

2024

Massachusetts Beach Testing Results: Annual Report



Planting Island Beach Marion, MA

Photo by Irena Draksic

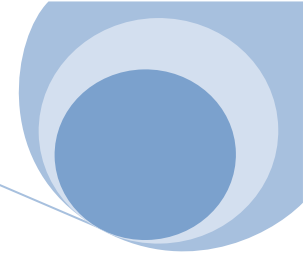
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Executive Summary

Swimming is one of the most popular recreational activities in Massachusetts (EOEEA, 2017), with over 111 million individual trips to coastal beaches annually (EOEEA, 2007). Each year, the Massachusetts Department of Public Health (DPH), Bureau of Climate and Environmental Health's Division of Environmental Toxicology, Hazard Assessment and Prevention collects beach water quality data from local health departments and the Massachusetts Department of Conservation and Recreation. This report provides a description and summary of that information.

- **Water quality:** In 2024, a total of 16,069 water samples were collected from 591 marine and 574 freshwater beach sampling locations. These locations represent 569 marine and 535 freshwater beaches statewide, with 100% of marine and 98% of freshwater beach communities reporting water quality information to DPH. Approximately 7.3% of marine samples and 4.9% of freshwater samples exceeded the Massachusetts bacterial water quality standards for beaches (described on page 2). While exceedances were above average in 2024, the overall low historical exceedance rates indicate that Massachusetts beaches generally have high water quality. Elevated bacteria accounted for 75% of beach posting days for poor water quality; additional reasons for notifications included cyanobacterial harmful algae blooms, rainfall (typically associated with elevated bacteria), and combined sewer overflows (CSOs).
- **Field data:** In 2024, nearly all water samples (99%) submitted to DPH had accompanying field data. Recent rainfall was identified as the most important factor contributing to elevated bacteria levels at recreational waterbodies. As in previous years, the exceedance rate was greatest in the 24 hours following rainfall. Pollution sources, particularly the presence of larger numbers of birds at marine and freshwater beaches, were also associated with higher levels of bacteria.
- **Public notification:** In 2024, the online [Interactive Beaches Water Quality Dashboard](#) was enhanced to include all statewide marine and freshwater beaches, which differs from the 2023 version that only covered marine beaches. Between Memorial Day and Labor Day, the new dashboard attracted over 500,000 page views and 250,000 unique viewers. This represents an increase from 2023 which experienced 65,000 page views and 45,000 unique viewers. Individuals are also notified of unsafe conditions at beaches by physical signage that beach operators are required to post. In 2024, 94% of marine and 76% of freshwater beaches complied with the public notification requirements. The lower compliance rate at freshwater beaches is likely to be a reporting failure, rather than a public notification failure, as the missed posting reports come from a small number of towns. DPH will work with these towns this coming season to improve reporting.

Introduction

Health risks to swimmers associated with poor water quality have been documented in numerous studies (Marion et al., 2010; Wade et al., 2003). Beachgoers may be exposed to pathogens through recreational activities in and around polluted waterbodies (Hlavsa et al., 2015). In the United States, most swimming-associated illnesses are caused by a variety of pathogens associated with fecal contamination (Cabelli et al., 1982; USEPA, 2012). Fecal matter can enter beach water in a variety of ways: sewage treatment system failures, combined sewer overflows, discharge of sewage by boats, re-suspension of sediments, and rainfall with resulting surface runoff (Galfi et al., 2016; Rodrigues et al., 2016).

To minimize swimming-associated illness and injury and to notify the public about the quality of beach water, DPH regulations require regular water quality monitoring and public notification of unsafe conditions. All public and semi-public bathing beaches in Massachusetts are monitored for fecal indicator bacteria (FIB), and on occasion, harmful algae. Monitoring occurs during the beach season which typically begins the weekend of Memorial Day and ends during the weekend of Labor Day.

DPH adopted the U.S. Environmental Protection Agency (USEPA) criteria for enterococci and *E. coli* in marine- and fresh-waters in 2001. These criteria consist of both a single sample and geometric mean (geomean) value reported as colony forming units per 100 milliliters of water (CFU/100 mL) (see Table 1). When beach water exceeds these water quality standards, DPH requires that the beach be posted with a notice alerting the public to the possible risk of swimming.

