6 HERBICIDES

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Herbicide use in waterways

Herbicide chemicals are commonly used to treat excessive aquatic plant growth. Aquatic herbicides kill or injure aquatic plants by affecting plant physiology either through uptake from the immediate vicinity of external contact (contact herbicides) or through uptake and translocation throughout the entire plant (systemic herbicides).

Herbicides are designed to reduce the abundance of at least one targeted plant species, but will often cause a temporary reduction in overall algal or plant biomass in the treated area. Herbicides are intended to kill plants, and while advances in selectivity have been achieved through new or altered formulation, reduced dose, or timing and location of application, more plants than just the target species are normally at risk (Mattson et al. 2004). In cases of excessive native plant growth, broad spectrum herbicides may be used to reduce the overall abundance of plants. However, in most cases the herbicide is designed to target the dominant species (selective herbicides), with lesser impacts to non-target species. Examples of the effects of commonly used herbicides on non-target plant species are listed in Table 1.

A variety of herbicide agents including Diquat (Reward), Fluridone (Sonar), Flumioxazin (Clipper), and Glyphosate (Rodeo) have been applied in ponds and lakes in Massachusetts for the purpose of controlling various species of invasive flora such as *Hydrilla sp.*, milfoil and fanwort. All herbicides presently used in Massachusetts have been approved by MassDEP and the U.S. Environmental Protection Agency (EPA). This approval process includes formal acute toxicity tests conducted on a variety of fish and invertebrates to determine toxicity and biologically acceptable application rates. Table 1 lists the common types of herbicides, the causative agent, application types and rates, and known effects.

The impacts of aquatic plant control range widely depending upon the features of the system and the method applied, as well as the extent and timing of application. **The three primary impacts to consider are 1) degraded water and habitat quality from dying plants, 2) acute chemical toxicity to early life stages of diadromous fish, and 3) acute chemical toxicity to non-target, native aquatic life**.

Herbicide Impacts to fish

Impacts of herbicide treatments on fish are rarely attributed to direct toxicity, rather it is low oxygen caused by decaying vegetation that leads to an herbicide-induced fish kill (Hoyer and Canfield, 1997). Treatments of dense invasive plants can result in large amounts of decaying plant biomass. This in turn triggers rapid growth of bacteria and can create lethal conditions for a variety of aquatic life as oxygen levels in the water become depleted. Herbicide-induced fish kills that have occurred in the US in recent years have mainly been a consequence of lowered oxygen during plant die-off, although overapplication in confined waters has also occurred (Hoyer and Canfield, 1997).

Herbicide toxicity to fish varies depending on species and life stage, as well as the active agent and formulation. Juvenile fish and invertebrates are used in testing for a more conservative estimate of impact thresholds, as adult organisms tend to have higher resistance to impacts (USEPA 1986; Paul et al. 1994; Mattson et al. 2004). Acute toxicity studies on juvenile rainbow trout (Johnson 2015) found Diquat and Glyphosate to be slightly toxic with 96-hour LC_{50} values of 21 mg/L and 86 mg/L, respectively. Acute

toxicity studies found Fluridone to be moderately toxic with 96-hour LC_{50} values ranging between 2.1 mg/L for juvenile bluegill sunfish and 11.7 mg/L for juvenile rainbow trout (Johnson 2015). Acute toxicity studies on juvenile rainbow trout and juvenile bluegill sunfish found Flumioxazin to be moderately toxic with 96-hour LC_{50} values ranging between 2.3 – 21 mg/L (MADAR and MassDEP 2013). An early lifestage toxicity test conducted on rainbow trout showed that Flumioxazin significantly affected larval growth with a lowest-observable-adverse-effect concentration of 16.0 µg/L (MADAR and MassDEP 2013). Studies to determine the acute effects on river herring eggs, larvae, and juveniles have not been conducted.

Herbicide impacts to zooplankton

In addition to fish and aquatic plants, aquatic herbicides have variable effects on zooplankton communities. Diquat has been shown to have strong negative effects on zooplankton (Duvall et al. 2001). Toxicity studies indicate zooplankton are differentially affected by different Glyphosate formulations with negligible effects on some taxa (Vera et al. 2012) to increased mortality in calanoid copepods (Vera et al. 2012), and *Daphnia* sp. (Cuhra et al. 2013). Other negative effects of Glyphosate, Fluridone, and Flumioxazin formulations among zooplankton taxa include reduced reproduction and recruitment (Durkin 2008; Papchenkova et al. 2009; Cuhra et al. 2013). These studies suggest that developmental toxicity could be produced acutely in other aquatic species (MADAR and MassDEP 2013).

Regulatory and environmental review

The Massachusetts Department of Environmental Protection (MassDEP) and local conservation commissions review and permit herbicide treatments in Massachusetts. These agencies coordinate with the Massachusetts Department of Fish and Game to provide review and guidance on possible impacts to existing aquatic resources, rare and endangered species. Marine and freshwater organisms in coastal watersheds are managed by the Massachusetts Division of Marine Fisheries (DMF) and the Massachusetts Division of Fisheries and Wildlife (DFW) according to jurisdictional boundaries defined in MGL Chapter 130, § 5. Approximate locations delineating the jurisdictional boundaries between the two agencies are listed in Appendix Table 6.1. In most coastal systems of the Commonwealth, the boundary separating the jurisdiction between the two agencies is located either at the "head of tide" or at the first obstruction on a coastal stream. Exceptions to these boundaries are described in a Memorandum of Understanding (MOU) between DFW and DMF prepared in 2003 for the purposes of creating a uniform regulatory process. The provisions of the MOU recognize that management of anadromous striped bass (*Morone saxatilis*) and river herring, (alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)), shall fall within the regulatory authority of DMF in all waters of the Commonwealth. Jurisdiction for all other diadromous species is split between DFW and DMF at the defined coastal boundaries. Since striped bass do not migrate to waters where herbicide treatments are done, the primary concern for DMF is the impact on river herring. On a case-by-case basis, consideration may be given to herbicide impacts to diadromous white perch and American eel.

