# Boston Water and Sewer Commission

# CSO Monitoring Report
# 2020

April 2021

**Boston Water and Sewer Commission**

**CSO Monitoring Report**
**For the period from January 1 to December 31, 2020**

**Table of Contents**


1. Introduction ....................................................................................1

   Program Background....................................................................7
   Public Notification Plan..................................................................9

2. Precipitation Summary....................................................................12
   Peak Intensity, Average Intensity....................................................23
   Typical Year Analysis....................................................................23
   Analysis of Return Periods.............................................................23

3. Modeled CSO Discharges..................................................................25

4. Water Quality..................................................................................26

   Water Quality Standards................................................................27
   Sampling Stations..........................................................................29
   Sampling Parameters.....................................................................31
   Summary of Wet Weather Water Quality Data.................................32
   Overview of Water Quality.............................................................32
   Conclusions...................................................................................39

**List of Tables**


Table 1: Commission CSO Outfalls, 2020 ..... **5, 6**

Table 2: 2020 Monthly Precipitation and Annual Totals ..... **14**

Table 3: Largest Storms Recorded by the Commission's rain gages ..... **15**

Table 4A: Storms with rainfall greater than 0.25 inches – January to June 2020 ..... **16**

Table 4B: Storms with rainfall greater than 0.25 inches – July to December 2020 ..... **18**

Table 5: Peak Intensity, Average Intensity ..... **20**

Table 6: Comparison of Size and Number of Rain Events, Typical Year versus 2020 ..... **20**

Table 7: Return Periods for 2020 Storms at Union Park ..... **21**

Table 8: Receiving Water Classifications in BWSC CSO Areas ..... **29**

Table 9: Boston Harbor Water Quality Statistics for 2020 – based on ***Enterococcus*** Levels ..... **33**

Table 10: Comparison of ***Enterococcus*** Levels at DCR and MWRA Sampling Stations during the swimming season ..... **34**

**List of Figures**

Figure 1A, 1B & 1C: Commission CSO Outfalls, 2020........................2, 3, 4

Figure 2: Example of a sign identifying a CSO discharge point...................10

Figure 3: BWSC Rain Gage Locations.............................................13

Figure 4: Boston Harbor Drainage System Surface Water Classifications.........28

Figure 5: MWRA and DCR monitoring Locations in Inner Harbor and Dorchester Bay.....................................................31

Figure 6: Enterococcus Levels at Carson Beach....................................35

Figure 7: Enterococcus Levels in Reserved Channel...............................36

Figure 8: Enterococcus Levels at Fort Point Channel at Stations 018, 019, 075, 138 and 178...........................38

## 1.0 INTRODUCTION

### Purpose

This report summarizes the Boston Water and Sewer Commission's (referred to hereafter as the Commission) 2020 Combined Sewer Overflow (CSO) Monitoring Program. The report presents discharge volumes, frequencies, and durations for the Commission's 37 permitted CSO outfalls. Discharges are based on values reported by the Massachusetts Water Resources Authority (MWRA) from its system-wide model, which MWRA recently recalibrated and updated to 2020 system conditions.

Year 2020 wet-weather overflows from the Commission's combined sewers are permitted under U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) permit number MA0101192, which took effect in May 2003. A separate permit exists for the Commission's stormwater outfalls.

Since 1990, the Commission has submitted annual CSO monitoring reports that estimate overflows from the combined sewer system. Prior to 2001, estimates were obtained with a computer model developed by the Commission that simulated the hydrology and hydraulics of its combined sewer system. In 2001, the Commission applied the MWRA CSO model to estimate CSO discharges. Since 2002, the Commission has used MWRA's collection system modeling results to estimate activity at BWSC CSOs.

The 37 permitted CSO outfall locations are shown in Figures 1A, 1B and 1C. These locations are also listed in Table 1. Eight (8) of these CSOs are inactive or unable to discharge. BOS 083, included in this group, was routed by the MWRA as part of their North Dorchester Bay CSO Storage Tunnel project (NDB Tunnel). The remaining 29 CSOs are active and can discharge into Boston Harbor, NDB Tunnel or the Muddy River. Five (5) of these CSOs are upstream of the MWRA's NDB Tunnel which discharges only during very large storms, a 25-year storm or larger.


**Figure 1A: CSO Outfalls 2020**


**Figure 1B: CSO Outfalls 2020**


**Figure 1C: CSO Outfalls 2020**

**Table 1: CSO Outfalls, 2020**

| Discharge Serial No. | Location | Receiving Water |
|---|---|---|
| 003 | Porter Street Drain, Bird Island Flats | Inner Harbor – Lower |
| 004 | Maverick Street, approximately 800 feet east of Jefferies Street | Inner Harbor – Lower |
| 005 | Jeffries Street at Summer Street Extension | Inner Harbor – Lower |
| 006 | Marginal Street at Ruth Street Extension - **closed** | Inner Harbor – Lower |
| 007 | Marginal Street at Cottage Street Extension- **closed** | Inner Harbor – Lower |
| 009 | Lo Presti Park, Summer Street at New Street Extension | Inner Harbor – Upper |
| 010 | Off Border Street 200 feet north of Decatur Street | Inner Harbor – Upper |
| 012 | Border Street at Eutaw Street Extension | Inner Harbor – Upper |
| 013 | Condor Street at Meridian Street Extension | Inner Harbor – Mystic/Chelsea |
| 014 | Chelsea River off Eagle Square and East Eagle Street | Inner Harbor – Mystic/Chelsea |
| 017 | Mystic River at Mishawum Street Extension | Inner Harbor – Mystic/Chelsea |
| 019 | Chelsea Street Extension | Inner Harbor – Upper |
| 046 | Boston Gatehouses Nos. 1 and 2, Muddy River | Muddy River |
| 049 | Nashua Street near Charles River Dam- **closed** | Charles River – Lower |
| 057 | Eastern Avenue Extension | Inner Harbor – Upper |
| 060 | Central Wharf (N.E. Aquarium), Central St. Extension | Inner Harbor – Upper |
| 062 | Oliver Street Extension | Inner Harbor – Fort Point Channel |
| 064 | Fort Point Channel at Summer Street | Inner Harbor – Fort Point Channel |
| 065 | Dorchester Avenue at Kneeland Street Extension | Inner Harbor – Fort Point Channel |

| Discharge Serial No. | Location | Receiving Water |
|---|---|---|
| 068 | Off Albany Street between Herald and Traveler Streets | Inner Harbor – Fort Point Channel |
| 070 | Roxbury Canal Conduit Outlet at Fourth Street Extended | Inner Harbor – Fort Point Channel |
| 072 | Fort Point Channel at Dorchester Avenue Bridge - **closed** | Inner Harbor – Fort Point Channel |
| 073 | Fort Point Channel at Mount Washington Avenue Extended | Inner Harbor – Fort Point Channel |
| 076 | Reserved Channel approximately 710 feet north of Pappas Street | Inner Harbor – Reserve Channel |
| 078 | Reserved Channel at I Street Extended | Inner Harbor – Reserve Channel |
| 079 | Summer Street | Inner Harbor – Reserve Channel |
| 080 | East First Street at Farragut Road Extension | Inner Harbor – Reserve Channel |
| 081 | Farragut Road Extended | Dorchester Bay – North |
| 082 | N Street Extended | Dorchester Bay – North |
| 083 | K Street Extended - **closed** | Dorchester Bay – North |
| 084 | H Street Extended | Dorchester Bay – North |
| 085 | Rev. Richard A. Burke Street Extended | Dorchester Bay – North |
| 086 | Old Colony Avenue at Logan and Gavin Way Extension | Dorchester Bay – North |
| 087 | Mount Vernon Street and Morrissey Boulevard -**closed** | Dorchester Bay – North |
| 088 | Fox Point Relief Outlet, Freeport Way Extension **closed in 2007** | Dorchester Bay – South |
| 089 | Fox Point, south of Savin Hill to Southview Street Extension - **closed in 2007** | Dorchester Bay – South |
| 090 | Commercial Point, Tenean Beach, 260 feet north of Victory Road - **closed in 2007** | Dorchester Bay – South |

## Program Background

### *1990-1991*

The Commission's CSO monitoring program began in 1990. During these two years, the program monitored CSO discharges, developed a CSO computer model and assessed the impact of CSO discharges on the receiving waters. Field monitoring consisted of measuring and sampling discharge at 14 outfalls, usually two each quarter. The computer model was initially developed to estimate discharges at 42 CSOs. To assess impact on receiving waters, model estimates were compared to water quality data collected by the MWRA's Environmental Quality Department. During this period, the Commission submitted quarterly reports in accordance with its NPDES permit. Reports during this period included the MWRA's Estimated Discharge Water Quality, which estimated the average pollutant concentrations from the discharges. These estimates were dropped in 1992.

### *1992-1994*

In 1992, the field monitoring aspect of the program was suspended because field work was being conducted by the MWRA as part of its CSO facilities planning. The MWRA collected data on CSO flows and water quality in 1992 and, exclusively, in the Stony Brook system in 1993. The Commission's CSO model was modified to include the Commission's Charles River CSOs in 1993. The Commission's model was recalibrated in 1994. During this period, the Commission submitted quarterly reports.

In 1993, the MWRA recommended over 100 system optimization projects (SOPs) to the Commission. SOPs are relatively low cost, easily implemented modifications to the combined sewer system for floatables control. SOPs included raising weirs, blocking overflows, installing tide gates, and installing underflow baffles. Baffles limit discharge of solids into overflow pipes. Commission staff raised weirs and blocked overflows. Contractors installed tide gates and a hanging baffle because of the complexity of the work.

### *1995-1998*

As part of the SOP, the Commission raised 79 weirs, blocked 15 regulators, installed 13 tide gates, and installed one hanging baffle. In May 1997, the MWRA completed improvements for the remaining SOPs. The Commission finished its remaining SOPs in October 1997. BOS 015 and BOS 052 were removed from the CSO model, as they stopped discharging overflows from combined sewers in 1994. These outfalls now function as storm drains. BOS 032, which was converted into a storm drain in 1997, and BOS 093, which was converted in 1998, were also subsequently removed from the model.

### *1999-2002*

In fall 1999, MWRA installed underflow baffles in four Commission regulators in Beacon Street: MC12, MC15, MC19 and MC25. These regulators overflow to MWRA's Boston Marginal Conduit (BMC) which conveys flow to the Prison Point CSO Facility. The BMC also can overflow to the Charles River in large storms. The Commission installed underflow baffles in eight regulators that overflow to Boston Harbor in 2001: 064-5, 068-1A, 070/5-2, 070/6-1, 070/8-3, 070/8-15, 070/9-4, and 070/10-5.

BOS 095, the last remaining CSO to the Neponset River, was closed in June 2000 following construction of storm drains in the area.

In September 2000, storm drain construction was completed and the last remaining CSO regulator in East Boston's Constitution Beach / BOS 002 area was closed.

In 2002, the Commission installed baffles at regulators 057-6 and 065-2, and raised the overflow weir at 070/10-5.

The Commission applied the MWRA's North System CSO SWMM model to estimate CSO discharges in 1999 and 2000, respectively. The Commission adapted the MWRA CSO model to run in SWMM version 4.4H. The Commission used MWRA's CSO modeling results to estimate 2002 CSO discharges.

Federal court-ordered sewer separation projects in Dorchester and the combined sewer portion of Stony Brook basin began in 2001. The Stony Brook separation area encompasses portions of Jamaica Plain, Roxbury and Mission Hill. The South Dorchester Bay sewer separation project is bounded by Columbia Road to the north and the Neponset River to the south.

