Massachusetts Department of ENVIRONMENTAL PROTECTION

2015 DWM ENVIRONMENTAL MONITORING OVERVIEW

(CN 441.0)

A brief overview of the surface water monitoring performed in 2015 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 being met in waters of the Commonwealth;
- Collect chemical, physical and biological data to support analysis and development of 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;
- Over the long term, collect water quality data to enable the determination of trends in parameter concentrations and/or loads;
- Develop new or revised standards, which may require short-term research monitoring directed towards the establishment or revision of water quality policies and standards; and to
- Measure the effectiveness of water quality management projects or programs such as the effectiveness of implementing TMDLs, Best Management Practices (BMP) for the control of nonpoint pollution, or a state-wide policy or permitting program.

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.

The 2015 surface water monitoring program completed the implementation of the statistically valid sampling design for Massachusetts' shallow (i.e., "wadable") streams that was initiated in 2010. The EPA strongly encourages states to adopt this approach for one or more waterbody types. The probabilistic survey design provides for the assessment of 100% of waters in a target population by monitoring a random sample of those waters. The ultimate goal of the DWM is to expend about 35% of annual monitoring resources on the probabilistic monitoring effort to satisfy the reporting requirements of CWA Section 305(b) while allotting the remaining 65% to deterministic or targeted data collection efforts such as the identification of pollution sources or the development of TMDLs. With the loss of full-time monitoring personnel in recent years, however, probabilistic monitoring efforts have consumed more than 50% of DWM's annual surface water monitoring resources, leaving less than half of those monitoring resources available each year for targeted monitoring activities. This trend continued in 2015. All of the monitoring activities of the DWM in 2015 are briefly described below.

PROBABILISTIC MONITORING & ASSESSMENT PROGRAM (MAP2) – The goals of the probabilistic survey are to provide an unbiased assessment (Support/Impaired) of aquatic life, recreational and aesthetic uses in wadable (i.e., 1st – 4th Strahler Order), non-tidal perennial streams of Massachusetts, and, over time, to provide an analysis of trends in the use assessments of those streams. The random sampling design allows for the determination, with a known statistical confidence, the percentage of wadable stream miles supporting and not supporting their designated uses. To implement the survey, Massachusetts' 1st – 4th order streams were apportioned into five separate groups or strata, one of which – the "Northeast Group" – was the focus of monitoring in 2015. The Northeast Group includes the Charles, Concord, Ipswich, Merrimack, Parker, Shawsheen and North Shore Coastal watersheds.

A total of 35 sites were monitored in 2015 (Table 1). The sites were divided into five groups that were visited on a weekly rotation to facilitate survey logistics and balance the sample load to the respective analytical laboratories. The primary objective at each sampling site was to collect sufficient data to assess, using the DWM's existing assessment methodology, the status (support/impaired) of aquatic life, recreational and aesthetic uses. All sampling and QA/QC was performed in accordance with the DWM's standard operating procedures, QAPP and SAP. A list of the water quality and ecological variables measured at each site, along with their sampling frequencies, is presented in Table 2.

Table 1. Location of randomly selected sites in the northeast watersheds of Massachusetts that were sampled in 2015 as part of the probabilistic wadable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-663	Charles	Hurd Brook	[approximately 800 feet downstream/east of Webster Street, Needham]
MAP2-675	Charles	Beaver Brook	[approximately 160 feet downstream/south of Trapelo Road, Waltham/Belmont]
MAP2-714	Shawsheen	Spring Brook	[approximately 250 feet upstream of mouth at confluence with Shawsheen River, Bedford]

