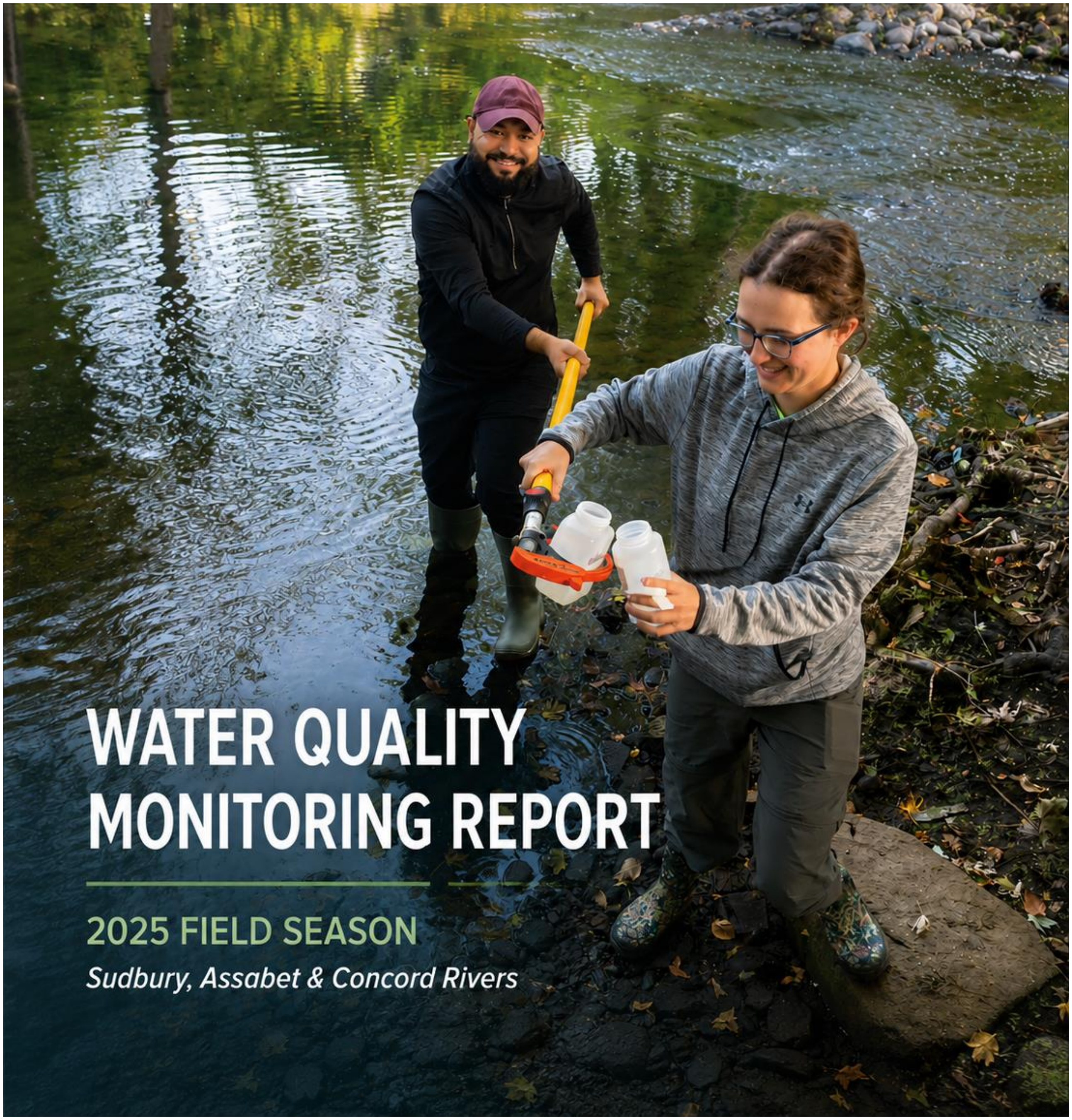
OARS

FOR THE SUDBURY ASSABET & CONCORD RIVERS



WATER QUALITY MONITORING REPORT

2025 FIELD SEASON

Sudbury, Assabet & Concord Rivers

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Available online at: **oars3rivers.org/our-work/river-science/water-quality/water-quality-reports/**

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Cover picture: monitoring the Assabet River (photo credit: Abigail McCarthy)

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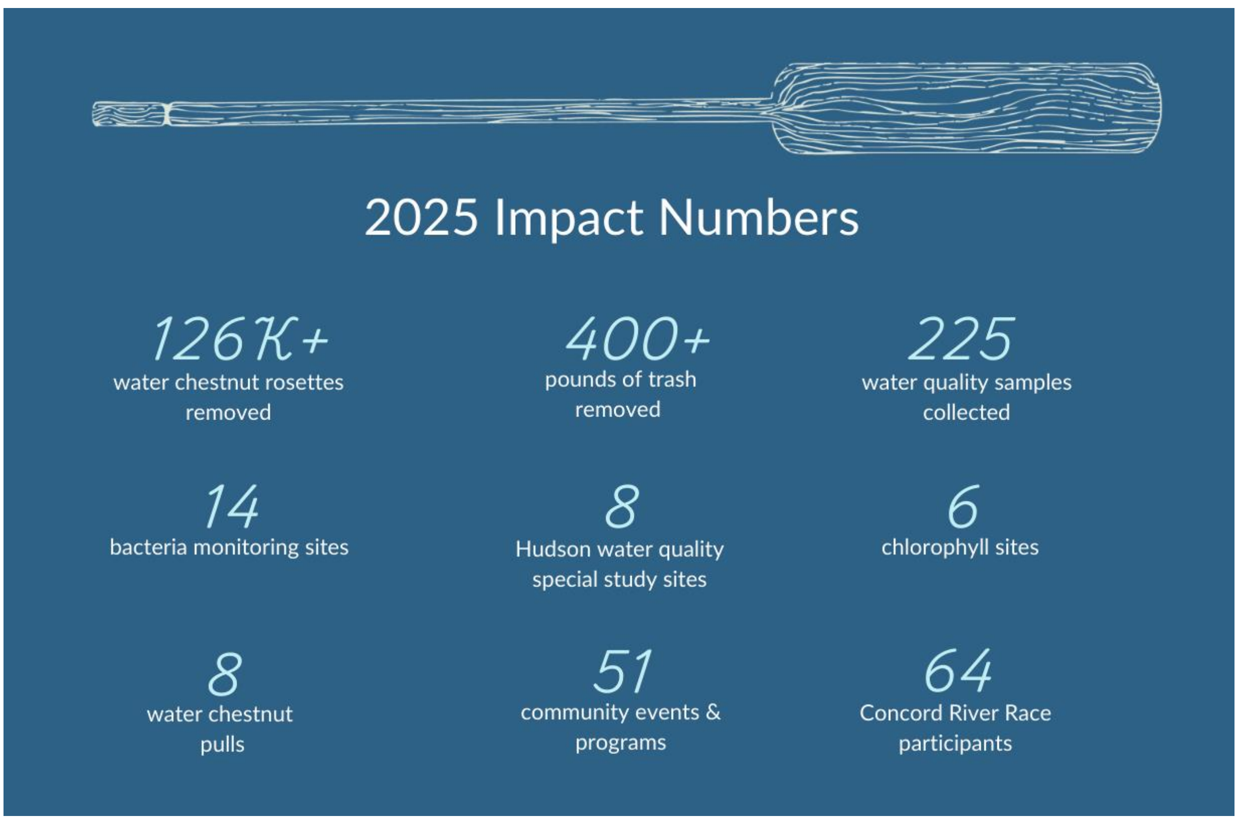
Report Purpose

This report presents the water quality, streamflow, bacteria, and aquatic plant biomass data OARS collected on the Sudbury, Assabet, and Concord rivers and tributary streams in 2025. It also summarizes and evaluates trends in the data between 1992 and 2025. The data collected are intended for use by municipal employees, engineers and consultants, conservation commission members, local environmental organizations and professionals to make progress towards a healthier watershed. This report is intended to display the data collected, to provide context that increases its usefulness for environmental benefits, and to communicate results in a format that is understandable for community members to feel empowered to serve as stewards of the watershed.

Since OARS was founded 40 years ago, major progress has been made for the water quality of the watershed in general. Eutrophication and phosphorus levels have been reduced, and dissolved oxygen has increased in most areas. This report will discuss the most pressing ongoing threats to water quality, which include the following: drought, wastewater treatment plant discharge, combined sewage overflows, *E. coli* bacterial contamination, rising water temperatures, and increasing conductance from road salt. More details are laid out in the body of the report.

Water quality reports for 1999–2025 are available on OARS' website (**oars3rivers.org/our-work/river-science/water-quality/water-quality-reports/**). All data are available upon request.



Report Summary

OARS conducts water quality, bacteria and streamflow monitoring on the mainstems and large tributaries of the Sudbury, Assabet, and Concord rivers. 2025 was OARS' 34th consecutive year collecting water quality data and its 7th year collecting *E. coli* bacteria data. Water quality data were collected at 25 sites (Figure 6). Bacteria data were collected at 14 sites (Table 4). Eight additional sites were monitored for water quality three times as part of a special study of water quality in Hudson (Figure 8).

The 2025 OARS Water Quality Monitoring Report documents both encouraging long-term improvements and continuing environmental stressors across the Sudbury, Assabet, and Concord River watershed. Monitoring results show that nutrient pollution and dissolved oxygen conditions have improved substantially since the OARS water quality program started monitoring the Assabet River in 1992. Ongoing concerns for water quality include drought, warming water temperatures, road salt contamination, bacteria pollution, combined sewage overflows and wastewater treatment plant discharges.

Climate, Hydrology, and Streamflow

Drought conditions in the Sudbury-Assabet-Concord Watershed were abnormally dry to moderate drought conditions in 2025. Summer streamflow was below average compared to long-term records dating back to 1980, while groundwater levels steadily declined through the summer and into fall. Average summer air temperatures have increased nearly 3°F since 1999 at Bedford Hanscom Field. In these warmer and drier conditions, the pollutant load is present at a higher concentration, which can increase stress on aquatic organisms and intensify water quality impairments. Low-flow conditions were especially important because wastewater effluent makes up a larger proportion of river flow during drought periods. Reduced groundwater recharge and anthropogenic water withdrawals continue to threaten summer baseflow conditions that are critical for maintaining aquatic habitat and water quality.

Water temperatures

Water temperatures remained elevated across many river sections during the summer monitoring season. Warm temperatures reduce dissolved oxygen availability and can stress aquatic life, particularly cold-water species such as brook trout in tributary streams. Several tributaries already listed by MassDEP as impaired for temperature continue to face temperature challenges.

Conductance

Conductance results continued to show evidence of chronic road salt contamination throughout the watershed, especially in urbanized tributaries and areas influenced by major roads. Elevated conductance and chloride concentrations were notable in tributaries such as Hop Brook and River Meadow Brook. Chloride contamination remains one of the clearest long-term increasing trends in the watershed and poses risks to freshwater organisms, especially during winter and spring runoff periods. Many sites exceeded EPA chronic exposure guidance values in the 2025 specific conductance data.

Dissolved oxygen

Dissolved oxygen conditions have improved over the long-term data record, compared to historical conditions before controls were implemented at wastewater treatment plants. Some river sections, however, still had low dissolved oxygen during the 2025 summer growing season, especially in slower-moving, dam-impounded reaches with excessive plant growth. Eutrophication continues to contribute to dissolved oxygen depletion in portions of the Assabet River system. Drought and warm water temperatures likely intensified dissolved oxygen stress during 2025.

Acidity (pH)

Most monitoring sites remained within Massachusetts Class B water quality standards for pH, though elevated pH values continued to occur in some nutrient-enriched river sections during periods of high aquatic plant productivity. These elevated pH conditions are associated with photosynthesis during algal blooms and excessive growth, especially in slow-moving, dam-impounded river reaches.

Phosphorus & Orthophosphate

Phosphorus reduction has been one of the watershed's major environmental successes. Since phosphorus discharge limits were strengthened beginning in the 1990s and most wastewater treatment upgrades were completed by 2011, total phosphorus concentrations have improved in the Assabet River system. Long-term graphs show large reductions in summer phosphorus concentrations after implementation of stricter wastewater discharge limits.

Despite these improvements, phosphorus continues to drive eutrophication in many river reaches. Orthophosphate, the biologically available form of phosphorus, continues to contribute to aquatic plant and algal growth. The report notes that sediment phosphorus release and legacy nutrient storage in impounded sections still affect river conditions, especially during warm summer periods with low flow.

Nitrate & Ammonia

Wastewater treatment plant discharges continue to influence nitrate concentrations, especially downstream of major treatment facilities on the Assabet River. EPA regional reference conditions list median summer nitrate concentrations around 0.43 mg/L, but downstream wastewater-influenced sites often exceed this level. Long-term analyses showed that wastewater effluent continues to be a dominant source of dissolved inorganic nitrogen in several river sections. Most Assabet sites have nitrate concentrations an order of magnitude greater than the Ecoregion reference condition of 0.34 mg/L (for NO_2+NO_3 as N) (EPA, 2000). Nitrate concentrations generally increased during low-flow periods when wastewater represented a larger percentage of streamflow. Ammonia concentrations were generally low and much improved compared to historical conditions, reflecting advances in wastewater treatment technology and permit requirements.

Total suspended solids

Total suspended solids loads are associated with periods of elevated precipitation and stormwater runoff. Under the 2025 drought conditions, some sites showed lower suspended sediment concentrations than the previous year, likely due to reduced runoff inputs.

Chlorophyll-a

Chlorophyll-*a* 2025 data were high in the lower Sudbury, with most or all measured levels exceeding the 50th percentile for data Reference Conditions for Ecoregion XIV of 4.00 mg/L at sites along the lower Sudbury. High Chlorophyll-*a* levels indicate elevated algal productivity. Although phosphorus reductions have improved conditions compared to past decades, nuisance plant growth and algal blooms continue, especially in impounded sections of the Assabet and Concord rivers. Invasive aquatic plants such as water chestnut, Eurasian milfoil, fanwort, and curly-leaf pondweed all remain widespread.

Bacteria

The Sudbury, Assabet and Concord Rivers are considered safe for secondary recreation, which includes boating and fishing but not eating the fish. Some sites, however, fail to meet safety thresholds for swimming. At three sites, *E. coli* exceeded the MA Surface Water Quality Standard based on primary contact (swimming) calculated using the geometric mean of data: Rt. 135 in Ashland (SUD-236), Rogers St Bridge in Lowell (CND-009) and Lawrence St. in Lowell (RVM-001). These three areas do not offer public swimming areas. On the one tributary stream monitored in 2025, *E. coli* concentrations at the River Meadow Brook site at Lawrence St., Lowell (RVM-001) exceeded the Massachusetts Secondary Contact Recommendation (boating) calculated with the 5-Sample Running Geometric Mean. High-precipitation days during low-precipitation years tend to have highest median *E. coli* levels.

Conclusions

OARS' long-term watershed restoration efforts have produced meaningful improvements in river health, especially through reductions in phosphorus pollution and improved wastewater treatment practices. However, many river segments remain classified as impaired due to ongoing issues including bacteria contamination, chloride pollution, nutrient enrichment, invasive species, dissolved oxygen stress, and warming temperatures. OARS' 2025 data demonstrate how drought and climate change can intensify existing impairments by reducing streamflow and increasing nutrient stress on aquatic ecosystems. Continued monitoring, infrastructure upgrades, stormwater management, and watershed stewardship remain essential for protecting the long-term health of the Sudbury, Assabet, and Concord watershed.

Water quality and bacteria data, collected under the *Quality Assurance Project Plan for OARS' Water Quality and Quantity Monitoring Program* (OARS, 2024), may be used by EPA and DEP in making regulatory decisions. The goals of OARS' monitoring program remain: to understand long-term trends in the condition of the rivers and their tributaries, to provide sound scientific information to evaluate and support regulatory decisions that affect the rivers, and to promote stewardship of the rivers through volunteer participation in the project.

Figure 1 OARS volunteers participate in a water chestnut pull to reduce invasive plants.

Introduction

OARS is an innovative, non-profit organization whose mission is to protect, improve, and preserve the Sudbury, Assabet, and Concord rivers and watershed for all people and wildlife. We are working to support a watershed with resilient streams and rivers that provide healthy wildlife habitat, water supplies, beauty, education, and recreational opportunities for all. Established in 1986 as the Organization for the Assabet River (OAR) by a group of concerned residents, OAR added the Sudbury and Concord rivers to its mission in 2011, becoming OARS.

Figure 2 The Concord Watershed flows into the Merrimack River as part of the greater Merrimack watershed. Image credit: Karl Musser based on USGS data.

Located in eastern Massachusetts, the Sudbury, Assabet, and Concord (SuAsCo) rivers collectively drain a 399-square-mile watershed that flows northward into the Merrimack River at Lowell. The rivers provide habitat for a variety of native species, including Eastern Brook Trout, Painted Turtles, crayfish, blue herons and a variety of birds, beavers, river otters, and muskrats.

The mainstem rivers, particularly the Assabet, have suffered from cultural eutrophication caused by excess nutrients coming from point and non-point sources and from the soft sediments. During the growing season, excess nutrients, phosphorus in particular, have fueled nuisance algal and macrophytic plant growth that interferes with recreational use of the rivers and causes daily variations in dissolved oxygen concentrations and pH that reduce the habitat quality for aquatic life. When the algae and plants decay, they generate strong sewage-like odors, can lower dissolved oxygen levels in the water column, and impair the aesthetics and use of the rivers. Invasive aquatic plants are also a problem throughout the watershed. The Sudbury River has a long history of invasive water chestnut (*Trapa natans*), and efforts to remediate this problem have been underway for many years. Significant water chestnut infestations are also common on the Concord River, particularly in the Billerica impoundment, and in sections of the Assabet River downstream of Hudson. Other invasive aquatic plants include Eurasian milfoil, fanwort, and curly leaf pondweed.

Figure 4. The Sudbury, Assabet and Concord rivers provide habitat for native species like the Eastern Brook Trout. Photo Credit: Bill Byrne

Under the federal Clean Water Act (Section 305b), states are required to evaluate the condition of the state's surface and groundwaters with respect to their ability to support designated uses, such as fishing and swimming, as defined in each of the state's surface water quality standards. The published Draft Massachusetts Integrated List of Waters for the Clean Water Act 2025/2026 Reporting Cycles identifies most assessed segments of the Assabet, Concord, and Sudbury rivers and many tributaries as Category 5 impaired waters on the Impaired Waters List as Category 5 ("Waters Requiring a TMDL") for a variety of impairments (MassDEP, 2023). This most recent report from MassDEP segmented impairments by Assessment Unit and also classifies several Concord River segments for PFAS fish tissue impairments. Table 1 provides a list of impairments by waterbody.

Table 1: Category 5 impaired waterways.[1]

Waterbody	Category 5 Impairments
Assabet River	Various including: Escherichia coli (*E. coli*), fecal coliform, benthic macroinvertebrates, fish bioassessments, nutrient/eutrophication biological indicators, odor, phosphorus, trash, dissolved oxygen, and invasive species
Concord River	Various including: Escherichia coli (*E. coli*), fecal coliform, mercury, chloride, trash, nutrient/eutrophication biological indicators, turbidity, invasive species, and PFAS in fish tissue
Sudbury River (d.s. of Fruit St. bridge)	Various including: mercury, dissolved oxygen, Escherichia coli (*E. coli*), and benthic macroinvertebrates
Beaver Brook	Escherichia coli (*E. coli*), dissolved oxygen
Broad Meadow Brook	Escherichia coli (*E. coli*), dissolved oxygen, benthic macroinvertebrates
Cochituate Brook	Escherichia coli (*E. coli),* trash, benthic macroinvertebrates, nutrient/eutrophication biological indicators
Cold Spring Brook	Dissolved oxygen, benthic macroinvertebrates
Coles Brook	Escherichia coli (*E. coli*), chloride
Eames Brook	Benthic macroinvertebrates, odor, nutrient/eutrophication biological indicators, trash
Elizabeth (& Assabet) Brook	Escherichia coli (*E. coli*), benthic macroinvertebrates
Hop Brook in Northborough	Benthic macroinvertebrates, chloride
Hop Brook in Sudbury	Phosphorus, dissolved oxygen, nutrient/eutrophication biological indicators, benthic macroinvertebrates, Escherichia coli (*E. coli*), turbidity, suspended solids, and pH
Nashoba Brook	Escherichia coli (*E. coli),* temperature, benthic macroinvertebrates
North Brook	Temperature
Pantry Brook	Fecal coliform
Picadilly Brook	Temperature, fish bioassessments
River Meadow Brook	Escherichia coli (*E. coli*), fecal coliform, temperature, trash, benthic macroinvertebrates, chloride, dissolved oxygen
Whitehall Brook	Benthic macroinvertebrates, dissolved oxygen

[1] Source: published Draft 2025/2026 MA Integrated List of Waters. https://www.mass.gov/doc/massachusetts-draft-integrated-list-of-waters-for-the-clean-water-act-20242026-reporting-cycle/download

History of Wastewater Treatment in the Watershed

Nutrient limits were first set for the Assabet River wastewater treatment plants (WWTPs) in 1993, seven years after OAR was established. The Environmental Protection Agency (EPA) and Mass. Department of Environmental Protection (MassDEP) set summer discharge concentration limits of 1.0 mg/L for all four plants that were active at this time, and by 2000, all plants reported average summer concentrations below 1.0 mg/L achieved through waste treatment with ferrous sulfate, ferrous chloride, ferric chloride, and/or alum.

Figure 5. Before nutrient limits were set for the Assabet River wastewater treatment plants in 1993, people used to call it the cesspool of Massachusetts due to plant growth from eutrophication.

The *Assabet River Total Maximum Daily Load for Total Phosphorus* study confirmed that the majority of the nutrients entering the Assabet River were coming from the wastewater treatment plants that discharge treated effluent to the river (MassDEP, 2004). Wastewater treatment plants were the major source of Ortho phosphorus, which is the bioavailable form of phosphorus. While non-point sources contributed nutrients via stormwater runoff, they contributed significantly less than the point sources. The 2004 study concluded that reductions in nutrient loads from both point and non-point sources would be required to restore the Assabet River to Class B conditions. MassDEP and EPA adopted a two-phased adaptive management plan to reduce phosphorus loads in the Assabet. In Phase 1, lower summertime total phosphorus discharge limits of 0.1 mg/L were required at the four major wastewater treatment plants. Methods to limit nutrient flux from the nutrient-rich sediments that accumulate in the impounded river sections were studied.

The *Assabet River, Massachusetts, Sediment and Dam Removal Study* examined sediment dredging, dam removal, and lower winter phosphorus discharge limits as ways of controlling the annual phosphorus loading from the sediments (ACOE, 2010). The study concluded that: (1) dredging would achieve, at best, short-term improvements, (2) phosphorus discharge from the wastewater treatment plants in the winter contributes to the annual phosphorus budget for the Assabet and, therefore, decreased winter phosphorus discharge limits would be another way to control phosphorus loading to the system, and (3) dam removal plus the Phase 1 wastewater treatment plant phosphorus discharge reductions would nearly meet the MassDEP (2004) goal of reducing the sediment phosphorus contribution by 90%, achieving an estimated 80% overall reduction.

Upgrades to the four municipal wastewater treatment plants that discharge to the Assabet River were completed by the spring of 2012: Hudson in September 2009, Maynard in spring 2011, Marlborough Westerly and Westborough in spring 2012. The Marlborough Easterly plant, discharging to the Sudbury River via Hop Brook, finished required upgrades by spring 2015. With the upgrades complete, all the treatment plants currently meet a summer total phosphorus discharge limit of 0.1 mg/L. In Phase 2 of the adaptive management plan, MassDEP and EPA were tasked with jointly deciding what additional phosphorus treatment would be needed for the Assabet to meet water quality standards. In 2023, they took the next step of reducing the winter phosphorus discharge limit from 1.0 mg/L to 0.2 mg/L[2], and as of 2025, Marlborough Easterly's summer discharge limit was set at 0.05 mg/L.

The existing baseflow in the Assabet and its tributaries must be preserved in order for the nutrient load reductions proposed in the state's Total Maximum Daily Load (TMDL) to effectively restore water quality in the mainstem. Baseflow, the flow of groundwater into the streams, is critical during the summer and is essential to diluting the effluent discharged to the rivers. The area's water resources are under the strain of an increasing demand for water supply and centralized wastewater treatment, which results in the net loss of water from many sub-basins and reduced baseflow in the mainstem and tributaries. Sufficient streamflow levels throughout the year are critical to supporting fish and other aquatic life.

[2] Marlborough Westerly Wastewater Treatment Plant limit 4.8 lb/day, which corresponds to 0.2 mg/L at design flow.

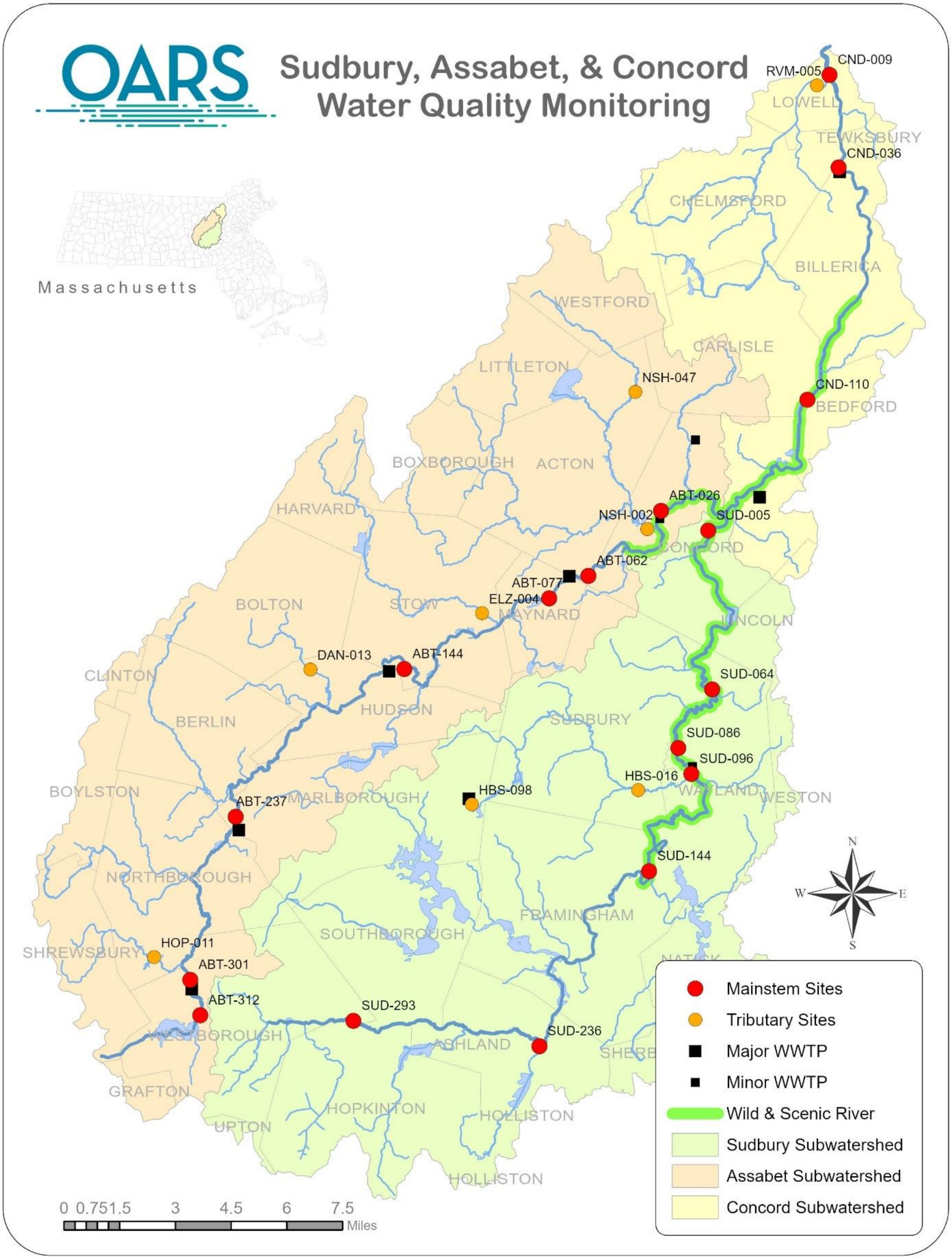


Figure 6: 2025 Water Quality Monitoring Sites

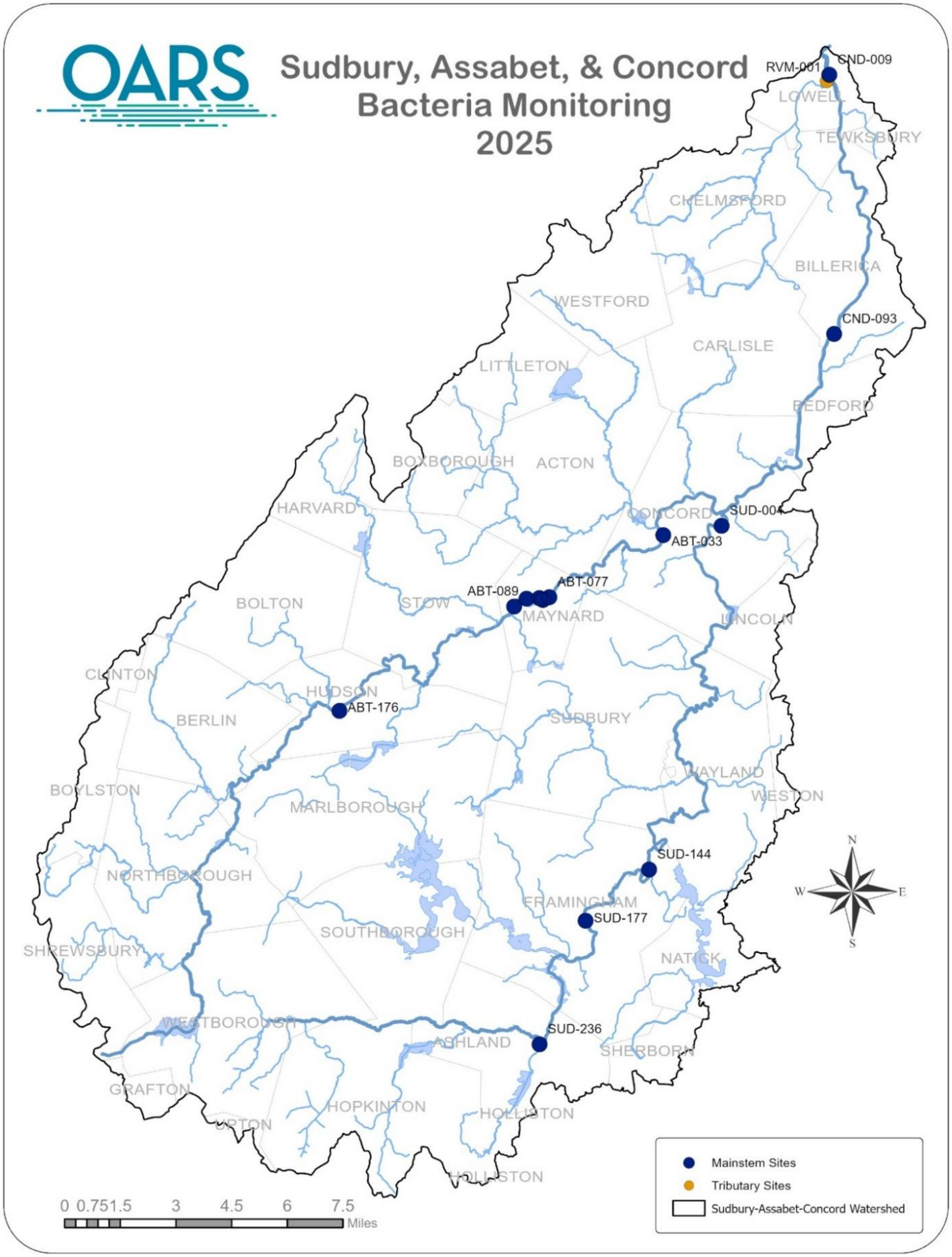


Figure 7 2025 bacteria monitoring sites

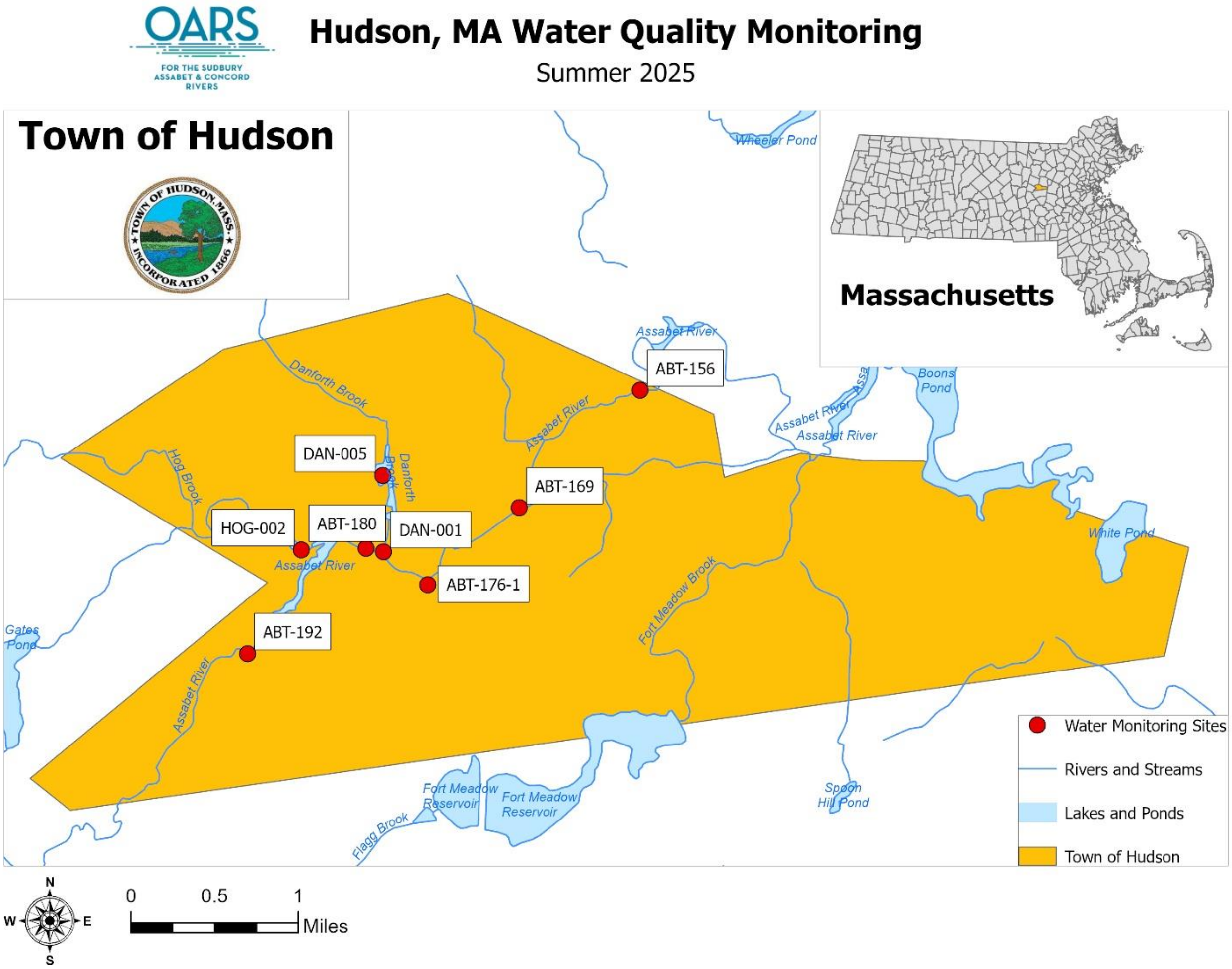


Figure 8. Town of Hudson special study water quality site map.

