Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies

Appendix F: Millers River Basin

Commonwealth of Massachusetts
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Massachusetts Department of Environmental Protection

The mission of the Massachusetts Department of Environmental Protection (MassDEP) is to protect and enhance the Commonwealth's natural resources – air, water, and land – to provide for the health, safety, and welfare of all people, and to ensure a clean and safe environment for future generations. In carrying out this mission MassDEP commits to address and advance environmental justice and equity for all people of the Commonwealth; provide meaningful, inclusive opportunities for people to participate in agency decisions that affect their lives; and ensure a diverse workforce that reflects the communities we serve.

Watershed Planning Program

The mission of the Watershed Planning Program (WPP) in the Massachusetts Department of Environmental Protection is to protect, enhance, and restore the quality and value of the waters of the Commonwealth. Guided by the federal Clean Water Act, WPP implements this mission statewide through five Sections that each have a different technical focus: (1) Surface Water Quality Standards; (2) Surface Water Quality Monitoring; (3) Data Management and Water Quality Assessment; (4) Total Maximum Daily Load; and (5) Nonpoint Source Management. Together with other MassDEP programs and state environmental agencies, WPP shares in the duty and responsibility to secure the environmental, recreational, and public health benefits of clean water for all people of the Commonwealth.

Acknowledgements

FB Environmental Associates, under contractual agreements with MassDEP, previously prepared two separate documents for the Watershed Planning Program: (1) *Massachusetts TMDL for Pathogen-Impaired Inland Fresh Water Rivers* and (2) *Massachusetts Statewide TMDL for Pathogen-Impaired Coastal Waterbodies*. MassDEP combined these two documents into a single statewide approach encompassing both inland fresh water and coastal impairments to prepare the *Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies*.

Disclaimer

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TABLE OF CONTENTS

1. Introduction

This appendix to the Massachusetts Statewide Total Maximum Daily Load (TMDL) for Pathogen-Impaired Waterbodies provides additional information to support the determination of the Total Maximum Daily Load (TMDL) for one pathogen-impaired river segment in the Millers River watershed (Figure 1-1). The core document and appendix together complete the TMDL for the pathogen-impaired river segment.

This appendix includes a description of the watershed and maps to identify the segments of focus for the TMDLs; the impaired uses, and the water classification and qualifiers as designated by the Massachusetts Surface Water Quality Standards (SWQS, 314 CMR 4.00); the water quality standards applicable to the impaired uses; the data supporting the pathogen impairment determination; and a description of the sources of pathogen loading with supporting maps. For water quality data, the Method Detection Limit (MDL) is reported and used for values below the MDL when calculating geometric means.

This appendix includes a summary of the allocation of the current indicator bacteria load into two categories: point sources (waste load allocation, WLA) and nonpoint sources (load allocation, LA), based on an analysis of watershed percent impervious cover. This appendix also identifies the percent reduction in indicator bacteria pollutant load from current conditions required to meet the TMDL, based on the highest levels of indicator bacteria recorded in the monitoring data. Refer to Tables 1-1 and 1-2.

Finally, for each impaired segment, this appendix presents existing local management efforts to reduce pathogen pollutant loading. General recommended next steps for implementation of this TMDL are provided in the Millers River Watershed Overview section.

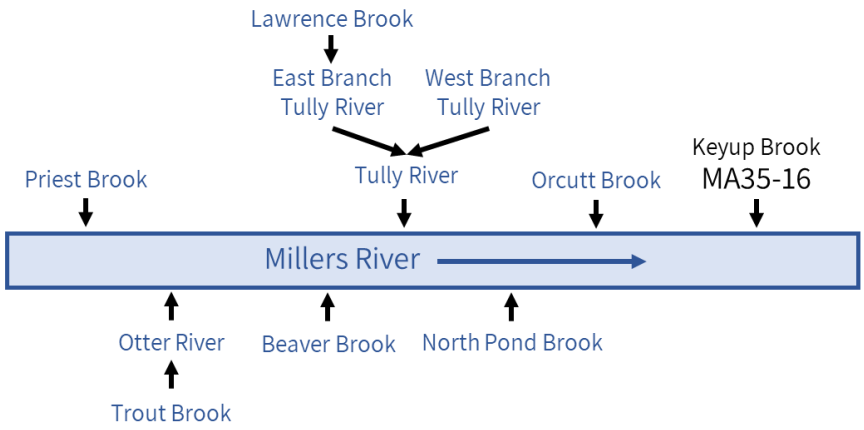


Figure 1-1. Conceptual diagram of water flow routing through the Miller River watershed, including the one pathogen-impaired river segment shown in black text. The mainstem of the Millers River is highlighted in light blue with unimpaired tributaries shown in blue text for reference. Not to scale.

