HOUSE . . . . No. 159

The Commonwealth of Massachusetts

SPECIAL REPORT OF THE DEPARTMENT OF PUBLIC HEALTH AND THE METROPOLITAN DISTRICT COMMISSION RELATIVE TO INCREASING THE CAPACITY OF THE CHARLES RIVER VALLEY SEWER.

[Metropolitan Affairs.]

DECEMBER 1, 1931.

To the General Court.

The Metropolitan District Commission and the Department of Public Health, acting as a Joint Board, as authorized under the provisions of chapter 40 of the Resolves of 1931 to investigate the matter of increasing the capacity of the Charles River Valley sewer of the South Metropolitan Sewerage District, have caused investigations to be made as provided in the resolve and submit the following report.

The resolve under which this investigation has been made reads as follows:

Resolved, That the department of public health and the metropolitan district commission, acting as a joint board, are hereby authorized and directed to investigate the matter of increasing the capacity of the Charles River valley sewer of the south metropolitan sewerage district and constructing such other works as may be necessary to adequately accommodate the sewage from the town of Watertown and other communities with the view to eliminating the overflow of sewage into the Charles river in or near said Watertown. Said board shall determine the capacity of the said sewer, and any sewer tributary to it, and the adequacy thereof for carrying off all sewage and industrial wastes produced within the territory tributary to said

sewers. Said board may enter the premises of any person or corporation served by said sewers for the purpose of making an examination of the amount and character of sewage and waste discharged therefrom, and it shall have access to all plans and maps of sewers and records of quantities of sewage and wastes on file in the offices of the municipalities served by said sewers. Said board shall report to the general court its findings and its recommendations, if any, by filing the same with the clerk of the house of representatives on or before December first in the current year, and, for the purposes of this resolve, the board may expend such sum, not exceeding five thousand dollars, as may hereafter be appropriated, and such sum shall be assessed on the cities and towns of the metropolitan sewerage district, south system, as a part of the cost of maintenance and operation of said south system.

As the period of the investigation did not include those seasons of the year when a maximum flow in the sewers is to be expected, much of the investigation was necessarily limited to examinations of the records of the flow in the Charles River Valley sewer made under the direction of the Sewerage Division of the Metropolitan District Commission, together with such hydraulic measurements as it was practicable to make in this and some of the lateral sewers to determine the capacity of the Charles River Valley sewer to accommodate the sewage tributary thereto, and an investigation into the condition of the Charles River Basin.

The Charles River Valley sewer was constructed in the year 1892 to provide an outlet for the sewage of the cities of Waltham and Newton and the towns of Watertown and Brookline and the Brighton district of the city of Boston. It was intended that storm water would be excluded from all new systems of sewers and extensions of existing sewers into the Charles River Valley sewer, and that the entrance of storm water from sewers already built should be strictly regulated. At times of considerable run-off mingled storm water and domestic sewage overflow into the Charles River from lateral sewers. This condition was anticipated and overflows were provided at the time the sewer was built.

During the early part of the summer of 1931 the discharge of sewage into the river in the vicinity of Galen

Street, Watertown, caused objectionable conditions, making it necessary to temporarily discontinue bathing in the upper parts of the basin. An examination made by engineers from the Department of Public Health at that time showed that the Watertown siphon at Galen Street, so far as could be determined, was completely clogged, and as soon as the deposits were removed from the siphon by employees of the town there was a free flow of sewage into the Charles River Valley sewer, and the discharge of sewage into the basin ceased. Since that time, except on two separate days in the early part of July at times of heavy rainfall, there has been no overflow of sewage at this siphon. If this siphon is kept free from deposits overflows are unlikely to occur except during periods of high run-off.

This siphon provides an outlet for the sewage from the sewers entering Watertown Square from North and South Main streets and Pleasant Street, and it is estimated that the combined capacity of these sewers when flowing full is about 8,000,000 gallons in twenty-four hours. Because of the low level of the Watertown sewer the capacity of the siphon when the Charles River Valley sewer is flowing full is not sufficient to provide for this amount of sewage unless the discharge through the siphon is increased by permitting the sewage to back up temporarily to an additional depth of about 2 feet above the top of the sewers at the head of the siphon in Watertown Square. This can be accomplished by providing an additional height of stop planks in the overflow manhole at Galen Street. If this arrangement should interfere with the operation of low fixtures near the siphon in Watertown Square, relief can be obtained by raising or removing the low fixtures or by pumping the sewage at such times as may be necessary.

The Charles River Valley sewer has always discharged mingled sewage and storm water into the Charles River at times of severe storms, and these discharges have become more frequent and larger in quantity with the increase of population contributory to the system. In

order to protect the Charles River Basin from pollution, it is important that further separation of sewage and storm water be made in the municipalities contributing to this sewer, or that suitable provision be made for diverting a larger amount of the combined storm water and sewage from the watershed of the Charles River.

Two plans appear to be available for the relief of this sewer, though further study will be necessary before the desirability of their adoption can be determined. One plan would be to extend the high-level Metropolitan sewer which terminates at Oak Square in Brighton to the Brighton–Newton line whence, if this sewer were extended by the city of Newton across that city, it would intercept two-thirds of the sewage of that city which now discharges into the Charles River Valley sewer. This would be a material relief. The other plan would be to provide a pumping station at some point in the lower part of the Charles River Valley by means of which a part of the sewage could be delivered into the high-level sewer by an independent line. If these plans are carried out, in the opinion of the Board there will be no necessity of increasing the capacity of the Charles River Valley sewer at least for a considerable number of years.

The development of the Charles River Basin since this sewer was built, and its increasing use for recreational purposes, makes the reduction of discharges from sewer overflows, and from other objectionable sources, increasingly desirable.

The Board recommends: first, in reference to conditions at the overflow at Galen Street, that the Watertown siphon be kept free from deposit, that the height of the overflow be raised by additional stop planks, and that if unsatisfactory conditions result these be relieved by pumping the sewage from the siphon at such times as may be necessary; and second, in reference to the capacity of the Charles River Valley sewer and discharge of sewer overflows therefrom and pollution from other sources, that the Department of Public Health continue

to observe conditions in the Charles River Basin, and that it report annually thereon with such recommendations tending to relieve unsatisfactory conditions as it deems advisable.

