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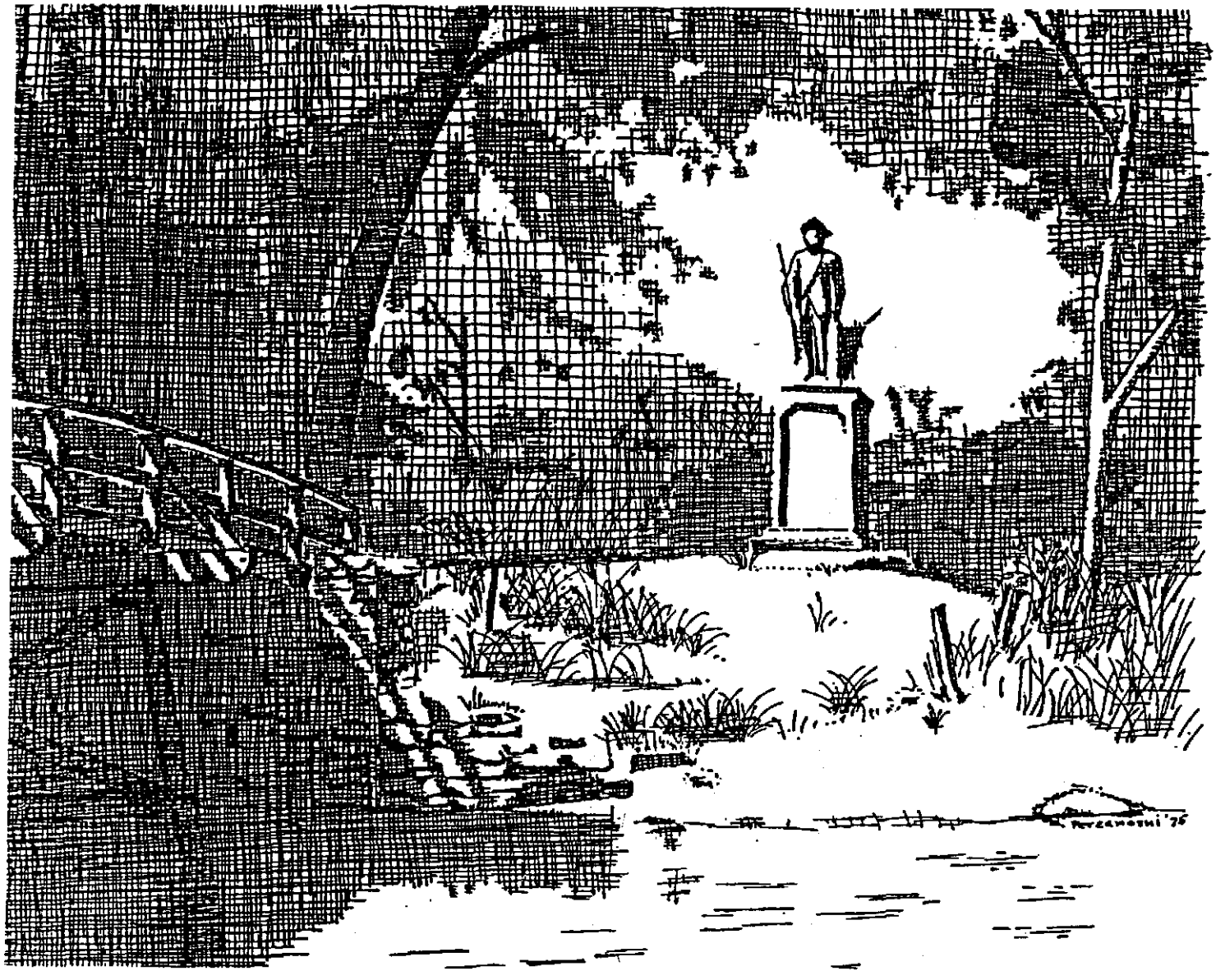
THE SUASCO RIVER BASIN



WATER QUALITY MANAGEMENT PLAN - 1981

massachusetts department of environmental quality engineering
DIVISION OF WATER POLLUTION CONTROL
thomas c. mcmahon, director

THE SUDBURY-ASSABET-CONCORD BASIN

WATER QUALITY MANAGEMENT PLAN

1981

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING

DIVISION OF WATER POLLUTION CONTROL

TECHNICAL SERVICES BRANCH

WESTBOROUGH, MASSACHUSETTS

JANUARY 1982

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Approved by Daniel Carter, State Purchasing Agent

EXECUTIVE SUMMARY

The 1979 Summary of Water Quality Report (305b report) states that only 26.2 miles of the 88.1 miles of surveyed rivers and streams in the Sudbury, Assabet, and Concord river basins meet or exceed designated Class B Massachusetts water quality standards.

Improved effluent quality from the municipal wastewater treatment plants at Westborough/Shrewsbury, Marlborough Westerly, Hudson, Maynard, Concord, and Billerica will be necessary to meet in-stream Class B standards.

The updated municipal wasteload allocations to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits are a result of an intensive mathematical modeling effort to predict required effluent quality to achieve Class B water quality standards in the SUASCO basin.

Non-point sources of pollution are not felt to be a major problem in the Sudbury, Assabet, and Concord (SUASCO) basin. However, drinking water supplies must be protected from possible impacts from road salting and uncontrolled septage disposal.

Two sites contaminated by toxic wastes have been documented in the SUASCO basin: town water supply wells in Acton contaminated by industrial solvents, and the watershed and streams adjacent to the Nyanza chemical waste dump in Ashland.

Abatement projects are actively addressing the major sources of pollution in the SUASCO basin. Most planned structural controls will not be in place until the mid-1980's, however.

A continuation of monitoring programs will be necessary to assess the effects of abatement projects, to monitor water quality, and to provide data for future water quality management planning.

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LIST OF ABBREVIATIONS

BPT	Best practicable treatment
CMRPC	Central Massachusetts Regional Planning Agency
DEQE	Department of Environmental Quality Engineering
DHW	Division of Hazardous Waste (of the DEQE)
I/I	Inflow/infiltration
MAPC	Metropolitan Area Planning Council
MDC	Metropolitan District Commission
MDWPC	Massachusetts Division of Water Pollution Control (of the DEQE)
NMAC	Northern Middlesex Area Commission
NPDES	National Pollutant Discharge Elimination System
P & S	Primary and secondary contact recreation
Sn	Seasonal
SUASCO	Sudbury, Assabet, and Concord
USGS	United States Geological Survey
WWTP	Wastewater treatment plant

FOREWORD

This document is part of the overall planning process as required by the Clean Water Act (PL95-217) and the Federal Water Pollution Control Act (PL92-500). It updates the 1975 303(e) water quality management plan for the Sudbury, Assabet, and Concord (SUASCO) River basin plan prepared by the Massachusetts Division of Water Pollution Control (MDWPC). It supplements the 208 Areawide Waste Management Plans prepared by the designated 208 agencies. It contains updated municipal wasteload effluent limitations to be incorporated into National Pollutant Discharge Elimination System permits.

The strategies and recommendations made in the 208 and 303(e) documents are intended to provide methods to achieve the goals of PL92-500 and PL95-217 as set forth in Section 101(a) as follows:

> Sec. 101. (a) The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act--
>
> (1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;
> (2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;
> (3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;
> (4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;
> (5) it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each state; and
> (6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans.

SUASCO BASIN DESCRIPTION

Located in east-central Massachusetts, the SUASCO River Basin is comprised of the Assabet and Sudbury Rivers which flow together to form the Concord River. The three rivers represent quite a constrast in waterbodies, each having its own unique physical characteristics and its own water quality problems. Figure 1 shows the location of the SUASCO River Basin in the Commonwealth, and Figure 2 shows the individual communities which comprise the SUASCO River Basin.

The Assabet River Basin

The Assabet River has its beginning in the Town of Westborough and flows northeast through the urban centers of Northborough, Hudson, Maynard, and Concord. Between these urbanized centers are stretches of rural and undeveloped watersheds. The river is characterized by the following repeating sequence: a sewage treatment plant effluent discharging into the headwaters of an impoundment. The impoundments are highly eutrophic with large amounts of aquatic growth, especially algal blooms during certain periods of the summer. The river is thirty-one miles long and has a drainage area of 175 square miles.

The Sudbury River Basin

The Sudbury River also has its beginning in the Town of Westborough, flowing from Cedar Swamp Pond eastward to Framingham, then north through the towns of Sudbury, Wayland, Lincoln, and into the Town of Concord. The Sudbury River is characterized by three distinct physical sections. Upstream of Framingham, the river is a narrow, rapidly flowing stream dotted with a few small impoundments. In Framingham, the river has two large impoundments: the first is part of the Metropolitan District Commission water supply, and the second is created by the Colonna Dam in Saxonville. The third and unique section of the river is that which flows through the national wildlife refuge meadowlands in the towns of Sudbury, Wayland, Lincoln, and Concord. Through this latter area (river distance of 12 miles), the river's elevation changes only <u>one</u> foot and the river is akin to an elongated lake. The Sudbury River is 41 miles long with a drainage area of 169 square miles, 29 of which drain to the MDC reservoirs.

The Hop Brook sub-basin is in the Sudbury basin. This major tributary to the Sudbury River is a highly eutrophic system of stream and impoundments.

The Concord River Basin

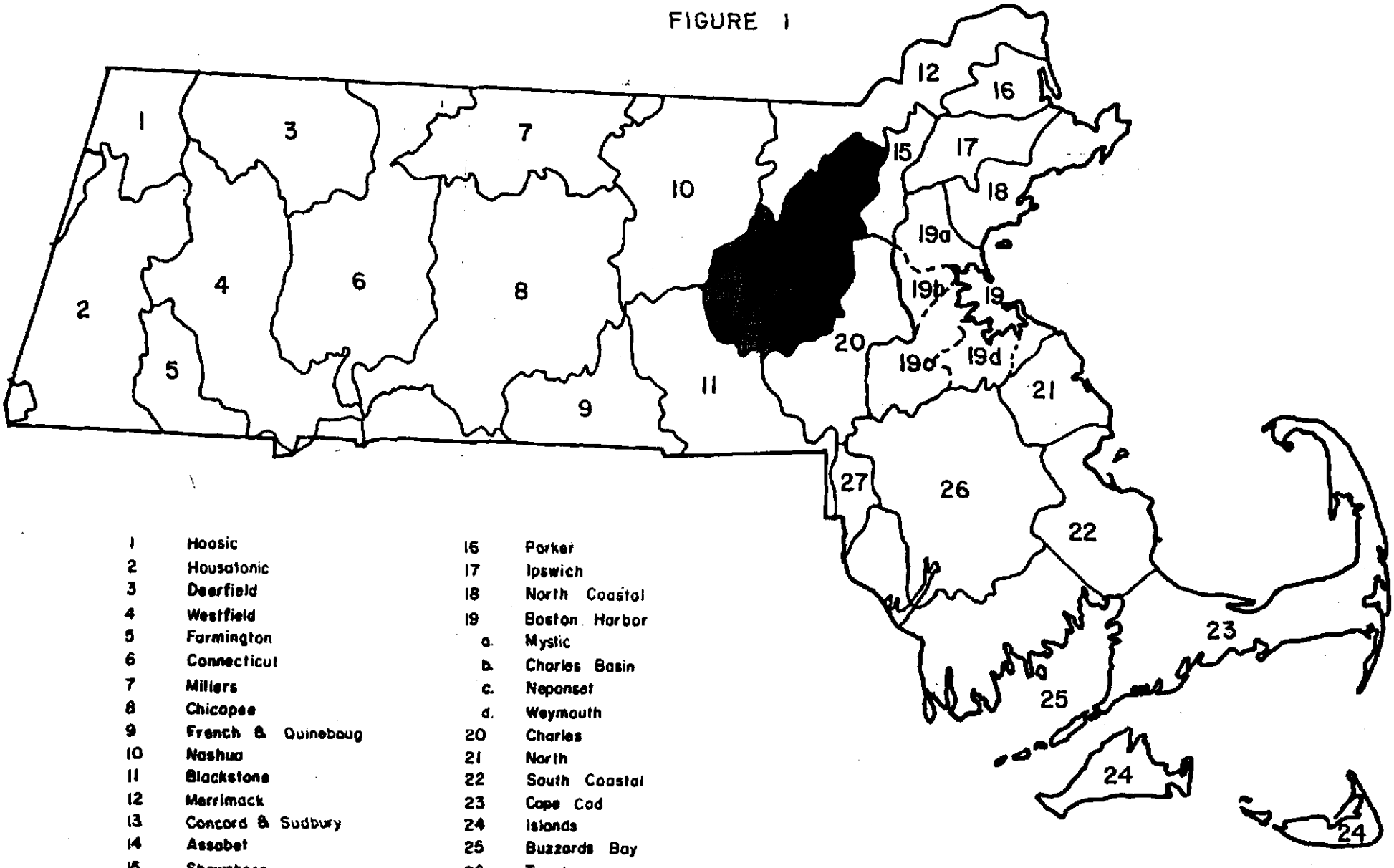
The confluence of the Assabet and Sudbury Rivers in the town of Concord marks the beginning of the Concord River. The Concord River flows north from Concord through the towns of Carlisle, Bedford, Billerica, and the city of Lowell where it flows into the Merrimack River. The Concord River retains the slow-moving characteristic of the Sudbury River. The portions of the Concord River in Billerica and Lowell are subject to the impacts of urban life. The Concord River is 15.8 miles long and drains 27 square miles.

In total, the SUASCO basin drains 318 square miles and consists of 88.1 miles of major rivers. Numerous small streams, not subject to point wastewater discharges, form the drainage network. These small streams have not been included in past water quality surveys. They are assumed to meet their classification as given in the 1978 Water Quality Standards[9] for Massachusetts.

COMMONWEALTH of MASSACHUSETTS

DRAINAGE AREAS

FIGURE 1



1	Hoosic	16	Parker
2	Housatonic	17	Ipswich
3	Deerfield	18	North Coastal
4	Westfield	19	Boston Harbor
5	Farmington	a.	Mystic
6	Connecticut	b.	Charles Basin
7	Millers	c.	Neponset
8	Chicopee	d.	Weymouth
9	French & Quinebaug	20	Charles
10	Nashua	21	North
11	Blackstone	22	South Coastal
12	Merrimack	23	Cape Cod
13	Concord & Sudbury	24	Islands
14	Assabet	25	Buzzards Bay
15	Shawsheen	26	Taunton
		27	Ten Mile


SUASCO RIVER
BASIN COMMUNITIES
BASIN LOCATION
Merrimack River
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
Concord River
WESTFORD
CARLISLE
LITTLETON
BEDFORD
BOXBOROUGH
ACTON
CONCORD
HARVARD
STOW
LINCOLN
BOLTON
MAYNARD
Assabet River
SUDBURY
Sudbury River
HUDSON
Hop Brook
WAYLAND
BERLIN
WESTON
BOYLSTON
MARLBOROUGH
Lake Cochituate
NORTHBOROUGH
Sudbury Reservoir
FRAMINGHAM
NATICK
SHREWSBURY
SOUTHBOROUGH
WESTBOROUGH
Sudbury River
ASHLAND
SHERBORN
North
GRAFTON
HOPKINTON
UPTON
HOLLISTON
0 1 2 3 4 5
MILES

FIGURE 2

EXISTING WATER QUALITY

WATER QUALITY SURVEYS AND ANALYSIS

The Sudbury, Assabet, and Concord (SUASCO) rivers and some of their tributaries were last sampled by the Massachusetts Division of Water Pollution Control (MDWPC) during the summer of 1979. Two publications contain the results of the surveys: The Concord and Sudbury Rivers - 1979 Water Quality Data[1], and The Assabet River - 1979 Water Quality Data.[2]

Previous surveys were conducted in the SUASCO Basin during 1969, 1973, and 1974 by the MDWPC. Results from these surveys can be found in MDWPC publications listed in the bibliography as number 3, 4, and 5, respectively.

Narrative analyses of the 1973 Sudbury and Concord data[6] and of the 1974 Assabet data[7] were published in 1975 by the MDWPC. No similar analyses have been produced from the 1979 data.

A consolidated assessment of SUASCO water quality can be found in the 1979 305(b) report[8] published by the MDWPC as required by PL92-500 and PL95-217 (Section 305(b)). Survey results from the 1979 SUASCO surveys are incorporated in the 1979 305(b) report. Appendix A of this report contains the section of the 1979 305(b) report pertaining to the SUASCO Basin.

WATER QUALITY STANDARDS AND VIOLATIONS

Water quality standards[9] for the Commonwealth of Massachusetts were last promulgated in 1978 and are currently under review. Appendix B of this report contains excerpts from the 1978 Massachusetts Water Quality Standards. The SUASCO classification designations are presented in Table 1. Figure 3 shows the SUASCO classifications.

The 305(b) report (p.8) states that of the 88.1 miles of river surveyed in the SUASCO basin (Sudbury, Assabet, and Concord rivers, and Hop Brook) 26.2 miles presently meet or exceed the Class B standards. The remaining river segments fail to meet Class B standards because one or more water quality standards are violated. Based on the 1978 water quality standards and the 1979 survey data, Table 2 shows these segments which are in violation of Class B standards and the specific standards violated.

WATER QUALITY INDEX

The Technical Services Branch of the MDWPC has adopted a modified version of the National Sanitation Foundation's water quality index.[10,11] The index gives an overall assessment of water quality at selected stations based on rating curves for selected water quality parameters. The results of the index for independent surveys can help to distinguish trends in overall water quality. However, the index results must be interpreted in light of certain influencing conditions: time of year, stream flow, antecedent conditions, etc. The water quality index for the SUASCO 1979 survey is presented in Appendix D along with a key to relative values.

