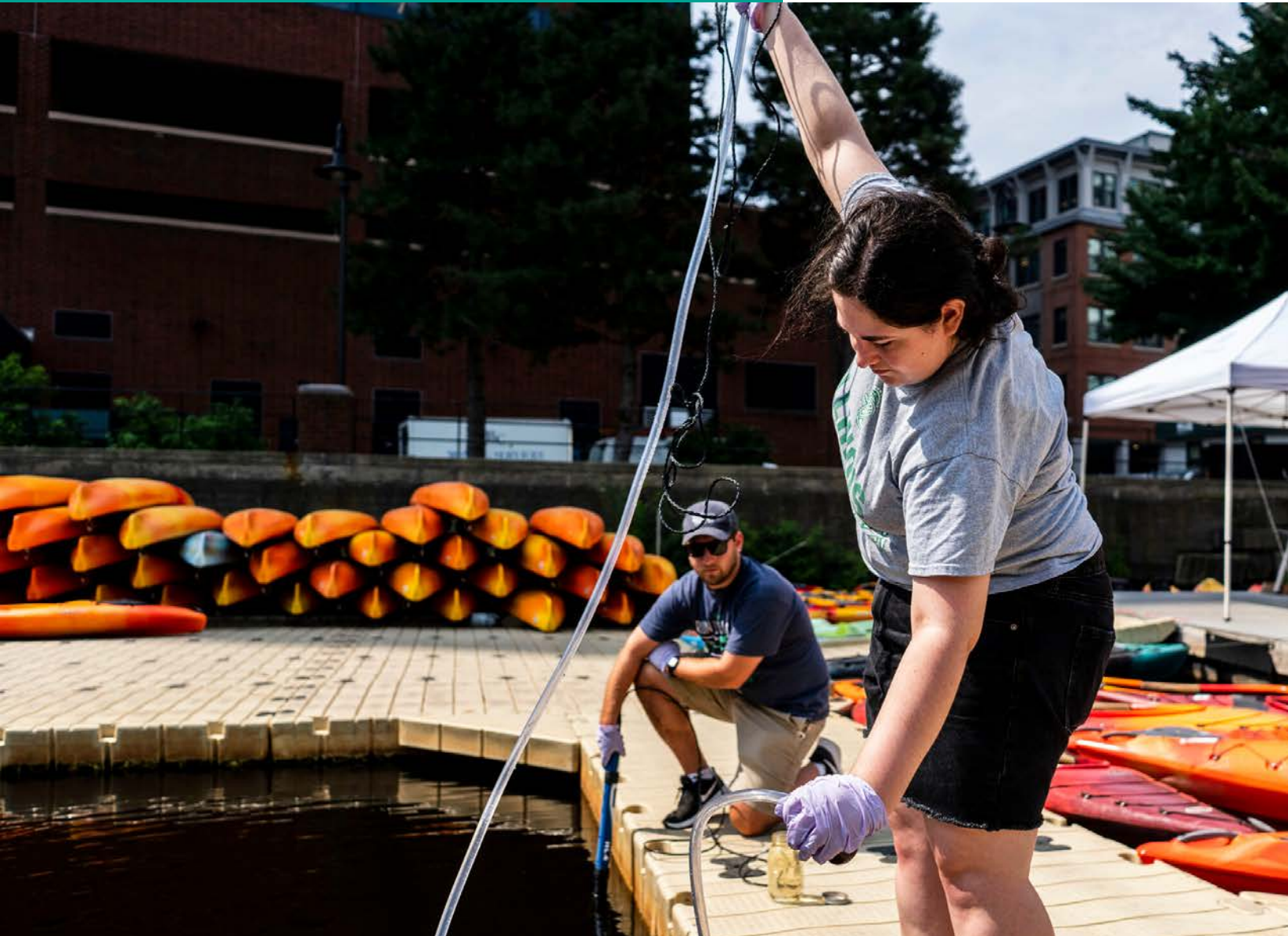




Charles River Watershed Association



RIVER SCIENCE PROGRAM

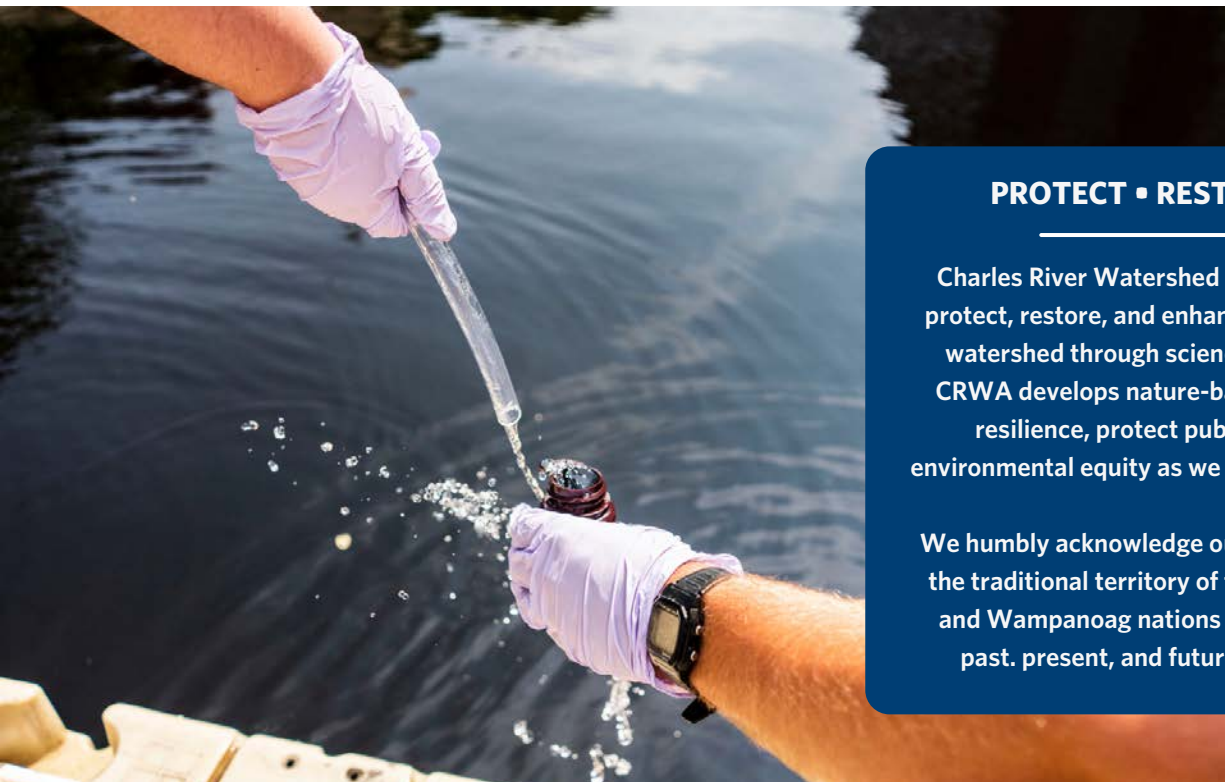
Annual Water Quality Report

JANUARY-DECEMBER 2021

MONITORING
WATER QUALITY
TO PROTECT
PUBLIC HEALTH.

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PROTECT • RESTORE • ENHANCE

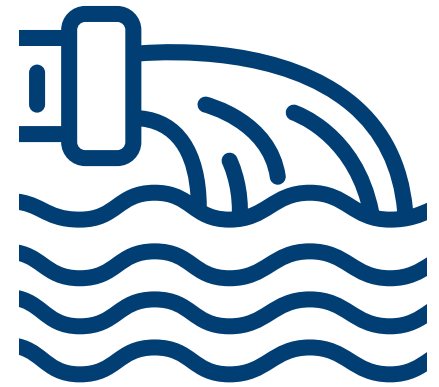
Charles River Watershed Association's mission is to protect, restore, and enhance the Charles River and its watershed through science, advocacy, and the law. CRWA develops nature-based strategies to increase resilience, protect public health, and promote environmental equity as we confront a changing climate.

