

SUMMARY
of
WATER QUALITY EVALUATIONS

BOSTON HARBOR AND TRIBUTARIES

JULY & AUGUST 1967



U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

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INTRODUCTION

The New England River Basins Comprehensive Program of the Federal Water Pollution Control Administration has completed extensive water quality investigations of the Charles River and Boston Harbor. These investigations were conducted as a joint effort with the Metropolitan District Commission and the Massachusetts Division of Water Pollution Control from July 14 - August 18, 1967. The work is part of an action program for water quality control and management, and is designed to advance the pollution control program that is already underway by state and local agencies. The goal of this program is to restore these waters for all legitimate uses including swimming, boating, and shellfish harvesting.

Numerous sampling stations were established on the Charles River and Boston Harbor and their tributaries. Samples were collected to test the dissolved oxygen content of the waters, the number of coliform and salmonella bacteria, the level of suspended solids, color and turbidity of the waters, and nitrogen and phosphorus concentrations. In total, over seven hundred water samples were taken during the one-month period. Samples of bottom material were also analyzed for biological characteristics. The resulting data is being used to evaluate existing water quality and to provide a basis for solutions to the complex water quality problems in the Charles River Watershed and Boston Harbor.

CHARLES RIVER WATERSHED

Dissolved Oxygen

An important indicator of water quality is the dissolved oxygen level. It is often used as a general measure of clean or dirty waters. Large concentrations of oxygen-demanding pollutants, such as sewage or industrial wastes, reduce the amount of dissolved oxygen in the water causing the loss of desirable aquatic life and fish population. Five milligrams of oxygen per liter, (mg/l), of water is the accepted minimum for maintaining a good fish habitat. If a complete depletion of the available dissolved oxygen occurs, offensive odors result.

During the evaluation, the minimum observed dissolved oxygen value was 3.1 mg/l which occurred upstream of Milford at Station C-1. (See Figure 1) Values less than 5.0 mg/l were observed at eight out of the 15 stations located on the main river. Average and minimum dissolved oxygen contents are shown on the attached Figure 2.

Bacteria

Another important indicator of pollution is the number of coliform bacteria detected in the samples. Coliform bacteria are a group of several different kinds of bacteria, usually of intestinal origin, which are detected by a specific standard test. These bacteria, while not usually harmful in themselves, indicate the probable presence of pathogenic or disease-causing bacteria. If ingested, these pathogenic bacteria can cause gastro-intestinal disease.

