Water Quality Report: 2025
Quabbin Reservoir Watershed
Ware River Watershed

Rain-on-Snow Hydrologic Monitoring, East Branch Swift River (Tansy Remiszewski, 2025)

August 2026

Massachusetts Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Management
Quabbin/Ware Region

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Abstract

This report is a summary of water quality monitoring methods and results from 26 surface water sites located throughout the Quabbin Reservoir and the Quabbin Reservoir and Ware River Watersheds, annual hydrological and meteorological summaries, and results from special investigations. The Department of Conservation and Recreation (DCR), Division of Water Supply Protection (DWSP), is the state agency charged with the responsibility of managing the Quabbin Reservoir and Quabbin Reservoir and Ware River watersheds and the surrounding natural resources owned by the Commonwealth in each watershed in order to protect, preserve, and enhance the environment of the Commonwealth and to assure the availability of safe drinking water for future generations. The Environmental Quality Section manages a comprehensive water quality monitoring program to ensure that Quabbin Reservoir water meets state drinking water quality standards. As part of this task, the Environmental Quality Section performs field work, collects water samples, interprets water quality data, and prepares reports of findings. This annual summary is intended to meet the needs of watershed managers, the interested public, and others whose decisions must incorporate regional water quality considerations.

The Quabbin Reservoir water quality satisfied the requirements of the Filtration Avoidance Criteria established under the Environmental Protection Agency Surface Water Treatment Rule for the entirety of 2025. Monitoring of major tributary inflows is a proactive measure aimed at identifying water quality patterns and potential problem areas that may require additional investigation or corrective action. Results from tributary monitoring were largely below state surface water quality thresholds; any exceedances were attributed to storm events, impacts of prolonged fall drought, wildlife impacts on water quality, and/or landscape attributes.

Some of the ancillary data presented in this report has been compiled with the assistance of outside agencies (e.g., U.S. Geological Survey) and other workgroups within DWSP whose efforts are acknowledged in the further sections.

CITATION
Division of Water Supply Protection. 2026. Water Quality Report: 2025 Quabbin Reservoir Watershed and Ware River Watershed. Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management.

Acknowledgements

This report was prepared by the Environmental Quality Section of DWSP, Quabbin/Ware Region. Travis Drury, Environmental Analyst III, Shasten Sherwell, Aquatic Biologist III, Tansy Remiszewski, Environmental Analyst II, Tayelor Gosselin, Aquatic Biologist II, and Brett Boisjolie, Environmental Analyst V were the primary authors. The authors acknowledge the following for their contributions to this report:

Michael Virgilio, Environmental Analyst I, for implementing watershed water quality sampling plans including water quality sampling, data management, special investigations, and GIS analysis. Michael Virgilio also performed data analyses for, and was a co-writer of, Appendix C.

The Massachusetts Water Resources Authority (MWRA), whose laboratory staff conducted nutrient, major ion, pathogen, and bacteriological analyses and contributed to the management of laboratory data, sample bottle preparation, and a plethora of sampling logistics.

Dan Clark, Regional Director of the Quabbin/Ware Region, and Lisa Gustavsen, Deputy Regional Director of the Quabbin/Ware Region, for providing leadership, program guidance, and report review and comments.

Jonathan Brody, Caulin Lauzon, and Julieta Klages of MWRA, who implemented sample collection plans and provided water system and daily water quality data from MWRA facilities, respectively.

Kristina Gutchess, former Environmental Analyst III, for development of the current reporting figure, table, and narrative templates, and for enhancing DWSP knowledge of biogeochemical patterns and processes throughout the watersheds.

Evan Krause, Aquatic Biologist I, for data collection and assisting with data visualization and analysis.

Jamie Carr, Environmental Analyst V, and Joy Trahan-Liptak, Aquatic Biologist III of the DSWP EQ Wachusett/Sudbury Region, for collaboration and review of draft report.

David Gatautis, Environmental Analyst II, for monitoring for potential invasive species and program leadership for the Quabbin Boat Seal Program.

Jeff Gagner, Drew Forest, and Alex Surreira, Civil Engineers from the Quabbin/Ware Region for collaboration on monitoring programs and providing select meteorological and yield data used in this report.

Joel Zimmerman, Regional Planner, for his assistance in final report production.

John Scannell, Director of the Division of Water Supply Protection.

Erica Poisson, DWSP GIS Director, and Philip Lamothe, GIS Specialist, for providing Geographical Information System data and support.

The U.S. Geological Survey, who, through a cooperative agreement established with DWSP, provided tributary streamflow data included in this report.

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Abbreviations

The following abbreviations are used in this report:

AIS	Aquatic Invasive Species
BWTF	Brutsch Water Treatment Facility
Cl	Chloride
CFR	Cold water fish habitat
CVA	Chicopee Valley Aqueduct
DCR	Massachusetts Department of Conservation and Recreation
DWSP	Division of Water Supply Protection
EPA	United States Environmental Protection Agency
EQA	Environmental Quality Assessment
E. coli	*Escherichia coli*
IQR	Interquartile range
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MassWildlife	Massachusetts Division of Fisheries and Wildlife
MCL	Maximum Contaminant Level
MLE	Maximum likelihood estimation
MWRA	Massachusetts Water Resources Authority
ND	No Data
NEON	National Ecological Observatory Network
N/A	Not applicable
OWM	Office of Watershed Management
NH_3-N	Ammonia-nitrogen
NH_4-N	Ammonium-nitrogen
NO_2-N	Nitrite-nitrogen
NO_3-N	Nitrate-nitrogen
NOAA	National Oceanographic and Atmospheric Administration
POR	Period of Record
Si	Silica
SMCL	Secondary Maximum Contaminant Level
SOP	Standard Operating Procedure
SWE	Snow Water Equivalent
SWTR	Surface Water Treatment Rule
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
UMass	University of Massachusetts, Amherst
UV_{254}	Ultraviolet Absorbance at 254 Nanometers
USGS	United States Geological Survey
WDI	Winsor Dam Intake
WRF	Warm water fish habitat

Units of Measurement

Chemical concentrations of constituents in solution or suspension are reported in milligrams per liter (mg/L) or micrograms per liter (μg/L). These units express the concentration of chemical constituents in solution as mass (mg or μg) of solute per unit of volume of water (L). One mg/L is equivalent to 1,000 μg/L. Fecal coliform results are reported as the number of presumptive colony forming units per 100 milliliters of water (CFU/100 mL). Total coliform and *Escherichia coli (E. coli)* are reported as the most probable number (MPN/100 mL), which is equivalent to CFU/100 mL and acceptable for regulatory reporting. UV_{254} results are reported as the amount of ultraviolet light at a 254 nm wavelength that is able to transmit through a water sample in absorbance units per centimeter of path length (ABU/cm).

The following units of measurement are used in this report:

ABU/cm	Absorbance units per centimeter of path length
ASU/mL	Areal standard units per milliliter
cfs	Cubic feet per second
CFU	Colony-forming unit
°C	Degrees Celsius
ft	Feet
in	Inches
μS/cm	Microsiemens per centimeter
L/mg-M	Liters per milligram per meter
MG	Million gallons
MGD	Million gallons per day
μg/L	Microgram per liter
mg/L	Milligram per liter
m	Meters
MPN	Most probable number (equivalent to CFU)
nm	Nanometers
NTU	Nephelometric turbidity units
S. U.	Standard Units (pH)

1. Introduction

The Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management (DWSP) manages and maintains a system of watersheds and reservoirs to provide water to the Massachusetts Water Resources Authority (MWRA), which in turn supplies unfiltered drinking water to approximately 2.7 million people in 53 communities in Massachusetts. The watershed system includes the Quabbin Reservoir, Ware River, Wachusett Reservoir, and Sudbury Reservoir Watersheds, interconnected by a series of aqueducts (Figure 1).

The U.S. EPA introduced the Federal Surface Water Treatment Rule (SWTR) in 1989, followed by the introduction of the Interim Enhanced Surface Water Treatment Rule (IESWTR) in 1998, and the Final Long Term Enhanced Surface Water Treatment Rule Term 1 (2002) and Term 2 (2006) (US EPA, 1989; 1998; 2002; 2006), to ensure that public water supply systems using surface water, or groundwater under the direct influence of surface water, provide safeguards against the contamination of water by viruses and bacteria. The regulations require filtration by every surface water supplier unless strict source water quality criteria and watershed protection goals can be met, including the development and implementation of a detailed watershed protection plan (US EPA, 2003). The DWSP and the MWRA have maintained a joint waiver for the filtration requirement of the SWTR since 1998 and work together to manage the watersheds and reservoirs in fulfillment of the waiver.

DWSP monitors the water quality and quantity within the watersheds and reservoirs (Commonwealth of MA, 2004). Water quality sampling and field inspections help identify surface waters with potential water quality issues, aid in the implementation of watershed protection plans, and ensure compliance with state and federal water quality criteria for public drinking water supply sources (e.g., the filtration avoidance requirements stipulated under the SWTR). Routine monitoring of bacteria and nutrients in the reservoirs and tributaries provides an indication of the sanitary quality of water sources, ensuring the security of water resources and public health. Monitoring is also conducted by DWSP staff to better understand the responses of the reservoir and tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the reservoirs and watersheds. A long-term record of water quality monitoring provides information regarding potential controls on observed changes in water quality over time and represents a proactive effort to identify emerging threats to water quality.

This report summarizes the water quality monitoring performed by DWSP in the Quabbin Reservoir and the Quabbin Reservoir and Ware River Watersheds during 2025.

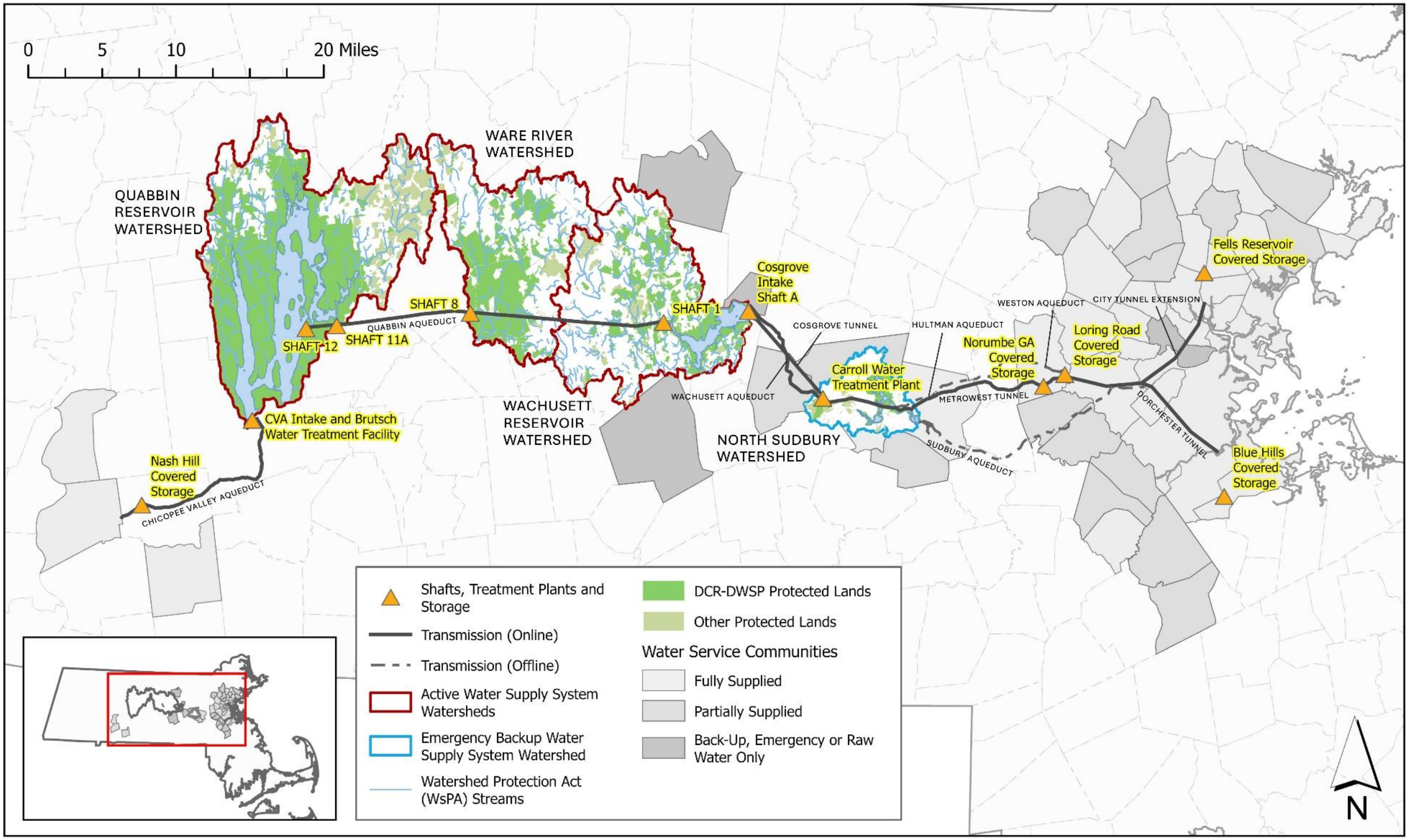


Figure 1. *Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed system. Inset map in the lower left depicts location of the watershed system relative to MA.*

1.1. Public Water Supply System Regulations

Source water quality criteria rely on an indicator organism (fecal coliform bacteria) and a surrogate parameter (turbidity) to provide a measure of the sanitary quality of the water. The SWTR requires that fecal coliform concentrations at the intake of an unfiltered surface water supply shall not exceed 20 colony-forming units (CFU) per 100 mL in ninety percent of the samples in any six-month period. There are two standards for turbidity levels at source water intakes. The SWTR requires that turbidity levels at the intake remain below five NTU. MassDEP regulations require that turbidity levels at the point of consumption for all public drinking water can only be above one NTU if it does not interfere with effective disinfection. Authority to enforce the US EPA's SWTR has been delegated to MassDEP.

The Quabbin Reservoir is designated as Class A Public Water Supply (314 CMR 4.06(1)(d)1) and thereby is considered an Outstanding Resource Water (ORW) for the purposes of water quality protection (314 CMR 4.06) in Massachusetts. Massachusetts DEP has developed numerical Class A water quality criteria for several parameters (see DCR 2023a, Appendix A). Required monitoring for additional constituents at different stages in the system (e.g., after treatment, after disinfection, and at the point of consumption) is conducted by MWRA. These elements and compounds include arsenic, polychlorinated biphenyls (PCBs), haloacetic acids, and per- and polyfluoroalkyl substances (PFAS). As MWRA produces reports that detail results of regulatory monitoring, monitoring results at each of the water system stages is not discussed as part of this report.

1.2. DWSP Monitoring Program Objectives

MWRA, as an unfiltered water supplier, is required to have a watershed protection program intended to promote and preserve high quality source water. A primary function of DWSP is to design and implement this watershed protection program for the DCR/MWRA water supply system. Watershed protection measures enacted by DWSP have been detailed in DWSP Watershed Protection Plans (WPPs) and WPP updates since 1991 (DWSP, 2023b). The goals of WPPs are to provide structured methodology to assess changes in existing threats to water quality across DWSP-managed watersheds, develop proactive strategies to prevent threats to water quality, and respond to potential threats to water quality to limit negative impacts. Environmental quality monitoring is one element of the WPPs developed by DWSP. The Watershed Protection Act of 1992 and associated Watershed Protection regulations (313 CMR 11.00) give DWSP the authority to regulate certain land uses and activities that take place within critical areas of the watershed in order to protect drinking water quality. The consistent high water quality of the Quabbin Reservoir can be attributed largely to the effectiveness of the WPPs.

DWSP staff rely on data generated by long-term monitoring programs to inform modifications to current WPPs. Data generated by long-term monitoring programs conducted by DWSP are used to assess current and historical water quality conditions, establish expected ranges of various water quality parameters, allow for routine screening of potential threats to water quality, provide early detection of change, and assess current watershed trends. Shorter-term investigations may also be conducted to evaluate specific issues. Monitoring efforts are reviewed and updated annually by DWSP to ensure that DWSP programs remain current, appropriate, and informative for the WPP goals. Changes to annual water quality monitoring programs performed by DWSP staff are discussed in each annual water quality report.

The overarching objectives of the water quality and hydrological monitoring programs conducted by DWSP are directly related to the WPP goals. These objectives are as follows:

- Maintain long-term water quality statistics relative to the protection of public health.
- Document achievements of watershed control criteria applicable to the filtration avoidance requirements stipulated under the US EPA's SWTR.
- Identify streams and water bodies that do not meet water quality standards and where specific control measures may be initiated to eliminate or mitigate pollution sources.
- Conduct proactive surveillance of water quality trends to identify emerging issues and support ongoing assessments of threats to water quality.

DWSP monitoring programs continuously adapt to emergent and high priority threats to water quality, while utilizing current scientific information, tools, and technologies. The achievement of water supply protection goals, including specific water quality targets, can be credited to the coordinated implementation of DWSP's many programs.

1.3. Overview of DCR/MWRA Water Supply System, Quabbin Reservoir and Ware River Watersheds

The Quabbin Aqueduct connects three water sources that serve as a source of drinking water to 50 communities in Massachusetts (with an additional three communities served directly from Quabbin Reservoir). The water sources connected by the Quabbin Aqueduct, from west to east, include the Quabbin Reservoir, the Ware River, and the Wachusett Reservoir (Figure 1). The Quabbin Reservoir is the largest of the sources, with a capacity of 412 billion gallons (Table 1, see also DWSP, 2023a for further context). In comparison, the Wachusett Reservoir holds 65 billion gallons at full capacity.

Water from the Quabbin Reservoir is transferred to the Wachusett Reservoir via the Quabbin Aqueduct Intake at Shaft 12 (Figure 1). Transfers at Shaft 12 typically account for more than half of the MWRA system supply. Water is also transferred directly to three western Massachusetts communities daily via the Chicopee Valley Aqueduct (CVA) from the Winsor Dam Intake (WDI). Water from the Ware River may be used to supplement Quabbin Reservoir. Ware River water is diverted into the Quabbin Aqueduct at Shaft 8 in Barre, MA, near DWSP Core tributary monitoring location 101 and delivered to the Quabbin Reservoir via gravity flow. Ware River water enters the reservoir at Shaft 11A, east of the baffle dams in Hardwick, MA. The diversion of water from the Ware River is limited to the period from October 15 to June 15 and is not permitted when mean daily flow at Shaft 8 is less than 85 MGD (131.5 cfs), per Chapter 375 of the Massachusetts Acts of 1926. DWSP and MWRA coordinate at least annually on diversion timing and duration.

Table 1. *General information on a) Quabbin Reservoir, b) Quabbin Reservoir Watershed, and c) Ware River Watershed.*

a) Quabbin Reservoir General Information

Description	Units	Quantity
Reservoir Capacity	Billion gallons	412
Reservoir Surface Area (at full capacity – elev. 530 feet)	Acres	24,469
Length of Reservoir Shoreline	Miles	118
Maximum Reservoir Depth	Feet	141
Mean Depth	Feet	45
Surface Elevation, at Full Capacity	Feet, relative to Boston City Base	530
Reservoir gain (average) from 1 inch of precipitation	Billion gallons	1.6

b) Quabbin Reservoir Watershed General Information

Description	Units	Quantity
Total Watershed Area (includes Quabbin Reservoir surface area)	Acres	119,946
Watershed Land Area (excludes Quabbin Reservoir surface area)	Acres	95,364
Proportion of Watershed that is Land Area	Percentage	80
DWSP Controlled Watershed Land Area	Acres	63,484
Proportion of DWSP Controlled Watershed Land Area	Percentage	67
Total Protected Land Area (includes DWSP, DWSP Fee, DWSP WPR, and other protected lands)	Acres	73,535
Proportion of Protected Land Area	Percentage	77

c) Ware River Watershed General Information

Description	Units	Quantity
Watershed Area	Acres	61,671
DWSP Controlled Watershed Area	Acres	25,756
Proportion of DWSP Controlled Watershed Area	Percentage	41
Total Protected Watershed Area (includes DWSP, DWSP Fee, DWSP WPR, and other protected lands)	Acres	33,081
Proportion of Protected Watershed Area	Percentage	54

1.4. Description of Quabbin Reservoir and Ware River Watersheds

The Quabbin Reservoir Watershed is located in the Swift River sub-basin of the Chicopee River, a major tributary of the Connecticut River, and part of the Central Uplands of north central Massachusetts (Figure 2). The Quabbin Reservoir Watershed encompasses approximately 187.5 sq. mi. (119,946 acres), including nearly all of the towns of New Salem and Petersham, considerable portions of Pelham, Shutesbury, and Wendell, and smaller portions of Orange, Hardwick, Phillipston, Belchertown, Ware, and Athol, MA. At full capacity, the surface area of the Quabbin Reservoir spans roughly 38.2 sq. mi. (24,469 acres), or 20% of the total watershed area, with nearly 118 miles of shoreline (Table 1). Mean and maximum depths of the Quabbin Reservoir at full capacity are 45 and 141 ft, respectively.

Approximately 88% of the land surface in the Quabbin Reservoir Watershed is forested cover, with a total area comprised of less than 2% each of developed (further classified as rural-residential) or agricultural cover (Table 2). DWSP owns and controls 63,484 acres (67% of the total watershed land area) for water supply protection purposes, and approximately 77% of the total land area in the watershed is protected from development through other means (Table 1). The relatively high proportion of forested, protected lands in the Quabbin Reservoir Watershed helps maintain exceptional water quality in the Quabbin Reservoir.

The Ware River Watershed is the geographical drainage area to Shaft 8 Intake on the Ware River in Barre, MA. This watershed neighbors the Quabbin Reservoir Watershed to the east (Figure 3). The Ware River begins as two branches (the East Branch and West Branch Ware River) that converge to form the Ware River in Hubbardston, MA. The Ware River Watershed area monitored by DWSP intersects portions of the municipalities of Barre, Phillipston, Hubbardston, Oakham, Rutland, Princeton, Templeton, and Westminster, MA. DWSP monitors an area of 96.5 square miles (61,737 acres) of the Ware River Watershed upstream of the Quabbin Aqueduct at Shaft 8 in Barre, MA. Further downstream, the Ware River joins the Quaboag River in Three Rivers, MA to form the Chicopee River.

Land cover in the Ware River Watershed is predominantly forest (75%), with approximately 41% of the watershed area (25,756 acres) controlled by DWSP (Table 1, Table 2). The Army Corps of Engineers controls approximately 600 acres (less than 1%) for flood control associated with the Barre Falls Dam on the Ware River in Barre, MA. Agriculture comprises less than 3% of total watershed area for the Ware River Watershed. Additional information regarding land use and ownership in the Quabbin Reservoir and Ware River Watersheds, as well as the calculation of statistics, is documented in the *Watershed Protection Plan FY24-FY28* (DWSP, 2023b) and the *2017 Land Management Plan* (DWSP, 2018a).

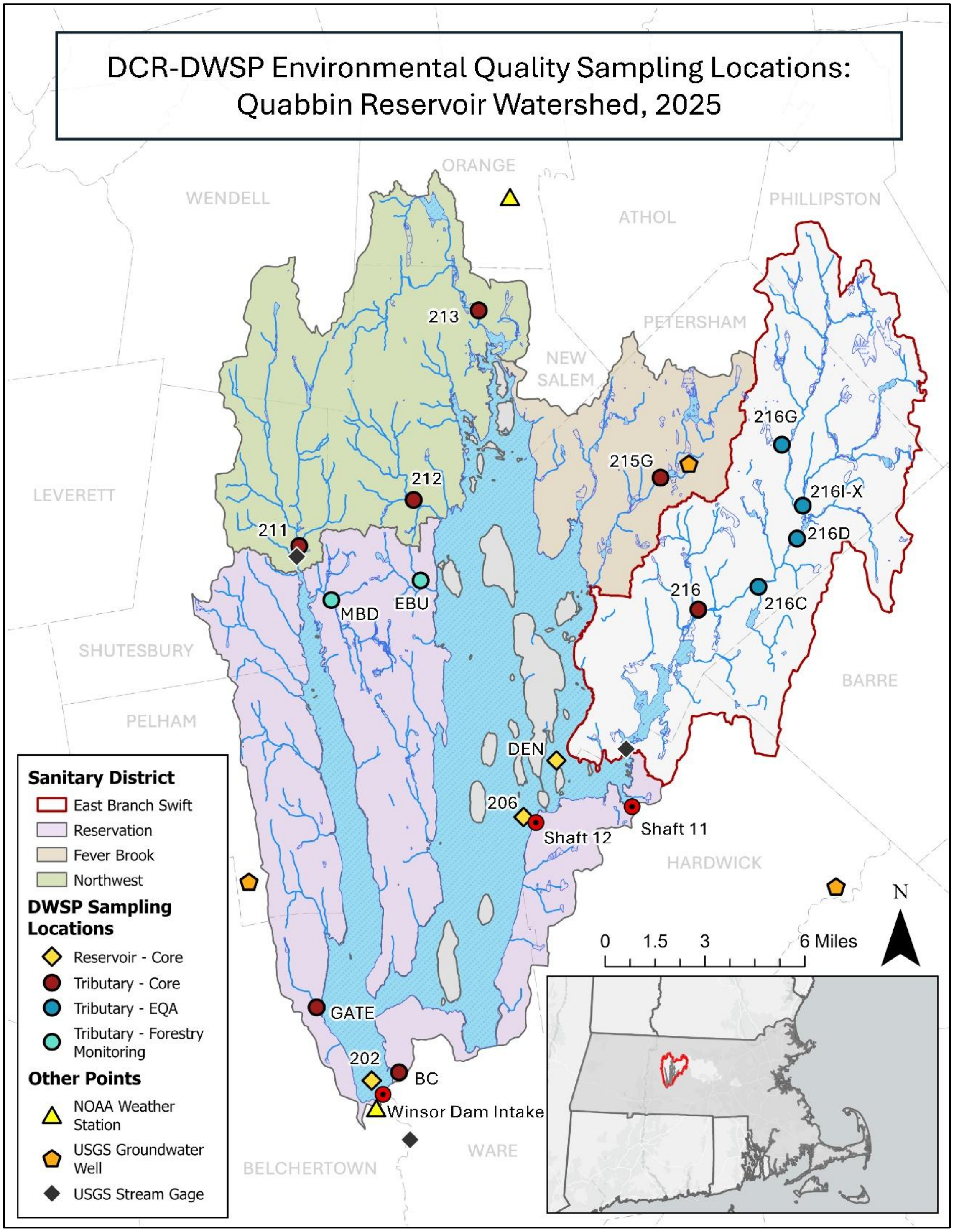


Figure 2. *Map of Quabbin Reservoir Watershed showing locations of Core and EQA monitoring sites sampled in 2025. Also shown are DWSP sanitary districts. Inset map depicts the watershed relative to Massachusetts.*

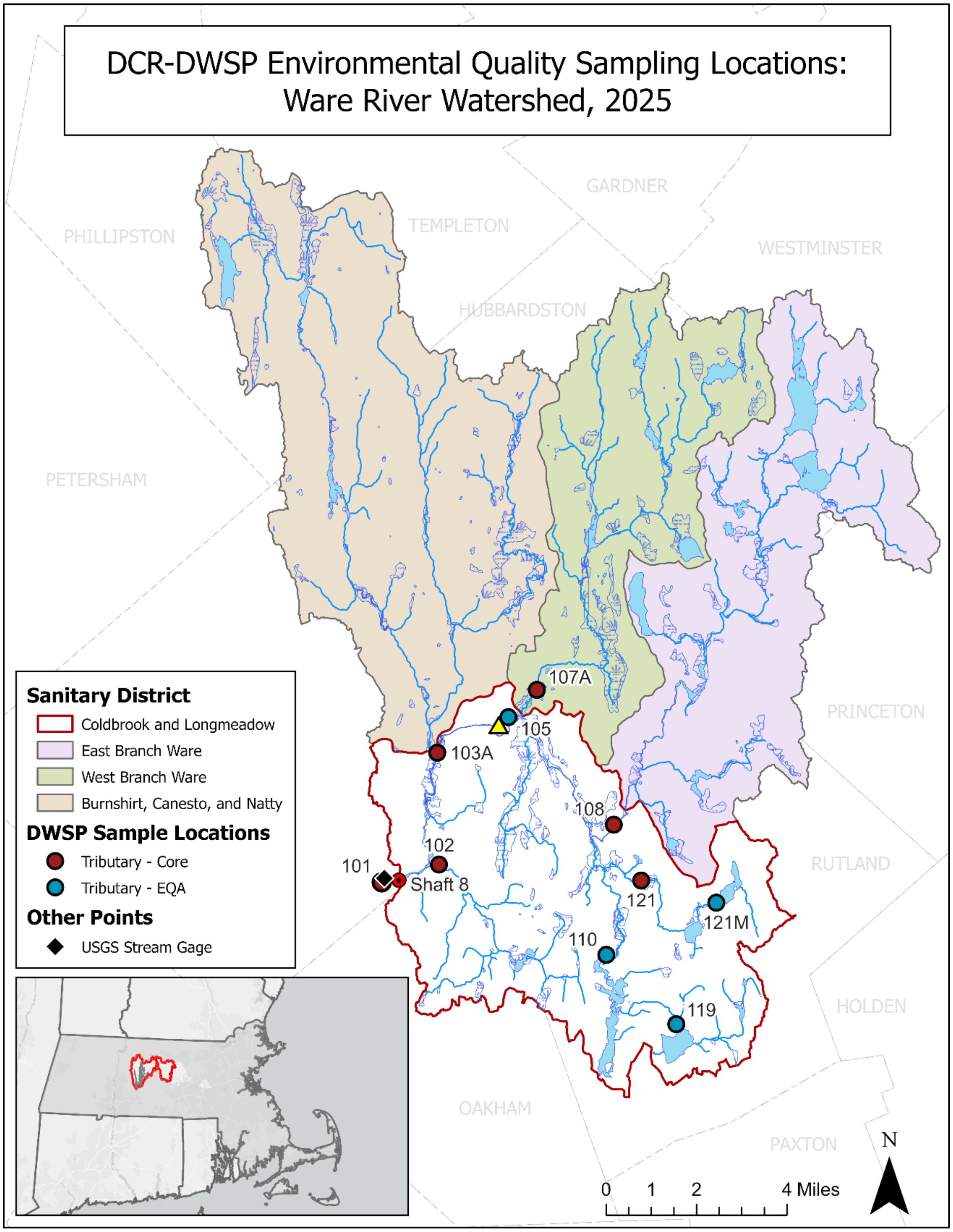


Figure 3. *Map of Ware River Watershed showing locations of Core and EQA monitoring sites sampled in 2025. Also shown are DWSP sanitary districts. Inset map depicts the watershed relative to Massachusetts.*

Table 2. *Proportion of total land area falling under land cover/land uses classes across Quabbin Reservoir and Ware River Watershed (adapted from DWSP 2023b).*

Land Cover/ Land Use Class	Quabbin Reservoir Watershed Proportion of Land Area (percent)	Ware River Watershed Proportion of Land Area (percent)
Forest	87.62	74.77
Wetland	4.99	11.61
Agriculture	3.42	3.81
Open Water	1.25	3.22
Residential	0.24	0.87
Commercial/Industrial	0.01	0.06
Other Non-Impervious	1.82	3.19
Other Impervious	1.33	2.47

2. Methods

DWSP's water quality monitoring programs in the Quabbin Reservoir and Ware River Watersheds seek to proactively assess and identify threats to water quality from biological, geological, and chemical sources. These programs include the collection and analysis of water quality samples from watershed surface waters, collection and enumeration of Quabbin Reservoir phytoplankton samples, record collection of *in situ* measurements from water quality probes, hydrological monitoring from USGS stream gages, meteorological monitoring from NOAA weather stations, monitoring for and management of aquatic invasive species within watershed water bodies, and the implementation of the Quabbin Boat Seal Program and associated Boat Decontamination Program. Standard operating procedures outlining specific details (e.g., make/model of equipment used) were developed by DWSP staff, and generally follow methods outlined in USGS and EPA protocols. Further documentation of parameter collection is provided in Section 6.1 of this report.

2.1. Monitoring Programs

In 2025, DWSP staff monitored water quality at 21 surface water sites in the Quabbin Reservoir and Ware River Watersheds and three sites within the Quabbin Reservoir. In addition, watershed ponds were monitored for aquatic invasive species (AIS), and hydrological and meteorological stations were monitored (Figure 2, Figure 3). The tributary monitoring locations within each watershed included Core sites and Environmental Quality Assessment (EQA) sites. Core sites represent long-term monitoring sites throughout the watershed that are included in the monitoring plan each year. Core sites are critical for DWSP assessments, as they provide a long-term record of water quality data from primary tributaries within each watershed. Each watershed is divided into sub-watersheds, referred to as sanitary districts (Figure 2, Figure 3). EQA sites within a single sanitary district are sampled approximately once every four to five years. Data from EQA sites are used to support assessments of potential threats to water quality within each sanitary district. Monitoring of EQA sites provides a year-long assessment of water quality within a specific area of each watershed, allowing for greater spatial coverage, a higher-resolution understanding of transport processes operating across the catchments embedded within the greater watershed, and elucidation of potential upstream impacts to Core sites. The East Branch Swift sanitary district within the Quabbin Reservoir Watershed and the Coldbrook and Longmeadow sanitary district within the Ware River Watershed were monitored in 2025. AIS investigations often follow EQA rotations, assessing long-term priority sites while incorporating regional waterbodies in line with sanitary districts of focus. Reservoir monitoring locations are long-term sampling sites located near shaft intakes and/or major stream inflows. In addition to DWSP sampling efforts, select hydrological and meteorological data from partner agencies is also routinely accessed and analyzed to better understand water quality patterns and potential drivers.

DWSP staff also conduct special investigations spanning multiple years. These vary across watersheds, but include storm water sampling, monitoring of potential water quality changes following forest management activities, and evaluation of spatial and temporal trends in elevated bacteria results relative to meteorological patterns. Results of special investigative efforts are further discussed in Sections 3.2.8, as well as being described in previous versions of DWSP annual water quality reports (DWSP 2023a).

2.1.1. Meteorological Monitoring

In 2025, daily precipitation and air temperature data were collected at three monitoring stations across the Quabbin Reservoir and Ware River Watersheds (Table 3; Figure 2; Figure 3). The DWSP Civil Engineering team operates a weather station at the DCR Quabbin Administration Building in Belchertown, MA within the Quabbin Reservoir Watershed. Additional weather data were accessed through NOAA's Climate Data Online portal (National Center for Environmental Information), which provides records from stations at Orange Municipal Airport (Orange, MA) and the US Army Corps of Engineers Barre Falls Dam (Barre, MA). This report's meteorological analyses are based on data from these DWSP (USC00190562) and NOAA stations (USW00054756; USC00190408).

During periods of snow cover, DWSP Civil Engineering personnel conducted weekly measurements of snow depth and snow water equivalent (SWE) at six locations throughout the Quabbin Reservoir Watershed (Table 3). Each site's snowpack measurements represent averages from six snow cores collected per visit. These weekly findings were submitted to NOAA and the National Operational Hydrological Remote Sensing Center (NOHRSC).

Table 3. *Meteorologic and hydrologic monitoring stations in the Quabbin Reservoir and Ware River watersheds. Air temperature data was not recorded at the Ware, MA station, and the NEON and DFW-DER streamflow sites were excluded from the 2025 data analysis.*

Measurement	Site Name	Site ID	Managed by	Period of Record (POR)
Air Temperature	Belchertown, MA	USC00190562	DWSP	1942-2025
Air Temperature	Orange Municipal Airport, Orange, MA	USW00054756	NOAA	1997-2025
Air Temperature	Barre Falls Dam, Barre, MA	USC00190408	NOAA	1960-2025
Precipitation	Belchertown, MA	USC00190562	DWSP	1942-2025
Precipitation	Orange Municipal Airport, Orange, MA	USW00054756	NOAA	1998-2025
Precipitation	Barre Falls Dam, Barre, MA	USC00190408	NOAA	1960-2025
Snowpack	4NW Hardwick – Q1 (Gate 43A)	Q1	DWSP	2018-2025
Snowpack	3SW Petersham – Q2 (Gate 40)	Q2	DWSP	2018-2025
Snowpack	2NW New Salem – Q3 (West of 202)	Q3	DWSP	2018-2025
Snowpack	1N Pelham – Q4 (Pelham Lookout)	Q4	DWSP	2018-2025
Snowpack	4E Belchertown – Q5 (Blue Meadow)	Q5	DWSP	2018-2025
Snowpack	3NW Petersham – Q6 (Balls Corner)	Q6	DWSP	2018-2025
Mean Daily Streamflow	Ware River, Barre	1172500	USGS	1987-2025
Mean Daily Streamflow	Ware River, Intake Works, Barre	1173000	USGS	1987-2025
Mean Daily Streamflow	Ware River, Gibbs Crossing	1173500	USGS	1987-2025
Mean Daily Streamflow	Swift River, West Ware	1175500	USGS	1987-2025
Mean Daily Streamflow	East Branch Swift River, Hardwick	1174500	USGS	1987-2025
Mean Daily Streamflow	West Branch Swift River, Shutesbury	1174565	USGS	1995-2025
Mean Daily Streamflow	Lower Hop Brook	N/A	NEON	2017-2025
Mean Daily Streamflow	Parker's Brook	N/A	DFW-DER	2012-2025
Reservoir Elevation	Quabbin Reservoir, at Winsor Dam	N/A	DWSP	1980-2025

2.1.2. Hydrological Monitoring

The U.S. Geological Survey (USGS) recorded mean daily streamflow for six tributaries in the Quabbin and Ware River Watersheds (three per watershed) in 2025 (Table 3). USGS stations have continuously monitored mean daily streamflow in these watersheds since October 1987, with the exception of the monitoring station along the West Branch Swift River (DWSP site ID 211; USGS 01174565), which began operations in 1995. The Massachusetts Department of Fish and Wildlife's Division of Ecological Restoration (DER) maintains a stream gage at Parkers Brook in the Ware River Watershed (DWSP site 102), providing daily streamflow data since late 2012. In 2017, the National Ecological Observatory Network (NEON) established a streamflow monitoring station along Lower Hop Brook (DWSP site 212), with daily data available from late 2020 onward (NEON, 2020).

Throughout 2025, DWSP maintained staff gages and collected water level data at several additional monitoring locations (sites GATE, 211, 213, 215G, and 216). DWSP Civil Engineering staff also maintain comprehensive records of Quabbin Reservoir elevation, with paper records dating back to the 1940s. Currently, reservoir elevation is measured at 15-minute intervals using a Stevens-Connect continuous sensor. For comparative analysis in this report, historical reservoir elevation records from 1980-2023 were utilized alongside current annual data.

2.1.3. Tributary Monitoring

DWSP staff monitored water quality at 21 stream sampling locations across the Quabbin Reservoir and Ware River Watersheds in 2025 (Table 4), along with two long-term study sites associated with a forest management study (Section 2.1.6.1). The tributary monitoring locations include Core sites and Environmental Quality Assessment (EQA) sites (Figure 2**,** Figure 3). Tributary locations vary in upstream catchment characteristics including land use and proportion wetland, as well as stream attributes (e.g., stream order, gradient, discharge, etc.). Sites are selected to characterize major inflows to the Quabbin Reservoir and Ware River, as well as to monitor areas of special interest and gather data on streams of varying upstream catchment and reach-scale attributes.

Samples were collected every other week (hereafter: biweekly) at tributary sites in 2025, with sampling in Quabbin Reservoir Watershed and Ware River Watershed alternating weekly. Monitoring frequency of analytes varied across watersheds, with less frequent analysis of nutrients in Ware River EQA sites (quarterly versus biweekly) and a quarterly sampling interval for all alkalinity analyses (Table 5). Samples were analyzed by MWRA laboratories per standard methods (Table 5). Sampling plans, locations, and sample collection frequencies vary across the period of record. Further discussion on changes to analytical methods across parameters and sampling frequencies across sites are detailed in Section 2.2. Further documentation on monitoring parameters is included in Section 6.1.

Table 4. *Drainage basin characteristics of DWSP tributary monitoring sites for a) Quabbin Reservoir Watershed and b) Ware River Watershed, 2025.*

a) Quabbin Reservoir Watershed

Site Type	Site ID	Site Description	Area (mi^2)	DWSP Land (mi^2)	DWSP Land (percent)	Wetland (mi^2)	Wetland (percent)
Core	211	West Branch Swift River	12.4	5.8	47.1	0.4	3.4
Core	212	Hop Brook	4.5	1.5	33.3	0.1	2.8
Core	213	Middle Branch Swift River	9.0	2.2	24.3	0.5	6.0
Core	215G	East Branch of Fever Brook	5.2	0.7	13.7	0.5	9.3
Core	216	East Branch Swift River	29.8	0.8	2.5	2.1	7.1
Core	GATE	Gates Brook	0.7	0.7	100	<0.1	3.6
Core	BC	Boat Cove Brook	0.2	0.2	100	<0.1	1.4
EQA	216G	Roaring Brook	1.0	0.0	0.0	0.1	6.6
EQA	216I-X	Moccasin Brook	7.0	0.1	1.3	0.6	8.9
EQA	216D	Connor Pond Outlet	21.3	0.2	0.8	1.6	7.5
EQA	216C	Carter Pond Outlet	2.5	0.1	4.2	0.2	6.5

b) Ware River Watershed

Site Type	Site ID	Site Description	Area (mi^2)	DWSP Land (mi^2)	DWSP Land (percent)	Wetland (mi^2)	Wetland (percent)
Core	101	Ware River, near Shaft 8	96.0	37.5	39.1	10.8	11.2
Core	102	Parkers Brook	5.3	4.5	84.8	0.6	10.3
Core	103A	Burnshirt River	86.5	29.2	33.8	9.8	11.3
Core	107A	West Branch Ware River	16.0	7.3	45.7	2.3	14.6
Core	108	East Branch Ware River	22.2	2.9	13.0	2.8	12.7
Core	121	Mill Brook	3.0	0.3	9.4	0.5	15.8
EQA	121M	Moulton Pond Outlet	1.6	0.1	4.5	0.3	18.0
EQA	119	Demond Pond Outlet	2.2	0.5	20.9	0.3	14.6
EQA	110	Whitehall Pond Outlet	5.2	2.0	38.6	0.6	11.9
EQA	105	Barre Falls Dam	54.6	19.3	35.4	8.0	14.7

Table 5. *Analytes included in DWSP tributary monitoring programs, analytical methods, and monitoring frequency for 2025. Biweekly sampling denotes samples collected on an every-other-week interval. Nutrient sampling was bi-weekly for all Quabbin tributary sites and Ware site 101, and quarterly for all other Ware monitoring sites.*

Group	Analyte	Method (2025)	Monitoring Frequency (2025)
Bacteria	Total Coliform	SM 9223B	Biweekly
Bacteria	*E. coli*	SM 9223B	Biweekly
Physical	Turbidity	SM 2130 B	Biweekly
Chemical	Alkalinity	SM 2320 B	Quarterly
Nutrients	NO_3-N	EPA 353.2	Biweekly or Quarterly
Nutrients	NH_3-N	EPA 350.1	Biweekly or Quarterly
Nutrients	TKN	EPA 351.2	Biweekly or Quarterly
Nutrients	TP	EPA 365.1	Biweekly or Quarterly
Organic Matter	TOC	SM 5310 B	Biweekly (Quabbin Sites and Ware Site 101)
Organic Matter	UV_{254}	SM 5910B 19th edition	Biweekly
Major Ions	Na	EPA 200.7	Biweekly
Major Ions	Cl	EPA 300.0	Biweekly
Field Parameters	Temperature	Gibs et al. (2012)	Biweekly
Field Parameters	Dissolved Oxygen	Gibs et al. (2012)	Biweekly
Field Parameters	pH	Gibs et al. (2012)	Biweekly
Field Parameters	Specific Conductance	Gibs et al. (2012)	Biweekly

2.1.4. Reservoir Monitoring

DWSP reservoir monitoring includes plankton monitoring, water quality sample collection, and the use of *in situ* sensors for water quality data collection at three monitoring stations (Table 6). The Quabbin Reservoir was sampled regularly in 2025 to monitor phytoplankton densities to anticipate potential taste and odor problems and recommend management actions as necessary. At site 202, phytoplankton was sampled every week from May to September and monthly from January to April and October to December. At sites 206 and Den Hill, phytoplankton was sampled monthly year-round (ice conditions permitting). A response plan to elevated phytoplankton densities was set so that if any of the taxa of concern exceeded established enhanced monitoring levels (EML), frequency of monitoring increased to twice a week for site 202 and twice a month for sites 206 and Den Hill (see Table 55).

Water quality samples were collected monthly in 2025 from March to December at three depths from three stations within the reservoir for analyses of UV_{254}, total organic carbon, turbidity, and bacteria. Water samples for analyses of nutrients, silica, alkalinity, pH, sodium, and chloride were collected quarterly (May, July, October, and December), with an additional collection date in August to capture physiochemical reservoir conditions during observed elevated phytoplankton densities (*Chrysosphaerella* aggregation) in the summer. Routine calcium monitoring was discontinued in 2023, due to low calcium levels observed in the reservoir (e.g., 1.81 to 2.33 mg/L in 2022) demonstrating low risk of zebra mussel colonization (DWSP, 2023a). Periodic special investigations to assess reservoir calcium levels are ongoing.

Manual water-column profiles of temperature, pH, dissolved oxygen, specific conductance, chlorophyll *a*, and phycocyanin were measured via a Yellow Springs Instruments (YSI) EXO2 sonde coincident to phytoplankton and water quality sampling at each site. In addition to manual water column profiles, a remote sensing profiling buoy was deployed by MWRA and DWSP in 2020; it is located close to sampling site 202 in Winsor Basin. Profiles are collected with YSI EXO2 sondes, identical to those used by DWSP for manual profiles. The profilers automatically run every six hours (12 am, 6 am, 12 pm, and 6 pm) and collect data at 1-m increments. Results are frequently used by DWSP to augment the routine profiles and phytoplankton sampling program. For example, if elevated chlorophyll *a* values are observed in remote sensing data, DWSP may sample earlier than scheduled to capture associated phytoplankton data. Reservoir monitoring results are discussed in Section 3.3 of this report.

Table 6. *Core monitoring locations in Quabbin Reservoir, 2025.*

Site Name	Site ID	Location	Maximum Depth (m)
Winsor Dam	202	Quabbin Reservoir west arm, offshore of Winsor Dam along former Swift River riverbed	42
Shaft 12	206	Quabbin Reservoir, offshore of Shaft 12	28
Den Hill	Den Hill	Quabbin Reservoir eastern basin, near Shaft 11a	19

2.1.5. Aquatic Invasive Species Monitoring and Management

DWSP implements an annual monitoring program for aquatic invasive species (AIS) in the Quabbin Reservoir, Quabbin Reservoir Watershed, and the Ware River Watershed. Several water bodies within the watersheds are monitored for AIS annually, whereas additional water bodies are evaluated every five years as a component of the current Environmental Quality Assessment (EQA) cycle. This means that the water bodies in a single sanitary district are surveyed for AIS every five years as time and staffing allows. In 2025, three water bodies within the EQA districts East Branch Swift and Coldbrook and Longmeadow were surveyed for AIS.

Two water bodies in the Ware River Watershed, in addition to the Ware River (upstream of the Shaft 8 Intake), were surveyed by DWSP for the presence of AIS in 2025 (Table 7). In addition, the Quabbin Reservoir's two regulating ponds (O'Loughlin and Pottapaug), the entire Quabbin Reservoir West Arm, and portions of the Quabbin Reservoir shoreline (Boat Launch Areas 1, 2, and 3) were also surveyed for AIS in 2025. Several water bodies, including the holding ponds and Brigham Pond, were visited more than once throughout the season for further survey or management efforts. Additional assessments conducted by the contractor TRC were completed under a MWRA contract. MWRA and the consultant assist DWSP with early detection of AIS by surveying portions of the Quabbin Reservoir and the Ware River annually. MWRA also manages AIS in the Ware River via a drawdown of the river system and manual harvest of invasives along the riverbed (3.4.3.1).

Further reservoir-based monitoring and prevention programs are also implemented to protect against the spread of invasives in the Quabbin Reservoir. To monitor for invasive zooplankton, oblique tows (one minute duration; 53-µm mesh) were performed every other month from May to October in proximity to the three reservoir Boat Launch Areas, and vertical tows (net lowered to two meters above bottom, 53-µm mesh) were collected at the three phytoplankton sampling sites (202, 206, and DEN). Samples collected via oblique net tows were screened to monitor for invasive zooplankton, whereas vertical tow samples were concentrated, preserved in alcohol, and later analyzed for community composition and AIS presence under a dissecting microscope. As a preventative means to further limit potential undesirable impacts to water quality resulting from AIS, DWSP staff coordinate boat inspections, boat/motor/equipment decontaminations, and monitoring of boat ramps in Quabbin Reservoir and Ware River Watersheds.

Table 7. *Water bodies surveyed in 2025 for aquatic invasive macrophyte species in a) Quabbin Reservoir and b) Ware River Watersheds by DWSP and MWRA contractor TRC.*

a) Quabbin Reservoir Watershed

Water Body Name	Location	Surveyed by	Date
Quabbin Reservoir	New Salem, Petersham, Hardwick	TRC	8/11 - 8/13/2025
Quabbin Reservoir, West Arm	Pelham, New Salem	TRC and DWSP	6/23 - 6/26, 7/9, and 8/11 - 8/13/2025
O'Loughlin Pond	New Salem	TRC and DWSP	5/24, 7/9, and 7/25/2025
Pottapaug Pond	Hardwick	TRC and DWSP	5/1, 5/30, 7/9, 8/27, 8/28/2025
Quabbin Reservoir, Boat Launch Area 1	Belchertown	DWSP	6/24/2025
Quabbin Reservoir, Boat Launch Area 2	New Salem	DWSP	6/11/2025
Quabbin Reservoir, Boat Launch Area 3	Petersham	DWSP	7/17/2025

b) Ware River Watershed

Water Body Name	Location	Surveyed by	Date
Ware River, Upstream of Shaft 8	Barre	TRC and DWSP	5/14 and 7/23/2025
Brigham Pond	Hubbardston	DWSP	6/12 and 9/18/2025
Long Pond	Rutland	DWSP	7/18/2025

2.1.6. Special Investigations

DWSP conducts both short-term and long-term investigations on select projects based on water quality concerns in the region. Forestry monitoring and Environmental Quality Assessments are current long-term programs to investigate water quality and landscape patterns related to land management.

2.1.6.1. Forestry Monitoring

DWSP continued to monitor water quality at two surface water sites in the Quabbin Reservoir Watershed (Figure 2) as part of a long-term study to assess the potential impacts of timber harvesting on water quality. The monitoring uses a paired-watershed study design, where water quality data are collected at a control and treatment watershed before and after timber operations. Water quality sampling at paired-watershed site locations is conducted at two intervals to ensure that monitoring captures a full range of streamflow conditions and solute mobilization conditions. Routine monthly-grab sampling and event-based sampling continued in 2025. Monthly grab samples have been collected at the Middle Branch Dickey (MBD) Brook (control site) and the East Branch Underhill (EBU) Brook (treatment site) on Prescott Peninsula since April 2002. Monthly grab samples have been analyzed for nutrients (NO_3-N, NO_2-N, TKN, and TP) since 2002 and total suspended solids (TSS), UV_{254}, NH_3-N, TOC, and DOC since 2014. Periodic event-based sampling of MBD and EBU was initiated in 2014 to characterize stream response during a variety of hydrological events (e.g., high- and low-intensity rainfall, rain-on-snow). Primary data generated by DWSP includes measurements of precipitation, stream flow, and concentrations of solutes collected across the event hydrograph (NO_3-N, NH_3-N, NO_2-N, TKN, TP, TSS, UV_{254}, TOC, and DOC), as well as investigations into hydrograph separation using stable water isotopes (Boutt, 2021). Concentration data collected during events serves to characterize the range of nutrient and sediment concentrations observed in these watersheds. Long-term forestry monitoring of water quality in MBD and EBU in 2025 included installation and routine maintenance of water-level loggers and precipitation gages, downloading of field data, monitoring of weather forecasts, sample collection, and associated data analysis.

2.1.6.2. Environmental Quality Assessments

DWSP conducts annual Environmental Quality Assessments (EQAs) of a single sanitary district in each watershed to assess potential sources of contamination across the watershed system. Each sanitary district is comprehensively evaluated by DWSP once every five years. Water quality monitoring of select Core and EQA sites within the selected sanitary district constitutes a component of the EQA. The EQA monitoring in 2025 focused on the East Branch Swift sanitary district in Quabbin Reservoir Watershed (Figure 2) and the Coldbrook and Longmeadow sanitary district in the Ware River Watershed (Figure 3).

2.2. Watershed Monitoring Parameters and Historical Context

DWSP water quality monitoring was comprised of 28 unique water quality characteristics (e.g., physical, chemical, and biological) measured in the Quabbin Reservoir and Ware River Watersheds in 2025 (Section 6.1). Parameters monitored by DWSP included those that may directly affect water quality (and thus, potability) and/or may indicate the presence of potential future negative impacts to water quality. An extensive discussion, including relevant regulatory and guidance thresholds for the parameters monitored by DWSP, was documented in the 2022 Quabbin/Ware Region Water Quality Report (DWSP 2023a, Appendix A). Analytical methods for concentration data are provided in Table 5. Results for various water quality parameters are compared to regulatory levels when applicable (DWSP 2023a, Appendix A).

DWSP updates sampling plans annually to align with Environmental Quality Assessments, assess potential water quality concerns, and/or to focus on new regions or sites of interest. Thus, historical sampling frequency of analytes varies across time and space (Figure 4, Figure 5, Figure 6). For example, monitoring frequency of several parameters was increased in Core tributaries from quarterly to biweekly in 2020 (DWSP, 2021a). Monitoring frequency of select analytes in Quabbin Reservoir also changed from quarterly to monthly in 2020. Bacteria analyses include total coliform and *E. coli*, the latter of which was added to DWSP monitoring programs in 2005. Inorganic N represents NO3-N and NH3-N, with the addition of NH3-N in 2011. Organics include UV_{254}, with the addition of total organic carbon at Quabbin Reservoir sites in 2020, at Quabbin Reservoir Watershed tributary sites in 2021, and Ware River site 101 in 2023. Metals and anions incorporate Na and Cl concentrations and were added within the last five years due to increasing concern over specific conductance trends in waterways of the Northeastern USA (DWSP 2023a). Further documentation on changes to water quality sampling plans is available in previous annual water quality reports.

Annual sampling coverage varies between Core and EQA tributary sites due to programmatic goals. Core sites are monitored annually for long-term coverage and a resulting period of record that is at a relatively fine temporal scale. For many sites with long-term water quality monitoring records locations, this allows for a more robust discussion of changes in water quality patterns over time (20-30 years), or more near-term (e.g., five-year or less) analysis of certain patterns for more recently added analytes (e.g., anions, TOC). In contrast, monitoring of EQA sites follows a five-year rotation focusing on different sub-basins within each of the two water supply watersheds. This monitoring is intended as a synoptic snapshot of conditions during the writing of these assessments, and thus these data have a significantly shorter period of record compared with Core monitoring locations. Period-of-record results from EQA sites rarely exceed three to four years of observation and are staggered in time. Due to these differences in temporal coverage, comparisons of conditions between 2025 results and historical records for EQA sites are less robust compared to the longer period of record for Core monitoring locations.

Select tributary monitoring sites previously established as EQA sites were converted to long-term (Core) monitoring sites in 2021 to provide better spatial coverage and consistent sampling of priority areas within either watershed (215G replaced 215 in the Quabbin Reservoir Watershed and 121 replaced 121B in the Ware River Watershed). Parkers Brook (102) was added to the Ware River Watershed monitoring program as a Core site in 2021. Changes in the frequency of analysis of select analytes, or transitions from EQA to Core site sampling frequencies may impact seasonal statistics, long-term patterns in water quality, and comparisons to historical ranges relative to sites that have not undergone significant changes to monitoring program structure. These considerations are further discussed within the water quality result narratives for the tributary and reservoir monitoring results.

There are a few notable shifts in analytical methods and detection limits over the period of record. Analytical methods for TKN returned to EPA Method 351.2 (O'Dell, 1993a) in 2023, consistent with all results prior to 2020. Beginning in 2020, analysis had shifted to Valderrama (1981) to facilitate monthly monitoring frequencies of N-species in Core sites in Quabbin Reservoir and biweekly monitoring in Core tributary sites. Results were reported as total nitrogen (TN) in 2020-2022. During the period of 2020-2022, TKN concentrations were derived by subtracting concentrations of NO_3-N and NO_2-N from TN concentrations. NO_2-N has been measured previously (2010) in samples collected from Core sites and was below laboratory detection limits in all samples in the Quabbin Reservoir (n = 18) and in all but four samples (n = 2,005 total measurements) in Core tributaries. Thus, NO_2-N was assumed to remain below laboratory detection limits (less than 0.005 mg/L) in all samples collected in 2020 and 2022. DWSP did not modify sample collection methods, thus uncertainty associated with TKN concentration data from this period is limited to assumptions made during calculations and/or sensitivity of different analytical methods. The detection limits for TN via Valderrama (1981) were 0.0034 mg/L. Results for TKN for tributary monitoring included in this report date from 2010 to the present.

Analytical methods for TP were modified in 2020. TP concentrations for tributaries were derived via EPA Method 365.1 (O'Dell, 1993b) until January 01, 2020. Analysis was performed via Valderrama (1981) thereafter to facilitate increased monitoring frequencies of TP in Core tributaries (e.g., every two weeks). Analytical methods for TP returned to EPA methods in 2021. Uncertainty associated with TP concentration data for 2020 is limited to sensitivity of different analytical methods, as sample collection and storage were not altered in 2020. Because of the variation associated with the change in TP methods for 2020, TP concentration data corresponding to samples collected in 2020 were excluded from calculations for period-of-record statistics. Also of note is that alkalinity concentration results were historically reported by titration to pH of 4.5 endpoint via Standard Method 2320B (DWSP, 2018b).

Sensors used for collection of *in situ* parameters by DWSP also vary over the period of record. Before 2021, DWSP staff used a Eureka Manta2 field sonde for data collection at Quabbin Reservoir. Starting in 2021, a shift was made to the YSI EXO2 sonde to better align data collection with MWRA and DWSP-Wachusett methods. Changes in sensor manufacturers, sonde configurations, and water column profile collection methods complicate direct comparisons to historical data for physiochemical parameters. These considerations are further discussed throughout the report.

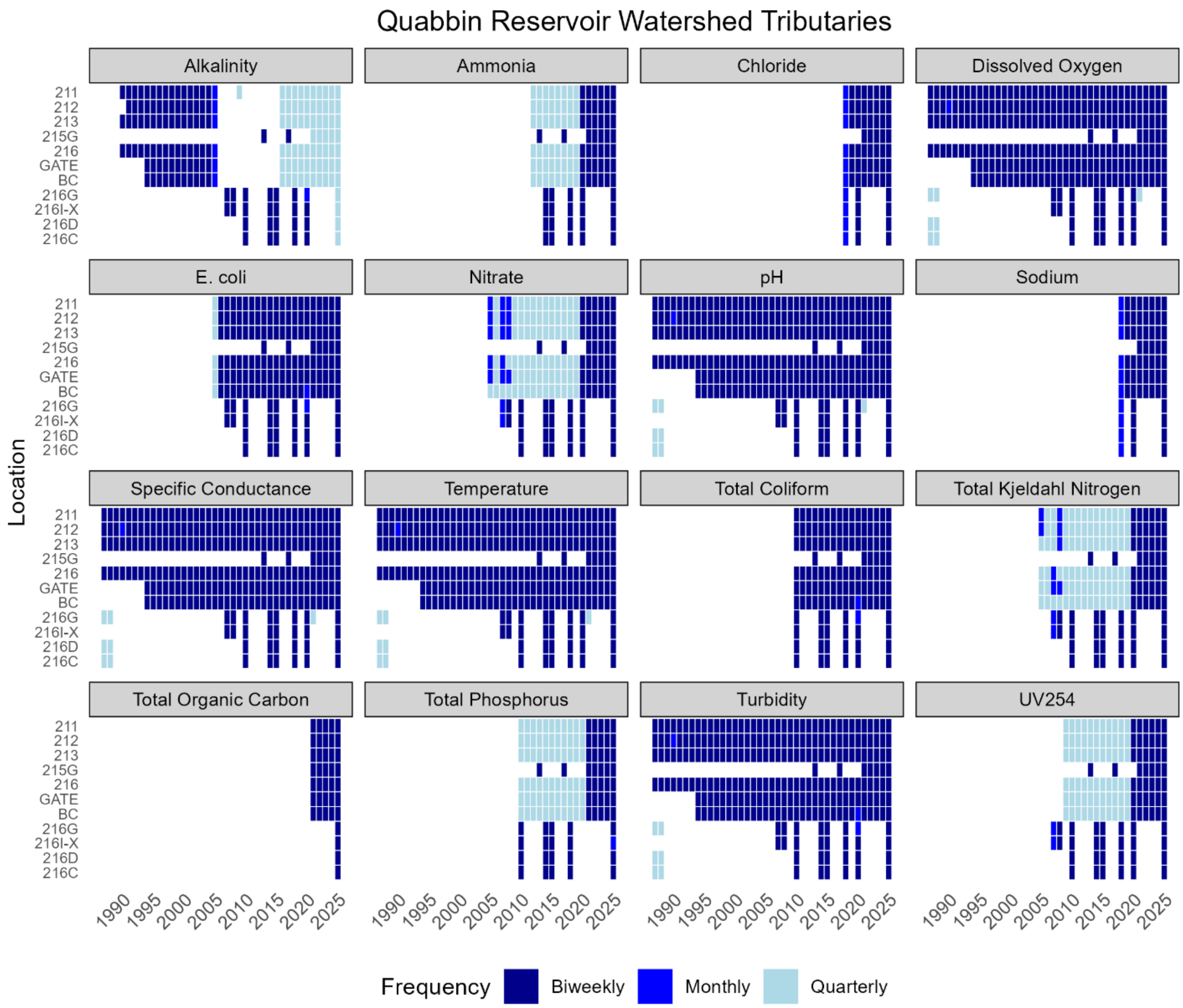


Figure 4. *Period of record for analytes measured in 2025 tributary monitoring sites in Quabbin Reservoir Watershed.*

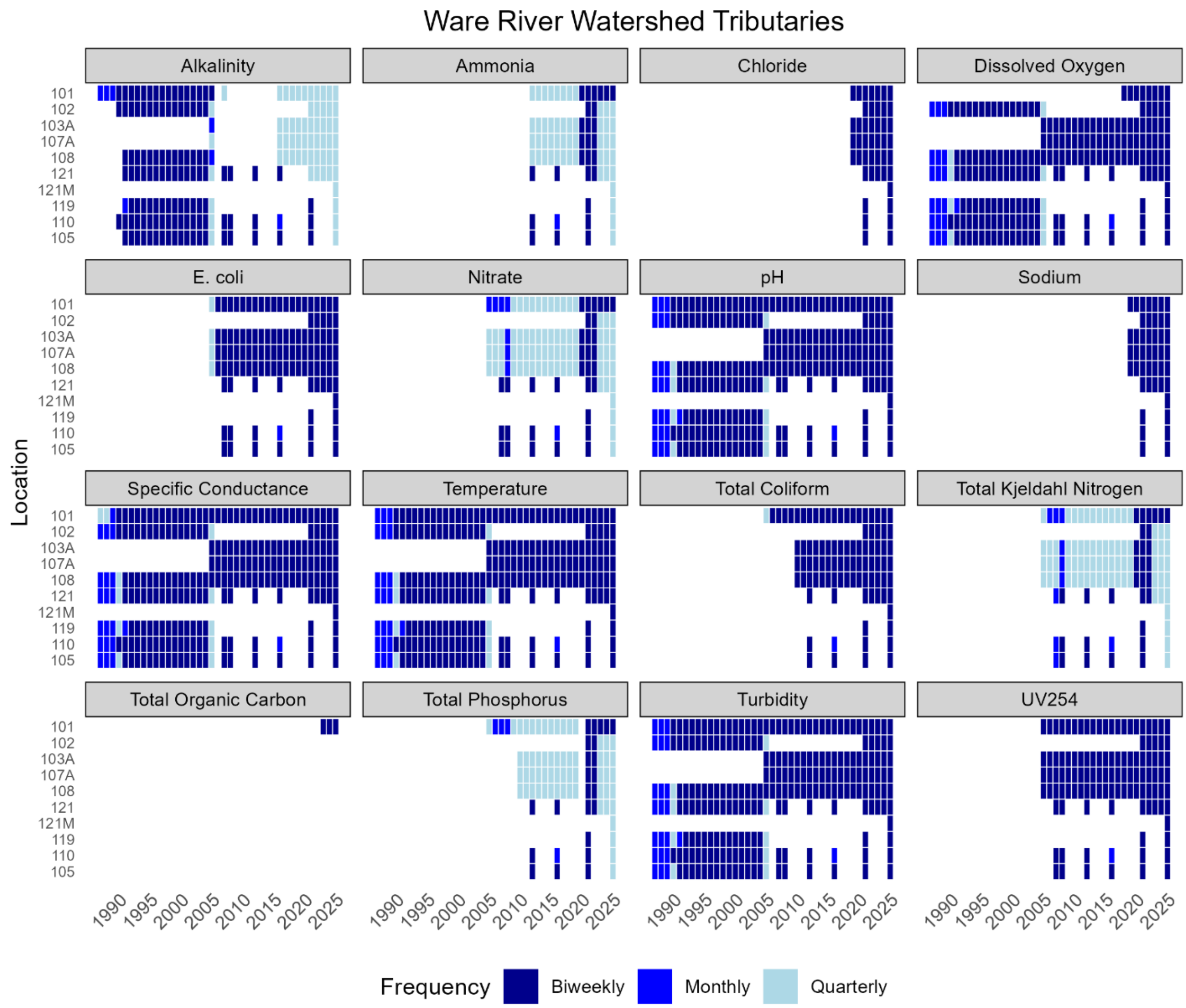


Figure 5. *Period of record for analytes measured in 2025 tributary monitoring sites in Ware River Watershed.*

Figure 6. *Period of record for analytes measured in Quabbin Reservoir monitoring sites.*

2.3. Data Management and Statistical Methods

Water quality, precipitation, and streamflow data collected since 1989 are stored in a Microsoft SQL Server database, maintained by DWSP. Database development efforts continue to build off the database migrated to a SQL Server platform in 2021 for cloud-based storage and easy access for filtering and analyzing historical records. The current database contains historical water quality data including field parameters (water temperature, dissolved oxygen, oxygen saturation, specific conductance, pH, Secchi depth, chlorophyll *a*, and phycocyanin) and constituent concentration results (alkalinity, NO_3-N, NO_2-N, NH_3-N, TP, TKN, Ca, Na, Cl, Si, dissolved and total carbon, *E. coli*, total and fecal coliform, hardness, UV_{254}, and turbidity), spanning the onset of DWSP monitoring (1987) through the present. Laboratory data, including concentrations of various constituents, were provided by MWRA staff and then uploaded to the DWSP water quality database via R-scripts and Shiny application tools designed for data download and database standardization (R Core Team, 2019; Winston et al., 2019). Plankton density summaries were generated by DWSP staff and included in database tables for long-term record keeping. Workflows are developed using R, RStudio, ArcGIS, and SQL Server Management software to automate QA/QC and data import processes for incoming raw data generated from field equipment (e.g., multiparameter probes), MWRA lab results, and phytoplankton identification and enumeration, as well calibration records and field notes.

DWSP continued to develop its water-quality database in 2025, processing and importing data from numerous monitoring workflows and organizing historical data records. Work related to DWSP data management and integration of historical records (prior to 2010) remains ongoing. This includes documentation of historical detection limits, verification of results, attribution of data flags, and ensuring completeness of record.

Annual water quality monitoring data are reviewed before being imported and periodically throughout the year for data accuracy and to compare results against seasonal normal ranges (25-75%) based on the site-specific monitoring period of record. Data flags are added to records that require qualifiers for analytical use and interpretation, or for records that should be excluded from analysis due to instrumentation error, sensor calibration issues, sample collection inconsistencies, environmental factors, or other considerations. A small subset of monitoring records were flagged and removed from summary reporting following review by DWSP and MWRA staff (less than 1% of records). For example, 2023 ammonia results from October were excluded from reporting due to documented linearity issues with the NH_3-N calibration curve during this period (Gottshall, 2024). Beginning in 2024, select records from water quality sensor data were removed following post-sample calibration tests that did not pass QA/QC checks.

Concentrations below laboratory reporting limits were replaced with the detection limit for all calculations performed in this report. Concentrations above upper reporting limits were assigned as equal to the upper detection limit. Censored data (results below detection limit) are flagged in the DWSP database. This method of handling censored data is consistent with that used in recent annual water quality reports for the Quabbin Reservoir and Ware River Watershed (DWSP, 2023a; DWSP 2024a). Due to the inherent non-normal distribution of environmental monitoring data, non-parametric measures of central tendency (median, interquartile range) were used to evaluate the variability of constituents observed in 2025 (Helsel, 2012).