Respectfully submitted,

DEPARTMENT OF PUBLIC HEALTH,

GEO. H. BIGELOW.
JAMES L. TIGHE.
FRANCIS H. LALLY.
GORDON HUTCHINS.

METROPOLITAN DISTRICT COMMISSION,

DAVIS B. KENISTON.
WM. F. ROGERS.
C. H. J. KIMBALL.
FRANK A. BAYRD.

CHIEF ENGINEER'S REPORT.

NOVEMBER 20, 1931.

To the Joint Board for Investigating the Matter of Increasing the Capacity of the Charles River Valley Sewer, GEORGE H. BIGELOW, M.D., *Chairman.*

GENTLEMEN: — Herewith is submitted a report relative to an investigation made under chapter 40 of the Resolves of 1931 of the matter of increasing the capacity of the Charles River Valley sewer of the South Metropolitan Sewerage District and constructing such other works as may be necessary to accommodate adequately the sewage from the town of Watertown and other communities with a view of eliminating the overflow of sewage into the Charles River in or near Watertown.

CHARLES RIVER VALLEY SEWER.

The Charles River Valley sewer was completed in the year 1892 in approximately the same location as proposed by the State Board of Health in its report to the Legislature in 1889, as directed under chapter 95 of the Resolves of 1887, and chapters 42 and 63 of the Resolves of 1888. It was designed to intercept the sewage from the cities of Waltham and Newton and the towns of Watertown and Brookline, also the Brighton district of Boston. It was proposed at that time that the sewer be designed to provide for the disposal of sewage from a population of approximately 157,800 persons, and a flow of 54.8 cubic feet of sewage per second (35.4 million gallons per day), or 225 gallons per person per day. These estimates were modified somewhat by Mr. Howard A. Carson, chief engineer of the then Metropolitan Sewerage Commission, after census figures of 1890 became available, to provide for an estimated population of 183,000 persons where the sewer originally discharged into the Boston main drainage works at Gainsborough

Street. When this sewer was constructed it was intended that storm water would be excluded from all new systems of sewers and extensions to existing sewers, and that the entrance of storm water from systems of sewers already built should be strictly regulated.

As originally constructed, this sewer had an outlet through the Boston main drainage system, entering that system near Gainsborough Street, but in 1904, because of the crowded condition of the sewers in the Boston main drainage district, the sewage above the vicinity of Vancouver Street was diverted to a pumping station located near Ward Street, and since that time has been pumped into the high level sewer of the South Metropolitan Sewerage District. The location, sizes and capacity of the Charles River Valley sewer are shown in the following table:

Location.	Diameter.	Length (Feet).	Full Capacity (Million Gallons Daily).
North Street, Newton, to Jasset Street, Newton	42″ x 48″	6,000	17.7
Jasset Street, Newton, to Galen Street, Watertown	47″ x 53″	3,250	19.1
Galen Street, Watertown, to Newton-Brighton line	50″ x 57½″	5,700	22.1
Newton-Brighton line to vicinity of Cambridge Street	54″ x 61½″	12,500	26.5
Vicinity of Cambridge Street	58″	750	25.8
Cambridge Street to St. Mary's Street	58″	5,800	28.4
St. Mary's Street to Vancouver Street	66″	5,500	37.0
Vancouver Street to Ward Street pumping station	78″ x 84″	700	-

The 66-inch circular sewer originally connected with the Boston main drainage system at the corner of Huntington Avenue and Gainsborough Street, and in order to divert the flow of the Charles River Valley sewer to the pumping station at Ward Street the 78 by 84 inch sewer was constructed, which intercepts the 66-inch sewer mentioned above, and the sewage tributary in Huntington Avenue east of this point was reversed in flow by the construction of a new invert within the sewer. The sewer connecting the old Charles River

Valley sewer to the pumping station has a carrying capacity when running full of 89.8 million gallons per day. At the Ward Street pumping station there are provided three pumps for pumping the sewage into the high level South Metropolitan sewer, a gravity sewer having outlet into Boston Harbor off Peddocks Island. Each of these pumps has a capacity of 50,000,000 gallons when operated against a total head of 45 feet.

Present Sewerage Requirements within the Watershed of the Charles River Valley Sewer.

Under existing conditions the Charles River Valley sewer as herein described is required to remove the sanitary sewage from the cities of Waltham and Newton, the town of Watertown, and the combined sewage from Brookline and parts of the Brighton and the Back Bay sections of the city of Boston.

The following table shows the estimated population now contributing sewage, and the total quantity of sewage disposed of through the Charles River Valley sewer according to the records available at the Ward Street pumping station of the South Metropolitan Sewerage District during each year since 1904. In this table, also, are shown the miles of sewers and the estimated population served by the sewers.

Average Daily Quantity of Sewage pumped from the Charles River Valley Sewer into the High Level Sewer.

Year.	Estimated Population Served.	Estimated Miles of Tributary Sewers.	Per Capita Average Daily Flow (Gallons).	Average Maximum Weekly Flow (Million Gallons Daily).[1]	Average Daily Flow (Million Gallons Daily).[1]	Average Minimum Weekly Flow (Million Gallons Daily).[1]	Inches of Rainfall at Waltham Water Works Pumping Station.
1905	117,500	302	131	18.18	15.39	13.87	40.22
1906	122,900	309	149	21.32	18.27	16.52	43.56
1907	128,000	313	156	22.74	19.99	17.88	41.15
1908	132,100	318	134	20.77	17.71	15.86	34.01
1909	138,300	326	132	22.38	18.22	16.17	41.74
1910[2]	127,500	295	150	23.53	19.14	16.72	33.97
1911	132,000	300	128	20.12	16.90	14.66	41.92
1912	136,200	307	140	22.91	19.10	16.54	42.30
1913	139,800	314	151	25.29	21.11	18.37	45.69
1914	144,900	322	151	26.65	21.96	18.90	35.58
1915	156,000	330	142	27.12	22.13	19.19	43.93
1916	161,800	335	156	29.25	25.19	22.71	33.88
1917	167,700	341	143	28.08	23.88	20.95	36.86
1918	173,600	343	138	28.11	24.04	21.20	36.15
1919	179,600	346	149	33.18	26.80	26.15	50.18
1920	185,300	351	149	31.55	27.55	24.94	48.00
1921	188,500	355	146	31.88	27.54	24.21	42.51
1922	193,700	357	154	34.19	29.81	26.16	47.02
1923	202,000	362	145	33.71	29.33	25.61	40.90
1924	207,900	368	145	34.44	30.09	26.47	37.44
1925	216,300	381	141	36.31	30.47	27.60	41.39
1926	221,500	388	138	38.51	30.48	28.64	42.05
1927	227,200	399	135	34.23	30.73	27.32	46.70
1928	232,500	413	137	36.00	31.88	29.12	43.83
1929	238,400	425	137	37.28	32.59	28.76	36.39
1930	244,200	438	114	32.70	27.77	24.96	32.54[3]

[1] Taken from records on file at Ward Street pumping station.

