CSO Annual Report – January 1 to December 31, 2024:

MWRA CSO Discharge Estimates and Rainfall Statistics

April 29, 2025

Prepared for the:
Massachusetts Water Resources Authority

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Tables

1. Introduction

The Massachusetts Water Resources Authority (MWRA) is required to submit an Annual Combined Sewer Overflow (CSO) Discharge Report in accordance with Section C.2 in both the *2024 Final Determination to Adopt a Water Quality Standards Variance for Combined Sewer Overflow Discharges to Alewife Brook/Upper Mystic River Basin* (Alewife/Mystic Variance) and the *2024 Final Determination to Adopt a Water Quality Standards Variance for Combined Sewer Overflow Discharges to Lower Charles River/Charles Basin* (Charles River Variance). The Annual CSO Discharge Reports are to be submitted to the Massachusetts Department of Environmental Protection (MassDEP) and the U.S. Environmental Protection Agency (EPA) beginning April 30, 2025. This is the first of five Annual CSO Discharge Reports required by the Variances, which expire on August 31, 2029, as presented in Table 1-1 below.

Table 1-1. Annual Reports Required by the 2024 Variances

Annual Report Number	Date to be Submitted
1	April 30, 2025
2	April 30, 2026
3	April 30, 2027
4	April 30, 2028
5	April 30, 2029

The Variances require that the annual report include "…estimates of CSO activations and volumes for all permitted CSO outfalls within the Variance waterbodies, for those owned and operated by MWRA, for the prior calendar year. MWRA shall include data from the MWRA CSO metering program, which may be supplemented by estimates generated using calibrated sewer system modeling. For each CSO event, MWRA shall also provide rainfall data associated with the CSO discharge, including the depth, duration, and intensity of the rain event, and an estimate of the storm recurrence interval, based on National Oceanic and Atmospheric Association (NOAA) Atlas 14, Volume 10, or as updated."[1]

Exhibit A Item 5 in both the Alewife/Mystic Variance and the Charles River Variance also requires MWRA to provide a progress report on the three projects listed in Exhibit A of the Alewife/Mystic Variance (*i.e.*, Somerville Marginal CSO Facility - New Connection and gate structure; Somerville Marginal CSO Facility Rehab Design; and CAM401A Metering and Model Calibration Update) and the one project listed in Exhibit A of the Charles River Variance (*i.e.*, CAM005 Weir Raising and Lengthening). These progress reports are to be submitted "…[a]t the same time MWRA submits the Annual CSO Discharge Reports required by C.2.(ii)…".

This report is organized into the following chapters:

Chapter 1: Introduction

Chapter 2: 2024 CSO Discharges and Rainfall Events. Presents the following:

- A summary of the rainfall data collected for 2024.
- The estimated CSO activation frequencies, discharge volumes, and rainfall statistics for each of the MWRA CSO outfalls tributary to the Variance waters calculated based on MWRA meter data.[2]

Chapter 3: Project Progress Report. Presents updates on the following projects:

- Somerville Marginal CSO Facility - New Connection and gate structure

[1] *2024 Final Determination to Adopt a Water Quality Standards Variance for Combined Sewer Overflow Discharges to Alewife Brook/Upper Mystic River Basin*, and *2024 Final Determination to Adopt a Water Quality Standards Variance for Combined Sewer Overflow Discharges to Lower Charles River/Charles Basin* Section C.2.
[2] Metered data are estimates of outfall discharge calculated using data from sensors, taking into account physical configurations and constraints.

- Somerville Marginal CSO Facility Rehab Design
- CAM401A Metering and Model Calibration Update
- CAM005 Weir Raising and Lengthening

Appendix A: Rainfall Data Collection and Analyses January 1, 2024 to December 31, 2024. Presents the following:

- A summary of the rainfall data collected for 2024 and characterizes the return period for each storm.

2. 2024 CSO Discharges and Rainfall Events

This section presents estimates of CSO activations and volumes for the permitted CSO outfalls within the Variance waterbodies owned and operated by MWRA, for the period of January 1, 2024 to December 31, 2024, based on monitoring data. These CSO outfalls are listed by receiving water in Table 2-1. For each CSO event, the rainfall data associated with the CSO discharge, including the depth, duration, intensity of the rain event, and an estimate of the storm recurrence interval based on NOAA Atlas 14, Volume 10 is provided in Table 2-2.

Table 2-1. MWRA CSO Outfalls that Discharges to Variance Waters

Receiving Water	Outfall
Alewife Brook	MWR003
Upper Mystic River	SOM007A/MWR205A (Somerville Marginal CSO Treatment Facility)
Lower Charles River	MWR010
	MWR018
	MWR019
	MWR020
	MWR201 (Cottage Farm CSO Treatment Facility)
	MWR023

2.1 Rainfall Analyses

The rainfall for the period of January 1, 2024 to December 31, 2024, was analyzed to support the understanding of the metered CSO discharges for the 2024 period. The recurrence intervals for each storm event were estimated by comparing rainfall depths and intensities to intensity-duration-frequency (IDF) curves in *Atlas-14.*[3]

Atlas 14 IDF values for Boston were extracted from NOAA's data server[4] on April 12, 2022. The Atlas 14 partial duration curves were used to assign the recurrence intervals. The smallest storm the partial duration curves address is the 1-year storm, so the partial duration IDF curves for the 3-month and 6-month frequencies were extrapolated. The storm recurrence intervals identified in the text and sections below are based on the 2019 edition of Atlas 14 referenced above.

Appendix A includes the following tables that were prepared in support of this analysis:

- Table A-4. Summary of Storm Events at Ward Street Headworks Rain Gauge (BO-DI-1) for January 1, 2024 to December 31, 2024

[3] Atlas 14 Volume 10 report : https://www.weather.gov/media/owp/oh/hdsc/docs/Atlas14_Volume10.pdf
[4] NOAA's Data server for MA: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ma

- Table A-5. Frequency of Events within Selected Ranges of Total Rainfall for January 1, 2024 to December 31, 2024
- Table A-6. Storms between January 1, 2024 to December 31, 2024, with Greater Than 2 Inches of Total Rainfall.[5]
- Table A-7. Storms Between January 1, 2024 to December 31, 2024, with Peak Intensities Greater than 0.40 inches/hour.[5]

The findings from those tables are summarized below.

- 2024 averaged 93 storm events across the assessed rain gauges with an average annual rainfall depth of 45.11 inches (Table A-5)
- The distribution of storms by rainfall depth categories for 2024 was as follows (Table A-5):
    - 46 storms with total depths less than 0.25 inches,
    - 19 storms with total depths between 0.25 and 0.5 inches,
    - 16 storms with total depths between 0.5 and 1.0 inches,
    - 9 storms with total depths between 1.0 and 2.0 inches, and
    - 5 storms with total depths greater than 2.0 inches.
- In terms of larger storms, for the four gauges shown in Table A-6, the number of storms with greater than 2 inches of total rainfall in 2024 ranged from three to six, for an average of 4.5 storms. Six storm events were recorded to have a depth greater than 2 inches at both Ward St (BO-DI-1) and Columbus Park (BO-DI-2), five storms at Chelsea Creek (CH-BO-1), as well as three storms at United States Geological Survey (USGS) Fresh Pond. The largest storm in 2024 was measured by the Ward Street gauge on December 11, 2024 with a total depth of 3.02 inches. (Table A-6).
- For the four gauges shown in Table A-7, the number of storms with peak intensities greater than 0.40 inches per hour ranged from 8 to 14. On June 26, 2024, the Ward Street gauge measured a storm with a peak intensity of 1.43 inches per hour which is equivalent to a 5-year 1-hour event. The other three gauges presented in Table A-7 had individual storms with maximum peak intensities between 0.72 and 1.19 inches per hour.