Seasonal statistics (mean, median, geometric mean) were calculated using methods depending on the occurrence of non-detects within each data grouping. Left-censored results were substituted with the detection limit concentration, and the normal statistic was calculated using base R functions when fewer than four values were detected in a data group. Statistics were calculated using functions from the NADA package (Lee, 2020) when four or more censored values were present in a data group. A parametric method, Maximum Likelihood Estimation (MLE), was used to compute annual geometric mean *E. coli* concentrations. A non-parametric method, Regression on Order Statistics (ROS), was used with other censored data (namely nutrients) to calculate seasonal mean and median concentrations. This modification to statistical methods may produce deviations from standard methods for calculating measures of central tendency for select parameters, as reported previously (DWSP, 2021b-c; DWSP, 2023a). For some analytes where most results are below detection limits (e.g., NH_3-N and NO_3-N), minimum values are reported at detection limits while mean and median values may be lower than detection limits based on ROS methods. Methods for determining measures of central tendency remain unchanged from prior reports for constituents with no censored values. These methods of handling censored data are expected to produce more robust and unbiased results. Many of the reported calculations in this analysis did not deviate substantially from those derived via prior methods.

Seasonal summary statistics (minimum, median, mean, and maximum values) of results from 2025 monitoring are reported along with seasonal statistics from the period of record (POR) available from DWSP data records. Results from each analyte's POR provide the range of variability expected at sampling locations and allow for comparison of 2025 seasonal results against their historical context. Inferences into seasonal dynamics or interannual variability are limited for sites with short-duration or intermittent temporal coverage (e.g., EQA sites, more recently added Core sites, see Figures 4-6), as well as parameters with quarterly sample collection, and are provided as a point of reference to a still-emerging understanding of seasonal variability for different parameters at different sites.

3. Results

3.1. Hydrology and Climate

The northerly latitude and geographic location of the Northeastern United States have made it prone to the moderating and moistening effects of the Atlantic Ocean, as well as the influence of hot and cold air masses from the continent's interior (Brown et al., 2010). This has resulted in a climate with a distinct seasonality historically characterized by cold, snowy winters and warm, humid summers. Additionally, the region's proximity to the northern hemisphere polar jet stream has led to highly variable weather patterns, reflected in a broad range of daily and annual temperatures and generally abundant precipitation throughout the year (Rustad et al., 2012). These patterns have begun to shift, however, as anthropogenic influences (e.g., the burning of fossil fuels) have led to a steady climb in global temperatures with a global 3°C rise predicted by the end of the century (United Nations Environment Programme, 2023). In the contiguous United States, the fastest warming region has been identified as the Northeast where seasonal differences in temperature have decreased in recent years as winters have warmed three times faster than summers (Horton et al., 2014; Young & Young, 2021). Due to the rate of warming in the Northeast, this region is projected to warm by an additional 1°C as global warming reaches 2°C (Karmalkar & Bradley, 2017).

Massachusetts has historically been susceptible to extreme weather events such as tropical storms, nor'easters, and recurring prolonged summer droughts, and the impact of these events can vary widely across the region due to its diverse topography and locational proximity to storm tracks (Thibeault & Seth, 2014; Siddique et al., 2020). Warming temperatures as the result of climate change have led to an increase in the frequency and magnitude of these events over time which has broadly impacted freshwater systems (Demaria et al., 2016). Hydrology for the region has traditionally been characterized by spring snowmelt floods with a falling hydrograph throughout the remainder of the growing season; however, an uptick in the frequency and duration of periodic high-intensity rainfall events has led to a less predictable hydrograph with high flow conditions occurring throughout the year regardless of seasonal influence (Siddique et al., 2020). Additionally, rising temperatures have been increasing the frequency of rain-on-snow events during winter months and melting snow earlier in the spring, causing winter-spring peak flows to occur approximately six days earlier in Massachusetts as compared to a century ago (Notaro et al., 2014; Demaria et al., 2016). Alterations to streamflow have been coupled with greater rates of evaporation throughout the region, causing precipitation during summer and fall months to fall on increasingly dry soils (Dudley et al., 2017). This leads to broad-scale impacts to water quality in the region as more particulates are flushed from the landscape into streams and rivers to be carried downstream (Willis & McDowell, 1982). Therefore, understanding annual hydrologic and meteorologic patterns in relation to both historical and predicted contexts provide valuable insights into water quality patterns for both the Quabbin Reservoir and Ware River watersheds.

3.1.1. Climatic Conditions

Historically, climatic conditions for the Quabbin Reservoir and Ware River watersheds have been monitored at three weather stations. Two of these stations, Belchertown (USC00190562) and the Orange Municipal Airport (USW00054756), are located in the Quabbin Reservoir Watershed, with Belchertown representing the southern end of the watershed and Orange representing the northern portion. The weather station at Barre Falls Dam (USC00190408) in Barre, MA, has traditionally represented climate conditions in the Ware River Watershed. Due to discrepancies in temperature data identified by NOAA during the latter half of 2025, temperature monitoring at this station has been temporarily discontinued, and data analysis for 2025 was therefore limited to precipitation conditions.

Conditions recorded in 2025 reflect broader regional trends observed across the Northeast, a year characterized by warmer- and drier-than-normal conditions, driven by persistent precipitation deficits and recurring drought. Massachusetts ranked its 20th warmest year on record, with regional precipitation coming in at 89% of normal (NRCC, 2026).

3.1.1.1. Air Temperature

Monthly mean, average minimum, and average maximum temperatures all trended below historical values during the early winter months at both the Belchertown and Orange weather stations in 2025. The lowest monthly average minimum temperature was recorded in January at Orange (-11.70°C versus a historical mean of -10.06°C) — the 11th lowest on record for that station — while the highest monthly average maximum was recorded at Belchertown in February (1.71°C versus 2.17°C; Figure 7). Temperatures rebounded through spring, trending warmer than average at both stations. Belchertown recorded a spring seasonal average of 8.73°C (12% above the historical mean) and Orange recorded 8.90°C (18% above historical mean).

Summer average temperatures at both stations were slightly above historical means (Table 8). Belchertown recorded a seasonal average of 20.80°C against a historical mean of 20.73°C, with average maximum temperatures also above the historical mean by 0.55°C (27.18°C versus 26.63°C). Orange recorded a seasonal average of 21.10°C, exceeding the historical mean by 0.57°C, and ranked as the sixth warmest summer mean on record for that station (Table 8). Average summer minimum and maximum temperatures were likewise above historical summer means (14.29°C, +0.15°C and 27.92°C, +0.97°C, respectively).

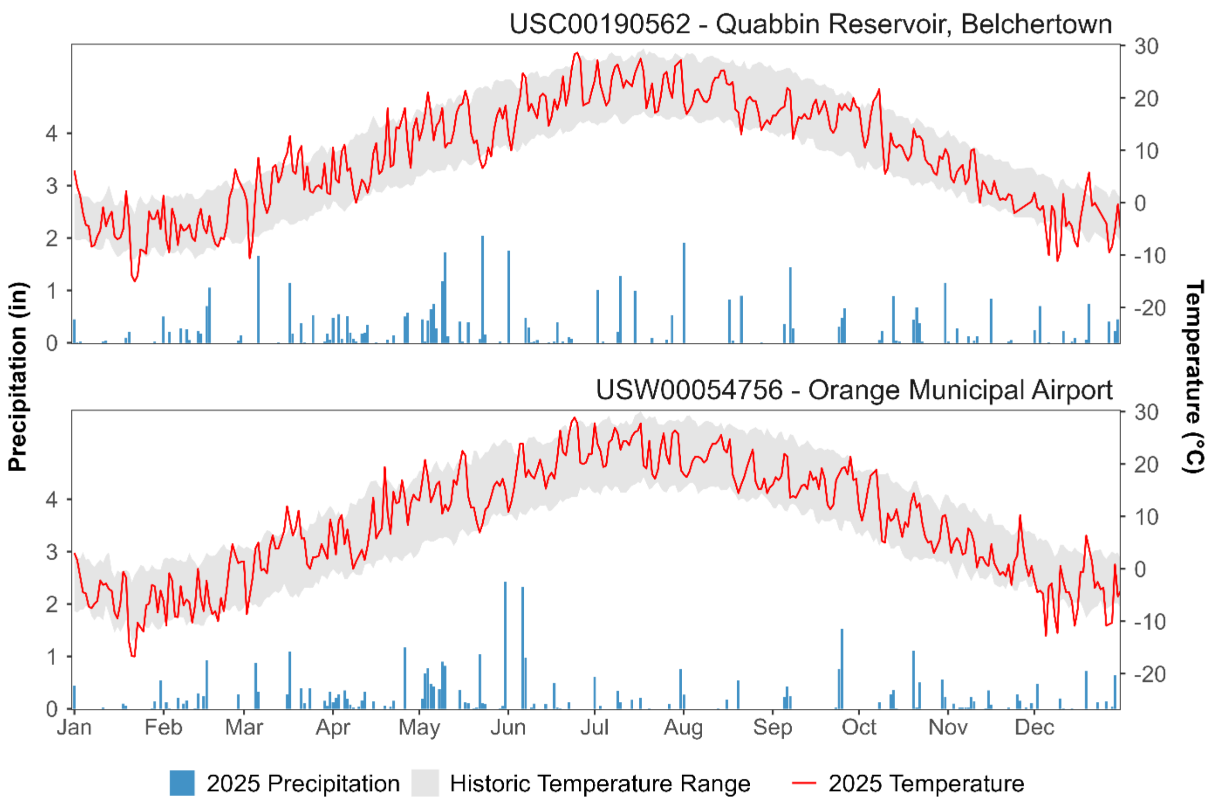


Figure 7. *Climatograph of precipitation totals and daily median air temperatures (in degrees Celsius) for weather stations in the Quabbin Reservoir Watershed. The shaded band represents historical mean daily temperature ranges (minimum to maximum temperature) for Belchertown (1990-2025) and Orange (1997-2025) weather stations.*

Fall average temperatures were above historical means at both stations. Belchertown recorded a seasonal mean of 11.22°C compared to a historical mean of 10.66°C; average maximums were also above historical fall means (17.38°C versus 16.11°C), while average minimums fell slightly below (5.06°C versus 5.20°C). Orange recorded a fall mean of 9.74°C, slightly below the historical mean of 10.30°C, with average maximums marginally above (16.36°C versus 16.28°C) and average minimums below (3.11°C versus 3.92°C).

December temperatures fell well below average at both stations. Belchertown recorded a monthly mean of -3.33°C compared to a historical value of -0.56°C, with average minimums showing the greatest departure at -8.56°C, or 3.56°C below the historical mean. December air temperature patterns at the Orange weather station were similar, recording a monthly mean of -4.17°C (-2.77°C below historical mean), an average minimum of -9.83°C (-3.29°C below historical average), and an average maximum of 1.03°C (-2.59°C below historical average).

Table 8. *Seasonal mean temperature values for the period of record and for 2025. Delta represents the difference between 2025 seasonal means compared to the period of record.*

Weather Station	Month	2025 Mean Daily (°C)	POR Mean Daily (°C)	Mean Daily Delta
Belchertown	Spring	8.88	7.77	1.12
Belchertown	Summer	20.80	20.73	0.06
Belchertown	Fall	11.22	10.66	0.56
Belchertown	Winter	-3.90	-2.65	-1.25
Orange	Spring	9.03	7.63	1.40
Orange	Summer	21.11	20.54	0.56
Orange	Fall	9.74	10.10	-0.36
Orange	Winter	-5.12	-3.19	-1.93

3.1.1.2. Precipitation

Both the Belchertown and Orange weather stations recorded below-average cumulative annual precipitation for 2025, with annual rainfall totals measuring 44.42 inches in Belchertown and 37.94 inches in Orange (Figure 8). These values were 5% and 11% below historical means respectively. The Barre Falls Dam weather station similarly recorded below-average annual precipitation, totaling 41 inches for 2025 — falling within the 38th percentile and ranking as the 22nd driest year in the 61-year period of record. These values align with drought conditions observed throughout Massachusetts in 2025, with drought persisting throughout the Quabbin watershed for large portions of the year.

The year began in a precipitation deficit, with the winter months of January and February recording cumulative precipitation totals below historical means at both stations. Belchertown recorded a cumulative 4.48 inches during these winter months compared to a historical mean of 6.42 inches, while Orange fell 1.61 inches below average at 3.67 inches of cumulative rainfall. January and February precipitation at Barre Falls Dam totaled 4.76 inches, below the historical mean of 5.94 inches. During this period, D0 (abnormally dry) and D1 (moderate drought) conditions were widespread across Massachusetts, with D0 affecting an average of 44.55% and 28.58% of the state in January and February, respectively, and D1 conditions covering 32.63% and 48.61% of the state (Figure 9). D2 (severe drought) conditions affected 22.32% of the state in January and 22.82% of the state in February, totaling in a cumulative 100% of the state experiencing drought for both months.

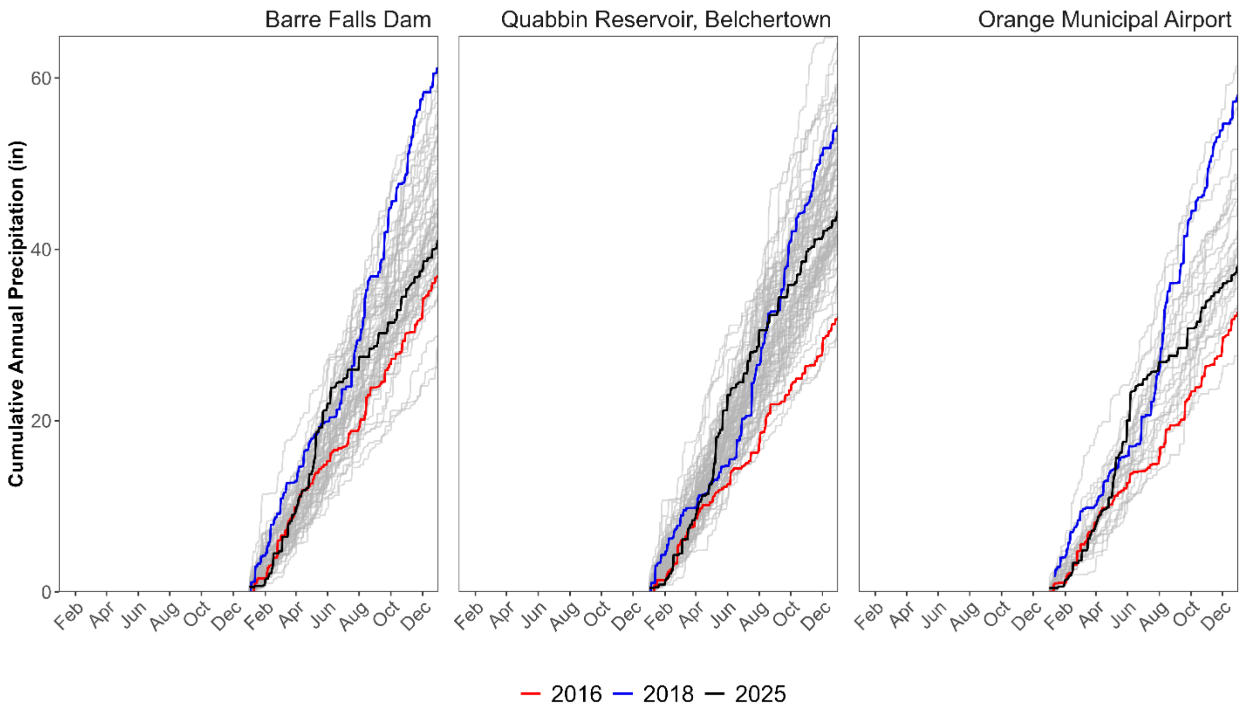


Figure 8. *Annual cumulative precipitation totals for Quabbin Reservoir Watershed weather stations. Red and blue lines indicate recent years of high and low annual precipitation totals (2016 and 2018, respectively) compared to the period of record (shaded lines; see Table 3 for site-specific record ranges) and to 2025 (black line).*

This deficit began to resolve in spring (March, April, May; Table 9), as all stations recorded well above-average rainfall. Belchertown measured a cumulative 16.74 inches, or 46% above the historical spring mean (+5.27 inches), and Orange totaled 16.35 inches — 66% above its historical spring mean of 9.87 inches. Barre Falls Dam recorded 16.79 inches for the season, approximately 51% above its historical spring mean of 11.12 inches. Drought conditions began responding to increased precipitation in March, though D0 and D1 conditions still dominated, covering 41.19% and 53.10% of Massachusetts respectively, with nearly no area drought-free. By May, conditions had improved considerably, with 52.83% of the state drought-free and D1 coverage dropping to just 9.90%. Spring rainfall was record-setting at Orange, where the cumulative monthly total of

8.99 inches in May surpassed the previous record of 6.52 inches set in 2017, capped by a single-day rainfall event of nearly 2.5 inches on May 31. Heavy May rainfall also stood out at Barre Falls Dam, where 7.8 inches ranked as the second wettest May on record behind 1984 (11.37 inches).

Table 9. *Seasonal mean cumulative precipitation (inches) from the period of record and seasonal cumulative precipitation for 2025 in a) Belchertown, b) Orange, and c) Barre. Delta represents the difference between 2025 total monthly precipitation compared to the POR. Precipitation variations are highlighted by an orange-red gradient, with precipitation deviations > 2" becoming darker based on magnitude.*

a) Belchertown (in)

Season	2025	POR	Delta
Spring	16.74	11.47	5.27
Summer	11.11	12.97	-1.86
Fall	8.91	11.93	-3.02
Winter	7.66	10.31	-2.65

b) Orange (in)

Season	2025	POR	Delta
Spring	16.35	9.87	6.48
Summer	7.54	12.26	-4.72
Fall	8.02	11.63	-3.61
Winter	6.03	8.85	-2.82

c) Barre (in)

Season	2025	POR	Delta
Spring	16.79	11.12	5.67
Summer	7.13	12.03	-4.9
Fall	8.76	11.64	-2.88
Winter	8.32	9.66	-1.34

Summer conditions (June, July, August) returned to below-average rainfall totals, with Belchertown dropping to 14% below historical means (11.11 inches versus 12.97 inches), Orange falling approximately 39% below average (7.54 inches versus 12.26 inches), and Barre Falls Dam recording 7.12 inches against a historical mean of 12.03 inches — a 41% deficit that ranked as the third driest summer on record behind 1964 (5.47") and 1963 (6.47"). Despite this, several large rainstorms occurred in the region over this period, with June 1 recording 1.72 inches of cumulative single-day rainfall at the Belchertown weather station and June 6 recording more than two inches of cumulative single-day rainfall in Orange. This was a likely contributor to much of Massachusetts remaining drought-free through June, with 92.80% of the state experiencing no-drought conditions. Even so, D0 conditions expanded through the remainder of summer during a hotter than average summer, covering 41.63% of the state by early August.

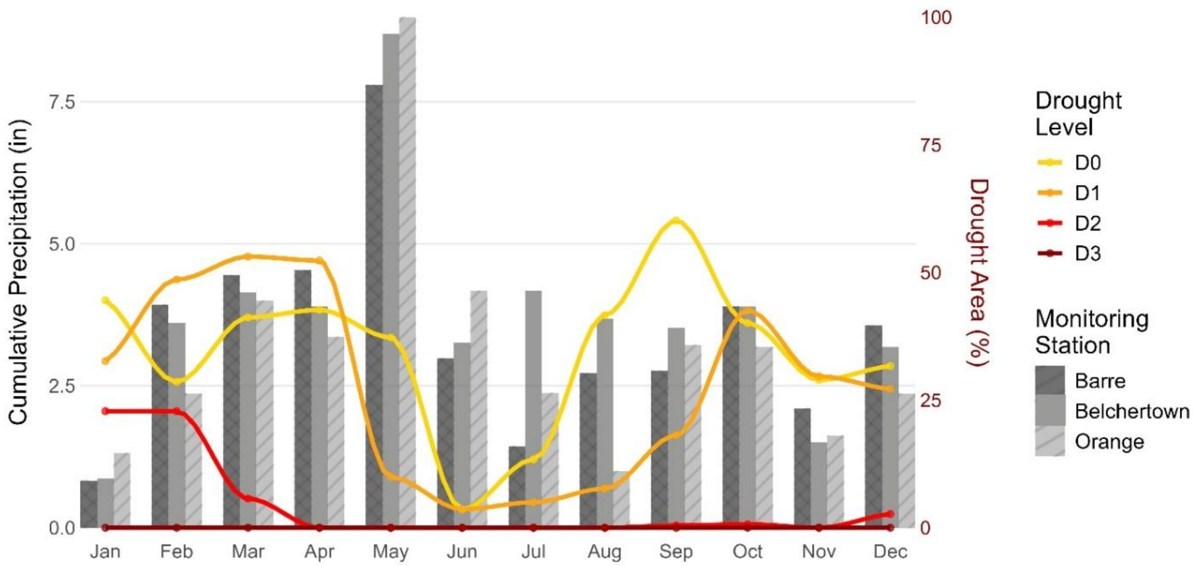


Figure 9. *Monthly cumulative precipitation at Quabbin Reservoir and Ware River Watershed weather stations and mean monthly drought conditions for Massachusetts in 2025. Each line represents a different level of drought severity (D0 = Abnormally Dry; D1 = Moderate Drought; D2 = Severe Drought; D3 = Extreme Drought). Reported drought conditions are monthly means for the state of Massachusetts as a whole.*

Fall precipitation was persistently below average at all stations, with autumn months receiving 70–73% less precipitation than historical means at Belchertown and Orange. Orange recorded a seasonal cumulative total of 8.02 inches compared to a historical mean of 11.63 inches, while Belchertown's cumulative precipitation for September, October, and November totaled 8.91 inches against a historical mean of 11.93 inches. Barre Falls Dam recorded 8.76 inches for the season against a historical mean of 11.64 inches, a deficit of roughly 25%. Drought intensified through fall, with D0 and D1 conditions expanding considerably. By October, D0 and D1 covered 40.08% and 42.60% of Massachusetts, respectively, and D2 conditions had reemerged, affecting 0.68% of the state. Dry conditions continued into December, with all stations recording cumulative monthly precipitation below average — 3.18 inches versus a historical mean of 3.89 inches in Belchertown; 2.36 inches versus 3.57 inches in Orange; and 3.56 inches versus 3.72 inches in Barre. D0 and D1 drought conditions remained widespread through December, covering 31.67% and 27.16% of Massachusetts, with D2 conditions persisting across 2.68% of the state.

Results from snow monitoring in the Quabbin Reservoir Watershed are presented in an annual memo summarizing seasonal patterns and multi-year trends prepared by the DWSP Civil Engineering Section (DWSP 2026). The long-term annual average since 1947 is 50.1-inches. Snowfall for the 2025-2026 winter season totaled 52-inches, ranking the 35th highest snowfall since 1947.

3.1.2. Streamflow

Mean daily streamflow was recorded at six USGS gages throughout the Quabbin Reservoir and Ware River watersheds (Table 3). Three gages recorded streamflow rates (cubic feet per second; cfs) in two major tributaries and one outflow of the Quabbin Reservoir Watershed (East Branch Swift River, Hardwick [01174500]; Swift River, West Ware [1175500]; West Branch Swift River, Shutesbury [1174565]) and three recorded streamflow in the Ware River Watershed (Ware River, Barre [1172500]; Ware River, Intake Works, Barre [1173000]; Ware River, Gibbs Crossing [1173500]; Table 10).

During the early winter months of 2025 (January and February), mean monthly streamflow was approximately 50% or less than historical means across all USGS gages, consistent with below-average precipitation and associated drought conditions documented during this period (Table 10). As conditions became more saturated entering spring due to record May rainfall, streamflow responded accordingly (Figure 10). Above-average flows were recorded at nearly all sites from March through May, with May representing the annual peak mean monthly flow across all locations. Ware River sites exhibited particularly elevated spring discharge relative to historical ranges. The East Branch Swift River gage recorded a May mean of 239.06 cfs compared to a historical mean of 91.72 cfs; the Ware River at Gibbs Crossing averaged 936.55 cfs against a historical mean of 401.41 cfs; and the West Branch Swift River’s May minimum flow (17.99 cfs) substantially exceeded its historical mean monthly minimum (5.68 cfs). The Swift River at West Ware was an exception, with May flows at approximately 26% of historical mean (198.89 cfs), likely attributable to its regulated flow regime.

Streamflow began declining at all sites in early summer. June flows decreased toward historical means, marking the transition from wet spring conditions to a drier early summer period. The East Branch Swift River declined from a May mean of 239.06 cfs to 112.67 cfs in June, remaining above its historical mean of 60.31 cfs, while the West Branch Swift River decreased from 72.89 cfs to 27.68 cfs, marginally exceeding its historical mean of 18.96 cfs. Monthly means at the Ware River gages declined by more than 200 cfs at all locations. Conditions at most gages fell below historical means as summer progressed. By August and September, the East Branch Swift River and West Branch Swift River approached near-zero discharge, recording September means of 0.22 cfs and 1.80 cfs, respectively, relative to historical means of 27.75 cfs and 10.96 cfs. August and September means at the Ware River gages were approximately one-quarter to one-third of historical values. The Swift River at West Ware again departed from this pattern, with July and August minimum flows (130 cfs and 126 cfs) well above historical mean monthly minimums (28 cfs and 27 cfs).

Table 10. *Monthly mean stream discharge (calculated from daily mean discharge records; cubic feet per second [cfs]) for 2025 compared to the period of record at USGS gages in the Quabbin Reservoir and Ware River watersheds. Years with incomplete records (i.e., missing greater than 5% of measurements) were excluded from analysis.*

West Branch Swift (01174565)

Month	2025	POR
Jan	12.23	32.29
Feb	7.76	28.09
Mar	53.51	42.93
Apr	46.37	45.73
May	72.89	25.55
Jun	27.68	18.96
Jul	2.09	13.81
Aug	1.08	9.73
Sep	1.80	10.96
Oct	4.45	17.72
Nov	6.48	21.69
Dec	12.04	31.75

East Branch Swift (01174500)

Month	2025	POR
Jan	42.97	88.46
Feb	35.70	86.75
Mar	178.31	137.37
Apr	156.84	160.36
May	239.06	91.72
Jun	112.67	60.31
Jul	19.79	37.50
Aug	3.77	27.57
Sep	0.22	27.75
Oct	4.32	45.53
Nov	12.10	66.79
Dec	23.85	87.32

Swift River, West Ware (1175500)

Month	2025	POR
Jan	48.02	120.78
Feb	48.00	115.28
Mar	49.65	125.40
Apr	49.96	207.09
May	51.83	198.89
Jun	58.53	120.75
Jul	133.10	81.98
Aug	131.81	77.80
Sep	106.87	85.73
Oct	85.62	71.35
Nov	43.81	70.36
Dec	42.33	100.29

Ware River, Intake Works (01173000)

Month	2025	POR
Jan	64.01	206.75
Feb	45.34	203.66
Mar	193.47	303.85
Apr	260.87	365.62
May	499.52	206.22
Jun	193.23	127.26
Jul	44.51	87.31
Aug	17.15	68.62
Sep	10.03	68.55
Oct	20.59	114.18
Nov	44.06	160.22
Dec	56.04	217.63

Ware River, Barre (1172500)

Month	2025	POR
Jan	39.67	116.04
Feb	17.82	114.96
Mar	163.55	169.02
Apr	138.76	213.74
May	271.71	118.67
Jun	96.53	70.42
Jul	17.26	46.76
Aug	5.16	36.58
Sep	3.74	36.75
Oct	11.06	65.60
Nov	26.45	93.75
Dec	40.56	121.60

Ware River, Gibbs Crossing (1173500)

Month	2025	POR
Jan	117.27	440.95
Feb	105.22	414.59
Mar	466.19	599.71
Apr	505.66	669.10
May	936.55	401.41
Jun	359.27	261.99
Jul	109.26	191.72
Aug	46.78	154.25
Sep	31.73	159.04
Oct	44.41	235.04
Nov	87.29	312.15
Dec	147.71	445.41

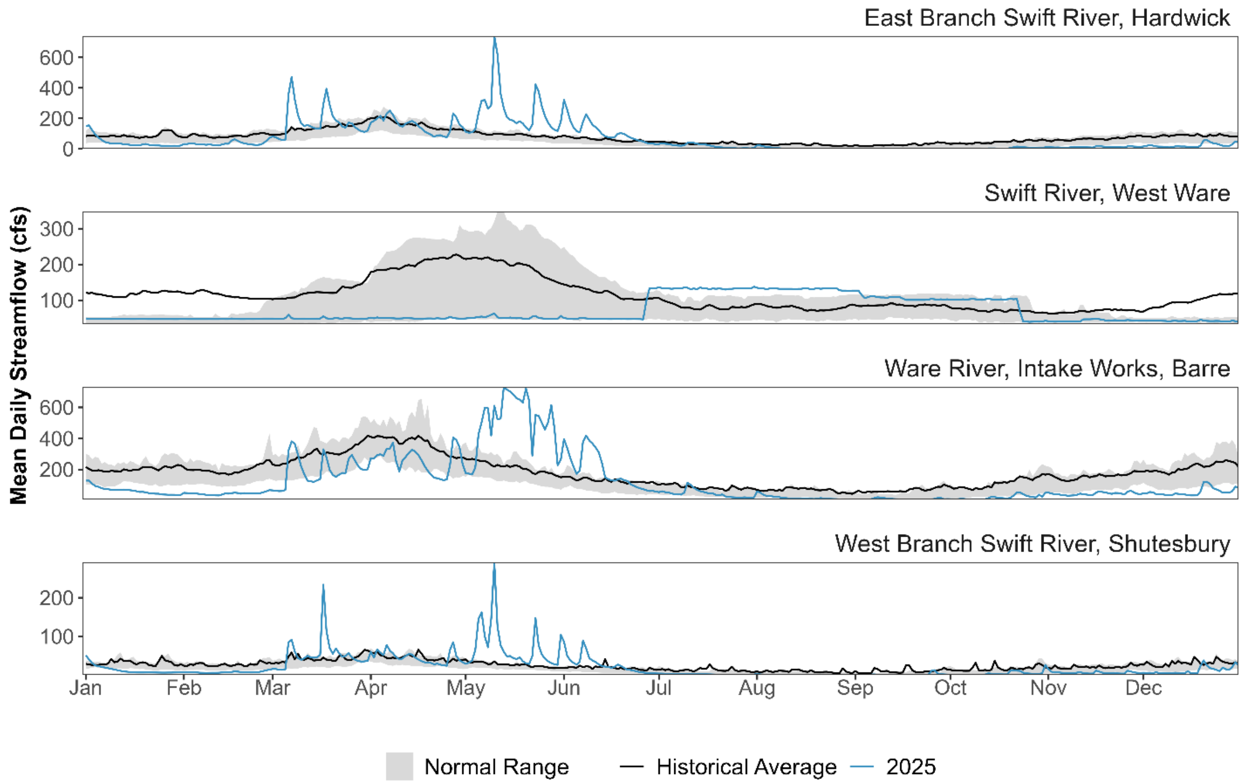


Figure 10. *Hydrographs of mean daily streamflow (cfs) at four USGS stream gages in the Quabbin Reservoir and Ware River watersheds. The mean values of all mean daily flows for the period of record are represented by the solid black line. Daily mean flows for 2025 are represented by the blue line. The gray band denotes the normal (25th to 75th percentile) flow range for the period of record.*

Below-average streamflow conditions persisted through fall. The West Branch Swift River October monthly mean (4.45 cfs) was approximately 25% of the historical mean (17.72 cfs). November mean monthly flow at the Ware River at Barre (26.45 cfs) was substantially below its historical mean of 93.75 cfs, and the East Branch Swift River showed little recovery from summer low-flow conditions. These conditions were sustained through the end of the calendar year, with streamflow remaining below historical means at all gages with the exception of the Swift River at West Ware. The Ware River at Gibbs Crossing December mean (147.71 cfs) was approximately one-third of its historical mean (445.41 cfs), and the East Branch Swift River December mean (23.85 cfs) remained well below its historical mean of 87.32 cfs. These below-average streamflow conditions persisted across the watersheds through year-end.

Mean daily streamflow in 2025 ranged widely across all monitored sites, reflecting the dramatic seasonal swings documented throughout the year. The most extreme low flows occurred at the East Branch Swift River, where mean daily discharge dropped to near zero from late August through mid-October. At the opposite end of the spectrum, the Ware River at Gibbs Crossing gage recorded some of the highest flows of the year, peaking on May 10 at 2,090 cfs. This was the highest single-day mean recorded across all gages in 2025, following 5.46 inches of rainfall over the preceding 10 days at the Belchertown weather station. The East Branch Swift River reached its own 2025 high on that same date at 740 cfs. The remaining gages peaked within days of the May 10 event, with all streams, other than the Swift River at West Ware gage, recording their highest mean daily flows of the year in response to May rainfall events.

Cumulative annual discharge was calculated from USGS daily mean streamflow records at each of the gage locations and reported in millions of gallons (MG; Figure 11). Three key sites were analyzed—the East Branch Swift River, the West Branch Swift River, and the Ware River Intake Works, Barre. Both the East and West Branch Swift Rivers are the primary tributaries contributing discharge to the Quabbin Reservoir Watershed, while the Ware River Intake Works gage marks the point where water can be diverted from the Ware River to the Quabbin Reservoir. The West Branch Swift River recorded 4,845 MG in 2025, the 11th lowest year on record. By comparison, the lowest cumulative streamflow at this site was 2,871 MG in 2002 and the highest was 10,353 MG in 2018, while the long-term mean is 5,773 MG. The East Branch Swift River has a higher sustained baseflow than the West Branch Swift and this was reflected in a cumulative annual discharge of 16,369 MG, though this value was below the site's long-term mean of 18,750 MG, and well below the 2023 high of 37,065 MG. At the Ware River Intake Works, cumulative discharge totaled 28,609 MG, ranking as the sixth lowest year on record at this gage and below the long-term mean of 40,693 MG. The site's minimum was 5,528 MG in 1987, and its maximum was 65,891 MG in 2011.

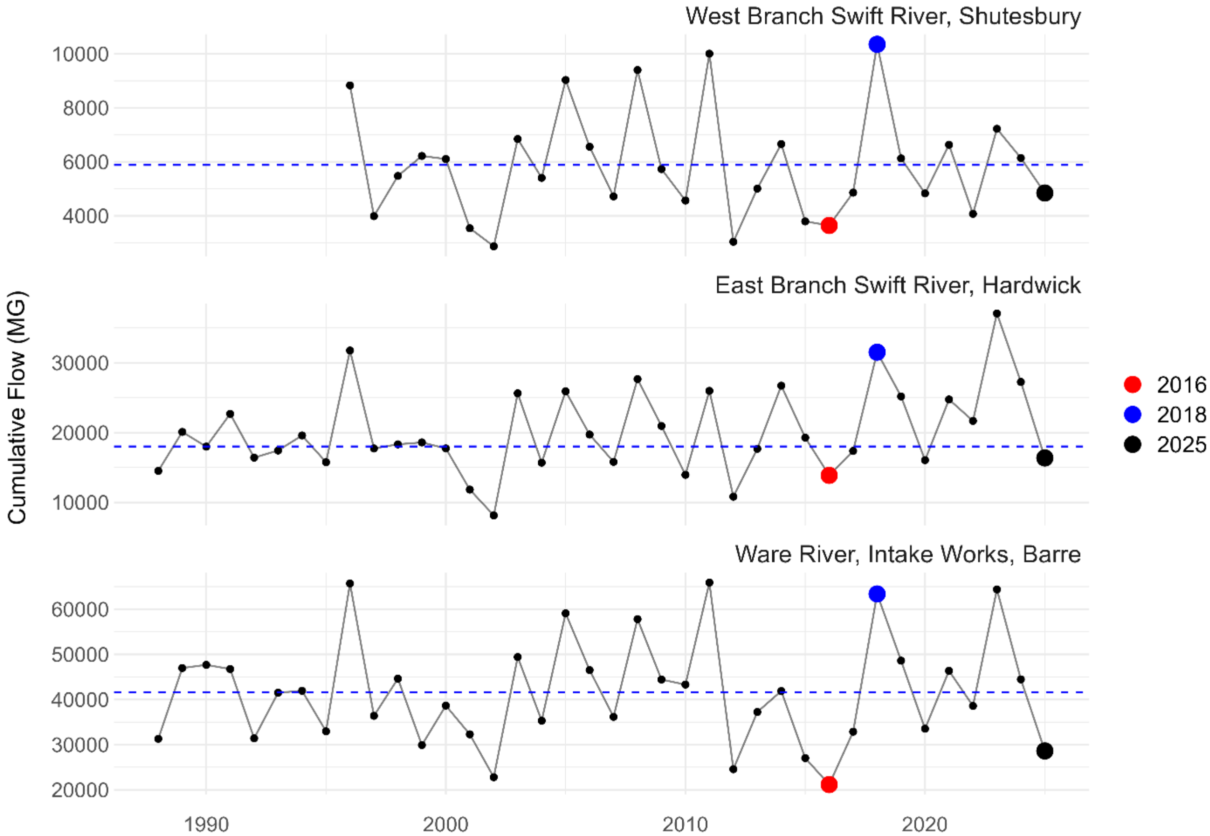


Figure 11. *Cumulative annual discharge in millions of gallons (MG) for the West Branch Swift, East Branch Swift and Ware River, Intake Works, gages. The highlighted years represent the current reporting year (black; 2025), a year of high precipitation (blue; 2018), and a drought year (red; 2016). The blue dashed line represents mean annual discharge.*

3.1.3. Groundwater

DWSP monitors records of groundwater levels from three USGS wells located on the perimeter of the Quabbin Reservoir Watershed, providing regional context for aquifer conditions that may influence watershed hydrology. Levels are reported as depth to water below land surface, where greater values indicate lower water levels. Characteristics for each well can be found in Table 11.

Groundwater levels across the watershed in 2025 were broadly consistent with the persistent precipitation deficits and below-average streamflow documented throughout the year. Winter conditions reflected the ongoing drought that occurred coming into and departing 2025, with all three wells recording deeper-than-average levels. Hardwick recorded a winter seasonal mean of 19.58 ft compared to a historical mean of 16.91 ft, and Pelham similarly fell below average at 5.24 ft versus 3.71 ft (Table 12). Petersham followed the same pattern, recording a winter mean of 14.20 ft against a historical value of 13.01 ft, consistent with the below-average streamflow and precipitation deficits observed across all monitored sites during the winter months.

Spring brought partial recovery across all three wells, coinciding with the above-average cumulative rainfall recorded at both watershed weather stations from March through May and the elevated streamflow observed at most gages. Petersham showed the strongest response, with levels rising closer to the surface than the historical mean (11.33 ft versus 12.52 ft). Hardwick and Pelham both approached their historical spring means as well (17.21 ft versus 16.35 ft and 3.16 ft versus 3.28 ft, respectively), suggesting meaningful aquifer recharge during this period despite antecedent drought conditions.

Table 11. *Groundwater well characteristics for three USGS monitoring locations in the Quabbin Reservoir Watershed.*

Site	Elevation (ft)	Well Depth (ft)	Aquifer Type	Period of Record
Hardwick (MA-HHW 1R)	583.47	35.05	Unconfined sand and gravel (glaciated regions)	1964-present
Pelham (MA-PDW 24)	939.44	25	Unconfined sand and gravel (glaciated regions)	1983-present
Petersham (MA-PHW 16)	793.79	39	Unconfined till	1984-present

Table 12. *Seasonal mean groundwater levels (ft) where the depth is equivalent to the distance below the surface. Lower numbers are closer to the surface while larger numbers are deeper underground.*

Location	Month	2025 High (ft)	2025 Mean (ft)	2025 Low (ft)	POR High (ft)	POR Mean (ft)	POR Low (ft)
Hardwick	Spring	15.66	17.21	19.51	13.79	16.35	19.51
Hardwick	Summer	16.00	17.70	19.20	15.07	17.64	19.35
Hardwick	Fall	19.22	19.63	19.85	14.66	17.90	19.85
Hardwick	Winter	19.30	19.58	19.83	14.93	16.91	19.86
Pelham	Spring	1.71	3.16	4.66	1.71	3.28	4.68
Pelham	Summer	2.19	4.38	6.21	2.04	4.68	7.50
Pelham	Fall	5.04	6.00	6.86	2.00	5.01	8.03
Pelham	Winter	4.51	5.24	5.67	1.94	3.71	6.59
Petersham	Spring	7.89	11.33	14.26	6.52	12.52	14.58
Petersham	Summer	11.78	14.09	15.61	7.56	14.28	16.16
Petersham	Fall	15.64	16.29	16.66	8.08	14.61	16.81
Petersham	Winter	13.56	14.20	16.16	8.58	13.01	16.16

Summer levels remained near historical means at Hardwick and Pelham (17.70 ft versus 17.64 ft and 4.38 ft versus 4.68 ft, respectively), reflecting the moderating influence of spring recharge even as precipitation returned to below-average totals and streamflow began declining across the watershed. Petersham diverged only slightly from its historical summer mean (14.09 ft versus 14.28 ft), indicating that recharge gains from the wet spring were largely sustained through the summer months.

Fall recorded the greatest departures from historical conditions at all three wells, mirroring the intensifying drought, persistent below-average precipitation, and steep streamflow declines documented across all monitoring stations through year-end. Hardwick recorded a fall seasonal mean of 19.63 ft compared to a historical mean of 17.90 ft, and Petersham showed the largest proportional departure at 16.29 ft versus 14.61 ft. Pelham also fell below average at 6.00 ft versus 5.01 ft, consistent with the drought conditions and declining streamflow observed across the watershed through year-end.

3.1.4. Reservoir Water Level Elevation

Quabbin Reservoir water surface level elevations remained within the normal operating range throughout 2025, though elevations approached the MWRA Below Normal operating level during several months (Figure 12). Reservoir water level elevations peaked on June 9 at 526.74 ft, reflecting above-average spring rainfall, before declining steadily through fall and into winter. October and December recorded the closest approaches to Below Normal operating level, with monthly means of 520.79 ft and 519.57 ft. The lowest reservoir elevation was recorded on December 17 at 519.42 ft. These conditions are consistent with the persistent drought, below-average precipitation, a low streamflow observed across Massachusetts throughout 2025.

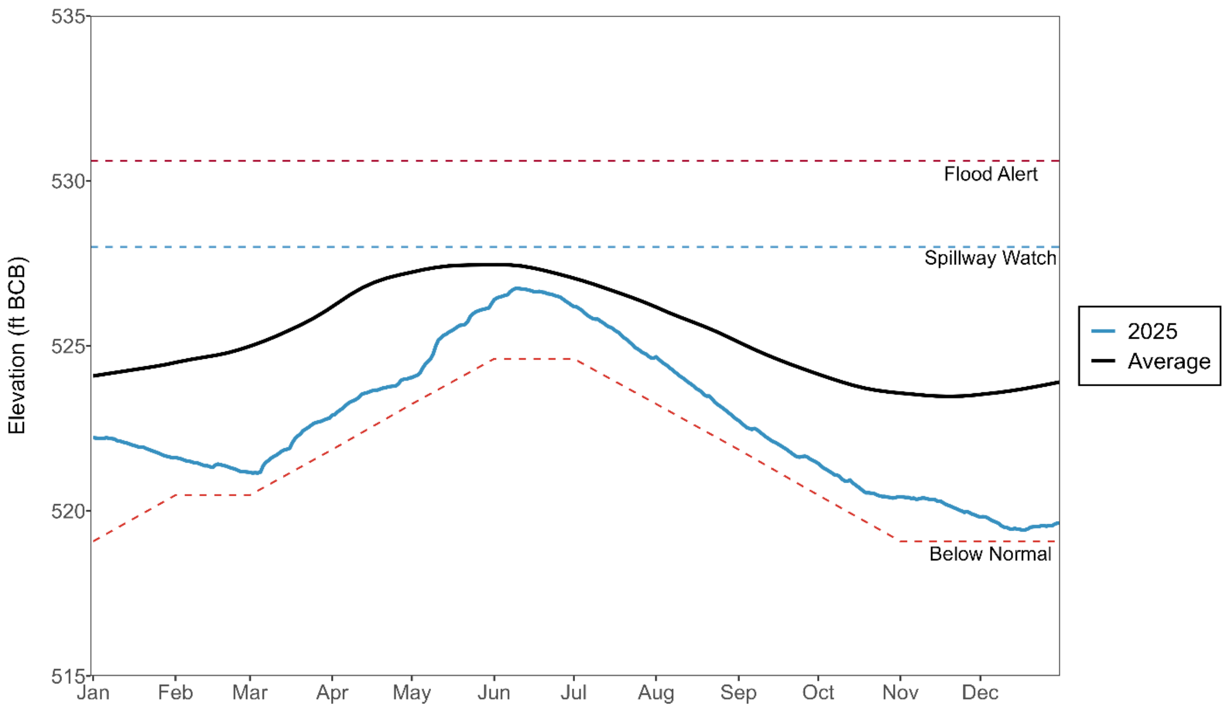


Figure 12. *Daily water level elevation of the Quabbin Reservoir from January 1 through December 31, 2025, relative to operating levels established by MWRA and the DWSP Civil Engineering Section (DWSP, 2019b). The black line is the mean daily elevation for the period of record (1980 through 2024).*

3.2. Tributary Monitoring

3.2.1. Water Temperature and Dissolved Oxygen

3.2.1.1. Water Temperature

Water temperature in Quabbin Reservoir Watershed tributaries ranged from -0.1 to 26.0°C in 2025, compared to the historical range of -0.5 to 27.0°C (Figure 13, Table 13). Two of the less frequently monitored EQA sites, 216G and 216I-X, had their highest recorded water temperature in 2025. Summer seasonal averages (mean and median) water temperatures were elevated in 2025 relative to historical seasonal averages at all sites except 216C and 216D. However, winter seasonal averages showed the opposite trend with 2025 being lower than average compared to historical averages at most sites. Boat Cove Brook (site BC) went dry in August and September in response to seasonal drought and thus was not sampled during this time. Roaring Brook (216G) was also dry and not sampled once in September. Additionally, the Barre Falls Dam site (105) was inaccessible in early 2025 due to snow and ice cover creating access issues.

MassDEP designates cold water fish habitats as rivers and streams in which mean and maximum daily temperatures over a seven-day period generally do not exceed 20°C (314 CMR 4.06). Warm water fish habitats generally exceed 20°C but may not surpass 28.3°C. Water temperature data generated by DWSP represent a discrete collection time, thus these data cannot be compared directly to cold water fish habitat criteria. Rather, comparisons to these thresholds may indicate the potential for a location to become impaired. Core sites 211, 212, and 216 in the Quabbin Reservoir Watershed represent rivers that have been identified as suitable habitat for cold water fish by MassDEP. Instantaneous water temperatures did not exceeded the 20°C threshold at site 211 in 2025, but it was exceeded on three dates in July at site 212 (20.9 °C on 7/02/2025, 21.9 °C on 7/15/2025, and 20.4 °C on 7/29/2025), and four dates at site 216 in July and August (23.5 °C on 7/02/2025, 25.3 °C on 7/15/2025, 24.8 °C on 7/29/2025, and 23.3 °C on 8/12/2025). No sites in the Quabbin Reservoir Watershed exceeded the temperature criteria for warm water fish habitat (28.3°C) in 2025.

Water temperature in Ware River Watershed Core tributaries ranged from 0.0 to 30.0°C in 2025 (Table 12). Five tributaries exceeded historical summer seasonal maximums in 2025 including three Core sites (102 – Parker's Brook, 107A – West Branch Ware River, 121 – Mill Brook) and two EQA sites (110 – Whitehall Pond Outlet, 119 – Demond Pond Outlet). All sites recorded elevated seasonal average (mean) temperatures in spring and summer relative to historical seasonal averages, corresponding with the higher-than-average air temperatures recorded in the watershed (see Table 8). The exception to this was Moulton Pond Outlet (site 121M), a new EQA site with no previous monitoring history. Mean water temperature at individual Core sites were 0.2 to 3.1°C warmer during the spring of 2025 relative to the period of record and summer mean water temperatures were 0.8 to 1.8°C warmer. These above-normal thermal conditions varied across sites and seasons, reflecting upstream catchment-specific characteristics (canopy cover, catchment scale, upstream inputs, groundwater contributions) that vary across these sampling locations and can affect stream temperature response to weather variability (Sprague, 2005; Mosley et al., 2012).

Core sites 102, 107A, and 108 in the Ware River Watershed are rivers that have been identified as suitable habitat for cold water fish by MassDEP. Instantaneous water temperatures exceeded the 20°C threshold in the summer on three dates at site 107A - West Branch Ware (21.3-25.8°C), four dates in summer site 108 – East Branch Ware in 2025 (20.3-26.1°C), and one date in summer at site 102 – Parker's Brook (20.8 °C). Three sites in the Ware River Watershed exceeded the temperature criteria for warm water fish habitat (28.3°C) in 2025: 110 – Whitehall Pond Outlet (28.4 °C, 30.0 °C), 119 – Demond Pond Outlet (28.5 °C), and 121M – Moulton Pond Outlet (28.7 °C) (Figure 13).

In addition to the routine discrete water temperature data, high-resolution continuous water temperature data were collected at five Core sites (211, 213, 215G, 216, GATE) in the Quabbin Reservoir Watershed. These data are presented in Appendix B. Quabbin Reservoir Watershed Continuous Temperature Monitoring.

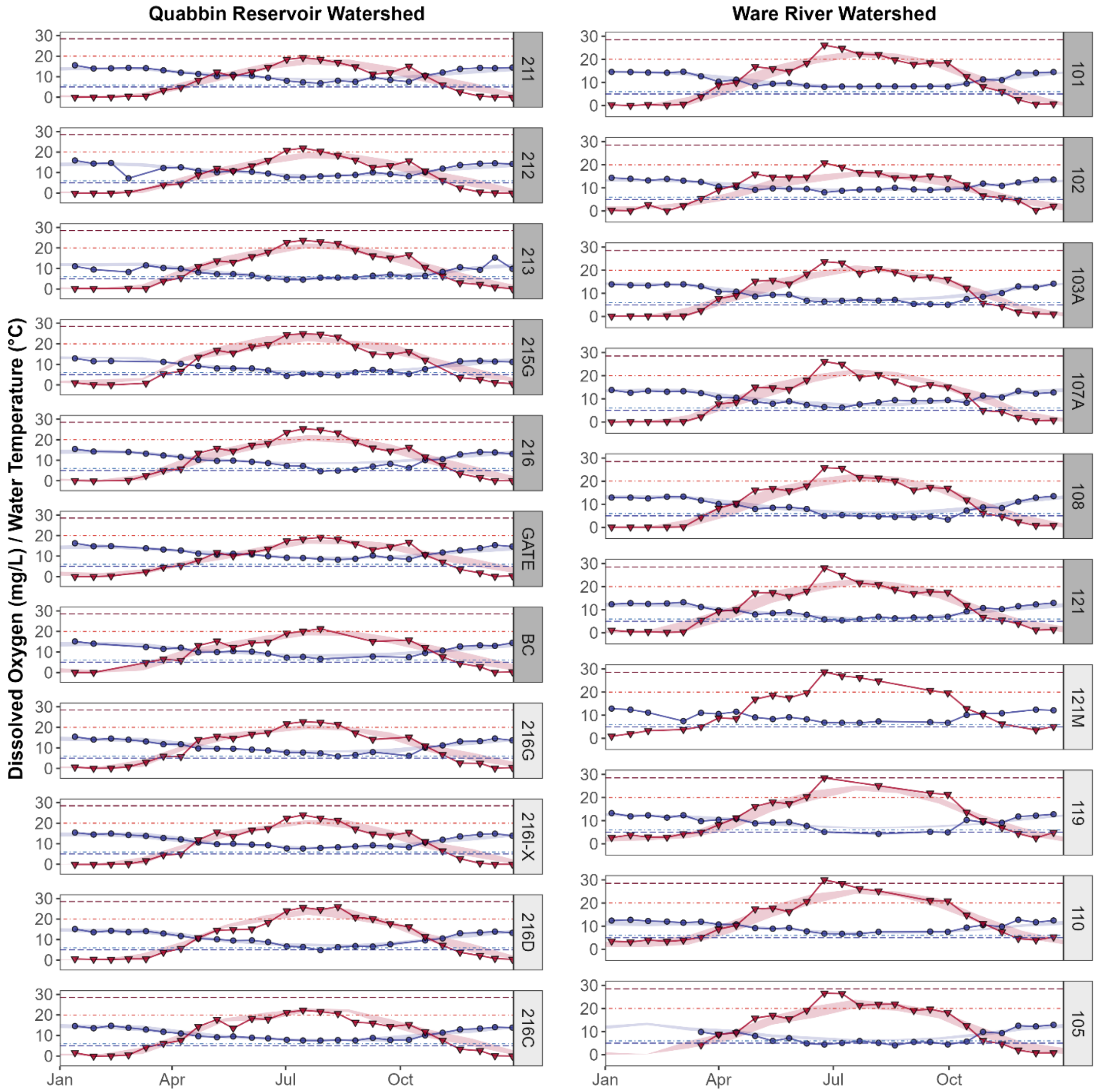


Figure 13. *Time series of water temperature (blue) and dissolved oxygen (red) measured in 2025 tributary sites. The shaded bands represent seasonal interquartile ranges (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations. The horizontal lines correspond to the lower recommended dissolved oxygen concentration for CFR (6.0 mg/L; light blue, dot-dash) and WFR (5.0 mg/L; dark blue, dashed), and the upper temperature limits for CFR (20°C; light red, dot-dash) and WFR (28.3°C; dark red, dashed) waters.*

Table 13. *Seasonal statistics for water temperature (°C) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	*Count 2025*	*Count POR*	*Min 2025*	*Min POR*	*Median 2025*	*Median POR*	*Mean 2025*	*Mean POR*	*Max 2025*	*Max POR*
211	Winter	7	265	0.0	-0.4	0.1	0.4	0.2	0.8	0.5	5.6
211	Spring	6	263	0.5	-0.1	6.5	6.0	6.5	5.8	12.2	18.2
211	Summer	7	269	12.4	9.0	16.9	16.3	16.4	16.2	19.3	21.0
211	Fall	6	261	2.6	0.0	10.9	9.0	9.6	9.0	15.1	19.1
212	Winter	7	247	-0.1	-0.4	0.0	0.1	0.1	0.7	0.5	6.0
212	Spring	5	249	4.0	-0.4	8.8	6.2	8.0	6.3	12.0	19.7
212	Summer	7	255	13.2	10.0	18.4	17.4	18.1	17.3	21.9	23.1
212	Fall	6	244	2.5	0.0	11.7	9.7	10.2	9.6	15.7	20.0
213	Winter	6	257	0.1	-0.2	0.3	0.2	0.7	0.6	2.2	9.0
213	Spring	6	257	0.2	-0.4	8.2	7.9	7.8	7.7	13.7	23.1
213	Summer	7	263	15.7	5.3	22.2	20.0	20.6	19.8	23.7	25.4
213	Fall	6	250	3.0	1.0	12.8	10.0	11.3	10.2	16.6	21.3
215G	Winter	6	35	0.0	0.0	0.8	1.8	0.9	2.0	2.7	6.0
215G	Spring	6	37	0.8	0.3	10.0	12.1	9.8	10.7	16.8	21.1
215G	Summer	7	39	18.5	14.2	23.3	21.5	22.0	21.4	24.9	27.0
215G	Fall	5	37	3.5	1.5	14.7	13.3	12.3	12.0	16.2	22.0
216	Winter	6	263	-0.1	-0.5	0.0	0.1	0.3	0.8	1.5	6.5
216	Spring	6	261	2.5	-0.5	9.6	8.9	9.5	8.1	15.8	22.5
216	Summer	7	269	17.3	8.8	23.3	20.0	21.6	19.7	25.3	25.5
216	Fall	6	255	3.4	0.3	13.0	10.6	11.5	10.5	16.2	21.7
GATE	Winter	6	187	0.0	-0.4	0.2	1.5	0.4	2.0	1.8	7.0
GATE	Spring	6	191	2.3	0.0	6.6	6.6	7.0	6.2	11.7	15.1
GATE	Summer	7	198	11.7	9.8	17.4	16.0	16.3	15.9	19.1	20.1
GATE	Fall	6	190	3.5	0.3	11.9	10.7	10.9	10.5	16.7	19.2
BC	Winter	5	186	0.0	-0.4	0.1	1.0	0.6	1.6	2.8	10.0
BC	Spring	6	195	4.8	0.0	9.4	8.4	9.6	8.2	15.3	20.1
BC	Summer	5	164	14.4	11.1	19.1	18.2	17.9	18.1	21.3	23.6
BC	Fall	5	149	4.4	0.1	12.1	10.6	11.0	10.7	15.8	20.9
216G	Winter	7	39	0.0	-0.1	0.4	0.6	0.6	1.1	2.5	3.4
216G	Spring	6	38	3.0	0.1	10.0	10.6	9.8	9.8	15.6	19.5
216G	Summer	7	43	16.6	14.9	21.4	19.2	19.9	19.1	22.7	22.2
216G	Fall	5	36	2.6	1.8	10.9	9.3	9.9	10.1	15.2	19.8
216I-X	Winter	7	37	-0.1	-0.2	0.0	0.1	0.1	0.6	0.5	3.1
216I-X	Spring	6	34	1.7	0.0	8.5	9.2	8.7	9.3	15.7	18.7
216I-X	Summer	7	43	16.6	14.0	21.4	19.6	20.2	19.2	24.0	23.8
216I-X	Fall	6	44	2.7	1.0	12.5	10.3	10.7	10.3	15.5	20.5
216D	Winter	7	31	0.3	-0.1	0.6	0.3	0.8	0.7	2.2	3.2
216D	Spring	6	32	0.6	0.2	8.3	8.7	8.4	8.5	14.8	21.2
216D	Summer	7	31	15.1	15.9	24.0	22.0	22.1	22.2	26.0	26.7
216D	Fall	6	34	3.8	2.9	13.8	12.3	12.7	12.3	20.1	23.9
216C	Winter	7	31	-0.1	-0.1	0.1	0.6	0.7	1.2	2.6	3.8
216C	Spring	6	31	4.2	0.0	10.5	10.5	10.6	10.0	17.8	20.5
216C	Summer	7	31	16.4	16.9	20.6	21.7	19.7	21.2	22.3	26.0
216C	Fall	6	34	3.3	2.8	13.1	12.0	11.4	11.9	16.0	21.9

Table 14. *Seasonal statistics for water temperature (°C) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	*Count 2025*	*Count POR*	*Min 2025*	*Min POR*	*Median 2025*	*Median POR*	*Mean 2025*	*Mean POR*	*Max 2025*	*Max POR*
101	Winter	6	222	0.0	-0.5	0.4	0.1	0.4	0.6	0.7	8.0
101	Spring	7	230	0.5	-0.5	9.9	9.0	10.1	8.7	16.8	21.3
101	Summer	6	233	18.3	11.5	22.1	21.0	22.2	21.0	26.1	27.0
101	Fall	7	235	2.5	0.8	12.5	10.8	12.0	11.1	18.5	23.9
102	Winter	6	126	0.1	0.0	0.3	1.4	0.9	1.5	2.7	8.0
102	Spring	7	130	2.2	1.0	11.2	7.4	10.5	7.4	16.0	17.5
102	Summer	6	132	14.3	10.0	16.6	15.0	17.0	15.2	20.8	20.6
102	Fall	7	132	4.5	1.0	11.3	8.0	10.3	8.7	15.1	19.0
103A	Winter	6	98	0.1	-1.4	0.2	0.2	0.5	0.7	1.1	7.0
103A	Spring	7	115	0.2	-0.4	9.1	9.0	9.2	8.6	15.7	19.6
103A	Summer	6	127	18.3	11.5	19.9	19.7	20.6	19.5	23.7	27.0
103A	Fall	7	128	1.9	0.3	12.2	9.9	10.6	9.9	17.1	21.7
107A	Winter	6	103	0.0	-0.5	0.1	0.1	0.3	0.6	0.7	7.0
107A	Spring	7	116	0.1	-0.1	8.5	8.9	8.9	8.7	15.0	22.1
107A	Summer	6	124	17.6	11.7	19.9	20.6	21.1	20.3	26.1	25.6
107A	Fall	7	127	1.9	0.4	11.5	10.1	9.8	10.1	16.1	23.0
108	Winter	6	214	0.1	-0.5	0.1	0.0	0.3	0.6	0.8	7.3
108	Spring	7	219	0.2	-0.5	10.4	8.3	10.3	8.4	16.8	22.5
108	Summer	6	227	17.9	12.2	21.4	20.7	22.0	20.4	25.8	26.3
108	Fall	7	228	2.4	0.0	11.8	10.0	10.7	10.4	17.2	23.6
121	Winter	6	140	0.2	0.0	0.8	0.7	0.8	1.0	1.4	8.0
121	Spring	7	139	0.4	0.0	10.0	10.0	10.8	9.6	17.4	24.1
121	Summer	6	150	18.0	12.0	21.2	21.0	22.0	20.5	28.1	28.0
121	Fall	7	153	4.0	1.0	11.8	10.0	11.5	10.5	17.8	22.7
121M	Winter	5	ND	0.9	ND	3.3	ND	3.0	ND	5.1	ND
121M	Spring	7	ND	3.8	ND	8.8	ND	11.3	ND	18.6	ND
121M	Summer	5	ND	19.7	ND	26.2	ND	25.3	ND	28.7	ND
121M	Fall	5	ND	6.2	ND	12.8	ND	13.9	ND	20.7	ND
119	Winter	6	105	2.5	0.0	2.9	2.0	3.3	2.3	4.9	8.0
119	Spring	7	102	4.3	1.0	11.2	9.0	11.5	9.5	18.1	23.0
119	Summer	3	87	20.3	14.6	25.1	23.0	24.6	22.5	28.5	27.5
119	Fall	6	88	4.4	2.0	11.8	11.0	13.0	10.9	21.9	22.0
110	Winter	6	128	3.2	-0.1	3.8	2.7	3.9	2.6	5.3	8.0
110	Spring	7	128	3.9	0.0	10.3	10.5	11.4	10.5	17.8	24.0
110	Summer	5	131	20.6	15.9	26.2	24.0	26.1	23.6	30.0	29.0
110	Fall	6	132	4.6	2.0	12.9	13.0	13.3	13.3	21.0	24.0
105	Winter	2	42	0.8	0.0	0.8	0.9	0.8	1.3	0.8	8.0
105	Spring	6	102	4.2	1.0	12.5	10.0	11.8	10.3	17.0	22.0
105	Summer	6	133	19.2	8.7	21.9	21.0	22.9	20.5	26.6	27.4
105	Fall	7	130	2.0	0.0	12.5	10.0	11.8	10.3	19.7	23.0

3.2.1.2. Dissolved Oxygen

Dissolved oxygen (DO) concentrations in Quabbin Reservoir Watershed tributaries ranged from 4.3 to 16.3 mg/L in 2025 (Table 15). Dissolved oxygen concentrations demonstrated a typical seasonality during 2025 and were relatively depleted during warmer months and elevated in winter and fall; DO was inversely related to water temperature (Figure 13). Despite elevated summer water temperatures across the watershed, summer average dissolved oxygen concentrations in 2025 were only slightly lower than historical seasonal averages. This lower-than-average dissolved oxygen was most pronounced in the East Branch Swift River (216, 2025 summer mean DO of 6.8 mg/L compared to 8.5 mg/L historical summer mean) and its tributary Roaring Brook (216G, 2025 summer mean of 7.6 mg/L compared to 8.3 historical summer mean). Record low seasonal dissolved oxygen concentrations were observed in 2025 at 216 (summer: 4.65 mg/L), 212 (winter: 7.23 mg/L), and 215G (summer: 4.33 mg/L, fall: 5.3 mg/L, winter: 11.17 mg/L) although the record lows at 215G may reflect the considerably shorter period of record compared to the other Quabbin Core sites (Table 15, POR n = 35-38 compared to 100+ for other Core sites).

Dissolved oxygen concentrations of Class A inland waters are a criterion used to determine the suitability of water resources for aquatic habitat. MassDEP designates cold water fish habitats as rivers and streams in which dissolved oxygen remains above 6 mg/L and warm water fish habitats as those with dissolved oxygen concentrations greater than 5 mg/L (314 CMR 4.06). Three locations in the Quabbin Reservoir Watershed are identified as cold-water fish habitats (e.g., 211, 212, 216), and in 2025 dissolved oxygen levels were detected below 6 mg/L at site 216 on three dates during the summer in 2025, two of which were also below 5 mg/L: 4.65 mg/L on 7/29/25, 4.92 on 8/12/25, and 5.45 on 8/26/25.

Dissolved oxygen concentrations in Ware River Watershed tributaries ranged from 3.4 to 14.6 mg/L in 2025 (Table 16), following typical seasonal elevated patterns in winter and fall as well as relatively depleted concentrations in the warmer months. Ware River tributary dissolved oxygen concentrations were largely within established seasonal ranges in 2025. Seasonal average dissolved oxygen concentrations in 2025 were slightly lower relative to historical averages at several sites, most pronounced during the fall. Among Core monitoring locations, fall mean DO values were 0.3 to 2.4 mg/L lower than historical fall means. These lower averages correspond to the low flows experienced in fall 2025 due to ongoing drought conditions (Section 3.1). Relevant to the class A inland water criteria of DEP fisheries habitat designations in Ware River Watershed (102, 107A, 108), dissolved oxygen concentrations were below 6 mg/L at site 108 on all eight sampling dates from 6/24/25 through 9/30/25. Dissolved oxygen concentrations remained above 6 mg/L at sites 102 and 107A for the entirety of 2025. Concentrations of dissolved oxygen fell below 5 mg/L two times at site 108 in 2025: 4.65 mg/L on 7/29/25 and 4.92 mg/L on 8/12/25.

