Annual Report

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National Pollutant Discharge Elimination System Phase II Stormwater Management Plan Maynard, Massachusetts

2004 Annual Report – Year 1

NPDES MS4 – MA 041208/W035581

Prepared for:

Maynard, Massachusetts
195 Main Street
Maynard, MA 01936

Prepared by:

Earth Tech, Inc.
196 Baker Avenue
Concord, Massachusetts 01742

Reports Submitted to:

United State Environmental Protection Agency
Water Technical Unit
P.O. Box 8127
Boston, MA 02144

Massachusetts Department of Environmental Protection
Division of Watershed Management
627 Main Street
Worcester, Massachusetts 01608

May 2004

63589

196 Baker Avenue, Concord, Massachusetts 01742

April 30, 2004

Department of Environmental Protection
Division of Watershed Management
627 Main Street, 2nd Floor
Worcester, MA 01608

United State Environmental Protection Agency
Water Technical Unit
P.O. Box 8127
Boston, MA 02144

Telephone
978.371.4000
Facsimile
978.371.2468

Subject: Maynard, MA
NPDES Phase II Stormwater Management Plan
Annual Evaluation

To Permit Reviewers:

On behalf of the Town of Maynard, we are submitting the following NPDES Phase II Stormwater Management Plan Annual Evaluation as required by the United States Environmental Protection Agency (US EPA) and the Massachusetts Department of Environmental Protection (MA DEP) for coverage under the US EPA NPDES Stormwater General Permit.

If there are any questions or comments with respect to any of the information contained in the Annual Evaluation or the accompanying detailed plan, please do not hesitate to contact the undersigned.

Very truly yours,

Earth Tech, Inc.

Abigail Thomas
Environmental Engineer

cc: Town of Maynard w/ attachments

Municipality/Organization: Town of Maynard

EPA NPDES Permit Number: MA 041208

MaDEP Transmittal Number: W- 035581

Annual Report Number & Reporting Period: No. 1: March 03-March 04

NPDES PII Small MS4 General Permit

Annual Report

Part I. General Information

Contact Person: Michael J. Gianotis Title: Town Administrator

Telephone #: Email:

Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature:

Printed Name: Michael J. Gianotis

Title: Town Administrator

Date:

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1.0 INTRODUCTION AND BACKGROUND

In 1990, The United States Environmental Protection Agency (EPA) began implementing a stormwater management program under the National Pollutant Discharge Elimination System (NPDES). This program, known as Phase I of the NPDES stormwater program, was intended to reduce pollution in stormwater discharges for large urban areas with populations of 100,000 or greater.

On December 8, 1999, the Phase II Rule of the NPDES stormwater program was published to address Municipal Separate Storm Sewer Systems (MS4s) within urban areas of populations less than 100,000 that were not addressed under the Phase I program. Objectives of the Phase II rule is for the MS4s to develop, implement and enforce a storm water program designed to reduce the discharge of pollutants to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act.

On May 1, 2003 the EPA issued the General Permit for Stormwater Discharges from MS4s. The general permit requires that the stormwater program for each MS4 submit an annual evaluation. The following report contains information regarding the activities on the stormwater program for the previous calendar year. The report contains the information required in the general permit as follows: (a) Self-Assessment Review of Compliance with the Permit Conditions; (b) Assessment of the Appropriateness of the selected BMPS; (c) Assessment of the Program towards Achieving the Measurable Goals; (d) Summary of the Results of Any Information that has been Collected and Analyzed; (e) Discussion of Activities for the Next Reporting Cycle; (f) Discussion of any Changes in Identified BMPs or Measurable Goals; and (g) Reference any Reliance on another Entity for Achieving any Measurable Goal.

2.0 SELF-ASSESSMENT REVIEW OF COMPLIANCE WITH THE PERMIT CONDITIONS

The Town of Maynard filed a National Pollutant Discharge Elimination System (NPDES) Phase II Stormwater Management Plan in June 2003. The EPA responded with a letter of deficiencies on September 24, 2003. The deficiencies included identification of other regulated MS4s within municipal boundaries, and the NOI signature. A letter was sent to the EPA in response to the deficiencies on October 23, 2003. On November 24, 2003, the EPA sent a letter to the town stating that the stormwater program was administratively complete and in compliance with the conditions of the General Permit.

3.0 ASSESSMENT OF THE APPROPRIATENESS OF THE SELECTED BMPS

Most of the Best Management Practices (BMPs) selected for the stormwater program were appropriate for the town of Maynard. The Town reviewed the BMPs and considers the BMP for the Illicit Discharge Detection and Elimination Plan to be redundant and will incorporate the plan into the Regulatory Mechanism.

BMP ID Number	BMP	BMP Description	Comments on Appropriateness
3.3.1	Illicit Discharge Detection and Elimination Plan	Organize Stormwater Management Team (SWMT) to monitor the Town's compliance with the permit requirements.	The Illicit Discharge Detection and Elimination Plan will be outlined in the Town By Law. The Town will incorporate the needed procedures for identification and reporting. BMP 3.3 will be removed from future reporting and integrated into BMP 3.2. The redundancy of BMP 3.3 was found to be inappropriate.
3.3.2		Identify procedures for locating areas likely to have illicit discharges, and illegal dumping.	
3.3.3		Develop procedures to identify the source of an illicit discharge	
3.3.4		Develop procedures for removing the source of the illicit discharge	
3.3.5		Develop procedures for program evaluation and assessment	

4.0 SUMMARY OF MINIMUM CONTROL MEASURES

In order to meet the six control measures required by the EPA, the town proposed to supplement their existing BMP's with the following BMPs. The following outlines the progress of the town in achieving the measurable goals for 2003. The annual evaluation of MPS is also detailed in Table 1-1 – Annual Evaluation. Table 1-1 also discusses activities for the next reporting cycle, and identifies any changes in the identified BMPs or measurable goals.

4.1 PUBLIC EDUCATION AND OUTREACH

The Town continued to work with the SuAsCo Watershed Community Council (SuAsCo) on public education and outreach. A flyer entitled, "Stormwater Matters", included in Attachment A, was sent out with the water bills on March 20, 2003. SuAsCo also started a community survey on December 18th, 2003. The survey will run through June 30' 2004, and the results will be tabulated in the 2005 Annual Report. A copy of the survey is included in Attachment, B.

4.2 PUBLIC PARTICIPATION AND INVOLVEMENT

The SuAsCo Watershed Community Council (SuAsCo) is also working with the town on public participation and involvement. A stormwater display was created and is displayed in Town Hall. The display will be circulated throughout the town and will be featured at public events. In addition, the display will be displayed at local banks, town meeting, Maynard Oktoberfest, and the Town Library.

4.3 ILLICIT DISCHARGE DETECTION AND ELIMINATION

Mapping

The entire stormwater system, including outfalls, will be mapped by Dufresne-Henry, as a part of the CWMP. A draft stormwater map is already complete and 50% of the outfalls have been field checked. The final 50% of outfall field checks will be done after the mapping is finalized.

Regulatory Mechanism

The SWMT and selectman's office has reviewed the EPA models for draft Town By Laws. A draft Stormwater By Law will be presented at the Fall 2004 Town Meeting. The Town By Law will include procedures for enforcement. Maynard will work with other similar towns in the areas to write a complete By Law.

MAYNARD, MASSACHUSETTS
NPDES PHASE II STORMWATER MANAGEMENT PLAN
ANNUAL EVALUATION OF MINIMUM CONTROL MEASURES

BMP Category to Subject of Interest (MCM)		BMP	Department Responsible for Implementing BMP	Measurable Goals	1st Year Goals	Progress on Goal(s) - Year 1	2nd Year	Planned Activities
1.0 Public Education and Outreach								
1.1.1	Homeowner Focus	Mail educational flyer with stormwater survey	SuAsCo Council and Stormwater Management Team (SWMT)	Flyer distribution. Compile and evaluate survey results	Mail flyer and survey and compile results	"Stormwater Matters" flyer sent out with water bills.		Survey Started December 18th, and will run through June 30th Results will be tabulated in the 2005 Annual Report.
1.2.1	Student Focus	Teach stormwater lesson to fifth grader students	SuAsCo Council and Stormwater Management Team (SWMT)	Prepare and implement lesson			Prepare and implement lesson	
1.3.1	Business Focus	Mail educational flyer with stormwater survey	SuAsCo Council and Stormwater Management Team (SWMT)	Flyer distribution.				
1.4.1	General Public Focus	Hold a stormwater media campaign	SuAsCo Council and Stormwater Management Team (SWMT)	4 press releases				
1.4.2	General Public Focus	Show a stormwater video on a local cable station	SuAsCo Council and Stormwater Management Team (SWMT)	Develop and air stormwater video				
2.0 Public Involvement and Participation								
2.1.1	Homeowner Focus	Circulate stormwater traveling display	SuAsCo Council	Develop display. Feature at 3 locations	Develop and feature display	A Stormwater display was created and is displayed in Town Hall.		The display will be circulated throughout the town and will be featured at public events. The display will be displayed at local banks, town meeting, Maynard Oktoberfest, the Town Library, etc.
2.2.1	Student Focus	Poster contest for fifth graders	SuAsCo Council and Stormwater Management Team (SWMT)	Hold poster contest			Hold poster contest	
2.2.2	Student Focus	Photo contest for high school students	SuAsCo Council and Stormwater Management Team (SWMT)	Hold photo contest				
2.3.1	General Public Focus	Hold a local stormwater summit	SuAsCo Council and Stormwater Management Team (SWMT)	Advertise and hold summit				
2.3.2	General Public Focus	Hold a watershed-wide stormwater summit	SuAsCo Council and Stormwater Management Team (SWMT)	Advertise and hold summit				

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ANNUAL EVALUATION OF MINIMUM CONTROL MEASURES

	BMP [illegible] (MCM)	BMP	[illegible] Responsible for Implementing BMP	Measurable Goals	[illegible] Goals	[illegible]	[illegible]	[illegible]
3.0 Illicit Discharge Detection and Elimination								
3.1.1	Stormwater System Mapping	Map outfalls	DPW	Field Check GIS Map Locations of outfalls.	Prioritize and schedule areas to be checked	As part of the CWMP, the entire stormwater system, including outfalls, will be mapped by Dufrense-Henry. A draft is already complete and 50% of the outfalls have been field checked.	Field Check 50% Outfalls	The final 50% of outfall field checks will be done after the mapping is finalized.
3.1.2		Map storm sewer system	DPW	Build GIS system map for stormwater planning, illicit discharge program, tracking system, and maintenance program	Develop GIS system map for storm sewers	As part of the CWMP, the entire stormwater system, including outfalls, will be mapped by Dufrense & Henry. A draft is already complete and 50% of the outfalls have been field checked.		
3.1.3		Map structural BMPs (i.e. detention basins, water quality inlets, Etc.)	DPW	Percentage of total structures			Identify Structures	
3.1.4		Develop regulations to have developers pay Town's cost for GIS update caused by their development	Planning Board	Consider options and implement recommendations for Planning Board Regulations revisions.			Draft and adopt recommended Planning Board Regulations	
3.1.5		Maintain GIS storm sewer system map	DPW	Update storm sewer system GIS map annually				
3.2.1	Regulatory Mechanism	Develop Town By-law prohibiting illegal non-storm water discharges into storm sewer system	Selectmen's Office/SWMT	Review existing policy and implement recommendations for regulatory revisions	Draft Town By-Law	The SWMT and selectman's office has reviewed the EPA models for draft by laws. A draft by law will be presented at the Fall 2004 Town Meeting.	Finalize Town By-Law	Draft By Laws Will be presented at the Fall 2004 Town Meeting. Maynard will work with other similar Town in the areas to write a complete By Law.
3.2.2		Develop enforcement procedures for non-storm water discharges, including illegal dumping	Selectmen's Office/SWMT	Development of enforcement procedures	Draft procedures	The Town By Law will include procedures for enforcement.	Finalize procedures	Procedures for enforcement will be included in the By Law.
3.3.1	Illicit Discharge Detection and Elimination Plan	Organize Stormwater Management Team (SWMT) to monitor the Town's compliance with the permit requirements.	Selectmen's Office	Meetings held	Conduct Meetings	Two SWMT meetings were held in 2003/2004.	Conduct Meetings	
3.3.2		Identify procedures for locating areas likely to have illicit discharges, and illegal dumping.	SWMT/DPW	Inspect outfalls for dry weather flows.	Develop a system for record keeping.	The DPW receives complaints and then visually inspects sites. In addition, the Town conducts several general visual inspections. The Conservation Commission has land stewards for the conservation lands. The Organization for the Assabet River conducts an Annual River Clean up. The Con Com/DPW/BOH all participate in a Townwide Annual Clean Up.	Prioritize outfalls.	
3.3.3		Develop procedures to identify the source of an illicit discharge	SWMT	Final Procedures Adopted	Draft Procedures	Procedures for Identifying and Removing a source of an illicit discharge are highly dependent on the circumstances of the discharge. This will be handled on a case by case basis.	Finalize Procedures	
3.3.4		Develop procedures for removing the source of the illicit discharge	SWMT	Final Procedures Adopted	Draft Procedures	Procedures for identifying and removing a source of an illicit discharge are highly dependent on the circumstances of the discharge. This will be handled on a case by case basis.	Finalize Procedures	
3.3.5		Develop procedures for program evaluation and assessment	SWMT	Annual Report	Establish format for report, prepare report	The procedures for program evaluation and assessment will be incorporated in to the Town By Law prohibiting non stormwater discharges. The By Law will be presented at the Fall 2004 Town Meeting.	Prepare report as required	The procedures for program evaluation and assessment will be incorporated in to the Town By Law prohibiting non stormwater discharges. The By Law will be presented at the Fall 2004 Town Meeting.
3.4.1	Educational Outreach	Identify measures to inform public employees, business, and general public of hazards with illegal discharges	SuAsCo Council and SWMT	Information materials distributed.				
3.5.1	Allowable Non-stormwater Discharges	Determine if any of the EPA listed non-stormwater flows need to be addressed by the Illicit discharge program.	SWMT	Decision made and if necessary addressed by the Illicit discharge program.	Review of the non-stormwater flows to determine if any are considered a significant contributor of pollutants to the Town	The non stormwater flows will be reviewed after the By Law is incorporated and the stormwater system map is complete.		The non stormwater flows will be reviewed after the By Law is incorporated and the stormwater system map is complete.
3.6.1	Waste Disposal Programs	Hazardous Waste Management and Drop-off Program	Board of Health	Conduct Twice a Year	Drop-off - Twice a Year	There is a monthly drop off date for some hazardous materials and others are accepted at the Annual Hazardous Water Drop Off event. The details are outlined in a mailing from the BOH.	Drop-off - Twice a Year	There is a monthly drop off date for some hazardous materials and others are accepted at the Annual Hazardous Water Drop Off event. The details are outlined in a mailing from the BOH.