TABLE 1

SUASCO RIVER BASIN CLASSIFICATION

BOUNDARY	MILE POINTS	CLASSIFICATION	DESIGNATED USES	OTHER RESTRICTIONS
Sudbury River				
Source to outlet of Saxonville Pond	13.4-16.4	B	Cold Water Fishery (Sn)* Recreation (P&S)***	Regulation 4.3**
Outlet Saxonville Pond to Wash Brook confluence	16.4-11.0	B	Aquatic Life Recreation (P&S)	Regulation 4.3
Wash Brook confluence to Assabet River confluence	11.0-0.0	B	Aquatic Life Recreation (P&S)	
Hop Brook				
Source to Sudbury River confluence	9.7-0.0	B	Warm Water Fishery Recreation (P&S)	
Concord River				
Confluence of Assabet and Sudbury Rivers to Merrimack River	15.2-0.0	B	Warm Water Fishery Recreation (P&S)	
Assabet River				
Source to Westborough WWTP	31.8-30.4	B	Aquatic Life Recreation (P&S)	Regulation 4.3
Westborough WWTP to outlet to Boons Pond	30.4-12.4	B	Aquatic Life Recreation (P&S)	
Outlet of Boons Pond to confluence with Sudbury River	12.4-0.0	B	Warm Water Fishery Recreation (P&S)	
White Pond to its outlet in Stow and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111****
Gates Pond to the intake in Berlin and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111

TABLE 1 (CONTINUED)

BOUNDARY	MILE POINTS	CLASSIFICATION	DESIGNATED USES	OTHER RESTRICTIONS
Fesgate Brook from its source to Gates Pond, Berlin	--	A	Public Water Supply	MGL, Ch. 111
Milham Brook Reservoir to its outlet in Marlborough and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Williams Lake to its outlet in Marlborough and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Cold Harbor Brook Reservoir in Shrewsbury and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Sandra Pond to its outlet in Westborough and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Sudbury Reservoir in Westborough, Marlborough, Southborough, Framingham and those tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Magog Pond to its outlet in Acton and tributaries thereto	--	A	Public Water Supply	MGL, Ch. 111
Other				
Surface waters of the Sudbury, Assabet and Concord River Drainage areas unless otherwise denoted above	--	B	--	Regulation 4.3

*Sn = seasonal

**See antidegradation provisions (Sec. 4) of 1978 Massachusetts Water Quality Standards, Appendix B.

***P&S = Primary and Secondary contact recreation - see p. 2 of 1978 Massachusetts Water Quality Standards, Appendix B

****Massachusetts General Laws, Ch. 111

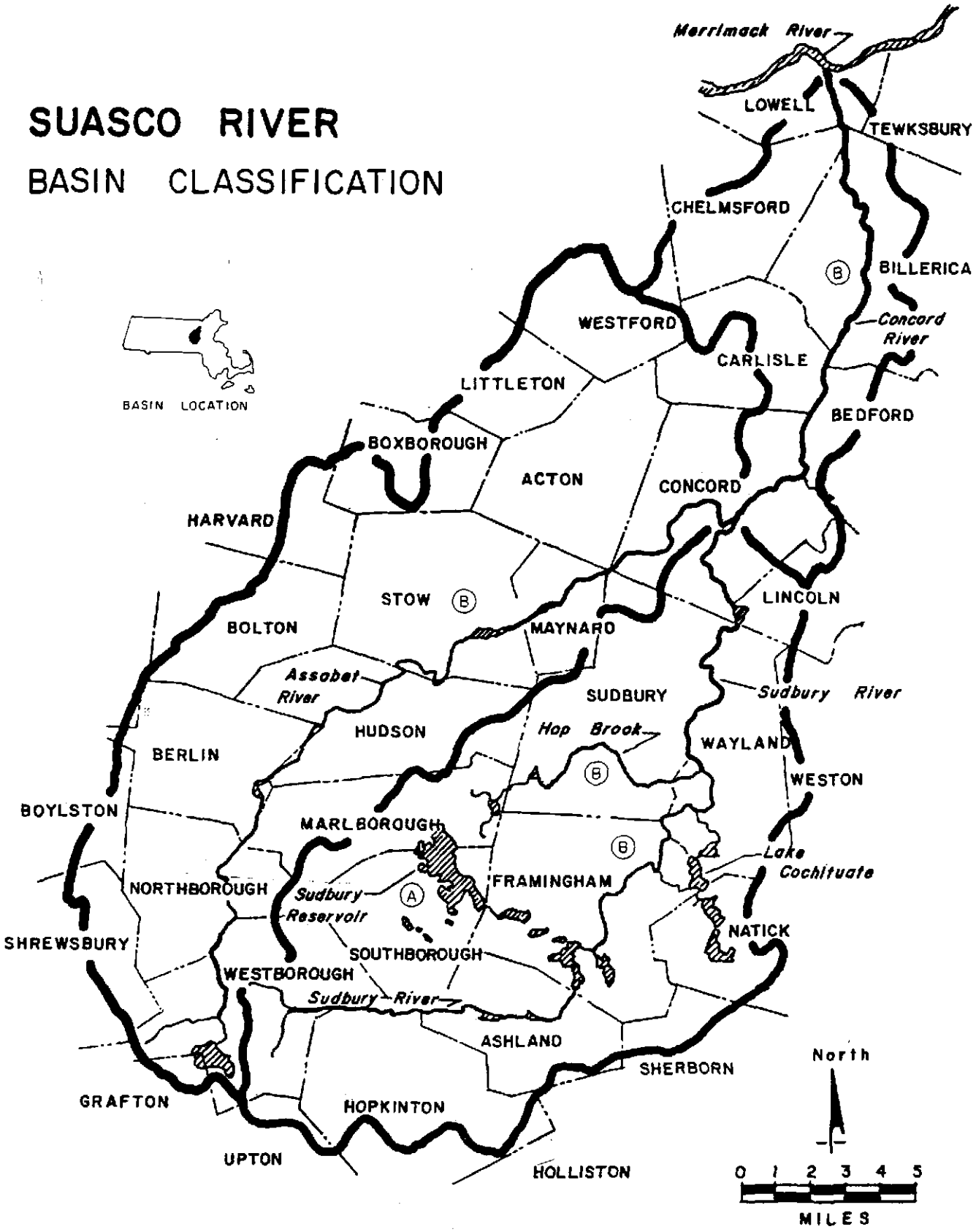

SUASCO RIVER
BASIN CLASSIFICATION
BASIN LOCATION
Merrimack River
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
WESTFORD
Concord River
CARLISLE
LITTLETON
BEDFORD
BOXBOROUGH
ACTON
CONCORD
HARVARD
STOW
LINCOLN
BOLTON
MAYNARD
Assabet River
SUDBURY
Sudbury River
HUDSON
Hop Brook
WAYLAND
BERLIN
WESTON
BOYLSTON
MARLBOROUGH
Lake Cochituate
NORTHBOROUGH
Sudbury Reservoir
FRAMINGHAM
NATICK
SHREWSBURY
SOUTHBOROUGH
WESTBOROUGH
Sudbury River
ASHLAND
SHERBORN
GRAFTON
HOPKINTON
UPTON
HOLLISTON
North
0 1 2 3 4 5
MILES

FIGURE 3

TABLE 2

WATER QUALITY STANDARDS SEGMENT VIOLATIONS

(Based on 1979 MDWPC Surveys (1,2))

ASSABET RIVER

Segment		Violations*
1	Outlet flow augmentation pond to Westborough WWTP	DO, FEC, P
2	Westborough WWTP to Shrewsbury WWTP	DO, FEC, P, NH3
3	Shrewsbury WWTP to Rt.20 dam, Northborough	DO, FEC, P, NH3
4	Rt.20 dam, Northborough to Marlborough West WWTP	DO, FEC, P, NH3
5	Marlborough West WWTP to Hudson WWTP	DO, FEC, P
6	Hudson WWTP to Boons Pond outlet	DO, FEC, P
7	Boons Pond outlet to Maynard WWTP	FEC, P
8	Maynard WWTP to Concord MCI WWTP	DO, FEC, P
9	Concord MCI WWTP to Sudbury River	DO, FEC, P

*DO = Dissolved Oxygen
FEC = Fecal Coliform
P = Total Phosphorus (>0.5 mg/l)
NH3 = Ammonia (>1.0 mg/l)
PH = pH

TABLE 2 (CONTINUED)

SUDBURY AND CONCORD RIVERS

Segment		Violations
1	Headwaters Sudbury River, Westborough, to Saxonville Pond outlet, Framingham	
2	Saxonville Pond outlet to Wash Brook confluence, Wayland	FEC
3	Wash Brook confluence to Assabet River confluence, Concord	DO, FEC
4	Hop Brook	DO, PH, P
5	Concord River from confluence of Sudbury and Assabet Rivers to Billerica WWTP	FEC
6	Concord River from Billerica WWTP to Merrimack River	FEC

WASTEWATER DISCHARGES

Municipal and industrial wastewater discharges constitute the main source of pollutants into the SUASCO's rivers and streams. Eight major municipal discharges are the source of most of the organic loading. Other smaller discharges contribute both organic loadings and heavy metals. Table 3 lists the significant point discharges in the SUASCO basin.

Each of these discharges is covered by a National Pollutant Discharge Elimination System (NPDES) permit which is issued jointly by the Commonwealth of Massachusetts and the United States Environmental Protection Agency (USEPA), as mandated by Sections 101b, 402, and 404 of the Clean Water Act of 1977 (PL95-217). The permit conditions specify plant flows and allowable concentrations of specific constituents allowed to be discharged.

These loadings have been developed based on the effect they will have on water quality (see: Model and Wasteload Allocations Section). Also contained in the permits are implementation schedules for the planning and construction of facilities necessary to obtain the level of water quality specified for a receiving stream in the Massachusetts Water Quality Standards.[9]

The original round of NPDES permits were issued in 1973-75. Many of the implementation schedules contained in them have not been met due to administrative changes in the planning process requirements and to extended negotiations by all the parties involved in the facility planning process. Most of the original permits have also expired although dischargers have been allowed to continue their discharges at first-round levels if they have filed for a new permit. The new permits will often reflect an implementation schedule for facility construction which is based on the latest MDWPC waste load allocation. In most cases, construction of new facilities or upgradings of present ones will not be complete until the mid 1980's.

The new permits will also include requirements for the development and implementation of an industrial pre-treatment program for industrial dischargers to the municipal collection system. The institution of pre-treatment programs will provide municipal operators better control over the operations of their WWTPs and the quality and consistency of the effluent.

Table 4 presents current permit conditions for the eight municipal SUASCO discharges. Additional information on implementation schedules is included, where necessary, in the respective discussions of the individual discharges which follows below and in the Abatement Programs section of this report. Figure 4 locates the discharges listed in Table 3.

Presented below are short descriptions of the eight major municipal WWTPs.

Westborough WWTP - Located on the headwaters of the Assabet River, this secondary extended aeration plant with intermittent sand filtration is being upgraded to an advanced secondary plant to provide the high quality effluent needed to achieve Class B standards in the receiving reach of the Assabet River.

Inflow/infiltration problems in Westborough have resulted in operational difficulties at the present plant. A sewer hook-up moratorium has been in effect in Westborough the past few years whereby any new tie-ins must alleviate an amount of I/I equal to twice the anticipated flow of the tie-in.

Thick solids deposition, with consequent high dissolved oxygen demand, occurs below the present outfall for up to one-half mile. Sludge handling capabilities at the WWTP are reportedly overburdened during the winter months.[12]

The implementation schedule set forth in the current NPDES permit (application date October 28, 1976) for the design and upgrading of the Westborough WWTP has not been totally met. However, the implementation process is continuing with a completed construction date estimated for 1985-86. The facilities plan proposes a bio-oxidation ditch as the principal process. Composting has been proposed to handle the sludge.

Westborough and Shrewsbury have entered into an inter-governmental agreement whereby a major portion of Shrewsbury's wastewater (Shrewsbury is also serviced by sub-surface disposal and by the Upper Blackstone Water Pollution Abatement District) will be treated at the upgraded Westborough WWTP. Consideration is being given to a regionalization plan with Hopkinton, also.

Shrewsbury WWTP - The discharge to the Assabet River from this trickling filter facility occurs about one-half mile downstream of the Westborough WWTP discharge. Infiltration/inflow and inadequate staffing have been reported as problems at this plant.[12] The effluent quality is consistently poor and results in extreme dissolved oxygen depletion, high coliform counts, and solids deposition below the discharge.

Regionalization with Westborough is proposed (see Westborough above). The substitution of one high quality discharge at Westborough for the two current discharges (Westborough and Shrewsbury WWTPs) will result in attainment of Class B standards below the discharge.

Marlborough Westerly WWTP - This activated sludge WWTP has been troubled with biological upsets due to industrial discharges of metals and organic shock loadings.[12] The 1981 MDWPC waste load allocation specifies a degree of advanced secondary treatment in order to produce a suitable effluent for discharge to the Assabet River.

Facilities planning for the Town of Marlborough will address needs at the Westerly WWTP including industrial pre-treatment and sludge management, infiltration/inflow throughout the town, and the impact of Northborough's wastewater on the Westerly WWTP.

Hudson WWTP - This trickling filter WWTP has consistently discharged a secondary effluent to the Assabet River. However, water quality modeling by the MDWPC in 1975 and 1981 indicated that an effluent better than secondary is required at the Hudson WWTP in order to meet water quality standards in the Assabet River. Consequently, the renewed NPDES permit of 1976 included an implementation schedule designed to achieve by July 1, 1982, the level of effluent quality designated by the MDWPC. While the July 1, 1982 target completion date will not be met, facilities planning is on-going and construction should be completed by the mid 1980's.

Maynard WWTP - This activated sludge WWTP has been beset with operational and design difficulties. Permitted effluent limits have been exceeded frequently due to these problems. Sludge disposal is inadequate due to failure of incinerators.[12]

The plant discharges to an impoundment on the Assabet River. This discharge has resulted in the accumulation of solids causing high dissolved oxygen demand and odor conditions in the impoundment. Coliform bacteria counts often have been high, due to the difficulty of effecting chlorination on effluent with high suspended solids.

Facility planning is on-going to correct the operational and design problems, including sludge disposal. Extension of the outfall to the main channel of the impoundment should be completed during the fall of 1982. As part of the outfall extension project, the impoundment will be dredged of accumulated deposits.[13] The relocation of the outfall together with an improved effluent should alleviate the dissolved oxygen and odor problems in the impoundment.

Concord WWTP - This WWTP is an old facility which utilizes Imhoff tanks, sand filters, and chlorination for treatment. Until December 1979, the outfall discharged to the Great Meadows National Wildlife Refuge which borders the Concord River. As a result of a determination by the U.S. Fish and Wildlife Service that the discharge was detrimental to the refuge, the outfall was relocated to the Concord River directly.

Ongoing facilities planning for Concord will provide for a secondary WWTP. Water quality modeling by the MDWPC indicates that a secondary quality effluent at Concord will not violate receiving stream standards in the Concord River.

Billerica WWTP - The Letchworth Avenue extended aeration WWTP is reported to have several design deficiencies, frequent equipment breakdowns, upsets due to industrial loadings, and hydraulic overloads.[12] Compliance monitoring data during the 1979 SUASCO survey indicated less than secondary effluent being discharged. Facilities planning will provide solutions to these problems, but an upgraded WWTP will not be on-line until the mid 1980's.

Marlborough Easterly WWTP - This advanced WWTP incorporates nitrification and phosphorus removal in producing a high quality effluent. The receiving water for the WWTP is Hop Brook, a perennial, low-flow stream, which is frequently impounded on its way to joining the Sudbury River in Wayland.

The MDWPC[14] and the United States Geological Survey[15] are investigating the dynamics of the Hop Brook system in order to provide alternative solutions for the eutrophication problem which exists in the brook and its impoundments.

TABLE 3

SIGNIFICANT WASTEWATER DISCHARGES

SUASCO RIVER BASIN

NO.		RECEIVING WATER	EXISTING TREATMENT	PROJECTED TREATMENT
1	Marlborough East WWTP, Marlborough	Hager Pond (Hop Brook)	Advanced/Phosphorus removal & identification	Advanced/Phosphorus removal removal and denitrification
2	Raytheon Co., Wayland	Sudbury River	BPT*	BPT
3	Concord WWTP, Concord	Concord River	Secondary	Secondary
4	Middlesex School, Concord	Spencer Brook	Advanced	Advanced
5	Billerica House of Correction, Billerica	Concord River	Secondary	Secondary
6	Billerica WWTP, Billerica	Concord River	Secondary	Secondary
7	Raytheon Co., Lowell	Concord River	BPT	BPT
8	Westborough WWTP, Westborough	Assabet River	Secondary (with sand filters)	Advanced Secondary
9	Shrewsbury WWTP, Northborough	Assabet River	Secondary	Discontinued (regionalized with Westborough)
10	Marlborough West WWTP, Marlborough	Assabet River	Secondary	Advanced Secondary
11	Hudson WWTP, Hudson	Assabet River	Secondary	Advanced Secondary
12	Digital, Maynard	Assabet River	BPT	BPT
13	Maynard WWTP, Maynard	Assabet River	Secondary	Secondary with relocated outfall
14	Concord MCI, Concord	Assabet River	Advanced	Advanced

*Best practicable treatment

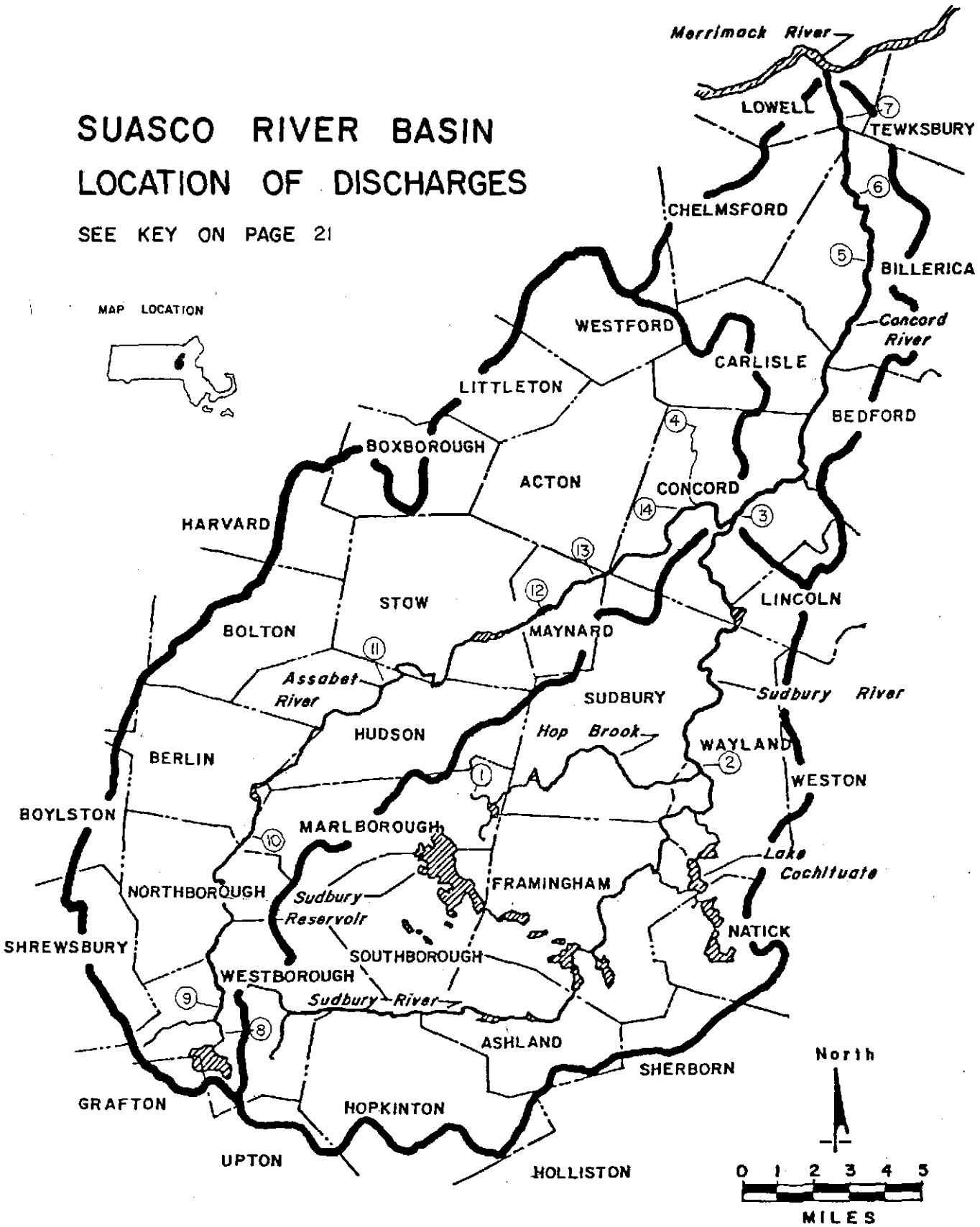

SUASCO RIVER BASIN
LOCATION OF DISCHARGES
SEE KEY ON PAGE 21
MAP LOCATION
Merrimack River
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
Concord River
WESTFORD
CARLISLE
BEDFORD
LITTLETON
BOXBOROUGH
ACTON
CONCORD
HARVARD
STOW
LINCOLN
BOLTON
MAYNARD
Assabet River
SUDBURY
Sudbury River
HUDSON
Hop Brook
WAYLAND
BERLIN
WESTON
BOYLSTON
MARLBOROUGH
Lake Cochituate
NORTHBOROUGH
Sudbury Reservoir
FRAMINGHAM
NATICK
SHREWSBURY
SOUTHBOROUGH
WESTBOROUGH
Sudbury River
ASHLAND
SHERBORN
GRAFTON
HOPKINTON
UPTON
HOLLISTON
North
0 1 2 3 4 5
MILES

FIGURE 4

TABLE 4

MUNICIPAL NPDES DISCHARGE PERMITS

FACILITY	NPDES NO.	EXPIRATION DATE	FLOW (MGD)	BOD-5 (mg/l)	TSS (mg/l)	OTHER	OTHER REQUIREMENTS
Billerica	MA0101711	Nov. 30, 1982	1.6	30.0	30.0	--	To develop a pretreatment program & I/I analysis
Concord	MA0100668	June 1, 1977 (drafted new permit public notice, not issued)	1.0	30.0	30.0	--	Seasonal limits for May 15 - Oct. 31
Hudson	MA0101788	July 1, 1982	2.0	30.0	30.0	--	After 7/1/82, required to discharge effluent quality as given in 1981 303(e) plan
Marlborough-East	MA0100498	Dec. 1, 1979 (reapplied & public hearing; not reissued)	5.5	7.0	15.0	NH_3=0.5 Year-round limits Phos.=0.75 Requested seasonal nutrient limits	
Marlborough-West	MA0100480	June 1, 1977 (new permit not issued)	2.0	30.0	30.0	--	
Maynard	MA0101001	July 1, 1977 (new permit drafted but not issued)	1.29	30.0	30.0	--	File for Step 1 by 5/1/78
Shrewsbury	MA0101249	July 1, 1982	1.75	50.0	30.0	--	By 5/1/78 for district w/Westborough; by 11/1/78 apply for construction grant
Westborough	MA0100412	July 1, 1982	1.1	15.0	15.0	--	Seasonal limits May 1 - Sept. 30. By 4/1/78, vote for district with Shrewsbury to upgrade & expand capacity.