Table 15. *Seasonal statistics for dissolved oxygen (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	*Count 2025*	*Count POR*	*Min 2025*	*Min POR*	*Median 2025*	*Median POR*	*Mean 2025*	*Mean POR*	*Max 2025*	*Max POR*
211	Winter	7	227	14.0	10.2	14.3	13.7	14.4	13.9	15.6	17.7
211	Spring	6	234	10.3	6.5	11.7	12.2	12.0	12.3	14.2	17.6
211	Summer	7	247	6.8	4.7	8.0	9.0	8.2	8.9	10.5	12.2
211	Fall	6	240	7.6	5.8	10.1	10.7	10.3	10.9	13.8	16.2
212	Winter	7	215	7.2	10.7	14.4	13.8	13.6	14.0	15.9	18.0
212	Spring	5	217	10.1	6.3	10.9	12.1	11.3	12.2	12.6	16.8
212	Summer	7	232	7.7	4.5	8.5	8.9	8.7	8.8	10.4	11.8
212	Fall	6	223	8.2	4.9	10.1	10.7	10.6	10.9	13.7	16.3
213	Winter	6	229	8.3	7.2	9.7	11.6	10.6	11.8	15.3	17.1
213	Spring	6	230	7.2	3.6	9.0	9.8	9.0	9.9	11.5	18.0
213	Summer	7	239	4.5	1.6	5.5	5.4	5.4	5.4	6.7	10.0
213	Fall	6	231	6.0	2.5	6.8	7.5	7.5	7.9	10.6	15.9
215G	Winter	6	35	11.2	11.3	11.6	12.9	11.7	13.0	12.9	14.9
215G	Spring	5	37	8.0	6.4	9.2	9.9	9.3	10.5	11.2	15.4
215G	Summer	7	38	4.3	4.6	5.5	6.5	5.9	6.5	8.0	9.3
215G	Fall	5	37	5.3	5.9	7.3	8.4	7.7	8.8	11.5	14.2
216	Winter	6	233	13.1	9.8	14.0	13.9	14.1	14.0	15.5	17.7
216	Spring	6	233	9.7	5.8	10.9	11.8	11.1	11.8	13.2	17.2
216	Summer	7	245	4.7	4.7	7.2	8.6	6.8	8.5	9.2	11.6
216	Fall	6	236	6.3	5.7	9.1	10.6	9.1	10.8	12.9	16.7
GATE	Winter	6	174	13.9	10.5	14.8	14.1	15.0	14.3	16.3	18.0
GATE	Spring	6	184	10.7	6.9	12.0	12.4	12.1	12.7	13.8	17.4
GATE	Summer	7	197	8.3	5.1	9.1	9.5	9.2	9.5	10.8	14.4
GATE	Fall	6	189	8.5	6.1	10.4	11.0	10.5	11.1	12.9	17.2
BC	Winter	5	180	13.0	10.9	14.1	13.4	14.0	13.7	15.1	17.2
BC	Spring	6	193	9.9	6.0	10.9	11.4	11.0	11.6	12.4	17.9
BC	Summer	5	163	6.6	4.6	7.6	8.5	8.2	8.4	10.2	11.5
BC	Fall	5	149	7.4	5.5	9.5	10.3	9.6	10.5	12.7	16.1
216G	Winter	7	37	13.2	12.2	14.0	13.7	14.2	14.1	15.4	17.7
216G	Spring	6	36	9.6	5.6	10.7	10.9	10.9	11.5	13.1	17.8
216G	Summer	7	42	5.9	4.6	7.7	8.6	7.6	8.3	9.1	10.8
216G	Fall	5	36	6.1	5.8	10.1	10.8	9.7	10.7	13.1	15.9
216I-X	Winter	7	35	13.9	12.2	14.6	14.2	14.6	14.4	15.4	17.0
216I-X	Spring	6	33	9.8	5.6	11.4	10.6	11.5	11.3	13.8	17.3
216I-X	Summer	7	43	7.7	4.4	8.3	8.5	8.5	8.2	9.6	10.4
216I-X	Fall	6	44	8.2	5.7	9.9	10.4	10.4	10.7	13.6	16.4
216D	Winter	7	29	13.3	12.1	13.7	14.1	13.9	14.5	15.1	17.7
216D	Spring	6	30	9.5	5.4	11.1	12.1	11.5	11.7	14.1	17.6
216D	Summer	7	30	4.9	4.0	6.7	7.6	7.1	7.5	9.6	10.0
216D	Fall	5	34	6.6	5.2	9.6	9.9	9.5	10.0	13.1	15.3
216C	Winter	7	29	13.4	10.9	13.9	14.1	14.0	14.3	14.7	16.7
216C	Spring	6	28	9.1	5.4	10.3	11.1	10.7	11.2	12.9	17.8
216C	Summer	7	30	7.5	4.6	7.8	8.3	8.0	7.9	8.9	9.6
216C	Fall	6	34	7.8	5.8	9.4	10.1	9.8	10.3	12.9	15.5

Table 16. *Seasonal statistics for dissolved oxygen (mg/L) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	41	14.1	11.9	14.4	14.6	14.3	14.5	14.5	16.1
101	Spring	7	44	8.4	7.4	10.3	11.3	10.9	11.4	14.6	16.3
101	Summer	6	42	8.1	5.1	8.2	8.2	8.3	8.2	8.5	10.9
101	Fall	7	46	8.2	7.3	9.5	10.6	10.1	10.8	14.2	14.7
102	Winter	6	112	13.2	9.1	13.7	13.2	13.7	13.2	14.4	16.6
102	Spring	7	120	9.1	6.2	10.3	11.4	10.7	11.5	13.1	15.9
102	Summer	6	124	8.1	7.7	9.3	9.2	9.2	9.2	10.0	11.0
102	Fall	7	123	9.0	7.6	9.9	11.1	10.4	11.0	12.4	15.4
103A	Winter	6	90	12.6	11.2	13.7	14.1	13.6	14.2	14.2	17.5
103A	Spring	7	110	8.6	6.6	10.7	10.8	10.8	11.2	13.9	17.3
103A	Summer	6	127	6.4	4.2	6.8	7.5	6.9	7.4	7.2	10.0
103A	Fall	7	126	5.1	4.1	7.5	10.0	7.9	10.3	13.0	17.0
107A	Winter	6	96	12.2	11.3	12.9	13.6	13.0	13.7	13.8	17.7
107A	Spring	7	115	7.9	6.7	10.5	10.6	10.3	11.0	13.3	17.7
107A	Summer	6	124	6.2	4.5	7.5	7.6	7.6	7.5	9.4	10.1
107A	Fall	7	125	8.3	6.5	9.4	10.1	10.2	10.5	13.4	17.4
108	Winter	6	196	12.5	4.9	12.9	13.0	13.0	13.1	13.5	17.7
108	Spring	7	207	7.9	4.6	9.8	10.6	10.0	10.6	13.3	17.2
108	Summer	6	220	4.5	3.5	4.9	6.5	5.4	6.5	8.0	9.3
108	Fall	7	217	3.4	4.1	7.2	8.6	6.8	9.0	11.1	15.5
121	Winter	6	127	12.3	9.4	12.6	12.3	12.6	12.2	13.0	16.2
121	Spring	7	129	7.9	6.2	9.7	9.7	9.9	9.9	13.3	13.6
121	Summer	6	143	5.4	4.1	6.2	6.5	6.4	6.6	7.8	10.1
121	Fall	7	144	6.6	6.1	9.3	8.8	8.9	8.9	11.5	14.3
121M	Winter	5	ND	11.1	ND	12.4	ND	12.2	ND	12.9	ND
121M	Spring	7	ND	7.5	ND	9.1	ND	9.6	ND	11.5	ND
121M	Summer	5	ND	6.7	ND	6.8	ND	7.2	ND	8.2	ND
121M	Fall	5	ND	6.7	ND	10.1	ND	9.1	ND	10.9	ND
119	Winter	6	94	11.3	9.4	12.3	12.3	12.3	12.3	13.3	14.8
119	Spring	7	93	8.8	7.2	9.8	10.6	10.1	10.4	12.4	13.7
119	Summer	3	81	4.3	4.0	5.1	7.1	5.7	7.1	7.7	9.0
119	Fall	6	80	5.0	6.0	9.2	8.9	8.4	9.2	11.8	12.4
110	Winter	6	117	11.7	5.4	12.3	11.2	12.2	11.1	12.7	14.4
110	Spring	7	119	8.9	6.9	10.7	10.2	10.3	10.1	11.9	13.5
110	Summer	5	124	6.7	5.1	6.8	7.4	7.1	7.3	7.7	9.0
110	Fall	6	123	7.5	5.3	9.6	8.4	9.6	8.8	12.7	13.7
105	Winter	2	40	12.3	7.1	12.6	12.5	12.6	12.2	12.9	14.2
105	Spring	6	91	6.0	6.4	8.4	9.4	8.3	9.6	9.8	14.4
105	Summer	6	124	4.1	2.6	5.0	6.6	4.9	6.6	5.9	17.6
105	Fall	7	120	4.5	5.2	5.7	8.8	7.6	9.1	12.5	14.5

3.2.2. Specific Conductance, Sodium, and Chloride

3.2.2.1. Specific Conductance

Specific conductance ranged from 22.7 to 367.8 µS/cm across Quabbin Reservoir Watershed monitoring tributaries and from 72.7 to 476.0 across monitoring tributaries in the Ware River Watershed during 2025 (Table 17, Table 18). Generally, specific conductance values were influenced by drought conditions throughout the year in both watersheds with the most elevated specific conductivity present at the beginning and end of 2025 when drought conditions were most severe (Figure 14). During the remainder of the year, specific conductivity was near normal in the Quabbin watershed, but in the Ware River Watershed specific conductivity remained elevated relative to the historical record throughout the year at most locations.

Across Quabbin Reservoir Watershed Core monitoring locations, spring mean results were the least elevated of the year with mean values 1.0 to 8.3 µS/cm above historical means. The spring mean at Boat Cove Brook (BC) was 1.2 µS/cm less than its historical mean. The relatively lower conductivity values in spring were likely due to the above average rainfall that season while all other seasons experienced below average precipitation (Section 3.1.1.2). Following the dilution of spring rainfall, specific conductivity in the streams increased during the summer to 1.6 to 37.7 µS/cm above historical means in the Quabbin Reservoir Watershed Core monitoring locations during lower stream flow conditions. As drought conditions worsened in the fall and streams were less diluted with rainfall, specific conductivity reached 6.3 to 39.2 µS/cm above historical means. However, conductivity at site 215G fell from a summer mean of 84.7 µS/cm to 79.3 µS/cm which resulted in it falling 5.4 µS/cm below the fall historical mean. As mentioned previously, the most notable season for conductivity in these streams was winter, with means 8.8 to 59.2 µS/cm above the historical mean. Three EQA locations and one Core location experienced their highest recorded specific conductivity values in winter 2025: 215G (167.8 µS/cm), 216G (367.8 µS/cm), 216D (92.1 µS/cm), and 216C (156.0 µS/cm).

Compared to the Quabbin Reservoir Watershed, specific conductance in Ware River Watershed streams is generally higher due to more development and less protected open space land. In 2025, specific conductivity was above average at all sampling locations in every season except for 121M which was sampled for the first time in 2025 and does not have historical data. Three Core locations and one EQA location in the Ware River Watershed experienced record specific conductivity values in 2025: 101 (241 µS/cm), 103A (207.9 µS/cm), 121 (461.0 µS/cm), and 105 (217.6 µS/cm). At the Core sampling locations, spring specific conductance values were 24.0 to 126.4 µS/cm above historical means. Summer conductivity values were 26.7 to 110.0 µS/cm above historical means. Fall conductivity values were 30.6 to 139.2 µS/cm above historical means. Winter conductivity values were 20.1 to 178.5 µS/cm above historical means. The most notable location in the Ware River Watershed in 2025 was 121, Mill Brook, which not only has the highest average specific conductivity values, but it also had the most elevated specific conductivity in each season.

Elevated specific conductance in surface waters in the northeast USA is attributed to legacy contributions from deicing salts via groundwater discharge to baseflow (Kelly et al., 2008). Site 121 continues to be a hot spot of specific conductance in the Ware River Watershed, representing the drainage area of a large portion of Rutland, which contains areas of high road density in residential developments. Contributions of road-salt laden runoff originating in the upstream reaches of Mill Brook (e.g., potentially sourced from several high-density residential housing developments, and runoff from Route 122 and 56 in Rutland, MA) may drive the dynamics observed in downstream reaches. The results during the drought conditions in 2025 seem to indicate elevated groundwater conductivity in the Mill River basin since it experienced the most elevated conductivity values compared to other locations. With below average rainfall, the groundwater was less diluted, which was likely the cause of the elevated specific conductivity throughout the year.

The Ware River Watershed was the focus of a special conductivity monitoring project from 2024 through the beginning of 2026. This project included additional sampling locations throughout the watershed with a special focus on the areas of highest conductivity near Rutland. A write-up of this monitoring project is presented in Appendix C. Ware River Watershed Conductivity Monitoring Project.

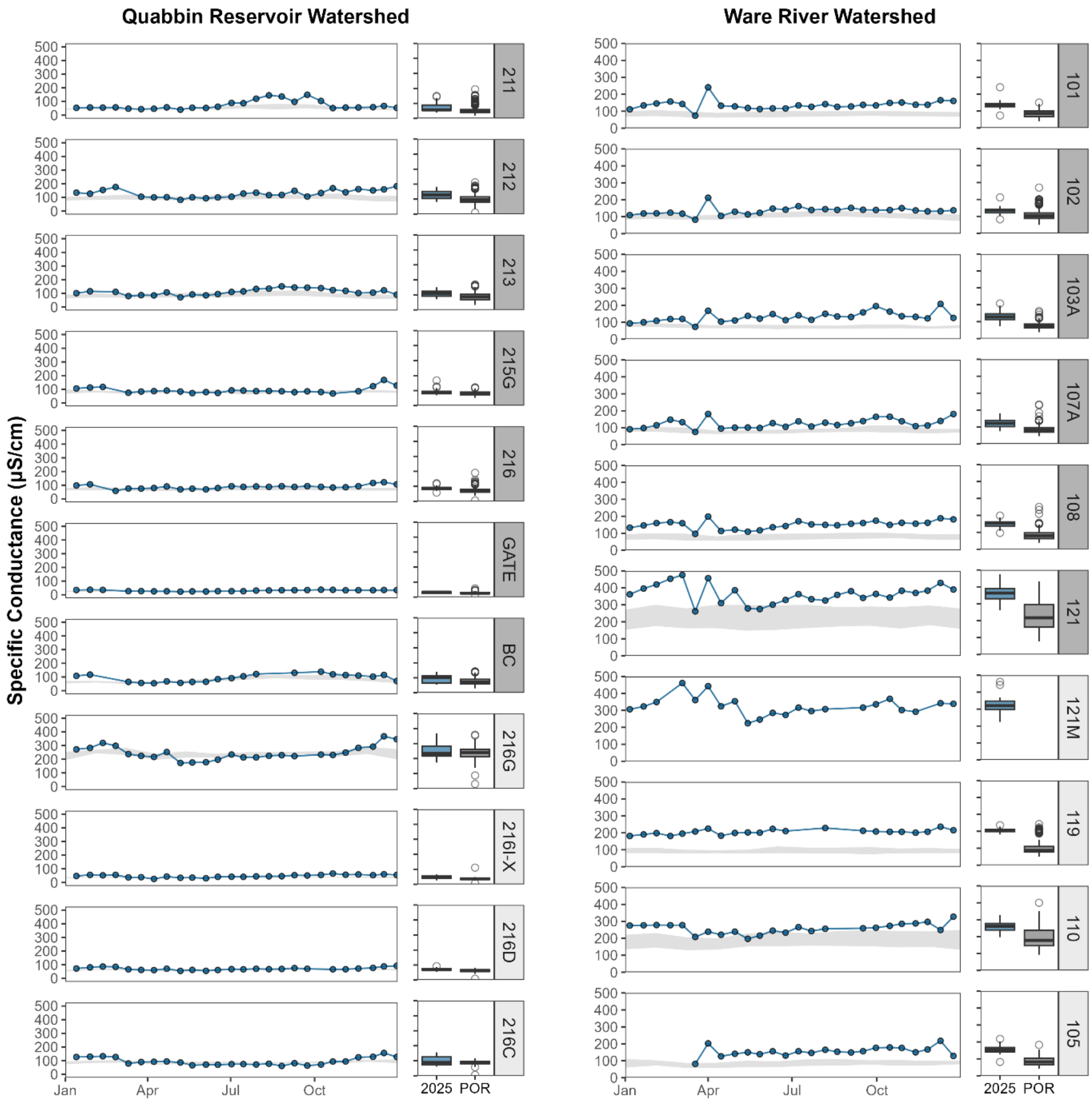


Figure 14. *Time series and boxplots of specific conductance results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 17. *Seasonal statistics for specific conductance (µS/cm) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	POR
211	Winter	7	226	53.3	17.7	56.3	43.7	57.4	45.7	67.7	194.0
211	Spring	6	227	40.1	28.0	47.2	45.0	48.4	47.1	57.2	130.0
211	Summer	7	236	52.6	25.0	89.3	57.0	99.1	61.4	145.1	156.7
211	Fall	6	224	51.6	26.7	77.1	50.0	85.9	56.3	149.4	151.7
212	Winter	7	213	127.1	10.5	154.6	92.0	154.9	95.7	181.9	212.0
212	Spring	5	213	81.8	35.0	100.7	93.1	97.8	95.6	104.9	190.0
212	Summer	7	228	93.8	52.0	116.5	102.0	113.7	102.8	134.4	170.0
212	Fall	6	213	106.4	48.0	142.9	100.0	142.1	104.3	167.2	180.0
213	Winter	6	225	90.2	42.0	107.9	80.0	107.3	79.2	121.8	135.9
213	Spring	6	224	70.8	33.0	85.7	83.0	86.8	83.3	107.1	141.2
213	Summer	7	236	85.1	42.0	114.2	97.9	117.3	96.9	151.0	168.9
213	Fall	6	222	102.2	40.0	131.1	88.2	127.9	88.7	143.0	165.7
215G	Winter	6	35	105.9	54.8	119.5	80.7	125.4	83.8	167.8	122.0
215G	Spring	6	37	71.9	57.8	83.3	79.4	81.5	80.4	90.2	115.2
215G	Summer	7	39	72.7	52.1	86.0	78.5	84.7	78.9	91.7	116.3
215G	Fall	5	37	68.9	63.0	79.3	84.4	79.3	84.8	85.3	113.9
216	Winter	6	223	58.3	5.6	106.2	70.0	100.9	73.1	121.2	190.0
216	Spring	6	225	69.1	40.0	75.3	68.0	77.2	68.9	90.2	115.2
216	Summer	7	235	69.3	38.0	87.7	72.0	85.4	73.4	92.3	144.0
216	Fall	6	219	83.0	43.0	87.4	70.0	87.9	73.1	92.9	132.7
GATE	Winter	6	186	33.1	17.0	34.9	25.5	34.9	26.0	36.5	48.5
GATE	Spring	6	190	22.7	18.1	25.1	23.0	25.1	24.1	26.5	30.0
GATE	Summer	7	198	23.7	1.7	26.1	26.0	28.1	25.8	33.0	58.0
GATE	Fall	6	186	32.6	15.0	34.0	28.1	34.4	28.1	36.8	42.0
BC	Winter	5	185	70.5	37.0	108.2	65.0	102.7	67.2	117.3	143.4
BC	Spring	6	194	53.9	30.0	60.5	60.0	60.6	61.8	68.1	100.9
BC	Summer	5	163	65.0	40.0	91.7	92.0	93.5	91.9	121.7	141.5
BC	Fall	5	145	110.8	29.9	119.4	90.0	122.8	90.4	138.8	141.1
216G	Winter	7	39	272.3	30.6	298.3	243.2	311.2	236.1	367.8	359.0
216G	Spring	6	36	172.9	87.5	220.8	229.7	213.5	232.6	252.5	353.3
216G	Summer	7	41	177.9	164.8	213.7	236.5	213.1	232.9	234.4	271.0
216G	Fall	5	30	222.6	137.6	233.9	247.6	243.9	244.8	283.4	296.2
216I-X	Winter	7	37	47.5	7.4	55.2	36.3	54.4	37.3	60.5	111.0
216I-X	Spring	6	33	26.0	25.0	36.6	32.6	35.9	33.5	43.6	46.2
216I-X	Summer	7	42	30.7	23.0	42.3	36.1	41.7	36.3	45.9	48.4
216I-X	Fall	6	39	51.2	26.0	56.1	40.3	56.8	38.4	65.7	47.0
216D	Winter	7	31	72.6	8.5	84.7	62.0	83.1	60.2	92.1	73.7
216D	Spring	6	30	55.0	46.0	62.1	63.1	62.9	62.3	71.0	81.8
216D	Summer	7	29	55.3	48.4	67.5	62.3	65.4	62.9	70.3	74.1
216D	Fall	5	29	66.5	40.9	70.3	63.6	70.3	63.2	75.4	74.5
216C	Winter	7	31	126.4	6.3	128.1	90.7	132.3	88.1	156.0	116.3
216C	Spring	6	29	66.2	57.7	88.3	84.2	84.7	84.5	94.1	112.1
216C	Summer	7	29	61.4	69.0	71.8	86.5	71.6	85.8	77.7	94.9
216C	Fall	6	29	64.0	59.8	87.5	91.6	88.2	88.8	124.4	113.5

Table 18. *Seasonal statistics for specific conductance (µS/cm) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	216	111.1	43.0	151.5	87.5	145.6	86.2	165.0	150.3
101	Spring	7	225	73.8	43.0	128.4	80.0	135.6	80.6	241.0	125.8
101	Summer	6	226	116.5	42.0	126.1	88.0	127.1	85.8	141.9	137.0
101	Fall	7	227	128.0	40.0	138.0	85.0	139.5	84.8	151.4	140.0
102	Winter	6	118	109.4	58.0	122.0	98.4	123.8	103.7	137.7	270.0
102	Spring	7	122	82.5	50.0	117.8	96.5	126.3	102.2	212.0	200.0
102	Summer	6	124	139.8	55.0	143.3	110.0	146.1	119.4	162.1	200.0
102	Fall	7	123	131.6	55.0	139.8	107.0	141.7	111.1	152.1	200.0
103A	Winter	6	98	93.1	54.0	113.6	78.3	125.6	78.9	207.9	109.4
103A	Spring	7	117	72.7	50.0	119.5	74.9	119.0	76.6	167.8	125.5
103A	Summer	6	126	112.2	38.0	137.4	70.1	133.2	74.5	149.7	162.7
103A	Fall	7	124	122.5	52.0	135.5	72.5	148.1	75.2	195.1	140.8
107A	Winter	6	102	91.2	57.0	127.4	86.2	128.7	86.6	180.7	132.5
107A	Spring	7	117	75.1	47.0	100.8	77.0	112.2	78.8	181.3	128.6
107A	Summer	6	123	105.7	46.0	121.7	82.8	120.7	83.2	137.7	141.7
107A	Fall	7	123	109.6	50.0	138.4	82.7	136.6	91.2	164.8	233.1
108	Winter	6	205	132.8	40.0	162.7	81.0	162.4	82.5	188.3	209.0
108	Spring	7	212	96.6	43.0	117.1	72.5	130.8	77.8	198.7	250.0
108	Summer	6	219	135.4	42.0	148.1	80.0	149.6	83.7	170.9	150.7
108	Fall	7	214	149.2	38.0	160.3	83.5	159.9	85.9	174.0	156.7
121	Winter	6	131	361.9	108.0	408.2	220.0	408.7	230.2	453.7	422.9
121	Spring	7	129	261.7	92.0	310.5	200.0	349.4	222.9	476.0	430.8
121	Summer	6	143	301.1	78.0	331.0	216.1	335.1	225.1	362.9	432.7
121	Fall	7	144	341.0	90.0	370.2	231.0	366.5	229.9	383.7	400.0
121M	Winter	5	ND	306.3	ND	338.4	ND	331.7	ND	349.0	ND
121M	Spring	7	ND	224.0	ND	353.7	ND	344.5	ND	461.0	ND
121M	Summer	5	ND	273.1	ND	295.5	ND	295.4	ND	316.2	ND
121M	Fall	5	ND	291.7	ND	316.3	ND	322.7	ND	367.9	ND
119	Winter	6	96	181.2	50.0	194.4	90.0	200.4	98.8	236.0	201.5
119	Spring	7	93	182.9	50.0	200.7	83.0	201.8	95.8	224.7	215.0
119	Summer	3	81	210.2	70.0	223.1	88.0	220.5	103.1	228.3	223.5
119	Fall	6	79	200.8	70.0	206.4	85.0	206.5	98.5	212.0	242.7
110	Winter	6	121	249.2	93.0	277.2	180.0	280.8	188.1	327.6	320.0
110	Spring	7	119	197.1	100.0	221.2	162.0	228.3	176.6	277.8	300.0
110	Summer	5	124	233.6	110.0	245.3	199.0	248.8	200.2	265.8	340.0
110	Fall	6	123	259.4	95.0	279.4	190.0	277.7	196.2	297.0	400.0
105	Winter	2	40	128.8	42.0	173.2	88.0	173.2	90.9	217.6	182.7
105	Spring	6	93	81.6	43.0	140.1	70.0	140.1	78.0	202.5	143.3
105	Summer	6	125	130.8	42.0	154.7	85.3	151.3	88.6	164.9	150.3
105	Fall	7	123	149.1	42.0	166.8	88.0	164.8	88.9	178.6	141.3

3.2.2.2. Sodium and Chloride

Routine monitoring for sodium (Na) and chloride (Cl) began in DWSP Core monitoring sites on Quabbin Reservoir Watershed in September 2018 and Ware River Watershed in January 2019. Concentrations of Na and Cl observed in monitoring tributaries in the Ware River Watershed ranged from 7.86 to 57.4 mg/L and from 11.6 to 111.0 mg/L, respectively, in 2025. Consistent with previous years, concentrations of these solutes in tributaries in the Quabbin Reservoir Watershed continue to be notably lower (1.63 to 48.9 mg/L for Na and 1.1 to 85.9 mg/L for Cl) relative to Ware. Timeseries patterns for these major ions are also consistent with patterns observed from specific conductance observation (Figure 15, Figure 16). Results were generally higher at the beginning and end of 2025 due to the impact of drought and reduced dilution from rainfall. Also, due to the shorter periods of record for sodium and chloride, 2025 results are not as elevated above period of record values as specific conductance, which has been slowly trending up over time.

The secondary MCL for Cl in drinking water (250 mg/L) established by the US EPA was not exceeded in any tributary samples collected in 2025 from the Quabbin Reservoir or Ware River watersheds. In 2025, the MassDEP Office of Research and Standards (ORS) guidelines for Na in drinking water (threshold of 20 mg/L Na) was exceeded at two sites in the Quabbin Reservoir Watershed—twice at 212 and all 25 samples at 216G—and in six sites in the Ware River Watershed—once at 103A, once at 105, all 24 samples at 110, 24 samples at 119, all 26 samples at 121, and all 22 samples at 121M.

The spatial heterogeneity in concentrations of Na and Cl observed in 2025 was consistent with prior monitoring. This reflects differences in land cover and watershed characteristics, such as impervious surface cover, that contribute to variable inputs of Na and Cl to individual tributaries across the two watersheds. Average annual concentrations of Na, Cl, and specific conductance are consistently greater in Core tributaries within the Ware River Watershed relative to Core monitoring sites in the Quabbin Reservoir Watershed. This may be reflective of the high ratio of protected, forested lands relative to developed lands in the Quabbin Reservoir Watershed, with comparatively more developed areas in Ware River Watershed (see Table 4). Previously documented analyses of Na, Cl, and specific conductance found approximately a 1:1 molar ratio of Na to Cl and linear relationship between Cl concentrations and specific conductance in surface waters (DWSP 2023a). This suggests that increasing concentrations of Cl, likely from road salt contributions, may be driving increasing trends in annual median specific conductance for the Core monitoring tributaries (see also Soper et al., 2021; DWSP 2024b).

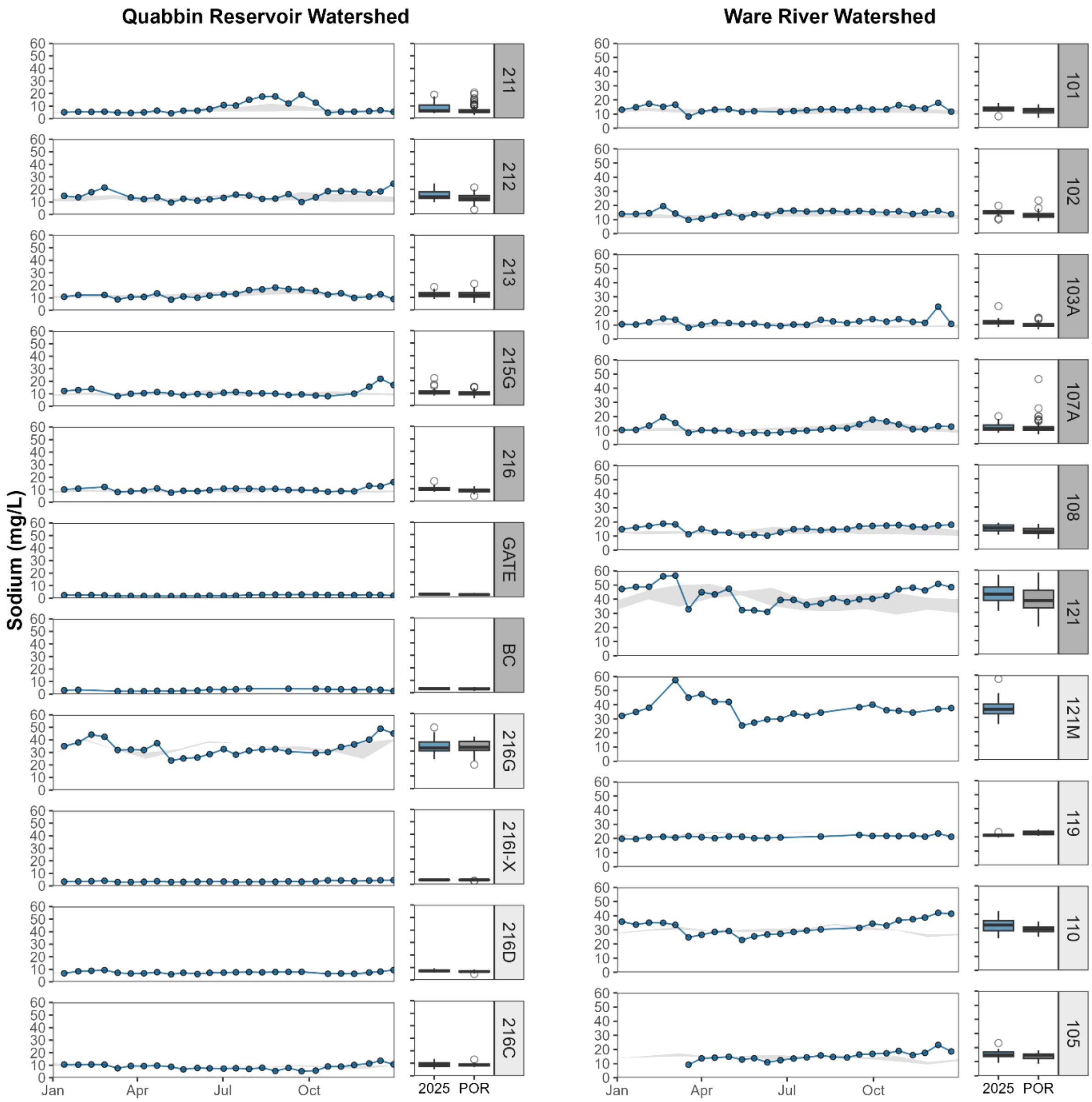


Figure 15. *Time series and boxplots of sodium results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

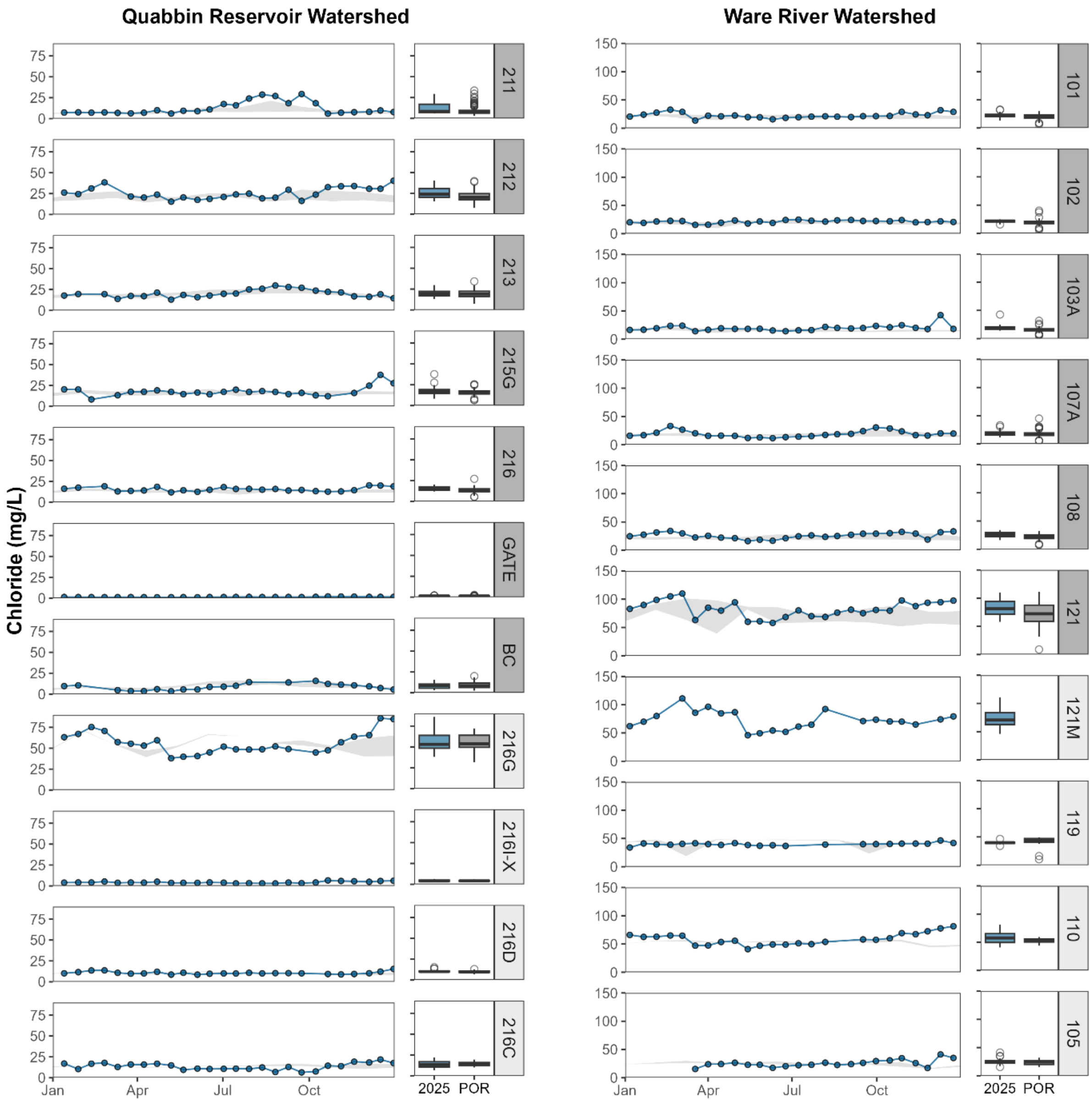


Figure 16. *Time series and boxplots of chloride results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

3.2.3. Turbidity

Turbidity ranged from 0.1 to 5.4 NTU in Quabbin Reservoir tributaries and from 0.4 to 5.4 NTU in Ware River Watershed Core tributaries during 2025 (Table 19, Table 20). Turbidity samples were not collected between March 11, 2025 and April 8, 2025 due to the closure of the MWRA Quabbin laboratory related to a building maintenance project. Turbidity results in the Quabbin Reservoir and Ware River Watershed reflected spatial and temporal variability of rainfall and subsequent runoff paired with drought conditions. (Figure 17).

Seasonal mean values were mostly below the period of record means across all sites and seasons in the Quabbin Reservoir Watershed, with values ranging from -0.37 to +0.61 in relation to period of record means. Most median values were less than 0.1 NTU different from period of record medians, with values ranging from -0.53 to +0.80 relative to period of record medians. The differences were larger in the Ware River Watershed with most seasonal mean values more than 0.2 NTU different than seasonal period of record means, ranging from -0.49 to +1.08 above period of record means. Seasonal median values were mostly above the period of record, ranging from -0.26 to 1.45 NTU above seasonal period of record medians.

No new seasonal maximum turbidity values were established in 2025 in the Ware River Watershed, and only one in the Quabbin Reservoir Watershed. Site 215G had a maximum turbidity of 2.0 NTU during winter 2025, which beat the previous winter maximum at that site of 1.3 NTU. This value tied the previous overall period of record maximum of 2.0 NTU at site 215G, though that period of record maximum occurred during the summer. Further, 2025 seasonal median values remained below 1 NTU at most Quabbin sites (less than or equal to 2 NTU at 212, BC, and 215G). Overall turbidity level remained consistent with previous monitoring records within these watersheds.

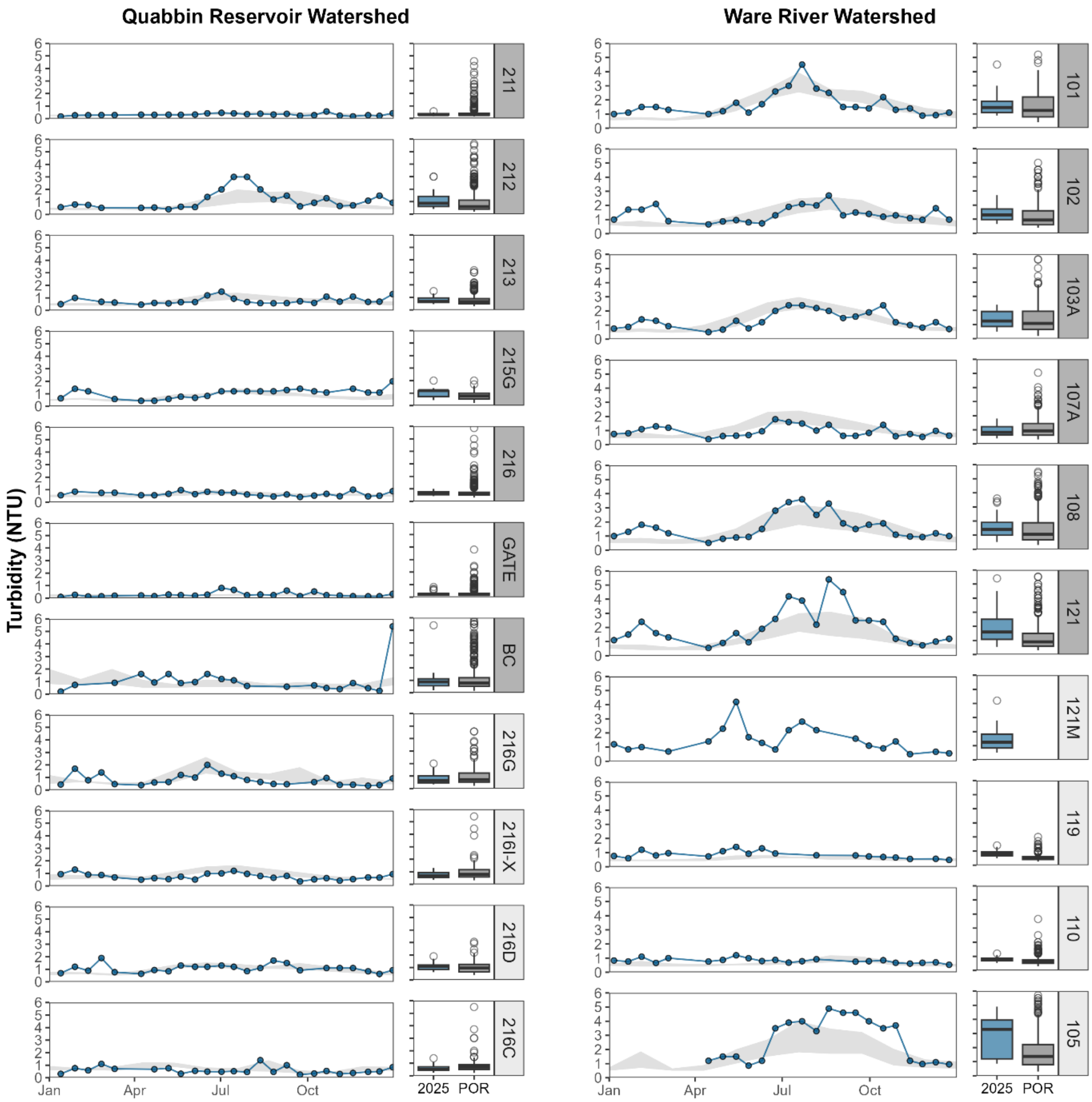


Figure 17. *Time series and boxplots of turbidity results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 19. *Seasonal statistics for turbidity (NTU) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	268	0.17	0.16	0.27	0.28	0.27	0.31	0.43	2.70
211	Spring	5	261	0.28	0.15	0.30	0.30	0.30	0.38	0.31	8.00
211	Summer	7	268	0.32	0.20	0.39	0.37	0.38	0.48	0.46	4.58
211	Fall	6	262	0.18	0.18	0.26	0.30	0.31	0.39	0.57	2.76
212	Winter	7	247	0.53	0.20	0.80	0.46	0.89	0.56	1.50	5.50
212	Spring	4	249	0.42	0.20	0.55	0.45	0.53	0.67	0.62	10.00
212	Summer	7	257	0.59	0.30	2.00	1.20	1.88	1.52	3.00	15.00
212	Fall	6	248	0.65	0.30	0.84	0.80	0.97	1.08	1.50	8.46
213	Winter	6	260	0.50	0.29	0.70	0.50	0.81	0.53	1.30	2.14
213	Spring	5	256	0.46	0.30	0.60	0.50	0.58	0.60	0.66	3.00
213	Summer	7	264	0.57	0.40	0.67	1.00	0.88	1.06	1.50	3.17
213	Fall	6	251	0.58	0.30	0.72	0.73	0.80	0.79	1.10	2.00
215G	Winter	6	36	0.64	0.21	1.15	0.59	1.24	0.63	2.00	1.30
215G	Spring	5	38	0.44	0.28	0.58	0.54	0.56	0.63	0.77	1.50
215G	Summer	7	41	0.68	0.56	1.20	1.10	1.07	1.11	1.20	2.00
215G	Fall	5	37	1.10	0.40	1.30	0.76	1.28	0.81	1.40	1.60
216	Winter	6	264	0.47	0.30	0.66	0.50	0.67	0.58	0.88	2.88
216	Spring	5	259	0.56	0.30	0.67	0.53	0.70	0.65	0.97	5.00
216	Summer	7	267	0.46	0.30	0.65	0.70	0.66	0.77	0.84	2.24
216	Fall	6	260	0.42	0.29	0.58	0.60	0.62	0.66	1.00	5.86
GATE	Winter	7	189	0.10	0.08	0.15	0.20	0.19	0.26	0.34	2.40
GATE	Spring	5	192	0.16	0.09	0.22	0.20	0.22	0.29	0.29	8.00
GATE	Summer	7	199	0.20	0.10	0.28	0.22	0.39	0.35	0.81	11.00
GATE	Fall	6	192	0.16	0.08	0.23	0.20	0.32	0.30	0.60	3.80
BC	Winter	5	189	0.20	0.18	0.47	1.00	1.41	1.30	5.40	6.85
BC	Spring	5	195	0.88	0.30	0.93	0.80	1.18	1.17	1.60	6.00
BC	Summer	5	162	0.65	0.23	1.10	0.75	1.10	1.14	1.60	23.00
BC	Fall	5	146	0.40	0.16	0.59	0.53	0.61	0.98	0.88	6.59
216G	Winter	7	41	0.34	0.30	0.78	0.66	0.85	0.80	1.70	3.70
216G	Spring	5	37	0.39	0.31	0.60	0.59	0.66	0.87	1.20	4.56
216G	Summer	7	43	0.48	0.49	0.99	1.27	1.04	1.86	2.00	20.00
216G	Fall	5	39	0.41	0.22	0.46	0.70	0.58	3.06	0.96	83.80
216I-X	Winter	7	39	0.66	0.40	0.90	0.57	0.90	0.73	1.30	4.45
216I-X	Spring	5	34	0.50	0.32	0.62	0.72	0.62	0.79	0.74	2.20
216I-X	Summer	7	44	0.51	0.72	0.96	1.30	0.87	1.32	1.20	2.33
216I-X	Fall	6	46	0.36	0.43	0.53	0.68	0.54	1.23	0.80	13.60
216D	Winter	7	31	0.63	0.41	0.89	0.65	1.01	0.72	1.90	2.44
216D	Spring	5	29	0.64	0.40	0.84	0.89	0.90	1.01	1.30	3.06
216D	Summer	7	31	0.85	0.42	1.20	1.23	1.22	1.26	1.70	2.19
216D	Fall	5	34	0.92	0.50	1.10	1.02	1.14	1.09	1.50	2.13
216C	Winter	7	31	0.31	0.40	0.59	0.71	0.65	0.82	1.10	3.72
216C	Spring	4	29	0.32	0.40	0.70	0.86	0.62	1.10	0.76	5.50
216C	Summer	7	31	0.46	0.22	0.49	0.68	0.62	1.52	1.40	16.00
216C	Fall	6	34	0.25	0.24	0.36	0.49	0.47	0.56	1.00	1.22

Table 20. *Seasonal statistics for turbidity (NTU) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	83	0.92	0.47	1.10	0.74	1.19	0.78	1.50	1.60
101	Spring	5	81	1.00	0.40	1.20	0.90	1.28	1.09	1.80	2.71
101	Summer	6	81	1.70	1.20	2.70	2.56	2.85	2.65	4.50	5.20
101	Fall	7	86	0.89	0.68	1.40	1.53	1.46	1.67	2.20	3.20
102	Winter	6	127	1.00	0.40	1.70	0.70	1.55	0.80	2.10	2.50
102	Spring	5	131	0.66	0.40	0.87	0.66	0.84	0.82	0.96	5.00
102	Summer	6	130	0.73	0.60	1.95	1.80	1.79	1.93	2.70	4.50
102	Fall	7	133	0.98	0.50	1.30	1.20	1.25	1.48	1.50	17.00
103A	Winter	6	103	0.72	0.33	1.04	0.62	1.04	0.69	1.40	2.70
103A	Spring	5	121	0.50	0.19	0.77	0.74	0.83	0.95	1.30	3.83
103A	Summer	6	125	1.20	0.83	2.10	2.32	2.03	2.44	2.40	6.63
103A	Fall	7	133	0.82	0.33	1.50	1.10	1.49	1.30	2.40	5.63
107A	Winter	6	106	0.64	0.35	0.90	0.61	0.93	0.72	1.30	2.54
107A	Spring	5	122	0.39	0.32	0.64	0.74	0.70	0.91	1.20	8.93
107A	Summer	6	122	0.95	0.82	1.45	1.70	1.38	1.87	1.80	5.05
107A	Fall	7	133	0.55	0.42	0.63	0.89	0.77	1.01	1.40	2.89
108	Winter	6	217	1.00	0.30	1.25	0.68	1.32	0.76	1.80	3.10
108	Spring	5	226	0.52	0.30	0.90	0.75	0.87	0.94	1.20	2.94
108	Summer	6	224	1.50	0.60	3.05	2.20	2.85	2.35	3.60	5.50
108	Fall	7	233	0.93	0.30	1.50	1.20	1.44	1.43	1.90	5.40
121	Winter	6	140	1.00	0.30	1.35	0.60	1.47	0.69	2.40	3.00
121	Spring	5	144	0.55	0.30	0.95	0.60	1.06	0.74	1.60	2.20
121	Summer	6	147	1.90	0.65	3.25	1.80	3.37	2.29	5.40	9.80
121	Fall	7	155	0.74	0.30	2.40	1.13	2.10	1.49	4.50	7.65
121M	Winter	5	ND	0.56	ND	0.84	ND	0.85	ND	1.20	ND
121M	Spring	5	ND	0.69	ND	1.70	ND	2.06	ND	4.20	ND
121M	Summer	5	ND	0.83	ND	2.20	ND	1.87	ND	2.80	ND
121M	Fall	5	ND	0.50	ND	1.10	ND	1.10	ND	1.60	ND
119	Winter	6	104	0.48	0.25	0.68	0.47	0.73	0.48	1.20	1.40
119	Spring	5	101	0.73	0.30	0.96	0.50	1.02	0.58	1.40	2.00
119	Summer	3	83	0.81	0.45	0.94	0.60	1.02	0.71	1.30	1.70
119	Fall	5	89	0.55	0.30	0.69	0.50	0.68	0.55	0.80	1.20
110	Winter	6	131	0.53	0.34	0.73	0.50	0.76	0.57	1.10	1.50
110	Spring	5	133	0.76	0.30	0.99	0.50	0.96	0.55	1.20	1.40
110	Summer	5	126	0.68	0.40	0.79	0.70	0.81	0.79	0.92	3.65
110	Fall	6	131	0.61	0.30	0.71	0.70	0.72	0.76	0.85	2.50
105	Winter	2	44	0.95	0.40	1.03	0.74	1.03	0.91	1.10	3.00
105	Spring	4	107	0.86	0.30	1.35	0.80	1.27	1.05	1.50	4.14
105	Summer	6	131	1.20	0.70	3.70	2.30	3.47	2.66	4.90	7.03
105	Fall	7	134	0.97	0.30	3.70	1.50	3.22	1.63	4.60	4.78

3.2.4. Total Coliform and E. coli Bacteria

Water quality monitoring of bacteria in the Quabbin Reservoir and Ware River Watershed tributary sites focused on *E. coli* and total coliform bacteria in 2025. Elevated bacteria results from Quabbin Reservoir and Ware River tributaries that exceed the upper bounds of seasonal norms (75^{th} percentiles) and cannot be attributed to a recent meteorological event are followed up with site inspection and re-sampling for *E. coli* concentrations. Historically, follow-up sampling has typically attributed elevated *E. coli* concentrations to wildlife activity, recent precipitation, and/or high flow conditions. In 2025, follow-up investigations were performed due to elevated *E. coli* levels at site 216G in the Quabbin Reservoir Watershed and at site 103A in the Ware River Watershed, where recent beaver activity and dam-building was found immediately upstream of the sample locations.

3.2.4.1. Total Coliform

Total coliform concentrations observed in tributaries in Quabbin Reservoir and Ware River Watersheds were characterized by distinct seasonality (Figure 18) consistent with stream temperatures throughout 2025 (Section 3.2.1.1). Intra-annual variability is high for observed concentrations of this parameter across DWSP monitoring sites. Total coliform in Quabbin Reservoir Watershed monitoring tributaries ranged from 134 to greater than 24,200 MPN/100 mL (Table 21) and from 31 to greater than 24,200 MPN/100 mL in monitoring tributaries in the Ware River Watershed in 2025 (Table 22). Seasonal total coliform concentrations for samples collected in 2025 were generally within seasonal normal ranges for the period of record. New record seasonal maximums were observed at several sites in 2025, varying by season (e.g., new maximums were observed at 216D in spring, 110 in summer, and 119 in fall). Overall, median seasonal total coliform concentrations in 2025 were slightly elevated at some sites in the Quabbin Reservoir Watershed and Ware River Watershed during spring and fall, but lower than the period of record medians during summer and winter (Table 21).

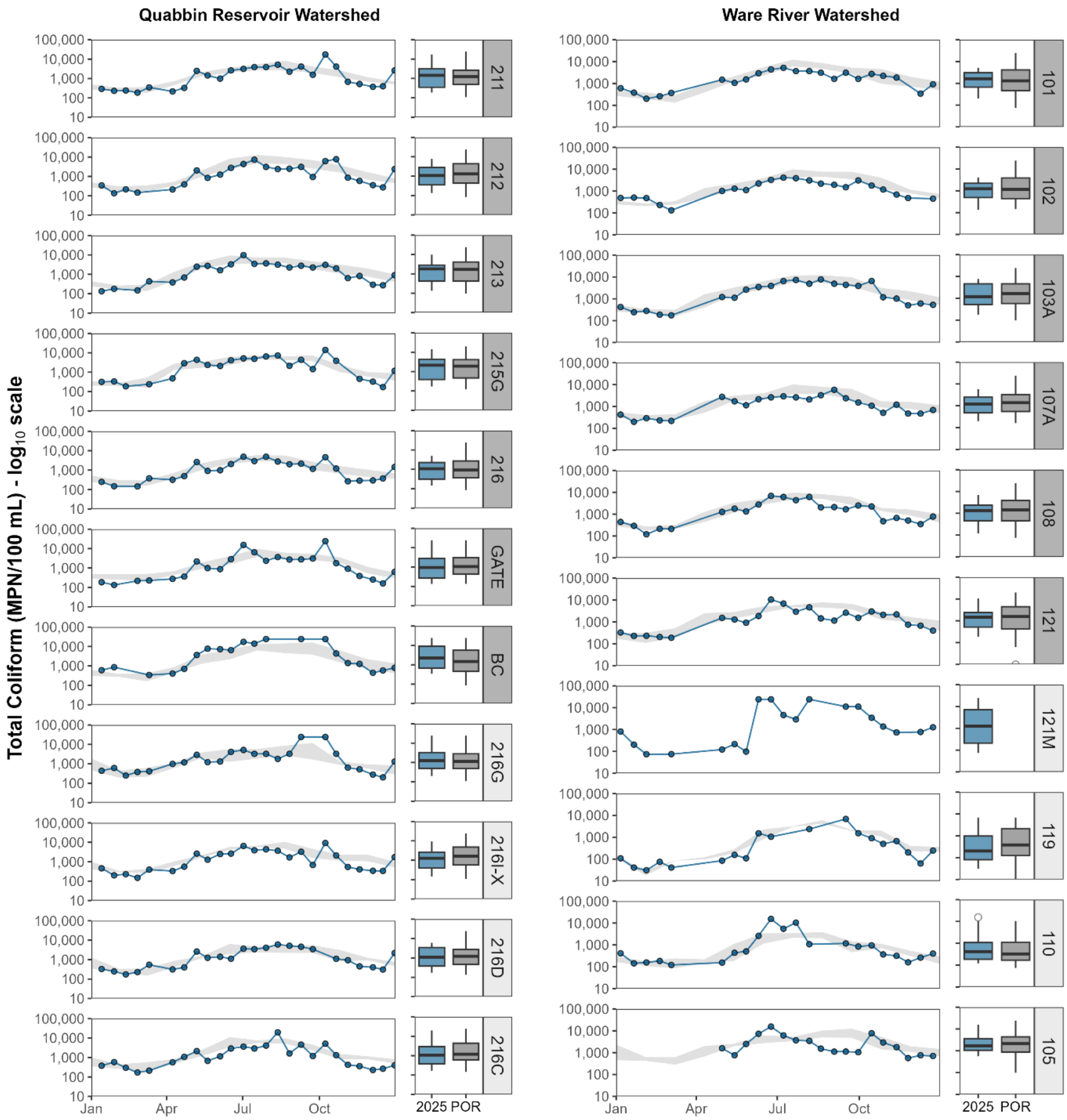


Figure 18. *Time series and boxplots of total coliform results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations. Results are plotted on a base-10 logarithmic scale.*

Table 21. *Seasonal statistics for total coliform (MPN/100mL) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	96	187	110	292	428	619	576	2610	5790
211	Spring	5	95	216	108	350	657	963	915	2480	4110
211	Summer	7	98	985	1220	3130	3450	3126	5354	5170	24200
211	Fall	6	97	521	488	2835	1520	4713	2940	17300	24200
212	Winter	7	95	135	98	272	399	550	688	2380	10500
212	Spring	4	96	213	84	613	492	872	960	2050	8660
212	Summer	7	100	1240	813	2760	5635	3366	7944	7270	24200
212	Fall	6	97	586	393	2007	2190	3215	4177	7700	24200
213	Winter	6	96	134	121	226	336	322	656	908	6870
213	Spring	5	97	384	97	683	703	1340	1972	2720	24200
213	Summer	7	100	1620	1720	3260	4880	3880	6466	9800	24200
213	Fall	6	97	638	327	2130	1860	1926	3333	3080	24200
215G	Winter	6	36	171	156	323	336	420	412	1180	1320
215G	Spring	5	38	241	122	2360	1420	2068	1760	4350	5480
215G	Summer	7	41	2100	1860	4880	4880	4594	5521	7270	17300
215G	Fall	5	37	457	504	3870	1990	4843	3078	14100	19900
216	Winter	6	96	145	86	271	348	443	597	1450	6490
216	Spring	5	95	318	95	489	512	941	875	2610	5170
216	Summer	7	98	985	759	2760	3550	2925	5556	4880	24200
216	Fall	6	97	266	285	1180	1050	1611	2110	4610	24200
GATE	Winter	6	95	134	135	202	369	264	479	631	5480
GATE	Spring	5	96	228	195	364	609	809	896	2190	7270
GATE	Summer	7	95	876	631	2850	3870	4921	5750	15500	24200
GATE	Fall	6	94	389	355	2270	2235	5519	3706	24200	24200
BC	Winter	5	95	443	122	602	397	657	787	860	8660
BC	Spring	5	98	341	86	703	710	2560	1604	7700	15500
BC	Summer	5	96	6490	1110	14100	7270	13872	9022	24200	24200
BC	Fall	5	90	1270	228	4350	2875	11084	5679	24200	24200
216G	Winter	7	30	201	134	379	469	495	1362	1310	13000
216G	Spring	5	28	414	108	1180	951	1342	1511	2910	6870
216G	Summer	7	28	1310	404	3260	3935	3166	5380	5170	24200
216G	Fall	5	28	520	341	3260	959	10564	3683	24200	24200
216I-X	Winter	7	29	148	272	336	473	490	1102	1720	7700
216I-X	Spring	5	26	331	110	554	1045	1032	1270	2610	4880
216I-X	Summer	7	30	1670	1210	3650	5790	3589	7137	6490	24200
216I-X	Fall	6	34	404	480	1388	1730	2698	3741	9210	24200
216D	Winter	7	31	173	189	309	373	554	1038	2190	8160
216D	Spring	5	28	313	135	545	660	1021	816	2610	1990
216D	Summer	7	30	1110	784	3650	3610	3559	4331	6020	14100
216D	Fall	5	34	450	546	1100	2165	2109	3921	4610	24200
216C	Winter	7	31	169	197	295	496	331	801	583	4610
216C	Spring	5	28	211	146	670	723	933	1730	2140	19900
216C	Summer	7	31	1150	1840	2910	6870	5179	8506	19900	24200
216C	Fall	6	34	359	573	1260	1345	2180	2248	5170	7270

Table 22. *Seasonal statistics for total coliform (MPN/100mL) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	84	199	84	360	386	448	610	910	3450
101	Spring	4	82	368	73	1265	841	1105	1145	1520	7700
101	Summer	6	81	2910	1300	3650	5790	3802	7291	5170	24200
101	Fall	6	88	1610	331	2035	1980	2182	3238	3080	24200
102	Winter	5	24	231	145	480	314	430	411	504	1670
102	Spring	4	27	132	181	1060	839	888	1228	1300	5790
102	Summer	6	25	2190	1470	3170	4610	3122	5377	4110	13000
102	Fall	7	28	481	435	1500	2425	1524	3947	3080	24200
103A	Winter	6	84	187	97	350	407	378	629	609	6490
103A	Spring	4	90	175	110	1160	959	1276	1365	2610	7270
103A	Summer	6	95	3450	1850	5685	6490	5610	8356	7700	24200
103A	Fall	7	98	504	404	3870	2605	3185	3893	6490	24200
107A	Winter	6	91	199	160	359	443	385	636	689	4350
107A	Spring	4	95	218	160	1430	988	1460	1506	2760	9210
107A	Summer	6	94	2100	959	2610	4230	2605	6092	3260	24200
107A	Fall	7	98	474	355	1210	1545	1852	3035	5790	24200
108	Winter	6	96	120	75	321	341	365	563	776	4610
108	Spring	4	95	211	121	1300	816	1150	1223	1790	5790
108	Summer	6	96	2050	1520	5240	5480	4715	6864	6870	24200
108	Fall	7	98	473	504	1670	1780	1452	3197	2490	24200
121	Winter	6	37	203	62	279	294	343	483	670	2490
121	Spring	4	40	187	121	1096	1030	975	1609	1520	6130
121	Summer	6	38	1440	1350	3760	4880	4697	5456	10500	19900
121	Fall	7	41	743	10	2100	1970	1900	3177	2990	14100
121M	Winter	5	ND	74	ND	771	ND	627	ND	1270	ND
121M	Spring	4	ND	75	ND	110	ND	128	ND	216	ND
121M	Summer	5	ND	2910	ND	24200	ND	16024	ND	24200	ND
121M	Fall	5	ND	738	ND	3450	ND	5592	ND	11200	ND
119	Winter	6	6	31	10	69	115	94	145	246	439
119	Spring	4	6	41	85	97	109	98	142	156	327
119	Summer	3	7	1050	563	1520	3260	1643	3056	2360	6870
119	Fall	6	7	201	187	788	588	1779	1162	6870	2480
110	Winter	6	19	144	74	224	171	261	213	414	520
110	Spring	4	19	121	74	296	189	304	458	504	3080
110	Summer	5	16	1080	233	5480	2320	7034	3230	15500	10500
110	Fall	6	13	160	269	607	538	637	829	1170	2680
105	Winter	2	16	703	298	729	608	729	1029	754	2990
105	Spring	3	19	754	98	1580	1540	1605	1727	2480	7700
105	Summer	6	20	1520	1610	4890	4480	6253	6162	15500	24200
105	Fall	7	20	563	399	1120	2820	2318	5251	7700	24200

3.2.4.2. *E. coli*

E. coli concentrations ranged from less than 10 to 906 MPN/100 mL in Quabbin Reservoir Watershed tributaries (Table 23) and from less than 10 to 341 MPN/100 mL in the Ware River Watershed tributaries in 2025 (Table 24). Across all sites, seasonal median 2025 results were largely within normal historical ranges (Figure 19). The main exception to this is Boat Cove Brook which experienced elevated summer and fall median *E. coli*. Thus, *E. coli* concentrations in Core tributaries in 2025 continued to demonstrate an overall high sanitary quality.

Of the 475 samples collected from tributaries in Quabbin Reservoir and Ware River Watershed tributaries and analyzed for *E. coli* in 2025, approximately 28% (n = 135) were below detection limits (less than 10 MPN/100 mL). Nine samples (2% of samples) exceeded the Class A statistical threshold value of 410 CFU/100 mL, which is not to be exceeded by more than 10% of samples in any 90 day or shorter period. This standard applies to surface waters designated for primary contact recreation and are not applicable for DWSP water supply waters and are used as a point of comparison only. Of this subset greater than 410 MPN/100 mL, four were collected on the same day (10/8/2025) in the Quabbin Reservoir Watershed during a rain event after nearly two weeks without precipitation. In fact, all results above 410 MPN/100 mL were collected either during rain events or the day after a rain event with the only exception being one Boat Cove Brook sample result of 613 MPN/100 mL on 11/4/2025. This sample was collected during extreme low flows and is likely wildlife-related as the next sample on 11/18/2025 was below the detection limit.

The maximum *E. coli* result (906 MPN/100mL) observed in 2025 occurred on 10/21/2025. This sample was collected at site 212 on Hop Brook in the Quabbin Reservoir Watershed one day after nearly an inch of rain, with rain continuing during sampling. The subsequent result on 11/4/2025 was low at 20 MPN/100 mL, and results were not elevated for the rest of 2025 at site 212.

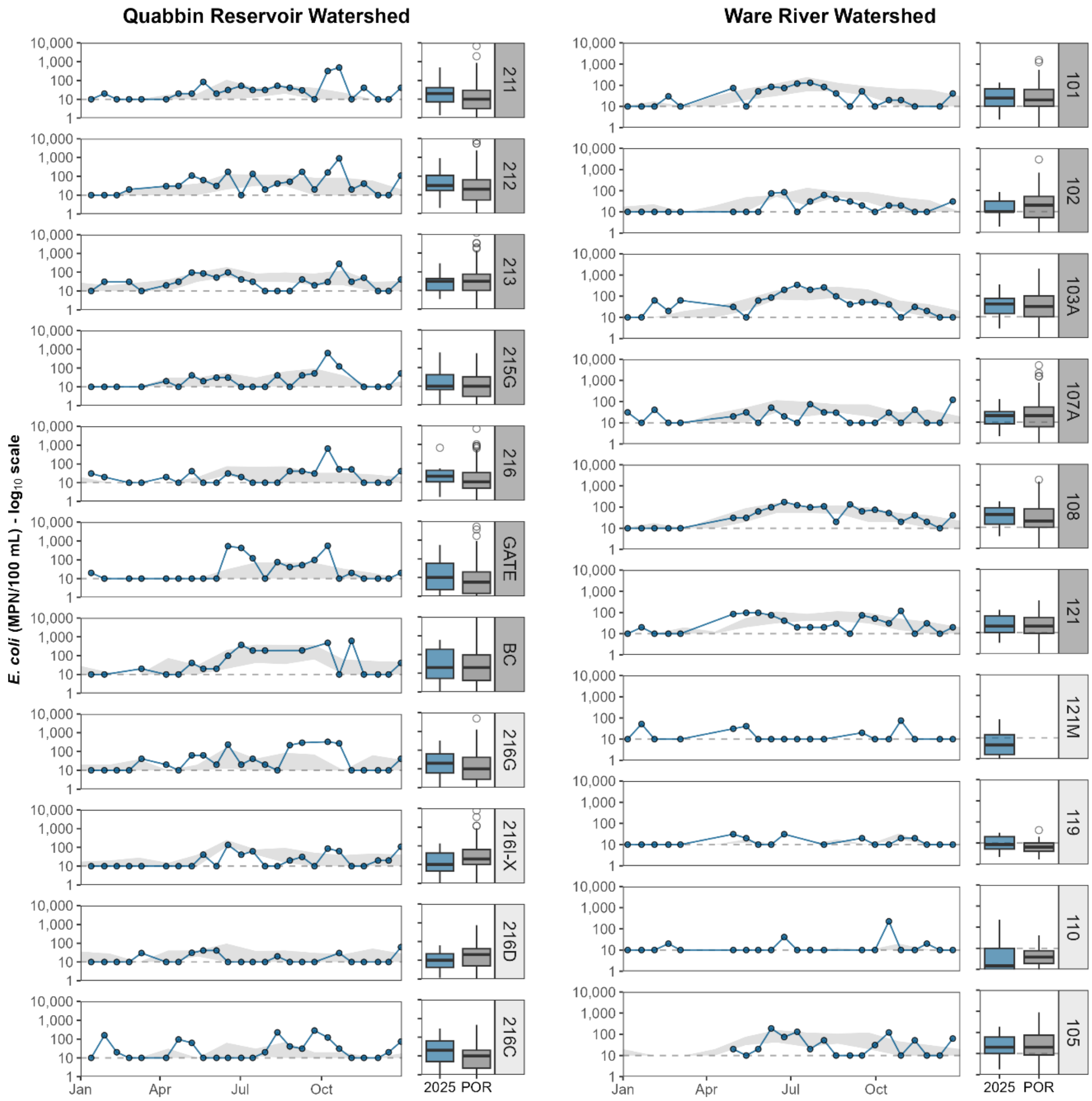


Figure 19. *Time series and boxplots of* E. coli *results (blue) from tributary monitoring sites during 2025 compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. The horizontal dashed grey and red lines correspond to laboratory detection limits (10 MPN/100 mL). Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 23. *Seasonal statistics for* E. coli *(MPN/100ml) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	127	10	10	5	3	13	13	41	723
211	Spring	5	119	10	10	20	7	27	15	84	156
211	Summer	7	126	20	10	31	31	37	140	52	6870
211	Fall	6	123	10	10	36	10	148	33	488	644
212	Winter	7	125	10	10	5	5	23	17	110	512
212	Spring	4	120	30	10	47	10	59	30	110	481
212	Summer	7	128	10	10	41	74	66	307	173	7700
212	Fall	6	123	20	10	101	31	220	94	906	2360
213	Winter	6	127	10	10	21	10	21	35	41	1090
213	Spring	5	121	10	10	31	30	49	47	96	426
213	Summer	7	129	10	10	31	63	36	445	97	24200
213	Fall	6	123	20	10	36	31	76	120	282	3260
215G	Winter	6	36	10	10	8	3	15	14	52	120
215G	Spring	5	38	10	10	20	7	19	13	41	63
215G	Summer	7	41	10	10	10	20	19	58	41	573
215G	Fall	5	37	10	10	52	10	171	45	631	546
216	Winter	6	127	10	10	13	10	18	17	41	292
216	Spring	5	119	10	10	10	10	17	15	41	187
216	Summer	7	126	10	10	10	41	18	85	41	1010
216	Fall	6	122	10	10	46	20	140	94	657	6870
GATE	Winter	6	124	10	10	8	1	11	15	20	537
GATE	Spring	5	120	10	10	5	1	6	17	10	529
GATE	Summer	7	122	10	10	75	20	172	92	529	3650
GATE	Fall	6	120	10	10	36	10	123	94	556	5170
BC	Winter	5	125	10	10	5	7	13	35	41	990
BC	Spring	5	122	10	10	20	10	18	38	41	697
BC	Summer	5	123	20	10	187	110	173	625	373	19900
BC	Fall	5	108	10	10	189	31	260	223	613	3870
216G	Winter	7	40	10	10	5	10	10	30	41	272
216G	Spring	5	36	10	10	41	7	38	28	63	473
216G	Summer	7	42	10	10	20	31	79	81	233	1260
216G	Fall	5	39	10	10	272	10	181	191	328	4880
216I-X	Winter	7	39	10	10	10	10	25	43	109	393
216I-X	Spring	5	34	10	10	5	10	13	24	41	233
216I-X	Summer	7	44	10	10	20	75	40	190	135	3450
216I-X	Fall	6	46	10	10	21	20	33	258	86	7700
216D	Winter	7	31	10	10	5	20	14	37	62	265
216D	Spring	5	28	10	10	30	20	24	62	41	754
216D	Summer	7	30	10	10	10	10	14	49	41	384
216D	Fall	5	34	10	10	10	15	12	60	30	554
216C	Winter	7	31	10	10	20	4	41	18	160	155
216C	Spring	5	28	10	10	10	3	37	21	96	272
216C	Summer	7	31	10	10	10	20	44	53	228	457
216C	Fall	6	34	10	10	31	10	80	20	285	355

Table 24. *Seasonal statistics for* E. coli *(MPN/100mL) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	84	10	10	10	10	17	16	41	146
101	Spring	4	82	10	10	29	20	34	30	74	228
101	Summer	6	81	41	10	85	85	89	135	132	1220
101	Fall	6	88	10	10	15	31	19	69	52	1550
102	Winter	5	24	10	10	10	7	12	17	31	110
102	Spring	4	27	10	10	8	6	8	26	10	256
102	Summer	6	25	10	10	52	63	51	102	85	697
102	Fall	7	28	10	10	20	20	17	163	31	2910
103A	Winter	6	103	10	10	10	10	19	13	63	197
103A	Spring	4	115	10	10	47	20	42	36	63	228
103A	Summer	6	119	86	10	200	122	197	201	341	1720
103A	Fall	7	128	10	10	41	41	35	98	52	1940
107A	Winter	6	106	10	10	21	6	36	13	122	96
107A	Spring	4	118	10	10	13	10	15	31	31	488
107A	Summer	6	116	10	10	31	52	36	103	75	1400
107A	Fall	7	128	10	10	10	20	15	113	41	4880
108	Winter	6	122	10	10	10	10	14	14	41	107
108	Spring	4	123	10	10	31	10	34	34	62	355
108	Summer	6	120	20	10	103	86	103	135	173	1780
108	Fall	7	128	20	10	52	31	58	75	134	1400
121	Winter	6	45	10	10	10	4	12	12	20	148
121	Spring	4	50	10	10	91	20	72	36	97	256
121	Summer	6	50	20	10	25	58	34	89	75	336
121	Fall	7	55	10	10	31	30	46	59	119	282
121M	Winter	5	ND	10	ND	5	ND	15	ND	52	ND
121M	Spring	4	ND	10	ND	18	ND	21	ND	41	ND
121M	Summer	5	ND	10	ND	5	ND	6	ND	10	ND
121M	Fall	5	ND	10	ND	5	ND	22	ND	75	ND
119	Winter	6	6	10	10	5	5	5	6	10	10
119	Spring	4	6	10	10	13	5	15	8	31	20
119	Summer	3	7	10	10	10	10	17	10	31	20
119	Fall	6	7	10	10	15	10	13	13	20	41
110	Winter	6	27	10	10	5	5	8	6	20	10
110	Spring	4	29	10	10	5	5	6	7	10	41
110	Summer	5	28	10	10	5	5	12	9	41	31
110	Fall	6	27	10	10	10	5	46	8	226	41
105	Winter	2	23	10	10	37	10	37	13	63	52
105	Spring	3	29	10	10	20	20	15	46	20	521
105	Summer	6	32	10	10	63	80	79	109	189	627
105	Fall	7	34	10	10	10	25	33	78	122	884

The annual geometric mean *E. coli* concentration remained below 126 MPN/100 mL for all Core monitoring sites in 2025 (Figure 20, Table 25, Table 26). Annual geometric mean results from 2025 were within established historical ranges. Temporal variability in annual geometric mean *E. coli* concentrations exhibited a non-uniform response to climate extremes (e.g., drought in 2016, 2020, and 2024; extreme precipitation in summer 2021 and 2023). This contrast may reflect the timing of sample collection relative to precipitation events throughout the period of record, differences in the degree to which the two watersheds may have been impacted by saturation excess overland flow, or variations in factors controlling the sources of *E. coli* to the watersheds.

