LOWER ASSABET RIVER and

POWDERMILL IMPOUNDMENT

1990

Part A: Water Quality Data

Part B: Wastewater Discharge Data

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
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WATER QUALITY DATA

WASTEWATER DISCHARGE DATA

PREPARED BY

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JULY 1991

TITLE: Lower Assabet River and Powdermill Impoundment, Parts A/B

DATE: July 1991

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FOREWORD

The Massachusetts Division of Water Pollution Control was established by the Massachusetts Clean Water Act, Chapter 21 of the General Laws as amended by Chapter 685 of the Acts of 1966. Included in the duties and responsibilities of the Division is the periodic examination of the water quality of various coastal waters, rivers, streams and ponds of the Commonwealth, as stated Section 27, Paragraph 5 of the Acts. This section further directs the Division to publish the results of such examination together with the standards of water quality established for the various waters. The Technical Services Branch of the Division of Water Pollution Control has, among its responsibilities, the execution of this directive. This report is published under the Authority of the Acts and is among a continuing series of reports issued by the Division presenting water quality data and analyses, water quality management plans, baseline and intensive limnological studies and various special studies.

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INTRODUCTION

This report is a compilation of the results of field and laboratory examinations of the Assabet River and the Maynard wastewater discharge during the summer of 1990 by the Technical Services Branch (TSB), Division of Water Pollution Control (DWPC), Department of Environmental Protection (DEP).

The study basically involved nutrient loading effects on the Assabet River.

Chemical and bacteriological samples were transported to the Lawrence Experiment Station (LES) of the DEP where they were analyzed according to procedures set forth in the most current edition of the American Public Health Association's Standard Methods for the Examination of Water and Wastewater. However, dissolved oxygen determinations were made by Technical Services Branch personnel using either the Winkler method, or the Hydrolab field instrument. In addition, water temperature and pH measurements were made at the time of sample collection.

River flow was measured both by TSB personnel, and at the United States Geological Survey (USGS) station on the Assabet River in Maynard. The data are intended to given an indication of the flow regime of the river during the sampling.

Personnel from the Maynard WWTP collected 24-hour composite samples using WWTP equipment. The samples were then picked up by TSB personnel for delivery and analysis at LES. The 24-hour composite samples are indicated in this report by bracketing the days over which the sample was taken, e.g., 8/22-23/90.

PHYSICAL CHARACTERISTICS OF THE ASSABET RIVER

The Assabet River, originating in impounded swamplike land in southwestern Westborough, flows through several highly populated areas including Westborough, Northborough, Hudson, Maynard, and Concord, until it joins with the Sudbury River in Concord to form the Concord River. It currently receives major discharges from four municipal wastewater treatment plants and a state prison treatment plant.

The varying physical characteristics of the Assabet River play a critical role in the chemical and biological activities which occur in the river. The reoccurring presence of dams and the slow moving, swampy impoundments they create are vital factors in the water quality of the Assabet. Table 1 lists the assigned water use classification of the Assabet River and its tributaries. Figure 1 shows the Assabet profile, with changes in elevation, and location of dams and wastewater treatment plant discharges. In the following description, the mile point from the confluence with the Sudbury River is shown in parenthesis.

The Assabet River begins at the outlet of the George H. Nichols Municipal Purpose Dam in the southwest section of Westborough. The dam creates a small impoundment of about 0.6 sq. mi., which collected water drainage from an area of about 7 sq. mi., much of which is swampland. The dam was intended to provide fish and wildlife habitat and low flow augmentation for pollution abatement. Decaying organic matter formed by the insufficient removal of trees and roots when the area was flooded produces inferior water quality within the impoundment. In addition, proper flow regulation is absent. Water which does flow through the dam, however, is aerated, and the resulting water quality in the newly emerging Assabet is good as far as dissolved oxygen and bacteriological parameters are concerned.

After a short, fast flowing stretch, the river begins its characteristic sluggish flow. "Hocomonco Stream" joins the river just above where the first of five wastewater treatment plants discharge into the Assabet - the town of Westborough Wastewater Treatment Plant (WWTP) (river mile 30.2). Shortly downstream, the Shrewsbury WWTP discharged to the river until the spring of 1987, when its flows were tied into the Westborough WWTP. The Assabet meanders its way through swamplike lands and flows by a golf course before reaching the next impounded area and dam on Route 20 in Northborough (river mile 26.5). Soon, another relatively steep gradient causes the river to accelerate through a small industrial complex. Then, taking a 90° turn, the Assabet enters the "headwater" pool of the Allen Road dam impoundment (25.4). After flowing through pasture lands, the basic pattern of the river is repeated - the Marlborough West WWTP (24.1) coincides with the slowing of the river flow. The river flows through swamplands until the dam at Route 85 is Hudson (18.2). Through Hudson center the flow is constricted by industrial developments on both banks. Passing out of Hudson center the pattern is again repeated - the Hudson WWTP discharges into the Assabet just above the swampland impoundment created by the Gleasondale dam (14.4). Following a short rapid section, the river flows in its characteristic slow meandering style for 4.5 miles through the town of Stow.

Flowing over the American Woolen Dam (9.0) and into the town of Maynard, the river's gradient sharply increases and the flow is channeled through the center of Maynard. The Assabet, for the fourth time, repeats its pattern - flowing into the Powdermill impoundment and receiving the discharge from the Maynard WWTP (6.8). From the Powdermill dam to the confluence with the Sudbury River, the river's gradient is relatively uniform. The Assabet flows through West Concord receiving its final discharge from the Massachusetts Correctional Institution (MCI) at West Concord (2.4). The river slowly reaches the Sudbury River just north of the center of Concord. The confluence of the Assabet and Sudbury rivers produces one main stream - the Concord River.

