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

Appendix C: Westfield River Basin

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Rebecca L. Tepper, Secretary
Massachusetts Department of Environmental Protection
Bonnie Heiple, Commissioner
Bureau of Water Resources
Kathleen M. Baskin, Assistant Commissioner

December 2024

CN 515.1.03

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

Appendix C: Westfield River Basin

Prepared by:
TMDL Section, Watershed Planning Program
Division of Watershed Management, Bureau of Water Resources
Massachusetts Department of Environmental Protection

December 2024

CN 515.1.03

Suggested Citation
MassDEP. 2024. Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies. CN 515.1, Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA.

Available Online

https://www.mass.gov/lists/total-maximum-daily-loads-by-watershed

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

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendations by the Massachusetts Department of Environmental Protection.

Contact Information

Watershed Planning Program
Division of Watershed Management, Bureau of Water Resources
Massachusetts Department of Environmental Protection
8 New Bond Street, Worcester, MA 01606
Website: https://www.mass.gov/guides/watershed-planning-program
Email address: dep.wpp@mass.gov

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 ten pathogen-impaired river segments in the Westfield 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 for the TMDLs; the Massachusetts Surface Water Quality Standards (SWQS, 314 CMR 4.00) water classification, impaired designated uses, qualifiers and the applicable water quality standards; 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 Westfield River Watershed Overview section.

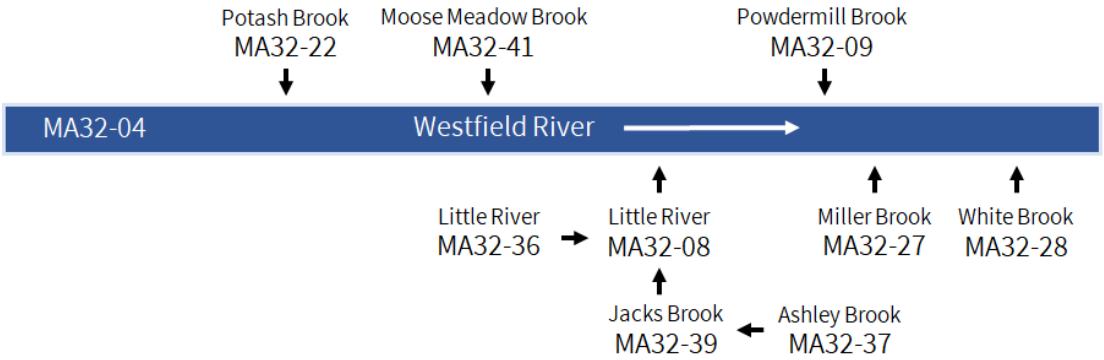


Figure 1-1. Conceptual diagram of water flow routing through the Westfield River watershed for the 10 pathogen-impaired river segments. The mainstem of the Westfield River is highlighted in blue. Tributary segments to the Westfield River are shown with black arrows. Not to scale.

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 Westfield 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)					
Westfield River		P	126	649	81%	WLA (2%)	0.1	0.6	5.9	59.1	590.8	5,908.0
MA32-04	B (CW, HQW)			(30 day)		LA (98%)	3.0	30.2	302.4	3,023.6	30,236.0	302,360.0
Little River		R	126	1,993	94%	WLA (3%)	0.1	0.9	9.1	91.4	914.5	9,144.7
MA32-08	B (CW)			(90 day)		LA (97%)	3.0	29.9	299.1	2,991.2	29,912.3	299,123.3
Powdermill Brook		R	126	229	45%	WLA (15%)	0.5	4.6	45.7	457.2	4,572.4	45,723.6
MA32-09	B			(90 day)		LA (85%)	2.6	26.3	262.5	2,625.4	26,254.4	262,544.5
Potash Brook		R	126	514	75%	WLA (4%)	0.1	1.4	13.5	135.5	1,354.6	13,546.2
MA32-22	B (CW)			(90 day)		LA (96%)	2.9	29.5	294.7	2,947.2	29,472.2	294,721.8
Miller Brook		R	126	280	55%	WLA (14%)	0.4	4.2	41.9	419.4	4,193.8	41,937.9
MA32-27	B (CW)			(90 day)		LA (86%)	2.7	26.6	266.3	2,663.3	26,633.0	266,330.1
White Brook		R	126	334	62%	WLA (19%)	0.6	6.0	59.7	597.5	5,974.8	59,748.1
MA32-28	B (CW)			(90 day)		LA (81%)	2.5	24.9	248.5	2,485.2	24,852.0	248,519.9
Little River		R	126	868	85%	WLA (2%)	0.1	0.6	6.1	60.7	607.1	6,071.2
MA32-36	B (CW)			(90 day)		LA (98%)	3.0	30.2	302.2	3,022.0	30,219.7	302,196.9
Ashley Brook		R	126	1,760	93%	WLA (10%)	0.3	3.0	30.5	304.6	3,045.8	30,458.4
MA32-37	B (CW)			(90 day)		LA (90%)	2.8	27.8	277.8	2,778.1	27,781.0	277,809.6
Jacks Brook		R	126	1,414	91%	WLA (7%)	0.2	2.1	20.8	208.1	2,081.1	20,811.2
MA32-39	B			(90 day)		LA (93%)	2.9	28.7	287.5	2,874.6	28,745.7	287,456.8
Moose Meadow Brook		R	126	2,377	95%	WLA (3%)	0.1	1.1	10.5	105.4	1,053.5	10,535.1
MA32-41	B			(90 day)		LA (97%)	3.0	29.8	297.7	2,977.3	29,773.3	297,732.9

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 Westfield 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)					
Westfield River		R	35	NA	-	WLA (2%)	-	0.2	1.6	16.4	164.1	1,641.1
MA32-04	B (CW, HQW)					LA (98%)	0.8	8.4	84.0	839.9	8,398.9	83,988.9
Little River		P	35	NA	-	WLA (3%)	-	0.3	2.5	25.4	254.0	2,540.2
MA32-08	B (CW)					LA (97%)	0.8	8.3	83.1	830.9	8,309.0	83,089.8
Powdermill Brook		P	35	NA	-	WLA (15%)	0.1	1.3	12.7	127.0	1,270.1	12,701.0
MA32-09	B					LA (85%)	0.7	7.3	72.9	729.3	7,292.9	72,929.0
Potash Brook		P	35	NA	-	WLA (4%)	-	0.4	3.8	37.6	376.3	3,762.8
MA32-22	B (CW)					LA (96%)	0.8	8.2	81.9	818.7	8,186.7	81,867.2

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)					
Miller Brook		P	35	NA	-	WLA (14%)	0.1	1.2	11.6	116.5	1,164.9	11,649.4
MA32-27	B (CW)					LA (86%)	0.7	7.4	74.0	739.8	7,398.1	73,980.6
White Brook		P	35	NA	-	WLA (19%)	0.2	1.7	16.6	166.0	1,659.7	16,596.7
MA32-28	B (CW)					LA (81%)	0.7	6.9	69.0	690.3	6,903.3	69,033.3
Little River		P	35	NA	-	WLA (2%)	-	0.2	1.7	16.9	168.6	1,686.4
MA32-36	B (CW)					LA (98%)	0.8	8.4	83.9	839.4	8,394.4	83,943.6
Ashley Brook		P	35	NA	-	WLA (10%)	0.1	0.8	8.5	84.6	846.1	8,460.7
MA32-37	B (CW)					LA (90%)	0.8	7.7	77.2	771.7	7,716.9	77,169.3
Jacks Brook		P	35	NA	-	WLA (7%)	0.1	0.6	5.8	57.8	578.1	5,780.9
MA32-39	B					LA (93%)	0.8	8.0	79.8	798.5	7,984.9	79,849.1
Moose Meadow Brook		P	35	NA	-	WLA (3%)	-	0.3	2.9	29.3	292.6	2,926.4
MA32-41	B					LA (97%)	0.8	8.3	82.7	827.0	8,270.4	82,703.6

Class *defined in the Massachusetts Surface Water Quality Standards (SWQS) at 314 CMR 4.02.*
Qualifiers *that identify segments with special characteristics are defined at 314 CMR 4.06(1)(d).*
- ***CW*** *= Cold Water; waters that meet the cold water fisheries (CWF) definition at 314 CMR 4.02 and are subject to CWF dissolved oxygen and temperature criteria*
- ***HQW*** *= High Quality Water; waters designated for protection under 314 CMR 4.04(2)*

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 TMD****L 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. Westfield River Watershed Overview

The Westfield River watershed covers an area of approximately 517 square miles in western Massachusetts (Figure 2-1). It includes the mainstem of the Westfield River which flows southeast to its confluence with the Connecticut River in Agawam; the Middle Branch Westfield River flowing from Peru through Chesterfield to its confluence with the mainstem of the Westfield River in Huntington; and the West Branch Westfield River flowing from Becket to its confluence with the mainstem of the Westfield River in Huntington. Overall, there are 89 named rivers, approximately 850 river miles, many smaller unnamed rivers, and 4,200 acres of lakes and ponds in the watershed (MassDEP, 2005).

The mainstem of the Westfield River (also known as the East Branch Westfield River) begins in Savoy and flows generally southeast. It drains 516 square miles, flowing over 55 miles before meeting its confluence with the Connecticut River in Agawam. The river course is altered by many dams in operation as flood control structures (MassDEP, 2005). The mainstem watershed contains one pathogen-impaired river segment.

The Middle Branch Westfield River begins in Worthington and flows generally southeast. It drains 102 square miles, flowing about 16 miles before meeting its confluence with the mainstem of the Westfield River in Huntington (MassDEP, 2005). The watershed does not contain any pathogen-impaired river segments.

The West Branch Westfield River begins in Becket and flows generally to the east. It drains 96 square miles, flowing about 18 miles before its confluence with the mainstem of the Westfield River in Huntington (MassDEP, 2005). The watershed does not contain any pathogen-impaired river segments.

The nine other pathogen-impaired river segments are tributary rivers to the downstream portion of the Westfield River in and downstream of the town of Russell.

The Westfield River's water level fluctuates rapidly in response to precipitation and snowmelt (MassDEP, 2005). Dams present along the mainstem Westfield River, and the Middle Branch Westfield River are operated by the U.S. Army Corps of Engineers to monitor and reduce the risk of flooding caused by the rivers, and many water supply reservoirs within the watershed store runoff year-round. The Westfield River watershed also acts as source water to the Barnes Aquifer. In addition to the aquifer, the watershed serves as a public water supply to seven utilities, including three industrial entities and four groundwater withdrawal systems (MassDEP, 2005).

A total of 43 miles of the Westfield River (including parts along the Main, Middle, and West Branches) were classified by the National Park Service as scenic or recreational under the Wild and Scenic Rivers Act and was the first such designation in Massachusetts (MassDEP, 2005). The 1993 decision, revised in 2004, was based on ecological and recreational values, and historical and literary importance (NWSRS, 2019).

The Westfield River watershed overlaps at least partially with 28 municipalities. Of these, 14 were identified as being direct sources of pathogen loading to the impaired river segments in this TMDL. The efforts of these municipalities contributing to pollutant loading are described in the segment-specific sections below. For each segment, the cities and towns that contain or border the impaired segment were identified. Towns comprising more than 10% of the impaired stream segment's sub-basin (that portion of its watershed not shared with upstream segments) were also included. 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., Huntington for the Westfield River MA32-04), 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.

The EPA and MassDEP jointly issued the General Permits for Stormwater Discharges from MS4s, which became effective July 1, 2018. Communities that discharge to pathogen-impaired waterbodies with approved TMDLs are required to implement enhanced best management practices (BMPs) for public education and designate the catchments as Problem Catchments or High Priority under the Illicit Discharge Detection and Elimination (IDDE)

Program, in addition to the requirement to reduce pollutants to the Maximum Extent Practicable (USEPA, 2020, Appendix F).

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

- Franklin Regional Council of Governments http://www.frcog.org/ (FRCOG, 2021)
- Pioneer Valley Planning Commission http://pvpc.org/ (PVPC, 2021)
- Berkshire Regional Planning Commission http://www.berkshireplanning.org/ (BRPC, 2021)

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 PVPC is a public sector agency which offers local technical assistance to the 43 cities within their jurisdiction and monitors some streams for indicator bacteria.
- BRPC has created an initiative to work with communities that will be impacted by the two proposed interstate natural gas pipelines (2014) to help them participate in the public process correctly and effectively.

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

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

The **Westfield River Watershed Association** (WRWA) aims to “protect and improve the natural resources of the watershed” while expanding recreational opportunities for the people of the community, https://www.westfieldriver.org/. (Westfield River Watershed Association, 2020)

The **Wild and Scenic Westfield River Committee** works to “preserve, protect and enhance the special qualities and outstanding resources of the Westfield River watershed in concert with local communities.” The committee also helps develop scientific data for streams within the watershed, supports environmental education, and provides grant and technical assistance, http://westfieldriverwildscenic.org/. (Wild & Scenic Westfield River Committee, 2020)

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

- **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, 2020).
- **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, 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.

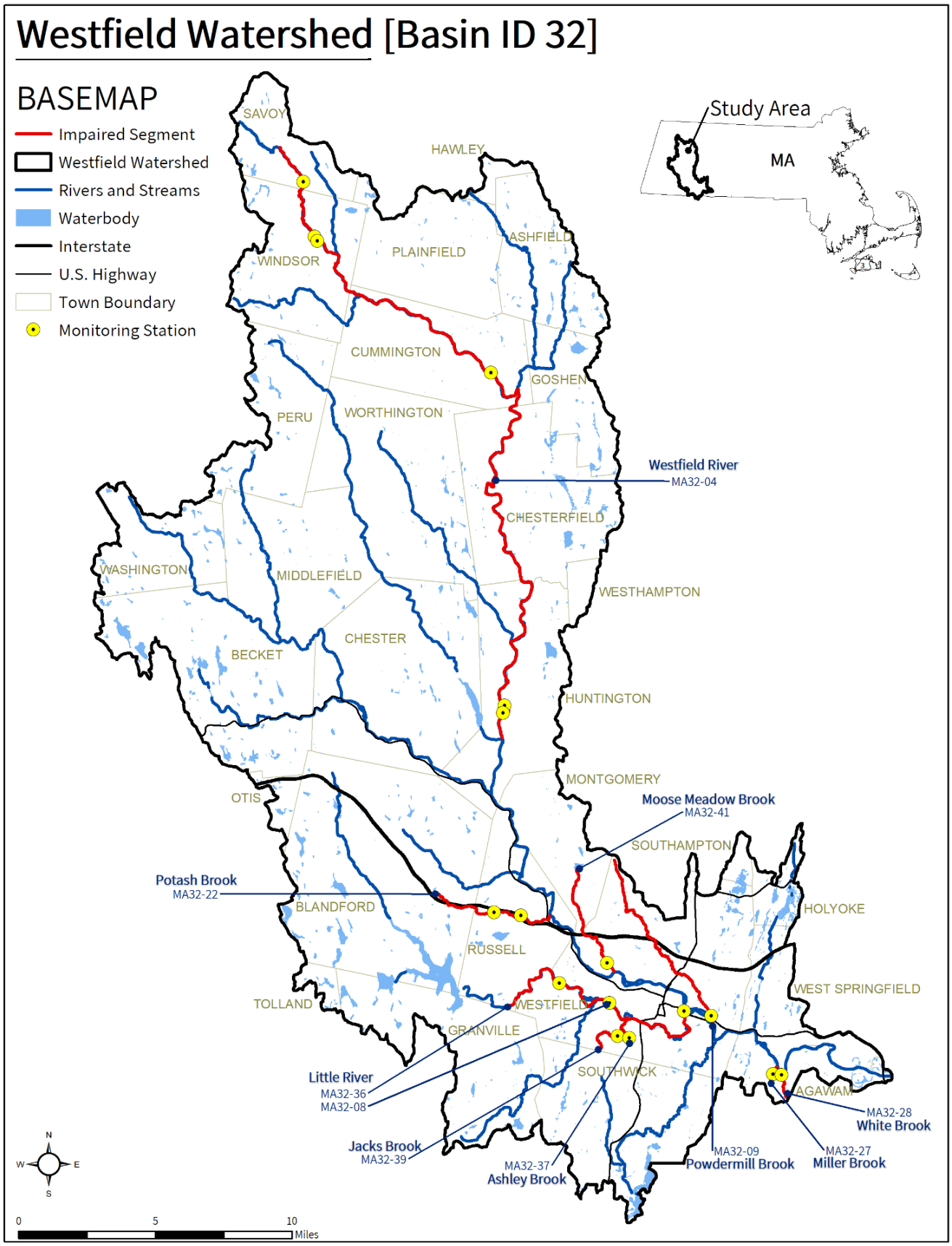


Figure 2-1: Map of all pathogen-impaired river segments, water quality monitoring stations, municipal borders, waterbodies, and roads in the Westfield River watershed.

3. MA32-04 Westfield River

3.1. Waterbody Overview

The Westfield River segment MA32-04 is 33.1 miles long and begins at the confluence of Drowned Land Brook and Center Brook in Savoy, MA. The segment flows in a southern direction through Windsor, Cummington, Chesterfield, and Huntington before ending at its confluence with Middle Branch Westfield River in Huntington, MA.

Tributaries to the Westfield River segment MA32-04 include Drowned Land Brook, Center Brook, Steep Bank Brook, Westfield Brook, Bartlett Brook, Rivulet Brook, Roaring Brook, Mill Brook, Meadow Brook, Swift River, Jewel Brook, Oak Hill Brook, Tower Brook, West Branch, Rocky Brook, Whitside Brook, Dead Branch Brook, Little River, Florida Brook, Sykes Brook, Pond Brook, and many additional unnamed tributaries. Lakes and ponds in the watershed include Windsor Pond, Damon Pond, Hammond Pond, Scout Pond, Norwich Pond, Knightville Reservoir, and other smaller ponds.

Key landmarks in the watershed include the town centers of Savoy, Windsor, Plainfield, Cummington, Goshen, Worthington, and Chesterfield; Norwich Pond; Knightville Dam and Reservation; the State Forests of Bryant Mountain, Gilbert Bliss, and Windsor; and many wildlife management areas. Segment MA32-04 is crossed by Main Road/MA-8A/MA-116 (Savoy); River Road (Windsor); West Main Street, Bridge Street, and Berkshire Trail/MA-9/MA-112 (Cummington); Main Road/MA-143 (Chesterfield), and Worthington Road/MA-112 (Huntington), and others. Roads run along most of the length of this impaired river segment.

The Westfield River (MA32-04) drains an area of 169 square miles, of which 3.2 mi^2 (2%) is impervious and 0.5 mi^2 (<1%) is directly connected impervious area (DCIA). The watershed may be[1] served by public sewer in Ashfield and Huntington, and no areas are within the NPDES General MS4 Stormwater Permit area (USEPA, 2020). 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

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 108,159

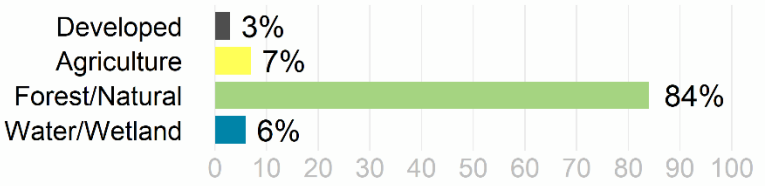
Segment Length (Miles): 33.1

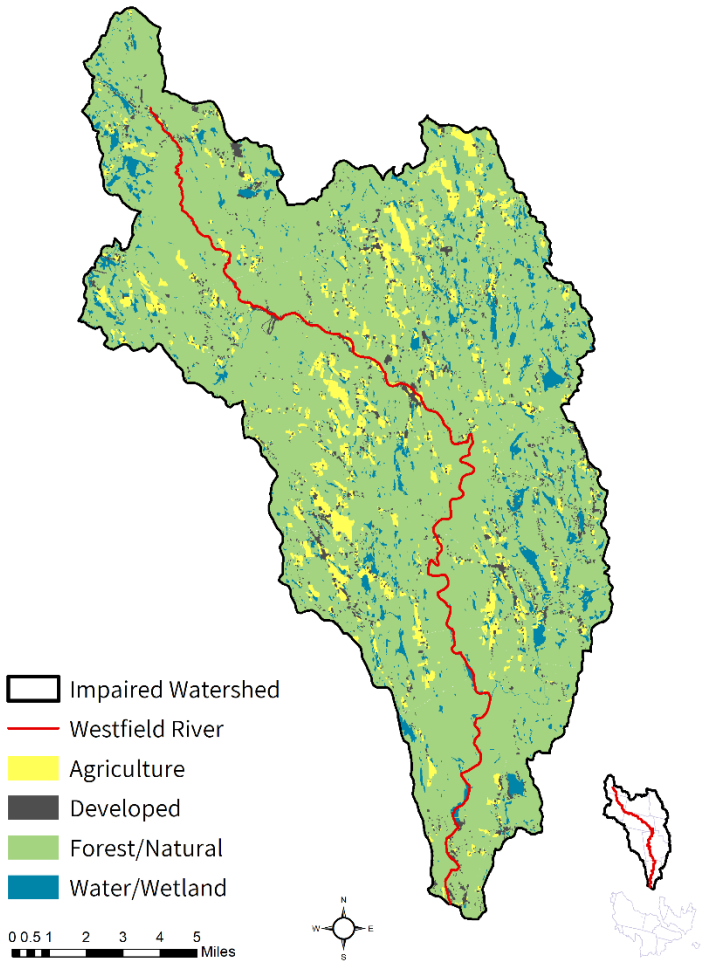
Impairment(s): Enterococci (Primary Contact Recreation)

Class (Qualifiers): B (Cold Water, High Quality Water)

Impervious Area (Acres, %): 2,073 (2%)

DCIA Area (Acres, %): 320 (<1%)





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

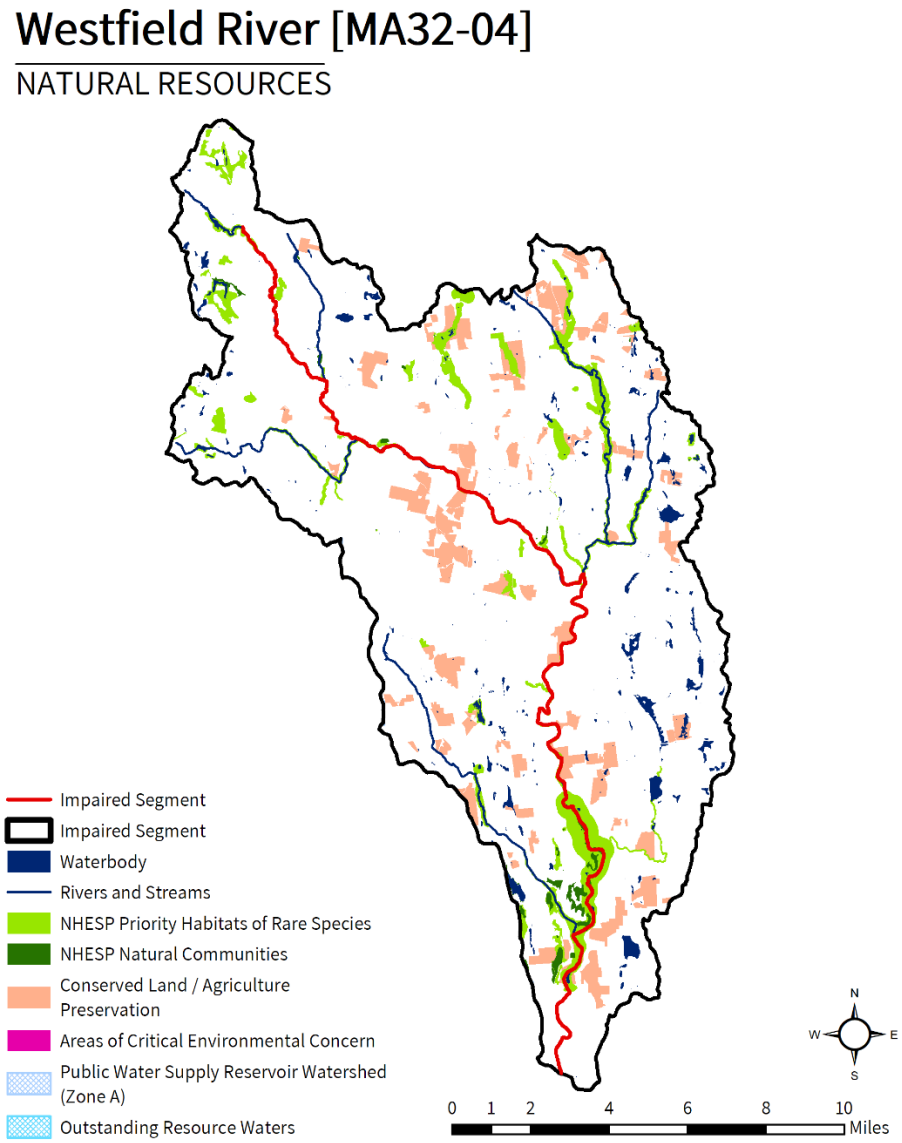
sewer overflows within the watershed. There are eight landfills and two unpermitted land disposal dumping grounds within the segment watershed. See Figure 3-1.