Overall, long-term records of annual geometric mean *E. coli* results do not exhibit unidirectional trends in the monitoring sites sampled in 2025. Boat Cove Brook, in the Quabbin Reservoir Watershed, has demonstrated a recent upward trend in annual *E. coli* concentrations from 2022 until 2024, but the geometric mean was lower in 2025 than recent years. Annual geometric mean *E. coli* results for 2025 compared to previous sampling years indicate a lack of persistent bacterial issues at these sites.

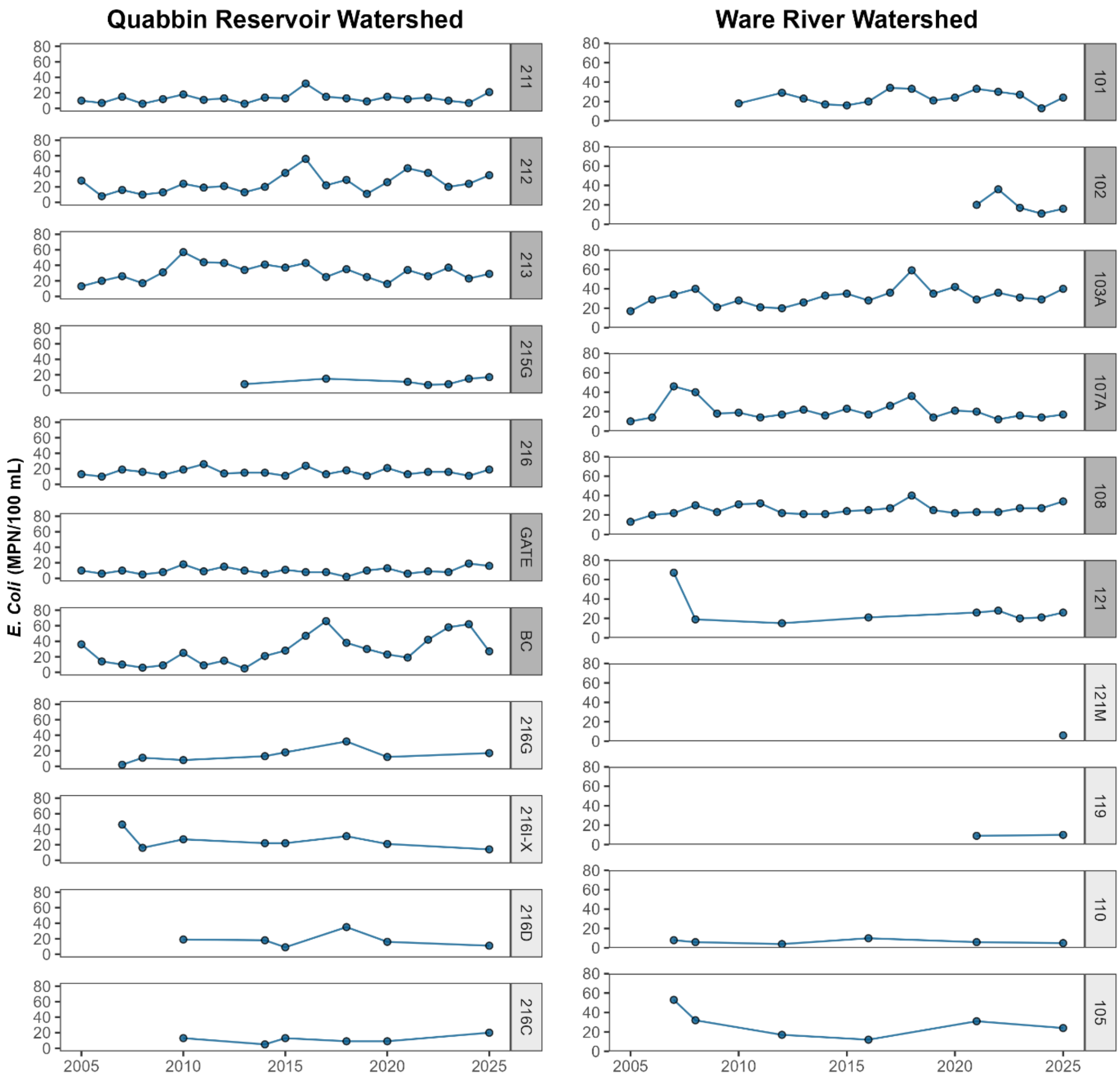


Figure 20. *Time series of annual geometric mean* E. coli *in tributary sites from 2010 to 2025. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 25. *Annual geometric mean* E. coli *(MPN/100mL) for Quabbin Reservoir Watershed tributary sites from historical sampling period of record.*

Year	211	212	213	215G	216	GATE	BC	216G	216I-X	216D	216C
2005	10	28	13	ND	13	10	36	ND	ND	ND	ND
2006	7	8	20	ND	10	6	14	ND	ND	ND	ND
2007	15	16	26	ND	19	10	10	2	46	ND	ND
2008	6	10	17	ND	16	5	6	11	16	ND	ND
2009	12	13	31	ND	12	8	9	ND	ND	ND	ND
2010	18	24	57	ND	19	18	25	8	27	19	13
2011	11	19	44	ND	26	9	9	ND	ND	ND	ND
2012	13	21	43	ND	14	15	15	ND	ND	ND	ND
2013	6	13	34	8	15	10	5	ND	ND	ND	ND
2014	14	20	41	ND	15	6	21	13	22	18	5
2015	13	38	37	ND	11	11	28	18	22	9	13
2016	32	56	43	ND	24	8	47	ND	ND	ND	ND
2017	15	22	25	15	13	8	66	ND	ND	ND	ND
2018	13	29	35	ND	18	2	38	32	31	35	9
2019	9	11	25	ND	11	10	30	ND	ND	ND	ND
2020	15	26	16	ND	21	13	23	12	21	16	9
2021	12	44	34	11	13	6	19	ND	ND	ND	ND
2022	14	38	26	7	16	9	42	ND	ND	ND	ND
2023	10	20	37	8	16	8	58	ND	ND	ND	ND
2024	7	24	23	15	11	19	62	ND	ND	ND	ND
2025	21	35	29	17	19	16	27	17	14	11	20

ND – No Data

Table 26. *Annual geometric mean* E. coli *(MPN/100mL) for Ware River Watershed tributary sites from historical sampling period of record.*

Year	101	102	103A	107A	108	121	121M	119	110	105
2005	ND	ND	17	10	13	ND	ND	ND	ND	ND
2006	ND	ND	29	14	20	ND	ND	ND	ND	ND
2007	ND	ND	34	46	22	67	ND	ND	8	53
2008	ND	ND	40	40	30	19	ND	ND	6	32
2009	ND	ND	21	18	23	ND	ND	ND	ND	ND
2010	18	ND	28	19	31	ND	ND	ND	ND	ND
2011	ND	ND	21	14	32	ND	ND	ND	ND	ND
2012	29	ND	20	17	22	15	ND	ND	4	17
2013	23	ND	26	22	21	ND	ND	ND	ND	ND
2014	17	ND	33	16	21	ND	ND	ND	ND	ND
2015	16	ND	35	23	24	ND	ND	ND	ND	ND
2016	20	ND	28	17	25	21	ND	ND	10	12
2017	34	ND	36	26	27	ND	ND	ND	ND	ND
2018	33	ND	59	36	40	ND	ND	ND	ND	ND
2019	21	ND	35	14	25	ND	ND	ND	ND	ND
2020	24	ND	42	21	22	ND	ND	ND	ND	ND
2021	33	20	29	20	23	26	ND	9	6	31
2022	30	36	36	12	23	28	ND	ND	ND	ND
2023	27	17	31	16	27	20	ND	ND	ND	ND
2024	13	11	29	14	27	21	ND	ND	ND	ND
2025	24	16	40	17	34	26	6	10	5	24

ND – No Data

3.2.5. Nutrients

DWSP monitored concentrations of nitrogen and phosphorus at tributary monitoring locations in the Quabbin Reservoir and Ware River Watersheds. Samples were analyzed for concentrations of nitrogen species (ammonia-nitrogen, nitrate-nitrogen, and total Kjeldahl nitrogen) and total phosphorus in 2025. Information on changes in analytical methods during the period of record are detailed in Section 2.2. Inference into seasonal patterns and site-specific variations in contributions of N-species is more limited at numerous Ware River sites due to variations in sampling frequency (quarterly versus biweekly, Figure 5). For example, the majority of historical nutrient sampling at site 101 was collected quarterly, affecting the timescale of comparison and limiting observations of water quality patterns relative to parameters more consistently monitored at finer temporal intervals (e.g., turbidity, bacteria analyses). In 2025, biweekly nutrient sampling was completed at all Quabbin Reservoir Watershed tributary sites and at Ware

River downstream of Shaft 8 Intake (site 101). The remaining Ware River Watershed monitoring locations were sampled on a quarterly basis.

3.2.5.1. Total Nitrogen

Organic nitrogen (TKN and NH_3-N) was the most abundant nitrogen form in tributaries in either watershed in 2025 (Figure 21). Dominance of organic nitrogen in headwater streams in the US has been documented previously (Scott et al., 2007). Streams in both Quabbin Reservoir and Ware River Watersheds exhibited a clear ramp up of nitrogen export in the late spring and summer months coincident to increased biological activity and plant growth. Among streams monitored in Quabbin Reservoir Watershed, organic nitrogen was higher and more consistently high in streams with a higher proportion of upstream wetland area (e.g., 215G, 216, and 213 compared to other sites, see Table 4).

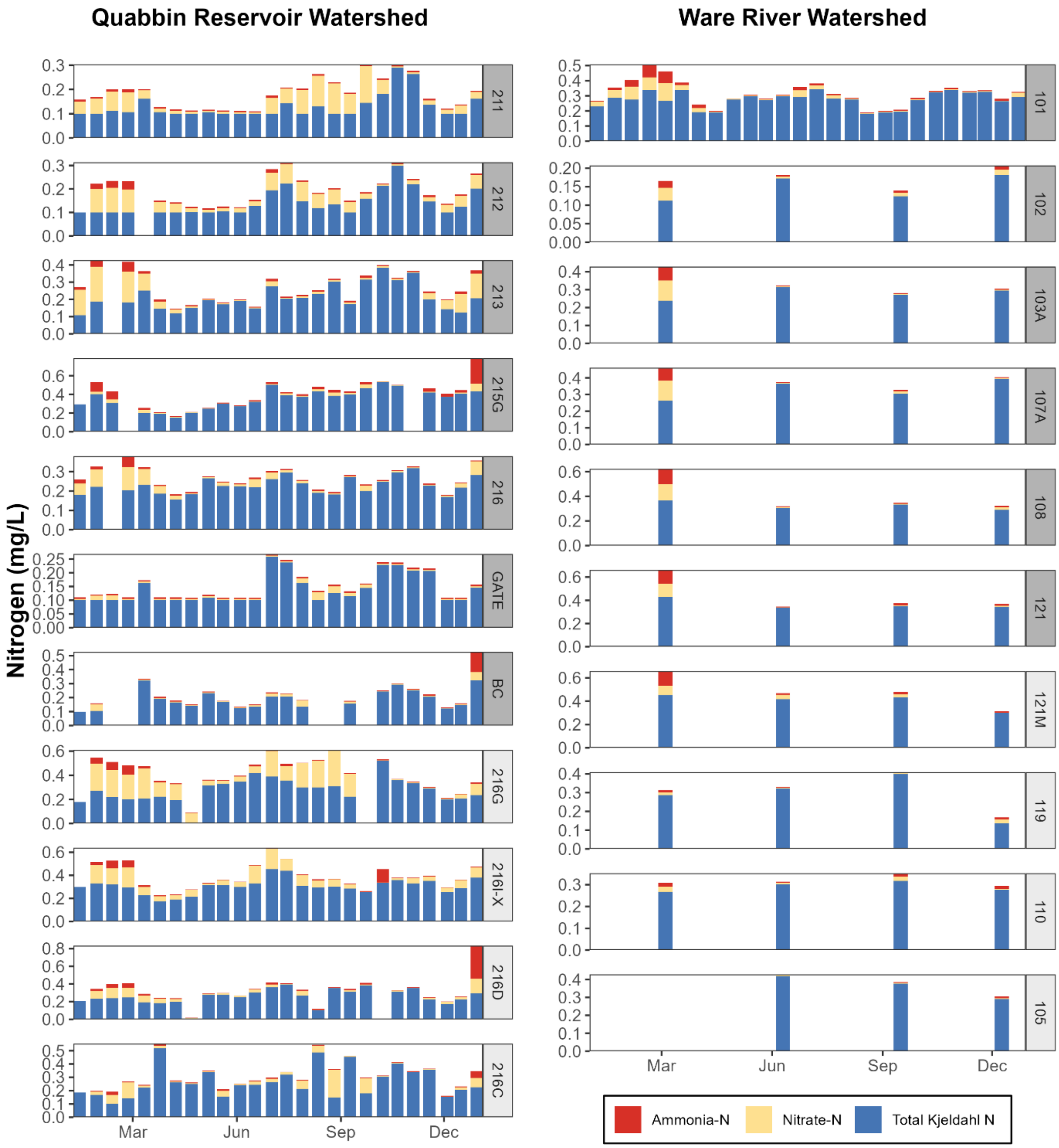


Figure 21. *Bar plots depicting the temporal distributions of nitrogen observed in Quabbin Reservoir Watershed and Ware River Watershed tributary sites during 2025. Some data points are missing due to dry conditions (inability to sample) or flagged data that was removed due to holding time or other analysis issues. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

3.2.5.1.1. Ammonia-Nitrogen

Concentrations of ammonia (NH_3-N) in Quabbin Reservoir and Ware River Watershed tributaries have routinely been below detection limits (44% of samples from tributaries in 2025). Concentrations of NH_3-N in Quabbin Reservoir and Ware River Watershed Core monitoring tributaries ranged from less than 0.005 to 0.376 mg/L and less than 0.005 to 0.127 mg/L, respectively, in 2025 (Table 27, Table 28). Concentrations of NH_3-N in Core monitoring tributaries in the Quabbin Reservoir and Ware River Watersheds were below the MA acute and chronic aquatic life criteria (17 mg/L and 1.9 mg/L, respectively) and the World Health Organization (WHO) taste and odor thresholds for drinking water (1.5 mg/L and 1.9 mg/L) for the entirety of 2025.

Seasonal average concentrations of NH_3-N observed in 2025 varied little from those of the period of record across Quabbin Reservoir Watershed monitoring streams with some slightly above the period of record averages and some slightly below. Periodic elevated results were noted at several sites during varying seasons (Figure 22). A rain-on-snow event on December 29, 2025 following extended fall low flows and subsequent high streamflow runoff led to some elevated ammonia concentrations at several sites in the Quabbin Reservoir Watershed. Ammonia was most elevated in that sampling event at sites with small ponds or wetlands immediately upstream of the sampling location (215G, 216D, and Boat Cove Brook) which may indicate that the ammonia was due to a combination of drought conditions and declining water levels with aquatic vegetation die-off and decomposition being flushed downstream. New winter maximum NH_3-N values were recorded at sites 211, 213, 215G, 216, Boat Cove Brook, and 216D, most of which were collected following the previously mentioned rain-on-snow event. New seasonal maximums were also recorded at site 215G in the spring and sites 216I-X and 216D in the fall. These new seasonal maximums occurred during a year of ongoing drought and lower than average streamflow, especially during fall and winter, which concentrates the ammonia in the streams.

Seasonal average concentrations of NH_3-N observed in 2025 also varied little from those of the period of record across Ware River Watershed Core monitoring streams apart from spring where all sites had mean values higher than the period record. Additionally, all Ware River Watershed sites had record high maximum ammonia values in the spring. These spring samples were collected on March 4, 2025 after a winter with little precipitation and below normal streamflow. The first major precipitation and high streamflow event of the year occurred two days later on March 6. The drought and low streamflow across the watershed likely lead to an unusual concentration of ammonia in the streams at a time when streamflow is usually much higher.

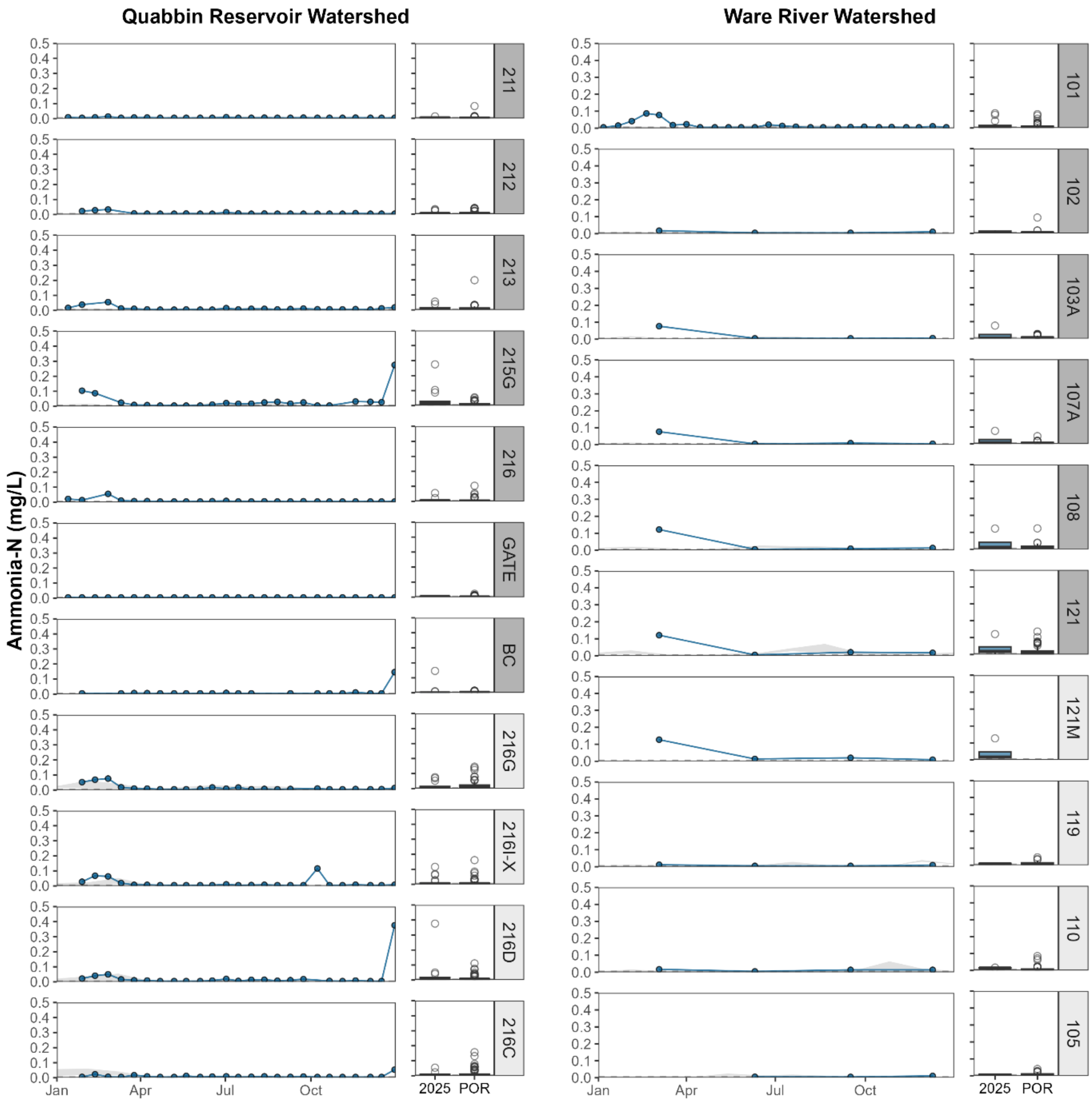


Figure 22. *Time series and boxplots of 2025 ammonia results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 27. *Seasonal statistics for ammonia (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	41	0.005	0.005	0.002	0.002	0.006	0.003	0.014	0.008
211	Spring	6	40	0.005	0.005	0.002	0.002	0.004	0.003	0.007	0.008
211	Summer	7	41	0.005	0.005	0.002	0.005	0.004	0.008	0.009	0.082
211	Fall	6	38	0.005	0.005	0.002	0.004	0.004	0.005	0.006	0.01
212	Winter	6	40	0.005	0.005	0.014	0.004	0.016	0.006	0.033	0.042
212	Spring	5	40	0.005	0.005	0.005	0.004	0.005	0.006	0.007	0.034
212	Summer	7	41	0.005	0.005	0.005	0.010	0.006	0.012	0.015	0.04
212	Fall	6	38	0.005	0.005	0.004	0.004	0.004	0.006	0.009	0.038
213	Winter	6	41	0.005	0.005	0.018	0.006	0.025	0.007	0.055	0.033
213	Spring	6	40	0.005	0.005	0.007	0.004	0.007	0.012	0.013	0.198
213	Summer	7	41	0.005	0.005	0.007	0.012	0.008	0.012	0.015	0.033
213	Fall	6	38	0.007	0.005	0.008	0.008	0.009	0.009	0.012	0.02
215G	Winter	5	36	0.027	0.005	0.087	0.006	0.105	0.009	0.275	0.033
215G	Spring	6	38	0.005	0.005	0.005	0.003	0.008	0.004	0.024	0.023
215G	Summer	7	41	0.005	0.005	0.018	0.014	0.019	0.016	0.029	0.056
215G	Fall	5	36	0.005	0.005	0.017	0.007	0.017	0.008	0.032	0.04
216	Winter	6	41	0.005	0.005	0.008	0.002	0.017	0.005	0.056	0.046
216	Spring	6	40	0.005	0.005	0.005	0.002	0.006	0.005	0.011	0.054
216	Summer	7	41	0.005	0.005	0.005	0.007	0.005	0.009	0.009	0.104
216	Fall	6	38	0.005	0.005	0.004	0.002	0.004	0.004	0.007	0.013
GATE	Winter	7	41	0.005	0.005	0.002	0.002	0.002	0.003	0.005	0.007
GATE	Spring	6	40	0.005	0.005	0.002	0.002	0.003	0.003	0.005	0.013
GATE	Summer	7	39	0.005	0.005	0.002	0.002	0.003	0.003	0.005	0.022
GATE	Fall	6	37	0.005	0.005	0.002	0.002	0.003	0.003	0.005	0.012
BC	Winter	4	41	0.005	0.005	0.002	0.002	0.038	0.003	0.146	0.015
BC	Spring	6	40	0.005	0.005	0.002	0.006	0.004	0.006	0.007	0.007
BC	Summer	5	36	0.005	0.005	0.002	0.005	0.004	0.006	0.008	0.015
BC	Fall	5	29	0.005	0.005	0.002	0.002	0.004	0.003	0.011	0.012
216G	Winter	6	24	0.005	0.005	0.033	0.012	0.036	0.03	0.076	0.146
216G	Spring	6	25	0.005	0.005	0.006	0.008	0.007	0.019	0.018	0.137
216G	Summer	7	23	0.005	0.005	0.007	0.021	0.009	0.023	0.017	0.052
216G	Fall	5	22	0.005	0.005	0.006	0.007	0.006	0.01	0.01	0.056
216I-X	Winter	6	23	0.005	0.005	0.018	0.006	0.029	0.012	0.068	0.076
216I-X	Spring	6	23	0.005	0.005	0.005	0.003	0.007	0.013	0.019	0.085
216I-X	Summer	7	25	0.005	0.005	0.002	0.005	0.005	0.012	0.01	0.161
216I-X	Fall	6	27	0.005	0.005	0.004	0.004	0.023	0.004	0.116	0.013
216D	Winter	6	24	0.005	0.005	0.031	0.008	0.082	0.014	0.376	0.076
216D	Spring	6	25	0.005	0.005	0.006	0.004	0.007	0.016	0.016	0.111
216D	Summer	7	25	0.005	0.005	0.008	0.005	0.010	0.007	0.019	0.026
216D	Fall	5	27	0.005	0.005	0.009	0.005	0.010	0.006	0.018	0.011
216C	Winter	6	24	0.005	0.005	0.006	0.018	0.016	0.033	0.054	0.157
216C	Spring	6	25	0.005	0.005	0.006	0.007	0.008	0.017	0.017	0.131
216C	Summer	7	25	0.005	0.005	0.006	0.006	0.006	0.006	0.009	0.013
216C	Fall	6	27	0.005	0.005	0.002	0.004	0.004	0.004	0.008	0.012

Table 28. *Seasonal statistics for ammonia (mg/L) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	39	0.005	0.005	0.013	0.004	0.027	0.005	0.087	0.024
101	Spring	7	39	0.005	0.005	0.002	0.003	0.018	0.006	0.077	0.031
101	Summer	6	40	0.005	0.005	0.007	0.011	0.009	0.016	0.021	0.082
101	Fall	7	40	0.005	0.005	0.005	0.005	0.005	0.007	0.008	0.055
102	Winter	1	14	0.011	0.005	0.011	0.006	0.011	0.007	0.011	0.017
102	Spring	1	15	0.018	0.005	0.018	0.002	0.018	0.004	0.018	0.014
102	Summer	1	15	0.005	0.005	0.002	0.006	0.002	0.007	0.005	0.016
102	Fall	1	16	0.005	0.005	0.002	0.001	0.002	0.008	0.005	0.093
103A	Winter	1	30	0.006	0.005	0.006	0.005	0.006	0.008	0.006	0.027
103A	Spring	1	26	0.077	0.005	0.077	0.004	0.077	0.007	0.077	0.028
103A	Summer	1	30	0.005	0.005	0.002	0.008	0.002	0.01	0.005	0.027
103A	Fall	1	30	0.005	0.005	0.002	0.004	0.002	0.005	0.005	0.012
107A	Winter	1	30	0.006	0.005	0.006	0.006	0.006	0.007	0.006	0.018
107A	Spring	1	27	0.077	0.005	0.077	0.002	0.077	0.006	0.077	0.046
107A	Summer	1	30	0.005	0.005	0.002	0.007	0.002	0.008	0.005	0.019
107A	Fall	1	30	0.009	0.005	0.009	0.003	0.009	0.004	0.009	0.017
108	Winter	1	30	0.013	0.005	0.013	0.008	0.013	0.014	0.013	0.123
108	Spring	1	27	0.122	0.005	0.122	0.005	0.122	0.008	0.122	0.039
108	Summer	1	30	0.005	0.005	0.005	0.020	0.005	0.02	0.005	0.037
108	Fall	1	30	0.009	0.005	0.009	0.008	0.009	0.008	0.009	0.017
121	Winter	1	27	0.017	0.005	0.017	0.011	0.017	0.02	0.017	0.069
121	Spring	1	28	0.121	0.005	0.121	0.006	0.121	0.007	0.121	0.02
121	Summer	1	28	0.005	0.005	0.002	0.020	0.002	0.03	0.005	0.136
121	Fall	1	29	0.021	0.005	0.021	0.006	0.021	0.015	0.021	0.103
121M	Winter	1	ND	0.009	ND	0.009	ND	0.009	ND	0.009	ND
121M	Spring	1	ND	0.127	ND	0.127	ND	0.127	ND	0.127	ND
121M	Summer	1	ND	0.013	ND	0.013	ND	0.013	ND	0.013	ND
121M	Fall	1	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
119	Winter	1	6	0.009	0.005	0.009	0.010	0.009	0.01	0.009	0.019
119	Spring	1	6	0.012	0.005	0.012	0.002	0.012	0.004	0.012	0.011
119	Summer	1	7	0.005	0.005	0.002	0.007	0.002	0.011	0.005	0.036
119	Fall	1	6	0.005	0.005	0.002	0.016	0.002	0.019	0.005	0.046
110	Winter	1	19	0.014	0.005	0.014	0.002	0.014	0.005	0.014	0.025
110	Spring	1	19	0.017	0.005	0.017	0.004	0.017	0.005	0.017	0.012
110	Summer	1	16	0.005	0.005	0.002	0.006	0.002	0.007	0.005	0.018
110	Fall	1	13	0.014	0.005	0.014	0.013	0.014	0.025	0.014	0.085
105	Winter	1	16	0.011	0.005	0.011	0.006	0.011	0.006	0.011	0.011
105	Spring	ND	19	ND	0.005	ND	0.007	ND	0.011	ND	0.04
105	Summer	1	20	0.006	0.005	0.006	0.012	0.006	0.012	0.006	0.027
105	Fall	1	20	0.005	0.005	0.002	0.005	0.002	0.005	0.005	0.011

3.2.5.1.2. Nitrate-Nitrogen

Concentrations of nitrate (NO_3-N) ranged from less than 0.005 to 0.298 mg/L in Quabbin Reservoir Watershed sites (Table 29, Figure 23) and from less than 0.005 to 0.135 mg/L in Ware River Watershed sites in 2025 (Table 30, Figure 23). All samples in both watersheds in 2025 were at or below the local ecoregional background levels for nitrate (0.16 - 0.31 mg/L) and well below the EPA MCL for drinking water of 10 mg/L.

In the Quabbin Reservoir Watershed annual median nitrate concentrations were below the period of record median values at all sites except 211 and 215G. Instream concentrations of NO_3-N generally followed established historical seasonal patterns in the Quabbin Reservoir Watershed, varying considerably across sites due to upstream catchment context. Three general time series patterns were observed. West Quabbin Core sites (BC, GATE, 211) were characterized by nitrate level increasing in late spring, peaking in summer, and declining into winter. Seasonal nitrate transport patterns at these relatively high-gradient low-order streams were likely driven by seasonal nutrient release from vegetation and soil, patterns of summer runoff and mobilization, and the timing of plant uptake of available nitrates. Central Quabbin tributaries East Branch Fever Brook (site 215G) and Middle Branch Swift (site 213) are sites with a relatively higher proportion of upstream wetland landcover (see Table 4). Time series of nitrate concentrations at these sites showed increased concentrations during winter, although the magnitude of these increases varied across sites. Wetlands can act as nutrient sinks during growing seasons and can release nitrates during winter when ground is frozen, leading to increased NO_3-N downstream (Johnston 1991). Reduced plant uptake of nitrates during the winter months also allows for accumulation in soils and subsequent leaching during winter rains and/or snowmelt. Seasonal patterns at Hop Brook (site 212) and East Branch Swift (site 216) exhibited both winter and summer increases in nitrate concentrations. These variable patterns indicated key differences in controls on biogeochemical N-cycling that could include variations in land cover, hydrological differences in groundwater recharge and overall difference in hydrologic complexity, and/or soil characteristics.

In the Ware River Watershed annual median nitrate concentrations were below the period of record median values at all sites except 110. Across all sites, the spring sample collected on March 4, 2025 was the highest value of the year. As discussed in the Ammonia-Nitrogen section (3.2.5.1.1), this sample was collected after a drought lasting months and streamflow was well below normal, which likely lead to an unusual concentration of nutrients in the stream at this time.

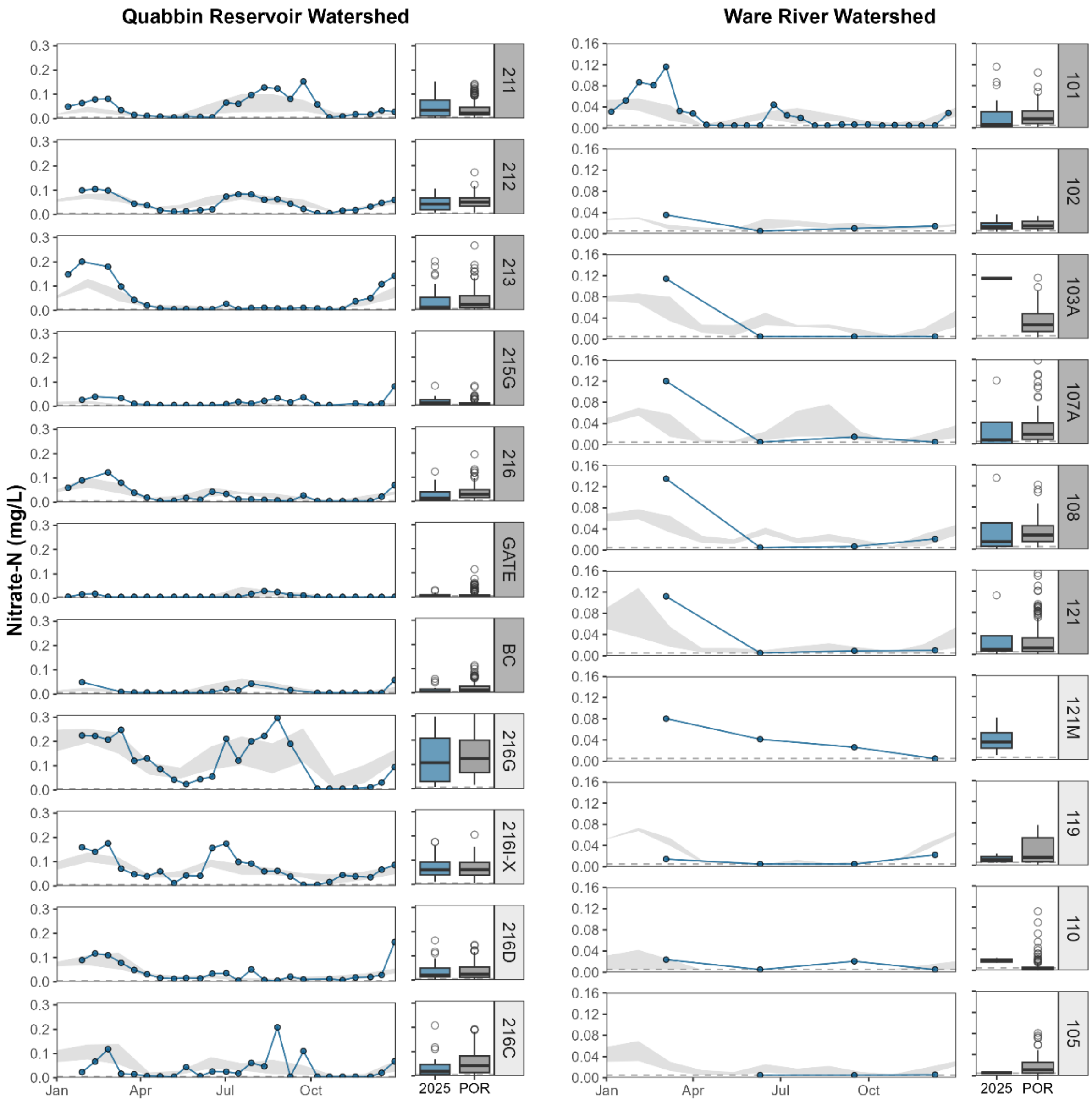


Figure 23. *Time series and boxplots of 2025 nitrate results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. The horizontal dashed grey lines correspond to laboratory detection limits (0.005 mg/L). Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 29. *Seasonal statistics for nitrate (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	46	0.017	0.008	0.050	0.020	0.050	0.024	0.082	0.104
211	Spring	6	48	0.005	0.005	0.010	0.015	0.013	0.020	0.035	0.071
211	Summer	7	50	0.005	0.005	0.065	0.044	0.070	0.057	0.128	0.143
211	Fall	6	49	0.005	0.005	0.038	0.025	0.054	0.038	0.153	0.139
212	Winter	6	45	0.032	0.033	0.079	0.060	0.074	0.060	0.105	0.173
212	Spring	5	48	0.012	0.005	0.018	0.046	0.025	0.051	0.044	0.122
212	Summer	7	49	0.018	0.008	0.064	0.061	0.058	0.062	0.083	0.116
212	Fall	6	49	0.005	0.005	0.017	0.034	0.018	0.034	0.044	0.084
213	Winter	6	46	0.051	0.018	0.146	0.069	0.139	0.081	0.201	0.266
213	Spring	6	48	0.005	0.005	0.015	0.033	0.030	0.049	0.099	0.186
213	Summer	7	49	0.005	0.005	0.008	0.008	0.009	0.011	0.027	0.044
213	Fall	6	49	0.005	0.005	0.008	0.011	0.012	0.017	0.038	0.058
215G	Winter	5	36	0.006	0.005	0.027	0.013	0.033	0.015	0.082	0.043
215G	Spring	6	38	0.005	0.005	0.005	0.003	0.010	0.004	0.034	0.021
215G	Summer	7	39	0.005	0.005	0.011	0.004	0.015	0.011	0.034	0.082
215G	Fall	5	37	0.005	0.005	0.012	0.005	0.014	0.006	0.038	0.018
216	Winter	6	46	0.005	0.017	0.065	0.046	0.063	0.053	0.123	0.194
216	Spring	6	48	0.005	0.005	0.018	0.028	0.028	0.040	0.080	0.133
216	Summer	7	49	0.008	0.007	0.012	0.034	0.019	0.038	0.043	0.096
216	Fall	6	48	0.005	0.005	0.002	0.010	0.007	0.014	0.028	0.036
GATE	Winter	7	46	0.005	0.005	0.005	0.004	0.008	0.005	0.018	0.024
GATE	Spring	6	48	0.005	0.005	0.002	0.002	0.002	0.003	0.005	0.014
GATE	Summer	7	46	0.005	0.005	0.005	0.010	0.012	0.020	0.029	0.115
GATE	Fall	6	46	0.005	0.005	0.002	0.004	0.006	0.009	0.012	0.055
BC	Winter	4	46	0.005	0.005	0.026	0.013	0.028	0.020	0.058	0.099
BC	Spring	6	48	0.005	0.005	0.005	0.007	0.005	0.011	0.009	0.043
BC	Summer	5	41	0.005	0.005	0.016	0.035	0.018	0.037	0.043	0.108
BC	Fall	5	36	0.005	0.005	0.002	0.006	0.005	0.014	0.016	0.114
216G	Winter	6	39	0.011	0.083	0.151	0.186	0.132	0.190	0.225	0.340
216G	Spring	6	38	0.024	0.031	0.103	0.100	0.109	0.118	0.248	0.279
216G	Summer	7	43	0.044	0.031	0.201	0.132	0.165	0.156	0.298	0.442
216G	Fall	5	38	0.005	0.005	0.002	0.060	0.041	0.098	0.190	0.419
216I-X	Winter	6	38	0.036	0.037	0.114	0.082	0.111	0.090	0.175	0.205
216I-X	Spring	6	36	0.012	0.021	0.045	0.050	0.045	0.060	0.071	0.132
216I-X	Summer	7	45	0.042	0.005	0.092	0.073	0.098	0.074	0.174	0.146
216I-X	Fall	6	45	0.005	0.005	0.028	0.038	0.024	0.041	0.045	0.123
216D	Winter	6	30	0.020	0.025	0.100	0.068	0.088	0.069	0.164	0.117
216D	Spring	6	31	0.013	0.005	0.024	0.031	0.034	0.046	0.078	0.146
216D	Summer	7	32	0.005	0.005	0.014	0.013	0.021	0.015	0.051	0.056
216D	Fall	5	34	0.007	0.005	0.012	0.015	0.014	0.022	0.021	0.142
216C	Winter	6	30	0.005	0.005	0.045	0.079	0.050	0.088	0.118	0.193
216C	Spring	6	31	0.005	0.005	0.011	0.025	0.015	0.046	0.044	0.160
216C	Summer	7	32	0.007	0.005	0.026	0.048	0.056	0.058	0.208	0.190
216C	Fall	6	34	0.005	0.005	0.002	0.012	0.020	0.025	0.110	0.163

Table 30. *Seasonal statistics for nitrate (mg/L) measured in the Ware River Watershed tributary sites in 2025 compared to period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	39	0.005	0.012	0.042	0.038	0.049	0.037	0.087	0.068
101	Spring	7	39	0.005	0.005	0.006	0.010	0.027	0.020	0.116	0.105
101	Summer	6	39	0.005	0.006	0.012	0.021	0.016	0.023	0.044	0.051
101	Fall	7	42	0.005	0.005	0.006	0.010	0.005	0.011	0.007	0.028
102	Winter	1	14	0.014	0.013	0.014	0.025	0.014	0.023	0.014	0.031
102	Spring	1	15	0.035	0.005	0.035	0.009	0.035	0.011	0.035	0.026
102	Summer	1	15	0.005	0.005	0.002	0.015	0.002	0.018	0.005	0.033
102	Fall	1	16	0.010	0.005	0.010	0.012	0.010	0.013	0.010	0.021
103A	Winter	1	36	0.005	0.010	0.002	0.061	0.002	0.053	0.005	0.092
103A	Spring	1	34	0.114	0.005	0.114	0.031	0.114	0.040	0.114	0.115
103A	Summer	1	39	0.005	0.005	0.002	0.027	0.002	0.032	0.005	0.071
103A	Fall	1	40	0.005	0.005	0.002	0.009	0.002	0.012	0.005	0.041
107A	Winter	1	36	0.005	0.009	0.002	0.037	0.002	0.040	0.005	0.106
107A	Spring	1	34	0.120	0.005	0.120	0.015	0.120	0.028	0.120	0.132
107A	Summer	1	39	0.005	0.005	0.002	0.020	0.002	0.031	0.005	0.158
107A	Fall	1	40	0.015	0.005	0.015	0.009	0.015	0.016	0.015	0.109
108	Winter	1	36	0.021	0.012	0.021	0.049	0.021	0.050	0.021	0.113
108	Spring	1	35	0.135	0.008	0.135	0.029	0.135	0.039	0.135	0.122
108	Summer	1	39	0.005	0.005	0.002	0.029	0.002	0.030	0.005	0.082
108	Fall	1	40	0.007	0.005	0.007	0.012	0.007	0.014	0.007	0.041
121	Winter	1	34	0.010	0.006	0.010	0.056	0.010	0.059	0.010	0.154
121	Spring	1	36	0.112	0.005	0.112	0.011	0.112	0.021	0.112	0.120
121	Summer	1	37	0.005	0.005	0.002	0.010	0.002	0.016	0.005	0.092
121	Fall	1	42	0.009	0.005	0.009	0.007	0.009	0.013	0.009	0.087
121M	Winter	1	ND	0.005	ND	0.002	ND	0.002	ND	0.005	ND
121M	Spring	1	ND	0.080	ND	0.080	ND	0.080	ND	0.080	ND
121M	Summer	1	ND	0.041	ND	0.041	ND	0.041	ND	0.041	ND
121M	Fall	1	ND	0.026	ND	0.026	ND	0.026	ND	0.026	ND
119	Winter	1	6	0.022	0.052	0.022	0.060	0.022	0.062	0.022	0.076
119	Spring	1	6	0.014	0.005	0.014	0.009	0.014	0.019	0.014	0.061
119	Summer	1	7	0.005	0.005	0.002	0.002	0.002	0.005	0.005	0.016
119	Fall	1	6	0.005	0.007	0.002	0.018	0.002	0.023	0.005	0.048
110	Winter	1	26	0.005	0.005	0.002	0.010	0.002	0.021	0.005	0.112
110	Spring	1	27	0.024	0.005	0.024	0.002	0.024	0.008	0.024	0.091
110	Summer	1	25	0.005	0.005	0.002	0.002	0.002	0.003	0.005	0.019
110	Fall	1	26	0.021	0.005	0.021	0.004	0.021	0.005	0.021	0.017
105	Winter	1	22	0.006	0.005	0.006	0.032	0.006	0.055	0.006	0.373
105	Spring	ND	27	ND	0.005	ND	0.009	ND	0.013	ND	0.073
105	Summer	1	29	0.005	0.005	0.002	0.015	0.002	0.016	0.005	0.041
105	Fall	1	33	0.005	0.005	0.002	0.007	0.002	0.008	0.005	0.035

3.2.5.1.3. Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) concentrations in Quabbin Reservoir Watershed tributary sites ranged from 0.1 to 0.538 mg/L and from 0.112 to 0.451 mg/L in the Ware River Watershed sites in 2025 (Table 31). TKN dynamics in tributaries in the Quabbin Reservoir and Ware River Watersheds loosely mirrored that of TP and organic content, with enrichment during summer months coinciding with biological productivity and vegetative growth cycles (Figure 24). New spring TKN maximums were recorded at two Ware River Watershed sites (121, 119) and one Quabbin Reservoir Watershed site (Boat Cove Brook). Additionally, new fall TKN maximums were recorded at one Ware River Watershed site (119) and two Quabbin Reservoir Watershed sites (211, 212). Periodic elevated TKN results in the spring and summer documented at sites across watersheds were mostly attributed to samples collected during or following rainfall events. The increased turbulence and mixing of water during high flow events following precipitation can resuspend sediment and organic matter from the streambed, releasing stored nutrients like TKN into the water column. Continued nutrient monitoring at these tributaries provide insights into how changing weather patterns and climatic conditions (e.g., varying seasonal drought and flood cycles) may affect nitrogen dynamics in these forested watersheds.

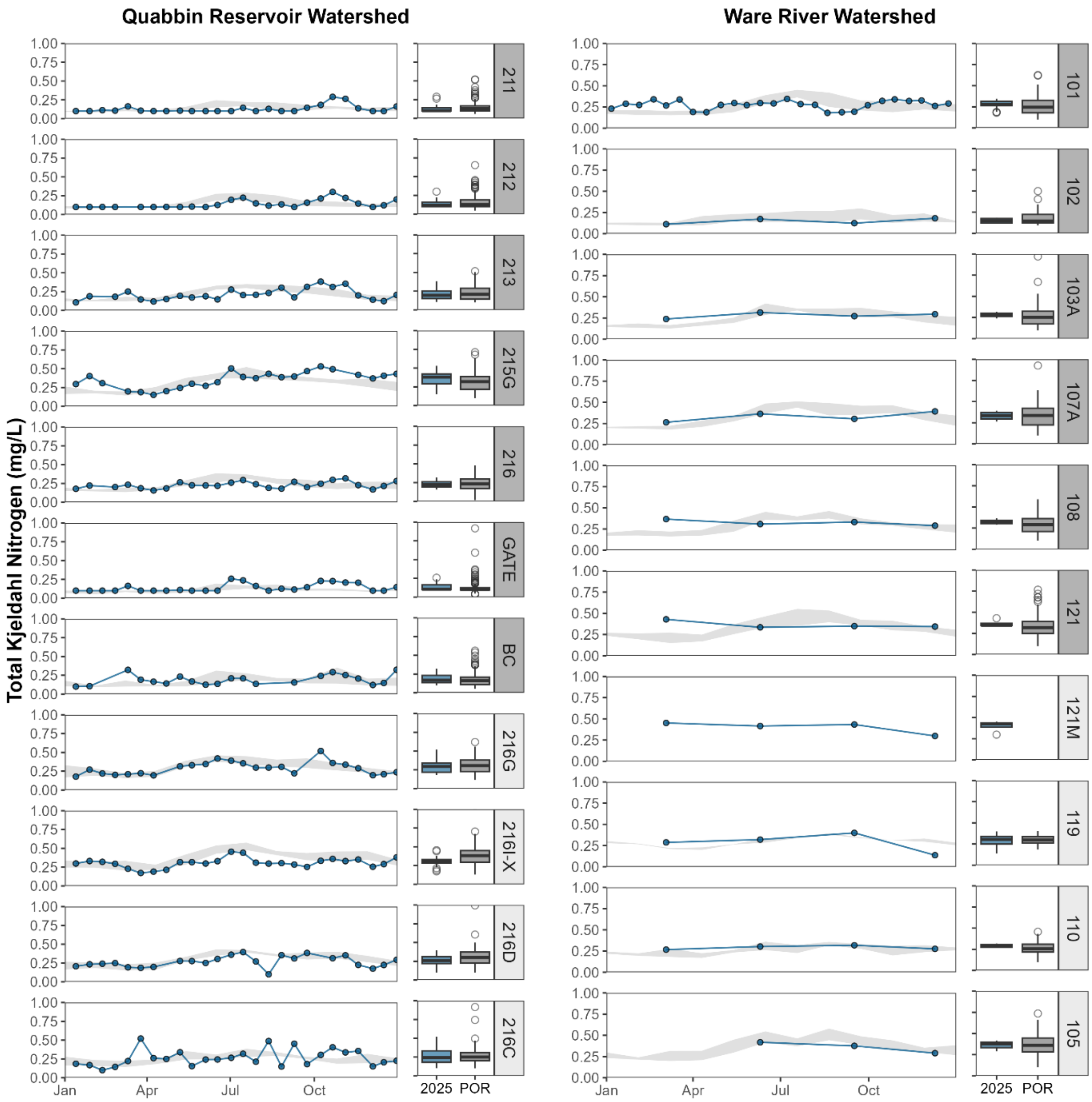


Figure 24. *Time series and boxplots of 2025 TKN results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 31. *Seasonal statistics for Total Kjeldahl Nitrogen (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	46	0.100	0.060	0.050	0.097	0.083	0.114	0.161	0.281
211	Spring	6	48	0.100	0.071	0.103	0.097	0.096	0.114	0.162	0.331
211	Summer	7	52	0.100	0.068	0.050	0.168	0.075	0.200	0.143	0.520
211	Fall	6	49	0.100	0.086	0.163	0.141	0.183	0.142	0.289	0.219
212	Winter	7	45	0.100	0.057	0.050	0.100	0.082	0.125	0.201	0.442
212	Spring	5	48	0.100	0.047	0.050	0.095	0.071	0.124	0.105	0.421
212	Summer	7	51	0.100	0.100	0.135	0.199	0.149	0.227	0.223	0.653
212	Fall	6	49	0.100	0.073	0.186	0.128	0.189	0.140	0.300	0.258
213	Winter	6	46	0.107	0.100	0.162	0.140	0.158	0.157	0.206	0.402
213	Spring	6	48	0.119	0.100	0.161	0.163	0.172	0.173	0.251	0.330
213	Summer	7	50	0.147	0.190	0.208	0.306	0.223	0.313	0.303	0.516
213	Fall	6	49	0.174	0.126	0.314	0.232	0.290	0.244	0.383	0.426
215G	Winter	6	36	0.296	0.100	0.386	0.219	0.369	0.236	0.432	0.462
215G	Spring	6	38	0.153	0.100	0.200	0.220	0.215	0.258	0.300	0.617
215G	Summer	7	41	0.273	0.268	0.387	0.420	0.383	0.422	0.504	0.679
215G	Fall	5	37	0.397	0.191	0.468	0.338	0.462	0.345	0.531	0.713
216	Winter	6	46	0.170	0.100	0.210	0.182	0.212	0.212	0.282	0.388
216	Spring	6	48	0.157	0.100	0.206	0.173	0.209	0.193	0.265	0.410
216	Summer	7	50	0.181	0.016	0.224	0.307	0.230	0.310	0.295	0.448
216	Fall	6	49	0.200	0.136	0.260	0.223	0.260	0.245	0.318	0.480
GATE	Winter	7	46	0.100	0.035	0.050	0.072	0.064	0.091	0.146	0.330
GATE	Spring	6	48	0.100	0.044	0.050	0.068	0.079	0.079	0.163	0.193
GATE	Summer	7	47	0.100	0.063	0.126	0.142	0.133	0.173	0.258	0.916
GATE	Fall	6	48	0.115	0.061	0.207	0.097	0.188	0.105	0.229	0.302
BC	Winter	5	46	0.100	0.054	0.121	0.133	0.149	0.153	0.323	0.425
BC	Spring	6	48	0.141	0.066	0.180	0.113	0.203	0.130	0.322	0.242
BC	Summer	5	43	0.125	0.100	0.136	0.209	0.163	0.234	0.209	0.562
BC	Fall	5	37	0.155	0.100	0.242	0.164	0.230	0.198	0.292	0.450
216G	Winter	7	40	0.178	0.115	0.210	0.237	0.216	0.246	0.271	0.431
216G	Spring	5	38	0.195	0.119	0.223	0.237	0.255	0.264	0.330	0.459
216G	Summer	7	42	0.298	0.274	0.345	0.392	0.345	0.393	0.419	0.559
216G	Fall	5	38	0.222	0.116	0.337	0.295	0.345	0.385	0.519	3.230
216I-X	Winter	7	37	0.255	0.130	0.298	0.305	0.310	0.302	0.380	0.646
216I-X	Spring	6	36	0.172	0.151	0.221	0.284	0.239	0.297	0.316	0.439
216I-X	Summer	7	44	0.297	0.340	0.309	0.478	0.347	0.485	0.455	0.703
216I-X	Fall	6	45	0.253	0.177	0.332	0.404	0.318	0.412	0.359	1.050
216D	Winter	7	31	0.176	0.100	0.233	0.224	0.232	0.224	0.293	0.398
216D	Spring	5	31	0.186	0.100	0.198	0.233	0.226	0.258	0.277	0.995
216D	Summer	7	32	0.100	0.315	0.304	0.383	0.306	0.387	0.396	0.500
216D	Fall	5	34	0.225	0.144	0.314	0.331	0.317	0.336	0.384	0.606
216C	Winter	7	31	0.101	0.100	0.168	0.226	0.169	0.217	0.226	0.405
216C	Spring	6	31	0.155	0.100	0.256	0.222	0.291	0.247	0.521	0.744
216C	Summer	7	32	0.149	0.124	0.243	0.306	0.274	0.383	0.488	2.160
216C	Fall	6	33	0.181	0.110	0.347	0.256	0.339	0.255	0.453	0.467

Table 32. *Seasonal statistics for TKN (mg/L) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	38	0.230	0.139	0.281	0.211	0.281	0.223	0.340	0.391
101	Spring	7	39	0.188	0.100	0.272	0.193	0.261	0.204	0.338	0.619
101	Summer	6	39	0.180	0.168	0.288	0.364	0.279	0.360	0.345	0.626
101	Fall	7	41	0.188	0.100	0.321	0.270	0.280	0.267	0.340	0.459
102	Winter	1	14	0.182	0.096	0.182	0.129	0.182	0.133	0.182	0.232
102	Spring	1	15	0.112	0.092	0.112	0.136	0.112	0.155	0.112	0.307
102	Summer	1	15	0.172	0.100	0.172	0.187	0.172	0.201	0.172	0.404
102	Fall	1	16	0.124	0.102	0.124	0.181	0.124	0.216	0.124	0.499
103A	Winter	1	36	0.295	0.117	0.295	0.184	0.295	0.197	0.295	0.391
103A	Spring	1	34	0.238	0.097	0.238	0.166	0.238	0.181	0.238	0.386
103A	Summer	1	38	0.315	0.175	0.315	0.326	0.315	0.355	0.315	0.971
103A	Fall	1	39	0.272	0.137	0.272	0.304	0.272	0.306	0.272	0.670
107A	Winter	1	36	0.393	0.122	0.393	0.224	0.393	0.254	0.393	0.526
107A	Spring	1	34	0.264	0.100	0.264	0.219	0.264	0.240	0.264	0.480
107A	Summer	1	38	0.364	0.311	0.364	0.430	0.364	0.447	0.364	0.926
107A	Fall	1	39	0.305	0.185	0.305	0.384	0.305	0.388	0.305	0.519
108	Winter	1	36	0.290	0.101	0.290	0.212	0.290	0.234	0.290	0.383
108	Spring	1	35	0.367	0.100	0.367	0.203	0.367	0.215	0.367	0.386
108	Summer	1	38	0.308	0.281	0.308	0.396	0.308	0.404	0.308	0.590
108	Fall	1	39	0.332	0.182	0.332	0.317	0.332	0.319	0.332	0.498
121	Winter	1	34	0.344	0.100	0.344	0.252	0.344	0.270	0.344	0.644
121	Spring	1	36	0.429	0.120	0.429	0.254	0.429	0.253	0.429	0.398
121	Summer	1	36	0.335	0.100	0.335	0.424	0.335	0.479	0.335	2.040
121	Fall	1	41	0.349	0.253	0.349	0.352	0.349	0.366	0.349	0.591
121M	Winter	1	ND	0.298	ND	0.298	ND	0.298	ND	0.298	ND
121M	Spring	1	ND	0.451	ND	0.451	ND	0.451	ND	0.451	ND
121M	Summer	1	ND	0.415	ND	0.415	ND	0.415	ND	0.415	ND
121M	Fall	1	ND	0.433	ND	0.433	ND	0.433	ND	0.433	ND
119	Winter	1	6	0.136	0.240	0.136	0.271	0.136	0.276	0.136	0.313
119	Spring	1	6	0.287	0.184	0.287	0.233	0.287	0.231	0.287	0.267
119	Summer	1	7	0.320	0.253	0.320	0.340	0.320	0.340	0.320	0.404
119	Fall	1	6	0.399	0.269	0.399	0.328	0.399	0.321	0.399	0.351
110	Winter	1	26	0.276	0.110	0.276	0.229	0.276	0.249	0.276	0.457
110	Spring	1	27	0.267	0.122	0.267	0.235	0.267	0.228	0.267	0.333
110	Summer	1	24	0.303	0.100	0.303	0.310	0.303	0.382	0.303	1.470
110	Fall	1	26	0.318	0.159	0.318	0.292	0.318	0.277	0.318	0.407
105	Winter	1	22	0.290	0.191	0.290	0.259	0.290	0.284	0.290	0.455
105	Spring	ND	27	ND	0.174	ND	0.299	ND	0.319	ND	0.736
105	Summer	1	28	0.418	0.100	0.418	0.454	0.418	0.466	0.418	0.662
105	Fall	1	33	0.376	0.189	0.376	0.385	0.376	0.395	0.376	0.643

3.2.5.2. Total Phosphorus

Total phosphorus (TP) concentrations measured in monitoring tributaries of the Quabbin Reservoir during 2025 ranged from less than 0.005 to 0053 mg/L (Table 33). In the Ware River Watershed, TP concentrations were between less than 0.005 to 0.034 mg/L in 2025 (Table 34). In tributaries in the Quabbin Reservoir Watershed and Ware River Watershed, TP concentrations exhibited distinct seasonality, with generally higher results during the summer and early fall and comparatively lower during the spring and winter (Figure 25). These patterns are consistent with other forested headwater catchments in the Northeast USA (Lisboa et al., 2020).

Seasonal median concentrations of TP were comparable to the period of record in both watersheds, with no clear pattern in the variability compared to periods of record. Each season had some site medians above the seasonal median and some site medians below the seasonal media. Quabbin Reservoir Watershed seasonal medians ranged from -0.026 to +0.008 mg/L compared to the period of record seasonal median and Ware River Watershed seasonal medians ranged from -0.016 to +0.012 mg/L compared to the period of record seasonal medians (Table 33, Table 34). While there were new recorded maximums and minimums in all seasons across the watersheds which may indicate increased seasonal variability based on climate impacts such as drought and changing precipitation frequency and intensity, annual median TP concentrations were below the period of record annual median values at all but three sites: 215G (0.0190 mg/L in 2025 versus 0.0155 mg/L POR) and BC (0.0177 mg/L in 2025 versus 0.01695 mg/L POR) in the Quabbin Reservoir Watershed and 101 (0.0186 mg/L in 2025 versus 0.0179 mg/L POR) in the Ware River Watershed. Elevated TP spikes coincided with samples collected during rain events (3/25/2025 & 10/8/2025) at certain Quabbin Reservoir Watershed tributaries. Variations in TP concentrations across Quabbin Reservoir and Ware River Watersheds sites may be partially attributed to variations in land cover, wetland connectivity, groundwater contributions, and timing of sample collection relative to hydrometeorological events (Reddy et al., 1999; Lisboa et al., 2016).

Table 33. *Seasonal statistics for total phosphorus (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	36	0.007	0.005	0.010	0.009	0.010	0.009	0.017	0.020
211	Spring	6	37	0.005	0.005	0.008	0.010	0.008	0.011	0.010	0.030
211	Summer	7	38	0.005	0.006	0.011	0.013	0.011	0.014	0.014	0.044
211	Fall	6	35	0.006	0.005	0.009	0.009	0.009	0.010	0.015	0.022
212	Winter	7	35	0.009	0.005	0.010	0.011	0.012	0.012	0.018	0.050
212	Spring	5	37	0.005	0.005	0.010	0.014	0.009	0.015	0.012	0.073
212	Summer	7	38	0.005	0.011	0.017	0.020	0.017	0.023	0.029	0.093
212	Fall	6	35	0.009	0.005	0.012	0.013	0.013	0.016	0.020	0.045
213	Winter	6	36	0.011	0.005	0.013	0.012	0.013	0.012	0.016	0.032
213	Spring	6	37	0.006	0.005	0.010	0.013	0.012	0.013	0.020	0.025
213	Summer	7	38	0.006	0.008	0.020	0.021	0.020	0.021	0.042	0.039
213	Fall	6	35	0.012	0.007	0.015	0.015	0.015	0.015	0.019	0.037
215G	Winter	6	35	0.018	0.005	0.021	0.013	0.020	0.013	0.023	0.025
215G	Spring	6	38	0.009	0.006	0.012	0.013	0.013	0.013	0.017	0.027
215G	Summer	7	41	0.009	0.009	0.019	0.022	0.019	0.022	0.024	0.032
215G	Fall	5	37	0.016	0.009	0.024	0.017	0.024	0.017	0.031	0.024
216	Winter	6	36	0.009	0.005	0.015	0.013	0.015	0.014	0.020	0.054
216	Spring	6	37	0.012	0.007	0.018	0.015	0.016	0.015	0.018	0.030
216	Summer	7	38	0.007	0.009	0.018	0.023	0.016	0.023	0.020	0.045
216	Fall	6	35	0.008	0.007	0.011	0.014	0.011	0.016	0.016	0.044
GATE	Winter	7	36	0.006	0.005	0.008	0.008	0.009	0.009	0.014	0.031
GATE	Spring	6	37	0.005	0.005	0.007	0.010	0.007	0.010	0.010	0.017
GATE	Summer	7	36	0.005	0.005	0.013	0.014	0.012	0.019	0.020	0.129
GATE	Fall	6	34	0.009	0.005	0.012	0.013	0.013	0.013	0.018	0.025
BC	Winter	5	36	0.006	0.005	0.016	0.013	0.016	0.014	0.028	0.035
BC	Spring	6	37	0.009	0.007	0.016	0.017	0.016	0.017	0.022	0.031
BC	Summer	5	35	0.011	0.008	0.022	0.021	0.020	0.022	0.026	0.061
BC	Fall	5	28	0.010	0.008	0.018	0.017	0.024	0.019	0.053	0.037
216G	Winter	7	25	0.006	0.009	0.013	0.016	0.013	0.016	0.022	0.025
216G	Spring	6	26	0.009	0.013	0.014	0.019	0.014	0.020	0.018	0.032
216G	Summer	7	26	0.015	0.014	0.021	0.028	0.022	0.029	0.033	0.053
216G	Fall	5	25	0.005	0.010	0.011	0.018	0.020	0.020	0.049	0.048
216I-X	Winter	2	22	0.013	0.012	0.018	0.021	0.018	0.023	0.024	0.065
216I-X	Spring	2	24	0.017	0.014	0.018	0.024	0.018	0.027	0.019	0.050
216I-X	Summer	1	26	0.016	0.023	0.016	0.042	0.016	0.042	0.016	0.059
216I-X	Fall	1	27	0.019	0.011	0.019	0.026	0.019	0.027	0.019	0.054
216D	Winter	7	25	0.016	0.012	0.018	0.020	0.019	0.021	0.022	0.038
216D	Spring	6	26	0.018	0.016	0.020	0.025	0.020	0.030	0.021	0.126
216D	Summer	7	26	0.016	0.024	0.024	0.033	0.024	0.034	0.028	0.043
216D	Fall	5	27	0.013	0.013	0.016	0.026	0.018	0.027	0.025	0.063
216C	Winter	7	25	0.010	0.009	0.013	0.018	0.015	0.019	0.025	0.035
216C	Spring	6	26	0.007	0.014	0.014	0.018	0.018	0.020	0.051	0.030
216C	Summer	7	26	0.010	0.010	0.015	0.019	0.015	0.029	0.022	0.288
216C	Fall	6	26	0.008	0.009	0.011	0.013	0.015	0.014	0.040	0.022

Table 34. *Seasonal statistics for total phosphorus (mg/L) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	32	0.011	0.005	0.017	0.014	0.017	0.014	0.022	0.026
101	Spring	7	35	0.009	0.007	0.016	0.014	0.016	0.014	0.025	0.027
101	Summer	6	33	0.021	0.005	0.026	0.028	0.026	0.030	0.034	0.059
101	Fall	7	35	0.013	0.009	0.020	0.021	0.019	0.021	0.027	0.044
102	Winter	1	14	0.022	0.010	0.022	0.018	0.022	0.017	0.022	0.026
102	Spring	1	15	0.018	0.011	0.018	0.014	0.018	0.020	0.018	0.046
102	Summer	1	15	0.019	0.013	0.019	0.028	0.019	0.027	0.019	0.038
102	Fall	1	16	0.019	0.014	0.019	0.028	0.019	0.032	0.019	0.145
103A	Winter	1	25	0.014	0.008	0.014	0.013	0.014	0.014	0.014	0.029
103A	Spring	1	24	0.014	0.007	0.014	0.013	0.014	0.014	0.014	0.027
103A	Summer	1	25	0.016	0.014	0.016	0.027	0.016	0.028	0.016	0.045
103A	Fall	1	25	0.015	0.011	0.015	0.023	0.015	0.023	0.015	0.040
107A	Winter	1	25	0.026	0.007	0.026	0.014	0.026	0.014	0.026	0.021
107A	Spring	1	25	0.015	0.009	0.015	0.013	0.015	0.014	0.015	0.025
107A	Summer	1	25	0.016	0.006	0.016	0.026	0.016	0.026	0.016	0.043
107A	Fall	1	25	0.009	0.010	0.009	0.021	0.009	0.021	0.009	0.036
108	Winter	1	25	0.010	0.006	0.010	0.012	0.010	0.013	0.010	0.034
108	Spring	1	25	0.015	0.008	0.015	0.011	0.015	0.012	0.015	0.024
108	Summer	1	25	0.015	0.005	0.015	0.023	0.015	0.024	0.015	0.043
108	Fall	1	25	0.015	0.008	0.015	0.020	0.015	0.021	0.015	0.041
121	Winter	1	27	0.013	0.008	0.013	0.013	0.013	0.013	0.013	0.020
121	Spring	1	28	0.014	0.005	0.014	0.013	0.014	0.016	0.014	0.036
121	Summer	1	28	0.015	0.005	0.015	0.025	0.015	0.027	0.015	0.056
121	Fall	1	29	0.013	0.010	0.013	0.016	0.013	0.021	0.013	0.056
121M	Winter	1	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
121M	Spring	1	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
121M	Summer	1	ND	0.014	ND	0.014	ND	0.014	ND	0.014	ND
121M	Fall	1	ND	0.012	ND	0.012	ND	0.012	ND	0.012	ND
119	Winter	1	6	0.007	0.008	0.007	0.011	0.007	0.011	0.007	0.016
119	Spring	1	6	0.013	0.006	0.013	0.009	0.013	0.010	0.013	0.015
119	Summer	1	7	0.009	0.006	0.009	0.011	0.009	0.011	0.009	0.015
119	Fall	1	7	0.012	0.009	0.012	0.013	0.012	0.030	0.012	0.134
110	Winter	1	19	0.011	0.006	0.011	0.010	0.011	0.010	0.011	0.015
110	Spring	1	19	0.011	0.006	0.011	0.011	0.011	0.013	0.011	0.024
110	Summer	1	16	0.010	0.007	0.010	0.013	0.010	0.012	0.010	0.018
110	Fall	1	13	0.007	0.007	0.007	0.012	0.007	0.013	0.007	0.019
105	Winter	1	16	0.009	0.011	0.009	0.016	0.009	0.016	0.009	0.020
105	Spring	ND	19	ND	0.010	ND	0.018	ND	0.022	ND	0.048
105	Summer	1	20	0.020	0.021	0.020	0.036	0.020	0.034	0.020	0.046
105	Fall	1	20	0.023	0.010	0.023	0.023	0.023	0.025	0.023	0.067

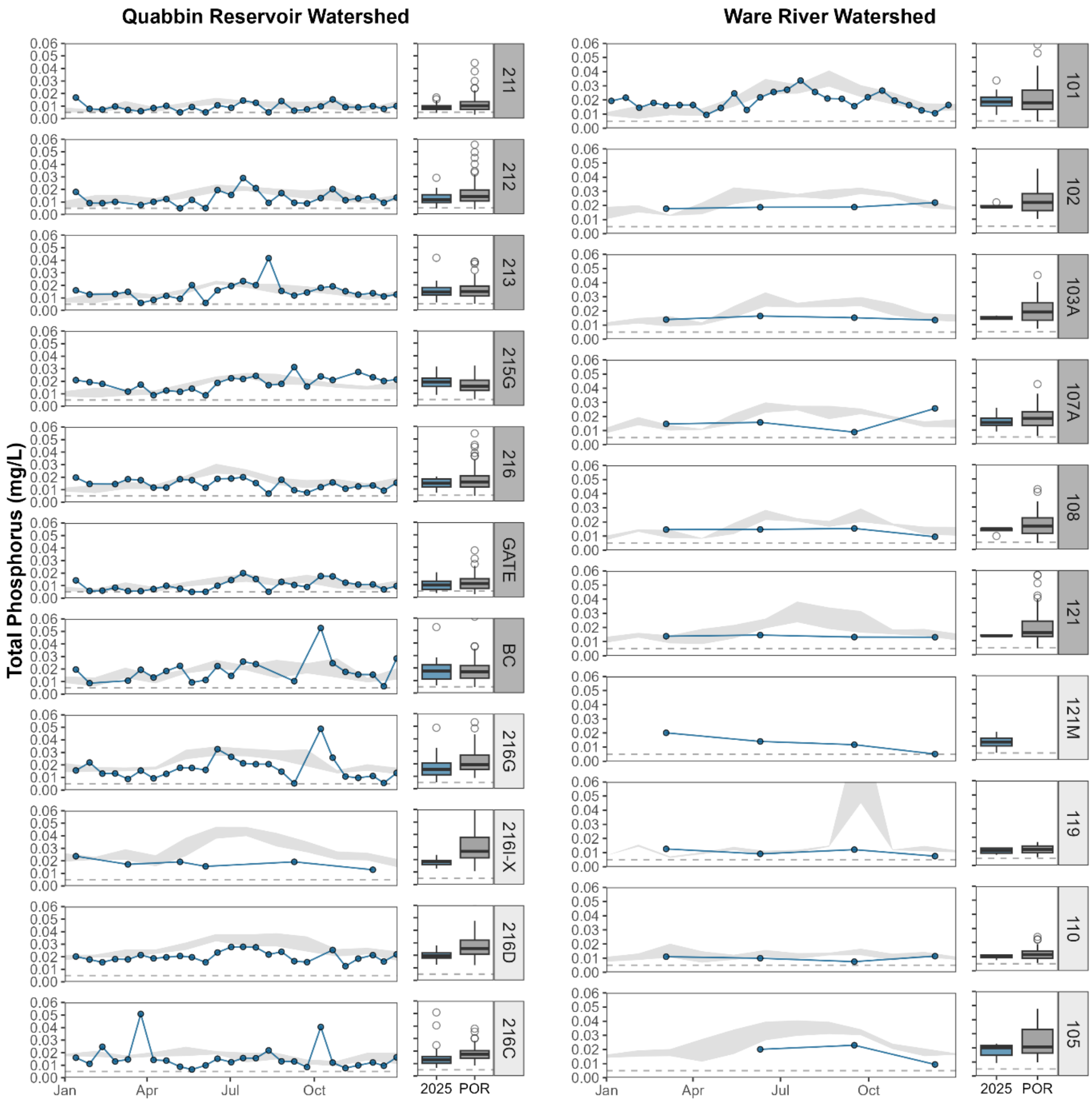


Figure 25. *Time series and boxplots of 2025 total phosphorus results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. The horizontal dashed grey line corresponds to laboratory detection limits (0.005 mg/L). Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

3.2.6. Total Organic Carbon and UV_{254}

3.2.6.1. Total Organic Carbon

Total organic carbon (TOC) was introduced to DWSP monitoring programs in 2021 as an additional proxy for understanding disinfection-byproduct precursor potential of source waters in the Quabbin Reservoir Watershed (Golea et al., 2017). TOC was monitored every two weeks in Core tributaries in the Quabbin Reservoir Watershed beginning in 2021. TOC was added to site 101 (Ware River at Shaft 8 Intake) and EQA sites beginning in 2023. Thus, annual monitoring continues to inform the full range of variability of concentrations of TOC in time and space throughout the Quabbin Reservoir and Ware River watersheds, with limited insight into long-term patterns. However, when considered with historical observations of mean UV_{254}, these analytes provide insight regarding the quantity and type of organic matter, as well as controls on its transport at the catchment scale (Garvey and Tobiason, 2003). High-resolution concentrations of TOC, in tandem with UV_{254} absorbance and streamflow data, may elucidate potential hot spots or hot moments of organic carbon loading to Quabbin Reservoir.

