

# 2020

## Massachusetts Beach Testing Results: Annual Report



**Little Neck, Ipswich, MA**

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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 Environmental Health's Environmental Toxicology Program 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 2020, a total of 14,788 water samples were collected from 583 marine and 480 freshwater beach sampling locations. These locations represent 527 marine and 444 freshwater beaches statewide, with 100% of marine and 84% of freshwater beach communities reporting water quality information to DPH. Approximately 5.1% and 5.6% of samples exceeded the Massachusetts bacterial water quality standards for marine and freshwater beaches, respectively. The overall low exceedance rates indicate that Massachusetts beaches generally have high water quality. Elevated bacteria accounted for 59% of beach posting days for poor water quality; additional reasons for notifications included: cyanobacterial harmful algae blooms, rainfall (typically associated with elevated bacteria), and other hazards (e.g., animal advisory, combined sewer overflow, missed sample).
- **Field data:** In 2020, a majority (99%) of water samples submitted to DPH had accompanying field data. Recent rainfall and pollution sources at sampling sites were identified as two important factors that contributed to elevated bacteria levels at recreational waterbodies. As in previous years, the exceedance rate dropped as days since rainfall increased. Pollution sources, particularly the presence of larger numbers of birds at marine and freshwater beaches, were associated with higher levels of bacteria.
- **Public notification:** DPH's marine beaches website ([http://ma.healthinspections.us/public\\_21/](http://ma.healthinspections.us/public_21/)) provides near real-time information on bacteria levels at public marine beaches during the beach season, as well as information on historical bacteria levels. In 2020, approximately 10,131 users visited the website with peak usage occurring during the months of July and August. Individuals are also notified of unsafe conditions at beaches by physical signage that beach operators are required to post. In 2020, 96% of marine and 69% of freshwater beaches were in compliance with the public notification requirements.

## 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 generally begins when the school year finishes in mid-June 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.



Hathaway Pond, Barnstable, MA

## Water Quality

**Marine beach exceedances** During the 2020 beach season, 8,257 samples were collected and analyzed from 583 marine sampling locations in the 60 communities with marine beaches. Of these 583 locations, 181 (31%) had at least one bacterial exceedance. A total of 422 out of the 8,257 samples exceeded the 104 CFU/100 mL standard bringing the percentage of exceedances for marine waters to 5.1%, which is slightly greater than the average historical exceedance rate of 4.9% (Figure 1).

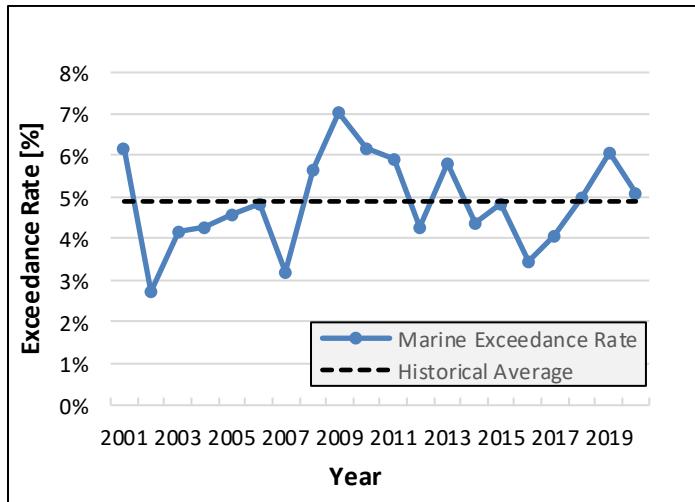


Figure 1. Marine beach exceedance rate (2001 – 2020)

**Freshwater beach exceedances** During the 2020 beach season, 6,531 samples from 480 freshwater sampling locations were collected and analyzed for the approved fecal indicator bacteria. Most freshwater beaches (84%) used *E. coli* as the indicator. Among the 480 freshwater locations, 155 (32%) in the 155 communities reporting beach data had at least one bacterial exceedance. A total of 363 out of 6,531 samples exceeded the standard bringing the percentage of freshwater exceedances to 5.6%, which is higher than the average historical exceedance rate of 4.0% (Figure 2).

