DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MASSACHUSETTS WATER RESOURCES COMMISSION
BOSTON, MASSACHUSETTS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-484 (SHEET 2 OF 3)

SURFACE WATER

STREAMFLOW REFLECTS USE OF WATER

Flow in most of the streams is affected by ground-water pumpage, surface-water diversions, or regulation. As examples of streamflow alteration, flow of East Branch Neponset River at Canton during periods of low flow is augmented by releases of stored water, and, occasionally on weekends, dams are closed and considerably reduce streamflow. The flow-duration curve, shown below, reflects this by the moderation of the slope between the 90 and 98 percentiles and by the sudden drop above the 98 percentile.

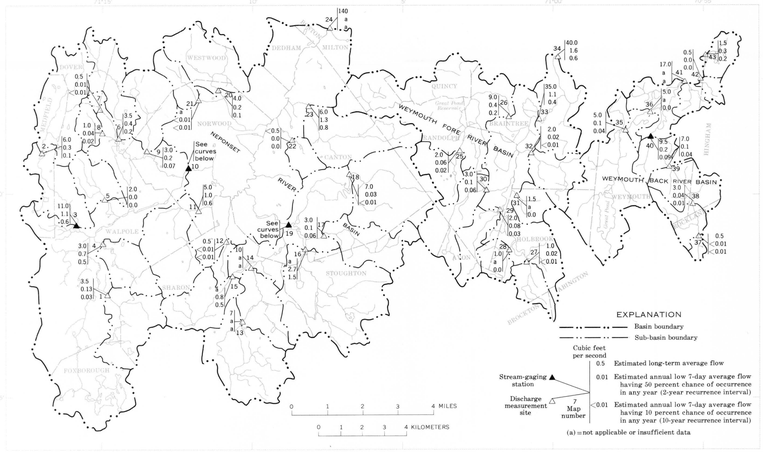
Available information indicates that Great Pond Reservoir in Braintree-Randolph and Great Pond in Weymouth usually spill only during spring high water. Therefore, most of the discharge from the drainage areas above these dams is impounded and utilized in municipal supplies. Further development of water resources in these drainage areas is probably restricted.

AVERAGE AND LOW FLOWS

The estimates of long-term average flow at selected sites shown on the map below are based on average flow data for stream-gaging stations in eastern Massachusetts and discharge data available for the sites. Because little data is available for these sites, particularly above the low-flow range, the estimates must be considered as rough approximations only. Estimated average streamflow from the study area is about 200 cfs or 47 billion gallons per year.

The estimated 7-day low flows are based on correlations of low-discharge data collected at the respective sites with long-term gaging station records. Seven-day low-flow estimates were made for streams not significantly affected by regulation, yet considerable differences in low-flow intensities exist between the subbasins. The 10-year, 7-day low-flow estimates range in unit discharge from 0 cfs per sq mi to 0.27 cfs per sq mi. This variation is caused by diversity of the geology, by pumpage—particularly in School Meadow Brook, Steep Hill Brook, Redwing Brook, Pecunit Brook, Farm River, Trout Brook, Monatiquot River, and Mill River basin, where waste water is exported from the basin in sewers—and probably in some cases by ground-water underflow between subbasins. The 7-day, 10-year recurrence-interval low flows in northern tributaries of the Taunton River basin near Canton and Stoughton are about 0.05 cfs per sq mi (Williams and others, 1971), whereas in adjacent tributaries of the East Branch Neponset River, Beaver Brook and Steep Hill Brook, these flows are about 0.20 cfs per sq mi. Along parts of the basin boundary in this vicinity, the ground-water divide is south of the topographic divide, and ground water flows north from the Taunton River basin into the East Branch Neponset River basin. This phenomenon is not uncommon and may occur in many places in or near the study area.

Because streamflow is influenced by man-made factors, the flow characteristics at the various sites may be unique not only to the particular gaged or measured site but also to the periods of base-data collection.