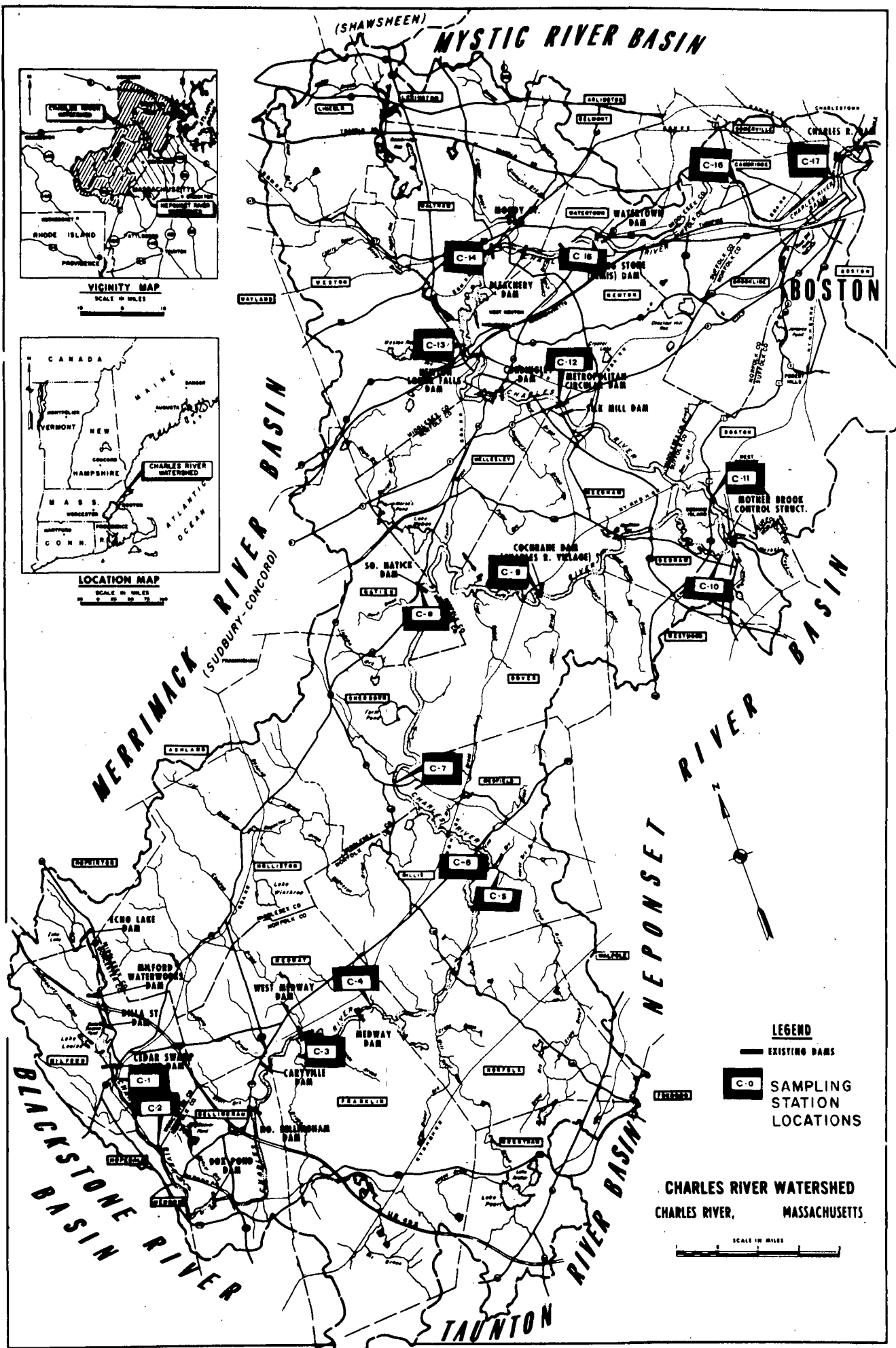
A count of 1,000 organisms per 100 milliliters is the generally accepted maximum if swimming is to be permitted. Counts in excess of this number were encountered at all sampling points in the Charles River Watershed. The highest counts occurred at the John Weeks Foot Bridge (C-16) in Cambridge, which averaged 220,000 organisms per 100 milliliters during the test period. A graph showing the average coliform counts at each station is attached as Figure 3. Coliform amounts, however, varied widely from day to day as a result of overflows from combined sewer systems in the area.

