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

Appendix E: Connecticut 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 15 pathogen-impaired river segments in the Connecticut River watershed (Figure 1-1). The core document and appendix together complete the TMDL for each of these pathogen-impaired river segments.

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 Connecticut River Watershed Overview section.

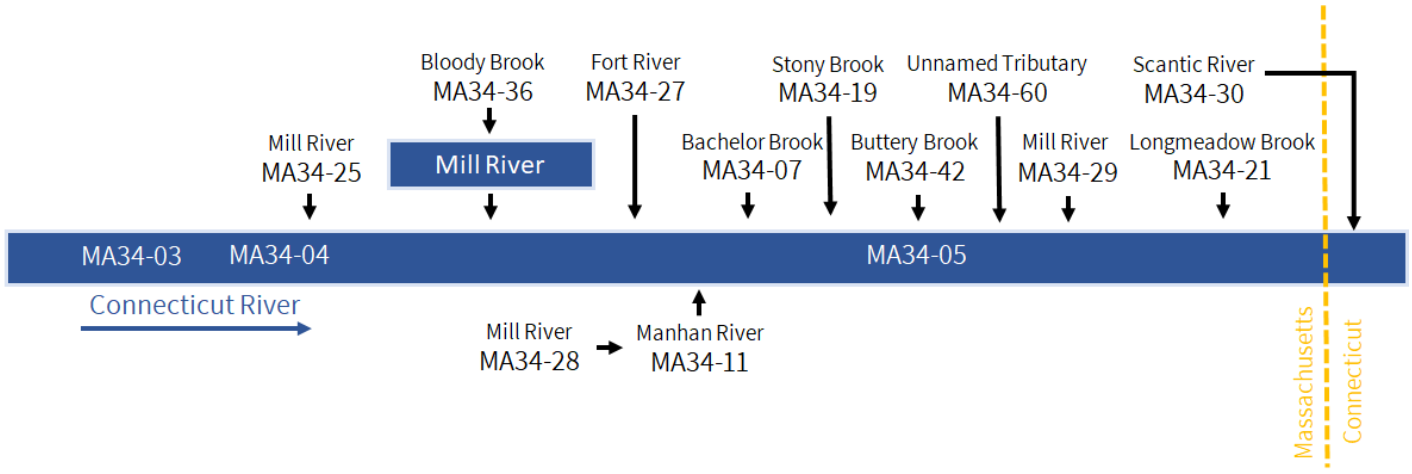


Figure 1-1. Conceptual diagram of water flow through the Connecticut River watershed for the 15 pathogen-impaired river segments. Mainstem segments are highlighted in blue. Tributary segments are shown with black arrows. One segment flows to the reach of the Connecticut River within the state of Connecticut. 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 Connecticut 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)					
Connecticut River MA34-03	B (WW, CSO)	R	126	NA	-	WLA (4%)	0.1	1.3	13.4	133.8	1,338.4	13,384.2
						LA (96%)	2.9	29.5	294.9	2,948.8	29,488.4	294,883.8
Connecticut River MA34-04	B (WW, CSO)	R	126	46 (30 day)	-	WLA (4%)	0.1	1.3	13.2	132.2	1,322.2	13,221.7
						LA (96%)	3.0	29.5	295.0	2,950.5	29,504.6	295,046.3
Connecticut River MA34-05	B (WW, CSO)	R	126	245 (30 day)	48%	WLA (5%)	0.1	1.4	13.9	138.8	1,387.5	13,875.4
						LA (95%)	2.9	29.4	294.4	2,943.9	29,439.3	294,392.6
Bachelor Brook MA34-07	B (WW)	R	126	232 (30 day)	46%	WLA (5%)	0.1	1.4	14.4	144.3	1,443.0	14,430.0
						LA (95%)	2.9	29.4	293.8	2,938.4	29,383.8	293,838.1
Manhan River MA34-11	B	R	126	388 (30 day)	68%	WLA (5%)	0.2	1.5	15.5	154.6	1,546.0	15,459.6
						LA (95%)	2.9	29.3	292.8	2,928.1	29,280.8	292,808.4
Stony Brook MA34-19	B	R	126	950 (90 day)	87%	WLA (9%)	0.3	2.9	29.1	290.6	2,905.7	29,057.2
						LA (91%)	2.8	27.9	279.2	2,792.1	27,921.1	279,210.8
Longmeadow Brook MA34-21	B	R	126	715 (90 day)	82%	WLA (17%)	0.5	5.4	53.8	537.7	5,377.2	53,772.1
						LA (83%)	2.5	25.4	254.5	2,545.0	25,449.6	254,495.9
Mill River MA34-25	B	R	126	254 (90 day)	50%	WLA (8%)	0.2	2.4	24.1	240.9	2,409.3	24,093.3
						LA (92%)	2.8	28.4	284.2	2,841.7	28,417.5	284,174.7
Fort River MA34-27	B	R	126	367 (90 day)	66%	WLA (5%)	0.2	1.7	16.5	165.4	1,654.0	16,540.5
						LA (95%)	2.9	29.2	291.7	2,917.3	29,172.8	291,727.5
Mill River MA34-28	B	R	126	2,420 (90 day)	95%	WLA (4%)	0.1	1.2	11.5	115.3	1,152.7	11,527.1
						LA (96%)	3.0	29.7	296.7	2,967.4	29,674.1	296,741.0
Mill River MA34-29	B (CSO)	R	126	1,789 (30 day)	93%	WLA (21%)	0.7	6.5	65.2	651.9	6,519.2	65,191.7
						LA (79%)	2.4	24.3	243.1	2,430.8	24,307.6	243,076.3
Scantic River MA34-30	B	R	126	506 (90 day)	75%	WLA (3%)	0.1	1.0	10.0	99.8	997.6	9,975.5
						LA (97%)	3.0	29.8	298.3	2,982.9	29,829.3	298,292.5
Bloody Brook MA34-36	B	R	126	352 (90 day)	64%	WLA (9%)	0.3	2.7	27.2	271.7	2,717.1	27,171.2
						LA (91%)	2.8	28.1	281.1	2,811.0	28,109.7	281,096.8
Buttery Brook MA34-42	B	R	126	1,407 (90 day)	91%	WLA (23%)	0.7	7.0	69.7	696.6	6,966.4	69,663.8
						LA (77%)	2.4	23.9	238.6	2,386.0	23,860.4	238,604.2
Unnamed Tributary MA34-60	B	R	126	738 (90 day)	83%	WLA (34%)	1.1	10.6	106.3	1,063.1	10,630.7	106,306.7
						LA (66%)	2.0	20.2	202.0	2,019.6	20,196.1	201,961.3

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 Connecticut 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)					
Connecticut River		P	35	NA	-	WLA (4%)	-	0.4	3.7	37.2	371.8	3,717.8
MA34-03	B (WW, CSO)					LA (96%)	0.8	8.2	81.9	819.1	8,191.2	81,912.2
Connecticut River		P	35	NA	-	WLA (4%)	-	0.4	3.7	36.7	367.3	3,672.7
MA34-04	B (WW, CSO)					LA (96%)	0.8	8.2	82.0	819.6	8,195.7	81,957.3
Connecticut River		P	35	NA	-	WLA (5%)	-	0.4	3.9	38.5	385.4	3,854.3
MA34-05	B (WW, CSO)					LA (95%)	0.8	8.2	81.8	817.8	8,177.6	81,775.7
Bachelor Brook		P	35	NA	-	WLA (5%)	-	0.4	4.0	40.1	400.8	4,008.3
MA34-07	B (WW)					LA (95%)	0.8	8.2	81.6	816.2	8,162.2	81,621.7
Manhan River		P	35	NA	-	WLA (5%)	-	0.4	4.3	42.9	429.4	4,294.3
MA34-11	B					LA (95%)	0.8	8.1	81.3	813.4	8,133.6	81,335.7
Stony Brook		P	35	NA	-	WLA (9%)	0.1	0.8	8.1	80.7	807.1	8,071.4
MA34-19	B					LA (91%)	0.8	7.8	77.6	775.6	7,755.9	77,558.6
Longmeadow Brook		P	35	NA	-	WLA (17%)	0.1	1.5	14.9	149.4	1,493.7	14,936.7
MA34-21	B					LA (83%)	0.7	7.1	70.7	706.9	7,069.3	70,693.3
Mill River		P	35	NA	-	WLA (8%)	0.1	0.7	6.7	66.9	669.3	6,692.6
MA34-25	B					LA (92%)	0.8	7.9	78.9	789.4	7,893.7	78,937.4
Fort River		P	35	NA	-	WLA (5%)	-	0.5	4.6	45.9	459.5	4,594.6
MA34-27	B					LA (95%)	0.8	8.1	81.0	810.4	8,103.5	81,035.4
Mill River		P	35	NA	-	WLA (4%)	-	0.3	3.2	32.0	320.2	3,202.0
MA34-28	B					LA (96%)	0.8	8.2	82.4	824.3	8,242.8	82,428.0
Mill River		P	35	NA	-	WLA (21%)	0.2	1.8	18.1	181.1	1,810.9	18,108.8
MA34-29	B (CSO)					LA (79%)	0.7	6.8	67.5	675.2	6,752.1	67,521.2
Scantic River		P	35	NA	-	WLA (3%)	-	0.3	2.8	27.7	277.1	2,771.0
MA34-30	B					LA (97%)	0.8	8.3	82.9	828.6	8,285.9	82,859.0
Bloody Brook		P	35	NA	-	WLA (9%)	0.1	0.8	7.5	75.5	754.8	7,547.6
MA34-36	B					LA (91%)	0.8	7.8	78.1	780.8	7,808.2	78,082.4
Buttery Brook		P	35	NA	-	WLA (23%)	0.2	1.9	19.4	193.5	1,935.1	19,351.1
MA34-42	B					LA (77%)	0.7	6.6	66.3	662.8	6,627.9	66,278.9
Unnamed Tributary		P	35	NA	-	WLA (34%)	0.3	3.0	29.5	295.3	2,953.0	29,529.6
MA34-60	B					LA (66%)	0.6	5.6	56.1	561.0	5,610.0	56,100.4

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).* ***CSO*** *= Combined Sewer Overflow; waters identified as impacted by the discharge of CSOs without a long-term control plan approved or fully implemented*

WW *= Warm Water; waters that meet the warm water fisheries (WWF) definition at 314 CMR 4.02 and are subject to WWF 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. Connecticut River Watershed Overview

The Connecticut River watershed is the largest watershed in New England, beginning near the Canadian border and flowing 410 miles south forming the Vermont-New Hampshire border and continues through Massachusetts and Connecticut to Long Island Sound. The Massachusetts portion of the Connecticut River watershed covers an area of approximately 2,726 miles within the central part of the state, including about 67 miles of the river's mainstem from Northfield to Agawam-Longmeadow border at the Massachusetts-Connecticut state line (Figure 2-1). The drainage area to the Massachusetts portion of the Connecticut River watershed includes the Deerfield, Westfield, Millers, and Chicopee River watersheds (refer to Appendix G, F, M, and D, respectively). This appendix covers the Connecticut River Basin according to the Massachusetts Water Resources Commission's delineation, which excludes the Deerfield, Millers, Westfield, and Chicopee River watersheds. As defined, the Connecticut River Basin drains approximately 670 square miles (MassDEP, 2008) and encompasses 164 named rivers; 590 named river miles; many smaller unnamed rivers; and many lakes, ponds, and impoundments in the watershed (USGS, 2019).

The Connecticut River watershed, as defined for this appendix, overlaps at least partially with 46 municipalities (104 municipalities when including the Deerfield, Westfield, Millers, and Chicopee River watersheds). Of these, 31 were identified as being direct sources of pathogen loading to the impaired river segments in this TMDL. The efforts of these municipalities to reduce pathogen pollution to surface waters 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. In addition, towns which may not meet the above characteristics, but which have land area in the sub-basin near the impaired segment (e.g., Town of Gill for the Connecticut River MA34-03), were included on a case-by-case basis. 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. Municipalities with MS4 systems in urban areas are coming under gradually increasing regulation to improve and protect water quality (for more detailed history, see Section 5.2 and 7.4 of the core document).

EPA and MassDEP jointly issue the General Permit 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, 2020a, Appendix F).

In addition to municipalities, there are six Regional Planning Agencies (RPAs) in the Connecticut 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 that cross town boundaries, such as pathogen pollutants and stormwater.

- Central Massachusetts Regional Planning Commission (CMRPC), http://www.cmrpc.org/ (CMRPC, 2020)
- Montachusett Regional Planning Commission (MRPC), http://www.mrpc.org/ (MRPC, n.d.)
- Berkshire Regional Planning Commission (BRPC), http://www.berkshireplanning.org/ (BRPC, 2020)
- Pioneer Valley Planning Commission (PVPC), http://pvpc.org/ (PVPC, n.d.)
- Franklin Regional Council of Governments (FRCOG), http://www.frcog.org/ (FRCOG, 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 and can aid in the acquisition of grant funds and the creation of master plans, new zoning bylaws, and maps.
- The PVPC is a public sector agency which offers technical assistance to the 43 cities within their jurisdiction.
- Although outside of the Connecticut River Basin, two tools developed by Metropolitan Area Planning Council (MAPC) are potentially valuable for all MS4 communities in the state. Municipalities and other RPAs (with permission from MAPC) should consider adapting and/or expanding on these tools in their area:
    - MAPC created a Stormwater Utility/Funding Starting Kit (Metropolitan Area Planning Council, MAPC, 2014).
    - MAPC and the Neponset River Watershed Association created a GIS toolkit to calculate MS4 outfall catchments, which is a requirement under the MS4 General Permit (Metropolitan Area Planning Council, MAPC, 2018).

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).

The **Connecticut River Conservancy** (CRC), formerly known as the Connecticut River Watershed Council, provides a multi-state collaboration between the four states situated within the Connecticut River watershed to improve natural habitats and decrease pollutants to waterways. The conservancy works to protect the Connecticut River watershed with businesses to provide the funds for and partner with organizations working on conservation efforts for habitats and recreation values, https://www.ctriver.org/ (CRC, 2015).

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.

- Removal of all CSOs in the watershed is a top priority.
- **Municipalities:** Continue to implement requirements of the MS4 permit, which includes specific requirements for waterbodies with an approved Bacteria/Pathogen TMDL, such as prioritization and reporting, enhanced BMPs, IDDE work, and education (USEPA, 2020a).
- **Regional Planning Agencies (RPAs) and municipalities:** Continue and expand collaboration on MS4 and 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.
    - Two tools developed by MAPC are potentially valuable in all MS4 communities in the state. Municipalities and other RPAs (with permission from MAPC) should consider adapting and/or expanding on these tools in their area:
        - Stormwater Utility/Funding Starting Kit (Metropolitan Area Planning Council, MAPC, 2014).
        - MAPC and the Neponset River Watershed Association created a GIS toolkit to calculate MS4 outfall catchments, which is a requirement under the MS4 General Permit (Metropolitan Area Planning Council, MAPC, 2018).
- **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.

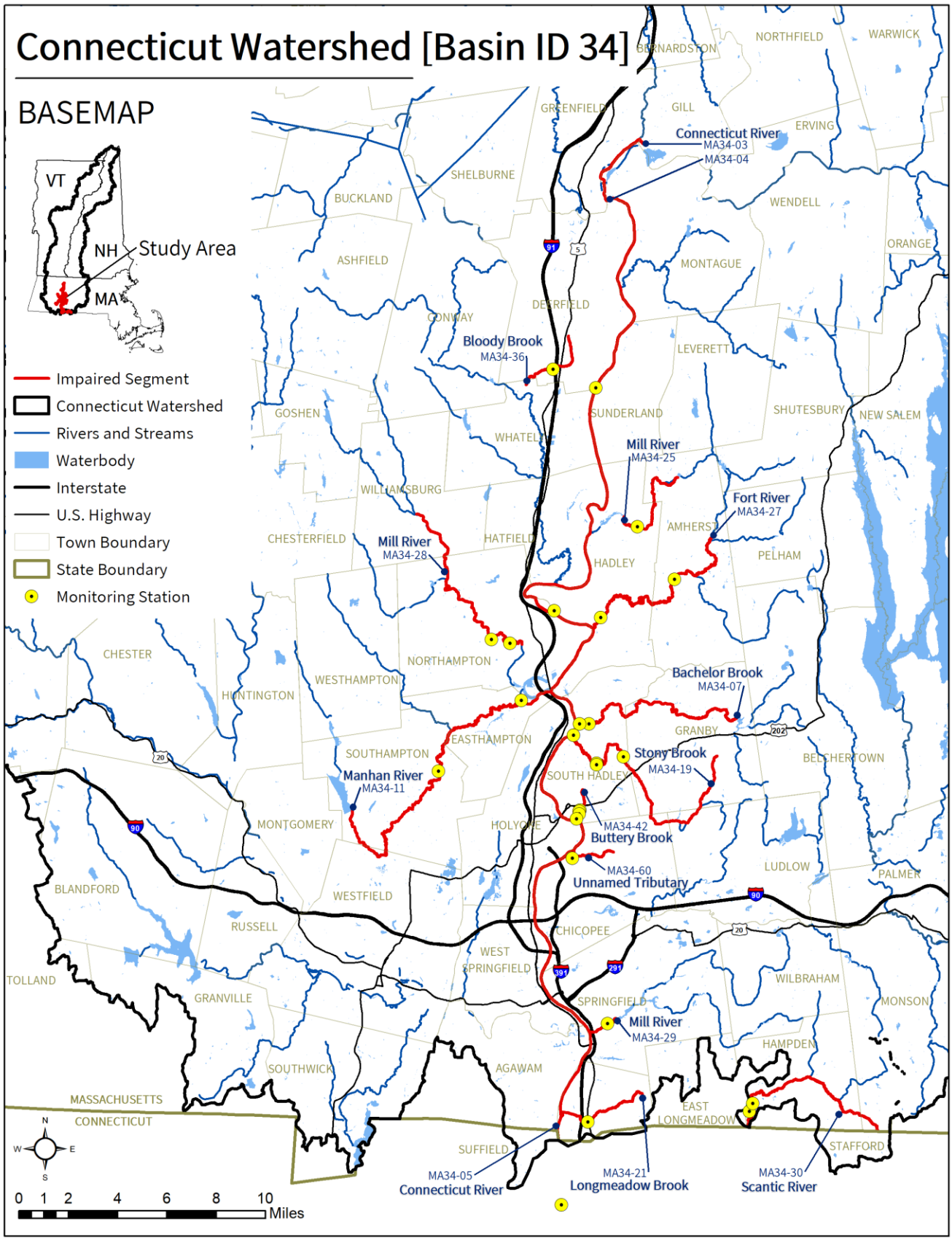


Figure 2-1: Map of all pathogen-impaired river segments, water quality monitoring stations, municipal borders, waterbodies, and roads in the Connecticut River watershed.

3. MA34-03 Connecticut River

3.1. Waterbody Overview

The Connecticut River segment MA34-03 is 3.7 miles long and begins at the Turners Falls dams (NATID: MA00848 and MA00849) along the Gill and Montague town border in MA. The segment generally flows southwest where it follows the town border between Greenfield and Montague before ending at its confluence with the Deerfield River (MA33-04) at the Greenfield-Deerfield town border in MA.

Tributaries to the Connecticut River segment MA34-03 include Fall Brook and other unnamed streams. The Montague Power Canal Reservoir is used for hydropower and flows beside the left bank of the river in Montague. The segment flows around Peskeomskut, Rawson, and Smead Islands. The pathogen-impaired Keyup Brook (MA35-16) in the Millers River watershed is just upstream of segment MA34-03. Barton Cove, an embayment of the Connecticut River just upstream from this segment, is listed for pathogens and other impairments.

Key landmarks near the impaired segment include the Turners Falls Airport, the villages of Riverside and Turners Falls, and Rocky Mountain Park. Segment MA34-03 is crossed by the Avenue A bridges (Montague) at the start of the segment and Montague City Road (Greenfield) 0.2 miles upstream from the end of the segment.

The Connecticut River segment MA34-03 drains a total area of 7,206 square miles, of which 313 mi^2 (4%) is impervious and 95 mi^2 (1%) is directly connected impervious area (DCIA)[1]. The Connecticut River segment MA34-03 watershed extends beyond MA into Vermont, New Hampshire, and Canada. Out of the total watershed area for MA34-03 (4,611,690 acres), 259,182 acres (405 mi^2, 6%) are within MA.

The watershed is partially[2] served by public sewer and 1% (8% within the MA portion of the watershed) is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). Within the immediate segment drainage area in MA, there are 11

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 4,611,690

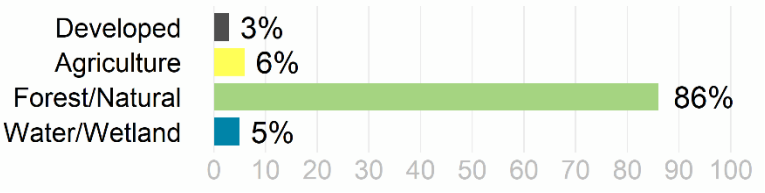
Segment Length (Miles): 3.7

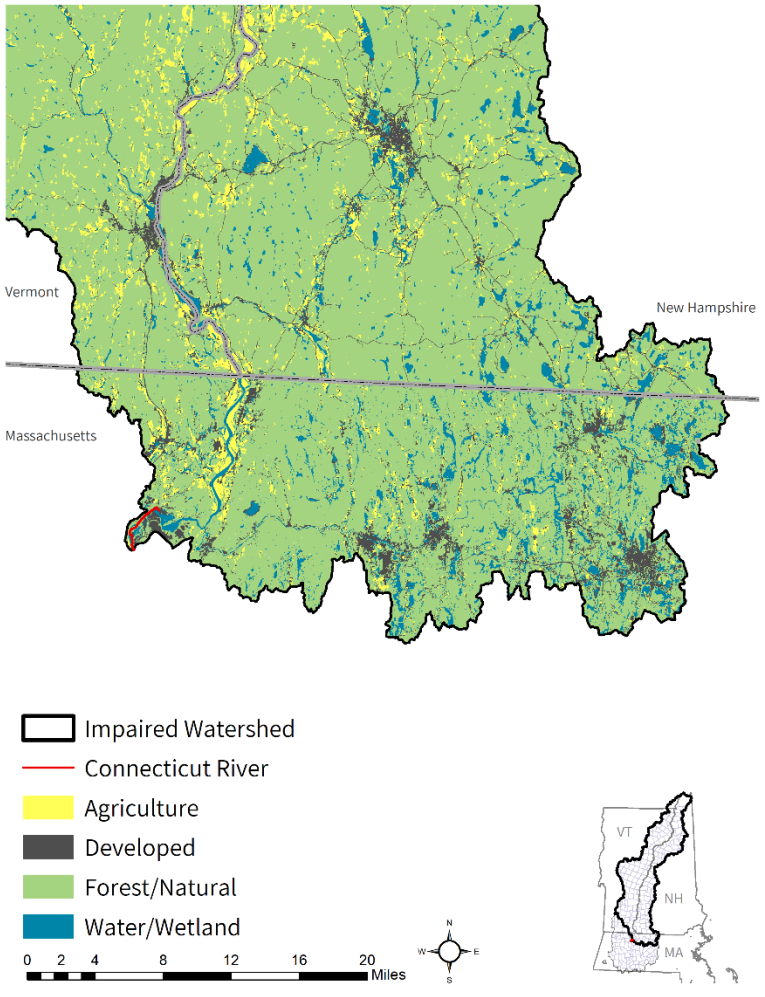
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifiers): B (Warm Water, CSO Receiving Water)

Impervious Area (Acres, %): 200,153 (4%)

DCIA Area (Acres, %): 60,889 (1%)





[1] IC and DCIA areas do not include 753,810 acres of land area in NH and Canada due to lack of impervious cover data availability. Therefore, 16% of the watershed is treated as 100% pervious when it is likely less than 100% pervious.

[2] 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.

NPDES permits on file governing point source discharges of pollutants to surface waters (Table 3-1) and no MassDEP discharge to groundwater permit for on-site wastewater discharge within the immediate drainage area. There is one industrial stormwater discharge within this watershed segment (Table 3-2). There is also one combined sewer overflow in the MA portion of the watershed, 220 landfills in the overall watershed (24 landfills within MA), and three unpermitted land disposal dumping grounds within the MA portion of the watershed. See Figure 3-1.

Table 3-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0032573	NORTHFIELD MT HERMON SCHOOL	GILL	OTH
MA0100005	ATHOL WWTP	ATHOL	MUN
MA0100161	ROYALSTON WASTEWATER TREATMENT PLANT	ROYALSTON	MUN
MA0100200	NORTHFIELD WWTF	NORTHFIELD	MUN
MA0100340	TEMPLETON WWTF	TEMPLETON	MUN
MA0100862	WINCHENDON WPCF	WINCHENDON	MUN
MA0100994	GARDNER WPCF	TEMPLETON	MUN
MA0101052	ERVING CENTER WWTP	ERVING	MUN
MA0101257	ORANGE WWTP	ORANGE	MUN
MA0101516	ERVING POTW # 1	ERVING	MUN
MA0102776	ERVING POTW #3	WENDELL	MUN

Table 3-2. National Pollutant Discharge Elimination System (NPDES) permits for Industrial discharges in the segment watershed. Only permits unique to this segment watershed are listed.

NPDES ID	NAME	TOWN
MA0005011	SOUTHWORTH CO TURNERS FALLS MI	MONTAGUE

Table 3-3. Combined Sewer Overflows (CSOs) discharging to the segment.

NPDES ID	NAME	TOWN	DEP OUTFALL ID
MA0100137	MONTAGUE WPCF/C	MONTAGUE	MON002

The right bank of the Connecticut River in segment MA34-03 is almost entirely forested, while the left bank contains high density residential, commercial, and industrial development. The MA portion of the watershed land cover is 4% agriculture, 8% developed, 77% forested/natural, and 10% water/wetland. Water is diverted from the Connecticut River segment MA34-03 at the Turners Falls Road bridge to flow through the Montague Power Canal for approximately two miles. This water is discharged back into segment MA34-03 approximately 0.5 miles upstream from the end of the segment.

The Connecticut River segment (MA34-03) watershed does not contain any Areas of Critical Environmental Concern in the MA portion of the watershed. Under the Massachusetts Natural Heritage and Endangered Species Program, 15,795 acres (6%) are classified as Priority Habitats of Rare Species and 3,120 acres (1%) are classified as Priority Natural Vegetation Communities within the MA portion of the watershed. There are 4,360 acres (2%) under Public Water Supply protection and 1,288 acres (<1%) identified as Outstanding Resource Waters in the MA portion of the watershed. Over 24,993 acres (10%) of land protected in perpetuity[3] exist within the MA portion of the watershed, which is part of a total of 92,394 acres (36%) of Protected and

[3] 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.

Recreational Open Space[4] within the MA portion of the watershed. Over 1.3 million acres (30%) of protected and open space lands exist within the entire watershed, excluding Canada. See Figure 3-1.

[4] 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).

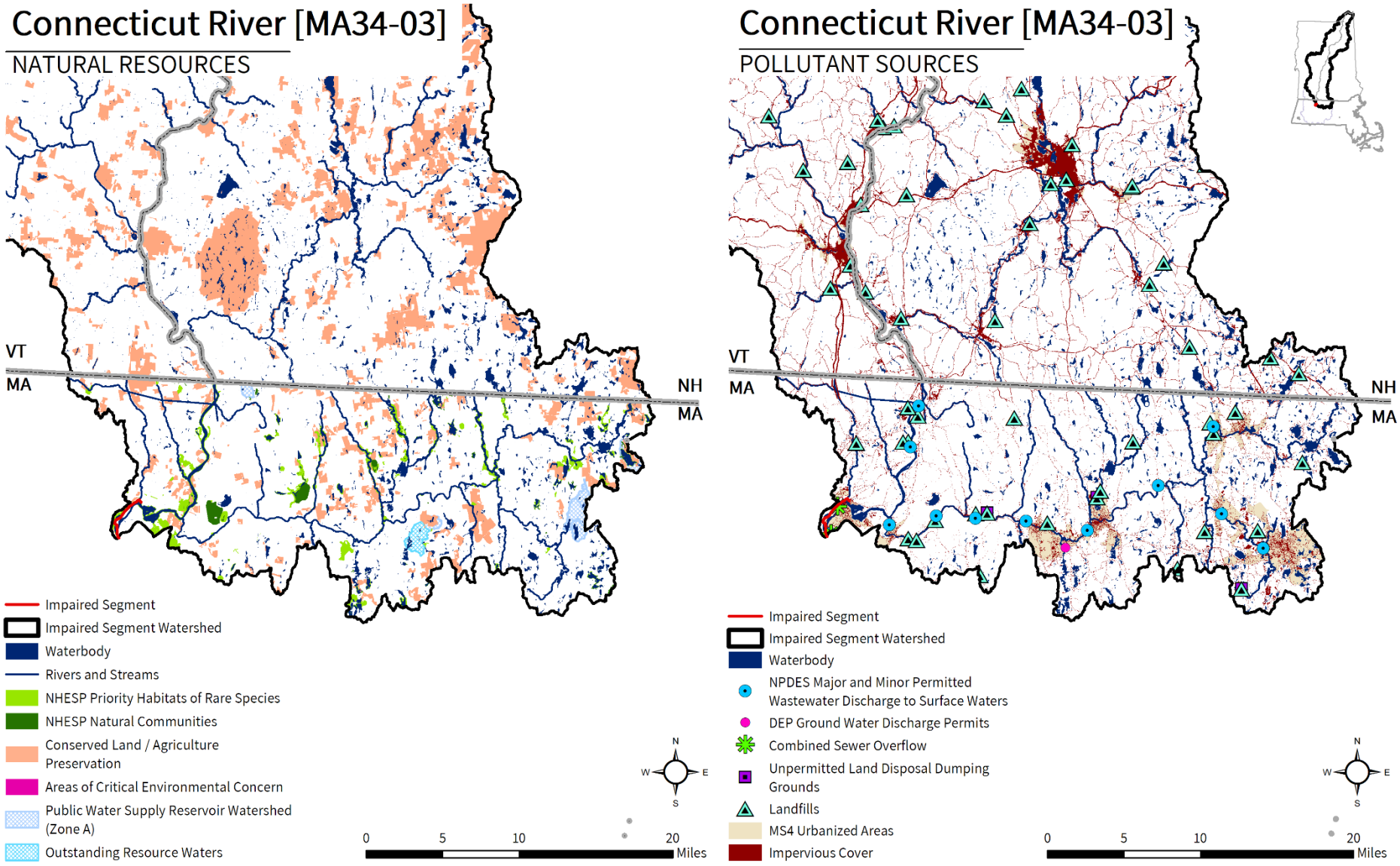


Figure 3-1. Natural resources and potential pollution sources draining to the Connecticut River segment MA34-03. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities

3.2. Waterbody Impairment Characterization

The Connecticut River (MA34-03) is a Class B Water, Warm Water and CSO Receiving Water (MassDEP, 2021).

No bacteria data were available to assess the Primary Contact Recreation use for the Connecticut River segment MA34-03. One permittee, MA0100137 (1 outfall), discharges to this segment. A presumptive impairment decision is being applied for this use since this waterbody does not have a CSO variance in place.

3.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Combined Sewer Overflow (CSO): There is one CSO in the direct drainage area to the segment, which by design releases untreated wastewater to surface waters when flows exceed system capacity, and therefore must be eliminated. For this reason, it is set as the highest priority pathogen source.

Urban Stormwater: Portions of the Connecticut River (MA34-03) watershed are densely developed, although most is forested. There is a large portion of the watershed that extends far upstream of the segment into Vermont, New Hampshire, and Canada, and about 3% of the entire watershed has been classified as developed land use, while 8% of the MA portion of the watershed is developed. Only 1% of the entire watershed land area is in MS4, while 8% of the MA portion of the watershed area is in MS4. Four percent (4%) of the entire watershed and 4% of the MA portion are classified as IC. Given the dense development adjacent to the segment in Turner Falls, as well as pockets of dense development throughout the watershed, stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With some of the watershed serviced by sewer and some (1% of the entire watershed, 8% of the MA portion) designated as MS4 area, illicit storm drain connections and/or illicit discharges from failing infrastructure such as leaky sewer lines or sanitary sewer overflows are likely a significant source of pathogens.

On-Site Wastewater Disposal Systems: There is one groundwater discharge permit for on-site wastewater discharge, which are large-capacity septic systems (non-residential). Most of the residential development in the watershed uses 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: Given the agricultural land use throughout the watershed (6% of entire watershed land area, 4% of the MA portion), agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies. Stormwater runoff from agricultural lands are likely a contributing source of pathogens to the impaired segment.

Pet Waste: Conservation lands, parks, and ballfields popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens. The Rocky Mountain Park provides trails for public recreation such as dog walking and is directly adjacent to the impaired segment. The dense residential streets between the Montague Power Canal and the river may also be a source of pet waste.

Wildlife Waste: There are large conservation lands and wetlands throughout the watershed, and many islands along the impaired segment. Large open mowed areas with a clear sightline to a waterbody, such as those along the Montague Power Canal, 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 (excludes upstream impaired segment watersheds). For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

Town of Deerfield

Approximately 10% of the Town of Deerfield is mapped as MS4 area, however, the town is not listed by EPA among Regulated MS4 Communities in Massachusetts. See: https://www.epa.gov/npdes-permits/regulated-ms4-massachusetts-communities. (USEPA, 2020b)

Deerfield has the following ordinances and bylaws:

- Stormwater Management Regulations: https://www.deerfieldma.us/sites/g/files/vyhlif3001/f/uploads/deerfield_stormwater_regulations.pdf (Town of Deerfield, 2011)
- Deerfield does not have any supplementary regulations beyond the MassDEP regulations for wetland protection.
- Pet Waste ordinance: https://ecode360.com/30385404 (Town of Deerfield, 1964)
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility (or similar): None found.
- Contact Recreation Regulations or Bylaws: None found.

Deerfield does not have a Master Plan available. Deerfield has an Open Space and Recreation Committee which has not met since 2012 (https://www.deerfieldma.us/open-space-recreation-committee). (Town of Deerfield, 2020a).

Town website: https://www.deerfieldma.us/ (Town of Deerfield, 2020b).

Deerfield stormwater page: https://ecode360.com/14659832. (Town of Deerfield, 2010)

Open Space and Recreation Plan: None found.

Town of Gill

Approximately 1% of the Town of Gill is mapped as MS4 area and the town is not listed by EPA among Regulated MS4 Communities in Massachusetts. See: https://www.epa.gov/npdes-permits/regulated-ms4-massachusetts-communities (USEPA, 2020b).

Gill has the following ordinances and bylaws:

- Gill does not have any supplementary regulations beyond the MassDEP regulations for stormwater management and wetland protection.
- Contact Recreation Bylaw: None found.
- Title V Supplementary Regulations: None found.
- Pet Waste Bylaw: None found.

The Town of Gill does not have a Master Plan available. The Open Space and Recreation Plan has a water resources section in the Environmental Inventory and Analysis chapter, which includes information on watershed protection (pages 4-7). Stormwater is noted as a threat to water quality, and the contact recreation section notes bacteria monitoring at Barton Cove in the Connecticut River. The Open Space and Recreation Plan does not have a sewer or septic system section but mentions septic systems as source of ground and surface water pollutants.

Town website: https://gillmass.org/ (Town of Gill, 2020)

Open Space and Recreation Plan: https://gillmass.org/files/Gill-OSRP-2011-FINAL.pdf (Town of Gill and FRCOG, 2011).

Town of Greenfield

Approximately 42% of the Town of Greenfield is mapped as MS4 area; however, the town is not listed by EPA among Regulated MS4 Communities in Massachusetts. See: https://www.epa.gov/npdes-permits/regulated-ms4-massachusetts-communities. (USEPA, 2020b).

Greenfield has the following ordinances and bylaws:

- Stormwater Ordinance: https://ecode360.com/30742035 (Town of Greenfield, 2012a)
- Wetland Ordinance: https://www.ecode360.com/30742390?highlight=&searchId=829249061462885#30742390 (Town of Greenfield, 2016)
- Pet Waste Bylaw: https://ecode360.com/30791277 (Town of Greenfield, 2011)
- Stormwater Utility: None found.
- Title V Supplementary Regulations: None found.

The Town of Greenfield has a Downtown Master Plan and a Comprehensive Sustainable Plan. Greenfield's Master Plan provides an extensive Water Resources section in the Natural Resources chapter. Stormwater is mentioned in the Nonpoint Source Pollutant section in the Natural, Historical, and Cultural Resources chapter. The Sewer Infrastructure section notes the town's plans to upgrade aging sewer and drainage infrastructure.

Town website: https://greenfield-ma.gov/ (SME, 2020)

Downtown Master Plan: https://greenfield-ma.gov/files/Downtown_Master_Plan_2003.pdf (Town of Greenfield, 2003)

Comprehensive Sustainable Plan: https://greenfield-ma.gov/files/Sustainable_Greenfield-Greenfields_2014_Comprehensive_Sustainable_Master_Plan.pdf (VHB, 2014)

Stormwater Page: https://ecode360.com/30742035 (Town of Greenfield, 2012a)

Open Space and Recreation Plan: https://greenfield-ma.gov/files/Greenfield_Open_Space__Recreation_Plan_FINAL.pdf (Town of Greenfield, 2012b).

Town of Montague

Montague is not within the MS4 area.

Montague has the following ordinances and bylaws:

- Stormwater Ordinance and/or Bylaws: https://montague-ma.gov/files/Planning_Board_Stormwater_Policy.pdf (Town of Montague, 2009)
- Stormwater Utility: None found.
- Title 5 Supplementary Regulation: Nothing beyond State of Massachusetts Title V Regulations.
- Wetland Protection Bylaw: Nothing beyond State of Massachusetts wetland protection regulations.
- Pet Waste Ordinance: None found.
- Contact Recreation Ordinance: None found.

The Montague Master Plan was adopted in 1999. The more recently adopted Montague Open Space and Recreation Plan (2017) has a Water Resources section in the Environmental Inventory and Analysis chapter. This chapter also provides information on addressing nonpoint source pollutants, which, as the plan notes, commonly causes elevated indicator bacteria after wet weather events. While the town of Montague does not list any impaired segments within its border, the open space plan does note that the Connecticut River, which is important to the town of Montague, requires a TMDL report. While there is no ordinance regarding contact recreation, the open space plan provides information on water quality testing to assess primary and secondary contract recreation in segments of the Connecticut River. The Montague website notes that the town has an NPDES permit for its Water Pollution Control Facility (https://www.montague-ma.gov/p/299/National-Pollution-Discharge-Elimination-System-Permit). (Town of Montague, 2008) The Master Plan notes that increasing the town sewer line capacity and improving aging lines is a goal.

