Massachusetts Department of ENVIRONMENTAL PROTECTION

2019 DWM ENVIRONMENTAL MONITORING OVERVIEW

(CN 518.0)

A brief overview of the surface water monitoring performed in 2019 by personnel of the MassDEP's Division of Watershed Management (DWM) is presented here. Information pertaining to the individual components of DWM's Surface Water Monitoring Program is presented at http://www.mass.gov/eea/agencies/massdep/water/watersheds/water-quality-monitoring-program.html#1.

The main programmatic objectives of the DWM related to surface water quality monitoring are to:

- Collect chemical, physical and biological data to assess the degree to which designated uses, such as aquatic life, primary and secondary contact recreation, fish consumption and aesthetics, are supported in the waters of the Commonwealth;
- Collect chemical, physical and biological data to support analysis and development of TMDLs and implementation plans to reduce pollutant loads to waters of the Commonwealth;
- Screen fish in selected waterbodies for fish tissue contaminants (metals, PCBs and organochlorine pesticides) to provide for public health risk assessment;
- To the extent feasible, locate pollution sources and promote and facilitate timely correction;
- Identify and assess new and emerging water contaminants of concern;
- Collect water quality data to enable the determination of trends in parameter concentrations and/or loads;
- Collect data to support the establishment or revision of water quality standards and policies; and to
- Measure the effectiveness of water quality management projects or programs such as the effectiveness of implementing TMDLs or watershed-based plans.

Quality assurance is maintained for DWM's watershed monitoring program to ensure implementation of an effective and efficient sampling design, to meet programmatic goals and to provide data meeting specific data quality objectives. The U.S. Environmental Protection Agency (USEPA) has approved a comprehensive Quality Assurance Program Plan (QAPP) that applies to the generation and use of surface water quality data by DWM for a five-year period (2015 – 2019). This five-year *program* QAPP is annually supplemented by project-specific Sampling and Analysis Plans (SAPs), which provide detailed information regarding individual *project* organization, tasks, background, sampling design and non-direct measurements. More information pertaining to the

DWM's Quality Management Program and the 2015 – 2019 QAPP can be found on-line at http://www.mass.gov/eea/agencies/massdep/water/watersheds/environmental-monitoring-quality-management-program.html.

In accordance with the DWM's long-range monitoring strategy, the 2019 monitoring program consisted of the ongoing implementation of both probabilistic (random) and deterministic (targeted) sampling networks designed to support the multiple objectives listed above. Probabilistic sampling designs provide statistically valid estimates of the use support status of 100% of the waters in a target population (e.g., shallow streams, lakes, etc.) with data and information collected from a random sample of those waters. Beginning in 2011 the DWM carried out a five-year probabilistic survey of shallow streams and then applied a similar sampling design to lakes and ponds from 2016 – 2018. In 2019 the DWM did not perform any probabilistic monitoring in the field. Instead, efforts were focused on designing and planning a statistically-valid sampling network for coastal waters to be piloted in 2020 and carried out in 2021-2023. Furthermore, this Massachusetts Coastal Condition Assessment (MCCA) is to be administered through a partnership with the MassBays Program who will secure contractual services to perform the field sampling and laboratory analyses each year.

With the interruption of probabilistic monitoring, the DWM was able to focus more field and laboratory resources in 2019 on watershed-based targeted assessment monitoring as it had done on a rotating watershed schedule back in 2005 – 2009. As such, the DWM performed monitoring activities in the Connecticut and Taunton watersheds. DWM monitoring coordinators reviewed historical data and information, examined GIS data layers, reviewed NPDES and water withdrawal permits, conducted reconnaissance and formulated individual watershed SAP's. While some of the monitoring was targeted at specific issues of concern, most of the monitoring in the Connecticut and Taunton watersheds was aimed at providing the necessary data and information to assess the extent to which water bodies are supporting their intended uses, as designated in the Massachusetts Surface Water Quality Standards. This information supports individual watershed assessments, which, in turn, inform the Massachusetts Integrated List of Waters submitted to the EPA in fulfillment of sections 305b (Summary of Water Quality) and 303d (List of Impaired Waters) of the Clean Water Act (CWA).

A number of targeted monitoring projects were carried out to meet multiple water quality assessment and management objectives. For example, monitoring efforts were resumed at selected sites in DWM's reference site network (RSN) and continued at the five northeast Regional Monitoring Network (RMN) sites located in Massachusetts. Monitoring projects were also carried out to support the development of TMDLs and to measure the effectiveness of TMDL implementation. Fish sampling was performed to obtain the data and information needed to inform risk assessment and management activities pertaining to fish edibility. Long-term monitoring continued in Mount Hope Bay and the Taunton and Connecticut watersheds. Monitoring activities aimed at assessing cold-water fishery resources and to measure the impacts of road salt application on surface waters were also carried out. These, as well as other monitoring activities performed in 2019, are described in more detail below.

Reference Site Network (RSN): The RSN was established in 2011 to characterize the reference condition for Massachusetts' rivers and streams to support multiple program objectives including, but not limited to, the interpretation of biological data obtained from the probabilistic monitoring stream network as well as the development of biocriteria and nutrient criteria. Least-disturbed reference sites were selected from the two most prominent Level III ecoregions (Northeastern Highlands, Northeastern Coastal Plain) in Massachusetts through the

application of a Human Disturbance Index that was derived from six individual streamflow and landscape disturbance indicators. A total of ten (10) sites were chosen for intensive study, beginning in 2011. New sites were added to the network in subsequent years until, in 2015, a total of 27 sites were sampled. Staffing constraints and other monitoring priorities limited the number of RSN sites sampled in 2017 to 12 and no sampling was carried out in 2018. Renewed focus on the development of biocriteria and the need for more reference-site data led to the resumption of RSN monitoring in 2019. A total of 35 sites were sampled (Table 1). Monitoring activities included habitat assessment; macroinvertebrate and fish population assessments; and physicochemical sampling. A list of the water quality and ecological variables measured at each site, along with their sampling frequencies, is presented in Table 2. More detail pertaining to each component of the RSN is presented below.