Table 1. Location of randomly selected sites in the northeast watersheds of Massachusetts that were sampled in 2015 as part of the probabilistic wadable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-682[a]	Shawsheen	Vine Brook	[just downstream/west of the Route 62 eastbound ramp to Route 3 northbound, Bedford]
MAP2-677	North Coastal	Saugus River	[approximately 1600 feet downstream/south of Route 129, Saugus]
MAP2-665[a]	Ipswich	Ipswich River	[approximately 2500 feet downstream/north of Route 114, Middleton/Danvers]
MAP2-693	Ipswich	Ipswich River	[approximately 175 feet downstream/east of Chestnut Street, North Reading]
MAP2-717	Shawsheen	Shawsheen River	[approximately 1900 feet upstream/north of Central Street, Andover]
MAP2-642	Ipswich	Ipswich River	[approximately 200 feet downstream/north of Peabody Street, Middleton]
MAP2-681	Ipswich	Fish Brook	[approximately 550 feet downstream/south of River Road/Fuller Lane, Topsfield/Boxford]
MAP2-673	Parker	Jackman Brook	[approximately 1200 feet upstream/south of Jackman Street, Georgetown]
MAP2-657	Merrimack	Powwow River	[approximately 7200 feet upstream of Newton Road, Amesbury]
MAP2-705	Merrimack	Cobbler Brook	[approximately 100 feet upstream/north of River Road, Merrimac]
MAP2-685	Shawsheen	Shawsheen River	[approximately 1300 feet downstream/west of Route 495 crossing nearest the Massachusetts Avenue ramp to Route 495 southbound, Lawrence]
MAP2-698	Merrimack	Cow Pond Brook	[approximately 1200 feet downstream/north of Bridge Street, Groton]
MAP2-710[a]	Merrimack	Stony Brook	[approximately 5000 feet upstream/west of Depot Street, Westford]
MAP2-718	Merrimack	Stony Brook	[approximately 200 feet upstream/west of Brookside Road, Westford]
MAP2-670	Merrimack	Stony Brook	[approximately 450 feet upstream/south of Route 3, Chelmsford]
MAP2-646	SuAsCo	River Meadow Brook	[approximately 1400 feet, upstream/south of Turnpike Road, Chelmsford]
MAP2-654	Merrimack	Beaver Brook	[approximately 4800 feet downstream/south of Lakeview Avenue, Dracut]
MAP2-707[a]	Merrimack	Beaver Brook	[approximately 50 feet downstream/east of Park Avenue, Dracut]
MAP2-652	Charles	Charles River	[approximately 1000 feet upstream/south of Route 495, Bellingham]

Table 1. Location of randomly selected sites in the northeast watersheds of Massachusetts that were sampled in 2015 as part of the probabilistic wadable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-700	Charles	Mill River	[approximately 250 feet upstream/south of Miller Street, Norfolk]
MAP2-716	Charles	Bogastow Brook	[approximately 800 feet downstream/north of Orchard Street, Millis]
MAP2-651	SuAsCo	Cold Spring Brook	[approximately 340 feet upstream/south of Clinton Street, Hopkinton]
MAP2-660[a]	SuAsCo	Whitehall Brook	[approximately 3500 feet upstream/east of Fruit Street, Hopkinton]
MAP2-715	SuAsCo	Unnamed Tributary	[unnamed tributary to Sudbury River locally known as 'Cochituate Brook', approximately 800 feet upstream of School Street (Route 126), Framingham]
MAP2-696	SuAsCo	Unnamed Tributary	[unnamed tributary to Hop Brook, approximately 875 feet downstream/north of Main Boulevard, Shrewsbury]
MAP2-703	SuAsCo	Hop Brook	[east of Otis Street, Northborough approximately 2900 feet upstream of mouth at confluence with Assabet River, Northborough]
MAP2-667[a,b]	SuAsCo	Unnamed Tributary	[unnamed tributary to Dunsdell Brook, approximately 750 feet upstream/north of Frost Street, Framingham]
MAP2-680	SuAsCo	Broad Meadow Brook	[approximately 680 feet downstream/south of Route 20, Marlborough]
MAP2-655	SuAsCo	Assabet Brook	[west of White Pond Road, Stow approximately 4200 feet upstream of mouth at confluence with Assabet River, Stow]
MAP2-692	SuAsCo	Great Brook	[Route 117 crossing nearest the Meadow Road intersection, Bolton]
MAP2-690[b]	SuAsCo	Unnamed Tributary	[unnamed tributary eventually to Elizabeth Brook, approximately 725 feet upstream/north of Stow Road, Harvard]
MAP2-694	SuAsCo	Nashoba Brook	[approximately 4000 feet upstream/west of Main Street (Route 27), Acton]

