MASSACHUSETTS
watershed·based plans

WATERSHED-BASED PLAN

East Branch North River

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Prepared By:

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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

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Executive Summary

Introduction: The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (EPA's) recommended format for "nine-element" watershed plans. This WBP was developed by Geosyntec Consultants, Inc. (Geosyntec) under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from the Massachusetts Department of Environmental Protection (MassDEP).

This WBP was prepared for the East Branch North River watershed, which is in the town of Colrain, Massachusetts as well as Halifax, Vermont. For this WBP, the delineation ends at the Massachusetts state border and does not include the Vermont portion of the watershed. For more information on the Vermont portion of the watershed see the *Deerfield River & Lower Connecticut River Tactical Basin Plan* (VT DEC 2020). The confluence of the East Branch North River and the West Branch North River forms the North River, which is a tributary to the Deerfield River. The total area of the East Branch North River watershed within Massachusetts is approximately 7,000 acres (approximately 11 square miles). Major streams in the watershed include East Branch North River (MA33-19), Spur Brook (MA33-106), Unnamed Tributary (MA33-107), Unnamed Tributary (MA33-108), and Unnamed Tributary (MA33-134).

Impairments and Pollution Sources: East Branch North River (MA33-19) is a category 5 water body on the 2016 Massachusetts Integrated List of Waters (303(d) list) due to *Escherichia coli* (*E. coli*) from agriculture and unknown sources. Water quality data from 2000, 2005, 2006, 2007, 2012, 2019 and 2021 indicated elevated levels of bacteria [above the Massachusetts Water Quality Standards].

Goals, Management Measures, and Funding: The long-term goal of this WBP is to reduce *E. coli* and Total Phosphorus (TP) loading to the East Branch North River, eventually leading to delisting of impaired waterbodies in the study area from the 303(d) list. It is expected that these pollutant load reductions will result in improvements to other water quality parameters throughout the watershed as well.

It is expected that these goals will be accomplished primarily through installation of agricultural Best Management Practices (BMPs) to capture runoff and reduce *E. coli* loading as well as implementation of watershed education and outreach to achieve additional pollutant load reductions. Agricultural BMP planning and implementation will initially be performed at various farms in the watershed, with funding from the Fiscal Year 2021 Section 319 grant program (MACD, 2020). MACD was awarded this funding to conduct outreach and education to farmers in the East Branch North River watershed; develop conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to financial resources; implement BMPs and ensure farmers follow operation and maintenance practices (MACD, 2020).

It is expected that future funding for management measures will be obtained from a variety of sources including Section 319 Grant Funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement Program (APSIP), Town capital funds, volunteer efforts, and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program.

Public Education and Outreach: Goals of public education and outreach are to provide information about proposed stormwater improvements and to promote watershed stewardship.

MACD will engage in outreach and dialogue with farmers in the East Branch North River watershed and share information about the availability of funds from MassDEP, the Massachusetts Department of Agricultural Resources (MDAR) and NRCS to implement BMPs to reduce contaminated runoff from agricultural operations.

An initial stakeholder meeting was held on May 26, 2021, which included core stakeholders in the East Branch North River watershed. The purpose of the meeting was to introduce stakeholders to one another and gain consensus on elements of this WBP.

Implementation Schedule and Evaluation Criteria: The implementation schedule includes milestones for outreach and education; monitoring; development and implementation of farm conservation plans; assisting farmers in obtaining access to financial resources; BMP implementation. and operation and maintenance plans.

This WBP recommends expanding the current water quality monitoring program to better understand water quality trends in the East Branch North River, including determining sources of pollution and evaluating the effectiveness of implemented BMPs and tracking compliance with the water quality goals identified in this WBP.

The WBP will be re-evaluated and adjusted, as needed, once every five years to assess progress and determine whether modifications are required to meet the established goal.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (EPA's) recommended format for "nine-element" watershed plans, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Most states develop WBPs only for selected watersheds. Massachusetts Department of Environmental Protection's (MassDEP's) approach has been to develop a tool to support statewide development of WBPs, so **that good projects in all areas of the state may be eligible for federal watershed implementation grant funds** under Section 319 of the Clean Water Act.

EPA guidelines promote the use of Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with Section 319 funds, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

Watershed-Based Plan Outline

This WBP for the East Branch North River watershed includes nine elements (a through i) in accordance with EPA Guidelines:

a) An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other watershed goals identified in the WBP), as discussed in item (b) immediately below.

b) An **estimate of the load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time).

c) A **description of the nonpoint source management measures** needed to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this WBP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d) An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA's) Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e) An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

f) A **schedule for implementing the nonpoint source management measures** identified in this plan that is reasonably expeditious.

g) A description of **interim, measurable milestones** for determining whether nonpoint source management measures or other control actions are being implemented.

h) A set of **criteria to determine if loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a nonpoint source total maximum daily load (TMDL) has been established, whether the TMDL needs to be revised.

i) A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Project Partners and Stakeholder Input

This WBP was developed by Geosyntec under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from MassDEP. This WBP was developed using funds from the Section 319 program to assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool (WBP Tool). The MACD was a recipient of Section 319 funding in Fiscal Year 2021 to implement public outreach and education as well as farm conservation plans and agricultural BMPs in the East Branch North River Watershed.

The following are core project stakeholders:

- Michael Leff – Massachusetts Association of Conservation Districts (MACD)
- Matthew Reardon – MassDEP
- Kimberly Noake MacPhee – Franklin County Regional Council of Governments (FRCOG)
- Ryan O'Donnell – Connecticut River Conservancy (CRC)
- Bill Dornbusch – Colrain Farm Owner, Past BMP Project Site Owner
- Erin Rodgers – Trout Unlimited (Deerfield River)
- Haynes Turkle – Chair, Colrain Agricultural Commission
- Nic Miller – Field Geology Services

This WBP was developed as part of an iterative process as outlined below:

- The Geosyntec project team first collected and reviewed existing data from MACD and other available sources.
- Subsequently, a stakeholder meeting was held on May 26, 2021 to solicit additional input and gain consensus on elements included in the plan (identifying problem areas, BMP projects, water quality goals, public outreach activities, etc.). The meeting minutes from the stakeholder conference call are included in **Appendix A**.
- Next, a WBP was drafted and reviewed by MassDEP.
- The WBP was then finalized based on MassDEP input.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool and supplemented by information provided in the Section 319 grant application for "Western Massachusetts Agricultural Nonpoint Source Program (MACD, 2020). Additional data sources were reviewed and are included in subsequent sections of this WBP.

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

General Watershed Information

This WBP was prepared for the East Branch North River watershed, which is in the town of Colrain, Massachusetts as well as Halifax, Vermont. For this WBP, the delineation ends at the Massachusetts state border and does not include the Vermont portion of the watershed. The confluence of the East Branch North River and the West Branch North River forms the North River, which is a tributary to the Deerfield River[1]. The total area of the East Branch North River watershed within Massachusetts is approximately 7,000 acres (approximately 11 square miles).

Table A-1 presents the general watershed information for the East Branch North River watershed[2] and **Figure A-1** includes a map of the watershed boundary.

Table A-1: General Watershed Information

Watershed Name (Assessment Unit ID):	East Branch North River (MA33-19); Spur Brook (MA33-106); Unnamed Tributary (MA33-107); Unnamed Tributary (MA33-108); Unnamed Tributary (MA33-134)
Major Basin:	Deerfield River
Watershed Area (within MA):	7,078.6 (ac)

[1] A WBP for the entire Deerfield River watershed was previously developed in 2015 (FRCOG, 2015).
[2] Watersheds are defined by the WBP-tool by utilizing MassGIS drainage sub-basins.

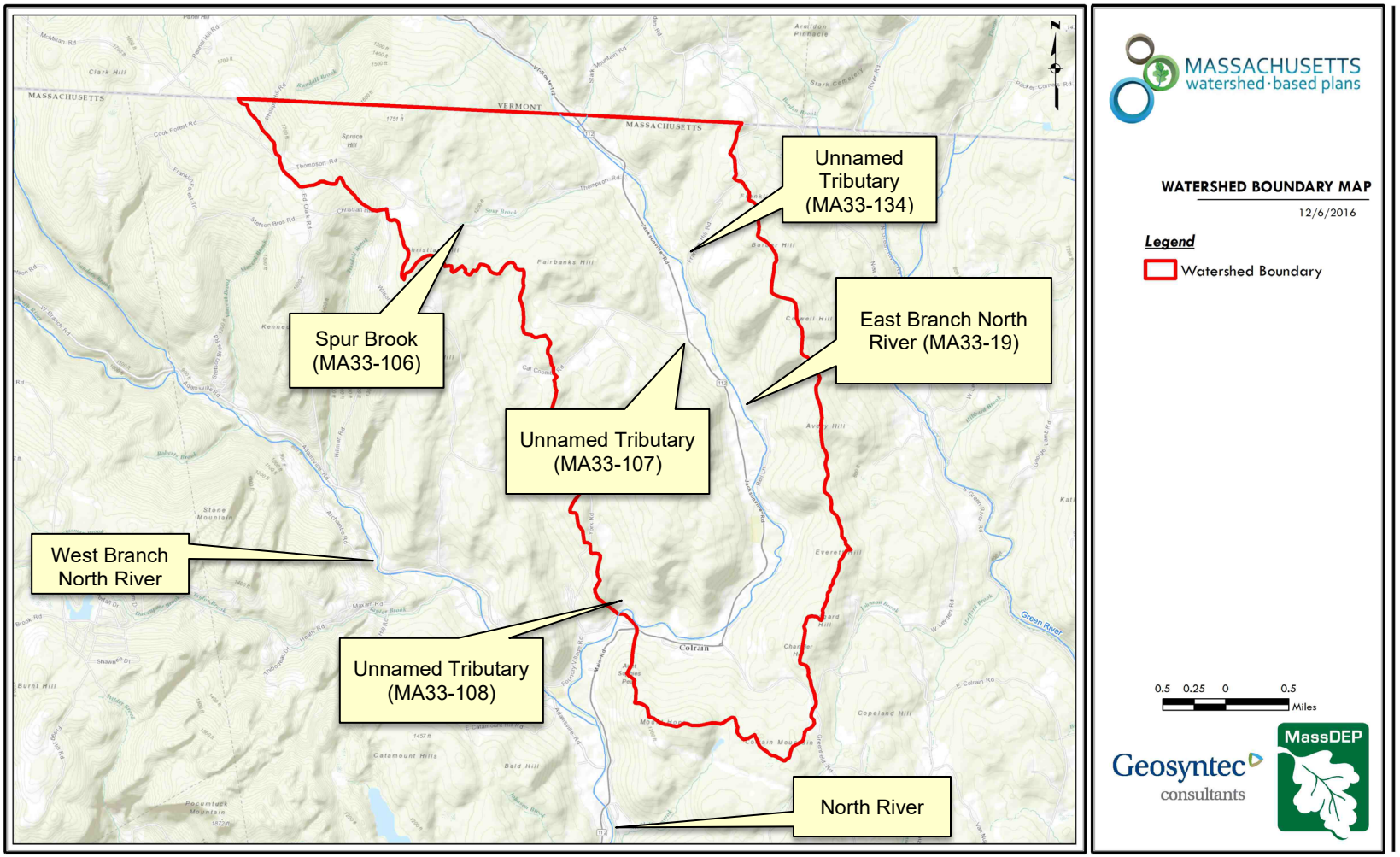


Figure A-1: Watershed Boundary Map

(MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

MassDEP Water Quality Assessment Report and TMDL Review

Water Quality Assessment Report

Appendix B includes select excerpts from the Deerfield River Watershed 2000 Water Quality Assessment Report (MassDEP, 2000) summarizing water quality data and information pertaining to the East Branch North River (MA33-19).

- Fecal coliform bacteria samples were collected from the East Branch North River at Lyonsville Village, north of the Arthur-Smith Covered Bridge on four different dates between August and November in 2000. The fecal coliform bacteria concentrations ranged from 50 to 280 colony forming units per 100 milliliters (cfu/100 mL), with only one of the four samples exceeding 235 cfu/100 mL [above the Massachusetts Water Quality Standards], which was during a wet weather event in September.
- In addition, a biological survey conducted in September 2000 noted no objectionable deposits, sheens, odors, or other conditions.
- Samples were also collected in 2003 for other water quality parameters at the "Colrain Brush Landfill/Former Town Dump", which historically received demolition waste, industrial waste, and municipal solid waste. The Town Dump portion was closed in 1976 and had not been capped or lined while the brush dump was closed and capped in 1989. The samples were collected from a groundwater seep on the bank of the East Branch North River downgradient of the former landfill and indicated high Iron (95,400 micrograms per liter (µg/L)), Manganese (8,250 µg/L), and Cadmium (1.8 µg/L); Volatile organic compounds (VOCs) were not detected (MassDEP, 2000).

Recommendations from the water quality assessment report (MassDEP, 2000) included:

- Continue water quality and biological monitoring—especially nutrient and bacteria sampling;
- Support local efforts to control streambank erosion;
- Work with NRCS to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff;
- Participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004);
- Apply land use planning techniques to direct development, preserve sensitive areas, and maintain or reduce impervious cover;
- Identify rural roads near receiving waters and evaluate potential for impacting water quality;
- Implement BMPs as described in the "Massachusetts Unpaved Roads BMP Manual" (Berkshire Regional Planning Commission, 2001); and
- Perform management of the Colrain Brush Landfill/Former Town Dump including performing additional field investigation to assess environmental risk, identifying and characterizing the extent of any impacts that may be present, and determining the need for corrective action.

TMDL

The East Branch North River watershed does not have a TMDL[3].

Water Quality Impairments and Pollution Sources

303 (d) List Impairments

Impairment categories from the MassDEP 2016 Massachusetts Integrated List of Waters (303(d) List) are listed in **Table A-2**. Known water quality impairments, as documented in the 2016 303(d) List are listed in **Table A-3,** which indicates that East Branch North River (MA33-19) is identified as a category 5 water body due to *Escherichia coli* (*E. coli*) from agricultural and unknown sources.

Table A-2: 2016 MA Integrated List of Waters Categories

Integrated List Category	Description
1	Unimpaired and not threatened for all designated uses.
2	Unimpaired for some uses and not assessed for others.
3	Insufficient information to make assessments for any uses.
4	Impaired or threatened for one or more uses, but not requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required
5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

Table A-3: Water Quality Impairments

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Suspected Impairment Source
MA33-19	East Branch North River	5	Primary Contact Recreation	Escherichia Coli (E. Coli)	Agriculture
MA33-19	East Branch North River	5	Primary Contact Recreation	Escherichia Coli (E. Coli)	Source Unknown

FRCOG Nonpoint Source Pollution Assessment

FRCOG conducted a nonpoint source pollution assessment in 2008 with funding from MassDEP's 604(b) grant program. The goal of this project was to provide an inventory and assessment of potential sources of nonpoint source pollution in the six priority subwatersheds of the Deerfield River watershed (including the North River watershed) and provide recommendations for future work to prevent or mitigate nonpoint

[3] The East Branch North River is part of the Connecticut River watershed; the Connecticut River flows into the Long Island Sound. The Long Island Sound has a TMDL: "A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound".

source pollution. The study identified two areas along the East Branch North River requiring further assessment and stabilization due to the potential threats to important town infrastructure; these included:

- The reach above and below the Route 112 bridge, particularly the area adjacent to the Colrain Central School's on-site septic system.
- The areas near the Town of Colrain's public water supply wells. These sites are located off Route 112 and near Call Road.

The study also identified several potential sources of nonpoint source pollution, including:

- Unpaved road runoff and sedimentation
- Colrain Brush Landfill/Former Town Dump
- "Colrain Sand and Gravel" gravel pit
- Illegal dumping and junkyards
- Livestock in the East Branch North River watershed listed in **Table A-4,** which indicates that most farms are located along Route 112 (Jacksonville Rd) and that cows are the most common livestock in the watershed.

Table A-4: FRCOG 2008 Livestock Survey

Name	Address	Property Area (acres)	Cow	Horse	Chicken	Goat	Pig	Sheep
Avery, Ke	**Jacksonville Rd**	300	X					
Bringham	**58 Jacksonville Rd**	200		2				
Cromack	**438 Jacksonville Rd**	75		3	4	2		10
Unnamed		100	X					
Unnamed	**Adams Place**	198	X					X
Potts, J.	**Jacksonville Rd**	100	X					X
Potts. J.B.	**Fairbanks Rd**	90	X					X
Roberts	**2 Roberts Ln**	246	X					
Sylvester	**268 Jacksonville Rd**	20	1		60		1	

Source: FRCOG, 2008.

X = the type of animal is kept on the property but the number of animals was not reported.

Also, as part of this project, The Deerfield River Watershed Association (DRWA) prepared a Quality Assurance Project Plan (QAPP) for a three-year (2005-2007) volunteer *E.coli* water quality sampling program for the Chickley and South Rivers, and the East Branch North River. The QAPP was approved by MassDEP and EPA. DRWA recruited and trained volunteers to collect the samples for this program and the samples were analyzed by DRWA staff with the Colilert® system. A summary of the findings of this study is listed below (FRCOG, 2008):

- **2005 - Year 1:** In the first year of the program, volunteers collected screening level samples during both wet and dry weather conditions. After analysis of the first-year data, DRWA and MassDEP agreed to discontinue wet weather sampling and focus on dry weather sampling during subsequent years.
- **2006 - Year 2:** After year 2006 sampling agricultural activity between Reil Lane and the Colrain Elementary School (upstream of the Route 112 bridge) was tentatively identified as a potential source of *E.coli* in the East Branch North River; however, further sampling was needed to confirm this assumption. Potential sources of elevated bacteria counts in the lower East Branch North River also remained unknown at the end of the second sampling season.

- **2007 - Year 3:** Although the 2006 results indicated agricultural activity upstream of the Route 112 bridge was a likely source of *E.coli*, the 2007 sampling efforts identified a source of elevated *E. coli* counts within an area downstream of the Route 112 bridge and adjacent to the Colrain Elementary School. In the Fall 2007, MassDEP collected one water sample at this location and submitted it for human marker testing; the results indicated a non-human origin of the *E. coli* collected from this stream location. Anecdotal evidence suggested that heavy pigeon use of the Route 112 bridge may be resulting in elevated *E. coli* counts in the East Branch North River below. Other animal use in and around the river and bridge could also be the source of elevated *E. coli* counts in this location (FRCOG, 2008).

River Corridor Mapping in the North River (Field Geology Services, 2018)

A report was developed in 2018, which describes the development of a river corridor mapping protocol based on the science of fluvial geomorphology that will allow riverine communities in Massachusetts to relatively easily and inexpensively delineate areas prone to flood and erosion hazards. The North River Watershed was used to test the methodology and compare the results with other geomorphic assessments recently completed in the watershed. For the study, river corridor was defined as "the area of the valley bottom and floodplain across which the river migrates over time in order to develop and sustain an equilibrium condition where changes in the channel's dimensions, planform, and gradient are minimized". The report concluded that compared to other geomorphic assessment methods that are available, the river corridor mapping protocol presented in the report was more effective at identifying the location and severity of erosion hazards and channel migration that are responsible for the most severe damages during storms like Tropical Storm Irene. The corridor mapping procedures were developed for use by conservation districts, towns, and other organizations working to better plan and prepare for future floods. The assessment found that the entire East Branch North River corridor is designated as moderate or higher risk due to the confined areas, valley constrictions, and artificially straightened reaches. The resulting East Branch North River Corridor Map is included in **Appendix C**.