[2] Extension of the high level sewer to Oak Square, Brighton, completed in 1909.

[3] The year 1930 was one of the driest on record in the valley of the Charles River.

The figures representing the average daily flow of sewage at the Ward Street pumping station do not agree with the figures published in the annual reports of the Sewerage Division of the Metropolitan District Commis-

sion, as the figures in those reports include some 2 to 3 million gallons per day which are returned to the pump well after being used for condensing purposes.

Condition of the Charles River Valley Sewer.

The sewers of the cities of Newton and Waltham and the town of Watertown are designed on the separate plan, but the recent investigation shows that a considerable amount of storm water reaches the sewers in these municipalities. The sewers of the Brighton section of Boston and the town of Brookline were originally designed and constructed to care for the combined flow of both sewage and storm water, but in recent years a certain amount of separation has been accomplished. There continues to be a large amount of surface drainage discharged into the sewers in these latter municipalities. Under the circumstances, while the records of the amount of sewage pumped into the high level sewer at the Ward Street pumping station in dry weather represent fairly accurately the dry weather flow of sewage from the sewers tributary to the Charles River Valley sewer and from the Gainsborough Street section of Boston at such times, they are not a true representation of the flow from these sewers during periods of any considerable run-off.

At such times mingled storm water and sewage escape through the overflows commonly controlled by "regulators," so called, which are located on the lateral connections at various points. These regulators are so arranged that when the sewage in the trunk sewer reaches a certain elevation the regulator closes and the mingled storm water and sewage overflow.

Flow in Charles River Valley Sewer.

At four different points on the Charles River Valley sewer, between the Newton–Waltham line and the Ward Street pumping station, gages have been in operation a number of years for recording the elevation of the flow at these points, but unfortunately records are

missing for the years 1904–09, 1912, 1914, 1922–24, and 1926–28, inclusive.

These gages are —

Gage No. 36 at the Newton–Waltham line.
Gage No. 37 at the Newton–Brighton line.
Gage No. 40 at Cottage Farm bridge.
Gage No. 41 at St. Mary's Street.

The average daily flow of sewage during the year 1930 per acre tributary to these gages was as follows:

	Estimated Area contributing Sewage (Acres).	Sewage Flow in Gallons per Acre per Day.		
		Average Maximum Weekly.	Average.	Average Minimum Weekly.
At gage No. 36	2,081	2,020	1,540	1,300
At gage No. 37	10,511	1,450	960	680
At gage No. 40	13,457	2,020	1,490	1,080
At gage No. 41	14,540	2,710	1,910	1,280

An examination of these records shows that during 1929 and 1930, years of low rainfall, the Charles River Valley sewer under average conditions was 20 per cent full at the Newton–Waltham line, 50 per cent full at the Newton–Brighton line, 70 per cent full at the Cottage Farm bridge, and 75 per cent full at St. Mary's Street.

Under average maximum weekly conditions during this period it was 25 per cent full at the Newton–Waltham line, 60 per cent full at the Newton–Brighton line, and at full capacity at the Cottage Farm bridge and at St. Mary's Street.

An examination of those records further shows that in the years 1918, 1919, 1920, 1921, and the more recent years for which records are available, this sewer at the Cottage Farm bridge and at St. Mary's Street was at full capacity at times of high run-off, and that much of the capacity of the Charles River Valley sewer is now required for the dry-weather flow.

Records on file in the office of the street commissioner

of the city of Newton show that during the present year the flow in parts of the Charles River Valley sewer between the Newton–Waltham line and Watertown, especially above the upper siphon connecting the sewers of the town of Watertown with the trunk sewer, has at several different times been surcharged.

Sewerage of Cities of Waltham and Newton and the Town of Watertown.

In order to ascertain the probable cause of the large flow in the Charles River Valley sewer above the Newton–Brighton line at times of even moderate rainfalls, an examination was made of the records in Waltham, Newton and Watertown of the miles and kinds of sewers in those municipalities, and what provision is made to exclude storm water. Probably in each of those municipalities some connections exist whereby roof water enters the sanitary sewers, but no connections are authorized whereby either roof water or surface water can be diverted into the sanitary sewers except in Brookline and Brighton.

It is the practice in Newton, Waltham and Watertown for all sewer connections to be made by employees of the sewer or street department, and connections in any other manner are forbidden. In each of these municipalities these connections extend from the sewer to the soil pipe in the house. Representatives of the sewer or street department when interviewed stated that no connections exist whereby drainage from roofs or surface drains enter the sewers, and in the city of Waltham an ordinance makes such connection an offence punishable by a fine. In spite of these regulations, storm water undoubtedly enters the sewers.

Observations were made during the past summer of the flow from the lateral sewers in Newton, Waltham and Watertown, in each case just above the connection with the Charles River Valley sewer during a period of average dry-weather flow and one of moderately high run-off. These observations show that at times of even

moderately high run-off the flow in these sewers is considerably increased. The results of these observations are shown in the following table:

City or Town.	Average Dry-Weather Flow in Lateral Sewers during 24-Hour Test on September 17-18, 1931.				Average Daily Water Consumption (Million Gallons Daily).	Estimated Rate of Flow Storm of October 16 (Million Gallons Daily).	Estimated per Capita Sewage Flow.	
	Total Capacity of All Sewers, Full (Million Gallons Daily).	Million Gallons Daily Sewage Flow.					Average Daily Gallons, September 17-18.	Storm of October 16 (gallons).
		Maximum.	Average.	Minimum.				
Waltham	22.80	3.91	3.20	2.43	2.24	5.56	86	150
Newton	26.00	7.87	5.83	3.98	5.14[1]	11.98	108	221
Watertown	19.57	3.75	2.41	1.25	2.17	5.26	69	150
Total	68.37	15.53	11.44	7.66	9.55	22.80	–	–

[1] Estimated.

