UNITED STATES DISTRICT COURT
for the
DISTRICT OF MASSACHUSETTS

UNITED STATES OF AMERICA, Plaintiff, v. METROPOLITAN DISTRICT COMMISSION, et al., Defendants.	CIVIL ACTION No. 85-0489-RGS
CONSERVATION LAW FOUNDATION OF NEW ENGLAND, INC., Plaintiff, v. METROPOLITAN DISTRICT COMMISSION, Defendants.	CIVIL ACTION No. 83-1614-RGS

MWRA BIANNUAL COMPLIANCE AND
PROGRESS REPORT AS OF DECEMBER 16, 2019

The Massachusetts Water Resources Authority (the "Authority") submits the following biannual compliance report for the period from June 15, 2019 to December 16, 2019, and supplementary compliance information in accordance with the Court's order of December 23, 1985, and subsequent orders of the Court.

I. Schedule Seven

There were no scheduled activities for the past six-month period on the Court's Schedule Seven.

A. Progress Report

1. Combined Sewer Overflow Program

a. Performance Assessment of Long-Term CSO Control Plan

On October 31, 2019, the Authority submitted to the United States Environmental Protection Agency ("EPA") and the Massachusetts Department of Environmental Protection ("DEP") the third of a series of planned semiannual progress reports on the performance assessment of its $911 million approved Long-Term CSO Control Plan (the "LTCP"). A copy of the report is attached as Exhibit A. The Authority also submitted copies of the report to the Boston Water and Sewer Commission and the cities of Cambridge, Chelsea and Somerville (together, the "CSO communities"), the Charles River Watershed Association, and the Mystic River Watershed Association and posted it to its website. The third semiannual report describes the Authority's rainfall data collection program, its CSO metering program, its continued work on the calibration of its hydraulic model, and its investigations into the factors contributing to higher than expected overflow activity at certain regulators and outfalls. The following summarizes the progress of this work.

Rainfall data were collected from January 1, 2019 through June 30, 2019, and the data were compared to the characteristics of storms in the "Typical Year", defined in the May 15, 2006 *Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control*, attached as Exhibit B, as amended May 2008 (the "Second Stipulation"). Rainfall analyses and comparison to the Typical Year rainfall help validate the CSO discharge estimates and evaluate the level of CSO activity during the 6-month period in the context of the Typical Year-based LTCP levels of control.

As to CSO discharges, for the period of January 1, 2019 through June 30, 2019, CSO activations and durations, as well as discharge volumes where measured, were estimated at CSO regulators and outfalls where the Authority had permanent or temporary meters during the data collection period. In addition to providing field measurements for CSO discharge quantification at most outfalls, the meter data are intended to support improved calibration and verification of the Authority's hydraulic model.

With respect to the hydraulic model work, the Authority completed the planned updates and improved calibration in November, approximately three months later than it anticipated in its June 14, 2019 Compliance and Progress Report. The calibration took more time than expected because of the significant amount of data generated by temporary meters at 57 potentially active regulator locations (25 locations more than originally scoped for the project) and permanent meters at other potentially active regulators. The data set also expanded with the many storms that occurred during the 2018 metering period.

The Authority also incorporated recent physical improvements into the model and included data from the CSO communities in the calibration process.

With the calibrated model, the Authority predicted CSO discharges for storms during the temporary metering period of April 15, 2018 through June 30, 2019. The results showed some discrepancies, at certain outfalls and regulators, compared to the discharges the Authority had measured with its meters. The Authority and its consultant are analyzing and investigating these discrepancies in an effort to bring the model predictions and metered discharges closer together - or explain the differences - and gain confidence in the calibration at these locations.

Notwithstanding its continuing investigations, the Authority reports in the attached Table C-1 of Exhibit C the accepted results of the current 2019 model simulations of storms in the Typical Year and a comparison of those results to the LTCP levels of CSO control. Attached as Table C-2 of Exhibit C is a list of those outfalls for which the Authority has less confidence in the Typical Year model results due to the discrepancies between the model-predicted and metered discharges for the storms of April 2018 through June 2019. In summary, the Authority and the CSO communities have eliminated CSO discharges or provided a 25-year storm level of control at 40 outfalls.[1] With respect to the remaining

[1] 34 of those outfalls are included in MWRA's LTCP. Boston Water and Sewer Commission (3 outfalls) and the cities of Cambridge (2 outfalls) and Chelsea (1 outfall) have closed an additional 6 outfalls. Cambridge's 2 outfalls - CAM009 and CAM011 - on the Charles River are blocked pending further hydraulic evaluation by Cambridge.

open discharge locations and levels of control in the Second Stipulation, the Authority (i) has accepted the model results for 36 locations (see Table C-1); and ii) is further investigating the model configuration and calibration at 10 locations (see Table C-2).[2] Of the 36 locations in Table C-1, the Typical Year model predictions show consistency with or improvement upon the LTCP levels of control at 20 locations and show higher than predicted annual discharge activation and/or volume at 16 locations. To address the 16, the Authority is diligently working with the CSO communities and its consultant to evaluate and develop plans for improvements through additional mitigation efforts. The Authority intends to complete its investigations into the model/meter discrepancies and then submit, in a supplemental filing to the Court as well as EPA and DEP, the model results for the storms of calendar year 2018 and the Typical Year, likely in the next one to two months.[3] Its next scheduled progress report is not due until June 2020.

Notwithstanding the Authority's continuing investigations into the meter/model discrepancies and the higher overflow activity at certain overflow locations, the recent Typical Year model run validates the accomplishments of the Authority and its member communities in their CSO control efforts and investments over the past 30 years. The Typical Year results show that region-

[2] These include 2 of the 4 treated CSO facilities (Prison Point and Cottage Farm).

[3] In an April 30, 2019 report to EPA and DEP on CSO discharge estimates for calendar year 2018, which were based primarily on meter data, the Authority advised that it would supplement the report with model results once it completed model calibration.

wide CSO discharge volume has been reduced from 3.3 billion gallons a year in the late 1980's to approximately 460 million gallons today, an 86% reduction. The Authority is confident that it will continue to make and show further improvement as its CSO performance assessment and related mitigation efforts continue toward submission of a final report in December 2021.

The Authority, with the cooperation and support of the CSO communities, continues to make important progress in evaluating and implementing system adjustments that may improve CSO performance. For example, the Authority and the City of Cambridge, with support from EPA and DEP, have recently received approval from the MWRA Board of Directors to proceed with a partial sewer separation project on a trial basis. This project involves a modification to Cambridge's sewer system serving the Cambridgeport neighborhood. The modified plan will remove peak stormwater flows that contribute to CSO discharges at the Authority's Cottage Farm facility, while allowing a portion of the separated stormwater to continue to drain to the sewer system to reduce the impact of phosphorous and other pollutants on the Charles River. The peak stormwater will be discharged to the Charles River through two City of Cambridge stormwater outfalls, one pre-existing and one recently constructed. This approach will assist the City in meeting its phosphorus loading requirements as established by a Total Maximum Daily Load for the Charles River and assist the Authority in achieving the LTCP levels of control at Cottage Farm. The Authority is also working closely with Chelsea, Somerville and the

Boston Water and Sewer Commission to establish other plans for mitigating CSO impacts.

b. CSO Water Quality Standards Variances

On August 30, 2019, DEP issued CSO variances to Massachusetts Surface Water Quality Standards for the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River for five years each to August 31, 2024. DEP issued the Charles River variance to the Authority and the City of Cambridge and issued the Alewife Brook/Upper Mystic River variance to the Authority and the cities of Cambridge and Somerville.

The variance conditions are consistent with the agreement reached among EPA, DEP and the Authority that was summarized in the *Joint Report on Agreement between Massachusetts Water Resources Authority, Environmental Protection Agency, and Department of Environmental Protection* filed with the Court on July 18, 2019. The variances require the Authority to conduct, as part of its CSO performance assessment, receiving water modeling to assess the remaining CSO water quality impacts in the Charles River and the Alewife Brook/Upper Mystic River and distinguish CSO and non-CSO (i.e., stormwater) impacts. The variances also require the Authority to conduct CSO and stormwater sampling to create new data sets that will support the receiving water quality modeling, submit semiannual progress reports, and submit the results of the CSO Performance Assessment and a Final CSO Water Quality Impact Report by December 31, 2021.

Since commencing the receiving water modeling work in the summer of 2019, the Authority has updated the Alewife Brook/Mystic River Basin and Charles River Basin model grids, including input locations for stormwater and CSO sources. The Authority has also developed mechanisms to translate the output of hydraulic collection system models, *i.e.*, CSO discharges, and runoff models into inputs for the receiving water models. Sources of water generating data for the receiving water models include upstream boundary flow, rainfall and groundwater, along with stormwater and CSO. Initial calibration of the stream flows in the receiving water models to measured stream flows has begun, using 2017 rainfall and corresponding runoff model results.

With respect to bacterial water quality, the Authority has reviewed available sources of data on stormwater, CSO and upstream boundary water quality and has begun collecting field data to supplement and update the available data. Sample collection and testing of CSO and stormwater during storm events has progressed through the past few months and will continue through June 2020.

The variances also include conditions intended to ensure further progress on CSO control, the mitigation of associated water quality impairment, and public notification of CSO discharges and their impacts. The variances further include schedules for progress reporting and public briefings on the CSO performance assessment and requirements for a program of near real-time public notifications of CSO discharges that the Authority, Cambridge and Somerville must implement for their respective outfalls by December 2020. In anticipation of these CSO notification requirements, the Authority's Board of Directors authorized it to purchase, for its permitted outfalls, the temporary meters referenced earlier in this report.

In addition, the variances specify project evaluations the Authority must conduct with the assistance and support of Cambridge and Somerville to potentially further control CSO discharges. These include the evaluation of system improvements to reduce activations and treated discharges from the Somerville-Marginal CSO Facility; the evaluation of enhanced pumping at the recently rehabilitated Alewife Brook Pump Station for potential to reduce CSO discharges to Alewife Brook; and system optimization evaluations of potentially beneficial modifications to CSO regulator structures. Lastly, the variances require the Authority, Cambridge and Somerville to each perform updated CSO control planning to evaluate the feasibility and cost of higher levels of control for their respective outfalls to the variance waters, with a Final Recommended Plan to be submitted to EPA and DEP by December 31, 2023.

Future semiannual progress reports will include comparisons of metered and model-predicted CSO discharges and the Authority's progress on the development of receiving water quality models and the collection of CSO and stormwater quality data for the Charles River and the Alewife Brook/Upper Mystic River. The Court-ordered performance assessment of whether the Typical Year LTCP levels of CSO control have been met will be based on the full results of data collection, system evaluations, and model simulations that are included in the scope of the Authority's post-construction monitoring program through 2021.

Respectfully submitted,

By its attorney,

/s/ Jonathan M. Ettinger

Jonathan M. Ettinger (BBO #552136)
Foley Hoag LLP
155 Seaport Boulevard
Boston, Massachusetts 02210
(617) 832-1000
jettinger@foleyhoag.com

Of Counsel:

Carolyn Francisco Murphy (BBO #567090)
General Counsel
Christopher L. John (BBO #559550)
Senior Staff Counsel
Massachusetts Water Resources Authority
100 First Avenue
Boston, Massachusetts 02129
(617) 242-6000

CERTIFICATE OF SERVICE

I hereby certify that a true and accurate copy of this document, which was filed via the Court's ECF system, will be sent electronically by the ECF system to the registered participants as identified on the Notice of Electronic Filing (NEF) and electronic copies (or paper copies upon request) will be sent to those indicated as non-registered participants (or the party's current representative) on December 16, 2019.

/s/ Jonathan M. Ettinger
Jonathan M. Ettinger (BBO #552136)
Jettinger@foleyhoag.com

Dated: December 16, 2019

EXHIBIT A

AECOM Imagine it. Delivered.

Task 4: Semiannual CSO Discharge Report No. 3
January 1, 2019 – June 30, 2019

CSO Post Construction Monitoring and Performance Assessment
MWRA Contract No. 7572

October 31, 2019

Project number: 60559027

Table of Contents

Figures

Tables

Definitions

Combined Sewer: A sewer that conveys stormwater and wastewater of domestic, commercial, and industrial origin. When wastewater and stormwater flows exceed the sewer capacity, overflows can occur. These overflows are called Combined Sewer Overflows (CSOs).

Combined Sewer Regulator: A CSO regulator controls flow by directing normal dry weather flow and a portion of wet weather flow to an interceptor for conveyance to full treatment. Excess wet weather flow is directed to an overflow conduit.

Continuity: A term used in fluid mechanics to describe the principle of conservation of mass. The continuity equation states that the flow rate for an incompressible fluid can be calculated by multiplying the area of flow by the average flow velocity.

Discharge Permits (NPDES): A permit issued by the U.S. EPA or a State regulatory agency under the National Pollutant Discharge Elimination System (NPDES) that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water. It also includes a compliance schedule for achieving those limits. The NPDES process was established under the Federal Clean Water Act.

Diversion Structure: A structure that diverts flow to either the associated control facility (i.e., tunnel, storage tank, etc.) or the CSO outfall if the capacity of the control measure is exceeded.

Doppler Velocity Meter: A velocity measurement device using sound pulses emitted in the upstream direction. The device records the reflection of these pulses on particles in the water from which the flow velocity can be quantified

Depth and Velocity Sensor: A device used to measure velocity and water level at a monitoring location from which the flowrate can be quantified.

Hydrograph Analysis: Analysis of graphical plots comparing the rate of flow versus time.

Hyetograph: A graphical plot of precipitation data over time. Graph of rainfall intensity during a storm event.

Inclinometer: A measurement device that is mounted on a tide gate and used to measure the angle of opening of a tide gate as a function of time.