TABLE 1

1990 ASSABET RIVER BASIN WATER QUALITY CLASSIFICATION*

BOUNDARY	MILE POINT	CLASS	OTHER RESTRICTIONS
Assabet River			
Source to Westborough STP	31.8 - 30.4	B	Warm Water High Quality Water
Westborough STP to outlet of Boones Pond	30.4 - 12.4	B	Warm Water
Outlet of Boones Pond to confluence with Sudbury River	12.4 - 0.0	B	Warm Water
Nagog Pond			
Source to outlet in Acton and those tributaries thereto	-	A	Public Water Supply
Westborough Reservoir			
Source to outlet in Westborough and those tributaries thereto	-	A	Public Water Supply
Gates Pond			
Source to outlet in Berlin and those tributaries thereto	-	A	Public Water Supply
White Pond			
Source to outlet in Hudson and those tributaries thereto	-	A	Public Water Supply

* Massachusetts Water Quality Standards, 1990

TABLE 1 (CONTINUED)

1990 ASSABET RIVER BASIN WATER QUALITY CLASSIFICATION*

BOUNDARY	MILE POINT	CLASS	OTHER RESTRICTIONS
Millham Reservoir			
Source to outlet in Marlborough and those tributaries thereto	-	A	Public Water Supply
Williams Lake			
Source to outlet in Marlborough and those tributaries thereto	-	A	Public Water Supply
Sudbury Reservoir			
In Westborough, Marlborough, Southborough, Framingham and those tributaries thereto	-	A	Public Water Supply

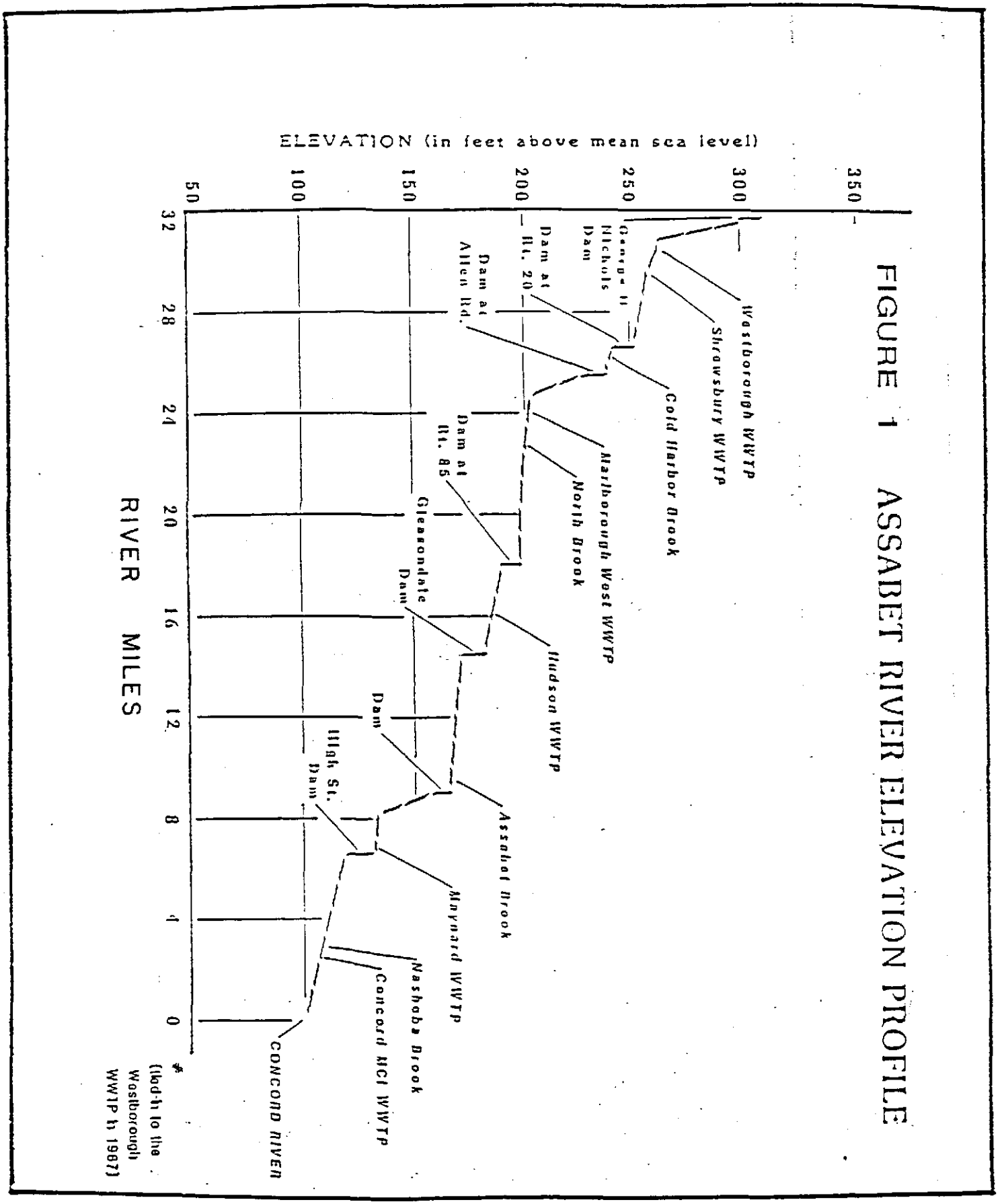


FIGURE 1 ASSABET RIVER ELEVATION PROFILE
ELEVATION (in feet above mean sea level)
350
300
250
200
150
100
50
RIVER MILES
32
28
24
20
16
12
8
4
0
Westborough WWTP
Shrewsbury WWTP
Cold Harbor Brook
Marlborough West WWTP
North Brook
Hudson WWTP
Assabet Brook
Maynard WWTP
Nashoba Brook
Concord NCI WWTP
CONCORD RIVER
Dam at Rt. 20
Dam at Allen Rd.
Dam at Rt. 85
Gleasondale Dam
Dam
High St. Dam
(Add-in to the Westborough WWTP in 1987)

