Massachusetts Department of ENVIRONMENTAL PROTECTION

2005 ENVIRONMENTAL MONITORING OVERVIEW

Water quality monitoring, assessment and management activities of MassDEP are sequentially performed in accordance with a rotating five-year watershed schedule. Surface waters are typically monitored during Year 2 of the cycle by the Division of Watershed Management's (DWM) Watershed Planning Section. 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 primary and secondary contact recreation, fish consumption, aquatic life, 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 a TMDL Best Management Practices (BMP) for the control of nonpoint pollution at a particular site, or of a comprehensive assessment of 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 (2005 through 2009). 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.

The DWM carried out monitoring activities in 2005 primarily within the *Deerfield, Millers, Ipswich* and *Shawsheen* watersheds and *Buzzards Bay* drainage area. Additional lake monitoring was performed throughout Massachusetts to support the development of nutrient criteria. Finally, bacterial source tracking (BST) was undertaken at selected sites in cooperation with the MassDEP Central (Worcester) and Western (Springfield) regional offices.

In consultation with appropriate agencies and organizations (e.g., USEPA, USGS, watershed associations, etc.) DWM monitoring coordinators reviewed historical data and information, examined GIS data layers, reviewed NPDES and water withdrawal permits, conducted reconnaissance and formulated individual watershed SAP's. While some of the DWM monitoring activities in 2005 were targeted at specific issues of concern, the majority of the monitoring in the "Year Two" watersheds was aimed at providing the necessary data and information to assess the extent to which water bodies are supporting their intended uses, as designated in the Massachusetts Surface Water Quality Standards. This information will be used in the preparation of individual watershed assessment reports, the Massachusetts Integrated List of Waters submitted to the EPA in fulfillment of sections 305b (Summary of Water Quality) and 303d (List of Impaired Waters) of the Clean Water Act (CWA), and will provide, in part, "the percent of waters that are safe for fishing, and support aquatic life and recreation", and other BRP "environmental indicators" identified in the State-EPA Performance Partnership Agreement (PPA).

The DWM made substantial progress in 2005 with ongoing efforts to automate selected routine data collection activities. In the past, the DWM collected theoretically "worst-case" dissolved oxygen data from rivers and streams by performing pre-dawn (typically 12-6 am) surveys using portable multiprobes. However, the following problems were encountered with this approach: 1) data regarding temperature maxima were not captured, as these occur later in the day; 2) DO data were limited to one point in time (not continuous) and may not have captured the true minimum; 3) staff schedules and functionality were stressed by having to work typically from 11pm to 7 am; and 4) working at night had greater potential for accidents (personal and equipment safety issues) and mistakes (data quality issues). To alleviate these problems, and to expand the quantity and quality of dissolved oxygen and temperature data obtained from "Year 2" watersheds, the DWM deployed unattended, continuously-monitoring multiprobe data loggers at selected locations for approximately 48 hours on multiple occasions throughout the assessment monitoring period. This program yielded DO and temperature data that were more representative of typical conditions in a manner that posed less risk to monitoring personnel.

Typically, the DWM's annual monitoring to assess surface water quality conditions in Massachusetts is successful in providing data for water body health assessment and development of TMDL implementation plans in support of Clean Water Act, sections 305(b) and 303(d) requirements. Due to constraints on time and resources, however, this monitoring is not as successful in 1) identifying with confidence the specific sources of pollution that cause water quality impairments and; 2) implementing follow-up actions for remediation. Therefore, during the summer of 2005, MassDEP's Bureau of Resource Protection (BRP) undertook a bacteria source tracking (BST) study with the goal of locating and eliminating sources of bacteria contamination to public bathing beaches in order to reduce or eliminate incidences of beach closures. This collaborative effort between the DWM and MassDEP's Central and Western regional offices was based on protocols developed for the DWM's 2004 Pilot Bacteria Source Tracking Project.

Monitoring to gather data in support of ongoing nutrient criteria development efforts continued in 2005. Thirty (30) lakes scattered throughout Massachusetts were chosen for study.

Finally, the DWM reinstated routine fish toxics monitoring in "Year 2" watersheds following an interruption of this program in 2003 and 2004 due to field and laboratory resource limitations. Edible fish fillets were obtained from two sites in each watershed and analyzed for the presence of heavy metals, PCBs and pesticides. Data were provided to the Massachusetts Department of Public Health (MDPH) for human health risk assessment and health advisories, as appropriate. Additional fish toxics monitoring was carried out in response to public requests or to support MassDEP's Bureau of Waste Site Cleanup. Finally, MassDEP's Office of Research and Standards continued some fish contaminant monitoring using a private contractor for field collections.

More detail pertaining to the monitoring activities accomplished in 2005 is presented below for both the "Year Two" watersheds, as well as throughout the state.