Concentrations of TOC ranged from 0.9 to 15.3 mg/L in tributaries of the Quabbin Reservoir Watershed and site 101 of the Ware River Watershed in 2025 (Table 35). Median seasonal monitoring results for TOC in 2025 were generally comparable to those observed from the previous years of monitoring for Quabbin Core sites and Ware River Site 101 (Figure 26) with variations from the period of record medians of -2.8 to +2.4, and both positive and negative variations in all seasons. Due to the limited period of record, comparisons of annual medians are more robust. In 2025, three of the seven sites with prior sampling data had annual median values above the period of record median (BC by +1.62, GATE by +0.29, and 101 by +0.1 mg/L). All other sites had 2025 medians below the period of record median. Continued monitoring of TOC in these streams is critical for determining actual baseline conditions and to capture the full range of seasonal variability under different hydrological conditions (e.g., extreme precipitation in summer 2023, prolonged drought in 2024 and 2025, etc.).

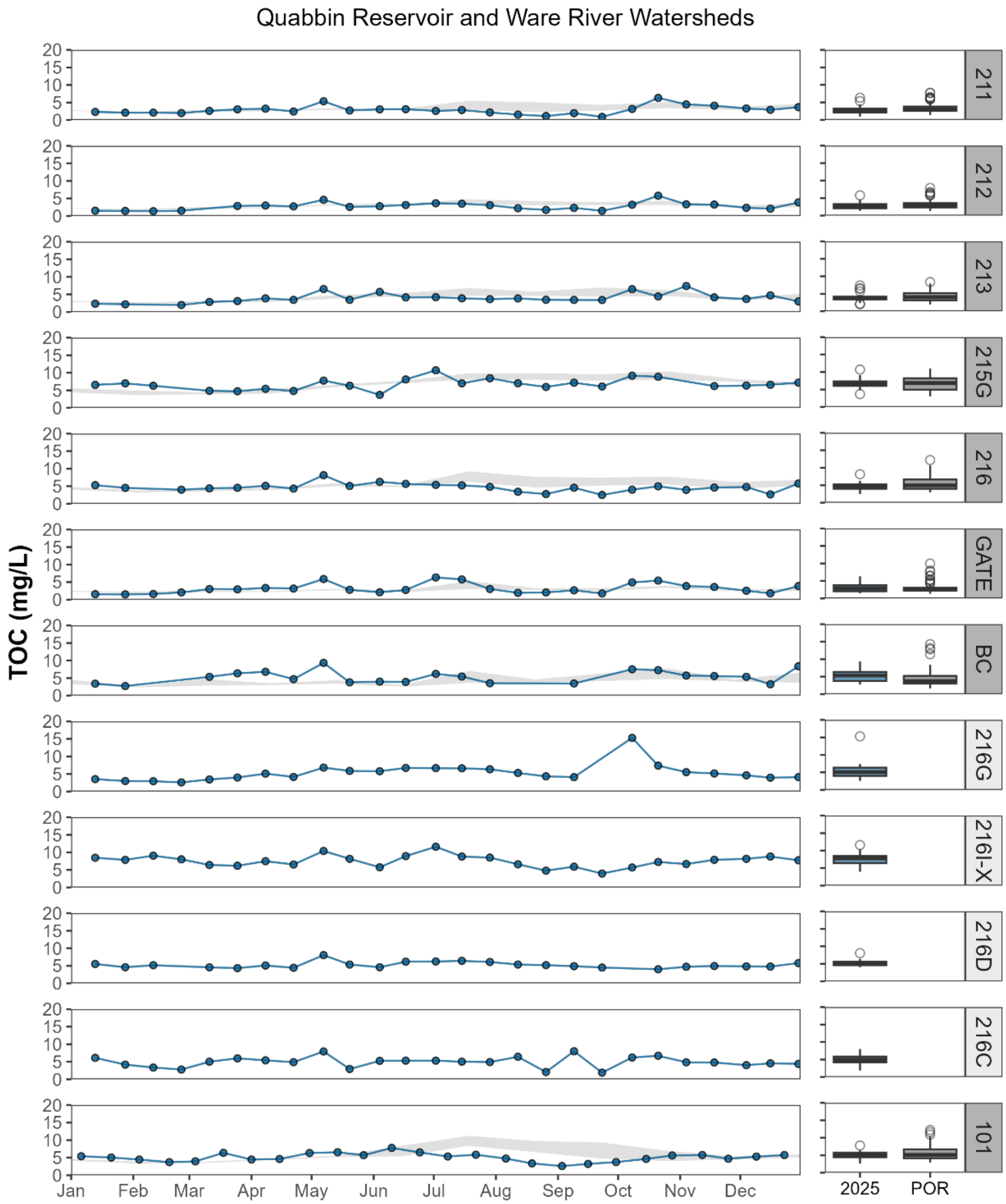


Figure 26. *Time series and boxplots of 2025 total organic carbon results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25th to 75th percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 35. *Seasonal statistics for total organic carbon (mg/L) measured in the Quabbin Reservoir and Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	25	1.99	1.79	2.32	2.80	2.64	3.08	3.67	6.54
211	Spring	6	27	2.44	1.92	2.90	2.73	3.25	2.87	5.36	4.54
211	Summer	7	28	1.14	1.38	2.61	3.42	2.35	3.82	3.09	7.74
211	Fall	6	24	0.91	1.95	3.63	3.65	3.49	3.90	6.32	7.68
212	Winter	7	24	1.38	1.32	1.51	2.28	2.02	2.43	3.88	4.22
212	Spring	5	27	2.59	1.58	2.86	2.48	3.15	2.62	4.61	4.04
212	Summer	7	27	1.73	2.41	3.08	3.49	2.87	3.90	3.63	7.90
212	Fall	6	24	1.47	1.86	3.24	3.16	3.23	3.42	5.78	6.45
213	Winter	6	26	1.98	1.96	2.67	3.19	2.98	3.43	4.72	5.97
213	Spring	6	27	2.84	2.31	3.44	3.39	3.86	3.62	6.52	6.22
213	Summer	7	28	3.45	3.65	3.87	4.96	4.12	5.31	5.70	8.36
213	Fall	6	24	3.39	2.31	4.27	4.62	4.87	4.89	7.38	7.92
215G	Winter	6	24	6.29	3.05	6.56	5.20	6.65	5.30	7.19	8.08
215G	Spring	6	27	4.73	3.33	5.14	4.61	5.65	4.95	7.76	7.76
215G	Summer	7	27	3.68	6.28	7.00	8.33	7.26	8.57	10.70	11.00
215G	Fall	5	24	6.09	6.28	7.17	8.17	7.50	8.55	9.17	10.80
216	Winter	6	26	2.67	3.00	4.65	4.50	4.51	4.67	5.77	7.10
216	Spring	6	27	4.32	2.99	4.80	4.04	5.26	4.48	8.14	7.00
216	Summer	7	28	2.76	3.69	5.24	5.60	4.79	6.24	6.25	10.60
216	Fall	6	23	2.50	3.36	4.29	6.54	4.10	6.29	4.98	12.20
GATE	Winter	7	24	1.51	1.34	1.80	2.43	2.14	2.60	3.87	7.65
GATE	Spring	6	27	2.81	1.80	3.10	2.43	3.53	2.55	5.89	4.07
GATE	Summer	7	26	1.95	1.77	2.77	2.89	3.44	3.45	6.34	9.98
GATE	Fall	6	24	1.77	1.88	3.74	2.91	3.71	3.31	5.44	7.95
BC	Winter	5	26	2.72	1.61	3.40	3.57	4.61	4.23	8.35	12.80
BC	Spring	6	27	3.78	2.31	5.85	3.49	6.05	3.72	9.33	6.25
BC	Summer	5	25	3.52	2.38	3.98	3.61	4.61	4.58	6.19	14.30
BC	Fall	5	18	3.46	3.23	5.71	4.65	5.90	5.72	7.51	13.20
216G	Winter	7	ND	2.60	ND	3.53	ND	3.53	ND	4.61	ND
216G	Spring	6	ND	3.44	ND	4.63	ND	4.90	ND	6.82	ND
216G	Summer	7	ND	4.33	ND	6.34	ND	5.96	ND	6.72	ND
216G	Fall	5	ND	4.09	ND	5.52	ND	7.49	ND	15.30	ND
216INDX	Winter	7	ND	7.74	ND	8.16	ND	8.30	ND	9.06	ND
216INDX	Spring	6	ND	6.18	ND	7.01	ND	7.53	ND	10.40	ND
216INDX	Summer	7	ND	4.78	ND	8.50	ND	7.85	ND	11.60	ND
216INDX	Fall	6	ND	3.96	ND	6.29	ND	6.23	ND	7.88	ND
216D	Winter	6	ND	4.60	ND	5.01	ND	5.12	ND	5.78	ND
216D	Spring	6	ND	4.35	ND	4.83	ND	5.31	ND	8.05	ND
216D	Summer	7	ND	4.60	ND	6.09	ND	5.73	ND	6.42	ND
216D	Fall	5	ND	4.01	ND	4.73	ND	4.62	ND	4.94	ND
216C	Winter	7	ND	2.77	ND	4.18	ND	4.19	ND	6.11	ND
216C	Spring	6	ND	2.93	ND	5.21	ND	5.35	ND	7.93	ND
216C	Summer	7	ND	2.07	ND	5.26	ND	4.90	ND	6.41	ND
216C	Fall	6	ND	1.89	ND	5.53	ND	5.41	ND	8.00	ND
101	Winter	6	11	3.72	2.93	5.18	4.52	4.94	4.43	5.75	6.32
101	Spring	7	14	3.95	3.34	5.70	4.56	5.43	4.55	6.55	6.43
101	Summer	6	12	3.36	5.39	5.59	8.41	5.59	8.43	7.78	12.20
101	Winter	7	25	1.99	1.79	2.32	2.80	2.64	3.08	3.67	6.54

3.2.6.2. UV_{254}

UV_{254} absorbance in Quabbin Reservoir Watershed tributary monitoring sites ranged from 0.024 to 0.598 ABU/cm in 2025 (Figure 27, Table 36). UV_{254} followed similar seasonal patterns in 2025 as the period of record, with results generally increasing in the summer and declining in fall. However, in 2025, fall values were considerably lower than normal due to drought conditions and low streamflow. UV_{254} readings dropped considerably in late summer into the fall, as a lack of precipitation and subsequent streamflow limited in-stream carbon transport processes. Fall median values deviated from period of record medians by a greater magnitude than results in any other season. Three sites had a slight positive deviation from the period of record (BC, GATE, 211) ranging from +0.014 to +0.035 ABU/cm, but the remaining sites ranged from -0.005 to -0.166 ABU/cm below the period of record medians. Observed spikes in UV_{254} were associated with sampling during or immediately after rain events on 5/7/2025, 7/2/2025, 10/8/2025, and 12/30/2025.

UV_{254} absorbance in Ware River Watershed tributary monitoring sites ranged from 0.093 to 0.566 ABU/cm in 2025 (Table 37, Figure 27). Similar to results from the Quabbin watershed sites, UV_{254} followed the historical trend of increasing in the summer and decreasing in the fall but fell to below average levels in the late summer and fall due to drought conditions. Fall median values deviated from period of record medians by a greater magnitude than results in any other season, ranging from -0.018 to -0.111 ABU/cm compared to the period of record medians. Annual median values were lower at every Ware River Watershed site in 2025 compared to period of record except 121, which was only 0.002 above the period of record median.

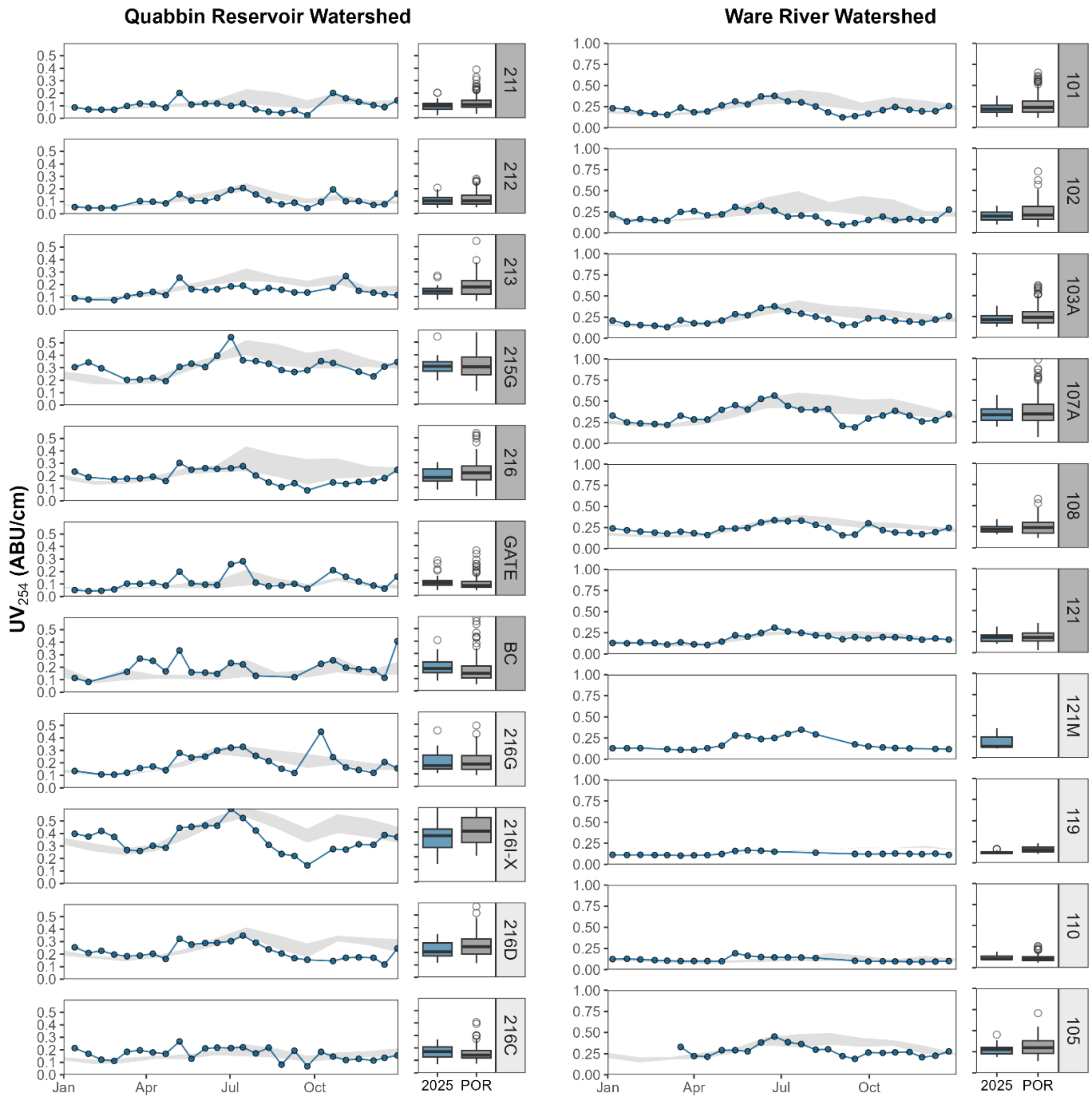


Figure 27. *Time series and boxplots of 2025 UV_{254} results (blue) from tributary monitoring sites compared against each site's period of record (gray). The gray shaded bands represent monthly interquartile range (25^{th} to 75^{th} percentile) for the period of record at each location. Dark gray site labels correspond to Core sampling locations; light gray site labels correspond to EQA sampling locations.*

Table 36. *Seasonal statistics for UV_{254} (ABU/cm) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	42	0.068	0.063	0.087	0.108	0.090	0.111	0.143	0.226
211	Spring	6	44	0.085	0.060	0.111	0.088	0.121	0.096	0.203	0.221
211	Summer	7	47	0.043	0.033	0.099	0.133	0.088	0.153	0.117	0.390
211	Fall	5	42	0.024	0.041	0.132	0.118	0.116	0.128	0.203	0.309
212	Winter	7	42	0.047	0.049	0.055	0.078	0.073	0.085	0.162	0.216
212	Spring	5	44	0.084	0.048	0.102	0.077	0.110	0.087	0.158	0.157
212	Summer	7	46	0.077	0.067	0.128	0.176	0.139	0.175	0.207	0.279
212	Fall	6	42	0.047	0.052	0.098	0.109	0.105	0.115	0.196	0.258
213	Winter	6	42	0.075	0.072	0.103	0.124	0.103	0.134	0.135	0.277
213	Spring	6	44	0.107	0.065	0.133	0.114	0.151	0.134	0.255	0.292
213	Summer	7	47	0.141	0.182	0.163	0.238	0.167	0.254	0.192	0.546
213	Fall	5	42	0.136	0.094	0.150	0.196	0.173	0.201	0.268	0.346
215G	Winter	6	36	0.231	0.108	0.307	0.264	0.305	0.255	0.345	0.365
215G	Spring	6	38	0.193	0.130	0.213	0.207	0.243	0.218	0.332	0.347
215G	Summer	7	41	0.281	0.262	0.353	0.397	0.367	0.411	0.545	0.582
215G	Fall	5	37	0.266	0.230	0.279	0.357	0.301	0.360	0.353	0.548
216	Winter	6	42	0.158	0.122	0.186	0.211	0.197	0.210	0.248	0.322
216	Spring	6	44	0.159	0.108	0.187	0.166	0.211	0.183	0.304	0.320
216	Summer	7	47	0.112	0.121	0.256	0.271	0.217	0.292	0.278	0.520
216	Fall	5	42	0.084	0.029	0.141	0.255	0.132	0.236	0.152	0.537
GATE	Winter	7	42	0.044	0.041	0.057	0.073	0.073	0.080	0.160	0.288
GATE	Spring	6	44	0.088	0.046	0.105	0.070	0.118	0.077	0.199	0.156
GATE	Summer	7	44	0.083	0.055	0.096	0.116	0.144	0.128	0.282	0.362
GATE	Fall	5	41	0.063	0.062	0.120	0.088	0.131	0.105	0.211	0.333
BC	Winter	5	42	0.082	0.052	0.115	0.153	0.180	0.168	0.408	0.559
BC	Spring	6	44	0.160	0.080	0.208	0.116	0.224	0.143	0.334	0.358
BC	Summer	5	41	0.131	0.082	0.157	0.141	0.178	0.184	0.233	0.587
BC	Fall	5	32	0.120	0.080	0.197	0.162	0.196	0.191	0.255	0.535
216G	Winter	6	40	0.106	0.092	0.127	0.135	0.138	0.139	0.206	0.230
216G	Spring	6	37	0.121	0.090	0.164	0.141	0.186	0.154	0.279	0.275
216G	Summer	7	43	0.152	0.172	0.256	0.276	0.260	0.291	0.328	0.488
216G	Fall	5	38	0.119	0.120	0.164	0.192	0.224	0.205	0.449	0.360
216I-X	Winter	7	38	0.310	0.226	0.376	0.334	0.376	0.345	0.420	0.527
216I-X	Spring	6	34	0.260	0.213	0.294	0.306	0.335	0.318	0.454	0.474
216I-X	Summer	7	44	0.236	0.351	0.462	0.521	0.431	0.534	0.598	0.794
216I-X	Fall	5	45	0.145	0.210	0.272	0.438	0.245	0.438	0.313	0.700
216D	Winter	7	31	0.117	0.151	0.210	0.197	0.203	0.221	0.255	0.449
216D	Spring	6	31	0.162	0.135	0.196	0.180	0.223	0.189	0.323	0.273
216D	Summer	7	32	0.205	0.199	0.291	0.317	0.281	0.331	0.349	0.568
216D	Fall	5	34	0.145	0.114	0.167	0.289	0.163	0.282	0.174	0.450
216C	Winter	7	31	0.111	0.075	0.136	0.140	0.146	0.138	0.214	0.273
216C	Spring	6	31	0.128	0.081	0.181	0.139	0.187	0.135	0.267	0.222
216C	Summer	7	32	0.082	0.082	0.214	0.173	0.191	0.187	0.220	0.407
216C	Fall	6	34	0.068	0.073	0.137	0.142	0.140	0.163	0.193	0.393

Table 37. *Seasonal statistics for UV_{254} (ABU/cm) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	84	0.164	0.119	0.209	0.196	0.208	0.204	0.257	0.398
101	Spring	7	83	0.153	0.114	0.237	0.193	0.232	0.208	0.312	0.337
101	Summer	6	84	0.183	0.132	0.307	0.337	0.300	0.349	0.378	0.651
101	Fall	7	84	0.124	0.128	0.196	0.267	0.185	0.287	0.247	0.613
102	Winter	6	24	0.136	0.104	0.160	0.178	0.184	0.187	0.276	0.323
102	Spring	7	27	0.145	0.133	0.249	0.181	0.238	0.199	0.310	0.322
102	Summer	6	25	0.121	0.117	0.202	0.294	0.217	0.342	0.320	0.726
102	Fall	7	28	0.097	0.067	0.152	0.248	0.148	0.269	0.195	0.515
103A	Winter	6	102	0.149	0.103	0.189	0.176	0.194	0.183	0.263	0.384
103A	Spring	7	120	0.131	0.103	0.209	0.177	0.209	0.192	0.286	0.622
103A	Summer	6	126	0.226	0.150	0.305	0.346	0.305	0.354	0.378	0.594
103A	Fall	7	130	0.155	0.136	0.199	0.265	0.197	0.278	0.237	0.609
107A	Winter	6	105	0.231	0.172	0.263	0.269	0.278	0.273	0.346	0.550
107A	Spring	7	124	0.220	0.070	0.328	0.275	0.339	0.289	0.454	0.484
107A	Summer	6	122	0.398	0.155	0.427	0.500	0.458	0.497	0.566	0.985
107A	Fall	7	129	0.190	0.164	0.295	0.406	0.285	0.413	0.386	0.772
108	Winter	6	121	0.191	0.119	0.211	0.174	0.216	0.183	0.248	0.312
108	Spring	7	129	0.162	0.116	0.202	0.173	0.207	0.186	0.245	0.324
108	Summer	6	125	0.250	0.204	0.318	0.335	0.306	0.337	0.337	0.579
108	Fall	7	129	0.158	0.159	0.189	0.262	0.200	0.275	0.300	0.481
121	Winter	6	44	0.126	0.090	0.133	0.146	0.146	0.143	0.184	0.191
121	Spring	7	49	0.106	0.029	0.137	0.123	0.148	0.137	0.221	0.257
121	Summer	6	48	0.211	0.180	0.249	0.244	0.251	0.251	0.311	0.352
121	Fall	7	54	0.168	0.139	0.187	0.205	0.187	0.212	0.199	0.312
121M	Winter	5	ND	0.117	ND	0.129	ND	0.126	ND	0.131	ND
121M	Spring	7	ND	0.110	ND	0.129	ND	0.168	ND	0.282	ND
121M	Summer	5	ND	0.238	ND	0.293	ND	0.286	ND	0.349	ND
121M	Fall	5	ND	0.126	ND	0.139	ND	0.145	ND	0.175	ND
119	Winter	6	6	0.110	0.144	0.113	0.150	0.115	0.156	0.127	0.176
119	Spring	7	6	0.103	0.106	0.110	0.107	0.125	0.111	0.165	0.124
119	Summer	3	7	0.138	0.128	0.150	0.155	0.150	0.152	0.161	0.173
119	Fall	6	7	0.121	0.191	0.124	0.196	0.124	0.202	0.129	0.232
110	Winter	6	26	0.095	0.062	0.116	0.116	0.113	0.111	0.128	0.148
110	Spring	7	26	0.098	0.062	0.102	0.089	0.124	0.090	0.193	0.130
110	Summer	5	26	0.137	0.079	0.144	0.118	0.143	0.128	0.148	0.258
110	Fall	6	26	0.093	0.062	0.097	0.115	0.097	0.129	0.104	0.251
105	Winter	2	22	0.226	0.139	0.251	0.238	0.251	0.227	0.277	0.307
105	Spring	6	28	0.214	0.151	0.284	0.230	0.271	0.244	0.330	0.360
105	Summer	6	30	0.298	0.259	0.373	0.420	0.364	0.406	0.453	0.549
105	Fall	7	33	0.188	0.170	0.260	0.352	0.239	0.349	0.269	0.707

3.2.7. Alkalinity and pH

3.2.7.1. Alkalinity

Alkalinity analyses were performed quarterly during 2025, but the spring quarterly samples were not collected due to a closure of the Quabbin MWRA lab during a building maintenance project. Alkalinity results among streams in the Quabbin Reservoir Watershed ranged from 0.77 to 29.70 mg/L in 2025 (Table 38). Quarterly results from winter and fall were elevated above historical averages and results from summer were below historical averages at all Quabbin tributary monitoring locations. The summer samples were collected on 6/4/2025, three days after Belchertown received 1.76" of rain. As rainwater is naturally slightly acidic with low alkalinity, this may have reduced the alkalinity in the streams for that sample period. In contrast, during the low flows due to drought in fall and winter, six record high seasonal alkalinities were recorded (215G and 216 in fall; 215G, 216, 216C, 216D in winter).

Alkalinity results among streams in the Ware River Watershed ranged from 3.52 to 26.70 mg/L in 2025 (Table 39). Seasonal patterns were similar to Quabbin Reservoir Watershed sites, with all summer values below historical averages except at sites 110 and 119, and all other samples in spring, fall, and winter above historical averages. New seasonal maximums were recorded in six streams in spring (102, 103A, 107A, 108, 110, 119), two streams in fall (105, 107A), and five streams in winter (102, 103A, 105, 108, 119). Interpretation of alkalinity results is limited by differences in sampling frequencies of this analyte across sites in this watershed, with period of record counts varying considerably across sites (Figure 5). Temporal changes in alkalinity concentrations in surface water may be attributed to a variety of factors (e.g., natural geogenic variability, urbanization and associated chemical weathering of the built environment, acid rain inputs, or changes in or introduced during sample collection and analysis) that vary both across and within these watersheds. Thus, much of the heterogeneity of alkalinity concentrations observed in tributaries within the Quabbin Reservoir and Ware River Watersheds is likely the result of the interactions of multiple variable forces, rather than readily attributable to a single direct cause.

Table 38. *Seasonal statistics for alkalinity (mg/L) measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	*Count 2025*	*Result 2025*	*Count POR*	*Minimum POR*	*Median POR*	*Mean POR*	*Max POR*
211	Winter	1	2.87	101	0.05	2.00	2.00	5.00
211	Spring	ND	ND	108	0.10	1.60	1.74	5.20
211	Summer	1	2.91	110	0.05	3.95	3.94	7.40
211	Fall	1	6.65	104	0.30	2.62	3.17	7.80
212	Winter	1	8.20	91	1.30	5.00	5.03	11.10
212	Spring	ND	ND	99	2.20	4.40	4.59	8.00
212	Summer	1	6.64	103	3.00	10.10	10.02	18.00
212	Fall	1	12.10	98	2.90	8.50	8.61	18.00
213	Winter	1	9.52	101	1.20	4.40	4.51	10.10
213	Spring	ND	ND	105	1.70	4.10	4.32	7.80
213	Summer	1	6.45	109	2.10	10.00	10.02	20.20
213	Fall	1	15.10	101	2.00	6.90	7.45	17.30
215G	Winter	1	5.20	13	1.65	3.06	3.10	4.87
215G	Spring	ND	ND	14	1.23	1.66	1.87	3.30
215G	Summer	1	2.31	17	2.12	4.32	4.24	5.97
215G	Fall	1	6.53	16	2.26	4.71	4.68	6.39
216	Winter	1	5.93	97	0.80	2.80	2.98	5.80
216	Spring	ND	ND	105	0.50	2.40	2.53	5.30
216	Summer	1	4.09	109	1.10	5.20	5.17	8.50
216	Fall	1	9.16	103	1.30	4.70	4.87	8.84
GATE	Winter	1	3.10	72	0.05	0.20	0.53	4.79
GATE	Spring	ND	ND	81	0.05	0.10	0.22	1.13
GATE	Summer	1	0.77	80	0.05	0.80	0.91	3.23
GATE	Fall	1	3.87	77	0.05	1.30	1.36	5.57
BC	Winter	1	22.10	71	5.60	13.30	13.67	33.50
BC	Spring	ND	ND	84	5.80	12.65	13.05	24.90
BC	Summer	1	13.50	51	9.10	24.80	24.52	37.20
BC	Fall	1	29.70	47	3.86	20.20	20.65	36.40
216G	Winter	1	6.57	41	3.00	5.46	5.64	9.77
216G	Spring	ND	ND	36	3.25	5.56	5.93	9.98
216G	Summer	1	7.75	42	5.96	9.89	9.94	15.70
216G	Fall	1	10.10	39	3.61	7.79	7.83	12.70
216I-X	Winter	1	3.78	39	1.45	2.46	2.62	4.86
216I-X	Spring	ND	ND	34	0.95	2.82	3.42	14.70
216I-X	Summer	1	3.32	44	2.74	6.12	5.96	8.63
216I-X	Fall	1	7.51	46	1.92	4.37	4.99	9.08
216D	Winter	1	5.27	31	1.63	3.32	3.37	5.02
216D	Spring	ND	ND	28	2.16	3.77	3.70	5.27
216D	Summer	1	3.70	30	2.97	5.94	5.98	8.49
216D	Fall	1	8.11	34	3.05	4.64	5.38	9.68
216C	Winter	1	13.90	31	3.75	7.49	7.41	10.80
216C	Spring	ND	ND	28	2.60	6.17	6.19	10.80
216C	Summer	1	6.24	30	6.63	9.73	9.69	13.20
216C	Fall	1	10.00	34	5.34	9.37	8.93	11.80

Table 39. *Seasonal statistics for alkalinity (mg/L) measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	*Count* 2025	*Result* 2025	*Count* POR	*Min* POR	*Median* POR	*Mean* POR	*Max* POR
101	Winter	1	5.91	8	1.39	3.15	3.29	5.35
101	Spring	1	4.29	9	2.85	3.40	3.36	4.19
101	Summer	1	4.37	9	3.64	7.08	6.97	8.55
101	Fall	1	8.74	8	2.41	7.68	6.72	8.95
102	Winter	1	7.79	96	1.30	3.40	3.46	6.40
102	Spring	1	6.45	97	1.10	2.80	2.84	5.10
102	Summer	1	3.81	103	1.50	5.50	5.30	8.00
102	Fall	1	8.47	99	1.10	5.10	4.95	16.30
103A	Winter	1	7.09	8	1.33	2.36	2.75	6.60
103A	Spring	1	3.62	14	0.40	2.00	1.90	3.24
103A	Summer	1	3.77	9	2.99	5.20	5.13	6.30
103A	Fall	1	9.96	8	1.96	6.53	6.63	11.40
107A	Winter	1	3.66	8	1.16	2.08	2.28	4.09
107A	Spring	1	5.18	13	0.05	2.20	2.11	3.01
107A	Summer	1	3.52	9	3.06	5.75	5.57	7.10
107A	Fall	1	8.65	8	1.09	5.68	5.25	8.51
108	Winter	1	7.23	93	0.90	2.70	3.13	7.18
108	Spring	1	7.46	102	0.40	2.50	2.59	5.53
108	Summer	1	4.43	102	2.20	6.40	6.58	12.80
108	Fall	1	10.00	99	0.70	5.10	5.54	14.00
121	Winter	1	15.00	109	3.37	7.40	8.14	17.10
121	Spring	1	13.90	111	2.50	6.59	7.15	16.60
121	Summer	1	12.20	120	4.50	14.45	17.78	95.10
121	Fall	1	26.70	121	4.20	11.40	13.98	41.00
121M	Winter	1	13.20	ND	ND	ND	ND	ND
121M	Spring	1	16.50	ND	ND	ND	ND	ND
121M	Summer	1	10.50	ND	ND	ND	ND	ND
121M	Fall	1	20.30	ND	ND	ND	ND	ND
119	Winter	1	13.20	93	3.10	8.90	8.68	11.70
119	Spring	1	14.70	91	3.30	7.50	7.38	10.30
119	Summer	1	11.30	78	7.40	9.25	9.28	12.40
119	Fall	1	12.40	81	7.90	9.80	9.75	12.70
110	Winter	1	9.52	121	3.20	6.98	7.13	11.70
110	Spring	1	13.10	122	1.96	5.51	5.78	11.80
110	Summer	1	8.34	121	3.70	8.10	8.25	12.60
110	Fall	1	11.70	122	4.70	7.60	7.93	14.00
105	Winter	1	7.25	41	0.30	3.65	3.52	6.60
105	Spring	ND	ND	97	0.81	3.30	3.52	10.50
105	Summer	1	4.60	124	2.40	7.25	7.32	13.60
105	Fall	1	12.00	125	0.40	4.87	5.28	11.30

3.2.7.2. pH

Since the passage of the Clean Air Act amendments in 1990, the amount of sulfur dioxide and nitrogen dioxide in precipitation in the northeastern United States has decreased dramatically, and continues to decrease, thereby increasing the pH of the precipitation in the Quabbin Reservoir and Ware River Watersheds (Feng et al., 2001). Spatial variability in surface water pH across the Quabbin Reservoir Watershed and Ware River Watersheds may be attributed to variations in watershed characteristics that may impact the area's speed of recovery from legacy acid rain or create additional acidic or basic runoff such as geogenic variability, land use, and meteorological drivers. Data QA/QC for historical records of this parameter are ongoing.

The pH in monitoring tributaries ranged from 5.27 to 7.47 in the Quabbin Reservoir Watershed in 2025 and from 5.70 to 7.57 in the Ware River Watershed (Table 40, Table 41). Observations of pH largely fell within historical seasonal ranges at all sites with long term monitoring records across both watersheds and results were similar to the slightly elevated values of alkalinity. No new record seasonal minimums were observed, but new seasonal maximums were observed at two sites in the spring (102, 119), one site in the summer (110), two sites in the fall (216C, 216I-X) and three sites in the winter (216C, 102, 103A). MassDEP has established a recommended range of pH for the protection of aquatic life (6.5 to 8.3 SU and within 0.5 SU of the natural background range). Median pH values observed in monitoring tributaries of both watersheds were within, or fell below, the minimum standards for Class A inland waters as established by MassDEP (6.5 to 8.3) in 2025, consistent with prior observations throughout the period of record.

Table 40. *Seasonal statistics for pH measured in the Quabbin Reservoir Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
211	Winter	7	266	6.06	4.10	6.49	6.10	6.40	6.07	6.55	7.23
211	Spring	6	265	5.99	4.85	6.31	6.07	6.24	6.03	6.45	7.09
211	Summer	7	266	6.39	4.40	6.54	6.30	6.51	6.21	6.59	6.93
211	Fall	6	257	6.05	4.90	6.31	6.14	6.31	6.12	6.53	6.93
212	Winter	7	248	6.53	4.86	6.65	6.52	6.64	6.47	6.80	7.38
212	Spring	5	251	6.63	4.65	6.76	6.60	6.76	6.53	6.85	7.64
212	Summer	7	252	6.85	5.10	7.03	6.80	7.02	6.71	7.12	7.43
212	Fall	6	241	6.65	5.56	6.80	6.70	6.81	6.63	7.00	7.13
213	Winter	6	258	6.00	5.01	6.17	6.11	6.16	6.12	6.33	7.07
213	Spring	6	259	6.09	5.02	6.24	6.20	6.23	6.14	6.36	7.07
213	Summer	7	260	6.16	4.95	6.21	6.20	6.24	6.16	6.36	7.20
213	Fall	6	247	6.07	5.04	6.27	6.16	6.25	6.11	6.39	6.60
215G	Winter	6	35	5.83	4.80	5.99	5.71	5.98	5.67	6.08	6.58
215G	Spring	6	37	5.27	4.81	5.91	5.98	5.82	5.80	6.06	6.37
215G	Summer	7	39	5.89	4.77	6.08	5.75	6.05	5.68	6.23	6.37
215G	Fall	5	37	6.16	4.73	6.19	5.82	6.20	5.77	6.25	6.73
216	Winter	6	264	6.79	4.77	6.83	6.40	6.86	6.35	7.03	7.17
216	Spring	6	263	6.54	5.31	6.65	6.40	6.67	6.36	6.83	7.56
216	Summer	7	265	6.78	5.37	6.89	6.70	6.98	6.66	7.16	7.63
216	Fall	6	253	6.82	5.53	6.91	6.60	6.91	6.55	7.02	7.24
GATE	Winter	6	187	6.52	4.09	6.74	5.64	6.83	5.69	7.47	7.75
GATE	Spring	6	193	5.85	4.32	5.94	5.50	5.95	5.51	6.12	6.62
GATE	Summer	7	195	5.56	4.39	6.44	6.00	6.26	5.94	6.64	7.21
GATE	Fall	6	188	6.43	4.72	6.54	6.18	6.53	6.05	6.58	7.20
BC	Winter	5	188	6.79	4.23	6.93	6.81	6.98	6.74	7.18	7.71
BC	Spring	6	197	7.03	5.59	7.11	6.94	7.11	6.88	7.18	7.97
BC	Summer	5	159	7.20	5.69	7.35	7.15	7.31	7.07	7.39	7.84
BC	Fall	5	147	7.01	5.15	7.10	6.96	7.13	6.91	7.29	7.50
216G	Winter	7	40	6.39	5.13	6.56	6.50	6.53	6.42	6.69	6.92
216G	Spring	6	40	6.59	5.69	6.75	6.55	6.75	6.51	6.92	7.24
216G	Summer	7	39	6.83	5.56	7.11	6.81	7.08	6.75	7.23	7.70
216G	Fall	5	33	6.65	6.15	6.75	6.72	6.73	6.69	6.80	7.07
216I-X	Winter	7	38	6.30	4.50	6.42	6.20	6.44	6.11	6.63	6.88
216I-X	Spring	6	36	6.18	5.05	6.37	6.17	6.40	6.09	6.59	6.68
216I-X	Summer	7	39	6.52	4.72	6.80	6.46	6.76	6.31	6.89	7.28
216I-X	Fall	6	41	6.54	5.68	6.62	6.34	6.67	6.32	6.88	6.80
216D	Winter	7	30	6.38	5.13	6.48	6.20	6.48	6.12	6.64	6.89
216D	Spring	6	31	5.85	5.16	6.45	6.08	6.37	6.05	6.55	6.78
216D	Summer	7	28	6.45	4.76	6.58	6.11	6.57	6.11	6.66	7.16
216D	Fall	6	29	6.48	5.78	6.57	6.27	6.57	6.28	6.67	6.82
216C	Winter	7	30	6.71	5.49	6.89	6.48	6.91	6.42	7.14	7.10
216C	Spring	6	30	6.76	5.39	6.85	6.37	6.84	6.31	6.91	7.04
216C	Summer	7	28	6.82	5.34	6.90	6.48	6.89	6.51	6.95	7.56
216C	Fall	6	29	6.69	6.13	6.93	6.54	6.90	6.53	7.05	6.93

Table 41. *Seasonal statistics for pH measured in the Ware River Watershed tributary sites during 2025 compared to the period of record (POR).*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
101	Winter	6	224	6.27	5.22	6.54	6.20	6.49	6.22	6.65	7.44
101	Spring	7	237	5.89	5.11	6.35	6.24	6.29	6.21	6.66	7.04
101	Summer	6	231	6.33	5.03	6.68	6.47	6.64	6.41	6.92	7.21
101	Fall	7	232	6.26	4.51	6.49	6.40	6.48	6.35	6.77	7.18
102	Winter	6	127	6.55	5.70	6.76	6.40	6.73	6.37	6.95	6.80
102	Spring	7	131	6.20	5.80	6.35	6.40	6.45	6.36	6.91	6.86
102	Summer	6	132	6.41	5.80	6.67	6.52	6.64	6.52	6.78	6.92
102	Fall	7	132	6.51	5.60	6.78	6.50	6.76	6.50	6.86	7.18
103A	Winter	6	100	5.92	5.16	6.61	6.06	6.70	6.03	7.57	6.81
103A	Spring	7	121	5.74	4.65	6.22	6.12	6.18	6.06	6.40	7.17
103A	Summer	6	123	6.40	4.43	6.44	6.21	6.48	6.07	6.72	7.02
103A	Fall	7	125	6.10	4.56	6.30	6.13	6.38	6.07	6.83	6.90
107A	Winter	6	102	5.85	1.11	6.10	5.80	6.12	5.77	6.47	7.06
107A	Spring	7	121	5.70	4.48	6.01	6.07	5.99	6.00	6.21	6.91
107A	Summer	6	120	5.99	4.77	6.56	6.25	6.41	6.15	6.59	6.85
107A	Fall	7	124	5.91	3.93	6.30	6.10	6.19	6.03	6.36	7.01
108	Winter	6	215	6.03	5.21	6.35	6.10	6.29	6.08	6.46	6.92
108	Spring	7	225	6.11	5.04	6.34	6.20	6.33	6.14	6.57	7.13
108	Summer	6	223	6.28	5.06	6.43	6.30	6.42	6.25	6.51	7.03
108	Fall	7	225	6.14	4.43	6.30	6.20	6.26	6.16	6.34	6.76
121	Winter	6	141	6.24	2.63	6.49	6.41	6.47	6.42	6.71	6.85
121	Spring	7	143	6.42	6.02	6.59	6.50	6.59	6.50	6.80	6.88
121	Summer	6	150	6.55	6.04	6.73	6.60	6.69	6.63	6.77	7.40
121	Fall	7	154	6.42	5.61	6.58	6.50	6.58	6.53	6.80	7.10
121M	Winter	5	ND	6.39	ND	6.59	ND	6.56	ND	6.72	ND
121M	Spring	7	ND	6.28	ND	6.78	ND	6.69	ND	6.99	ND
121M	Summer	5	ND	6.97	ND	7.01	ND	7.03	ND	7.12	ND
121M	Fall	5	ND	6.78	ND	6.90	ND	6.87	ND	6.96	ND
119	Winter	6	105	6.77	5.70	6.85	6.70	6.85	6.67	6.90	7.10
119	Spring	7	102	6.57	6.02	7.10	6.80	7.00	6.70	7.19	7.00
119	Summer	3	87	6.72	6.47	6.97	6.90	6.93	6.87	7.09	7.13
119	Fall	6	88	6.68	6.01	6.83	6.90	6.82	6.82	6.91	7.10
110	Winter	6	131	6.42	2.87	6.61	6.40	6.62	6.41	6.81	7.14
110	Spring	7	132	6.48	5.77	6.74	6.60	6.72	6.58	6.93	7.08
110	Summer	5	131	6.85	6.36	6.99	6.80	6.98	6.80	7.15	7.14
110	Fall	6	133	6.68	6.19	6.82	6.70	6.80	6.69	6.91	7.10
105	Winter	2	44	5.77	5.40	6.09	6.03	6.09	6.00	6.40	6.90
105	Spring	6	106	5.82	5.50	6.16	6.10	6.12	6.10	6.32	6.60
105	Summer	6	133	6.00	5.70	6.55	6.40	6.47	6.32	6.64	6.80
105	Fall	7	133	6.18	5.10	6.38	6.14	6.35	6.12	6.48	6.60

3.2.8. Special Investigations

3.2.8.1. Forestry Monitoring

Timber harvesting in the treatment watershed (EBU) began on December 18, 2019 and was completed October 11, 2020. The post-treatment period of the long-term forestry monitoring project began with data collected in 2020 and continued into 2025. Preliminary analyses of calibration period data have been summarized in anticipation of study completion, which will focus on analyzing conditions across pre-treatment and post-treatment study periods.

3.2.8.2. Environmental Quality Assessments

Surface water samples collected in 2025 throughout the East Branch Swift and Coldbrook and Longmeadow sanitary districts ultimately revealed no widespread indicators of impairment/degradation of water quality. Additional sampling for specific conductance in the Coldbrook and Longmeadow sanitary district was conducted and is reported in Appendix C. Ware River Watershed Conductivity Monitoring Project. Observations of elevated results (e.g., results above historical seasonal normal ranges and/or *E. coli* monitoring results above Class A standards) were followed up with field investigations and follow up sampling. Monitoring of EQA sites in the Quabbin Reservoir will shift to sites in the Quabbin Northwest Sanitary District in 2026, with subsequent reporting in 2027. Monitoring of EQA sites in the Ware River Watershed will continue in the Coldbrook Longmeadow Sanitary District in 2026 for a second year, with subsequent reporting in 2027.

3.3. Reservoir Monitoring

Water quality of the Quabbin Reservoir in 2025 continued to meet the source water quality criteria stipulated under the SWTR and associated filtration avoidance waiver. The following sections provide a detailed summary of DWSP monitoring efforts conducted in 2025 for the purpose of evaluating the physical, chemical, and biological dynamics of the Quabbin Reservoir. Unless otherwise noted, data presented in this section was collected by DWSP.

Depth profiles of physiochemical parameters reveal general patterns in water column characteristics such as the timing of seasonal turnover and stratification, the relative position of the epilimnion, metalimnion, and hypolimnion, the general degree of mixing within the water column, and the timing and location of relative increases in primary productivity. For this report, several depth profiles of various physiochemical water quality parameters (water temperature, pH, dissolved oxygen, specific conductance, and chlorophyll *a*) from each site were selected to demonstrate changes in seasonal conditions and show periods of peak primary productivity. A YSI EXO2 multiparameter sonde was used in 2025 for manual depth profiles, replacing the Eureka Manta used from 2006 to 2020. Seasonal descriptive statistics of parameters (water temperature, dissolved oxygen, chlorophyll *a*, pH, and specific conductance) were calculated for each site to summarize the variation of conditions throughout 2025, relative to the period of record. The period of record spans from 2021 to 2024 for all parameters except water temperature, which extends from 2006 to 2024 due to the well-documented near 1:1 correlation between measurements from the Eureka Manta and the EXO2 sensors for this parameter.

3.3.1. Water Temperature

Water column temperature profiles indicate the timing of seasonal changes in stratification throughout the Quabbin Reservoir (Figure 28). Shifts in the timing and extent of the various stages of stratification may have profound implications on water quality, ecology, and primary productivity. The timing of seasonal turnover in 2025 was consistent with the historical record. However, an overall increase in water temperature was observed in 2025 compared to the period of record. Minimum temperatures were warmer than that of the period of record across all sites and all seasons, with the greatest divergence from historical minimums during the winter at site 202 (6.5°C warmer than the period of record). Mean temperatures were warmer than the period of record during all seasons at site 202, and during fall and winter at sites 206 and Den Hill, with the greatest divergence from seasonal means occurring at site 202 in the winter (2.2°C warmer than the period of record). Maximum temperatures in 2025 did not exceed the established historical range (Table 42). Variations in temporal data coverage across years (resulting from ice coverage) may in part drive deviations in observed temperatures during the winter and spring months. In 2025 full ice cover (except for few pockets of open water) was observed during the month of February, prohibiting on-reservoir monitoring. Statistics provided include measurements conducted in conjunction with monthly Quabbin Reservoir water quality monitoring (March to December) and routine phytoplankton sampling (January to December, except for February at site 202 and January and February at sites 206 and Den Hill due to ice conditions).

Table 42. *Seasonal statistics of water temperature (°C) in Quabbin Reservoir during 2025 relative to the period of record (2006 -2024) at DWSP monitoring sites.*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Spring	233	2846	3.8	1.3	7.2	6.7	7.8	7.3	14.6	17.7
202	Summer	672	7271	7.3	5.8	11.0	10.6	13.7	13.4	26.2	26.7
202	Fall	264	5414	8.2	7.0	12.9	11.7	14.1	13.3	21.8	23.7
202	Winter	37	1047	8.6	2.0	8.6	7.0	8.6	6.4	8.7	10.0
206	Spring	81	1673	4.0	1.8	5.1	7.4	6.7	7.8	13.2	16.9
206	Summer	109	3956	8.6	6.3	12.5	12.5	14.5	14.9	24.6	26.8
206	Fall	77	3158	10.5	6.3	12.5	13.1	15.3	14.5	21.2	23.6
206	Winter	25	695	7.1	1.4	7.6	5.9	7.5	5.5	7.6	9.8
Den Hill	Spring	75	859	4.2	4.4	6.3	8.7	7.7	9.1	15.6	20.2
Den Hill	Summer	67	2237	9.7	7.7	15.6	17.3	16.6	17.3	25.2	26.9
Den Hill	Fall	46	1583	11.0	6.9	19.6	14.8	17.0	15.3	21.5	24.1
Den Hill	Winter	15	303	5.8	1.4	6.0	5.4	6.0	5.3	6.0	8.4

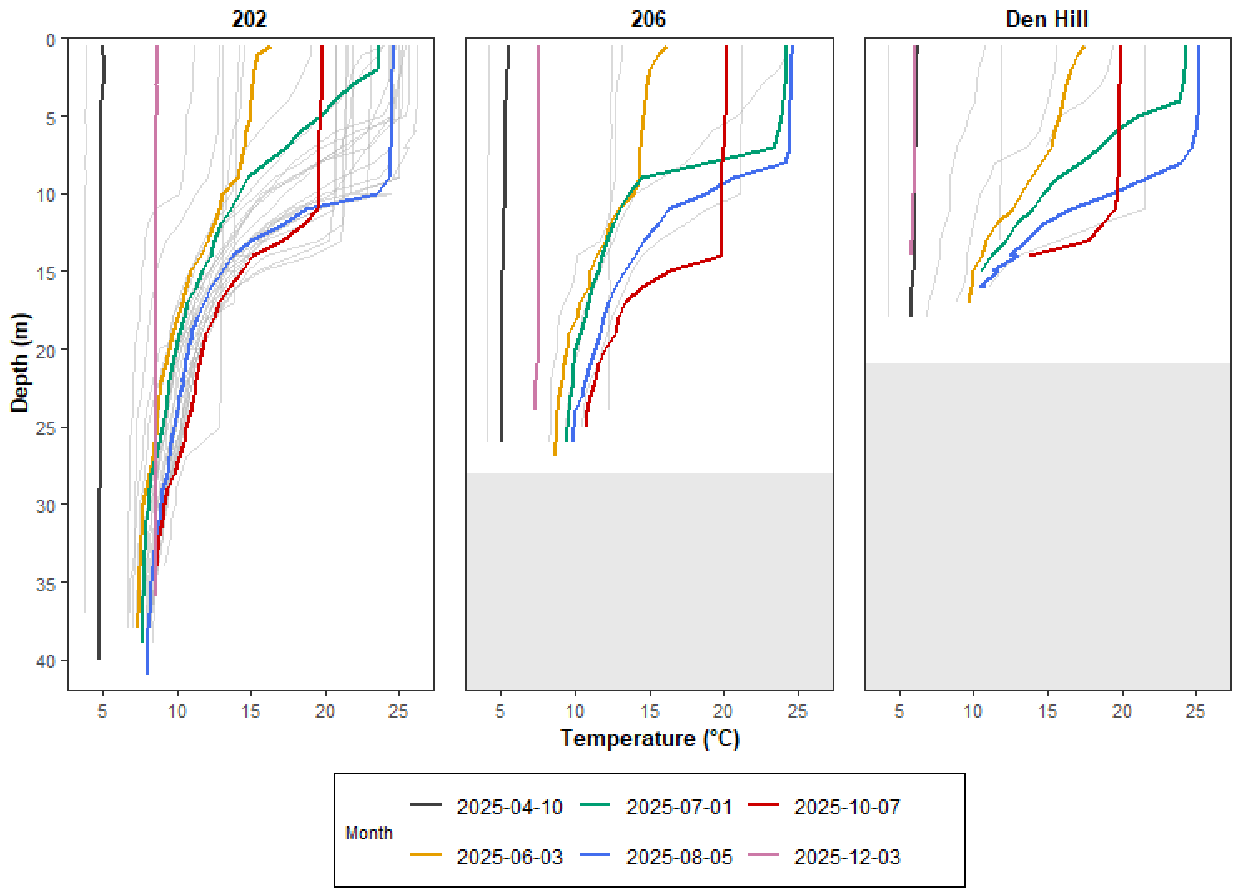


Figure 28. *Profiles of temperature at Quabbin Reservoir Core sites on select dates in 2025. The different colors represent the different stages of thermal stratification from a fully mixed water column in spring and winter (dark gray and pink) to a stratified water column in the summer and fall (yellow, green, blue, and red). Light gray lines in each plot show profiles from other 2025 sample dates. Gray bands at sites 206 and Den Hill indicate the maximum water column depth recorded for 2025.*

3.3.2. Chlorophyll a

Chlorophyll *a* may be used to estimate the overall biomass of the phytoplankton community. DWSP staff record *in-situ* measurements of chlorophyll *a* (in addition to concentrations of dissolved oxygen) to determine the location(s) in the water column where samples are collected for phytoplankton enumeration. On average, chlorophyll *a* concentrations in the reservoir are low and characteristic of low-productivity oligotrophic systems.

In 2025, chlorophyll *a* concentrations remained low throughout the year. Concentrations during spring, fall, and winter remained below 5 µg/L while increasing slightly during the summer months. The maximum chlorophyll *a* concentrations observed via manual profiles collected by DWSP staff were 10.3 µg/L at site 202 on July 24, 7.5 µg/L at site 206 on August 5, and 4.4 µg/L at Den Hill on July 1 (Table 43, Figure 29). These maximum chlorophyll *a* concentrations match the timing of the short-lived *Chrysosphaerella* aggregation seen in 2025 (Section 3.4.10). In 2025, the highest mean chlorophyll *a* (mean for entire water column) was 2.4 µg/L at site Den Hill during spring (Table 43).

Table 43. *Seasonal statistics for chlorophyll* a *(µg/L) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2021 – 2024) at DWSP monitoring sites.*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Spring	233	934	0.1	0.1	1.0	1.1	1.1	1.2	2.5	4.0
202	Summer	671	1946	0.0	0.0	0.8	0.8	1.1	1.3	10.3	43.2
202	Fall	264	788	0.1	0.0	0.5	0.6	0.6	0.8	1.2	33.2
202	Winter	37	373	0.3	0.2	0.9	1.0	0.8	1.0	1.0	2.1
206	Spring	81	343	0.1	0.1	1.4	1.3	1.4	1.5	2.4	4.3
206	Summer	109	467	0.2	0.1	0.9	1.0	1.3	1.7	7.5	26.8
206	Fall	77	350	0.4	0.1	0.7	0.9	0.7	0.9	1.2	6.7
206	Winter	25	218	0.5	0.2	1.0	1.1	0.9	1.2	1.2	2.3
Den Hill	Spring	75	185	0.8	0.6	2.5	1.9	2.3	2.4	3.6	5.8
Den Hill	Summer	67	322	0.5	0.4	1.3	1.1	1.7	1.4	4.4	22.0
Den Hill	Fall	46	217	0.5	0.2	0.8	1.0	0.8	1.0	1.4	2.0
Den Hill	Winter	15	98	0.4	0.6	0.7	1.3	0.6	1.5	0.8	3.2

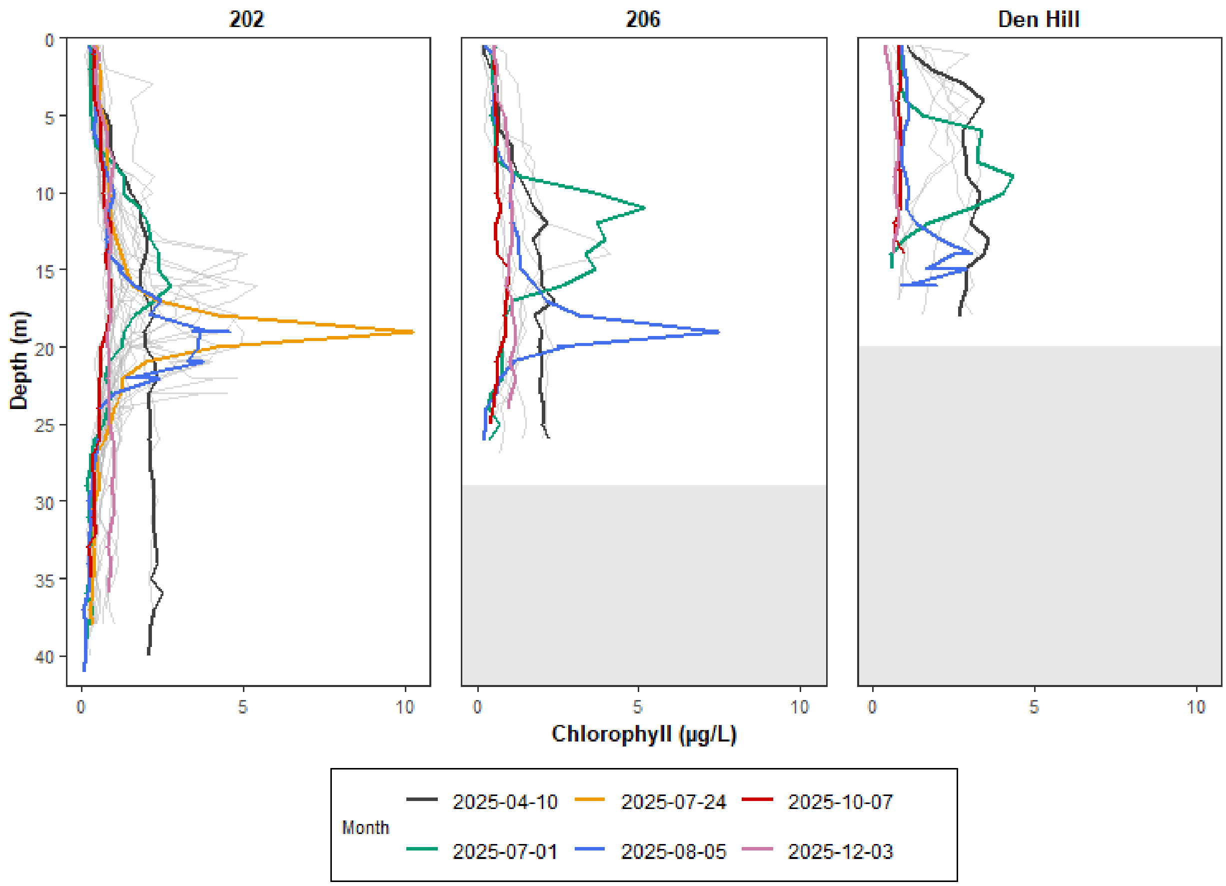


Figure 29. *Profiles of chlorophyll* a *at Quabbin Reservoir Core sites on select dates in 2025 to represent seasonality. The dark gray profile shows chlorophyll* a *values during spring. The green, yellow, and blue profiles correspond to chlorophyll* a *values in the summer. The red and pink profiles represent chlorophyll* a *values in the fall and winter. Gray lines in each plot show profiles from other 2025 sample dates. Gray bands at sites 206 and Den Hill indicate the max water column depth recorded for 2025.*

3.3.3. Dissolved Oxygen

Concentrations of dissolved oxygen in Quabbin Reservoir followed expected seasonal patterns in 2025. Changes in dissolved oxygen concentrations in Quabbin Reservoir generally coincided with changes in water temperatures, followed stratification stages, and/or rose with relative increases in phytoplankton abundance. Dissolved oxygen concentrations were typically greater in the spring and winter, likely attributed to cooler water temperatures, and lowest in fall due to a decline in phytoplankton productivity prior to fall turnover (Table 44). During summer, concentrations of dissolved oxygen in surface water decreased with stratification, as the warmer water in the epilimnion became unable to hold as much oxygen as colder deep water. Once stratified, dissolved oxygen levels below the thermocline became elevated due to cooler water temperature and phytoplankton activity (Figure 30).

Table 44. *Seasonal statistics for dissolved oxygen (mg/L) in Quabbin Reservoir during 2025 relative to the period of record (2021 – 2025) at DWSP monitoring sites.*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Spring	233	935	10.6	9.9	12.2	12.1	12.0	12.1	13.3	13.6
202	Summer	672	1954	8.2	8.1	10.3	10.8	10.2	10.4	11.8	12.5
202	Fall	264	788	6.9	6.0	8.9	9.2	9.1	9.3	10.8	12.4
202	Winter	37	374	10.7	9.8	10.7	11.9	10.8	11.6	11.1	13.1
206	Spring	81	343	11.1	10.3	12.5	12.7	12.3	12.4	13.4	13.8
206	Summer	109	467	8.4	8.1	10.3	10.3	10.1	10.0	11.2	11.8
206	Fall	77	350	6.8	6.9	8.9	9.1	9.2	9.2	10.8	11.1
206	Winter	25	218	11.3	10.7	11.4	12.6	11.5	12.2	12.2	13.6
Den Hill	Spring	75	185	10.3	9.6	11.8	11.9	11.6	11.6	12.4	12.6
Den Hill	Summer	67	322	4.7	4.8	8.4	8.4	8.4	8.5	10.1	10.7
Den Hill	Fall	46	217	2.1	1.8	8.6	8.4	8.3	8.1	10.0	10.4
Den Hill	Winter	15	98	11.6	11.0	11.6	11.2	11.6	11.8	11.6	13.4

Following typical seasonal patterns for Quabbin Reservoir, dissolved oxygen depletion was most pronounced during the late stages of stratification, with concentrations declining with depth at all sites (Figure 30). This occurs as water below the thermocline remains isolated from atmospheric influence and the consumption of oxygen during decomposition exceeds the production of oxygen during photosynthesis. While this pattern was observed at all sites, dissolved oxygen at sites 202 and 206 remained above 6.0 mg/L unlike at Den Hill where dissolved oxygen declined below this level. Dissolved oxygen is typically depleted at depth at Den Hill during the late summer and fall, with an annual minimum between 1.8 and 2.7 mg/L in the last five years. In 2025, the observed low dissolved oxygen levels (below 6.0 mg/L) at Den Hill were limited to the lower-most five meters of the water column (Figure 30).

Following fall turnover in November, oxygen was recirculated throughout the water column at all sites. Dissolved oxygen was the greatest during the spring, with an annual maximum concentration of 13.4 mg/L at 206 (Figure 30, Table 44). The median dissolved oxygen concentrations in 2025 remained above 6.0 mg/L at all sites (Table 44), sustaining concentrations required to support cold water aquatic species (314 CMR 4.06).

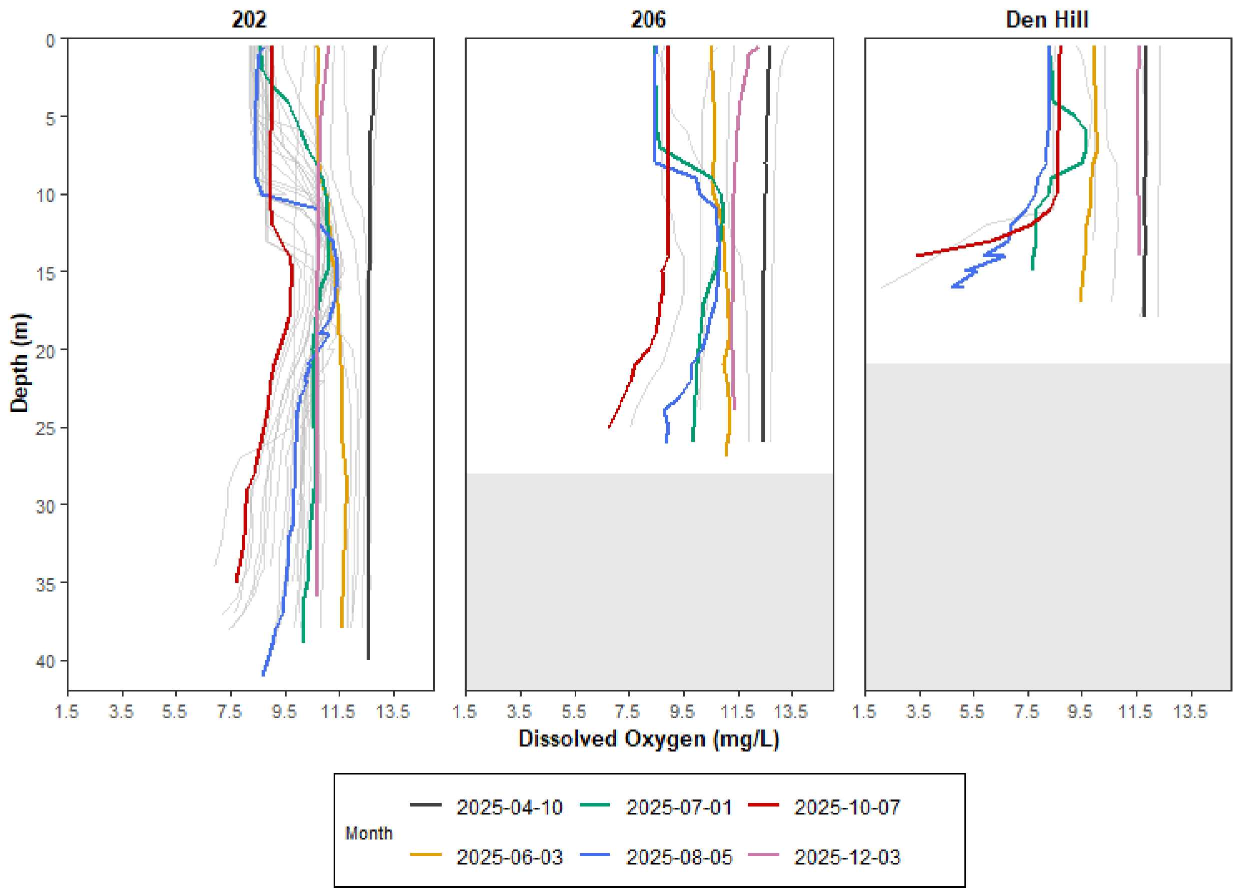


Figure 30. *Profiles of dissolved oxygen at Quabbin Reservoir Core sites on select dates in 2025. The different colors represent the different stages of stratification from a fully mixed water column in spring and winter (dark gray and pink) to a stratified water column in the summer and fall (yellow, green, blue, and red). Light gray lines in each plot show profiles from other 2025 sample dates. Gray bands at sites 206 and Den Hill indicate the maximum water column depth recorded for 2025.*

3.3.4. Alkalinity and pH

The dynamics of pH in Quabbin Reservoir are largely governed by the exchange of inorganic carbon between the atmosphere and water (carbon dioxide-bicarbonate-carbonate buffering). The pH of Quabbin Reservoir generally decreases with depth and may vary with changes in photosynthesis and respiration and contributions from various weather events (e.g., surface water inputs). Generally, pH within Quabbin Reservoir is unremarkable, ranging from 5.0 to 7.8 in 2025, and has not exhibited strong temporal trends since the onset of routine monitoring by DWSP. Quabbin Reservoir water remains slightly acidic with median pH at DWSP monitoring sites ranging from 6.4 to 6.9 in 2025 (Table 45).