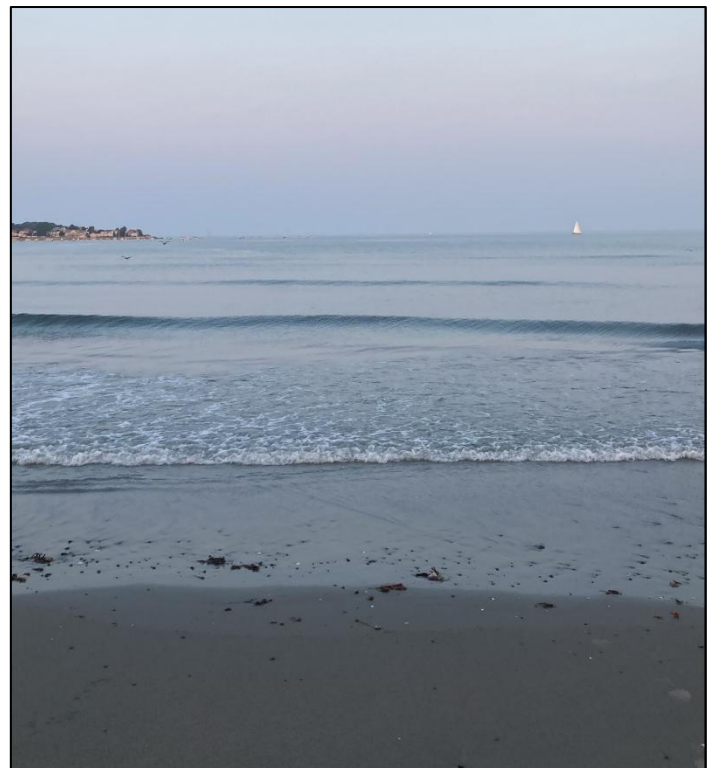
At a majority of beaches in Massachusetts, water quality is considered to be unacceptable when two samples collected on consecutive days exceed the water quality standards. This approach is consistent with DPH regulations and has helped to minimize the impact of beach closures on vulnerable socio-economic populations, whose local beach may be the only accessible means of recreation during the summer.

Some of the highest use beaches operated by the state are in the urban areas of Boston, Lynn, Quincy, and Revere. Beaches with a history of multi-day elevated bacteria levels are required to post after a single exceedance. Posting is also required when the geomean of the five most recent samples exceeds the geomean standard.

Beach Type	Indicator	Single Sample	Geomean
Marine	Enterococci	>104	>35
Freshwater	Enterococci	>61	>33
	<i>E. coli</i>	>235	>126

Table 1. DPH recreational water quality criteria (CFU/100 mL)

In addition to water samples, field data such as days since rainfall and potential pollution sources are required to be recorded at the time of sample collection. Field data help facilitate the interpretation of bacteria data and can improve the understanding of water quality at the local and state level.



Kings Beach, Lynn, MA

Photo by Logan Bailey

Water Quality

Marine beach exceedances During the 2024 beach season, 8,459 samples were collected and analyzed from 591 marine sampling locations in the 60 communities with marine beaches. Of these 591 locations, 231 (39.1%) had at least one bacterial exceedance. A total of 620 out of the 8,459 samples exceeded the 104 CFU/100 mL standard bringing the percentage of exceedances for marine waters to 7.3%. The 2024 exceedance rate is higher than the historic average (5.3%) (Figure 1).

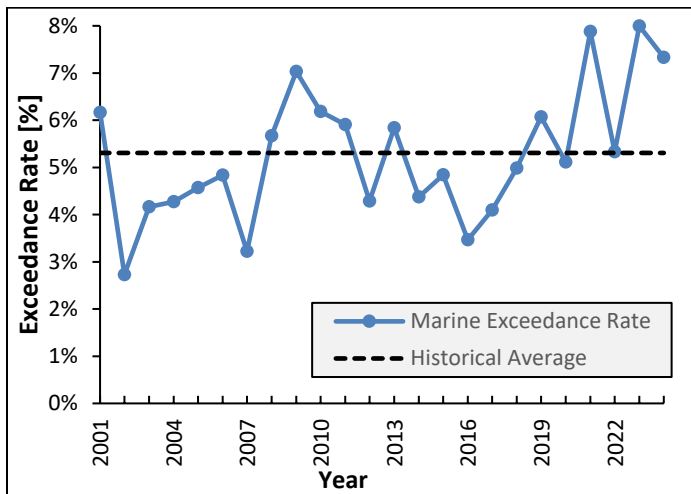


Figure 1. Marine beach exceedance rate (2001 – 2024).