a – Fish data not collected due to water depth.
b – Incomplete water quality data set due to stream going dry.

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

Variable	Sample Frequency (Minimum)
Bacteria (*E. coli*)	5
Nutrients (TN,TP, Nitrate/Nitrite, Ammonia)	5
Color	5
Turbidity	5
Chloride	5

Metals	3
Dissolved Oxygen/Temperature Probe Deploys (June-September)	continuous
Habitat Assessment	1
Fish Community	1
Macroinvertebrate Community	1

Individual components of the wadable stream survey are described below.

***Water Quality (Chemical, Microbiological and Physical)*:** Each month, from May to September, grab water samples were collected at each site, field preserved, as appropriate, and delivered to the Senator William X. Wall Experiment Station (WES) in Lawrence, MA for nutrient (total phosphorus, total nitrogen, nitrate/nitrite nitrogen and ammonia nitrogen), chloride and bacterial (*E. coli)* analyses. A small number of nutrient and chloride samples were analyzed at a commercial laboratory when WES was experiencing instrumentation problems. Samples were also collected and transported to the DWM's Worcester Office where they were analyzed for turbidity and true color. Water quality sondes were deployed *in-situ* from June to September to obtain long-term continuous temperature and dissolved oxygen data. Finally, samples for the analysis of dissolved metals were collected from each site on three occasions using wade-in, clean-hands techniques. Samples were filtered, preserved and delivered to WES for analysis.

***Biological Monitoring (Macroinvertebrates, Fish, Habitat)*:** Benthic macroinvertebrate and fish community assessments, along with associated habitat evaluations, were performed to assess the *Aquatic Life Use* status. These communities integrate environmental conditions (chemical – including nutrients and toxics, and physical – including flow and water temperature) over extended periods of time and are excellent measures of a waterbody's overall "health".

The benthic macroinvertebrate community was sampled once during the index period July through August, at all but two sites, using 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 to determine biological condition and *Aquatic Life Use* status.

Fish community sampling for the presence/absence of resident fish species was performed once at each site throughout the sampling season (June – September). 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 reach.

DETERMINISTIC ("TARGETED") MONITORING PROGRAM (TMP) – Several waterbodies were selected, or "targeted", for monitoring activities designed to fulfill the needs for specific data and information to support such program elements as TMDL development and implementation, human health risk assessment and climate change. While the probabilistic monitoring described above was focused in the Northeast Group of watersheds, targeted monitoring activities were carried out in watersheds scattered throughout Massachusetts. More detail pertaining to the targeted

monitoring activities of the DWM in 2015 is presented below.

Reference Site Network (RSN): The DWM has identified the need to characterize the reference condition for Massachusetts' surface waters to support multiple program objectives including, but not limited to, the interpretation of biological data obtained from the probabilistic monitoring network as well as the development of biocriteria and nutrient criteria. For example, the DWM is currently exploring the development of tiered aquatic life uses that will increase the accuracy of aquatic life use assessments and improve water quality goal-setting processes. An understanding of the inter-year and intra-year variation within the indices of biotic integrity used for assessment is a critical initial step toward the development and implementation of biocriteria and tiered aquatic life use.

