

# 2018

## Massachusetts Beach Testing Results: Annual Report



**Pay Beach, Oak Bluffs, 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 2018, a total of 15,642 water samples were collected from 583 marine and 582 freshwater beach sampling locations. These locations represent 526 marine and 542 freshwater beaches statewide, with 100% of marine and 98% of freshwater beach communities reporting water quality information to DPH. Approximately 5.0% and 4.9% 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 82% of beach postings for poor water quality; additional reasons for notifications included: cyanobacterial harmful algae blooms, rainfall (typically associated with elevated bacteria), and other hazards (e.g., storm damage and water clarity/visibility issues).
- **Field data:** In 2018, a majority (98%) 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 number of exceedances dropped exponentially as days since rainfall increased. Pollution sources, particularly the presence of larger numbers of birds at 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 of bacteria levels at public marine beaches during the beach season, as well as information on historical bacteria levels. In 2018, approximately 7,100 users visited the website with peak usage occurring during the month of July. Individuals are also notified of unsafe conditions at beaches by physical signage that beach operators are required to post. In 2018, 99% of marine and 88% 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. 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.



Micozzi Beach, Billerica, MA

## Water Quality

**Marine beach exceedances** During the 2018 beach season, 7,947 samples were collected and analyzed from 583 marine sampling locations in the 60 communities with marine beaches. Of these 583 locations, 157 (27%) had at least one bacterial exceedance (see Figure 1). A total of 396 out of the 7,947 samples exceeded the 104 CFU/100 mL standard bringing the percentage of exceedances for marine waters to 5.0%, which is near the average historical exceedance rate of 4.8%. The number of marine beach exceedances in each community is shown in Figure 1. Marine beaches in Boston, Lynn, Provincetown, and Quincy had the highest number of exceedances.

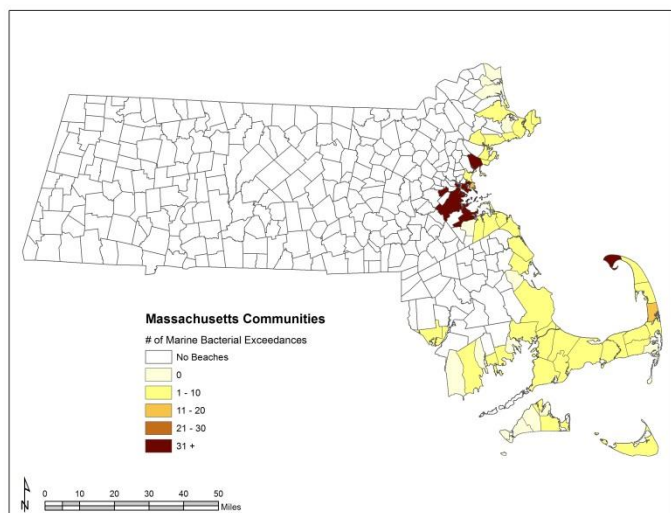


Figure 1. Marine beach water quality exceedances in 2018

**Freshwater beach exceedances** During the 2018 beach season, 7,695 samples from 582 freshwater sampling locations were collected and analyzed for the approved fecal indicator bacteria. Most freshwater beaches (90%) used *E. coli*. Among the 582 freshwater locations, 157 (27%) in the 181 communities reporting beach data had at least one bacterial exceedance (Figure 2). A total of 380 out of 7,695 samples exceeded the standard bringing the percentage of freshwater exceedances to 4.9%, which is higher than the average historical exceedance rate of 4.0%. The number of freshwater beach exceedances in each community is shown in Figure 2. Freshwater

exceedances varied among communities with the highest number occurring in Ashby, Barnstable, Sharon, Templeton, Townsend, West Tisbury, and Worcester.

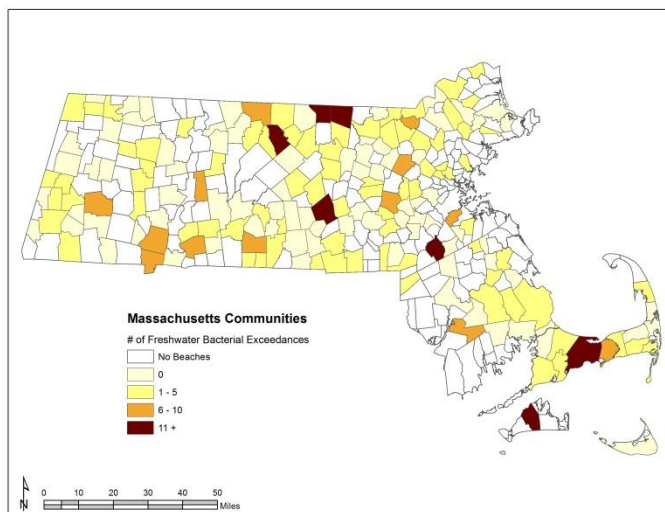


Figure 2. Freshwater beach water quality exceedances in 2018

**Posting beaches** In 2018, beaches were posted on 370 occasions, advising individuals to not swim in the water. Figure 3 displays the causes of postings -- with the majority of postings due to the exceedance or expected exceedance (i.e., rainfall) of a water quality standard. For marine beaches, there were 191 postings due to elevated bacteria, rainfall, or other reasons (e.g., storm damage, missed sample). For freshwater beaches, there were 179 postings due to elevated bacteria, cyanobacterial harmful algae blooms, or poor water clarity.