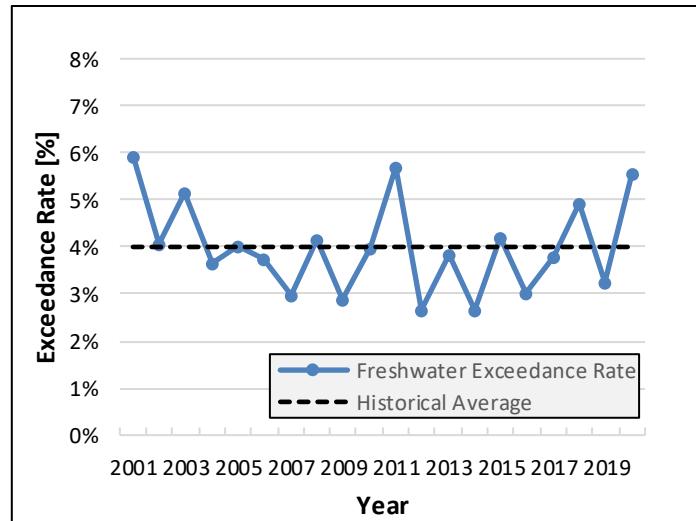


Figure 2. Freshwater beach exceedance rate (2001 – 2020)

**Posting beaches** In 2020, beaches were posted for 2,926 days, advising individuals to not swim in the water. Figure 3 displays the causes of postings -- 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 1,586 total posting days due to either elevated bacteria (49% of days), rainfall (1%), or other reasons (jellyfish advisory, combined sewer overflow, or missed sample) (50%). For freshwater beaches, there were 1,340 posting days, 71% of which were due to elevated bacteria, with the other 29% due to cyanobacterial harmful algae blooms.

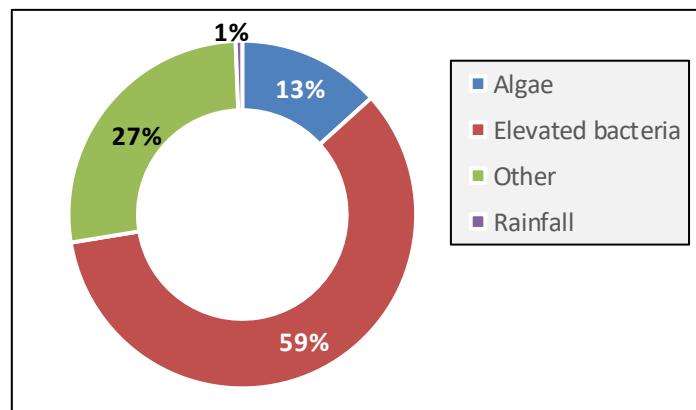


Figure 3. Posting details for marine and freshwater beaches in 2020

**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 have high population densities, low income, and high levels of non-vehicle ownership. This means that more individuals in these communities, compared to other areas in the state, will tend to frequent a local public beach for cooling off or enjoying summer recreation. As rainfall is a significant factor in flushing enteric bacteria into beach water, any increase in rain near a population-dense EJ area will lead to an increase in exceedances.

Approximately half (55%) of beach locations in Massachusetts are located in a municipality that contains an EJ community. Marine and freshwater beaches in EJ communities had a higher exceedance rate than beaches in non-EJ communities (Figure 4).

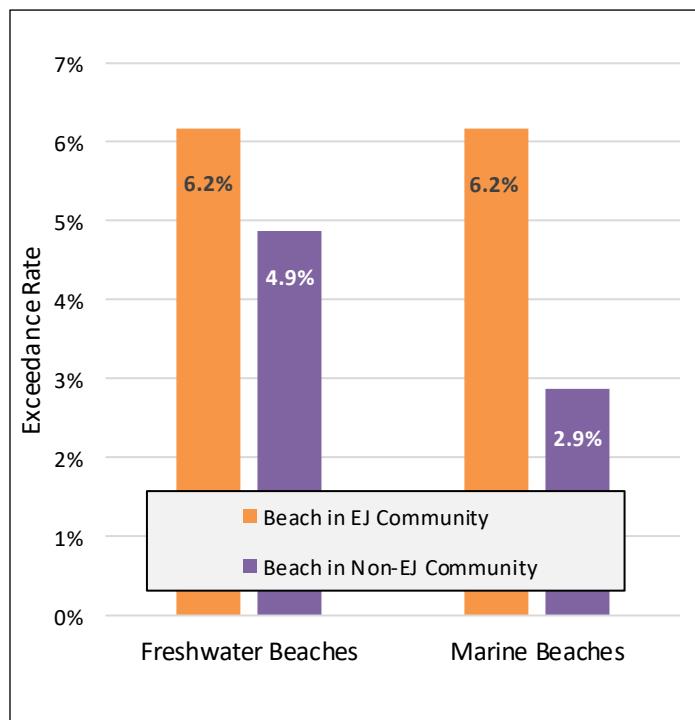


Figure 4. Exceedance rate at beaches located in an EJ community and beaches not located in an EJ community

## Field Data

**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 5 shows the mean bacteria levels of samples at marine and freshwater beach locations in 2020 compared to the number of reported bathers, birds, and dogs. The data indicate that increases in bird populations during sampling were associated with increases in bacteria levels at marine and freshwater beaches. Increases in human populations were also associated with higher bacterial levels at freshwater beaches, while their impact was less consistent at marine beaches. Enterococci results at freshwater beaches were not included in this analysis due to the low number of samples.

