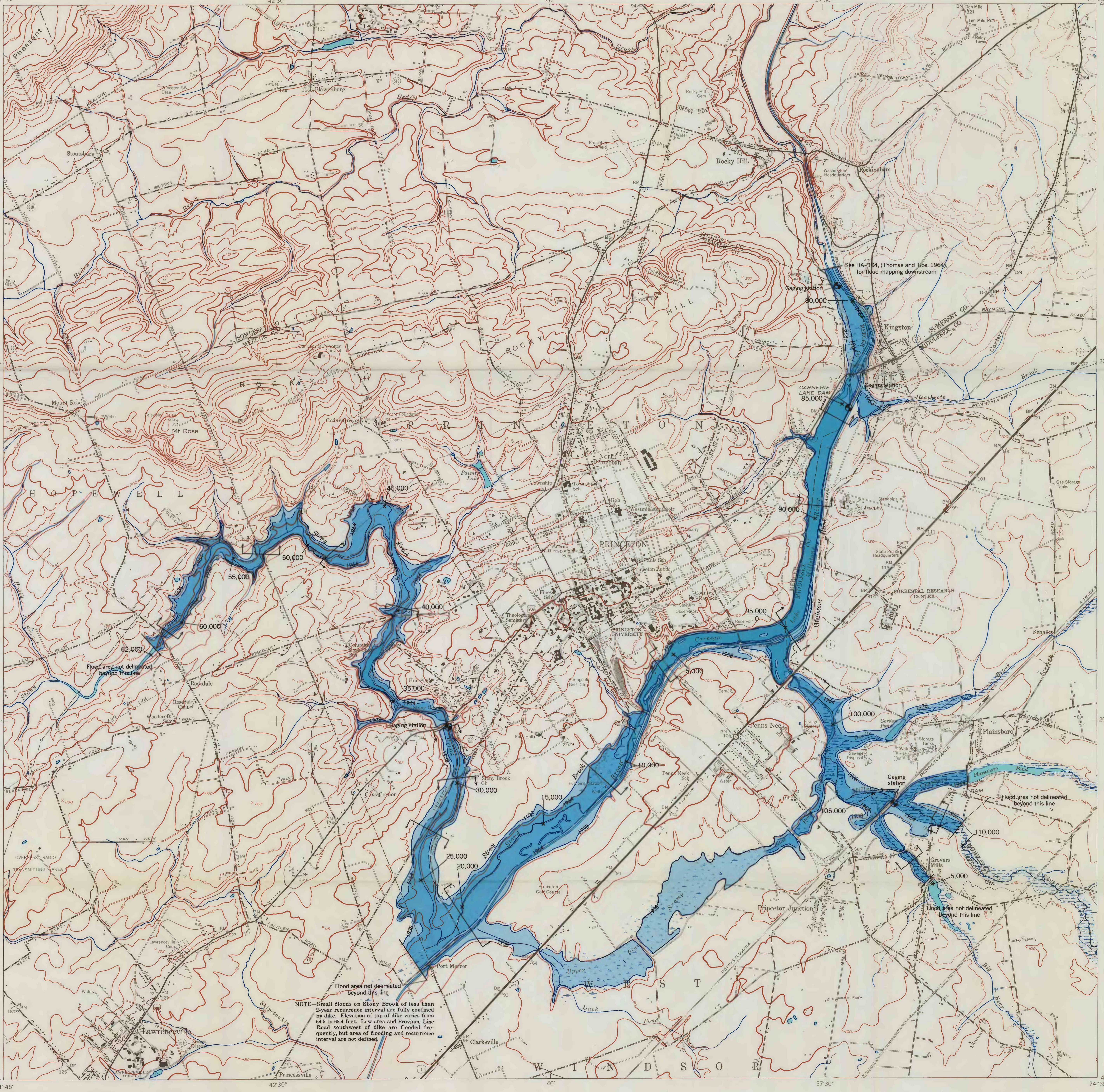

Base from U.S. Geological Survey topographic quadrangles: Rocky Hill, 7½′, 1954; Monmouth Junction, 7½′, 1954; Princeton, 7½′, 1954 and Hightstown, 7½′, 1954

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION

Area flooded September 1938

Area flooded January 1964

Boundary of 1938 flood

Boundary of 1964 flood

Cross-section location

Distance along channel measured in feet — 5,000

FLOODS ON MILLSTONE RIVER AND STONY BROOK IN VICINITY OF PRINCETON, NEW JERSEY

This atlas provides hydrologic data for evaluating the extent, depth, and frequency of flooding along the Millstone River and Stony Brook in the vicinity of Princeton, New Jersey. The approximate boundaries of inundation during the floods of September 1938 and January 1964 are mapped in order to illustrate the difference in extent that can be expected between the maximum recorded flood and a comparatively small flood. Although floods greater than that of September 1938 have occurred in the past, their definition is not within the scope and purposes of this report.