Municipal Vulnerability Preparedness and Hazard Mitigation Plans

The Town of Colrain completed municipal vulnerability preparedness (MVP) and hazard mitigation plans (with assistance from FRCOG) in 2018 and 2020, respectively. The MVP plan (Town of Colrain, 2018) noted the following areas of concern in regard to the East Branch North River:

- Buildings, facilities, and an uncapped landfill very close to the East Branch North river
- Many vulnerable bridges and culverts throughout the Town of Colrain including on state-owned land
- A need for sewer and septic in the village center
- Eroding riverbanks along the East Branch North River
- Invasive plant species along the river corridor
- Farm fields without buffers along the East Branch North River

The hazard mitigation plan (Town of Colrain, 2020) noted riverbank erosion as well as concerns about large landslides, mudslides, and slumping along the East Branch North River. The plan also stated that the roads, bridges, and culverts in the Town of Colrain's village center as vulnerable to high flood events, including a key area of concern near the Colrain Elementary School (Town of Colrain, 2020).

May 26, 2021 Stakeholder Meeting Pollutant Sources Identified

In addition, other potential pollution sources to East Branch North River that were discussed during the stakeholder meeting on May 26, 2021 (meeting minutes included in **Appendix A**) included sediment loading from unpaved roads, septic systems, and salting of Route 112 during winter months. It was noted during the meeting that Colrain has the highest number of unpaved road miles in Franklin County (approximately 30 miles).

MassDEP Water Quality Monitoring Program Data

Historical and current Technical Memoranda (TM) produced by the MassDEP Watershed Planning Program are available here: Water Quality Technical Memoranda | Mass.gov and are organized my major watersheds in Massachusetts. Most of these TMs present the water chemistry and biological sampling results of WPP monitoring surveys. The TMs pertaining primarily to biological information (e.g., benthic macroinvertebrates, periphyton, fish populations) contain biological data and metrics that are currently not reported elsewhere. The data contained in the water quality TMs are also provided on the "Data" page (Water Quality Monitoring Program Data | Mass.gov). Many of these TMs have helped inform Clean Water Act 305(b) assessment and 303(d) listing decisions. Water quality monitoring data is available for the East Branch North River from the years 2005 and 2012 (MassDEP, 2021). The *E. coli* data is presented in **Table A-5**, and both years (2005, 2012) exceeded the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) for *E. coli*, which states that the geometric mean of samples from the most recent 6 months shall not exceed 126 colonies per 100 milliliters (typically based on a minimum of 5 samples) and no single sample shall exceed 235 colonies per 100 milliliters. The TP data from 2005 and 2012 is presented in **Table A-6**, and the average and maximum TP concentrations were all below the TP EPA "Gold Book" (EPA, 1986) standard of 50 micrograms per liter (µg/L).

Table A-5: MassDEP Water Quality Monitoring Program *E. coli* Data

Unique ID	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)
W2255	[approximately 2,225 feet upstream of the Route 112 crossing nearest Jesse Wood Road, Colrain]	5/17/2005	28
		6/7/2005	201
		7/19/2005	548
		8/16/2005	411
		9/21/2005	167
W2255	**2005 Minimum**		28
	2005 Maximum		548
	2005 Median		201
	2005 Mean		271
W1347	["Lyonsville Road", Colrain (site of old Arthur Smith Covered Bridge, no road crossing here)]	5/23/2012	111
		6/13/2012	345
		6/28/2012	50
		8/2/2012	238
		8/30/2012	22
		9/27/2012	21
W1347	**2012 Minimum**		21
	2012 Maximum		345
	2012 Median		81
	2012 Mean		131

Sources: MassDEP, 2021

"MPN/100 mL" = most probable number per 100 milliliters

"CFU/100 mL"= colony forming units per 100 milliliters

Samples taken samples taken in 2005 were reported in CFU/100 mL and those taken in 2012 were reported in MPN/100 mL and

Table A-6: MassDEP Water Quality Monitoring Program TP Data

Unique ID	Sampling Location	Date	TP (µg/L)
W2255	[approximately 2,225 feet upstream of the Route 112 crossing nearest Jesse Wood Road, Colrain]	5/17/2005	8
		6/8/2005	11
		7/20/2005	7
		8/17/2005	11
		9/20/2005	<5
W1347	["Lyonsville Road", Colrain (site of old Arthur Smith Covered Bridge, no road crossing here)]	5/23/2012	6
		6/28/2012	5
		8/2/2012	20
		8/30/2012	<5
		9/27/2012	<5

Sources: MassDEP, 2021

"µg/L" = micrograms per Liter

Additional Water Quality Data

Additional water quality data collected by the DRWA in 2007, 2017, 2018, 2019, and 2020 is described below. **Appendix D** also includes Massachusetts Department of Fish and Game fish population sampling results from the East Branch North River and its tributaries.

DRWA conducted a macroinvertebrate assessment in the North River watershed in September 2007. Six sampling locations in the East Branch North River watershed (2 in Vermont and 4 in Massachusetts) were included and are identified in **Figure A-2**. Based on the assessment, substrate embeddedness, sediment deposition, and habitat diversity generally improved in an upriver direction. Erosion and sedimentation problems were noted throughout the lower section of the East Branch North River (sample locations EBNM01, EBNM02, EBNM03). The biological condition for all East Branch North River sampling locations were assessed as "Not impacted".

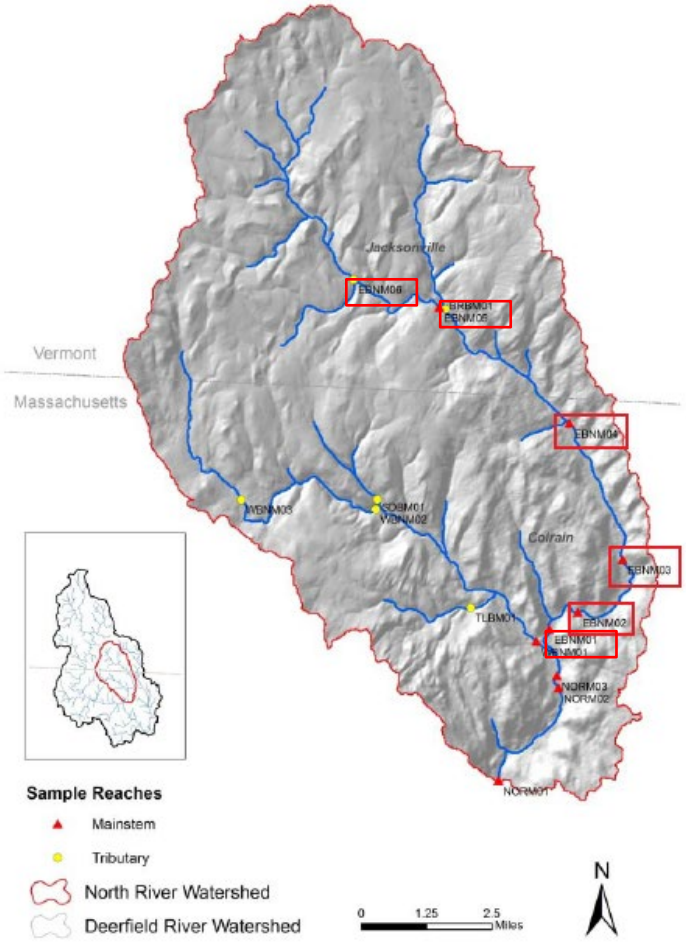


Figure A-2: September 2007 DWRA Macroinvertebrate Sampling Locations

Source: DRWA, 2008.

Red outlines indicate sampling locations within the East Branch North River watershed

DRWA collected water quality samples at three sampling locations in the East Branch North River watershed (2 in Vermont and 1 in Massachusetts) in 2017, 2018, 2019, and 2020. Samples were collected, which included Total Phosphorus (TP) and *E. coli* on alternative Wednesday mornings from the end of June to the beginning of September during each of the years. TP data were collected in 2017, 2018, and 2019, and *E. coli* data were collected in 2018, 2019, and 2020. A map identifying the Massachusetts sampling location is included in **Figure A-3**. The TP and *E. coli* results are presented in **Table A-7** and **Table A-8**, respectively. The average and maximum TP concentrations were all below the TP EPA "Gold Book" (EPA, 1986) standard of 50 micrograms per liter (µg/L). The *E. coli* data from 2019 exceeded the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) for *E. coli*, which states that the geometric mean of samples from

the most recent 6 months shall not exceed 126 colonies per 100 milliliters (typically based on a minimum of 5 samples) and no single sample shall exceed 235 colonies per 100 milliliters. However, the *E. coli* data from 2018 and 2020 did not exceed this standard. At the writing of this WBP, one sampling event has occurred in the 2021 season on June 23, 2021 and the result (461.1 cfu/100 ml) exceeded the single sample standard of 235 colonies per 100 milliliters.

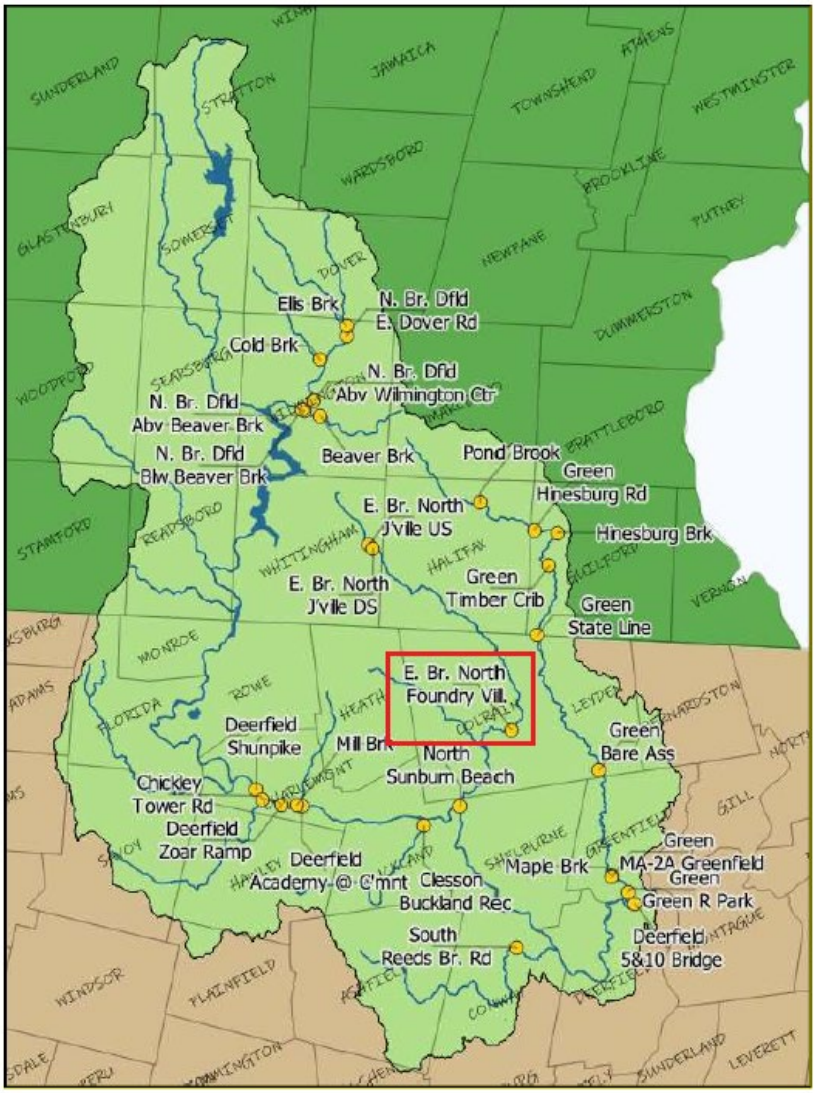


Figure A-3: DRWA 2017 – 2020 Sampling Location

Source: DRWA, 2019. Note: the sampling location for the East Branch North River was the same from 2017 through 2020. Red outline identifies the Massachusetts sampling location within the East Branch North River watershed

Table A-7: DRWA 2017, 2018, 2019 TP Data – East Branch North River Foundry Village Sampling Location

Site ID	Year	Number of samples collected	Average TP (µg/L)	Maximum TP (µg/L)
MA-EBN_02.4	**2017**	5	28	42
MA-EBN_02.4	**2018**	4	9	10
MA-EBN_02.4	**2019**	5	18	41

Sources: DRWA, 2017; DRWA, 2018; DRWA, 2019
"µg/L" = micrograms per Liter

Table A-8: DRWA 2018-2020 *E. Coli* Data – East Branch North River Foundry Village Sampling Location

Site ID	Date	*E. coli* (MPN/100 mL or CFU/100 mL)	Wet Weather (Yes/No)
MA-EBN_02.4	6/27/2018	47	No
	7/11/2018	99	Yes
	8/8/2018	167	Yes
	9/5/2018	93	No
MA-EBN_02.4	2018 Minimum	47	No
	2018 Maximum	167	Yes
	2018 Median	96	NA
	2018 Mean	102	NA
MA-EBN_02.4	6/26/2019	921	Yes
	7/10/2019	39	No
	7/24/2019	0	Yes
	8/7/2019	101	No
	8/21/2019	125	Yes
	9/4/2019	153	Yes
MA-EBN_02.4	2019 Minimum	0	Yes
	2019 Maximum	921	Yes
	2019 Median	113	NA
	2019 Mean	223	NA
MA-EBN_02.4	9/2/2020	121	Yes
	8/19/2020	64	No
	7/22/2020	52	No
	7/8/2020	91	No
MA-EBN_02.4	2020 Minimum	52	No
	2020 Maximum	121	Yes
	2020 Median	77	NA
	2020 Mean	82	NA
MA-EBN_02.4	6/23/2021	461	Yes

Sources: DRWA, 2018; DRWA, 2019; DRWA, 2020
"MPN/100 mL" = most probable number per 100 milliliters
"CFU/100 mL"= colony forming units per 100 milliliters
Samples taken in 2018 and 2019 were reported in MPN/100 mL and samples taken in 2020 and 2021 were reported in CFU/100 mL
"NA" = not applicable

Water Quality Goals

Water quality goals may be established for a variety of purposes, including the following:

a) For **waterbodies with known impairments**, a TMDL is established by MassDEP and EPA as the maximum amount of the target pollutant that the waterbody can receive and still safely meet water quality standards. If the waterbody has a TMDL for TP or total nitrogen (TN), or total suspended solids (TSS), that information is provided below and included as a water quality goal.[4]

b) For **waterbodies without a TMDL for** TP, a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (EPA, 1986) (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 µg/L in any stream at the point where it

[4] As noted above the East Branch North River does not have a TMDL. It is worth noting that The East Branch North River is part of the Connecticut River watershed; the Connecticut River flows into the Long Island Sound. The Long Island Sound has a TMDL: "A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound".

enters any lake or reservoir, nor should TP exceed 25 µg/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 µg/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.

c) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. East Branch North River is a Class 'B' waterbody. The water quality goals for *E. coli* bacteria are based on the Massachusetts Surface Water Quality Standards.

d) **Other water quality goals set by the community** (e.g., protection of high-quality waters, in-lake TP concentration goal to reduce recurrence of cyanobacteria blooms, etc.).

Based on the East Branch North River impairment and water quality data identified above, water quality goals were identified for TP and bacteria (*E. coli*) and are listed in **Table A-9**. Element C of this WBP includes proposed management measures to address these water quality goals.

Table A-9: Water Quality Goals

Pollutant	Goal	Source
Total Phosphorus (TP)	Total phosphorus should not exceed: --50 ug/L in any stream --25 ug/L within any lake or reservoir	Quality Criteria for Water (EPA, 1986)
Bacteria	**Class B Standards** • Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013)

Land Use Information

Land use information and impervious cover is presented by the below tables and figures. Land use source data is from 2005 and was obtained from MassGIS (2009a).

Watershed Land Uses

Land use in the East Branch North River watershed is mostly forested (approximately 85 percent); approximately 10 percent of the watershed is agricultural; approximately 2 percent of the watershed is residential; approximately 2 percent of the watershed is open land or water; less than 1 percent of the watershed is industrial or commercial; and 0 percent of the watershed is designated as highway[5] (**Table A-10**; **Figure A-4**). Most of the agricultural land in the watershed is concentrated adjacent to the mainstem of the East Branch North River.

Table A-10: Subwatershed Land Uses

Land Use	Area (acres)	% of Watershed
Forest	6,044	85.4
Agriculture	710	10
Low Density Residential	146	2.1
Open Land	95	1.3
Water	66	0.9
Commercial	9.4	0.1
High Density Residential	6.1	0.1
Medium Density Residential	2.6	0
Industrial	0.3	0
Highway	0	0

[5] Although 0 percent of the watershed is designated as highway in the land use GIS source data, there are roads in the East Branch North River watershed. The major road in the watershed is Route 112, which is a Massachusetts scenic byway.

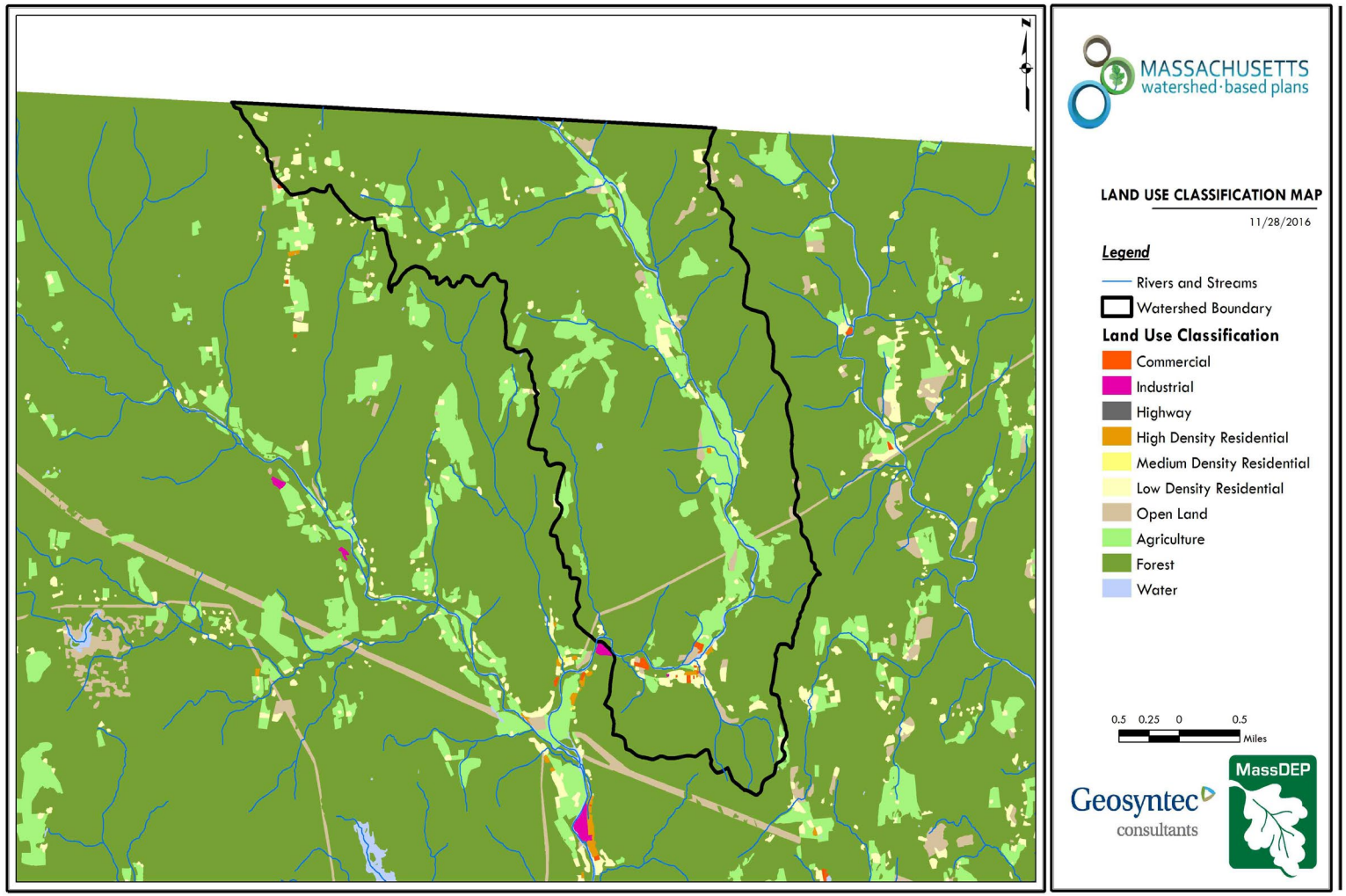


Figure A-4: Subwatershed Land Use Map

(MassGIS, 2007; MassGIS, 2009a; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc. Impervious area within the East Branch North River watershed is mainly associated with Route 112. **Figure A-5** is an impervious cover map for East Branch North River watershed.