An examination of the above table indicates that much rain water readily enters the sewers in Newton, Waltham and Watertown in spite of the precautions taken by those in charge of sewer construction. The large flow of storm water entering the Charles River Valley sewer above Galen Street results in a surcharged condition of this sewer at times. The depth of flow in this sewer at this street shown by observations made by the Sewerage Division of the Metropolitan District Commission during the past year is as follows:

Flow in Charles River Valley Sewer at Galen Street Manhole.

[Capacity, full, 22.1 Million Gallons Daily.]

1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.	1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.
Jan. 1	–	–	Feb. 17	–	–
2	–	–	18	85.5	.43
3	–	–	19	–	.48
4	–	–	20	74.1	.18
5	–	–	21	–	.03
6	–	1.01	22	–	.01
7	–	.05	23	–	–
8	–	–	24	69.8	–
9	–	–	25	–	–
10	–	–	26	–	–
11	–	–	27	71.0	–
12	–	–	28	–	–
13	–	.80	Mar. 1	–	–
14	–	–	2	78.3	–
15	–	–	3	–	–
16	–	–	4	–	.10
17	–	–	5	–	.43
18	–	–	6	–	–
19	–	.02	7	–	.01
20	–	.76	8	–	–
21	–	–	9	–	2.19
22	–	–	10	–	–
23	–	–	11	–	.01
24	–	–	12	–	.06
25	–	–	13	–	–
26	–	–	14	–	–
27	–	–	15	–	–
28	–	–	16	–	–
29	–	–	17	–	.04
30	56.4	.15	18	–	–
31	–	.44	19	–	–
Feb. 1	–	.01	20	–	–
2	59.4	.04	21	–	–
3	–	–	22	–	–
4	–	–	23	–	–
5	51.1	–	24	–	–
6	–	–	25	–	–
7	45.8	–	26	–	.59
8	–	.04	27	–	.02
9	54.2	.20	28	–	–
10	–	.53	29	–[1]	.71
11	54.2	–	30	–	.74
12	–	–	31	–	–
13	–	–	Apr. 1	–	.02
14	73.0	.14	2	95.0	.51
15	–	.11	3	–	–
16	60.5	–	4	–	.25

[1] Surcharged.

Flow in Charles River Valley Sewer at Galen Street Manhole — Continued.

1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.	1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.
Apr. 5	–	–	May 24	–	.40
6	89.7	–	25	68.9	–
7	–	–	26	–	.03
8	–	.51	27	–	–
9	–	–	28	–	–
10	–	–	29	–	–
11	–	–	30	–	–
12	–	–	31	–	.03
13	81.4	–	June 1	62.6	.31
14	–	–	2	–	.02
15	–	–	3	–	–
16	–	–	4	–	–
17	75.1	–	5	–	–
18	–	–	6	–	–
19	–	–	7	–	–
20	–	–	8	60.5	.16
21	74.1	–	9	–	.64
22	–	–	10	–	3.57
23	–	–	11	–	.67
24	71.0	.05	12	85.5	.15
25	–	–	13	–	.05
26	–	.04	14	–	–
27	76.1	1.20	15	87.6	–
28	–	–	16	–	1.82
29	–	–	17	–	.49
30	–	.02	18	–	.05
May 1	–	–	19	–	–
2	–	–	20	–	–
3	–	–	21	–	–
4	–	–	22	91.8	–
5	–	–	23	–	–
6	–	–	24	–	.19
7	–	–	25	–	–
8	–	–	26	–	–
9	–	1.08	27	–	.30
10	–	–	28	–	.01
11	69.9	.54	29	77.2	–
12	–	.01	30	77.2	–
13	–	.34	July 1	69.9	–
14	–	.31	2	72.0	–
15	–	.41	3	64.7	–
16	–	–	4	–	–
17	–	.03	5	–	–
18	73.0	–	6	73.0	–
19	–	–	7	64.7	.96
20	–	–	8	–	1.24
21	–	–	9	–	.02
22	–	.23	10	–	.03
23	–	.03	11	56.3	.18

Flow in Charles River Valley Sewer at Galen Street Manhole — Continued.

1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.	1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.
July 12	–	–	Aug. 29	53.2	.03
13	66.8	–	30	–	–
14	61.6	–	31	–	.02
15	58.5	.19	Sept. 1	51.1	–
16	58.5	.03	2	44.8	–
17	57.4	–	3	43.8	.26
18	59.4	–	4	50.0	.06
19	–	–	5	49.0	–
20	62.8	–	6	–	–
21	52.2	.01	7	–	–
22	54.2	.02	8	51.1	–
23	52.2	.03	9	45.8	–
24	55.4	–	10	41.8	–
25	50.0	.05	11	50.0	–
26	–	–	12	45.8	–
27	55.4	–	13	–	–
28	55.4	–	14	52.2	–
29	48.1	–	15	50.0	.17
30	48.1	.07	16	45.8	.48
31	54.2	–	17	45.8	–
Aug. 1	45.8	–	18	50.0	.08
2	–	–	19	48.1	–
3	52.2	.05	20	–	–
4	45.8	.13	21	50.0	.22
5	45.8	–	22	45.8	.01
6	41.8	–	23	48.1	.02
7	43.8	–	24	42.8	–
8	41.8	.11	25	50.0	.03
9	–	–	26	39.6	.01
10	51.1	.01	27	–	.10
11	43.8	.03	28	51.1	.01
12	45.8	.62	29	42.8	–
13	48.1	1.54	30	41.8	–
14	45.8	.01	Oct. 1	43.8	–
15	44.8	.05	2	45.8	–
16	–	.14	3	48.1	–
17	52.2	–	4	–	–
18	45.8	.01	5	50.0	–
19	43.8	–	6	45.8	–
20	41.8	.17	7	43.8	–
21	50.0	–	8	43.8	.02
22	39.6	–	9	48.1	–
23	–	–	10	41.8	–
24	51.2	–	11	–	–
25	48.1	.05	12	–	–
26	45.8	–	13	50.0	–
27	49.0	.66	14	41.8	–
28	54.2	.99	15	43.8	.31

Flow in Charles River Valley Sewer at Galen Street Manhole — Concluded.