We humbly acknowledge our work is carried out across the traditional territory of the Massachusetts, Nipmuc, and Wampanoag nations and recognize them as the past, present, and future caretakers of this land.

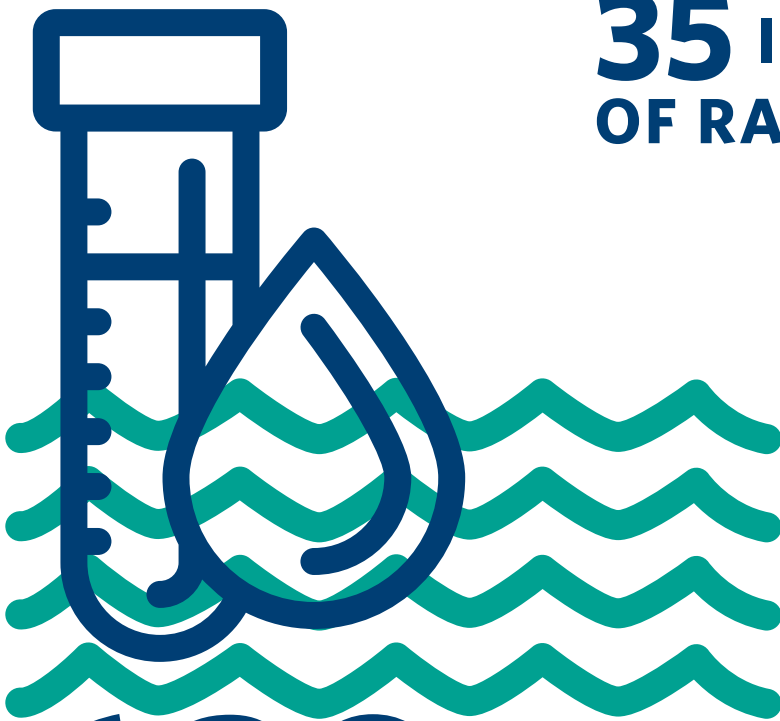
By the Numbers



35 INCHES
OF RAINFALL



53 SEWER
OVERFLOWS



629 WATER
QUALITY SAMPLES



985 TOTAL
VOLUNTEERS

121 FLAGGING PROGRAM SAMPLES · 53 CYANOBACTERIA SAMPLES · 445 VOLUNTEER MONTHLY MONITOR E.COLI SAMPLES · 10 BENTHIC MACROINVERTABRATE SAMPLES



About the River Science Program

There's no way around it- we depend on clean, healthy rivers.