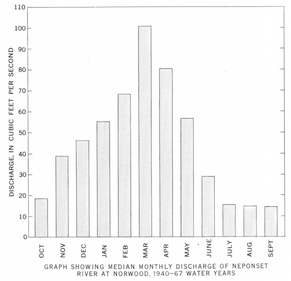
MAP SHOWING AVERAGE AND LOW FLOWS AT SELECTED SITES

Map No.	Stream	Site description
1	School Meadow Brook	Washington St., Walpole
2	Mine Brook	Philip St., Medfield
3	Mine Brook[1]	At inlet to Turner Pond, Walpole, gaging station records June 1967 to July 1968
4	Spring Brook	200 feet below Memorial Pond, Walpole
5	Neponset River tributary	Gould St., Walpole
6	Mill Brook	500 feet above inlet to Pettee Pond, Westwood
7	Bubbling Brook	North St., Westwood-Walpole
8	Bubbling Brook tributary	North St., Walpole
9	Germany Brook	Nichols St., Norwood
10	Neponset River	Pleasant St., Norwood, gaging station records Oct. 1939 to present
11	Traphole Brook	Sumner St., Norwood
12	Neponset River tributary No. 2	Edge Hill Rd., Sharon
13	Massapoag Brook	Ames St., Sharon
14	Massapoag Brook	State Highway 27, Sharon
15	Beaver Brook	Maskwonicut St., Sharon
16	Steep Hill Brook	Bailey St., Canton
17	Redwing Brook	Pleasant St., Canton
18	Pequid Brook	State Highway 138, Canton
19	East Branch Neponset River	Washington St., Canton, gaging station records Oct. 1952 to present
20	Purgatory Brook	U.S. Highway 1, Norwood
21	Plantingfield Brook	State Highway 1A, Norwood
22	Pecunit Brook	Elm St., Canton
23	Ponkapog Brook	Elm St., Canton
24	Neponset River	Neponset Valley Parkway, Boston-Milton
25	Norroway Brook	Oak St., Randolph
26	Farm River	Pond St., Braintree
27	Trout Brook	0.2 mile above Lake Holbrook, Holbrook
28	Cochato River tributary	South St., Holbrook
29	Mary Lee Brook	800 feet above mouth, Randolph
30	Glovers Brook	North St., Randolph
31	Tumbling Brook	Center St., Holbrook
32	Cranberry Brook	State Highway 37, Braintree
33	Monatiquot River	Jefferson St., Braintree
34	Monatiquot River	Middle St., Braintree
35	Mill River	Front St., Weymouth
36	Mill River	Middle St., Weymouth
37	Old Swamp River	Forest St., Rockland
38	Old Swamp River	Sharp St., Hingham
39	Old Swamp River	Ralph Talbot St., Weymouth
40	Old Swamp River	State Highway 3, Weymouth, gaging station records May 1966 to present
41	Whitmans Pond Outlet	Pleasant St., Weymouth
42	Whitmans Pond Outlet tributary No. 2	Broad St., Weymouth
43	Fresh River	0.4 mile above mouth, Hingham

[1]Municipal wells put into operation upstream from site in June 1968. Data shown represent conditions prior to June 1968.

ANNUAL STREAMFLOW CYCLE

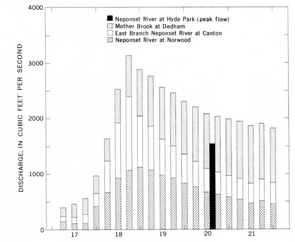
Maximum streamflow normally occurs during March from snowmelt augmenting the rainfall, low evapotranspiration, and near maximum ground-water discharge as shown on the graph below. Evapotranspiration increases during the spring to a maximum during the summer. Aquifer recharge, ground-water discharge, and overland runoff diminish as a result of evapotranspiration, and streamflow becomes minimal during the summer. As evapotranspiration decreases during the fall and winter, ground-water recharge and discharge increase and streamflow reflects the increase.