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ANNUAL EVALUATION OF MINIMUM CONTROL MEASURES

4.0 Construction Site Storm Water Runoff Control

[illegible]		BMP	Department Responsible for Implementing BMP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4.1.1	Regulatory Mechanism	Develop and implement Town By-Laws regulating erosion and sediment control for construction sites utilizing appropriate BMPs	SWMT	Implement Town By-Laws			Draft Town By-Law	
4.1.2		Add design standards and criteria as necessary to Town department regulations regarding construction site erosion control	Planning Board/ Conservation Commission/SWMT	Update Regulations	Review possible BMPs	The Conservation Commission reviewed possible BMPs. Construction site erosion control, design standards, and BMPs are already incorporated into the NOI process.	Incorporate Into Rules and Regulations/Cons Com By-laws	
4.1.3		Evaluate sanctions for enforcement of erosion and sediment controls	SWMT/Selectmen's Office	Develop goals, draft and final sanctions	Develop Goals for Sanctions	The SWMT has reviewed goals for sanctions and will work on a draft for 2005.	Draft Sanctions	
4.2.1	Site Plan Review Procedures	Implement pre-construction review of project storm water pollution prevention plan (SWPPP)	Planning Board/Conservation Commission	Identify and train staff		Conducted through NOI process	Identify and train staff	Conducted through NOI process
4.3.1	Site Inspection/ Enforcement Procedures	Conduct construction site inspections	Planning Board/ Conservation Commission/ DPW	Identify and train staff. Review each project.		Budget currently being reviewed for Site Inspection Training Course	Identify Staff	Budget Currently being reviewed for Site Inspection Training Course
4.3.2		Develop a procedure for handling reports from the public of non-compliance	Storm Water Management Team	Development of procedure			Draft Procedure	

5.0 Post-Construction Storm Water Management in New Development and Redevelopment

[illegible]		BMP	Department Responsible for Implementing BMP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.1.1	Regulatory Mechanism	Develop and implement by laws regulating controls for post-construction runoff utilizing appropriate BMPs	Storm Water Management Team (SWMT)	Implement By Laws	Develop Goals for Zoning By-Laws, Planning Board Rules and Regulations, and Conservation Commission By-Laws	Town is working toward developing Town Policies. An infiltration policy was already adopted.	Draft Town Policies	Goals were edited to work toward a series of Town policies instead of seeking approval for Draft By Laws.
5.2.1	Review BMP Designs	Pre-construction review for conformance with standards/regulations	Planning Board/ Conservation Commission	Review each project.	Conduct Reviews	Pre construction and construction inspections of conformance with regulations and BMP practices are conducted by the Conservation Commission through the NOI Process.	Conduct Reviews	Pre construction and construction inspections of conformance with regulations and BMP practices are conducted by the Conservation Commission through the NOI Process
5.3.1	Site Inspection/ Enforcement Procedures	During construction inspect that BMPs are properly constructed.	Planning Board/ Conservation Commission	Inspect each project.	Conduct Inspections	Pre construction and construction inspections of conformance with regulations and BMP practices are conducted by the Conservation Commission through the NOI Process.	Conduct Inspections	Pre construction and construction inspections of conformance with regulations and BMP practices are conducted by the Conservation Commission through the NOI Process
5.3.2		Post-construction provide inspection to be assured that the BMPs O & M procedures have been followed	DPW	Identify and train staff. Inspection as required			Identify Staff	Staff was identified as the Conservation Commission Agent and training programs are being evaluated.
5.4.1	O&M Procedures for Stormwater BMPs	Develop Procedures for Operation and Maintenance Requirements of Structural BMPs	Storm Water Management Team (SWMT)	Development of Procedures			Draft procedures	

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ANNUAL EVALUATION OF MINIMUM CONTROL MEASURES

6.0 Pollution Prevention and Good Housekeeping for Municipal Operations

BMP ID # (MCM)		BMP	Department Responsible for Implementing BMP	Measurable Goals	1st Year Goals	Progress on Goals - Year 1	2nd Year	Revisions or Additions
6.1.1	Employee Training Program	Training On Spill Reporting and Response Protocols, Hazardous Materials Training, Pesticide and Fertilizer Application	DPW/Fire Dept.	Conduct annual training	Determine goals for training	The goals are to obtain a pesticide application license in the DPW. In addition, the fire dept. will continue to receive annual haz mat training.	Develop program	The responsible department was changed to include the fire dept.
6.2.1	Stormwater Sewer System Operation and Maintenance	Storm sewer system and catch basin inspection program	DPW	Annual Inspection	Develop record keeping procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins.	Implement Procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins. The goal is to maintain this program.
6.2.2		Storm sewer system and catch basin cleaning program	DPW	Annual cleaning of catch basins	Develop record keeping procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins.	Implement record keeping procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins. The goal is to maintain this program.
6.2.3		Structural BMP inspection and maintenance program	DPW	Develop and implement record keeping. Inspect all BMPs once per year.	Develop record keeping procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins.	Implement record keeping procedures	An outside contractor is hired annually to track, clean and inspect structures for all 901 catch basins. The goal is to maintain this program.
6.3.1	Parks and Open Space	Fertilizer and pesticide application and management controls	DPW/FORESTRY	Annually summarize applications	Determine goals for program	The goals are to continue to minimize pesticide application and minimize fertilization. The annual goal is to train a DPW employee in pesticide application.	Draft program	
6.4.1	Municipal Industrial Operations	Evaluate Operations at the Public Works Facility, transfer station, and the WWTF	DPW Consultant	Individual SWPPPs for each site	Evaluate operations and make recommendations for improvements	Operations were evaluated at each site and several improvements were made. The Highway Garage installed a series of sediment basins, stone trenches and sediment ponds. The WWTP installed a fence to discourage illegal dumping, removed pile s of wood chips/junk, and resloped the river's edge to reduce erosion.	Implement 50 percent of Improvements	
6.4.2		Review maintenance and repair programs for municipal vehicles	DPW	Develop program controls and record keeping.			Develop program controls and record keeping.	
6.4.3		Review municipal vehicle washing controls	DPW	Develop program controls and record keeping.			Develop program controls and record keeping.	
6.4.4		Review Salt Storage Operations	DPW	Develop and implement program controls and record keeping.	Develop program controls and record keeping.	Program controls and record keeping goals were eliminated due to the fact that the entire salt operation was improved, so that every aspect is conducted under the cover of the salt shed.	-	Program controls and record keeping goals were eliminated due to the fact that the entire salt operation was improved, so that every aspect is conducted under the cover of the salt shed.
6.4.5		Review Fueling Operations	DPW	Develop and implement program controls and record keeping.	Develop program controls and record keeping.	In 2004, the fuel lines were inspected and the DPW will review the results. In 2000, the fuels tanks were replaced and sensors detect potential leaks or problems. The sensing equipment is reviewed twice a year.	Implement program controls and record keeping.	In 2004, the fuel lines were inspected and the DPW will review the results. In 2000, the fuels tanks were replaced and sensors detect potential leaks or problems. The sensing equipment is reviewed twice a year.
6.5.1	Municipal Roads	Street sweeping	DPW	Strengthen record tracking system. Evaluate frequency in urban areas.			Evaluate and strengthen record keeping	Incorporate Vacuum Sweeping into project specifications.

Illicit Discharge Detection and Elimination Plan

The Stormwater Management Team (SWMT) held two meetings in 2003/2004. The SWMT determined that the procedures for program evaluation and assessment will be incorporated into the Town By Law prohibiting non stormwater discharges. The By Law will be presented at the Fall 2004 Town Meeting.

The SWMT also determined that there is not one specific way to handle all types of illegal discharges. Procedures for identifying and removing a source of an illicit discharge are highly dependent on the circumstances of the discharge. Each circumstance will be handled on a case by case basis.

In regards to locating illicit discharges, the Town conducts several general visual inspections. The Conservation Commission (Con Com) has land stewards for each conservation land. The Organization for the Assabet River (OAR) conducts an Annual River Clean up. The Con Com/DPW/BOH all participate in a Town wide Annual Clean Up, and the DPW visually inspects sites when they receive complaints. Details concerning the town wide clean up are included in Attachment C.

4.4 CONSTRUCTION SITE RUNOFF CONTROL MEASURES

Regulatory Mechanism

The Conservation Commission (Con Com) reviewed possible BMPs. The Con Com determined that construction site erosion control, design standards, and BMPs are incorporated into the NOI process. In addition the NOI process includes procedures for stormwater management in the site plan review process.

The Con Com plans to take a larger role in site inspection. The SWMT is reviewing the budget for the Con Com agent to attend a Site Inspection Training Course. The course would allow the Con Com agent to be more active in the site review process and be more involved in incorporating stormwater management into construction in Town.

4.5 POST-CONSTRUCTION RUNOFF CONTROL MEASURES

Regulatory Mechanism

The Town is working toward developing Town Policies concerning post construction runoff control measures. The stormwater management goals were edited to include goals which work toward a series of Town policies instead of seeking approvals through By Laws. The change in procedure allows for faster development of post-construction runoff policies. An infiltration policy was already adopted. The policy is included in Attachment D.

4.6 POLLUTION PREVENTION/GOOD HOUSEKEEPING

Employee Training

The DPW determined that the employee training goal was to obtain a pesticide application license in 2004. The DPW also transferred the responsibility of hazardous material discharge response to the fire department. The fire department will continue to receive annual hazardous material training.

Stormwater System Operation and Maintenance

The DPW determined that an outside contractor should control the stormwater system maintenance. The contractor will be hired annually to track, clean and inspect structures for all 901 catch basins. Sam's Catch Bain cleaning was hired for 2003. A new contract will be bid in July 2004. The goal is to maintain this program.

Parks and Open Space

The goals for the town parks and open space are to continue to minimize pesticide application and minimize fertilization. The DPW's goal for 2004 is a DPW employee in pesticide application.

Municipal Operations

Municipal operations were evaluated at each site and several improvements were made in 2003. The DPW installed a series of sediment basins, stone trenches and sediment ponds at the highway garage. The DPW also installed a fence to discourage illegal dumping, removed piles of wood chips/junk, and resloped the river's edge to reduce erosion at the wastewater treatment plant. For the salt storage area, program controls and record keeping goals were eliminated due to the fact that the entire salt operation was improved, so that every aspect is conducted under the cover of the salt shed. In early 2004, the fuel lines were inspected and the DPW will review the results. In 2000, the fuels tanks were replaced and sensors detect potential leaks or problems. The sensing equipment is reviewed twice a year. The DPW will continue to inspect their work areas and make improvements as necessary.

5.0 SUMMARY OF THE RESULTS OF ANY INFORMATION THAT HAS BEEN COLLECTED AND ANALYZED

The Assabet River in Maynard is constantly tested for illicit discharges. The Town of Maynard monitors their wastewater treatment plant to ensure that the effluent meets discharge limitations. The summary of daily water quality data is included in Attachment E. The Organization for the Assabet River also monitors the Assabet River. In 2003, the Town of Maynard received the, "Stream Watch and Water Quality Monitoring Program Final Report – Summer 2002", included in Attachment F. OAR also monitored the river in 2003 and will finalized the 2003 report by Summer 2004.

6.0 PROGRAM OUTPUTS AND ACCOMPLISHMENTS

Mapping and Illicit Discharges

Outfall mapping complete	(%)	
Estimated or actual number of outfalls	(#)	
System-Wide mapping complete	(%)	Field Data Completed
Mapping method(s)		
▪ Paper/Mylar	(%)	
▪ CADD	(%)	
▪ GIS	(%)	Draft Started
Outfalls inspected/screened	(# or %)	
Illicit discharges identified	(#)	
Illicit connections removed	(#) (est. gpd)	
% of population on sewer	(%)	98
% of population on septic systems	(%)	2

Operations and Maintenance

Average frequency of catch basin cleaning (non-commercial/non-arterial streets)	(times/yr)	1
Average frequency of catch basin cleaning (commercial/arterial or other critical streets)	(times/yr)	1
Total number of structures cleaned	(#)	900+
Storm drain cleaned	(LF or mi.)	
Qty. of screenings/debris removed from storm sewer infrastructure	(lbs. or tons)	
Disposal or use of sweepings (landfill, POTW, compost, recycle for sand, beneficial use, etc.)		Mixed with stone for gravel
Cost of screenings disposal	($)	0
Average frequency of street sweeping (non-commercial/non-arterial streets)	(times/yr)	1
Average frequency of street sweeping (commercial/arterial or other critical streets)	(times/yr)	1 CBD is swept as needed
Qty. of sand/debris collected by sweeping	(lbs. or tons)	500 tons
Disposal of sweepings (landfill, POTW, compost, beneficial use, etc.)	(location)	
Cost of sweepings disposal	($)	0
Vacuum street sweepers purchased/leased	(#)	0
Vacuum street sweepers specified in contracts	(y/n)	0

Reduction in application on public land of: ("N/A" = never used; "100%" = elimination)		
▪ Fertilizers	(lbs. or %)	2,000 lbs
▪ Herbicides	(lbs. or %)	0 lbs
▪ Pesticides – As needed only when grubs are a problem	(lbs. or %)	
Anti-/De-Icing products and ratios	% NaCl % $CaCl_2$ % $MgCl_2$ % CMA % Kac % KCl % Sand	20 80
Pre-wetting techniques utilized	(y/n)	N
Manual control spreaders used	(y/n)	Y
Automatic or Zero-velocity spreaders used	(y/n)	
Estimated net reduction in typical year salt application	(lbs. or %)	
Salt pile(s) covered in storage shed(s)	(y/n)	Y
Storage shed(s) in design or under construction	(y/n)	Existing

7.0 REFERENCE ANY RELIANCE ON ANOTHER ENTITY FOR ACHIEVING ANY MEASURABLE GOAL

The Town of Maynard relies on several outside entities to help with their stormwater management.

- Consultants - The town continues to work with Earth Tech on their stormwater management program. In addition, the town is working with Dufresne-Henry on their Comprehensive Wastewater Management Plan (CWMP). As a part of the CWMP, Dufresne-Henry are mapping the Town's stormwater system.

- Educators - The town is working with the SuAsCo Watershed Community Council on public education and participation.

- Outside Contractor – The Town continues to use an outside contractor to track, clean and inspect all 901 catch basins.

ATTACHMENT A

FLYER - "STORMWATER MATTERS"

Have you ever wondered where all the water goes when it rains or after the snow melts? Some of it seeps into the ground or evaporates, but much of it runs off over the land or through storm drains and then flows into our streams and ponds. This runoff water is called **"stormwater."**

Stormwater picks up litter, sand, bacteria, oil, and other chemicals as it flows over the land, and it carries these pollutants to our streams, ponds, and wetlands. Runoff from paved surfaces, such as roads, parking lots, and rooftops, may contribute large amounts of polluted stormwater.

Simply by putting fewer pollutants on the land, stormwater will be cleaner as it flows into our lakes and rivers. Cleaning up stormwater not only benefits your neighborhood and town, it benefits the entire network of water bodies and land that make up our watershed. We all need clean water for drinking, swimming, fishing, boating, and for protecting wildlife.

Keeping stormwater clean is in your best interest. Please read on to see how you can help.

Enter the

"SuAsCo Raffle for Stormwater Umbrellas"!

Detach and send the self-test panel with your answers and contact information to:

SuAsCo Watershed Community Council
P.O. Box 176
Maynard, MA 01754

Please keep the rest of the brochure.

The stormwater raffle will take place on June 30, 2004!

Our town is working hard to protect water quality by keeping pollutants out of stormwater. We're also trying to prevent flooding and erosion by managing stormwater flow. Our community has to comply with new federal and state stormwater requirements, and we need your help.

STORMWATER matters.

You'll see this stormwater logo a lot as our community and other cities and towns throughout Massachusetts reach out to residents for help in keeping stormwater clean. Please follow the tips in this flyer and save it as a useful reference. And please participate in our town's stormwater programs.

For more information about what our town is doing to clean up stormwater, you can contact:

Michael Gianotis, Town Administrator
Maynard Board of Selectmen
Phone number: 978-897-1001
E-mail: mgianotis@townofmaynard.net
Town web site: web.maynard.ma.us

SuAsCo Watershed Community Council

This brochure was created by the SuAsCo Watershed Community Council, a non-profit alliance of businesses, municipalities, environmental organizations, and state/federal/regional government agencies. For more information about stormwater, you can also visit the SuAsCo web site at www.SuAsCo.org

Help spread the word: Stormwater Matters!

STORMWATER matters™

What is stormwater? Why should I care about it?

The word "stormwater" is new to me: ☐ yes ☐ no

Try this self-test before reading on.
Multiple answers are possible.

1) The water that flows into a storm drain in the street most likely:
- ☐ a goes to a wastewater treatment plant
- ☐ b goes to the nearest stream, pond, or wetland
- ☐ c stays in the drain until it seeps into the ground.