Herbicides and other chemical treatments are administered mainly to freshwater ponds, lakes, and other impoundments (not rivers, since the flow in riverine environments prevent the concentration of herbicides necessary for effective treatment). For this reason, the first step in project review should be to determine if river herring are present in the watershed and can access the treatment area. If these conditions are met, then review should continue. If these conditions are not met (i.e. river herring are not present in the watershed or cannot access the treatment area due to obstruction), the agency requesting comment should be notified that there are no DMF recommendations for the project.

Given concerns over herbicide treatments on early life stages of river herring and the potential for significant degradation of water quality when plants die off, a precautionary approach to herbicide

treatments is necessary. To avoid impacts to early life stages of river herring and other diadromous fish, DMF recommends a TOY restriction from 4/1 – 6/30 to minimize impacts to spring immigration and spawning, in addition to no full pond treatments in a given year.

In certain cases, an incursion into recommended TOY restrictions may be justified if the proposed treatment can be designed to minimize risk to aquatic life. For example, Flumioxazin, the causative agent in Clipper ©, targets plants in their early growth cycle in the spring. For this reason, an incursion into the spring TOY may be desired to maximize efficiency of treatment. A request for a TOY waiver should be made by the project proponent to the regulatory agency and sent to the DMF Habitat Program for review. Determinations for TOY incursions should be made on a case-by-case basis and requires consultation with DMF Diadromous Project biologists to consider the presence and timing of river herring spawning within the treatment area in relation to the proposed treatment.

In order to reduce possible impacts from water quality shifts and plant die-off, and to provide refuge for transient and resident fish in the pond, no more than 50% of the pond shall be treated in a given year. Water quality monitoring prior to and after treatment should be conducted by the proponent to record changes in basic water chemistry parameters (residual herbicide concentrations, water temperature, dissolved oxygen, pH, Secchi Disc depth and/or turbidity). Water quality monitoring should encompass a broad spatial and temporal scale to determine the area of effect and the rate of impact and recovery of water chemistry parameters. For spatial coverage, monitoring should be conducted in both treatment areas and untreated (control) areas. At each test site, water chemistry parameters should be conducted throughout the water column starting at the surface (0.25 to 0.5 m below surface) and at 1.0 m intervals to the bottom (0.25 to 0.5 m above bottom). For temporal coverage, monitoring should be conducted at each site prior to and after treatment. Pre-treatment monitoring should be conducted 48-hours and 24-hours prior to treatment. Post-treatment monitoring should be conducted 24-hours, 48-hours, 5 days, 7 days, 14 days and 21 days after treatment to document water quality responses.

Additional monitoring by the proponent should document changes to target and non-target plant densities as well as any resulting fish kills. In many cases, treatment is planned over the course of multiple phases and years. Therefore, it is recommended the proponent submit annual reports detailing treatment activities and resulting water chemistry data as well as treatment plans for the following year to DMF for review and comment.

DMF Recommendations

Reviewers should take the following steps in reviewing herbicide treatment projects:

1. Determine if a river herring run is present in the watershed and if the treatment area is accessible to them. If these criteria are met, proceed to the step 2. If these criteria are not met, DMF has no recommendations for the project.

2. *MA DMF response letter*: a spring TOY (4/1 – 6/30) is recommended.

3. *TOY Incursions*: If the proponent requests an incursion into TOY period(s), a request detailing a waiver, the length of time, the rationale for the request and water quality monitoring program must be made in writing and sent to the DMF Habitat Project 30 days prior to onset of treatment application for review and consideration.

    • Consult with DMF Diadromous Fisheries Project for review and determination if TOY waiver is warranted.

- Review the water quality monitoring program proposed by the proponent, or if absent, recommend that a program is required. The following items should be included in monitoring plans (see Table 2):

    a. Maximum area of the waterbody to be treated in a given year (≤ 50% total area).

    b. Water chemistry monitoring conducted in treated and untreated areas. Target a minimum of 3 sampling stations for ponds <50 acres and increase number with larger treatment areas (minimum 5 sampling stations for ponds > 50 acres). In addition, a minimum of 2 untreated stations downstream of the treatment areas should be sampled for all ponds.

    c. Vertical profiles of basic water chemistry (water temperature, DO, pH, Secchi Disc depth and/or turbidity, and herbicide residue) conducted at 1-meter increments from the bottom to the surface.

    d. Monitoring to be conducted 48-hr, 24-hr prior to and, 24-hr, 48-hr, 5 days, 7 days, 14 days and 21 days after treatment.

    e. Document changes in species and relative abundance of target and non-target plant densities.

    f. Document fish kill incidents (see Chase et al. *In press* for details).

    g. Summary report of treatment activities, water quality data and follow-up treatments to be sent to DMF for review.

    h. An approved Quality Assurance/Quality Control Plan that describes water chemistry protocols and equipment (see Chase et al. *In press* for details).

