Massachusetts Department of ENVIRONMENTAL PROTECTION

2011 DWM ENVIRONMENTAL MONITORING OVERVIEW

(CN 334.0)

A brief overview of the surface water monitoring performed in 2011 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/dep/water/resources/envmonit.htm.

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 (2010 – 2014). 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.

Since 1992, water quality monitoring, assessment and management activities of the MassDEP have been sequentially performed in accordance with a rotating five-year watershed schedule. Surface waters are typically monitored during "Year Two" of this cycle by the DWM Watershed Planning Section. While the DWM will continue to monitor in accordance with a five-year rotating schedule, the makeup of the watershed groups that are the focus of monitoring each year was adjusted in 2009 to more efficiently focus limited resources in the field and laboratory, and to respond to evolving requirements of the Environmental Protection Agency (EPA) for surface water data and related information to support reporting under the Clean Water Act (CWA). An explanation of how and why the new watershed alignment was established is presented at http://www.mass.gov/dep/water/resources/swmonadj.htm. While the watersheds were originally arranged to evenly distribute the administrative workload (i.e., permit issuance) from year to year, the water resources to be monitored (i.e., river miles) were not equitably distributed and were scattered throughout the Commonwealth. The new alignment balances the allocation of monitoring resources each year and focuses them more efficiently in one region.

The 2011 surface water monitoring program continued the implementation of the statistically valid sampling design for Massachusetts' shallow (i.e., "wadeable") 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, DWM's surface water monitoring efforts in 2011 focused primarily on the implementation of the probabilistic wadeable stream survey, with much less attention given to deterministic monitoring activities. All of the monitoring activities of the DWM in 2011 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 wadeable (i.e., 1^{st} – 4^{th} 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 wadeable stream miles supporting and not supporting their designated uses. To implement the survey, Massachusetts' 1^{st} – 4^{th} order streams were apportioned into five separate groups or strata, one of which – the "Central" – was the focus of monitoring in 2011. The Central Group comprises the Blackstone, French, Millers, Nashua, Quinebaug and Ten Mile watersheds. A new group will be monitored in each of the next four years to complete the realigned watershed cycle and provide statewide coverage after 5 years.

A total of 36 sites were monitored in 2011 (Table 1). The sites were divided into four 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 "Central" region of Massachusetts that were sampled in 2011 as part of the probabilistic wadeable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-002	Millers	Mahoney Brook	[approximately 340 feet downstream from Betty Spring Road, Gardner]
MAP2-004	Ten Mile	Sevenmile River	[approximately 440 feet downstream from Roy Avenue, Attleboro]
MAP2-007	Nashua	Monoosnoc Brook	[approximately 475 feet downstream from Mechanic Street, Leominster]
MAP2-008[a]	Blackstone	Dark Brook	[approximately 620 feet upstream from Inwood Road, Auburn]
MAP2-012	Blackstone	Mumford River	[approximately 2580 feet downstream from Main Street, Sutton]
MAP2-013[c]	Millers	West Gulf Brook	[approximately 440 feet downstream from Gulf Road, Athol]
MAP2-015	Quinebaug	Breakneck Brook	[approximately 5290 feet downstream from MA/CT state line, Sturbridge]
MAP2-018[b]	Blackstone	Tatnuck Brook	[unnamed tributary eventually to Tatnuck Brook, approximately 175 feet upstream from Chapin Road, Holden]
MAP2-023	Nashua	Catacoonamug Brook	[approximately 40 feet upstream from Pond Street, Shirley]
MAP2-024	French	UNT of South Fork River	[unnamed tributary eventually to South Fork, approximately 140 feet from outlet of Granite Reservoir, Charlton]
MAP2-026[d]	Blackstone	Quinsigamond River	[Brigham Hill Road, Grafton]
MAP2-027[d]	Quinebaug	Cady Brook	[at the confluence with the Quinebaug River, Southbridge]
MAP2-030	Nashua	Whitman River	[approximately 200 feet downstream from Route 2A (State Road East), Westminster]
MAP2-031	Quinebaug	Stevens Brook	[approximately 510 feet downstream from the Old Stafford Road crossing nearest Howlett Road, Holland]
MAP2-032	Blackstone	Peters River	[approximately 1300 feet upstream from Wrentham Road, Bellingham]
MAP2-033[a]	Millers	Jacks Brook	[approximately 175 feet upstream from North Street, Erving]
MAP2-035	Nashua	Whitman River	[approximately 50 feet upstream from Whitmanville Road, Westminster]