Table 2: OARS 2025 Water Quality Monitoring Sites List

OARS Site #	Waterbody	Site Description	Municipality	SARIS #	Lat/Lon	Sampling Dates			Gage reading /streamflow*
						June/Jul/ Aug	May/ Sept	Nov/ March	
CND-009	Concord River	Rogers Street	Lowell	46500	42° 38' 09"/ -71° 18' 05"	√	√	√	(USGS gage)
CND-036	Concord River	Bristol & Amherst Streets	Billerica	46500	42° 35' 59"/ -71° 17' 49"	√			
CND-110	Concord River	Route 225	Bedford	46500	42° 30' 33"/ -71° 18' 51"	√			
ABT-026	Lower Assabet	Route 2	Concord	46775	42° 27' 57"/ -71° 23' 28"	√	√	√	
ABT-062	Lower Assabet	Route 62 (Canoe access)	Acton	46775	42° 26' 27"/ -71° 25' 46"	√			
ABT-077	Lower Assabet	USGS Maynard Gage	Maynard	46775	42° 25' 55"/ -71° 26' 59"	√	√	√	(USGS gage)
ABT-144	Upper Assabet	Route 62 (Gleasondale)	Stow	46775	42° 24' 16"/ -71° 31' 35"	√			
ABT-237	Upper Assabet	Robin Hill Road	Marlborough	46775	42° 20' 48"/ -71° 36' 53"	√			
ABT-301	Upper Assabet	Route 9	Westborough	46775	42° 16' 59"/ -71° 38' 19"	√	√	√	
ABT-312	Assabet Headwater	Mill Road	Westborough	46775	42° 16' 10"/ -71° 38′ 00″	√	√	√	√
SUD-005	Lower Sudbury	Route 62 (Boat House)	Concord	47650	42° 27' 30"/ -71° 21' 59"	√	√	√	
SUD-064	Lower Sudbury	Sherman Bridge Road	Wayland	47650	42° 23' 47"/ -71° 21' 52"	√	√		
SUD-086	Lower Sudbury	River Road	Wayland	47650	42° 22' 26"/ -71° 22' 54"	√	√		
SUD-096	Lower Sudbury	Route 20	Wayland	47650	42° 21' 49"/ -71° 22' 31"	√	√		
SUD-144	Lower Sudbury	Sudbury Landing	Framingham	47650	42° 19' 32"/ -71° 23' 51"	√	√	√	(USGS gage)
SUD-236	Upper Sudbury	Chestnut Street	Ashland	47650	42° 15' 27"/ -71° 27' 18"	√			
SUD-293	Upper Sudbury	Fruit Street	Southborough	47650	42° 16' 03"/ -71° 33' 09"	√	√	√	√
DAN-013	Danforth Brook	Route 85	Hudson	47275	42° 24' 14"/ -71° 34' 29"	√	√	√	√
ELZ-004	Elizabeth Brook	White Pond Road	Stow	47125	42° 25' 36"/ -71° 29' 07"	√	√	√	
HOP-011	Hop Brook N'boro	Otis Street	Northborough	47600	42° 21' 26"/ -71° 37' 46"	√	√	√	√
HBS-016	Hop Brook Sudbury	Landham Road	Sudbury	47825	42° 21' 26"/ -71° 24' 11"	√	√	√	
HBS-098	Hop Brook Sudbury	Route 20 Above Hager Pond	Marlborough	47825	42° 21' 03"/ -71° 29' 26"	√			
NSH-002	Nashoba Brook	Commonwealth Ave.	Concord	unnamed	42° 27' 32"/ -71° 23' 50"	√	√	√	√
NSH-047	Nashoba Brook	Wheeler Lane	Acton	46875	42° 30' 43"/ -71° 24' 17"	√	√	√	(USGS gage)
RVM-005	River Meadow	Thorndike Street	Lowell	46525	42° 37' 55"/ -71° 18' 32"	√	√	√	√

* USGS gage indicates that data is collected from USGS real-time gaging stations via USGS National Water Information System (NWIS). OARS Gages are maintained and read manually by OARS volunteers and staff.
** USGS gage at Mill Road, Westborough, is no longer available on the real-time USGS NWS website; gage is maintained and read by OARS.

Table 3: OARS Hudson Water Quality Special Study Site List, 2025

OARS Site #	Waterbody	Description	Municipality	Lat/Lon
ABT-156	Upper Assabet	WWTP, Hudson	Hudson	42° 24' 13"/ -71° 32' 12"
DAN-005	Upper Assabet	Main St. Bike Path	Hudson	42° 23' 32"/ -71° 33' 12"
DAN-001	Upper Assabet	Wheeler Road Conservation Land	Hudson	42° 23' 12"/ -71° 33' 41"
HOG-002	Hog Brook	Foss Conservation Land	Hudson	42° 22' 51"/ -71° 34' 57"
ABT-192	Danforth Brook	Bruces Pond Outlet	Hudson	42° 23' 23"/ -71° 33' 60"
ABT-176-1	Upper Assabet	Apsley St Bridge	Hudson	42° 23' 46"/ -71° 34' 00"
ABT-170	Upper Assabet	Rt. 85 Bridge	Hudson	42° 24' 14"/ -71° 34' 29"
DAN-013	Danforth Brook	Tripps Pond	Hudson	42° 23' 23"/ -71° 34' 34"

Table 4: OARS Bacteria Monitoring Sites List, 2025

OARS Site #	Waterbody	Description	Municipality	Lat/Lon
ABT-077	Lower Assabet River	USGS Maynard Gage	Maynard	42° 25' 55"/ -71° 26' 59"
ABT-176	Upper Assabet River	Wheeler Road	Hudson	42° 23' 14"/ -71° 33' 39"
CND-009	Lower Concord River	Rogers Street	Lowell	42° 38' 09"/ -71° 18' 05"
CND-093	Upper Concord River	Concord River at Rt. 4	Billerica	42° 32' 09"/ -71° 17' 57"
RVM-001	River Meadow Brook	645 Lawrence St.	Lowell	42° 37' 60"/ -71° 18' 11"
SUD-144	Lower Sudbury River	Sudbury Landing	Framingham	42° 19' 32"/ -71° 23' 51"
SUD-236	Upper Sudbury River	Chestnut Street	Ashland	42° 15' 27"/ -71° 27' 18"
ABT-033	Lower Assabet River	Rt. 62, W Concord	Concord	42° 27' 19"/ -71° 23' 24"
ABT-079	Lower Assabet River	Walnut St Bridge	Maynard	42° 25' 51"/ -71° 27' 12"
ABT-080	Lower Assabet River	Main St & Walnut	Maynard	42° 25' 54"/ -71° 27' 19"
ABT-084	Lower Assabet River	Maynard Town Hall	Maynard	42° 25' 43"/ -71° 27' 42"
ABT-089	Lower Assabet River	Rt. 117	Maynard	42° 25' 28"/ -71° 28' 07"
SUD-177	Upper Sudbury	Kellog Street	Framingham	42° 23' 41"/ -71° 25' 51"
SUD-004	Lower Sudbury	Nashawtuc Road	Concord	42° 27' 30"/ -71° 21' 33

Water Quality Monitoring

Water Quality Sampling Methods

Figure 9. Trained volunteer Patrick Thayer collects a water quality sample.

Trained volunteers and OARS staff monitored water quality at sites throughout the watershed (Figure 6, Table 2). Each site was assigned a three-letter prefix for the waterbody name plus three numbers designating river miles (to one decimal) above its confluence with the next stream (Table 7). Water quality monitoring was conducted one Sunday each month in March, May, June, July, August, September, and November. All sites were sampled in June, July, and August. In March, May, September, and November, only selected sites were sampled. From the growing season of May to September, monitoring was conducted between 6:00 am and 9:30 am to capture the diurnal low in dissolved oxygen readings. In the non-growing season, when dissolved oxygen does not vary dramatically over the day, monitoring was conducted before 12:00 pm. Streamflow was either calculated from stage readings of OARS' gages using stage/discharge rating curves developed per the United States Geological Survey (USGS) standards (Rantz, 1982; Smoot, 1968) or recorded from the USGS real-time gage websites.

Nutrient, chloride, suspended solids, and chlorophyll-*a* samples were taken using bottles supplied by state-certified laboratories under contract with OARS and were stored in the dark on ice during transport from the field to the lab. Samples were delivered to the lab within 26 hours of collection and analyzed within their respective hold times. Chlorophyll-*a* samples were delivered to the lab within 6 hours of sampling. *In situ* readings of temperature, dissolved oxygen, pH, and conductance were taken using multi-function YSI Pro-series or 6-series meters. Pre- and post-calibration was done by OARS staff. To ensure that samples were representative of the bulk flow of the river, bottle samples and meter readings were taken from the main flow of the river at 6–12 inches depth by wading, using a pole, or by lowering the meter from a bridge. Duplicate field samples and distilled water field blanks were taken for 10% of the samples to ensure high quality data collection methods. Table 3 summarizes the parameters measured, laboratory methods, and equipment used. Detailed descriptions of sampling methods and quality control measures are available in the *Quality Assurance Project Plan for OARS' Water Quality and Quantity Monitoring Program*, available on request (OARS, 2025).

Table 3: Water Quality Sampling and Analysis Methods 2025

Parameter	Analysis Method #	Equipment Range/ Reporting Limits	Sampling Equipment	Laboratory
Water Temperature	---	-5–45 degrees C	YSI multi-par. sonde	---
pH	---	0–14 units	YSI multi-par. sonde	---
Dissolved oxygen	---	0–50 mg/L	YSI multi-par. sonde	---
Conductance	---	0–10,000 µS/cm	YSI multi-par. sonde	---
Total Suspended Solids	SM 2540D	5–100 mg/L	bottle	Pace Analytical
Total Phosphorus	SM 4500-P-E	0.01–1 mg/L	bottle	Pace Analytical
Orthophosphate	SM 4500-P-E	0.005–1 mg/L	bottle	Pace Analytical
Nitrate-N	SM 4500-NO3-F	0.1–10 mg/L	bottle	Pace Analytical
Ammonia-N	SM 4500-NH3-BH	0.075–10 mg/L	bottle	Pace Analytical
Chloride	EPA 300.0	1–1000 mg/L	bottle	Pace Analytical
Chlorophyll–*a*	SM 10200-H(3)	2–100 µg/L	bottle	Pace Analytical

Bacteria Sampling Methods

Trained water quality volunteers collected bacteria samples on nine sampling days at 14 sites (Table 2). The sites were selected with the objective of evaluating recreational areas of the rivers and monitoring populated areas with suspected pollution sources. Bacteria monitoring was conducted two Mondays per month from May to September between 6:00 am and 8:00 am. *E. coli* samples were taken using sterile bottles supplied by the state certified lab under contract with OARS and were stored in the dark on ice during transport from the field to the lab. Samples were delivered to the lab within 6 hours of collection and analyzed within 8 hours of collection. To ensure that samples were representative of the bulk flow of the river, bottle samples were taken from the main flow of the river at six inches depth by wading or using a pole. Duplicate field samples and field blanks of sterile water were taken for 10% of the samples. Table 4 below summarizes laboratory methods and equipment used. Detailed descriptions of sampling methods and quality control measures are available in the *Quality Assurance Project Plan for OARS' Water Quality and Quantity Monitoring Program* (OARS, 2024).

Table 4: Bacteria Sampling and Analysis Methods

Parameter	Analysis Method #	Equipment Range/ Reporting Limits	Sampling Equipment	Laboratory
E. coli	SM 9223-B (IDEXX Colilert)	1 MPN/100 mL *	bottle	Nashoba Analytical

* MPN = most probable number

Water Quality Review Methods

Water quality measurements were compared with the 2021 Massachusetts Water Quality Standards (MassDEP, 2021) (Table 5). For nutrient concentrations (where the Massachusetts standard is narrative), results were compared with EPA "Gold Book" total phosphorus criteria (EPA, 1986) and with summertime data for Ecoregion XIV subregion 59 (EPA, 2000) (Table 6). All mainstem river sections are designated Class B waters, and all except for the lower Sudbury are Warm Water fisheries. The lower Sudbury has a reduced Aquatic Life designation, which applies Class C dissolved oxygen and temperature criteria. The MA Division of Fisheries and Wildlife lists 33 tributary streams in the basin as Coldwater Fish Resources (CFRs) (Mass Department of Fish and Wildlife, 2025). See Appendix VI. for water quality designations by river segment and the list of cold-water tributaries.

For data analysis, the water monitoring sites are divided into sections: (1) Upper Assabet mainstem, (2) Lower Assabet mainstem, (3) Upper Sudbury mainstem, (4) Lower Sudbury mainstem, and (5) Concord mainstem. Tributary sites are analyzed individually. Tributary and mainstem basin characteristics calculated using the USGS's StreamStats program are available in Appendix II.

Table 5: MassDEP Class B Water Quality Standards and Guidance (MassDEP, 2021)

Parameter	Standard / Guidance Class B	Standard / Guidance Class B "Aquatic Life"
Dissolved oxygen	≥ 5.0 mg/l for warm water fisheries ≥ 6.0 mg/l for cold water fisheries	≥ 5.0 mg/l 16 hours of any 24-hour period and ≥ 3.0 mg/l at any time
Temperature	M7DM* <28.3°C and Δ < 2.8°C for warm water fisheries M7DM* <20.0°C and Δ < 1.7°C for cold water fisheries	≤29.4 °C and Δ ≤ 2.8°C
pH	6.5–8.3 and < 0.5 outside the natural background range	
Nutrients	"control cultural eutrophication" / Gold Book** standard TP < 0.05 mg/l for rivers entering a lake or impounded section	
Suspended Solids	"free from floating, suspended and settleable solids in concentrations and combinations that would impair any use assigned to this class"	
Aesthetics	All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.	
E. coli	Primary Contact: Geometric Mean < 126 CFU/100 ml and 90% of samples < 410 CFU/100 ml Secondary Contact: Geometric Mean < 630 CFU/100 ml and 90% of samples < 1260 CFU/100 ml	
Chloride	EPA Recommended Criteria*** < 230 mg/L chronic exposure, < 860 mg/L acute exposure.	

* M7DM – Mean of 7-day daily maximum
** EPA, 1986, Gold Book.
*** EPA, 2002, National Recommended Water Quality Criteria.

Table 6: Reference Conditions for Ecoregion XIV (subregion 59) Streams (EPA, 2000)

Nutrient Parameter	25th percentile of summer data	50th percentile of summer data
Total Phosphorus	0.025 mg/L	0.050 mg/L
Orthophosphate	0.010 mg/L	0.025 mg/L
Total Nitrogen	0.44 mg/L	0.74 mg/L
NO_2 + NO_3 (as N)	0.34 mg/L	0.43 mg/L
Chlorophyll-*a* (Spec A method)	2.00 μg/L *	4.00 μg/L *

* Chlorophyll-*a* data are available only for subregion 63

Climate and Drought Conditions

Air temperatures

The summer of 2025 showed high summer temperatures, compared to historic averages (Figure 9). Warm summer temperatures increase evapotranspiration and deplete both soil moisture and groundwater recharge. Mean winter of 2025 temperatures were lower than 2024 and 2023. Air temperature data from the Bedford Hanscom airfield shows a nearly five-degree Fahrenheit increase in the trend line of average summer air temperature since 1999 (Figure 9).

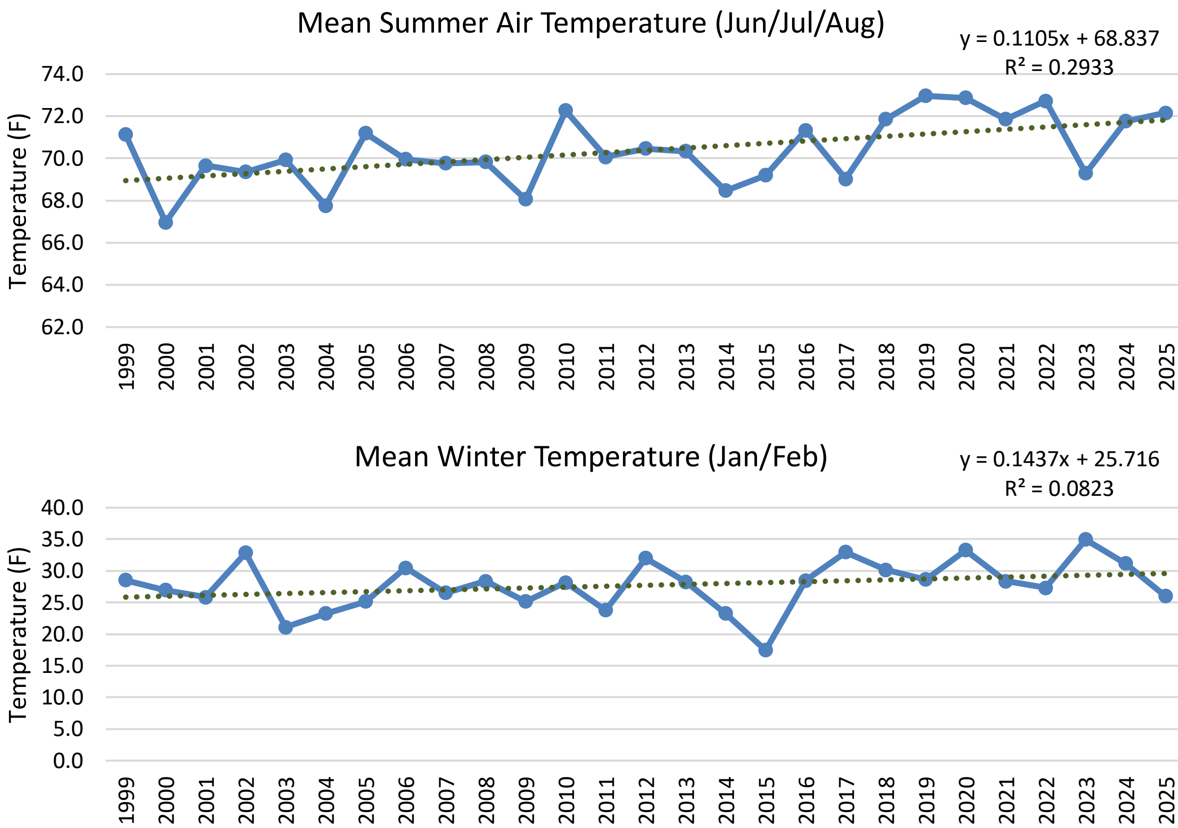


Figure 10. Annual summer and winter air temperature (1999–2025), NWS data, Bedford Hanscom Field, Bedford, MA

Precipitation

Most of 2025 was classified as abnormally dry or moderate drought conditions within the Sudbury-Assabet-Concord (SuAsCo) Watershed, according to the U.S. Drought Monitor (Figure 11). Precipitation influences water quality conditions throughout the watershed. OARS data show how precipitation, and the associated increase in stormwater runoff and streamflow tend correlate positively with concentrations of total suspended solids and total phosphorus and negatively with nitrate. Samples collected during rising streamflow conditions may capture the "first flush" runoff effect, when accumulated pollutants are rapidly washed into streams during a storm event. Reduced streamflow can contribute to elevated contaminant concentrations because there is less dilution from precipitation and runoff inputs.

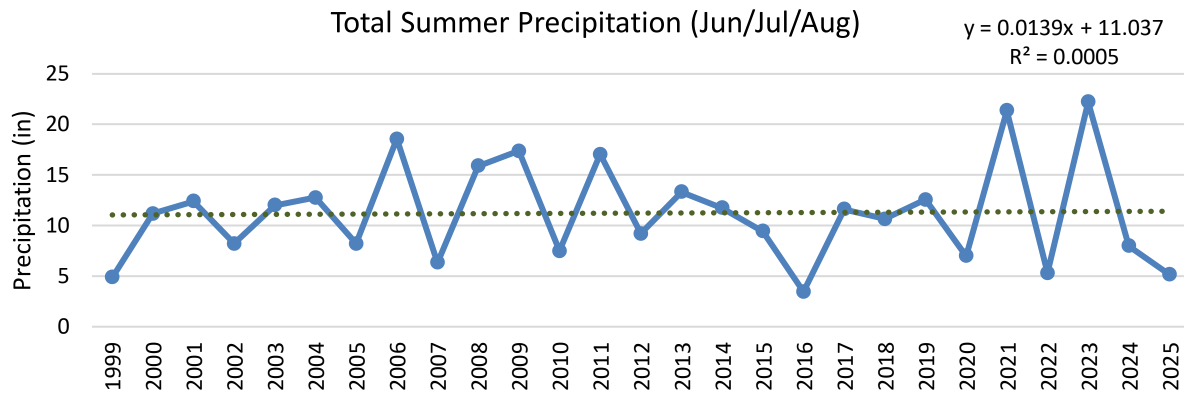


Figure 12: Annual summer precipitation (1999–2025), NWS data, Bedford Hanscom Field, Bedford, MA

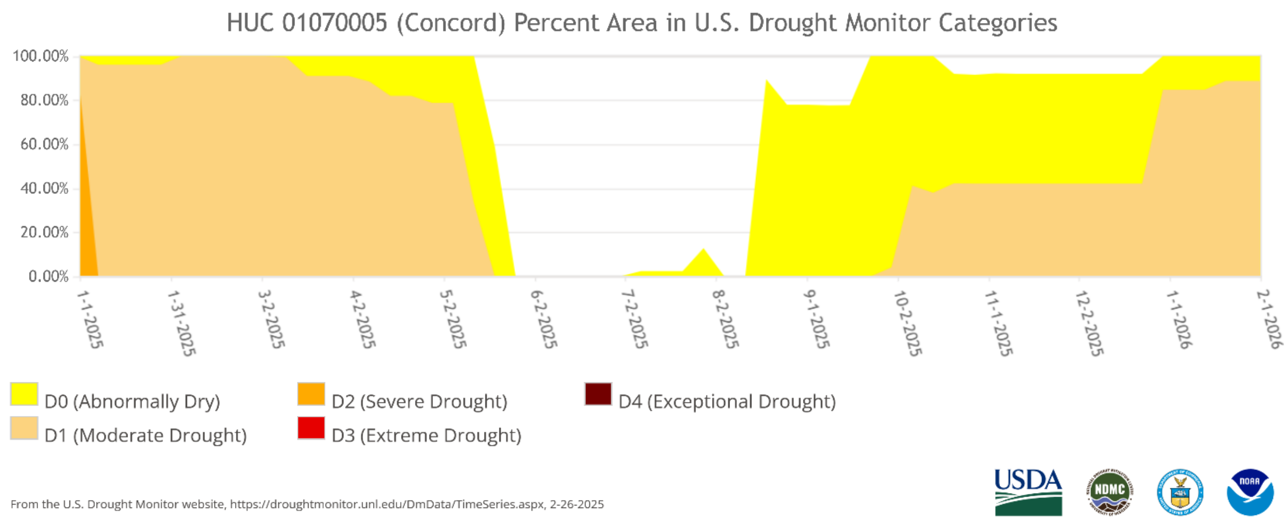


Figure 11. U.S. Drought Monitor status 2025 for Concord watershed

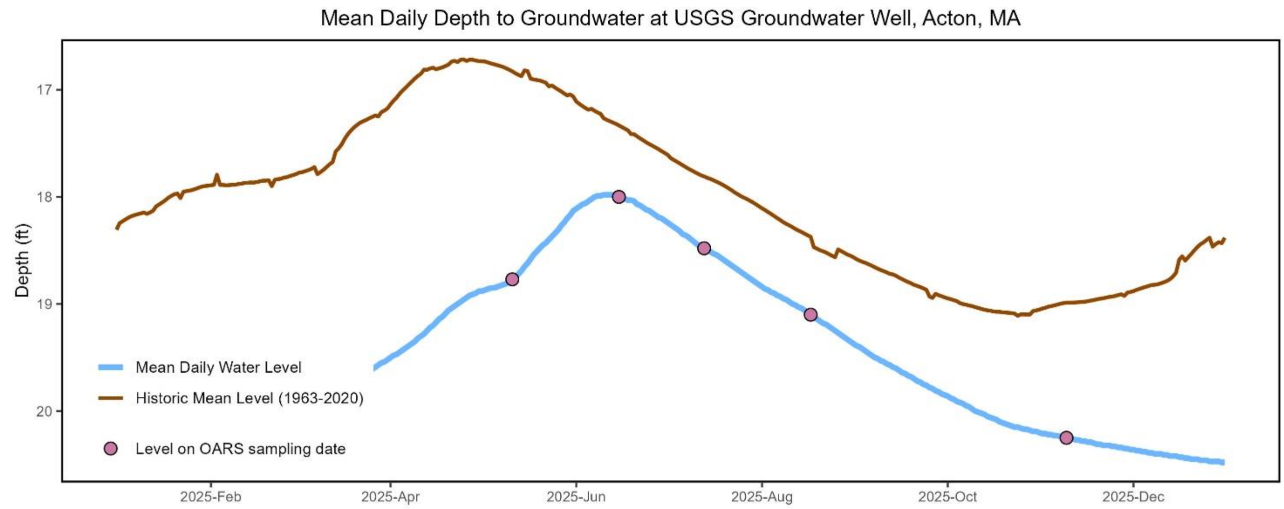


Figure 13. Mean daily groundwater depth at USGS groundwater well in Acton

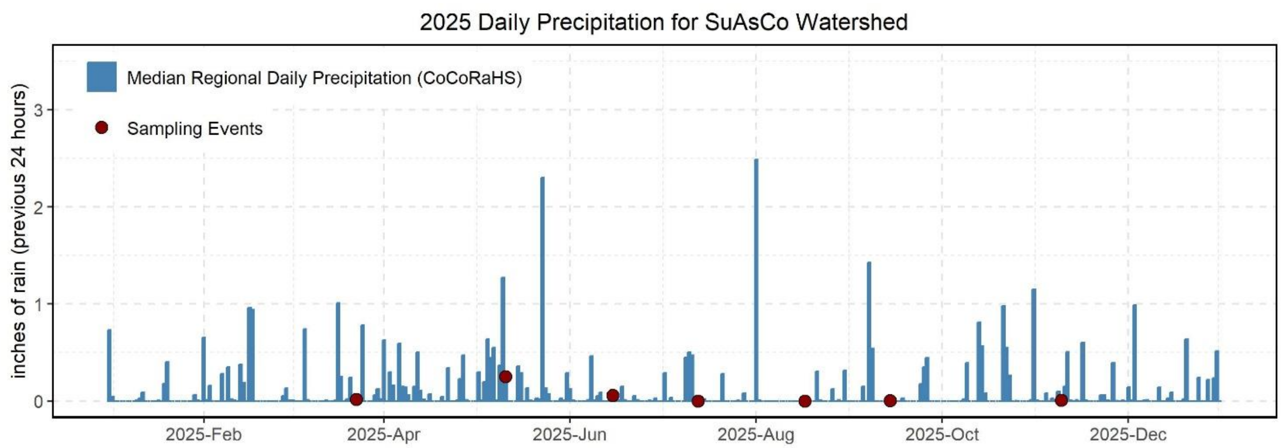


Figure 14. Daily rainfall[3] with sampling dates

[3] Daily rainfall sourced from CoCoRaHS, for box bounded by 42.22852/-71.70227 and 42.51766/-71.31912. **cocorahs.org/ViewData/**

Streamflow

The 2025 mean summer streamflow was below average, compared to data since 1980 (Figure 14). Mean daily streamflow for 2025 at the Assabet, Sudbury, and Concord river gage was much lower than the historic mean streamflow for the period of record (Figure 15.) Note that flow at the Sudbury River gage in Saxonville/Framingham is affected by reservoir dam releases and manipulations. The Sudbury River water chemistry is impacted by water supplied from the Massachusetts Water Resource Authority. The Mass. Department of Conservation and Recreation's Division of Water Supply Protection owns or has control of activity on 15% of the Sudbury watershed as a water supply reserve (Massachusetts Department of Conservation and Recreation, n.d.).

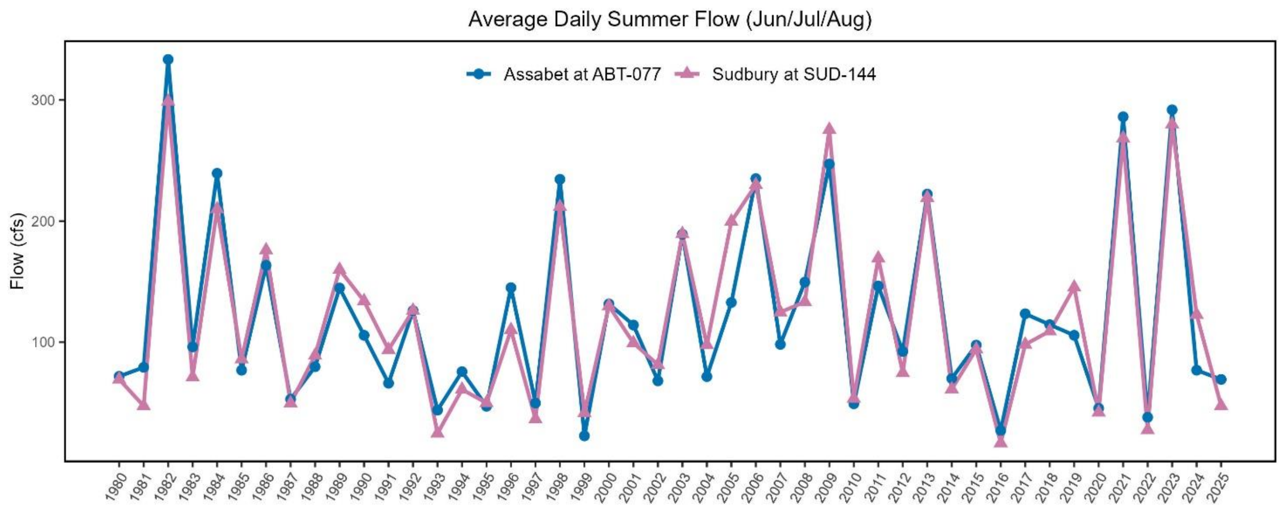


Figure 15 Average summer streamflow (June/July/August) 1980-2025.