COMBINED SEWER AND STORMWATER DISCHARGES

During periods of rainfall or melting snow, stream water quality degradation can occur from combined sewer overflows and stormwater discharges. Combined sewers are structures of various forms which transport both wastewaters and overland drainage, and which, during periods of high flows due especially to overland runoff, discharge a mixture of wastewater and drainage to streams. Additionally, dry weather combined discharges are possible in the event of faulty maintenance of control structures. Stormwater discharges result from the collection of precipitation runoff from sources such as streets, open areas, and roof drainage. Stormwater discharges will contain such constituents as street litter, automobile exhaust deposits and oil and grease, fertilizers and other chemicals, sand and silts, salts, dry-flow sewer depositional material, and anything else that the storm flushes into the collection system. Combined sewer discharges will contain those constituents found in stormwater discharges along with raw sewage and, possibly, industrial wastes.

Abatement, control, and treatment of combined sewer and stormwater discharges can be a complex and expensive task in the use of existing collection systems. Fortunately, the SUASCO Basin has only one combined sewer system and it has now been structurally controlled and subject to treatment (see paragraph below). Stormwater discharges, however, are found in all towns in the SUASCO Basin. None of these discharges are currently subject to any controls or treatment which are designed to ameliorate their effect on stream water quality.

Until recently, there existed in Lowell a number of combined sewer overflows to both the Concord and Merrimack rivers. Structural controls were implemented in 1980 which now route the combined wastewater to the new Duck Island WWTP. Since no other combined sewers are found in the SUASCO, there is no longer a combined sewer overflow problem in the basin.

An inventory of stormwater discharges to the SUASCO Basin was undertaken in 1977 for the Metropolitan Area Planning Council (MAPC).[16] Through this inventory it was found that those SUASCO towns in the MAPC area generally cleaned their catch basins on a yearly basis. The 208 agencies for the remaining SUASCO towns, the Central Massachusetts Regional Planning Commission (CMRPC) and the Northern Middlesex Area Commission (NMAC), found through their surveys that stormwater controls were limited to catch basin cleaning and street sweeping.[17,18]

The MDWPC does not have any extensive quantitative data on stormwater discharge constituents or on their effect on the streams in the SUASCO Basin. The investigation of stormwater discharges and their effects is not a priority item for the MDWPC in the SUASCO basin. Nonetheless, while the MDWPC is not currently planning an active program to control and treat stormwater through structural means, consideration of non-structural control strategies for existing collection areas as outlined in the 208 plans[17,18,19] covering the towns in the SUASCO Basin is recommended to alleviate degradation from these intermittent discharges. This plan also recommends that new development of areas consider the implementation of those structural and non-structural strategies advocated by the 208 agencies which will provide cost-effective control of stormwater discharge pollutants to the streams of the SUASCO Basin.

MODEL AND WASTE LOAD ALLOCATIONS

During 1980-1981 the MDWPC updated the municipal wastewater treatment plant waste load allocations for the SUASCO Basin. Previous load allocations were arrived at using the basic Streeter-Phelps equation and were incorporated into the MDWPC SUASCO 1975 Water Quality Management Plan.[20] The recent 1980-1981 load allocations were derived, when possible, from the use of the MDWPC's STREAM (see glossary) model, a sophisticated version of Streeter-Phelps which includes variables (benthic oxygen demand, runoff inputs, photosynthesis, tributaries) not considered by the basic Streeter-Phelps equation.

Water quality data from the 1979 surveys of the Assabet, Sudbury, and Concord rivers along with subsequently collected hydraulic data were used to attempt to calibrate and verify models of the respective rivers with respect to dissolved oxygen and carbonaceous and nitrogenous biochemical oxygen demand. If a calibrated and verified model could be constructed, then a simulation model based on the 7-day, 10-year low flow for the respective river would be used to evaluate treatment alternatives for the municipal WWTP discharges. Because of concern about the validity of modeling the nutrients phosphorus and nitrogen, addressing nutrient load allocations has been postponed. However, 201 facilities plans will consider nutrient removal if further investigations verify the need. For those cases where, because of complex hydraulic behavior of the river, the model was unable to simulate the survey data, secondary treatment has been proposed.

The municipal waste load allocations for the SUASCO Basin are presented in Table 5. A brief discussion of the individual load allocations and the type of analysis used in its development follows:

Westborough-Shrewsbury

The two towns have entered into an inter-municipal agreement whereby Westborough will own and operate the WWTP and Shrewsbury will have its wastewater treated under a user's services charge arrangement.

The stringent load allocation results from the WWTP being located near the headwaters of the Assabet River where the flow from the WWTP is generally much greater than the flow of the river at the point of mixing.

The STREAM 7A (see glossary) model was used to develop the Westborough-Shrewsbury load allocation based on the 1979 Assabet River surveys by the MDWPC.

A proposal by the 201 facilities planning consultant for Hopkinton has been made to treat wastewater from Hopkinton at the Westborough plant. If this is allowed, adjustments in design will have to be made to accommodate the increased flow.

Westborough is presently considering the private development of a large industrial/recreational park. Development time has been estimated at ten years. The wastewater volume generated by the development will have to be properly disposed of. The present 201 facilities plan for Westborough does not consider the park.

Marlborough West

Designed as a conventional secondary plant (30 mg/1 BOD_5 in effluent), flows consistently less than design flow have allowed the plant to maintain a better than secondary effluent. However, the WWTP has been subjected to frequent upsets because of shock loadings from a number of local industries. The development of a pre-treatment program for industries discharging to this WWTP has been incorporated into its proposed renewed NPDES permit.

The 1981 modeling effort by the MDWPC indicates that at the design flow of 2 MGD an advanced secondary effluent will be required to maintain stream standards in the Assabet River at the 7-day, 10-year low flow. The on-going facilities planning study for Marlborough will be able to use this waste load allocation as a basis to upgrade the Marlborough West WWTP. Nutrient removal is not being required at this time.

Hudson

The load allocation for the Hudson WWTP was developed using the STREAM 7B (see glossary) model. The updated allocation calls for a degree of advanced secondary treatment with post-aeration. Nutrient removal is not being required at this time, but the town has been notified that it may be in the future (Appendix C).

Maynard

The 1975 MDWPC SUASCO Water Quality Management Plan had originally called for advanced secondary treatment at Maynard. The recent modeling effort was unable to conclusively justify a degree of treatment beyond secondary with post-aeration. The Division of Waterways is undertaking a project (estimated completion in the fall of 1982) to relocate the outfall via a diffuser to the main channel of the Assabet River in order to alleviate solids deposition problems associated with the current discharge. Currently, the WWTP discharges near the bank of an impoundment of the Assabet River. Dissolved oxygen, odor, and sediment accumulation problems have developed over the years. The extension of the outfall from the bank to the main channel of the impoundment, plus the improved effluent from the upgraded WWTP, should alleviate the aforementioned problems. The MDWPC has requested that a monitoring requirement be included in the Maynard WWTP NPDES permit making the town responsible for monitoring water quality below the relocated outfall.

Concord

The 1975 MDWPC SUASCO Water Quality Management Plan had originally called for advanced secondary treatment at Concord. The recent modeling effort was unable to conclusively justify a degree of treatment beyond secondary with post-aeration. Facility planning will be based on this requirement.

Billerica

The 1975 MDWPC SUASCO Water Quality Management Plan had originally called for advanced secondary treatment at Billerica. The recent modeling effort was unable to justify conclusively a degree of treatment beyond secondary

with post-aeration. Facility planning will be based on this requirement.

Marlborough East

The Marlborough East WWTP is presently the only municipal discharger in the SUASCO Basin with nutrient control written into its permit. The plant has a good record of meeting both its nutrient limits and its stringent BOD limit. No modeling was conducted for this load allocation. The Town of Marlborough has recently requested seasonal limits for BOD, NH_3, and P for this WWTP.

Nutrient Control

The 1975 MDWPC SUASCO Management Plan proposed phosphorus and nitrogen control for all WWTPs in the SUASCO Basin. At this time, however, because of the lack of a technically defensible nutrient model, there is no requirement for nutrient effluent limitations except at the Marlborough Easterly plant. However, because observations and water quality data provide evidence of eutrophication in the Sudbury, Assabet, and Concord rivers, MDWPC has notified all the above towns (Appendix C) that the possibility of future nutrient control exists and that any facilities planning undertaken should consider the possibility of addition of nutrient control.

Seasonal Effluent Limitations

General physical, biological, and hydrological conditions that exist during extended periods of low in-stream temperature and reduced duration and intensity of sunlight, i.e., through the fall until the spring, are very favorable in maintaining a consistently high dissolved oxygen concentration in-stream. Therefore, the MDWPC will, if circumstances allow, permit dischargers to increase the BOD_5 of their discharges up to limits defined as secondary (30 mg BOD_5/liter) for the period of October 15 through March 31.

As the Westborough-Shrewsbury, Marlborough Westerly, Marlborough Easterly, and Hudson WWTPs are, or will be, required to discharge a better than secondary effluent, they would all be eligible to apply for a seasonal effluent limitation. Because of the low dilutional capacity of the Assabet River, it is recommended that a seasonal survey be conducted by the MDWPC to ascertain that a seasonal discharger does not cause water quality violations.

In the case of the Marlborough Easterly WWTP, a request for seasonal limits for phosphorus and ammonia would have to be considered in light of the eutrophic condition of Hop Brook and its impoundments. The MDWPC has produced one study of the Hop Brook Basin[14] and the USGS is currently reviewing in-house its study[15] of Hop Brook undertaken in cooperation with the MDWPC. The conclusions from these studies should be considered in deciding whether to grant a seasonal nutrient limitation.

Chlorination and Alternative Disinfectants

The use of chlorine for disinfection has come under scrutiny because of its toxicity to aquatic organisms and its reaction with compounds in the effluent forming toxic or even very small amounts of carcinogenic chlorinated compounds. The Technical Services Branch of the MDWPC has undertaken a disinfection study.[21] The MDWPC is currently formulating a toxic substances monitoring strategy which will address chlorination effects.

Because Billerica uses the Concord River as a water supply source, the effects of chlorination as a disinfection method at upstream WWTPs should be investigated if toxic or carcinogenic chlorinated compounds are found in significant quantities at the Billerica water supply intake.

If levels of chlorinated hydrocarbons detrimental to aquatic life and/or to drinking water quality are found, an assessment should be made of the significant sources. Alternative disinfection methods should be evaluated and adopted for any significant sources.

TABLE 5

SUASCO RIVER BASIN

MUNICIPAL EFFLUENT LIMITATIONS*
(Limits are in mg/l unless otherwise specified and given for monthly average)

WWTP	FLOW (MGD)	BOD_5	SUSPENDED SOLIDS	AMMONIA NITROGEN	EFFLUENT DISSOLVED OXYGEN
Westborough**	7.68	10	10	1.0	6.0
Marlborough Westerly**	2.0	15	15	3.0	2.0
Hudson**	2.6	15	15	3.0	6.0
Maynard	1.45***	30	30	--	6.0
Concord	1.20***	30	30	--	6.0
Billerica	4.8***	30	30	--	6.0
Marlborough Easterly****	5.5	7	15	0.5	≥80% saturation

*All permits include settleable solids @ 0.1 ml/l (weekly average), total coliform @ 1000/100 ml (monthly average), and fecal coliform @ 400/100 ml (monthly average).

**These limits will be required between April 1 through October 15. From October 16 through March 31 a lesser degree of treatment, probably the equivalent of secondary, will be allowed. See Appendix C.

***Design flow obtained from facilities plan.

****Permit includes phosphate as phosphorus (PO_4-P) at 0.75 mg/l.

ABATEMENT PROGRAMS

The following is a synopsis of current abatement projects in the SUASCO Basin. A discussion of abatement actions that are generally applicable to any town as a preventive measure follows the town-by-town discussions.

Acton

Acton currently has a 201 facilities plan under review. The recommended wastewater treatment scheme in the plan is the continued dependence of on-lot septic systems with septage treatment by means of a lagoon. This is in accord with the 208 plan recommendation. The 201 plan recommends that the town apply for construction grant funding to rehabilitate private septic systems under a maintenance program to be developed by the town and approved at the State/EPA level.

In 1978 the town closed two drinking supply wells (Assabet #1 and #2) because of industrial contamination by a chlorinated hydrocarbon. Currently a NPDES permit is under review which will allow the pumping of these wells, with discharge to the Assabet River, to attempt to flush out the contaminants. Continued groundwater monitoring in the vicinity of the contaminated wells is recommended.

Ashland

Ashland is served by the Metropolitan District Commission and by subsurface systems. Since 1974 the town has extended its sewerage capacity and has provided sewerage systems for some of the subsurface disposal problem areas.

No projects are currently in progress although the town is considering applying for funds for further sewer expansion.

The Nyanza chemical waste dump site in Ashland is being actively investigated by DEQE and DHW. The site has been included in the recent USEPA list of 114 interim top priority hazardous waste sites. Clean-up of the site is anticipated once methods are decided upon. For more information, see the Toxic Pollutants section of this report.

Berlin

Berlin is served entirely by subsurface sewage disposal systems for waste disposal and by private wells for water supply. No applications for grants have been made to study alternative waste treatment methods. However, the CMRPC 208 plan recommends the initiation in 1983 of a facilities plan to assess municipal sewerage needs if septic system rehabilitation is insufficient to alleviate the septic system failures that have been occurring.

The town has no abatement projects under consideration. It is in the process of making arrangements for septage disposal at the Hudson WWTP.

Billerica

Billerica is served by a 1.6 MGD secondary WWTP. The recent MDWPC review of

load allocations in the SUASCO Basin has recommended the continuance of secondary treatment at Billerica with the inclusion of post-aeration. Effluent limits as recommended by the MDWPC can be found in the section on "Wastewater Discharges."

Billerica is currently in the construction grant Step II application process. The project is concerned with the WWTP upgrading, inflow and infiltration, and interceptor sewers. The Step II application is scheduled to be submitted to the MDWPC and EPA during the summer of 1981.

Boxborough

At present, Boxborough is adequately served by its subsurface disposal systems. No active abatement projects are on-going.

Septage disposal in Boxborough is handled through private contractors with the town having little control over disposal sites. It is recommended that a regulated system of disposal be established.

Carlisle

Carlisle is served by individual on-lot subsurface disposal systems. The town has adopted a ticketing system by which septage haulers, licensed by the town, dispose of their septage at the Greater Lawrence Sanitary District facility. No abatement projects are foreseen.

Concord

Concord currently operates a wastewater treatment facility composed of Imhoff tanks with sand filters for effluent polishing. A 201 facilities plan is addressing the upgrading to a secondary treatment facility, the extension of sewerage in the town, the inflow/infiltration problem, and septage-handling strategies. The MDWPC is requiring secondary treatment with post-aeration for the Concord facility.

In December 1979, the Concord outfall was relocated so that it discharged directly to the Concord River rather than to the wetlands adjacent to the river.

Framingham

Framingham is served by the MDC and by subsurface disposal. The extensions of the MDC Framingham Extension Sewer and the Farm Pond Interceptor are being considered. The Framingham Extension Sewer Plan is in the final review stage.

The completion of the Farm Pond Project will prevent the occasional manhole surcharges which have resulted in sewage/stormwater impacting the Sudbury River.[22]

Hopkinton

Presently, Hopkinton is served by individual on-lot subsurface disposal. A 201 facilities plan is studying alternative waste disposal schemes.

Regionalization with either Milford (Charles River Basin) or Westborough-Shrewsbury and the extension of the MDC into Hopkinton are being considered for the problem areas.

Reliance on subsurface disposal in outlying areas will continue. The town should develop a septage disposal program as it has no authorized disposal sites. Septage disposal is at the discretion of the private pump-out services.

Hudson

Hudson is served presently by a secondary WWTP discharging to the Assabet River. The MDWPC has determined that advanced secondary treatment at Hudson is needed to achieve Class B standards. A 201 facilities plan is currently under review. Extension of the sewerage area is considered. Septage handling for the Town of Stow is included in the facilities plan.

Lincoln

The town is serviced almost entirely by subsurface disposal systems. Arrangements are being made with the Greater Lawrence Sanitary District to receive the town's septage. A prior arrangement with the MDC in Framingham was not successful. The town is planning to institute better controls over septage haulers.

A small package plant with ground disposal serves an apartment complex. A recent Board of Health inspection showed no operating problems at the plant. The town has no expectation of sewering in the foreseeable future.

Littleton

Littleton is serviced by subsurface disposal. Arrangements are being made with Ayer (Nashua River Basin) to handle the town's septage. No active projects are on-going.

Because the town is located near major transportation routes, population growth may be significant. An assessment of the need for sewerage may be in order. Additional information concerning Littleton may be found in the MDWPC 1975 "Merrimack River Water Quality Management Plan."[33]

Marlborough

The Town of Marlborough is served by two WWTPs. The central and eastern sections are served by the Marlborough-Easterly WWTP, an advanced treatment facility providing nitrification (conversion of ammonia to nitrate) and phosphorus removal. Unfortunately, the plant's effluent is discharged to Hop Brook, a perennial low flow stream, which forms the source for a series of eutrophied impoundments. An unpublished long-term monitoring study by the MDWPC[14] showed little evidence of a reversal of the eutrophication trend. The USGS, under a MDWPC research and demonstration project, has undertaken a study to investigate possible solutions to the eutrophication problem along Hop Brook and its impoundments.[15]

The western section of Marlborough, and parts of Northborough, are served by the secondary Marlborough-Westerly plant. The town has been notified

(Appendix C) by the MDWPC that advanced secondary treatment will be required in order to meet Class B standards in the Assabet River below the discharge.

Marlborough has engaged a consultant who recently filed a notice of intent for application for funds for a Step 1 facilities plan. The plan will evaluate wastewater management needs at the Westerly plant, as well as sludge management, industrial pretreatment and infiltration/inflow for the whole town. Northborough's impact on the Westerly plant will also be included.

Nutrient removal at the Westerly plant is not being required by the MDWPC at this time, but provisions for its incorporation in the treatment process should be addressed in the facilities plan.

Maynard

Maynard has had operational problems with its activated sludge WWTP. The WWTP discharges to an impoundment of the Assabet River. An on-going 201 facilities planning study is addressing these problems. The MDWPC, in its 1980-1981 review of effluent limits on the SUASCO, is requiring secondary treatment. Earlier requirements for advanced treatment and nutrient removal have been dropped. The Division of Waterways is funding a project to move the WWTP discharge to the main channel of an Assabet River impoundment. In addition, the impoundment will be dredged with the spoils being contained along the banks.[7] Construction will begin as soon as the necessary permits are obtained.

Natick

Heavily populated areas of Natick are served by the MDC. Outlying areas rely on subsurface sewage disposal. A consultant has recently completed the final draft 201 facilities plan addressing sewerage needs in the town. The plan recommends both extension of interceptors and the continued reliance on sub-surface disposal where feasible. A significant part of the Natick watershed is in the Charles River Basin. Additional information concerning Natick will be found in the 1975 MDWPC "Charles River Water Quality Management Report."[23]

Northborough

The Town of Northborough is served by individual on-lot subsurface disposal and by the Marlborough-Westerly WWTP. An interceptor extension project was recently completed. The construction of lateral sewers is the only on-going project in Northborough.

Shrewsbury

Shrewsbury is served by both the Upper Blackstone Water Pollution Abatement District (UBWPAD) and the Shrewsbury WWTP. The UBWPAD discharges to the Blackstone River. The Shrewsbury WWTP discharges a low quality effluent to the Assabet River approximately one-half mile below the Westborough WWTP discharge. Water quality conditions below the Shrewsbury discharge are below standards during the summer months.

Shrewsbury has entered into an intergovernmental agreement with Westborough

to jointly finance the upgrading of the Westborough WWTP to an advanced secondary plant, and to send its wastewater, less the portion treated at UBWPAD, to the upgraded plant. The 201 facilities plan for the Westborough-Shrewsbury WWTP is under review. Construction is estimated to be completed by the mid 1980's.

Southborough

Southborough is served exclusively by on-lot subsurface disposal. The 201 facilities plan for the Framingham Extension Sewer addresses septic system failure in Southborough and allows for the inclusion of wastewater from Southborough if a decision to sewer the town is made. An assessment of sewerage needs is recommended for Southborough in light of projected population growth and development pressures along Route 9.

Stow

Stow relies entirely on subsurface disposal. An agreement with Hudson provides for septage disposal. The 1974 MDWPC water quality management plan projected no need for a sewerage system because of moderate growth projections and adequate zoning protection. This projection still appears accurate.