Freshwater beach exceedances During the 2024 beach season, 7,610 samples were collected and analyzed from 574 freshwater sampling locations in the 180 communities reporting freshwater beach data. Most freshwater beaches (88%) used *E. coli* as the fecal indicator bacteria, with the other 12% using *Enterococci*. Among the 574 freshwater locations, 167 (29%) had at least one bacterial exceedance. A total of 370 out of 7,610 samples (4.9%) exceeded the single sample standard, which represents an exceedance rate slightly above the historic average exceedance rate of 4.2% (Figure 2).

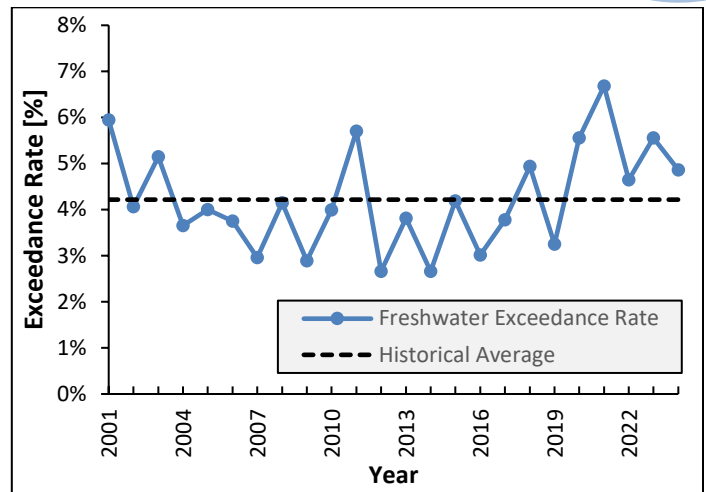


Figure 2. Freshwater beach exceedance rate (2001 – 2024).

Posting beaches Of the 1,104 beaches operating in 2024, 250 (22.6%) had to post no swimming signs on one or more days during the season. In total, there were a combined 4,525 posting days in 2024, with the majority of posting days due to the exceedance or expected exceedance (e.g., rainfall) of a water quality standard. For marine beaches, there were 1,598 total posting days due to elevated bacteria (85%), rainfall (1%), combined sewer overflows (CSOs) (5%), or other reasons (8%) (Figure 3). For freshwater beaches, there were 2,927 posting days due to elevated bacteria (69%), cyanobacterial harmful algal blooms (30%), or other reasons (1%) (Figure 3). Other reasons for posting included: exceedances at adjacent beaches, missed sampling, road maintenance, fiberglass shards on beach, and unstable access to the beach.

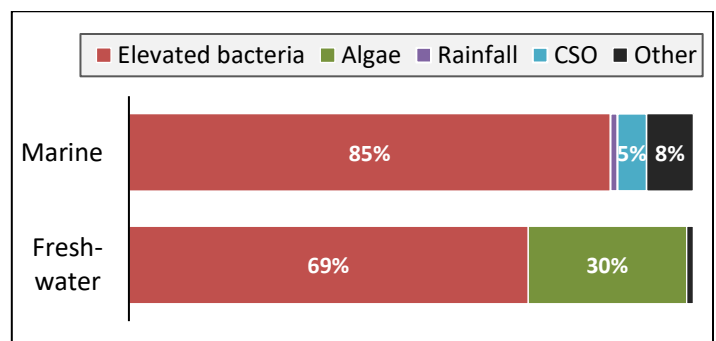


Figure 3. Posting details for marine and freshwater beaches in 2024.