Impervious areas that are directly connected (DCIA) to receiving waters (via storm sewers, gutters, or other impervious drainage pathways) produce higher runoff volumes and transport stormwater pollutants with greater efficiency than disconnected impervious cover areas which are surrounded by vegetated, pervious land. Runoff volumes from disconnected impervious cover areas are reduced as stormwater infiltrates when it flows across adjacent pervious surfaces.

An estimate of DCIA for the watershed was calculated based on the Sutherland equations. EPA provides guidance (EPA, 2010) on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the **total impervious area (TIA)** of a watershed. The estimated TIA and DCIA for the East Branch North River watershed is 1.5 percent and 1.2 percent, respectively.

The relationship between TIA and water quality can generally be categorized as listed by **Table A-11** (Schueler et al. 2009). The TIA value for the watershed range is 1.5%; therefore, the river and surrounding tributaries can be expected to show good to excellent water quality. It is likely there is better water quality in the upstream forested parts of the watershed while more downstream developed areas have poorer water quality.

Table A-11: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0% to 10%	Typically high quality, and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
11% to 25%	These streams show clear signs of degradation. Elevated storm flows begin to alter stream geometry, with evident erosion and channel widening. Streams banks become unstable, and physical stream habitat is degraded. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.
26% to 60%	These streams typically no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Biological quality is typically poor, dominated by pollution tolerant insects and fish. Water quality is consistently rated as fair to poor, and water recreation is often no longer possible due to the presence of high bacteria levels.
>60%	These streams are typical of “urban drainage”, with most ecological functions greatly impaired or absent, and the stream channel primarily functioning as a conveyance for stormwater flows.

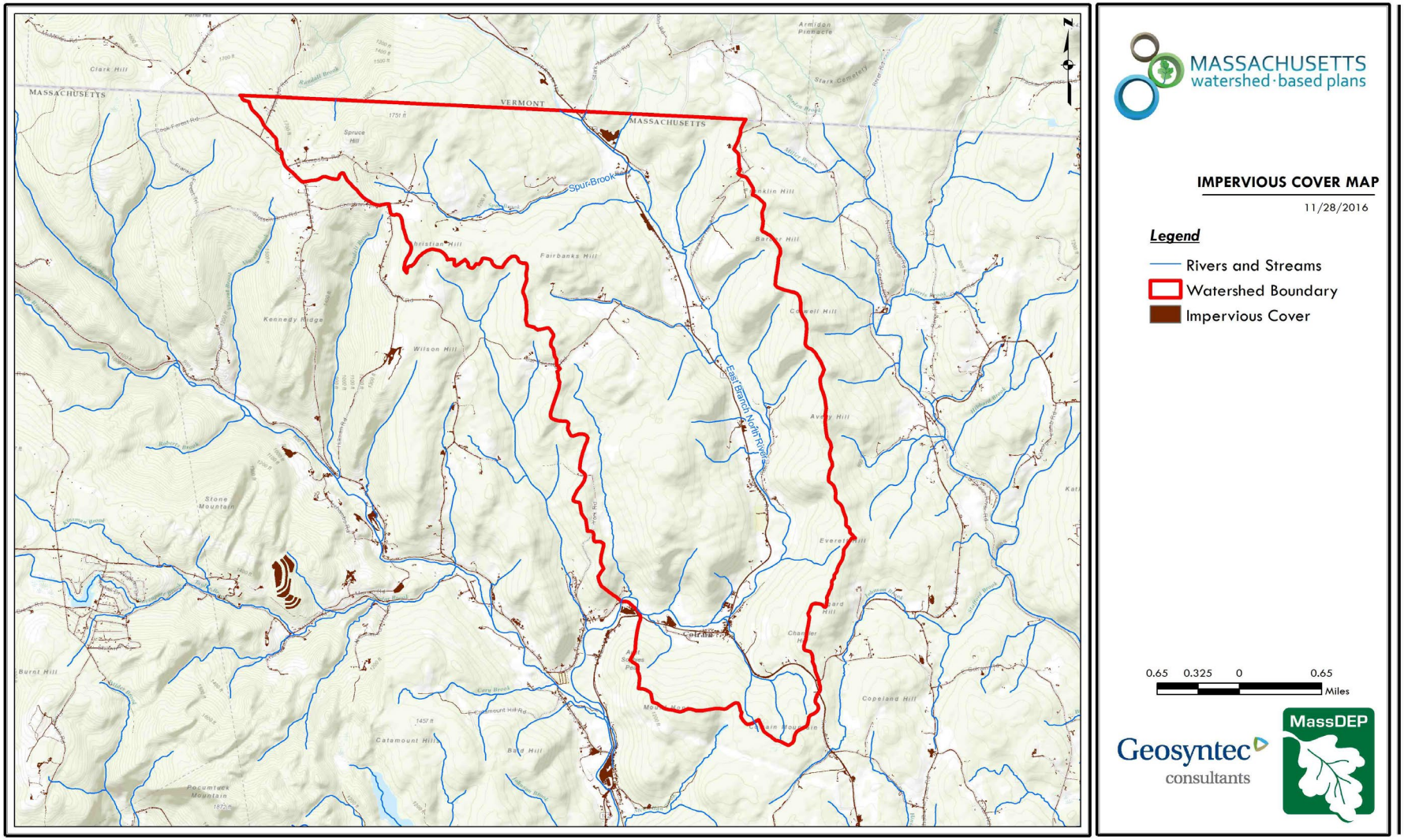


Figure A-5: Subwatershed Impervious Surface Map

(MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Pollutant Loading

The land use data (MassGIS, 2009a) was intersected with impervious cover data (MassGIS, 2009b) and USDA NRCS soils data (USDA NRCS and MassGIS, 2012) to create a combined land use/land cover grid. The grid was used to sum the total area of each unique land use/land cover type.

The amount of DCIA was estimated using the Sutherland equations as described above and any reduction in impervious area due to disconnection (i.e., the area difference between TIA and DCIA) was assigned to the pervious D soil category for that land use to simulate that some infiltration will likely occur after runoff from disconnected impervious surfaces passes over pervious surfaces.

Pollutant loading for key nonpoint source pollutants in the watershed was estimated by multiplying each land use/cover type area by its pollutant load export rate (PLER). The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from EPA (Voorhees, 2016) (see documentation provided in **Appendix E**) as follows:

$$L_n = A_n * P_n$$

Where L_n = Loading of land use/cover type n (lb/yr); A_n = area of land use/cover type n (acres); P_n = pollutant load export rate of land use/cover type n (lb/acre/yr)

Table A-12 presents the estimated land-use based TP, TN and TSS within the East Branch North River watershed. The largest contributor of the land use-based TP, TN and TSS load originates from areas designated as forested. TP and TN generated from forested areas is generally a result of natural processes such as decomposition of leaf litter and other organic material; the forested portions of the watershed therefore are unlikely to provide opportunities for nutrient load reductions through best management practices. Agricultural areas are the second largest contributors of land-use based TP, TN and TSS load in the watershed. Agricultural areas provide excellent opportunities for nutrient load reductions through agricultural BMPs as described in the following sections.

Table A-12: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Forest	747	3,586	127.51
Agriculture	347	2,082	21.81
Low Density Residential	35	350	4.75
Open Land	26	229	4.88
Commercial	10	89	1.11
High Density Residential	5	35	0.53
Medium Density Residential	1	7	0.10
Highway	0	0	0.00
Industrial	0	1	0.01
TOTAL	1,171	6,379	160.70

[1]These estimates do not consider loads from point sources or septic systems.

It is important to note pollutant loads presented in **Table A-12** do not consider loads from point sources or septic systems. In the East Branch North River watershed, septic systems have been identified as a potential source of pollutant loading since they are used throughout the watershed. Septic system sources should be separately evaluated to determine whether septic system upgrades or sanitary sewer system conversion would cost-effectively reduce bacteria and nutrient sources in the watershed.

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

Estimated Pollutant Loads

Estimated pollutant loads for TP (1,171 lbs/yr), TN (6,379 lbs/yr), and TSS (161 tons/yr) were previously presented in **Table A-12** of this WBP. *E. coli* loading has not been estimated for this WBP, because there are no known PLERs for *E. coli*.

Water Quality Goals and Required Load Reduction

There are many methodologies that can be used to set pollutant load reduction goals for a WBP. Goals can be based on water quality criteria, surface water standards, existing monitoring data, existing TMDL criteria, or other data. As discussed in Element A, water quality goals for this WBP are focused on reducing *E. coli* and TP loading to East Branch North River. The water quality goals, and corresponding required loading reductions are included in **Table B-1**.

The method used in the WBP tool[6] for calculating a water quality goal for TP produces a water quality goal of 2,204 lbs/yr, which is greater than the estimated TP load of 1,171 bs/yr. Given the iterative and adaptive nature of this WBP, the monitoring portion of this WBP (**Element I**) recommends that monitoring be performed to better understand the existing TP loading to East Branch North River, which may help establish a specific TP related water quality goal with the next update of the WBP (expected in 2024). In the interim, a 10 percent reduction in the estimated watershed loading to 1,050 lbs/yr is proposed to improve the water quality within East Branch North River.

[6] According to the EPA Gold Book, TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir. The WBP tool estimated the water quality loading goal by multiplying this target maximum TP concentration (50 ug/L) by the estimated annual watershed discharge for the East Branch North River watershed. To estimate the annual watershed discharge, the mean flow was used, which was estimated based on United States Geological Survey (USGS) "Runoff Depth" estimates for Massachusetts (Cohen and Randall, 1998). Cohen and Randall (1998) provide statewide estimates of annual Precipitation (P), Evapotranspiration (ET), and Runoff (R) depths for the northeastern U.S. According to their method, Runoff Depth (R) is defined as all water reaching a discharge point (including surface and groundwater), and is calculated by: P - ET = R. A mean Runoff Depth R was determined for the watershed by calculating the average value of R within the watershed boundary.

The proposed projects described in this WBP are expected to reduce both *E. coli* and TP loads to East Branch North River; however, additional load reductions may be required to meet the water quality goals.

The following adaptive sequence is recommended to sequentially track and meet these load reduction goals:

1. Given current water quality conditions, establish an **interim goal** to reduce land use-based TP by 10 percent (121 lbs/yr) over the next 10 years (by 2031).

2. Given current water quality conditions, establish an **interim goal** to reduce the geometric mean concentration of *E. coli* by 50 percent over the next 10 years (by 2031).

3. Continue and expand on the baseline water quality monitoring program in accordance with **Element I**. Results from the monitoring program should advise if **Element C** management measures have been effective at addressing listed water quality impairments or water quality goals for other indicator parameters established by **Table A-7** of this WBP (e.g., TP and *E. coli*). Results can further be used to periodically inform or adjust load reduction goals.

4. Establish a **long-term reduction goal** to reduce land-use-based TP and *E. coli* over the next 15 years. Based on monitoring data, establish additional **long-term reduction goal(s)**, if needed, to lead to delisting of East Branch North River from the 303(d) list.

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus	1,171 lbs/yr	1,050 lbs/yr	121 lbs/yr
Bacteria (*E. Coli*)[1]	*MSWQS for bacteria are concentration standards (e.g., colonies of fecal coliform bacteria per 100 ml), which are difficult to predict based on estimated annual loading.*	Class B. **Class B Standards** • Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	50% - Concentration-based

1. *As noted in Element A, the E. coli water quality goal in the East Branch North River watershed is based on the Massachusetts Surface Water Quality Standards (MSWQS) (314 CMR 4.00, 2013) that apply to the Water Class of the selected water body. Both segments in the East Branch North River watershed are classified as "Class B" waterbodies.*

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Existing Management Measures

The following agricultural and/or structural BMP improvement projects have been implemented in the East Branch North River watershed.

Soil Bioengineering Streambank Protection Measures

In 1993, a Section 319 grant-funded project (91-03/319) was implemented in an area that was eroding and threatening Town of Colrain water supply wells. The project failed several years after installation, but water supply wells were not damaged by further erosion in the area (MassDEP, 2000).

Colrain Elementary School Streambank Stabilization Project

In 2000, NRCS and Colrain Elementary School collaborated on a project, which stabilized the streambank on an eroding section of the riverbank adjacent to the school (MassDEP, 2000).

East Branch North River Restoration Project

In 2020, a river restoration project was completed on two large privately owned parcels located on both sides of the East Branch North River in Massachusetts adjacent to the border with Vermont (owned by Dornbusch and Cromack). The restoration was implemented along approximately 5,200 linear feet of the East Branch North River mainstem and involved forested buffer planting, herbaceous buffer planting, farm road relocation, tributary restoration, stream ford stabilization, and bank stabilization (Field Geology Services, 2020).

Ongoing Management Measures

Western Massachusetts Agricultural Nonpoint Source Program

Pollutant load modeling presented in Element A (**Table A-12**) indicated that roughly 30% of the total land-use based nutrient (TP and TN) loading in the watershed originates from agricultural areas. MACD was awarded Fiscal Year 2021 Section 319 grant funding for its "Western Massachusetts Agricultural Nonpoint Source Program", which includes implementing watershed-wide farm conservation practices and agricultural BMPs in the East Branch North River watershed to contribute to addressing this loading. The MACD's general strategy is to conduct outreach and education to farmers in the East Branch North River watershed; develop conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to financial resources; and ensure farmers follow operation and maintenance practices recommended by MACD and/or NRCS (MACD, 2020). During the stakeholder meeting that was held on May 26, 2021, numerous farms in the East Branch North River watershed were identified for outreach and possible implementation of agricultural BMPs. These farms as well as other areas of interest are identified in **Figure C-1**.

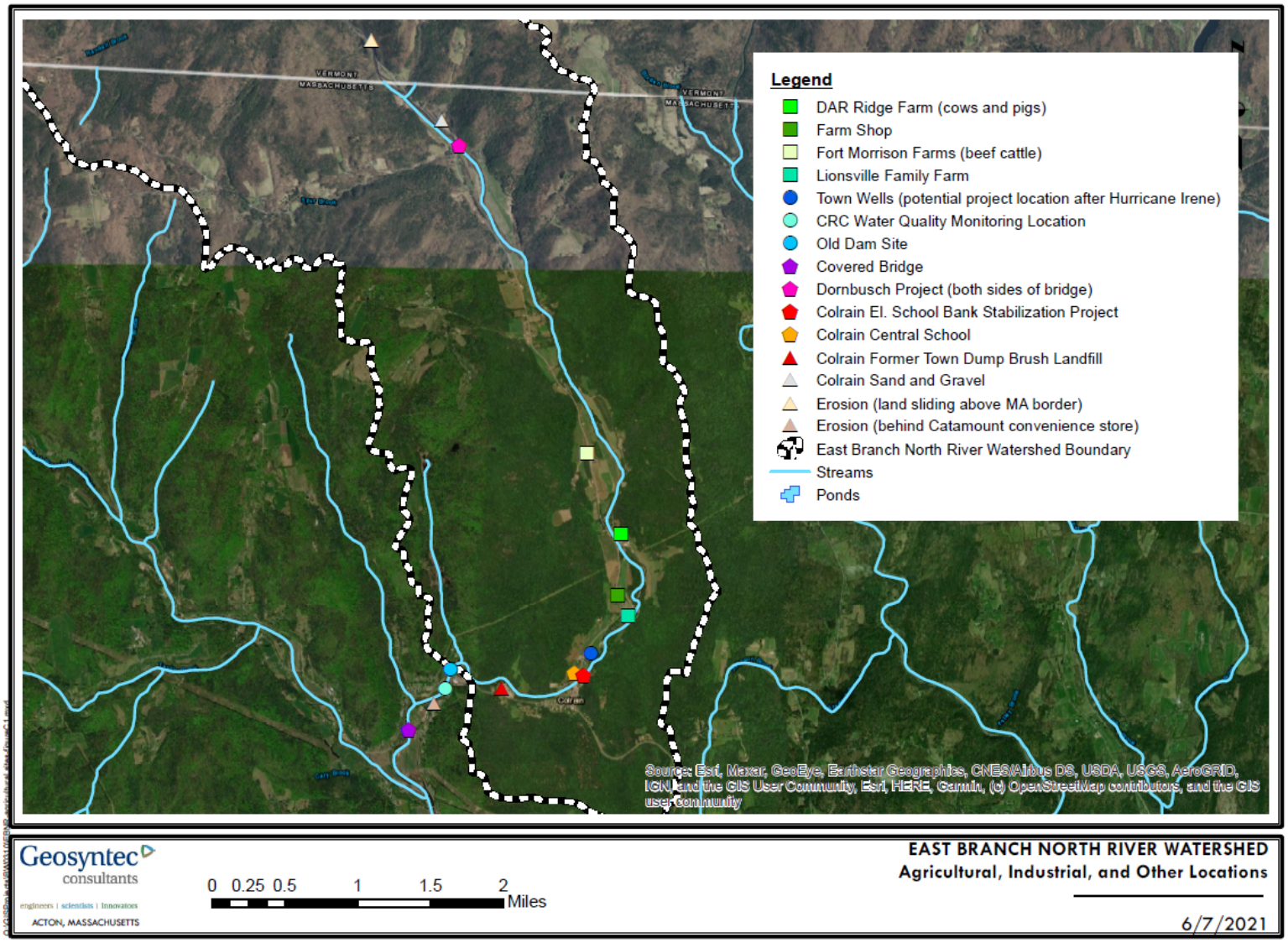


Figure C-1: Agricultural, Industrial, and Other Locations

Fluvial Geomorphic Assessment of the North River Watershed (Field Geology Services, 2015)

Field Geology Services conducted a fluvial geomorphic assessment of the North River watershed in 2015, for FRCOG, to determine the causes of channel instability and identify restoration options to better manage riverine problems. River restoration project concepts were developed. Figure C-2 identifies the general locations of the reaches that correspond to the river restoration concept descriptions listed in **Table C-1**. Through a priority ranking process, five sites were selected for further conceptual design. Three of these sites are within the East Branch North River watershed and included:

- Colrain Fire District Site (Reach 9 in **Figure C-2**):
- Massachusetts Department of Transportation bridge replacement site (Route 112 Bridge just downstream of Colrain Fire District Site)
- Foundry Village Impoundment Site (Reach 8 in **Figure C-2**)

Except for the Colrain Fire District site (see below), these concepts have not been further developed.

