**Sampling & Analysis Plan**

2022 Targeted Assessment monitoring

Rivers

in

Northeastern Massachusetts

(Watershed Cohort A2)

CN#: 553.0

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Massachusetts Department of Environmental Protection

Division of Watershed Management

Watershed Planning Program

8 New Bond Street

Worcester, MA

***NOTE: This draft sampling plan provides detail re: sampling locations, frequencies, analytes, etc. and is intended to augment WPP’s multi-year programmatic QAPP approved by EPA for 2020 through 2024. The contents mirror selected elements of WPP’s programmatic QAPP (i.e.,QA-R5 EPA Guidance). See the QAPP for relevant information not provided in this SAP.***

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#### Project Organization

The Massachusetts Department of Environmental Protection (MassDEP), Division of Watershed Management (DWM), Watershed Planning Program (WPP) gathers background information, formulates sampling plans and carries out monitoring and assessment activities on rivers, lakes and coastal waters pursuant to the requirements of the Clean Water Act (CWA). Massachusetts’ water monitoring programs include both deterministic (targeted) and probabilistic (random) sampling networks and encompass both rotating watershed monitoring cycles as well as non-rotating, priority-driven schedules (see *A Strategy for Monitoring and Assessing the Quality of Massachusetts’ Waters to Support Multiple Water Resource Management Objectives 2016 – 2025* at <https://www.mass.gov/doc/water-quality-monitoring-strategy-2016-2025/download>).

Targeted monitoring networks are a component of the Massachusetts’ water monitoring strategy and are used to achieve a wide range of objectives. The types of monitoring objectives that can be addressed with targeted monitoring include water resource assessment, source identification, stressor identification, trend analysis, TMDL development, water quality criteria/biocriteria development and 303(d) list development. Targeted monitoring networks have typically been implemented on rotating watershed schedules in conjunction with the other components of the monitoring strategy. This Sampling and Analysis Plan (SAP) provides details pertaining to targeted water resource monitoring planned by the WPP for rivers in northeastern Massachusetts in 2022. Specific descriptions of WPP staff roles and responsibilities for this monitoring project are detailed in Table 1. In addition, the WPP fulltime monitoring program staff will be augmented by the hiring of five (5) seasonal employees from May through September to ensure that enough personnel are available to carry out field surveys and selected laboratory analyses, as planned.

| **Table 1.** Project Roles and Responsibilities related to monitoring and data use | |
| --- | --- |
| **Project Personnel** | **Responsibility** |
| Project Coordinators  -Dahlia Tympanick (Site Allotment 1)  -Pete Mitchell (Site Allotment 2)  -Allyson Yarra (Site Allotment 3) | Responsible for site reconnaissance, obtaining landowner access permission, defining logistics for efficient monitoring and generation of useable data at assigned sites using the procedures contained in WPP SOPs. |
| Fish population survey crews  -Dan Davis (lead)  -Pete Mitchell (lead)  -WPP staff and seasonal employees | Responsible for conducting accurate, precise fish population sampling using electrofishing techniques contained in WPP SOPs. |
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| Benthic macroinvertebrate survey crews  -James Meek (lead)  -Dan Davis (lead)  -Pete Mitchell (lead)  -Dahlia Tympanick (lead)  -Allyson Yarra (lead)  -WPP staff and seasonal employees | Responsible for benthic macroinvertebrate and aquatic habitat survey data collection using procedures contained in WPP SOPs. |
| Water quality survey crews  -James Meek (lead)  -Dahlia Tympanick (lead)  -Pete Mitchell (lead)  -Dan Davis (lead)  -Allyson Yarra (lead)  -WPP staff and seasonal employees | Responsible for the collection of samples and data at assigned sites using the sample collection techniques and probe use procedures contained in WPP SOPs. |

For each field monitoring survey event, the staff member serving as the survey crew leader (at a minimum) will have met the following qualifications:

• Familiarity with this SAP and all applicable SOPs for that survey

• Completion of a multiprobe sampling/grab sampling/QC training segment

• Prior field experience with survey equipment and with similar monitoring surveys

• Be physically able to access the sites, carry equipment and samples, and perform the sampling.

Survey crew leaders will be accompanied by one or more additional crew members for each survey, depending on the kind of sampling to be undertaken (e.g., water, macroinvertebrates, fish, etc.). All field survey crew personnel and WES/WPP lab personnel will be trained in the proper application of standard operating procedures (SOPs). Field training may range from formal WPP training sessions to field instructions provided by a trained and experienced WPP survey crew leader. WPP lab training (e.g., chlorophyll *a*, color, turbidity) will be provided to selected WPP staff, who will run the analyses. All WPP training activities will be documented using signature sheets.

Dr. Oscar Pancorbo, Director of MassDEP’s Wall Experiment Station (WES), and/or his designees, will coordinate with the WPP regarding sample delivery, analyses, and reporting. WES has been selected to perform total phosphorus, total nitrogen, nitrate/nitrite, ammonia, chloride, trace elements (Ca+, Mg+, and Na+), dissolved hardness, and dissolved organic carbon (DOC).

The project manager at Alpha Analytical and Cole Ecological and/or their designees will coordinate with the WPP regarding sample delivery, analyses, and reporting. Alpha Analytical has been selected to perform *E. coli* analyses on water samples collected as part of this project. Cole Ecological has been selected to perform macroinvertebrate taxonomic identification on samples collected as part of this project.

#### Project Definition and Background

For nearly a decade probabilistic sampling designs were utilized by the WPP to assess the condition of Massachusetts’ shallow streams (2011-2015) and lakes and ponds (2016-2018). The use of statistically valid state-scale sampling networks allows for the determination of the percentage of stream miles or lake acres that are meeting water quality standards; however, they are not as useful for identifying individual waters for assessment and listing in accordance with sections 305(b) and 303(d) of the CWA. Massachusetts’ water monitoring strategy (MassDEP 2018) highlights the value of deterministic (i.e., targeted) monitoring for confirming causes and identifying sources of impairment or, alternatively, demonstrating that previously impaired waters are now supporting their beneficial uses. The WPP has prioritized the Parker, Ipswich, North Coastal, Boston Harbor, and Charles watersheds in northeastern Massachusetts (A2) for assessment monitoring in 2022, year two of a new seven-year recurring river basin schedule (see Appendix A). The WPP has developed a general approach for prioritizing waters to be monitored that focuses on strengthening the categorization of waters (i.e., assessment units or AUs) included on Massachusetts’ integrated CWA section 305(b)/303(d) report (IR) (MassDEP 2019). Highest priority will be given to gathering data and information on AUs currently listed as impaired that may not be and, therefore, could be delisted, as well as on AUs that are not currently identified as impaired but there is some evidence to suggest that they are impaired and should be listed as such (see Sampling Process Design below). Approximately 200 stream sites located throughout Cohort A, had been prioritized and scheduled for monitoring in 2021 (A1) and 2022 (A2).