BUZZARDS BAY

The 2005 surveys of the Buzzards Bay Drainage Area focused on obtaining information (i.e. water quality, bacteria, benthic macroinvertebrate populations and fish tissue contaminants) at a total of 25 river stations plus six lakes and two fish toxics sampling sites. The specific objectives of this monitoring were to:

- Evaluate specific water bodies to determine if Massachusetts Water Quality Standards are being met;
- Provide quality-assured data for use by DWM in developing TMDLs;
- Screen fish in two lakes to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, PCBs and pesticides);
- Provide quality assured fecal coliform, E. coli and Enterococcus sp. bacteria data for the purpose of assessing Primary and Secondary Contact Recreation uses;
- Provide quality assured lake and river water quality data for MassDEP's Nutrient Criteria Development Project; and to
- Provide quality assured water quality data in support of the §319 grant project *Cranberry Bog Phosphorus Dynamics for TMDL Development*.

Individual monitoring elements are described below. Water quality and biological monitoring sites are summarized in the matrix at the end of this section.

1) **Water quality:** Water quality surveys were conducted during the weeks of May 2, May 30 (continuous temperature and DO only), June 6, June 27, August 1,August 29 and September 11 (bacteria only). Samples for nutrient analyses as well as dissolved oxygen and other field measurements were obtained from a total of twenty-five (25) stations. Samples for bacterial

analysis (fecal coliform, E. coli and Enterococcus sp.) were obtained from twenty-three (23) sites. Finally, continuous temperature and dissolved oxygen monitoring with unattended metered probes was carried out at 18 sites.

2) **Biological monitoring:** Macroinvertebrate sampling and habitat assessments were performed to assess the aquatic life use status for 305(b) reporting requirements. All river segments that were sampled were previously "not assessed" for the Aquatic Life use. The macroinvertebrate sampling procedures utilized Rapid Biomonitoring Protocols (RBPs) (9 sites) and/or the Chironomid Pupal Exuviae Methodology (CPEM) (9 sites). Periphyton assessments were performed at three sites where macroinvertebrate sampling was conducted. This consisted of an approximation of the algal coverage within the reach, and scrapes of various substrates within the riffle zone to obtain samples for taxonomic identification to genus.

3) **Lake Monitoring:** Lake sampling was intended to provide water quality information for designated use support determination. Large, previously unassessed lakes that are adjacent to or downstream of cranberry bog operations were given priority for sampling in 2005 because past assessments have found impairment in such lakes. In addition to use assessment, information from these lakes would support the §319 cranberry study (01-12/319 *Cranberry Bog Phosphorus Dynamics for TMDL Development*) as well as ongoing efforts to establish nutrient criteria for Massachusetts' waters. The 2005 lakes monitoring in the Buzzards Bay Watershed consisted of three rounds, or approximately once per month throughout the summer, at the following six lakes: Dunham Pond, Carver; Leonards Pond, Rochester; Mary's Pond, Rochester; Sampson Pond, Carver; Snipatuit Pond, Rochester; and Wenham Pond, Carver.

4) **Fish Toxics Monitoring:** Fish toxics monitoring was performed at two (2) locations. Fish collections were made on June 7 at Sampson Pond (Carver) and on June 9 at New Bedford Reservoir (Acushnet). Edible fillets were analyzed for the presence of heavy metals (including mercury), PCB, and organochlorine pesticides. Fish consumption advisories will be issued by the DPH if necessary.

Buzzards Bay Drainage Area – 2005 Water Quality and Biological Monitoring Sampling Matrix

River/Stream	Monitoring Site Description (sample type*)
Copicut River	Dnstr. from driveway to Rod & Gun Club of New Bedford, Dartmouth (1,2,3,4)
Shingle Island River	Flag Swamp Road, Dartmouth (1,2,3)
Shingle Island River	Hixville Road, Dartmouth (1,2,3,4)
Shingle Island River	Dnstr. from Old Fall River Road, Dartmouth (6,7,8)
East Branch Westport River	Upstr. from Forge Pond, Westport (1, 2, 3, 4, 6,7,8)
East Branch Westport River	Upstr. at Old County Road, Westport (1,2,3,5)
Bread and Cheese Brook	Route 6, Westport (1,2,3)
Bread and Cheese Brook	American Legion Highway (Route 177), Westport (1,2,3,4,6,7)
Snell Creek	Drift Road, Westport (1,2,3,4,6)
Snell Creek	Marcus' Bridge, Westport (1,2,3,4)
Kirby Brook	Drift Road, Westport (1,2,3,4,7)
Angeline Brook	Cornell Road, Westport (1,2,3,4,6,7)
Paskamanset River	Route 6, Dartmouth (1,2,3)
Paskamanset River	Russells Mills Road, Dartmouth (1,2,3,4,5,6,8)
Acushnet River	Leonard Street, Acushnet (1,2,3,4)
Acushnet River	Hamlin Street, Acushnet (1,2,3,4)

