



Save the Harbor  
Save the Bay



For more information, or for additional copies of this report, contact:

Save the Harbor/Save the Bay • 286 Congress Street, 7th Floor • Boston, Massachusetts 02210 • 617-451-2860 x103 • [www.savetheharbor.org](http://www.savetheharbor.org)

# Why The BEACHES CLOSE...

A Public Report of Save the Harbor/Save the Bay's Science Advisory Committee

THE SOURCES OF BACTERIAL CONTAMINATION ON THE  
BEACHES OF NORTH DORCHESTER AND SOUTH BOSTON.



Save the Harbor  
Save the Bay

## BACKGROUND

Despite the many successes of the Boston Harbor Clean Up, there are still frequent beach closures due to poor water quality. The counts of *Enterococcus* bacteria on beaches and in swimming areas of North Dorchester Bay (Fig. 1) exceeded the federal and state swimming standard, on average, 18 percent of tested days in recent swimming seasons (Table 1). In 2001, the Save the Harbor/Save the Bay annual “Swim for Boston Harbor” was cancelled because high bacteria levels made the water unsafe for swimming.

In an effort to understand the causes of the closures, Save the Harbor/Save the Bay convened a Science Advisory Committee (SAC), made up of independent scientists from some of the state’s leading academic institutions. Members of state and federal agencies, as well as public-interest organizations, provided technical assistance.

This report summarizes the SAC discussions about beach closures in North Dorchester Bay.

### KEY WORDS

**CSO** – (Combined Sewer Overflow) A mixture of sewage and stormwater that has very high bacteria levels and is associated with human health hazards. A CSO pipe that contains CSO material and is not activated, directs flow to a treatment plant.

**CSO activation** – A result of a large rain event that exceeds the sewer system capacity and opens floodgates to discharge untreated CSO into the receiving water body.

**Stormwater** – Water that flows over the land surface, accumulating and dissolving material in its path; stormwater carries pollutants and bacteria that cause serious water quality problems.

**Enterococcus** – A bacterium that is frequently used in water quality tests because it is an indicator of concentrations of other bacteria that are harmful to human health. Enterococci is the plural form of *enterococcus*; bacteria is the plural form of bacterium.

**Illegal hook-ups** – Refers to misconnections between residential homes and the sewer system that result in sewage containing human waste contaminating stormwater drains and pipes. Sewer line connections from buildings directly to stormwater pipes (an illegal activity) that result in sewage containing human waste contaminating stormwater drains and pipes.

Swimming season (Jun 1 – Sep 15)	Total number of sampled days	Number of days that at least one beach failed to meet swimming standard	Percentage of sampled days that at least one beach failed to meet swimming standard.
2000	79	12	15%
2001	79	18	23%
2002	62	8	13%
2003	57	11	19%

**Table 1.** South Boston beaches; days that samples failed to meet swimming standards in 2000-2003 sampling seasons. Table includes data collected by the Massachusetts Water Resources Authority and the Department of Conservation and Recreation (Dept of Conservation and Recreation 2003).

## What causes beach closures?

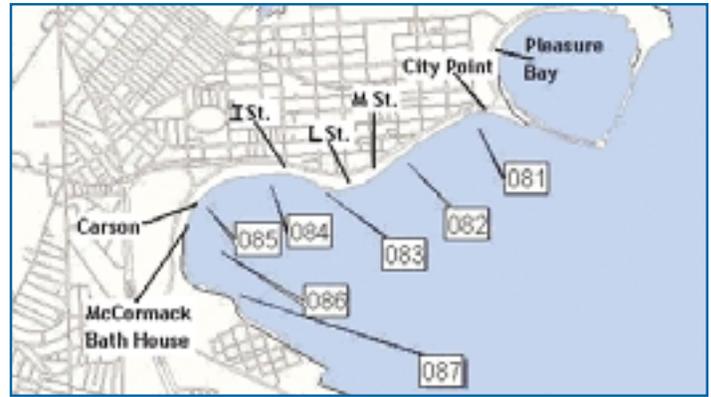
The SAC explored the causes of beach closures and identified an extensive list of potential sources of beach contamination. Sources considered include combined sewer overflows (CSOs), stormwater, untreated sewage from leaky pipes and illegal hookups that empty into storm sewers, waste from recreational and commercial vessels, and sediments contaminated by pathogens. Other sources, which potentially impact beaches, include pet waste, sea and shore birds, and dirty diapers on the beaches.