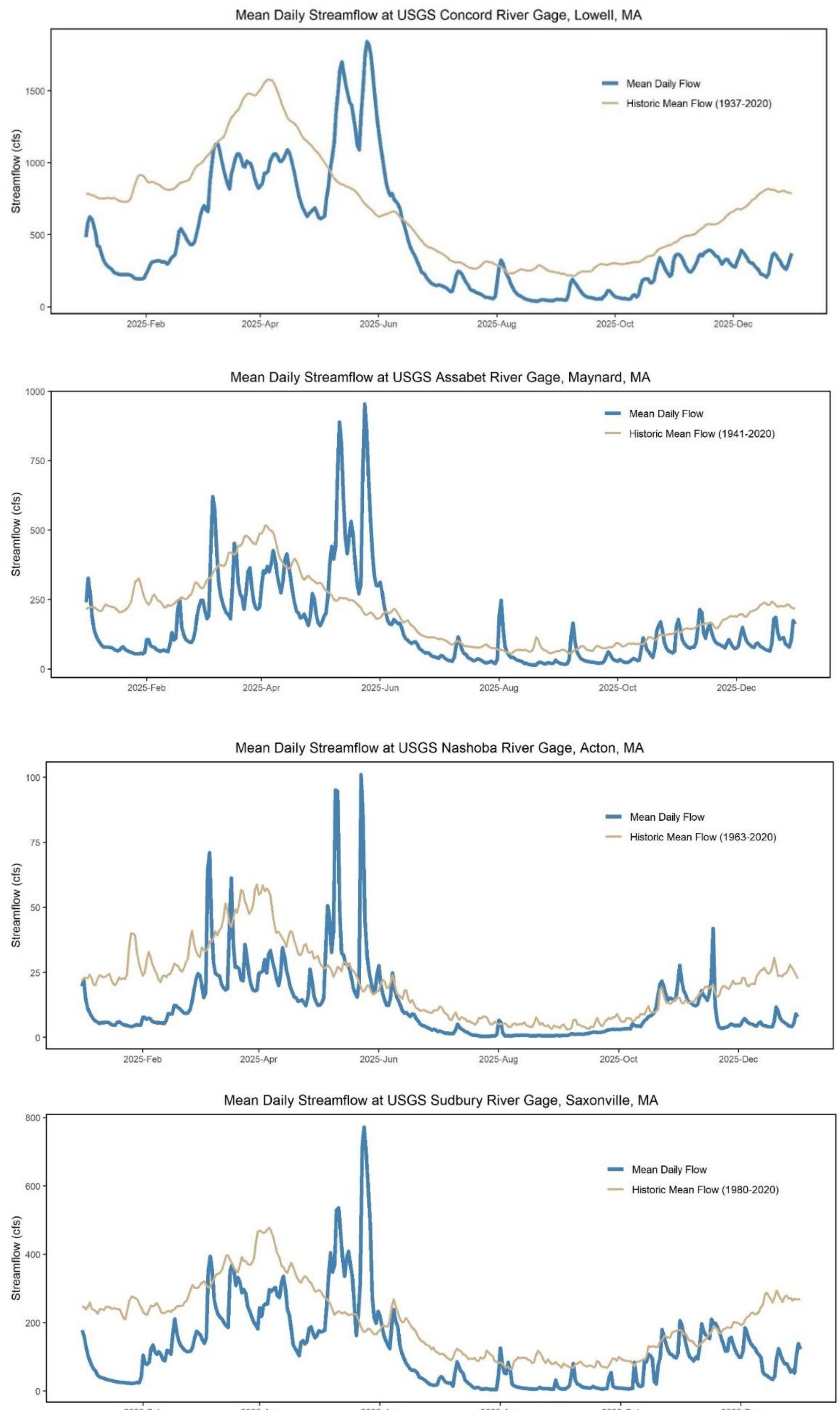


Figure 16. Mean Daily Streamflow by river for the Concord, Assabet and Sudbury Rivers and Nashoba Brook (2025)

Groundwater

2025 Groundwater levels in Acton were extremely low compared to historic levels, according to data from the USGS monitoring well in Acton[4] (Figure 16). Groundwater levels are influenced by both precipitation and evapotranspiration and in turn play a critical role in sustaining baseflow to streams during dry periods. In particular, the maximum annual groundwater level was significantly lower than in recent years, indicating that groundwater recharge was limited and failed to recover to typical seasonal highs.

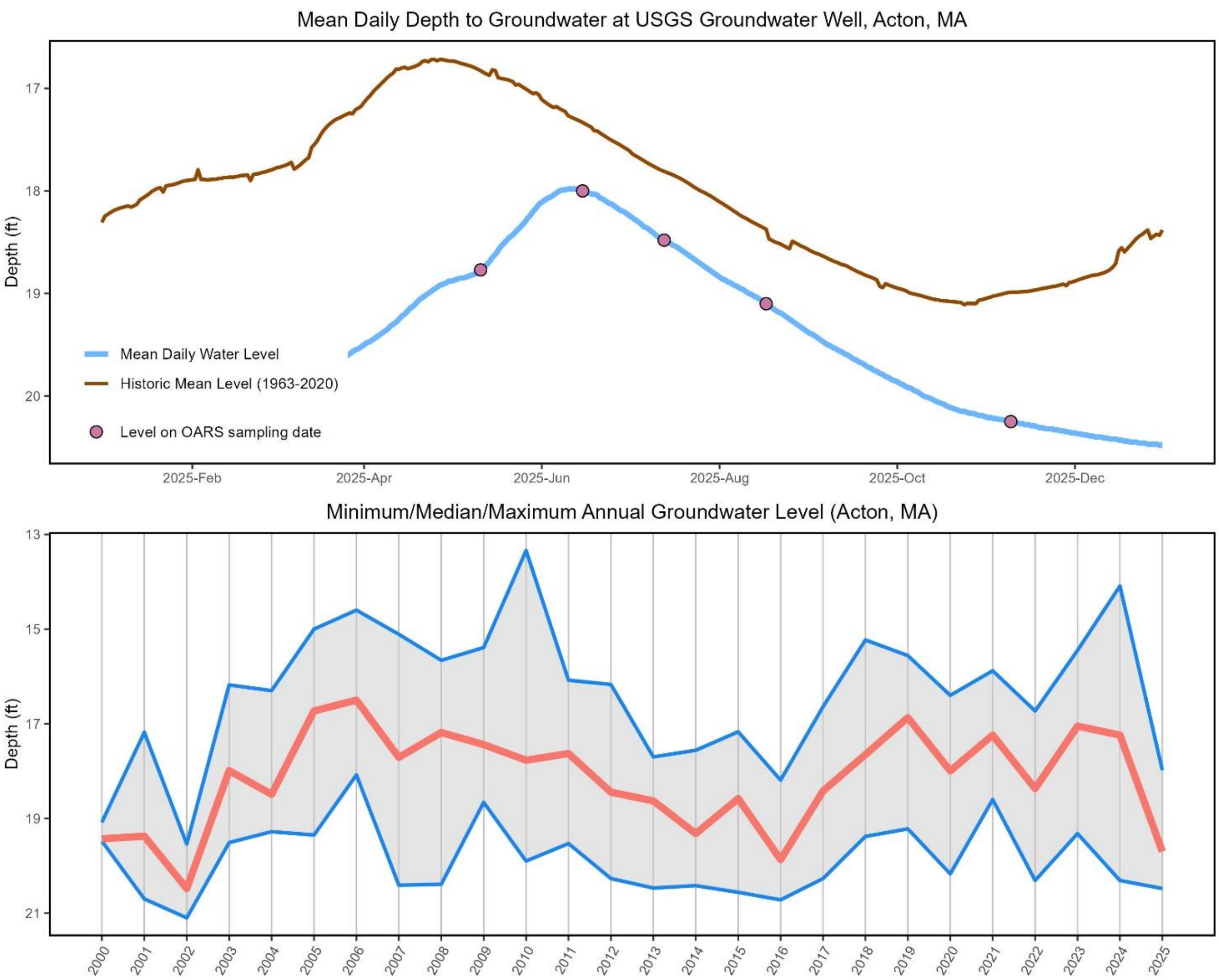


Figure 17: Groundwater Levels at the USGS Monitoring Well in Acton, MA

[4] USGS 422812071244401 MA-ACW 158 ACTON, MA, **waterdata.usgs.gov/monitoring-location/422812071244401**

Wastewater Treatment Plant Discharge

Eight wastewater treatment plants discharge significant volumes of water into the Sudbury, Assabet and Concord rivers (Figure 17). Many of the plants discharge into the upstream, most vulnerable sections of the rivers. The largest plant, Westborough, discharges to the headwaters of the Assabet River. The third largest plant, Marlborough Easterly, discharges to the headwaters of Hop Brook. Note that wastewater treatment plant discharge correlates with precipitation and groundwater levels.

During low flow times, the discharge of these treatment plants represents a significant portion of the total flow of the rivers, especially for the Assabet River. Streamflow measured at the Assabet River gage in Maynard includes effluent discharges from three of the four major municipal wastewater treatment plants on the river (Hudson, Marlborough Westerly, and Westborough). In 2025, seven of the eight wastewater treatment plants in the watershed were at or extremely close to compliance with their National Pollution Discharge Elimination (NPDES) permit. In 2024 and 2025, the Hudson Wastewater Treatment Facility failed to meet National Pollution Discharge Permit requirements for parameters including chlorine, pH, dissolved oxygen, biochemical oxygen demand, phosphorus, temperature, and *E. coli* discharges into the Assabet River, according to EPA ECHO data (Figure 18).

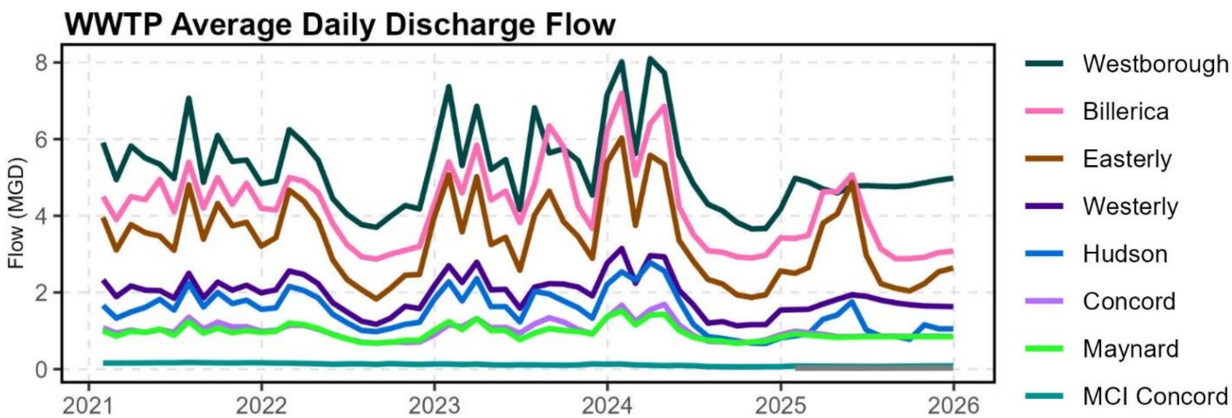


Figure 18: Wastewater Treatment Plant Discharge Flow is released from eight wastewater treatment plants into rivers after treatment, graphed in millions of gallons per day (Jan 2020–Dec 2025).

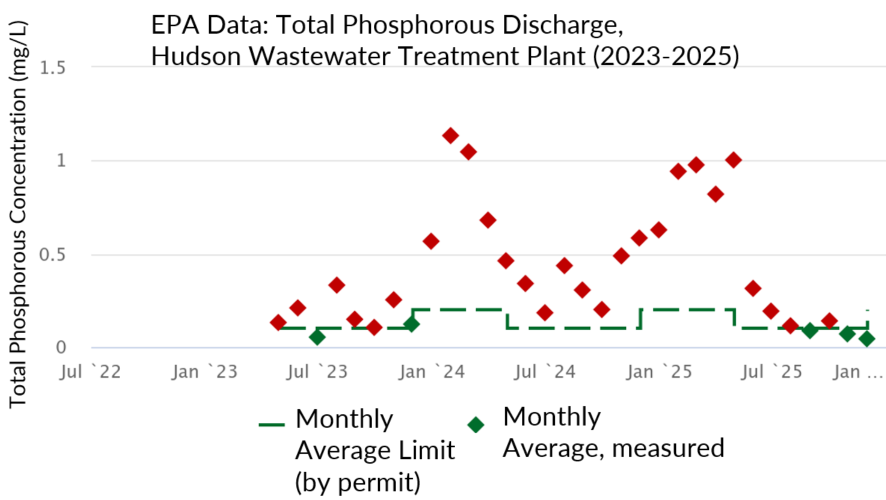
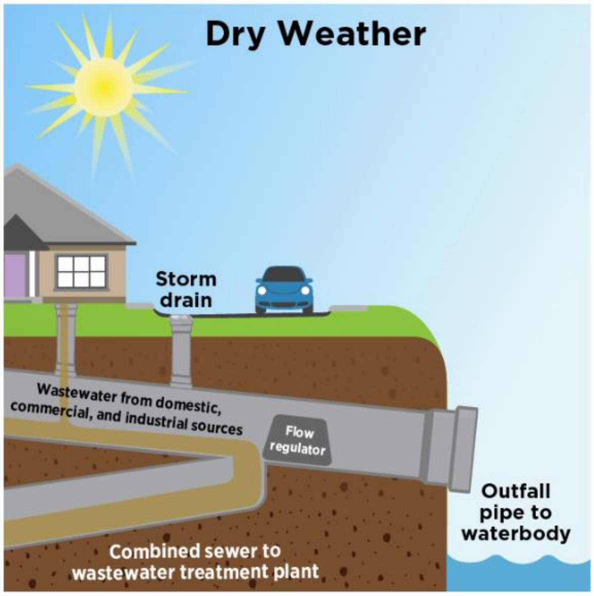


Figure 19 EPA ECHO data show that the Hudson Municipal Wastewater Treatment Plant failed to meet its NPDES permit limit for phosphorus in effluent discharge throughout 2025.

Combined Sewage Overflows



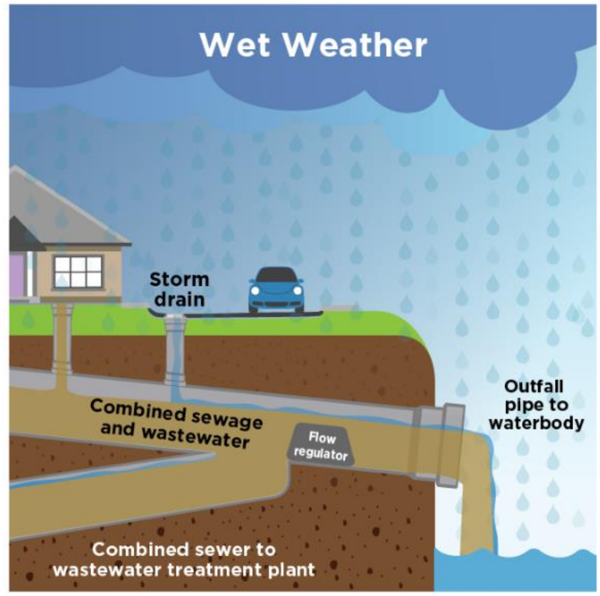


Figure 20 The combined flow of wastewater and stormwater can overwhelm the system when Combined Sewage Overflows (CSOs) occur. Source: US EPA.

Combined sewage overflows occur in combined sewer systems where wastewater and stormwater flow through the same pipes (US EPA, 2025). According to the EPA, “In dry weather, all wastewater flows to a wastewater treatment plant where it is treated before being discharged to a waterbody. But during wet weather, stormwater also enters the system. The combined flow of wastewater and stormwater can overwhelm the system. Permitted outfalls are located throughout the system to act as relief points during wet weather. These outfalls discharge untreated or partially treated stormwater and wastewater into nearby waterbodies. These discharges are called CSOs” (US Environmental Protection Agency, 2025).

Combined sewage overflows are found at the Warren Station in the Concord watershed in the City of Lowell (Figure 20). Four combined sewage overflows were recorded at this station in 2025. On December 29th, approximately half a million gallons of combined sewage overflows entered the Concord River at the Warren Station during a rain event of less than one inch (Figure 21). Combined sewage overflows at this station are located in neighborhoods classified as Massachusetts Environmental Justice Populations due to their high percentages of residents who are members of racial minority groups (Massachusetts Executive Office of Energy and Environmental Affairs, 2021). Combined sewage overflows are permitted (NPDES Permit MA0100633), and these facilities received $200,000 in fines for permit violations in 2019, according to the US EPA ECHO website (US Environmental Protection Agency, 2025).

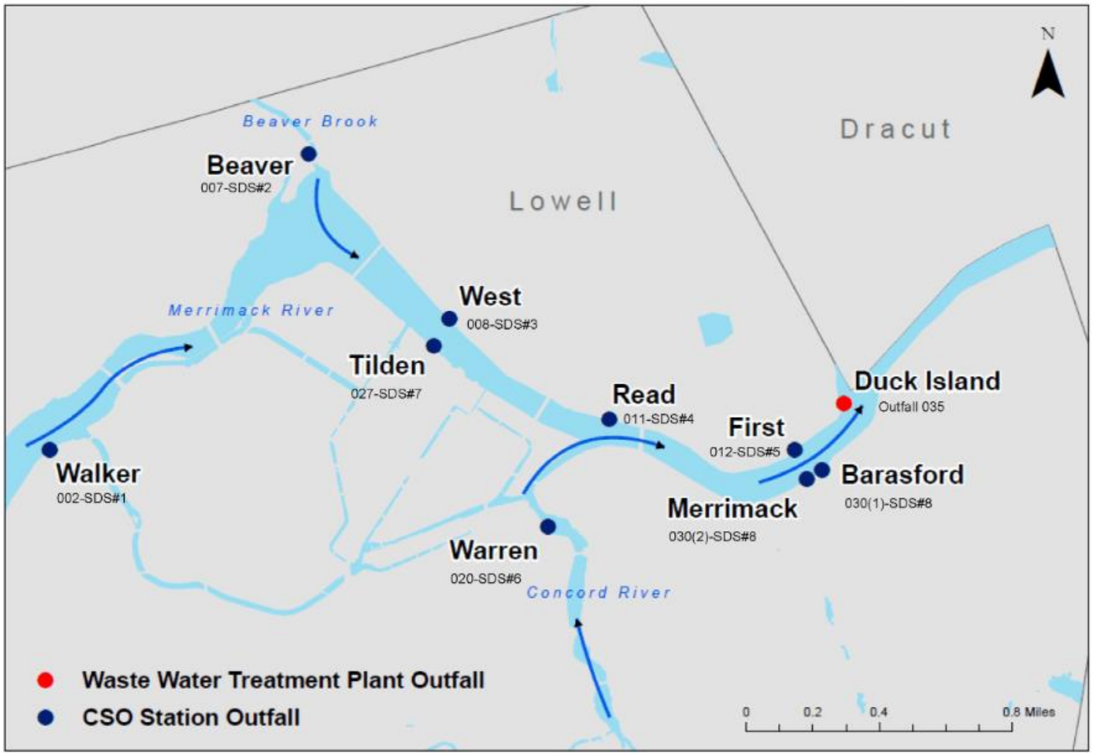


Figure 21 Combined Sewage Overflows (CSOs) occur within the Concord Watershed at Warren Station, one of the nine combined sewage overflow sites in the area around downtown Lowell, MA. Figure source: lowellma.gov

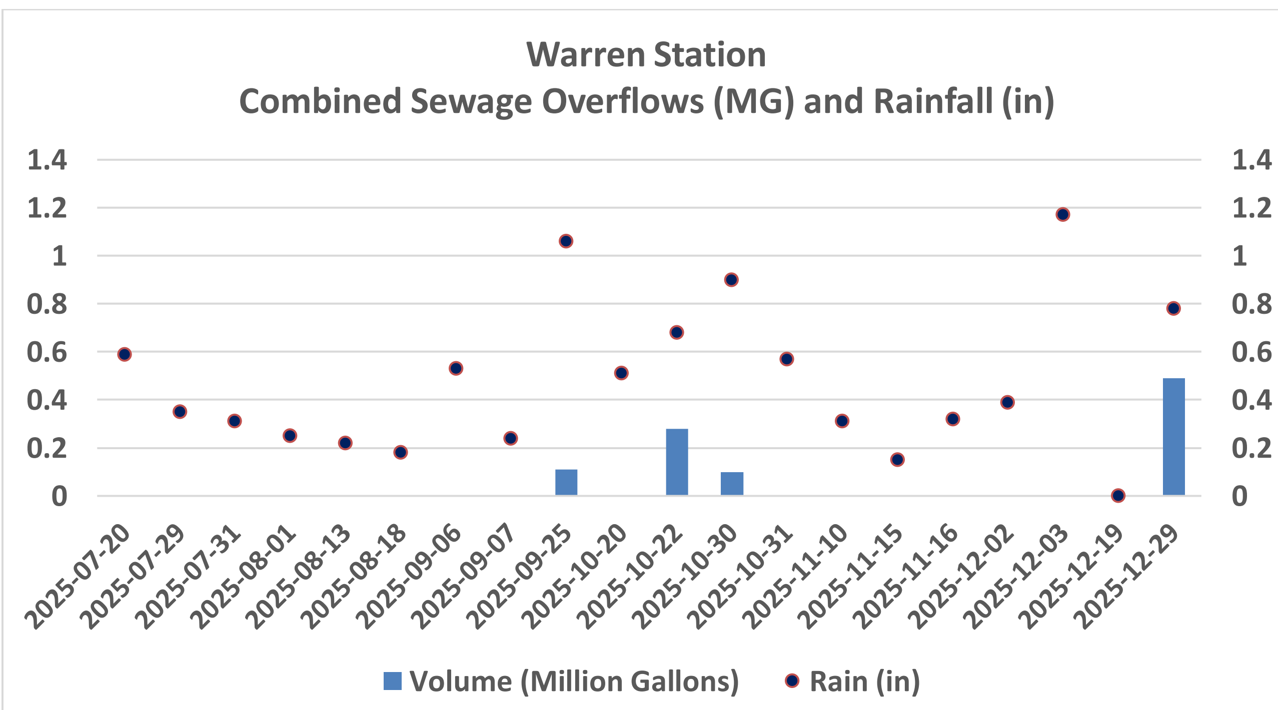


Figure 22 Four combined sewage overflows were recorded at the Warren Station site in Lowell, MA in 2025, recorded in millions of gallons of discharge during rain events (inches). Data source: lowellma.gov.

OARS Water Quality Data

OARS water quality data are intended to provide reliable information for municipalities, all interested stakeholders and community members, and the Commonwealth of Massachusetts. OARS releases a River Report Card once every five years with additional information about long-term trends[5].

Full data are available in an Excel Spreadsheet on OARS website and can be filtered to individual sites or years on request by email to OARS Water Quality Program Manager. Mainstem statistics for all water quality parameters are provided in tabular form in Appendix I.

How to Read Water Quality Results

Site numbers: Each site is assigned a three-letter prefix for the waterbody name plus three numbers designating river miles (to one decimal) above its confluence with the next stream. Water generally flows from high-numbered to low-numbered sites. Example: CND-009 is located the Concord River, 0.9 km from the confluence with the Merrimack. A drop of water at CND-093 flows 8.2 km downstream before it reaches CND-009.

Load: Load is the total mass of a nutrient or pollutant that is carried downstream per day. Our load calculations are based on a combination of measured flow at sites with gages and distance-based flow estimates at the sites without gages.

Boxplots: Many of the graphs are boxplot-type graphs. In a boxplot graph, the box represents the middle 50% of the data (1st quartile to 3rd quartile, or 25th to 75th percentile), the line in the middle of the box is the median, the lower whisker represents the bottom 25% of the data, and the upper whisker represents the upper 25% of the data. Outliers are any points above or below the box by more than 1.5 times the interquartile range. The interquartile range is defined as the range between the 1st quartile and the 3rd quartile (bottom to top of the box).

[5] **ecoreportcard.org**

Water Temperature

***Importance of water temperature**: Many native species, such as Eastern Brook Trout, survive in a specific range of water temperatures.*

***Threats to water temperature**: Air temperatures in the entire watershed have risen along with global temperature increases over the past decades. Periods of drought that decrease water quantity can result in warmer water temperatures. Some wastewater treatment plants and other permitted facilities release warmed water into rivers. Dams slow the flow of water, creating impoundments with elevated water temperatures.*

2025 data:

Water temperatures at all sites met the Class B warm water fisheries standard (<28.3°C) on all testing dates in 2025 (Figure 23 and Figure 24). The cold-water standard is the recommended maximum for brook trout, and for brown trout the maximum is 23.9°C. All tributaries exceeded the cold-water fisheries standard in July. Danforth Brook, Hop Brook and Hog Brook are classified as cold water fisheries (Mass Fish and Wildlife, 2025). However, the Hog Brook and both of the two Hop Brook sites show median summer temperatures above the cold-water fisheries standard. The upstream Danforth Brook monitoring site (DAN-013) has a median summer temperature below the cold-water fisheries standard, but as the water flows downstream, less than one kilometer away the median summer temperature at DAN-005 has risen above the cold-water fisheries standard.

Long-term trends:

OARS has monitored water temperature with multi-parameter sondes from 1997 to 2025. River temperatures tend to increase as water moves downstream, especially for the Assabet and Sudbury Rivers. The Concord River summer water temperature has been mostly increasing since 2004 (Figure 23). Along the Lower Assabet River, maximum detected water temperatures have been increasing from 1997 to 2025 (Figure 24). The uppermost site in the Assabet (ABT-312) also shows an upward trend in temperatures for the period of record (Figure 24). The lower Nashoba and upper Assabet sites are both located downstream of large impoundments, which have a warming effect.

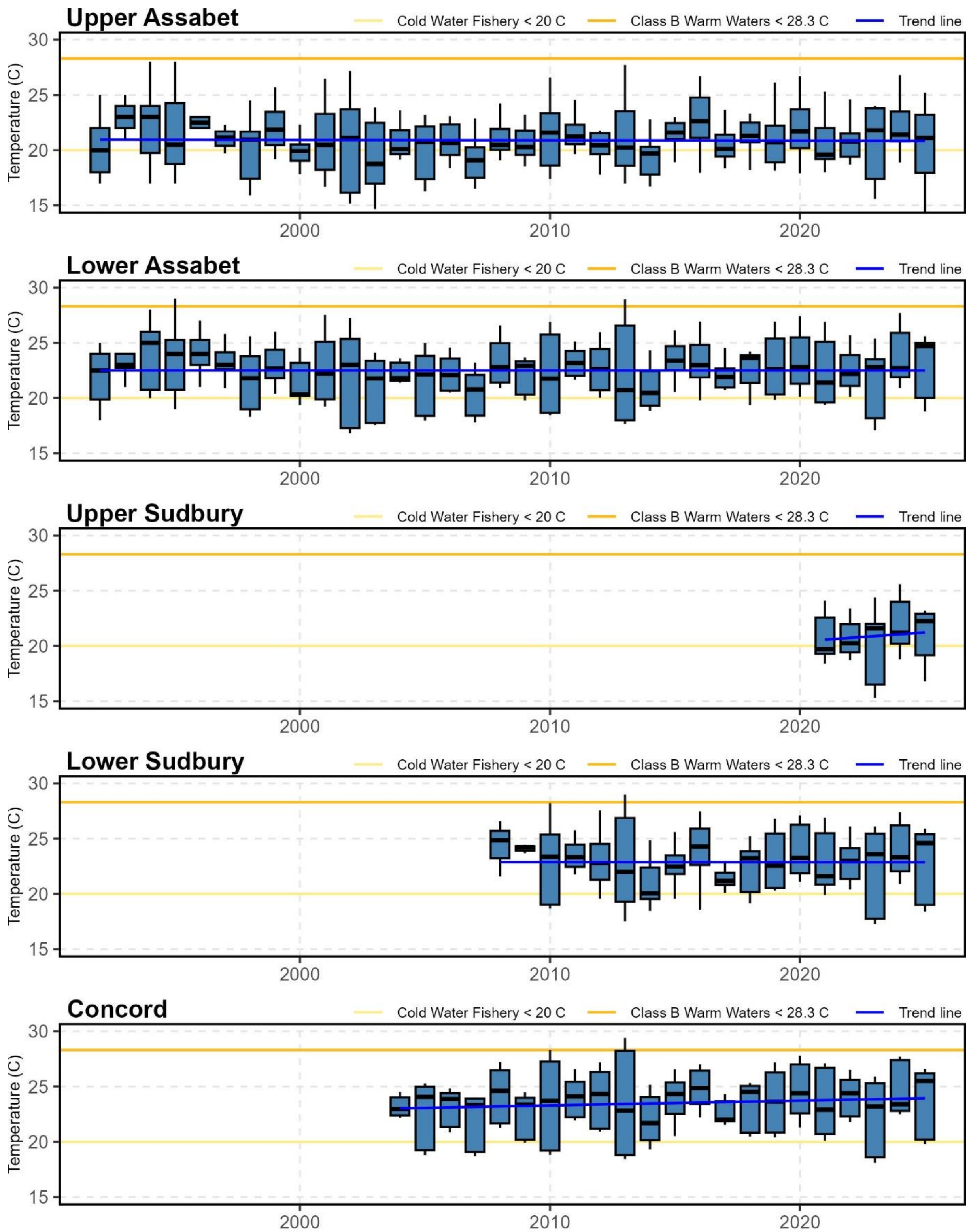


Figure 23 Water temperatures for the Assabet, Sudbury and Concord Rivers (1992-2025)

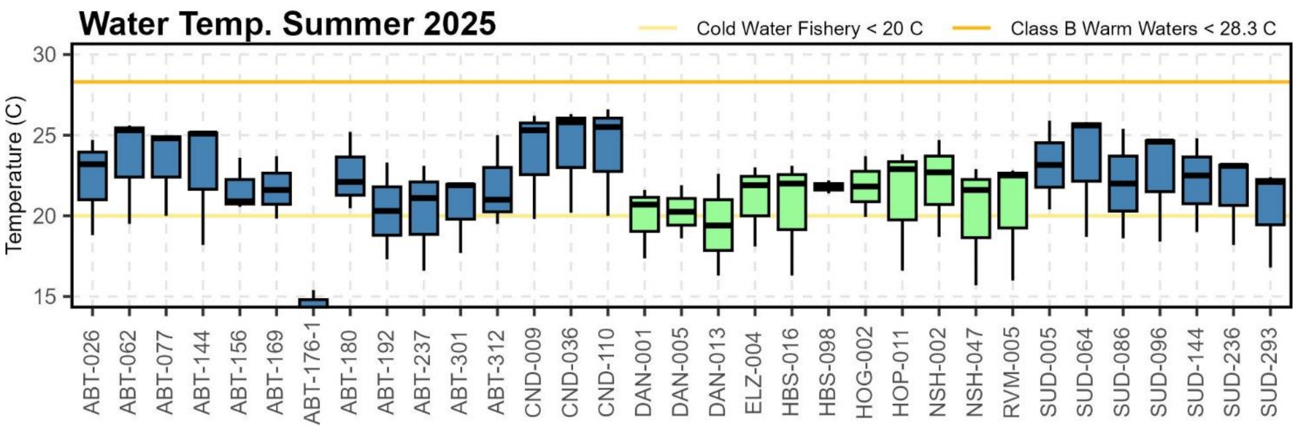


Figure 24: Water temperature by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

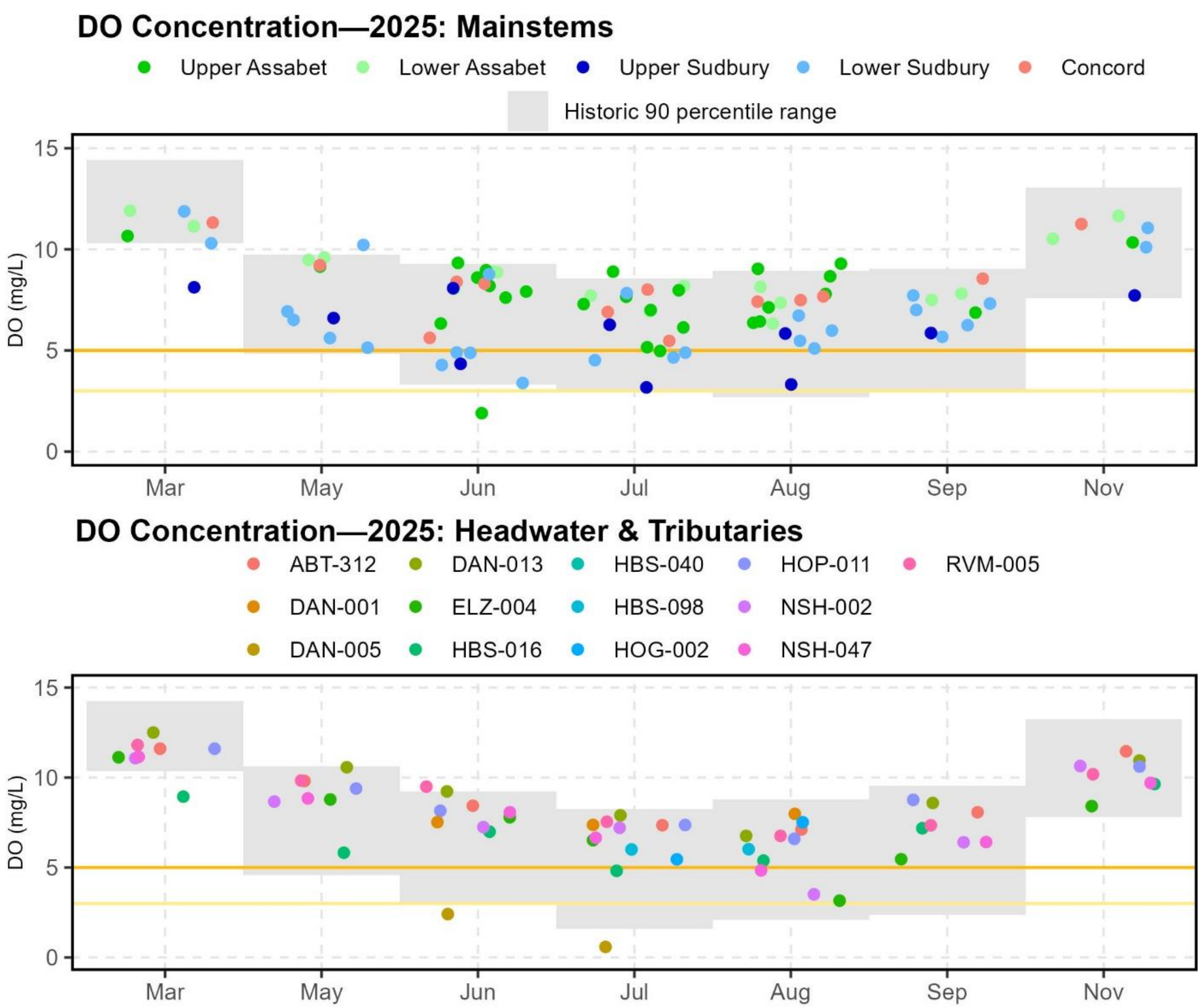


Figure 25: Water temperature by month and site (2025)

Conductance & Chloride

***Importance of specific conductance and chloride**: specific conductance is a measure of a solution's ability to conduct electricity. Specific conductance is used as a proxy for chloride because they have a linear relationship. Conductance is an indirect indicator of pollutants, especially road salt. Fish and macroinvertebrates can only tolerate certain levels of chloride.*

***Threats to specific conductance and chloride:** The main contributor to specific conductance in the watershed is salt applied to roads during icy winter conditions. Road salt, wastewater, landfill leachate, fertilizers, and erosion can all contribute to specific conductance changes.*

Why monitor specific conductance & chloride:

Road salt is the dominant source of dissolved ions in the region's fresh water, and chloride is an indicator of road salt pollution. OARS started sampling for chloride in 2018 to measure the effect of road salt application on the rivers. In the New England region, chloride highly correlates with conductance in a linear relationship (Heath, 2011; MassDEP, 2018). This strong correlation allows us to confidently make conclusions about chloride based on easily collected conductance measurements. Hence, OARS' sampling program measures conductance at all sites. OARS analyzes for chloride at a site downstream of the Westborough Wastewater Treatment Plant to monitor high conductance there because the Massachusetts Department of Environmental Protection requires chloride data to classify water quality downstream of wastewater treatment plants as impaired.

