MILLERS RIVER WATERSHED
SMART MONITORING PROGRAM 2000-2004

Technical Memorandum TM-35-8

The Millers River downstream of Farley Bridge, Erving/Wendell

Prepared By:
Therese Beaudoin
December 2013

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Richard Sullivan, Secretary
Massachusetts Department Of Environmental Protection
Ken Kimmell, Commissioner
Bureau of Resource Protection
Beth Card, Assistant Commissioner
Division of Watershed Management
Rebecca Weidman, Director
Watershed Planning Program
Kim Groff, Director

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF LATIN NAMES

Latin Name	Common name	Latin Name	Common name
Callitriche sp.	starwort	*Pontedaria cordata*	pickerelweed
Clemmys insculpta	wood turtle	*Potamogeton* sp	pondweed
Elodea sp.	waterweed	*Pseudacris crucifer*	spring peeper
Graminae	grasses	*Rana sylvatica*	wood frog
Juncus sp.	rushes	*Sagittaria* sp.	arrowhead
Lemna sp.	duckweed	*Scirpus* sp.	sedges
Nerodia sipedon	Northern water snake	*Vallisneria* sp.	American eelgrass
Peltandra virginica	arrow arum	*Wolffia* sp.	watermeal

LIST OF ACRONYMS

7Q10	lowest 7-day average streamflow that occurs, on average, once every 10 years
BRP	Bureau of Resource Protection
ºC	degree Celsius
CERO	CEntral Regional Office
CFR	Coldwater Fishery Resource
cfs	cubic feet per second
CSO	Combined Sewer Overflow
DO	dissolved oxygen
DWM	Division of Watershed Management
ºF	degree Fahrenheit
m	meter
MassDEP	Massachusetts Department of Environmental Protection
mg/L	milligrams per liter
mi^2	square mile
NH_3-N	ammonia nitrogen
NO_3NO_2-N	nitrate-nitrite nitrogen
NTU	Nephelometric Turbidity Unit
ppm	parts per million
POR	Period of Record
POTW	Privately Owned Treatment Works
QAPP	Quality Assurance Project Plan
SMART	Strategic Monitoring and Assessment for River basin Teams
SOP	standard operating procedure
SU	Standard Unit
SWMA	State Wildlife Management Area
T	temperature
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
uS/cm	microsiemen per centimeter
USGS	United States Geological Survey
WES	Wall Experiment Station
WPCF	Water Pollution Control Facility
WWTP	Wastewater Treatment Plant
% sat	percent oxygen saturation

Cover photo by Therese Beaudoin, MassDEP. 7 August 2002.

All photos in document taken by Therese Beaudoin. MassDEP. CERO.
SMART monitoring logo designed by Robert Kimball and Barbara Kimball.

INTRODUCTION

The Millers River Watershed lies in both Massachusetts and New Hampshire. Of the total drainage area of 389 mi^2, 310 mi^2 lie in MA (approximately 80%). From the outlet of Sunset Lake, Ashburnham, the Millers River flows approximately 46.5 miles to the Connecticut River, Gill, MA through largely hilly terrain. Eight dams lie on the mainstem, including the Birch Hill Flood Control Project and numerous hydropower structures. Other than these impoundments, the Millers River is characterized by swift flow and numerous rapids. The watershed is largely undeveloped and forested, with town centers and industry often located along the rivers, including Winchendon, Gardner, Templeton (Baldwinville), Athol, Orange and Erving. Annual precipitation ranges from 46 to 48 inches over most of the watershed, with small areas in Ashburnham and Wendell receiving more (48 to 50 inches), and in Orange/Athol receiving less (44 to 46 inches)(Ostiguy et al 2010). The Millers Watershed encompasses part or all of 17 municipalities. Additional information can be found in the *Millers River Watershed 2000 Water Quality Assessment Report* (Kennedy and Rojko 2004). The Millers River, from its source to the Connecticut River confluence, is designated a Coldwater Fisheries Resource (MassDFG 2011).

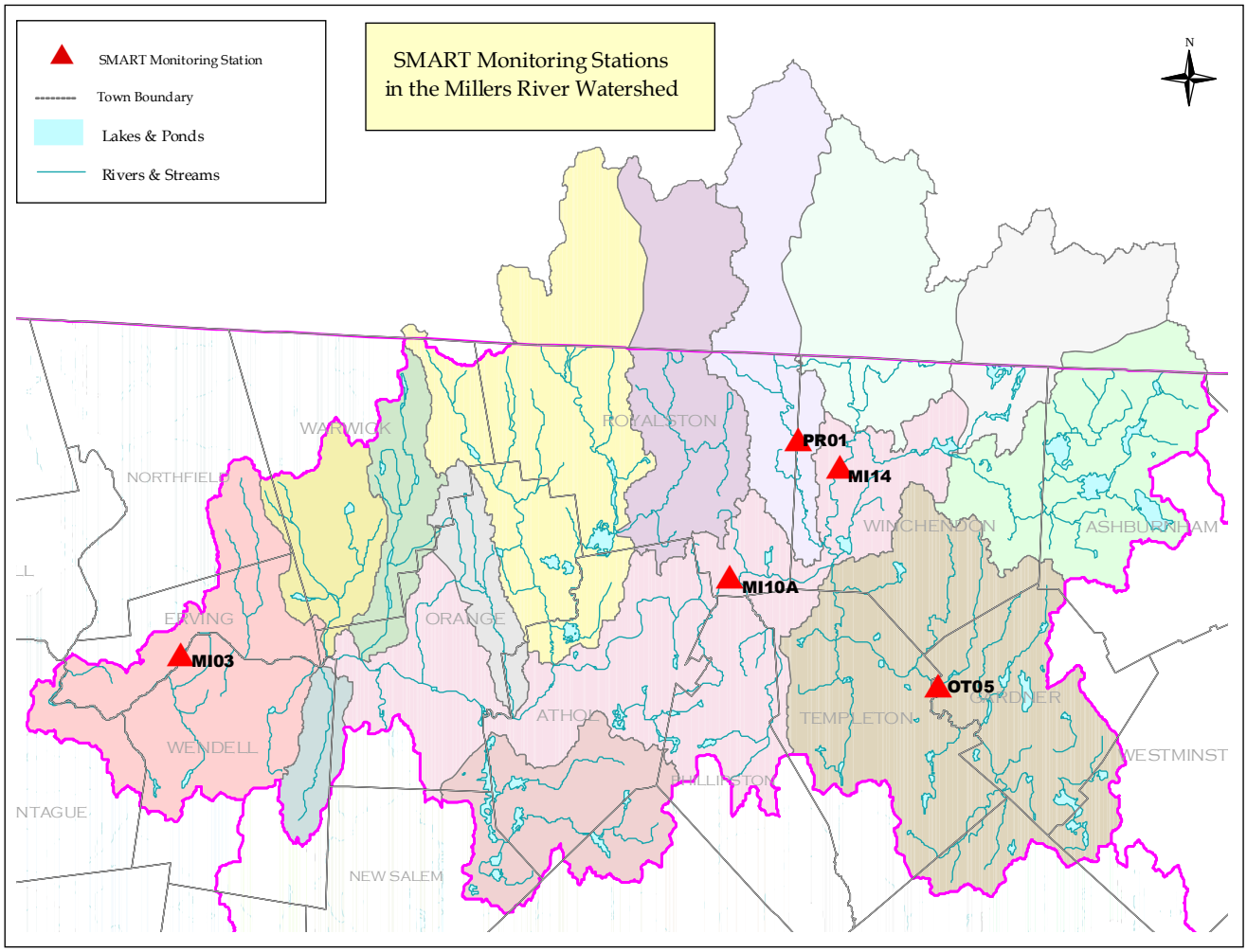
The purpose of this technical memo is to present observations and data collected in the Millers watershed by the SMART program. Bimonthly water quality monitoring began in March 2000. The sampling plan matrix for the years 2000 through 2004 is presented in Table 1. The location of sampling stations is presented in Figure 1. Sampling components at all stations included: *in situ* measurements, physico-chemical and nutrient sampling, flow measurements (at existing gaging stations), and general field observations. Each sampling component is described in the sections that follow.

Table 1 Millers Basin SMART Sampling Summary – 2000 through 2004

Location and Segment Numbers	Station Name	Dates Sampled[1]
Millers River @ Sibley Road, Winchendon MA35-02	MI14	2000: 3/22, 5/10, 7/5, 8/23, 11/8 2001: 2/14, 4/11, 6/13, 8/8, 10/17, 12/5 2002: 2/27, 4/10, 6/11, 8/7, 10/9 2003: 1/8, 3/12, 5/7, 7/9, 9/10, 11/5 2004: 2/18, 4/14, 6/9, 8/11, 10/13 [1]The SMART Monitoring program began in the Millers basin in March 2000.
Priest Brook @ USGS flow gaging station, Winchendon Road, Royalston MA35-10	PR01	
Otter River @ USGS flow gaging station, Bridge Street, Gardner MA35-07	OT05	
Millers River @ USGS flow gaging station, Blossom Road, Royalston MA35-03	MI10A	
Millers River @ USGS flow gaging station, Farley Road, Wendell MA35-05	MI14	

The quality control and assurance plan (QAPP) for the SMART program is presented in CN 12.1: *Strategic Monitoring and Assessment for River basin Teams Quality Assurance Project Plan* (Beaudoin 2010). The QAPP presents data quality objectives, quality assurance procedures, and other program-specific information. This technical memorandum will report deviations from the procedures described in the QAPP.

Figure 1 MassDEP SMART Millers River Watershed Water Quality Station Locations



PROJECT OBJECTIVES

The primary water quality objectives of the SMART monitoring program are:

- Document baseline water quality by: providing information on low flow/event flow variation, seasonal variation and frequency of selected constituents; and establishing reference distributions of key constituents for ecoregion delineation and "clean water" sites;
- Estimate loads of detected water constituents at key locations by: quantifying nitrogen loadings to coastal waters; and calculating phosphorous loads upstream/downstream of representative land use areas;
- Define long term trends in water quality by: documenting improvements associated with major abatement projects; and identifying trends at least-impacted stations (that may result from factors such as acid precipitation);
- Assess attainment of water quality uses by: comparing existing water quality with water quality standards; and by assessing use support for the fishable/swimmable goal;
- Provide support for other programs by: determining reference distributions for ecoregion stations; conducting trend analysis for the 305(b) reports and basin plans; quantifying nutrient loadings for load allocations (TMDLs); obtaining data on nonpoint source loadings for more intensive Year 2 sampling; providing guidance for volunteer monitoring; collecting data for development of statistically-based water quality standards and for improvement of CSO and Stormwater policies; and developing a long-term database on conditions at key locations for the development of new programs and basic research.

As stated in the Introduction, this document presents observations and data collected in the Millers Watershed under the SMART program from 2000-2004. An assessment of the data will be presented in future reports.

METHODS

Water quality samples were collected in the Millers basin on the dates shown in Table 1 and for the parameters described below; station locations are shown in Figure 1 above. The parameters encompassed in the sampling program include:

- *in situ* measurements: dissolved oxygen (DO), percent oxygen saturation, pH, specific conductivity, temperature (T), depth and total dissolved solids (TDS);
- physico-chemical constituents: total alkalinity, chlorides, hardness, total suspended solids, turbidity;
- nutrients: ammonia-nitrogen, nitrate-nitrite-nitrogen, total Kjeldahl nitrogen (which was changed to total nitrogen in 2004), and total phosphorus; and
- Microtox® from July 12, 2000 through August 15, 2001.

Water quality sampling procedures are included in *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MA DEP 1999b). Use of the *in situ* monitoring equipment followed procedures set forth in *CN 4.0 Water Quality Multi-probe Instrument Use, Standard Operating Procedure* (MA DEP 1999a). Physical/chemical and nutrient samples were analyzed at the Wall Experiment Station (WES), the DEP analytical laboratory located in Lawrence, Massachusetts. All samples were collected, transported, analyzed, and discarded according to chain-of-custody procedures.

In addition to the measurements and analytes noted above, field observations were recorded at each station on standardized field sheets, photographs, and field notebooks. Field observations included date/time, location, crewmembers, snow cover, canopy cover, water odors, colors, sheens, foams, estimated water quantity and velocity, weather conditions, observed uses, wildlife, aquatic algae and macrophytes, potential pollution sources, and unusual conditions. Number and type of samples were recorded, as well as the last set of *in situ* data collected. A summary of field observations collected during this sampling period are presented in Table 2 after the station descriptions.

Each station selected for the SMART Monitoring program is described according to key characteristics associated with water quality at that location, as follows:

- Reference: a reference station is located in a stream segment that is minimally influenced by anthropogenic activities;
- Impact: an impact station is located where several sources of pollution come together and can be is used to calibrate a mass balance model, or where critical reactions take place such as at an oxygen sag point; and
- Boundary: a boundary station is located at a pour point i.e., where water leaves a designated river basin, or at a state line.

Field sheets, raw data files, chain of custody forms, lab reports, and other metadata used in this report are managed and maintained by MassDEP Division of Watershed Management (DWM) in the Water Quality Access Database in Worcester, MA. The validation of the water quality data included data entry into DWM databases;, data entry quality control checks; analysis for outliers, blank contamination, duplicates, precision, and holding time violations; and project level review. The project coordinator, as identified in the QAPP for the SMART program, reviews the data for reasonableness, completeness and acceptability; see CN 83.0, CN149.0, CN202.0, CN211.0, and CN265.0 for the DWM data validation reports of 2000-2004 (MassDEP 2003, 2004b, 2005b, 2005a, 2006).

Due to resource limitations at the WES laboratory, nutrient samples collected during the period of October 2003 through June 2004 were frozen, and later analyzed for total phosphorous only.

Although samples were collected for Microtox analyses during the time period noted above, continuous manufacturer's product contamination issues with the assay's growth media produced invalid results and therefore, prevented use of the data.

STATION OBSERVATIONS

Station MI14 – Millers River at Sibley Road, Winchendon, MA (river mile 35.141)

Figure 2 Googe Earth view of Station MI14 area

Figure 3 Station MI14 upstream

Station MI14 was accessed from the eastern shore upstream of the former Sibley Road Bridge. Samples were collected by wading in or using a sampling pole on most dates. On several events, samples were collected from the top of the eastern bridge abutment via bucket drop, due to rapid flow and water height. Both locations are representative of water quality conditions in this reach. On 2 sampling events, the river was inaccessible due to deep snow on the access road (2/14/2001) and limited time (1/8/2003). Station MI14 serves as an impact station i.e., it is located downstream of known source(s) of pollution.