While each of these sources potentially contributes to bacterial contamination, evidence suggests that human wastes in contaminated stormwater and CSO are the greatest sources of beach closures.

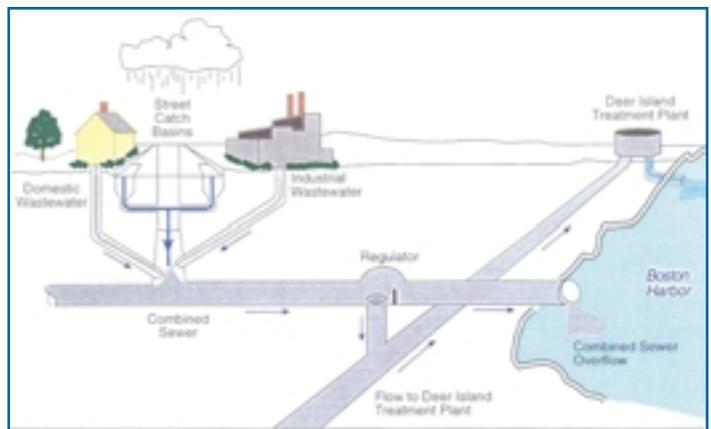
## What data did the scientists review?

Beach water quality monitoring occurs during the summertime on the South Boston beaches. Water samples are taken near the shore by the Department of Conservation and Recreation (DCR, formerly MDC) and the Massachusetts Water Resources Authority (MWRA), sent to a laboratory, and cultured for 24 hours. 100 milliliters (about a 1/2 cup of water) from the sample are tested for *Enterococcus* bacteria levels, which is an indicator of concentrations of viruses, bacteria, and protozoa that may be harmful to human health. If the *Enterococcus* counts exceed the federal and state Department of Public Health standards of 104 counts per 100 ml, beaches should be closed to swimming. Similarly, if a five-sample mean of *Enterococcus* exceeds 35 counts per 100 ml over a 30-day period, the beaches are closed to swimming.

The SAC also reviewed computer models (commissioned by the MWRA) that were designed to predict the effect of rainfall on *Enterococcus* bacteria levels in the swimming waters.



**Figure 1.** Map of North Dorchester Bay beaches, and nearby sewage and stormwater outfall pipes labeled 081 - 087. Water quality sampling locations include Pleasure Bay, City Point, M. St., and Carson beaches (I St. & McCormack Bath House) (Adapted from Boston Water and Sewer Commission 2004).



**Figure 2.** Scenario of how contaminated stormwater and sewage flow through the pipes and may discharge onto the beaches through a CSO outfall pipe (MWRA 1997).



**Figure 3.** Map of drainage areas for the sewage and stormwater outfall pipes near the beaches of North Dorchester Bay (Metcalf & Eddy 2000).

The SAC explored the causes of beach closures and identified an extensive list of potential sources of beach contamination. While each of these sources potentially contributes to bacterial contamination, evidence suggests that human wastes in contaminated stormwater and CSO are the greatest sources of beach closures.