Table 1-1. ***E. Coli*** Total Maximum Daily Loads (TMDLs), the percent reductions needed to meet the TMDL target (126 CFU/100ml) based on the Massachusetts Surface Water Quality Standards (SWQS), and the flow-based TMDL allocations for pathogen-impaired **freshwater** assessment units in the Millers River Basin

Waterbody & Assessment Unit	Class (Qualifier)	TMDL Type	SWQS-Based TMDL target (CFU/100ml)	Maximum Geomean (CFU/100ml)	Geomean Percent Reduction	TMDL Allocation	*Flow (cfs)*					
							1	*10*	*100*	*1,000*	*10,000*	*100,000*
							Flow-Based Target TMDL (CFU/day*10^9)					
Keyup Brook		R	126	166	24%	WLA (2%)	0.1	0.6	6.1	61.1	610.6	6,106.5
MA35-16	B (CW)			(90 day)		LA (98%)	3.0	30.2	302.2	3,021.6	30,216.2	302,161.5

Table 1-2. **Enterococci** Total Maximum Daily Loads, the percent reductions needed to meet the TMDL target (35 CFU/100ml) based on the Massachusetts Surface Water Quality Standards (SWQS), and the flow-based TMDL allocations for pathogen-impaired **freshwater** assessment units in the Millers River Basin

Waterbody & Assessment Unit	Class (Qualifier)	TMDL Type	SWQS-Based TMDL target (CFU/100ml)	Maximum Geomean (CFU/100ml)	Geomean Percent Reduction	TMDL Allocation	*Flow (cfs)*					
							1	*10*	*100*	*1,000*	*10,000*	*100,000*
							Flow-Based Target TMDL (CFU/day*10^9)					
Keyup Brook		P	35	NA	-	WLA (2%)	0.0	0.2	1.7	17.0	169.6	1,696.2
MA35-16	B (CW)					LA (98%)	0.8	8.4	83.9	839.3	8,393.4	83,933.8

Class *defined in the Massachusetts Surface Water Quality Standards (SWQS) at 314 CMR 4.02.*
Qualifiers *that identify segments with special characteristics are defined at 314 CMR 4.06(1)(d).*
CW *= Cold Water; waters that meet the cold water fisheries (CWF) definition at 314 CMR 4.02 and are subject to CWF dissolved oxygen and temperature criteria*
Pathogen bacteria units are presented in colony-forming units or CFU per 100 milliliter or ml.

TMDL Type *identifies the restorative or protective action approach:*
R *= Restorative TMDL addressing a pathogen impairment identified in the 2018/2020 Integrated List of Waters*
R* *= Restorative TMDL addressing a historic impairment of former indicator bacteria for which no current applicable criteria are available See Section 2.3 of the core document for summary of water quality criteria and designated uses.*
P *= Protective TMDL addressing all applicable uses, regardless of impairment status, for the associated pathogen (refer to the Massachusetts SWQS: 314 CMR 4.00)*
Target TMDL or Total Maximum Daily Load is presented as both SWQS-Based and Flow-Based.
SWQS-Based TMDL Target *is the target concentration applicable to the TMDL pollutant indicator bacteria based on the Surface Water Quality Standards (314 CMR 4.00).*
Flow-Based Target TMDL *is the target concentration (CFU/100mL) multiplied by the standard flow volume (cubic feet per second or cfs). See Section 4.2.2 in core document for full equation and conversion factors.*
Maximum Geomean *is the highest calculated 30- or 90- day rolling geometric mean for TMDL pollutant indicator bacteria associated with the segment.*
Geomean Percent Reduction *is the percent reduction from the highest calculated 30- or 90- day rolling geomean needed to achieve the target concentration. Percent reductions are for planning purposes only.*

2. Millers River Watershed Overview

The Massachusetts portion of the Millers River watershed covers an area of approximately 310 square miles in north central Massachusetts (Figure 2-1). The Millers River watershed also extends 79 square miles north into New Hampshire. It includes the Otter River, East Branch Tully River, and the Millers River. There are 91 named rivers with a total river length of 242 miles; many smaller unnamed rivers; and 100 lakes, ponds, and impoundments. The Millers River watershed is mostly forested with small areas of development concentrated often near the river and its tributaries. The entire Millers River has been classified as a Coldwater Fish Resource (CFR). The watershed is generally hilly and river flow is swift excluding the impoundments (MassDEP, 2016).