River Restoration at the Colrain Fire District Well Site (Milone & MacBroom, Inc., 2018)

A more developed conceptual design for the river restoration at the Colrain Fire District Well Site was prepared in 2018; the original concept was completed by Field Geology Services (2015) (see above). This project has not yet progressed beyond this conceptual design phase. The conceptual design includes:

- Relocating a segment of the East Branch North River in this location through the forested floodplain closer to its historical alignment;
- Re-grading the existing riverbank at a shallower slope and vegetating with willow stakes and hardwood trees;
- Installing boulder heaps and random boulder clusters in the riverbed to provide flow diversity, increase oxygenation, and improve aquatic habitat; and
- Raising well heads, pumps, and other equipment in the public well field to above the 100-year flood elevation.

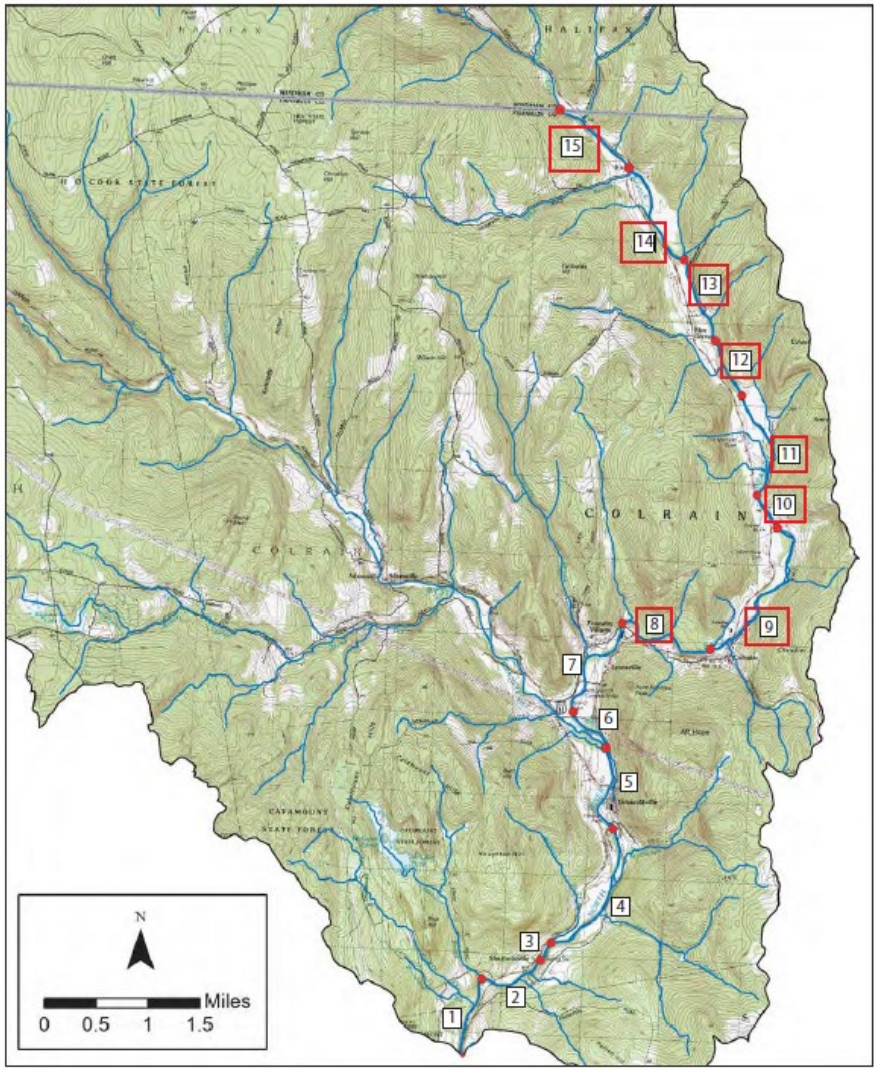


Figure C-2: Location of Reach identification numbers in the North River (red boxes identify reaches in the East Branch North River)

Source: Field Geology Services, 2015.

Table C-1: Restoration Project Concepts

Reach	Site Description	Project Concept Description	Technical Feasibility
15	Adjacent segments with very high needs along Rt. 112. Stream confined between road and medium to high glacial right bank	Construct series of instream structures, including deflectors and weirs	High
15	270-ft long severe mass failure	Stabilize long mass failure with boulder supported log jams	Moderate
15	Unstable banks directly upstream of stream crossing represents threat to Rt. 112 bridge	Stabilize bank with bioengineering and establish riparian buffer with riparian plantings and no-mow zones along edge of hayfield	Very High
11-10	Reil Rd bridge is damaged and there is severe erosion, channel avulsion, and loading hazards	Re-align and stabilize main and side channels upstream of bridge, includes de-snagging and deflectors	High
10	Highly impaired segment with very poor habitat and blocked side channel on forested floodplain	Divert flow into blocked side channel with bank cutting and engineered log jam utilizing LWD from upstream segment	Very High
9	Excessive sediment accumulating around Rt. 112 bridge, scheduled for replacement by MassDOT	Establish a maintenance plan for removal of excess sediment from in and around bridge structure	Very High
9	High visibility segment in center of Town in need of riparian improvements and bank stabilization	Riparian planting and establishment of a no mow zone with or without boulder deflector toe protection	Very High
8	Large unstable landslide in historic landfill threatens Town buildings and represents serious sediment and pollution source	Re-configure stormwater outfall and runoff from road and parking lot, stabilize slope and toe of bank	Moderate
8	Legacy sediments upstream of historic ruined dam confined channel and prevent floodplain access	Remove legacy sediment and restore historic floodplain	High

Source: Field Geology Services, 2015.

Future Management Measures

Implementing agricultural BMPs, along with incorporating structural BMPs (e.g. low impact development practices) on new and existing development, and investigation and remediation of potential other sources such as failing septic systems will be necessary to achieve a measurable and sustainable improvement in water quality in the East Branch North River. The following general sequence is recommended to identify and implement future structural BMPs. Note this approach applies largely to non-agricultural BMPs as MACD's project is to build relationships with the agricultural community, which would guide any future agricultural BMP implementation.

1. **Identify Potential Implementation Locations:** Perform a desktop analysis using aerial imagery and GIS data to develop a preliminary list of potentially feasible implementation locations based on land use; soil type (i.e., hydrologic soil groups A and B); available public open space (e.g., lawn area in front of a police station); potential redevelopment sites where additional public-private partnerships may be leveraged; and other factors such as proximity to receiving waters, known problem areas, or publicly owned right of ways or easements. See BMP Hotspot Map analysis below, which helps identify potential implementation locations.

2. **Visit Potential Implementation Locations:** Perform field reconnaissance, preferably during a period of active runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility, and identify potential BMP ideas. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

3. **Develop BMP Concepts:** Once potential BMP locations are conceptualized, use the BMP-selector tool on the watershed-based planning tool to help develop concepts[7]. Concepts can vary widely. One method is to develop 1-page fact sheets for each concept that includes a site description, including definition of the problem, a description of the proposed BMPs, annotated site photographs with conceptual BMP design details, and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints. The fact sheet can also include information obtained from the BMP-selector tool including cost estimates, load reduction estimates, and sizing information (i.e., BMP footprint, drainage area, etc.).

4. **Rank BMP Concepts:** Once BMP concepts are developed, perform a priority ranking based on site-specific factors to identify the implementation order. Ranking can include many factors including cost, expected pollutant load reductions, implementation complexity, potential outreach opportunities and visibility to public, accessibility, expected operation and maintenance effort, and others.

Prioritized BMP concepts should focus on reducing *E. coli* and TP loading to the East Branch North River as summarized by **Element B.**

[7] An additional reference for developing BMP concepts in unpaved road areas is "Massachusetts Unpaved Roads BMP Manual" (Berkshire Regional Planning Commission, 2001): https://megamanual.geosyntec.com/npsmanual/Unpaved%20Road.pdf

BMP Hotspot Map:

The following GIS-based analysis[8] was performed within the watershed to identify high priority parcels for BMP (also referred to as management measure) implementation:

- Each parcel within the watershed was evaluated based on ten different criteria accounting for the parcel ownership, social value, and implementation feasibility (See **Table C-1** for more detail below);
- Each criterion was then given a score from 0 to 5 to represent the priority for BMP implementation based on a metric corresponding to the criterion (e.g., a score of 0 would represent lowest priority for BMP implementation whereas a score of 5 would represent highest priority for BMP implementation);
- A multiplier was also assigned to each criterion, which reflected the weighted importance of the criterion (e.g., a criterion with a multiplier of 3 had greater weight on the overall prioritization of the parcel than a criterion with a multiplier of 1); and
- The weighted scores for all the criteria were then summed for each parcel to calculate a total BMP priority score.

Table C-2 presents the criteria, indicator type, metrics, scores, and multipliers that were used for this analysis. Parcels with total scores above 60 are recommended for further investigation for BMP implementation suitability. **Figure C-3** presents the resulting BMP Hotspot Map for the East Branch North River watershed. The following link includes a Microsoft Excel file with information for all parcels that have a score above 60: hotspots.

This analysis solely evaluated individual parcels for BMP implementation suitability and likelihood for the measures to perform effectively within the parcel's features. This analysis does not quantify the pollutant loading to these parcels from the parcel's upstream catchment. When further evaluating a parcel's BMP implementation suitability and cost-effectiveness of BMP implementation, the existing pollutant loading from the parcel's upstream catchment and potential pollutant load reduction from BMP implementation should be evaluated.

Large agricultural parcels of the watershed, adjacent to the East Branch North River, received high hot spot scores above 60, which indicates that these properties provide opportunities for pollutant load reductions through BMPs.

[8] GIS data used for the BMP Hotspot Map analysis included: MassGIS (2015a); MassGIS (2015b); MassGIS (2017a); MassGIS (2017b); MassGIS (2020); MA Department of Revenue Division of Local Services (2016); MassGIS (2005); ArcGIS (2020); MassGIS (2009b); MassGIS (2012); and ArcGIS (2020b).

Table C-2: Matrix for BMP Hotspot Map GIS-based Analysis

Criteria	Indicator Type	METRICS																										Multiplier	Maximum Potential Score
		Yes or No?		Hydrologic Soil Group				Land Use Type									Water Table Depth				Parcel Area			Parcel Average Slope						
		Yes	No	A or A/D	B or B/D	C or C/D	D	Low and Medium Density Residential	High Density Residential	Commercial	Industrial	Highway	Agriculture	Forest	Open Land	Water	101-200 cm	62-100 cm	31-61 cm	0-30 cm	Greater than 2 acres	Between 1-2 acres	Less than 1 acre	Less than 2%	Between 2% and 15%	Greater than 15%	Less than 50%	Between 51% and 100%		
Is the parcel a school, fire station, police station, town hall or library?	Ownership	5	0																									2	10
Is the parcel's use code in the 900 series (i.e. public property or university)?	Ownership	5	0																									2	10
Is parcel fully or partially in an Environmental Justice Area?	Social	5	0																									2	10
Most favorable Hydrologic Soil Group within Parcel	Implementation Feasibility			5	3	0	0																					2	10
Most favorable Land Use in Parcel	Implementation Feasibility							1	2	4	2	4	5	1	4	X[1]												3	15
Most favorable Water Table Depth (deepest in Parcel)	Implementation Feasibility																5	4	3	0								2	10
Parcel Area	Implementation Feasibility																				5	4	1					3	15
Parcel Average Slope	Implementation Feasibility																							3	5	1		1	5
Percent Impervious Area in Parcel	Implementation Feasibility																										5	2.5	1	5
Within 100 ft buffer of receiving water (stream or lake/pond)?	Implementation Feasibility	5	2																									2	10

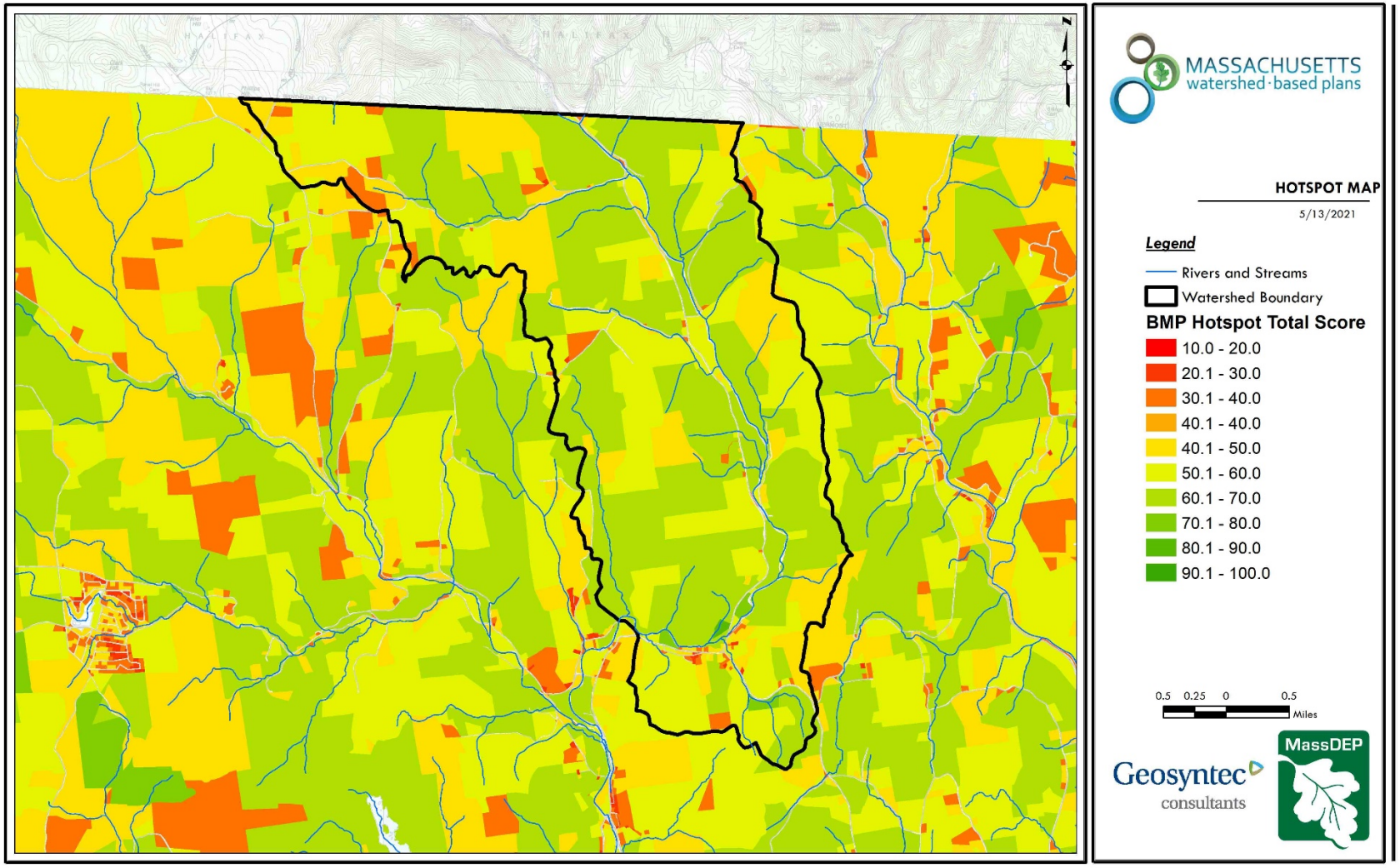


Figure C-3: BMP Hotspot Map (MassGIS (2015a), MassGIS (2015b), MassGIS (2017a), MassGIS (2017b), MassGIS (2020), MA Department of Revenue Division of Local Services (2016), MassGIS (2005), ArcGIS (2020), MassGIS (2009a), MassGIS (2012), ArcGIS (2020b))

Additional Non-structural BMPs

It is recommended that nonstructural BMPs that the Town of Colrain and the Massachusetts Department of Transportation (MassDOT) currently implement, including street sweeping and catch basin cleaning on Route 112, be evaluated and potentially optimized for removal of TP and bacteria. First, it is recommended that potential pollutant load removals from ongoing activities be calculated in accordance with **Elements H and I** of this document. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions, such as increased frequency or improved technology.

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Current and Future Management Measures

The funding needed to implement the MACD Western Massachusetts Agricultural Nonpoint Source Program (described in **Element C**) is presented in **Table D-1** (MACD, 2020). These costs will be divided between the East Branch North River watershed and three other watersheds in Western Massachusetts. The total cost for the program was estimated at $434,000.

Table D-1: Summary of Proposed BMPs Costs (Western Massachusetts Agricultural Nonpoint Source Program)

Expense Item	s.319 Amount	Non-Federal Match and Source	Total Amount
Salary and Wages			
Project Coordinator	$9,000	$2,000	$11,000
Sub-contractors	$81,000	$5,000	$86,000
Students Assistance	$3,882	$0	$3,882
Supplies			
BMP Materials and Supplies	$160,000	$0	$160,000
DMBE/DWBE		$168,000	$168,000
Travel	$750	$0	$750
Indirect Costs			
Overhead	$9,000	$0	$9,000
Totals	**$259,000**	**$175,000**	**$434,000**

Funding for future BMP installations to further reduce loads within the watershed may be provided by a variety of sources including Section 319 funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement Program (APSIP), Town and City capital funds, volunteer efforts, and NRCS grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program. MACD has previously been

successful with and will continue to pursue securing grant funding through various sources. Guidance is available to provide additional information on potential funding sources for nonpoint source pollution reduction efforts[9].

[9] Guidance on funding sources to address nonpoint source pollution:
http://prj.geosyntec.com/prjMADEPWBP_Files/Guide/Element%20D%20-%20Funds%20and%20Resources%20Guide.pdf

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Public information and education was one of the topics discussed during the stakeholder meeting of May 26, 2021 (**Appendix A**). A large component of the MACD Western Massachusetts Agricultural Nonpoint Source Program involves outreach to farmers. The components of the watershed public information and education program are described below. Additional outreach efforts will be determined when future management measures and activities are planned for implementation in the watershed. This section of the WBP will be updated when the plan is reevaluated in 2024 in accordance with elements F&G of this document.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

1. Provide information and incentives to farmers on funding resources for BMP implementation
2. Provide information about farm conservation plans and agricultural BMPs and their anticipated water quality benefits.
3. Provide information to promote watershed stewardship.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

1. Farm-owners in the watershed (targeted through MACD), with a focus on farmers who have had previous contact with NRCS and/or MACD.
2. Watershed organizations and other user groups, including the CRC and the DRWA.
3. Businesses, schools, and local government within the watershed.
4. All watershed residents.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

1. MACD will conduct outreach and education activities, including farm tours highlighting agricultural BMPs.
2. CRC and the DRWA provide information about the Connecticut River watershed and Deerfield River watershed including the East Branch North River on their websites (https://www.ctriver.org/; https://deerfieldriver.org/) and typically host events such as river clean up days.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the number of workshops and farm tours and the attendance at each.
2. Track the number of materials and information, such as fact sheets and emails, and the size of the lists receiving these materials.
3. Track the farms who receive funding and from what sources.