2) Used motor oil can be:
- ☐ a recycled by household hazardous waste collection programs
- ☐ b accepted by the place where purchased with a receipt
- ☐ c put down a storm drain because it will be treated there.

3) When I wash my car, it is best to:
- ☐ a use a commercial car wash
- ☐ b wash it on the street
- ☐ c wash it on the lawn.

4) If I use too much fertilizer on my lawn, the rain will:
- ☐ a push it deeper into the soil
- ☐ b wash it into the nearest stream or pond
- ☐ c dissolve it and make it harmless.

5) The best way to dispose of pet waste is:
- ☐ a put it in a storm drain
- ☐ b leave it on the lawn or curb
- ☐ c put it in the trash or flush it down the toilet.

6) Polluted stormwater might impair the quality of:
- ☐ a my drinking water
- ☐ b my favorite boating or swimming spot
- ☐ c the environment for aquatic species.

7) Stormwater is a problem for:
- ☐ a "big business" to fix
- ☐ b the government to fix
- ☐ c town residents to fix.

8) My age bracket is:
☐ <20 ☐ 20 – 50 ☐ >50

Name
Address
Town
Phone

ATTACHMENT B

STORMWATER SURVEY

Enter the

"SuAsCo Raffle for Stormwater Umbrellas"!

Detach and send the completed survey with your contact information to the SuAsCo Watershed Community Council. Multiple answers are possible.

The stormwater raffle will take place on June 30, 2004!

Cut along this edge

Stormwater is the runoff water after it rains or snows. Stormwater picks up litter, sand, and chemicals as it flows over the land and into storm drains, and it carries these pollutants to our streams, ponds, and wetlands. Simply by putting fewer pollutants on the land, we can help keep stormwater clean. Cleaner stormwater means cleaner water for drinking, swimming, fishing, boating, and for protecting wildlife.

STORMWATER matters.

STORMWATER SURVEY

The word "stormwater" is new to me: ☐ yes ☐ no

1) The water that flows into a storm drain in the street most likely:
- ☐ a goes to a wastewater treatment plant
- ☐ b goes to the nearest stream, pond, or wetland
- ☐ c stays in the drain until it seeps into the ground.

2) Used motor oil can be:
- ☐ a recycled by household hazardous waste collection programs
- ☐ b accepted by the place where purchased with a receipt
- ☐ c put down a storm drain because it will be treated there.

3) When I wash my car, it is best to:
- ☐ a use a commercial car wash
- ☐ b wash it on the street
- ☐ c wash it on the lawn.

4) If I use too much fertilizer on my lawn, the rain will:
- ☐ a push it deeper into the soil
- ☐ b wash it into the nearest stream or pond
- ☐ c dissolve it and make it harmless.

5) The best way to dispose of pet waste is:
- ☐ a put it in a storm drain
- ☐ b leave it on the lawn or curb
- ☐ c put it in the trash or flush it down the toilet.

6) Polluted stormwater might impair the quality of:
- ☐ a my drinking water
- ☐ b my favorite boating or swimming spot
- ☐ c the environment for aquatic species.

7) Stormwater is a problem for:
- ☐ a "big business" to fix
- ☐ b the government to fix
- ☐ c town residents to fix.

8) My age bracket is:
☐ <20 ☐ 20 – 50 ☐ >50

9) I completed this survey
☐ before ☐ after
reading the flyer or display.

Name
Address
Town
Phone

Place Stamp Here

SuAsCo Watershed Community Council
P.O. Box 176
Maynard, MA 01754

STORMWATER matters™

ATTACHMENT C

TOWNWIDE CLEANUP DETAILS

MAYNARD'S TOWN WIDE CLEAN UP

The townwide cleanup starts on Saturday. Volunteers (singles or groups) register with the Board of Health or cleanup organizers, state their clean-up areas, and get yellow bags. Volunteers cleanup roadsides, conservation land, parks, downtown, etc. Filled yellow bags are then picked up free of the $2-charge-for-extra-trash charge at the roadside by the town's weekly contracted trash men.

Saturday April 24 –

Time Location Leader

8:30 a.m. Summer Hill Rd from Stow line to Doug Moore
Summer Hill conservation land Conservation Commissioner
Entrance

9:30 a.m. Town Parking Lot behind Gruber Kevin Fox
Furniture Cleanup Advocate

10 a.m. New Library Site - (Roosevelt Friends of the
School, Nason Street) Maynard Public Library

1 p.m. Silver Hill Rd (meet midway John Dwyer
down Silver Hill Rd. Conservation Commissioner

Sunday April 25 -
2 p.m. Rail Trail from Sudbury St to Stow David Mark
line (meet at Main St/Sudbury St) Assabet River Rail Trail

ATTACHMENT D

TOWN INFILTRATION POLICY

Maynard Conservation Commission
Policy Guidance Relating to On-Site Stormwater Management

3 February 2004

Preamble

In order to meet the requirements of the Mass. DEP Stormwater Management Policy, U.S. EPA NPDES Phase II Stormwater requirements and good engineering practices, it is often necessary to design Stormwater Best Management Practices (BMPs) into stormwater systems that retain and infiltrate stormwater runoff.

The retention and infiltration of runoff in stormwater management systems generally serve to:

- Limit peak flood flows, erosion, and transport of contaminants.
- Reduce increases in flood volumes due to urbanization.
- Provide recharge to maintain and enhance groundwater resources.
- Help maintain base flows in streams and wetlands.

Poorly designed open retention and infiltration BMPs can often create man-made bodies of stagnant water, resulting in mosquito breeding areas, odor problems, as well as other public health and safety problems. Also, even well designed retention and infiltration BMPs can become significant health and safety problems for the community from the lack of proper maintenance of the facilities.

Guidance

The Town of Maynard Conservation Commission recognizes the importance of meeting the various State and Federal Stormwater Management Requirements and the need for infiltration and retention BMPs as available methods for meeting those requirements. However, in order to be considered a "Best Management Practice", health and safety of the public is to be considered as one of the primary factors in selecting stormwater management practices and in the design of those practices.

Therefore, in considering designs for Stormwater BMPs for all projects submitted for approval by the Town of Maynard Conservation Commission, the designer and applicant must clearly demonstrate that:

- The Stormwater BMP will not create stagnant and un-healthful ponded water.
- The Stormwater BMP is designed to protect the safety of the public.
- Long term Operation and Maintenance of the system will be provided for. A well-developed Operation and Maintenance Plan must be included as part of any stormwater design submitted for approval.

____

for the Maynard Conservation Commission

ATTACHMENT E

MAYNARD WWTF EFFLUENT EVALUATION

**TABLE 2. Summary of Daily Water Quality Data
Maynard WWTF Effluent Evaluation. March 2004.**

PARAMETER	UNITS		EFFLUENT	RECEIVING WATER
Alkalinity	mg/L	Day 0	90	20
		Day 2	230	18
		Day 4	160	25
Hardness	mg/L	Day 0	100	55
		Day 2	84	49
		Day 4	98	57
Specific Conductance	µmhos/cm	Day 0	612	348
		Day 1	607	349
		Day 2	893	346
		Day 3	871	336
		Day 4	719	359
		Day 5	726	374
pH	SU	Day 0	7.27	6.89
		Day 1	7.39	6.98
		Day 2	7.57	6.80
		Day 3	7.56	7.11
		Day 4	7.49	6.88
		Day 5	7.55	6.93
Total Solids	mg/L	Day 0	384	208
		Day 2	612	-
		Day 4	484	-
Total Suspended Solids	mg/L	Day 0	<10	<10
		Day 2	<10	-
		Day 4	<10	-
Total Residual Chlorine	mg/L	Day 0	0.4	<0.05
		Day 2	0.2	<0.05
		Day 4	0.3	<0.05
Ammonia	mg/L	Day 0	9.7	0.3
Total Organic Carbon	mg/L	Day 0	14.5	6.1

TABLE 5. Summary of Analytical Chemistry Results, Maynard WWTF Effluent Evaluation, March 2004.

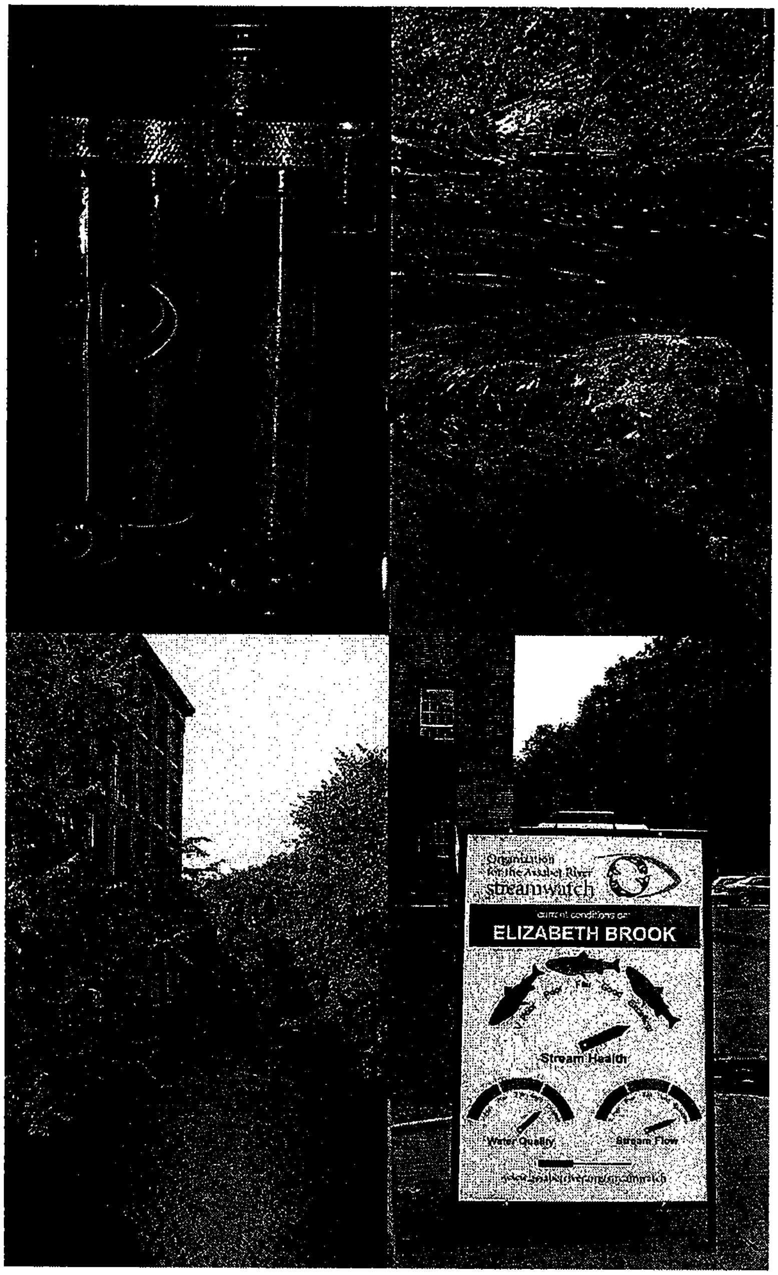
PARAMETER	UNITS	EFFLUENT	RECEIVING WATER
Aluminum, total	mg/L	0.26	0.08
Cadmium, total	mg/L	<0.001	-
Calcium, total	mg/L	28	15
Chromium, total	mg/L	<0.002	-
Copper, total	mg/L	0.026	<0.002
Lead, total	mg/L	<0.005	<0.005
Magnesium, total	mg/L	6.4	3.1
Nickel, total	mg/L	0.005	<0.003
Zinc, total	mg/L	0.039	0.018

ATTACHMENT F

STREAM WATCH AND WATER QUALITY MONITROING PROGRAM - FINAL REPORT - 2002

Organization for the Assabet River

StreamWatch and Water Quality Monitoring Program
Final Report - Summer 2002



Issued December 2003

Acknowledgments

OAR wishes to thank our many dedicated volunteers for their work in the field and on our board and advisory committees. We'd especially like to thank our 2002 water quality volunteers: Sue Beede, Jeanne Cahill, Ann Cairns, Jennifer Chiapella, David Downing, Paul Feshbach-Meriney, Phil Gott, David Gray, Paul Goldman, Kimberly Groff, Erik Hansen, Cindy Hutchison, Lynn Knight, Tim Lawson, Debbie Listernick, Matt Liebman, Michal Mueller, Doug Moffat, Marty Moran, Peter Norton, Ellen Oak, Barbara Offenhartz, Jeanne Peterson, Al Peirce, Len Rappoli, Ed and Prue Stuhr, Mike & Lizzy Worthy. For scientific review and editorial help, thanks to Sue Beede, Julia Blatt, Cindy Delpapa, and Warren Kimball.

We greatly appreciate the support for our water quality sampling program from the towns of Maynard, Hudson, and Concord. Funding for the StreamWatch portion of this program came from the U.S. Environmental Protection Agency EMPACT Metro Program. In-kind services were provided by Thorstensen Laboratory Inc. of Westford, and U.S. Environmental Rental Corporation of Waltham.

Author: Suzanne Flint, OAR Staff Scientist

Cover (clockwise from top left): sensors of a YSI water quality meter, Danforth Brook, StreamWatch sign, Assabet River passing Gleasondale Industries in Stow.

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Abstract

In 2002, The Organization for the Assabet River's long standing water quality monitoring program was expanded to form the monitoring portion of the Assabet River StreamWatch project. StreamWatch is a cooperative project of the Assabet River Consortium, the Organization for the Assabet River (OAR), USGS, the Massachusetts Division of Fisheries and Wildlife, and the Massachusetts Audubon Society. The goals of the water quality monitoring program are to understand long-term water quality trends, provide sound scientific information to evaluate regulatory decisions, and promote stewardship of the watershed. Data collected by the program also support StreamWatch project goals. Specifically they help characterize fish habitat conditions in the main tributaries of the Assabet and provide timely, accurate information to the public.

Water quality data was collected at 12 mainstem and, for the first time, nine tributary sites in the Assabet River watershed. Weekly streamflow and habitat availability data was also collected at one tributary site, Danforth Brook, to help develop and pilot a Stream Health index for the StreamWatch project. (A full description of the development of the Stream Health index is available separately at www.assabetriver.org/streamwatch/howindex.html.) This report covers the water quality and streamflow data collected on both the mainstem and tributaries in 2002 for the period June to October.

The mean monthly streamflows in 2002 were low from July to the beginning of October at the USGS gage on the Assabet in Maynard as compared with the period of record; daily mean flows were below the 7Q10 for nine consecutive days in late August. Flows in Danforth Brook were very low, dropping from 1.7 cfs when weekly monitoring started in mid-June to <0.05 cfs by the third week of August and remained very low through the middle of October. Dissolved oxygen (DO) concentrations at mainstem Assabet sites below the Westborough wastewater treatment plant discharge (the first wastewater discharge on the river) failed to meet the Massachusetts Class B Water Quality Standards (WQS) DO criteria 5 of 48 measurements from June to September. DO concentrations at tributary and headwater sites failed to meet WQS 14 of 45 measurements; the low DO concentrations on the tributaries appeared to be related to low flows and/or to natural conditions such as upstream marshy conditions or beaver dams.

Total phosphorus (TP) and total nitrogen (TN) concentrations on the mainstem Assabet River below the Westborough wastewater treatment plant discharge were consistently above recommended maximum concentrations. TP concentrations at mainstem sites ranged from <0.01 to 0.46 mg/L, exceeding the EPA "Gold Book" criteria, 0.050 mg/L, in 33 of 44 measurements. Median total phosphorus and total nitrogen concentrations in the headwater and tributary sites were lower than median TP and TN concentrations in the mainstem. TP concentrations in the headwater and tributary sites ranged from <0.01 to 0.47 mg/L, equal to or lower than 0.050 mg/L in 34 of 40 measurements. The highest TP concentrations in the tributaries were measured on Elizabeth Brook downstream of a beaver dam that was breached during the summer.