The Millers River in Massachusetts begins at the outlet of Sunset Lake in Ashburnham, MA and flows generally west. The Millers River flows about 51 miles (46.5 of which are in Massachusetts). The river course is slowed and altered by eight hydropower or flood control dams and receives treated wastewater effluent from the Erving Center WWTP. The Millers River ends at its confluence with the Connecticut River at the town boundary of Erving, Gill, and Montague (MassDEP, 2004). There is one pathogen-impaired river segment in the Millers River watershed. A total of 16 miles of the Millers River have been classified by the National Park Service as Historic or Cultural under the Wild and Scenic Rivers Act (NPS, 2016).

The Millers River watershed overlaps at least partially with 17 municipalities. Of these, two were identified as being direct sources of pathogen loading to the impaired river segment in this TMDL. The efforts of these municipalities to reduce pollutant loading are described in the segment-specific sections below. For each segment, the cities and towns that contain or border the impaired segment were identified. Towns comprising more than 10% of the impaired stream segment's sub-basin (that portion of its watershed not shared with upstream segments) were also included. See Figure 2-1 for a map showing impaired segments and municipalities.

Many municipalities operate and maintain municipal separate storm sewer systems (MS4s) in urban areas. These networks of drains and pipes convey polluted runoff from streets and developed areas to streams. In addition, these networks are sometimes subject to direct wastewater inflows through illegal cross-connections, leaks from sewer pipes or septic systems, dumping, or other unauthorized wastewater sources, and together these sources are termed illicit discharges.

EPA and MassDEP jointly issued the General Permits for Stormwater Discharges from MS4s, which became effective July 1, 2018. Communities that discharge to pathogen-impaired waterbodies with approved TMDLs are required to implement enhanced best management practices (BMPs) for public education and designate the catchments as Problem Catchments or High Priority under the Illicit Discharge Detection and Elimination (IDDE) Program, in addition to the requirement to reduce pollutants to the Maximum Extent Practicable (USEPA, 2020; Appendix F).

In addition to municipalities, there are two Regional Planning Agencies (RPAs) in the Millers River watershed. These are public organizations advising municipalities, private business groups, and state and federal governments on a range of matters. Their research, coordination, and technical assistance is especially valuable on watershed issues such as pathogen pollutants and stormwater that cross town boundaries.

- Franklin Regional Council of Governments (FRCOG), http://www.frcog.org/ (FRCOG, 2020)
- Montachusett Regional Planning Commission (MRPC), http://www.mrpc.org/ (MRPC, 2020)

The following RPA initiatives and tools are especially noteworthy:

- There are regional stormwater coalitions within some RPAs, and these are noted in the segment-specific sections below.
- The MRPC offers local technical assistance to municipalities within their jurisdiction, can aid in the acquisition of grant funds, and can help guide the creation of master plans, new zoning bylaws, and maps.
- The FRCOG can assist with incorporating low impact development (LID) into local bylaws.

Beyond these activities, the Massachusetts Statewide Municipal Stormwater Coalition (MSMSC), composed of about 10 stormwater groups around the state, further coordinates with and assists municipalities on pathogen pollutant concerns in the "Think Blue" campaign (Think Blue Massachusetts, 2019).

Additional watershed scale initiatives are carried out by several organizations including:

The **Millers River Watershed Council** organizes a Bacteria Sampling Team of volunteers to collect water quality measurements, https://millerswatershed.org/ (MRWC, 2020)

Millers River Environmental Center through the Athol Bird and Nature Club, http://atholbirdclub.org/millers-river-environmental-center/ (MREC, 2020)

The following actions will help reduce pathogen loads to the streams. The list is a starting point and is not comprehensive. For a more detailed discussion of pollutant reduction actions, see Section 5 "Implementation" of the core TMDL document.

- Collect additional water quality data for all segments for which existing data are all older than five years.
- **Municipalities:** Though neither of the municipalities within the segment watershed are regulated under the MS4 General Permit, the municipalities should still focus on mitigating stormwater runoff issues to protect water quality.
- **Regional Planning Agencies (RPAs) and municipalities:** Continue and expand collaboration on stormwater issues. Cooperatively developing tools and sharing knowledge has many advantages, including reduced costs, increased innovation, and more consistent and effective stream restoration efforts at the watershed scale.
    - A Stormwater Utility creation tool developed by the Metropolitan Area Planning Council (MAPC) is potentially valuable in all stormwater impacted communities in the state. Municipalities and other RPAs (with permission from MAPC) should consider adapting and/or expanding on this tool in their area (MAPC, 2014).
- **USDA NRCS and landowners:** Develop comprehensive nutrient management plans for agriculture, using local connections to farmers for outreach.
- **Parks departments, schools, private landowners, and others** who maintain large mowed fields with direct access to water should consider maintaining a vegetative buffer along the water's edge. Buffers slow and filter stormwater runoff, provide a visual screen that can reduce large aggregations of waterfowl, and have many other water quality benefits at low cost.