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

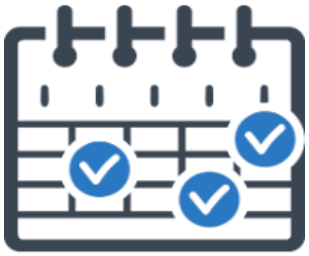


Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated in 2024, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects will be identified through future data analysis and stakeholder engagement and will be included in updates to the implementation schedule.

Table FG-1: Implementation Schedule and Interim Measurable Milestones

Category	Action	Cost Estimate	Year(s)
Monitoring	Perform water quality sampling as part of the existing water quality monitoring program per Element H&I		Annual
Western Massachusetts Agricultural Nonpoint Source Program	MACD will provide a conservation planner and • Focus on farmers who have had previous contact with NRCS and MACD to engage as many as possible in the implementation of BMPs • Identify a second conservation planner to further scale outreach and BMP implementation practices in the East Branch North River watershed.	$108,500	2021—2022
Public Education and Outreach	MACD will conduct outreach and education activities, including farm tours highlighting agricultural BMPs.		2022
	DRWA and CRC river cleanup and cleanup of invasive species		Annual
Adaptive Management and Plan Updates	Establish a working group that includes stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.		2021
	Reevaluate WBP at least once every five years and adjust, as needed, based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). – Next update, December 2024		2024
	Use monitoring results to reevaluate BMP effectiveness at reducing E. coli and TP and/or other indicator parameters in East Branch North River and establish additional long-term reduction goal(s), if needed.		**2031**
	Delist East Branch North River from the 303(d) list.		**2036**

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The interim loading reduction goal is presented in Element B of this WBP. Element C of this plan describes management measures that will be implemented to help achieve this targeted load reduction. The evaluation criteria and monitoring program described below will be used to establish a baseline and measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of the East Branch North River and in making progress toward achieving the water quality goals.

Direct Measurements

Direct measurements are generally expected to be performed as described below. DRWA has been documenting the water quality in the Deerfield River and tributaries intermittently since 1990. The most recent iteration of the DRWA water quality monitoring program has been running since 2017 and includes one sampling location in the East Branch North River (Foundry Village Road). The DRWA water quality monitoring program is a volunteer program. Before the start of each season, each volunteer is required to attend a training session with the program coordinator. Training sessions are held riverside so that each volunteer can practice under the supervision of the coordinator before going out into the field. Sites are tested on the Deerfield mainstem and its tributaries in both Vermont and Massachusetts. Volunteers visit these sites on alternate Wednesday mornings from June to September to collect samples that are tested for *E. coli*, TN, TP, turbidity, and conductivity.

It is suggested that water quality monitoring in the East Branch North River continue under this program and expanded as described below. MassDEP also provides support for water quality monitoring efforts through its Water Quality Monitoring Grant Program.

River Sampling

Regular sampling will be established to understand the water quality in East Branch North River including determining sources of pollution and tracking achievements toward water quality goals. Key features of the water quality monitoring program will include:

- Analytes: The samples collected should primarily be analyzed for *E. coli* and TP. Additional parameters such as chlorophyll-a, dissolved oxygen, temperature, conductivity, pH, dissolved phosphorus, and flow

rate could provide additional data to better understand the health of the watershed and East Branch North River.

- Sampling Frequency: It is recommended that, at a minimum, the current frequency of sampling is continued (i.e., a minimum of five sampling events; alternate Wednesday mornings from June to September). *E. coli* sampling conducted at this frequency aligns with the proposed surface water quality standard revisions and MassDEP assessment requirements and will provide the most value.
- Locations: The water quality monitoring program should be focused in East Branch North River downstream of suspected *E. coli* and/or TP sources. If possible, samples should be collected within the East Branch North River directly downstream of implemented BMPs to determine the impact of BMPs within the watershed (samples at these locations prior to BMP implementation should also be collected to establish a baseline). Monitoring locations should ultimately be selected based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed. BMP performance monitoring locations will be selected after BMPs have been identified for implementation.
- Planning: As noted above, it is suggested that the current DRWA/CRC volunteer water quality monitoring program continue and expand and possibly seek support through the MassDEP Water Quality Monitoring Grant Program.

Indirect Indicators of Load Reduction

Non-Structural BMPs

Potential load reductions from non-structural BMPs (i.e., street sweeping and catch basin cleaning on Route 112) can be estimated from indirect indicators, such as the number of miles swept, or the number of catch basins cleaned. As summarized by **Figure HI-1** and **Figure HI-2**, Appendix F of the 2016 Massachusetts Small MS4 General Permit provides specific guidance for calculating TP removal from these practices. As indicated by **Element C**, it is recommended that potential TP removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

$$Credit_{sweeping} = IA_{swept} \times PLE_{IC\text{-}land\ use} \times PRF_{sweeping} \times AF \qquad \textbf{(Equation 2-1)}$$

Where:

$Credit_{sweeping}$	=	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA_{swept}	=	Area of impervious surface that is swept under the enhanced sweeping program (acres)
$PLE_{IC\text{-}land\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
$PRF_{sweeping}$	=	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-3).
AF	=	Annual Frequency of sweeping. For example, if sweeping does not occur in Dec/Jan/Feb, the AF would be 9 mo./12 mo. = 0.75. For year-round sweeping, AF=1.0[1]

As an alternative, the permittee may apply a credible sweeping model of the Watershed and perform continuous simulations reflecting build-up and wash-off of phosphorus using long-term local rainfall data.

Table 2-3: Phosphorus reduction efficiency factors ($PRF_{sweeping}$) for sweeping impervious areas

Frequency[1]	Sweeper Technology	$PRF_{sweeping}$
2/year (spring and fall)[2]	Mechanical Broom	0.01
2/year (spring and fall)[2]	Vacuum Assisted	0.02
2/year (spring and fall)[2]	High-Efficiency Regenerative Air-Vacuum	0.02
Monthly	Mechanical Broom	0.03
Monthly	Vacuum Assisted	0.04
Monthly	High Efficiency Regenerative Air-Vacuum	0.08
Weekly	Mechanical Broom	0.05
Weekly	Vacuum Assisted	0.08
Weekly	High Efficiency Regenerative Air-Vacuum	0.10

Figure HI-1. Street Sweeping Calculation Methodology

$$Credit_{CB} = IA_{CB} \times PLE_{IC\text{-}land\ use} \times PRF_{CB} \qquad \textbf{(Equation 2-2)}$$

Where:

$Credit_{CB}$	=	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA_{CB}	=	Impervious drainage area to catch basins (acres)
$PLE_{IC\text{-}and\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
PRF_{CB}	=	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-4)

Table 2-4: Phosphorus reduction efficiency factor (PRF_{CB}) for semi-annual catch basin cleaning

Frequency	Practice	PRF_{CB}
Semi-annual	Catch Basin Cleaning	0.02

Figure HI-2. Catch Basin Cleaning Calculation Methodology

Project-Specific Indicators

Number of BMPs Installed and Pollutant Reduction Estimates:

Anticipated pollutant load reductions from future BMPs will be tracked as BMPs are installed.

Adaptive Management

As discussed by Element B, the baseline monitoring program will be used to evaluate and establish a long-term (i.e., 15-year) *E. coli* and TP load reduction goal (or other parameter(s) depending on results). Long-term goals will be re-evaluated at least **once every five years** and adaptively adjusted based on additional monitoring results and other indirect indicators. If monitoring results and indirect indicators do not show improvement to the *E. coli* and TP concentrations and other indicators (e.g., DO) measured within the watershed, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

References

314 CMR 4“00 (2013). "*Division of Water Pollution Control, Massachusetts Surface Water Quality” Standards*"

Berkshire Regional Planning Commission (2001). “*The Massachusetts Unpaved Roads BMP Manual*”.

Cohen, A. J.; Randall, A“D. (1998). "*Mean annual runoff, precipitation, and evapotranspiration in the glaciated northeastern United State”, 1951-80.*" Prepared for United States Geological Survey, Reston VA.

DRWA“ (2008). "*North River Watershed 2007 Macroinvertebrate Assessment (Franklin County, Massachusetts and Windham County, Vermont)”.* DRAFT. Michael B. Cole, DRWA. September 2008.

DRWA“ (2017). "*Water Quality Monitoring 2017 Program Report.”*

DRWA“ (2018). "*Water Quality Monitoring 2018 Program Report.”*

DRWA“ (2019). "*Water Quality Monitoring 2019 Program Report.”*

DRWA“ (2020). "*East Branch North River, Foundry Village Rd Ballfields Water Quality Data.”* Accessed on 25 May 2021. https://connecticutriver.us/node/395.

EPA (1986). "*Quality Criteria for Water (Gold Book)*" EPA 440/5-86-001. Office of Water, Regulations and Standards. Washington, D.C.

EPA. (2010). "EPA's Methodology to Calculate Baseline Estimates of Impervious Area (IA) and Directly Connected Impervious Area (DCIA) for Massachusetts Communities."

Field Geology Services (2015). "Fluvial Geomorphic Assessment of the North River Watershed, MA.” Prepared for Franklin Regional Council of Governments, Greenfield, MA.

Field Geology Services (2018). "*Development of River Corridor Mapping Procedure with Initial Application in the North River Watershed, MA.”* Prepared for Franklin Regional Council of Governments, Greenfield, MA.

Field Geology Services (2020). "*East Branch North River Restoration Project, Dornbusch and Cromack Parcels, Colrain, Franklin County, Massachusetts Plan Set.”* Approved by MassDEP on August 4, 2020.

FRCOG (2008). "*Nonpoint Source Pollution Assessment for the Deerfield River Watershed.” Section* 604(b) Project Number 04-02/604. Prepared for the Massachusetts Department of Environmental Protection. June 2008.

FRCOG (2015). *“A Watershed-Based Plan to Maintain the Health and Improve the Resiliency of the Deerfield River Watershed, 15-04/319, Dates: 2015--2017.”* Prepared for the Massachusetts Department of Environmental Protection, Bureau of Water Resources and U.S. Environmental Protection Agency Region 1.

MassDEP (2000). "*Deerfield River Watershed 2000 Water Quality Assessment Report*"

MassDEP (2019). "*Massachusetts Year 2016 Integrated List of Waters, Final Listing of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*". December 2019.

MassDEP (2021). "*Water Quality Monitoring Program Data*". Data Files. https://www.mass.gov/guides/water-quality-monitoring-program-data. Accessed 6/24/2021.

MassGIS (1999). "*Networked Hydro Centerlines*" Shapefile

MassGIS (2001). "*USGS Topographic Quadrangle Images*" Image

MassGIS (2007). "*Drainage Sub-basins*" Shapefile

MassGIS (2009a). "*Land Use (2005)*" Shapefile

MassGIS (2009b). "*Impervious Surface*" Image

MassGIS (2012). "*2010 U.S. Census Environmental Justice Populations*" Shapefile

MassGIS (2015a). "*Fire Stations*" Shapefile

MassGIS (2015b). "*Police Stations*" Shapefile

MassGIS (2017a). "*Town and City Halls*" Layer

MassGIS (2017b). "*Libraries*" Layer

MassGIS (2020). "*Massachusetts Schools (Pre-K through High School)*" Datalayer

MassGIS (2021). "*Standardized Assessors' Parcels*" Mapping Data Set

Milone & MacBroom, Inc. (2018). "*Concept Design Memorandum River Restoration at the Colrain Fire District Well Site North River Colrain, Massachusetts MMI #2525-15).*" Prepared for Connecticut River Conservancy, Greenfield, Massachusetts.

Schueler, T.R., Fraley-McNeal, L, and K. Cappiella (2009). "*Is impervious cover still important? Review of recent research*" Journal of Hydrologic Engineering 14 (4): 309-315.

New York State Department of Environmental Conservation (NYSDEC) and Connecticut Department of Environmental Protection (CTDEP) (2000). "*A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound*". December 2000.

Town of Colrain, MA (2018). "*Municipal Vulnerability Preparedness (MVP) Resiliency Plan.*" Facilitated by the Franklin Regional Council of Governments.

Town of Colrain, MA (2020). "*Town of Colrain Hazard Mitigation Plan.*" Prepared by Colrain Hazard Plan Update Committee (Local Planning Team) and Franklin Regional Council of Governments.

United States Geological Survey (2016). "*National Hydrography Dataset, High Resolution Shapefile*"

USDA NRCS and MassGIS (2012). "*NRCS SSURGO-Certified Soils*" Shapefile

VT DEC (2020). "*Deerfield River & Lower Connecticut River Tactical Basin Plan*". Published May 2020, Vermont Department of Environmental Conservation, Montpelier, VT

Voorhees, Mark, EPA. (2016). "*FW: Description of additional modelling work for Opti-Tool Project*" Message to Chad Yaindl, Geosyntec Consultants. 23 April 2015. E-mail.

Appendices

Appendix A – Stakeholder Meeting Minutes

Meeting Minutes

SORENSEN

Project Name:	East Branch North River Watershed-Based Plan		
Project #:	SP #1078		
Location:	East Branch North River Watershed (Colrain, MA)		
Meeting Date, #:	2021-5-26	Meeting Time:	1:00 PM - 2:30 PM
Prepared By:	Marie Sorensen, RA	Meeting Location:	Zoom videoconference per Sorensen Partners invitation
Distribution:	All listed below		

Attendees:

Name	Organization	Contact Information
Michael Leff	Massachusetts Association of Conservation Districts (MACD)	mleffmacd@gmail.com
Matt Reardon	Massachusetts Department of Environmental Protection (MassDEP)	Matthew.Reardon@state.ma.us
Julia Keay	Geosyntec Consultants, Inc.	jkeay@geosyntec.com
Emma Williamson	Geosyntec Consultants, Inc.	ewilliamson@geosyntec.com
Adam Questad	Geosyntec Consultants, Inc.	aquestad@geosyntec.com
Marie Sorensen	Sorensen Partners | Architects + Planners, Inc.	msorensen@sorensenpartners.com
Kimberly Noake MacPhee	Franklin County Regional Council of Governments (FRCOG)	kmacphee@frcog.org
Ryan O'Donnell	CT River Conservancy (CRC)	rodonnell@ctriver.org
Bill Dornbusch	Colrain farm owner, past BMP project site owner	bdornbusch@gmail.com
Erin Rodgers	Trout Unlimited – Deerfield River	erin.rodgers@tu.org
Haynes Turkle	Chair, Colrain Agricultural Commission	hturkle@gmail.com
Andrea Donlon	CT River Conservancy (CRC)	adonlon@ctriver.org
Nic Miller	Field Geology Services	nicolas.miller1@gmail.com

"*This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.*"

Minutes to be considered final unless comments are received within five (5) business days.

AGENDA

- Greeting – Matt Reardon, MassDEP & Marie Sorensen, Sorensen Partners
- Watershed & Goals Overview (10 min) – Julia Keay & Adam Questad, Geosyntec
- s. 319 Grant Project Spotlight (15 min) – Michael Leff, MACD
- Brief Introductions from All Participants (15 min) – All
- Discussion of Completed, Ongoing, and Future Efforts (50 min) – All

WATERSHED & GOALS OVERVIEW/SECTION 319 GRANT PROJECT SPOTLIGHT

- **Adam Questad** described the goal of creating the watershed-based plan for East Branch North River: to gather data about what's been done in the watershed: Where are potential pollutant sources? What are projects ongoing? Where would we want to implement new projects? Where might we want to do monitoring?
- **Julia Keay** of Geosyntec discussed the watershed: mostly forested, with 10% agricultural use, most located adjacent to the East Branch North River. Noted as a Category 5 waterbody in the 2016 MA Integrated List of Waters. But a 2017 study from CT River Conservancy showed improvements in *E.Coli* data. Not including VT portion of the watershed, which makes up about 2/3 of the watershed. Most of impervious cover and agricultural areas are concentrated adjacent to the river.
- **Michael Leff, s. 319 grantee**, discussed the grant project. This is the third of a few grants MACD has with MassDEP. There are three sub-watersheds that are being focused on, along with Mill River and Moose Meadow Brook. Once we have a watershed-based plan, we have consultants go out and meet with farmers to discuss BMPs geared towards reducing runoff of nonpoint sources of pollution, which ultimately result in more economical farming practices, so it's a win-win. Once we find the farmers, we put them in touch with a technical service provider who can lead towards getting cost-share funding for installation. Looking forward to doing more of this in the East Branch North River watershed. Having a watershed-based plan is great for any organizations in the area who are looking to do grant proposals.

BRIEF INTRODUCTIONS FROM ALL PARTICIPANTS

Participants were asked to briefly address the following prompts:

⇒ Name?
⇒ Affiliation
⇒ Your connection to Moose Meadow Brook?
⇒ Specific projects, public outreach, and/or monitoring work you do or have done

Julia Keay, Geosyntec. Water Resources Engineer. Will be helping to write the WBP along with Emma and Adam from Geosyntec. Is from Western MA so familiar with the Deerfield River watershed.

Adam Questad, Geosyntec. Engineer. Assisting Julia with Marie and Matt on the project, along with Matt and Michael.

Emma Williamson, Geosyntec. Recently joined the project team at Geosyntec.

Marie Sorensen, Sorensen Partners. Working with Geosyntec and MassDEP to identify stakeholders and landowners who have an advocacy, scientific, or land-ownership interest in the watershed.

Matt Reardon, MassDEP, Nonpoint Source Program Coordinator. The nonpoint source (NPS) program has the 604b water quality planning grants and the s.319 grant program, which is more implementation-based. There is funding for potential projects; all participation is voluntary .

Michael Leff, ED, MACD. Grantee for this s.319 grant project. Lives in Chesterfield, MA. Bill Dornbusch is his connection to the East Branch North River. His farm was the site of a river restoration project that he helped advance with CRC and Andrea Donlon. Was constructed last summer. Had mostly been working for Franklin Conservation District (FCD) until last fall and now is director of MACD.

Kimberly Noake McPhee, Land Use and Natural Resources Program Manager, FRCOG. Regional planning agency for the 26 towns in the county. Does a lot of work with Colrain. Colrain is a Municipal Vulnerability Preparedness (MVP) community and FRCOG recently updated Colrain's Haz Mitigation Plan. Last June completed a habitat assessment for the East Branch North River down to the confluence, and out of that project came the identification of about 20 possible in-stream restoration projects, bank stabilization projects that would restore the degraded habitat and geomorphic function of the river. One of those projects was the Dornbusch property which was taken up by the CT River Conservancy among other stakeholders. Bill and his family were really pleased to have that project be completed. Helps communities submit grant applications and submit priority projects. There were two other projects (studies) FRCOG did for the Deerfield River watershed – healthy river plan and climate change plan.

Ryan O'Donnell, Water Quality Monitoring Coordinator, CT River Conservancy. Coordinates the samples referenced by Julia, able to get nitrogen and phosphorous tested previously, and able to continue to monitor bacteria in the MA portion of the watershed. Lives in the next watershed to the west.

Bill Dornbusch, Colrain farm owner. Fortunate beneficiary of a beneficial project by CT River Conservancy to do bank stabilization. Property starts just below the VT state line and runs for a mile along the river. Also a member of the Colrain Conservation Commission.

Erin Rodgers, Trout Unlimited. Does more work on West Branch North River or on the VT side of the East Branch. Was responsible for all the water quality assessment data in the East Branch North River. Worked on culvert data collection for Deerfield River Watershed Association (DRWA).