Intensity-Duration-Frequency (IDF) Curve: A mathematical function that relates the rainfall intensity with its duration and frequency of occurrence. These curves are commonly used in hydrology for flood forecasting and civil engineering for urban drainage design. IDF curves are also analyzed in hydrometeorology because of the interest in the time-structure of rainfall.

Intrusion Velocity: A velocity measurement made with a Peak Velocity sensor in which the sensor is facing towards a tide gate to spot reverse flow through a tide gate.

Level Sensor (or Level Meter): A device used to measure flow depth at a monitoring location.

Long-Term Control Plan: A phased approach required under the Environmental Protection Agency's CSO Control Policy and part of the strategy to control CSOs. LTCPs aim to reduce the frequency, duration, and volume of CSO events through system characterization, development and evaluation of alternatives, and selection and implementation of controls. For this report, the term LTCP refers to the plan developed by MWRA in the 1990s to reduce CSO volumes in the cities of Boston, Cambridge, Somerville and Chelsea.

Manning's Equation: An empirical equation for calculating flow rate or velocity that applies to uniform flow in open channels and is a function of the channel roughness, flow area, wetted perimeter and channel slope.

Meter: An instrument for measuring and recording data such as water level, velocity, or both. Flow meters typically measure water level and velocity from which the flowrate can be calculated.

Nine Minimum Controls (NMCs): Technology-based controls that address CSOs without extensive engineering studies or significant construction costs.

Precipitation: The process by which atmospheric moisture falls onto a land or water surface as rain, snow, hail, or other forms of moisture.

Pressure Sensor (Dp): A device used to measure the depth of water by determining the force acting on the sensor based on the water level above the sensor.

Rain Gauge: An instrument that measures the amount of rain that has fallen in a particular place at a set time interval.

Regression Analysis: A statistical process that produces a mathematical function (regression equation) that relates a dependent variable to independent variable.

Scattergraph: A plot of individual measurements of different values used to evaluate whether metered data adheres to hydraulic theory and forms expected hydraulic patterns. For this project, scattergraphs show either flow velocity vs. water depths for a flow monitor or the depth and intensity of rainfall required to generate overflows according to available data.

Sediment: Particulate material deposited at the bottom of a conduit or natural waterway.

Tributary: The area that contributes flow to a point in the sewer system.

Typical Year Rainfall or Typical Year: The performance objectives of MWRA's approved Long-Term CSO Control Plan include annual frequency and volume of CSO discharge at each outfall based on "Typical Year" rainfall from 40 years of rainfall records at Logan Airport, 1949-1987 plus 1992.
The Typical Year was a specifically constructed rainfall series that was based primarily on a single year (1992) that was close to the 40-year average in total rainfall and distribution of rainfall events of different sizes. The rainfall series was adjusted by adding and subtracting certain storms to make the series closer to the actual averages in annual precipitation, number of storms within different ranges of depth and storm intensities. The development of the Typical Year is described in MWRA's System Master Plan Baseline Assessment, June 15, 1994. The Typical Year consists of 93 storms with a total precipitation of 46.8 inches.

Ultrasonic Sensors (Du): A device used to measure depth of water by the use of ultrasonic waves, determined by the travel time between the emission and reception of the wave reflected back from the target.

Weir: A wall or plate placed perpendicular or parallel to the flow. The depth of flow over the weir can be used to quantify the flow rate through a calculation or use of a chart or conversion table.

1. Introduction

1.1 Purpose and Scope of the CSO Performance Assessment

On November 8, 2017, the Massachusetts Water Resources Authority (MWRA) commenced a multi-year study to measure the performance of its $911 million long-term combined sewer overflow ("CSO") control plan (the "Long-Term Control Plan" or "LTCP"). The CSO performance assessment is intended to comply with the last scheduled milestone in the nearly 35-year-old Federal District Court Order in the Boston Harbor Case (U.S. v. M.D.C., et al, No. 85-0489 MA).

MWRA has addressed 183 CSO-related court scheduled milestones, including completion of the thirty-five (35) wastewater system projects that comprise the LTCP by December 2015 and commencement of the CSO performance assessment by January 2018 (which, as noted above, MWRA met in November 2017). The last court milestone requires MWRA to submit by December 2021[1] the results of its performance assessment to the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP) demonstrating whether it has achieved the levels of CSO control specified in the LTCP. MWRA's obligations for CSO control under the Court Order are defined in the March 15, 2006, *Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control*, as amended on April 30, 2008 (the "Second Stipulation"). For more information about MWRA's federal court obligations for CSO control, see Section 1.3.5 in Semiannual CSO Discharge Report No. 2, May 3, 2019, at: http://www.mwra.com/cso/pcmpa-reports/2_050319_MWRA_w_appendices.pdf.

MWRA's CSO performance assessment includes the following key scope elements:

- Inspections at all CSO regulators addressed in the LTCP to confirm closed or active status and to confirm or update the physical and hydraulic conditions of the CSO regulators and outfalls that remain active
- Collection of extensive rainfall data and overflow related data (field measurements) at remaining CSO regulators
- Upgrade and improvement of the calibration of MWRA's hydraulic model of the wastewater system using the inspection information and overflow data
- Assessment of system performance for CSO control, and the consideration of performance improvements
- Assessment of the water quality impacts of remaining CSOs and compliance with Massachusetts Water Quality Standards

1.2 Semiannual Progress Reports

This Semiannual CSO Discharge Report No. 3 is the third of a series of interim reports MWRA plans to issue on the progress of the performance assessment (see Table 1-1 on the following page). This third report addresses the data collection period from January 1, 2019 through June 30, 2019. It follows on Semiannual CSO Discharge Report No. 1, which MWRA issued on November 30, 2018, and Semiannual CSO Discharge Report No. 2, which MWRA issued on May 3, 2019. Semiannual reports can be found on MWRA's website (http://www.mwra.com/) at http://www.mwra.com/cso/pcmapa.html. This Semiannual Report No. 3 includes the following:

[1] On July 19, 2019, Federal District Court Judge Richard G. Stearns issued an order extending the milestone for submission of the final report by one year, from December 31, 2020 to December 31, 2021. MWRA had requested the extension to provide the time necessary to perform receiving water quality modeling for the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River.

- Rainfall data collection and analyses for the period January 1, 2019 through June 30, 2019, and comparison to the Typical Year (Section 2)
- CSO metering program, data collection and review, and quantification of measured CSO discharges for the period January 1, 2019 through June 30, 2019 (Section 3)
- Hydraulic model updates and calibration (Section 4)
- Investigations into overflow activity at select locations (Section 5)
- Progress developing the receiving water quality models for the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River (Section 6)
- Activities underway toward issuance of the fourth semiannual progress report in April 2020 (Section 7)

Table 1-1. Semiannual CSO Discharge Reports

Report #	Data Collection Period	Schedule
1	April 15, 2018 through June 30, 2018 (2.5 months)	November 30, 2018
2	July 1, 2018 through December 31, 2018 (6 months)	May 3, 2019
3	January 1, 2019 through June 30, 2019 (6 months)	October 31, 2019
4	July 1, 2019 through December 31, 2019 (6 months)	April 30, 2020
5	January 1, 2020 through June 30, 2020 (6 months)	October 31, 2020
6	July 1, 2020 through December 31, 2020 (6 months)	April 30, 2021
7	January 1, 2021 through June 30, 2021 (6 months)	October 31, 2021

1.3 Progress of CSO Post-Construction Monitoring and Performance Assessment

MWRA has continued to make substantial progress with the performance assessment. This third semiannual progress report documents data collection and analyses and CSO discharge estimates for the period January 1, 2019 through June 30, 2019, and other related work activities since issuance of the second semiannual report in April 2019.

Data Collection and Analyses

MWRA has continued to collect and analyze rainfall data at the 20 gauges within the MWRA wastewater service area it has utilized for the CSO performance assessment since the beginning of the data collection efforts in April 2018. Most of these gauges are located in or near areas served by combined sewers. The rainfall data are analyzed to determine the rainfall characteristics of each storm in the collection period, including storm duration, total volume/depth of rain, average rainfall intensity, peak rainfall intensities and storm recurrence interval (e.g., 3-month storm, 1-year storm, etc.). The rainfall characteristics support a comparison of the collection period storms to the Typical Year (see Section 2.2) and the validation of measured CSO discharges (see Section 3.1 and Appendix D). The rainfall data also support ongoing improved calibration of MWRA's hydraulic model (see Section 4.2) and will be input to the calibrated model to produce storm-by-storm model-predicted CSO discharges.

MWRA continued to employ CSO metering technology at 57 potentially active CSO regulators through February 2019. With a determination that it had collected sufficient data since April 2018 to characterize CSO discharges and improve the calibration of the hydraulic model, MWRA took temporary meters out of service at 21 of the 57 CSO regulators on March 1, 2019 (see Section 3.3). Temporary meters will remain in place and operational until June 30, 2020 at the other 36 CSO regulators, along with permanent meters at CSO treatment facilities and in MWRA's interceptor system and temporary or permanent CSO meters maintained by the CSO communities. Some of the 36 temporary meters that will remain in place support ongoing site-specific investigations and the evaluation of potential system modifications that may improve CSO performance (Section 5). Temporary meters will remain in place at all CSO regulators associated with outfalls along the Charles River, the Alewife Brook and the Upper Mystic River to support CSO variance related water quality assessments (see Section 1.5 and Section 6). Section 3 presents a summary of the metering program and the meter results for the period January 1, 2019 through June 30, 2019.

Hydraulic Model Upgrade and Improved Calibration

In developing the LTCP beginning in 1992, MWRA's hydraulic model was used to evaluate CSO control alternatives and gain regulatory and court approvals for the LTCP, including the Typical Year long-term levels of CSO control. MWRA has since used the model to track progress toward attainment of the LTCP levels of control - during the time the LTCP projects were completed and in the ongoing CSO performance assessment as the MWRA identifies and attempts to remediate system conditions that may compromise LTCP compliance. Since early 2019, MWRA has been performing upgrades to and improved calibration of the model using the extensive inspection and overflow meter data it collected in 2018 (See Section 4).

MWRA expects to complete and verify the calibration over the next several weeks. MWRA will then use the model to predict system performance and CSO discharges in all storms during the metering period April 15, 2018 through June 30, 2019, and MWRA will continue to use the model to simulate storms in the forthcoming semiannual reporting periods. MWRA will utilize the improved model to assess the hydraulic performance of the sewer system, compare current levels of control to the LTCP targets, and assess the benefits of additional system modifications where necessary to attain compliance. Ultimately, the hydraulic model is the necessary tool to verify attainment of the LTCP Typical Year levels of control in compliance with the December 2021 court milestone.

Development of Plans for Receiving Water Quality Modeling and Water Quality Sampling

MWRA reached agreement with EPA and DEP to add receiving water quality modeling to the CSO performance assessment to assess the water quality impacts and compliance with Water Quality Standards of remaining CSO discharges to the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River. A formal agreement on the scope of work MWRA will undertake for receiving water model development and associated water quality sampling was entered in Federal District Court along with the motion to extend the court milestone for submission of the final CSO performance assessment report from December 31, 2020 to December 31, 2021. As noted above, the Court accepted the motion, along with the scope of work, on July 19, 2019. Section 6 of this report describes the work plans for water quality modeling and associated sampling.

Site-Specific Overflow Activity Investigations

Overflow data collected in the storms since April 15, 2018, showed relatively high CSO activity at most regulators and outfalls. Calendar year 2018 was a wet year, with a greater number of storms, greater rainfall volume and greater number of storms with high peak intensity. MWRA is investigating the contribution of rainfall to the higher CSO activity, and is also investigating whether site-specific conditions at certain regulators contributed to the higher activity and may be amenable to adjustment that can improve system performance. MWRA has been conducting the investigations in coordination with the CSO communities in part to validate the metering installations and measured CSOs and identify site-specific overflow factors (see Section 5).

In summary, the main tasks MWRA has continued, completed or commenced since issuing the second semiannual report in April 2019 include:

- Continued collection and analysis of rainfall and meter data, and quantification and validation of measured CSO discharges;
- Updated the hydraulic model to reflect system inspections and updated information from the CSO communities;
- Improved calibration of the hydraulic model using data collected in 2018;

- Continued regular coordination with BWSC, Cambridge, Chelsea and Somerville on the CSO measurements, system performance evaluations and improvements, and the CSO communities' maintenance and system improvement plans that may affect system performance and CSO discharges; and
- Prepared plans, collected and analyzed stormwater and CSO samples for the development and use of receiving water quality models to assess the impacts of remaining CSO discharges to the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River.

1.4 LTCP Levels of CSO Control

The long-term levels of CSO control recommended by MWRA in the LTCP, approved by EPA and DEP, and accepted by the Court are included in Exhibit B to the Second Stipulation and presented in Table 1-2, below. Table 1-3 on page 7 presents the LTCP levels of control on a receiving water segment basis, along with the LTCP projects and costs that contribute to meeting the level of control for each water segment. The 35 LTCP projects were completed and brought into beneficial service in the period 2006 through 2015 in compliance with court schedule design and construction milestones for each project. Information describing each of the LTCP projects, along with cost and schedule, was presented in the first and second semiannual progress reports, which are posted to MWRA's website at: http://www.mwra.com/cso/pcmapa.html.

