tenths foot per mile; sometimes, in making the crossings of the valley, reaching nearly one foot per mile for short distances, and in intervening pools being as low as three-tenths foot per mile. ... from the Bad Axe River down to the rapids at LeClaire there is at nearly all times a draught of at least four feet, except in the two channels which, separating above Mendota, to one by that place and the other by Guttenburg, each about twelve miles long, and unite again at Cassville. The left hand channel is called Crooked Slough, and is more narrow and crooked than the other, and joins the other at its foot by several mouths. .... the obstruction from snags have not been specially alluded to; but snags are found in limited numbers at all parts of the river, and at least one snag-boat should be constantly employed removing them and the wrecks that lie in the channel way."

General Warren's report to Congress was in regard to navigation of the Upper Mississippi River to promote settlement and development of the surrounding country. As early as the 1830's the Federal Government, aware of the upper river's important role in settlement of the valley, began improvements in the interest of navigation. The original surveys of the rapids at the mouth of the Des Moines River and at Rock Island were prepared by Lieutenant Robert E. Lee. By 1878, the first comprehensive plan of improvement, the 4 1/2-foot channel project was authorized by Congress. As features of that project, several of the most seriously obstructive rapids were by-passed by short lateral canals with navigation locks. In 1907 a six-foot channel project was authorized, the increased depth being obtained mainly by construction of hundreds of wing dams to constrict low water flows. In 1930, congress authorized the nine-foot channel project including the Mississippi River from the mouth of the Missouri River to Minneapolis.

The present day Upper Mississippi River between St. Louis, Missouri and Minneapolis, Minnesota, is a stairway of water which makes navigation possible during low flow periods. In the 699 miles of river from St. Anthony Falls and the last lock of the project, No. 27, the Mississippi has a fall of about 420 feet through the 29 locks and dams.

The climate is characterized by moderately hot summers and cold winters. Weather stations in the study reach have recorded high temperatures of about 110 degrees and low temperatures of about 32 degrees below zero Fahrenheit. Average annual temperature is about 47 degrees. Average annual precipitation in the study reach is 40 inches.

Developments in the Flood Plain

In 1930, Congress authorized the canalization of the Upper Mississippi River to provide a nine-foot channel of adequate width for navigation by construction of a system of locks and dams supplemented by channel dredging. The dams were constructed to provide a minimum of nine feet in the navigation channel during summer time low flow periods. During these low flow periods, the river becomes a series of steps or pools which river tows and other watercraft climb or descend as they travel upstream or downstream. Locks 11 and 12 in and near the study reach were opened to navigation in 1939.

Provision of adequate commercial navigation depths and stabilization of river stage fluctuations by the nine-foot canalization project resulted in a change in the method of transportation from overland methods to water based operations. Riverside land developments include harbor and dock facilities for commercial and industrial utilization, small boat harbors and marinas, recreational and residential areas, and major rail and highway transportation systems.

Major highways and railways parallel both banks of the river and are subject to flooding by floods of the magnitude of the April 1965 flood. Permanent homes and summer residences occupy the river banks in the unincorporated area of the study reach and most are subject to damage from major floods. Sewage treatment facilities at Cassville are subject to some damage from major floods. Sewage treatment plants are protected by levees at Dubuque and East Dubuque.

Flood plain development has taken place at Cassville, including both industrial and residential developments. Marine and commercial development of Hamm Island at Dubuque is taking place. The Iowa Natural Resources Council, by permit, limits filling on the Island to an elevation of 610.0 feet, mean sea level. The Dubuque Local Flood Protection Project was approved by the Iowa Natural Resources Council with the understanding that, consistent with Council Order 63-216, Hamm Island would be left open for conveyance of flood flows and no fill would be placed above elevation 610. In East Dubuque, major residential development has taken place in the flood plain.

FLOOD SITUATION

Sources of Data and Records

Stream gages have been established and maintained on the Mississippi River by the Corps of Engineers, the U. S. Geological Survey, and the U. S. Weather Bureau. Table 2 lists the gages, their location, flood stage and date of establishment.

Historical documents and records were searched for information concerning past floods to supplement gaging station records. These records have provided a knowledge of floods which have occurred on the Mississippi River.

Flooded area maps for this report were prepared from U.S.G.S. quadrangle sheets titled: Miles, Illinois-Iowa, 1935; Green Island, Illinois-Iowa, 1953; Hanover, Iowa, 1968; Bellevue, Illinois-Iowa, 1968; Galena, Illinois-Iowa, 1968; Menominee, Illinois-Iowa, 1955; Dubuque South, Illinois-Iowa, 1955; Dubuque North, Illinois-Iowa-Wisconsin, 1956; Kieler, Illinois-Wisconsin, 1961; Potosi, Iowa-Wisconsin, 1957; Balltown, Iowa-Wisconsin, 1955; Cassville, Iowa-Wisconsin, 1955; and Turkey River, Iowa-Wisconsin, 1957. Army Map Service topographic maps were also used for a small part of the study area. Bridge data was obtained from Rock Island District, Corps of Engineer files. Table 4 is a summary of bridge information and Figures 2 through 4 show these bridges.

Crest stages and discharges for the ten highest floods at the Dubuque, Iowa gage are shown in Table 3.

Photographs of past floods were obtained from the Rock Island District, Corps of Engineer files, and local residents.

Flood Season and Flood Characteristics

Although large floods from heavy general storms have occurred in the Mississippi River Basin, the main flood season is in early spring. The basin area covered by a heavy intense storm is generally small in comparison to the total basin area in the study reach. Flood stages rise slowly and remain high for relatively long periods. For example, at the Dubuque gage during the April 1965 flood, the river rose from low water stage of 8 feet to peak stage of approximately 27 feet in about 27 days. The river remained above the 17 foot flood stage for approximately 29 days.

TABLE 2

MISSISSIPPI RIVER GAGES

Gage	Miles Above Ohio River	Gage Location	Gage Type	Gage Zero Elevation 4th G.A.,1912	Flood Stage Feet	Records Available
Maquoketa River (C. of E.)	549.4	100' above old mouth of Maquoketa River	Staff Gage	576.70	14.0	July 24, 1930 to 1939
Lock & Dam 12 Tailwater (C. of E.)	556.6		Automatic Recording Gage	580.20	----	1935 to Date
Lock & Dam 12 Pool (C. of E.)	556.8					1938 to Date
Gordon's Ferry (C. of E.)	566.2	Directly riverward of R.R. Depot at Gordon's Ferry	Staff Gage	582.10	18.0	Oct. 19, 1936 to Date
Dubuque, Iowa (U.S. Weather Bureau)	579.9	On right bank at foot of 4th Street in Dubuque	Automatic Recording Gage	585.47	17.0*	Aug. 1, 1873 to Date
Lock & Dam 11 Tailwater (C. of E.)	582.9		Automatic Recording Gage	588.20	----	1936 to Date
Lock & Dam 11 Pool (C. of E.)	583.1			588.2	----	1936 to Date
Specht's Ferry, Iowa (C. of E.)	592.3	On right bank 1060 feet upstream of depot	Staff Gage	590.59	----	1930 to Date
Waupeton, Iowa (C. of E.)	599.9	On right bank across from store	Staff Gage	593.30	----	July 26, 1930 to Date
Cassville, WI (C. of E.)	606.3	On left bank on steel sheet pile cribbing at pump-house at E.J. Stoneman Station of Dairyland Power Company	Float Type Gage	596.29	18.0	Aug. 16, 1951 to Date

* Flood stage at East Dubuque, Illinois, is 15 feet

TABLE 3

TEN HIGHEST KNOWN FLOODS 1/
AT DUBUQUE, IOWA MILE 579.9

Order No.	Date of Crest	Gage Heights 2/ Stage Feet	Gage Heights 2/ Elevation Feet	Estimated Peak Discharge c.f.s.
1	April 26, 1965	26.81	612.28	306,500
2	April 23, 1969	23.11	608.58	231,000
3	April 22, 1951	22.7	608.17	223,000
4	April 25, 1952	22.7	608.17	223,000
5	March 23, 1973	21.84	607.31	214,420
6	April 20, 1870	21.83	607.30	3/
7	June 23, 24, 1880	21.7	607.17	3/
8	May 12,13, 1888	21.4	606.87	3/
9	April 7, 1920	21.0	606.47	3/
10	April 21, 1922	21.0	606.47	3/

1/ In order of gage height
2/ Feet above mean sea level, datum of 1912
3/ Discharge unknown

Factors Affecting Flooding and Its Impact

Obstructions to flood flows - Natural obstructions to flood flows include trees, brush, and other vegetation growing along the stream banks and on islands in the floodway. Man-made developments, such as bridges and dams, represent potential obstructions to floodflows.

In general, obstructions restrict floodflows and result in deeper overbank flows and unpredictable areas of flooding, destruction of or damage to bridges, and an increased velocity of flow immediately downstream. Bridges in the study reach, except the Illinois Central Railroad bridge at Dubuque, are not obstructive to floodflows. The Illinois Central Railroad bridge, however, is low in relation to flood elevations. During the Intermediate Regional Flood and the Standard Project Flood, the floodwaters would reach the low members of the bridge structure such that the structure would block a part of the flow area. The potential for jamming due to an accumulation of floating debris or ice would be present during these floods.

The navigation dams in the study reach offer no serious obstruction to floodflows. Gate sills are constructed in the bed of the river at the location of the dams. As floodwaters produce increasing stages, the operating gates are raised above the water surface resulting in no more obstruction than a high clearance bridge. In addition, during major floods, flow occurs over planned overflow sections to eliminate obstruction to the floodwater.

Pertinent information on all bridges in the study reach is shown in Table 4. Photographs of bridges and dams are shown in Figures 1 through 5.

Flood damage reduction measures - The Flood Control Act of 1962 authorized the construction of a project at Dubuque to provide local protection from floods on the Mississippi River. The project consisted of a system of levees and flood walls along the city's river front, closure structures for streets and railroads, pumping stations for the removal of interior drainage, and a closure structure and pumping station at the mouth of the Dubuque commercial harbor. This project, completed in 1974, was designed by the Rock Island District Corps of Engineers and approved by the Iowa Natural Resources Council.

The City of East Dubuque, Illinois constructed an emergency dike during the 1965 flood to contain floodwater. This dike since has been rebuilt and raised approximately 3 feet to an elevation above the 100 year frequency flood.

TABLE 4

BRIDGES ACROSS MISSISSIPPI RIVER

Miles Above Ohio River	Identification	Type	Length of Channel Span Feet	Intermediate Regional Flood Crest Elevation Feet	Minimum Clearance of Channel Span		
					Low Steel Elevation Feet	Above Int. Reg. Flood Feet	Above 1965 Flood Feet
579.3	Julien Dubuque Highway Bridge	Steel Truss, Fixed	2145	614.0	658.4	44.4	46.3
579.9	Illinois Central R.R.	Steel Truss, Swing	1273	614.2	612.7	- 1.5	0.2
582.8	Eagle Point Bridge	Steel Truss, Fixed	1627	615.3	663.3	48.0	49.3

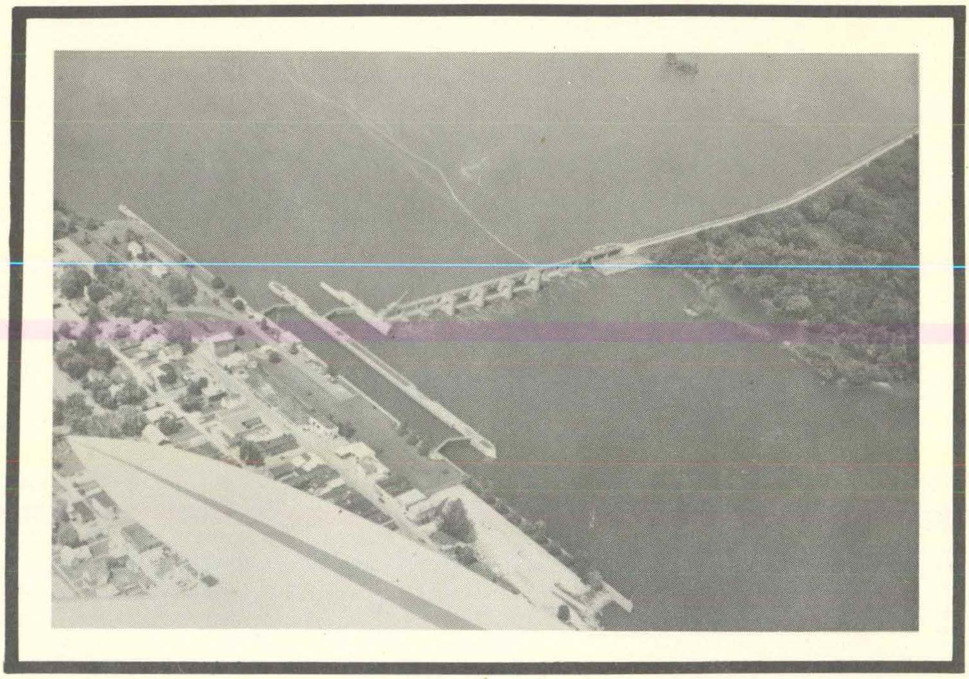


Figure 1. Lock and Dam No. 12 at Bellevue, Iowa, at Mile 556.7, looking upstream.

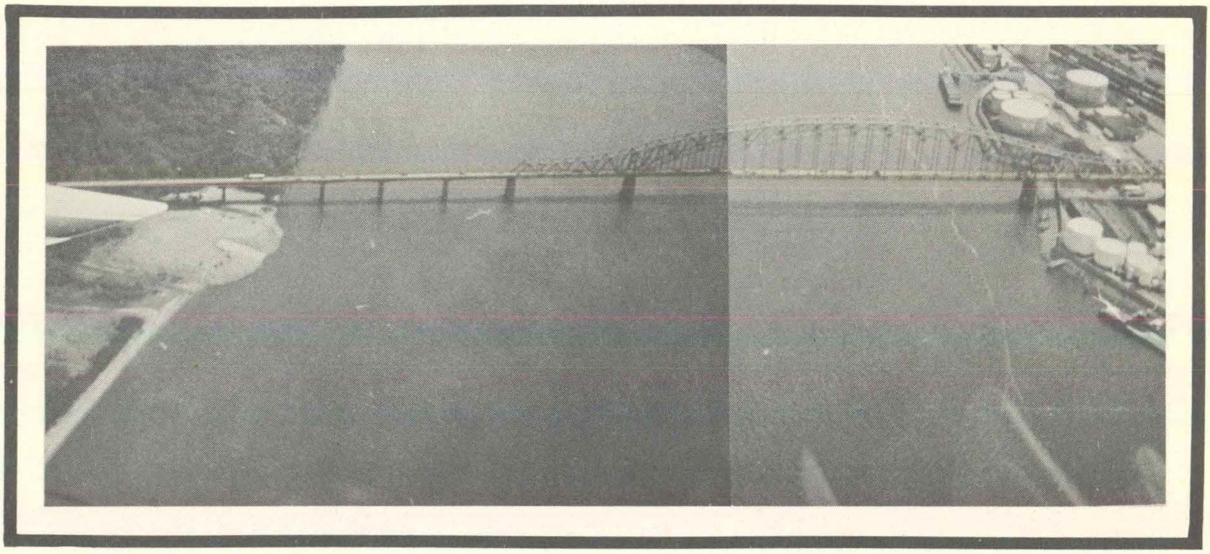


Figure 2. Julien Dubuque Bridge at Dubuque, Iowa, Mile 579.3, looking at upstream side.