Table 1. Location of selected "reference/least disturbed" sites that were sampled in 2019 as part of the reference site network

Site	Watershed	Waterbody	Site Description
AA01	South Coastal	Aaron River	[approximately 700 feet downstream of confluence of tributary from Bound Brook Pond, Hingham (in the Wompatuck State Park upstream of the inlet of Aaron River Reservoir)]
AH02	Bashbish	Ashley Hill Brook	[northwest of Roads End Road (Whitbeck Road) approximately 250 feet downstream of Lee Pond Brook confluence, Mount Washington]
AM01[b]	Connecticut	Amethyst Brook	[approximately 150 feet upstream of the North Valley Road crossing nearest Amherst Road intersection, Pelham]
BB01[b]	Ipswich	Unnamed Tributary	[unnamed tributary to the Pritchards Pond impoundment of Boston Brook, approximately 50 feet from confluence with northern lobe of pond, Middleton]
BH01	Bashbish	Bashbish Brook	[south of Falls Road, approximately 200 feet upstream of the confluence of Wright Brook, Mount Washington]
BK02	Blackstone	Unnamed Tributary	[unnamed tributary to Whitin Reservoir, "Ridge Trail" in the Douglas State Forest, Douglas]
BNB01	Quinebaug	Breakneck Brook	[approximately 8450 feet downstream/north from MA/CT state line, Sturbridge]
CN01	Chicopee	Canesto Brook	[approximately 975 feet north/upstream of Hubbardston Road (Route 62), Barre]
DL01[b]	Connecticut	Doolittle Brook	[approximately 1500 feet south/downstream of Shutesbury Road, Leverett]
DU01	Deerfield	Dunbar Brook	[west of River Road, approximately 1400 feet upstream from the Dunbar Brook Dam (MA00222), Florida]
EBT01	Millers	East Branch Tully River	[approximately 2000 feet upstream from Route 68 (Warwick Road), Royalston]
EM02	Blackstone	Scadden Brook	[approximately 300 feet upstream of mouth at inlet of Lee Pond, Uxbridge]
FHB02[a]	South Coastal	First Herring Brook	[west of Route 3A, approximately 825 feet upstream from mouth at inlet of Tack Factory Pond, Scituate]
GB01	Chicopee	Great Brook	[Draper Road, East Brookfield]

Table 1. Location of selected "reference/least disturbed" sites that were sampled in 2019 as part of the reference site network

Site	Watershed	Waterbody	Site Description
GR01[b]	Ipswich	Gravelly Brook	[approximately 200 feet upstream/north of Topsfield Road, Ipswich]
HBD01	Farmington	Brook Hubbard	[west of Hartland Hollow Road, approximately 75 feet upstream of confluence with Pond Brook, Granville]
KY01	Millers	Keyup Brook	[approximately 500 feet upstream/north of Laurel Lake Road, Erving]
MP01	Nashua	Mulpus Brook	[approximately 2900 feet downstream/east of Holman Street, Lunenburg]
MS02	Nashua	Mason Brook	[approximately 80 feet upstream/north of Brooks Crossing, Townsend]
PDB01	Farmington	Pond Brook	[west of Hartland Hollow Road, approximately 75 feet upstream of mouth at confluence with Hubbard Brook, Granville]
PHB01	Nashua	Pearl Hill Brook	[approximately 2775 feet downstream/north from Vinton Pond Road, Townsend]
RA00[b]	Taunton	Rattlesnake Brook	[approximately 1300 feet upstream/east from Route 24/79 (Amvets Memorial Highway), Freetown]
RB02	Quinebaug	Rocky Brook	[in Douglas State Forest approximately 2400 feet downstream of footbridge on unnamed easterly extention of High Street, Douglas]
RBR02[b]	Connecticut	Roaring Brook	[approximately 250 feet downstream from the Shutesbury Road crossing nearest the Shutesbury/Leverett border, Leverett]
RLB01	Chicopee	Rutland Brook	[approximately 1050 feet upstream of mouth at inlet to Connor Pond, Petersham]
RTB01	Blackstone	Round Top Brook	[approximately 1400 feet downstream/south from the confluence of Tinkerville Brook, Burrillville, Rhode Island (approximately 1600 feet from MA/RI border)]
SB01	Westfield	Sanderson Brook	[Sanderson Brook Road bridge nearest Route 20, Chester]
SHB01	South Coastal	Second Herring Brook	[Route 123 (Main Street) crossing, Norwell]
SW01	Nashua	Stillwater River	[Route 140, Princeton]
TR01	Westfield	Trout Brook	[Parish Road, Worthington]
TY01[b]	Taunton	Terry Brook	[approximately 350 feet upstream from inlet of Terry Brook Pond, Freetown]
WA01	Blackstone	Warren Brook	[approximately 1400 feet south/downstream of Fowler Street crossing nearest Orchard Street, Upton (the northern most crossing)]
WG01[b]	Taunton	Unnamed Tributary	[unnamed tributary to the Wading River, northwest off the northern end of Noyes Street, Norton]
WR01	Westfield	Westfield River	[approximately 2500 feet upstream from the River Road crossing nearest Windigo Road, Windsor]
WT01	Westfield	Shaker Mill Brook	[approximately 1150 feet upstream of Nocher Road, Becket]

Table 1. Location of selected "reference/least disturbed" sites that were sampled in 2019 as part of the reference site network

Site	Watershed	Waterbody	Site Description

a – Fish data not collected, stream went dry
b – Diatom sample collected

Table 2. Sampling frequency of water quality and ecological variables measured at RSN sites.