- Issue a second response letter detailing decision on approval/disapproval of TOY waiver request

Examples of DMF Comment Letters

Cleanup of Agawam Mill Pond Inc to ConCom 12-15-14.pdf

Cleanup of Agawam Mill Pond_Phase 2017 TOY Incursion to ConCom 3-15-17.pdf

White Island Pond Alliance (Herbicide Treatment) to Plymouth ConCom 4-4-14.pdf

MA DCR Lakes and Ponds Program Hood Pond Ipswich/Topsfield 20191036

Medford Boat club, Arlington, use of Solitude management DMF to ConCom 20181067 june 20, 2018

Examples of Water Quality Monitoring Plans and Reports

Agawam PH 2- Final Report Nov 2017.pdf

Agawam Mill Pond 2021 – Treatment Plan 5-10-21.pdf

Above Example Comment Letters and Monitoring Plans/Reports available upon request. Please contact MA DMF at dmf.envreview-south@mass.gov for any requests.

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Table 1. Description of active agents, application rates and known effects of herbicide products commonly used in aquatic plant management projects.

Product	Agent/Type	Application	Application/Rate	Known Effects
©Clipper	Flumioxazin Contact Broad-spectrum	Submerged, emergent, floating vegetation	0.375 - 0.75 lbs/acre Applied to waters with pH range: 5-7. Minimum retreatment interval is 28 days	•Significant declines to native and non-native flora (ACT 2013). •Concentrations over 21 days exceed chronic LOC for fish.
©SONAR	Fluridone Systemic Broad-spectrum (high dose) Selective (low dose)	SAV (Eurasian milfoil, curly-leaf pondweed)	USEPA limit: 0.15ppm 8lbs/acre (Sonar SRP) 0.4 quarts/acre (Sonar AS) Not to be applied within ¼ mile of potable water intake	•Lethal effects to plants (30-60 days) •Significant biomass reduction in all non-target plant species except *Chara* sp., and *Najas* sp. (≥ 10ppb; Netherland et al. 1997) •Excellent control of Eurasian watermilfoil, no change in species diversity of native plants (Madsen et al. 2002) •Low-moderate toxicity to fish
©AVAST	Fluridone	SAV (Eurasian milfoil, curly-leaf pondweed)	USEPA limit: 0.15ppm Not to be applied within ¼ mile of potable water intake	•Lethal effects to plants (30-60 days) •Low-moderate toxicity to fish
©Rodeo	Glyphosate Systemic Broad-spectrum	Emergent aquatic weeds (can be used to target specific plants)	0.2 mg/L (max. 0.7mg/L) Not to be applied within ¼ mile of potable water intake	•Localized O_2 depletion •Increased TSS •Contact injures and kills non-target plants, can act as a source of phosphorous (Austin et al. 1991) •LC_{50} levels variable in fish (Westerdahl and Getsinger 1988)
©Aquaneat	Glyphosate Systemic Broad-spectrum	Emergent aquatic weeds	0.2 mg/L (max. 0.7mg/L) Not to be applied within ¼ mile of potable water intake	•Localized O_2 depletion Increased TSS•LC_{50} levels variable in fish (Westerdahl and Getsinger 1988)
©Reward	Diquat Contact Broad-spectrum	Submerged, emergent, floating vegetation	0.1-1.5 ppm Photolysis half-life: 1-3 weeks	•Low bioaccumulation in fish (HSDB 1994) •O_2 depletion •Significant decrease in all plant biomass post-treatment (Parsons et al. 2007)
ProCella COR© EC	Florpyrauxifen-benzyl	Submerged, emergent and floating aquatic plants (Eurasian and variable watermilfoil, hydrilla, alligator weed, water hyacinth, water primrose)	Subsurface rates: 1 – 25 PDUs/acre-ft Foliar broadcast rates: 5.0 – 10.0 PDUs/acre Recommended usage rate in MA: 10 ppb; up to 3 applications per year with 14 days between applications (MADAR and MADEP 2019)	• O_2 depletion • Waterbodies with high plant densities should be treated in sections to prevent fish suffocation (USEPA 2017) • Sublethal effects in fish (lethargy, surfacing) were observed (LC_{50} = 3.2 mg/L; USEPA 2017)

Table 2. Proposed water quality monitoring for herbicide treatment projects.

Parameter	Recommendation
Number of Monitoring Stations	• Minimum of 3 treatment stations and 2 untreated stations (waters ≤ 50 acres) • Minimum of 5 treatment stations and 2 untreated stations (waters > 50 acres)
Monitoring Station Locations	• Minimum of 1 shoreline, 1 mid-depth, and 1 deep water station
Station Depths	• Surface, bottom (within 0.5 m) and at 1 m intervals throughout water column
Water Quality Parameters	• Temperature, pH, Dissolved oxygen (all depths) • Herbicide residue (all depths) • Secchi disc depth, and/or turbidity (surface)
Sampling Schedule	• Pre-treatment: 48 and 24 hours • Post-treatment: 1 day, 2 days, 5 days, 7 days, 14 days, and 21 days
Additional Observations	• Post-treatment monitoring for changes in target and non-target plant densities • Post-treatment monitoring for fish kills

Appendix Table 6.1. Approximate locations of boundaries (head of tide; first obstructions) for jurisdictional purposes between DMF and DFW for Massachusetts coastal streams (per MGL Chapter 130, Section 1). Information on the presence of diadromous species at these locations is available in Evans et al. (2011), Reback et al. (2004a,b; 2005) and Brady et al (2005).

