MYSTIC RIVER WATERSHED ASSOCIATION, INC.

WATER QUALITY REPORT

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by

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Copies of this report available from Professor Kroesser, Chemical Engineering Department, Tufts University, Medford, Massachusetts 02155

Acknowledgments

Ms. Nancy Halstvedt, the committee's most valuable member, is leaving the area to do graduate work at another University. She has made significant contributions in all phases of the monitoring program, and will be missed. Douglas Turner has now moved into the vacancy she created, as co-chairman with William Kroesser.

The three of us would like to express our appreciation of the work done by Habitat, Inc., especially Chris Burnett and his students, and by Peter French of Brandeis University.

Contributors from Tufts University include Fred Defeo, Richard Warrington, Joan Harrison, Fred Test, Charles Martone, Bruce Blades, and Paul Burnett, and the many students who contributed to the previous reports of the Committee.

We also appreciate the help given to us by Dr. Peter Braun, Professor Bruce Hanes, Professor Lin Brown, Professor Norton Nickerson, Professor Thomas Gibb, and by Mr. John Vernaglia, Mr. Joseph Cavezzoni, and the Aberjona River Commission, the Metropolitan District Commission and Commissioner Sears, and by the Conservation Commissions of the various cities and towns in the area.

Introduction

The Mystic River Watershed Association was formed in 1970, and incorporated in 1972. Its goals are protection and enhancement of its natural environment, especially that area adjacent to the river. The goals are described in greater detail in the

Association's bylaws, available from Dr. Peter Braun, president, 6 Parker Road, Arlington, Massachusetts, 02174.

At present there are several working committees of the Association, including the Water Quality Monitoring, Community Relations, Communications, and Recreation. The association has also sponsored citizen cleanup efforts.

This report deals only with the first subject, that of monitoring the quality of the water. It is important to have quantitative information on present conditions. Clean water is necessary not only for water contact sports and to protect fishing areas, but also to avoid odor and unsightliness in green areas used for picnics, bicycling and other leisure activities.

The earliest available measurements of water quality in the Mystic River Valley were made during the Summer of 1967, and published in 1970 by the Massachusetts Division of Water Pollution Control (1). Early in 1970, students at Tufts University began a monitoring program, and reported the results at a Symposium they held for the Community in May of that year. The enthusiasm created at that meeting helped create the impetus for the formation of the Mystic River Watershed Association, a month later. The monitoring has continued under the supervision of Professor Kroesser, and the results are published regularly (2, 3).

In 1971 a comprehensive study was made of the Aberjona River and its tributaries by Fred DeFeo (4). This study includes a complete sanitary survey of about half of the Mystic

Watershed area.

In 1972, Habitat, Inc., a school of the environment in Belmont, Mass., began a monitoring program (18, 19). Several area high schools, notably Malden and Everett High, have also made measurements (5). All of the above data are included in this report.

There is flow rate data available for the U.S.G.S. gaging station in Winchester (6) and flow data for the entire river system is included in the design plans for the Amelia Earhart Dam (7). The Massachusetts Department of Natural Resources also has water quality data for the region above the gaging station available at the Andover office, and has put a number of industrial pollutors on an implementation schedule.

Professor Kroesser maintains a file of all data taken in the watershed area. If you have any such data, you are requested to send him a copy so that others working on environmental quality can make use of your efforts.

Present Monitoring Program

In May 1972, the Association requested that the MDC begin a basic monitoring program. Commissioner Sears agreed to this, and the first set of data was taken on September 5, 1972.

The tests requested were:

Coliform Bacteria (total)
BOD (5 day)
pH
Chlorides
Nitrogen (total)
Nitrogen (ammonia)
Phosphate (total)

The MDC also made measurements of DO and temperature, but did not perform tests for pH and chlorides.

The schedule involves monthly tests during the Summer, and bimonthly during the Winter, with one set of tests during January, March, May, June, July, August, September and November. Swimming beaches would, of course, be monitored often, with weekly tests of total and fecal coliform during the swimming season.

The 10 sites chosen were:

1. Aberjona River at Olympia Street, Woburn
2. Aberjona River at USGS Gaging Station
3. Sandy Beach
4. Mystic Lakes Dam Overflow
5. Mill Brook at Mystic Valley Parkway
6. Mystic River at Route 60 (High St. Medford St.)
7. Alewife Brook at Dilboy Field Parking lot
8. Mystic River at Winthrop Street, Medford
9. Malden River at Route 16
10. Mystic River at Amelia Earhart Dam

These tests require bottles sterilized in boiling water, but do not require any on site preparation or chemical additions as a test for DO would. The samples should be delivered to the lab within a few hours after collection. The lab would then refrigerate them and run the tests the next morning.