Variable	Sample Frequency (Minimum)
Nutrients (TN,TP, Nitrate/Nitrite, Ammonia)	4
Chloride	4
Color	3
Turbidity	3
Dissolved Oxygen/Temperature Probe Deploys (June – Sept.)	continuous
Habitat Assessment	1
Fish Community	1
Macroinvertebrate Community	1
Diatoms	1

***Water Quality*:** Water samples were collected from each site monthly from June through September, field preserved as appropriate, and delivered to the Senator William X. Wall Experiment Station in Lawrence (WES) for nutrient (total phosphorus, total nitrogen, nitrate/nitrite nitrogen and ammonia nitrogen) and chloride analysis and the DWM lab in Worcester for turbidity and color analysis. In addition, data loggers were deployed *in-situ* from June to September to obtain long-term continuous temperature and dissolved oxygen data.

***Biological Monitoring*:** Benthic macroinvertebrate, fish and diatom community assessments, along with associated habitat evaluations, were performed to support multiple program objectives, as described above, as well as to assess the *Aquatic Life Use* support status.

The benthic macroinvertebrate community at each site was sampled once during the period July-September through the use of Rapid Bioassessment Protocols (RBP) III or a modification thereof, depending upon available habitat. For example, typical RBP III kick-sampling protocols could not be used at low-gradient sites so a multi-habitat sampling method (i.e., multiple net sweeps) was employed. Specimens were preserved in the field and transported to the DWM lab for further processing. Sample sorting and taxonomic identifications were performed at a contract laboratory. Where applicable, benthic macroinvertebrate functional feeding group, community composition, biotic index using pollution tolerance, and abundance metrics will be calculated for analysis.

Fish community sampling for the presence/absence of resident fish species was carried out during the period August-October at all but one site. Fish were collected within a 100-meter reach using a backpack or tote barge-mounted electro-fishing equipment and held in plastic buckets containing stream water. Fish were identified to species and a minimum of 25 individuals of each species were measured and weighed. Fish were then redistributed throughout the sampled reach.

Diatoms were collected at eight (8) sites in an effort to expand the DWM's existing database and extend the range of stressors (nutrients, dissolved oxygen, pH, conductivity, etc.) to which the diatom community responds. Diatom data may inform the development of a Biological Condition Gradient (BCG) as well as provide ecological information for stream assessments. Samples were obtained by scraping algae from a predetermined area of coarse substrate (i.e., cobble) at each site. Samples were shipped to a contract laboratory for taxonomic identification and enumeration.

Targeted Assessment Monitoring – Connecticut Watershed: The primary goal of the 2019 Connecticut River Watershed monitoring program was to collect water quality and biological community data to determine whether waterbodies in the watershed meet water quality standards and support the following designated beneficial uses: Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics. The specific objectives of this monitoring were to:

- Determine the biological health of "not assessed" (not enough current data/information exists or no reliable data are available) and "never assessed" (status of their designated uses has never been reported) rivers/streams within the watershed by conducting assessments based on biological (aquatic macroinvertebrates, fish, periphyton, bacteria) communities.

- Provide biological, habitat, and dissolved oxygen, temperature, and chemical data to DWM's Environmental Monitoring and Assessment Program to be used in making *Aquatic Life* and *Aesthetics* use assessments required by Section 305(b) of the CWA. Provide data for other informational needs of Massachusetts' regulatory programs.

- Provide quality-assured *E. coli* data for the purpose of assessing P*rimary* and *Secondary Contact Recreational* uses in rivers/streams.

- Provide phosphorus and nitrogen water concentration data to augment the USGS Long Island Sound nutrient study.

- Provide temperature, dissolved oxygen, habitat and biological data to examine DFG's classification of a waterbody as a "coldwater fishery resource" (CFR). If this classification is supported, the stream may then be classified as a "cold water fishery" (CWF) in a future revision of the water quality standards.

A total of 25 sites in the Connecticut River Watershed were sampled in 2019. Monitoring consisted of the collection of water samples for physicochemical analyses; macroinvertebrate, fish and periphyton (diatom) population assessments; and habitat assessment. Sampling site descriptions and the water quality and ecological variables measured at each site are presented in Table 3. More detail pertaining to each component of the monitoring program is presented below.

Table 3. Connecticut River Watershed – 2019 Water Quality and Biological Sampling Matrix

Site ID	Waterbody	Site Description	Sample Type*
W2842	Mill Brook	[approximately 160 feet upstream of Main Street (Route 10), Northfield]	1, 2, 3, 4, 7, 9, 10