Table 1-2. LTCP Levels of Control from Exhibit B to the Second Stipulation (1 of 3)

CSO OUTFALL	LONG TERM CONTROL PLAN	
	TYPICAL YEAR	
	Activation Frequency	Volume (MG)
ALEWIFE BROOK		
CAM001	5	0.19
CAM002	4	0.69
MWR003	5	0.98
CAM004	To be closed	N/A
CAM400	To be closed	N/A
CAM401A	5	1.61
CAM401B	7	2.15
SOM001A	3	1.67
SOM001	Closed	N/A
SOM002A	Closed	N/A
SOM003	Closed	N/A
SOM004	Closed	N/A
TOTAL		**7.29**
UPPER MYSTIC RIVER		
SOM007A/MWR205A (Somerville Marginal)	3	3.48
SOM007	Closed	N/A
TOTAL		**3.48**
MYSTIC / CHELSEA CONFLUENCE		
MWR205 (Somerville Marginal)	39	60.58
BOS013	4	0.54
BOS014	0	0.00
BOS015	Closed	N/A
BOS017	1	0.02
CHE002	4	0.22
CHE003	3	0.04
CHE004	3	0.32
CHE008	0	0.00
TOTAL		**61.72**

Table 1-2. LTCP Levels of Control from Exhibit B to the Second Stipulation (2 of 3)

CSO OUTFALL	LONG TERM CONTROL PLAN	
	TYPICAL YEAR	
	Activation Frequency	Volume (MG)
UPPER INNER HARBOR		
BOS009	5	0.59
BOS010	4	0.72
BOS012	5	0.72
BOS019	2	0.58
BOS050	Closed	N/A
BOS052	Closed	N/A
BOS057	1	0.43
BOS058	Closed	N/A
BOS060	0	0.00
MWR203 (Prison Point)	17	243.00
TOTAL		**246.04**
LOWER INNER HARBOR		
BOS003	4	2.87
BOS004	5	1.84
BOS005	1	0.01
BOS006	4	0.24
BOS007	6	1.05
TOTAL		**6.01**
CONSTITUTION BEACH		
MWR207	Closed	N/A
TOTAL		**0.00**
FORT POINT CHANNEL		
BOS062	1	0.01
BOS064	0	0.00
BOS065	1	0.06
BOS068	0	0.00
BOS070		
BOS070/DBC	3	2.19
UPPS	17	71.37
BOS070/RCC	2	0.26
BOS072	0	0.00
BOS073	0	0.00
TOTAL		**73.89**
RESERVED CHANNEL		
BOS076	3	0.91
BOS078	3	0.28
BOS079	1	0.04
BOS080	3	0.25
TOTAL		**1.48**

Table 1-2. LTCP Levels of Control from Exhibit B to the Second Stipulation (3 of 3)

CSO OUTFALL	LONG TERM CONTROL PLAN	
	TYPICAL YEAR	
	Activation Frequency	Volume (MG)
NORTHERN DORCHESTER BAY		
BOS081	0 / 25 year	N/A
BOS082	0 / 25 year	N/A
BOS083	0 / 25 year	N/A
BOS084	0 / 25 year	N/A
BOS085	0 / 25 year	N/A
BOS086	0 / 25 year	N/A
BOS087	0 / 25 year	N/A
TOTAL		**0.00**
SOUTHERN DORCHESTER BAY		
BOS088	To be closed	N/A
BOS089 (Fox Point)	To be closed	N/A
BOS090 (Commercial Point)	To be closed	N/A
TOTAL		**0.00**
UPPER CHARLES		
BOS032	Closed	N/A
BOS033	Closed	N/A
CAM005	3	0.84
CAM007	1	0.03
CAM009	2	0.01
CAM011	0	0.00
TOTAL		**0.88**
LOWER CHARLES		
BOS028	Closed	N/A
BOS042	Closed	N/A
BOS049	To be closed	N/A
CAM017	1	0.45
MWR010	0	0.00
MWR018	0	0.00
MWR019	0	0.00
MWR020	0	0.00
MWR021	Closed	N/A
MWR022	Closed	N/A
MWR201 (Cottage Farm)	2	6.30
MWR023	2	0.13
SOM010	Closed	N/A
TOTAL		**6.88**
NEPONSET RIVER		
BOS093	Closed	N/A
BOS095	Closed	N/A
TOTAL		**0.00**
BACK BAY FENS		
BOS046	2	5.38
TOTAL		**5.38**

Table 1-3. LTCP Levels of Control by Receiving Water and Related Projects and Cost

Receiving Water	LTCP Levels of Control (Typical Year Rainfall) Activations	Volume (million gallons)	LTCP Projects*	Capital Cost* ($ millions)
Alewife Brook/Upper Mystic River	7 untreated and 3 treated at Somerville Marginal	7.3 3.5	• Cambridge/Alewife Sewer Separation • MWR003 Gate and Rindge Siphon Relief • Interceptor Connections/Floatables • Connection/Floatables at Outfall SOM01A • Somerville Baffle Manhole Separation • Cambridge Floatables Control (portion)	110.0
Mystic River/Chelsea Creek Confluence and Chelsea Creek	4 untreated and 39 treated at Somerville Marginal	1.1 57.1	• Somerville Marginal CSO Facility Upgrade • Hydraulic Relief at BOS017 • BOS019 Storage Conduit • Chelsea Trunk Sewer Replacement • Chelsea Branch Sewer Relief • CHE008 Outfall Repairs • East Boston Branch Sewer Relief (portion)	92.0
Charles River (including Stony Brook and Back Bay Fens)	3 untreated and 2 treated at Cottage Farm	6.8 6.3	• Cottage Farm CSO Facility Upgrade • Stony Brook Sewer Separation • Hydraulic Relief at CAM005 • Cottage Farm Brookline Connection and Inflow Controls • Brookline Sewer Separation • Bulfinch Triangle Sewer Separation • MWRA Outfall Closings and Floatables Control • Cambridge Floatables Control (portion)	88.9
Inner Harbor	6 untreated and 17 treated at Prison Point	9.1 243.0	• Prison Point CSO Facility Upgrade • Prison Point Optimization • East Boston Branch Sewer Relief (portion)	47.5
Fort Point Channel	3 untreated and 17 treated at Union Park	2.5 71.4	• Union Park Treatment Facility • BOS072-073 Sewer Separation and System Optimization • BWSC Floatables Control • Lower Dorchester Brook Sewer Modifications	62.0
Constitution Beach	Eliminate		• Constitution Beach Sewer Separation	3.7
North Dorchester Bay	Eliminate		• N. Dorchester Bay Storage Tunnel and Related Facilities • Pleasure Bay Storm Drain Improvements • Morrissey Blvd Storm Drain	253.7
Reserved Channel	3 untreated	1.5	• Reserved Channel Sewer Separation	70.5
South Dorchester Bay	Eliminate		• Fox Point CSO Facility Upgrade (interim improvement) • Commercial Pt. CSO Facility Upgrade (interim improvement) • South Dorchester Bay Sewer Separation	126.6
Neponset River	Eliminate		• Neponset River Sewer Separation	2.4
Regional			• Planning, Technical Support and Land Acquisition	53.7
TOTAL **Treated**		**410** **381**		**911.0**

*Floatables controls at remaining outfalls are included in the listed projects and capital budgets.

Performance Tracking

MWRA has conducted annual CSO performance assessments and CSO discharge tracking for nearly two decades. These efforts have included:

- Annual collection and review of facility operating records, meter data and other system performance indicators
- Updates to the MWRA collection system hydraulic model with new information about system conditions
- Estimation, using model predictions and facility records, of CSO activations and discharge volume at all active outfalls during the previous calendar year
- Updated simulation of CSO discharges from Typical Year rainfall

MWRA has conducted these annual data reviews, updates, and discharge estimates to satisfy reporting requirements in the MWRA and CSO community NPDES permits and in the conditions of the CSO variances for the Charles River and Alewife Brook/Upper Mystic River. These annual updates and assessments, submitted to EPA and DEP by April 30 each year (for the previous calendar year), have also allowed MWRA to measure, track and understand system performance as it continued to implement the LTCP projects.

MWRA incorporates completed sewer system improvements, such as completed CSO projects, significant system or operational changes, and other new information about system conditions into the model. Modeled operations of MWRA facilities, such as pumping stations and CSO treatment facilities, are updated to reflect current operating protocols. While Typical Year simulations employ confirmed and updated standard operating procedures, these standard procedures are adjusted to reflect actual operating conditions from facility records when the model is used to simulate individual storms. Meter data and other system performance indicators are used to compare measured conditions to model results for selected storms, allowing MWRA to evaluate model accuracy.

In addition to modeling all of the actual rainfall events for the previous calendar year, MWRA also models the Typical Year rainfall with end-of-year updated system conditions for each annual report. This has allowed MWRA to compare updated system performance against the levels of control in the LTCP and to track progress toward the CSO control goals, which are based on Typical Year rainfall. To be able to understand and explain the estimated discharges for each calendar year, which can vary greatly from Typical Year predictions, MWRA performs a detailed review and comparison of the characteristics of the year's actual storms to the characteristics of the storms in the Typical Year.

For the storms of 2018, the data MWRA collected from its extensive metering program indicated that the MWRA hydraulic model was in need of improved calibration (Section 4). The calibration and verification effort, which MWRA expects to complete over the next several weeks, will improve CSO discharge predictions compared to past model results and bring model-predicted CSO discharges and metered discharge estimates closer together.

1.5 Massachusetts Water Quality Standards and CSO Variances

In 1998, EPA and DEP issued their approvals of MWRA's 1997 recommended CSO control plan. Along with these approvals, DEP issued water quality standards determinations for all CSO-affected receiving water segments. This brought the plan's approved levels of CSO control into compliance with Massachusetts Water Quality Standards. DEP's water quality standards determinations are shown in Table 1-4 on the following page, along with the associated required levels of CSO control.

MWRA's Long-Term Control Plan, a 2006 approved update to the 1997 plan, has eliminated or "effectively eliminated" (i.e., 25-year storm level of control at South Boston beaches) CSO discharges to the waters for which DEP maintained the classification of Class B or Class SB, where CSO discharges are prohibited primarily to protect beaches and shellfish beds. Class B waters are inland waters designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Class SB waters are coastal and marine waters designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary recreation. The Class B or SB standard indicates that the water is "fishable and swimmable."

For the fresh water segment that DEP designated Class B (Neponset River) and the marine water segments designated Class SB, MWRA confirmed through its CSO performance assessment inspections in 2018 that all CSO regulators other than those tributary to the South Boston beaches are permanently closed, and, therefore, CSO discharges to these Class B and Class SB waters have been eliminated. The South Boston CSO Storage Tunnel captures overflows from all regulators tributary to the South Boston beaches. The ongoing CSO performance assessment will include an evaluation of the tunnel's performance in the many storms since start-up in May 2011 and will verify whether the tunnel is performing as intended for CSO and separate stormwater control and can provide total CSO capture up to and including the 25-year storm.

Table 1-4. Water Quality Standards and Required Levels of CSO Control

Water Quality Standard Classification	Receiving Water Segment	Required Level of CSO Control	CSO Control Status
Class B	Neponset River	CSO prohibited (25-year storm control for the South Boston beaches)	South Boston (North Dorchester Bay) storage tunnel captures CSO up to 25-year storm. All CSO outfalls to the other sensitive waters are now permanently closed.
Class SB	North Dorchester Bay South Dorchester Bay Constitution Beach		
Class B(cso)	Back Bay Fens	>95% compliance with Class B or SB ("fishable/swimmable") Must meet level of control for CSO activation and frequency in the approved Long-Term Control Plan (LTCP)	All LTCP projects are complete, and CSO discharges are greatly reduced. Ongoing performance assessment is intended to verify whether LTCP levels of control are attained.
Class SB(cso)	Mystic/Chelsea Rivers Confluence Boston Inner Harbor Fort Point Channel Reserved Channel		
Class B (CSO Variance)	Alewife Brook Upper Mystic River Charles River	Class B standards sustained with temporary authorizations for CSO discharges as the LTCP is implemented and verified (1998-2020)	All LTCP projects are complete, and CSO discharges are greatly reduced. Ongoing performance assessment is intended to verify whether LTCP levels of control are attained and to support long-term WQS designations.

For the water segments DEP designated B(cso) or SB(cso), CSO discharges must meet Class B or SB standards (i.e., no CSO impact) at least 95% of the time, or meet a higher level of compliance in accordance with the levels of CSO control in the approved LTCP. For waters designated Class B(cso) or SB(cso) in Table 1-4, compliance with water quality standards will be demonstrated by verifying attainment of the LTCP levels of CSO control (i.e., Typical Year activation frequency and volume).

DEP did not change the Class B designations for the Charles River and the Alewife Brook/Upper Mystic River, but instead issued variances to Class B water quality standards for CSO. Since 1998, DEP has issued a series of multiple-year CSO variances. Each variance extension acknowledged that it was not feasible to attain the Class B bacteria criteria and associated recreational uses for these receiving waters within the variance period. The variances apply only to the permitted CSO outfalls to these receiving waters and do not otherwise modify Class B water quality standards. The variances allow MWRA and the

CSO communities to continue to discharge limited levels of CSO to these waters. The variances include conditions intended to ensure progress on CSO control and mitigation of water quality impairments. Specifically, the variances include detailed requirements in the following categories: levels of control, receiving water quality modeling, performance assessment, public notification of CSO discharges, other actions to minimize CSOs and their impacts, and updated CSO control planning.

On August 30, 2019, DEP issued Final Determinations for CSO variances for Lower Charles River/Charles Basin and Alewife Brook/Upper Mystic River for a five-year period through August 31, 2024. DEP issued the two variances, one for the Lower Charles River/Charles Basin to CSO permittees MWRA and the City of Cambridge, and a second for the Alewife Brook/Upper Mystic River to CSO permittees MWRA and the City of Somerville. The Final Determinations, including conditions, as well as related fact sheets, are posted to DEP's website at: https://www.mass.gov/guides/sanitary-sewer-systems-combined-sewer-overflows#-2019-charles-river-basin-and-alewife/upper-mystic-river-final-combined-sewer-overflow-variances-.