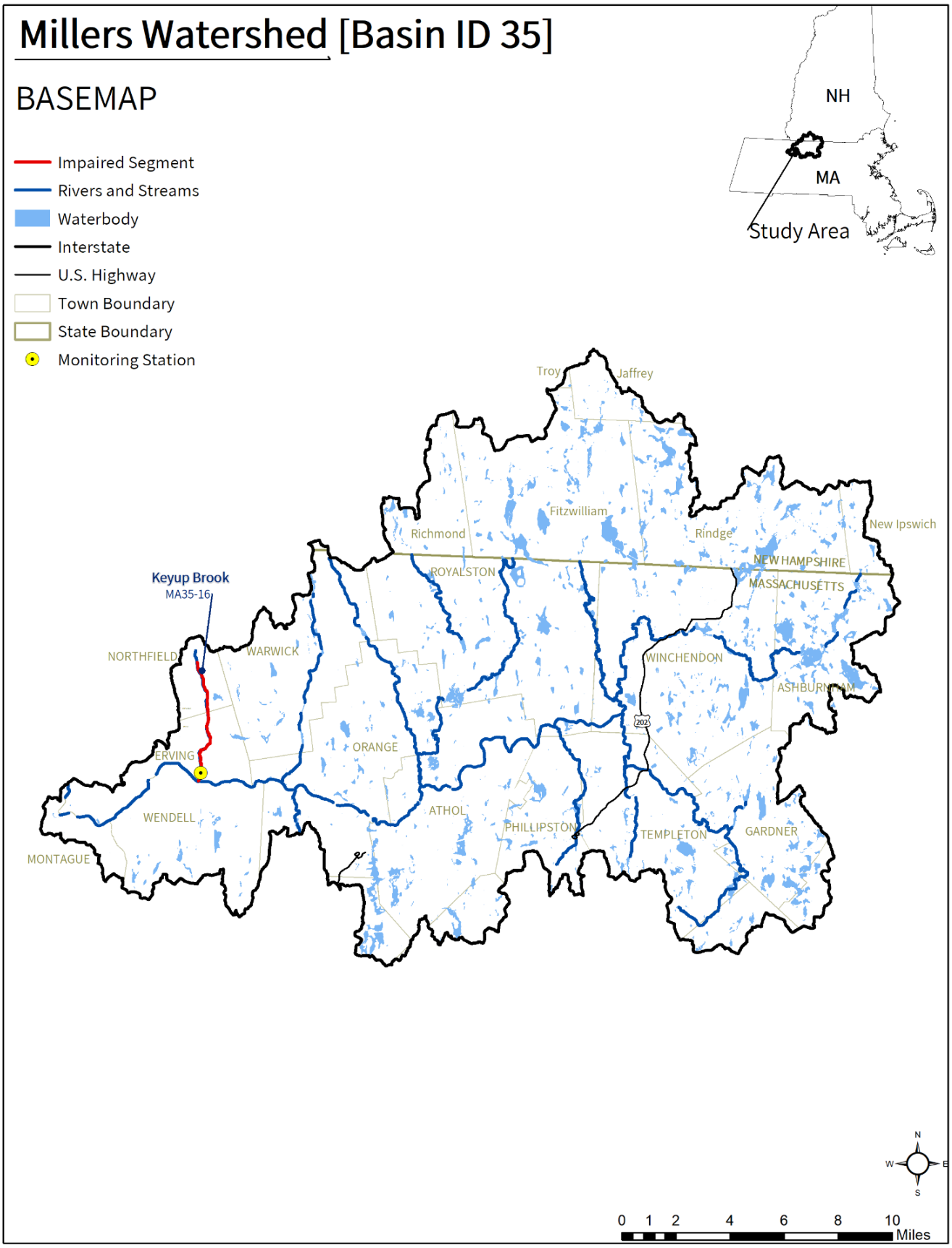


Figure 2-1: Map of all pathogen-impaired river segments, water quality monitoring stations, municipal borders, waterbodies, and roads in the Millers River watershed.

3. MA35-16 Keyup Brook

3.1. Segment Overview

The Keyup Brook segment MA35-16 is 5.0 miles long and begins at its headwaters within the Great Swamp of the Northfield State Forest in Northfield, MA. The segment flows south into Erving and ends at its confluence with the Millers River in Erving, MA.