Table 1. Location of randomly selected sites in the "Central" region of Massachusetts that were sampled in 2011 as part of the probabilistic wadeable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-037	Millers	UNT to Millers River	[unnamed tributary, outlet Lake Watatic/inlet Lower Naukeag Lake, approximately 70 feet downstream of Cross Road, Ashburnham]
MAP2-041	Millers	West Branch Tully River	[approximately 1200 feet downstream from the Tully Road crossing nearest Creamery Hill Road, Orange]
MAP2-043	Quinebaug	West Brook	[approximately 600 feet upstream from Palmer Road (Route 20), Brimfield]
MAP2-045	Millers	Ellinwood Brook	[approximately 4500 feet upstream from South Athol Road, Athol]
MAP2-046	Nashua	North Nashua River	[approximately 200 feet downstream from Mill Pond #1 Dam (MA00877), Fitchburg]
MAP2-047[c]	French	Little River	[unnamed tributary to Pikes Pond approximately 650 feet upstream from the Massachusetts Turnpike (Rt90), Charlton]
MAP2-049	Millers	North Pond Brook	[approximately 4200 feet upstream of the onramp - Holtshire Road to Route 2 eastbound, Orange]
MAP2-050	Blackstone	Middle River	[approximately 1200 feet downstream from Fremont Street, Worcester]
MAP2-055	Nashua	Bowers Brook	[approximately 830 feet downstream from West Lancaster Country Road, Harvard]
MAP2-059	Quinebaug	UNT to Quinebaug River	[unnamed tributary eventually to the Quinebaug River approximately 900 feet upstream from the Massachusetts Turnpike (Route 90), Sturbridge]
MAP2-060	Blackstone	Bacon Brook	[approximately 700 feet upstream from River Road, Uxbridge]
MAP2-066	Blackstone	Kettle Brook	[approximately 425 feet upstream of Stafford Street, Worcester]
MAP2-067	Nashua	UNT to Phillips Brook	[unnamed tributary to Phillips Brook, Potato Hill Road, Westminster]
MAP2-068	Ten Mile	Ten Mile River	[approximately 2780 feet downstream from Pond Street, Seekonk]
MAP2-069	Millers	Millers River	[approximately 3430 feet downstreeam from the Route 12 crossing nearest North Ashburnham Road, Winchendon]
MAP2-071	Nashua	Wekepeke Brook	[approximately 160 feet upstream of the Route 190 crossing in Lancaster]
MAP2-072[d]	French	Wellington Brook	[approximately 1275 feet upstream of Main Street (Route 12), Oxford]
MAP2-075	Quinebaug	Hatchet Brook	[Dennison Cross Road, Southbridge]

Table 1. Location of randomly selected sites in the "Central" region of Massachusetts that were sampled in 2011 as part of the probabilistic wadeable stream survey.

Site	Watershed	Waterbody	Site Description
MAP2-077	Millers	Stockwell Brook	[approximately 230 feet upstream of Norcross Road, Royalston]

a – Fish population data not collected at these sites due to unsafe sampling conditions.
b – Macroinvertebrate community data not collected at these sites due insufficient water.
c – Included periphyton sampling
d – Included periphyton sampling and chlorophyll analysis

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

Variable	Sample Frequency (Minimum)
Bacteria (*E. coli*)	**6**
Nutrients (TN,TP, Nitrate/Nitrite, Ammonia)	5
Color	5
Turbidity	5
Chloride	5
Metals	3
Dissolved Oxygen Probe Deploys (48-120 hours)	3
Temperature Probe Deploys (July-September)	1
Habitat Assessment	1
Fish Community	1
Macroinvertebrate Community	1
Periphyton/Chlorophyll (selected sites only)	1

Individual components of the wadeable 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 in Lawrence (WES) for nutrient (total phosphorus, total nitrogen and ammonia nitrogen) and *E. coli* analysis and the DWM lab in Worcester for E. coli, turbidity and color analysis. A sixth sampling event for *E. coli* only was also performed.