Sudbury

Plans and specifications for regional septage treatment with Wayland are currently under review. Construction should begin by the fall of 1981. As Sudbury currently relies entirely on subsurface disposal, the septage disposal site should provide adequate treatment for domestic wastes.

In the event a sewerage needs study shows the necessity for a sewerage system for either Sudbury and/or Wayland, no discharge to the Sudbury River is recommended because of existing dissolved oxygen problems caused by natural conditions and because increased nutrient loading would lead to accelerated eutrophication.

Wayland

See Sudbury. Wayland relies entirely on subsurface disposal.

Westborough

The 201 facilities plan for the Westborough-Shrewsbury WWTP is currently under review. The implementation of the plan's recommendations, expected to be completed by 1985, will result in the upgrading of the present WWTP to a multi-channel oxidation process which will meet the effluent limits required by the MDWPC to maintain Class B standards in the upper Assabet River. The Westborough facilities plan also addresses such issues as inflow/infiltration, extension of sewerage areas, septage management, and sludge management.

TABLE 6

SUMMARY OF ABATEMENT PROJECTS

SUASCO RIVER BASIN

COMMUNITY	PROJECT	CONSULTANT	ESTIMATED COMPLETION DATE	COMMENTS
Acton	Facilities Plan	Anderson-Nichols	Jan. 1982	Additional Step 1 work needed: geo-hydrology; septic tank rehabilitation study
Billerica	Facilities Plan	Fay,Spofford, and Thorndike	Jul. 1981	Step 1 underway
	Expansion of sewerage system		Jan. 1990	
	Upgrade WWTP		Jan. 1985	
Concord	Facilities Plan	Camp, Dresser, & McKee	Jul. 1981	Step 1 underway
	Expansion of sewerage system		Jan. 1985	
	Upgrade WWTP		Jan. 1985	
Framingham	Expansion of MSD* system	Anderson-Nichols	Jan. 1982	Minor expansion completed and projected
	Farm Pond Interceptor Facilities Plan	Hayley & Ward	under review	Extension of sewerage
Hopkinton	Facilities Plan	Weston & Sampson	Dec. 1981	Town investigating several alternatives
Hudson	Facilities Plan	Whitman & Howard	under review	Advanced secondary treatment proposed
	Upgrade WWTP		Jan. 1984	
Marlborough	Facilities Plan	Metcalf & Eddy	Jan. 1983	Step 1 application under review; covers citywide sludge management; Westerly
	Upgrade WWTP West		Jan. 1985	WWTP upgrading
Maynard	Facilities Plan	Dufresne-Henry	Jul. 1981	Step 2 application under review
	Upgrade WWTP		Jan. 1985	
	Prescott Impoundment	Cullinan Engineering	Nov. 1981	3-month project to extend WWTP outfall and dredge accumulated sludge

*MSD - Metropolitan Sewerage District

TABLE 6 (CONTINUED)

COMMUNITY	PROJECT	CONSULTANT	ESTIMATED COMPLETION DATE	COMMENTS
Natick	Framingham Extension Sewer	Anderson-Nichols	Jan. 1982	Minor expansion completed and projected
Northborough	Construction of sewerage system	- -	- -	Completed 1981
Shrewsbury	Facilities Plan Upgrade WWTP	Fay, Spofford & Thorndike	July 1981 Jan. 1985	Upgraded facility will be regional with Westborough
Sudbury & Wayland	Septage Treatment Facility	Roy Weston Assoc.	Jun. 1982	Plans under review; construction should begin Sept. 1981
Westborough	Facilities Plan Upgrade WWTP	SEA	Jan. 1981 Jan. 1985	Facilities plan under review; must comply with PRM on AWT; will be regional with Shrewsbury and possibly Hopkinton.

NON-POINT SOURCES

The non-point source pollutant category includes any of a diverse group of pollutants from a number of sources which include leachate from landfills, salts from road de-icing and salt storage, lawn fertilizer and agricultural runoff, erosion from construction and mining operations, and leachate from septic systems and cesspools. Quantification of the impact of non-point sources is difficult because it enters a waterbody along its perimeter, not at the end of a pipe, and thus it is difficult to measure flows and concentrations.

Nevertheless, non-point sources can be significant and were singled out by the Clean Water Act (PL95-217) as an element to be investigated by the formation of 208 agencies. The three 208 agencies covering the SUASCO Basin are the Metropolitan Area Planning Council (MAPC),[19] the Northern Middlesex Area Commission (NMAC),[18] and the Central Massachusetts Regional Planning Commission (CMRPC).[17] See Table 7 for a list of SUASCO cities and towns and their corresponding 208 agencies. Figure 5 presents the coverage of the 208 agencies in the SUASCO Basin. While all three 208 agencies have investigated the various sources of non-point source pollution in their respective areas, none was able to make a quantitative assessment of non-point sources because of financial and manpower constraints. Nevertheless, recommendations dealing with existing and potential non-point sources were made by the three agencies based on qualitative appraisals. These recommendations are mainly in the form of management practice controls, improved maintenance of existing structures, and zoning controls.

The MAPC 208 plan covers the majority of towns in the SUASCO Basin. The only significant non-point sources found in the SUASCO Basin, according to the MAPC, are sanitary landfill leachate, road salt storage and application, and leachate from failing septic systems. The MAPC report (p.4-23, Part 1, Volume 1) recommends priority monitoring of landfill sites in Wayland, Ashland, Framingham, Hopkinton, Hudson, Maynard, Stow and Natick. Additionally, the closed landfill in Southborough should be monitored for its possible water quality impact.

The need for managing road salt is indicated for the communities of Acton, Littleton, Marlborough and Southborough (MAPC, pp.3-635, 3-697, 3-706, 3-724, Part I, Volume III) because of existing and potential impacts on drinking water supplies. Additionally, road salt management is recommended for all MAPC-SUASCO communities as a preventative measure. The Department of Environmental Quality Engineering (DEQE) is investigating road salt use in Massachusetts. Their report has been released. While the MDWPC has no data to suggest an instream impact on water quality in the SUASCO Basin from the practice of road salt storage and spreading, concern over the excessive introduction of road salt to the groundwater and to surface water supplies is warranted. The correct functioning of subsurface sewage disposal systems is necessary to protect water quality and the public health. The MAPC recommends the implementation of local controls, maintenance programs, and homeowner education in maintaining properly operating sub-surface disposal systems. Management of septage is also required to prevent uncontrolled disposal of this potential health and water quality hazard.

Two other 208 agencies, Northern Middlesex Area Commission (NMAC) and Central Massachusetts Regional Planning Commission (CMRPC), cover the

remaining SUASCO communities. Their assessments of non-point sources and their recommendations are similar to MAPC's and can be found in their respective reports.[17,18]

Point source discharges--mainly from municipal WWTPs--still are the dominant source of pollutants into the three major SUASCO rivers and Hop Brook at this time. With future upgradings (mid 1980's) and improved operation and maintenance of the basin's WWTPs, a better estimation of the effects of non-point sources can be made. Until the point sources are adequately controlled, however, the recommendations contained in the MAPC, NMAC, and CMRPC 208 reports should be followed as a preventative water quality protection measure. Once point source control is adequately instituted, the MDWPC should assess the degree of water quality achieved and decide whether further benefits can be reasonably obtained by addressing more fully the non-point sources.

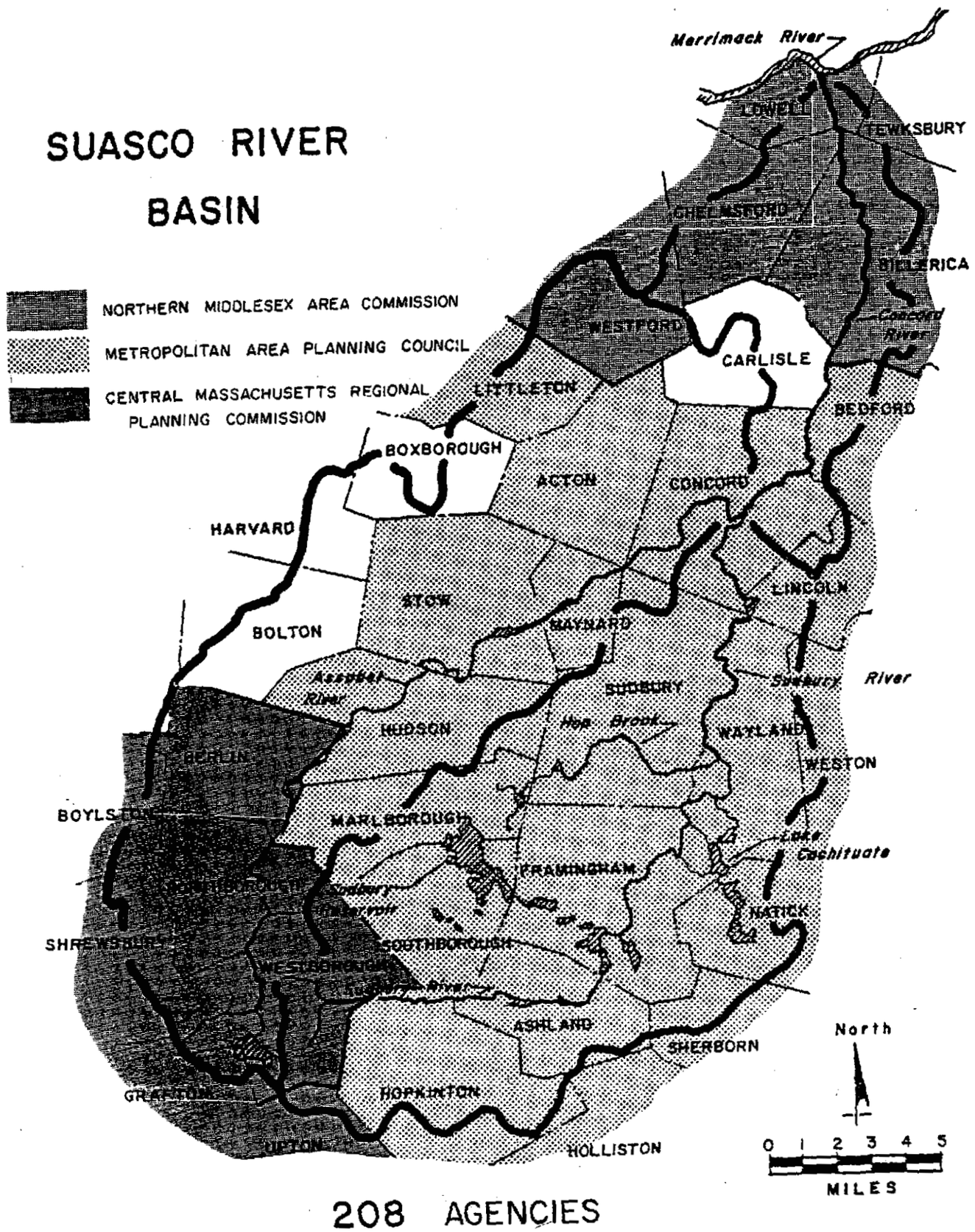
TABLE 7

COMMUNITIES AND 208 AGENCY

SUASCO RIVER BASIN

MUNICIPALITY	BASIN PLAN	208 AGENCY
Acton	SUASCO	MAPC
Ashland	SUASCO	MAPC
Berlin	SUASCO	CMRPC
Billerica	SUASCO	NMAC
Boxborough	SUASCO	*
Carlisle	SUASCO	*
Concord	SUASCO	MAPC
Framingham	SUASCO	MAPC
Hopkinton	SUASCO	MAPC
Hudson	SUASCO	MAPC
Lincoln	SUASCO	MAPC
Littleton	SUASCO	MAPC
Marlborough	SUASCO	MAPC
Maynard	SUASCO	MAPC
Natick	SUASCO	MAPC
Northborough	SUASCO	CMRPC
Shrewsbury	SUASCO	CMRPC
Southborough	SUASCO	MAPC
Stow	SUASCO	MAPC
Sudbury	SUASCO	MAPC
Wayland	SUASCO	MAPC
Westborough	SUASCO	CMRPC

*Non-designated municipality



208 AGENCIES

FIGURE 5

TOXIC POLLUTANTS

Concern about contamination of groundwater and streams by toxic chemicals has necessitated the development of plans to detect and control sources of toxic chemicals. In addition, there is the need to assess the impact of toxic chemicals on the biological and physical quality of ground and surface waters.

The EPA has identified 129 chemical compounds as being priority pollutants and has proposed water quality criteria (qualitative or quantitative estimates of the concentration in ambient waters which, when not exceeded, will ensure a water quality sufficient to protect a specified water use) for all of them. The EPA is currently endeavoring to establish effluent guidelines for 21 industrial categories and for publicly-owned treatment works. The end product of this process will be the development and issuance by the Massachusetts Division of Water Pollution Control of National Pollutant Discharge Elimination System (NPDES) permits which will address toxic chemicals as well as conventional pollutants.

Because of the multiplicity of compounds to be tested for, the development of techniques only recently to detect many of the compounds in trace quantities, and the past lack of emphasis in controlling these toxics, the MDWPC has only limited data on the concentrations of these compounds in the waters of Massachusetts. In the SUASCO Basin, analyses for a number of heavy metals have been made on selected wastewater discharges. No wastewaters have been analyzed for specific organic chemicals which appear on the EPA priority toxics list. Data on heavy metal wastewater analyses for certain industries and WWTPs can be found in the various water quality data (Part A) and wastewater discharge data (Part B) publications of the MDWPC. No extensive in-stream data on the EPA priority pollutant chemicals is available from the MDWPC for SUASCO waters.

The MDWPC is initiating a bioassay program to screen effluents. The program plan has been formulated, but not fully implemented. It will involve sites in the SUASCO Basin. Sites will be selected on the basis of probable contamination (discharges and instream stations below effluents containing industrial wastes) and in areas where no probable contamination exists in order to indicate background and conditions. A bioassay laboratory is being constructed under a three-year research and demonstration program at the University of Massachusetts, Amherst, to assist in this part of the toxics program.

Because municipalities operating WWTPs will eventually be covered by the toxics section of a NPDES permit, it will be necessary to control the types of industrial wastes accepted at the municipal WWTP. Consequently, it is recommended that these municipalities consider the establishment of programs to screen industrial contributors for the designated priority pollutants and to require appropriate pre-treatment as necessary. This type of inventory program will be part of the overall pre-treatment program to be required by the USEPA/MDWPC in forthcoming NPDES permits.

The recent formation and staffing of DEQE's Division of Hazardous Waste (DHW) will provide managerial and regulatory control over the storage and disposal of hazardous wastes including those on EPA's priority pollutant list. The success of this program, which will require the cooperation of local officials and citizens, will reduce or eliminate the possibility of toxic contamination of ground and surface waters. It is recommended that full cooperation of town officials with the DHW be established inasmuch as the area of toxic contamination represents a case where a little prevention is a lot less costly than remedial action and clean up.

A recent DHW report, Management for Site Investigations: The Preliminary Site Assessment,[24] lists the known hazardous waste disposal sites, both legal and illegal, in the state. Two such sites are designated in the SUASCO Basin. In Acton, two town water supply wells (Assabet #1 and #2) have been closed because of contamination by chlorinated hydrocarbons from a local industry. Whether nearby surface waters, especially the Assabet River, are contaminated is not known. A NPDES permit is under review which will permit the pumping of the wells with discharge to the Assabet River. The MDWPC proposes, in the draft permit, to monitor the effects of the discharge.

In Ashland, heavy metal and organic contamination of the Sudbury River and nearby groundwater from sources on the Nyanza chemical waste dump site has been documented by the MDWPC and DEQE. The USEPA has recently named the Ashland site as one of the interim 114 top-priority waste dumps to be cleaned up. Mercury levels in fish flesh have been found to exceed US FDA recommended levels. Sediments in the upstream reservoirs and in the upper Sudbury River have relatively high concentrations of toxic heavy metals. More information can be found in the DEQE/DHW preliminary site assessment report.[25] Alternatives for clean up of the site are currently being investigated by a consultant. Potential use of the Sudbury River as a water supply will require a thorough and definitive investigation.

FUTURE MONITORING PROGRAMS

A continuing water quality monitoring effort is needed to:

1. assess the results of abatement projects;
2. identify water quality problems and sources of pollution;
3. provide data for special studies, i.e., toxics, non-point sources, etc., when needed; and
4. provide an historical record of water quality.

The monitoring program by the Commonwealth consists of the following elements:

1. Intensive water quality surveys
2. Lake monitoring
3. Biological monitoring
4. Compliance monitoring
5. Groundwater monitoring
6. National Water Quality Surveillance Sampling Network
7. Water Quality Monitoring Network
8. Special studies

All of these programs are essential to effective management and the safeguarding of the Commonwealth's waters. The following is a projection of the role each element will play in SUASCO water quality management in the future.

Intensive Water Quality Surveys

This type of survey is conducted to assess the general water quality condition of a river and to provide data for modeling and planning purposes. The last intensive survey in the SUASCO Basin was during the summer of 1979. The data from this survey were used to establish the latest waste load allocations for the SUASCO WWTPs. Prior to this, intensive surveys in the SUASCO were conducted by the MDWPC during 1965, 1969, 1973, and 1974.

No new basin-wide intensive survey should be necessary until after the upgradings of the SUASCO municipal WWTPs.

Lake Monitoring

The monitoring of the basin's lakes and ponds involves three types of surveys:

1. Baseline - a one-day survey which collects data on the morphology and basic chemical and biological parameters to give a general assessment of the lake's condition.
2. Intensive - generally a year-long survey during which the lake

might be sampled 10-15 times. This type of survey collects data similar to that for the baseline survey, but additional data is collected on the lake's drainage basin.

3. Diagnostic/Feasibility study - these intensive surveys are funded by the Commonwealth in conjunction with Section 314 funds of PL92-500 to assess the feasibility of restoring lakes to a multiple-use condition and have been conducted by the DWPC during the 1979-1981 period.

Baseline surveys should continue in order to provide background data on the lakes and ponds of the SUASCO Basin. Data from these surveys should continue to be published as in the past. Additionally, the data should be entered into the MDWPCs computerized Ponds and Lakes Information System (PALIS) in order to establish a state-wide readily-referenced data base.

Intensive surveys should continue on an as-needed basis. They can form the basis for local management decisions. They also serve to provide detailed information on the seasonal changes in a lake's biology and chemistry. Results of the intensive surveys will be continued to be published on a lake-by-lake basis, and the data will be entered into PALIS.

Three SUASCO lakes were studied under the 314 Clean Lakes Program. The Town of Billerica, the USEPA, and the MDWPC have already initiated a restoration program for Nutting Lake after completing a diagnostic/feasibility study. It will be monitored to assess the results of the restoration. Boons Pond and Fort Pond were also studied. The results of these studies have been recently published by the MDWPC.[26,27] Limited funding of the 314 program for fiscal 1982 will probably not be sufficient to fund the start of Phase II restoration work on Boons Pond or Fort Pond. Local and state government or private groups will have to decide if and how the recommendations in the diagnostic/feasibility studies for these two ponds should be implemented.

Consideration should be given by the MDWPC to formally implementing the PALIS program for past and future lakes' data. The ability afforded by PALIS to rapidly search and report on the extensive lakes data base would be a useful analytical tool, as well as a time-saving aid in the collation and distribution of data. Further merits of the PALIS program are discussed in Publication No. 108 of the Water Resources Research Center at the University of Massachusetts/ Amherst.[28]

Biological Monitoring

In the Declaration of Goals and Policy Section (Section 101(a)2) of PL95-217 it is stated "It is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife...be achieved by July 1, 1983." In order for a waterbody to provide for protection and propagation of the above, the supporting biological communities making up the food chain must be present and viable. Biological monitoring of the flora and fauna is thus necessary to determine whether the above goal is being met. Additionally, biomonitoring supplements physical chemical data in assessing order quality: for example, unexpected biological diversity might highlight a problem (heavy metals, pesticides, etc.) not uncovered by the chemical parameter-limited physical data.

Biomonitoring in the SUASCO by the MDWPC has been limited to the data contained in a 1977 MAPC 208 report[29] and to data published in the baseline, intensive and diagnostic/feasibility lake studies by the MDWPC. The National Eutrophication Survey[30] surveyed a number of SUASCO impoundments in 1974 to assess their trophic status.

In the past, chemical data has been the main indicator of water quality. The present concern about hazardous and toxic wastes, however, will justify the use of biological indicators to assess water quality. The MDWPC has contracted for the development of bioassay tests. Bioassay tests can be used to detect the effects of toxic compounds in water bodies and can be employed as a screening tool to determine if sophisticated chemical analysis is needed to identify specific toxic compounds. Additionally, bioassays (algal assays) can be useful in determining whether control of nutrients in effluent is required to prevent eutrophication.