Appendix A presents the rainfall data measured during the period of January 1, 2024 to December 31, 2024. It also describes the analysis of the rainfall data used to characterize the return period of each storm event. Further detail regarding the rainfall data collection and processing can be found in Chapter 9 of the *December 2021 CSO Report*.

2.2 Estimates of CSO Discharges to Variance Waters for 2024

Table 2-2 below presents the volume of each CSO discharge to the Variance waters for MWRA-owned CSO outfalls based on meter data and the rainfall statistics for each event. These data were collected by MWRA and supplemented with monitoring data from the Boston Water and Sewer Commission (BWSC) for regulators tributary to outfall MWR023. MWRA and the CSO communities have been collecting meter data used to report the CSO discharges at each of the outfalls tributary to the Variance waters as part of the CSO Notification Program. The MassDEP regulations set forth at *314 CMR 16.00: Notification Requirements to Promote Public Awareness of Sewage Pollution* requires MWRA and CSO communities to notify the public of CSO activations within two hours and estimate volumes within five business days. CSO volumes are posted for individual storm events on MWRA's website at Combined Sewer Overflow (CSO) Notifications | MWRA.

[5] Storms greater than 2 inches total depth or greater than 0.4 inches/hour peak intensity were identified for further analysis because storms of those sizes tend to be associated with more significant CSO discharge volumes.

Table 2-2. 2024 MWRA Metered CSO Discharges to Variance Waters and Rainfall Statistics for Corresponding Events

MWRA Metered[1] CSO Discharge Estimates			Rainfall Statistics					
Outfall/ Receiving Water	**Date**	**Volume (MG)**	**Rain Gauge**	**Duration (hr)**	**Depth (in)**	**Peak Intensity (in/hr)**	**NOAA Atlas 14 - 1hr Recurrence Interval**	**NOAA Atlas 14 - 24hr Recurrence Interval**
Alewife Brook								
MWR003	1/10/2024	2.02	USGS Fresh Pond	15.25	2.24	0.72	6m-1y	6m-1y
Total	**1**	**2.02**						
Upper Mystic								
SOM007A/ MWR205A (treated)[2]	1/10/2024	3.93	Somerville	13.00	2.72	0.89	1y	1y
	3/23/2024	0.51		17.50	2.03	0.39	3m	6m
	3/29/2024	0.87		40.25	2.16	0.16	<3m	6m
	4/4/2024	2.64		32.75	1.43	0.17	<3m	3m-6m
	12/11/2024	6.36		23.50	2.89	0.57	6m	1-2y
Total	**5**	**14.31**						
Lower Charles								
MWR010	-	-	-	-	-	-	-	-
Total	**-**	**-**						
MWR018	1/10/2024	0.33	Ward Street (BO-DI-1)	15.50	2.93	0.79	6m-1y	1-2y
	6/26/2024	0.14		10.75	2.51	1.43	5y	1y
Total	**2**	**0.47**						
MWR019	1/10/2024	0.21	Ward Street (BO-DI-1)	15.50	2.93	0.79	6m-1y	1-2y
	6/26/2024	0.04		10.75	2.51	1.43	5y	1y
Total	**2**	**0.25**						
MWR020	1/10/2024	0.23	Ward Street (BO-DI-1)	15.50	2.93	0.79	6m-1y	1-2y
	6/26/2024	0.05		10.75	2.51	1.43	5y	1y
Total	**2**	**0.28**						
MWR201 (Cottage Farm) (treated)	1/10/2024	21.33	Allston[3]	13.00	2.71	0.80	6m-1y	1y
	1/13/2024	3.55		13.75	1.46	0.41	3m	3m-6m
	3/23/2024	6.29		18.25	2.32	0.42	3m	6m-1y
	5/30/2024	8.08		9.50	1.79	0.69	6m-1y	6m
	12/11/2024	3.75		28.25	2.61	0.43	3m	1y
Total	**5**	**43.00**						
MWR023	1/10/2024	0.09	Roxbury[3]	22.25	2.91	0.76	6m-1y	1-2y
	6/26/2024	0.12		11.00	2.68	1.65	9y	1y
Total	**2**	**0.21**						

(1) Metered data are estimates of outfall discharge calculated using data from sensors, taking into account physical configurations and constraints.
(2) CSO portion of MWR205A/SOM007A discharge is treated.
(3) Rain gages are owned and operated by BWSC.

3. Project Progress Report

Exhibit A Item 5 in both the Alewife/Mystic Variance and the Charles River Variance requires MWRA to provide a progress report on the three projects listed below in Table 3-1 and the one project listed below in Table 3-2.

Table 3-1. Alewife Brook/Upper Mystic River Project Progress Updates

Project Name	Potentially Impacted Variance Water Outfall	Project Description (From 2024 Variance)	Project Progress Update
Somerville Marginal CSO Facility - New Connection and Gate Structure	MWR205A/SOM007A	• Design and installation of gate structure from Somerville Marginal CSO facility influent line to MWRA Section 35 to maximize flows within interceptor. • Anticipated date of completion: December 2025	• MWRA under Contract with RJV Construction Corp (Contract 7985). • The construction phase Notice to Proceed was issued October 26, 2024. • CIPP lining of impacted Somerville Sewer is anticipated in spring 2025. • Excavation for construction of gated connection chamber is anticipated early summer 2025. • Testing is anticipated to be in November 2025. • Challenges: Deep excavation to construct chamber within onramp to Interstate 93.
Somerville Marginal CSO Facility Rehabilitation Design	MWR205A/SOM007A	• Complete Design of Facility Rehab to ensure reliable treatment of remaining CSO discharges. • Anticipated date of completion: February 2028	• Scope of services to be used in procurement of a consultant to design and provide engineering services during construction (ESDC) has been drafted and is under internal MWRA review. • Notice to proceed for consultant design/ESDC services anticipated in late summer 2025.
CAM401A Metering and Model Calibration Update	CAM401A	• Working with the City of Cambridge, perform further system metering and hydraulic model calibration to improve CAM401A system understanding and address differences in current hydraulic models. • Date of completion: October 2024	• The metering program and model calibration are complete. • Refer to December 27, 2024, Supplement to the Post Construction Monitoring Program for additional details. https://www.mwra.com/media/file/supplementaltofinal122724

Table 3-2. Charles River Project Progress Update

Project Name	Potentially Impacted Outfall	Project Description (From 2024 Variance)	Project Progress Update
CAM005 Weir Raising and Lengthening	CAM005	• Further investigate through internal survey all physical dimensions in the CAM005 Regulator to determine if the CAM005 weir can be raised to reduce activations but also increased in length to minimize increases to upstream wastewater levels. • Anticipated date of completion: December 2025	• MWRA issued a Task Order to Kleinfelder to evaluate and design weir improvements within the CAM005 regulator in summer 2024. • Kleinfelder completed the internal survey in September 2024. • The Preliminary Design Report (PDR) was submitted to MWRA on February 7, 2025. The PDR includes recommendations for weir configurations and preliminary cost estimates. • The final Preliminary Design Report was submitted to MWRA on March 10, 2025. • Kleinfelder is currently working on the 90% Design Package

4. Next steps

MWRA, Cambridge, and Somerville continue to progress forward the work required by the Variances and to develop draft Updated CSO Control Plans. In addition, MWRA, Cambridge, and Somerville continue to pursue the development of projects that will further reduce CSO discharges.

