POLLUTION OF NASHUA RIVER AND RECOMMENDATIONS FOR IMPROVEMENT

Merrimack River Project
U. S. Department of Health, Education, and Welfare
Public Health Service
Division of Water Supply and Pollution Control
Region I
Lawrence, Massachusetts

JULY 1965

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by
Herbert R. Pahren, Director
Merrimack River Project

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SUMMARY AND CONCLUSIONS

The Nashua River Basin was included in the Conference in the matter of Pollution of the Interstate and Massachusetts Intrastate Waters of the Merrimack and Nashua Rivers held in Boston, Massachusetts on February 11, 1964. This report discusses the degree of remedial action necessary to secure abatement of the Nashua River pollution.

Serious pollution exists in the North Nashua River from the Weyerhaeuser Paper Company, Fitchburg, Massachusetts to the confluence of the north and south branches of the Nashua River at Lancaster, Mass. and in the Nashua River from Lancaster to the mouth of the Nashua River in New Hampshire. This pollution prevents the use of the stream for legitimate water uses.

The principal causes of the pollution of the Nashua River are the discharges from paper mills of suspended solids, organic matter causing biochemical oxygen demand, and materials discoloring the stream. By far the largest loadings emanate from the three paper industries of Fitchburg, Massachusetts. Inadequate sewage treatment at Fitchburg, Massachusetts and the discharges by non-paper industries of materials causing biochemical oxygen demand also contribute to the problem.

The Nashua River system has been classified for future highest use by the state and interstate agencies. However, the Class D classification of the North Nashua River below the Weyerhaeuser Paper Company and the Nashua River above the Harvard-Bolton town line does not permit the

development of any recreational use of the river as desired by citizens of the area.

The facilities to achieve the pollution abatement measures recommended are not to be considered the ultimate requirement, but only a first step. Future development of the Nashua River Basin may dictate higher degrees of waste treatment at some future date.

RECOMMENDATIONS

In order to achieve the desired water quality in the Nashua River system it is recommended that specific limits be placed on the pollutional constituents discharged by each paper industry. The following are the limits recommended for the pollutional constituents added to the receiving stream by each paper industry:

Weyerhaeuser Paper Company

Suspended solids - 2,500 pounds per day

Biochemical oxygen demand - 1,500 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Fitchburg Paper Company

Suspended solids - 1,300 pounds per day

Biochemical oxygen demand - 800 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Falulah Paper Company

Suspended solids - 900 pounds per day

Biochemical oxygen demand - 1,100 pounds per day

Materials causing discolorations of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Mead Corporation

Suspended solids - 450 pounds per day

Biochemical oxygen demand - 450 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Hollingsworth & Vose Company

Suspended solids - 250 pounds per day

Biochemical oxygen demand - 600 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Groton Leather Board Company

Suspended solids - 250 pounds per day

Biochemical oxygen demand - 200 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

St. Regis Paper Company

Suspended solids - 800 pounds per day

Biochemical oxygen demand - 900 pounds per day

Materials causing discoloration of the receiving stream shall be reduced sufficiently so that such discoloration is not unduly noticeable.

Non-paper waste discharges are also to be treated to a satisfactory degree prior to being discharged to the receiving stream. Each of these discharges with inadequate treatment will be discussed.

Fitchburg

Facilities to provide secondary treatment of all dry-weather municipal wastes are to be provided.

Pepperell

Facilities are to be provided that will result in compliance with the classification of the Nashua River.

Simonds Saw and Steel Company

Wastes are to receive treatment commensurate with the degree of treatment provided other wastes in the Fitchburg area.

Foster Grant Company

Wastes are to receive treatment commensurate with the degree of treatment provided other wastes in the Leominster area.

The discharge of any industrial waste into a municipal system is satisfactory if arrangements can be made and satisfactory treatment is provided by the municipality.

Preliminary plans for the pollution abatement program for the Nashua River Valley are to be completed and submitted to the Massachusetts Department of Public Health not later than September 1965. Following the review of the plans and adjustments if any, the design and installation of facilities to reduce the waste loads to the Nashua River system are to proceed forthwith. Unless arrangements are made to have a municipality assume responsibility for and is accepting the wastes from any of the

industries listed, the facilities to achieve the recommendations for each industry are to be completed and in operation no later than July 1, 1968. Construction of the necessary sewage treatment facilities for Fitchburg and Pepperell is to be under way prior to July 1, 1968.

POLLUTION OF NASHUA RIVER AND RECOMMENDATIONS FOR IMPROVEMENT

INTRODUCTION

The Nashua River Basin was included in the Conference in the Matter of Pollution of the Interstate and Massachusetts Intrastate Waters of the Merrimack and Nashua Rivers held in Boston, Massachusetts on February 11, 1964. The sources of Nashua River pollution and the effect on water quality were described at the Conference.(1) A sketch showing the Nashua River is presented in Figure 1.