Region	Watershed	Stream	Boundary	City/Town	River Mile	GPS Latitude	GPS Longitude
North Coastal	Merrimack	Merrimack River	Interstate 495	Haverhill	16.1	42° 46' 06.044" N	71° 07' 12.089" W
North Coastal	Merrimack	Powwow River	Mill Street Dam	Amesbury	7.1	42° 51' 24.608" N	70° 55' 46.359" W
North Coastal	Merrimack	Back River	Clarks Pond Dam	Amesbury	0.4	42° 51' 37.663" N	70° 55' 35.866" W
North Coastal	Merrimack	Artichoke River	Emery Lane (Curzon's Mill) Dam	Newburyport	1.2	42° 49' 09.330" N	70° 56' 14.603" W
North Coastal	Merrimack	Indian River	Mill Pond Dam	West Newbury	2.9	42° 48' 23.727" N	70° 58' 01.553" W
North Coastal	Merrimack	Shawsheen River	Rte. 133 Dam	Andover	25.0	42° 40' 20.522" N	70° 08' 58.243" W
North Coastal	Merrimack	Spickett River	Spickett River Dam	Lawrence	12.7	42° 42' 26.609" N	70° 08' 52.669" W
North Coastal	Parker	Little River	Hanover Street	Newbury	2.2	42° 47' 24.097" N	70° 52' 35.068" W
North Coastal	Parker	Parker River	Woolen Mill Dam/Central St.	Newbury	9.3	42° 45' 00.072" N	70° 55' 44.862" W
North Coastal	Parker	Mill River	Jewel Mill Dam	Rowley	4.2	42° 44' 20.829" N	70° 54' 01.723" W
North Coastal	Parker	Egypt River	Munic. Elect. Generating Plant	Ipswich	5.3	42° 41' 53.259" N	70° 52' 09.286" W
North Coastal	Ipswich	Ipswich River	Ipswich Mills Dam	Ipswich	3.7	42° 40' 39.110" N	70° 50' 15.572" W
North Coastal	North Coastal	Essex River	Elevation change (Apple Street)	Essex	1.0	42° 37' 30.514" N	70° 47' 24.096" W
North Coastal	North Coastal	Ebben Creek (Essex R.)	Grove Street	Essex	1.1	42° 37' 29.011" N	70° 45' 50.075" W
North Coastal	North Coastal	Walker Creek	Route 133	Gloucester	2.0	42° 37' 27.034" N	70° 44' 15.048" W
North Coastal	North Coastal	Alewife Brook	Cherry Street	Gloucester	1.2	42° 37' 48.089" N	70° 40' 12.092" W
North Coastal	North Coastal	Goose Cove	Falls above Denniston Street	Gloucester	0.0	42° 39' 07.120" N	70° 39' 54.417" W
North Coastal	North Coastal	Langsford Pond	Route 127 Spillway	Gloucester	0.1	42° 39' 39.842" N	70° 40' 15.568" W
North Coastal	North Coastal	Mill Brook	King Street Dam	Rockport	0.1	42° 39' 30.550" N	70° 37' 23.693" W
North Coastal	North Coastal	Sawmill Brook	Frank Street Culvert	Rockport	0.5	42° 38' 16.246" N	70° 36' 36.842" W
North Coastal	North Coastal	Sleepy Hollow Pond	Atlantic Street Culvert	Gloucester	0.6	42° 38' 48.394" N	70° 41' 53.121" W
North Coastal	North Coastal	Little River	W. Gloucester Water Treat. Facility	Gloucester	1.4	42° 36' 38.252" N	70° 42' 29.395" W
North Coastal	North Coastal	Fernwood Lake	R.R. Tracks (Lower Banjo Pond)	Gloucester	0.1	42° 37' 00.300" N	70° 41' 28.860" W
North Coastal	North Coastal	Buswell Pond	Duck Pond Culvert	Gloucester	0.1	42° 35' 49.015" N	70° 41' 08.085" W
North Coastal	North Coastal	West Pond	Shore Road Culvert	Gloucester	0.0	42° 34' 30.581" N	70° 42' 30.557" W
North Coastal	North Coastal	Chubb Creek	None	Beverly/Manchester	1.0	N/A	N/A
North Coastal	North Coastal	Bass River	Dam above Elliot Street	Beverly	1.6	42° 33' 30.838" N	70° 53' 17.332" W
North Coastal	North Coastal	Porter River	None	Danvers	1.7	N/A	N/A
North Coastal	North Coastal	Crane River	Mill Pond Dam	Danvers	1.8	42° 33' 33.396" N	70° 56' 32.043" W
North Coastal	North Coastal	Crane Brook	Interstate 95	Danvers	1.6	42° 33' 34.003" N	70° 58' 25.069" W
North Coastal	North Coastal	Porter Brook	Poplar Street	Danvers	0.0	42° 34' 05.037" N	70° 55' 40.031" W
North Coastal	North Coastal	Forest River	Railroad Bridge	Salem/Peabody	1.1	42° 29' 32.072" N	70° 54' 29.071" W