Montague Town Website: https://www.montague-ma.gov/ (Town of Montague, 2020)

Master Plan: https://www.montague-ma.gov/files/Montague_Comprehensive_Plan_1999.pdf (Town of Montague, 1999)

Stormwater Web Page: https://www.montague-ma.gov/p/33/Water-Pollution-Control-Facility (Town of Montague, 2020b)

Open Space and Recreation Plan: https://www.montague-ma.gov/files/Montague_Open_Space_and_Recreation_Plan_nomaps.pdf (Town of Montague, 2017)

4. MA34-04 Connecticut River

4.1. Waterbody Overview

The Connecticut River segment MA34-04 is 34.5 miles long and begins at the confluence of the Connecticut and Deerfield Rivers along the Greenfield-Deerfield, MA town boundary. The segment flows south along the Deerfield-Montague town boundary, the Deerfield-Sunderland town boundary, the Whately-Sunderland town boundary, the Hadley-Hatfield town boundary, the Hadley-Northampton town boundary, and the Holyoke-South Hadley town boundary. Segment MA34-04 is bound at its downstream end by the Holyoke Dam (NATID: MA00973) on the Holyoke-South Hadley, MA town boundary.

Direct tributaries to the Connecticut River segment MA34-04 include Pole Swamp Brook, Cranberry Pond Brook, Gunn Brook, Clapp Brook, Sugarloaf Brook, Great Drain, Mohawk Brook, Russellville Brook, Cow Bridge Brook, Mill River, Dry Brook, and White Brook. Pathogen-impaired tributaries to segment MA34-04 (not mapped) include many in the Deerfield River watershed (segments MA33-03, MA33-04, MA33-101, MA33-102, MA33-19, MA33-21, and MA33-30) and the Millers watershed (MA35-16). Pathogen-impaired tributaries to the segment in the direct Connecticut River watershed include: the Connecticut River (MA34-03), Bachelor Brook (MA34-07), Manhan River (MA34-11), Stony Brook (MA34-19), Mill River (MA34-25), Fort River (MA34-27), Mill River (MA34-28), and Bloody Brook (MA34-36). Major lakes and reservoirs within the segment watershed include Tighe Carmody Reservoir, Tully Lake, and White Reservoir.

Key landmarks near the impaired segment include the East Deerfield Railroad Yard, the Bitzer State Hatchery, the UMass Crop Animal Research and Education Center, South Sugarloaf Mountain, CT River Paddlers Trail campsite, the North Hadley and Hatfield town centers, and Elwell State Park. Segment MA34-04 is crossed by the Sunderland Bridge/MA-116 (Sunderland), Bridge Street/MA-9 and the Norwottuck Rail Trail Bridge (Northampton), and US-202 (Holyoke).

The Connecticut River (MA34-04) drains a total area of 8,312 square miles, of which 356 mi^2 (4%)

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 5,319,465

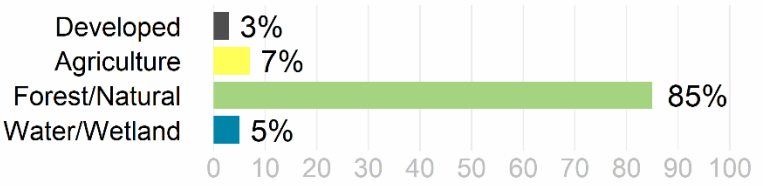
Segment Length (Miles): 34.5

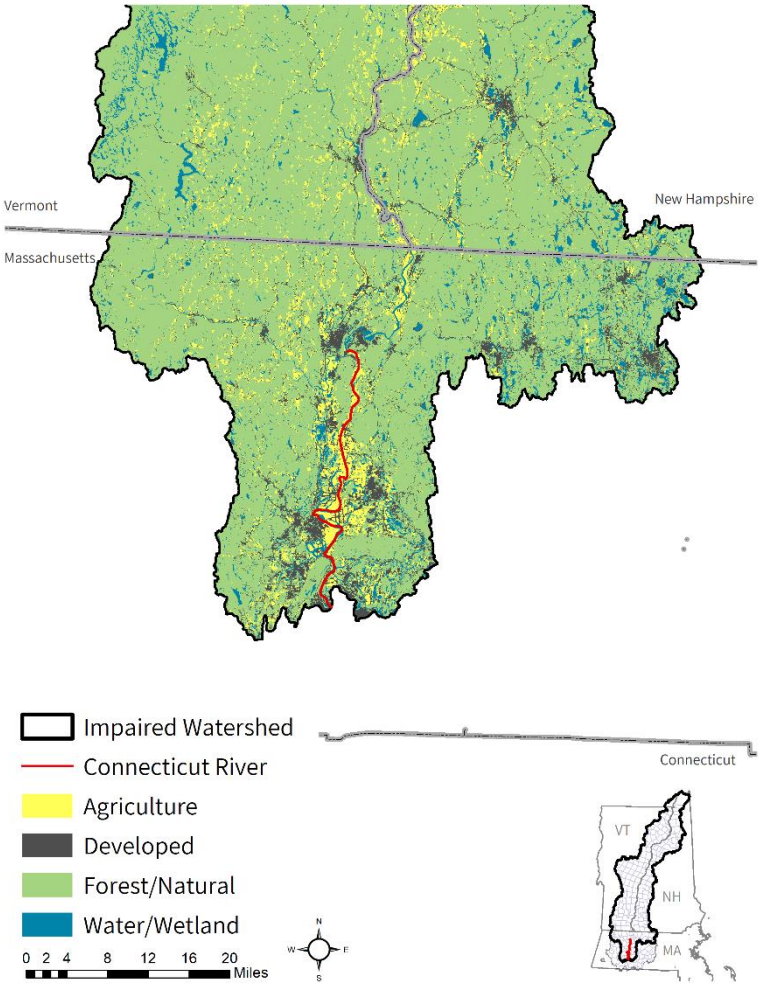
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (Warm Water, CSO Receiving Water)

Impervious Area (Acres, %): 228,081 (4%)

DCIA Area (Acres, %): 79,515 (2%)





is impervious and 124 mi^2 (2%) is directly connected impervious area (DCIA)[5]. The segment watershed extends beyond MA into Vermont, New Hampshire, and Canada. Out of the total watershed area for MA34-04 (5,319,465 acres), 764,144 acres (1,194 mi^2, 14%) are within MA.

The watershed is partially[6] served by public sewer and 2% (8% within the MA portion of the watershed) is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). Within the MA portion of the watershed, there are 25 NPDES permits on file governing point source discharges of pollutants to surface waters, 13 of which are located within the immediate drainage area (Table 4-1). There are five industrial stormwater discharge permits located within the segment drainage area (Table 4-2). There are four MassDEP discharge to groundwater permits for on-site wastewater discharge within the MA portion of the segment watershed (Table 4-3). There are also six combined sewer overflows in the MA portion of the watershed (Table 4-4), 279 landfills in the overall watershed and 74 landfills within the MA portion of the watershed, and six unpermitted land disposal dumping grounds within the MA portion of the watershed. See Figure 4-1.

Table 4-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0100099	HADLEY WWTP	HADLEY	MUN
MA0100137	MONTAGUE WPCF	MONTAGUE	MUN
MA0100188	MONROE WWTF	MONROE	MUN
MA0100218	AMHERST WWTP	HADLEY	MUN
MA0101214	GREENFIELD WPCP	GREENFIELD	MUN
MA0101290	HATFIELD WWTP	HATFIELD	MUN
MA0101818	NORTHAMPTON POTW	NORTHAMPTON	MUN
MAG580001	OLD DEERFIELD WWTP	DEERFIELD	MUN
MAG580002	SHELBURNE FALLS WWTF	BUCKLAND	MUN
MAG580003	CHARLEMONT SEWER DISTRICT WWPT	CHARLEMONT	MUN
MAG580004	SOUTH DEERFIELD WWTP	DEERFIELD	MUN
MAG580005	SUNDERLAND WWTF	SUNDERLAND	MUN

Table 4-2. National Pollutant Discharge Elimination System (NPDES) permits for Industrial Stormwater discharges in the segment watershed. Only permits unique to this segment watershed are listed.

NPDES ID	NAME	TOWN
MA0110051	BITZER TROUT HATCHERY	MONTAGUE
MA0005339	MT TOM STATION	HOLYOKE
MA0000272	BOSTON & MAINE - E. DEERFIELD	DEERFIELD
MA0040207	CHANG FARMS INC	WHATELY
MA0000272	BOSTON & MAINE - E. DEERFIELD	DEERFIELD

Table 4-3. Groundwater discharge permits in the segment watershed. Only permits unique to this segment watershed are shown. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. Flow = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
594-2	ASHFIELD WASTEWATER TREATMENT FACILITY	ASHFIELD	Sanitary Discharge	25,000
622-2	QUABBIN VALLEY HEALTHCARE	ATHOL	Sanitary Discharge	22,000

[5] IC and DCIA areas do not include 753,810 acres in NH and Canada due to lack of impervious cover data availability. Therefore, 14% of the watershed is treated as 100% pervious when it is likely less than 100% pervious.

[6] 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.

Table 4-4. Combined Sewer Overflows (CSOs) discharging to the segment.

NPDES ID	NAME	TOWN	DEP OUTFALL ID
MA0100137	MONTAGUE WPCF/C	MONTAGUE	MON001
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL018
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL019
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL020
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL021
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL023

The Connecticut River segment MA34-04 contains a wooded buffer along most of its reach, providing some shading and stormwater filtering from most agricultural fields and developed areas along the riverbanks. Exceptions include a marina in South Hadley and several large agricultural fields in Hadley and Northampton. The land uses along the river corridor are mostly agricultural, including corn and other vegetables, greenhouses, and hayfields. The watershed area within MA consists of 8% agriculture, 9% developed, 75% forested/natural, and 8% water/wetland.

The Connecticut River segment (MA34-04) watershed does not contain any Areas of Critical Environmental Concern in the MA portion of the watershed. Under the Massachusetts Natural Heritage and Endangered Species Program, 88,900 acres (12%) are classified as Priority Habitats of Rare Species and 9,402 acres (1%) are classified as Priority Natural Vegetation Communities within the MA portion of the watershed. There are 73,546 acres (10%) under Public Water Supply protection and 1,902 acres (<1%) identified as Outstanding Resource Waters in the MA portion of the watershed. Over 73,573 acres (10%) of land protected in perpetuity[7] exist within the MA portion of the watershed, which is part of a total of 238,977 acres (31%) of Protected and Recreational Open Space[8] in the MA portion of the watershed. Over 1.6 million acres (31%) of protected and open space lands exist within the entire watershed, excluding Canada. See Figure 4-1.

[7] 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.

[8] 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).

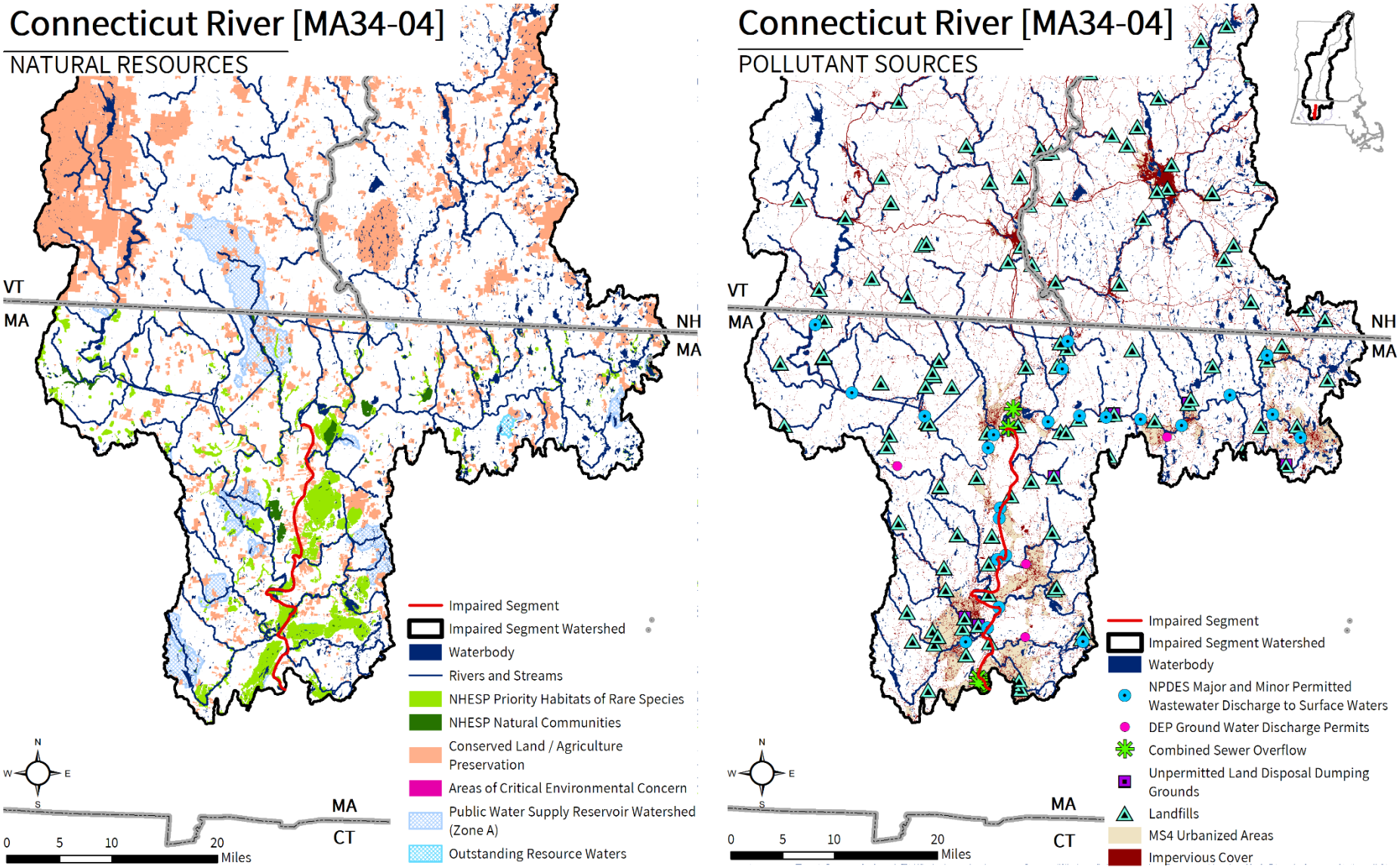


Figure 4-1. Natural resources and potential pollution sources draining to the Connecticut River segment MA34-04. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities

4.2. Waterbody Impairment Characterization

The Connecticut River (MA34-04) is a Class B , Warm Water and CSO Receiving Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the stations listed below (refer to Tables 4-5, 4-6; Figure 4-2). 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, 30-day rolling basis.

- In 2008, six samples were collected at W1045, resulting in no days when the 30-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 six samples, none exceeded the STV criterion.
- In 2008, six samples were collected at W1784, resulting in no days when the 30-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 six samples, none exceeded the STV criterion.

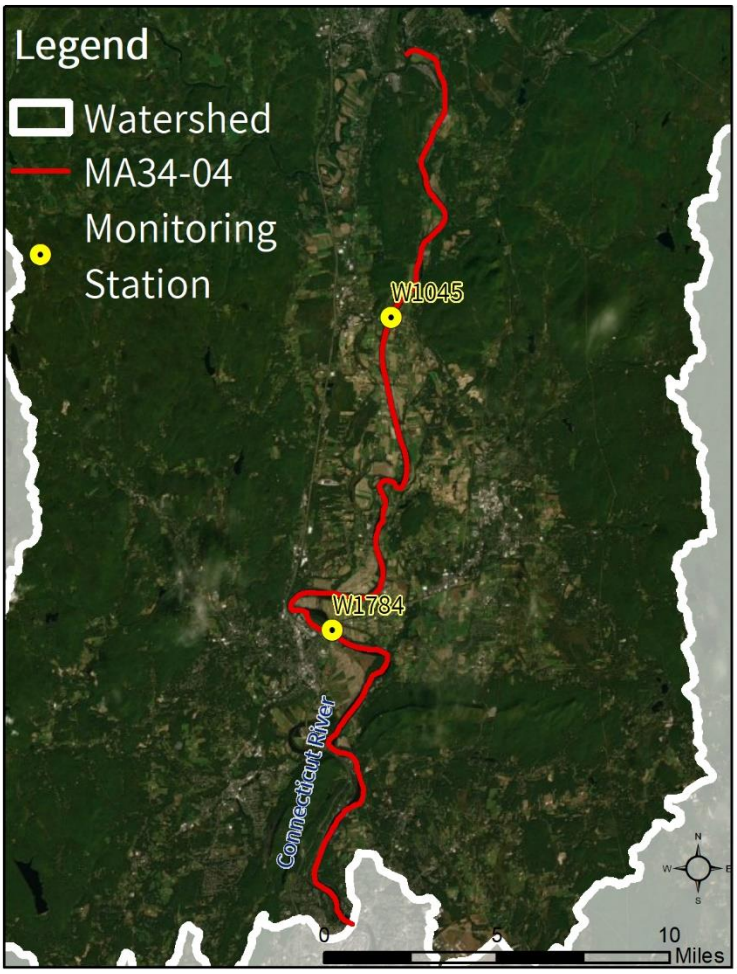


Figure 4-2. Location of monitoring station(s) along the impaired river segment.

Two permittees, MA0100137 (1 outfall) and MA0101630 (4 outfalls), discharge to this segment. A presumptive impairment decision is being applied for this use since this waterbody does not have a CSO variance in place.

Table 4-5. Summary of indicator bacteria sampling results by station for the Connecticut River (MA34-04). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1045	5/6/2008	9/9/2008	6	37	0	0
W1784	5/6/2008	9/9/2008	6	46	0	0

Table 4-6. Indicator bacteria data by station, indicator, and date for the Connecticut River (MA34-04). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1045	*E. coli*	5/6/2008	DRY	8	8	
W1045	*E. coli*	6/3/2008	DRY	8	8	
W1045	*E. coli*	7/1/2008	DRY	10	9	
W1045	*E. coli*	7/29/2008	WET	40	20	
W1045	*E. coli*	9/3/2008	DRY	10	10	
W1045	*E. coli*	9/9/2008	WET	140	37	
W1784	*E. coli*	5/6/2008	DRY	2	2	
W1784	*E. coli*	6/3/2008	DRY	8	4	
W1784	*E. coli*	7/1/2008	DRY	30	15	
W1784	*E. coli*	7/29/2008	WET	70	46	
W1784	*E. coli*	9/3/2008	DRY	10	10	
W1784	*E. coli*	9/9/2008	WET	180	42	

4.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Combined Sewer Overflow (CSO): There are two CSOs draining directly to the segment, six CSOs in the direct drainage area to the segment, and seven CSOs within the entire MA portion of the watershed. CSOs by design release untreated wastewater to surface waters when flows exceed system capacity, and therefore must be eliminated. For this reason, it is set as the highest priority pathogen source.

Urban Stormwater: Portions of the Connecticut River (MA34-04) watershed are moderately developed, although due to the expansive size of the watershed, only 2% of the entire watershed land area is in MS4 (10% within the MA portion of the watershed) and 2% is DCIA. There is a large area of the watershed that extends far upstream of the segment into Vermont, New Hampshire, and Canada. About 3% of the entire watershed has been classified as developed land use (9% in the MA portion). Stormwater runoff from urban areas is likely a source of pathogens.

Illicit Sewage Discharges: With some of the watershed serviced by sewer and some (2% of the entire watershed, 10% of the portion within MA) designated as MS4 area, illicit storm drain connections and/or illicit discharges from failing infrastructure such as leaky sewer lines or sanitary sewer overflows are likely a source of pathogens.

On-Site Wastewater Disposal Systems: There are two groundwater discharge permits for on-site wastewater discharge within the immediate drainage area (4 within the entire watershed area), which are large-capacity septic systems (non-residential). Most of the residential development in the watershed uses 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: While there is a moderate amount of agriculture (7% of the entire watershed land area, 8% of the watershed land area within MA), the river valley itself is heavily agricultural with large fields of row crops, hayfields, and greenhouses visible in recent aerial photos along the river corridor. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to the segment.

Pet Waste: Conservation lands, parks, and ballfields popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens. Examples in the watershed include the Rainbow Beach Conservation Area, Norwottuck Rail Trail, Connecticut River Greenway State Park, and several residential neighborhoods.

Wildlife Waste: There are large conservation lands and wetlands throughout the watershed. Large open mowed areas with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

4.4. Existing Local Management

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

Town of Deerfield. See Section 3.4

Town of Greenfield. See Section 3.4

Town of Hadley

Almost a third of Hadley is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Hadley (Permit ID #MAR041008) has an EPA approved Notice of Intent (NOI). Hadley has a Stormwater Management Plan on file at the Department of Public Works. The town has mapped all of its stormwater outfall system. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2005. According to the NOI, there are two stormwater outfalls to Fort River MA34-27 and seven stormwater outfalls into the Connecticut River MA34-04 (including tributaries), all impaired for *E. coli*.

Hadley has the following ordinance and bylaws:

- Stormwater Ordinance: https://ecode360.com/30052296 (Town of South Hadley, 2017)
- Erosion and Sediment Control: https://ecode360.com/13511992 (Town of Hadley, 2019a)
- Title V Supplementary Regulations: https://ecode360.com/30821296 (Town of South Hadley, 1992)
- Wetland Protection Bylaw: https://ecode360.com/30054113 (Town of South Hadley, 2011)
- Pet Waste Ordinance: https://ecode360.com/30054111?highlight=dog,dogs%20dogs&searchId=8034864052839663#30054111 (Town of South Hadley, 2010)

The Master Plan has a Water Resources section in its Natural Resources chapter, addressing tributaries, wetlands, vernal pools, and aquifers. This section mentions the Connecticut River, an impaired waterway that flows through the Town of Hadley. In addition, the Managing Stormwater Runoff section covers low impact development and the adoption of the 2008 stormwater management bylaw. The Sewer Infrastructure section notes that most of the town is served by public sewer, which is aging and an area of concern for the town.

Town website: https://www.hadleyma.org/ (Town of Hadley, 2020)

Master Plan: https://www.southhadley.org/227/Adopted-Endorsed-2010-Master-Plan (Town of South Hadley, 2010)

Stormwater Page: https://www.hadleyma.org/stormwater (Town of Hadley, 2019b)

Open Space and Recreation Plan: https://www.hadleyma.org/conservation-commission/pages/open-space-plans (Town of Hadley, 2014)

Town of Hatfield

A small area of Hatfield is subject stormwater regulations under the NPDES General MS4 Stormwater Permit. Hatfield (Permit ID #MAR041010) has an EPA approved Notice of Intent (NOI). Hatfield has a Stormwater

Management Plan on file at the Town Office. The town has mapped 90% of its stormwater outfall system and the map is on file at the Town Office. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater-regulations in 2008. According to the NOI, there is one stormwater outfall into Mill River MA34-25 and two stormwater outfalls into the Connecticut River segment MA34-03, both impaired for *E. coli*.

Hatfield has the following ordinances and bylaws:

- Stormwater Ordinance, Chapter 7 of Hatfield Zoning Bylaws: None found.
- Wetland Protection Bylaw, Chapter 3.14 of Town Bylaws: None found.
- Title V Supplementary Regulations: None found.
- Pet Waste: None found.

Hatfield's Master Plan has a Natural Resources chapter which includes information on water resources within the town, mentioning both the Mill River and the Connecticut River, two impaired waterways within the MS4 area. At the time the plan was written, it suggested a Stormwater Management Plan be implemented which has since been done. The Sewer Infrastructure section of the plan notes that a third of the community is on sewer, and there is a need for expansion.

Town website: https://www.townofhatfield.org/ (Town of Hatfield, 2020)

Master Plan: https://www.townofhatfield.org/sites/g/files/vyhlif3246/f/uploads/masterplan.pdf (Town of Hatfield, 2009)

Open Space and Recreation Plan: http://www.townofhatfield.org/open-space-committee/files/open-space-plan-2014 (Town of Hatfield, 2014)

City of Holyoke

More than half of Holyoke is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Holyoke (Permit ID #MAR041011) has an EPA approved Notice of Intent (NOI). According to the NOI, there are 15 stormwater outfalls into the Connecticut River segment MA34-05, impaired for *E. coli*.

Holyoke has the following ordinances and bylaws:

- Stormwater Ordinance: https://library.municode.com/ma/holyoke/codes/code_of_ordinances?nodeId=PTIICOOR_CH38EN_ARTIVSTMA (City of Holyoke, 2020b)
- Holyoke does not have any supplementary regulations beyond the MassDEP regulations for wetland protection.
- Title V Supplemental Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste Ordinance: https://library.municode.com/ma/holyoke/codes/code_of_ordinances?nodeId=PTIICOOR_CH14AN_ARTIINGE_S14-11ANWA (City of Holyoke, 2014)

The Holyoke Master Plan from 1999 provides limited information on the environmental resources within the town and goals to protect resources. The plan mentions that, as of 1999, there is a new treatment plant for improved water quality and "expanded sewer system and secondary treatment supports increased industrial development in Ingleside and residential growth in Whiting Farms" (page 12). The plan notes a goal of "protection of ground and surface drinking water resources," including the watersheds for Holyoke's drinking water reservoirs (page 21-22).

Town website: https://www.holyoke.org/ (City of Holyoke, 2020a)

1999 Master Plan: https://holyokeredevelopment.com/wp-content/uploads/Master-Plan-1999.pdf (City of Holyoke, 1999)

Stormwater Management Program: https://storage.googleapis.com/proudcity/holyokema/uploads/2020/04/SWMP-201900909-for-posting.pdf (City of Holyoke, 2019)

Open Space and Recreation Plan: abbreviated section in the 1999 Master Plan

Town of Montague. See Section 3.4

Town of Northampton

Less than half of Northampton is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Northampton (Permit ID #MAR041016) has an EPA approved Notice of Intent (NOI). The town does not have a Stormwater Management Plan. Northampton has mapped 90% of its stormwater outfall system and attached the map to the NOI as a PDF. The town plans to complete the map in 2020. The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2004. According to the NOI, there are eight stormwater outfalls to the Connecticut River segment MA34-04 and 54 stormwater outfalls into the Mill River MA34-28, both impaired for *E. coli*.

Northampton has the following ordinances and bylaws:

- Stormwater Ordinance: https://ecode360.com/13265221 (City of Northampton, 2004)
- Wetland Protection Bylaw: https://www.ecode360.com/13265228?#13265228 (City of Northampton, 1989)
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: https://www.northamptonma.gov/726/Stormwater-Flood-Control-Utility (City of Northampton, 2014)
- Pet Waste: https://www.ecode360.com/11954222 (City of Northampton, 2012)

Northampton has a Sustainable Northampton Plan (Comprehensive Plan) and a Multi-Hazard Mitigation Plan but no standalone comprehensive plan for the city. The Multi-Hazard Mitigation Plan has a section on water resources in the city, which mentions the Connecticut River, Mill River, and Manhan River, all pathogen-impaired segments. Both plans mention stormwater, with the Sustainable Northampton Plan noting a goal of upgrading the city's stormwater management system. The plan does not have a sewer or septic section but notes recommendations to extend and improve the sewer system.

Town website: https://www.northamptonma.gov/ (City of Northampton, 2020)

Sustainable Northampton Plan: http://www.northamptonma.gov/DocumentCenter/View/838/SustainableNorthamptonPlan?bidId= (City of Northampton, 2008)

Multi-Hazard Mitigation Plan: http://www.northamptonma.gov/DocumentCenter/View/4264/Northampton-Multi-Hazard-Mitigation-Plan-8132015?bidId= (City of Northampton, 2015)

Stormwater page: https://www.northamptonma.gov/1813/Stormwater (City of Northampton, 2018b)

Open Space and Recreation Plan: http://www.northamptonma.gov/DocumentCenter/View/1812/Open-Space--Recreation-Plan-2018-2025-approved-EOEEA-05-7-2019?bidId= (City of Northampton, 2018a)

Town of South Hadley

More than half of South Hadley is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. South Hadley (Permit ID #MAR041020) has an EPA approved Notice of Intent (NOI). The town has a Stormwater Management Plan on file at the South Hadley Division of Water Pollution Control. The town has mapped 90% of its stormwater outfall system. The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2008. According to the NOI, there are seven stormwater outfalls to Buttery Brook MA34-07, four stormwater outfalls into the Connecticut River MA34-05, and 17 stormwater outfalls into Stony Brook MA34-19, all impaired for *E. coli*.

South Hadley has the following ordinances and bylaws:

- Stormwater Ordinance:https://www.southhadley.org/DocumentCenter/View/955/Stormwater-Bylaw-Erosion-and-Sediment-Control-PDF?bidId= (Town of South Hadley, n.d., a)
- Wetland Protection Ordinance:https://ecode360.com/30052799?highlight=wetlands%20protection&searchId=31856557605734324#30052799 (Town of South Hadley, 2017)
- Title V supplementary Regulations: https://ecode360.com/30821273 (South Hadley, 1992)
- Pet Waste Ordinance:https://www.southhadley.org/1040/Take-the-Pet-Waste-Pledge (Town of South Hadley, n.d., b)
- Stormwater Utility: None found.

The South Hadley Master Plan has a Natural Resources section in Chapter 5, which identifies issues such as the need for monitoring the community's environmental resources' quality and condition (page 5-2) and an extensive section on water resources. This section also mentions Buttery Brook, the Connecticut River, and Stony Brook, which are pathogen-impaired segments within the town. The Natural Resources chapter also provides a section on managing stormwater runoff, starting on page 5-13. The Municipal Services and Facilities section, Chapter 3, notes that most of the town is serviced by sewer, except for the area north of Bachelors Brook which relies on septic systems, due to topographical constraints in installing a sewer line.

South Hadley Town website: https://www.southhadley.org/ (Town of South Hadley, 2020b)

South Hadley Master Plan: https://www.southhadley.org/227/Adopted-Endorsed-2010-Master-Plan (Town of South Hadley, 2020a)

Open Space and Recreation Plan: https://www.southhadley.org/DocumentCenter/View/408/2012-to-2019-Open-Space-and-Recreation-Plan-PDF (Town of South Hadley, 2014)

Town of Sunderland

Sunderland is not within the MS4 area and does not have a Stormwater Management Plan on file.

Sunderland has the following ordinances and bylaws:

- Wetland Protection bylaw, Chapter 122 https://www.ecode360.com/12480943 (Town of Sunderland, 1990)
- Pet waste bylaw: Chapter 130 Dogs, 130-4: Nonconforming dogs. https://www.townofsunderland.us/sites/g/files/vyhlif3891/f/uploads/by_laws_-_dogs_0.pdf (Town of Sunderland, 2014a)
- Sunderland has a Water District: https://www.townofsunderland.us/our-community/pages/sunderland-water-district (Town of Sunderland, n.d.)

Town of Sunderland Master Plan: https://www.townofsunderland.us/sites/g/files/vyhlif3891/f/uploads/sunderland_master_plan_1974.pdf (Philip B. Herr & Associates, 1974)

Sunderland's Open Space and Recreation Plan: https://www.townofsunderland.us/sites/g/files/vyhlif3891/f/uploads/osrp-final-revised-06.11.14.pdf (Town of Sunderland, 2014b)

Town of Whately

Whately is not within the MS4 area. Whatley's town webpage with general bylaws is under construction.

Whatley's Community Preservation Committee Plan: https://www.whately.org/community-preservation-committee (Town of Whately, 2009)

5. MA34-05 Connecticut River

5.1. Waterbody Overview

The Connecticut River segment MA34-05 is 15.9 miles long and begins at the Holyoke Dam (NATID: MA00973) at the Holyoke-South Hadley town boundary. The segment flows to the south along the town boundaries of Holyoke-Chicopee, West Springfield-Chicopee, West Springfield-Springfield, and Agawam-Longmeadow, MA. Segment MA34-05 ends at the Massachusetts-Connecticut border in Longmeadow, MA.

Direct tributaries to the Connecticut River segment MA34-05 include the pathogen-impaired segments Buttery Brook (MA34-42), unnamed tributary (MA34-60), Longmeadow Brook (MA34-21), and the Mill River (MA34-29). Additional pathogen-impaired tributaries to segment MA34-05 (not mapped) include many in the Chicopee and Westfield River watersheds. A total of 48 pathogen-impaired segments exist in the MA portion of the MA34-05 segment watershed. Additional direct tributaries include Tannery Brook, Goldine Brook, Bagg Brook, Piper Brook, Pecousic Brook, Cooley Brook, Threemile Brook, and Raspberry Brook. Major lakes and reservoirs within the segment watershed include the Cobble Mountain Reservoir and the Quabbin Reservoir, plus many others. The canals of Holyoke are hydrologically connected with this segment.

Key landmarks near the impaired segment include the urban centers of Holyoke and Springfield, Depot Square, the Holyoke Shopping Center, the Springfield Country Club and golf course, and the Fannie Stebbins Wildlife Refuge. Segment MA34-05 is crossed by I-391, Bridge Street, and Cabot Street/MA-116 (Holyoke); Massachusetts Turnpike/I-90 and I-91 (Chicopee); West Street/US-20, Memorial Bridge, and South End Bridge/US-5 (Springfield).

The Connecticut River (MA34-05) drains a total area of 9,644 square miles, of which 434 mi^2 (5%) is impervious and 159 mi^2 (2%) is directly connected impervious area (DCIA)[9]. The Connecticut River segment MA34-05 watershed extends beyond Massachusetts into Connecticut, Vermont, New Hampshire, and Canada. Out of

Reduction from Highest Calculated Geomean: 49%

Watershed Area (Acres): 6,172,232

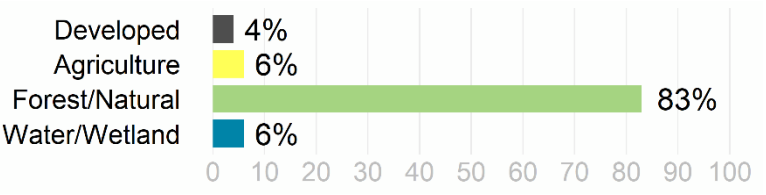
Segment Length (Miles): 15.9

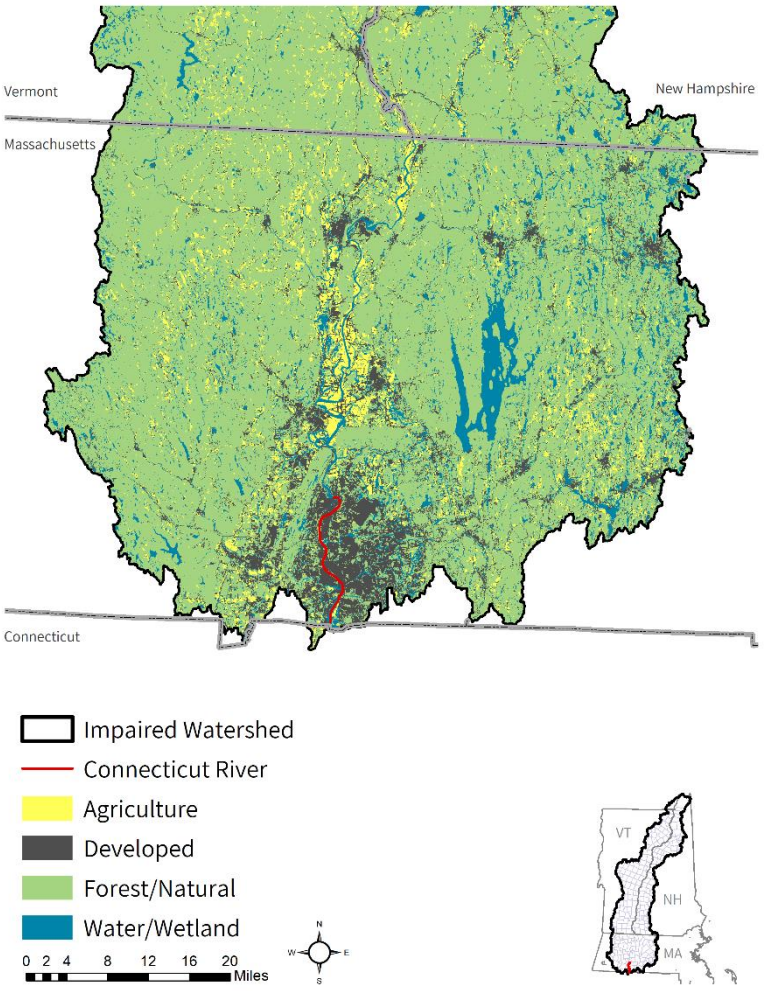
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (Warm Water, CSO Receiving Water)

Impervious Area (Acres, %): 277,740 (5%)

DCIA Area (Acres, %): 101,719 (2%)





[9] IC and DCIA areas do not include 753,810 acres in NH and Canada due to lack of impervious cover data availability. Therefore, 12% of the watershed is treated as 100% pervious when it is likely less than 100% pervious.

the total watershed area for MA34-05 (6,172,232 acres), 1,615,026 acres (2,523 mi^2, 26%) are within MA.

The watershed is partially[10] served by public sewer and 4% (13% within the MA portion of the watershed) is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). Within the MA portion of the watershed, there are 42 NPDES permits on file governing point source discharges of pollutants to surface waters, 17 of which are located within the immediate drainage area (Table 5-1). There is one Industrial discharge permit in the segment watershed (Table 5-2). There are eight MassDEP discharge to groundwater permits for on-site wastewater discharge within the MA portion of the segment watershed, four of which are located within the immediate drainage area (Table 5-3). There are also 53 combined sewer overflows in the MA portion of the watershed with 27 discharging to this segment, 386 landfills in the entire watershed and 181 landfills within MA, and 14 unpermitted land disposal dumping grounds within the MA portion of the watershed. See Figure 5-1.

Table 5-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0023027	RENAISSANCE MANOR OF WESTFIELD WWTP	WESTFIELD	OTH
MA0100102	HARDWICK WPC - GILBERTVILLE	HARDWICK	MUN
MA0100455	SOUTH HADLEY WWTP	CHICOPEE	MUN
MA0100889	WARE WWTP	WARE	MUN
MA0100919	SPENCER WWTP	SPENCER	MUN
MA0100960	RUSSELL VILLAGE WWTF	RUSSELL	MUN
MA0101168	PALMER WPCF	PALMER	MUN
MA0101265	HUNTINGTON WWTP	HUNTINGTON	MUN
MA0101508	CHICOPEE WPCF	CHICOPEE	MUN
MA0101567	WARREN WWTF	WARREN	MUN
MA0101613	SPRINGFIELD WWTP	AGAWAM	MUN
MA0101630	HOLYOKE WPCF	HOLYOKE	MUN
MA0101800	WESTFIELD WPCP	WESTFIELD	MUN
MA0102431	HARDWICK WPC - WHEELWRIGHT	HARDWICK	MUN
MA0103152	BARRE WWTP	BARRE	MUN
MA0103233	WORONOCO VILLAGE WWTF	RUSSELL	MUN
MA0101061	NORTH BROOKFIELD WWTP	NORTH BROOKFIELD	MUN

Table 5-2. National Pollutant Discharge Elimination System (NPDES) permits for Industrial Stormwater discharge in the segment watershed. Only permits unique to this segment watershed are shown.