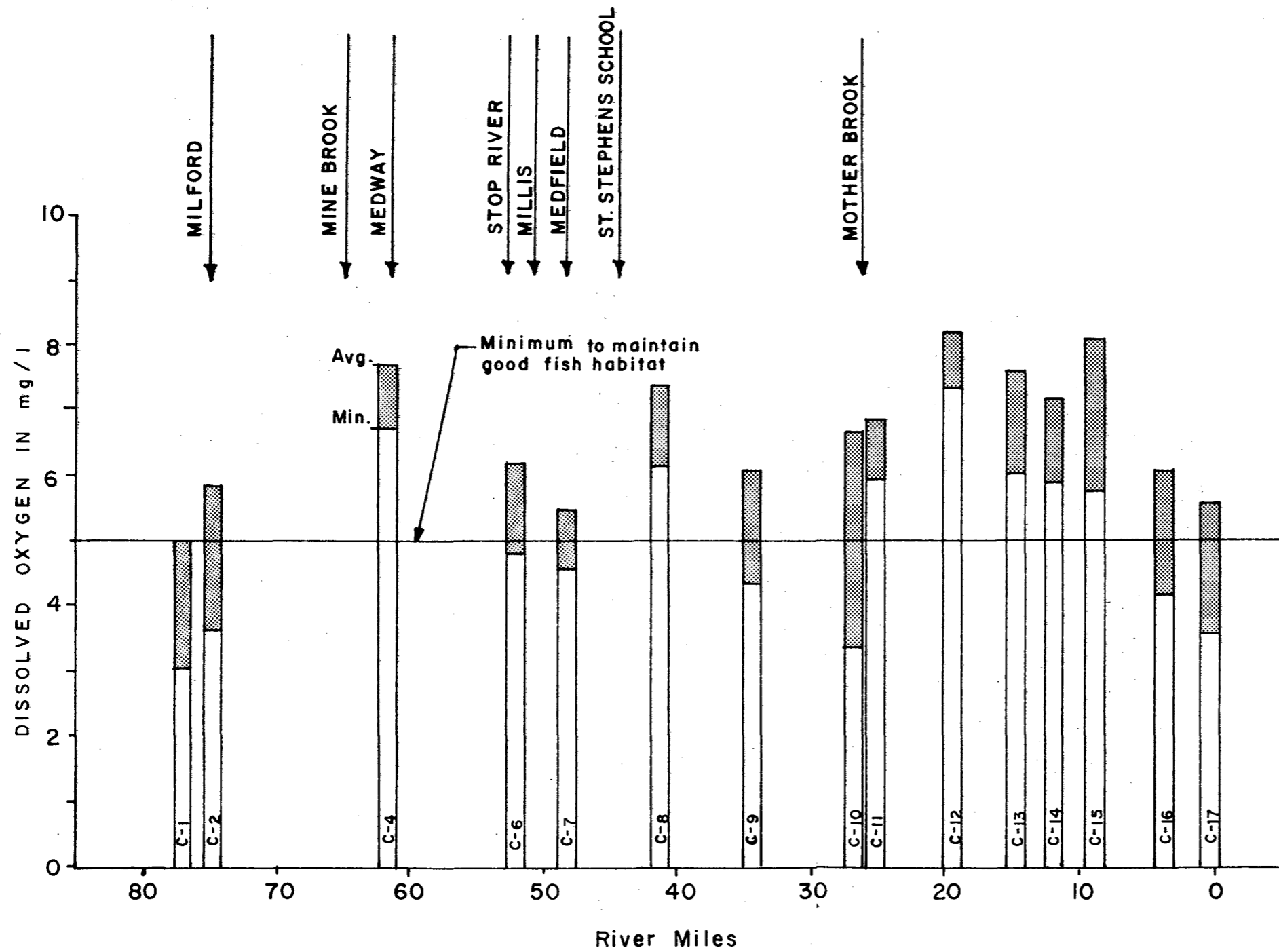
Tests were also made for the presence of Salmonella, which is one of the most common disease-producing organisms. One-half of the test results were positive indicating the serious nature of pollution in the watershed.

Biological Studies

Analysis of bottom organisms, aquatic plants, nutrients, bacteriological and chemical factors in the Charles River revealed water quality degradation from Milford, Massachusetts through Medfield, Massachusetts, a distance of 32 miles. Water quality in the middle reaches of the river from Medfield to Wellesley, Massachusetts was less degraded, but nutrients from upstream sources caused dense growths of aquatic plants, including phytoplankton (suspended algae), in these areas. An over-abundance of aquatic plants can cause unsightly conditions, reduce dissolved oxygen contents and limit water resource potentials.

Below Wellesley the river was characterized by a reduction of organisms associated with clean water and an increase in the population of sludgeworms which are characteristic of polluted waters. In the Lower Charles River Basin itself, no bottom organisms were found at the John Weeks Foot Bridge (C-16), and at the Longfellow Bridge (C-17). The absence of such organisms suggests that toxic conditions have even prevented the establishment of pollution tolerant animal life on the bottom.