The goal of the 2022 monitoring effort is to collect enough water quality and biomonitoring data to assess the aquatic life, recreational and aesthetic use support status of the AUs represented by the sampling sites. The WPP proposes to gather the following kinds of environmental data and information at each site in fulfillment of this goal:

* Benthic macroinvertebrate community
* Habitat assessment
* Fish community
* Nutrients (total phosphorus, total nitrogen, nitrate-nitrite, and ammonia)
* Chloride
* Trace elements (Ca+, Mg+, and Na+)
* Dissolved hardness (calculated from Ca+ and Mg+)
* Dissolved organic carbon (DOC)
* pH (instantaneous)
* Temperature (instantaneous)
* Continuous temperature (4-5-month duration)
* Dissolved oxygen (instantaneous)
* Continuous dissolved oxygen (4-5-month duration)
* *Escherichia coli* bacteria
* Selected field observations

#### Project Description

**Overview of Targeted Assessment Monitoring in 2022**

##### Water Quality (Chemical and Physical)

Water quality grab samples will be collected five or six times from May to September at all the sites using wade-in techniques described in WPP standard operating procedures (SOP). Some samples may be collected from non-wadable sites with sampling poles or Van Dorn water samplers lowered from bridges or other available structures. Samples will be field filtered/preserved, as appropriate, and delivered to the appropriate laboratory. Samples will be delivered to Senator William Wall Experiment Station in Lawrence (WES) for total phosphorus, total nitrogen, nitrate-nitrite, ammonia, chloride, trace elements (Ca+, Mg+, and Na+), dissolved hardness, and dissolved organic carbon analysis and Alpha Analytical in Westborough for *E. coli* analysis. A minimum of one duplicate and one blank sample per analyte will be tested for QC for each sampling crew (10% of the samples).

Onset multiprobe (dissolved oxygen and temperature) will be deployed on a long-term continuous basis from May/June through September at all sites. At deployment and prior to retrieval of multiprobes, as well as at various times during the deployment, QC readings will be taken using a separate meter as specified in WPP’s unattended probe SOPs. After retrieval of deployed multiprobes, post-deployment calibration and QC checks on the data will be performed.

##### Water Quality (Bacteriological)

Water quality samples for *E. coli* bacteria analysis will be collected at all water quality monitoring sites. Sampling will be performed on six occasions within a 90-day window between June 1 and September 30. (Primary Contact Recreation Season). Crews of two persons each will collect the samples following protocols outlined in approved DWM and WES SOPs. Samples will be stored on ice and transported to Alpha Analytical, within approximately 6 hours of collection for analysis. A minimum of one duplicate and one blank sample will be tested for QC for each sampling crew (10% of the samples).

##### Benthic Macroinvertebrate Community

The benthic macroinvertebrate community will be sampled once at all sites between July 1 and September 30. These organisms can integrate environmental conditions (chemical – including nutrients and toxics; and physical – including flow and water temperature) over a long period of time and are an excellent measure of the water body’s health. The sampling methodologies will vary per WPP standard operating procedures depending on available habitat (i.e. high gradient versus low gradient). Specimens will be placed into 2L Nalgene jars, preserved with denatured 95% ethanol and transported to the WPP lab for storage. A contractor will process (i.e. subsample) the macroinvertebrate samples and complete the necessary taxonomic identifications. In addition, RBP habitat assessments will be completed at all sites sampled for benthic macroinvertebrates.

##### Fish Community

Fish community analyses will be conducted once between July 1 and September 30 at all sites. Fish, like macroinvertebrates, integrate environmental conditions over a long period of time and are an additional measure of a water body’s health. Fish will be collected within a 100-meter reach using a backpack or tote barge electrofisher and non-lethal techniques described in WPP standard operating procedures. Collected fish will be held in plastic buckets containing stream water until they are identified to species and a maximum of 25 individuals of each species are measured and weighed. The collected fish will then be redistributed throughout the reach. In addition, RBP habitat assessments will be completed at all sites sampled for fish.

#### Sampling Process Design

The 2022 sampling process is designed to collect water quality and biomonitoring data to support the assessment of selected rivers and streams in northeastern Massachusetts. Both AUs and waters without AUs were selected for monitoring according to the prioritization scheme for targeted assessment monitoring outlined in the description of the WPP’s new Seven-year Flexible Watershed Monitoring Schedule (Appendix A). Methods for identifying candidate monitoring sites were developed for each of the top five (i.e., medium to high) priority categories and applied to rivers and streams in Cohort A to create a master list of potential sites. Brief descriptions of the site selection processes follow.

Priority Category 1 (High):This priority category focuses on the identification of waters on the IR with causes of impairment that could be removed either because they have been restored or their original listing was in error. This process entailed a review of the 2016 IR with attention given to older impairment listings carried forward from previous assessment and listing cycles for which no new data have been collected in the last 20 years. These waters were considered more likely to exhibit changes in their listing status because enough time had elapsed for various pollution control strategies to restore past impairments, or because assessment and listing methodologies had changed. River and stream AUs that were suspected of having inappropriate causes of impairment were added to the list of candidate waters to be monitored and assessed in 2021 (A1) and 2022 (A2) to determine whether they can be delisted in a future integrated reporting cycle.

Priority Categories 2 (High) and 3 (Medium):These priority categories are aimed at identifying existing AUs (priority category 2) and/or other waters that are not yet defined as AUs (priority category 3) that are suspected of being impaired but are not included in the IR as such. Candidate rivers and streams for these priority categories were identified by selecting all perennial 2nd order and higher NHDPlus High Resolution (HR) reaches (USGS 2019) within catchments characterized as stressed or highly stressed by the human disturbance gradient created for MassDEP biocriteria development (Jessup 2019).  Any of the selected reaches that are part of AUs for which the aquatic life use was already impaired in the 2016 IR, or will likely be impaired in the 2018/2020 IR, were eliminated from the priority category 2 and 3 candidate list.  The remaining rivers and streams on the candidate list were evaluated in GIS using aerial photography and other coverages to eliminate those with small watersheds (intermittency), sample feasibility issues (e.g. tidal, wetland, artificial pathway through a run-of-river impoundment, etc.), or with only small stream reaches in stressed or highly stressed catchments. The remaining rivers and streams were added to the list of candidate waters to be monitored and assessed in 2021 (A1) and 2022 (A2)

Priority Category 4 (Medium): Some AUs are listed in the IR as impaired solely for a bioassessment cause (e.g. “benthic macroinvertebrates”, “fish bioassessments”, “lack of a cold water assemblage”, “combined biota/habitat bioassessments”). These priority category 4 waters are candidates for the process of stressor identification which will help identify underlying causes of biological impairment and define appropriate measures (TMDL, habitat restoration, etc.) for their restoration. Candidate AUs were chosen first by simply identifying those AUs in the 2016 IR for which the aquatic life use was impaired for one or more bioassessment cause, but no additional underlying pollutants or other causes were listed. Secondly, newer data not reflected in the 2016 IR were reviewed to determine whether enough stressor data are already available for some of the candidate AUs, in which case they were eliminated from further consideration for monitoring in 2021 (A1) and 2022 (A2).

