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The Flood of June 1998 in Massachusetts and Rhode Island

Prepared in cooperation with the Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS)

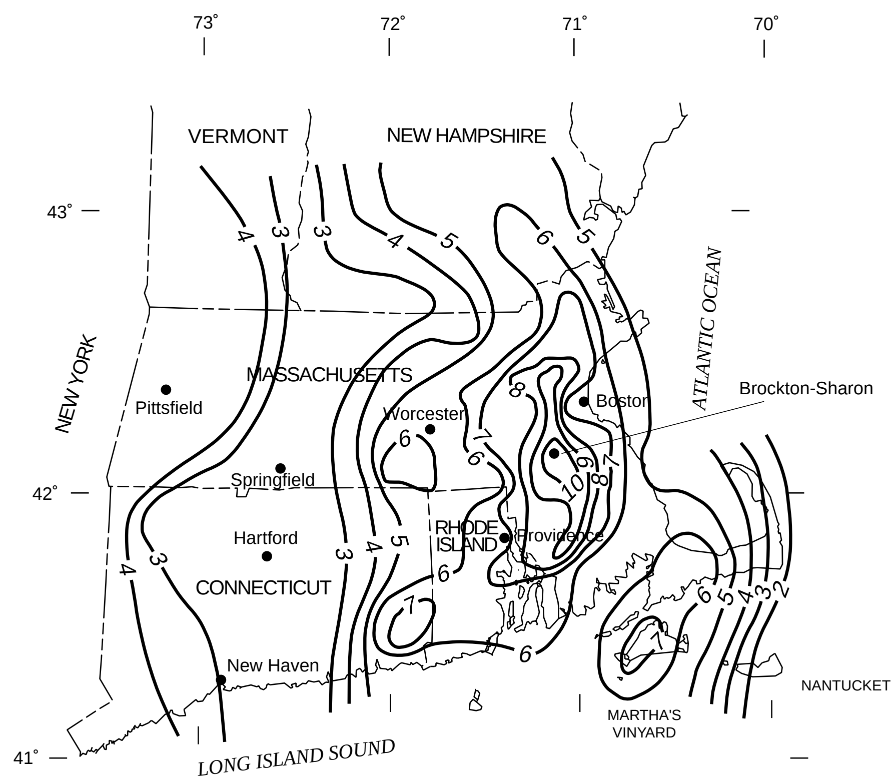
More than 10 inches of rain fell on some areas of eastern Massachusetts and more than 7 inches fell on some areas of Rhode Island during and intense and prolonged rainstorm from June 12 through June 15, 1998. On some streams, the magnitude of the floods resulting from the rain would be exceeded, on average, only once every 50 years. Estimated property damage from the June 1998 floods totaled nearly 5 million dollars (Bryan Clain, Massachusetts Emergency Management Agency, oral commun., 1998)

HYDROLOGIC AND CLIMATIC CONDITIONS LEADING TO THE JUNE 1998 FLOOD

The most important fact or contributing to a flood is usually the amount of rainfall. The magnitude of a flood within a river basin depends on the amount and intensity of the rain, duration of a rainstorm, and the conditions preceding a rainstorm. The June 12-15 storm was unusual in its timing and magnitude. Most storms that produce large precipitation totals and floods in New England occur either from the late winter to spring or mid-summer to fall. In late winter and spring, rain falling on snow or frozen ground causes snowmelt and high runoff. The subsequent floods are larger than precipitation alone would create. Flooding in mid-summer to fall usually is caused by hurricanes or occasionally severe summer cyclonic storms that commonly generate precipitation of high intensity and short duration. The June 1998 flood in eastern Massachusetts and Rhode Island was caused by an intense, slow-moving frontal storm.

Rivers and ground-water levels in most of eastern Massachusetts and Rhode Island were generally already above normal before the storm began on June 12. These above-normal streamflow and ground-water conditions were caused by above-normal precipitation during the previous month. For example, total precipitation for May at the National Weather Service (NWS) gage in Boston, Massachusetts was 6.85 inches, 3.60 inches above normal, and total precipitation at Providence, Rhode Island was 6.05 inches, 2.29 inches above normal (National Oceanic and Atmospheric Administration, National Weather Service, accessed July 30, 1998, at `http://www.nws.noaa.gov/er/box/index.html`).