Region	Watershed	Stream	Boundary	City/Town	River Mile	GPS Latitude	GPS Longitude
North Coastal	North Coastal	Proctor Brook	None	Salem/Peabody	5.6	N/A	N/A
North Coastal	North Coastal	North River	Howley Street	Salem	1.5	42° 31' 27.082" N	70° 55' 07.035" W
North Coastal	North Coastal	Shute Brook	None	Saugus	2.0	N/A	N/A
North Coastal	North Coastal	Saugus River	Hamilton Street	Saugus	2.5	42° 27' 56.015" N	71° 00' 15.044" W
Boston Harbor	Mystic	Mystic River	Amelia Earhart Dam & Locks	Somersett/Everett	1.7	42° 23' 41.782" N	71° 04' 32.072" W
Boston Harbor	Charles	Charles River	Charles River Locks	Boston	0.9	42° 22' 06.924" N	71° 03' 42.812" W
Boston Harbor	Neponset	Neponset River	Baker Chocolate Factory Dam	Milton	4.2	42° 16' 14.096" N	71° 04' 07.531" W
Boston Harbor	Weymouth/Weir	Furnace Brook	None	Quincy	1.9	N/A	N/A
Boston Harbor	Weymouth/Weir	Town River	Monroe Field Culvert	Quincy	2.0	42° 15' 02.521" N	70° 59' 33.070" W
Boston Harbor	Weymouth/Weir	Smelt Brook	R.R. Culvert	Weymouth	0.13	42° 13' 17.282" N	70° 50' 04.374" W
Boston Harbor	Weymouth/Weir	Fore/Monatiquot River	McCusker Road Culvert	Braintree	5.5	42° 13' 16.016" N	70° 58' 58.974" W
Boston Harbor	Weymouth/Weir	Back River	Railroad Bridge	Weymouth	2.5	42° 13' 09.092" N	70° 55' 23.024" W
Boston Harbor	Weymouth/Weir	Broad Cove	None	Hingham	0.5	N/A	N/A
Boston Harbor	Weymouth/Weir	Weir River	Foundry Pond Dam	Hingham	2.7	42° 15' 48.794" N	70° 51' 38.082" W
Boston Harbor	Weymouth/Weir	Straits Pond	Straits Pond Tidegate	Hull/Cohasset	1.0	42° 15' 37.146" N	70° 50' 40.373" W
South Coastal	South Coastal	Little Harbor	Little Harbor Tide Gate	Cohasset	0.9	42° 15' 15.207" N	70° 48' 37.263" W
South Coastal	South Coastal	Musquashcut Brook	Musquashcut Pond Tide Gate	Scituate	1.2	42° 13' 31.113" N	70° 45' 34.019" W
South Coastal	South Coastal	Bound Brook	Hunters Pond Dam	Scituate/Cohasset	0.0	42° 13' 22.798" N	70° 47' 19.747" W
South Coastal	South Coastal	First Herring Brook	Old Oaken Bucket Pond Dam	Scituate	0.0	42° 10' 39.404" N	70° 45' 00.941" W
South Coastal	South Coastal	North River	Route 3 Northbound	Pembroke	6.5	42° 06' 58.022" N	70° 46' 40.089" W
South Coastal	South Coastal	Second Herring Brook	Gordon Pond Dam	Norwell	0.3	42° 09' 04.692" N	70° 47' 16.927" W
South Coastal	South Coastal	Third Herring Brook	Tiffany (Tack Factory) Pond	Norwell/Hanover	1.1	42° 07' 21.669" N	70° 48' 32.744" W
South Coastal	South Coastal	Indianhead River	Elm Street Dam	Hanover/Pembroke	2.0	42° 06' 01.128" N	70° 49' 26.429" W
South Coastal	South Coastal	Herring Brook	Barker Street Dam	Pembroke	2.2	42° 04' 32.359" N	70° 48' 02.697" W
South Coastal	South Coastal	Robinson's Creek	Howland Pond Dam	Pembroke	0.1	42° 05' 56.874" N	70° 47' 34.827" W
South Coastal	South Coastal	Macombers Creek	Damon's Point Road Culvert	Marshfield	1.4	42° 09' 05.309" N	70° 43' 42.556" W
South Coastal	South Coastal	South River	Willow Street	Marshfield	6.0	42° 05' 35.014" N	70° 42' 43.097" W
South Coastal	South Coastal	Green Harbor River	Green Harbor River Tide Gates	Marshfield	0.6	42° 05' 10.980" N	70° 39' 02.536" W
South Coastal	South Coastal	West Brook	North Hill Marsh Bog Sluice	Duxbury	1.0	42° 02' 48.533" N	70° 42' 22.934" W
South Coastal	South Coastal	Bluefish River	Amory Dam	Duxbury	1.6	42° 02' 17.568" N	70° 40' 32.983" W
South Coastal	South Coastal	Island Creek	Mill Pond Fishway	Duxbury	0.8	42° 01' 00.633" N	70° 42' 38.443" W
South Coastal	South Coastal	Halls Brook	Mill Pond Dam	Kingston	0.3	41° 59' 59.697" N	70° 43' 34.971" W
South Coastal	South Coastal	Jones River	Main Street	Kingston	1.3	41° 59' 45.078" N	70° 43' 23.011" W
South Coastal	South Coastal	Laundry Brook	Brook Street Culvert	Kingston	0.1	41° 59' 18.437" N	70° 43' 45.739" W
South Coastal	South Coastal	Smelt Brook	Foundry Pond Dam	Kingston	0.4	41° 59' 09.301" N	70° 42' 35.618" W
South Coastal	South Coastal	Town Brook	Water Street Dam	Plymouth	0.0	41° 57' 21.978" N	70° 39' 42.942" W
South Coastal	South Coastal	Shingle Brook	Howland Pond Dam	Plymouth	0.3	41° 55' 33.774" N	70° 36' 48.901" W
South Coastal	South Coastal	Eel River	Hayden Mill Pond Control	Plymouth	2.2	41° 55' 26.832" N	70° 37' 17.105" W
South Coastal	South Coastal	Beaver Dam Brook	Bog Reservoir Sluice	Plymouth	1.8	41° 54' 58.869" N	70° 34' 11.974" W
South Coastal	South Coastal	Indian Brook	Indian Brook Pond Dam	Plymouth	0.5	41° 53' 13.509" N	70° 32' 14.261" W