Introduction

The Assabet River has a watershed of about 177 square miles in eastern Massachusetts and is within EPA's Ecoregion XIV subregion 59, the eastern coastal plain. The Massachusetts Department of Environmental Protection (DEP, 2002b) lists all sections of the Assabet River, from the Assabet River Reservoir (A1 Impoundment) in Westborough to the river's confluence with the Sudbury River in Concord, as Category 5 Waters: "Waters Requiring a TMDL." The tributaries of the Assabet River are largely unassessed (DEP, 2002b).

The mainstem river suffers primarily from eutrophication caused by excess nutrients entering the river. During the growing season, these excess nutrients, phosphorus in particular, fuel nuisance algal and aquatic plant growth which interfere directly with recreational use of the river and cause large daily variations in the concentration of dissolved oxygen in the water, making the river poor habitat for aquatic life. When the algae and plants decay, whenever they are exposed on the river banks and at the end of the growing season, they generate strong sewage-like odors and lower dissolved oxygen levels in the river.

The findings of the Assabet River TMDL Phase One Study (ENSR 2001) confirm that the majority of the nutrients entering the river come from the wastewater treatment plants that discharge treated effluent to the river. In particular, treatment plants are the major source of ortho-phosphorus (the bioavailable form of phosphorus) throughout the year. Non-point sources also contribute nutrients, but, overall, significantly less than the point sources over the growing season. Sediments, which tend to accumulate in the impoundments behind dams, are currently a minor source of nutrients to the river compared with other sources. Sediment quantity and quality in the main impoundments of the river is currently being studied.

Flow, particularly baseflow, is critical to supporting fish and other aquatic life in the river and tributary themselves and is essential to diluting the effluent being discharged to the river. For the nutrient load reductions needed to restore water quality in the mainstem to be effective, the existing baseflow in the river and its tributaries must be preserved and, if possible, augmented. The water resources of the area are under the combined strain of the increasing demand for water supply and wastewater treatment that results in the net loss of water from many sub-basins, and low baseflow in the mainstem and tributaries.

For these reasons the Organization for the Assabet River (OAR) conducts a water quality monitoring program aimed at understanding water quality and quantity in the mainstem and tributaries of the Assabet. The summer of 2002 was OAR's eleventh consecutive summer collecting data at 12 mainstem sites, including the longest standing sites above and below each major wastewater treatment plant, and its first year collecting data at nine tributary sites. Water quality data collected under OAR's Water Quality Monitoring Program QAPP, approved by the EPA in 2000, may be used by EPA and DEP in making regulatory decisions. The goals of OAR's water quality monitoring program remain: to understand long-term trends in the condition of the river and its tributaries, provide sound scientific information to evaluate regulatory decisions that affect the river, and to promote stewardship of the river through volunteer participation in the project.

In addition, the data collected supports the goals of the StreamWatch project: to characterize fish habitat conditions in the main tributary sub-basins of the Assabet River and provide timely, accurate information to the public, local decision makers, and scientists. Weekly streamflow and habitat availability data was collected at one tributary site, Danforth Brook, to develop and pilot a Stream Health index for the StreamWatch project. (A full description of the development of the Stream Health index is available at www.assabetriver.org/streamwatch/howindex.html.) This report covers the water quality and streamflow data collected on both the mainstem and tributaries.

Methods

Twenty-eight trained volunteers and two OAR staff members monitored water quality at 12 sites along the mainstem and nine sites on the main tributaries of the Assabet (Figure 1, Table 2). Sites are designated a three letter prefix for the waterbody name plus three number designation of rivermiles above its confluence with the next stream. For example the Cold Harbor Brook site at Cherry Street in Northborough, 3.0 miles upstream of the confluence of the brook with the Assabet River, is designated "CLD-030." Water quality monitoring (bottle samples, *in-situ* measurements, and observations) was conducted one weekend (5:00 am - 9:00 am) each month in June, July, August, and September. In October, only *in-situ* measurements were taken. Staff gage readings were taken weekly at Danforth Brook; pictures of Danforth Brook were taken periodically throughout the summer. Flow and stage readings from the USGS gage at Maynard were downloaded from the USGS web page once a week.

Samples for nutrients and suspended solids were taken using bottles supplied by the laboratories and were stored in the dark on ice during transport from the field to the lab. Samples to be analyzed by Thorstensen Laboratory were delivered to the laboratory within 4 hours. *In-situ* readings of temperature, dissolved oxygen, pH, and conductivity were taken using multi-function YSI 6000-series meters. To ensure that samples were representative of the bulk flow of the river in wadeable free-running sections, bottle samples and YSI readings were taken from the main flow of the river at mid-depth. At ten percent of the sites during each sampling event, duplicate field samples were taken. At ten percent of the sites during each sampling event, field blanks of distilled water were taken. Table 2, below, summarizes the parameters measured, laboratory methods and equipment used. A detailed description of sampling methods and quality control measures is available in the QAPP (OAR, 2000a).

Table 1: OAR Sampling Sites - Summer 2002

Reach	New Site #	Old Site #	Site Description	Data Collected: In-situ	Data Collected: Bottle Samples	Data Collected: Staff gage
Headwater	ABT-311	31.0	Assabet at Maynard Street, Westboro	X	X	X
Upper Mainstem	ABT-301	30.1	by Rte 9 East bridge, Westboro	X	X	
Upper Mainstem	ABT-280	28.0	by School St. bridge, Northboro	X	X	
Upper Mainstem	ABT-242	24.2	by Boundary Rd. bridge, Northboro	X	X	
Upper Mainstem	ABT-238	23.8	upstream of dam off Robin Hill Rd., Marlboro	X	X	
Upper Mainstem	ABT-162	16.2	by Cox Street bridge, Hudson	X	X	X
Upper Mainstem	ABT-144	14.4	downstream of Gleasondale dam, Rte 62, Stow	X	X	
Lower Mainstem	ABT-077	7.7	by USGS gage, Rte 27/62, Maynard	X	X	
Lower Mainstem	ABT-063	6.3	upstream of Rte 62 nr. Acton Ford, Acton	X	X	
Lower Mainstem	ABT-033	3.3	by Rte 62 bridge nr. Donut Shop, W. Concord	X	X	
Lower Mainstem	ABT-026	2.6	by Rte 2 bridge, Concord	X	X	
Lower Mainstem	ABT-010	1.0	nr Lowell Road, Concord (previously "nr. Dakins Brook")	X	X	
Tributaries	HOP-011	–	Hop Brook, nr Otis Street, Northboro	X	X	X
Tributaries	CLD-030	–	Cold Harbor Brook, Cherry Street bridge, Northboro	X	X	X
Tributaries	NTH-009	–	North Brook, Whitney Ave. bridge, Berlin	X	X	X
Tributaries	DAN-013	–	Danforth Brook, nr. Rte 85 bridge, Hudson	X	X	X
Tributaries	FTM-012	–	Fort Meadow Brook, Shay Road bridge, Hudson	X	X	X
Tributaries	ELZ-004	–	Elizabeth Brook, nr. White Pond Rd., Stow	X	X	X
Tributaries	NSH-002	T2.9	Nashoba Brook, Commonwealth Ave. bridge, W. Concord	X	X	X
Tributaries	SPN-003	--	Spencer Brook, Barrett's Mill Rd bridge, Concord	X	X	X

[a] *In-situ*: temperature, DO, pH, and conductivity
[b] Bottle Samples: TSS, TP, ortho-P, TKN, nitrates, and ammonia

Figure 1: Assabet River Watershed and Sampling Sites 2002

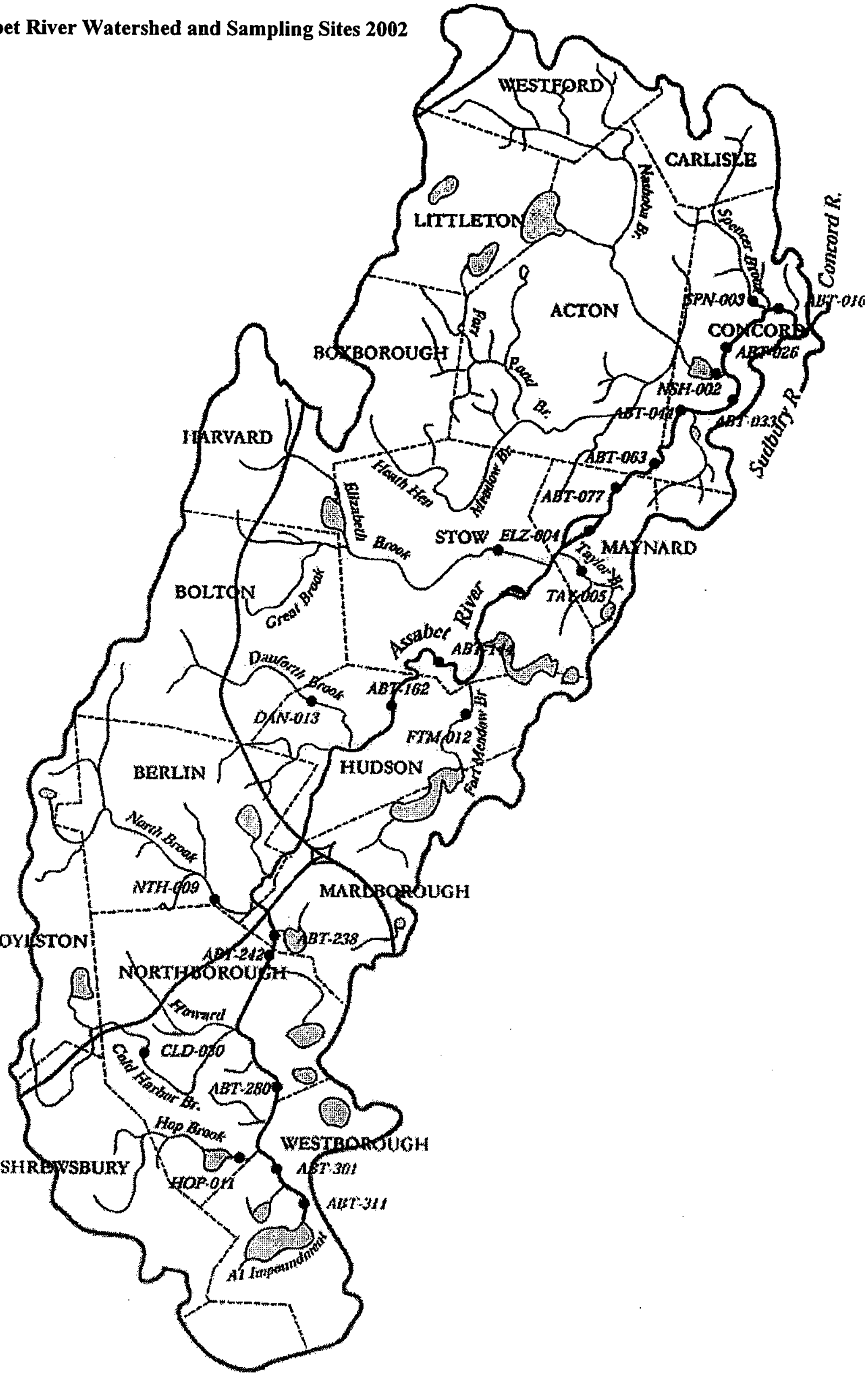


Figure 2: Assabet River Profile - Elevation vs. Rivermile

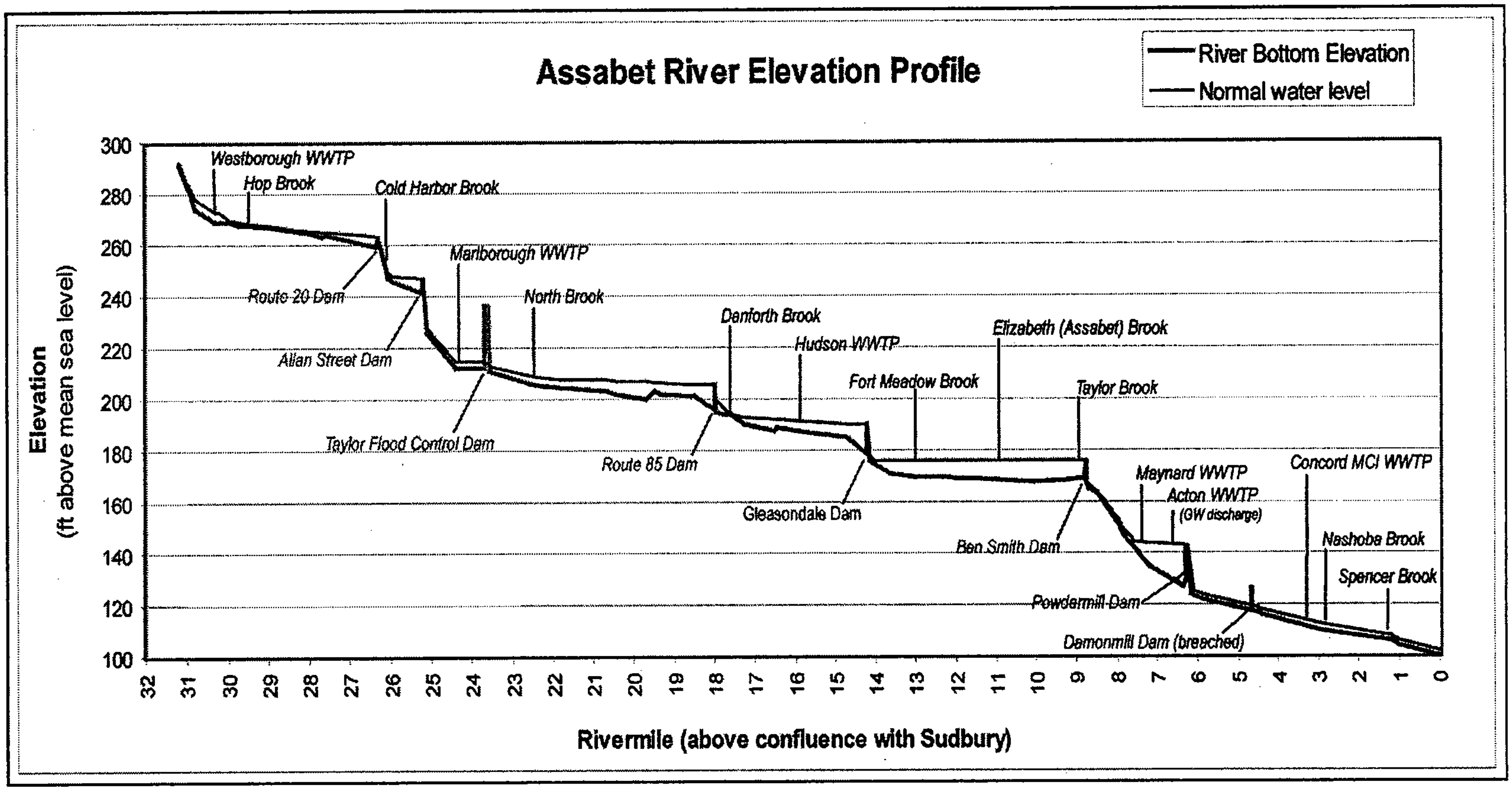


Table 2: Sampling and Analysis Methods

Parameter	Sample Type	Analysis Method #	Detection Limits	Sampling Equipment	Laboratory
Temperature	*in-situ*	—	-5 - 45° C	YSI 6000-series	—
pH	*in-situ*	—	0 to 14 units	YSI 6000-series	—
Dissolved oxygen	*in-situ*	—	0 - 50 mg/L	YSI 6000-series	—
Conductivity	*in-situ*	—	0 to 1000 μS/cm	YSI 6000-series	—
Total Suspended Solids	bottle	EPA 160.2[a]	1.0 mg/L	bottle	Thorstensen Laboratory
Total phosphorus	bottle	EPA 365.2	0.01 mg/L	bottle	Thorstensen Laboratory
ortho-Phosphate	bottle	EPA 365.2	0.01 mg/L	bottle	Thorstensen Laboratory
Total Kjeldahl Nitrogen	bottle	EPA 351.3	0.05 mg/L	bottle	Thorstensen Laboratory
Nitrates	bottle	EPA 352.1	0.01mg/L	bottle	Thorstensen Laboratory
Ammonia	bottle	EPA 350.3	0.03 mg/L	bottle	Thorstensen Laboratory
Fecal Coliforms	bottle	SM 9222D[b]	0 / 100ml	bottle	Thorstensen Laboratory

[a] USEPA, 1983.
[b] American Public Health Association, 1995.