Biomonitoring in the SUASCO should be considered upon the completion of the contracted studies. Eutrophic impoundments should be studied with respect to nutrient loadings from municipal treatment plants. Bioassay toxicity studies should be conducted for both general background information and in the vicinity of known dischargers of toxic-containing wastes. A general biological assessment of the SUASCO should be undertaken to provide background information.

Compliance Monitoring

Monitoring of waste discharges is required by PL95-217 to assure compliance with the terms of the discharge permits and to provide loading data for use in computer modeling. The past practice of monitoring every major and twenty percent of the minor discharges each year has been discontinued in favor of monitoring selected discharges. Discharges to be monitored will be selected at the request of a regional MDWPC office, new treatment plants after the start-up phase, all treatment facilities in a basin during an intensive basin survey, and all treatment facilities on a spot check basis.

Compliance monitoring in the SUASCO will not be intensive until after the projected upgradings at the various municipal plants are completed. A list of plants subject to monitoring can be found on page 21 of this report.

Groundwater Monitoring

The Massachusetts Department of Environmental Quality Engineering is in the process of formulating a groundwater program. The program will, at the least, classify groundwater and establish rules and regulations to protect groundwaters in cooperation with local government. The role of the MDWPC in the groundwater program is currently under review.

Instances of groundwater contamination have already been documented in the SUASCO Basin and have resulted in the closure of water supply wells in Acton. Groundwater contamination and well closures have also occurred in other parts of Massachusetts. Because the rehabilitation of a groundwater is a costly and lengthy process, and because aquifers exist without regard to political boundaries, it is necessary that state, local, and private officials cooperate to formulate a strong and enforceable grounwater policy.

National Water Quality Surveillance Sampling Network (NWQSSN)

This program was set up in Massachusetts in the summer of 1974 to assess the impact of pollution abatement projects on selected streams. The program is currently under review and a decision on whether to continue it will be made by mid-1982.

There are no NWQSSN stations in the SUASCO Basin. Because the Concord River serves as a source of drinking water, consideration is being given to using the Sudbury as a drinking supply source, and significant abatement projects are planned for the SUASCO, consideration should be given by the MDWPC to establishing NWQSSN stations at selected points if the program is continued past 1982.

Water Quality Monitoring Network

This network consists of nine telemetric monitors operated jointly by the MDWPC and the United States Geological Survey. The monitors provide continuous records of dissolved oxygen, temperature, pH, and specific conductance. The data are published annually by the USGS in Water Resources Data for Massachusetts and Rhode Island (formerly included data from New Hampshire and Vermont).

No monitor is maintained in the SUASCO Basin. Except in the case of a long-term special study, the need for a continuous monitor is not necessary.

Special Studies

A special study usually involves a long-term effort to obtain data on a particularly complex situation. For instance, during the latter 1970's, a phosphorus monitoring program was run to determine the effect of the Marlborough Easterly effluent on the series of impoundments along Hop Brook. Also, studies on the biokinetics[31] and on nitrification[32] in the Assabet River was conducted by Northeastern University under contract to the MDWPC.

Presently, only one special study--an investigation of the flow augmentation pond in Westborough is being conducted by the MDWPC. It is anticipated, however, that a number of such studies will be undertaken upon the completion of some of the abatement projects, i.e., phosphorus below Westborough-Shrewsbury WWTP and the effect of the diffuser planned for the Maynard WWTP discharge, among others.

PLAN SUMMARY AND RECOMMENDATIONS

This Water Quality Management Plan for the SUASCO river basin updates the 1975 plan. Its primary purpose is to present a strategy for obtaining the water quality goals established by the Clean Water Act (PL95-217), the Federal Water Pollution Control Act (PL92-500), and the 1978 Massachusetts Water Quality Standards. This plan identifies source point pollution control as the major vehicle through which these goals can be realized. Because the major point source discharges to the SUASCO basin rivers are municipal WWTPs, the plan focuses primarily on these point sources.

Water quality surveys in 1979 and subsequent water quality mathematical modeling during 1979-80 led to the establishment of waste load allocations for the municipal WWTPs in the SUASCO basin (see Water Quality Modeling and Waste Load Allocation section). Attainment of the WWTP discharge levels specified in the waste load allocations should provide for the attainment of Class B water quality throughout the basin's receiving waters as required in the 1978 Massachusetts Water Quality Standards.

Therefore, it is the recommendation of this plan that the effluent limitations specified in this plan for the respective WWTPs be incorporated into the respective governing NPDES permits.

The town-by-town abatement programs discussed in this plan indicates that the abatement recommendations made in the 1975 plan and the respective 208 area-wide plans are still being implemented and are behind schedule. The new round of NPDES permits should incorporate revised implementation schedules.

The institution of stringent basin-wide non-point source controls should wait for an assessment of such sources after the major point sources are adequately controlled.

Toxic waste contamination of surface and groundwaters has already been documented in the SUASCO basin. The Nyanza waste site in Ashland has been designated a priority hazardous waste site by the USEPA. It is also the subject of an on-going intensive study by DEQE. With the MDC investigating the use of surface waters downstream of the Nyanza site, the necessary measures as determined by DHW/DEQE/USEPA for securing or cleaning of the site must be undertaken. It is recommended that the MDWPC monitor the effects upon surface water quality and aquatic biota during the resolution of this problem.

Monitoring of surface water quality during resolution of the Acton town well contamination problem has already been proposed in the draft NPDES. The pumping of the two wells with discharge to the Assabet River is proposed to remedy the groundwater contamination. It is the recommendation of this plan that MDWPC monitor surface water quality during the pumping of the wells.

Both of the above sites should be considered for inclusion in the MDWPC bioassay program once it is implemented.

Water quality monitoring in the SUASCO basin must be continued to assess the results of abatement projects. However, as significant abatement projects will not be completed until the mid 1980's, no intensive water quality surveys will be needed until then.

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GLOSSARY

Ammonia-Nitrogen - Nitrogen in the form of dissolved ammonia gas (NH_3) or ammonium ion (NH_4^+). Concentrations over one or two mg/l are toxic to certain fish and other aquatic organisms. Nitrification of ammonia by bacteria to nitrite and nitrate exerts a biochemical oxygen demand. Ammonia is also a nutrient for algae and other aquatic plants.

Biochemical Oxygen Demand (BOD) - The amount of oxygen required by bacteria to stabilize organic matter. Biochemical refers to the fact that a chemical change is carried out by biological organisms (bacteria). BOD consists of two parts, carbonaceous and nitrogenous. The carbonaceous portion occurs first; compounds of carbon are broken down with the carbon released combining with oxygen to form carbon dioxide. In the nitrogenous portion, organic compounds of nitrogen are broken down to ammonia which in turn is converted to hydrogen gas and, successively, nitrite and nitrate. Although the total BOD of a waste may take 30 days or more to exert itself, the portion exerted after 5 days has become the standard test through recurrent usage. The 5 day BOD of untreated sewage normally ranges from 150 to 300 mg/l. Streams not subject to pollution will normally have 5 day BOD's of 2.0 mg/l or less.

Coliform Bacteria - Found in abundance in the intestinal tract of warm-blooded animals. Although not harmful themselves, the presence of coliforms often indicates that pathogenic bacteria are also present. Since they can be detected by relatively simple test procedures, coliforms are used to indicate the extent of bacterial pollution. Tests are often conducted to measure the total and fecal coliform. Fecal coliform make up about 90 percent of the coliforms in fecal matter. Non-fecal coliform may originate in soil, grain, or decaying vegetation. Untreated sewage contains upwards of 20,000,000 coliforms per 100 milliliters. The legal maximum for swimming areas is 1000 coliform per 100 ml, while for public water supplies it is 100 per 100 ml.

Combined Sewers - In many older cities, one system of sewers carries both storm water and sewage, hence the name "combined." Such systems have numerous overflows to the nearest waterbody. These overflows are considered point sources of pollution.

Dissolved Oxygen (DO) - The uncombined oxygen in water which is available to aquatic life; DO is therefore the critical parameter for fish propagation. Numerous factors influence DO, including organic wastes, bottom deposits, stream hydraulic characteristics, nutrients, and aquatic organisms. Most mathematical models simulate the impact of these factors on stream DO concentrations. Saturation DO, or the equilibrium concentration, is primarily a function of temperature. DO values in excess of saturation are usually the result of algal blooms and therefore indicate an upset in the ecological balance. Optimum DO values range from 6.0 mg/l (minimum allowable for cold water fisheries) to saturation values. The latter range from 14.6 mg/l at 0° C (32°F) to 6.6 mg/l at 40° C (104°F).

Milligrams per Liter (mg/l) - The metric system is used to express concentrations in water chemistry because it allows simpler calculations than

the English System. The basis of the metric system is the unit weight and volume of water at standard conditions (20°C). At these conditions, one milliliter of water equals one cubic centimeter and weighs one gram. One milligram per liter is therefore essentially equal to one part per million by weight or volume.

Models - mathematical descriptions which predict the response of a stream to a change in loadings to the stream. Models can range from simple desk-top calculations to complex computerized ones. A good model of a physical/biological system (e.g., a stream) is predicated on the understanding and estimation of the most important physical/biological parameters which define the response of the system to a change in those parameters. The models used by the MDWPC, STREAM 7A and STREAM 7B, are complex, computerized models based on the Streeter-Phelps equations relating dissolved oxygen concentration to BOD utilization, various other oxygen-demanding reactions, and reoxygenation mechanisms. The model's equations, if verified by intensive stream data, are used to predict stream responses to other conditions. Therefore, the water quality analyst can use the model to develop wasteload allocations for discharges.

Monitoring Program - The entire sampling program required by federal regulations are carried out by the states. The program consists of seven elements; intensive water quality surveys, biological monitoring, automatic water quality monitors, National Water Quality Surveillance Sampling Network, lake monitoring, compliance (waste discharge) monitoring and groundwater monitoring.

Non-point Source - Any source of pollution not defined above. Sources such as urban stormwater runoff, which may reach a waterbody either through a pipe or directly, are included in this category since point source control technology (construction of sewers and treatment plants) is usually not feasible for such sources.

Permit Program - The National Pollutant Discharge Elimination System, whereby each discharge to a waterbody must apply for and receive a permit. Each permit consists of two major parts:

Effluent Limitations: The maximum amount which may be discharged in terms of quantity and quality for the period of the permit (a maximum of five years).

Compliance Schedule: A schedule of abatement actions for the discharge which will lead to attainment of water quality goals.

At the completion of the compliance schedule, a new permit will be issued with new effluent limitations. For example, an existing treatment facility which causes violations of water quality standards would be required to maintain at least the existing level of treatment under the effluent limitations section of the permit. The compliance schedule would require the construction of additional treatment to meet the standards. At the completion of that construction, a new permit would be issued with effluent limitations necessary to maintain standards.

Point Source - A continuous discharge of pollutants through a pipe or similar

conduit. Primarily included are sewage and industrial wastes, whether treated or untreated.

Reach - A section of waterbody with common water quality and hydraulic characteristics. This division of a watercourse is made for mathematical modeling purposes. In practically all cases, a segment consists of several reaches.

Segment - A section of a watercourse with common water quality characteristics and use classification. Watercourses are divided into segments in order to rank the impact of individual waste discharges.

STREAM 7A and STREAM 7B - STREAM 7A is the complex computer model used by the MDWPC since 1975 to develop wasteload allocations. STREAM 7B (online December 1980) is an updated version of STREAM 7A. Both models use essentially the same equations. Input and output for STREAM 7B are simplified over those for STREAM 7A. STREAM 7B also has more optional features. Both models produce identical numerical output for a given set of input.

Total Phosphorus (Total P) - The sum total of phosphorus in all forms in which it may be present, including dissolved and particulate, organic and inorganic, in living cells and, most importantly, in the form of dissolved phosphate ion ($PO_4^{\equiv}$). Phosphate is a primary nutrient for algae and other aquatic plants.

7-Day 10-Year Low Flow, or more precisely, Annual Minimum 7-Day Mean Flow at the 10-Year Recurrence Interval - At a given station along a river, the smallest average flow for seven consecutive days is found for each year of record (say N years), and all N of these "annual minimum 7-day mean flows" are ranked from least (rank 1) to greatest (rank N). The flow of rank M has recurrence interval equal to the quotient (N+1)/M. Thus, that flow having rank M equal to (N+1)/10 is the annual minimum 7-day mean flow at the 10-year recurrence interval for the river station. For example, for 39 years of record, the 7-day 10-year low flow is that flow having rank M equal to (39+1)/10 = 4, e.e., it is the fourth smallest of the 39 annual minimum 7-day mean flows.

APPENDIX A

1979 305B REPORT EXCERPT

21. SUASCO RIVER BASIN

(Sudbury-Assabet-Concord)

ASSABET RIVER

The Assabet River has its beginnings in the Town of Westborough and flows northeasterly through the urban centers of Northborough, Hudson, Maynard, and Concord. The river is characterized by the following repeating sequence: a sewage treatment plant effluent discharging into a slow flowing impoundment which is highly eutrophic with large amounts of aquatic growth and algal blooms. The river is 31 miles long and has a drainage area of 175 square miles. The basin is urban along most of the Assabet's course and rural in most of the outlying areas of the basin.

The upgrading of the five municipal sewage treatment plants will significantly improve the water quality of the Assabet River. The improvements should be completed within the next five years.

Water Quality Surveys

In the summer of 1979, the Division conducted an intensive water quality survey of the Assabet River. The previous survey was conducted in 1974. The 1979 survey data is published in the report, Assabet River 1979 Water Quality Data. The report contains physical, chemical, and biological data from 26 stations which were sampled during two weeks of the summer. During the survey, the major wastewater discharges were sampled as part of the state compliance monitoring program. The data are included in the 1979 report.

Segmentation

The Assabet River is divided into nine segments according to wastewater discharge locations and significant changes in stream hydraulics. Table 23.A presents the segments, the assigned water quality classifications and present water quality conditions.

Present Conditions

Segment 1* - Outlet of the flow augmentation pond to the Westborough WWTP
The water quality of this segment is reflected by the water quality of the flow augmentation pond. The excessive algal counts at the segment's one station are a result of washout from the augmentation pond. Dissolved oxygen levels are below Class B standards during periods of low flow and elevated temperature. Moderate fecal coliform counts have been noted.

Phosphorus levels are two to three times the proposed in-stream limit of 0.1 mg P/l. Conditions are not expected to improve unless water quality from the augmentation pond improves.

Segment 2 - Westborough WWTP to the Shrewsbury WWTP - Low flow conditions severely limit the assimilative capacity of this segment. Dissolved oxygen, fecal coliform bacteria, phosphorus and ammonia-nitrogen levels are in excess of designated stream standards. Scheduled upgrading of the Westborough WWTP will greatly alleviate these problems, allowing the segment to approach Class B quality.

Segment 3* - Shrewsbury WWTP to the dam at Route 20, Northborough - The low quality Shrewsbury discharge and resulting extensive benthic deposits contribute significantly to the severe dissolved oxygen deficit in this segment. High nutrient and coliform bacteria levels occur in this segment. Planned regionalization with the Town of Westborough will eliminate this discharge and have a marked effect on downstream water quality.

Segment 4* - With the regionalization of wastewater treatment for Westborough and Shrewsbury through construction of an advanced secondary plant, water quality in this segment will be greatly enhanced. The impact of urban runoff can then be assessed for this segment.

Segment 5* - Marlborough West WWTP to the Hudson WWTP - This segment consists of a long stretch of free-flowing water followed by a large impoundment in Hudson and then another free-flowing stretch up to the WWTP. Nutrients from the three upstream treatment plants are responsible for the extensive growth of attached and floating macrophytes in this segment. Moderate fecal coliform levels are most likely ascribed to non-point sources and urban runoff. Dissolved oxygen violations presently occurring in this segment should be abated by upgrading of the upstream WWTPs.

Segment 6 - Hudson WWTP to the outlet of Boons Pond - Organic and nutrient input from the WWTP cause eutrophic conditions in the impoundment in the upstream portion of the segment. Dissolved oxygen depletion occurs as do moderate fecal coliform violations. With the upgrading of the Hudson WWTP, the water quality will approach Class B.

Segment 7 - Outlet of Boons Pond to the Maynard WWTP - Moderate levels of fecal coliform and phosphorus are found in this segment which more closely approaches Class B quality than any other segment in the entire Assabet River.

Segment 8 - Maynard WWTP to Concord MCI WWTP - Organic, nutrient and bacteria inputs from the Maynard WWTP prevent this segment from meeting Class B standards. Future upgrading of the WWTP will improve the water quality of this segment.

Segment 9 - Concord MCI WWTP to Sudbury River - Upstream discharges and urban runoff cause water quality violations in this segment. Moderate violations of dissolved oxygen, fecal coliform and phosphorus are problems which will be modified by upgrading the upstream discharges.

*Updated from 1979 305b Report

TABLE 23.A

ASSABET RIVER BASIN

(Key found on page A-13)

SURFACE WATER SEGMENT PRESENT (4/80) PROJECTED (1983)	LENGTH (MILES)	CLASSIFICATION/ CONDITION	THERMAL	OXYGEN DEPLETION	FECAL COLIFORM	DISSOLVED SOLIDS	SUSPENDED SOLIDS	pH	TOTAL PHOSPHORUS	AMMONIA (NH_3-N)	METALS (SPECIFY)	TOXIC ORGANICS	DATA BASE
SEGMENT 1	1.4	B / U	0 →	2 MU,N →	1 U →	0 →	0 →	0 →	2 A,U →	0 →	X △	X △	1974, 1979
Projected	1.4	B / B	0 →	2 MU,N →	1 U →	0 →	0 →	0 →	2 A,U →	0 →	X △	X △	
SEGMENT 2	0.8	B / U	0 →	3 MU →	1 MU →	0 →	0 →	0 →	3 MU →	2 MU →	X △	X △	1974, 1979
Projected	0.8	B / B	0 →	1 MU ↑	1 MU →	0 →	0 →	0 →	1 MU ↑	1 MU ↑	X △	X △	
SEGMENT 3	3.1	B / U	0 →	3 MU →	2 MU →	0 →	0 →	0 →	3 MU →	3 MU →	X △	X △	1974, 1979
Projected	3.1	B / B	0 →	1 MU ↑	1 MU ↑	0 →	0 →	0 →	1 MU ↑	1 MU ↑	X △	X △	

ASSABET RIVER BASIN

SURFACE WATER SEGMENT PRESENT (4/80) PROJECTED (1983)	LENGTH (MILES)	CLASSIFICATION/ CONDITION	THERMAL	OXYGEN DEPLETION	FECAL COLIFORM	DISSOLVED SOLIDS	SUSPENDED SOLIDS	pH	TOTAL PHOSPHORUS	AMMONIA (NH_3-N)	METALS (SPECIFY)	TOXIC ORGANICS	DATA BASE
SEGMENT 4	2.5	B / U	0 →	3 MU →	2 MU,U →	0 →	0 →	0 →	3 MU →	2 MU →	X △	X △	1974, 1979
Projected	2.5	B / B	0 →	1 MU ↑	1 MU,U ↑	0 →	0 →	0 →	1 MU ↑	1 ↑	X MU △	X △	
SEGMENT 5	8.1	B / U	0 →	3 MU →	2 MU,U →	0 →	0 →	0 →	3 MU →	1 MU →	X △	X △	1974, 1979
Projected	8.1	B / B	0 →	1 MU ↑	1 MU,U ↑	0 →	0 →	0 →	1 MU ↑	1 MU →	X △	X △	
SEGMENT 6	3.5	B / U	0 →	3 MU →	2 MU →	0 →	0 →	0 →	3 MU →	0 →	X △	X △	1974, 1979
Projected	3.5	B / B	0 →	1 MU ↑	1 MU ↑	0 →	0 →	0 →	1 MU ↑	0 →	X △	X △	