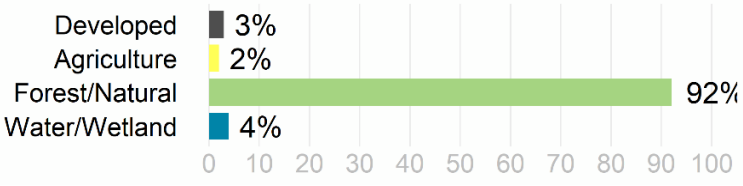
Tributaries include Jacks Brook and other unnamed streams. There are no named lakes or ponds within the segment watershed. Key landmarks in the watershed include Round Mountain, Northfield State Forest, Erving State Forest, and the Erving town center. The segment is crossed by Orange Road, Laurel Lake Road, Swamp Road (twice), Highland Avenue, Church Street, West Main Street/MA-2/MA-2A, and Crescent Street in Erving.

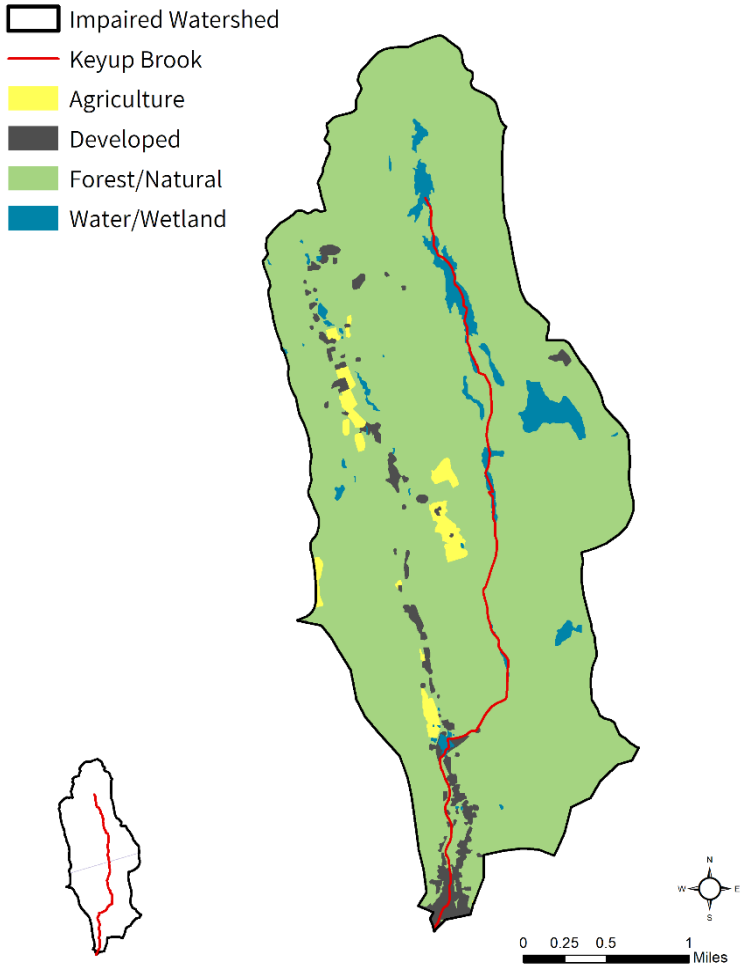
The Keyup Brook (MA35-16) watershed drains an area of 7.06 square miles, of which 0.14 mi^2 (2%) is impervious and 0.04 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[1] served by public sewer, and none of the watershed subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 2-1.

The watershed is almost entirely forested (92%) and wetland (4%), with a small amount of developed (3%) and agricultural (2%) lands. Developed land use consists of low to very low density residential areas, mostly along the Jacks Brook tributary and the most downstream portion of the segment. Agricultural land appears to be used for hay or row crops and meadowland.

In the Keyup Brook (MA35-16) watershed, under the Natural Heritage and Endangered Species Program, there are no areas of Priority Habitats of Rare Species or Priority Natural Vegetation

Reduction from Highest Calculated Geomean: 24%
Watershed Area (Acres): 4,518
Segment Length (Miles): 5.0
Impairment(s): *E. coli* (Primary Contact Recreation)
Class (Qualifier): B
Impervious Area (Acres, %): 89 (2%)
DCIA Area (Acres, %): 26 (2%)



