



Housatonic Valley Association

Bacteria Monitoring in the Upper Housatonic Watershed 2021

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Introduction

HVA is the watershed organization for the Housatonic River watershed. The 2021 Bacteria Monitoring program was led by Alison Dixon, Berkshire Watershed Conservation Manager. The program focused on sites in the upper Housatonic Watershed including twenty-two sites in the following sub watersheds: East Branch (9 sites), West Branch (3), Green (7 sites), Williams (1 sites) and Konkapot Rivers (2 sites).

HVA's goal was to assess multiple sites throughout the watershed to monitor the recreational health of the rivers, add data to the state's dataset and to identify any unforeseen issues with the intent to follow up with further investigation to identify the source(s) of bacteria and, where possible, resolve the issues.

This project was funded by three different grants. The Berkshire Environmental Education Fund funded the Southern sites and West branch of the Housatonic River. The Central Berkshire Fund funded monitoring sites in the East Branch of Housatonic River watershed. All other expenses were funded by member donations.

Methods

HVA conducted its bacteria monitoring sampling under the 2019-2022 Bacteria Monitoring QAPP with a 2021 QAPP amendment. Previously established COVID protocols from the 2020 QAPP amendment were followed for the monitoring season. Sampling was conducted from June to September 2021 using eleven trained Water Quality Monitoring Volunteers and two HVA River Steward Interns. Four sites were sampled eight times while nine sites were sampled seven times, eight sites were sampled six times and one site was sampled five times. Due to high water levels and safety, on one sampling event only four sites were sampled.

In order to ensure a review of the field data sheet and sample collected, an intern, alongside the Field Coordinator reviewed the field data sheet to ensure it was completed fully and correctly, that the sample bottle was labeled correctly, that the temperature of the cooler registered 0 degrees Celsius, and temperature of the "Temp" sample bottle was at less than 4 degrees Celsius. This review was indicated on the field data sheet in the Chain of Custody section. When no one was available to check these sample collection aspects, the Berkshire Community College Chain of Custody serves as the sample validation.

All samples collected were immediately placed in wet ice in coolers that were at 0 degrees Celsius. When samples were transferred, they were buried in ice. All samples were delivered to the lab within the holding period of six hours. Volunteers were trained individually and shown their sampling sites. Their sampling method was reviewed again in the field. A record of their training is attached to this report.

The collected samples were kept on ice and transported to Berkshire Community College Lab in Lee, Massachusetts. Berkshire Community College used the Colilert Method 9223B to analyze each sample for *E. coli*. In accordance with this method, the results were provided in the format of Most Probable Number (MPN). See Appendix A for the Berkshire Community College Lab's Standard Operating Procedure. At each sample event, a field duplicate and field blank

were collected. The relative percent difference (RPD) of the field duplicate compared to the site’s results were calculated using the formula below:

$$ABS((LOG10(original) - LOG10(duplicate))/AVERAGE(LOG10(original), LOG10(duplicate)))*100$$

In accordance with the QAPP, the results of the calculated RPD were analyzed with respect to the following table which outlined the required field precision.

Parameter	Reporting Limit	Accuracy (% Recovery)	Field Precision (RPD %)	Expected Range
<i>E. coli</i>	1 MPN/100ml	Blanks and negatives show no colonies; positives show colonies	For log10 transformed field duplicate data: <30%RPD (<50 MPN/100mls) <20% (51-500 MPN) <10 %RPD (501-2420 MPN)	0 – 2419.6 MPN/100ml

The precipitation data was collected from one website <https://forecast.weather.gov/data/obhistory/KPSF.html>.

Regarding data management, all data entered were checked for accuracy and, if any errors were noted and corrected these corrections were reviewed for accuracy once more.

Sample Sites

The following twenty-two sites were sampled in 2021. Appendix B includes the full photo record and notes for the 2021 sampling sites which is part of the QAPP 2021 Amendment.