### What do the data say?

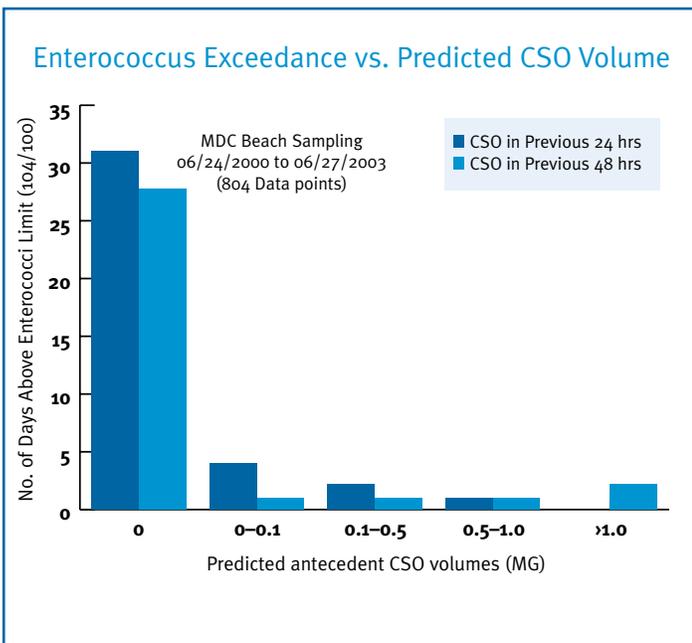
After looking at both the water quality data and models, as well as a discussion of existing literature, the SAC combined their experience and best professional judgement to determine the relative contributions of each source to beach closures. The SAC concluded that there are three primary sources of pollution that close the beaches:

- Sewage from broken pipes and illegal connections between homes and the sewer system;
- Contaminated stormwater; and
- The combination of sewage and stormwater that occurs when there is a CSO activation.

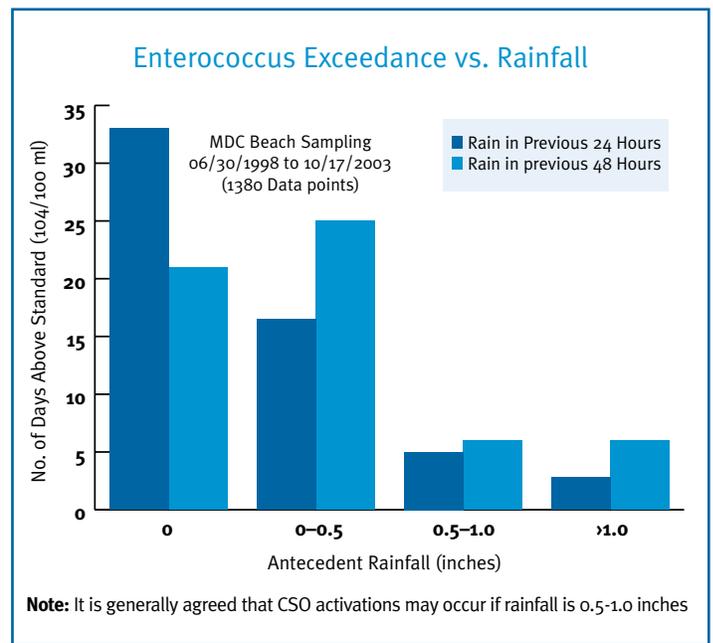
All three sources flow to the beaches through the existing network of stormwater and CSO overflow pipes.

Very few swimming standard exceedances appear to be caused by CSO activations, which are rare events caused by large or intense storms (Fig. 4). Most beach closings occur during “dry” or damp weather or in association with small summer storms (Fig. 5) when there appears to be no CSO activation (Fig. 4). Although it depends on the amount of rainfall per hour and the duration of the storm, most CSO activations occur with rainfall depths of 0.5 inches or more, based on MWRA data.

The majority of *Enterococcus* standard exceedances (that close the beaches) are related to stormwater from small, frequent rain events or “dry” weather, and not to CSOs.



**Figure 4.** *Enterococcus* exceedance vs. predicted CSO volume showed that the greatest number of days that exceed the standard are not related to CSO (MWRA 2003).



**Figure 5.** *Enterococcus* exceedance vs. rainfall showed that the greatest number of days that exceed the standard occur during “dry” weather (0 in.) or after very small rain events (0-0.5 in.) (MWRA 2003).

## What happens when a CSO activation occurs?

Because bacteria discharged during a CSO event is so concentrated (more than 10 times the bacterial concentration than stormwater), and there is so much of it in a big storm, a CSO activation discharges a large amount of pollution to North Dorchester Bay.