Priority Category 5 (Medium): This monitoring priority is focused on AUs that may be cold water fisheries (CWF), but available data and information are insufficient for designating them as such in the water quality standards. A preliminary list of candidate streams was created by removing streams already designated, or proposed for designation as CWF, in the Massachusetts surface water quality standards (SWQS) from the Massachusetts Division of Fisheries and Wildlife (MassDFW) list of Coldwater Fisheries Resources (CFR). Efforts were then made to determine whether enough data are currently available for the remaining waters on the CFR list to support their designation as CWF in future revisions of the SWQS. Those waters in Cohort A for which additional data are needed were proposed for monitoring in 2021 (A1) and 2022 (A2).

A final master list of priority monitoring segments/streams/rivers was created by combining the results of the individual selection processes carried out for the five priority categories and comparing this list to monitoring recommendations that were made by WPP staff during previous assessments of these waters to add any additional segments/rivers/streams. In addition, duplicate segments/streams/rivers were eliminated from the master list. Finally, segments/streams/rivers identified in the category 5 (cold water fisheries) selection process were eliminated if they were not represented in NHD, or identified as intermittent or 1st order in NHD, or had recently collected temperature data that had not yet been assessed.

A total of 61 candidate sites on priority segments/rivers/streams in Cohort A2 were assigned to 9 individual site groups which, in turn, were combined into three allotments for the 2022 monitoring effort. Each allotment of approximately 16-24 sites was assigned to an individual WPP monitoring coordinator who is responsible for site reconnaissance, adding additional sites to fill out a survey group (if necessary), replacing site that are unsampleable or inaccessible, obtaining landowner access permission, defining logistics for efficient monitoring, and generation of useable data at assigned sites using the procedures contained in WPP SOPs. Based on the field reconnaissance information and logistical/resource considerations, a final list of 66 sites was developed for monitoring in 2022 (Table 2). Monitoring site locations are illustrated in Figure 1. The project and monitoring schedules are outlined in Table 3.

