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HYDROLOGIC EFFECTS OF STORMS OF JUNE 24-28, 1974, IN LEE AND COLLIER COUNTIES, FLORIDA

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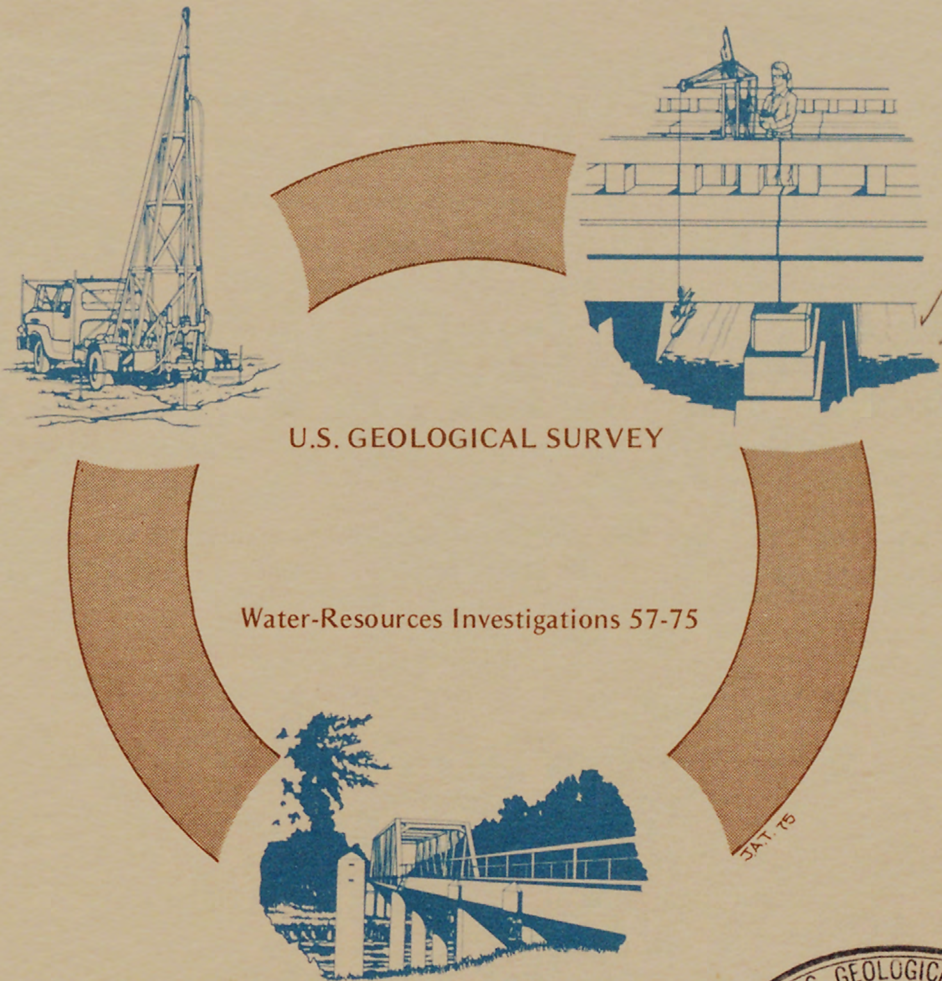

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BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No.
4. Title and Subtitle Hydrologic effects of storms of June 24-28, 1974, in Lee and Collier Counties, Florida			5. Report Date January 1976 6.
7. Author(s) R. A. Miller and M. A. Benson			8. Performing Organization Rept. No. 57-75
9. Performing Organization Name and Address U.S. Geological Survey, WRD 325 John Knox Road, Suite F-240 Tallahassee, Florida 32303			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address U.S. Geological Survey, WRD 325 John Knox Road, Suite F-240 Tallahassee, Florida 32303			13. Type of Report & Period Covered Final 1974 14.

15. Supplementary Notes

In cooperation with the County commissioners of Collier and Lee Counties

16. Abstracts

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17. Key Words and Document Analysis. 17a. Descriptors

Floods, frequency analysis, ground water, rainfall

17b. Identifiers/Open-Ended Terms

Rainfall-frequency, flood frequency, stage frequency, South Florida.

Hurricane Donna (1960)

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
No restriction on distribution	UNCLASSIFIED	35
	20. Security Class (This Page) UNCLASSIFIED	22. Price

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By R. A. Miller and M. A. Benson

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CITY OF NAPLES, FLORIDA

January 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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325 John Knox Road, F-240
Tallahassee, Florida 32303

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HYDROLOGIC EFFECTS OF STORMS OF JUNE 24-28, 1974, IN LEE AND COLLIER COUNTIES, FLORIDA

By

R. A. Miller and M. A. Benson

ABSTRACT

The storms of June 24-28, 1974, in Lee and Collier Counties, Florida, produced common meteorological events although widespread flooding, beach erosion, and utility failures occurred.

Recurrence intervals of the rainfall at Fort Myers are less than 5 years for durations under 6 hours, and less than 10 years for durations under 2 days.

Recurrence intervals for peak ground-water elevations in Lee and Collier Counties as a result of the storm are less than 5 years, as are the recurrence intervals for both stage and discharge in streams.

INTRODUCTION

During the latter part of June 1974 two storm systems crossed peninsular Florida in a northeasterly direction and produced considerable damage as a result of heavy rains and high tides. Both storm systems entered Florida from the Gulf of Mexico, one about one-half and the other about one-third of the way down the peninsula.

This report documents the storms' effects in Lee County and the western part of Collier County (fig. 1). Other reports on the hydrology of this area — but not including information on storms — have been prepared by Missimer and Boggess (1974); Sproul, Boggess, and Woodard (1972); McCoy (1962, 1973).

Comparison and evaluation of the severity of hydrologic events is best done on a frequency basis, whereby the probability or recurrence interval of the events is computed on the basis of available data. This can be done for rainfall, discharge, and stage data. Some data for locations outside the area of the report were used to compute recurrence intervals as outlined above. This was done to better define the conditions near the boundaries of the area and to indicate trends of storm severity through the area.

The authors thank the following company and governmental agencies for assistance in providing data and interpretations:

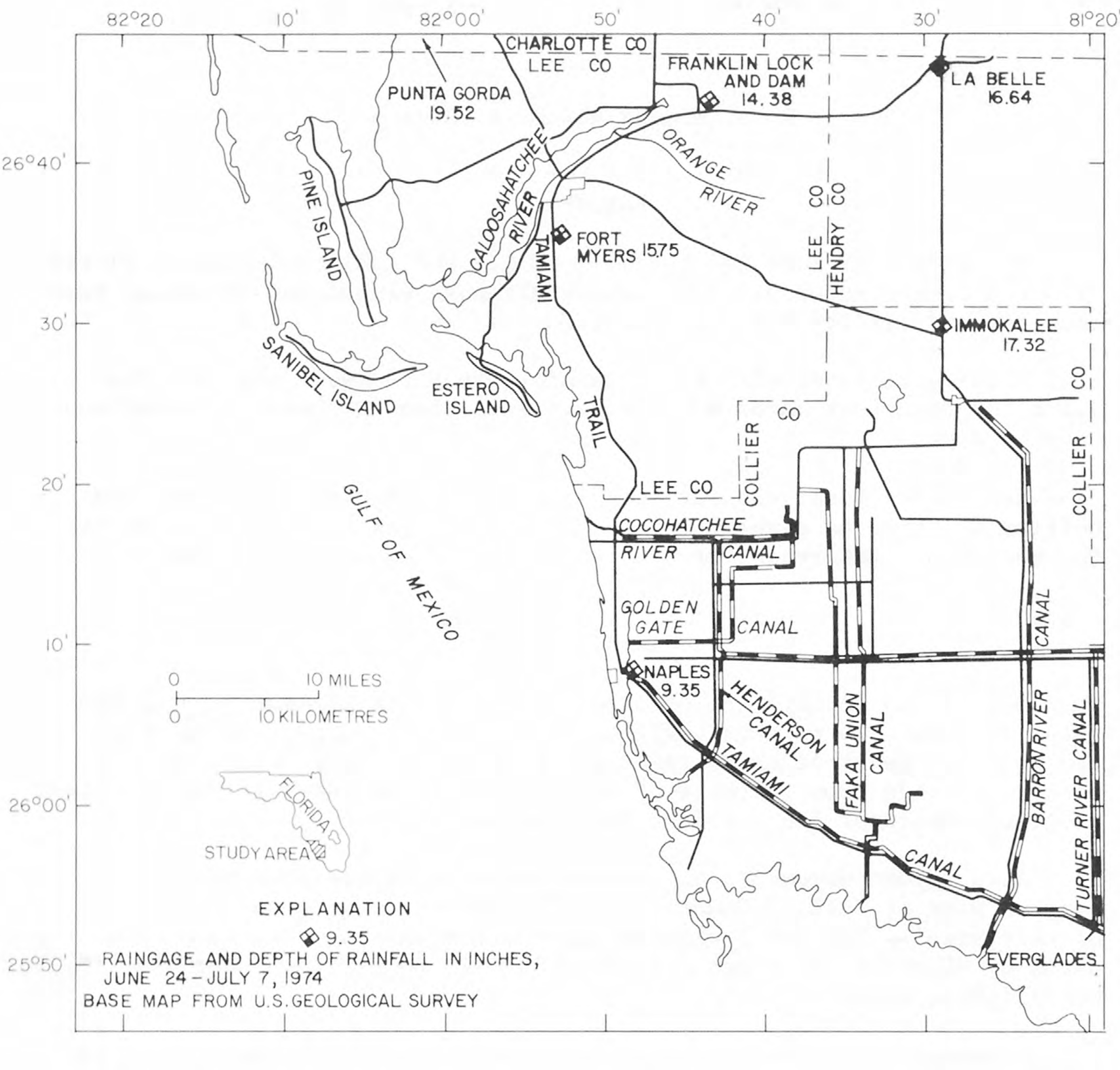


Figure 1.--Area of southwest Florida covered by this report, Lee and western Collier counties.

National Oceanic and Atmospheric Administration:
Tides Processing Branch, Rockville, Md.
National Weather Service, Page Field, Fort Myers, Fla.
National Weather Service, User's Services, Ashville, N.C.
National Hurricane Center, Coral Gables, Fla.

U.S. Army Corps of Engineer, Jacksonville, Fla., and Clewiston, Fla.

Federal Disaster Assistance Administration, Atlanta, Ga.

Johnson Engineering, Inc., Fort Myers, Fla.

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below:

Multiply English unit	By	To obtain metric unit
feet (ft)	0.3048	metres (m)
miles per hour (mi/h)	1.609	kilometres per hour (km/h)
inches (in)	25.4	millimetres (mm)

METEOROLOGICAL CONDITIONS

During June 21-28, 1974, a complex of meteorological conditions resulted in two storm systems that entered Florida from the Gulf of Mexico. While crossing the state, the storms caused considerable damage, particularly along the Gulf coast, as a result of heavy rains and high tides. The first system produced an unnamed subtropical storm. The term "storm" denotes that wind velocities were between 39 and 73 mi/h (63 to 117 km/h) and the term "subtropical" means that the phenomenon originated in the subtropical zone (25° to 35° latitude). The second system produced a tropical depression. The term "depression" denotes that wind velocities were less than 39 mi/h (63 km/h) and the term "tropical" means that the phenomenon originated in the tropical zone (10° to 25° latitude).