***2003-2005***

The 2003 CSO monitoring report was the first report under the new NPDES permit issued by USEPA, effective in May 2003. For the 2005 report, as required by section D item 4 of the NPDES permit, CSO statistics were compared to the typical year of the future planned conditions used in the MWRA Final CSO Facilities Plan. As also required, the report assessed whether CSO activation volume and frequency were in accordance with the estimates in the MWRA CSO Facilities Plan.

Work continued on the sewer separation projects in Dorchester and the Stony Brook system.

CSO estimates were obtained from the MWRA model and flow measurements. In 2004 the MWRA completed the conversion of its existing SWMM model to an InfoWorks model that incorporates greater detail in collection system assets owned by MWRA.

As part of the Neponset River sewer separation project, inflow sources from sewer systems in the Neponset area were removed, reducing the amount of stormwater in the sewer system by removing non-residential, private drainage connections such as private parking lots.

In March 2005, the Commission commenced construction of the Fort Point Channel BOS 072-073 sewer separation project.

Eight flow meters were installed in October 2005 at CSOs that discharge to Dorchester Bay. The meters are maintained by Severn Trent Pipeline Services (now ADS Corporation).

*2006*

As part of the South Dorchester Bay sewer separation project (completed in 2007), the Commission conducted flow monitoring and system performance evaluations to determine whether former CSO regulators can be closed without adverse effects in large storms.

In September 2006, the Commission completed sewer separation for the Stony Brook sewer separation project and initiated flow monitoring and system performance evaluations to verify that the expected level of CSO control has been achieved.

The Fort Point Channel BOS 072-073 Sewer Separation project was 98% complete at the end of 2006.

In December 2006, the Commission initiated the first of two planned construction contracts for the Morrissey Boulevard storm drain project. This contract involved construction of a diversion chamber that allows stormwater flows that previously discharged to outfall BOS 087 to be diverted to Savin Hill Cove in storms greater than the 1-year design storm. The second contract included construction of the Morrissey Boulevard storm drain conduit.

In July 2006, the Commission commenced the design portion of the Reserved Channel Sewer Separation project and collected data through field investigations, building inspections, geotechnical investigations, and flow metering. Construction was completed in 2015.

The Commission awarded a contract for design services for the Bulfinch Triangle sewer separation project and issued a notice to proceed in August 2006.

*2007-2010*

The separation of the combined sewer areas in Dorchester was completed, making it possible to close the regulators in this area. Consequently, BOS 088, BOS 089 and BOS 090 are no longer discharging overflows from combined sewers.

The construction of the storm drain in Morrissey Boulevard began in 2007 and was completed in June 2009.

The Bullfinch Triangle sewer separation project was completed in 2010.

The Commission completed a study of the Lower Dorchester Brook Sewer System which recommended the relocation of the regulator on the New Boston Main Interceptor to a location near the Boston Main Interceptor. The relocation will make it possible to remove a significant amount of stormwater from the Commission's interceptor system.

**Public Notification Plan**

In compliance with the Nine Minimum Controls, the Commission maintains signs that indicate CSO outfalls and keeps the community abreast of its sewer management actions. An example of a sign identifying outfall BOS 004 in East Boston is shown in Figure 2.

The Commission has developed maps showing the location of all active CSO outfalls. The maps were sent to local yacht clubs, marinas, and environmental groups concerned with water quality in Boston Harbor.


**Figure 2: Example of a sign identifying a CSO**

*Plans for the Commission's Public Notification Plan*

The Commission developed computer models to simulate the collections system; one model for the sewer system and another for the storm drainage system. Previously, the Commission had planned to use the sewer model for public notification after calibrating this model. The plan has been modified. The current plan is to monitor flows and determine when overflows occur and how long they last.

The Commission procured metering services in 2013 to measure flows at 10 regulator locations. These measurements will be used to determine overflow events and eventually for model calibration of the sewer model. The flow meters were deployed in the Fall of 2013. The regulators are considered "most likely" to overflow during a typical year will be monitored first. The Commission plans to post overflow events onto its website. In 2017, the Commission monitored several storms to identify overflows. The CSO Public Notification web page went live in 2018 and the overflow information is now available on the Commission's website: https://www.flowworks.com/bwsccsonotification/#/

In 2019, the Commission signed a Discharge Notification for Combined Sewer Overflows contract with ADS Environmental Services. The project will identify regulators discharging to public water bodies, develop and implement a monitoring plan, and post real-time notification of overflows to the public. The Commission's web page will be modified accordingly. In 2020, ADS was installing monitoring equipment.

## 2.0 PRECIPITATION SUMMARY

For a number of years, the Commission collected rainfall from eight rain gages located on the rooftops of public buildings; recently the system was expanded to ten locations. This rainfall data continues to be available to other agencies and the public on the Commission's web site at https://www.bwsc.org/environment-education/rainfall-garden.asp. The gages are located at the following locations:

1. *Union Park Pumping Station, 120 Malden St. in the South End*
2. *Roslindale, Washington Irving Middle School at 105 Cummins Highway*
3. *Dorchester-Adams, Boston Public Library Branch at 690 Adams St.*
4. *Union Square – Allston, Boston Fire Department at 460 Cambridge St.*
5. *Hyde Park, Boston Police Station at 1243 Hyde Park Ave.*
6. *Dorchester-Talbot, Joseph Lee School at 155 Talbot Ave. in Mattapan*
7. *Charlestown, Harvard Kent School at 50 Bunker Hill St.*
8. *Longwood Medical Area, MASCO Building at 375 Longwood Ave.*
9. *Roxbury, Eggleston Square Branch of Boston Library*
10. *East Boston, East Boston Branch of Boston Library*

These gages transmit data using a cellular modem, the original devices used dial up technology. The Dorchester-Adams location was out of service for the entire year due to ongoing building renovations. The Commission selected a new location for the Dorchester-Adams gage but has yet to install the gage because of COVID-19.

Before the Commission installed rain gages, it relied solely on the rain gage at Logan Airport. Often, the Logan rainfall did not reflect the rainfall away from Boston Harbor. For example, storms passing over Roslindale or Hyde Park were often missed by the Logan gage. The Commission installed rain gages so that it could examine the rainfall from storms affecting drainage systems serving the inland areas of Boston.

Over the last 10 years, patterns exist in the rainfall distributions; some locations consistently have more rainfall than others. Generally, the Commission's gages record more rainfall than Logan Airport. The Commission's ten rain gages are shown on Figure 3 on the following page.

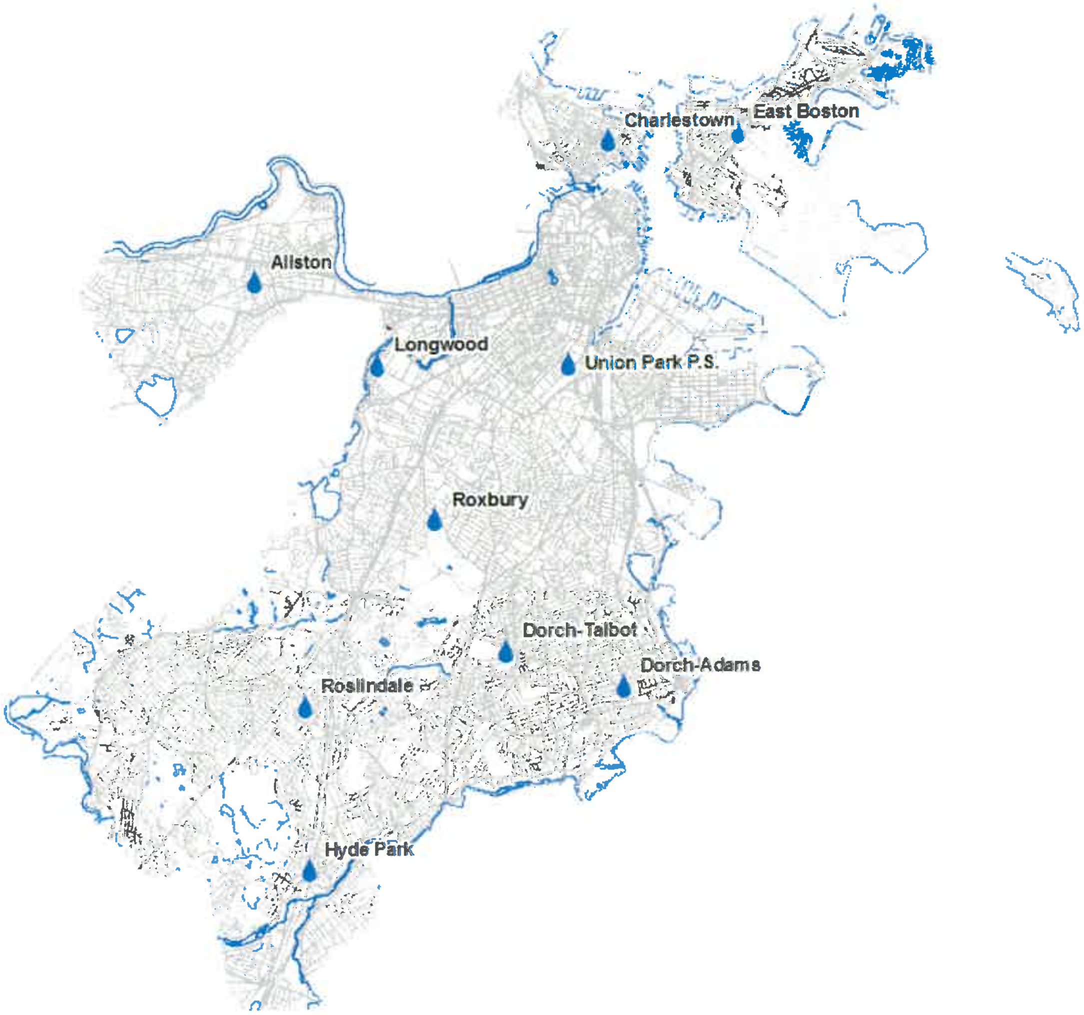



**Figure 3** – BWSC Rain Gage Locations

## Table 2: 2020 Monthly Precipitation and Annual Totals

| | *Allston* | *Charlestown* | *Dorchester Adams* | *Dorchester Talbot* | *East Boston* | *Hyde Park* |
|---|---|---|---|---|---|---|
| *January* | 1.30 | 1.31 | * | 1.53 | 1.37 | 1.36 |
| *February* | 3.45 | 3.31 | * | 3.63 | 3.39 | 3.60 |
| *March* | 4.09 | 3.60 | * | 4.45 | 3.77 | 4.65 |
| *April* | 4.94 | 4.93 | * | 6.50 | 5.60 | 7.28 |
| *May* | 2.37 | 2.55 | * | 2.76 | 2.51 | 2.80 |
| *June* | 3.08 | 2.53 | * | 3.19 | 2.79 | 5.53 |
| *July* | 1.35 | 1.71 | * | 1.90 | 1.90 | 1.79 |
| *August* | 1.37 | 1.63 | * | 2.50 | 1.92 | 3.80 |
| *September* | 1.39 | 0.71 | * | 1.68 | 1.32 | 1.73 |
| *October* | 4.96 | * | * | 6.27 | 5.66 | 6.36 |
| *November* | 5.19 | * | * | 5.23 | 4.35 | 5.28 |
| *December* | 5.55 | * | * | 5.57 | 5.50 | 6.17 |
| | **39.04** | **22.28** | * | **45.21** | **40.08** | **50.35** |

| | *Longwood* | *Roslindale* | *Roxbury* | *UPPS* | *Logan* | *Normal* |
|---|---|---|---|---|---|---|
| *January* | 1.33 | 1.53 | 1.42 | 1.46 | 1.43 | 3.35 |
| *February* | 3.55 | 3.80 | 3.46 | 3.49 | 3.30 | 3.27 |
| *March* | 4.28 | 4.72 | 4.11 | 4.10 | 3.35 | 4.33 |
| *April* | 5.35 | 7.19 | 6.15 | 5.92 | 4.33 | 3.74 |
| *May* | 2.73 | 3.01 | 2.50 | 2.44 | 2.21 | 3.50 |
| *June* | 1.52 | 3.11 | 3.38 | 3.07 | 2.51 | 3.66 |
| *July* | * | 1.47 | 1.60 | 1.48 | 2.10 | 3.43 |
| *August* | * | 2.63 | 1.80 | 1.65 | 2.28 | 3.35 |
| *September* | * | 1.80 | 1.79 | 1.41 | 0.93 | 3.43 |
| *October* | * | 6.21 | 5.95 | 5.73 | 5.02 | 3.94 |
| *November* | * | 5.48 | 5.09 | 4.55 | 3.35 | 3.98 |
| *December* | * | 6.42 | 5.75 | 5.50 | 5.48 | 3.78 |
| | **18.76** | **47.37** | **43.00** | **40.80** | **36.29** | **43.76** |