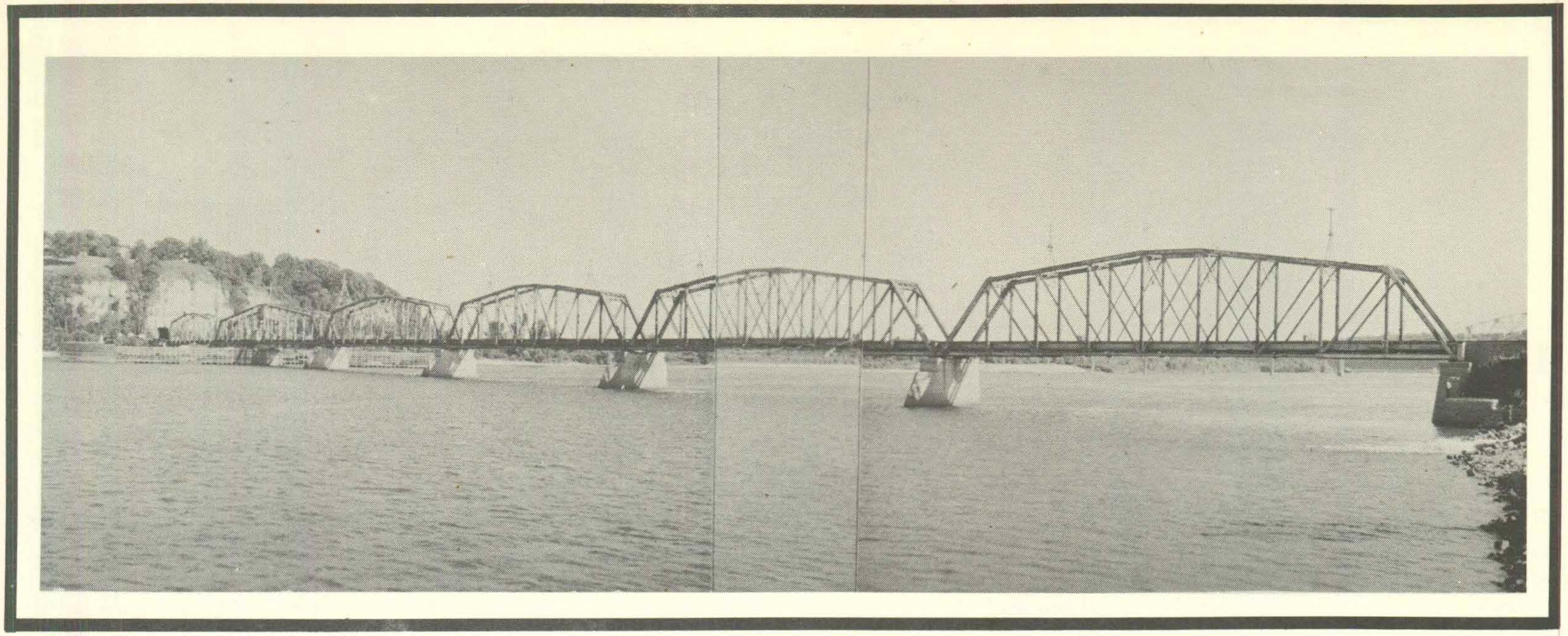


Figure 3. Illinois Central Railroad Bridge at Dubuque, Iowa, Mile 579.9, looking at upstream side.

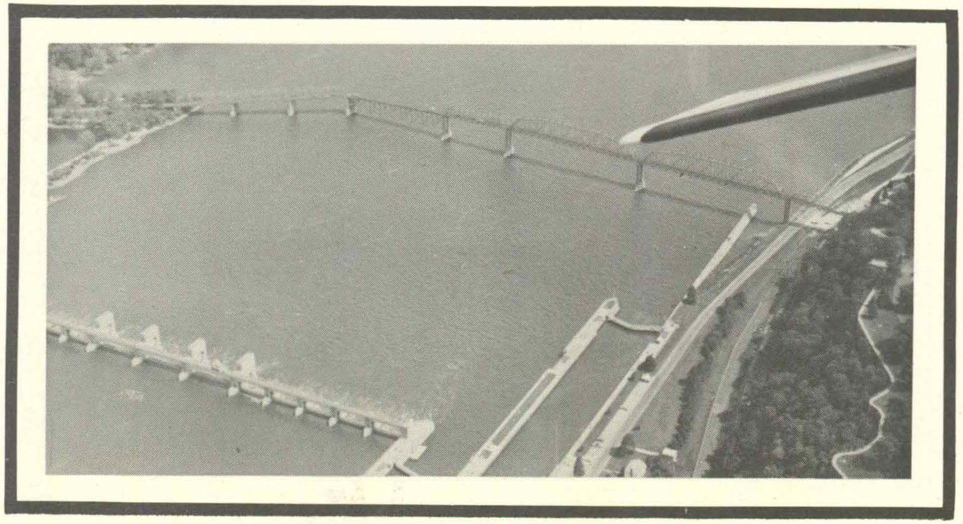


Figure 4. Eagle Point Bridge at Dubuque, Iowa, Mile 582.8, looking at the upstream side of the bridge.

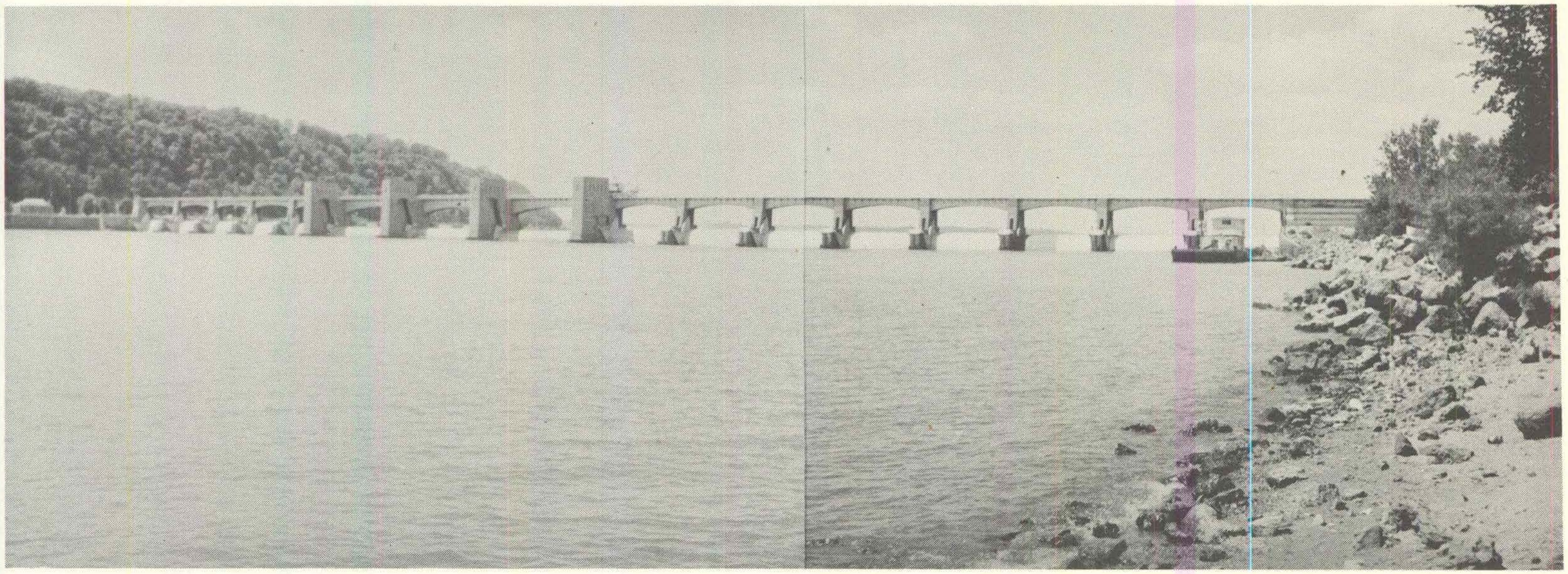


Figure 5. Lock and Dam No. 11 at Dubuque, Iowa, Mile 583.0, looking northwesterly at downstream side.

There are no flood plain zoning ordinances at any of the cities within the study reach; however, this report has been requested so that it may be used as a basis for the development of flood plain management regulatory measures.

Other factors and their impacts - Flooding and threats of flooding promote action in flood warning and flood fighting activities. Storage of floatable materials in the flood plain represents potential loss and damage during flood flows.

Flood warning and forecasting - The National Oceanic and Atmospheric Administration (NOAA) National Weather Service Office at Moline, Illinois is the River District Office (RDO) responsible for providing river forecasting service in this reach of the Mississippi River with support from the River Forecast Center (RFC) at Kansas City, Missouri, where specific river stage forecasts are made for key points along the Mississippi River when significant rises are anticipated. River stage forecasts for intermediate points are made by RDO Moline as needed. RDO Moline promptly disseminates all river stage forecasts to news media and to local officials by the best communications available including telephone and teletype.

The RFC is staffed by professional hydrologists responsible for the preparation of key river stage forecasts based on the water content of snow cover, rainfall-runoff relations, streamflow routing and a working knowledge of anticipated weather conditions. The lead time between distribution of river stage forecasts and the flood crest normally ranges from a day for rain to several weeks for snow melt.

Flood fighting and emergency evacuation plans - The City of Dubuque has a formal plan for closure operations of dikes and floodwalls within the city during floods. Specific action at various river stages are outlined in the city's "Emergency Flood Control Plan", February 1974.

In other areas of the study reach, provisions for alerting area residents and coordinating operations of city and county public service agencies in time of emergency are accomplished through the State Civil Defense Office. Subsequent flood fighting, evacuation, and rescue activities are coordinated on a county-wide basis with local public agencies.

Material storage on the flood plain - Due to development in the communities within the study reach there are quantities of floatable materials stored on flood plain land. Much of the material is lumber, and large volume light weight containers. Throughout the area there are many boats and docks which may break loose such as those located in the Dubuque, Iowa, area. During floods these floatable materials may be carried downstream and lodge against buildings and bridges creating more hazardous flooding problems.

PAST FLOODS

Summary of Historical Floods

The ten highest known floods on the Mississippi River at the Dubuque, Iowa, gage occurred in 1870, 1880, 1888, 1920, 1922, 1951, 1952, 1965, 1969, and 1973. The April 1965 flood was the highest of record. The floods of April 1969, April 1951, and April 1952 follow the 1965 flood in the order of gage height.

Flood Records

Information on historical floods in the study reach was obtained from stream gaging station records maintained by the U.S. Geological Survey, the Corps of Engineers, and the U.S. Weather Bureau. High water marks were obtained and newspapers and historical documents were researched for information concerning past floods.

Flood Descriptions

Descriptions of large Mississippi River floods that have occurred are based on newspaper accounts and historical records. The following descriptions of historical floods through the great flood of 1892 were taken from "Mississippi River Floods", by William J. Petersen, Ph. D., in the Palimpsest, Volume 46, Number 7, issued in July 1965, by the State Historical Society of Iowa.

Flood of June 1828

The Military posts along the Upper Mississippi River recorded destructive floods before permanent settlement of the area began. "The first Fort Crawford at Prairie du Chien was continually plagued with spring freshets that frequently flooded the barracks to a depth of three or four feet for several days in succession and were invariably followed by bilious diseases," according to Dr. Petersen. "In 1828, for example, the June flood made Prairie du Chien an island over which steam boats could pass in any direction. Fences were swept away, the fort was for a time abandoned and many inhabitants of the village were compelled to retreat across the slough to the higher part of the Prairie or to seek safety in boats, on rafts, or in the lofts of houses. - - - Although reference is made to the great flood of 1828, it should be remembered that actual measurements could not be made in land uninhabited by the white man. Doubt must therefore be placed on the accuracy of the year 1828 as a measuring rod for floods that follow."

Flood of 1870

"The flood of 1870 was devastating below Dubuque. The Davenport Daily Democrat of April 18 noted that the river was rising very fast at this point, having raised 12 inches in the last 24 hours', two days later it quoted the Rock Island Argus as follows:

"Never in the memory of the earliest resident have we been visited by such a high stage of water on the Mississippi at this point. The lowest water known here was in the year 1864, from which hydrographic calculations are made as from zero. The highest water mark known is that of 1862, when the water reached the height of 15 feet and eight inches above zero or low water mark.'

"On April 21 Thomas Winkles, who had kept a measurement of the Mississippi at various stages, informed the Democrat that the 1870 flood was eight inches above the high water mark of 1859. The next day the same editor revealed that nearly every cellar on the levee was flooded and factories and mills were shut down with at least one foot of water on the floor. Gazing over the vast expanse, the editor declared, 'the water has full sway from the bridge to the slaughter house, three miles away on Front Street.'

"The next day, on April 23, the Daily Democrat quoted old settlers as saying the river was higher than it had been since 1828. Front Street was full of water to the curbstone, and factories and warehouses near the river were islands, while the ferry dock 'loons up somewhere out at sea.'"

Flood of 1880

"The flood of 1880 occured in June, a decade after the flood of 1870. The Dubuque Daily Times of June 16 noted that the Mississippi had risen more than two feet in forty-eight hours and was 'still walking up like a race horse.' A dispatch from LaCrosse said the Mississippi was already four inches over the high-water mark of 1870 and still was rising. On the levee the scene was lively, the Daily Times recorded. Small boats were constantly going out or coming in loaded with wood and other plunder, and storekeepers were busy shoving their wares to higher quarters. The river stood at 16'4" and lacked five feet of coming up to the 1870 high-water mark.

"The store rooms in the long brick building on the levee are filled with grain, and speculators are very nervous, as the water is very apt to compel them to throw their grain on a busted market which will be a large loss to them. It is estimated that 90,000 bushels of grain are stored in this building alone which cannot be removed without a serious loss.

"On June 18 the Daily Times forecast a stand in the river with two feet still to go before reaching the 1870 level. The next day, however, the Times told its readers that all hopes of stand were unfounded as the Mississippi contined to rise at an ever-increasing rate. Word from up river reached Dubuque that three feet more could be expected before the flood came to a crest. 'The grain and corn dealers on the levee are frantically engaged in bagging wheat and hauling out corn,' the Dubuque editor observed. The merchants are building trestles on the floor to hold their goods, or are moving them to an upper floor. Dubuque's talented artist, Alex Simplot, was reported making a sketch of the flooded levee for Frank Leslie's pictorial magazine.

"By noon on June 20, the water had reached within 15 inches of the 1870 high, and railroad men were reported 'piling rock on their bridges' to hold them down. According to a reporter for the Daily Times, over one-half the houses on the flats were filled with water and people were swimming in knee deep water in their back yards. The sidewalks and bridges were all held down with stones and tied to trees. Along Elm Street people were reported to have built elevated sidewalks from their second story windows.