Maximum intensity and maximum daily rainfall totals occurred on June 13, 1998, with lesser amounts on the following days. Rainfall totals in Massachusetts and Rhode Island ranged from 2 inches on eastern Cape Cod and Nantucket Island (fig. 1) to more than 10 inches of rain in an area approximately 30 miles south of Boston (towns of Brockton and Sharon), Massachusetts



EXPLANATION

— 4 — RAINFALL, IN INCHES–Recorded for storm of June 12-15, 1998

Base from U. S. Geological Survey digital data, Albers Equal Area Conic projection, 1992, Standard parallels 29°30' and 45°30', central meridian-96°,1:250,000 scale. Rainfall data from Department of Commerce, National Weather Service, NWSFO/NERFC, Taunton, Massachusetts

0 40 80 MILES
0 40 80 KILOMETERS

Figure 1. Map showing rainfall accumulations during the June 12-15, 1998 storm in southern New England

(David Vallee, National Oceanic and Atmospheric Administration, National Weather Service, written commun., 1998). The average rainfall over the entire state of Rhode Island during this storm was about 6 inches, whereas western Massachusetts received between 3 and 5 inches of rain. At the U.S. Geological Survey (USGS) gaging station on the Shawsheen River (station 9 on fig. 2 and table 1), 8.6 inches of rain were recorded during this storm, with the most rain (5.8 inches) falling on June 13, 1998. The storm set a new 24-hour precipitation record of 5.99 inches at the NWS gage in Boston, surpassing the previous record of 5.35 inches, set during June 9-10, 1875 (National Oceanic and Atmospheric Administration, National Weather Service, accessed July 30, 1998, at (`http://www.nws.noaa.gov/er/box/fcsts/BOSCLMBOS.html`). The total precipitation for June 12-15 in Boston was 7.93 inches.

THE JUNE 1998 FLOOD

The USGS operates gaging stations (fig. 2) on rivers throughout Massachusetts and Rhode Island where water level and flow are monitored continuously. Many stations are equipped with instrumentation that allows the USGS, the NWS, State and national emergency management agencies, and other organizations to monitor remotely the current water level and flow of the rivers. The remote monitoring of gaging stations during the June 1998 storm allowed officials to provide flood warnings and manage response efforts in order to minimize damages caused by the flooding. Current water level and streamflow data for many of the USGS gaging stations are available on the Internet at `http://mass1.er.usgs.gov/water.htm`.

Data collected at the USGS gaging stations made it possible to calculate the recurrence interval of peak flows during this storm relative to previously recorded peak flows at the stations (table 1). A recurrence interval is a measure of the average number of years between events of a given magnitude. For example, a 50-year flood occurs once in 50 years, on average, and has a 1-in-50 chance of being exceeded in any given year. Recurrence intervals for peak flows recorded during the June 1998 flood were calculated for gaging stations with more than 10 years of continuous records, using methods recommended by the U.S. Interagency Advisory Committee on Water Data (1982).

Recurrence intervals of peak flows calculated for the June 1998 flood in Massachusetts ranged from 1.5 year on the Hoosic River (station 46 on fig. 2 and tables 1) to 50 years on the Aberjona, Neponset, Wading, and Threemile Rivers (stations 14, 18, 24, and 25). Recurrence intervals of peak flows in Rhode Island ranged from 1.5 years on the Nipmuc and Usquepaug Rivers (stations 29 and 37) to 15 years at the Pawtuxet River (station 34).