ASSABET RIVER BASIN

SURFACE WATER SEGMENT PRESENT (4/80) PROJECTED (1983)	LENGTH (MILES)	CLASSIFICATION/ CONDITION	THERMAL	OXYGEN DEPLETION	FECAL COLIFORM	DISSOLVED SOLIDS	SUSPENDED SOLIDS	pH	TOTAL PHOSPHORUS	AMMONIA (NH_3-N)	METALS (SPECIFY)	TOXIC ORGANICS	DATA BASE
SEGMENT 7	5.6	B / C	0 →	0 →	2 U →	0 →	0 →	0 →	2 MU,U →	0 →	X △	X △	1974, 1979
Projected	5.6	B / B	0 →	0 →	1 U ↑	0 →	0 →	0 →	1 MU,U ↑	0 →	X △	X △	
SEGMENT 8	4.2	B / U	0 →	2 MU →	2 MU,U →	0 →	0 →	0 →	2 MU →	1 MU →	X △	X △	1974, 1979
Projected	4.2	B / B	0 →	1 MU ↑	1 MU,U ↑	0 →	0 →	0 →	1 MU ↑	1 MU →	X △	X △	
SEGMENT 9	2.6	B / U	0 →	2 MU,U →	2 MU,U →	0 →	0 →	0 →	2 MU →	0 →	X △	X △	1974, 1979
Projected	2.6	B / B	0 →	1 U ↑	1 MU,U ↑	0 →	0 →	0 →	1 MU ↑	0 →	X △	X △	

Total miles Class B - 0.0
Total miles Class C - 5.6
Total miles unsatisfactory conditions - 26.2

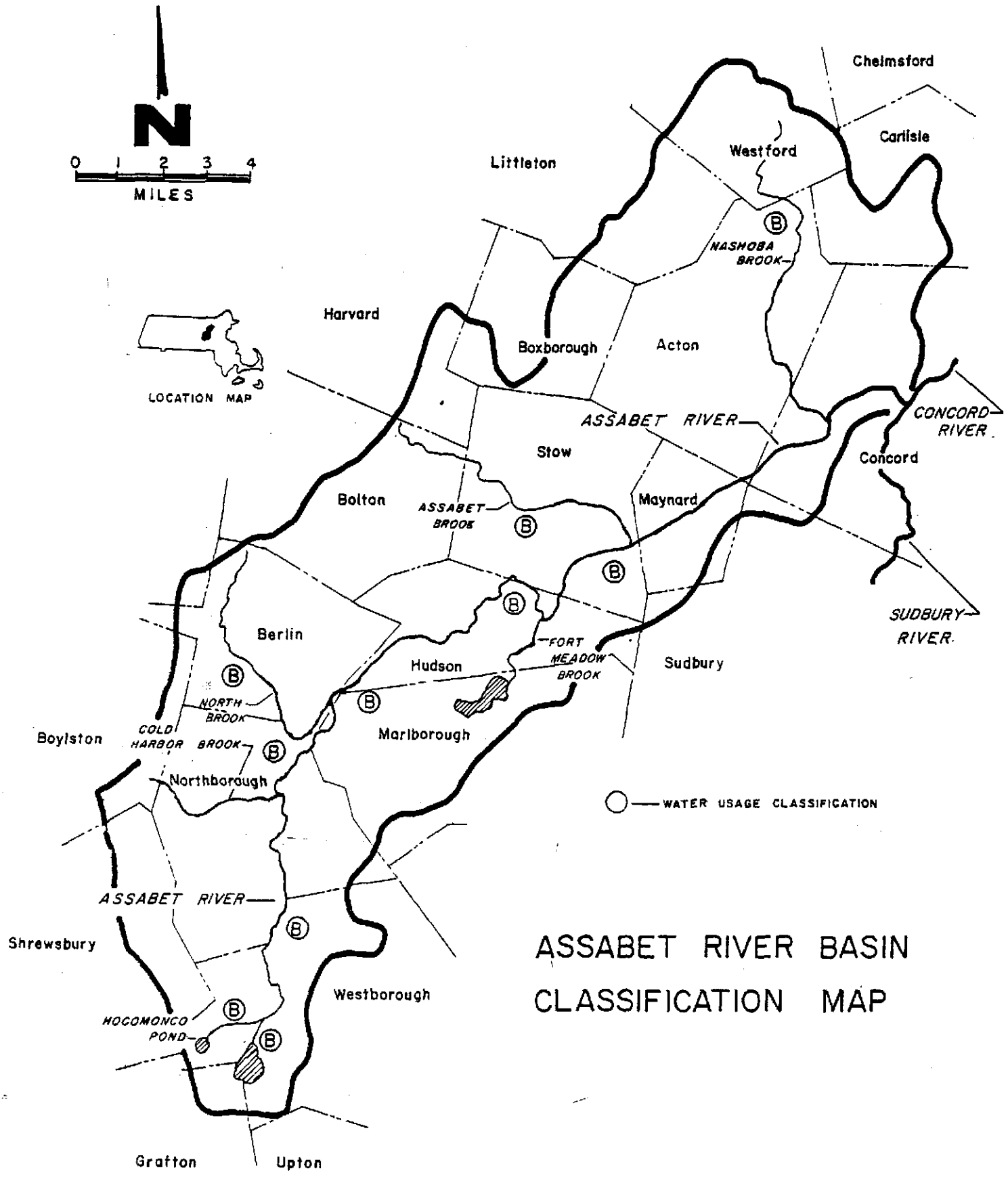

N
0 1 2 3 4
MILES
LOCATION MAP
Chelmsford
Carlisle
Westford
Littleton
NASHOBA BROOK
Harvard
Boxborough
Acton
ASSABET RIVER
CONCORD RIVER
Stow
Concord
Bolton
ASSABET BROOK
Maynard
SUDBURY RIVER
Berlin
FORT MEADOW BROOK
Hudson
Sudbury
NORTH BROOK
Boylston
COLD HARBOR BROOK
Marlborough
Northborough
WATER USAGE CLASSIFICATION
ASSABET RIVER
Shrewsbury
Westborough
HOCOMONCO POND
Grafton
Upton
ASSABET RIVER BASIN
CLASSIFICATION MAP

FIGURE A-1

CONCORD AND SUDBURY RIVER BASINS

Located in east-central Massachusetts, the Concord and Sudbury River Basins, along with the Assabet River Basin, form the SUASCO River Basin. The river systems represent quite a contrast, each having its own unique physical characteristics and its own water quality problems.

The Sudbury River also has its beginning in the Town of Westborough, flowing from Cedar Swamp Pond eastward to Framingham, then north through the towns of Sudbury, Wayland, Lincoln, and into the Town of Concord. The Sudbury River is characterized by three distinct physical sections. Upstream of Framingham the river is a narrow, rapidly-flowing stream dotted with a few small impoundments. In Framingham, the river has two large impoundments: the first is part of the Metropolitan District Commission water supply, and the second is created by the Colonna Dam in Saxonville. The third and unique section of the river is that which flows through the Great Meadows National Wildlife Refuge meadowlands in the towns of Sudbury, Wayland, Lincoln, and Concord. Through this area (river distance of 12 miles), the river's elevation changes only one foot and the river is akin to an elongated lake.

The Sudbury River is 41 miles long with a drainage area of 160 square miles, 29 of which drain to the MDC reservoirs. This area is rapidly being urbanized with tremendous population growth rates in many of the towns within the basin.

The Concord River flows north through the towns of Concord, Carlisle, Bedford, Billerica, and the City of Lowell where it flows into the Merrimack River. The Concord River retains the slow-moving characteristic of the Sudbury River as it flows north through the Great Meadows Wildlife Refuge Area. From the Talbot Dam in Billerica, the river is an urban river, receiving industrial and municipal discharges and raw sewage discharges from the sewers and canals in the City of Lowell.

The Concord River is 15.8 miles long and runs 62 square miles, for a combined total (including the Assabet and Sudbury rivers) of 406 square miles. The Concord River Basin has two main urban centers in the Lowell and Concord areas, and some rural areas such as those still found in Carlisle. The Concord area is steeped in history and culture. For example, the "shot heard round the world" was fired at the North Bridge in Concord. The transcendental literary geniuses, such as Thoreau, Emerson, and Whitman, resided in the area.

Water Quality Surveys

In the summer of 1979, the Division of Water Pollution Control conducted an intensive water quality survey of the Concord and Sudbury rivers. During the weeks of June 11-14 and August 13-16, samples were collected every four hours for a continuous 72-hour period. Nine locations on the Concord River, fifteen on the Sudbury River, six on Hop Brook, and one on

the Assabet River were sampled each week. Samples were analyzed for dissolved oxygen, temperature, chemical parameters, coliform bacteria and chlorophyll a levels. The results of this survey are published by the Division in the report entitled, The Concord and Sudbury River Basins 1979 Water Quality Data. Also included in the survey was sampling of the major wastewater discharges in the basins and in-stream flow measurements. The survey was part of the Division's on-going monitoring program which included surveys in 1973 and 1977.

Segmentation

The rivers are divided into segments according to major changes in stream hydraulics or significant changes in water quality. Hop Brook, a major tributary to the Sudbury River, is included as a segment. Table 23.B presents a description of the segments, the present water quality condition and the assigned water quality classification.

Present Conditions

Segment 1 - Sudbury River from the headwaters in Westborough to the outlet of Saxonville Pond, Framingham - The most recent survey investigations showed that this segment meets Class B water quality.

Segment 2 - Sudbury River from the outlet of Saxonville Pond, Framingham to confluence with Wash Brook, Wayland - This segment had low dissolved oxygen levels due to natural impacts of wetlands. Moderate coliform bacteria levels were found. This segment does not exactly meet Class B criteria and thus, the present quality is conservatively considered to be Class C.

Segment 3 - Sudbury River from the confluence with Wash Brook, Wayland to the confluence with the Assabet River - This segment was found to have moderate dissolved oxygen violations due to algae and moderate coliform bacteria violations. The segment does not meet its assigned B classification.

Segment 4 - Hop Brook from the Marlborough East WWTP effluent to the confluence with the Sudbury River - The wastewater treatment facility provides tertiary treatment including nitrification and phosphorus removal. Due to its unfortunate location at the headwaters of Hop Brook, the effluent contributes to eutrophic conditions downstream. The upper portion of Hop Brook is a series of millponds which experience severe algal blooms during the summer. Following this series of ponds, the brook flows rapidly, carrying large populations of algae and moderate levels of phosphorus. In this section of the brook, moderate coliform bacteria violations were found and moderate dissolved oxygen depletions resulted from wetland influence. This segment does not meet its assigned B classification.

Segment 5 - Concord River from the confluence of the Sudbury and Assabet rivers to the Billerica WWTP effluent - This segment has very minor coliform bacteria problems. The segment is listed as meeting its B classification.

Segment 6 - Concord River from the Billerica WWTP effluent to Merrimack River - This segment has had severe coliform bacteria problems due to combined sewer overflows in the City of Lowell. No surveys have been done since the correction of the combined sewer problem in Lowell. The segment did not meet its assigned classification as of the 1979 MDWPC survey.

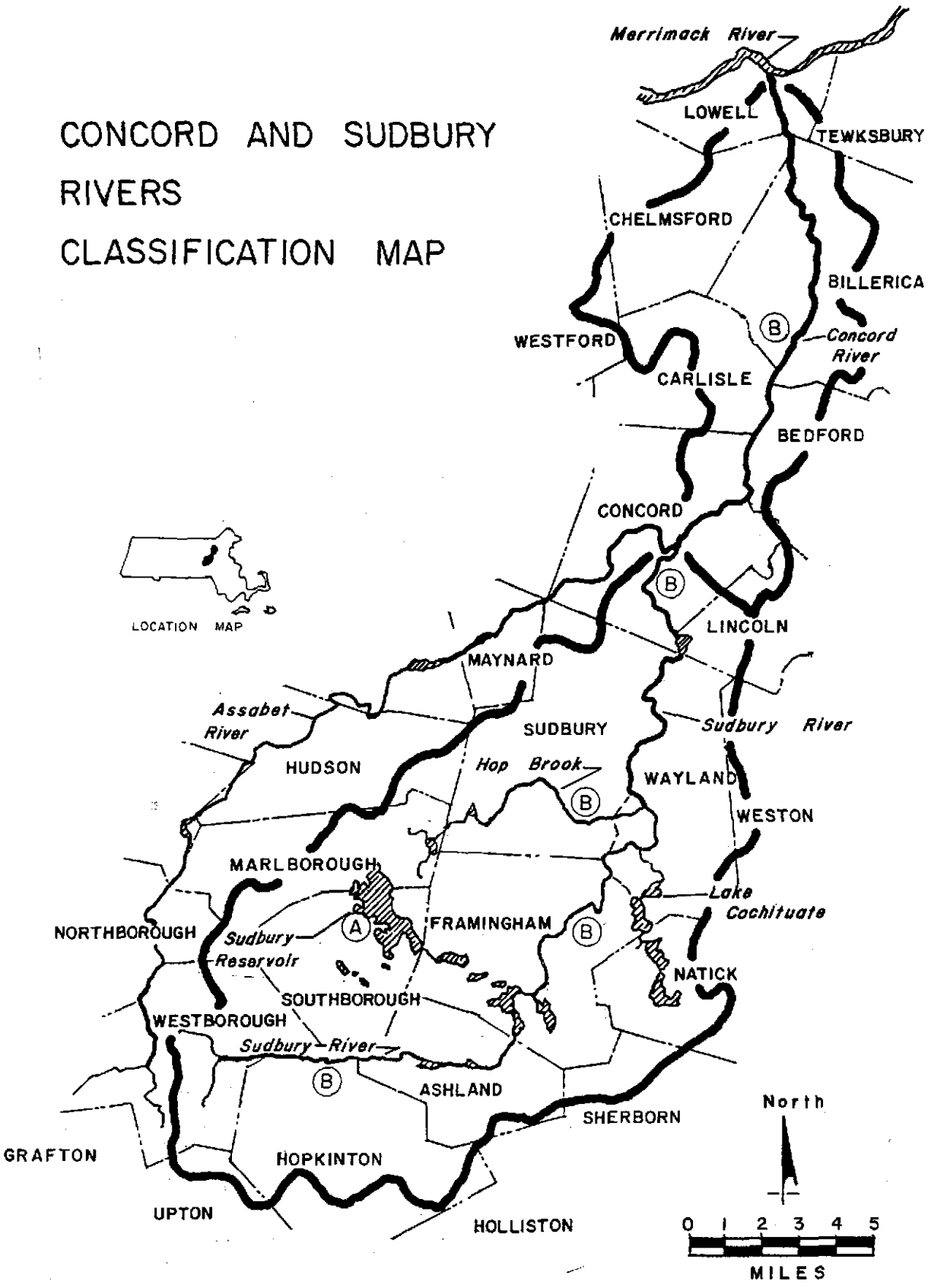

CONCORD AND SUDBURY
RIVERS
CLASSIFICATION MAP
Merrimack River
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
WESTFORD
Concord River
CARLISLE
BEDFORD
CONCORD
LOCATION MAP
LINCOLN
MAYNARD
Assabet River
SUDBURY
Sudbury River
HUDSON
Hop Brook
WAYLAND
WESTON
MARLBOROUGH
Lake Cochituate
NORTHBOROUGH
Sudbury Reservoir
FRAMINGHAM
NATICK
SOUTHBOROUGH
WESTBOROUGH
Sudbury River
ASHLAND
SHERBORN
North
GRAFTON
HOPKINTON
UPTON
HOLLISTON
0 1 2 3 4 5
MILES

FIGURE A-2

TABLE 23.B

CONCORD AND SUDBURY RIVER BASINS

(Key found on page A-13)

SURFACE WATER SEGMENT PRESENT (4/80) PROJECTED (1983)	LENGTH (MILES)	CLASSIFICATION/ CONDITION	THERMAL	OXYGEN DEPLETION	FECAL COLIFORM	DISSOLVED SOLIDS	SUSPENDED SOLIDS	pH	TOTAL PHOSPHORUS	AMMONIA (NH_3-N)	METALS (SPECIFY)	TOXIC ORGANICS	DATA BASE
SEGMENT 1	15.0	B / B	0 →	2 N →	1 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	1973, 1979
Projected	15.0	B / B	0 →	2 N →	1 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	
SEGMENT 2	5.4	B / C	0 →	2 N,U →	2 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	1973, 1979
Projected	5.4	B / C	0 →	2 N,U →	1 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	
SEGMENT 3	11.0	B / C	0 →	2 N,U →	2 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	1973, 1979
Projected	11.0	B / C	0 →	2 N,U →	2 U →	0 →	0 →	0 →	0 →	0 →	X △	X △	

LAKES AND PONDS

Within the SuAsCo River Basin there are 121 lakes and ponds which cover 6,888 acres. Twenty-three surveys, three intensives completed, one in progress, and nineteen baselines have been conducted in the basin.

Inventory

SuAsCo River Basin

	Concord & Sudbury	Assabet
Number of lakes and ponds	63	58
Surface area of lakes and ponds (acres)	4,485	2,403
Number of lakes and ponds greater than 10 acres	41	34
Surface area of lakes and ponds greater than 10 acres	4,373	2,273
Number of officially recognized Great Ponds	6	6
Surface area of officially recognized Great Ponds (acres)	442	353

Intensive Surveys:

Name	Location	Year Surveyed
Nutting Lake	Billerica	1974-1975
Waushakum Pond	Ashland/Framingham	1975-1976
Lake Cochituate	Natick/Wayland/Framingham	1976-1977-1978-1979-1980
Boons Pond	Hudson/Stow	1979-1980
Fort Pond	Hudson/Stow	1979-1980

Classification:

Name	Location	Drainage	Severity Points	Stratified/ Unstratified *
Flow Augmentation Pd.	Westborough	Assabet	14	S
Lake Cochituate (North, Middle & Carling Basin)	Framingham/ Wayland/Natick	Sudbury	12	S
Boons Pond	Hudson/Stow	Assabet	11	S
Lake Cochituate (South Basin)	Natick	Sudbury	10	S
Fort Pond	Littleton	Assabet	10	S

*Key on Pages A-14 and A-15

Key to Tables

Severity of Problem

3 Major - Repeated standards violations or other severe effects

2 Moderate - Occasional standards violations or other effects

1 Minor - Some effects but uses not generally impaired

0 None - No noticeable effects

X Insufficient information for assessments

Source of Problem

A ~ Agriculture

C ~ Construction

CS ~ Combined sewer overflow

G ~ Groundwater

H ~ Hydrologic Modification

I ~ Industrial discharge

M ~ Non-coal mining

MU ~ Municipal discharge

N ~ Natural causes

O ~ On-site wastewater treatment

R ~ Residual

S ~ Silviculture

T ~ Other (specify)

U ~ Urban runoff

? ~ Source unknown

Apparent Trends

Improvement ↑

Degradation ↓

No change →

Trend unknown △

314 LAKE CLASSIFICATION SYSTEM

The Division of Water Pollution Control has developed a lake classification system as an aid to setting priorities for the Lake Restoration Program (Section 314 of PL92-500, as amended)in Massachusetts. This system is generally applied only to those lakes for which the Division has collected water quality data. Although a host of physical, chemical, and biological parameters are measured during the normal lake survey, only six critical parameters are employed in the lake classification priority system. The six parameters are: hypolimnetic dissolved oxygen, secchi disc reading, phytoplankton count, total ammonia- and nitrate-nitrogen, total phosphorus, and aquatic macrophyton. The most recent survey data are used and the priority listing is updated annually. The optimum season for collecting lake data is mid- to late summer, or during peak biological production. Unfortunately, this cannot always be achieved; thus spring or autumnal data have to be used in the lake classification system.

The limits used for awarding severity points for the six parameters have been based on several considerations and information sources. These include lake classifications of other states, the natural range of parameters in Massachusetts, limnological texts, and accepted indices of eutrophication reported in the literature. The severity point system has been formulated as follows:

PARAMETER	CONCENTRATION OR DEGREE OF SEVERITY	POINTS
Hypolimnetic Dissolved Oxygen	≥5.0 mg/l	0
	<5.0-3.0 mg/l	1
	<3.0-1.0 mg/l	2
	<1.0 mg/l	3
Transparency (Secchi Disc Reading)	≥15 feet	0
	<15-10 feet	1
	<10-4 feet	2
	<4 feet*	3
Phytoplankton	0-500 ASU or natural units/ml	0
	>500-1000 ASU or natural units/ml	1
	>1000-1500 ASU or natural units/ml	2
	>1500 ASU or summer "blooms"	3
Epilimnetic NH_3 + NO_3-N	0-0.15 mg/l	0
	>0.15-0.3 mg/l	1
	>0.3-0.5 mg/l	2
	>0.5 mg/l	3

*Four feet is the minimum allowable transparency at bathing beaches, as stated in Article VII of the State Sanitary Code.

PARAMETER	CONCENTRATION OR DEGREE OF SEVERITY	POINTS
Epilimnetic Total Phosphorus	0-.01 mg/l	0
	>0.01-0.05 mg/l	1
	>0.05-0.10 mg/l	2
	>0.10 mg/l	3
Aquatic Vegetation	Sparse	0
	Medium	1
	Dense	2
	Very dense	3

It is expected that chlorophyll a data will soon augment or replace the phytoplankton data as they become part of the routine lake survey. The severity points may be interpreted as follows:

0 = No problem. Considered to be representative of clean water quality.