On three separate occasions, multi-probed water quality sondes were deployed in-situ for a minimum of 48 hours to obtain continuous analyses for temperature, dissolved oxygen, percent oxygen saturation, pH, specific conductance, and total dissolved solids. In addition, temperature sensors were deployed at all sites from June through September to obtain long-term, continuous water temperature data.

Samples for the analysis of dissolved metals were collected from each site on three occasions by personnel of the USEPA using wade-in, clean-hands techniques. Samples were filtered in the field and transported to the USEPA's New England Regional Laboratory (NERL) in Chelmsford for analysis.

***Biological Monitoring (Macroinvertebrates, Fish, Habitat)*:** Benthic macroinvertebrate and fish community assessments, along with associated habitat evaluations, were performed at each site 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 an excellent measure of a waterbody's overall "health". Standard RBP habitat assessments were completed during both the invertebrate and fish sampling events.

The benthic macroinvertebrate community was sampled at each site once during the months of July and 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. 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 all but two sites 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 reach.

DETERMINISTIC ("TARGETED") MONITORING PROGRAM (TMP) – Although the majority of DWM's monitoring efforts in 2011 were focused on the probabilistic wadeable stream survey described above, some waterbodies were selected, or "targeted", for monitoring activities designed to fulfill the needs for specific data and information to support such program elements as 303(d) Listing, TMDL calculation, criteria development and human health risk assessment. While some targeted monitoring activities were focused in the Central Group of watersheds in accordance with the rotating watershed schedule, other monitoring work was carried out in watersheds throughout Massachusetts. More detail pertaining to the targeted monitoring activities of the DWM in 2011 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 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 (Table 3) were chosen for intensive study over three years, beginning in 2011. 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 at the end of the project. Monitoring activities included habitat assessment; macroinvertebrate, fish and algal population (selected sites) 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 2011 as part of the reference site network.

Site	Watershed	Waterbody	Site Description
CR01[ac]	Deerfield	Cold River	[approximately 325 feet upstream of Mohawk Trail (Route 2), Florida/Savoy (upstream of Black Brook confluence)]
WSR01[d]	Chicopee	West Branch Swift River	[approximately 640 feet upstream from Cooleyville Road Extension, Shutesbury]
WB01[d]	Millers	Whetstone Brook	[approximately 160 feet downstream of Kentfield Road (Kempfield Road), Wendell]
TR01[d]	Nashua	Trout Brook	[approximately 140 feet upstream of Manning Street, Holden]
SB01[e]	Westfield	Sanderson Brook	[Sanderson Brook Road bridge nearest Route 20, Chester]
PB01	Westfield	Pond Brook	[approximately 275 feet upstream of Beech Hill Road, Blandford]
SC01[c]	Connecticut	Scantic River	[approximately 2330 feet upstream of Chapin Road, approximately 40 feet upstream of the confluence of the unnamed tributary from Goodwill Pond), Hampden]
BB01	Quinebaug	Browns Brook	[approximately 2120 feet upstream from May Brook Road, Holland]
RB01[b]	Blackstone	Rocky Brook	[in Douglas State Forest approximately 350 feet downstream of footbridge on the unnamed easterly extension of High Street, Douglas]
BK01[b]	Blackstone	Unnamed Tributary	[unnamed tributary to Whitin Reservoir approximately 975 feet downstream from the "Ridge Trail" in the Douglas State Forest, Douglas]

a – Fish population data not collected at these sites due to unsafe sampling conditions.
b – Macroinvertebrate community data collected only in April/May.
c – Macroinvertebrate community data collected only in July/August.
d – Included periphyton sampling
e – Included periphyton sampling and chlorophyll analysis