For the variance waters, in addition to verifying whether the LTCP levels of CSO control are attained, the variances require MWRA to conduct water quality monitoring and receiving water quality modeling, described in Section 6 of this report. With the receiving water models for the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River, MWRA will assess the impacts of remaining CSO discharges and the level of compliance with water quality standards. These assessments are intended to support eventual use attainability analyses, water quality standards reviews and designations, and associated CSO determinations for these waters by the regulatory agencies.

2. Rainfall and Rainfall Analyses

Rainfall is a driving factor in the analysis of CSOs, as the occurrence of overflows within the MWRA sewer system is dependent on rainfall intensity and/or depth. This section presents the rainfall data measured during the period of January 1 through June 30, 2019. It also describes the analysis of the rainfall data used to characterize the return period of each storm event and a comparison of measured rainfall for this period to the rainfall included in the Typical Year.

2.1 Rainfall Data Collection & Processing

Rainfall has been quantified for this analysis using 15-minute rainfall data collected at 20 rain gauges distributed over the MWRA system. Rain gauges are listed in Table 2-1, and the locations are shown in Figure 2-1.

Table 2-1. Rain Gauges

Gauge Code	Name	Owner
BO-DI-1	Ward St.	MWRA
BO-DI-2	Columbus Park	MWRA
BWSC001	Union Park Pump Sta.	BWSC
BWSC002	Roslindale	BWSC
BWSC003	Dorchester Adams St.	BWSC
BWSC004	Allston	BWSC
BWSC007	Charlestown	BWSC
EB	East Boston	BWSC
BWSC008	Longwood Medical	BWSC
HP	Hyde Park	BWSC

Gauge Code	Name	Owner
DT	Dorchester -Talbot	BWSC
Rox	Roxbury	BWSC
CH-BO-1	Chelsea Creek	MWRA
FRESH_POND	USGS Fresh Pond	USGS
HF-1C	Hanscom AFB	MWRA
RG-WF-1	Hayes Pump Sta.	MWRA
SOM	Somerville Remote	MWRA
Lex	Lexington Farm	Project
SP	Spot Pond	Project
WF	Waltham Farm	Project

Quality assurance and quality control are provided by reviewing the data from nearby gauges, comparing total rainfall depth and rainfall intensity values for individual storm events by month. The shape of rainfall hyetographs is reviewed for irregularities. Rain gauges with significantly higher or lower total rainfall depths than other gauges, and unusual hyetograph shapes, are 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 2-2). Table 2-3 documents the rainfall data replaced and lists the reason for the replacement. The review of the data for this period showed that the winter weather in January, February and March impacted the quality of the data at some of the rain gauges especially when the temperature was below freezing. Rainfall data used for the analysis are provided in Appendix A.

Intensity-Duration-Frequency (IDF) analysis was used to characterize the return periods of the storm events in the January through June 2019 metering period. Storm recurrence intervals for 1-hour, 24-hour, and 48-hour durations were identified for each storm event based on the IDF analysis. Storm recurrence intervals were based on Technical Paper 40, Rainfall Frequency Atlas of the United States (TP-40), and Technical Paper 49, Two-To Ten-Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States (TP-49), with values extrapolated for the 3- and 6-month storms.

Additional information on the methodologies for rainfall data collection and processing can be found in Semiannual Reports No. 1 and No. 2. Semiannual reports can be found on MWRA's website (http://www.mwra.com/) at http://www.mwra.com/cso/pcmapa.html.

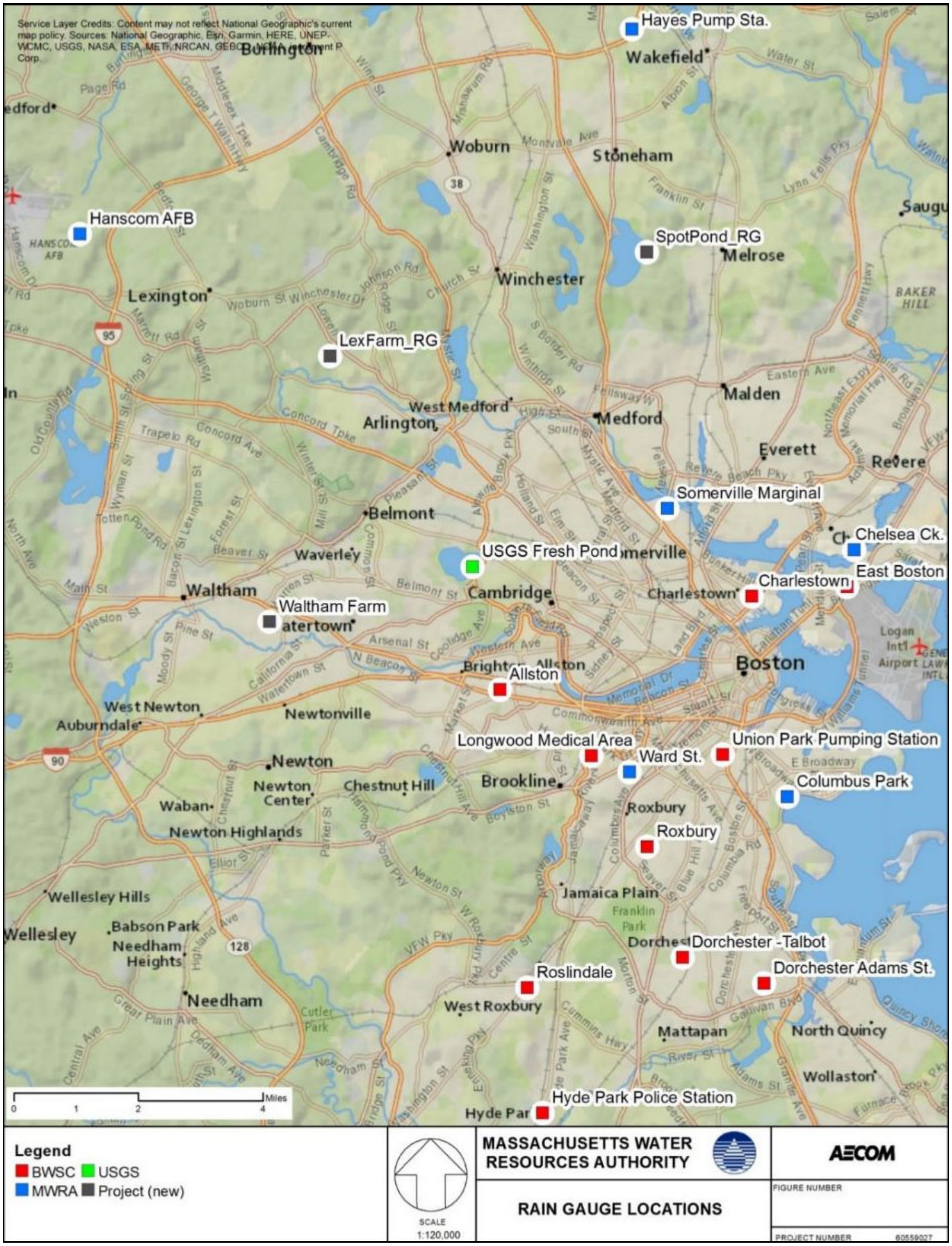


Figure 2-1. Rain Gauge Location Plan

Table 2-2. 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 St.	BO-DI-1	BWSC008	0.66	Roxbury	1.23
Columbus Park	BO-DI-2	BWSC001	1.24	Roxbury	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	Roxbury	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	Roxbury	1.86
Charlestown	BWSC007	East Boston	1.53	CH-BO-1	1.80
Longwood Medical Area	BWSC008	BO-DI-1	0.67	Roxbury	1.71
Chelsea Ck.	CH-BO-1	East Boston	0.60	BWSC007	1.80
East Boston	East Boston	CH-BO-1	0.60	BWSC007	1.53
USGS Fresh Pond	FRESH_POND	BWSC004	2.21	Somerville	3.26
Hanscom AFB	HF-1C	LexFarm_RG	4.47	WALTHAM	6.92
LexFarm_RG	LexFarm_RG	FRESH_POND	4.08	WALTHAM	4.37
Hayes Pump Sta.	RG-WF-1	SpotPond_RG	3.58	LexFarm_RG	7.13
Roxbury	Roxbury	BO-DI-1	1.23	BWSC008	1.71
Somerville Marginal	Somerville	BWSC007	1.95	CH-BO-1	3.07
SpotPond_RG	SpotPond_RG	Somerville	4.12	LexFarm_RG	5.34
Waltham Farm	WALTHAM	FRESH_POND	3.37	BWSC004	3.86

Table 2-3. Summary of Rainfall Data Replacement

Rain Gauge	Replacement Data Start Time	Replacement Data End Time	Replacement Rain Gauge	Reason for Data Replacement
Allston	January 1, 2019 0:00	January 1, 2019 12:00	Longwood Medical	No data available
	January 5, 2019 0:00	March 11, 2019 0:00	USGS	
	March 11, 2019 0:15	June 30, 2019 23:45	Longwood Medical	
Ward St. (BO-DI-1)	January 25, 2019 9:15	January 25, 2019 10:00	CH-BO-1	Low confidence in data based on neighboring rain gauges
Columbus Park (BO-DI-2)	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
Charlestown	January 5, 2019 0:00	March 11, 2019 0:00	CH-BO-1	Low confidence in data due to winter conditions
Chelsea Ck. (CH-BO-1)	January 25, 2019 8:00	January 25, 2019 9:00	BO-DI-1	Low confidence in data based on neighboring rain gauges
	April 5, 2019 18:00	April 7, 2019 15:00	East Boston	Low confidence in data based on neighboring rain gauges
	April 15, 2019 11:30	April 15, 2019 12:15	East Boston	Low confidence in data based on neighboring rain gauges
Dorchester Adams	January 1, 2019 0:00	January 1, 2019 12:00	Roxbury	No data available
	January 1, 2019 12:15	March 11, 2019 0:00	BO-DI-1	
	March 11, 2019 0:15	April 30, 2019 23:45	Roxbury	
	May 1, 2019 0:00	June 30, 2019 23:45	Roslindale	

Table 2-3. Summary of Rainfall Data Replacement (Continued)

Rain Gauge	Replacement Data Start Time	Replacement Data End Time	Replacement Rain Gauge	Reason for Data Replacement
Dorchester Talbot	January 1, 2019 0:00	January 1, 2019 12:00	Roxbury	No data available
	January 1, 2019 12:15	March 11, 2019 0:00	BO-DI-1	
	March 11, 2019 0:15	April 30, 2019 23:45	Roxbury	
	May 1, 2019 0:00	June 30, 2019 23:45	Roslindale	
East Boston	January 5, 2019 0:00	March 11, 2019 0:00	CH-BO-1	Low confidence in data due to winter conditions
Hanscom AFB (HF-1C)	January 1, 2019 12:15	January 4, 2019 23:45	Lexington Farm	Irregularities in metering data
	January 5, 2019 0:00	March 11, 2019 0:00	USGS	
	March 11, 2019 0:15	April 10, 2019 17:45	Lexington Farm	
	April 10, 2019 18:00	April 30, 2019 23:45	Waltham Farm	
	May 1, 2019 0:00	June 30, 2019 23:45	Lexington Farm	
Hyde Park	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
	June 20, 2019 0:00	June 26, 2019 0:00	Roslindale	No data available
Lexington Farm	January 5, 2019 0:00	March 11, 2019 0:00	USGS	Low confidence in data due to winter conditions
	April 19, 2019 18:00	April 30, 2019 23:45	USGS	Low confidence in data based on neighboring rain gauges
Longwood	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
Hayes Pump Sta. (RG-WF-1)	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
Roslindale	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
Roxbury	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
	May 1, 2019 0:00	May 31, 2019 23:45	BO-DI-1	No data available
Somerville	January 1, 2019 0:00	January 1, 2019 12:00	Charlestown	No data available
	January 1, 2019 12:15	March 11, 2019 0:00	CH-BO-1	
	March 11, 2019 0:15	April 12, 2019 15:00	Charlestown	
Spot Pond	January 5, 2019 0:00	March 11, 2019 0:00	CH-BO-1	Low confidence in data due to winter conditions
	April 14, 2019 18:00	April 23, 2019 18:00	Somerville	Low confidence in data based on neighboring rain gauges
	June 20, 2019 0:00	June 22, 2019 0:00	Somerville	Low confidence in data based on neighboring rain gauges
Union Park Pump Station	January 5, 2019 0:00	March 11, 2019 0:00	BO-DI-1	Low confidence in data due to winter conditions
	June 27, 2019 10:15	June 27, 2019 10:30	BO-DI-2	Low confidence in data based on neighboring rain gauges
Waltham Farm	January 5, 2019 0:00	March 11, 2019 0:00	USGS	Low confidence in data due to winter conditions

2.2 Monitored Storms and Comparison of Storms to Typical Year Storms

For the period of January 1 to June 30, 2019, 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. The storm recurrence intervals were assigned values of <3 months, 3 months, 3-6 months, 6 months, 1 year, or the nearest year, based on comparison to the IDF values from TP-40/TP-49. Table 2-4 presents the summary of storm events for Ward Street Headworks for the period January- June 2019. These data show that 62 storm events occurred in the 6-month period January- June 2019 at the Ward Street rain gauge. Each of the events had recurrence intervals of less than 3 months at both the 1-hour and 24-hour recurrence intervals with two exceptions: April 22, 2019 had a 24-hour recurrence interval of 1-2 years, and June 21, 2019 had a 1-hour recurrence interval of 3 to 6 months. Tables summarizing the storm events from January- June 2019 for the other rain gauges are provided in Appendix B.