Before June 21, surface barometric pressures over the southwestern part of the Gulf of Mexico gradually lowered as a result of the northeastward extension of the trough from dissipating Hurricane Dolores near Acapulco, Mexico. During the last week in June, an unusually strong upper atmospheric trough of low pressure developed over the southeastern United States and adjacent waters. This brought a week of record-breaking low temperatures to much of the eastern two-thirds of the country. This trough had two other effects on Florida weather. First, it helped to generate the sub-tropical storm in the eastern part of the Gulf, that crossed Florida just north of Tampa and Orlando on June 25. Second, it produced conditions unfavorable to the further development of the tropical depression previously existing in the southwestern part of Gulf of Mexico. This caused the depression to turn back in a southerly direction and then, when it reverted to a northeasterly direction, it was weakened, and finally crossed Florida on June 27, somewhat north of the first storm system. The paths of these two disturbances and the associated dates are shown on the map on figure 2.

The strong southerly winds associated with these two storm systems produced tides of 2 to 4 ft (0.6 to 1.2 m) above normal from Everglades City to the Tampa Bay area. Sustained winds of 35 to 45 mi/h (55 to 70 km/h) with gusts between 50 and 65 mi/h (80 to 105 km/h) were reported from the Fort Myers and Naples area during the night and early morning hours of June 24-25. Although neither of these storm systems achieved hurricane status, gale warnings were issued during June 25 from Naples to Homosassa on the Gulf coast.

Rainfall for June 25-28 totaled 20 in (510 mm) in the Tampa Bay area, which is north of Lee County, and 10 in (250 mm) or more over much of west-central Florida. Several tornadoes and waterspouts during the 4-day period caused only minor damages and no injuries.

RAINFALL

Rainfall data for June 24 to July 7, 1974, were provided by six gages at Franklin Lock near Olga, Naples, Immokalee, Fort Myers, La Belle and Punta Gorda (fig. 1). Daily rainfall values are available for all stations, and additionally, hourly values are available for Fort Myers. All stations except Franklin Lock are operated by the National Weather Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The Franklin Lock station is operated by the U.S. Army Corps of Engineers.

Depths of Rainfall

Daily amounts of rainfall for each of the six stations are given in table 1; the hourly data from the Fort Myers station are given in table 2. Total rainfall for June 24 to July 7, 1974, ranged from 9.35 in (237 mm) at the Naples station to 19.52 in (496 mm) at the Punta Gorda station.

Frequencies of Rainfall

From the data collected at the Fort Myers station, and shown in tables 1 and 2, maximum amounts of rainfall at that station for various

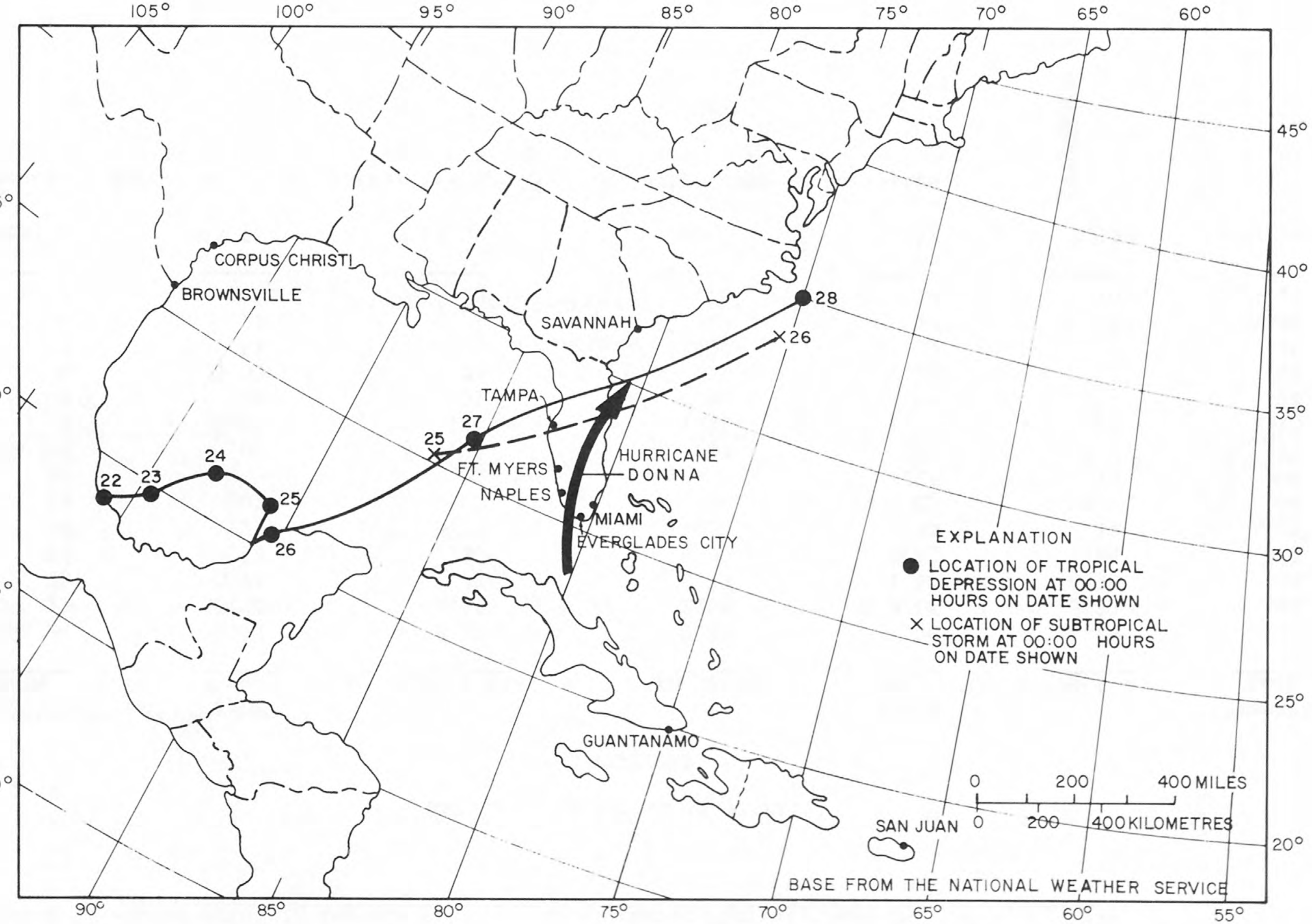


Figure 2.--Tracks of disturbances causing the Gulf coast flooding of June 24-28, 1974 and Hurricane Donna in 1960.

Table 1.--Daily rainfall for six stations in southwest Florida, June 24 - July 7, 1974

Rainfall, in inches (T = trace)

STATIONS

Date	Fort Myers	Immokalee	La Belle	Punta Gorda	Naples	Franklin Lock
June 24	2.94	2.41	0.35	3.08	1.56	2.25
25	5.52	6.45	2.40	3.16	3.33	4.81
26	0.22	.75	2.73	1.40	1.30	.14
27	.58	.30	.08	2.50	.64	.63
28	.35	3.20	4.50	2.30	1.12	1.09
29	.07	.05	1.68	.03	T	.08
30	T	.00	.00	2.26	.15	.00
July 1	.04	.00	.07	.35	T	.87
2	1.45	.32	1.11	2.53	.09	1.15
3	.74	.55	.80	.08	.00	.28
4	3.09	.28	.51	1.02	T	.65
5	.48	.20	1.24	.19	.23	.16
6	.27	2.71	.42	.43	.23	1.09
7	T	.10	.75	.19	.70	1.18
Total:	15.75	17.32	16.64	19.52	9.35	14.38

Source of data: National Weather Service and U.S. Army Corps of Engineers.

Table 2.--Hourly rainfall for the Fort Myers station, June 24-28, 1974

Rainfall, in inches (T = trace)

Time, hours

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Sum
0.06	0.03	0.04	0.01	0.04	0.78	0.29	0.50	0.40	0.12	0.17	0.06	T	0.01	0.05	0.03	0.02	0.02	0.04	0.02	0.04	0.09	0.10	0.02	2.94
.02	T	.01	.11	.55	.88	1.51	1.00	.55	.20	.09	.07	.18	.12	.07	.04	.02	T	T	T	.00	T	.07	.03	5.52
.01	.03	.09	.04	T	T	T	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.05	0.22
.03	T	.00	.00	.00	.00	.00	T	T	.00	.00	.33	.09	.09	.04	T	T	T	T	T	.00	.00	T	T	0.58
.03	.09	.05	.00	.00	.00	.15	.00	.00	T	.03	T	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	0.35

Source of data: National Weather Service.

time durations are:

Duration	Maximum amount of rainfall (in)
1 hour	1.51
6 hour	4.69
1 day	5.52
2 day	8.46

Depth - duration - frequency curves for the Ft. Myers area were computed and drawn using the techniques given by U.S. Department of Commerce (1961, 1964). The calculated values are shown in table 3, and plotted in figure 3. Superimposed on figure 3 are the maximum rainfall amounts as given above.

The 1-hour rainfall proved to be only slightly greater than an annual occurrence. The 1-day rainfall was approximately a 2½-year event, the 6-hour rainfall was a 5½-year event, and the 2-day rainfall was an 8-year event. For durations longer than 2 days, the recurrence interval decreased. Thus the rainfall recorded at Ft. Myers during the storm period, for any duration, proved to be less than a 10-year event. It is expected that the rainfall intensity during the storm period south of the Ft. Myers station was even less rare.

SURFACE-WATER STAGES

Surface-water stage data are available from three different data networks. They are the gaging stations (where the maximum recorded gage height was simply noted), the crest-stage gage stations (CSG), and miscellaneous sites. The locations of the gaging stations and crest-stage gages are shown in figure 4. Most of the CSG stations are located in Lee County and were recently installed. The miscellenaous sites are at bridges or other prominent locations which were readily accessible immediately after the storm.

High-Water Marks

A tabulation of the high-water mark elevations and locations obtained from all sources is given in table 4. The high-water mark elevations at gaging stations and CSG sites are shown in figure 5 and those for miscellaneous sites are shown in figure 6. All elevations are to mean sea level, datum of 1929.

Stage Frequencies

Maximum stages as defined by high-water marks, or more specifically their elevations, can be placed in perspective by analyzing them with

Table 3.--Rainfall[a] for various durations and return periods for Fort Myers

Return period (year)	Rainfall, in inches — Duration: 1 hour	6 hours	1 day	2 days
2	2.2	3.5	5.0	5.5
5	2.7	4.6	6.6	7.5
10	3.0	5.2	7.7	8.5
25	3.4	6.2	9.0	10.5
50	3.7	6.8	10.0	12.
100	4.0	7.5	11.0	14.

a Calculated by techniques described in U.S. Department of Commerce (1964).