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

Variable	Sample Frequency (Minimum)
Nutrients (TN,TP, Nitrate/Nitrite, Ammonia)	3
Color	3
Turbidity	3
Chloride	3
Dissolved Oxygen Probe Deploys (48-120 hours)	1
Temperature Probe Deploys (May-October)	1
Habitat Assessment	1
Fish Community	1
Macroinvertebrate Community	2
Periphyton/Chlorophyll (selected sites only)	1

***Water Quality (Chemical, Microbiological and Physical)*:** Each month, from June 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 and ammonia nitrogen) analysis and the DWM lab in Worcester for turbidity and color analysis.

On one occasion, multi-probed water quality sondes were deployed in-situ for a minimum of 48 hours to obtain continuous analyses for temperature, dissolved oxygen, percent oxygen saturation, pH, specific conductance, and total dissolved solids. In addition, temperature sensors were deployed at all sites from May through October to obtain long-term, continuous water temperature data.

***Biological Monitoring (Macroinvertebrates, Fish, Habitat)*:** Benthic macroinvertebrate and fish community assessments, along with associated habitat evaluations, were performed at each site 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 an excellent measure of a waterbody's overall "health". Standard RBP habitat assessments were completed during both the invertebrate and fish sampling events

The benthic macroinvertebrate community was sampled twice at each site once during the months of April and May and again in July and 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. 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 all but two sites 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 reach.

Periphyton Sampling to Support Resource Assessment and Criteria Development: This ongoing pilot program is evaluating the efficacy of using periphyton community attributes as indicators of instream nutrient levels and gathering data in support of resource assessment and nutrient criteria development. The focus of sampling in 2011 differed from previous DWM investigations that focused primarily on defining the relationship between benthic algal areal coverage and/or biomass and in-stream nutrient concentrations over a range of impairment levels. Instead, a consulting laboratory was retained to perform diatom analyses (i.e., counts, biovolume, speciation and statistics) on stream samples, thus shifting the emphasis from algal production to community statistics and, in some cases, indicator species. Furthermore, an attempt was made to sample mostly reference streams, as these have been underrepresented in the past in DWM's biological community assessments. With "Irene" and other tropical storms affecting the representativeness of some sampling locations, however, four sites from the Reference Site Network (Table 3) and five sites from the Probabilistic Monitoring and Assessment Program (Table 1) were chosen for diatom sampling. It is hoped that increased knowledge of diatom community structure, at both reference and potentially impaired sites, will support aquatic life use assessments and complement similar assessment techniques that rely on fish and macroinvertebrate community characteristics. Finally, chlorophyll a analysis – a surrogate for algal biomass – and percent algal cover estimates were conducted primarily at the probabilistic sites evaluated. Both of these parameters continue to be tested for use in aquatic life and recreational use assessments.

Field and Lab Support for the Assessment and Management of Nuisance Algae:
Investigations pertaining to nuisance algae focused on the non-native species, Didymosphaerium *geminata* (didymo) and toxic cyanobacteria blooms. These are briefly described below.

***Didymosphaenia* (didymo)**

While didymo has not yet been found in Massachusetts' waters, its presence has been confirmed in adjacent states. In May, 2011 the DWM sampled four sites along the West Branch Farmington River following confirmed reports of this nuisance diatom occurring downstream from Colebrook River Lake, an impounded section of the river in Connecticut (Table 5). Sampling was repeated in September at three of the sites. Didymo was not found in samples collected on either date from any of the sampling sites.

Table 5: Location and dates of sampling in 2011 for the presence of *Didymosphaerium geminata* (didymo) in the West Branch Farmington River.