Water quality measurements were compared with the Massachusetts Water Quality Standards for Class B waters (MADEP, 1997) and the guidance for determining use support (MADEP, 2002a) and with the EPA "Gold Book" total phosphorus criteria of 0.05 mg/L TP (USEPA, 1986) (Table 3). All segments of the Assabet are designated Class B warm waters; all of the tributary streams assessed in this project are designated Class B waters. For nutrient concentrations (where the Massachusetts standard is narrative) results were compared with summertime data for Ecoregion XIV subregion 59 streams (Table 4) (USEPA, 2000).

Table 3: Water Quality Standards and Guidance for Use Support

Parameter	Standard
Dissolved oxygen[a]	5.0 mg/l and 60% saturation in warm water fisheries 6.0 mg/l and 75% saturation in cold water fisheries
pH[a]	6.5 – 8.3 for inland waters
Nutrients[a]	"control cultural eutrophication"
Total phosphorus[b]	0.050 mg/L total phosphorus
Temperature[a]	28.3° C and Δ < 2.8° C for warm water fisheries 20.0° C and Δ < 1.7° C for cold water fisheries
Suspended Solids[c]	Aquatic life: 25 mg/L maximum, Δ 10 mg/L due to a discharge
Fecal Coliforms[c]	Primary contact recreational use Dry weather guidance: (<5 samples taken) <400cfu/100ml Wet weather guidance: dry weather samples meet and wet samples ≤ 2000 cfu/100ml Secondary contact recreational use Dry weather guidance: (< 5 samples taken) ≤ 2000 cfu/100ml Wet weather guidance: dry weather samples meet and wet samples ≤ 4000cfu/100ml
Aesthetics Biocommunity[c]	Primary or secondary contact recreational use: no nuisance organisms that render the water aesthetically objectionable or unusable, BPJ; Cover of macrophytes <50% within any portion of the lake area at maximum extent of growth.

[a] MADEP. 1997.
[b] US EPA. 1986.
[c] MADEP. 2002.

Table 4: Reference conditions for aggregate Ecoregion XIV subregion 59 streams [a]

Parameter	Reference condition (25th percentile based on summer data for Ecoregion XIV subregion 59)
Total Phosphorus (mg/L)	0.025
Total Nitrogen (mg/L)	0.44
NO2 + NO3 (mg/L)	0.34
TKN (mg/L)	0.30

[a] USEPA. 2000.

Note that the EPA recommendations for total phosphorus and total nitrogen water quality standards in river systems changed between the draft and final recommendations. In 2000 our results (OAR 2000b) were compared with the draft recommendations (USEPA 1999).

Reaches and Tributaries

All the sites tested this year were in relatively free-flowing sections of the river and tributaries. For the purposes of data analysis, the sites are divided into an upper reach, a lower reach, and the headwater and tributary sites. The upper reach of the river is from site ABT-301 (Route 9, Westborough) to site ABT-144 (Gleasondale, Stow). The lower reach of the river is from site ABT-077 (Route 62, Maynard) to site ABT-010 (near Lowell Road, Concord). For comparison with the mainstem reaches, the headwaters site ABT-311 (Maynard Street, Westborough) is either reported separately or analyzed with the tributary sites. ABT-311 is upstream of the first wastewater treatment plant discharge. Sites HOP-011 (Hop Brook), CLD-030 (Cold Harbor Brook), NTH-009 (North Brook), DAN-013 (Danforth Brook), FTM-012 (Fort Meadow), ELZ-004 (Elizabeth Brook), SPN-003 (Spencer Brook), and NSH-002 (Nashoba Brook) are all tributaries to the Assabet River. Table 5 lists tributary and mainstem basin characteristics calculated using USGS's StreamStats program.

Table 5: StreamStats drainage basin statistics

	Statistics at Mouth of Tributary[a]				
Tributary Streams	Latitude/Longitude at Mouth of Tributary	Drainage Area (sq.mi.)	Stratified Drift Area (sq.mi.)	% area stratified drift	Slope[b] (%)
Cold Harbor Brook, Northboro	42.3238/-71.6413	6.86	1.97	28.72	5.01
Danforth/ Mill Brook, Hudson	42.3897/-71.5666	7.17	2.06	28.73	3.58
Elizabeth Brook, Stow	42.4217/-71.4776	19.09	6.93	36.30	3.73
Fort Meadow Brook, Hudson	42.3975/-71.5169	6.25	1.76	28.16	3.77
Hop Brook, Northboro/Shrewsbury	42.2887/-71.6449	7.87	2.09	26.56	3.57
Nashoba Brook, Concord	42.4592/-71.3942	48.05	19.05	39.65	2.29
North Brook, Berlin	42.3576/-71.6188	16.89	4.12	24.39	4.38
Spencer Brook, Concord	42.4714/-71.3731	7.16	2.16	30.17	2.09
Taylor Brook, Maynard	42.4248/-71.4695	4.15	3.27	78.80	1.38
Mainstem Assabet	Statistics at Mainstem Assabet River Sites[a]				
mouth Assabet, Concord	42.4652/-71.3596	177.81	73.00	41.06	3.01
Boundary St., Marlboro/Northboro	42.3416/-71.6163	34.93	13.70	39.22	3.45
Maynard St., Westboro	42.2741/-71.6322	6.79	1.64	24.15	3.61
outlet of A1 Impound., Westboro	42.2672/-71.6354	6.51	1.53	23.50	3.65

[a] Calculated using USGS's StreamStats program.

[b] Slope is the mean basin slope calculated from the slope of each grid cell in the designated subbasin.

Results and Discussion

Reach and tributary statistics are summarized for the summer in Table 7, below. Full monthly summaries of the water quality data are attached in the Appendix. Individual parameters are discussed below.

Flow

Streamflow has a direct impact on the concentration of nutrients in the water column and the availability of aquatic habitat and an indirect impact on water temperature, dissolved oxygen concentration, pH, and conductivity. The mild drought that affected New England starting in late 2001 and over the summer of 2002 affected streams throughout the Assabet watershed. According to Mass Department of Environmental Management's Drought Management Task Force, although all areas of the state were downgraded from a drought "warning" to a drought "advisory" in May, monthly rainfalls in July, August, and September were below average and the drought advisory remained in effect until mid-December 2002.

In Table 6 and Figure 3 monthly mean streamflows on the mainstem Assabet for 2002, as measured at the UGSG gage in Maynard (USGS 01097000), are compared with the monthly means for the three previous years and for the period of record (1941 to 2002). Streamflows on the mainstem in 2002 were below 7Q2 flows (20.1 cfs; Wandle and Fontaine, 1984) for 20 consecutive days in August and below 7Q10 flows (15.1 cfs; Wandle and Fontaine, 1894) for nine of those days. Mean monthly streamflows were also below the long-term monthly means in September and October.

Once a week streamflow was calculated from the stage-discharge rating curve for the monitoring site on Danforth Brook (the pilot site for the StreamWatch project). When monitoring started in mid-June, flow in Danforth Brook was 1.7 cubic feet per second (cfs). Streamflows in Danforth dropped steadily during July and August to < 0.05 cfs by the third week of August and remained very low through the middle of October (Figure 4). Streamflows also appeared low at the other tributary sampling sites from July to October and the site at Spencer Brook was completely dry in September.

Table 6: Mean Monthly Streamflows (USGS Gage, Maynard)

	Mean Monthly Streamflows at USGS Gage, Maynard (cfs)				
Time Period	1999	2000	2001	2002	Period of Record [a]
June	29	246	234	151	153
July	20	72	85	37	73
August	19	81	27	19	62
September	95	46	18	25	63
October	92	60	31	54	92

[a] period of record: 1941 – present.
(http://waterdata.usgs.gov/ma/nwis/monthly/?site_no=01097000&agency_cd=USGS)

Figure 3: Mean Monthly Streamflows (USGS Gage, Maynard)

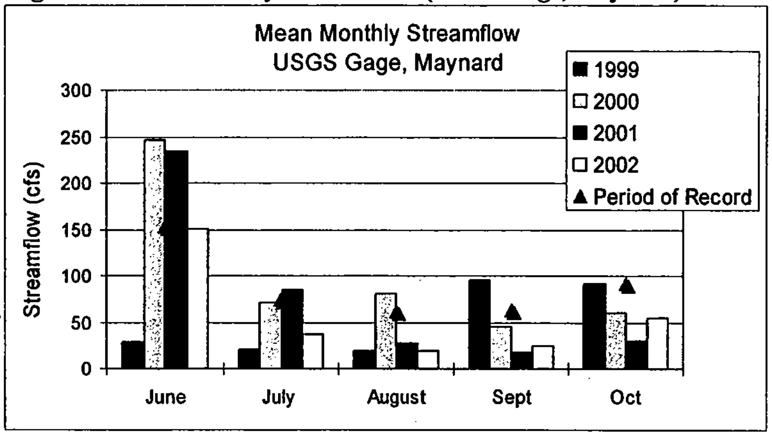


Figure 4: Flow in Danforth Brook - Summer 2002

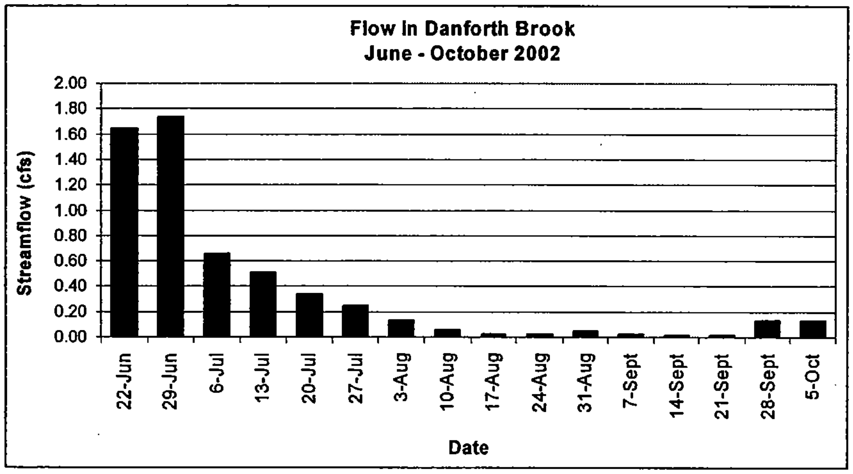


Figure 5: Danforth Brook, Hudson, August 24, 2002 (Flow = <0.05cfs)

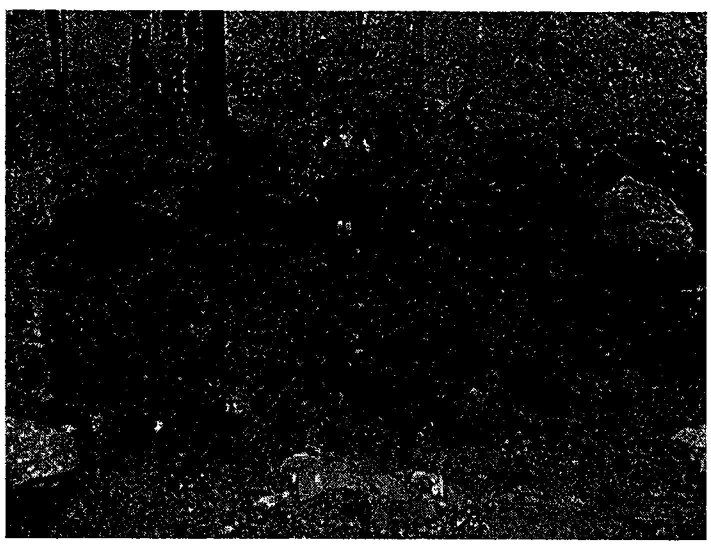


Table 7: Reach Statistics

Date	Sites	Reach	Statistic	Mainstem Reach and Tributary Statistics (morning readings between 5:30 - 8:30 am)												
				Water Temp (°C)	DO (mg/L)	DO % Sat.	Cond. (µS/cm)	pH	TSS (mg/L)	Total P (mg/L)	ortho-P (mg/L)	NO3 (mg/L)	NH3 (mg/L)	TKN (mg/L)	Avail. N	Total N
15-June-02	ABT-301 to ABT-010	Mainstem	Minimum	15.18	7.42	76.0	324	6.58	1.0	<0.01	<0.01	0.9	0.06	0.50	0.99	1.43
	ABT-301 to ABT-010	Mainstem	Maximum	17.29	9.32	94.8	414	7.08	8.0	0.31	0.10	2.3	0.21	0.73	2.38	2.72
	ABT-301 to ABT-010	Mainstem	Median	16.43	8.43	87.0	374	6.97	3.0	0.09	0.05	1.4	0.13	0.56	1.50	2.16
	ABT-301 to ABT144	Upper Mainstem	Median	15.47	8.44	84.2	385	6.98	3.5	0.17	0.07	2.0	0.10	0.54	2.03	2.51
	ABT-077 to ABT-010	Lower Mainstem	Median	17.23	8.43	87.7	347	6.96	3.0	0.09	0.04	0.9	0.14	0.56	1.05	1.56
	ABT-311 & Tributaries	Headwater & Tributaries	Minimum	13.92	1.31	14.0	105	5.87	<1.0	<0.01	<0.01	0.01	0.03	0.03	0.04	0.56
	ABT-311 & Tributaries	Headwater & Tributaries	Maximum	17.36	9.38	92.2	386	7.17	6.0	0.25	0.11	0.69	0.14	1.20	0.82	1.51
	ABT-311 & Tributaries	Headwater & Tributaries	Median	16.20	8.84	87.9	176	6.80	2.0	0.005	0.005	0.31	0.06	0.55	0.36	1.10
20-July-02	ABT-301 to ABT-010	Mainstem	Minimum	20.76	5.09	57.2	565	6.37	<1.0	<0.01	<0.01	1.1	0.07	0.15	1.19	1.26
	ABT-301 to ABT-010	Mainstem	Maximum	24.12	7.97	94.0	867	7.38	5.0	0.46	0.12	8.7	0.23	1.40	8.84	9.31
	ABT-301 to ABT-010	Mainstem	Median	22.66	6.34	74.0	679	7.12	1.0	0.01	0.01	2.5	0.11	0.78	2.61	3.37
	ABT-301 to ABT144	Upper Mainstem	Median	21.23	5.78	64.9	738	6.85	1.0	0.21	0.09	4.0	0.13	0.84	4.17	5.11
	ABT-077 to ABT-010	Lower Mainstem	Median	22.99	6.52	75.6	595	7.20	1.0	0.01	0.01	1.1	0.10	0.66	1.20	1.76
	ABT-311 & Tributaries	Headwater & Tributaries	Minimum	18.60	0.74	8.4	63	5.85	<1.0	<0.01	<0.01	<0.01	0.06	0.18	0.09	0.29
	ABT-311 & Tributaries	Headwater & Tributaries	Maximum	23.52	8.42	92.4	704	7.38	27.5	0.47	0.10	1.1	0.70	0.84	1.17	1.28
	ABT-311 & Tributaries	Headwater & Tributaries	Median	20.99	5.84	67.9	361	6.88	1.3	0.01	0.01	0.29	0.08	0.31	0.39	0.59
17-August-02	ABT-301 to ABT-010	Mainstem	Minimum	23.55	1.47	18.2	702	6.51	<1.0*	<0.01*	<0.01*	1.1*	0.03*	0.25*	1.13*	1.55*
	ABT-301 to ABT-010	Mainstem	Maximum	27.27	7.37	93.1	1031	7.52	17.0*	0.42*	0.16*	10.3*	0.34*	1.10*	10.37*	10.82*
	ABT-301 to ABT-010	Mainstem	Median	25.48	6.47	77.6	880	7.16	1.0*	0.10*	0.08*	3.7*	0.07*	0.49*	3.77*	4.14*
	ABT-301 to ABT144	Upper Mainstem	Median	24.46	5.52	65.3	964	6.84	0.8*	0.22*	0.10*	6.8*	0.08*	0.51*	6.87*	7.25*
	ABT-077 to ABT-010	Lower Mainstem	Median	26.12	6.81	84.3	732	7.32	1.0*	0.09*	0.07*	1.3*	0.03*	0.35*	1.33*	1.78*
	ABT-311 & Tributaries	Headwater & Tributaries	Minimum	18.32	1.14	13.3	102	5.94	<1.0*	<0.01*	<0.01*	0.2*	0.02*	0.13*	0.35*	0.54*
	ABT-311 & Tributaries	Headwater & Tributaries	Maximum	27.36	7.90	91.9	831	7.45	18.0*	0.28*	0.19*	1.4*	0.41*	1.70*	1.56*	2.60*
	ABT-311 & Tributaries	Headwater & Tributaries	Median	22.89	4.77	55.5	394	6.78	5.0*	0.005*	0.005*	0.3*	0.12*	0.96*	0.44*	1.40*

* August nutrient data not for regulatory use; data did not pass QC.