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. Over time, the number of sites in this network expanded until, in 2015, a total of 27 sites were sampled (Table 3). The primary objective at each sampling site was to collect sufficient data to begin evaluating inter-year and intra-year variation in the biological communities. Monitoring activities included habitat assessment; macroinvertebrate and fish population assessments; and physicochemical sampling. All sampling and QA/QC was performed in accordance with the DWM's standard operating procedures, QAPP and SAP. A list of the water quality and ecological variables measured at each site, along with their sampling frequencies, is presented in Table 4. More detail pertaining to each component of the RSN is presented below.

Table 3. Location of selected "reference/least disturbed" sites that were sampled in 2015 as part of the reference site network.

Site	Watershed	Waterbody	Site Description
CR01	Deerfield	Cold River	[approximately 325 feet upstream of Mohawk Trail (Route 2), Florida/Savoy (upstream of Black Brook confluence)]
GR01	Deerfield	Green River	[east of Green River Road, Colrain approximately 50 feet upstream/north of the confluence of Thorne Brook, Leyden]
TB01	Deerfield	Thorne Brook	[east of Green River Road, approximately 100 feet upstream of confluence with the Green River, Leyden]
EBT01	Millers	East Branch Tully River	[approximately 2000 feet upstream from Route 68 (Warwick Road), Royalston]
BH01	Bash Bish	Bashbish Brook	[south of Falls Road, approximately 200 feet upstream of the confluence of Wright Brook, Mount Washington]
WE01	Housatonic	West Brook	[approximately 1300 feet downstream of the Beartown Road crossing nearest the intersection with Beartown Mountain Road, Great Barrington]
YB02	Housatonic	Yokun Brook	[approximately 1800 feet upstream of Edgewood Drive, Lenox]
FB01	Westfield	Factory Brook	[east off Town Hill Road, approximately 4400 feet upstream of confluence with the Westfield River, Middlefield]

Table 3. Location of selected "reference/least disturbed" sites that were sampled in 2015 as part of the reference site network.

Site	Watershed	Waterbody	Site Description
SB01	Westfield	Sanderson Brook	[Sanderson Brook Road bridge nearest Route 20, Chester]
MBW01	Westfield	Middle Branch Westfield River	[approximately 1000 feet upstream/north of Bailey Road, Chester]
CP01	Deerfield	Chapel Brook	[approximately 300 feet upstream of Main Poland Road, Conway]
WB01	Millers	Whetstone Brook	[approximately 160 feet downstream of Kentfield Road (Kempfield Road), Wendell]
WSR01	Chicopee	West Branch Swift River	[approximately 640 feet upstream from Cooleyville Road Extension, Shutesbury]
KING01	Chicopee	Kings Brook	[Route 67 crossing, Palmer]
PHB01	Nashua	Pearl Hill Brook	[approximately 2775 feet downstream/north from Vinton Pond Road, Townsend]
SAL01	Merrimack	Salmon Brook	[approximately 325 feet upstream/south of the Massachusetts/New Hampshire border, west of High Street, Dunstable]
MIL01[a]	Parker	Mill River	[approximately 4300 feet upstream/south of Glen Street, Rowley]
BOS01	Ipswich	Boston Brook	[approximately 900 feet upstream/west of Liberty Street, Middleton]
LIZ01	Concord	Great Brook	[north of Route 117, Bolton approximately 1400 feet upstream of mouth at inlet of Delaney Pond, Stow]
NOR01	Concord	North Brook	[approximately 2400 feet upstream/north of Randall Road, Berlin]
TR01	Nashua	Trout Brook	[approximately 140 feet upstream of Manning Street, Holden]
WBW01	Buzzards Bay	West Branch Westport River	[east of Route 81, Tiverton RI approximately 3500 feet upstream of the inlet of Grays Mill Pond, Little Compton, Rhode Island]
BCB01	Buzzards Bay	Bread And Cheese Brook	[approximately 980 feet downstream of Route 177, Westport]
RA00	Taunton	Rattlesnake Brook	[approximately 1300 feet upstream/east from Route 24/79 (Amvets Memorial Highway), Freetown]
EB01	Blackstone	Emerson Brook	[approximately 200 feet upstream of the Route 146 southbound off-ramp to Chocolog Road, Uxbridge]
RTB01	Blackstone	Round Top Brook	[approximately 1400 feet downstream/south from the confluence of Tinkerville Brook, Burriville, Rhode Island (approximately 1600 feet from MA/RI border)]

Table 3. Location of selected "reference/least disturbed" sites that were sampled in 2015 as part of the reference site network.