The role that Tufts University and Habitat, Inc., will take is to make detailed studies on particular areas of known or suspected problems. For example, if high ammonia appears in the monthly test results, the schools could send out a team to test at a large number of sites on a weekly or daily basis, and to make all of the nitrogen tests: nitrate, nitrite, organic nitrogen, and ammonia. Thus, a University group would have as its goal the answering of specific questions raised by the monthly monitoring. Also, a student group might conduct tests

raquiring a great deal of sampling time, for example, rowing out on the Mystic Lakes and taking water samples at six foot depth intervals.

A large number of sampling locations has been used in the previous studies. We have chosen the 10 sites listed above as being most useful for an analysis of the entire watershed area. A table in the Appendix lists our site locations and also gives the sampling station number for all previous investigators. The present sampling stations are also shown on the map at the beginning of this report.

Results and Discussion

The results of the water quality measurements are shown on the following tables for the seven basic tests at each of the ten sampling locations. Other water quality data is available from Professor Kroesser but is not shown here.

The test for Coliform bacteria (8) indicates the presence of warm-blooded animals. Many times a high coliform count occurs because of the animals living near or in the water. Fecal coliform tests would confirm the presence of fecal matter from warm-blooded animals. In this particular investigation we have generally made total coliform tests. A high value was interpreted as a signal that we should make a visual search of the river banks for obvious sources, such as sewage outfalls. This plan seemed to work well since the sources must be located in order to know which city or town to notify to obtain repairs. All investigators used the Millipore method (8) except for DeFec, who used the MPN method (9).

Total Coliform Counts, Colonies per 100 ml. (Geometric Mean)

For Class B water, limit is 1000 average; 2400 in no more than 20% of samples.

	1967 Summer	1970 Winter Spring	1971 Spring	1972 Spring	1972 ~~Summer~~ Sept	Oct.	Nov.
1	8,250		2,600		21,000	5,000	1,6[illegible]
2	3,800	133	4,500		6,000	4,000	12,500
3		86		313	2,400	2,000	2,100
4	184				2,300	600	1,000
5				4,400	94,000	13,000	18,000
6	2,700	1,200		820	2,000	1,000	2,500
7		84,000		5,300	61,000	184,000	65,000
8	28,600	78,000		13,000	83,000	65,000	58,000
9	3,200				36,000	2,000	3,600
10	9,200	24,000			16,000	5,000	4,500

BOD (Biochemical Oxygen Demand, 5 day) mg/l

1	4.0		80.5	0.4	8.4	5.9
2	4.5		5.3	4.6	4.8	6.3
3				5.8	3.8	3.2
4	2.6			5.4	6.4	2.7
5				5.6	4.0	6.8
6	6.6			4.6	2.6	3.2
7				3.4	8.0	6.1
8	6.5			2.0	5.2	7.0
9	5.3			3.4	5.0	5.2
10	7.0			4.2	5.6	4.1

pH

For class B water, pH must be between 6.5 and 8.0

	1967 Summer	1970 Winter Spring	1971 Spring	1972 Spring	1972 Summer
1	7.7		5.3		
2	7.1		5.7		
3					
4	7.8				
5					
6	8.6				
7					
8	7.8				
9	7.8				
10	7.8				

Chloride, mg/l

1	300	260
2	96	165
3		
4	90	
5		
6	210	
7		
8	1300	
9	3000	
10	2700	

Nitrogen, Total, mg/l

For Class B water, limit is 0.5 mg/l

	1967 Summer	1970 Winter Spring	1971 Spring	1972 Spring	1972 ~~Summer~~ Sept	Oct.	Nov.
1	105.5				6.25	82.0	15.4
2	9.5				5.10	19.4	3.65
3					1.75	15.4	10.7
4	6.2				1.85	2.10	10.0
5					1.25	1.74	3.08
6	4.2				1.30	30.4	4.15
7					1.25	2.50	2.28
8	3.6				1.10	7.20	4.37
9	2.0				1.10	2.29	4.14
10	3.3				2.30		4.26

Nitrogen (Ammonia), mg/l

For Class B water, limit is 0.5 mg/l

1	83.5		10.7	5.0	76.4	11.45
2	5.0		2.9	2.5	18 7	1.70
3				0.96	14.0	4.14
4	2.7		3.3	1.72	1.02	4.26
5				0.50	0.37	0.77
6	0.36			0.50	10.5	2.78
7				0.60	1.14	0.66
8	0.88			0.70	4.94	2.62
9	0.22			0.43	0.97	1.35
10	0.26			0.60	13.3	1.84