Haynes Turkle, Chair, Colrain Agricultural Commission. Doesn't have a lot of expertise with the water quality issues. Has been focusing mostly on farm loss in Colrain to create awareness about this and to help farms that are struggling economically and in other ways. Have lost a considerable number of dairy farms in Colrain, though per capita they have more than any other town in Franklin County. Lots go out of business or convert to beef cows. There are two dairy farms along the East Branch, one has already converted to beef cows. Always interested in connecting farms and farmers to project.

Andrea Donlon, River Steward, CT River Conservancy. Tries to keep tabs on all things river in this part of the state. Does a lot of advocacy work as a part of her job. Reviews permit applications. Worked on the project on Bill Dornbusch's property. Got to see all the permits completed and the wood buttresses and significant riparian plantings. Other projects were done, on the list Kimberly mentioned, including the geomorphology study (2015) – but none of the other projects got past the finish line to final design and construction. Lives in Buckland, nearby.

Nic Miller, Field Geology Services. Was involved with FRCOG in drafting and delineation of the stream corridor. As well as projects centered around the Barnhardt Dam where the east and west branches come together.

DISCUSSION OF COMPLETED, ONGOING, AND FUTURE PROJECTS

A general discussion was held on the following topics:

1. Agricultural or Structural BMP Projects in watershed
2. Pollutant Load Reduction Estimates for BMP projects
3. Monitoring efforts
4. Potential *E.Coli* & other nonpoint source pollution sources
5. Public education and outreach
6. Additional grant funding available

Andrea Donlon. The Dornbush project was located on both sides of the last bridge before the border of VT.

Michael Leff. This and other projects were intended to follow up on Hurricane Irene and damage following in its wake. Permitting obstacles are often related to the river itself.

Kimberly MacPhee. Agrees there's often this period of lag or learning curve. Even though these solutions are being promoted by grant funding agencies, there is often work in the river channel and its banks. The regulatory framework for that has not really caught up.

Andrea Donlon. Did end up ditching the part of the project that would have involved placing habitat structures in the river, because it would have required putting vehicles into the river. They had to offload that element even though it was the original idea of the project.

Kimberly MacPhee. On the South River floodplain reconnection project, they did get the regulatory agencies to be happy with the boulder weirs they wanted to put in the channel, but then the landowners did not want to participate in the project, so they dropped that element. We're in a brave new world with permitting.

Has been working on a "river corridor easement" that could be put into the WBP. It's a plan to permanently protect the river corridor and allow activities to continue. They also have a "model river corridor protection district which is an overlay district that could be part of the WBP because based on the delineation of the river corridor. Can share shape files.

Haynes Turkle. Has noticed two farms are highlighted with a pin. Is there a project planned there?

Julia Keay. No. Just noticed that they were adjacent to the East Branch North River. Julia identified that one has beef (Fort Morristown Farms), and one has cattle and pigs (DAR-Ridge).

Haynes Turkle. One other large farm is a vegetable production farm. The other was a vegetable production farm and is going to be moving into marijuana production (Lionsville Family Farm – outside of boundaries of watershed).

Adam Questad. Are there other project reports we could review?

Nic Miller. Could send those to Adam.

Andrea Donlon. Could send preliminary designs for projects that have happened. One was at the location of the town wells that are close to the river. This was upstream of Colrain Central School. This was a potential project following Irene.

Nic Miller. During Irene there were two sets of wells that were affected. There was an avulsion upstream where the channel shifted into a new position. There was a lot of sediment. The wells are in a pretty precarious location. A design was put together to protect that well site, which involved improving the access road down to the wells, doing some bank stabilization to minimize erosion encroaching towards the well. Downstream there is a human-made constriction that is impacting the well. There is another water supply – Shelburne Falls Water District (outside of project area), similar situation there during Irene.

Marie Sorensen. Colrain Brush Landfill / Former Town Dump – is that a source of concern?

Kimberly MacPhee. This is the old dump site where the former town offices are. They did a Deerfield River assessment in 2008, and that was a problem area noted. Also noted in the early-2000s. There is material that is mobilized in storm events, works its way out of the bank. Town has looked into different sources of funding to stabilize that area. Kevin Fox, Town Administrator, has more background on the site.

Marie Sorensen. What about unpaved rural roads?

Kimberly MacPhee. Colrain has the highest number of miles of unpaved roads in Franklin County, 30-odd miles. Yes they are likely to be contributing a significant amount of sediment to the upland tributary areas as well as possibly to the river itself. FRCOG has that mapping.

NRCS project at Colrain Elementary School, 2000. Talk to someone in the Greenfield NRCS office about that.

Michael Leff. Gary Blazejewski is the NRCS District Conservationist and would probably have access to this information.

Kimberly MacPhee. Erin, is there information that could be going from the Ecosheds Database that could be helpful in terms of drainage and sedimentation?

Erin Rodgers. Doesn't think they included information in the Deerfield area.

Kimberly MacPhee. FRCOG is going to be doing an inventory study of the drainage structures, under the transportation Planning Programs' workplan, data will be available starting in September.

Adam Questad. Intention is for these to be living plans, so information can be added over time.

Matt Reardon. Michael Cole did a bunch of invertebrate sampling in the watershed, for the Deerfield River. Found aquatic life was not impacted.

MassDEP has not sampled there since 2012. The CRC information would be more up to date.

Ryan O'Donnell. The sample location is upstream from the covered bridge, near the baseball field. Upstream in Jacksonville there's a water treatment plant, and they have occasionally caught high phosphorous readings from it.

In the VT part of the watershed, all along Rte. 112, the landslide areas from Irene are still pretty active.

Michael Leff. Also, the few tenths of a mile upstream of the Dornbusch farm are still pretty active.

Nic Miller. Two places with significant sediment inputs are the old town dump site and behind the Catamount Store on Rte. 112.

Haynes Turkle. Colrain does not do any specific public outreach that he is aware of.

Ryan O'Donnell. A "wild and scenic river" designation is being sought for the Deerfield River by the Deerfield River Watershed Association

Andrea Donlon. Colrain Elementary School does some river education. Talia Miller is the staff person. They raise trout that they put back into the stream. They research plastics and other issues.

Also the library is not far from the river. They have a microscope that can be checked out.

Marie Sorensen. Are any BMP projects active now in design, or in seeking grants?

Kimberly MacPhee. Will be working with the Town of Colrain and possibly one other town on an unpaved roads project, which would build on the drainage culvert inventory work that the FRCOG is going to be doing next year. Have realized how challenging the maintenance is for these roads and how much sediment is being contributed to wetlands, rivers, streams. There would be conceptual designs done for sites in Colrain.

Marie Sorensen. Rte. 112 runs along the river. Is there any exceptionally heavy salting or other practices we should be aware of?

Kimberly MacPhee. Doesn't know about that.

Andrea Donlon. Rte. 112, if its anything like Buckland, then yes, the whole region is heavily salted.

Haynes Turkle. Town maintains portion north of center of town; MassDOT maintains portion south of town center.

Matt Reardon. Does Erin have any ideas about trout? Any projects nearby or that could be done in this watershed.

Erin Rodgers. Yes there are plenty of undersized culverts that could be addressed. There is a lot of potential for habitat work given the heavily forested headwater streams.

Andrea Donlon. Department of Fish and Game should have fish surveys.

Matt Reardon. Yes we have that data up to 2019.

Andrea Donlon. Also be aware that there was an acid spill at the Barnhardt plant in 2019, Labor Day weekend, outside of watershed, but there was a significant fish kill because of that. There was no enforcement order posted because of that. There may be some fine that could be posted.

Kimberly MacPhee. When will the East Branch North River watershed-based plan be completed?

Julia Keay. Planning for end of June.

Contact: Julia Keay, JKeay@geosyntec.com
Adam Questad, AQuestad@geosyntec.com
Matt Reardon, Matthew.Reardon@state.ma.us

Appendix B – Select Excerpts from Water Quality Assessment Report (MassDEP, 2000)

(Note: relevant information is included directly from these documents for informational purposes and has not been modified).

Deerfield River Watershed 2000 Water Quality Assessment Report (MA33-19 - East Branch North River)

AQUATIC LIFE

Habitat and Flow

The East Branch North River has been experiencing major erosion in localized areas. The river is naturally subject to high and flashy spring flows and spring ice jams that contribute to streambank erosion. There is also a past history of gravel mining in and near the river that likely has impacted the geomorphology and hydrology of this segment. A Section 319 bioengineering project was implemented in an area that was eroding and threatening town water supply wells in 1993 (MA DEP 1996c). The project failed several years after installation, but at the time of this report the water supply wells had not been damaged by further erosion in this area. Agricultural (i.e., small-scale farming) activities are common along the North River and its East Branch - in many cases crops are planted immediately adjacent (i.e., minimally buffered) to the river.

The East Branch North River was sampled by DWM downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. At the time of the survey the river was roughly 13 m wide with depths ranging from 0.3 m to 0.9 m. The substrates were comprised primarily of boulders and cobble. The overall habitat score was 190 (Appendix B). The stream banks, although steep, were stable.

Biology

Compared to the Cold River reference station (Station CR01), the RBP III analysis indicated the benthic community was non/slightly impacted in the East Branch North River downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. The presence of a certain macroinvertebrate species indicative of high concentrations of suspended organics provided evidence of nutrient enrichment of this stream (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the East Branch North River in 1988 (Appendix C). Although fish sampling efficiency was rated as poor due to stream width and depth encountered, fish species captured by DWM in September 2000, in order of abundance, included Atlantic salmon (Salmo salar), longnose dace (Rhinichthys cataractae), blacknose dace (Rhinichthys atratulus), and one each of yellow bullhead (Ameiurus natalis), banded killifish (Fundulus diaphanous), and tessellated darter (Etheostoma olmstedi) (Appendix B). Only the Atlantic salmon is considered to be intolerant of pollution.

DWM biologists collected periphyton samples from station NORO2A (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as <1% and percent algal cover was 100%. This site had a thin covering of coccoid green algae on 100% of the stable substrates, which is an indication of slightly enriched conditions but not considered nuisance algae growth (Appendix D).

Chemistry

DWM collected water quality samples from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 (Appendix G, Tables G3 and G4).

Water quality samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6) on as many as six occasions between August and November 2000 by ESS as part of a study performed for the Deerfield Watershed Team (ESS 2002).

DO and % saturation

Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.2 mg/L or 93.9% saturation. Saturation was as high as 106.6%.

Temperature

The maximum instream temperature was 19.6°C.

pH

The pH ranged from 6.9 to 7.4 SU.

Turbidity

Turbidity ranged from 0.60 to 41.8 NTU although five of six measurements were less than 1.6 NTU. The elevated turbidity occurred during a wet weather event in October 2000.

Conductivity
Specific conductivity measurements ranged from 80.3 to 107.8 µS/cm.

The Aquatic Life Use is assessed as support for the East Branch North River based primarily on the benthic macroinvertebrate community analysis and the limited water quality data. It should be noted, however, that nutrient/organic loadings originating from various forms of runoff (especially upstream agriculture, road crossings, and NPS inputs originating from Colrain center) probably contribute to the slightly enriched nature of this stream system (Appendix B) so the Aquatic Life Use is identified with an Alert Status. Streambank erosion in localized areas along this segment is also of concern.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected one fecal coliform bacteria sample from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).
Fecal coliform bacteria samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6), on six occasions between August and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts during the Primary Contact Recreational season (n=4) ranged from 50 to 280 cfu/100 mL, with only one of the four samples exceeding 200 cfu/100 mL. The elevated bacteria count was during a wet weather event in September.

No objectionable deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the East Branch North River in September 2000 (Appendix B).
The Recreational and Aesthetics Uses are assessed as support for East Branch North River based on the generally low fecal coliform bacteria counts and the habitat quality information. The Primary Contact Recreational Use, however, is identified with an Alert Status because of the slightly elevated bacteria count documented by ESS during one wet weather event.

The Massachusetts portion of the drainage area of this segment is approximately 13.82 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest 82.5%
Agriculture 11.4%
Residential 3.1%

Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Colrain Brush Landfill/Former Town Dump. This landfill is over 25 years old. The former town dump portion received demolition waste, industrial waste and municipal solid waste. This portion, closed in 1976, is not capped or lined. The brush dump was closed and capped in 1989. The site is within 50 feet of the North River and within one half mile of public and private water supplies and potentially productive aquifers. Fuss and O'Neill (2003) concluded that this site ranked high for the potential to impact sensitive environmental receptors and recommended it for screening level sampling. Samples collected in April 2003 from a groundwater seep on the bank of the North River downgradient of the landfill were high in iron (95,400 µg/L), manganese (8,250 µg/L), and cadmium (1.8 µg/L). No VOCs were detected.

Report Recommendations:
• Continue to conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, biomonitoring is recommended here and fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring throughout the East Branch subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.
• Support local efforts to control streambank erosion. The NRCS and the Colrain Elementary School are currently collaborating on a streambank stabilization project on an eroding section of riverbank adjacent to the school.
• Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
• The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
• In order to prevent degradation of water quality in the East Branch of the North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of

impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their community's rural character.

• The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

• Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of the Colrain Brush Landfill/Former Town Dump including: performing additional field investigation to assess environmental risk, identifying and characterizing the extent of any impacts that may be present, and determining the need for corrective action. The report identified significant quantities of exposed refuse within 50 feet of the North River and groundwater seeps hydraulically connected to the North River as major issues of concern.

Appendix C – East Branch North River Corridor Map

River Corridor Map - East Branch North River

River Corridor Map - Topographic map (USGS) - Plate 1 of 3.

Field Geology Services
Fluvial Geomorphology

Appendix D –Excerpt and Adaptation of 2016 Deerfield Watershed Integrated Report Data Compendium

Excerpt And Adaptation of 2016 Deerfield Watershed Integrated Report Data Compendium

Basis and rationale for assessing and listing waters in the Deerfield River Watershed pursuant to the requirements of sections 305(b), 314 and 303(d) of the Clean Water Act: 2016 Reporting Cycle

Prepared by:
Massachusetts Department of Environmental Protection
Division of Watershed Management, Watershed Planning Program

Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, Massachusetts

December 2017

East Branch North River (MA33-19)

Location:	Vermont line, Colrain to confluence with West Branch North River, Colrain.
AU Type:	RIVER
AU Size:	7.5 MILES
Classification/Qualifier:	B: CWF, HQW

Fish, other Aquatic Life and Wildlife (Support with "Alert")

The Aquatic Life Use was assessed as "Support" based on the results of benthic invertebrate studies by DRWA (2007), multiple DFG fish population studies (2005-2012) and the results of 2005 DWM water quality surveys. This segment received an "Alert" due to habitat degradation due to bank erosion and sedimentation identified by Cole and FRCOG 2014 (Data Source: 26).

Biology

East Branch North River was sampled (off Rt 112 0.75mi N of Franklin Hill Rd, Colrain (42.72156, 72.70887)) on 08/14/2006 (SampleID 1854), using the backpack shocking method. A total of 436 individuals were collected with 8 species represented. 5 cold water species were found. The sample was composed of 100% fluvial specialists/dependents and 59% intolerant/moderately intolerant, while 41% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database								
Station Description	East Branch North River -- off Rt 112 0.75mi N of Franklin Hill Rd, Colrain (42.72156,							
Habitat Comments	CFR							
Efficiency	seconds not recorded(Seconds Shocked -)							
Sample Date	**Species**	8						
08/14/06	**Total Ind**	436						
Method	**% Dom**	41%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	6	82%					
3314275	FD	2	18%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	5	36%					
	M	2	23%					
	T	1	41%					
	SampleID	1854						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	1	165	165	C	FS	I	Top Carnivore
Rainbow trout	RT	2	270	278	C	FS	I	Top Carnivore
Blacknose dace	BND	178	28	79	CW	FS	T	Generalist Feeder
Common shiner	CS	2	75	79	CW	FD	M	Generalist Feeder
Atlantic salmon	AS	55	62	171	C	FS	I	Top Carnivore
Longnose dace	LND	98	35	109	CW	FS	M	Benthic Insectivore
Slimy sculpin	SC	25	33	75	C	FS	I	Benthic Insectivore
Longnose Sucker	LNS	75	41	165	C	FD	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

East Branch North River was sampled (along Rt 112, N of Franklin Hill Rd ~0.75mi, Colrain (42.72144, 72.70926)) on 08/15/2007 (SampleID 2092), using the backpack shocking method. A total of 527 individuals were collected with 9 species represented. 5 cold water species were found. The sample was composed of 100% fluvial specialists/dependents and 52% intolerant/moderately intolerant, while 48% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database								
Station Description	East Branch North River -- along Rt 112, N of Franklin Hill Rd ~0.75mi, Colrain							
Habitat Comments	2 backpacks used. Longnose suckers present. CFR							
Efficiency	2 backpacks used(Seconds Shocked - 5480)							
Sample Date	**Species**	9						
08/15/07	**Total Ind**	527						
Method	**% Dom**	48%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	8	94%					
3314275	FD	1	6%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	5	24%					
	M	2	28%					
	T	2	48%					
	SampleID	2092						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	1	157	157	C	FS	I	Top Carnivore
Rainbow trout	RT	1	241	241	C	FS	I	Top Carnivore
Fallfish	F	1	65	65	CW	FS	M	Generalist Feeder
Blacknose dace	BND	252	20	80	CW	FS	T	Generalist Feeder
Atlantic salmon	AS	45	71	158	C	FS	I	Top Carnivore
Longnose dace	LND	146	25	86	CW	FS	M	Benthic Insectivore
Creek chub	CRC	1	50	50	CW	FS	T	Generalist Feeder
Slimy sculpin	SC	48	28	86	C	FS	I	Benthic Insectivore
Longnose Sucker	LNS	32	34	150	C	FD	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

East Branch North River was sampled (Along Rt 112 N, 3/4mi N of Franklin Hill Rd, Colrain (42.72171, 72.70934)) on 09/04/2012 (SampleID 4123), using the backpack shocking method. A total of 706 individuals were collected with 7 species represented. 3 cold water species were found. The sample was composed of 100% fluvial specialists/dependents and 55% intolerant/moderately intolerant, while 45% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database								
Station Description	East Branch North River -- Along Rt 112 N, 3/4mi N of Franklin Hill Rd, Colrain							
Habitat Comments	2 backpacks used. Wide, shallow. Missed a lot of fish. Overcast, light rain.							
Efficiency	2 backpacks used:1448s, 1650s(Seconds Shocked - 3098)							
Sample Date	**Species**	7						
09/04/12	**Total Ind**	706						
Method	**% Dom**	45%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	5	85%					
3314275	FD	2	15%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	3	20%					
	M	2	35%					
	T	2	45%					
	SampleID	4123						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Blacknose dace	BND	315	20	69	CW	FS	T	Generalist Feeder
Common shiner	CS	67	30	50	CW	FD	M	Generalist Feeder
Atlantic salmon	AS	66	62	169	C	FS	I	Top Carnivore
Longnose dace	LND	180	35	96	CW	FS	M	Benthic Insectivore
Creek chub	CRC	2	34	52	CW	FS	T	Generalist Feeder
Slimy sculpin	SC	34	36	90	C	FS	I	Benthic Insectivore
Longnose Sucker	LNS	42	52	190	C	FD	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Result from DRWA Macroinvertebrate Assessment Program (Data Source: 12)							
Year	Site	River	Segment	Location	Habitat Score	IBI Score	Biological Condition
2007	EBNM01	E Br North River	MA33-19	RM ~3.5, upriver side of Lyonsville Rd Bridge (Arthur A. Smith bridge)	125	38	Non-Impacted
2007	EBNM02	E Br North River	MA33-19	RM ~4, downriver end of old dump site adj to Colrain fire dept and town hall	162	42	Non-Impacted
2007	EBNM03	E Br North River	MA33-19	RM ~6, ~100 m below Reil Lane	139	38	Non-Impacted
2007	EBNM04	E Br North River	MA33-19	Rt 112 crossing just below VT/MA border (bact site NOR006)	147	42	Non-Impacted

Habitat and Flow

Excerpt from the 2013 North River Fish Communities and Physical Habitat Assessment, Franklin County Massachusetts (Data Source: 26):

EXECUTIVE SUMMARY

The Franklin Regional Council of Governments was awarded a 604b grant to perform a comprehensive assessment of the North River and the Massachusetts portion of the East Branch of the North River to provide information on the causes of erosion, channel instability, and habitat degradation. This assessment included a geomorphic study that resulted in the development of conceptual restoration designs for several highest-ranked priority sites and final designs and cost estimates for the highest ranked restoration priority site. In order to inform the development of projects that seek to benefit both landowner property and river health, an assessment of river habitat and fish communities was performed as an attendant study to the geomorphic assessment. This study serves as a benchmark for future evaluations of both the potential success of restoration efforts, as well as of any further degradation. This report details the methods, findings, and recommendations of this study.