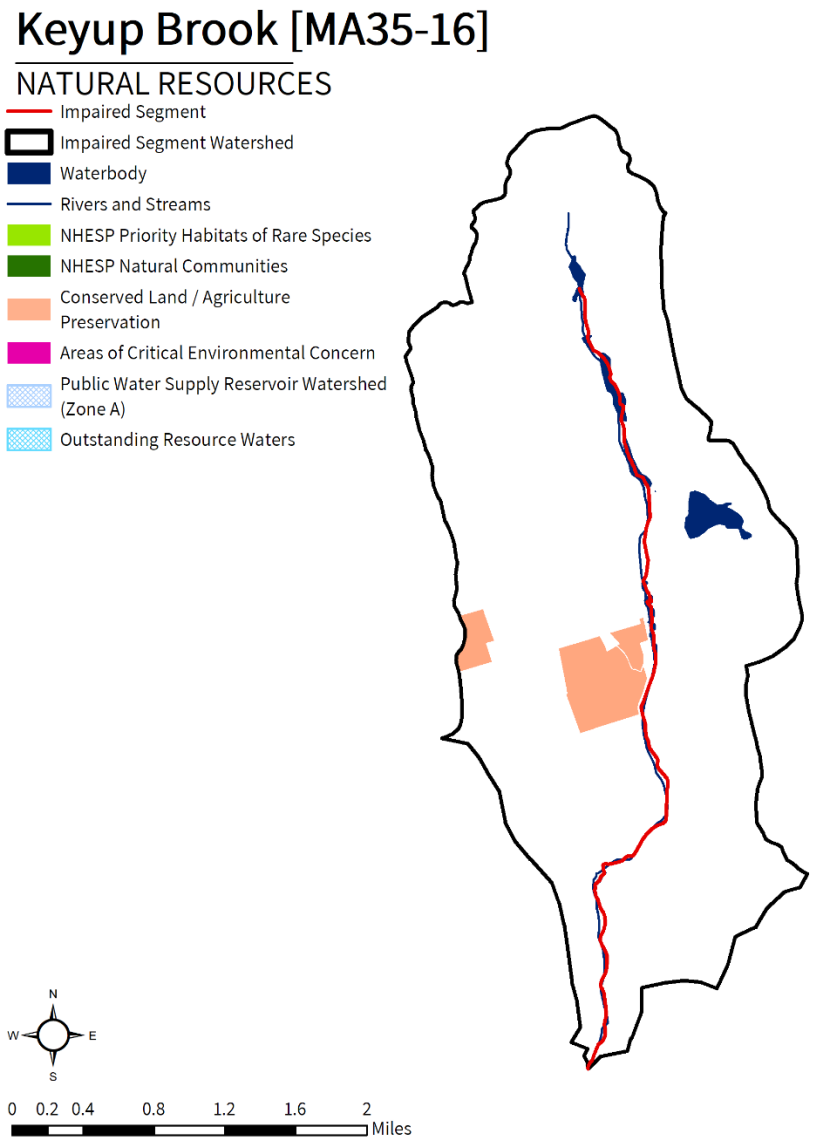


[1] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP 2020), MS4 reports, and local knowledge.

Communities. There are no Areas of Critical Environmental Concern, no areas under Public Water Supply protection, and no areas identified as Outstanding Resource Waters in the watershed. Over 165 acres (4%) of land protected in perpetuity[2] exist within the segment watershed, which is part of a total of 2,327 acres (52%) of Protected and Recreational Open Space[3]. See Figure 3-1.

[2] Land protected in perpetuity include several interests such as conservation restriction, agricultural preservation, private deed restrictions, wetland restrictions, aquifer protection, historic preservation, etc. Refer to Mass GIS metadata for the Protected and Recreational Open Space data layer.

[3] Only land protected in perpetuity is shown on the natural resources map. Protected and Recreational Open Space estimates reflect areas in the State of Massachusetts only (and thus reflect only a portion of the total open space for watersheds that extend outside the State of Massachusetts).



