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April 29, 2016

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Subject: CSO Discharge Estimates and Rainfall Analyses for Calendar Year 2015

Dear Mr. Brander and Mr. Borci:

Enclosed please find documentation of the Massachusetts Water Resources Authority's (MWRA) estimates of Combined Sewer Overflow (CSO) discharges in its service area during calendar year 2015. MWRA is required to submit estimates of CSO activations and volumes for the previous calendar year for the Alewife Brook/Upper Mystic River and the Lower Charles River/Charles Basin in accordance with conditions in the Variance Extensions for CSO Discharges to these waters, issued by the Massachusetts Department of Environmental Protection in 2013 pursuant to the Massachusetts Surface Water Quality Standards at 314 CMR 4.00. The Variance Extensions authorize limited CSO discharges to the Alewife Brook/Upper Mystic River and the Lower Charles River/Charles Basin in conjunction with National Pollution Discharge Elimination System (NPDES) permits MA0103284, MA0101974, MA0101982, and MA0101192 issued to MWRA, the City of Somerville, the City of Cambridge, and the Boston Water and Sewer Commission (BWSC), respectively.

MWRA reports herewith its estimates of calendar year 2015 CSO activation frequency, total discharge duration and total discharge volume from the CSO outfalls within its service area addressed in MWRA's approved CSO Long-Term Control Plan (LTCP), including but not limited to the outfalls discharging to the Alewife Brook/Upper Mystic River and the Lower Charles River/ Charles Basin. MWRA has also provided this information to its member communities with CSOs, including BWSC and the cities of Cambridge, Chelsea and Somerville.

Table 10: Summary of 2015 and Typical Year Model Simulation Results and Comparison to Typical Year Long-Term CSO Control Plan

Table 10, attached, presents estimated CSO activations, discharge duration and discharge volume at each CSO outfall during calendar year 2015. For most outfalls, the estimates were developed using the MWRA InfoWorks sewer system model by simulating each of the rainfall events in 2015 with system conditions existing at the time of each storm and with storm-specific system operations. In support of these simulations, MWRA updated the model to account for new information and known changes to the system, including CSO projects and other system improvements that were completed during the year. Each system change was incorporated into the 2015 rainfall simulations for subsequently occurring storms, and all of the changes were incorporated into the 2015 Typical Year simulation, which represents end-of-year conditions. The most significant model updates for 2015 reflect the following completed sewer system improvements and new information. These and other model updates are also briefly listed at the bottom of Table 10.

- On October 28, 2015, MWRA attained substantial completion of the Control Gate and Floatables Control at Outfall MWR003 and MWRA Rindge Avenue Siphon Relief project in compliance with Schedule Seven of the Federal Court Order in the Boston Harbor Case. System/model updates included replacement of the former fixed weir with the new weir gate and its automated control logic, installation of an underflow baffle for floatables control, replacement of the former 30-inch diameter Rindge Avenue Siphon with the new 48-inch diameter siphon, installation of a check valve (flap gate) on the MWR003 outfall, and cured-in-place lining of an adjacent section of MWRA's Alewife Brook Sewer.

- On December 23, 2015, the City of Cambridge attained substantial completion of the CAM004 Sewer Separation project, in compliance with Schedule Seven. System/model updates included removal of the separated stormwater, elimination of CSO discharges at Outfall CAM004, and pipe and pipe connection modifications at the interfaces of the Cambridge and MWRA systems.

- Though MWRA attained substantial completion of the Interceptor Connection Relief and Floatables Control at Outfall SOM01A project in December 2013, the associated improvements were inadvertently not incorporated into the model until early 2015. The system/model updates included installation of an underflow baffle for floatables control and adjustment of the SOM01A weir elevation 3 inches higher. While the completed improvements included the work to allow an increase in the size and capacity of the connection between the City of Somerville's Tannery Brook Conduit and MWRA's Alewife Brook Conduit, this connection had not yet been increased pending completion of the CAM004 sewer separation project (December 2015) and an ongoing Alewife Brook subsystem performance assessment by MWRA in coordination with the City of Cambridge.