*** not operable**

In 2020, rainfall was slightly above average. In April, October and December, gages recorded significantly above average rainfall while rainfall in January and July through September was below normal, see Table 2. The rain gages at Charlestown and Longwood did not operate during the second half of the year. The rain gage at Dorchester-Adams did not operate for the entire year.

**Table 3: Largest storms recorded by the Commission's rain gages**

| | Allston | | Charlestown | | Dorchester – Adams * | | Dorchester -Talbot | |
|---|---|---|---|---|---|---|---|---|
| Rank | rainfall (in) | start date | rainfall (in) | start date | rainfall (in) | start date | rainfall (in) | start date |
| 1 | 2.13 | 05-Dec-20 | 1.39 | 23-Mar-20 | *no data | | 2.12 | 05-Dec-20 |
| 2 | 1.87 | 25-Dec-20 | 0.99 | 28-Jun-20 | | | 2.06 | 25-Dec-20 |
| 3 | 1.71 | 23-Nov-20 | 0.96 | 13-Apr-20 | | | 1.92 | 23-Nov-20 |

| | East Boston | | Hyde Park | | Longwood | | Roslindale | |
|---|---|---|---|---|---|---|---|---|
| Rank | rainfall (in) | start date | rainfall (in) | start date | rainfall (in) | start date | rainfall (in) | start date |
| 1 | 2.27 | 05-Dec-20 | 3.01 | 28-Jun-20 | 1.53 | 23-Mar-20 | 2.45 | 05-Dec-20 |
| 2 | 1.70 | 23-Nov-20 | 2.47 | 05-Dec-20 | 1.03 | 03-Apr-20 | 2.00 | 25-Dec-20 |
| 3 | 1.64 | 25-Dec-20 | 2.26 | 23-Aug-20 | 0.98 | 13-Apr-20 | 1.89 | 23-Nov-20 |

| | Roxbury | | Union Park PS | |
|---|---|---|---|---|
| Rank | rainfall (in) | start date | rainfall (in) | start date |
| 1 | 2.13 | 05-Dec-20 | 2.06 | 05-Dec-20 |
| 2 | 1.92 | 23-Nov-20 | 1.74 | 25-Dec-20 |
| 3 | 1.82 | 25-Dec-20 | 1.70 | 23-Nov-20 |

**January through June 2020**

Rainfall patterns were slightly above average patterns. The largest storm of the first six months began on March 23, 2020. The Dorchester Adams gage was out of service from January through June, an "*" denotes the dates when gage was not operable.

**Table 4A: Storms with rainfall greater than 0.25 inches from January to June 2020**

| | Allston | Charlestown | Dorch-Adams | Dorch-Talbot | East Boston | Hyde Park | Longwood | Roslindale | Roxbury | UPPS |
|---|---|---|---|---|---|---|---|---|---|---|
| date | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth |
| 1/19/20 | 0.32 | 0.25 | * | 0.31 | 0.27 | 0.32 | 0.27 | 0.38 | 0.32 | 0.32 |
| 1/25/20 | 0.55 | 0.55 | * | 0.59 | 0.63 | 0.51 | 0.59 | 0.58 | 0.59 | 0.67 |
| | | | | | | | | | | |
| 2/06/20 | 0.47 | 0.47 | * | 0.51 | 0.49 | 0.51 | 0.51 | 0.54 | 0.50 | 0.51 |
| 2/07/20 | 0.39 | 0.36 | * | 0.37 | 0.38 | 0.38 | 0.36 | 0.40 | 0.36 | 0.35 |
| 2/11/20 | | | * | | | 0.25 | | | | |
| 2/13/20 | 0.55 | 0.54 | * | 0.62 | 0.56 | 0.63 | 0.57 | 0.64 | 0.55 | 0.57 |
| 2/18/20 | 0.45 | 0.46 | * | 0.44 | 0.48 | 0.42 | 0.47 | 0.45 | 0.44 | 0.45 |
| 2/25/20 | | | * | 0.32 | | 0.29 | 0.27 | 0.32 | 0.31 | 0.29 |
| 2/27/20 | 0.88 | 0.80 | * | 0.84 | 0.79 | 0.75 | 0.81 | 0.83 | 0.78 | 0.82 |
| | | | | | | | | | | |
| 3//13/20 | 0.45 | 0.30 | * | | 0.27 | 0.28 | 0.40 | 0.34 | 0.26 | 0.26 |
| 3/19/20 | 0.64 | 0.56 | * | 0.67 | 0.61 | 0.65 | 0.67 | 0.70 | 0.64 | 0.65 |
| 3/23/20 | 1.51 | 1.39 | * | 1.92 | 1.43 | 1.68 | 1.53 | 1.66 | 1.52 | 1.51 |
| 3/24/20 | 0.45 | 0.31 | * | 0.31 | 0.35 | 0.66 | 0.46 | 0.64 | 0.50 | 0.46 |
| 3/29/20 | 0.76 | 0.78 | * | 0.85 | 0.84 | 0.84 | 0.87 | 0.89 | 0.80 | 0.88 |
| | | | | | | | | | | |
| 4/02/20 | | | * | 0.31 | | 0.4 | | 0.36 | | |
| 4/03/20 | 0.98 | 0.90 | * | 1.48 | 1.11 | 1.79 | 1.03 | 1.67 | 1.40 | 1.29 |
| 4/09/20 | 0.62 | 0.62 | * | 0.68 | 0.64 | 0.59 | 0.66 | 0.72 | 0.67 | 0.66 |
| 4/13/20 | 0.83 | 0.92 | * | 1.24 | 0.92 | 1.37 | 0.98 | 1.31 | 1.07 | 1.00 |
| 4/18/20 | 0.7 | 0.69 | * | 0.72 | 0.74 | 0.79 | 0.73 | 0.8 | 0.75 | 0.78 |
| 4/21/20 | 0.36 | 0.41 | * | 0.41 | 0.38 | 0.41 | 0.39 | 0.47 | 0.43 | 0.41 |
| 4/24/20 | | | * | 0.26 | | 0.29 | | 0.28 | | |
| 4/26/20 | 0.31 | 0.27 | * | 0.42 | 0.37 | 0.42 | 0.33 | 0.41 | 0.38 | 0.38 |
| 4/27/20 | 0.59 | 0.57 | * | 0.77 | 0.84 | 0.95 | 0.58 | 0.88 | 0.79 | 0.81 |

| | Allston | Charlestown | Dorch-Adams | Dorch-Talbot | East Boston | Hyde Park | Longwood | Roslindale | Roxbury | UPPS |
|---|---|---|---|---|---|---|---|---|---|---|
| date | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth |
| | | | | | | | | | | |
| **5/01/20** | **0.88** | **0.84** | * | **1.03** | **0.83** | **0.99** | **0.91** | **1.17** | **0.92** | **0.87** |
| **5/08/20** | **0.25** | **0.25** | * | **0.34** | **0.26** | **0.35** | **0.28** | **0.34** | **0.30** | **0.27** |
| **5/11/20** | **0.30** | **0.35** | * | **0.28** | **0.37** | **0.27** | **0.34** | **0.34** | **0.32** | **0.30** |
| **5/15/20** | **0.62** | **0.68** | * | **0.83** | **0.64** | **0.77** | **0.71** | **0.78** | **0.66** | **0.67** |
| | | | | | | | | | | |
| **6/05/20** | | **0.25** | * | | | | | | | |
| **6/06/20** | **0.27** | | * | **0.73** | | **0.88** | **0.66** | **0.90** | **0.74** | **0.59** |
| **6/11/20** | **0.64** | **0.62** | * | **0.58** | **0.66** | **0.63** | **0.68** | **0.74** | **0.69** | **0.69** |
| **6/28/20** | **1.39** | **0.99** | * | **0.72** | **1.03** | **3.01** | * | **0.87** | **1.09** | **1.09** |
| **6/29/20** | **0.35** | **0.41** | * | **0.93** | **0.73** | **0.58** | * | **0.35** | **0.41** | **0.44** |

**July through December 2020**

Rainfall patterns were slightly above average patterns. The largest storms of the second six months began on November 23, December 5 and December 25, 2020. The Dorchester Adams and Longwood gages were out of service from July through December and the Charlestown gage was out of service from October through December, an "*" denotes the dates when each gage was not operable.