	Sampling Dates	
Site Description	**May 9**	**September 28**
Base of Ed Jones Dam, Haydn Pond Road, Otis	X	X
Reservoir Road and Route 8, Otis	X	X
Tolland State Park, Sandisfield	X	--
Clark Road, Sandisfield	X	X

Cyanobacteria Bloom Investigations

In 2011, MassDEP once again had the services of two trained biologists to provide technical expertise and laboratory support to 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, both biologists performed cyanobacterial counts and identifications on water samples to determine whether cell counts exceeded MassDPH advisory levels for recreational waters. As in the past, lab services and technical support were provided to the Massachusetts Department of Conservation and Recreation (MassDCR) and Charles River Watershed Association (CRWA) in support of the annual Charles River Swim, although the lack of a cyanobacterial bloom there this summer meant that no samples were analyzed by MassDEP. In addition, samples were received from other state and federal agency personnel as well as local public health officials. All taxonomic identifications and counts were forwarded to MassDPH for risk assessment and management. Where applicable, MassDPH health advisories were issued. A list of waterbodies from which MassDEP processed samples is presented in Table 6.

Table 6. Waterbodies from which algae samples were obtained and delivered to MassDEP biologists for taxonomic identifications and counts. Results were submitted to MassDPH.

Waterbody	Municipality
Middle Pond	Barnstable
Mystic Lake	Barnstable
Wequaquet Lake	Barnstable
Shubael Pond	Barnstable
West Monponsett[a]	Halifax[b]
East Monponsett	Halifax
West Monponsett Pond	Halifax
Haynes Reservoir[a]	Leominster
Sassaquin Pond	New Bedford
Oldham Pond	Pembroke
Great Sandy Bottom Pond[a]	Pembroke[c]
Long Pond	Plymouth
Savery Pond	Plymouth
White Island Pond	Plymouth
Sandra Pond[a]	Westborough

a – public water supply
b – backup supply that is occasionally diverted to Silver Lake, principal supply to the City of Brockton
c – Abington/Rockland joint waterworks

Bacteria Sampling to Support 303(d) Listing and the TMDL Program: The goal of this sampling effort was to collect sufficient pathogen data at 26 sites (Table 7) on 10 assessment segments in the Central Basin Group to evaluate whether those segments should remain on the 303(d) list. Approximately once a month from May to October, 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) or the DWM lab in Worcester for E. coli analysis. A minimum of six samples were collected at each site over the course of the summer. All

sampling and QA/QC was performed in accordance with the DWM's standard operating procedures, QAPP and SAP.

Table 7. Location of sites in the "Central" region of Massachusetts that were sampled in 2011 as part of the targeted monitoring to support 303(d) Listing and the TMDL Program.

Site	Watershed	Segment	Waterbody	Site Description
MI202	Millers	MA35-01	Millers River	[Route 202, Winchendon]
MR01	Millers	MA35-01	Millers River	[approximately 720 feet upstream of River Street (approximately 100 feet upstream of the Winchendon WWTP discharge), Winchendon]
MR02	Millers	MA35-04	Millers River	[near the southern end of Bearsden Road, approximately 190 feet downstream from the confluence of Gulf Brook, Athol]
MI08	Millers	MA35-04	Millers River	[Route 2A bridge, Athol]
MI07	Millers	MA35-04	Millers River	[Daniel Shays Highway bridge, Athol]
MR03	Millers	MA35-04	Millers River	[South Main Street (Route 122), Orange]
MI05A	Millers	MA35-04	Millers River	[Holtshire Road bridge, Orange]
M06	Millers	MA35-08	Otter River	[immediately downstream of Route 202 bridge, Templeton]
M07	Millers	MA35-08	Otter River	[abandoned RR bridge (approximatley 0.2 miles upstream from confluence with Millers River), Winchendon]
BB01	Millers	MA35-09	Beaver Brook	[Freight Shed Road (south of Route 68), Templeton/Phillipston]
BB02	Millers	MA35-09	Beaver Brook	[Birch Hill Dam Road, Royalston]
QR01	Quinebaug	MA41-01	Quinebaug River	[upstream of Sturbridge WWTP on the Old Sturbridge Village access road (Stallion Hill Road), Sturbridge]
QR00	Quinebaug	MA41-01	Quinebaug River	[Holland Road bridge, Sturbridge.]
QR02	Quinebaug	MA41-01	Quinebaug River	[East Brimfield Road, Holland]
QR03	Quinebaug	MA41-01	Quinebaug River	[Holland East Brimfield Road, Brimfield]
QR09	Quinebaug	MA41-03	Quinebaug River	[at Dresser Hill Road bridge, downstream of the Southbridge WWTP, Southbridge]
QR04	Quinebaug	MA41-03	Quinebaug River	[approximately 3650 feet downstream from Dresser Hill Road (approximately 250 feet downstream of the confluence of the unnamed tributary exiting Sylvestri Pond), Dudley]
CA03	Quinebaug	MA41-05	Cady Brook	[at Route 20 bridge, Charlton, upstream of Charlton WWTP discharge]
FR01	French	MA42-05	French River	[approximately 200 feet downstream from Brandon Road, Webster]

