DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE NORTHEASTERN ILLINOIS METROPOLITAN
AREA PLANNING COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA-234

FLOODS IN WAUKEGAN QUADRANGLE NORTHEASTERN ILLINOIS

This report presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Waukegan quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for formulating effective flood-plain regulations that would minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to ground-water resources.

The approximate areas inundated by floods along streams in the Waukegan 7½-minute quadrangle are delineated on a topographic map. The quadrangle location is shown in figure 1. Inundated areas are shown for the floods listed below:

Date of flood	Area flooded
June 1937	Skokie River downstream from mile 41.7.
November 1951	Waukegan River.
April 1960	Skokie River upstream from mile 41.7.
April 1966	Pettibone Creek and tributary; Waukegan River tributary.

The flood of November 1951 was reported to have been the highest observed on Waukegan River in the past 65 years.

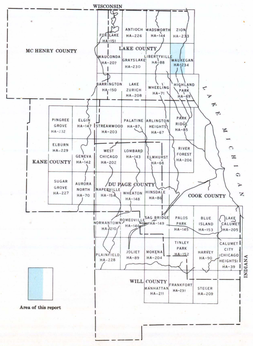

FIGURE 1.—*Index map of northeastern Illinois showing location of quadrangles in the flood-hazard mapping program.*

Greater floods than those whose boundaries are shown on the map are possible. The flood boundaries shown provide a record of historic fact that reflects channel conditions existing when the floods occurred. Changes in channel conditions, waterway openings at highways and railroads, or changes in runoff characteristics of the streams caused by increased urbanization that may have taken place subsequent to the floods represented on the map could affect the height reached by a future flood of comparable discharge. Protective works built after the floods shown may reduce the frequency of flooding in the area but will not necessarily eliminate all future flooding. The inundation pattern of future floods may be affected by new highways and bridges, relocation and improvement of stream channels, and other cultural changes.

The general procedure used in defining the flood boundaries was to construct flood profiles from elevations of floodmarks identified in the field and from data available from other agencies. The extent of flooding delineated on the topographic map was derived from the profiles by interpolation between contours (lines of equal ground elevations) and by plotting overflow limits identified during field investigations and surveys. The portrayal of flood boundaries is consistent with the scale of the map (1 inch = 2,000 feet; contour interval, 10 feet).

There are several depressions or lowland areas in the Waukegan quadrangle where surface water accumulates because of inadequate drainage to the streams. Frequency and depth of flooding in these areas are unrelated to the water-surface elevation along the streams. Some areas are flooded only briefly after periods of heavy rainfall or snowmelt, whereas others remain inundated continuously, depending largely upon the rates of evaporation and seepage into the ground. Flood boundaries are shown for all such areas that were detected in this investigation.

Cooperation and acknowledgment.— The preparation of this report is a part of an extensive flood-mapping program financed through a cooperative agreement between the Northeastern Illinois Metropolitan Area Planning Commission and the U.S. Geological Survey. Under the agreement, flood maps will be prepared for the 7½-minute quadrangles shown in figure 1. The program includes parts of Cook, Kane, McHenry, and Will Counties, and all of Du Page and Lake Counties. The six counties cooperate in the program financially through separate agreements with the Planning Commission. Financial support for the preparation of this report was provided by Lake County.

The cooperative program is administered on behalf of the Planning Commission by Matthew L. Rockwell, Executive Director, and is directly coordinated by John R. Sheaffer, Chief Planner.

The report was prepared by the U.S. Geological Survey under the administrative direction of William D. Mitchell, district chief, and under the immediate supervision of Davis W. Ellis, engineer-in-charge of the project.

Acknowledgment is made to the Lake County Highway Department for supplying some of the data on which this report is based.

Additional data were obtained from officials of municipalities in the area, particularly Lake Forest; from Greeley and Hansen, Hydraulic and Sanitary Engineers, Chicago, Ill.; from personal interviews with private citizens and public officials in the area; and from field investigations.

Flood height.— The height of a flood at a gaging station usually is stated in terms of gage height, or stage, which is the elevation of the water surface above a selected datum plane. Elevations shown in this report are in feet above mean sea level. Gage heights for the crest-stage gage in the Waukegan quadrangle can be converted to elevations above mean sea level by adding the gage height to the datum of gage listed in the following table. The size of drainage basin for the gage is also shown in the table. The subbasin divides from which the area was determined are shown on the flood map.

Crest-stage gage	Station number	Datum of gage above mean sea level (feet)	Drainage area (square miles)
Skokie River at Lake Bluff (State Highway 176)	5-5349	665.28	8.14

The maximum and minimum monthly mean water levels of Lake Michigan at Calumet Harbor (at mouth of Calumet River), for each calendar year during the period 1904–65 are shown in figure 2.