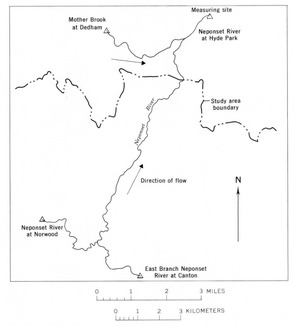


GRAPH SHOWING MEDIAN MONTHLY DISCHARGE OF NEPONSET RIVER AT NORWOOD, 1940–67 WATER YEARS

EFFECTS OF BASIN STORAGE ON STORM RUNOFF

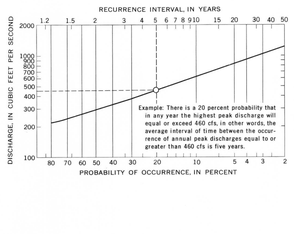
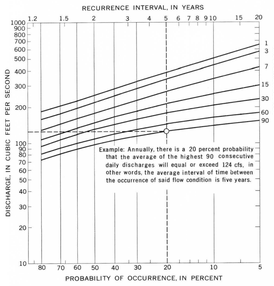
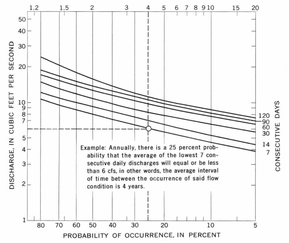
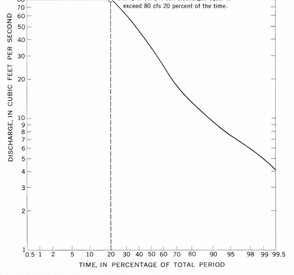
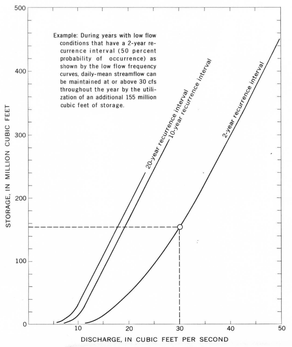
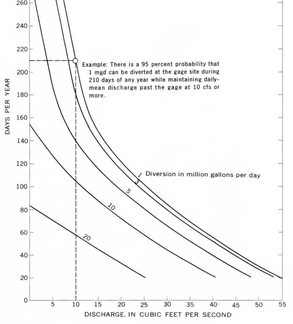
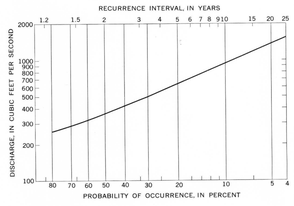
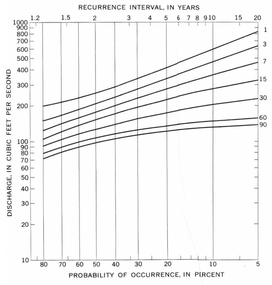
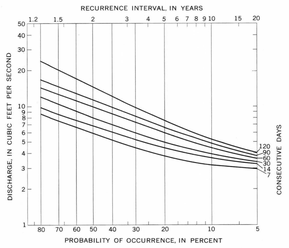
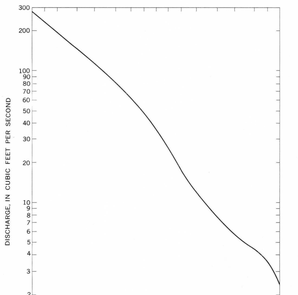
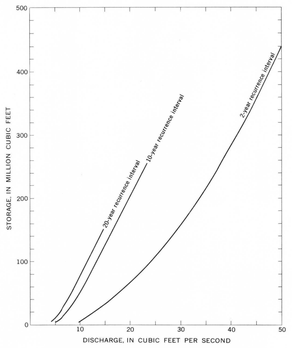
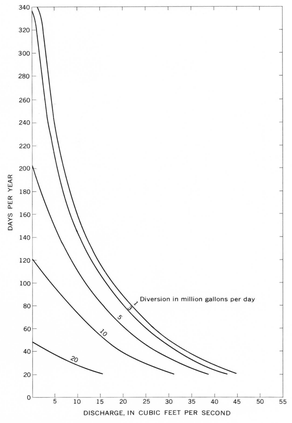
Many factors including storm duration and intensity, availability of storage space, and topographic relief influence the intensity of peak flows. Because of low stream gradients, large storage capacities in wetlands, ponds, and flood plains, and the relatively undeveloped status of the flood plains, floods are not usually a problem in the study area. Wetlands and ponds occupy about 20 square miles and are fairly evenly distributed. Discharges, shown on the graph below, in the Neponset River valley during the March 1968 flood illustrate the effects of basin storage on the intensity of storm runoff. The peak discharge of the Neponset River at Hyde Park occurred about 1½ days after the peak at the Norwood gage and the East Branch Neponset River gage. The drainage area above the Hyde Park site is 35 square miles more than the sum of the areas above these gaging stations. Nevertheless, the maximum sum of the concurrent discharges at the gages and in Mother Brook (a diversion from the Charles River, gaged at Dedham) was higher than the peak at Hyde Park. Furthermore, the combined concurrent discharges remained higher until well after the time of the Hyde Park peak. Much of the discharge into the zone between these gages and the Hyde Park site was taken into basin storage and gradually released to the downstream reaches, thereby producing a prolonged storm runoff of low intensity at Hyde Park. Although neglecting that some of the flow at Hyde Park originates in the Charles River basin and applying solely the area of the Neponset River basin above the site, the unit discharge of the peak at Hyde Park was only 16 cfs (cubic feet per second) per sq mi. The unit discharge of the peaks at Norwood and at the East Branch Neponset River gage were 32 cfs per sq mi and 52 cfs per sq mi, respectively. The higher flows of the Neponset River at Norwood and the East Branch Neponset River at Canton are also attenuated by basin storage—note moderate slopes of flood-frequency curves and high-flow-frequency curves, and high discharge end of duration curves.