1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.	1931.	Per Cent Full Depth.	Inches of Rainfall at Waltham Waterworks Pumping Station for Previous Day.
Oct. 16	49.0	.40	Oct. 24	37.6	-
17	43.8	.58	25	-	-
18	-	.01	26	52.2	.08
19	50.0	-	27	45.8	.15
20	48.1	-	28	41.8	.01
21	49.0	-	29	43.8	.32
22	42.8	-	30	48.1	.48
23	41.8	-	31	40.6	-

Siphon at Galen Street, Watertown.

The sewage from the lateral sewers of the town of Watertown in Pleasant Street and in North and South Main streets enters the Charles River Valley sewer at Galen Street through a 24-inch inverted siphon under the Charles River. This siphon can be considered as beginning at the manhole which receives the flow from the Pleasant and North and South Main Street sewers on the north side of the river at Watertown Square where the invert of the sewer is at elevation 11.11 feet above Boston City Base. From this junction manhole to the overflow manhole the siphon drops 1.65 feet in 227 feet, then dips steeply to elevation 3.17, a drop of 6.29 feet in the next 56 feet to a second manhole, crossing the river a distance of 166.9 feet to a manhole with an additional drop of 0.51 of a foot. It then rises to the second manhole on the south side of the river to elevation 4.60 in a distance of 65.6 feet. At elevation 9.53, or an additional rise of 4.93 feet, it takes off to join a manhole near the Metropolitan regulator, a distance of 34.7 feet to an elevation of 9.65, from which point it discharges into the Charles River Valley sewer, the invert of which is at elevation 8.38 and the vertical diameter of which is 4.79

feet. During the early part of the past summer, when sewage was flowing into the Charles River from theWatertown sewer at Galen Street, the siphon was found to be entirely clogged with deposits.

The maximum capacity of the sewers entering Watertown Square at the head of the siphon is about 8,000,000 gallons per day. Whenever the Metropolitan sewer is not more than 62.5 per cent full, and the siphon is operating properly, all of this flow will enter the Metropolitan sewer without any overflow into the Charles River, but as the sewage rises in the Metropolitan sewer a part of the sewage from Watertown must either overflow or the sewage must back up in the Watertown sewers. When the Metropolitan sewer is full the backing up at the head of the siphon in Watertown Square will amount to about 2 feet, provided the flashboards in the overflow manhole are raised sufficiently to prevent overflow. If backing up to this height causes the flooding of any low fixtures in Watertown, pumping the sewage will be necessary unless the fixtures are raised or removed.

Condition of Charles River in or near Watertown.

The matter of pollution of the Charles River in the vicinity of Watertown has been investigated a number of times in recent years by the Department of Public Health, because of the use of the river for purposes of recreation, and samples of the water of the river in the vicinity of that municipality and from parts of the Charles River Basin have been collected and analyzed at regular intervals under the direction of the Department of Public Health for a number of years.

On several occasions the river in its entire course has been investigated, the most recent extensive investigation having been made in the year 1919 in accordance with chapter 9 of the resolves of that year. At the time of that investigation the river and its tributaries were found to be polluted by both sewage and manufacturing waste in some of the upper parts of its course, especially in the towns of Milford, Bellingham, Franklin and

Medway, and from industrial wastes in the cities of Newton and Waltham and the towns of Wellesley and Watertown. The results of the analyses showed that the water of the river entering the Charles River Basin at that time was not notably polluted.

The analyses of samples of the water collected from the Charles River Basin during the years 1930 and 1931 show that during this period it was seriously polluted in the upper part of the basin when sewage was overflowing from the Watertown sewer. The analyses of samples of water from several parts of the basin where the water may be affected at times by the overflow of sewage from the sewers tributary to the Charles River Valley sewer are shown in the following tables:

Charles River Basin.

Cottage Farm Bridge — Surface.

Year.	AVERAGE CHEMICAL ANALYSIS. (Parts in 100,000.)															AVERAGE BACTERIAL RESULTS.	
	Color.	Residue on Evaporation.			Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.	Iron.	Dissolved Oxygen. — Per Cent Saturated.	Average 4-Day Count. — Per c.c.	Average B-Coli. — Per 100 c.c.
		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Albuminoid. In Suspension.		Nitrates.	Nitrites.						
1909 . .	0.47	187.81	10.60	40.21	.0177	.0366	.0261	.0105	85.70	.0074	.0013	0.84	–	–	–	–	–
1910 . .	0.46	219.32	10.89	39.35	.0214	.0343	.0250	.0093	102.25	.0064	.0011	0.72	–	–	–	–	–
1911 . .	0.52	75.26	10.09	32.57	.0221	.0389	.0279	.0110	35.98	.0121	.0012	–	–	–	–	–	–
1912 . .	0.58	91.00	8.74	35.95	.0145	.0426	.0275	.0151	40.65	.0118	.0007	0.92	–	–	–	–	–
1913 . .	0.64	81.58	5.58	18.10	.0147	.0422	.0300	.0122	37.31	.0112	.0007	–	–	–	–	11,700	100
1914 . .	0.53	134.33	4.76	18.33	.0288	.0394	.0298	.0096	61.51	.0126	.0009	0.87	–	–	–	–	–
1915 . .	0.67	45.58	6.15	26.50	.0196	.0412	.0337	.0075	19.01	.0109	.0003	0.89	–	–	–	–	–
1916 . .	0.66	16.66	4.53	12.13	.0486	.0331	.0263	.0068	34.24	–	–	0.98	–	–	–	–	–