W1782	Fall River	[approximately 1000 feet upstream from eastern end of Factory Hollow Road, Greenfield (under power lines)]	1, 2, 3, 5, 7, 9, 10
W2843	Mill River	[approximately 550 feet downstream of South Deerfield Road (first crossing east of Graves Road), Conway]	1, 2, 3, 4, 7, 8, 10
W1063	Bloody Brook	[Whately Road, Deerfield]	1, 2, 3, 4
W2844	Bloody Brook	[Pleasant Street, Deerfield]	1, 2, 4
W1061	Mill River	[Maple Street, Hatfield]	1, 2, 3, 6, 7, 10
W1796	Mill River	[Clement Street, Northampton]	1, 2, 3, 5, 7, 8, 10
W2845	Fort River	[Pelham Road, Amherst]	1, 2, 3, 6, 7, 9, 10
W2846	Cushman Brook	[approximately 900 feet upstream of Factory Hollow Pond/State Street, Amherst]	1, 2, 3, 5, 7, 9, 10
W2854	Russellville Brook	[approximately 250 feet downstream of Route 47, Hadley]	1, 2, 3, 4, 7, 8, 10
W1050	Mill River	[Mill River Lane, Hadley]	1, 2, 3, 4, 7, 9, 10
W2847	Mill River	[unnamed tributary to the Connecticut River, approximately 450 feet downstream of River Drive (Route 47), Hadley]	1, 2, 3, 4, 7, 10
W1051	Fort River	[Route 47, Hadley]	1, 2, 3, 6, 7, 9, 10
W2848	Lampson Brook	[approximately 500 feet upstream of the Belchertown WWTP outfall, east of George Hannum Street, Belchertown]	1, 2, 3, 4, 7, 9, 10
W1055	Lampson Brook	[George Hannum Street, approximatley 50 feet downstream of Belchertown WWTP (MA0102148) discharge, Belchertown]	1, 2, 3, 4, 7, 8, 9, 10
W2849	Bachelor Brook	[Woodbridge Street, South Hadley]	1, 2, 3, 4, 7, 8, 10
W2850	Elmer Brook	[approximately 170 feet downstream of Pearl Street, South Hadley]	1, 2, 3, 5, 7, 8, 10
W1065	Manhan River	[Fort Hill Road, Easthampton]	1, 2, 3, 6, 7, 10
W2851	Broad Brook	[Unnamed tributary to Manhan River approximately 100 feet downstream of "bike path" north of the outlet of Lower Mill Pond, Easthampton]	1, 2, 3, 4, 7, 10
W1792	Stony Brook	[at the one lane bridge approximately 425 feet upstream from the Route 116 crossing, South Hadley]	1, 2, 3, 5, 7, 8, 10
W2852	Buttery Brook	[Bridge Street (Route 116), South Hadley]	1, 2, 3, 4, 7, 8, 10
W2855	Willimansett Brook	[unnamed tributary to the Connecticut River, locally known as "Willimansett Brook", approximately 340 feet upstream of Yelle Street, Chicopee]	1, 2, 3, 4, 7, 8, 10
W1786	Mill River	[approximately 225 feet upstream of Mill Street (opposite the intersection of Cherry Street and Clifton Avenue), Springfield]	1, 2, 3, 4, 7, 10
W2853	Pecousic Brook	[unnamed tributary to the Connecticut River, Pecousic Drive, Springfield]	1, 2, 3, 4, 7, 8, 10
W1794	Longmeadow Brook	[the "slip of road" west at the Route 5 crossing, Longmeadow]	1, 2, 3, 4, 7, 10

***Sample Types**

1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – Nutrients (total phosphorus, total nitrogen, nitrate/nitrite, ammonia), chloride, color, turbidity, 3 – *E. coli* bacteria samples, 4 – Unattended continuous dissolved oxygen and temperature, 5 – Unattended continuous temperature, 6 – Unattended continuous conductivity and temperature, 7 – Benthic macroinvertebrate community, 8 – Fish population, 9 – Diatoms, 10 – Habitat assessment

***Water Quality*:** Water samples were collected from each site monthly from May through September, field preserved as appropriate, and delivered to the Senator William X. Wall Experiment Station in Lawrence (WES) for nutrient (total phosphorus, total nitrogen, nitrate/nitrite nitrogen and ammonia nitrogen) and chloride analysis and the DWM lab in Worcester for turbidity and color analysis. Six (6) samples for the analysis of *E. coli* were obtained from each site during July to September and transported to a commercial laboratory in western Massachusetts in order to comply with the prescribed holding time for bacteria samples. Field measurements of dissolved oxygen, temperature, pH and conductivity were taken during all but "bacteria only" sampling events. Finally, sondes and data loggers were deployed *in-situ* from May to September to obtain long-term, continuous temperature, dissolved oxygen and/or conductivity data, depending upon the site (see Table 3).

***Biological Monitoring*:** Biological community assessments, along with associated habitat evaluations, were performed to determine the *Aquatic Life Use* support status for CWA section 305(b) reporting requirements. The benthic macroinvertebrate community was sampled at 23 sites once during the period July-September through the use of Rapid Bioassessment Protocols (RBP) III or a modification thereof, depending upon available habitat. For example, typical RBP III kick-sampling protocols could not be used at low-gradient sites so a multi-habitat sampling method (i.e., multiple net sweeps) was employed. Specimens were preserved in the field and transported to the DWM lab for further processing. Sample sorting and taxonomic identifications were performed at a contract laboratory. Where applicable, benthic macroinvertebrate functional feeding group, community composition, biotic index using pollution tolerance, and abundance metrics will be calculated for analysis.

Fish community sampling for the presence/absence of resident fish species was carried out during the period August-October at ten (10) sites. Fish were collected within a 100-meter reach using a backpack or tote barge-mounted electro-fishing equipment and held in plastic buckets containing stream water. Fish were identified to species and a minimum of 25 individuals of each species were measured and weighed. Fish were then redistributed throughout the sampled reach.

Diatoms were collected at eight (8) sites in an effort to expand the DWM's existing database and extend the range of stressors (nutrients, dissolved oxygen, pH, conductivity, etc.) to which the diatom community responds. Diatom data may inform the development of a Biological Condition Gradient (BCG) as well as provide ecological information for stream assessments. Samples were obtained by scraping algae from a predetermined area of coarse substrate (i.e., cobble) at each site. Samples were shipped to a contract laboratory for taxonomic identification and enumeration.