Long-term trends:

Summer conductance graphs show a clear upward trend in conductance/chloride for all river sections on a decadal scale (Figure 26). The increasing conductance trend has been quantified throughout New England and attributed to road-salt application and its accumulation in groundwater and soils (Daley, 2009; Zuidema, 2018; Evans, 2018). Long-term data show a trend of high conductance in dry years (low dilution) and low conductance in wet years (high dilution). 2025 was a very dry year with high conductance (Figure 25). The Sudbury, Assabet and Concord Rivers' specific conductance rose above 500 µS/cm in 2025. Monthly analysis usually shows conductance increasing later in the summer as flows decrease and salts become more concentrated (OARS Water Quality report, 2024). Temperature also affects specific conductance, as the warmer waters have higher specific conductance.

2025 data:

Conductance levels in 2025 were relatively high. Hot spots below wastewater treatment plants and major roads were elevated and clearly distinct from the other sites. River Meadow Brook (RVM-005) in Chelmsford, for example, receives run-off with significant road salt from I-495 and highway interchanges that has caused elevated specific conductance levels (Figure 20). Hop Brook (HOP-011) conductance levels are also impacted by major highways. Our conductance and chloride data also show that the Westborough Wastewater Treatment Plant is a major source of chloride in the Assabet River. In Hudson, specific conductance was high at all sites.

Chloride increases pose a threat to the ecological health of all our waterways. The estimated chloride for many of these sites is approaching or exceeding the EPA continuous criterion. The EPA has established a Continuous Concentration Criterion for chloride of 230 mg/L and a short-term Maximum Concentration Criterion of 860 mg/L (EPA, 2002). The EPA's criteria were based on fish tolerances, but recent research has indicated that macroinvertebrate tolerances may be much lower (Moody, 2024). Healthy streams supporting good mixed fisheries have a conductance range between 150 and 500 µS/cm (Ellis, 1944). Most OARS sites along the mainstem Sudbury, Assabet and Concord rivers have been above the healthy range for specific conductance/chloride in recent years.

Conductance hot spots can be highly localized. Our monitoring usually highlights high conductance levels downstream of the wastewater treatment plants (ABT-301, ABT-237, ABT-144, HBS-098) and downstream of highways (RVM-005, HOP-011). Two of the headwater and tributary sites (ABT-312 and DAN-013) are consistently within the mixed fishery range. The headwaters site ABT-312 (Mill Street, Westborough) is upstream of the first wastewater treatment plant discharge. OARS has conducted surveys of other tributaries and shown that conductance levels can increase from 400 to 1400 µS/cm in short distances of the same brook, driven by road and parking-lot runoff.

Conductance is not as elevated along the Sudbury River, compared with the Assabet and Concord Rivers, likely due to dilution from external water sources. Within the Sudbury-Assabet-Concord watershed, the Massachusetts Water Resources Authority (MWRA) supplies water to the towns of Northborough, Marlborough, Southborough, Framingham, and Ashland (Massachusetts Water Resources Authority, 2026). The local environmental organization Green Acton provides additional analysis of road salt in Nashoba Brook on their website (Kastens et al., 2024).

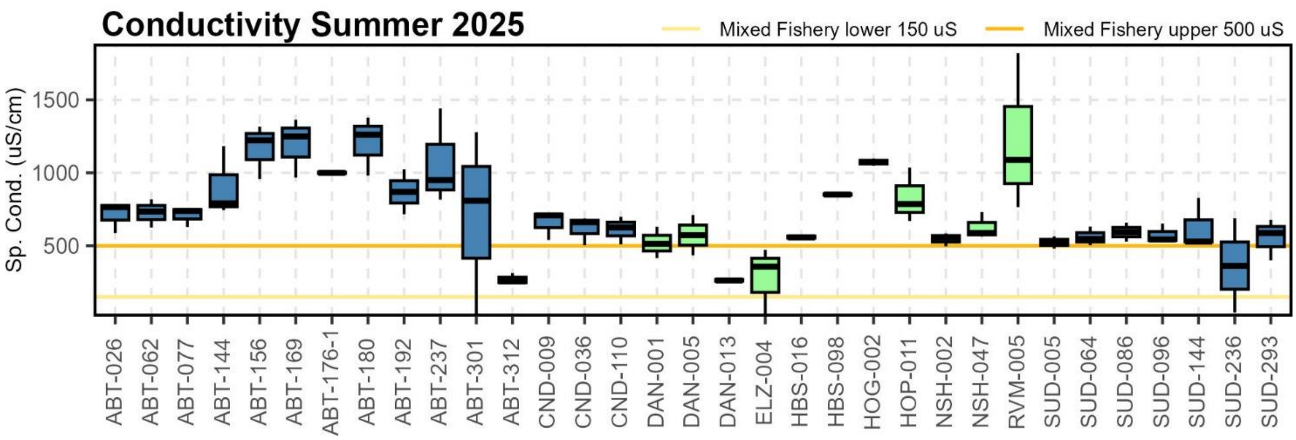


Figure 26: Specific conductance by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

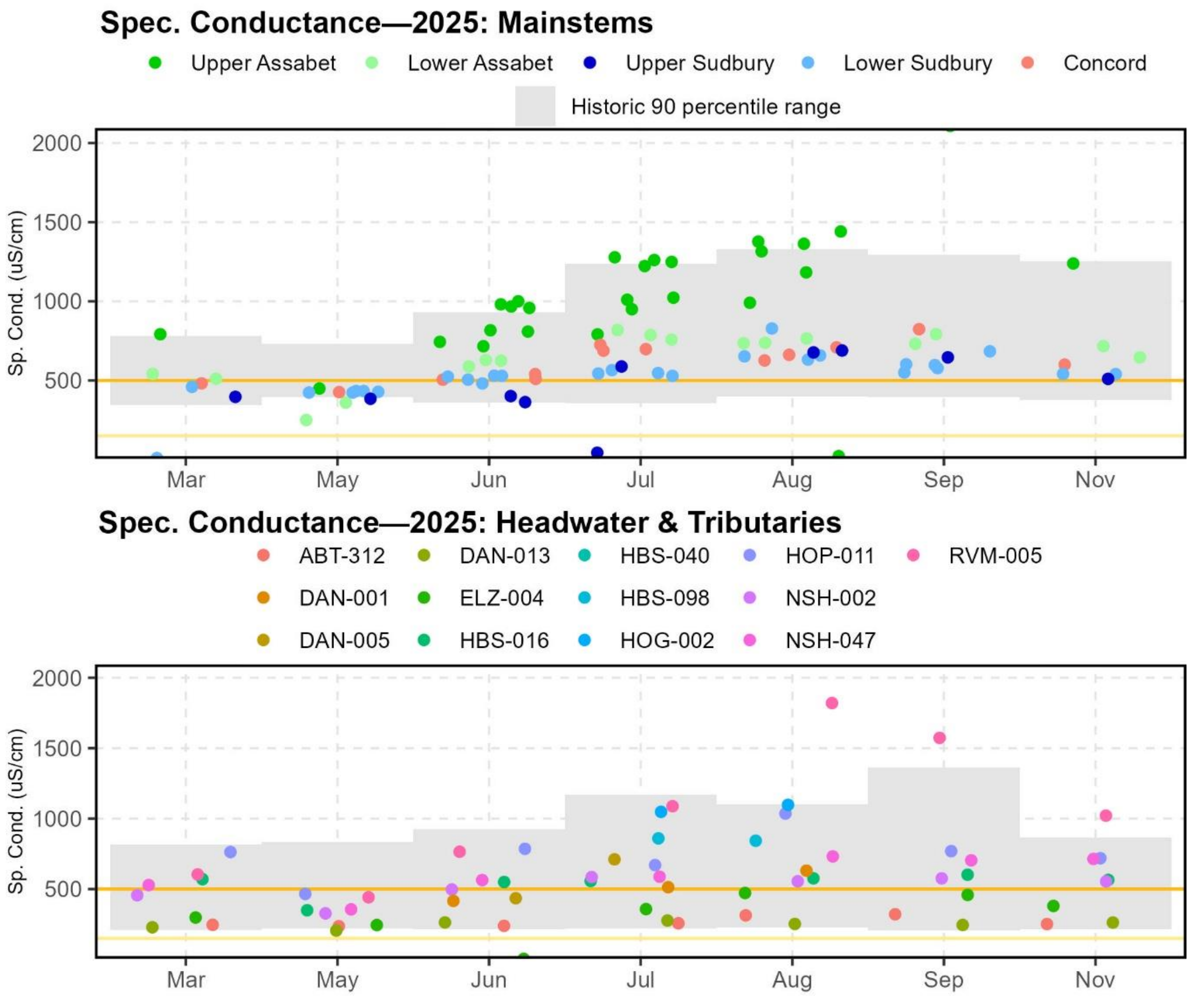


Figure 27 Specific Conductance Data by month and site, 2025

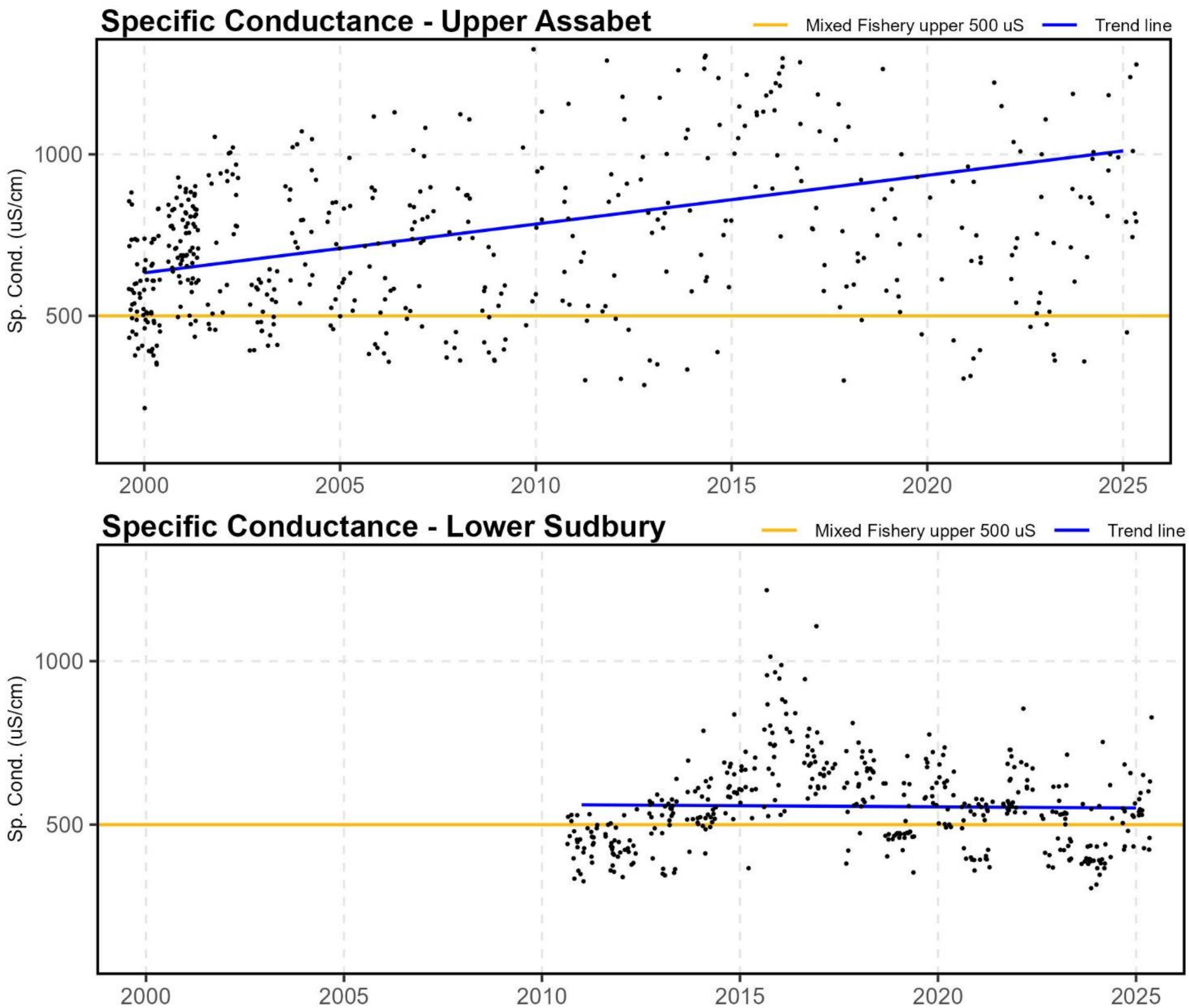


Figure 28 Specific conductance data, Upper Assabet and Lower Sudbury River 2000-2025

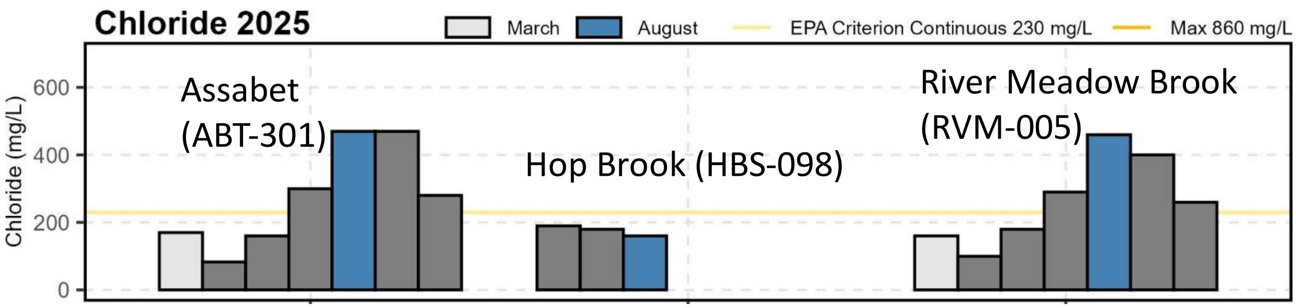


Figure 29. Chloride was monitored at three sites in the watershed: Assabet River (ABT-301), Hop Brook (HBS-098), River Meadow Brook (RVM-005).

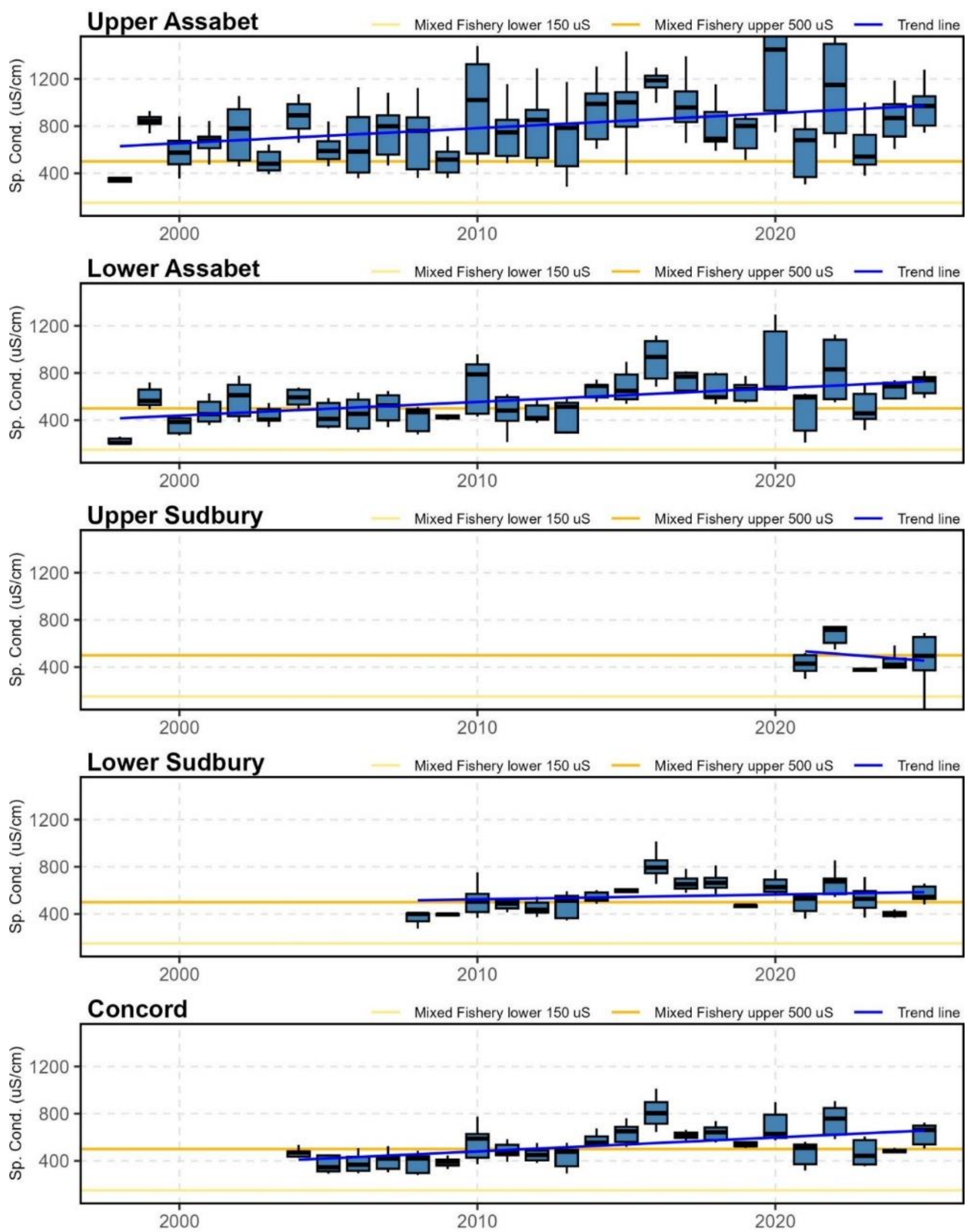


Figure 30 Specific conductance by year and section (June/July/August) (1998-2025)

Dissolved Oxygen

Importance of dissolved oxygen: Dissolved oxygen (DO) measures how much oxygen is dissolved in the water. Aquatic organisms, such as fish and zooplankton, require minimum levels of oxygen to live.

Threats to dissolved oxygen: Droughts threaten dissolved oxygen levels because slow-moving water tends to contain less dissolved oxygen compared to rapidly moving water. Rooted aquatic plants and algae produce oxygen as a product of photosynthesis. Eutrophication (warm water with excessive plant growth) can result in very low dissolved oxygen, causing fish kills. Dissolved oxygen also changes seasonally with temperature, as cold water can hold more oxygen. Thus, warming temperatures globally also threaten dissolved oxygen levels.

Long-term trends:

Increasing dissolved oxygen levels in the Assabet indicate an improved environment for local fish and wildlife over the past 40 years. Dissolved oxygen levels in the Assabet River have increased (improved) significantly over OARS' data record (Figure 32). This is evident from 1999 to 2000, when all four wastewater plants implemented improved water treatment procedures (Figure 26).

In the Lower Sudbury River, we have been watching a concerning dissolved oxygen downward trend in dissolved oxygen levels, but levels have rebounded in recent years, such as 2022 and 2024. It is possible that the preceding high flood years washed out accumulated organic detritus, thus reducing biological oxygen demand in the following years. The Lower Sudbury is surrounded by large wetland areas, which naturally have low dissolved oxygen levels due to still water and high respiration. Elizabeth Brook and the Sudbury headwaters have chronic low dissolved oxygen and pH levels downstream of large wetlands.

2025 data:

Low minimum dissolved oxygen concentrations and large diurnal variations in dissolved oxygen can indicate eutrophic conditions and violate water quality standards for dissolved oxygen. In our rivers, dissolved oxygen remains consistently above the minimum water quality standards at the Assabet and Concord river sites. Dissolved oxygen at the Lower Sudbury sites tends to hover near or below the Class B standard (>5.0 mg/L) (Figure 30 and Figure 31). The Lower Sudbury is also surrounded by large wetland areas, and wetlands naturally have low dissolved oxygen levels due to still water and high respiration. Even though the Lower Sudbury sites were close to this threshold, dissolved oxygen at these sites was significantly higher than in 2023. We have seen a pattern of very low dissolved oxygen during high flow years when the marshlands are flooded, and 2023 fit this pattern. The Massachusetts Water Resources Authority influences the Sudbury River through providing water to multiple towns and also controlling reservoirs, which influences water quality in general.

The Hop Brook site (HBS-016) showed significantly improved dissolved oxygen levels in 2025. During previous years, this site consistently had the lowest dissolved oxygen levels due to the combination of wetlands and high nutrient loads coming from upstream. The Hop Brook site (HBS-016) continues to show a distinct improvement in dissolved oxygen since 2015, the same year upgrades were completed at the upstream Marlborough Easterly Wastewater Treatment Plant. From 2024 to 2025, HBS-016 improved from below the Class B Aquatic Life standard (>3 mg/L) to above the Class B Water Quality Standard (>5 mg/L).

Low dissolved oxygen levels tend to coincide with low pH in eutrophic conditions. This was especially evident in the Sudbury headwaters (SUD-293).

The low dissolved oxygen levels in September and November in Danforth Brook (DAN-013) are typical for very low flows at that site. The Nashoba Brook site (NSH-002) shows a gradual decline in dissolved oxygen. This site is dissolved oxygen downstream of Warner's Pond in Concord, created in 1857 by a dam on Nashoba Brook. The pond is now in a critical state with excessive aquatic biomass. The Town of Concord, which owns the dam, is evaluating measures to reduce the biomass and improve water quality.

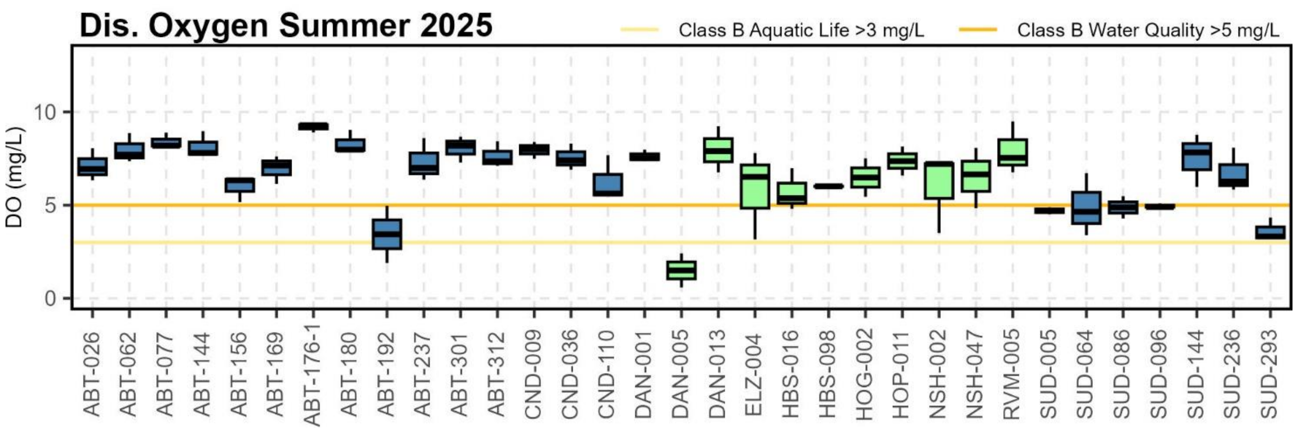


Figure 31: Dissolved oxygen concentration by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

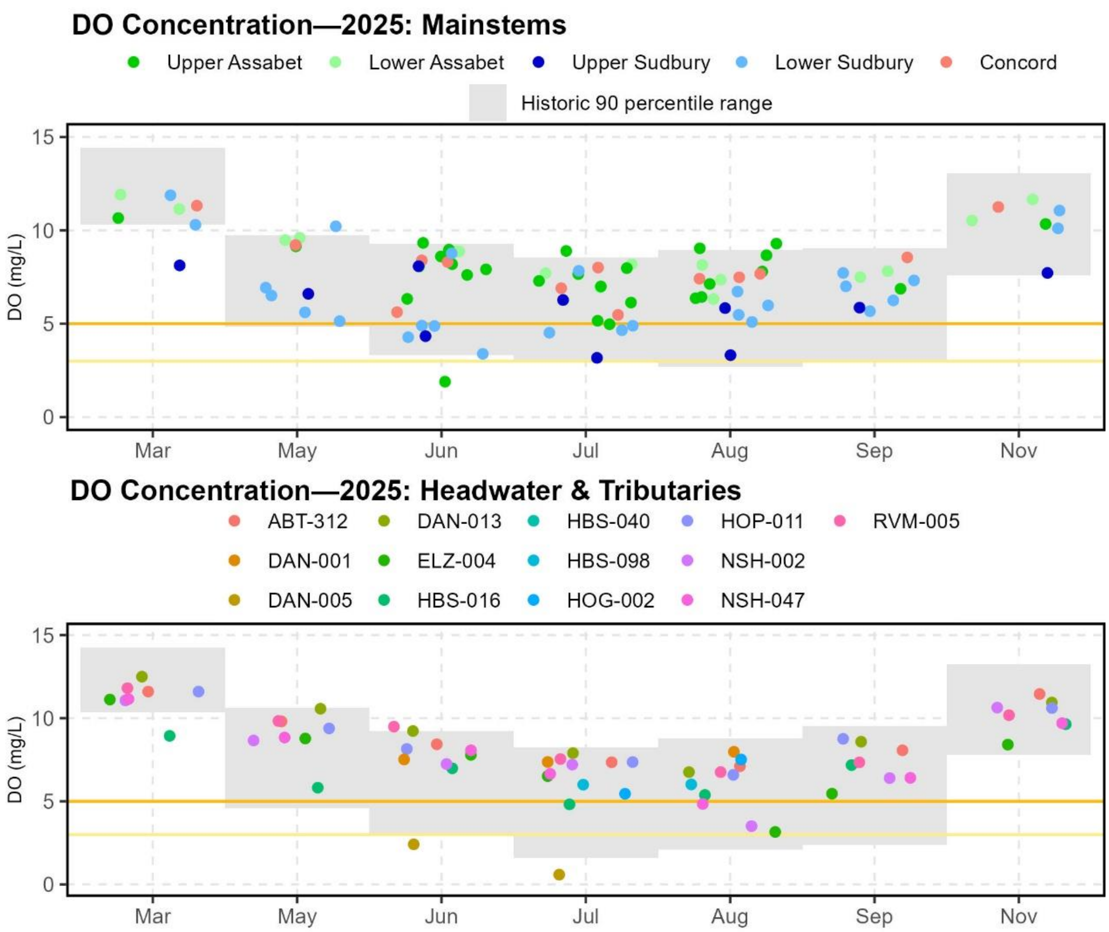


Figure 32: Dissolved oxygen by month and site (2025)

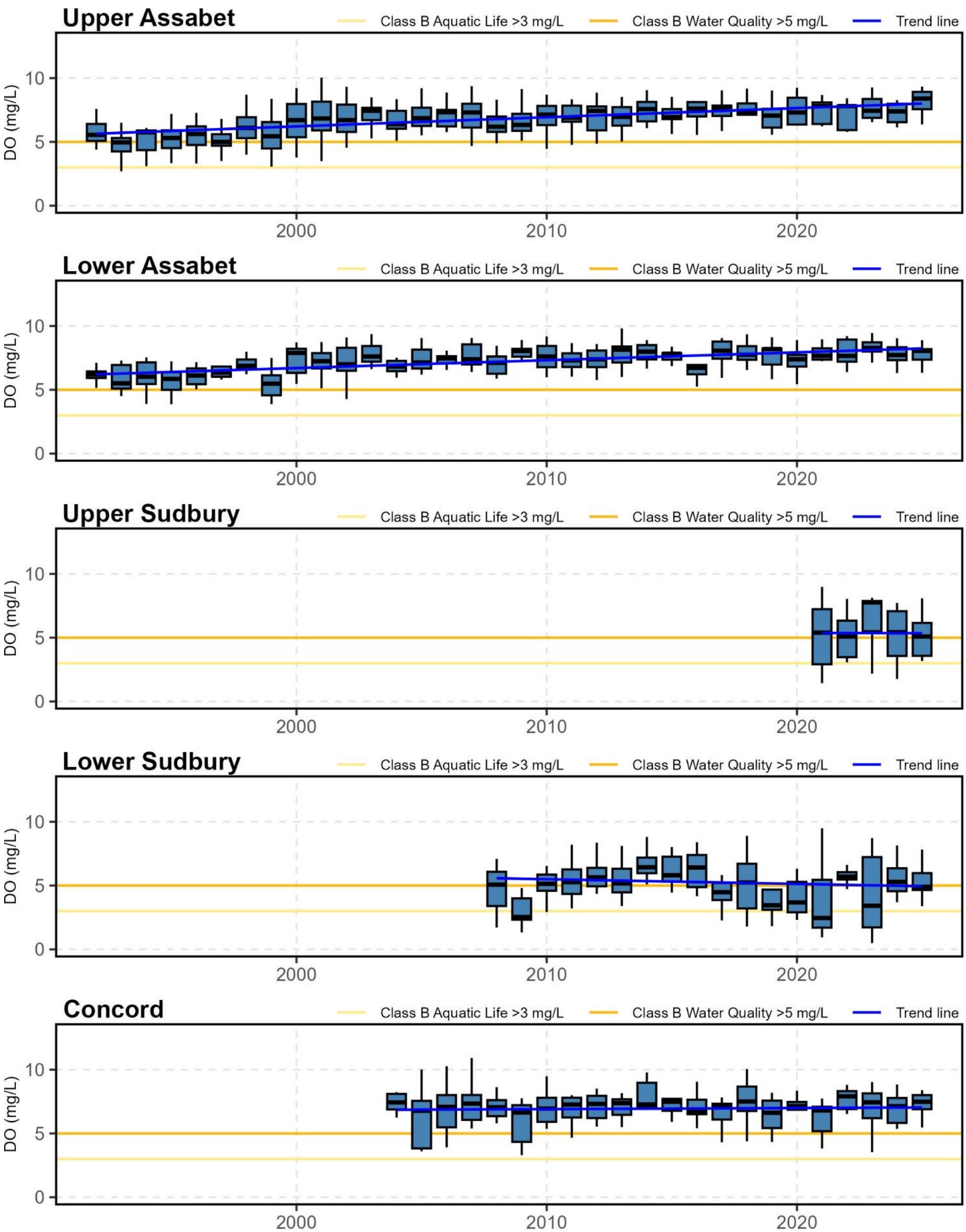
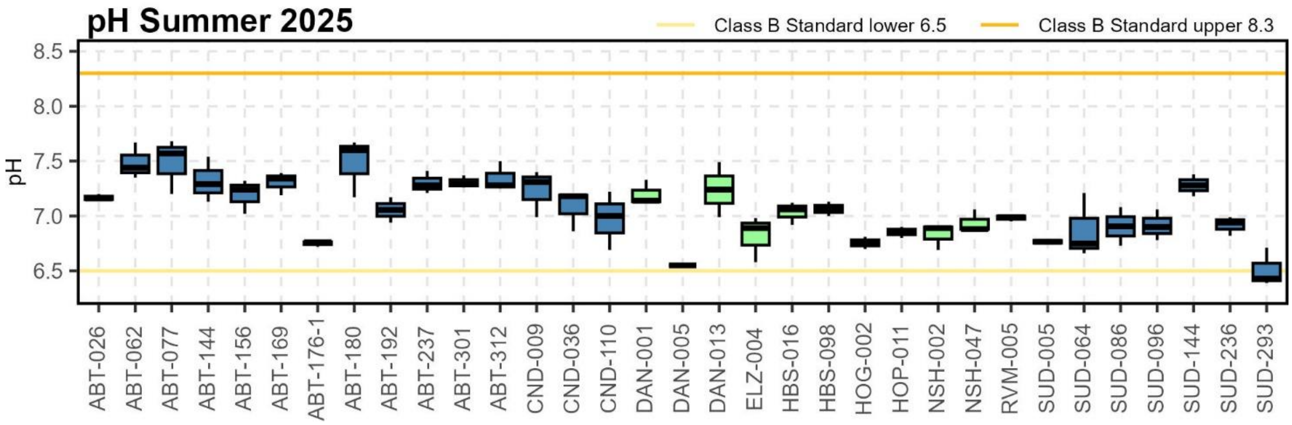


Figure 33: Dissolved oxygen by year and section (June/July/August)

Figure 34: Dissolved oxygen trends for selected sites (June/July/August)



Acidity (pH)

Importance of pH: pH ("potential of hydrogen") quantifies acidity from 0-14, with 0 being the most acidic and 14 being the most basic. On this scale, 7.0 is neutral, and most water bodies have a pH between 6.5 and 8.5 (U.S. Environmental Protection Agency, n.d.). Acid water (low pH) especially threatens wildlife in rivers by damaging fish gills, reducing reproduction/survival and number of species present for both fish and insects, and increasing the rates of heavy metal leaching.

Threats to pH: Most rainwater is slightly acidic and can lower pH (increase acidity). Wastewater treatment plant discharge into rivers can raise pH. Leachate from septic systems and landfills can acidify water bodies.

Long-term trends:

OARS watches for major pH changes as an indicator of human impact on the watershed's overall health. Carbon dioxide dissolved in water can lower pH, and thus can indicate high levels of respiration or eutrophication, and photosynthesis can raise pH by consuming carbon dioxide.