1 = Slight problem; borderline case considered to be potentially degrading.

2 = Definite problem. Considered unacceptable for lake water quality.

3 = Severe problem, undoubtedly causing degradation of the lake's water quality or some recreational uses.

Lakes, ponds, and reservoirs are first divided into two major categories:

1) Those which stratify during the summer

2) Those which do not stratify during the summer

Next, severity points are assigned to each of the above critical parameters. On the basis of the severity point system, a priority listing can be maintained. This listing, in conjunction with other available data, can then be used for a trophic level classification system. On the basis of a possible 18 severity points, the trophic level index would be as follows:

0 - 6	oligotrophic
6 - 12	mesotrophic
12 - 18	eutrophic

The overlap of severity points is intentional and meant to underscore the system's flexibility. The general range of severity points is considered more important than the absolute total for a given lake.

APPENDIX B

Commonwealth of Massachusetts

Water Resources Commission

Division of Water Pollution Control

WATER QUALITY STANDARDS

PART I GENERAL PROVISIONS

Regulation 1.1 Title. These regulations shall be known as the "Massachusetts Water Quality Standards."

Regulation 1.2 Organization of Standards. The Massachusetts Water Quality Standards are comprised of five units: General Provisions (Part 1), Application of Standards (Part 2), Water Quality Criteria (Part 3), Anti-degradation Provisions (Part 4), and Basin Classifications and Maps (Part 5).

Regulation 1.3 Authority. The Massachusetts Water Quality Standards are adopted by the Division pursuant to the provisions of M.G.L. c.21, §27 and other enabling acts relating thereto.

Regulation 1.4 Purpose. The Massachusetts Act charges the Division with the duty and responsibility to enhance the quality and value of the water resources of the Commonwealth and directs the Division to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Federal Act. The objective of the Federal Act is the restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters. As a goal towards this objective, the Federal Act requires, by 1983, the achievement of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water wherever attainable. To achieve the foregoing requirements, the Division has adopted the Massachusetts Water Quality Standards which designate the uses for which the various waters of the Commonwealth shall be enhanced, maintained and protected; which prescribe the water quality criteria required to sustain the designated uses; and which contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges.

Regulation 1.5 Definitions. As used in these standards, the following words have the following meanings:

Artifical conditions - Those conditions resulting from human alteration of the chemical, physical or biological integrity of waters.

Beneficial use - Any use not impairing the most sensitive use designated in the classification tables contained in Part 5; except that in no case shall the assimilation or transport of pollutants be deemed a beneficial use.

Cold water fishery - Waters whose quality is capable of sustaining a year-round population of cold water trout (salmonidae).

Division - The Massachusetts Division of Water Pollution Control, as established by General Laws c.21, §26.

Discharge - Any addition of any pollutant to the waters of the Commonwealth.

EPA - The United States Environmental Protection Agency.

Federal Act - The Federal Water Pollution Control Act, as amended, 33 U.S.C. §§1251, et seq.

Massachusetts Act - The Massachusetts Clean Waters Act, as amended, General Laws, C.21, §§26-53, inclusive.

Pollutant - Any element or property of sewage, agricultural, industrial or commercial waste, runoff, leachate, heated effluent, or other matter, in whatever form and whether originating at a point or major non-point source, which is or may be discharged, drained or otherwise introduced into any sewerage system, treatment works or waters of the Commonwealth.

Primary contact recreation - Any recreation or other water use, such as swimming and water skiing, in which there is prolonged and intimate contact with the water sufficient to constitute a health hazard.

Seasonal cold water fishery - Waters whose quality is capable of sustaining only an extremely limited cold water population on a year-round basis, with cold water fish in these streams provided largely by stocking.

Secondary contact recreation - Any recreation or other water use in which contact with the water is either incidental or accidental, such as fishing, boating and limited contact incident to shoreline activities.

Segment - A finite portion of a water body established by the Division for the purpose of classification.

Warm water fishery - Waters whose quality is not capable of sustaining a year-round cold water or seasonal cold water fishery.

Waters of the Commonwealth - All waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries and coastal waters, but not including groundwaters.

Regulation 1.6 Severability. If any provision of these standards is held invalid, the remainder of these standards shall not be affected thereby.

Regulation 1.7 Repealer. The "Rules and Regulations for the Establishment of Minimum Water Quality Standards and for the Protection of the Quality and Value of Water Resources" filed with the Secretary of the Commonwealth on May 2, 1974 and the "River Basin Classifications" filed with the Secretary of the Commonwealth on July 21, 1967 are hereby repealed, except that all permits, orders, determinations or other actions of the Division, based upon such standards and river basin classifications, and any court actions seeking to enforce such standards, permits, orders and determinations shall remain in full force and effect until modified, amended, revoked or reissued by the Division and/or the courts of the Commonwealth, as appropriate.

Regulation 1.8 Effective Date. These standards shall become effective upon publication by the Secretary of the Commonwealth pursuant to the provisions of G.L. c.30A, §6.

PART 2 APPLICATION OF STANDARDS

Regulation 2.1 Establishment of Effluent Limitations. In regulating discharges of pollutants to waters of the Commonwealth, the Division will limit or prohibit such discharges to insure that the water quality standards of the receiving waters will be maintained or attained. The determination by the Division of the applicable level of treatment for an individual discharger will be made in the establishement of effluent limitations, the Division must consider natural background conditions, protect existing downstream uses, and not interfere with the maintenance and attainment of beneficial uses in downstream waters. Toward this end, the Division may provide a reasonable margin of safety to account for any lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the quality of the receiving waters.

Municipal discharges to inland waters and industrial discharges to all waters must provide minimum of secondary treatment or its industrial waste equivalent. In coastal and marine waters, municipal dischargers must provide a minimum of primary treatment plus disinfection. The above minimum treatment requirements will be increased where necessary to satisfy other state and federal laws and regulations or to achieve the water quality assigned in these regulations, whichever is the most stringent.

As used in this section, "secondary treatment" is that process or group of processes capable of removing from untreated wastewater, a minimum of 85% of the 5-day biochemical oxygen demand and suspended solids, and virtually all floating and settleable solids, followed by disinfection. The "equivalent" treatment for industrial waste may generally be defined as that process or group of processes achieving maximum practicable removal of solids, oils, grease, acids, alkalis, toxic materials, bacteria, taste and

odor causing materials, color and other objectionable constituents contained in untreated waste to produce an effluent equivalent to that obtained from secondary treatment of sewage or the effluent from the most efficient treatment facilities in current use for any specific category of industrial waste. Disinfection of treated effluent may be discontinued between October 15 and April 1 at the discretion of the Division. At the discretion of the Division, nitrification and/or phosphorus removal processes at municipal sewage treatment facilities may be seasonally discontinued.

Regulation 2.2 Mixing Zones. In applying these standards, the Division may recognize, where appropriate, a limited mixing zone or zone of initial dilution on a case-by-case basis. The location, size and shape of these zones shall provide for the maximum protection of aquatic resources. At a minimum, mixing zones must:

a) Meet the criteria for aesthetics;

b) Be limited to an area or volume that will minimize interference with the designated uses or established community of aquatic life in the segment;

c) Allow an appropriate zone of passage for migrating fish and other organisms; and

d) Not result in substances accumulating in sediments, aquatic life or food chains to exceed known or predicted safe exposure levels for the health of humans or aquatic life.

Regulation 2.3 Hydrologic Conditions. The Division will determine the most severe hydrologic condition at which water quality standards must be met. In classifying the inland waters of the Commonwealth and in applying these standards to such waters, the critical low flow condition at and above which these standards must be met is the average minimum consecutive seven day flow to be expected once in ten years, unless otherwise stated by the Division in these standards. In artificially regulated waters, the critical low flow will be established by the Division through agreement with the Federal, state or private interest controlling the flow. The minimum flow established in such agreement will become the critical low flow under this section for those waters covered by the agreement.

Regulation 2.4 Procedures for Sampling and Analysis. For the purpose of collecting, preserving and analyzing samples in connection with these water quality standards, the fourteenth edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, or Methods for Chemical Analysis of Water and Wastes published by the U.S. Environmental Protection Agency should be used. Where a method is not given in these publications, the latest procedures of the American Society for Testing Materials (ASTM) shall be used, or any other equivalent method approved by the Division.

PART 3 MINIMUM WATER QUALITY CRITERIA AND ASSOCIATED USES

Regulation 3.1 Description of Contents. This part sets forth the Classes to be used by the Division in classifying the waters of the Commonwealth according to the uses for which the waters shall be enhanced, maintained and protected. For each class, the most sensitive beneficial uses are identified and minimum criteria for water quality in the water column are established. The minimum criteria in Reg. 3.4 have been developed by applying the criteria contained in the EPA publication Quality Criteria for Water (EPA-440/9-76-023) to account for local conditions including, but not limited to:

a) The characteristics of the biological community;

b) Temperature, weather and flow characteristics; and

c) Synergistic and antagonistic affects of combinations of pollutants.

Regulation 3.2 Coordination with Federal Criteria. The Division will use the EPA publication entitled Quality Criteria for Water, EPA-440/9-76-023 as guidance in establishing case-by-case discharge limits for pollutants not specifically listed in these standards but included under the heading "Other Constituents" in Regulation 3.4, for identifying bioassay application factors and for interpretations of narrative criteria. Where the minimum criteria specifically listed by the Division in this part differ from those contained in the federal criteria, the provisions of the specifically listed criteria in these standards shall apply.

Regulation 3.3 Classes and Designated Uses. The waters of the Commonwealth will be assigned to one of the classes listed below. Each class is defined by the most sensitive, and therefore governing, uses which it is intended to protect. The classes are:

Classes for Inland Waters

Class A - Waters assigned to this class are designated for use as a source of public water supply.

Class B - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; and for primary and secondary contact recreation.

Class C - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; and for secondary contact recreation.

Classes for Coastal and Marine Waters

Class SA - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; for primary and secondary contact recreation; and for shellfish harvesting without depuration in approved areas.

Class SB - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; for primary and secondary contact recreation; and for shellfish harvesting with depuration (Restricted Shellfish Areas).

Class SC - Waters assigned to this class are designated for the protection and propagation of fish, other aquatic life and wildlife; and for secondary contact recreation.

Regulation 3.4 Minimum Criteria. The following minimum criteria are adopted and shall be applicable to all waters of the Commonwealth.

A. These minimum criteria are applicable to all waters of the Commonwealth, unless criteria specified for individual classes are more stringent.

Parameter	Criteria
1. Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: a) Settle to form objectionable deposits; b) Float as debris, scum or other matter to form nuisances; c) Produce objectionable odor, color, taste or turbidity; or d) Result in the dominance of nuisance species.
2. Radioactive Substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3. Tainting Substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4. Color, Turbidity, Total Suspended Solids	Shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use.
5. Oil and Grease	The water surface shall be free from floating oils, grease and petrochemicals and any concentrations or combinations in the water column or sediments that are aesthetically objectionable or deleterious to the biota are prohibited. For oil and grease of petroleum origin, the maximum allowable discharge concentration is 15 mg/l.

6.	Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7.	Other Constituents	Waters shall be free from pollutants in concentrations or combinations that: a) Exceed the recommended limits on the most sensitive receiving water use; b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or c) Exceed site-specific safe exposure levels determined by bioassay using sensitive resident species.

B. Inland Waters - the following additional minimum criteria are applicable to inland water classifications.

For Class A waters:

	Parameter	Criteria
1.	Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2.	Temperature	Shall not exceed $83^{\circ}F$ ($28.3^{\circ}c$) in warm water fisheries or $68^{\circ}F$ ($20^{\circ}c$) in cold fisheries nor shall the rise resulting from artificial origin exceed $4.0^{\circ}F$ ($2.2^{\circ}c$).
3.	pH	As naturally occurs.
4.	Total Coliform Bacteria	Shall not exceed a log mean for a set of samples of 50 per 100 ml during any monthly sampling period.
5.	Turbidity	None other than of natural origin.
6.	Total Dissolved Solids	Shall not exceed 500 mg/l.
7.	Chlorides	Shall not exceed 250 mg/l.
8.	Sulfates	Shall not exceed 250 mg/l.
9.	Nitrate	Shall not exceed 10 mg/l as nitrogen.

For Class B waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5-8.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 200 per 100 ml, nor shall more than 10% of the total samples exceed 400 per 100 ml during any monthly sampling period, except as provided in Regulation 2.1.

For Class C waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5-9.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 1000 per 100 ml, nor shall more than 10% of the total samples exceed 2,500 per 100 ml during any monthly sampling period, except as provided in Regulation 2.1.

C. Coastal and Marine Waters - the following additional minimum criteria are applicable to coastal and marine waters.

For Class SA waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 6.0 mg/l.
2. Temperature	None except where the increase will not exceed the recommended limits on the most sensitive water use.
3. pH	Shall be in the range of 6.5-8.5 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Total Coliform Bacteria	Shall not exceed a median value of 70 MPN per 100 ml and not more than 10% of the samples shall exceed 230 MPN per 100 ml in any monthly sampling period.

For Class SB waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 6.0 mg/l.
2. Temperature	None except where the increase will not exceed the recommended limits on the most sensitive water use.
3. pH	Shall be in the range of 6.5-8.5 and not more than 0.2 units outside of the naturally occurring range.
4. Total Coliform Bacteria	Shall not exceed a median value of 700 MPN per 100 ml and not more than 20% of the samples shall exceed 1000 MPN per 100 ml during any monthly sampling period, except as provided in Regulation 2.1.

For Class SC waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 6.0 mg/l.
2. Temperature	None except where the increase will not exceed the recommended limits on the most sensitive water use.

3.	pH	Shall be in the range of 6.5-8.5 standard units and not more than 0.2 units outside the naturally occurring range.
4.	Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 1000 MPN per 100 ml, nor shall more than 10% of the total samples exceed 2500 MPN per 100 ml during any monthly sampling period, except as provided in Regulation 2.1.

PART 4 ANTIDEGRADATION PROVISIONS

Regulation 4.1 Protection of Existing Uses. In all cases, from and after the date these regulations become effective, the quality of the waters of the Commonwealth shall be maintained and protected to sustain existing beneficial uses.

Regulation 4.2 Protection of High Quality Waters. From and after the the date these regulations become effective, waters designated by the Division in Regulation 5.5 whose quality is or becomes consistently higher than that quality necessary to sustain the national goal uses shall be maintained at that higher level of quality unless limited degradation is authorized by the Division. Limited degradation may be allowed by the Division as a variance from this regulation as provided in Section 4.6.

Regulation 4.3 Protection of Low Flow Waters. Certain waters will be designated by the Division in Regulation 5.5 of these standards for protection under this section due to their inability to accept pollutant discharges. New or increased discharges of pollutants to waters so designated are prohibited unless a variance is granted by the Division as provided in Regulation 4.6.

Regulation 4.4 National Resource Waters. Waters which constitute an outstanding national resource as determined by their outstanding recreational, ecological and/or aesthetic values shall be preserved. These waters shall be designated for preservation by the Division in Regulation 5.5 of these standards. Waters so designated may not be degraded and are not subject to a variance procedure. New discharges of pollutants to such waters are prohibited. Existing discharges shall be eliminated unless the discharger is able to demonstrate that:

a) Alternative means of disposal are not reasonably available or feasible; and

b) The discharge will not affect the quality of the water as a national resource.

Regulation 4.5 Control of Eutrophication. The discharge of nutrients, primarily phosphorus or nitrogen, to waters of the Commonwealth will be limited or prohibited by the Division as necessary to prevent excessive

eutrophication of such waters. There shall be no new or increased discharges of nutrients into lakes and ponds, or tributaries thereto. Existing discharges containing nutrients which encourage eutrophication or growth of weeds or algae shall be treated. Activities which may result in non-point discharges of nutrients shall be conducted in accordance with the best management practices reasonably determined by the Division to be necessary to preclude or minimize such discharges of nutrients.

Regulation 4.6 Variances. A variance to authorize a discharge in water designated for protection under regulation 4.2 may be allowed by the Division where the applicant demonstrates that:

1) The proposed degradation will not result in water quality less than specified for the class; and

2) The adverse economic and social impacts specifically resulting from imposition of controls more stringent than secondary treatment to maintain the higher water quality are substantial and widespread in comparison to other economic factors and are not warranted by a comparison of the economic, social and other benefits to the public resulting from maintenance of the higher quality water.

In addition to the above, the applicant for a variance to authorize a discharge into waters designated for protection under Regulation 4.3 must demonstrate that:

3) Alternative means of disposal are not reasonably available or feasible.

In any proceeding where such variance is at issue, the Division shall circulate a public notice in accordance with the procedures set for in G.L. c30A, §3. Said notice shall state that a variance is under consideration by the Division, and indicate the Director's tentative determination relative thereto. To the extent feasible, the variance proceeding shall be conducted as part of any pending discharge permit proceedings pursuant to G.L. c.21, §43. In any variance procedure, the burden of proof relative to justifying the variance shall be on the party requesting the variance. Any variance granted pursuant to this regulation shall not extend beyond the expiration date of the permit.

PART 5 BASIN CLASSIFICATIONS AND MAPS

Regulation 5.1 Description of Contents. This part sets forth the procedures and guidelines the Division must follow in classifying the waters of the Commonwealth, and the classifications themselves. The procedural rules for classifying are contained in Regulations 5.2 through 5.4. Regulation 5.5 contains maps and tabulations identifying the assignment by the Division of each segment to one of the classes set forth in Part 3.3 of these Standards, the designation of uses and associated criteria for that segment and the imposition of special limitations in regulations 4.2, 4.3, and 4.4 to that segment.

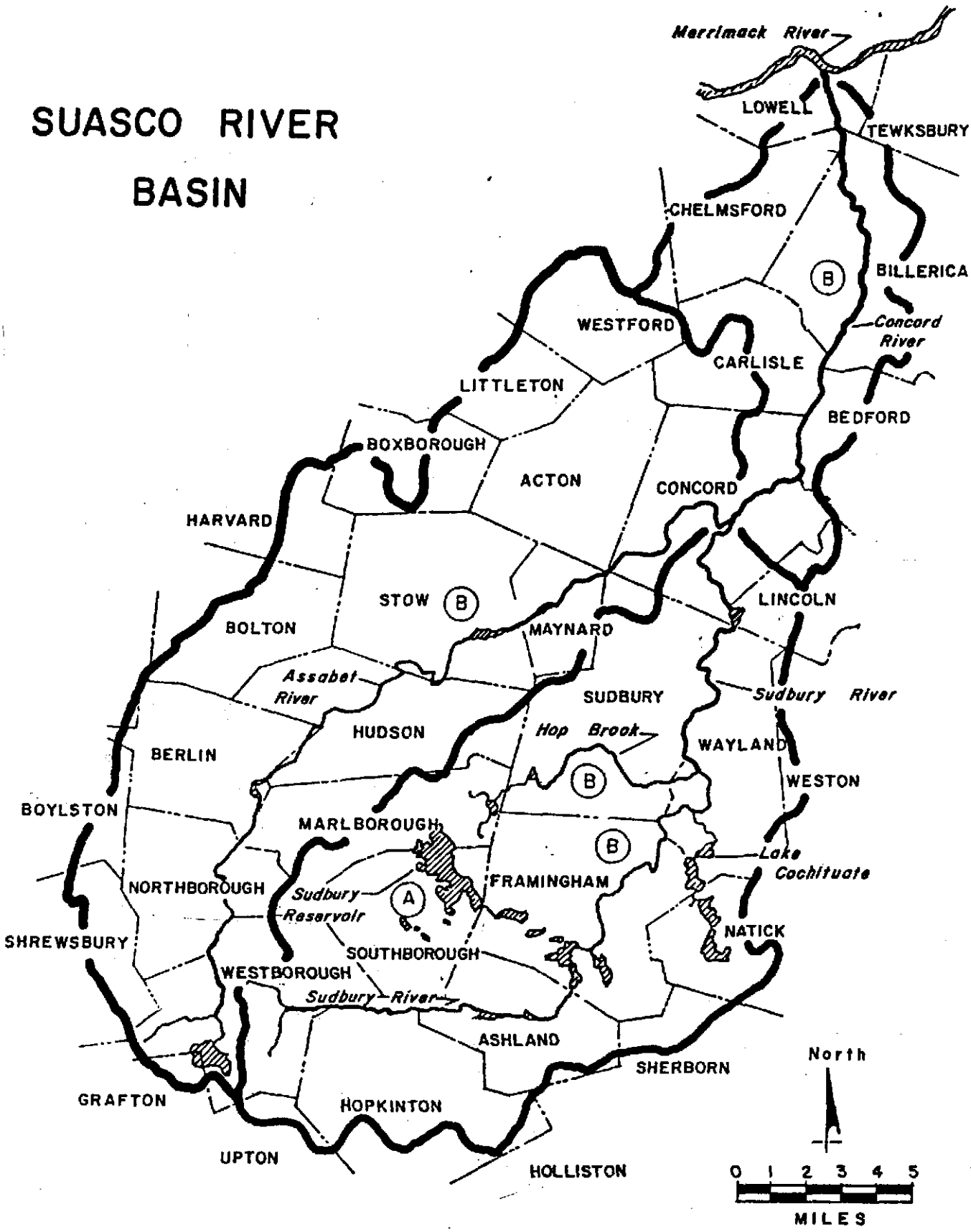
Regulation 5.2 Designation of Uses. In determining the appropriate classification for a particular water, the Division must fulfill its statutory mandate as set forth in Regulation 1.4 of these standards. Wherever attainable, the Division shall designate the national goal uses of protection and propagation of fish, shellfish, aquatic life and wildlife and recreation in and on the waters in classifying the waters of the Commonwealth. In determining whether the national goal uses are attainable for a given water, the Division has considered limitations imposed by natural conditions, irreversible artificial conditions and the availability of feasible technological treatment methods and designated the optimum number of beneficial uses attainable in the circumstances.