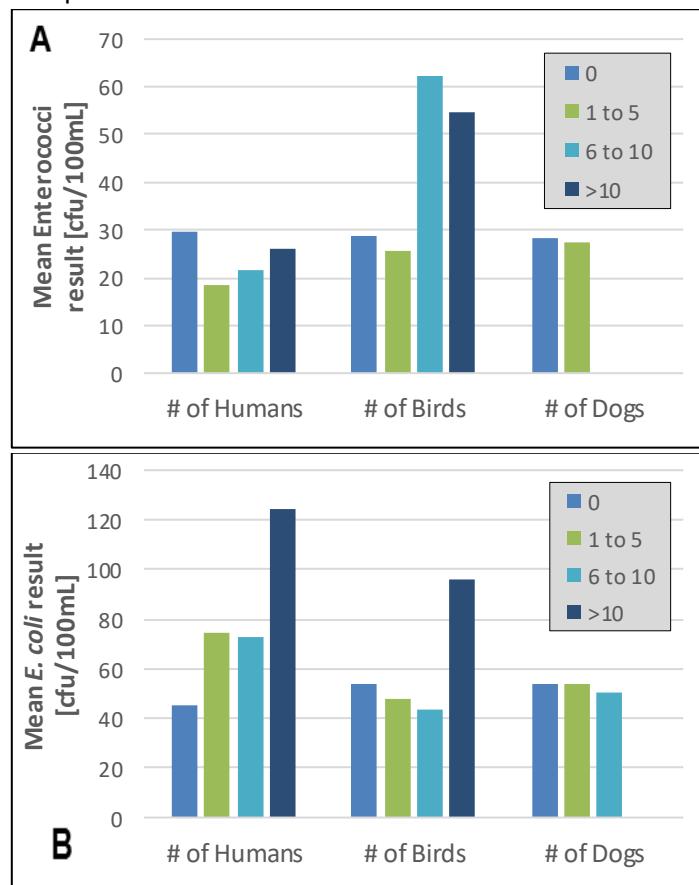


Figure 5. Mean bacteria levels and numbers of birds, dogs, and humans at marine (A) and freshwater (B) beaches

**Rainfall** Rainfall is recognized as one of the major drivers of bacterial exceedances in beach water (Harder-Lauridsen et al., 2013). Occurrences of exceedance will typically drop as time between rainfall and sample collection increases (Figure 6). For both marine beaches and freshwater beaches, the rate of exceedance steadily dropped after 24 hours of a rain event.

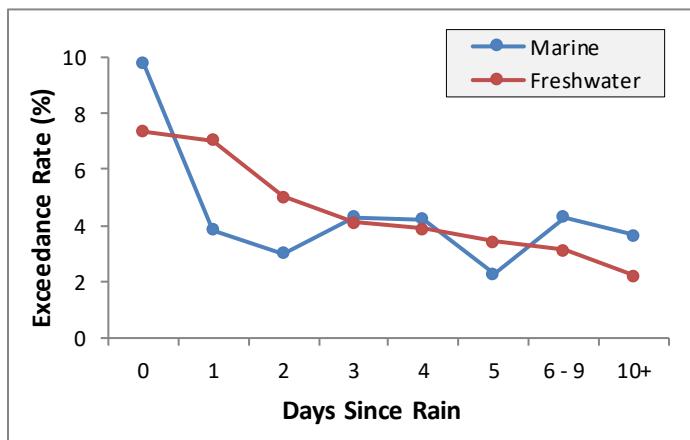


Figure 6. Relationship between the exceedance rate and days since rainfall in 2020

Historically, at both marine and freshwater beaches, exceedances generally rise and fall with rainfall amounts, with some exceptions. In 2020, this pattern was observed in both marine and freshwater results. This historical relationship between exceedances of water quality criteria at marine and freshwater beaches and the total amount of rainfall between June and August is shown in Figure 7. The rainfall data were obtained from the National Oceanic and Atmospheric Administration (NOAA, 2020). 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.