The atlas has been prepared to aid individuals, organizations, and governmental agencies who plan or make decisions for the best use of flood-plain lands along the Millstone River, Stony Brook, and Carnegie Lake. The map and flood data are essential for an appraisal of the hazards involved in flood-plain occupation and provide a technical basis for making decisions leading to land uses compatible with the degree and frequency of flooding expected.

This atlas was prepared as part of an investigative program financed through a cooperative agreement between the U.S. Geological Survey and the New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply. The cooperative program is administered on behalf of the Department of Conservation and Economic Development by Robert A. Roe, Commissioner, and is directly coordinated by George R. Shanklin, Director and Chief Engineer of the Division of Water Policy and Supply. The flood maps were prepared by the Geological Survey under the general direction of J. E. McCall, district chief, and under the immediate supervision of A. C. Lendo, supervising hydraulic engineer.

Flood history.—Data on large floods that occurred before the gaging stations were established were obtained from published reports, from interviews with long-time residents, and from other sources. The Geological Survey of New Jersey Report on Water Supply (1894), and the Annual Reports of the State Geologist for the years 1896 and 1903 list major floods that occurred in 1810, 1865, 1882, 1896, and 1903. Available data are insufficient to compare their magnitudes with later floods recorded at gaging stations.

Flood height.—The height of a flood at a gaging station usually is stated in terms of gage height or stage; the elevation of the water surface above a selected datum plane. Flood heights shown in this atlas are elevations above mean sea level, datum of 1929, which is equivalent to the New Jersey Geodetic Control Survey datum. Gage heights or stages at gaging stations on Millstone River and Stony Brook can be converted to elevations above mean sea level by adding the gage height to the appropriate datum of gage listed below. Location of gaging stations, measured along the stream channel from a point near the mouth, and period of record also are shown.

Gaging station	Distance along channel (feet)	Datum of gage above mean sea level (feet)	Period of record
Stony Brook at Princeton	32,400	62.23	October 1953 to September 1965
Millstone River at Plainsboro	106,100	53.41	May 1964 to September 1965
Lake Carnegie at Princeton	84,900	* 50.00	October and November 1924, May 1925, and January 1926 to September 1965
Millstone River near Kingston	79,100	38.00	May 1933 to September 1949

*Prior to October 1, 1950, datum 2.56 feet higher.

Flood occurrence.—The irregular distribution of flood events is evident by the pattern of flood occurrences at the gaging station on Lake Carnegie at Princeton during the period 1926–64 (fig. 1). Floods above 54.5-foot elevation occurred 13 times in the 39-year period, an average of one flood each 3 years. Although no flood of this magnitude occurred in 29 of the years, the three greatest recorded floods occurred during the 5-year period 1934–38.

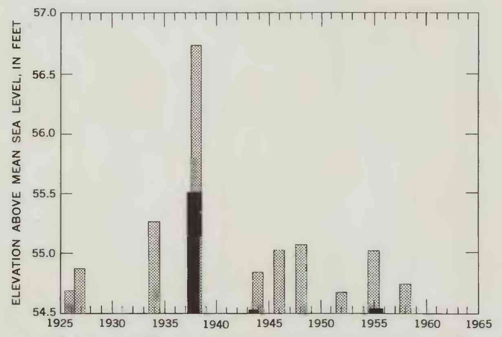

FIGURE 1.—*Floods above 54.5-foot elevation, Lake Carnegie at Princeton, 1926–64.*

Flood discharge.—The rate of discharge of a stream is the volume of flow that passes a specific location in a given period of time. Discharge rates are usually expressed in units of cubic feet per second (cfs). Peak discharge is the maximum discharge attained by a flood. The peak discharge during a flood generally occurs at the time of the maximum height of the flood. However, if the stream is affected by variable backwater, the peak discharge may not coincide with maximum stage.