Rainfall Rainfall is recognized as one of the major drivers of bacterial exceedances in beach water (Harder-Lauridsen et al., 2013). Historically, overall exceedances at both marine and freshwater beaches generally rise and fall with the total amount of summer rainfall, with some exceptions. This pattern was observed in 2024, with exceedances rates at both marine and freshwater beaches declining from the previous year corresponding with less summer precipitation (Figure 4). The rainfall data were obtained from the National Oceanic and Atmospheric Administration (NOAA, 2024). Data sets from two coastal communities, Boston and Chatham, were used to represent monthly rainfall amounts at marine beaches. For rainfall at freshwater beaches, data sets from Amherst and Ashburnham, along with those from Boston and Chatham, were used to represent monthly rainfall across the state.

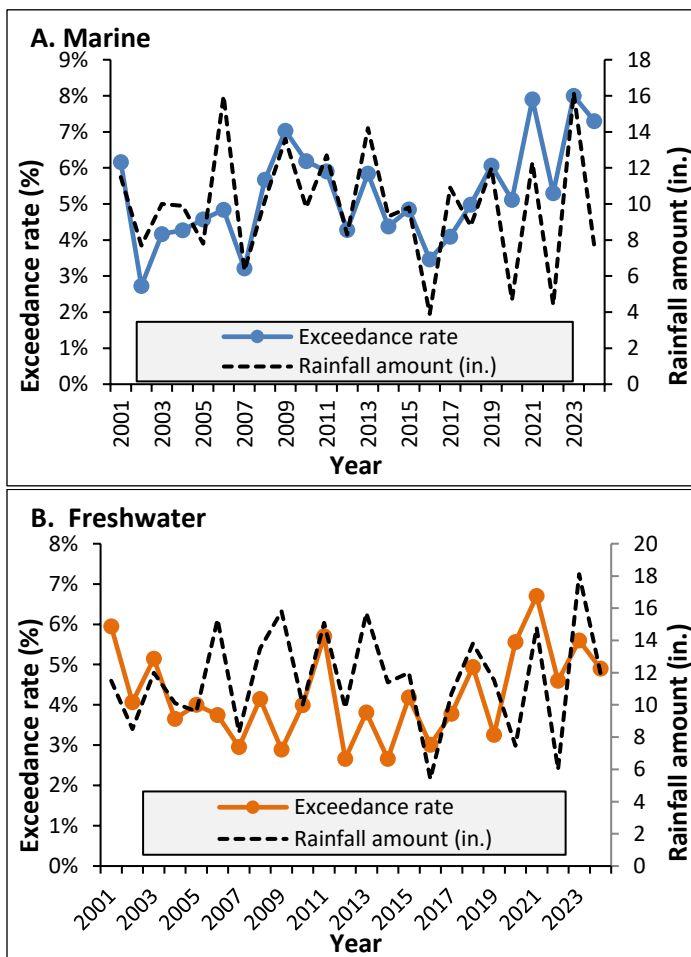


Figure 4. The historical relationship between rainfall amounts and exceedance rates at (A) marine and (B) freshwater beaches.

Occurrences of exceedances will typically drop as time between rainfall and sample collection increases. For marine beaches in 2024, samples collected within 24 hours following rainfall were most likely to exceed the state standard (Figure 5). In contrast, freshwater beaches showed no discernable relationship between sample exceedance rate and days since rain in 2024 (Figure 5).

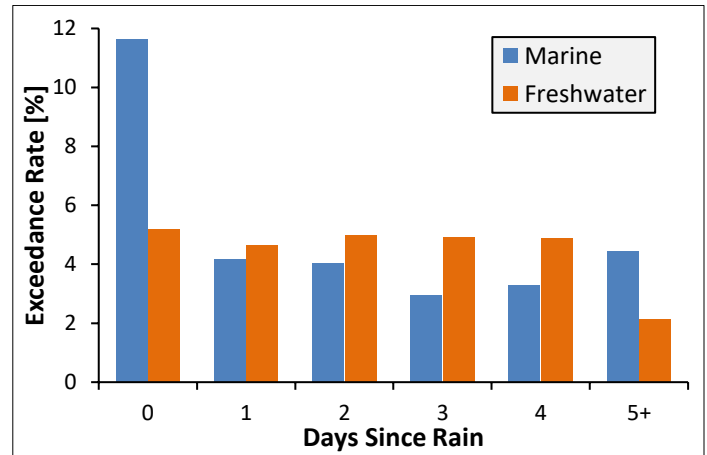


Figure 5. Relationship between the exceedance rate and days since rainfall in 2024.