- MWRA continues to work with the City of Chelsea on a comparison of the CSO activation data from Chelsea's overflow meters to the CSO discharge predictions of MWRA's hydraulic model, for outfalls CHE004 and CHE008. In 2015, Chelsea and MWRA together reviewed their past investigations and available data and developed a plan for gathering additional system information and flow data, with the initial goals of better understanding the conditions in the sewers that can contribute to CSO discharges and relating those conditions to the overflow meter data and model configuration and predictions.

  In December 2015, Chelsea and MWRA installed temporary meters and level sensors immediately upstream of the CHE004 and CHE008 regulator structures to confirm wet weather inflows and hydraulic grade lines. The data are currently under review to inform our continuing investigations. The 2015 data highlights the difficulties in obtaining accurate metering data under certain conditions at all locations. From the data, MWRA has already made certain model adjustments, including reducing wet weather inflow to the CHE008 regulator and increasing head loss within the CHE008 and CHE004 regulator structures. Additional temporary metering will be performed at CHE008 in 2016.

- Adjustments were made to the model related to the Somerville-Marginal CSO facility, including modifications to the opening and closing rates of the influent gates and the protocol for dewatering the influent chamber after each storm. MWRA also removed from the model a flap gate downstream of the facility that was determined not to be present.

- Model runoff coefficients were updated in certain drainage areas to incorporate new information from BWSC on the status of its sewer separation projects in various parts of the city.

- The model's elevations of overflow weirs tributary to Outfall BOS064 were increased slightly, based on recent field information from BWSC.

At the outfalls associated with MWRA's four CSO treatment facilities, the discharge estimates (activation frequency, duration and volume) presented in Table 10 for calendar year 2015 storms are from recorded measurements at the facilities, not model predictions. These outfalls are MWR201 (Cottage Farm), MWR203 (Prison Point), MWR205 (Somerville-Marginal), and MWR215 (Union Park). The activation frequencies and durations in Table 10 for outfalls SOM007A/MWR205A (Somerville-Marginal high tide relief) and BOS019 are from data generated by MWRA depth sensors at the overflow weirs, but the estimated annual volumes at these two outfalls are from model predictions. The following table compares the recorded CSO measurements to the model predictions for these facilities for the storms in 2015 and for Typical Year rainfall under 2015 system conditions and the approved LTCP.

Comparison of MWRA CSO Discharge Measurements to Model Predictions

Facility	Measured in 2015		Model Predicted					
			2015 Storms		Typical Year/2015		Typical Year/LTCP	
	#	Volume	#	Volume	#	Volume	#	Volume
Cottage Farm	2	32.67	2	37.68	5	12.75	2	6.30
Prison Point	13	171.71	13	190.49	18	279.84	17	243.00
Somerville Marginal*	19	79.38	16	49.78	22	71.68	39	60.58
Union Park	4	16.91	6	21.16	11	33.76	17	71.37
SOM007A/SOM205A	3	NM	2	9.36	3	1.98	3	3.48
BOS019	1	NM	1	1.02	2	0.30	2	0.58

Notes: Volumes are in million gallons. NM = not measured. Typical Year simulations utilize standard operating procedures and do not incorporate earlier opening of influent gates on thunderstorm forecasts.
* All flow through CSO facility to outfalls MWR205 and SOM007A/MWR205A

Table 10 compares the results of the Typical Year simulation using end-of-year 2015 system conditions to the activation frequencies and annual volumes in the approved Long-Term Control Plan as defined in Exhibit B to the Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control in the Federal District Court Order in the Boston Harbor Case (as amended in May 2008). This comparison allows a tracking of progress towards meeting the long-term control levels.

Rainfall Summary Tables and Rainfall Intensity Comparison Graph

Figure 1: Rainfall Intensity Comparison: 2015 vs. Typical Year

Table 1: Comparison of Frequency of Rain Events within Selected Ranges of Total Rainfall, Typical Year Versus 2015

Table 2: Comparison of Storms with Greater than 2 Inches of Total Rainfall, Typical Year Versus 2015

Table 3: Comparison of Storms with Peak Intensities Greater than 0.40 Inch/Hour, Typical Year Versus 2015

Table 4: Top Ten Storms Contributing the Most CSO (Comparison of Model Predicted CSO Volumes for Storms in 2015 to Storms in the Typical Year)

These rainfall comparisons were developed to be able to explain the magnitude of the estimated CSO discharges caused by 2015 rainfall relative to the model predicted discharges for the Typical Year with 2015 system conditions. These comparisons help to confirm that actual CSO discharges (and their associated impacts) are in line with the predictions that supported regulatory approvals of MWRA's LTCP. They also help to verify progress toward the approved long-term levels of control.