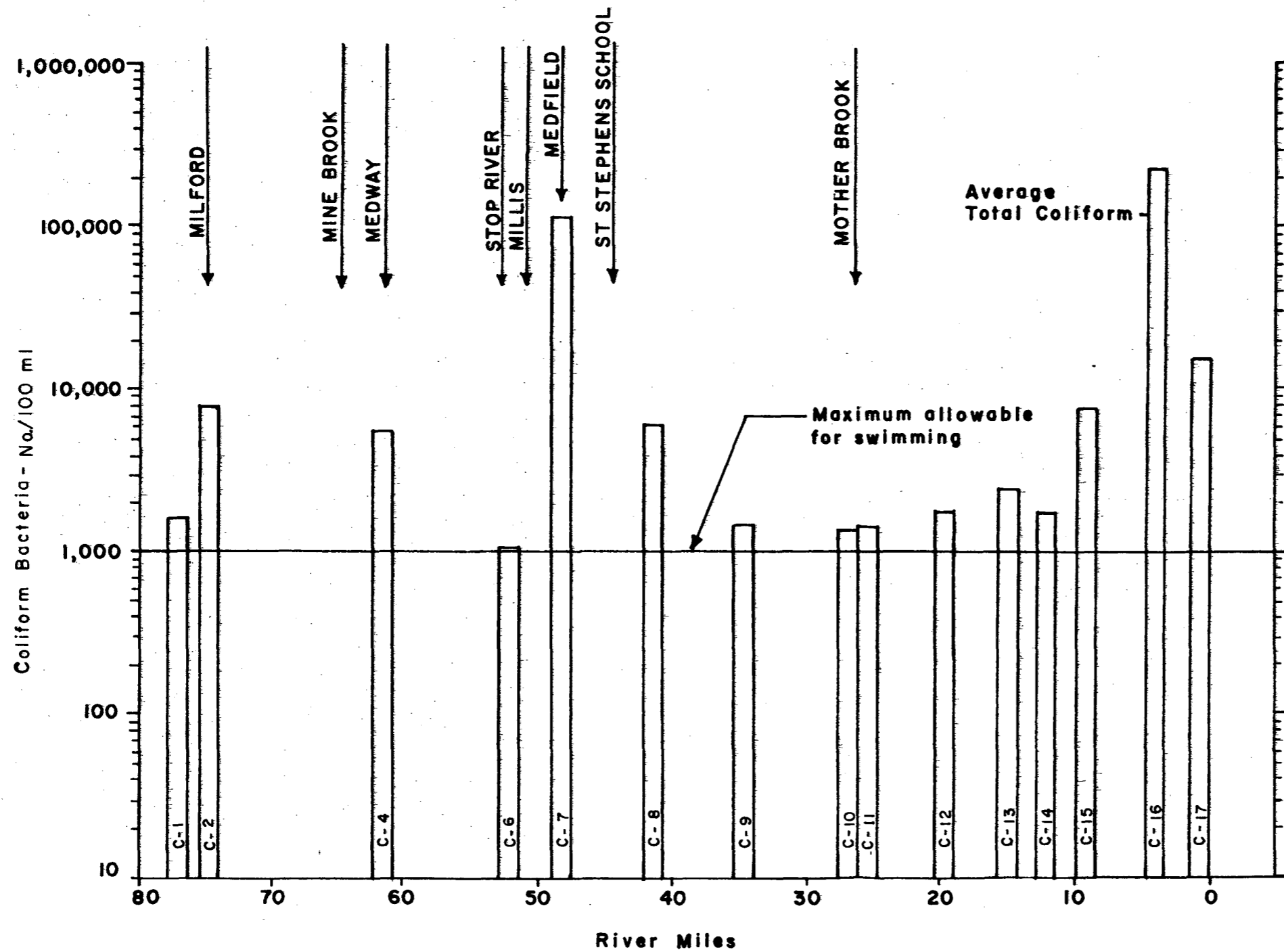
NOTE:

Results are based on 13 samples taken of each station between July 17 and August 15, 1967

WATER QUALITY CONTROL EVALUATION
CHARLES RIVER WATERSHED
 DISSOLVED OXYGEN
 (D.O.)

U.S. DEPARTMENT OF THE INTERIOR
 FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
 NORTHEAST REGION BOSTON, MASS.

FIGURE 2



NOTE:

Results are based on 13 samples taken at each station between July 17 and August 15, 1967

WATER QUALITY CONTROL EVALUATION
 CHARLES RIVER WATERSHED
 AVERAGE COLIFORM BACTERIA

U. S. DEPARTMENT OF THE INTERIOR
 FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
 NORTHEAST REGION BOSTON, MASS.

FIGURE 3

BOSTON HARBOR

Water quality analyses of Boston Harbor revealed that all reaches of the Harbor and each of its tributary streams, except the inland marine reaches of the Weymouth Back and Weir Rivers, were polluted. About one-third of the Harbor's area was grossly polluted by municipal and industrial waste discharges and combined sewer overflows to the Harbor. In addition, combined sewers discharged wastes to the reaches of the Mystic, Malden, Chelsea, Weymouth Fore, and Neponset Rivers nearest the Harbor. Extensive deposits of decayed organic matter and oil residues covered much of the Harbor bed. High bacteria counts, the over-abundance of pollution-associated organisms, and the near absence of aquatic life in these tributary streams were indications of severely polluted waters.