Subsequent to the Conference, Secretary Celebrezze recommended that a pollution abatement program commensurate with that on the Merrimack River be established for Massachusetts communities and industries in the Massachusetts portion of the Nashua River Valley with all preliminary plans completed and submitted to the Massachusetts Department of Public Health not later than September 1965.

At the program review of the Merrimack River Project held February 25, 1965, a brief discussion was held on the degree of remedial action which is necessary to secure abatement of the Nashua River pollution. The review committee suggested that the Merrimack River Project develop a brief report outlining the wastes to be expected from each industry after the wastes have been reduced with good housekeeping practices and treatment, and the effect of residual loadings on the Nashua River. This report fulfills the request of the program review committee.

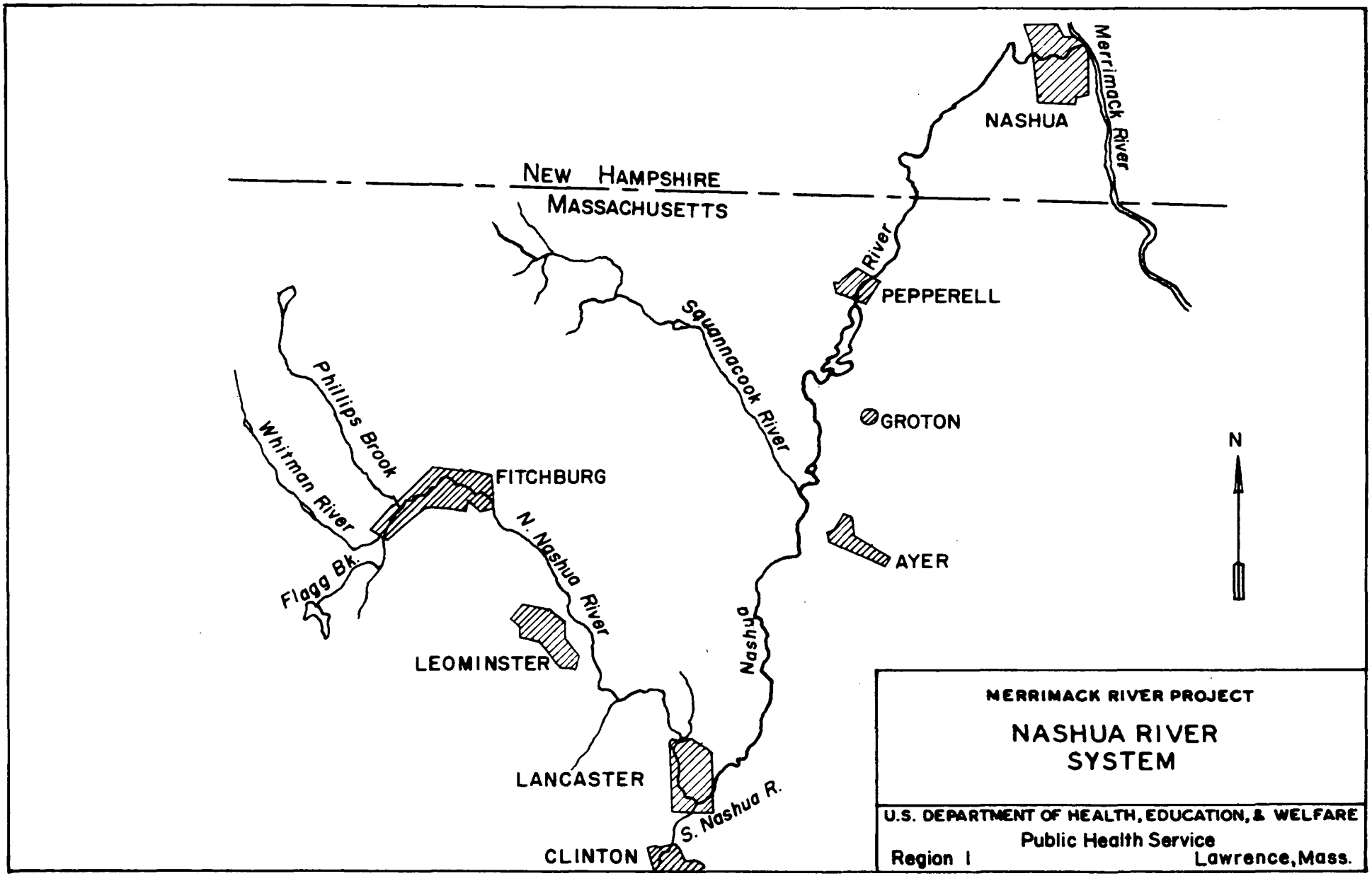

NEW HAMPSHIRE
MASSACHUSETTS
NASHUA
Merrimack River
River
PEPPERELL
Squannacook River
GROTON
AYER
Phillips Brook
Whitman River
FITCHBURG
N. Nashua River
Flagg Bk.
LEOMINSTER
Nashua
LANCASTER
S. Nashua R.
CLINTON
N
MERRIMACK RIVER PROJECT
NASHUA RIVER SYSTEM
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service
Region I
Lawrence, Mass.

