Massachusetts Department of ENVIRONMENTAL PROTECTION

2010 DWM ENVIRONMENTAL MONITORING OVERVIEW

(CN 333.0)

A brief overview of the surface water monitoring performed in 2010 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.

In addition to the new watershed configuration, the 2010 surface water monitoring program featured the implementation of a new, statistically valid sampling design for Massachusetts' shallow (i.e., "wadeable") streams. The EPA has been strongly encouraging all states nationwide 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 recent loss of both full-time and seasonal monitoring personnel, however, DWM's assessment monitoring efforts in 2010 were limited to the implementation of the probabilistic wadeable stream survey. These efforts are described below.

PROBABILISTIC WADEABLE STREAM SURVEY – 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 "Northeast" – was the focus of monitoring in 2010. 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 29 sites were monitored in 2010 (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 "Northeast" region of Massachusetts that were sampled in 2010 as part of the probabilistic wadeable stream survey.

Site	Watershed	Waterbody	Site Description
MA09A-101	Merrimack	South Branch Souhegan River	Approximately 2200 feet downstream of Jones Hill Road, Ashby
MA09A-105	Concord	Cold Harbor Brook	Crawford Street, Northborough
MA09A-107	Concord	Beaver Brook	Approximately 375 feet upstream of Summer Street, Chelmsford
MA09A-111	Shawsheen	Shawsheen River	Approximately 2800 feet downstream of Winthrop Avenue (Route 114), Lawrence
MA09A-115	Shawsheen	Shawsheen River	Approximately 550 feet downstream of Salem Road (Route 129), Wilmington/Billerica
MA09A-118	Merrimack	Deep Brook	Approximately 500 feet downstream of Ledge Road, Chelmsford
MA09A-128	Merrimack	Cobbler Brook	East of Hansom Drive, approximately 4100 feet downstream of Harriman Road, Merrimack
MA09A-134	Charles	Unnamed	Unnamed tributary to the Charles River approximately 180 feet downstream of Farm Street, Dover
MA09A-135[a]	Parker	Penn Brook	Approximately 390 feet upstream of East Main Street (Route 133), Georgetown
MA09A-137[a]	Shawsheen	Shawsheen River	Approximately 2600 feet downstream of Route 93, Andover
MA09A-143	North Coastal	North River	Approximately 200 feet downstream of Caller Street, Peabody
MA09A-144	Concord	Nashoba Brook	Approximately 2500 feet upstream from Route 2A/119, Acton (approximately 900 feet downstream from railroad crossing)
MA09A-145	Charles	Charles River	Approximately 1800 feet downstream of Washington Street (Route 16), Newton/Wellesley
MA09A-148	Charles	Charles River	Approximately 760 feet downstream of Maple Street, Bellingham
MA09A-149	Shawsheen	Shawsheen River	Approximately 350 feet upstream of Middlesex Turnpike, Bedford
MA09A-152	Concord	Elizabeth Brook	Wheeler Road, Stow
MA09A-154	Concord	Cochituate Brook	Unnamed tributary to Sudbury River locally known as Cochituate Brook, approximately 600 feet upstream of School Street (Route 126), Framingham

Site	Watershed	Waterbody	Site Description
MA09A-158	Merrimack	Johnson Creek	Approximately 1280 feet upstream of Main Street, Groveland
MA09A-159	North Coastal	Saugus River	Approximately 970 feet downstream of Salem Street, Lynnfield/Wakefield
MA09A-164	Charles	Chicken Brook	Approximately 970 feet downstream of Winthrop Street, Medway
MA09A-170	Concord	Hop Brook	Approximately 2800 feet downstream of Peakham Road, Sudbury (approximately 25 feet upstream of the confluence of the unnamed tributary from Blandford Pond)
MA09A-172	Concord	Unnamed	Unnamed tributary locally known as 'Coles Brook', approximately 550 feet upstream of Robinwood Road, Acton
MA09A-174	Merrimack	Unnamed	Approximately 1000 feet upstream of Route 495, Haverhill
MA09A-176	Shawsheen	Unnamed	Approximately 660 feet upstream of Webb Brook Road, Billerica
MA09A-180	Concord	Elizabeth Brook	Approximately 260 feet downstream of Delaney Street, Stow
MA09A-181	Shawsheen	Shawsheen River	Approximately 50 feet upstream of Mill Street, Tewksbury
MA09A-185	Concord	Cold Harbor Brook	Approximately 300 feet upstream of Route 290, Northborough
MA09A-186	Concord	Unnamed	Approximately 450 feet upstream of Pleasant Street (Route 30), Framingham
MA09A-192[b]	Merrimack	Stony Brook	Approximately 240 feet upstream of Route 3, Chelmsford

a – Fish population data not collected at these sites due to unsafe sampling conditions.
b – Limited dataset available for this site.