MWRA's estimate of total CSO discharge volume in 2015, 329 million gallons (MG), is 23 percent less than the total Typical Year CSO discharge volume of 425 MG for the same (2015) system conditions. The slightly higher estimated volume of untreated CSO discharge, 28 MG, compared to the Typical Year discharge volume of 27 MG is due to the impact of the large storm on September 30, 2015, which contributed 25.8 MG, or 92 percent, of the 28 MG total discharge

volume. In viewing Table 4 2015 Top Ten Storms contributing to the most CSO, the September 30, 2015 storm contributed 50% of the total CSO discharged in 2015.

MWRA's model predicted that 37 of the 47 potentially active untreated CSO outfalls in the system either did not activate in 2015 or activated only in the September 30th storm, evidence of the high level of control that has been achieved at the untreated outfalls.
Additional work, not part of the MWRA approved LTCP, also continues.

Alewife Brook: MWRA and the City of Cambridge, in coordination, have begun to assess the performances of their sewer systems following the completion of the last two Alewife Brook CSO projects in late 2015. Cambridge plans to install temporary meters into its sewer system this spring. Data from these temporary meters and from MWRA's permanent meters, as well as data from Cambridge's permanent overflow meters, will be available to assess hydraulic conditions in support of increasing the hydraulic capacity of the upgraded connection of Somerville's Tannery Brook Conduit to MWRA's Alewife Brook Conduit at Outfall SOM01A and making other potential system adjustments.

Charles River/Cottage Farm: The City of Cambridge's ongoing, long-term sewer separation work tributary to MWRA's North Charles Met and North Charles Relief sewers, including but not limited to the Western Avenue sewer separation project currently in construction, is predicted to reduce CSO discharges at outfalls CAM005 and CAM007 and at the Cottage Farm facility.

Downtown and Fort Point Channel: BWSC is continuing with sewer separation projects that are expected to further lower CSO discharges to the Dorchester Brook Conduit and the Roxbury Canal Conduit and lower hydraulic burden (backwater) within the New East Side Interceptor. In addition, BWSC has installed flow meters in systems related to these conduits, which MWRA intends to use for verification and possible recalibration of its model.

East Boston: The 2015 Typical Year discharge predictions are higher than LTCP levels at a few of the East Boston outfalls, including BOS003 and BOS014. BWSC plans to perform additional sewer separation in East Boston in the coming years. BWSC recently installed flow meters in East Boston, and MWRA intends to use the data for verification and potential recalibration of its model.

Prison Point Facility: CSO discharge volume remains higher than the LTCP level at this facility. MWRA will further attempt to optimize its use of "thunderstorm" activation levels as part of its real-time control of Prison Point facility. Calendar year 2015 had numerous and unusual forecasted intense thunderstorms that dissipated to less intense storms literally as they reached the Prison Point tributary area when the facility was activating. MWRA will reevaluate with the City of Somerville the lowered weir elevation at the SOM009 regulator. This revised weir elevation lowered following the extreme storm of July 10, 2010 that had caused serious flooding in Union Square.

Reserved Channel: BWSC attained substantial completion of the Reserved Channel Sewer Separation project in December 2015, in compliance with Schedule Seven. With the removal of large quantities of stormwater from the tributary sewer system now complete, MWRA and BWSC are discussing a reevaluation of overflow weir elevations to minimize CSO to the Reserved Channel while protecting upstream systems.

Should you have questions, please feel free to contact me, at 617-788-4359.