WATER QUALITY SAMPLING DATA

TABLE 2

1990 ASSABET RIVER AND POWDERMILL IMPOUNDMENT SURVEYS

LOCATION OF SAMPLING STATIONS

STATION NUMBER	LOCATION	RIVER MILE
	Assabet River	
AS20	Routes 27/62 at USGS gage, Maynard	7.7
AS21	Above Powdermill Dam, Acton	6.5
AS23	Route 62, second bridge, Concord	4.6
AS24	Route 62, third bridge, Concord	3.3
AS25	Routes 2/2A, Concord	2.6
	Powdermill Impoundment	
PM01	30 ft. downstream of Maynard WWTP, 20 ft from shore	6.75
PM02	20 ft. directly downstream of PM01, 20 ft from shore	6.75
PM03	Deep hole of Impoundment, across from Perry Pkg.	6.7
PM04	Just upstream of High Street Dam	6.5
PM06	Upstream of Maynard WWTP, at impoundment inlet	6.95

FIGURE 2
Assabet River Powdermill Impoundment
Location of Sampling Stations

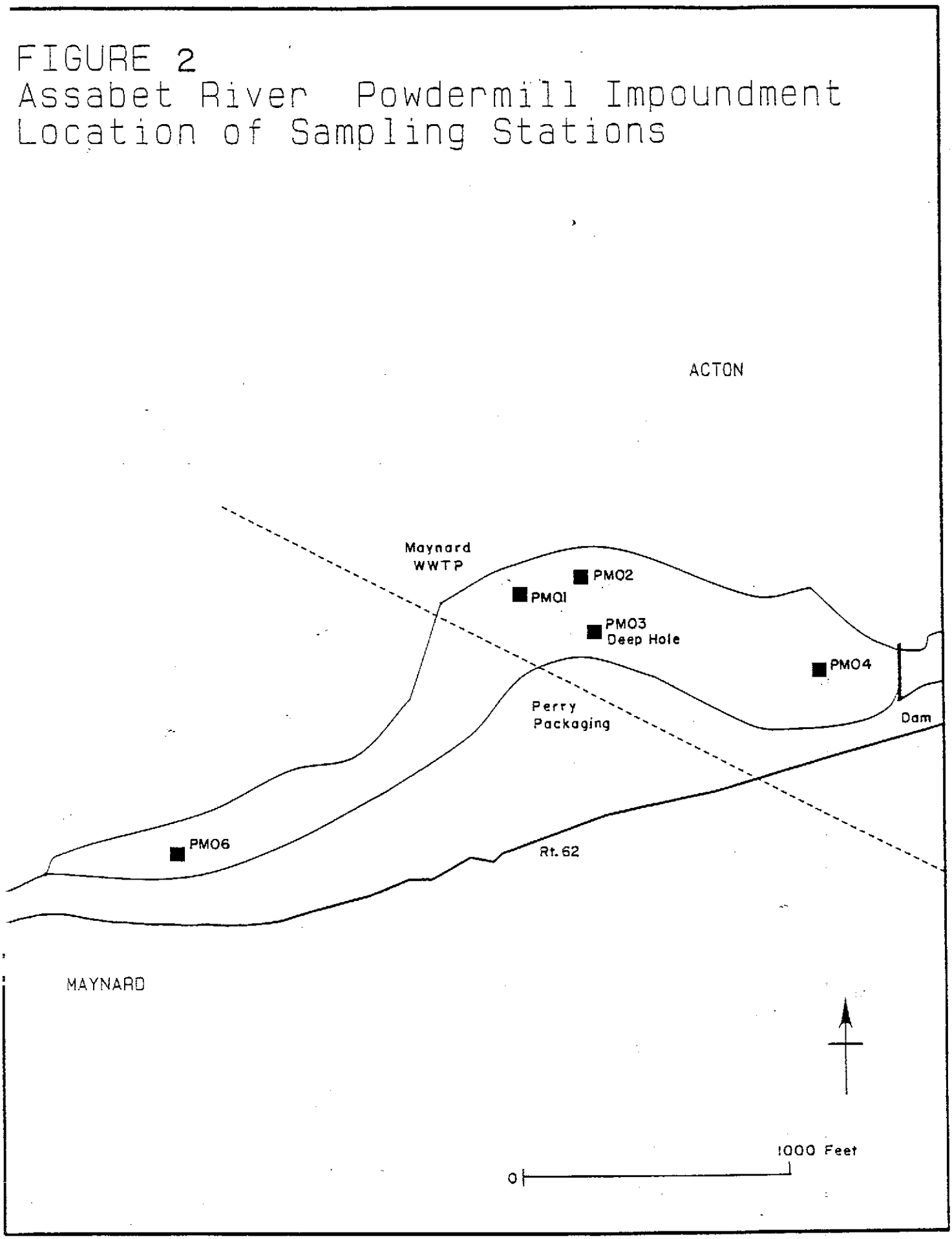


Figure 3

LOCATION of SAMPLING STATIONS

ASSABET RIVER BASIN

TABLE 3

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

TIME-TEMPERATURE (°F)-DISSOLVED OXYGEN (mg/l)-pH (Standard Units)