Cyanobacteria Harmful Algal Blooms Cyanobacteria (sometimes called blue-green algae) occur naturally in freshwater. Under certain environmental conditions, they can multiply quickly, creating a highly concentrated area known as a cyanobacterial harmful algal bloom, or cyanoHAB. Some HABs produce toxins (known as cyanotoxins) which can be harmful to human and animal health. People and animals can be exposed to cyanobacteria through direct skin contact, ingestion, or inhalation; symptoms range from skin irritation to neurological and liver damage (DPH, 2019).

In 2024, 71 cyanoHAB public health advisories were issued across 57 recreational waterbodies in Massachusetts. This total includes waterbodies with permitted beaches as well as those used for non-swimming recreational activities, such as boating, rowing/paddling, and fishing. The Central and Southeastern regions of the state saw the highest number of advisories in 2024 (Figure 6).

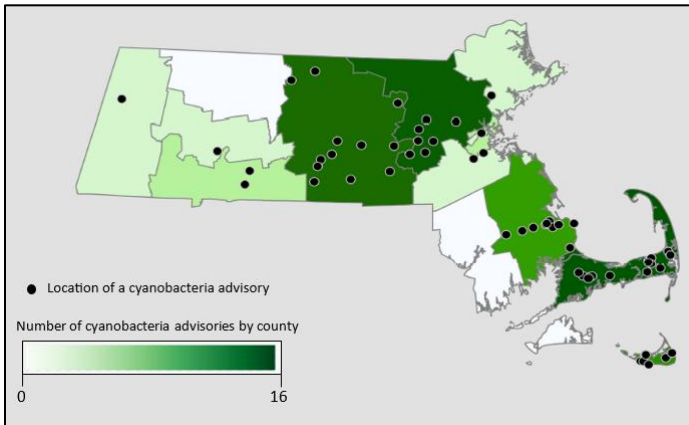


Figure 6. In 2024, Barnstable County reported 16 cyanobacteria advisories, followed by Middlesex (15), Worcester (13), Nantucket (10), Plymouth (9), Hampden (2), and Suffolk (2). Berkshire, Essex, Hampshire, and Norfolk Counties each had 1 reported advisory.

Over the past five years, the number of beach closure days due to cyanoHABs have fluctuated, usually following similar fluctuations in average summer rainfall. During the drought of 2022, cyanobacteria advisories only resulted in 252 total beach closure days, while during the historically wet summers of 2021 and 2023, cyanobacteria advisories caused 896 and 752 closure days, respectively. Conversely, despite a decline in rainfall in 2024, there were 863 total beach closure days due to cyanobacteria, an increase of 111 days over the previous year (Figure 7).

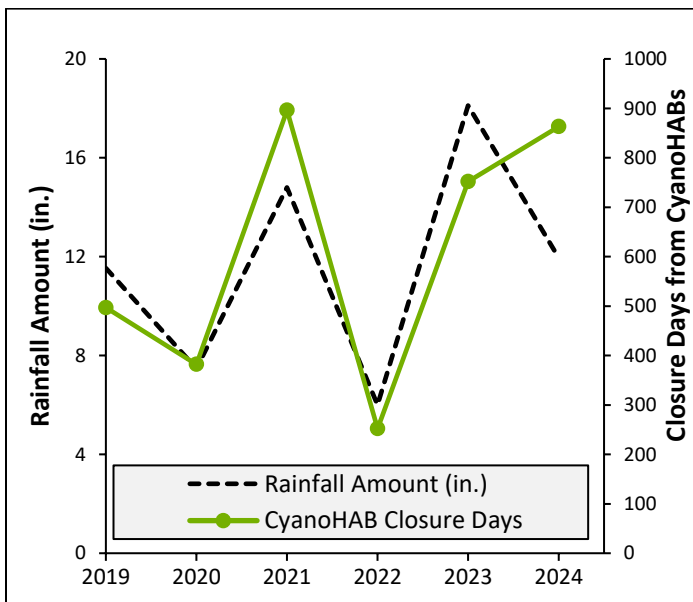


Figure 7. Relationship between average rainfall and the total number of beach closures due to cyanobacteria advisories (in days).