Table 1: HVA’s 2020 Bacteria Monitoring Sampling Sites in the Upper Housatonic Watershed

Site ID	Waterbody	Description	Town	Latitude	Longitude
GNR400	Green River	Upstream of the Rte. 23/41 bridge	Great Barrington	42.179629	-73.3793878
ALF 90	Alford Brook	Downstream of Willson Road Bridge	West Stockbridge	42.297736	-73.408268
ALF100	Alford Brook	Upstream of the East Road Bridge SITE ADDED (replacing WMR400)	Alford	42.23842	-73.41156
KPT500	Konkapot River	Downstream of the River Road bridge	New Marlborough	42.1586198	-73.26275
KPT600	Konkapot River	Downstream of Canaan-Southfield Road bridge	New Marlborough	42.066444	-73.28401
CNB300	Cone Brook	Downstream of Swamp Road crossing	Richmond	42.35853999	-73.3540
CNB400	Cone Brook	Upstream of Cone Hill Road Bridge	West Stockbridge	42.3481454	-73.36529
HBB200	Hubbard Brook	Main St., behind Mom's Café	Egremont	42.16043	-73.41811
HBB500	Hubbard Brook	Downstream of Sheffield-Egremont Road Bridge	Great Barrington	42.149555	-73.391032
EAB200	East Branch of the Housatonic River	Downstream of the Old Windsor Road	Dalton	42.473696	-73.14121
EAB210	East Branch of the Housatonic River	Just before the confluence with Center Pond, end of Riverview Drive- access the river by the stormwater	Dalton	42.47639147	-73.154868
EAB220	East Branch of the Housatonic River	Upstream of Rte. 8/Main Street bridge, Center Pond Outlet	Dalton	42.474297	-73.1566588
EAB280	East Branch of the Housatonic River	Upstream of West Housatonic Street Bridge	Dalton	42.471374	-73.1686657

Table 1 (continued): HVA’s 2020 Bacteria Monitoring Sampling Sites in the Upper Housatonic Watershed

Site ID	Waterbody	Description	Town	Latitude	Longitude
EAB500	East Branch of Housatonic River	Upstream of the Elm Street Bridge	Pittsfield	42.44511812	-73.24405254
BBK200	Barton Brook	Downstream of Sleepy Hollow Drive Bridge	Dalton	42.46045971	-73.17678075
BBK400	Barton Brook	Upstream of the Hubbard Avenue Bridge	Dalton	42.462041	-73.1886675
WFB200	Wahconah Falls Brook	Upstream of the first Route 9 Bridge(upstream of former WFB01.2)	Dalton	42.487321	-73.13180217
WFB300	Wahconah Falls Brook	Upstream of the Route 9 Bridge (formerly WFB01.2)	Dalton	42.4843668	-73.14845314
WLK400	Walker Brook	Downstream of where brook daylights	Dalton	42.47282302	-73.16461538
WEB300	West Branch	Upstream of Linden Street Bridge	Pittsfield	42.45694	-73.26076
LLB200	Lilly Brook	Upstream of the Westbrook Terrace Bridge	Pittsfield	42.4512801	-73.32829566
JCB300	Jacoby Brook	Downstream of the railroad bridge	Pittsfield	42.4401347	-73.3059433

Results

Table 2: Housatonic Watershed Bacteria Results 2020: East Branch Watershed

(Sample collection and analysis times are available in Appendix D and F)

Site ID	Waterbody	June 3 *(MPN)	June 17 *(MPN)	July 1 *(MPN)	July 22 *(MPN)	July 29 *(MPN)	Aug 11 *(MPN)	Sept 1 *(MPN)	Sept 23 *(MPN)	**Geo Mean
EAB200	East Branch	48.8	206.4	>2419.6	88.4	95.9	161.6	488.4	107.6	161.71
EAB210	East Branch	95.9	249.5	1986.3	Water levels high	121.1	344.8	488.4	228.2	300.48
EAB220	East Branch	98.5	360.9	>2419.6	139.6	115.3	579.4	387.3	162.4	214.44
EAB280	East Branch	95.9	204.6	>2419.6	Water levels high	146.7	275.5	461.1	113	185.93
EAB500	East Branch	228.2	238.2	2419.6	Water levels high	248.1	307.6	1046.2	122.4	386.37
BBK200	Barton Brook	24.9	16	106.7	Water levels high	48	NS	93.3	5.2	31.57
BBK400	Barton Brook	125.9	dry	866.4	Water levels high	83.3	NS	138.6	29.8	130.28