The Westfield River watershed encompasses a rural part of the state, predominantly forest lands with minimal urban area. The scattered agricultural lands (7% of land area) are more than twice the developed land (3%). Developed areas are primarily residential. Together, forested/natural areas and water/wetland areas make up 90% of the segment's watershed area. The segment itself is almost entirely within a forested corridor, except for the small villages of Savoy, West Cummington, and Cummington along the banks.

In the watershed of the Westfield River (MA32-04), under the Natural Heritage and Endangered Species Program, there are 7,662 acres (7%) of Priority Habitats of Rare Species and 659 acres (1%) of Priority Natural Vegetation Communities. There are 44 acres (<1%) under Public Water Supply protection but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 9,145 acres (8%) of land protected in perpetuity[2] exist within the segment watershed, which is part of a total of 34,379 acres (32%) of Protected and Recreational Open Space[3]. See Figure 3-1.

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

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



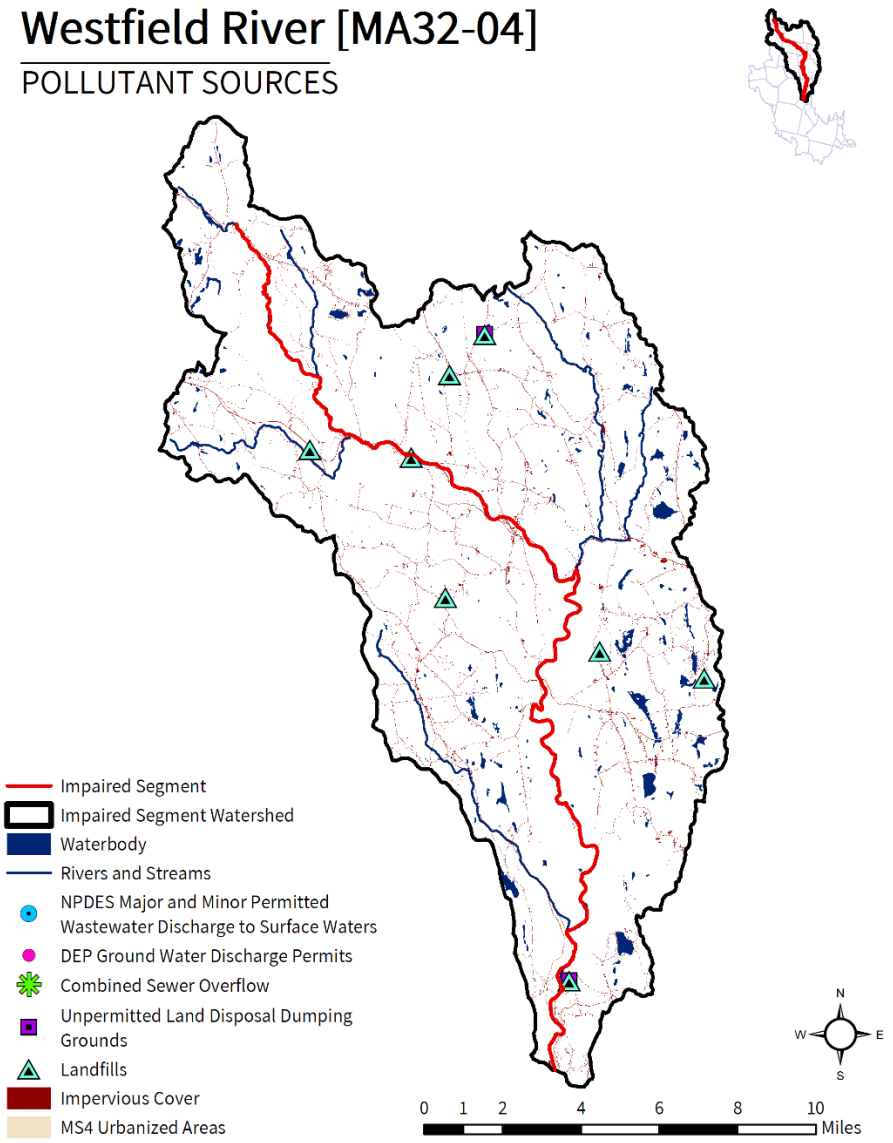


Figure 3-1. Natural resources and potential pollution sources draining to the Westfield River segment MA32-04. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

3.2. Waterbody Impairment Characterization

The Westfield River (MA32-04) is a Class B, Cold Water, and High Quality Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria Enterococci at the MA DPH stations #4909 and #4944, which are located at a designated public bathing beach known as the Westfield River Beach. MassDEP assessed the Primary Contact Recreation use as not supporting since beach swimming advisory postings frequently exceeded 10% for years where there were data available (Table 3-1). 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 (Tables 3-2 and 3-3).

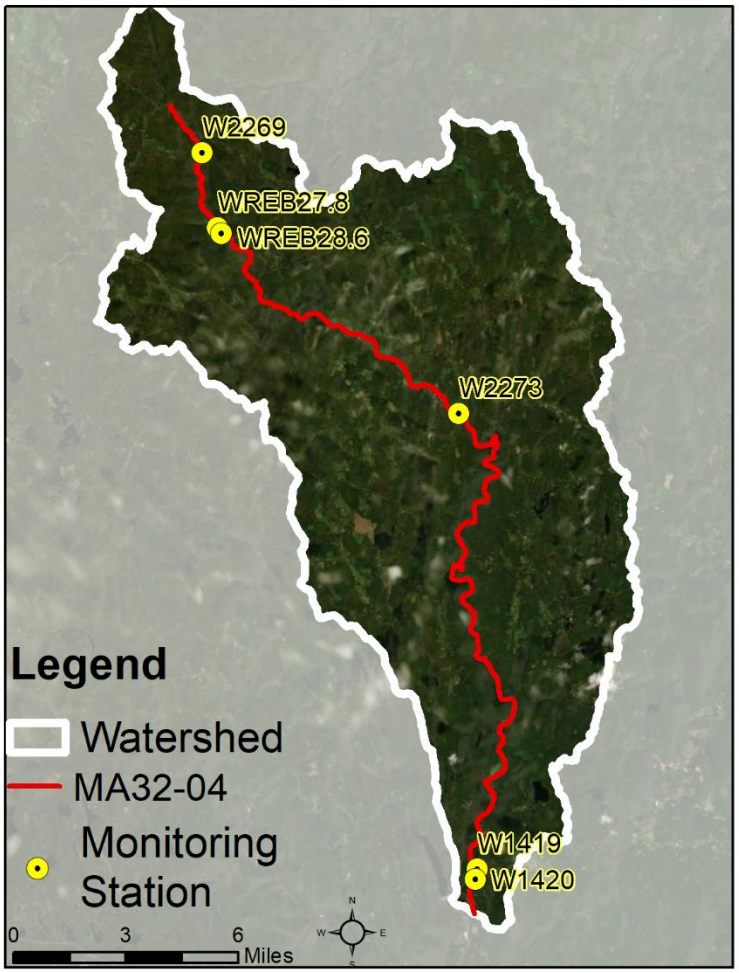


Figure 3-2. Location of monitoring station(s) along the impaired river segment.

Table 3-1. Summary of MA DPH beach posting data for 2005-2013 by station for Westfield River Beach (MA32-04). Percentages indicate the portion of Enterococci sample results that exceeded MA DPH beach criteria for the bathing season in each year. No more than 10% of samples within a season can exceed SWQS.

ID	Name	Town	2005	2006	2007	2008	2009	2010	2011	2012	2013	Beach Decision
4909	Westfield River Beach	Windsor	23%	18%	8%	26%						Impair
4944	Westfield River Beach	Huntington	87%									Impair

Table 3-2. Summary of indicator bacteria sampling results by station for the Little River (MA32-08). 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
W1419	5/9/2006	10/3/2006	5	24	0	0
W1420	4/26/2009	11/22/2009	8	191	1	2
WREB27.8	4/26/2009	11/22/2009	8	112	0	0
WREB28.6	4/26/2009	11/22/2009	8	112	0	0
W2269	5/17/2012	9/20/2012	6	56.3	0	0
W2273	5/17/2012	9/20/2012	6	300	3	1

Table 3-3. Indicator bacteria data by station, indicator, and date for the Little River (MA32-08). 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)
W1419	*E. coli*	5/9/2006	DRY	20	20	
W1419	*E. coli*	6/13/2006	DRY	12	15	
W1419	*E. coli*	7/25/2006	DRY	8	12	
W1419	*E. coli*	8/29/2006	WET	56	18	
W1419	*E. coli*	10/3/2006	WET	32	24	
W1419	Fecal Coliform	5/9/2006	DRY	120		
W1419	Fecal Coliform	6/13/2006	DRY	14		
W1419	Fecal Coliform	7/25/2006	DRY	22		
W1419	Fecal Coliform	8/29/2006	WET	30		
W1419	Fecal Coliform	10/3/2006	WET	50		
W1420	*E. coli*	4/26/2009	DRY	1	1	
W1420	*E. coli*	5/18/2009	WET	461	21	
W1420	*E. coli*	6/28/2009	DRY	44	27	
W1420	*E. coli*	7/26/2009	WET	91	123	
W1420	*E. coli*	8/23/2009	WET	225	97	
W1420	*E. coli*	9/27/2009	WET	36	90	
W1420	*E. coli*	10/25/2009	WET	866	191	
W1420	*E. coli*	11/22/2009	DRY	16	79	
WREB27.8	*E. coli*	4/26/2009	DRY	1	1	
WREB27.8	*E. coli*	5/18/2009	WET	38	6	
WREB27.8	*E. coli*	6/28/2009	DRY	24	10	
WREB27.8	*E. coli*	7/26/2009	WET	53	36	
WREB27.8	*E. coli*	8/23/2009	WET	96	50	
WREB27.8	*E. coli*	9/27/2009	WET	190	99	
WREB27.8	*E. coli*	10/25/2009	WET	77	112	
WREB27.8	*E. coli*	11/22/2009	DRY	21	67	
WREB28.6	*E. coli*	4/26/2009	DRY	1	1	
WREB28.6	*E. coli*	5/18/2009	WET	37	6	
WREB28.6	*E. coli*	6/28/2009	DRY	39	11	

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
WREB28.6	*E. coli*	7/26/2009	WET	49	41	
WREB28.6	*E. coli*	8/23/2009	WET	99	57	
WREB28.6	*E. coli*	9/27/2009	WET	260	108	
WREB28.6	*E. coli*	10/25/2009	WET	54	112	
WREB28.6	*E. coli*	11/22/2009	DRY	61	95	
W2269	*E. coli*	5/17/2012	WET	33	33	
W2269	*E. coli*	5/31/2012	WET	88	54	
W2269	*E. coli*	6/21/2012	DRY	36	47	
W2269	*E. coli*	7/26/2012	WET	14	35	
W2269	*E. coli*	8/23/2012	DRY	8	24	
W2269	*E. coli*	9/20/2012	WET	172	27	
W2273	*E. coli*	5/17/2012	WET	25	25	
W2273	*E. coli*	5/30/2012	WET	249	79	
W2273	*E. coli*	6/14/2012	WET	66	74	
W2273	*E. coli*	7/19/2012	DRY	649	128	
W2273	*E. coli*	8/16/2012	WET	146	199	
W2273	*E. coli*	9/20/2012	WET	285	300	

3.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a small amount of development in the watershed, with no land area in MS4 and <1% as DCIA. Ninety percent of the watershed is forest, natural areas, water, or wetlands. There are rural roadways that follow the river and three small villages along its banks. Stormwater runoff from urban areas could be a locally significant source of pathogens.

Illicit Sewage Discharges: A portion of the watershed may rely on sewer service. There may also be private wastewater infrastructure, such as building wastewater drains, which may intersect with storm drainage in isolated areas. Leaky wastewater lines and illicit connections are a possible source of pathogens, though not at the same scale as more urbanized environments. Other forms of illicit discharges may occur, including unauthorized dumping of wastewater from pump-out trucks, campers, or other sources. Swimmers at the public beach may represent a direct illicit source of pathogens if restrooms are not used or available.

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

Agriculture: Agricultural activities in the watershed account for 7% of the total land use, with some areas adjacent to the segment. Agricultural activities visible on recent aerial photos include open fields, hayfields, row crops, and pastureland. Activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens. Pets may be allowed at the public beach and thus may be a direct source of pathogens to the segment.

Wildlife Waste: There are large, forested lands and wetlands throughout the watershed. Large open mowed areas or fields with a clear sightline to a waterbody, like those in the village of Savoy and around the Knightville Reservoir, may attract excessive waterfowl and elevate indicator bacteria counts in the water. Waterfowl may utilize the public beach area to eat any food left by visitors.

3.4. Existing Local Management

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

Town of Chesterfield

Chesterfield is not within the MS4 area.

Chesterfield has the following relevant ordinances and bylaws:

- Chesterfield does not have any supplementary regulations beyond the MassDEP regulations for stormwater management and wetland protection.
- Title 5 Supplementary Regulations: None found.
- Pet Waste: None found.
- Stormwater Utility (or similar): None found.
- Contact Recreation Regulations or Bylaws: None found.

The Town of Chesterfield does not offer a Master Plan or Open Space Plan on their website http://www.townofchesterfieldma.com/ (Town of Chesterfield, 2021). Chesterfield adopted a Hazard Mitigation Plan in 2016 http://www.pvpc.org/sites/default/files/ChesterfieldHMP2016.pdf (Town of Chesterfield, 2016). This plan notes that Chesterfield has hazard mitigation capabilities in place, including "limitations on development in floodplains [and] stormwater management." Action items in the plan include expanding the Chesterfield Zoning Bylaw to address increased stormwater runoff town wide. The plan also has a section on Chesterfield water resources, starting on page 13. The plan notes that Chesterfield does not have a public water supply, public sewer, or wastewater treatment plant.

Town of Cummington

Cummington is not within the MS4 area.

Cummington has the following relevant ordinances and bylaws:

- Cummington does not have any supplementary regulations beyond the MassDEP regulations for stormwater management and wetland protection.
- Pet waste ordinance: http://www.cummington-ma.gov/Bylaws.php?Bylaws (Town of Cummington, 2020a)
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility (or similar): None found.
- Contact Recreation Regulations or Bylaws: None found.

Cummington does not have a Master Plan. The Open Space and Recreation Plan has a water resources section in the Community Setting chapter, noting that water flowing through Cummington eventually discharges to the Westfield River. The Water Supply Systems and Sewer Service section notes only on-site septic systems for sewage disposal and most residents outside the town centers rely on private wells for water supply. Stormwater is not mentioned, though the town has plans to adopt a stormwater management bylaw.

Town website: http://www.cummington-ma.gov/ (Town of Cummington, 2021)

Open Space and Recreation Plan: https://cummington-ma.gov/Boards.php?55 (Town of Cummington, 2020b)

Town of Huntington

Huntington is not within the MS4 area.

Huntington has the following relevant ordinances and bylaws:

- Huntington does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title 5 Supplemental Regulations: None found.

- Stormwater Utility: None found.
- Pet Waste Ordinance: https://huntingtonma.us/RegDocs/General%20Bylaws%20amended%206.5.2017.pdf (Town of Huntington, 2017)

The Community Development Plan for the Town of Huntington notes that "the vast majority of the town has pervious cover" and an expansive "amount of permanently protected open space," and thus water quality is generally not a problem (page 21). The plan has a section on Huntington's Natural and Historical Resources, noting the Westfield River. Stormwater runoff is mentioned in relation to the town's long-term goal to conduct water quality planning and preservation (page 8). The plan does not provide information on the town's sewer infrastructure, though it mentions plans to strengthen the town's septic system regulations.

Town website: https://huntingtonma.us (Town of Huntington, 2021)

Master Plan (Community Development Plan): http://huntingtonma.us/Reports/huntington%20community%20development%20plan%20and%20vision.pdf (Town of Huntington, 2003)

Open Space and Recreation Plan: not available, though mentioned within the Community Development Plan.

Town of Plainfield

Plainfield is not within the MS4 area.

Plainfield has the following relevant ordinances and bylaws:

- Plainfield 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 Town of Plainfield does not have a Master Plan. The town website is https://plainfield-ma.us/ (Plainfield, 2021)

The Town of Plainfield does not have an Open Space and Recreation Plan.

Town of Savoy

Savoy is not within the MS4 area. Savoy had no relevant ordinances or bylaws. Savoy does not have a Master Plan available. Savoy does not have an Open Space and Recreation Plan available.

Town of Windsor

Windsor is not within the MS4 area. Windsor has no relevant ordinances and bylaws. Windsor has no Master Plan available. Windsor had no Open Space and Recreation Plan available.

Town of Worthington

Worthington is not within the MS4 area. Worthington has no relevant ordinances or bylaws.

Worthington has no available Master Plan.

Worthington's Open Space and Recreation Plan: https://worthington-ma.us/wp-content/uploads/2018/06/OSPlan2006.pdf (Town of Worthington, 2006)

4. MA32-08 Little River

4.1. Waterbody Overview

The Little River segment MA32-08 is 4.9 miles long and begins at Hortons Bridge (Granville Road) in Westfield, MA. The segment flows to the east between two large agricultural complexes, then north to end at its confluence with the Westfield River in Westfield, MA.

Tributaries to the Little River segment MA32-08 include the pathogen-impaired segments Little River MA32-36 (immediately upstream) and Jacks Brook MA32-39; Hundred Acre Brook; and several smaller unnamed streams. Major lakes and ponds within the watershed include Crane Pond along the segment itself, Cobble Mountain Reservoir, Borden Brook Reservoir, and Cooley Lake (Pine Lake).

Key landmarks in the watershed along the impaired segment include Pine Hill Cemetery, Baystate Noble Hospital, Westfield Middle School, Highland Elementary School, Columbus Greenway Trail, and the Springfield Aqueduct. Segment MA32-08 is crossed by Southwick Road/US-202/MA-10, Hundred Acres Road, Columbus Greenway (trail), and East Main Street/MA-20, all within Westfield.

The Little River (MA32-08) drains an area of 85 square miles, of which 2.5 mi^2 (3%) is impervious and 0.9 mi^2 (1%) is directly connected impervious area (DCIA). The watershed is partially[4] served by public sewer and 9% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are three landfills, no combined sewer overflows, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 4-1.