Dissolved Oxygen

Dissolved oxygen contents in the Harbor varied widely from point to point and from day to day. They ranged from a minimum of 2.4 mg/l to a maximum of 16.0 mg/l. Values less than 5.0 mg/l occurred at all harbor stations at some time during the evaluation. With few exceptions, low levels at each station in the Harbor occurred following rainfall. This indicates the water of the Harbor is well mixed and that overflows from combined sewers and storm runoff exert a strong influence.

Values in the tributary streams were generally lower ranging from a minimum of 0.3 mg/l to a maximum of 9.6 mg/l. The Mystic,

Malden, Chelsea and Neponset Rivers all had minimum values of less than 2.5 mg/l.

Bacteria

High coliform bacteria counts appeared throughout the Harbor and tributaries with the exception of Hull Bay and Weymouth Back River. Again wide variations were found at almost all locations with the highest totals occurring in the Mystic River, the Chelsea River, the Inner Harbor and adjacent to Deer Island.

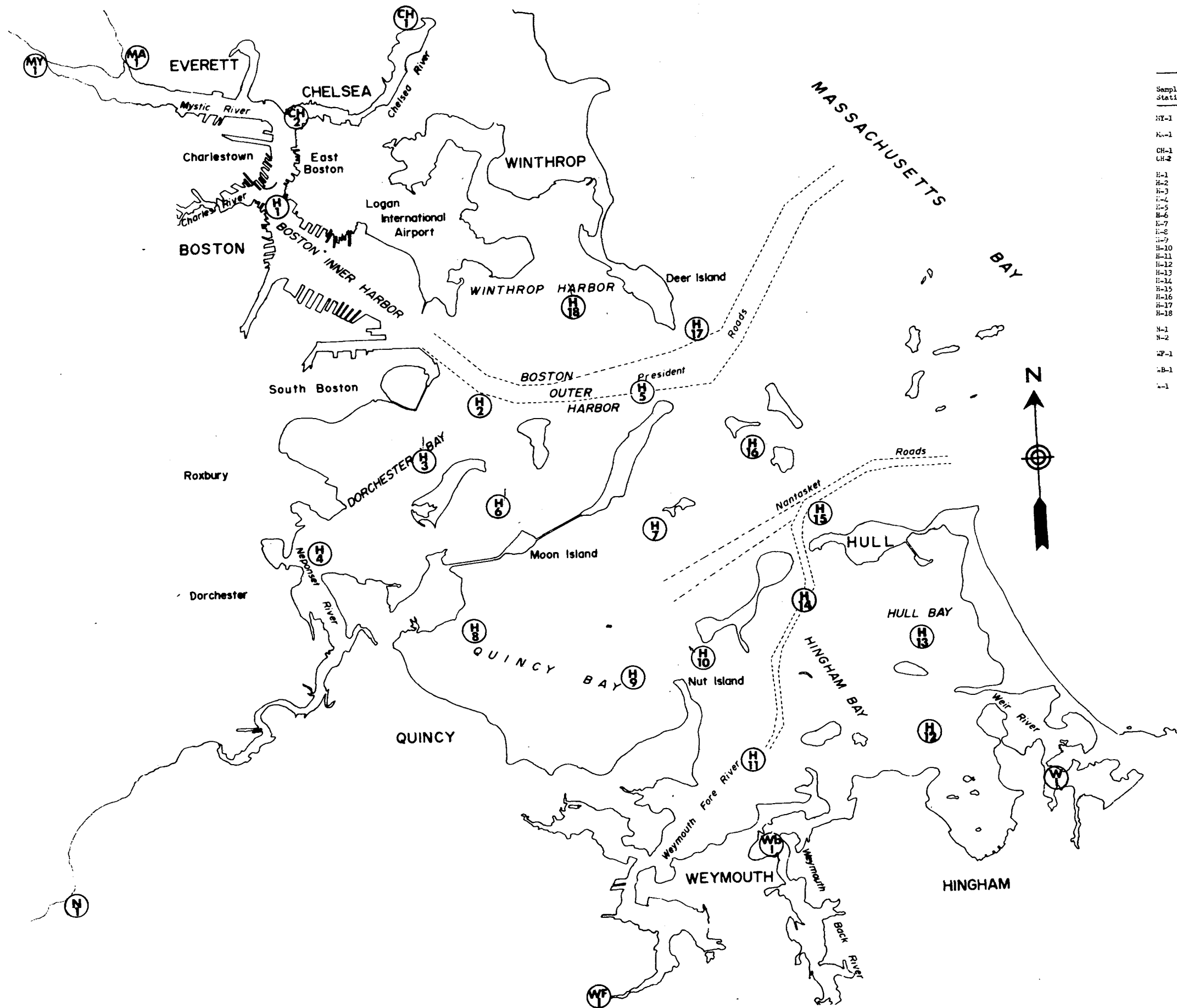
In addition to the tests for total and fecal coliforms, tests for the detection of Salmonella bacteria were performed by placing swabs in the Harbor and selected tributaries. Of the 12 swabs that were placed in these waters, 11 were recovered and 6 were positive for Salmonella which indicates contamination by disease-producing organisms.