Acushnet River	Tarkiln Hill Road/Main Street, New Bedford/Acushnet (1,2,3,4,6,7)
Buttonwood Brook	Walter Fuller Memorial Parkway, New Bedford (1,2,3)
Buttonwood Brook	Elm Street, Dartmouth (1,2,3,4,6,7)
Mattapoisett River	Wolf Island Road, Rochester (1,2,3,4,5)
Mattapoisett River	At town wells, end of Tinkham Road, Mattapoisett (6,7)
Mattapoisett River	River Road, Mattapoisett (1,2,3,4,5)
Weweantic River	Rochester Road, Carver (1,2,3,4,5)
Weweantic River	Fearing Hill Road, Wareham (1,2,3,4,5)
Sippican River	County Road, Marion (1,2,3,4)
Unnamed Aucoot Cove trib.	Abel's Way, upstr. from Marion WWTP, Marion (1,2)
Unnamed Aucoot Cove trib.	Olde Meadow Road, dnstr from Marion WWTP, Marion (1,2,7)

*1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – nutrients, 3 – bacteria samples, 4 – unattended continuous dissolved oxygen and temperature, 5 – chlorophyll, 6 – Macroinvertebrate Rapid Bioassessment Protocol (RBP) III and habitat assessment, 7 – Chironomid Pupal Exuviae (CPEM), 8 – periphyton

DEERFIELD

The 2005 surveys of the Deerfield Watershed focused on obtaining information to meet the following objectives:

- Determine the biological health of "unassessed" and "not assessed" rivers/streams within the watershed by conducting assessments based on biological (aquatic macroinvertebrates, fish, periphyton, bacteria) communities;

- Provide biological and habitat data to document the status of benthic and fish communities over time (trend monitoring); provide biological, habitat, and dissolved oxygen, temperature, and chemical data to be used in making *Aquatic Life* and *Aesthetics* use assessments required by Section 305(b) of the Clean Water Act; provide data for other informational needs of Massachusetts regulatory agencies;

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

- Screen fish to provide data to the MDPH for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides); and to

- Isolate/identify sources of elevated bacteria using Source Tracking protocols and coordinate with state and local officials to restore degraded water quality.

Individual monitoring elements are described below. Water quality and biological monitoring sites are summarized in the matrix at the end of this section.

1) **Water quality:** Water quality surveys were conducted during the weeks of May 5 (continuous temperature and DO only), May 16, June 6, July 18, August 15 and September 19. Samples for nutrient analyses as well as dissolved oxygen and other field measurements were obtained from a total of eight (8) stations. Samples for bacterial analysis (fecal coliform and E. coli) were obtained from these eight sites plus twenty-two (22) additional locations. Continuous (four days) temperature and dissolved oxygen monitoring with unattended metered probes was carried out

at ten (10) sites and long-term (seven weeks) temperature-only data loggers were deployed at an additional four sites.

2) **Biological monitoring:** Benthic macroinvertebrate (15 sites), fish community (6 sites) and habitat assessments were performed to assess the aquatic life use status for 305(b) reporting requirements. The macroinvertebrate and fish sampling procedures utilized Rapid Biomonitoring Protocols (RBPs). Periphyton assessments were performed at ten (10) sites where macroinvertebrate sampling was conducted. This consisted of an approximation of the algal coverage within the reach, and scrapes of various substrates within the riffle zone to obtain samples for taxonomic identification to genus.

3) **Fish Toxics Monitoring:** Fish toxics monitoring was performed at one site on the mainstem Deerfield River on June 16. Edible fillets were analyzed for the presence of heavy metals (including mercury), PCB, and organochlorine pesticides. Fish consumption advisories will be issued by the DPH if necessary.

Deerfield River Watershed – 2005 Water Quality and Biological Monitoring Sampling Matrix