**Table 4B: Storms with rainfall greater than 0.25 inches from July to December 2020**

| | **Allston** | **Charlestown** | **Dorch-Adams** | **Dorch-Talbot** | **East Boston** | **Hyde Park** | **Longwood** | **Roslindale** | **Roxbury** | **UPPS** |
|---|---|---|---|---|---|---|---|---|---|---|
| date | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth |
| **7/05/20** | | | * | **0.31** | | **0.42** | * | **0.30** | **0.28** | |
| **7/13/20** | | | * | | | **0.28** | * | | | |
| **7/14/20** | | **0.31** | * | | **0.48** | | * | | | |
| **7/17/20** | | | * | **0.30** | | **0.27** | * | **0.29** | **0.26** | |
| **7/22/20** | **0.33** | **0.39** | * | **0.26** | **0.43** | **0.27** | * | **0.21** | **0.25** | **0.28** |
| **7/23/20** | **0.39** | **0.52** | * | **0.59** | **0.49** | **0.34** | * | **0.28** | **0.44** | **0.56** |
| | | | | | | | | | | |
| **8/04/20** | | | * | **0.26** | **0.32** | | * | | | |
| **8/16/20** | | | * | **0.26** | | **0.25** | * | **0.27** | | |
| **8/22/20** | | | * | **0.31** | | **0.31** | * | **0.38** | | |
| **8/23/20** | **0.54** | **0.84** | * | **1.03** | **0.97** | **2.26** | * | **1.08** | **0.67** | **0.70** |
| **8/27/20** | | | * | **0.29** | | **0.44** | * | **0.32** | **0.27** | |
| | | | | | | | | | | |
| **9/02/20** | **0.26** | **0.25** | * | | **0.25** | | * | | | |
| **9/10/20** | **0.48** | **0.43** | * | **0.28** | **0.31** | | * | **0.33** | **0.38** | |
| **9/30/20** | **0.63** | | * | **1.09** | **0.75** | **1.30** | * | **1.10** | **1.14** | **0.97** |
| | | | | | | | | | | |
| **10/13/20** | **1.41** | * | * | **1.70** | **1.64** | **1.70** | * | **1.62** | **1.76** | **1.67** |
| **10/16/20** | **0.64** | * | * | **0.94** | **0.85** | **0.82** | * | **0.76** | **0.74** | **0.71** |
| **10/17/20** | **1.25** | * | * | **1.34** | **1.30** | **1.42** | * | **1.44** | **1.28** | **1.22** |
| **10/28/20** | **0.31** | * | * | **0.31** | **0.27** | **0.31** | * | **0.32** | **0.32** | **0.31** |
| **10/29/20** | **1.05** | * | * | **1.17** | **1.02** | **1.23** | * | **1.22** | **1.09** | **1.04** |
| **10/31/20** | | * | * | **0.40** | **0.30** | **0.44** | * | **0.49** | **0.42** | **0.39** |

| | Allston | Charlestown | Dorch-Adams | Dorch-Talbot | East Boston | Hyde Park | Longwood | Roslindale | Roxbury | UPPS |
|---|---|---|---|---|---|---|---|---|---|---|
| date | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth | rainfall depth |
| | | | | | | | | | | |
| **11/01/20** | **0.62** | * | * | **0.73** | **0.64** | **0.73** | * | **0.74** | **0.63** | **0.62** |
| **11/13/20** | **0.33** | * | * | **0.33** | **0.33** | **0.34** | * | **0.39** | **0.37** | **0.33** |
| **11/15/20** | **0.48** | * | * | **0.47** | **0.46** | **0.55** | * | **0.53** | **0.51** | **0.48** |
| **11/23/20** | **1.70** | * | * | **1.92** | **1.70** | **1.78** | * | **1.89** | **1.92** | **1.70** |
| **11/26/20** | **0.26** | * | * | **0.30** | | **0.34** | * | **0.35** | **0.28** | **0.26** |
| **11/30/20** | **1.09** | * | * | **1.33** | **0.95** | **1.39** | * | **1.45** | **1.30** | **1.09** |
| | | | | | | | | | | |
| **12/01/20** | **0.78** | * | * | **0.57** | **0.44** | **0.83** | * | **0.86** | **0.74** | **0.56** |
| **12/05/20** | **2.13** | * | * | **2.12** | **2.27** | **2.47** | * | **2.45** | **2.13** | **2.06** |
| **12/12/20** | **0.47** | * | * | **0.44** | **0.52** | **0.43** | * | **0.50** | **0.47** | **0.49** |
| **12/21/20** | | * | * | | **0.28** | | * | | | **0.25** |
| **12/25/20** | **1.87** | * | * | **2.06** | **1.64** | **1.94** | * | **2.00** | **1.82** | **1.74** |

**Peak Intensity, Average Intensity**

Table 5 below provides duration, volume, average intensity and peak intensity for each storm event recorded by the UPPS gage in 2020.

**Table 5: Storms recorded at the UUPS gage in 2020**

| Event | Date & Start Time | Duration (hr) | Volume (in) | Average Intensity (in/hr) | Peak 1-hr Intensity (in/hr) |
|---|---|---|---|---|---|
| 1 | 1/4/2020 11:00 | 17.75 | 0.29 | 0.01 | 0.06 |
| 2 | 1/8/2020 1:30 | 0.25 | 0.01 | 0.04 | 0.01 |
| 3 | 1/12/2020 4:00 | 5.25 | 0.05 | 0.01 | 0.04 |
| 4 | 1/13/2020 9:00 | 8.5 | 0.02 | <.01 | 0.01 |
| 5 | 1/16/2020 3:30 | 6 | 0.1 | <.01 | 0.05 |
| 6 | 1/19/2020 9:00 | 3.25 | 0.32 | 0.1 | 0.25 |
| 7 | 1/25/2020 17:30 | 5.5 | 0.67 | 0.15 | 0.31 |
| 8 | 2/1/2020 4:30 | 0.25 | 0.01 | 0.04 | 0.01 |
| 9 | 2/5/2020 2:15 | 3 | 0.04 | 0.01 | 0.02 |
| 10 | 2/6/2020 2:30 | 18.5 | 0.51 | 0.02 | 0.14 |
| 11 | 2/7/2020 0:30 | 13.75 | 0.35 | 0.02 | 0.13 |
| 12 | 2/10/2020 4:30 | 9.5 | 0.17 | 0.01 | 0.09 |
| 13 | 2/11/2020 5:00 | 10.75 | 0.16 | 0.01 | 0.08 |
| 14 | 2/13/2020 1:15 | 13 | 0.57 | 0.04 | 0.2 |
| 15 | 2/18/2020 14:45 | 6.75 | 0.45 | 0.07 | 0.12 |
| 16 | 2/25/2020 20:45 | 6 | 0.39 | 0.06 | 0.13 |
| 17 | 2/27/2020 1:45 | 10.25 | 0.82 | 0.08 | 0.28 |
| 18 | 3/3/2020 19:00 | 0.75 | 0.03 | 0.01 | 0.03 |
| 19 | 3/4/2020 1:30 | 0.5 | 0.03 | 0.02 | 0.03 |
| 20 | 3/13/2020 2:00 | 15.25 | 0.26 | 0.02 | 0.11 |
| 21 | 3/17/2020 8:45 | 1 | 0.02 | 0.02 | 0.02 |
| 22 | 3/19/2020 5:30 | 14.25 | 0.65 | 0.05 | 0.2 |
| 23 | 3/23/2020 15:30 | 14.25 | 1.97 | 0.13 | 0.48 |
| 24 | 3/28/2020 21:00 | 26.75 | 0.98 | 0.4 | 0.15 |
| 25 | 3/30/2020 14:45 | 9 | 0.13 | 0.01 | 0.01 |
| 26 | 4/2/2020 15:15 | 36.25 | 1.58 | 0.04 | 0.18 |
| 27 | 4/8/2020 6:15 | 2.25 | 0.06 | 0.03 | 0.03 |
| 28 | 4/9/2020 10:45 | 8.25 | 0.66 | 0.08 | 0.3 |
| 29 | 4/10/2020 17:00 | 0.25 | 0.02 | 0.08 | 0.02 |
| 30 | 4/13/2020 5:30 | 15 | 1 | 0.06 | 0.34 |
| 31 | 4/18/2020 1:00 | 15 | 0.78 | 0.05 | 0.18 |
| 32 | 4/21/2020 16:15 | 2.5 | 0.41 | 0.16 | 0.32 |

| Event | Date & Start Time | Duration (hr) | Volume (in) | Average Intensity (in/hr) | Peak 1-hr Intensity (in/hr) |
|---|---|---|---|---|---|
| 33 | 4/24/2020 4:30 | 12 | 0.22 | 0.02 | 0.06 |
| 34 | 4/26/2020 14:45 | 33 | 1.19 | 0.04 | 0.11 |
| 35 | 5/1/2020 2:45 | 12 | 0.87 | 0.07 | 0.31 |
| 36 | 5/8/2020 18:45 | 9.25 | 0.41 | 0.04 | 0.08 |
| 37 | 5/11/2020 17:15 | 6 | 0.3 | 0.05 | 0.21 |
| 38 | 5/15/2020 2:15 | 23.25 | 0.71 | 0.03 | 0.39 |
| 39 | 5/30/2020 3:15 | 0.75 | 0.14 | 0.19 | 0.14 |
| 40 | 6/2/2020 19:30 | 8 | 0.03 | <.01 | 0.02 |
| 41 | 6/5/2020 4:45 | 0.5 | 0.07 | 0.14 | 0.07 |
| 42 | 6/6/2020 15:30 | 6.5 | 0.59 | 0.09 | 0.54 |
| 43 | 6/11/2020 13:15 | 5.5 | 0.69 | 0.13 | 0.31 |
| 44 | 6/24/2020 19:30 | 0.25 | 0.04 | 0.16 | 0.04 |
| 45 | 6/27/2020 15:45 | 0.25 | 0.02 | 0.08 | 0.02 |
| 46 | 6/28/2020 13:30 | 12 | 1.1 | 0.09 | 0.83 |
| 47 | 6/29/2020 11:30 | 17 | 0.44 | 0.03 | 0.29 |
| 48 | 6/30/2020 13:15 | 0.5 | 0.07 | 0.14 | 0.07 |
| 49 | 7/1/2020 6:45 | 5 | 0.15 | 0.03 | 0.14 |
| 50 | 7/5/2020 22:30 | 1.25 | 0.13 | 0.13 | 0.12 |
| 51 | 7/10/2020 23:15 | 0.75 | 0.02 | 0.03 | 0.02 |
| 52 | 7/13/2020 14:15 | 0.25 | 0.11 | 0.44 | 0.11 |
| 53 | 7/14/2020 11:00 | 0.25 | 0.04 | 0.16 | 0.04 |
| 54 | 7/15/2020 4:45 | 0.5 | 0.04 | 0.08 | 0.04 |
| 55 | 7/17/2020 6:00 | 2 | 0.14 | 0.07 | 0.12 |
| 56 | 7/22/2020 6:30 | 16.75 | 0.28 | 0.02 | 0.18 |
| 57 | 7/23/2020 16:45 | 0.25 | 0.56 | 2.24 | 0.56 |
| 58 | 8/2/2020 17:00 | 0.25 | 0.04 | 0.16 | 0.04 |
| 59 | 8/4/2020 16:30 | 1 | 0.15 | 0.15 | 0.15 |
| 60 | 8/16/2020 18:45 | 9 | 0.26 | 0.3 | 0.11 |
| 61 | 8/18/2020 2:15 | 1 | 0.1 | 0.1 | 0.1 |
| 62 | 8/19/2020 18:30 | 0.5 | 0.03 | 0.06 | 0.03 |
| 63 | 8/23/2020 16:45 | 3.75 | 0.7 | 0.2 | 0.61 |
| 64 | 8/27/2020 13:30 | 1 | 0.22 | 0.22 | 0.22 |
| 65 | 8/29/2020 10:30 | 2 | 0.06 | 0.03 | 0.04 |
| 66 | 9/2/2020 11:45 | 6.25 | 0.2 | 0.03 | 0.13 |
| 67 | 9/3/2020 5:00 | 8.25 | 0.02 | <.01 | 0.01 |
| 68 | 9/10/2020 16:45 | 3.75 | 0.22 | 0.06 | 0.12 |