Although the watershed has only 5% of the land area in agricultural use, the segment itself flows near three large agricultural complexes with expansive row crops, barns, and greenhouses. The watershed overall is only moderately

Reduction from Highest Calculated Geomean: 94%

Watershed Area (Acres): 54,702

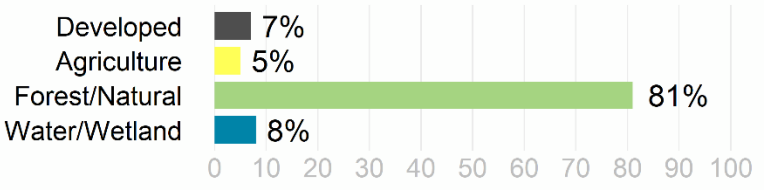
Segment Length (Miles): 4.9

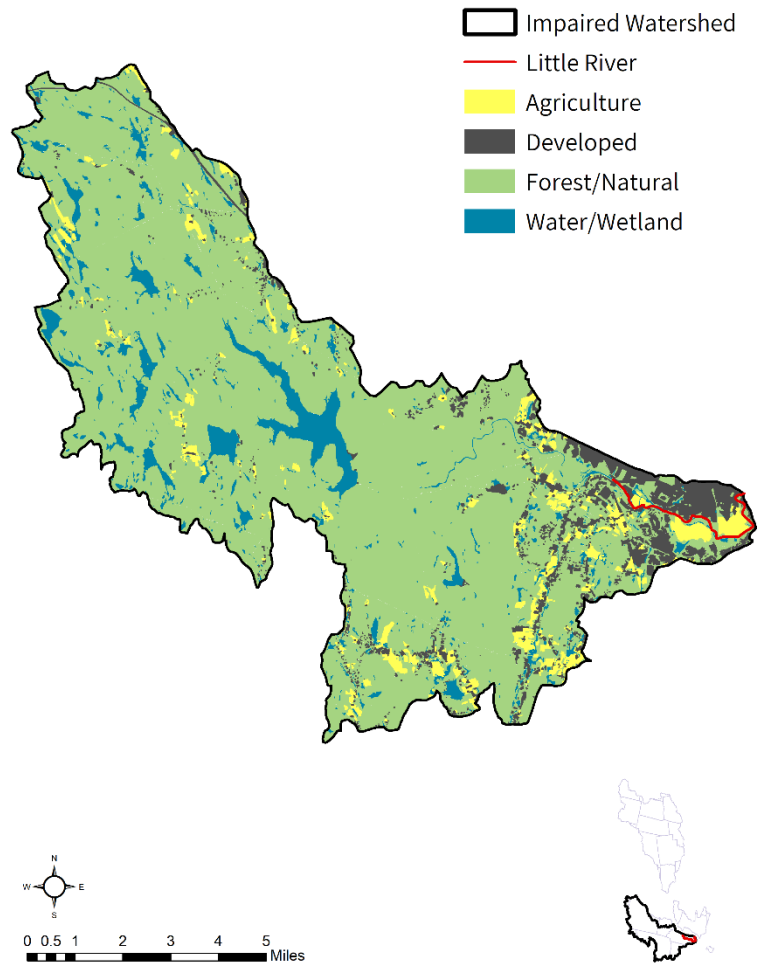
Impairment(s): *E. coli* and fecal coliform (Primary Contact Recreation)

Class (Qualifier): B (Cold Water)

Impervious Area (Acres, %): 1,623 (3%)

DCIA Area (Acres, %): 603 (1%)





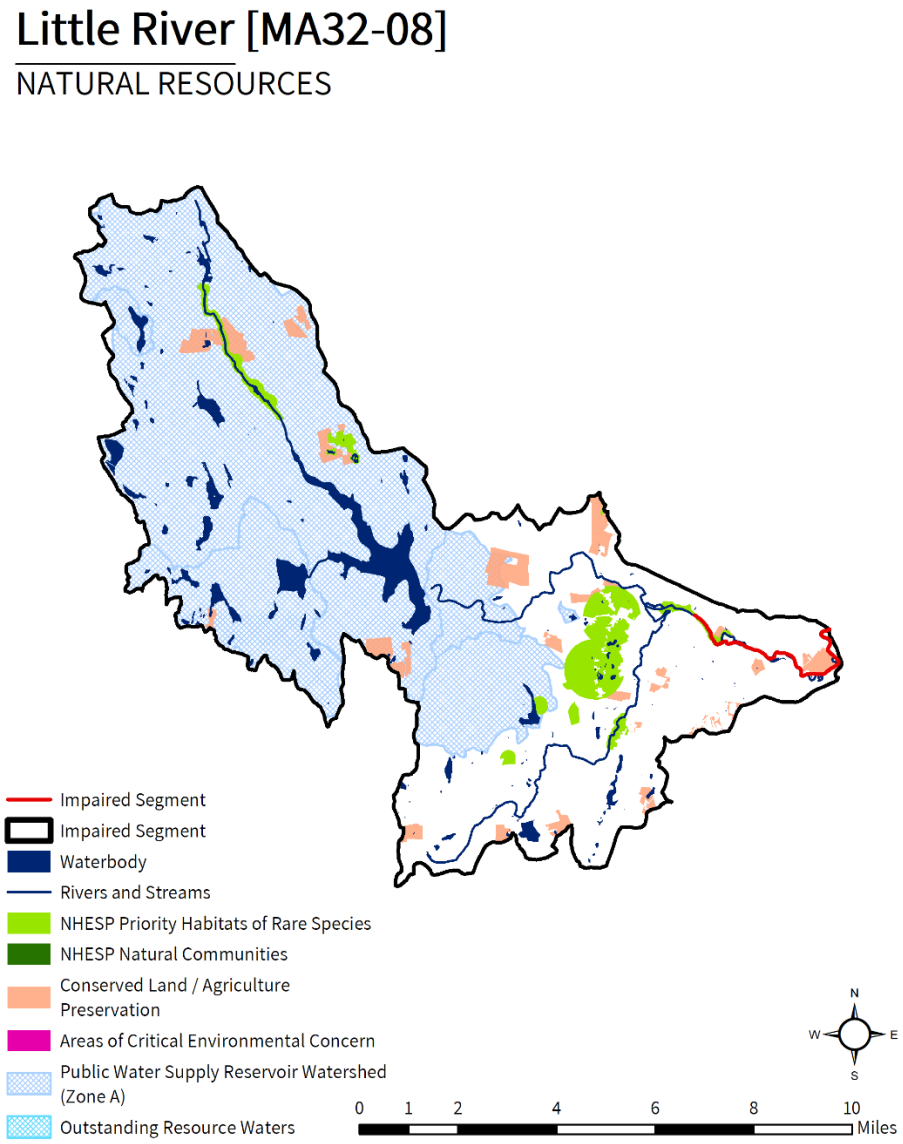
[4] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local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

developed with 7% of the land developed. The area around the segment is medium to high density mixed residential, commercial, and transportation development, including some commercial and warehouse developments with expansive parking lots, especially along South Broad Street and Main Street/MA-20. Nonetheless, most of the river has at least some wooded buffer along the banks.

In the Little River (MA32-08) watershed, under the Natural Heritage and Endangered Species Program, there are 2,190 acres (4%) of Priority Habitats of Rare Species. There are 34,224 acres (63%) under Public Water Supply protection, but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 2,571 acres (5%) of land protected in perpetuity[5] exist within the segment watershed, which is part of a total of 23,680 acres (43%) of Protected and Recreational Open Space[6]. See Figure 4-1.

[5] 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.

[6] 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).



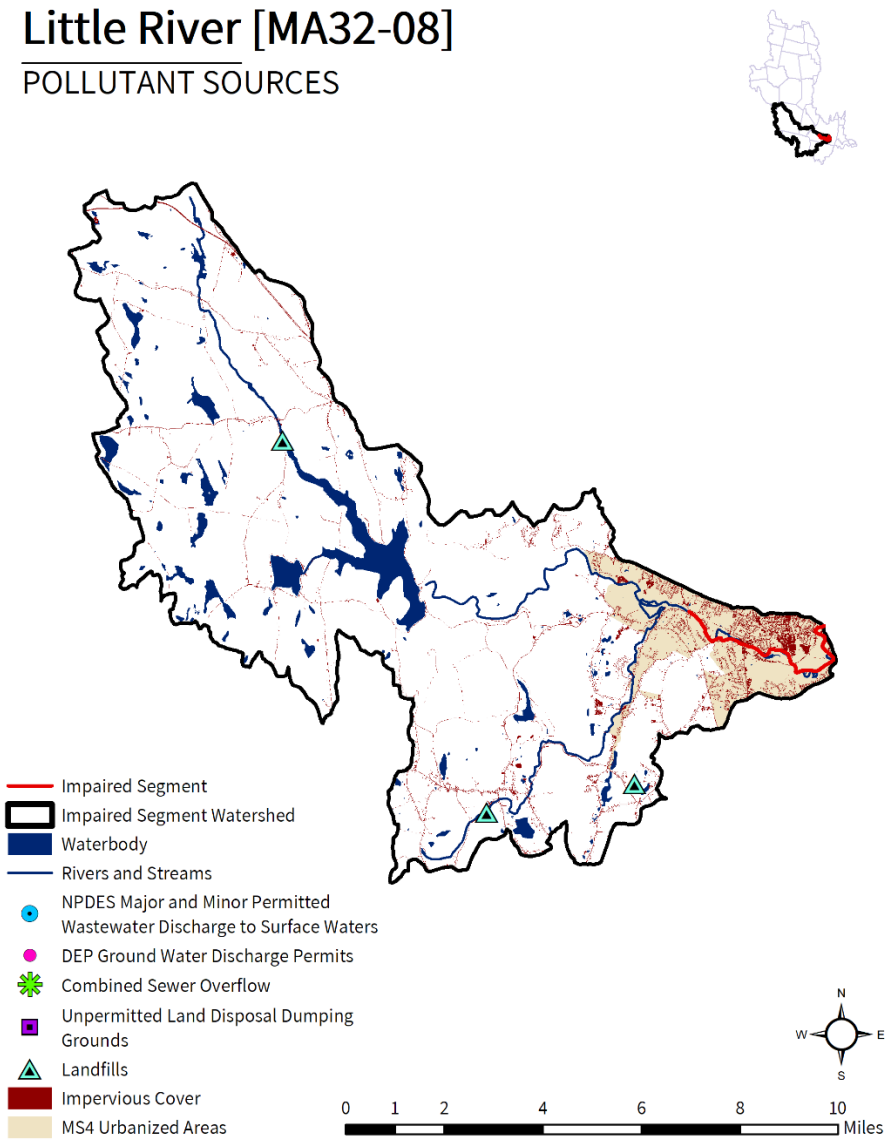


Figure 4-1. Natural resources and potential pollution sources draining to the Little River segment MA32-08. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

4.2. Waterbody Impairment Characterization

The Little River (MA32-08) is a Class B, Cold 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 4-1, 4-2; 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, 90-day rolling basis.

- Between 2006-2009, 13 samples were collected at W0808, resulting in 10 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 13 samples, one exceeded the STV criterion during both wet and dry weather.

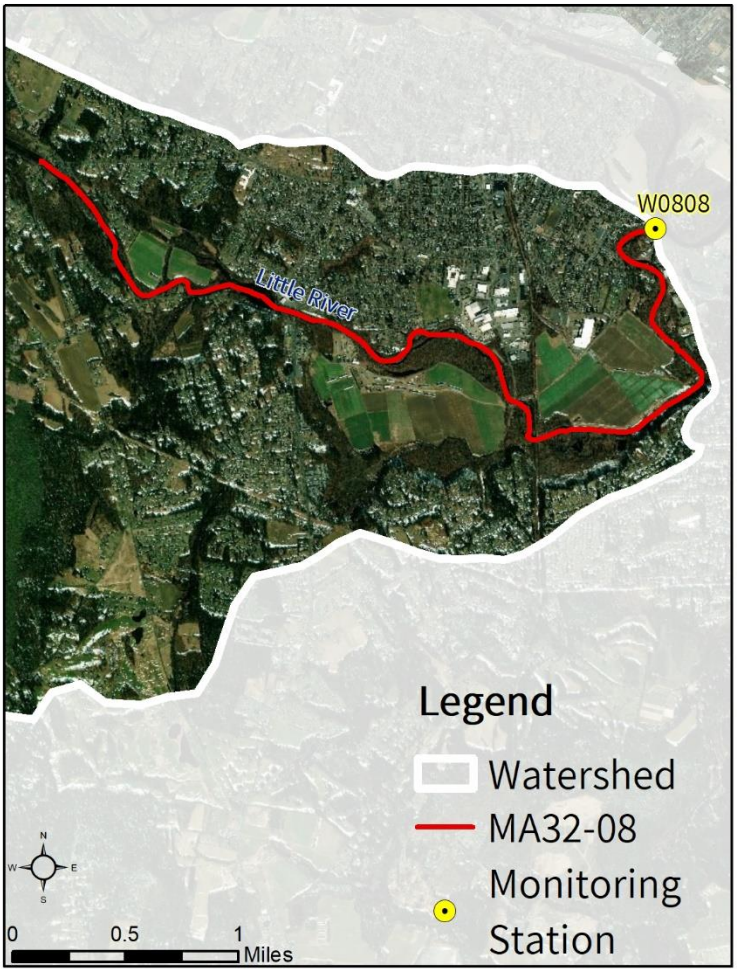


Figure 4-2. Location of monitoring station(s) along the impaired river segment.

Table 4-1. Summary of indicator bacteria sampling results by station for the Little River (MA32-08). 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
W0808	5/9/2006	11/22/2009	13	1993	10	6

Table 4-2. Indicator bacteria data by station, indicator, and date for the Little River (MA32-08). 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)
W0808	*E. coli*	5/9/2006	DRY	20	20	
W0808	*E. coli*	6/13/2006	DRY	80	40	
W0808	*E. coli*	7/25/2006	DRY	156	63	
W0808	*E. coli*	8/29/2006	WET	832	218	
W0808	*E. coli*	10/3/2006	WET	224	307	
W0808	Fecal Coliform	5/9/2006	DRY	80		
W0808	Fecal Coliform	6/13/2006	DRY	150		
W0808	Fecal Coliform	7/25/2006	DRY	280		
W0808	Fecal Coliform	8/29/2006	WET	880		
W0808	Fecal Coliform	10/3/2006	WET	195		
W0808	*E. coli*	4/26/2009	DRY	1986	1986	
W0808	*E. coli*	5/18/2009	WET	1553	1756	
W0808	*E. coli*	6/28/2009	DRY	185	829	
W0808	*E. coli*	7/26/2009	WET	345	463	
W0808	*E. coli*	8/23/2009	WET	2420	537	
W0808	*E. coli*	9/27/2009	WET	1374	1047	
W0808	*E. coli*	10/25/2009	WET	2382	1993	
W0808	*E. coli*	11/22/2009	DRY	326	1022	

4.3. 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 Little River (MA32-08) 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 downstream end of the watershed is heavily developed, with 9% of the land area in MS4 and 1% as DCIA. Development within the watershed consists of transportation networks, low to high density residential development, and commercial and industrial infrastructure. Many large commercial and warehouse developments with expansive parking lots are concentrated around the segment itself. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: The immediate drainage area to the impaired segment relies largely on sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 residential development in the upper 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 activities in the watershed account for 5% of the total land use, and several expansive areas dedicated to row crops, large barns, and greenhouses are immediately adjacent to the river. Agricultural areas adjacent to upstream tributaries could also provide a direct conduit to the river. 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 one significant 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.

Wildlife Waste: Nearly the entire river segment is surrounded by a wooded buffer. Any large open mowed areas or fields 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 Blandford

Blandford is not within the MS4 area. Blandford had no relevant ordinances and bylaws. Blandford did not have an available Master Plan or Open Space and Recreation Plan.

Town of Granville

Granville is not within the MS4 area. Granville has no relevant ordinances and bylaws. Granville did not have a Master Plan available.

Granville has an Open Space and Recreation Plan:
https://www.townofgranville.net/sites/g/files/vyhlif4471/f/uploads/open_space_recreation_plan.pdf
https://www.townofgranville.net/ (Town of Granville, 2004)

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 web page: https://www.cityofwestfield.org/233/Stormwater (City of Westfield, 2020a) 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 (City of Westfield, 2020b)

Westfield has the following relevant 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, 2019a)
- Wetland Protection Division 2, https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH13PLDE_ARTVCOCO_DIV2WEPR (City of Westfield, 2019b)
- 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, 2019c)
- The Town has a Sanitary Sewer Master Plan https://www.westfieldpolice.org/499/Sanitary-Sewer-Master-Plan (City of Westfield, N.d.)

Westfield has no available Master Plan.

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

5. MA32-09 Powdermill Brook

5.1. Waterbody Overview

The Powdermill Brook segment MA32-09 is 8.4 miles long and begins as a perennial stream northeast of Montgomery Road and west of Grindstone Mountain in Westfield, MA. The segment flows in a southeastern direction though portions of urbanized Westfield to end at its confluence with the Westfield River in Westfield.

Tributaries to Powdermill Brook segment MA32-09 include Simmons Brook, Arm Brook, and Pond Brook. Lakes and ponds in the watershed include Montgomery Road Pond, Arm Brook Pond, Powdermill Brook Pond (along the segment), and in the upper portions of the watershed the Hampton Ponds (Pequot, Horse, Doe, Buck, and several smaller ponds).

Key landmarks in the watershed include the junction of I-90 and US-202/MA-10, Barnes Municipal Airport, Westfield High School, East Mountain Country Club, and Hampton Ponds State Park. Segment MA32-09 is crossed by Montgomery Road, Russellville Road, I-90, North Elm Street/US-202/MA-10, Lower Sandy Hill Road, JS Land Road, Union Street, Springfield Road/US-20, and the Berkshire Subdivision and Pioneer Valley railroads, all within Westfield, MA.

Powdermill Brook (MA32-09) drains an area of 19.6 square miles, of which 2.9 mi^2 (15%) is impervious and 1.6 mi^2 (8%) is directly connected impervious area (DCIA). The watershed is partially[7] served by public sewer and 64% of the land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, three landfills, and no unpermitted land disposal dumping grounds within the watershed. See Figure 5-1.

The upper Powdermill Brook watershed is mostly forested with low density residential development, while the downstream portion is

Reduction from Highest Calculated Geomean: 45%

Watershed Area (Acres): 12,542

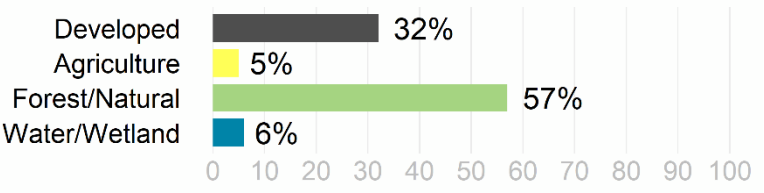
Segment Length (Miles): 8.4

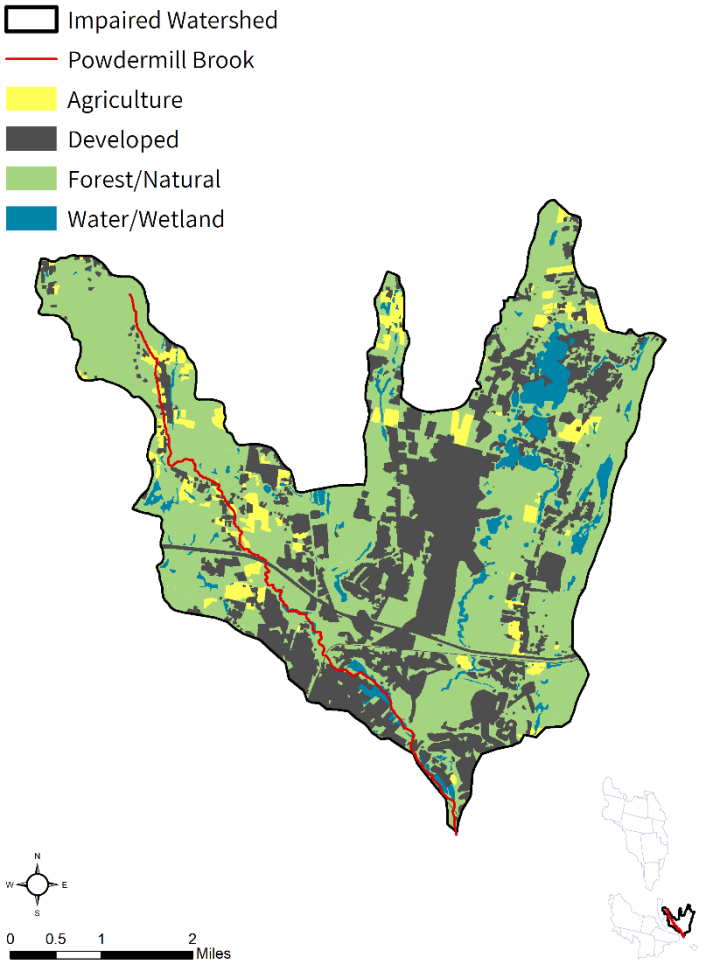
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 1,860 (15%)

DCIA Area (Acres, %): 1,040 (8%)





[7] 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.

urbanized, containing a mix of medium density residential areas and medium to high density commercial, industrial, and transportation infrastructure, including an interstate highway and an airport. The segment itself flows between residential properties, large open fields and wetlands, agricultural fields, several large-scale commercial properties, and a sand quarry. Much of the brook has at least some wooded buffer along its banks, although there are large fields mowed to the water's edge in several locations, especially north of Union Street.

In the Powdermill Brook (MA32-09) watershed, under the Natural Heritage and Endangered Species Program, there are 3,328 acres (27%) of Priority Habitats of Rare Species and 174 acres (1%) of Priority Natural Vegetation Communities. There are nine acres (<1%) under Public Water Supply protection but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 89 acres (1%) of land protected in perpetuity[8] exist within the segment watershed, which is part of a total of 1,158 acres (9%) of Protected and Recreational Open Space[9]. See Figure 5-1.

[8] 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.

[9] 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).

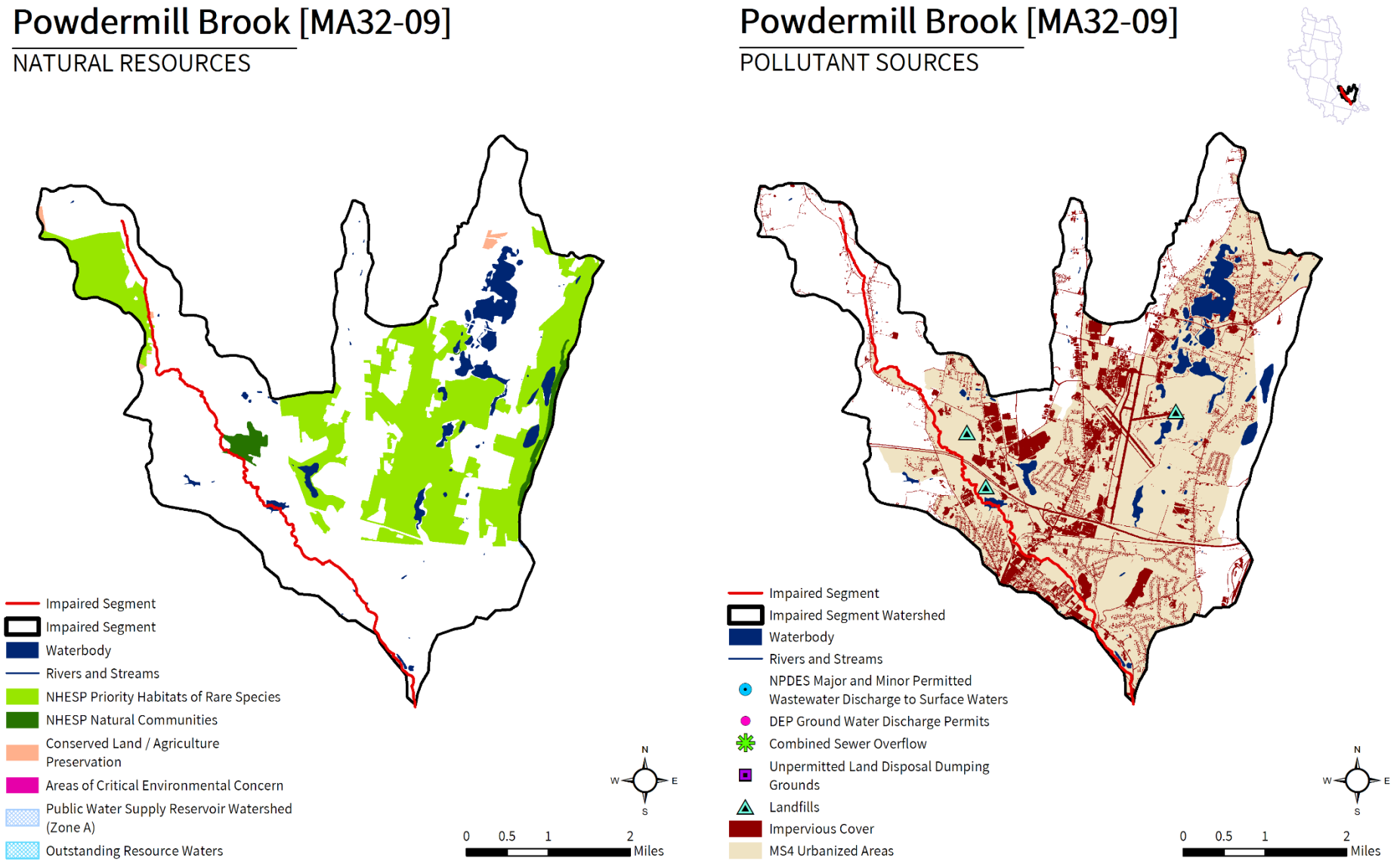


Figure 5-1. Natural resources and potential pollution sources draining to Powdermill Brook segment MA32-09. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

5.2. Waterbody Impairment Characterization

Powdermill Brook (MA32-09) 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 identified below (refer to Tables 5-1, 5-2; 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, 90-day rolling basis.

