FLOOD OF AUGUST 1966 IN THE LOWER LOUP RIVER BASIN, NEBRASKA

The greatest flood of record in the 42-mile reach of the Loup River between Fullerton and the mouth of the river near Columbus, Nebr., occurred on August 12 and 13, 1966. Property damage amounted to several million dollars. This report presents maps showing the extent of inundation during that flood and data on the peak stages and discharges of that and earlier floods of record at the regular gaging stations in the same reach. The information can be used as an aid in evaluating the effects of flooding on economic development of valley lands, in designing improvements to alleviate existing flood problems, and in formulating zoning regulations that would minimize property damage by future floods.

Description of area.——The reach of the Loup River that flooded is in Nance and Platte Counties. All runoff from an area of 15,200 square miles passes through the lower end of this reach; however, only about 6,530 square miles of the drainage area contributes directly to surface runoff. All tributaries entering the reach drain areas north of the river; those that contributed most to the flood were the Cedar River and Plum and Beaver Creeks. (See fig. 1.)

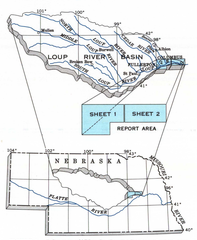

FIGURE 1.—*Index map of Nebraska showing location of report area.*

About 7.5 miles downstream from Fullerton most of the normal flow of the Loup River is diverted into the Loup River Canal of the Loup River Public Power District. The canal, which has a capacity of 3,000 cfs (cubic feet per second), is north of the river and its distance from the river increases to about 4 miles in the vicinity of Columbus. The water passes through two powerplants, one northwest of Monroe and the other northeast of Columbus, and discharges into the Platte River about 2 miles downstream from the confluence of the Loup and the Platte Rivers.

The principal towns in the area and their population in 1960 are as follows:

Town	Population
Fullerton	1,473
Genoa	1,069
Monroe	200
Columbus	12,476

Of these, only Monroe escaped significant flood damage.

Acknowledgments.——This hydrologic atlas was prepared in cooperation with the Nebraska Water Resources Division.

Acknowledgment is made to the Loup River Public Power District, officials of the municipalities, and farmers for their assistance during the field surveys.

Flood-producing storm.——The rain that caused the flood in the lower Loup River drainage basin occurred on August 12, 1966, beginning about 11 a.m. and ending about 11 p.m. The storm centered near the towns of Albion and Greeley in Boone and Greeley Counties, respectively, and heavy rain fell on all or parts of Boone, Nance, Howard, Greeley, Valley, and Wheeler Counties. Results of a bucket survey indicated that amounts ranging from 4 to 10 inches fell on about 2,200 square miles and from 10 to 17 inches on 600 square miles. The Cedar River and Plum and Beaver Creeks received the greater part of the direct runoff.

Extent of inundation.——As shown on the maps, the flooded area included valley land in the lower reaches of the Cedar River and of Plum and Beaver Creeks in addition to that along the Loup River. It also included valley land along the Platte River for short distances upstream and downstream from the confluence of the Loup and Platte Rivers; the flooding along the Platte River upstream from the confluence was caused by backwater from the Loup River and was not due to runoff direct to the Platte River. The extent of inundation was determined immediately after the flood by identifying floodmarks on both sides of each stream at distance intervals of about half a mile.

The 1966 flood not only exceeded all other floods during the period of record but is believed to have been the greatest in a much longer time. Long-term residents of the area remember no flood of equal magnitude, nor do they recall having heard earlier residents tell of such a flood; however, greater floods are possible. According to local residents, the stage of the 1966 flood exceeded that of the 1947 flood by 1.0 to 1.8 feet.

The boundaries of the area inundated during any particular flood reflect the channel and flood-plain conditions existing at that time. Thus, if these conditions change during a given flood, or between floods, the boundaries of inundation will be affected accordingly. The boundaries of the flood of August 1966, for example, reflect failure of many of the levees on the flood plain of the Loup River and four major breaks in levees along the Loup River Canal. If the levees had held, or broken in other places, the extent of inundation would have differed in many details. The boundaries of inundation during future floods will depend not only on natural shifts of the river channel but also on the capacity of waterway openings beneath new highway and railroad bridges, the effectiveness of levees built to protect selected tracts from flooding, and the degree of urbanization of flood-plain areas. Obviously, the inundation boundaries shown on the accompanying maps are unique for the August 1966 flood, and another flood, even one of the same magnitude, will likely have somewhat different limits because channel and flood-plain conditions will have been altered to some extent. For these reasons, planning for use of the flood plain and estimation of the flood hazards for particular tracts on or adjacent to the flood plain should not be based wholly on the flood boundaries shown on the maps but should include an evaluation of all factors affecting the extent of inundation.