Very truly yours,

Michael J. Hornbrook
Chief Operating Officer

CSO File: 1000.21

TABLE 10. SUMMARY OF 2015 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

	2015 RAINFALL UNDER 2015 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2015 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
Outfall	**Activation Frequency**	**Duration (hrs)**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
ALEWIFE BROOK							
CAM001	1	1.22	0.07	1	0.04	5	0.19
CAM002	1	4.83	0.41	2	0.25	4	0.69
MWR003	1	7.96	1.10	4	1.05	5	0.98
CAM004	5	13.42	4.35	Closed	N/A	Closed	N/A
CAM400	Closed	N/A	N/A	Closed	N/A	Closed	N/A
CAM401A	1	4.94	0.75	2	0.56	5	1.61
CAM401B	1	7.95	0.59	4	0.35	7	2.15
SOM001A	2	8.98	5.35	5	4.36	3	1.67
SOM001	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM002A	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM003	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM004	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**49.31**	**12.62**		**6.60**		**7.29**
UPPER MYSTIC RIVER							
SOM007A/MWR205A [1]	3	5.55	9.36	3	1.98	3	3.48
SOM007	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**5.55**	**9.36**		**1.98**		**3.48**
MYSTIC/CHELSEA CONFLUENCE							
MWR205 (Somerville Marginal Facility) [2]	19	67.10	79.38	22	71.68	39	60.58
BOS013	1	2.99	0.04	4	0.13	4	0.54
BOS014	1	3.17	0.17	4	0.53	0	0.00
BOS015	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS017	0	0.00	0.00	0	0.00	1	0.02
CHE002	Closed	N/A	N/A	Closed	N/A	4	0.22
CHE003	0	0.00	0.00	0	0.00	3	0.04
CHE004	3	7.17	0.37	4	0.54	3	0.32
CHE008	2	4.13	0.45	7	1.83	0	0.00
TOTAL		**84.56**	**80.40**		**74.72**		**61.72**
UPPER INNER HARBOR							
BOS009	1	0.86	0.03	3	0.10	5	0.59
BOS010	1	1.33	0.03	5	0.63	4	0.72
BOS012	1	0.45	0.01	7	0.55	5	0.72
BOS019 [3]	1	5.00	1.02	2	0.30	2	0.58
BOS050	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS052	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS057	1	1.12	0.39	2	0.58	1	0.43
BOS058	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS060	1	0.83	0.09	1	0.02	0	0.00
MWR203 (Prison Point) [4]	13	46.49	171.71	18	279.84	17	243.00
TOTAL		**56.07**	**173.28**		**282.01**		**246.04**
LOWER INNER HARBOR							
BOS003	4	12.29	4.52	8	5.42	4	2.87
BOS004	4	14.29	0.74	8	1.11	5	1.84
BOS005	0	0.00	0.00	0	0.00	1	0.01
BOS006 [5]	Closed	N/A	N/A	Closed	N/A	4	0.24
BOS007 [5]	Closed	N/A	N/A	Closed	N/A	6	1.05
TOTAL		**26.58**	**5.26**		**6.53**		**6.01**

TABLE 10. SUMMARY OF 2015 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

	2015 RAINFALL UNDER 2015 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2015 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
Outfall	**Activation Frequency**	**Duration (hrs)**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
CONSTITUTION BEACH							
MWR207	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**N/A**	**N/A**		**N/A**		**N/A**
FORT POINT CHANNEL							
BOS062	0	0.00	0.00	0	0.00	1	0.01
BOS064	0	0.00	0.00	0	0.00	0	0.00
BOS065	0	0.00	0.00	1	0.55	1	0.06
BOS068	0	0.00	0.00	0	0.00	0	0.00
BOS070							
BOS070/DBC	1	0.99	0.09	4	3.04	3	2.19
MWR215 (Union Park) [4]	4	12.17	16.91	11	33.76	17	71.37
BOS070/RCC	3	2.32	0.07	6	0.87	2	0.26
BOS072	0	0.00	0.00	0	0.00	0	0.00
BOS073	0	0.00	0.00	0	0.00	0	0.00
TOTAL		**15.47**	**17.08**		**38.22**		**73.89**
RESERVED CHANNEL							
BOS076	4	4.61	0.38	6	1.17	3	0.91
BOS078	1	0.84	0.02	0	0.00	3	0.28
BOS079	0	0.00	0.00	0	0.00	1	0.04
BOS080	2	2.03	0.02	7	0.24	3	0.25
TOTAL		**7.48**	**0.43**		**1.41**		**1.48**
NORTHERN DORCHESTER BAY							
BOS081	0	0.00	0.00	0	0.00	0 / 25 year	N/A
BOS082	0	0.00	0.00	0	0.00	0 / 25 year	N/A
BOS083 [6]	Closed	N/A	N/A	Closed	N/A	0 / 25 year	N/A
BOS084	0	0.00	0.00	0	0.00	0 / 25 year	N/A
BOS085	0	0.00	0.00	0	0.00	0 / 25 year	N/A
BOS086	0	0.00	0.00	0	0.00	0 / 25 year	N/A
BOS087	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**0.00**	**0.00**		**0.00**		**0.00**
SOUTHERN DORCHESTER BAY							
BOS088/BOS089 (Fox Point)	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS090 (Commercial Point)	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**N/A**	**N/A**		**N/A**		**N/A**
UPPER CHARLES							
BOS032	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS033	Closed	N/A	N/A	Closed	N/A	Closed	N/A
CAM005	2	8.95	2.53	3	1.37	3	0.84
CAM007	2	2.72	1.65	2	0.26	1	0.03
CAM009 [7]	Closed	N/A	N/A	Closed	N/A	2	0.01
CAM011 [7]	Closed	N/A	N/A	Closed	N/A	0	0.00
TOTAL		**11.67**	**4.19**		**1.63**		**0.88**