Appendix A Rainfall Processing and Analyses January 1, 2024 to December 31, 2024

A.1 Rainfall Analyses

This section presents the rainfall data measured from 20 gauges within the MWRA wastewater service area during the period of January 1, 2024 to December 31, 2024. It also describes the analysis of the rainfall data used to characterize the return period of each storm event and an assessment of measured rainfall for the 2024 period.

Intensity-Duration-Frequency (IDF) curve values for Atlas 14 for Boston (x-y coordinates: 42.3590, -71.0586) were extracted from NOAA's data server on April 12, 2022. The Atlas 14 partial duration curves were used to assign the recurrence intervals. The smallest storm the partial duration curves addresses is the 1-year storm, so the partial duration IDF curves for the 3-month and 6-month frequencies were extrapolated. The storm recurrence intervals identified in the report sections above and in Appendix A are based on the 2019 edition of Atlas 14 referenced above.

A.1.1 Rainfall Data Collection and Processing

Rainfall was quantified for this analysis using 15-minute rainfall data collected at rain gauges distributed over the MWRA system. The rain gauges are listed in Table A-1 and the locations are shown in Figure A-1.

Table A-1. Rain Gauges

Gauge Code	Name	Owner	Gauge Code	Name	Owner
BO-DI-1	Ward St.	MWRA	BWSC006	Dorchester -Talbot	BWSC
BO-DI-2	Columbus Park	MWRA	Rox	Roxbury	BWSC
BWSC001	Union Park Pump Sta.	BWSC	CH-BO-1	Chelsea Ck.	MWRA
BWSC002	Roslindale	BWSC	FRESH_POND	USGS Fresh Pond	USGS
BWSC003	Dorchester Adams St.	BWSC	HF-1C	Hanscom AFB	MWRA
BWSC004	Allston	BWSC	RG-WF-1	Hayes Pump Sta.	MWRA
BWSC007	Charlestown	BWSC	SOM	Somerville Remote	MWRA
EB	East Boston	BWSC	Lex	Lexington Farm	Project (1)
BWSC008	Longwood Medical	BWSC	SP	Spot Pond	Project (1)
BWSC005	Hyde Park	BWSC	WF	Waltham Farm	Project (1)

Notes:
(1) Project gauges were removed as of July 1, 2020. Project gauge data has been replaced with the nearest rain gauge, following the QA/QC procedures and closest rain gauges substitution table.

Quality assurance and quality control were provided by reviewing the data based on geographic location, comparing total rainfall depth and rainfall intensity values by month and for individual storm events. The shape of the rainfall hyetographs was reviewed for irregularities. Rain gauges with significantly higher or lower total rainfall depths than other gauges, and unusual hyetograph shapes, were flagged as suspect and further reviewed.

Suspect or missing rain gauge data were replaced with data from the rain gauge in closest linear proximity. If the closest gauge also had suspect data, the second closest rain gauge was used. Table A-2 identifies the two closest rain gauges to each of the rain gauges. Replacement of suspect data was recorded in Table A-3.

Additional information on the methodologies for rainfall data collection and processing can be found in Chapter 9 of the *December 2021 CSO Report*.