Flood height.——The height or stage of a flood can be expressed in terms of feet above an arbitrary datum on a gage (gage height) or in feet above mean sea level. The accompanying maps show the peak height of the August 1966 flood in feet above mean sea level, and figures 2–5 show the peak heights of all floods of record at the four Geological Survey gaging stations in the reach both in feet above mean sea level and in feet above gage datum. Pertinent information for the four gaging stations is given below:

Gaging station	Gage datum (feet above mean sea level)	Drainage area (square miles)	
		Total	Contributing
Cedar River near Fullerton	1,440.40	1,220	490
Beaver Creek at Genoa	1,542.13	827	410
Loup River near Genoa	1,540.13	14,400	6,000
Loup River at Columbus	1,439.29	15,200	6,530

Flood discharge.——The rate of discharge of a stream is the volume of flow that passes a particular location in a given period of time; discharge rate generally is expressed in cubic feet per second (cfs). Peak discharge, or the maximum discharge during a flood, usually occurs at the time of the maximum height; but if a stream is affected by backwater, the time of the peak discharge may not coincide with the time of maximum height. For example, during winter, backwater from ice jams may cause flooding during a period of relatively low flow. Data on the maximum height and estimated peak discharge during both the August 1966 flood and the previously known maximum flood are given below for the four gaging stations:

Gaging station	August 1966 flood		Previously recorded maximum flood		
	Maximum gage height (ft)	Peak discharge (cfs)	Date	Maximum gage height (ft)	Peak discharge (cfs)
Cedar River near Fullerton	14.90	64,700	7-19-50	9.84	33,100
Beaver Creek at Genoa	19.39	14,200	7-19-50	20.65	21,200
Loup River near Genoa	13.93	129,000	6-28-47	10.12	90,000
Loup River at Columbus	13.61	119,000	6-28-47	12.00	85,000

It should be noted that the peak discharge for the August 1966 flood on Beaver Creek at Genoa was less than the peak discharge at that point for the maximum flood of record.

Flood frequency.——Data on the August 1966 flood and records of earlier floods at the same stations were used to determine the recurrence interval of floods of different heights and of different rates of discharge. As applied to flood events, recurrence interval is the average number of years within which a given flood will be equaled or exceeded once. For floods greater than the 10-year flood, the recurrence interval is virtually inversely related to the chance of a specific flood being equaled or exceeded in any one year. Thus, a 20-year flood would have 1 chance in 20, or a 5-percent chance of being equaled or exceeded in any year.

Figures 6–13 show, respectively, the relation of recurrence interval to discharge and the relation of recurrence interval to flood height. The latter is dependent on the relation of stage to discharge, which is affected by changes in channel and flood-plain conditions. The curves in figures 10–13 are based on conditions existing in 1966; future changes in those conditions would require redefinition of the curves.

The general relation between recurrence intervals and flood heights at the four gaging stations is given below:

Recurrence interval (years)	Elevation above mean sea level (feet)			
	Cedar River near Fullerton	Beaver Creek at Genoa	Loup River near Genoa	Loup River at Columbus
100	1,451.0	1,560.8	1,552.9	1,442.8
50	1,450.4	1,560.0	1,552.5	1,441.9
25	1,450.0	1,559.3	1,552.1	1,441.3
20	1,449.6	1,558.7	1,551.8	1,440.8
10	1,448.7	1,557.3	1,551.2	1,439.9
5	1,447.6	1,555.4	1,550.5	1,439.0
2	1,446.4	1,553.7	1,550.1	1,438.3
1	1,445.3	1,552.2	1,549.7	1,437.8

It is emphasized that recurrence intervals are average figures--that is, the average number of years between floods that equal or exceed a given magnitude. The fact that a major flood occurs at a certain time does not reduce the probability of that flood being exceeded in the next year or even in the next week.

Flood and low-water profiles.——Profiles of the peak stage of the August 1966 flood and profiles of low flow are shown in figures 14–18 for the Cedar River, Plum and Beaver Creeks, and the Loup and Platte Rivers. The profiles of the peak stage are based on the high-water marks established immediately after the flood, whereas those for low flow are based on elevations read directly from the topographic maps. The base line for each profile follows the main channel of the river, and distances along the base line are expressed in river miles upstream from the mouth. Because these streams, except for the Platte River, follow sinuous courses and have rather broad flood plains, a distance measured in river miles is somewhat greater than a distance measured along the valley axis between the same two points. For this reason, the flood profiles shown are not as steep nor as smooth as they would be if the base line followed the valley axis instead of the stream channel.

Depth of flooding.——The approximate depth of flooding at any point can be determined by subtracting the ground elevation shown on the topographic map from the elevation of the nearest point on the flood profile. More nearly accurate flood depths can be obtained if the ground elevation is determined by leveling from a point of known elevation.