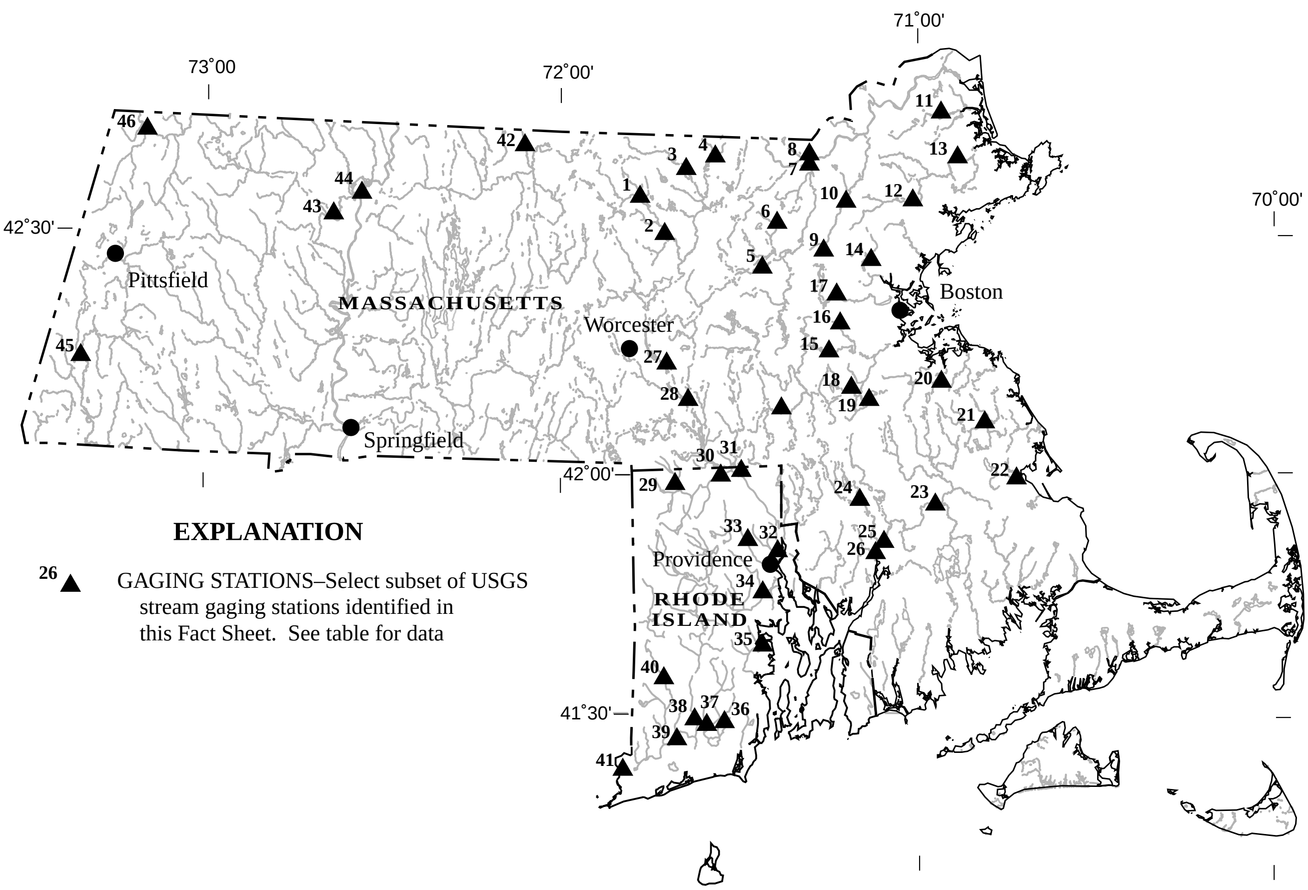


Figure 2. Map showing subset of USGS gaging stations used in Massachusetts in Rhode Island (data for each shown in Tables 1 and 2).

Table 1. Comparison of peak stages and discharges during the June 12-15, 1998 rainstorm with historical peak stages and discharges at selected U.S. Geological Survey gaging stations in Massachusetts and Rhode Island

[Station numbers shown in figure 2; ft^3/s, cubic feet per second; --, not determined; mi^2, square miles; ft, feet above an arbitary datum]