River/Stream	Monitoring Site Description (sample type*)
Deerfield River	At USGS gage #01168500 south of Mohawk Trail (Rte. 2), Charlemont (3,9)
Deerfield River	Upstr. from south-bound lane of Route 91, Deerfield (3,5,7)
Deerfield River	Dnstr. from River Road/Zoar Road (Florida Bridge), Florida/Charlemont (3,5,7)
Cold River	Upstr. from Cold River Road, Charlemont (5,7)
Cold River	Dnstr. from Cold River Road, Charlemont (3)
North River	Dnstr. from Route 112, Colrain (3,5,7)
North River	Dnstr. from Adamsville Road behind BBA, Colrain (5)
South River	Emmets Road, Ashfield (3,4,6,8)
South River	At USGS gage #01169900 near Reeds Bridge Road, Conway (3)
South River	Baptist Corner Road, Ashfield (8)
Chickley River	Tower Road, Charlemont (1,2,3)
Chickley River	Most downstream crossing of Savoy Road, Hawley (3)
Pelham Brook	Zoar Road, Charlemont (3)
Bozrah Brook	Upstr. at South River Road, Charlemont (3,4)
Mill Brook	Dnstr. from Mountain Road, Charlemont (3,5)
Clesson Brook	Route 112, Buckland (1,2,3,4,5,7)
Clesson Brook	Upper Street, Buckland (3)
Clark Brook	Route 112, Buckland (1,2,3,4,6)
Bear River	Upstr. from Shelburne Falls Road, Conway (3,5,7)
Bear River	Approximately 150' from confluence with Deerfield River, Conway (8)
Davis Mine Brook	Upstr. from confluence with Mill Brook, Charlemont (5,7)
East Branch North R.	"Lyonsville Road", Colrain (1,2,3)
Dragon Brook	Bassett Road, Shelburne (3,6)
Dragon Brook	Approximately 250' from confluence with Deerfield River, Shelburne (8)
Hinsdale Brook	Green River Road, Greenfield (3,5,7)
Shingle Brook	Hawks Brook, Shelburne (3,4,6)
Tissdell Brook	Adamsville Road, Colrain (3)
Foundry Brook	Foundry Village Road, Colrain (3,4)
Smith Brook	Upstr. from Ashfield Road (Route 112), Buckland (3)
West Branch North R.	Adamsville Road, Colrain (1,2,3)
Green River	At USGS gage #01170100 upstr. from West Leyden Road, Colrain (3)

Green River	0.5 miles upstr. from USGS gage #01170100, Colrain (5)
Green River	Footbridge east off Petty Plain Road, Greenfield (3,5)
Taylor Brook	Most downstream crossing of Heath Road, Colrain (3)
Creamery Brook	Williamsburg Road, Ashfield (1,2,3,4,5,6,7)
Wheeler Brook	South off Shelburne Road, Greenfield (3,4,5)
Poland Brook	Most upstream crossing of North Poland Road, Conway (1,2,3,4,5,7)
Chapel Brook	Upstr. from Main Poland Road, Conway (1,2,3,4,6)

*1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – nutrients, 3 – bacteria,
4 – unattended continuous dissolved oxygen and temperature, 5 – Macroinvertebrate Rapid Bioassessment Protocol (RBP) III and habitat assessment, 6 – fish population, 7 – periphyton,
8 – continuous temperature measurements, 9 – fish toxics

4) **Bacterial Source Tracking:**

Limited sampling was performed in the Deerfield River watershed to locate and abate chronic and episodic sources of high bacteria. Samples collected on October 4, 2005 from two subwatersheds (Green and South rivers) were analyzed using the commercially available Enzyme Substrate Test for *E. coli.* Seven stations in areas that exhibited elevated counts on October 4 were sampled again on October 5. From this limited source tracking effort, three "hot spots" were identified in the Green River and South River subwatershed. Optical brightener samplers deployed at two of these stations also tested positive, indicating that the elevated bacteria were associated with a human source. Results from these surveys have been discussed with the Deerfield River Watershed volunteer monitoring coordinator and Riverways Stream Team coordinator with the goal of encouraging additional volunteer monitoring activities in these areas.

IPSWICH

The 2005 surveys of the Ipswich Watershed focused on obtaining information to meet the following objectives:

- Evaluate specific waterbodies for support of designated uses, determine if surface water quality standards are being met and evaluate the level of waterbody impairment;
- Provide quality-assured *E. coli*i data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts freshwater criteria for *E. coli*;
- Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides); and
- Provide data for the development of TMDLs.

Individual monitoring elements are described below. Water quality and biological monitoring sites are summarized in the matrix at the end of this section.

1) **Water quality:** Water quality surveys were conducted during the weeks of May 13 (continuous

temperature and DO only), May 23, June 20, July 25, August 22 and September 26. Samples for nutrient, color and turbidity analyses as well as dissolved oxygen and other field measurements were obtained from a total of ten (10) stations. Samples for bacterial analysis (fecal coliform and E. coli) were obtained from these ten sites plus five (5) additional locations. Continuous (four days) temperature and dissolved oxygen monitoring with unattended metered probes was carried out at nine (9) sites and long-term (seven weeks) temperature-only data loggers were deployed at an additional three sites.

2) **Biological monitoring:** Benthic macroinvertebrate and habitat assessments were performed at eight (8) sites to assess the aquatic life use status for 305(b) reporting requirements. Habitat assessments only were performed at two additional locations. The macroinvertebrate sampling procedures utilized Rapid Biomonitoring Protocols (RBPs) (7 sites) and/or the Chironomid Pupal Exuviae Methodology (CPEM) (3 sites). Periphyton assessments were performed at four (4) sites where macroinvertebrate sampling was conducted. This consisted of an approximation of the algal coverage within the reach, and scrapes of various substrates within the riffle zone to obtain samples for taxonomic identification to genus. Fish population assessment was carried out at the Gravelly Brook site.