Land uses near this station included forest, sand/gravel extraction, residential, and a large downstream flood control project (Birch Hill Dam; Birch Hill Flood Control Project) which impounds the river in this reach (Figure 2) during flood management operations (USACOE 2013, Google Earth 2011a). The western side of the Millers River corridor in this area lies within the Birch Hill State Wildlife Management Area (see northquabbinwoods.org for a description of the BHSWMA and Birch Hill Wildlife Management Area for a map) (North Quabbin Woods, 2011; Mass Wildlife 2011b). Massachusetts State Wildlife Management Areas (SWMA) were "designed to forever ensure the survival, health and viability of all our native wildlife communities" (MassWildlife, 2011a). The Massachusetts Department of Fish and Game stocks this reach of the Millers River with trout (Norris 2011). The Winchendon WWTP discharge is located 1.6 miles upstream, and Winchendon Center lies an additional 2.5 miles above this. There are no large water withdrawals upstream.

The river is a run in this area, approximately 70 feet wide, typically less than 3 feet deep and roughly uniform across the channel throughout the year (Figure 3). Deciduous and evergreen trees provide shade along the stream corridor edges, but the canopy does not generally cover the channel. The bottom is sand and muck, with moderate to dense coverage with sedges (*Scirpus* sp.). Other aquatic macrophytes observed at Station MI14 included American eelgrass (*Vallisneria* sp.), duckweed (*Lemna* sp.), watermeal (*Wolffia* sp.), pondweed (*Potamogeton* sp.), rushes (*Juncus* sp.), and arrowhead (*Sagittaria* sp.). Although the observation of periphyton was often limited by the angle of light on the water surface and/or the deeply tannic color of the water column, filamentous algae was noted on 2 events, and "rusty spots" on vegetation on another. Evidence of beaver activity was noted in this area, including downed trees, partially severed trunks, and stripped bark. A vernal pool populated by wood frogs (*Rana sylvatica*) and spring peepers (*Pseudacris crucifer*) is adjacent to the river northwest of Sibley Road. Dense populations of mosquitoes are common after rain events.

Approximately 65% of observations indicated a clear water column, with a few reports of slight turbidity noted. Water color was typically red/tannic, with few observations of clear or brown color. The station was characterized by a lack of water odors and sheens during this time period. Foam was noted on 30% of the sampling events. Minor quantities of trash were noted, including 1-2 car tires and floatables (fish bait containers).

Station PR01 – Priest Brook downstream from Winchendon Road, at the USGS gage, Royalston, MA (river mile 4.206)

Figure 4 Google Earth view of Station PR01 area

Figure 5 Station PR01 upstream

Station PR01 was accessed from shore near the USGS flow gaging station downstream of Winchendon Road, Royalston. Samples were collected by wading in or with a sampling pole. Station PR01 serves as a reference station.

The land use surrounding this area is primarily forested and wetland, with very little development (Figure 4) (Google Earth 2011b). From Fitzwilliam, New Hampshire, Priest Brook flows through forestland and several palustrine wetlands. There are no municipal or industrial discharges in the Priest Brook watershed or water supply withdrawals. Most of the Priest Brook corridor lies within the Birch Hill SWMA, as well as the flood control zone for the Birch Hill Dam project. The Massachusetts Department of Fish and Game stocks Priest Brook with trout (Norris 2011).

The river at this location is a run, approximately 20 feet wide shaded with nearly complete canopy cover of a mixture of conifers and deciduous trees, although the area at and upstream of the bridge is mainly open sky (Figure 5). The stream bottom consisted of a mixture of gravel and cobble with some sand; numerous boulders are scattered in the channel upstream. The most commonly noted periphyton was dense moss covering all visible submerged rock surfaces. Aquatic macrophytes included sedges (*Scirpus* sp.), American eelgrass (*Vallisneria* sp.), pickerelweed (*Pontedaria cordata*), rushes (*Juncus* sp.), *Potamogeton* sp. (pondweed), and *Elodea* sp. (waterweed). A wood turtle (*Clemmys insculpta),* a species of special concern in Massachusetts, was noted at Station PR01 in May 2003; documentation was provided to NHESP staff for the designation of this area as Priority Habitat. Beaver activity included a dam at the upper side of the Winchendon Road Bridge (removed mid-2002), downed trees, and stripped bark. Dense populations of mosquitoes are common after rain events.

The water column was clear on most dates sampled, with occasional slight turbidity and a single highly turbid event on 8 August 2001 (dry weather conditions). The water column was characterized by red/brown tannins and a lack of odor, with a single observation of musty and sulfide/dog feces. The presence of foam was common, although typically sparse, and sheens were never observed. Trash was typically absent from the stream channel.

Station OT05 – Otter River at Turner Road/Bridge Street, Templeton/Gardner, near the USGS gage (river mile 6.490)

Figure 6 Google Earth view of Station OT05 area

Figure 7 Station OT05 upstream

Station OT05 was accessed from the northern shore upstream of the Bridge Street/Turner Road Bridge, Gardner/Templeton. During a single event the site was accessed from the southern shore due to an access limitation associated with bridge construction activities. Both sites are considered to represent conditions in this reach. Samples were collected by wading in or with a sampling pole. Station OT05 is an impact station.

Land uses near and upstream of OT05 included forest, sand/gravel extraction, and minor residential development (Figure 6)(Google Earth 2011c). The Massachusetts Department of Fish and Game stocks the Otter River with trout (Norris 2011). The Gardner WPCF discharge is located 3.5 miles upstream, and Gardner center lies in the same area. A small dam is approximately 300 feet above Station OT05.

The river flows through a short rapids, with a channel approximately 20 feet wide and mostly shaded (Figure 7). The bottom consisted of gravel and cobble, with some sand and a few boulders. Periphyton was common and often dense, including film and filamentous algae, as well as moss, throughout the year. Aquatic macrophytes were present only along the periphery of the stream channel, and included sparse grasses (Graminae) and sedges (*Scirpus* sp.), and "star weed", possibly a species of starwort (*Callitriche* sp.). Beaver activity was noted in the area, including downed trees and partially severed trunks. Mallard ducks were observed here. Dense populations of mosquitoes are common after rain events.

The water column at this station ranged from clear to highly turbid; it was slightly turbid on most events. The water color was typically red/brown, and on a few occasions grey (3) or clear (2). Effluent odors were typical; others noted were musty or odorless. Foam was present on all but one event, and sheens were entirely absent. Trash was absent throughout this time period.

Station MI10A – Millers River at the USGS gage, South Royalston, MA (river mile 27.662)

Figure 8 Google Earth view of Station MI10A area

Figure 9 Station MI10A upstream

Station MI10A was accessed from the northern shore at the USGS gaging station on Blossom Street, downstream of the King Street Bridge. On 3 sampling events, the river was inaccessible due to bank-to-bank ice coverage (2/14/2001, 3/12/2003, and 2/18/2004). Samples were collected by wading in or with a sampling pole. Station MI10A serves as an impact station.

Land uses near and upstream of this station include forest, residential, and a large downstream flood control project which alters the river flow through this reach under specific conditions (Figure 8)(Google Earth 2011d). Much of the proximal watershed up- and downstream of this station lies within the Otter River State Forest and the Birch Hill SWMA. The Massachusetts Department of Fish and Game stocks this reach of the Millers River with trout (Norris 2011). Upstream discharges (below Station MI14) include Gardner, Seaman Paper Company (Templeton), and Templeton. A small number of water withdrawals are located in the area, serving a few people.

The river is a run in this area, approximately 95 feet wide, and the channel is typically too deep to wade (Figure 9). Deciduous trees provide shade along the stream corridor edges only; the channel is almost entirely open to the sun. The bottom consisted of boulder, cobble, gravel and sand when visible, often with a thin layer of silt. Aquatic macrophyte growth was sparse, and plants noted here included grasses (Graminae), American eelgrass (*Vallisneria* sp.), duckweed (*Lemna* sp.), pickerelweed (*Pontedaria cordata*) and sedges (*Scirpus* sp.). Periphytic growth ranged from none to dense, and consisted of moss, film and filamentous algae, and floc. Evidence of beaver activity included a lodge against the southern bank, downed trees, partially severed trunks, and stripped bark. Other aquatic wildlife noted were mussels, crayfish, frogs, and a flock of geese. Dense populations of mosquitoes are common after rain events. Damselflies and dragonflies (adults) were abundant during summer sampling events.

The water column noted at this station was typically slightly turbid; conditions were clear on few events, and murky once (6/11/2002, under dry conditions). Water color was brown and/or red on all dates. The station was characterized by a lack of water odors during this time period, and on two dates, musky odors were detected. Foam, usually sparse but sometimes moderate to dense, was noted in this area on all but two of the sampling events; sheens were not observed. The only trash noted at this station was a few bricks.

Station MI03 - Millers River downstream of Farley Road, near the USGS gage, Erving/Wendell, MA (river mile 5.876)

Figure 10 Google Earth view of Station MI03 area

Figure 11 Station MI03 upstream

Station MI03 was accessed from the western shore at the USGS gaging station off Farley Road, downstream of the Farley Bridge in March and May 2000. However, this location was found to be within a backwater at lower flows, and potentially within the zone of the Farley Village wastewater treatment plant discharge. The station was moved to the eastern shore in July, 2000. On two winter events, sampling was conducted from the downstream side of the Farley Bridge via bucket drops since the river was inaccessible from shore due to ice shelves extending over the channel (2/14/2001, 1/8/2003). All sites are considered to represent conditions in this reach. Samples were collected by wading in or with a sampling pole (with the exception of the two bucket drops). Station MI03 serves as a boundary station i.e., upstream of its confluence with a larger river, in this case, the Connecticut.

Land uses near and upstream of this station include forest, residential, roadways, and town centers (Erving, Orange, Athol; Figure 10) (Google Earth 2011e). The Massachusetts Department of Fish and Game stocks this reach of the Millers River with trout (Norris 2011). Upstream discharges (downstream of Station MI10A) include South Royalston WWTP, L. S. Starrett Company (Athol), Athol WWTP, Orange WWTP, the Erving Center WWTP, and the Farley POTW. As the station was moved to be outside of the potential influence of the Farley POTW, the closest of these is the Erving WWTP, located approximately 3.3 miles upstream. The Erving Paper company has two large (>100,000 MGD) withdrawals in that area, including a groundwater well and a surface water intake. Several small non-community water supplies are located in the same area.

The river is a run in this area, bounded by rapids up- and downstream (Figure 11). The channel is approximately 110 feet wide and typically too deep to wade across. Deciduous trees provide shade along the stream corridor edges only; the channel is almost entirely open to the sun. The bottom consisted of boulder, sand and traces of silt when noted. Aquatic macrophyte growth was sparse and mostly limited to the shoreline. Plants noted here included grasses (Graminae), American eelgrass (*Vallisneria* sp.), waterweed (*Elodea* sp.), arrowhead (*Sagittaria* sp.) and a thin-leaf form of pondweed (*Potamogeton* sp.). Periphytic growth was noted on 3 events, ranging from sparse to moderate, including filamentous algae, algal mats, and rusty spots. Evidence of beaver activity was noted in this area, including downed trees, partially severed trunks, and stripped bark. Stoneflies (adults and exuviae) were abundant at this station; dragonflies, caddisflies and damselflies were also noted. Other aquatic wildlife noted were mussels, frogs, and northern water snakes (*Nerodia sipedon)*. This stretch of the Millers River is stocked annually. Fly fishermen were observed on numerous dates.

The water column was clear on half of the sampling events, and slightly turbid on the rest. Water color was brown and/or red on all dates. The station was typified by a lack of water odors during this time period, with odors detected on five dates (musky, fishy, sulfide, chemical). Foam, generally very sparse or sparse, was noted in this area on most sampling events; sheens were not observed. Trash was usually absent; when noted, it was limited to sparse cigarette butts and the cement blocks of a former riverside structure.

Table 2 Summary of Observations at Station MI14, Millers River, Winchendon 2000-2004

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
3/22/2000	--	--	--	Tannic	--	Foam	--	--	Dry
5/10/2000	--	--	--	Highly tannic	--	--	--	--	Wet
7/5/2000	--	--	--	--	--	--	--	--	Dry
8/23/2000	--	--	--	Red	--	--	--	--	Dry
11/8/2000	--	--	--	Tannic	--	Very sparse	--	--	Dry
2/14/2001	Station not sampled on this date; not accessible due to snow/ice								
4/17/2001	--	--	--	Tannic	--	None	--	--	Dry
6/13/2001	--	--	--	--	--	--	--	--	Wet
8/8/2001	--	Tires	Moderate: blue-green algal mats	Brown/highly tannic	None	None	None	Slight	Dry
10/17/2001	--	Tires	Sparse: brown filamentous	Brown/red	None	None	None	Slight	Dry
12/5/2001	--	Tire, metal objects	None	Brown/red	None	Sparse	None	Clear	Dry
2/27/2002	--	Trash	None	Brown	None	None	None	Slight	Wet
4/10/2002	--	Minor	None	Red	None	None	None	Clear	Wet
6/11/2002	--	Unobservable	Unobservable	Dark red	None	None	None	Clear	Dry
8/7/2002	--	None	Moderate: red "rusty" spots	Red	None	None	None	Slight	Wet
10/9/2002	--	Unobservable	Unobservable	Highly tannic	None	None	None	Clear	Dry
1/8/2003	Station not sampled on this date; time constraint								
3/12/2003	--	Unobservable	Unobservable	Clear	None	None	None	Clear	Dry
5/7/2003	--	None	None	Deep red	None	Foam	None	Clear	Wet
7/9/2003	--	Tire	None	Red	--	None	None	Clear	Wet
9/10/2003	Boulder/sand	None	None	Deep red	None	None	None	Slight	Dry
11/5/2003	Sand/silt/mud	None	None	Red	None	Foam	None	Clear	Wet
2/18/2004	Unobservable	Unobservable	Unobservable	Red	None	None	None	Clear	Dry
4/14/2004	Unobservable	Unobservable	Unobservable	Dark red	None	Very sparse	None	Unobservable	Wet
6/9/2004	Sand	Minor: tires, floatables	None	Red	None	Foam	None	Clear	Wet
8/11/2004	Sand/silt/mud	Tire	None	Red	None	None	None	Slight	Wet
10/13/2004	Boulder/sand/silt	Minor: tire, floatables (bait packaging)	None	Red	None	None	None	Clear	Dry
-- : Data not available									

Table 3 Summary of Observations at Station PR01, Priest Brook, Royalston 2000-2004