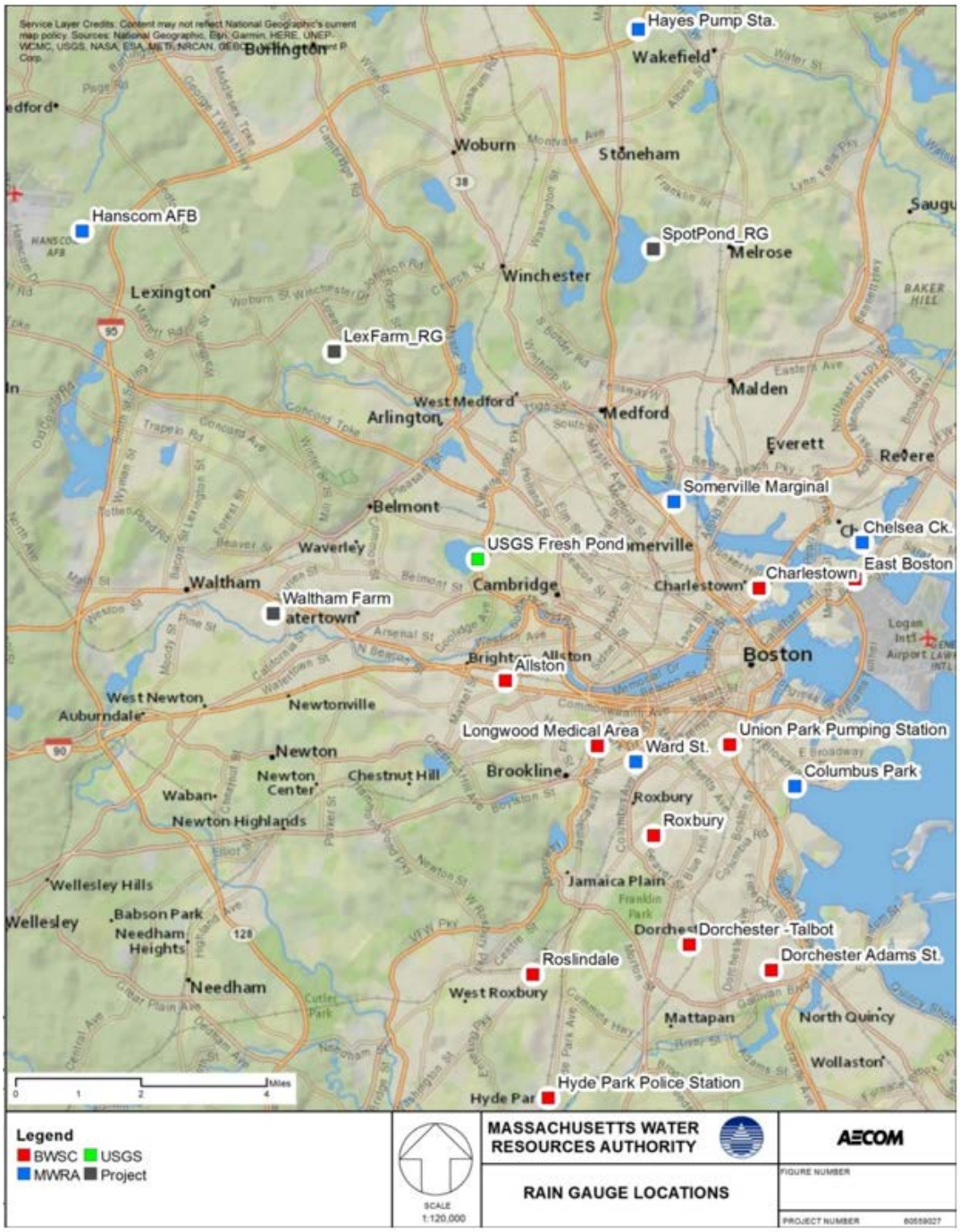

Figure A-1. Rain Gauge Location Plan

Table A-2. Closest Rain Gauges for Data Substitution

Origin Gauge		Closest Gauge		Second Closest Gauge	
Gauge Name	**Gauge Code**	**Gauge Code**	**Distance (mi)**	**Gauge Code**	**Distance (mi)**
Ward Street	BO-DI-1	BWSC008	0.66	Rox	1.23
Columbus Park	BO-DI-2	BWSC001	1.24	Rox	2.39
Union Park Pumping Station	BWSC001	BO-DI-2	1.24	BO-DI-1	1.52
Roslindale	BWSC002	BWSC005	2.02	BWSC006	2.54
Dorchester Adams St.	BWSC003	BWSC006	1.37	Rox	2.88
Allston	BWSC004	BWSC008	1.81	FRESH_POND	2.03
Hyde Park Police Station	BWSC005	BWSC002	2.02	BWSC006	3.36
Dorchester -Talbot	BWSC006	BWSC003	1.37	Rox	1.86
Charlestown	BWSC007	EB	1.53	CH-BO-1	1.80
Longwood Medical Area	BWSC008	BO-DI-1	0.67	Roxbury	1.71
Chelsea Creek	CH-BO-1	EB	0.60	BWSC007	1.80
East Boston	EB	CH-BO-1	0.60	BWSC007	1.53
USGS Fresh Pond	FRESH_POND	BWSC004	2.21	SOM	3.26
Hanscom AFB	HF-1C	Lex	4.47	WF	6.92
Lexington Farm	Lex	FRESH_POND	4.08	WF	4.37
Hayes Pump Sta.	RG-WF-1	SP	3.58	Lex	7.13
Roxbury	Rox	BO-DI-1	1.23	BWSC008	1.71
Somerville	SOM	BWSC007	1.95	CH-BO-1	3.07
Spot Pond	SP	SOM	4.12	Lex	5.34
Waltham Farm	WF	FRESH_POND	3.37	BWSC004	3.86

Table A-3. Summary of Rainfall Data Replacement, January 1, 2024 to December 31, 2024

Rain Gauge	Replacement Data Start Time	Replacement Data End Time	Replacement Rain Gauge
Allston (BWSC004)	1/6/2024 19:45	1/8/2024 16:30	USGS Fresh Pond
	1/16/2024 2:30	1/23/2024 13:30	USGS Fresh Pond
	12/20/2024 5:45	12/28/2024 2:00	USGS Fresh Pond
Charlestown (BWSC007)	1/6/2024 19:45	1/8/2024 16:30	Somerville Marginal (SOM)
	1/16/2024 2:30	1/23/2024 13:30	Somerville Marginal (SOM)
	12/20/2024 5:45	12/28/2024 2:00	Somerville Marginal (SOM)
Dorchester-Adams (BWSC003)	1/6/2024 19:45	1/8/2024 16:30	Columbus Park (BO-DI-2)
	1/16/2024 2:30	1/23/2024 13:30	Columbus Park (BO-DI-2)
	12/20/2024 5:45	12/28/2024 2:00	Columbus Park (BO-DI-2)
Dorchester-Talbot (BWSC006)	1/6/2024 19:45	1/8/2024 16:30	Ward St. (BO-DI-1)
	1/16/2024 2:30	1/23/2024 13:30	Ward St. (BO-DI-1)
	12/20/2024 5:45	12/28/2024 2:00	Ward St. (BO-DI-1)
East Boston (EB)	1/6/2024 19:45	1/8/2024 16:30	Somerville Marginal (SOM)
	1/16/2024 2:30	1/23/2024 13:30	Somerville Marginal (SOM)
	12/20/2024 5:45	12/28/2024 2:00	Somerville Marginal (SOM)
Hyde Park (BWSC005)	1/6/2024 19:45	1/8/2024 16:30	Ward St. (BO-DI-1)
	1/16/2024 2:30	1/23/2024 13:30	Ward St. (BO-DI-1)
	12/20/2024 5:45	12/28/2024 2:00	Ward St. (BO-DI-1)
Longwood Medical Area (BWSC008)	1/6/2024 19:45	1/8/2024 16:30	Ward St. (BO-DI-1)
	1/16/2024 2:30	1/23/2024 13:30	Ward St. (BO-DI-1)
	12/20/2024 5:45	12/28/2024 2:00	Ward St. (BO-DI-1)
Roslindale (BWSC002)	1/6/2024 19:45	1/8/2024 16:30	Ward St. (BO-DI-1)
	1/16/2024 2:30	1/23/2024 13:30	Ward St. (BO-DI-1)
	12/20/2024 5:45	12/28/2024 2:00	Ward St. (BO-DI-1)
Roxbury (Rox)	1/6/2024 19:45	1/8/2024 16:30	Ward St. (BO-DI-1)
	1/16/2024 2:30	1/23/2024 13:30	Ward St. (BO-DI-1)
	12/20/2024 5:45	12/28/2024 2:00	Ward St. (BO-DI-1)
Union Park Pumping Station (BWSC001)	1/6/2024 19:45	1/8/2024 16:30	Columbus Park (BO-DI-2)
	1/16/2024 2:30	1/23/2024 13:30	Columbus Park (BO-DI-2)
	12/20/2024 5:45	12/28/2024 2:00	Columbus Park (BO-DI-2)
Columbus Park (BO-DI-2)	11/19/2024 11:00	11/19/2024 11:15	Union Park Pumping Station (BWSC001)
Chelsea Creek (CH-BO-1)	1/6/2024 19:45	1/8/2024 16:30	Somerville Marginal (SOM)
	1/16/2024 2:30	1/23/2024 13:30	Somerville Marginal (SOM)
	12/20/2024 5:45	12/28/2024 2:00	Somerville Marginal (SOM)
Ward Street (BO-DI-1)	2/2/2024 9:15	2/2/2024 9:30	Roxbury (Rox)
USGS fresh pond (FRESH_POND)	2/2/2024 22:00	2/2/2024 22:45	Allston
	3/13/2024 10:45	3/13/2024 12:15	Allston
	5/22/2024 9:30	5/22/2024 10:30	Allston
	9/24/2024 8:45	9/24/2024 10:00	Allston
	11/27/2024 11:15	11/27/2024 12:15	Allston