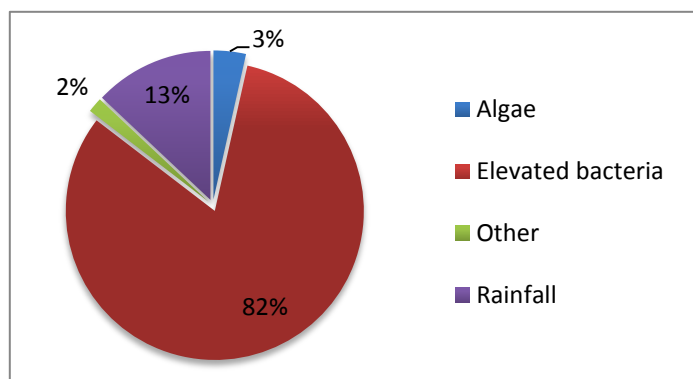


Figure 3. Posting details for marine and freshwater beaches in 2018

## Field Data

**Potential pollution sources** Information on potential sources of bacteria was not consistently reported in the past, and if it was, it was typically reported on a present/absent basis. 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 4 shows the mean bacteria levels of samples at marine and freshwater beach locations in 2018 compared to the number of reported bathers, birds, and dogs. Similar to 2017, the data indicate that an increase in bird populations during sampling at freshwater beaches was associated with an increase in bacteria levels, while the impact of the other pollution sources was less consistent. Note that results for enterococci at freshwater beaches were not evaluated due to the low number of samples

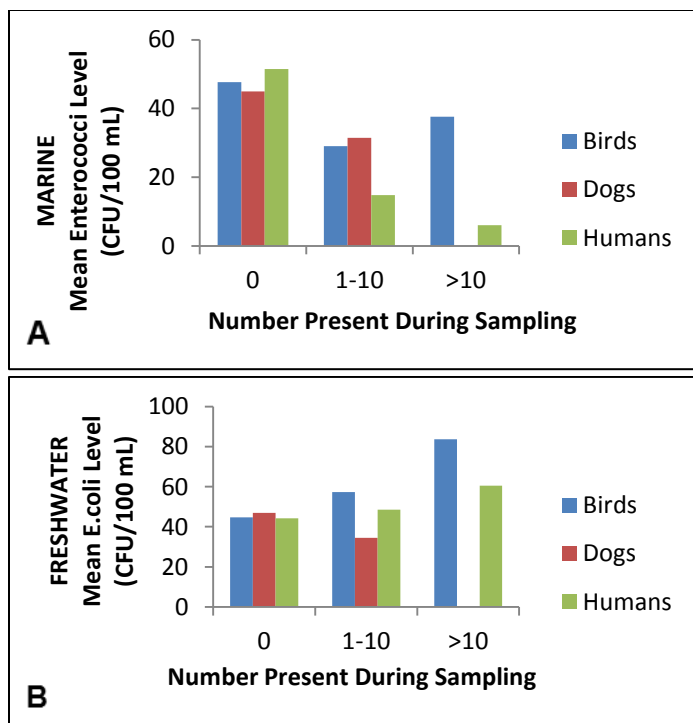


Figure 4. Mean bacteria levels and numbers of birds, dogs, and humans at marine (A) and freshwater (B) beaches

**Rainfall** Rainfall is recognized as one of the major drivers of bacterial exceedances in beach water (Harder-Lauridsen et al., 2013). An exponential drop in the number of exceedances occurs as the time between rainfall and sample collection increases (Figure 5). For marine beaches, 229 of 396 bacterial exceedances occurred within 24 hours after a rain event; at freshwater beaches, 165 of 380 exceedances were observed within 24 hours after a rain event.

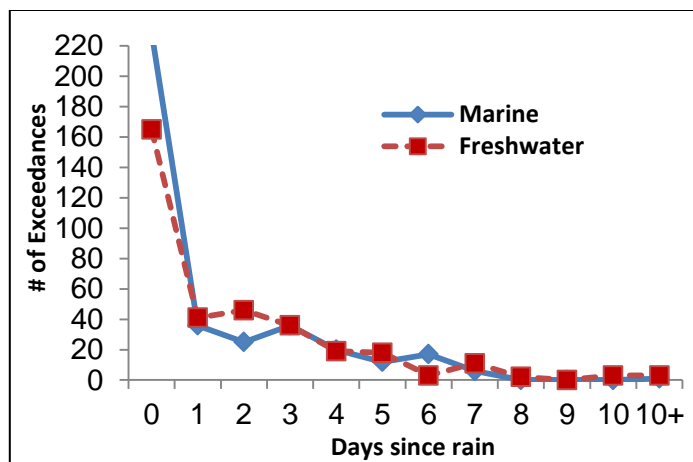


Figure 5. Relationship between the number of bacterial exceedances and days since rainfall in 2018

Historically, at both marine and freshwater beaches, exceedances generally rise and fall with rainfall amounts, with some exceptions. In 2018, this pattern was observed in the freshwater results but not in the marine 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 6. The rainfall data were obtained from the National Oceanic and Atmospheric Administration (NOAA, 2018). 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.