FIGURE 1

SOURCES OF POLLUTION

Estimates have been made of the waste discharges to the Nashua River and its tributaries within Massachusetts. These estimates are based on surveys by the Massachusetts Department of Public Health and the National Council for Stream Improvement and are summarized in Table I.

Tremendous quantities of suspended solids and oxygen demanding organic matter are discharged to the Nashua River. Most of this is discharged by the paper mills in the Basin. For example, 95 percent of the suspended solids and 80.8 percent of the biochemical oxygen demand discharged to the Nashua River in Massachusetts come from the paper mills. By far the largest loadings emanate from the three paper industries of Fitchburg, Massachusetts.

Materials used in the paper making process also impart a white color to the stream. The North Nashua River from Weyerhaeuser Paper Company at Fitchburg, Massachusetts to its mouth and an extensive section of the Nashua River have a white appearance from these pollutants.

EFFECTS OF POLLUTION ON STREAM AND WATER USES

Data were collected during 1962 and 1963 in the Nashua River Basin by the Massachusetts Department of Public Health and the National Council for Stream Improvement.[2] The dissolved oxygen on the days samples were collected was approximately 80 percent of saturation in the North Nashua River above Fitchburg, Massachusetts. However, the dissolved oxygen de-

TABLE I

Estimated Characteristics of Sewage and Industrial Wastes
Discharged to the Nashua River and Tributaries within Massachusetts

Discharge	Treatment and/or Waste Reduction Measures	Population Equivalents Discharged					
		Bacterial		Suspended Solids		Oxygen Demand	
		Number	% Total	Number	% Total	Number	% Total
Cushing Academy	Secondary with Cl_2	3	0.01	45	0.01	30	0.02
State Hospital (Gardner)	Secondary with Cl_2	16	0.07	80	0.02	80	0.05
Weyerhaeuser Paper Co.	Save-alls, wastes recirculated, starch substitution, settling	-	-	184,600	34.36	39,650	23.68
Fitchburg Paper Co.	Save-alls, wastes recirculated retention aids	-	-	108,200	20.14	37,060	22.14
Simonds Saw & Steel Co.	None	-	-	-	-	5,800	3.46
Falulah Paper Co.	Wastes recirculated, chemical precipitation, vacuum filtration of sludge	-	-	115,400	21.47	27,940	16.69
Fitchburg	Inadequate secondary	18,900	79.66	20,700	3.85	19,500	11.64
Mead Corporation	Starch substitution, wastes recirculated	-	-	30,300	5.64	5,700	3.40
Foster Grant Co.	None	-	-	-	-	2,500	1.49
Leominster	Secondary	2,700	11.38	3,200	0.60	2,140	1.28
Atlantic Union College	Partly primary, partly secondary	210	0.89	210	0.04	280	0.17
Clinton	Secondary	1,300	5.48	1,560	0.29	1,040	0.62
Girls Industrial School	Secondary	15	0.06	18	-	18	0.01
Ayer	Secondary	375	1.58	750	0.14	500	0.30
Hollingsworth & Vose Co.	Settling, wastes recirculated	-	-	1,470	0.27	6,650	3.97
Groton Leatherboard Co.	Settling, wastes recirculated	-	-	5,880	1.09	2,120	1.27
Groton School	Secondary	8	0.03	10	-	10	0.01
St. Regis Paper Co.	Save-alls, wastes recirculated	-	-	64,700	12.04	16,200	9.68
Pepperell	None	200	0.84	200	0.04	200	0.12
TOTAL		23,727	100.0	537,323	100.0	167,418	100.0

creased rapidly between Fitchburg and Leominster to as low as 20 percent of saturation. Reaeration from rapids increased the dissolved oxygen in some reaches but was inadequate to prevent excessive depletion. The Nashua River below the North Nashua River confluence was also in very poor condition. Throughout most of its length in Massachusetts, the dissolved oxygen was less than 50 percent of saturation and at times was at or near zero for considerable distances. Limited sampling by the Merrimack River Project in 1964 and June 1965 showed zero dissolved oxygen at times in the Nashua River in Massachusetts and in New Hampshire.