Targeted Assessment Monitoring – Taunton Watershed: The primary goal of the 2019 Taunton River Watershed monitoring program was to collect water quality and biological community data to determine whether waterbodies in the watershed meet water quality standards and support the following designated beneficial uses: Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics. The specific objectives of this monitoring were to:

- Collect physical/chemical/biological data upstream and downstream from selected major NPDES permit holding facilities within the upper watershed.

- Return to sites previously sampled for biological data to help discern current biological conditions.

- Return to sites/segments which have been flagged during past assessments as needing more data to clarify current conditions.

A total of 32 sites in the Taunton River Watershed were sampled in 2019. Monitoring consisted of the collection of water samples for physicochemical analyses; macroinvertebrate, fish and periphyton (diatom) population assessments; and habitat assessment. Sampling site descriptions and the water quality and ecological variables measured at each site are presented in Table 4. More detail pertaining to each component of the monitoring program is presented below.

Table 4. Taunton River Watershed – 2019 Water Quality and Biological Sampling Matrix

Site ID	Waterbody	Site Description	Sample Type*
W1497	Beaver Brook	[Belmont Street bridge, East Bridgewater]	1, 2, 3, 4, 5, 6, 8
W2833	Canoe River	[Route 495 southbound exit ramp to Route 123 (Eastman Street), Norton]	1, 2, 3, 4, 5, 6, 7, 8
W0816	Cedar Swamp River	[Malbone Street, Lakeville]	1, 2, 3, 4, 5, 8
W2829	Hockomock River	[Maple Street, West Bridgewater]	1, 2, 3, 4, 5, 8
W1501	Matfield River	[High Street bridge, Bridgewater]	1, 2, 3, 4, 6, 8
W1498	Meadow Brook	[West Union Street bridge, East Bridgewater]	1, 2, 3, 4, 5, 6, 8
W2372	Mill River	[approximately 220 feet downstream/southeast from Route 44 (Winthrop Street), Taunton]	1, 2, 3, 4, 5, 6, 8
W2830	Mulberry Meadow Brook	[Highland Street, Easton]	1, 2, 3, 4, 5, 6, 7, 8
W2832	Mulberry Meadow Brook	[Plain Street, Norton]	1, 2, 3, 4, 5, 6, 8
W0317	Nemasket River	[Route 44 bridge, Middleborough (approximately 1000 feet upstream of Middleborough WWTP discharge, NPDES # MA0101591)]	1, 2, 3, 4, 5, 6, 8
W0318	Nemasket River	[Plymouth Street bridge, Middleborough (approximately 1.5 miles downstream of Middleborough WWTP discharge, NPDES # MA0101591)]	1, 2, 3, 4, 5, 6, 8
W0869	Poor Meadow Brook	[Main Street, Hanson]	1, 2, 3, 4, 5, 6, 7, 8
W2377	Rumford River	[approximately 675 feet downstream/south from Cocasset Street, Foxborough]	1, 2, 3, 4, 5, 6, 8
W2402	Rumford River	[approximately 1450 feet upstream/north from the Route 140 ramp to Route 495 north bound, Mansfield]	1, 2, 3, 4, 5, 6, 8
W1490	Salisbury Brook	[Otis Street bridge, Brockton]	1, 2, 3, 4, 5, 6, 7, 8
W1494	Salisbury Plain River	[Sargent's Way bridge, Brockton (as it appears in 2001 ortho photo)]	1, 2, 3, 4, 5, 6, 8
W1495	Salisbury Plain river	[Matfield Street opposite intersection with Michelles Way, East Bridgewater]	1, 2, 3, 4, 5, 6, 8
W1499	Satucket River	[Plymouth Street (Route 106) bridge, East Bridgewater]	1, 2, 3, 4, 5, 6, 7, 8
W2836	Sawmill Brook	[Bedford Street, (Route 18, 28), Bridgewater]	1, 2, 3, 4, 5, 6, 8
W2838	Segreganset River	[south off Karen Road, Dighton]	1, 2, 3, 4, 5, 6, 7, 8

W0868	Shumatuscacant River	[West Washington Street, Hanson]	1, 2, 3, 4, 5, 8
W1503	Taunton River	[Green Street/Plymouth Street bridge, Bridgewater/Middleborough]	1, 2, 3, 4
W1504	Taunton River	[South Street East /Old Colony Avenue bridge, Raynham/Taunton]	1, 2, 3, 4
W0821	Three Mile River	[Norton Avenue (near Harvey Street), Taunton]	1, 2, 3, 4, 5, 6, 8
W1508	Three Mile River	[Cohannet Street bridge, Taunton]	1, 2, 3, 4, 5, 6, 8
W2835	Three Mile River	[Crane Street, Norton]	1, 2, 3, 4
W2831	Town River	[approximately 900 feet downstream/east of Broad Street (Route 18), Bridgewater]	1, 2, 3, 4, 5, 6, 8
W2405	Town River	[approximately 25 feet upstream/west from Hayward Street, Bridgewater]	1, 2, 3, 4, 5, 6, 8
W1493	Trout Brook	[between Crescent and Summer streets (downstream of discharge pipe under Crescent Street), Brockton]	1, 2, 3, 4, 5, 6, 8
W0870	Wading River	[Barrows Street, Norton]	1, 2, 3, 4, 5, 6, 8
W0858	Wading River	[Route 140, Norton]	1, 2, 3, 4, 5, 6, 7, 8
W2834	Winnetuxet River	[River Street, Halifax]	1, 2, 3, 4

***Sample Types**
1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – Nutrients (total phosphorus, total nitrogen, nitrate/nitrite, ammonia), chloride, color, turbidity, 3 – *E. coli* bacteria samples, 4 – Unattended continuous dissolved oxygen and temperature, 5 – Benthic macroinvertebrate community, 6 – Fish population, 7 – Diatoms, 8 – Habitat assessment

***Water Quality*:** Water samples were collected from each site monthly from May through September, field preserved as appropriate, and delivered to the Senator William X. Wall Experiment Station in Lawrence (WES) for nutrient (total phosphorus, total nitrogen, nitrate/nitrite nitrogen and ammonia nitrogen) and chloride analysis and the DWM lab in Worcester for turbidity and color analysis. Six (6) samples for the analysis of *E. coli* were obtained from each site during June to September and transported to a commercial laboratory in order to comply with the prescribed holding time for bacteria samples. Field measurements of dissolved oxygen, temperature, pH and conductivity were taken during all but "bacteria only" sampling events. Finally, sondes and data loggers were deployed *in-situ* from May to September to obtain long-term, continuous temperature and dissolved oxygen data.