GRAPH SHOWING ATTENUATION OF MARCH 1968 FLOOD PEAK IN NEPONSET RIVER VALLEY BY BASIN STORAGE

CURVES SHOWING STREAMFLOW CHARACTERISTICS AT THE NEPONSET RIVER AND EAST BRANCH NEPONSET RIVER GAGING STATIONS

STREAM-GAGING STATION	FLOOD FREQUENCY	HIGH-FLOW FREQUENCY	LOW-FLOW FREQUENCY	FLOW DURATION	STREAMFLOW MAINTENANCE WITH ADDITIONAL STORAGE	DIVERSIONS
Neponset River at Norwood Drainage area: 35.2 square miles Period of record: October 1939 to present Base period used for analyzing data: 1940–67 water years; 1940–66 climatic years Maximum instantaneous discharge 1887–1970: 1,490 cfs on August 19, 1955 Average flow, 1940–67 water years: 50.7 cfs						
East Branch Neponset River at Canton Drainage area: 27.2 square miles Period of record: October 1952 to present Base period used for analyzing data: 1953–67 water years; 1953–66 climatic years Maximum instantaneous discharge 1953–70: 1,790 cfs on August 19, 1955 Average flow, 1940–67 water years[1]: 44.6 cfs [1]Based on correlation of data from Neponset River at Norwood.						
GLOSSARY Climatic year — Twelve-month period beginning April 1 of year designated Recurrence interval — Average interval of time between occurrences of a condition or event 7-day low flow — Average of the flows that occur during the 7 lowest consecutive days in a climatic year Unit discharge — Discharge divided by drainage area Water year — Twelve-month period ending September 30 of year designated.	The relative frequency of various flows which occur as the highest peak discharge during a water year is shown above. These curves are used in studies of flood inundation, flood control, land zoning, and design of structures on flood plains.	The relative frequency of the occurrence of dscharges that represent the average of the daily mean discarges which occur during a specified number of consecutive days of highest total discharge during a water year is sown above. These curves are used in such studies as flod volume, flood-control reservoir capacity, and storge-reservoir recharge.	The relative frequency of the occurrence of discharges that represent the average of the daily mean discharges during a specified number of consecutive days of lowest total discharge during a climatic year is shown above. Low-flow frequency data are used in studies of waste dilution, availability of water for supply or cooling, reservoir storage capacity, and other fields where low flows are critical.	The percentage of time during which daily mean discharge equals or exceeds various rates without regard to the sequence in which the flows occur is shown above. The curves reflect all of the hydrologic factors which influence streamflow. Therefore, the differences between the overall characteristics of basins may be compared on the basis of the shapes of their respective curves. The high discharge end of the curve represents surface-water runoff primarily and the slope of the curve is indicative of the surface-water storage, basin physiography, and rainfall and snowmelt characteristics in the basin upstream from the gage site. For streams that are not influenced by artificial storage, the low discharge end of the curve primarily represents ground-water runoff and the slope of the curve reflects the amount of subsurface storage which contributes to streamflow, swamp storage, and channel storage. For basins where there is artificial storage, the curve also reflects the release or storage of water, especially in the lower discharge ranges.	The amount of storage that must be provided (over and above that which was available and utilized during the base periods) in order to support minimum-daily discharges at or above indicated levels during conditions of low flow shown by the low-flow frequency curves at 2-, 10-, and 20-year recurrence intervals (50, 10, and 5 percent probability of ocurrence) is shown above. The storage curves do not include effects of reservoir leakage or evaporation.	The number of days per year when diversions of certain amounts can be made from streamflow at the gages while maintaining various daily mean discharges are shown above. The curves are based on a 95 percent probability that any year would include the indicated number of days when discharge would be sufficient to supply the diversion-discharge combinations shown (20-year recurrence interval for maximum number of days per year of sufficient flow). With a greater use of storage, there would be an increase in the number of days when diversions of given amounts could be made.

Repetitiveness of streamflow conditions is shown above in two ways. First, the chance of the occurrence of a given discharge is shown as the percent probability of having the discharge occur during any individual year. Second, the chance of occurrence is shown in terms of a return period (recurrence interval) which is the average of the intervals of time between the incidents of the given discharge. Where there is not considerable experience in using the recurrence interval concept, it may be well to think in terms of the probability of having a given flow condition during any year. After an unusual flow condition, there is a tendency to think that such a condition will not occur again for a longperiod of time. This is not true, any condition, no matter how rare, can happen during any year because the chance of occurrence is the same during all years. For instance, for 50-year floods there is no assurance that the period between the ocurrence of two such floods will be even close to 50 years lon; The 50 years signifies the *average* of the intervals between loods of this magnitude, and, the flood can actually occu during consecutive years because there is an annual 2 percent chance of occurrence.

The slope of curves of these types reflects the amount of storage available and utilized in the basins above the gages. In the high-flow and low-flow frequency curves this particularly pertains to the slope of the curves dealing with the lower numbers of consecutive days. Large amounts of storage in a basin is reflected by curves with low slopes, whereas, if there is little basin storage, the curves are steep.

The above curves reflect flow conditions during the base periods. If, in the future, hydrologic conditions, diversions, and the artificial manipulation of flow are the same as during the base periods, the curves may be used to estimate the future occurrence of the parameters or items shown.

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HYDROLOGY AND WATER RESOURCES OF THE NEPONSET AND WEYMOUTH RIVER BASINS, MASSACHUSETTS

By
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