Table 2-4. Summary of Storm Events at Ward Street Headworks Rain Gauge for January-June 2019

Event	Date & Start Time (2)	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.33	0.07	0.14	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 8:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
4	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
5	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
6	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
7	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
8	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
9	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
10	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
11	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
12	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
19	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
20	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 10:45	12.5	0.27	0.02	0.24	0.01	0.01	<3m	<3m	N/A
22	3/22/2019 0:00	28.25	0.87	0.03	0.24	0.03	0.02	<3m	<3m	N/A
23	3/29/2019 13:30	2.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.13	0.03	0.05	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:00	6.75	0.41	0.06	0.1	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	6.75	0.17	0.03	0.04	0.01	0.00	<3m	<3m	N/A
27	4/8/2019 3:00	10.5	0.41	0.04	0.14	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:30	1	0.06	0.06	0.06	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:00	10	0.4	0.04	0.1	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 21:30	17.75	0.93	0.05	0.65	0.04	0.02	3-6m	<3m	N/A
31	4/19/2019 23:15	26	0.27	0.01	0.12	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:30	17.75	2.66	0.15	0.36	0.11	0.06	<3m	1-2yr	N/A
33	4/23/2019 22:15	2.5	0.12	0.05	0.09	0.02	0.06	<3m	<3m	N/A
34	4/26/2019 6:45	27.75	1.66	0.06	0.48	0.07	0.03	<3m	<3m	N/A
35	4/28/2019 17:45	0.75	0.02	0.03	0.02	0.00	0.03	<3m	<3m	N/A

Table 2-4. Summary of Storm Events at Ward Street Headworks Rain Gauge for January-June 2019 (Continued)

Event	Date & Start Time (2)	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
36	4/30/2019 1:45	8	0.14	0.02	0.04	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 1:15	13	0.05	0.00	0.02	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:30	16.25	0.26	0.02	0.12	0.01	0.01	<3m	<3m	N/A
39	5/5/2019 4:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
40	5/7/2019 18:30	3.25	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
41	5/11/2019 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 7:00	13	0.49	0.04	0.08	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:30	16.75	0.98	0.06	0.31	0.04	0.03	<3m	<3m	N/A
44	5/16/2019 0:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:15	7.75	0.24	0.03	0.07	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:15	2	0.16	0.08	0.14	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:15	3	0.15	0.05	0.14	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 22:45	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:30	2.25	0.3	0.13	0.24	0.01	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	12	0.35	0.03	0.11	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:45	2.75	0.31	0.11	0.18	0.01	0.01	<3m	<3m	N/A
52	6/2/2019 22:15	2.75	0.08	0.03	0.05	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:30	0.5	0.04	0.08	0.04	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:45	11.5	0.88	0.08	0.24	0.04	0.02	<3m	<3m	N/A
55	6/13/2019 8:00	10	0.71	0.07	0.23	0.03	0.01	<3m	<3m	N/A
56	6/16/2019 10:00	9.25	0.09	0.01	0.03	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	3.5	0.1	0.03	0.07	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 5:45	6.5	0.34	0.05	0.26	0.01	0.01	<3m	<3m	N/A
59	6/21/2019 1:45	13.25	0.83	0.06	0.64	0.05	0.02	3-6m	<3m	N/A
60	6/25/2019 12:45	8	0.12	0.02	0.05	0.01	0.00	<3m	<3m	N/A
61	6/29/2019 4:30	11.5	0.74	0.06	0.36	0.03	0.02	<3m	<3m	N/A
62	6/30/2019 14:00	4.25	0.08	0.02	0.06	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

(2) Ward St. rainfall data was replaced with Chelsea Creek rainfall data from January 25, 2019 9:15 through January 25, 2019 10:00.

The characteristics of the rain events that occurred in the January 1 through June 30, 2019 monitoring period were compared to rainfall characteristics from the Typical Year to help interpret the measured CSO activations and volumes in comparison to Typical Year performance.

The total rainfall and number of storms at each rain gauge were identified for the period of January 1 through June 30, 2019, as well as the number of storms in ranges of rainfall depth. These values were then compared to the values from the Typical Year. Table 2-5 presents this comparison. The six-month monitoring period is half of the Typical Year period. As indicated in Table 2-5, during the first half of 2019, rain gauges measured an average of 62 storms with total rainfall volume of 22.5 inches, compared with 93 storms and 46.8 inches in the Typical Year. This indicates that the rainfall depth for the six-month monitoring period is approximately half of the Typical Year total rainfall depth, but the total number of storms is already approximately two-thirds of the total for the Typical Year. As indicated by Table 2-5, the monitoring period is tracking towards a greater number of storms with less than 0.5 inches of rainfall. The numbers of storms in the 0.5 to 1.0 inch and 1.0 to 2.0 inch ranges are on pace with the Typical Year, while the number of storms with greater than 2.0 inches of rainfall is tracking well below the Typical Year.

These observations suggest that more small-volume storms and fewer large-volume storms occurred during the monitoring period than in the Typical Year. CSO discharges in this period may be impacted by this difference in rainfall characteristics, since the reduction in the number of the larger (>2.0-inch) storms (one of the contributing factors producing the greatest CSO volumes) is less for this period.

Table 2-5: Frequency of Events within Selected Ranges of Total Rainfall for January-June, 2019

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
Typical Year	46.8	93	49	14	16	8	6
January-June 2019 Metering Data							
Average of 20 Rain Gauges							
Average	22.5	62	33	15	9	4	1
MWRA Rain Gauges							
Ward Street	24	62	31	15	12	3	1
Columbus Park	24.13	64	34	13	10	6	1
Chelsea Creek	24.21	67	40	15	4	7	1
HF-1C	20.3	60	30	19	8	2	1
RG-WF-1	21.69	59	29	19	5	6	0
BWSC Rain Gauges							
Allston	18.65	58	34	13	9	1	1
Charlestown	21.85	64	36	17	6	4	1
Dorchester – Adam	24.76	62	33	12	11	5	1
Dorchester-Talbot	24.76	62	33	12	11	5	1
Hyde Park	25.5	64	34	13	10	6	1
East Boston	23.77	63	36	16	4	5	2
Longwood	22.97	63	34	13	12	3	1
Roslindale	25.23	62	32	14	12	3	1
Roxbury	23.9	62	32	14	12	3	1
Union Park	23.43	62	32	14	11	4	1
USGS Rain Gauge							
Fresh Pond	17.61	58	35	11	10	1	1
Project Gauges							
Lexington Farm	19.24	58	30	19	9	1	1
Spot Pond	21.59	64	33	18	9	4	0
Somerville	21.43	61	33	15	8	5	0
Waltham Farm	20.3	59	33	14	8	3	1

Storms with greater than two inches of total rainfall at the Ward Street, Columbus Park, Chelsea Creek Headworks, and USGS Fresh Pond rain gauges were identified and compared to storms with greater than two inches of total rainfall in the Typical Year (Table 2-6). As noted above, experience has shown that large storms often account for a disproportionate volume of CSO. Table 2-6 indicates the April 22, 2019 storm as the only observed storm in the monitoring period with greater than two inches of rainfall. As indicated in Table 2-6, the one storm in the monitoring period with greater than 2.0 inches of rainfall had a shorter duration and higher average intensity than the six storms from the Typical Year with greater than 2.0 inches of rainfall. The peak intensity of the April 22, 2019 storm fell within the range of peak intensities from the six Typical Year storms.

Table 2-6. Com Comparison of Storms from January 1 through June 30, 2019 and Typical Year with Greater than Two Inches of Total Rainfall

Rain Gauge	Date	Duration (hr)	Total Rainfall (in)	Average Intensity (in/hr)	Peak Intensity (in/hr)	Storm Recurrence Interval (24-hr)
Typical Year	12/11/1992	50	3.89	0.08	0.2	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
January-June 2019 Metering Data						
Ward Street	4/22/2019	17.75	2.66	0.15	0.36	1-2yr
Columbus Park	4/22/2019	17	2.59	0.15	0.4	6m-1yr
Chelsea Creek	4/22/2019	18.75	2.63	0.14	0.44	6m-1yr
Fresh Pond	4/22/2019	18.5	2.15	0.12	0.47	3-6m

Storms with peak rainfall intensities greater than 0.40 in/hr at the Ward Street, Columbus Park, Chelsea Creek Headworks, and USGS Fresh Pond rain gauges were identified and compared to storms with greater than 0.40 in/hr of peak intensity in the Typical Year (Table 2-7). Storms with intensities greater than 0.40 in/hr are of importance because higher intensity storms have been found to produce more CSO activations and volumes than lower intensity storms. In the six-month monitoring period, three rain gauges measured three storms and one gauge measured five storms exceeding 0.4 inches per hour, while the Typical Year had nine storms with intensities greater than 0.4 in/hr. Thus, the six-month monitoring period is generally tracking under the Typical Year in terms of numbers of storms with intensities greater than 0.4 in/hr.

Table 2-7. Comparison of Storms with Peak Intensities Greater than 0.40 inches/hour from January 1 through June 30, 2019 versus the Full Typical Year

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
January-June 2019 Metering Data						
Ward Street Headworks (BO-DI-1)	4/14/2019	17.75	0.93	0.05	0.65	3-6m
	4/26/2019	27.75	1.66	0.06	0.48	<3m
	6/21/2019	13.25	0.83	0.06	0.64	3-6m
Columbus Park Headworks (BO-DI-2)	4/14/2019	17.5	0.77	0.04	0.54	3m
	4/22/2019	17	2.59	0.15	0.4	<3m
	6/21/2019	13	1.03	0.08	0.79	6m-1yr

Table 2-7. Comparison of Storms with Peak Intensities Greater than 0.40 inches/hour from January 1 through June 30, 2019 versus the Full Typical Year (Continued)

Rain Gauge	Date	Duration (hours)	Total Rainfall (inches)	Average Intensity (inch/hour)	Peak Intensity (inch/hour)	Storm Recurrence Interval (1-hour)
Chelsea Creek Headworks (CH-BO-1)	4/14/2019	16.75	0.78	0.05	0.55	3m
	4/22/2019	18.75	2.63	0.14	0.44	<3m
	4/26/2019	21.75	1.47	0.07	0.48	<3m
	6/20/2019	33.5	1.28	0.04	0.68	3-6m
	6/29/2019	11.5	1.82	0.16	1.67	7 yr
Fresh Pond (USGS)	4/15/2019	17.25	0.86	0.05	0.65	3-6m
	4/22/2019	18.5	2.15	0.12	0.47	<3m
	6/20/2019	33	1.02	0.03	0.44	<3m

For storms with peak rainfall intensities greater than 0.4 in/hr at Ward Street Headworks, Columbus Park Headworks, Chelsea Creek Headworks, and USGS Fresh Pond rain gauges, hyetographs were developed. These hyetographs show the 15-minute rainfall intensities and show 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 but where the peak occurs at the beginning of the storm. An example hyetograph is shown in Figure 2-2 with the remaining hyetographs in Appendix C.

In summary, comparisons of the six-month monitoring period to the Typical Year suggest that 2019 rainfall was tracking toward similar total rainfall to the Typical Year, but with more smaller-rainfall volume storms, and fewer high-rainfall volume and intensity storms than the Typical Year.

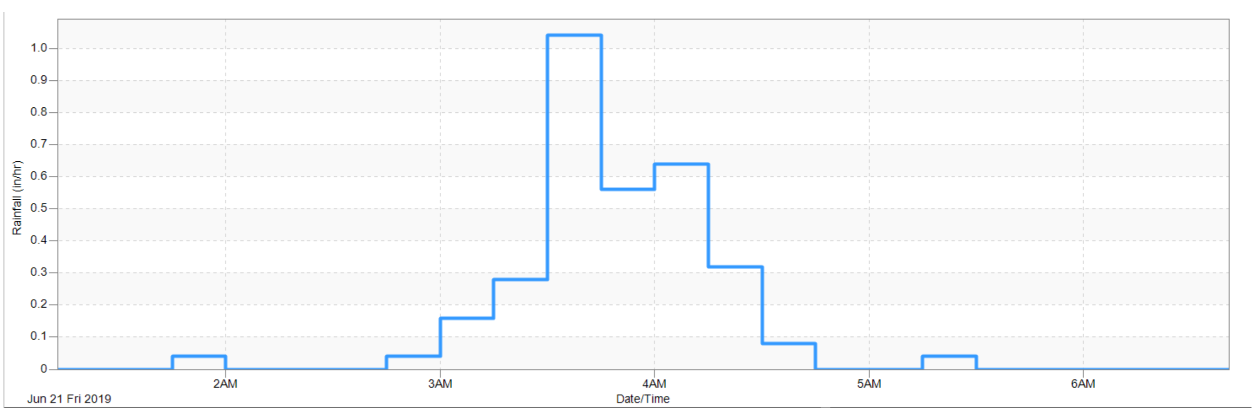


Figure 2-2. Hyetograph from the Ward Street Headworks Gauge for June 21, 2019

3. Metered CSO Discharge Review

Each CSO regulator was provided with a unique flow metering configuration designed to estimate CSO activations or confirm that the regulator was not active. Additional information on the CSO Metering Plan can be found in Section 3 of. Semiannual Report No. 2. The objective of this section is to review the accuracy and reasonableness of the measured CSO activations. Various methods were used to review CSO discharges, as described below.

3.1 Methods Used for Metered CSO Discharge Review

A variety of methods were used for the assessment of metered CSO discharges. Not all of the methods were applicable to each of the meter configurations, but the intent was to use available information to assess the accuracy and reasonableness of the measured CSO activations. Depending on the particular meter configuration, the review of meter data may have included the following methods:

- Direct measurement
- Comparison with other meters
- Analysis of influent meter scattergraphs of flow and depth to assess how well the influent meters conformed to hydraulic theory
- Comparison of influent meter volume with rainfall to assess how well the volumes correlated with rainfall
- Field inspection of level-only meter locations to check for evidence of CSO discharges
- Chalking of level-only meter locations to assess how well the meter depth compared with depth recorded by the chalk
- Correlation of CSO activation with rainfall depth and intensity using scattergraphs. Updated scattergraphs which include the activation and non-activation events from April 15, 2018 to June 30, 2019 are provided in Appendix D.
- Calculation of CSO discharge using alternate methods
- Evaluation of reasonableness of meter data

Additional information on each of these methods is discussed in Semiannual Report No. 2.