Table 7. Location of sites in the "Central" region of Massachusetts that were sampled in 2011 as part of the targeted monitoring to support 303(d) Listing and the TMDL Program.

FR94-10	French	MA42-06	French River	[downstream of the Perryville Dam and downstream of the Webster-Dudley WWTP, Perryville Rd. bridge, Webster]
KB09	Blackstone	MA51-01	Kettle Brook	[Auburn Street, Leicester]
KB11	Blackstone	MA51-01	Kettle Brook	[Rockland Road, Auburn]
KB02	Blackstone	MA51-01	Kettle Brook	[Webster Street, Worcester. (Outlet Leesville Pond, inlet Curtis Pond, tributary to Middle River.)]
MD01	Blackstone	MA51-02	Middle River	[Walmart bridge crossing, Worcester]
MD02	Blackstone	MA51-03	Blackstone River	[Approx. 1000 feet Downstream Mill Brook confluence with Blackstone, Worcester]
MB01	Blackstone	MA51-08	Mill Brook	[Mill Brook outfall, Worcester]

Fish Toxics Monitoring: DWM completed fish sampling at three sites at the recommendation of the Inter-agency Fish Toxics Committee (Table 8). Edible fillets from fish collected at all three waterbodies were analyzed for the presence of mercury. Samples from Horn 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 8. 2011 fish toxics monitoring sites.

Watershed	Monitoring Site Description
Chicopee	Browning Pond (Oakham/Spencer)
Buzzards Bay	Copicut Reservoir (Dartmouth/Fall River)
Mystic	Horn Pond (Woburn)

Lake Monitoring: Baseline lakes sampling in the summer of 2011 focused on follow-up monitoring of the East and West White Island Pond in Plymouth as implementation of the TMDL. In addition, DWM sampled East and West Monponsett ponds in Halifax as the next likely targets for TMDL development. Data from this sampling effort will support a pre-draft TMDL for these lakes and also may be used for regulatory purposes. Sampling consisted of three monthly visits to each lake and samples were also collected from inlet streams and observations were made of duckweed on White Oak Reservoir. 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. Occasional sampling by SERO staff of other lakes for toxic cyanobacteria blooms was conducted on an as-needed basis to identify species and measure cell densities.

MassDEP and EPA staff also conducted a plant survey of Bare Hill Pond in Harvard as a follow up to the TMDL. MasDEP and the town of Plymouth staff conducted a shoreline sample and evaluation of Savery Pond in Plymouth in response to a complaint about a nuisance bloom on a

lake with a cranberry bog discharge.

Fish Kill Investigation: Field assistance was provided to the MassDEP Northeast Region (NERO) and the Division of Fisheries and Wildlife in the investigation of a fish kill at Waushacum Pond (Framingham/Ashland).