TABLE 10. SUMMARY OF 2015 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

	2015 RAINFALL UNDER 2015 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2015 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
Outfall	**Activation Frequency**	**Duration (hrs)**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
LOWER CHARLES							
BOS028	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS042	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS049	Closed	N/A	N/A	Closed	N/A	Closed	N/A
CAM017	1	1.00	1.79	1	1.51	1	0.45
MWR010	0	0.00	0.00	0	0.00	0	0.00
MWR018	1	1.98	1.08	0	0.00	0	0.00
MWR019	1	0.66	0.01	0	0.00	0	0.00
MWR020	0	0.00	0.00	0	0.00	0	0.00
MWR021	Closed	N/A	N/A	Closed	N/A	Closed	N/A
MWR022	Closed	N/A	N/A	Closed	N/A	Closed	N/A
MWR201 (Cottage Farm) [4]	2	8.33	32.67	5	12.75	2	6.30
MWR023	0	0.00	0.00	1	0.02	2	0.13
SOM010	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**11.97**	**35.56**		**14.28**		**6.88**
NEPONSET RIVER							
BOS093	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS095	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		**N/A**	**N/A**		**N/A**		**N/A**
BACK BAY FENS							
BOS046 [8]	0	0.00	0.00	1	1.56	2	5.38
TOTAL		**0.00**	**0.00**		**1.56**		**5.38**
Total Treated			**301**		**398**		**381**
Total Untreated			**28**		**27**		**23**
GRAND TOTAL			**329**		**425**		**404**

(1) Includes portion of flow treated at Somerville Marginal facility and separate stormwater entering the Somerville Marginal Conduit (outfall) downstream of the facility. Activation frequency and volume for 2015 rainfall are from MWRA depth sensor measurements and MWRA model results, respectively.

(2) Volume represents all flow through the CSO treatment facility. Activation frequency and volume for 2015 rainfall are from MWRA facility records (measurements).

(3) Activation frequency and volume for 2015 rainfall are from MWRA depth sensor measurements and MWRA model results, respectively.

(4) Activation frequency and volume for 2015 rainfall are from MWRA facility records (measurements).

(5) BWSC has permanently closed outfalls BOS006 and BOS007 in East Boston as part of sewer separation and development plans in the tributary areas, although the outfalls were assumed to remain active in the long-term CSO control plan.

(6) CSO discharge at Outfall BOS083 was redirected to Outfall BOS084 as part of the construction of the North Dorchester Bay Storage Tunnel.

(7) The City of Cambridge closed outfalls CAM009 and CAM011 in November 2007, and continues to monitor upstream hydraulic effects.

(8) Volumes represent model predicted total discharge at outfall BOS046, including Stony Brook Conduit stormwater and CSO contributions.

Key 2015 Model Updates

Incorporated Cambridge CAM004 sewer separation.

Incorporated MWR003 Siphon and Weir Control Gate.

Incorporated underflow baffle and adjusted weir elevation at outfall SOM01A.

Incorporated CIPP rehabilitation of Alewife Brook Sewer near MWR003 siphon.

