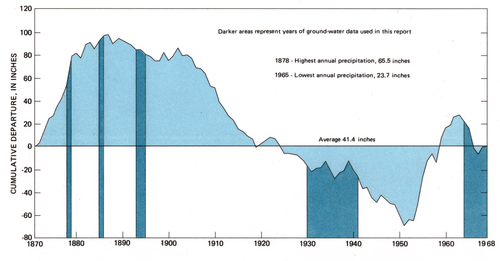


FIGURE 2.—GRAPH SHOWING CUMULATIVE DEPARTURE OF ANNUAL PRECIPITATION AT BOSTON (1871-1968).

Upward-trending line indicates years of above-average rainfall and downward-trending line indicates years of below-average rainfall. Scattered ground-water measurements in the Back Bay area over the last 90 years and frequent measurements during the 1930's and 1960's suggest only minor variation of the water table in response to long-term precipitation trends. Several successive years of below-average precipitation are reflected by lower water levels in some wells, but not in others. Rapid rise and decline of water levels in some wells reflect response to individual storms.

GROUND-WATER OBSERVATIONS

In 1878, seven observation wells were installed in Back Bay for the Joint Board for the Improvement of Charles River before the construction of the first major sewer system (fig. 3). In 1885, after the system had been in operation for about a year, the water levels in these wells were nearly unchanged at about 1.5 to 2.5 feet above mean sea level (table). Additional wells installed in 1894 (fig. 3) showed that water levels were below mean sea level in two areas adjacent to sewers; this was attributed to drainage of water into the sewers (Mass. Metropolitan Park Comm. and State Board of Health, 1894).

When construction plans for the Charles River Dam were approved, the controlled altitude of the Charles River Basin was set at about 2.4 feet above mean sea level (Grade 8, Boston City Base). This altitude is the average of the 10 highest of the 14 water-level measurements for January 1894 (table). This altitude was chosen to keep ground-water levels high enough to prevent rotting of foundation pile caused by exposure to air, and low enough to prevent flooding of basements.

Comparison of March 1968 ground-water levels in Back Bay with levels from the period of highest cumulative departure from average annual precipitation from 1878–94 (fig. 2) indicates that levels were the same or slightly higher in 1968 except at Berkeley and Stuart Streets.

The Boston Sewer Department drilled 130 2-inch wells 10 to 20 feet deep between 1929 and 1936, and the Works Progress Administration installed 570 others between 1936 and 1940. The Works Progress Administration recorded water levels in most of these 700 wells from 1936 to 1940 (some wells were not measured for the entire 4-year period), but the only records still preserved are the maximum and minimum water levels during that period (Works Progress Administration, 1940). At least 32 of these wells in Back Bay were measured intermittently during 1930–39. Although annual precipitation within this period ranged more than 20 percent above and below the long-term average, nearly average precipitation for the whole 10-year period slowed the deficient-precipitation trend of 1901–50 (fig. 2).

Two water-table contour maps (sheets 1 and 2) were constructed from the data obtained between 1936 and 1940. Because only the maximum and minimum water-level data are available for this period, the contour maps of the lowest water level (sheet 1) and the highest water level (sheet 2) are composite maps. The value of these maps to engineers may well be greater than a series of synoptic water-table configurations for one particular year because there is more concern about the range in water-table fluctuation than with the configuration of the water table at any given time.

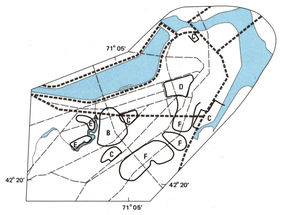
To compare water levels with those of the 1936–40 base period, the Geological Survey located and hydraulically tested 376 of the observation wells in 1967. Of these, 232 were found usable and, together with six wells drilled by the Geological Survey, were used to measure low water level in 1967 (sheet 3) and high water level in 1968 (sheet 4).

COMPOSITE HIGH WATER-TABLE MAP, 1936-40

This map was constructed from the highest recorded water levels measured during the years 1936–40, regardless of the month or year in which the highs occurred. Although it differs in detail from the highest water level of any one year, the water-table contours show that water from the Charles River Basin recharged unconsolidated deposits along much of the north shore of the peninsula. Ground water discharged to most of the Muddy River upstream from Boylston Street (area A, key map) and into storm drains, sewers, and underdrains.

Dewatering for construction projects in the old Gravelly Point area (B) did not span the entire 1936–40 period; the sand and gravel beneath the silt and mud were partly dewatered only during part of this time. When the sand and gravel beds were saturated, water above the silt and mud was not perched. Thus, the composite high water table in this area occurred in the fill.

Local recharge occurred in areas not covered with buildings or pavement, such as the railroad yards (C), Boston Common and Public Garden (D), and relatively unpaved areas in Back Bay Fens (E). The generally high water table along Washington Street (F) reflects the combined effects of recharge and low permeability through fine-grained sediments. Small areas of recharge indicated by high ground-water levels in one or two wells may be due to water-main leaks.