Table A-3. Summary of Rainfall Data Replacement, January 1, 2024 to December 31, 2024

Rain Gauge	Replacement Data Start Time	Replacement Data End Time	Replacement Rain Gauge
Hayes Pump Station (RG-WF-1)	1/6/2024 19:45	1/8/2024 16:30	Somerville Marginal (SOM)
	1/16/2024 2:30	1/23/2024 13:30	Somerville Marginal (SOM)
	9/20/2024 21:45	10/14/2024 20:00	Somerville Marginal (SOM)
	12/20/2024 5:45	12/28/2024 2:00	Somerville Marginal (SOM)
Somerville Marginal (SOM)	3/4/2024 2:45	3/4/2024 13:00	Charlestown (BWSC007)
	6/26/2024 19:30	6/27/2024 7:45	Charlestown (BWSC007)
Hanscom AFB (HF-1C)	1/1/2024 0:00	12/31/2024 23:45	USGS Fresh Pond
Waltham Farm (WF)	1/1/2024 0:00	12/31/2024 23:45	USGS Fresh Pond
Lex-Farm (Lex)	1/1/2024 0:00	12/31/2024 23:45	USGS Fresh Pond
Spot Pond (SP)	1/1/2024 0:00	12/31/2024 23:45	Hayes Pump Station (RG-WF-1)

A.1.2 Monitored Storms

For the period of January 1, 2024 to December 31, 2024, the rainfall data at each rain gauge were analyzed and summarized, providing the date and time, duration, volume, average intensity, peak 1-hour, 24-hour, and 48-hour intensities and storm recurrence intervals for each storm. An inter-event time of 12-hours between storm events was used for this analysis. The storm recurrence intervals were assigned values of less than 3 months, 3 months, 3-6 months, 6 months, 1 year, 1-2 year, or the nearest 6-month interval for recurrence intervals greater than 2-year, based on comparison to the IDF values from Atlas 14. Table A-4 presents the summary of storm events for Ward Street Headworks for the period of January 1, 2024 to December 31, 2024. These data show that 97 storm events occurred in the year long period at the Ward Street Headworks rain gauge (BO-DI-1). The majority of events had a less than 3-month recurrence interval at 1-hour, 24-hour or 48-hour durations.

Table A-4. Summary of Storm Events at Ward Street Headworks Rain Gauge (BO-DI-1) for January 1, 2024 to December 31, 2024

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1hr Intensity (in/hr)	Peak 24hr Intensity (in/hr)	Peak 48hr Intensity (in/hr)	Atlas-14 Recurrence Interval[1]		
								1-hr	24-hr	48-hr
1	1/6/2024 22:15	32.00	1.24	0.04	0.13	0.05	0.03	<3m	3m	3m
2	1/9/2024 17:45	15.50	2.93	0.19	0.79	0.12	0.06	6m-1y	1-2y	N/A
3	1/13/2024 2:30	13.75	1.58	0.11	0.47	0.07	0.03	3m-6m	3m-6m	N/A
4	1/16/2024 3:45	13.25	0.50	0.04	0.18	0.02	0.01	<3m	<3m	N/A
5	1/23/2024 23:30	3.50	0.08	0.02	0.03	0.00	0.00	<3m	<3m	N/A
6	1/24/2024 17:45	12.75	0.53	0.04	0.13	0.02	0.01	<3m	<3m	N/A
7	1/26/2024 5:00	12.00	0.73	0.06	0.19	0.03	0.02	<3m	<3m	N/A
8	1/27/2024 5:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
9	1/28/2024 12:45	15.75	0.45	0.03	0.08	0.02	0.01	<3m	<3m	N/A
10	2/2/2024 20:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
11	2/10/2024 19:45	1.25	0.06	0.05	0.05	0.00	0.00	<3m	<3m	N/A
12	2/13/2024 7:30	5.25	0.32	0.06	0.13	0.01	0.01	<3m	<3m	N/A
13	2/23/2024 2:30	4.50	0.06	0.01	0.04	0.00	0.00	<3m	<3m	N/A
14	2/27/2024 22:45	26.00	0.33	0.01	0.08	0.01	0.01	<3m	<3m	<3m
15	3/2/2024 14:15	15.75	1.51	0.10	0.44	0.06	0.03	3m-6m	3m-6m	N/A
16	3/5/2024 11:45	12.00	0.22	0.02	0.09	0.01	0.00	<3m	<3m	N/A
17	3/6/2024 17:00	19.75	1.62	0.08	0.50	0.07	0.03	3m-6m	6m	N/A
18	3/9/2024 22:30	8.00	1.19	0.15	0.29	0.05	0.02	<3m	3m	N/A

Table A-4. Summary of Storm Events at Ward Street Headworks Rain Gauge (BO-DI-1) for January 1, 2024 to December 31, 2024