Long-term data show a clear upward trend in pH in the Assabet River, which is a positive sign of reduced eutrophication and lower levels of aquatic respiration driven by long-term phosphorus reductions from wastewater treatment plant discharge. Reducing nutrients can reduce biomass, which would result in less respiration from decomposition, less dissolved carbon dioxide, and a higher pH. This hypothesis is also supported by the corresponding improvement in dissolved oxygen shown above (Figure 32).

The pH readings in the Hop Brook in Sudbury and the farthest upstream Sudbury River site consistently have very low pH related to wetlands, nutrient load, and low dissolved oxygen. The Assabet River sites downstream of Ben Smith Dam show consistently high pH probably driven by floating algal growth. ELZ-004 has had unusually low pH levels for the last six years. For the past six years, the Elizabeth Brook site (ELZ-004) has had depressed (more acidic) pH levels (Figure 35).

2025 data:

Acidity (pH) readings in 2025 were almost all within the EPA recommended pH limits for freshwater. From 2024 to 2025, the pH at Sudbury River SUD-293 site slightly decreased/worsened, sometimes going below the Class B Standard lower limit of 6.5 pH. The Danforth Brook site, DAN-005 showed concerningly low pH levels, just above the Class B Standard lower limit of 6.5 pH. The pH also increased/improved at Hop Brook Spring, HBS-016 but slightly decreased at the other Hop Brook Site HOP-011. HBS-016 and SUD-293 have upstream wetlands with significant opportunities for organic decomposition and very low dissolved oxygen levels, as discussed above in the dissolved oxygen section.

For the fourth year in a row, two sites downstream of major dams (ABT-077 and ABT-062) had higher pH than the upstream sites. ABT-077 shows high pH levels since 2012 at this site downstream of the Ben Smith Dam Impoundment and the Hudson Wastewater Treatment Plant. The Hudson Wastewater Treatment Plant discharge violations exceeded the pH limits during the 2025 year. ABT-062 is downstream of the Powdermill Dam impoundment and the Maynard Wastewater Treatment Plant, which was generally in compliance with its discharge permits during 2025. The Westborough Wastewater Treatment Facility's average discharge maximum pH is slightly alkaline, at pH 7.6.

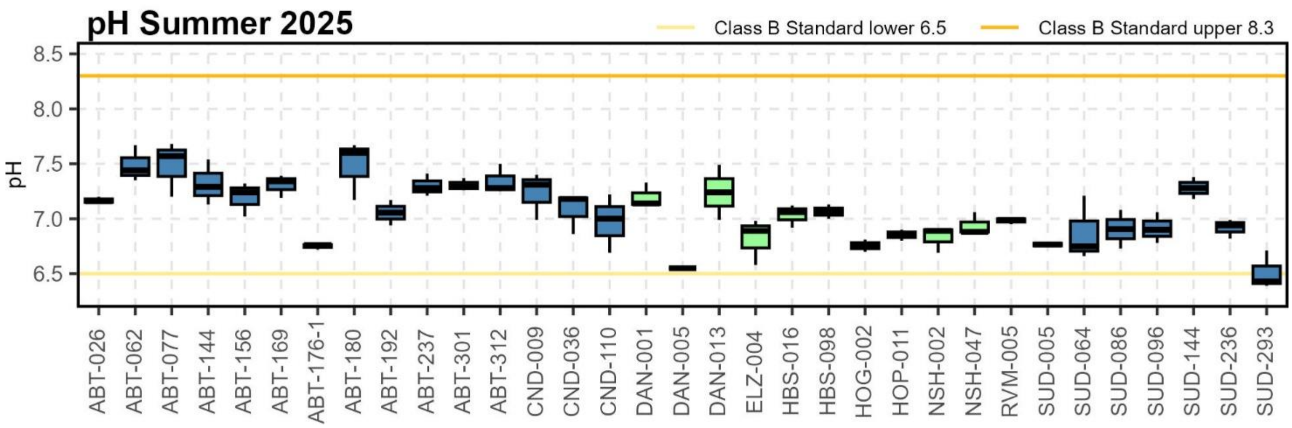


Figure 35: pH by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

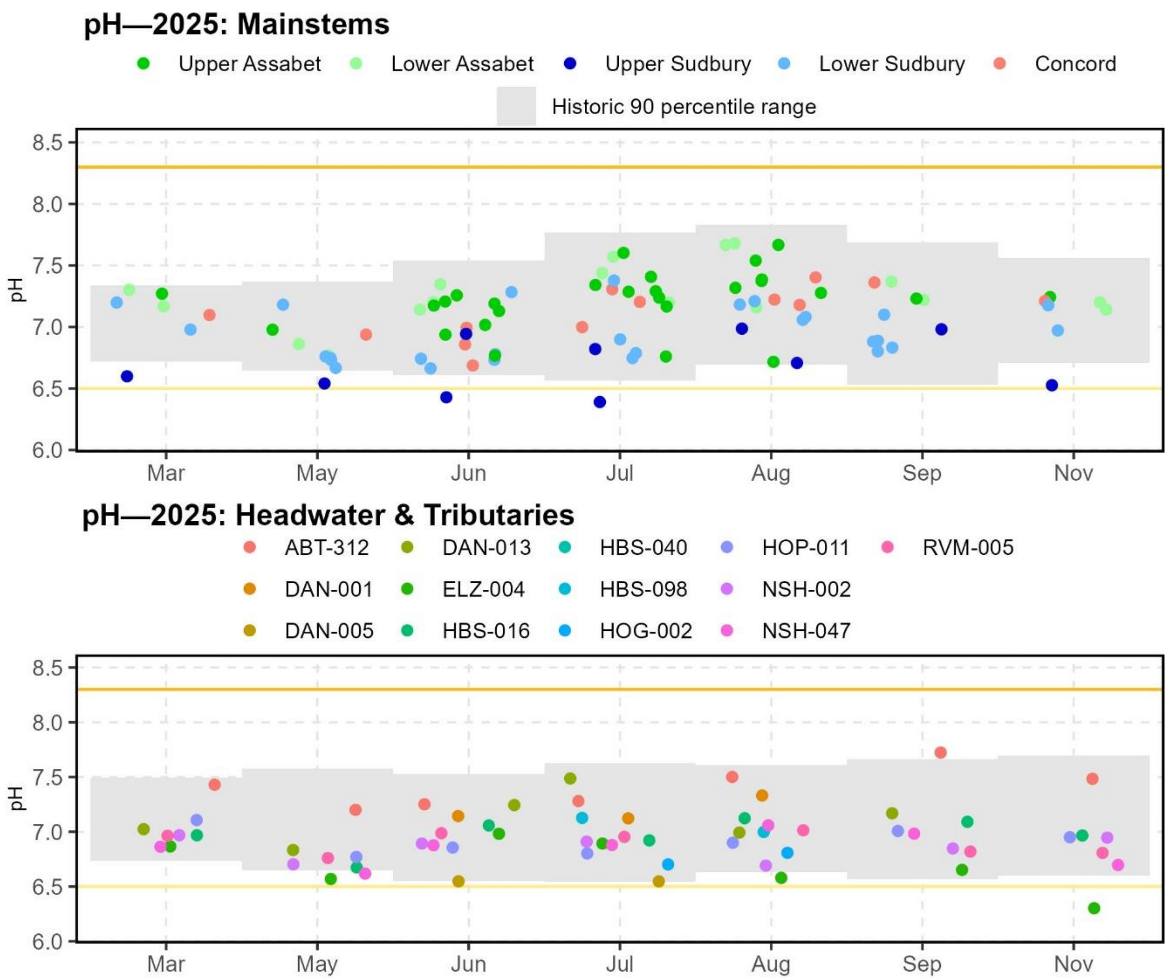


Figure 36: pH by month and site (2025)

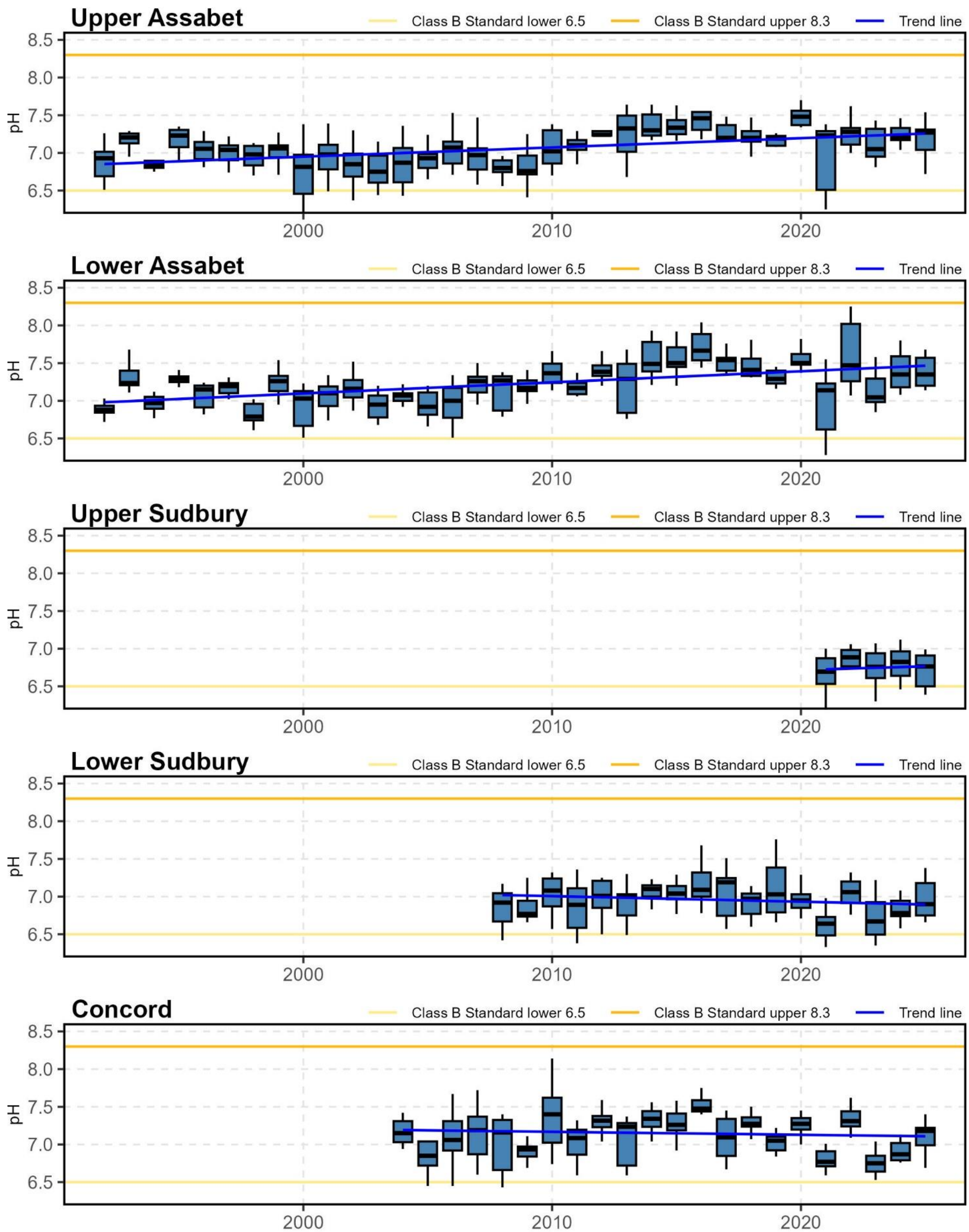


Figure 37: pH by year and section (June/July/August)

Total Phosphorus

Importance of total phosphorus: Total phosphorus is the primary indicator of wastewater treatment plant performance, as historically the wastewater treatment plants released excess phosphorus into the rivers, causing eutrophication and foul odors. Eutrophication from excess phosphorus can lead to fish kills and lowers habitat quality for native species.

Threats to total phosphorus: wastewater treatment plants that violate permits release excess phosphorus into rivers, and runoff containing fertilizer can also increase phosphorus, leading to eutrophication in rivers.

Long-term trends:

Total Phosphorus is the primary indicator OARS monitored as improvements were made to the wastewater treatment plants on the Assabet River. Phosphorus is considered the limiting nutrient for primary production in freshwater systems because it is available in much lower proportions per biological need than the other essential nutrients, nitrogen and carbon. A Total Maximum Daily Load (TMDL) for phosphorus was established for the Assabet River in 2004 (MassDEP, 2004), and permit limits were set effective 2010 for each of the wastewater treatment plants to meet the TMDL. Significant reductions in instream phosphorus concentrations have been achieved as a result of these permit limits (Figure 39). OARS' long-term data from the nineties shows dramatic improvements in phosphorus after the final plant upgrades were implemented in 2012. Since 2012, mainstem concentrations have been close to the 0.05 mg/l phosphorus target in all mainstem rivers.

2025 data:

In 2025, total phosphorus concentrations were at or below the EPA Gold Book recommendation of 0.05 mg/L at most but not all sites (Figure 38). Phosphorus levels increased along tributaries, such as Nashoba Brook and River Meadow Brook in 2025. High-flow events, such as those that occurred during 2021 and 2023, can inject quantities of phosphorus into the river system. 2025 had high phosphorus levels during the summer after high rainfall events in the beginning of June.

Hop Brook Spring sites HBS-098 and Hop Brook in Northborough (HOP-011) show decreases/improvements in the phosphorus levels in 2025, but the HBS-016 shows increased phosphorus levels. Hop Brook in Sudbury (HBS-016) has historically shown the highest total phosphorus levels in our watershed, which is also true for 2025. Hop Brook in Northborough (HOP-011) is downstream of a large wetland, a highway interchange, a sand quarry, and numerous retail parking lots that could contribute runoff into the rivers. This catchment area has an opportunity to improve the water quality with green stormwater infrastructure. It is downstream of four large impoundments that collected phosphorus discharged from the Marlborough Easterly Wastewater Treatment Plant, which could still remain in the sediment. The Hop Brook Protection Association is working to determine what actions can be taken to improve water quality in these impoundments, and OARS has provided additional data to support these efforts during multiple years.

From 2024 to 2025, phosphorus increased at all sites along the Concord River; rising above the EPA Gold Book Standard of <0.05 mg/L at all three sites, which were below the limit in 2024. From 2024 to 2025, phosphorus increased at all sites along the Sudbury River; in particular, phosphorus levels rose above the EPA Gold Book Standard of <0.05 mg/L at most sites along the Sudbury River at SUD-005, SUD-064, SUD-086, SUD-096 where they were below the limit in 2024. The Sudbury River headwater site, SUD-293, tends to have high total phosphorus, low pH, and low dissolved oxygen. It is downstream of a major swamp, Cedar Swamp, and a major highway interchange.

The Hudson Wastewater Treatment Plant significantly exceeded its permit for phosphorus discharge into the Assabet River during both 2024 and 2025. Toward the end of the 2025 year, the permit violations became less severe but still persisted. Hudson had equipment issues such as a final clarifier failure in 2023 and significant staffing issues during and following the COVID pandemic. OARS has raised a flag with Mass. Department of Environmental Protection and the Environmental Protection Agency on multiple occasions regarding permit violations from the plant. From 2023 to 2025, the Town of Hudson has implemented significant upgrades to their wastewater treatment plant, and the plant violations have become less severe in 2026.

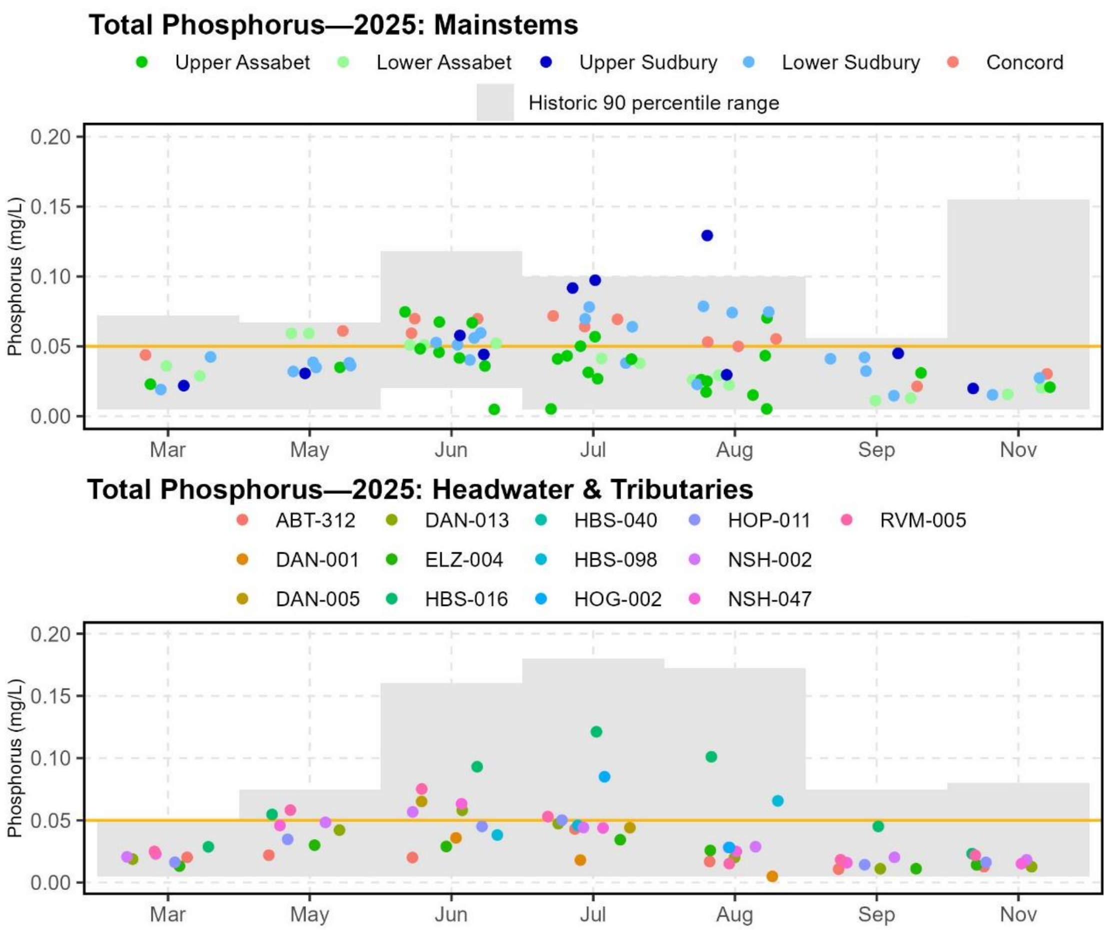


Figure 38. Total phosphorus concentration by month and river site (2025)

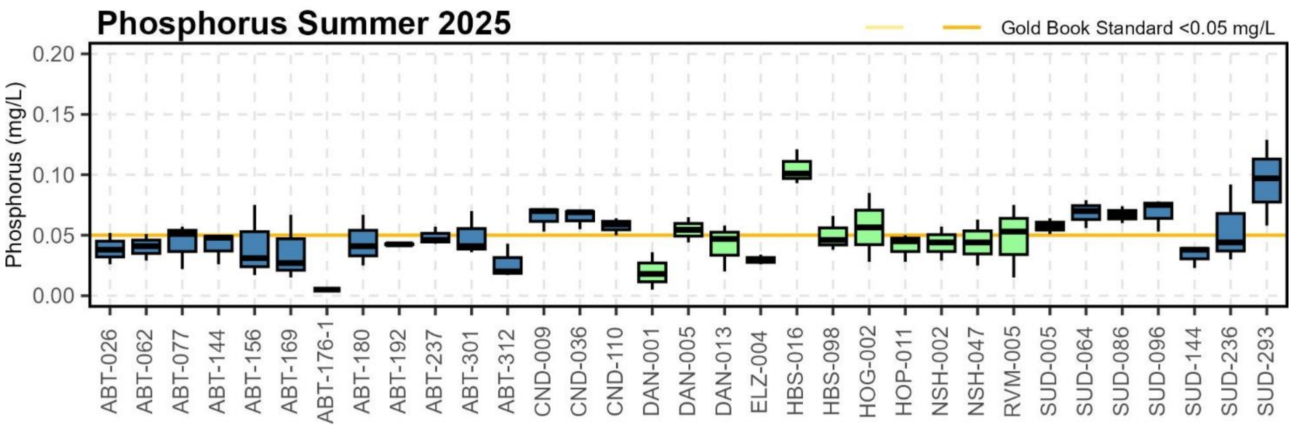


Figure 39: Total Phosphorus concentration by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

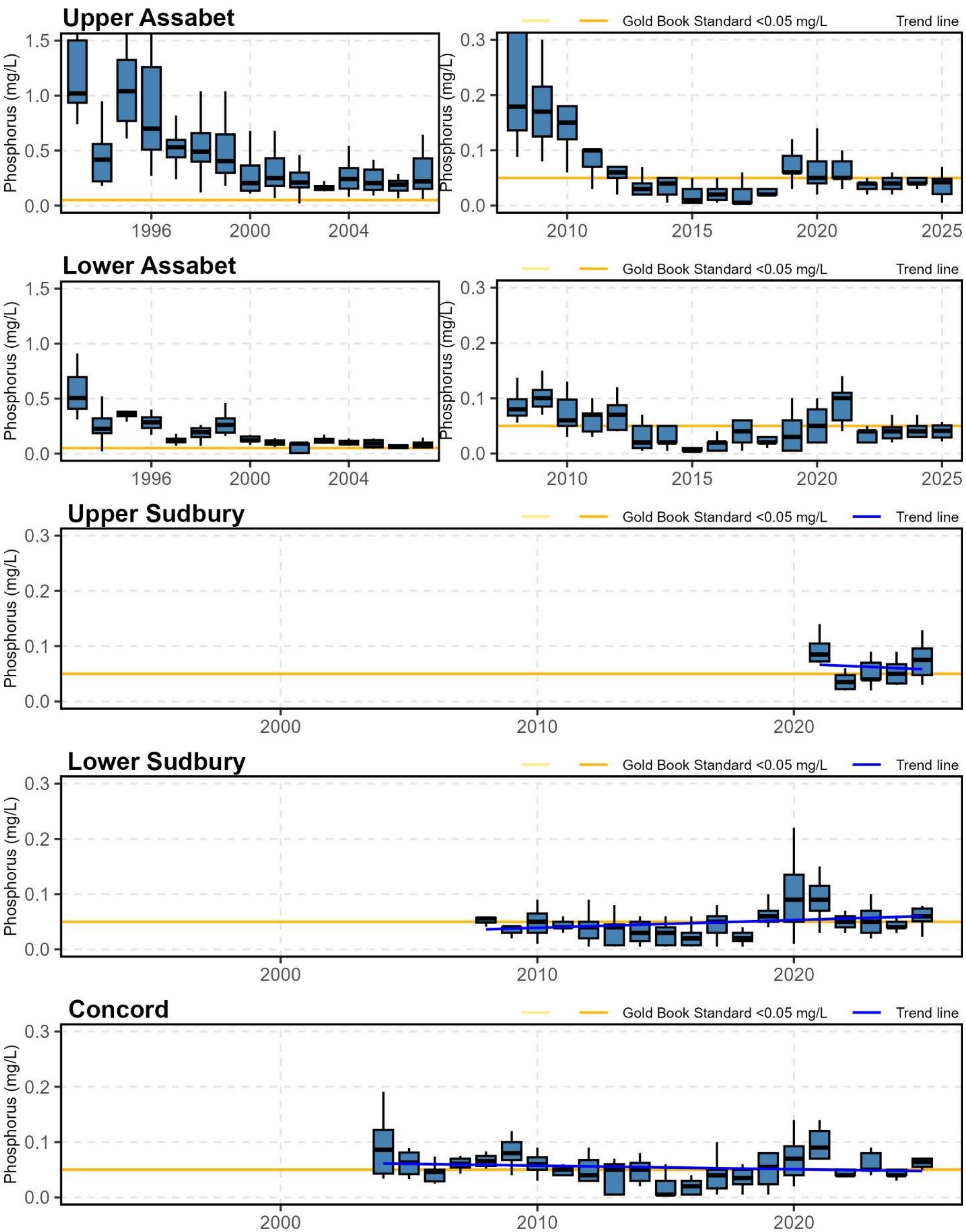
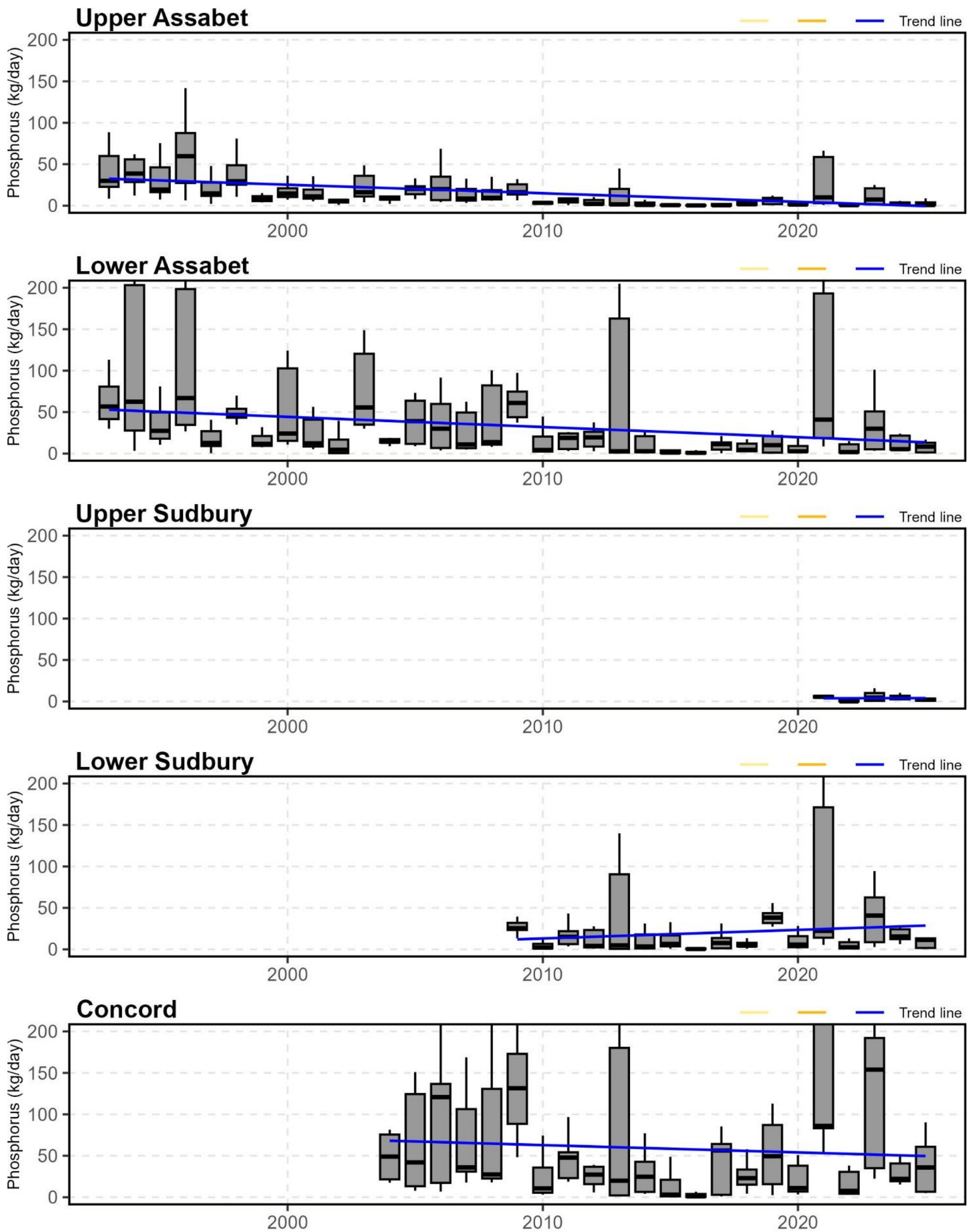


Figure 40: Total phosphorus concentration by year and river section (June/July/August). The improvements are significant enough to necessitate a change in the scale for concentration in Figure 33 between the years 2007 and 2008.


Upper Assabet
Trend line
Phosphorus (kg/day)
200
150
100
50
0
2000
2010
2020
Lower Assabet
Trend line
Phosphorus (kg/day)
200
150
100
50
0
2000
2010
2020
Upper Sudbury
Trend line
Phosphorus (kg/day)
200
150
100
50
0
2000
2010
2020
Lower Sudbury
Trend line
Phosphorus (kg/day)
200
150
100
50
0
2000
2010
2020
Concord
Trend line
Phosphorus (kg/day)
200
150
100
50
0
2000
2010
2020

Orthophosphate

Importance of orthophosphate: Orthophosphate represents the bioavailable portion of total phosphorus, in dissolved form in water.

Threats associated with Orthophosphate: Orthophosphate is the inorganic phosphorus that is the main constituent in fertilizers and the main form of phosphorus discharged by wastewater treatment plants. Excessive orthophosphate harms rivers.

Long-term trends:

Orthophosphate is trending down in the Assabet River. We still see high orthophosphate proportions in Hop Brook downstream of the impoundments that have collected legacy contamination from wastewater treatment plants. The Assabet River orthophosphate plots show clearly how the proportion of total phosphorus represented by orthophosphate as well as absolute concentrations of orthophosphate decreased significantly after the wastewater treatment plant upgrades in 2012 (Figure 44).

2025 data:

Analysis of orthophosphate shows that orthophosphate represents 9% to 92% of phosphorus during the summer of 2025, compared to 12-58% during the summer in 2024 (Figure 40). This percentage tends to be slightly higher in wet years, and this year it was high at multiple new sites added in Hudson. The Upper Assabet usually has higher proportions of orthophosphate in the winter because the wastewater treatment plants have higher discharge limits in the winter.

Hop Brook in Sudbury (HBS-016), which historically has the highest total phosphorus levels, had 49% orthophosphate (Figure 40). This site is located in a large wetland and downstream of several impoundments with large quantities of legacy phosphorus in the sediments. A monthly analysis of orthophosphate showed a high proportion in the Upper Assabet in November (Figure 42). An analysis of average historical proportions shows how orthophosphate proportions tend to be highest in the spring in March, likely due to runoff, when dissolved inorganic phosphorus is being washed off the land (Figure 43). Historically, orthophosphate proportions are generally low in the summer and increase at the end of the growing season in September; however, 2025 did not show this trend, and orthophosphate remained low at the end of the season, during the drought that increased in severity throughout the 2025 year.