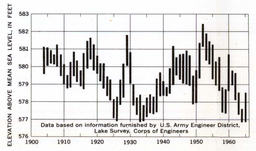

FIGURE 2.—*Maximum and minimum monthly mean water levels of Lake Michigan at Calumet Harbor, for each calendar year, 1904–65.*

Gage height and year of occurrence of each annual flood (highest peak stage in each calendar year) above 658-foot elevation at the gaging station on Des Plaines River near Gurnee, Ill., during the period 1946–65 are shown in figure 3. The irregular occurrence of floods is evident.

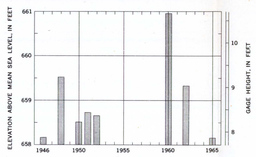

FIGURE 3.—*Annual floods above 658-foot elevation, 1946–65, Des Plaines River near Gurnee (Belvidere Road).*

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 rates usually are expressed in units of cubic feet per second (cfs). Peak discharge, the maximum discharge attained by a flood, generally occurs at the time of the maximum height (stage) of the flood, but if a stream is affected by variable backwater, the time of the peak discharge may not coincide with that of the maximum stage. For example, backwater from an ice or debris jam may cause a high stage during a period of relatively low discharge.

Flood frequency.— Frequencies of floods at the Geological Survey gaging stations on Des Plaines River near Gurnee and Skokie River at Lake Forest were derived from streamflow records for the stations, combined with records for other nearby stations and with the regional flood frequency relation for streams in northern Illinois (Mitchell 1954). The Gurnee Station is 3½ miles west of Waukegan quadrangle and the Lake Forest station is 1¼ miles south of Waukegan quadrangle.

The general relations between frequency and discharge and between frequency and stage are shown in figures 4–7. The relation between stage and frequency is dependent on the relation of stage to discharge which is affected by changes in the physical conditions of stream channels and constrictions. The stage-frequency curves shown in figures 6 and 7 are based on channel conditions existing in 1966. Longer records and future changes in channel conditions may define somewhat different flood-frequency curves. Extrapolation of the curves beyond the limits shown is not recommended.

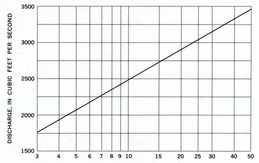

FIGURE 4.—*Frequency of flood discharges on Des Plaines River near Gurnee (Belvidere Road).*

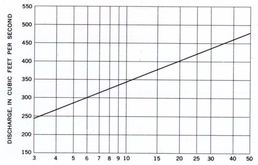

FIGURE 5.—*Frequency of flood discharges on Skokie River at Lake Forest (State Highway 59A–Westleigh Road).*

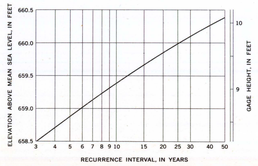

FIGURE 6.—*Frequency of flood stages on Des Plaines River near Gurnee (Belvidere Road).*

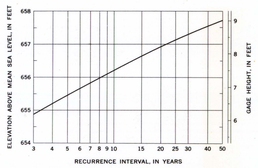

FIGURE 7.—*Frequency of flood stages on Skokie River at Lake Forest (State Highway 59A–Westleigh Road).*

Recurrence intervals.— As applied to flood events, recurrence interval is the average interval of time within which a given flood will be equaled or exceeded once. Frequencies of floods can be stated in terms of their probabilities of occurrence (virtually, reciprocals of their recurrence intervals for floods with recurrence intervals greater than 10 years). For example, a flood with a 25-year recurrence interval would have a 4-percent chance of being equaled or exceeded in any given year, or a flood with a 50-year recurrence interval would have a 2-percent chance of being equaled or exceeded in any given year.

The general relation between recurrence interval and flood height at the gaging stations on Des Plaines River near Gurnee (fig. 6) and Skokie River at Lake Forest (fig. 7) is tabulated below:

Recurrence interval (years)	Elevation above mean sea level (feet)	
	Des Plaines River near Gurnee	Skokie River at Lake Forest
50	660.4	657.7
25	660.0	657.1
10	659.4	656.2
5	658.9	655.5
3	658.5	654.9

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

Flood profiles.— Profiles of the water surface, based primarily on elevations of marks left by floods of June 1937, November 1951, April 1960, February 1966, and April 1966 are shown in figures 8–10. Where floodmarks could not be identified, the profiles were constructed on the basis of flood crests determined from photographs and from reports by local residents, and on the basis of elevations of streambeds and lower flood stages. River miles used for the profiles correspond to those marked along the streams on the flood map.