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1hr Intensity (in/hr)	Peak 24hr Intensity (in/hr)	Peak 48hr Intensity (in/hr)	Atlas-14 Recurrence Interval[1]		
								1-hr	24-hr	48-hr
19	3/15/2024 5:00	0.50	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
20	3/17/2024 7:30	0.75	0.02	0.03	0.02	0.00	0.00	<3m	<3m	N/A
21	3/20/2024 18:00	1.50	0.09	0.06	0.07	0.00	0.00	<3m	<3m	N/A
22	3/23/2024 4:30	16.75	2.50	0.15	0.45	0.10	0.05	3m-6m	1y	N/A
23	3/26/2024 22:45	9.25	0.03	0.00	0.02	0.00	0.00	<3m	<3m	N/A
24	3/27/2024 21:00	38.75	2.31	0.06	0.13	0.08	0.05	<3m	6m	6m-1y
25	4/2/2024 18:45	0.75	0.02	0.03	0.02	0.00	0.00	<3m	<3m	N/A
26	4/3/2024 9:30	31.75	2.09	0.07	0.24	0.08	0.04	<3m	6m	6m
27	4/6/2024 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
28	4/6/2024 16:15	2.25	0.06	0.03	0.04	0.00	0.00	<3m	<3m	N/A
29	4/11/2024 11:00	3.00	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
30	4/12/2024 4:00	11.00	0.82	0.07	0.29	0.03	0.02	<3m	<3m	N/A
31	4/14/2024 17:15	5.75	0.05	0.01	0.03	0.00	0.00	<3m	<3m	N/A
32	4/18/2024 8:15	10.00	0.15	0.02	0.06	0.01	0.00	<3m	<3m	N/A
33	4/20/2024 6:30	6.75	0.30	0.04	0.23	0.01	0.01	<3m	<3m	N/A
34	4/28/2024 2:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
35	4/30/2024 3:45	1.75	0.20	0.11	0.17	0.01	0.00	<3m	<3m	N/A
36	4/30/2024 23:00	5.25	0.07	0.01	0.02	0.00	0.00	<3m	<3m	N/A
37	5/2/2024 19:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
38	5/5/2024 15:45	10.00	0.46	0.05	0.13	0.02	0.01	<3m	<3m	N/A
39	5/8/2024 8:15	12.75	0.81	0.06	0.33	0.03	0.02	3m	<3m	N/A
40	5/15/2024 21:00	20.25	0.84	0.04	0.18	0.03	0.02	<3m	<3m	N/A
41	5/18/2024 19:45	12.25	0.23	0.02	0.06	0.01	0.00	<3m	<3m	N/A
42	5/23/2024 11:00	2.00	0.11	0.06	0.08	0.00	0.00	<3m	<3m	N/A
43	5/26/2024 3:15	2.75	0.06	0.02	0.04	0.00	0.00	<3m	<3m	N/A
44	5/27/2024 21:30	3.75	0.51	0.14	0.37	0.02	0.01	3m	<3m	N/A
45	5/30/2024 3:30	10.50	1.58	0.15	0.64	0.07	0.03	6m	3m-6m	N/A
46	6/7/2024 21:00	1.00	0.03	0.03	0.03	0.00	0.00	<3m	<3m	N/A
47	6/9/2024 9:30	3.25	0.31	0.10	0.21	0.01	0.01	<3m	<3m	N/A
48	6/14/2024 12:15	13.50	0.70	0.05	0.61	0.03	0.01	6m	<3m	N/A
49	6/20/2024 19:45	1.50	0.42	0.28	0.41	0.02	0.01	3m	<3m	N/A
50	6/21/2024 17:45	2.25	0.68	0.30	0.55	0.03	0.01	6m	<3m	N/A
51	6/22/2024 15:00	2.25	0.25	0.11	0.15	0.01	0.01	<3m	<3m	N/A
52	6/23/2024 7:00	1.00	0.07	0.07	0.07	0.00	0.00	<3m	<3m	N/A
53	6/24/2024 21:45	1.00	0.10	0.10	0.10	0.00	0.00	<3m	<3m	N/A
54	6/26/2024 18:30	10.75	2.51	0.23	1.43	0.10	0.05	5y	1y	N/A
55	6/30/2024 15:15	1.00	0.02	0.02	0.02	0.00	0.00	<3m	<3m	N/A
56	7/1/2024 13:30	3.25	0.04	0.01	0.03	0.00	0.00	<3m	<3m	N/A
57	7/5/2024 5:30	1.50	0.48	0.32	0.44	0.02	0.01	3m-6m	<3m	N/A
58	7/6/2024 10:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
59	7/12/2024 18:15	0.50	0.10	0.20	0.10	0.00	0.00	<3m	<3m	N/A
60	7/13/2024 8:00	5.25	0.32	0.06	0.12	0.01	0.01	<3m	<3m	N/A
61	7/15/2024 16:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
62	7/17/2024 23:30	2.00	0.20	0.10	0.17	0.01	0.00	<3m	<3m	N/A
63	7/23/2024 2:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
64	7/24/2024 12:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
65	7/28/2024 20:00	14.25	0.04	0.00	0.02	0.00	0.00	<3m	<3m	N/A
66	7/31/2024 10:00	3.50	0.25	0.07	0.22	0.01	0.01	<3m	<3m	N/A
67	8/2/2024 15:15	0.50	0.20	0.40	0.20	0.01	0.00	<3m	<3m	N/A

Table A-4. Summary of Storm Events at Ward Street Headworks Rain Gauge (BO-DI-1) for January 1, 2024 to December 31, 2024

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1hr Intensity (in/hr)	Peak 24hr Intensity (in/hr)	Peak 48hr Intensity (in/hr)	Atlas-14 Recurrence Interval[1]		
								1-hr	24-hr	48-hr
68	8/4/2024 14:45	4.75	0.68	0.14	0.45	0.03	0.01	3m-6m	<3m	N/A
69	8/6/2024 5:15	3.50	0.41	0.12	0.28	0.02	0.01	<3m	<3m	N/A
70	8/6/2024 21:45	8.00	0.48	0.06	0.24	0.02	0.01	<3m	<3m	N/A
71	8/8/2024 18:30	36.50	0.56	0.02	0.15	0.01	0.01	<3m	<3m	<3m
72	8/15/2024 15:15	1.25	0.35	0.28	0.34	0.01	0.01	3m	<3m	N/A
73	8/18/2024 5:45	1.50	0.12	0.08	0.10	0.01	0.00	<3m	<3m	N/A
74	8/19/2024 1:45	30.00	0.29	0.01	0.10	0.01	0.01	<3m	<3m	<3m
75	8/21/2024 20:00	0.50	0.15	0.30	0.15	0.01	0.00	<3m	<3m	N/A
76	9/20/2024 13:30	34.75	0.98	0.03	0.17	0.04	0.02	<3m	3m	3m
77	9/26/2024 15:15	6.25	0.45	0.07	0.19	0.02	0.01	<3m	<3m	N/A
78	10/7/2024 3:15	10.25	0.41	0.04	0.17	0.02	0.01	<3m	<3m	N/A
79	10/8/2024 7:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
80	10/13/2024 15:15	28.25	0.27	0.01	0.06	0.01	0.01	<3m	<3m	<3m
81	10/29/2024 23:15	3.75	0.24	0.06	0.10	0.01	0.01	<3m	<3m	N/A
82	11/10/2024 23:45	8.50	0.09	0.01	0.05	0.00	0.00	<3m	<3m	N/A
83	11/21/2024 1:15	25.75	1.34	0.05	0.18	0.06	0.03	<3m	3m-6m	3m-6m
84	11/22/2024 16:45	17.00	1.35	0.08	0.14	0.06	0.03	<3m	3m-6m	N/A
85	11/26/2024 9:30	5.25	0.33	0.06	0.10	0.01	0.01	<3m	<3m	N/A
86	11/28/2024 9:45	19.50	0.79	0.04	0.23	0.03	0.02	<3m	<3m	N/A
87	12/4/2024 21:00	12.00	0.47	0.04	0.08	0.02	0.01	<3m	<3m	N/A
88	12/8/2024 0:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
89	12/9/2024 15:00	12.00	0.51	0.04	0.10	0.02	0.01	<3m	<3m	N/A
90	12/11/2024 0:15	23.75	3.02	0.13	0.57	0.13	0.06	6m	1-2y	N/A
91	12/17/2024 0:15	4.75	0.16	0.03	0.06	0.01	0.00	<3m	<3m	N/A
92	12/18/2024 18:30	14.50	0.78	0.05	0.23	0.03	0.02	<3m	<3m	N/A
93	12/20/2024 8:15	20.75	0.54	0.03	0.08	0.02	0.01	<3m	<3m	N/A
94	12/24/2024 11:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
95	12/28/2024 6:15	3.25	0.10	0.03	0.07	0.00	0.00	<3m	<3m	N/A
96	12/29/2024 12:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
97	12/30/2024 5:45	5.50	0.66	0.12	0.39	0.03	0.01	3m	<3m	N/A

Notes:

(1) Recurrence intervals given in ranges of less than 3 months (<3m), 3-months, (3m), 3-6 months (3-6m), 6 months (6m), 6 months-1 year (6m-1y), 1 year (1y), 1 to 2 year (1y-2y) or the nearest 6-month interval for recurrence intervals >2 year, based on Atlas 14.