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
3/22/2000	--	--	--	Tannic	--	Foam	--	--	Dry
5/10/2000	--	--	--	Highly tannic	--	Foam	--	--	Wet
7/5/2000	--	--	--	--	--	--	--	--	Dry
8/23/2000	--	--	--	Red	--	Foam	--	--	Dry
11/8/2000	--	--	--	Highly tannic	--	Foam	--	--	Dry
2/14/2001	--	--	--	--	--	--	--	--	Dry
4/11/2001	--	--	--	Highly tannic	--	Foam	--	--	Dry
6/13/2001	--	--	--	Tannic	--	Foam	--	--	Wet
8/8/2001	--	None	Sparse: mossy filamentous	Brown/highly tannic	Musty	None	None	Highly turbid	Dry
10/17/2001	--	None	Dense: mossy brown	Brown/red	None	Sparse	None	Slight	Dry
12/5/2001	--	None	Sparse: mossy green/brown	Brown/red	None	Sparse	None	Slight	Dry
2/27/2002	--	None	None	Brown	None	Sparse	None	Slight	Wet
4/10/2002	--	None	Sparse: brown mossy filamentous	Red	None	Sparse	None	Clear	Wet
6/11/2002	--	Trash	Moderate: mossy green/brown	Deep red	None	Sparse	None	Slight	Dry
8/7/2002	--	None	Moderate: thin film; brown moss	Red	None	None	None	Slight	Wet
10/9/2002	--	None		Deep red	None	None	None	Clear	Dry
1/8/2003	--	None	Unobservable	Red	None	None	None	Clear	Wet
3/12/2003	--	Minor	Moderate: mossy green/brown	Red	None	None	None	Clear	Dry
5/7/2003	Sand	None	Sparse	Deep red	None	Foam	None	Clear	Wet
7/9/2003	--	None	Unobservable	Red	None	None	None	Slight	Wet
9/10/2003	Boulder/sand/silt	None	None	Red	None	None	None	Clear	Dry
11/5/2003	Cobble/sand/silt/mud	None	None	Red	None	Foam	None	Clear	Wet
2/18/2004	Boulder/cobble/gravel/sand	None	Dense: moss	Red	None	None	None	Clear	Dry
4/14/2004	--	None	Moderate: green moss	Deep red, "Coca-Cola"	None	Foam	None	Clear	Wet
6/9/2004	Cobble/sand	None	Moderate: moss	Red	None	Sparse	None	Clear	Wet
8/11/2004	Boulder/cobble/gravel/sand/silt	None	Very dense: moss	Red	None	Foam	None	Clear	Wet
10/13/2004	Boulder/cobble/gravel/sand	None	Dense: green moss	Dark red	Sulfide, dog feces	None	None	Clear	Dry

-- : Data not available

Table 4 Summary of Observations at Station OT05, Otter River, Gardner/Templeton 2000-2004

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
3/22/2000	--	--	--	--	--	--	--	--	Dry
5/10/2000	--	--	--	--	--	Foam	--	--	Wet
7/5/2000	--	--	--	Deep red	--	--	--	Highly turbid	Dry
8/23/2000	Cobble/gravel	None	Moss	Dark tannic	--	Foam	--	None visible	Dry
11/8/2000	--	--	--	--	--	Foam	--	--	Dry
2/14/2001	--	--	--	--	--	Foam	--	--	Dry
4/11/2001	--	--	--	Highly tannic	Effluent	--	--	--	Dry
6/13/2001	--	--	--	Highly chocolate brown	--	--	--	--	Wet
8/8/2001	--	None	Moderate: brown/green moss	Brown/highly tannic	Musty	Foam	None	Slight	Dry
10/17/2001	--	None	Dense: moss	Brown	None	Foam	None	Slight	Dry
12/5/2001	--	None	Moderate: brown/green moss	Brown	Musty	Sparse	None	Slight	Dry
2/27/2002	--	Hay bales, construction materials	Sparse: green filamentous	Brown	None	Foam	None	Slight	Wet
4/10/2002	--	Minor erosion	Dense: bright green filamentous	Brown	Septic, musty	Foam	None	Slight	Wet
6/11/2002	--	None	Dense: dark green mossy	Brown/red	Septic, musty	Foam	None	Highly cloudy	Dry
8/7/2002	--	None	Dense: green moss; red/brown filamentous; slime	Gray	None	Foam	None	Slight	Wet
10/9/2002	--	None	Dense: brown/green moss; reddish slime	Gray	None	Foam	None	Slight	Dry
1/8/2003	--	None	Unobservable	Light yellow	None	None	None	Slight	Wet
3/12/2003	--	None	Sparse: green mossy	Red	Strong septic	Foam	None	Clear	Dry
5/7/2003	Gravel	None	Dense: green/brown moss	--	None	Foam	None	--	Wet
7/9/2003	Cobble/gravel	None	Moderate: filamentous	Red	Strong septic	Foam	None	Slight	Wet
9/10/2003	Boulder/cobble/gravel	None	Dense: grey filamentous, film	Gray	Septic	Very sparse	None	Highly cloudy	Dry
11/5/2003	Cobble/gravel/sand	None	Unobservable	Red	None	Foam	None	Clear	Wet
2/18/2004	Cobble/gravel	None	None	Clear	None	Very sparse	None	Clear	Dry
4/14/2004	Unobservable	Unobservable	Unobservable	Red	Effluent	Foam	None	Moderate	Wet
6/9/2004	Cobble/gravel/sand	None	Dense: moss	Brown/red	Effluent	Foam	None	Moderate	Wet
8/11/2004	Boulder/cobble/gravel/sand/silt	None	Green filamentous; very dense; moss	Red	None	Foam	None	Clear	Wet
10/13/2004	Boulder/cobble/gravel/sand	Trash	Very dense: green moss	Clear	Chlorine, effluent	Moderate	None	Slight	Dry
-- : Data not available									

Table 5 Summary of Observations at Station MI10A, Millers River, Royalston 2000-2004

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam
3/22/2000	--	--	--	--	--	Foam
5/10/2000	--	--	--	--	--	--
7/5/2000	--	--	--	--	--	Foam
8/23/2000	--	--	--	--	--	Foam
11/8/2000	--	--	--	--	--	Foam
2/14/2001	--	--	--	--	--	Foam
4/11/2001	--	--	--	--	--	None
6/13/2001	--	--	--	--	--	Foam
8/8/2001	--	None	None	Brown/tannic	Musty	None
10/17/2001	--	None	None	Brown/red	None	None
12/5/2001	--	None	Sparse: thin film; brown decaying matter	Brown/red	None	Sparse
2/27/2002	--	None	None	Black	None	Foam
4/10/2002	--	None	Sparse: mossy brown filamentous	Brown	None	Sparse
6/11/2002	--	None	None	Very red	None	Sparse
8/7/2002	--	Minor: cigarette butts	None	Red	"Chemical"	None
10/9/2002	--	None	None	Clear	Sulfide	None
1/8/2003	--	Unobservable	Unobservable	Red	None	Foam
3/12/2003	--	Unobservable	Unobservable	Red	None	Foam
5/7/2003	--	None	Sparse: green filamentous	Red	None	Foam
7/9/2003	--	Minor	None	Highly tannic	Musty, "pond" smell	Dense
9/10/2003	Boulder/cobble/gravel/sand	None	None	Red	None	Very sparse
11/5/2003	Bedrock/boulder/cobble/gravel/sand/ silt/mud	None	None	Red	None	Foam
2/18/2004	Unobservable	Unobservable	Unobservable	Red	None	Very sparse
4/14/2004	Boulder/cobble/gravel/sand	None	None	Clear	None	Very sparse
6/9/2004	Boulder/cobble/gravel/sand	None	None	Red	Fishy	Foam
8/11/2004	Boulder/cobble/gravel/sand/silt	Minor: metals, cement abutments	Sparse: green filamentous; sparse, moss	Red	None	Sparse
10/13/2004	Boulder/cobble/gravel/sand/silt	None	None	Slight red	None	Sparse

-- : Data not available

Table 6 Summary of Observations at Station MI03, Millers River, Erving/Wendell 2000-2004

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
3/22/2000	--	--	--	--	--	Foam	--	--	Dry
5/10/2000	--	--	--	--	--	--	--	--	Wet
7/5/2000	--	--	--	--	--	Foam	--	--	Dry
8/23/2000	--	--	--	--	--	Foam	--	--	Dry
11/8/2000	--	--	--	--	--	Foam	--	--	Dry
2/14/2001	--	--	--	--	--	Foam	--	--	Dry
4/11/2001	--	--	--	--	--	None	--	--	Dry
6/13/2001	--	--	--	--	--	Foam	--	--	Wet
8/8/2001	--	None	None	Brown/tannic	Musty	None	None	Slight	Dry
10/17/2001	--	None	None	Brown/red	None	None	None	Slight	Dry
12/5/2001	--	None	Sparse: thin film; brown decaying matter	Brown/red	None	Sparse	None	Slight	Dry
2/27/2002	--	None	None	Black	None	Foam	None	Slight	Wet
4/10/2002	--	None	Sparse: mossy brown filamentous	Brown	None	Sparse	None	Slight	Wet
6/11/2002	--	None	None	Very red	None	Sparse	None	Slight	Dry
8/7/2002	--	Minor: cigarette butts	None	Red	"Chemical"	None	None	Slight	Wet
10/9/2002	--	None	None	Clear	Sulfide	None	None	Clear	Dry
1/8/2003	--	Unobservable	Unobservable	Red	None	Foam	None	Slight	Wet
3/12/2003	--	Unobservable	Unobservable	Red	None	Foam	None	Clear	Dry
5/7/2003	--	None	Sparse: green filamentous	Red	None	Foam	None	Clear	Wet
7/9/2003	--	Minor	None	Highly tannic	Musty, "pond" smell	Dense	None	Slight	Dry
9/10/2003	Boulder/cobble/gravel/sand	None	None	Red	None	Very sparse	None	Clear	Dry
11/5/2003	Bedrock/boulder/cobble/gravel/sand/ silt/mud	None	None	Red	None	Foam	None	Clear	Wet
2/18/2004	Unobservable	Unobservable	Unobservable	Red	None	Very sparse	None	Clear	Dry
4/14/2004	Boulder/cobble/gravel/sand	None	None	Clear	None	Very sparse	None	Clear	Wet
6/9/2004	Boulder/cobble/gravel/sand	None	None	Red	Fishy	Foam	None	Clear	Wet
8/11/2004	Boulder/cobble/gravel/sand/silt	Minor: metals, cement abutments	Sparse: green filamentous; sparse, moss	Red	None	Sparse	None	Clear	Wet
10/13/2004	Boulder/cobble/gravel/sand/silt	None	None	Slight red	None	Sparse	None	Clear	Dry
-- : Data not available									

SURVEY CONDITIONS

Stream discharge and precipitation data are used to determine hydrologic conditions and, consequently, if water quality surveys should be described as dry- or wet weather-influenced events. Precipitation data for each monitoring event were obtained from the National Oceanic and Atmospheric Administration (NOAA). The presence/absence of precipitation during the five days prior to each sampling event was based on the National Weather Service data located on their website http://www7.ncdc.noaa.gov/IPS/cd/cd.html;jsessionid=ABE64BF7DDF02CF50177DF08D65C8E3B?_page=0&jsessionid=ABE64BF7DDF02CF50177DF08D65C8E3B&state=MA&_target1=Next+%3E (NOAA 2011). Weather stations closest to the Millers watershed sampling stations are located in Orange and Fitchburg, MA; data collected at these stations were utilized in this report. On average, precipitation varies little across the watershed, approximately 46 to 48 inches/year, with localized areas in Ashburnham and Wendell receiving more (48 to 50 inches), and in Orange/Athol receiving less (Ostiguy et al 2010).

During dry weather, trace amounts of precipitation may fall, but there is no measurable change in stream flow. The USGS operates five real time stream gaging stations in the Millers River Watershed that are applicable to this water quality data set, as shown below:

- Millers River near Winchendon, MA (USGS 2011a)
- Priest Brook near Winchendon, MA (USGS 2011b)
- Otter River at Otter River, MA (USGS 2011c)
- Millers River at South Royalston, MA (USGS 2011d) and
- Millers River at Erving, MA (USGS 2011e).

Data from these stations can be found at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

The period of record (POR) mean streamflow values are the mean of daily mean values for each day for 93 - 94 years of record at the USGS Millers River gage at Erving, MA (USGS station number 01166500), recorded in cfs. The daily data are reported at http://waterdata.usgs.gov/ma/nwis/dvstat/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915-07-01,2009-03-15&format=html_table&stat_cds=mean_va&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list (USGS 2011f). The monthly and annual mean discharges are found at http://waterdata.usgs.gov/ma/nwis/monthly/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915-07,2009-03&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list (monthly)(USGS 2011g) and http://waterdata.usgs.gov/ma/nwis/annual/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915,2009&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list (annual) (USGS 2011h).

Wet weather is defined as precipitation within a five-day antecedent period that leads to more than a slight increase in stream discharge at the five stations listed above (i.e., flow). Under dry weather conditions, trace amounts of precipitation may fall, but no measurable change in stream flow occurs. The discharge values were also examined relative to the 7Q10 low flow (lowest 7-day average streamflow that occurs, on average, once every 10 years) which is 46.8 cfs at the USGS gaging station on the Millers River at Erving, MA (Wandle and Fontaine 1984). At some of the Millers flow gaging stations, precipitation-related stream fluctuations were difficult to distinguish from manipulated fluctuations on some events. Observations of discharge at the reference station on Priest Brook (PR01) supplemented discharge data on the Millers River.

Table 7 (precipitation) and Table 8 (stream discharge) contain information on survey conditions during each sampling event. Both the precipitation and the stream discharge data were used to estimate hydrological conditions during water quality sampling.

March 22, 2000 – The first survey of the SMART Monitoring Program in the Millers watershed was conducted during a relatively dry period. Streamflow data show that discharge during the sampling event was near the monthly and point of record mean values for that day at the Millers River gage at Erving (1,550 cfs). Streamflow consistently decreased during the week before the sampling event. Little snow remained on the ground in the watershed. Therefore, the samples collected during this event reflect dry weather conditions. Air temperature during the sampling event ranged from 32 to 45

degrees Fahrenheit (°F), and cloud cover went from overcast at the first four stations to sunny at the last (MI14, Millers River at Sibley Road, Winchendon). Patches of snow remained in the watershed; buds had not formed on deciduous trees.

May 10, 2000 – Approximately 0.38 inches of rainfall was recorded at Birch Hill Dam the day before the survey, and localized sprinkles were noted during monitoring; however, no increase in river flow was noted during the sampling event at the watershed gages. Mean discharge at the Millers River/Erving gage on the date of sample collection was less than both the monthly and point of record mean values (610cfs vs. 830.5 and 817 cfs). The samples collected during this event reflect dry weather conditions. Air temperature ranged from 58 to 62°F; skies ranged from overcast to raining. Field notes included thunder and heavy fog associated with a west-to-east moving storm front. Foliage was newly emerged.