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, Ammonia)	5
Color	5
Turbidity	5
Total Suspended Solids	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

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 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 month of July, 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 MONITORING ACTIVITIES – Although the majority of DWM's monitoring efforts in 2010 were focused on the probabilistic wadeable stream survey in the watersheds of northeastern Massachusetts, 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 TMDL and nutrient criteria development, and human health risk assessment. These deterministic monitoring sites were selected apart from the rotating watershed schedule, and were located in both the northeastern watersheds as well as other watersheds throughout Massachusetts.

While the probabilistic assessment monitoring described above is useful for determining the overall status of water quality conditions at the watershed and, ultimately, state-wide scale, the data and information gained through those efforts are often insufficient for identifying with confidence the location and magnitude of the specific sources of pollution contributing to water quality impairment, and typically do not directly support follow-up actions aimed at restoring impaired waters. To address the need for this kind of data and information, the bacteria source tracking (BST) efforts of DWM's regional monitoring personnel, now limited to a single individual in the southeast regional office (SERO), were continued in 2010 with the goal of locating and eliminating sources of bacterial contamination to surface waters.

More detail pertaining to the targeted monitoring activities of the DWM in 2010 is presented below.

Fish Toxics Monitoring: DWM completed fish sampling at five sites at the recommendation of the Inter-agency Fish Toxics Committee (Table 3). Edible fillets from all five waterbodies were analyzed for the presence of mercury. Samples from Jamaica and Leverett ponds 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 3. 2010 fish toxics monitoring sites.

Watershed	Monitoring Site Description
Ipswich	Pleasant Pond (Wenham, Hamilton)
Chicopee	Lake Mattawa (Orange)
Millers	Moores Pond (Warwick)
Charles	Jamaica Pond (Boston)
Charles	Leverett Pond (Brookline, Boston)

Periphyton Cover and Biomass: Seven of the probabilistic monitoring sites were selected for periphyton sampling as part of a pilot project to evaluate the efficacy of using periphyton community attributes as indicators of instream nutrient levels (Table 4), and to provide data in support of nutrient criteria development. The goal was to examine the relationship between benthic algal areal coverage and biomass and in-stream nutrient concentrations over a range of impairment levels, as determined from resident macroinvertebrate community metrics. By choosing a subset of the probabilistic sites, the water quality and biological data collected for the wadeable stream survey can also support the periphyton pilot project. Periphyton sampling was performed at each site up to three times over the months of June, July, August and September (Table 4). For each sampling event, algal percent coverage was measured and periphyton biomass was estimated from the analysis of chlorophyll a in samples obtained from natural substrates. Standard habitat measurements included stream velocity determinations and estimates of light available to the benthic algae (e.g., canopy cover).

Table 4. Wadeable stream survey sites and frequency of periphyton sampling conducted in support of nutrient criteria development.

Site	Waterbody	Number of Site Visits
MA09A-101	South Branch Souhegan River	3
MA09A-143	North River	2
MA09A-148	Charles River	3
MA09A-152	Elizabeth Brook	3
MA09A-154	Cochituate Brook	1
MA09A-181	Shawsheen River	3
MA09A-192	Stony Brook	1

Lake Monitoring: Baseline lakes sampling in the summer of 2010 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. 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. Sediment core samples were also taken in East and West Monponsett Ponds and the cores were incubated in the DWM lab to determine sediment phosphorus release rates. 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 (see below).

A separate study on nutrient limitation of darkly colored lakes was initiated. The algal assay test was conducted in West Monponsett Pond in Halifax using bottles of lake water suspended in the lake. The in-situ nutrient additions of combinations of nitrogen, phosphorus and light were made and the bottles incubated for two weeks. All bottles were sampled for chlorophyll a, and algal species identification and algal densities are being determined on preserved samples. The chlorophyll a showed a stimulation to all three factors (N, P and light) with significant interaction. Water quality sampling was also conducted on one day at Turners Pond in New Bedford but time did not allow the assay tests to be run in that lake.

Cyanobacteria Bloom Investigations: MassDEP expanded its capacity, in 2010, to provide technical expertise and laboratory support to the investigation of potentially toxic algae (cyanobacteria) blooms. While one staff biologist at DWM-Worcester continued to provide this

support, additional assistance was contributed by MassDEP's Southeast Regional Office (SERO) where a second staff biologist was trained and made available to respond to several blooms that occurred in that region. Working 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. 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 5. Besides the cyanobacteria counts described above, a water sample collected from Mystic Lake (Barnstable) was analyzed for the presence of the toxin microcystin-LR using the Envirologix test kit.

Table 5. Waterbodies from which algae samples were obtained and delivered to MassDEP biologists for taxonomic identifications and counts. Results were submitted to MassDPH.