Site	Watershed	Waterbody	Site Description
BB01	Quinebaug	Browns Brook	[approximately 2120 feet upstream from May Brook Road, Holland]

a – Fish data not collected due to water depth.

Table 4. Sampling frequency of water quality and ecological variables measured at RSN sites.

Variable	Sample Frequency (Minimum)
Nutrients (TN,TP, Nitrate/Nitrite, Ammonia)	4
Color	4
Turbidity	4
Chloride	4
Dissolved Oxygen/Temperature Probe Deploys (May-September)	continuous
Habitat Assessment	1
Fish Community	1
Macroinvertebrate Community	1

***Water Quality (Physico-chemical)*:** Approximately monthly, from May to August, grab water samples were collected at each site, 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. A small number of nutrient and chloride samples were analyzed at a commercial laboratory when WES was experiencing instrumentation problems. In addition, water quality sondes were deployed *in-situ* from May to September to obtain long-term continuous temperature and dissolved oxygen data.

***Biological Monitoring (Macroinvertebrates, Fish, Habitat)*:** Benthic macroinvertebrate and fish community assessments, along with associated habitat evaluations, were performed to assess the *Aquatic Life Use* status and to support multiple program objectives, as described above. These communities integrate environmental conditions (chemical – including nutrients and toxics, and physical – including flow and water temperature) over extended periods of time and are excellent measures of a waterbody's overall "health".

The benthic macroinvertebrate community was sampled at each site once during the index period July through August using 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 performed once at each site during the late summer. 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.

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. Working from MassDEP's DWM-Worcester and Southeast Regional (SERO) offices, respectively, and in collaboration with MassDPH, staff biologists performed cyanobacterial counts and identifications on water samples to determine whether cell counts exceeded MassDPH advisory levels for recreational waters. Lab services and technical support were provided to State and Federal agency personnel and local public health officials. Phytoplankton samples were collected from several water bodies and taxonomic identifications and counts were forwarded to MassDPH for risk assessment and management. A list of water bodies from which MassDEP processed samples is presented in Table 5.

Waterbody	Municipality	Number of sampling events
White Oak Reservoir	Hanson	2
West Monponsett	Halifax/Hanson	14
East Monponsett	Halifax	6
Lake Quinsigamond	Worcester/Shrewsbury	4
Lake Attitash	Amesbury, Merrimac	3
Willis Lake	Sudbury	3
White Pond	Concord	1
Stetson Reservoir	Pembroke	2
Dean's Pond	Shrewsbury	1
Jamaica Pond	Boston (Jamaica Plain)	1
Blue Rock Golf Course Pond	South Yarmouth	1
Long Pond Reservoir/Falmouth Water Dept.	Falmouth	48
Cedar Pond	Orleans	1
Queen Sewell Pond	Bourne/Buzzards Bay Village	1
Savery Pond	Plymouth	3
Uncle Harvey's Pond	Orleans	1

Phycocyanin measurements were included as part of the cyanobacteria investigations conducted in 2015. Phycocyanin is a pigment found primarily in cyanobacteria. DWM staff are working to try to develop a predictable relationship between the cell count of cyanobacteria and phycocyanin levels so that phycocyanin can be used as a surrogate for cell counts. Cell counts and identifications require more skill and time than does obtaining phycocyanin readings; however, developing the database that is needed to relate cell count densities and phycocyanin readings is also time-consuming.