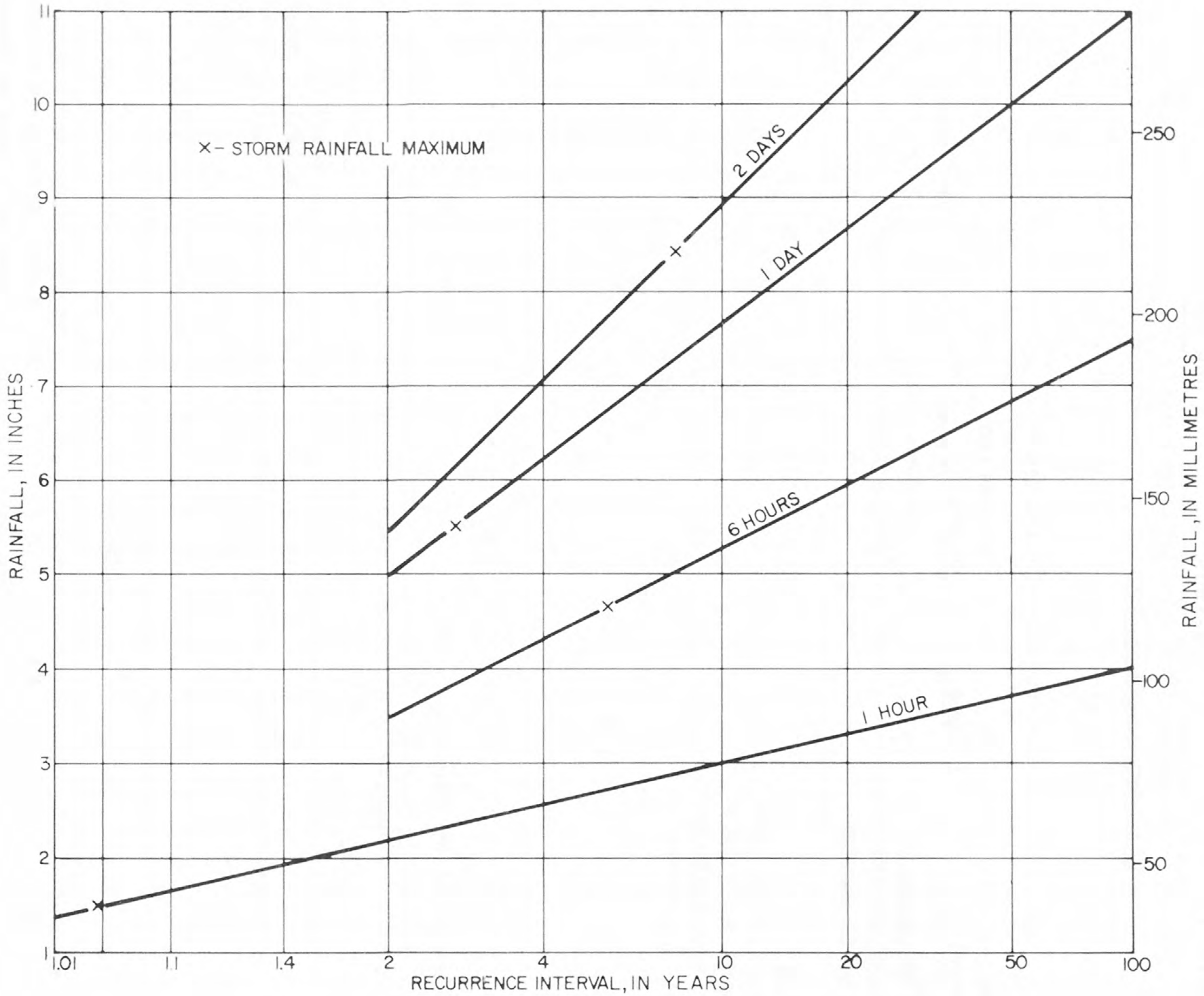


Figure 3.--Rainfall depth-frequency-duration curves for area of Fort Myers, Florida.

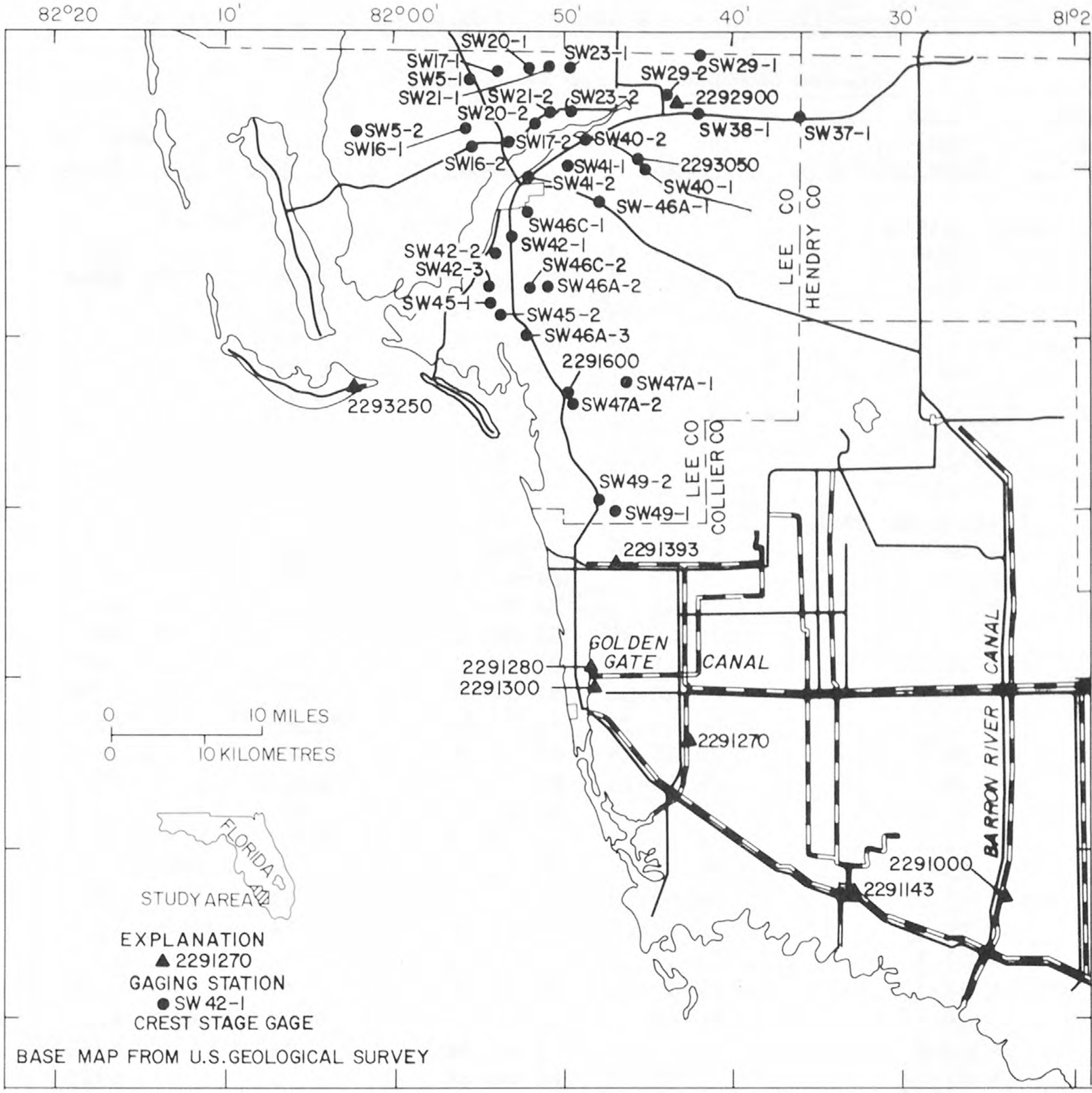


Figure 4.--Location of gaging stations and crest-stage gages in southwest Florida.

Table 4.--Location and elevation of high-water marks in Lee and Collier Counties, June 24 - July 14, 1974.

Site	Location lat	Location long	Peak (ft, MSL)	Date of Peak
Gaged Sites				
2291000	25-57-28	81-21-19	4.63	7/14
2291143	25-57-59	81-30-23	3.96	6/26
2291270	26-05-59	81-41-14	7.51	6/26
2291280	26-10-26	81-47-06	3.13	6/25 or 26
2291300	26-10-01	81-46-02	5.70	6/26
2291393	26-16-21	81-45-53	9.13	7/ 6
2292900	26-43-25	81-45-55	4.83	6/25
2293250	26-26-34	82-02-25	3.77	6/25
Crest-Stage Gages				
2291600	26-26-04	81-48-18	3.50	6/28
2293050	26-40-12	81-43-56	9.65	6/26
SW 5-1	26-44-37	81-55-01	20.5	6/25
SW 5-2	26-41-39	82-02-21	4.28	6/25
SW 16-1	26-41-47	81-55-12	5.24	6/25
SW 16-2[a]	26-40-54	81-54-40	4.71	6/25
SW 17-2	26-40-54	81-52-40	5.60	6/25
SW 20-1	26-45-18	81-51-05	23.13	7/ 8
SW 20-2	26-42-14	81-50-42	5.54	7/ 8
SW 21-1	26-45-18	81-49-30	23.32	7/ 8
SW 21-2	26-42-53	81-49-20	8.79	7/ 8
SW 23-1	26-45-19	81-48-34	24.25	7/ 8
SW 23-2	26-42-53	81-48-32	4.91	6/25
SW 29-2[a]	26-43-49	81-42-06	5.29	6/25
SW 37-1	26-42-30	81-35-58	4.37	6/25
SW 38-1	26-42-53	81-40-22	4.76	6/25
SW 40-1	26-40-12	81-43-55	6.78 (8.50)[c]	6/26
SW 40-2	26-41-15	81-47-32	4.92	6/25
SW 41-1	26-39-53	81-48-46	11.56	6/25
SW 41-2[a]	26-39-04	81-51-25	5.21	6/25
SW 42-1	26-35-43	81-52-25	12.65	6/25
SW 42-3	26-32-39	81-53-45	5.11	6/25
SW 45-2[a]	26-31-13	81-52-59	4.44	6/25
SW 46A-1	26-37-36	81-46-43	20.30	6/25
SW 46A-2	26-32-47	81-50-04	16.08	6/29
SW 46A-3[b]	26-29-57	81-51-14	8.34	6/29
SW 46C-1	26-37-19	81-51-22	16.58	6/25
SW 46C-2	26-32-47	81-51-20	14.65	6/29
SW 47A-2	26-26-04	81-48-19	3.50	6/29
SW 49-1	26-19-52	81-45-57	12.20	7/ 3
SW 49-2	26-20-32	81-46-45	4.54	7/ 3

Table 4 (Cont.).--Location and elevation of high water marks in Lee and Collier Counties, June 24 - July 14, 1974.