WFB200	Wahconah Falls Brook	12.1	32.3	156.5	Water levels high	NS	224.7	51.2	387.3	80.52
WFB300	Wahconah Falls Brook	22.6	73.8	224.7	Water levels high	NS	88	90.8	117.8	84.06
WLK400	Walker Brook	>2419.6	579.4	>2419.6	101.2	1203.3	1553.1	2419.6	193.5	609.57

Table 3: Housatonic Watershed Bacteria Results 2020: East Branch Watershed

(Sample collection and analysis times are available in Appendix D and F)

Site ID	Waterbody	June 3 (*MPN)	June 17 (*MPN)	July 1 (*MPN)	July 22 (*MPN)	July 29 (*MPN)	Aug 11 (*MPN)	Sept 1 (*MPN)	Sept 16 (*MPN)	**Geo Mean
WEB300	West Branch	79.4	79.4	344.8	613.1	NS	113.7	108.1	190.4	146.43
LLB200	Lilly Brook	13.2	13.2	8.6	6.3	NS	30.9	56.3	147	36.75
JCB300	Jacoby Brook	461.1	461.1	488.4	461.1	517.2	344.8	161.6	2419.6	494.6

Table 4: Housatonic Watershed Bacteria Results 2021: Williams, Green, and Konkapot River Watersheds

(Sample collection and analysis times are available in Appendix D and F)

Site ID	Waterbody	Town	June 3 (*MPN)	June 17 (*MPN)	July 1 (*MPN)	July 22 (*MPN)	July 29 (*MPN)	Aug 11 (*MPN)	Sept 16 (*MPN)	**Geo Mean
GNR400	Green River	Great Barrington	90.9	105.0	2419.6	NS	71.7	67.0	NS	161.8
*ALF 90	Alford Brook	West Stockbridge	88.6	60.2	547.5	60.2	64.6	238.2	410.6	141.0
*ALF100	Alford Brook	Alford	38.9	920.8	816.4	54.6	73.8	44.8	461.1	157.8
KPT500	Konkapot River	New Marlborough	39.3	63.7	307.6	NS	151.5	78.9	517.2	129.7
KPT600	Konkapot River	New Marlborough	76.3	261.3	387.3	NS	143.0	48.7	461.1	170.8
CNB300	Cone Brook	Richmond	9.8	37.3	307.6	37.9	69.1	35.0	325.5	61.6
CNB400	Cone Brook	West Stockbridge	461.1	275.5	488.4	70.8	90.9	325.5	365.4	241.2
HBB200	Hubbard Brook	Egremont	46.4	39.5	143.9	NS	68.3	24.1	275.5	70.2
HBB500	Hubbard Brook	Great Barrington	60.2	172.3	920.8	NS	146.7	275.5	866.4	263.5

*MPN = Most probable number

** NS= not sampled

***The Geo Mean column provides the calculated geometric mean of all the samples collected at that site. In accordance with Massachusetts Water Quality Standards for *E. coli*, the geometric mean of at least 5 samples taken in 6 months shall not exceed 126 colonies per 100ml. Also no one sample should exceed 410 MPN in a 90 day period (Table 4). Any numbers in red denotes where results do not meet these state standards.

***Dates highlighted in blue are sampling events which occurred after a rainfall of greater than 0.1 inches within 72 hours of sampling. (Complete precipitation information is available in Table 7 on page 10.) *E. coli* results above the Massachusetts State’s standards were observed at many sampling sites primarily after a precipitation event greater than 0.1 inches and occurring within 72 hours prior to sampling. On July 1, 2021, almost all sampling sites were extremely elevated after heavy rainfall of almost 1.25 inches occurred 24 hours prior to sampling and 2.44 inches occurred 72 hours prior to sampling.