***Biological Monitoring*:** Biological community assessments, along with associated habitat evaluations, were performed to determine the *Aquatic Life Use* support status for CWA section 305(b) reporting requirements. The benthic macroinvertebrate community was sampled at 27 sites once during the period July-September through the use of Rapid Bioassessment Protocols (RBP) III or a modification thereof, depending upon available habitat. For example, typical RBP III kick-sampling protocols could not be used at low-gradient sites so a multi-habitat sampling method (i.e., multiple net sweeps) was employed. Specimens were preserved in the field and transported to the DWM lab for further processing. Sample sorting and taxonomic identifications were performed at a contract laboratory. Where applicable, benthic macroinvertebrate functional feeding group, community composition, biotic index using pollution tolerance, and abundance metrics will be calculated for analysis.

Fish community sampling for the presence/absence of resident fish species was carried out during the period August-October at 25 sites. Fish were collected within a 100-meter reach using a backpack or tote barge-mounted electro-fishing equipment and held in plastic buckets containing stream water. Fish were identified to species and a minimum of 25 individuals of

each species were measured and weighed. Fish were then redistributed throughout the sampled reach.

Diatoms were collected at seven (7) sites in an effort to expand the DWM's existing database and extend the range of stressors (nutrients, dissolved oxygen, pH, conductivity, etc.) to which the diatom community responds. Diatom data may inform the development of a Biological Condition Gradient (BCG) as well as provide ecological information for stream assessments. Samples were obtained by scraping algae from a predetermined area of coarse substrate (i.e., cobble) at each site. Samples were shipped to a contract laboratory for taxonomic identification and enumeration.

Fish Toxics Monitoring: Fish sampling was performed at nine sites at the recommendation of the Inter-agency Fish Toxics Committee (Table 5). Edible fillets from fish collected at all nine waterbodies were analyzed for the presence of mercury, arsenic, cadmium and selenium. Samples from the four lakes in Worcester and the Merrimack River were also analyzed for PCB and organochlorine pesticides. If necessary, fish consumption advisories will be issued by the Massachusetts Department of Public Health.

Table 5. 2019 fish toxics monitoring sites.

Watershed	Water Body (Municipality)	Analytes
Blackstone	Coes Reservoir (Worcester)	Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids
Blackstone	Indian Lake (Worcester)	Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids
Blackstone	Bell Pond (Worcester)	Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids
Blackstone	Lake Quinsigamond (Worcester/Shrewsbury)	Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids
Concord	White Pond (Concord)	Hg, As, Cd, Se
Islands	Miacomet Pond (Nantucket)	Hg, As, Cd, Se
Islands	Tom Nevers Pond (Nantucket)	Hg, As, Cd, Se
Islands	Gibbs Pond (Nantucket)	Hg, As, Cd, Se
Merrimack	Merrimack River (between Route 93, Andover/Methuen and the Essex Dam, Lawrence)	Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids

Lake Monitoring in the Mystic River Watershed: In collaboration with the USEPA, water quality monitoring was performed at three lakes in the Mystic River watershed that currently appear on the CWA section 303(d) list as impaired by phosphorus and related indicators of over-enrichment. Horn Pond (Woburn), Spy Pond (Arlington) and Wedge Pond (Winchester) were sampled monthly from June through October to obtain data to update assessment information and support the calibration of a Lake Loading Response Model (LLRM) as a step toward developing phosphorus TMDLs for these ponds. During each sampling event, a vertical profile (dissolved oxygen, temperature, pH and conductivity) and Secchi disk transparency were obtained at the lake "deep hole", and samples were collected for the analysis of Total Phosphorus, Total Nitrogen, chlorophyll a, color and turbidity. Nutrient samples were analyzed at EPA's regional laboratory in Chelmsford and the remaining analyses were performed at the DWM laboratory in Worcester. A second round of sampling at these ponds is planned for 2020.

Baseline Lake Sampling of Monponsett Pond, Halifax: The 2019 Baseline Lakes Survey focused on obtaining additional water quality information from East Monponsett Pond and West Monponsett Pond in Halifax. The specific objectives of this monitoring were to:

- Evaluate the lakes to determine if Massachusetts's water quality standards are met
- Provide data to show improvement from the implementation of phosphorus TMDLs

Assisted by staff from MassDEP's southeast regional office (SERO), DWM sampled the epilimnetic waters (surface and bottom) at the deep holes of both East and West Monponsett ponds on June 12, July 16, August 14 and September 17. Samples were analyzed for total phosphorus, total nitrogen, chlorophyll-a, color and turbidity. Vertical DO/temperature/pH/conductivity profiles and Secchi disk transparency measurements were also obtained on all four sampling dates.

Monitoring the Effects on Water Quality of Road-Salt Application: DWM continued to monitor seasonal chloride levels and dynamics in selected waters potentially impaired by road salt application. Continuous conductivity loggers were deployed at nine sites along the I-91 corridor (Connecticut River Watershed) from October, 2018 through June, 2019. This work included the collection of chloride grab samples to check the accuracy of the specific conductance-chloride regression model. Twelve sites in the upper Blackstone River Watershed were selected as the next study area. Conductivity probes were deployed at these sites in November, 2019 and will be retrieved in June, 2020.