STATION		7/10/90	8/9/90	8/21/90
PM01	*	0630+	0552	1200+
(Surface)	**	71.6	75.0	68.7
	***	4.3	5.1	6.9
	****	6.8	7.0	6.7
PM02 (Surface)		0630+	-	-
		71.7	-	-
		4.6	-	-
		6.6	-	-
PM03 (Surface)		0630+	0525	1200+
		74.1	76.0	65.7
		6.0	3.6	6.0
		6.6	5.5	6.4
PM03 (1 m)		0630+	-	1200+
		74.1	-	65.3
		5.9	-	6.1
		6.6	-	6.4
PM03 (2 m)		0630+	-	1200+
		74.1	-	65.1
		5.6	-	6.2
		6.5	-	6.4
PM03 (Bottom)		-	0525	1200+
(2.3 m)		-	76.0	67.3
		-	3.3	5.8
		-	5.5	6.4
PM04 (Surface)		0630+	0608	1200+[1]
		74.7	76.0	67.8
		7.2	1.7	5.9
		6.7	6.9	6.3
PM04 (Bottom)		-	0608	-
		-	76.0	-
		-	0.0	-
		-	6.9	-
PM06 (Surface)		0630+	0540	1200+[1]
		73.9	74.0	69.1
		6.4	6.7	7.7
		6.6	6.5	6.6
PM06 (Bottom)		-	0540	-
		-	74.0	-
		-	3.7	-
		-	6.5	-

TABLE 3 (CONTINUED)

STATION		7/10/90 RUN 1	7/10/90 RUN 2	8/9/90	8/21/90 RUN 1	8/21/90 RUN 2
AS20	*	0545	0745	0635	0506	1003
	**	73.5	73.5	76.0	67.0	66.0
	***	6.5	7.0	6.1	6.3	7.5
	****	5.6	6.5	6.9	-	6.7
AS21		0552	0751	-	0512	1011
		74.0	74.0	-	69.0	66.0
		6.9	7.0	-	6.2	6.1
		6.3	6.4	-	-	6.7
AS23		0600	0915	0645	0522	1018
		73.0	73.0	75.0	66.0	66.0
		4.5	7.3	6.0	5.5	6.8
		6.3	6.6	6.7	-	6.7
AS24		0604	0943	0652	0529	1027
		72.0	73.5	76.0	65.0	65.5
		4.8	6.4	5.3	5.3	6.3
		6.2	6.6	6.8	-	6.7
AS25		0611	0936	0703	0535	1036
		72.5	73.5	75.0	64.0	65.0
		5.2	6.4	7.5	5.5	6.4
		6.4	6.6	6.8	-	6.7
Maynard WWTP		-	1010	-	-	-
		-	69.0	-	-	-
		-	6.6	-	-	-
		-	7.1	-	-	-

* Time
** Temperature (°F)
*** Dissolved Oxygen (mg/l)
**** pH (Standard Units)

\+ Indicates that sampling began at 0630 or 1200, but the time that individual samples were taken was not recorded.
1 (Sample taken at 0.5 m)
\- No data taken