"The Mississippi was said to be several inches above the 1870 mark on June 21 and still was rising. On June 23 the water was reported at a stand on nine inches above the 1870 mark but still a few inches below the 1844 mark. It stood at 22'5" on June 22 and 22'8" on June 24, at which point it crested. Iowa River towns downstream from Dubuque underwent similar ravages."

Flood of 1881

"The flood of 1880 occurred during the normal June rise but soon receded. In contrast, the flood of 1881 occurred in October and was of much longer duration.

"On October 7 the Mississippi stood at 16'9" and two days later it was at 18'1". On October 11 the levee was submerged but no great damage done. The Couler Creek bridge on Lake Street (now Garfield) was held down by piles of rock. Twenty-five houses between Eleventh and Seventeenth Streets east of the railroad tracks were surrounded by water and their inhabitants were forced to move to the second story. For a few days the river receded but heavy rains in the north brought flood waters up over the twenty-foot level again. According to the Daily Times:

'Fantastic stories of the flood have come in from the north. Hundreds of square miles are reported to be submerged, farmers are picking their corn from boats, and cows are belly-deep in the field, eating hay from the tops of hay cocks. Thousands of tons of hay have been destroyed and farmers are selling their cattle at any price rather than run the risk of wintering them.'

"From Davenport word came to Dubuque that navigation had become dangerous for rafts--one was broken up and another wrecked within twenty-four hours. Meanwhile, the water stood at one foot below the 1870 level and two feet under the 1880 level at Dubuque. Damage was less than expected, the greatest loss was due to the closing of the factories and the resulting loss of work for 1,500 men. According to the Dubuque Daily Times:

"'This terrible flood has taught Dubuque a lesson, and hereafter when putting up new buildings on the river front there will be a higher standard gauge for high water than any hitherto known.'

"'The high water has knocked business completely. There is nothing doing in the way of carrying freight. The warehouses and landings up and down the river are drowned out, the roads are impassable, and there is no delivering of receipts by rail, owing to the switches being under water.'

"Meanwhile, Clinton has wired that the Mississippi was within two feet of its all-time high-water mark. The two saw mills in Lyons as well as the paper mill had shut down because of the fall freshet."

Flood of 1888

The spring flood of 1888 was one of the worst on the Upper Mississippi. On April 20th the Dubuque Daily Times chronicled a 17-foot stage. "The islands are all covered; the lower portion of East Dubuque being a vast lake." The editor reported, "Lower Main Street is nearly underwater and the flats along the east side of the city are gradually being submerged." The next day the river reached the curbstone of the Diamond Jo boat store after a one-foot rise.

The Mississippi stood at 20.3 feet for several days but then dropped slowly, only to rise again to 20.8 feet by May 9, due to heavy rains and melting snow. This was only a scant foot below the 1880 high water mark. Business houses built platforms on which to store their goods or removed the merchandise. Many factories and lumber yards were closed, and hundreds of men were thrown out of work. People in the flats moved out of their homes and General C. H. Gooth's newly-built levee on Third Street was washed out. According to the Times:

"All the way from Dubuque to Keokuk the Mississippi set records or near records in 1888. The Clinton Weekly Herald of April 26, 1888, declared the river had been rising 'continuously' since early spring. After a slight decline, the Herald of May 10 noted the Mississippi had reached the 17'10" mark, the same point reached on April 26, 27, 28. All low places 'in Lyons, Chancy, Fulton, and East Clinton' were once more submerged and the editor suggested a 'notice to quit' ought to be served on the rising waters. By May 17 the Weekly Herald reported a stage of 20'2" above the low water mark of 1864 or within two inches of its all-time high of 1880. The 1888 flood, lasting as it did over a long period of time, was one of the most costly in the bustling lumber town's history."

Flood of 1892

"The flood of 1892 swept down the Mississippi with devastating velocity, a rise of four feet in four days being chronicled by the Dubuque Daily Times of June 1892. 'All lowlands are flooded,' the editor declared. 'Farmers were driven from their fields again, and may abandon corn planting altogether. It is still raining tonight.'

The Dubuque Herald of June 2 reported the lowlands submerged and the Mississippi 'a vast sheet of water from shore to shore.'

"Sawmills are closed, and large sawdust accretions are being cut away. The Burlington road's tracks are surrounded and caving in. All the cellars along Front Street are filled with water from the seepage. Along the valley of Couler Creek the worst situation is found. Sewers are reported washed out, the street cars are cut off, houses and streets under water, and bad damage being done by washing. This is only a hasty summary of the mischief.

"By 1892 most river folk were keenly aware of the many moods of the Father of Waters. Despite its frequent depredations, they loved to dwell upon the bank of the majestic waterway and neither storm nor flood could lure them to a safer and more certain shore."

Flood of 1920

The flood of 1920, declared the Dubuque Times-Journal of March 27, was "an extraordinary occurrence" because "high water usually comes during May and June." The flood was remarkable for several reasons: its early season---which began on March 22; its unprecedented rise of 4 1/2 feet in 48 hours---which the United States Weather Bureau at Dubuque felt was perhaps the greatest rise for a 48-hour period ever recorded in Dubuque; and its precipitate decline after cresting at 21.0 feet on April 6. "The present high water," the Dubuque editor concluded, "is a result of the large amount of rain and snow during March and the quick breakup of the ice in the river."

The Dubuque editor felt the city was fortunate there had been no big rain in conjunction with the flood. According to the Times Journal: "In the 1881 flood, 9.31 inches fell in one week. During the 1888 flood, it rained every day but three in a 16-day period for a total of 5.49 inches."

The peak of the flood---21 feet---was reached on Tuesday, April 6, at which time the United States Engineers estimated 130 billion gallons of water flowed by Dubuque within the 24-hour period.

Flood of April 26, 1951

This flood originated from snowmelt in the central portions of Minnesota and Wisconsin. The Minnesota River basin was the principal contributor to the flood flow since the spring snowmelt did not extend far upstream on the Mississippi headwater area above Minneapolis. The Minnesota River basin experienced an average of 36 inches of snowfall in March as compared to a normal fall of 8 inches. Melting of the snow cover was rapid starting near the end of the first week in April. The resulting crest flow on the Minnesota River at Mankato was the highest of record. During April and May, the Turkey River at the upstream end of the study reach was at or above flood stage.

"Possible great flood damage in the Meredosia Drainage District was prevented yesterday by sandbagging both sides of the Route 84 pavement embankment. The route serves as a levee for the district which includes 50,000 acres of fertile farm land. Water was within a foot of the top of the Route 84 pavement in places below Albany and in some places it was over the railroad tracks adjacent to Route 84."

Flood of April 28, 1965

The flood of April 1965 in the study reach was caused by a combination of hydrologic factors contributing to a high rate of runoff. Precipitation in August and September of 1964 in the upstream areas of the Upper Mississippi Basin was considerably above normal. As a result, the ground was nearly saturated when very cold temperatures in December caused deep frost penetration. The deep frost made the ground impervious to snowmelt and spring rainfall. Normal snowfall followed over most of the Upper Mississippi Basin during December 1964 and January 1965. Early in February, one-half to one inch of rain fell with above freezing temperatures. The snow cover absorbed the rain and increased in density. Above normal snowfall occurred during March with exceptionally heavy amounts in the basin above Minneapolis and St. Paul. Below normal temperatures were recorded through January, February, and March. After the first of April, temperatures rose to and remained above freezing.

The heavy runoff from the general spring thaw in combination with that from heavy rainfall during April, caused record flooding on the Mississippi River between Dubuque, Iowa, and Hannibal, Missouri. Runoff from snowmelt on the tributary streams in Iowa and Illinois occurred before the crest on the main stem arrived.

400,000 sandbags in Dubuque and 100,000 in East Dubuque were used to hold back flood waters.

April 19, River stage 16.4 (at tailwater of Lock and Dam 15) Engineers reported 650,000 sandbags have been provided so far for flood fighting.

The Illinois Bell Telephone Company was installing emergency phone equipment at business places that might be flooded. Expensive phone equipment in the basements of such places was to be removed.

Between Cordova and Albany 500 volunteers battled to save the Meredosia dike. Highway 84 on top of the dike was closed.

April 23, River stage 18.8---The Mississippi reached the previous high water mark for this century set in 1952 at 18.63 feet and kept right on going up. It reached 19 feet by noon.

Rain during the night totaled .45 of an inch and again hampered dike work.

Governor Kerner asked President Johnson to declare Illinois a disaster area, citing flood and tornado damage of more than $25 million.

National Guardsmen battled furiously to protect Point Mississippi in Bettendorf.

Five Quad-City industries closed because of high water and six others were operating on a curtailed basis.

The Centennial and Iowa-Illinois Memorial bridges were clogged with traffic. They were the only ones open along a 200-mile stretch of the Mississippi.

Damage in the Rock Island District of Army Engineers, stretching from Guttenberg, Iowa, to Clarksville, Missouri, was placed at $10 million.

Flood of April 1967

Snow surveys conducted by the St. Paul District, Corps of Engineers, in cooperation with the Weather Bureau, indicated the following water content of the snow on February 21, 1967:

Minnesota River Basin, 2 to 4 inches

Wisconsin River Basin, 2 to 6 inches

Chippewa River Basin, 3 to 6 inches

St. Croix River Basin, 5 to 6 inches

Mississippi Basin above Minneapolis, 4 to 6 inches

The tributary basins in Iowa and Illinois had insignificant amounts of water content on that date.

By March 29, normal and below normal rainfall and above normal temperatures produced rapid snowmelt and runoff from the smaller tributaries in southern Minnesota and Wisconsin. By April 15 only minor rises had been experienced on the tributaries and no major highways or railroads were out of service. Moderate to severe wave damage to levees and shore installation occurred on April 14 due to high winds.

Crest stages during the flood reached levels approximately one foot lower than the flood of April 1952. Although considerable rain fell during the snowmelt runoff period, it came ahead or behind the Mississippi River crest wave and had only minor effects on flood crest elevations.

Flood of April 1969

The five major elements for spring snowmelt floods include fall precipitation, frost depth, snow depth, rate of snowmelt, and additional precipitation during the snowmelt period. Events leading up to the April 1969 flood are described in the following paragraphs.

Heavy rainfall over parts of Minnesota and Wisconsin began in August 1968 and continued into September. Above normal precipitation in central and southern Minnesota continued into October. Minnesota River flows from Mankato downstream were the highest for any October since records began in 1903.

Frost depths were not particularly great, but the soil was saturated with moisture from the heavy summer and fall rains combined with an early deep snowfall. Cold temperatures came after the early snowfall. As a result, frost penetration was not great. Depth of frost in January averaged only 6 to 7 inches in Wisconsin.

Weather Bureau records dating back to 1890 indicated record to near record December snowfall over most of Minnesota. Minneapolis-St. Paul recorded 28.7 inches of snow compared to previous record of 25.0 inches in 1950; International Falls reported 18.9 inches with previous record of 16.9 inches in 1953; La Crosse, Wisconsin reported in excess of 26 inches compared to previous record of 25.5 in 1927. Near record snowfall occurred at Duluth with 37.7 inches as compared to 44.3 inches in 1950. Through January 31, 1969, Minneapolis-St. Paul established a new total snow season record of 55.2 inches. Normal snow season snowfall is 20.8 inches.

Snowmelt during the last two weeks in March occurred ideally. Alternate periods of warming and cooling melted the snow slowly over the Turkey River Basin in northeast Iowa, the Root and Zumbro River Basins in Minnesota and the Kickapoo and the small basins in southern Wisconsin. Very little additional precipitation accumulated over the heavy snowpack in Minnesota and Wisconsin during March.

The main snowmelt rise on the Minnesota River began during the first week in April. Snowmelt over the extreme upper portion of the Minnesota River basin and the Mississippi River basin above Minneapolis was of little consequence until the beginning of the second week in April.

Crest flows arrived in the upper end of the Rock Island District near Lock and Dam No. 10 on April 23. At most gaging stations in the study reach, this flood equaled or exceeded the observed flood stages of 1952. At most gaging stations in this study reach, the 1952 flood produced the second highest observed flood crest elevations.

Flood scenes for selected floods are shown in Figures 6 through 9.

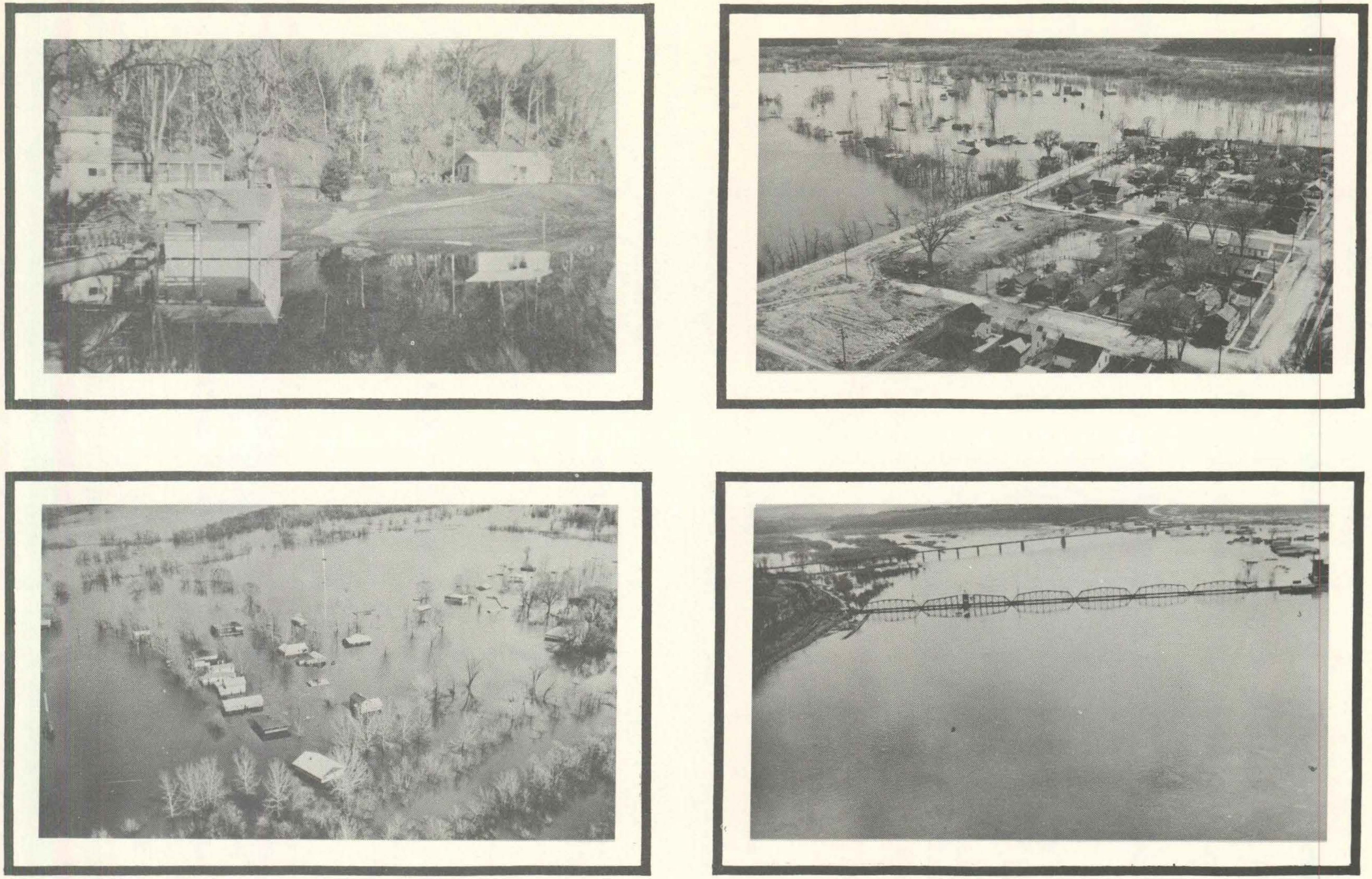


Figure 6. Flooding along River in April, 1965. Upper left: Gordon's Ferry, Iowa. Upper right: East Dubuque, Illinois, in vicinity of Fifth and Sixth Streets. Lower left: East Dubuque, Illinois, looking southeasterly at the outer flats addition. Lower right: Looking at the upstream side of the Illinois Central R.R. Bridge at Dubuque, Iowa. The Julien Dubuque Bridge is located in the background.