Intense algal blooms have been observed in the Nashua River in Pepperell, Massachusetts and in New Hampshire. Dissolved oxygen data obtained near the Massachusetts-New Hampshire state line indicate typical effects of the algae where oxygen is produced by these plants during the daylight but not at night. The diurnal fluctuation results in ranges of oxygen from supersaturation to zero.

During the period July 14-24, 1963 countless thousands of non-game fish were killed in the Nashua River near the Massachusetts-New Hampshire state line. The area affected covered 15 to 20 miles of stream. Observers attributed the kill to depletion of dissolved oxygen.

Suspended solids are also a problem in the Nashua River. Paper fibers can be seen along the banks of the stream, deposited there during higher flows. The stream passes through a number of ponds and impoundments, resulting in settling of the suspended matter. The solids decompose on the bottom, and in many cases the decomposition gases buoy up the sludge and the black sludge floats on the stream surface causing very unsightly conditions.

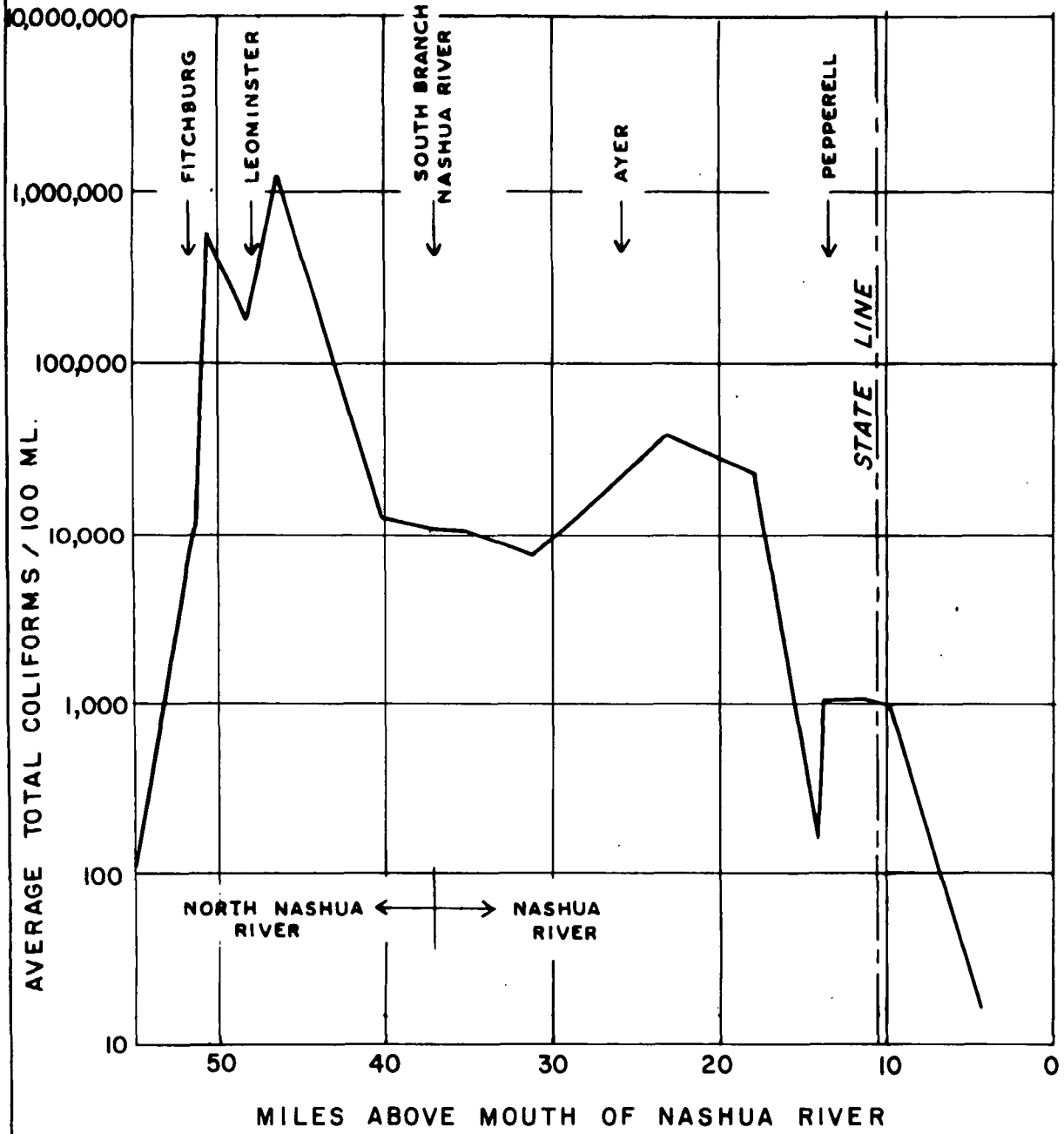
A bottom sample was taken in the Nashua River canal at the Route 3 by-pass bridge in August 1964. During low flows all of the river is diverted into the canal. The bottom consisted mostly of organic sludge and contained 8,210 biological organisms per square meter. Of these, 99.2 percent were sludge worms, midge fly larvae, and midge fly pupae--organisms which are tolerant to pollution. No pollution sensitive organisms were found.