NPDES ID	NAME	TOWN
MA0004707	NAEA ENERGY MASS- W. SPRINGFIELD STA.	WEST SPRINGFIELD

Table 5-3. Groundwater discharge permits in the segment watershed. Only permits unique to this segment watershed are shown. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. Flow = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
824-0	2 STATE YMCA	BECKET	Sanitary Discharge	40,000
882-0	AZURE GREEN/ABYSS DISTRIBUTION	MIDDLEFIELD	Other	66,240
502-3	DOC TRAINING FACILITY	NEW BRAINTREE	Sanitary Discharge	114,000
808-1	QUABOG ON THE COMMON	WEST BROOKFIELD	Sanitary Discharge	18,310

[10] 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.

Table 5-4. Combined Sewer Overflows (CSOs) discharging to the segment.

NPDES ID	NAME	TOWN	DEP OUTFALL ID
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI03
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI04
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI05
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI07
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI08
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI09
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI24
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR007
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR008
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR010
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR011
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR012
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR013
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR014
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR015A
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR015B
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR016
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR018
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR042
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR049
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL011
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL016
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL017
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL02
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL07
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL08
MA0101630	HOLYOKE WPCF/CS	HOLYOKE	HOL09

The Connecticut River segment MA34-05 contains mostly developed (primarily residential then commercial) areas along its shoreline, with much less agricultural area compared with the immediate upstream impaired segment (MA34-04). The segment watershed within MA consists of 7% agriculture, 11% developed, 73% forested/natural, and 9% water/wetland.

The Connecticut River segment (MA34-05) watershed contains 438 acres (<1%) of Areas of Critical Environmental Concern in the MA portion of the watershed. Under the Massachusetts Natural Heritage and Endangered Species Program, 180,585 acres (11%) are classified as Priority Habitats of Rare Species and 15,806 acres (1%) are classified as Priority Natural Vegetation Communities within the MA portion of the watershed. There are 343,622 acres (21%) under Public Water Supply protection and 1,902 acres (<1%) identified as Outstanding Resource Waters in the MA portion of the watershed. Over 122,222 acres (8%) of land protected in perpetuity[11] exist within the MA portion of the watershed, which is part of a total of 525,970 acres (33%) of Protected and Recreational Open Space[12] in the MA portion of the watershed. Over 1.9 million acres (31%) of protected and open space lands exist within the entire watershed, excluding Canada. See Figure 5-1.

[11] 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.

[12] 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).

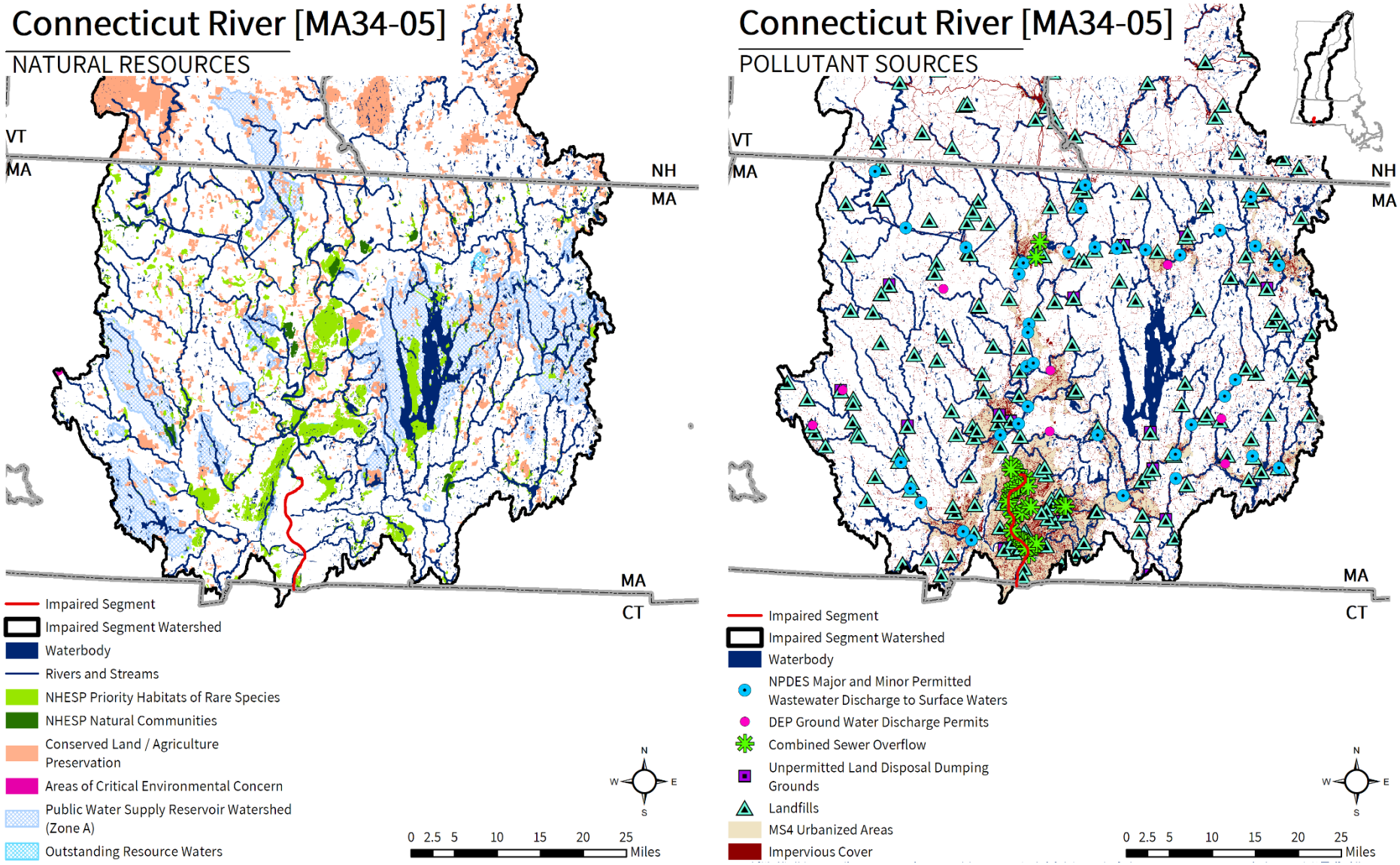


Figure 5-1. Natural resources and potential pollution sources draining to the Connecticut River segment MA34-05. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

5.2. Waterbody Impairment Characterization

The Connecticut River (MA34-05) is a Class B, Warm Water and CSO Receiving 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 5-5, 5-6; Figure 5-2). 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, 30-day rolling basis.

- In 2008, five samples were collected at W1395, resulting in one day when the 30-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.

Three permittees, MA0101508 (8 outfalls), MA0101630 (6 outfalls), and MA0103331 (12 outfalls), discharge to this segment. A presumptive impairment decision is being applied for this use since this waterbody does not have a CSO variance in place.

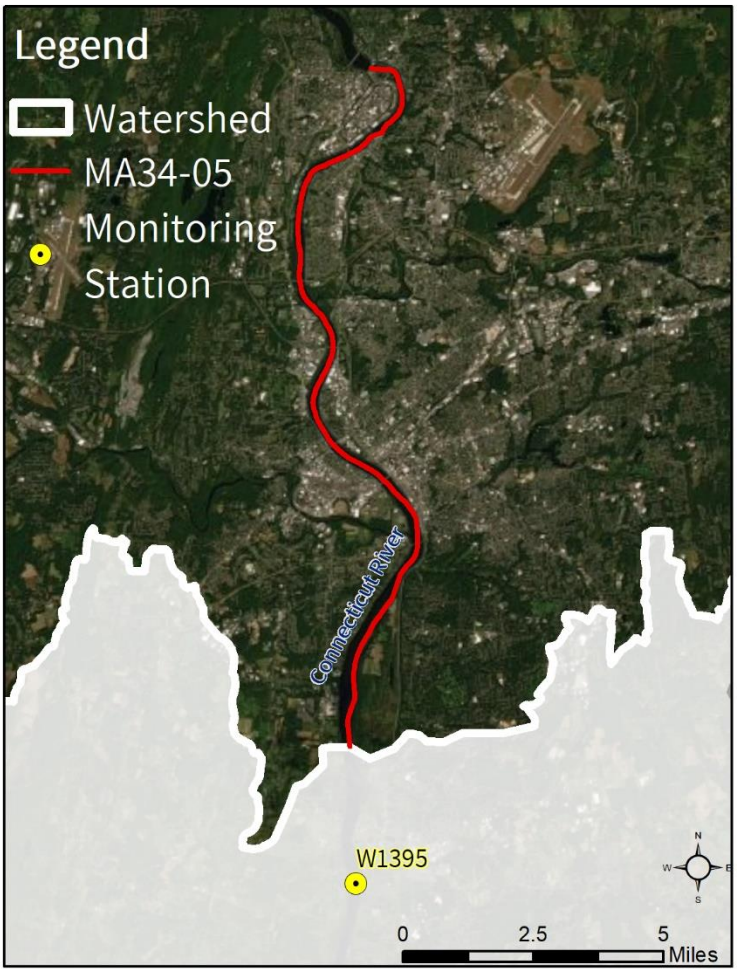


Figure 5-2. Location of monitoring station(s) along the impaired river segment.

Table 5-5. Summary of indicator bacteria sampling results by station for the Connecticut River (MA34-05). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1395	5/6/2008	9/3/2008	5	245	1	0

Table 5-6. Indicator bacteria data by station, indicator, and date for the Connecticut River (MA34-05). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1395	*E. coli*	5/6/2008	DRY	24	24	
W1395	*E. coli*	6/3/2008	DRY	44	32	
W1395	*E. coli*	7/1/2008	WET	230	101	
W1395	*E. coli*	7/29/2008	WET	260	245	
W1395	*E. coli*	9/3/2008	DRY	10	10	

5.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Combined Sewer Overflow (CSO): There are 53 CSOs in the MA portion of the segment watershed, which by design releases untreated wastewater to surface waters when flows exceed system capacity, and therefore must be eliminated. For this reason, it is set as the highest priority pathogen source.

Urban Stormwater: Portions of the Connecticut River (MA34-05) watershed are highly developed. However, due to the expansive size of the watershed, only 4% of the entire watershed land area is in MS4 (13% of the MA portion) and 2% is DCIA. The watershed extends far upstream of the segment into Vermont, New Hampshire, and Canada. About 4% of the entire watershed has been classified as developed land use (11% of the MA portion). Stormwater runoff from urban areas is a likely source of pathogens as the segment flows through highly developed areas.

Illicit Sewage Discharges: With some of the watershed serviced by sewer and some (4% of the entire watershed, 13% of the portion within MA) designated as MS4 area, illicit storm drain connections and/or illicit discharges from failing infrastructure such as leaky sewer lines or sanitary sewer overflows are likely a source of pathogens.

On-Site Wastewater Disposal Systems: There are four groundwater discharge permits for on-site wastewater discharge within the immediate drainage area, which are large-capacity septic systems (non-residential). The town of Agawam in its 2018 MS4 reported a history of septic system failures in town and that a planned South West Area sewer expansion to remedy the failures had been postponed indefinitely. Some of the residential development in the watershed uses 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: Agriculture makes up a significant portion of the watershed land use (6% of entire watershed land area, 7% of the MA portion), though most of the riparian corridor along this segment is urbanized. Agricultural activities visible on recent aerial photos within the immediate drainage area include open fields, hayfields, and row crops, generally located near the downstream section of the segment. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies. Stormwater runoff from agricultural lands are likely a contributing source of pathogens to the impaired segment.

Pet Waste: Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens. Some examples include Springdale Park, Nash Field, and Pynchon Point along the impaired segment.

Wildlife Waste: There are large conservation lands and wetlands throughout the watershed. Large open mowed areas with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

5.4. Existing Local Management

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

Town of Agawam

More than half of Agawam is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Agawam (Permit ID #MAR041001) has an EPA approved Notice of Intent (NOI). Agawam has a Stormwater Management Plan on file (Section 175-35), available at https://ecode360.com/27013918?highlight=wetlands&searchId=5701906503542443#27013918. (Town of Agawam, 2006). Agawam has mapped all of its MS4 stormwater system and has adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations. There are 39 stormwater outfalls to the Connecticut River with *E. coli* impairment reported. Agawam had plans for a South West Area sewer expansion to address a history of failing septic systems in that area, though the plans have been indefinitely postponed as of 2018. More recently, the town has worked with the Pioneer Valley Planning Commission and consultants to research instituting a stormwater utility or fee to fund water quality protection.

Agawam has the following ordinances and bylaws:

- Sanitary Sewers, 159-20: https://ecode360.com/AG1041/search?query=sewer&scope=all&sortOrder=relevance (Town of Agawam, n.d., a)
- Pet waste bylaw: 96-14: Removal of dog or cat waste from property https://ecode360.com/33035052?highlight=dog&searchId=5701849960739638#33035052 (Town of Agawam, n.d., b)

Agawam's Master Plan: https://www.agawam.ma.us/DocumentCenter/View/977/Master-plan-executive-summary (Town of Agawam, 2018)

Agawam's Open Space and Recreation Plan: https://www.agawam.ma.us/DocumentCenter/View/609/Open-Space-and-Recreation-Plan-PDF (Town of Agawam, 2014)

City of Chicopee

All of Chicopee is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Chicopee (Permit ID #MAR041003) has an EPA approved Notice of Intent (NOI) covered under the MS4 General Permit through June 30, 2022. Chicopee has a Stormwater Management Plan available at https://ecode360.com/6480440 . (City of Chicopee, 2019) The town has mapped all of its MS4 stormwater system, which is available online by request. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2003. According to the NOI, there are two outfalls to tributary Fuller Brook MA36-41 (including a wetland/tributary) impaired by *E. coli*. There are 16 outfalls into the Chicopee River MA36-24 impaired by fecal coliform. There are 69 outfalls into the Chicopee River MA36-25 (including wetlands/tributaries), 46 outfalls into the Connecticut River MA34-05 (including wetlands/tributaries), one outfall into Stony-Brook MA34-19, and two outfalls into an unnamed tributary to Poor Brook MA36-39, all impaired by *E. coli*.

Chicopee has the following ordinances and bylaws:

- Stormwater Management Ordinance: https://ecode360.com/6480440 (City of Chicopee, 2019)
- Wetlands Protection Ordinance:
- https://www.chicopeema.gov/DocumentCenter/View/784/Conservation-Commission-Local-Wetland-Regulations-PDF (City of Chicopee, 2010)
- Stormwater Utility: https://www.chicopeema.gov/DocumentCenter/View/8156/Storm-Fee-and-Sewer-Use-Fee-Rate-Schedule (City of Chicopee, 2017)
- Title 5 Supplementary Regulations: None found.

- Pet Waste: https://www.chicopeema.gov/403/Animals (City of Chicopee, n.d.)
- Contact Recreation Regulations or Bylaws: None found.

Chicopee's Master Plan is currently in development (2019). The Chicopee Open Space and Recreation Plan has a water resources section in the Environmental Inventory and Analysis section. The plan notes that "In 1999, Chicopee was the first community in Massachusetts to adopt a user fee for stormwater management." The plan also details the town's stormwater system and participation in the NPDES program. Information on the town's sewer service can be found in the Community Setting section of the plan.

Open and Space/Recreation Plan: https://www.chicopeema.gov/DocumentCenter/View/3018/Chicopee2015OSRP?bidId= (City of Chicopee, 2015)

City of Holyoke. See Section 4.4

Town of Longmeadow

Almost all of the Town of Longmeadow is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Longmeadow (Permit ID #MAR041013) has an EPA approved Notice of Intent (NOI). The town has a completed a Stormwater Management Plan which is available at https://www.longmeadow.org/DocumentCenter/View/4904/Stormwater-Management-Program (Town of Longmeadow, 2020a) Longmeadow has mapped all of its MS4 stormwater system and the map is available on the town website. The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2009. According to the NOI, there are two stormwater outfalls into the Connecticut River MA34-05, impaired for *E. coli*.

Longmeadow has the following ordinances and bylaws:

- Stormwater Ordinance: https://www.longmeadow.org/DocumentCenter/View/4904/Stormwater-Management-Program (Town of Longmeadow, 2020)
- Wetland Protection Bylaw, page 39 of General Bylaws: https://www.longmeadow.org/DocumentCenter/View/4277/Longmeadow-General-By-Laws-through-2019 (Town of Longmeadow, 2019a)
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: https://www.longmeadow.org/1130/Stormwater (Town of Longmeadow, 2021)
- Pet Waste, page 70 of General Bylaws: :https://www.longmeadow.org/DocumentCenter/View/4277/Longmeadow-General-By-Laws-through-2019 (Town of Longmeadow, 2019b)

Longmeadow is currently in the process of updating their 1978 Master Plan. The Longmeadow Open Space and Recreation Plan is partially available online. The plan has a Water Resources section in the Environmental Inventory and Analysis chapter. As of 1978, most of the town was on sewer. The 1978 plan also mentions storm drainage and surface water runoff in the context of protecting watercourses to prevent flooding in the town, starting on page 7-2.

Town website: https://www.longmeadow.org/ (Town of Longmeadow, 2020b)

Longmeadow Master Plan: http://longmeadowbiz.com/LRP/LRP-Final.pdf (Longmeadow, 2004)

Open Space and Recreation Plan: https://www.scribd.com/document/82341579/Longmeadow-Open-Space-Plan (Town of Longmeadow, 2012)

Town of South Hadley. See Section 4.4

City of Springfield

All of Springfield is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Springfield (Permit ID #MAR041023) has an EPA approved Notice of Intent (NOI). Springfield has a Stormwater

Management Plan on file at 70 Tapley Street, Department of Public Works, and has mapped all of its MS4 stormwater system. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in September 9, 2013. Springfield reports 13 outfalls to the Connecticut River MA34-05 with *E. coli* impairment, eight stormwater outfalls to the Mill River MA 34029 with *E. coli* impairment, 22 outfalls to the Chicopee River MA 36-24 with fecal coliform impairment, and 29 outfalls to the Poor Brook MA 36-39 with *E. coli* impairment. The city's 2018 MS4 report notes that permitting had begun on a new sanitary sewer crossing of the Connecticut River which would reduce CSO events by hundreds of millions of gallons and that several million dollars had been spent on improving parks and removing impervious surfaces.

Springfield has the following ordinances and bylaws:

- Stormwater Regulations: https://ecode360.com/32304263 (City of Springfield, 2013)
- Title 5 Supplemental Regulations: Article III Building Sewers and Separate Sewers https://ecode360.com/14666151?highlight=sewer&searchId=6051534394334268#14666151 (City of Springfield, n.d.)
- Wetland Bylaws: Chapter 417 https://ecode360.com/14667728 (City of Springfield, 1993)
- Pet Waste: Section 110-11 Animal Waste https://ecode360.com/32320250 (City of Springfield, 2016)

Springfield had no available Master Plan.

Springfield's Open Space and Recreation Plan is at: https://www.springfield-ma.gov/planning/fileadmin/Planning_files/Open_Space_Plan/OpenSpace_FINAL_2015.pdf (City of Springfield, 2015)

Town of West Springfield

Almost all of West Springfield is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. West Springfield (Permit ID #MAR041222) has an EPA approved NOI. It has mapped all of its MS4 stormwater system, with a map attached to its NOI. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2007-2009. There were no reported outfalls to waterbodies.

Storm Water Management Plan: https://www.townofwestspringfield.org/government/departments/public-works/storm-water (West Springfield, 2020)

West Springfield had no information on ordinances or bylaws.

West Springfield's Master Plan mentions stormwater and has a Sanitary Wastewater Treatment section (10-7): https://www.townofwestspringfield.org/home/showdocument?id=1532 (West Springfield, 2009)

West Springfield Open Space and Recreation Plan: https://www.townofwestspringfield.org/home/showdocument?id=1534 (West Springfield, 2015)

6. MA34-07 Bachelor Brook

6.1. Waterbody Overview

The Bachelor Brook segment MA34-07 is 11.5 miles long and begins at the outlet of Forge Pond in Granby, MA, then flows generally west. Segment MA34-07 flows through former segments Aldrich Lake (east basin, MA34002 and west basin, MA34106). The impaired segment ends at its confluence with the pathogen-impaired Connecticut River segment MA34-04 in South Hadley, MA.

Named tributaries to Bachelor Brook (MA34-07) include from upstream to downstream (east to west) Lampson Brook, which flows into Weston Brook then Bachelor Brook upstream of Forge Pond; Turkey Hill Brook; Ingraham Brook; and Elmer Brook. Major lakes and ponds within the segment watershed include Forge Pond and Metacomet Lake. Lakes and ponds along Bachelor Brook include Aldrich Lake, Bachelor Brook Reservoir, and Pearl City Pond.

Key landmarks in the watershed include Stony Brook Resource Area, Granby Sand Plain State Park, part of Long Mountain and Mount Norwottuck, Mount Holyoke Range State Park, Belchertown village center, and part of the Orchards Club Golf Course.

Bachelor Brook is crossed by School Street, Trompke Avenue, North Street, Porter Street, Aldrich Street, Notch Place, and Burnett Street in Granby; and Amhurst Road/MA-116, Woodbridge Street, and Hadley Street/MA-47 in South Hadley.

The Bachelor Brook watershed (MA34-07) drains an area of 32 square miles, of which 1.5 mi^2 (5%) is impervious and 0.5 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[13] served by public sewer and 20% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There is one NPDES permit on file governing point source discharges of pollutants to surface waters (Table 6-1) and one MassDEP discharge to groundwater permit for on-site wastewater discharge (Table 6-2) within the watershed. There are no combined sewer

Reduction from Highest Calculated Geomean: 46%

Watershed Area (Acres): 20,178

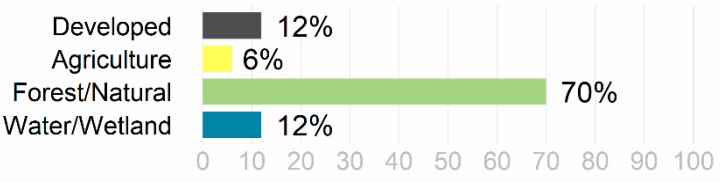
Segment Length (Miles): 11.5

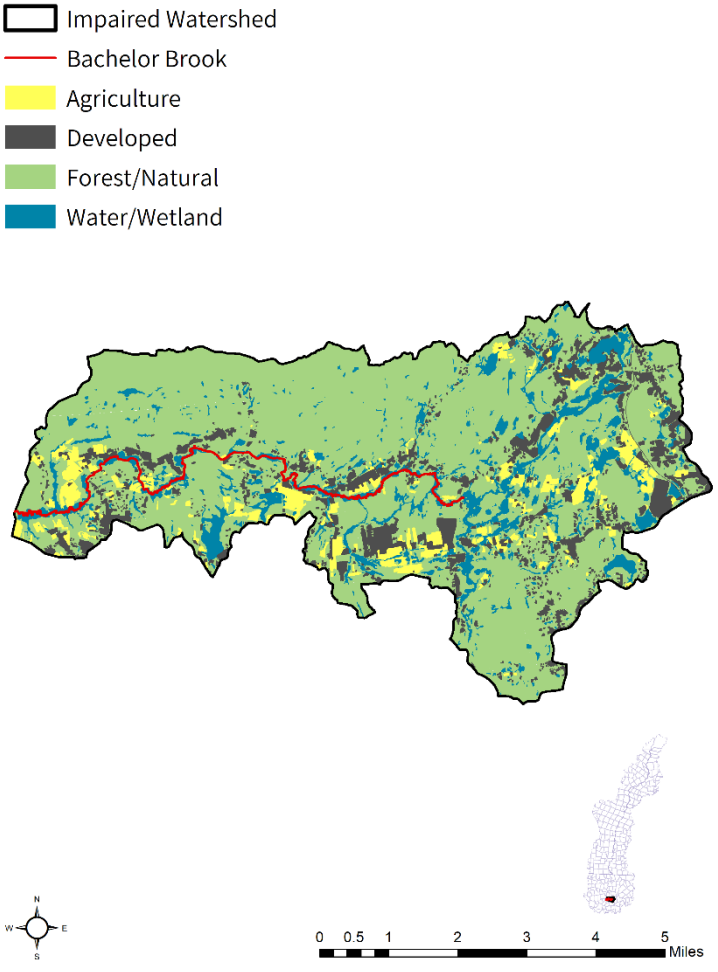
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (Warm Water)

Impervious Area (Acres, %): 945 (5%)

DCIA Area (Acres, %): 325 (2%)





[13] 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.

overflows, two landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 6-1.

Table 6-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0102148	BELCHERTOWN WWTP	BELCHERTOWN	MUN

Table 6-2. Groundwater discharge permits in the segment watershed. Only permits unique to this segment watershed are shown. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. Flow = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
879-0	GRANBY HEIGHTS CONDOS	GRANBY	Sanitary Discharge	17,600

The segment mostly flows through varied land uses, predominately forested and natural areas, low and medium mixed residential and commercial development, and agriculture. Most of the upper segment is surrounded by fringing meadow wetlands.

The watershed of the Bachelor Brook segment (MA34-07) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 5,849 acres (29%) of Priority Habitats of Rare Species and 121 acres (1%) of Priority Natural Vegetation Communities. There are 0.02 acres (<1%) under Public Water Supply protection and 614 acres (3%) identified as Outstanding Resource Waters. Over 395 acres (2%) of land protected in perpetuity[14] exist within the segment watershed, which is part of a total of 5,958 acres (30%) of Protected and Recreational Open Space[15]. See Figure 6-1.

[14] 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.

[15] 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).

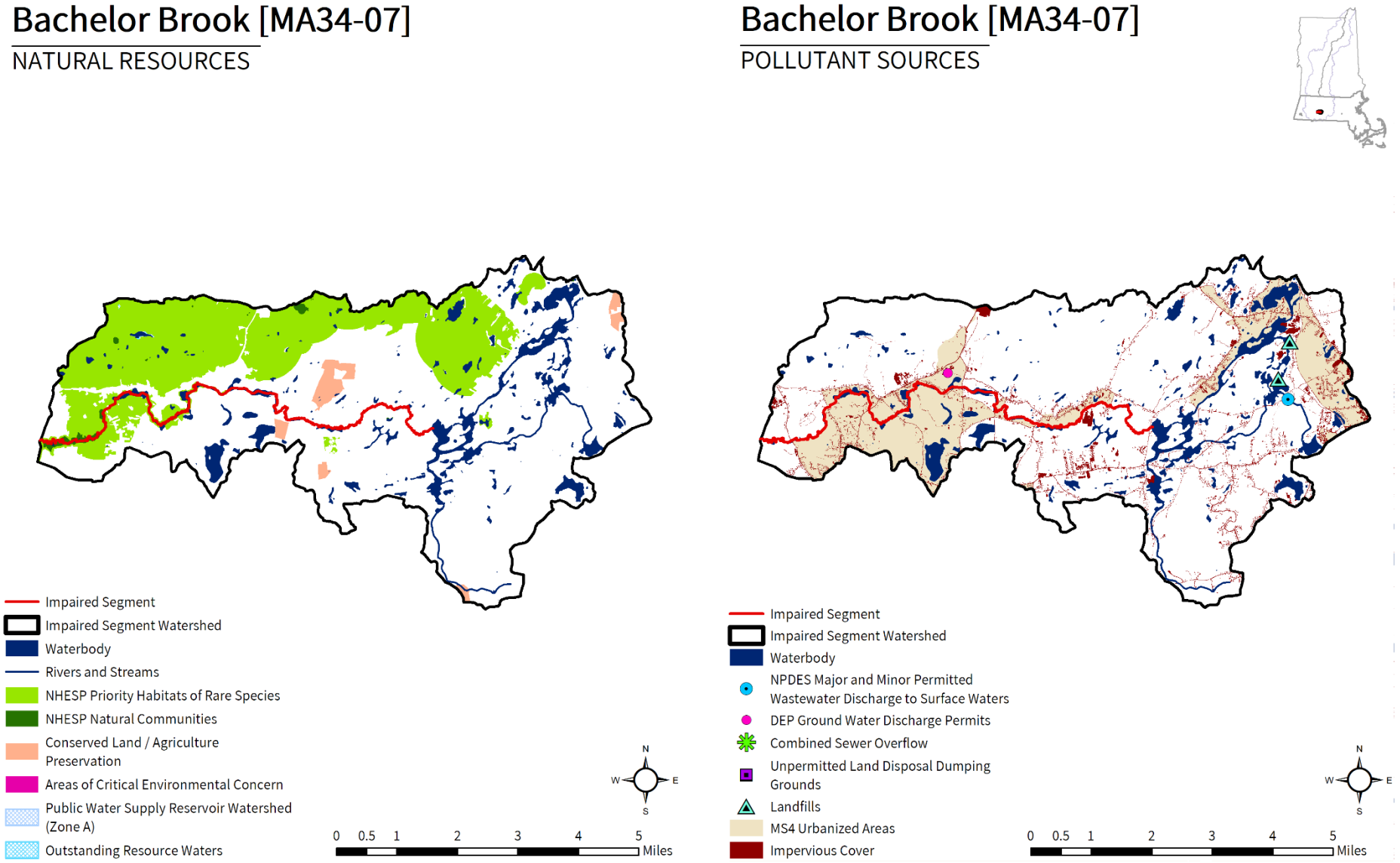


Figure 6-1. Natural resources and potential pollution sources draining to Bachelor Brook segment MA34-07. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

6.2. Waterbody Impairment Characterization

Bachelor Brook (MA34-07) is a Class B, Warm Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the stations listed below (refer to Tables 6-3, 6-4; Figure 6-2). 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, 30-day rolling basis.

- In 2008, six samples were collected at W1052, resulting in four days when the 30-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 six samples, none exceeded the STV criterion.
- In 2014, five samples were collected at W2463, resulting in three days when the 30-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.

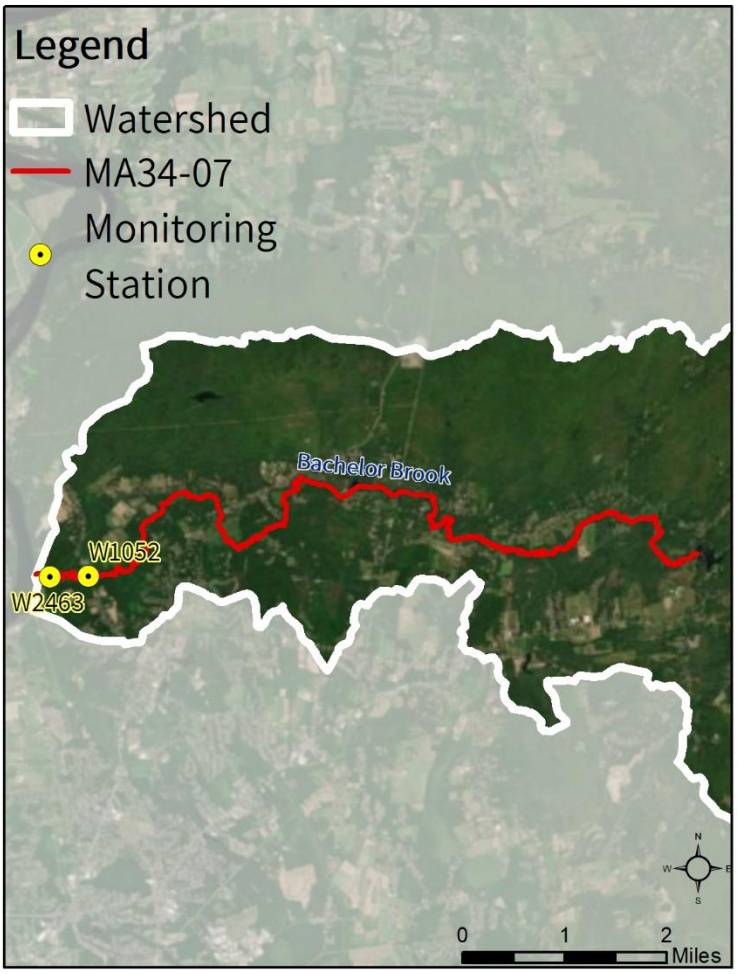


Figure 6-2. Location of monitoring station(s) along the impaired river segment.

Table 6-3. Summary of indicator bacteria sampling results by station for Bachelor Brook (MA34-07). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1052	5/6/2008	9/9/2008	6	232	4	0
W2463	5/15/2014	9/3/2014	5	203	3	0

Table 6-4. Indicator bacteria data by station, indicator, and date for Bachelor Brook (MA34-07). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1052	*E. coli*	5/6/2008	DRY	76	76	
W1052	*E. coli*	6/3/2008	DRY	100	87	
W1052	*E. coli*	7/1/2008	WET	160	126	
W1052	*E. coli*	7/29/2008	WET	180	170	
W1052	*E. coli*	9/3/2008	DRY	180	180	
W1052	*E. coli*	9/9/2008	WET	300	232	
W2463	*E. coli*	5/15/2014	DRY	43	43	
W2463	*E. coli*	6/11/2014	DRY	140	78	
W2463	*E. coli*	7/15/2014	WET	199	199	
W2463	*E. coli*	8/7/2014	DRY	201	200	
W2463	*E. coli*	9/3/2014	DRY	206	203	

6.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for Bachelor Brook (MA34-07) were generally elevated during both wet and dry weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated results during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: The areas around the segment are moderately developed, consisting of residential development in Granby and South Hadley. In terms of the entire watershed, 20% of the land area is in MS4 and 2% is DCIA. These factors indicate that stormwater runoff is likely a significant source of pathogens.

Illicit Sewage Discharges: Some of the upstream portion and most of the downstream portion of the watershed is served by public sewer, and some of the watershed (20%) is designated as MS4 area. 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.

On-Site Wastewater Disposal Systems: There is one groundwater discharge permit for on-site wastewater discharge, which are large-capacity septic systems (non-residential). Much of the upstream watershed is served by septic systems, so it is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 6% of the watershed area and are a potential source of pathogens. Agricultural activities visible on recent aerial photos near the brook include open fields, hayfields, row crops, and pasture; some of which are directly adjacent to impaired segment. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

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

Wildlife Waste: There are large conservation lands and open meadow wetlands throughout the watershed and along the impaired segment. Large open mowed areas and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

6.4. 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 Belchertown

Less than half of Belchertown is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Belchertown (Permit ID #MAR04117) has an EPA approved Notice of Intent (NOI). Belchertown has mapped all of its stormwater outfalls and a map is attached to the NOI. Belchertown adopted illicit discharge detection and elimination (2017), erosion and sediment control (2007), and post-construction stormwater regulations (2007). The NOI shows no outfalls to pathogen-impaired waters.

Belchertown has the following ordinances and bylaws:

- Stormwater management bylaw: https://ecode360.com/9050635 (Town of Belchertown, 2020)
- Stormwater utility bylaw: https://ecode360.com/BE1703/laws/LF1115521.pdf (Town of Belchertown, 2019)
- Wetland protection bylaw: https://ecode360.com/9053437 (Town of Belchertown, 1992) and https://ecode360.com/9050902 (Town of Belchertown, 2020)
- Title V Supplemental Regulations: https://ecode360.com/9052167?highlight=sewage%20disposal&searchId=8653301501493781#9052167 (Town of Belchertown, 1986)
- Pet Waste Bylaw: https://ecode360.com/9050134?highlight=waste&searchId=8652661913293411#9050134 (Town of Belchertown, n.d.)

Belchertown has a Community Plan linked from the town website https://www.belchertown.org/departments/planning/community_plan.php (Town of Belchertown, 2009)

Belchertown's Hazard Mitigation Plan and 2016 Update are available via the Pioneer Valley Planning Commission: http://www.pvpc.org/plans/town-belchertown-hazard-mitigation-plan (Town of Belchertown, 2009)

Open Space and Recreation Plan: https://www.belchertown.org/Belchertown_Open_Space_and_Rec_Plan_lowest_res.pdf (Town of Belchertown, 2013)

Town of Granby

Almost a third of Granby is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Granby (Permit ID #MAR041007) has an EPA approved Notice of Intent (NOI). Granby has a Stormwater Management Plan on file at the Highway Department Office. The town has mapped all of its stormwater outfall

system and attached a copy to its NOI. The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2008. According to the NOI, there are 20 stormwater outfalls into *E. coli* impaired Stony Brook MA34-19 (including wetlands and tributaries).

Granby has the following ordinances and bylaws:

- Granby does not have any supplementary regulations beyond the MassDEP regulations for stormwater management and wetland protection.
- Stormwater Utility: None found.
- Title V Supplementary Regulations: None found.
- Pet Waste Bylaw: None found.

The Granby Master Plan's Open Space Chapter has a water resources section which mentions stormwater. The plan also mentions an impaired stream within its border, Stony Brook, as a priority open space area. Granby is served almost entirely by on-site septic systems, though there is a proposal to extend the sewer system to the New Ludlow Road area as the "area is densely populated with small lot sizes, poor soils, and a high groundwater table, making it difficult to maintain septic systems that meet Title V regulations." Coliform bacteria are mentioned in the water supply section as the community supports a testing program for residential wells.

Granby Town Website: https://www.granby-ma.gov/ (Town of Granby, n.d., a)

Granby Master Plan: https://www.granby-ma.gov/planning-board/pages/2016-master-plan (Town of Granby, 2016)

Granby Stormwater Page: https://www.granby-ma.gov/highway-department/pages/storm-water-information (Town of Granby, n.d., b)

Open Space and Recreation Plan: https://www.granby-ma.gov/sites/g/files/vyhlif4466/f/uploads/open_space_and_recreation_plan-2006.pdf (Town of Granby, 2006)

Town of South Hadley. See Section 4.4

7. MA34-11 Manhan River

7.1. Waterbody Overview

The Manhan River segment MA34-11 is 18.9 miles long and begins at the outlet of the Tighe Carmody Reservoir in Southampton, MA. Segment MA34-11 flows through Southampton, Westfield, and Easthampton, while the segment watershed extends into 12 surrounding towns. The segment is bound at its downstream end by its confluence with the Connecticut River (MA34-04) in Easthampton, MA.