Table 7: Reach and Tributary Statistics - Continued

	Sites	Reach	Statistic	Water Temp (°C)	DO (mg/L)	DO %Sat	Cond (µS/cm)	pH	TSS (mg/L)	Total P (mg/L)	Ortho P (mg/L)	NO3 (mg/L)	NH3 (mg/L)	TKN (mg/L)	Avail N	Total N
21-September-02	ABT-301 to ABT-010	Mainstem	Minimum	18.88	3.44	38.1	572	6.64	<1.0	0.07	0.04	1.4	0.08	0.15	1.77	1.90
	ABT-301 to ABT-010	Mainstem	Maximum	21.14	9.47	106.7	927	7.52	17.0	0.46	0.38	10.5	0.42	0.82	10.69	10.82
	ABT-301 to ABT-010	Mainstem	Median	20.29	7.24	79.4	763	7.17	1.0	0.10	0.08	6.2	0.09	0.32	6.47	6.60
	ABT-301 to ABT144	Upper Mainstem	Median	20.21	6.13	67.4	848	6.88	0.5	0.32	0.29	7.5	0.17	0.30	7.57	7.64
	ABT-077 to ABT-010	Lower Mainstem	Median	20.32	8.56	95.4	634	7.32	2.0	0.08	0.06	1.7	0.25	0.36	1.95	2.02
	ABT-311 & Tributaries	Headwater & Tributaries	Minimum	15.25	1.80	19.2	70	6.22	<1.0	<0.01	<0.01	0.15	0.06	0.18	0.27	0.37
	ABT-311 & Tributaries	Headwater & Tributaries	Maximum	21.28	8.51	91.3	716	7.25	51.0	0.08	0.04	1.1	1.00	1.20	1.70	1.91
	ABT-311 & Tributaries	Headwater & Tributaries	Median	18.68	5.77	62.4	331	7.01	1.0	0.02	0.01	0.21	0.27	0.40	0.54	0.59
19-October-02	ABT-301 to ABT-010	Mainstem	Minimum	10.08	7.19	70.7	344	6.62								
	ABT-301 to ABT-010	Mainstem	Maximum	14.49	10.23	91.3	733	7.31								
	ABT-301 to ABT-010	Mainstem	Median	11.22	9.40	85.4	448	7.12								
	ABT-301 to ABT144	Upper Mainstem	Median	11.08	9.36	84.4	421	6.92								
	ABT-077 to ABT-010	Lower Mainstem	Median	11.27	9.40	86.0	451	7.25								
	ABT-311 & Tributaries	Headwater & Tributaries	Minimum	7.67	3.06	27.2	43	6.21								
	ABT-311 & Tributaries	Headwater & Tributaries	Maximum	11.48	10.71	93.0	423	7.46								
	ABT-311 & Tributaries	Headwater & Tributaries	Median	9.23	9.43	81.8	233	7.02								

Temperature and pH

Dissolved oxygen (DO), water temperature, pH, and conductivity measurements were taken in June, July, August, September, and October between 5:30am – 8:30am, when daily dissolved oxygen concentrations are expected to be at their lowest. Summary statistics for all *in-situ* readings are in Table 7, above.

Water temperatures in the mainstem and tributaries met standards criteria on all dates tested. Temperatures in the mainstem ranged from 7.67 – 27.27 °C, with the lowest readings in October and the highest in August. Temperatures in the tributaries ranged from 8.35 – 27.36 °C, with the lowest reading in October and the highest in August.

pH in the mainstem met standards criteria at all mainstem sites on all dates tested except for ABT-301 in July; pHs in the mainstem ranged from 6.37 – 7.52. In the tributaries, pH's below the WQS (6.5) were measured in Taylor Brook (June, July, and August), Cold Harbor Brook (July, August, September, and October), and Danforth Brook (August and September). The low pH readings were generally associated with dissolved oxygen readings below 5.0 mg/L. The low DO and pH readings were likely a result of stagnant conditions or natural conditions: the flow in Danforth Brook site was virtually stagnant (<0.5 cfs) in August and September; the Cold Harbor Brook site is below a long swampy area (Figure 6); both the Elizabeth and Taylor Brook sites are below beaver dams.

Figure 6: Cold Harbor Brook, near West Street, Northborough, upstream of sampling site.

Dissolved Oxygen

Dissolved oxygen concentrations are generally lowest between 5am – 8am after plant and microbial respiration has been removing oxygen from the water column overnight. Low minimum DO concentrations and large diurnal variations in DO indicate eutrophic conditions. Summary statistics for DO readings are in Table 7, above.

DO concentrations on the mainstem failed to meet standards criteria (≥ 5.0 mg/L and 60% saturation) at one site in July, three sites in August, and one site in September. DO concentrations in the mainstem ranged from 7.42 – 9.32 mg/L in June, 5.09 – 7.97 mg/L in July, 1.47 – 7.37 mg/L in August, 3.44 – 9.47 mg/L in September, and 7.19 – 10.23 mg/L in October. Figures 7 and 8, below, show DO concentrations in August.

DO concentrations at tributary sites failed to meet standards criteria at two sites in June, three sites in July, seven sites in August, three sites in September, and one site in October. The low DO readings were likely a result of upstream swampy conditions, beaver dams, or stagnant conditions at the site. The low DO readings at Elizabeth Brook were investigated further (see "Elizabeth Brook in September," below).

Figure 7: Mainstem Dissolved Oxygen Concentrations - Aug 2002

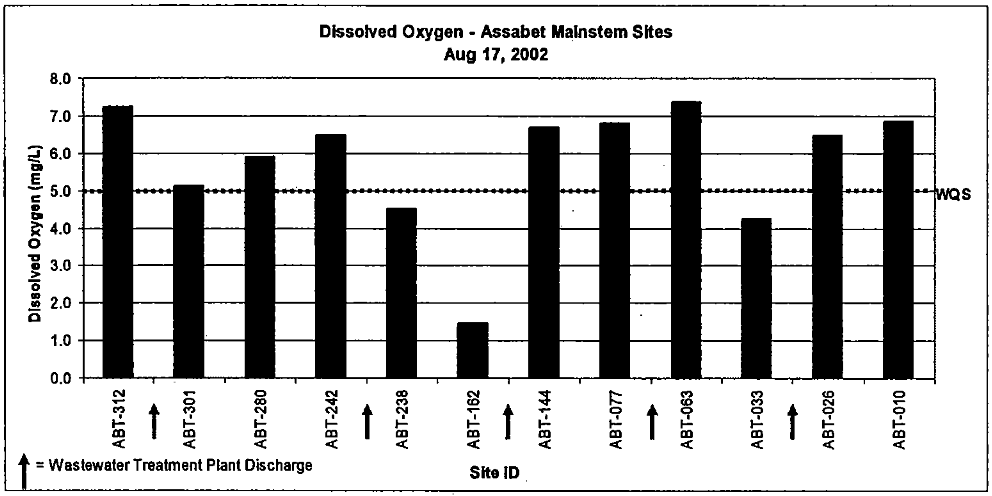
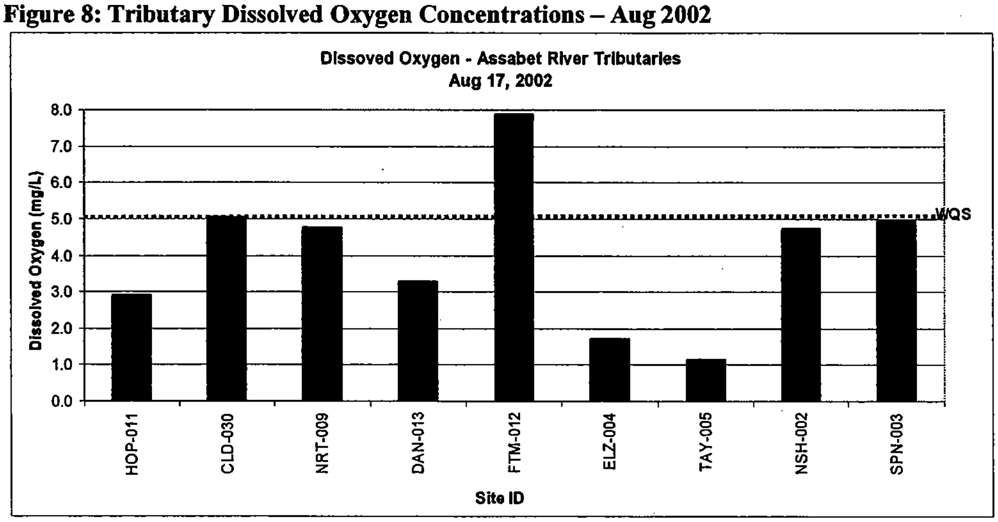


Figure 8: Tributary Dissolved Oxygen Concentrations – Aug 2002



Nutrients

Summary statistics for nutrient concentrations are in Table 7, above. Median nutrient concentrations were calculated for the upper (sites ABT-301 to ABT-144) and lower (sites ABT-077 to ABT-010) mainstem reaches and for the combined headwater and tributary sites. (Figures 9 – 12 show nutrient concentrations in the mainstem vs. the headwater and tributary sites.)

In general, nutrient concentrations along the mainstem below the first wastewater discharge were well above Ecoregion reference conditions (25^{th} percentile of the summertime data) for total phosphorus, total nitrogen, and nitrates. Total phosphorus concentrations in the mainstem ranged from <0.01 – 0.46 mg/L, exceeding the Ecoregion reference condition, 0.025 mg/L, and the EPA "Gold Book" criteria, 0.050 mg/L, in 33 of 44 measurements. Total nitrogen concentrations ranged from 2.16 – 10.82 mg/L, exceeding the reference condition, 0.44 mg/L, in 40 of 40 measurements. Nitrate concentrations ranged from <0.01 mg/L to 10.5 mg/L nitrate-N, exceeding the reference condition, 0.34 mg/L nitrate + nitrite-N, in 44 of 44 measurements. Median nutrient concentrations in the mainstem river were higher in the upper reach than in the lower reach for total phosphorus, ortho-phosphorus, total nitrogen, and nitrate concentrations. Ammonia concentrations ranged from 0.03 – 0.42 mg/L ammonia-N, with median concentrations lower in the upper reach than the lower reach in June and September.

In headwaters and the tributaries, total phosphorus (TP) and ortho-phosphate (ortho-P) concentrations were significantly lower than in the mainstem reaches. Total phosphorus concentrations ranged from <0.01 mg/L – 0.47 mg/L TP, with 29 of 40 total phosphorus readings below 0.025 mg/L TP. Median total phosphorus concentrations in these sites were below the median TP concentrations for both the upper and lower mainstem reaches. The highest total phosphorus concentrations were measured in Elizabeth Brook (see discussion below). Total nitrogen (TN) concentrations in the headwater and tributaries ranged from 0.29 – 2.60 mg/L, exceeding 0.34 mg/L in 27 of 34 measurements. The median TN and nitrate concentrations at the headwater and tributary sites were also lower than median concentrations in the mainstem. Ammonia concentrations ranged from 0.02 – 1.00 mg/L, with the highest measurement at Elizabeth Brook. Median ammonia concentrations were higher in the tributaries than in either mainstem reach in August and higher than in the upper mainstem reach in September.

Figure 9: Total Phosphorus Concentrations (2002)

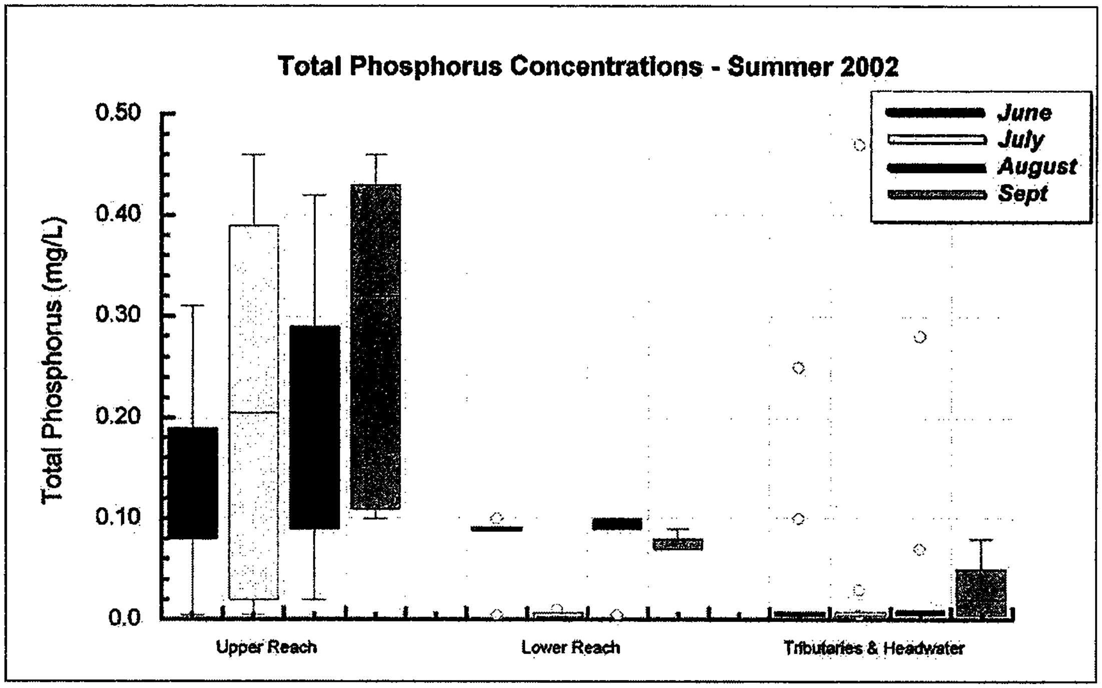


Figure 10: Total Nitrogen Concentrations (2002)