Site	Location lat	Location long	Peak (ft,MSL)	Date of Peak
Miscellaneous Sites				
COLLIER COUNTY-Highway U.S.#41				
Br. 84; Turner R. Canal	25-53-[d]	81-15½-	2.56	
Br. 77	25-54½-	81-21½-	2.56	
Br. 76; Barron R. Canal	25-54½-	81-21½-	2.91	
Br. 58	25-57½-	81-29½-	2.87	
Fahka Union Canal	25-57½-	81-30½-	3.63	
Br. 51	25-58-	81-32-	2.95	
Br. 37	26-00-	81-36-	3.32	
Br. 16	26-06-17	81-44-45	5.05	
Br. 15; Haldeman River	26-07-23	81-45-46	2.46	
Br. 14; Gordon River	26-08-23	81-47-13	2.64	
Br. 13; Gordon River	26-08-29	81-47-24	3.97	
Cocohatchee River	26-16-55	81-48-07	2.85	
COLLIER COUNTY-Western Section				
A bridge 4.8 mi SW intersection of SR 92 & US 41	25-56	81-39	2.27	
Boat basin @ NW corner of Mooringline Dr bridge	26-10-25	81-48-50	2.81	Not known
Seawall parking area on east side of Gulf shore Blvd. just south of Park Shore Dr.	26-12-13	81-49-00	2.94	
LEE COUNTY				
FL-1	26-39-55	82-09-25	4.20	
FL-2	26-37-59	82-04-02	4.82	
FL-3	26-45-55	82-02-15	12.83	
FL-4	26-45-45	82-02-15	12.10	
FL-5	26-42-56	81-54-12	17.45	
FL-6	26-43-25	81-41-55	5.17	
FL-7	26-42-49	81-36-19	6.34	
FL-8	26-40-50	81-44-32	4.78 (6.84)	
FL-9	26-38-49	81-52-08	5.04	
FL-10	26-29-52	81-51-09	7.71	
FL-11	26-28-30	81-50-15	2.57	
FL-12	26-34-36	81-53-54	4.28	
FL-13	26-32-27	81-55-08	4.88	
FL-14	26-32-02	81-55-37	4.88	
FL-15	26-29-38	81-58-39	4.69	
FL-16	26-29-31	81-59-27	5.36	

Table 4 (Cont.).--Location and elevation of high water marks in Lee and Collier Counties, June 24 - July 14, 1974.

Site	Location lat	Location long	Peak (ft,MSL)	Date of Peak
LEE COUNTY (Cont'd)				
FL-17	26-29-10	82-00-35	4.43 (7.72)	
FL-18	26-28-55	82-00-20	5.81	
FL-19	26-28-36	82-01-32	5.97	
FL-20	26-27-16	82-00-53	5.30	
FL-21	26-26-25	82-02-22	5.20	
FL-22	26-26-21	82-02-17	6.03	Not known
FL-23	26-25-18	82-04-49		
FL-24	26-28-58	82-10-58	4.70	
FL-25	26-37-59	81-57-04	5.03 (8.24)	
FL-26	26-27-23	81-57-16	4.32	
FL-27	26-27-21	81-57-17	4.74 (9.67)	
FL-28	26-27-11	81-57-56	6.67 (9.78)	
FL-29	26-27-09	81-57-54	6.56 (9.30)	
FL-30	26-26-51	81-56-15	4.95 (9.10)	
FL-31	26-25-31	81-54-28	5.00 (8.21)	
FL-32	26-24-15	81-52-58	5.08	
FL-33	26-23-59	81-52-14	4.63	
FL-34	26-22-37	81-51-40	5.00	
FL-35	26-21-33	81-51-30	4.36	
FL-36	26-19-49	81-50-15	4.07	

a--Tidal Marks
b--Gage operated by Johnson Engineering, Inc.
c--High-water mark elevations in parentheses are from Hurricane Donna
d--Locations south of latitude 26° can not be located to nearest second

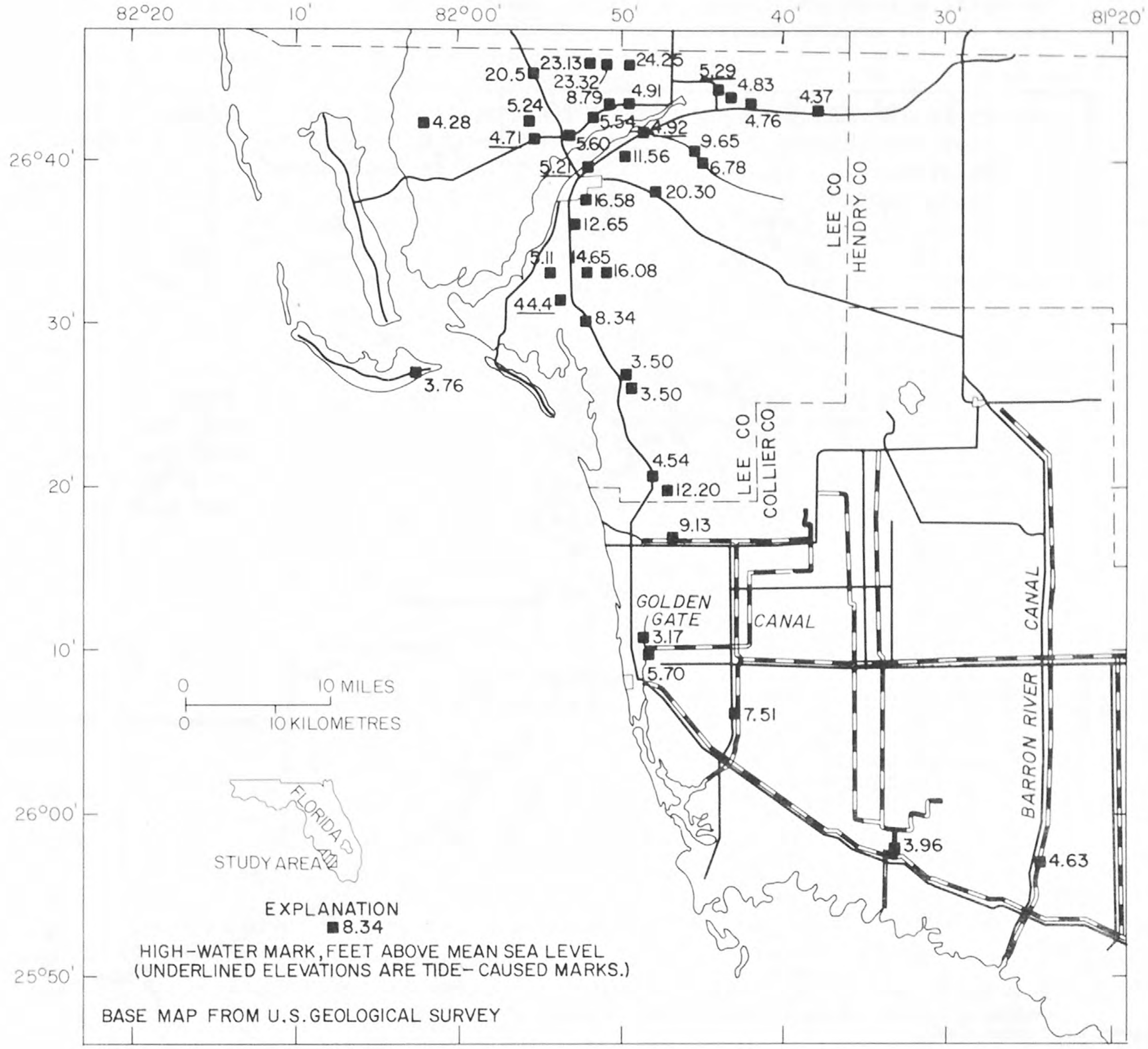


Figure 5.--Elevations of high-water marks, June 24-July 14, 1974, in southwest Florida at gaging stations and crest-stage gages.

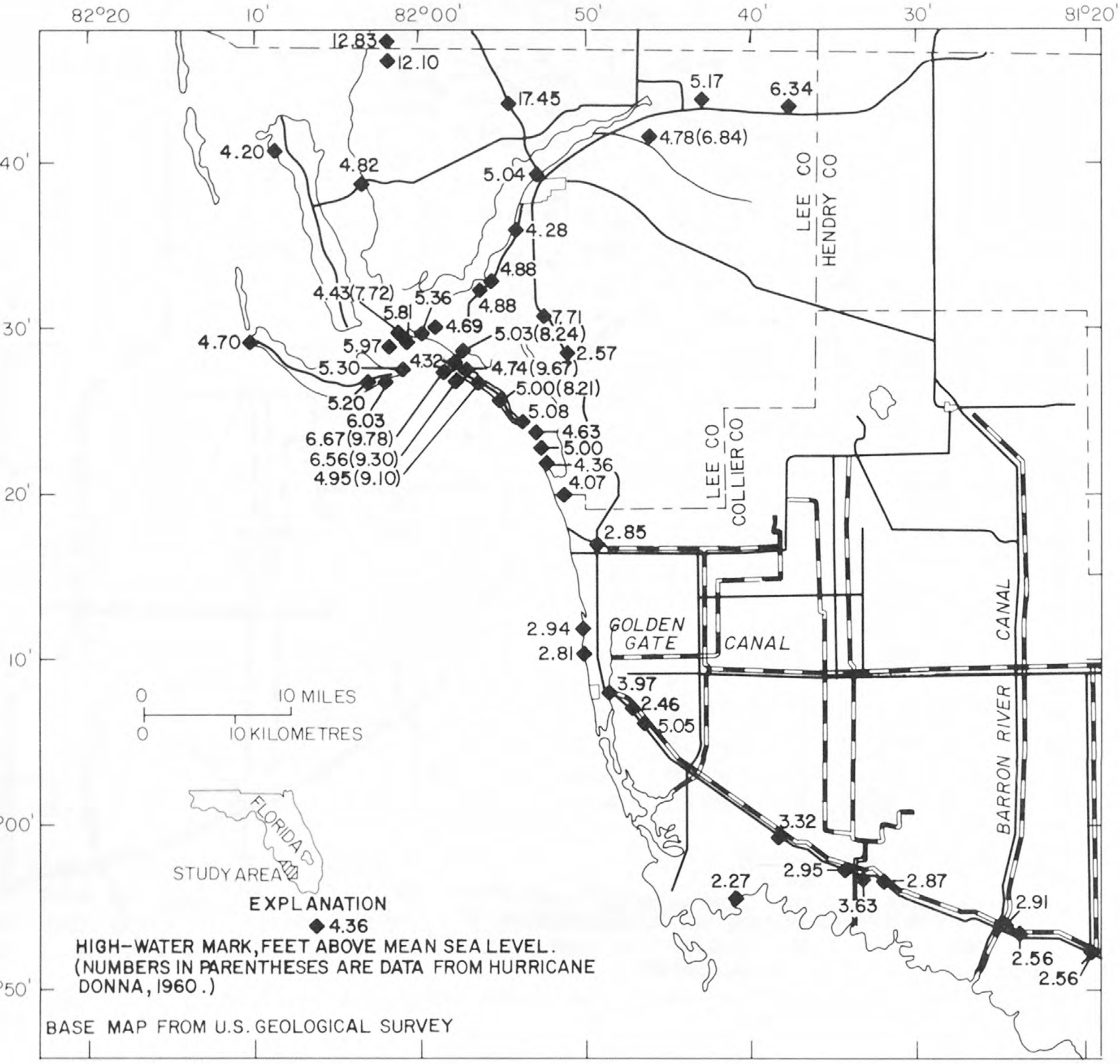


Figure 6.--Elevations of high-water marks, June 24-July 8, 1974, in southwest Florida at miscellaneous sites.

respect to frequency of occurrence. That is, how often does a stage of given elevation occur? Of course, the less frequent stages are of most interest because they produce the greater flooding.