Please refer to the following Appendices for raw data and tabulation of the results:

- Appendix C provides a complete spreadsheet of the results in the Mass DEP format
- Appendix D provides a list of sampled sites with sampling date together with the Field Data Sheets, and BCC Chain of Custody form for each sampling event in chronological order.
- Appendix F provides the BCC results.

Table 5. Bacterial Indicator Criteria for Inland Waters from <https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards#current-regulations>

Bacterial Indicator	Bacterial Criteria for Inland Waters (cfu/100mL)	
	* Geometric Mean	* Statistical Threshold Value
<i>E. coli</i>	≤126	≤410
*The geometric mean for at least one indicator shall not be exceeded in any 90-day or smaller interval. No more than 10% of all samples collected within that interval shall exceed the statistical threshold value for the indicator.		

Table 6. Summary of Tributaries that meet State Standards

Waterbody	# of Sites Sampled	Notes MPN = Most Probable Number of bacteria colonies
East Branch of Housatonic River	5	Failed to meet the state standards at all five sites. One sampling event, conducted after 2.44 inches of rainfall had very high E coli results: 4/5 sites registered 2419MPN with the fifth site >1900MPN.
Barton Brook	2	Met state standards for one site while the other site did not as a result of one sampling event >800MPN.
Walker Brook	1	Failed to meet the state standards. 6/8 sampling events were >410MPN
Wahconah Falls Brook	2	Both sites met state standards. The Geo Mean for both sites was <85MPN.
West Branch of Housatonic River	1	Only one site was sampled and with one result >410 failed to meet state standards.
Lilly Brook	1	Met state standards with 5/7 sampling events <50MPN.
Jacoby Brook	1	Failed to meet state standards with 6/8 sampling events >410MPN and 1/8 at the upper limit of 2419MPN after a significant rainfall.
Alford Brook	2	Both sites failed to meet state standards. 3/7 sampling events failed at one site while 2/7 sampling events failed at the other site.
Green River	1	Failed to meet state standards. One sampling event was at the upper limit of 2419MPN after a significant rainfall.
Cone Brook	2	One site met state standards with all sampling events <70MPN. The downstream site failed to meet state standards with 2/7 sampling events >410MPN.
Konkapot River	2	One site failed to meet state standards and had 1/6 sampling events >410MPN. The other site was close to the limit for failing geometric mean standards and had one failed sampling event.
Hubbard Brook	2	The upstream site met state standards with a geometric mean of <61MPN. The downstream site failed to meet state standards with 2/6 sampling events >410MPN.

Precipitation data from the National Oceanic and Atmospheric Administrations was obtained from one website (see methods) and recorded at 24, 48, and 72 hours before the sampling dates (Table 5). See Figure 1 for 24 hour precipitation totals and Figure 2 for 48 and 72 hour precipitation totals.

Table 7. Total precipitation amounts for 24, 48, 72 hours prior to sampling.

Sampling Date	24 hours	48 hours	72 hours
6/3/2021	0.08	0.08	0.13
6/17/2021	0	0.03	0.16
7/1/2021	1.25	2.44	2.44
7/22/2021	0.21	0.27	0.27
7/29/2021	0	1.52	1.52
*8/11/2021	<0.01	<0.01	<0.01
8/12/2021	0	0	0
8/26/2021	0	0.79	1.55
9/1/2021	0	0.83	0.83
9/16/2021	0	0.45	0.45
9/23/2021	0	0.11	0.11

*Indicates a trace amount of rainfall according to recorded data from the National Oceanic and Atmospheric Administrations. Note: Lab results on 8/26/2021 were erroneous and were discarded.