3) **Fish Toxics Monitoring:** Fish toxics monitoring was performed at one site on the Ipswich River known as " Wenham Swamp" on July 1. Edible fillets were analyzed for the presence of heavy metals (including mercury), PCB, and organochlorine pesticides. Fish consumption advisories will be issued by the DPH if necessary.

Ipswich River Watershed – 2005 Water Quality and Biological Monitoring Sampling Matrix

River/Stream	Monitoring Site Description (sample type*)
Ipswich River	Mill Street, North Reading/Reading (1,2,3,4,6)
Ipswich River	Central Street, North Reading (1,2,3,4)
Ipswich River	Peabody Street, Middleton (1,2,3,4)
Ipswich River	Dnstr. from Boston Street, Middleton/Peabody (5,8)
Ipswich River	Off Topsfield Road (upstream from Gravelly Brook), Ipswich (1,2,3,4)
Ipswich River	Mill Road/Highland Street, Ipswich/Hamilton (1,2,3,4)
Ipswich River	Wenham Swamp, Hamilton/Topsfield/Wenham (9)
Kimball Brook	Heard Drive, Ipswich (3)
Miles River	Driveway of #187 County Road, Ipswich (1,2,3,4,5,6,8)
Gravelly Brook	Topsfield Road, Ipswich (5,6,7,10)
Howlett Brook	North Street, Topsfield (3)
Howlett Brook	East Street, Topsfield (10)
Howlett Brook	Upstr. from Ipswich Road, Topsfield (5)
Fish Brook	Washington Street/Endicott Road, Topsfield/Boxford (3,10)
Fish Brook	Upstr. from Washington Street/Endicott Road, Topsfield/Boxford (5,8)
Boston Brook	Liberty Street, Middleton (1,2,3,4,5)
Wills Brook	Near old railroad bed upstream from Ipswich River confluence, Lynnfield (3)
Martins Brook	Park Street, North Reading (1,2,3,4,5,8)
Lubbers Brook	Concord Street, Wilmington (1,2,3,4,5**)
Maple Meadow Brook	Federal Street, Wilmington (1,2,3,5**)
Unnamed tributary	Mt. Vernon Street, Middleton (3)

*1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – nutrients/color/turbidity, 3 – bacteria samples, 4 – unattended continuous dissolved oxygen and temperature, 5 – Rapid Bioassessment Protocol (RBP) III and habitat assessment, 6 – Chironomid Pupal Exuviae (CPEM), 7 – fish population, 8 –

periphyton, 9 – fish toxics, 10 – continuous temperature measurements

** habitat assessment only

MILLERS

The 2005 surveys of the Millers Watershed focused on obtaining water quality and biological information to assess designated use support status, to evaluate the impacts of NPDES discharges and nonpoint sources of pollution on water quality and biota, and to provide data for the derivation of TMDLs and pollution abatement measures. To fulfill these and other general program goals monitoring was performed to meet the following specific objectives:

- Evaluate water quality and aquatic habitat in the Millers River, Otter River and Beaver Brook at stations that bracket major and minor point source discharges;

- Evaluate water quality and aquatic habitat in tributaries of the Otter River Watershed in order to assess impacts from known or suspected non-point sources of pollution such as sand and gravel operations and road sanding practices to assess sediment depositional load and turbidity to the Otter River mainstem;

- Perform benthic macroalgae and periphyton surveys in segments of the Millers and Otter Rivers that bracket municipal and industrial waste water treatment plants in order to estimate impacts of nutrient loading from point source discharges in these rivers;

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

- Screen fish to provide data to the MDPH for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides); and

- With the assistance of the USEPA, perform ambient in-stream toxicity testing in segments of the Millers and Otter Rivers that bracket municipal and industrial waste water treatment plants (WWTP) in order to estimate impacts to native biota from point source discharges in these rivers.

Individual monitoring elements are described below. Water quality and biological monitoring sites are summarized in the matrix at the end of this section.

1) **Water quality:** Water quality surveys were conducted during the weeks of May 9, May 19 (continuous temperature and DO only), June 13, July 11, August 8 and September 12. Samples for the analysis of nutrients and other conventional pollutants, bacteria (fecal coliform and *E. coli*), as well as dissolved oxygen and other field measurements were obtained from twenty-one (21) stations. Continuous (four days) temperature and dissolved oxygen monitoring with unattended metered probes was carried out at seventeen (17) sites.

2) **Biological monitoring:** Macroinvertebrate sampling and habitat assessments were performed to assess the aquatic life use status for 305(b) reporting requirements. The macroinvertebrate sampling procedures utilized Rapid Biomonitoring Protocols (RBPs) (9 sites) and/or the Chironomid Pupal Exuviae Methodology (CPEM) (9 sites). Periphyton assessments

were performed at six (6) sites. These consisted of estimating the algal coverage at each site and making scrapes of various substrates to obtain samples for taxonomic identification and chlorophyll analysis.