| **Table 2.** Watershed Cohort A2 2022 monitoring sites | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site ID** | **Unique ID** | **Assessment Unit (AU)** | **Waterbody** | **Watershed** | **Site Group1** | **Site Description** | **Latitude** | **Longitude** | **Priority Category2** |
| [EL01](http://maps.google.com/maps?q=loc:42.19490917,-70.89309902) | W3123 | MA74-21 | Eel River | Neponset | 1 | [Colonial Road, Hingham] | 42.19491 | -70.89310 | CWF determination |
| [PR01](http://maps.google.com/maps?q=loc:42.20298433,-70.90145862) | W2039 | MA74-20 | Plymouth River | Weymouth & Weir | 1 | [Ward Street, Hingham] | 42.20298 | -70.90146 | Unassessed (suspect impairment) |
| [PR02](http://maps.google.com/maps?q=loc:42.19943678,-70.92084891) | W2919 | MA74-20 | Plymouth River | Weymouth & Weir | 1 | [Colonels Drive, Weymouth] | 42.19944 | -70.92085 | Unassessed (suspect impairment) |
| [OS01](http://maps.google.com/maps?q=loc:42.19258744,-70.94329349) | W2046 | MA74-03 | Old Swamp River | Weymouth & Weir | 1 | [Libbey Industrial Parkway, Weymouth] | 42.19259 | -70.94329 | Unassessed (suspect impairment) |
| [MR01](http://maps.google.com/maps?q=loc:42.20269726,-70.9417829) | W3124 | MA74-04 | Mill River | Weymouth & Weir | 1 | [approximately 640 feet upstream of inlet to Whitmans Pond and approximately 925 feet downstream from Washington Street, Weymouth] | 42.20270 | -70.94178 | Unassessed (suspect impairment) |
| [MR02](http://maps.google.com/maps?q=loc:42.19324533,-70.95931587) | W2047 | MA74-04 | Mill River | Weymouth & Weir | 1 | [Front Street (upstream of the outfall downstream of the bridge), Weymouth] | 42.19325 | -70.95932 | Unassessed (suspect impairment) |
| [SM01](http://maps.google.com/maps?q=loc:42.21629798,-70.97234539) | W3125 | MA74-24 | Smelt Brook | Weymouth & Weir | 1 | [Stetson Street, Braintree] | 42.21630 | -70.97235 | Unassessed (suspect impairment) |
| [FR01](http://maps.google.com/maps?q=loc:42.19918489,-71.02404807) | W2053 | MA74-27 | Farm River | Weymouth & Weir | 1 | [approximately 300 feet upstream from Pond Street, Braintree] | 42.19918 | -71.02405 | Unassessed (suspect impairment) |
| [CB01](http://maps.google.com/maps?q=loc:42.18379489,-71.01129661) | W2049 | MA74-22 | Cranberry Brook | Weymouth & Weir | 2 | [upstream of road and two stormwater outfalls, Route 37 (Washington Street), Braintree] | 42.18379 | -71.01130 | Unassessed (suspect impairment) |
| [MY01](http://maps.google.com/maps?q=loc:42.16013468,-71.02947632) | W3126 | MA74-23 | Mary Lee Brook | Weymouth & Weir | 2 | [Wilmarth Road, Randolph] | 42.16013 | -71.02948 | Unassessed (suspect impairment) |
| [UN01](http://maps.google.com/maps?q=loc:42.12700036,-71.12643496) | W2555 | MA73-32 | Unnamed Tributary | Neponset | 2 | [unnamed tributary to unnamed tributary to Steep Hill Brook, Pratts Court, Stoughton] | 42.12700 | -71.12643 | Unassessed (suspect impairment) |
| [UT01](http://maps.google.com/maps?q=loc:42.13065954,-71.12928401) | W2554 | MA73-32 | Unnamed Tributary | Neponset | 2 | [unnamed tributary to Steep Hill Brook, Central Street, Stoughton] | 42.13066 | -71.12928 | Delisting |
| [MP01](http://maps.google.com/maps?q=loc:42.14787754,-71.14845309) | W3127 | MA73-21 | Massapoag Brook | Neponset | 2 | [approximately 520 feet downstream from Old Shepard Street, Canton] | 42.14788 | -71.14845 | Delisting |
| [UB01](http://maps.google.com/maps?q=loc:42.11279819,-71.20050852) | W3128 | MA73-35 | Unnamed Tributary | Neponset | 2 | [unnamed tributary to Beaver Brook approximately 760 feet upstream of mouth at confluence with Beaver Brook, north of West Street, Sharon] | 42.11280 | -71.20051 | CWF determination |
| [TH01](http://maps.google.com/maps?q=loc:42.16145887,-71.1918344) | W3129 | MA73-17 | Traphole Brook | Neponset | 2 | [approximately 1275 feet downstream from Sumner Street, Norwood] | 42.16146 | -71.19183 | Listing |
| [PK01](http://maps.google.com/maps?q=loc:42.20323377,-71.13501796) | W0566 | MA73-27 | Ponkapog Brook | Neponset | 3 | [Elm Street, Canton] | 42.20323 | -71.13502 | Listing |
| [PB01](http://maps.google.com/maps?q=loc:42.21042525,-71.18587937) | W3130 | MA73-24 | Purgatory Brook | Neponset | 3 | [approximately 580 feet upstream of Route 1 (near Everett Street), Norwood] | 42.21043 | -71.18588 | Listing |
| [PF01](http://maps.google.com/maps?q=loc:42.20484339,-71.19002253) | W3131 | MA73-23 | Plantingfield Brook | Neponset | 3 | [approximately 700 feet downstream from Neponset Street, Norwood] | 42.20484 | -71.19002 | Delisting |
| [HW01](http://maps.google.com/maps?q=loc:42.1746126,-71.21009717) | W3132 | MA73-16 | Hawes Brook | Neponset | 3 | [approximately 600 feet upstream of Washington Street, Norwood] | 42.17461 | -71.21010 | Listing |
| [GM01](http://maps.google.com/maps?q=loc:42.1952478,-71.22448267) | W3133 | MA73-15 | Germany Brook | Neponset | 3 | [approximately 300 feet upstream of Westover Parkway, Norwood] | 42.19525 | -71.22448 | CWF determination |
| [MK01](http://maps.google.com/maps?q=loc:42.19683573,-71.2385392) | W3134 | MA73-12 | Mill Brook | Neponset | 3 | [TAM Arack Road, Westwood] | 42.19684 | -71.23854 | Listing |
| [BB01](http://maps.google.com/maps?q=loc:42.1934687,-71.24276003) | W1940 | MA73-11 | Bubbling Brook | Neponset | 3 | [Trailside Drive, Walpole] | 42.19347 | -71.24276 | None |
| [MN01](http://maps.google.com/maps?q=loc:42.1769181,-71.28254286) | W0539 | MA73-09 | Mine Brook | Neponset | 3 | [upstream/north of Elm Street, Medfield] | 42.17692 | -71.28254 | Delisting |
| [Stony](http://maps.google.com/maps?q=loc:42.25908596,-71.13652242) | W3020 | MA72-37 | Stony Brook | Charles | 4 | [approximately 200 feet west/upstream of the Stony Brook Reservation trailhead parking, east off Enneking Parkway, Boston] | 42.25909 | -71.13652 | None |
| [Pow](http://maps.google.com/maps?q=loc:42.25660125,-71.24142183) | W3111 | MA72-20 | Powissett Brook | Charles | 4 | [Dedham Street, Dover] | 42.25660 | -71.24142 | Stressor identification |
| [Trout](http://maps.google.com/maps?q=loc:42.25417326,-71.29337351) | W0408 | MA72-19 | Trout Brook | Charles | 4 | [Haven Street, Dover] | 42.25417 | -71.29337 | Delisting |
| [Davis](http://maps.google.com/maps?q=loc:42.26836055,-71.33039383) | W3112 | MA72-05 | Davis Brook | Charles | 4 | [aquaduct crossing northeast of Riverbend Drive, Natick] | 42.26836 | -71.33039 | Unassessed (suspect impairment) |
| [Bogle](http://maps.google.com/maps?q=loc:42.31026814,-71.32418978) | W3113 | MA72-43 | Bogle Brook | Charles | 4 | [approximately 825 feet northeast/upstream of Woodside Avenue, Wellesley] | 42.31027 | -71.32419 | Unassessed (suspect impairment) |
| [Seavern](http://maps.google.com/maps?q=loc:42.34154459,-71.26662505) | W1590 | MA72-44 | Seaverns Brook | Charles | 4 | [approximately 1100 feet downstream from Park Road, Weston] | 42.34154 | -71.26663 | Listing |
| [Tub](http://maps.google.com/maps?q=loc:42.20894589,-71.26694884) | W1937 | MA73-07 | Tubwreck Brook | Neponset | 5 | [Draper Road, Dover] | 42.20895 | -71.26695 | None |
| [Stop](http://maps.google.com/maps?q=loc:42.15866554,-71.30280984) | W1151 | MA72-10 | Stop River | Charles | 5 | [Noon Hill Road, Medfield] | 42.15867 | -71.30281 | Delisting |
| [Vine](http://maps.google.com/maps?q=loc:42.1840512,-71.31591897) | W3114 | MA72-05 | Vine Brook | Charles | 5 | [approximately 440 feet south/downstream from Main Street, Medford] | 42.18405 | -71.31592 | Unassessed (suspect impairment) |