| Event | Date & Start Time | Duration (hr) | Volume (in) | Average Intensity (in/hr) | Peak 1-hr Intensity (in/hr) |
|---|---|---|---|---|---|
| 69 | 9/30/2020 2:30 | 8.75 | 0.97 | 0.11 | 0.32 |
| 70 | 10/7/2020 17:45 | 0.5 | 0.15 | 0.30 | 0.15 |
| 71 | 10/13/2020 5:15 | 17.75 | 1.67 | 0.09 | 0.38 |
| 72 | 10/16/2020 13:00 | 19.75 | 2.29 | 0.11 | 0.35 |
| 73 | 10/21/2020 5:30 | 3.5 | 0.08 | 0.02 | 0.03 |
| 74 | 10/28/2020 3:30 | 13.75 | 0.31 | 0.02 | 0.1 |
| 75 | 10/29/2020 10:45 | 20.75 | 1.2 | 0.06 | 0.12 |
| 76 | 10/31/2020 11:00 | 1.5 | 0.39 | 0.26 | 0.35 |
| 77 | 11/1/2020 15:00 | 7 | 0.62 | 0.09 | 0.25 |
| 78 | 11/11/2020 23:30 | 0.25 | 0.01 | 0.04 | 0.01 |
| 79 | 11/13/2020 0:00 | 18.5 | 0.33 | 0.02 | 0.1 |
| 80 | 11/15/2020 21:00 | 4 | 0.53 | 0.13 | 0.44 |
| 81 | 11/23/2020 4:00 | 8.5 | 1.7 | 0.2 | 0.55 |
| 82 | 11/25/2020 20:00 | 0.25 | 0.01 | 0.04 | 0.01 |
| 83 | 11/26/2020 2:45 | 10.75 | 0.26 | 0.02 | 0.09 |
| 84 | 11/30/2020 11:45 | 14.25 | 1.65 | 0.12 | 0.52 |
| 85 | 12/4/2020 22:00 | 0.25 | 0.01 | 0.04 | 0.01 |
| 86 | 12/5/2020 2:00 | 20.25 | 2.06 | 0.1 | 0.36 |
| 87 | 12/12/2020 12:30 | 5.75 | 0.49 | 0.09 | 0.2 |
| 88 | 12/14/2020 9:00 | 7.75 | 0.07 | 0.01 | 0.02 |
| 89 | 12/18/2020 14:30 | 0.5 | 0.02 | 0.04 | 0.02 |
| 90 | 12/19/2020 14:45 | 0.25 | 0.01 | 0.04 | 0.01 |
| 91 | 12/20/2020 10:30 | 14.25 | 0.17 | 0.01 | 0.04 |
| 92 | 12/21/2020 7:00 | 8 | 0.25 | 0.03 | 0.05 |
| 93 | 12/25/2020 2:45 | 15.5 | 1.74 | 0.11 | 0.52 |
| 94 | 12/31/2020 4:30 | 1.75 | 0.12 | 0.06 | 0.1 |

## Typical Year Analysis

The rainfall in 2020 exceeded four of the MWRA's Typical Year criteria, see Table 6. Looking at the number of storms, all the fully operable gages exceeded the 44 storms of a typical year. The rain gages at Charlestown and Longwood did not operate during the second half of the year. The rain gage at Dorchester-Adams did not operate for the entire year.

In summary, the 2020 rainfall was more than a typical year. The number of storms that met or exceeded the MWRA criteria for depths are highlighted in yellow.

**Table 6: Comparison of size and number of rain events in 2020 versus Typical Year**

| | total rainfall in inches | Number of storms by depth | | | | |
|---|---|---|---|---|---|---|
| | | depth 0.25 to 0.5 inches | depth 0.5 to 1.0 inches | depth 1.0 to 2.0 inches | depth >= 2.0 inches | number of storms |
| MWRA Typical Year | **46.80** | **14** | **16** | **8** | **6** | **44** |
| Allston | 39.04 | 21 | 18 | 8 | 1 | 48 |
| Charlestown *** | 22.28 | 16 | 16 | 1 | 0 | 33 |
| Dorchester-Adams | * | * | * | * | * | * |
| Dorchester-Talbot | 45.21 | 25 | 18 | 11 | 2 | 56 |
| East Boston | 40.08 | 25 | 18 | 6 | 1 | 50 |
| Hyde Park | 50.35 | 25 | 19 | 10 | 3 | 57 |
| Longwood ** | 18.76 | 10 | 14 | 2 | 0 | 26 |
| Roslindale | 47.37 | 25 | 19 | 11 | 2 | 57 |
| Roxbury | 43.00 | 21 | 19 | 11 | 1 | 52 |
| Union Park PS | 40.80 | 19 | 19 | 10 | 1 | 49 |

(*) Not operable for January through December
(**) Not operable for July through December
(***) Not operable for October through December

## Analysis of Return Periods

In 2020, rainfall depths can also be categorized by return frequency. In the following return period analysis four return frequencies were chosen; the 1-month, 3-month, 6-month and 1-year storm, see Table 7 below. The number of observed of events can be measured against the number of times an event should occur in a year. The bottom row in the table shows the normal numbers each sized storm. For example, a 1-month storm should occur 12 times a year while a 1-year only once.

In this table, the storm return periods are also broken down by time intervals; the left-hand column has three intervals from 1-hour to 24-hours. For each time interval and return period, CDM calculated the corresponding rainfall depth which is shown on the left side of the chart. The number of times these depths are exceeded are indicated on the right.

During a one-hour period, more 1-month and 3-month events occurred than would be expected. For example, fourteen 1-month storms were recorded during a 24 hour interval when 12 storms would be considered to be normal. In 2020, for most of these measures, the number of observed events were less than normal.

**Table 7: Return periods for 2020 storms at Union Park**

| interval (hours) | depth (inches at return period) | | | | number of observed events in 2020 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-month | 3-month | 6-month | 1-year | 1-month | 3-month | 6-month | 1-year |
| 1 | 0.3 | 0.49 | 0.61 | 0.86 | 14 | 5 | 1 | 0 |
| 6 | 0.71 | 1.15 | 1.42 | 1.68 | 7 | 3 | 0 | 0 |
| 24 | 0.99 | 1.71 | 2.16 | 2.63 | 9 | 2 | 0 | 0 |
| | | | | **Normal** | **12** | **4** | **2** | **1** |

## 3.0 Modeled CSO Discharges

The MWRA provides the Commission with estimates of the CSO discharge volume, frequency and duration that have been used to prepare this section of the CSO Monitoring Report. The Commission analyzes these estimates prior to preparing this section. The Commission has not received this data yet. After receiving the model estimates, the Commission will need several weeks to review this data and prepare an analysis. A supplemental report containing the model estimates and our analysis will be submitted to the regulatory agencies.

## 4.0 Water Quality

This section evaluates the water quality data collected from Boston Harbor by the MWRA's Environmental Quality Department (ENQUAD) in 2020. The MWRA's bacterial data will be used to assess the impacts of CSO discharges. There are no discharges to Boston beaches. Swimming at beaches can be restricted if bacterial levels exceed certain standards. Stormwater discharges, also a source of bacteria, can elevate these levels above those acceptable for swimming.

Water quality data in three portions of Boston Harbor will be examined; (1) Carson Beach, (2) Fort Point Channel and (3) Reserved Channel. Fort Point Channel and Reserved Channel are not used for swimming but CSO outfalls can discharge into these waters. Fort Point Channel has five CSO outfalls; of these, BOS 070 contributes the largest discharges to this receiving water. Reserved Channel has four CSO outfalls, the combined areas tributary to these outfalls have been separated. Carson Beach has CSO outfalls that provide relief for the MWRA's consolidation conduit. These outfalls should overflow only during very large storms.

The MWRA sampled the waters in Boston Harbor throughout 2020, providing the Commission with data from their far field locations as well as the DCR locations on the beaches. Generally, the MWRA took approximately twenty samples in the waters off Carson Beach between March and October as part of routine surveys in the Dorchester Bay region. During the bathing season, the MWRA increased its program. The DCR collected samples from the beach during the bathing season while the MWRA sample locations are about 100 meters offshore.

Most of the swimming beaches in Boston are in Dorchester Bay. Carson Beach is generally considered to be the most popular beach along this section of the South Boston coastline. Carson Beach along with several other beaches is sampled during the bathing season. Malibu Beach and Tenean Beach, also in Dorchester Bay, are located to the south of Carson Beach. Data from Malibu and Tenean beaches are not included in this report because there are no active CSO outfalls near these beaches. At one time two CSOs on Dorchester Bay, BOS 088/089 and BOS 090 were located near Malibu Beach and Tenean Beach. The separation of the areas tributary to these outfalls was completed in 2006. 2020 marks the fourteenth year that CSO discharges to the Dorchester Bay have been eliminated.

Rainfall is the driving factor in generating CSOs and most CSOs are of short duration. However, correlating rainfall to bacterial levels from CSOs is complicated. The timing of the sampling and discharges is important. Along the beaches, the samples can be collected only at high tide. Usually a CSO discharge occurs when the tide has receded. If an overflow has occurred before sampling, currents and wind can disperse the discharges away from the sampling locations.

The Commission has ten permitted CSOs outfalls in Dorchester Bay located near beaches. In May 2011, the MWRA began to operate a consolidation tunnel along these beaches. The tunnel has been designed to eliminate CSOs from storms up to the 25-year storm event and stormwater discharges up to the 5-year storm. The Commission has closed BOS 087; sending its stormwater to the MWRA tunnel, or to Savin Hill Cove in storms greater than the 1-year storm. The MWRA has effectively closed BOS 083 by routing all flows to BOS 084 system upstream of the consolidation tunnel.

*Other Sources of Bacteria*

In dry weather, it is possible that activities such as boating and bathing can contribute to the bacterial levels measured by the MWRA.

The Commission recognizes that illegal connections to storm drains and leaky sanitary pipes are also sources of bacteria. The identification and removal of these sources present complex issues. The Commission has several programs underway to identify and correct these conditions.

**Water Quality Standards**

Water quality standards for the portions of Boston Harbor affected by BWSC CSOs are promulgated by Massachusetts Department of Environmental Protection (DEP) and Massachusetts Department of Public Health (DPH).

Massachusetts DEP has adopted the Massachusetts Surface Water Quality Standards (314 CMR 4.00). These standards identify designated uses for all waters of the Commonwealth, and prescribe minimum water quality criteria required to sustain the designated uses.

The receiving waters for the CSOs described in this report – Boston Inner Harbor, North and South Dorchester Bay, Muddy River / Back Bay Fens, the Lower Charles River Basin and part of Boston Harbor are classified as follows:

- Boston Inner Harbor is classified SB (CSO), indicating that it is marine water affected by combined sewer overflows as defined in 314 CMR 4.00.
- North and South Dorchester Bay are classified SB. This classification prohibits CSO discharges in these areas. DEP changed the classification of North and South Dorchester Bay to SB from SB (CSO) in 1997.
- The Lower Charles River Basin is classified B-Variance. The variance was issued by DEP in 1998. The Lower Basin was formerly classified B (CSO). In 2007, DEP issued the MWRA five consecutive variances each one for up to 3 years duration for the Charles River and the Alewife Brook/Upper Mystic River. The variances require the MWRA to comply with the milestones of the CSO Control Plan and the level of control referenced in Schedule 6 and the levels of control referenced in the Federal District Court Order's Second CSO Stipulation (2006). Four additional projects have been added to the CSO Control Plan since the previous variance was issued. One of these projects, the separation of the Bulfinch Triangle, was administered by the Commission.
- The Muddy River / Back Bay Fens is classified as B (CSO), indicating that it is fresh water affected by combined sewer overflows as defined in 314 CMR 4.00.

Figure 4 contains a map of the DEP surface water classifications for Boston Harbor. In addition, Table 10 lists the surface water classifications for Boston Harbor.