Analysis of frequency is accomplished by ranking all annual events numerically, with the event of highest magnitude receiving the smallest numerical rank. The recurrence interval of the event is calculated by dividing the number of years of record plus 1 year by the numerical rank. In this procedure the most rare event is given a recurrence interval approximately equal to the number of years of record and the most common event (largest numerical rank) is given a recurrence interval of slightly greater than 1 year. Plots of the data may then be prepared showing stage as a function of recurrence interval.

Frequency analysis, although possible, is not reliable for all established stations because the length of record may be too short. A record of less than 10 year is not considered to be long enough to define a reliable frequency relation (Dalrymple; 1960). For this reason only data from stations having 10 year or more of record were included in this report.

Considering this limitation, only four stations had sufficient length of record for analysis - Barron River Canal near Everglades (2291000), Golden Gate Canal at Naples (2291300), Orange River at Buckingham (2293050), and Shell Creek near Punta Gorda (2298202). The lengths of record are respectively 22, 10, 13, and 10 years.

The stage-frequency plots for the stations are shown in figure 7. Noted on each plot is the 1974 event. The frequencies or recurrence intervals, for the four stations are:

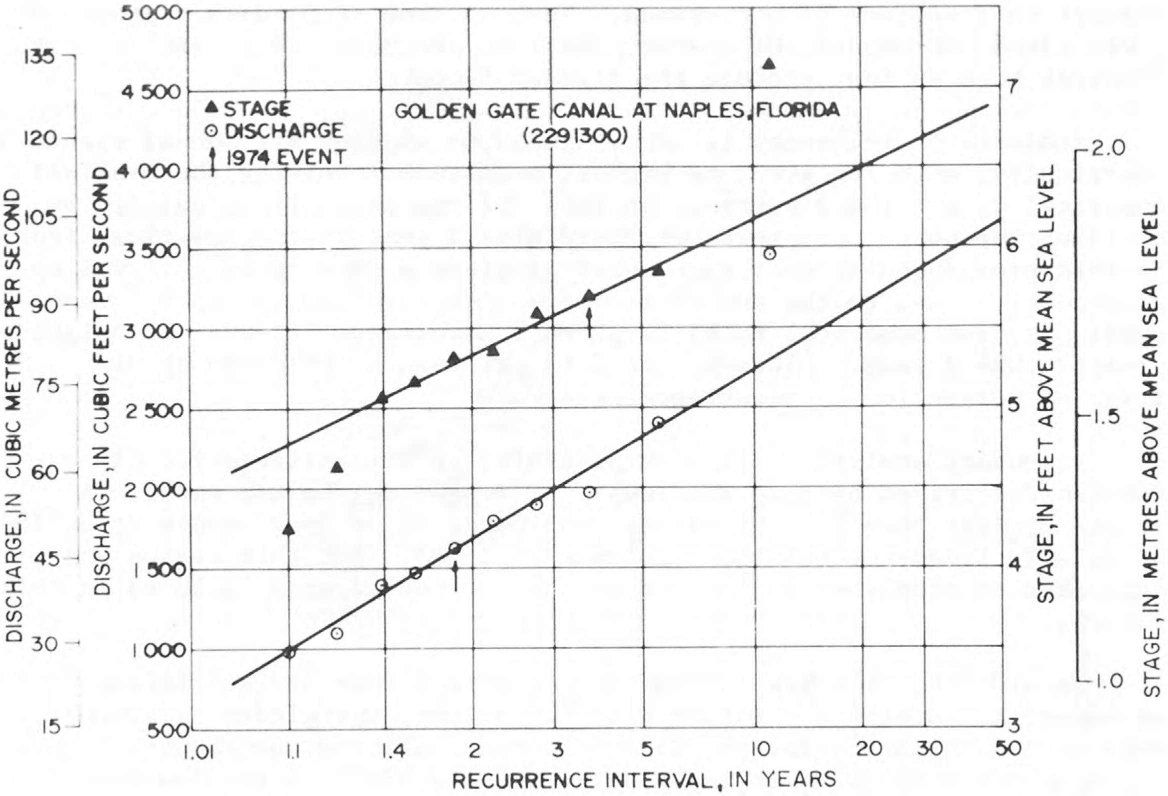
Station	Recurrence interval (years)
Barron River Canal	<1.1
Golden Gate Canal	3.7
Orange River	4.0
Shell Creek	$>10.$

The Shell Creek station is in Charlotte County nort of Lee County, and was used to verify the trend of increasing rarity of the 1974 maximum stage in a northerly direction.

RUNOFF

Streamflow Stations

The effect of the rainfall on peak discharges of surface streams during or subsequent to the storms was examined at 8 streamflow gaging stations and 2 CSG stations (fig. 5) maintained by the U.S. Geological



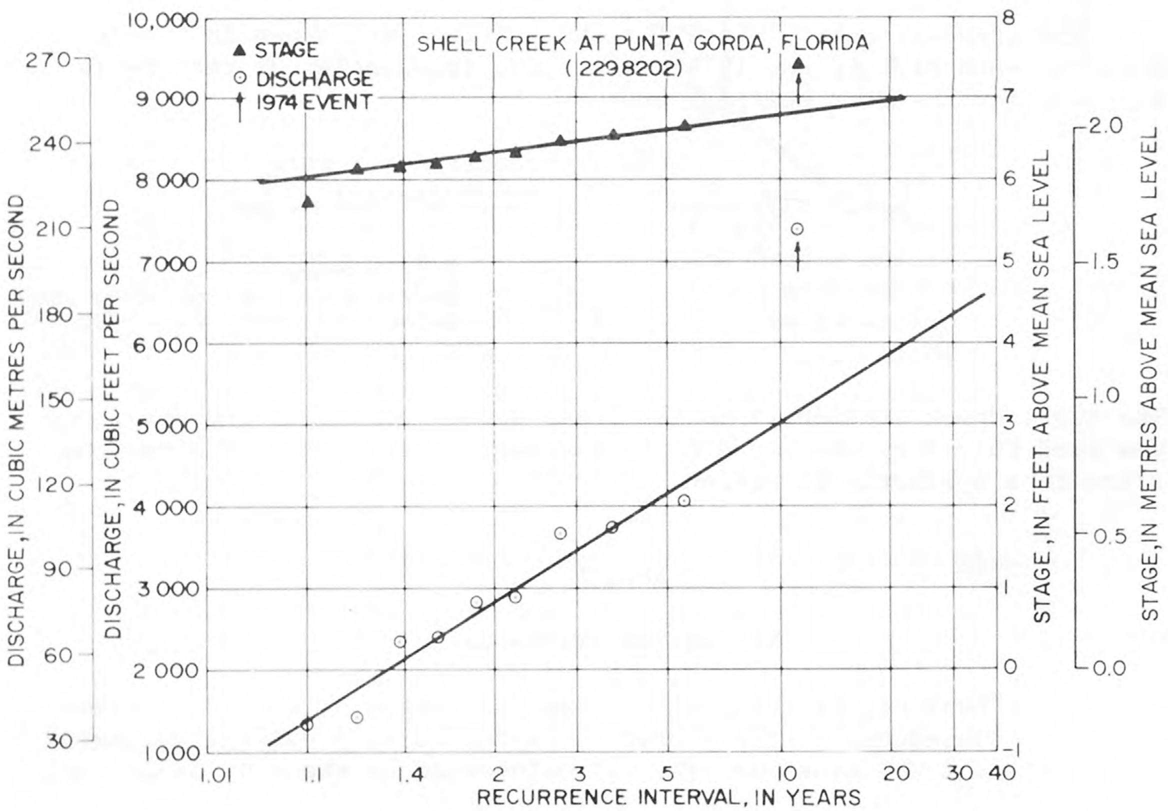
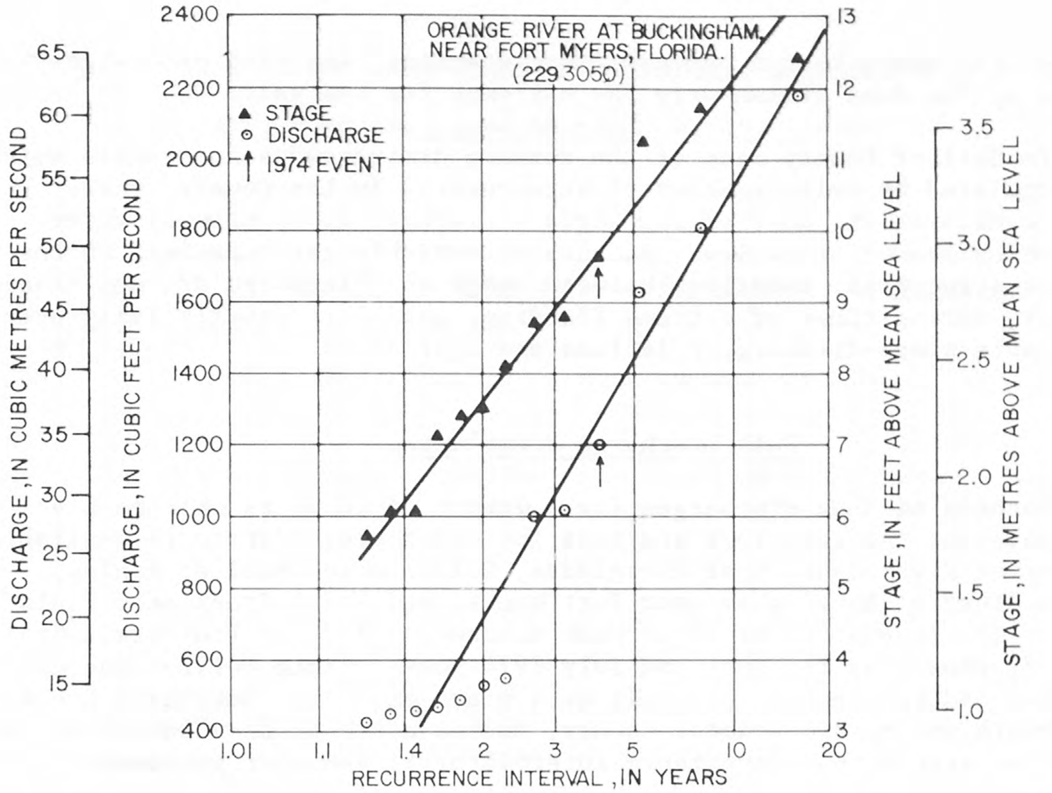


Figure 7.--Discharge and stage frequency at four sites located in southwest Florida.