Incorporated BWSC Dudley Square, Mass. Ave./Roxbury, Mass. Ave./Dorchester, New Market and South Boston A Street sewer separations.

Adjusted weir elevations using BWSC field measurements at outfall BOS064.

Removed flap gate downstream of Somerville Marginal CSO Facility. Adjusted influent gates opening and closing speed. Adjusted set points for dewatering influent chamber.

Calibrated Chelsea CHE008 tributary area and regulator structure minor loss coefficient using temporary meter data.

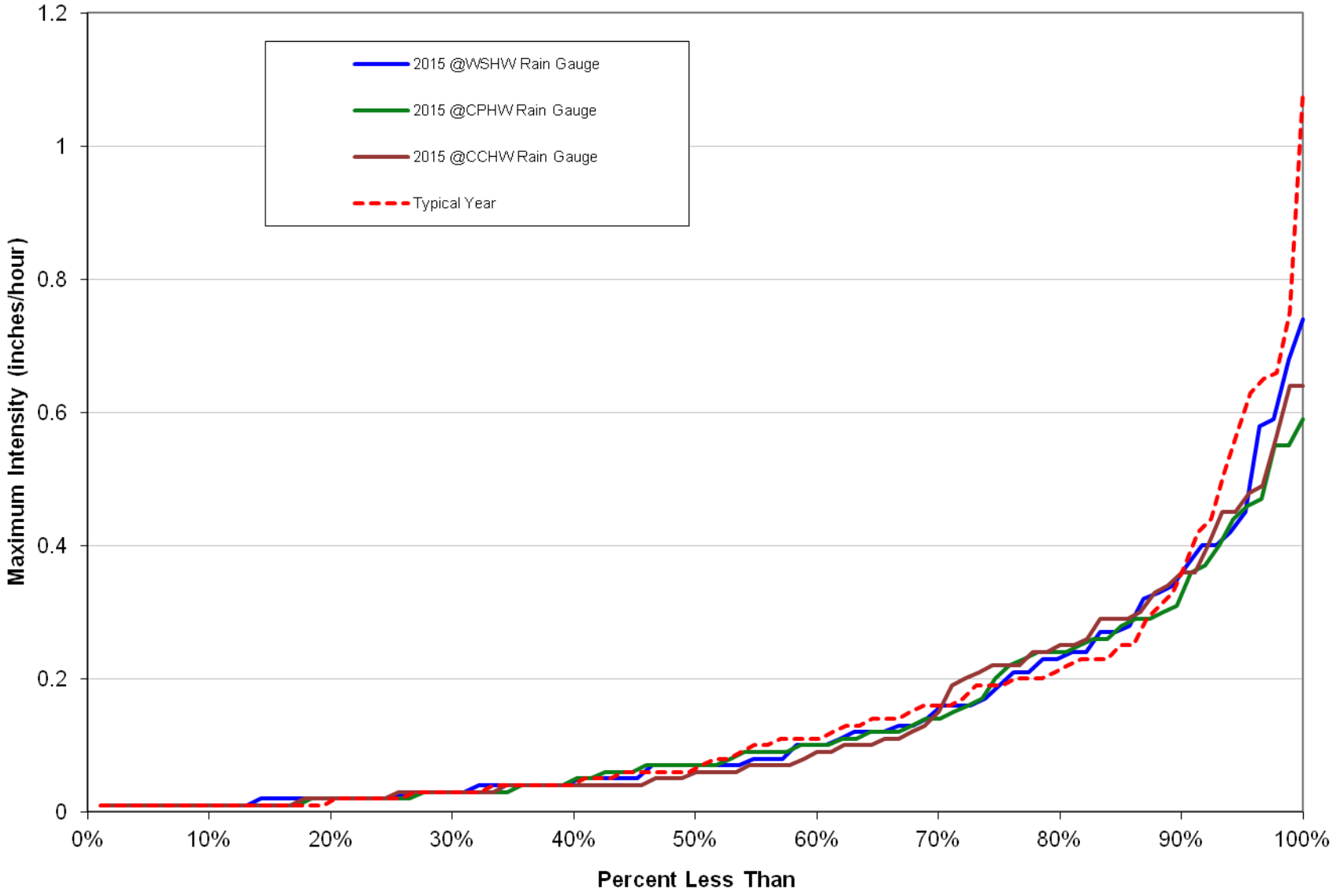

FIGURE 1. RAINFALL INTENSITY COMPARISON: 2015 VS. TYPICAL YEAR

RAINFALL CHARACTERISTICS

TABLE 1. COMPARISON OF FREQUENCY OF RAIN EVENTS WITHIN SELECTED RANGES OF TOTAL RAINFALL, TYPICAL YEAR VERSUS 2015

Conditions	Total Rainfall (inches)	Total Number of Storms	Number of Storms by Volume				
			Volume < 0.25 inches	Volume 0.25 to 0.5 inches	Volume 0.5 to 1.0 inches	Volume 1.0 to 2.0 inches	Volume >= 2.0 inches
Typical Year	46.8	93	49	14	16	8	6
MWRA Rain Gauges							
Ward Street	35.07	84	43	17	14	8	2
Columbus Park	34.81	87	49	14	13	9	2
Chelsea Creek	35.52	90	57	10	12	8	3
HF-1C	38.95	91	53	15	11	9	3
RG-WF-1	34.73	98	63	14	12	7	2