Potential pollution sources Starting in 2017, beach operators were asked to report the number of swimmers, birds, and dogs present in the water when a sample was collected. Figure 8 shows the mean bacteria levels of samples at marine and freshwater beach locations in 2024 compared to the number of reported swimmers, birds, and dogs. The data indicate that the presence of larger numbers of birds was associated with increases in bacteria levels at marine and freshwater beaches. No clear relationship was observed between bacteria levels and the number of humans or dogs present. Enterococci results at freshwater beaches were not included in this analysis due to the low number of samples.

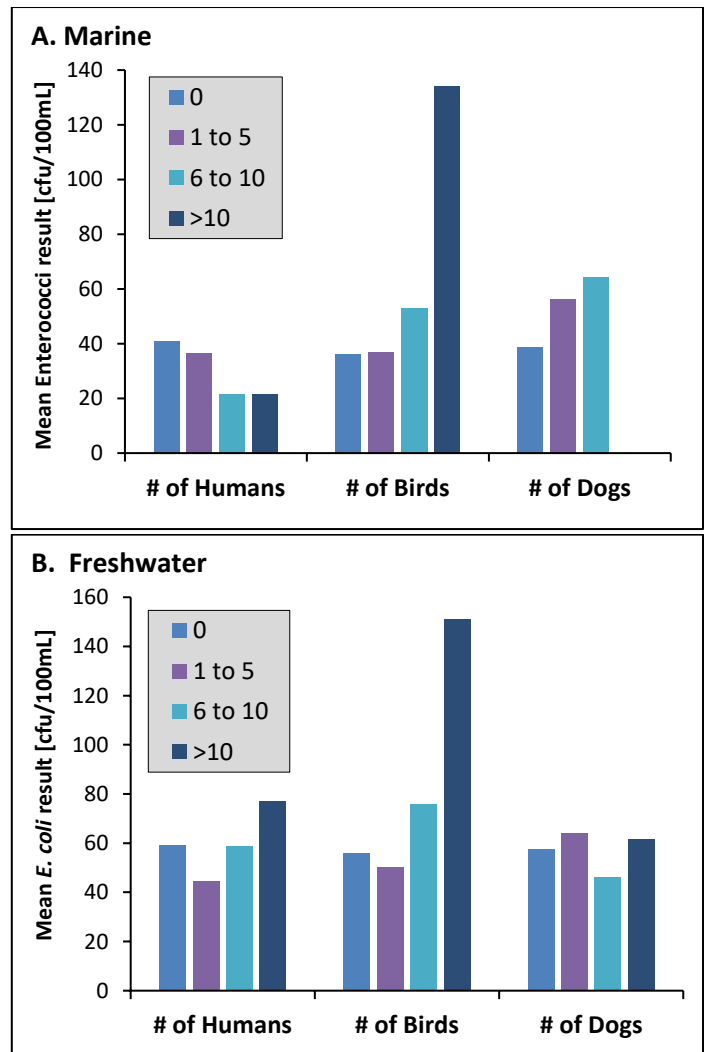


Figure 8. Mean bacteria levels and numbers of birds, dogs, and humans at marine (top) and freshwater (bottom) beaches in 2024.

Environmental Justice Communities Beach access and water quality are particularly important in environmental justice (EJ) communities, as these communities are disproportionately affected by the increased presence of environmental hazards and poor health outcomes (DPH, 2017). For example, EJ communities are characterized by high population densities, low income, and high levels of non-vehicle ownership. Individuals in these communities, compared to other areas in the state, are more likely to rely on a local beach as a place to cool off during extreme heat events.

In 2024, 24.8% of Massachusetts beaches were located in or close to an EJ neighborhood, based on the EJ census block group map from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA, 2024). Beaches were identified as close to an EJ neighborhood if they were within 0.25 miles of an EJ block group – with 0.25 miles being the standard definition for “walking distance” used in urban planning (Yang and Diez-Rous, 2012).