Tributaries to the Manhan River (MA34-11) include Tucker Brook, Breakneck Brook, and Blue Meadow Brook, which flow into the Tighe Carmody Reservoir upstream of the impaired segment. Sacket Brook Red Brook, Alder Meadow Brook, Moose Brook, Potash Brook, Bassett Brook, Hannum Brook, and Broad Brook flow from the southeast into the Manhan River. The North Branch Manhan River and Mill River (MA34-28, pathogen-impaired) flow into the impaired segment from the central and northern parts of the watershed. Named lakes and ponds within the segment watershed include Hulberts Pond near the downstream end of the segment, Pine Island Lake as the source of the North Branch Manhan River, White Reservoir, Tighe Carmody Reservoir, Lower Highland Lake along the West Branch Mill River, and Mountain Street Reservoir east of Mill River.

Key landmarks in the watershed include the town centers of Easthampton, Southampton, and Westhampton; Southampton Country Club and Golf Course, and Pine Grove Golf Course. Prominent conservation areas include Lyman Conservation Area, Pomeroy Mountain, Saw Mill Hills Conservation Area, Meadows Conservation Area, and the Arcadia Sanctuary.

The impaired segment is crossed by Manhan Road, Russellville Road, Gilbert Road, College Highway/MA-10 (twice), East Street, and Riverdale Road (Southampton); and Glendale Street, Northampton Street/MA-10, Lovefield Street, Fort Hill Road, I-91, North Street/US-5, and the Connecticut River Mainline railroad (Easthampton).

The Manhan River segment (MA34-11) drains an area of 143 square miles, of which 7 mi^2 (5%) is impervious and 3 mi^2 (2%) is directly connected

Reduction from Highest Calculated Geomean: 68%

Watershed Area (Acres): 91,611

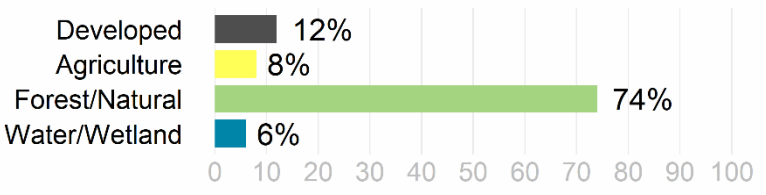
Segment Length (Miles): 18.9

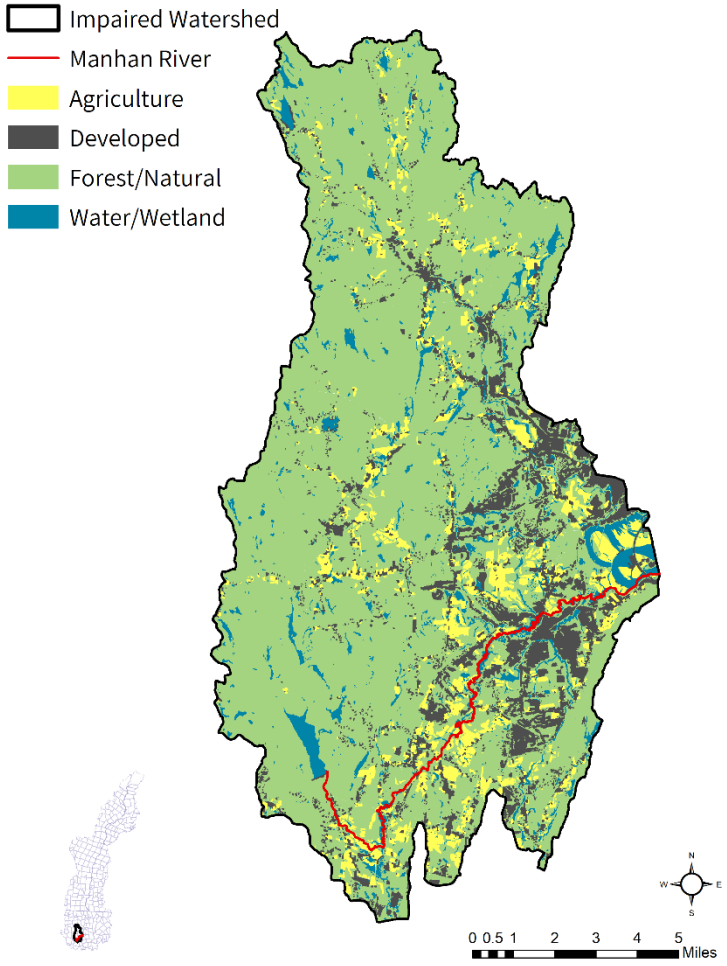
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 4,594 (5%)

DCIA Area (Acres, %): 1,934 (2%)





impervious area (DCIA). The watershed is likely partially served[16] by public sewer and 18% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There is one NPDES permit on file governing point source discharges of pollutants to surface waters within the segment watershed (also located within the immediate drainage area) (Table 7-1). There are no MassDEP discharge to groundwater permits for on-site wastewater discharge or combined sewer overflows within the segment watershed. There are 13 landfills and two unpermitted land disposal dumping grounds within the watershed. See Figure 7-1.

Table 7-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0101478	EASTHAMPTON WWTF	EASTHAMPTON	MUN

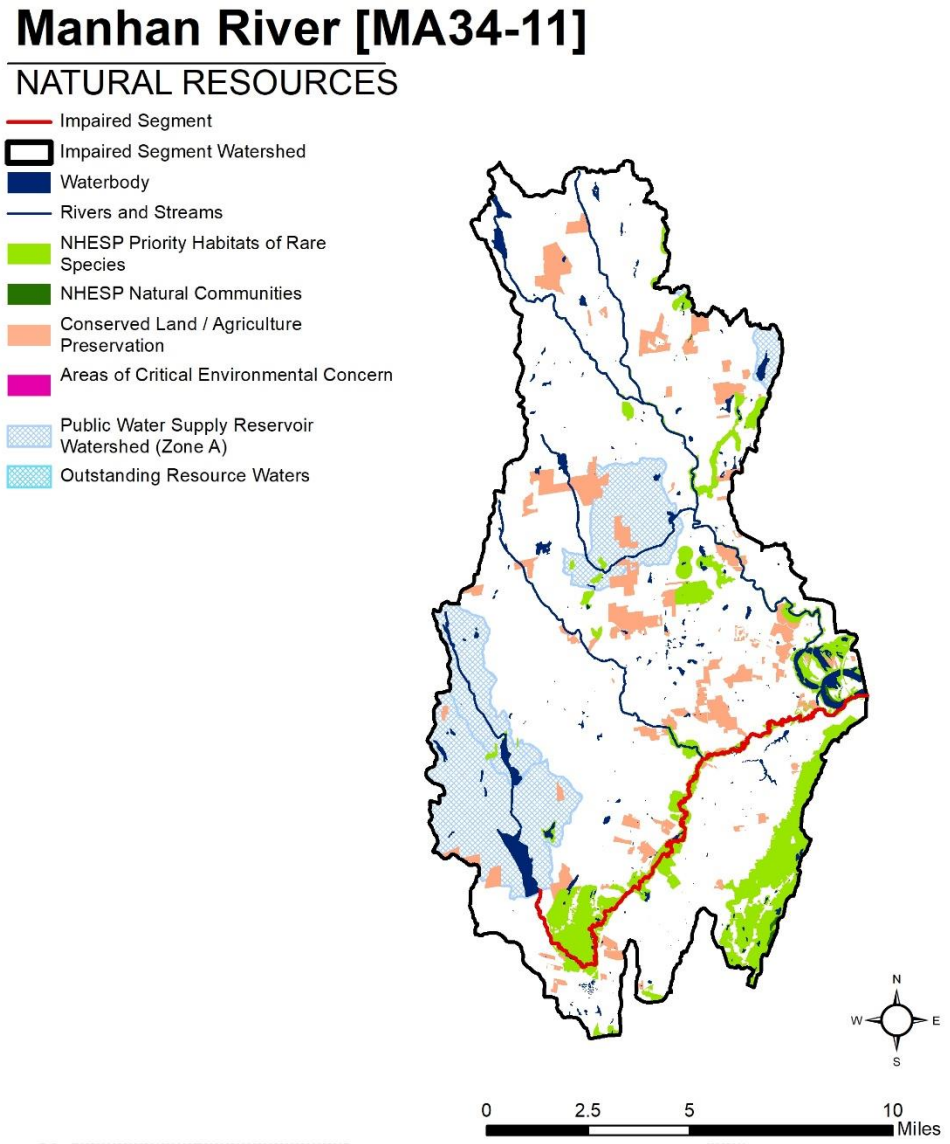
The overall watershed is predominantly forested (74%), with significant areas of developed (12%) and agricultural (8%) land cover. Nearly the entire riparian corridor maintains a wooded buffer, though the river flows near low to medium density mixed development for most of its length, including high density mixed residential and commercial development in downtown Easthampton along the lower portion of the segment.

The watershed of the Manhan River segment (MA34-11) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 9,266 acres (10%) of Priority Habitats of Rare Species and 102 acres (<1%) of Priority Natural Vegetation Communities. There are 13,653 acres (15%) under Public Water Supply protection and no areas identified as Outstanding Resource Waters. Over 7,181 acres (8%) of land protected in perpetuity[17] exist within the segment watershed, which is part of a total of 24,077 acres (26%) of Protected and Recreational Open Space[18]. See Figure 7-1.

[16] 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.

[17] 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.

[18] 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).



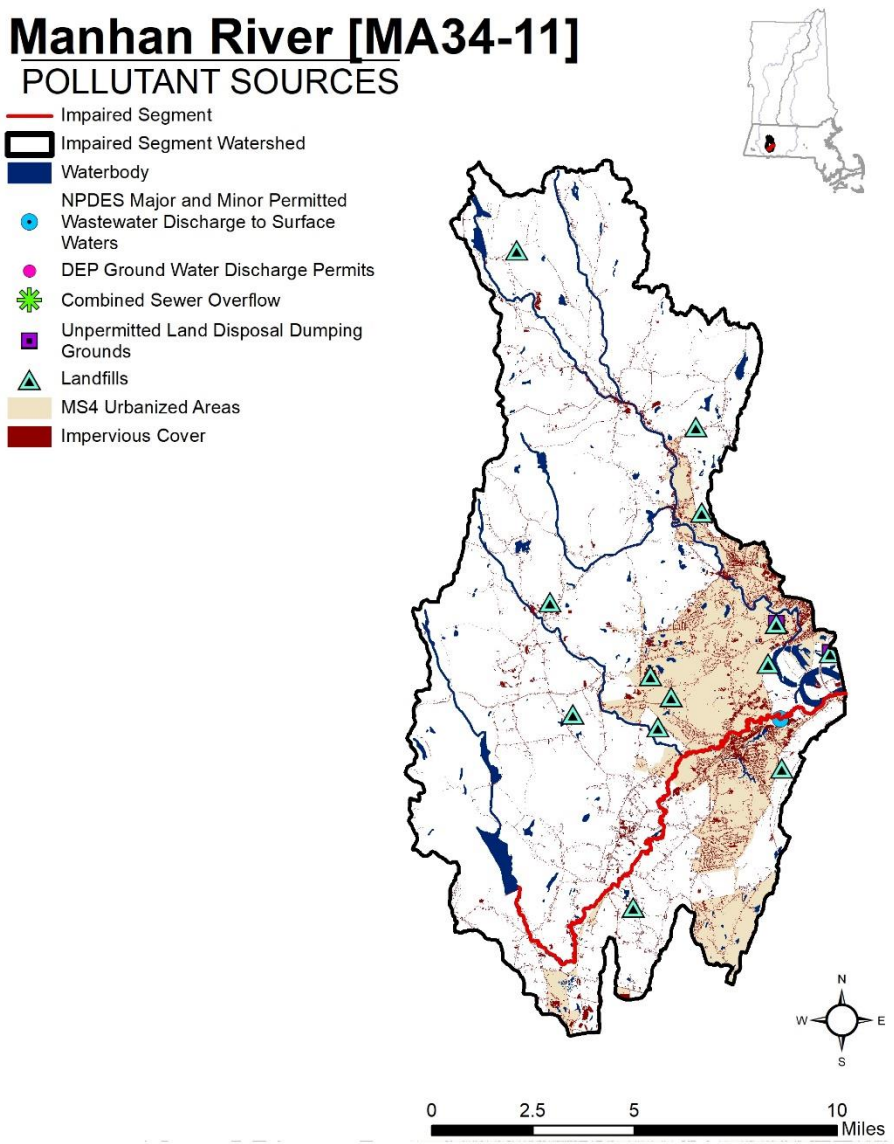


Figure 7-1. Natural resources and potential pollution sources draining to the Manhan River segment MA34-11. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

7.2. Waterbody Impairment Characterization

The Manhan River (MA34-11) 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 stations listed below (refer to Tables 7-2, 7-3; Figure 7-2). 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, 30-day rolling basis.

- In 2008, six samples were collected at W1065, resulting in four days when the 30-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 six samples, one exceeded the STV criterion during wet weather.
- In 2008, six samples were collected at W1793, resulting in one day when the 30-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 six samples, one exceeded the STV criterion during wet weather.

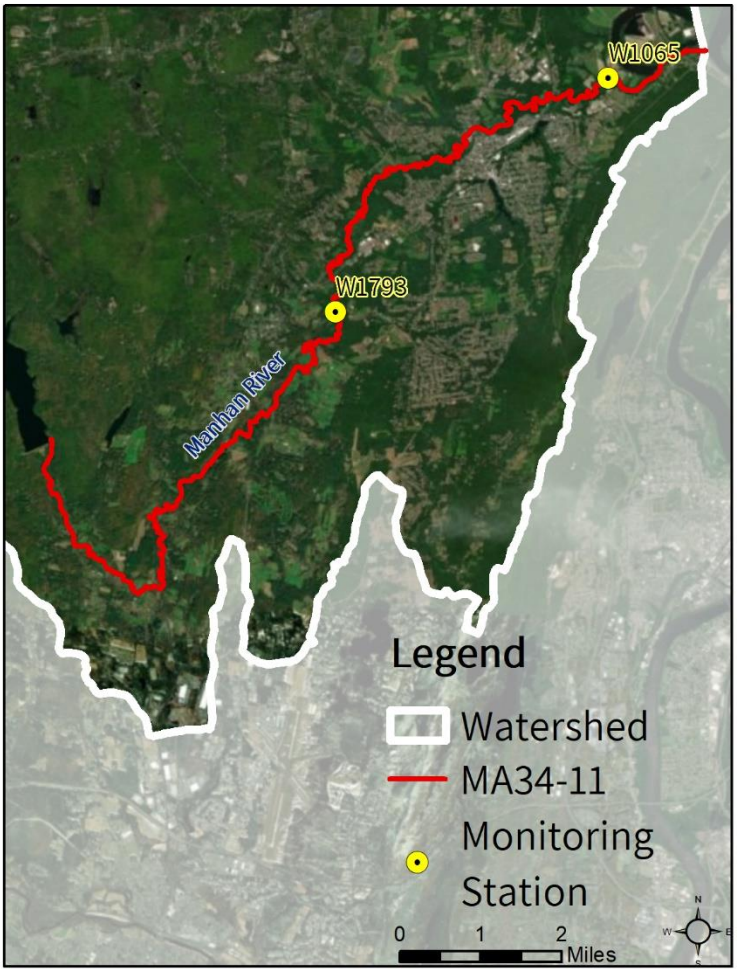


Figure 7-2. Location of monitoring station(s) along the impaired river segment.

Table 7-2. Summary of indicator bacteria sampling results by station for the Manhan River (MA34-11). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1065	5/6/2008	9/9/2008	6	388	4	1
W1793	5/6/2008	9/9/2008	6	245	1	1

Table 7-3. Indicator bacteria data by station, indicator, and date for the Manhan River (MA34-11). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1065	*E. coli*	5/6/2008	DRY	26	26	
W1065	*E. coli*	6/3/2008	DRY	100	51	
W1065	*E. coli*	7/1/2008	WET	300	173	
W1065	*E. coli*	7/29/2008	WET	200	245	
W1065	*E. coli*	9/3/2008	DRY	160	160	
W1065	*E. coli*	9/9/2008	WET	940	388	
W1793	*E. coli*	5/6/2008	DRY	24	24	
W1793	*E. coli*	6/3/2008	DRY	32	28	
W1793	*E. coli*	7/1/2008	WET	20	25	
W1793	*E. coli*	7/29/2008	WET	130	51	
W1793	*E. coli*	9/3/2008	DRY	50	50	
W1793	*E. coli*	9/9/2008	WET	1200	245	

7.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for the Manhan River (MA34-11) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels.

Each potential pathogen source is described in further detail below.

Urban Stormwater: The Manhan River (MA34-11) watershed is moderately developed, with 18% of the land area in MS4 and 2% as DCIA. Development within the direct drainage area include low density residential areas with some areas of high density mixed residential, commercial, and industrial areas in Southampton and Easthampton. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: The area immediately surrounding the impaired segment contains areas served by public sewer and 18% of the watershed is designated as MS4 area. 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.

On-Site Wastewater Disposal Systems: Given the large portion of the upstream watershed with only partial sewer coverage, septic systems further upstream are also a possible source. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 8% of the watershed area. Agricultural activities visible on recent aerial photos within the immediate drainage area include hayfields, row crops, and pasture, some directly adjacent to impaired segment. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are parks, ballfields, nature preserves, and hiking trails throughout the direct drainage area to the impaired segment. Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Almost the entire river segment maintains a wooded buffer along the riparian corridor, though there are isolated areas that are somewhat cleared, such as around the confluence of Brickyard Brook. Any conservation and recreational lands with large open mowed areas or wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

7.4. 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 Easthampton

Approximately three quarters of Easthampton is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Easthampton (Permit ID #MAR041006) has an EPA approved Notice of Intent (NOI). Easthampton has a Stormwater Management Plan on file at the Town Office of Easthampton. The town has mapped all of its MS4 stormwater system, with the map attached to the NOI. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2011. According to the NOI, there are 51 stormwater outfalls into the Manhan River MA34-11 and two outfalls into the Connecticut River MA34-03, both segments impaired for *E. coli*.

Easthampton has the following ordinances and bylaws:

- Stormwater ordinance: https://easthamptonma.gov/forms-documents/public-works/stormwater-management-plan.html (Town of Easthampton, 2018)
- Wetland Protection Act: Easthampton wetlands control ordinance repealed 1998.
- Title 5 Supplementary Regulations: None found.
- Pet Waste: None found.
- Stormwater Utility (or similar): None found.
- Contact Recreation Regulations or Bylaws: None found.

Easthampton's Master Plan (https://easthamptonma.gov/index.php/planning) (Town of Easthampton, 2008) provides a brief section noting that their wastewater management "infrastructure continues to age" and will require updates to meet the public's need for clean drinking water, sanitary sewer, and wastewater treatment (page 167). The Open Space and Recreation Plan provides a section on Easthampton waterways (page 5), mentioning the Manhan River and Connecticut River, both of which are impaired for *E. coli*. The water quality section of the plan mentions pathogen impairment as a threat to Easthampton's surface waters (page 25).

Easthampton town website: https://easthamptonma.gov/ (Town of Easthampton, 2020)

Easthampton Stormwater Management Plan: https://easthamptonma.gov/forms-documents/public-works/stormwater-management-plan.html (Town of Easthampton, 2018)

Open Space and Recreation Plan: https://easthamptonma.gov/back-to-forms-documents/planning/plans-and-documents/613-open-space-and-recreation-plan-2013-final/file.html (Town of Easthampton, 2013)

Town of Northampton. See Section 4.4

Town of Southampton

A small portion of Southampton is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Southampton (Permit ID #MAR041021) has an EPA approved Notice of Intent (NOI). The town has a Stormwater Management Plan on file at the Southampton Highway Department. The town has mapped all of its stormwater outfall system. The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2007. According to the NOI, there is one stormwater outfall into the Manhan River MA34011, impaired for *E. coli*.

Southampton has the following ordinances and bylaws:

- Stormwater Ordinance: http://www.townofsouthampton.org/Local%20Laws/Southampton_MA_Zoning%20Bylaw%20Erosion%20and%20Sediment%20Ordinance2-2.pdf (Town of Southampton, n.d.)
- Wetland Protection Bylaw: http://www.townofsouthampton.org/Town%20Clerk/Zoning%20by-law%203-15-2018.pdf (Town of Southampton, 1986)
- Title V Supplementary Regulation: None found.
- Pet Waste Ordinance: None found.

Southampton Master Plan covers watersheds and water resources in Section 4.1.3 Open Space and Natural Resources. The town also has a water conservation plan, outlining management strategies the town can implement to take water conservation measures, both at the municipal level and consumer level. The plan mentions the Manhan River Corridor, an impaired segment. The town has already implemented a stormwater management ordinance, and the plan recommends adopting additional low impact development standards. Chapter 6, Public Services and Facilities, notes that the town's lack of wastewater infrastructure in portions of the town with poor soils has led to failing septic systems. Currently, there is no town sewer infrastructure.

Town website: https://townofsouthampton.org/ (Town of Southampton, 2020)

Master Plan: https://southampton.masterplan.pvpc.org/docs/mp-drafts/2013/shamp-2013-masterplan-report.pdf (Southampton, 2013)

Water Conservation Plan: https://southampton.masterplan.pvpc.org/docs/PreviousPlans/WaterConservationPlan2005.pdf (PVPC, 2005)

Open Space and Recreation Plan: https://southampton.masterplan.pvpc.org/docs/OtherDocuments/FINAL%20OSRP%208.18.08.pdf (Town of Southampton, 2008)

City of Westfield

More than half of Westfield is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Westfield (Permit ID #MAR041236) has an EPA approved Notice of Intent (NOI). Westfield has a Stormwater Management Plan on file (link below) and has mapped all of its MS4 stormwater system. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2006. There are no stormwater outfalls reported to the impaired segments.

Stormwater Management Plan:https://www.cityofwestfield.org/DocumentCenter/View/9377/Stormwater-Management-Plan-20200630 (Woodard & Curran, 2020)

Westfield has the following ordinances and bylaws:

- Stormwater Management and Stormwater Control bylaw: Code of Ordinances, Division 4
- Stormwater Utility Ordinance, Division 2A https://www.cityofwestfield.org/DocumentCenter/View/394/Oridinance-No-1518?bidId= (City of Westfield, 2010)
- Article III Sewer Use https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH18DEPUWO_ARTIIISEUS (City of Westfield, n.d., a)

- Wetland Protection Division 2, https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH13PLDE_ARTVCOCO_DIV2WEPR (City of Westfield, 1993)
- Pet waste: Sec. 4-34. - Removal of dog or cat waste from public property or the property of others https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH4ANFO_ARTIIANCO (City of Westfield, 2006)

Westfield had no available Master Plan.

Westfield Stormwater Management page: https://www.cityofwestfield.org/233/Stormwater (City of Westfield, 2018)

Westfield Sanitary Sewer Master Plan: https://www.westfieldpolice.org/499/Sanitary-Sewer-Master-Plan (City of Westfield, n.d., b)

Westfield's Open Space and Recreation Plan:
bhttps://www.cityofwestfield.org/DocumentCenter/View/6309/2018-OSRP?bidId= (City of Westfield, 2018a)

Town of Westhampton

Westhampton received a NPDES General MS4 Stormwater General Permit waiver on June 13, 2016: https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/westhampton-epa-waiver-response.pdf (Town of Westhampton, 2016)

Westhampton has no relevant ordinances and bylaws.

Westhampton has no available Master Plan.

Westhampton 's Open Space and Recreation Plan: https://www.westhampton-ma.com/sites/g/files/vyhlif5191/f/uploads/open_space_plan_2010-2017.pdf (Town of Westhampton, 2010)

Town of Williamsburg

Williamsburg received a NPDES General MS4 Stormwater General Permit waiver on February 14, 2019: https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/williamsburg-epa-waiver-response.pdf. (Town of Williamsburg, 2019b)

Williamsburg has the following ordinances and bylaws:

- Sewer Regulations: https://www.burgy.org/sites/g/files/vyhlif1451/f/uploads/2018_sewer_regulations_from_nohofinal_voted_on.pdf (Town of Williamsburg, 2019a)
- Pet waste: Dog Bylaws, Section VI Violations: https://www.burgy.org/sites/g/files/vyhlif1451/f/uploads/dog.pdf (Town of Williamsburg, n.d.)

Williamsburg had no available Master Plan.

Williamsburg's Open Space and Recreation Plan: https://www.burgy.org/sites/g/files/vyhlif1451/f/uploads/2011open_space_plan.pdf (Town of Williamsburg, 2011)

8. MA34-19 Stony Brook

8.1. Waterbody Overview

The Stony Brook segment MA34-19 is 13.3 miles long and begins at its headwaters east of Fox Hill and Kendall Street in Granby, MA. The segment flows south into Ludlow, then west into Chicopee, then north back into Granby, then northwest into South Hadley, then south through Upper Pond (formerly MA34095) and Lower Pond (formerly MA34049) and finally northwest to end at its confluence with the Connecticut River (MA34-04) in South Hadley, MA.

Tributaries to Stony Brook include Second Pond Brook, Cross Brook, Muddy Brook, Leaping Well Brook, and several unnamed streams. Lakes and ponds include Second Pond, Wade Pond, and Leaping Pond Reservoir.

Key landmarks in the watershed include the town centers of Granby and South Hadley, part of the Hawks Conservation Area, Orchards Golf Club, Westover Golf Club, part of the Westover Air Reserve Base, and Mt Holyoke College. Stony Brook is crossed by Kendall Street, Taylor Street, New Ludlow Road, Morgan Street, and West State Street/US-202 (Granby); West Street (Ludlow); South Street near Wade Pond (Chicopee); and Morgan Street (twice), College Street/MA-116, and Alvord Street (South Hadley).

Stony Brook (MA34-19) drains an area of 23 square miles, of which 2.2 mi^2 (9%) is impervious and 1.0 mi^2 (4%) is directly connected impervious area (DCIA). The watershed is partially[19] served by public sewer and 55% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). In the watershed, there are no NPDES permits governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge, no combined sewer overflows, two landfills, and no unpermitted land disposal dumping grounds. See Figure 8-1.

Stony Brook (MA34-19) flows through varied land uses. Forest and natural areas are the largest category (43%). Developed areas (28%) range from low to medium density residential, high density mixed development in downtown South Hadley, institutional

Reduction from Highest Calculated Geomean: 87%

Watershed Area (Acres): 14,635

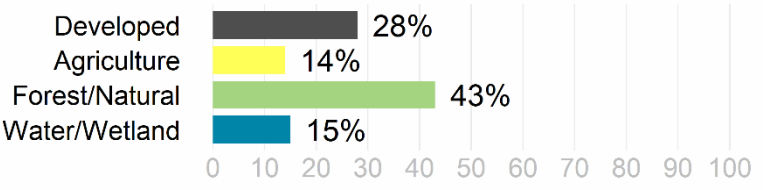
Segment Length (Miles): 13.3

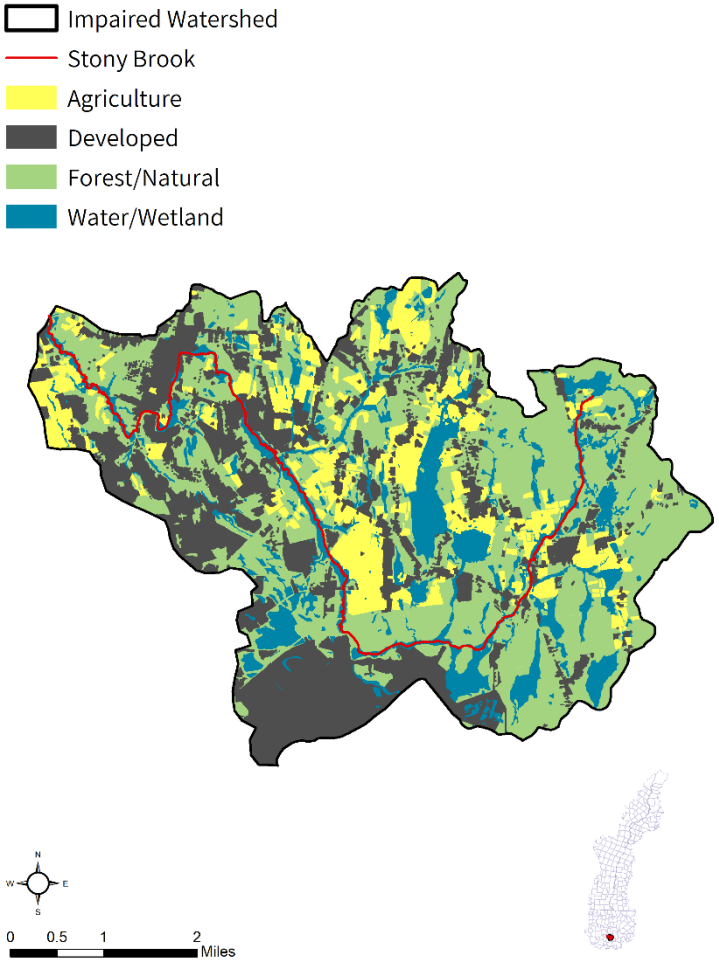
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 1,380 (9%)

DCIA Area (Acres, %): 642 (4%)





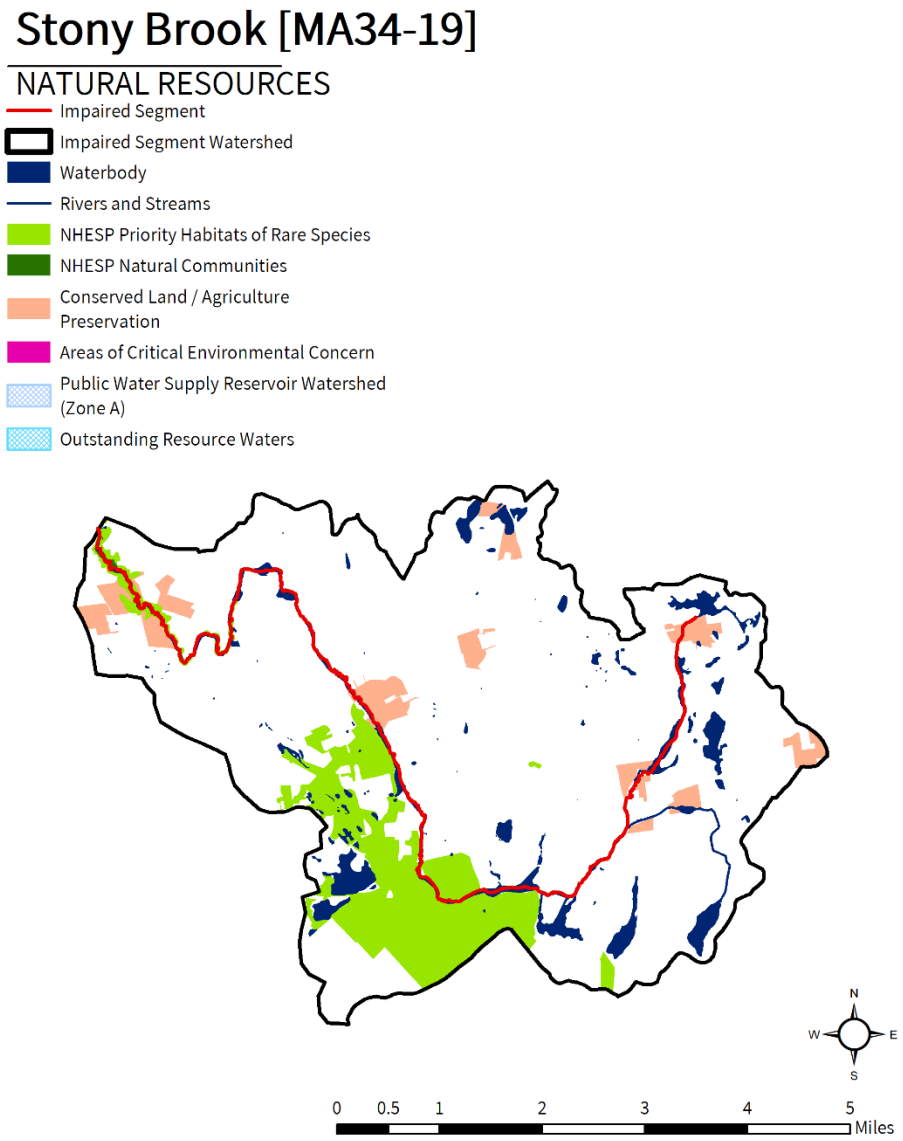
[19] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local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

land uses such as an airport, a college, and a county jail; sand and gravel extraction; and recreational lands including golf courses and an equestrian center, all within proximity to the segment. Agricultural land uses visible on recent aerial photos include row crops, orchards, greenhouses, tree farms, and hayfields, with some near or at the brook's edge. Most of the upper brook flows through open meadow fringing wetlands.

The Stony Brook (MA34-19) watershed does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 1,708 acres (12%) of Priority Habitats of Rare Species and 15 acres (<1%) of Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection and no areas identified as Outstanding Resource Waters. Over 705 acres (5%) of land protected in perpetuity[20] exist within the segment watershed, which is part of a total of 1,891 acres (13%) of Protected and Recreational Open Space[21]. See Figure 8-1.

[20] 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.

[21] 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).



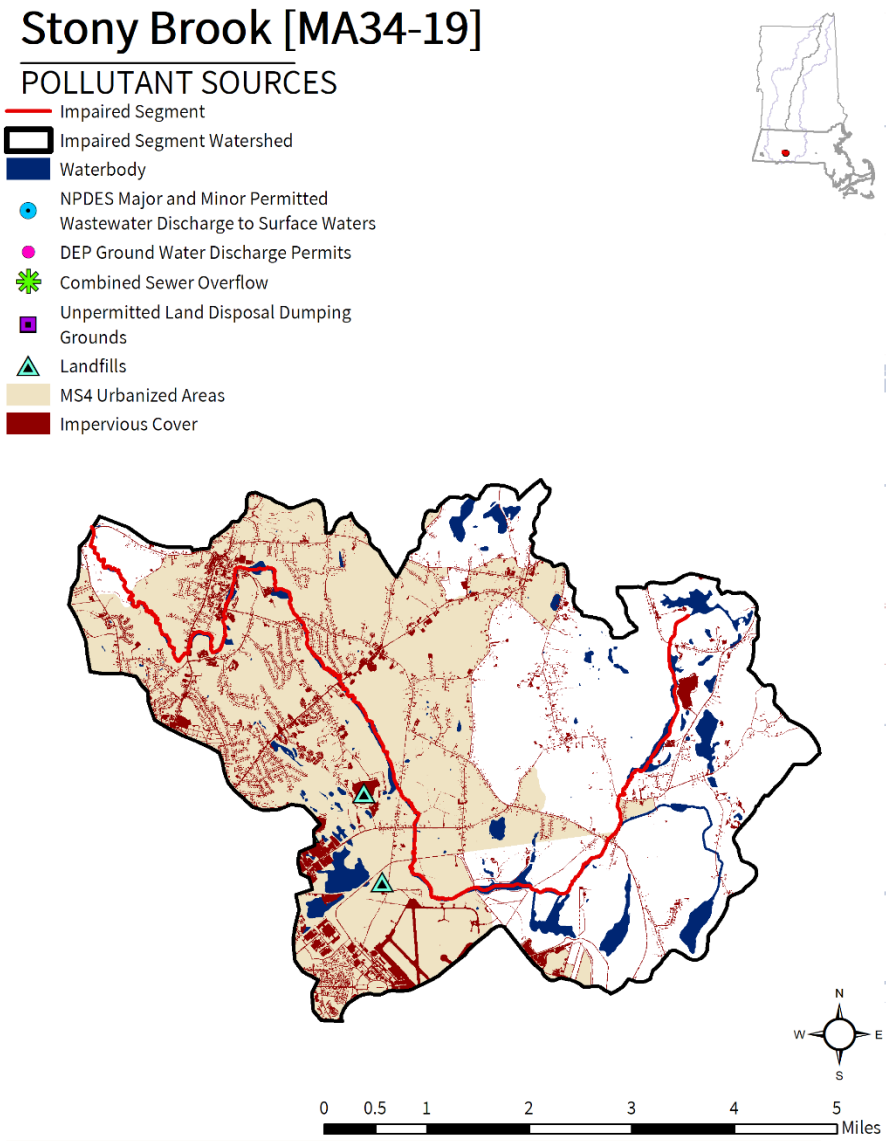


Figure 8-1. Natural resources and potential pollution sources draining to the Stony Brook segment MA34-19. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

8.2. Waterbody Impairment Characterization

Stony Brook (MA34-19) 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 stations identified below (refer to Tables 8-1, 8-2; Figure 8-2). 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. Data presented below include data collected by MassDEP and the Town of South Hadley (Town of South Hadley, 2009).

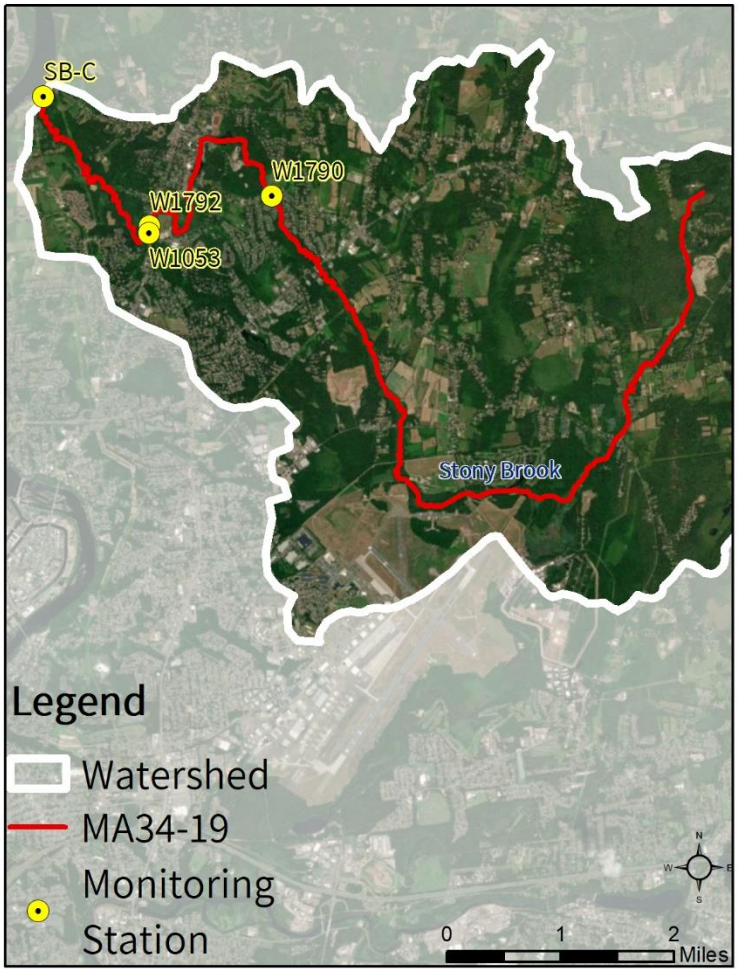


Figure 8-2. Location of monitoring station(s) along the impaired river segment.