Monitoring Water Quality in Mount Hope Bay: In 2016, MassDEP acquired two YSI marine water quality monitoring buoys to address data gaps in the Massachusetts waters of Narragansett Bay and its sub-embayment Mount Hope Bay. The deployment of these buoys expands the existing Narragansett Bay Fixed-Site Monitoring Network (NBFSMN) currently administered by the Rhode Island Department of Environmental Management (RIDEM) and the University of Rhode Island Graduate School of Oceanography (URI). Until recently, there were no NBFSMN stations located in the eastern portion of Mount Hope Bay in Massachusetts. The addition of the two monitoring buoys in Massachusetts is helping to define ambient water quality conditions for dissolved oxygen, nitrate-nitrogen, algal abundance, temperature, and other parameters. Specifically, the data may be used to assess trends over time, identify impaired waters, assess the effectiveness of management decisions (i.e. wastewater treatment facilities (WWTF) upgrades, TMDL efforts, and stormwater management), and support refinement, calibration, and validation of water quality models.

After the initial pilot deployment from September-November 2016, MassDEP has redeployed the two buoys from May-November annually since 2017 at approximately the same locations in the bay. Bi-monthly grab water samples were collected for water chemistry analyses at each buoy location within one meter of the deployed sensors during each deployment (2016-2019). Instantaneous grab sample data will be compared to corresponding sensor data to validate the accuracy of sensor measurements. MassDEP's long-term plan for the buoys is to continue collecting continuous, real-time data seasonally in coastal systems to address data gaps and aid management decisions.

Field and Lab Support for the Assessment and Management of Cyanobacteria Blooms: MassDEP continued to provide technical expertise and laboratory support for the investigation of potentially toxic algae (cyanobacteria) blooms. Staff biologists performed cyanobacteria counts and identifications on water samples to determine whether cell counts exceeded MassDPH advisory levels for recreational waters. In addition, samples were collected and/or analyzed *ad hoc* from lakes in DWM's Lakes Baseline networks if blooms were observed by DWM sampling crews or if water samples exhibited elevated chlorophyll levels in the lab. A list of waterbodies from which MassDEP processed samples in 2019 is presented in Table 6.

Table 6. Waterbodies for which MassDEP staff performed cyanobacteria cell counts (C) and/or taxonomic identifications (ID) in 2019, either at the request of the MassDPH, or in response to a bloom observed by sampling crews while conducting lake monitoring activities of the DWM.

Waterbody	Municipality	Number of sampling events	Sample Processing
South Watuppa Pond	Fall River	7	C, ID
East Monponsett Pond	Halifax/Hanson	11	C, ID
West Monponsett Pond	Halifax/Hanson	11	C, ID

Participation in the Northeast Regional Monitoring Network (RMN): In collaboration with its regional offices, states, tribes, and other entities, the USEPA has established Regional Monitoring Networks (RMNs). The goal of the RMNs is to help EPA and their partners collect current, baseline biological, thermal, and hydrologic data from freshwater wadeable streams. Over time, these data can help facilitate a better understanding of relationships between biological, thermal, and hydrologic data, ecosystem responses and recovery from extreme weather events, and effects of climate change and regional phenomena such as drought and pollutant/nutrient deposition on aquatic ecosystems.

As part of the Northeast RMN, MassDEP has established five sites in Massachusetts which have been designated for long-term monitoring for temperature regimes, flow characteristics, and stream macroinvertebrate communities. These sites are Hubbard Brook in Granville, Brown's Brook in Holland, Parker's Brook in Oakham, West Branch Swift River in Shutesbury, and Cold River in Florida. Since 2012 MassDEP has been collecting air and water time-series temperature data, as well as annual macroinvertebrate kick-samples. Time-series streamflow data are collected at these sites by the USGS (3 sites) or the Massachusetts Division of Ecological Restoration (2 sites).

Continuous Stream Temperature Monitoring: DWM deployed temperature or temperature/conductivity sondes and dataloggers from June - September, 2019 at a total of 37 sites on 23 streams (Table 7) in the Connecticut and Millers river watersheds and on Martha's Vineyard as part of its ongoing short-term stream temperature monitoring network. Sensors were deployed to capture the maximum water temperatures anticipated during the summer season and the data will be used to identify or confirm the presence of cold-water fishery resources and to inform aquatic life use assessment.

Table 7. 2019 short-term temperature monitoring network.

Watershed	Stream Name	Municipality	Number of Sites
Islands	Tiasquam Brook	Chilmark, West Tisbury	8
Connecticut	Amethyst Brook	Amherst	1
Connecticut	Hop Brook	Belchertown, Amherst	2
Connecticut	Long Plain Brook	Leverett, Sunderland	2
Connecticut	Louisiana Brook	Northfield	1
Connecticut	Roaring Brook	Leverett	1
Connecticut	Sawmill River	Leverett	1
Connecticut	Unnamed tributary to Bachelor Brook	Granby	1
Connecticut	Unnamed tributary to Hop Brook (1)	Amherst	1
Connecticut	Unnamed tributary to Hop Brook (2)	Belchertown	1
Connecticut	Unnamed tributary to Sawmill River	Leverett	1
Connecticut	Brewer Brook	Westhampton	1
Connecticut	Manhan River	Westhampton, Southampton	2
Connecticut	Parsons Brook	Northampton	2
Connecticut	Red Brook	Southampton	1
Connecticut	Roaring Brook	Whately, Conway	2
Connecticut	Roberts Meadow Brook	Westhampton, Northampton	2
Connecticut	Unnamed tributary	Whately	1
Connecticut	West Branch Mill River	Williamsburg	1
Connecticut	West Wait Brook	Northfield	1
Connecticut	White Brook	Easthampton	1
Millers	Beaver Brook	Royalston	1
Millers	Lyons Brook	Wendell, Montague	2
Total sites			**37**