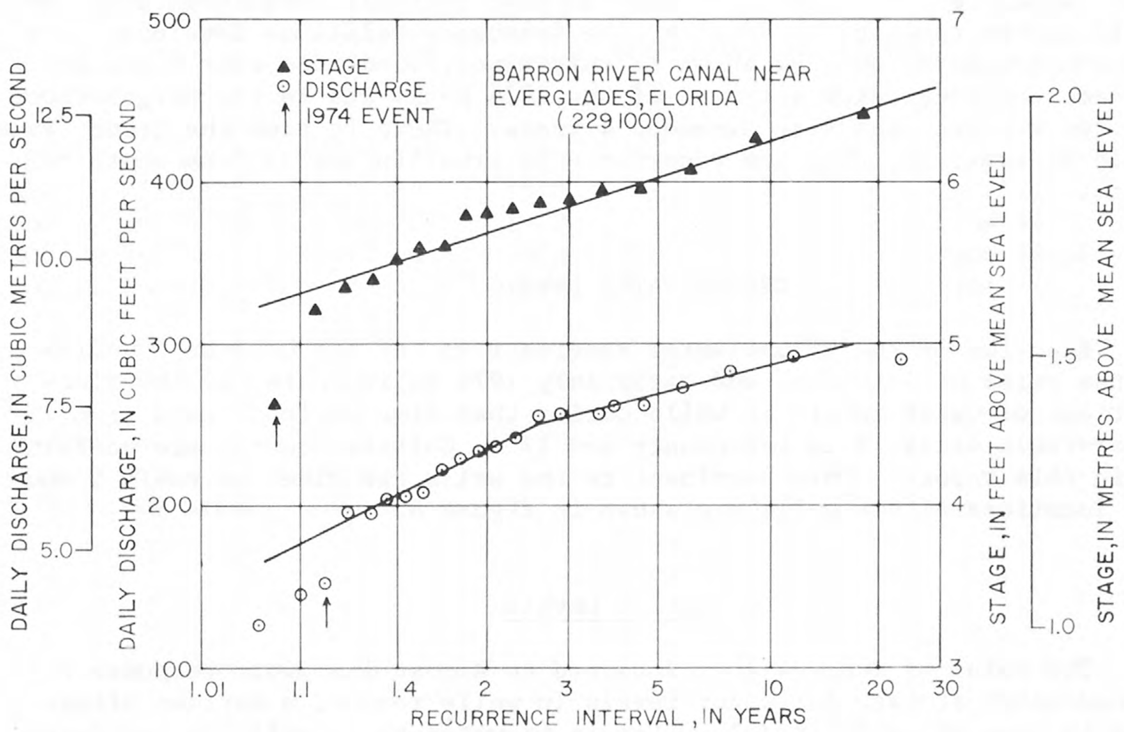


Figure 7.--(Cont.) Discharge and stage frequency at four sites located in southwest Florida.

Survey. At most, though not all these stations, the peak discharges caused by the June storms were the extremes for the year.

In Collier County many of the surface drainageways are canals which are regulated by salinity-control structures. In Lee County, where fewer canals exist, most of the surface drainage is by natural waterways which are uncontrolled. Because of variable gate openings on the control structures, relations between stage and discharge are not stable. However, during times of extreme flooding, gates are usually fully open and stable stage-discharge relations are approached.

Peak Discharge Frequencies

Records of peak discharges for a length of 10 years or more are available for the same four stations for which stage data were available - the Barron River Canal near Everglades, Golden Gate Canal at Naples, Orange River at Buckingham near Fort Myers, and Shell Creek near Punta Gorda. The frequency curves of peak discharges for the four stations (fig. 7) show that the June and July 1974 peaks within Collier and Lee Counties had recurrence intervals of 4 years or less. But Shell Creek near Punta Gorda in Charlotte County, to the north of Lee County, had a peak discharge with a recurrence interval of 11 years or greater.

At the remaining 6 stations whose records were analyzed, lengths of that record were less than 10 years so that reliable frequency relations could not be developed. However, the frequency relations developed from the short record (but not shown in this report) indicate that for most streams the recurrence interval of the 1974 peaks was in the neighborhood of 1 or 2 years, and none exceeded 4 years. There is also the trend, as would be expected, that the recurrence interval increased from south to north.

GROUND-WATER LEVELS

Reaction of the ground-water reservoir in Lee and Collier Counties to the rains of late June and early July 1974 is indicated by the fluctuations of water levels in wells during that time period. Data from 15 water-table wells, 3 in Lee County and 12 in Collier County, are contained in this report. Data pertinent to the wells are given in table 5 and the locations of the wells are shown in figure 8.

Maximum Levels

The rains of June 24-July 7 caused an almost immediate response in ground-water storage and water levels in wells reached a maximum either late in June or early in July. Levels in water-table wells in Lee County peaked during the first week of July. The wells in Collier County peaked

Table 5.--Location and maximum levels of water-table wells in Lee and Collier Counties, June 26 - July 8, 1974.

Well No.	Location Lat.	Long.	Beginning of Record	Maximum Stage of 1974 feet, MSL	Date of Maximum Stage
LEE COUNTY					
246 [a]	26-38-02	81-49-34	1945	19.78	July 2
576	26-42-53	81-36-54	1967	7.38	July 4-5
1137	26-39-50	81-35-53	1970	.02[b]	July 7
COLLIER COUNTY					
131	26-25-16	81-16-54	1952	26.06	July 6
296	26-06-40	81-20-43	1960	11.96	July 8
381	26-06-30	81-41-16	1963	8.38	June 26
382	26-10-53	81-43-07	1963	9.85	June 26
383	26-15-37	81-39-02	1963	13.40	July 6
384	26-16-20	81-45-07	1963	12.48	July 6
462	26-27-24	81-26-07	1968	2.08[c]	not known
495	25-57-48	81-18-18	1970	6.20	July 10
496	26-01-11	81-24-39	1970	5.44	June 26
500	26-05-59	81-44-28	1972	3.85	June 28
502	26-14-08	81-30-54	1972	13.94	June 26-July 8
503	26-17-41	81-23-54	1972	19.20	June 26

a Well subject to pumping
b Feet below land surface
c Depth to water

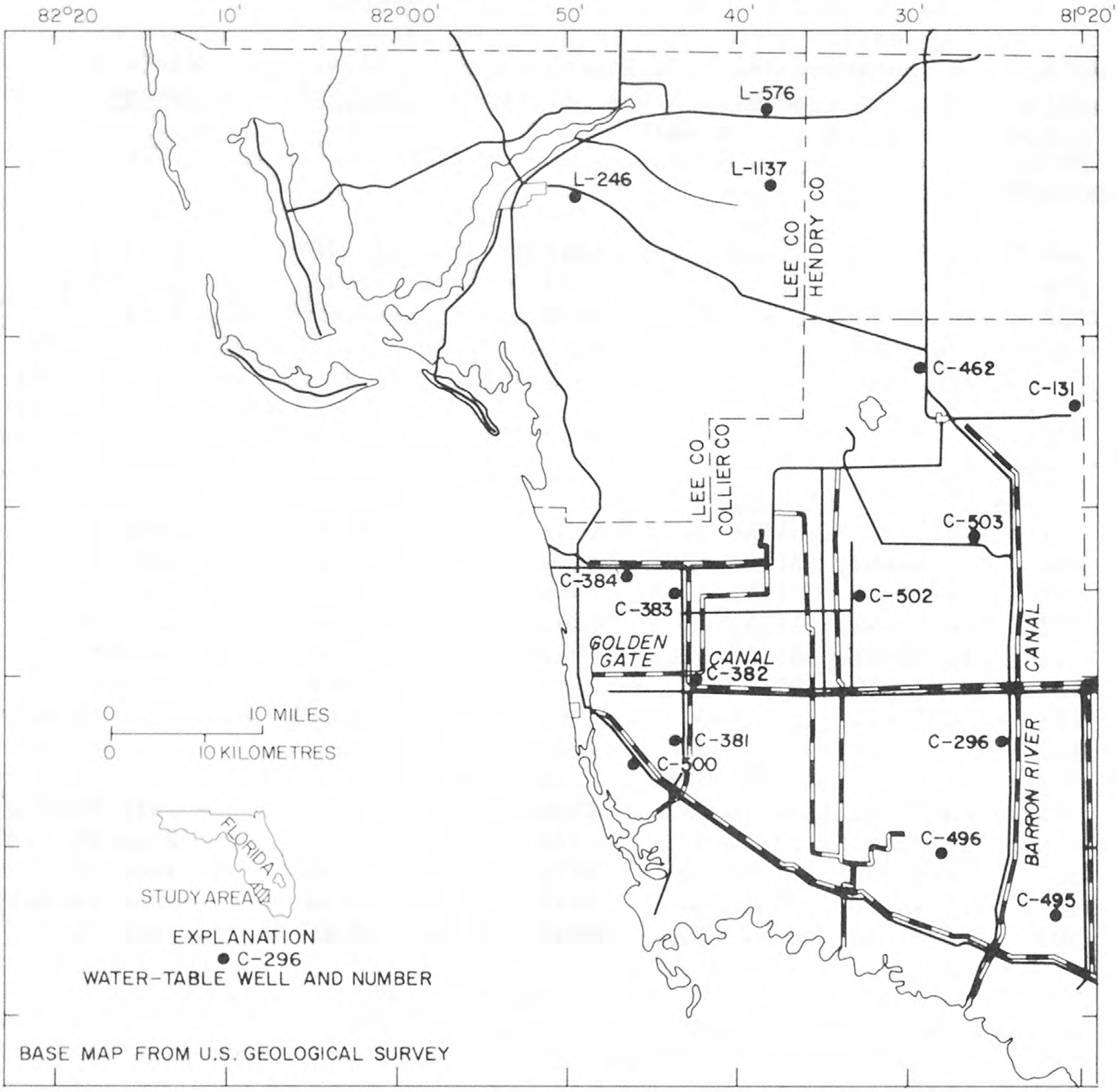


Figure 8.--Location of water-table wells in southwest Florida.

sometime between June 26 and July 10 — the more northern wells peaked late in the period.

Frequencies of Maximum Levels

Data were sufficient for frequency analyses for only 6 of the 15 wells. For only two of the six did the recurrence intervals exceed 5 years: wells C-383 and C-384 in Collier County.