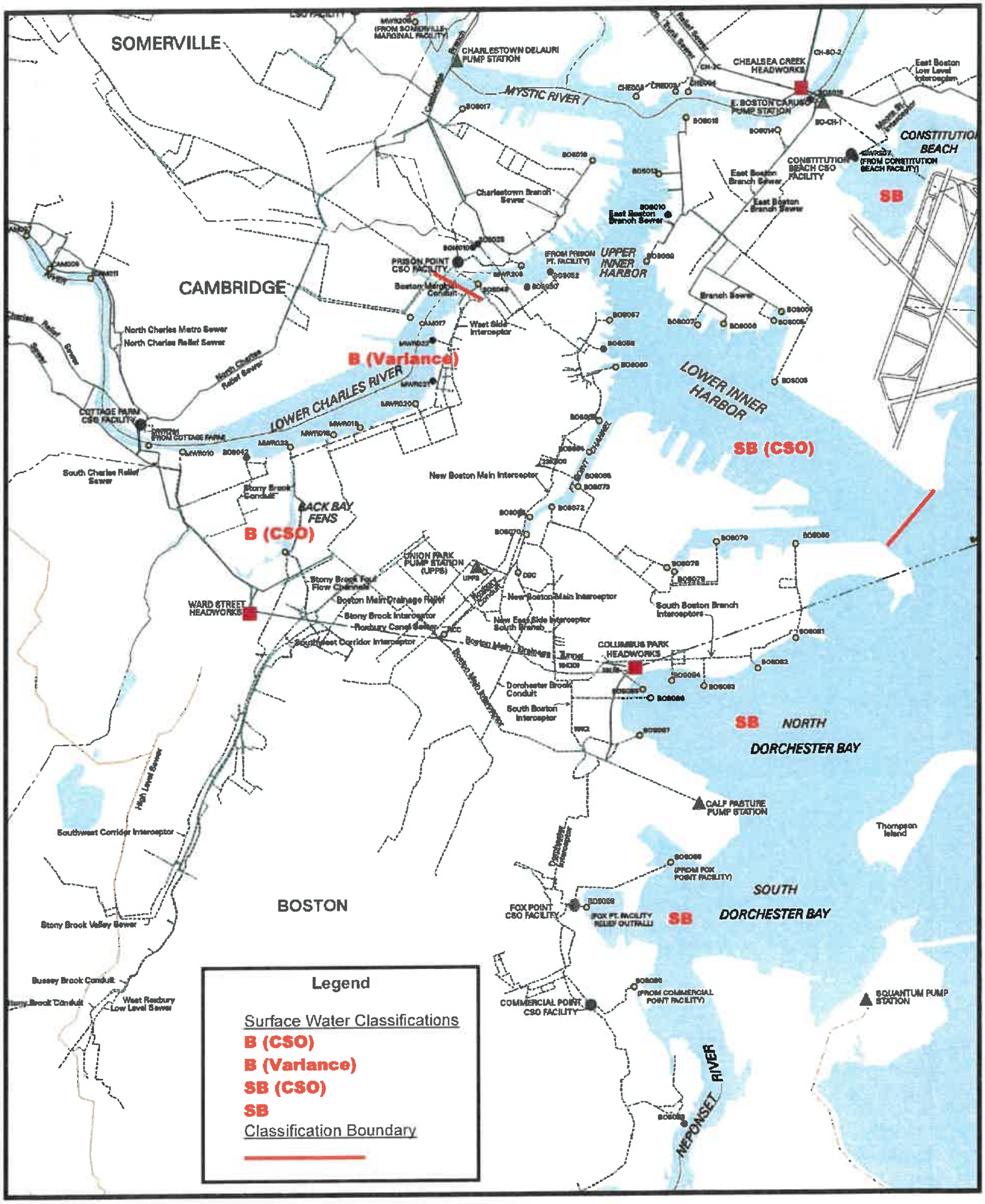



**Figure 4: Boston Harbor Drainage System Surface Water Classifications**

**Table 8: Receiving Water Classifications in BWSC CSO Areas**

| Boundary | Class | BWSC CSOs |
|---|---|---|
| **Boston Harbor Drainage Area** | | |
| Boston Inner Harbor westerly inside a line from the southern tip of Governors Island to Fort Independence including the tidal waters of the Charles, Mystic, Island End and Chelsea (Creek) Rivers and Reserved, Fort Point and Little Mystic Channels | SB (CSO) | BOS 003 – BOS 019<br>BOS 057 – BOS 080 |
| Dorchester Bay (North and South) | SB | BOS 081 – BOS 090 |
| **Charles River Basin** | | |
| Watertown Dam to Science Park Dam | B (Variance) | BOS 049 |
| Muddy River (Entire Length) | B (CSO) | BOS 046 |

USEPA has encouraged states to revise their water quality standards and replace fecal coliform with *Enterococcus* as the indicator bacteria for marine waters. *Enterococcus* is considered a better indicator of human sewage.

Massachusetts DPH maintains minimum bacteriological standards for bathing beaches (105 CMR 445). For marine waters (including all of Boston Harbor), *Enterococcus* is the indicator organism. At a bathing beach, no single sample should exceed 104 colonies per 100 mL, and the geometric mean of the most recent five samples in a single bathing season should not exceed 35 colonies per 100 mL.

For fresh water beaches, the indicator organism is either *E. coli* or *Enterococcus*. While no fresh-water bathing beaches are affected by BWSC CSO discharges, the fresh water standards are reprinted here. The regulations state that:

> No single *E. Coli* sample shall exceed 235 colonies per 100 ml. and the geometric mean of the most recent five *E. Coli* samples within the same bathing season shall not exceed 126 colonies per 100 ml; or
>
> No single *Enterococci* sample shall exceed 61 colonies per 100 ml. and the geometric mean of the most recent five (5) *Enterococci* samples within the same bathing season shall not exceed 33 colonies per 100 ml.

### Sampling Stations

The MWRA Environmental Quality Department provided the Commission year round, with data from 554 surface samples taken at 28 locations. Data from 14 of these locations was analyzed; these sampling stations are shown on Figure 5. Generally, MWRA collected approximately twenty samples at these locations between March and October. MWRA suspended sampling between mid March and mid May for the COVID-19 pandemic. All of the samples were analyzed for *Enterococcus* and fecal coliform.

The analysis that follows will use only the *Enterococcus* data from surface samples since surface waters are more representative of water quality at bathing beaches.

***Inner Harbor – Fort Point Channel***

The MWRA collects samples throughout the Inner Harbor but for our analysis only the five stations in the Fort Point Channel will be used: Stations 075, 018, 019, 138 and 178. The locations of these stations which are shown on Figure 6, are in Fort Point Channel and extend from the BOS 070 outfall to its confluence with the Inner Harbor. Station 075 is located near the BOS 070 outfall at the end of the channel. Moving toward the Harbor, Station 018 is on the Summer Street Bridge near the BOS 064 outfall. Station 178 is the Moakley Bridge. Stations 019 and 138 are in open water near the confluence of the channel and the Inner Harbor as well as near the outfall of BOS 060. These five stations form a transect along the length of the Fort Point Channel. In addition to BOS 070, the following outfalls; BOS 062, BOS 064, BOS 065, BOS 068, and BOS 073 can discharge into Fort Point Channel.

***South Boston - Carson Beach***

Five sampling stations along the South Boston beaches are shown on Figure 5; MDC 21 Carson Beach at M Street, MDC 22 – Carson Beach at I Street, MDC 23 – Carson Beach at McCormack Bathhouse along with the nearby MWRA stations; Station 033 and Station 036. The MDC stations were sampled weekly for *Enterococcus* during the swimming season from Memorial Day to Labor Day, by the Division of Urban Parks and Recreation (DUPR, formerly MDC, now part of the Department of Conservation and Recreation, DCR), with bacterial analysis by G&L Labs, Quincy to determine the bathing status at the beach. The beach stations were monitored at the surface only. The other two MWRA stations, 033 (near CSO BOS 083) and 036 (near CSO BOS 085-087), were monitored from March to October as part of MWRA routine sampling.

***South Boston – Pleasure Bay/City Point Beach***

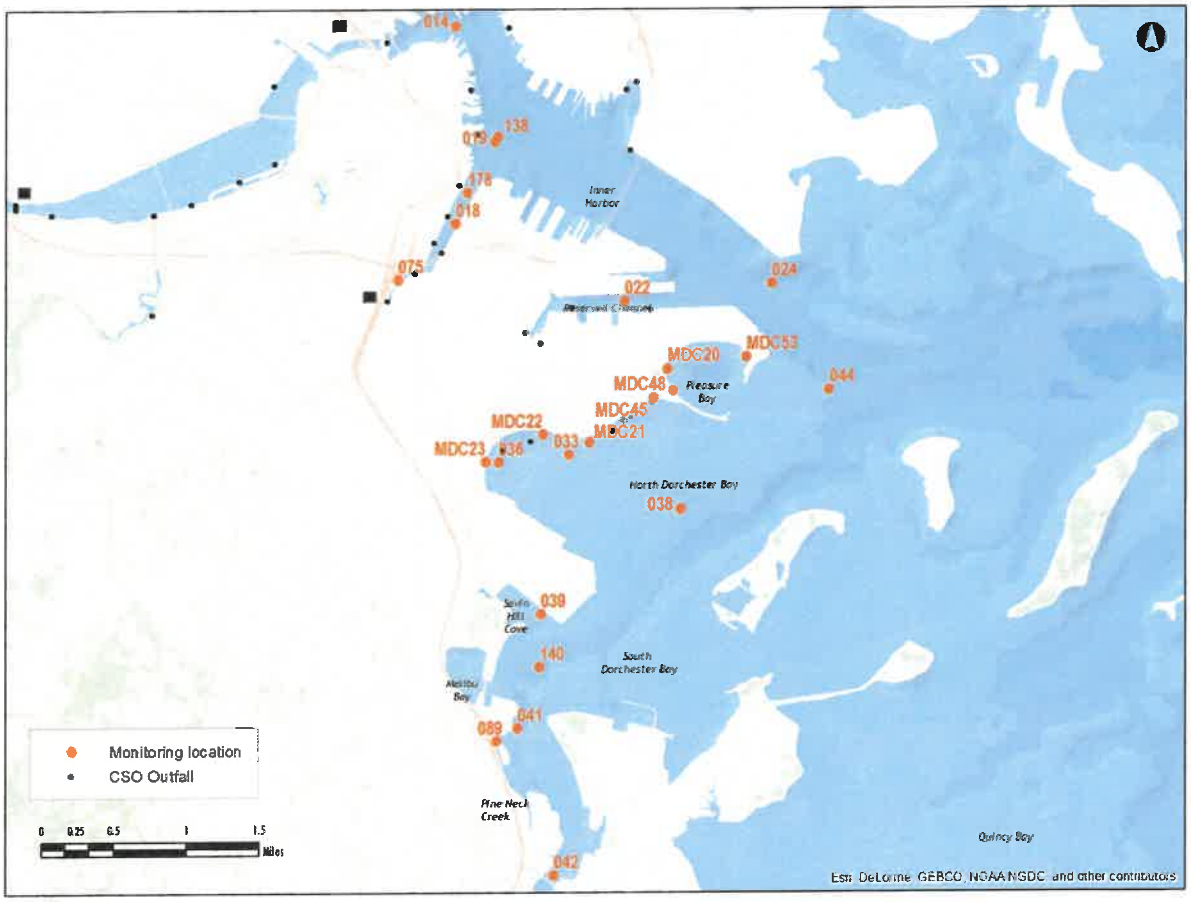
Four sampling stations near Castle Island were also monitored; MDC 20, MDC 45, MDC 48 and MDC 53. Data from MDC 20, MDC 48 and MDC 53 were not charted because they are influenced by storm drains rather than CSOs.