Table 45. *Seasonal statistics for pH in Quabbin Reservoir during 2025 relative to the period of record (2021 – 2024) at DWSP monitoring sites.*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Spring	233	935	6.1	6.0	6.4	6.7	6.4	6.6	7.1	7.8
202	Summer	672	1954	5.2	5.5	6.4	6.6	6.3	6.6	7.8	7.9
202	Fall	264	788	5.1	5.0	6.0	6.4	6.0	6.3	7.6	7.6
202	Winter	37	374	6.5	6.0	6.6	6.6	6.6	6.6	6.6	7.8
206	Spring	81	343	6.2	6.4	6.5	6.9	6.5	6.8	7.1	7.9
206	Summer	109	467	5.8	5.8	6.7	6.7	6.6	6.7	7.3	7.4
206	Fall	77	350	5.0	5.7	6.4	6.6	6.3	6.5	7.3	7.4
206	Winter	25	218	6.1	6.1	6.5	6.7	6.4	6.7	6.6	7.6
Den Hill	Spring	75	185	6.0	6.1	6.6	6.7	6.6	6.7	7.3	7.4
Den Hill	Summer	67	322	5.0	5.6	6.3	6.6	6.2	6.5	7.4	7.2
Den Hill	Fall	46	217	5.0	5.6	6.5	6.6	6.3	6.5	7.1	7.5
Den Hill	Winter	15	98	6.2	6.1	6.2	6.5	6.3	6.5	6.5	7.1

Alkalinity in Quabbin Reservoir remained low (less than 7 mg/L as $CaCO_3$) throughout 2025 and exhibited little variability with depth, changes in stratification, or seasonality (Table 46). Alkalinity concentrations ranged from 3.76 to 5.41 mg/L as $CaCO_3$ in 2025. Consistent with previous years, median alkalinity was greatest at Den Hill in 2025 (4.28 to 4.46 mg/L as $CaCO_3$), relative to other routine monitoring sites in Quabbin Reservoir. Alkalinity measured at each site in the Quabbin Reservoir during 2025 exceeded historical minimums, medians, and means but remained within the established maximum range of values for each site (Table 46). A steady increase in alkalinity has been observed in the Quabbin Reservoir since 2005. Increasing trends in low-alkalinity lakes and large rivers have been observed across the US and attributed to recovery from acid rain and contamination from road salt runoff (Stoddard et al., 1999; Stets et al., 2014; NH DES, 2020). Additionally, the pH (annual precipitation-weighted mean) of rainfall within the Quabbin Reservoir Watershed has been increasing steadily for decades (Feng et al., 2021). Temporal changes in alkalinity concentrations in lakes and reservoirs in New England may be attributed to interactions of multiple factors (e.g., natural geogenic variability, urbanization and associated chemical weathering of the built environment, acid rain inputs, or changes in or introduced during sample collection and analysis).

Table 46. *Statistics for alkalinity as $CaCO_3$ (mg/L) in Quabbin Reservoir during 2025 relative to the period of record (2005 – 2024) at DWSP monitoring sites.*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	4	143	4.01	2.66	4.35	3.70	4.53	3.59	5.41	6.37
202	Mid	4	158	3.93	2.47	4.18	3.65	4.17	3.52	4.40	4.50
202	Deep	4	165	4.03	2.51	4.25	3.61	4.27	3.48	4.56	4.51
206	Surface	3	142	4.05	2.44	4.18	3.79	4.28	3.65	4.61	6.20
206	Mid	4	156	3.89	2.44	4.27	3.74	4.22	3.57	4.45	4.33
206	Deep	4	163	4.10	2.63	4.35	3.69	4.31	3.56	4.44	5.51
Den Hill	Surface	4	139	3.76	2.54	4.40	3.93	4.33	3.86	4.74	5.10
Den Hill	Mid	4	152	4.15	2.76	4.28	3.87	4.34	3.80	4.64	4.68
Den Hill	Deep	4	159	4.42	2.60	4.46	3.86	4.52	3.84	4.73	7.50

3.3.5. Specific Conductance, Sodium, and Chloride

Specific conductance measured in the Quabbin Reservoir has historically been low, relative to other water bodies in the northeastern United States, such as those in highly urbanized watersheds that may exceed 1,000 µS/cm. The relatively low observed specific conductance in Quabbin Reservoir waters is likely a reflection of land cover (e.g., percent developed lands, total land miles, and/or percentage of impervious surface cover), the low catchment area-to-surface area ratio of the Quabbin Reservoir, geogenic characteristics of the watershed, and land management practices across the watershed. Specific conductance in 2025 varied little with depth or season at sites 202 and 206, unlike at Den Hill where seasonal and spatial variability was observed (Table 47, Figure 31). At Den Hill, higher specific conductance was observed during spring conditions throughout the water column and then again at depth (lower-most five meters of the water column) during summer (Figure 31). Higher mean specific conductance during spring is consistent with seasonal concentrations of specific conductance documented in major east Quabbin tributaries, likely attributed to road salt runoff. Specific conductance measured in Quabbin Reservoir during 2025 ranged from an annual minimum of 43.7 µS/cm at site 202 to an annual maximum of 57.4 µS/cm at Den Hill (Table 47). Specific conductance maximums at site Den Hill and 206 exceeded the historical range during the spring and summer, respectively (Table 47). Elevated specific conductance values were observed in surface water (0.5 m) at Den Hill on April 10, 2025 and at depth (20 m) at site 206 on June 3, 2025 (Figure 31).

Table 47. *Seasonal statistics for specific conductance (µS/cm) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2021 – 2024) at DWSP monitoring sites.*

Location	Season	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Spring	233	935	45.3	45.3	46.5	47.5	46.5	47.4	47.4	49.2
202	Summer	672	1954	43.7	45.5	46.4	47.6	46.5	47.6	49.0	49.8
202	Fall	264	788	46.2	45.2	47.0	47.9	47.0	47.7	47.6	49.7
202	Winter	37	373	47.3	46.8	47.4	48.1	47.4	48.6	47.4	56.1
206	Spring	81	343	44.6	45.8	46.5	47.7	46.5	47.6	48.7	49.0
206	Summer	109	467	44.7	46.0	46.6	47.9	46.6	47.9	51.1	49.9
206	Fall	77	350	46.9	46.4	47.6	47.8	47.5	47.8	47.8	50.0
206	Winter	25	218	47.4	47.1	47.5	48.2	47.5	48.4	47.6	51.4
Den Hill	Spring	75	185	52.4	46.3	55.8	50.1	55.7	50.3	57.4	55.9
Den Hill	Summer	67	322	48.5	46.4	50.7	49.3	50.9	49.7	53.8	55.7
Den Hill	Fall	46	217	49.2	47.4	49.3	49.3	49.8	49.8	55.0	56.7
Den Hill	Winter	15	98	49.7	47.8	49.7	51.0	49.7	51.7	49.8	57.8

Routine monitoring of concentrations of sodium (Na) and chloride (Cl) in Quabbin Reservoir began in 2020. In 2025, monitoring for Na and Cl in Quabbin Reservoir was conducted quarterly. Sodium concentrations ranged from a minimum of 5.40 mg/L at the middle of the water column of site 206, to a maximum of 6.55 mg/L at the surface of the water column of site Den Hill (Table 48). Chloride concentrations ranged from a minimum of 7.62 mg/L at the bottom of the water column of site 202 to a maximum of 10.00 mg/L at the surface of the water column at site Den Hill (Table 48). Sodium annual minimums, medians, and means exceeded the historical range at all sites and depths, while chloride minimum values in 2025 were generally higher than the historical record at all sites, but only medians and means at site Den Hill exceeded the historical range (Table 48). Neither ORS guidelines for Na (20 mg/L) or the SMCL for Cl (250 mg/L) were exceeded in samples collected from Quabbin Reservoir in 2025 (see Section 6.1).

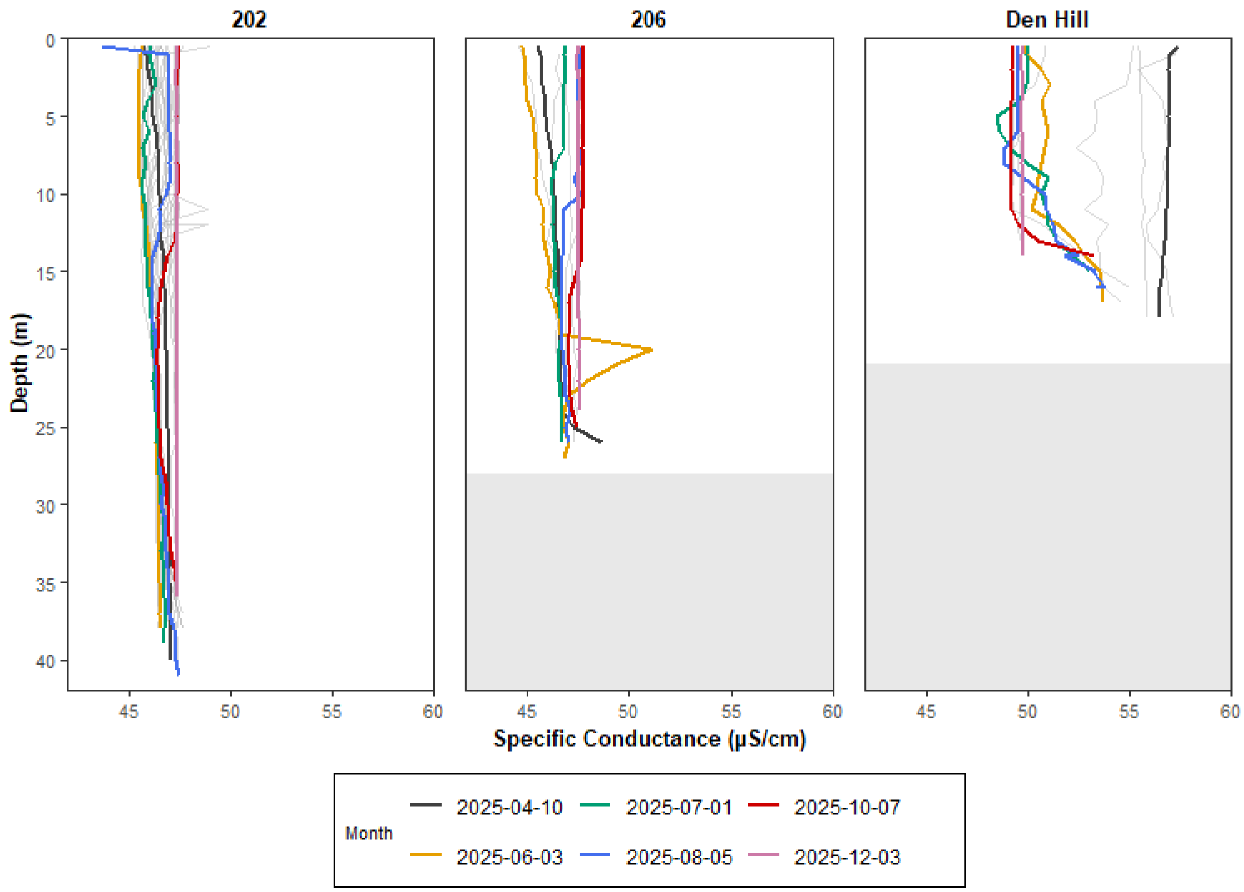


Figure 31. *Profiles of specific conductance at Quabbin Reservoir Core sites in 2025. The different colors represent the different stages of stratification from a fully mixed water column in spring and winter (dark gray and pink) to a stratified water column in the summer and fall (yellow, green, blue, and red). Light gray lines in each plot show profiles from other 2025 sample dates. Gray bands at sites 206 and Den Hill indicate the maximum water column depth recorded for 2025.*

Table 48. *Concentration results for a) sodium (mg/L) and b) chloride (mg/L) measured in Quabbin Reservoir during 2025 relative to the period of record (POR; 2020 – 2024) at DWSP monitoring sites.*

a) Sodium (mg/L)

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	5	21	5.49	5.11	5.65	5.45	5.64	5.46	5.78	5.79
202	Mid	5	20	5.57	4.99	5.62	5.48	5.64	5.47	5.76	5.74
202	Deep	5	21	5.55	5.01	5.63	5.51	5.64	5.53	5.74	6.00
206	Surface	6	21	5.45	5.16	5.70	5.49	5.71	5.56	6.05	6.15
206	Mid	5	21	5.40	5.20	5.67	5.44	5.61	5.50	5.81	6.11
206	Deep	5	21	5.56	5.15	5.62	5.51	5.62	5.52	5.69	6.08
Den Hill	Surface	5	21	5.91	5.17	6.06	5.73	6.11	5.73	6.55	6.45
Den Hill	Mid	5	21	5.83	5.45	6.06	5.67	6.04	5.73	6.24	6.09
Den Hill	Deep	5	21	5.92	5.40	6.23	5.75	6.19	5.80	6.49	6.31

b) Chloride (mg/L)

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	5	23	7.66	7.65	7.81	7.98	7.86	8.03	8.16	8.59
202	Mid	5	23	7.67	7.67	7.99	7.95	7.91	8.06	8.18	8.61
202	Deep	5	23	7.62	7.39	7.81	8.03	7.88	7.99	8.15	8.37
206	Surface	5	23	7.70	7.53	7.87	8.02	7.93	8.07	8.28	8.42
206	Mid	5	23	7.71	7.44	7.98	8.07	8.04	8.11	8.29	8.74
206	Deep	5	23	7.73	7.41	7.95	8.00	7.98	8.02	8.27	8.64
Den Hill	Surface	5	23	8.23	7.21	8.54	8.41	8.78	8.43	10.00	9.98
Den Hill	Mid	5	23	8.20	7.75	8.71	8.47	8.83	8.51	9.79	9.51
Den Hill	Deep	5	23	8.33	7.41	9.03	8.44	9.06	8.54	9.76	9.86

3.3.6. Turbidity

Turbidity measured in the Quabbin Reservoir was low and relatively stable throughout the year. Turbidity levels in Quabbin Reservoir ranged from 0.21 NTU to 0.94 NTU during 2025 (Table 49); minimum, median, and mean levels were slightly higher than the historical record but fell within the maximum historical range of turbidity observed at DWSP monitoring sites (Table 49). Turbidity remained below 1.0 NTU in Quabbin Reservoir in all samples collected by DWSP in 2025.

Table 49. *Statistics for turbidity (NTU) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2005 – 2024) at DWSP monitoring sites.*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	9	157	0.23	0.16	0.30	0.27	0.30	0.28	0.47	0.67
202	Mid	9	176	0.23	0.19	0.30	0.28	0.34	0.29	0.67	0.73
202	Deep	9	184	0.28	0.16	0.31	0.26	0.35	0.28	0.61	1.04
206	Surface	9	157	0.23	0.16	0.32	0.28	0.34	0.30	0.72	0.88
206	Mid	9	173	0.21	0.19	0.29	0.31	0.30	0.32	0.38	0.82
206	Deep	9	182	0.25	0.18	0.35	0.32	0.40	0.35	0.85	1.21
Den Hill	Surface	9	153	0.33	0.25	0.42	0.40	0.49	0.42	0.75	0.98
Den Hill	Mid	9	169	0.34	0.24	0.54	0.44	0.57	0.45	0.94	1.13
Den Hill	Deep	9	177	0.32	0.22	0.51	0.47	0.51	0.57	0.70	4.00

As is typical, Den Hill exhibited routinely elevated turbidity relative to other Core monitoring locations within the Quabbin Reservoir (Figure 32). This well-established spatial gradient has previously been attributed to local inputs from the East Branch Swift River (DWSP, 2021a).

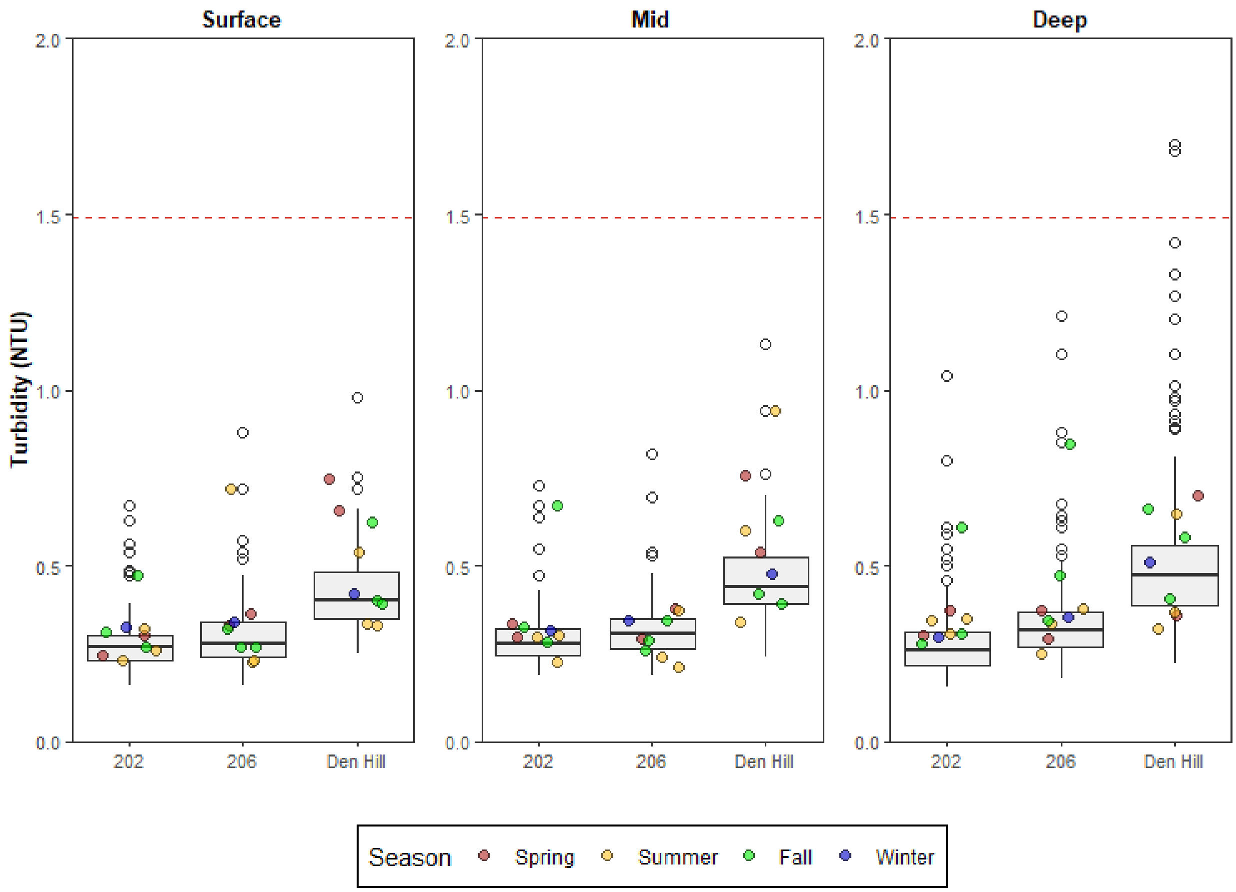


Figure 32. *Boxplots depicting the seasonal and vertical distributions of turbidity in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median. Outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively. The MassDEP 1 NTU standard, which applies to the intake, is marked by the red dashed line in each panel.*

3.3.7. Secchi Disk Depth/Transparency

Simultaneous aided and unaided Secchi disk transparencies were measured in the Quabbin Reservoir in 2025. Aided Secchi disk measurements were made using a standard view scope (4-inch diameter tube, 3-feet long, black on inside with Plexiglas disk on one end) to reduce variability introduced by surface glare and waves. The aided Secchi measurements resulted in greater transparency than unaided. On average, aided transparency was approximately 1.94 m deeper than unaided measurements. The largest difference between aided and unaided measurements was 3.69 m, taken at sampling site 202 on May 7, 2025 (Figure 33). This large difference was most likely due to surface glare. The smallest difference was recorded on April 10, 2025 at site Den Hill, with a 0.39 m difference between transparencies. This was likely due to low waves, which lowered surface glare.

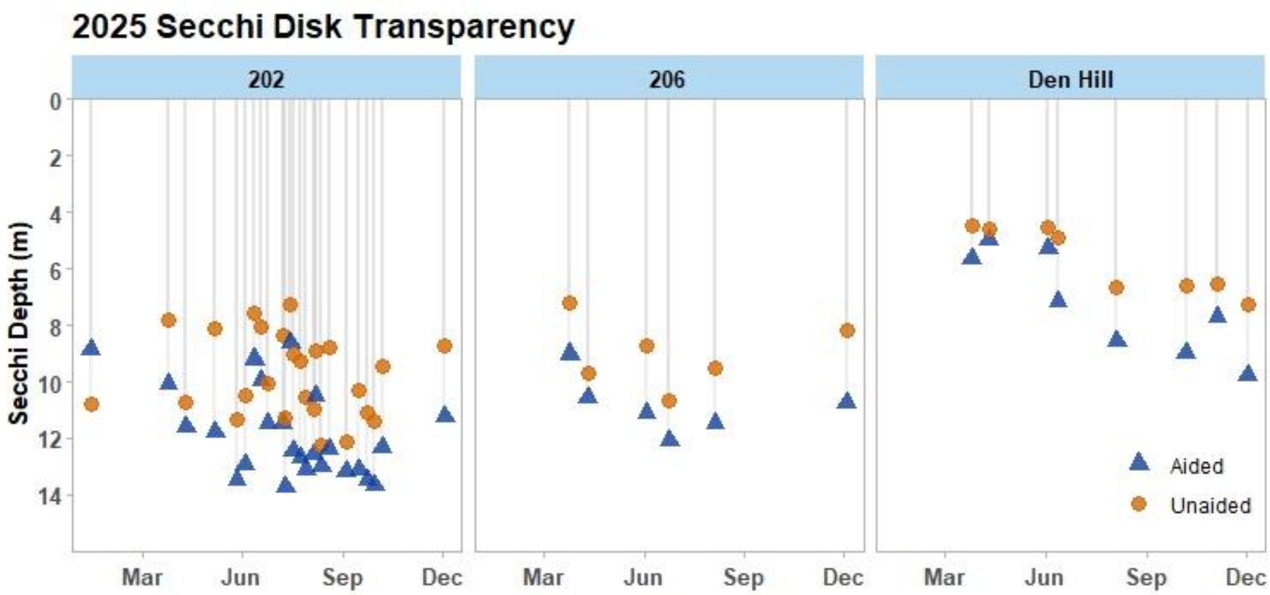


Figure 33. *Secchi disk transparencies measured in 2025 in Quabbin Reservoir at DWSP monitoring sites 202 (maximum depth 42 m), 206 (maximum depth 29 m), and Den Hill (maximum depth 20 m). Orange circle data points are unaided measurements, and dark blue triangle points are aided, collected using a view scope.*

Water in the Quabbin Reservoir continued to demonstrate exceptional clarity in 2025, with a median aided Secchi disk transparency of 12.4, 10.9, and 7.5-m, and median unaided Secchi of 10.0, 9.1, and 5.7 m at sites 202, 206, and Den Hill, respectively. Secchi disk transparency in Quabbin Reservoir was generally consistent with previous monitoring, mirroring seasonal patterns of phytoplankton dynamics (Worden, 2000; DWSP, 2019a) and turbidity. The minimum Secchi disk transparency observed in 2025 was 4.5 m unaided (March 25, 2025) and 5.0 m aided (April 10, 2025) at monitoring site Den Hill. The maximum Secchi disk transparency was 12.2 m unaided (August 12, 2025) and 13.7 m aided (July 10, 2025) at monitoring site 202.

Transparency at monitoring site Den Hill was characteristically lower than at sites 202 and 206 (Figure 33), reflecting the nearby contribution of large riverine inputs from the East Branch Swift River. The East Branch Swift River is estimated to contribute as much as 9 to 16 percent of the annual inflow to the Quabbin Reservoir (DWSP, 2007). Thus, this inflow may act as a source of color and sediment, reducing transparency and resulting in slightly elevated levels of turbidity within the Quabbin Reservoir during and following high streamflow events, periodically observed at the Den Hill monitoring site due to proximity.

3.3.8. Nutrients

Patterns of nutrient distributions in Quabbin Reservoir in 2025 were generally consistent with those documented previously by Worden (2000) and historical ranges observed in Quabbin Reservoir by DWSP monitoring. Prominent seasonal, spatial, and vertical variations were present, likely due to the interactions of demand by phytoplankton in the epilimnion and metalimnion, the decomposition of organic matter in the hypolimnion, and the timing and extent of terrestrial-derived sources of nutrients delivered via riverine loading to the Quabbin Reservoir.

3.3.8.1. Total Nitrogen (Ammonia-Nitrogen, Nitrate-Nitrogen, and Total Kjeldahl Nitrogen)

Concentrations of ammonia (NH_3-N) and nitrate (NO_3-N) ranged from less than 0.005 to 0.023 mg/L and from less than 0.005 to 0.065 mg/L, respectively, in Quabbin Reservoir during 2025. Overall, concentrations of ammonia and nitrate followed the vertical and temporal variation characteristic of historical seasonal ranges for each site (Table 50). Concentrations of ammonia and nitrate were generally elevated in the hypolimnion and at Den Hill relative to other sites. Ammonia was below detection limits (less than 0.005 mg/L) in all samples collected from the epilimnion at site 202 and in most samples collected from the epilimnion at sites 206 and Den Hill. As is characteristically observed, ammonia and nitrate concentrations generally increased in the hypolimnion in the late summer and fall at all sites, likely coincident with decomposition. In previous years, ammonia and nitrate concentrations decreased at all sites following fall turnover as the water column gets homogenized, but in 2025 ammonia and nitrate concentrations increased during the winter and were higher than the historical mean at sites 206 and Den Hill (Figure 34 and Figure 35).

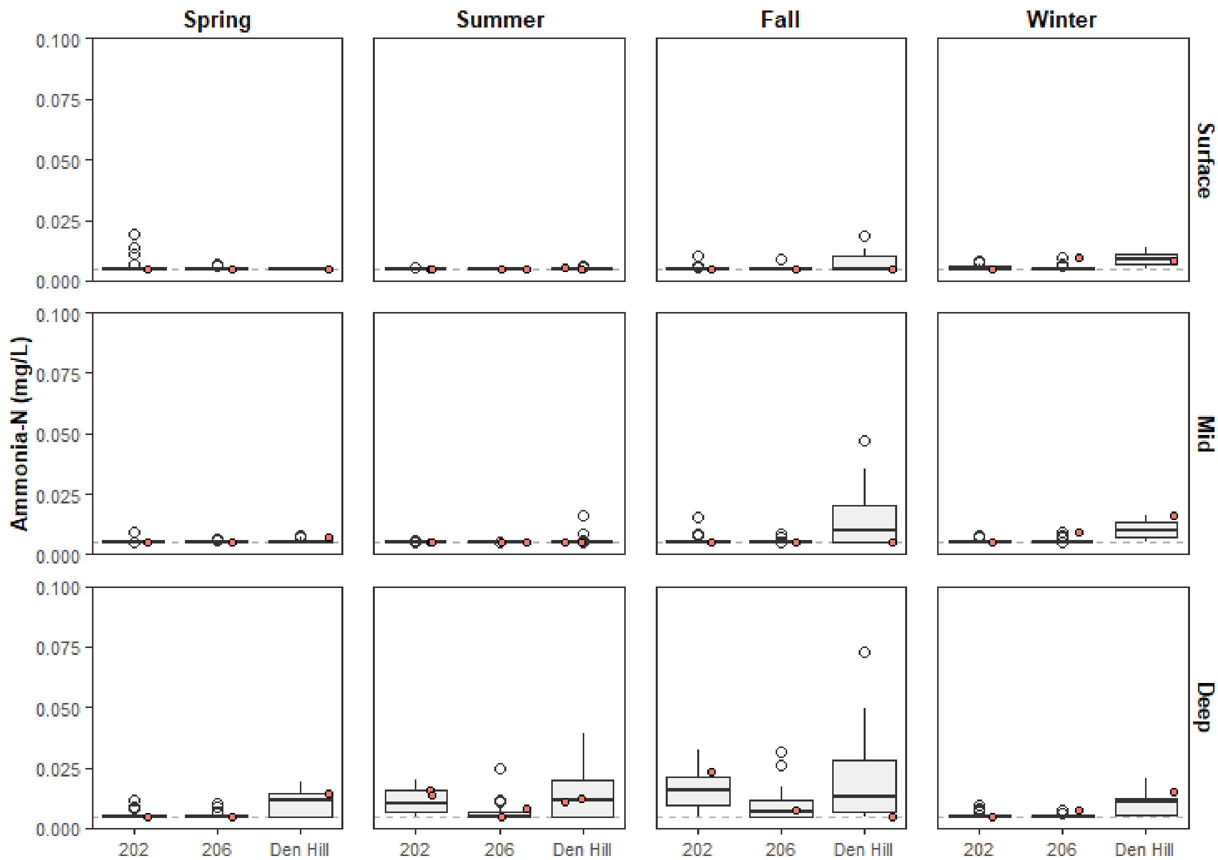


Figure 34. *Boxplots depicting the seasonal and vertical distribution of ammonia in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively. The dashed line represents the detection limit (0.005 mg/L).*

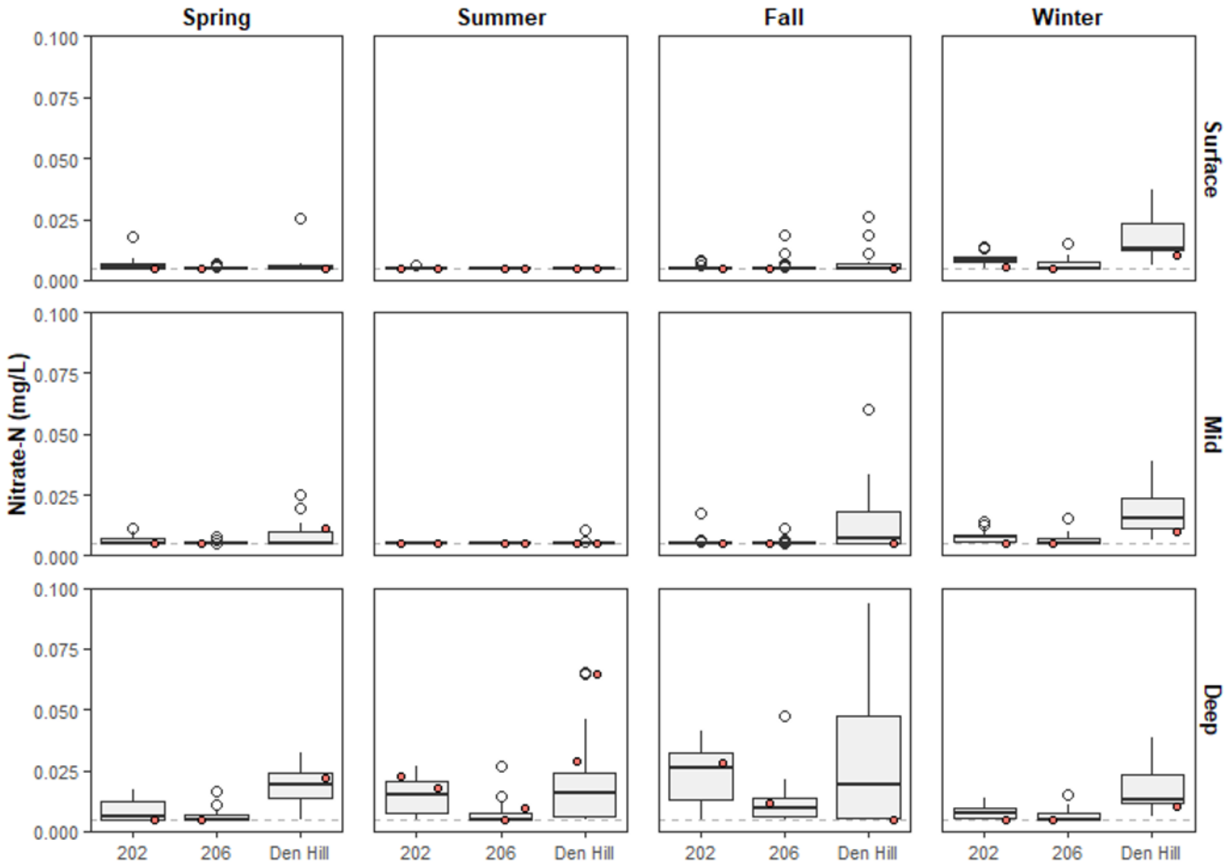


Figure 35. *Boxplots depicting the seasonal and vertical distribution of nitrate in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively. The dashed line represents the detection limit (0.005 mg/L).*

Concentrations of TKN in Quabbin Reservoir Core sites ranged from 0.077 to 0.211 mg/L in 2025 (Table 50). TKN concentrations in Quabbin Reservoir exhibited little spatial variability in 2025 (Figure 36). However, some seasonal variability was detected as higher TKN values were observed during the fall at all sites and depths. Overall, most of the TKN concentrations in Quabbin Reservoir approached the historical seasonal medians throughout the water column. A proportion of the variability in concentrations of TKN observed in 2025, when compared to the historical records, may be attributed to assumptions made during calculations of TKN concentrations for 2020 through 2022 data (e.g., substituting the detection limit of NO_2-N and NO_3-N), or related to differences in sensitivity of different laboratory methods (e.g., the detection limits for TN via Valderrama [1981] were lower than that of EPA 351.2 used previously).

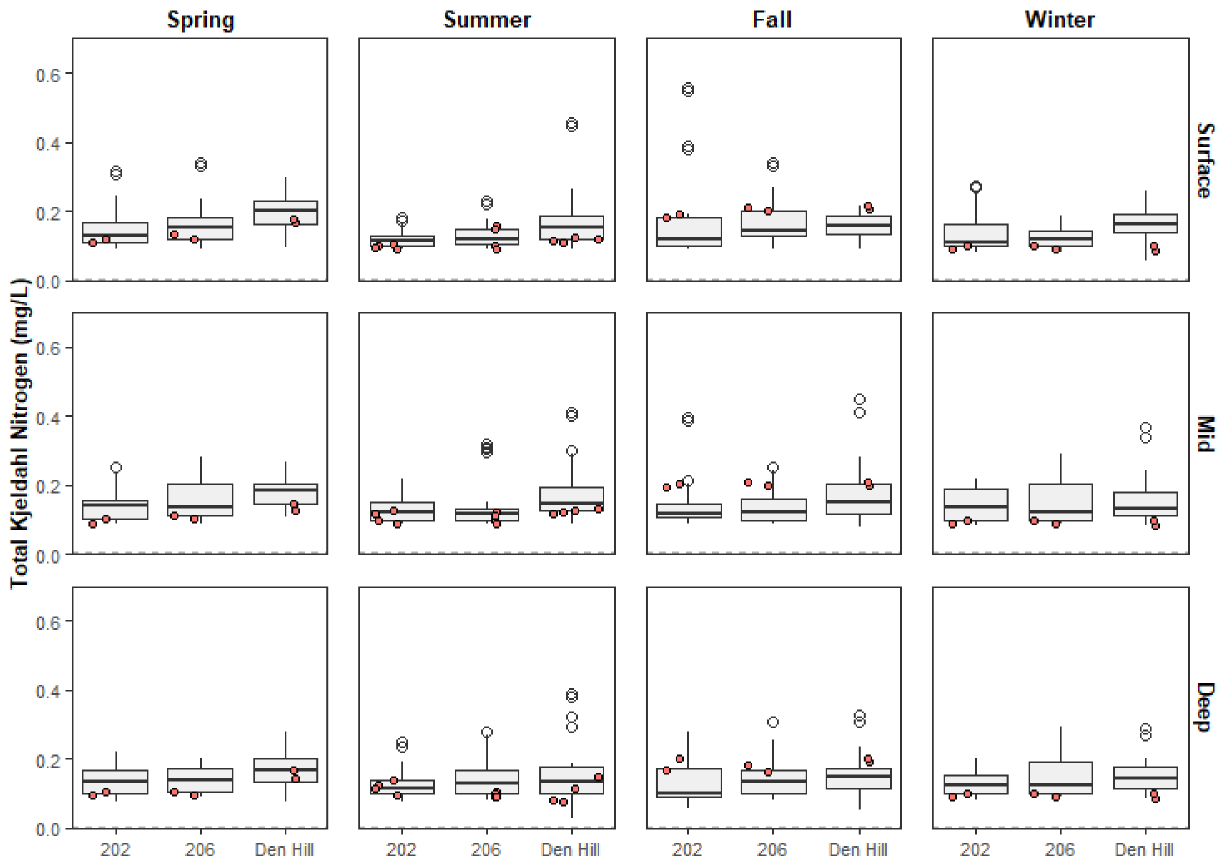


Figure 36. *Boxplots depicting the seasonal and vertical distributions of total Kjeldahl nitrogen (TKN) in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively.*

Table 50. *Descriptive statistics for a) ammonia (mg/L), b) nitrate (mg/L), and c) TKN (mg/L) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2020 – 2024).*

a) Ammonia (mg/L)

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	5	77	<0.005	0.005	0.002	0.002	0.002	0.003	0.005	0.019
202	Mid	5	77	<0.005	0.005	0.002	0.003	0.003	0.004	0.005	0.016
202	Deep	5	77	<0.005	0.005	0.013	0.008	0.011	0.010	0.023	0.032
206	Surface	5	77	<0.005	0.005	0.002	0.003	0.004	0.003	0.009	0.010
206	Mid	5	77	<0.005	0.005	0.002	0.002	0.004	0.003	0.010	0.020
206	Deep	5	76	<0.005	0.005	0.008	0.004	0.006	0.006	0.008	0.032
Den Hill	Surface	5	75	<0.005	0.005	0.002	0.004	0.004	0.006	0.008	0.019
Den Hill	Mid	5	76	<0.005	0.005	0.005	0.005	0.007	0.008	0.016	0.047
Den Hill	Deep	5	75	<0.005	0.005	0.012	0.011	0.011	0.014	0.015	0.073

b) Nitrate (mg/L)

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	5	79	<0.005	0.005	0.002	0.004	0.003	0.005	0.005	0.018
202	Mid	5	79	<0.005	0.005	0.002	0.004	0.003	0.005	0.005	0.018
202	Deep	5	79	<0.005	0.005	0.018	0.012	0.015	0.014	0.028	0.042
206	Surface	5	79	<0.005	0.005	0.002	0.002	0.002	0.003	0.005	0.018
206	Mid	5	79	<0.005	0.005	0.002	0.003	0.002	0.004	0.005	0.015
206	Deep	5	78	<0.005	0.005	0.002	0.006	0.006	0.007	0.012	0.047
Den Hill	Surface	5	77	<0.005	0.005	0.002	0.004	0.004	0.007	0.010	0.037
Den Hill	Mid	5	77	<0.005	0.005	0.002	0.005	0.006	0.010	0.012	0.060
Den Hill	Deep	5	77	<0.005	0.005	0.022	0.016	0.026	0.021	0.065	0.094

c) Total Kjeldahl Nitrogen (mg/L)

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	5	102	0.090	0.082	0.102	0.122	0.117	0.148	0.194	0.560
202	Mid	5	104	0.090	0.082	0.099	0.132	0.119	0.145	0.204	0.399
202	Deep	5	104	0.090	0.059	0.111	0.124	0.122	0.131	0.200	0.278
206	Surface	5	104	0.090	0.080	0.127	0.133	0.133	0.147	0.211	0.342
206	Mid	5	104	0.090	0.090	0.107	0.126	0.120	0.144	0.208	0.322
206	Deep	5	104	0.090	0.081	0.097	0.136	0.111	0.147	0.182	0.309
Den Hill	Surface	5	100	0.085	0.058	0.124	0.167	0.141	0.176	0.218	0.457
Den Hill	Mid	5	100	0.085	0.077	0.129	0.155	0.136	0.174	0.210	0.449
Den Hill	Deep	5	100	0.077	0.031	0.129	0.150	0.130	0.160	0.204	0.389

3.3.8.2. *Total Phosphorus*

Vertical and spatial patterns in total phosphorus (TP) concentrations observed in Quabbin Reservoir remained consistent with those previously observed. Concentrations of TP ranged from below the detection limit of less than 0.005 to 0.007 mg/L in 2025 (Table 51). Overall, TP concentrations in Quabbin Reservoir were within the historical range throughout the water column, except for one result from the surface water at site 206 (Figure 37). Concentrations of TP remained low throughout the water column for the entirety of 2025, and all samples remained well below the 10 µg/L threshold for classification as an oligotrophic water body (Carlson, 1977).

Table 51. *Descriptive statistics for total phosphorus (mg/L) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2020 – 2024). Detection limits for TP in 2025 were less than 0.005 mg/L.*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	4	68	<0.005	0.005	0.002	0.004	0.002	0.005	0.005	0.010
202	Mid	5	67	<0.005	0.005	0.002	0.004	0.002	0.005	0.005	0.014
202	Deep	5	67	<0.005	0.005	0.002	0.004	0.003	0.005	0.006	0.010
206	Surface	5	67	<0.005	0.005	0.002	0.003	0.003	0.004	0.007	0.010
206	Mid	5	67	<0.005	0.005	0.002	0.003	0.002	0.004	0.005	0.015
206	Deep	5	67	<0.005	0.005	0.002	0.004	0.003	0.005	0.005	0.010
Den Hill	Surface	5	66	<0.005	0.005	0.002	0.005	0.004	0.006	0.006	0.027
Den Hill	Mid	5	66	<0.005	0.005	0.005	0.006	0.005	0.006	0.007	0.014
Den Hill	Deep	5	66	<0.005	0.005	0.005	0.007	0.005	0.007	0.007	0.014

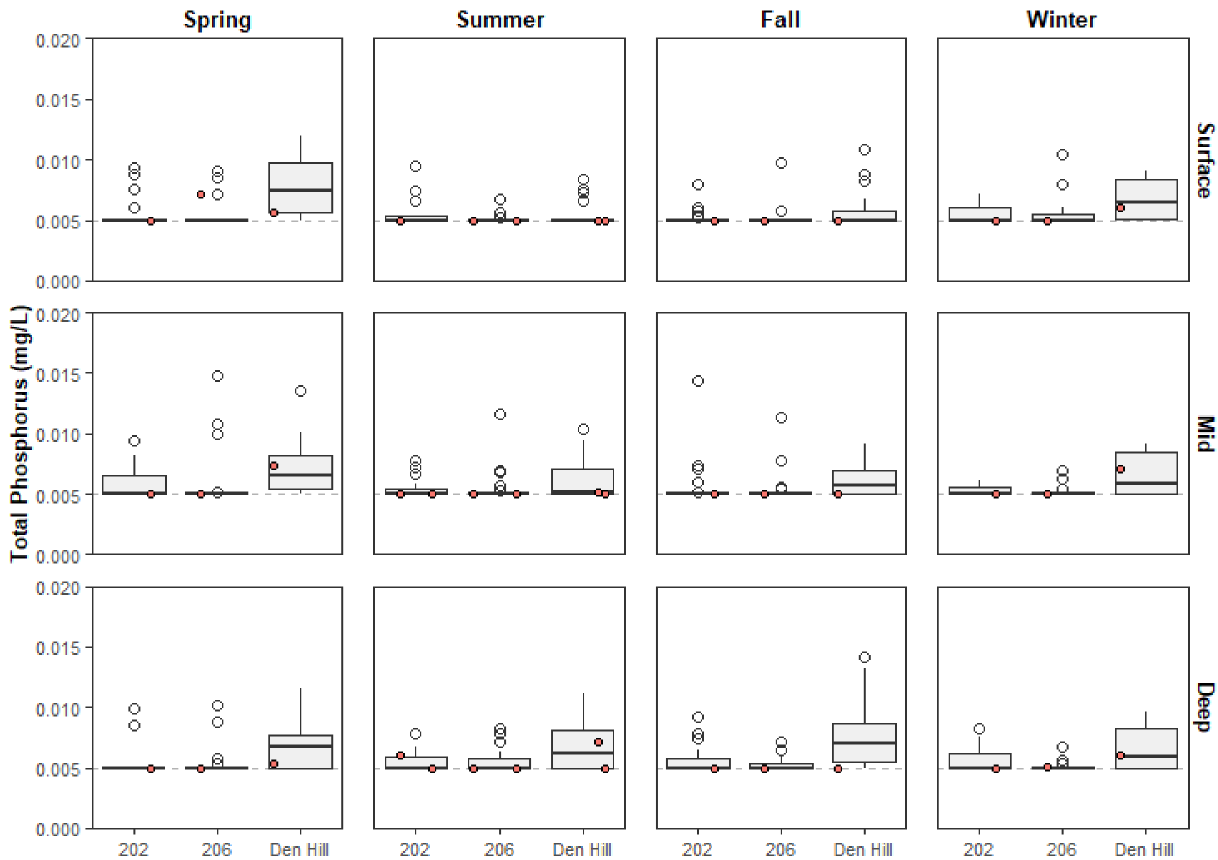


Figure 37. *Boxplots depicting the seasonal and vertical distributions of total phosphorus in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively.*

3.3.8.3. Total Silica

Silica is utilized by phytoplankton, particularly diatoms and chrysophytes, to form their frustules, tests, and scales (Reynolds, 2006). Total silica concentrations in Quabbin Reservoir ranged from 0.95 to 3.76 mg/L in 2025 (Table 52). Overall, elevated total silica concentrations were observed in 2025, with the majority of spring, summer, and fall results above historical medians (Figure 38). After fall, total silica levels decreased and by winter results were below historical medians, particularly at sites 206 and Den Hill (Figure 38). It has been observed that total silica at 202 and Den Hill, particularly at depth, has been increasing over time (2010 to 2025).

Concentrations of total silica in the Quabbin Reservoir exhibited spatial and temporal gradients consistent with riverine inputs in the spring, seasonal phytoplankton productivity in the spring and summer, and subsequent endogenous loading from phytoplankton die-offs in late summer and fall. In 2025, total silica concentrations were generally higher in the spring, summer, and fall and lower in the winter, consistent with previous results. Compared to 2024, where noticeable elevated total silica levels in the hypolimnion in late summer (August) were observed, total silica levels in 2025 were more stable throughout the year. This is likely the result of a short duration *Chrysosphaerella* aggregation in 2025 compared to a longer duration aggregation in 2024 (see Section 3.3.9 and DWSP 2024a), suggesting that elevated concentrations seen in previous years at depth are due to the sinking of dead *Chrysosphaerella* colonies.

Total silica concentrations were greatest at Den Hill during the spring, similar to patterns observed in turbidity, TOC, and UV_{254} across monitoring sites and likely the result of the proximity of Den Hill to the confluence of the East Branch Swift River with the Quabbin Reservoir.

Table 52. *Descriptive statistics for silica (mg/L) in Quabbin Reservoir during 2025 relative to the period of record (POR; 2010 - 2024).*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	9	79	1.01	1.30	1.97	1.83	1.94	1.83	2.38	2.32
202	Mid	9	79	1.61	1.24	1.97	1.81	1.93	1.81	2.24	2.34
202	Deep	9	81	1.95	1.37	2.23	2.16	2.43	2.14	3.04	2.93
206	Surface	7	79	0.95	1.23	1.88	1.74	1.74	1.72	1.96	2.40
206	Mid	8	80	1.19	1.19	1.85	1.67	1.77	1.68	2.04	2.27
206	Deep	8	80	1.17	1.32	2.07	1.88	1.98	1.89	2.28	2.60
Den Hill	Surface	8	78	1.42	1.25	2.03	1.85	2.35	2.08	3.64	3.75
Den Hill	Mid	8	77	1.81	1.00	2.21	1.90	2.45	2.15	3.61	3.84
Den Hill	Deep	9	77	1.27	1.55	2.97	2.65	2.78	2.68	3.76	3.97

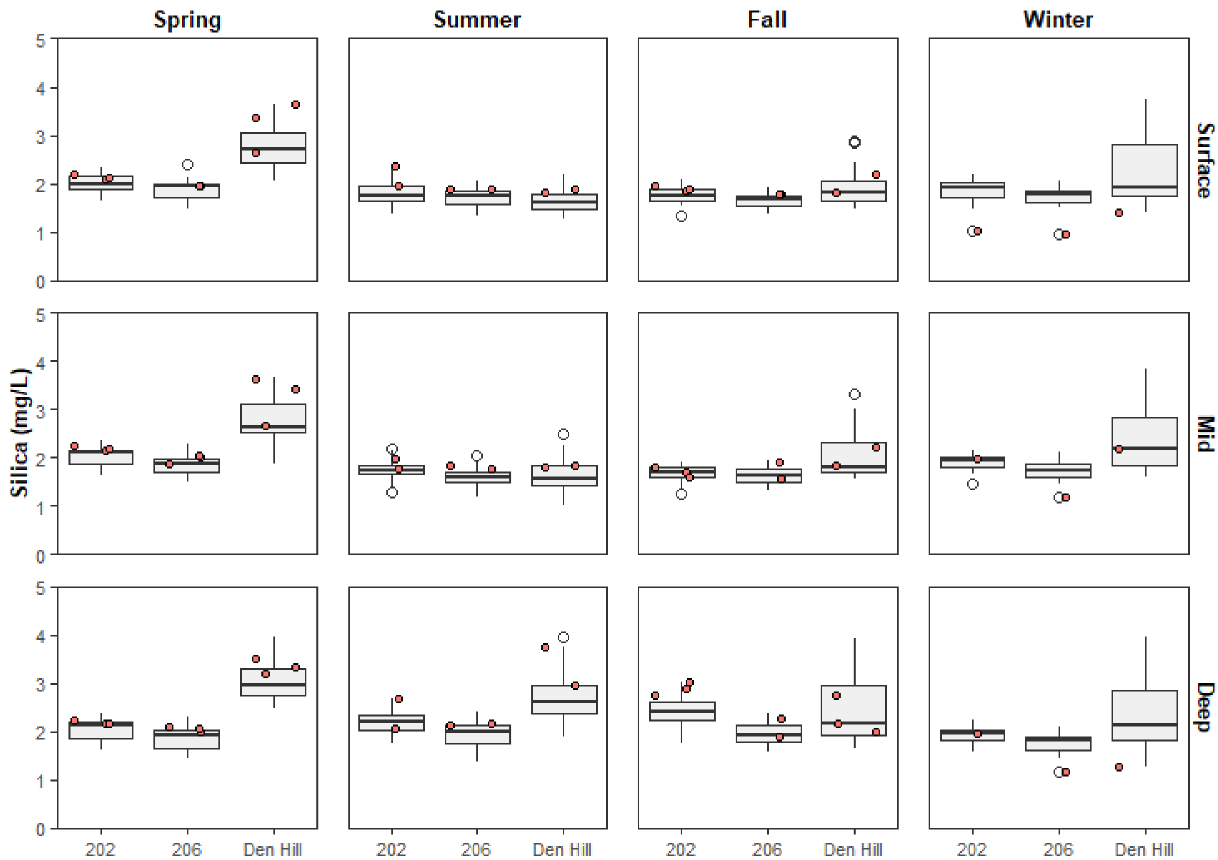


Figure 38. *Boxplots depicting the seasonal and vertical distributions of silica observed in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively.*

3.3.8.4. UV_{254} and Total Organic Carbon

3.3.8.4.1. UV_{254} Absorbance

UV_{254} absorbance in Quabbin Reservoir ranged from 0.022 to 0.084 ABU/cm in 2025 (Table 53). Overall annual minimums, medians, and means marginally exceeded the historical statistics at all sites, but none of the sites exceeded the historical maximums observed. An increase in monitoring frequency for UV_{254} in Quabbin Reservoir started in 2020. The higher resolution dataset generated in the previous years may elucidate new insights regarding intra-annual variability in UV_{254} absorbance in Quabbin Reservoir. This increased sampling frequency may also contribute to the observed annual median results above historical medians.

Table 53. *Descriptive statistics for UV_{254} (ABU/cm)measured in Core reservoir monitoring sites in the Quabbin Reservoir in 2025 relative to the period of record (POR; 2005, 2010-2024).*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	9	87	0.022	0.016	0.024	0.023	0.024	0.023	0.027	0.034
202	Mid	9	87	0.022	0.017	0.024	0.024	0.026	0.024	0.030	0.038
202	Deep	10	86	0.022	0.017	0.024	0.023	0.024	0.023	0.027	0.031
206	Surface	10	87	0.023	0.017	0.024	0.024	0.025	0.024	0.027	0.093
206	Mid	10	87	0.023	0.017	0.026	0.025	0.027	0.025	0.030	0.036
206	Deep	10	87	0.023	0.017	0.025	0.024	0.025	0.024	0.027	0.034
Den Hill	Surface	10	85	0.031	0.023	0.048	0.046	0.053	0.052	0.084	0.122
Den Hill	Mid	10	85	0.031	0.022	0.060	0.041	0.055	0.050	0.083	0.139
Den Hill	Deep	9	85	0.032	0.023	0.055	0.048	0.056	0.053	0.079	0.171

UV_{254} absorbance in the Quabbin Reservoir is impacted by contributions from major tributaries, precipitation inputs, algal dynamics reservoir circulation, and mixing. Spatial gradients in UV_{254} are largely reflective of localized inputs (e.g., elevated UV_{254} at Den Hill relative to other monitoring sites). Median annual UV_{254} was greatest at Den Hill and displayed little seasonal variation in samples collected from 202 and 206 in 2025 (Figure 39). Similar to last year's pattern, seasonality in UV_{254} absorbance was well established for Den Hill, with higher UV_{254} absorbances during spring. Similar to 2024, but unlike other previous years, elevated UV_{254} absorbances were also observed during the summer at all depths in Den Hill, likely attributed to potential increased loading from the East Branch Swift River during high stream flow events during summer.

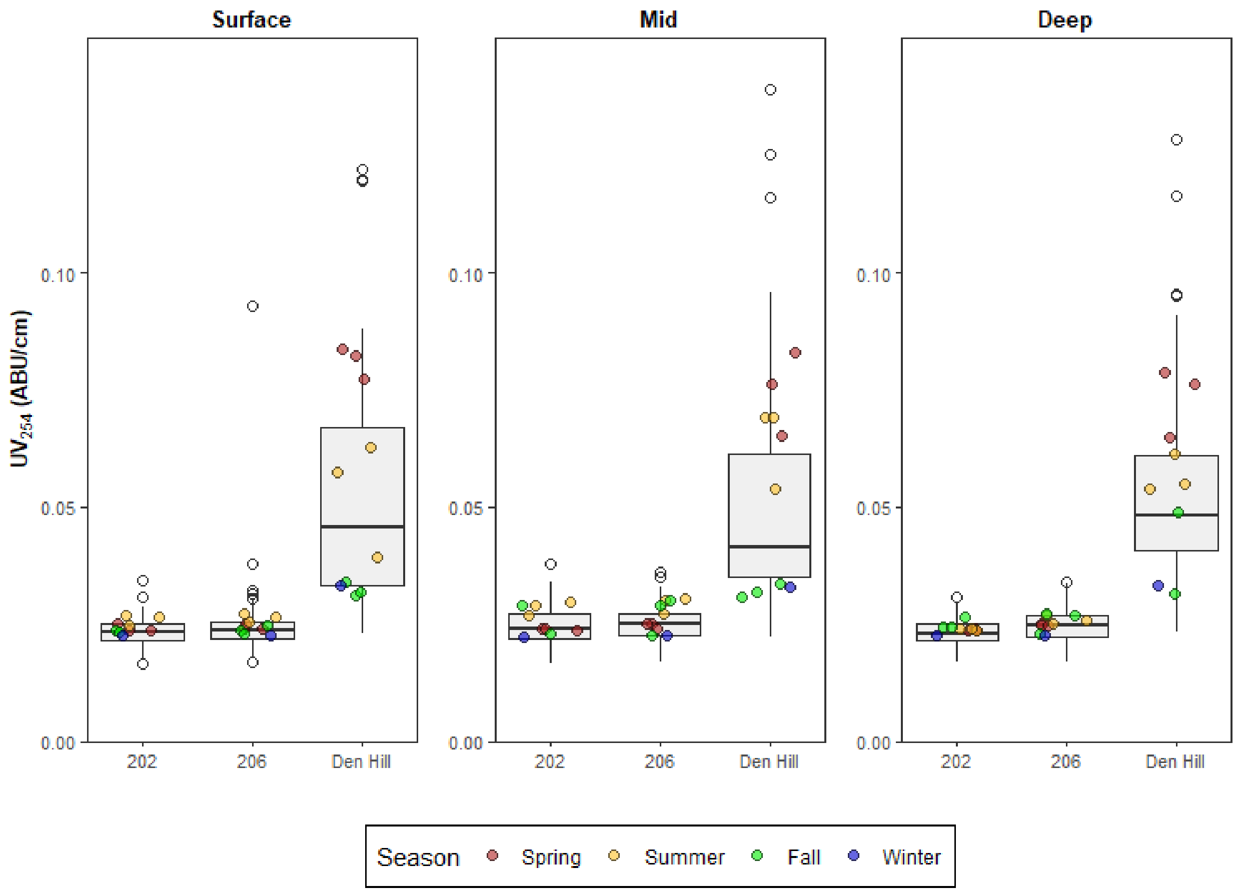


Figure 39. *Boxplots depicting the seasonal and vertical distributions of UV_{254} observed in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively.*

3.3.8.4.2. Total Organic Carbon

Routine monitoring for total organic carbon (TOC) in Quabbin Reservoir began in 2020. TOC concentrations ranged from 1.52 to 3.32 ABU/cm in 2025 (Table 54). TOC concentrations at sites 202 and 206 in 2025 were lower than the historical median, while concentrations at Den Hill were above the historical median. However, all concentrations were comparable to results seen in the last five years and to results generated nearly two decades prior (2 mg/L to 2.7 mg/L; concentrations approached or exceeded 3 mg/L at Den Hill) (Garvey and Tobiason, 2003; DWSP, 2021a). Concentrations of TOC measured in Quabbin Reservoir during 2025 were less than global mean concentrations for deep and north temperate lakes (3.463 mg/L and 5.809 mg/L, respectively) (Chen et al., 2015).

Similar to results from previous years, TOC concentrations were higher at Den Hill compared to 202 and 206. TOC at Den Hill exhibited seasonal variability with higher concentrations in the spring, while TOC at sites 202 and 206 exhibited little variability with depth or season (Figure 40). Elevated TOC concentrations at Den Hill in the spring are likely attributed to the proximity of this site to riverine inputs from the East Branch Swift River.

Spatial gradients in TOC generally mirrored UV_{254} absorbance – with relative enrichment in samples collected from Den Hill compared to 202 and 206. However, correlations among these parameters have previously been mixed, with the strongest relationships presented by Den Hill and comparatively poor relationships between UV_{254} and TOC at 202 and 206 (DWSP, 2022).

Table 54. *Descriptive statistics for total organic carbon (mg/L) measured in Core reservoir monitoring sites in the Quabbin Reservoir in 2025 relative to the period of record (POR; 2020 - 2024).*

Location	Depth	Count 2025	Count POR	Min 2025	Min POR	Median 2025	Median POR	Mean 2025	Mean POR	Max 2025	Max POR
202	Surface	10	44	1.81	1.79	1.93	2.21	2.02	2.20	2.30	2.68
202	Mid	10	44	1.86	1.73	2.08	2.08	2.14	2.13	2.99	2.79
202	Deep	10	44	1.52	1.55	1.90	1.96	1.87	1.95	2.24	2.42
206	Surface	10	43	1.84	1.78	2.08	2.24	2.10	2.19	2.44	2.66
206	Mid	10	44	1.87	1.78	2.03	2.15	2.04	2.18	2.31	2.69
206	Deep	10	42	1.64	1.66	1.87	2.12	1.91	2.11	2.28	2.58
Den Hill	Surface	10	44	2.07	2.03	2.56	2.50	2.57	2.65	3.32	3.57
Den Hill	Mid	10	44	2.14	1.86	2.56	2.39	2.56	2.48	2.92	3.59
Den Hill	Deep	10	44	2.01	1.92	2.38	2.33	2.45	2.47	2.96	3.83

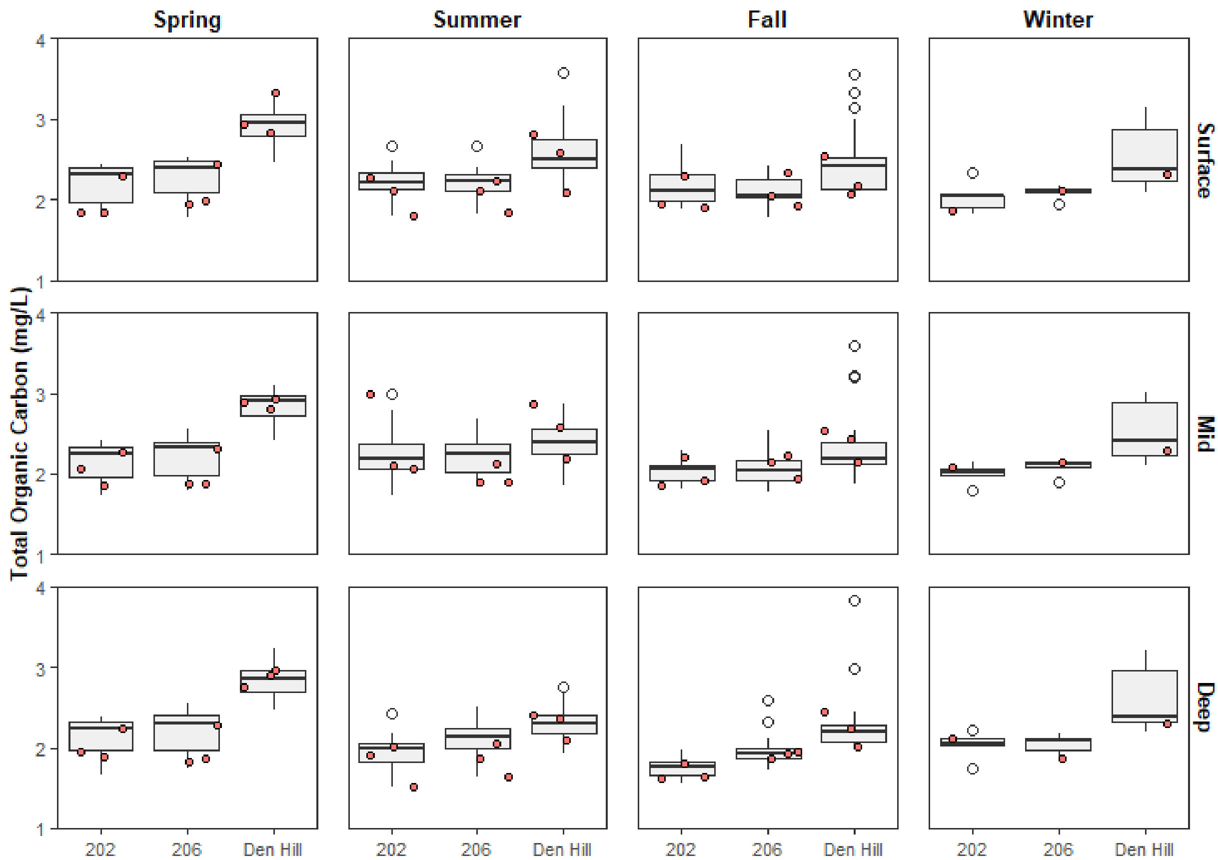


Figure 40. *Boxplots depicting the seasonal and vertical distributions of TOC in Quabbin Reservoir Core sites. Results corresponding to samples collected in 2025 are signified by the colored points. The solid black line represents the historical median, outliers for the period of record are represented by open circles, and the whiskers and box represent 1.5 times the interquartile range, and the 25th and 75th percentiles of all data, respectively.*

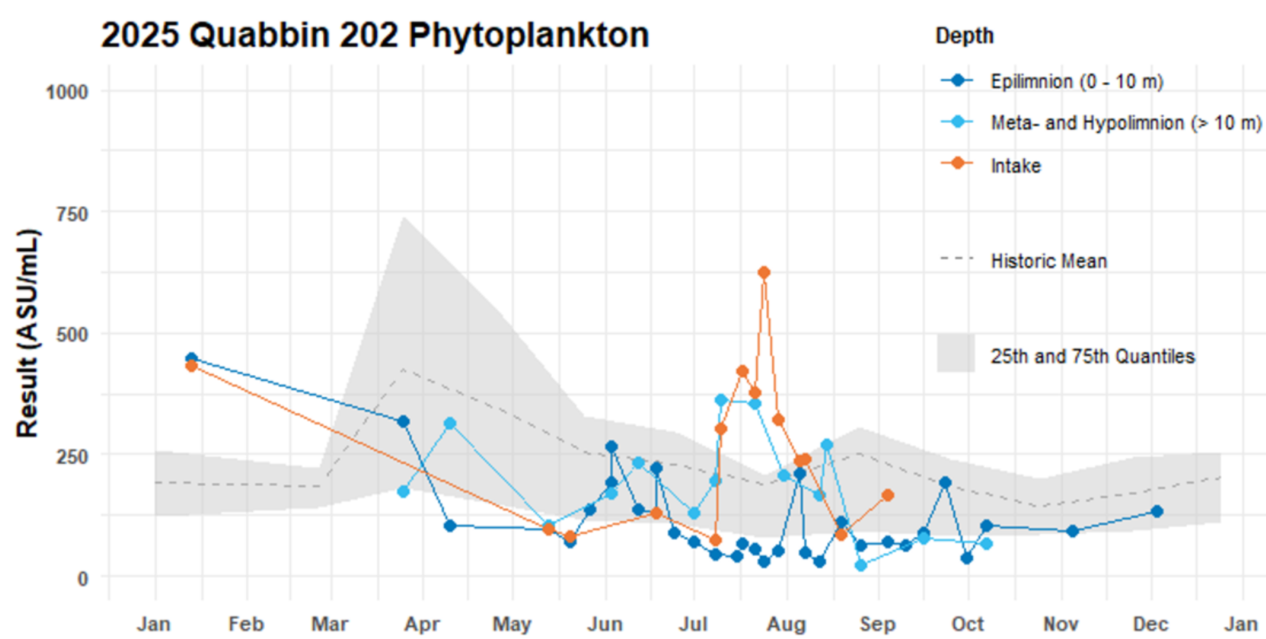
3.3.9. Phytoplankton

3.3.9.1. Sampling

Samples for phytoplankton enumeration were collected from Quabbin Reservoir Core monitoring sites 202, 206, and Den Hill on 35, 10, and 11 days in 2025, respectively. Samples for phytoplankton enumeration were collected from two to three depths, depending on the location: 1) from the epilimnion at 3 m, 2) at the chlorophyll *a* maximum (with simultaneous high dissolved oxygen), typically within the metalimnion, and 3) near intake depths to closely monitor phytoplankton community composition and potential taste and odor impacts. Intake sampling was performed regularly at site 202 to maintain a regular record of phytoplankton densities that directly influence the quality of water flowing into the Winsor Dam Intake (WDI) as part of the CVA system. Occasional sampling at the intake depth was performed (as needed) at site 206 to understand phytoplankton densities entering the Quabbin Aqueduct at Shaft 12 and subsequently transported to Wachusett Reservoir (see Figure 1).

In 2025, samples were collected for routine monitoring at site 202 monthly from January to April (ice conditions prevented sampling in February) and then again from October to December. During the growing season (May through September) sampling frequency increased to weekly at site 202. At sites 206 and Den Hill, samples were collected monthly starting in March. Under special circumstances (e.g., exceedance of enhanced monitoring levels (EML), see Table 55) sampling frequency of phytoplankton was increased, and additional samples were collected based on *in-situ* readings of chlorophyll *a* and dissolved oxygen. Sampling frequency was increased to twice per week at site 202 between June 26 and August 19 in response to consistent exceedance of the *Chrysosphaerella* EML during this period. At Den Hill, sampling frequency was increased to twice per month during April in response to the *Uroglenopsis* EML exceedance on April 10 and in June due to the *Dolichospermum* EML exceedance on June 3.