Inorganic materials used to impart a white color to the paper products are contained in the discharges to the stream, resulting in an intensely colored stream for many miles. Much of the coloring material is in suspended form and forms part of the stream turbidity.

Bacteriological analyses were made on samples from the Nashua River Basin during June 15-17, 1965. The total coliform densities are shown in Figure 2. As may be noted, the coliform values are relatively high in the Fitchburg-Leominster section of the North Nashua River, indicating sewerage system deficiencies or operational problems.

Nashua River water is used for industrial process water by several of the paper industries. Where necessary to precondition the water, facilities ranging from coarse sand filters to ion exchange processes are used.

Because of the polluted conditions in the Nashua River, it is not used for fishing. This river is populated by various types of coarse fish in the New Hampshire section. Based on the character of the stream, it appears that improvement of its water quality would make recreational fishing possible.



MERRIMACK RIVER PROJECT

COLIFORMS IN NORTH NASHUA & NASHUA RIVERS JUNE 15-17, 1965

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
Region 1 Lawrence, Mass.

FIGURE 2.

WATER QUALITY OBJECTIVES

Water quality has been a problem in the Nashua River for many decades. In fact this river has been cited in the report of the New England New York Inter-Agency Committee as being "outstanding for its absolute worthlessness as a fish stream" because of the pollution.(3)

However, citizens living downstream from the sources of pollution wish to improve the water quality in the Nashua River Basin. At a public meeting held September 17, 1964 at Lancaster, Massachusetts, the Nashua River Study Committee pointed out that the people of the area wish to use the Nashua River for recreational purposes. A communication, shown in the Appendix, expresses the conclusions of the group and the officials of the town of Lancaster, Massachusetts concerning the water quality objectives for the Nashua River.

At a meeting held November 12, 1964, in Nashua, New Hampshire, the Technical Subcommittee of the New England Interstate Water Pollution Control Commission discussed the existing classification of the Nashua River. It was agreed that the North Nashua River was Class E, in nuisance condition, from the Weyerhaeuser Paper Company discharge to the confluence of the North and South Branches of the Nashua River. It was further agreed that the Nashua River was Class E from this confluence to Hollis Depot, New Hampshire, and Class D from Hollis Depot to the mouth of the Nashua River. A chart showing the classification system is presented in the Appendix.

On April 27, 1965 the Commonwealth of Massachusetts, the New Hampshire Water Pollution Commission and the New England Interstate Water Pollution Control Commission classified the Nashua River for future highest use. The North Nashua River was classified "B" above Weyerhaeuser Paper Company at Fitchburg and Class D from Weyerhaeuser to the confluence of the North and South Branches of the Nashua River. The Nashua River was classified "D" from the confluence of the North and South Branches to the Harvard-Bolton town line, 3.9 miles below the confluence. This river was then classified "C" with the dissolved oxygen modified to four parts per million from the Harvard-Bolton line to Unkety Brook, 0.7 miles upstream of the Massachusetts-New Hampshire state line. The Nashua River was classified "C", without modification, from Unkety Brook to its mouth.

With Class D waters only a minimum amount of dissolved oxygen would be required, so as to avoid septic conditions. According to the New England Interstate Water Pollution Control Commission classification system the Class D section of the river would not be suitable for recreational use but would be suitable for transportation of sewage and industrial wastes without nuisance. Therefore if the stream is not better than Class D, the part of the Nashua River system thus classificed would be unsuitable for the uses desired by the Town of Lancaster.

In considering the future condition and uses of a stream, attention should be given not only to present population and industrial discharges, but also to future population, expansion of industrial capacity, and the possible introduction of new industries into the area. Water quality should be set sufficiently high and waste loadings must be sufficiently

low so that economic growth is not hindered and the maximum beneficial use is made of the stream.

It would not be proper to condemn a portion of the Nashua River system to a status where it is only "suitable for transportation of sewage and industrial wastes without nuisance." This is especially true since means are presently available to substantially correct the pollution problem. Waste discharges should therefore be controlled to allow economic growth of the area and some recreational use of the river. To achieve these objectives the principal controls should be placed on discharges of suspended solids, materials causing biochemical oxygen demand, color and bacteria.