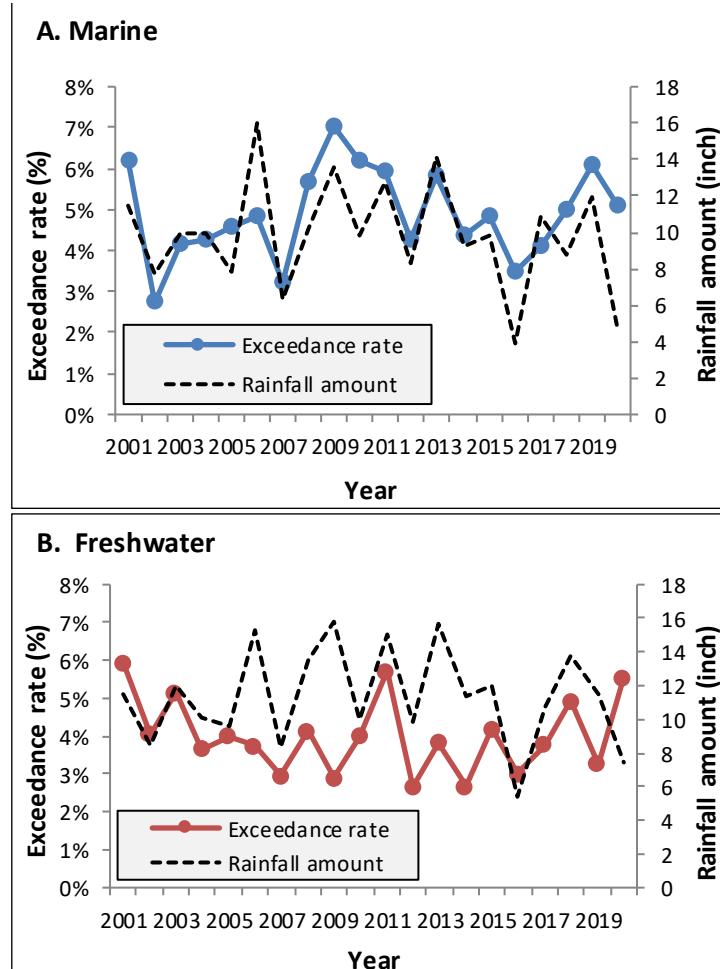


Figure 7. The historical relationship between rainfall amounts and exceedance rates at (A) marine and (B) freshwater beaches in Massachusetts from the 2001 to 2020 beach seasons

## Public Notification

**Beach website** The DPH beach monitoring website ([http://ma.healthinspections.us/public\\_21/](http://ma.healthinspections.us/public_21/)) provides the public with up-to-date marine beach testing and posting information and presents the data in an easy-to-use format. In 2020, 10,131 users visited the website during the beach season (this includes both new and returning users). An analysis of weekly usage data demonstrated an increase in the number of users as the beach season progressed (Figure 8) with a maximum number of users ( $n=1,294$ ) occurring in week 13, in mid-August. Website usage also spiked during the 4<sup>th</sup> of July week ( $n=1,067$ ).

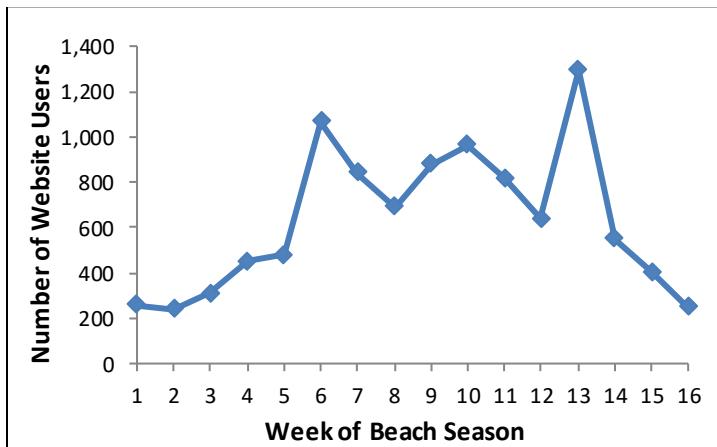


Figure 8. Number of DPH marine beach website users per week during the 2020 beach season

**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. Marine and freshwater beaches were posted properly 96% and 69% of the time, respectively.

## Conclusions

In 2020, the exceedance rates at both marine and freshwater beaches were greater than the historical average. However, given the number of beaches sampled in Massachusetts, average historical exceedance rates of less than 5% indicate that the state has beaches with generally high water quality. Public notification of marine results and postings via DPH's marine beaches website continued to be a highly utilized means of communicating with the public.

## Acknowledgements

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that bathing beaches were tested, and data submitted appropriately.

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

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