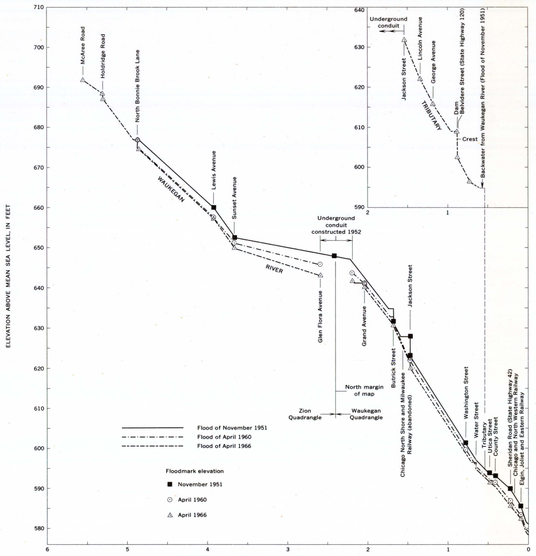

FIGURE 8.—*Profiles of floods on Waukegan River and tributary.*

Flood depths.— Depth of flooding at any point can be estimated by subtracting the ground elevation from the water-surface elevation at the same point, indicated by the profiles in figures 8–10. The approximate ground elevation can be determined from contours on the map, although more accurate elevations can be obtained by leveling from nearby bench marks.

Additional data.— Other information pertaining to floods in the Waukegan quadrangle can be obtained at the office of the U.S. Geological Survey, Oak Park, Ill., and from the following published reports:

Daniels, W. S., and Hale, M. D., 1958, Floods of October 1954 in the Chicago area, Illinois and Indiana: U.S. Geol. Survey Water-Supply Paper 1370–B, p. 107–200.

Mitchell, W. D., 1954, Floods in Illinois, magnitude and frequency: Illinois Dept. Public Works and Bldgs., Div. of Waterways, 386p.

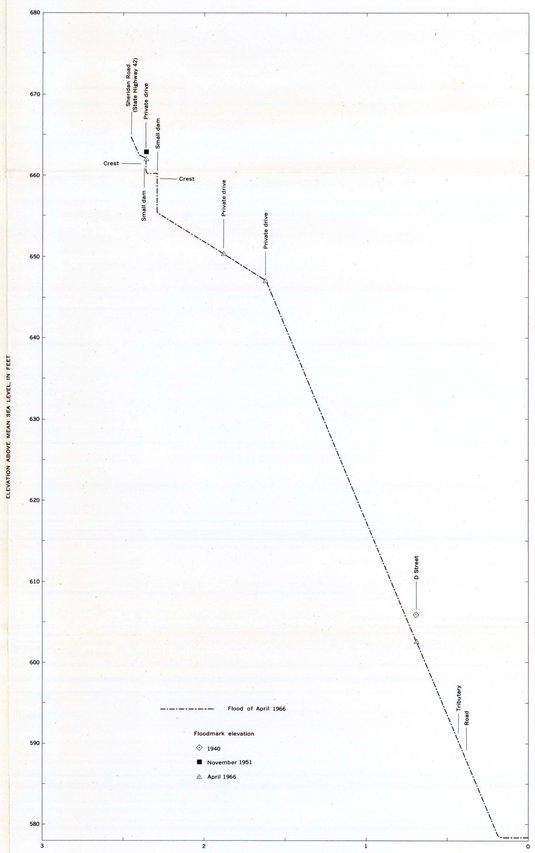

FIGURE 9.—*Profile of flood on Pettibone Creek.*

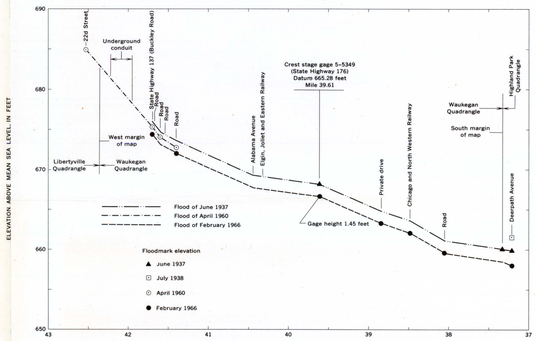

FIGURE 10.—*Profiles of floods on Skokie River.*

EXPLANATION

Area flooded
Boundary of 1937 flood — 1937 —
Boundary of 1951 flood — 1951 —
Boundary of 1960 flood — 1960 - - -
Boundary of 1966 flood — 1966 — —
Drainage divide
River mile measured along stream channel
Inundated areas defined for different floods, upstream and downstream
40 ×
1966 + | 1951

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By
Roman T. Mycyk and V. Jeff May

1967

For sale by U.S. Geological Survey, price 75 cents