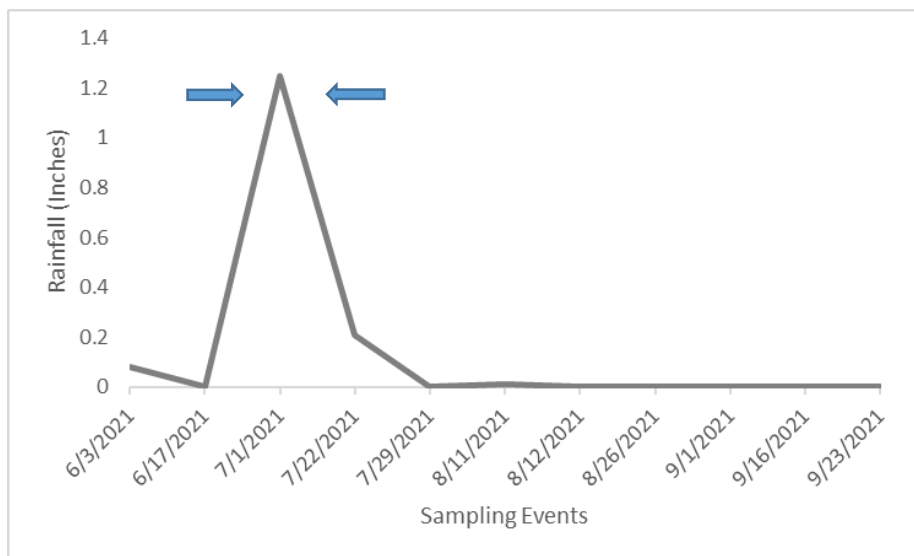


Figure 1. Precipitation totals in a 24-hour period prior to sampling dates as was recorded by the National Oceanic and Atmospheric Administrations. Data found in the table are the sampling dates.

Note: Lab results on 8/26/2021 were erroneous and were discarded.

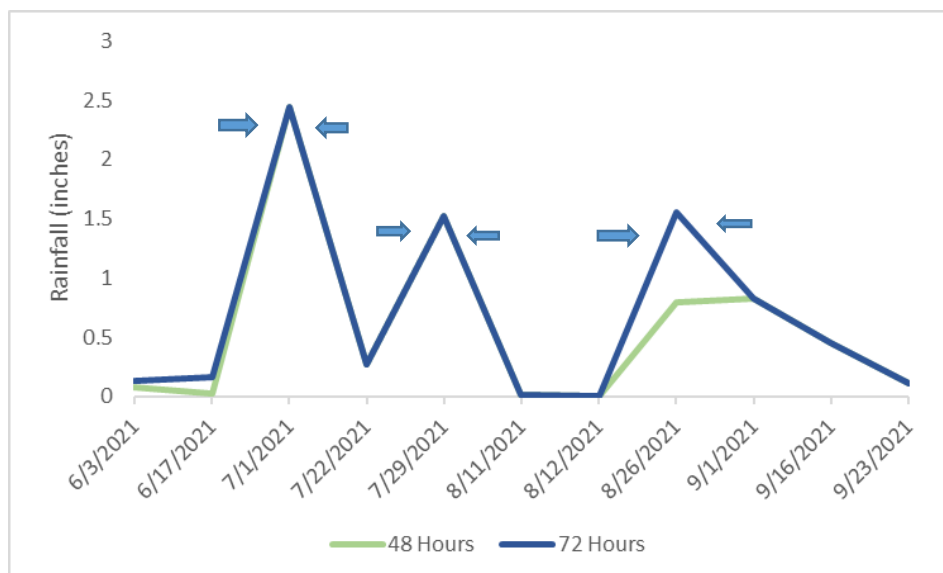


Figure 2. Precipitation totals for 48-hour and 72-hour periods prior to sampling dates as recorded by the National Oceanic and Atmospheric Administrations. Data found in the table are sampling dates. Lab results on 8/26/2021 were erroneous and were discarded.

Prior to the sampling dates of July 1 and July 29 over an inch and half of precipitation was recorded at 48 and 72 hours prior to sampling and likely impacted the sampling results. Over an inch of rain was recorded August 26, but the lab results were discarded. In the 24-hour period prior to sampling on July 1, over an inch of rain was recorded. These significant sampling dates are indicated by the blue arrows.