Regulation 5.3 Other Applicable Standards. Waters classified by the Division in this part may be subject to additional restrictions pursuant to federal or Massachusetts statutes and regulations. Where such additional restrictions are known, they are noted in the classifications in this part. Where these restrictions impose requirements more stringent than required under the Massachusetts or Federal Acts, e.g. public health restrictions relative to water supplies, such restrictions shall be considered and applied by the Division in classifying the waters to the extent authorized in the Massachusetts Act.

Regulation 5.4 Fisheries Designations. For inland waters certain specific criteria become applicable on the basis of their designation as a particular type of fishery. Therefore, inland segments are designated as cold water, seasonal cold water or warm water fisheries. In seasonal cold water fisheries, criteria for cold water fisheries apply during the period of September 15 through June 30 annually, and criteria for warm water fisheries apply at all other times.

Where the Division determines that natural conditions prevent the attainment of water quality capable of supporting a warm water fishery, a use designation of aquatic life has been made. In each segment so designated in Regulation 5.5, the criteria for a warm water fishery apply for all constituents except those affected by the natural condition, which constituents shall be governed by the most sensitive resident species as determined by the Director in consultation with the Massachusetts Division of Fisheries and Game.

Regulation 5.5 Classifications. For the purpose of applying the Massachusetts Water Quality Standards, the waters of the Commonwealth are hereby classified as shown in the following tables which are a part of these regulations. Columns 1 and 2 of the tables describes the segment. Column 3 identifies the applicable classification of the segment. Column 4 identifies the use or uses for which the segment is designated; (P&S) means primary and secondary contact recreation, (Sn) means seasonal fishery, (O) means open shellfishing (R) means restricted shellfishing. Column 5 identifies the applicable provisions of Part 4 and Regulation 5.3.


SUASCO RIVER BASIN
Merrimack River
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
WESTFORD
Concord River
CARLISLE
LITTLETON
BEDFORD
BOXBOROUGH
ACTON
CONCORD
HARVARD
STOW
LINCOLN
BOLTON
MAYNARD
Assabet River
SUDBURY
Sudbury River
HUDSON
Hop Brook
WAYLAND
BERLIN
WESTON
BOYLSTON
MARLBOROUGH
Lake Cochituate
NORTHBOROUGH
FRAMINGHAM
Sudbury Reservoir
NATICK
SHREWSBURY
SOUTHBOROUGH
WESTBOROUGH
Sudbury River
ASHLAND
SHERBORN
GRAFTON
HOPKINTON
UPTON
HOLLISTON
North
0 1 2 3 4 5
MILES

APPENDIX C

LETTERS TO TOWNS/CITIES CONCERNING EFFLUENT LIMITATIONS TO BE USED IN FACILITIES PLANNING

December 1, 1980

Kenneth J. Powderly, Chairman
Board of Sewer Commissioners
250 Boston Road
Billerica, Massachusetts 01862

Re: Billerica
Facility Planning Study
MASS-WPC 657

Dear Mr. Powderly:

The Division of Water Pollution Control has recently conducted an extensive analysis of the present and proposed wastewater discharges to the Assabet and Concord Rivers. This evaluation included both economic and environmental concerns.

Although Advanced Secondary Treatment (AST) had originally been proposed by this Division for the Billerica Wastewater Treatment Plant, this recent study failed to produce conclusive evidence that advanced levels of treatment would be necessary in order to maintain the prescribed water quality standards within the Assabet and Concord Rivers. The economics involved in providing AST does not warrant a margin of safety to compensate for the lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the receiving waters in this particular case.

Therefore, secondary treatment with post-aeration is being recommended for the Billerica Wastewater Treatment Plant. Effluent limits which should be used in the ongoing facility planning study are as follows:

Effluent Characteristics	Discharge Limitations		
	Monthly Average	Weekly Average	Maximum Day
Biochemical Oxygen Demand, 5-day, 20 C	30 MG/L	45 MG/L	50 MG/L
Total Suspended Solids	30 MG/L	45 MG/L	50 MG/L
Settleable Solids	0.1 ML/L	0.1 ML/L	0.3 ML/L
Fecal Coliform Bacteria	200/100ML	400/100ML	400/100ML
Total Coliform Bacteria	1000/100ML	2000/100ML	2000/100ML
Dissolved Oxygen	6.0 mg/l minimum		

The control of nutrients entering the Assabet and Concord Rivers appears desirable. However, the benefits of phosphorus removal are questionable and therefore it is not being required at this time. As techniques for evaluating the desirability of removing phosphorus are improved, the situation in the Assabet and Concord Rivers will be reviewed. The possibility that phosphorus removal will be required in the future should be addressed within the facility plan.

If you have any questions or comments concerning this matter, please do not hesitate to contact this office.

Very truly yours,

Thomas C. McMahon
Director

TCM/MKP/ds

cc: Environmental Protection Agency, Municipal Facilities Branch, JFK Building, Boston, Ma 02203
Fay, Spofford and Thorndike, One Beacon Street, Boston, Ma 02108

bcc: Russ Isaac, Water Quality

December 1, 1980

Steven E. Sheiffer, Town Manager
c/o Board of Selectment
Town House
Concord, Massachusetts 01742

Re: Concord
Facility Planning Study
MASS-WPC 671

Dear Mr. Sheiffer:

The Division of Water Pollution Control has recently conducted an extensive analysis of the present and proposed wastewater discharges to the Assabet and Concord Rivers. This evaluation included both economic and environmental concerns.

Although Advanced Secondary Treatment (AST) had originally been proposed by this Division for the Concord Wastewater Treatmetn Plant, this recent study failed to produce conclusive evidence that advanced levels of treatment uld be necessary in order to maintain the prescribed water quality standards within the Assabet and Concord Rivers. The economics involved in providing AST does not warrant a margin of safety to compensate for the lack of knowlege concerning the relationship between the pollutants being discharged and their impact on the receiving waters in this particular case.

Therefore, secondary treatment with post-aeration is being recommended for the Concord Wastewater Treatment Plant. Effluent limits which should be used in the ongoing facility planning study are as follows:

Effluent Characteristic	Discharge Limitations		
	Monthly Average	Weekly Average	Maximum Day
Biochemical Oxygen Demand, 5-day, 20° C	30 MG/L	45 MG/L	50 MG/L
Total Suspended Solids	30 MG/L	45 MG/L	50 MG/L
Settleable Solids	0.1 ML/L	0.1 ML/L	0.3 ML/L
Fecal Coliform Bacteria	200/100ML	400/100/ML	400/100ML
Total Coliform Bacteria	1000/100ML	2000/100ML	2000/100ML
Dissolved Oxygen	6.0 mg/l minimum		

The control of nutrients entering the Assabet and Concord Rivers appears desirable. However, the benefits of phosphorus removal are questionable and therefore it is not being required at this time. As techniques for evaluating the desirability of removing phosphorus are improved, the situation in the Assabet and Concord Rivers will be reviewed. The possibility that phosphorus removal will be required in the future should be addressed within the facility plan.

If you have any questions or comments concerning this matter, please do not hesitate to contact this office.

Very truly yours,

Thomas C. McMahon
Director

TCM/MKP/ds

cc: Environmental Protection Agency, Municipal Facilities Branch, JFK Building, Boston, Ma 02203
Camp, Dresser and McKee, One Center Plaza, Boston, Ma 02108

bcc: Russ Isaac, Water Quality

November 28, 1980

Honorable Joseph A. Ferrechia, Mayor
Office of the Mayor
City Hall
Marlborough, Massachusetts 01752

Re: City of Marlborough
Westerly Treatment Plant
(Step 1 Application Expected)

Dear Mayor Ferrechia:

The Division of Water Pollution Control has conducted an extensive analysis of the present and proposed wastewater discharges to the Assabet River. The results of this study indicate the need for Advanced Secondary Treatment (AST) at the Marlborough Westerly Wastewater Treatment Facility.

Specific limitations for oxygen demanding substances, based on an estimated flow of 2.0 MGD, would be as follows:

From April 1 through October 15 of each year

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATION		
	Monthly Average	Weekly Average	Maximum Day
Biochemical Oxygen Demand (5 Day, 20°C)	15 mg/l	20 mg/l	25 mg/l
Suspended Solids	15 mg/l	20 mg/l	25 mg/l
Settleable Solids	0.1 ml/l	0.1 ml/l	0.3 ml/l
Ammonia-Nitrogen	3.0 mg/l	3.5 mg/l	4.0 mg/l

From October 16 through March 31 of each year a lesser degree of treatment, probably the equivalent of secondary treatment, would be allowed. Disinfection will be required year-round.

While control of nutrients loadings to the Assabet River appears desirable, the fact that the National Eutrophication Survey identified nitrogen as the limiting nutrient in several Assabet River impoundments makes phosphorus removal inappropriate at this time. As techniques for evaluating the desirability of removing phosphorus are improved,

the situation in the Assabet River will be reviewed. The possibility that phosphorus removal will be required in the future should therefore be taken into account in the facility design.

We trust this information will allow the City to proceed with the preparation of a Step 1 (Facility Planning Study) Grant. Once this Facility Planning Study is to point of finalizing design flows, the Division should be notified so that these effluent limits can be modified if necessary.

If you have any questions or comments concerning this matter, please do not hesitate to contact this office.

Very truly yours,

Thomas C. McMahon
Director

TCM/MKP/ds

cc: Environmental Municipal Facilities Branch, JFK Building, Boston, Ma 02203
Metcalf and Eddy, Inc., 50 Staniford St., Boston, Ma 02114

bcc: Russ Isaac, Water Quality

November 28, 1980

John Tobin, Chairman
Board of Public Works
Municipal Building
Maynard, Massachusetts 01754

Re: Maynard
Facility Planning Study
MASS-WPC 724

Dear Mr. Tobin:

The Division of Water Pollution Control has recently conducted an extensive analysis of the present and proposed wastewater discharges to the Assabet and Concord Rivers. This evaluation included both economic and environmental concerns.

Although Advanced Secondary Treatment (AST) had originally been proposed by this Division for the Maynard Wastewater Treatment Plant, this recent study failed to produce conclusive evidence that advanced levels of treatment would be necessary in order to maintain the prescribed water quality standards within the Assabet and Concord Rivers. The economics involved in providing AST does not warrant a margin of safety to compensate for the lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the receiving waters in this particular case.

Therefore, secondary treatment with post-aeration is being recommended for the Maynard Wastewater Treatment Plant. Effluent limits which should be used in the ongoing facility planning study are as follows:

Effluent Characteristics	Discharge Limitations Monthly Average	Weekly Average	Maximum Day
Biochemical Oxygen Demand, 5-day, 20°C	30 MG/L	45 MG/L	50 MG/L
Total Suspended Solids	30 MG/L	45 MG/L	50 MG/L
Settleable Solids	0.1 MG/L	0.1 MG/L	0.3 ML/L
Fecal Coliform Bacteria	200/100ML	400/100ML	400/100ML
Total Coliform Bacteria	1000/100ML	2000/100ML	2000/100ML
Dissolved Oxygen		6.0 mg/l minimum	

In addition to meeting the above limits the facility plan should evaluate the possibility of relocating the effluent pipe such that the discharge is below the High Street impoundment.

The control of nutrients entering the Assabet and Concord Rivers appears desirable. However, the benefits of phosphorus removal are questionable and therefore it is not being required at this time. As techniques for evaluating the desirability of removing phosphorus are improved, the situation in the Assabet and Concord Rivers will be reviewed. The possibility that phosphorus removal will be required in the future should be addressed within the facility plan.

If you have any questions or comments concerning this matter, please do not hesitate to contact this office.

Very truly yours,

Thomas C. McMahon
Director

TCM/MEP/ds

cc: Environmental Protection Agency, Municipal Facilities Branch, JFK Building, Boston, Ma 02203
Dufresne - Henry, 89 Main Street, Concord, Ma 01742
bcc: Russ Isaac, Water Quality

A1
Paul
Main File

October 23, 1980

William R. Porter, Authorized Representative
Board of Selectmen
Town Hall
West Main Street
Westborough, Massachusetts 01581

Re: Westborough, MA
MASS - WPC - 448

Dear Mr. Porter:

The Division of Water Pollution Control has conducted an extensive analysis of the present and proposed wastewater discharges for the Westborough - Shrewsbury area. The results of this study indicate the need for a level of treatment between advanced secondary (AST) and advanced wastewater treatment (AWT) at the proposed facility. In view of the uncertainties within the analysis and the anticipated improvement in quality of water released from the upstream impoundment (site A-5), the Division is only requiring advanced secondary treatment at the proposed discharge at this time.

The effluent limitations based on a flow rate of 6.5 MGD would be as follows:

From April 1 through October 15 of each year

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATION		
	Monthly Average	Weekly Average	Maximum Day
Biochemical Oxygen Demand (5 Day, 20°C)	10 mg/l	15 mg/l	20 mg/l
Suspended Solids	10 mg/l	15 mg/l	20 mg/l
Settleable Solids	0.1 ml/l	0.1 ml/l	0.3 ml/l
Ammonia - Nitrogen	1.0 mg/l	1.5 mg/l	2.0 mg/l
Dissolved Oxygen			6.0 mg/l minimum

From October 16 through March 31 of each year a lesser degree of treatment, probably the equivalent of secondary treatment, would be allowed.

Should water quality violations occur as a result of this discharge, the cost effectiveness of additional treatment and/or increased quality/quantity of releases from impoundment site A-5 would be assessed.

While control of nutrients loadings to the Assabet River appears desirable, the fact that the National Eutrophication Survey identified nitrogen as the limiting nutrient in several Assabet River impoundments makes phosphorus removal inappropriate at this time. As techniques for evaluating the desirability of removing phosphorus are improved, the situation in the Assabet River will be reviewed. The possibility that phosphorus removal will be required in the future should therefore be taken into account in the facility design.

If you have any questions or comments concerning this matter, please do not hesitate to contact Mr. Mark Pare of this office.

Very truly yours,

Thomas C. McMahon
Director

TCM/MKP/ds

cc: EPA, Municipal Facilities Branch, JFK Building, Boston, Ma 02203
Stephen Geribo, SEA Consultants, Inc., 54 Canal St., Boston, Ma 02114
Richard D. Carney, Town Manager, Municipal Building, Shrewsbury, MA 01545
E. J. Hanwey , Fay, Spofford and Thorndike, Inc., One Beacon St., Boston, Ma 02108

bcc: Russell Isaac, Planning and Technical Services

APPENDIX D

1979 SUASCO WATER QUALITY INDEX

The Water Quality Index (WQI) used by the MDWPC attempts to present an estimate of water quality as a single number between 0 and 100. Nine parameters are used to generate this number: dissolved oxygen (DO), fecal coliforms (FEC), pH (PH), BOD5 (BOD), nitrate-nitrogen (NO3), phosphate (P), ammonia-nitrogen (NH3), turbidity (T), and total solids (TS). The WQI number associated with a surface water can be described as follows:

WQI Number	Description of Water Quality
100-90	Excellent
70-89	Good
50-69	Fair
25-49	Poor
0-24	Very Poor

A compilation of the WQI for the 1979 SUASCO surveys is presented below. Under the column Parameter Violated are listed those parameters which rate below 70, 50 (marked with one asterisk), or 25 (marked with two asterisks). Station locations can be found in references (1) and (2) of the bibliography. No WQI was produced for the 1974 data as turbidity and fecal coliforms were not analyzed for that year.

Further information on the MDWPC WQI can be found in references (10) and (11).

ASSABET RIVER 1979 WQI

Station	June Survey Parameter Violated	June WQI	August WQI	August Survey Parameter Violated
AS01	FEC BOD	75.7	67.7	BOD* NH3 DO*
AS02	FEC BOD* P* NH3* DO	61.7	56.4	FEC BOD* P* NH3 DO*
AS03	FEC BOD* P* NH3** DO	56.2	40.0	BOD* P* NH3** DO**
AS04	FEC BOD* P* NH3** DO*	53.6	40.4	BOD* P* NH3** DO**
AS05	FEC BOD P* NH3** DO**	48.5	43.5	BOD* P* NH3** DO**
AS06	FEC* BOD P NH3*	61.8	47.1	BOD P* NH3** DO**
AS07	FEC BOD P NH3* DO	65.7	63.6	FEC P* DO*
AS08	FEC BOD P* NH3* DO	66.5	59.4	P* NH3* DO*
AS09	FEC BOD P NH3	71.0	64.9	P* DO*
AS10	FEC P NH3 DO	69.4	60.8	FEC P* DO**
AS11	FEC P NH3 DO	70.0	64.3	P DO**
AS12	BOD P NH3	76.8	79.2	P DO
AS13	FEC* P NH3	74.9	76.4	FEC P DO
AS14	FEC P NH3	79.3	75.3	P DO*
AS15	FEC P NH3*	72.6	62.4	P* DO**
AS16	P NH3 DO	75.6	70.0	BOD P* DO*
AS17	BOD DO	79.1	87.4	P
AS18	FEC BOD NH3	75.2	75.9	FEC* P
AS19	FEC P NH3	77.1	70.8	FEC BOD* P NH3
AS20	FEC BOD P NH3	76.0	75.2	FEC P NH3*

ASSABET RIVER 1979 WQI (CONTINUED)

Station	June Survey Parameter Violated	June WQI	August WQI	August Survey Parameter Violated
AS21	FEC BOD P NH3	73.0	80.5	P
AS22	FEC BOD P NH3	77.4	82.7	P
AS23	FEC P NH3	76.4	81.9	P
AS24	FEC NH3	75.8	83.7	P

SUDBURY AND CONCORD RIVERS 1979 WQI

Station	June Survey Parameter Violated	June WQI	August WQI	August Survey Parameter Violated
SC01	DO**	67.5	67.6	DO**
SC02		86.9	85.9	
SC03	FEC	85.9	84.8	FEC
SC04	NH3	86.8	83.0	NH3
SC05		85.9	85.3	
SC06	FEC	85.6	86.0	
SC07	FEC	84.0	88.1	
SC08	FEC	83.2	84.0	FEC
SC09	FEC DO	72.7	69.9	FEC DO*
SC10	NO3* P NH3* TS*	65.2	66.0	FEC NO3 NH3* TS DO
SC11	BOD NO3 P NH3 TS	71.5	46.1	PH* BOD* NO3 P TS DO**
SC12	BOD P NH3 DO	74.6	77.6	BOD* P TS
SC13		84.6	81.5	
SC14		84.2	82.1	BOD DO
SC15		82.8	73.0	FEC* DO
SC16	DO	80.8	81.7	DO
SC17	DO	81.5	76.7	DO*
SC18	DO	81.5	73.3	FEC DO*
SC19	DO	81.8	74.1	DO*
SC20		84.9	79.8	FEC DO
SC21		84.5	79.1	FEC DO
SC22	FEC P	79.7	82.5	
SC23		83.4	81.7	
SC24		83.7	82.3	
SC25		83.0	82.4	
SC26		82.5	82.4	
SC27	DO	81.2	79.9	FEC
SC28		81.4	80.7	FEC
SC29	FEC	82.1	83.1	
SC30	FEC**	68.9	70.8	FEC*
SC31	FEC** BOD NH3	62.7	65.1	FEC** BOD NH3