Flood frequency.—Frequencies of floods at the gaging stations on Stony Brook at Princeton, Millstone River at Plainsboro, Lake Carnegie at Princeton, and Millstone River near Kingston were derived from streamflow records at these stations, combined with records at other nearby stations and with the regional flood-frequency relation for streams in central New Jersey (Thomas, 1964). The relation between frequency and elevation at these stations is shown in figure 2.

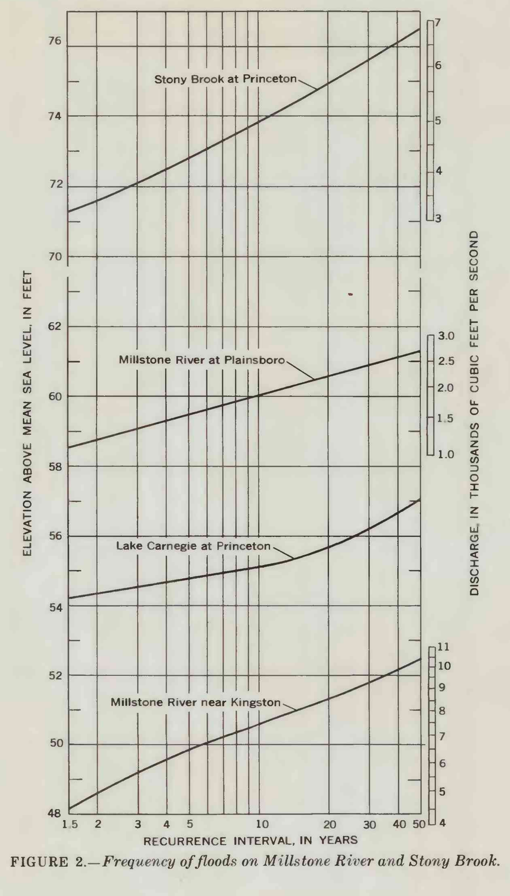

FIGURE 2.—*Frequency of floods on Millstone River and Stony Brook.*

The relation between elevation and frequency is dependent on the relation of stage to discharge. The stage-discharge relation is affected by changes in physical conditions and is not necessarily permanent. The frequency curves shown are based on channel conditions existing in 1965. Large errors may result if these flood-frequency curves are extrapolated beyond a recurrence interval of 50 years.

Recurrence intervals.—Recurrence interval is the number of years, on the average, within which a given flood will be equaled or exceeded. For floods having recurrence intervals greater than 10 years, the recurrence interval is inversely related to the probability of a specific flood being equaled or exceeded in any one year. Thus a 10-year flood would have about one chance in 10, or a 10-percent chance, of being equaled or exceeded in any year.

The general relation between recurrence interval and flood height or discharge at gaging stations on Stony Brook and Millstone River (fig. 2) is tabulated below:

Recurrence interval (years)	Stony Brook at Princeton		Millstone River at Plainsboro		Lake Carnegie at Princeton	Millstone River near Kingston	
	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Elevation above mean sea level (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)
50	76.5	6,700	61.3	2,690	57.1	52.5	10,500
40	76.1	6,400	61.1	2,550	56.6	52.2	9,960
30	75.6	6,100	60.9	2,410	56.1	51.8	9,300
20	75.0	5,650	60.6	2,210	55.6	51.4	8,650
10	73.9	4,990	60.0	1,850	55.1	50.6	7,460
5	72.8	4,240	59.5	1,550	54.8	49.9	6,500
1.5	71.3	3,260	58.6	1,110	54.2	48.2	4,480

Recurrence intervals are average values—the average number of years that will elapse between floods that equal or exceed a given magnitude. For example, about 10 floods of the magnitude of a 10-year flood or greater may be expected to occur in a 100-year period. However, because of the irregular nature of flood events, the fact that a 10-year flood is experienced in one year does not reduce the probability of that flood being equaled or exceeded in the next year or in the next month.

Flood profiles.—Profiles of the water surface based on the floods of September 1938, August 1955, and January 1964 are shown in figure 3. Flood profiles corresponding to other flood magnitudes can be plotted on this diagram generally parallel to those shown. Distances along the channel of the Millstone River used in the profiles were first established by the Works Progress Administration, New Jersey Riparian and Stream Survey, in 1935–39, and are a continuation of those used by Thomas and Tice (1964). The zero point of channel distances for Stony Brook is located at the intersection of the centerline of Carnegie Lake with the Mercer-Middlesex County boundary (approximate original channel of Millstone River).