- In 2006, five samples were collected at W0805, 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 wet weather.

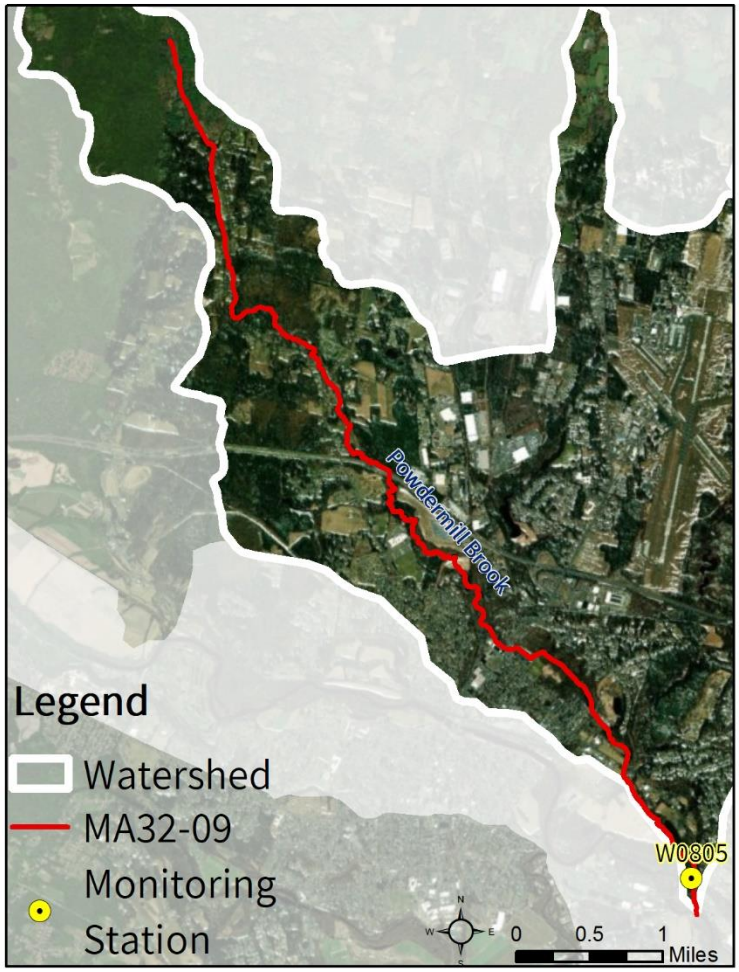


Figure 5-2. Location of monitoring station(s) along the impaired river segment.

Table 5-1. Summary of indicator bacteria sampling results by station for Powdermill Brook (MA32-09). 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
W0805	5/9/2006	10/3/2006	5	229	1	1

Table 5-2. Indicator bacteria data by station, indicator, and date for Powdermill Brook (MA32-09). 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)
W0805	*E. coli*	5/9/2006	DRY	60	60	
W0805	*E. coli*	6/13/2006	DRY	76	68	
W0805	*E. coli*	7/25/2006	DRY	96	76	
W0805	*E. coli*	8/29/2006	WET	216	116	
W0805	*E. coli*	10/3/2006	WET	576	229	

5.3. 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 Powdermill Brook (MA32-09) 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: Portions of the watershed are heavily developed, with 64% of the land area in MS4 and 8% as DCIA. The lower watershed surrounding the brook is dominated by medium to high density mixed residential, commercial, industrial, and transportation land uses, including an interstate highway and airport. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: The lower watershed consists of mostly sewered areas. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 upper 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 activities in the watershed account for 5% of the total land use, including some areas of row crops and hayfields adjacent to the brook. Additional agricultural areas adjacent to upstream tributaries could also provide a direct conduit 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 many medium to high density residential developments near Powdermill Brook, including some with access via mowed fields. 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: Some areas along Powdermill Brook are mowed to the water's edge, especially downstream of North Elm Street. The Powdermill Dam and Twiss Street capped landfill and solar installation may also provide a water view. Several areas along the brook are open meadow wetland. Large open mowed areas, fields, or wetlands 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. For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

City of Westfield. See Section 4.4

6. MA32-22 Potash Brook

6.1. Waterbody Overview

The Potash Brook segment MA32-22 is 5.2 miles long and begins at the outlet of Dunlap Pond in Blandford, MA. The segment flows east following I-90 into Russell to end at its confluence with the Westfield River in the village of Woronoco in Russell, MA.

Tributaries to Potash Brook segment MA32-22 include Pond Brook and several smaller unnamed streams. Russell Pond is also in the watershed.

Key landmarks in the watershed include Woronoco Heights, Russell Town Beach (Russell Pond), Mount Nero, and the Russell Fire Department. Segment MA32-22 is crossed by I-90 (Blandford and Russell), Blandford Turnpike/MA-23 (Blandford, three times), Blandford Road/MA-23 (Russell, four times), Westfield Road/MA-20, and Woronoco Road.

Potash Brook (MA32-22) drains an area of 6.6 square miles, of which 0.3 mi^2 (4%) is impervious and 0.1 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[10] served by public sewer and <1% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 6-1.

The segment watershed is primarily wooded (84% of land use). Although there is relatively little developed land in the watershed (10%), the segment itself flows along I-90 and MA-23 for nearly its entire length, encountering multiple road crossings. Much of the low density residential development in the watershed is concentrated in the stream corridor. The

Reduction from Highest Calculated Geomean: 75%

Watershed Area (Acres): 4,214

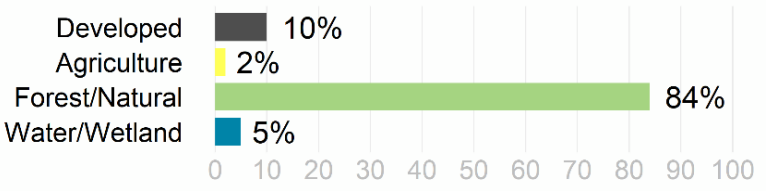
Segment Length (Miles): 5.2

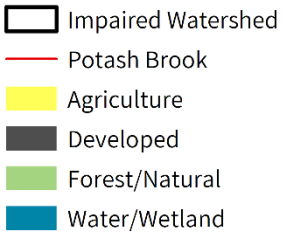
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (Cold Water)

Impervious Area (Acres, %): 185 (4%)

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





[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.

agricultural fields within the western, upstream watershed appear to be used for haying, and evidence of livestock is visible on recent Google Earth imagery.

In the watershed of Potash Brook (MA32-22), under the Natural Heritage and Endangered Species Program, there are 0.4 acres (<1%) of Priority Habitats of Rare Species. There are 12.6 acres (<1%) under Public Water Supply protection but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 92 acres (2%) of land protected in perpetuity[11] exist within the segment watershed, which is part of a total of 1,327 acres (31%) of Protected and Recreational Open Space[12]. See Figure 6-1.

[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).

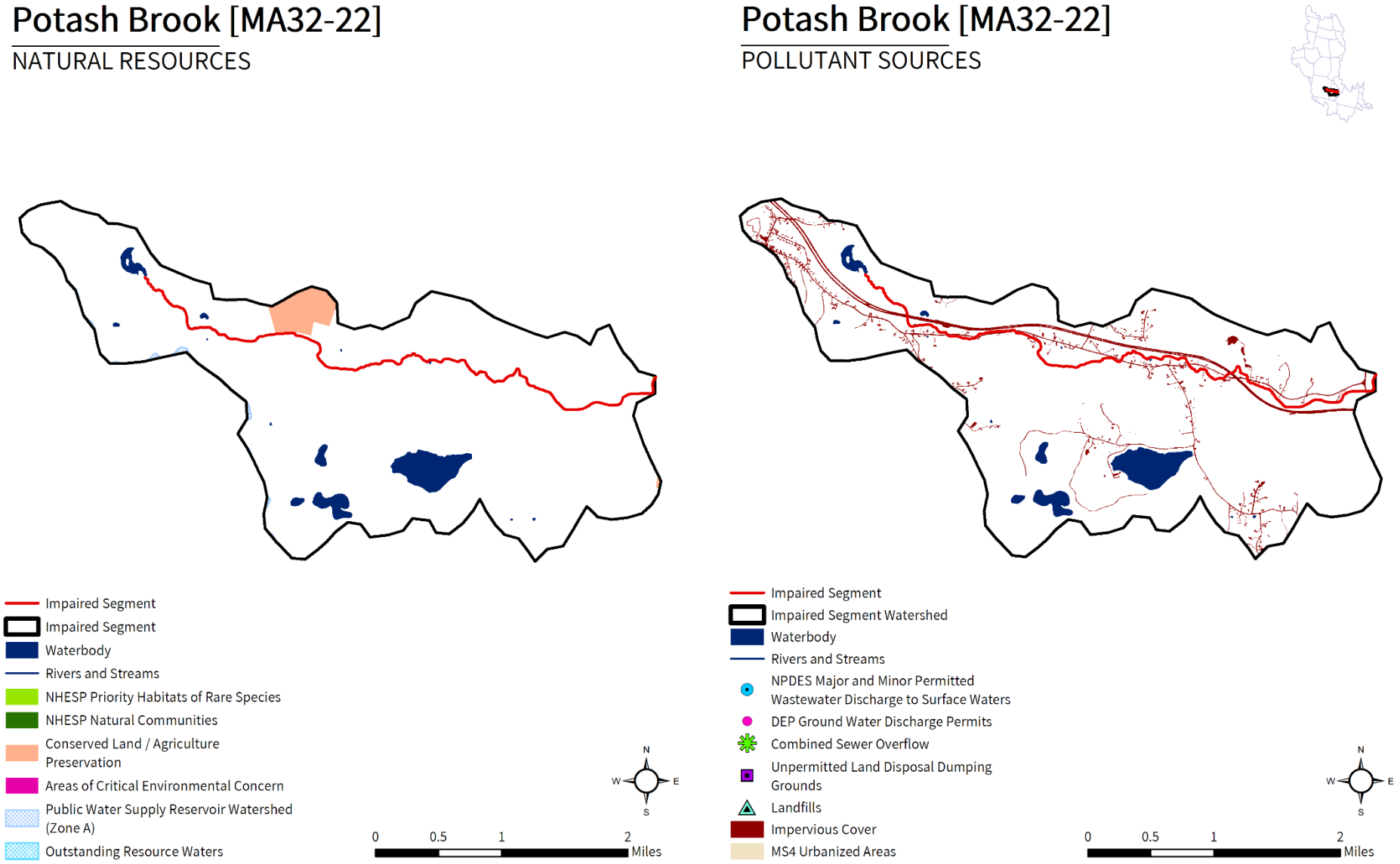


Figure 6-1. Natural resources and potential pollution sources draining to the Potash Brook segment MA32-22. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

6.2. Waterbody Impairment Characterization

Potash Brook (MA32-22) is a Class B, Cold 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 6-1, 6-2; 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, 90-day rolling basis.

- In 2009, eight samples were collected at PTB1.3 (PVPC, 2010), resulting in three 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 eight samples, one exceeded the STV criterion in during wet weather.
- In 2006, five samples were collected at W1454, resulting in 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 five samples, none exceeded the STV criterion.

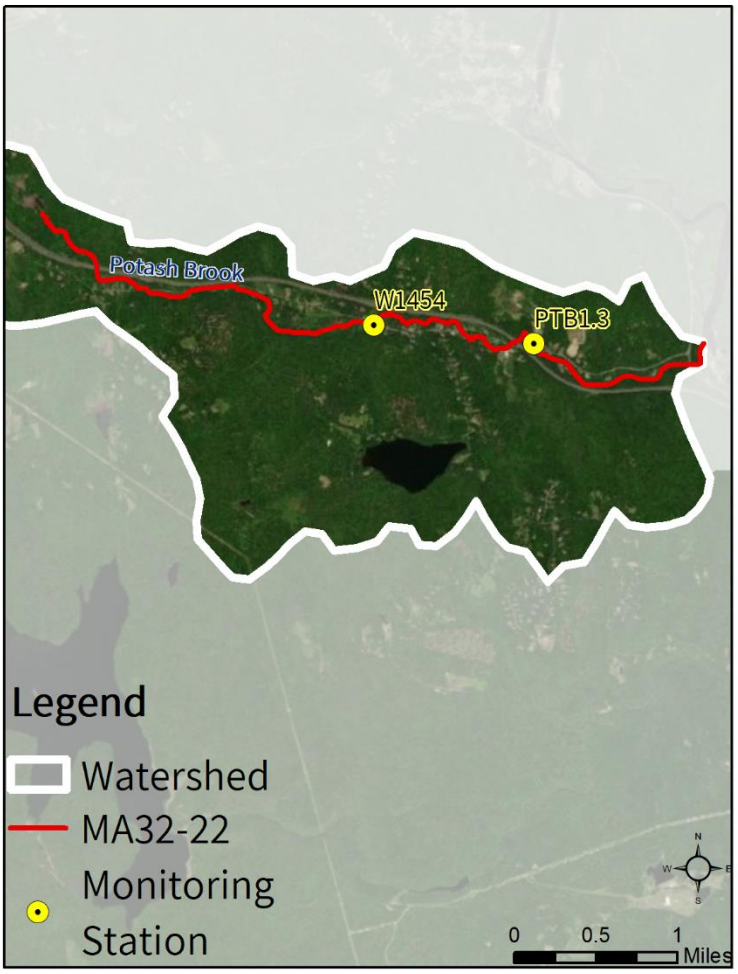


Figure 6-2. Location of monitoring station(s) along the impaired river segment.

Table 6-1. Summary of indicator bacteria sampling results by station for Potash Brook (MA32-22). 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
PTB1.3	4/26/2009	11/22/2009	8	514	3	1
W1454	5/9/2006	10/3/2006	5	73	0	0

Table 6-2. Indicator bacteria data by station, indicator, and date for Potash Brook (MA32-22). 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)
PTB1.3	*E. coli*	4/26/2009	DRY	54	54	
PTB1.3	*E. coli*	5/18/2009	WET	162	94	
PTB1.3	*E. coli*	6/28/2009	DRY	44	73	
PTB1.3	*E. coli*	7/26/2009	WET	249	121	
PTB1.3	*E. coli*	8/23/2009	WET	2420	298	
PTB1.3	*E. coli*	9/27/2009	WET	225	514	
PTB1.3	*E. coli*	10/25/2009	WET	201	478	
PTB1.3	*E. coli*	11/22/2009	DRY	28	108	
W1454	*E. coli*	5/9/2006	DRY	20	20	
W1454	*E. coli*	6/13/2006	DRY	4	9	
W1454	*E. coli*	7/25/2006	DRY	68	18	
W1454	*E. coli*	8/29/2006	WET	144	34	
W1454	*E. coli*	10/3/2006	WET	40	73	

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 Potash Brook (MA32-22) 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 <1% of the land area in MS4 and 2% as DCIA. Development within the watershed consists of residential development near the Blandford town center and the I-90 corridor. Stormwater runoff from urban areas is likely a contributing source of pathogens.

Illicit Sewage Discharges: The downstream portion of the watershed is mostly served by sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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: Development in the upstream portions of 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: Although activities in the watershed only account for 2% of the total land use, agricultural activities visible on recent aerial photos include open fields, hayfields, and row crops near the segment itself. 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. Although there are no public fields or parks adjacent to the impaired segment, the segment flows near low density residential development where dog walking likely occurs and where runoff may transport unmanaged pet waste.

Wildlife Waste: There are open meadow wetlands in the watershed, especially around the headwaters at Dunlap Pond. Large open mowed areas, fields, or 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 Blandford. See Section 4.4

Town of Russell

A small portion of Russell is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit, and the town was granted a MS4 General Permit waiver, available at: https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/russell-epa-waiver-response.pdf (USEPA, 2017).

Russell has the following relevant ordinances and bylaws:

- Russell does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Pet Waste Bylaw: Article 7 – Regulations for Keeping of Dogs and Other Dumb Animal**s** Section 6G of town bylaws http://www.townofrussell.us/files/2008_By-Laws_Sewer_Use2.htm. (Town of Russell, N.d.)
- Title 5 Supplemental Regulations: None found.
- Stormwater Utility: None found.

The Town of Russell does not have a Master Plan or Open Space and Recreation Plan available.

The town website is http://www.townofrussell.us/. (Town of Russell, 2021)

7. MA32-27 Miller Brook

7.1. Waterbody Overview

The Miller Brook segment MA32-27 is 0.6 miles long and begins at the outlet of a small unnamed pond in Robinson State Park, north of North Street in Agawam, MA. The segment flows to the north to end at its confluence with the Westfield River in Agawam, MA.

There is one unnamed tributary to segment MA32-27, and no ponds except the headwaters pond within the segment watershed. The major landmark in the watershed is Robinson State Park. Segment MA32-27 is crossed by Park Entrance Road and a utility corridor.

Miller Brook (MA32-27) drains an area of 0.5 square miles, of which 0.1 mi^2 (14%) is impervious and 0.03 mi^2 (6%) is directly connected impervious area (DCIA). The watershed is mostly[13] served by public sewer and 91% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 7-1.

43% of the Miller Brook watershed is developed land use. The development is mostly medium density residential, with just a few small commercial properties. The segment itself flows entirely through forested/natural and water/wetland land uses; however, these areas are all within Robinson State Park and are likely heavily used for recreational purposes.

In the Miller Brook (MA32-27) watershed, under the Natural Heritage and Endangered Species Program, there are 129 acres (40%) of Priority Habitats of Rare Species. There are no Areas of Critical Environmental Concern, no areas under Public Water Supply protection, and no areas identified as Outstanding Resource Waters in the

Reduction from Highest Calculated Geomean: 55%

Watershed Area (Acres): 320

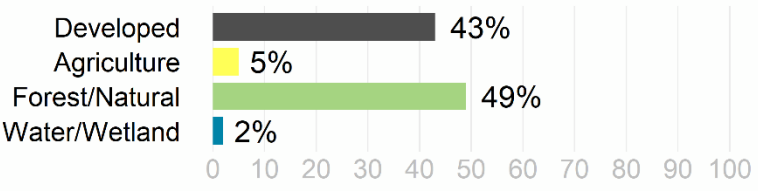
Segment Length (Miles): 0.6

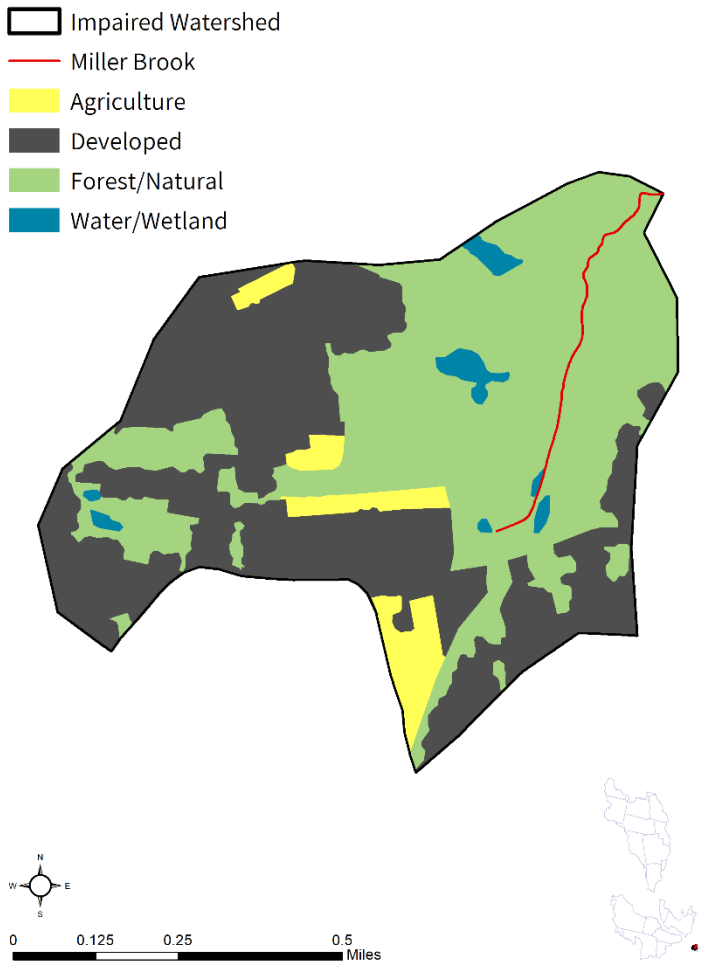
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B (Cold Water)

Impervious Area (Acres, %): 43 (14%)

DCIA Area (Acres, %): 21 (6%)





[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.

watershed. No land protected in perpetuity[14] exist within the segment watershed, which would otherwise be part of a total of 130 acres (41%) of Protected and Recreational Open Space15. See Figure 7-1.

[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).