				Previous maximum discharge			June 12-15, 1998 rainstorm		
Station No.	USGS Station ID No.	Station name	Drainage area (mi^2)	Date (mo/yr)	Peak stage (ft)	Maximum discharge (ft^3/s)	Peak stage (ft)	[1]Peak discharge (ft^3/s)	Recurrence interval (years)
1	01094400	North Nashua River at Fitchburg, MA	63.4	4/87	7.78	3,510	6.42	1,710	2
2	01094500	North Nashua River near Leominster, MA	110	3/36	20.53	16,300	5.24	2,450	3
3	01096000	Squannacook River near W. Groton, MA	63.7	4/87	8.16	4,220	6.46	1,880	3
4	01096500	Nashua River at East Pepperell, MA	435	3/36	19.10	20,900	8.15	4,300	3
5	01097000	Assabet River at Maynard, MA	116	8/55	8.94	4,250	5.52	1,490	3
6	01097300	Nashoba Brook near Acton, MA	12.8	1/79	5.57	679	6.89	291	4
7	01099500	Concord River below River Meadow Brook at Lowell, MA	400	1/79	9.60	5,410	7.97	3,070	4
8	01100000	Merrimack River below Concord River at Lowell, MA	4635	3/36	68.40	173,000	52.74	52,800	5
9	01100568	Shawsheen River at Hanscom Field near Bedford, MA	2.09	10/96	6.68	373	8.69	684	--
10	01100600	Shawsheen River near Wilmington, MA	36.5	10/96	10.49	1,850	9.03	1,240	20
11	01101000	Parker River at Byfield, MA	21.3	10/96	7.82	883	4.26	302	5
12	01101500	Ipswich River at South Middleton, MA	44.5	4/87	7.88	1,010	6.67	600	7
13	01102000	Ipswich River near Ipswich, MA	125	4/87	9.43	3,550	7.20	1,950	10
14	01102500	Aberjona River at Winchester, MA	24.1	1/79	15.46	1,330	15.22	1,070	50
15	01103500	Charles River at Dover, MA	183	8/55	9.24	3,220	6.84	2,070	5
16	01104200	Charles River at Wellesley, MA	211	3/68	6.20	2,410	5.53	1,920	10
17	01104500	Charles River at Waltham, MA	227	2/76	6.54	4,150	5.51	2,230	13
18	01105000	Neponset River at Norwood, MA	34.7	8/55	14.65	1,490	10.89	1,100	50
19	01105500	East Branch Neponset River at Canton, MA	27.2	8/55	8.18	1,790	5.78	1,050	11
20	01105600	Old Swamp River near South Weymouth, MA	4.5	5/84	5.02	590	4.97	234	3
21	01105730	Indian Head River at Hanover, MA	30.3	3/68	7.13	1,390	5.52	734	3
22	01105870	Jones River at Kingston, MA	15.7	3/68	4.50	575	4.40	198	2
23	01108000	Taunton River near Bridgewater, MA	258	3/68	14.48	4,980	10.01	2,850	4
24	01109000	Wading River near Norton, MA	43.3	3/68	11.47	1,460	11.47	1,220	50
25	01109060	Threemile River at North Dighton, MA	84.3	3/68	8.30	2,490	8.89	2,870	50
26	01109070	Segreganset River near Dighton, MA	10.6	3/68	7.51	867	6.15	588	7
27	01110000	Quinsigamond River at North Grafton, MA	25.6	8/55	5.15	820	3.25	316	5
28	01110500	Blackstone River at Northbridge, MA	139	8/55	16.74	16,900	8.75	2,920	3
29	01111300	Nipmuc River near Harrisville, RI	16.0	1/79	8.53	1,840	6.56	448	1.5
30	01111500	Branch River at Forestdale, RI	91.2	1/79	11.80	5,470	7.57	2,080	3
31	01112500	Blackstone River at Woonsocket, RI	416	8/55	11.80	32,900	9.08	6,720	3
32	01114000	Moshassuck River at Providence, RI	23.1	3/68	3.46	2,390	5.13	1,160	4
33	01114500	Woonasquatucket River at Centerdale, RI	38.3	3/68	7.75	1,440	5.54	842	4
34	01116500	Pawtuxet River at Cranston, RI	200	6/82	14.50	5,440	11.14	3,200	15
35	01117000	Hunt River near East Greenwich, RI	22.9	6/82	3.73	1,020	2.56	384	3
36	01117350	Chipuxet River at West Kingston, RI	9.99	6/82	--	250	6.82	113	2
37	01117420	Usquepaug River near Usquepaug, RI	39.1	6/82	9.23	1,060	6.33	347	1.5
38	01117468	Beaver River near Usquepaug, RI	8.87	6/82	3.83	370	2.91	163	4
39	01117500	Pawcatuck River at Wood River Junction, RI	100	6/82	8.75	1,860	5.25	897	4
40	01117800	Wood River near Arcadia, RI	35.2	3/68	8.64	896	6.63	494	3
41	01118500	Pawcatuck River at Westerly, RI	295	6/82	12.86	7,070	7.76	2,660	3
42	01162500	Priest Brook near Winchendon, MA	19.4	9/38	9.90	3,000	4.87	367	2
43	01170000	Deerfield River near West Deerfield, MA	557	4/87	17.71	61,700	4.87	15,200	2
44	01170500	Connecticut River at Montague City, MA	7860	3/36	49.20	236,000	26.00	68,900	1.5
45	01197500	Housatonic River near Great Barrington, MA	282	1/49	12.08	12,200	7.42	4,140	3
46	01332500	Hoosic River near Williamstown, MA	126	12/48	14.85	13,000	8.48	2,950	1.5