During the 2021 season, HVA's 2021 QAPP (2019 – 2022 QAPP with 2021 amendments) was followed. The 2021 amendments updated the sampling sites to include an extra site upstream from Center Pond on the East Branch of the Housatonic River. One proposed site, located in the Southwest Branch of the Housatonic River, May Brook was not sampled due to the lack of funding.

The key HVA personnel contact (information below), Alison Dixon, oversaw the project and database management for HVA's 2021 season:

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At each sampling event one field duplicate and one field blank were completed and delivered to the lab with the samples. Distilled water was used for the field blanks, the results of which were all <1 MPN and met the data quality requirements outlined in the QAPP.

Table 8: Field Blank Results

Sample ID	Sample Type	Sample Date	Sample Time	<i>E. coli</i> (MPN)
CNB301060321	Field blank	6/3/2021	7:59 a.m.	<1
BBK401060321	Field blank	6/3/2021	8:45 a.m.	<1
HBB201061721	Field blank	6/17/2021	7:45 a.m.	<1
EAB201061721	Field blank	6/17/2021	8:05 a.m.	<1
KPT601070121	Field blank	7/1/2021	8:06 a.m.	<1
LLB201070121	Field blank	7/1/2021	9:30 a.m.	<1
JCB302072221	Field blank	7/22/2021	9:31 a.m.	<1
ALF101072221	Field blank	7/22/2021	9:40 a.m.	<1
ALF101072921	Field blank	7/29/2021	8:45 a.m.	<1
BBK201072921	Field blank	7/29/2021	8:45 a.m.	<1
GNR401081121	Field blank	8/11/2021	8:11 a.m.	<1
WFB201081221	Field blank	8/12/2021	7:45 a.m.	<1
WFB301090121	Field blank	9/1/2021	8:21 a.m.	<1
CNB301091621	Field blank	9/16/2021	10:02 a.m.	<1
EAB221092321	Field blank	9/23/2021	7:54 a.m.	<1

Table 9: Field Duplicate Results and %RPD calculations

Sample ID	Sample Type	QC Match	Sample Date	<i>E. coli</i> (MPN)
ALF90060321	Sample	ALF92060321	6/3/2020	88.6
ALF92060321	Field Duplicate	ALF90060321	6/3/2020	65.7
RPD				6.9
BBK200060321	Sample	BBK202060321	6/3/2021	24.9
BBK202060321	Field Duplicate	BBK200060321	6/3/2021	18.9
RPD				8.96
KPT500061721	Sample	KPT502061721	6/17/2021	63.7
KPT502061721	Field Duplicate	KPT500061721	6/17/2021	67.7
RPD				1.46
EAB280061721	Sample	EAB282061721	6/17/2021	204.6
EAB282061721	Field Duplicate	EAB280061721	6/17/2021	204.6
RPD				0
CNB400070121	Sample	CNB402070121	7/1/2021	488.4
CNB402070121	Field Duplicate	CNB400070121	7/1/2021	648.8
RPD				4.48
WFB300070121	Sample	WFB302070121	7/1/2021	224.7

Table 9: Field Duplicate Results and %RPD calculation continued below

Sample ID	Sample Type	QC Match	Sample Date	<i>E. coli</i> (MPN)
WFB302070121	Field Duplicate	WFB300070121	7/1/2021	185
RPD				3.66
JCB300072221	Sample	JCB302072221	7/22/2021	517.2
JCB302072221	Field Duplicate	JCB300072221	7/22/2021	547.5
RPD				0.91
HBB200072921	Sample	HBB202072921	7/29/2021	90.8
HBB202072921	Field Duplicate	HBB200072921	7/29/2021	68.3
RPD				6.52
LLB200072921	Sample	LLB201072921	7/29/2021	30.9
LLB201072921	Field Duplicate	LLB200072921	7/29/2021	32.7
RPD				1.64
CNB300081121	Sample	CNB302081121	8/11/2021	35
CNB302081121	Field Duplicate	CNB300081121	8/11/2021	29.5
RPD				4.93
EAB210081221	Sample	EAB212081221	8/12/2021	344.8
EAB212081221	Field Duplicate	EAB210081221	8/12/2021	290.9
RPD				2.95
JCB300090121	Sample	JCB302090121	9/1/2021	2419.6
JCB302090121	Field Duplicate	JCB300090121	9/1/2021	2419.6
RPD				0
HBB500091621	Sample	HBB502091621	9/16/2021	866.4
HBB502091621	Field Duplicate	HBB500091621	9/16/2021	1046.2
RPD				2.75
EAB210092321	Sample	EAB210092321	9/23/2021	228.2
EAB210092321	Field Duplicate	EAB210092321	9/23/2021	167
RPD				5.92
0213-09	Sample	0213-10	9/10/2020	82
0213-10	Field Duplicate	0213-09	9/10/2020	93.3
RPD				2.9