Since our founding in 1965, we have witnessed the transformation of the Charles River- no longer the "Dirty Water" of the past but again a magnificent, living river thanks to the power of the Clean Water Act and decades of relentless, loving vigilance from ordinary advocates like you.

Since 1995, our River Science Program has formed the backbone of our work. Today, our work to monitor water quality to protect public health is as important as ever.

CRWA has been working to measure changes in the Charles River since 1995, and our River Science program serves as a model for watershed science programs across the country. Each year, we bring hundreds of dedicated volunteers together to monitor water chemistry, track pollution, identify cyanobacteria blooms, assess streamflow, and manage invasive plants.

As we celebrate the fifty-year anniversary of the revolutionary Clean Water Act, our commitment to sound science and closely monitoring water quality to measure changes in the Charles River is as important as ever. Climate change is bringing unprecedented challenges to our watershed- extreme heat, drought, flooding- which are already impacting water quality and threatening public health.

The data we collect is vital- both the Environmental Protection Agency and the MA Department of Environmental Protection depend on CRWA's sampling data to develop and enforce water quality standards and protect public health. And, as climate change brings more frequent cyanobacteria blooms, severe droughts, combined sewer overflows, and more- our robust understanding of water quality and quantity provides us with the data we need to advocate for protections for our communities and ensure a clean, climate-resilient Charles River for future generations.

Meet the Sampling Programs



Cyanobacteria Monitoring

CRWA monitors cyanobacteria, or blue-green algae, levels in the Lower Basin each summer. With high heat and excess nutrients, cyanobacteria levels can explode into a bloom, which has negative health effects on humans, animals, and the ecosystem. We report data to the Department of Public Health and inform river users.



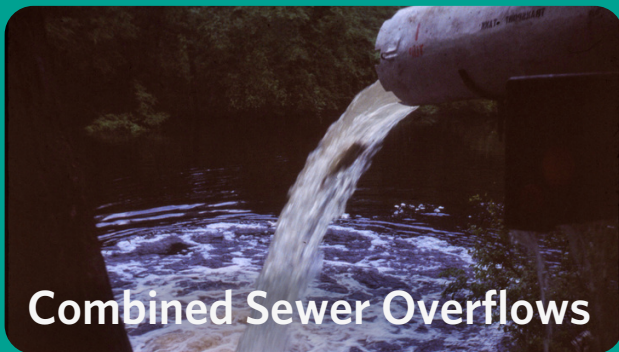
Volunteer Monthly Monitors

Since 1995, the Volunteer Monthly Monitoring Program (VMM) has been an essential part of CRWA's work. Each month, over 80 community scientist volunteers gather at 35 sites along the stem of the Charles River to collect water samples, measure temperature and depth, and record river conditions, which helps us study ecosystem health, stormwater pollution, and sewage overflows.



Flagging Program

CRWA's Flagging Program provides live notifications for boaters about the current state of the river's health from Watertown to Boston. Daily river health is predicted by models of bacteria levels, sampling results, notifications of combined sewer overflows (CSOs), and cyanobacteria blooms. Boathouses then fly red and blue flags to keep river users informed about water quality.



Combined Sewer Overflows

CRWA closely tracks combined sewer overflows (CSOs), which occur when our aging sewer systems discharge untreated wastewater into our waterways, threatening public health and ecosystem health in the Charles River. We then inform the public through our Flagging Program and monitor for ecosystem impacts.



Biological Monitoring

Biological Monitoring allows CRWA to learn about the health of Charles River tributaries. Volunteers sample benthic macroinvertebrates (BMIs), or small river bugs that live on stream beds and banks, and conduct habitat assessments to observe overall stream health. These data are then used to identify restoration projects.

E. Coli Bacteria

Escherichia coli (E. coli) bacteria species is frequently used as an indicator of water quality. High concentrations of E. coli indicate the presence of pathogens that may be harmful to human health. In 2021, CRWA's VMM and Flagging programs collected 473 E. coli bacteria samples in the Charles River and its tributaries. Here, we compare these levels to Massachusetts' Water Quality Standards for each sample: 235 cfu/100mL for primary contact (the "swimming" standard) and 1260 cfu/100mL for secondary contact (the "boating" standard).