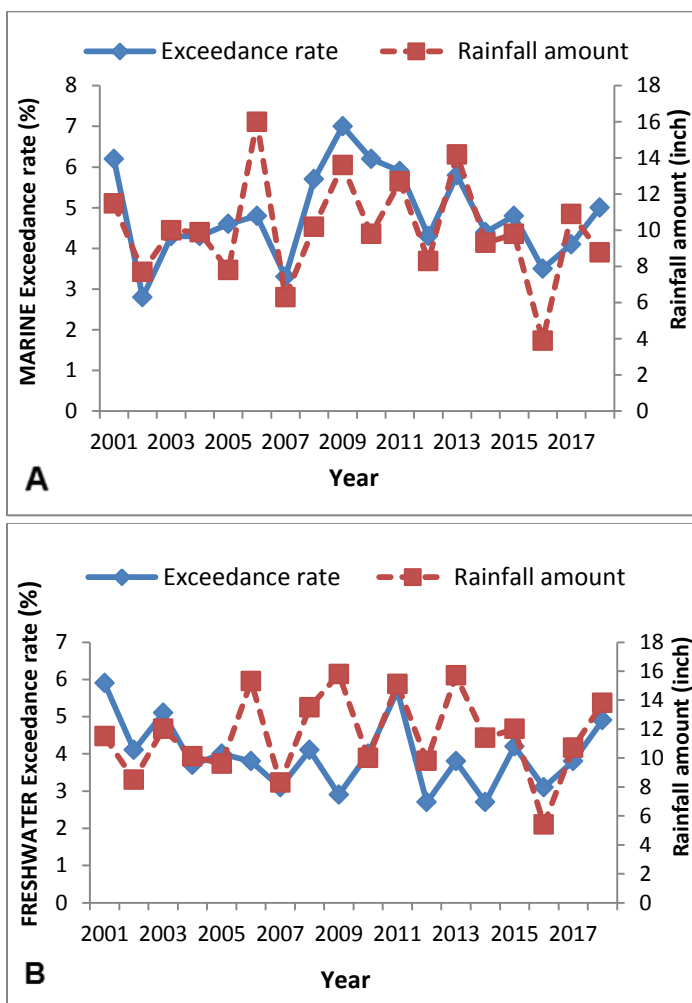


Figure 6. The historical relationship between rainfall amounts and exceedance rates at (A) marine and (B) freshwater beaches in Massachusetts from the 2001 to 2018 beach seasons

## 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 2018, approximately 7,100 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 7) with a maximum number of users (n=1,107) occurring in week 7 in the middle of July.

**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 99% and 88% of the time, respectively.

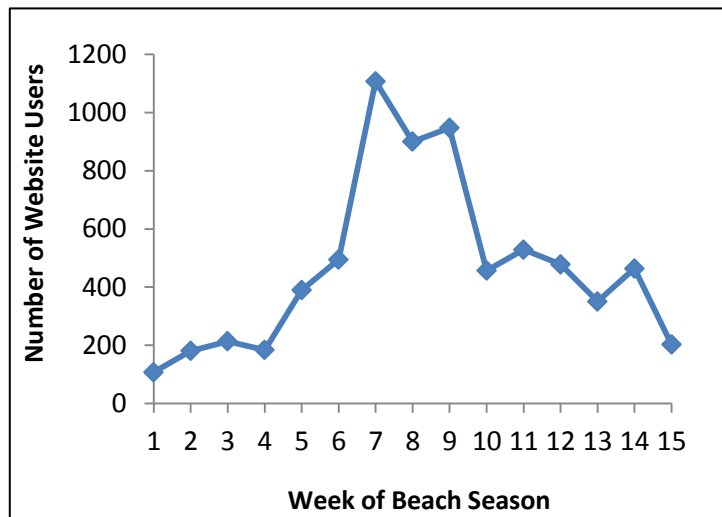


Figure 7. Number of DPH marine beach website users per week during the 2018 beach season

## Conclusions

In 2018, the exceedance rates at marine and freshwater beaches were near or slightly greater than historical averages. Spikes in exceedances were often associated with significant rain events that occurred during the months of July and August throughout the state. However, given the number of beaches sampled in Massachusetts, the average historical exceedance rates of 5% or less 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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**For more information, please visit:**

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

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

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