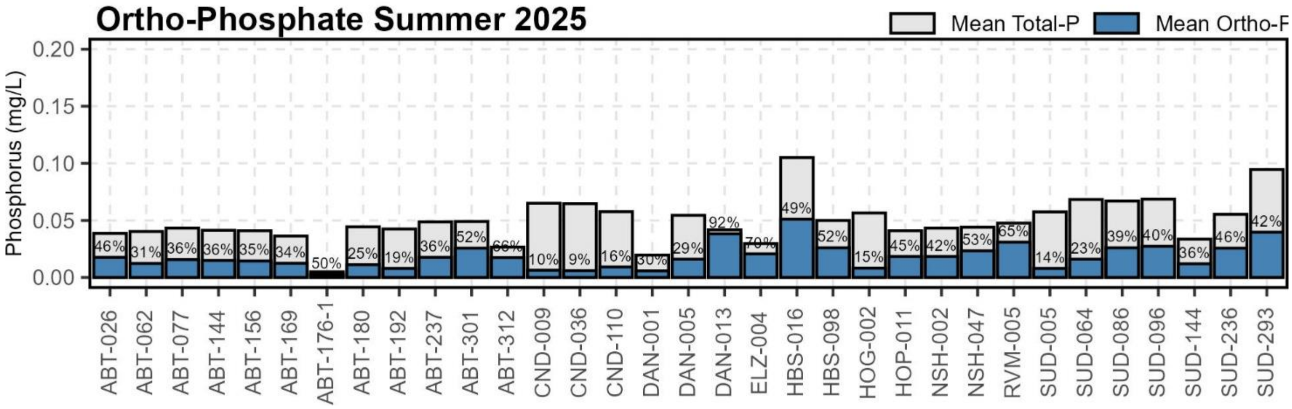


Figure 41: Ortho-P concentration and proportion by site, summer (Jun–Aug 2025)

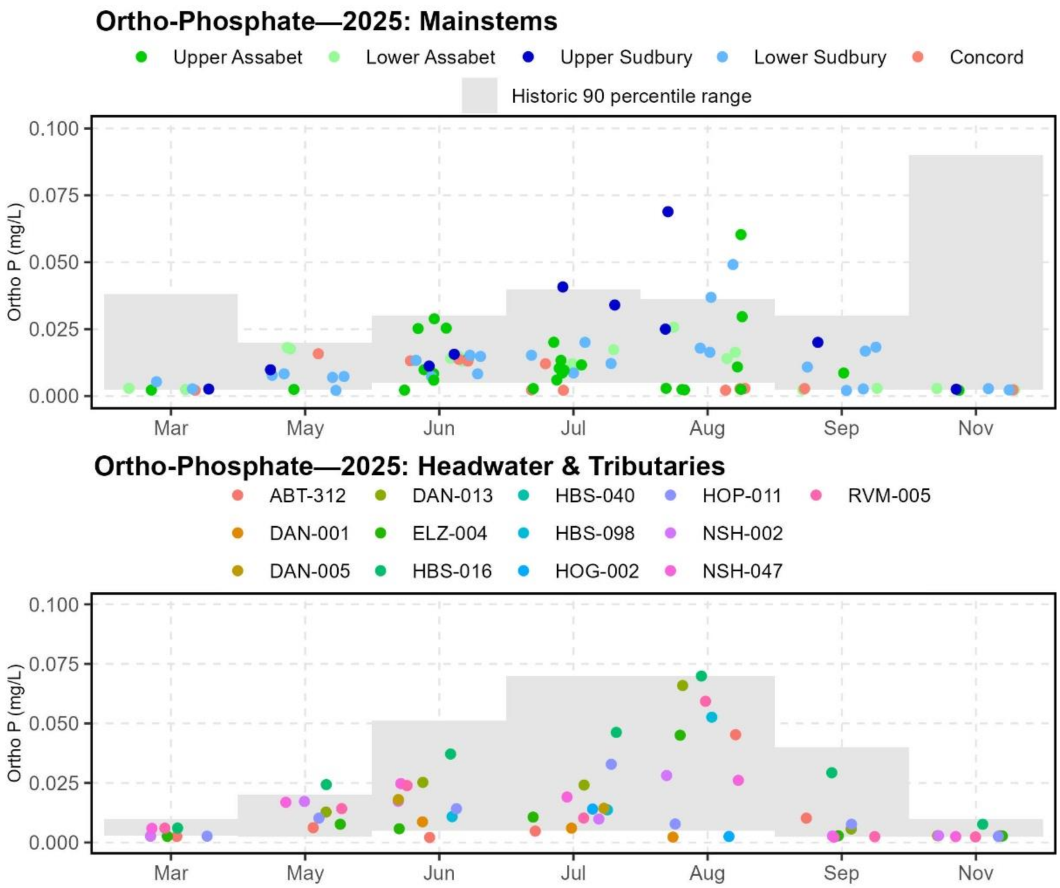


Figure 42 Orthophosphate data by month and site (2025)

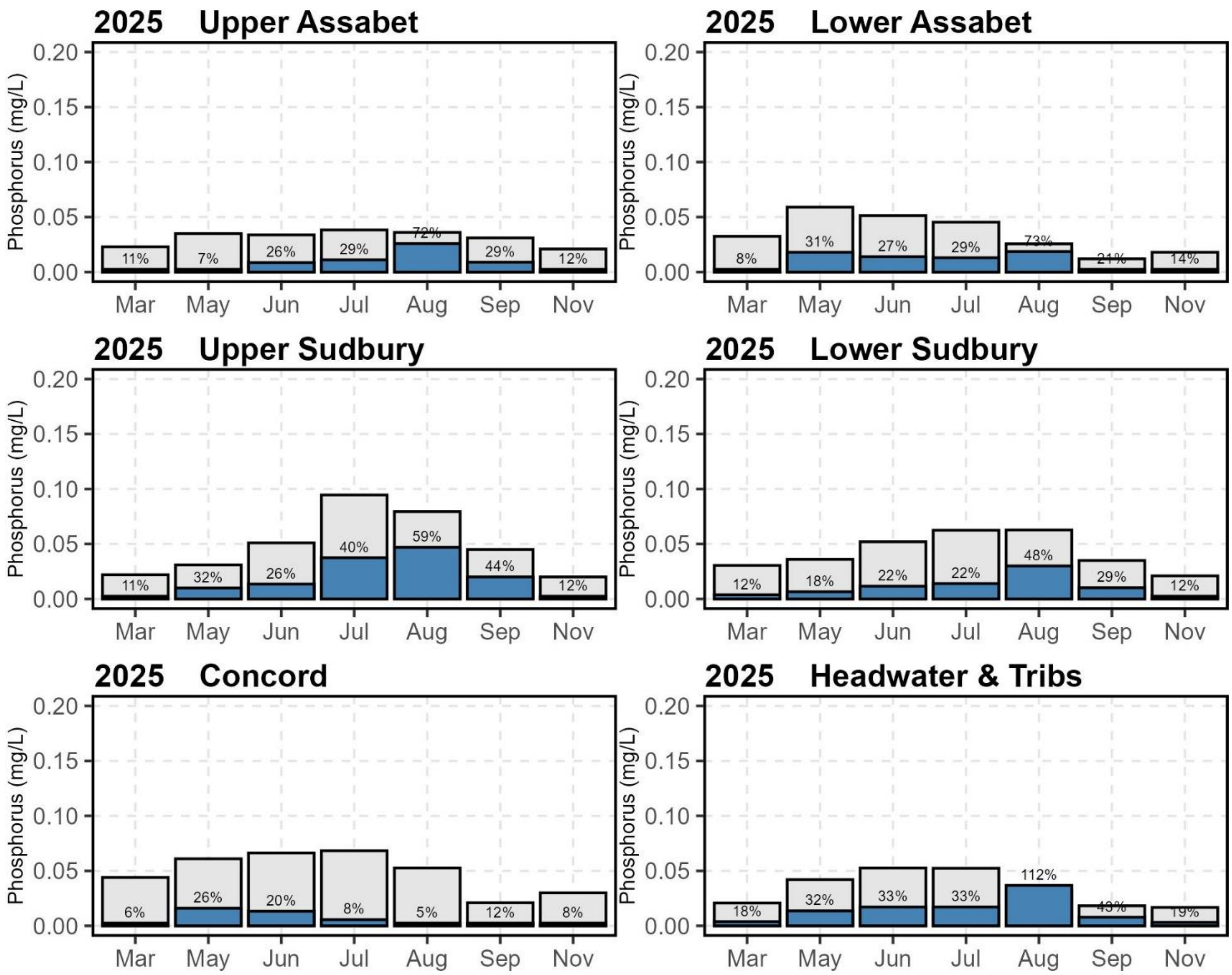


Figure 43: Ortho-P concentration and proportion by month and section (2025, mean)

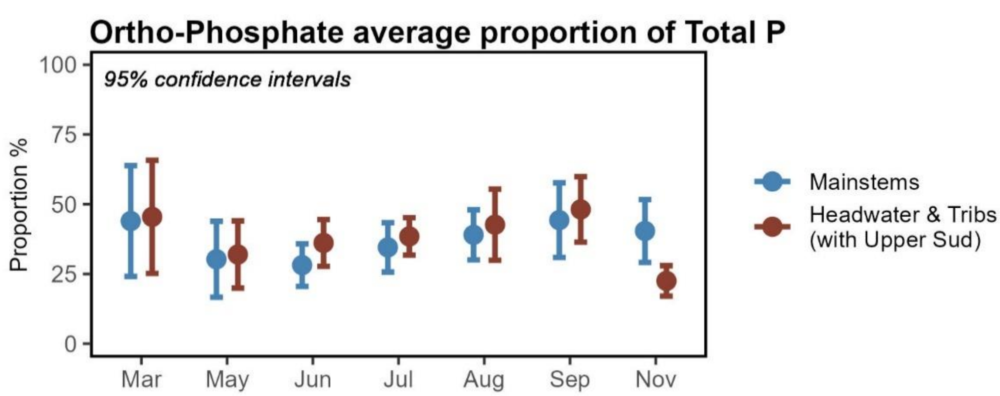


Figure 44: Ortho-P 12-year historical average proportion of Total Phosphorus

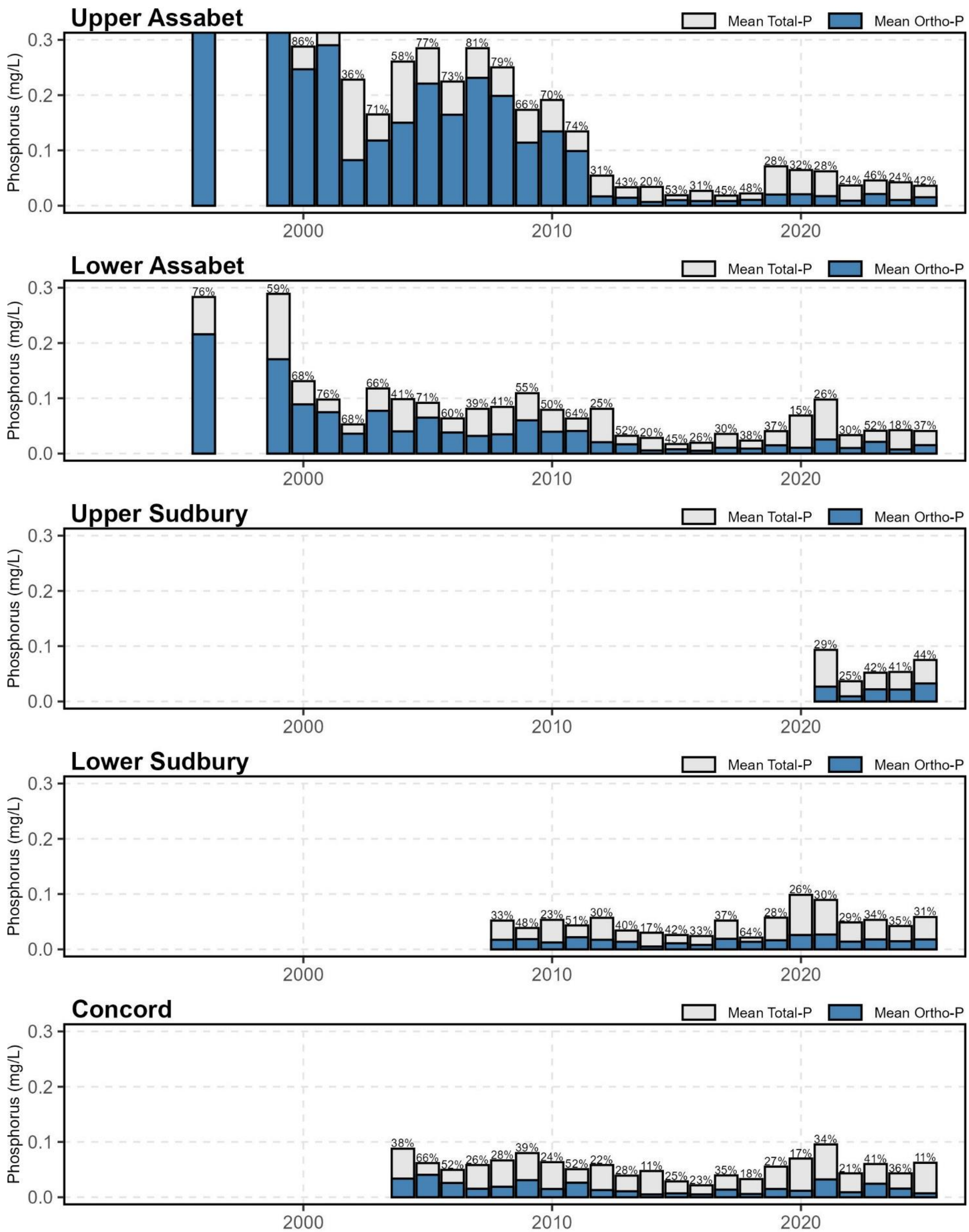


Figure 45: Ortho-P concentration and proportion by year and section (June/July/August)

Nitrate (NO_3)

Importance of nitrate: nitrogen is the limiting nutrient for tidal estuaries. High nitrate levels are toxic to many wildlife species and can negatively impact dissolved oxygen levels.

Threats to nitrate: Wastewater treatment plants are the primary source of nitrate, which is also in fertilizers.

Long-term trends:

Wastewater treatment plants are the primary source of nitrate in the Sudbury, Assabet and Concord rivers, and nitrate discharges are currently not regulated. Our data show that a significant and increasing load is being passed downstream to the Merrimack River. Nitrogen is the limiting nutrient for tidal estuaries. The Sudbury, Assabet and Concord rivers all flow into the Merrimack, which enters the sea, thus carrying nitrate from our watershed towards estuaries. **Nitrate** levels are very high downstream of all wastewater treatment plants, and trends show that river concentrations and loads are increasing over time.

Nitrate (NO_3) is the secondary nutrient of concern in fresh waters, secondary because it is not the limiting nutrient. However, there are some conditions where this is not the case, such as anoxic bottom waters of impoundments (ENSR, 2001). In anoxic bottom waters, phosphorus can be sourced from the sediments, and atmospheric nitrogen is not available. Plants that derive nutrients from the bottom water, such as filamentous green algae, could thus be limited by nitrate. Additionally, nitrate is the primary nutrient of concern in estuarine environments and it easily flows downstream in its dissolved form.

Long-term nitrate data show an increasing trend in concentration and load in the Assabet River (Figure 48, Figure 49). Note that the load from the Upper Assabet wastewater treatment plants is also visible flowing downstream in the Lower Assabet and Concord. Nitrate load is not reduced at all with distance downstream, so discharge loads from the Concord to the Merrimack and eventually its estuary are significant (Figure 49). Our data also show very low loads sourced from tributaries and river sections that are not receivers of wastewater treatment plant discharge (Figure 50).

2025 data:

2025 results confirm that wastewater treatment plants are the primary source of nitrate in the watershed. The highest nitrate concentrations are in the Upper Assabet below the Westborough (ABT-301), Westerly (ABT-237), and Hudson (ABT-144) wastewater treatment plants (Figure 45). Most Assabet sites have concentrations an order of magnitude greater than the Ecoregion reference condition of 0.34 mg/L (for NO_2+NO_3 as N) (EPA, 2000). *Note that OARS changed sampling plans as of 2021 to sample nitrate at fewer sites (river mouths and key Report Card sites) to focus on nitrate being transported to downstream estuaries.*

The monthly nitrate data analysis shows higher concentrations in the Assabet and Concord, primarily originating from the Assabet wastewater treatment plants, and an increase in the later months of the year (Figure 46). The seasonal increase is driven by discharge from the Westborough wastewater treatment plant. Nitrate concentrations at our downstream sampling site (ABT-301) have historically tended to be much higher in September and November than earlier in the year (Figure 47). Westborough nitrate discharge concentrations are generally stable throughout the year.

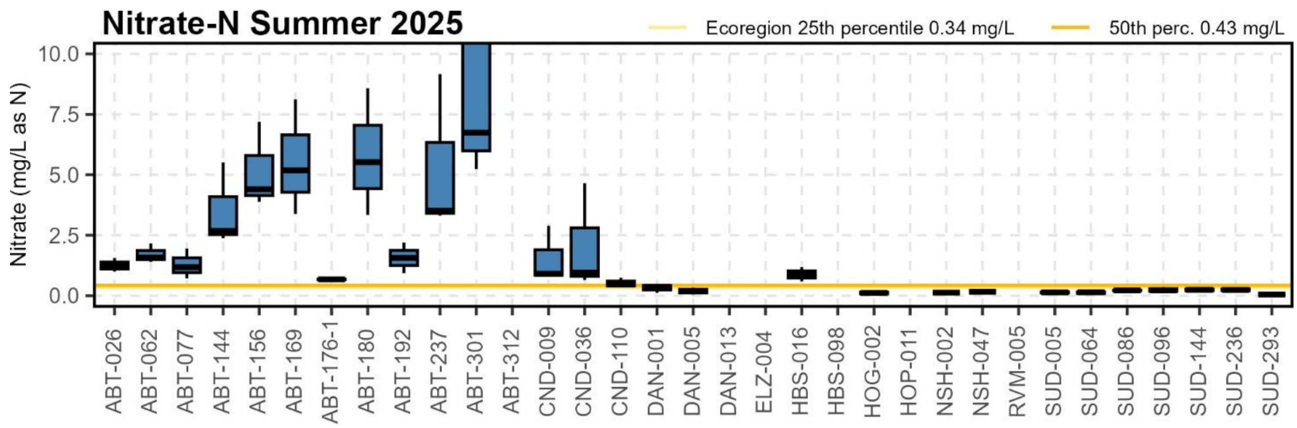


Figure 46: Nitrate concentration by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

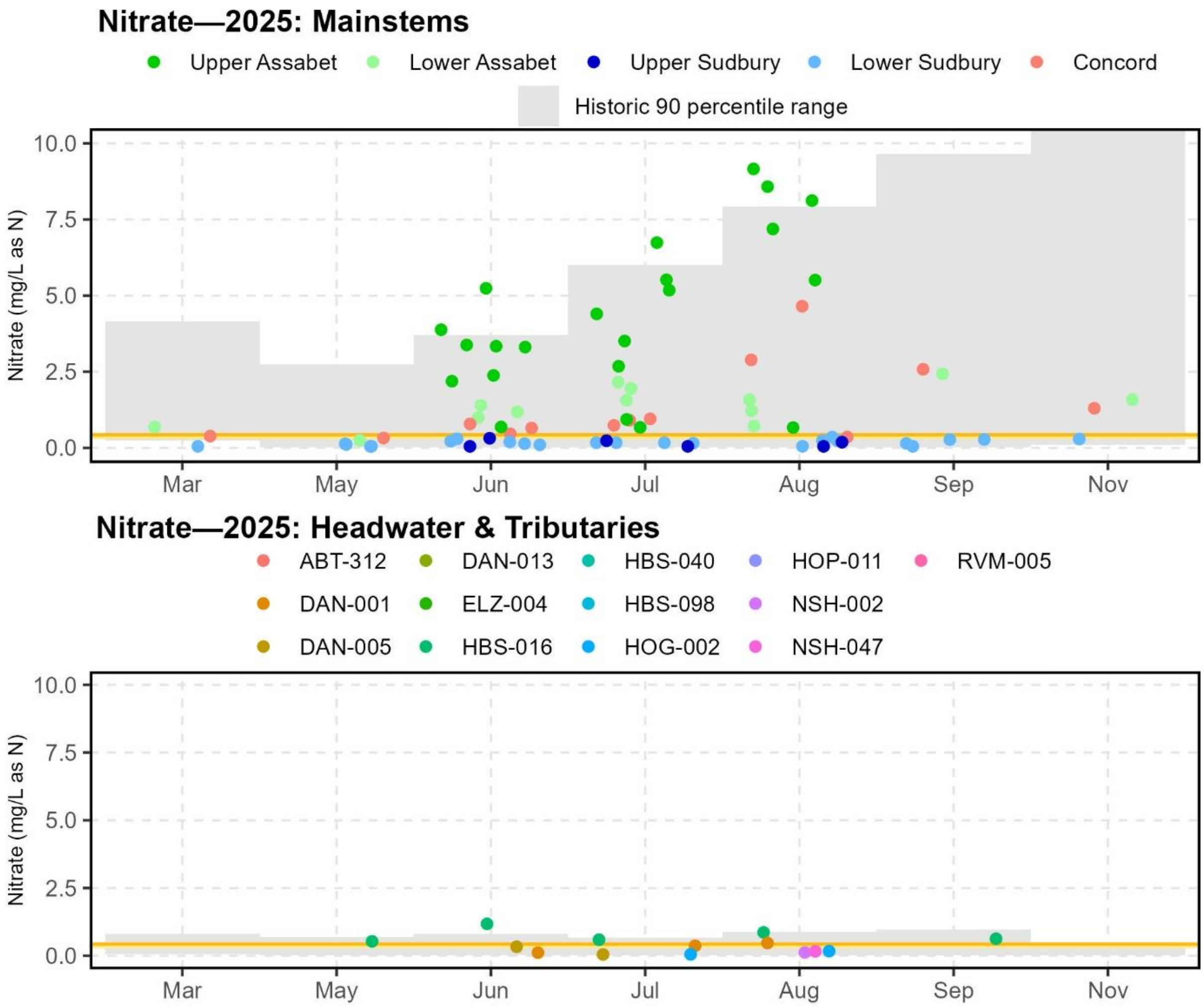


Figure 47: Nitrate concentration by month and site (2025)

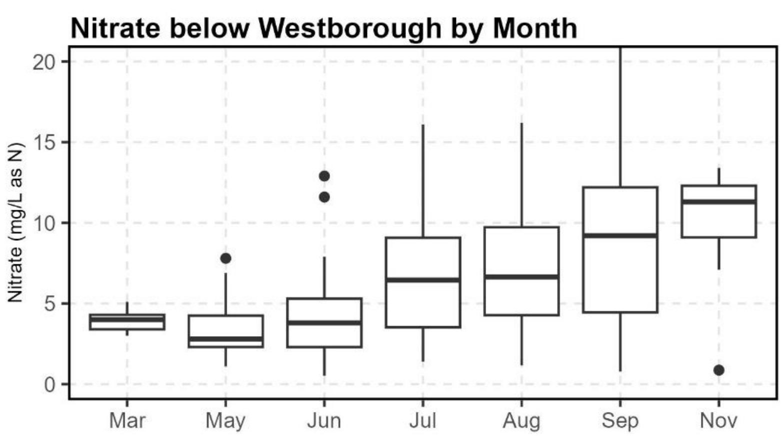


Figure 48. Nitrate concentration by month at ABT-301 below Westborough Wastewater Treatment Plant (2018-2025)

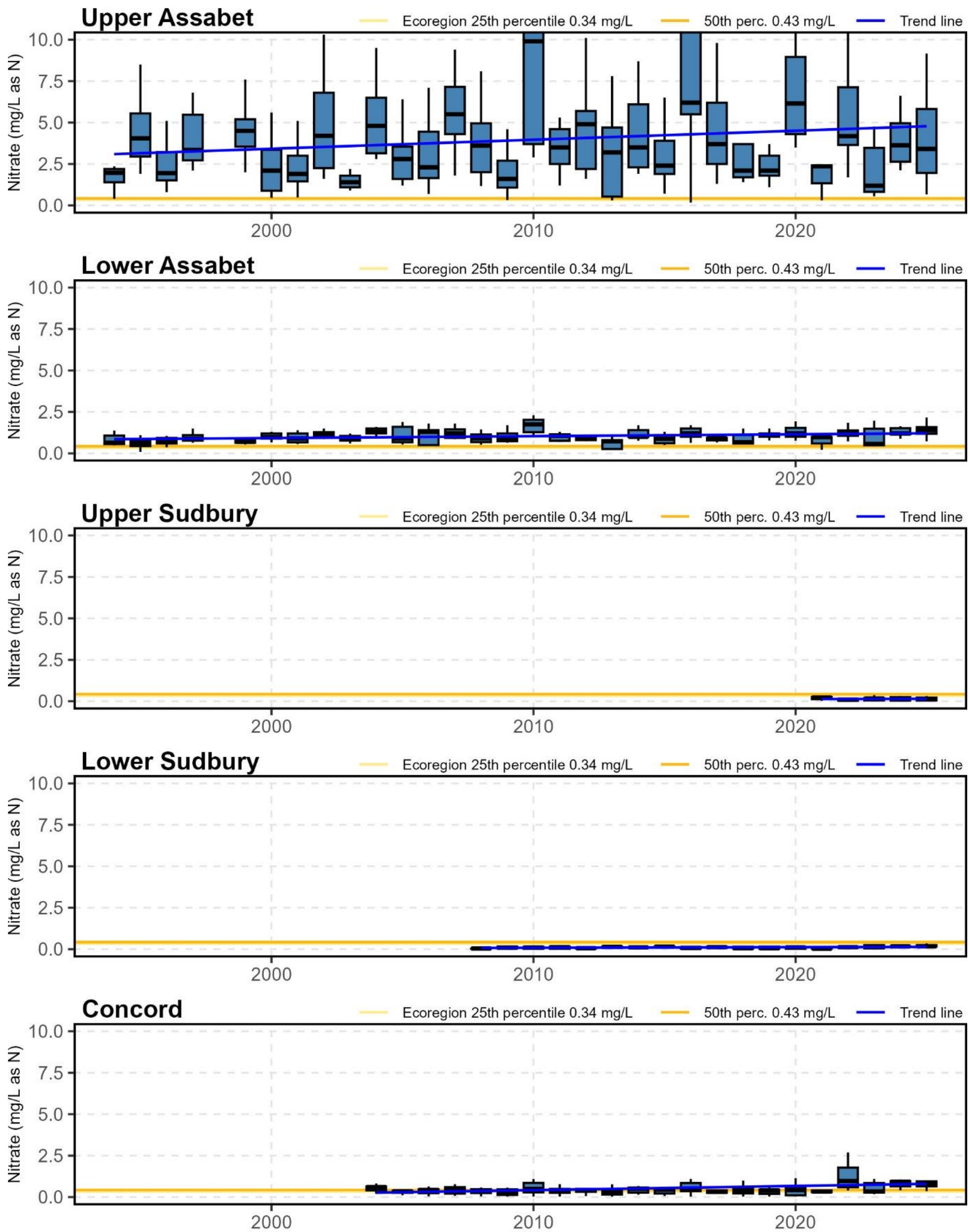


Figure 49. Nitrate concentration by year and section (June/July/August)

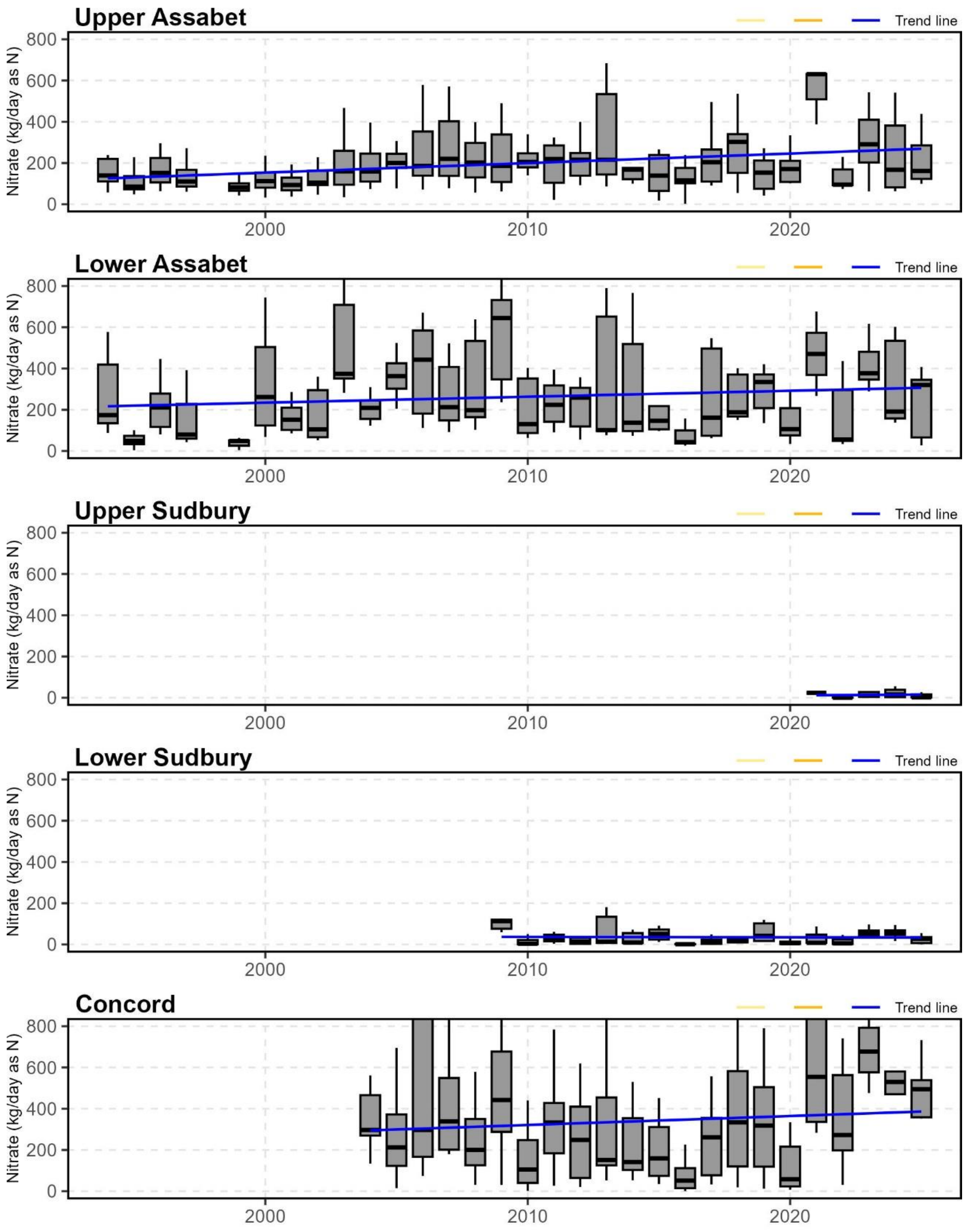


Figure 50. Nitrate estimated load by year and section (June/July/August)

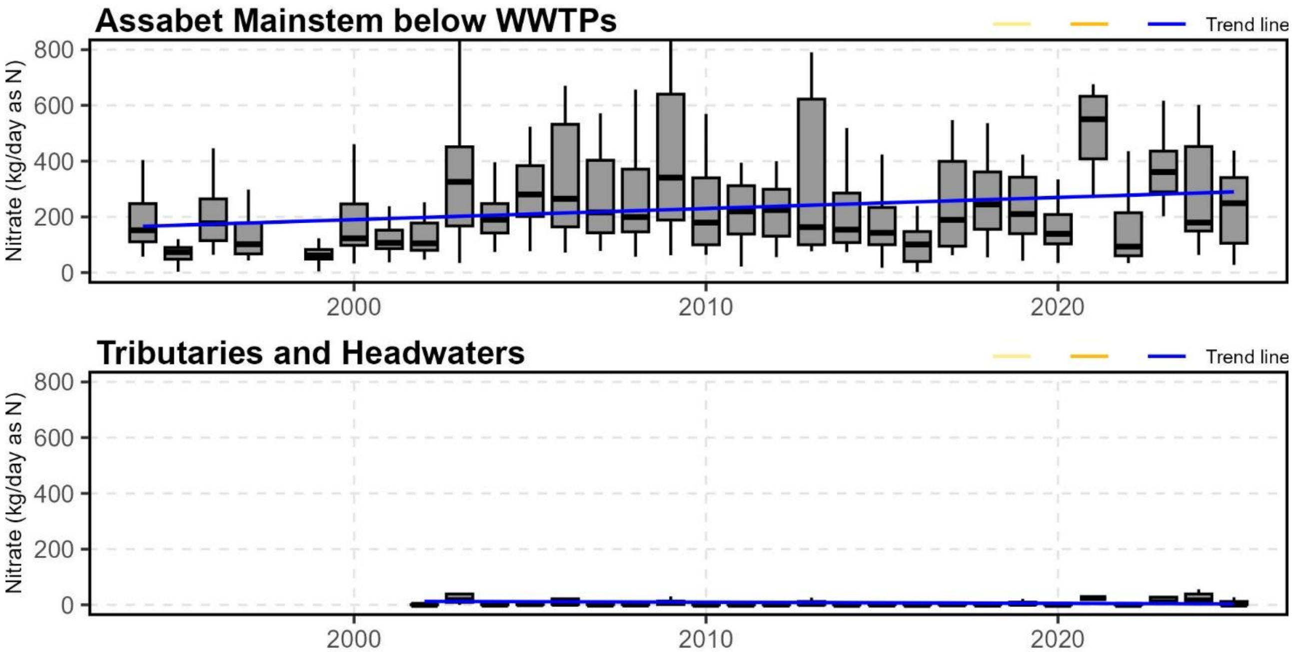


Figure 51. Nitrate estimated load on the Assabet River below wastewater treatment plants, compared to nitrate load for tributaries and headwaters (June/July/August)

Ammonia

Importance of ammonia: Ammonia (NH_3) is a form of nitrogen that can be toxic to aquatic life at high concentrations.

Threats/causes of ammonia: Sources of ammonia include industry, fertilizer, decomposition of organic waste matter, municipal wastewater discharges, natural nitrogen fixation in the environment, and it is produced and excreted by fish.

Ammonia maintains an equilibrium in the environment with the ammonium ion (NH_4^+) based on temperature and pH. Un-ionized ammonia (NH_3) is more toxic than ammonium ion. For our reporting and threshold criteria, we report total ammonia nitrogen (NH_3 and NH_4^+ as N). The toxicity of total ammonia is highly dependent on temperature and pH (more toxic at higher temperature and pH). At pH values of 7.5 (our average maximum value) and water temperatures of 23°C (our average maximum summer temperature), the EPA criteria for ammonia for salmonid fish specify a chronic level of 1.2 mg-N/L and an acute level of 7.2 mg-N/L (EPA, 2013).

Long-term trends:

The ammonia levels recorded in the Sudbury, Assabet and Concord have consistently been below toxicity threshold values since permit limits were applied to the wastewater treatment plants in 2000. Most ammonia measurements have been below the detection limit of 0.1 mg/L since 2012, when the wastewater treatment plant upgrades were completed (Figure 53). The uptick in ammonia levels in 2017 was the year following the most severe drought in recent history. Now, sites downstream of wetlands often have the highest ammonia values. Only a few sites have had frequent results above the detection limit. The most consistent site with high levels is RVM-005 (River Meadow Brook, and levels are sometimes high at the Easterly Wastewater Treatment Plant (ABT-044).

In 2024, OARS recorded a spike in ammonia at the site on the Assabet downstream of the Hudson Wastewater Treatment Plant after the recent operational issues there. The Maynard Wastewater Treatment Plant has a higher permitted ammonia limit than the other plants. There have been two fish kills reported downstream of the Maynard Wastewater Treatment Plant (2020 and 2023), but Mass Department of Fish and Wildlife has determined that both were due to natural causes related to spring temperature changes.

2025 data:

In 2025, ammonia was very high on the Sudbury and Assabet Rivers, but the levels were still well below concentrations toxic to fish. From 2024 to 2025, ammonia increased at every site measured except for Elizabeth Brook (ELZ-004) and Hop Brook (HOP-011), which had unusually high values the previous year. Concentrations were especially high along the Assabet River in Hudson. Brooks with organic matter decomposition in wetlands tend to have high ammonia levels (e.g., ELZ-004, HOP-011, RVM-005, and SUD-293), but Elizabeth Brook did not show such high levels this year. Two sites below wastewater treatment plants had elevated ammonia levels in both 2024 and 2025 (HBS-098 and ABT-144). ABT-144 is downstream of the Hudson Wastewater Treatment Plant, which has been having operational issues for more than a year. Hudson's discharge ammonia concentrations were well above the permit limit for the past two years (**Error! Reference source not found.**).