Similar to recent years, phytoplankton levels at sites 202 and 206 were generally below the historical mean during spring (March – May) and winter (December), but above historical mean during summer (June – August). At Den Hill, phytoplankton levels were highest during spring (March – May), followed by a decline in June and elevated levels during summer (July – August) (Figure 43). As in previous years, elevated summer phytoplankton levels in 2025 were mainly attributed to a reservoir-wide *Chrysosphaerella* aggregation. Maximum total phytoplankton densities in 2025 were 625 ASU/mL at site 202 observed on July 24 at 19 m, 802 ASU/mL at site 206 observed on July 1 at 11 m, and 675 ASU/mL at site Den Hill observed on April 10 at 3 m (Figure 41 and Figure 43). The *Chrysosphaerella* aggregation was first observed on June 12 at site 202 and Den Hill (site 206 not sampled on this date). Density of this aggregation varied by site, with higher densities observed at 206, followed by Den Hill and then 202. Overall, the 2025 aggregation was lower in density and shorter in duration (eight weeks) than the aggregation observed in 2024 (10 weeks). Drinking water quality was not impacted in 2025.



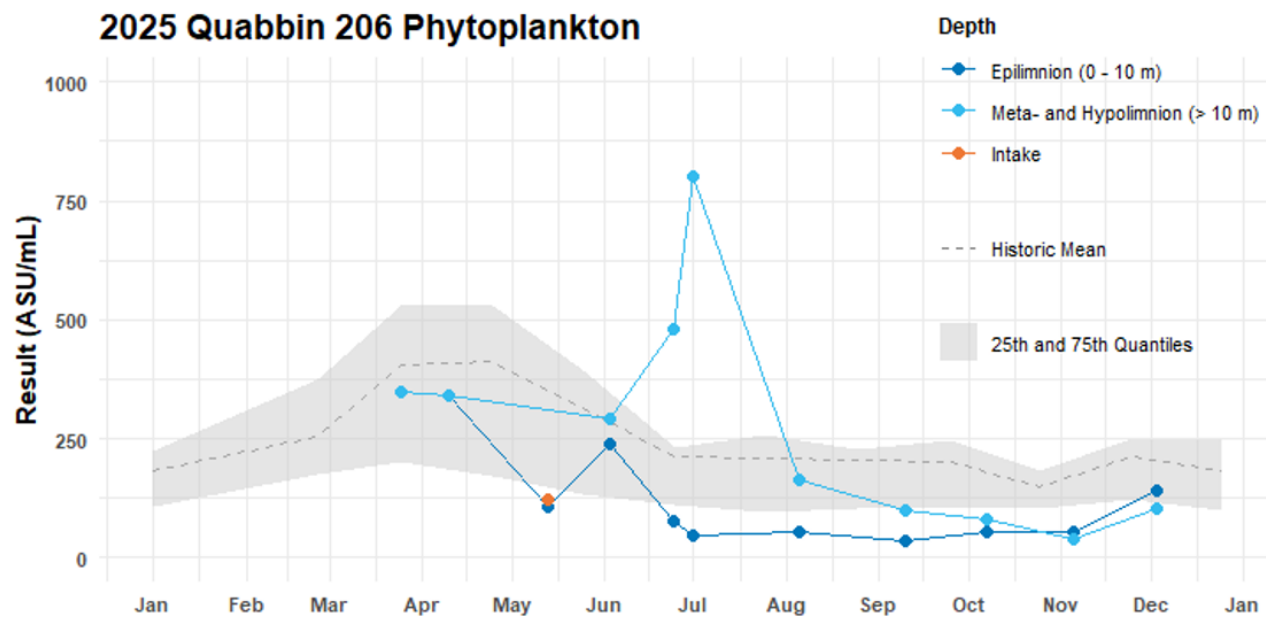


Figure 41. *Total phytoplankton densities during 2025 from sampling sites 202 (top) and 206 (bottom). Sample classification (epilimnion or meta- and hypolimnion) based on depth as defined by summer temperature profiles. The average for historical data covering 2007-2024 is indicated by the dashed line, with 25th and 75th quantiles represented as gray bands, corresponding to all sample depths.*

Community composition patterns in 2025 were similar to previous years. As is typically observed in Quabbin Reservoir, spring samples from all sites were dominated by diatoms, with the highest densities corresponding to *Asterionella* and *Tabellaria*. Following increased stability of stratification in late May and early June, phytoplankton diversity increased following a slight decline in total densities (Figure 41). This is likely explained by a depletion of available nutrients limiting growth, and increasing competition, resulting in a shift in community composition (Cole and Weihe, 2016). Community composition shifted from diatom dominance driven mainly by *Asterionella*, to a greater variety (albeit at lower densities) of chlorophytes, chrysophytes, and cyanophytes for a short period (Figure 42). A sudden increase in chrysophytes in mid-June caused another shift in community composition. For the remainder of the summer, chrysophytes, specifically *Chrysosphaerella*, dominated the community composition at all sites (Figure 44). As the *Chrysosphaerella* aggregation dwindled in early August, an increase in cyanophytes was observed, ultimately dominating the community composition during the fall. It is typical to observe cyanobacteria dominance during the late summer and fall due to these organisms' heightened performance in warm water compared to other phytoplankton (Whitton, 2012).

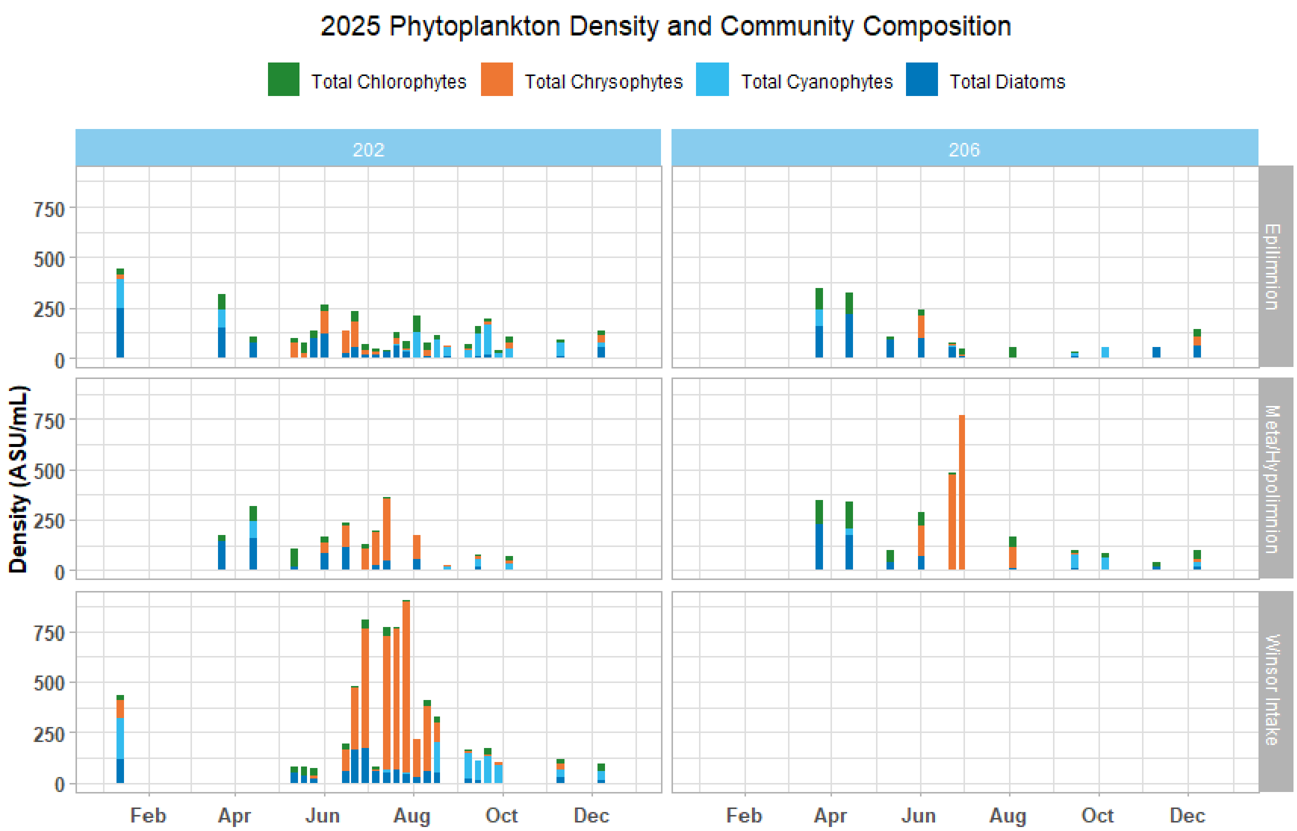


Figure 42. *Phytoplankton community composition, observed in 2025 from the epilimnion and meta/hypolimnion at sampling sites 202 and 206 and at the intake depth for site 202.*

Variability in community composition across depths was observed at all sites, with phytoplankton levels in the epilimnion generally differing from those in the metalimnion. At sites 202 and 206, epilimnetic samples typically had lower phytoplankton densities than metalimnetic samples. This pattern was especially evident during the summer period of elevated densities associated with the previously discussed *Chrysosphaerella* aggregation, which did not affect densities in the epilimnion. As a result, epilimnetic total densities at sites 202 and 206 remained below the historical mean for most of the year, except for levels above the historical mean during January at 202. In contrast, the epilimnion at Den Hill exhibited higher phytoplankton levels year-round than the metalimnion. Unlike sites 202 and 206, the Chrysosphaerella aggregation at Den Hill was observed in the epilimnion (Figure 43, Figure 44).

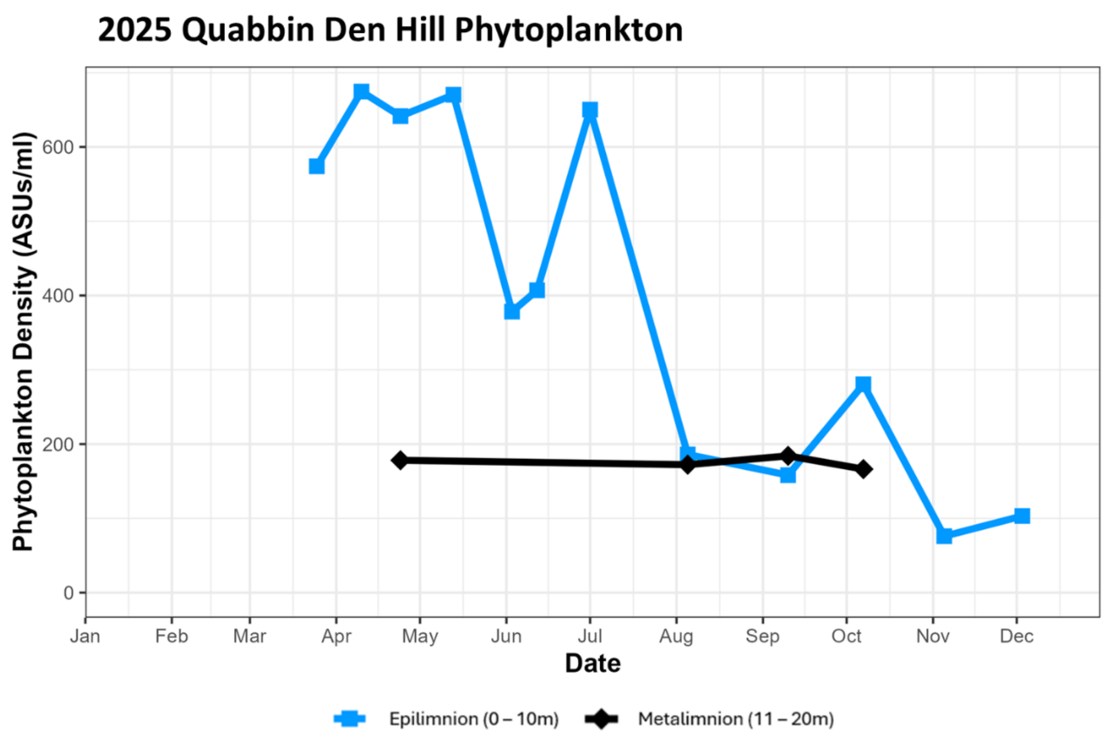


Figure 43. *Total phytoplankton densities during 2025 from sampling site Den Hill. Sample classification (epilimnion or metalimnion) based on depth as defined by summer temperature profiles. Samples collected from the epilimnion are shown in blue and samples collected from the metalimnion are shown in black.*

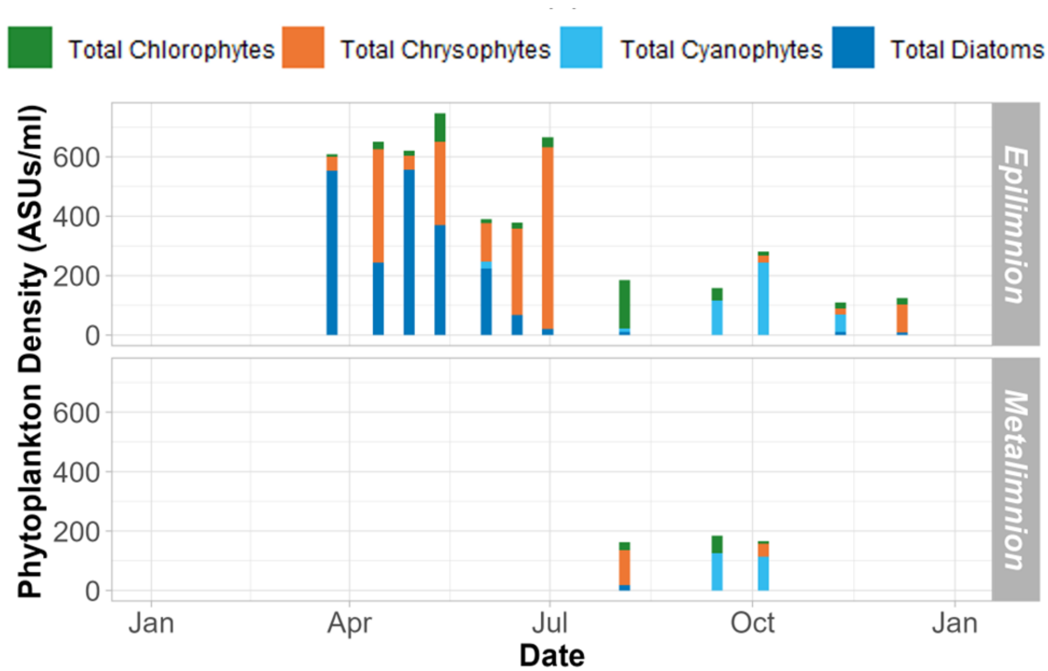


Figure 44. *Phytoplankton community composition, observed in 2025 from the epilimnion and metalimnion at sampling site Den Hill.*

Overall total densities and changes in community composition were consistent with trends observed in the Quabbin Reservoir over the last seven years. Elevated chrysophyte densities, particularly *Chrysosphaerella*, during the summer have been observed since 2019 (DWSP, 2020).

Over the last seven years, monitoring methodology has been modified to better capture phytoplankton aggregations by incorporating measurements of chlorophyll *a*. Prior to 2019, sample depths were selected primarily based on the temperature and dissolved oxygen profiles. Routine profiling of chlorophyll *a* began in 2016 to better inform the selection of sample collection depths for phytoplankton enumeration, supplementing temperature and dissolved oxygen profiles. However, the official change in sample depth selection occurred in 2019, when depths with maximum chlorophyll *a* concentrations began to be specifically targeted for sample collection. This change in field procedures should be considered when interpreting historical patterns of phytoplankton abundance in Quabbin Reservoir, as the sampling focus is now directly driven by chlorophyll *a* values, often resulting in collection of higher phytoplankton densities.

3.3.9.2. Taste and Odor Taxa

Chrysophyte blooms are responsible for nuisance taste and odor properties of water (Lin, 1977; Watson and Jüttner, 2019), oftentimes resulting in reports of undesirable aesthetic characteristics of finished water, such as a "fishy" or "cucumber" taste and odor (Sandgren et al., 1995; Paterson et al., 2004). Chrysophytes have been routinely detected throughout the water column in the Quabbin Reservoir (Worden, 2000; DWSP, 2019a). Chrysophyte densities have been elevated in four of the past seven years (2019, 2022, 2024, 2025), driven by metalimnetic aggregations.

Several taxa are closely monitored by DWSP to detect potential production of undesirable tastes and odors or cyanotoxin impacts to the drinking water supply. EMLs have been set for four chrysophytes and one cyanobacteria taxa (Table 55).

Table 55. *Enhanced monitoring level (EML) for taxa of concern.*

Nuisance Organism Class	Nuisance Organism Genus	Quabbin Reservoir EML (ASU/mL)
Cyanophyte	*Dolichospermum*	15
Chrysophyte	*Synura*	10
Chrysophyte	*Chrysosphaerella*	100
Chrysophyte	*Uroglenopsis*	200
Chrysophyte	*Dinobryon*	200

In 2025, all taxa of concern were observed but only the *Chrysosphaerella*, *Uroglenopsis*, and *Dolichospermum* EMLs were exceeded. *Chrysosphaerella* exceeded the 100 ASU/mL EML 21 times, and high densities were observed at all sites. At Den Hill, *Uroglenopsis* exceeded the 200 ASU/mL EML twice and *Dolichospermum* exceeded the 15 ASU/mL EML once. *Dinobryon* was observed at all sites but always below the 200 ASU/mL EML (Figure 45). Due to the exceedance of the EMLs, primarily *Chrysosphaerella*, monitoring frequency was increased from weekly to twice per week at site 202, and from monthly to twice per month at sites 206 and Den Hill to track *Chrysosphaerella* levels. Increased monitoring frequency remained until levels fell below the established EML. Return to normal monitoring frequency at all sites occurred after August 19, 2025.

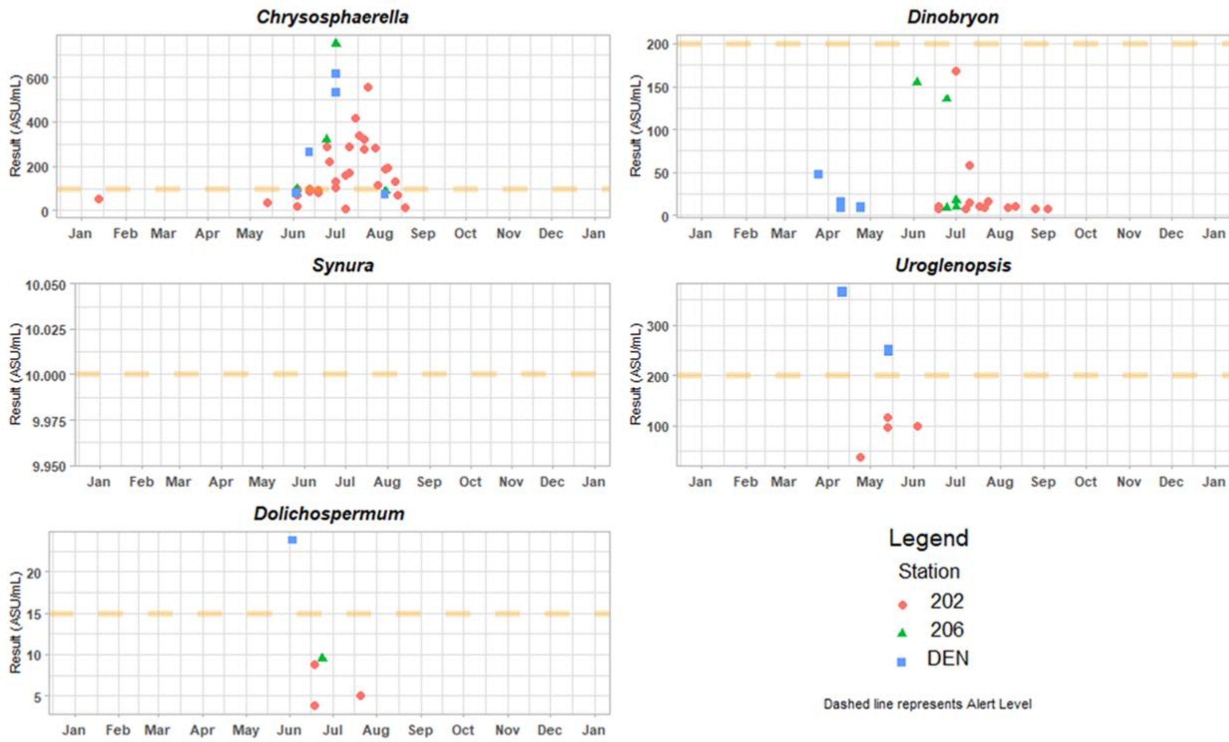


Figure 45. *Occurrence of phytoplankton taxa of concern at Quabbin sampling sites 202, 206, and Den Hill (DEN) during 2025. Dashed line represents the established enhanced monitoring level (EML) specific to each taxa. Lack of occurrence indicates that taxa were not observed during regular monitoring.*

3.4. Aquatic Invasive Species Monitoring and Management

Aquatic invasive species (AIS) include macrophytes, phytoplankton, zooplankton and larger fauna (primarily from the Mollusca phylum). Introduction of AIS may have adverse impacts on water quality including changes in water color and increases in turbidity, phytoplankton growth, and concentrations of trihalomethane (THM) precursors (Gettys et al., 2009). These increases result from the function of these plants as nutrient "pumps" extracting nutrients from sediment and releasing them into the water column, primarily as dissolved and particulate organic matter (Gettys et al., 2009). Invasive macrophyte species are known to aggressively displace native vegetation and grow to nuisance densities, while invasive zooplankton and fauna outcompete native species and disrupt aquatic food webs, thus altering water quality. AIS can be introduced and transported within watersheds via human or wildlife pathways including, but not limited to, aquarium releases, recreational activity (e.g., fishing and boating equipment), waterfowl movements, and downstream flow.

Portions of Quabbin Reservoir and select ponds within the Quabbin Reservoir and Ware River Watersheds are periodically surveyed for the presence of AIS by DWSP staff and by MWRA contractors. Several AIS have been documented through these efforts, in some cases initiating a management response (DWSP, 2020). Early detection of AIS, education, and participation from the public is critical for successful prevention of new or increased AIS infestations. Management of AIS in Quabbin Reservoir Watershed and Ware River Watershed is primarily based on prevention programs. The following sections of this report provide details of observed AIS presence in the reservoir and watersheds during the 2025 survey season and documents the prevention and management programs currently in place within the watersheds.

3.4.1. Invasive Aquatic Macrophyte Monitoring and Distribution

Aquatic macrophyte surveys are conducted during the growing season and have been performed periodically since 1998 and on a regular basis since 2006 and 2010 in the Quabbin Reservoir and Ware River Watersheds, respectively. Shoreline assessments entail visual observations of the littoral zone via kayak, small boat, or on foot depending on water level. Some water bodies are surveyed annually, while others are surveyed every five years on a rotating schedule based on the Environmental Quality Assessment (EQA) District where the water body is located (Appendix D. Quabbin Reservoir AIS Survey Zones). Routine monitoring prioritizes water bodies with ramps suitable for launching trailered boats, as this type of activity increases the risk of AIS spread (Rothlisberger et al., 2011). Within the past 10 years, 46 different watershed ponds (including the Reservoir's holding ponds, Prescott Peninsula ponds, and the Ware River itself) across the two watersheds were surveyed either annually or within the EQA schedule. See 6.5 Appendix E for a visual of historical AIS observations throughout the watersheds.

The following sections summarize the distribution of invasive aquatic macrophytes in the reservoir, the Quabbin Reservoir Watershed, and Ware River Watershed (Table 56). In 2025, efforts in the Quabbin Reservoir were focused on surveying the entire West Arm of the Reservoir. In addition, the Reservoir's Boat Launch Areas 1, 2, and 3, and the two holding ponds (O'Loughlin and Pottapaug Ponds) were also surveyed. A total of three water bodies were surveyed in the Ware River Watershed in 2025, including portions of the Ware River upstream of the Shaft 8 intake. The 2025 EQA Districts were the East Branch Swift and Coldbrook and Longmeadow, with three surveyed water bodies within these districts. Other annually surveyed water bodies were within the Fever Brook, Quabbin Northwest, Quabbin Reservation, and West Branch Ware sanitary districts.

Table 56. *Aquatic invasive species observed in the Quabbin Reservoir, Quabbin Reservoir Watershed, and Ware River Watershed since the beginning of the AIS program in 2010. Quabbin Reservoir includes O'Loughlin and Pottapaug holding ponds. An asterisk (*) indicates no observations made within recent years (2020-2025).*

Scientific Name	Common Name	Quabbin Reservoir	Quabbin Reservoir Watershed	Ware River Watershed
Cabomba caroliniana	Fanwort	N/A	x*	x
Iris pseudacorus	Yellow Flag Iris	x	x	x
Lythrum salicaria	Purple Loosestrife	x	x	x
Myosotis scorpioides	True Forget-me-not	x*	x	x
Myriophyllum heterophyllum	Variable Leaf Milfoil	x	x	x
Najas minor	Brittle Naiad	x*	N/A	N/A
Potamogeton crispus	Curly-leaf Pond Weed	N/A	N/A	x
Phragmites australis	Common Reed	x	x	x
Rorrippa microphyllum	One Row Yellowcress	x*	x*	x*
Trapa natans	Water Chestnut	N/A	N/A	x
Utricularia inflata	Swollen Bladderwort	x	N/A	x*
Cipangopaludina chinensis	Chinese Mystery Snail	x	x	x

3.4.1.1. Contracted Aquatic Macrophyte Surveys

Since 2013, MWRA contractors have conducted annual point-intercept surveys of DWSP/MWRA source and emergency reservoirs. Additionally, since 2024, MWRA contractors have surveyed O'Loughlin Pond, Pottapaug Pond, and sections of the Reservoir near BLA3 for *Utricularia inflata* (swollen bladderwort) and removed plants via hand harvesting to manage populations. MWRA contracted with TRC for both the annual macrophyte survey and *U. inflata* management efforts.

Myriophyllum heterophyllum (variable leaf milfoil) and *U. inflata* were the only submersed AIS observed in the Quabbin Reservoir and Ware River Watersheds during the Annual Macrophyte Survey. Emergent invasives are not specifically included in the contractor point-intercept surveys, but the continued presence of *Phragmites australis* in the Quabbin Reservoir was noted. The extent and density of *M. heterophyllum* in Quabbin Reservoir increased slightly compared to 2024 (observed at 15% of surveyed points; TRC, 2025b). Compared to 2024, the extent and density of *U. inflata* also slightly increased (observed at 3% of surveyed points), but it should be noted that the timing of the Annual Macrophyte Survey does not accurately reflect *U. inflata* populations.

3.4.1.2. Cabomba caroliniana

Cabomba caroliniana (fanwort) originates from the southeastern United States (Texas to Virginia) and was introduced outside its range through the aquarium plant trade, where it then spread via dumping and cultivation (Bickel, 2015; Bickel, 2017; Schooler et al., 2009). *C. caroliniana* reproduces via fragmentation, allowing it to spread quickly and outcompete native species. Unmanaged, this species will form dense mats at the water's surface, crowding out other plants and creating hazards for recreationists (Schooler et al., 2009). The long stems impede boats and can get tangled in propellers, paddles, and fishing lines. In addition, swimmers can also become entangled (Schooler et al., 2009). Like other mat-forming AIS, *C. caroliniana* can alter water quality and native composition by nutrient loading and decreasing available dissolved oxygen. Methods of control for this species attempt to limit fragmentation by using chemical treatments, drawdowns, biological control, or manual removal.

Although not present in the Quabbin Reservoir, *C. caroliniana* has been found in both watersheds with the first instance reported in Queen Lake (Phillipston, MA) in 2010. Since then, this species has been detected in several other waterbodies within the watersheds. No new infestations were found during the 2025 survey season (Table 57).

First discovered in the main body of Long Pond in 2021 in the northern cove near the boat ramp, *C. caroliniana* has spread to become the dominant macrophyte in much of the northern littoral zones. This AIS is also present in the southern extent of the pond, but to a lesser degree, and must compete with *M. heterophyllum* (another AIS) in these areas. No AIS management has been conducted in this pond by DWSP, and without intervention this AIS is expected to continue its population expansion.

Table 57. *Waterbodies with* Cabomba caroliniana *(fanwort) present during the 2025 DWSP AIS survey with survey date and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Long Pond	Rutland	Ware River	07/18/2025	08/06/2021

3.4.1.3. Myriophyllum heterophyllum

Myriophyllum heterophyllum (variable-leaf milfoil) is the most frequently encountered submersed AIS in the watersheds. Although native to the southeastern United States, *M. heterophyllum* is considered invasive in the northeastern states (Bailey, 2007). This species mainly spreads via seeds and fragmentation, where stem pieces with at least one node can regrow into a viable plant (Bailey, 2007; Gross et al., 2020; Halstead et al., 2003). As a result, this species can colonize and outcompete native species within a short period of time, making prevention and rapid response crucial to its management. Unfortunately, *M. heterophyllum* can grow undetected until it is already well-established (Halstead et al., 2003), resulting in higher management costs and effort. When left unchecked, this species creates dense mats throughout the water column, creating boating hazards (clogging propellers and fishing lines), swimming hazards, and decreasing native species' diversity (Bailey, 2007; Halstead et al., 2003). In addition, large amounts of decaying plant matter increase nutrient loading (phosphorus and nitrogen) which reduces dissolved oxygen levels that other species (namely fish) require (Halstead et al., 2003). Due to fragmentation, removal efforts seek to keep the plant intact by utilizing either diver assisted suction harvesting (DASH), herbicide treatments, or covering with benthic barriers.

M. heterophyllum is well distributed in portions of Quabbin Reservoir, with established populations at Boat Launch Areas 2 and 3 and the holding ponds (O'Loughlin and Pottapaug). In addition, *M. heterophyllum* is well established in the Ware River, most notably at (and upstream of) the Shaft 8 intake. Due to the aggressive nature of this species, it is abundant and widely distributed in the waterbodies where it has become established. No new infestations were detected in the 2025 DWSP surveys (Table 58).

Management of *M. heterophyllum* is conducted annually by DCR contractors above and below the Ware River Shaft 8 intake. This year, the macrophyte survey was conducted by TRC, with removal efforts by DRG (see Section 3.4.2 for more information). In addition, the Asnacomet "Comet" Pond Lake Association has been working with DCR-Lakes and Ponds since 2018, when *M. heterophyllum* was discovered, to manage plants. With initial financial support from DWSP, management efforts have included hand-harvesting and diver-assisted suction harvesting (DASH). DCR-Lakes and Ponds staff, in conjunction with contractors, revisited Asnacomet Pond in 2025 to continue harvesting efforts. On June 11 and 25, 2025, DASH resumed along the northern and western shorelines. Over two days, around 60 pounds of *M. heterophyllum* was removed from these areas, mainly harvested from the northern shoreline. Contractors suggest ongoing management, one harvest day per month between May and September, to maintain low densities.

Table 58. *Waterbodies with* Myriophyllum heterophyllum *(variable-leaf milfoil) present during the 2025 DWSP AIS survey with survey dates and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Boat Area 2 Shoreline	New Salem	Quabbin Reservoir	06/11/2025	2006
Boat Area 3 Shoreline	Petersham	Quabbin Reservoir	07/17/2025	2006
Brigham Pond	Hubbardston	Ware River	09/18/2025	10/14/2010
Long Pond	Rutland	Ware River	07/18/2025	8/13/2010
O'Loughlin Pond	New Salem	Quabbin Reservoir	07/25/2025	2006
Pottapaug Pond	Hardwick	Quabbin Reservoir	08/28/2025	2006
Ware River (boat launch to Burnshirt River)	Barre	Ware River	05/14/2025	7/8/2016

3.4.1.4. Najas minor

Najas minor (brittle naiad) was introduced to North America in the early 20th century from its native range of Eurasia and northern Africa (Wentz and Stuckey, 1971; Les et al., 2015; Volk, 2019). Although the exact method of introduction is unknown, its spread has been attributed to cultivation escapes and waterfowl food propagation programs (Les et al., 2015). Spreading mainly via seed dispersal (Les et al., 2015; Volk, 2019), *N. minor* has been documented throughout much of the eastern United States. Waterfowl and recreational equipment assist in *N. minor*'s dispersal, as the small and inconspicuous seeds remain viable after consumption and can cling to the outside of boats, trailers, and other equipment that come in contact with water (Volk, 2019). Although fragmentation itself does not produce separate viable plants, the fragments carry seeds that are then dispersed throughout the waterbody (Volk, 2019). Similar to other mat-forming AIS, *N. minor* can displace native plants, and impacts recreational activities such as swimming, boating, and fishing (Les et al., 2015; Volk, 2019).

N. minor was first documented by contractors in 2014 at O'Loughlin Pond. DWSP hypothesize that *N. minor* seeds were introduced into the pond via avian passage, as birds are known to feed on the indistinguishable native *Najas gracillima* seeds (Martin and Uhler 1939; Reynolds et al., 2015). The *N. minor* infestation in O'Loughlin Pond was quickly harvested using DASH and has not been observed since. This AIS has not been found elsewhere in the Quabbin Reservoir Watershed, or in the Ware River Watershed.

3.4.1.5. Potamogeton crispus

Potamogeton crispus (curly-leaf pondweed) was first observed in Philadelphia in the 1840s, and is native to Eurasia, Africa, and Australia (Bolduan et al., 1994; Zhou et al., 2017). By the 1860s, *P. crispus* was abundant within the Lehigh River in Pennsylvania and Delaware, and by the 1880s had spread to Massachusetts and New York (Bolduan et al., 1994). The spread of this species seems to be associated with fish hatchery activity, as early reports from several states were either found in fish hatchery ponds or waters associated with them (Bolduan et al., 1994). Unlike other plant species that remain dormant in winter, *P. crispus* acts like a winter annual, continuing to grow during the winter season (Bolduan et al., 1994; Johnson et al., 2012; Zhou et al., 2017). This species reproduces via rhizomes and turions, which sprout in the fall and grow rapidly in the early spring, senescing and depositing turions in the sediment by midsummer (Bolduan et al., 1994; Johnson et al., 2012; Zhou et al., 2017). Although this plant's impact on native macrophytes is still being researched, it has been found to impact phosphorus (Owens et al., 2007), nitrogen, and other heavy metals (Zhou et al., 2017), acting as a nutrient loader once this species has senesced.

P. crispus was first identified in 2013 at Whitehall Pond, a waterbody located within Rutland State Park and owned by DCR. Fortunately, this species has not been observed elsewhere within either watershed. As Whitehall Pond has a DCR-managed beach, management and treatment are overseen by DCR Lakes and Ponds. Beginning in 2013, management of *P. crispus* has included mechanical and hand harvesting, as well as chemical control. These treatment actions have reduced *P. crispus* densities, however some plants are still present – most likely from turions sprouting after treatment occurred. In 2025 no macrophyte surveys were conducted at Whitehall Pond by DWSP, but it was treated again in June.

3.4.1.6. Trapa natans

Trapa natans (water chestnut) has a wide native distribution, ranging from Eurasia to Africa (Mikulyuk and Nault, 2009; Walusiak et al., 2024), and was first observed in Massachusetts in the late 1890s (Burk et al., 1976, USFWS, 2018). By the 1940s, *T. natans* was well established along the Sudbury River, and in 1974 covered "several hundred square feet" near the intersection of Stony Brook and Route 116 in South Hadley (Burk et al., 1976). Unlike other AIS mentioned in this section, *T. natans* is a floating-leaf aquatic species, and reproduces mainly via seeds, often referred to as "chestnuts". Each chestnut can produce 10-15 rosettes, and each rosette can produce up to 20 chestnuts (USFWS, 2018) which drop down into the sediment to overwinter (O'Neill, 2006). These chestnuts then sprout in the spring but may remain dormant in the substrate for up to 12 years before sprouting (O'Neill, 2006; Phartyal et al., 2018). Rosettes may also detach from their stems and float to another area via wind or currents, resulting in a new infestation (Groth et al., 1996; O'Neill, 2006; USFWS, 2018). This reproductive strategy (i.e., many seeds with a long viability window) allows *T. natans* to outcompete native species, and results in exponential population growth (Burk et al., 1976; USFWS, 2018).

As a floating plant, *T. natans* can cover the majority of the water surface when conditions are right, intercepting most of the available sunlight (USFWS, 2018; Walusiak et al., 2024). This AIS can drastically impact the native ecosystem, outcompeting native macrophytes for sunlight and nutrients, thus decreasing habitat suitability for associated flora and fauna such as algae, zooplankton, ducks, and other waterfowl (USFWS, 2018; Walusiak et al., 2024). Additionally, *T. natans* impedes many recreational activities. Waterways become unnavigable, fishing lines can become tangled, and the chestnuts' sharp spines can cause puncture wounds when stepped on (USFWS, 2018; Walusiak et al., 2024). These spines also act as a vector for spread by clinging to boats, recreational gear, and fur or feathers (Mikulyuk and Nault, 2009; O'Neill, 2006).

T. natans was observed for the first time in the Ware River Watershed during the 2024 DWSP survey at Brigham Pond (Table 59). In the 2021 macrophyte survey of Brigham Pond no *T. natans* was detected, suggesting that this infestation is still in the early stages. Management efforts during early infestation stages are critical in preventing this species from taking over an area and should be considered as an ongoing management effort for DWSP staff.

In response to the initial discovery in 2024, DWSP staff were able to remove an estimated 60 gallons of plant material the same day as the survey. Comparatively in 2025, DWSP staff were able to remove and dispose of an estimated 420 gallons of *T. natans* from Brigham Pond over the course of four days (an average of 105 gallons per day). This large increase is likely due to a difference in staff effort level and timing. In 2024 removal only occurred during one day in mid-September with two staff when plants were already senescing, compared to two to five staff over four dates from mid-June (when rosettes first began to appear) to mid-September. Also of note were the sizes of plants. In mid-June the rosettes are just emerging and are significantly smaller in size than the rosettes observed in August or September.

No new populations were observed during the 2025 DWSP macrophyte surveys.

Table 59. *Waterbodies with* Trapa natans *(water chestnut) present during the 2025 AIS survey with survey date and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Brigham Pond	Hubbardston	Ware River	09/18/2025	09/17/2024

3.4.1.7. Phragmites australis

Phragmites australis (common reed) is the most widely distributed emergent AIS in the Reservoir and the watersheds. Unlike other AIS, not all *P. australis* are invasive. This species has three distinct subspecies (ssp.) – ssp. *americanus* (native), ssp. *berlandieri* (native), and ssp. *australis* (invasive) (Lambert et al., 2010; Hazelton et al., 2014). Here-after, *P.* australis is referring to the invasive subspecies. *P. australis* is native to Europe, and has spread to most of the United States, occupying areas where the native subspecies inhabit and areas where they do not (Lambert et al., 2010). This AIS can spread via seed, but the main method is clonal propagation via rhizomes and stolons (Meyerson et al., 2000; Lambert et al., 2010; Hazelton et al., 2014). This allows *P. australis* to spread rapidly once introduced to an area, becoming denser and larger in the following years, and resulting in reductions in native plant biodiversity (Warren et al., 2001), declines in habitat quality for native fauna (Able and Hagan, 2003), and disruptions to natural nutrient cycling (Meyerson et al., 2000; Hazelton et al., 2014). Although labor intensive, pioneer or small infestations may be eradicated with annual management efforts and should be prioritized before they become dense established stands. Potential management practices include mechanical harvesting (excavation, cutting, hand-pulling, and benthic barriers) and herbicides (Warren et al., 2001; Hazelton et al., 2014). Each method has benefits and drawbacks, and use should be tailored to the area and management plan goals.

P. australis is well established throughout the reservoir, forming dense patches along the shoreline. In addition, '*Phragmites* islands' have formed in some shallow locations of the reservoir where this AIS completely dominates. However, *P. australis* can be difficult to identify at early growth stages, making documentation of spread difficult. Therefore, additional surveys are often required to confirm the identifications. Observations initially made at O'Loughlin Pond during the 2023 DWSP survey fall into this category and have not been confirmed. No new infestations were found during the 2025 DWSP survey season (Table 60).

Table 60. *Waterbodies with* Phragmites australis *(common reed) present during the 2025 DWSP AIS survey with survey date and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Boat Area 2 Shoreline	New Salem	Quabbin Reservoir	06/11/2025	1970s
Boat Area 3 Shoreline	Petersham	Quabbin Reservoir	07/17/2025	08/11/2014
Long Pond	Rutland	Ware River	07/18/2025	09/07/2018
O'Loughlin Pond	New Salem	Quabbin Reservoir	07/25/2025	07/11/2023
Pottapaug Pond	Hardwick	Quabbin Reservoir	08/28/2025	1970s
West Arm Quabbin Reservoir	Belchertown, Pelham, and Shutesbury	Quabbin Reservoir	07/09/2025	7/14/2017

3.4.1.8. Utricularia inflata

Utricularia inflata (swollen bladderwort) is a carnivorous aquatic plant native to much of the southeastern coastline, from Texas and Florida to Delaware (Titus and Grisé, 2009). This AIS has since expanded its range, first observed in the Adirondack Mountains in 1999 (Titus and Grisé, 2009; Urban and Titus, 2010), and now also present in several northeastern states including Massachusetts. *U. inflata* spreads via seeds and fragmentation, where its vegetative propagules separate from the main stem to form an independent plant (Urban and Dwyer, 2016). Unmanaged, this species will form dense mats at the water's surface, creating recreational hazards, disrupting the native food web, and altering water chemistry. Due to its carnivorous nature (Miranda et al., 2021), *U. inflata* competes with native species (such as fish larva/fry) that feed on aquatic insect larva and zooplankton, disrupting the food chain. In addition, due to its mat-forming properties, *U. inflata* can increase light attenuation and cause the extirpation of native species (Urban and Dwyer, 2016).

U. inflata was first documented in the Ware River Watershed and Quabbin Reservoir (Boat Launch Area 2) in 2017. The single plant at BLA2 was removed, and no additional plants have been found until 2025. Although no observations of *U. inflata* were made between 2019 and 2023 in either watershed, identification of this species when not in bloom is difficult, and it is possible the seasonality of past surveys affected our understanding of its presence and distribution. In May of 2023 this species was observed in the fragment barrier on Pottapaug Pond and later confirmed on O'Loughlin Pond as well. Management efforts have been ongoing since.

DWSP, in partnership with MWRA, hired contractors to survey and hand remove *U. inflata* on Pottapaug Pond and O'Loughlin Pond during the 2025 DWSP survey season. More information on these management efforts can be found in Section 3.4.3.

Table 61. *Waterbodies with* Utricularia inflata *(swollen bladderwort) present during the 2025 DWSP AIS survey with survey dates and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Boat Area 2 Shoreline	New Salem	Quabbin Reservoir	06/11/2025	08/08/2017
O'Loughlin Pond	New Salem	Quabbin Reservoir	07/25/2025	05/21/2024
Pottapaug Pond	Hardwick	Quabbin Reservoir	08/28/2025	05/26/2023

3.4.1.9. Iris pseudacorus

Iris pseudacorus (yellow flag iris) is an invasive species that closely resembles the native blue flag iris when not flowering. Originally introduced as a horticultural plant to North America in the 1900s (Jacobs et al., 2010; Stoneburner et al., 2021), *I. pseudacorus* has spread throughout most of the United States. Although terrestrial in nature, this species is closely tied to wetlands and is often found along shorelines. *I. pseudacorus* spreads via seeds and rhizomes and may experience 'rhizome splitting', resulting in separate plants from the original (Sutherland, 1990; Jacobs et al., 2010; Hayasaka et al., 2018). If left unmanaged, *I. pseudacorus* can alter riparian zones by out-competing native sedges and rushes that support waterfowl and other native species (Jacobs et al., 2010; Hayasaka et al., 2018). It may also create dense stands that impede water flow (Stoneburner et al., 2021).

I. pseudacorus has been documented in the reservoir and within both watersheds. This species was first documented in Connor Pond (Petersham, MA) in 2013 where it now colonizes large stretches of the western shoreline and has become densely distributed in many small coves. It is hypothesized that this population is the source of plants observed in Pottapaug Pond and at Boat Launch Area 3 from seed pods floating downstream. In 2019, the fragment barrier at Boat Launch Area 3 was repositioned to catch floating seed pods more effectively. No new *I. pseudacorus* infestations were observed during the 2025 DWSP surveys (Table 62).

Table 62. *Waterbodies with* Iris pseudacorus *(yellow-flag iris) present during the 2025 DWSP AIS survey with survey dates and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Pottapaug Pond	Hardwick	Quabbin Reservoir	08/28/2025	2015

3.4.1.10. Lythrum salicaria

Lythrum salicaria (purple loosestrife) originates from Eurasia and was introduced to North America in the early 1800s (Stuckey, 1980; Mullin, 1998; Nagel and Griffin, 2001; Blossey et al., 2001). Since then, it has spread throughout most of the United States, usually inhabiting wetlands, marsh-like, or riparian sites (Mullin, 1998; Nagel and Griffin, 2001). *L. salicaria* is a prolific invasive, producing as many as 2.7 million seeds annually, which create long-lived seed banks that require regular maintenance to keep to manageable levels (Nagel and Griffin, 2001; Henne et al., 2005; Mahaney et al., 2006). If left unchecked, *L. salicaria* can disturb the native ecosystem by outcompeting native plants for space (Stuckey, 1980), decreasing food sources for songbirds, and reducing suitable nesting habitat for waterfowl (Mullin, 1998; Henne et al., 2005). Management of this species is usually either mechanical harvesting or chemical treatment (Mullin, 1998; Henne et al., 2005).

L. salicaria was first documented in 2011 in both watersheds. Since then, this invasive species has spread from the initial three waterbodies to almost twenty, with varying degrees of infestation levels (individual plants to small clusters). This plant is difficult to identify when not in bloom, making accurate estimates of its extent throughout the watersheds difficult to attain. Despite this, populations of *L. salicaria* do not appear to be changing rapidly year after year, demonstrating a relatively low threat to water quality. No new infestations were observed during the 2025 DWSP surveys (Table 62).

Table 63. *Waterbodies with Lythrum salicaria (purple loosestrife) present during the 2025 DWSP AIS survey with survey dates and date of first observation.*

Waterbody Name	Town	Watershed	Last Obs.	First Obs.
Boat Area 3 Shoreline	Petersham	Quabbin Reservoir	07/17/2025	08/24/2022
Long Pond	Rutland	Ware River	07/18/2025	08/19/2013
Pottapaug Pond	Hardwick	Quabbin Reservoir	08/28/2025	08/20/2011

3.4.1.11. Myosotis scorpioides

Myositis scorpioides (true forget-me-not) is native to Eurasia, and although not considered a true aquatic plant, it does inhabit wet disturbed shorelines. Now found throughout the United States, *M. scorpioides* has naturalized in many areas, but has remained a potential invasive within the New England states. Scientific research regarding this species is sparse, resulting in a relatively unknown impact to water quality and native wetland vegetation. As a result, any populations observed during DWSP surveys are monitored and removed as needed. When not blooming, *M. scorpioides* can be difficult to identify, which may account for variations in observed populations from year-to-year. This species spreads via seed production and through an extensive and shallow root system. To effectively manage for this species, continuous removal efforts before plants seed would be required.

M. scorpioides was first observed in the Quabbin Reservoir Watershed in 2012, along the shoreline of BLA2 and at Gaston Pond in Barre. Since then, it has been observed in several other ponds within both watersheds. Observations have been variable however, and some populations have not been observed in several years. No *M. scorpioides* were observed during the 2025 DWSP survey season.

3.4.1.12. *Rorippa microphylla*

Rorippa microphylla (one row yellowcress), also known as *Nasturtium microphyllum*, is native to Europe and has spread to much of the world due to its popularity as a salad green (GoBotany, 2024). This species is considered invasive in Connecticut but not in Massachusetts. Although a closely related species, *Rorippa amphibia* (water yellowcress), is on the Massachusetts Prohibited Plant List, *R. microphylla* remains absent (MDAR, 2026). Due to a lack of scientific literature on this species, observations of this non-native should be closely monitored to determine its effect on native species.

R. microphylla is present in both watersheds. It was first observed in the Quabbin Reservoir (BLA2) in 2013 and the Ware River Watershed in 2014. When not flowering, this species can be difficult to identify, and closely resembles other native and state listed species. As a result, *R. microphylla* observations are not consistent, highlighting the importance of marking population locations for subsequent survey efforts. No *R. microphylla* was observed during the 2025 DWSP survey season.

3.4.2. Invasive Aquatic Fauna Monitoring and Distribution

Visual surveys for *Cipangopaludina chinensis* (Chinese mystery snail) and adult *Dreissena polymorpha* (zebra mussels) are performed alongside aquatic macrophyte surveys. Net tows for invasive zooplankton and the larval stages of *D. polymorpha* in the reservoir began in 2009. The following sections summarize the presence and absence of potential invasive aquatic fauna threats in the Quabbin and Ware River Watersheds.

3.4.2.1. *Dreissena polymorpha*

Dreissena polymorpha (zebra mussels) were discovered in Massachusetts in 2009, leading to the development and adoption of the Quabbin Boat Decontamination Program (Section 3.4.3). Since then, it has been determined that the low pH and calcium levels found in the Quabbin Reservoir (Section 3.3.4) make it unsuitable for *D. polymorpha* reproduction and growth. As a result, it is unlikely to find fully mature *D. polymorpha* in the reservoir. Despite this, plankton net tows are scanned for the immature larval stages of *D. polymorpha*. To date, no immature larval stages have been found in the reservoir.

3.4.2.2. Invasive Zooplankton

The potential invasive zooplankton of concern are *Bythotrephes longimanus* (spiny waterflea) and *Cercopagis pengoi* (fishhook waterflea). In 2025 oblique tows were collected every other month from May to October near the Boat Launch Areas (BLAs) and scanned for their presence. As of 2025, neither species has been documented in the Quabbin Reservoir.

3.4.3. AIS Management and Boat Decontamination Programs

Aquatic invasive species (AIS) management within the Quabbin Reservoir and Ware River Watersheds is currently limited to two projects: *Myriophyllum heterophyllum* removal on the Ware River, and *Utricularia inflata* removal on the Quabbin Reservoir and O'Loughlin and Pottapaug holding ponds. Funding from MWRA supports both management projects.

The DWSP Quabbin Reservoir/Ware River Region runs several prevention programs designed to limit the spread of AIS throughout the watersheds. These programs include the Quabbin Boat Seal Program for anglers on the Quabbin Reservoir and two self-certification programs within the Ware River Watershed. The Quabbin Boat Decontamination program was initiated in 2009. The Self-Certification programs began in 2010.

3.4.3.1. Ware River Management of Myriophyllum heterophyllum

Annual management of *M. heterophyllum* has occurred since 2016 in the basin above the Shaft 8 intake along the Ware River and in sections above the railroad and Route 122 bridges along the Ware River. Despite these efforts, *M. heterophyllum* remains an issue for water operations due to plant fragmentation. Control methods are currently restricted to physical removal of plants and drawdowns. Winter drawdowns may lessen the labor necessary to reduce *M. heterophyllum* in this area; however, the hard freezes required for this to be effective are not consistent or predictable. In addition, the population of *M. heterophyllum* upstream of the Shaft 8 intake continues to repopulate the area.

M. heterophyllum upstream of Route 122 saw an increase in distribution, covering 6.5 acres in 2025 compared to 4.3 acres in 2024 (TRC, 2025b). Davey Resource Group was contracted by MWRA to physically remove plants for the eighth consecutive year. The 2025 harvest yielded a 192% increase in total gallons removed compared to the previous year, most likely due to limited rain events washing *M. heterophyllum* downstream (Davey Resource Group Inc., 2025). Downstream of Route 122 saw an increase of 102% in gallons removed while upstream saw an increase of 269%. This difference is most likely due to an increased amount of time spent above the Route 122 bridge due to minimal rain events (Davey Resource Group Inc., 2025). Depopulating the entire river above Route 122 would be impractical, daunting, and extremely expensive. This is an ongoing issue with no foreseeable permanent solution. For this reason, the focus is to keep the basin above the intake as free of *M. heterophyllum* as is feasible.

3.4.3.2. Quabbin Reservoir and Holding Ponds – Management of Utricularia inflata

Since its discovery in 2023, removal efforts of *Utricularia inflata* have been ongoing at the Quabbin holding ponds: O'Loughlin Pond and Pottapaug Pond, and the Quabbin Reservoir as of 2025. Removal efforts in 2023 were initially conducted by DWSP and a MWRA contractor but were limited due to early plant senescence. A contractor (TRC) was hired through MWRA for the 2024-2025 growing season of *U. inflata* (May-July).

Management on Pottapaug and O'Loughlin was conducted in three stages in 2025: an initial growth survey, a point-intercept (PI) survey, and removal. The initial growth survey was conducted on May 12 to determine the presence of key identifiable features (i.e. inflorescences and floating structures). Following this, a point-intercept survey was conducted on O'Loughlin Pond and the Quabbin Reservoir in the vicinity of Boat Launch Area 3 (BLA3). A total of 596 survey points were visited (443 points near BLA3 and 153 points on O'Loughlin). As a PI survey was completed on Pottapaug Pond in in 2024, no survey was conducted in 2025 in lieu of focusing on removal efforts. Of the 436 points near BLA3, 13 points had sparse coverage, and four points were unable to be surveyed due to low water levels brought on by drought conditions. Of the 153 points on O'Loughlin, 34 points had sparse coverage, and only one point had moderate coverage (TRC, 2025a). Compared to 2024, O'Loughlin saw an increase in distribution within the pond in 2025. This is most likely due to the use of an aquatic plant rake in 2025 to more accurately capture underwater plant density as opposed to relying only on floating plant structures (as was done in 2024).

Subsequent removal efforts began May 19 and continued until June 13. Minimal amounts of plant fragments observed on the reservoir were removed during the PI surveys conducted on May 14-15. The Quabbin Reservoir was the primary focus for removal efforts, followed by O'Loughlin where eradication may be possible, and then Pottapaug where the density is magnitudes greater. A total of four removal days occurred on O'Loughlin Pond, the first coinciding with the PI survey, resulting in a total of approximately 48 gallons of *U. inflata* removed. This increase compared to 2024 (where only 1 gallon was removed) can be partially attributed to the use of an aquatic plant rake reaching plants deeper in the water column, and an overall increase in removal efforts. Eight removal days were conducted on Pottapaug Pond, resulting in the removal of 275 gallons of *U. inflata* (TRC, 2025a). This represents a stark decrease in plant matter removed (compared to 1,527 gallons over a 21-day period in 2024), and may be a result of 2024 management actions, a decrease in removal efforts (21 days in 2024 versus 8 days in 2025), and/or attributed to differing seasonal conditions between 2024 and 2025.

In 2024, *U. inflata* populations experienced a "boom" year – most plants developed floating structures and flowered. Comparatively in 2025, populations experienced a "bust" year – where most plants did not develop floating structures or flowers on either the holding ponds or the reservoir. The lack of easily identifiable features hinders removal efforts due to the increased time needed to locate plants. Causes for this "boom" and "bust" cycle are still unknown (Mitchell et al., 1994) but may be attributed to summer/fall droughts followed by winter ice cover. This, when combined with previous extensive removal efforts, as seen on Pottapaug in 2024, may have resulted in the decrease in total gallons of plant material removed from Pottapaug in 2025.

O'Loughlin Pond and Pottapaug Pond remained closed to recreational boating in 2026 to minimize *U. inflata* fragmentation and prevent further distribution, particularly into the reservoir.

3.4.3.3. Quabbin Boat Decontamination Program

The Quabbin Boat Decontamination program was initiated in 2009 to mitigate the risk of AIS introduction into the reservoir through recreational boat fishing. The Quabbin Reservoir is a popular destination for anglers as the system hosts both cold and warm water fish species. DCR provides rental boats for anglers to use on the Quabbin Reservoir, however many people prefer to use their own boats. Though some anglers exclusively fish at the Quabbin Reservoir, many others fish at a variety of locations across New England within a season. This provides a potential pathway for the interchange of AIS between bodies of water.

The Quabbin Boat Decontamination Program was developed to prevent the spread of AIS, which includes plants (*M. heterophyllum*, *M. spicatum, H. verticillata* etc.), zooplankton (*B. longimanus* and *C. pengoi*), and invertebrates (*D. polymorpha* and *Cipangopaludina chinensis*). Many invasive species are very well adapted to endure harsh conditions, such as periods of desiccation. Plants can spread via small seeds and small plant fragments. Zooplankton and zebra mussels are microscopic during certain life stages and can persist inside boat motors for long periods of time. The boat inspection and decontamination programs required by DWSP serve to limit the introduction of these invasive species into the Quabbin Reservoir.

The Quabbin Boat Decontamination Program consists of two options for recreational boaters to clean their boats: warm-weather decontamination (WWD) and cold-weather quarantine (CWQ). WWD events occurred over fifteen dates in 2025 throughout the fishing season, and the cold-weather quarantine program occurred over five dates in 2025 after the fishing season had closed. Samples of biological substances collected off boats inspected during either the WWD or CWQ programs were identified whenever possible.

During WWD, before vessel inspection and decontamination, boaters are asked where the vessel was last launched to determine potential AIS threats (i.e., a vessel last launched at Lake Winnipesaukee may be harboring *B. longimanus* (invasive zooplankton) or *T. natans* (invasive macrophyte), both of which are not present in the Quabbin Reservoir). Afterwards, DWSP staff inspect all parts of the boat (including hulls, all through-hull fittings, live wells, bilge, downriggers, anchors, lines, and trolling motors) in addition to the boat trailers (including rollers and bunks). If the vessel passes inspection, the motor is then flushed with hot water (140 °F) while running until the water runs out of the motor for 10 seconds at the same temperature. The vessel, including hulls, live wells, bilge, anchors, trailer, and fishing gear (such as poles and nets), are then washed with high pressure hot water. Any organisms that may be present in the motor or on the vessel should be killed by this process. While this program requires payment from anglers, it enables them to fish outside of the Quabbin Reservoir, then return following the completion of a decontamination event. This significantly reduces the risk of AIS introduction from other water bodies without restricting anglers to exclusively fish at the Quabbin Reservoir.

Unlike WWD, CWQ requires no fee. Boats are tagged at the beginning of the winter season, ensuring they remain on trailers for around four months. At least three consecutive days below 32°F, or 46 days with an average low temperature of 30 °F is required to cause desiccation or cold thermal death for any potential AIS (McMahon et al., 1993). The 2024-2025 winter season (October-April) had six consecutive days below 32°F, and a 46-day average low of 15°F.

In 2025, 125 boats were inspected and decontaminated through the WWD program. This is lower than the previous five-year average (160 boats average from 2020-2024). Seventy boats were inspected and sealed through the CWQ program in 2025. This is lower than the previous five-year average (82 boats average from 2020-2024). In 2025, around 42% of boaters used the WWD for the first time, and around 13% of boaters used the CWQ for the first time.

Public perception of the boat decontamination programs has improved since their inception. While the programs initially met some resistance, many anglers are now grateful for the opportunity to safely recreate between the Quabbin Reservoir and other water bodies. This is likely due to a region-wide effort from state and local officials as well as pond associations to educate anglers on the risks of AIS. Participation in boat inspections and cleaning programs is now standard practice at many recreational waterbodies in, and outside of, Massachusetts. Though the public is becoming more aware of AIS, continued education is crucial. Many boaters remain unaware of the span of AIS beyond zebra mussels and common invasive plant species. This demonstrates the importance of continued education efforts to keep anglers engaged to ensure the Quabbin Reservoir remains free of new AIS infestations.

3.4.3.4. Boat Ramp Monitoring and Self-Certification Programs

The Boat Ramp Monitoring and Self-Certification Program was established in 2010 to reduce the spread of AIS in ponds that allow boaters in the Ware River Watershed. The program was implemented in 2010 utilizing two full-time seasonal positions to educate boaters and inspect watercraft. Since then, a self-certification boat inspection process has been in place to streamline the program while reducing DWSP staff resources. Efforts are focused on Asnacomet Pond in Hubbardston and Long Pond in Rutland due to the high volume of boaters utilizing these waterbodies.

Self-certification forms are prominently displayed at Asnacomet and Long Pond in boxes on the kiosks near each boat ramp, along with signage directing boaters to self-certify their watercraft as free of AIS before launching. Kiosks, signs, and forms were updated in 2021 to make the program clear and information accessible. Forms include questions about where the boat was last used, how long it was out of the water, how they cleaned their boats and with what, and if they are aware of any AIS in the location they previously boated. These questions provide information for management purposes, in addition to encouraging boaters to take responsibility for understanding the risk of AIS in their recreational water bodies.

Boaters are asked to display the completed forms on their car dashboard. Parking areas at both ponds are periodically checked through the boating season to monitor for compliance with the program. Vehicles/boaters not displaying a completed form are given instructions, and a blank form.

Cabomba caroliniana (fanwort) was first identified in 2021 during an annual macrophyte survey at Long Pond, a DCR-owned pond that utilizes self-certification. Fragments of *C. caroliniana* were found near the boat launch, and a dense patch had formed in the cove between the boat launch and road. The size of individual plants, and the spread of the patch indicate this invasive plant had been present in Long Pond for over a year before discovery. Due to the location of the infestation in the water body, it is very likely it was introduced by boaters. This AIS introduction highlights the importance of the self-certification process and presents an example of the consequences that follow noncompliance.

4. Conclusions and Next Steps

Monitoring results generated by DWSP in 2025 documented the continued high quality of water in the Quabbin Reservoir and its tributaries. The requirements of the filtration avoidance criteria under the SWTR were satisfied for the entirety of 2025. Increased sampling intervals for parameters of particular interest (e.g., nutrients, organics) have allowed DWSP to develop a better understanding of the range of variability across sites and across seasons for these analytes and better characterize patterns under different meteorological and hydrological contexts (e.g., drought season of 2025 compared to high rainfall and streamflow year of 2023). Water quality monitoring continues to assess and document water quality in the Quabbin Reservoir and Ware River Watersheds and ensure continued fulfillment of the requirements stipulated by the SWTR. DWSP sampling plans will continue to be developed in coordination with MWRA and UMass partners to best adapt to emerging water quality concerns.

4.1. Meteorology and Hydrology

Atmospheric temperatures in the Quabbin Reservoir Watershed remained relatively consistent with historical norms in 2025, with seasonal averages showing modest variation and daily median temperatures largely within the normal range throughout the year. The most pronounced departures occurred during the winter months, when temperatures fell consistently below historical means. January was the 11th coldest month on record at the Orange weather station, with the mean monthly minimum temperature reaching -11.70°C — 1.64°C below its historical mean of -10.06°C.

Despite a record-setting May at the Orange weather station, where cumulative monthly rainfall reached 8.99 inches, annual precipitation totals finished 5% and 11% below historical means at the Belchertown and Orange weather stations, respectively. Drought conditions persisted through year-end, with portions of Massachusetts reaching D2 (severe drought) designation in December — echoing the dry conditions that characterized the start of the year.

The late-spring rainfall surplus was clearly reflected in streamflow, with May recording the highest flows of the year across all monitored sites. The Ware River at Gibbs Crossing reached a peak of 2,090 cfs on May 10, following more than five inches of rainfall over the preceding 10 days. While several notable rainfall events extended into early summer, their influence was short-lived. Drought conditions dominated through the remainder of the year, driving streamflow well below historical means across both the Quabbin Reservoir and Ware River watersheds. By late summer, monitored Quabbin Reservoir tributaries approached near-zero discharge, and December streamflow at Ware River gages fell within the lower third of historical ranges. Groundwater levels followed a similar trajectory — meaningful aquifer recharge occurred in response to spring rainfall, but levels declined steadily through fall and into winter across all three monitored wells, consistent with the persistent precipitation deficits and reduced streamflow observed across the watershed.

Taken together, local climatic and hydrologic conditions in 2025 aligned closely with broader regional patterns documented across the Northeast. The year was defined by two distinct phases — a wet spring that temporarily erased drought conditions established entering the year, followed by a return to drought through late summer, fall, and winter. By December, portions of Massachusetts had reached D2 drought conditions, reservoir elevations were just within the normal range, and streamflow remained below historical means across nearly all monitored locations. These conditions reflect an increasingly variable hydrologic regime in which episodic high-precipitation events punctuate extended dry periods, a pattern consistent with projected climate trends for the Northeast region (NRCC, 2026).

4.2. Tributary Water Quality

Results generated from routine monitoring of tributaries in Quabbin Reservoir and Ware River Watersheds in 2025 were largely consistent with historical data and met drinking water quality standards. Water quality patterns in tributaries of these two watersheds reflected the distinct differences in seasonal rainfall and streamflow observed in 2025. The year began with the continuation of the drought from 2024, followed by record rainfall in the spring. After the spring rain, drought conditions returned in summer, fall, and into winter at the end of the year.

Specific conductance values were higher than average across all Ware River Watershed sites, but less elevated in the Quabbin Reservoir Watershed. These results highlight the likely higher specific conductance values in the shallow groundwater in the Ware River Watershed due to legacy road salt application and other anthropogenic impacts. During drought, as seen in most of 2025, streams have a higher percentage of water from shallow groundwater compared to precipitation and surface runoff, and this was the primary driver of results for all parameters across both watersheds in 2025. Lack of runoff for most of the year resulted in lower-than-average UV_{254} and TOC results in most sites across both watersheds, with values dropping especially low in the fall due to conditions with very low streamflow. Nutrient results across both watersheds showed little variation from historical precedent. Nitrogen results were slightly elevated at some locations, but primarily following rain events, especially after long dry periods. Total phosphorus results were lower at most locations in 2025 compared with the period of record. Results from bacterial analysis, including total coliform values, *E. coli* values, and geometric mean *E. coli* values were largely within normal historical ranges in 2025. Monitoring results of water quality parameters in Quabbin Reservoir Watershed and Ware River Watershed in 2025 were consistent with historical data, did not suggest the presence of any new substantial point-source contributions, and ultimately demonstrated continued adherence to drinking water quality standards.

4.3. Reservoir Water Quality

Results of routine water quality profiles collected in Quabbin Reservoir in 2025 were comparable to historical data and indicated that the timing of turnover and stratification occurred in line with prior seasons. Phytoplankton densities observed in 2025 were lower than those recorded in 2024. Elevated phytoplankton levels during summer in 2025 were primarily associated with a *Chrysosphaerella* aggregation; however, the aggregation was lower in density and shorter in duration than those observed in 2019, 2022, and 2024. Unlike previous aggregations, the 2025 event did not impact drinking water quality. Overall, changes in phytoplankton community composition in 2025 were consistent with patterns observed in prior years.

Water quality monitoring showed that nutrient (TP, TKN, ammonia, and nitrate) levels have not increased over the period of record and that the observed low nutrient levels still characterized the Quabbin Reservoir as an oligotrophic water body (Carlson, 1977). Due to the low nutrient concentrations and the inconsistent pattern of phytoplankton aggregations observed in the last seven years, it is believed that the high levels of *Chrysosphaerella* observed some years were not influenced by nutrients but by other hydrological and climatic drivers (such as temperature, photosynthetically active radiation, possible silica, and precipitation/high riverine flows). Years with observed aggregations (2019, 2022, 2024, and 2025) experienced drought conditions (or partial drought conditions) while years without aggregations experienced consistent flood conditions. The impact of drought and flood conditions on phytoplankton aggregations will continue to be studied by DWSP staff and will be discussed in future reports.

4.4. Aquatic Invasive Species Monitoring and Management

Continued prevention efforts and monitoring of current and potential invaders are the main priority of the AIS Program at Quabbin. Changes in environmental factors due to climate change, which previously prevented certain species from establishing in New England, has led to an increase in invasive species' spread throughout the region. With the integration of digital data collection and GPS, information about AIS spread within waterbodies in the Quabbin and Ware River Watersheds will help aid future prevention, education, and management efforts.

Overall, AIS observations during the DWSP 2025 surveys remained similar to previous years. High priority management projects, such as management of *U. inflata* on the holding ponds and adjacent Reservoir areas, should continue to reduce potential spread. Further investigations should be conducted around Boat Launch Area 2, as this plant was first seen here in 2017 and was observed again in 2025. Additional early-season macrophyte surveys should be conducted on waterbodies that have historically documented presence of this AIS to confirm current presence or absence.

Removal efforts of *T. natans* on Brigham Pond in 2024 seemed to have an effect on populations in 2025, as less drifting rosettes were observed. As this is only the second year of removal, data is insufficient to say how effective DWSP efforts have been. Management efforts should continue at Brigham Pond indefinitely until this AIS has been eradicated. Educational opportunities and public involvement should also be explored to help prevent this AIS from spreading further.

No new AIS were detected in 2025. However, surveys of EQA ponds should continue as scheduling and staffing allows, and management actions should be taken, when possible, to mitigate the risk to source waters.