| [Mill](http://maps.google.com/maps?q=loc:42.19598069,-71.33022096) | W1586 | MA72-39 | Mill Brook | Charles | 5 | [North Meadows Road (Route 27), Medfield (identified as North Brook on USGS 1987 Medfield quadrangle)] | 42.19598 | -71.33022 | None |
| [Dop](http://maps.google.com/maps?q=loc:42.21553968,-71.40765942) | W0416 | MA72-40 | Dopping Brook | Charles | 5 | [Whitney Street, Holliston] | 42.21554 | -71.40766 | Listing |
| [Jar](http://maps.google.com/maps?q=loc:42.21956372,-71.43509098) | W3115 | MA72050 | Jar Brook | Charles | 5 | [Travis Road, Holliston] | 42.21956 | -71.43509 | Unassessed (suspect impairment) |
| [Huckl](http://maps.google.com/maps?q=loc:42.1629781,-71.52325769) | W3116 | MA72068 | Huckleberry Brook | Charles | 5 | [approximately 425 feet south/downstream from Shadowbrook Lane, Milford] | 42.16298 | -71.52326 | Unassessed (suspect impairment) |
| [Misco](http://maps.google.com/maps?q=loc:42.04091222,-71.42652553) | W3117 | MA72-14 | Miscoe Brook | Charles | 6 | [South Street, Franklin] | 42.04091 | -71.42653 | None |
| [Dix](http://maps.google.com/maps?q=loc:42.06029614,-71.42140501) | W3005 | MA72-14 | Dix Brook | Charles | 6 | [Financial Park, Franklin] | 42.06030 | -71.42141 | CWF determination |
| [Uncas](http://maps.google.com/maps?q=loc:42.07149449,-71.35824989) | W3118 | MA72092 | Uncas Brook | Charles | 6 | [Elysium Street, Wrentham] | 42.07149 | -71.35825 | None |
| [Shep](http://maps.google.com/maps?q=loc:42.11866643,-71.40062992) | W3119 | MA72-50 | Shepards Brook | Charles | 6 | [approximately 1800 feet west/downstream from Lincoln Street, Franklin] | 42.11867 | -71.40063 | CWF determination |
| [Mine](http://maps.google.com/maps?q=loc:42.12453197,-71.43065489) | W1147 | MA72-14 | Mine Brook | Charles | 6 | [Pond Street, Franklin] | 42.12453 | -71.43065 | Delisting |
| [ChasB](http://maps.google.com/maps?q=loc:42.130189,-71.444902) | W3120 | MA72-04 | Charles River | Charles | 6 | [approximately 330 feet southwest/upstream of Pearl Street, Bellingham] | 42.13019 | -71.44490 | None |
| [Stall](http://maps.google.com/maps?q=loc:42.1239344,-71.45510631) | W3121 | MA72-04 | Stall Brook | Charles | 6 | [Hartford Avenue, Bellingham] | 42.12393 | -71.45511 | None |
| [ChasA](http://maps.google.com/maps?q=loc:42.14007115,-71.3896734) | W0414 | MA72-04 | Charles River | Charles | 6 | [Walker Street, Medway (near USGS flow gaging station #01103280) (upstream of Charles River Pollution Control District (MA0102598) discharge)] | 42.14007 | -71.38967 | None |
| [Chkn](http://maps.google.com/maps?q=loc:42.14618022,-71.42589748) | W3122 | MA72-34 | Chicken Brook | Charles | 6 | [approximately 550 feet southeast/downstream from Main Street, Medway] | 42.14618 | -71.42590 | Listing |
| [LR01](http://maps.google.com/maps?q=loc:42.79435312,-70.89091777) | W3090 | MA91-11 | Little River | Parker | 7 | [Parker Street, Newburyport/Scotland Road, Newbury] | 42.79435 | -70.89092 | Unassessed (suspect impairment) |
| [OP01](http://maps.google.com/maps?q=loc:42.72371971,-70.87883871) | W3095 | MA91-10 | Ox Pasture Brook | Parker | 7 | [Cross Street, Rowley] | 42.72372 | -70.87884 | None |
| [KB01](http://maps.google.com/maps?q=loc:42.67483584,-70.8406667) | W0119 | MA92-21 | Kimball Brook | Ipswich | 7 | [Kimball Street, Ipswich] | 42.67484 | -70.84067 | Delisting |
| [MR01](http://maps.google.com/maps?q=loc:42.65653259,-70.84213859) | W3135 | MA92-03 | Miles River | Ipswich | 7 | [approximately 710 feet upstream of Country Road, Ipswich] | 42.65653 | -70.84214 | Delisting |
| [LC01](http://maps.google.com/maps?q=loc:42.64726356,-70.84333564) | W0122 | MA92-20 | Long Causeway Brook | Ipswich | 7 | [Route 1A, Ipswich/Hamilton] | 42.64726 | -70.84334 | None |
| [IR01](http://maps.google.com/maps?q=loc:42.65895077,-70.89067537) | W3104 | MA92-15 | Ipswich River | Ipswich | 7 | [Willowdale Road, Ipswich/Winthrop Street, Hamilton] | 42.65895 | -70.89068 | Delisting |
| [HW01](http://maps.google.com/maps?q=loc:42.655056,-70.91707049) | W0125 | MA92-17 | Howlett Brook | Ipswich | 7 | [Ipswich Road, Topsfield (near confluence with Ipswich River)] | 42.65506 | -70.91707 | Listing |
| [MB01](http://maps.google.com/maps?q=loc:42.66980951,-71.08109678) | W3137 | MA92-14 | Mosquito Brook | Ipswich | 8 | [approximately 200 feet upstream of Blue Ridge Road, North Andover (upstream of power corridor crossing)] | 42.66981 | -71.08110 | Unassessed (suspect impairment) |
| [UI01](http://maps.google.com/maps?q=loc:42.59309411,-71.01092148) | W0105 | MA92-12 | Unnamed Tributary | Ipswich | 8 | [unnamed tributary to Ipswich River at Mt. Vernon Street, Middleton] | 42.59309 | -71.01092 | Listing |
| [CB01](http://maps.google.com/maps?q=loc:42.55961592,-70.94786247) | W3138 | MA93-02 | Crane Brook | North Coastal | 8 | [approximately 150 feet downstream from Pine Street, Danvers] | 42.55962 | -70.94786 | None |
| [UB01](http://maps.google.com/maps?q=loc:42.55460638,-70.84992581) | W3139 | MA93-58 | Unnamed Tributary | North Coastal | 8 | [unnamed tributary to Beverly Cove, Hale Street, Beverly] | 42.55461 | -70.84993 | None |
| [NB01](http://maps.google.com/maps?q=loc:42.55380649,-71.00363733) | W0131 | MA92-11 | Norris Brook | Ipswich | 8 | [Russell Street, Peabody] | 42.55381 | -71.00364 | Delisting |
| [UI02](http://maps.google.com/maps?q=loc:42.57710419,-71.07091712) | W0100 | MA92-09 | Unnamed Tributary | Ipswich | 8 | [unnamed tributary to the Ipswich River, Elm Street (near intersection with Willow Street), North Reading] | 42.57710 | -71.07092 | Listing |
| [ML01](http://maps.google.com/maps?q=loc:42.55245,-71.1688) | W3140 | MA92-04 | Mill Brook | Ipswich | 8 | [Church Street, Wilmington] | 42.55245 | -71.16880 | None |
| [HB01](http://maps.google.com/maps?q=loc:42.48718042,-71.019888) | W3141 | MA93-33 | Hawkes Brook | North Coastal | 9 | [southwest of the Route 129 and Route 1 cloverleaf, approximately 200 feet upstream of mouth at confluence with Saugus River, Saugus] | 42.48718 | -71.01989 | None |
| [PB01](http://maps.google.com/maps?q=loc:42.46206403,-71.00875391) | W3142 | MA93-50 | Shute Brook | North Coastal | 9 | [approximately 180 feet downstream from Central Street, Saugus] | 42.46206 | -71.00875 | Listing |
| [BP01](http://maps.google.com/maps?q=loc:42.47975992,-71.02006732) | W3143 | MA93-48 | Bennetts Pond Brook | North Coastal | 9 | [southeast of the Lynn Falls Parkway and Route 1 coverleaf, approximately 150 feet upstream of mouth at confluence with the Saugus River, Saugus] | 42.47976 | -71.02007 | Listing |
| [MU01](http://maps.google.com/maps?q=loc:42.43524414,-71.19406671) | W1977 | MA71-15 | Munroe Brook | Mystic | 9 | [at footbridge south of Bartlett Avenue, Lexington] | 42.43524 | -71.19407 | Listing |
| [SG01](http://maps.google.com/maps?q=loc:42.47137193,-71.17418508) | W1972 | MA71-11 | Shaker Glen Brook | Mystic | 9 | [Totman Drive, Woburn] | 42.47137 | -71.17419 | Listing |
| [CU01](http://maps.google.com/maps?q=loc:42.48174166,-71.17429933) | W3144 | MA71-10 | Cummings Brook | Mystic | 9 | [approximately 75 feet downstream from Willow Street, Woburn] | 42.48174 | -71.17430 | Listing |
| [LB01](http://maps.google.com/maps?q=loc:42.47967045,-71.18146577) | W3145 | MA71-10 | Little Brook | Mystic | 9 | [approximately 625 feet downstream from Bedford Street, Woburn] | 42.47967 | -71.18147 | Unassessed (suspect impairment) |
| 1 Groups 1-3 = Site Allotment A1-1, Groups 4-6 = Site Allotment A1-2, Groups 7-9 = Site Allotment A1-3  2See Appendix A for Priority Category descriptions. None = site was added after prioritization to replace dropped sites or fill survey group gaps (Monitoring Coordinators decision) | | | | | | | | | |