July 5, 2000 – This summer survey occurred during a relatively dry period. Although 0.32 inches of rain were recorded on July 4 at the Birch Hill Dam and discharge at the Millers watershed gages increased, flows returned to pre-storm levels by the time of the sampling event. Discharge at the Millers River gage at Erving averaged 265 cfs, less than both the monthly and point of record mean values (305.0 and 333 cfs). Data reflect dry weather conditions. Air temperature ranged from 75 to 86°F with sunny skies throughout the event.

August 23, 2000 – During the 5 days prior to this monitoring event, only 0.03 inches of precipitation fell. Streamflow decreased steadily during this period, from 713 cfs on 18 August, to 289 cfs at the Millers River gage in Erving on the event date. This range falls within the monthly mean for August 2000 (610.8 cfs) and the POR mean (210 cfs). Due to the minimal precipitation and steadily decreasing flow, the data reflect dry weather conditions. Air temperature (based on a limited data set, n=2 out of 5 sampling stations) ranged from 70 to 75°F and skies were overcast (n=3) during the sampling event.

November 8, 2000 – Within the 5 days prior to this monitoring event, only 0.04 inches of precipitation fell. Streamflow was consistently low, ranging from 230 to 251 cfs at the Millers River gage at Erving. This discharge range is below both the monthly and point of record mean values (409.1 and 482 cfs). Data collected during this event reflect dry conditions. Air temperature ranged from 49 to 58°F, and cloud cover ranged from 40 to 80%. Foliage was noted to be completely down, and stream flows were low, throughout the watershed.

February 14, 2001 – This winter sampling event took place during a relatively dry period, with 0.37 inches of precipitation recorded in the preceding 5 days. Discharge at the gages at the Millers River at Erving and South Royalston indicate the likelihood of artificial manipulation i.e., not precipitation-driven variations; discharge at the Priest Brook gage shows rising discharge on February 10th, after the precipitation event noted above, with flows returning to pre-storm levels by the time of sampling. Therefore, data collected during this event reflect dry weather conditions. Air temperature ranged from 30 to 31°F with overcast skies. Snow and ice shelves extended over watershed streams, ranging from narrow strips (OT05) to complete channel cover (MI10A), thus preventing river access.

April 11, 2001 – Precipitation during the 5-day period prior to this event ranged from 0.04 to 0.67 inches (as light rain and haze). Streams and rivers were swollen with snowmelt, and snow remained throughout the watershed. Precipitation and streamflow data indicate wet weather/runoff conditions. Air temperature ranged from 46 to 52°F and cloud cover from 60 to 100% throughout the sampling event. Field observations indicate that foliage was not yet out, and buds on tree branches were as yet absent.

April 17, 2001 – Sampling could not be conducted at the Winchendon station (MI14) on April 11th due to the presence of deep snow at the access road, as well as time constraints. However, it was critical to obtain high water data and observations at this station, so monitoring was performed on this later date at this one station. The water level observed on April 17th was the highest ever observed at this location, assumed to be associated with flood control operations at the downstream Birch Hill Dam Army Corps project. The top of the Sibley Road Bridge abutment from which sampling usually occurred was submerged under 3-4 feet of water on this date. Discharge in the Millers River remained high, ranging from 3,280 cfs to 3,780 cfs in the 5 days preceding and the day of monitoring (as measured at the Erving gage), still much higher than the monthly mean (2,458 cfs) and the POR average (1,620 cfs). Although precipitation was minimal during the preceding 5 days, the high discharge levels and water level at the station reflect wet weather/runoff conditions. Field notes indicate that foliage was not yet out, although buds had begun to form on trees and shrubs.

June 13, 2001 – Nearly an inch of rain associated with a severe storm front fell on the area the day before this event. Stream discharge at the Millers River gage in Erving at the time of sample collection decreased steadily in the 5 days preceding sampling, with a rise concurrent with precipitation on June 12th. Discharge on June 13th continued to increase, indicating that data collected reflect wet/runoff conditions. Air temperature ranged from 74 to 83°F, cloud cover ranged

from 0 to 15% with hazy sun, and humid conditions. Field observations noted full foliage and clouds of mosquitoes at all stations.

August 8, 2001 – A summer storm brought a total of 2.95 inches of rain to the Millers watershed in on August 4-5, followed by dry weather on August 6-8. Streamflow at both the Erving and South Royalston gages on the Millers River appear to reflect artificial manipulation of river flows, as well as precipitation-related fluctuations. Discharge at the Priest Brook gage shows discharge decreasing on August 5th, with flows steady at approximately 10 cfs from August 6th through August 8th. Discharge at the Millers River gage from August 3-8 ranged from 93 to 277 cfs, generally within the monthly mean for August 2001 (113.2 cfs) and the POR daily mean streamflow (240 cfs). Data collected during this event reflect dry weather conditions, particularly in the upper watershed. On this hazy, hot and humid day, air temperature ranged from 84 to 88°F and cloud cover ranged from 0 to 45%. Water levels were noted as low at most stations.

October 17, 2001 – Precipitation on October 15-17 ranged from 0.04 to 0.41 inches at Tully Lake. Discharge at the Erving gage on the Millers River varied little, ranging from 95 to126 cfs which is generally within the monthly mean for October 2001 (117.1 cfs) and the POR daily mean streamflow (366 cfs). Water levels were noted to be low to very low at all stations. Precipitation and streamflow data, as well as field observations, indicate dry weather conditions. Air temperature ranged from 49 to 55°F and cloud cover ranged from 75 to 100%. Although most of the leaves remained on the trees near the Millers River in Erving, the foliage was essentially down in the upper watershed stations. Water levels were noted as low to very low at all stations.

December 5, 2001 – This late fall/early winter sampling event occurred within a dry period, with 0.17 inches of snow recorded at Tully Lake on November 30th, and 0.19 inches in the early morning hours of the sampling event. Discharge at the Erving gage on the Millers River varied little, ranging from 118 to131 cfs which is nearly half of the monthly mean for December 2001 (215.6 cfs) and the POR daily mean streamflow (687 cfs). Due to the relatively steady discharge and minimal precipitation, the data collected reflect dry weather conditions. Air temperature ranged from 53 to 68°F and cloud cover ranged from 0 to 35%. Foliage was down at all stations. Again, water levels were noted as low to very low at all stations. Very active beavers were noted at Station PR01 (Priest Brook, Royalston).

February 27, 2002 - Winter sampling in 2002 occurred during a storm event (rain/snow), although only 0.07 inches of precipitation were recorded at Tully Lake on this date. Mean discharge at the Millers River gage in Erving on the sampling date (483 cfs) was within the mean discharge for February 2002 (354.1 cfs) and the POR average (732 cfs), and do not appear to reflect runoff conditions. However, discharge data at the Priest Brook gage indicate rising streamflows on this date. Precipitation fell throughout monitoring, in the form of rain/snow, changing to sleet, then to heavy wet snow. Based on the rising discharge on Priest Brook and field observations, the data reflect wet weather/runoff. Air temperature ranged from 35 to 40ºF. Snow/ice cover was noted as absent on all streams on this date. Beaver activity was noted at Station MI10A (Millers River, Royalston).

April 10, 2002 – Light rain fell overnight prior to this event, for a total of 0.07 inches; precipitation in the previous 5 days was minimal (0.02 inches). Discharge on the Millers River at the Erving gage decreased steadily from April 6-10, with an average flow of 453 cfs on the sampling date. The Priest Brook gage indicated steadily decreasing flows from April 5-10th. Based on precipitation and flow data, water quality on the sampling date reflects dry conditions. Air temperature ranged from 58 to 66ºF, and cloud cover was minimal (0-5%). A fly fisherman was seen at the Millers River in Erving, as the river had recently been stocked with trout.

June 11, 2002 – Rain fell on each of the 5 days prior to this early summer sampling event, ranging from 0.02 inches (June June 9-10) to 1.27 inches (June7). Flow data reflect surface runoff as well, with mean daily discharge peaking on June 8th at the Millers River/Erving gage (1,740 cfs) and decreasing to 975 cfs on the sampling date. Discharge at Priest Brook also peaked on June 8th, and decreased steadily to the time of sampling (45 cfs), but not to pre-storm levels (30 cfs). Based on precipitation and flow data, water quality data reflect wet/runoff conditions. Air temperature ranged from 72 to 83ºF and skies were sunny with increasing haze. Foliage was completely leafed out in the watershed. Water levels were noted as higher than usual at most stations.

August 7, 2002 - Rainfall over the 5 days before this event totaled 0.39 inches at the Tully Lake gage, falling on August 2nd and 3rd. Discharge at the Erving gage was low overall, peaking on August 3rd at 94 cfs and decreasing steadily to 65 cfs on the sampling date (discharge at the Priest Brook gage reflected the same pattern). Based on the low precipitation and decreasing discharge during this period, water quality data reflect dry conditions. Air temperature ranged from 72 to 76ºF and cloud cover increased throughout the event (<5 to 70%).

October 9, 2002 – Minimal precipitation fell in the 5 days preceding this event, with 0.13 inches of rain on October 5**th,** followed by 4 days of dry weather. Average daily discharge decreased steadily in this period, from 84 to 61 cfs at the

Millers River in Erving (a pattern also reflected at the Priest Brook gage). Based on the precipitation and discharge data, water quality data reflect dry weather conditions. Air temperature ranged from 50 to 60ºF with cloud cover ranging from 20 to 100%. The foliage was noted as changing colors, although most leaves remained on the trees throughout the watershed.

January 8, 2003 – This winter event followed 4 days of intermittent snowfall, ranging from 0.01(January 5th) to 0.44 (January 4th) inches per day. Snow was observed on the ground throughout the watershed. During the same period, streamflow decreased steadily, from 804 cfs (January 3rd) to 601 cfs (January 8th) (discharge at Priest Brook followed the same pattern). These values are slightly above the POR mean discharge (633 cfs), as well as the monthly mean flow (465.8 cfs). Based on the above, water quality reflects dry conditions. Air temperature ranged from 27 to 30ºF under snowy skies. The stream channel was partly covered with ice stretching out from the banks at most stations; ice chunks and slush were noted in the flow. Ice and snow rendered staff gages unusable throughout the watershed.

March 12, 2003 – This early spring event fell within a dry period, with 0.12 inches of snow falling on March 7th. Streamflow decreased steadily at watershed gages during the 5 days preceding monitoring, with estimated mean flows falling from 700 cfs to 440 cfs at the Millers River in Erving. Precipitation and flow data indicate that conditions monitored reflect dry weather conditions. Air temperature ranged from 39 to 46ºF; skies were overcast at the beginning of monitoring, but decreased to approximately 20% cloud cover by the last station. Snow and ice shelves impacted watershed streams, ranging from narrow strips (OT05) to complete channel cover (MI10A), preventing river access as well as staff gage readings.

May 7, 2003 – Precipitation totaled 1.16 inches within the 5 days prior to this spring sampling event (1.14 inches on May 2nd and 3rd). Stream flow at the Millers River gage in Erving rose to a high of 1,300 cfs on May 4th, then fell steadily to a mean of 876 cfs on May 7th; flows varied about the monthly mean for May 2003 (822.3 cfs) and the POR mean (913 cfs). A similar pattern in discharge was observed at the Priest Brook gage during this time period. However, discharge had not fallen to pre-storm levels. Precipitation and flow data reflect wet weather/runoff conditions. Air temperature ranged from 68 to 75ºF and cloud cover varied widely throughout the monitoring (0 to 98%). Field notes indicate that although buds had begun to develop leaves, the foliage had not yet emerged. Water level at all stations was typical for this time of year.

July 9, 2003 – No precipitation was recorded at the Tully Lake gage in the 5 days preceding the monitoring event, although field notes indicate that rain begin to fall by 10:00 a.m. on July 9th, and fell steadily and sometimes heavily throughout the remainder of monitoring activities. Streamflow decreased steadily in these 5 days, rising slightly on July 9th; no rise was measured at the Priest Brook gage. Water quality data reflect dry conditions for this event. Air temperature fell from 74 to 70ºF and light rain turned to a steady, heavy rain during this event. Water levels were noted as low at all stations.

September 10, 2003 – Approximately 0.11 inches of rain fell 5 days before this late summer event on September 5th. Flow data collected at gages throughout the watershed indicate generally decreasing discharge throughout the 5-day period from September 5-10th. Water quality reflects dry weather conditions on this event. Air temperature ranged from 62 to 82ºF and skies were sunny during this event. Water levels were approximately 0.5 to 1.0 feet lower than typically seen at all watershed stations.

In general, pH levels measured in the Millers River at Erving were much higher than usually observed at this location during this event, reaching a maximum of 8.38 SU during field activities. The water quality standard for pH was exceeded at this point (Shall be in the range of 6.5 through 8.3 standard units and not more than 0.5 units outside of the natural background range). pH at Station MI03 prior to this date (3/22/2000 through 3/12/2003) ranged from 5.80 to 7.71 SU, with an average pH of 6.64 SU. The pH measured at the Wendell/Depot Road Bridge in Orange immediately after monitoring in Erving was 6.85 SU. The source may have been a spill within the town of Erving. SMART staff called the Emergency Response group in the MassDEP Western Regional Office. Tony Kurpaska contacted staff at the Erving WWTP. The operator of the plant measured pH in the river at the Arch Street Bridge, which is located upstream of the SMART station and downstream of the Erving WWTP as well as the Erving Paper Mill facility, and noted a pH of 6.75 SU. Post calibration of the monitoring unit did not indicate any anomalies. The source of the elevated pH readings has not been identified.

November 5, 2003 - Approximately 0.2 inches of rainfall was recorded within the 48 hours before and during this mid-fall monitoring event. Stream discharge data, however, showed a generally decreasing flow throughout the 5 days preceding and including the sampling date. Data collected during this event reflect dry conditions. Air temperature ranged from 42 to 52ºF and precipitation ranging from drizzle to heavy rain during this event. Water levels were noted as 1 to 2 feet higher than usual at all stations.

February 18, 2004 – This winter event occurred during a dry period, with no recorded precipitation occurring on or within the 5 preceding days. Streamflow varied little in this time frame. Water quality information collected on this date reflects dry conditions. Air temperature ranged from 26 to 34ºF and cloud cover from 10 to 65% on this date. The stream channel was partly covered with ice stretching out from the banks at most stations; monitoring could not be conducted at Station MI10A (Millers River, South Royalston). Ice and snow rendered staff gages unusable throughout the watershed.