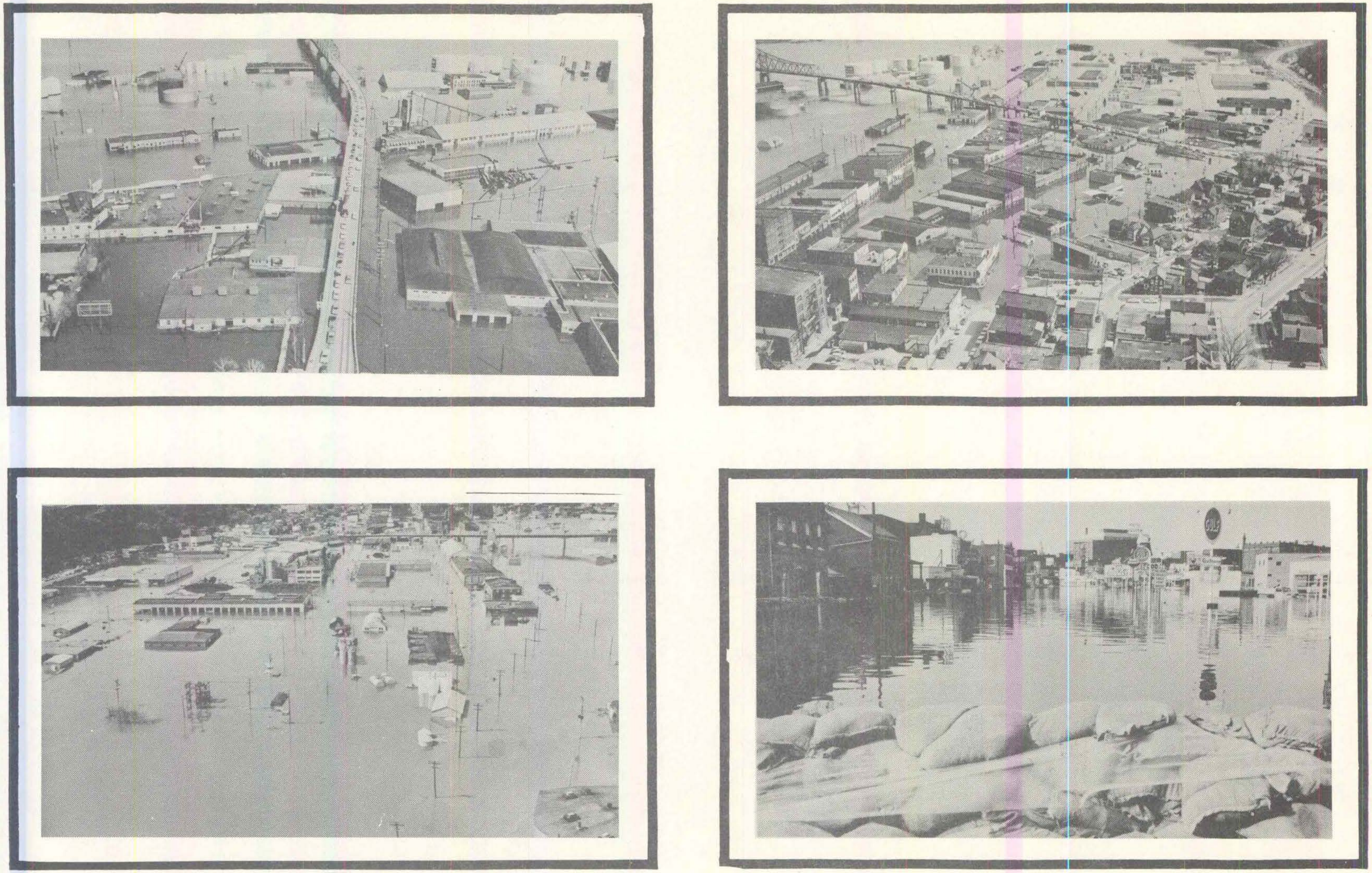


Figure 7. Flood conditions in April, 1965 at Dubuque, Iowa. Upper left: Looking east along the Julien Dubuque bridge. Upper right: View looking south at the lower end of the industrial area. Lower left: Looking north from the lower end of the industrial area. Lower right: At the intersection of highways 61, 67, 20 and 30, looking north on Locust Street.

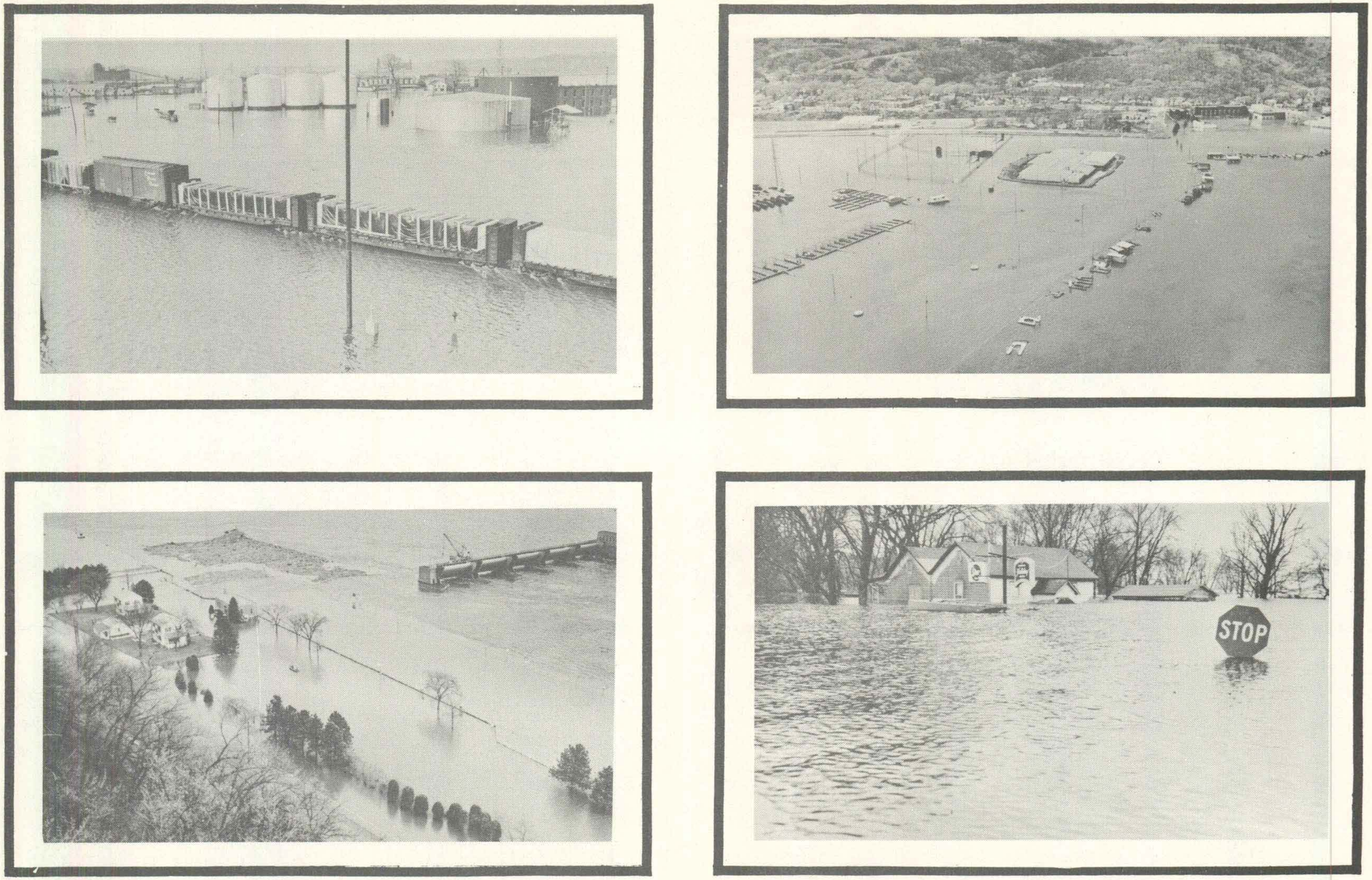


Figure 8. Photographs of flooding in April, 1965. Upper left: Dubuque, Iowa, looking north from the west end of Julien Dubuque Bridge. Upper right: Northeast Dubuque, Iowa, looking at the municipal water works. Riverdale Bowl is located near center of photograph. Lower left: View from Eagle Point Park of Lock and Dam No. 11, looking upstream. Lower right: Wisconsin side at highway 61 north of East Dubuque, Illinois.

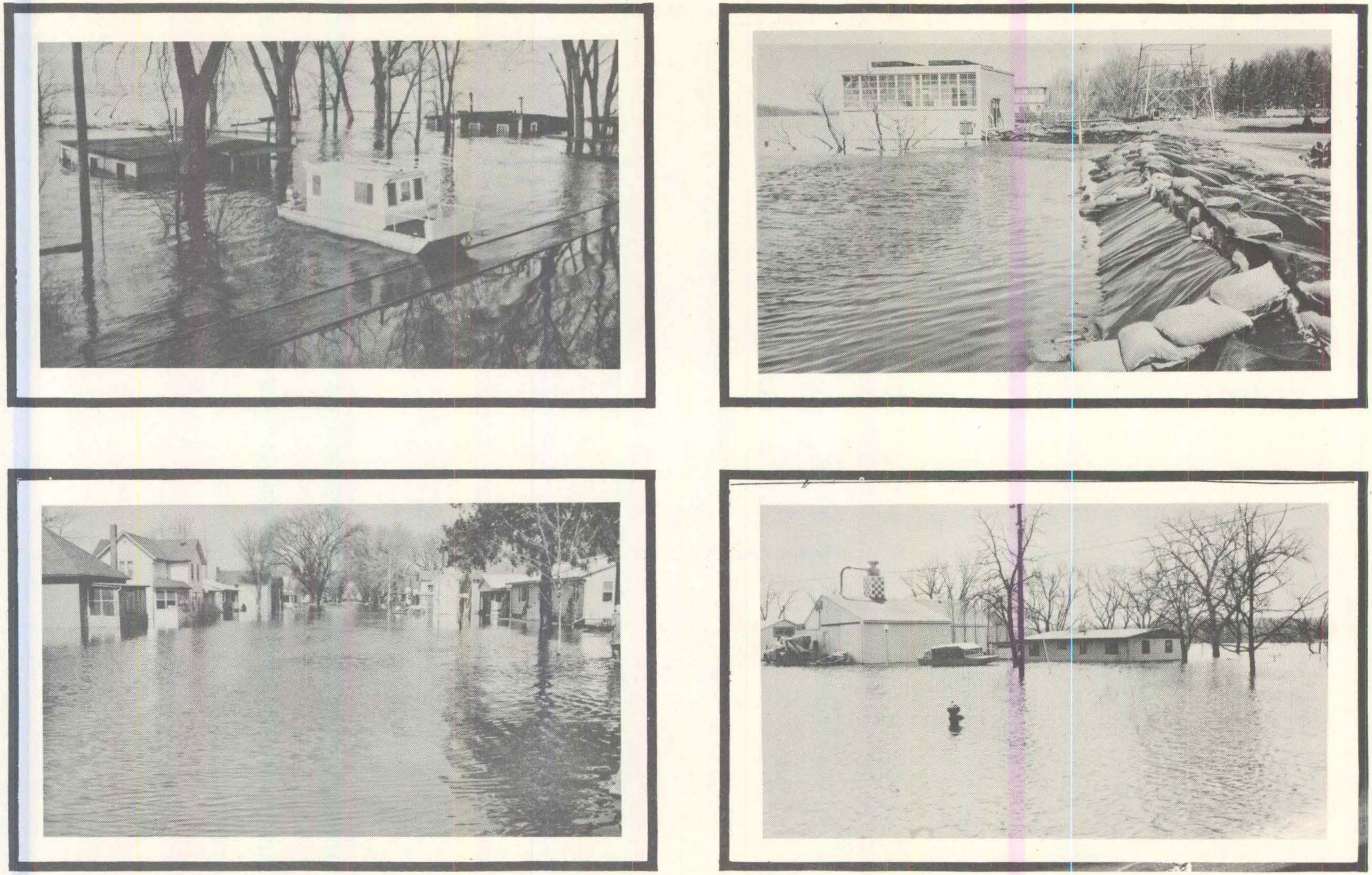


Figure 9. Flooding in April-May 1965 along Mississippi River. Upper left: View at Specht's Ferry, Iowa, looking southeasterly. Both buildings in the background have been removed. Upper right: Cassville, Wisconsin, Dairyland Electric Plant looking north. Lower left: Looking north on highway 133 at Cassville, Wisconsin. Lower right: Walz Lumber Company at Cassville, Wisconsin.

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past could occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of snowmelt, rainfall and runoff which caused these floods could occur in the study reach. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions of like topography, watershed cover and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the Intermediate Regional Flood and the Standard Project Flood. The Standard Project Flood represents a reasonable upper limit of expected flooding in the study area. The Intermediate Regional Flood may reasonably be expected to occur more frequently, although it will not be as severe as the infrequent Standard Project Flood.

Frequency

Frequency curves of the peak discharges on the Mississippi River were developed for key stations within the Rock Island District, Corps of Engineers. Statistical analyses of the flow records included correlations with the long-term record at the Dubuque gaging station and with flow records outside the Rock Island District at St. Paul, Minnesota, and St. Louis, Missouri. The April 1965 flood is approximately the 50-year flood below Lock and Dam 11 and between the 50-year and 100-year flood above Lock and Dam 11 as estimated by the statistical analysis of gaging station records. The occurrence of the Standard Project Flood would be an extremely rare event, however, it could occur in any year. This flood represents the upper limit of flood volume and peak discharge that may be expected. Assignment of a frequency to this flood is considered impractical.