1917 . .	0.61	18.92	4.48	14.44	.0219	.0348	.0266	.0082	16.44	–	–	–	–	–	68.6	–	–
1918 . .	0.57	9.05	2.80	6.25	.0206	.0354	.0250	.0104	1.65	–	–	–	–	.055	–	–	–
1919 . .	0.71	34.56	7.20	27.36	.0308	.0379	.0315	.0064	12.94	–	–	0.72	–	–	72.2	6,900	6,700
1920 . .	0.22	466.20	–	–	.0172	.0256	.0208	.0048	230.00	–	–	0.92	–	.020	–	–	–
1921 . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922 . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923 . .	0.22	282.35	54.50	227.85	.0221	.0271	.0209	.0062	142.50	–	–	0.72	–	.021	–	3,900	1,000
1924 . .	0.35	344.65	72.20	272.45	.0310	.0367	.0237	.0130	157.00	–	–	0.80	–	.036	–	1,400	500
1925 . .	0.34	339.59	72.87	266.72	.0280	.0389	.0262	.0127	155.31	–	–	0.83	6.0	.033	44.6	–	–
1926 . .	0.33	416.42	77.68	338.74	.0364	.0355	.0256	.0099	195.17	–	–	0.96	–	.025	66.8	–	–
1927 . .	0.69	86.02	17.58	68.44	.0235	.0312	.0256	.0056	37.36	–	–	1.02	–	.054	46.8	–	–
1928 . .	0.72	34.90	6.70	28.20	.0360	.0322	.0267	.0055	14.00	–	–	1.00	8.0	.078	–	600	1,000
1929 . .	0.56	96.12	18.70	77.42	.0310	.0313	.0212	.0101	46.01	–	–	0.65	–	.042	–	1,300	670
1930 . .	0.22	281.72	56.20	225.52	.0340	.0239	.0168	.0071	147.69	–	–	0.70	–	.023	92.4	1,800	2,700
1931 . .	0.63	78.93	16.29	62.65	.0289	.0313	.0208	.0105	35.76	–	–	0.94	13.6	.054	77.7	1,700	3,400

Charles River Basin.

Western Avenue — Surface.

Year.	AVERAGE CHEMICAL ANALYSIS. (Parts in 100,000.)														AVERAGE BACTERIAL RESULTS.	
	Color.	Residue on Evaporation.			Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.	Iron.	Dissolved Oxygen. — Per Cent Saturated.	Average 4-Day Count. — Per c.c.	Average B-Coli. — Per 100 c.c.
		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid.				Nitrates.	Nitrites.						
						Total.	In Solution.	In Suspension.									
1909 . .	0.48	167.11	10.43	30.3	.0194	.0389	.0282	.0107	72.60	.0086	.0012	0.83	–	–	–	–	–
1910 . .	0.50	198.76	8.99	30.76	.0222	.0397	.0277	.0120	95.10	.0080	.0012	0.74	–	–	–	–	–
1911 . .	0.53	67.15	9.07	32.13	.0214	.0380	.0236	.0144	28.67	.0113	.0012	–	–	–	–	–	–
1912 . .	0.60	74.42	8.20	34.20	.0172	.0395	.0280	.0115	32.59	.0135	.0009	–	–	–	–	–	–
1913 . .	0.66	64.80	7.14	22.03	.0172	.0417	.0285	.0132	19.55	.0139	.0009	–	–	–	–	5,000	100
1914 . .	0.53	130.24	3.58	12.78	.0234	.0370	.0281	.0089	54.95	.0135	.0011	0.85	–	–	–	–	–
1915 . .	0.67	33.81	4.69	16.98	.0214	.0416	.0326	.0090	13.11	.0166	.0003	0.90	–	–	–	–	–
1916 . .	0.66	11.71	3.40	8.90	.0202	.0319	.0262	.0057	24.93	–	–	0.93	–	–	–	–	–

1917	. .	0.64	17.21	3.61	13.60	.0217	.0335	.0266	.0069	10.62	–	–	–	–	–	62.1	–	–
1918	. .	0.64	8.65	2.95	5.70	.0177	.0388	.0300	.0088	.99	–	–	–	–	.052	–	–	–
1919	. .	0.71	19.06	4.22	14.84	.0271	.0379	.0325	.0054	9.72	–	–	0.81	–	–	69.7	19,300	4,000
1920	. .	0.24	423.50	–	–	.0216	.0272	.0204	.0068	205.00	–	–	0.96	–	.025	–	–	–
1921	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923	. .	0.25	270.70	46.60	174.10	.0228	.0327	.0232	.0095	153.00	–	–	0.65	–	.031	–	–	–
1924	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1926	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927	. .	0.36	18.50	4.00	14.50	.0380	.0410	.0296	.0114	16.10	–	–	0.49	12.8	.053	–	–	–
1928	. .	1.00	11.30	4.60	6.70	.0330	.0385	.0330	.0055	2.00	–	–	1.16	3.0	.105	–	1,050	1,000
1929	. .	0.55	95.37	16.81	75.21	.0327	.0333	.0230	.0103	51.53	–	–	0.64	–	.047	–	1,400	70
1930	. .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3,100	3,150
1931	. .	0.69	63.95	12.82	51.12	.0274	.0299	.0208	.0091	26.37	–	–	1.04	13.8	.072	90.5	1,300	5,300

Charles River Basin.

North Beacon Street — Surface.

Year.	AVERAGE CHEMICAL ANALYSIS. (Parts in 100,000.)															AVERAGE BACTERIAL RESULTS.	
	Color.	Residue on Evaporation.			Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.	Iron.	Dissolved Oxygen. — Per Cent Saturated.	Average 4-Day Count. — Per c.c.	Average B-Coli. — Per 100 c.c.
		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Albuminoid. In Suspension.		Nitrates.	Nitrites.						
1909 . .	0.44	139.60	6.38	21.93	.0312	.0396	.0278	.0118	62.89	.0068	.0012	0.77	–	–	–	–	–
1910 . .	0.56	91.89	9.06	19.41	.0194	.0416	.0309	.0107	41.65	.0045	.0015	0.51	–	–	–	–	–
1911 . .	0.64	19.46	5.47	13.99	.0191	.0392	.0288	.0104	5.45	.0123	.0010	0.78	–	–	–	–	–
1912 . .	0.65	28.00	5.63	22.37	.0197	.0350	.0280	.0070	11.47	.0187	.0015	0.77	–	–	–	–	–
1913 . .	0.74	16.14	4.05	12.08	.0104	.0336	.0272	.0064	3.97	.0184	.0009	0.81	–	–	–	11,000	100
1914 . .	0.57	65.47	3.56	15.74	.0267	.0350	.0271	.0079	27.91	.0152	.0012	0.12	–	–	–	–	–
1915 . .	0.75	16.23	3.72	12.52	.0187	.0.95	.0385	.0110	4.46	.0069	.0001	0.90	–	–	–	–	–
1916 . .	0.69	5.98	3.38	5.31	.0163	.0299	.0237	.0062	10.45	–	–	0.73	–	–	–	–	–