In addition to the CSO discharge, these larger storms also cause large stormwater discharges to the beaches, which contribute significantly to the total bacteria counts and may be sufficient, by themselves, to close the beaches.

## Why are there “dry” weather closings?

On several days, the beaches were closed during “dry” weather. “Dry” weather closures are puzzling because there should not be discharge from either CSOs or stormwater systems, and therefore, no sources of bacteria.

Upon investigation, sanitary sewage was discovered in the pipes off the beaches, as well as evidence of broken sewer pipes and illegal hook-ups to residential homes. The Environmental Protection Agency (EPA) and the DCR further theorized that sewage accumulates in the pipes until it flushes out by tides, wind, and currents. *Enterococcus* data collected on 11/5/2002 showed that water samples collected during “dry” weather and at low tide exceeded the standard in the swimming area.

**“The majority of beach closures occur during, or just after, smaller, more frequent storms or “dry” weather, when contaminated stormwater and other material in the pipes discharge into the shallow waters of North Dorchester Bay.”**

Boston Water & Sewer Commission (BWSC) continues to identify broken pipes and illegal hook-ups to the sewer system. Illegal connections are important to address because they result in sewage entering pipes that will not be treated, and then discharging onto the beaches. Although illegal hook-ups and broken pipes are difficult to trace and may never be completely eliminated, BWSC continues to identify and fix these problems. Homeowners can help by requiring that their contractors provide proof that they connect to sewer infrastructure properly and that the infrastructure is well maintained.



## Factors to be addressed in evaluating alternative proposals

While uncertainties remain, there is a consensus on a number of issues:

1. Three sources cause beach closures in North Dorchester Bay:
  - sewage from illegal hook-ups and broken pipes;
  - contaminated stormwater; and
  - CSO.
2. CSO events and the intense or large storms that cause them are infrequent.
3. The majority of beach closures occur during, or just after, smaller, more frequent storms or “dry” weather, when contaminated stormwater and other material in the pipes discharge into the shallow waters of North Dorchester Bay.

The significant bacterial sources of beach closures flow through a network of pipes in North Dorchester Bay. Solutions to reduce the frequency of bacterial contamination of the beaches should include stormwater treatment, ongoing infrastructure maintenance, and CSO elimination.

## PLANS FOR ELIMINATING CSOs AND STORMWATER DISCHARGES

### What is the originally approved plan?

In 1997, The MWRA, the DEP, the EPA, and the Federal Court approved a CSO control plan that would eliminate all CSO and stormwater discharges onto the North Dorchester Bay beaches. This fulfilled a 1985 court order that resulted from a lawsuit brought by the Conservation Law Foundation and the EPA to clean up Boston Harbor.

That plan called for the construction of a 13-foot diameter underground storage tunnel along the shore and a 600 million gallons per day (mgd) pumping treatment facility. The tunnel and facility store stormwater and CSO discharges during small events, and transport and treat material during larger events.

Siting difficulties prevented the MWRA from implementing the approved plan. As a result, the MWRA began a review of the situation and agreed to present a plan by March 31, 2004.

Alternative plans should be evaluated for the protection they offer the public and keeping beaches open for swimming. Issues to consider include:

- Degree of CSO control;
- Degree of stormwater management; and
- Impact on the number of safe swimming days.

### Degree of CSO control

All of the plans presented to date provide a relatively high level of CSO control. Nevertheless, in large storms some of the plans allow untreated CSO discharges into North Dorchester Bay, while other plans allow treated CSO discharges into the Reserved Channel.

**In large (and small) rain events, stormwater management must be part of the solution for there to be an increase in swimming days.**



### Degree of stormwater management

The majority of the beach closures in North Dorchester Bay are caused by contaminated stormwater from small rain events and from illegal connections to the stormwater infrastructure. Additionally, the volume of stormwater discharge increases dramatically during large storms that result in CSO activations. Therefore, plans that remove CSO during a severe storm, but do not address the increased volume of contaminated stormwater, will likely result in beach closures.