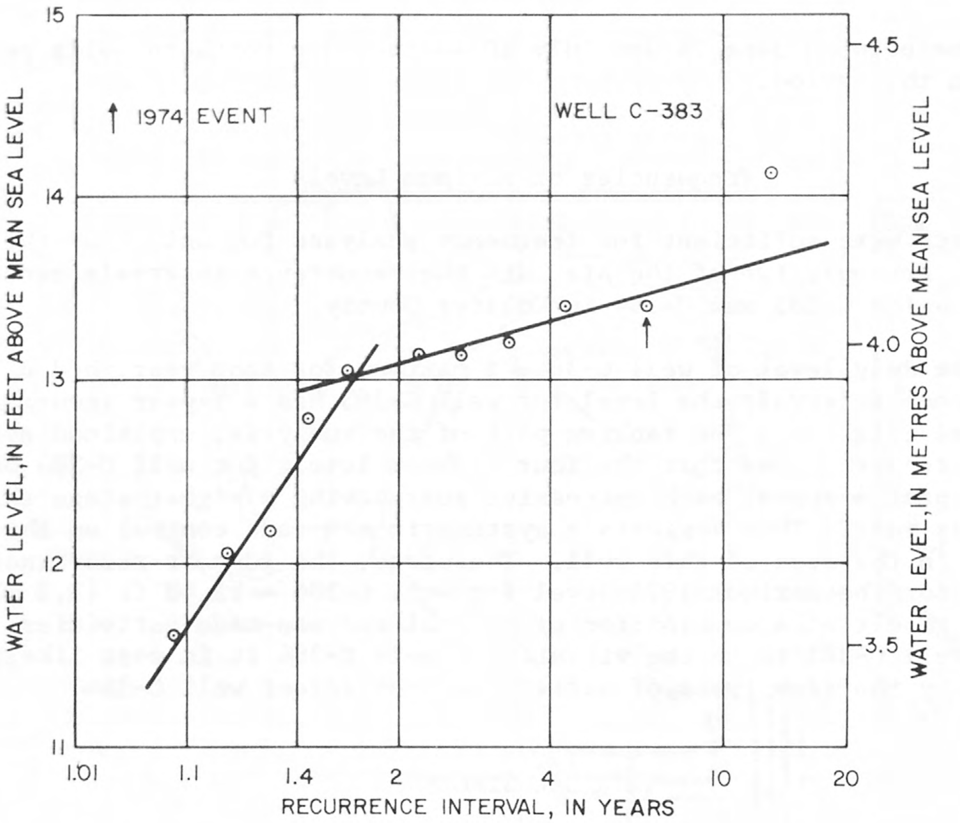
The July level of well C-384, a maximum for that year, had a 10-year recurrence interval; the level for well C-383 had a 5-year recurrence interval (fig. 9). The ranking part of the analysis, explained earlier in the report, shows that the four highest levels for well C-384 occurred in the past 4 years, each successive year having a higher stage than the previous year. This suggests a systematic man-made control on the water levels in the area of this well. Therefore, the 10-year recurrence interval for the maximum 1974 level for well C-384 — 12.48 ft (3.8 m) may be the result of a combination of natural and man-made activities. Because well C-383 is in the vicinity of well C-384 it is most likely affected by the same types of activities that affect well C-384.

TIDAL STAGES

Although systematic tidal records have been collected at both Naples and Fort Myers since 1965, annual extremes are available at these sites for only 6 and 5 years respectively because of gaps in the records. The records are much too short to allow any stage-frequency relations to be developed or the recurrence interval of the 1974 event to be estimated. The tidal stages can, however, be compared to the stages which occurred during the 1960 Hurricane Donna, which is known to be a rare event.

Tides during the June 1974 storm were reported by the National Oceanic and Atmospheric Administration (NOAA) to be between 2 and 4 ft (0.6 and 1.2 m) above normal from Everglades City to the Tampa Bay area. The continuous tidal gage at Naples showed a maximum elevation of 3.9 ft (1.2 m) above mean sea level at 0530 hours, June 25.

The U.S. Army Corps of Engineers report for Hurricane Donna (1961a) gives a high-water elevation of 11.6 ft (3.5 m) at Naples and 10.4 ft (3.1 m) at Fort Myers Beach, both of which were determined from high-water marks. The two elevations at Naples may not be strictly comparable since a gage has inherent responses which tend to dampen out peak values relative to those from high-water marks. But the comparison does give some idea of the difference in magnitude between the two events.



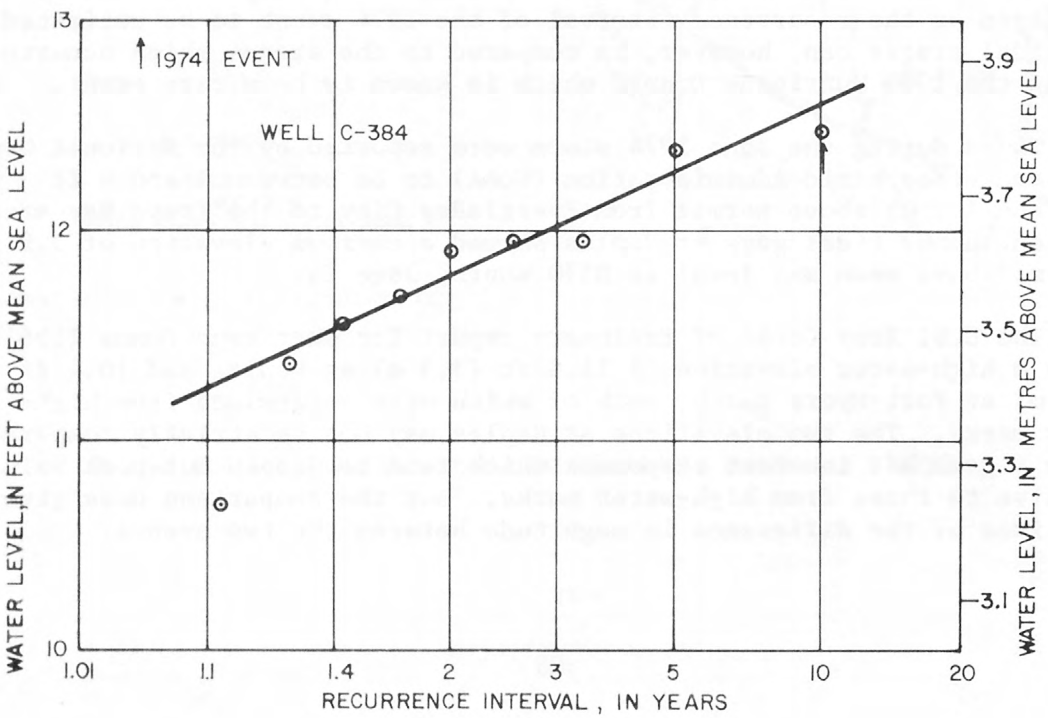


Figure 9.--Recurrence interval of water levels in wells C-383 and C-384.

CALOOSAHATCHEE ESTUARY STAGES

During the night and early morning hours of June 24-25, strong winds blew off the ocean from the south-southwest with sustained speeds of 35 to 45 mi/h (56 to 72 km/h). Since the Caloosahatchee Estuary is oriented in a southwest to northeast direction the sustained winds caused a mounding of the water in the northeast part of the estuary and superimposed a meteorological tide on the astronomical tide. This combination of tides caused the high tide for the period to occur near midday on June 25, 1974, with a peak stage of 5.2 ft (1.6 m), mean sea level, at Franklin Dam.

Figure 10 shows both the reservoir stage and tidal stage at Franklin Dam from midnight June 23 to noon June 26. The tidal stage exceeded the reservoir stage from approximately 0700 hours until 1500 hours on June 25; the dam was overtopped by the tide from approximately 0800 hours until 1500 hours. Crest elevation of the dam is 4.2 ft (1.3 m), mean sea level.

Plotted in the same figure is the specific conductance of the river water as recorded approximately 200 ft (60 m) upstream of the dam. Specific conductance, a direct indication of salinity, indicated the invasion of tidal water from below the dam. The high salinity water slug remained upstream of the dam for only a short time after overtopping of the dam ceased, but a secondary slug remained upstream of the dam for an additional 4 or 5 hours. After this time the specific conductance returned to the range of values recorded prior to the overtopping of the dam.

The presence of salt water upstream of the dam is jeopardous because of a nearby water supply intake and, to a much lesser degree, because of possible contamination of the aquifer in the area. The problem is not simply the volume of salt water that moves upstream of the dam, but also the length of time it remains upstream.

It would appear from rainfall, stage, and discharge frequencies calculated for the June 1974 event that topping of the dam by storm tides may not be rare. But from figure 10 it is seen that the salt slug does not remain upstream of the dam for a long period of time if fresh water is available to flush the salt slug downstream. Therefore, unless high winds occurred (causing overtopping of the dam) without the simultaneous occurrence of the heavy rains that are responsible for high streamflows - and this is extremely unlikely - no serious problems of salinity in the waters above Franklin Dam would come about because of the topping of the dam.

STORM DAMAGE

Newspaper reports (FORT MYERS NEWS-PRESS of June 27) of the June storms show pictures of damaged beach homes, of fallen trees, and of cars partly submerged along city streets. However, according to the same reports, "a survey of local insurance agents indicated there was little major damage to homes and businesses." The most notable structural damage was the loss

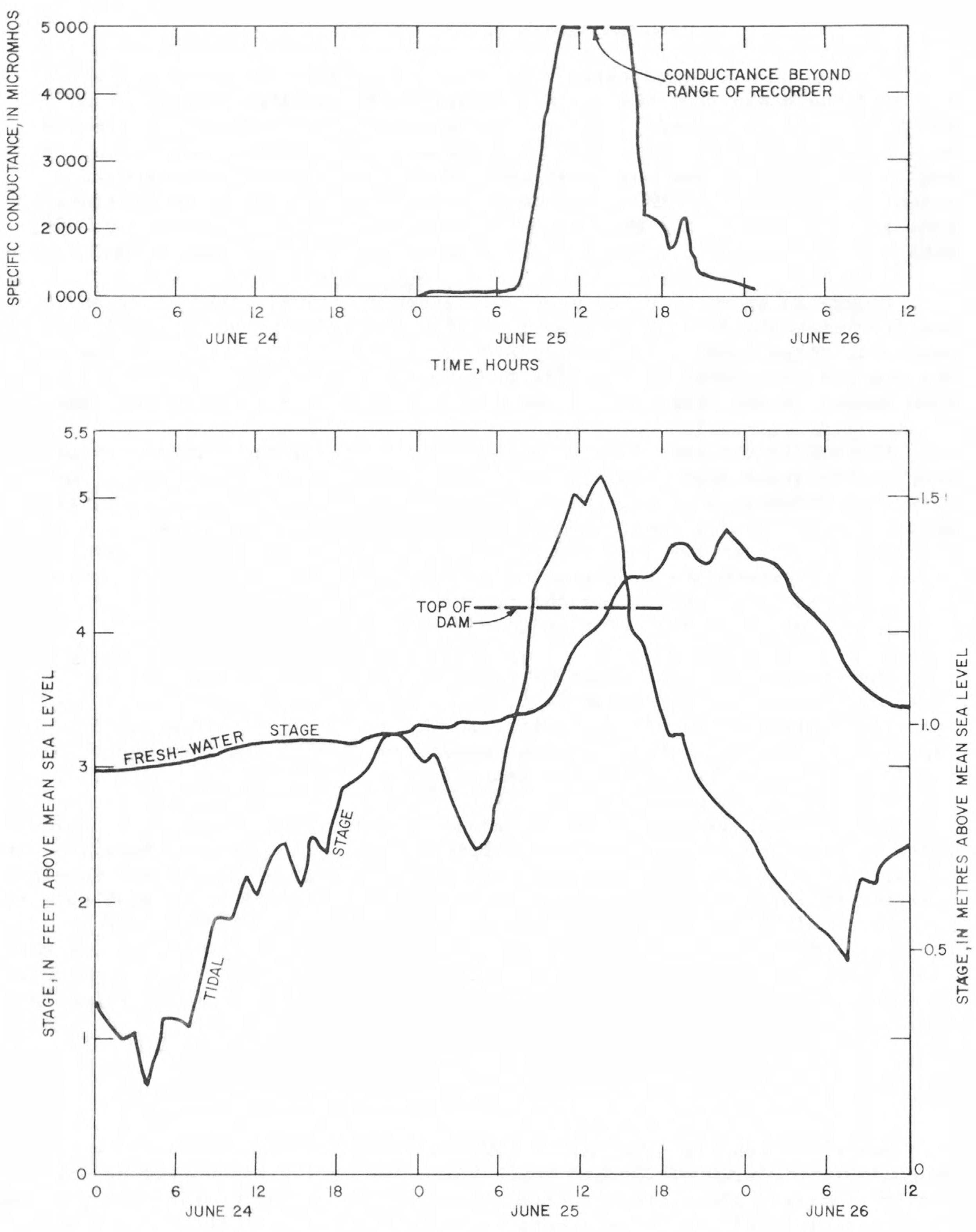


Figure 10.--Stage and specific conductance at Franklin Dam, June 24-26, 1974.

of about 100 yards (91.4 m) of dock at the historical homesite of Thomas Edison along the Caloosahatchee river-front.