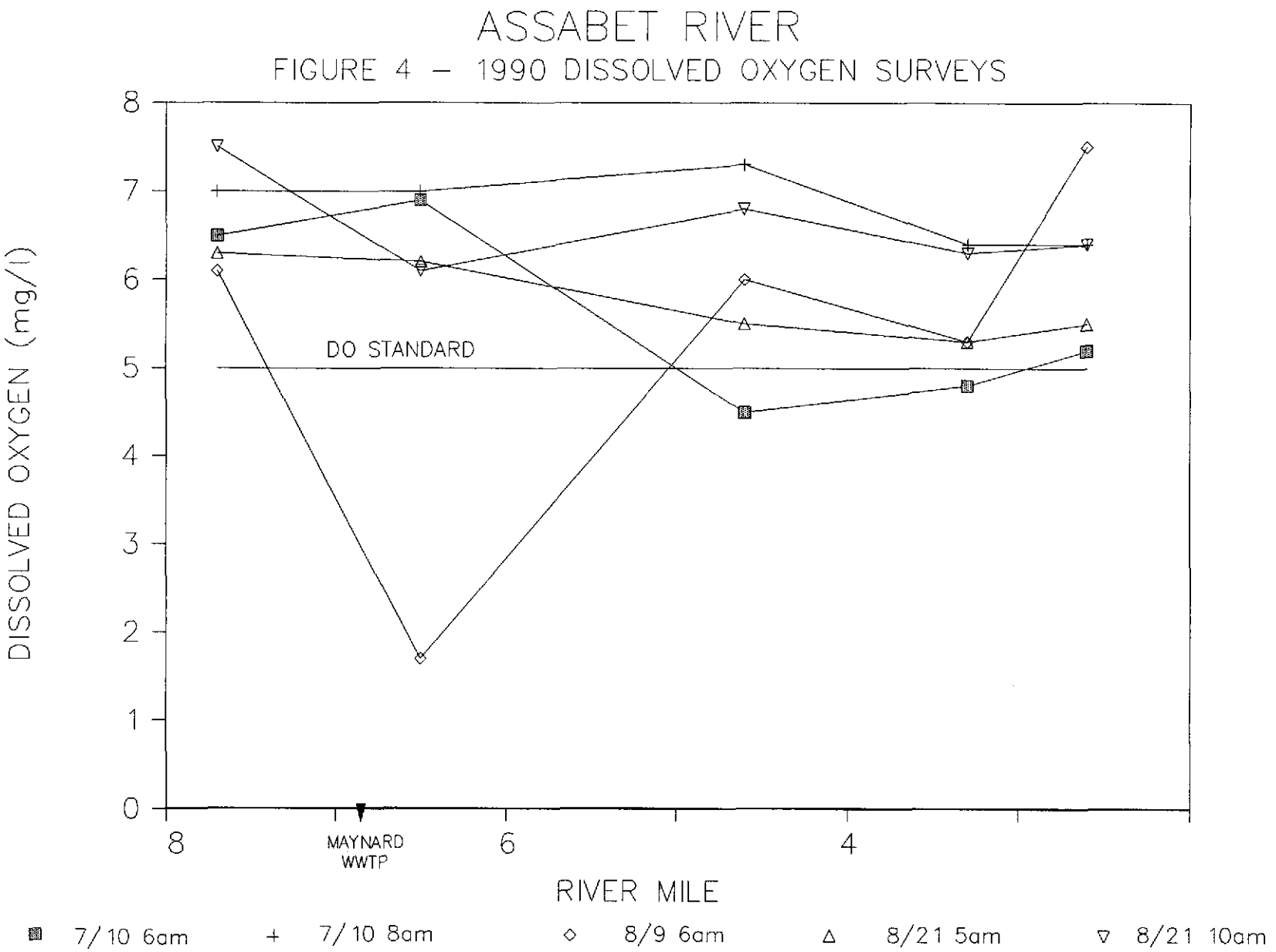

ASSABET RIVER
FIGURE 4 – 1990 DISSOLVED OXYGEN SURVEYS
DISSOLVED OXYGEN (mg/l)
8
7
6
5
4
3
2
1
0
DO STANDARD
8
MAYNARD WWTP
6
4
RIVER MILE
7/10 6am
7/10 8am
8/9 6am
8/21 5am
8/21 10am

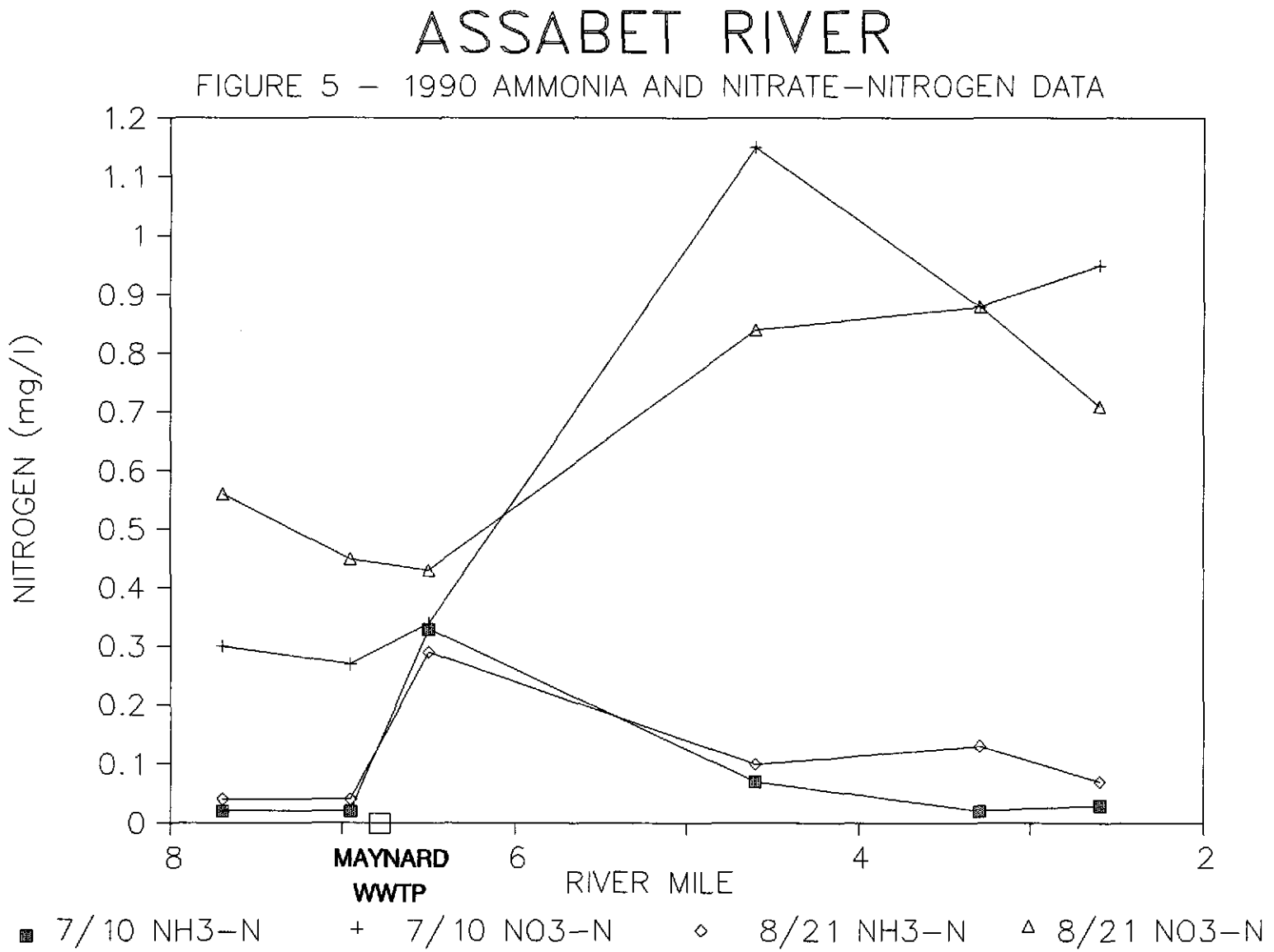
TABLE 4

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

NUTRIENT DATA (mg/l)