***Dorchester Bay***

In addition to the beach stations, four other stations are in Dorchester Bay; Stations 038, 039, 044 and 140. Station 038 is a farfield station off Old Harbor while Station 039 is located near BOS 089, the principal outfall for MWRA's former Fox Point CSO Treatment Facility. With the completion of sewer separation in 2006, this CSO facility has been decommissioned. Discharges at BOS 089 are stormwater. Water quality analysis for Stations 038 and 039 are not included in this report.

Station 044 is located at the mouth of Dorchester Bay off Castle Island. Station 140 is located near the mouth of Malibu Bay.

**Figure 5: MWRA and DCR Monitoring Locations in Inner Harbor and Dorchester Bay**




## Sampling Parameters

MWRA collected samples for *Enterococcus* and fecal coliform in Boston Harbor. Each of these bacteria are used as human sewage indicators. In marine waters, MWRA also tests for fecal coliform bacteria, which was historically used as a human sewage indicator because this class of bacteria is easily cultured and identified. As easier and less expensive tests for *E. coli* and *Enterococcus* have been developed, these bacteria have largely replaced fecal coliform as an indicator organism. However, fecal coliform is still being analyzed for marine waters, since it is used as the indicator species for shellfish bed water quality.

### *Enterococcus*

Enterococci are gram-positive, spherical bacteria that colonize in groups or chains. They are naturally found in the digestive tract flora of many organisms, including humans. They tolerate relatively high salt and acid concentrations, and thus are used as an indicator of human sewage in marine waters.

The DCR sampled four locations at Carson Beach (MDC 21, MDC 22, MDC 23 and MDC 45) and three locations near Pleasure Bay (MDC 20, MDC 48 and MDC 53). These locations are tested weekly during the bathing season and analyzed at G&L Labs, Quincy for *Enterococcus*. MWRA performed the analysis for *Enterococcus* on samples collected at their sampling locations.

**Summary of Wet-Weather Water Quality Data**

The relationship of bacteria levels in Boston Harbor and wet-weather conditions were examined to identify the influence of CSOs on water quality. Wet weather was defined as a day meeting one or more of the following conditions:

- at least 0.15 inches of precipitation on that day
- at least 0.5 inches of precipitation on that day and the preceding day
- at least 1.0 inches of precipitation on that day and the two preceding days
- at least 1.5 inches of precipitation on that day and the three preceding days

This definition for wet weather acknowledges that water quality impacts associated with rainfall (e.g. stormwater runoff and CSO discharges) can occur up to several days after a precipitation event.

An overview of the water quality in Boston Harbor is presented first, followed by a more detailed discussion of data collected at Carson Beach and Pleasure Bay/City Point in Dorchester Bay and Fort Point Channel.

**Overview of Water Quality**

During the 2020 Monitoring Program, the MWRA analyzed their samples and recorded data collected by Department of Conservation and Recreation (DCR) and analyzed by G&L Labs. The MWRA provided the Commission with data from both agencies for the entire year. The Commission's analysis focuses on Carson Beach (Dorchester Bay), Reserved Channel (Inner Harbor) and Fort Point Channel (Inner Harbor).

The waters along Carson Beach attract a large number of swimmers, sunbathers and recreational boaters. Water samples were collected in these waters from June 22 to September 2, 2020. Samples were collected at 4 locations along the Carson/City Point Beaches and 3 locations near Pleasure Bay. However, this report will focus on Carson Beach which could be impacted by CSO discharges from the MWRA's storage tunnel in extremely large storms. The area tributary to Pleasure Bay is separated and subjected to stormwater discharges only.

The DCR has been sampling at Pleasure Bay and City Point Beaches since 2010. The MWRA collected samples off Carson Beach at Station 033 and Station 036 throughout the year. The MWRA Station 038 is much further away from the beaches. On occasion, the MWRA sampling coincided with the DCR sampling during the swimming season.

The following table, Table 11, summarizes the water quality analysis from locations in North Dorchester Bay, Reserved Channel and Fort Point Channel. The analysis focuses on the *Enterococcus* levels from 14 sampling locations.

The MWRA samples were collected from January to December 2020 while the DCR stations were sampled from May 20 to September 3, 2020. The MWRA collected samples from the surface and from the bottom, only the surface samples are presented in the table below. The DCR and Carson Beach locations are subject to the swimming standards.

**Table 9: Boston Harbor Water Quality Data Statistics for 2020 – based on *Enterococcus Levels***

| Station | Location Description | Number of Samples | Maximum #/100 ml | # samples > 104 / 100 ml |
|---|---|---|---|---|
| 075 s | Fort Point Channel near BOS 070 outfall | 20 | 24,300 | 14 |
| 018 s | Fort Point Channel, Summer St Bridge | 20 | 24,200 | 8 |
| 178 s | Fort Point Channel Moakley Bridge | 20 | 3,080 | 4 |
| 019 s | Mouth of Fort Point Channel near BOS 060 | 20 | 388 | 2 |
| 138 s | Inner Harbor off Aquarium | 18 | 173 | 2 |
| | | | | |
| MDC 21 | DCR Station Carson Beach M Street | 17 | 144 | 1 |
| MDC 22 | DCR Station Carson Beach I Street | 16 | 60 | 0 |
| MDC 23 | DCR Station Carson Beach McCormack Bathhouse | 16 | 17 | 0 |
| MDC 45 | DCR Station City Point Beach | 16 | 10 | 0 |
| 033 s | Carson Beach west end of L St Bathhouse | 20 | 63 | 0 |
| 036 s | Carson Beach 100 m off McCormack Bathhouse | 20 | 131 | 1 |
| 038 s | Dorchester Bay, Mid Old Harbor | 19 | 52 | 0 |
| | | | | |
| 022 s | Reserved Channel, mid-channel | 20 | 4,110 | 4 |
| 024 s | Inner, Harbor, mouth | 37 | 345 | 2 |

The swimming season, as defined by the DCR, runs from Memorial Day to Labor Day (May 25 to September 7, 2020). The 2020 swimming season is dry compared to the previous year's; one storm with over one inch of rainfall, 2019 had three such storms. The largest storm occurred on June 28th when 1.09 inches were recorded at the Union Park Pumping Station gage.

During 2020, MWRA sampled at Stations 033 and 036, both stations are located about 100 meters off the beach. Sampling began in March and concluded in October. The swimming standard was exceeded once at Station 036, on June 30th, the reading was 131/100 ml.

Very little correlation exists between rainfall and bacterial contamination. A selection of rainfall and corresponding bacterial results are show on the table below, see Table 10. Two of the results exceeded the swimming standard. In addition to the June 30th reading, at MDC 21, on July 30th, the reading was 144/100 ml.

**Table 10: Comparison of *Enterococcus* levels at DCR and MWRA Sampling Stations –**
during the swimming season

| rainfall on sampling date or previous day | sampling date | MDC21 | MDC22 | MDC23 | MDC45 | 33 | 36 |
|---|---|---|---|---|---|---|---|
| 0.00 | 28-May-20 | 2 | 2 | 2 | 10 | | |
| 0.00 | 4-Jun-20 | 2 | 2 | 2 | 2 | | |
| 0.69 | 11-Jun-20 | 2 | 7 | 2 | 2 | | |
| 0.00 | 18-Jun-20 | 2 | 2 | 2 | 2 | | |
| 0.00 | 22-Jun-20 | | | | | 10 | 10 |
| 0.04 | 24-Jun-20 | | | | | 10 | 10 |
| 0.04 | 25-Jun-20 | 2 | 2 | 2 | 2 | 10 | 10 |
| 0.00 | 26-Jun-20 | | | | | 10 | 10 |
| 0.44 | 30-Jun-20 | | | | | 63 | 131 |
| 0.15 | 1-Jul-20 | | | | | 20 | 41 |
| 0.15 | 2-Jul-20 | 4 | 2 | 2 | 2 | 10 | 10 |
| 0.00 | 9-Jul-20 | 2 | 2 | 12 | 2 | | |
| 0.04 | 16-Jul-20 | 2 | 2 | 2 | 2 | | |
| 0.00 | 20-Jul-20 | | | | | 10 | 10 |
| 0.56 | 23-Jul-20 | 2 | 20 | 3 | 2 | | |
| 0.00 | 30-Jul-20 | 144 | 2 | 2 | 2 | | |
| 0.00 | 31-Jul-20 | 2 | | | | | |
| 0.04 | 3-Aug-20 | | | | | 10 | 10 |
| 0.15 | 4-Aug-20 | | | | | 10 | 10 |
| 0.00 | 5-Aug-20 | | | | | 10 | 10 |
| 0.00 | 6-Aug-20 | 5 | 60 | 17 | 4 | | |
| 0.00 | 13-Aug-20 | 2 | 2 | 8 | 4 | | |
| 0.03 | 20-Aug-20 | 7 | 2 | 7 | 2 | | |
| 0.22 | 27-Aug-20 | 4 | 2 | 4 | 2 | | |
| 0.20 | 3-Sep-20 | 2 | 2 | 2 | 2 | | |

Notes: DCR sampling stations – MDC 21, MDC 22, MDC 23 and MDC 45, MWRA sampling stations 033 and 036

### *Carson Beach - Dorchester Bay*

The Water Quality Standard was exceeded twice during 2020.