- In 2009, five samples were collected at SB-C, resulting in five 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, four exceeded the STV criterion during both wet and dry weather.
- In 2009, five samples were collected at W1053, resulting in five 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, three exceeded the STV criterion during both wet and dry weather. This station is located downstream of a CSO eliminated in 2007 (Town of South Hadley, 2009).
- In 2008, six samples were collected at W1790, 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 six samples, none exceeded the STV criterion.
- From 2008-2009, 11 samples were collected at W1792, resulting in nine 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 11 samples, two exceeded the STV criterion during both wet and dry weather. This station is located upstream of a CSO eliminated in 2007 (Town of South Hadley, 2009).

Table 8-1. Summary of indicator bacteria sampling results by station for Stony Brook (MA34-19). 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
SB-C	6/30/2009	9/24/2009	5	812	5	4
W1053	6/30/2009	9/24/2009	5	493	5	3
W1790	5/6/2008	9/9/2008	6	163	4	0
W1792	5/6/2008	9/24/2009	11	950	9	2

Table 8-2. Indicator bacteria data by station, indicator, and date for Stony Brook (MA34-19). 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)
SB-C	*E. coli*	6/30/2009	DRY	680	680	
SB-C	*E. coli*	8/7/2009	DRY	970	812	
SB-C	*E. coli*	8/28/2009	WET	640	750	
SB-C	*E. coli*	9/18/2009	DRY	324	608	
SB-C	*E. coli*	9/24/2009	DRY	620	610	
W1053	*E. coli*	6/30/2009	DRY	360	360	
W1053	*E. coli*	8/7/2009	DRY	470	411	
W1053	*E. coli*	8/28/2009	WET	710	493	
W1053	*E. coli*	9/18/2009	DRY	272	425	
W1053	*E. coli*	9/24/2009	DRY	560	449	
W1790	*E. coli*	5/6/2008	DRY	52	52	
W1790	*E. coli*	6/3/2008	DRY	320	129	
W1790	*E. coli*	7/1/2008	WET	230	156	
W1790	*E. coli*	7/29/2008	WET	110	143	
W1790	*E. coli*	9/3/2008	DRY	70	121	
W1790	*E. coli*	9/9/2008	WET	400	163	
W1792	*E. coli*	5/6/2008	DRY	52	52	
W1792	*E. coli*	6/3/2008	DRY	272	119	
W1792	*E. coli*	7/1/2008	WET	260	154	
W1792	*E. coli*	7/29/2008	WET	130	148	
W1792	*E. coli*	9/3/2008	DRY	70	133	
W1792	*E. coli*	9/9/2008	WET	200	147	
W1792	*E. coli*	6/30/2009	DRY	950	950	
W1792	*E. coli*	8/7/2009	DRY	340	568	
W1792	*E. coli*	8/28/2009	WET	680	603	
W1792	*E. coli*	9/18/2009	DRY	312	512	
W1792	*E. coli*	9/24/2009	DRY	370	480	

8.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for Stony Brook (MA34-19) were elevated during both wet and dry weather. Elevated indicator bacteria during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated indicator bacteria during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the Stony Brook (MA34-19) watershed are highly developed, with 55% of the land area in MS4 and 4% as DCIA. Development includes low to high density residential development, as well as areas of commercial, institutional, industrial, and transportation land uses. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With some of the watershed in sewer service and most of the watershed (55%) designated as MS4 area, illicit sewage discharges are a potential source of pathogens to Stony Brook. 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.

On-Site Wastewater Disposal Systems: Much of the upstream watershed is served by septic systems. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 14% of the watershed area and are a potential source of pathogens. Agricultural activities visible on recent aerial photos within the immediate drainage area include hayfields, row crops, greenhouses, and orchards, some of which are directly adjacent to impaired segment. There is also an equestrian center adjacent to the brook. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are a few parks and ballfields adjacent to the river, as well as hundreds of acres of conservation lands throughout the watershed. Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: There are several large open fields adjacent to the brook, such as north of Kendall Street in Granby. There are also wide fringing meadow marshes around portions of the brook, such as those north of Carver Street in Granby, in the Westover Conservation Area in Ludlow, and north of Westover Air Reserve Base. Conservation and recreational lands with large open mowed areas and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

8.4. 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.

City of Chicopee. See Section 5.4

Town of Granby. See Section 6.4

Town of Ludlow

About half of Ludlow is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Ludlow (Permit ID #MAR041014) has an EPA approved Notice of Intent (NOI). The town has completed a Stormwater Management Plan which is on file at 198 Sportsmen Road, Ludlow, MA 01056 and linked below. The city has mapped all of its stormwater outfall system, and the map is available on the city website. Ludlow adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2006. According to the NOI, there are ten stormwater outfalls into the Chicopee River MA36-24, impaired for fecal coliform.

Ludlow Stormwater Management Plan: https://www.ludlow.ma.us/235/Stormwater-Management-Information (Town of Ludlow, 2020a)

Ludlow's ordinance and bylaws:

- Ludlow does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste: None found.

The Ludlow Master Plan has a Natural Resources chapter with a section on Watershed Resources, mentioning the Chicopee River, which is an impaired segment in the town. The plan notes that the two main areas of concern for Ludlow's water resources are the lack of adequate riparian buffers, and that many areas surrounding surface waters are unprotected and threatened by development. The plan has a limited wastewater section. The town is a member of the Connecticut River Stormwater Committee.

Town website: http://www.ludlow.ma.us/home.htm (Town of Ludlow, 2020b)

Master Plan: http://ludlow.ma.us/masterplan/docs/master-plan/ludlow-mp-FINAL.pdf (Town of Ludlow, 2011)

Open Space and Recreation Plan: http://www.ludlow.ma.us/masterplan/docs/Ludlow%20Open%20Space%20Plan_FINAL.pdf (Town of Ludlow, 2006)

Town of South Hadley. See Section 4.4

9. MA34-21 Longmeadow Brook

9.1. Waterbody Overview

The Longmeadow Brook segment MA34-21 is 4.5 miles long and begins at the outlet of Turner Park Pond in Longmeadow, MA. The segment flows west to end at its confluence with the Connecticut River (MA34-05) in Longmeadow, MA. Besides Turner Park Pond, there are no named tributaries, lakes, ponds, or reservoirs to the brook.

Key landmarks within the segment watershed include the Twins Hill Country Club and golf course, Turner Park, Longmeadow High School, Glenbrook Middle School, Longmeadow Country Club, I-91, and part of the Fannie Stebbins Wildlife Refuge. Segment MA34-21 is crossed by Academy Drive, Frank Smith Road, Merriweather Drive, Shaker Road/MA-192, Longmeadow Street/US-5, I-91, Bark Haul Road, Pondside Road, West Road, and the Connecticut Main Line railroad, all within Longmeadow, MA.

Longmeadow Brook drains a total area of 5.3 square miles, of which 0.9 mi^2 (17%) is impervious and 0.5 mi^2 (9%) is directly connected impervious area (DCIA). About 5% of the southern portion of the watershed (162 of 3,372 acres) extends into Connecticut.

The watershed is likely mostly[22] served by public sewer and the entire watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge, no combined sewer overflows, and no unpermitted land disposal dumping grounds within the segment watershed. There are three landfills, all within MA, in the watershed. See Figure 9-1.

Half (50%) of the Longmeadow Brook watershed is developed. Most of the segment flows through medium density residential development with at least some wooded buffer around the stream. An exception is the mowed areas to the brook's banks as it flows through the Longmeadow Country Club golf course, including an impounded section of the brook just upstream of Shaker

Reduction from Highest Calculated Geomean: 82%

Watershed Area (Acres): 3,372

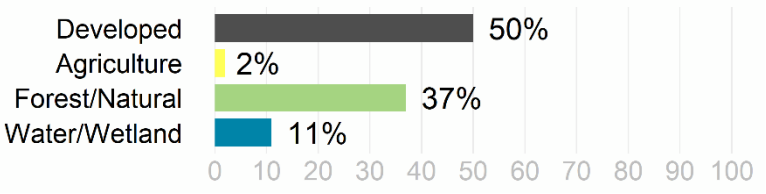
Segment Length (Miles): 4.5

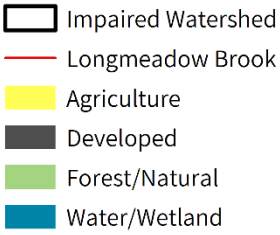
Impairment(s): *E. coli* (Primary Contact Recreation)

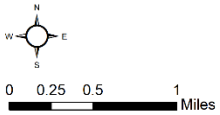
Class (Qualifier): B

Impervious Area (Acres, %): 588 (17%)

DCIA Area (Acres, %): 311 (9%)







[22] 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.

Road/MA-192. There are fewer developed areas in the riparian corridor downstream of Shaker Road, with much of the brook flowing through fringing meadow marsh. The most downstream portion of the watershed west of I-91 is predominantly wooded conservation land and agricultural fields.

The Longmeadow Brook (MA34-21) watershed does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 288 acres (9%) of Priority Habitats of Rare Species and eight acres (<1%) of Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection and no areas identified as Outstanding Resource Waters. About 29 acres (1%) of land protected in perpetuity[23] exist within the segment watershed, which is part of a total of 786 acres (23%) of Protected and Recreational Open Space[24]. See Figure 9-1.

[23] 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.

[24] 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).

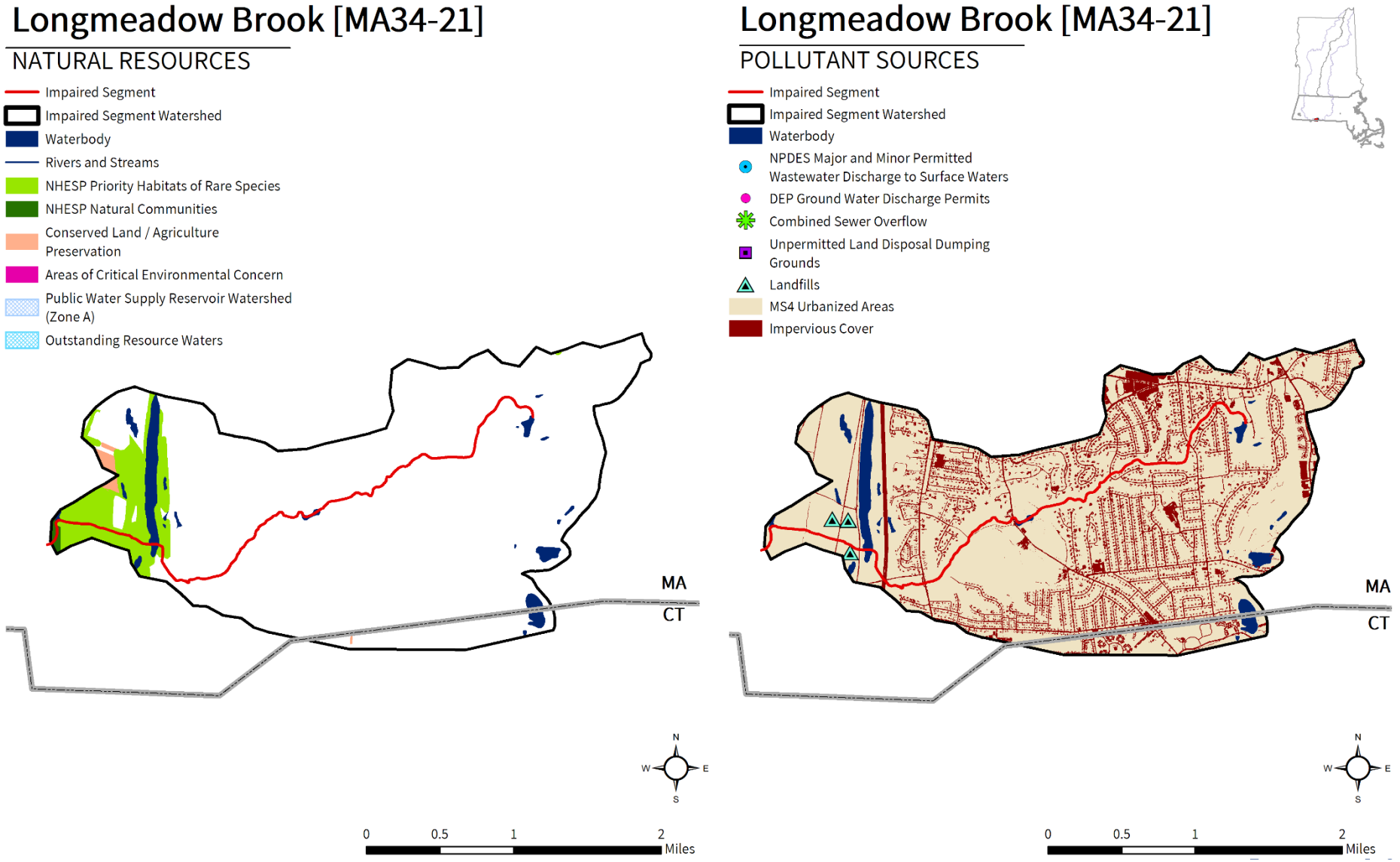


Figure 9-1. Natural resources and potential pollution sources draining to the Longmeadow Brook segment MA34-21. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

9.2. Waterbody Impairment Characterization

Longmeadow Brook (MA34-21) 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 9-1, 9-2; Figure 9-2). 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 2008, six samples were collected at W1794, 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 six samples, two exceeded the STV criterion during wet weather.

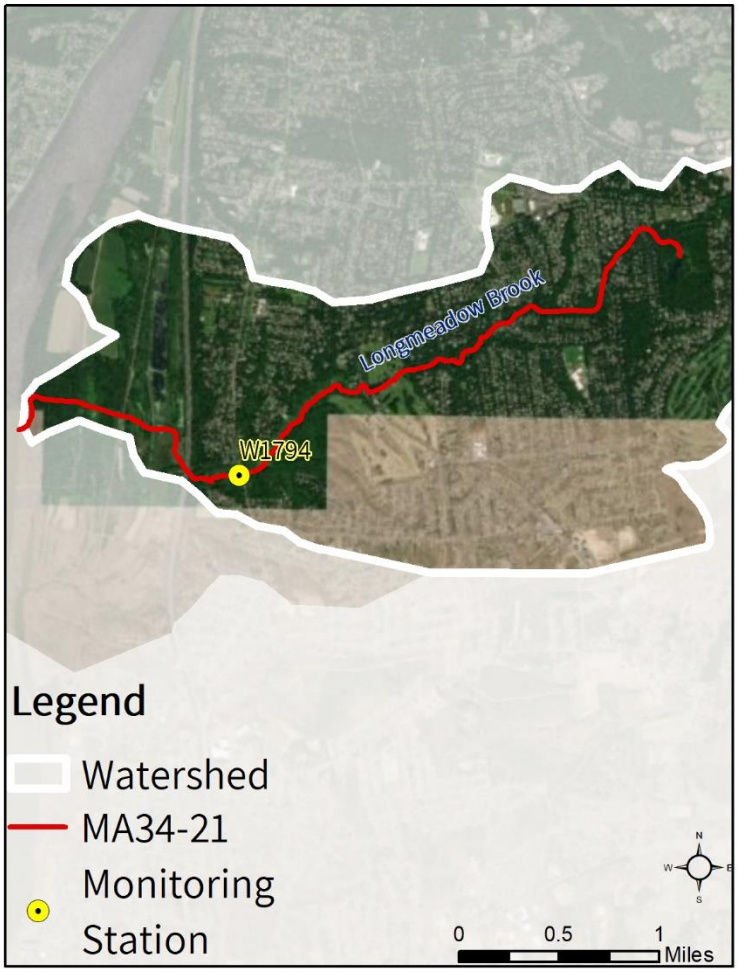


Figure 9-2. Location of monitoring station(s) along the impaired river segment.

Table 9-1. Summary of indicator bacteria sampling results by station for Longmeadow Brook (MA34-21). 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
W1794	5/6/2008	9/9/2008	6	715	4	2

Table 9-2. Indicator bacteria data by station, indicator, and date for Longmeadow Brook (MA34-21). 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)
W1794	*E. coli*	5/6/2008	DRY	48	48	
W1794	*E. coli*	6/3/2008	DRY	216	102	
W1794	*E. coli*	7/1/2008	WET	780	201	
W1794	*E. coli*	7/29/2008	WET	380	235	
W1794	*E. coli*	9/3/2008	DRY	220	403	
W1794	*E. coli*	9/9/2008	WET	4000	715	

9.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for Longmeadow Brook (MA34-21) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Given the relatively small sample set, additional sampling under both wet and dry conditions, ideally at more than one location, would likely help to identify pollutant sources.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Overall, the Longmeadow Brook (MA34-21) watershed is heavily developed with the entire land area in MS4 and 9% as DCIA. Except for a narrow, wooded buffer zone, medium density residential development occupies the entire river corridor and most of the watershed upstream of I-91. The brook flows through Longmeadow Country Club golf course where there is no vegetated buffer and mowed areas extend right to the water's edge with large greens maintained within 15 feet of the brook. Stormwater runoff from urban areas is likely the most significant source of pathogens.

Illicit Sewage Discharges: With most, if not all, of the watershed in sewer service and the entire watershed designated as MS4, 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.

On-Site Wastewater Disposal Systems: Given that a small portion of the watershed is likely not covered by sewer service, septic systems are a smaller but possible source of pathogens. It is likely that some septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 2% of the watershed and are a small but potential source of pathogens. Agricultural activities visible on recent aerial photos within the immediate drainage area appear to be large hayfields or row crops, mostly in the downstream portion of the watershed and not within the immediate riparian corridor. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are large residential neighborhoods in the upper half of the watershed, as well as large conservation lands in the lower half of the watershed. Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody, such as those where the stream flows through a golf course, may attract excessive waterfowl and elevate indicator bacteria counts in the water.

9.4. 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 Longmeadow. See Section 5.4

10. MA34-25 Mill River

10.1. Waterbody Overview

The Mill River segment MA34-25 is 5.2 miles long and begins at the outlet of Factory Hollow Pond (Puffers Pond) in Amherst, MA. The segment flows to the west to MA-16, then south along MA-16, then west again to end at its inlet to Lake Warner in Hadley, MA.

Tributaries to segment MA34-25 include Cushman Brook (upstream of Factory Hollow Pond), and Swamp Brook (with its tributary Eastman Brook). Streams further upstream include Doolittle Brook, Mountain Brook, and Roaring Brook. Lakes, ponds, and reservoirs within the segment watershed include Leverett Pond, Atkins Reservoir, and Campus Pond.

Key landmarks in the watershed include the Shutesbury and Leverett town centers, the University of Massachusetts at Amherst, and many conservation areas throughout the watershed. Segment MA34-25 is crossed by Mill Street, Montague Road/MA-63, Sunderland Road, MA-116 (three times), and Meadow Street (Amherst); and Roosevelt Street (Hadley).

Mill River (MA34-25) drains an area of 30 square miles, of which 2.3 mi^2 (8%) is impervious and 1.2 mi^2 (4%) is directly connected impervious area (DCIA). A portion of the watershed is served by public sewer[25] and 20% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters within the segment watershed but one MassDEP discharge to groundwater permit for on-site wastewater discharge in the watershed (Table 10-1). There are no combined sewer overflows, no unpermitted land disposal dumping grounds, and one landfill within the segment watershed. See Figure 10-1.

Reduction from Highest Calculated Geomean: 50%

Watershed Area (Acres): 19,225

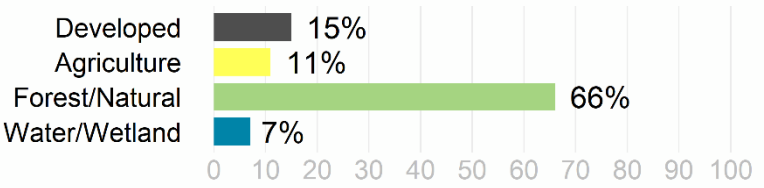
Segment Length (Miles): 5.2

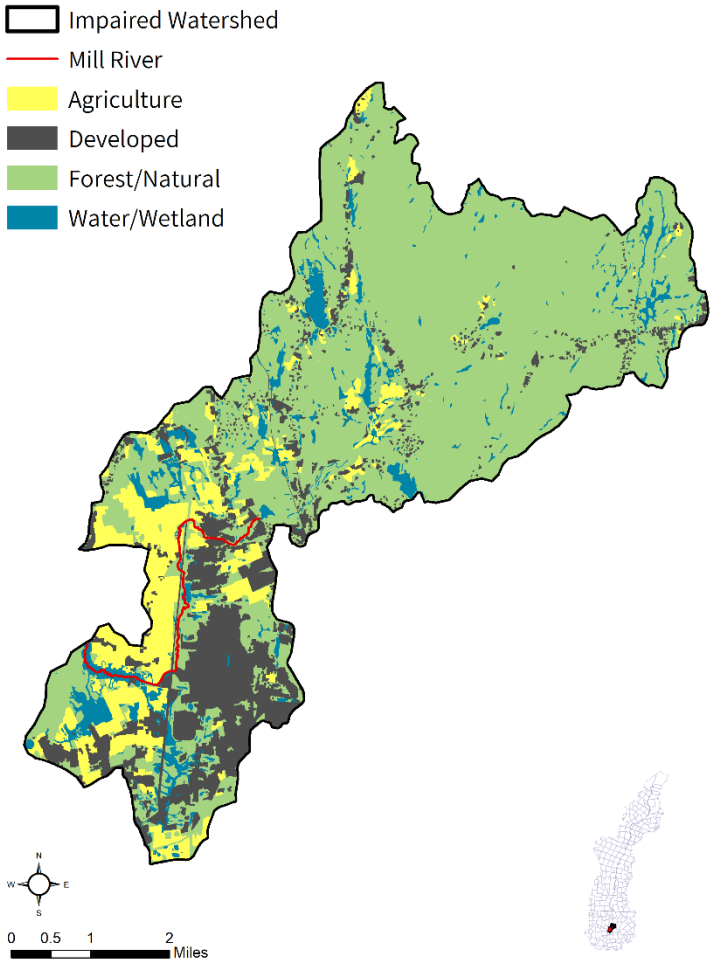
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 1,503 (8%)

DCIA Area (Acres, %): 771 (4%)





[25] 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.

Table 10-1. Groundwater discharge permits in the segment watershed. Only permits unique to this segment watershed are shown. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. Flow = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
914-1M1	UMASS CHP BOILER	AMHERST	Reclaimed Water	200,000

Land use in the upper watershed is predominantly forested. Medium density mixed residential, commercial, and institutional (university) land uses are concentrated in the lower watershed on the segment's left banks, with some locations showing high density features such as large parking lots near the river. About 2.3 miles of Mill River runs roughly along the arterial road MA-116. Land use on the right bank of the river is dominated by large agricultural fields including row crops, greenhouses, livestock, and the Massachusetts Department of Agriculture apiary.

The watershed of the Mill River (MA34-25) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 3,700 acres (19%) of Priority Habitats of Rare Species and 33 acres (<1%) of Priority Natural Vegetation Communities. There are 1,124 acres (6%) under Public Water Supply protection and no areas identified as Outstanding Resource Waters. Over 4,391 acres (23%) of land protected in perpetuity[26] exist within the segment watershed, which is part of a total of 6,028 acres (31%) of Protected and Recreational Open Space[27]. See Figure 10-1.

[26] 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.

[27] 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).

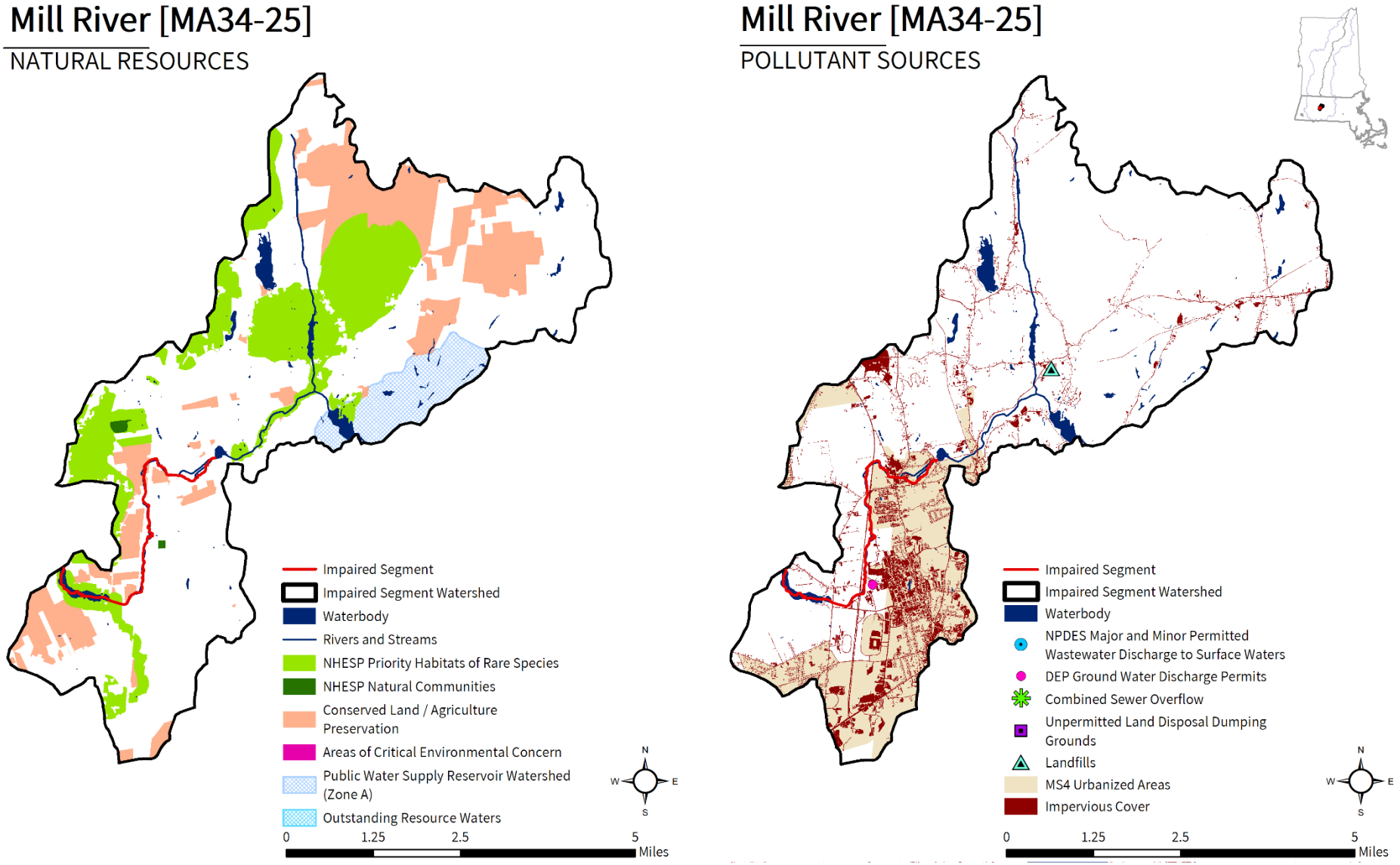


Figure 10-1. Natural resources and potential pollution sources draining to the Mill River segment MA34-25. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

10.2. Waterbody Impairment Characterization

The Mill River (MA34-25) 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 stations listed below (refer to Tables 10-2, 10-3; Figure 10-2). 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 2008, six samples were collected at W1050, resulting in two 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 six samples, one exceeded the STV criterion during wet weather.

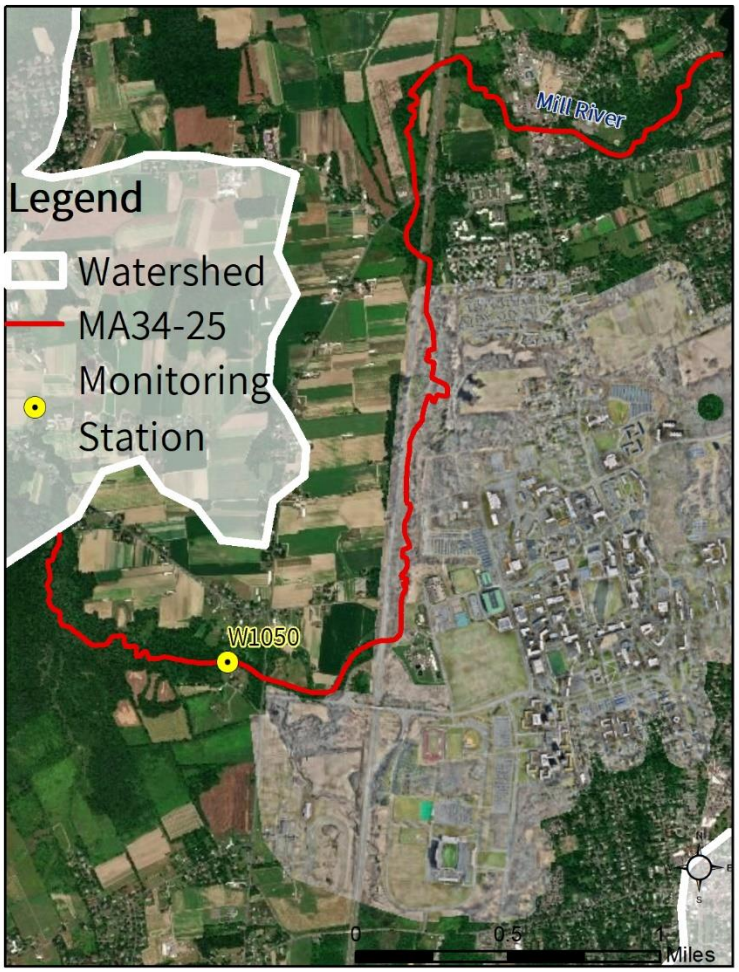


Figure 10-2. Location of monitoring station(s) along the impaired river segment.

Table 10-2. Summary of indicator bacteria sampling results by station for the Mill River (MA34-25). 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
W1050	5/6/2008	9/9/2008	6	254	2	1

Table 10-3. Indicator bacteria data by station, indicator, and date for the Mill River (MA34-25). 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)
W1050	*E. coli*	5/6/2008	DRY	26	26	
W1050	*E. coli*	6/3/2008	DRY	232	78	
W1050	*E. coli*	7/1/2008	DRY	200	106	
W1050	*E. coli*	7/29/2008	WET	140	114	
W1050	*E. coli*	9/3/2008	DRY	340	212	
W1050	*E. coli*	9/9/2008	WET	440	254	

10.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the Mill River (MA34-25) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are highly developed, with 20% of the land area in MS4, 4% as DCIA, and areas of medium to high density mixed residential, commercial, and institutional (university) land use along or near the impaired segment. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With a portion of the watershed serviced by sewer and 20% designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: There is one groundwater discharge permit for on-site wastewater discharge, which is a large-capacity septic system (non-residential), and much of the residential development in the upper watershed is likely served by septic systems. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 11% of the watershed and are a potential source of pathogens. Agricultural activities visible on recent aerial photos within the immediate drainage area include hayfields, row crops, greenhouses, and livestock, many in proximity to the river. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are medium and high-density residential neighborhoods near the river, and the headwaters pond is a popular recreational site. The upstream watershed contains several conservation lands and wetlands. Conservation lands, parks, ballfields, and neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody and wetlands may attract excessive waterfowl and elevate indicator bacteria counts in the water.

10.4. 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 Amherst

More than half of Amherst is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Amherst (Permit ID #MAR041247) has an EPA approved Notice of Intent (NOI). The town has a Stormwater Management Plan available (link below). Amherst has mapped all its stormwater outfall system and attached the map to the NOI. According to the NOI, the town plans to implement illicit discharge detection and elimination (written plan 2022, full implementation 2028), erosion and sediment control (2021), and post-construction stormwater regulations (2023). The NOI shows 21 stormwater outfalls into the Fort River MA34-27 and one stormwater outfall into the Mill River MA34-25, both impaired for *E. coli*.

Amherst Stormwater Management Plan:
https://www.amherstma.gov/DocumentCenter/View/48068/Amherst-Stormwater-Management-Program?bidId=
(Town of Amherst, 2019)

Amherst has the following ordinances and bylaws:

- Stormwater Management bylaw: None found.
- Title V Supplemental Regulations: None found.
- Wetland Protection Bylaw: https://www.amherstma.gov/1269/Wetlands-Bylaw-and-Regulations (Town of Amherst, n.d., a)
- Pet Waste Bylaw: https://www.amherstma.gov/DocumentCenter/View/1822/AMHERST-TOWN-BYLAW-ANIMAL?bidId=#:~:text=A.-,It%20shall%20be%20unlawful%20for%20the%20owner%2Fguardian%20or%20keeper,recreational%20field%2C%20or%20public%20recreational (Town of Amherst, n.d., b)
- Stormwater Utility: None found.

Amherst's Master Plan (https://www.amherstma.gov/526/Master-Plan) (Town of Amherst, 2020) has a Natural and Cultural Resources chapter with a Water Resources section. The plan mentions stormwater but does not discuss impaired streams, sewer/septic infrastructure, or pathogen impairment. The Amherst website is https://www.amherstma.gov/. (Town of Amherst, n.d., c)

Open Space and Recreation Plan: https://www.amherstma.gov/629/Open-Space-Recreation-Plan (Town of Amherst, 2017)

Town of Hadley. See Section 4.4

Town of Leverett

The Town of Leverett is not within the MS4 area.

Leverett ordinances and bylaws:

- Leverett does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: None found.

- Pet Waste: None found.

Leverett does not have a Master Plan available. The Open Space and Recreation Plan, updated in 2010, has an extensive Water Resources section. The Open Space and Recreation Plan does not provide any information about stormwater reduction efforts within the town. There is a brief Sewage Disposal section which notes that each household has a private septic system and there are no town plans for a community sewage disposal system. There have been many septic upgrades over the last five years.

Town website: https://leverett.ma.us/ (Town of Leverett, 2020)

Open Space and Recreation Plan: https://leverett.ma.us/files/OSRP_Update-2010_FINAL.pdf (Town of Leverett, 2010)

Town of Shutesbury

Shutesbury is not within the MS4 area.

Shutesbury has the following ordinances and bylaws:

- Wetlands Protection bylaw: http://www.shutesbury.org/sites/default/files/offices_committees/conservation/wetlands_protection_bylaw.pdf (Town of Shutesbury, 1990)

Shutesbury's Master Plan mentions stormwater and has a section on Water Resources (pages 1-14) under Natural Resources. The Master Plan also mentions the impaired waters of Lake Wyola and has a section on Water and Sewer Systems (pages 2-19): https://www.shutesbury.org/sites/default/files/offices_committees/planning_board/MasterPlan.pdf (Town of Shutesbury, 2004)

Shutesbury has an Open Space and Recreation Plan: https://www.shutesbury.org/sites/default/files/offices_committees/open_space_cmte/plan/FINAL%20SHUTESBURY%20OPEN%20SPACE%20PLAN%20May%202015final.pdf (Town of Shutesbury,2012)

A watershed-based plan has been created for this watershed by the Massachusetts Association of Conservation Districts, University of Massachusetts, Amherst and Geosyntec Consultants, Inc. (Geosyntec 2021b).

11. MA34-27 Fort River

11.1. Waterbody Overview

The Fort River segment MA34-27 is 12.8 miles long and begins at the confluence of Adams and Amethyst Brooks in Amherst, MA. Segment MA34-27 flows generally southwest through Amherst and into Hadley, MA, where it ends at its confluence with the Connecticut River (MA34-04).

Additional tributaries to the Fort River include Hop Brook, Plum Brook, and Harts Brook. Major lakes and reservoirs within the segment watershed include Baker, Hawley, and Hill Reservoirs.

Key landmarks in the watershed include the village of Amherst Center, Hampshire College and the Hampshire Mall, the Hickory Ridge Golf Course, the Amherst Transfer and Recycling Center, and Mount Orient. Segment MA34-27 is crossed by Main Street, Belchertown Road/MA-9 (Amherst); and South East Street, the Norwottuck Rail Trail, West Street/MA-116, South Maple Street, and Bay Road/MA-47 (Hadley).

Fort River drains an area of 55 square miles, of which 2.9 mi^2 (5%) is impervious and 1.2 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[28] served by public sewer and 22% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge, no combined sewer overflows, and no unpermitted land disposal dumping grounds within the segment watershed. There are two landfills. See Figure 11-1.

The upper portion of the watershed is predominantly forest. The lower watershed is low to medium density mixed residential and commercial land use combined with expansive agricultural fields. Although forested and natural areas (66%) make up most of the land uses within the segment watershed, the segment itself is surrounded by agricultural fields growing mostly corn and hay, often with only a narrow strip of

Reduction from Highest Calculated Geomean: 66%

Watershed Area (Acres): 35,055

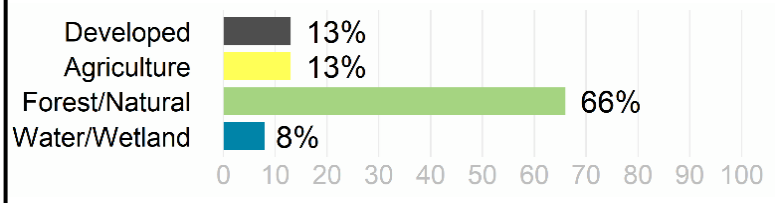
Segment Length (Miles): 12.8

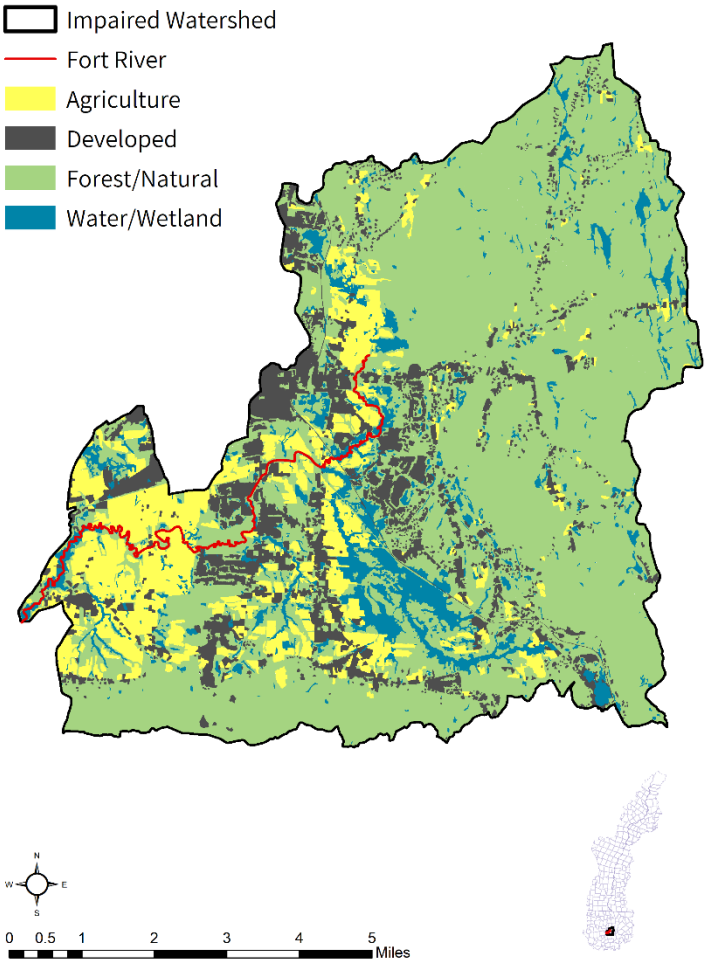
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 1,881 (5%)

DCIA Area (Acres, %): 741 (2%)





[28] 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.

trees for riparian buffer. The river also flows through a large golf course, though mostly maintains a narrow, wooded buffer zone through the course.