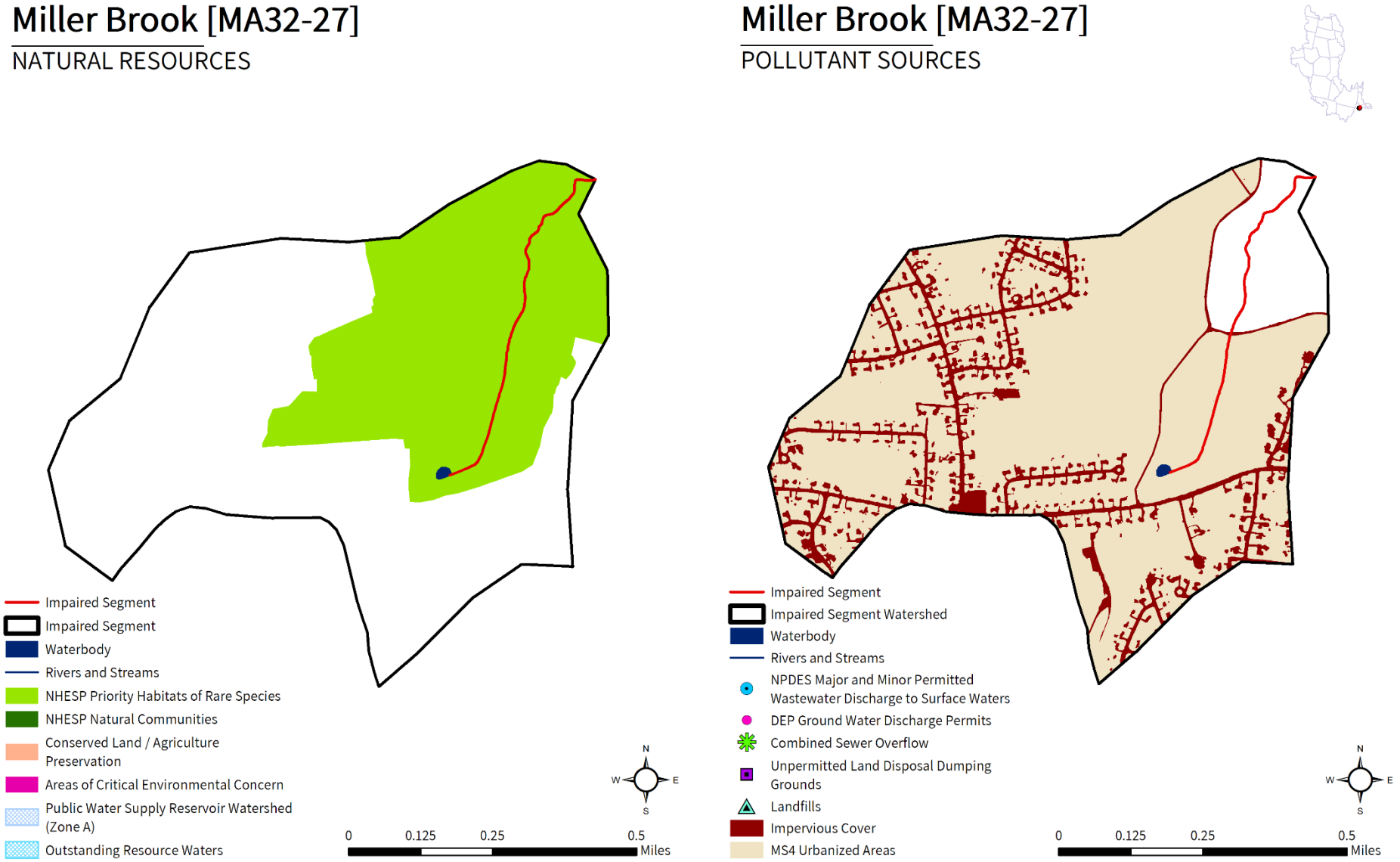


Figure 7-1. Natural resources and potential pollution sources draining to Miller Brook segment MA32-27. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

7.2. Waterbody Impairment Characterization

Miller Brook (MA32-27) is a Class B, Cold 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 7-1, 7-2; 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, 90-day rolling basis.

- In 2006, five samples were collected at W0228, resulting in three 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 dry weather.

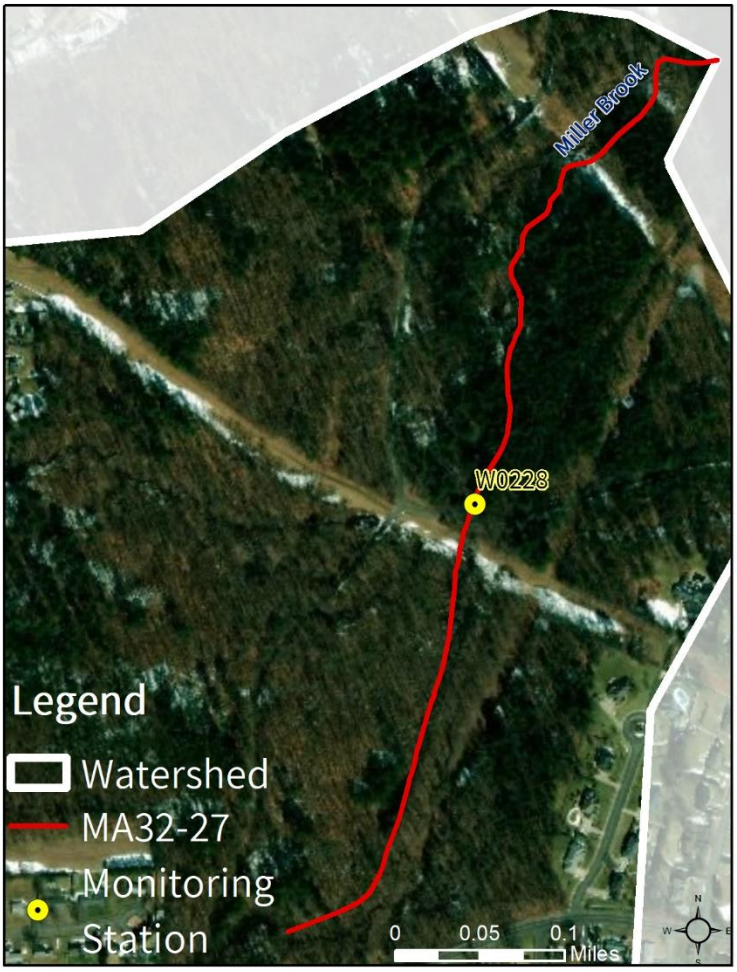


Figure 7-2. Location of monitoring station(s) along the impaired river segment.

Table 7-1. Summary of indicator bacteria sampling results by station for Miller Brook (MA32-27). 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
W0228	5/9/2006	10/3/2006	5	280	3	1

Table 7-2. Indicator bacteria data by station, indicator, and date for Miller Brook (MA32-27). 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)
W0228	*E. coli*	5/9/2006	DRY	20	20	
W0228	*E. coli*	6/13/2006	DRY	204	64	
W0228	*E. coli*	7/25/2006	DRY	1000	160	
W0228	*E. coli*	8/29/2006	WET	108	280	
W0228	*E. coli*	10/3/2006	WET	192	275	

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 Miller Brook (MA32-27) were elevated during dry weather. 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: Portions of the watershed are highly developed, with 91% of the land area in MS4 and 6% as DCIA. Development within the watershed is almost entirely medium density residential neighborhoods. With development covering 43% of the watershed area, stormwater runoff from urban areas is likely a significant contributing source of pathogens.

Illicit Sewage Discharges: Most of the watershed is serviced by municipal sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for 5% of the total land use, with open fields and row crops visible on recent aerial photos. 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 brook flows through Robinson State Park, which has an extensive trail network, some of which cross or are adjacent to the impaired segment. Beyond the park, the watershed is almost entirely residential neighborhoods. 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: Nearly the entire immediate area surrounding the brook is forested, though it contains a large trail network, and there may be open areas along trails which encourage wildlife to congregate. Large open mowed areas, fields, 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.

City 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, link below). Agawam has mapped all of its MS4 stormwater system and adopted illicit discharge detection and elimination (IDDE) regulations. It adopted erosion and sediment control (ESC) and post-construction stormwater regulations in 2006. There are 39 stormwater outfalls to the Connecticut River with *E. coli* impairment reported.

Agawam has the following relevant ordinances and bylaws:

- Sanitary Sewers, 159-20: https://ecode360.com/AG1041/searchquery=sewer&scope=all&sortOrder=relevance (City 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 (City of Agawam, N.d., b)

Agawam had no Master Plan available.

Agawam Stormwater Management Plan: https://ecode360.com/27013918?highlight=wetlands&searchId=5701906503542443#27013918 (City of Agawam, N.d., c)

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

8. MA32-28 White Brook

8.1. Waterbody Overview

The White Brook segment MA32-28 is 0.9 miles long and begins just north of MA-147 and south of Oak Street in Agawam, MA. The segment flows to the north to end at its confluence with the Westfield River in Agawam, MA.

There are two unnamed tributaries to White Brook segment MA32-28 and no lakes or ponds within the segment watershed. Key landmarks in the watershed include Sacred Heart Parish Cemetery and Robinson State Park. White Brook (MA32-28) is crossed by Oak Street, North Street, and Park Entrance Road, all within Agawam.

White Brook (MA32-28) drains an area of 0.7 square miles, of which 0.1 mi^2 (19%) is impervious and 0.08 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is mostly[16] served by public sewer and 94% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 8-1.

The White Brook watershed is generally urbanized, with medium density residential neighborhoods and a small amount of commercial development, as well as two utility corridors. The segment itself, however, flows mostly through forested and natural areas, including Robinson State Park. There is one agricultural area in the uppermost part of the watershed dedicated to row crops.

In the White Brook (MA32-28) watershed, under the Natural Heritage and Endangered Species Program, there are 43 acres (10%) of Priority Habitats of Rare Species. There are no Areas of Critical Environmental Concern, no areas under Public Water Supply protection, and no areas

Reduction from Highest Calculated Geomean: 62%

Watershed Area (Acres): 434

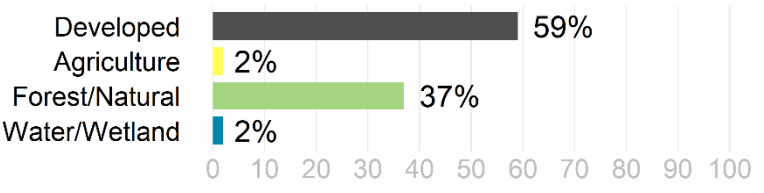
Segment Length (Miles): 0.9

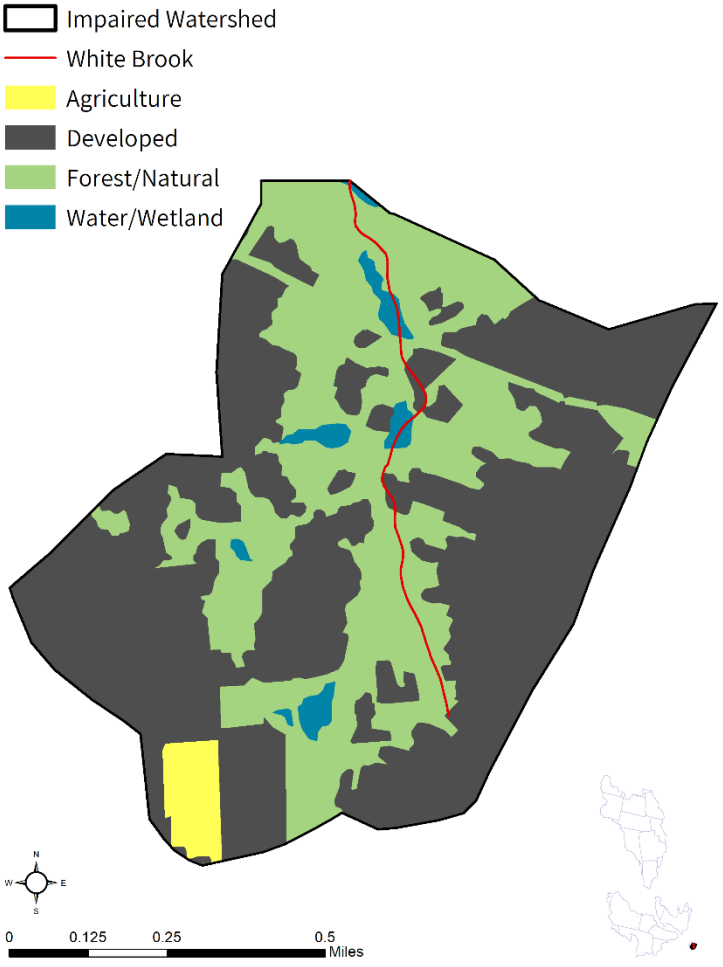
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B (Cold Water)

Impervious Area (Acres, %): 84 (19%)

DCIA Area (Acres, %): 51 (12%)



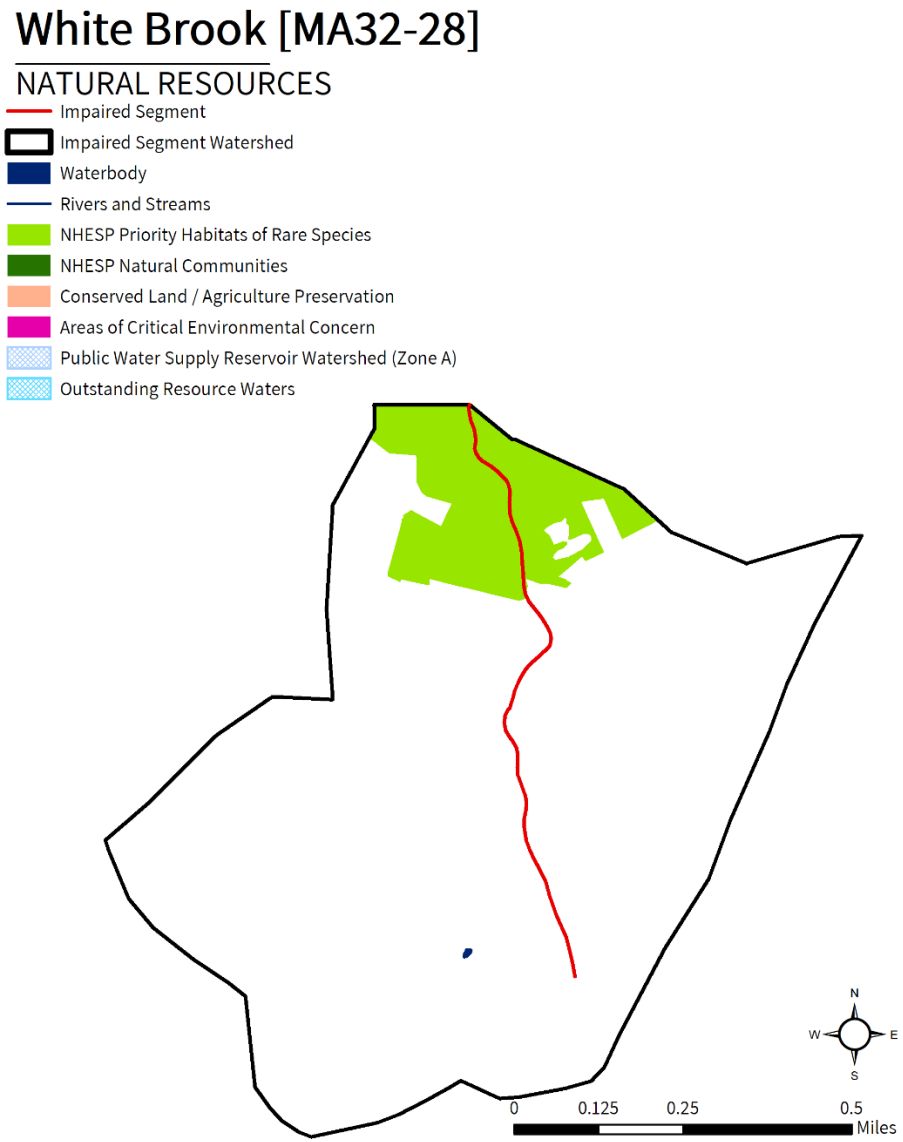


[16] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local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

identified as Outstanding Resource Waters in the watershed. No land protected in perpetuity[17] exist within the segment watershed, which would otherwise be part of a total of 42 acres (10%) of Protected and Recreational Open Space[18]. See Figure 8-1.

[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).



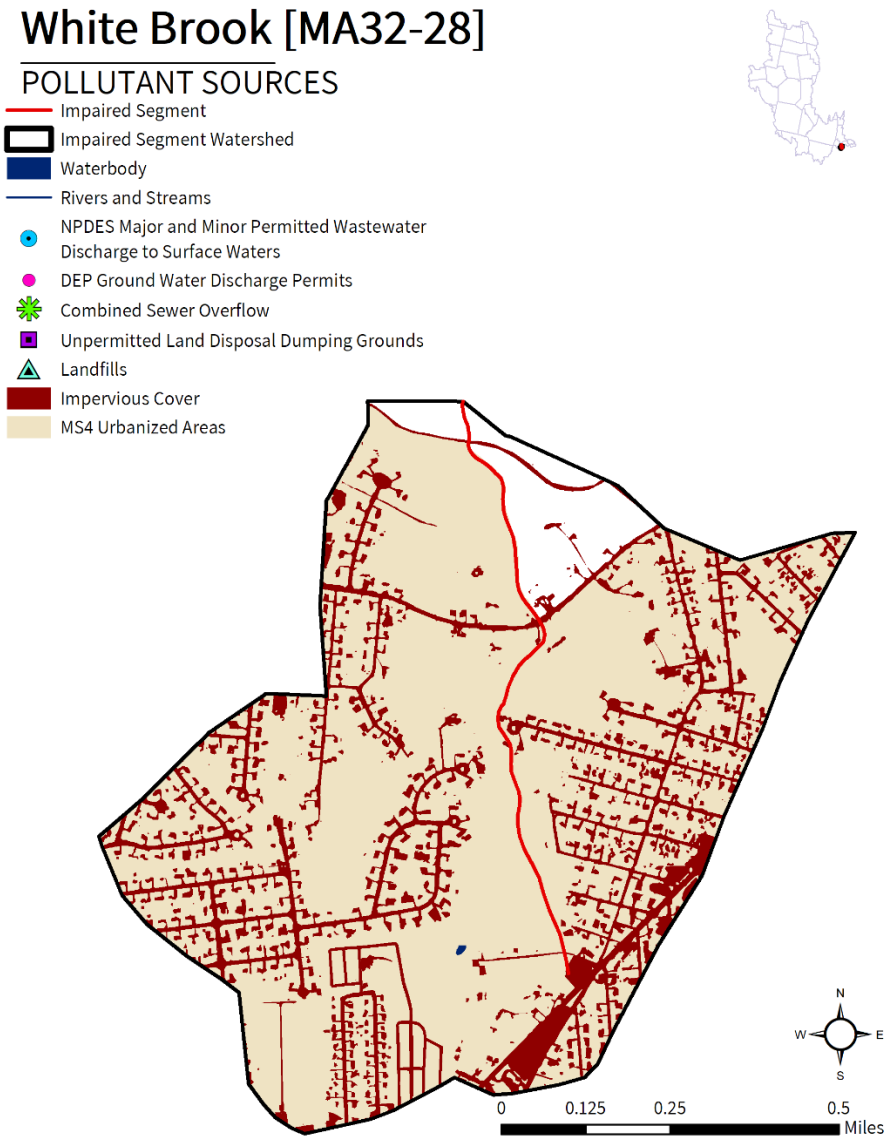


Figure 8-1. Natural resources and potential pollution sources draining to White Brook segment MA32-28. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

8.2. Waterbody Impairment Characterization

White Brook (MA32-28) is a Class B, Cold 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 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.

- In 2006, five samples were collected at W0229, 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 five samples, one exceeded the STV criterion during wet weather.

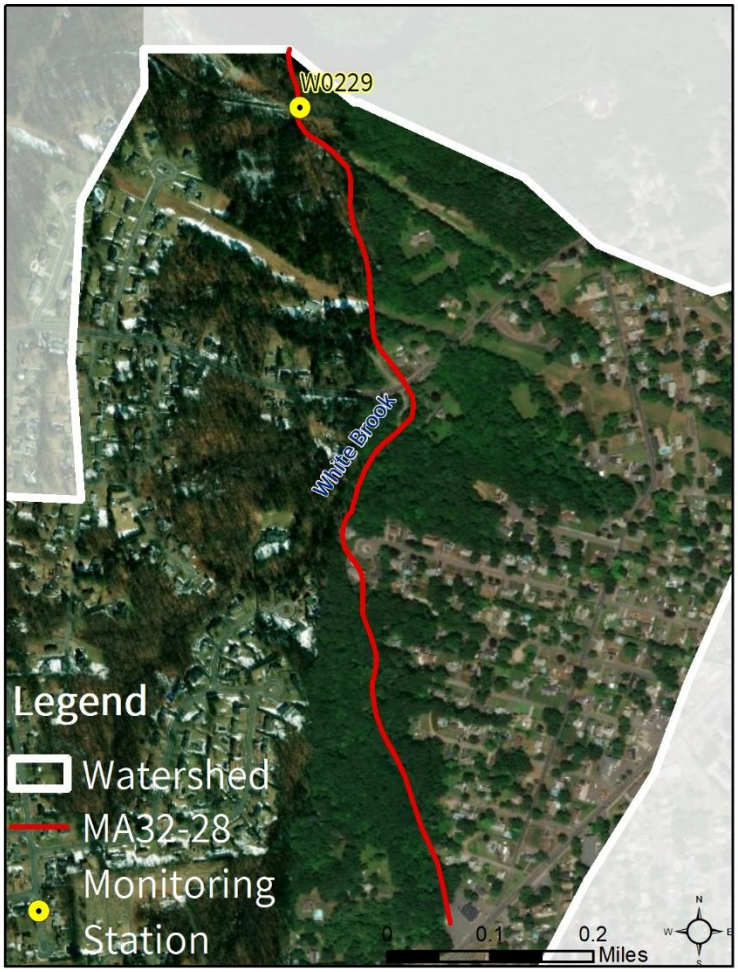


Figure 8-2. Location of monitoring station(s) along the impaired river segment.

Table 8-1. Summary of indicator bacteria sampling results by station for White Brook (MA32-28). 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
W0229	5/9/2006	10/3/2006	5	334	2	1

Table 8-2. Indicator bacteria data by station, indicator, and date for White Brook (MA32-28). 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)
W0229	*E. coli*	5/9/2006	DRY	100	100	
W0229	*E. coli*	6/13/2006	DRY	32	57	
W0229	*E. coli*	7/25/2006	DRY	396	108	
W0229	*E. coli*	8/29/2006	WET	576	194	
W0229	*E. coli*	10/3/2006	WET	164	334	

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 White Brook (MA32-28) 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 94% of the land area in MS4 and 12% as DCIA. Development within the watershed consists largely of residential development between Springfield Street and North Street in Agawam, MA. With development covering 59% of the watershed, stormwater runoff from urban areas is likely a significant contributing source of pathogens.

Illicit Sewage Discharges: Most of the watershed is serviced by municipal sewer, and most (94%) has been designated as MS4. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 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.

Agriculture: Agricultural activities in the watershed account for 2% of the total land use and include one field of row crops visible on recent aerial photos. 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 brook flows through Robinson State Park, which has an extensive trail network, some of which cross or are adjacent to the impaired segment. Beyond the park, the watershed is almost entirely residential neighborhoods. 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: The immediate area surrounding the brook is largely forested, though it contains a large trail network, and there may be open areas along trails which encourage wildlife to congregate. Large open mowed areas, fields, or 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.

Town of Agawam. See Section 7.4

9. MA32-36 Little River

9.1. Waterbody Overview

The Little River segment MA32-36 is 5.8 miles long and begins at the Springfield Water Works Intake Dam (NATID: MA00708) northwest of George Road in Russell, MA. The segment flows north along the Russell-Westfield town boundary, then east into Westfield. The Little River ends at Horton's Bridge (formerly part of segment MA32-26) in Westfield, MA.