Map

Description automatically generated

**Figure 1.** Watershed Cohort A2 2022 targeted assessment monitoring sites

| **Table 3.** Project Schedule for 2022 targeted assessment monitoring | | | |
| --- | --- | --- | --- |
| **Activity** | **Approx. Date of Initiation** | **Approx. Date of Completion** | **Deliverable** |
| Coordination, staff meetings, reconnaissance, river/stream sampling plan development, site selection, etc. | Jan 2022 | Apr 2022 | Draft sampling plan; meeting notes, etc. |
| Draft sampling plan review and approval | Mar 2022 | Apr 2022 | Internal WPP concurrence on sampling plan |
| Probe deploy/retrieval | May 2022 | Sep 2022 | Continuous DO/temperature data |
| Water quality sampling surveys  (6 visits) | May 2022 | Sep 2022 | Field data; lab samples to WES, WPP, EPA and/or contract lab(s) |
| Benthic/Habitat sampling surveys  (1 visit) | Jul 2022 | Sep 2022 | Field data; benthic samples to contractor |
| Fish Population sampling surveys  (1 visit) | Aug 2022 | Sep 2022 | Field data |
| Data QA/QC review and validation | Jan 2023 | Jun 2023 | 2022 Data Validation Report |
| Data review, analysis and preliminary reporting | Jun 2023 | Mar 2024 | Final data analysis |

#### Non-Direct Measurements

Table 4 presents a brief list of relevant external data sources that may be used in coordinating monitoring efforts or the interpretation of monitoring data. For example, stage data from the USGS could be used to determine if water levels are appropriate for certain types of sampling or rain data from NCEI could be used to determine if a sampling event occurred during wet or dry weather.

**Table 4.** External data sources used for the 2022 targeted assessment monitoring

|  |  |
| --- | --- |
| **Organization** | **Data** |
| United States Geological Survey (USGS)  <https://www.usgs.gov/centers/new-england-water/> | Continuously stream stage and discharge measurements at gage stations within the project extent. |
| National Centers for Environmental Information (NCEI)  <https://www.ncdc.noaa.gov/> | Daily precipitation and temperature data weather stations within the project extent. |
| The Weather Underground  <http://www.wunderground.com/> | Daily precipitation and temperature data weather stations within the southwestern basin group. |

#### Literature Cited

Jessup, B. 2019.  *DRAFT Development of Indices of Biotic Integrity for Assessing Macroinvertebrate Assemblages in Massachusetts Freshwater Wadeable Streams*. Tetra Tech, Inc.  Montpelier, VT.

MassDEP. 2018*. A Strategy for Monitoring and Assessing the Quality of Massachusetts’ Waters to Support Multiple Water Resource Management Objectives 2016 – 2025.* CN 203.5 Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

[Online]. <https://www.mass.gov/doc/water-quality-monitoring-strategy-2016-2025/download>

MassDEP. 2019. *Massachusetts Year 2016 Integrated List of Waters – Final Listing of the Condition of Massachusetts’ Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.* CN 470.1Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. [Online]. <https://www.mass.gov/files/documents/2020/01/07/16ilwplist.pdf>

MassGIS. 2019. MA DFW Coldwater Fisheries Resources (1:25, 000). [Online] <https://docs.digital.mass.gov/dataset/massgis-data-ma-dfw-coldwater-fisheries-resources-125-000>

USGS. 2019. NHDPlus High Resolution. [Online]. <https://www.usgs.gov/core-science-systems/ngp/national-hydrography/nhdplus-high-resolution>. United States Geological Survey, Reston, VA.

#### Appendix A – Seven-year Flexible Watershed Monitoring Schedule

**Introduction**

Most elements of the MassDEP’s existing surface water monitoring program are administered by personnel of the Division of Watershed Management’s Watershed Planning Program (DWM-WPP). Current and proposed surface water monitoring program elements are presented in *A Strategy for Monitoring and Assessing the Quality of Massachusetts’ Waters to Support Multiple Water Resource Management Objectives 2016 - 2025* (the Monitoring Strategy). The ultimate goal embodied in the Monitoring Strategy is to implement a comprehensive monitoring program that serves all water quality management needs and addresses all water body types. As such, the monitoring program is designed to provide data and information from streams, rivers, lakes, reservoirs, estuaries, coastal areas and wetlands to support the five major objectives listed below.