Individual flood profiles for Big Bear Brook and Cranbury Brook are not shown but they closely approximate the profile for Millstone River in the reaches shown on the map. Along other tributary streams the areas shown as subject to inundation are those that would be flooded by backwater from the Millstone River, Stony Brook, or Delaware and Raritan Canal. More extensive flooding along tributaries could result from severe local thunderstorms, particularly upstream from the mouth.

The abrupt change in the profiles at some road crossings indicates the difference in water-surface elevations at the upstream and downstream sides of bridges. Changes in channel capacity through bridge openings or accumulations of debris may alter the drop in water surface through the bridge and also change the overflow pattern of floods.

Flood depths.—Depth of flooding at any point can be estimated by subtracting the ground elevation from the water-surface elevation indicated by the profiles in figure 3. The approximate ground elevation can be determined from the contours on the maps. More accurate elevations can be obtained by leveling to nearby bench marks. Seven cross sections (figs. 4 and 5) illustrate the depth of flooding experienced at several locations on the map.

Extent of flooding.—The boundary of inundation is shown for the maximum recorded flood of September 1938. The recurrence interval of this flood is about 40 years for the Millstone River near Kingston and Carnegie Lake and about 32 years for Stony Brook at Princeton. The boundary for the flood of January 1964 is also shown to illustrate the difference in areal extent of flooding that can be expected between a large and small flood. The recurrence interval of the January 1964 flood is about 1.3 years for Millstone River near Kingston and Carnegie Lake and about 1.8 years for Stony Brook at Princeton. The boundaries of inundation were determined by plotting the ground position of the water-surface elevation indicated by the September 1938 and January 1964 flood profiles (fig. 3). Boundaries of inundation for other floods can similarly be determined. The flood boundaries shown on the map reflect channel conditions as they existed when the floods occurred; channel changes that may have been made later may change the overflow pattern for future floods.

Future conditions.—The flood-evaluation data in this atlas are applicable to river-channel conditions existing prior to 1965. Desilting basins on Stony Brook upstream from Carnegie Lake may significantly affect floodflows on Stony Brook, but the effect on the Millstone River downstream from Carnegie Lake is expected to be small. Future protective works may reduce the frequency of flooding in the area but will not necessarily eliminate flooding. The inundation pattern of future floods may be affected by the construction of embankments, large land fills, bridges, and other cultural changes.

Additional data.—Other information pertaining to floods in the vicinity of Princeton, New Jersey, may be obtained at the office of the U.S. Geological Survey, Trenton, New Jersey, and from the following reports:

Bettendorf, J. A., 1966, Extent and frequency of inundation of flood plain in vicinity of Princeton, New Jersey: U.S. Geol. Survey open-file report, 31 p.

Bogart, D. B., 1960, Floods of August-October 1955 New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854 p.

Dola, Steven, 1961, Flood damage alleviation in New Jersey: New Jersey Dept. Conserv. and Econ. Devel., Water Resources Circ. 3, 20 p.

Paulsen, C. G., 1940, Hurricane floods of September 1938: U.S. Geol. Survey Water-Supply Paper 867, 562 p.

Thomas, D. M., 1964, Floods in New Jersey, magnitude and frequency: New Jersey Dept. Conserv. and Econ. Devel., Water Resources Circ. 13, 145 p.

Thomas, D. M., and Tice, R. H., 1964, Floods on Raritan and Millstone Rivers in Somerset County, New Jersey: U.S. Geol. Survey Hydrol. Inv. Atlas HA-104.