91 VOLUNTEERS



35 LOCATIONS

**473 TOTAL
E.COLI SAMPLES**

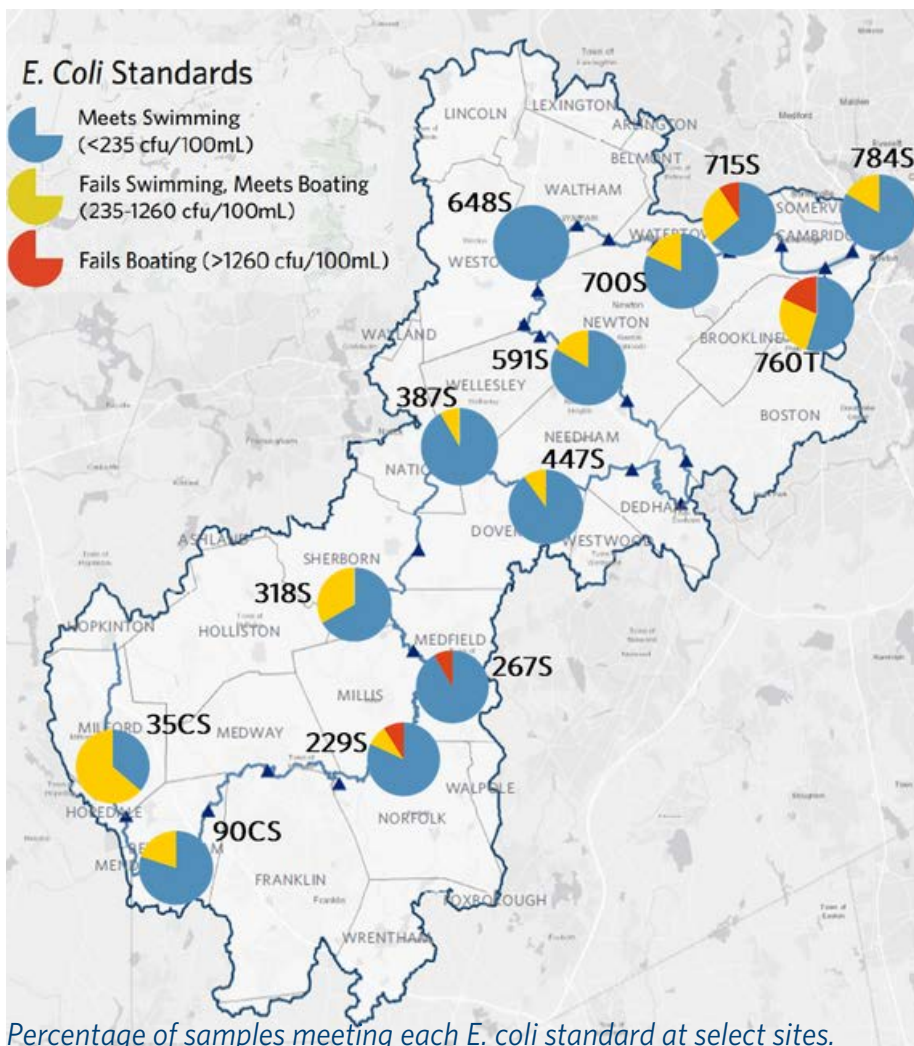
Understanding the Data

UPPER WATERSHED

As the river flows from its source in Hopkinton, it runs along the I-495 corridor, which is experiencing rapid development from the road and building constructions. Additionally, water levels in the headwaters of the Charles can get low. Less water results in more concentrated pollution.


LOWER WATERSHED

From Watertown to Boston Harbor, the river passes through high-density urban areas. In these more developed areas, rain washes pollutants from roads and buildings into storm drains that lead directly to the Charles without getting filtered. Additionally, the Lower Basin historically suffers from prolonged cyanobacteria blooms and frequent sewage overflows into the river during heavy rainfall.



Excess Nutrients

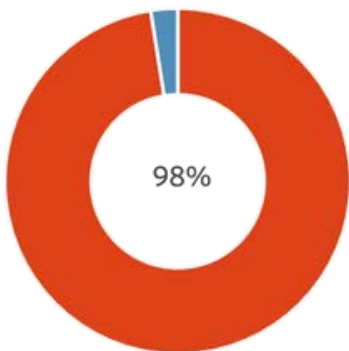
Phosphorus and nitrogen are some of the main sources of pollution in the Charles River, primarily carried to the river by stormwater runoff from the urban watershed. CRWA measures nutrients through the VMM program at 12 sites 4 times each year. When there are too many nutrients, the ecosystem is thrown off balance in a process called eutrophication. Many parts of the Charles River are eutrophic, especially during warm summer months, often causing aquatic invasive plant growth, cyanobacteria blooms, and even fish kills.



40 PHOSPHORUS
40 NITROGEN
80 TOTAL
NUTRIENT SAMPLES

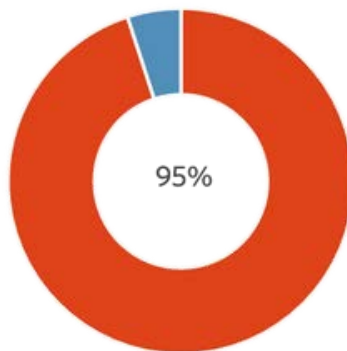


Phosphorus



Percentage of phosphorus samples exceeding the action limit of 0.0238 mg/L.

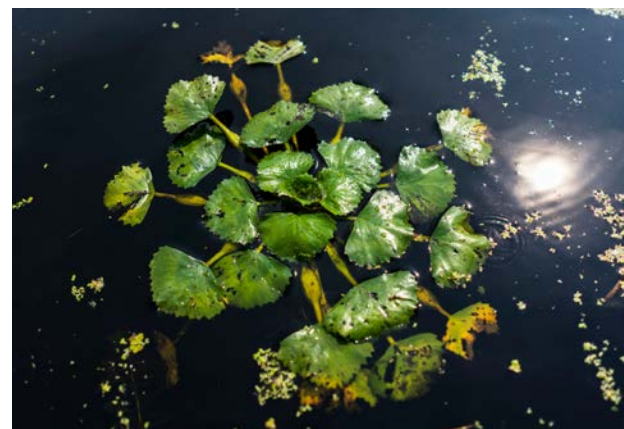
Nitrogen



Percentage of nitrogen samples exceeding the action limit of 0.57 mg/L.