RECOMMENDED LIMITS AND EFFECTS ON STREAM

The available data from each Nashua River paper industry were analyzed from the standpoint of the type of product and mill capacity. Data were then obtained on the expected discharge per unit of production from typical mills throughout the country producing the same type of product.[4][5][6] These unit waste loads, without treatment, from properly designed and operated paper mills were applied to each paper mill in the Nashua River Basin producing the same type of product. Then considering the treatability of the resulting waste loads and the production capacity, limits of suspended solids and biochemical oxygen demand discharged to the Nashua River were derived for each paper industry. A summary of these recommended limits, along with the actual waste loads during 1962 and 1963 as measured by the National Council for Stream Improvement[2] are presented in Table II.

TABLE II

Summary of Paper Industry Waste Loads
and Recommended Limits Added to Stream

Paper Industry	Principal Product	Capacity Tons Per Day	Suspended Solids, PPD Added			BOD, PPD Added		
			1962	1963	HEW Limit	1962	1963	HEW Limit
Weyerhaeuser Company	Book	375	26,472	31,376	2,500	13,945	6,741	1,500
Fitchburg Paper Co.	Bond and Specialty	200	16,140	18,400	1,300	4,550	6,300	800
Falulah Paper Co.	Board	90	26,103	19,600	900	5,460	4,750	1,100
Mead Corporation	Board	43	4,205	5,150	450	1,960	975	450
Hollingsworth & Vose Co.	Specialty	45	1,750	250	250	1,460	1,130	600
Groton Leather Board Co.	Stereotype Dry Mats	30*	886	1,000	250	340	360	200
St. Regis Paper Co.	Kraft	115	16,600	11,000	800	3,500	2,750	900

*Estimated

In arriving at these limits, it was considered essential that the mills reduce their waste load to the maximum extent by means of physical processes. A combination of settling, flotation and coagulation is needed in some cases.

Substantially all of the suspended solids must be removed from the wastes discharged if sludge deposits are to be prevented in the downstream ponds. Not only settleable solids should be removed but other suspended matter as well.

Tests by the National Council for Stream Improvement[2] indicated that a significant amount of biochemical oxygen demand would be removed from the wastes of the Nashua River paper mills by plain sedimentation. However, this degree of BOD removal is still considered inadequate to protect the desired future uses of the Nashua River. Residual BOD would be reduced by the bacteria of the receiving stream but in doing so the bacteria produce 0.5 pounds of living suspended matter that can settle and produce sludge for each pound of BOD removed.[5] The biological sludge produced may cause nuisance conditions during warm weather. Removal of additional BOD by flotation, coagulation, or other processes would provide a more suitable effluent and will result in better stream conditions.

The appearance of a stream does not necessarily indicate its quality, but if no effort has been exerted to remove the most obvious pollution, the public frequently assumes that little effort has been expended to remove the other forms. Often it is easier to reduce the color of an effluent than to erase erroneous conceptions from the minds of observers.