BWSC Rain Gauges							
Allston	35.61	85	48	14	13	8	2
Dorchester - Adam Street	33.11	85	48	16	10	9	2
Charlestown	32.59	86	54	11	12	7	2
Roslindale	32.91	87	53	14	8	10	2
Union Park	32.71	82	47	13	12	8	2
USGS Rain Gauge							
Fresh Pond	32.94	96	61	14	12	7	2

TABLE 2. COMPARISON OF STORMS WITH GREATER THAN 2 INCHES OF TOTAL RAINFALL, TYPICAL YEAR VERSUS 2015

Rain Gauge	Date	Duration (hours)	Total Rainfall (inches)	Average Intensity (inch/hour)	Peak Intensity (inch/hour)	Storm Recurrence Interval (24-hour)
Typical Year	12/11/1992	50	3.89	0.08	0.20	1y
	8/15/1992	72	2.91	0.04	0.66	3m
	9/22/1992	23	2.76	0.12	0.65	1y
	11/21/1992	84	2.39	0.03	0.31	3m
	5/31/1992	30	2.24	0.07	0.37	3m-6m
	10/9/1992	65	2.04	0.03	0.42	<3m
Ward Street Headworks (BO-DI-1)	9/29/2015	21	3.24	0.15	0.68	2-5y
	5/31/2015	58.25	2.42	0.04	0.37	<3m
Columbus Park Headworks (BO-DI-2)	5/31/2015	57.75	2.97	0.05	0.46	<3m
	9/29/2015	20.75	2.48	0.12	0.44	6m
Chelsea Creek Headworks (CH-BO-1)	9/29/2015	28	3.26	0.12	0.64	2-5y
	5/31/2015	58.5	2.52	0.04	0.30	<3m
	6/27/2015	15	2.17	0.14	0.56	3m-6m
Fresh Pond (from USGS)	9/29/2015	20.25	3.91	0.19	1.05	2-5y
	5/31/2015	58.25	2.47	0.04	0.41	<3m