Understanding the Data

The vast majority of nutrient levels were well above the 25th percentile of nutrient samples taken in rivers and streams in the northeast US (EPA, 2000), which CRWA considers an action limit. Ideally, nutrient levels would be below these thresholds to limit the effects of eutrophication on the Charles River.

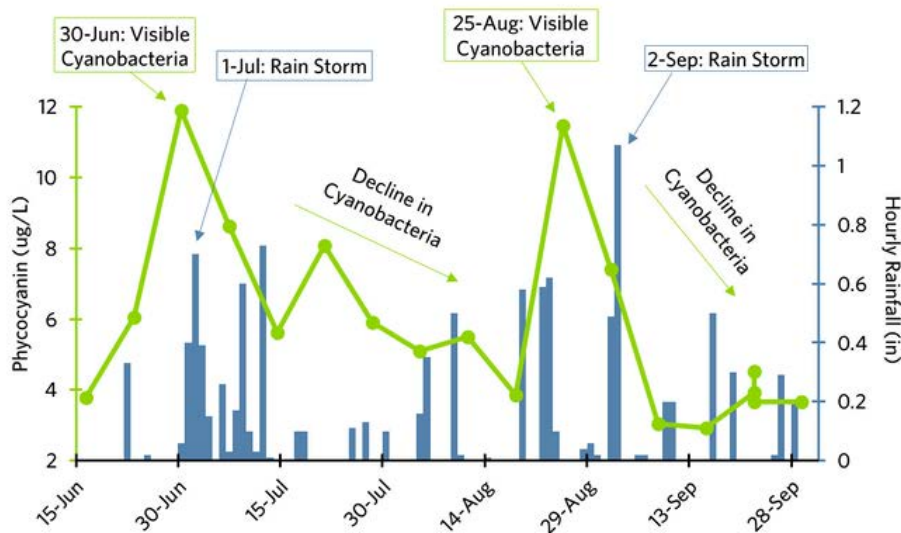


Cyanobacteria Monitoring



CYANOBACTERIA
53 SAMPLES
61 VISUAL
OBSERVATIONS

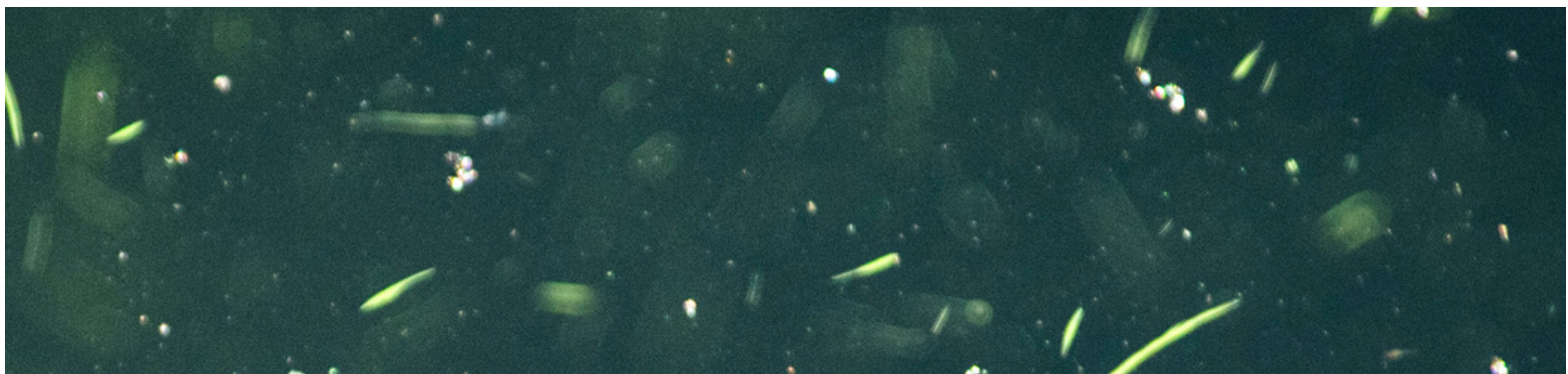
During the summer, CRWA monitors cyanobacteria concentrations at three sites in the lower Charles River. Collecting samples and making visual observations allows us to track the progression of blooms that may arise. When blooms begin, we notify the Mass. Department of Public Health (DPH), which determines if a bloom advisory should be put in place. CRWA also includes bloom notifications in our Flagging program, flying red flags when DPH recommends an advisory, as cyanobacteria toxins indicate a potential for public health risks.



Phycocyanin concentrations (cyanobacteria indicator) and hourly rainfall measured in the Esplanade lagoons in 2021.

Understanding the Data

Because of higher than normal precipitation in 2021, the Lower Basin did not experience an official cyanobacteria bloom. However, cyanobacteria concentrations did rise periodically and could be seen with the naked eye. Each time CRWA detected cyanobacteria, heavy rainfall of several extreme storms diluted cyanobacteria concentrations.