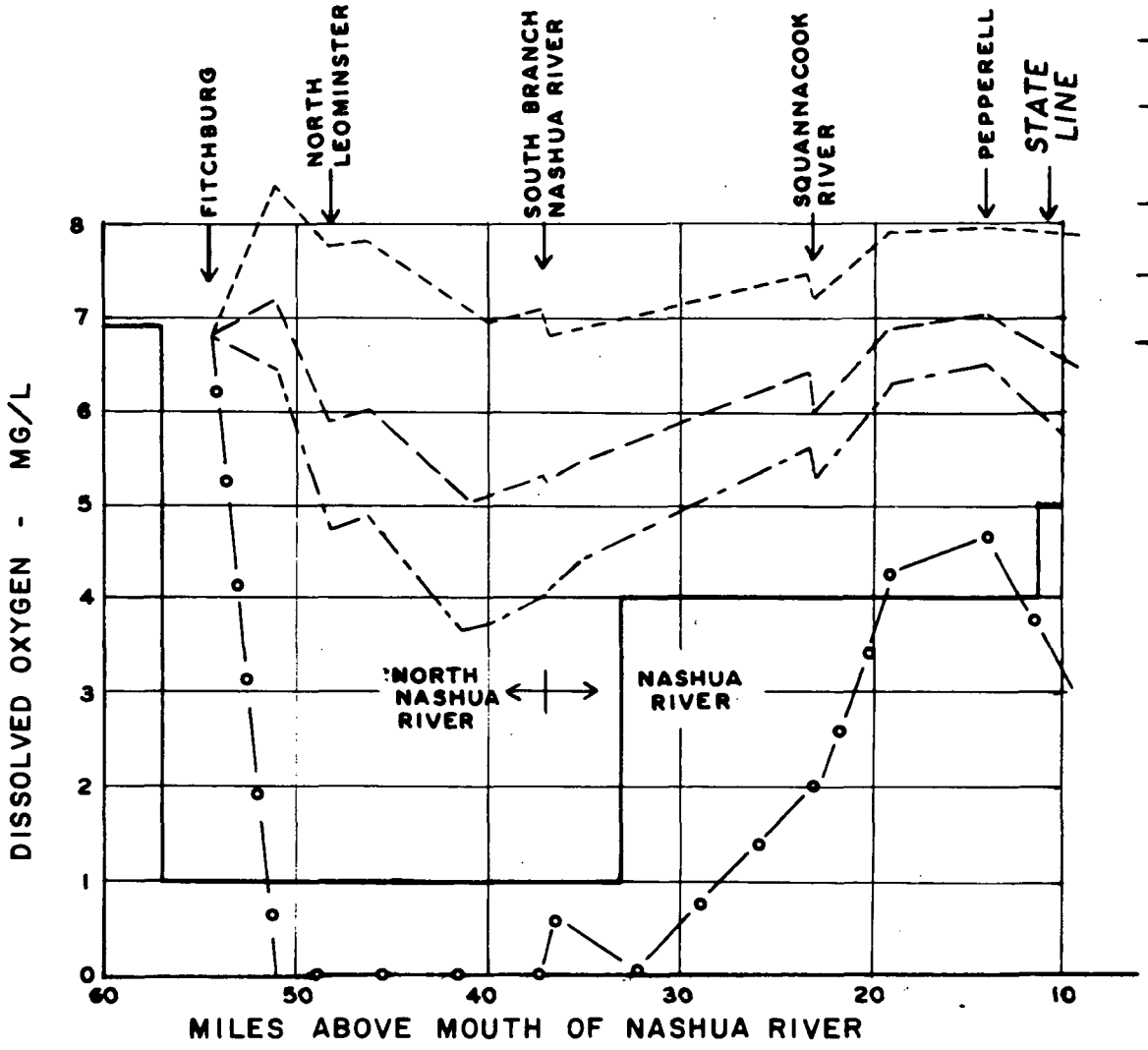
Most of the white color seen in the Nashua River system is caused by

materials in suspended or colloidal form. Therefore, it should not be difficult to remove substantially all of the color at the same time the suspended solids and BOD are reduced to desired levels. It should be the objective to reduce the materials causing color to such an extent that the artificial color from the paper mills is not unduly noticeable in the stream.

Figure 3 shows the calculated dissolved oxygen levels in the North Nashua and Nashua Rivers under several assumed conditions. It also presents the minimum dissolved oxygen levels required by the classification. For the Class D section where the dissolved oxygen must be greater than zero, a value of 1.0 mg/l was selected for convenience of presentation.

For the calculations, the low-seven-day average flow occurring once in five years was used. The curve showing the conditions with present discharges neglects the effects of sludge deposits as there are insufficient data available to properly take the deposits into accounts. In spite of this, the calculated dissolved oxygen would be zero for many miles of stream at the flow assumed.

The curve showing the dissolved oxygen in the stream if the industrial discharges are limited to the loads recommended at present production levels, indicates that the oxygen would be adequate. When the recommended limit of BOD per unit of production is used with the production expected by 1985, a minimum dissolved oxygen of about 3.7 mg/l results. The increased production for future years is based on the U. S. Forest Service projected paper and board production for Massachusetts.[7] It was assumed that the Nashua River paper mills would increase their production in the



—— MINIMUM DISSOLVED OXYGEN OF CLASSIFICATION

- - - - CONDITION WITH MAXIMUM IN-PLANT BOD REDUCTION PLUS 85 PERCENT ADDITIONAL

— — — CONDITION WITH RECOMMENDED BOD LIMIT WITH PRESENT PRODUCTION

— · — · — CONDITION WITH RECOMMENDED BOD LIMIT WITH 1985 PRODUCTION

—o— CALCULATED PRESENT CONDITIONS

MERRIMACK RIVER PROJECT

DISSOLVED OXYGEN CONDITIONS NORTH NASHUA & NASHUA RIVERS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
Region I Lawrence, Mass.

FIGURE 3

same proportion as the projected increase for the State. Thus with the recommended limits, the Nashua River would be satisfactory from the standpoint of dissolved oxygen for almost the next 20 years. At that time it may be necessary to reconsider the degree of waste treatment needed.

Figure 3 also shows conditions of the Nashua River if the paper industries effected maximum in-plant BOD reduction and, in addition, reduced the resulting BOD load by 85 percent. This curve assumes production will be at present levels and shows the maximum possible dissolved oxygen in the stream. These extreme waste reductions are not recommended because the future stream uses would not require the dissolved oxygen levels to be as high as those resulting from this degree of treatment and the additional cost would be high. However, the limits recommended in Table II, although difficult to attain in several instances, would result in very satisfactory stream quality at present, with assimilative capacity remaining for future economic development.