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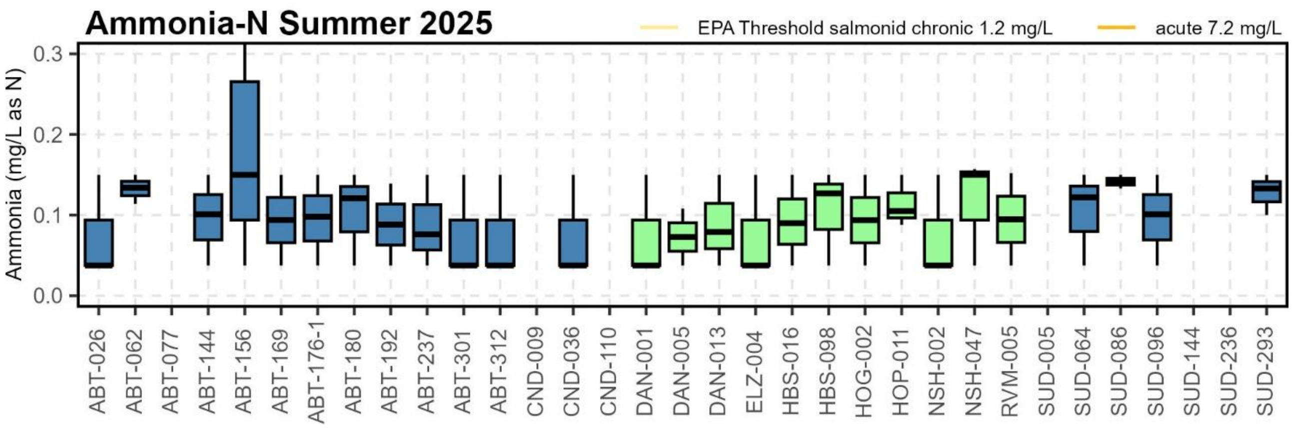

Figure 52. Ammonia concentration by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

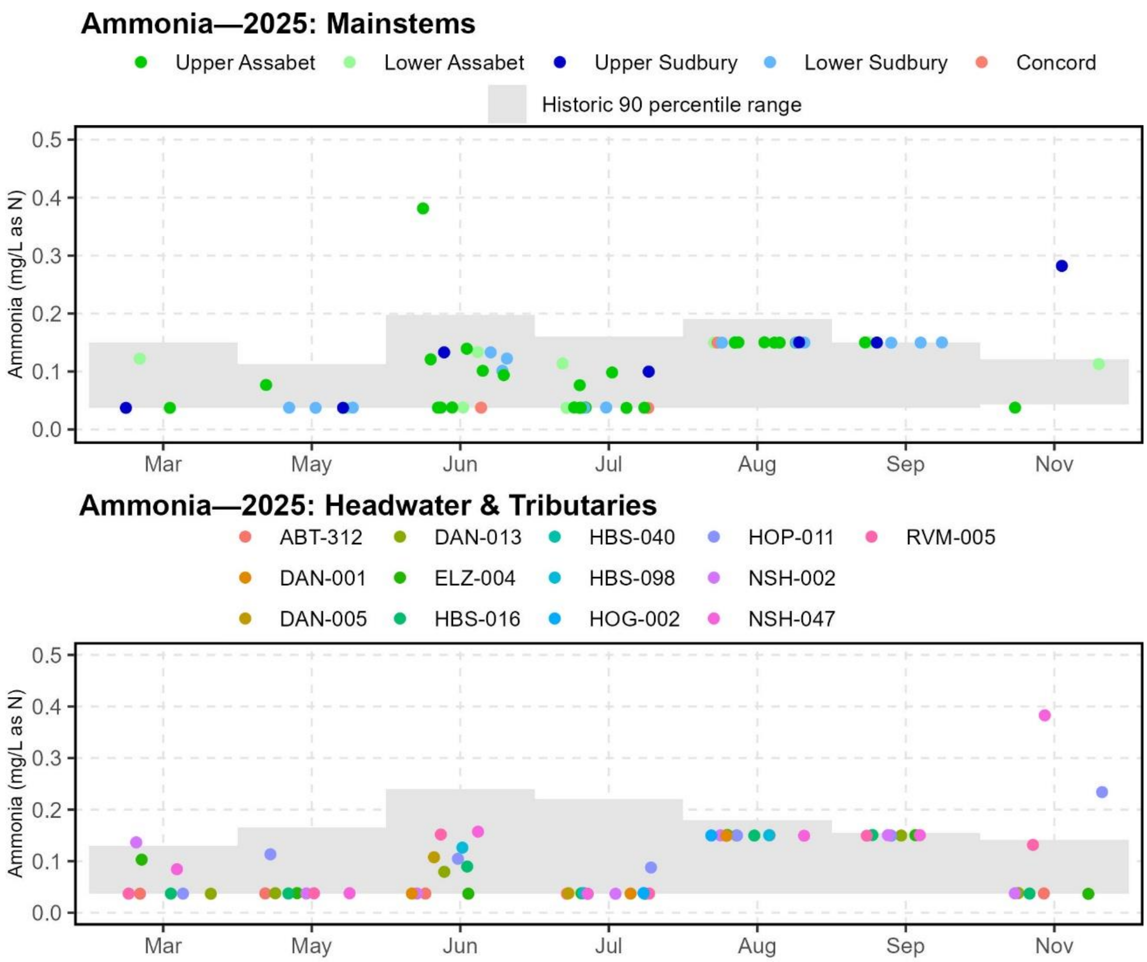

Figure 53. Ammonia concentration by month and site (2025)

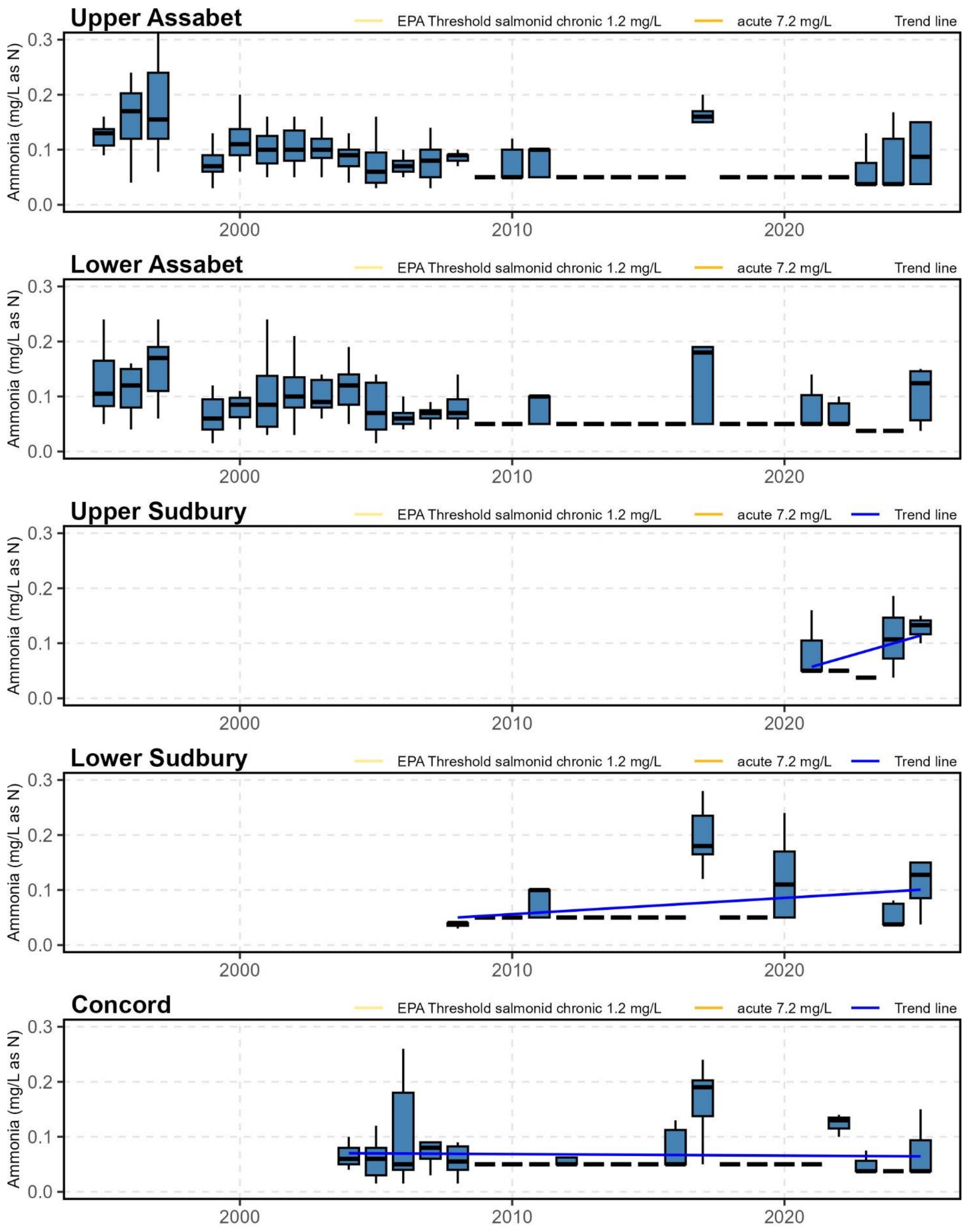

Figure 54. Ammonia concentration by year and section (June/July/August)

Total Suspended Solids (TSS)

Importance of total suspended solids: measures all non-dissolved particulates in the water, including pollutants, soil, silt and clay, and organic matter. Water with higher total suspended solids can have increased temperature and slower photosynthesis.

Threats to total suspended solids: High concentrations of total suspended solids can indicate erosion, runoff, live or decaying algae, disturbed sediment, discharge of sediment-laden water, or motorized boating. Total suspended solids can increase due to sediments in urban runoff, soil erosion, industrial discharge, or fertilizers.

Long-term trends:

Total suspended solids concentrations are usually highest in the Lower Sudbury and Concord rivers, possibly driven by motorized boating that is common in these sections. Our long-term concentration data continue to show an improving trend in all our rivers (Figure 56). Load analysis shows the effect of precipitation and high flows on total suspended solids load in 2013, 2021, and 2023 (Figure 57). In 2025, concentrations were higher than the previous year in the Sudbury and Concord Rivers, and the load was higher than the previous year in all rivers.

2025 data:

2025 total suspended solids data were relatively low, as expected from a drought year with low storm run-off. In 2025, total suspended solid levels returned to the typical range at two sites that were extreme outliers for high total suspended solids during the previous year: ABT-237 and Nashoba Brook (NSH-047). In 2024, TSS levels at most sites were generally subdued, but those two sites had elevated levels (Figure 54 and Figure 55). The Assabet River site downstream of the Marlborough Easterly Wastewater Treatment Plant (ABT-237) often has high total suspended solids levels and recorded its highest level yet in August of 2024 during the very low flows. This site is also immediately downstream of the Tyler Retarding Dam, which produces significant turbidity. Also, the Nashoba Brook Wheeler Lane site (NSH-047) recorded very high TSS levels in July of 2024 but returned to more typical levels in 2025. Historically, total suspended solid data have shown high variation at this site during low flow periods.

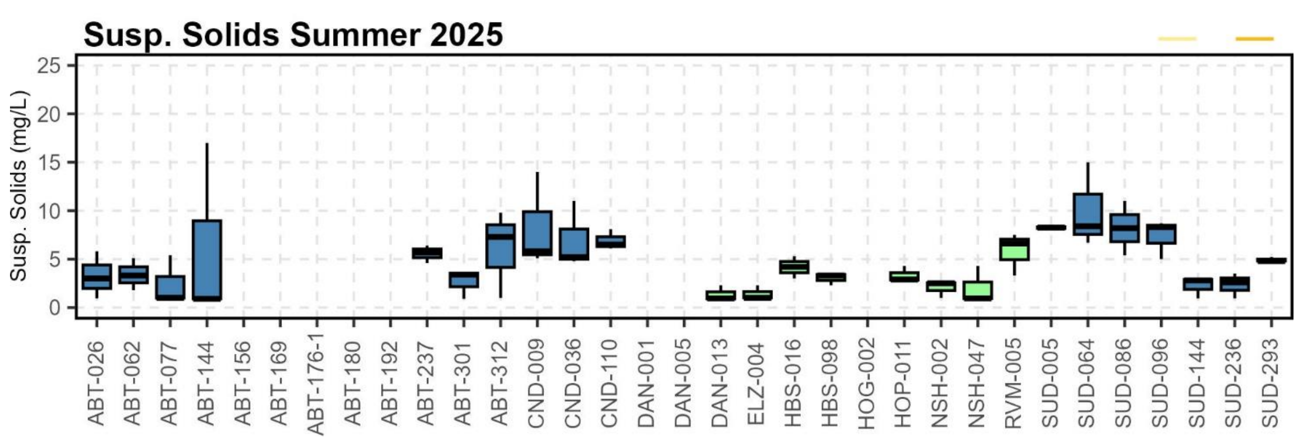

Figure 55. Total suspended solids concentrations by site, summer (Jun–Aug 2025)

The tributary sites in this by-site chart are grouped together and colored green, from DAN-013 to RVM-005. Mainstem sites are grouped by river and listed in river mile sequence from downstream to upstream.

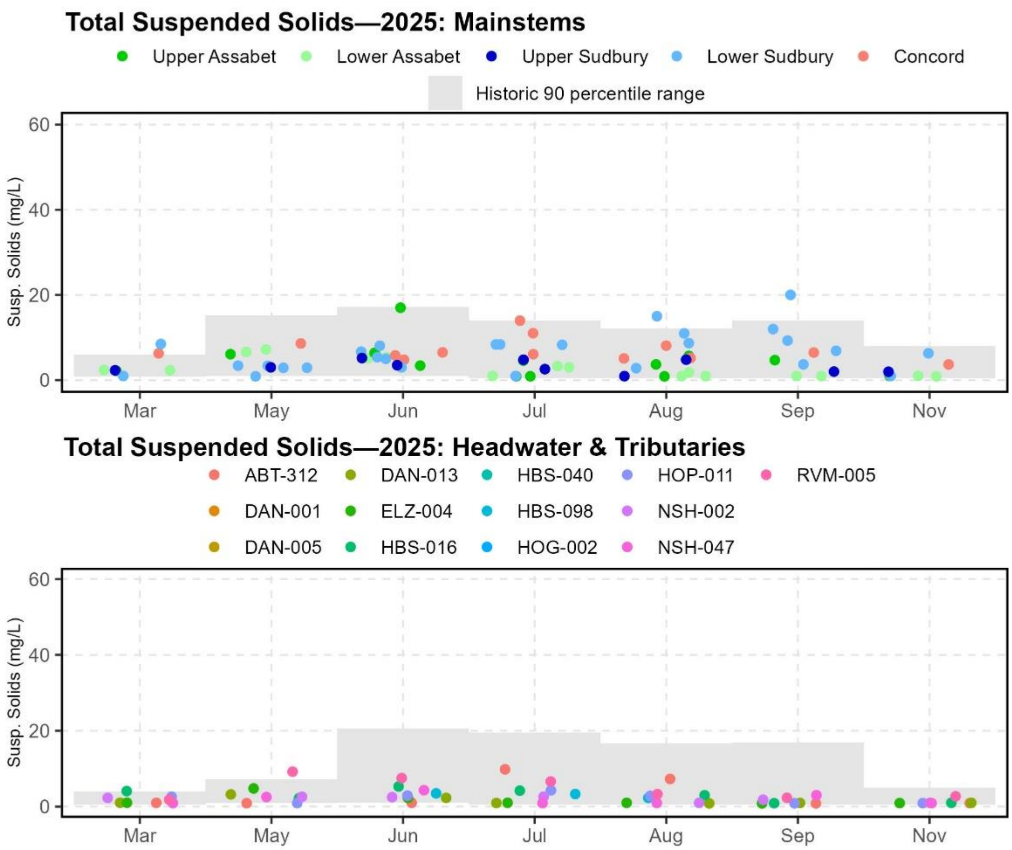

Figure 56. Total suspended solids concentration by month and site (2025)

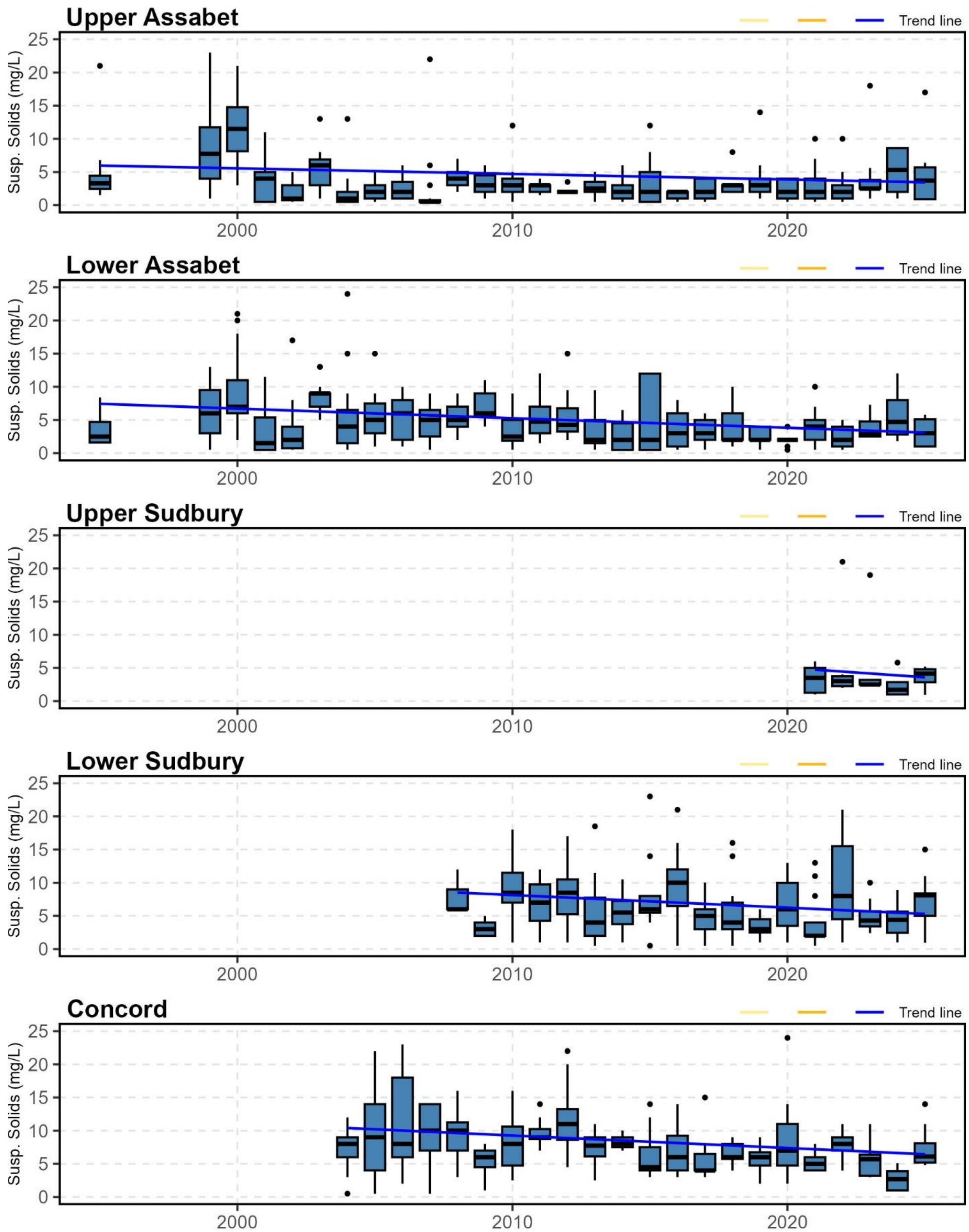

Figure 57. Total suspended solids concentration by year and section (June/July/August)

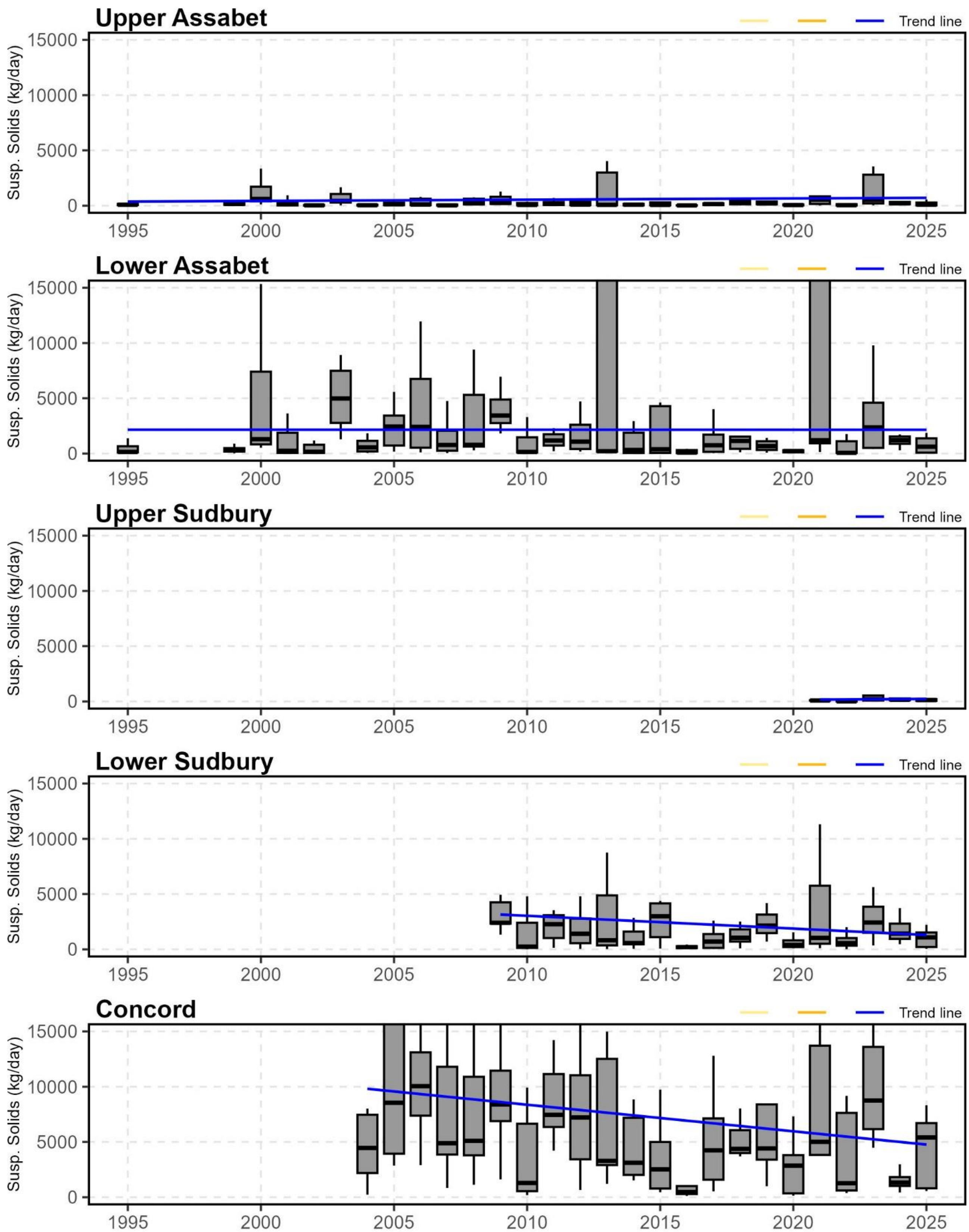

Figure 58. Total suspended solids estimated load by year and section (June/July/August)

Chlorophyll-*a*

Importance of Chlorophyll-a: Chlorophyll-a is the principal photosynthetic pigment in algae and vascular plants. Chlorophyl-a can be an indicator of eutrophication. High nutrient levels could result in algal blooms. Blue-green algal blooms are toxic to humans and wildlife.

Threats to/from Chlorophyll-a: High chlorophyll-a are an indicator of eutrophication, and concentrations tend to have a strong inverse correlation with summer rainfall.

Long-term trends:

Chlorophyll-*a* concentration gives an estimate of the biomass of planktonic algae in the river and is an indicator of eutrophication. However, rivers like the Assabet, where vegetation is dominated by large-rooted and floating aquatic plants, may have low chlorophyll-*a* concentrations and still be considered eutrophic. OARS measures chlorophyll-*a* only in the Sudbury River. There is no numeric standard for chlorophyll-*a* in Massachusetts waters. Results have been compared to the EPA Ecoregion XIV summer reference conditions (25^{th} percentile 2 µg/L, and 50^{th} percentile 4 µg/L). OARS samples for chlorophyll-*a* in the Sudbury River and Hop Brook in June, July, and August. The Concord and Assabet rivers are not sampled for chlorophyll-*a*. OARS has received anecdotal reports in recent years of dogs passing away due to blue-green algal exposure within the watershed.

2025 data:

Chlorophyll-*a* typically increases in July and August, which was true in 2025 (Figure 58 and Figure 59). Chlorophyll-*a* concentrations in the Sudbury tend to increase downstream, which was true for both 2024 and 2025. Chlorophyll-a levels can depend on temperature and flow, and they tend to have a strong inverse correlation with summer rainfall, meaning that low rainfall results in high chlorophyll-*a* concentrations (Figure 60). High chlorophyll-a levels in 2010 and 2016 skew the trendline downward, but otherwise the chlorophyll-a levels fail to show a significant trend.

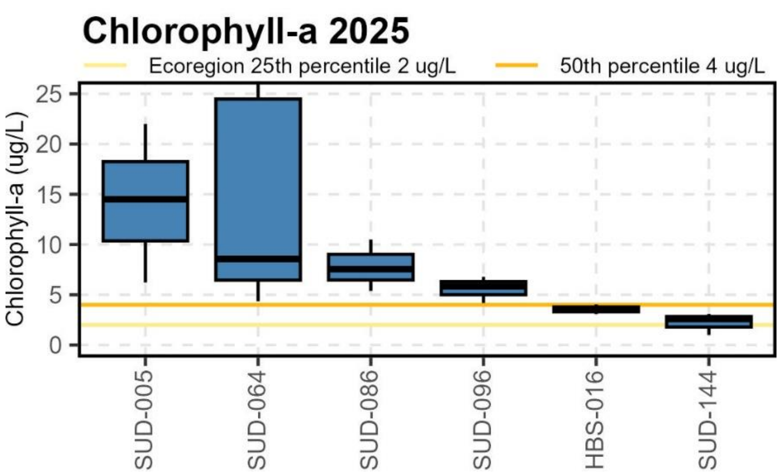

Figure 59. Chlorophyll-*a* concentration by site, summer (Jun–Aug 2025)

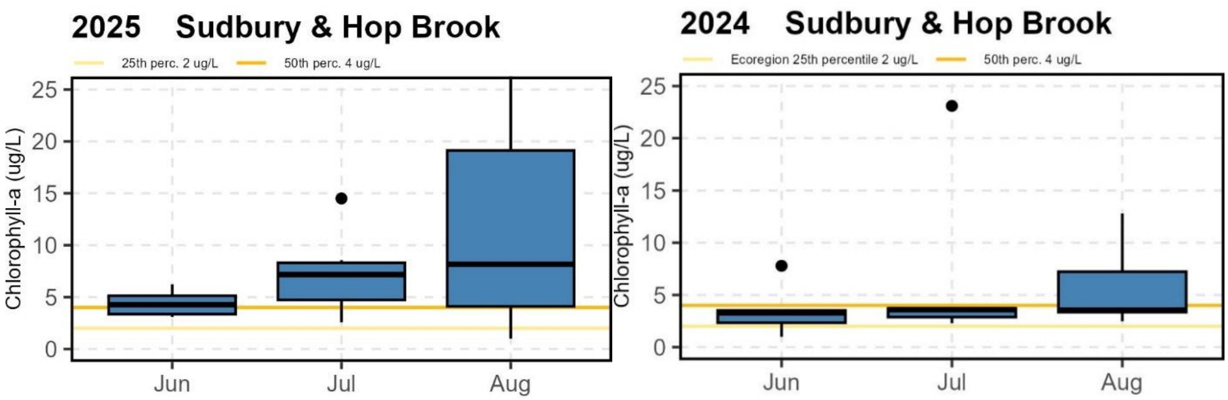

Figure 60. Chlorophyll-*a* concentration by month (2024 and 2025)

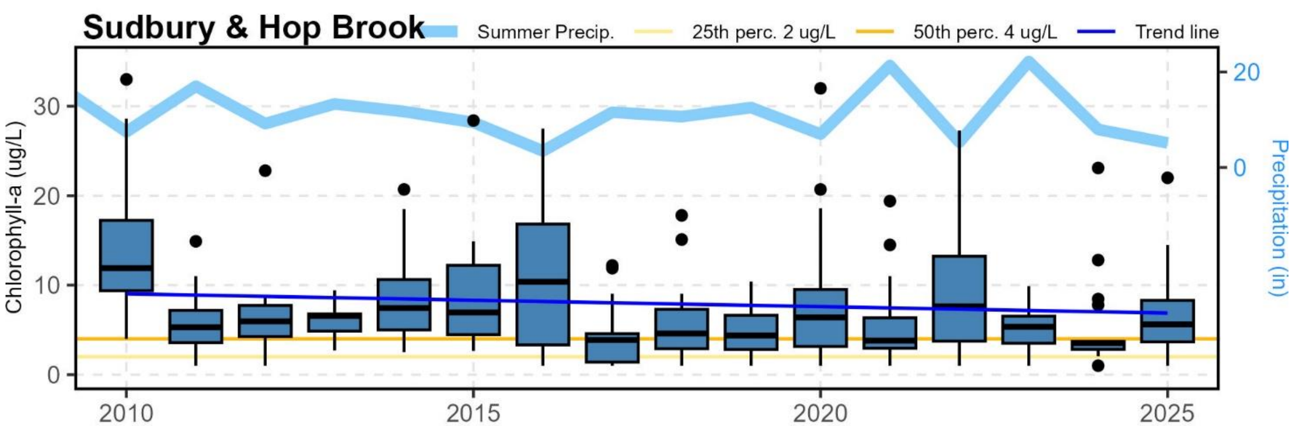

Figure 61. Chlorophyll-*a* concentration by year (June/July/August)

Hudson Water Quality Results

The Hudson Water Quality Monitoring Program objective is to provide data that will identify impaired watershed areas of Hudson. Please see the Hudson Water Quality Summer 2025 report for more information, including extensive data analysis and an overview of water quality challenges with specific recommendations for actionable steps to improve water quality in Hudson.

Thank you to Hudson residents Jason Cunha, Brooke Warrington, and Patrick Thayer, for providing the following written summary and figures in this Hudson Water Quality section:

Nitrate is the dominant and most urgent water quality concern in Hudson's reach of the Assabet. EPA ecoregion reference conditions refer to what a healthy New England stream should be under natural ecological conditions. All four mainstem sites recorded nitrate concentrations far above the EPA ecoregion reference condition of 0.31 mg/L. The Westborough, Marlborough Westerly, and Hudson Waste Water Treatment Plants discharging upstream on the Assabet are possible point source pollutants, while non-point source pollutants may include stormwater, lawn fertilizers, and septic systems. Nitrate discharge from wastewater treatment plants is monitored under NPDES permits but is not subject to numeric effluent limits, unlike phosphorus which has had a Total Maximum Daily Load (TMDL) since 2004.

Dissolved oxygen impairment was documented at two sites throughout the summer. Danforth Brook at the Apsley Street Bridge (DAN-005) recorded near-anoxic conditions in all three sampling events, with a mean DO of just 1.13 mg/L, which is far below the MassDEP Class B minimum of 6 mg/L and lethal to most aquatic life. The Fossile Conservation Land site (ABT 192) on the Assabet mainstem also recorded consistently impaired DO (mean 3.56 mg/L) throughout the summer, with the June reading near-anoxic at 1.99 mg/L.

Total phosphorus was near, but mostly within, the Assabet TMDL target of 0.05 mg/L, with June readings most frequently exceeding it.

Specific conductance is uniformly elevated watershed-wide, with all sites recording values substantially above reference conditions. This is consistent with the long-term salinization trend documented by OARS across the entire SuAsCo watershed, driven primarily by road salt. Wastewater Treatment Plants also contributes to elevated conductance at mainstem sites. The Wheeler Road Conservation Land tributary (ABT-176-1) was the program's most ecologically distinctive site. It is a cold, well-oxygenated groundwater-fed flow with temperatures 6-9 degrees Celsius below adjacent mainstem sites. This cold-water refugia function is ecologically valuable, though a persistent nitrate signal (mean 0.675 mg/L, stable across all three events) warrants investigation given the legacy tanning dump site upstream on conservation land.

Site	Location	Temperature (°C) *(Class B)*	pH *(Class B)*	DO (mg/L) *(Class B)*	Sp. Cond. (µS/cm) *(reference)*	Nitrate (mg/L) *(reference)*	Total P (mg/L) *(reference)*	Overall Status
ABT-192	Fossile Conservation Land	**19.7**	**7.05**	**3.56**	**848**	**1.56 (Jun-Jul mean); ND (Aug)**	**0.043**	**Concern**
HOG-002	Tripps Pond	**21.0**	**6.79**	**6.62**	**1,062**	**0.239 (Jun/Aug mean); ND (Jul)**	**0.051**	**Moderate**
ABT-180	Downtown Riverwalk	**22.6**	**7.48**	**8.34**	**1,207**	**5.81**	**0.044**	**Moderate / Concern**
DAN-001	Bruce's Pond Outlet	**19.9**	**7.15**	**7.60**	**519**	**0.317**	**0.027**	**Good**
DAN-005	Apsley St. Bridge	**19.5**	**6.50**	**1.13**	**605**	**0.330 (Jun); ND (Jul, Aug)**	**0.045**	**Critical**
ABT-176-1	Wheeler Road Trib.	**14.4**	**6.75**	**9.17**	**1,000**	**0.675**	**Non-detect (all events)**	**Mixed**
ABT-169	Main St. Bike Path	**21.7**	**7.31**	**6.97**	**1,193**	**5.56**	**0.036**	**Concern**
ABT-156	WWTP Area	**21.7**	**7.19**	**5.97**	**1,165**	**5.16**	**0.041**	**Concern**

Note: Values are 3-event seasonal means (June–August 2025). "ND" = lab non-detect; nitrate means use detect events only, with ND events shown separately.

Note: DO at ABT-180 reflects early-morning sampling (~6:15am) near the Washington Street Dam and may miss overnight DO lows in nutrient-enriched reaches. See Section 4.5.