TABLE 3. COMPARISON OF STORMS WITH PEAK INTENSITIES GREATER THAN 0.40 INCHES/HOUR, TYPICAL YEAR VERSUS 2015

Rain Gauge	Date	Duration (hours)	Total Rainfall (inches)	Average Intensity (inch/hour)	Peak Intensity (inch/hour)	Storm Recurrence Interval (1-hour)
Typical Year	10/23/1992	4	1.18	0.29	1.08	1-2y
	8/11/1992	11	0.87	0.08	0.75	6m-1y
	8/15/1992	72	2.91	0.04	0.66	3m-6m
	9/22/1992	23	2.76	0.12	0.65	3m-6m
	5/2/1992	7	1.14	0.16	0.63	3m-6m
	9/9/1992	1	0.57	0.57	0.57	3m
	9/3/1992	13	1.19	0.09	0.51	< 3m
	6/5/1992	18	1.34	0.07	0.44	< 3m
	10/9/1992	65	2.04	0.03	0.42	< 3m
Ward Street Headworks (BO-DI-1)	7/9/2015	6.00	1.57	0.26	0.74	6m-1y
	9/29/2015	21.00	3.24	0.15	0.68	3m-6m
	8/4/2015	0.75	0.59	0.79	0.59	3m-6m
	6/20/2015	15.00	1.73	0.12	0.58	3m-6m
	10/28/2015	16.75	1.39	0.08	0.45	< 3m
	6/27/2015	16.25	1.70	0.10	0.42	< 3m
	4/20/2015	18.25	1.31	0.07	0.40	< 3m
	8/5/2015	0.50	0.40	0.80	0.40	< 3m
Columbus Park Headworks (BO-DI-2)	6/20/2015	14.25	1.52	0.11	0.59	3m-6m
	6/27/2015	14.75	1.90	0.13	0.55	< 3m
	7/9/2015	6.00	1.39	0.23	0.55	< 3m
	8/4/2015	3.75	0.59	0.16	0.47	< 3m
	5/31/2015	57.75	2.97	0.05	0.46	< 3m
	9/29/2015	20.75	2.48	0.12	0.44	< 3m
	4/20/2015	17.00	1.17	0.07	0.40	< 3m
Chelsea Creek Headworks (CH-BO-1)	6/21/2015	22.75	1.88	0.08	0.64	3m-6m
	9/29/2015	28.00	3.26	0.12	0.64	3m-6m
	6/27/2015	15.00	2.17	0.14	0.56	< 3m
	8/4/2015	1.00	0.49	0.49	0.49	< 3m
	6/29/2015	0.25	0.48	1.92	0.48	< 3m
	4/20/2015	16.75	1.21	0.07	0.45	< 3m
	7/9/2015	6.25	1.19	0.19	0.45	< 3m
	12/1/2015	32.25	0.88	0.03	0.40	< 3m
Fresh Pond (from USGS)	9/29/2015	20.25	3.91	0.19	1.05	1-2y
	7/9/2015	7.00	1.15	0.16	0.54	< 3m
	4/20/2015	17.25	1.42	0.08	0.53	< 3m
	10/26/2015	0.75	0.51	0.68	0.51	< 3m
	10/28/2015	17.25	1.71	0.10	0.46	< 3m
	5/31/2015	58.25	2.47	0.04	0.41	< 3m

Table 4. Top Ten Storms Contributing the Most CSO

For 2015 Storms:

No.	Storm Event	CSO Volume By Storm		Cumulative CSO Volume	
		(MG)	% of Total CSO Discharged in 2015 (329 MG)	(MG)	% of Total CSO Discharged in 2015 (329 MG)
1	9/30/2015 Storm	163.77	49.8%	163.77	49.8%
2	7/10/2015 Storm	32.95	10.0%	196.72	59.8%
3	6/28/2015 Storm	29.05	8.8%	225.77	68.7%
4	6/21/2015 Storm	19.58	6.0%	245.35	74.6%
5	10/29/2015 Storm	15.58	4.7%	260.93	79.4%
6	5/31/2015 Storm	10.94	3.3%	271.87	82.7%
7	4/20/2015 Storm	10.88	3.3%	282.75	86.0%
8	8/4/2015 Storm	10.18	3.1%	292.93	89.1%
9	12/23/2015 Storm	8.37	2.5%	301.30	91.6%
10	3/26/2015 Storm	7.68	2.3%	308.98	94.0%

For the Typical Year Rainfall:

No.	Storm Event	CSO Volume By Storm		Cumulative CSO Volume	
		(MG)	% of Total CSO Discharged in Typical Year (425 MG)	(MG)	% of Total CSO Discharged in Typical Year (425 MG)
1	9/23/92	81.67	19.2%	81.67	19.2%
2	12/11/92	55.20	13.0%	136.87	32.2%
3	6/1/92	45.20	10.6%	182.07	42.8%
4	10/23/92	44.70	10.5%	226.77	53.3%
5	8/16/92	37.91	8.9%	264.68	62.2%
6	11/23/92	22.40	5.3%	287.08	67.5%
7	5/2/92	19.25	4.5%	306.33	72.0%
8	3/7/92	18.12	4.3%	324.45	76.3%
9	6/6/92	15.63	3.7%	340.07	79.9%
10	8/11/92	14.11	3.3%	354.18	83.3%