1917	0.67	6.83	2.80	5.18	.0078	.0327	.0236	.0091	1.01	–	–	–	–	–	66.9	–	–
1918	0.66	7.10	2.60	4.50	.0112	.0410	.0278	.0132	.68	–	–	–	–	.051	–	–	–
1919	0.72	10.14	3.50	6.64	.0146	.0367	.0325	.0042	1.04	–	–	0.73	–	–	80.5	9,600	1,000
1920	0.32	416.40	–	–	.0924	.0284	.0240	.0044	197.00	–	–	1.16	–	.055	–	–	–
1921	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923	0.36	79.10	14.50	64.60	.0099	.0325	.0259	.0066	60.23	–	–	0.70	–	.050	–	7,000	10,000
1924	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1926	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1928	0.94	10.40	5.00	5.40	.0125	.0400	.0310	.0090	.73	–	–	1.24	2.6	.120	–	2,800	10
1929	0.60	55.90	9.80	46.10	.0287	.0319	.0231	.0088	24.08	–	–	0.63	–	.062	–	3,900	1,000
1930	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5,800	3,700
1931	0.93	16.00	4.69	11.31	.0238	.0308	.0226	.0082	4.03	–	–	1.26	4.3	.087	72.8	4,100	3,850

Charles River Basin.

Charles River at Watertown Dam.

Year.	Average Chemical Analysis. (Parts in 100,000.)														Average Bacterial Results.	
	Color.	Residue on Evaporation.			Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.	Iron.	Dissolved Oxygen. — Per Cent Saturated.	Average 4-Day Count. — Per c.c.	Average B-Coli. — Per 100 c.c.
		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Albuminoid. In Suspension.		Nitrates.	Nitrites.						
1923	0.43	19.55	3.35	16.20	.0109	.0139	.0301	.0138	3.87	–	–	0.80	–	.068	–	78,000	10,000
1924	0.38	14.80	4.45	10.35	.0272	.0442	.0323	.0119	1.80	–	–	0.60	–	.065	–	18,950	1,000
1925	0.52	10.60	3.67	6.93	.0124	.0348	.0293	.0055	1.24	–	–	0.74	3.0	.048	38.7	–	–
1926	0.50	11.43	4.07	7.36	.0208	.0351	.0284	.0067	1.24	–	–	0.75	3.0	.058	40.8	–	–
1927	0.97	10.06	4.34	5.72	.0156	.0357	.0296	.0061	0.75	–	–	1.26	2.5	.074	52.2	–	–
1928	1.02	8.70	4.10	4.60	.0150	.0380	.0340	.0040	0.65	–	–	1.28	2.3	.085	–	–	–
1929	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29,000	3,700
1930	0.43	13.50	3.54	9.96	.0238	.0284	.0170	.0114	1.65	–	–	0.56	–	.079	58.0	2,300	2,300
1931	0.70	9.76	3.03	6.73	.0141	.0286	.0213	.0073	0.98	–	–	0.99	3.1	.100	66.1	9,600	3,400

The above tables show that the water of the Charles River as it enters the Charles River Basin at the Watertown Dam has not deteriorated in quality in recent years and has not been in an objectionable condition at any time.

On account of the condition of the Charles River Basin immediately below Watertown and down as far as Cambridge, a condition which was brought about by the discharge of sewage into the river at Watertown, the Department of Public Health advised that bathing in the Charles River in this portion of the basin be discontinued temporarily. No evidence is available to show that this condition resulted in sickness among those using this part of the basin for bathing, but bathing in sewage-polluted water is, of course, inadvisable.

It is evident from the results of the recent investigations that, while the water of the Charles River Basin has not deteriorated to such an extent as to make it generally objectionable in this region, it has been objectionable at times in its upper portions because of the presence of sewage.

The overflow of sewage into this basin from the various regulating stations along the course of the Charles River Valley sewer is unavoidable under present conditions, and such overflow must inevitably occur unless the tributary sewers are relieved of some of the storm water by more complete separation of the storm water from the domestic sewage or additional works are provided.

Probable Future Sewerage Requirements of the Charles River Valley.

Within the limits of the Charles River watershed there still remain the towns of Bellingham, Norfolk, Medway, Holliston, Sherborn, Dover, Westwood, Lincoln and Weston, and parts of Natick, Hopkinton and Wrentham, which are not provided with sewerage, but of these towns Medway and Weston are the only ones which are urgently in need of a sewerage system and means of sewage disposal at the present time.

The towns of Bellingham, Norfolk, Sherborn and Dover have no public water supply as yet, and it probably will be a number of years before sewerage for these towns will require consideration. The towns of Medway, Hollis-ton, Hopkinton, Wrentham, Westwood, Natick and Lincoln have public water supplies, but except in the town of Medway the Charles River has not been found to be seriously polluted by sewage. In all of these towns it probably will be feasible to dispose of the sewage locally by filtering it through sand at suitable sewage treatment works.

In the town of Weston several institutions and schools, some of which are of considerable size, have been lo-cated at points where the disposal of sewage has become a menace to the purity of the water supply of the city of Cambridge in Stony Brook, and to the water of the Metropolitan Water District. The problem of sewage disposal in this town has become a serious one, and a study of this problem should be made in the immediate future and means provided for the proper disposal of the sewage of the town.