The % RPD was calculated for all the sampling events using the results from the original and field duplicate samples . For each event, the %RPD was less than 10% and well within the field precision parameters. For two of the sampling events , the %RPD calculated was 0 as the results for the sample and duplicate were identical. However, the volunteer’s collection method was reviewed to ensure that their method was in accordance with the QAPP.

Regarding data management, following each sampling event, data was entered into an excel spreadsheet in the DEP format and an alternative format for sharing with stakeholders. Data was

checked for accuracy and, if any errors were noted, they were corrected. Corrections were reviewed for accuracy once more. The data was found to be complete and met the data quality objectives. No results were flagged.

Discussion

East Branch of the Housatonic River Watershed:

Ten sites within the East Branch of the Housatonic River watershed were sampled on eight separate dates. Five sites were located along the East Branch of the Housatonic River. In addition, tributaries of the East Branch were sampled including Barton, Walker, and Wahconah Falls Brook located in Dalton.

The state has designated the East Branch of the Housatonic River as a Category 5 water that is impaired for the segment of the East Branch from the outlet of Center Pond to the confluence with the West Branch in Pittsfield. One of the impairments is due to bacteria. While the geometric mean of all the sampling results indicated that the East Branch sites within this impaired segment (EAB 280 and EAB 300) did not meet standards, the results were generally only above state standards when a significant precipitation event occurred prior to sampling. The sample site EAB 220 located above the outlet in Center Pond and above the impaired segment did not meet state standards for two of the sampling events with the results >410MPN. The results of the site further upstream on the East Branch, and not in the impaired segment (EAB200 and EAB210) located at Old Windsor Road bridge also appear to be impacted primarily by precipitation events and did not meet state standards.

Polluted stormwater runoff is often bacteria laden and will result in higher *E. coli* readings in urban or semi-urban areas. Upstream of the sampling site on Center Pond are numerous residencies, including apartment buildings that border the northern edge of the pond. Further investigation to determine potential sources such as a leaking sewer pipe is advisable.

The highest *E. coli* readings at all of the sampling sites in the East Branch watershed occurred following the most significant rain event in the entire sampling season. In the 72 hours prior to sampling on July 1, 2.44 inches of rain were recorded at the Pittsfield Airport weather station. Four of the five East Branch sampling sites had results of >2419.6 MPN. Stormwater runoff is the most likely reason for the increased readings across all of the sampling sites. Barton and Wahconah Falls Brook on July 1, ranged from 106.7-866.4 MPN. Walker Brook failed to meet state standards at almost all sampling events including July 1. For Walker Brook, the amount of precipitation does not appear to be the only reason for elevated *E. coli* results and further investigation is required. As this is a buried stream, locating the source(s) will be challenging. Illicit connections are suspected.

Southwest and West Branch of the Housatonic River:

Two sites, Lilly Brook and Jacoby Brook were sampled in the Southwest Branch of the Housatonic River. Lilly Brook consistently throughout the sampling events had low *E. coli* results with the greatest on September 16, 2021 <150 MPN. It seems that regardless of the amount of precipitation, Lilly Brook is not impacted. However, Jacoby Brook is the complete opposite in that the six of the eight sampling events, it failed with >410 MPN and the highest recorded on September 16 at the max of 2419 MPN. At the time of sampling, in the 48 hours before 0.45 inches of rain was recorded by the National Oceanic and Atmospheric Administration.