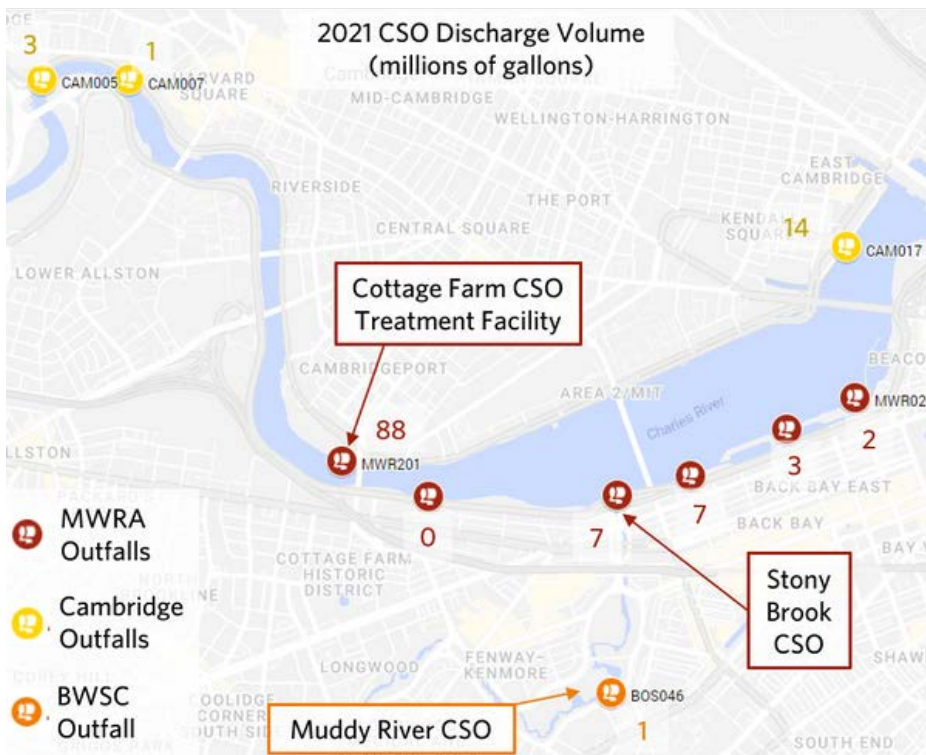
Combined Sewer Overflows



53 CSOs
RELEASED
SEWAGE FOR
OVER 172 HOURS

Combined Sewer Overflows (CSOs) occur when heavy rain and intense storms cause our outdated combined sewer system to reach capacity and overflow into local water bodies, carrying pollutants like bacteria, viruses, excess nutrients, pharmaceuticals, trash, and PFAS straight into our rivers.

There are currently ten active CSO outfalls that discharge into the Charles and Muddy Rivers that are managed by the Massachusetts Water Resources Authority (MWRA), the City of Cambridge, and the Boston Water and Sewer Commission. CRWA tracks these overflows through the newly required public notification system enacted in January 2021 and provides updates to boaters through our Flagging Program to protect public health.



Map of CSO outfall locations in the Charles River and approximate volume of sewage and stormwater discharged from each in 2021.

Understanding the Data

Because of frequent heavy storms in 2021, CSOs were triggered over 50 times, discharging over 126 million gallons of sewage and stormwater into the Charles River.

This is about the volume of 36 olympic sized swimming pools.

In contrast, during drought conditions in 2020, there were only fourteen CSOs. With climate change bringing more frequent, intense rainfall events, we will likely see more CSOs in the future.