The Charles River Valley sewer under present condi-tions is the only outlet for the sewage of Waltham, Newton and Watertown, nearly all of Brookline, and the Brighton section of the city of Boston not tributary to the high level sewer. Much of the total area of these towns is sewered, but there remain some unsewered areas, and it is estimated that if the past rate of increase in the flow of sewage continues the average quantity of sewage to be disposed of in the next thirty years from the municipalities now contributing sewage will be as follows:

Year.	Estimated Average Daily Flow of Sewage at Ward Street Pumping Station.
1935	37.0
1940	40.6
1945	44.2
1950	47.0
1955	50.6
1960	54.0

Allowing for the fact that the average maximum weekly rate of flow in recent years has been about 150 per cent of the average daily flow throughout the year, it has been estimated that the flow of sewage throughout the length of the Charles River Valley sewer under average maximum conditions in the future will be about as follows:

Year.	Flow in Million Gallons in 24 Hours.			
	Newton-Waltham Line.	Newton-Brighton Line.	Cottage Farm Bridge.	St. Mary's Street.
Capacity, full	17.7	26.5	28.4	37.2
1935	6.2	24.3	33.8[1]	48.8[1]
1940	6.8	25.5	35.2[1]	51.1[1]
1945	7.4	26.7[1]	36.7[1]	53.5[1]
1950	8.0	27.8[1]	38.2[1]	55.8[1]

[1] When these greater quantities reach the sewer it will necessitate the sewer running under a head.

Relief of the Charles River Valley Sewer.

Unless the amount of storm water entering the sewers in Newton, Waltham and Watertown is considerably reduced, it may be necessary to supplement the capacity of the Charles River Valley sewer by providing a new sewer in the valley of this river for the disposal of storm water and sewage from these municipalities, with an additional outlet into the high level sewer of the South Metropolitan sewerage system.

The Brookline–Brighton extension of the high level sewer which was completed in the year 1909 was designed to intercept the sewage from the higher sections of Brookline, Brighton and Newton. In the year 1914 consideration was given to the extension of this sewer from its terminus at Oak Square, Brighton, to Newton Lower Falls, with the view of intercepting the sewage of a part of the town of Wellesley. A more satisfactory outlet for the sewage from the town of Wellesley was found at that time through the towns of Needham and Dedham to the Neponset Valley sewer, and the Brighton branch of the high level sewer was never extended beyond Oak Square. The sewer at this point is 5 feet, 9 inches wide by 6 feet high, and has a capacity of 43,200,000 gallons per day when full, while at its lower end near Centre Street it is 7 feet in diameter and has a carrying capacity of 66,000,000 gallons a day. So far as can be determined, the flow in this sewer seldom reaches 3.5 million gallons per day, even in the lower part of its course, and there is ample capacity for all of the sewage which could be intercepted by it in Brighton and Newton if extended to the latter municipality.

If this sewer were extended as originally planned, or in conjunction with intercepting sewers which might be constructed by the city of Newton, it could relieve the Charles River Valley sewer of the sewage from about two-thirds of the area now served by sewers tributary thereto and reduce the average dry-weather flow in the Charles River Valley sewer at the point where the Galen Street siphon enters by about 40 per cent. This extension could ultimately be made to serve a total area of about 6,560 acres by gravity, and additional areas by pumping.

In the report of the special commission relative to the discharge of sewage into Boston Harbor, — Senate Document No. 56 of the Legislature of 1931, — it was pointed out that the capacity of the Charles River Valley sewer was rapidly being reached, and that before long it would be necessary to provide relief so as to prevent an excessive overflow of storm water into the Charles River Basin. Reference was also made to the high level sewer

which extends to Oak Square, Brighton, and to the possibility of pumping all or a portion of the flow in the Charles River Valley sewer at some point in Brighton into this branch of the high level sewer.

While these works need not be constructed at the present time, it is desirable that the investigations be continued in order that more definite information may be obtained as to the probable date when additional works for the relief of the Charles River Valley will be required.

Conclusions.

The results of the investigations show that the objectionable conditions in the Charles River at Watertown and in the upper portion of the Charles River Basin, which were very serious during the early part of the past summer, were due to the discharge of the sewage from the main portions of Watertown directly into the river just above Galen Street. This discharge was caused by the practically complete clogging of the siphon at this point which conveys the sewage from the main portion of Watertown across the river to the Charles River Valley sewer on the southerly side of the stream. Upon the thorough cleaning out of this siphon the discharge of sewage into the river ceased, and, excepting on one or two occasions in early July as a result of heavy rainfall, there was no discharge of sewage or sewage overflow at this siphon during the period of this investigation.

The investigation further shows that when the siphon is in proper working order all of the sewage brought to the head of the siphon in Watertown Square is delivered to the Metropolitan sewer on the south side of the river at all times when the sewage in the latter sewer is below 62.5 per cent of its depth. With the Metropolitan sewer full all the sewage can still be delivered into the Charles River Valley sewer if the sewage is allowed to back up in the Watertown sewer, the amount of rise at the upper end of the siphon probably being about 2.0 feet. If the backing up of the sewage should cause difficulties with low fixtures they can be obviated by pumping the sewage unless such fixtures are raised or removed.

For immediate relief of the objectionable pollution of Charles River that has occurred at Watertown it is necessary, first, to keep the siphon clean; second, to raise somewhat the height of the overflow; and third, to provide, if necessary, a means of pumping the sewage temporarily.

As a further result of this study it appears that the Charles River Valley sewer is becoming inadequate to care for the sewage of the district which it now serves, in addition to the storm water from combined systems, without causing undesirably frequent overflows into the Charles River Basin.

It is probable that this difficulty might be relieved by extending the high level sewer from its present terminus at Oak Square, Brighton, to the Newton city line, and a sewer thence across the city of Newton as far as may be necessary to relieve the Charles River Valley sewer. This additional sewer would relieve the Charles River Valley sewer of the sewage from about two-thirds of the area of that city now served by sewers.

It is also probable that by building a pumping station in the lower part of the valley and pumping some of the sewage into the high level sewer by an independent line the further enlargement of the Charles River sewer can be postponed for a considerable number of years.

It is unquestionably most desirable to prevent, so far as possible, the serious pollution of the Charles River Basin, but the scope of the resolve did not provide for the necessary investigations to determine what plan may be the most desirable for the permanent relief of other sewers, as well as the Charles River Valley sewer, which now have overflows into the Charles River Basin, and it is recommended that a further investigation be made of sewerage in the Charles River Valley.

Respectfully submitted,

ARTHUR D. WESTON,
Chief Engineer.