One site was sampled in the West Branch of the Housatonic River and failed to meet state standards with the Geo Mean >126. It was due to one sampling event on July 22 that the bacteria was recorded at 613.4 MPN. However, in the 24 hours prior to sampling, 0.21 inches of rain had fallen.

Williams, Green, Housatonic and Konkapot Rivers:

Similarly, in the Green, Williams, Housatonic and Konkapot Rivers the higher bacteria levels were observed following significant precipitation events. The highest *E. coli* readings were recorded on July 1, after a significant rainfall of 2.44 inches, 72 hours prior to sampling for half of the sites sampled that day. Both sites at Alford Brook failed with three of the eight sampling events >410 MPN. The site in the Green River failed on July 1, with bacteria levels at the upper limit of 2419 MPN. In both Cone Brook and Hubbard Brook sampling sites, one site failed to meet state standards. Both sites failed on July 1 after the significant rainfall. Cone Brook had failed on June 3 after >0.1 inches of rain occurred 72 hours prior to sampling.

Conclusion

East Branch of the Housatonic Watershed - Areas for further investigation or monitoring include:

- For the most part, if the influx to the East Branch of polluted stormwater runoff could be reduced and any bacteria sources at Center Pond (and upstream of Center Pond) were identified and resolved, the upper section of the impaired East Branch (Center Pond Outlet) could possibly meet state standards and be considered for delisting from the impaired list. Locating sites appropriate for the installation of green infrastructure to absorb the stormwater runoff would be beneficial, especially in Dalton.
- Sampling sites located above Center Pond should continue to be monitored as the bacterial counts were high after significant rainfall events.
- Walker Brook- Most of the sampling events failed to meet state standards with the consecutively highest bacterial readings out of the sampling sites. This bacteria input is contributing to the impairment of the East Branch. This is a buried stream. Further investigation is needed to determine these elevated counts regardless of the amount of precipitation.

Williams River Watershed- Areas for further investigation include:

- Cone Brook- One sampling site met state standards while the other failed in two of the seven sampling events which both had a significant rainfall recorded prior to sampling. The site that failed was located downstream of active agricultural land. Continue to monitor the sites and coordinate with the farmers to review agricultural management practices and alter practices to reduce agricultural NPS runoff.

Green River Watershed - Areas for further investigation include:

- Alford Brook –Continued to have elevated bacterial counts on three out of eight sampling events mostly occurring after precipitation events. There is the possibility that agricultural

nonpoint source (NPS) pollution may be elevating the bacteria in the brook as several farms border the brook upstream of this sample site. Outreach to the farms, in partnership with NRCS, Berkshire Conservation District, and town officials, is recommended to determine willingness of the farmers to review farm management practices and, if possible alter practices to reduce agricultural NPS runoff.

- Green River - The only site sampled in 2021 is a site just upstream of a recreational swimming hole. This site had one result of 2419 MPN, but the other results were well within the standards. The Town of Great Barrington sampled this site regularly in 2021 because of elevated *E coli* results in 2020. HVA will continue to monitor especially after significant rainfall.

Other tributaries

- Hubbard Brook- One site met state standards while the other failed on July 1 and September 16 which both sampling events had significant rainfall recorded. KPT 600 was the sampling site that failed to meet state standards which is located downstream from agricultural activity. Continue to monitor and recommend to the farmers to review and alter farm management practices that could reduce agricultural NPS runoff.

Konkapot River Watershed

- Two sites were sampled in the Konkapot River both sites failed to meet state standards as both sites had a sampling event fail on September 16th after 0.21 inches of rain had fallen in 24 hours prior to sampling. The geometric mean of one of the sites did meet state standards. This is a rural river that flows past several residences. It is probable that the higher results are a result of stormwater runoff from the roads and could also be the result of leaching septic systems from residential properties upstream of the site. Continued sampling at this site and other sites on the Konkapot River will be considered for 2022.