Table 2. Comparison of peak stages and discharges during the October 1996 and June 12-15, 1998 rainstorms at selected U.S. Geological Survey gaging stations in Massachusetts

[Station numbers shown in figure 2; ft^3/s, cubic feet per second; mi^2, square miles; ft, feet above an arbitary datum]

				October 20-21, 1996 rainstorm			June 12-15, 1998 rainstorm		
Station no.	USGS Station ID No.	Station name	Drainage area (mi^2)	Peak stage (ft)	Peak discharge (ft^3/s)	Recurrence interval (years)	Peak stage (ft)	Peak discharge (ft^3/s)	Recurrence interval (years)
6	01097300	Nashoba Brook near Acton, MA	12.8	5.55	665	30	6.89	291	4
10	01100600	Shawsheen River near Wilmington, MA	36.5	10.49	1,850	70	9.03	1,240	20
11	01101000	Parker River at Byfield, MA	21.3	7.82	883	150	4.26	302	5
13	01102000	Ipswich River near Ipswich, MA	125	8.98	3,120	60	7.20	1,950	10
14	01102500	Aberjona River at Winchester, MA	24.1	16.78	1,150	50	15.22	1,070	50
15	01103500	Charles River at Dover, MA	183	5.13	1,370	3	6.84	2,070	5
16	01104200	Charles River at Wellesley, MA	211	5.16	1,440	3	5.53	1,920	10
17	01104500	Charles River at Waltham, MA	227	6.05	2,990	20	5.51	2,230	13
18	01105000	Neponset River at Norwood, MA	34.7	9.45	760	12	10.89	1,100	50
24	01109000	Wading River near Norton, MA	43.3	8.45	410	1.5	11.47	1,220	50

COMPARISON WITH THE OCTOBER 1996 FLOOD

The most recent storm that caused flooding in Massachusetts and Rhode Island previous to June 1998 occurred during October 20-21, 1996. This storm and the June 1998 storm were the result of intense frontal systems (with local maximum rainfall accumulations of about 10 inches). The climatic conditions preceding the storms were similar, but the storms differed in areal distribution and intensity. The 1996 storm lasted about 24 hours and primarily affected northeastern Massachusetts, eastern New Hampshire, and southern Maine. The 1998 storm lasted about 4 days and primarily affected southeastern Massachusetts and Rhode Island.

The maximum recurrence intervals of the peak flows recorded at several gages near Boston and in northeastern Massachusetts during the 1996 storm were equal to or greater than 30 years, as exemplified by Nashoba Brook, Shawsheen River, Parker River, Ipswich River, and Aberjona River (stations 6, 10, 11, 13, and 14 on fig. 2 and table 2). The maximum recurrence intervals of the peak flows recorded during the 1998 storm were 50 years at several gages in eastern Massachusetts, as exemplified by the Aberjona, Neponset, Wading, and Threemile Rivers (stations 14, 18, 24, and 25 on fig. 2 and table 1). About 7 inches of rain fell in the Aberjona River Basin during the 1996 and 1998 storms, and the recurrence interval for the peak flow from the basin during both storms was 50 years (station 14 on fig. 2 and table 2). The upper Charles River Basin did not receive intense rain during the 1996 rainstorm, but the Boston area, encompassing the lower Charles River Basin, received more than 8 inches of rain. The highest recurrence-interval peak flows on the Charles River were recorded only at the most downstream gage at Waltham (station 17 on fig. 2 and table 2), while lower recurrence-interval peak flows were recorded upstream at Dover and Wellesley (stations 15 and 16). The area of most intense rainfall was closer to the upper Charles River Basin during the 1998 storm than during the 1996 storm, as indicated by the higher recurrence intervals for peak flow at the two upstream gaging stations for the 1998 storm than for the 1996 storm.

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References

U.S. Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency: U.S. Geological Survey, Hydrology Subcommittee Bulletin 17B, 183 p.

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Photo. USGS Hydrologist inspecting a flooded gaging station along the Wading River near Norton, Massachusetts