Phosphate, total, mg/l

For Class B water, limit is 0.05 mg/l

Nuisance algae growths often develop above 0.01 mg/l

	1967 Summer	1970 Winter Spring	1971 Spring	1972 Spring	~~1972 Summer~~ Sept	1972 Nov	1972 Oct
1.	.06			.06	10.5	5.9	6.6
2.	.12			.12	7.7	4.8	5.5
3.					5.1	9.5	3.4
4.	.06				4.4	9.2	5.3
5.					7.9	8.1	4.2
6.	.33				4.6	5.0	2.8
7.					5.4	7.1	5.0
8.	.28				6.4	5.9	4.6
9.	.19				8.0	9.0	8.1
10.	.20				6.2	5.7	5.3

DISSOLVED OXYGEN, mg/l

(should be above 4 and 75% saturated for Class B water)

1	2.2		5.8	10.0	8.6
2	8.7		8.2	11.0	9.8
3			9.0	10.2	9.8
4	9.4		8.2	9.6	9.2
5			8.8	11.6	10.8
6	11.6		8.0	10.0	8.2
7			7.8	8.4	8.2
8	10.9		7.4	9.6	9.6
9	9.4		7.4	9.4	9.2
10	8.7		12.0	9.8	8.4

Massachusetts standards require a coliform count under 100 organisms per 100 ml. for class A water, and under 1000 for class B waters. When several measurements are made at the same location in the same season, the geometric average is reported for coliform counts, while the arithmetic average is used for all other tests.

A count of zero does not indicate that the water is clean, since there may be a toxic substance which is lethal to the bacteria. Clean waters would have a count which is small but non-zero, generally 100 to 400 for rivers, and one or less for tap water.

Tests are available to confirm the presence of other bacteria but are not used routinely in water quality analysis.

In general, the river has a coliform level higher than that expected from class B water. The low flow rates make it difficult to alleviate this situation. The unusually high counts in 1970 and 1972, however, were sewage overflows. The first came from a Cambridge sewer where Massachusetts Avenue crosses Alewife Brook, which was repaired promptly when reported to Commissioner Sears of the MDC. The second is in Medford where Boston Avenue crosses the Mystic River. This problem was reported to the city through Councillor James Kurker, and repairs are expected to be completed soon. The testing and identification of this problem was accomplished by Chris Burnett (19).

pH is a measure of the acidity or alkalinity of the water (10). a pH of 7 is neutral, while low values are acidic and high values are basic. Values beyond the range of 6.5 to 8 can harm the aquatic life and can raise their sensitivity to other toxic materials, such as ammonia.

Whenever an unusual pH value is found, the cause should be determined. If no biological explanation is apparent, it may be the result of the discharge of chemical wastes.

In 1971, DeFeo (4) and Hustvedt (17) found that high concentrations of acid were being dumped into the Aberjona River in Woburn, and these showed up on Stations 1 and 2. The DNR has required all chemical companies to neutralize their wastes, and thus future problems are not expected. There are no unusual ph values elsewhere in the watershed.

Biochemical Oxygen Demand (BOD) is the amount of oxygen necessary to oxydize all of the biological material to its final state (11). Thus, it is a measure of how much oxygen is required to degrade the organic material in the water. Water with a high BOD requires a great deal of oxygen; if the surface aeration and mixing currents are not enough to supply the needed oxygen from the air, then the dissolved oxygen level may fall below that necessary for fish, thereby causing a fish kill. Generally speaking, the more "attractive" game fish (trout) require higher levels of dissolved oxygen than do the "trash" fish (carp, catfish). Thus, a high BOD with poor surface transfer of oxygen can ruin the sportfishing use of a water body.

Nitrogen compounds can exist in water as nitrates, nitrites, ammonia, and organic nitrogen. The total nitrogen test (12) measures the sum of these nitrogen compounds (excluding only the atmospheric nitrogen dissolved in the water, which is of no consequence). Nitrogen compounds enter the water from air pollution, fertilizer runoff, sewage, chemicals and decaying aquatic

MYSTIC RIVER SAMPLING STATIONS

Location	1967	1970	1971	Habitat 1972	This Report
Aberjona R. Reading	1		1		
Aberjona R. Reading			2		
Halls Brook			3		
Aberjona R. at Olympia St. Woburn	2		4		1
Unnamed Brook			5		
Aberjona R, below Burbank Pond	3		6		
Sweetwater Brook			7		
Aberjona R, at Washington St. Winchester			8		
Aberjona R, at Swanton Street			9		
Horn Pond Brook at Wedge Pond			10		
Aberjona R, at Gaging Station	4	0	11		2
Mystic Lakes at Narrows			12		
Sandy Beach		9		2	3
Mystic Lakes Dam	5				4
Mill Brook at Lower Mystic Lake				3	5
Mystic R. at High Street	6	8			6
Alewife Brook at Dilboy Field		6		5	7
Mystic R. at Winthrop St.	7	2,11,1		8	8
Malden R. at Rt. 16	8				9
Mystic R. at Amelia Earhart Dam	9	12			10
Reference Number	(1)	(2)	(4)	(19)	