In large (and small) rain events, stormwater management must be part of the solution for there to be an increase in swimming days.

### Impact on the number of safe swimming days

In addition to CSO and stormwater control, proposed plans should be evaluated for their impact on the number of safe swimming days. Any solution, like the originally approved plan, that removes CSO, stormwater, and any other contaminated material in the pipes, increases the number of safe swimming days from current conditions.

Any alternative that does not manage stormwater and stormwater infrastructure may continue conditions that currently keep beaches closed.

## SUMMARY

The SAC concludes that the primary bacterial sources that close beaches of South Boston and North Dorchester are human wastes in stormwater and CSOs. In order to increase the number of clean swimming days, an effective plan should address all significant sources of bacteria.

## WORKS CITED

Department of Conservation and Recreation, Division of Urban Parks and Recreation. "Final Report for Water Quality Testing, MDC Recreational Waters 2003 Beach Season"; December 2003.

Adapted from Boston Water and Sewer Commission; 2004.

Metcalf & Eddy.

MWRA. Combined Sewer Overflow Facilities Plan Environmental Impact Report. Report prepared by Metcalf & Eddy; July 31, 1997.

MWRA. Adapted from South Boston CSO Reassessment. Presentation prepared by Metcalf & Eddy; December 16, 2003.

## ACKNOWLEDGEMENTS

**Thanks to the members of Save the Harbor/Save the Bay's Science Advisory Committee:**

Chair; Judith Pederson, Ph.D., MITSG Center for Coastal Resources, MIT Sea Grant College Program

Vice Chair; Michael Shiaris, Ph.D., Chair, Biology Department, University of Massachusetts Boston

Eric Adams, Ph.D., Department of Civil and Environmental Engineering, MIT

Todd P. Callaghan, Ph.D., Massachusetts Office of Coastal Zone Management

Julie Carruthers, Ph.D., Department of Environmental, Coastal and Ocean Sciences, University of Massachusetts Boston

Robert Chen, Ph.D., Department of Environmental, Coastal and Ocean Sciences, University of Massachusetts Boston

Harriet Diamond, M.B. Biological Oceanography, Principal, Diamond Environmental Associates

Bernie Gardner, Ph.D., Department of Environmental, Coastal and Ocean Sciences, University of Massachusetts Boston

Joseph Harrington, Ph.D., Department of Environmental Health, Harvard School of Public Health and Engineering and Applied Sciences, Faculty of Arts and Sciences

Chantal Lefebvre, MSc, The Urban Harbors Institute, University of Massachusetts Boston

Curtis Olsen, Ph.D., Chair, Department of Environmental, Coastal and Ocean Sciences, University of Massachusetts Boston

James Shine, Ph.D., Department of Environmental Health, Harvard School of Public Health

Andrew R. Solow, Ph.D., Director, Marine Policy Center, Woods Hole Oceanographic Institution

William Spitzer, Ph.D., Vice President, New England Aquarium

Gordon Wallace, Ph.D., Department of Environmental, Coastal and Ocean Sciences, University of Massachusetts Boston

**Thanks to the many city, state and federal agencies, public interest organizations and technical advisors who participated in this inquiry:**

Boston Water and Sewer Commission

Conservation Law Foundation

Department of Conservation and Recreation

Department of Environmental Protection

Massachusetts Water Resources Authority

United States Environmental Protection Agency, Region 1

**Thanks to those who support the work of the committee and the publication of this report:**

Anonymous

Forrest Berkley & Marcie Tyre

Cabot Family Charitable Trust

Executive Office of Environmental Affairs – Coastal Zone Management

Grand Circle Foundation

Maine Community Foundation

Harold Whitworth Pierce Charitable Trust

The Children's Museum

The Nicholson Foundation

tpgcreative

UMass Boston Urban Harbors Institute

**Thanks to Bruce Berman, Ben Kelly and Megan Lim of Save the Harbor/Save the Bay.**

**For more information, or for additional copies of this report, contact:**

Save the Harbor/Save the Bay  
286 Congress Street, 7th Floor  
Boston, Massachusetts 02210