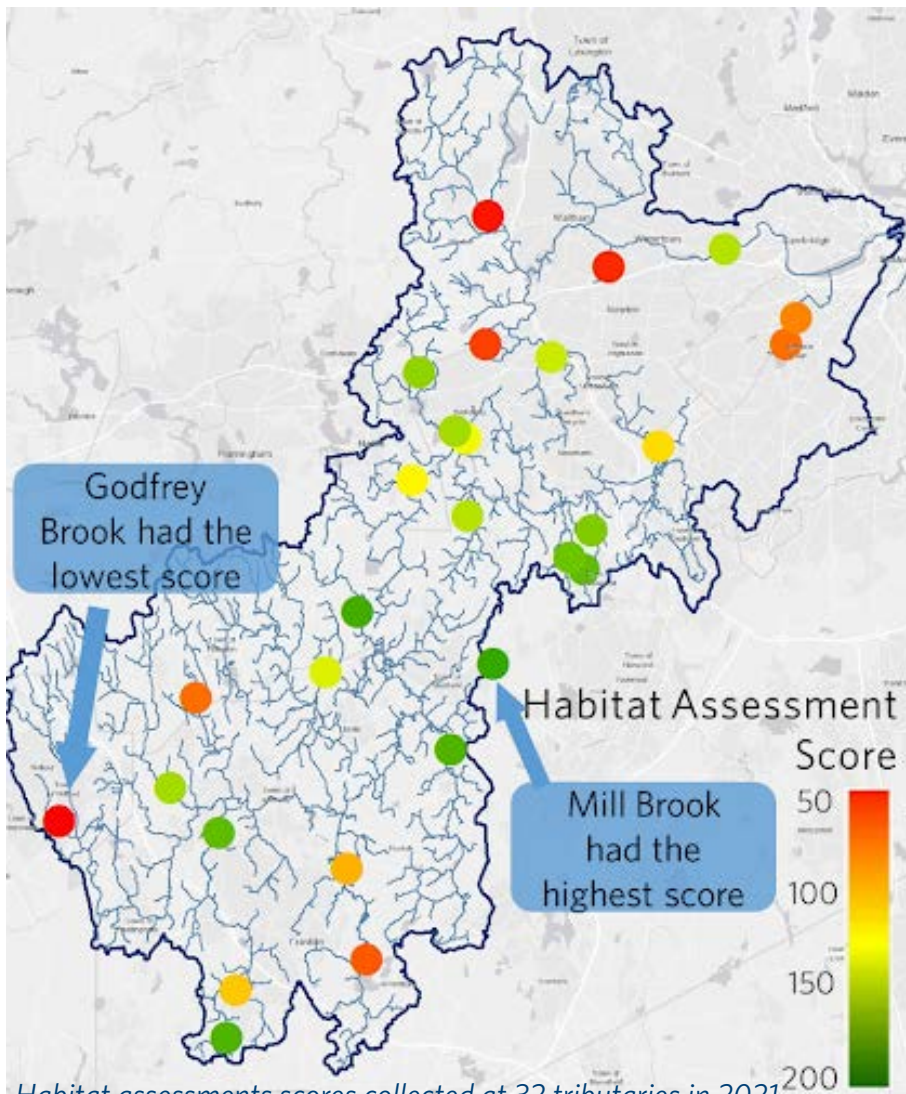
Biological Monitoring

CRWA volunteers sampled benthic macroinvertebrates and conducted habitat assessments at thirty-two tributaries throughout the Charles River Watershed to understand ecosystem health. Using EPA Bioassessment and Habitat Assessment forms, volunteers and CRWA staff translate aquatic animal and invertebrate population data and habitat assessment scores into overall water quality scores.



27 LOYAL VOLUNTEERS

32 HABITAT ASSESSMENTS



Habitat assessments scores collected at 32 tributaries in 2021.

Understanding the Data

Habitat assessment scores varied widely across the watershed- reflecting differences in land use, development, and pollution. Godfrey Brook, in the rapidly developing upper watershed near the I-495 corridor had the lowest score, and Mill Brook, which flows through conserved land and wetland areas in Dover had the highest score.





Our Changing Climate

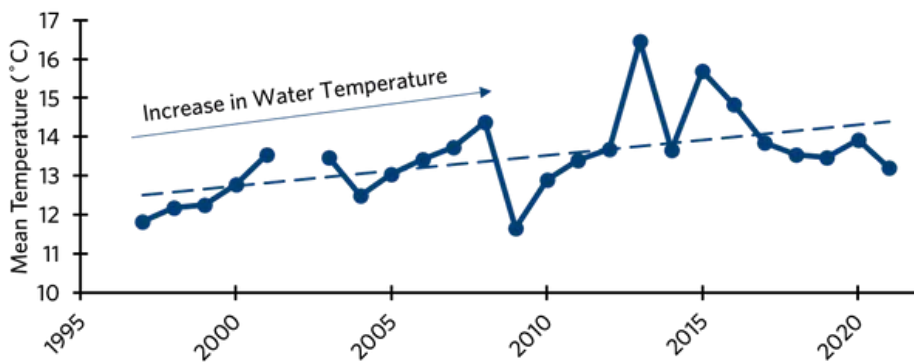
If the last year proves anything, it's that climate change isn't coming- it's here.

Our watershed saw thirty-five inches of precipitation, twenty-four days of extreme heat, and several significant localized flooding events during 2021 Flagging Season alone.

And, we can't forget the climate impacts we saw in 2020, with an extreme drought and high temperatures causing water shortages and triggering the longest cyanobacteria bloom in recent history which lasted for twelve consecutive weeks.



As our climate continues to change, our steadfast commitment to closely monitoring water quality to track changes in the Charles River is as important as ever, and it allows us to utilize our robust dataset to advocate for solutions and build resilience for our watershed and all who call it home.



Trends Over Time

Our robust dataset confirms our changing climate is already impacting the Charles River ecosystem.

Average water temperature taken each year from 35 sites in the Charles River. Trendline shows overall increase in water temperature over time.

What's Being Done

We celebrated a lot of successes in 2021, but the work is far from over. Charles River Watershed Association will continue to use sound science to develop nature-based solutions to protect public health, advocate for environmental equity, and restore a clean, resilient river for future generations.