STATION	TOTAL KJELDAHL-N	AMMONIA-NITROGEN	NITRATE-NITROGEN	TOTAL PHOSPHORUS	ORTHO-PHOSPHORUS
			7/10/90		
PM01	11/12*	7.4/6.8	1.36/1.35	3.4/3.2	2.8/2.7
PM03(T)	1.2	0.57	0.39	0.65	0.56
PM03(B)	1.4	0.58	0.38	0.61	0.53
PM04	0.96	0.33	0.34	0.56	0.47
PM06	0.85	0.02	0.27	0.39	0.33
AS20	1.2	0.02	0.30	0.42	0.36
AS23	1.2/0.89*	0.08/0.06	1.30/1.00	0.47/0.46	0.41/0.41
AS24	0.74	0.02	0.88	0.41	0.37
AS25	0.70	0.03	0.95	0.37	0.33
AS50Q	0.22	<0.02	0.51	0.04	<0.02
			8/21/90		
PM01	12	8.0	4.0	3.8	3.6
PM03(T)	0.44	0.07	0.38	0.45	0.35
PM03(B)	0.93	0.26	0.42	0.48	0.42
PM04	0.81	0.29	0.43	0.51	0.44
PM06	0.40	0.04	0.45	0.42	0.34
AS20	0.87	0.04	0.56	0.41	0.35
AS23	1.1	0.10	0.84	0.48	0.42
AS24	4.0	0.13	0.88	0.45	0.40
AS25	0.98	0.07	0.71	0.37	0.32

* - Duplicate
T - Top
B - Bottom
AS50Q - Distilled Water Blank


ASSABET RIVER
FIGURE 5 – 1990 AMMONIA AND NITRATE–NITROGEN DATA
NITROGEN (mg/l)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
6
4
2
MAYNARD
WWTP
RIVER MILE
7/10 NH3–N
7/10 NO3–N
8/21 NH3–N
8/21 NO3–N