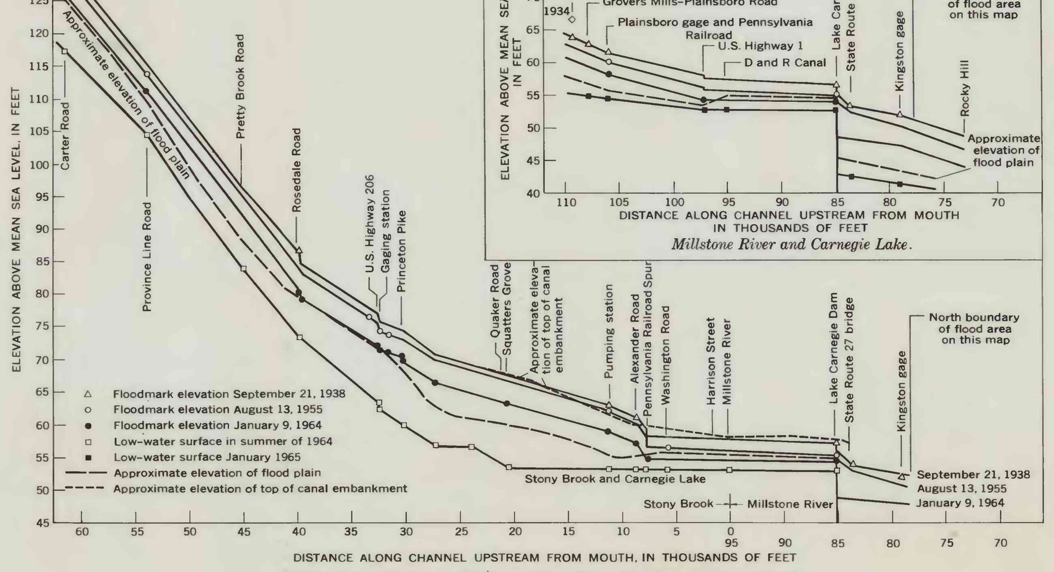

FIGURE 3.—*Profiles of Millstone River, Stony Brook, and Carnegie Lake.*

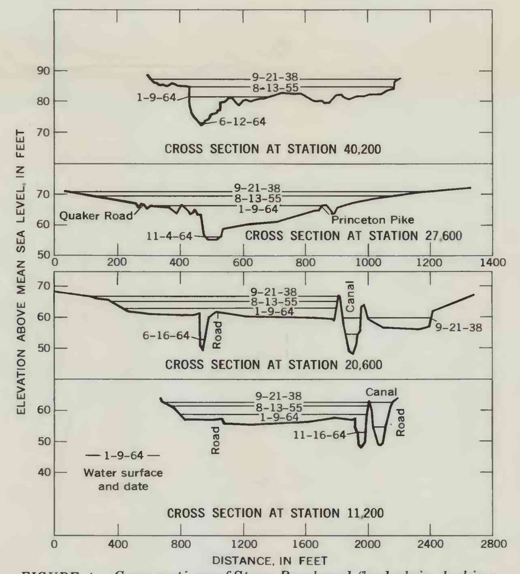

FIGURE 4.—*Cross sections of Stony Brook and flood plain, looking downstream.*

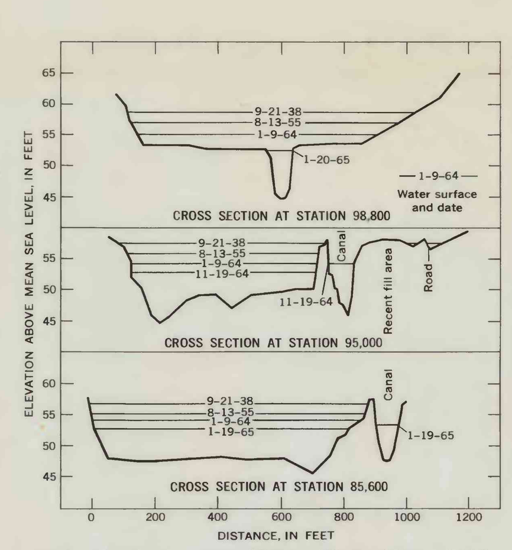

FIGURE 5.—*Cross sections of Millstone River and Carnegie Lake and their flood plains, looking downstream.*

Major floods recorded at U.S. Geological Survey gaging stations on Stony Brook and Millstone River

Date of flood	Stony Brook at Princeton				Millstone River: Lake Carnegie at Princeton		Millstone River: Near Kingston			Average recurrence interval (years)
	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Recurrence interval (years)	Stage (feet)	Elevation above mean sea level (feet)	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	
Sept. 12, 13, 1960	10.85	73.08	4,400	6	4.44	54.44	-	-	-	2
Aug. 13, 1955	11.90	74.13	5,130	12	5.02	55.02	-	-	-	8
Dec. 30, 1948	-	-	-	-	2.6[a]	55.2	12.86	50.86	7,230	12
Sept. 21, 1938	-	-	-	32	4.20[b]	56.76	14.12	52.12	9,820	40

[a] From graph of 8 a.m. readings, datum then in use.
[b] From floodmark, datum then in use.

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FLOODS ON MILLSTONE RIVER AND STONY BROOK IN VICINITY OF PRINCETON, NEW JERSEY

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1967