Intermediate Regional Flood

The Intermediate Regional Flood (IRF) is defined as one that has an average frequency of occurrence of once in 100 years, although it has a one percent chance of occurring in any year. The peak flow of this flood was developed from statistical analyses of streamflow records and runoff characteristics for the stream under study. In determining the Intermediate Regional Flood, statistical studies were made using the records of flood data from gaging stations throughout the study reach. Peak flows thus developed for the Intermediate Regional Flood at selected locations in the study area are shown in Table 5.

Standard Project Flood

The Standard Project Flood (SPF) is defined as a major flood that can be expected to occur from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the study area is located, excluding extremely rare combinations. The Corps of Engineers, in cooperation with the NOAA Weather Service, has made comprehensive studies and investigations based on the past records of experienced storms and floods and has developed generalized procedures for estimating the flood potential of streams. Peak discharges for the Standard Project Flood at selected locations in the study area are shown in Table 5.

TABLE 5

PEAK FLOWS FOR INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS

Location	Miles Above Ohio River	Drainage Area sq. mi.	IRF Discharge c.f.s.	SPF Discharge c.f.s.
Lock and Dam 12	556.7	82,400	328,000	446,000
Gordon's Ferry	566.2	82,100	327,000	446,000
Lock and Dam 11	583.0	81,500	326,000	445,000
Cassville	606.3	80.000	323,000	440,000

Table 6 shows water surface elevations for the April 1965, the Intermediate Regional, and Standard Project Floods through the study reach.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, and developments in the flood plain. An Intermediate Regional or Standard Project Flood on the Mississippi River would result in inundation of residential, commercial, and industrial sections in the study reach. Deep floodwater flowing at high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second could easily sweep an adult person off his feet, thus creating definite danger of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed, or in vehicles that are ultimately submerged or floated. Water lines can be ruptured by deposits of debris and the force of floodwaters, thus creating the possibility of contaminated domestic water supplies. Damaged sanitary sewerlines and sewage

TABLE 6

RELATIVE FLOOD HEIGHTS 1/

			Intermediate Regional Flood		Standard Project Flood		
Mile	Identification	April 1965 High Water Elevation Feet	Elevation Feet	Feet Above Maximum High Water Feet	Elevation Feet	Feet Above Maximum High Water Feet	Remarks
549.4	Above Maquoketa River	601.7	603.5	1.8	608.9	7.2	Gage established July 24, 1930
556.6	Lock & Dam 12 Tailwater	603.8	605.6	1.8	611.1	7.3	Both lock gages
556.8	Lock & Dam 12 Pool	604.2	606.0	1.8	611.6	7.4	established January 1, 1936
559.8		604.6	606.1	1.5	611.7	7.1	1965 high water mark
562.6		605.2	606.6	1.4	612.0	6.8	1965 high water mark
566.2	Gordon's Ferry	606.4	607.8	1.4	612.8	6.4	Gage established October 19, 1936
578.5	Downstream of levee	611.6	613.2	1.6	619.4	7.8	1965 high water mark
578.5	Upstream of levee	611.7	613.6	1.9	619.4	7.7	1965 high water mark
579.9	Dubuque, Iowa	612.5	614.2	1.7	620.2	7.7	Gage established August 1, 1878
582.9	Lock & Dam 11 Tailwater	613.9	615.4	1.5	620.8	6.9	Both lock gages established
583.1	Lock & Dam 11 Pool	614.4	615.9	1.5	621.4	7.0	June 1, 1936
592.3	Specht's Ferry	615.5	616.5	1.0	621.8	6.3	Gage established October 7, 1936
596.0		615.9	616.8	0.9	621.9	6.0	1965 high water mark
599.9	Waupeton, Iowa	616.9	617.6	0.7	622.5	5.6	Gage established July 27, 1930
603.6		618.9	619.4	0.5	624.5	5.6	1965 high water mark
606.3	Cassville, Wisconsin	620.6	621.1	0.5	626.1	5.5	Gage established August 16, 1951

1/ Datum of 1912, 4th General Adjustment treatment plants could result in the pollution of floodwaters creating health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded areas and flood damages - Plate 2 is the index map to Plates 3 through 6 showing flooded areas in the study reach. Areas that would be flooded by the Intermediate Regional and Standard Project Floods are shown in detail on Plates 3 through 6. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries. The areas that would be flooded by the Intermediate Regional and Standard Project Floods include agricultural, commercial, industrial, and residential developments and the associated streets, roads, and private and public utilities. Considerable damage to these facilities would occur during an Intermediate Regional Flood. However, due to the wider extent, greater depths of flooding, higher velocity flow and longer duration of flooding during a Standard Project Flood, damage would be even more severe than during an Intermediate Regional Flood. During a Standard Project Flood, the Dubuque Local Flood Protection Project levees are assumed to hold with emergency flood fighting measures. Plates 7 and 8 show water surface profiles of the Intermediate Regional and Standard Project Floods. Depth of flow in the channel can be estimated from these illustrations. Plate 9 shows a measured cross section at the Julien Dubuque Bridge.

Obstructions - During floods, debris collecting on bridges and culverts could decrease their carrying capacity and cause greater water depths (backwater effect) upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing profiles of the Intermediate Regional and Standard Project Floods. Similarly, the maps of flooded areas show the backwater effect of obstructive bridges, but do not reflect increased water surface elevation that could be caused by debris collecting against the structures.

Velocities of flow - Flow velocities during floods depend on the size and shape of the cross section, conditions of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream. Discharge measurements made by the U.S. Geological Survey during the April 1965 flood show that main channel velocities ranged from one to six feet per second in the vicinity of the Julien Dubuque Bridge. Overbank velocities in the area ranged from one half to two feet per second. Water flowing less than two feet per second would deposit silt or debris in the flow area.

Rates of rise and duration of flooding - Spring snowmelt is usually the cause of Mississippi River flooding in the study reach although major floods have occurred as a result of heavy storms covering a large portion of the basin.

The five major elements governing the magnitude of snowmelt floods are fall precipitation, frost depths, snow depth, rate of snowmelt, and amount of additional precipitation during the snowmelt period. During the snowmelt floods of 1952, 1965, 1967, and 1969, the river rose from low water to flood stage in 17, 14, 16, and 28 days, respectively. Rise from flood stage to peak stage occurred in 12, 13, 4, and 10 days, respectively. Maximum rate of rise of 2 foot per day occurred during the 1965 flood. The duration of the rise above flood stage was 23. 29, 14, and 21 days, respectively. Stage hydrographs for these floods are shown on Plate 10.

Photographs, future flood heights - The following photographs in Figures 10 through 23 indicate the expected Intermediate Regional and Standard Project Flood levels at various locations in the study reach.

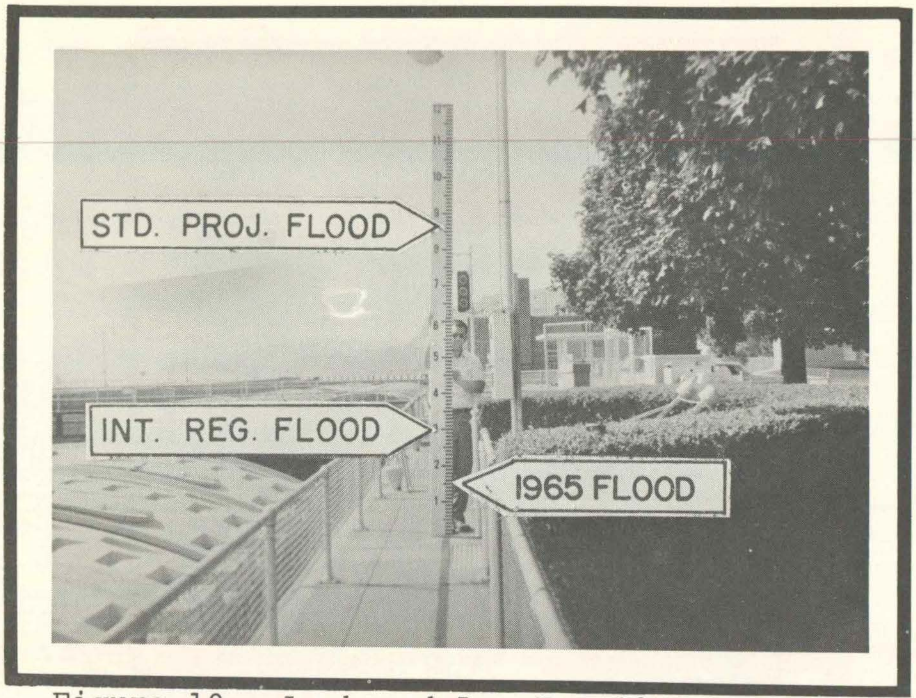


Figure 10. Lock and Dam No. 12 at Bellevue, Iowa, Mile 556.8. Corps of Engineers gage is located here.

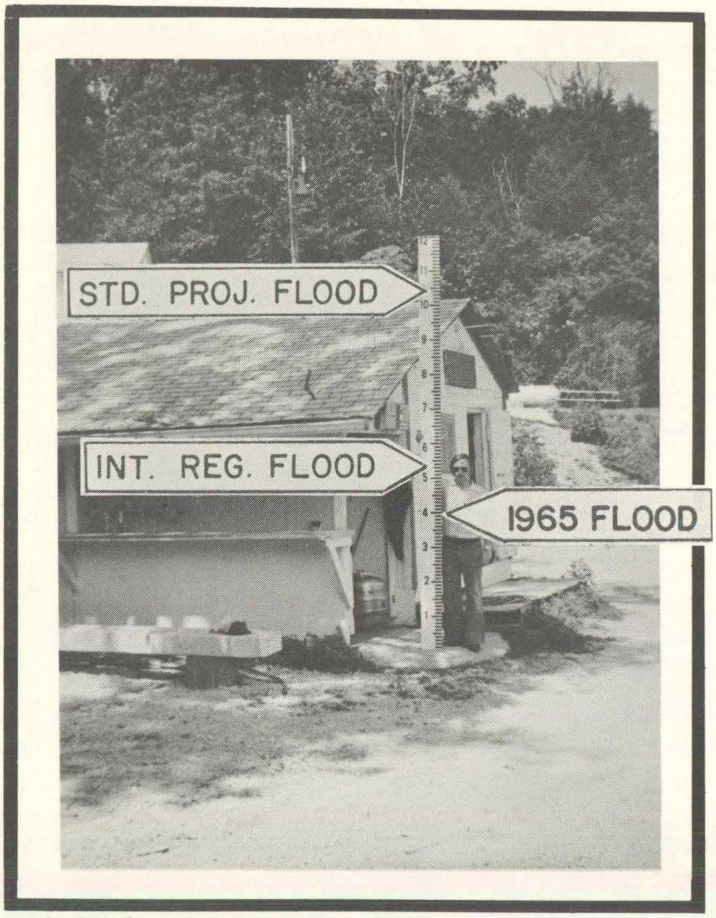


Figure 11. Gordon's Ferry, Iowa, Mile 566.2. Corps of Engineers gage is located near here.

Figure 12. Dubuque, Iowa, south end of levee, Mile 579.0. The Intermediate Regional Flood is 5.4 below the top of the dike and the 1965 flood would have been 7.2 feet below the top of the dike.

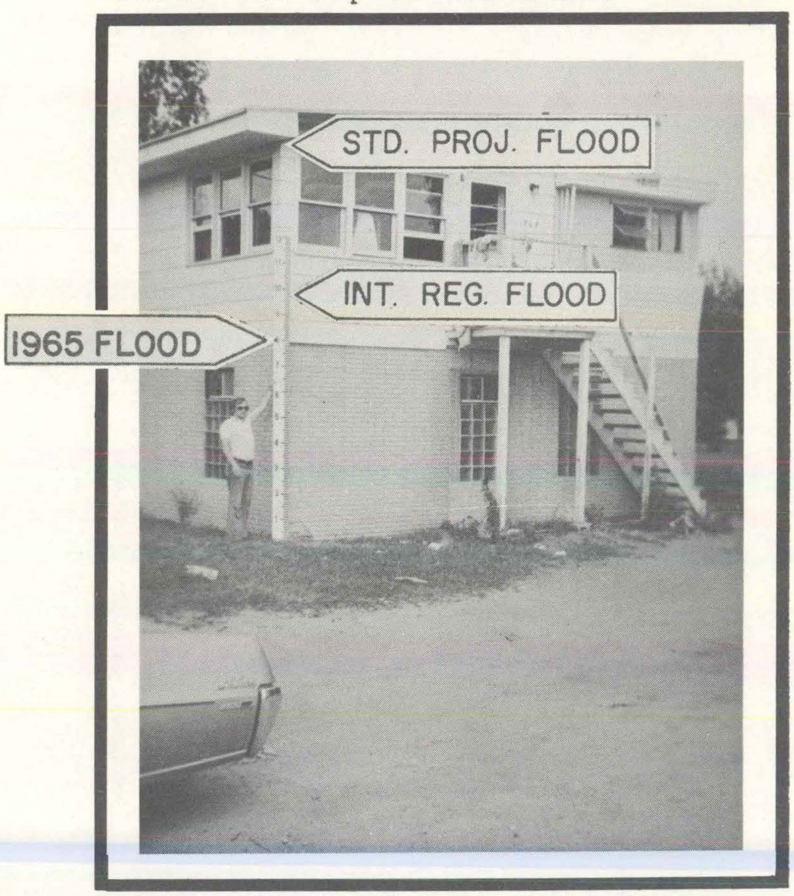


Figure 13. East Dubuque, Illinois, 707 Bastan Road, Mile 579.0.

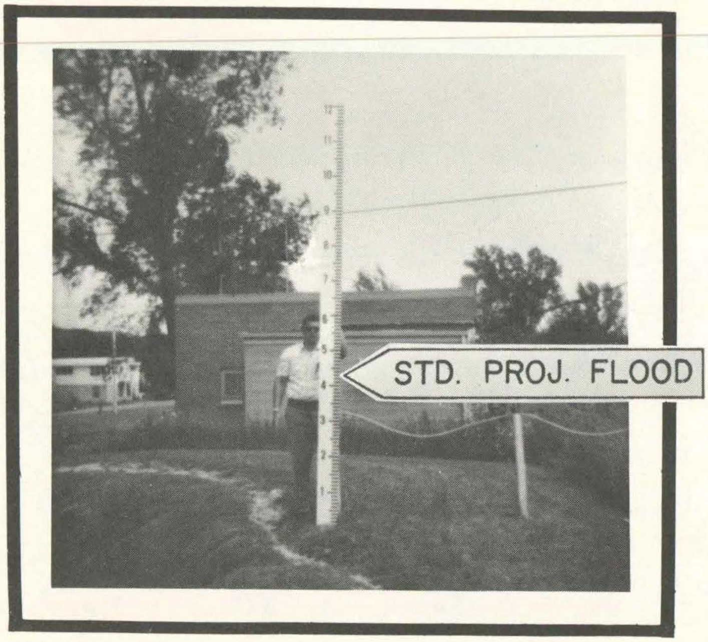


Figure 14. East Dubuque, Illinois, on levee by KDTH radio station, Mile 579.1. The Intermediate Regional Flood would be 1.5 feet and the 1965 flood would have been 3.4 feet below this point.