ASSABET RIVER

FIGURE 6 – 1990 TOTAL AND ORHTO–PHOSPHORUS DATA

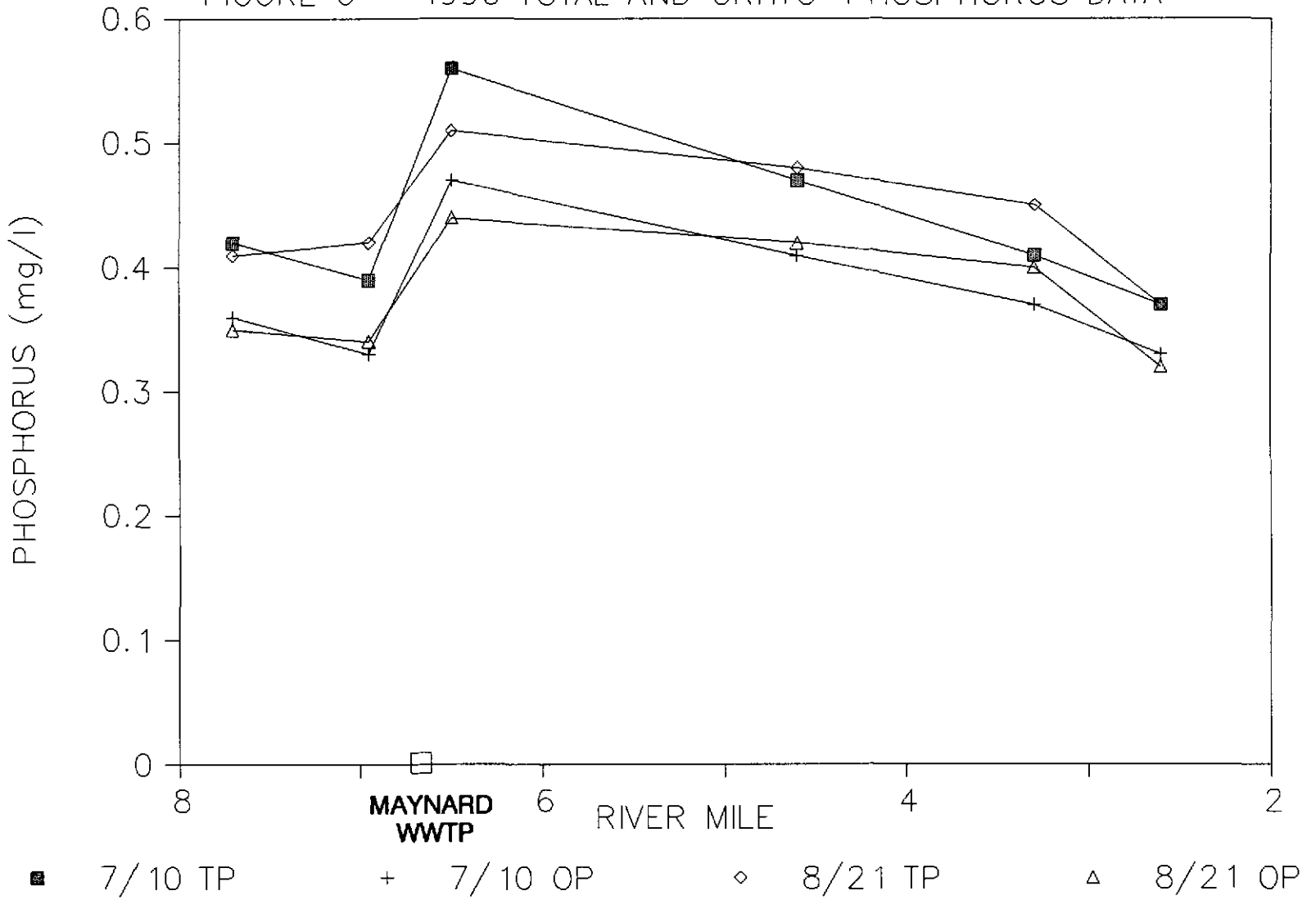


TABLE 5

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

ALGAE/CHLOROPHYLL *a* DATA

STATION	DATE	ALGAE (Natural units/ml)	CHLOROPHYLL *a* (mg/m^3)
AS20	7/10/90	-	2.49
PM03	7/10/90	-	2.158
AS20	8/21/90	877	13.2
PM03	8/21/90	1402	9.899

- No data taken

TABLE 6

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

SEDIMENT DATA

(All results in mg/kg unless noted)

	PM01		PM02		PM03		PM04		PM06	
PARAMETER	7/10	8/21	7/10	8/21	7/10	8/21	7/10	8/21	7/10	8/21
Total Volatile Solids (%)	19	-	33	-	7	5.5	15	27	10	15
Total Kjeldahl-N	8,820	-	15,560	-	2,540	2,250	4,350	13,560	2,610	5,350
Total Phosphorus	4,740	-	1,230	-	670	2,260	2,210	3,700	1,295	2,270
Aluminum	7,200	-	9,700	-	-	-	-	-	8,550	-
Cadmium	5.0	-	3.5	-	-	-	-	-	1.5	-
Chromium	550	-	650	-	-	-	-	-	47	-
Copper	14,500	-	11,000	-	-	-	-	-	95	-
Iron	19,500	-	20,500	-	-	-	-	-	17,000	-
Lead	2,400	-	2,750	-	-	-	-	-	150	-
Manganese	220	-	195	-	-	-	-	-	500	-
Mercury	2.4	-	3.3	-	-	-	-	-	0.8	-
Nickel	26	-	31	-	-	-	-	-	65	-
Zinc	315	-	550	-	-	-	-	-	200	-

- No data taken

TABLE 7

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

FLOW DATA (cfs)

STATION	DATE	TSB MEASUREMENT	U.S.G.S GAGE MEASUREMENT
AS20	7/10/90	47.3	38
AS23	7/10/90	55.6	-
AS20	8/21/90	-	72
AS23	8/21/90	81.1	-

- No measurements taken

TABLE 8

1990 LOWER ASSABET/POWDERMILL IMPOUNDMENT SURVEY

MAYNARD WASTEWATER TREATMENT PLANT

RESULTS OF LABORATORY ANALYSES
(All data in mg/l unless noted)

PARAMETER	7/10/90	8/21/90
BOD_5	100	12
pH (Standard Units)	7.2	7.2
Alkalinity	76	99
Hardness	47	45
Suspended Solids	5.0	5.0
Settleable Solids (ml/l)	<0.05	<0.05
Turbidity (NTU)	3.1	3.3
Total Kjeldahl-N	17	21
Ammonia-N	12	16
Nitrate-N	6.7	5.8
Total Phosphorus	7.2	6.2
Ortho-Phosphorus	6.1	6.1
Chloride	55	57
Fecal Coliform Bacteria (#/100 ml)	30	400
Dissolved Oxygen	6.6	-
Temperature (°F)	69	-
Aluminum	<0.05	-
Cadmium	<0.001	-
Chromium	0.005	-
Copper	0.10	-
Iron	0.17	-
Lead	<0.002	-
Manganese	0.03	-
Mercury	<0.0002	-
Nickel	<0.005	-
Zinc	0.04	-

- No data taken

APPENDIX A

ANALYTICAL METHODS USED AT LAWRENCE EXPERIMENT STATION

PARAMETER (Water Column)	METHOD	REPORTED AS
Dissolved Oxygen	Azide modification of Winkler method. 0.0375 N sodium thiosulfate titrant, 300 ml sample. EPA Method 360.2	mg/l D.O.
BOD	5-day oxygen depletion at 20°C. EPA Method 405.1	mg/l BOD
pH	Electrometric, glass indicator, silver chloride reference. EPA Method 150.1	pH Standard Units
Total Alkalinity	0.02 N sulfuric acid potentiometric metric titration to pH 4.5, Orion Model 701, digital pH meter. EPA Method 310.1	mg/l $CaCO_3$
Phenolphthalein Alkalinity	0.02 N sulfuric acid potentiometric titration to pH 8.3. Orion Model 701, digital pH meter	mg/l $CaCO_3$
Acidity	0.02 N sodium hydroxide potentiometric titration. Orion Model 701, digital pH meter. EPA Method 305.1	mg/l $CaCO_3$
Suspended Solids	Filtration through standard glass fiber filter paper. Residue dried at 103-105°C. Gravimetric. EPA Method 160.2	mg/l S.S.
Total Solids	Evaporation to dryness at 103-105°C. Gravimetric. EPA Method 160.3	mg/l T.S.