3) **Fish Toxics Monitoring:** Fish toxics monitoring was performed at one site each on the Millers and Otter rivers on June 11 and June 12, respectively. Edible fillets were analyzed for the presence of heavy metals (including mercury), PCB, and organochlorine pesticides. Fish consumption advisories will be issued by the DPH if necessary.

4) **USEPA Ambient Surface Water Toxicity Testing:** USEPA provided assistance to the DWM by performing field sampling and toxicity testing of ambient surface waters at ten (10) sites throughout the Millers Watershed.

Millers River Watershed – 2005 Water Quality and Biological Monitoring Sampling Matrix

River/Stream	Monitoring Site Description (sample type*)
Millers River	Unnamed dirt road #450R, Spring Street (Route 12), Winchendon (1,2,3,4)
Millers River	River Street and Bruce Road, Winchendon (9)
Millers River	Route 202, Winchendon (1,2,3,4,5,9)
Millers River	Old bridge abutments, eastern shore of closed dirt road, Winchendon (7,9)
Millers River	South of Blossom Street, west of King St. at USGS Gage #01164000, Royalston (1,2,3)
Millers River	Route 2A, Athol (1,2,3)
Millers River	Upstr. from Route 122, Orange (8)
Millers River	Holtshire Road, Orange (1,2,3,4,5)
Millers River	At USGS Gage #01166500 near Bridge St./Farley Rd., Erving/Wendell (1,2,3,5,7)
Millers River	East Mineral Road/River Road, Montague/Erving (1,2,3,4)
Millers River	Arch Street, Erving (9)
Lyons Brook	Mormon Hollow Road, Wendell (1,2,3,4)
Mormon Hollow Brook	Mormon Hollow Road, Wendell (1,2,3,4)
Keyup Brook	Church Street, Erving (1,2,3,4)
Whetstone Brook	Depot Road, Wendell (1,2,3,4)
Tully River	Approx. 550 ft. upstream from confluence with Millers River, Athol (1,2,3,4)
West Branch Tully River	Royalston Road, Orange (1,2,3,4)
W. Branch Tully River	Upstr. from Flagg Road, Orange (6)
East Branch Tully River	Tully Road/Pinedale Road, Orange/Athol (1,2,3,4,6,7)
East Branch Tully River	Warwick Road (Route 68), Royalston (4)
Lawrence Brook	Athol Road, upstream from Doane Falls, Royalston (1,2,3,5)
Boyce Brook	Warwick Road (Route 68), Royalston (1,2,3,4)
Beaver Brook	Main Road south of Route 68, Phillipston (1,2,3,4,5,6,7,9)
Beaver Brook	State Road (Routes 202/2A), Phillipston (1,2,3,4,6,7,9)
Otter River	Route 2A, Gardner (1,2,3,4,7)
Otter River	Upstr. from Route 202, Templeton (4,5,6)
Otter River	At Route 202, Templeton (1,2,3,9)
Otter River	Dnstr. from Route 202, Templeton (6,7,8)
Otter River	Upstr. from Bridge/Turner St., Gardner/Templeton (6,7,9)
Otter River	Upstr. from Main Street at Seaman Paper, Templeton (6,9)
Otter River	Dnstr. from Seaman Paper below railroad bridge, Templeton (9)
N. Branch Millers River	Glenallen Street (Route 202), Winchendon (1,2,3)
Priest Brook	Dnstr. from Winchendon Road, Royalston (6,7)

*1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – chem/nutrients, 3 – bacteria,

4 – unattended continuous dissolved oxygen and temperature, 5 – periphyton/chlorophyll, 6 – Macroinvertebrate Rapid Bioassessment Protocol (RBP) III and habitat assessment, 7 – Chironomid Pupal Exuviae (CPEM), 8 – fish toxics, 9 – ambient surface water toxicity testing by the USEPA

SHAWSHEEN

The 2005 surveys of the Shawsheen Watershed focused on obtaining information to meet the following objectives:

- Evaluate specific waterbodies for support of designated uses, determine if surface water quality standards are being met and evaluate the level of waterbody impairment;
- Provide quality-assured *E. coli*i data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts freshwater criteria for *E. coli*;
- Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides); and
- Provide data for the development of TMDLs.

Individual monitoring elements are described below. Water quality and biological monitoring sites are summarized in the matrix at the end of this section.