April 14, 2004 – Approximately 0.36 inches of precipitation was recorded at Tully Lake on April 13th, with an additional 1.21 inches on the day of monitoring. Streamflow rose simultaneously with the rain and data collected on this date reflect wet/runoff conditions. Air temperature ranged from 54 to 56ºF, with overcast skies. Water levels were noted as 1+ feet higher than usual at the Millers River in Erving, the Otter River in Gardner/Templeton, and Priest Brook, Royalston. Wood frog calls were noted as a "cacophony of quacking" from a wetland adjacent to the Millers River in Winchendon.

June 9, 2004 - This late spring event also fell within a dry period; only 0.06 inches of rain fell within the previous 5 days, and streamflow fell consistently. Data collected on this date reflect dry conditions. Air temperature ranged from 84 to 92ºF with humid conditions; cloud cover ranged from clear to hazy.

August 11, 2004 – Approximately 0.24 inches of precipitation were recorded on this monitoring date, with only 0.01 inches noted in the preceding 5 days. Stream discharge decreased at watershed gages. Data collected on this date reflect dry conditions. Air temperature ranged from 71 to 74ºF; skies were overcast or drizzly.

October 13, 2004 – Fall 2004 monitoring fell within a dry period, with no precipitation recorded during the preceding 5 days. Streamflow gradually decreased during this time, and data collected on this event reflect dry weather conditions. Air temperature ranged from 46 to 66ºF, with sunny skies throughout the monitoring effort.

Table 7 Millers Basin Precipitation Data Summary 2000-2004 (inches of precipitation)

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Wet/Dry Conditions**
22 March 2000	0*	0.90	0.15	0	0	0	Dry
10 May 2000***	0.02	0	0	0	0.28	0	Dry
5 July 2000***	0.03	0	0	0	0.32	0	Dry
23 Aug 2000	0	0.03	0	0	0	0	Dry
8 Nov 2000	0	0	0	0.04	0	0	Dry
14 Feb 2001	0.15	0.22	0	0	0	0	Dry
11 April 2001	0	0.12	0.67	0.04	0.25	0	Wet
17 April 2001	0.13	0.12	0	0	0	0	Wet
13 June 2001	0	0	0	0	0.98	0	Wet
8 Aug 2001	0	2.02	0.93	0	0	0	Dry
17 Oct 2001	0	0	0	0.41	0.14	0.04	Dry
5 Dec 2001	0.17	0	0	0	0	0.19	Dry
27 Feb 2002	0.02	T	0	0	0	0.07	Wet
10 April 2002	0	0	0	0	0.01	0.06	Dry
11 June 2002	0.95	1.27	0.04	0.02	0.02	0	Wet
7 Aug 2002	0.11	0.28	0	0	0	0	Dry
9 Oct 2002	T	0.13	0	0	0	0	Dry
8 Jan 2003	0	0.44	0.01	0.07	0.04	0.09	Dry
12 Mar 2003	0.12	0	0	0	0	0	Dry
7 May 2003	0.14	1.00	0	0	0	0.02	Wet
9 July 2003	0	0	0	0	0	0	Dry (first Station), Wet (remaining stations)
10 Sept 2003***	0.11	0	0	0	0	0	Dry
5 Nov 2003	0	0	0	0.18	T	0.02	Dry
18 Feb 2004***	0	0	0	0	0	0	Dry
14 April 2004	0	0	0	0	0.36	1.21	Wet
9 June 2004	0.06	0	0	0	0	0	Dry
11 Aug 2004	0.01	0	0	0	0	0.24	Dry
13 Oct 2004	0	0	0	0	0	0	Dry

*Unofficial data from the National Weather Service station at Tully Lake or Birch Hill Dam, Royalston, MA available at http://www7.ncdc.noaa.gov/IPS/cd/cd.html;jsessionid=ABE64BF7DDF02CF50177DF08D65C8E3B?_page=0&jsessionid=ABE64BF7DDF02CF50177DF08D65C8E3B&state=MA&_target1=Next+%3E

T= trace amount; an amount too small to measure
** Based on streamflow and precipitation data.
*** - Data collected at Birch Hill Dam, Royalston in absence of Tully Lake Data

Table 8 Millers River at Erving, MA
USGS Flow Data Summary Discharge (cfs) 2000-2004

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR** Mean
22 March 2000	1,880*	2,050	1,890	1,750	1,690	1,550	1,501	1,440
10 May 2000	713	672	645	611	632	610	830.5	817
5 July 2000	386	332	308	292	298	265	305.0	333
23 Aug 2000	716	603	453	370	309	289	610.8	210
8 Nov 2000	244	251	239	240	232	230	409.1	482
14 Feb 2001	517	593	680	726	699	681	542.3	577
11 April 2001	924	2,080	2,470	1,990	3,860	4,090	2,458	1,720
17 April 2001	3,510	3,780	3,280	3,530	3,520	3,490	2,458	1,620
13 June 2001	673	485	420	327	511	583	570.2	554
8 Aug 2001	93	233	277	216	194	163	113.2	240
17 Oct 2001	95	101	92	118	126	123	117.1	366
5 Dec 2001	118	131	131	130	120	122	215.6	687
27 Feb 2002	592	615	558	505	462	483	354.1	732
10 April 2002	1,130	1,720	1,570	685	471	453	749.8	1,770
11 June 2002	822	1,570	1,740	1,550	1,210	975	692.9	576
7 Aug 2002	85	94	86	79	71	65	61.6	221
9 Oct 2002	84	77	73	67	62	61	124.1	340
8 Jan 2003	804	780	773	734	646	601	465.8	633
12 Mar 2003	700[e]	600[e]	550[e]	580[e]	450[e]	440[e]	1,428	1,010
7 May 2003	773	1,160	1,300	1,210	993	876	822.3	913
9 July 2003	289	224	199	186	148	160	165.3	303
10 Sept 2003	277	276	253	232	219	146	283.8	204
5 Nov 2003	2,430	1,790	1,400	1,220	1,110	1,050	883.4	520
18 Feb 2004	376[e]	374[e]	367[e]	358[e]	355[e]	354	353.7	600
14 April 2004	2,270	2,080	1,890	1,740	1,710	2,810	2.076	1,710
9 June 2004	578	519	457	403	364	337	314.3	605
11 Aug 2004	131	118	111	99	107	94	216.5	272
13 Oct 2004	397	371	345	337	319	305	510.2	321

***Gage # 01112500 data found at Daily Data at Millers River, Erving MA**
****POR*-Period of Record, monthly mean value based on entire 74-75 year record (10/1/1928-9/30/2004) found at Surface-Water Data Statistics for USGS 01166500 Millers River at Erving, MA**
[e]=estimated value
7Q10 = 46.8 cfs @ USGS gaging station, Millers River at Erving, MA

RESULTS AND QUALITY ASSURANCE/QUALITY CONTROL

The results of SMART monitoring conducted in the Millers watershed from 2000 through 2004 are included below. Table 9 through Table 13 present *in-situ* multiprobe readings, including temperature, pH, dissolved oxygen, percent oxygen saturation, depth, specific conductivity, and total dissolved solids. Table 14 through Table 18 contain nutrient (ammonia-nitrogen, nitrate-nitrite nitrogen, total nitrogen or total Kjeldahl nitrogen, and total phosphorus), chlorides, hardness, total alkalinity, total suspended solids and turbidity data. Ambient field blank and duplicate sample data are presented in Table 19 and Table 20, respectively. Most results are expressed as milligrams per liter (mg/L). Exceptions include: depth in meters (m); temperature in degrees Celsius (ºC); pH in Standard Units (SU); conductivity in microsiemens per centimeter (uS/cm); dissolved oxygen saturation in percent (%); and turbidity, in Nephelometric Turbidity Units (NTU).

Field sheets, field notebooks, chain of custody forms, raw data files, lab reports and other metadata are maintained by CERO in Worcester, MA and data are stored electronically in the Division of Watershed Management's (DWM) water quality database. Detailed information regarding the data validation process is explained in the separate document, *Summary of Current Data Validation Procedures* (MassDEP 2004a). Specific validation criteria used for 2000-2004 data include, but are not limited to: conformance to the SMART Monitoring Quality Assurance Project Plan (MassDEP 2010) and DWM standard operating procedures (SOPs), precision, accuracy, representativeness, holding times, sample preservation, frequency of field QC samples, contamination of field blanks, stability of multiprobe readings and documentation. The following data qualifiers were applied as needed:

Multiprobe data qualifiers:

** = Missing data.
-- = No data.
= Censored data (data that have been discarded for some reason).
c = Greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.
i = Inaccurate readings from multiprobe likely.
m = Method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed.
r = Data not representative of actual field conditions.
s = Field sheet recorded data were used to accept data, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.
u = Unstable readings.

Laboratory sample data qualifiers:

** = Missing data.
-- = No data.
= Censored data (data that have been discarded for some reason).
[ ] = A result reported inside brackets has been censored, but is shown for informational purposes.
b = Blank contamination in lab reagent blanks and/or field blank samples.
d = Precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP.
e = Not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for *E. coli* bacteria is greater than fecal coliform bacteria.
h = Holding time violation (usually indicating possible bias low).
j = 'Estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the reporting detection limit (RDL) and greater than the method detection limit (MDL) (RDL > x > MDL). Also used to note where values have been reported at levels less than the MDL.
m = Method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

Table 9 MassDEP SMART 2000-2004 Millers Watershed *In Situ* Multiprobe Data. Station MI14.

MILLERS RIVER (Saris: 3522150)

Unique_ID: 694 Station: MI14, Mile Point: 35.1

Description: just upstream/north of old bridge abutments on eastern shore of closed dirt road (Sibley Road on 1998 Winchendon USGS quad), Winchendon

Date	OWMID	Time	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/22/2000	SM-0020	12:34	4.4	5.8	70.3	45	12.5	94
5/10/2000	SM-0053	12:58	16.1	5.9	81.4	52.1	8.8	88
7/5/2000	SM-0086	13:42	22.8	6.0	89	57	6.8	77
8/23/2000	SM-0133	12:40	17.1	5.9	82.8	53	8.1	82
11/8/2000	SM-0180	12:53	6.8	6.0	81.1	51.9	11.0	88
4/17/2001	SM-0259	12:56	4.2	5.1	60.7	38.8	12.2	92
6/13/2001	SM-0298	13:08	20.1u	6.0	84.5	54.1	8.4	91
8/8/2001	SM-0338	13:28	26.0	6.3	122	77.8	7.0	84
10/17/2001	SM-0378	13:01	12.0	6.1	115	73.7	6.8	62
12/5/2001	SM-0418	14:30	6.6	6.1	102	65.4	10.8iu	86u
2/27/2002	SM-0457	13:19	2.9	6.0	111	70.9	11.9	88
4/10/2002	SM-0497	13:07	10.7	6.1	96.4	61.7	10.8	95
6/11/2002	SM-0537	13:02	20.0	5.8	84.3	53.9	8.2	89
8/7/2002	SM-0577	13:36	21.5	6.4	138	88.6	6.7	75
10/9/2002	SM-0617	13:11	11.0	5.9	128	81.9	7.4	65
3/12/2003	SM-0698	12:35	0.1	5.6	134	85.6	12.5	87
5/7/2003	SM-0739	13:11	15.0	5.7	109	69.8	9.5	96
7/9/2003	SM-0780	13:17	22.2	6.3 i	146	93	5.9	69
9/10/2003	SM-0832	14:03	17.1	6.3 c	128	83	8.1	84
11/5/2003	SM-0875	12:24	9.4	5.9	93	61	11.4	100
2/18/2004	SM-5917	12:38	0.0	6.2	120	78	13.6	93
4/14/2004	SM-5958	12:56	6.7	5.9	82	53	11.8	96
6/9/2004	SM-5999	13:07	21.3	6.3	108	70	8.8	99
8/11/2004	SM-6041	13:18	20.6	6.3	132	86	6.8	76
10/13/2004	SM-6082	12:57	11.0	6.2	103	67	9.9	90

Table 10 MassDEP SMART 2000-2004 Millers Watershed *In Situ* Multiprobe Data. Station PR01.

PRIEST BROOK (Saris: 3524150)								
Unique_ID: 693 Station: PR01, Mile Point: 4.2								
Description: approximately 10 meters downstream/south of River Street at USGS flow gauging station, Royalston								
Date	OWMID	Time	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/22/2000	SM-0019	12:02	4.0	4.9	42.7	27.3	11.4	84
5/10/2000	SM-0052	12:27	16.5	5.1	46.2	29.6	5.5	56
7/5/2000	SM-0085	13:06	22.2	5.3	47.1	30.2	5.3	60
8/23/2000	SM-0132	12:12	16.6	5.1	41	26.2	5.4	54
11/8/2000	SM-0179	12:22	6.1	5.1	45.6	29.2	8.7	69
2/14/2001	SM-0218	13:12	-0.1	5.1	55	35.2	9.1u	60u
4/11/2001	SM-0257	13:07	0.2	4.7	46.5	29.8	11.4	76
6/13/2001	SM-0297	12:38	19.0	5.2	42.6	27.3	6.0	64
8/8/2001	SM-0337	12:46	25.7u	5.7	50.1	32	3.6	43
10/17/2001	SM-0377	12:28	11.7	5.5	61.1	39.1	6.2	56
12/5/2001	SM-0417	12:44	5.1	5.4	60.5	38.7	8.9iu	68u
2/27/2002	SM-0456	12:34	0.0	5.2	57.2	36.6	10.1 u	69 u
4/10/2002	SM-0496	12:28	11.2	5.3	52.6	33.6	8.7	77
6/11/2002	SM-0536	12:30	19.2	5.1	51.3	32.9	5.9	63
8/7/2002	SM-0576	13:04	22.3	5.9	54.3	34.7	5.9	67
10/9/2002	SM-0616	12:37	11.1	5.3	55.2	35.3	5.4 u	47 u
1/8/2003	SM-0656	12:56	0.1	4.7	63.2	40.5	9.5	68
3/12/2003	SM-0697	11:57	0.2	4.7	72.1	46.2	9.5	67
5/7/2003	SM-0738	12:35	13.4	4.8	58.6	37.5	7.5	73
7/9/2003	SM-0779	12:43	23.4	5.6 i	65.9	42.2	2.9 u	34 u
9/10/2003	SM-0831	13:30	16.7	5.3 c	60	39	4.8	50
11/5/2003	SM-0874	12:00	8.3	5.0	55	36	8.1	69
2/18/2004	SM-5916	12:02	0.1	5.6	62	41	10.6	73
4/14/2004	SM-5957	12:22	5.7	5.0	35	23	10.7	85
6/9/2004	SM-5998	12:36	21.6	5.4	48	31	6.4	73
8/11/2004	SM-6040	12:41	20.4	5.6	56	36	3.5	38
10/13/2004	SM-6081	12:32	10.4	5.4	50	33	7.0	62

Table 11 MassDEP SMART 2000-2004 Millers Watershed *In Situ* Multiprobe Data. Station OT05.