Region	Watershed	Stream	Boundary	City/Town	River Mile	GPS Latitude	GPS Longitude
South Coastal	South Coastal	Savery Pond	Salt Pond Control Structure	Plymouth	0.5	41° 50' 38.526" N	70° 32' 26.734" W
South Coastal	South Coastal	Monument River	Canal Culvert	Bourne	0.0	41° 16' 17.684" N	70° 33' 47.899" W
Cape Cod Bay	Cape Cod	Mill Creek	Sandwich Grist Mill Dam	Sandwich	2.1	41° 45' 27.531" N	70° 30' 01.498" W
Cape Cod Bay	Cape Cod	Maraspin Creek	Commerce Road	Barnstable	0.7	41° 42' 13.078" N	70° 17' 17.072" W
Cape Cod Bay	Cape Cod	Boat Cove Creek	Mill Pond Dam	Barnstable	2.2	41° 42' 33.151" N	70° 22' 54.822" W
Cape Cod Bay	Cape Cod	Whites Brook	Matthews Pond Outlet	Yarmouth	1.2	41° 42' 45.316" N	70° 13' 27.741" W
Cape Cod Bay	Cape Cod	Sesuit Creek	Route 6A	Dennis	1.5	41° 44' 41.083" N	70° 10' 24.072" W
Cape Cod Bay	Cape Cod	Quivett Creek	Route 6A	Dennis	1.5	41° 44' 41.040" N	70° 08' 42.064" W
Cape Cod Bay	Cape Cod	Stoney Brook	Lower Mill Pond Dam	Brewster	1.8	41° 44' 40.473" N	70° 06' 45.011" W
Cape Cod Bay	Cape Cod	Rock Harbor Creek	Rock Harbor Road Culvert	Orleans	1.4	41° 47' 50.100" N	69° 59' 29.700" W
Cape Cod Bay	Cape Cod	Herring River	Herring Pond Dam	Eastham	1.2	41° 49' 22.133" N	69° 59' 18.434" W
Cape Cod Bay	Cape Cod	Herring Brook	Herring Brook Road Control	Eastham	0.4	41° 49' 51.983" N	69° 59' 52.242" W
Cape Cod Bay	Cape Cod	Herring River	Chequesett Road Tide Gate	Wellfleet	0.0	41° 55' 51.991" N	70° 03' 52.150" W
Cape Cod Bay	Cape Cod	Pamet River	Tide Gate	Truro	1.6	41° 59' 37.500" N	70° 03' 01.100" W
Cape Cod Bay	Cape Cod	Pilgrim Lake	Pilgrim Lake Control	Provincetown	0.3	42° 03' 09.800" N	70° 07' 05.900" W
Nantucket Sound	Cape Cod	Pilgrim Lake	Pilgrim Lake Ladder	Orleans	0.4	41° 46' 07.807" N	69° 58' 41.848" W
Nantucket Sound	Cape Cod	Muddy Creek	None	Chatham/Harwich	1.6	N/A	N/A
Nantucket Sound	Cape Cod	Stillwater Pond	Stillwater Pond Fishway	Chatham	0.1	41° 42' 20.079" N	69° 59' 05.091" W
Nantucket Sound	Cape Cod	Frost Fish Creek	Frost Fish Creek Trail Culvert	Chatham	0.3	41° 42' 07.328" N	69° 58' 13.451" W
Nantucket Sound	Cape Cod	Red River	Skinequit Pond Fishway	Harwich	0.3	41° 40' 19.048" N	70° 02' 38.001" W
Nantucket Sound	Cape Cod	Andrews River	None	Harwich	1.8	N/A	N/A
Nantucket Sound	Cape Cod	Herring River	West Reservoir Dam	Harwich	3.9	41° 40' 55.442" N	70° 07' 19.680" W
Nantucket Sound	Cape Cod	Swan Pond River	None	Dennis	2.4	N/A	N/A
Nantucket Sound	Cape Cod	Fresh Pond Tributary	None	Dennis	0.7	N/A	N/A
Nantucket Sound	Cape Cod	Weir Creek	None	Dennis	2.1	N/A	N/A
Nantucket Sound	Cape Cod	Bass River	North Dennis Road	Yarmouth	5.5	41° 42' 18.044" N	70° 11' 38.095" W
Nantucket Sound	Cape Cod	Parkers River	Seine (Swan) Pond Inlet	Yarmouth	2.0	41° 39' 37.904" N	70° 12' 36.426" W
Nantucket Sound	Cape Cod	Town Brook	Mill Pond Fishway	W. Yarmouth	0.0	41° 39' 30.272" N	70° 15' 36.784" W
Nantucket Sound	Cape Cod	Mill Creek	Mill Pond Dam (Baxter Grist Mill)	W. Yarmouth	0.9	41° 39' 27.290" N	70° 15' 40.069" W
Nantucket Sound	Cape Cod	Stewarts Creek	Aunt Betty's Pond Control	Barnstable	1.2	41° 38' 56.554" N	70° 17' 42.533" W
Nantucket Sound	Cape Cod	Halls Creek	Marchant Mill Road Culvert	Barnstable	1.0	41° 38' 06.799" N	70° 18' 32.994" W
Nantucket Sound	Cape Cod	Lake Elizabeth	Lake Elizabeth Dam	Barnstable	2.2	41° 38' 16.016" N	70° 20' 01.623" W
Nantucket Sound	Cape Cod	Centerville River	Wequaquet Lake Control	Barnstable	1.6	41° 39' 36.635" N	70° 20' 05.489" W
Nantucket Sound	Cape Cod	Bumps River	Bumps River Road Culvert	Barnstable	1.1	41° 38' 54.131" N	70° 21' 46.355" W
Nantucket Sound	Cape Cod	Marstons Mills River	Route 28 Stream Baffles	Barnstable	0.9	41° 39' 01.576" N	70° 24' 51.657" W
Nantucket Sound	Cape Cod	Little River	Old Post Road Culvert	Barnstable	0.3	41° 37' 35.627" N	70° 25' 35.224" W
Nantucket Sound	Cape Cod	Rushy Marsh Pond	Rushy Marsh Pond Culvert	Barnstable	0.0	41° 35' 57.796" N	70° 26' 32.610" W
Nantucket Sound	Cape Cod	Santuit River	Mill Road	Mashpee	0.8	41° 37' 40.001" N	70° 27' 03.046" W
Nantucket Sound	Cape Cod	Mashpee River	Bog Sluice DS Washburn Pond	Mashpee	4.2	41° 38' 41.724" N	70° 29' 01.582" W
Vineyard Sound	Cape Cod	Quashnet River	Route 28	Falmouth	1.3	41° 35' 26.065" N	70° 30' 30.019" W