The total rainfall and number of storms at each rain gauge were identified for the period from January 1, 2024 to December 31, 2024, and the number of storms were categorized by depth. Table A-5 presents this comparison. As indicated in Table A-5, during 2024 the rain gauges measured an average total rainfall volume of 45.11 inches.

Table A-5. Frequency of Events within Selected Ranges of Total Rainfall for January 1, 2024 -- December 31, 2024

Rain Gauge	Total Rainfall (inches)	Total Number of Storms	Number of Storms by Depth				
			Depth < 0.25 inches	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
January - December 2024							
Average of Rain Gauges							
Average	45.11	93	46	19	16	9	5
MWRA Rain Gauges							
Ward Street	49.10	97	47	20	16	8	6
Columbus Park	44.68	90	44	17	14	9	6
Chelsea Creek	45.95	92	43	20	16	8	5
Hanscom AFB	37.33	84	39	19	15	8	3
Somerville	42.18	94	49	15	17	9	4
Hayes PS	39.94	91	48	18	15	7	3
BWSC Rain Gauges							
Allston	45.70	95	46	22	13	9	5
Charlestown	44.72	93	43	20	17	9	4
Dorch-Adams	48.75	101	52	17	16	10	6
Dorch-Talbot	50.77	102	52	18	16	10	6
Hyde Park	52.04	102	52	17	16	12	5
East Boston	47.55	91	43	17	18	7	6
Longwood	47.96	99	51	16	18	8	6
Roslindale	54.47	97	43	20	18	9	7
Roxbury	49.85	101	49	22	15	9	6
Union Park	49.37	96	46	19	17	7	7
USGS Rain Gauge							
Fresh Pond	37.33	84	39	19	15	8	3
MWRA Project Gauges (Removed)[1]							
Lexington Farm	37.33	84	39	19	15	8	3
Spot Pond	39.94	91	48	18	15	7	3
Waltham Farm	37.33	84	39	19	15	8	3

Notes:

(1) Project gauges were removed as of July 1, 2020. Project gauge data has been replaced with the nearest rain gauge, following the QA/QC procedures and closest rain gauges substitution table.

Historical data shows that storms with depths greater than 2 inches are of importance because higher depth storms are more likely to cause CSO activations and larger volumes compared to lower depth storms. Storms with greater than 2 inches of total rainfall at the Ward Street, Columbus Park, Chelsea Creek Headworks, and USGS Fresh Pond rain gauges were identified in Table A-6 for the 2024 time period.

Table A-6. Storms Between January 1, 2024 to December 31, 2024, with Greater Than 2 Inches of Total Rainfall

Rain gauge	Date	Duration (hr)	Total Rainfall (inches)	Average Intensity (in/hr)	Peak Intensity (in/hr)	Storm Recurrence Interval (24-hr)(1)
January - December 2024 Rain Gauge Data						
Ward Street Headworks (BO-DI-1)	1/9/2024	15.50	2.93	0.19	0.79	1-2y
	3/23/2024	16.75	2.50	0.15	0.45	1y
	3/27/2024	38.75	2.31	0.06	0.13	6m
	4/3/2024	31.75	2.09	0.07	0.24	6m
	6/26/2024	10.75	2.51	0.23	1.43	1y
	12/11/2024	23.75	3.02	0.13	0.57	1-2y
Columbus Park Headworks (BO-DI-2)	1/9/2024	15.50	2.16	0.14	0.61	6m-1y
	3/23/2024	16.25	2.30	0.14	0.44	6m-1y
	3/27/2024	40.75	2.52	0.06	0.17	6m-1y
	4/3/2024	30.50	2.05	0.07	0.30	6m
	6/26/2024	10.75	2.14	0.20	1.19	6m-1y
	12/11/2024	24.00	2.51	0.10	0.36	1y
Chelsea Creek Headworks (CH-BO-1)	1/9/2024	19.25	2.39	0.12	0.73	6m-1y
	3/23/2024	19.25	2.42	0.13	0.44	6m-1y
	3/27/2024	43.00	2.45	0.06	0.14	6m-1y
	11/21/2024	55.25	2.54	0.05	0.25	3m-6m
	12/10/2024	30.25	2.71	0.09	0.46	1y
Fresh Pond (USGS)	1/9/2024	15.25	2.24	0.15	0.72	6m-1y
	3/23/2024	16.75	2.07	0.12	0.40	6m-1y
	12/11/2024	19.25	2.16	0.11	0.28	6m-1y

Notes:

(1) Recurrence intervals given in ranges of less than 3 months (<3m), 3-months, (3m), 3-6 months (3-6m), 6 months (6m), 6 months-1year (6m-1y), 1 year (1y), 1 to 2 year (1y-2y) or the nearest 6-month interval for recurrence intervals >2 year, based on Atlas 14.

The storm with the largest depth over the 2024 period was recorded at Ward Street Headworks on December 11th, 2024, with 3.02 inches of rainfall over 23.75 hours, which equates to a 1-2yr 24-hour duration recurrence interval.

Storms with intensities greater than 0.40 in/hr are of importance because higher intensity storms are more likely to cause CSO activations and volumes compared to lower intensity storms. For the four gauges shown in Table A-7, the number of storms with peak intensities greater than 0.40 in/hr ranged from eight to fourteen. The maximum return interval was recorded at the Ward Street Headworks gauge which recorded a 5-year return interval for the 1-hour duration on June 26th, 2024. While this storm resulted in CSO activations across the sewershed, it also displayed spatial variability as it was recorded as a 3-6 month storm at USGS Fresh Pond rain gauge. In addition, the number of storms with peak intensities greater than 0.75 in/hr ranged from 0 to 2 storms across the four gages in Table A-7.

For storms with peak rainfall intensities greater than 0.4 in/hr at Ward Street Headworks, Columbus Park Headworks, and Chelsea Creek Headworks rain gauges, hyetographs were developed. These hyetographs show the 15-minute

rainfall intensities and the distribution of rainfall during the storm. Rainfall distribution during a storm can impact the behavior of system hydraulics due to soil saturation. For example, a storm where the peak rainfall occurs towards the end of the event will generally create more CSO than a storm with similar total rainfall and peak intensity, where the peak occurs at the beginning of the storm. An example hyetograph for the January 9th, 2024, storm at the Ward Street gauge is shown in Figure A-2. This hyetograph is an example of the peak of the storm occurring towards the end of the event, which could compound the impact of this event (2.93 inches total rainfall at the Ward Street gauge) on CSO volumes.