In 2015 efforts were focused on calibrating and testing various types of equipment for phycocyanin determinations. Instruments evaluated were a probe: Turner Designs (Cyclops) and two meters: Turner Designs Aquafluor and Beagle Bioproducts FluorQuik which is on loan from the EPA. This evaluation was confounded somewhat by the variation in sampling methods employed by the different agencies currently involved with the assessment and management of cyanobacteria blooms. For example, MassDEP and MADPH have adopted a sampling protocol for collecting and processing samples for phycocyanin and chlorophyll readings that differs from that being developed by the EPA Region 1 in conjunction with personnel from the New England states. The EPA uses a depth-integrated 1-meter sample for their phycocyanin and chlorophyll

readings, and the samples are frozen and thawed to break up the cyanobacteria cells before they are analyzed. MADPH uses a grab sample collected at a depth of 0.25 m for cyanobacteria counts. An effort was made to obtain phycocyanin readings that reflected these two different approaches. Counts and taxonomic identifications were performed on a subset of these samples. The number and kinds of samples that were analyzed for the presence of phycocyanin in 2015 is presented in Table 6.

Plans are under development to include phycocyanin measurements at drinking water facilities and reservoirs for screening purposes and as part of routine monitoring efforts. Currently, the MassDEP 'FAST' vehicle at NERO is being utilized to respond to emergency requests for assistance regarding possible cyanobacteria blooms. The vehicle is equipped with a Turner Designs (Cyclops) probe. The 'FAST' vehicle was used during the summer of 2015 to respond to a bloom at Jamaica Pond in Boston.

Table 6: The number of phycocyanin and chlorophyll measurements carried out in the field and lab using the various instruments and sampling protocols under evaluation

Waterbody	**Cyclops Probe**	**Aquafluor**				**Beagle**				**Extracted Chlorophyll a**	
	Integrated	Integrated		Grab		Integrated		Grab		Integrated	Grab
		Field	Frozen	Field	Frozen	Field	Frozen	Field	Frozen		
White Oak Reservoir	1	1	0	0	0	1	0	0	0	0	1
Lake Quinsigamond	4	3	2	0	1	3	2	1	1	1	1
Lake Attitash	3	2	2	0	1	2	2	0	1	1	3
Willis Lake	4	1	3	1	0	1	4	1	0	2	3
White Pond	1	1	0	0	0	0	0	0	0	0	1
Stetson Reservoir	1	1	0	0	0	1	0	0	0	0	1
Dean's Pond	1	0			1	0	0	0	0	0	1
Jamaica Pond	1	0	1	0	0	0	0	0	0	0	2
Total sampling events	**16**	**9**	**8**	**1**	**3**	**8**	**8**	**2**	**2**	**4**	**13**

Fish Toxics Monitoring: DWM completed fish sampling at six sites at the recommendation of the Inter-agency Fish Toxics Committee (Table 7). Edible fillets from fish collected at all six waterbodies were analyzed for the presence of mercury, and samples from Spicket River/Stevens Pond and Lake Waban were also scheduled for the analysis of additional heavy metals. Finally, samples from Spicket River/Stevens Pond were also analyzed for PCB and organochlorine pesticides. If necessary, fish consumption advisories will be issued by the Massachusetts Department of Public Health (MassDPH).

Table 7. 2015 fish toxics monitoring sites.

Watershed	**Monitoring Site Description**
Charles	Lake Waban (Wellesley)
Concord	Farrar Pond (Lincoln)
French	Sargents Pond (Leicester)
Housatonic	Richmond Pond (Richmond/Pittsfield)
Merrimack	Spicket River/Stevens Pond (Lawrence)
Quinebaug	Big Alum Pond (Sturbridge)

Lake Monitoring: Baseline lakes sampling in the summer of 2015 focused on monitoring East and West Monponsett ponds in Halifax as the next likely targets for TMDL development. Because White Oak Reservoir and Stetson Pond (both also thought to be impaired) are in the same greater Monponsett watershed they were also included in the sampling plan and such data will be used to develop an overall TMDL for all ponds. Sampling consisted of four monthly visits to each lake and nutrient samples were also collected from inlet streams. Data collection focused on total phosphorus and total nitrogen. Secchi disk transparency, color, chlorophyll *a* and multi-probe data were also collected. Blooms of cyanobacteria were identified and counted and results passed on to MassDPH for evaluation and, where applicable, public advisories against swimming or contact due to toxic cyanobacteria.