Tributaries to Little River segment MA32-36 include Sodum Brook, Cook Brook, Little Stream, and Munn Brook. Major lakes, ponds, and reservoirs within the segment watershed include Cobble Mountain Reservoir, Borden Brook Reservoir, and Cooley Lake (Pine Lake).

Key landmarks in the watershed include the Cobble Mountain Reservoir and Granville town center. Segment MA32-36 is crossed by Northwest Road in Westfield approximately 2.6 miles upstream of the end of the segment.

The Little River (MA32-36) drains an area of 79 square miles, of which 1.5 mi^2 (2%) is impervious and 0.4 mi^2 (<1%) is directly connected impervious area (DCIA). The watershed is partially[19] served by public sewer and 4% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, three landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 9-1.

The Little River watershed is predominantly mountainous and undeveloped, with forests, water, and wetlands accounting for 92% of the land area. Most development is low to medium density mixed residential and commercial development, though there are a small number of larger properties with expansive parking lots. The upper segment flows through a steep forested

Reduction from Highest Calculated Geomean: 85%

Watershed Area (Acres): 50,257

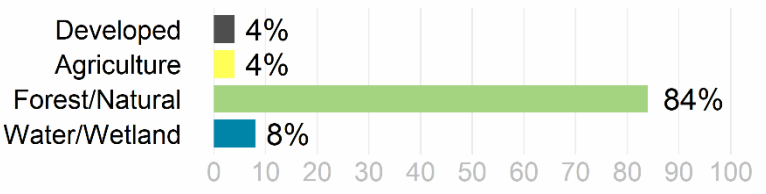
Segment Length (Miles): 5.8

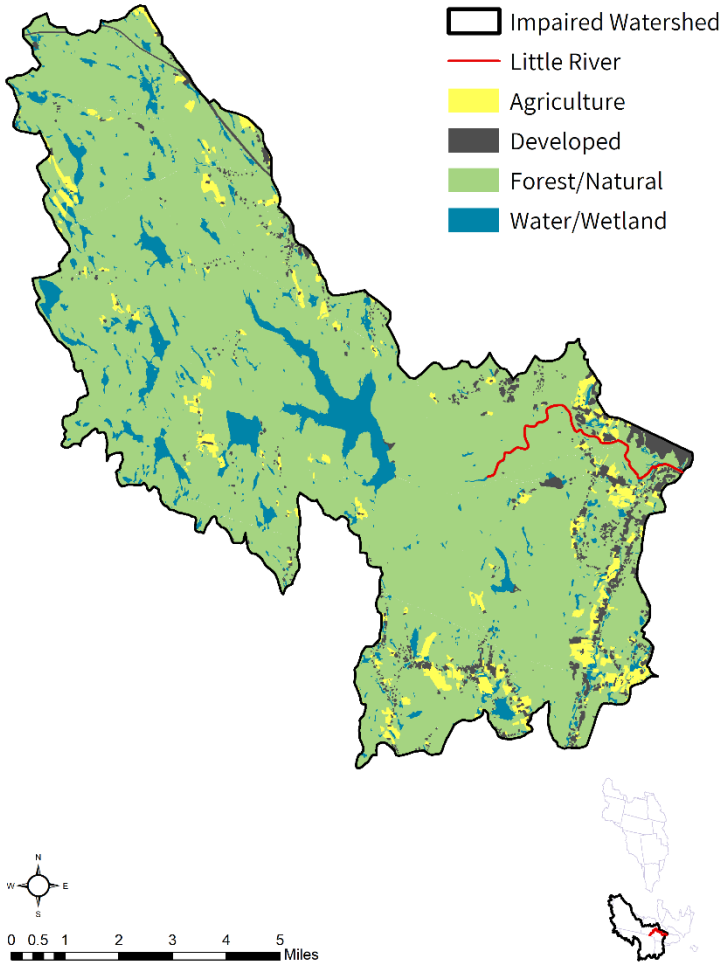
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B (Cold Water)

Impervious Area (Acres, %): 990(2%)

DCIA Area (Acres, %): 236 (<1%)





[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.

valley without road access, while the lower segment flows through low density residential areas, mostly within a wide forested buffer zone.

In the Little River (MA32-36) watershed, under the Natural Heritage and Endangered Species Program, there are 2,095 acres (4%) of Priority Habitats of Rare Species. There are 34,224 acres (68%) under Public Water Supply protection, but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 2,237 acres (4%) of land protected in perpetuity[20] exist within the segment watershed, which is part of a total of 23,156 acres (46%) of Protected and Recreational Open Space[21]. See Figure 9-1.

[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).

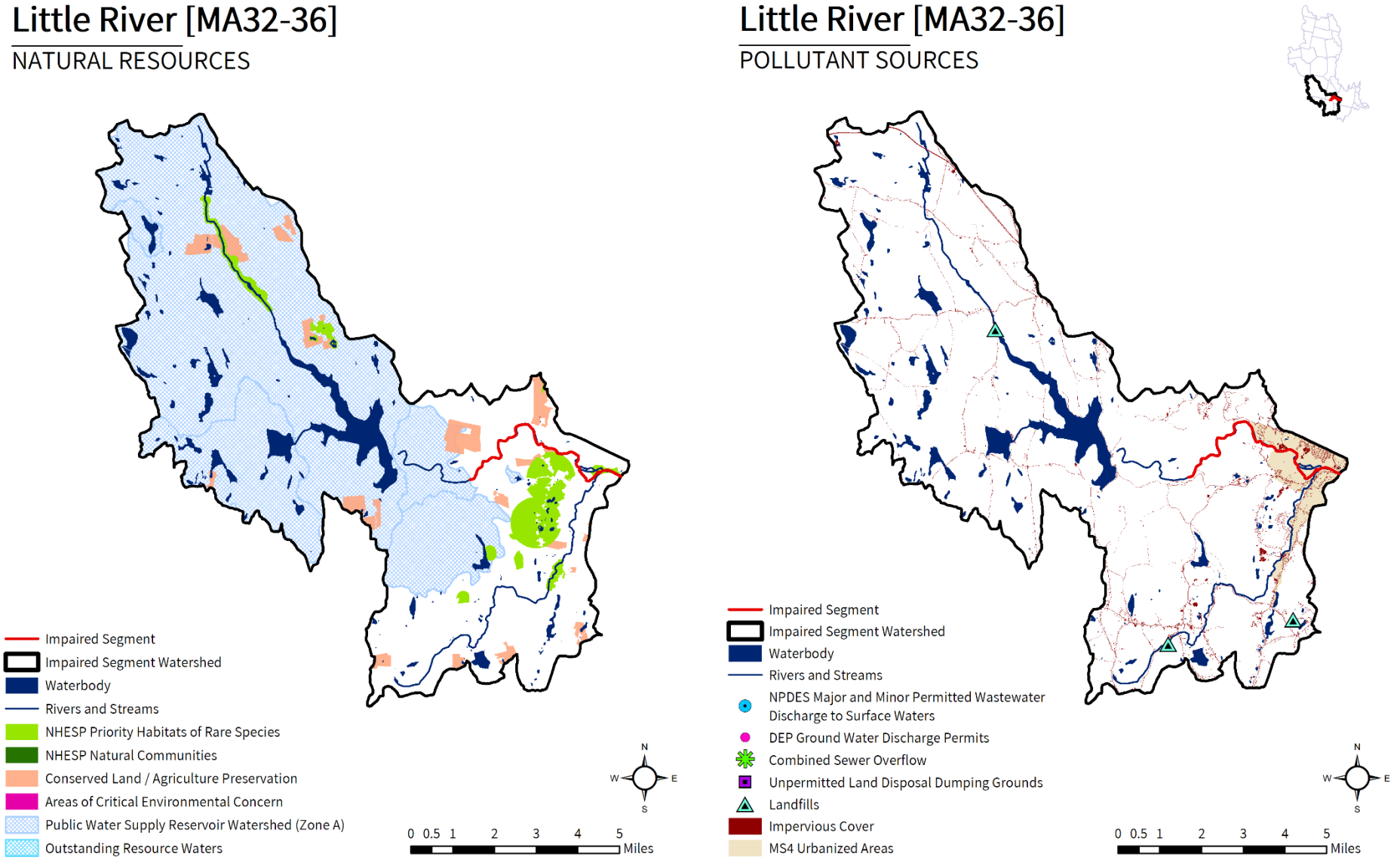


Figure 9-1. Natural resources and potential pollution sources draining to the Little River segment MA32-36. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

9.2. Waterbody Impairment Characterization

The Little River (MA32-36) is a Class B, Cold 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 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 2009, eight samples were collected at W0237, 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 eight samples, two exceeded the STV criterion during wet weather.
- In 2006, five samples were collected at W1462, resulting in 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 five samples, none exceeded the STV criterion.

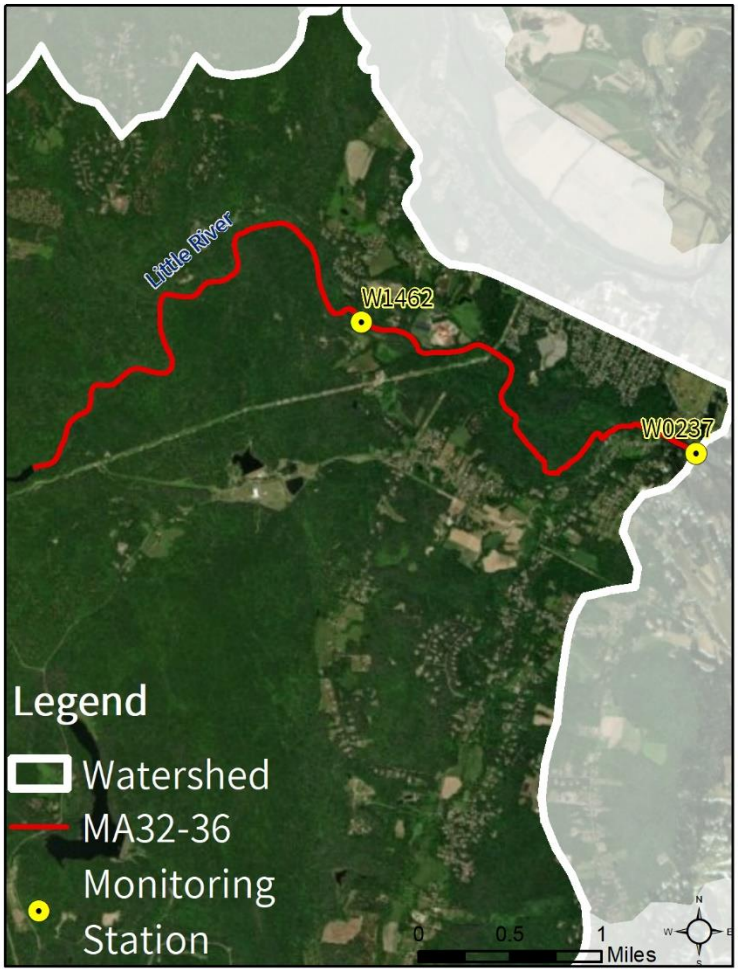


Figure 9-2. Location of monitoring station(s) along the impaired river segment.

Table 9-1. Summary of indicator bacteria sampling results by station for the Little River (MA32-36). 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
W0237	4/26/2009	11/22/2009	8	868	5	2
W1462	5/9/2006	10/3/2006	5	71	0	0

Table 9-2. Indicator bacteria data by station, indicator, and date for the Little River (MA32-36). 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)
W0237	*E. coli*	4/26/2009	DRY	22	22	
W0237	*E. coli*	5/18/2009	WET	210	68	
W0237	*E. coli*	6/28/2009	DRY	214	100	
W0237	*E. coli*	7/26/2009	WET	179	200	
W0237	*E. coli*	8/23/2009	WET	2420	453	
W0237	*E. coli*	9/27/2009	WET	225	460	
W0237	*E. coli*	10/25/2009	WET	1203	868	
W0237	*E. coli*	11/22/2009	DRY	46	232	
W1462	*E. coli*	5/9/2006	DRY	20	20	
W1462	*E. coli*	6/13/2006	DRY	32	25	
W1462	*E. coli*	7/25/2006	DRY	64	34	
W1462	*E. coli*	8/29/2006	WET	176	71	
W1462	*E. coli*	10/3/2006	WET	4	36	

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 the Little River (MA32-36) 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 downstream portion of the watershed are moderately developed, with 4% of the land area in MS4 and <1% as DCIA. Development within the watershed consists of low to medium density residential development and only a small amount of commercial and industrial infrastructure. Stormwater runoff from urban areas is likely a contributing source of pathogens to the downstream portion of the segment.

Illicit Sewage Discharges: The watershed is partially served by sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 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 activities in the watershed account for 4% of the total land use. Agricultural activities visible on recent aerial photos within the watershed include open fields, hayfields, row crops, and pasturelands. 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 23,000 acres of open space within the watershed, including parks, ballfields, and residential neighborhoods, which may be popular for dog-walking. Paths which are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens from unmanaged pet waste.

Wildlife Waste: Most of the segment flows through a wide forested buffer, though there are a few small open areas along the downstream part of the segment. 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.

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 Blandford. See Section 4.4

Town of Granville. See Section 4.4

Town of Russell. See Section 6.4

City of Westfield. See Section 4.4

10. MA32-37 Ashley Brook

10.1. Waterbody Overview

Ashley Brook segment MA32-37 is 0.5 miles long and begins at its headwaters of the perennial portion of the brook south of Hillside Road and west of Beveridge Boulevard in Westfield, MA. The segment flows northwest to end at its confluence with Jacks Brook (MA32-39) in Westfield, MA.

There are no named tributaries to Ashley Brook, and one unnamed pond in the headwaters. The Springfield Aqueduct crosses the segment but is not hydrologically connected.

Key landmarks in the watershed include part of the Ranch Golf Club and the Plantation Conservation Area. The segment is crossed by Hillside Road approximately 0.1 miles downstream of the start of the segment.

Ashley Brook (MA32-37) drains an area of one square mile, of which 0.1 mi^2 (10%) is impervious and 0.04 mi^2 (4%) is directly connected impervious area (DCIA). The watershed is partially[22] served by public sewer and 58% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 10-1.

The watershed is generally developed, with medium density residential neighborhoods covering much of the land area. The segment flows through a forested corridor, and the upper watershed is mostly wooded. The agricultural land within the watershed is used for hay production.

In the watershed of Ashley Brook (MA32-37), under the Natural Heritage and Endangered Species Program, there are no areas of Priority Habitats of Rare Species or Priority Natural Vegetation Communities. There are no Areas of Critical Environmental Concern, no areas under Public Water Supply protection, and no areas identified as Outstanding Resource Waters in the

Reduction from Highest Calculated Geomean: 93%

Watershed Area (Acres): 688

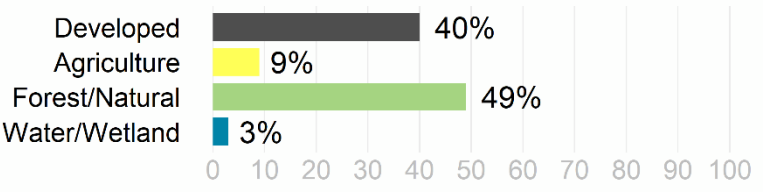
Segment Length (Miles): 0.5

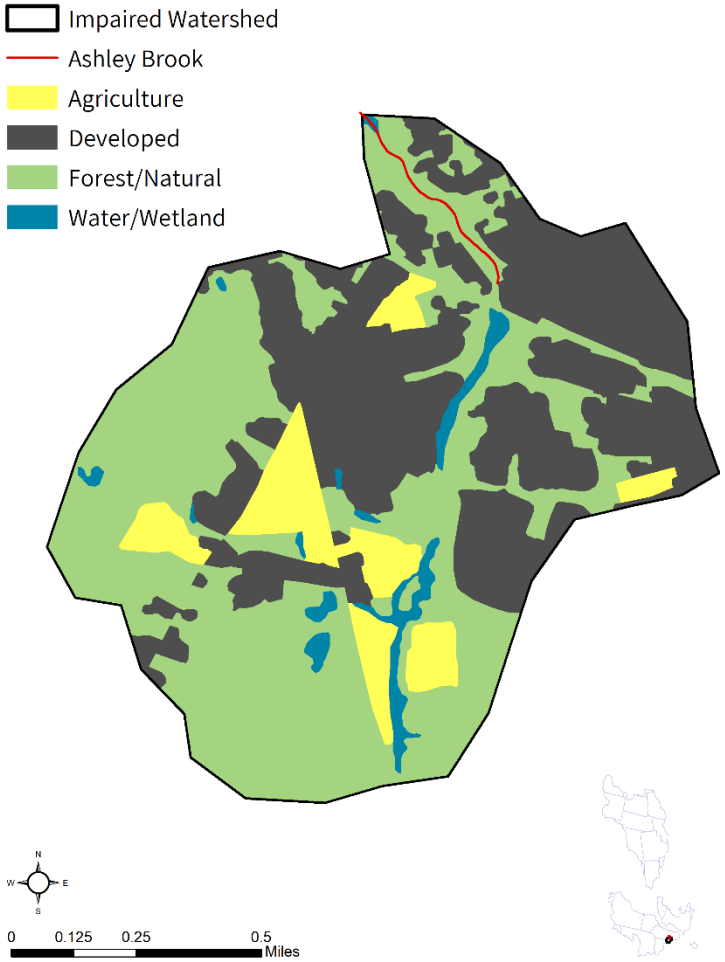
Impairment(s): *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 68 (10%)

DCIA Area (Acres, %): 28 (4%)





[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.

watershed. Over 35 acres (5%) of land protected in perpetuity[23] exist within the segment watershed, all of which is Protected and Recreational Open Space[24]. See Figure10-1.

[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).

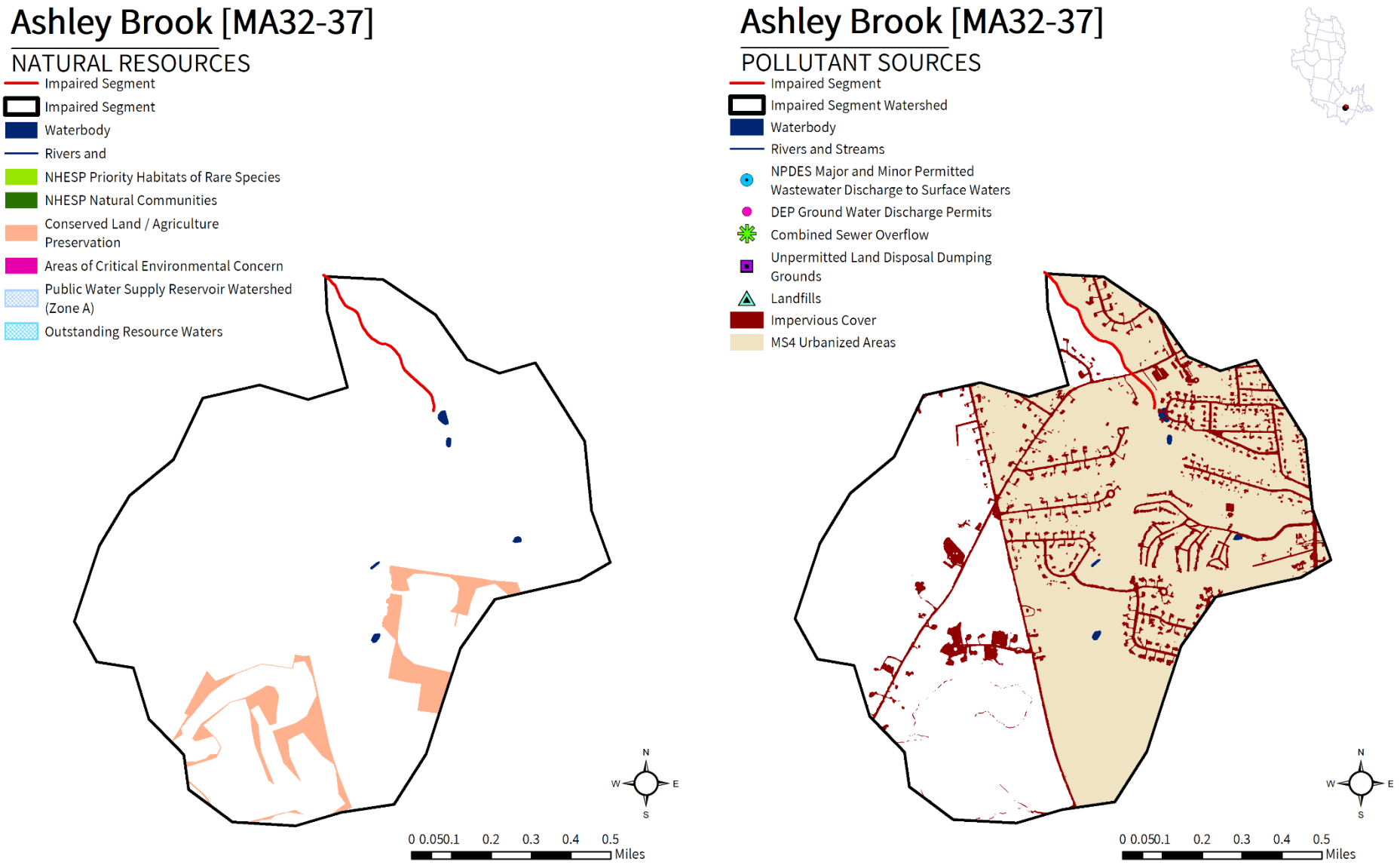


Figure 10-1. Natural resources and potential pollution sources draining to the Ashley Brook segment MA32-37. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

10.2. Waterbody Impairment Characterization

Ashley Brook (MA32-37) 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 10-1, 10-2; 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 2009, eight samples were collected at ASHB0.3 (PVPC, 2010), resulting in eight 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 eight samples, five exceeded the STV criterion during both wet and dry weather.