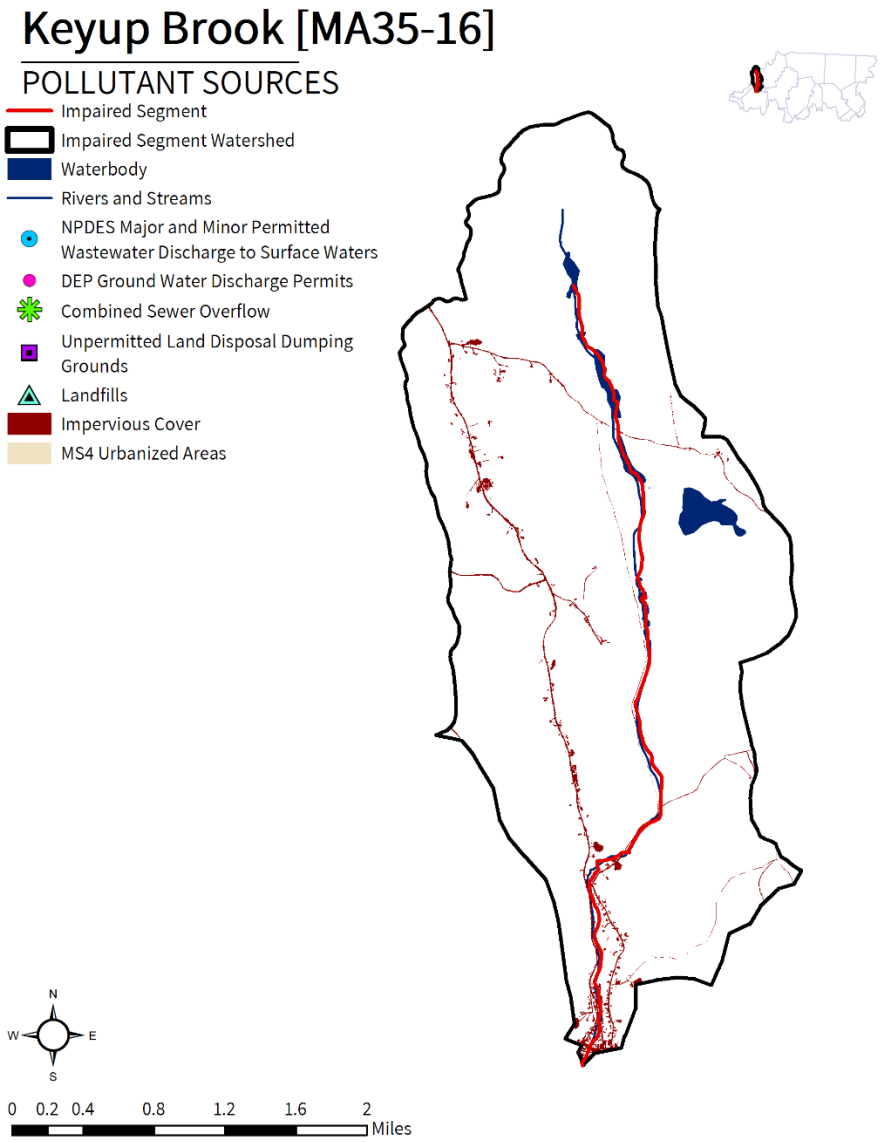


Figure 3-1. Natural resources and potential pollution sources draining to the Keyup Brook segment MA35-16. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

3.2. Waterbody Impairment Characterization

Keyup Brook (MA35-16) is a Class B Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the station listed below (refer to Tables 3-1, 3-2; Figure 3-2). Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli.* The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2005, five samples were collected at W1344, resulting in four days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, none exceeded the STV criterion.