Monitoring to Estimate Contaminant Loadings: Massachusetts' long-term monitoring strategy identifies, as one of its key monitoring objectives, monitoring to support the development, implementation and evaluation of pollution control strategies, and indicates that "limited fixed-site monitoring may be required to quantify pollutant loadings." In 2017-2018 the USGS installed a flow monitoring station in the Connecticut River near Northfield, MA (USGS Station 01161280) and initiated weekly water-quality sampling to provide data for the estimation of nutrient loads entering Massachusetts from upstream sources. In addition, the water-quality sampling frequency was increased to weekly at the USGS monitor station in the Connecticut River at Thompsonville CT (USGS Station 01184000) to refine estimates of nutrient loads leaving Massachusetts. Funded collaboratively by the Springfield Water and Sewer Commission, MassDEP, and USGS, this monitoring study will increase our understanding of the nutrient contributions from Massachusetts to Long Island Sound. Additionally, since 2018, MassDEP has been collaborating with USGS and funding water-quality sampling at existing USGS flow gage stations located near the confluence of each of the Deerfield, Millers, Chicopee and Westfield Rivers with the Connecticut River. Monitoring these locations will assist in prioritizing areas for nitrogen load reductions and making informed nutrient management decisions. MassDEP has also been collaborating with USGS and funding water-quality sampling in the Taunton River Watershed (at existing USGS flow gage stations in the Taunton, Threemile, Mill, and Segreganset rivers) to quantify nutrient loadings to the lower Taunton River and Mount Hope Bay (see **Monitoring Water Quality in Mount Hope Bay** above).

Bacteria Source Tracking Activities of the Southeast Regional Office (SEROBST): The DWM regional monitoring coordinator, used the IDEXX quanti-tray system on site in the Southeast Region lab, to determine the concentration of "indicator bacteria" (*E.coli* and Enterococcus) in surface water, at stormdrain outfalls and within drainage infrastructure (manholes).

Additional source tracking tools used were:

- Hach test kits: to determine detergent concentrations.
- Ammonia and potassium meters: to determine ammonia/potassium ratios

These data were combined with field observations and in some cases, discussions with local watershed groups and/or municipal officials to refine sampling locations, in an attempt to track and isolate the dry-weather source(s) of *E. coli* and/or Enterococcus bacteria. A small number of opportunities for "Human Marker" analyses (fluorescent whitening agents, DNA, and caffeine) were made available by the WES State Lab. These analyses were utilized in cases where bacteria concentrations were high but no obvious source could be immediately located, in an attempt to determine if the bacteria were from a human or animal source.

Subwatersheds where bacteria source tracking was conducted are presented below in Table 8.

Highlights of the 2019 sampling season

- The partnership with EPA Region-1 and Rhode Island DEM continued into this year, with the goal of monitoring water quality in the lower section of the Palmer River Watershed. Monitoring was focused in areas that were deemed most vulnerable to agricultural impacts and with the long-term goal of assessing trends over time in correlation to ongoing installation of agricultural BMPs. Samples were collected from April through November at 14 fixed stations on an outgoing tide (weather independent). EPA supplied YSI meters to measure temperature, specific conductance and salinity. Grab samples were tested (by EPA Region 1 lab) for *E.coli* (some *E.coli* analyses run by MassDEP SERO lab), enterococcus, total nitrogen, ammonia, nitrate/nitrite, total phosphorus, orthophosphate and total suspended solids (TSS).

- The EPA succeeded in acquiring SNP grant funding which is being used for a project with FB Environmental Associates and Horsley Witten Group. One of the goals of the project is to create a database of all of the Palmer River data from 1960-2018 and then based on this data use a specific methodology to determine which of a series of samples (frozen from the past couple of years), will be run for PhyloChip/qPCR analysis. This analysis will be run by Dr. Gary Andersen, of Lawrence Berkley National Laboratory.

- The overall purpose of the project is to (1) develop recommendations for use of the PhyloChip to maximize the ability to identify fecal contamination sources with limited resources; (2) analyze water quality trends in the Palmer River watershed using existing water quality data, geospatial information, and summary papers; and (3) assessing the impact that changing land use is expected to have in the Palmer River watershed and providing recommendations for reducing the impacts of land development on water quality.

- The successful partnership with the City of Brockton continued with:

- SEROBST worked with City employees to follow up on a number of hotspot source areas, building on our work from the previous few years. The City is dedicated to the BST process, using their state-of-the-art camera truck every day for that purpose.
    1. The Grove Street outfall (Salisbury Plain River).
    2. Pleasant/Carrlyn/Irving (Lovett Brook watershed).
    3. Trout Brook source tracking upstream of Court Street.

Table 8. Subwatersheds where bacteria source tracking was conducted over the course of approximately 30 sample days. Note: This table includes only the names of those municipalities where sampling took place. New sub-watersheds are highlighted in **bold.**

Name	Basin	Segment	Municipalities sampled	Number of sample days
Palmer River project (incl. Rocky Run Brook and Torrey Creek)	Narragansett Bay	53-05 53-16 53-17	Seekonk & Rehoboth	8
Salisbury Plain River	Taunton	62-05	Brockton	2
Trout Brook	Taunton	62-07	Brockton	2
Salisbury Brook	Taunton	62-08	Brockton	1
Lovett Brook	Taunton	62-46	Brockton	1