Bacteria Source Tracking Activities of the Southeast Region (SERO): The DWM regional monitoring coordinator, assisted by additional regional staff members, used the IDEXX quanti-tray system on-site in the Southeast Region lab, to determine the concentration of indicator bacteria in surface water and outfall samples (see Table 9). In addition, Hach test kits were sometimes utilized to determine detergent concentrations at sample locations. 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 follow-up analyses (i.e. for 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.

A trial "wet weather" sampling effort was conducted in partnership with EPA-region 1 at stormwater outfalls discharging to Provincetown Harbor. This effort was made in an attempt to help the town identify which outfalls were the biggest contributors of bacterial pollution to the harbor during a storm event.

A trial "BST for lakes & ponds" effort was also begun in 2011. Upon request from regional and municipal contacts, sampling was conducted at Sassaquin Pond (New Bedford) and Monponsett Pond (Halifax/Hanson) for bacteria at stormwater outfalls and at set locations along the shoreline of the ponds, in an attempt to identify the presence of faulty septic systems and measure their impact (in terms of bacterial pollution) on the ponds. In addition, additional samples, measurements and observations were collected at Sassaquin Pond to provide "survey data" to the DWM Lakes and Ponds program.

The SERO-BST program worked alongside an ecologist from the MIT Sea Grant College Program (for sampling and deciphering of data) and with WES State Lab (for analyses) to get Nitrate/Nitrite and Total Nitrogen data for a number of sample stations in the Jones River watershed, alongside BST E.coli and Enterococcus data. The reasoning behind the collection of Nitrogen data was that evidence of nutrient enrichment and impairment had been reported for several reaches and water bodies in the Jones River watershed. It was deemed worthwhile to conduct a preliminary survey of nitrogen concentrations in these waters to (1) identify any problem reaches that might exist, and (2) guide the design of more comprehensive sampling and source tracking efforts.

Table 9. 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
Ten Mile River	Ten Mile	MA52-02	North Attleboro	1
Speedway Brook	Ten Mile	MA52-05	Attleboro	3
Bungay River	**Ten Mile**	**MA52-06**	**Attleboro**	**2**
Rocky Run Brook	Narragansett/Mt. Hope Bay	MA53-16	Rehoboth	4
Lee River	Narragansett/Mt. Hope Bay	MA61-01	Swansea	4
Taunton River (Tributary Cobb Brook)	Taunton	MA62-02	Taunton	1 + 1 Human Marker
Trout Brook	Taunton	MA62-07	Brockton	4 + 1 Human Marker
Salisbury Brook	Taunton	MA62-08	Brockton	3 + 1 Smoke testing
Mill River	Taunton	MA62-29	Taunton	4
Meadow Brook	Taunton	MA62-38	East Bridgewater	1 + 1 Dye testing
Lovett Brook	Taunton	MA62-46	Brockton	1 + 1 Smoke testing
Muddy Cove Brook	**Taunton**	**MA62-51**	**Dighton**	**2**
Three Mile River	**Taunton**	**MA62-57**	**Dighton & Taunton**	**3**
Monponsett Pond	**Taunton**	**MA62218**	**Halifax & Hanson**	**1**
Hawes Brook	Boston Harbor	MA73-16	Norwood	3
Weymouth Back River	Weymouth & Weir	MA74-13	Weymouth	2
South River	South Coastal	MA94-09	Marshfield	1 Human Marker
Jones River	**South Coastal**	**MA94-14**	**Kingston**	**2 + 1 Human Marker**
Buttonwood Brook	Buzzards Bay	MA95-13	New Bedford	3
Mattapoisett Harbor	Buzzards Bay	MA95-35	Mattapoisett	2 + 1 Human Marker
East Branch Westport River	Buzzards Bay	MA95-41	Westport	1 + 1 Human Marker
Agawam River	**Buzzards Bay**	**MA95-29 & MA95-28**	**Wareham**	**1 each**
Sassaquin Pond	**Buzzards Bay**	**MA62232**	**New Bedford**	**2**
Provincetown Harbor	**Cape Cod**	**MA96-29**	**Provincetown**	**3**