OTTER RIVER (Saris: 3523800)

Unique_ID: 691 Station: OT05, Mile Point: 6.5

Description: approximately 35 meters upstream/southeast of Turner Street, Templeton (approximately 30 feet upstream of USGS flow gauging

Date	OWMID	Time	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/22/2000	SM-0016	11:02	4.1	5.8	246	158	12.0	89
5/10/2000	SM-0049	11:13	17.6	6.1	226	145	7.8	80
7/5/2000	SM-0082	11:57	22.1	6.1	312	200	7.2	81
8/23/2000	SM-0129	11:11	17.6	6.1	273	175	8.2	84
11/8/2000	SM-0176	11:17	7.4	6.0	262	168	10.7	87
2/14/2001	SM-0216	12:00	0.0	5.6	387	248	11.6u	77u
4/11/2001	SM-0254	11:36	1.8	5.5	200	128	12.5	87
6/13/2001	SM-0294	11:32	19.4	6.0	229	146	8.0	85
8/8/2001	SM-0334	11:29	25.4	6.4	300	192	6.9	83
10/17/2001	SM-0374	11:14	12.5	6.4	337	215	9.2	85
12/5/2001	SM-0414	11:18	7.2	6.2u	402	258	11.4iu	92iu
2/27/2002	SM-0452	10:23	3.9	6.6	154	99	13.0	98
4/10/2002	SM-0492	10:06	9.4	6.9 c	134	85.6	11.9	101
6/11/2002	SM-0532	10:16	19.3	6.4	107	68.5	9.3	99
8/7/2002	SM-0572	10:31	21.5	7.7 c	315	202	9.3	103
10/9/2002	SM-0612	10:16	11.0	7.5 c	334	213	11.6	102
1/8/2003	SM-0653	11:18	0.1	5.8	435	279	11.6	83
3/12/2003	SM-0694	11:00	0.6	5.7	497	318	11.8	84
5/7/2003	SM-0735	11:22	13.7	6.2	321	206	9.4	93
7/9/2003	SM-0776	11:32	23.3	6.3 i	448	287	6.7	80
9/10/2003	SM-0828	12:20	16.7	6.6 c	512 u	333 u	9.6	99
11/5/2003	SM-0871	10:59	8.9	6.1	258	168	10.9	94
2/18/2004	SM-5913	10:59	0.1	6.3	388	252	13.0 u	89 u
4/14/2004	SM-5954	11:10	6.7	6.2	227	148	11.2	92
6/9/2004	SM-5995	11:29	21.5	6.5	294	191	7.5	85
8/11/2004	SM-6037	11:22	21.0	6.6	476	310	7.9	89
10/13/2004	SM-6078	11:22	11.2	6.4	379	246	9.5	86

Table 12 MassDEP SMART 2000-2004 Millers Watershed *In Situ* Multiprobe Data. Station MI10A.

MILLERS RIVER (Saris: 3522150)

Unique_ID: 692 Station: MI10A, Mile Point: 27.6

Description: Blossom Street, approximately 150 meters downstream/west of King Street at USGS flow gauging station, Royalston.

Date	OWMID	Time	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/22/2000	SM-0018	11:33	4.1	5.6	110	70.6	12.5	92
5/10/2000	SM-0051	11:55	17.7	6.1	137	87.9	8.4	86
7/5/2000	SM-0084	12:35	23.8	6.3	139	89	7.3	85
8/23/2000	SM-0131	11:44	18.2	6.2	137	87.9	8.4	87
11/8/2000	SM-0178	11:54	7.1	6.3	166	106	11.3	92
4/11/2001	SM-0256	12:29	2.8	5.6	132	84.5	12.8	92
6/13/2001	SM-0296	12:08	19.0	6.2	139	88.7	8.4	90
8/8/2001	SM-0336	12:08	26.8	6.6	226	145	7.2	88
10/17/2001	SM-0376	11:53	12.7	6.6	337	216	9.3	86
12/5/2001	SM-0416	12:06	5.8	5.8	222	142	9.8i	76
2/27/2002	SM-0455	11:58	3.8	6.1	182	117	11.9	90
4/10/2002	SM-0495	11:56	9.1	5.9	121	77.3	11.3	96
6/11/2002	SM-0535	11:56	19.1	5.9	127	81.4	8.2	87
8/7/2002	SM-0575	12:25	24.3	6.9 c	265	169	8.2	96
10/9/2002	SM-0615	12:07	12.5	6.5	260	166	9.5	86
1/8/2003	SM-0655	12:09	0.0	5.7	216	138	12.4	89
3/12/2003	Ice Out	11:25j	--	--	--	--	--	--
5/7/2003	SM-0737	11:58	13.7	5.9	170	109	9.5	94
7/9/2003	SM-0778	12:13	24.6	6.7 i	277	177	6.9	84
9/10/2003	SM-0830	12:56	18.7	6.7 c	233	151	9.2	99
11/5/2003	SM-0873	11:32	9.4	6.0	136	88	11.1	97
2/18/2004	(Ice Out)	--	--	--	--	--	--	--
4/14/2004	SM-5956	11:44	6.3	6.1	112	73	11.6	94
6/9/2004	SM-5997	12:05	22.3	6.6	179	116	8.2	95
8/11/2004	SM-6039	11:59	21.5	6.7	238	155	8.0	91
10/13/2004	SM-6080	11:54	11.4	6.5	180	117	10.0	91

Table 13 MassDEP SMART 2000-2004 Millers Watershed *In Situ* Multiprobe Data. Station MI03.

MILLERS RIVER (Saris: 3522150)

Unique_ID: 690 Station: MI03, Mile Point: 5.8

Description: downstream/south of Bridge Street, Erving/Wendell.

Date	OWMID	Time	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/22/2000	SM-0015	9:59	4.6	6.1	89.1	57	13.1	98
5/10/2000	SM-0048	10:05	17.7	6.7	117	74.8	9.2	95
7/5/2000	SM-0081	10:57	22.4	7.3c	121	77.7	8.6	98
8/23/2000	SM-0128	10:14	17.7	7.2c	129	82.6	9.9	102
11/8/2000	SM-0175	10:00	7.2	6.9	142u	91.0u	12.2	99
2/14/2001	SM-0215	10:36	-0.2	6.0	195	125	13.1u	87u
4/11/2001	SM-0253	10:13	2.3	5.8	96.3	61.7	13.8u	98u
6/13/2001	SM-0293	10:10	18.5	6.9c	127	81	9.7	102
8/8/2001	SM-0333	10:03	25.5	7.2c	212	136	8.0u	97u
10/17/2001	SM-0373	10:06	12.9	7.1cu	240	153	10.9	101
12/5/2001	SM-0413	10:07	6.6	7.0cu	235	150	13.5iu	107iu
2/27/2002	SM-0452	10:23	3.9	6.6	154	99	13.0	98
4/10/2002	SM-0492	10:06	9.4	6.9 c	134	85.6	11.9	101
6/11/2002	SM-0532	10:16	19.3	6.4	107	68.5	9.3	99
8/7/2002	SM-0572	10:31	21.5	7.7 c	315	202	9.3	103
10/9/2002	SM-0612	10:16	11.0	7.5 c	334	213	11.6	102
3/12/2003	SM-0698	12:35	0.1	5.6	134	85.6	12.5	87
5/7/2003	SM-0739	13:11	15.0	5.7	109	69.8	9.5	96
7/9/2003	SM-0780	13:17	22.2	6.3 i	146	93	5.9	69
9/10/2003	SM-0832	14:03	17.1	6.3 c	128	83	8.1	84
11/5/2003	SM-0875	12:24	9.4	5.9	93	61	11.4	100
2/18/2004	SM-5912	10:05	0.0	6.5	182	118	13.8 u	95 u
4/14/2004	SM-5953	10:05	6.5	6.4	93	60	12.4	101
6/9/2004	SM-5994	10:25	20.6	7.2	150	98	9.3	104
8/11/2004	SM-6036	10:19	22.6	7.9	252	164	9.1	105
10/13/2004	SM-6077	10:20	10.8	7.1	151	98	10.7	97

Table 14 MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station MI14.

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0020		**	<2	7.5	14	1.2	0.7	0.22	--	<0.02	0.06	0.016
5/10/2000	SM-0053		12:58	3	8.5	16	4	2	0.41	--	0.05	0.04	0.035
7/5/2000	SM-0086		13:42	4	11	19	2.8	2.2	0.49	--	0.12	0.11	0.058
8/23/2000	SM-0133		13:00	3	9.3	17	4.3	2.4	0.49	--	** d	0.09d	0.053
11/8/2000	SM-0180		12:53	3	8.9	16	2.1	1.7	0.38	--	0.1	0.06	0.052
4/17/2001	SM-0259	--	12:56	<2f	6.1f	13f	<1.0f	0.75f	0.27f	--	<0.02f	<0.06f	0.013f
6/13/2001	SM-0298	--	13:08	3	9.2	30	5.5	2.3	0.47	--	0.12	0.06	0.046
8/8/2001	SM-0338	--	13:15	9	14	26	1.3	2.2	##h	--	0.25	0.3	0.076
10/17/2001	SM-0378	--	12:50	7	13	22	4	2.8	0.98	--	0.61	0.11	0.11
12/5/2001	SM-0418	--	14:35	7	11	20	2.9	2.8	0.76	--	0.44	0.1	0.086
2/27/2002	SM-0457	--	13:20	2	12	25	2.9	1.6	0.53	--	0.13	0.09	0.061
4/10/2002	SM-0497	--	13:15	3	10	20	2.5	1.5	0.43	--	0.06	<0.06	0.038
6/11/2002	SM-0537	--	12:55	<2.0	8.1	16	3.7	1.8	0.44	--	0.02 j	<0.02	0.046 b
8/7/2002	SM-0577	--	13:30	9	15	28	1.8	2.4	0.67	--	<0.02	0.45	0.16
10/9/2002	SM-0617	--	13:10	9	15	25	2.4	2	0.52	--	0.12	0.27	0.14
3/12/2003	SM-0698	--	12:30	<2 m	12 m	31 m	1.2 m	0.99 m	0.49 hm	--	0.17 m	0.12 m	0.023 m
5/7/2003	SM-0739	--	13:05	<2	9.8	25	2.6	1.4	0.41	--	<0.06	<0.06	0.032
7/9/2003	SM-0780	--	13:15	10	17	28	1.9	2.7	0.62	--	0.1	0.18	0.11
9/10/2003	SM-0832	--	14:00	6	13	25	8.4 d	3.1	--	1.0 bh	<0.02	0.24	0.15
11/5/2003	SM-0875	--	12:30	--	--	--	--	3.0*	--	0.42 h	<0.03 h	0.09 h	0.041 h
2/18/2004	SM-0917	--	12:30	--	--	--	--	1.7* m	--	0.62 jm	0.24 jm	0.13 jm	0.035 m
4/14/2004	SM-0958	--	12:40	--	--	--	--	3.0*	--	0.34 j	<0.01 j	0.08 j	0.031
6/9/2004	SM-0999	--	13:00	--	--	--	--	1.7*	--	0.45 j	0.13 j	<0.06 j	0.025
8/11/2004	SM-1041	--	13:10	9	14	26	2.3 d	2.8	--	1.3	0.37	0.27	0.043
10/13/2004	SM-1082	--	12:55	4	10	21	2.2	1.5	--	0.54	0.06	0.08	0.029

Table 15 MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station PR01.

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0019		12:02	<2	5.3	7	<1.0	0.3	0.1	--	<0.02	<0.02	<0.005
5/10/2000	SM-0052		12:27	4	6	7	1.8	1.5	0.34	--	<0.02	<0.02	0.032
7/5/2000	SM-0085		13:06	4	6.6	10	2.4	1.4	0.41	--	<0.02	0.02	0.045
8/23/2000	SM-0132		12:15	<2	5	6	<1.0	0.8	0.49e	--	** de	<0.02d	0.025
11/8/2000	SM-0179		12:22	2	6.2	7	<1.0	0.63	0.3	--	<0.02	<0.02	0.018
2/14/2001	SM-0218	--	13:12	2m	7.9m	10m	<1.0m	0.85m	0.29m	--	0.06m	0.07m	0.020m
4/11/2001	SM-0257	--	13:07	<2	5.5	9	1.9	0.7	0.14	--	<0.02	<0.06	0.016
6/13/2001	SM-0297	--	12:38	<2	5.6	9	1.2	1.3	0.36	--	0.07	<0.06	0.033
8/8/2001	SM-0337	--	12:35	5	6.3	10	2	1.7	##h	--	<0.02	<0.06	0.05
10/17/2001	SM-0377	--	12:20	<2	8.3	11	<1.0	0.85	0.34	--	<0.02	<0.06	0.024
12/5/2001	SM-0417	--	12:55	3	6.9	12	<1.0	0.8	0.32	--	<0.02	<0.06	0.019
2/27/2002	SM-0456	--	12:35	<2.0	8.4	11	<1.0	0.55	0.25 j	--	<0.02	<0.02	0.015
4/10/2002	SM-0496	--	12:30	<2.0	7.4	6	<1.0	0.45	0.28 j	--	<0.02	<0.02	0.019
6/11/2002	SM-0536	--	12:25	<2.0	5.7	8	<1.0	0.7	0.37	--	<0.02	<0.02	0.025 b
8/7/2002	SM-0576	--	13:00	4	6.9	11	3.8	2.6	0.65	--	<0.02	<0.02	0.035
10/9/2002	SM-0616	--	12:35	2	8.9	9	3.4	2	0.69	--	0.07	<0.02	0.053
1/8/2003	SM-0656	--	12:45	<2 m	8.0 m	11 m	<1.0 m	0.28 m	0.24 m	--	0.10 m	<0.02 m	0.010 m
3/12/2003	SM-0697	--	11:50	<2 m	8.9 m	15 m	<1.0 m	0.43 m	0.35 hm	--	<0.02 m	<0.06 m	0.011 m
5/7/2003	SM-0738	--	12:30	<2	6.7	10	<1.0	0.76	0.31	--	<0.06	<0.06	0.017
7/9/2003	SM-0779	--	12:40	3	8.7	11	13	2.9	0.81	--	<0.02	<0.02	0.063 b
9/10/2003	SM-0831	--	13:25	2	6.6	11	1.4 d	1.1	--	0.73 bh	<0.02	<0.02	0.029
11/5/2003	SM-0874	--	11:55	--	--	--	--	0.5*	--	0.34 h	<0.01 h	<0.02 h	0.018 h
2/18/2004	SM-0916	--	11:55	--	--	--	--	2.1* m	--	0.42 jm	0.11 jm	0.06 jm	0.031 m
4/14/2004	SM-0957	--	12:10	--	--	--	--	1.1*	--	0.21 j	<0.01 j	<0.02 j	0.019
6/9/2004	SM-0998	--	12:30	--	--	--	--	1.3*	--	0.34 j	<0.01 j	<0.02 j	0.022
8/11/2004	SM-1040	--	12:25	4	6.4	9	2.4 d	1.8	--	0.63	<0.01	<0.02	0.046
10/13/2004	SM-1081	--	12:25	2	5.6	8	1.6	0.84	--	0.41	<0.01	<0.02	0.02

Table 16 MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station OT05 (includes duplicate sample results).