Region	Watershed	Stream	Boundary	City/Town	River Mile	GPS Latitude	GPS Longitude
Vineyard Sound	Cape Cod	Childs River	Barrows Road	Falmouth	0.4	41° 35' 07.034" N	70° 31' 35.095" W
Vineyard Sound	Cape Cod	Mill Pond/Green Pond	Mill Pond Dam	Falmouth	2.2	41° 34' 44.117" N	70° 33' 49.510" W
Vineyard Sound	Cape Cod	Flax Pond (Coonamesett R.)	John Parker Road Culvert	Falmouth	0.1	41° 35' 09.769" N	70° 34' 17.747" W
Vineyard Sound	Cape Cod	Coonamesett River	John Parker Road Fishway	Falmouth	0.3	41° 34' 54.260" N	70° 34' 24.354" W
Vineyard Sound	Cape Cod	Little Pond	None	Falmouth	0.1	N/A	N/A
Vineyard Sound	Cape Cod	Fresh River	Shivericks Pond Dam	Falmouth	1.0	41° 33' 13.623" N	70° 37' 00.897" W
Vineyard Sound	Cape Cod	Salt Pond	None	Falmouth	0.1	N/A	N/A
Vineyard Sound	Cape Cod	Trunk River	Oyster Pond Control	Falmouth	0.2	41° 32' 13.330" N	70° 38' 24.047" W
Buzzards Bay	Cape Cod	Herring Brook	Herring Brook Dam	Falmouth	0.6	41° 37' 24.337" N	70° 37' 45.959" W
Buzzards Bay	Cape Cod	Wild Harbor River	Dam Pond Culvert	Falmouth	0.8	41° 38' 02.436" N	70° 37' 56.091" W
Buzzards Bay	Cape Cod	Ceadr Lake Ditch	Bay Road Culvert	Falmouth	0.3	41° 38' 56.061" N	70° 37' 35.525" W
Buzzards Bay	Cape Cod	Red Brook	Red Brook Conrail Culvert	Bourne	0.0	41° 40' 36.534" N	70° 36' 47.367" W
Buzzards Bay	Cape Cod	Pocasset River	Shop Pond Dam	Bourne	1.0	41° 41' 48.022" N	70° 36' 18.048" W
Islands	Martha's Vineyard	Lagoon Pond	Richard Madieras Fishway	Tisbury/Oak Bluffs	2.2	41° 25' 47.137" N	70° 35' 59.186" W
Islands	Martha's Vineyard	Farm Pond	None	Oak Bluffs	0.0	N/A	N/A
Islands	Martha's Vineyard	Sengekontacket Pond	Sengekontacket Development	Oak Bluffs/Edgartown	1.6	41° 25' 05.720" N	70° 34' 23.528" W
Islands	Martha's Vineyard	Trapps Pond	None	Edgartown	0.0	N/A	N/A
Islands	Martha's Vineyard	Mattakeset Herring Creek	None	Edgartown	1.2	N/A	N/A
Islands	Martha's Vineyard	Edgartown Great Pond	Edgartown Great Pond Barrier	Edgartown	0.0	N/A	N/A
Islands	Martha's Vineyard	Jobs Neck Pond	None	Edgartown	0.0	N/A	N/A
Islands	Martha's Vineyard	Oyster Pond	None	Edgartown	0.0	N/A	N/A
Islands	Martha's Vineyard	Tisbury Great Pond	None	Chilmark/W. Tisbury	0.0	N/A	N/A
Islands	Martha's Vineyard	Mill Brook	Outlet to Tisbury Great Pond	Chilmark	0.0	41° 22' 45.046" N	70° 40' 12.052" W
Islands	Martha's Vineyard	Fulling Mill Brook	Tributary upstream of unamed pond	Chilmark	0.0	41° 20' 40.067" N	70° 43' 08.012" W
Islands	Martha's Vineyard	Tiasquam River	Looks Pond Dam	Chilmark/W. Tisbury	0.3	41° 22' 40.814" N	70° 40' 44.601" W
Islands	Martha's Vineyard	Black Point Pond	None	Chilmark	0.2	N/A	N/A
Islands	Martha's Vineyard	Chilmark Pond	None	Chilmark	0.0	N/A	N/A
Islands	Martha's Vineyard	Roaring Brook	Mouth	Chilmark	0.0	41° 22' 41.082" N	70° 44' 39.062" W
Islands	Martha's Vineyard	Gay Head Herring Creek	None	Chilmark/Aquinnah	0.3	N/A	N/A
Islands	Martha's Vineyard	James Pond	None	W. Tisbury	0.3	N/A	N/A
Islands	Martha's Vineyard	Lake Tashmoo	Old Water Supply Pond	Tisbury/V. Haven	0.1	41° 26' 55.199" N	70° 37' 20.101" W
Islands	Nantucket	Sesechacha Pond	Barrier Beach	Nantucket	0.0	41° 18' 03.686" N	69° 58' 31.904" W
Islands	Nantucket	Folgers Marsh	None	Nantucket	0.8	N/A	N/A
Islands	Nantucket	Hither Creek/Long Pond	None	Nantucket	2.2	N/A	N/A
Islands	Nantucket	Hummock Pond	Barrier Beach	Nantucket	0.0	41° 15' 18.353" N	70° 09' 50.602" W
Islands	Nantucket	Miacomet Pond	Barrier Beach	Nantucket	0.0	41° 14' 36.516" N	70° 07' 05.219" W
SE Mass	Buzzards Bay	Bourne Pond Brook	Bourne Pond Outlet	Bourne	0.4	41° 44' 56.681" N	70° 35' 53.879" W
SE Mass	Buzzards Bay	Red Brook	Route 25 Stream Baffle	Wareham	1.4	41° 46' 34.002" N	70° 37' 50.599" W
SE Mass	Buzzards Bay	Gibbs Brook	Gibbs Brook Culvert	Wareham	0.1	41° 45' 20.484" N	70° 39' 12.952" W
SE Mass	Buzzards Bay	Agawam River	Mill Pond Dam	Wareham	2.9	41° 45' 44.416" N	70° 40' 33.584" W