Table A-7. Storms Between January 1, 2024 to December 31, 2024, with Peak Intensities Greater than 0.40 inches/hour

Rain gauge	Date	Duration (hr)	Total Rainfall (inches)	Average Intensity (in/hr)	Peak Intensity (in/hr)	Storm Recurrence Interval (1-hr)(1)
January - December 2024 Rain Gauge Data						
Ward Street Headworks (BO-DI-1)	1/9/2024	15.5	2.93	0.19	0.79	6m-1y
	1/13/2024	13.75	1.58	0.11	0.47	3m-6m
	3/2/2024	15.75	1.51	0.10	0.44	3m-6m
	3/6/2024	19.75	1.62	0.08	0.50	3m-6m
	3/23/2024	16.75	2.50	0.15	0.45	3m-6m
	5/30/2024	10.5	1.58	0.15	0.64	6m
	6/14/2024	13.5	0.70	0.05	0.61	6m
	6/20/2024	1.5	0.42	0.28	0.41	3m
	6/21/2024	2.25	0.68	0.30	0.55	6m
	6/26/2024	10.75	2.51	0.23	1.43	5y
	7/5/2024	1.5	0.48	0.32	0.44	3m-6m
	8/4/2024	4.75	0.68	0.14	0.45	3m-6m
	12/11/2024	23.75	3.02	0.13	0.57	6m
Columbus Park Headworks (BO-DI-2)	1/9/2024	15.50	2.16	0.14	0.61	6m
	1/13/2024	13.75	1.35	0.10	0.48	3m-6m
	3/6/2024	24.75	1.77	0.07	0.59	6m
	3/23/2024	16.25	2.30	0.14	0.44	3m-6m
	5/30/2024	10.75	1.59	0.15	0.51	3m-6m
	6/21/2024	38.25	0.90	0.02	0.52	3m-6m
	6/26/2024	10.75	2.14	0.20	1.19	3y
	8/2/2024	0.75	0.56	0.75	0.56	6m
Chelsea Creek Headworks (CH-BO-1)	1/9/2024	19.25	2.39	0.12	0.73	6m-1y
	1/13/2024	13.75	1.48	0.11	0.53	3m-6m
	3/2/2024	16.00	1.50	0.09	0.41	3m
	3/6/2024	19.00	1.41	0.07	0.46	3m-6m
	3/23/2024	19.25	2.42	0.13	0.44	3m-6m
	5/8/2024	12.75	0.85	0.07	0.44	3m-6m
	5/30/2024	9.25	1.79	0.19	0.62	6m
	6/14/2024	12.50	0.75	0.06	0.68	6m-1y
	6/20/2024	1.50	0.59	0.39	0.57	6m
	6/26/2024	9.75	1.10	0.11	0.60	6m

Rain gauge	Date	Duration (hr)	Total Rainfall (inches)	Average Intensity (in/hr)	Peak Intensity (in/hr)	Storm Recurrence Interval (1-hr)(1)
	7/5/2024	1.50	0.74	0.49	0.66	6m
	8/2/2024	0.50	0.86	1.72	0.86	1y
	8/4/2024	4.50	0.99	0.22	0.80	6m-1y
	12/10/2024	30.25	2.71	0.09	0.46	3m-6m
Fresh Pond (USGS)	1/9/2024	15.25	2.24	0.15	0.72	6m-1y
	3/23/2024	16.75	2.07	0.12	0.40	3m
	5/8/2024	8.75	0.83	0.09	0.47	3m-6m
	5/30/2024	5.75	1.62	0.28	0.64	6m
	6/20/2024	1.50	0.6	0.40	0.57	6m
	6/26/2024	10.75	0.86	0.08	0.46	3m-6m
	7/31/2024	1.00	0.65	0.65	0.65	6m
	8/4/2024	2.25	0.66	0.29	0.58	6m

Notes:

(1) Recurrence intervals given in ranges of less than 3 months (<3m), 3-months, (3m), 3-6 months (3-6m), 6 months (6m), 6 months-1 year (6m-1y), 1 year (1y), 1 to 2 year (1y-2y) or the nearest 6-month interval for recurrence intervals >2 year, based on Atlas 14.

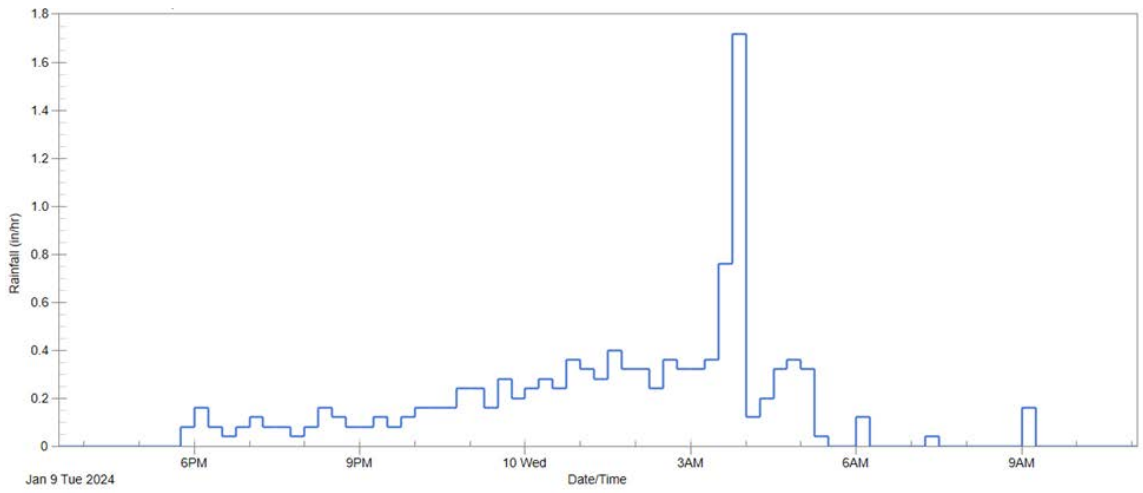

Figure A-2. Hyetograph from the Ward Street Headworks Gauge for January 9-10, 2024

The following is a summary of the rainfall from January 1, 2024 to December 31, 2024:

- 2024 averaged 93 storm events across the rain gauges assessed, with an average annual rainfall depth of 45.11 inches (Table A-5)
- The distribution of storms by rainfall depth categories for 2024 was as follows:
    - 46 storms with total depths less than 0.25 inches,
    - 19 storms with total depths between 0.25 and 0.5 inches,
    - 16 storms with total depths between 0.5 and 1.0 inches,
    - 9 storms with total depths between 1.0 and 2.0 inches, and

- 5 storms with total depths greater than 2.0 inches (Table A-5).

- In terms of larger storms, for the four gauges shown in Table A-6, the number of storms with greater than 2 inches of total rainfall in 2024 ranged from three to six, for an average of 4.5 storms. Six storm events were recorded to have a depth greater than 2 inches at both Ward St (BO-DI-1) and Columbus Park (BO-DI-2), five storms at Chelsea Creek (CH-BO-1), as well as three storms at USGS Fresh Pond. The largest storm in 2024 was measured by the Ward Street gauge on December 11, 2024 with a total depth of 3.02 inches (Table A-6).

- For the four gauges shown in Table A-7, the number of storms with peak intensities greater than 0.40 inches per hour ranged from 8 to 14. On June 26, 2024 the Ward Street gauge measured a storm with a peak intensity of 1.43 inches per hour which is equivalent to a 5-year 1-hour event. The other three gauges presented in Table A-7 had individual storms with maximum peak intensities between 0.72 and 1.19 inches per hour.