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0016	SM-0017	11:02	2	22	59	1.4	1.3	0.21	--	<0.02	0.44	0.062
3/22/2000	SM-0017	SM-0016	11:07	2	22	58	1.3	1.3	0.21	--	<0.02	0.46	0.061
5/10/2000	SM-0049	SM-0050	11:13	6	23	50	7.6	4.4	0.94	--	0.19	0.5	0.11
5/10/2000	SM-0050	SM-0049	11:18	7	22	53	6.5	4.1	0.85	--	0.21	0.53	0.11
7/5/2000	SM-0082	SM-0083	11:57	7	38	68	8.6	12	0.73	--	0.03d	3.1	0.17
7/5/2000	SM-0083	SM-0082	11:57	7	39	68	7	12	0.73	--	<0.02d	3.2	0.17
8/23/2000	SM-0129	SM-0130	11:10	7	33	57	6	8.6	0.7	--	** d	1.8 d	0.11
8/23/2000	SM-0130	SM-0129	11:10	8	33	56	5.7	8.5	0.69	--	** d	3.1 d	0.11
11/8/2000	SM-0176	SM-0177	11:17	5	32	54	2.4	5.1	0.71	--	<0.02	3.8	0.39
11/8/2000	SM-0177	SM-0176	11:22	6	32	53	2.9	5.1	0.65	--	<0.02	3.8	0.39
2/14/2001	SM-0216	SM-0217	12:00	4	33	100	1.6	2.6	0.59	--	0.14d	1.5	0.17
2/14/2001	SM-0217	SM-0216	12:05	5	33	100	1.8	2.7	0.62	--	0.11d	1.5	0.17
4/11/2001	SM-0254	SM-0255	11:36	3	17	50	5.2	2.6	0.3	--	0.08	0.28	0.042
4/11/2001	SM-0255	SM-0254	11:41	3	17	50	5.8	2.3	0.3	--	0.09	0.3	0.041
6/13/2001	SM-0294	SM-0295	11:32	4	22	54	12	10	0.75	--	0.1	1.1	0.16
6/13/2001	SM-0295	SM-0294	11:37	5	22	54	11	12	0.67	--	0.11	1.1	0.16
8/8/2001	SM-0335	SM-0334	**	12	35	60	5.4	8.9	##h	--	<0.02	4.1	0.21
8/8/2001	SM-0334	SM-0335	11:15	11	36	48	6.9	8.4	##h	--	<0.02	4	0.21
10/17/2001	SM-0375	SM-0374	**	12	40	72	2.3	4.6	0.56	--	<0.02	3.1	0.27
10/17/2001	SM-0374	SM-0375	11:05	12	40	75	2.8	4.6	0.55	--	<0.02	3.1	0.27
12/5/2001	SM-0415	SM-0414	**	12	50	75	3.4	5.1	1.1	--	##d	9.5	0.97
12/5/2001	SM-0414	SM-0415	11:25	12	50	75	3.2	5.1	0.96	--	##d	9.5	0.92

Table 16 continued. MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station OT05 (includes duplicate sample results).

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/27/2002	SM-0453	SM-0454	11:20	6	40	94	1.8	2	0.56	--	0.14	2.3	0.28
2/27/2002	SM-0454	SM-0453	11:20	7	41	96	2	2.1	0.54	--	0.14	2.2	0.27
4/10/2002	SM-0493	SM-0494	11:20	9	34	80	3.4	2.5	0.85	--	0.54	0.69	0.074
4/10/2002	SM-0494	SM-0493	11:20	9	34	81	3	2.3	0.87	--	0.52	0.66	0.08
6/11/2002	SM-0533	SM-0534	11:10	6	24	56	8.9	6.4	0.64	--	<0.02	0.89	0.14 b
6/11/2002	SM-0534	SM-0533	11:10	5	24	56	8.3	6.3	0.64	--	<0.02	0.89	0.13 b
8/7/2002	SM-0573	SM-0574	11:40	18	60	100	7	6.7	1.3	--	<0.02	6.6	0.18
8/7/2002	SM-0574	SM-0573	11:40	18	60	99	6.7	6.8	1.3	--	<0.02	7.2	0.18
10/9/2002	SM-0613	SM-0614	11:20	16	56	88	1.7	3.6	1.2	--	0.18	7.1	0.18
10/9/2002	SM-0614	SM-0613	11:20	15	56	88	1.8	3.5	1.2	--	0.2	7.1	0.18
1/8/2003	SM-0653	SM-0654	11:05	5	31	110	2.6	1.6	0.62	--	0.42 d	1.1	0.15
1/8/2003	SM-0654	SM-0653	11:05	5	32	110	2.8	1.7	0.67	--	0.52 d	1.1	0.15
3/12/2003	SM-0694	SM-0695	10:50	7	37	130	1.4	1.8	0.62 h	--	0.18	1.2	0.15
3/12/2003	SM-0695	SM-0694	10:50	6	37	130	1.3	1.9	0.66 h	--	0.15	1.3	0.16
5/7/2003	SM-0735	SM-0736	11:15	5	26	79	3	2.3	0.74	--	0.34	0.22	0.052 j
5/7/2003	SM-0736	SM-0735	11:15	6	27	78	3.2	2.2	0.82	--	0.33	0.2	0.049 j
7/9/2003	SM-0776	SM-0777	11:30	7	47	90	7.9 d	16	1.3	--	0.3	3.8	0.17
7/9/2003	SM-0777	SM-0776	11:30	5	47	99	10 d	14	1.3	--	0.29	3.8	0.17
9/10/2003	SM-0828	SM-0829	12:20	10	58	100	## d	11 d	--	10 bh	<0.02	9	0.17 d
9/10/2003	SM-0829	SM-0828	12:20	11	58	100	## d	7.3 d	--	10 bh	<0.02	9	0.11 d
11/5/2003	SM-0871	SM-0872	11:00	--	--	--	--	4.1*	--	1.4 h	<0.03 h	0.89 h	0.15 h
11/5/2003	SM-0872	SM-0871	11:00	--	--	--	--	4.2*	--	1.4 h	<0.03 h	0.88 h	0.15 h

Table 16 continued. MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station OT05 (includes duplicate sample results).

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/18/2004	SM-0913	SM-0914	10:55	--	--	--	--	4.0*	--	3.2 j	0.20 j	2.6 j	0.32
2/18/2004	SM-0914	SM-0913	10:55	--	--	--	--	4.1*	--	3.1 j	0.20 j	2.6 j	0.32
4/14/2004	SM-0954	SM-0955	10:55	--	--	--	--	8.0*	--	0.72 dj	0.07 j	0.33 dj	0.060 d
4/14/2004	SM-0955	SM-0954	10:55	--	--	--	--	7.6*	--	0.58 dj	0.06 j	0.24 dj	0.045 d
6/9/2004	SM-0995	SM-0996	11:20	--	--	--	--	7.5*	--	2.6 j	0.22 j	1.7 dj	0.096
6/9/2004	SM-0996	SM-0995	11:20	--	--	--	--	7.8*	--	2.9 j	0.24 j	1.9 dj	0.11
8/11/2004	SM-1037	SM-1038	11:15	12	55	98	3.6 d	8.6	--	8.3	<0.01	7.3	0.13
8/11/2004	SM-1038	SM-1037	11:15	11	55	98	7.8 d	8	--	8.4	<0.01	7.4	0.11
10/13/2004	SM-1078	SM-1079	11:15	6	43	83	2.8 d	5.3	--	4.2	<0.03	3.8	0.082
10/13/2004	SM-1079	SM-1078	11:15	6	43	83	4.1 d	5.4	--	4.2	<0.03	3.8	0.085

Table 17 MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station MI10A.

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0018		11:33	3	10	25	<1.0	0.9	0.19	--	<0.02	0.11	0.018
5/10/2000	SM-0051		11:55	5	14	29	5.4	3	0.52	--	<0.02	0.17	0.06
7/5/2000	SM-0084		12:35	5	18	29	2.5	4.7	0.42	--	<0.02	0.58	0.097
8/23/2000	SM-0131		11:45	5	17	26	1.8	3.6	0.54	--	** d	0.37d	0.06
11/8/2000	SM-0178		11:54	5	23	31	1.1	3.2	0.42	--	0.08	0.74	0.079
4/11/2001	SM-0256	--	12:29	3	12	32	2.4	1.8	0.26	--	0.08	0.18	0.027
6/13/2001	SM-0296	--	12:08	5	16	31	7.8	8.8	0.63	--	0.12	0.35	0.1
8/8/2001	SM-0336	--	12:00	10	29	45	2	2.9	##h	--	<0.02	0.66	0.079
10/17/2001	SM-0376	--	11:45	13	50	60	3.3	3.6	0.72	--	<0.02	1.5	0.093
12/5/2001	SM-0416	--	12:15	7	23	49	10	5.1	0.71	--	<0.02	0.65	0.15
2/27/2002	SM-0455	--	11:55	4	20	40	2.8	2	0.39	--	0.06	0.36	0.06
4/10/2002	SM-0495	--	11:55	2	12	26	1.1	1.1	0.36	--	<0.02	<0.06	0.031
6/11/2002	SM-0535	--	11:55	3	14	26	4.6	3.1	0.53	--	0.03 j	0.1	0.065 b
8/7/2002	SM-0575	--	12:20	12	31	53	1.5	2.5	0.91	--	<0.02	0.94	0.099
10/9/2002	SM-0615	--	12:05	14	36	48	2.1	3.3	0.75	--	0.18	0.87	0.096
1/8/2003	SM-0655	--	12:05	3	19	52	1.4	1.2	0.45	--	0.54	0.28	0.04
3/12/2003	Ice Out	--	11:25j	--	--	--	--	--	--	--	--	--	--
5/7/2003	SM-0737	--	11:55	3	16	39	2.6	1.8	0.46	--	0.14	0.12	0.028 j
7/9/2003	SM-0778	--	12:05	11	35	56	1.8	5.3	0.64	--	<0.02	0.85	0.1
9/10/2003	SM-0830	--	12:55	8	27	47	1.6 d	2.5	--	1.4 bh	<0.02	0.38	0.064
11/5/2003	SM-0873	--	11:30	--	--	--	--	2.5*	--	0.58 h	<0.03 h	0.18 h	0.057 h
2/18/2004	(Ice Out)	--	--	--	--	--	--	--	--	--	--	--	--
4/14/2004	SM-0956	--	11:35	--	--	--	--	4.2*	--	0.45 j	0.05 j	0.12 j	0.037
6/9/2004	SM-0997	--	12:00	--	--	--	--	3.8*	--	0.65 j	0.05 j	0.28 j	0.045
8/11/2004	SM-1039	--	11:50	9	25	49	1.5 d	3.2	--	1.6	<0.03	0.99	0.069
10/13/2004	SM-1080	--	11:50	6	20	36	1.6	2.3	--	0.9	<0.03	0.43	0.042

Table 18 MassDEP SMART 2000-2004 Millers Watershed Nutrients, Chlorides, Hardness, Total Alkalinity, Total Suspended Solids and Turbidity Data. Station MI03.

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0015		9:59	3	11	18	1.4	1	0.18	--	<0.02	0.08	0.015
5/10/2000	SM-0048		10:05	5	16	17	2.7	1.8	0.37	--	<0.02	0.13	0.042
7/5/2000	SM-0081		10:57	6	18	24	1.7	2.8	0.28	--	<0.02	0.35	0.062
8/23/2000	SM-0128		10:30	9	21	24	1.1	2	0.44	--	** d	0.32d	0.043
11/8/2000	SM-0175		10:00	9	25	25	1.2	2.1	0.36	--	<0.02	0.48	0.062
2/14/2001	SM-0215	--	10:36	6m	21m	44m	1.6m	1.7m	0.48m	--	0.17m	0.34m	0.051m
4/11/2001	SM-0253	--	10:13	2	11	22	9.8	2.6	0.28	--	0.07	0.13	0.041
6/13/2001	SM-0293	--	10:11	5	18	32	3	2.4	0.38	--	0.13	0.36	0.053
8/8/2001	SM-0333	--	9:50	11	35	38	3.3	1.9	##h	--	<0.02	0.61	0.062
10/17/2001	SM-0373	--	9:55	19	44	49	1.9	1.7	0.33	--	<0.02	0.53	0.071
12/5/2001	SM-0413	--	10:15	17	39	39	2	4.6	0.38	--	0.07	<0.06	0.066
2/27/2002	SM-0452	--	10:20	7	20	33	2.2	1.4	0.33	--	<0.02	0.2	0.051
4/10/2002	SM-0492	--	10:15	4	17	27	2	1.1	0.31	--	<0.02	0.06	0.031
6/11/2002	SM-0532	--	10:10	4	13	21	4.2	2.3	0.41	--	<0.02	0.07	0.049 b
8/7/2002	SM-0572	--	10:30	21	49	57	<1.0	1.2	0.56	--	<0.02	0.66	0.052
10/9/2002	SM-0612	--	10:15	25	63	59	14	3.5	1.2	--	0.12	1.2	0.18
1/8/2003	SM-0652	--	9:50	3 m	19 m	40 m	1.1 m	0.94 m	0.36 m	--	0.08 m	0.24 m	0.033 m
3/12/2003	SM-0693	--	9:45	4 m	22 m	53 m	1.9 m	1.2 m	0.49 hm	--	0.12 m	0.26 m	0.046 m
5/7/2003	SM-0734	--	10:05	3	16	33	2.5	1.5	0.37	--	0.14	0.08	0.036 j
7/9/2003	SM-0775	--	10:25	10	33	41	2.7	1.8	0.46	--	<0.02	0.26	0.055 b
9/10/2003	SM-0827	--	10:25	10	30	32	<1.0 d	1.4	--	0.93 bh	<0.06	0.36	0.04
11/5/2003	SM-0870	--	10:05	--	--	--	--	2.2*	--	0.47 h	<0.01 h	0.14 h	0.040 h
2/18/2004	SM-0912	--	10:00	--	--	--	--	3.3* m	--	0.86 jm	0.16 jm	0.38 jm	0.065 m
4/14/2004	SM-0953	--	9:55	--	--	--	--	4.2*	--	0.40 j	<0.04 j	0.10 j	0.044
6/9/2004	SM-0994	--	10:05	--	--	--	--	2.4*	--	0.55 j	<0.01 j	0.22 j	0.037
8/11/2004	SM-1036	--	10:05	17	38	47	1.5 d	2.2	--	0.82	<0.01	0.38	0.047
10/13/2004	SM-1077	--	10:10	10	21	29	1.8	1.5	--	0.67	<0.01	0.32	0.038

Table 19 MassDEP SMART 2000-2004 Millers Watershed Ambient Field Blanks.