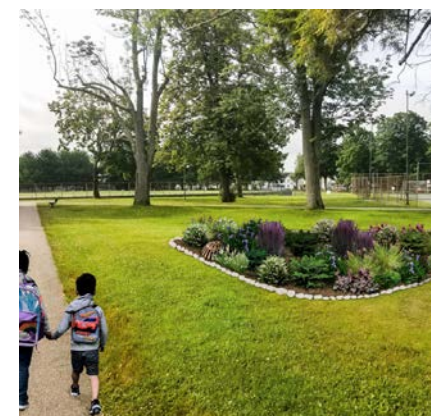


PUTTING AN END TO CSOs

We began the year with an enormous victory for water quality and public health. In January, Governor Charlie Baker signed a landmark bill that requires prompt, timely public notification of all combined sewage discharges into our waterbodies. This legislation could not come at a better time. A staggering fifty-three combined-sewer overflows released upwards of 126 million gallons of sewage into the Lower Basin of the Charles River. And these are only the ones we knew about. With thirty-five inches of heavy precipitation during Flagging Season, the fragility of our current system for managing wastewater came to light, and residents of our watershed were unjustly exposed to pollutant-laden water carrying bacteria, excess nutrients, pharmaceuticals, and even harmful PFAS compounds. The enactment of the CSO Notification Law is likely to expose even more discharges, which will be a necessary wake-up call to legislators that we cannot tolerate these harmful overflows into our waterways.

RESTORING A CLEAN, FREE-FLOWING RIVER

We launched a concerted effort to restore a clean, free-flowing, dam-free Charles River. Today, nineteen dams interrupt our river—impeding migratory fish passage, destroying the river ecosystem, upholding the legacy of colonization and dispossession of Indigenous nations, and significantly reducing the climate resilience of our river. Dam removal has always been an important part of our advocacy work, but as feasibility studies were completed for both Wrentham Eagle Dam and Watertown Dam, and the Town of Natick kicked off a discussion of the removal of the Charles River Dam at South Natick, our efforts suddenly became more tangible. We are building momentum to remove these failing, defunct mill dams to restore fish passage and heal the river ecosystem.



GREEN INFRASTRUCTURE FOR MILFORD

We often speak of nature-based solutions, but it is a unique delight to be able to implement them. Based on priority interventions identified in the Milford subwatershed restoration study completed last year, the installation of two rain gardens and infiltration chambers at Milford Town Park will have enormously positive effects on the Charles River. Green infrastructure promises the reduction of 25 pounds of nutrient pollution load into the river, 160,000 gallons, or half an acre, of groundwater recharge, and will help Milford meet required pollution reductions each year. These nature-based solutions will help provide ecological resilience, making Milford more adaptable to drought and reducing the potential for flood damage in a climate change-altered future.

What's Being Done



ASSESSING THE HEALTH OF THE NVSA

The Charles River Natural Valley Storage Area (NVSA) is a network of 8,100 acres of preserved wetlands that provides significant flood mitigation for Boston and other downstream cities and towns. With your support, along with a grant from the Massachusetts Environmental Trust, we conducted stream health assessments including a survey of fish populations, habitat assessments, and river bug sampling. We found that Dix Brook, a tributary of Mine Brook and the Charles River, is degraded and that the overall area is threatened by the many effects of development such as invasive species growth, loss of biodiversity, reduced riparian habitat, low streamflow, and poor water quality. Our work focused on an especially vulnerable priority area in the Town of Franklin and confirmed action is needed to rehabilitate coldwater fish populations, mitigate stormwater pollution, improve water quality, and restore biodiversity.

FORMING CONNECTIONS WITH WATER QUALITY DATA

CRWA has long kept tabs on water quality, but this year, we expanded public outreach and made our data more relevant and accessible to all. We celebrated the launch of the E.Coli Dashboard, a live interactive map that reveals E.Coli trends across the watershed that is available on our website. Created in collaboration with Code for Boston, the E.Coli Dashboard brings data reported in our annual EPA Report Card grades to life and greatly improves its accessibility to equip watershed residents with the knowledge and understanding to make informed decisions about their safety when getting out onto the river.



Additionally, we expanded outreach for our Flagging Program, a live notification system that uses color-coded flags to indicate whether the river’s water quality meets the boating safety standard at twelve participating boathouses between Watertown and Boston. Available to the public via flags posted at boathouses, daily email notifications, and even a Flagging Twitter bot, we are the only resource for boaters, rowers, swimmers, kayakers, and paddlers alike to determine whether they should take precautions on the river. This year, we brought our data directly to the boating community with our first in-person event in two years, welcoming community members, boaters, and local legislators to an information session at Watertown Yacht Club.



Acknowledgments

Charles River Watershed Association is immensely grateful to all of its funders, volunteers, and partners. Without you, we would not be able to continue monitoring the health of the Charles River, or effectively address the challenges caused by pollution, contamination and runoff, and climate change. Thank you for all that you do!

FUNDERS

Bilezikian Family Foundation
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MWRA Deer Island Laboratory

VOLUNTEER MONTHLY

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Terry McKiernan
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- Kerrie Grover
- Laurie Haig
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- Lily Burnham
- Lisa McDonough
- Lisa Ryan
- Lora Iliev
- Margaret Zeitouny
- Nicole Moore
- Nina Villalba
- Richard E. Curtis
- Shimin Ou
- Susan Lynch
- Thomas Trainor

CYANOBACTERIA VOLUNTEERS

- David Shubow
- Morgan Truncer
- Nicole Voss
- Erin Kane

2021 CRWA INTERNS

- Ashley Derosiers
- Sylvie Ficco
- Nik Johnson
- Neosha Narayanan
- Racheal Rodman
- Henry Torpey