KEY MAP TO AREAS MENTIONED IN TEXT

EXPLANATION

- 2376 — Observation well. *Number is well with hydrograph*
- Observation well not used because of lack of data or apparent spurious water level
- Observation well not used because of short period of record
- Water-table contour. *Shows altitude of water table. Dashed where approximate; hachured indicates depression. Contour interval is 1 foot. Sea level datum of 1929*
- Direction of ground-water movement near shores of the Charles River Basin and Muddy River
- Channel of Muddy River under roadways
- Artificial pond (perched)
- Pumping station
- City of Boston major sewer and storm drain distribution system. *Where two intersecting lines are solid, sewers or drains are interconnected; where two lines cross but are not interconnected, the solid line overlies the interrupted line. Only major sewers and drains are shown; minor ones underlie most streets but are not shown.*
- P — Metropolitan District Commission combined sewer and storm drain. P, pressurized line
- Brook conduit
- Interceptor and combined sewer
- Sanitary sewer
- Storm drain
- Recharge in unpaved area or partly unpaved area
- Possible recharge from water-main leak

Base redrawn from Boston Redevelopment Authority, 1:9,000 city base, March 1969

0 ½ MILE
0 ½ KILOMETRE

EXPLANATION

1 — Well installed in 1878, number refers to table below

7 — Well installed in 1885, number refers to table below

Sewers constructed in 1884

FIGURE 3.—MAP SHOWING OBSERVATION WELLS IN BACK BAY, 1878-94.

Table of ground-water levels in Back Bay, 1878–94

Well No.	Observations before sewer construction[1]			Observations after sewer construction (1884)[1]		
	Jan.	1878 Feb.	Mar.	1885 Mar.	1893 Dec.	1894 Jan.
1		2.65	2.85	2.25	1.95	2.35
2		2.45	2.55	2.45	2.05	2.15
3		2.25	2.45	2.25	1.95	2.15
4	2.35	2.45	2.55	2.65	2.75	2.95
5	2.15	2.25	2.45	2.35	2.55	2.85
6	1.45	1.65	1.85	1.85	1.85	2.25
7		1.75	1.85	1.05	1.85	1.55
8						-1.35
9						-1.15
10						2.05
11						2.45
12						2.35
13						2.55
14						.65

[1] Water levels in feet above or below mean sea level.

SELECTED REFERENCES

Aberthaw Company, ca. 1933, Report on water levels at the site of the new publishing building for The Christian Science Publishing Society: Boston, Mass., 30 p.

Massachusetts House of Representatives, 1894, Report of the Joint Board, consisting of the Metropolitan Park Commission and the State Board of Health, upon the improvement of Charles River from the Waltham line to the Charles River Bridge: H. Doc. 775, Boston, Mass., 51 p.

U.S. Weather Bureau, Local climatological summaries for 1938, 1951, and 1968: Boston, Mass.

Works Progress Administration, 1940, Ground-water-level survey, Building Department, City of Boston: W.P.A. Projects nos. 5325 and 18868.

MEAN SEA LEVEL AND OTHER DATUM PLANES

See sheet 1 for further details

	feet
Sea-level datum, Commonwealth Pier 5, 1921-23	0.00
Mean tide level, Commonwealth Pier 5, 1929	-.12
Mean low water, Boston Harbor, 1929	-4.84
Boston low water datum, 1929	-4.87
Boston City Base	-5.65
Metropolitan District Commission (sewers)	-105.62

SCALE 1:6 000

1000 500 0 1000 FEET

250 125 0 250 METRES

Hydrograph constructed from data collected for the Prudential Insurance Co. of America by Metcalf & Eddy, Inc., Boston, Mass., (1968)

FIGURE 4.—HYDROGRAPHS SHOWING COMPARISON OF GROUND-WATER LEVELS AND PRECIPITATION (1930-39).

Hydrographs for two wells, Boston 2376 and 2377 (Sewer Department wells S4-124 and S5-09), which were generally measured monthly, reflect the monthly precipitation record only to a small degree. Monthly measurements may or may not reflect recharge from precipitation, depending upon the distribution of precipitation relative to the time of water-level measurement during the month. Although Boston 2377 is within 150 feet of the Charles River Basin, its water level was generally 2 to 3 feet lower than that of the basin. Wooden sheeting on either side of the Metropolitan District Commission sewer probably hindered ground-water movement southward to replace water drained by sewers and storm drains along Beacon Street. The water level in Boston 2376 was below mean sea level except for a short period in 1931, demonstrating draining by a large interceptor and combined sewer less than 50 feet away.

Interior—Geological Survey, Reston, Va.—1975 —W73230

GROUND–WATER LEVELS ON BOSTON PENINSULA, MASSACHUSETTS

By
John E. Cotton and David F. Delaney

1975