Fish and habitat survey reaches were selected following reconnaissance surveys of the entire watershed and consultation with the geomorphic assessment consultant (Field Geology Services). Reaches were selected to represent the range of channel types and conditions occurring along the length of the North River and its East Branch. Four reaches were selected from the East Branch of the North River and one reach from the North River. Two reaches occurred within confined sections of the river system, two reaches occurred within unconfined sections of the river system, and one reach, NRF5, occurred in a transitional zone from a confined to an unconfined channel type. The reaches were distributed throughout the North River and its East Branch from river mile 1.9 to river mile 10.9. Physical habitat, fish communities, and water chemistry were sampled from the 5 survey reaches in the early fall of 2013. Physical habitat surveys were performed in accordance with the Physical Habitat Characterization protocols of the US Environmental Protection Agency's Wadeable Streams Assessment Field Operations Manual. Fish community surveys followed Massachusetts Division of Fisheries and Wildlife stream electrofishing surveys protocols.

Physical habitat conditions in the North River and its East Branch were variable, and conditions did not correlate with longitudinal position along the river. Rather, unconfined sections of the river occurring on wide valley floors were consistently more degraded and supported lower habitat quality than did confined sections of the river system. Limiting factors in the river system include a lack of instream habitat complexity and cover (lack of deep pools, instream boulders or wood, clean gravels, etc.), elevated sediment loading, and inadequate riparian buffers. This degradation was generally more severe in unconfined sections of the river that had historically been channelized and straightened.

Fish Consumption **(Not Assessed)**

Primary Contact Recreation (Non-Support)

Primary Contact Recreation use status was Non-support based on *E. coli* data from MassDEP 2005 water quality survey (Data Source: 28). (Unique ID 1347 geomean = 184) and FRCOG (Data Source: 8).

Bacteria Results from the FRCOG/DRWA 604b Bacteria Monitoring and Source Tracking (2005-2007) Data Source: 8

			06/02 /05 06/17 /06	06/05 /05 06/23 /06	06/12 /05 07/08 /06	07/06 /05 07/21 /06	07/13 /05 08/06 /06	07/31 /05 08/19 /06	08/13 /05 09/09 /06	08/14 /05	08/28 /05	09/15 /05		
Year	Site	Segment	06/16 /07	06/30 /07	07/02 /07	07/15 /07	07/17 /07	07/22 /07	07/28 /07	08/11 /07	08/12 /07	08/25 /07	Geom ean	N
2005	NOR-004	MA33-19			36.9	387.3	11			35	579.4	178.5	91	6
2005	NOR-005	MA33-19			137.6	2420	62			294.3	563.5	887.3	381	6
2007	NOR-005	MA33-19		218.7		248.9			163.9		124.2	748.6	242	5
2006	NOR-005	MA33-19	44.9	79.4	410.6	135.4	186	117.8	35.9				107	7
2007	NOR-005 AB-1	MA33-19	93.0	50.4		72.3			69.1		35.9	62.4	61	6
2006	NOR-005B	MA33-19	47.1	76.7	92.4	37.9	138.8	29.2					61	6
2006	NOR-005C	MA33-19	40.9	248.9	116.9	46.4	151.5	36.9					82	6
2005	NOR-006	MA33-19			74.9	75.4	26.2			90.4	770.1	841.4	143	6
2007	NOR-010A	MA33-19	42.0	72.3		95.9					69.1	111.2	74	5
2007	NOR-010C	MA33-19	46.5	69.7		107.1					82.6	172.6	87	5
2007	NOR-010D	MA33-19	63.8	71.2		113.9					101.7	218.7	103	5

Source Tracking Results Excerpts: "Based on the 2006 results, agricultural activity between Reil Lane and the Colrain Elementary School was identified as a potential source of bacteria in the North River. However, the sources of some elevated bacteria counts remained undetected following the 2006 sampling season, including the sporadically elevated counts in the lower East Branch of the North River." AND "The 2007 sampling program objectives included identifying sources of bacteria contamination occurring in the East Branch of the North River in Colrain. These efforts focused exclusively on dry-weather sampling. Despite these efforts, these sources went largely unidentified. Efforts to identify the source of bacteria contamination occurring at NOR-005 in the North River ultimately suggested a source under or immediately downriver of the Rte. 112 bridge in Colrain center (suggesting a human source such as failing septic system), but human marker testing by DEP in early October failed to show a human source of the contamination." AND "Further investigation of this year's results could include a thorough visual inspection of the Rte. 112 bridge and associated river area. Anecdotal evidence suggests that even heavy pigeon use of a bridge may result in elevated bacteria counts in the river below. Other animal use in and around the river and bridge, as well as failing septic system(s) could be resulting in the elevated bacteria counts measured at NOR-005."

North River WERO BST E. coli Results - Segment MA33-19 Site Locations (Data Source: 6, For Station Map See Appendix)						
		NRVRDFLD12.0	NRVRDFLD13.0	NRVRDFLD14.0	NRVRDFLD15.0	NRVRDFLD16.0
06/11/07	Dry	98.5	6.3	70.3	22.8	NS
09/05/07		140.8	8.6	95.9	44.1	>2419.6
09/10/07		NS	NS	NS	NS	866.4
10/03/07		NS	NS	NS	NS	461.1
		NRVRDFLD16.5	NRVRDFLD17.0	NRVRDFLD18.0	NRVRDFLD19.0	
06/11/07	Dry	44.1	NS	NS	NS	
09/05/07		NS	NS	NS	NS	
09/10/07		866.4	816.4	1046.2	NS	
10/03/07		18.7	16.0	23.1	56.3	
Excerpts from report indicating sources: The high count may have resulted from agricultural practices upstream. A survey of the upstream reach discovered multiple areas where manure used as fertilizer was piled close to the river. The trend of increasing counts with increasing upstream location tends to support the conclusion that the source for the *E. coli* is in the area of high agricultural activity.						

WERO North River BST Segment MA33-19 (Data Source: 5) Sampling Site Locations					
North River Watershed					
		NRDFLD14	NRDFLD14.7	NRDFLD16	NRDFLD16.3
6/9/2008	Dry	88.2	137.6	129.1	101.9
		NRDFLD16.5	NRDFLD17	NRDFLD18	NRDFLD19
6/9/2008	Dry	96	62	101	21.3
BST Summary Eight samples were collected from the North River immediately downstream and upstream of the Colrain Elementary School as a continuation of the investigation of high E. coli counts in samples collected next to the school in 2007. These samples, collected during dry weather conditions, exhibited E. coli counts from 62.0 to 137.6 MPN per 100mL of sample (Table 2). The fact that all samples were below the MPCRS supports the conclusion in 2007 that the source of high bacteria counts was likely agricultural practices upstream of the school and not the school itself.					

Secondary Contact Recreation **(Support)**

Secondary Contact Recreation use supported based on *E. coli* data from MassDEP 2005 water quality survey (Data Source: 28) and FRCOG (2005 - 2007) (all geomean values below 630).

Aesthetic (Support)

The Aesthetic use is supported since no objectionable conditions were noted during field observations made by MassDEP survey personnel (Data Source: 2).

Site	Segment	Date	Odor	Water Clarity	Color	Aquatic Plants	Periphyton	Floating Scum	Obj. Deposits
EBNR01	MA33-19	05/17/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	06/07/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	06/08/05	None	Clear	Clear	None	Moderate	Foam	No
EBNR01	MA33-19	07/19/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	07/20/05	None	Clear	Brownish	None	Sparse	No	No
EBNR01	MA33-19	08/16/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	08/17/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	09/20/05	None	Clear	Clear	None	None	No	No
EBNR01	MA33-19	09/21/05	None	Clear	Clear	None	Dense	No	No
DWM Field Sheet Observations 2005 (Data Source: 2).									

Excerpts from Nonpoint Source Pollution Assessment for the Deerfield River Watershed prepared by Franklin County Regional Council of Governments for Segment East Branch North River (MA33-19) (Data Source: 8)

Segment EB1a and EB1b – Vermont State Line to Franklin Hill Road

Three galvanized pipes were found in this segment. The pipes carry runoff from the unnamed tributaries to the east of the river under Jacksonville Road and into the East Branch North River. All of the pipes appeared to be in good condition. However, two of the pipes (P-1 and P-2) pose a significant barrier to fish and wildlife passage. Volunteers noted bank erosion on both the river right and left banks, but the most extensive erosion was on the river left bank. This erosion was caused by the flooding of October 2005. Another problem volunteers noticed was a lack of adequate riparian buffer on the river right bank. There is only about 15 feet of forest on the bank which gradually becomes a single line of trees next to a mowed pasture. Although no large areas of trash and debris were seen, there is scattered debris along this segment, including: plastic water bottles, old tractor inner tubes, buckets, and plastic bags.

Segment EB2 – Franklin Hill Road to Reils Road

In the upper part of this segment, volunteers saw a few empty barrels and junk vehicles along Franklin Hill Road on the river left bank. The dominant feature in this segment is the dairy farm located on the river right bank at the lower end of this segment. There is little or no riparian buffer on the river right bank and the bank is eroding in several locations. Attempts have been made in the past, and recently, to protect the bank with hard structures such as riprap and large boulders. The river left bank includes a farm at the northern end of Reils Lane. There is also very little riparian buffer on this section of bank.

Segment EB3 – Reils Road to Foundry Village Road

There were also several large metal bars, wood pallets and other materials strewn along the river left bank. Just upstream of the bridge is the Colrain Log Yard, which has an active logging operation and farm. Downstream of the power lines, just north of the North River Cemetery, there is significant bank erosion along the river left bank for approximately 350-500 feet. The bank currently does not have any riparian buffer. There was also a 2-foot PVC pipe with significant clear flow on the river left bank in approximately the same location, which the volunteers thought could be carrying water from a feeder stream. Several residences are located on River Street, and yard waste dumped along the left bank.

A section of the bank in this area was eroded and nearby, two outflow pipes were flowing – a 4-inch metal pipe and a 1-foot metal pipe. Both of the pipes had a clear flow. The steep river left bank behind the Town Offices and Highway Department is littered for over 650 feet with debris and trash. There was obvious evidence this was the old town dump with everything from oil and propane tanks; car parts, bumpers, frames and chassis; culverts and concrete; filing cabinets; and other various metal debris and equipment. In addition, a portion of the bank on the inside bend is eroding and there was evidence of glass and other trash buried beneath. Volunteers could see the Town's sand pile from the river, even though it is perched on the top of the very steep river left bank. There was very little vegetative buffer and it appears the pile lacks a cover and silt fencing to contain the materials on site. From what can be seen from the river, there appears to be some sand drifting down the bank, though it had not yet reached the river. Downstream of the Foundry Village Road bridge, there is a concrete 3-foot pipe on the river left bank discharging an iron colored substance. The pipe is adjacent to the prefabricated house building business (aka "Truss Factory") and in close proximity to an old Brownfield site.

Segment EB4 – Foundry Village Road to Adamsville Road

Volunteers noted that this segment has areas of significant erosion, most of which occurred as a result of the October 2005 floods.

Foundry Brook (MA33-25)

Location:	Headwaters north of Calvin Coombs Road, Colrain to confluence with East Branch North River, Colrain.
AU Type:	RIVER
AU Size:	2.8 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of slimy sculpin, multiple year classes of Brook Trout and results of DWM water surveys. (Note: Stream should be considered for protection as a Tier I cold-water fishery).

Biology

Foundry Brook was sampled (Along Cary Dr off Foundary Acres, Colrain (42.6789, 72.7215)) on 08/25/2008 (SampleID 2739), using the backpack shocking method. A total of 59 individuals were collected with 2 species represented. 2 cold water species were found including 19 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)

Station Description	Foundry Brook -- Along Cary Dr off Foundary Acres, Colrain (42.6789, 72.7215)
Habitat Comments	Classic Brk trout stream. CFR
Efficiency	(Seconds Shocked - 488)

Sample Date	**Species**	2	
08/25/08	**Total Ind**	59	
Method	**% Dom**	63%	
Backpack Shocking	**Habitat**	**Species**	**% Ind**
Saris/Palis	FS	2	100%
3314300	FD	0	0%
	MG	0	0%
	Tolerant	**Species**	**% Ind**
	I	2	100%
	M	0	0%
	T	0	0%
	SampleID	2739	

Common Name	Fish Code	Count	Min Length	Max Length	Temp	FG	PT	Function
Brook trout	EBT	22	58	165	C	FS	I	Top Carnivore
Slimy sculpin	SC	37	35	78	C	FS	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Foundry Brook was sampled (Foundry Village Rd to Cary Dr in Foundry Acres, Colrain (42.67804, 72.72165)) on 09/18/2012 (SampleID 4151), using the backpack shocking method. A total of 178 individuals were

collected with 3 species represented. 3 cold water species were found including 47 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	Foundry Brook -- Foundry Village Rd to Cary Dr in Foundry Acres, Colrain (42.67804, 72.72165)							
Habitat Comments	Campsites. Nice shelter, start at wooden bridge. Cobble, gravel. 1+ salmon (only 1)! Nice pools, stable banks, good tree cover in sections. Some sedimentation issues at riffles. Nice spot to work up fish in the rain.							
Efficiency	(Seconds Shocked - 906)							
Sample Date	**Species**	3						
09/18/12	**Total Ind**	178						
Method	**% Dom**	71%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	3	100%					
3314300	FD	0	0%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	3	100%					
	M	0	0%					
	T	0	0%					
	SampleID	4151						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	51	55	180	C	FS	I	Top Carnivore
Atlantic salmon	AS	1	123	123	C	FS	I	Top Carnivore
Slimy sculpin	SC	126	20	94	C	FS	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption (Not Assessed)

Primary Contact Recreation (Support)

Primary Contact Recreation use supported based on *E. coli* data (geo mean=15) from MassDEP 2005 water quality survey (Data Source: 28).

Secondary Contact Recreation (Support)

Secondary Contact Recreation use supported based on *E. coli* data (geo mean=15) from MassDEP 2005 water quality survey (Data Source: 28).

Aesthetic (Support)

Aesthetic use supported based on field observations of DWM survey personnel:

Site	Segment	Date	Odor	Water Clarity	Color	Aquatic Plants	Periphyton	Floating Scum	Obj. Deposits
FOU01	MA33-25	05/17/05	None	Clear	Clear	None	Sparse	No	No
FOU01	MA33-25	06/07/05	None	Clear	Clear	None	None	No	No
FOU01	MA33-25	07/19/05	None	Clear	Clear	None	Moderate	No	No
FOU01	MA33-25	08/16/05	None	Clear	Clear	None	None	No	No
FOU01	MA33-25	09/21/05	None	Clear	Clear	None	Sparse	No	No

DWM Field Sheet Observations 2005 (Data Source: 2).

SPUR BROOK (MA33-106)

Location:	Headwaters, outlet small pond just west at intersection of Christian Hill Road and Thompson Road, Colrain to confluence with East Branch North River, Colrain.
AU Type:	RIVER
AU Size:	2 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of multiple year classes of Brook Trout. (Note: Stream should be considered for protection as a Tier I cold-water fishery).

Biology

Spur Brook was sampled (Thompson Rd 0.25mi upstream of Stranahan Rd., Colrain (42.7243, 72.7249)) on 08/02/2005 (SampleID 1127), using the backpack shocking method. A total of 10 individuals were collected with 1 species represented. 1 cold water species were found including 5 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	Spur Brook -- Thompson Rd 0.25mi upstream of Stranahan Rd., Colrain (42.7243, 72.7249)							
Habitat Comments	High gradient stream looked for SC's but found none. CFR							
Efficiency	(Seconds Shocked -)							
Sample Date	Species	1						
08/02/05	Total Ind	10						
Method	% Dom	100%						
Backpack Shocking	Habitat	Species	% Ind					
Saris/Palis	FS	1	100%					
3314325	FD	0	0%					
	MG	0	0%					
	Tolerant	Species	% Ind					
	I	1	100%					
	M	0	0%					
	T	0	0%					
	SampleID	1127						
Common Name	Fish Code	Count	Min Length	Max Length	Temp	FG	PT	Function
Brook trout	EBT	10	53	209	C	FS	I	Top Carnivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption (Not Assessed)

Primary Contact Recreation **(Not Assessed)**

Secondary Contact Recreation **(Not Assessed)**

Aesthetic **(Not Assessed)**

Unnamed Tributary (MA33-105)

Location:	Unnamed tributary to Glen Brook, headwaters north of Oak Hill Road, Leyden to confluence Glen Brook, Greenfield.
AU Type:	RIVER
AU Size:	1.9 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of multiple year classes of Brook Trout. (Note: Stream should be considered for protection as a Tier I cold-water fishery).

Biology

UNT to Glen Brook was sampled (Oak Hill Rd (downstream of rd), Greenfield (42.65278272, 72.59832856)) on 07/20/2006 (SampleID 1508), using the backpack shocking method. A total of 23 individuals were collected with 1 species represented. 1 cold water species were found including 21 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)

Station Description	UNT to Glen Brook -- Oak Hill Rd (downstream of rd), Greenfield (42.65278272, 72.59832856)
Habitat Comments	shocked upstream to culvert including pool immediately below culvert; low flow and culvert perched 1 ft above current water level; rest of stream trickle below culvert pool; noticed upwelling springs along banks
Efficiency	(Seconds Shocked - 614)

Sample Date	**Species**	1	
07/20/06	**Total Ind**	23	
Method	**% Dom**	100%	
Backpack Shocking	**Habitat**	**Species**	**% Ind**
Saris/Palis	FS	1	100%
3313230	FD	0	0%
	MG	0	0%
	Tolerant	**Species**	**% Ind**
	I	1	100%
	M	0	0%
	T	0	0%
	SampleID	1508	

Common Name	Fish Code	Count	Min Length	Max Length	Temp	FG	PT	Function
Brook trout	EBT	23	46	185	C	FS	I	Top Carnivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption (Not assessed)

Primary Contact Recreation **(Not assessed)**

Secondary Contact Recreation **(Not assessed)**

Aesthetic **(Not assessed)**

Unnamed Tributary (MA33-107)

Location:	Unnamed tributary to the East Branch North River, headwaters south of Fairbanks Road, Colrain to the confluence of the East Branch North River, Colrain.
AU Type:	RIVER
AU Size:	1.7 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of slimy sculpin and multiple year classes of Brook Trout. (Note: Stream should be considered for protection as a Tier I cold-water fishery).