The bacterial exceedance rate at beaches close to EJ neighborhoods was higher than those beyond walking distance for both marine and freshwater beaches, though the difference was more pronounced for marine beaches (Figure 9).

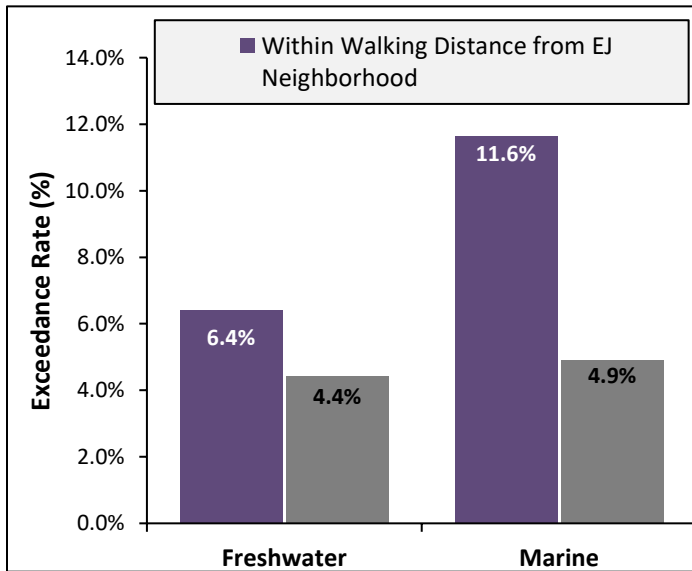


Figure 9. Relationship between 2024 beach exceedance rate and walkable distance from EJ block groups.



Micozzi Beach, Billerica, MA

Photo by Tanya Ambrose

Public Notification

Beach website In 2024, DPH expanded the online beach water quality dashboard (<https://www.mass.gov/info-details/interactive-beach-water-quality-dashboard>) to include both marine and freshwater beaches, thus providing the public with statewide, up-to-date beach testing data and beach posting information in an accessible, easy-to-use format. The dashboard was viewed over 500,000 times by 250,000 unique viewers between Memorial Day and Labor Day 2024. Page views spiked ahead of the July 4th holiday, partly due to increased press coverage of the dashboard. The dashboard’s highest traffic day was Tuesday, July 2nd, with over 72,000 views and nearly 50,000 first-time users.

The dashboard displays data reported to DPH by local health departments, beach operators, and testing laboratories through DPH’s beach data portal, which was developed in 2023. Many critical improvements were made to the portal in 2024 to streamline the data submission process and to more clearly communicate required actions to local health and beach operators

based on their most recent water quality results. These improvements enable quicker and more accurate public notification of beach data results and postings.

Beach postings When water quality standards are exceeded or other safety concerns exist, beach operators are required to post signage at the beach advising individuals of the hazard and recommending they stay out of the water. This is an essential part of the public notification system. Based on posting data reported to DPH, marine and freshwater beaches were posted properly 94% and 76% of the time, respectively. The lower compliance rate at freshwater beaches is likely to be a reporting failure, rather than a public notification failure, as the missed posting reports come from a small number of towns. DPH will work with these towns this coming season to improve reporting.



Wellfleet Beach, Wellfleet, MA

Photo by Kate Adams

Conclusions

In 2024, the exceedance rates at both marine and freshwater beaches were above the historical average. However, average historical exceedance rates of 5.3% at marine beaches and 4.2% at freshwater beaches indicate that the state has beaches with generally good water quality. Elevated bacteria levels, rainfall events, CSO discharges, and cyanobacterial harmful algal blooms were the primary drivers of beach posting days for poor water quality. Public notification of beach testing results and postings via DPH's new dashboard was a highly utilized means of communicating with the public.

Acknowledgements

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For more information, please visit:

DPH Beaches website: <http://www.mass.gov/beaches>

DPH Interactive Beach Dashboard: <http://www.mass.gov/beachdata>

DPH Algae website: <http://www.mass.gov/dph/algae>

Or contact:

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Aurora Borealis at Folly Cove Beach

Cape Ann, MA

Photo by Kate Adams