Monitoring to Assess Climate Change: DWM staff continued to monitor air and water temperature and collect macroinvertebrate samples at five sites in Massachusetts as part of an ongoing collaborative effort among multiple federal and state agencies, NGOs, and academic institutions across New York and New England to assess the effects of climate change in the Northeast. Spearheaded by the EPA, this effort is aimed at coordinating temperature and biological data collection across the region. Similar "regional" collaborations have been established across the country.

In Massachusetts the five sites are Hubbard River in Granville, Brown's Brook in Holland, Parker's Brook in Oakham, West Branch Swift River in Shutesbury, and Cold River in Florida. UMass/Amherst and MassWildlife's Division of Ecological Restoration (DER) are the other partners on the "Massachusetts Team." DER has installed flow-gaging equipment at the three sites without USGS gages and is developing flow rating curves for them. UMass is playing a coordinating role and also plans to address the fisheries component.

Bacteria Source Tracking Activities of the Southeast Regional Office (SERO): The DWM regional monitoring coordinator, aided by a seasonal employee, 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 in Table 8.

Highlights of the 2015 sampling season

- The successful multi-year partnership with the City of Brockton continued with joint source tracking efforts, discovery of multiple new sources and corrections within the

drainage infrastructures, influencing Trout Brook, Lovett Brook, Salisbury Brook and Salisbury Plain River.

- The successful multi-year partnership with the City of Norwood continued with:

    - As a result of City work to actively investigate the Arcadia Road drainage area (tributary to Hawes Brook) for sources highlighted by SEROBST in 2013, three houses were discovered to have their sanitary sewer directly connect to the drain. These homes were reconnected to the sewer line. SEROBST follow up samples suggest that there have been significant improvements in water quality during dry weather conditions at the arcadia road drainage outfalls compared to 2010/2011.

- The partnership with EPA Region-1 and Rhode Island DEM continued into this year, with the goal of conducting bacteria source tracking throughout the Palmer River Watershed.

    - SEROBST and RIDEM partnered to conduct a tidal study in September in the lower section of the watershed between Reed Street and Old Providence Street. Samples collected and tested for E.coli, Enteroccocus and Fecal coliform at eight stations at high, ebb and low tide, to study the changes in concentrations and consider the ramifications of that data for eliminating sources of bacteria in the watershed.
    - SEROBST focused source tracking efforts on Torrey Creek, Fullers Brook and an unnamed tributary to the upper-Palmer with some suspected agricultural sources. Samples were collected for Human Marker analysis to clarify the nature of the source(s) on Torrey Creek. Clear indications of agricultural impacts were observed on the unnamed tributary between Colonial Way and Pine Street, this information was shared with NRCS and MACD.

- The successful partnership with the City of Taunton continued:

    - A direct toilet connection to the brook was removed in late 2014. Follow-up samples on Cobb Brook suggest that there have been improvements in water quality during dry weather conditions at the bottom of the brook (West Water Street) compared to 2011/2012.
    - A hotspot area discovered on an unnamed tributary to the Mill River related to a drainage area on Warren Street was investigated by the City of Taunton and it was discovered that the sanitary sewer for an adjacent residence was discharging directly to the stream under Warren Street. Follow up samples suggest that there have been significant improvements in water quality during dry weather conditions downstream of Warren Street compared to 2014.
    - Joint source tracking efforts (SEROBST & City) on Weir Street (Mill River drainage) highlighted significant improvements in water quality of dry weather flow originating on Weir Street since 2008 and 2011. One remaining source was tracked to an area in close proximity to the bridge; the City will be further investigating and correcting this source.