The watershed of the Fort River (MA34-27) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 6,672 acres (19%) of Priority Habitats of Rare Species and 122 acres (<1%) of Priority Natural Vegetation Communities. There are 6,498 acres (19%) under Public Water Supply protection and no areas identified as Outstanding Resource Waters. Over 5,399 acres (15%) of land protected in perpetuity[29] exist within the segment watershed, which is part of a total of 12,505 acres (36%) of Protected and Recreational Open Space[30]. See Figure 11-1.

[29] 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.

[30] 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).

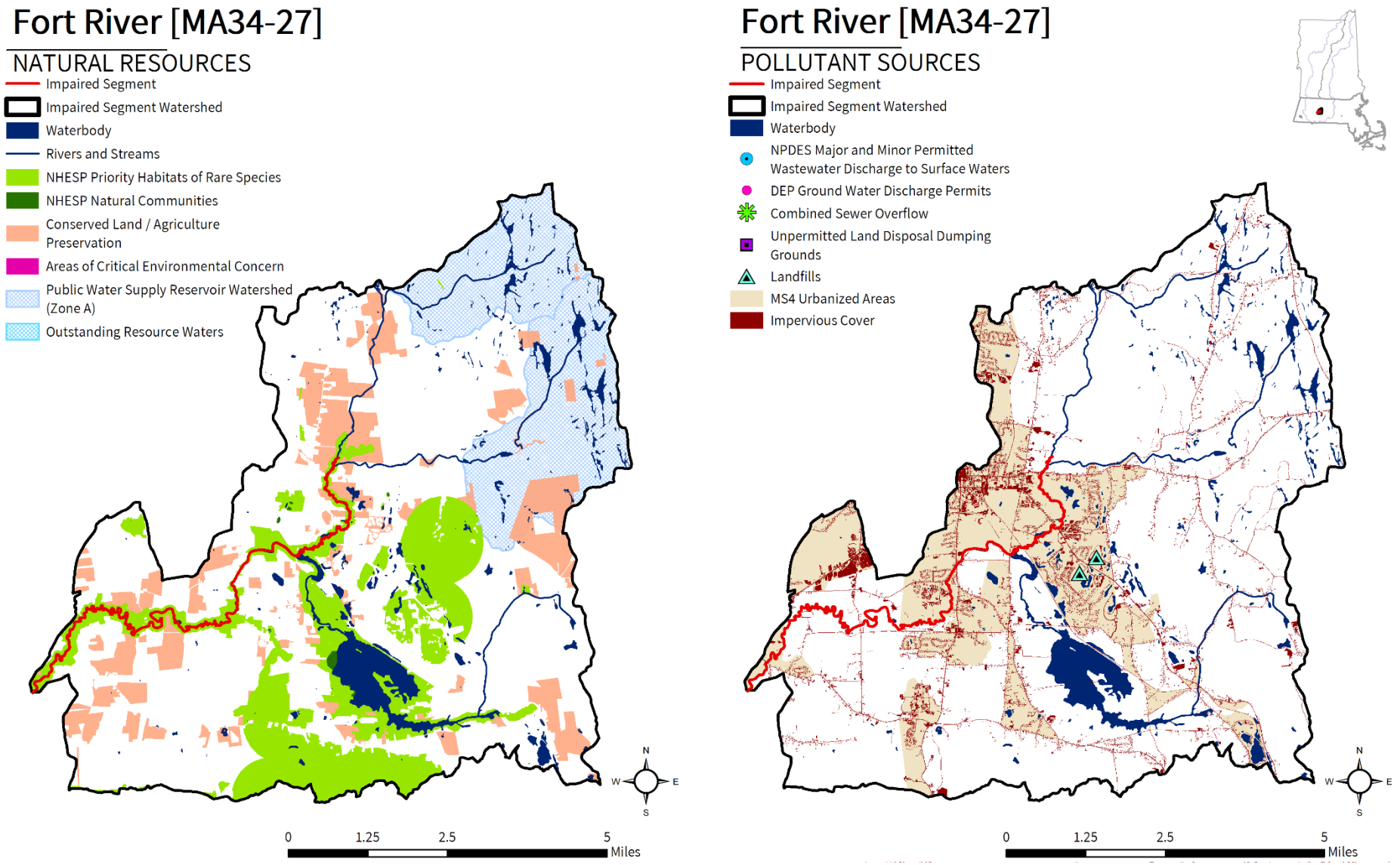


Figure 11-1. Natural resources and potential pollution sources draining to the Fort River segment MA34-27. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

11.2. Waterbody Impairment Characterization

The Fort River (MA34-27) 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 stations listed below (refer to Tables 11-1, 11-2; Figure 11-2). 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 2008, six samples were collected at W1051, 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 six samples, one exceeded the STV criterion during wet weather.
- In 2008, six samples were collected at W1804, and there were no 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 six samples, one exceeded the STV criterion during wet weather.

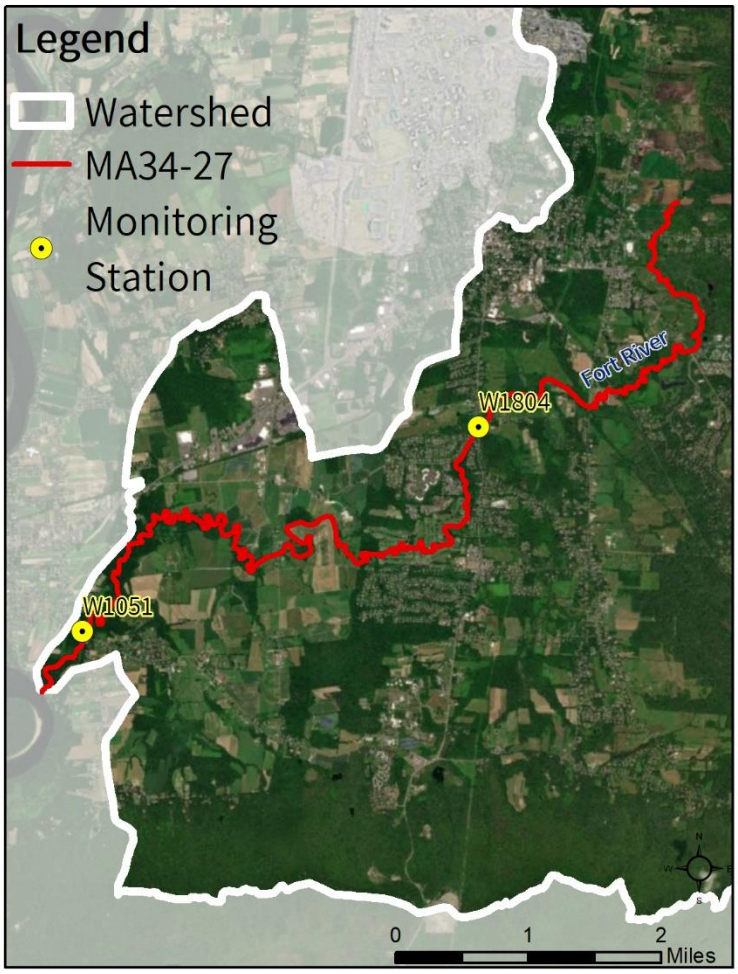


Figure 11-2. Location of monitoring station(s) along the impaired river segment.

Table 11-1. Summary of indicator bacteria sampling results by station for the Fort River (MA34-27). 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
W1051	5/6/2008	9/9/2008	6	367	4	1
W1804	5/6/2008	9/9/2008	6	118	0	1

Table 11-2. Indicator bacteria data by station, indicator, and date for the Fort River (MA34-27). 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)
W1051	*E. coli*	5/6/2008	DRY	52	52	
W1051	*E. coli*	6/3/2008	DRY	208	104	
W1051	*E. coli*	7/1/2008	DRY	240	137	
W1051	*E. coli*	7/29/2008	WET	210	153	
W1051	*E. coli*	9/3/2008	DRY	240	230	
W1051	*E. coli*	9/9/2008	WET	1500	367	
W1804	*E. coli*	5/6/2008	DRY	24	24	
W1804	*E. coli*	6/3/2008	DRY	60	38	
W1804	*E. coli*	7/1/2008	DRY	100	52	
W1804	*E. coli*	7/29/2008	WET	30	46	
W1804	*E. coli*	9/3/2008	DRY	140	75	
W1804	*E. coli*	9/9/2008	WET	460	118	

11.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the Fort River (MA834-27) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the Fort River (MA34-27) watershed are highly developed, with 22% of the land area in MS4 and 2% as DCIA, and the river itself flowing through mixed residential and commercial development. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With a portion of the watershed serviced by sewer and designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Most of the upper watershed is likely served by on-site wastewater disposal systems. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 13% of the watershed, nearly equal with developed land use. Agricultural activities visible on recent aerial photos within the immediate drainage area include open fields,

hayfields, row crops, and pastures, and many have little or no vegetative buffer between active fields and the river. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: Much of the middle and downstream portion of the segment is surrounded by forested land, and there are several recreational trails such as the Emily Dickenson Trail, Harvey Allen Trail, and the Norwottuck Rail Trail which run parallel to or cross the river. Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: There are several large fields in the watershed with little to no vegetative buffer around the river, including some agricultural fields and a few areas in the Hickory Ridge Golf Course. Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

11.4. 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 Amherst. See Section 10.4

Town of Belchertown. See Section 6.4

Town of Hadley. See Section 4.4

Town of Pelham

Pelham received a MS4 General Permit waiver on August 19, 2015: https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/pelham-epa-waiver-response.pdf (Town of Pelham, 2015)

Pelham has the following ordinances and bylaws:

- Wetlands Protection bylaw: Chapter 119 https://www.townofpelham.org/board-selectmen/code-town-pelham/pages/wetlands-protection (Town of Pelham, 1987)
- Dog waste bylaw: Chapter 5 Animals, Article II Section 5-9 Dog waste https://www.townofpelham.org/board-selectmen/code-town-pelham/pages/chapter-5-animals (Town of Pelham, n.d.)

Pelham's Master Plan has a section on Sewers (page 20):https://www.townofpelham.org/sites/g/files/vyhlif4851/f/uploads/pelhammasterplan-1997.pdf (Town of Pelham, 2017b)

Pelham's Master Plan has a section on Open Space and Natural Resources Chapter 6.0 Page 51 and Chapter 7.0 Recreation Page 59. https://www.townofpelham.org/sites/g/files/vyhlif4851/f/uploads/pelhammasterplan-1997.pdf (Town of Pelham, 2017a)

A watershed-based plan has been created for this watershed by the Town of Amherst, University of Massachusetts, Amherst and Geosyntec Consultants, Inc. (Geosyntec, 2021a).

12. MA34-28 Mill River

12.1. Waterbody Overview

The Mill River segment MA34-28 is 10 miles long and begins at the confluence of the East and West Branch Mill River in Williamsburg, MA. The segment flows southeast from Williamsburg into Northampton, MA to end at Paradise Pond Dam.

Tributaries to Mill River segment MA34-28 include East and West Branch Mill River, Unquomonk Brook, Joe Wright Book, Beaver Brook, Roberts Meadow Brook, Deer Brook, Florence Stream, Sandy Hill Brook, Bradford Brook, Brewer Brook, Day Brook, Rogers Brook, and Broughtons Brook. Major lakes and reservoirs within the segment watershed include Graham Pond, Lower Highland Lake, Upper Highland Lake, Mountain Street Reservoir, Florence Stream, Roberts Meadow Reservoir, and Upper Leeds Reservoir.

Key landmarks in the watershed include the villages of Williamsburg, Haydenville, and Leeds (Williamsburg); the village of Florence (Northampton), portions of Smith College, the North Hampton Country Club and Beaver Brook golf course. Segment MA34-28 is crossed by Main Street/MA-9, Bridge Street, and South Main Street (Williamsburg); and River Road, Mulberry Street, Hotel Bridge, Main Street (three times), Meadow Street, Pine Street, Bliss Street, and Clement Street (Northampton).

The Mill River (MA34-28) drains an area of 54 square miles, of which 2.0 mi^2 (4%) is impervious and 0.9 mi^2 (2%) is directly connected impervious area (DCIA). Portions of the watershed in Northampton and Williamsburg are served by public sewer[31] and 9% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge, and no combined sewer overflows within the watershed. There are four landfills and one unpermitted land disposal dumping grounds within the watershed. See Figure 12-1.

Reduction from Highest Calculated Geomean: 95%

Watershed Area (Acres): 34,814

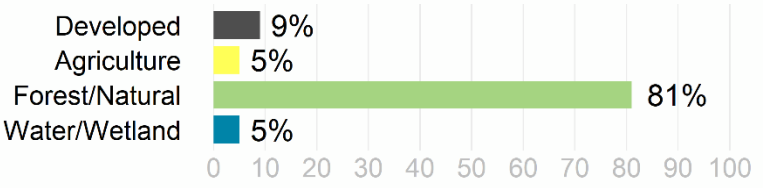
Segment Length (Miles): 10.0

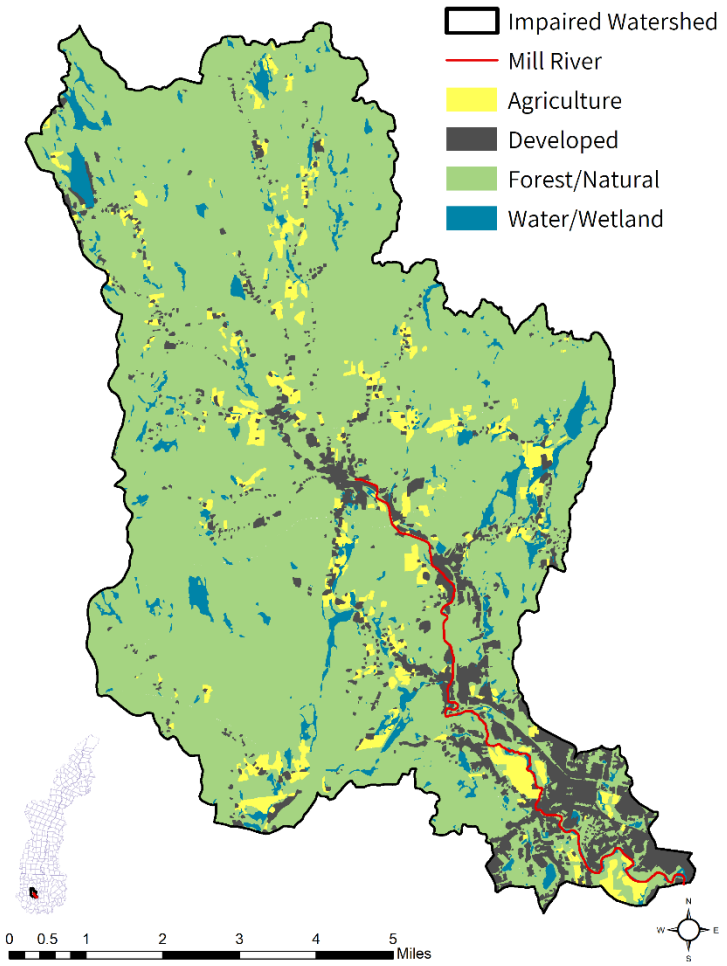
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 1,302 (4%)

DCIA Area (Acres, %): 549 (2%)





[31] 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.

The overall watershed is predominantly forested, though the developed areas are highly concentrated along the river. The upper portion of the segment flows through generally low-density residential development. From the village of Florence to the downstream end, the river corridor is largely mixed medium residential and commercial development with a few large agricultural fields. Most of the river flows through a wooded buffer, though about 4.5 miles of the river flows along MA-9.

The watershed of the Mill River (MA34-28) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 1,574 acres (5%) of Priority Habitats of Rare Species and five acres (<1%) of Priority Natural Vegetation Communities. There are 4,413 acres (13%) under Public Water Supply protection and no areas identified as Outstanding Resource Waters. Over 2,768 acres (8%) of land protected in perpetuity[32] exist within the segment watershed, which is part of a total of 10,095 acres (29%) of Protected and Recreational Open Space[33]. See Figure 12-1.

[32] 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.

[33] 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).

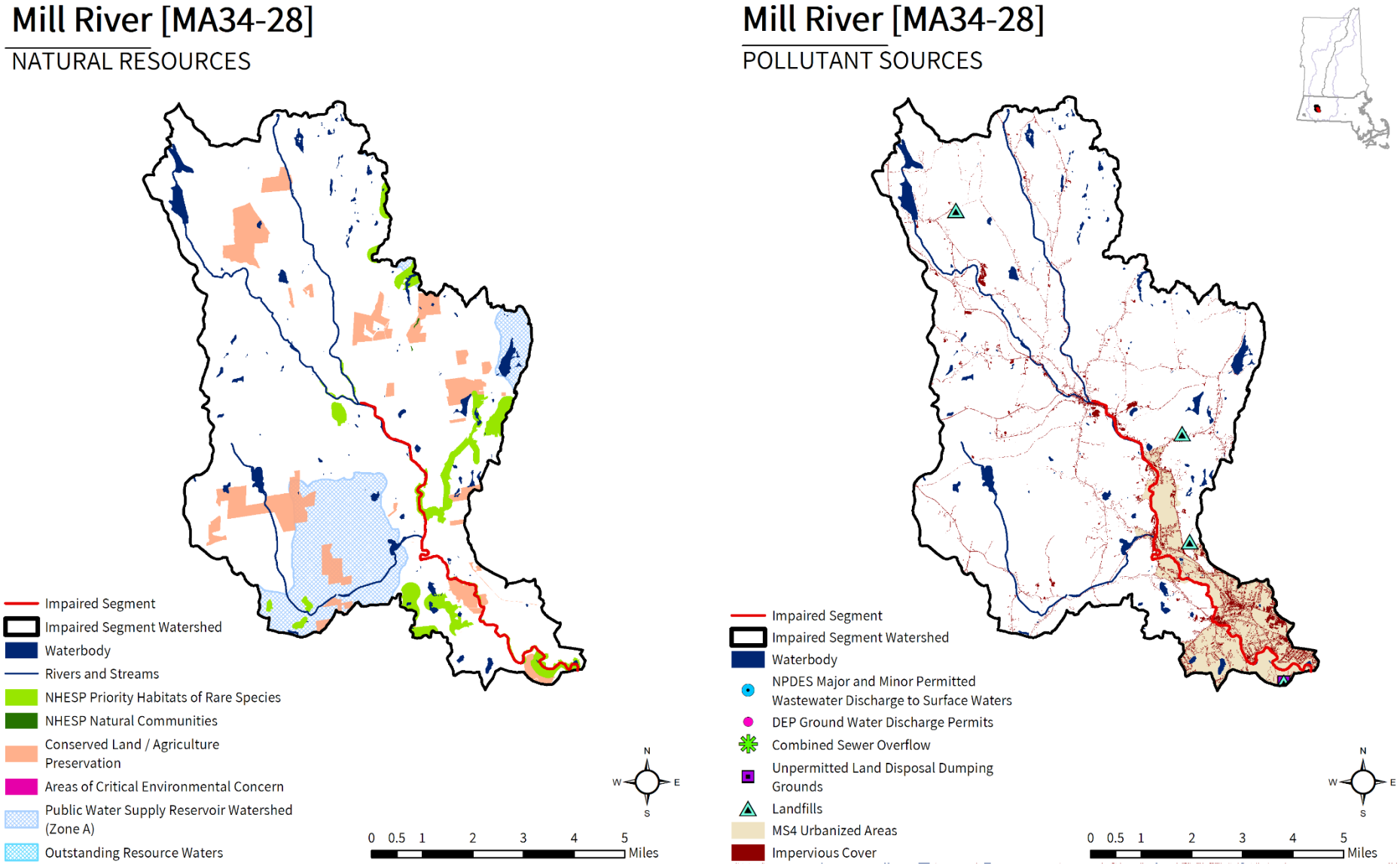


Figure 12-1. Natural resources and potential pollution sources draining to the Mill River segment MA34-28. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

12.2. Waterbody Impairment Characterization

The Mill River (MA34-28) 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 12-1, 12-2; Figure 12-2). 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.

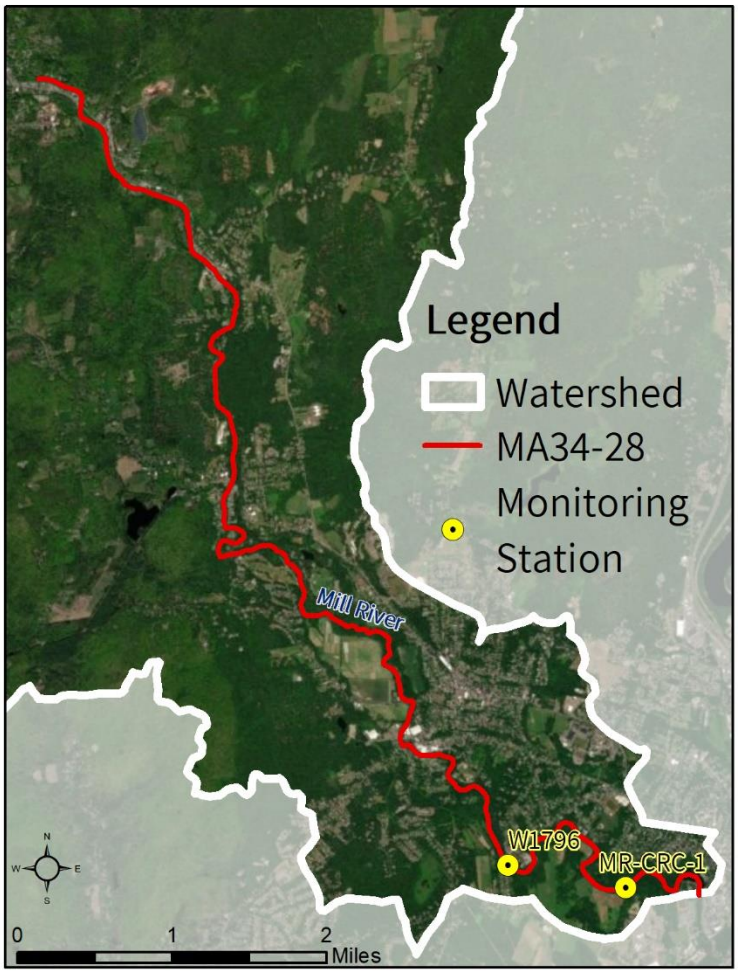


Figure 12-2. Location of monitoring station(s) along the impaired river segment.

- From 2012-2019, 134 samples were collected at MR-CRC-1 (CRC, 2020), resulting in 133 days when the 90-day rolling geomean exceeded the criterion. Since there were more than 10 samples collected in each year from 2012-2018, the STV criterion was applied to the 90-day rolling 90th percentile. From 2012-2019, 134 samples were collected at MR-CRC-1, resulting in 109 days when the 90-day rolling 90th percentile exceeded the STV criterion. Note: the number of days that exceeded the STV criterion also includes the number of single samples exceeding the STV criterion for 2019 (year with less than 10 samples).
- In 2008, six samples were collected at W1796, resulting in one day 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 six samples, one exceeded the STV criterion during wet weather only.

Table 12-1 Summary of indicator bacteria sampling results by station for the Mill River (MA34-28). 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
MR-CRC-1	5/31/2012	6/6/2019	134	2420	133	109*
W1796	5/6/2008	9/9/2008	6	201	1	1

**Since more than 10 samples were available in each year from 2012-2018, this value represents the number of days exceeding the STV criterion for the 90-day rolling 90th percentile from 2012-2018 plus the number of single samples exceeding the STV criterion for 2019.*

Table 12-2. Indicator bacteria data by station, indicator, and date for the Mill River (MA34-28). 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)
MR-CRC-1	*E. coli*	5/31/2012	WET	727	727	727
MR-CRC-1	*E. coli*	6/7/2012	DRY	172	354	672
MR-CRC-1	*E. coli*	6/14/2012	WET	194	289	620
MR-CRC-1	*E. coli*	6/21/2012	DRY	160	250	567
MR-CRC-1	*E. coli*	6/28/2012	WET	131	219	514
MR-CRC-1	*E. coli*	7/5/2012	DRY	157	208	185
MR-CRC-1	*E. coli*	7/12/2012	DRY	461	233	354
MR-CRC-1	*E. coli*	7/19/2012	DRY	365	246	423
MR-CRC-1	*E. coli*	7/26/2012	WET	435	262	451
MR-CRC-1	*E. coli*	8/2/2012	DRY	291	265	451
MR-CRC-1	*E. coli*	8/9/2012	DRY	125	247	451
MR-CRC-1	*E. coli*	8/16/2012	WET	435	259	435
MR-CRC-1	*E. coli*	8/23/2012	DRY	91	239	435
MR-CRC-1	*E. coli*	8/30/2012	WET	328	225	392
MR-CRC-1	*E. coli*	9/6/2012	WET	2420	276	1626
MR-CRC-1	*E. coli*	9/13/2012	DRY	99	262	1626
MR-CRC-1	*E. coli*	9/20/2012	WET	1046	303	1870
MR-CRC-1	*E. coli*	9/27/2012	DRY	116	300	1870
MR-CRC-1	*E. coli*	10/4/2012	DRY	91	287	1870
MR-CRC-1	*E. coli*	5/30/2013	WET	770	770	770
MR-CRC-1	*E. coli*	6/6/2013	DRY	111	292	704
MR-CRC-1	*E. coli*	6/13/2013	WET	111	212	638
MR-CRC-1	*E. coli*	6/20/2013	WET	73	162	572
MR-CRC-1	*E. coli*	6/27/2013	DRY	219	172	550
MR-CRC-1	*E. coli*	7/4/2013	DRY	91	155	176
MR-CRC-1	*E. coli*	7/11/2013	DRY	727	193	524
MR-CRC-1	*E. coli*	7/18/2013	DRY	147	187	524
MR-CRC-1	*E. coli*	7/25/2013	WET	613	213	681
MR-CRC-1	*E. coli*	8/1/2013	DRY	140	204	681
MR-CRC-1	*E. coli*	8/8/2013	DRY	131	196	681
MR-CRC-1	*E. coli*	8/15/2013	DRY	105	186	427
MR-CRC-1	*E. coli*	8/22/2013	DRY	184	186	441
MR-CRC-1	*E. coli*	8/29/2013	DRY	240	170	218
MR-CRC-1	*E. coli*	9/5/2013	DRY	387	187	328
MR-CRC-1	*E. coli*	9/12/2013	WET	687	215	567
MR-CRC-1	*E. coli*	9/19/2013	DRY	91	219	567
MR-CRC-1	*E. coli*	9/26/2013	DRY	102	207	567
MR-CRC-1	*E. coli*	10/3/2013	DRY	285	226	567
MR-CRC-1	*E. coli*	5/29/2014	DRY	152	152	152
MR-CRC-1	*E. coli*	6/5/2014	DRY	172	162	170
MR-CRC-1	*E. coli*	6/12/2014	DRY	131	151	168
MR-CRC-1	*E. coli*	6/19/2014	DRY	214	165	201
MR-CRC-1	*E. coli*	6/26/2014	WET	2420	282	1538
MR-CRC-1	*E. coli*	7/3/2014	WET	2420	403	2420
MR-CRC-1	*E. coli*	7/10/2014	WET	326	391	2420
MR-CRC-1	*E. coli*	7/17/2014	WET	435	396	2420
MR-CRC-1	*E. coli*	7/24/2014	WET	2420	485	2420
MR-CRC-1	*E. coli*	7/31/2014	DRY	139	428	2420
MR-CRC-1	*E. coli*	8/7/2014	DRY	86	370	1626

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
MR-CRC-1	*E. coli*	8/14/2014	WET	2420	432	2420
MR-CRC-1	*E. coli*	8/21/2014	DRY	93	384	2420
MR-CRC-1	*E. coli*	8/28/2014	DRY	119	377	1508
MR-CRC-1	*E. coli*	9/4/2014	DRY	172	377	1521
MR-CRC-1	*E. coli*	9/11/2014	DRY	96	368	1521
MR-CRC-1	*E. coli*	9/18/2014	DRY	59	333	151
MR-CRC-1	*E. coli*	9/25/2014	DRY	96	260	151
MR-CRC-1	*E. coli*	10/2/2014	WET	1986	256	1260
MR-CRC-1	*E. coli*	5/28/2015	WET	2420	2420	2420
MR-CRC-1	*E. coli*	6/4/2015	WET	261	795	2204
MR-CRC-1	*E. coli*	6/11/2015	WET	236	530	1988
MR-CRC-1	*E. coli*	6/18/2015	WET	172	400	1772
MR-CRC-1	*E. coli*	6/25/2015	DRY	120	314	1556
MR-CRC-1	*E. coli*	7/2/2015	WET	435	332	365
MR-CRC-1	*E. coli*	7/9/2015	DRY	214	312	355
MR-CRC-1	*E. coli*	7/16/2015	DRY	122	277	347
MR-CRC-1	*E. coli*	7/23/2015	DRY	127	254	347
MR-CRC-1	*E. coli*	7/30/2015	DRY	345	262	399
MR-CRC-1	*E. coli*	8/6/2015	DRY	186	254	293
MR-CRC-1	*E. coli*	8/13/2015	WET	387	263	370
MR-CRC-1	*E. coli*	8/20/2015	DRY	115	247	370
MR-CRC-1	*E. coli*	8/27/2015	WET	308	211	370
MR-CRC-1	*E. coli*	9/3/2015	DRY	122	199	355
MR-CRC-1	*E. coli*	9/10/2015	WET	2420	238	1607
MR-CRC-1	*E. coli*	9/17/2015	DRY	135	233	1575
MR-CRC-1	*E. coli*	9/24/2015	DRY	78	226	1575
MR-CRC-1	*E. coli*	10/1/2015	WET	2420	258	2420
MR-CRC-1	*E. coli*	6/2/2016	DRY	161	161	161
MR-CRC-1	*E. coli*	6/9/2016	DRY	291	216	278
MR-CRC-1	*E. coli*	6/16/2016	DRY	488	284	449
MR-CRC-1	*E. coli*	6/23/2016	DRY	131	234	429
MR-CRC-1	*E. coli*	6/30/2016	DRY	435	265	467
MR-CRC-1	*E. coli*	7/7/2016	DRY	1986	371	1387
MR-CRC-1	*E. coli*	7/14/2016	DRY	238	348	1387
MR-CRC-1	*E. coli*	7/21/2016	DRY	236	331	1366
MR-CRC-1	*E. coli*	7/28/2016	DRY	162	306	1366
MR-CRC-1	*E. coli*	8/4/2016	WET	613	328	1437
MR-CRC-1	*E. coli*	8/11/2016	DRY	866	358	765
MR-CRC-1	*E. coli*	8/18/2016	DRY	1553	405	1278
MR-CRC-1	*E. coli*	8/25/2016	DRY	365	402	1278
MR-CRC-1	*E. coli*	9/1/2016	DRY	194	407	1278
MR-CRC-1	*E. coli*	9/8/2016	DRY	517	426	1278
MR-CRC-1	*E. coli*	9/15/2016	DRY	122	383	1139
MR-CRC-1	*E. coli*	9/22/2016	WET	980	447	795
MR-CRC-1	*E. coli*	9/29/2016	WET	173	416	795
MR-CRC-1	*E. coli*	10/6/2016	DRY	99	331	795
MR-CRC-1	*E. coli*	6/1/2017	WET	770	770	770
MR-CRC-1	*E. coli*	6/8/2017	WET	131	318	706
MR-CRC-1	*E. coli*	6/15/2017	DRY	125	233	642
MR-CRC-1	*E. coli*	6/22/2017	WET	308	250	631
MR-CRC-1	*E. coli*	6/29/2017	DRY	146	224	585
MR-CRC-1	*E. coli*	7/6/2017	DRY	210	222	269
MR-CRC-1	*E. coli*	7/13/2017	DRY	1986	303	1315
MR-CRC-1	*E. coli*	7/20/2017	DRY	186	285	1315
MR-CRC-1	*E. coli*	7/27/2017	WET	172	270	1276

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
MR-CRC-1	*E. coli*	8/3/2017	DRY	117	248	1276
MR-CRC-1	*E. coli*	8/10/2017	DRY	326	254	1322
MR-CRC-1	*E. coli*	8/17/2017	DRY	110	237	270
MR-CRC-1	*E. coli*	8/24/2017	WET	308	242	319
MR-CRC-1	*E. coli*	8/31/2017	DRY	980	247	718
MR-CRC-1	*E. coli*	9/7/2017	WET	816	284	914
MR-CRC-1	*E. coli*	9/14/2017	DRY	108	281	914
MR-CRC-1	*E. coli*	9/21/2017	DRY	135	263	914
MR-CRC-1	*E. coli*	9/28/2017	DRY	488	289	914
MR-CRC-1	*E. coli*	10/5/2017	DRY	62	263	685
MR-CRC-1	*E. coli*	5/31/2018	DRY	201	201	201
MR-CRC-1	*E. coli*	6/7/2018	WET	228	214	225
MR-CRC-1	*E. coli*	6/14/2018	DRY	248	225	244
MR-CRC-1	*E. coli*	6/21/2018	WET	111	188	242
MR-CRC-1	*E. coli*	6/28/2018	WET	2420	314	1551
MR-CRC-1	*E. coli*	7/5/2018	DRY	155	279	1551
MR-CRC-1	*E. coli*	7/12/2018	DRY	104	242	1551
MR-CRC-1	*E. coli*	7/19/2018	WET	228	241	1543
MR-CRC-1	*E. coli*	7/26/2018	WET	1733	300	2145
MR-CRC-1	*E. coli*	8/2/2018	WET	345	304	1178
MR-CRC-1	*E. coli*	8/9/2018	WET	1986	360	1885
MR-CRC-1	*E. coli*	8/16/2018	DRY	127	330	1885
MR-CRC-1	*E. coli*	8/23/2018	WET	192	317	1885
MR-CRC-1	*E. coli*	8/30/2018	DRY	196	316	1330
MR-CRC-1	*E. coli*	9/6/2018	DRY	115	300	1270
MR-CRC-1	*E. coli*	9/13/2018	WET	980	334	666
MR-CRC-1	*E. coli*	9/20/2018	WET	214	351	674
MR-CRC-1	*E. coli*	9/27/2018	WET	1553	339	1324
MR-CRC-1	*E. coli*	5/30/2019	DRY	75	75	
MR-CRC-1	*E. coli*	6/6/2019	DRY	488	191	
W1796	*E. coli*	5/6/2008	DRY	4	4	
W1796	*E. coli*	6/3/2008	DRY	20	9	
W1796	*E. coli*	7/1/2008	DRY	140	22	
W1796	*E. coli*	7/29/2008	WET	80	31	
W1796	*E. coli*	9/3/2008	DRY	50	82	
W1796	*E. coli*	9/9/2008	WET	2900	201	

12.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the Mill River (MA34-28) were elevated during both wet and dry weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow

during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated indicator bacteria during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Although the Mill River (MA34-28) watershed is mostly forested, developed areas are concentrated along the river corridor, and the river runs parallel to River Road/MA-9 for about 4.5 miles. In some areas, such as Look Park and Nonotuck Street in Florence (Northampton), there are parking lots, streets, and large commercial buildings immediately adjacent to the river. Overall, 9% of the land area is in MS4 and 2% is DCIA, mostly concentrated in the downstream portion of the watershed. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With portions of the watershed in sewer service and 9% of the watershed designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: With most of the upper watershed served by septic systems, it is likely that a number of septic systems are not being properly maintained and are discharging untreated effluent to groundwater, representing a possible source of pathogens to the river.

Agriculture: Agricultural areas account for 5% of the watershed and are a potential source of pathogens. Agricultural activities visible on recent aerial photos include large open fields or hayfields, row crops, and pastureland, some of which are adjacent to the river. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are many parks, ballfields, and residential neighborhoods within the watershed along the impaired segment. Areas popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water. Most of the river is within a wooded buffer zone, though there are a few narrow buffer areas where it may not provide a visual screen, especially along the downstream stretches of the impaired segment where parks and agricultural fields are very close to the Mill River.

12.4. 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 Goshen

The Town of Goshen is not within the MS4 area.

Goshen's ordinances and bylaws:

- Goshen does not have any supplementary regulations beyond the MassDEP regulations for stormwater management and wetland protection.
- Title V Supplementary Regulations: None found.
- Pet Waste Bylaw: None found.

The Town of Goshen Hazard Mitigation Plan notes the town is considering adding "stormwater retentions/detention requirements to subdivision rules and regulations." The Master Plan has a limited section on Town of Goshen Water Supply (page 17) and the Hazard Mitigation Plan has a section on Water Resources describing waterbodies within the Westfield River watershed and Connecticut River watershed (page 9). The Master Plan does not have a section on the town sewer infrastructure.

Town website: https://www.goshen-ma.us/ (Town of Goshen, 2020)

Master Plan: https://www.goshen-ma.us/documents/master-plan-2019-proposal-for-goshen-town-center/ (Town of Goshen, 2019)

Hazard Mitigation Plan: http://www.pvpc.org/sites/default/files/GoshenHMP2016.pdf (Town of Goshen, 2016)

Open Space and Recreation Plan (available through request): https://www.goshen-ma.us/departments/open-space-committee/ (Town of Goshen, 2012)

Town of Northampton. See Section 4.4

Town of Williamsburg. See Section 7.4

13. MA34-29 Mill River

13.1. Waterbody Overview

The Mill River segment MA34-29 is 1.3 miles long and begins at the outlet of nutrient impaired Watershops Pond (MA34099) in Springfield, MA. The segment flows southwest to end at its confluence with the Connecticut River (MA34-05) in Springfield, MA. The last 0.2 miles of the river is buried beneath urban development in Springfield, MA.

There are no named tributaries flowing into segment MA34-29. Within the watershed, upstream tributaries to Watershops Pond include the north and south branches to the Mill River and Schneelock Brook. Major lakes and reservoirs within the segment watershed include Breckwood Lake, Mill Pond, Bass Pond, Quarry Pond, Island Pond, Venture Pond, Nine Mile Pond, and Watershops Pond.