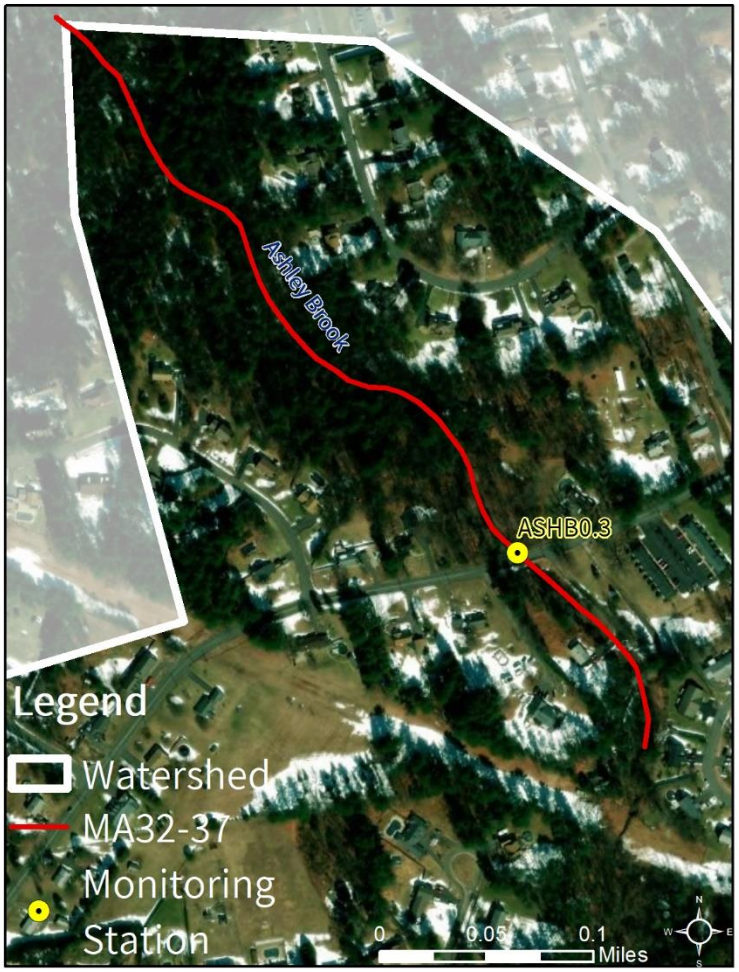


Figure 10-2. Location of monitoring station(s) along the impaired river segment.

Table 10-1. Summary of indicator bacteria sampling results by station for Ashley Brook (MA32-37). 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
ASHB0.3	4/26/2009	11/22/2009	8	1760	8	5

Table 10-2. Indicator bacteria data by station, indicator, and date for Ashley Brook (MA32-37). 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)
ASHB0.3	*E. coli*	4/26/2009	DRY	225	225	
ASHB0.3	*E. coli*	5/18/2009	WET	144	180	
ASHB0.3	*E. coli*	6/28/2009	DRY	866	304	
ASHB0.3	*E. coli*	7/26/2009	WET	387	364	
ASHB0.3	*E. coli*	8/23/2009	WET	1733	834	
ASHB0.3	*E. coli*	9/27/2009	WET	2420	1175	
ASHB0.3	*E. coli*	10/25/2009	WET	1300	1760	
ASHB0.3	*E. coli*	11/22/2009	DRY	517	1176	

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 Ashley Brook (MA32-37) 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: Portions of the watershed are highly developed, with 58% of the land area in MS4 and 4% as DCIA. Development within the watershed consists of low to medium density residential development. With development covering 40% of the watershed area, stormwater runoff from urban areas is likely a significant contributing source of pathogens.

Illicit Sewage Discharges: The upstream portion of the watershed contain some sewer service areas, while the downstream portion of the watershed is mostly served by sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 residential development in the upstream portions of the watershed rely on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for 9% of the total land use. Agricultural activities visible on recent aerial photos within the watershed include hayfields. 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. Although there are no public fields or parks adjacent to the impaired segment, the lower watershed around the segment consists primarily of residential neighborhoods that likely contain numerous dogs.

Wildlife Waste: In the upstream portion of the watershed (upstream of the impaired segment), there are several large, mowed areas around ponds and intermittent streams. Conservation lands and fields with large open mowed areas throughout the watershed and with a clear sightline to a waterbody 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 Southwick

Fifteen percent (15%) of Southwick is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Southwick (Permit ID #MAR041022) has an EPA approved Notice of Intent (NOI). Southwick has a draft hardcopy Stormwater Management Plan on file with its Department of Public Works at 661 College Highway, Southwick, MA 01077. The town has mapped all of its MS4 stormwater system. The town also adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2008-2009. In its NOI, it reports no stormwater outfalls or impaired waters.

Southwick has the following relevant ordinances and bylaws:

- Stormwater Management Bylaw 185-36.1: Erosion and Sediment Control for Stormwater Management, https://ecode360.com/13768195 (Town of Southwick, 2009)
- Title 5 Regulation: Section 410-8 Enforceable schedule for completion of upgrades (of septic systems) and Section 52-2 Sewer and drainage easement https://ecode360.com/10447847?highlight=sewer&searchId=6051156249259725 (Town of Southwick, N.d., a)
- Wetlands Bylaw 450-3: https://ecode360.com/10450419?highlight=wetlands%20bylaw&searchId=6051119011917457#10450419 (Town of Southwick, N.d., b)
- Pet waste regulations: Chapter 69 Animals. Art. 1, Section 69-14: Removal of dog or cat waste from public property or the property of others https://ecode360.com/10447927?highlight=waste&searchId=622531741788607#10447927 (Town of Southwick, N.d., c)

Southwick had no available Master Plan.

Southwick's Open Space and Recreation Plan: https://www.southwickma.org/sites/g/files/vyhlif1241/f/uploads/southwick_osrp_2019_final.pdf (Town of Southwick, 2020)

City of Westfield. See Section 4.4

11. MA32-39 Jacks Brook

11.1. Waterbody Overview

The Jacks Brook segment MA32-39 is 2.4 miles long and begins as a perennial stream east of Fowler Road and northeast of the Fowler Road/Reservoir Road intersection in Westfield, MA. The segment flows alongside Fowler Road to the north and east before turning east to end at the inlet of Crane Pond/Little River (MA32-08) in Westfield, MA.

The Springfield Aqueduct crosses the watershed and segment MA32-39 but is not hydrologically connected to Jacks Brook. The only named tributary to the brook is pathogen-impaired Ashley Brook (MA32-37). There are no named lakes or ponds within the segment watershed.

Key landmarks in the watershed include part of the Ranch Golf Club, the Plantation Conservation Area, and the Bush Hill.

Jacks Brook (MA32-39) drains an area of 2.9 square miles, of which 0.2 mi^2 (7%) is impervious and 0.1 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[25] served by public sewer and 32% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters within the watershed and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 11-1.

Portions of the watershed are highly developed (26%), consisting of medium density residential neighborhoods, though most of the land use is forested or natural (58%). The segment itself flows through a mix of forested and agricultural lands, which are primarily hayfields and row crops. There is little to no natural vegetated buffer between the brook and some of the agricultural areas.

In the Jacks Brook (MA32-39) watershed, under the Natural Heritage and Endangered Species Program, there is one acre (<1%) of Priority Habitats of Rare Species. There are no Areas of

Reduction from Highest Calculated Geomean: 91%

Watershed Area (Acres): 1,853

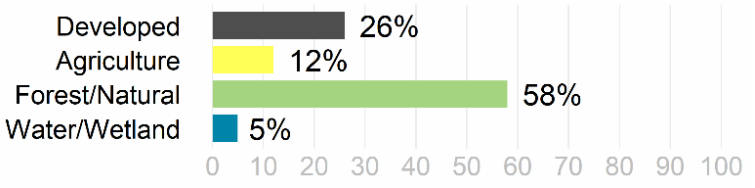
Segment Length (Miles): 2.4

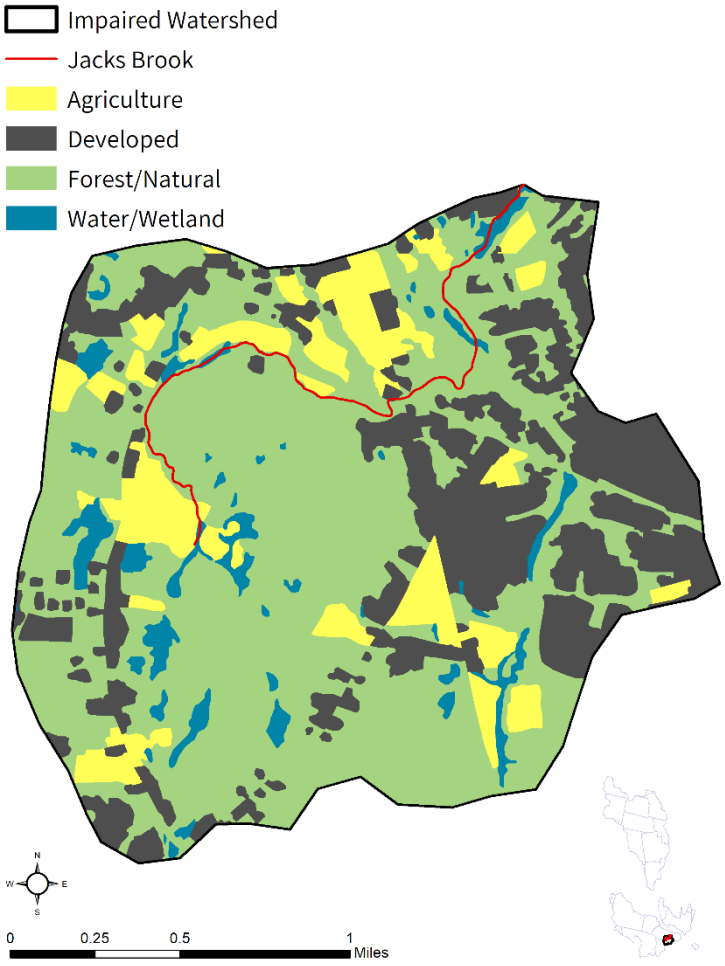
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 125 (7%)

DCIA Area (Acres, %): 43 (2%)



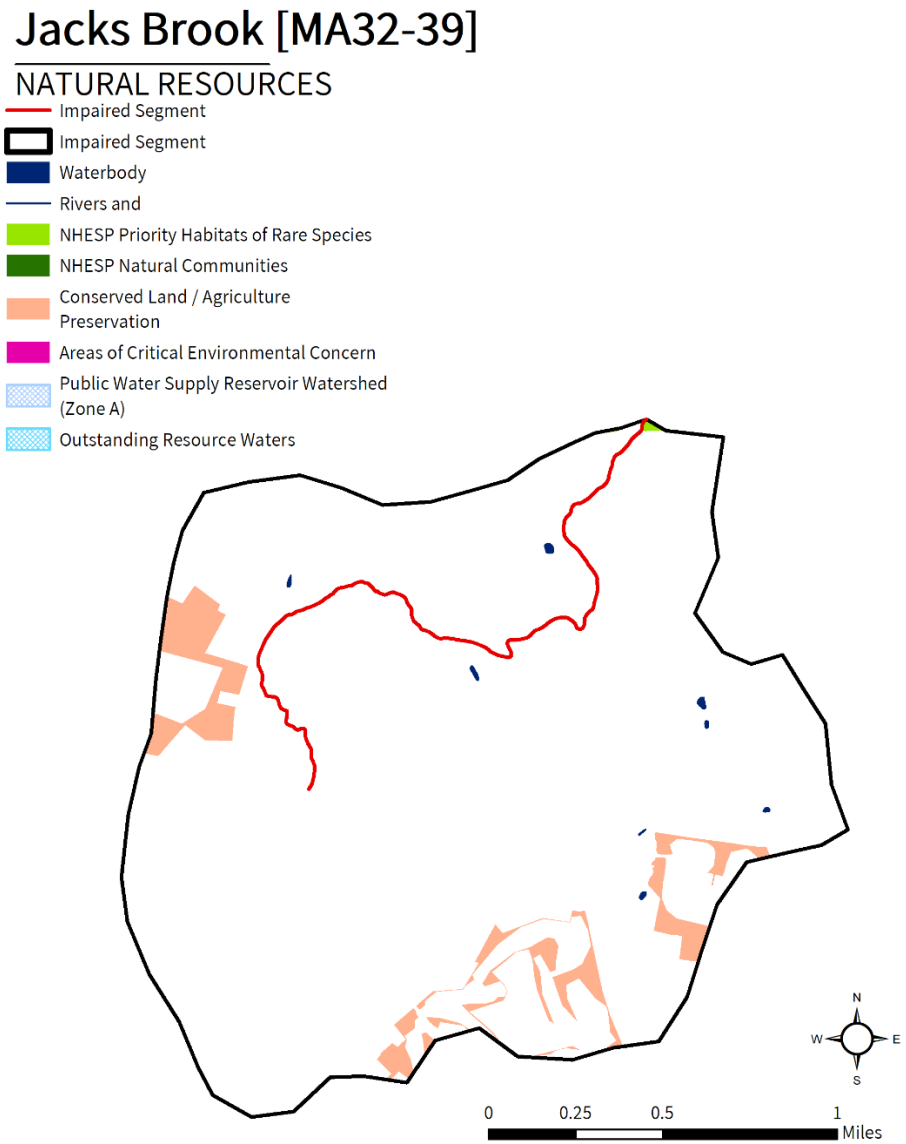


[25] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local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

Critical Environmental Concern, areas under Public Water Supply protection, nor areas identified as Outstanding Resource Waters in the watershed. Over 79 acres (4%) of land protected in perpetuity[26] exist within the segment watershed, which is part of a total of 100 acres (5%) of Protected and Recreational Open Space[27]. See Figure 11-1.

[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).



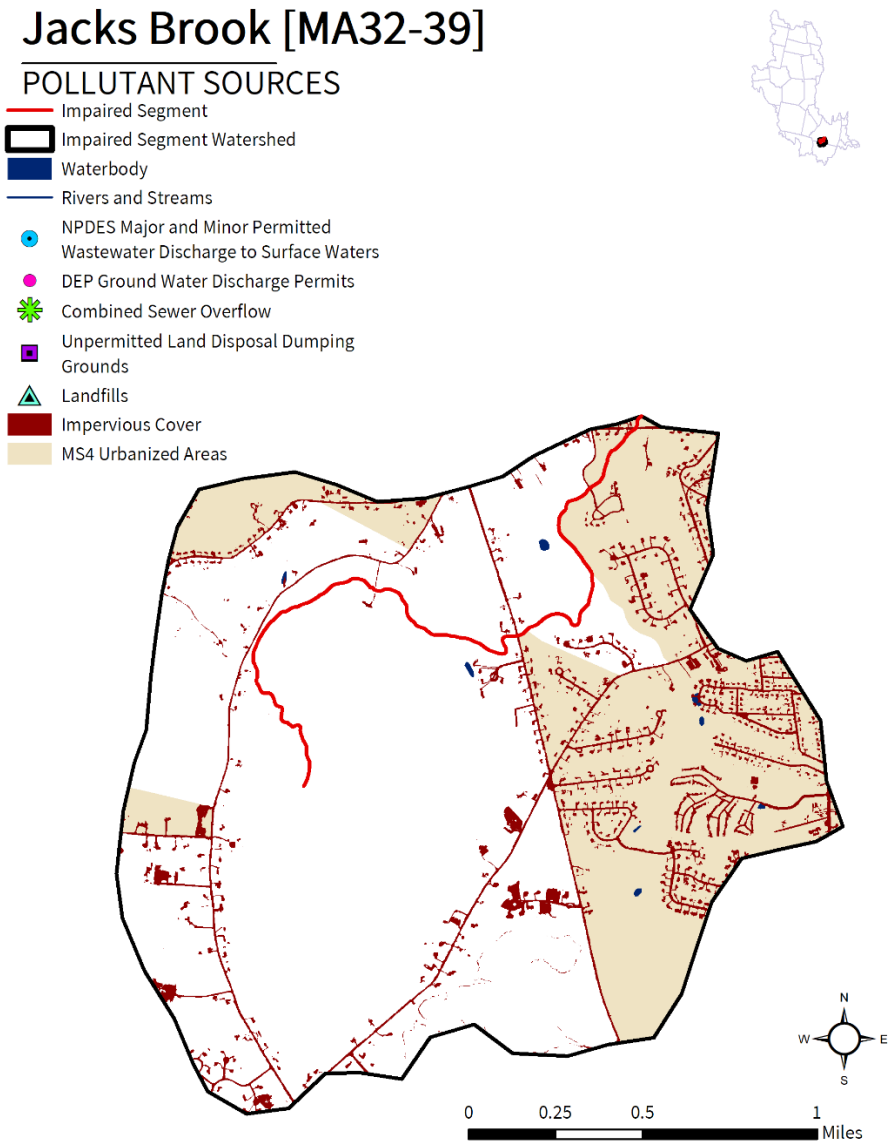


Figure 11-1. Natural resources and potential pollution sources draining to the Jacks Brook segment MA32-39. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

11.2. Waterbody Impairment Characterization

Jacks Brook (MA32-39) 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 identified 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 2009, eight samples were collected at JACB0.01(PVPC, 2010), resulting in seven 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 eight samples, four exceeded the STV criterion during both wet and dry weather.

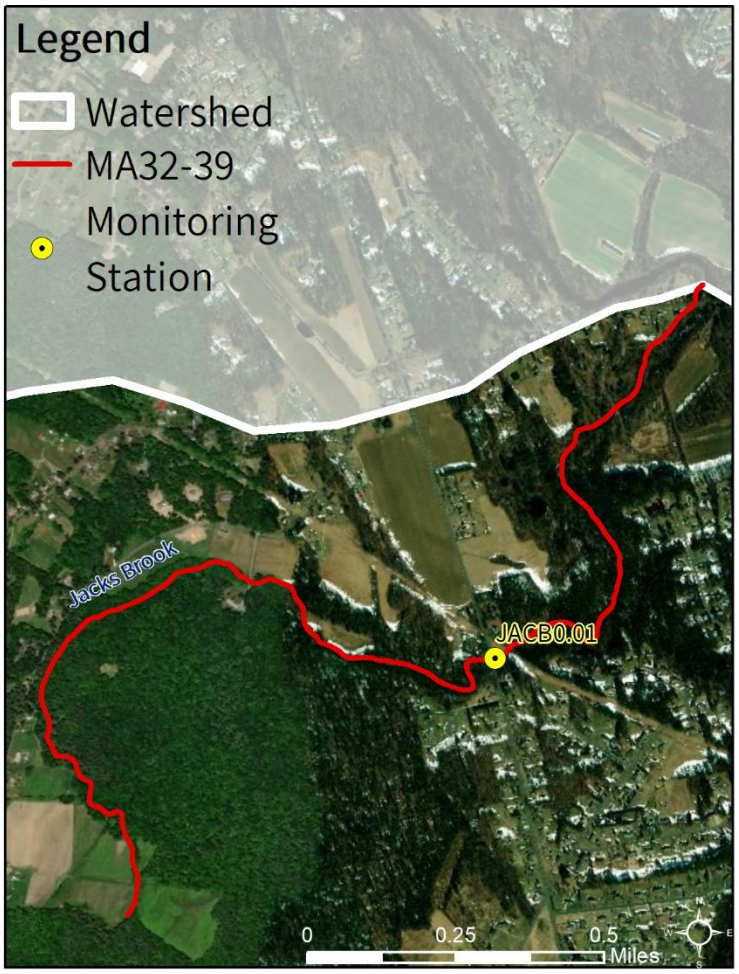


Figure 11-2. Location of monitoring station(s) along the impaired river segment.

Table 11-1. Summary of indicator bacteria sampling results by station for Jacks Brook (MA32-39). 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
JACB0.01	4/26/2009	11/22/2009	8	1414	7	4

Table 11-2. Indicator bacteria data by station, indicator, and date for Jacks Brook (MA32-39). 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)
JACB0.01	*E. coli*	4/26/2009	DRY	1414	1414	
JACB0.01	*E. coli*	5/18/2009	WET	104	383	
JACB0.01	*E. coli*	6/28/2009	DRY	81	228	
JACB0.01	*E. coli*	7/26/2009	WET	118	100	
JACB0.01	*E. coli*	8/23/2009	WET	517	170	
JACB0.01	*E. coli*	9/27/2009	WET	2420	529	
JACB0.01	*E. coli*	10/25/2009	WET	548	882	
JACB0.01	*E. coli*	11/22/2009	DRY	76	465	

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 Jacks Brook (MA32-39) were elevated during both wet and dry weather. Elevated indicator bacteria levels during wet weather suggest 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 levels during dry weather indicate that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, may be present.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are developed, with 32% of the land area in MS4 and 2% as DCIA. Development within the watershed consists of low to medium density residential development. With development covering 26% of the watershed area, stormwater runoff from urban areas is likely a large contributing source of pathogens.

Illicit Sewage Discharges: The upstream portions of the watershed contain some sewer service areas, while the downstream portion of the watershed is mostly served by sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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 residential development in the upstream portions of the watershed relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for 12% of the total land use. Agricultural land uses visible on recent aerial photos within the watershed include open fields, hayfields, and row crops. While most of

the segment flows through a wooded buffer, there is little to no wooded buffer between some agricultural fields and the brook, such as along Fowler Road. 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 significant source of pathogens to the 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. Although there are no public fields or parks adjacent to the impaired segment, the segment watershed includes many residential areas.

Wildlife Waste: There are a few large, mowed areas and agricultural fields in the upstream portion of the watershed adjacent to the brook. Conservation lands and fields with large open mowed areas and 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 (excludes upstream impaired segment watersheds). For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

Town of Southwick. See Section 10.4

City of Westfield. See Section 4.4

12. MA32-41 Moose Meadow Brook

12.1. Waterbody Overview

The Moose Meadow Brook segment MA32-41 is 4.8 miles long and begins at the outlet of the Westfield Reservoir in Montgomery, MA. The segment (formerly part of segment MA32-23) flows to the south into Westfield where it ends at its confluence with the Westfield River. Tributaries include Cooley Brook and several unnamed streams, and the segment flows through the Tekoa Reservoir in Montgomery. Shatterack Pond is in the watershed, well upstream of the impaired segment.

Key landmarks in the watershed include the Montgomery town center and town hall, I-90, and the Part of the Hawks Nest Conservation Area. Segment MA32-41 is crossed by Tekoa Road (three times) in Montgomery; and the Massachusetts Turnpike/I-90 and Pochassic Road in Westfield.

Moose Meadow Brook (MA32-41) drains an area of 8.1 square miles, of which 0.3 mi^2 (3%) is impervious and 0.1 mi^2 (1%) is directly connected impervious area (DCIA). The watershed is partially[28] served by public sewer and <1% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 12-1.

The upper watershed is almost entirely forested, including large tracts of the Westfield Watershed Wildlife Conservation Easement. The lower watershed contains a mix of low density residential development, agriculture, a large quarry, and an interstate highway. The upper two thirds of the segment itself flows through forested areas including large areas with no development. The lower third flows through low density residential and agricultural areas south of I-90, and includes some lawns mowed to the water's edge.