APPENDIX A (CONTINUED)

ANALYTICAL METHODS USED AT LAWRENCE EXPERIMENT STATION

PARAMETER (Water Column)	METHOD	REPORTED AS
Chloride	Argentometric (titration with silver nitrate). EPA Method 325.3	mg/l Cl
Specific Conductance	Wheatstone Bridge type meter. Yellow Springs Instrument conductivity bridge, Model 31 EPA Method 120.1	umhos/cm
Total Kjeldahl-Nitrogen	Acid digestion using Technicon BD-40 Block Digester. Colorimetric analysis (reaction of ammonia, sodium salicylate, sodium nitroprusside, and sodium hypochlorite in buffered alkaline medium) using Technicon Auto Analyzer II. EPA Method 351.3	mg/l TKN
Ammonia-Nitrogen	Phenate method, automated. Colorimetric analysis using Technicon Auto Analyzer II. EPA Method 350.1	mg/l NH_3-N
Nitrate-Nitrogen	Hydrazine reduction method, automated. Colorimetric analysis using Technicon Auto Analyzer II. EPA Method 351.3	mg/l NO_3-N
Total Phosphorus	Acid digestion using Technicon BD-40 Block Digester. Ascorbic acid reduction colorimetric method using Technicon Auto Analyzer II. EPA Method 365.4	mg/l P
Fecal Coliform	Membrane filter technique	Fecal coliforms/100 ml
Total Oil and Grease	Partition-Gravimetric Method. EPA Method 413.1	mg/l

APPENDIX A (CONTINUED)

ANALYTICAL METHODS USED AT LAWRENCE EXPERIMENT STATION

PARAMETER (Water Column)	METHOD	REPORTED AS
Aluminum	Inductively Coupled Argon Plasma technique (ICAP). Perkin-Elmer. EPA Method 200.7	mg/l
Arsenic	Atomic Absorption Spectrophotometry. Graphite furnace. Instrumentation Laboratory Model 951. EPA Method 206.2	mg/l
Cadmium, chromium, copper, iron, lead, nickel, silver, zinc, hardness (Ca+Mg)	Atomic Absorption Spectrophotometry. Air-acetylene flame. Perkin-Elmer Zeeman Model 5100. EPA Methods Cd-213.2, Cr-218.1, Cu-220.1, Fe-236.1, Pb-239.1, Ni-249.1, Ag-272.1, Zn-289.1	mg/l
Mercury	Cold Vapor Method. EPA Method 245.1	mg/l
Volatile Organics	Purge and trap GC/MS EPA Method 624	ug/l
Acid and Base/ Neutral Extractables	Extraction with methylene chloride followed by GC/MS. EPA Method 625	ug/l
Polychlorinated biphenyls	Organochlorine Pesticides and PCBs. Extraction with methylene chloride followed by GC. EPA Method 608	ug/l

APPENDIX A (CONTINUED)

ANALYTICAL METHODS USED AT LAWRENCE EXPERIMENT STATION

PARAMETER (Sediment)	METHOD	REPORTED AS
% Volatile Solids	Residue from Total Solids determination ignited at 550°C. Gravimetric EPA Method 160.4	% Volatile Solids
Total Kjeldahl-Nitrogen	Acid digestion using Technicon BD-40 Block Digester. Colorimetric analysis (reaction of ammonia, sodium salicylate, sodium nitroprusside, and sodium hypochlorite in buffered alkaline medium) using Technicon Auto Analyzer II. EPA Method 351.3	mg/kg dry weight
Total Phosphorus	Acid digestion using Technicon BD-40 Block Digester. Ascorbic acid reduction colorimetric method using Technicon Auto Analyzer II. EPA Method 365.4	mg/kg dry weight
Aluminum	Inductively Coupled Argon Plasma technique (ICAP). Perkin-Elmer. EPA Method 200.7	mg/kg dry weight
Arsenic, chromium, copper, lead, nickel, zinc	Atomic Absorption Spectrophotometry. Air-acetylene flame. Perkin-Elmer Zeeman Model 5100. EPA Methods As-206.2, Cr-218.1, Cu-220.1, Ni-249.1, Zn-289.1	mg/kg dry weight
Mercury	Cold Vapor Method. EPA Method 245.1	mg/kg dry weight
Polychlorinated biphenyls	Organaochlorine Pesticides and PCBs SW-846. EPA Method 8080	ug/g dry weight
Polycylic aromatic hydrocarbons	EPA Method 8270	ug/g dry weight

APPENDIX B

CLASSIFICATION OF SLUDGE FOR LAND APPLICATION

310 CMR 32.00

	ALLOWABLE CONCENTRATIONS (mg/kg)		
PARAMETER	CLASS I	CLASS II	CLASS III
Cadmium	2	2-25	>25
Lead	<300	300-1000	>1000
Nickel	<200	--	>200
Zinc	<2500	--	>2500
Copper	<1000	--	>1000
Chromium (Total)	<1000	--	>1000
Mercury	<10	--	>10
Molybdenum	<10	--	>10
Boron (water soluble)	<300	--	>300
PCBs in Class I sludge which is a commercial fertilizer	<2	2-10	>10
PCBs in Class I sludge which is a commercial soil conditioner	<1	1-10	>10