1) **Water quality:** Water quality surveys were conducted during the weeks of May 13 (continuous temperature and DO only), May 23, June 20, July 25, August 22 and September 26. Samples for nutrient, color and turbidity analyses, as well as dissolved oxygen and other field measurements, were obtained from a total of eleven (11) stations. Samples for bacterial analysis (fecal coliform and E. coli) were obtained from these eleven sites plus five (5) more locations. Continuous (four days) temperature and dissolved oxygen monitoring with unattended metered probes was carried out at eight (8) sites and long-term (seven weeks) temperature-only data loggers were deployed at an additional three sites. Finally, the USAF collaborated with the DWM by collecting bacteria samples from six additional surface-water sites on the Hanscom Air Force Base on each of the five DWM survey dates. These samples were analyzed at a contract laboratory.

2) **Biological monitoring:** Benthic macroinvertebrate and habitat assessments were performed (10 sites) to assess the aquatic life use status for 305(b) reporting requirements. The macroinvertebrate sampling procedures utilized Rapid Biomonitoring Protocols (RBPs) (6 sites) and/or the Chironomid Pupal Exuviae Methodology (CPEM) (7 sites). Periphyton assessments were performed at three (3) sites where macroinvertebrate sampling was conducted. This consisted of an approximation of the algal coverage within the reach, and scrapes of various substrates within the riffle zone to obtain samples for taxonomic identification to genus. Fish population assessment was carried out at the downstream Rogers Brook site.

3) **Fish Toxics Monitoring:** Fish toxics monitoring was performed at Round Pond in Tewksbury on June 1. Edible fillets were analyzed for the presence of heavy metals (including mercury), PCB, and organochlorine pesticides. Fish consumption advisories will be issued by the DPH if necessary.

Shawsheen River Watershed – 2005 Water Quality and Biological Monitoring Sampling Matrix

River/Stream	Monitoring Site Description (sample type*)
Unnamed tributary	Locally known as Pinnacle Brook, Pinnacle Street, Tewksbury (1,2,3,6)
Shawsheen River	Summer Street, Bedford (1,2,3,4,6)
Shawsheen River	Dnstr. from Great Road (Routes 4/225), Bedford (5,8)
Shawsheen River	Route 3A, Billerica (1,2,3,4,6)
Shawsheen River	At USGS Gage #01100600 near Route 129, Billerica/Wilmington (3)
Shawsheen River	Central Street, Andover (1,2,3,4,5,6,8)
Shawsheen River	Loring Street, Lawrence (3)
Shawsheen River	Mill Street, Tewksbury (1,2,3,4,5,6,8)
Rogers Brook	Chestnut Court, Andover (10)
Rogers Brook	Approx. 550 ft. upstr. fr. Shawsheen River confluence, Andover (1,2,3,4,5,7,10)
Strong Water Brook	Shawsheen Street, Tewksbury (1,2,3,4)
Content Brook	Upstr. from Whipple Road, Tewksbury (5)
Content Brook	Beech Street, Tewksbury (1,2,3)
Vine Brook	Terrace Hall Avenue, Burlington (1,2,3,4,5)
Sandy Brook	Sandy Brook Road, Burlington (3)
Long Meadow Brook	South Bedford Street, Burlington (3)
Spring Brook	Route 62, Bedford (3)
Elm Brook	Great Road (Routes 4 & 225), Bedford (1,2,3,4,5,6,10)
Kiln Brook	Hartwell Avenue, Lexington (1,2,3)

*1 – Attended multi-probe (DO, temperature, pH, conductance), 2 – nutrients/color/turbidity, 3 – bacteria samples, 4 – unattended continuous dissolved oxygen and temperature, 5 – Rapid Bioassessment Protocol (RBP) III and habitat assessment, 6 – Chironomid Pupal Exuviae (CPEM), 7 – fish population, 8 – periphyton, 9 – fish toxics, 10 – continuous temperature measurements

ADDITIONAL MONITORING ACTIVITIES – Some monitoring was performed in watersheds that were not actually in "Year 2" of the five-year watershed cycle. This is briefly described below:

1) **Fish toxics monitoring:** DWM completed fish sampling in the Indian Head River at Curtis Crossing (Pembroke/Hanover) at the request of MassDEP's Bureau of Waste Site Cleanup (BWSC) and in Fort Meadow Reservoir (Marlborough/Hudson) as recommended by the Inter-agency Fish Toxics Committee.

2) **Lake Monitoring:**

Thirty lakes statewide (see table below) were sampled on one occasion to provide data in support of several ongoing DWM program elements. Specific monitoring goals were:

a) To provide data to develop new nutrient criteria for lakes. Specifically, the objective for 2005 was to establish a relationship between nutrient (total phosphorus) concentrations and the maintenance of trout space (cold oxygenated water) in the hypolimnion of the lakes;
b) To provide data to determine if a lake should be listed on the 303d list of waters not meeting Water Quality Standards;
c) To provide data to develop TMDLs for lakes on the 303d integrated list; and
d) To provide data for 305b assessment purposes.

Lake monitoring included in situ water quality profile measurements (i.e., temperature, dissolved oxygen, pH, specific conductance), Secchi disk readings, and water quality sampling for phosphorus analysis, chlorophyll a determinations and the analysis of apparent color. Grab samples for algae identification were taken when blooms were observed.