3.2 Methods Used for Calculation of CSO Discharge Volume

When the meter data indicated that an activation occurred, the CSO volume was calculated using various methods depending on the meter configuration.

In locations where depth and velocity sensors are installed, measurements were used to calculate flowrate and total volume of CSO activations. CSO flowrate was calculated by using one of three methods: Continuity, Continuity by subtraction, or a weir equation. The Continuity (Qc) method used the cross sectional area of the pipe in flow (estimated by depth measurement) multiplied by the velocity measurement to estimate the flow. The Continuity by subtraction (Qs) method used the flow difference from two separate pipes (i.e. influent and DWF connection) as calculated by depth measurement multiplied by the velocity measurement. The Weir (Qw) method used a depth measurement over a weir structure and an appropriate weir equation. In each case, CSO volume was computed by integrating CSO flowrate over time.

In locations where CSO flowrates and volumes could not be measured by depth/velocity sensors in the outfall, an attempt was made to estimate the overflow volume using other means such as Manning's Equation or the Scattergraph method. Table 3-1 identifies the locations where alternative CSO calculation methods to the continuity equation were applied. In locations where the continuity methods or alternative methods could not be used, the overflow was reported as duration only.

Table 3-1. Locations Using Alternative (Non-Continuity Equation) CSO Calculation Methods

Outfall	Regulator	Calculation Method
BOS014	RE014-2	Scattergraph Method
BOS09	RE09-2	Scattergraph Method
BOS010	RE010-2	Scattergraph Method
BOS057	RE057-6	Weir Equation
BOS060	RE060-7	Scattergraph Method
BOS004	RE04-6	Scattergraph Method

At some locations, volumes were not estimated. Volumes were not calculated using alternate means for a number of reasons:

- Use of the weir equation assumes a free discharge condition. Therefore, the presence of backwater from conditions such as high tide may prevent use of such methods.
- CSO volumes were not calculated at level-only sites.
- In some cases, CSO volumes were not provided because the meter data are under review.

The total CSO volume from the upstream BOS046/MWR023 regulators that can overflow to BSWC Stony Brook Conduit is proportioned between outfalls MWR023 and BOS046 for reporting purposes during periods when Boston Gatehouse No. 1 is open. However, Boston Gatehouse No. 1 was not reported to be opened during the January to June 2019 monitoring period, and any overflow from the upstream regulators would be reported as being conveyed to the MWR023 outfall. It should also be noted that the total volume indicated for outfall MWR023 would not include volume that may have discharged from upstream regulators that were level-only sites, where volumes could not be estimated based on available data. However, no overflows occurred during the January 1-June 30, 2019 monitoring period at level-only monitoring locations.

3.3 Evaluation of Metering Program

Meter configurations were intended to quantify the CSO activation frequency, duration, and volumes at most locations, as well as calibrate MWRA's hydraulic model. The project metering program has been continuously evaluated since its implementation on April 15, 2018. These evaluations included a review of meter data for quality and applicability to this performance assessment, a review of rainfall conditions for the period, and an assessment of whether sufficient data were available for model calibration. For calibration, the meter data and rainfall data collected from April 15, 2018 through December 31, 2018 were reviewed. Based on this review, the period was found to have many storms of various sizes and durations that resulted in CSO activations; thus, it was found that sufficient meter data had been collected for model calibration, and calibration meters were no longer needed.

3.3.1 Adjustment of Metering Program

Having collected sufficient data for model calibration, the metering program was revised to focus on flow monitoring at regulator locations within the Variance areas, as well as at regulators where system changes may be made. The Variance waters include the Charles River, Alewife Brook, and the Upper Mystic River. Based on this metering approach, the flow meters at 21 of the 57 locations were removed as of March 1, 2019. Table 3-2 presents the locations where meters were removed.

Table 3-2. Meters Removed from the Metering Program as of March 1, 2019

Outfall	Regulator
BOS013	RE013-1
BOS014	RE014-2
BOS017	RE017-3
BOS009	RE009-2
BOS010	RE010-2
BOS012	RE012-2
BOS003	RE003-2
BOS003	RE003-7
BOS004	RE004-6
BOS005	RE005-1
BOS062	RE062-4
BOS064	RE064-4
BOS064	RE064-5
BOS068	RE068-2 (1a)
BOS070/RCC	RE070/5-3
BOS076	RE076/4-2
BOS078	RE078-1
BOS078	RE078-2
BOS078	TG 78 at outfall for RE078-1 & RE078-2
BOS079	RE079-3
BOS080	RE080-2B

3.3.2 Metering Program Going Forward

Metering data are continuing to be collected and analyzed at regulators within the Variance areas, as well as at regulators where system changes may be made. These meters will continue to collect data to identify CSO activation frequency, duration, and volumes through June 2020.

3.4 Meter Review Results

Metering data were used to identify CSO activation frequency, duration, and volumes where applicable. Based on the evaluations of meter data supporting previous Semiannual Reports, suspect data were generally found to fall into one or more of the following categories.

- Level sensor activations
- Unreasonable data
- Inconsistent CSO volumes
- Questionable overflow elevations

Many of the issues previously identified have been resolved. As new data are obtained, these results may be revised. The metered CSO activation frequencies, durations, and volumes for the January 1 through June 30, 2019 monitoring period are presented below in Section 3.5.

3.4.1 Level Sensor Activations

Level sensor-only configurations were installed at locations where the hydraulic model predicted that no overflows would occur during either the typical year and/or the 2-year design storm. The data indicated that no overflows occurred during the January 1-June 30, 2019 monitoring period at level-only monitoring locations.

3.4.2 Unreasonable Data

Metering equipment can occasionally become fouled and produce unreasonable results or fail to record any data. Metering data were reviewed to assess reasonableness based on neighboring meters, storm characteristics, and system conditions. During the current monitoring period no significant meter fouling or unreasonable results were obtained, and no modifications to metering configurations were necessary.

3.4.3 Inconsistent CSO Volumes

The CSO volumes at some regulators including RE401A (CAM401A), RE011 (CAM001), RE021 (CAM002), and CAM017 were not able to be verified and were thus considered inconsistent.

CSO discharges to outfall CAM401A were anticipated to be estimated using a weir equation. However, a screening facility with brushes, as shown in Figure 3-1, makes a standard weir equation inapplicable. Additional investigation into estimating the CSO discharge volume using alternative weir equations provided by the City of Cambridge is ongoing.

Figure 3-1. Brushes at CAM401A

At outfalls CAM001 and CAM002, it was anticipated that the Cambridge meters on the outfall pipes could be used to quantify CSO discharge volumes. Confidence in the volumes estimated at these locations is low due to concerns with the quality of the meter data, and therefore these locations are being treated as level-only sites.

CAM017 is a complex site with three bending weirs and multiple meters, including an inclinometer. During previous monitoring periods it was observed that there were inconsistencies in the metering data and overflow volumes could not be estimated. A level sensor operated by the MWRA appears to produce reliable results and therefore this sensor was used to assess whether an overflow occurred. No CSO activations occurred during the January 1-June 30, 2019 monitoring period. This location will continue to be monitored and studied as prior monitoring periods demonstrated inconsistencies in CSO volumes.

3.4.4 Questionable Overflow Elevation

A key component of the data analysis is evaluating when the water level in the regulator exceeds the overflow elevation. These elevations were measured during the field inspections and were used to identify the “trigger” elevation with a corresponding “trigger” meter. Additional months of metering data and assessment of the regulators during calibration have refined trigger values. The use of scattergraphs, additional field measurements, and further investigations into meter configurations have improved the accuracy of many of these values. No questionable overflow elevations were identified for the current monitoring period.

3.5 Meter Results

A summary of the January 1- June 30, 2019 meter results is provided in Table 3-3. As discussed in the previous sections, metering in regulators is challenging. The turbulence present in a regulator structure can interfere with recorded measurements. In addition, regulators are inherently complicated structures and it is sometimes difficult in the field to identify the proper location to place the meter. There may be unanticipated activations, unreasonable data, inconsistent CSO volumes, and/or questionable overflow elevations.

MWRA and its consultant have been evaluating causes and impacts of inconsistencies between metered and modeled data. In our research, it was learned that The New York City Department of Environmental Protection conducted a multiple-year metering pilot program to identify favorable methodologies to quantify overflows. A Water Environment Research Foundation report dated May 2015 summarizes this work. The report concluded that differences between metered and modeled discharges are not always due to an incorrect model. Rather, when CSO discharges recorded by a meter are significantly different from model predictions, the modelers should compare CSO discharges against an independent data source. In some cases, this may be a field visit to confirm both the meter location and visual indications of an overflow. In other cases, it may be comparing metered flows against other measurements such as inclinometer readings (if the inclinometer indicates that the flap valve did not open then a CSO is unlikely to have occurred). Field work may also include investigations upstream to identify sources of inflow that were not anticipated, such as incorrectly connected roof or storm drains. MWRA and its consultant will continue to review the meter data received each month consistent with the approach described above.

Table 3-3. Summary of January 1 to June 30, 2019 Meter Results

Outfall	Regulator ID	Level Only	Meter Removed March 1, 2019	January 1-June 30, 2019		
				Activation Frequency	Total Duration (hrs)	Total Volume (MG)
Alewife Brook						
CAM001	RE-011	Y		0	0	N/A
CAM002	RE-021			1	0.17	N/A
MWR003	RE-031			0	0	0
CAM401A	RE-401			7	7.5	N/A
CAM401B	RE-401B			0	0	0
SOM001A	RE-01A			2	0.67	0.67
Upper Mystic River						
SOM007A/MWR205A		Y		5	6.51	4.67
Mystic/Chelsea Confluence						
MWR205 (Somerville Marginal Facility)				12	40.72	34.89
BOS013	RE013-1		Y	0	0	0
BOS014	RE014-2		Y	0	0	0
BOS017	RE017-3		Y	0	0	0
CHE003	RE-031	Y		0	0	0
CHE004	RE-041			9 (2)	12.27	0.29
CHE008	RE-081			8 (3)	8.5	0.87
Upper Inner Harbor						
BOS009	RE009-2		Y	1	1.58	0.06
BOS010	RE010-2		Y	0	0	0
BOS012	RE012-2		Y	0	0	0
BOS019	RE019-2	Y		2	4.94	N/A
BOS057	RE057-6			2	1	0.17
BOS060	RE060-7			2	1.33	0.32
	RE060-20			1	0.16	N/A
MWR203 (Prison Point)				7	32.23	118.26
Lower Inner Harbor						
BOS003	RE003-2		Y	0	0	0
	RE003-7		Y	0	0	0
	RE003-12			18 (15)	99.17	11.33
BOS004	RE004-6		Y	0	0	0
BOS005	RE005-1	Y	Y	0	0	0
Fort Point Channel						
BOS062	RE062-4		Y	0	0	0
BOS064	RE064-4		Y	0	0	0
	RE064-5	Y	Y	0	0	0
BOS065	RE065-2	Y		4	7.58	N/A
BOS068	RE068-1A	Y	Y	0	0	0
BOS070/DBC	RE070/8-3			3 (2)	1.92	0.33
	RE070/8-6	Y		0	0	0
	RE070/8-7	Y		2	1.25	N/A
	RE070/8-8	Y		0	0	N/A
	RE070/8-13	Y		1	0.08	N/A
	RE070/8-15	Y		0	0	0
	RE070/9-4			5 (3)	3.41	0.43
	RE070/10-5			1	0.08	0.01
	RE070/7-2			7 (1)	8.25	0.04
MWR215 (Union Park)				4	13.25	10.03
BOS070/RCC	RE070/5-3	Y	Y	0	0	0

Table 3-3. Summary of January 1 to June 30, 2019 Meter Results (Continued)

Outfall	Regulator ID	Level Only	Meter Removed March 1, 2019	January 1-June 30, 2019		
				Activation Frequency	Total Duration (hrs)	Total Volume (MG)
BOS073	RE073-4			0	0	0
Reserved Channel						
BOS076	RE076/2-3			0	0	0
	RE076/4-3			0	0	0
BOS078	RE078-1 RE078-2			0	0	0
BOS079	RE079-3	Y		0	0	0
BOS080	RE080-2B	Y		0	0	0
Upper Charles						
CAM005	RE-051			5	3.75	N/A
CAM007	RE-071			0	0	0
Lower Charles						
CAM017	CAM017			0	0	0
MWR010	RE37	Y		0	0	0
	RE036-9	Y		0	0	0
MWR018	Charles River			0	0	0
MWR019	Charles River			0	0	0
MWR020	Charles River			0	0	0
MWR201	Cottage Farm			2	3.75	8.44
MWR023	RE046-19	Y		0	0	0
	RE046-30			0	0	0
	RE046-50	Y		0	0	0
	RE046-54	Y		0	0	0
	RE046-55	Y		0	0	0
	RE046-62A	Y		0	0	0
	RE046-90	Y		0	0	0
	RE046-100			1 (0)	<.0.25	0
	RE046-105			0	0	0
	RE046-381	Y		0	0	0
	RE046-192	Y		0	0	0
Back Bay Fens						
BOS046	Fens Gatehouse #1			0	0	0

Notes:

- For locations indicated with a “Y” in the meter removed column, the meter was removed on March 1, 2019 and results summarized in the table only reflect data through February 28, 2019.
- Numbers in parenthesis indicate number of activations with volumes greater than 0.01 MG.
- Duration of CSO activations were rounded to the nearest 0.25 hour.
- Flow volumes are estimates based on information available. Direct measurements in the outfall pipe, weir equation, scattergraphs and other methods were used to estimate volumes. Where activations occurred and volume is reported as 0.00 MG, volumes were less than 0.01 MG. In locations where these methods were not applicable (N/A), such as the sites with level-only sensors, no volume was approximated.