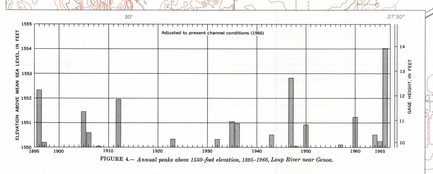

FIGURE 4.—*Annual peaks above 1550-foot elevation, 1895–1966, Loup River near Genoa.*

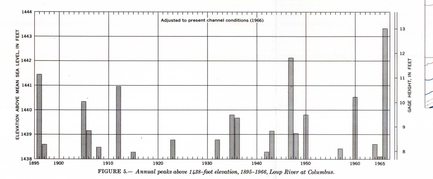

FIGURE 5.—*Annual peaks above 1438-foot elevation, 1895–1966, Loup River at Columbus.*

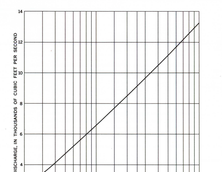

FIGURE 6.—*Frequency of peak discharge, Cedar River near Fullerton.*

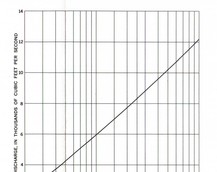

FIGURE 7.—*Frequency of peak discharge, Beaver Creek at Genoa.*

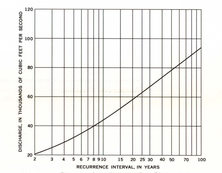

FIGURE 8.—*Frequency of peak discharges, Loup River near Genoa.*

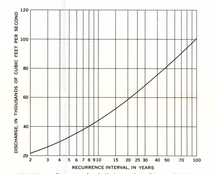

FIGURE 9.—*Frequency of peak discharges, Loup River at Columbus.*

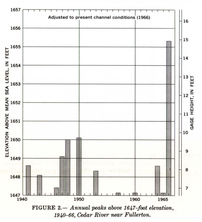

FIGURE 2.—*Annual peaks above 1437-foot elevation, 1940–66, Cedar River near Fullerton.*

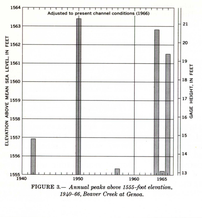

FIGURE 3.—*Annual peaks above 1555-foot elevation, 1940–66, Beaver Creek at Genoa.*

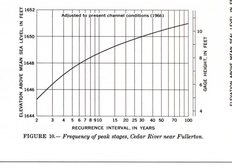

FIGURE 10.—*Frequency of peak stages, Cedar River near Fullerton.*

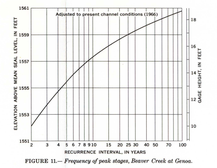

FIGURE 11.—*Frequency of peak stages, Beaver Creek at Genoa.*

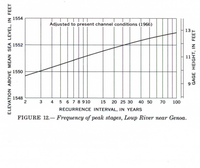

FIGURE 12.—*Frequency of peak stages, Loup River near Genoa.*

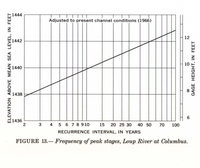

FIGURE 13.—*Frequency of peak stages, Loup River at Columbus.*

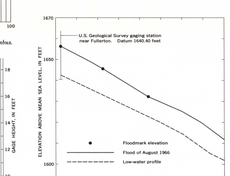

FIGURE 14.—*Profiles of low water and flood of August 1966, Cedar River.*

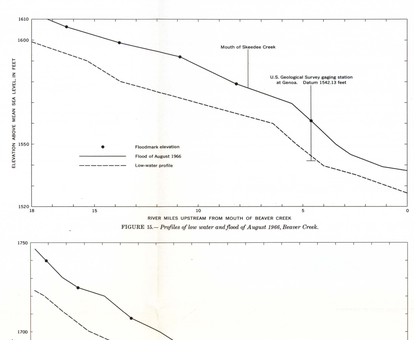

FIGURE 15.—*Profiles of low water and flood of August 1966, Beaver Creek.*

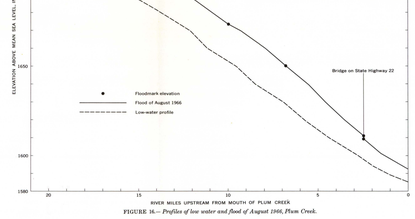

FIGURE 16.—*Profiles of low water and flood of August 1966, Plum Creek.*

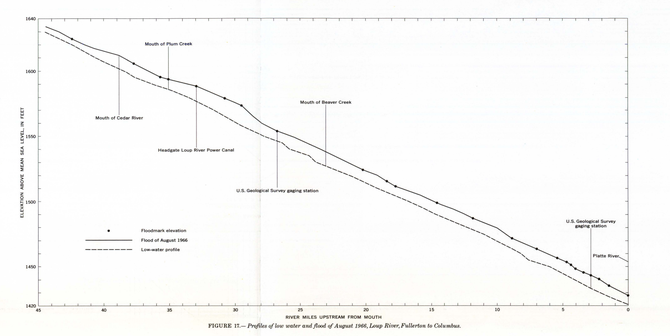

FIGURE 17.—*Profiles of low water and flood of August 1966, Loup River, Fullerton to Columbus.*

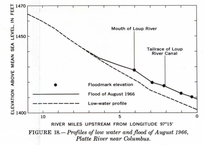

FIGURE 18.—*Profiles of low water and flood of August 1966, Platte River near Columbus.*

Base from U.S. Geological Survey
Columbus, Duncan, and Monroe, 1958

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1967—W6721

FLOOD OF AUGUST 1966 IN THE LOWER LOUP RIVER BASIN, NEBRASKA

See sheet 1 for explanation

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