Lakes Sampled in 2005					
Name	**Municipality**	**Name**	**Municipality**	**Name**	**Municipality**
Goose	Lee	Horn	Woburn	White	Concord
Onota	Pittsfield	Upper Mystic	Winchester	Cochituate	Natick
Stockbridge	Stockbridge	Farm	Sherborn	Baldpate	Boxford
Norwich	Huntington	Jamaica	Boston	Sluice	Lynn
Windsor	Windsor	Baddacook	Groton	Russell	Kingston
Packard	Orange	Fort	Lancaster	Ashumet	Mashpee
Lorraine	Springfield	Mirror	Harvard	Flax	Brewster
Big Alum	Sturbridge	Spectacle	Lancaster	Mashpee/Wake.	Mashpee
Webster	Webster	Hopkinton	Hopkinton	Scargo	Dennis
Quinsigamond	Shrewsbury	Waushakum	Framingham	Spectacle	Sandwich

3) **Bacteria Source Tracking:**

Bacteria Source Tracking Projects were performed at selected bathing beaches collaboratively with MassDEP's Central and Western regional offices using protocols developed in 2004 by the DWM that provide site-specific data for the identification and abatement of specific bacterial pollution sources. The DWM reviewed existing bacteria data and information from the Department of Public Health and developed a list of beach sites for potential study in the Central and Western Regions of MassDEP. DWM and the Regional office personnel reviewed these data and other pertinent information such as GIS land use and/or infrastructure maps and selected up to two beaches per region for field reconnaissance. Beaches selected for bacteria source tracking in the Central Region were at Coes Reservoir (Worcester) and West Hill Dam (Uxbridge). The Westfield River at Gardner State Park, Huntington was the site chosen in the Western Region.

Screening level bacteria sampling for *E. coli* was conducted on at least three occasions (during dry weather only) in each beach subwatershed. Bacteria sample analysis was conducted by DWM personnel using an in-house commercially available enzyme substrate testing system. A source tracking advisory team (STAT), made up of representatives from MassDEP/DWM, MassDEP/Central Regional Office and MassDEP/Western Regional office reviewed the data and refined sampling locations based on bacteria "signals" and field observations. DWM and the Regional offices conducted iterative bacteria sampling for *E. coli* in each beach subwatershed during dry weather to isolate sources of dry weather flows of bacteria. In some cases follow-up analyses (e.g., optical brighteners, fluorescent whitening agents, etc.) were performed in an attempt to determine if the bacteria were from human or animal sources.

Ultimately, the appropriate authorities will be notified of the suspected source(s) and recommendations for further source tracking work (e.g., for Phase II communities engaged in Illicit Discharge Detection Elimination (IDDE) work), immediate clean up, or MassDEP enforcement action will be made.

4) **Perchlorate Sampling:**

Water samples for perchlorate analysis were collected once in June and once in September from ten locations in the Concord and Merrimack watersheds. This collaborative effort with MassDEP's Northeast Regional Office (NERO) was a follow-up to extensive sampling and analysis performed in 2004 in response to the discovery of perchlorate in the Town of Tewksbury's municipal water supply. The 2005 sampling provided confirmation that the source of perchlorate had been eliminated.

5) **Quabbin Reservoir Survey:**

DWM staff worked with personnel from the Division of Fish and Game (DFG) and Department of Conservation and Recreation to collect water and fish samples from Quabbin Reservoir in support of ongoing research by MassDEP's Office of Research and Standards (ORS) on toxic contaminants in fish. A one-day water-monitoring event included *in situ* measurements of pH, temperature, and dissolved oxygen as well as sampling for dissolved organic carbon (DOC) analysis at the Environmental Institute's Environmental Analysis Lab at Umass-Amherst. Fish samples were collected over two days and delivered to MassDEP's Wall Experiment Station (WES) for mercury analysis.

6) **Blue-green Algae Bloom Investigations:**

Throughout the summer of 2005 MassDEP and/or Department of Public Health staff members collected algae samples from five waterbodies in response to known or suspected blue-green algal blooms that had the potential of being toxic. These were Quaboag Pond (Brookfield/East Brookfield), Quacumquasitt Pond (Brookfield/East Brookfield/Sturbridge), Long Pond (Dracut), Dunham Pond (Carver) and Wedge Pond (Winchester). In the case of Quaboag Pond samples were obtained on several occasions to monitor the algal population following treatment with copper sulfate. Phytoplankton identifications and counts were completed for each of the samples to determine whether the World Health Organization (WHO) criterion for blue-green algae blooms was exceeded.

7) **Spindleville Pond Investigation:**

Working with MassDEP's Central Regional Office (CERO) the DWM responded to a report of objectionable color and turbidity in Spindleville Pond (Hopedale).