Figure 15. East Dubuque, Illinois, on levee adjacent to sewage treatment plant, Mile 579.3. The Intermediate Regional Flood would be 4.6 feet and the 1965 flood would have been 6.4 feet below this point.

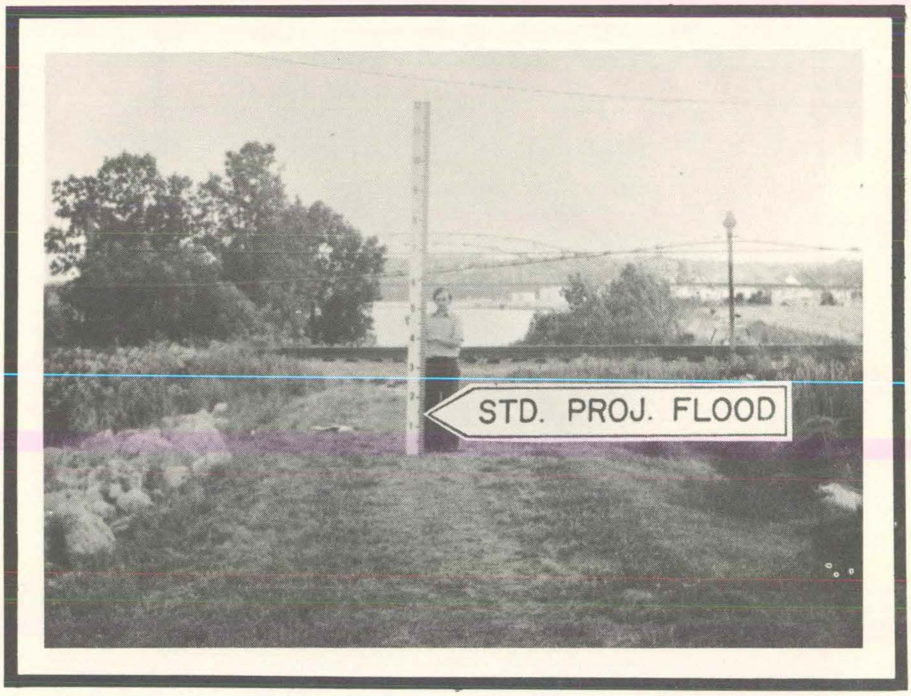


Figure 16. Dubuque, Iowa, on levee adjacent to west end of Illinois Central R.R. Bridge, Mile 580.0. The Intermediate Regional Flood is 4.6 feet below the top of the dike and the 1965 flood would have been 6.3 feet below the top of the dike.

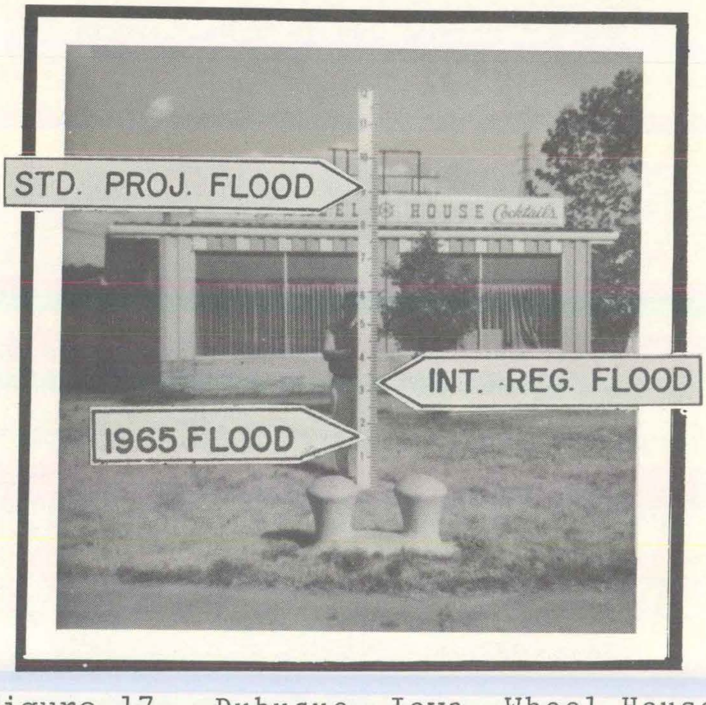


Figure 17. Dubuque, Iowa, Wheel House Restaurant on Hamm Island, Mile 580.8.

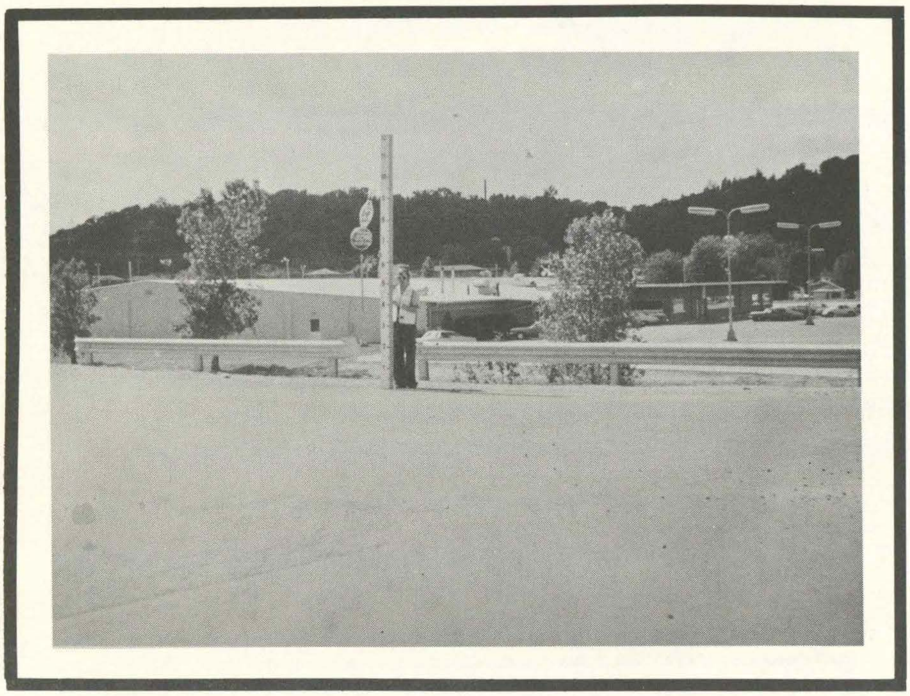


Figure 18. Dubuque, Iowa, on levee adjacent to Riverdale Bowl, Mile 582.2. The Standard Project Flood is 1.2, the Intermediate Flood is 6.8, and the 1965 flood would have been 8.3 feet below the top of the dike.

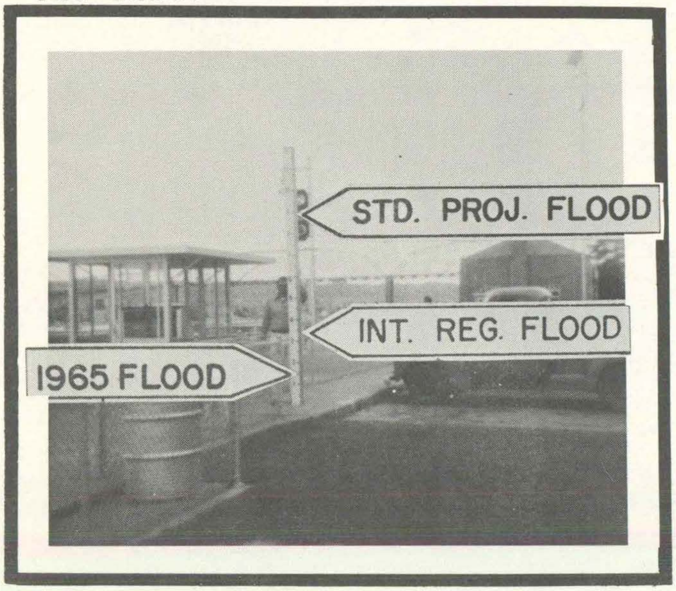


Figure 19. Lock and Dam No. 11, Mile 583.1. Corps of Engineers gage is located here.

Figure 20. Specht's Ferry, Iowa, Mile 592.0. Corps of Engineer gages are located here and upstream approximately 0.3 mile.

Figure 21. North Buena Vista, Iowa, at the west end of mobile home park, Mile 603.5.

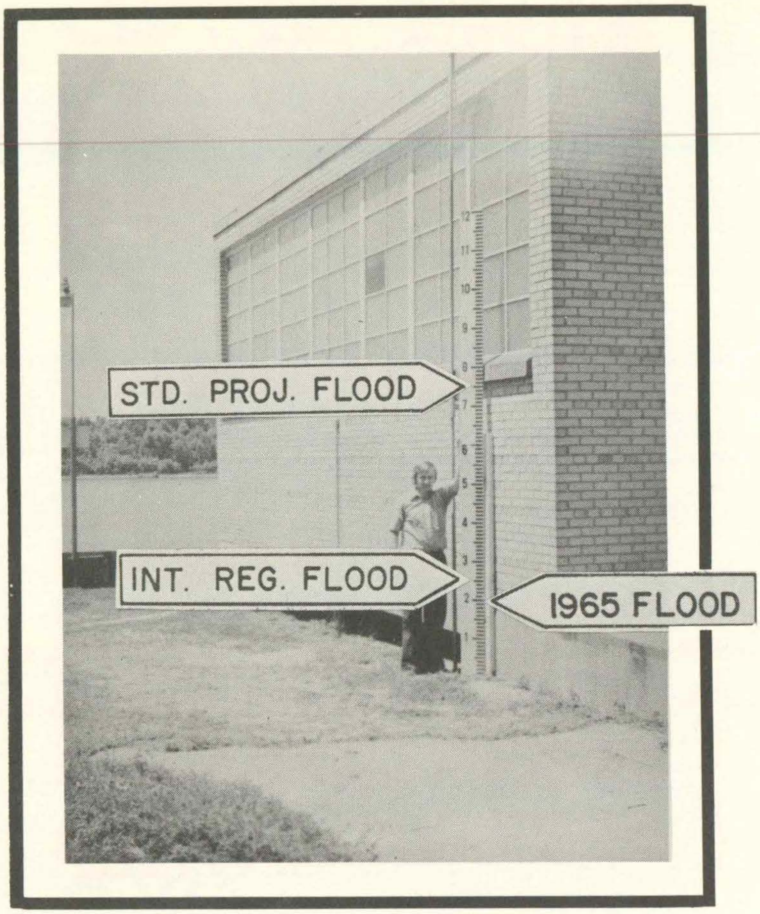


Figure 22. Cassville, Wisconsin, at the pump house of the Stoneman Generating Station Dairyland Electric Cooperative, Mile 606.3. Corps of Engineers gage is located here.

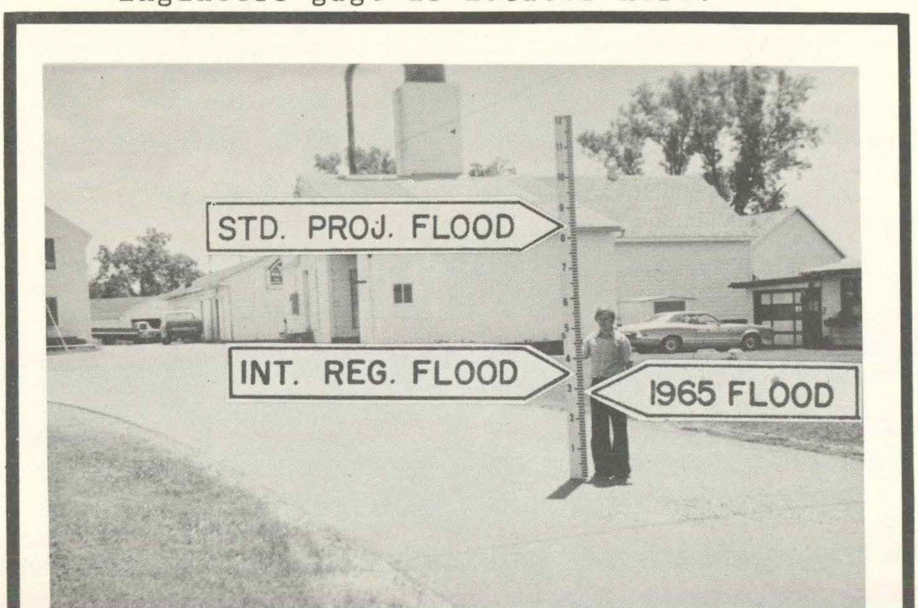


Figure 23. Upstream of the Walz Lumber Company at Mile 607.0, at Cassville, Wisconsin.

GLOSSARY

Backwater. The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

Discharge. As applied to a stream, the rate of flow, or volume of water flowing at a given place and within a given period of time, usually expressed as cubic feet per second (c.f.s.).

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Hydrograph. A graph showing flow values against time at a given point, usually measured in cubic feet per second. The area under the curve indicates total volume of flow.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

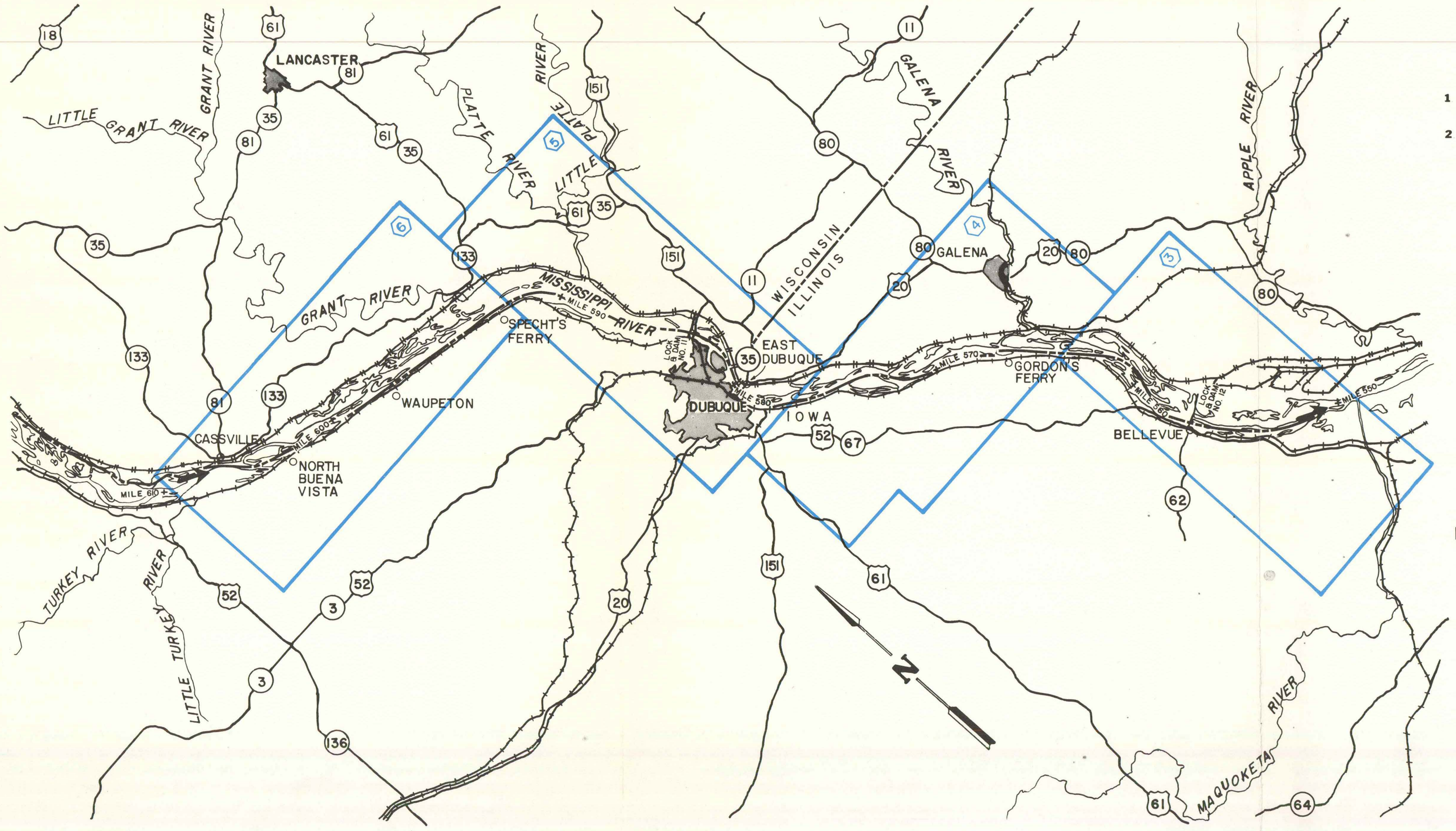
Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Slope. The inclination of gradient from the horizontal of a line or surface. The degree of inclination is usually expressed as a ratio such as 1:25, indicating 1 unit rise in 25 units of horizontal distance.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40-60 percent of the Probable Maximum Floods for the same basins. As used by the Corps of Engineers, Standard Project Floods are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance Elevation. The elevation at the top of the opening of a culvert, or other structure through which water may flow along a watercourse.