Region	Watershed	Stream	Boundary	City/Town	River Mile	GPS Latitude	GPS Longitude
SE Mass	Buzzards Bay	Wankinco River	Parker Mills Dam	Wareham	0.7	41° 46' 01.789" N	70° 43' 19.891" W
SE Mass	Buzzards Bay	Weweantic River	Horseshoe Pond Dam	Wareham	4.3	41° 45' 55.047" N	70° 44' 51.047" W
SE Mass	Buzzards Bay	Sippican River	Hathaway Pond Dam	Marion	3.6	41° 44' 02.360" N	70° 47' 39.373" W
SE Mass	Buzzards Bay	Tinkham Pond	Tinkham Pond Control	Mattapoisett	1.2	41° 40' 56.092" N	70° 51' 23.814" W
SE Mass	Buzzards Bay	Mattapoisett River	Route 6 Crossing	Mattapoisett	0.7	41° 39' 25.533" N	70° 50' 03.390" W
SE Mass	Buzzards Bay	Acushnet River	Main Street	New Bedford	4.0	41° 40' 54.055" N	70° 55' 08.038" W
SE Mass	Buzzards Bay	Buttonwood Brook	Buttonwood Pond Park Dam	New Bedford	2.0	41° 37' 55.852" N	70° 57' 13.607" W
SE Mass	Buzzards Bay	Paskamanset/Slocum River	Russells Mills Pond Dam	Dartmouth	0.0	41° 34' 16.661" N	71° 00' 16.430" W
SE Mass	Buzzards Bay	Westport River - East Branch	Old County Road	Westport	8.0	41° 37' 15.050" N	71° 03' 35.020" W
SE Mass	Buzzards Bay	Westport River - West Branch	Gray's Mill Pond Dam	Adamsville, RI	3.4	41° 33' 20.989" N	71° 07' 35.801" W
SE Mass	Buzzards Bay	Cockeast Pond	Cockeast Pond Outlet	Westport	0.1	41° 30' 35.131" N	71° 05' 53.262" W
SE Mass	Buzzards Bay	Richmond Pond	None	Westport	1.6	41° 30' 24.487" N	71° 06' 50.392" W
SE Mass	Taunton	Taunton River	Threemile River	Dighton	10.5	41° 51' 14.032" N	71° 06' 32.044" W
SE Mass	Taunton	Labor in Vain Brook	Somerset Reservoir Outlet	Somerset	0.9	41° 46' 38.295" N	71° 08' 29.843" W
SE Mass	Taunton	Assonet River	Tisdale Pond Dam	Freetown	3.6	41° 47' 45.526" N	71° 03' 56.750" W
SE Mass	Taunton	Rattlesnake Brook	Bleachery Reservoir Outlet	Freetown	0.1	41° 46' 50.976" N	71° 05' 11.744" W
SE Mass	Taunton	Muddy Cove Brook	Elm Street	Dighton	0.5	41° 48' 48.080" N	71° 07' 42.086" W
SE Mass	Taunton	Segreganset River	Unnamed Dam	Dighton	0.9	41° 49' 36.972" N	71° 07' 40.685" W
SE Mass	Taunton	Three Mile River	Dam below Harodite Factory	Dighton	1.1	41° 51' 46.323" N	71° 07' 21.375" W
SE Mass	Taunton	Berkley Street Tributary	Unnamed Dam	Taunton	0.3	41° 52' 30.784" N	71° 05' 21.510" W
SE Mass	Taunton	Oakland Mill (Brickyard) Pond	Oakland Mill Ponds Culvert	Taunton	0.3	41° 53' 20.012" N	71° 04' 50.273" W
SE Mass	Taunton	Mill River	Site of former Hopewell Mills Dam	Taunton	2.4	41° 54' 54.381" N	71° 05' 49.104" W
SE Mass	Narragansett Bay	Lewin Brook	Swansea Print Works Dam	Swansea	0.1	41° 44' 43.054" N	71° 11' 31.095" W
SE Mass	Narragansett Bay	Lee River	Swan Finishing Dam	Swansea	3.0	41° 44' 43.847" N	71° 11' 32.530" W
SE Mass	Narragansett Bay	Cole River	Route 6 Dam	Swansea	2.5	41° 44' 49.723" N	71° 12' 10.208" W
SE Mass	Narragansett Bay	Rocky Run	None	Swansea/Rehoboth	8.6	N/A	N/A
SE Mass	Narragansett Bay	Palmer River	Shad Factory Pond Dam	Rehoboth	7.7	41° 48' 32.204" N	71° 16' 43.526" W
SE Mass	Narragansett Bay	Runnins River	Mobil Dam	E. Providence, RI	0.7	41° 47' 00.145" N	71° 19' 48.546" W