1. Assess the status or condition of Massachusetts’ waters
2. Develop, implement and evaluate pollution control strategies
3. Develop policies and standards and identify emerging issues
4. Measure the effectiveness of water quality management programs
5. Maintain reserve monitoring capacity to respond to unforeseen data needs

Major themes inherent in both the MassDEP’s water management programs and the monitoring elements that support them are 1) the focus on the watershed as the fundamental planning unit for water quality management, 2) the assessment of biological communities, such as aquatic macroinvertebrates and fish, as the most reliable indicators of water quality conditions and ecosystem health, 3) the application of new technology and streamlined systems for data processing and analysis to support monitoring and assessment activities, and 4) the formation and reliance on partnerships and collaboration to meet water quality goals. Massachusetts’ existing and proposed water monitoring programs include both deterministic (targeted) and probabilistic (random) sampling networks and encompass both rotating watershed monitoring cycles as well as non-rotating, priority-driven schedules.

Probabilistic sampling designs provide statistically valid estimates of the use support status of 100% of the waters in a target population (e.g., shallow streams, deep rivers, lakes, etc.) with data and information collected from a random sample of those waters. Beginning in 2011 MassDEP carried out a five-year probabilistic survey of shallow streams and applied a similar sampling design to lakes and ponds from 2016 – 2018. A random sampling design for Massachusetts’ coastal waters is currently in development.

While probabilistically derived sampling networks determine, at larger scales (e.g., statewide), the percentage of stream miles or lake acres that are meeting water quality standards, they are not as useful for assessing the use-support status of individual water bodies or assessment units (AU) or for identifying individual impaired waters for listing pursuant to § 303(d) of the Clean Water Act (CWA). The Monitoring Strategy calls for the use of targeted monitoring designs to confirm causes and identify sources of impairment or to demonstrate that previously impaired waters are now supporting their beneficial uses and can be removed from the 303(d) list of impaired waters. Furthermore, monitoring data from targeted waters are needed to develop, implement and measure the effectiveness of control strategies, such as TMDLs, watershed-based plans, National Pollutant Discharge Elimination System (NPDES) wastewater discharge permits and best management practices (BMP). These program elements and the monitoring networks needed to support them are depicted in Figure 1.

**Rotating Watershed Water Quality Management**

Watershed protection is the dominant theme of many state water quality management programs, and the EPA has endorsed this approach by providing financial and technical support for watershed-based water quality management activities. In 1993 the MassDEP placed the 27 major watersheds and coastal drainage areas (loosely termed “basins”) in Massachusetts on a rotating five-year schedule to synchronize monitoring, assessment and other components of its watershed management program. The goal was to allocate one year to each of five water management steps or phases (i.e., Year 1 – planning; Year 2 – monitoring; Year 3 – assessment; Year 4 – implementation of control strategies; and Year 5 – effectiveness evaluation), after which the process would begin again.

The completion of all the steps in the watershed management process within a five-year timeframe proved to be impracticable. The practice of watershed management is inherently complex, resource-intensive and time-consuming and project demand often outpaces available funding and other resources. Therefore, while MassDEP’s water management program continues to progress in a stepwise fashion to restore impaired waters and protect waters that meet water quality standards, in practice these steps are typically not completed within a five-year timeframe as originally conceived. Furthermore, the watersheds were originally grouped to balance workloads associated with permitting and other related administrative tasks rather than equalizing the number of river miles or lake acres among the five groups for monitoring and assessment purposes. To facilitate monitoring, the “basins” were regrouped in 2010 on a regional basis to take advantage of potential benefits to monitoring survey logistics of more closely aligned watersheds, and to more equitably distribute Massachusetts’ total river miles among the five groups. To date, despite this new arrangement, targeted assessment monitoring in these watershed groups has been precluded by priority-driven monitoring schedules and a general lack of resources.

**Flexible Seven-Year Basin Rotation for Monitoring**

The use of the watershed, or river basin, as a fundamental planning unit for water quality management was a guiding principle in the development of the Monitoring Strategy, and it remains a goal of the DWM-WPP to resume monitoring and assessment activities on a rotating watershed schedule. However, the need exists to maintain enough flexibility within that schedule to perform additional monitoring to meet other water management program needs. To that end, the DWM-WPP is establishing a sequential schedule that provides the opportunity for monitoring to be carried out in each watershed at least once every seven years yet allows for monitoring resources to be disproportionately applied in each watershed to fulfill specific water resource management objectives. Massachusetts’ 27 major watersheds and coastal drainage areas have been arranged by geography (and hydrology) into four major groups, or cohorts (A-D), each consisting of from three to ten “basins”. In turn, each major cohort is subdivided into one or two minor cohorts, each of which represents one year of the seven-year monitoring schedule (Figures 2 and 3).

Basic assessment monitoring will be performed in each minor cohort for one year and will be consecutive within major cohorts (e.g. A2 will always follow A1). However, the extended time allotted to the major cohorts (two years for all but three basins) allows for the basic schedule to be adapted to fulfill specific data needs. As such, the level of effort applied to monitoring within each major cohort, will not necessarily be evenly distributed through the minor cohorts or among individual basins, but will vary depending on priorities and objectives. Therefore, targeted monitoring may be focused anywhere within the major cohort and, if necessary, extend through all or a portion of the time allotted to that cohort. A few examples are presented below to illustrate how the above design provides the flexibility to meet a number of monitoring objectives while maintaining an overall rotating watershed structure.

Absent the need for site- or project-specific data, the overall monitoring goal will default to basic assessment and monitoring each year will be designed in accordance with the prioritization scheme presented in the following section. In Cohort A, the Concord, Merrimack, Nashua and Shawsheen watersheds (A1) would be monitored in Year 1 followed by the Ipswich, Parker, and Charles watersheds, and North Coastal and Boston Harbor coastal drainage systems (A2) in Year 2. WPP monitoring resources could be applied disproportionately, if, for example, the Merrimack and Charles watersheds received higher priority for whatever reason, in which case they might be monitored for both years in Cohort A.

Alternatively, sampling at selected locations could be performed for up to two years in larger-order rivers if pollutant loading information is needed to support TMDL development or NPDES permit development, while rotating through smaller-order rivers in the corresponding minor cohorts. If intensive surveys were needed to support model development in a particular watershed, they could also be carried out in multiple years within the major cohort. Finally, depending upon circumstances, monitoring resources might be more efficiently applied by performing stream sampling in both minor cohorts (A1 and A2) in the first year followed by lake sampling in the second year.