Reduction from Highest Calculated Geomean: 95%

Watershed Area (Acres): 5,207

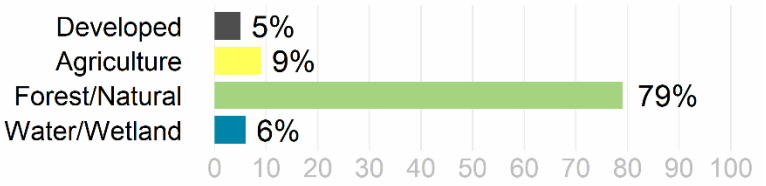
Segment Length (Miles): 4.8

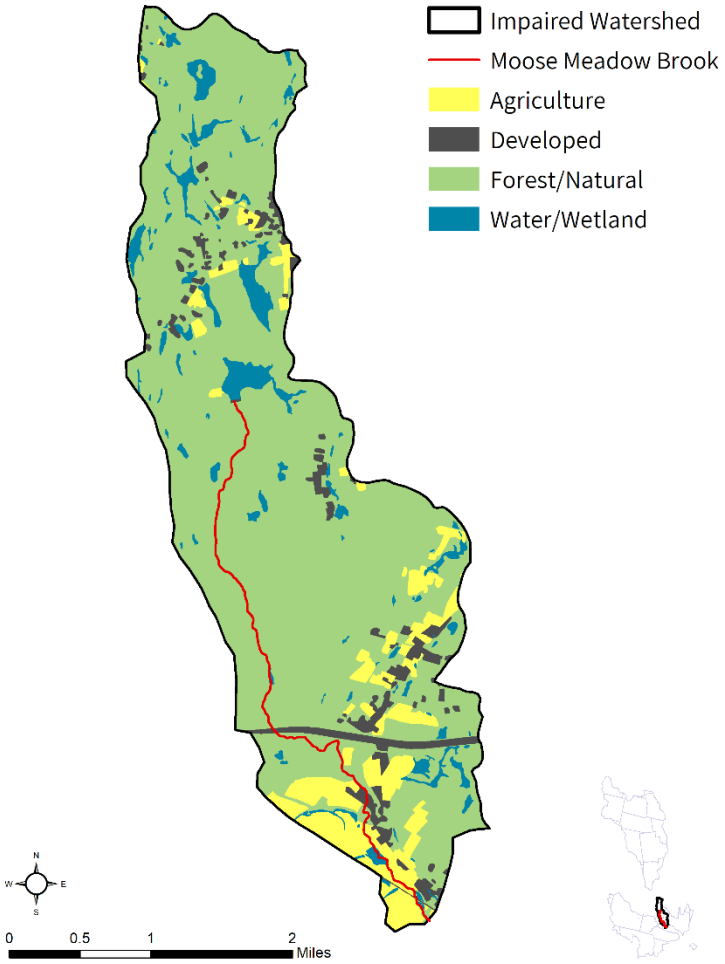
Impairment(s): *E. coli* and fecal coliform (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 178 (3%)

DCIA Area (Acres, %): 67 (1%)





[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.

Agricultural fields in the watershed appear to be used for growing hay and corn.

In the Moose Meadow Brook (MA32-41) watershed, under the Natural Heritage and Endangered Species Program, there are 2,585 acres (50%) of Priority Habitats of Rare Species and 17 acres (<1%) of Priority Natural Vegetation Communities. There are 0.5 acres (<1%) under Public Water Supply protection but no Areas of Critical Environmental Concern or Outstanding Resource Waters identified in the watershed. Over 2,713 acres (52%) of land protected in perpetuity[29] exist within the segment watershed, which is part of a total of 2,784 acres (53%) of Protected and Recreational Open Space[30]. See Figure 12-1.

[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).

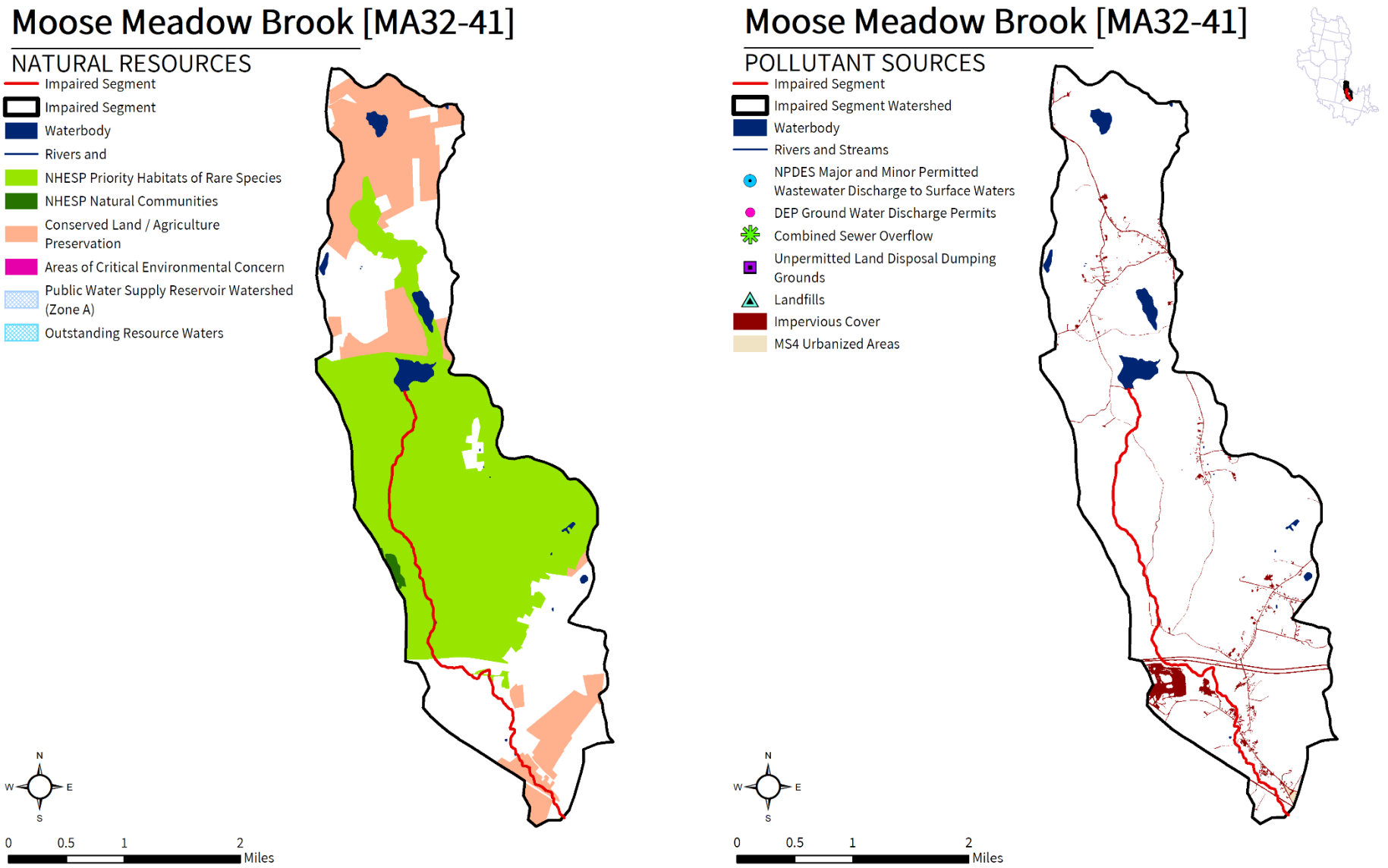


Figure 12-1. Natural resources and potential pollution sources draining to the Moose Meadow Brook segment MA32-41. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

12.2. Waterbody Impairment Characterization

Moose Meadow Brook (MA32-41) 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 identified 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.

- In 2006, five samples were collected at W0812, 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, all exceeded the STV criterion.

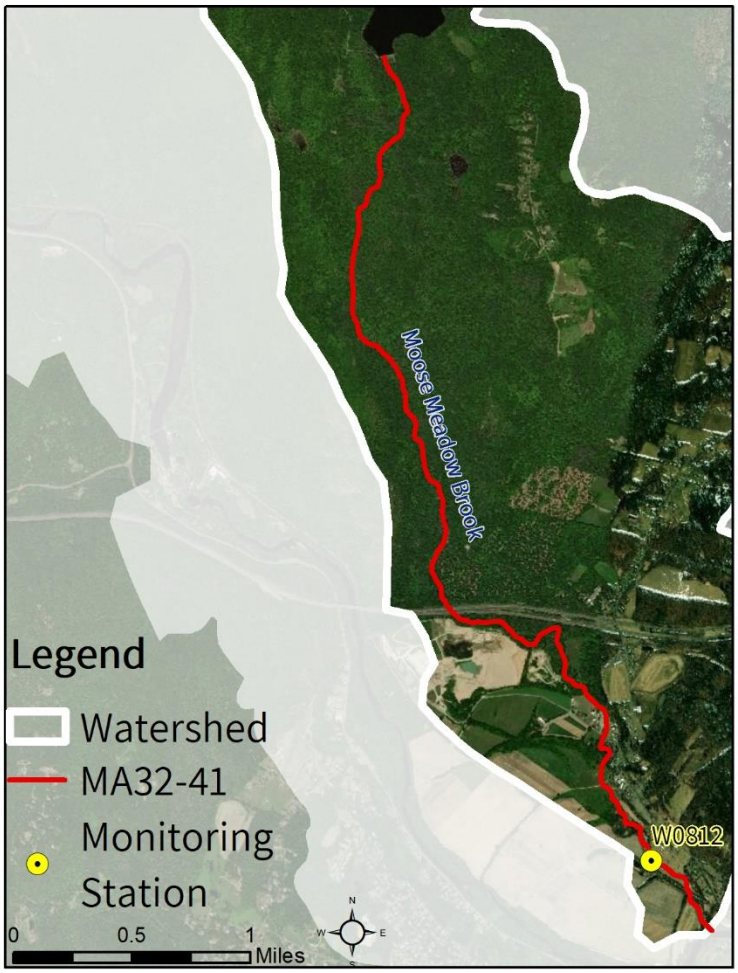


Figure 12-2. Location of monitoring station(s) along the impaired river segment.

Table 12-1. Summary of indicator bacteria sampling results by station for Moose Meadow Brook (MA32-41). 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
W0812	5/9/2006	10/3/2006	5	2377	5	5

Table 12-2. Indicator bacteria data by station, indicator, and date for Moose Meadow Brook (MA32-41). 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)
W0812	*E. coli*	5/9/2006	DRY	540	540	
W0812	*E. coli*	6/13/2006	DRY	440	487	
W0812	*E. coli*	7/25/2006	DRY	1770	749	
W0812	*E. coli*	8/29/2006	WET	2750	1289	
W0812	*E. coli*	10/3/2006	WET	2760	2377	
W0812	Fecal Coliform	5/9/2006	DRY	660		
W0812	Fecal Coliform	6/13/2006	DRY	2100		
W0812	Fecal Coliform	7/25/2006	DRY	318		
W0812	Fecal Coliform	8/29/2006	WET	6040		
W0812	Fecal Coliform	10/3/2006	WET	2190		

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 Moose Meadow Brook (MA32-41) 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: Portions of the watershed are moderately developed, but <1% is MS4 area and only 1% is DCIA. Development within the watershed consists of low to medium density residential development, industrial parcels, and transportation corridors. Although development covers only 5% of the watershed area, the lower portion of the impaired segment flows through developed areas, including several areas where there is little or no natural vegetative buffer around the stream. Given these factors, stormwater runoff from urban areas is likely a contributing source of pathogens.

Illicit Sewage Discharges: The downstream portion of the watershed is likely mostly served by sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSO), 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: Development in the upstream portions of the watershed relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for 9% of the total land use. Agricultural activities visible on recent aerial photos within the watershed include open fields, hayfields, row crops, and pastureland. Some agricultural fields along Pochassic Road are directly adjacent to the brook and have little to no vegetative buffer at the water's edge. 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 significant 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. Although there are no public fields or parks adjacent to the impaired segment, the segment watershed includes many residential homes where lawns are mowed to the water's edge, which may facilitate pet waste entering the stream through runoff or direct pet access.

Wildlife Waste: Conservation lands and fields with large open mowed areas throughout the watershed and with a clear sightline to a waterbody, such as those near Pochassic Road in the lower third of the impaired segment, may attract excessive waterfowl and elevate indicator bacteria counts in the water.

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 Montgomery

The Town of Montgomery is not within the MS4 area.

Montgomery's ordinance and bylaws:

- Montgomery 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 Town of Montgomery does not have a Master Plan or Open Space and Recreation Plan available.

The town website is http://www.montgomeryma.gov/ (Town of Montgomery, 2020)

City of Westfield. See Section 4.4

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

13. References

BRPC. (2021) [online]. *Berkshire Regional Planning Commission*. Available at https://berkshireplanning.org/

City of Agawam. (n.d., a) [online]. *Section 159-20 Sanitary Sewers.* Chapter 159. Subdivision of Land. Town of Agawam, Massachusetts. Available at https://ecode360.com/AG1041/search?query=sewer&scope=all&sortOrder=relevance

City of Agawam. (n.d., b) [online]. *Chapter 96 Dogs and Other Animals.* Town of Agawam, MA / Part II: General Legislation. Section 96-14 Removal of dog or cat waste from property. Available at https://ecode360.com/33035052?highlight=dog&searchId=5701849960739638#33035052

City of Agawam. (n.d., c) [online]. *Article IV Sanitary Sewers, Storms Drains and Connections.* Section 175-35 Stormwater Management Plan. Town of Agawam, MA / Part II: General Legislation / Water and Sewer. Available at https://ecode360.com/27013918?highlight=wetlands&searchId=5701906503542443#27013918

City of Agawam. (2014) [online]. *Agawam 2014 Open Space and Recreation Plan.* Agawam, MA. Available at https://www.agawam.ma.us/DocumentCenter/View/609/Open-Space-and-Recreation-Plan-PDF

City of Westfield. (n.d.) [online]. *Sanitary Sewer Master Plan.* Westfield, MA. Available at https://www.westfieldpolice.org/499/Sanitary-Sewer-Master-Plan

City of Westfield. (2010) [online]. *Ordinance No. 1518.* City of Westfield. April 15, 2010. Available at https://www.cityofwestfield.org/DocumentCenter/View/394/Oridinance-No-1518?bidId=

City of Westfield. (2018) [online]. *Open Space and Recreation Plan.* City of Westfield. 2018-2025. Updated August 2018. Available at https://www.cityofwestfield.org/DocumentCenter/View/6309/2018-OSRP?bidId=

City of Westfield. (2019a) [online]. *Article III. Sewer Use.* Sec. 18-176. Definitions. Westfield, MA. June 21, 2019. Available at https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH18DEPUWO_ARTIIISEUS

City of Westfield. (2019b) [online]. *Ordinance No. 1109*. *Division 2. Wetlands Protection.* Westfield, MA. June 21, 2019. Available at https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH13PLDE_ARTVCOCO_DIV2WEPR

City of Westfield. (2019c) [online]. *Chapter 4 – Animals and Fowl.* Article II. - Animal Control. Ordinance No. 1425. Westfield, MA. June 21, 2019. Available at https://library.municode.com/ma/westfield/codes/code_of_ordinances?nodeId=PTIICOOR_CH4ANFO_ARTIIANCO

City of Westfield. (2020a) [online]. *Stormwater.* Westfield, MA. Available at https://www.cityofwestfield.org/233/Stormwater

City of Westfield. (2020b) [online]. *Stormwater Management Program Plan.* City of Westfield, MA. Updated June 2020. Available at https://www.cityofwestfield.org/DocumentCenter/View/9377/Stormwater-Management-Plan-20200630

FRCOG. (2021) [online]. *Franklin Regional Council of Government.* Available at https://frcog.org/

Geosyntec. (2021) [online]. *Watershed-based Plan – Moose Meadow Brook.* Prepared by Massachusetts Association of Conservation Districts and Geosyntec Consultants, Inc. June 2021. Available at https://prj.geosyntec.com/MassDEPWBP/Content/ShowAcceptedPlan?pid=1554

MassDEP. (2005) [online]. *Westfield River Watershed 2001 Water Quality Assessment Repo*rt. Massachusetts Department of Environmental Protection. Division of Watershed Management. Worcester, MA. April 2005. Available at https://www.mass.gov/doc/westfield-river-watershed-water-quality-assessment-report-2001-0/download

MassDEP. (2020) [online]. *Water Utility Resilience Program.* Massachusetts Department of Environmental Protection. Worcester, MA. Available at https://www.mass.gov/guides/water-utility-resilience-program

MassDEP. (2021). *314 CMR 4.00: Massachusetts Surface Water Quality Standards.* Massachusetts Department of Environmental Protection. Boston, MA. Available at https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards#current-regulations

MassDEP. (2022a). *Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle.* CN 505.1. Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA. Available at https://www.mass.gov/doc/final-massachusetts-integrated-list-of-waters-for-the-clean-water-act-20182020-reporting-cycle/download

MassDEP. (2022b) [online]. Appendix 26 Westfield River Basin Assessment and Listing Decision Summary, Draft Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle, CN 568.0. Massachusetts Department of Environmental Protection, Watershed Planning Program, Worcester, MA. November 2022. Available at https://www.mass.gov/doc/draft-2022-integrated-list-of-waters-appendix-26-westfield-river-basin-assessment-and-listing-decision-summary/download

MAPC. (2014) [online]. *Stormwater Financing/Utility Starter Kit*. Metropolitan Area Planning Council. Boston, MA. Available at https://www.mapc.org/resource-library/stormwater-financing-utility-starter-kit/

MAPC. (2018) [online]. *MS4 Outfall Catchment Calculator.* Metropolitan Area Planning Council. Boston, MA. Available at https://www.mapc.org/resource-library/ms4-outfall-catchment-calculator/

NWSRS. (2019) [online]. *National Wild and Scenic Rivers Systems*. June 6, 2019. Available at https://www.rivers.gov/rivers/westfield.php

PVPC. (2010). *Westfield River Water Quality Monitoring Project Final Report 2008-04/604b including APPENDIX*. Pioneer Valley Planning Commission. Springfield, MA.

PVPC. (2021) [online]. *Pioneer Valley Planning Commission.* Springfield, MA. Available at http://www.pvpc.org/

Think Blue Massachusetts. (2019) [online]. *About Think Blue Massachusetts.* Available at https://www.thinkbluemassachusetts.org/about-us

Town of Chesterfield. (2016) [online]. *Hazard Mitigation Plan Update.* Town of Chesterfield, MA. Adopted by the Chesterfield Board of Selectmen on August 22, 2016. Prepared by The Chesterfield Hazard Mitigation Planning Committee and The Pioneer Valley Planning Commission. Available at http://www.pvpc.org/sites/default/files/ChesterfieldHMP2016.pdf

Town of Chesterfield. (2021) [online]. *Chesterfield, Massachusetts.* Available at https://townofchesterfieldma.com/

Town of Cummington. (2020a) [online]. *General By-Laws.* Dog By-law*.* Cummington, Mass. Amended 8-26-2020. Available at https://cummington-ma.gov/Bylaws.php?Bylaws

Town of Cummington. (2020b) [online]. *Cummington Open Space Committee.* Cummington, Mass. Available at https://cummington-ma.gov/Boards.php?55

Town of Cummington. (2021) [online]. *Town of Cummington, Mass.* Available at https://www.cummington-ma.gov/

Town of Granville. (2004) [online]. *Open Space and Recreation Plan.* 2004. Town of Granville, Massachusetts. Available at https://www.townofgranville.net/sites/g/files/vyhlif4471/f/uploads/open_space_recreation_plan.pdf

Town of Huntington. (2003) [online]. *Huntington Vision: Huntington Community Development Plan*. Huntington, MA. Available at https://huntingtonma.us/Reports/huntington%20community%20development%20plan%20and%20vision.pdf

Town of Huntington. (2017) [online]. *General Bylaws*. Section 12 Dogs, Section 12-7B Nuisance-Public Safety page 6. Huntington, Massachusetts. Amended June 5, 2017. Available at https://huntingtonma.us/RegDocs/General%20Bylaws%20amended%206.5.2017.pdf

Town of Huntington. (2021) [online]. *Huntington, Massachusetts.* Available at https://huntingtonma.us/

Town of Montgomery. (2020) [online]. *Montgomery, MA.* Available at http://www.montgomeryma.gov/

Town of Plainfield. (2021) [online]. *Plainfield, Massachusetts.* Available at https://plainfield-ma.us/e/1/Departments

Town of Russell. (n.d.) [online]. *General By-laws.* Article 7 – Regulations for Keeping of Dogs and Other Dumb Animals. Section 6 Violations. Russell, Massachusetts. Available at http://www.townofrussell.us/files/2008_By-Laws_Sewer_Use2.htm

Town of Russell. (2021) [online]. *Facts About Russell, Massachusetts.* Available at http://www.townofrussell.us/index.ht

Town of Southwick. (n.d., a) [online]. *Chapter 52 Selectmen, Board of.* Section 52-5 Sewer and drainage easements. Town of Southwick, MA / Division 1 Bylaws/ Part I, Administrative Legislation. Available at https://ecode360.com/10447847?highlight=sewer&searchId=6051156249259725

Town of Southwick. (n.d., b) [online]. *Chapter 450 Wetlands Regulations*. Article II General Wetlands Regulations. Section 450-3 Values protected by the Southwick Wetlands Bylaw. Town of Southwick, MA / Division 1, Bylaw / Division 5, Miscellaneous Regulations / Wetlands Regulations. Available at https://ecode360.com/10450419?highlight=wetlands%20bylaw&searchId=6051119011917457#10450419

Town of Southwick. (n.d., c) [online]. *Chapter 69 Animals.* Article I Dogs. Section 69-14 Removal of dog or cat waste from public property or the property of others. Town of Southwick, MA / Division 1, Bylaws / Part II, General Legislation. Available at https://ecode360.com/10447927

Town of Southwick. (2009) [online]. *Article VI General Legislation.* Section 185-36.1 Erosion and Sediment Control for Stormwater Management. Town of Southwick, MA / Division 1 Bylaws / Part II, General Bylaws / Zoning. 3-16-2009. Available at https://ecode360.com/13768195

Town of Southwick. (2020) [online]. *Southwick Open Space and Recreation Plan.* Final Draft February 2020. Town of Southwick, MA. Available at https://www.southwickma.org/sites/g/files/vyhlif1241/f/uploads/southwick_osrp_2019_final.pdf

Town of Worthington. (2006) [online]. *Worthington Open Space and Recreation Plan Update.* December 2006. Worthington, Massachusetts. Available at https://worthington-ma.us/wp-content/uploads/2018/06/OSPlan2006.pdf

USEPA. (2017) [online]. *USEPA National Pollutant Discharge Elimination System (NPDES)- Small Municipal Separate Storm Sewer System (MS4) Request for Waiver from Permit Coverage.* Town of Russell, MA. Available at https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/russell-epa-waiver-response.pdf

USEPA. (2020) [online]. *General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts.* United States Environmental Protection Agency Region 1. National Pollutant Discharge Elimination System (NPDES). Issued April 4, 2016. Modified December 7, 2020. Available at: https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/final-2016-ma-sms4-gp-mod.pdf

Wild & Scenic Westfield River Committee. (2020) [online]. *Wild & Scenic Westfield River Committee.* Available at https://westfieldriverwildscenic.org/

WRWA. (2020) [online]. *Westfield River Watershed Association.* Available at https://www.westfieldriver.org/