NOTES;

1. PLATE NUMBER CORRESPONDS TO TOPOGRAPHIC MAP OF FLOODED AREA
2. STATIONING IS MEASURED IN MILES FROM THE MOUTH OF OHIO RIVER

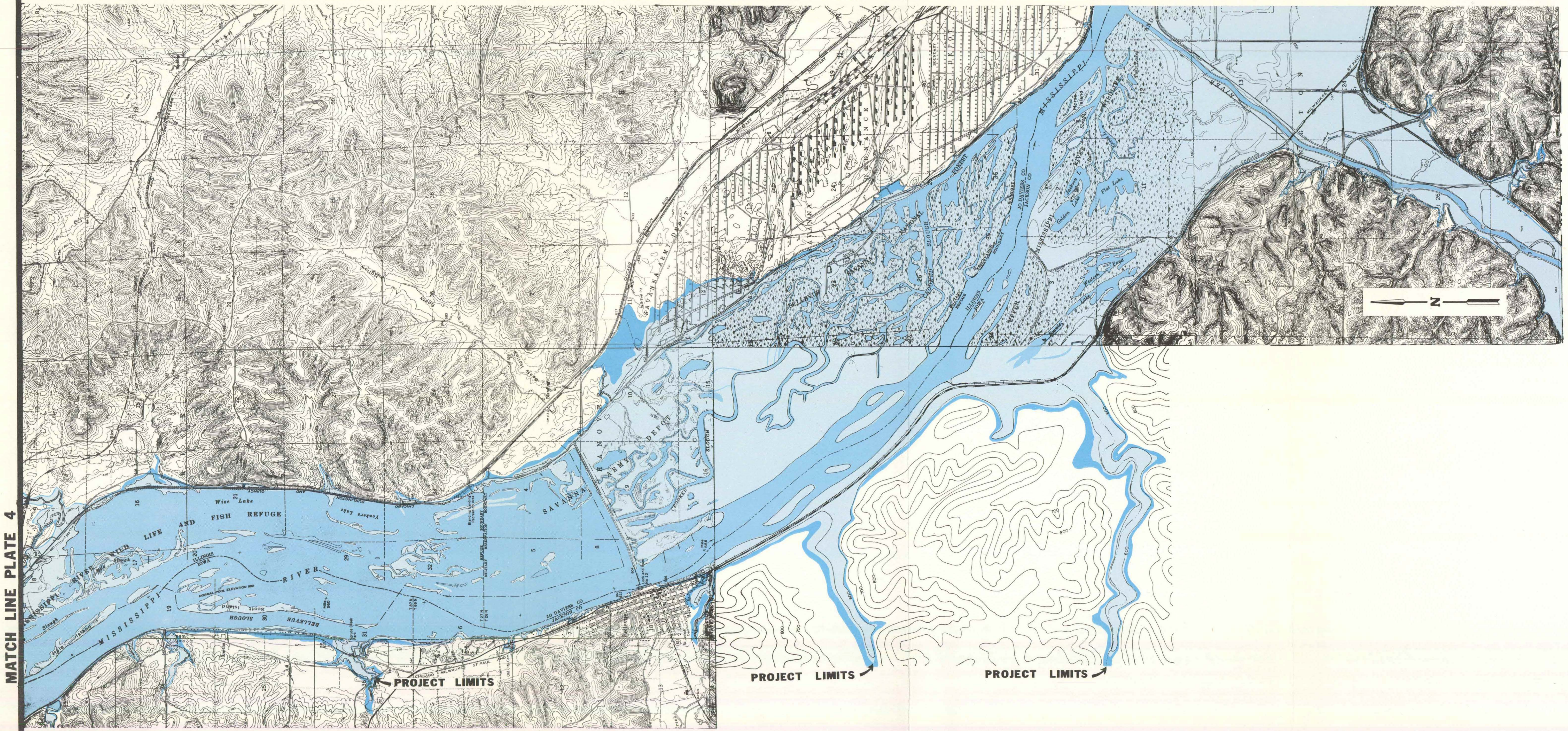
FLOOD PLAIN INFORMATION REPORT
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5
INDEX SHEET FOR FLOODED AREA MAP

5 0 5 10

SCALE IN MILES

U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS

OCTOBER 1974



LEGEND

- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD
- CHANNEL

+560 DISTANCE FROM MOUTH OF OHIO RIVER IN MILES

NOTE:

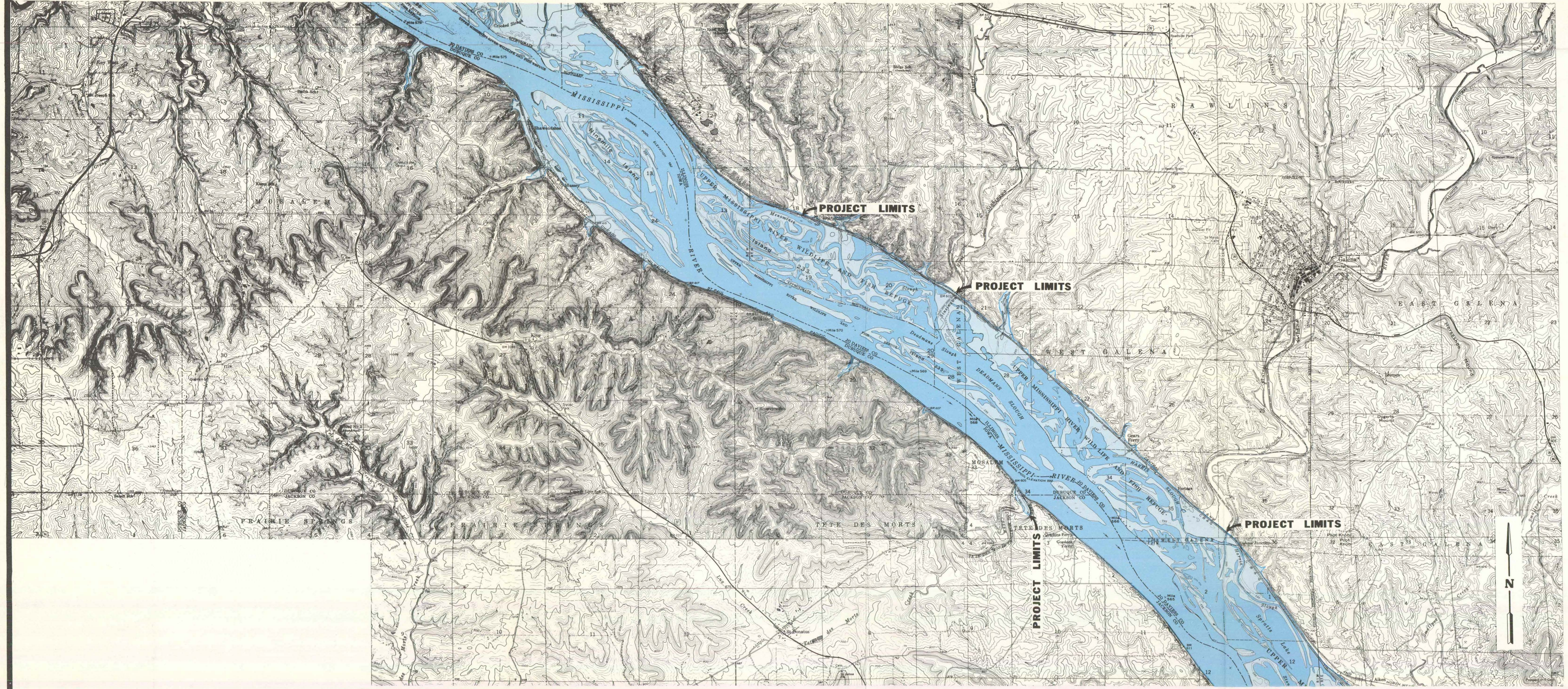
LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.

FLOOD PLAIN INFORMATION REPORT
TOPOGRAPHIC MAP OF FLOODED AREA
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5

4000 2000 0 2000 4000
SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS

OCTOBER 1974



LEGEND

- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD
- CHANNEL

+570 DISTANCE FROM MOUTH OF OHIO RIVER IN MILES

NOTE:

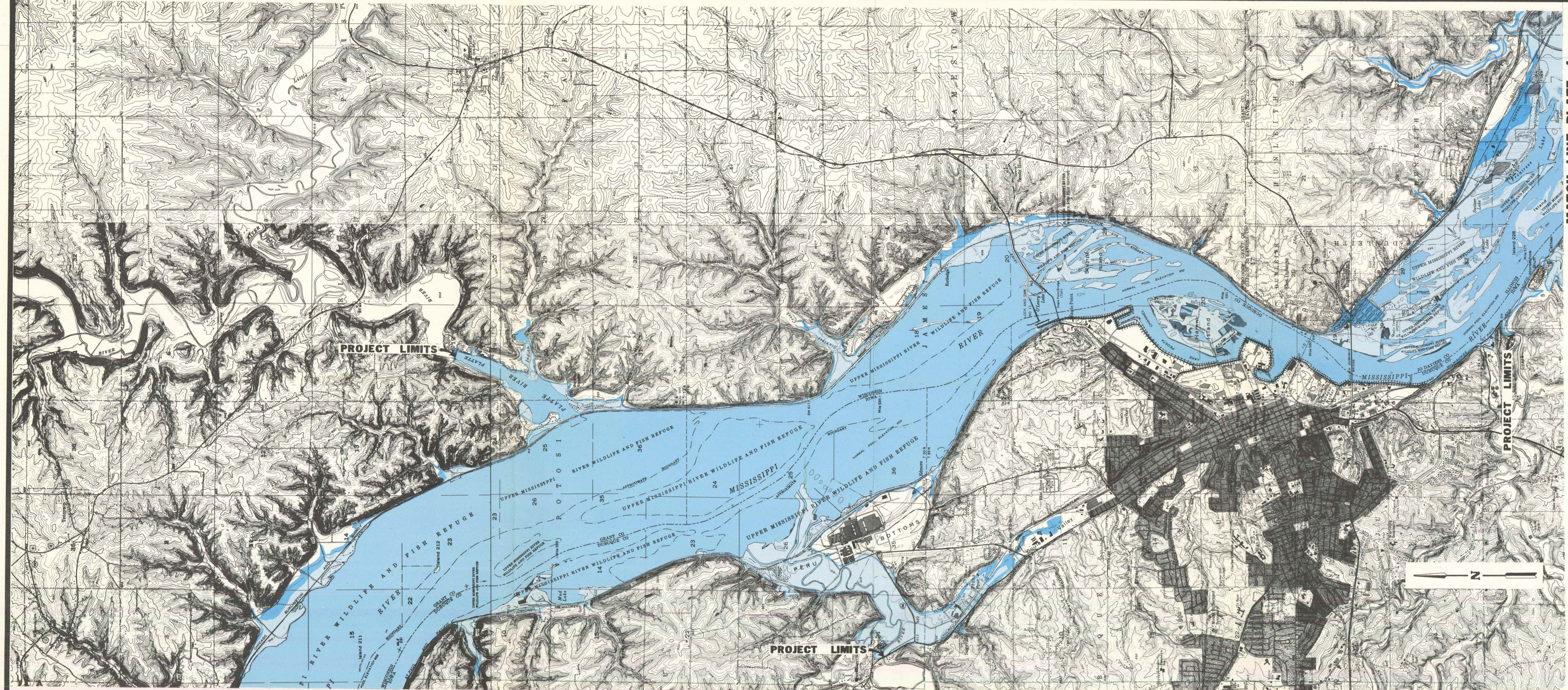
LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.