The proposed rotating basin structure not only provides flexibility to prioritize and apportion monitoring resources, but also presents multiple options for managing various monitoring program elements. For example, the delegation of monitoring projects to WPP monitoring personnel can be place-based (e.g., monitoring coordinator is assigned a basin for managing any monitoring activities in that basin), expertise-driven (e.g., one coordinator manages all fish sampling to be carried out in a given year, or resource-driven (e.g., one coordinator manages lake monitoring, while others coordinate stream sampling, etc.). In any case, projects will be assigned in accordance with the monitoring priorities established for the major cohort and may extend up to two years in most cohorts.

**Prioritizing Waters for Targeted Assessment Monitoring**

| **Priority** | **Priority Order** | **General Category** | **Category Descriptions1** |
| --- | --- | --- | --- |
| High | 1 | Delisting | Assessment units currently listed in Categories 4c or 5 where there are indications it should not be listed for at least one impairment cause (indications can be environmental improvement or listing/assessment methodology changes or errors). |
| High | 2 | Listing | Assessment units NOT listed in Categories 4c or 5 where there are indications it should be listed for at least one impairment cause (indications can be environmental degradation or listing/assessment methodology changes or errors). |
| Medium | 3 | Unassessed (suspect impairment) | Assessment units listed in Category 3 or waters without an assessment unit where there are indications it could listed in Categories 4c or 5 for at least one impairment cause (i.e. unassessed waters suspected to be impaired). |
| Medium | 4 | Stressor Identification | Assessment units listed in Category 5 for a non-pollutant (i.e. Fishes Bioassessment, Aquatic Macroinvertebrate Bioassessment) with no stressor impairment causes. |
| Medium | 5 | CWF Determination | Assessment units or waters without an assessment unit thought to be an undesignated or under documented coldwater fishery (CWF). |
| Low | 6 | Unassessed (suspect support) | Assessment units listed in Category 3 or waters without an assessment where there are indications it could listed in Category 1 or 2 (i.e. unassessed waters likely to support uses). |
| Low | 7 | Priority NPDES | Assessment units or most sensitive receiving waters with a prioritized NPDES permit development (i.e. situations where a reassessment of the targeted assessment unit would be of value). |
| Low | 8 | TMDL Effectiveness | Assessment units currently listed in Category 4a where the TMDL was potentially successful in removing the use impairment or the original listing of the impairment cause was potentially in error. |
| Low | 9 | Priority TMDL | Assessment units in Category 5 prioritized for TMDL development (i.e. situations where a reassessment of the listed assessment unit would be of value). |

1 – Assessment units placed in prioritization categories based on available information (indications) from multiple sources (monitoring data, landscape data, pollution control measures, assessment methodologies, etc.). Annual basin selection will be consistent with rotating basin schedule. Monitoring parameters will generally include all typical default analytes (e.g., bacteria, nutrients, chloride, probes) unless an indicator specific project is identified.

**Figure 1.** Monitoring Networks for Multiple Water Management Objectives



**Figure 2**. DWM-WPP Seven-Year Basin Rotation for Water Resource Monitoring

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **NHD Water Resource Estimations** | | | | | **Assessment Units** | |
| **NAME** | **Major Cohort** | **Total Years in Cohort** | **Minor Cohort** | **Perennial River Miles** | **River Miles per Year** | **Lakes > 5 Acres** | **Lake Acreage** | **Lakes per Year** | **River Segments (Total Length Miles)** | **Lake Segments (Total Area Acres)** |
| Concord (SuAsCo) | A | 2  (2021-2022) | A1 | 529 | 1324 | 134 | 7186 | 367 | 53 (187) | 61 (6572) |
| Merrimack | A1 | 344 | 93 | 5071 | 39 (140) | 29 (3515) |
| Nashua | A1 | 664 | 126 | 10344 | 79 (273) | 69 (9524) |
| Shawsheen | A1 | 98 | 12 | 408 | 21 (65) | 14 (406) |
| Ipswich | A2 | 157 | 68 | 2992 | 22 (97) | 39 (1922) |
| North Coastal | A2 | 116 | 64 | 2698 | 22 (41) | 42 (2006) |
| Parker | A2 | 81 | 24 | 588 | 7 (28) | 12 (290) |
| Charles | A2 | 384 | 113 | 3726 | 45 (178) | 50 (2824) |
| Boston Harbor | A2 | 274 | 100 | 4352 | 60 (166) | 50 (2982) |
| Connecticut | B | 2  (2023-2024) | B1 | 999 | 1722 | 96 | 3358 | 233 | 63 (345) | 46 (2460) |
| Chicopee | B1 | 907 | 168 | 31113 | 51 (259) | 74 (29797) |
| Millers | B2 | 435 | 97 | 4762 | 30 (134) | 64 (3846) |
| Westfield | B2 | 630 | 85 | 4295 | 63 (320) | 33 (3648) |
| Deerfield | B2 | 474 | 21 | 788 | 130 (366) | 22 (561) |
| Ten Mile | C | 2  (2025-2026) | C1 | 92 | 1322 | 21 | 937 | 611 | 10 (35) | 12 (595) |
| Taunton | C1 | 746 | 223 | 13697 | 49 (222) | 87 (10901) |
| Narragansett Bay | C1 | 178 | 29 | 4552 | 20 (65) | 6 (3769) |
| Blackstone | C1 | 334 | 148 | 6509 | 48 (168) | 100 (5177) |
| Quinebaug | C1 | 210 | 56 | 2451 | 28 (86) | 25 (1980) |
| French | C1 | 97 | 56 | 3603 | 18 (39) | 43 (3420) |
| Buzzards Bay | C2 | 479 | 210 | 6546 | 25 (79) | 72 (4983) |
| South Coastal | C2 | 244 | 131 | 4925 | 22 (58) | 75 (4214) |
| Cape Cod | C2 | 177 | 280 | 11567 | 16 (33) | 68 (5706) |
| Islands | C2 | 86 | 69 | 5738 | 6 (12) | 5 (106) |
| Housatonic | D | 1  (2027) | D1 | 547 | 952 | 117 | 5982 | 194 | 35 (219) | 33 (4284) |
| Hudson | D1 | 229 | 13 | 759 | 26 (109) | 8 (716) |
| Farmington | D1 | 175 | 64 | 3907 | 40 (108) | 18 (2135) |
|  |  |  | **Totals** | 9687 |  | 2618 | 152852 |  | 1028 (3830) | 1157 (118338) |

**Figure 3.** DWM-WPP Seven-Year Basin Rotation for Water Resource Monitoring

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