4. Hydraulic Modeling

This section details the updates made to the MWRA's collection system model and the procedures being utilized for model calibration. The calibration effort is utilizing a large set of rainfall and CSO discharge data from the extensive array of temporary overflow meters MWRA deployed in 2018 and the large number of rainfall events that occurred that year. The sizable data set provides for significant improvement of model calibration and, therefore, the model's ability to more accurately predict system performance and CSO discharges across a range of storm characteristics. Model upgrade and calibration will not end with this current effort. As it has always done, MWRA will continue to improve the model and model calibration as it and its member communities make improvements to their systems and as MWRA collects new information about the system and system performance.

The MWRA's hydraulic model is the primary tool used to evaluate the performance of the MWRA system during a typical year. Environmental variables such as rainfall, tide, and evaporation serve as inputs to the model. These variables are used to estimate the flow entering the sewer system, as well as the hydraulic performance of the system at the CSO regulators. The hydraulic model was first established during development of the Long Term Control Plan using the USEPA Storm Water Management Model (SWMM) software. It was then updated and converted to InfoWorks CS in the early 2000s to better serve MWRA's needs during LTCP implementation. The InfoWorks CS model is the tool that has been used for multiple years to estimate CSO volumes. The InfoWorks CS model has been converted to InfoWorks ICM, the successor modeling software to InfoWorks CS.

The purpose of the Post Construction Compliance Monitoring Program (PCCMP) is to demonstrate the attainment of the levels of CSO control recommended in MWRA's LTCP. The levels of CSO control in the MWRA's LTCP at each CSO outfall are based on Typical Year precipitation. Model simulations will be run for all rainfall events for the calendar years 2018, 2019, 2020, and the Typical Year to generate model-predicted CSO discharge frequency, durations, and volumes. These results will be summarized in future reports once the model has been calibrated.

As noted above, the InfoWorks CS model has been converted to InfoWorks ICM. InfoWorks CS is no longer a product supported by Innovyze Software. InfoWorks ICM has similar hydraulic computation abilities as CS but adds capabilities such as improved database management. The version used for this report is ICM 8.5, which was the most current version at the time of conversion from InfoWorks CS.

4.1 Model Updates

The MWRA system is a dynamic system, and as a result the model is constantly being updated with known changes to the physical configuration of the system. The model was and continues to be updated with 2019 system conditions. These conditions include the following modifications:

- **SOM001A:** A plate was removed from the dry weather flow connection, changing the connection from a 24-inch diameter opening to the equivalent of a 36-inch diameter opening. This connection was updated in the model for 2019.
- **CAM002:** A plate was removed from the weir, changing the overflow elevation from 112.08 feet-MDC to 111.08 feet-MDC. An additional plate was removed (June 16, 2019) which opened a connection between the influent line to CAM002 and the Alewife Brook Conduit. These changes were updated in the model.
- **East Boston nozzles:** Field investigations found nozzles in the dry weather flow connections to the interceptors at a number of East Boston regulators. The model was adjusted to restrict the flow to the interceptor as part of calibration efforts to simulate the hydraulic impacts of the nozzles.
- **Incorporation of community models**: In a number of locations, more detailed community models were incorporated into the MWRA model to improve the accuracy of the modeled representation.

- **Weir in South Boston Interceptor:** Discussions with the City of Boston identified a weir on the South Boston Interceptor. This weir was added to the model along with sediment that the metering data suggest has accumulated upstream of the weir.
- **Leaking tide gates:** Metering data suggest that several locations have leaking tide gates. The model was adapted to simulate the leaking tidal water.
- **Alewife Brook Pump Station:** The pump station was previously on a bypass due to a rehabilitation project. The rehabilitation is complete. The model has been configured to reflect the current operation.
- **CSO Facility gate operation data:** MWRA provided gate operation data for storm events during the 2018 and 2019 monitoring periods. The model was updated to include the gate operation data to reflect actual gate operations.

The 2019 version of the model will be used for storms that occur in 2019, while model calibration will continue to be evaluated using the 2018 conditions.

4.2 Model Calibration

The process of calibrating the MWRA's hydraulic model to the meter data collected from the temporary, permanent, and community meters began in January 2019. MWRA expects to complete and verify the calibration over the next several weeks following submittal of this report.

Model calibration is a multiple-step process, outlined by the following five steps. These steps are further discussed in the sections to follow:

1. Identify the calibration period.
2. Collect and QA/QC the data necessary for model calibration.
3. Update the model's physical configuration at the regulators based on site inspections, record drawings, rim measurements, and other available information.
4. Calibrate to the dry weather and wet weather flows at the influent meters to regulators.
5. Calibrate to the overflow meters targeted at closely matching the observed CSO activations.

For coordination and efficiency purposes, the model was divided into submodels for calibration. The submodels were then combined after calibration of those individual areas was completed.

The model network was updated based on field inspections and rim measurements taken at each of the monitored regulator locations. In locations where the configuration of the regulator remained in question, additional resources such as community models, GIS data, system drawings, or further field investigations were used.

4.2.1 Calibration Period

The period used for model calibration was April 15, 2018 through September 30, 2018. Meter data collected after September 30, 2018 were used to serve as an independent check of the calibration. The calibration period includes a number of storms of varying sizes and intensities, occurring during spring conditions, where groundwater is typically high, and summer / fall conditions, when groundwater is typically lower. The objective of calibration is to replicate the response to a variety of storm events at each meter location. The model is being calibrated to multiple storms within the calibration period, comparing depth, volumes, and peak flows.

4.2.2 Data for Model Calibration

The data used for model calibration includes flow monitoring data, rainfall data, temperature data, and tide data.

Depth and velocity metering data: The project team is calibrating to data from temporary project meters, permanent community meters, and MWRA meters. Data flagged as questionable is not used for model calibration. Additional information on the metering data is presented in Section 3.

Rainfall: Rainfall data collected from 20 rain gauges are used in the calibration. The rainfall data are summarized in Section 2.

Temperature: Daily temperature data downloaded from NOAA are used to compute potential evapotranspiration (PET), which is required for simulating seasonal ground infiltration.

Tide: Hourly tidal data are used as a boundary condition at outfalls and were downloaded from NOAA.

SCADA data: SCADA data provided by MWRA are being reviewed to assess whether there were operational anomalies or issues that differed from the typical operations that are the basis for the facilities' operational settings in the hydraulic model.

4.2.3 Dry Weather Calibration

Dry weather calibration involves adjusting the dry weather parameters in the model if necessary, to match the meter data. The continuous dry weather period of August 29 to September 2, 2018 was used as the dry weather calibration period. An example dry weather calibration plot is shown in Figure 4-1.

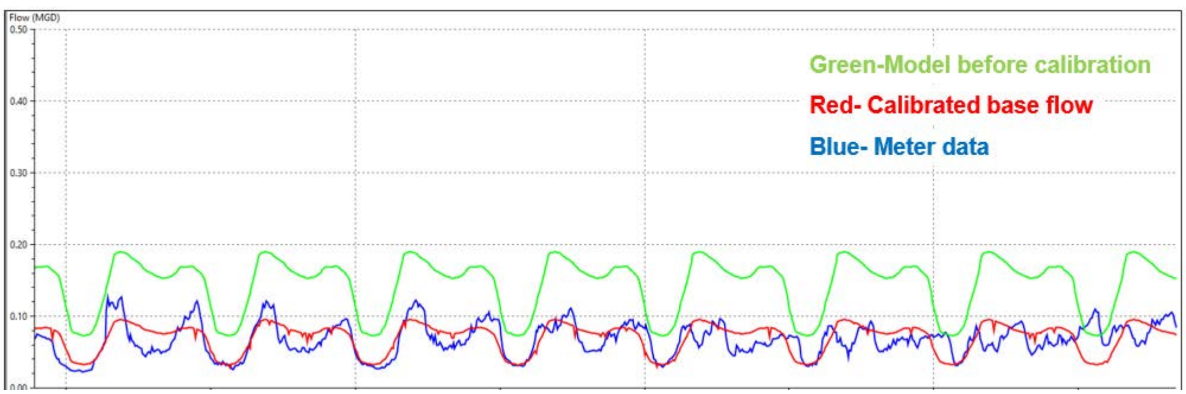


Figure 4-1. Base Flow Calibration

When a significant difference was noted between the base flow observed in the spring and summer, groundwater impacts were assessed. Base flow was calibrated for the summer period, and the groundwater infiltration module of ICM was used to adjust base flow during the spring when groundwater impacts would occur.

4.2.4 Wet Weather Calibration

Wet weather calibration involves adjusting the model as necessary and appropriate to attempt to match the response observed by the influent meters during wet weather events. Adjustments include changes to parameters that affect total volume or peak flow in the model.

The metered storm response volume (MG) and peak flow (MGD) were calculated for a number of storm events and compared to the modeled response in plots such as the ones shown in Figure 4-2. Each red dot represents a storm event. If the metered and modeled volumes and peak flows matched exactly, the red dots would fall on the dotted blue line. However, the rainfall gauge may be located some distance away from the sewershed that contributes flow to the meter. As a result, the rainfall recorded by the rain gauge may be different than the actual rain that falls near the meter, which may contribute to differences between the metered flow and the flow predicted in the model. In some cases, the rainfall falling on the meter area may be less than the amount recorded by the meter, and sometimes it will be more. The approach used for model calibration was to simulate numerous storms and then adjust the calibration so that approximately half of the storms fall above the dotted blue line, and half fall below. The lines on either side of the dotted blue line represent the calibration standards set forth by the Chartered Institution of Water and Environmental Management (CIWEM) in the UK, which state that a calibrated model should predict volumes and peak flows within the range of +20% and -15% (CIWEM, 2017). Predicted volumes and peak flows for most storm events should fall within the lines on either side of the dotted blue line. Due to the spatial variation of rainfall, especially during isolated thunderstorm events, not all of the storm events will fall within those lines.

Calibration plots, shown in Figure 4-3, are also used to assess the meter calibration. The model and meter data should follow similar shapes during the storm response.

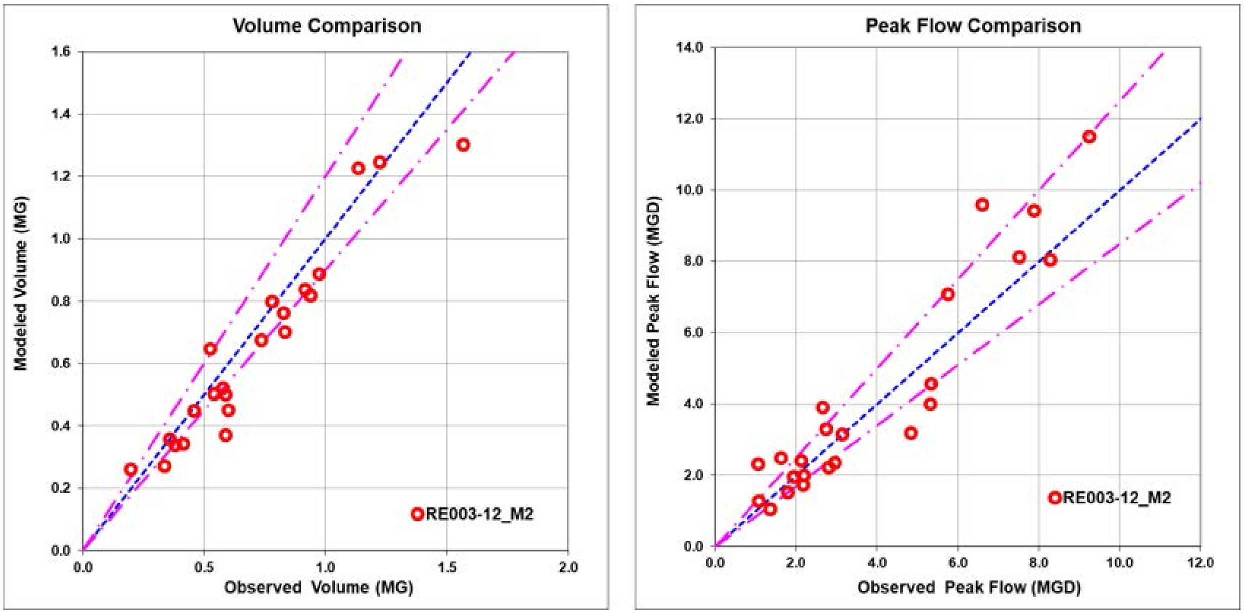


Figure 4-2. Storm Volume and Peak Flow Calibration Plots

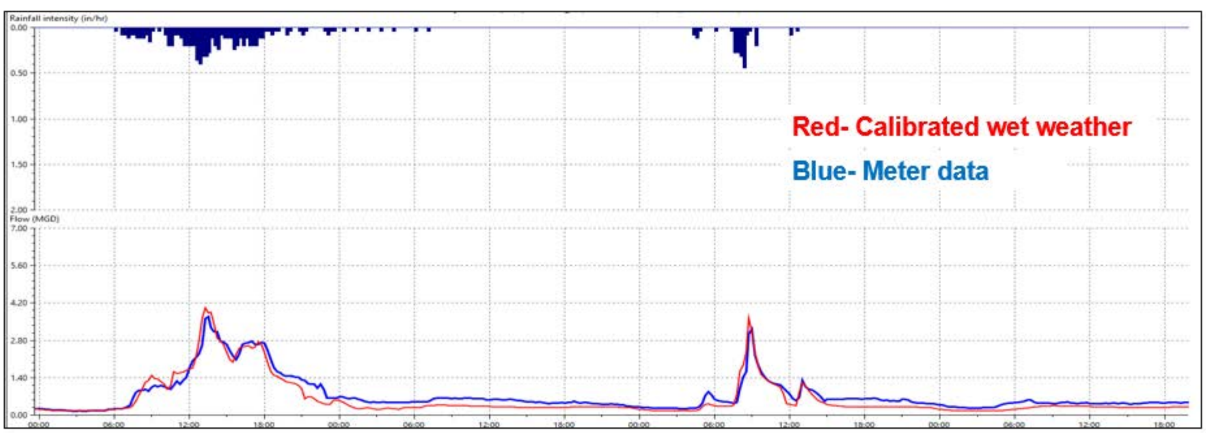


Figure 4-3. RE003-12 Influent Meter Calibration Plot

Once the influent meters are calibrated, the overflows from the regulators are calibrated. Overflow calibration involves adjusting parameters to attempt to match the observed overflow frequency and volume. Calibrating the model to the metered overflow data typically involves controlling the distribution of volume between the dry weather flow connection and the overflow pipe. In locations where calibrating the influent meters is not sufficient for matching the overflow activations, improving the match of the activations can be achieved by adjusting the roughness of the dry weather flow connection or by modifying the diameter of the dry weather flow connection (if supported by field observations/data). This portion of the calibration process also requires consideration of the downstream conditions of the interceptor, as those conditions can affect the flow through the dry weather connection.