FLOOD PLAIN INFORMATION REPORT
TOPOGRAPHIC MAP OF FLOODED AREA
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5

4000 2000 0 2000 4000
SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS

OCTOBER 1974



LEGEND

- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD
- CHANNEL

+584 DISTANCE FROM MOUTH OF OHIO RIVER IN MILES

NOTES:

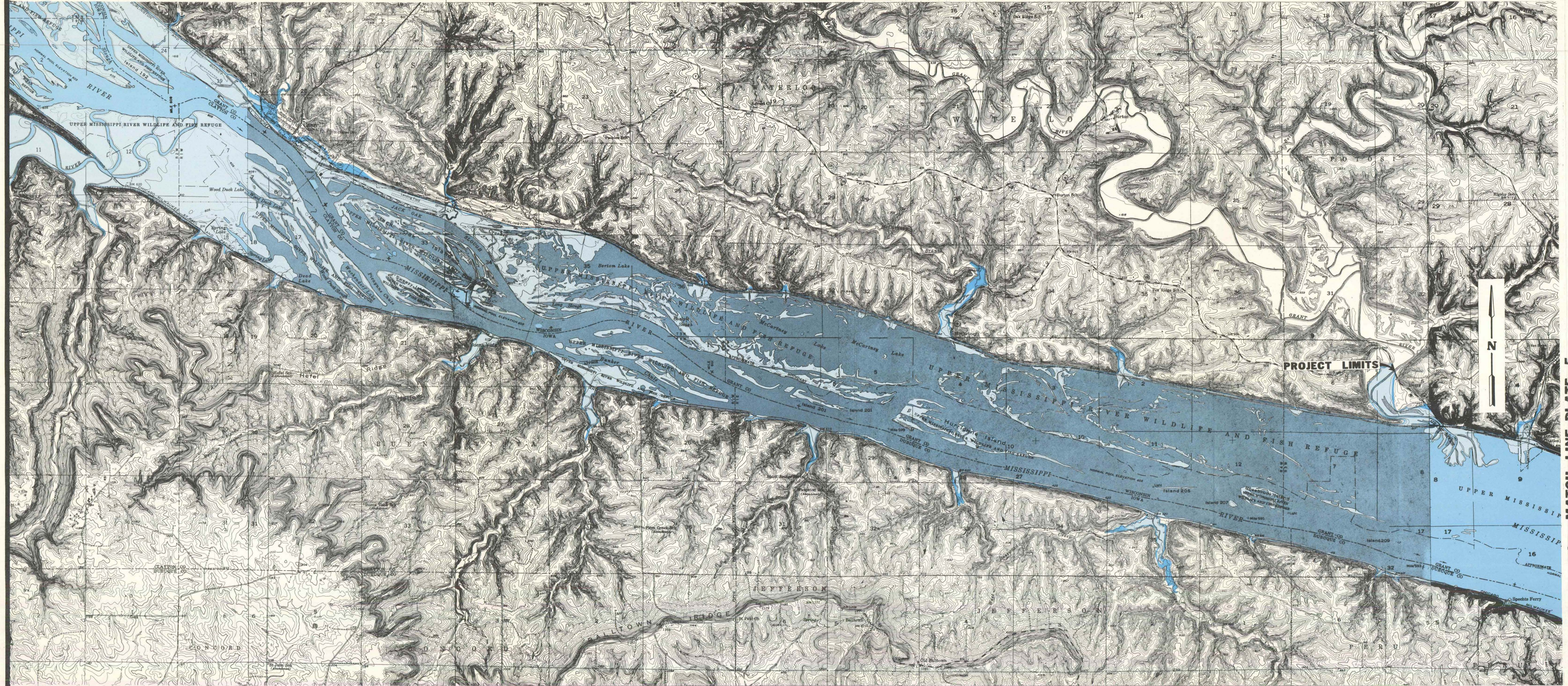
1. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
2. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO LOCAL RUNOFF.

FLOOD PLAIN INFORMATION REPORT
TOPOGRAPHIC MAP OF FLOODED AREA
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5

4000 2000 0 2000 4000
SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS

OCTOBER 1974



MATCH LINE PLATE 5

LEGEND

- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD
- CHANNEL

+ 601 DISTANCE FROM MOUTH OF OHIO RIVER IN MILES

NOTE:

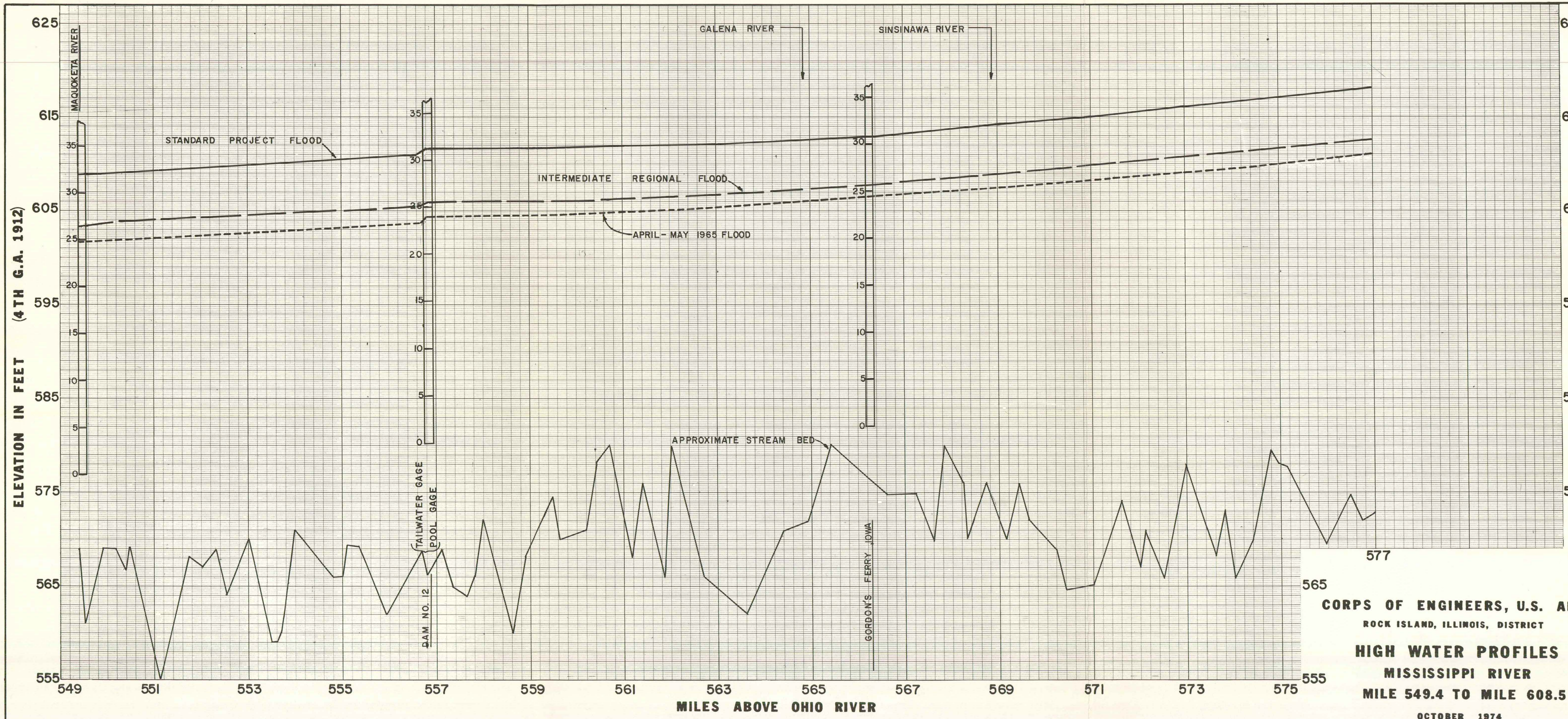
LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.

FLOOD PLAIN INFORMATION REPORT
TOPOGRAPHIC MAP OF FLOODED AREA
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5

4000 2000 0 2000 4000
SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS

OCTOBER 1974



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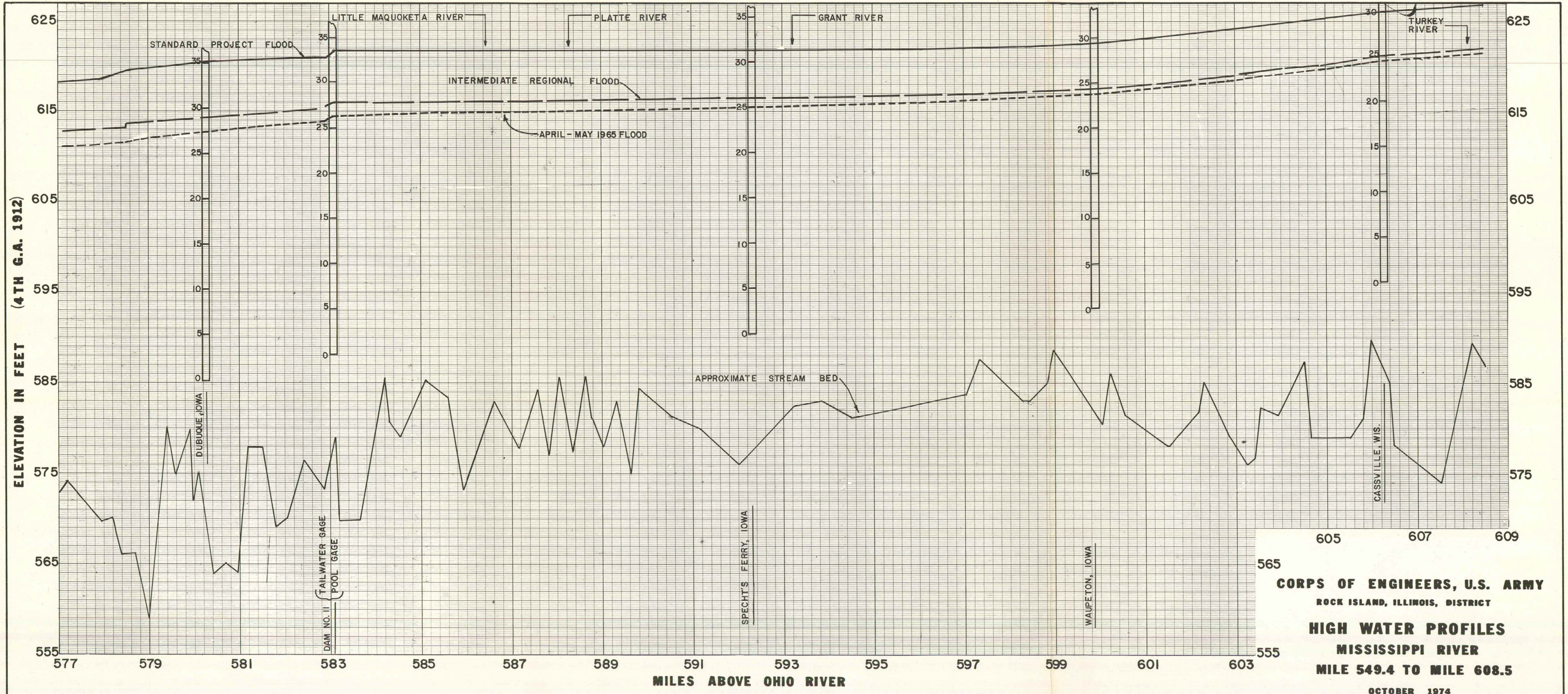
ROCK ISLAND, ILLINOIS, DISTRICT

HIGH WATER PROFILES
MISSISSIPPI RIVER
MILE 549.4 TO MILE 608.5

OCTOBER 1974

PLATE 7



CORPS OF ENGINEERS, U.S. ARMY

ROCK ISLAND, ILLINOIS, DISTRICT

HIGH WATER PROFILES

MISSISSIPPI RIVER

MILE 549.4 TO MILE 608.5

OCTOBER 1974

PLATE 8

NOTE:
NUMBERS IN THE SECTION ABOVE REPRESENT CHANNEL VELOCITIES AT POINTS INDICATED DURING THE HIGH WATER OF APRIL 26, 1965. MEASUREMENTS WERE TAKEN AT THE JULIEN DUBUQUE BRIDGE.

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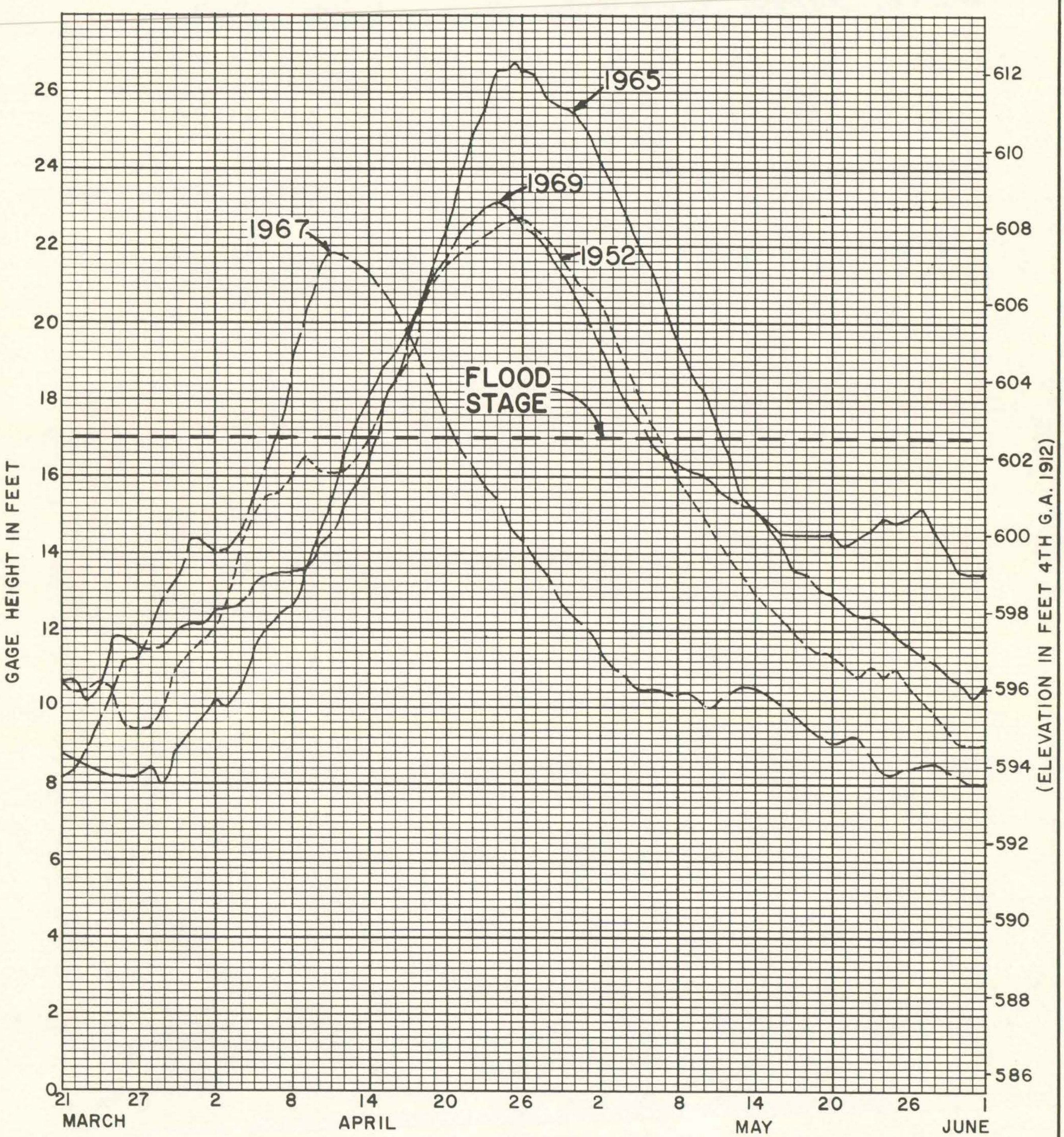
ROCK ISLAND, ILLINOIS, DISTRICT

MISSISSIPPI RIVER
CHANNEL CROSS SECTION
MILE 579.3
LOOKING UPSTREAM
OCTOBER 1974

PLATE 9



1952, 1965, 1967, 1969

WEATHER BUREAU STREAM GAGE
AT RIVER MILE 579.9

CORPS OF ENGINEERS, U.S. ARMY

ROCK ISLAND, ILLINOIS, DISTRICT

STAGE HYDROGRAPH

MISSISSIPPI RIVER

MILE 549.4 TO MILE 608.5

OCTOBER 1974