Biology

UNT to East Branch North River (2) was sampled (upstream of Calvin Coombs Rd xing, Colrain (42.7089, 72.70603)) on 09/22/2010 (SampleID 3250), using the backpack shocking method. A total of 43 individuals were collected with 2 species represented. 2 cold water species were found including 28 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	UNT to East Branch North River (2) -- upstream of Calvin Coombs Rd xing, Colrain (42.7089, 72.70603)							
Habitat Comments	Little water. Man made dam (debris & plastic) impeding all water & fish just downstream of culvert holding in many EBT. Is DS of SID 3251 site.							
Efficiency	(Seconds Shocked - 445)							
Sample Date	**Species**	2						
09/22/10	**Total Ind**	43						
Method	**% Dom**	65%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	2	100%					
3314320	FD	0	0%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	2	100%					
	M	0	0%					
	T	0	0%					
	SampleID	3250						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	28	50	140	C	FS	I	Top Carnivore
Slimy sculpin	SC	15	24	94	C	FS	I	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

UNT to East Branch North River (2) was sampled (Along Calvin Coombs Rd 0.3mi W of Rt 112, Colrain (42.70985, 72.70908)) on 09/12/2012 (SampleID 4145), using the backpack shocking method. A total of 82 individuals were collected with 1 species represented. 1 cold water species were found including 82 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	UNT to East Branch North River (2) -- Along Calvin Coombs Rd 0.3mi W of Rt 112, Colrain (42.70985, 72.70908)							
Habitat Comments	Bedrock controlled step pools. Little gravel. Banks in good shape, no apparent blowouts. Small woody debris, shaded. This is upstream of the exact site sampled last year.							
Efficiency	(Seconds Shocked - 869)							
Sample Date	**Species**	1						
09/12/12	**Total Ind**	82						
Method	**% Dom**	100%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	1	100%					
3314320	FD	0	0%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	1	100%					
	M	0	0%					
	T	0	0%					
	SampleID	4145						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	82	48	107	C	FS	I	Top Carnivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption (Not assessed)

Primary Contact Recreation (Not assessed)

Secondary Contact Recreation (Not assessed)

Aesthetic (Not assessed)

Unnamed Tributary (MA33-108)

Location:	Unnamed tributary to East Branch North River, headwaters outlet Mt. Brook Reservoir, Colrain to confluence with East Branch North River, Colrain.
AU Type:	RIVER
AU Size:	1.4 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of multiple year classes of Brook Trout. (Note: Stream should be considered for protection as a Tier I cold-water fishery).

Biology

UNT to East Branch North River (1) was sampled (DS of homestead at top of York Rd, Colrain (42.68957, 72.71645)) on 09/27/2010 (SampleID 3242), using the backpack shocking method. A total of 41 individuals were collected with 1 species represented. 1 cold water species were found including 41 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	UNT to East Branch North River (1) -- DS of homestead at top of York Rd, Colrain (42.68957, 72.71645)							
Habitat Comments	Trib junction DS of homestead. Very small stream. Very low flow. Steep-cobble/boulders, pools. Large wood. No trout US of trib							
Efficiency	(Seconds Shocked - 692)							
Sample Date	**Species**	1						
09/27/10	**Total Ind**	41						
Method	**% Dom**	100%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	1	100%					
3314305	FD	0	0%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	1	100%					
	M	0	0%					
	T	0	0%					
	SampleID	3242						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	41	44	139	C	FS	I	Top Carnivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

UNT to East Branch North River (1) was sampled (Off York Rd, 1.2mi N of Foundry Village Rd, DS of homestead, Colrain (42.69053, 72.71655)) on 09/18/2012 (SampleID 4152), using the backpack shocking method. A total of 64 individuals were collected with 1 species represented. 1 cold water species were found including 62 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 100% intolerant/moderately intolerant, while 0% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	UNT to East Branch North River (1) -- Off York Rd, 1.2mi N of Foundry Village Rd, DS of homestead, Colrain (42.69053, 72.71655)							
Habitat Comments	Small pools, short riffles. Lots of trees down in channel. Some bank sloughing & scour but doesn't appear much different from last year. Cobble, bedrock substrate.							
Efficiency	(Seconds Shocked - 587)							
Sample Date	**Species**	1						
09/18/12	**Total Ind**	64						
Method	**% Dom**	100%						
Backpack Shocking	**Habitat**	**Species**	**% Ind**					
Saris/Palis	FS	1	100%					
3314305	FD	0	0%					
	MG	0	0%					
	Tolerant	**Species**	**% Ind**					
	I	1	100%					
	M	0	0%					
	T	0	0%					
	SampleID	4152						
Common Name	**Fish Code**	**Count**	**Min Length**	**Max Length**	**Temp**	**FG**	**PT**	**Function**
Brook trout	EBT	64	33	150	C	FS	I	Top Carnivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption (Not assessed)

Primary Contact Recreation (Not assessed)

Secondary Contact Recreation (Not assessed)

Aesthetic (Not assessed)

Unnamed Tributary (MA33-134)

Location:	Unnamed tributary to East Branch North River from headwaters east of Franklin Hill Road and southwest at Franklin Hill, Colrain to mouth at confluence with East Branch North River, Colrain.
AU Type:	RIVER
AU Size:	0.7 MILES
Classification/Qualifier:	B

Fish, other Aquatic Life and Wildlife (Support)

The Aquatic Life Use was assessed as "Support" based on the presence of multiple year classes of Brook Trout. (Note: Stream should be considered for protection as a Tier I cold-water fishery). This segment was "alerted" based on DFG biologists' observations of "high levels of silt".

Biology

UNT to East Branch North River (4) was sampled (Franklin Hill Rd xing & downstream, Colrain (42.71885, 72.70313)) on 09/29/2010 (SampleID 3247), using the backpack shocking method. A total of 56 individuals were collected with 3 species represented. 1 cold water species were found including 11 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 20% intolerant/moderately intolerant, while 80% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)

Station Description	UNT to East Branch North River (4) -- Franklin Hill Rd xing & downstream, Colrain (42.71885, 72.70313)							
Habitat Comments	Started at xing, shocked pools down to site (where we found first fish). No fish above ledges. Steep ledge & boulders w/ pools. Filled w/ silt (construction?). Nice looking, steep stream. Dry before river (submerges into gravel of flood plain)							
Efficiency	2 ' wide, 4-6' pools. Seconds not recorded(Seconds Shocked -)							
Sample Date	Species	3						
09/29/10	Total Ind	56						
Method	% Dom	75%						
Backpack Shocking	Habitat	Species	% Ind					
Saris/Palis	FS	3	100%					
3314323	FD	0	0%					
	MG	0	0%					
	Tolerant	Species	% Ind					
	I	1	20%					
	M	0	0%					
	T	2	80%					
	SampleID	3247						
Common Name	Fish Code	Count	Min Length	Max Length	Temp	FG	PT	Function
Blacknose dace	BND	42	33	77	CW	FS	T	Generalist Feeder
Brook trout	EBT	11	52	104	C	FS	I	Top Carnivore

Creek chub	CRC	3	45	61	CW	FS	T	Generalist Feeder

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

UNT to East Branch North River (4) was sampled (Off Franklin Hill Rd 300ft upstream from GPS coordinates, Colrain (42.7183, 72.70441)) on 09/12/2012 (SampleID 4143), using the backpack shocking method. A total of 54 individuals were collected with 3 species represented. 1 cold water species were found including 15 trout less than or equal to 140 mm. The sample was composed of 100% fluvial specialists/dependents and 50% intolerant/moderately intolerant, while 50% were considered tolerant to pollution. (Data Source: 1)

Deerfield Fish Population Data from DFG Database (Data Source: 1)								
Station Description	UNT to East Branch North River (4) -- Off Franklin Hill Rd 300ft upstream from GPS coordinates, Colrain (42.7183, 72.70441)							
Habitat Comments	Low gradient, high levels of silt. Small pools. Fern & moss covered banks. Hemlock, alder, oak overstory. Went subsurface at starting point, disconnected from that point to EB North R. very shallow, most fish found in pools. Above top of reach, stream hea							
Efficiency	(Seconds Shocked - 340)							
Sample Date	Species	3						
09/12/12	Total Ind	54						
Method	% Dom	50%						
Backpack Shocking	Habitat	Species	% Ind					
Saris/Palis	FS	3	100%					
3314323	FD	0	0%					
	MG	0	0%					
	Tolerant	Species	% Ind					
	I	1	30%					
	M	1	20%					
	T	1	50%					
	SampleID	4143						
Common Name	Fish Code	Count	Min Length	Max Length	Temp	FG	PT	Function
Blacknose dace	BND	27	30	75	CW	FS	T	Generalist Feeder
Brook trout	EBT	16	50	151	C	FS	I	Top Carnivore
Longnose dace	LND	11	35	70	CW	FS	M	Benthic Insectivore

FS = Fluvial specialist, FD= Fluvial Dependent, MG= Macrohabitat Generalist, I= Intolerant, M= Moderately Intolerant, T= Tolerant, C= Coldwater, CW= Coolwater, WW= Warmwater

Fish Consumption **(Not assessed)**

Primary Contact Recreation **(Not assessed)**

Secondary Contact Recreation **(Not assessed)**

Aesthetic **(Not assessed)**

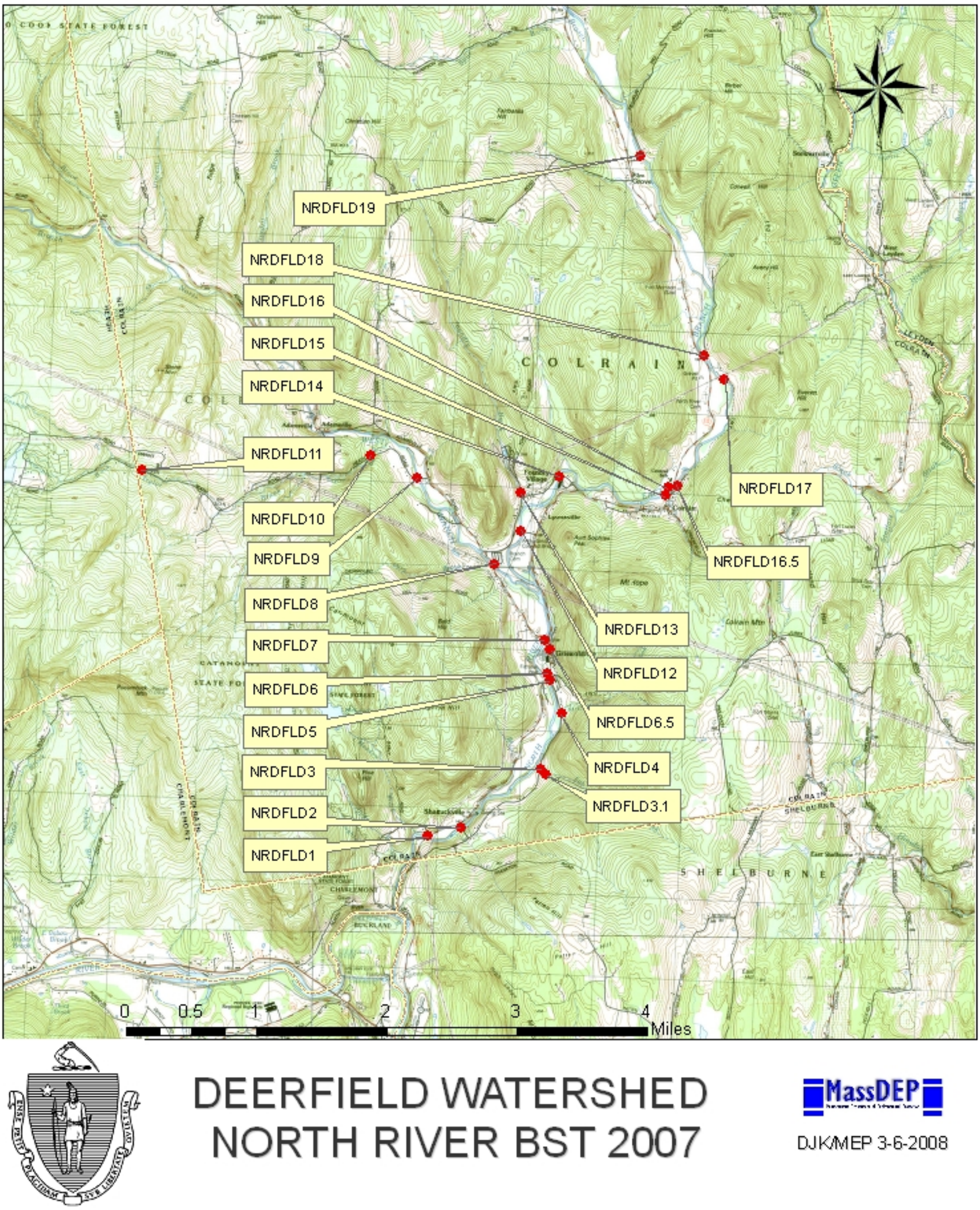
DATA SOURCES

1. MA DFG. 20013. Fish Population Database 1998-2013. Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife, Westborough, MA.
2. MassDEP. 2005. Open File. 2005 DWM Field Sheets for the Deerfield watershed. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA
3. MassDEP. 2007. *2005 Deerfield River Watershed Fish Population Assessment*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA
4. USGS. 2008. [Online]. National Water Information System: Web Interface. Data Retrieved December 2008. United States Geological Survey. Reston, VA. http://waterdata.usgs.gov/ma/nwis/.
5. MassDEP. 2008. *2008 Western Region Bacteria Source Tracking Project*. CN 327.5. Massachusetts Department of Environmental Protection, Division of Watershed Management, Western Region Office. Springfield, MA
6. MassDEP. 2007. *2007 Western Region Bacteria Source Tracking Project*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Western Region Office. Springfield, MA
7. MA DCR. 2005. [Online]. RIFLS online database. Massachusetts Department of Conservation and Recreation, Riverways Program, River Instream Flow Stewards (RIFLS). Boston, MA. http://www.rifls.org/
8. FRCOG. 2008. *Nonpoint Pollution Source Assessment for the Deerfield River Watershed*. Planning Department, Franklin Regional Council of Governments. Greenfield, MA
9. MA DPH. 2013. *Freshwater Fish Consumption Advisory List – August 2013.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.
10. DRWA. 2006. *Green River Watershed 2005 Macroinvertebrate Assessment.* Deerfield River Watershed Association. Shelburne Falls, MA.
11. DRWA. 2007. *South River Watershed 2006 Macroinvertebrate Assessment.* Deerfield River Watershed Association. Shelburne Falls, MA.
12. DRWA. 2008. *North River Watershed 2007 Macroinvertebrate Assessment.* Deerfield River Watershed Association. Shelburne Falls, MA.
13. DRWA. 2007. *FRCOG/DRWA Deerfield River Watershed, 2005/2006 Bacteria Monitoring*, 2006 Summary. Deerfield River Watershed Association. Shelburne Falls, MA.
14. Field, J. 2013. *Fluvial Geomorphic Assessment of the South River Watershed, MA*. Prepared for Franklin Regional Council of Governments. Field Geology Services, Farmington, ME.
15. MassDEP. Undated. *Scanned 305B Historical 303 WBS report coding sheet file information deerfield91_02_searchable.pdf*. Massachusetts Department of Environmental Protection, DWM, Worcester, MA.
16. MassDEP. 2007. *Baseline Lake Survey 2003 Technical Memo.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA
17. Duerring, C.L., L.E. Kennedy, and P. Mitchell. 2004. *Deerfield River Watershed 2000 Water Quality Assessment Report.* Report Number 33-AC-1, DWM Control Number CN087.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA
18. Normandeau. 2008. Monitoring of the Migration of Radio Tagged Adult Atlantic Salmon in the Deerfield River, 2007. Normandeau Associated, Inc. Westmoreland, NH.
19. MassDEP. 2014. *Open Files NPDES permittee whole effluent toxicity testing data stored in MassDEP ToxTD Database*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.
20. USACOE. 2007. *Final Report General Investigation Somerset and Searsburg Dams (Deerfield River Watershed) Greenfield, Massachusetts*. US Army Corps of Engineers New England District. Concord, MA.
21. Cole, M. (mikebcole@comcast.net) *Re: external data and 303(d) listing with DRWA_data_export_10-7-14 excel spreadsheet attachment*. 2014. Email to Laurie Kennedy at Massachusetts Department of Environmental Protection dated 7 October 2014.
22. MassDEP, Undated. *Report to the Senate and House of Representatives on water quality at beaches under the care and control of the Department of Conservation and Recreation*. MassDEP, Boston, MA. Available online @ http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/dcrbeachfin.pdf.

23. Cole, Michael, B. 2008. *Assessment of Benthic Macroinvertebrate Communities in Relation to Regulated Flow in the Deerfield River, Massachusetts*. ABR, Inc.—Environmental Research & Services. Greenfield, MA.
24. Cole, M.B. 2013. *2012 South River Fish Communities and Physical Habitat Assessment, Franklin County, Massachusetts*. Prepared for Franklin Regional Council of Governments. ABR, Inc. .—Environmental Research & Services. Greenfield, MA.
25. MassDEP. 2009. *Deerfield River Watershed 2005 Benthic Macroinvertebrate Assessment*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA
26. Cole, M. B. and FRCOG. 2014. *Final North River Fish Communities and Physical Habitat Assessment, Franklin County, Massachusetts*.
27. Fiorentino, J. 1997. Technical Memorandum TM-33-1 1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.
28. Meek, J. and K. O'Brien-Clayton. 2012. *Deerfield River Watershed 2005 DWM Water Quality Monitoring Data.* DWM Control Number CN 223.2. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.
29. MassDEP. Undated. *Open files DWM deployed thermistor data*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.
30. MassDEP. Undated. *Open files DWM deployed thermistor data analysis*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Appendix

WERO 2007 BST Sampling Locations



DEERFIELD WATERSHED
NORTH RIVER BST 2007

DJK/MEP 3-6-2008

Appendix E – Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.59
AGRICULTURE, HSG B	0.45	29.4	2.59
AGRICULTURE, HSG C	0.45	59.8	2.59
AGRICULTURE, HSG D	0.45	91.0	2.59
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.27
COMMERCIAL, HSG B	0.12	29.4	1.16
COMMERCIAL, HSG C	0.21	59.8	2.41
COMMERCIAL, HSG D	0.37	91.0	3.66
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.54
FOREST, HSG B	0.12	29.4	0.54
FOREST, HSG C	0.12	59.8	0.54
FOREST, HSG D	0.12	91.0	0.54
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.27
HIGHWAY, HSG B	0.12	29.4	1.16
HIGHWAY, HSG C	0.21	59.8	2.41
HIGHWAY, HSG D	0.37	91.0	3.66
HIGHWAY, IMPERVIOUS	1.34	1,480	10.2
INDUSTRIAL, HSG A	0.03	7.14	0.27
INDUSTRIAL, HSG B	0.12	29.4	1.16
INDUSTRIAL, HSG C	0.21	59.8	2.41

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
INDUSTRIAL, HSG D	0.37	91.0	3.66
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
LOW DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.12	7.14	0.27
OPEN LAND, HSG B	0.12	29.4	1.16
OPEN LAND, HSG C	0.12	59.8	2.41
OPEN LAND, HSG D	0.12	91.0	3.66
OPEN LAND, IMPERVIOUS	1.52	650	11.3

[1]HSG = Hydrologic Soil Group