Date	OWMID	QAQC	Time	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	TN	NH3-N	NO3-NO2-N	TPhos
			24hr	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0021	BLANK	**	<2	<0.66	<1.0	<1.0	<0.1	<0.10	--	<0.02	<0.02	<0.005
5/10/2000	SM-0054	BLANK	13:05	<2	<0.66	<1.0	<1.0	<0.1	<0.10	--	<0.02	<0.02	<0.010
7/5/2000	SM-0087	BLANK	13:45	<2	<0.66	<2.0	<1.0	<0.1	<0.10	--	<0.02	<0.02	<0.010
8/23/2000	SM-0134	BLANK	13:00	<2	<0.66	<2.0	<1.0	<0.1	<0.10	--	** d	<0.02d	<0.010
11/8/2000	SM-0181	BLANK	12:58	<2	<0.66	<1.0	<1.0	<0.1	<0.10	--	<0.02	<0.02	<0.010
2/14/2001	SM-0219	Blank	13:35	<2	<0.66	<1	<1.0	<0.10	<0.10	--	<0.02	<0.06	<0.010
4/11/2001	SM-0258	Blank	**	<2	<0.66	<1	<1.0	<0.10	<0.10	--	<0.02	<0.06	<0.010
6/13/2001	SM-0299	Blank	13:25	<2	<0.66	<1	<1.0	<0.10	<0.10	--	<0.02	<0.06	<0.010
8/8/2001	SM-0339	Blank	**	<2	<0.66	<1	<1.0	<0.10	##h	--	<0.02	<0.06	<0.005
10/17/2001	SM-0379	Blank	**	<2	<0.66	<1	<1.0	<0.10	<0.10	--	<0.02	<0.06	<0.005
12/5/2001	SM-0419	Blank	**	<2.0	<0.66	2b	<1.0	<0.10	<0.10	--	<0.02	<0.06	<0.005
2/27/2002	SM-0458	Blank	13:00j	<2.0	<0.66	<1.0	<1.0	<0.10	<0.10	--	<0.02	<0.02	<0.005
4/10/2002	SM-0498	Blank	12:55j	<2.0	<0.66	<1.0	<1.0	<0.10	<0.10	--	<0.02	<0.02	<0.005
6/11/2002	SM-0538	Blank	12:50j	<2.0	<0.66	<1.0	<1.0	<0.10	<0.10	--	<0.02	<0.02	0.007 bj
8/7/2002	SM-0578	Blank	13:20j	<2.0	<0.66	<1.0	<1.0	<0.10	<0.10	--	<0.02	<0.02	<0.005
10/9/2002	SM-0618	Blank	12:55j	<2.0	<0.66	<1.0	<1.0	<0.10	<0.10	--	<0.06	<0.02	<0.005
1/8/2003	SM-0658	Blank	12:35j	<2	<0.66	<1	<1.0	<0.10	<0.10	--	<0.06	<0.02	<0.005
3/12/2003	SM-0699	Blank	12:20j	<2	<0.66	<1	<1.0	<0.10	0.14 bh	--	<0.02	<0.02	<0.005
5/7/2003	SM-0740	Blank	12:55j	<2	<0.66	<1	<1.0	0.12 b	<0.10	--	<0.02	<0.06	<0.005 j
7/9/2003	SM-0781	Blank	13:00j	<2	<0.66	<1	<1.0	0.28 b	0.14 b	--	<0.02	<0.02	0.008 b
9/10/2003	SM-0833	Blank	14:00	<2	<0.66	<1	<1.0 d	<0.10	--	0.14 bh	<0.02	<0.02	<0.005
11/5/2003	SM-0876	Blank	12:20j	--	--	--	--	<0.5*	--	<0.040 h	<0.01 h	<0.02 h	<0.005 h
2/18/2004	SM-0918	Blank	12:35	--	--	--	--	<0.5*	--	0.050 bj	<0.01 j	<0.02 j	<0.005
4/14/2004	SM-0959	Blank	12:45	--	--	--	--	<0.5*	--	0.058 bj	<0.01 j	<0.02 j	0.006 b
6/9/2004	SM-1000	Blank	13:05	--	--	--	--	<0.5*	--	0.041 bj	<0.01 j	<0.02 j	<0.005
8/11/2004	SM-1042	Blank	13:15	<2	<0.66	<1	<1.0 d	<0.10	--	<0.12	<0.01	<0.02	<0.005
10/13/2004	SM-1083	Blank	13:00	<2	<0.66	<1	<1.0	<0.10	--	<0.040	<0.01	<0.02	<0.005

Table 20 MassDEP SMART 2000-2004 Millers Field Duplicate Results.

Date	OWMID	QAQC	Time	Depth	Alkalinity	Hardness	Chloride	SSolids	Turb	TKN	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(m)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
3/22/2000	SM-0016	SM-0017	11:02	--	2	22	59	1.4	1.3	0.21	<0.02	0.44	0.062
3/22/2000	SM-0017	SM-0016	11:07	--	2	22	58	1.3	1.3	0.21	<0.02	0.46	0.061
Relative	*Percent*	*Difference*			*0.00%*	*0.00%*	*1.70%*	*7.40%*	*0.00%*	*0.00%*	*0.00%*	*4.40%*	*1.60%*
5/10/2000	SM-0049	SM-0050	11:13	--	6	23	50	7.6	4.4	0.94	0.19	0.5	0.11
5/10/2000	SM-0050	SM-0049	11:18	--	7	22	53	6.5	4.1	0.85	0.21	0.53	0.11
Relative	*Percent*	*Difference*			*15.40%*	*4.40%*	*5.80%*	*15.60%*	*7.10%*	*10.10%*	*10.00%*	*5.80%*	*0.00%*
7/5/2000	SM-0082	SM-0083	11:57	--	7	38	68	8.6	12	0.73	0.03d	3.1	0.17
7/5/2000	SM-0083	SM-0082	11:57	--	7	39	68	7	12	0.73	<0.02d	3.2	0.17
Relative	*Percent*	*Difference*			*0.00%*	*2.60%*	*0.00%*	*20.50%*	*0.00%*	*0.00%*	*40.00%*	*3.20%*	*0.00%*
8/23/2000	SM-0129	SM-0130	11:10	--	7	33	57	6	8.6	0.7	** d	1.8 d	0.11
8/23/2000	SM-0130	SM-0129	11:10	--	8	33	56	5.7	8.5	0.69	** d	3.1 d	0.11
Relative	*Percent*	*Difference*			*13.30%*	*0.00%*	*1.80%*	*5.10%*	*1.20%*	*1.40%*		*53.10%*	*0.00%*
11/8/2000	SM-0176	SM-0177	11:17	--	5	32	54	2.4	5.1	0.71	<0.02	3.8	0.39
11/8/2000	SM-0177	SM-0176	11:22	--	6	32	53	2.9	5.1	0.65	<0.02	3.8	0.39
Relative	*Percent*	*Difference*			*18.20%*	*0.00%*	*1.90%*	*18.90%*	*0.00%*	*8.80%*	*0.00%*	*0.00%*	*0.00%*

REFERENCES

Beaudoin, T. 2010 (unpublished). *CN 12.1: Strategic Monitoring and Assessment for River basin Teams Quality Assurance Project Plan. 2008-2012.* Massachusetts Department of Environmental Protection. Central Regional Office. Worcester, MA.

Google Earth. 2011a. "MI14". 42º40'20.89"N and 72º05'34.57"W. September 21, 2010. 11 Jan 2011.

Google Earth. 2011b. "PR01". 42º40'57.88"N and 72º06'53.87"W. September 21, 2010. 11 Jan 2011.

Google Earth. 2011c. "OT05". 42º35'17.53"N and 72º02'27.49"W. September 21, 2010. 11 Jan 2011.

Google Earth. 2011d. "MI10A". 42º37'47.57"N and 72º09'01.20"W. September 21, 2010. 11 Jan 2011.

Google Earth. 2011e. "MI03". 42º35'51.29"N and 72º26'15.58"W. September 7, 2010. 11 Jan 2011.

Kennedy, L.E. and A. M. Rojko. March 2004. CN *089.0: Millers River Watershed: 2000 Water Quality Assessment Report.* Report 35-AC-1. Massachusetts Department of Environmental Protection. Division of Watershed Management. Worcester, MA.

MassDEP. 2006. *CN 265.0 Draft Final Data Validation Report for Year 2004 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. October, 2006.

MassDEP. 2005a. *CN 211.0 Data Validation Report for Year 2003 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. November, 2005

MassDEP. 2005b. *CN 202.0 Data Validation Report for Year 2002 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. October, 2005

MassDEP. 2004a. CN 056.1. *Summary of Current DWM Data Validation Procedures*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2004b. *CN 149.0 Data Validation Report for Year 2001 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. December, 2004.

MassDEP. 2003. *CN 83.0 Data Validation Report for Year 2000 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. March 5, 2003.

MassDEP. 1999a. *CN 4.0 Water Quality Multi-probe Instrument Use, Standard Operating Procedure.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 1999b. *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDFG. 2011 [online]. *Coldwater Fisheries Resources. Millers River Watershed.* Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife. Westborough, MA. 31 May 2011. http://www.mass.gov/dfwele/dfw/fisheries/conservation/cfr/cfr_millers_river.htm

MassWildlife. 2011a. *MassWildlife Activities.* Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife. Westborough, MA. 5 January 2011. Available at: http://www.mass.gov/dfwele/dfw/activities.htm

MassWildlife. 2011b. *Wildlife Management Area Maps. Birch Hill Wildlife Management Area.* Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife. Westborough, MA. 5 January 2011. Available at Birch Hill Wildlife Management Area

NOAA. 2010 [online]. *NWS Taunton, MA: Daily Data for 72 locations in the Northeast*. Recent (but unofficial) daily climate data for New England, Eastern and Southeastern New York and Northern New Jersey. National Oceanic and

Atmospheric Administration. National Weather Service Forecast Office: Boston, MA. Available at http://www.erh.noaa.gov/box/dailystns.shtml

Norris, A. (Alicia.Norris@state.ma.us). 2011. *Re: Fisheries information request.* Fish stocking activities near five SMART stations in the Millers Watershed, Massachusetts. Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife, Westborough, MA. Email to Therese Beaudoin, Massachusetts Department of Environmental Protection, Bureau of Resource Management, Worcester, MA dated 14 March 2010.

North Quabbin Woods. *Area Guide – Birch Hill Wildlife Management Area. North Quabbin Woods; project of the North Quabbin Community Coalition.* Royalston, MA. 5 January 2011. Available at northquabbinwoods.org

Ostiguy, Lance J., Weiskel, Peter K. and Stacey A. Archfield. 2010 [Online]. *Average Annual Precipitation, in Inches, for Massachusetts as Computed over the Period 1971-2000 Using the Parameter-Elevation Regressions on Independent Slopes (PRISM) Model. Appendix 1, Figure 1-2. 16 February 2011.* Available at http://pubs.usgs.gov/sir/2009/5227/pdf/Appendix/sir2009-5227_appendix1_fig2.pdf

USACE. 2013 [online]. *Birch Hill Dam, Royalston, MA. Flood Damage Reduction*. U. S. Army Corps of Engineers. Royalston, MA. 16 February 2011. Available at Birch Hill State Flood Control Project

USGS. 2011a [online]. Discharge and gage height at the USGS Millers River gage near Winchendon, MA (USGS station number 01162000) from June 1916 to current year. 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

USGS. 2011b [online]. Discharge and gage height at the USGS Priest Brook gage near Winchendon, MA (USGS station number 01162500) from May 1916 to current year. 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

USGS. 2011c [online]. Discharge and gage height at the USGS Otter River gage at Otter River, MA (USGS station number 01163200) from December 1964 to current year. 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

USGS. 2011d [online]. Discharge and gage height at the USGS Millers River gage at South Royalston, MA (USGS station number 01164000) from July 1939 to current year. 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

USGS. 2011e [online]. Discharge and gage height at the USGS Millers River gage at Erving, MA (USGS station number 01166500) from July 1915 to current year. 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/current?type=dailystagedischarge&group_key=basin_cd&search_site_no_station_nm=

USGS. 2011f [online]. USGS Surface-Water Daily Statistics for Massachusetts. USGS Millers River gage at Erving, MA (USGS station number 01166500). Mean of daily mean discharge values for each day for 93-94 years of record in cfs (Calculation period 1 October 1915 through 30 September 2009). 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/dvstat/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915-07-01,2009-03-15&format=html_table&stat_cds=mean_va&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list.

USGS. 2011g [online]. USGS Surface-Water Monthly Statistics for Massachusetts. USGS Millers River gage at Erving, MA. (USGS station number 01166500). Monthly mean discharge values for 93-94 years of record in cfs (Calculation period 1 October 1915 through 30 September 2009). 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/monthly/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915-07,2009-03&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

USGS. 2011h [online]. USGS Surface-Water Annual Statistics for Massachusetts. USGS Millers River gage at Erving, MA. (USGS station number 01166500). Annual mean discharge values for 93-94 years of record in cfs (Calculation period water years 1916 through 2008). 16 February 2011. Available at http://waterdata.usgs.gov/ma/nwis/annual/?referred_module=sw&site_no=01166500&por_01166500_1=1269036,00060,1,1915,2009&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

Wandle, S. W. and Fontaine, R.A.. 1984 [Online]. *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts-Coastal River Basins of the North Shore and Massachusetts Bay*. Water-Resources Investigations Report 84-4284. United States Geological Survey. Available at http://pubs.er.usgs.gov/publication/wri844284