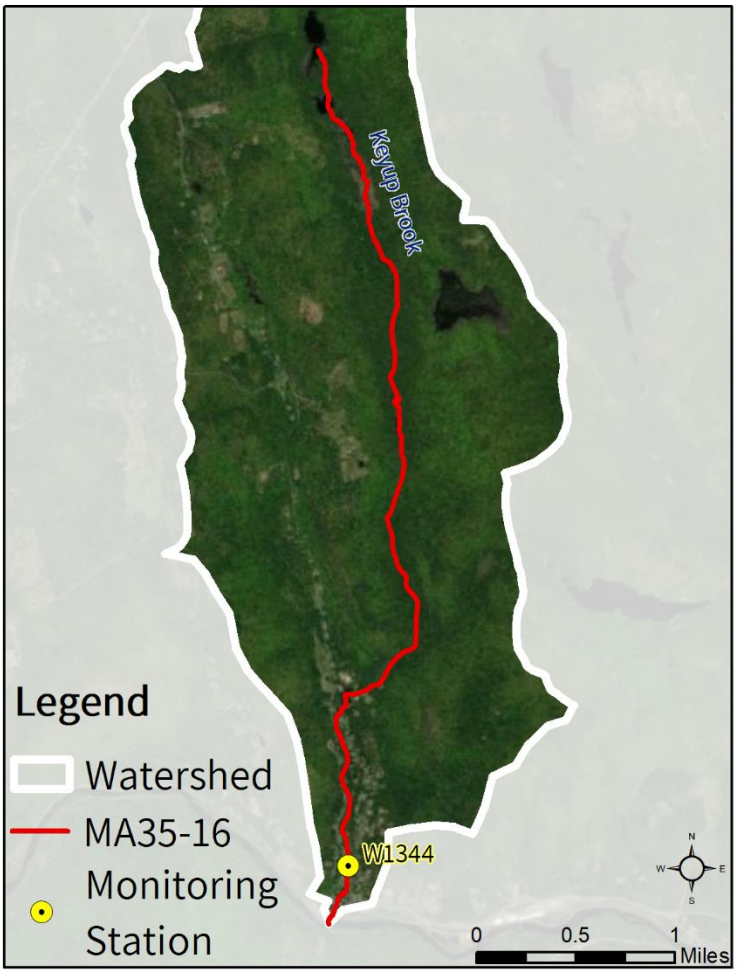


Figure 3-2. Location of monitoring station(s) along the impaired river segment.

Table 3-1. Summary of indicator bacteria sampling results by station for Keyup Brook (MA35-16). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria, and the number of single samples exceeding the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli* indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1344	5/11/2005	9/14/2005	5	166	4	0

Table 3-2. Indicator bacteria data by station, indicator, and date for Keyup Brook (MA35-16). Each sample date was designated wet or dry weather with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text highlights criteria exceedances of 410 CFU/100 mL (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the Statistical Threshold Value or STV) and 126 CFU/100 mL (applied to rolling 90-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1344	*E. coli*	5/11/2005	DRY	100	100	
W1344	*E. coli*	6/14/2005	WET	170	130	
W1344	*E. coli*	7/13/2005	DRY	270	166	
W1344	*E. coli*	8/9/2005	DRY	64	143	
W1344	*E. coli*	9/14/2005	DRY	190	149	
W1344	Fecal Coliform	5/11/2005	DRY	84		
W1344	Fecal Coliform	6/14/2005	WET	190		
W1344	Fecal Coliform	7/13/2005	DRY	360		
W1344	Fecal Coliform	8/9/2005	DRY	71		
W1344	Fecal Coliform	9/14/2005	DRY	97		

3.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: The watershed is minimally developed with none of the land area in MS4 and 2% as DCIA. Development within the watershed consists of low density residential development near the Erving town center. Stormwater runoff from urban areas is likely a low to moderate source of pathogens.

Illicit Sewage Discharges: Some of the watershed contains sewer service areas. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows, which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Illicit connections of wastewater to stormwater drains are also a risk. Illicit storm drain connections and/or illicit discharges from failing infrastructure such as leaky sewer lines or SSOs are likely a source of pathogens.

On-Site Wastewater Disposal Systems: Most development in the watershed likely relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities account for 2% of the total land use area within the watershed. Those activities visible on recent aerial photos within the MA portion of the watershed include open fields, hayfields, and row crops. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: Conservation and recreational lands, parks, ballfields, or residential streets which may be popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Large open mowed areas such as conservation and recreational lands, fields, and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

3.4. Existing Local Management

This section identifies the municipalities immediately surrounding the impaired segment and its sub-basin. For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

Town of Erving

Erving is not within the MS4 area.

Erving has the following relevant regulation:

- Pet waste bylaw: Section XIV page 8, Dog Waste Disposal https://www.ervingma.gov/sites/g/files/vyhlif4401/f/uploads/erving_dog_bylaw.pdf (Town of Erving, 2007)

The Erving Master Plan is available online at https://www.ervingma.gov/sites/g/files/vyhlif4401/f/uploads/ervingmasterplan_2002.pdf (Town of Erving and FRCOG, 2002). Erving's Master Plan has a section (Chapter 1-7) that is dedicated to Water Resources and refers to the impaired Millers River in Table 1-5 in Section 1-13. It also has a section (Chapter 2-17) on Wastewater Treatment.
Erving Open Space and Recreation Plan:
https://www.ervingma.gov/sites/g/files/vyhlif4401/f/uploads/erving_osrp_2018_body_11-27-18.pdf (Town of Erving and FRCOG, 2018)

Town of Northfield

Northfield is not within the MS4 area.

Northfield has the following relevant regulation:

- Dog waste bylaw: page 5 https://www.northfieldma.gov/sites/g/files/vyhlif991/f/uploads/bylaws_and_regulations.pdf(Town of Northfield, n.d.)

Northfield has a Master Plan, and it references the impaired Connecticut River on page 11: https://www.northfieldma.gov/sites/g/files/vyhlif991/f/uploads/a_master_plan_for_northfield.pdf (Town of Northfield et al, 2014)

Northfield's Open Space and Recreation Plan: https://www.northfieldma.gov/sites/g/files/vyhlif991/f/uploads/2013_plan_sans_appendices_5.2mb.pdf. (Town of Northfield, 2013)

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