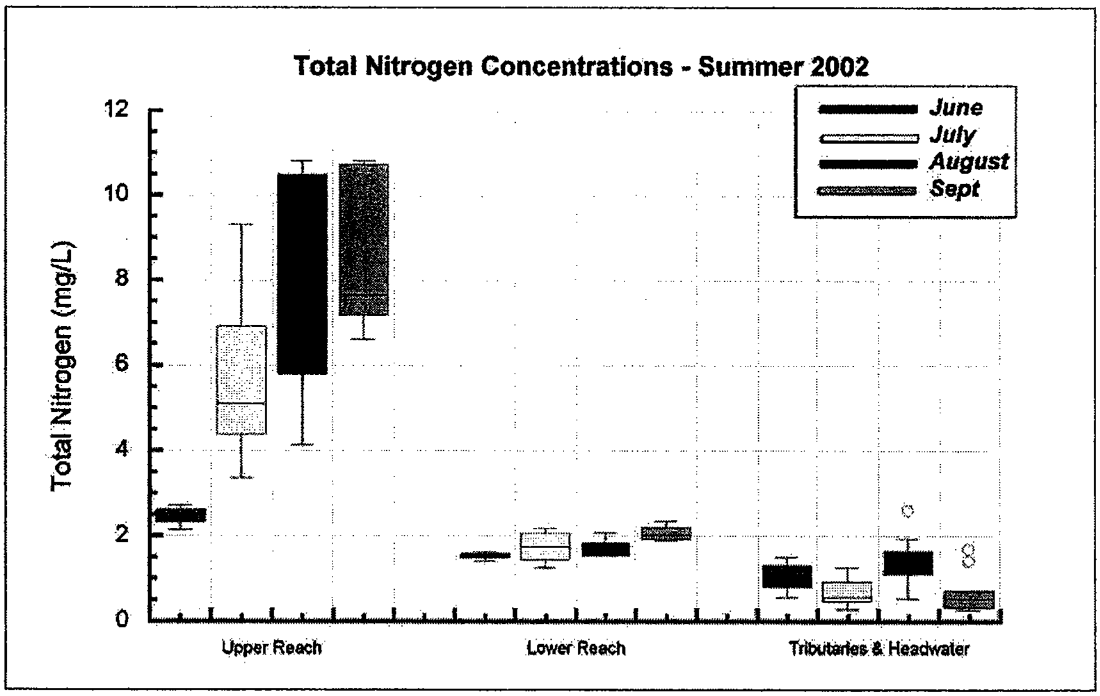


Figure 11: Nitrate Concentrations (2002)

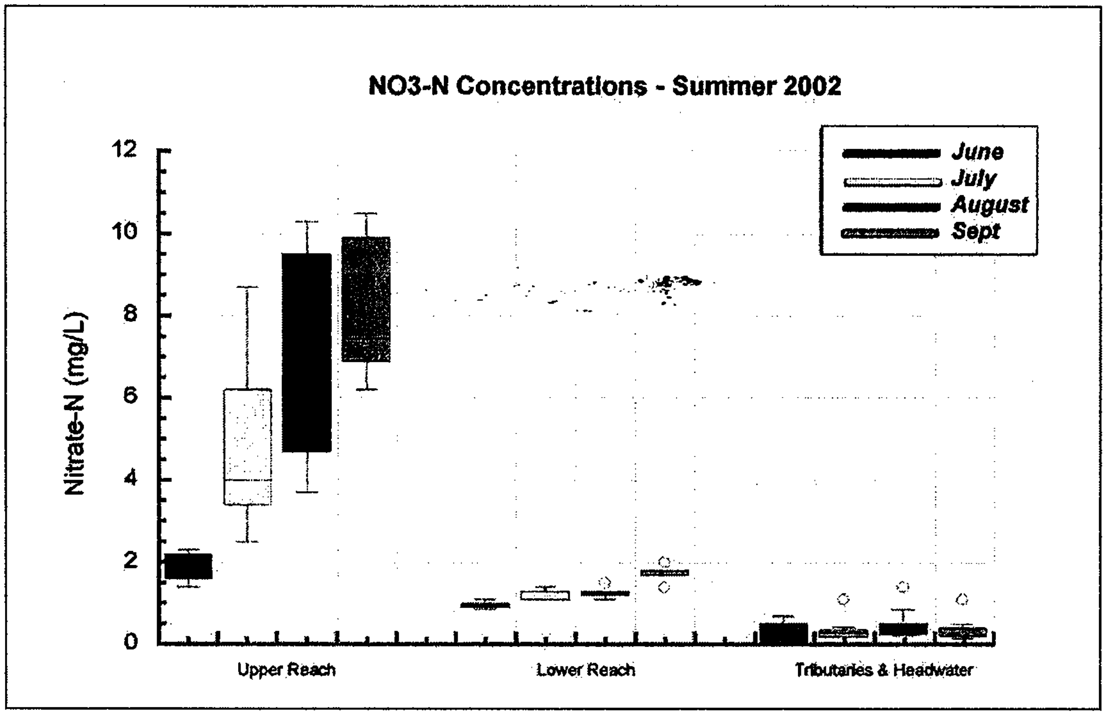
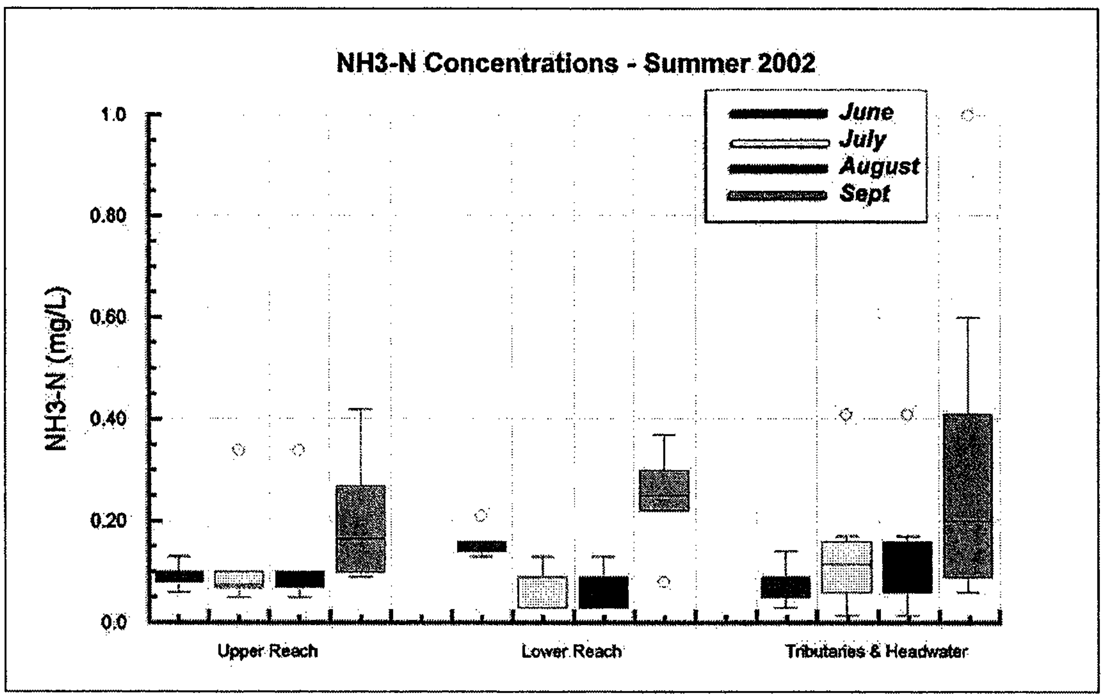


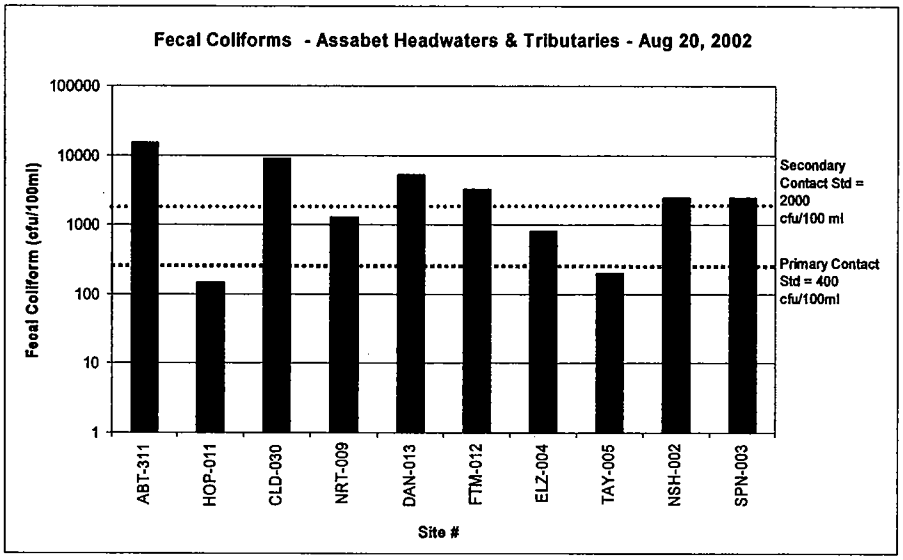
Figure 12: Median Ammonia Concentrations (2002)



Fecal Coliforms

Headwater and tributary sites were tested for fecal coliforms on August 20th in the first six hours after 0.44 inches of rainfall following 14 days with trace or no precipitation. Fecal coliform counts at six of the ten sites tested (Figure 13) exceeded the recommended secondary contact standard (2000cfu/100ml; MADEP 2002a). These results suggest the need for further wet and dry weather sampling on the tributaries.

Figure 13: Fecal coliforms (August 20, 2002)



Elizabeth Brook in September

Because total phosphorus concentrations (Figure 14) in Elizabeth Brook had been higher than in any of the other tributaries over the summer and dissolved oxygen concentrations (Figure 15) in the brook were very low, the brook was surveyed visually on August 20th and further *in-situ* readings were taken upstream on September 25th.

Figure 14: Total Phosphorus Concentrations in Tributaries

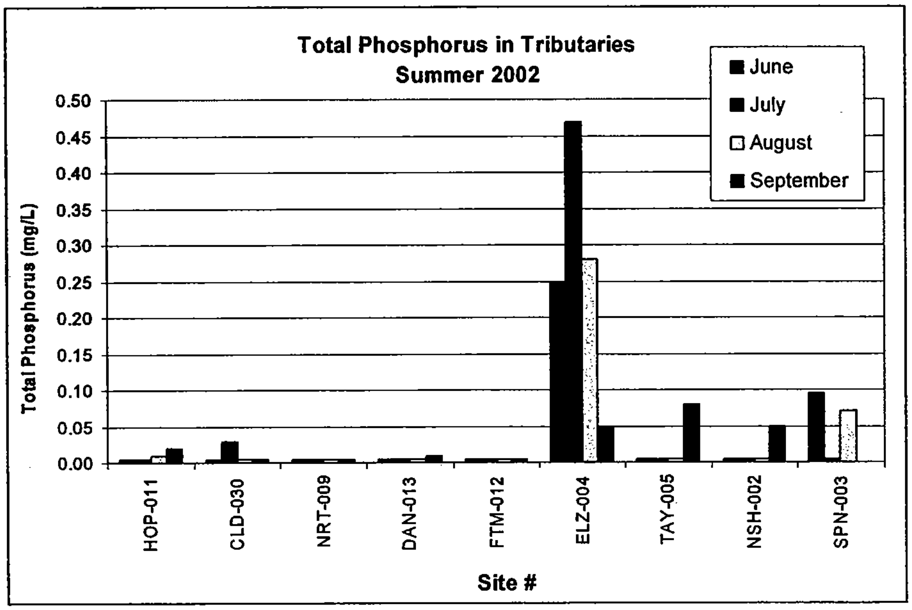
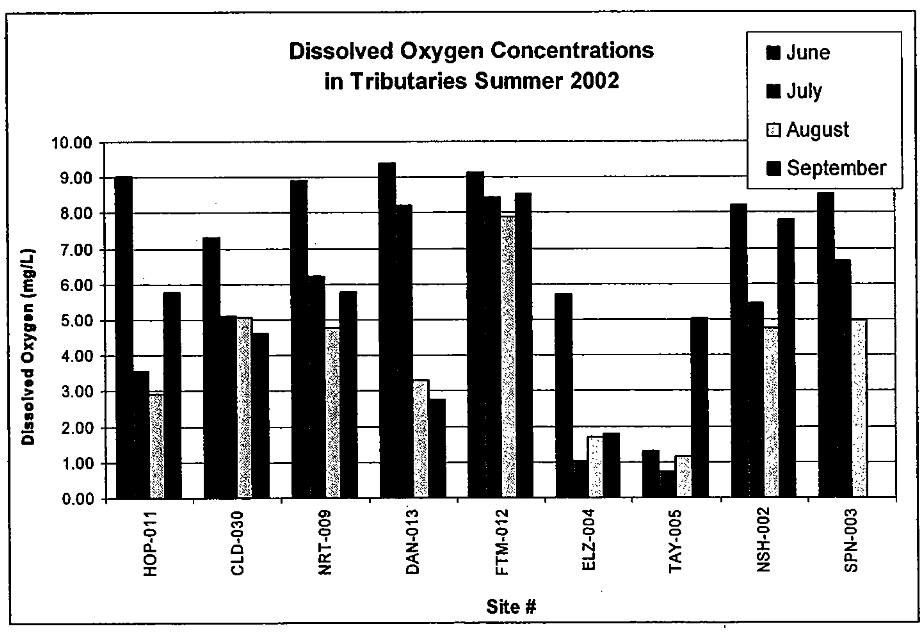


Figure 15: Dissolved Oxygen Concentrations in Tributaries



About 0.6mi upstream from the regular sampling site a beaver dam was found blocking a culvert in the Stow Town Forest (Gardner Hill Conservation Area). When the stream was initially surveyed on August 20th, the beaver dam had been partially breached and was, apparently, releasing stored water from the impounded section above the dam. By September 25th, when the *in-situ* measurements were taken, the beaver dam had been completely removed and grating installed under the culvert. (Figures 16 & 17). *In-situ* measurements were taken at seven sites (Table 8, Figs. 18 & 19) starting at the regular sampling site (ELZ-004) and working upstream. Dissolved oxygen readings in the free-flowing sections of the stream upstream of the area impacted by the beaver dam were over 100% saturation (Table 8); in comparison, DO readings at the two sites downstream of the beaver dam were 32.2% and 41.6%. DO concentrations in Fletcher Pond were also very low (1.18%). It is likely that the low DO concentrations and high nutrient readings at ELZ-004 over the summer reflected the impact of upstream the beaver dam on water quality.

Similarly, the Taylor Brook sampling site is just downstream of a beaver dam blocking a culvert under Old Patrol Road on the Assabet River National Wildlife Refuge, although that dam remained undisturbed through the summer and there was little flow over or through the dam. Dissolved oxygen measurements at Taylor Brook over the summer were very low but, unlike Elizabeth Brook, total phosphorus concentrations (and other nutrients concentrations measured) were low.