Waterbody	Municipality
Carbuncle Pond	Oxford
Charles River – Lower Basin	Boston
Cliff Pond	Brewster
Elbow Pond	Brewster
Haynes Reservoir	Leominster
Hinckley Pond	Brewster
Long Pond Reservoir	Falmouth
Lovell's Pond	Barnstable
Middle Pond	Barnstable
Mystic Lake	Barnstable
North Head of Hummock Pond	Nantucket
Santuit Pond	Mashpee
Lake Siog	Holland
Stetson Pond	Pembroke
Walker Pond	Brewster
Wampatuck Pond	Hanson
West Monponsett Pond	Halifax
White Island Pond	Plymouth

Monitoring Potential Effects of Aerial Insecticide Spraying: In accordance with the Commonwealth of Massachusetts' 2010 operational plan for managing mosquito-borne diseases DWM biologists conducted biological monitoring in southeastern Massachusetts to coincide with aerial spraying of the insecticide Anvil 10 + 10 to control the mosquito vectors of Eastern Equine Encephalitis virus (EEEv). Aquatic macroinvertebrates were collected from four waterbodies within the anticipated aerial spray zone and one waterbody outside that area (Table 6). The biological monitoring was designed as a semiquantitative evaluation of acute impairment to aquatic life caused by the aerial insecticide application, as indicated by the macroinvertebrate communities in lentic waterbodies. While not formally part of the

biomonitoring effort, DWM biologists also made an effort to take note of aerial/terrestrial invertebrates active at the sampling sites on the dates visited.

Table 6. Site descriptions and sampling dates for macroinvertebrate sampling pre- and post-application of insecticide.

Waterbody	Site Description	Pre-spray sample date	Post-spray sample date
Nemasket River	Downstream from Nemasket Street and upstream from Oliver Mill, Middleborough	2 Aug. 2010	12 Aug. 2010
Snipatuit Pond	Littoral zone adjacent to boat launch, Neck Rd., Rochester	3 Aug. 2010	11 Aug. 2010
Skeeter Mill Pond	Littoral zone along northern edge; access from Water St., Bridgewater	3 Aug. 2010	12 Aug. 2010
Elm Street Impoundment (Jones River)	Littoral zone along southern edge; access from park at Elm St., Kingston	4 Aug. 2010	11 Aug. 2010
Park Pond *(reference site)*	Littoral zone along northern edge, east of inlet; Choate Park, Medway	2 Aug. 2010	16 Aug. 2010

Monitoring Activities of the Southeast Region (SERO)

Bacteria Source Tracking: Bacteria source tracking (BST) studies were performed in 2010 in selected subwatersheds (Table 7) by the DWM Regional Monitoring Coordinator based at the MassDEP Southeast (SERO) regional office with the assistance of additional regional staff members. The bacteria source tracking surveys followed protocols developed in 2004 by the DWM that provide site-specific data for the identification and abatement of specific bacterial pollution sources. SERO personnel 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. 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 MassDEP's analytical laboratory in Lawrence (WES). 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.

Table 7: Subwatersheds where bacteria source tracking was conducted over the course of approximately 38 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**	**7 + Human Marker**
Speedway Brook	Ten Mile	MA52-05	Attleboro	2
Runnins River	Narragansett	MA53-01	Seekonk	2 + Human Marker
Rocky Run Brook	**Narragansett**	**MA53-16**	**Rehoboth**	**2 + Human Marker**
Trout Brook	Taunton	MA62-07	Brockton	3
Salisbury Brook	Taunton	MA62-08	Brockton	2
Meadow Brook	Taunton	MA62-38	East Bridgewater	2 + Human Marker
Lovett Brook	Taunton	MA62-46	Brockton	2
Hawes Brook	Boston Harbor	MA73-16	Norwood	4 + Human Marker
Purgatory Brook	Boston Harbor	MA73-24	Norwood	3
Mill River	**Boston Harbor**	**MA74-04**	**Weymouth**	**3**
Weymouth Back River	**Weymouth & Weir**	**MA74-13**	**Weymouth**	**4 + Human Marker**
Weymouth Fore River	**Weymouth & Weir**	**MA74-14**	**Weymouth**	**3**
South River	**South Coastal**	**MA94-09**	**Marshfield**	**1 + Human Marker**
Buttonwood Brook	Buzzards Bay	MA95-13	New Bedford	2 + Human Marker
Mattapoisett Harbor	Buzzards Bay	MA95-35	Mattapoisett	1
East Branch Westport River	**Buzzards Bay**	**MA95-41**	**Westport**	**3**

Assessment of waterbodies with the potential to be removed from the 303(d) List: SERO personnel performed bacterial analyses on samples collected from segment MA62-49 of the Wading River (Norton/Mansfield) to reassess the recreational use support status of this waterbody and, if compliant with water quality standards, remove it from the CWA section 303(d) List of Impaired Waters. Four (4) sample locations were selected according to guidance from DWM Worcester, to best reflect water quality in the Wading River watershed. The watershed was sampled six (6) times throughout the 2010 primary recreation season during a variety of weather conditions.