REFERENCES

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2. Final Report - Nashua River Survey, submitted by The National Council for Stream Improvement, New York, New York, January 15, 1964.

3. The Resources of the New England - New York Region, Part Two, Chapter XV, Merrimack River Basin, New England, New York, Inter-Agency Committee, 1954.

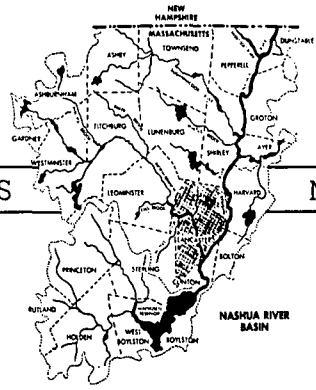
4. Pulp, Paper and Paperboard, Harry W. Gelm, contained in ACS Monograph No. 118, Industrial Wastes - Their Disposal and Treatment, Reinhold Publishing Corporation, 1953.

5. White Water Wastes from Paper and Paperboard Mills, New England Interstate Water Pollution Control Commission, Boston 8, Mass., December 1963.

6. Unpublished data on wastes from paper and paperboard mills in files of Merrimack River Project, U. S. Department of Health, Education, and Welfare, Lawrence, Massachusetts.

7. New England Economic Survey, State Projections, Projected Employment and Production in the Forest Industries in New England by States, Prepared by the Northeast Forest Experiment Station, U. S. Forest Service, July 1964.

APPENDICES



TOWN OF LANCASTER, MASSACHUSETTS — NASHUA RIVER STUDY COMMITTEE

1 Buttonwood Lane
Lancaster, Mass.
April 1, 1965

Mr. Herbert R. Pahren, Director
Merrimack River Project, DWSPC
U. S. Public Health Service
37 Shattuck Street
Lawrence, Massachusetts 01843

Dear Mr. Pahren:

We have received a letter from Mrs. Mildred E. Smith, Sanitary Engineer of the Water Supply and Pollution Control Branch of the Department of Health, Education and Welfare, in which she has stated that the department is interested in the statement of the desired objectives for water quality of the Nashua River.

After meeting with the Board of Selectmen of Lancaster, and in consequence of earlier meetings with other officials of the Department of Public Health, our committee has concluded that our ultimate objective would be Classification B for the Nashua River. Our efforts along with proposed combined efforts of other towns in the Nashua River Basin will be toward that objective. It may interest you to know at this time that our committee is presently attempting to organize on a regional basis, similar committees in all towns in the Nashua River Basin with a view toward disseminating information regarding pollution control and steps to be taken on the local level which will be helpful in improving the condition of this River.

We would appreciate being advised of any new developments along pollution control lines so that we may alert interested parties through our proposed newspaper releases.

Thanking you for any assistance you can provide us in this regard, I remain,

Very truly yours,

John E. Burgoyne

John E. Burgoyne
Chairman

JEB:cp

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION

Classification and Standards of Quality for Interstate Waters
(As Revised and Adopted October 1, 1959)

	CLASS A	CLASS B	CLASS C	CLASS D
		Suitability for Use		
	Suitable for any water use. Character uniformly excellent.	Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value. Acceptable for public water supply with filtration and disinfection.	Suitable for recreational boating, irrigation of crops not used for consumption without cooking; habitat for wildlife and common food and game fishes indigenous to the region; industrial cooling and most industrial process uses.	Suitable for transportation of sewage and industrial wastes without nuisance, and for power, navigation and certain industrial uses.
		Standards of Quality		
Dissolved oxygen	Not less than 75% sat.	Not less than 75% sat.	Not less than 5 p.p.m.	Present at all times
Oil and grease	None	No appreciable amount	Not objectionable	Not objectionable
Odor, scum, floating solids, or debris	None	None	None	Not objectionable
Sludge deposits	None	None	None	Not objectionable
Color and turbidity	None	Not objectionable	Not objectionable	Not objectionable
Phenols or other taste producing substances	None	None	None	
Substances potentially toxic	None	None	Not in toxic concentrations or combinations	Not in toxic concentrations or combinations
Free acids or alkalies	None	None	None	Not in objectionable amounts
Radioactivity	Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved.			
Coliform bacteria	* Within limits approved by State Department of Health for uses involved.	Bacterial content of bathing waters shall meet limits approved by State Department of Health and acceptability will depend on sanitary survey.		

* Sea waters used for the taking of market shellfish shall not have a median coliform content in excess of 70 per 100 ml.

NOTE: Waters falling below these descriptions are considered as unsatisfactory and as Class E.
These standards do not apply to conditions brought about by natural causes.
For purpose of distinction as to use, waters used or proposed for public water supply shall be so designated.