The location of sampling stations, and data on dissolved oxygen and coliform bacteria are shown on Figure 4.

Nutrients

High concentrations of nutrients such as ammonia, nitrogen and soluble phosphorous caused by the discharge of waste waters, were found throughout the Harbor including the Weymouth Back and Fore Rivers and salt water reaches of the Chelsea, Charles, Malden and Mystic Rivers. This condition caused an over-enrichment of the water which stimulated the growth and development of dense populations of undesirable aquatic organisms such as algae growths.

and sea lettuce. These organisms cause noxious conditions in parts of the Harbor which prevent swimming, cause unsightly growths at marine facilities and increase maintenance costs associated with buoys and piers.



DISSOLVED OXYGEN (mg/l)
TOTAL COLIFORMS (per 100 ml)

Sample Station	Dissolved Oxygen (mg/l)			Total Coliforms For 100 ml. (Membrane Filter Method)		
	Maximum	Minimum	Average	Maximum	Minimum	Average
MY-1	9.2	1.6	3.9	1,700,000	1,100	33,700
MA-1	9.5	2.3	5.1	140,000	1,000	20,600
CH-1	8.6	2.4	5.2	1,500,000	9,200	71,300
CH-2	9.4	1.4	5.0	89,000	3,000	21,700
H-1	2.0	3.2	5.0	520,000	1,300	33,100
H-2	12.3	3.1	7.3	330,000	3,000	27,500
H-3	9.8	3.4	6.9	67,000	4,100	6,400
H-4	9.8	2.1	6.7	46,000	300	2,300
H-5	10.0	2.6	6.7	21,000	1,000	31,700
H-6	10.4	1.7	6.2	250,000	1,600	32,600
H-7	11.0	2.4	6.3	36,000	100	4,700
H-8	11.7	2.2	6.9	3,600	<2	50
H-9	13.3	2.5	7.5	4,300	<2	130
H-10	15.5	2.6	7.5	2,300	70	940
H-11	13.3	2.5	7.4	7,500	16	400
H-12	12.6	3.1	7.9	260	<10	90
H-13	12.0	3.2	7.4	880	2	60
H-14	16.0	2.8	8.5	2,300	6	240
H-15	15.6	2.4	8.7	1,600	26	280
H-16	13.8	2.9	8.4	52,000	500	6,400
H-17	11.6	2.4	8.2	1,750,000	2,500	44,000
H-18	11.2	4.8	7.7	110,000	2,900	22,400
N-1	1.2	0.3	0.8	110,000	700	8,500
N-2	5.6	1.8	3.8	53,000	3,800	14,200
WF-1	8.2	5.4	7.0	22,000	<100	1,300
WB-1	8.8	5.8	7.7	470	8	30
W-1	9.6	6.3	8.2	1,800	180	360

NOTE:
Results are based on 13 samples at each station taken between July 17, and August 18, 1967.

WATER QUALITY CONTROL EVALUATION
BOSTON HARBOR
STATION LOCATIONS & SELECTED WATER QUALITY DATA
U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHEAST REGION BOSTON, MASS.

FIGURE 4

CONCLUSION

The degraded water quality of the Charles River and Boston Harbor significantly reduces the use and value of these waters which must serve a surrounding metropolitan area.

The data gathered through this investigation on water quality in the Charles River and Boston Harbor have provided much needed information for the development of an effective and adequate pollution control program. Mathematical models will be developed to help delineate a framework for action. The models will simulate the response of the waters to various pollutional loads, tidal and flow variations and temperatures. They will be used to project future conditions, evaluate alternatives and to help determine the additional measures necessary to restore the quality of the waters of the Charles River and Boston Harbor for total community use including recreational, educational and commercial purposes.