Key landmarks in the watershed include the town center of Wilbraham, Springfield College, Blunt Park, Woodland Park Conservation Area, and the Rice Nature Preserve. Segment MA34-29 is crossed by Allen Street, Hancock Street, Mill Street, Locust Street, Main Street, I-91, and the Connecticut River Walk and Bikeway (Springfield).

The Mill River (MA34-29) drains an area of 34 square miles, of which 7 mi^2 (21%) is impervious and 5 mi^2 (15%) is directly connected impervious area (DCIA). The watershed is mostly[34] served by public sewer and 90% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). 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 segment watershed. There are 10 combined sewer overflows (Table 13-1), four landfills, and one unpermitted land disposal dumping ground within the segment watershed. See Figure 13-1.

The watershed contains more developed land (51%) than forested/natural land (35%). While the upper watershed contains forested areas, the segment itself flows through high density mixed residential, commercial, industrial, and

Reduction from Highest Calculated Geomean: 93%

Watershed Area (Acres): 21,581

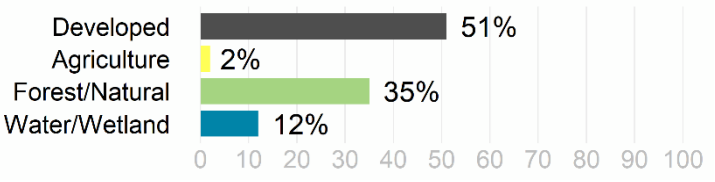
Segment Length (Miles): 1.3

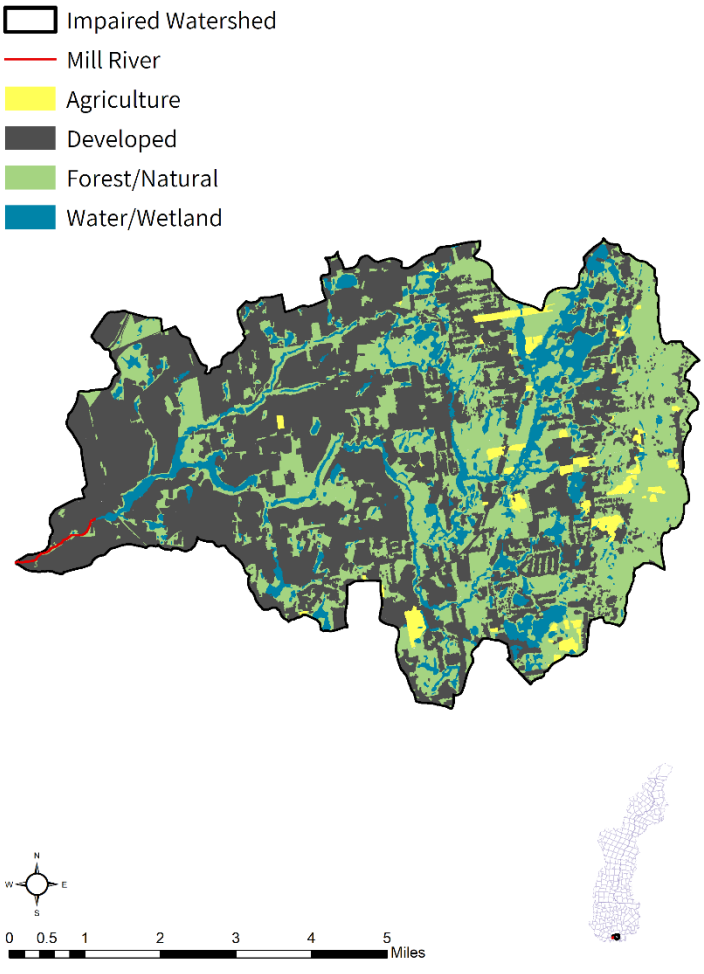
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (CSO Receiving Water)

Impervious Area (Acres, %): 4,564 (21%)

DCIA Area (Acres, %): 3,168 (15%)





[34] 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.

transportation land uses. Most of the river corridor has a narrow, wooded buffer, though the last 0.2 miles is buried beneath parking lots, an interstate highway, and other urban roads.

The watershed of the Mill River (MA34-29) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 1,882 acres (9%) of Priority Habitats of Rare Species and 63 acres (<1%) of Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection or identified as Outstanding Resource Waters. Over 400 acres (2%) of land protected in perpetuity[35] exist within the segment watershed, which is part of a total of 3,812 acres (18%) of Protected and Recreational Open Space[36]. Figure 13-1.

Table 13-1. Combined Sewer Overflows (CSOs) discharging to the segment.

NPDES ID	NAME	TOWN	DEP OUTFALL ID
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR017
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR019
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR024
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR025
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR045
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR046
MA0101613	SPRINGFIELD CSO	SPRINGFIELD	SPR048

[35] 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.

[36] 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).

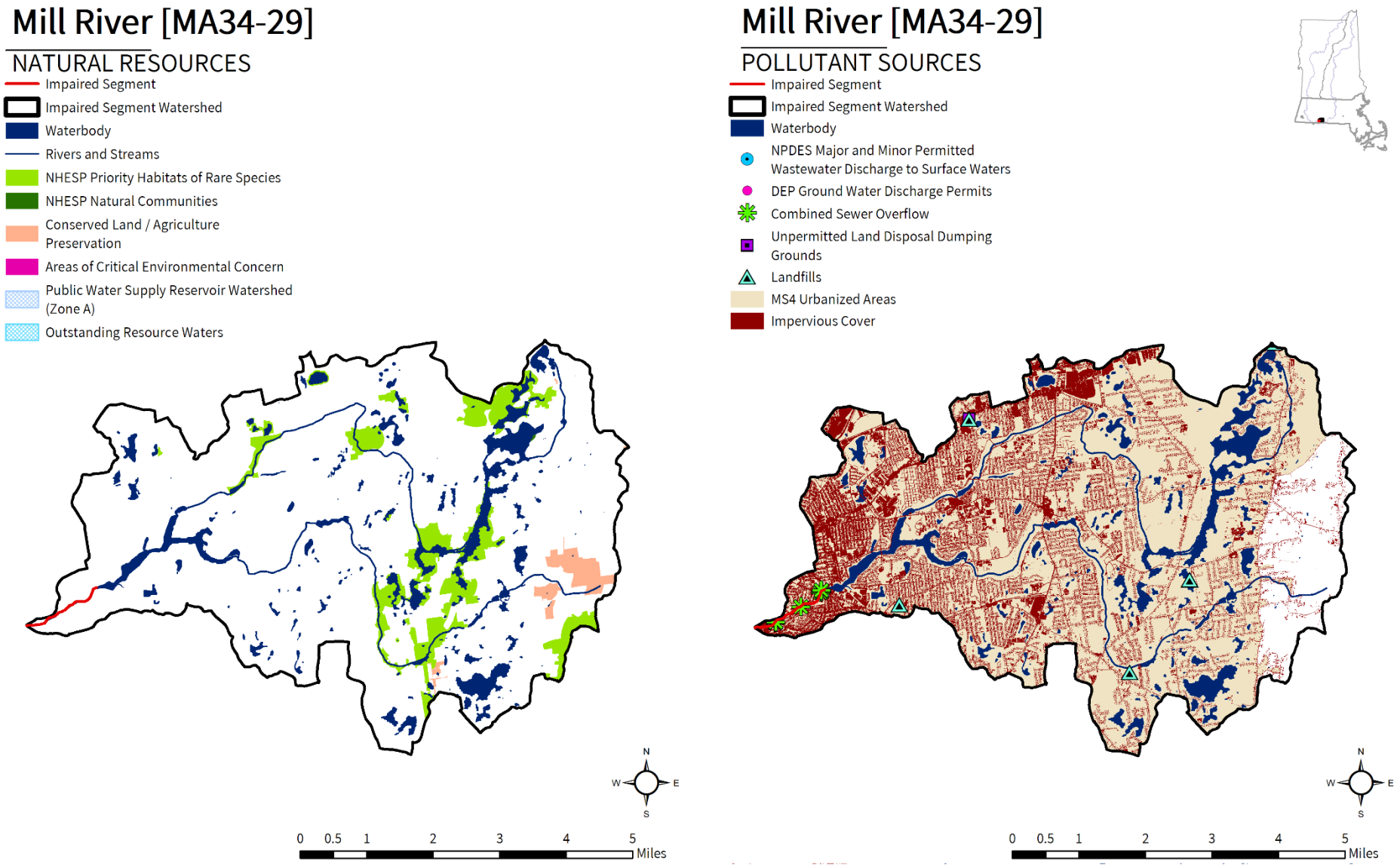


Figure 13-1. Natural resources and potential pollution sources draining to the Mill River segment MA34-29. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

13.2. Waterbody Impairment Characterization

The Mill River (MA34-29) is a Class B, CSO receiving water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the station identified below (refer to Tables 13-2, 13-3; Figure 13-2). 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, 30-day rolling basis.

- In 2008, six samples were collected at W1786, resulting in five days when the 30-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 six samples, three exceeded the STV criterion during both wet and dry weather.

One permittee, MA0103331 (7 outfalls), discharges to this segment. A presumptive impairment decision is being applied for this use since this waterbody does not have a CSO variance in place. In addition, this use is impaired based on field observations of sewage odors and trash.

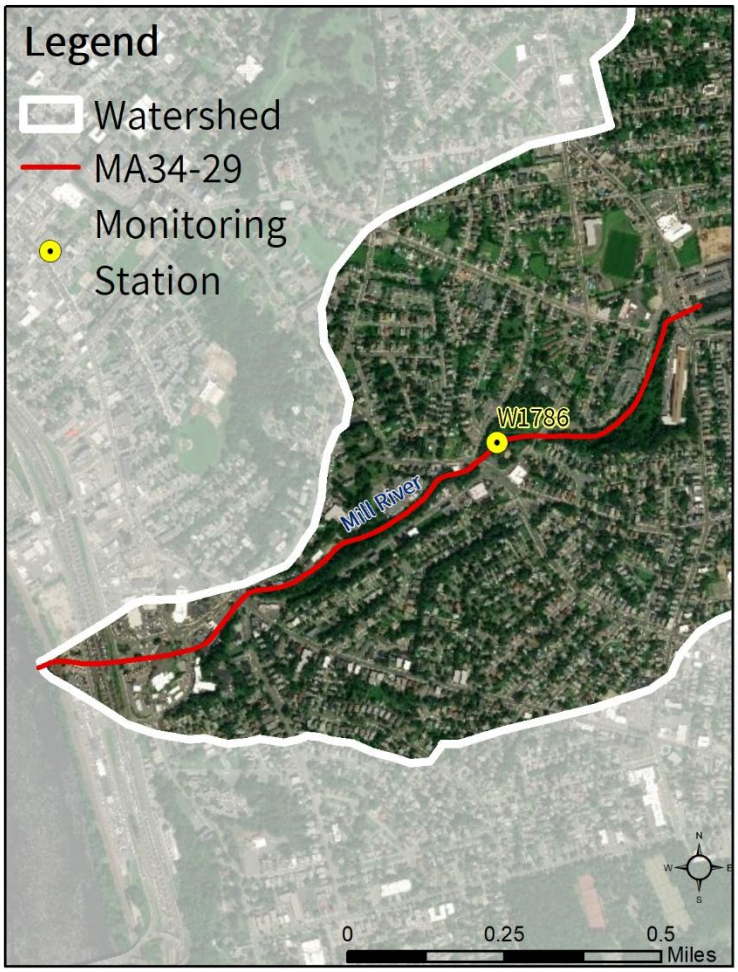


Figure 13-2. Location of monitoring station(s) along the impaired river segment.

Table 13-2. Summary of indicator bacteria sampling results by station for the Mill River (MA34-29). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1786	5/6/2008	9/9/2008	6	1789	5	3

Table 13-3. Indicator bacteria data by station, indicator, and date for the Mill River (MA34-29). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1786	*E. coli*	5/6/2008	DRY	88	88	
W1786	*E. coli*	6/3/2008	DRY	328	170	
W1786	*E. coli*	7/1/2008	WET	200	256	
W1786	*E. coli*	7/29/2008	WET	740	385	
W1786	*E. coli*	9/3/2008	DRY	800	800	
W1786	*E. coli*	9/9/2008	WET	4000	1789	

13.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for the Mill River (MA34-29) were elevated during both wet and dry weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated results during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Combined Sewer Overflow (CSO): There is one CSO (7 outfalls, Table 13-1) in the direct drainage area to the segment, which by design releases untreated wastewater to surface waters when flows exceed system capacity, and therefore must be eliminated. For this reason, it is set as the highest priority pathogen source.

Urban Stormwater: Most of the watershed is highly developed, with 90% of the land area in MS4 and 15% as DCIA. The impaired segment flows along densely developed residential neighborhoods before entering culverts beneath commercial, industrial, and transportation infrastructure near its confluence with the Connecticut River. The remainder of the watershed upstream of the impaired segment consists of medium to high density residential development. Stormwater runoff from urban areas is likely one of the most significant sources of pathogens.

Illicit Sewage Discharges: With most of the land area likely in sewer service and most (90%) of the watershed designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Some of the residential development in the watershed may use 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. There are likely far fewer septic systems along the impaired segment compared with the headwater areas of the watershed.

Agriculture: Agricultural areas account for 2% of the watershed and are a small but potential source of pathogens. Agricultural activities visible on recent aerial photos include open fields, hayfields, row crops, and pastureland, all in the upper portion of the watershed away from the impaired segment. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: In addition to the high-density residential neighborhoods, there is one park along the impaired segment itself, and over 3,800 acres of open space in the watershed. Conservation lands, parks, ballfields, and neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody along the impaired segment or near headwater tributaries may attract excessive waterfowl and elevate indicator bacteria counts in the water.

13.4. 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.

City of Springfield. See Section 5.4

Town of Wilbraham

Most of Wilbraham is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Wilbraham (Permit ID #MAR041025) has an EPA approved Notice of Intent (NOI). Wilbraham has a Stormwater Management page (link below), and the SWMP is on file at the DPW Office, 240 Springfield Street. The town has mapped all of its MS4 stormwater system. It adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2007. There are seven stormwater outfalls to the Chicopee River MA36-24 with fecal coliform impairment, five outfalls to the wetlands/tributaries to the Chicopee River MA36-24 with fecal coliform impairment, and one outfall to the wetlands/tributaries to the Chicopee River MA36-22 with *E. coli* impairment.

Wilbraham has the following ordinances and bylaws:

- Stormwater Phase II comprehensive bylaw https://www.wilbraham-ma.gov/DocumentCenter/View/190/Town-Bylaws?bidId= (Town of Wilbraham, 2015) and https://www.wilbraham-ma.gov/DocumentCenter/View/437/Stormwater-Bylaw?bidId= (Town of Wilbraham, n.d., a)
- Pet waste: Dog Bylaw (604.5) https://www.wilbraham-ma.gov/DocumentCenter/View/190/Town-Bylaws?bidId= (Town of Wilbraham, 2015)

The Town of Wilbraham's Master Plan has a Water Supply and Sanitary Sewerage section, Chapter 9. https://www.wilbraham-ma.gov/DocumentCenter/View/780/Master-Plan-1963?bidId= (Town of Wilbraham, 1963)

Wilbraham stormwater page: https://www.wilbraham-ma.gov/494/Stormwater-Information (Town Wilbraham, n.d., b)

Wilbraham Water Division: https://www.wilbraham-ma.gov/194/Water (Town of Wilbraham, n.d., c)

Wilbraham's Open Space and Recreation Plan: https://www.wilbraham-ma.gov/DocumentCenter/View/1534/OSRP-2014-2021?bidId= (Town of Wilbraham, 2014)

14. MA34-30 Scantic River

14.1. Waterbody Overview

The Scantic River segment MA34-30 is 9.6 miles long and begins at the Massachusetts-Connecticut border (<1 mile west of Hancock Road) in Monson, MA. The segment flows northwest into Hampden to its confluence with Big Brook before flowing southwest to end at the Massachusetts-Connecticut border (<1 mile east of Somers Road/MA-83) in Hampden, MA.

Tributaries include Temple Brook, East Brook, Big Brook, and West Brook. Lakes, ponds, and reservoirs include Boulder Hill Pond, Butler Road Pond, and Goodwill Pond.

Key landmarks within the segment watershed include the town center of Hampden, Hampden Memorial Park, Sunrise Park Conservation Area, and Minnechaug Mountain. Segment MA34-30 is crossed by Hancock Road (Monson); and Stafford Road, Rock-A-Dundee Road, Chapin Road, Main Street (twice), Somers Road, and Mill Road (Hampden).

The Scantic River (MA34-30) drains 25 square miles, of which 0.8 mi^2 (3%) is impervious and 0.2 mi^2 (1%) is directly connected impervious area (DCIA). Out of a total watershed area of 15,967 acres, 13,686 acres (86%) are within Massachusetts and the rest (14%) are within Connecticut.

The watershed is partially[37] served by public sewer and 6% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge, no combined sewer overflows, one landfill, and no unpermitted land disposal dumping grounds in the segment watershed. See Figure 14-1.

The Scantic River watershed is predominantly forested, although most of the developed areas are concentrated along the lower river corridor or tributaries. The watershed consists of 5%

Reduction from Highest Calculated Geomean: 75%

Watershed Area (Acres): 15,967

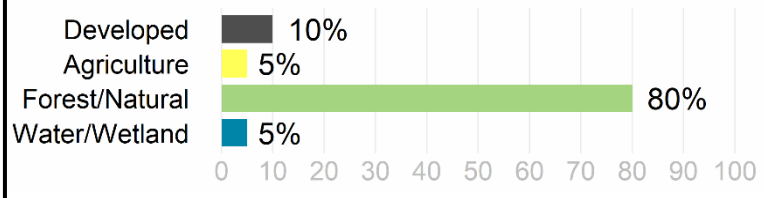
Segment Length (Miles): 9.6

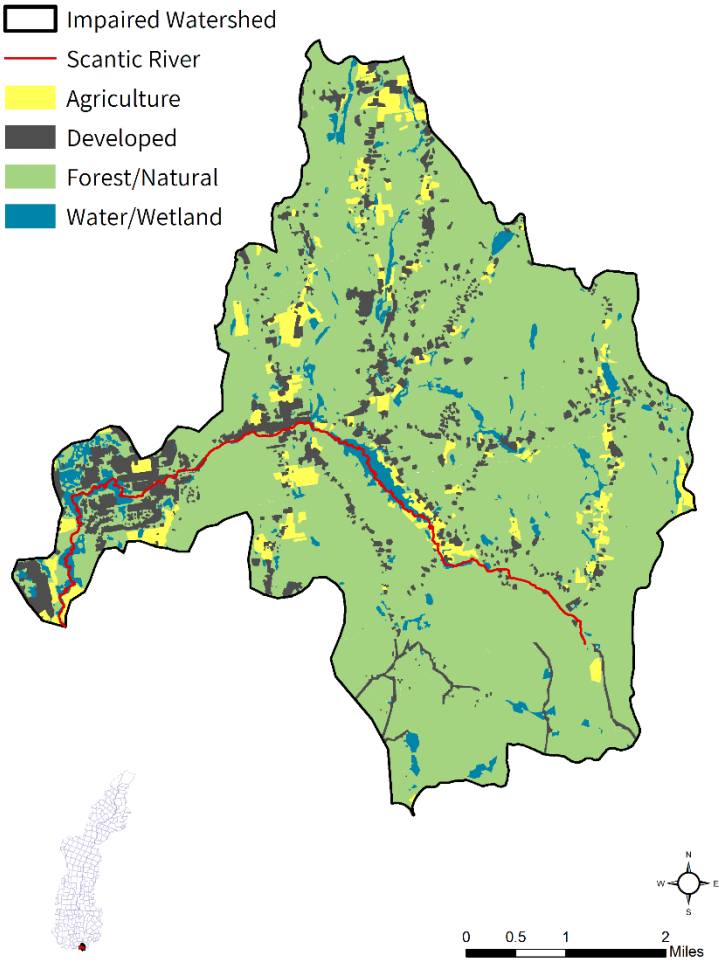
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 517 (3%)

DCIA Area (Acres, %): 133 (1%)





[37] 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.

agriculture, 10% developed, 80% forested/natural, and 5% water/wetland.

The Scantic River (MA34-30) watershed does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 6,450 acres (40%) of Priority Habitats of Rare Species and no Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection or identified as Outstanding Resource Waters. Over 3,373 acres (21%) of land protected in perpetuity[38] exist within the segment watershed, which is part of a total of 4,294 acres (27%) of Protected and Recreational Open Space[39]. See Figure 14-1.

[38] 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.

[39] 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).

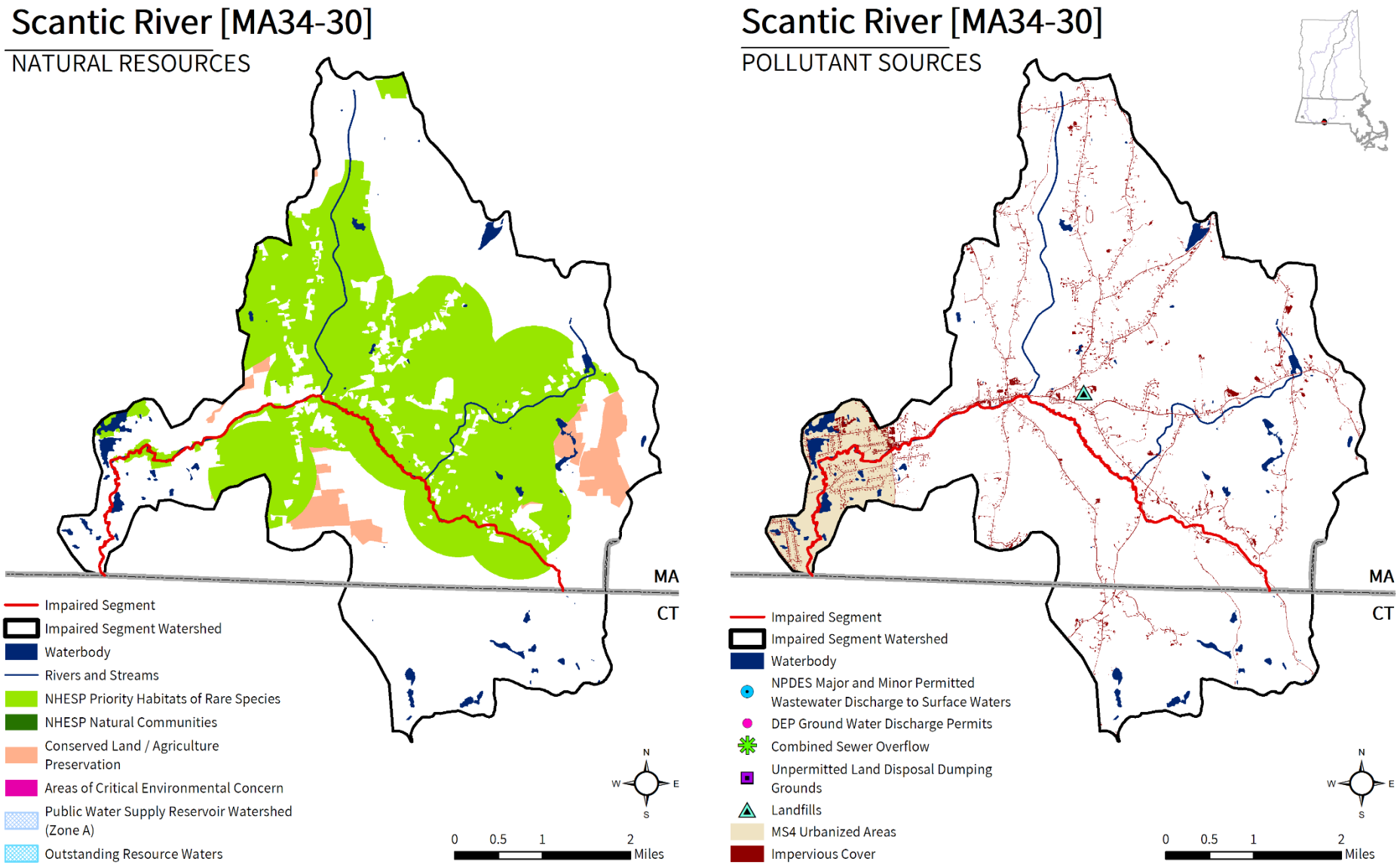


Figure 14-1. Natural resources and potential pollution sources draining to the Scantic River segment MA34-30. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

14.2. Waterbody Impairment Characterization

The Scantic River (MA34-30) 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 stations listed below (refer to Tables 14-1, 14-2; Figure 14-2). 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 2008, six samples were collected at W1789, resulting in two 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 six samples, one exceeded the STV criterion during wet weather.
- In 2014, five samples were collected at W1880, resulting in one day 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, one exceeded the STV criterion during dry weather.

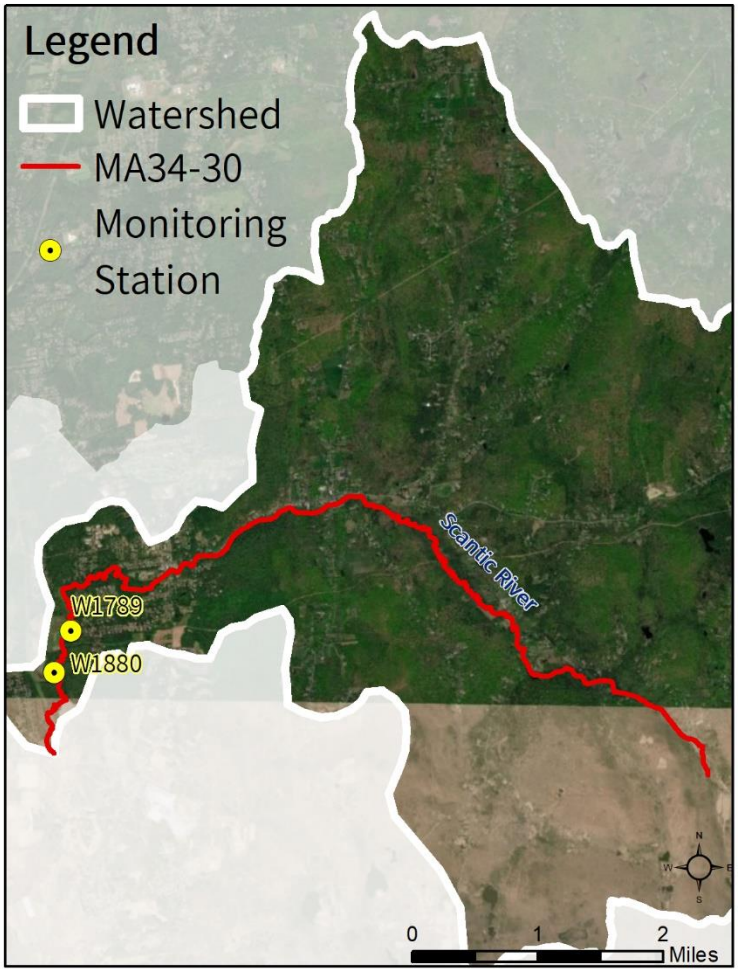


Figure 14-2. Location of monitoring station(s) along the impaired river segment.

Table 14-1. Summary of indicator bacteria sampling results by station for the Scantic River (MA34-30). 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
W1789	5/6/2008	9/9/2008	6	506	2	1
W1880	5/6/2014	8/21/2014	5	157	1	1

Table 14-2. Indicator bacteria data by station, indicator, and date for the Scantic River (MA34-30). 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)
W1789	*E. coli*	5/6/2008	DRY	16	16	
W1789	*E. coli*	6/3/2008	DRY	52	29	
W1789	*E. coli*	7/1/2008	WET	310	64	
W1789	*E. coli*	7/29/2008	WET	280	92	
W1789	*E. coli*	9/3/2008	DRY	210	263	
W1789	*E. coli*	9/9/2008	WET	3600	506	
W1880	*E. coli*	5/6/2014	DRY	14	14	
W1880	*E. coli*	6/2/2014	DRY	32	21	
W1880	*E. coli*	7/2/2014	DRY	119	38	
W1880	*E. coli*	7/29/2014	WET	387	67	
W1880	*E. coli*	8/21/2014	DRY	411	157	

14.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for the Scantic River (MA34-30) were elevated during both wet and dry weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated results during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: The Scantic River (MA34-30) watershed has 6% of the land area in MS4 and 1% as DCIA. Development consists of low to medium density residential neighborhoods, much of which is concentrated along the segment. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With a portion of the land area in sewer service and 6% of the watershed designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Almost all the residential development in the watershed uses 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 areas account for 5% of the watershed and are a potential source of pathogens. Agricultural activities visible on recent aerial photos within the immediate drainage area include open fields, hayfields, row crops, and pastureland, some of which are directly adjacent to the segment. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: In addition to the medium density residential areas, there are over 4,200 acres of open space in the watershed. Conservation lands, parks, ballfields, and residential neighborhoods popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody along the impaired segment or near headwater tributaries may attract excessive waterfowl and elevate indicator bacteria counts in the water.

14.4. Existing Local Management

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

Town of Hampden

Less than a quarter of Hampden is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Hampden (Permit ID #MAR041009) has an EPA approved Notice of Intent (NOI). Hampden has a Stormwater Management Plan on file at the Town Office. The town has mapped all of its stormwater outfall system and submitted a map attached to the NOI. It adopted illicit discharge detection and elimination (IDDE) and erosion and sediment control (ESC) regulations in 2005 and post-construction stormwater regulations in 2008. According to the NOI, there are no stormwater outfalls into impaired segments of the MS4 area.

Hampden has the following ordinance and bylaws:

- Stormwater Ordinance, Chapter XIV, Page 20: ttps://www.hampdenma.gov/sites/g/files/vyhlif656/f/uploads/gbl_18-05-14_indexed.pdf (Town of Hampden, 2018) and Chapter XIV (A) Page 25 https://www.hampdenma.gov/sites/g/files/vyhlif656/f/uploads/9.17.20_hampden_stormwater_program_update.pdf (Town of Hampden, 2020a)
- Wetland Ordinance/Bylaw:https://www.hampdenma.gov/sites/g/files/vyhlif656/f/uploads/gbl_18-05-14_indexed.pdf (Town of Hampden, 2018)
- Pet Waste Ordinance: https://www.hampdenma.gov/stormwater-committee/news/pet-waste-reminder (Town of Hampden, 2020b)
- Stormwater Utility: None found.
- Title V Supplementary Regulations: https://www.hampdenma.gov/board-health/pages/title-5-inspections (Town of Hampden, n.d.)

The Town of Hampden does not have a Master Plan available. The Open Space and Recreation Plan has a water resources section addressing water supply, aquifer recharge, watersheds, surface water, flood hazard areas, and wetlands. The plan does not mention stream impairments specifically. The plan covers stormwater in the Wetlands section. The town does not have any sewer infrastructure, though there is the potential for installation in some parts of town.

Town website: https://www.hampdenma.gov/ (Town of Hampden, 2021)

Stormwater page: https://www.hampdenma.gov/stormwater-committee (Town of Hampden, 2020c)

Open Space and Recreation Plan:
http://www.pvpc.org/sites/default/files/Hampden%20OSRP%20Update%202017%20-FINAL-070318_r1.pdf
(Town of Hampden, 2017)

Town of Monson

A small area of Monson is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Monson (Permit ID #MAR041015) has an EPA approved Notice of Intent (NOI). The town has a Stormwater Management Plan on file at the Town Hall at 110 Main Street, Monson, MA. The town has mapped all of its stormwater outfall system, and the map was submitted as an attachment to the NOI (AECOM, 2019). The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2006. According to the NOI, there is one stormwater outfall into the Quaboag River MA36-16, impaired for fecal coliform.

Monson's ordinances and bylaws:

- Monson does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste: None found.

The Monson Master Plan has a Water Resources section in the Natural and Historic Resources chapter which includes a section on water quality threats, detailing sediment, phosphorus, nitrogen, metals, pesticides and herbicides, pathogens -- including bacteria and viruses -- and salts, as threats. The plan mentions the Quaboag River, stating that though the segment is still impaired, the water quality has improved since the mid-1850s. The Municipal Services and Infrastructure chapter has a Sewer System section, starting on page 60. Approximately 60% of the town uses on-site septic disposal.

Town website: https://www.monson-ma.gov/ (Town of Monson, 2020)

Master Plan: https://www.monson-ma.gov/planning-board/pages/monson-master-plan (Town of Monson, n.d.)

Stormwater page: https://www.monson-ma.gov/sites/g/files/vyhlif926/f/uploads/monson_stormwater_management_program_june_25_2019.pdf (town of Monson, 2019)
Source Water Protection Plan: https://www.monson-ma.gov/sites/g/files/vyhlif926/f/uploads/source_water_protection_plan.pdf#:~:text=Chicopee%20Brook%20%2D%20Bunyan%20Road%2C%20Monson%2C%20MA.&text=A%20Source%20Water%20Protection%20Plan,manage%20potentially%20contaminating%20land%20uses.&text=Assessment%20of%20the%20risks%20to,posed%20by%20contaminant%20sources%3B%204. (Town of Monson, 2006)
Open Space and Recreation Plan: https://www.monson-ma.gov/sites/g/files/vyhlif926/f/uploads/monson_osrp_2014.pdf (Town of Monson, 2014)

15. MA34-36 Bloody Brook

15.1. Waterbody Overview

The Bloody Brook segment MA34-36 is 3.7 miles long and begins as a perennial stream east of the railroad tracks north of North Main Street in Deerfield, MA. The segment flows south along North Main Street before flowing west to end at its confluence with the Mill River in Whately, MA. There are no named tributaries to segment MA34-36 or lakes, ponds, or reservoirs within the watershed.

Key landmarks in the watershed include the village of South Deerfield, the Magic Wings Butterfly Conservatory, part of Mt Sugarloaf State Reservation, and Deerfield Elementary School. Segment MA34-36 is crossed by Greenfield Road/US-5/MA-10/MA-116, I-91, Whately Road (twice), and the Connecticut River Mainline railroad in Deerfield, as well as a commercial driveway in Whately.

Bloody Brook (MA34-36) drains an area of 5.7 square miles, of which 0.5 mi^2 (9%) is impervious and 0.2 mi^2 (4%) is directly connected impervious area (DCIA). Much of the watershed is served[40] by public sewer and 34% of the watershed is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, no MassDEP discharge to groundwater permits for on-site wastewater discharge within the segment watershed, no combined sewer overflows, one landfill, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 15-1.

The watershed is heavily agricultural, with large hayfields and row crops, often extending to the brook's edge. The upper portion of the segment flows through a medium density mixed residential and commercial district, then crosses under the I-91 corridor. The lower segment flows through fringing meadow marshes.

The watershed of Bloody Brook (MA34-36) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and

Reduction from Highest Calculated Geomean: 64%

Watershed Area (Acres): 3,618

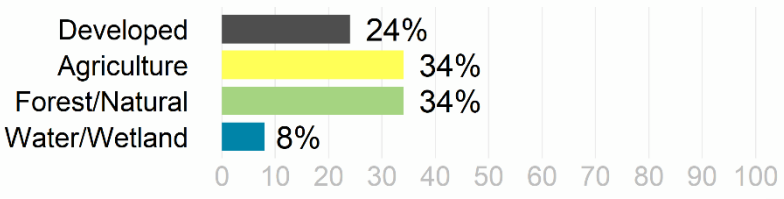
Segment Length (Miles): 3.7

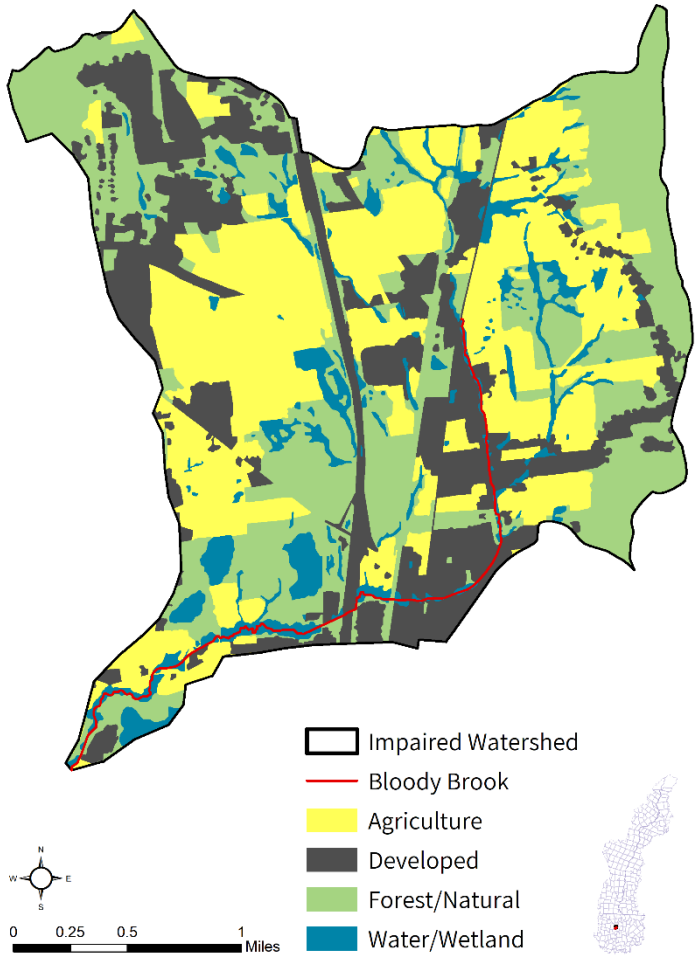
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 319 (9%)

DCIA Area (Acres, %): 153 (4%)



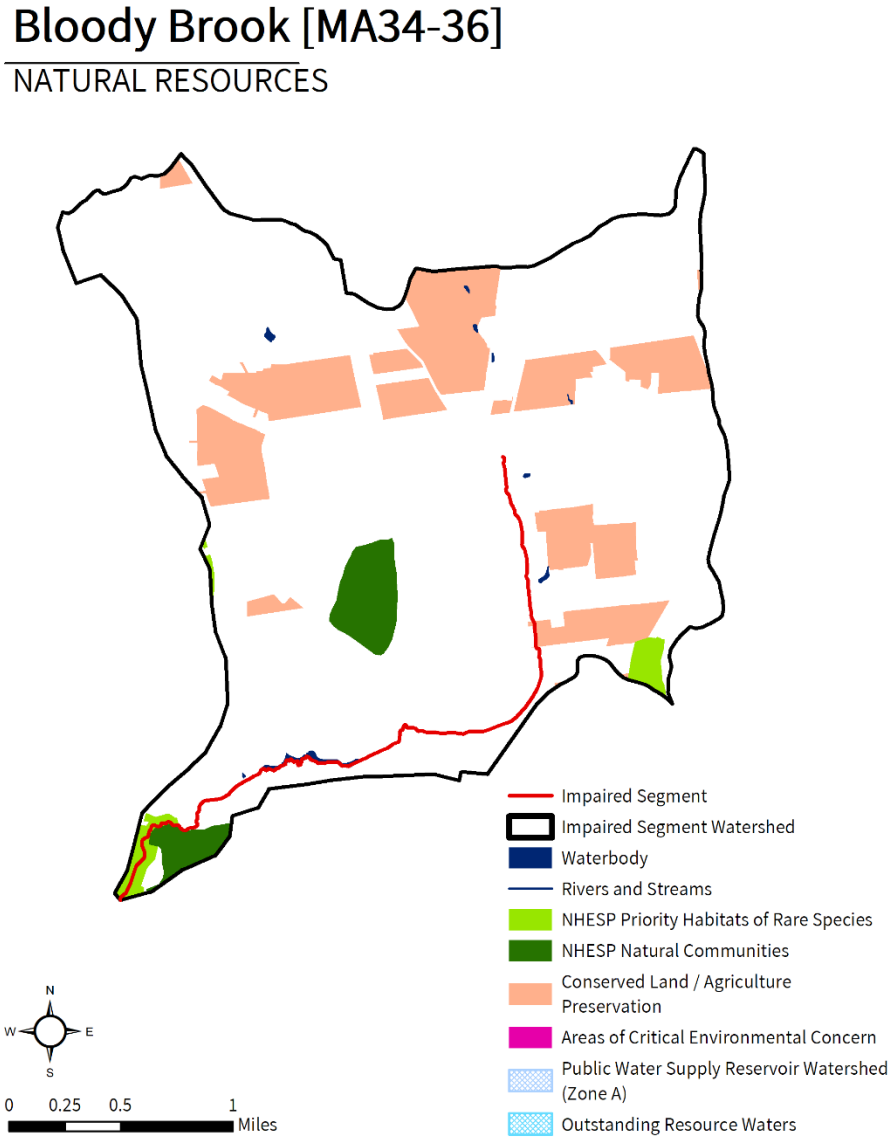


[40] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local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

Endangered Species Program, there are 50 acres (1%) of Priority Habitats of Rare Species and 108 acres (3%) of Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection or identified as Outstanding Resource Waters. Over 538 acres (15%) of land protected in perpetuity[41] exist within the segment watershed, which is part of a total of 638 acres (18%) of Protected and Recreational Open Space[42]. See Figure 15-1.