Note: Temperature and DO are seasonal means. DAN-001 and DAN-005, on cold-water Danforth Brook, are held to stricter Class B limits (DO ≥6.0 mg/L; temperature ≤20°C, vs 28.3°C for warm-water sites). Both average just under 20°C though individual mid-summer readings exceeded it; the criterion is the seven-day mean of daily maximum, not a single reading, and naturally occurring exceedances are not violations (314 CMR 4.03(5)). Under the stricter DO bar, DAN-001 (7.60 mg/L) passes while DAN-005 (1.13 mg/L) falls critically short.

Note: All sites fall within the Class B pH range (6.5–8.3); DAN-005 sits at the 6.50 lower boundary, its August reading (6.42) within the 0.5-unit natural-background allowance.

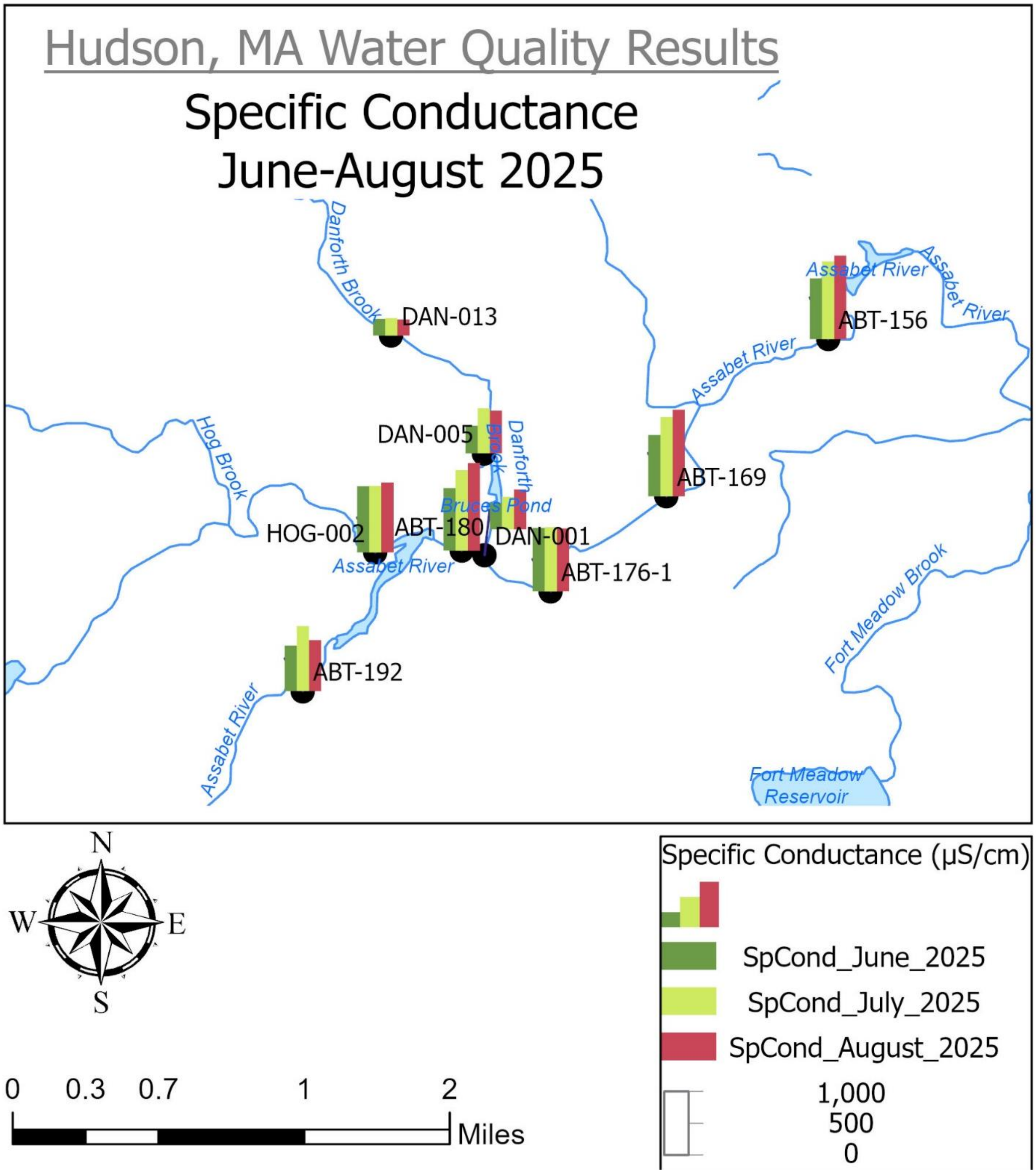

Figure 62. Specific conductance data for Town of Hudson, June, July and August, 2025. Figure by Jason Cunha, Brooke Warrington and Patrick Thayer.

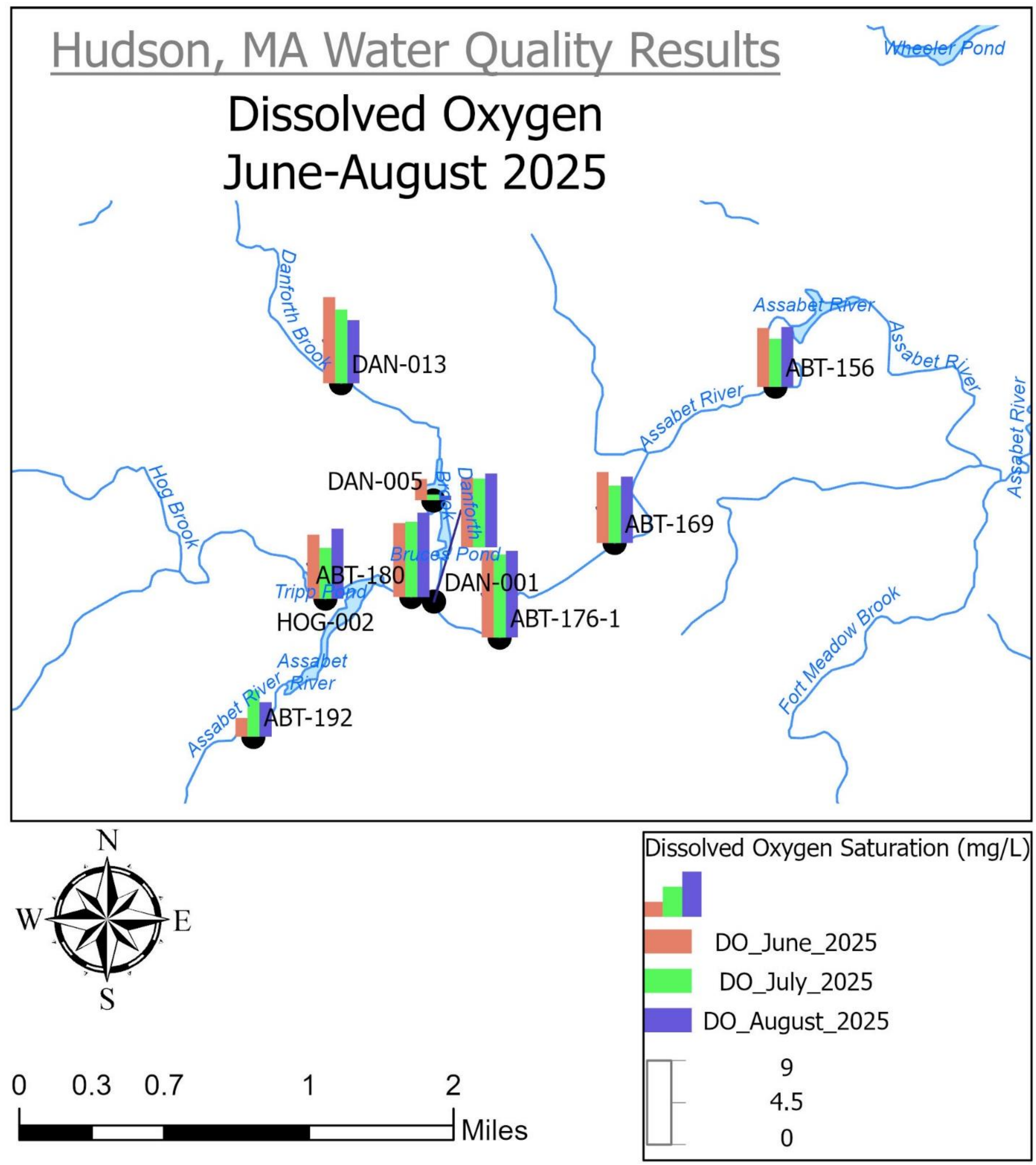

Figure 63. Dissolved oxygen data for Town of Hudson, June, July and August, 2025. Figure by Jason Cunha, Brooke Warrington and Patrick Thayer.

Bacteria Results

Importance of E. coli: Escherichia coli (*E. coli*) bacteria are an indicator of fecal contamination in water bodies.

Threats by E. coli: Escherichia coli (*E. coli*) concentrations pose a public health risk, with the potential to cause symptoms ranging from diarrhea and vomiting to kidney failure, depending on the strain.

Escherichia coli (*E. coli*) monitoring is critical for effective watershed management and recreational water protection. *E. coli* bacteria are an indicator of fecal contamination in water bodies (U.S. Geological Survey, 2018). OARS has been tracking *E. coli* levels on the Sudbury-Assabet-Concord watershed to identify *E. coli* levels at hot spots. In 2025, OARS tested 126 water samples for *E. coli* across 14 sites along the Assabet, Sudbury and Concord rivers, as well as River Meadow Brook in Lowell (a tributary to the Concord River) in Massachusetts, to evaluate where *E. coli* levels exceed any of the six safety thresholds for recreational uses, including swimming and boating. Volunteers collected samples at 14 sites on nine collection days from mid-May to mid-September 2025 on a biweekly schedule.

The Sudbury, Assabet and Concord Rivers are considered safe for secondary recreation, which includes boating and fishing but not eating the fish. Some sites, however, fail to meet safety thresholds for swimming. At three sites, *E. coli* exceeded the MA Surface Water Quality Standard based on primary contact (swimming) calculated by the geometric mean of data: Rt. 135 in Ashland (SUD-236), Rogers St Bridge in Lowell (CND-009) and Lawrence St. in Lowell (RVM-001). These three areas do not offer public swimming areas. On the one tributary stream monitored in 2025, *E. coli* concentrations at the River Meadow Brook site at Lawrence St., Lowell (RVM-001) exceeded the Massachusetts Secondary Contact Recommendation (boating) calculated with the 5-Sample Running Geometric Mean. High-precipitation days during low-precipitation years tend to have the highest median *E. coli* levels. OARS will continue to monitor bacteria levels and work with municipalities to provide data that informs decision-making for the health of the watershed.

See Appendix V for geomean analysis of bacteria data.

Please read the full OARS 2025 bacteria report at:
https://oars3rivers.org/wp-content/uploads/2026/07/Bacteria-Monitoring-Summary-2025.pdf

Table 7. OARS *E. coli* (CFU/100 mL) Results, 2025.												
Site #	Description	Town	River	12 May	27 May	16 Jun	30 Jun	14 Jul	28 Jul	18 Aug	2 Sep	15 Sep
ABT-033	Rt. 62 Pump Stn.	Concord	Assabet	147	82	172	155	99	52	63	52	28
ABT-077	USGS gage	Maynard	Assabet	162	68	248	156	72	116	613	172	142
ABT-079	Walnut St Bridge	Maynard	Assabet	185	102	113	162	144	378	579	345	387
ABT-080	Main St and Walnut St	Maynard	Assabet	249	111	108	111	125	172	435	308	112
ABT-084	Maynard Town Hall	Maynard	Assabet	172	93	105	135	81	58	50	16	102
ABT-089	Rt. 117	Maynard	Assabet	261	104	81	44	53	58	84	17	36
ABT-176	Wheeler Rd	Hudson	Assabet	345	140	326	436	236	158	125	135	148
SUD-004	Nashawtuc Rd	Concord	Sudbury	86	55	93	78	140	83	66	58	54
SUD-144	Sudbury Landing	Framingham	Sudbury	69	99	88	166	158	219	210	179	201
SUD-177	Kellog St	Framingham	Sudbury	131	133	328	291	272	76	50	42	70
SUD-236	Rt 135	Ashland	Sudbury	162	75	921	365	548	1986	167	261	210
CND-009	Rogers St Bridge	Lowell	Concord	199	120	178	326	580	186	411	387	178
CND-093	Rt 4 Carter Ave	Billerica	Concord	146	93	46	12	54	51	10	14	12
RVM-001	Lawrence St.	Lowell	River Meadow	144	411	488	1203	411	1414	649	687	219

Table Legend:
Dark Red Highlighting: sample concentration exceeds recommended boating levels (Recommended that 90% of samples ≤1260 CFU/100 ml.)
Medium Highlighting**:** sample concentration exceeds Massachusetts Surface Water Quality Standard based on primary contact, such as swimming. (Recommended that 90% of samples ≤410 CFU/100 ml.)
Light Orange Highlighting**:** Sample concentrations exceeding the Beach Action Value (BAV) of 235 CFU/100 ml.

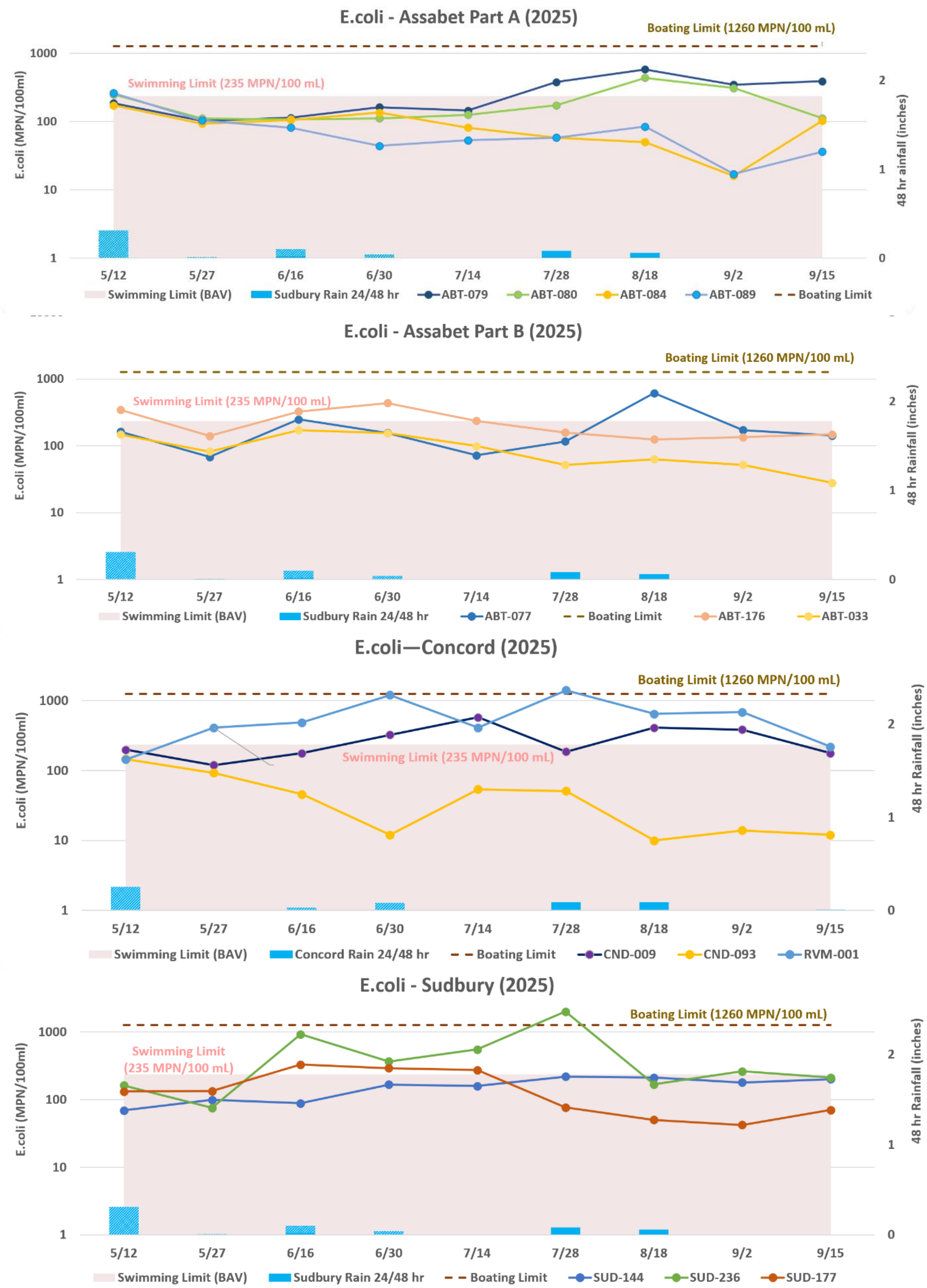

Figure 64. Graphical view of bacteria vs. rainfall (2025)

Conclusions

The overall water quality in the Sudbury-Assabet Concord Watershed has significantly improved over the past 40 years. Improvements in phosphorus and total dissolved oxygen have improved local water quality thanks to increased water treatment by wastewater treatment plants within the watershed. OARS has played a major role in advocacy for setting legal limits through measures such as Total Maximum Daily Load regulations for wastewater treatment plants. OARS has pushed successfully for meaningful changes, both through the court system and through our community education and volunteer programs.

Water quality has somewhat declined over the past six years primarily due to the impact of drought and flood cycles. In particular, from 2018 to 2025, recent declines in the water quality in the Lower Sudbury and Concord rivers have been driven by the impact of drought, heavy precipitation, and flooding on phosphorus concentrations and dissolved oxygen. In the Assabet, the water quality has had an upward improving trend, but the Upper Assabet continues to have water quality issues due to nitrate discharges from the Westborough Wastewater Treatment Plant. Between 2014 and 2018, there were four years with average precipitation and one drought year. In comparison, between 2020 and 2025, there were three major drought years and two major flood years. Both droughts and floods have adverse impacts on phosphorus and dissolved oxygen.

Most challenges to water quality in the watershed are caused by humans, especially human waste and development. Bacteria hot spots continue to challenge our watershed, and OARS provides information to help towns identify bacteria locations with potential sewage contamination so that towns can work towards solving these issues. The Hudson Wastewater Treatment Plant struggled significantly in 2024 and 2025 with discharge permit violations for multiple water quality parameters, especially for phosphorus. Combined sewage overflows continue to pollute the water by releasing untreated sewage into the Concord River at Warren Station in Lowell, which is an Environmental Justice Community with a high minority population. There is significant work to be done to monitor these challenges and work with communities towards meaningful solutions to these challenges in our watershed.

Monitoring and protecting the watershed is important work that must continue. OARS' Ecological Restoration Program actively manages projects to remove outdated and dangerous dams that harm water quality and wildlife habitats within the watershed. In 2026, OARS led the new SuAsCo Climate Collaborative, a voluntary partnership of 36 watershed communities working together to address climate change. For additional information about long-term water quality and ecological trends in the watershed, OARS releases a River Report Card once every five years. OARS will continue to monitor water quality trends, to educate community members, and to provide publicly available scientific data for the communities we serve.

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Appendix I

Long-term Trend Analysis

Summer (June/July/August) trends have been analyzed for most parameters from 1992 to the present (where available). Over the years, the list of actual sites has evolved significantly, so it is important to understand which sites have been added or discontinued over the trend time-period. Sites that are less than 0.1 river miles apart and where there are no significant river changes (e.g., tributaries joining) were considered the same (e.g., ABT-311/ABT-312). **Table** 2 lists the long-term sites used and their sections.

Table 7: OARS Water Quality Sites, 1992-2025

Sections	Sites	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Assbt. Head	ABT-311/ABT-312	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Upper Assabet	ABT-301	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ABT-280					X	X	X	X	X	X	X	X	X	X	X	X	X	X																
	ABT-263/ABT-262								X	X	X																								
	ABT-253/ABT-252								X	X	X																								
	ABT-242	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																
	ABT-238/ABT-237	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ABT-220								X	X	X																								
	ABT-196					X	X	X	X	X	X																								
	ABT-182								X	X	X																								
	ABT-159									X	X																								
	ABT-144*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lower Assabet	ABT-077	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ABT-065	X	X	X	X	X	X	X	X																										
	ABT-063/ABT-062								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ABT-047								X	X																									
	ABT-044									X	X																								
	ABT-033	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																
	ABT-026	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ABT-010								X	X	X	X	X	X	X	X	X	X	X	X	X	X													
Concord	CND-009													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	CND-036																														X	X	X	X	X
	CND-045																	X	X	X	X	X	X	X	X	X	X	X	X	X					
	CND-093													X	X	X	X																		
	CND-110																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	CND-161													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Lower Sudbury	SUD-005																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	SUD-064																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	SUD-086																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	SUD-096																					X	X	X	X	X	X	X	X	X	X	X	X	X	X
	SUD-098																		X	X	X	X													
	SUD-144																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Upper Sudbury	SUD-236																														X	X	X	X	X
	SUD-293																														X	X	X	X	X
Hop Brook (Sudbury)	HBS-016																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	HBS-098																														X	X	X	X	X
Nashoba Brook	NSH-047																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NSH-002											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
River Meadow Brook	RVM-005													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	RVM-038													X	X	X	X	X	X																
Other Tributary Streams	HOP-011											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NTH-009											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
	DAN-013											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	ELZ-004											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	CLD-030											X	X	X	X	X	X	X	X																
	FTM-012											X	X	X	X	X	X																		
	SPN-003											X	X	X	X	X	X																		

* ABT-144 was moved from above to below the Gleasondale dam in 2000.

Appendix II

StreamStats Drainage Basin Statistics

	Statistics at Mouth of River or Tributary[a]				
Mainstem Rivers Headwaters Tributary Streams	Latitude/Longitude at Mouth	Drainage Area (sq.mi.)	Stratified Drift Area (sq.mi.)	% area stratified drift	Slope [b] (%)
Assabet River	42.4652/-71.3596	177.81	73.00	41.1	3.01
Assabet @ Maynard St, Westboro	42.2741/-71.6322	7.16	1.72	24.0	3.67
Hop Brook (Northborough)	42.2887/-71.6449	7.87	2.09	26.6	3.57
Cold Harbor Brook	42.3238/-71.6413	6.86	1.97	28.7	5.01
North Brook	42.3576/-71.6188	16.89	4.12	24.4	4.38
Danforth Brook	42.3897/-71.5666	7.17	2.06	28.7	3.58
Fort Meadow Brook	42.3975/-71.5169	6.25	1.76	28.2	3.77
Elizabeth Brook	42.4217/-71.4776	19.09	6.93	36.3	3.73
Nashoba Brook	42.4592/-71.3942	48.05	19.05	39.7	2.29
Sudbury River	42.4637/-71.3578	162	49.13	30.3	2.52
Sudbury @ Cedar St, Hopkinton	42.2649/-71.5364	20.8	8.51	40.9	3.22
Hop Brook (Sudbury)	42.3627/-71.3733	22.0	14.5	65.9	2.44
Concord River	42.6351/-71.3015	400.0	197.97	49.5	2.63
River Meadow Brook	42.6318/-71.3087	26.32	16.18	61.5	1.91

[a] Calculated using USGS's StreamStats program, 2025 (**streamstats.usgs.gov/ss/**)

[b] Slope is the mean basin slope calculated from the slope of each grid cell in the designated basin (1:250K DEM).

Appendix III Mainstem Statistics

2025 Statistics—Mean values

	Reach	# Sites	Temp (°C)	DO % Sat	DO Conc (mg/L)	Cond (µS/cm)	pH	TSS (mg/L)	TP (mg/L)	ortho-P (mg/L)	NO_3-N (mg/L)	NH_3-N (mg/L)	Cl- (mg/L)	Chl (µg/L)
March 23, 2025	Concord	1	8.6	97.10	11.32	481.70	7.10	6.30	0.044	0.003	0.388			
	Lower Assabet	2	7.8	96.95	11.53	526.50	7.24	2.35	0.033	0.003	0.688	0.122		
	Upper Assabet	1	7.9	90.00	10.66	792.00	7.27	2.20	0.023	0.003		0.038	170	
	Lower Sudbury	2	7.9	93.45	11.09	234.65	7.09	4.75	0.031	0.004	0.050			
	Upper Sudbury	1	5.7	64.80	8.12	396.60	6.60	2.30	0.022	0.003		0.038		
May 11, 2025	Concord	1	14.6	90.80	9.22	426.30	6.94	8.60	0.061	0.016	0.325			
	Lower Assabet	2	13.0	90.65	9.54	305.10	6.82	6.90	0.059	0.018	0.250	0.038		
	Upper Assabet	1	14.7	90.40	9.15	449.00	6.98	6.10	0.035	0.003		0.077	83	
	Lower Sudbury	5	14.7	67.86	6.88	428.54	6.82	2.70	0.036	0.007	0.087	0.038		
	Upper Sudbury	1	12.9	62.80	6.60	384.50	6.54	3.00	0.031	0.010		0.038		
June 15, 2025	Concord	3	20.0	81.90	7.44	518.33	6.85	5.70	0.066	0.013	0.633	0.038		
	Lower Assabet	3	19.4	93.77	8.60	614.00	7.23	5.43	0.051	0.014	1.192	0.086		
	Upper Assabet	4	16.6	90.03	8.77	842.50	7.09	8.93	0.034	0.009	2.904	0.053	160	
	Lower Sudbury	5	19.6	56.82	5.24	513.78	6.84	5.64	0.052	0.012	0.190	0.119		4.65
	Upper Sudbury	2	17.5	65.25	6.21	381.90	6.69	4.35	0.051	0.014	0.183	0.133		
July 13, 2025	Concord	3	25.7	83.43	6.79	703.67	7.17	10.37	0.068	0.006	0.866	0.038		
	Lower Assabet	3	25.0	92.43	7.61	787.67	7.40	2.43	0.045	0.013	1.890	0.076		
	Upper Assabet	4	21.4	87.03	7.71	1007.25	7.19	2.13	0.038	0.011	3.401	0.062	300	
	Lower Sudbury	5	25.9	66.53	5.47	546.20	6.96	6.51	0.063	0.014	0.167	0.038		8.00
	Upper Sudbury	2	22.8	55.00	4.72	315.70	6.61	3.70	0.095	0.038	0.143	0.100		

2025 Statistics—Mean values

	Reach	# Sites	Temp (°C)	DO % Sat	DO Conc (mg/L)	Cond (µS/cm)	pH	TSS (mg/L)	TP (mg/L)	ortho-P (mg/L)	NO_3-N (mg/L)	NH_3-N (mg/L)	Cl- (mg/L)	Chl (µg/L)
August 17, 2025	Concord	3	26.2	93.27	7.53	665.67	7.27	6.13	0.053	0.003	2.632	0.150		
	Lower Assabet	3	24.5	87.60	7.28	746.00	7.50	1.23	0.026	0.019	1.174	0.150		
	Upper Assabet	3	20.6	88.95	8.03	909.15	7.23	3.43	0.036	0.026	7.884	0.150	470	
	Lower Sudbury	5	23.6	70.05	5.82	692.50	7.13	9.38	0.063	0.030	0.221	0.150		15.95
	Upper Sudbury	2	22.6	53.20	4.58	683.00	6.85	2.88	0.080	0.047	0.119	0.150		
September 14, 2025	Concord	1	20.6	95.50	8.55	824.00	7.36	6.50	0.021	0.003	2.580			
	Lower Assabet	2	18.9	82.55	7.66	762.50	7.30	0.98	0.012	0.003	2.430	0.150		
	Upper Assabet	1	19.9	75.80	6.87	2108.00	7.23	4.70	0.031	0.009		0.150	470	
	Lower Sudbury	5	19.3	74.02	6.79	602.20	6.90	10.38	0.035	0.010	0.186	0.150		
	Upper Sudbury	1	15.9	59.40	5.86	646.00	6.98	2.00	0.045	0.020		0.150		
November 9, 2025	Concord	1	8.9	97.10	11.25	600.00	7.21	3.70	0.030	0.003	1.300			
	Lower Assabet	2	8.45	94.95	11.10	681.50	7.17	0.95	0.018	0.003	1.580	0.113		
	Upper Assabet	1	12.2	96.70	10.34	1239.00	7.24	1.00	0.021	0.003		0.038	280	
	Lower Sudbury	2	8.9	91.55	10.59	540.50	7.08	3.65	0.021	0.003	0.291			
	Upper Sudbury	1	8.1	65.60	7.72	510.00	6.53	2.00	0.020	0.003		0.282		

Blank = not sampled/not recorded/censored

Appendix IV Data Quality Notes

OARS' data quality objectives and data qualifiers are available in OARS' annual Quality Control Report on request (OARS, 2024).

Appendix V Water Quality Data

Full 2025 data and data history back to 1992 are available on OARS website.

Table 2. OARS *E. coli* (CFU/100 mL) Geomean of Results, 2025.

Site #	Description	Town	Geometric Mean of all Samples	Geomean 12 May	Geomean 27 May	Geomean 16 Jun	Geomean 30 Jun	Geomean 14 Jul	Geomean 28 Jul	Geomean 18 Aug	Geomean 2 Sep	Geomean 15 Sep
ABT-033	Rt. 62 Pump Station	Concord	**81**	nc	nc	nc	nc	126	102	97	76	54
ABT-077	USGS Gage	Maynard	**156**	nc	nc	nc	nc	125	117	182	169	166
ABT-079	Walnut St Bridge	Maynard	**225**	nc	nc	nc	nc	138	159	225	281	335
ABT-080	Main St and Walnut St	Maynard	**168**	nc	nc	nc	nc	133	123	162	200	200
ABT-084	Maynard Town Hall	Maynard	**76**	nc	nc	nc	nc	113	91	80	55	52
ABT-089	Rt. 117	Maynard	**63**	nc	nc	nc	nc	87	65	62	45	44
ABT-176	Wheeler Rd	Hudson	**205**	nc	nc	nc	nc	277	237	231	194	156
SUD-004	Nashawtuc Rd	Concord	**76**	nc	nc	nc	nc	86	86	89	81	75
SUD-144	Sudbury Landing	Framingham	**144**	nc	nc	nc	nc	110	138	160	185	192
SUD-177	Kellog St	Framingham	**120**	nc	nc	nc	nc	214	192	158	105	79
SUD-236	Rt. 135	Ashland	**325**	nc	nc	nc	nc	295	487	572	444	398
CND-009	Rogers St Bridge	Lowell	**253**	nc	nc	nc	nc	240	237	303	354	314
CND-093	Rt. 4 / Carter Ave	Billerica	**32**	nc	nc	nc	nc	53	43	27	22	22
RVM-001	Lawrence St.	Lowell	**501**	nc	nc	nc	nc	428	**675**	**740**	**792**	563

Table Legend:
Bold text: Geometric mean calculated from all samples
Dark Orange Highlighting: 5-Sample Running Geometric Mean concentrations exceeding the Massachusetts Secondary Contact Recommendation (boating) of 630 CFU/100 ml.
Light Orange Highlighting: 5-Sample Running Geometric Mean concentrations exceeding the Massachusetts Surface Water Quality Standard based on primary contact (swimming) of 235 CFU/100 ml shown in bold.
Purple Highlighting: Geometric mean concentrations (calculated with all samples) exceeding the Massachusetts Surface Water Quality Standard based on primary contact (swimming) of 235 CFU/100 ml shown in bold.
nc: not calculated

Appendix VI River and Tributary Classifications

MassDEP SuAsCo river segment classification by water quality criteria (MassDEP, 2021).

River	Section	Designation
Assabet	Headwaters to Westborough Wastewater Treatment Plant	Class B, Warm Water, High Quality Water
Assabet	Westborough Wastewater Treatment Plant to confluence with the Sudbury	Class B, Warm Water
Concord	Confluence of the Assabet and Sudbury to the Billerica drinking water withdrawal	Class B, Warm Water, Treated Water Supply
Concord	Billerica withdrawal to Roger's St. in Lowell	Class B, Warm Water
Concord	Rogers St. to confluence with the Merrimack	Class B, Warm Water, CSO
Sudbury	Headwaters at Cedar Swamp Pond to Fruit St. in Hopkinton	Class B, Warm Water, Outstanding Resource Water
Sudbury	Fruit St. to the outlet of Saxonville Pond in Framingham	Class B, Warm Water, High Quality Water
Sudbury	Saxonville Pond to Hop Brook	Class B, Aquatic Life, High Quality Water
Sudbury	Hop Brook to confluence with the Assabet	Class B, Aquatic Life
Tributaries	Most tributaries	Class B, Cold Water

Massachusetts Division of Fisheries and Wildlife List of Coldwater Fish Resources in the Concord (SuAsCo) basin (MassDFW, 2025). 33 Streams. *Note that MassDEP identifies 27 tributary streams as CFRs in its Sustainable Water Management Initiative viewer (MassDEP, 2012).*

Stream Name	SARIS #
Cranberry Brook	8247885
Danforth Brook	8247275
Flagg Brook	8247225
Great Brook	8247175
Hayward Brook	8248000
Hog Brook	8247325
Hop Brook (1)	8247600
Hop Brook (2)	8247825
Howard Brook	8247525
Jackstraw Brook	8248475
Landham (Allowance) Brook	8247900
Nagog Brook	8246900
North Brook	8247375
Nourse Brook	8247627
Piccadilly Brook	8248450
Pine Brook	8247950
Rawson Hill Brook	8247575
Run Brook	8247875
Second Division Brook	8247075
Sheepsfall Brook	8247250
UNT to A-1 Site (2)	8247628
UNT to Assabet River	8247260
UNT to Cranberry Brook	8247886
UNT to Great Brook	8247180
UNT to Hog Brook (Fosgate Brook)	8247327
UNT to Hop Brook	8247879
UNT to Hop Brook (2, 1; Trout Brook)	8247830
UNT to Hop Brook (2, 3)	8247855
UNT to Nashoba Brook	8246876
UNT to North Brook	8247435
UNT to Nourse Brook	8248530
UNT to Pine Brook	8247965
UNT to Second Division Brook	8247076
Wrack Meadow Brook	8247440