Table 8: In-situ readings on Elizabeth Brook, Sept 25, 2002

Elizabeth Brook – September 25, 2002								
Site/Sample ID #			*In-situ* Readings					
Site ID #	Site Name	Town	Time	Water Temp (°C)	DO (mg/L)	DO % Sat	Cond. (µS/cm)	pH
ELZ-051	US* of Delaney Rd bridge	Stow	1:40 PM	19.21	9.81	106.3	338	6.76
ELZ-039	DS* of Rte 117 bridge	Stow	1:28 PM	16.64	9.87	101.4	289	6.82
ELZ-025	US of Wheeler Rd bridge	Stow	1:18 PM	20.22	9.67	106.9	261	6.98
ELZ-019	in Fletcher Pond	Stow	12:57 PM	20.31	1.18	13.1	290	6.65
ELZ-018	Box Mill Rd. DS of dam	Stow	1:04 PM	19.31	7.71	83.7	280	6.82
ELZ-010	DS of culvert at town forest	Stow	12:41 PM	16.50	3.14	32.2	235	6.53
ELZ-004	DS of culvert nr. White Pond Rd.	Stow	12:21 PM	16.62	4.05	41.6	245	6.57

* US = upstream; DS = downstream

Figure 16: Partially-breached beaver dam at Stow Town Forest (August 20, 2002)

Figure 17: Breached beaver dam at Stow Town Forest (September 25, 2002)

Figure 18: Elizabeth Brook Downstream Sampling Sites, Stow MA (Sept 02)

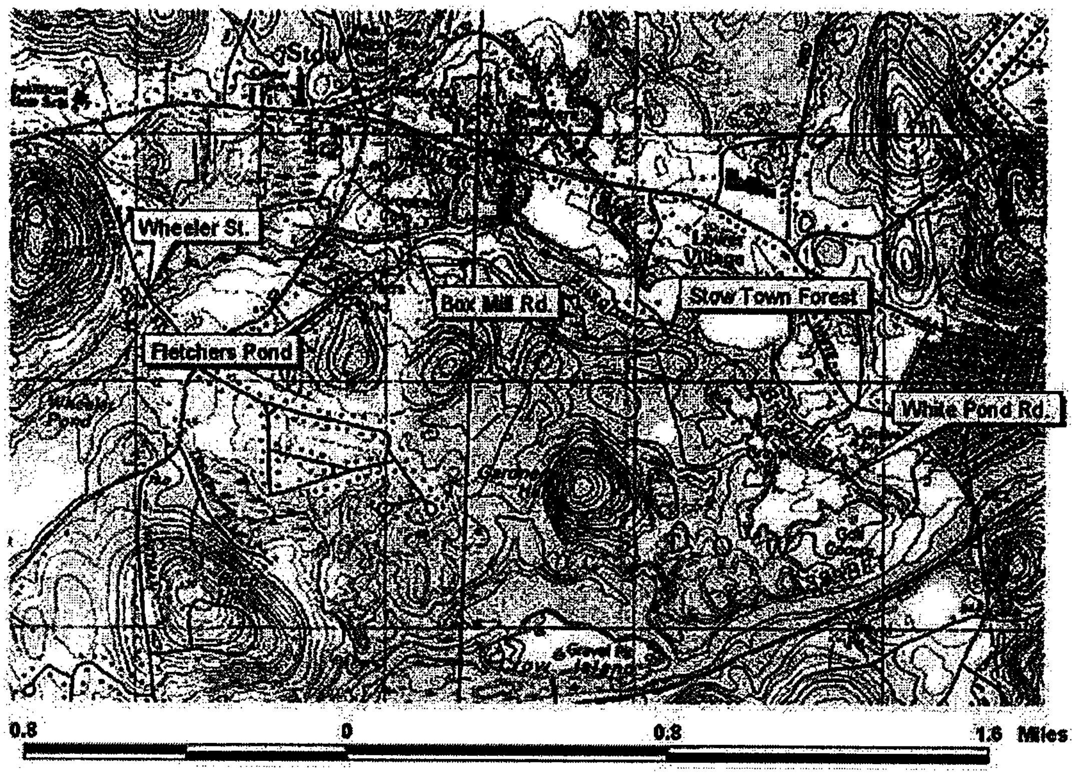
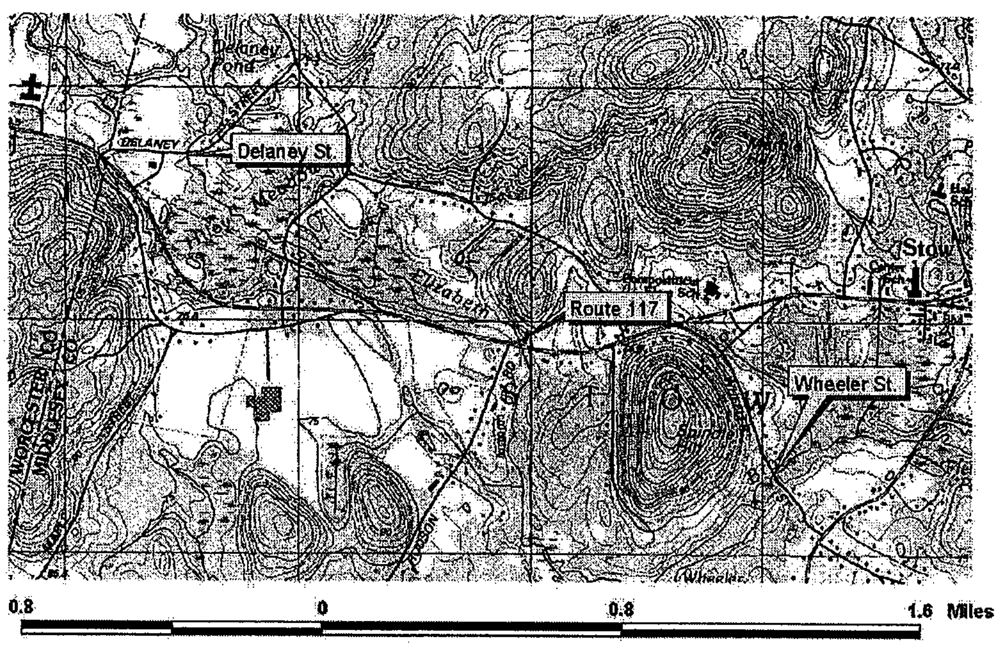


Figure 19: Elizabeth Brook Upstream Sampling Sites, Stow MA (Sept 02)



Conclusions

The mild drought that affected New England over the summer of 2002 affected streams throughout the Assabet watershed. The mean monthly streamflows at the USGS gage on the Assabet in Maynard were near normal in June 2002, but low from July to the beginning of October as compared with the period of record. Flows in Danforth Brook were very low, dropping from 1.7 cfs when monitoring started in mid-June to <0.05 cfs by the third week of August and remaining very low through the middle of October. The sampling site at Spencer Brook was dry in September.

Dissolved oxygen (DO) concentrations at mainstem Assabet sites below the first wastewater treatment plant discharge failed to meet the Massachusetts Class B dissolved oxygen criteria in 5 of 48 measurements (10.4%) from June to September. DO concentrations at tributary and headwater sites failed to meet DO criteria in 14 of 45 measurements (31.1%); the main problems on the tributaries appeared to be related to low flows in the late summer or natural conditions such as upstream marshy conditions or beaver dams.

On the mainstem Assabet River starting below the first wastewater treatment plant discharge, nutrient concentrations, both phosphorus and nitrogen species, were consistently above maximum recommended levels. Total phosphorus concentrations on the mainstem ranged from <0.01 to 0.46 mg/L. Total nitrogen concentrations on the mainstem below the first wastewater discharge ranged from 1.26 to 10.82 mg/L. Median total phosphorus and total nitrogen concentrations in both the upper and lower mainstem reaches were higher than in the headwater and tributary sites.

Nutrient concentrations in the Assabet headwater (upstream of the first wastewater treatment plant discharge) and tributary sites were generally lower than on the mainstem. Total phosphorus concentrations at these sites were generally below the EPA reference condition (25^{th} percentile of the Ecoregion summer data) of 0.025 mg/L TP, ranging from <0.01 – 0.47 mg/L with median concentrations below 0.025 mg/L. The highest TP readings were on Elizabeth Brook in July and August when the upstream beaver dam was likely being breached and releasing the water impounded behind the dam.

Total nitrogen concentrations on the tributaries ranged from 0.29 to 2.60 mg/L. Median total nitrogen concentrations were lower in the headwater and tributaries than in the mainstem. Median ammonia concentrations in headwater and tributary sites varied over the summer with the highest ammonia concentration (1.00 mg/L) measured at the Elizabeth Brook site in September when that site was likely still affected by the breaching of the upstream beaver dam. The median ammonia concentration in the headwaters and tributaries was lower than the mainstem median concentrations in June and July, but higher in August and similar to the mainstem concentrations in September.

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Glossary of Terms

Ammonia (NH3): a form of nitrogen available to uptake by plants and microorganisms. Sources include the breakdown of organic nitrogen in sediments and untreated sewage. Other sources of ammonia include: fertilizer, home cleaning products and food processing. While ammonia can be readily utilized by plants, high concentrations of ammonia are directly toxic to aquatic life. A secondary effect of increased ammonia occurs when bacteria oxidize the NH_3 to NO_3, a process called nitrification, consuming four atoms of oxygen for every atom of nitrogen converted. This process can dramatically lower dissolved oxygen in the water.

Baseflow: the flow of water from aquifers into the streambed. In natural systems in New England baseflow makes up most of the river flow during the summer.

Biochemical oxygen demand (BOD): oxygen required to break down organic matter and to oxidize reduced chemicals (in water or sewage). BOD provides a direct measure of the decomposition or oxidation processes in the water column. The more difficult-to-perform **sediment oxygen demand (SOD)** test measures the decomposition processes in the sediments.

Conductivity: the ability of the water to conduct a charge, which increases with increasing concentrations of charged ions in the water. Conductivity is a rough indicator of pollutants, such as untreated waste, entering the stream.

Dissolved Oxygen: the presence of oxygen gas molecules (O2) in the water. The concentration of dissolved oxygen (DO) in the water column provides a direct indication of the water's ability to support aquatic life like fish and macroinvertebrates. Aquatic plants and bacteria in the sediments remove dissolved oxygen from the water when they respire (plants respire mainly at night). Therefore, the lowest dissolved oxygen concentrations of the day occur in the early in the morning. During the day plants add oxygen to the water column through photosynthesis. Both extreme (low or high) DO concentrations and large changes in DO concentrations over the day (diurnal variation) are damaging to the habitat.

Eutrophic: abundant in nutrients and having high rates of productivity frequently resulting in oxygen depletion below the surface layer.

Mesotrophic: having a nutrient loading resulting in moderate productivity.

Nitrogen: a major nutrient supporting plant growth. Nitrogen is measured in its various forms as **nitrate (NO_3), ammonia (NH_3),** and **total Kjeldahl nitrogen (TKN). Total nitrogen** is calculated as the sum of TKN and nitrates. **Available nitrogen**, calculated as the sum of nitrate and ammonia, gives a measure of the nitrogen readily available for absorption by plants. Once absorbed, nitrogen is incorporated into proteins, amino acids, nucleic acids, and other molecules. Although most aquatic plant growth in rivers is limited by the availability of phosphorus, increased nitrogen availability can also lead to algal blooms.

Oligotrophic: having a small supply of nutrients, low production of organic matter, low rates of decomposition, and high dissolved oxygen in the lower layers of the water column.

Phosphorus: Plants need nutrients to grow; in particular they need a balance of phosphorus (P) and nitrogen (N). Phosphorus is measured as **total phosphorus** (TP) and **ortho-phosphate** (ortho-P; soluble inorganic phosphate, the form required by plants). In most fresh waters, the concentration of phosphorus available to plants is low enough that the plants cannot grow at their maximum rate. But in water bodies, like the Assabet, where human activities add phosphorus to the environment, the added phosphorus allows much greater growth of aquatic plants.

Oxidation/reduction potential provides a measure of the condition of the suspended solids: to what extent the organic material in them has been degraded by microorganisms.

pH: the negative log of the hydrogen ion concentration in water, a measure of the acidity of water. pH is measured on a scale from 1 to 14, with 1 being very acidic, 7 being neutral, and 14 being very basic. Extreme pHs, in either direction, can be toxic to fish and other aquatic life. pH plays role in the behavior of other pollutants such as heavy metals in the environment. High or low pH levels can be the result of acid rain/snow, chemicals entering the waterways, or algal blooms.

Total suspended solids (TSS): the amount of silt, clay, organic material and algae in the water. Sources include erosion and the solids in effluent. Once in the water column, suspended solids are transported downstream and settle gradually, along with decaying plant matter, to form thick organic-rich sediments in the slower sections of the river.

Stage and streamflow measure the amount of water in the river. Stage is the height of the water above the riverbed, and is read at staff gages at several points along the mainstem river and at sites on eight tributaries. Streamflow measures the volume of water passing a given point in the river. Flow is measured by the USGS at their gage in Maynard and reported on the USGS web page; flow at the Danforth Brook site is calculated from the Danforth rating curve.

Temperature affects the ecosystem in a number of ways: many organisms, especially cool water fish, are sensitive to high temperatures; the solubility of oxygen is lower in warmer water, decreasing the supply of dissolved oxygen; algae, weeds, and pathogenic microorganisms can all grow faster in warmer water.

Appendix I: Massachusetts Proposed Listing of Individual Categories of Waters

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Massachusetts Category 2 Waters: "Attaining some uses; other uses not assessed"			
Name	Segment ID	Description	Uses Attained
Fort Meadow Brook (8247220)	MA82B-11_2002	Outlet of Fort Meadow Reservoir (Marlboro/Hudson) to confluence with Assabet River, Hudson. Miles 2.8 – 0.0	Aquatic Life Aesthetics
Massachusetts Category 3 Waters: "No Uses Assessed"			
Name	Segment ID	Description	No uses assessed
Elizabeth Brook (8247150)	MA82B-12_2002	From outlet of unnamed pond (Delaney Project) west of Harvard Road to inlet Fletchers Pond, Stow. Miles 3.8 – 0.0	
Nashoba Brook (8246875)	MA82B-14_2002	Source just south of Route 110 in Westford to confluence with Fort Pond Brook, Concord. Miles 9.0 – 0.0	
Spencer Brook (8246825)	MA82B-15_2002	Outlet of unnamed pond, Carlisle north of Bellows Hill to inlet Angiers Pond, Concord. Miles 4.0 – 0.0	
Taylor Brook (8247100)	MA82B-08_2002	Outlet Puffer Pond to confluence with Assabet River, Maynard. Miles 1.80 – 0.0	
Massachusetts Category 4c Waters: "Impairment not caused by a pollutant"			
Name	Segment ID	Description	Impairment Cause
Unnamed tributary (8246805)	MA82B-16_2002	Outlet of Angiers Pond to confluence with Assabet River, Concord. Miles 0.5 – 0.0	Flow alternation
Massachusetts Category 5 Waters: "Waters requiring a TMDL"			
Name	Segment ID	Description	Pollutant Needing TMDL
Assabet River Reservoir (82004)	MA82004_2002	Westborough	Metals; Noxious aquatic plants; Turbidity; (Exotic species)
Warner's Pond (82110)	MA82110_2002	Concord	Metals; Noxious aquatic plants; (Exotic species)
Assabet River (8246775)	MA82B-01_2002	Outlet Flow Augmentation Pond to Westborough WWTP, Westborough. Miles 31.8 – 30.4	Nutrients; Organic enrichment/Low DO; Pathogens
Assabet River (8246775)	MA82B-02_2002	Westborough WWTP, Westborough to Route 20 Dam, Northborough. Miles 30.4 – 26.7	Metals; Nutrients; Organic enrichment/Low DO; Pathogens
Assabet River (8246775)	MA82B-03_2002	Route 20 Dam, Northborough to Marlborough West WWTP, Marlborough. Miles 26.7 – 24.3	Nutrients; Pathogens
Assabet River (8246775)	MA82B-04_2002	Marlborough West WWTP, Marlborough to Hudson WWTP, Hudson. Miles 24.3 – 16.4	Cause unknown; Metals; Nutrients; Organic enrichment/Low DO; Pathogens
Assabet River (8246775)	MA82B-05_2002	Hudson WWTP Hudson to Routes 27/62 at USGS Gage, Maynard. Miles 16.4 – 7.6	Nutrients; Organic enrichment/Low DO; Pathogens
Assabet River (8246775)	MA82B-06_2002	Routes 27/62 at USGS Gage, Maynard to Powdermill Dam, Acton. Miles 7.6 – 6.4	Priority organics; Metals; Nutrients; Organic enrichment/Low DO; Thermal modifications; Taste, odor and color; Suspended solids; Noxious aquatic plants
Assabet River (8246775)	MA82B-07_2002	Powdermill Dam, Acton to confluence with Sudbury River, Concord. Miles 6.4 – 0.0	Nutrients; Organic enrichment/Low DO; Pathogens