According to figures assembled from various agencies by the Federal Disaster Assistance Administration, damage was mostly from beach erosion. It reports that in Collier County, $5,000 was the cost of clearing debris and that in Lee County, clearing debris and repairing roads cost between $50,000 and $60,000. The cost of repairing the beach erosion by replacement of the sand was estimated at $873,000 in Collier County and $600,000 in Lee County.

HISTORICAL STORM DATA

Reliable quantitative records of past storms do not extend far back into the past for southwest Florida. Therefore to rank storms according to severity of storm is almost impossible. But some feeling for storm severity can be gained from newspaper accounts and from local long-time residents. A long-time resident of southwest Florida (Mrs. Leon Crumpler of Punta Rassa) recalls (in the FORT MYERS NEWS-PRESS of June 26, 1974) other much larger storms in the hurricanes of 1910, 1921, 1926, 1944 and 1960. In a tabulation of high water from 1848 through 1960, the U.S. Army Corps of Engineers lists high-water values only for 1944 and 1960 at Naples and only for 1960 at Fort Myers (1961b).

Hurricane Donna - 1960

It is instructive to study what happened during Hurricane Donna relative to the June 1974 storms. Hurricane Donna struck the Florida Keys from the southeast on September 10, 1960, turned northward and entered the Florida peninsula on the Gulf Coast, proceeded northward through Cape Sable, Marco, Naples, Fort Myers, Lakeland, and DeLand, and exited on the east coast at Flagler Beach early on September 11 (fig. 2).

Damage during Hurricane Donna was caused by winds, tidal inundation and wave action, and flooding in surface streams. During the passage of the hurricane, wind speeds in the Naples-Punta Gorda-Fort Myers area reached 90 to 130 mi/h (145 to 210 km/h), with maximum gusts to 150 mi/h (240 km/h). These wind speeds are three times those of the June 1974 storm. Hurricane Donna unroofed buildings and overturned and smashed trailer homes. In Lee County 1,100 buildings and 210 trailer homes were destroyed or badly damaged; in Collier County over 200 buildings and over 100 trailer homes were destroyed or damaged.

During Hurricane Donna, peak tides were 4 to 8 ft (1.2 to 2.4 m) higher than those for 1974. Tide heights resulting from Hurricane Donna, as determined from high-water marks, are shown in figure 11 while those resulting from the June-July storm of 1974 are shown in figure 6.

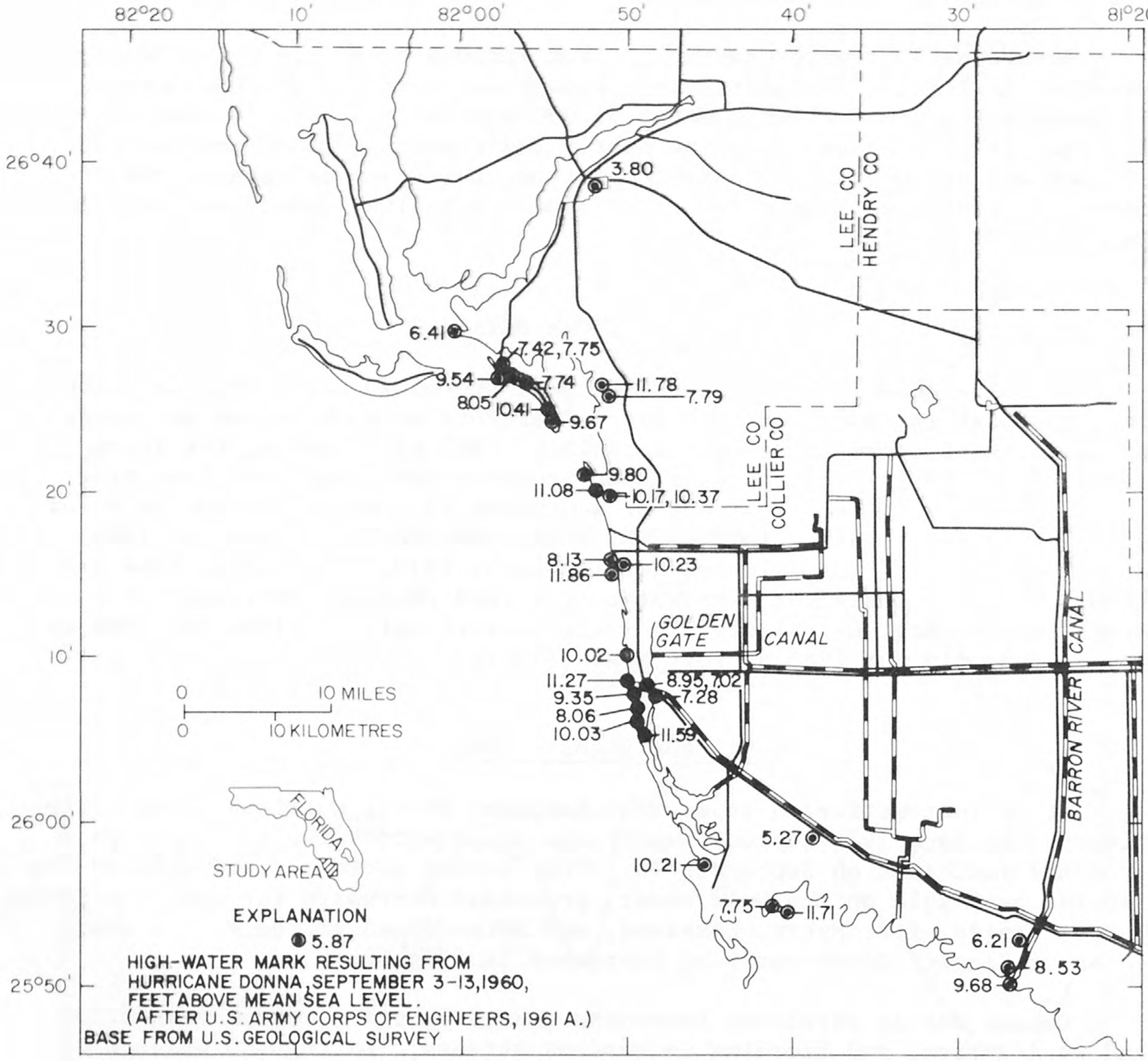


Figure 11.--Elevations of high-water marks of Hurricane Donna (1960) in southwest Florida.

Flooding of streams and inundation of low-lying areas were both a result of unusual circumstances. During Hurricane Donna, rainfall was 6 in (150 mm) or less and reached a maximum of only 8 in (200 mm). However, rain had been falling heavily for 2 months before the hurricane. Obviously, the flooding was not due solely to the hurricane rainfall but to the combination of hurricane rainfall and the inability of the already saturated soil to receive any large quantities of water.

SUMMARY

Although the rains associated with the storms of June 24-28, 1974, within Lee and Collier Counties, Florida, were not unusually heavy, they caused widespread flooding, and general inconvenience. Trees and power lines were downed, roads were flooded and some areas were without electricity or telephone service for 10 hours or more. Some septic tanks were flooded, and a warning was issued to people in these areas that they should boil their drinking water.

The recurrence intervals of the rainfall experienced at Fort Myers are less than 5 years for durations under 6 hours and less than 10 years for durations under 2 days. The recurrence intervals of extreme stages in streams were computed for four locations where the records were long enough to permit frequency analysis. At three of the four locations within the area of the report, recurrence intervals of peak stages were less than 5 years. Similarly, recurrence intervals of the 1974 peaks for stream discharges were 4 years or less. For stages and discharges, recurrence intervals increased towards the north. The data from observation wells also indicate that recurrence intervals of peak ground-water levels were generally less than 5 years.

Thus, all meteorological and hydrologic data related to these storms indicate that throughout the report area, recurrence intervals of peak events for the most part did not exceed 5 years.

Rainfall resulting from Hurricane Donna was not heavy. But the flooding which resulted was very severe although it is impossible to determine the recurrence interval due to the short period of stage and discharge records.

This and other similar documentation of storm events and their effects furnish important data needed by responsible local agencies for proper land planning and zoning with the aim of providing for the safety and protection of property of the people living within their jurisdictions.

REFERENCES

Dalrymple, T., 1960, Flood-frequency analyses, U.S. Geol. Survey Water Supply Paper 1543-A, 80 p.

McCoy, J., 1973, Summary of hydrologic conditions in Collier County, Florida, 1972: U.S. Geological Survey Open-File Report, 118 p.

McCoy, H.J., 1962, Ground-water resources of Collier County, Florida: Florida Geol. Survey Rept. Inv. 31, 82 p.

Missimer, T.M., and Boggess, D.H., 1974, Fluctuations of the water table in Lee County, Florida, 1969-73: U.S. Geol. Survey Open-File Report, 41 p.

Sproul, C.R., Boggess, D.H., and Woodard, H.J., 1972, Saline-water intrusion from deep artesian sources in the McGregor Isles area of Lee County, Florida: Florida Dept. of Natural Resurces Inf. Cir. No. 75, 30 p.

U.S. Army Corps of Engineers, 1961a, Report on Storms and Floods in Florida, July-September 1960: U.S. Army Engineer District, Jacksonville, Office of the District Engineer, Jacksonville, Fla.

______________________________, 1961b, Survey report - analysis of hurricane problems in coastal areas of Florida: U.S. Army Engineer District, Jacksonville, Office of the District Engineer, Jacksonville, Fla.

U.S. Department of Commerce, 1961, Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years: U.S. Weather Bureau Technical Paper No. 40, 115 p.

_____________________________, 1964, Two to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States: U.S. Weather Bureau Technical Paper No. 49, 29 p.

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