4.5. Proposed Quabbin Reservoir and Ware River Watershed Monitoring Programs for 2026

The water quality sampling plan for the Quabbin Reservoir and Ware River Watersheds is reviewed and modified annually to direct focus to different sub-basins within the watersheds, investigate new areas/analytes based on emerging water quality concerns, and adapt to changing conditions (including but not limited to changes in land use/land cover and/or climate-driven hydrometeorological changes). Planned changes to 2026 monitoring programs are detailed below.

4.5.1. Tributary Monitoring

The 2026 sampling plan retains the long-term Core sites in both watersheds and replaces the sites used to support Environmental Quality Assessment (EQA) efforts in Quabbin Reservoir and Ware River Watersheds. The Quabbin Reservoir Watershed tributary monitoring program includes seven Core sites and up to seven EQA sites. In 2026, DCR will continue to sample every two weeks in the Quabbin Reservoir Watershed, discontinue monitoring at EQA sites monitored in 2025 (216C, 216D, 216G, 216I-X) and begin monitoring at four EQA sites located in the West Branch Swift sanitary district (211F, 211G, 212A, 213B). All Core sites will remain. The same suite of analytes and sample frequency is planned for this watershed (Table 5). EQA reporting for the West Branch Swift sanitary district is planned for 2027.

The Ware River Watershed tributary monitoring program includes six Core sites and up to six EQA sites. DCR will continue to sample every two weeks at Core sites and due to the rotation of EQA sites, 2026 would have originally been a gap year between sanitary districts. However, DCR will continue monitoring at the EQA sites monitored in 2025 (105, 119, 110, 121M) located in the Coldbrook-Longmeadow sanitary district. Monitoring at site 101 will remain consistent with that of tributaries in the Quabbin Reservoir Watershed. Nutrient (NO_3-N, NH_3-N, TKN, and TP) monitoring will continue at a quarterly sampling interval in the remaining monitoring tributaries in the Ware River Watershed in 2026. All other analyses will remain unchanged from 2025 (Table 5).

4.5.2. Reservoir Monitoring

Monthly Quabbin Reservoir monitoring at Core sites (202, 206, and Den Hill) will be conducted by DWSP from March through December 2026, weather and reservoir conditions permitting. This monitoring will include analyses for turbidity, total and fecal coliform, *E. coli,* TOC, UV_{254}, and extracted chlorophyll *a*. Quarterly Quabbin Reservoir monitoring will be conducted in May, July, October, and December. In addition to the monthly analytes, quarterly monitoring will include alkalinity, Na, Cl, and nutrients (NO_3-N, NH_3-N, TKN, TP, and Si). Routine monitoring for phytoplankton will be performed by DWSP weekly at site 202 during the growing season (May 1 through September 30, 2026), monthly at site 202 outside of the growing season, and monthly at sites 206 and Den Hill year-round (weather permitting). *In situ* profiles of temperature, pH, specific conductance, dissolved oxygen, turbidity, chlorophyll *a*, and phycocyanin will be collected at each monitoring site within the Quabbin Reservoir and used to determine appropriate sample collection depth and inform controls on phytoplankton dynamics in Quabbin Reservoir. Increase in phytoplankton monitoring in 2026 will be determined by a combined approach of exceedance of EML for specific taxa of concern and exceedance of 10 µg/L of chlorophyll *a* from in situ profiles.

4.5.3. Aquatic Invasive Species Monitoring and Management

Every year, DWSP monitors select ponds for AIS in addition to contractors hired by MWRA who survey the Quabbin Reservoir, holding ponds, and the Ware River around the Shaft 8 intake. For the 2026 survey season, fourteen waterbodies are planned for DWSP surveys. This includes the two holding ponds, three boat launch areas, and Zone 2 of the Quabbin Reservoir (Table 64).

DWSP has conducted periodic AIS surveys of the Quabbin Reservoir but has been limited to the West Arm and Boat Launch Areas. MWRA contractors have also conducted annual surveys of the Reservoir, but these are limited to specified points and do not cover the full extent of the Quabbin Reservoir's littoral zone. To prioritize the protection of our source waters and collect a more comprehensive overview of AIS in the area, Quabbin littoral areas will be separated into five zones for DWSP to survey on a rotating basis (i.e., surveying one zone every five years). In 2026, Zone 2 will be surveyed (see Section 6.4 Appendix D).

Additional water bodies have been added to the survey list in response to ongoing investigations or areas of particular management concern. Early season surveys (ESS) continue to prove beneficial to understanding the current extent of AIS that precede the general growing season. These surveys currently target two AIS species: *P. crispus* and *U. inflata*. In 2026, additional ESS will be conducted at Long Pond, Whitehall Pond, and upstream of O'Loughlin Pond along with DWSP's annual ESS at both holding ponds, BLA2, BLA3, and the Ware River upstream of the boat launch.

Table 64. *Proposed AIS monitoring schedule for calendar year 2026 in the a) Quabbin Reservoir Watershed and b) Ware River Watershed.*

a) Quabbin Reservoir Watershed

Water Body Name	Location	Type	Last Survey Year	To Be Surveyed by
Quabbin Reservoir	New Salem, Petersham, Hardwick	Annual	2025	MWRA Contractor
Quabbin Reservoir, Zone 2	New Salem, Ware	Annual	N/A	DWSP
Quabbin Reservoir, Boat Launch Area 1	Belchertown	Annual	2025	MWRA Contractor and DWSP
Quabbin Reservoir, Boat Launch Area 2	New Salem	Annual	2025	MWRA Contractor and DWSP
Quabbin Reservoir, Boat Launch Area 3	Petersham	Annual	2025	MWRA Contractor and DWSP
O'Loughlin Pond	New Salem	Annual	2025	MWRA Contractor and DWSP
Pottapaug Pond	Hardwick	Annual	2025	MWRA Contractor and DWSP
Connor Pond	Petersham	EQA	2021	DWSP
O'Loughlin Pond - Upstream	New Salem	EQA	N/A	DWSP

b) Ware River Watershed

Water Body Name	Location	Type	Last Survey Year	To Be Surveyed by
Ware River, Upstream of Shaft 8	Barre	Annual	2025	MWRA Contractor and DWSP
Ware River, Upstream of Boat Launch	Barre	Annual	2025	DWSP
Brigham Pond	Hubbardston	Annual	2025	DWSP
Moosehorn Pond	Hubbardston	Biannual	2021	DWSP
Long Pond	Rutland	Annual	2025	DWSP
Whitehall Pond	Rutland	Biannual	2024	DWSP

Management of *Utricularia inflata* at the Pottapaug and O'Loughlin holding ponds, BLA3, and (as of 2026) BLA2, will continue in the calendar year 2026 season by DWSP staff and MWRA contractor TRC (see Table 65 for a breakdown of responsibilities and overall schedule). TRC was hired in 2024 for a two-year project - this is the second year. Following observations of floating structures from DWSP, an initial point-intercept survey will be conducted on all areas identified in this project (Pottapaug, O'Loughlin, and adjacent Quabbin Reservoir areas near BLA2 and BLA3) to confirm presence, extent of infestation, and density. During harvesting efforts, contractors will be required to provide periodic updates, noting amount harvested and harvest locations through email and a DWSP Survey 123 form. Upon receipt of the final report, DWSP will work with MWRA to determine next management steps.

Table 65. *Proposed timeline for 2026* Utricularia inflata *surveys, harvest efforts, and reporting.*

Month	Task
May	DWSP - Silt Fence Disposal Site Set-up
May	DWSP - Plant Growth Survey
May - June	Contractor - Point-intercept Surveys
May - June	Contractor - Plant Removal
June - July	Contractor - to Submit Draft Report
August	Contractor - to Submit Final Report

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6. Appendices

6.1. Appendix A. 2025 Watershed Monitoring Parameters

Table A1. *Water quality parameters, and associated analytical methods, monitored by DWSP in surface water in the Quabbin Reservoir Watershed and Ware River Watershed in 2025. Monitoring for select parameters in Quabbin Reservoir or tributary monitoring locations is indicated by an "X" in columns R and T, respectively. Precipitation and air temperature measurements were recorded from meteorological stations maintained by DWSP and NOAA. Discharge measurements were recorded from stream gages maintained by USGS.*

Parameter Name	Units	Sampling Group	Analysis Location(s)	Analysis Method	R	T
Air Temperature	Deg-F	Meteorological	Field-Sensor	N/A	N/A	N/A
Ammonia-nitrogen	mg/L	Nutrients	MWRA Lab	EPA 350.1, 353.2	X	X
Alkalinity	mg/L $CaCO_3$	Nutrients	MWRA Lab	SM 2320 B	X	X
Blue Green Algae	µg/L	Field parameter	Field-Sensor	*In situ* Fluorometry	X	
Blue Green Algae RFU	RFU	Field parameter	Field-Sensor	*In situ* Fluorometry	N/A	N/A
Chloride	mg/L	Nutrients	MWRA Lab	EPA 300.0	X	X
Chlorophyll	µg/L	Field parameter	Field-Sensor	*In situ* Fluorometry	X	N/A
Chlorophyll RFU	RFU	Field parameter	Field-Sensor	*In situ* Fluorometry	N/A	N/A
Chlorophyll volts	volts	Field parameter	Field-Sensor	*In situ* Fluorometry	N/A	N/A
Discharge	cfs	Field Parameter	Field-Sensor	N/A	N/A	X
Dissolved Oxygen	mg/L	Field Parameter	Field-Sensor	SM 4500-O G-2001	X	X
E. coli	MPN/100 mL	Bacteria	MWRA Lab	9223B 20th Edition (Enzyme Substrate Procedure)	X	X
Fecal Coliform	MPN/100 mL	Bacteria	MWRA Lab	SM 9222D	X	N/A
Mean UV_{254}	ABU/cm	Organic Matter	MWRA Lab	SM 5910B 19th edition	X	X
Nitrate-nitrogen	mg/L	Nutrients	MWRA Lab	EPA 350.1, 353.2	X	X
Nitrite-nitrogen	mg/L	Nutrients	MWRA Lab	EPA 350.1, 353.2	X	X
Oxygen Saturation	percent	Field parameter	Field-Sensor	SM 4500-O G-2001	X	X
pH	S.U.	Field parameter	Field-Sensor	SM4500-H+ B-2000	X	X
Precipitation	in	Meteorological	Field-Sensor (USGS/NOAA)	N/A	N/A	N/A
Secchi Depth	ft	Field parameter	Field-Sensor	N/A	X	
Silica	µg/L	Nutrients	MWRA Lab	EPA 200.7	X	N/A
Sodium	µg/L	Nutrients	MWRA Lab	EPA 200.7	X	X
Specific Conductance	µS/cm	Field parameter	Field-Sensor	SM 2510 B-1997	X	X
Staff Gage Height	ft	Field parameter	Field-Sensor	Pressure Transducer/ Visual staff plate reading	N/A	X
Total Coliform	MPN/100 mL	Bacteria	MWRA Lab	9223B 20th Edition	X	X
Total Kjeldahl Nitrogen	mg/L	Nutrients	MWRA Lab	EPA 351.2	X	X

Parameter Name	Units	Sampling Group	Analysis Location(s)	Analysis Method	R	T
Total Nitrogen	mg/L	Nutrients	MWRA Lab	Calculated	N/A	N/A
Total Organic Carbon	mg/L	Organic Matter	MWRA Lab	SM 5310 B	X	X
Total Phosphorus	µg/mL	Nutrients	MWRA Lab	EPA 365.1	X	X
Total Suspended Solids	mg/L	Nutrients	MWRA Lab	SM2540	N/A	N/A
Turbidity FNU	FNU	Field parameter	Field-Sensor	ISO7027	N/A	N/A
Turbidity NTU	NTU	Bacteria	DWSP Lab, USGS	EPA 180.1	X	X
Water Depth	m	Field Parameter	Field-Sensor	N/A	X	N/A
Water Temperature	Deg-C	Field Parameter	Field-Sensor, USGS	SM 2550 B-2000	X	X

6.2. Appendix B. Quabbin Reservoir Watershed Continuous Temperature Monitoring

Stream temperature data were collected at five Core monitoring locations in the Quabbin Reservoir Watershed in 2025 — at Gates Brook (GATE), the West Branch Swift (211), the Middle Branch Swift (213), the East Branch Fever Brook (215G), and the East Branch Swift (216) using a HOBO pressure transducer. Data were collected continuously in 15-minute intervals throughout the year, with the exception of two gaps due to technical issues — April 7 through April 30 at all monitoring locations, and June 5 through July 9 at Site 213. Due to these gaps, April data were excluded for all monitoring locations, and June and July data were excluded for Site 213.

Due to widespread drought across Massachusetts throughout much of 2025, data were filtered to limit ambient temperature influences caused by low flow conditions. Measurements were flagged and removed if they met either of the following criteria: (1) temperature changed by approximately 1°C between consecutive 15-minute observations, or (2) the daily temperature range exceeded 5.5°C, consistent with a logger in very shallow or thermally disconnected water. The 5.5°C threshold corresponded to approximately the 90th percentile of observed daily diel ranges across QRWS monitoring sites.

Following data filtering, temperature statistics were summarized for each site. Site 215G was the warmest monitoring location overall, with an annual mean of 10.92°C, likely reflecting a combination of its coarse streambed, where water pools and warms among large rocks at low flows, and a relatively high proportion of upstream wetlands (Table 4). Sites GATE and 211 were the coolest, both averaging below 9°C annually, with GATE recording the smallest overall annual range (22.15°C). Gates Brook is a small stream with a heavily forested watershed, allowing for greater thermal buffering relative to the other monitoring locations. All monitoring locations hovered near 0°C during winter months, with Site 213 recording the coldest winter temperatures (January: -0.87°C; February: -0.27°C).

The transition from May to June brought sharp thermal increases, with mean monthly temperatures at Sites 215G and 216 rising by over 4°C (Figure B1). Site 215G was the warmest during summer months, recording the highest July mean at 24.31°C. Site 216 also ran warm, with a July mean of 22.95°C and a single-day peak of 27.96°C, likely driven by low flow conditions — flow measured at a USGS gage downstream of the monitoring location approached zero by September. GATE was more thermally moderate, staying below 22°C even at its maximum. Fall cooling was gradual, with most sites dropping steadily through October and November. During this period, the lowest single-day minimum was recorded at Site 211 (0.67°C) and the narrowest seasonal range at Site 211 (17.47°C). Site 213 recorded the warmest fall maximum (21.38°C), consistent with its warmer late-season thermal character and relatively high upstream wetland coverage.

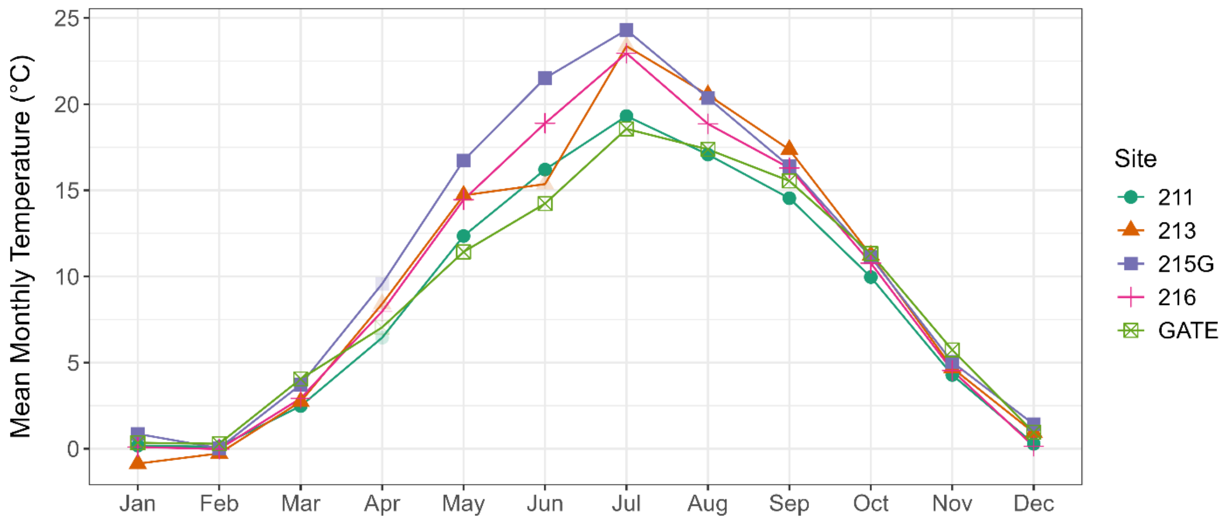

Figure B1. *Mean monthly stream temperature at Core Quabbin Reservoir Watershed monitoring locations. Symbols with high transparency indicate months where the data was not used for analysis due to technical issues.*

6.3. Appendix C. Ware River Watershed Conductivity Monitoring Project

Site 103A (Left) and LM1 (Right)

May 2026

Michael Virgilio – Environmental Analyst
Travis Drury – Environmental Analyst
Massachusetts Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Management
Quabbin/Ware Region

6.3.1. Introduction

Due to an observed increase in specific conductance values in the Ware River Watershed since DCR began monitoring conductivity in the 1980s, a special project was initiated to identify the areas with the highest conductivity values. Though DCR has existing long-term monitoring locations throughout the Ware River Watershed (Core sites sampled every year and EQA sites sampled annually on a rotating basis), a finer resolution of data was desired to better identify hot spots and evaluate seasonality. Sampling for this investigation began in January 2024 and ended in February 2026.

6.3.2. Methods

To choose new locations to sample, a few assumptions were made to frame the scope of expectations and choose a hypothesis to test against the data collected. Before choosing sites, the following hypothesis was made: that more impervious surface leads to an increase of unfiltered concentrations of runoff and increased concentrations of road salt in the waterways. After choosing site locations, ArcGIS Pro was used to delineate the upstream areas from the exact sample locations. All delineations had been created using Arc Hydro to derive flow direction and accumulation from a custom hydro-conditioned version of the MassGIS bare earth digital elevation model created from lidar terrain elevation data. Total percent impervious surface was then calculated upstream of every site using data from the Land Cover Land Use 2016 layer made by MassGIS.

Sampling locations were chosen for the Ware River Watershed Conductivity Monitoring Project (WCMP) in locations with access to roadway crossings of streams and spatially distributed in the watershed but concentrated in the southern and eastern parts of the watershed which is known to have higher concentrations of specific conductivity. Thirteen sites—beginning with the letters CM—were selected for monitoring and an additional four sites—beginning with the letters CR—were monitored as reference locations due to their small, less impacted watersheds (Table C1). These seventeen sites were sampled monthly beginning in January 2024. A YSI Pro Quatro meter was used to collect specific conductance, temperature, dissolved oxygen, and pH data.

Table C1. *Ware River Watershed conductivity initial monitoring sites.*

Site	Location Description	Latitude	Longitude
CM1	Wine Brook from Route 101 downstream of dam	42.535290	-72.098122
CM2	West Branch Ware River from Brigham Street	42.477615	-71.997085
CM3	Joslin Brook from New Westminister Road	42.480996	-71.975680
CM4	East Branch Ware River from Hubbardston Road	42.447600	-71.961002
CM5	Asnacomet Pond Outflow from East Comet Pond Road	42.449047	-71.978825
CM6	West Branch Ware River from Route 62	42.444634	-71.994444
CM7	Mill Brook Outflow of Moulton Pond from Pommogussett	42.385370	-71.958302
CM8	Demond Pond Brook from Turkey Hill Road	42.353415	-71.960606
CM9	Long Pond Trib Inflow from Whitehall Road	42.367337	-71.988122
CM10	Muddy Brook from Whitehall Road	42.370053	-72.014122
CM11	Muddy Brook from Route 122	42.375034	-72.028949
CM12	Longmeadow Brook/Mill Brook from Intervale Road	42.400506	-71.998618
CM13	Longmeadow Brook/Mill Brook Trib from Prison Camp	42.393090	-71.998765
CR1	West Wachusett Brook from Rhodes Road	42.477259	-71.918828
CR2	East Branch Ware River Trib from Brigham Road	42.421263	-72.008397
CR3	Potash Brook from Coldbrook Road	42.410451	-72.032186
CR5	Muddy Brook Trib from Pine Plain Road	42.376493	-72.010866

Beginning in March 2025, the original 17 sites were reduced to quarterly sampling, and monthly sampling was initiated on a new set of 22 sites in the Coldbrook and Longmeadow District in the southern portion of the Ware River Watershed (Table C2). This sampling regime continued through February 2026 when sampling for the Ware River Watershed Conductivity Monitoring Project ceased (Figure C1).

Table C2. *Coldbrook and Longmeadow Sanitary District conductivity monitoring sites.*

Site	Location Description	Latitude	Longitude
L-R6	Demond Pond Brook from Ware Road	42.361545	-71.985104
L-R5	Demond Pond Brook Tributary from Ware Road	42.359104	-71.984112
C-P5	Folly Brook Tributary from Pine Plain Road	42.388269	-72.025057
C-P4	Folly Brook from Pine Plane Road	42.385500	-72.023191
L-M1	Moulton Pond Tributary from Britney Drive	42.383769	-71.947280
L-D1	Demond Pond Brook from Kenwood Drive	42.357215	-71.950672
C-W2	Ware River Tributary from Ganger Road	42.415857	-72.056147
C-P1	Parkers Brook from Pine Road	42.390815	-72.040591
C-P11	Muddy Brook from Whitehall Road	42.373992	-72.003597
L-T1	Mill Brook from Depot Road	42.381773	-71.964486
L-B2	Stevens Brook from Reuben Walker Road	42.411127	-72.021904
C-PA1	Potash Brook from Coldbrook Road	42.404911	-72.044228
L-B1	East Branch Ware River from Prison Camp Road	42.415987	-72.007299
L-R7	Demond Pond Brook Tributary from Pleasantdale Road	42.358297	-71.970877
L-R1	Long Pond Tributary from Whitehall Road	42.367570	-71.988223
L-R2	Long Pond from Barre Paxton Road	42.359927	-71.991965
L-R8	Demond Pond Tributary from Pleasantdale Road	42.354690	-71.976834
C-P10	Muddy Brook Tributary from Barre Paxton Road	42.366833	-72.013432
L-M2	Moulton Pond Tributary from Lord Lane	42.381946	-71.947050
L-M4	Moulton Pond Tributary from Grizzly Drive	42.397931	-71.953640
L-M3	Moulton Pond Tributary from Lord Lane	42.381983	-71.946999
L-B3	Longmeadow Brook from Intervale Road	42.400222	-71.997426

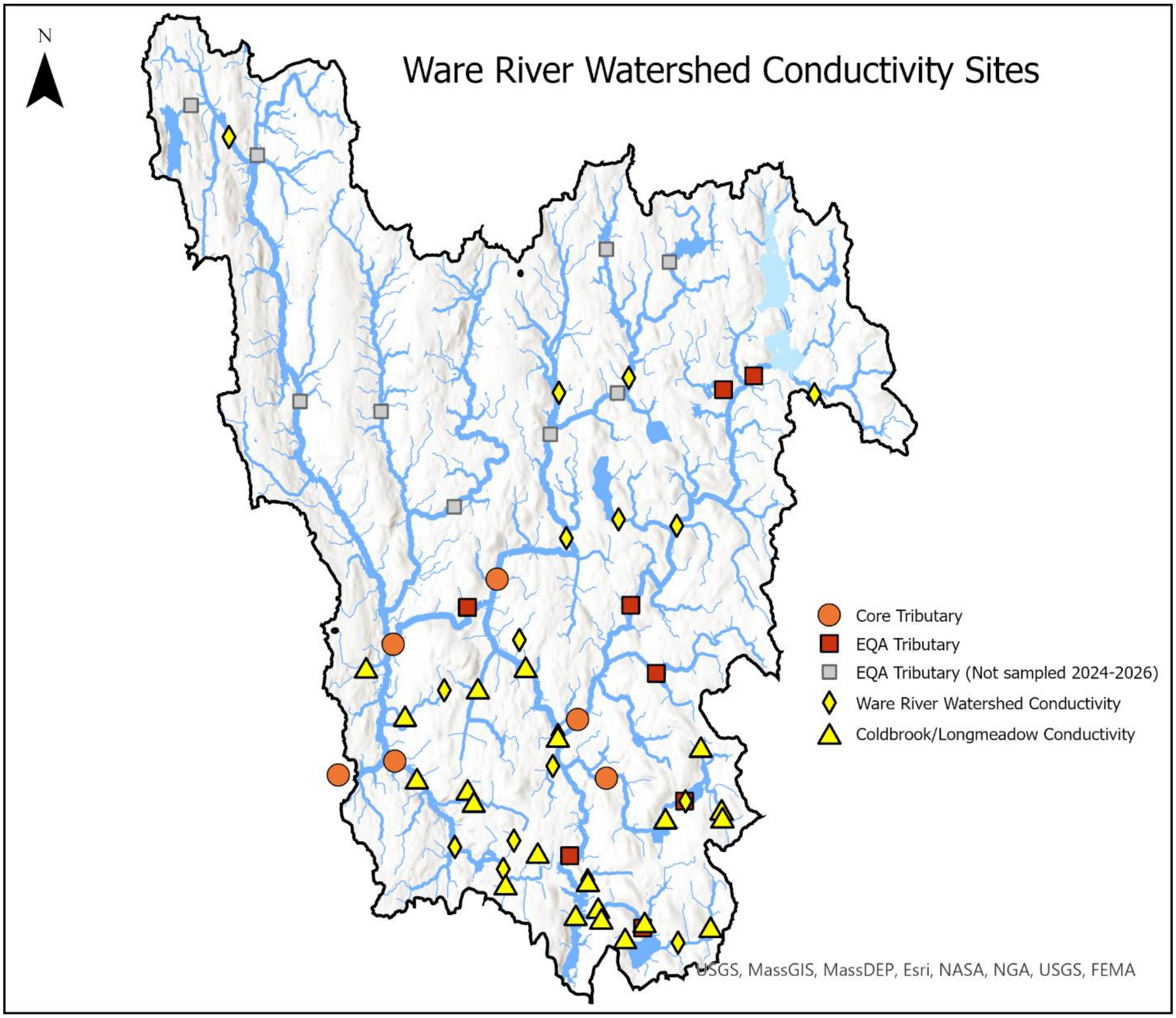

Figure C1. *Ware Conductivity Monitoring Project, Core, and EQA sampling sites.*

6.3.3. Results and Discussion

6.3.3.1. Specific Conductance

A heat map of median specific conductance values for all sites in the Ware River Watershed monitored during the Ware River Conductivity Monitoring Project (Core, EQA, and conductivity sites) was produced to highlight the areas with the highest conductivity results (Figure C2). Overall, the median conductivity was highest in streams closer to downtown Rutland, which is the most densely developed area of the watershed. To further examine seasonal variability, median specific conductance values by season are presented in Figure C3. Seasonal conductivity was highest in winter, with some results likely capturing runoff from recently salted roads.

Elevated results in other seasons indicate elevated groundwater conductivity being released to streams throughout the year.

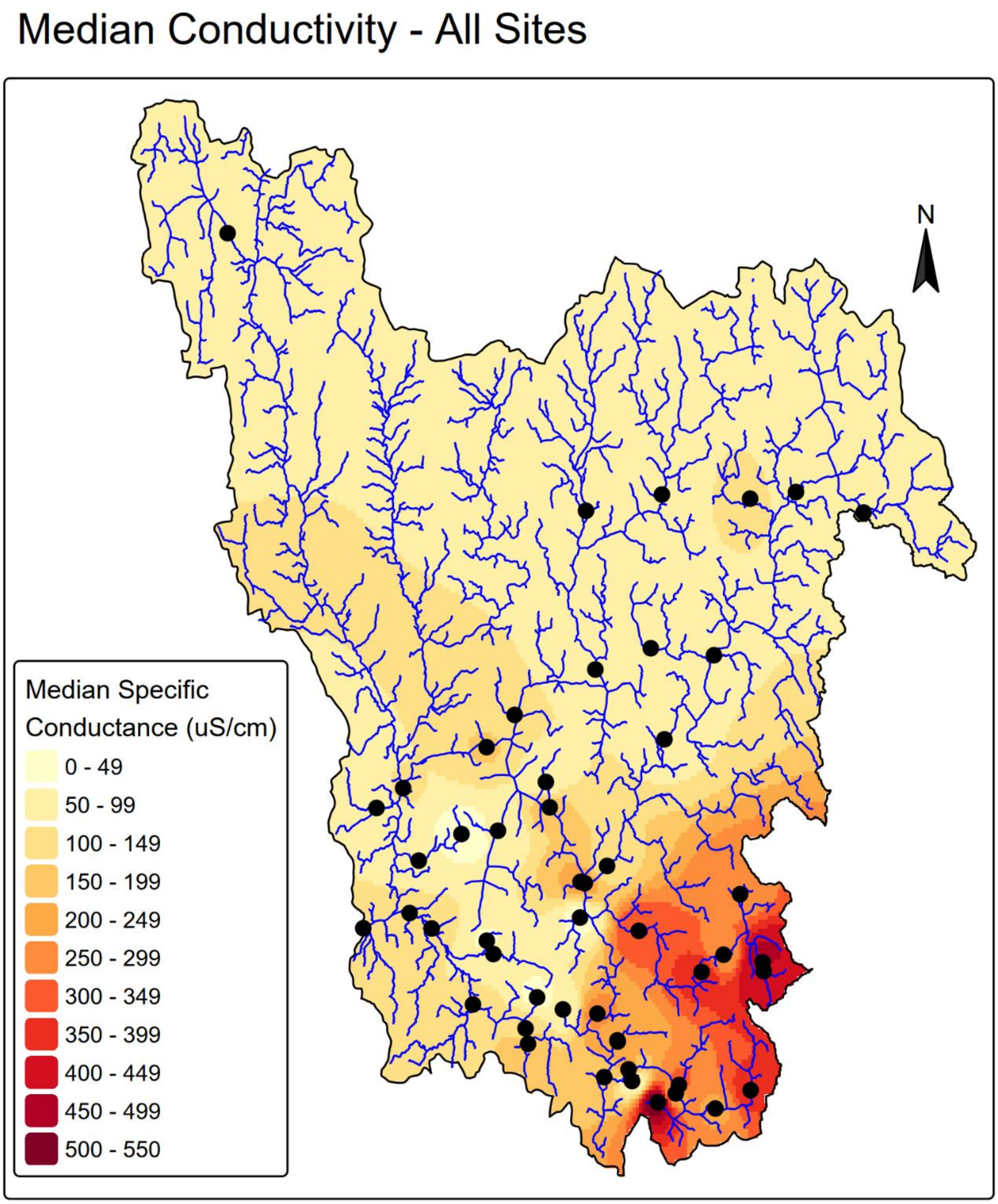

Figure C2. *Heat map of median specific conductance in the Ware River Watershed.*

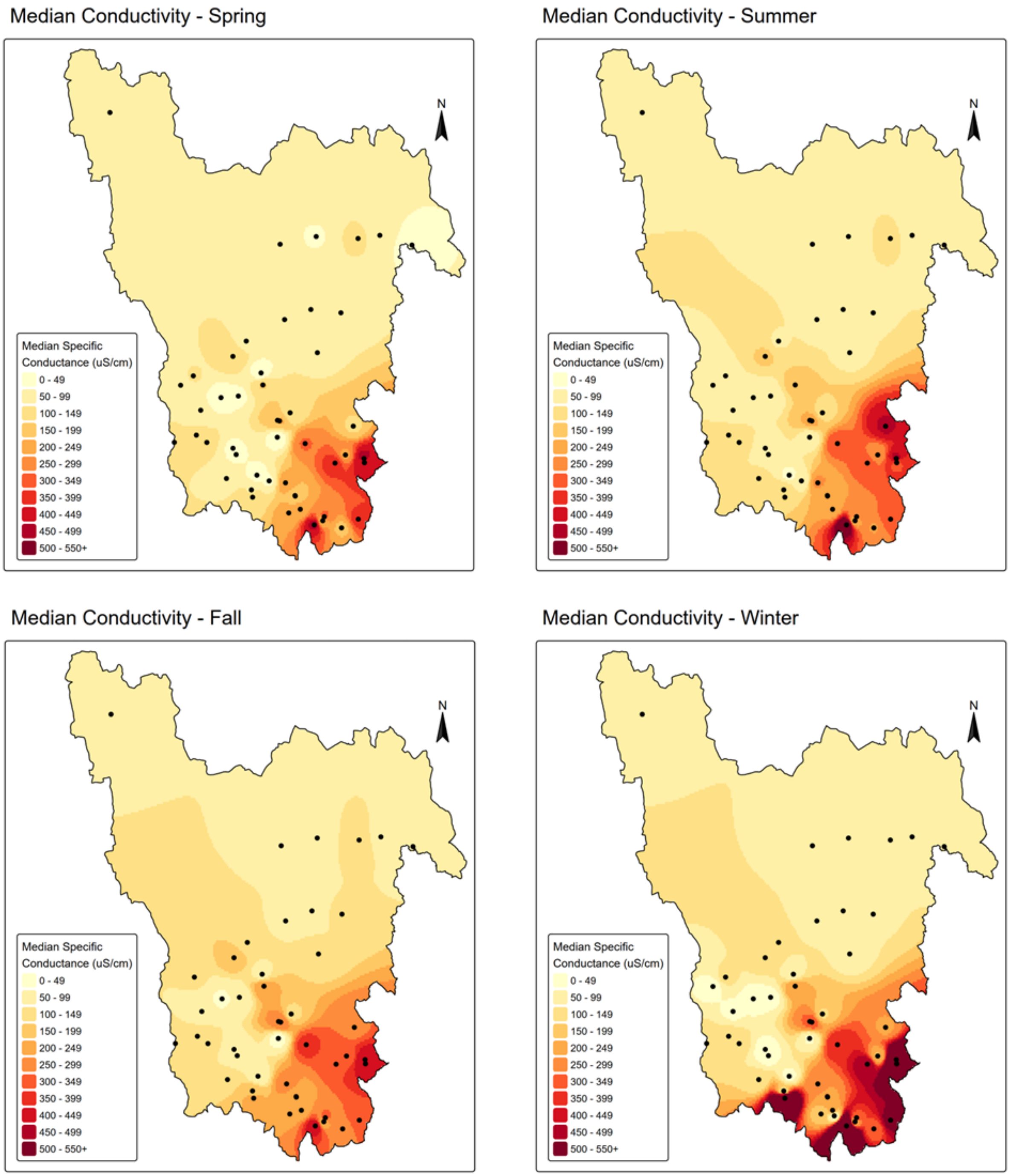

Figure C3. *Seasonal median specific conductance in the Ware River Watershed*

6.3.3.2. Specific Conductance and Impervious Surface Area

As road salt is the most likely source of most of the ions causing elevated specific conductance in the Ware River Watershed, results were compared with the percent of impervious surfaces in the drainage basin for each sampling location. The range of specific conductance values for each site are shown as boxplots and arranged from highest to lowest impervious surface area in Figure C4.

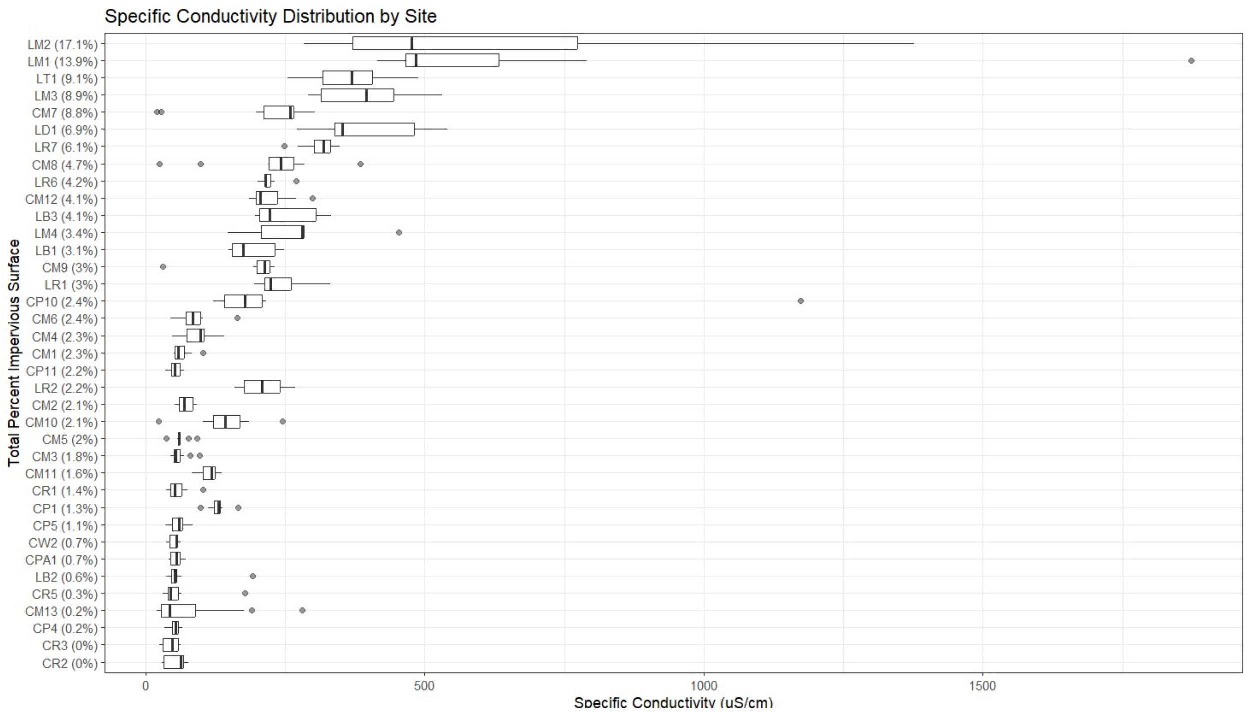

Figure C4. *Specific conductivity box plot by site, ordered from top to bottom by highest to lowest percent of total impervious surface in the upstream watershed area.*

Figure C4 helps identify which sites raise concern for closer investigation. Generally, as total percent impervious surface upstream of the sample location increases, so does specific conductivity concentration and variability. Percent total impervious surface is greatest in Moulton, Thayer and Demond Pond subbasins. Some sites are elevated beyond natural levels and include unexplained outliers.

Figure C5 shows that sites with greater total percent impervious surface upstream tend to have higher median specific conductivity in every season throughout the year. However, this relationship is strongest in the winter where r^2= 0.901, and the correlation weakens throughout the rest of the seasons. This matches our hypothesis that total percent impervious surface may increase the risk of road salt entering our streams. The relationship of specific conductance and impervious surface area, while strongest in the winter, still remains statistically significant throughout the year, showing concern for an increasing trend year to year as the salt persists and concentrates in the groundwater and waterways.

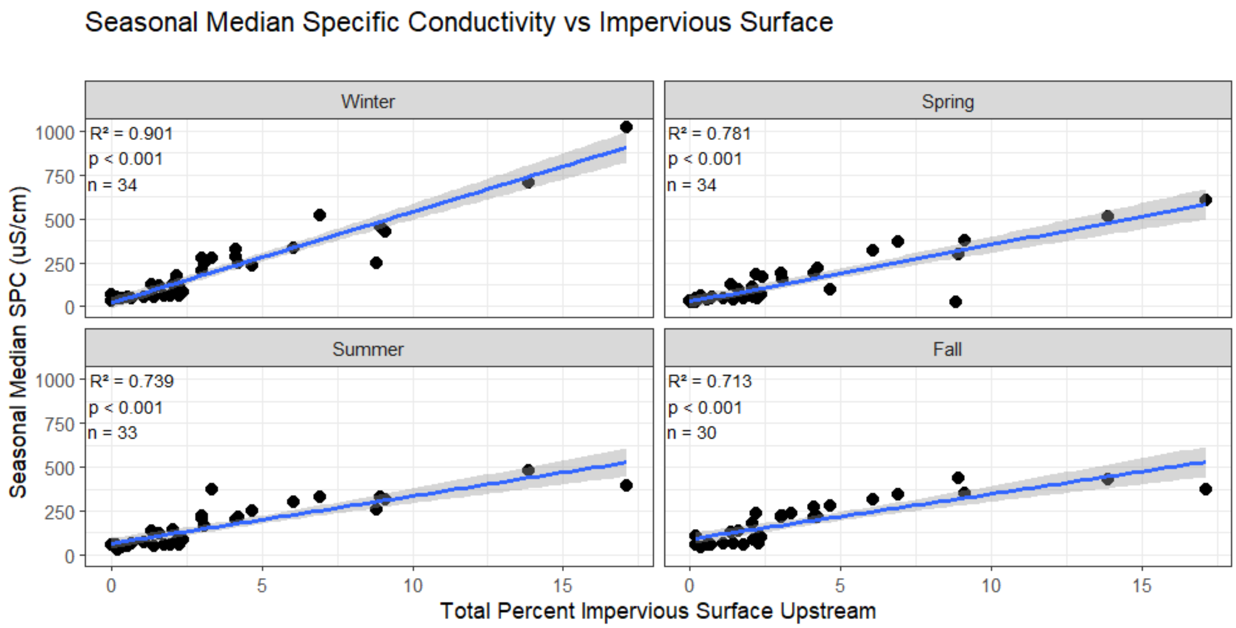

Figure C5. *Seasonal linear regressions of median specific conductivity and percent impervious surface upstream.*

A linear regression of total percent impervious surface upstream to the interquartile range of specific conductivity values at each site throughout the year is shown in Figure C6. Using the interquartile range instead of the full range of values helps filter out high and low outliers in the data. The interquartile range of specific conductivity generally increases with a strong correlation to total percent impervious surface upstream of each site. This shows that developed watersheds experience increased variability in regular specific conductance values, not just random outliers, nor simply consistently higher values. Sites with less impervious surface show more stable and consistent specific conductance values.

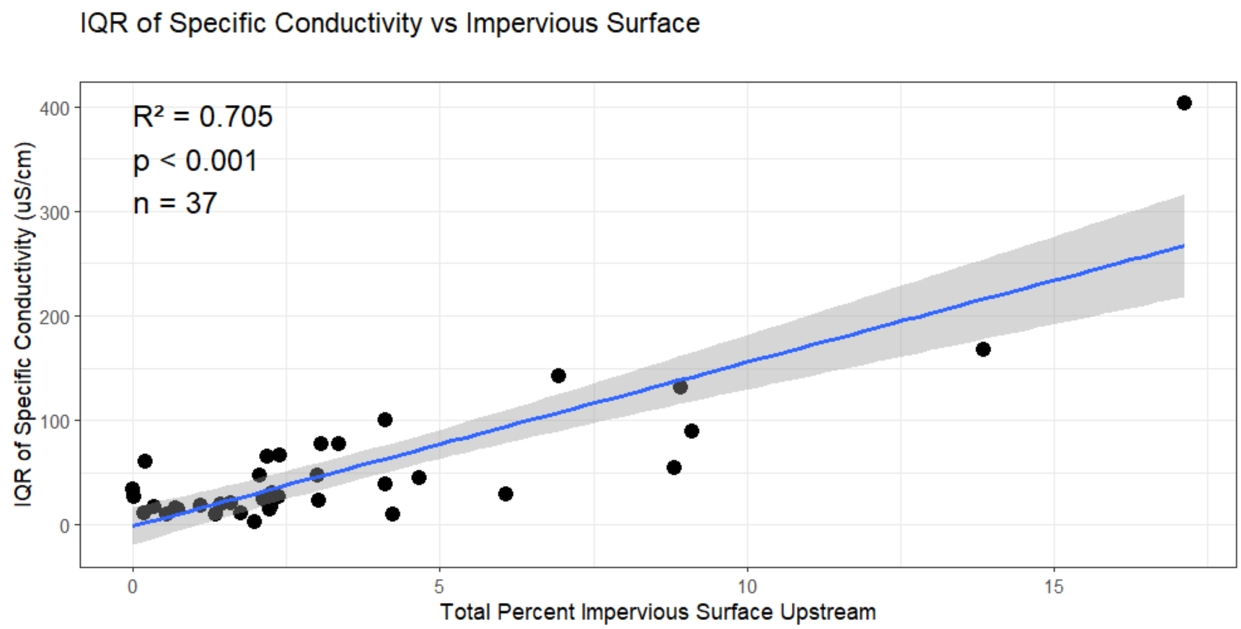

Figure C6. *Linear regression of the interquartile range (IQR) of specific conductivity at each site with its percent of impervious surface upstream.*

The results show that consistently across the Ware River Watershed Conductivity Project study sites, upstream total percent impervious surface is greatly associated with the measured specific conductivity of the samples. Sites with more total percent impervious surface upstream proved to also have higher seasonal median measurements of specific conductivity. Median specific conductivity is greater throughout every season in watersheds with more impervious surface; however, the strongest correlation occurs in the winter. This seasonal pattern is consistent with expected road salt influence, but the occurrence of good correlation across the warmer seasons also suggests that the raised specific conductivity values persist throughout the whole year, which could result in increasing trends in specific conductivity in the streams and groundwater. The specific conductivity interquartile range also increased with a strong correlation to increased total percent upstream impervious surface, suggesting that more developed watersheds have greater and consistent variability in levels of specific conductivity, not just a few isolated events. Overall, the results indicate that greater total upstream impervious surface is associated with both elevated and more variable levels of specific conductivity, particularly in the winter and spring seasons.

6.3.3.3. Dissolved Oxygen and pH

In addition to collecting data on specific conductance values, data were collected on dissolved oxygen (Figure C7) and pH (Figure C8). While these parameters were not key to this project, they are presented here as a snapshot that may inform future studies of the Ware River Watershed.

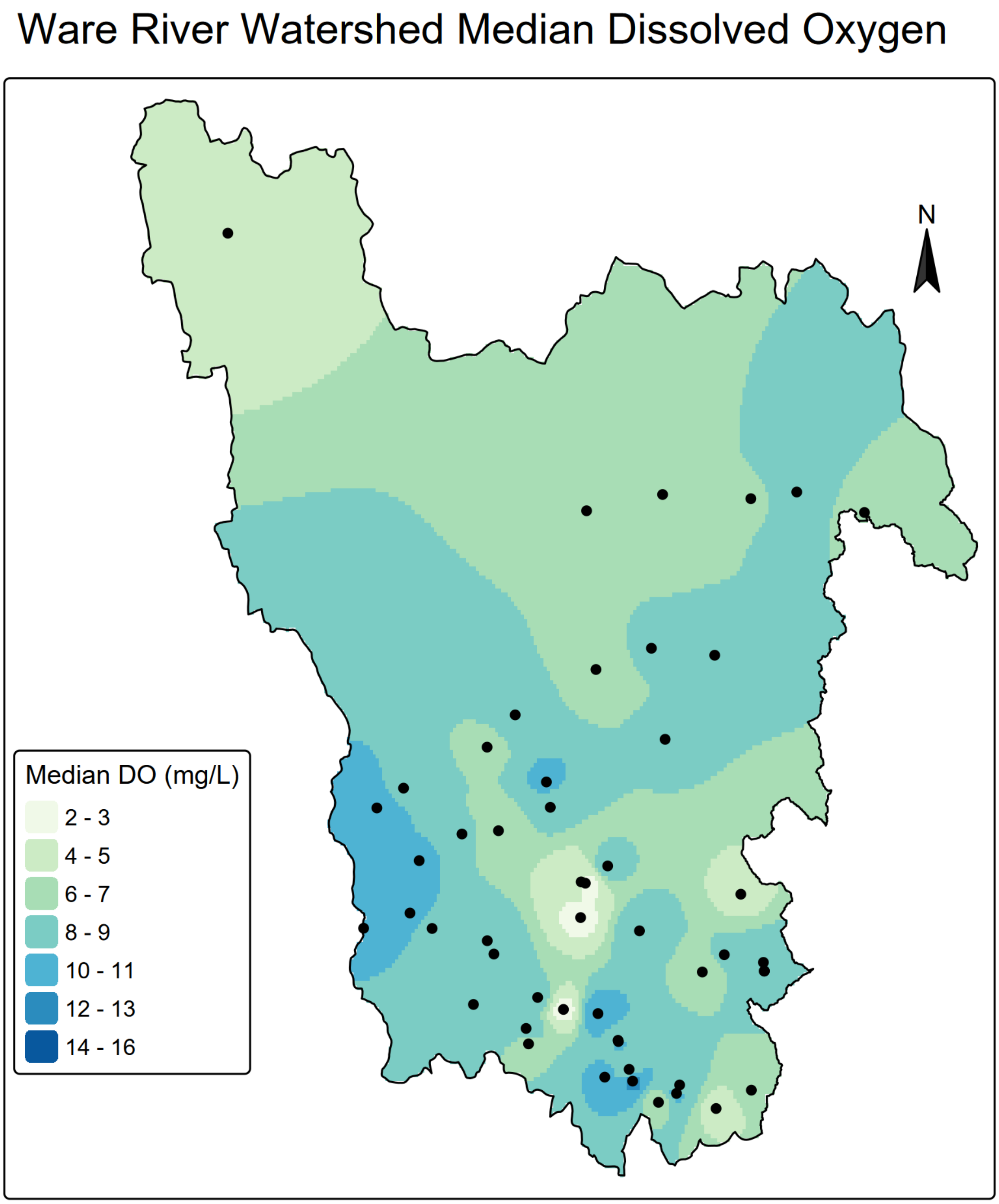

Figure C7. *Heat map of Ware River Watershed median dissolved oxygen values.*

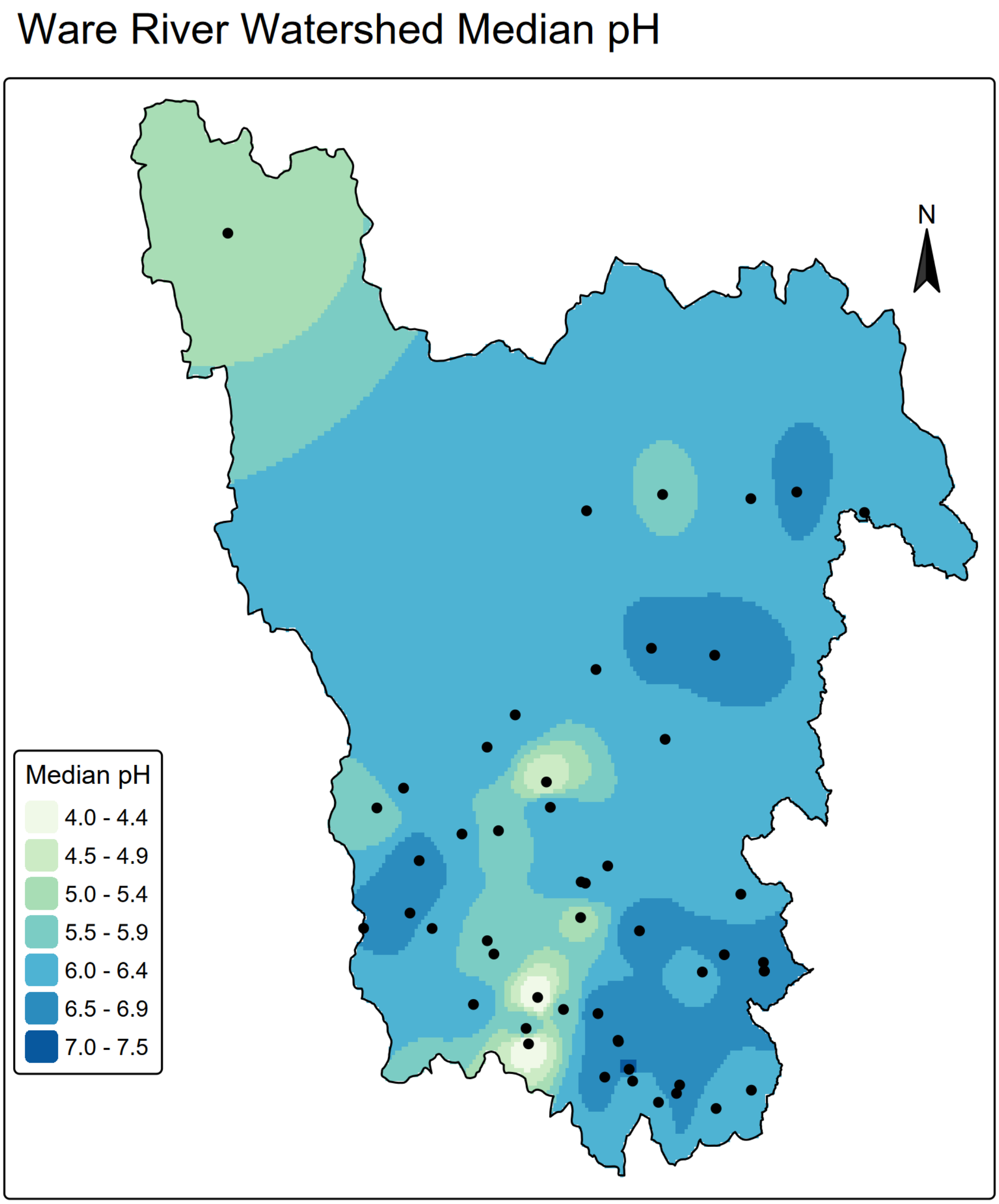

Figure C8. *Heat map of Ware River Watershed median pH values.*

6.3.4. Conclusion

Specific conductance will continue to be monitored at the Core and EQA routine locations, which will provide a continuous record to identify trends over time. Additionally, due to the concentration of specific conductance values in the Coldbrook and Longmeadow EQA District, EQ staff may consider performing another round of conductivity monitoring at these locations during future EQA cycles.

DWSP and MWRA collaboratively established a Salt Use Reduction Grant program in FY21 in the Wachusett Reservoir watershed. This program has been used to assist communities with covering salt storage areas, converting from using solid rock salt to salt brine, and upgrading plows to reduce the amount of road salt needed. The planned expansion of this program to the Quabbin Reservoir and Ware River Watersheds will help reduce the amount of road salt being used in these watersheds. The groundwater in the Ware River Watershed is already impacted by legacy road salt application, but the long-term reduction of road salt application going forward will likely slow the increase or reduce the conductivity in the watershed. Continued monitoring by DWSP will be key to identifying long-term trends in specific conductance.

6.4. Appendix D. Quabbin Reservoir AIS Survey Zones

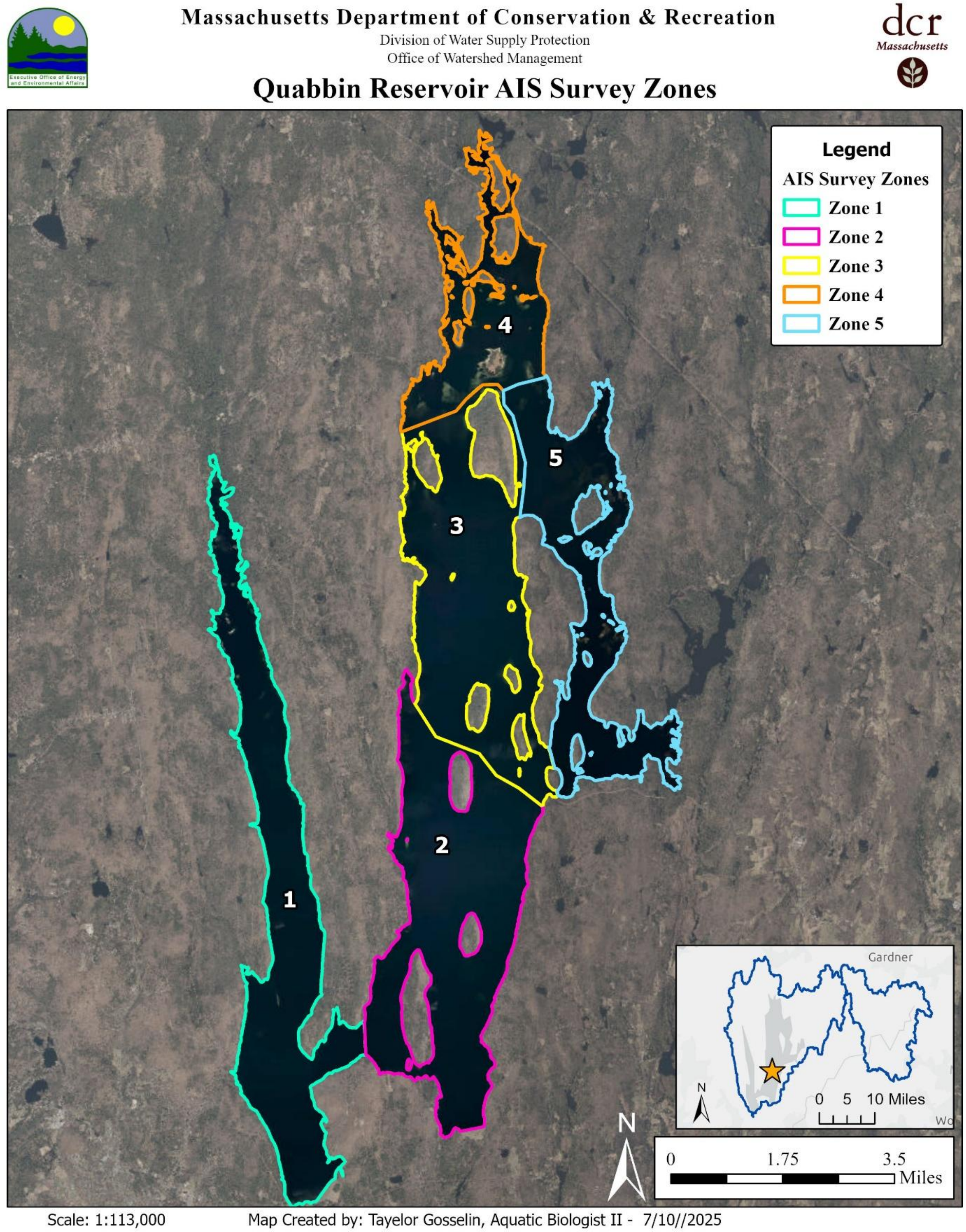

Figure D1. *Quabbin Reservoir AIS survey zones.*

6.5. Appendix E. Quabbin Reservoir and Ware River Watershed AIS Presence Maps

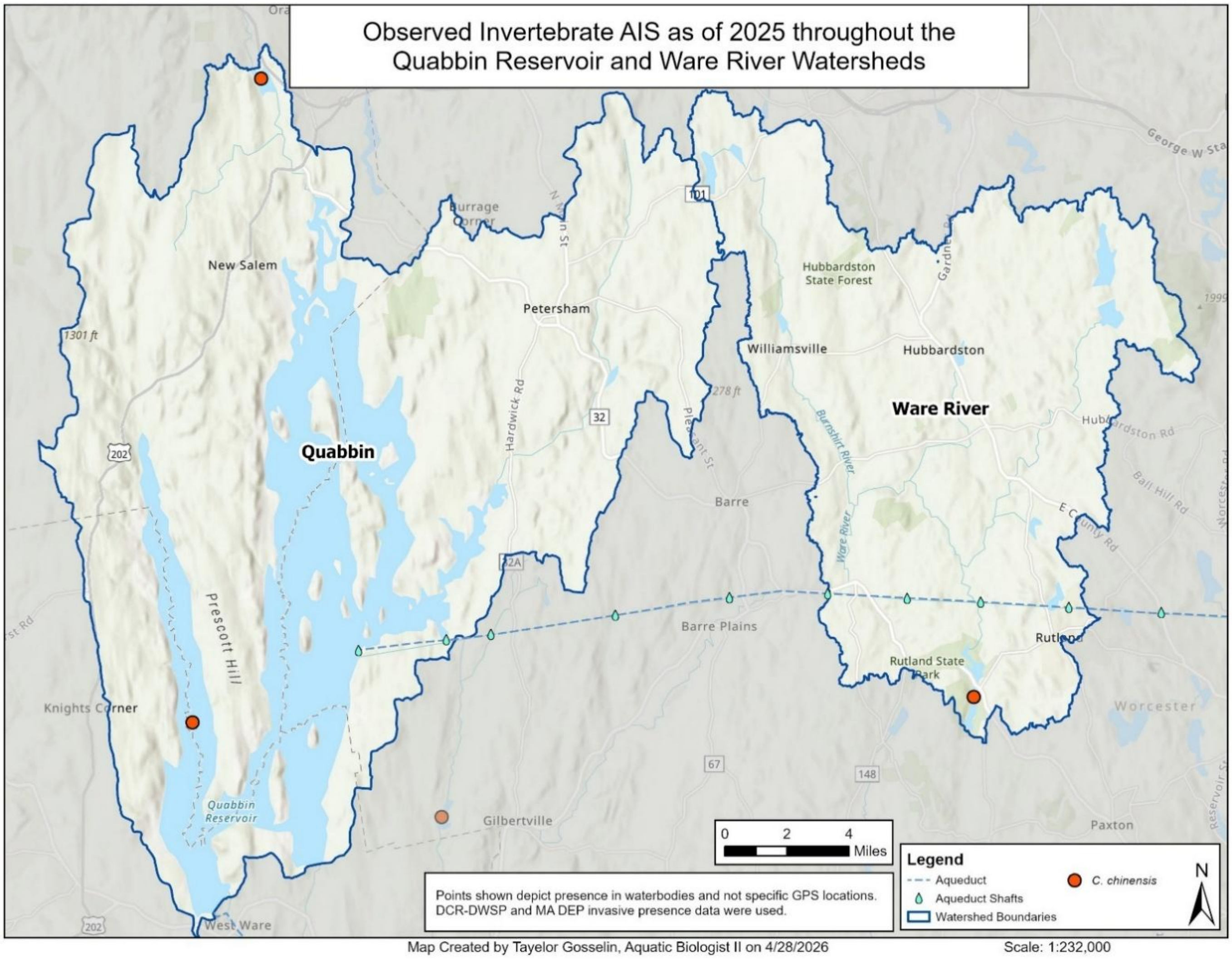

Figure E1. *Observed invertebrate AIS as of 2025 throughout the Quabbin Reservoir and Ware River watersheds.*

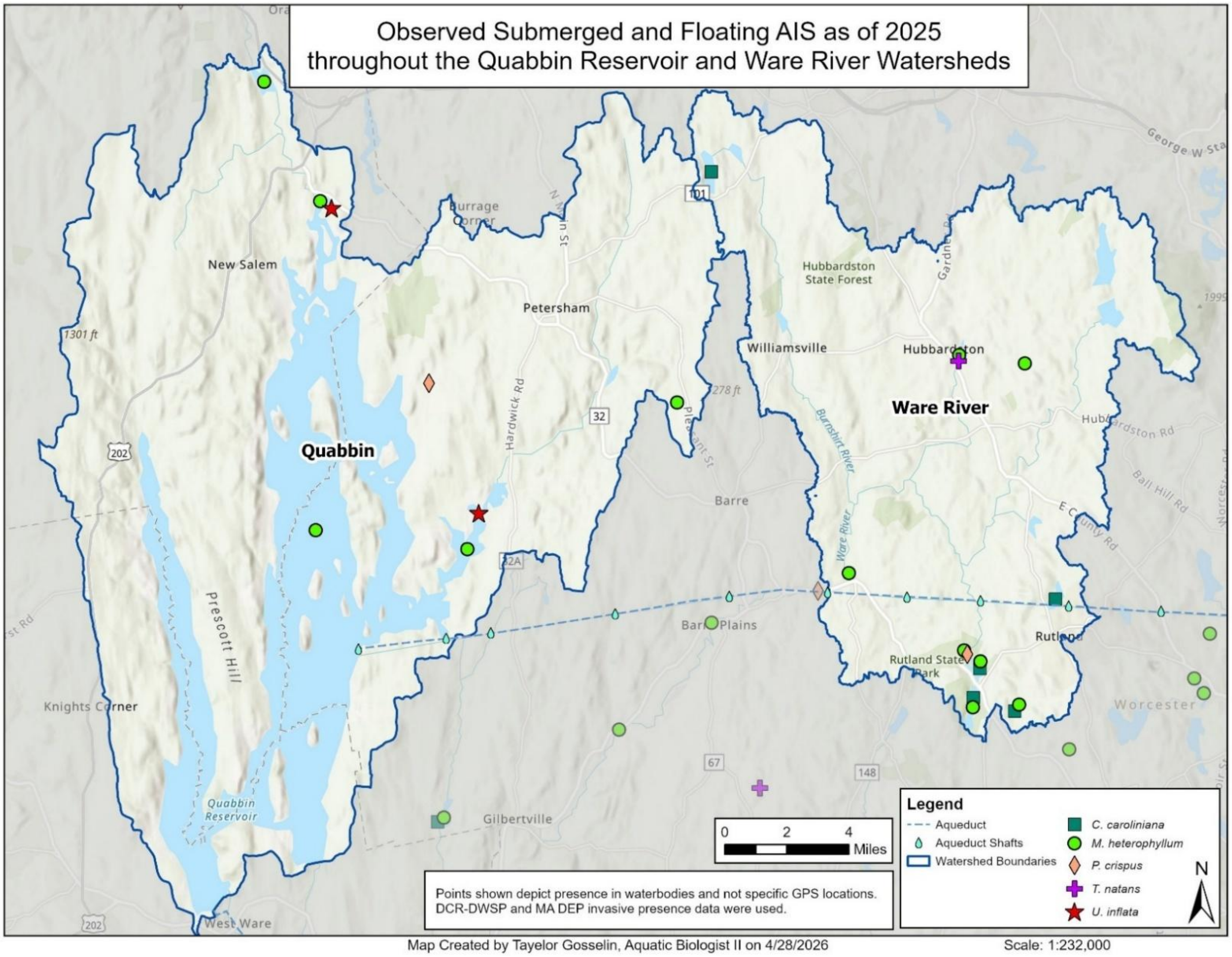

Figure E2. *Observed submerged and floating AIS as of 2025 throughout the Quabbin Reservoir and Ware River watersheds.*

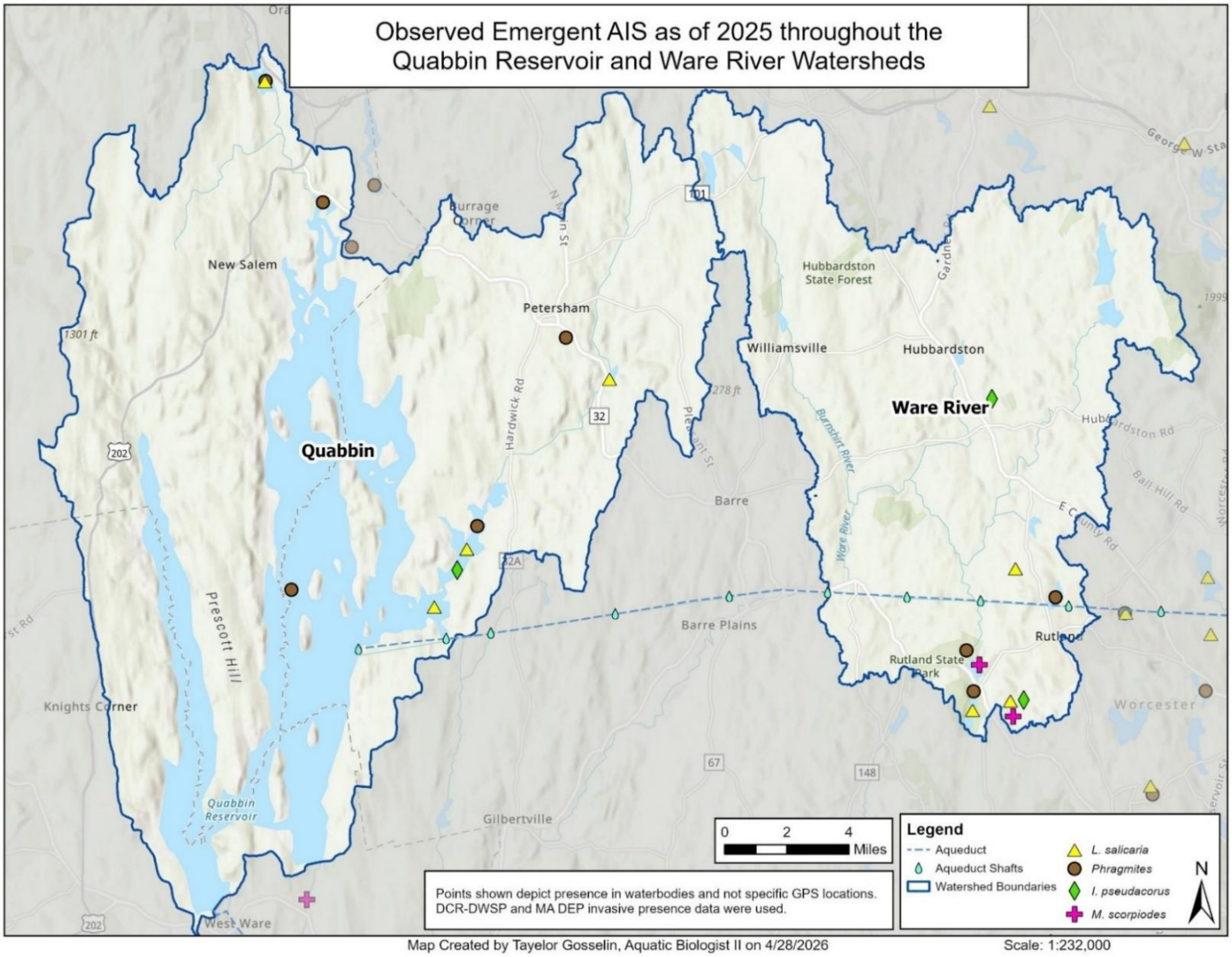

Figure E3. *Observed emergent AIS as of 2025 throughout the Quabbin Reservoir and Ware River watersheds.*