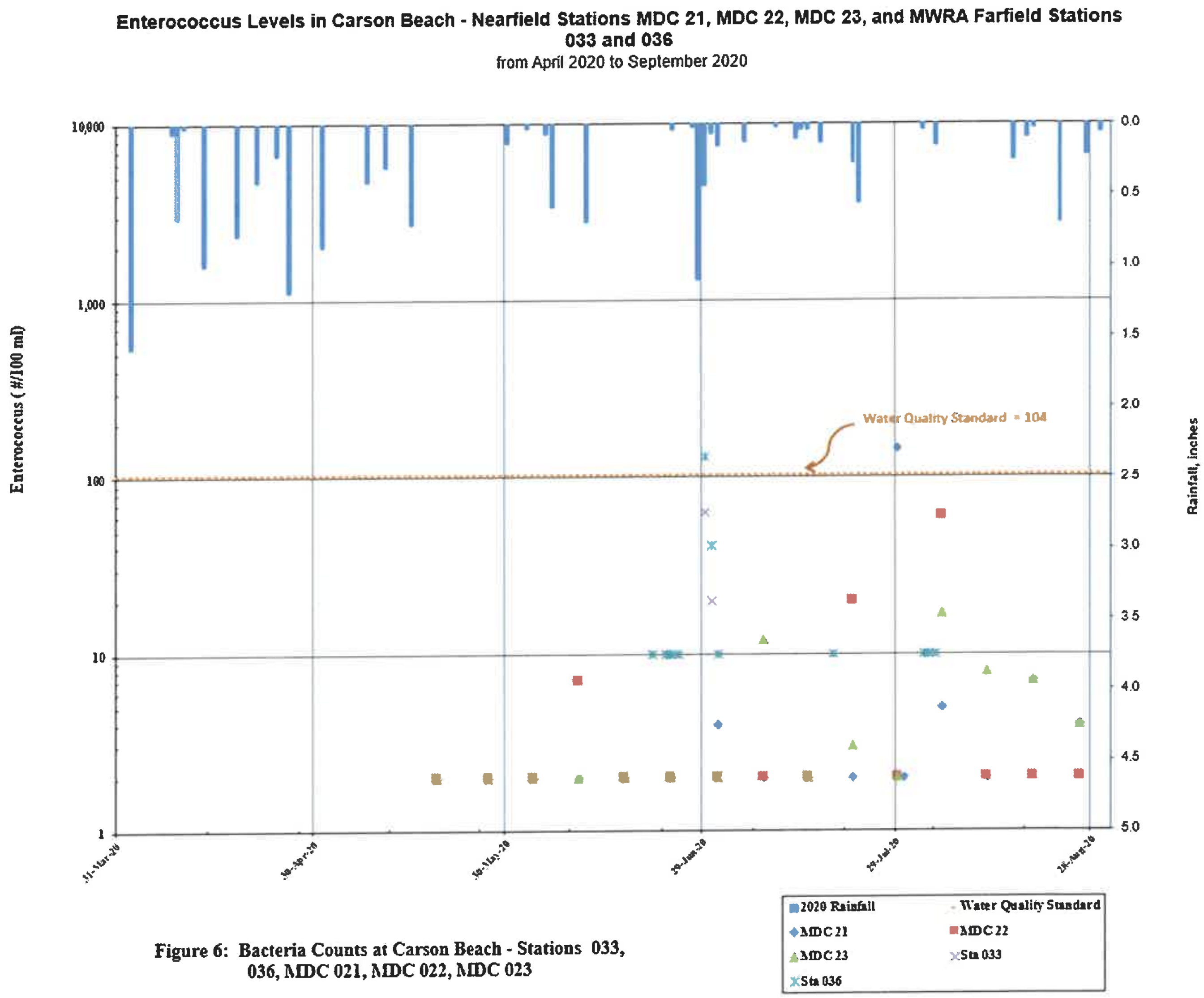



**Figure 6: Bacteria Counts at Carson Beach - Stations 033, 036, MDC 021, MDC 022, MDC 023**

## Reserved Channel and Inner Harbor

In the Reserved Channel, there were six samples showing bacteria levels over the *Enterococcus* standard. Three were after a rain event in July. The areas tributary to Reserved Channel were separated a few years ago although regulators exist on four CSO outfalls. The Commission's NPDES Permit allows these four CSO outfalls to discharge in wet weather. The source of the bacterial contamination could have been these outfalls or the discharges from storm drains.

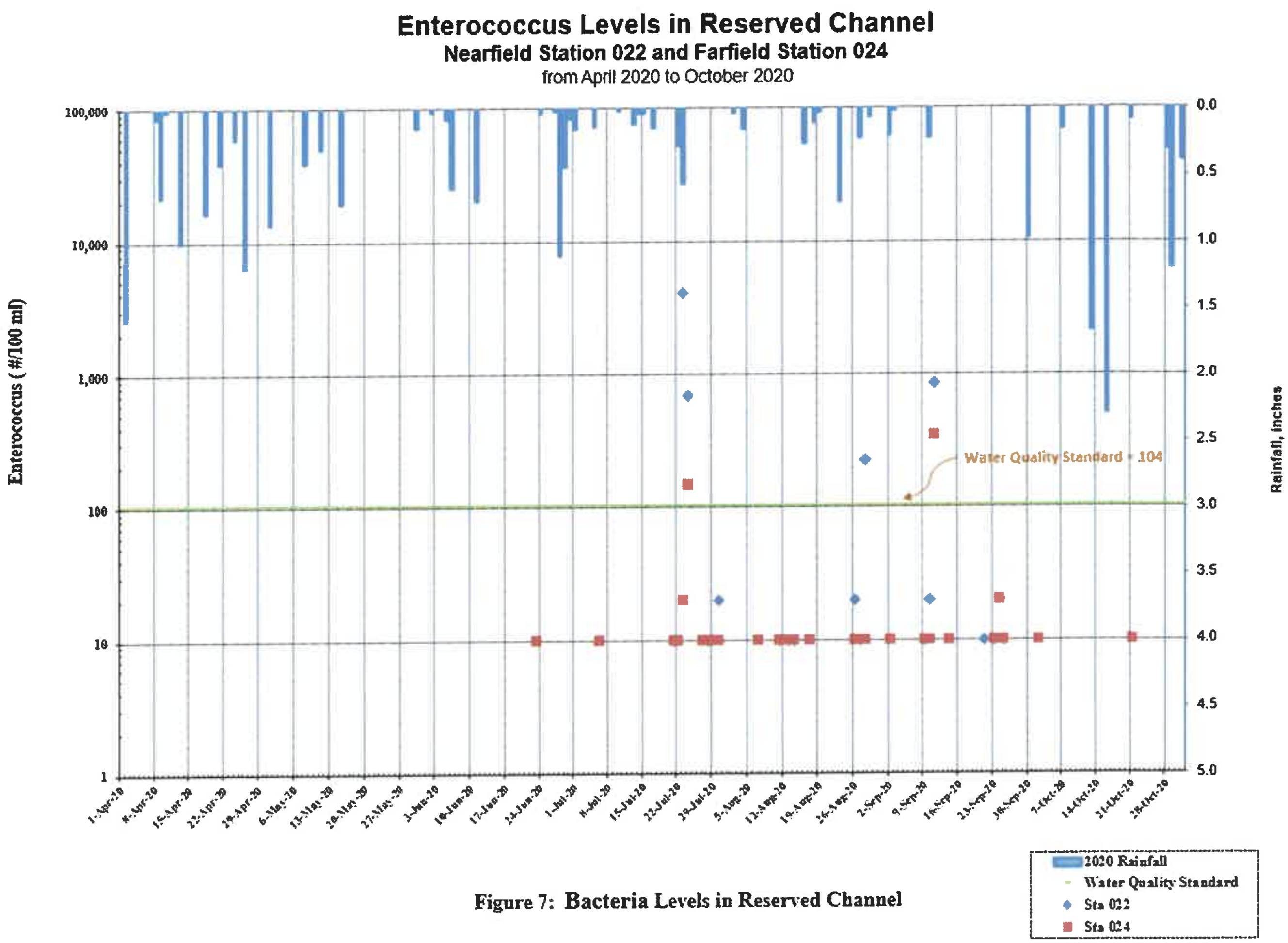



**Figure 7: Bacteria Levels in Reserved Channel**

**Stations 018, 019, 075, 138 and 178 – Fort Point Channel**

Although Fort Point Channel is not used for swimming, high bacterial counts are a concern and were measured frequently. Of the 98 samples collected, 30 were higher than 104/100 ml. At Station 075 near the BOS 070 outfall, 14 out of the 20 samples were above 104/100 ml. Water quality improved as the sample locations moved further away. Station 018 recorded 8 out of 20 samples with elevated bacterial levels. Station 178 recorded 4 out of 20 samples above 104/100 ml.

The MWRA added Station 075 near the BOS 070 outfall and Station 178 at the Moakley Bridge in 2009 to provide data along the length of the channel. Several CSOs can discharge into this area, BOS 064, BOS 065, BOS 068, BOS 070, and BOS 073.

The most active is BOS 070 which discharges flows from the MWRA's CSO Facility at Union Park Pumping Station. It should be noted that Union Park Pumping Station discharges are screened and disinfected prior to discharge into the Roxbury Canal Conduit.

A plot of *Enterococcus* bacteria counts is shown on Figure 8.

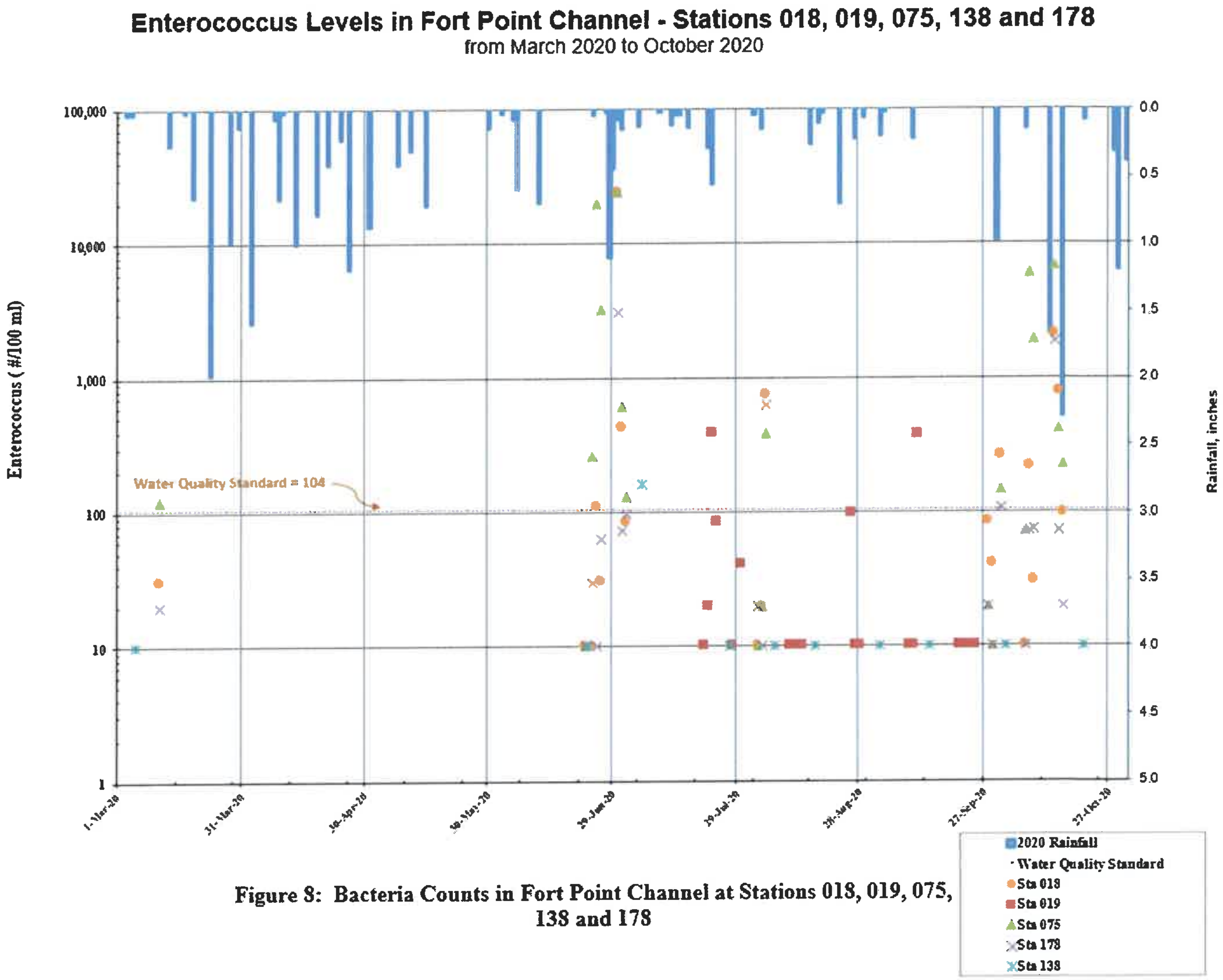



**Figure 8: Bacteria Counts in Fort Point Channel at Stations 018, 019, 075, 138 and 178**

## Conclusions

Water quality data collected by MWRA showed that high bacteria counts occurred regularly in Boston Harbor during 2020. Other potential sources of bacterial contamination to Boston Harbor include stormwater, illicit sanitary connections, pet and bird waste, bathers and illegal boat discharges. CSOs appear to be only one factor contributing to bacterial levels making it difficult to identify the source of contamination.