[41] 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.

[42] 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).



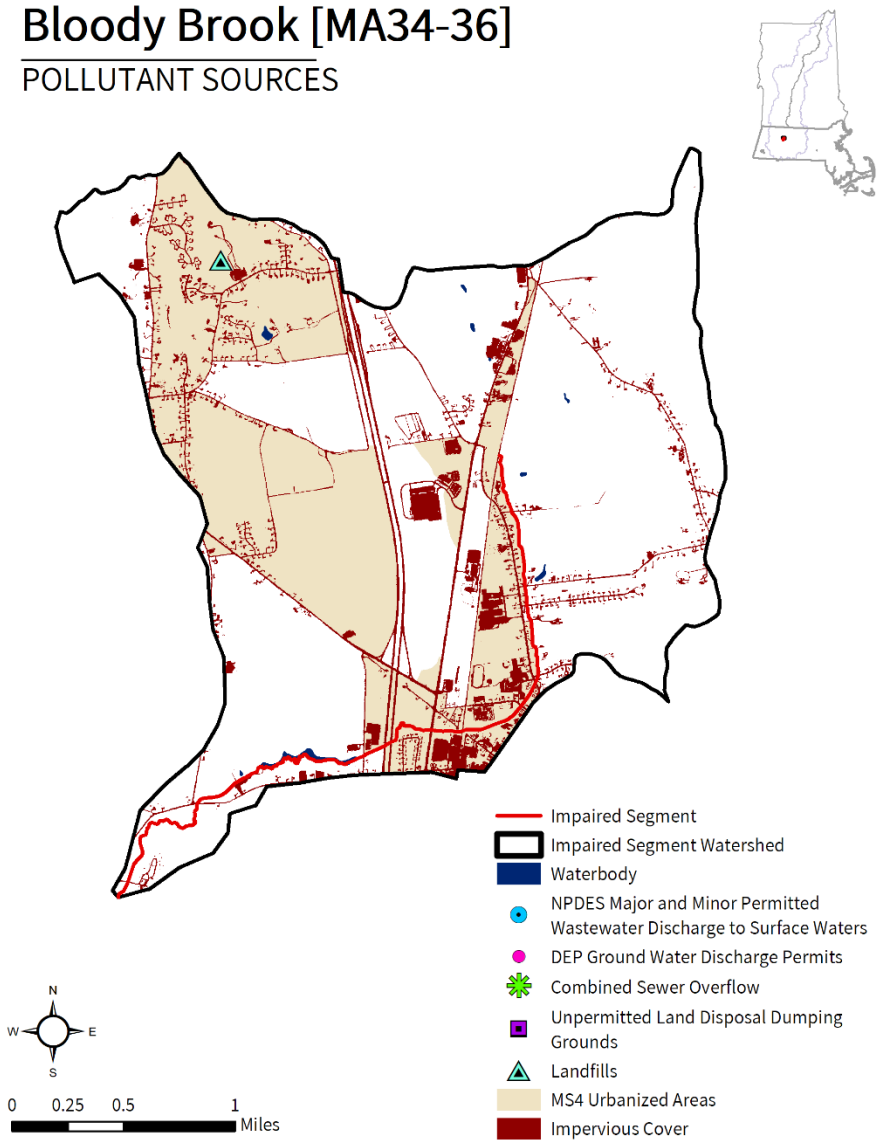


Figure 15-1. Natural resources and potential pollution sources draining to Bloody Brook segment MA34-36. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

15.2. Waterbody Impairment Characterization

Bloody Brook (MA34-36) 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 stations listed below (refer to Tables 15-1, 15-2; Figure 15-2). 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 2008, six samples were collected at W1063, 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 six samples, two exceeded the STV criterion during wet weather.

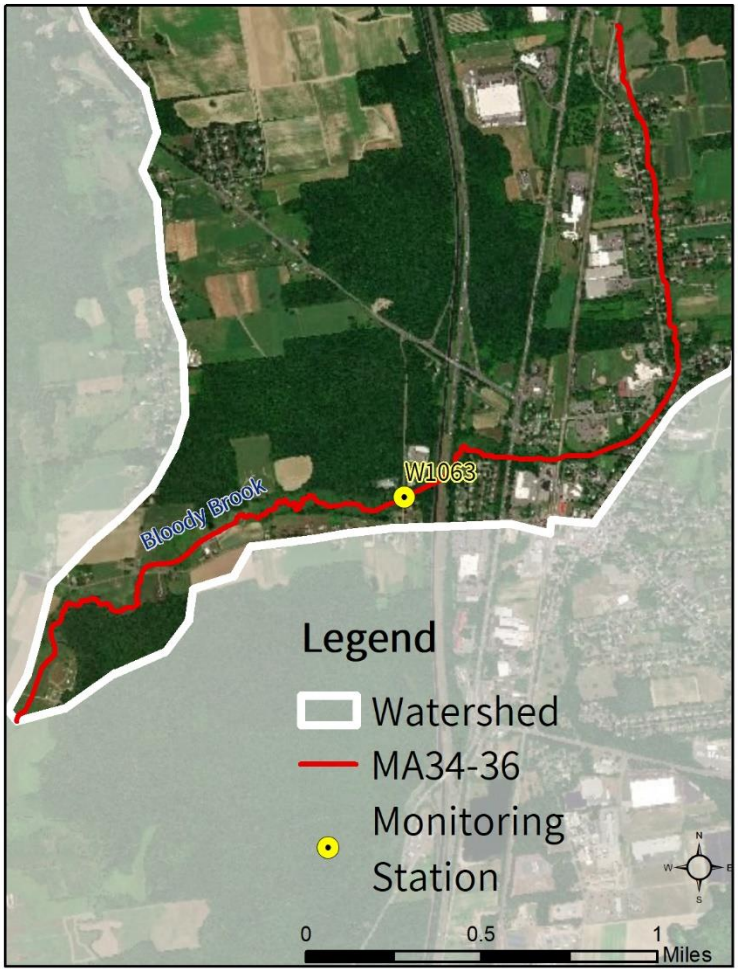


Figure 15-2. Location of monitoring station(s) along the impaired river segment.

Table 15-1. Summary of indicator bacteria sampling results by station for Bloody Brook (MA34-36). 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
W1063	5/6/2008	9/9/2008	6	352	4	2

Table 15-2. Indicator bacteria data by station, indicator, and date for Bloody Brook (MA34-36). 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)
W1063	*E. coli*	5/6/2008	DRY	92	92	
W1063	*E. coli*	6/3/2008	DRY	108	100	
W1063	*E. coli*	7/1/2008	WET	230	132	
W1063	*E. coli*	7/29/2008	WET	410	175	
W1063	*E. coli*	9/3/2008	DRY	170	252	
W1063	*E. coli*	9/9/2008	WET	960	352	

15.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Bloody Brook (MA34-36) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are moderately developed with 34% of the land area in MS4 and 4% as DCIA. Development within the watershed includes low density residential and medium density mixed residential and commercial areas, as well as a major interstate transportation corridor. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With most land area in sewer service and some (34%) of the watershed designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Some of the residential development in the watershed may use septic systems for wastewater treatment. It is likely that some of the septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 34% of the watershed area, more than developed land (24%). Agricultural activities visible on recent aerial photos within the immediate drainage area include open fields, hayfields, greenhouses, and row crops. Many agricultural areas are immediately adjacent to the brook with little

or no vegetative buffer. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are over 600 acres of open space in the watershed. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: There are several areas where large, mowed fields are adjacent to the brook, especially downstream of I-91. Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

15.4. 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 Deerfield. See Section 3.4

Town of Whately. See Section 4.4

16. MA34-42 Buttery Brook

16.1. Waterbody Overview

Buttery Brook segment MA34-42 is 1.6 miles long and begins as a perennial stream west of Haig Avenue in South Hadley, MA. The segment flows south towards the Vietnam Veterans Memorial Bridge, passing under the US-202 and MA-116 intersection. The brook ends at its confluence with the Connecticut River (MA34-05).

Tributaries to Buttery Brook segment MA34-42 include Newton Smith Brook and two unnamed streams. Buttery Brook Pond is also in the watershed.

Key landmarks in the watershed include the Notre Dame cemetery, the Pioneer Valley Preforming Arts Center, Black Stevens Conservation Area, and the cloverleaf MA-116 and US-202 intersection. Buttery Brook is crossed by Purple Heart Drive/US-202 (including ramps to MA-116), Gaylord Street, School Street, Main Street, and Bridge Street/MA-116 in South Hadley.

Buttery Brook (MA34-42) drains an area of 3.2 square miles, of which 0.7 mi^2 (23%) is impervious and 0.4 mi^2 (14%) is directly connected impervious area (DCIA). The entire watershed is served[43] by public sewer and is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). 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 segment watershed. There are also no combined sewer overflows, one landfill, and no unpermitted land disposal dumping grounds within the watershed. See Figure 16-1.

Developed land accounts for the largest percent of land use within the segment watershed (58%), consisting of mixed medium to high density residential and commercial development. The segment itself flows initially through fields, then past an equestrian center before passing under the MA-116 and US-202 intersection via culverts. From this intersection, the segment flows through a dense urban landscape.

Reduction from Highest Calculated Geomean: 91%

Watershed Area (Acres): 2,024

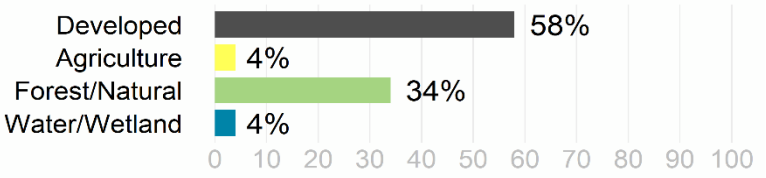
Segment Length (Miles): 1.6

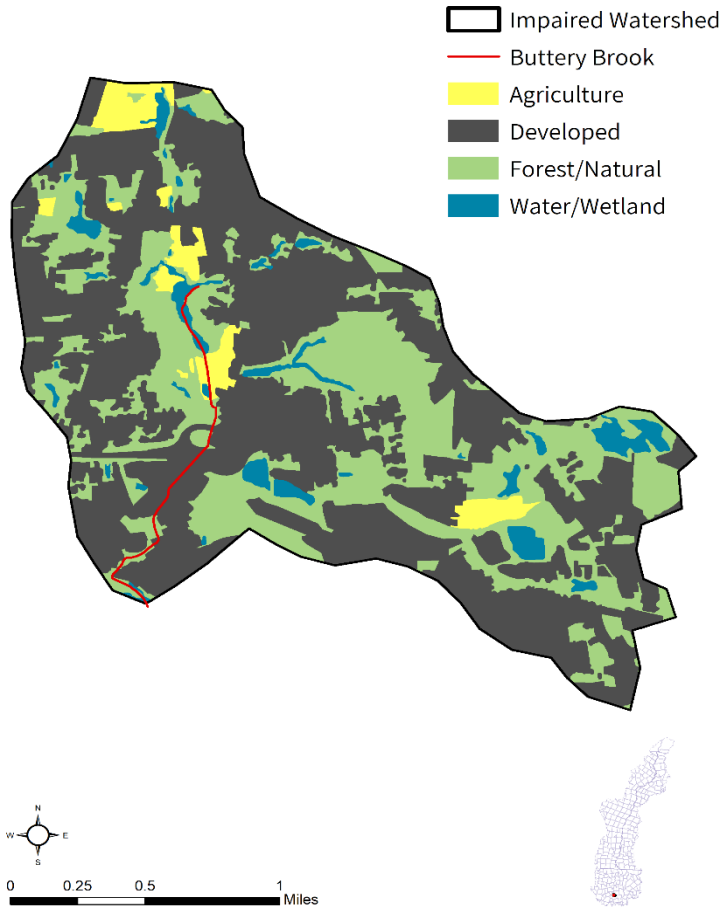
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 457 (23%)

DCIA Area (Acres, %): 274 (14%)





[43] 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.

The watershed of Buttery Brook (MA34-42) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 108 acres (5%) of Priority Habitats of Rare Species but no Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection or identified as Outstanding Resource Waters. There is no land protected in perpetuity[44] within the segment watershed, which would otherwise be part of a total a total of 181 acres (9%) of Protected and Recreational Open Space[45]. See Figure 16-1.

[44] 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.

[45] 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).

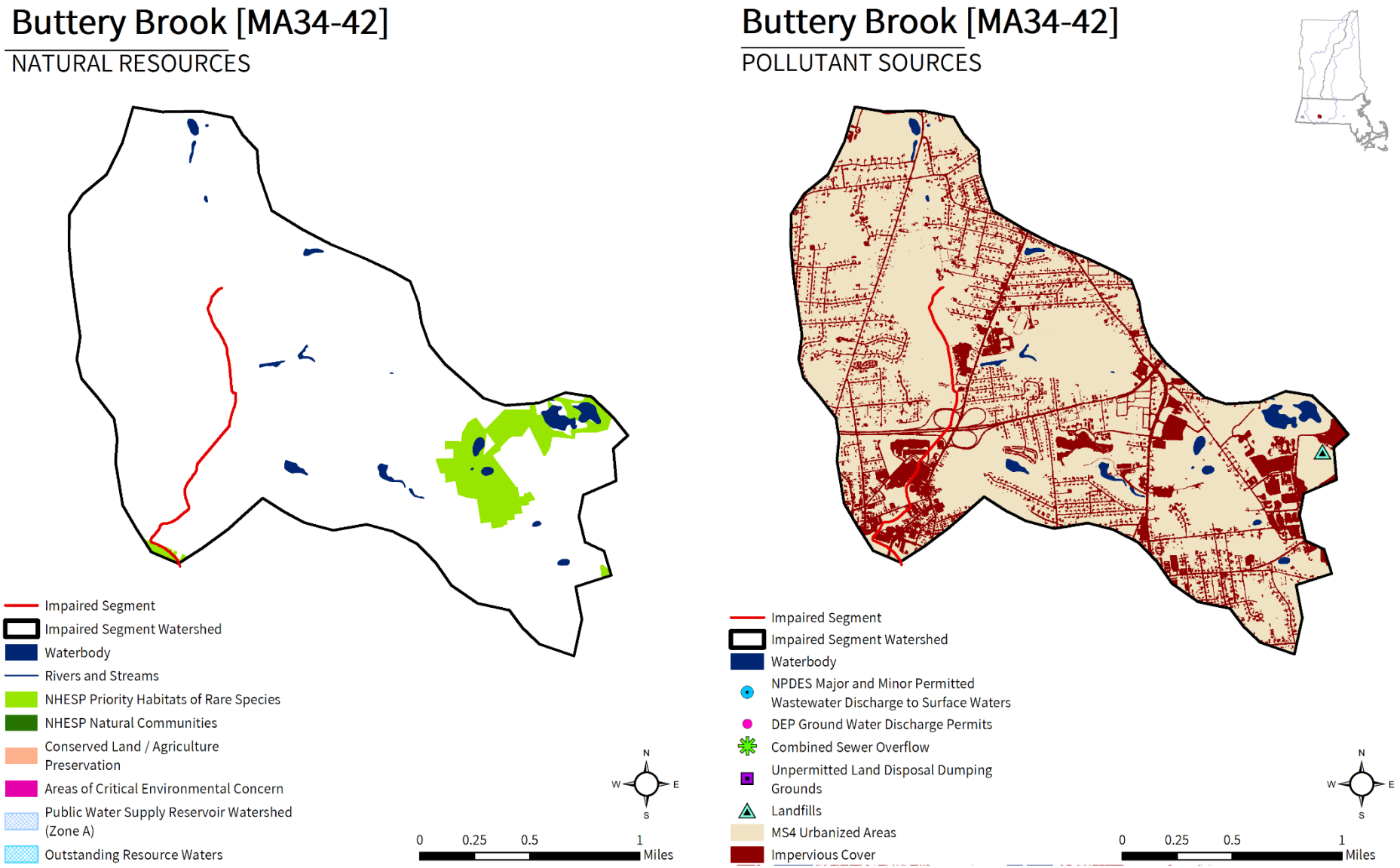


Figure 16-1. Natural resources and potential pollution sources draining to Buttery Brook segment MA34-42. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

16.2. Waterbody Impairment Characterization

Buttery Brook (MA34-42) 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 stations listed below (refer to Tables 16-1, 16-2; Figure 16-2). 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. Data presented below include data collected by MassDEP and the Town of South Hadley (2009).

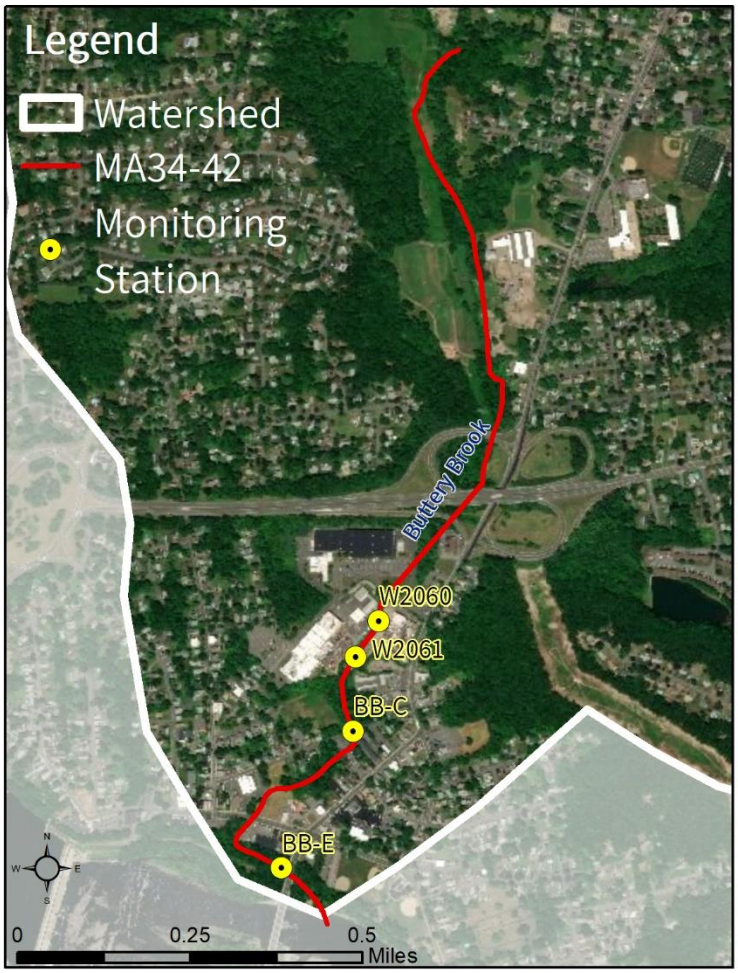


Figure 16-2. Location of monitoring station(s) along the impaired river segment.

- In 2009, five samples were collected at BB-C, resulting in five 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, three exceeded the STV criterion during dry weather.
- In 2009, five samples were collected at BB-E, resulting in five 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, one exceeded the STV criterion during wet weather.
- In 2009, five samples were collected at W2060, resulting in five 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, two exceeded the STV criterion during both wet and dry weather.
- In 2009, five samples were collected at W2061, resulting in five 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, two exceeded the STV criterion during both wet and dry weather.

Table 16-1. Summary of indicator bacteria sampling results by station for Buttery Brook (MA34-42). 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
BB-C	6/30/2009	9/24/2009	5	1407	5	3
BB-E	9/29/2009	10/15/2009	5	500	5	1

W2060	6/30/2009	9/24/2009	5	716	5	2
W2061	6/30/2009	9/24/2009	5	745	5	2

Table 16-2. Indicator bacteria data by station, indicator, and date for Buttery Brook (MA34-42). 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)
BB-C	*E. coli*	6/30/2009	DRY	900	900	
BB-C	*E. coli*	8/6/2009	DRY	2200	1407	
BB-C	*E. coli*	8/28/2009	WET	410	933	
BB-C	*E. coli*	9/15/2009	DRY	250	671	
BB-C	*E. coli*	9/24/2009	DRY	140	491	
BB-E	*E. coli*	9/29/2009	WET	500	500	
BB-E	*E. coli*	9/30/2009	DRY	180	300	
BB-E	*E. coli*	10/6/2009	DRY	190	258	
BB-E	*E. coli*	10/9/2009	WET	122	214	
BB-E	*E. coli*	10/15/2009	DRY	34	148	
W2060	*E. coli*	6/30/2009	DRY	144	144	
W2060	*E. coli*	8/6/2009	DRY	3550	716	
W2060	*E. coli*	8/28/2009	WET	626	685	
W2060	*E. coli*	9/15/2009	DRY	218	514	
W2060	*E. coli*	9/24/2009	DRY	124	387	
W2061	*E. coli*	6/30/2009	DRY	132	132	
W2061	*E. coli*	8/6/2009	DRY	4,200	745	
W2061	*E. coli*	8/28/2009	WET	490	648	
W2061	*E. coli*	9/15/2009	DRY	158	455	
W2061	*E. coli*	9/24/2009	DRY	116	346	

16.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Buttery Brook (MA34-42) were elevated during both wet and dry weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated results during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: The watershed is highly developed with the entire land area in MS4 and 14% as DCIA. Development within the watershed includes medium and high density mixed residential and commercial

development and four-lane highway corridor with a cloverleaf intersection. Given the expansive impervious surfaces and dense urban landscape, stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: With virtually all land area in sewer service and designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Despite full sewer service, there may be a few residential homes or commercial buildings that have not connected to sewer and still use septic systems. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 4% of the watershed and are a potential source of pathogens. Agricultural activities visible on recent aerial photos within the immediate drainage area include open fields, hayfields, row crops, and an equestrian center, some immediately adjacent to the brook. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are 181 acres of open space in the watershed, along with many dense residential neighborhoods. Conservation lands, parks, ballfields, and residential streets popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody along the impaired segment or near headwater tributaries may attract excessive waterfowl and elevate indicator bacteria counts in the water.

16.4. 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 South Hadley. See Section 4.4

17. MA34-60 Unnamed Tributary

17.1. Waterbody Overview

The Unnamed Tributary segment MA34-60 (labeled as Willimansett Brook on some maps) is 2.3 miles long and begins as a perennial stream east of Memorial Drive/MA-33 in Chicopee, MA. The segment generally flows to the west including its 1200 feet within a culvert near the end of the segment at its confluence with the Connecticut River (MA34-05) in Chicopee, MA.

There are no named tributaries to the Unnamed Tributary segment MA34-60. A portion of the stream behind Fletcher Circle is labeled Langewald Pond and another west of Memorial Drive/MA-33 is labeled Mountain Lake on some maps, though recent aerials do not show impoundments. Key landmarks in the watershed include the Fairview neighborhood (Chicopee), the Bellamy Middle School, and the western edge of Westover Air Reserve Base. Segment MA34-60 is crossed by Jamrog Drive, Memorial Drive/MA-33, Ingham Street, a paved footpath from Ingham Street to Bellamy Middle School, Laclede Avenue, Pendleton Avenue, Yelle Street, Prospect Street, and North Chicopee Street, all in Chicopee.

The Unnamed Tributary (MA34-60) drains an area of 2.9 square miles, of which 1.0 mi^2 (34%) is impervious and 0.8 mi^2 (26%) is directly connected impervious area (DCIA). The entire watershed is served[46] by public sewer and is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020a). 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 segment watershed. There is one combined sewer overflow (Table 17-1), no landfills, and no unpermitted land disposal dumping grounds within the watershed. See Figure 17-1.

The segment flows through a narrow, wooded wetland corridor for most of its length. Outside of this corridor, the landscape is heavily urbanized, consisting of medium to high density residential neighborhoods and mixed commercial, industrial, and transportation land uses elsewhere.

Reduction from Highest Calculated Geomean: 92%

Watershed Area (Acres): 1,866

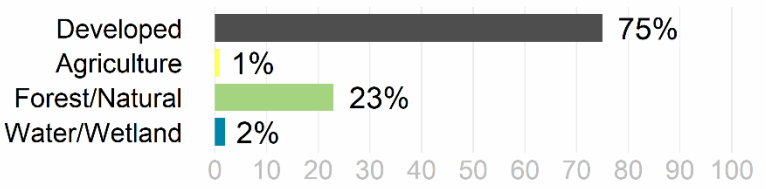
Segment Length (Miles): 2.3

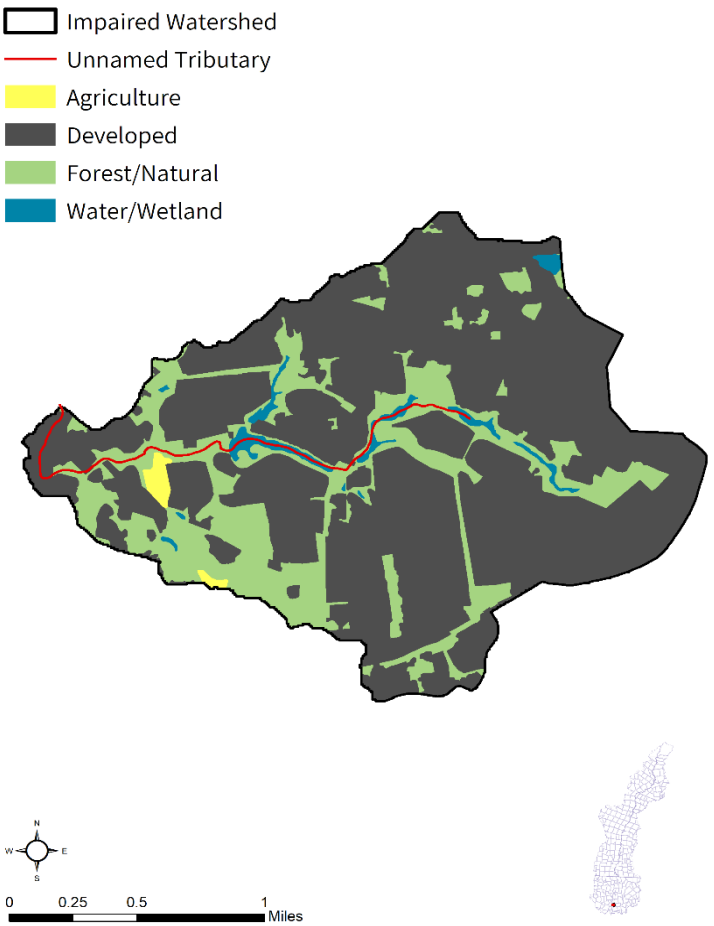
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 643 (34%)

DCIA Area (Acres, %): 489 (26%)





[46] 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.

The watershed of the Unnamed Tributary (MA34-60) does not contain any Areas of Critical Environmental Concern. Under the Natural Heritage and Endangered Species Program, there are 0.3 acres (<1%) of Priority Habitats of Rare Species but no Priority Natural Vegetation Communities. There are no areas under Public Water Supply protection or identified as Outstanding Resource Waters. There is no land protected in perpetuity[47] within the segment watershed, which would otherwise be part of a total of 30 acres (2%) of Protected and Recreational Open Space[48]. See Figure 17-1.

Table 17-1. Combined Sewer Overflows (CSOs) discharging to the segment.

NPDES ID	NAME	TOWN	DEP OUTFALL ID
MA0101508	CHICOPEE WPC/CS	CHICOPEE	CHI42

[47] 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.

[48] 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).

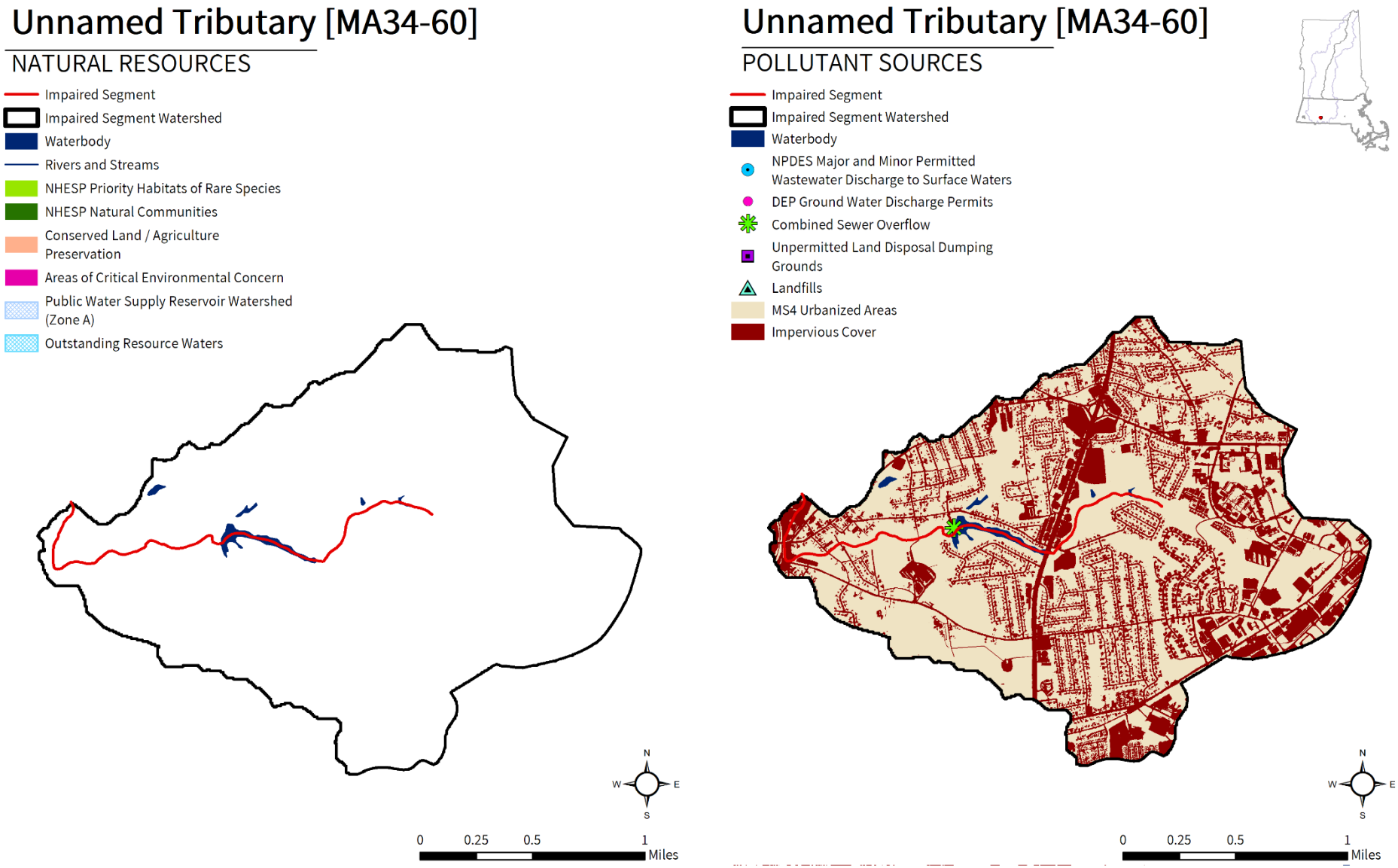


Figure 17-1. Natural resources and potential pollution sources draining to the Unnamed Tributary segment MA34-60. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

17.2. Waterbody Impairment Characterization

The Unnamed Tributary (MA34-60) 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 17-2, 17-3; Figure 17-2). 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, 30-day rolling basis.

- In 2008, six samples were collected at W1798, resulting in two days when the 30-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 six samples, two exceeded the STV criterion during wet weather.

One permittee, MA0101508 (1 outfall), discharges to this segment. A presumptive impairment decision is being applied for this use since this waterbody does not have a CSO variance in place.

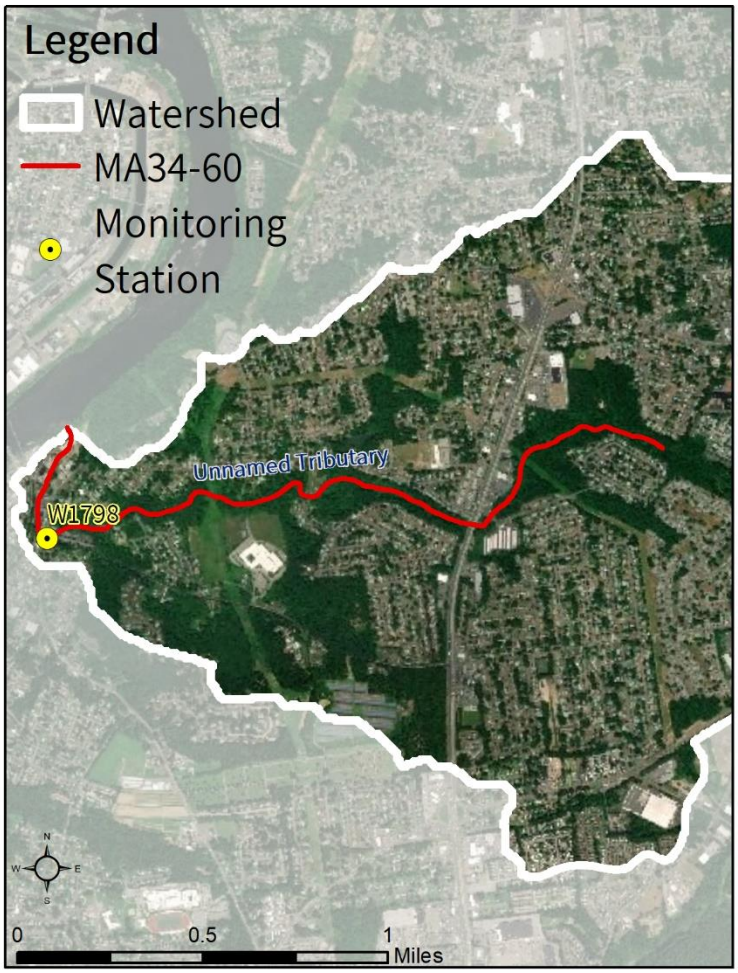


Figure 17-2. Location of monitoring station(s) along the impaired river segment.

Table 17-2. Summary of indicator bacteria sampling results by station for the Unnamed Tributary (MA34-60). The maximum 30-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 30-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 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1798	5/6/2008	9/9/2008	6	1673	4	2

Table 17-3. Indicator bacteria data by station, indicator, and date for the Unnamed Tributary (MA34-60). 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 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1798	*E. coli*	5/6/2008	DRY	4	4	
W1798	*E. coli*	6/3/2008	DRY	80	18	
W1798	*E. coli*	7/1/2008	WET	230	136	
W1798	*E. coli*	7/29/2008	WET	460	325	
W1798	*E. coli*	9/3/2008	DRY	140	140	
W1798	*E. coli*	9/9/2008	WET	20000	1673	

17.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

Indicator bacteria data for the Unnamed Tributary (MA34-60) were elevated during wet weather. Elevated results during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels.

Each potential pathogen source is described in further detail below.

Combined Sewer Overflow (CSO): There is one CSO in the direct drainage area to the segment, which by design releases untreated wastewater to surface waters when flows exceed system capacity, and therefore must be eliminated. For this reason, it is set as the highest priority pathogen source.

Urban Stormwater: The watershed is highly developed, with the entire land area in MS4 and 26% as DCIA. Given the dense urban fabric of the watershed, stormwater runoff from urban areas is likely one of the most significant sources of pathogens.

Illicit Sewage Discharges: With most of the land area in sewer service and all the watershed designated as MS4 area, 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.

On-Site Wastewater Disposal Systems: Although the watershed is served by public sewer, there may be a few residential homes and commercial buildings which have not connected to sewer and still rely on septic systems. Some septic systems are probably not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural areas account for 1% of the watershed, and activities visible on recent aerial photos within the immediate drainage area include open fields adjacent to a utility corridor. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies. Stormwater runoff from agricultural lands within the direct drainage area are not likely a major contributing source of pathogens to the impaired segment.

Pet Waste: There are many dense residential neighborhoods in the segment watershed. There are also a few ballfields and parks which may be popular for dog-walking. Residential areas, trails, and parks, especially where paths are adjacent to rivers, ponds, or wetlands, may represent a possible source of pathogens.

Wildlife Waste: Conservation and recreational lands with large open mowed areas with a clear sightline to a waterbody along the impaired segment or near headwater tributaries may attract excessive waterfowl and elevate indicator bacteria counts in the water. There are a few ballfields with possible sightlines to the stream at the edges of Westover Air Reserve Base.

17.4. 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.

City of Chicopee. See Section 5.4

18. References

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