- Due to continued concerns communicated by beach association members over swimming beach closures at “Briarwood Beach” (on the Weweantic River), SEROBST collected one additional round of samples in the beach area on an outgoing tide in July. Bacteria

concentrations were very low. Communication was maintained with the Town of Wareham DPW over suspected issues with laterals and I&I in the beach area. SEROBST also engaged in dialogue with concerned locals about the possibilities of large qualities of caterpillar fecal matter "frass" being a potential source of bacteria to the beach.

- Based on freshwater beach closure data, a dialogue was started with the City of North Attleboro regarding Falls Pond and Whitings Pond. The city shared maps and drain outfall location information to facilitate a SEROBST dry weather outfall survey and sampling effort. This effort ruled out the presence of dry weather sources of bacteria entering the ponds via the stormdrains and the few private drainage pipes observed.

- Five new watersheds underwent baseline sampling for bacteria source tracking. Significant hotspots were identified on the Kickamuit River at Old Warren rd (samples for human marker analyses were submitted at the end of the summer) and Labor in Vain Creek at Marsh Street (watershed for Peirce Beach, suffering numerous dry weather closures).

Table 8. Subwatersheds where bacteria source tracking was conducted over the course of approximately 40 sample days. Note: This table includes only the names of those municipalities where sampling took place and new sub-watersheds are highlighted in **bold.**

Name	Basin	Segment	Municipalities sampled	Number of sample days
Falls pond & Whitings pond	**Ten Mile**	**52-02_2012**	**North Attleboro**	**2**
Speedway Brook	Ten Mile River	52-05_2006	Attleboro	4
Sevenmile River	Ten Mile River	52-08_2006	Attleboro & Pawtucket	4
Runnins River	Narragansett Bay	53-01_2006	Seekonk	2 + Human Marker
Palmer River	Narragansett Bay	53-05_2006	Seekonk & Rehoboth	4
Fullers Brook	Narragansett Bay	53-12_2006	Rehoboth	3
Clear Run Brook	Narragansett Bay	53-15_2006	Rehoboth	
Rocky Run Brook	Narragansett Bay	53-16_2006	Rehoboth	4 + Human Marker
Torrey Creek	Narragansett Bay	53-17_2010	Rehoboth	4 + Human Marker
Coles River	**Mount Hope Bay**	**61-04_2006**	**Swansea**	**3**
Kickamuit River	**Mount Hope Bay**	**61-08_2006**	**Swansea**	**4**+ Human Marker
Taunton River	Taunton	62-02_2006	Taunton	1
Labor In Vain Creek	**Taunton**	**62-04_2006**	**Somerset**	**3**
Salisbury Plain River	Taunton	62-05_2006	Brockton	2
Trout Brook	Taunton	62-07_2006	Brockton	5
Salisbury Brook	Taunton	62-08_2006	Brockton	7
Mill River	Taunton	62-29_2006	Taunton	4 + Human Marker
Matfield River	**Taunton**	**62-32_2006**	**East Bridgewater**	**3**
Cobb Brook	Taunton	62-43_2006	Taunton	2
Lovett Brook	Taunton	62-46_2010	Taunton	2

School Meadow Brook	**Neponset**	**73-06_2006**	**Walpole**	**3**
Hawes Brook	Neponset	73-16_2006	Norwood	2
Germany Brook	Neponset	73-15_2006	Norwood	1
Plantingfield Brook	Neponset	73-23_2006	Norwood	1 + Human Marker
Steephill Brook	**Neponset**	**73-32_2006**	**Stoughton**	**3**
French Stream	South Coastal	94-03_2008	Hanover	1
Weweantic River	Buzzards Bay	95-05_2006	Wareham	1