4.2.5 Groundwater Calibration

Significant groundwater impacts were observed at some metering locations. Groundwater was added to these locations to improve the calibration and model prediction of storm events. These groundwater impacts improved model-predicted results for storm events during the spring and fall months where significant groundwater impacts were observed. Figure 4-4 demonstrates the impact that the groundwater module had on calibration. As demonstrated in the figure, adding the groundwater modules greatly improved the ability for the model to simulate the significant groundwater observed in the spring. The model simulation with the groundwater turned on (green) closely matches the metering data (blue), while when the groundwater is not turned on (red) greater variation occurred between the meter and model predicted flows.

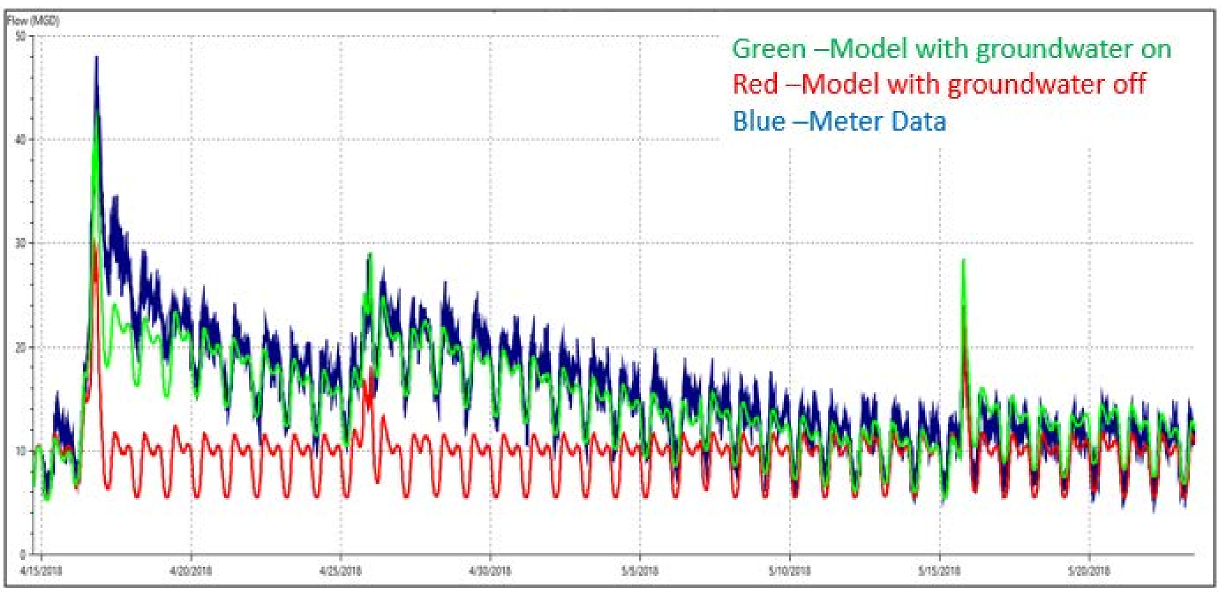


Figure 4-4. Groundwater Calibration Example

4.2.6 Calibration Progress Update

MWRA expects to complete model calibration and verification of the calibration over the next several weeks following submittal of this report. Current efforts include reviewing scattergraphs of the influent meters (see Figure 4-2), reviewing calibration plots (see Figure 4-3), comparing model predicted and metered flows and water levels at critical points, as well as comparing metered and model predicted CSO activations and volumes.

5. Site-Specific Overflow Activity Investigations

This section provides an early and preliminary assessment of compliance with the LTCP Typical Year levels of control based on the regulator and outfall inspections conducted in 2018 and the measured overflow activity at CSO regulators and outfalls from meter data collected in the period April 15, 2018, through June 30, 2019. This section also describes the progress of MWRA's investigations where the meter data showed relatively high CSO discharge activity during the 2018 metering period. As previously mentioned, rainfall in 2018 exceeded Typical Year rainfall for the number of storms, total rainfall volume and the number of storms with high peak intensities. Rainfall in the metering period January 1, 2019 through June 30, 2019 is trending closer to Typical Year characteristics, though there have been a relatively high number of small storms (by rainfall volume) in this period.

5.1 Preliminary Assessment of LTCP Compliance

The review of information collected from the CSO regulator and outfall inspections MWRA conducted in 2018 and the review of measured CSO discharges using the meter data collected in the period April 15, 2018, through June 30, 2019, allow a preliminary assessment of CSO performance relative to the LTCP levels of control. The performance assessment for remaining active outfalls is based on data and quantified CSO discharges for actual storms in the metering period, and, as noted above, this period saw a greater number and intensity of storms compared to the Typical Year. Once ongoing hydraulic model calibration is complete (Section 4), MWRA will be able to simulate the system's performance for Typical Year rainfall and directly compare that performance to the LTCP levels of control.

MWRA's LTCP addressed 84 CSO outfalls that were active in the late 1980s when MWRA commenced CSO control planning. It calls for the permanent closing of 27 of the 84 outfalls. The inspections MWRA conducted in 2018 confirmed that CSO discharges have been eliminated at all 27 outfalls. In addition, the inspections confirmed that six additional CSO outfalls indicated in the LTCP to remain active have been closed in Boston (3), Cambridge (2), and Chelsea (1), and two additional outfalls where CSO would be eliminated up to the 25-year storm (South Boston beaches) have also been closed (see Table 5-1 on the next page).

The LTCP calls for the elimination of CSO discharges from seven outfalls along the South Boston beaches (North Dorchester Bay) up to the 25-year storm, an "effective elimination" provided by MWRA's South Boston CSO storage tunnel. Two of these outfalls (BOS083 and BOS087) were permanently closed during construction of the tunnel. MWRA recently completed an evaluation of tunnel performance (now undergoing final review) utilizing rainfall and tunnel performance data it has collected since it brought the tunnel into service in May 2011. While a 25-year storm has not occurred in that time, the evaluation results confirm that the tunnel is meeting its intended performance and would prevent any CSO discharge to the beaches at the remaining five outfalls up to and including the 25-year storm. The evaluation also confirmed that the tunnel would capture all CSO and separate stormwater flows up to the 5-year storm. No CSO has discharged to the beaches in the several hundred rainfall events since tunnel startup in May 2011. MWRA closed the stormwater gates to the tunnel and allowed separate stormwater discharge to the beaches in only three of those storms, Hurricane Irene in August 2011, the 4.5-inch (>5-year) storm on December 9, 2014, and during the storm surge and coastal flooding event on March 2, 2018.

A total of 40 of the 84 CSO outfalls addressed in the LTCP are closed or have a 25-year storm level of control. At the 44 outfalls that remain active, an evaluation of the discharges measured in the storms of April 15, 2018 through June 30, 2019 suggests that discharges from up to 26 of these outfalls are in-line with the LTCP levels of control. At approximately 18 outfalls, MWRA is investigating whether the higher measured CSO activity was due solely to greater rainfall, and whether site-specific conditions at certain regulators also contributed to the higher activity and may be amenable to adjustment that can improve system performance. MWRA has been conducting the investigations in coordination with the CSO communities in part to validate the metering installations and measured CSOs and identify site-specific overflow factors and potential improvements. The following discussion describes the progress of MWRA's investigations into the overflow activities at these outfalls and other outfalls where the inspections or data indicate hydraulic conditions that may be amendable to or warrant improvement.

Table 5-1 The 84 CSO Outfalls Addressed in MWRA's CSO Control Plan

Closed Outfalls		25-Year Storm Level of Control	Remaining Active Outfalls	
Alewife Brook SOM001 SOM002 SOM002A SOM003 SOM004 CAM400 CAM004 Upper Mystic River SOM006 SOM007 Mystic/Chelsea Confluence BOS015 CHE002 Upper Inner Harbor BOS050 BOS052 BOS058 Lower Inner Harbor BOS006 BOS007 Constitution Beach BOS002/MWR207 Fort Point Channel BOS072	Upper Charles Basin BOS032 BOS033 CAM009 (1) CAM011 (1) Lower Charles Basin BOS028 BOS042 BOS049 MWR021 MWR022 SOM010 North Dorchester Bay BOS083 BOS087 South Dorchester Bay BOS088/MWR209 BOS089 BOS090/MWR211 Neponset River BOS093 BOS095	North Dorchester Bay (South Boston Beaches) BOS081 BOS082 BOS084 BOS085 BOS086	Alewife Brook CAM001 CAM002 CAM401A CAM401B SOM01A MWR003 Upper Mystic River MWR205A/SOM007A (2) Mystic/Chelsea Confluence MWR205 (2) BOS017 CHE003 CHE004 CHE008 BOS013 BOS014 Upper Inner Harbor BOS009 BOS010 BOS012 BOS019 BOS057 BOS060 MWR203 (2) Lower Inner Harbor BOS003 BOS004 BOS005	Fort Point Channel BOS062 BOS064 BOS065 BOS068 BOS070 BOS073 Reserved Channel BOS076 BOS078 BOS079 BOS080 Upper Charles Basin CAM005 CAM007 Lower Charles Basin CAM017 MWR010 MWR018 MWR019 MWR020 MWR201 (2) MWR023 Back Bay Fens BOS046
35 outfalls		5 outfalls	44 outfalls	

(1) Closed since 2007, pending additional hydraulic investigations by the City of Cambridge.
The Union Park facility (MWR215) discharges treated flows upstream of BOS070 and is not included in the count of 84 outfalls.
(2) Conveys flows from a CSO treatment facility

5.2 Overflow Activity Investigation Summary

Since commencement of the performance assessment's metering program in April 2018, MWRA has continuously evaluated the CSO activation frequency and discharge volume as quantified from the meter data against the required outfall-by-outfall frequencies and volumes in the LTCP. These evaluations provide an initial and preliminary assessment of the likelihood of meeting the LTCP Typical Year levels of control. The general approach for the site-specific overflow activity investigations includes confirming the regulator and metering configurations, verifying the effectiveness of the metering setup, validating the meter data and overflow measurements, and assessing whether there are impacts from other system hydraulic conditions, such as possible downstream hydraulic restrictions, or operational protocols.
At community CSO regulators and outfalls, MWRA conducts these investigations in close coordination with the community. These investigations can result in adjustments to the metering setup or the method for quantifying overflows from the meter data. The investigations can also result in adjustments to MWRA's hydraulic model to improve the model's representation of confirmed physical and hydraulic conditions and bring model predictions closer to the meter data and measured overflow values. For additional information on the approach for overflow activity investigations, see Section 6.1 in Semiannual Report No. 2.

Table 5-2 on the next page is an updated version of Table 6-1 in the previous (first and second) semiannual reports. The table provides updates on MWRA's site-specific overflow activity investigations. Investigation efforts and findings summarized in Table 5-2 are discussed in further detail, below. While Table 5-2 presents the summary updates by receiving water to indicate the waters affected by the potentially higher discharges, the additional text below groups these outfalls by subsystem, since the technical investigations deal with system conditions that may affect multiple regulators and outfalls, even outfalls discharging to different receiving water segments.

Table 5-2. Overflow Activity Investigation

Receiving Water	Outfall	Summary of Investigation
Alewife Brook	SOM001A	Removal of hydraulic restrictions at the connection to MWRA's interceptor in 2019 reduced activation frequency at this location. Modifications may impact other overflows along Alewife Brook. However, metering data suggest that additional CSO control may be necessary to meet LTCP level of control.
	CAM401A	Coordination with the City of Cambridge is underway to investigate whether the LTCP level of control is being met.
Upper Mystic River	MWR205A/ SOM007A	Unmetered stormwater from nearby Somerville drainage areas enters the outfall and may contribute to overflows. Also see MWR205, below.
Mystic/Chelsea Confluence	MWR205 (Somerville Marginal Facility)	Investigations are focusing on stormwater flows and the potential to increase the capacity of the upstream connection to the MWRA interceptor.
	BOS013	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
	BOS014	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
	BOS017	Investigation underway with BWSC of a potentially leaking tide gate that may be contributing to overflows.
	CHE004	Coordination with the City of Chelsea is underway to investigate higher discharges and potential improvement measures.
	CHE008	Coordination with the City of Chelsea is underway to investigate higher discharges and potential improvement measures.
Upper Inner Harbor	BOS009	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
	BOS010	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
	BOS012	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
	BOS019	No activations occurred during the 2019 monitoring period. Discharges in 2018 were affected by larger number and intensity of storms.
	BOS057	Coordination with BWSC is underway to investigate the potential of tidal inflow contributing to overflows.
	BOS060	MWRA is coordinating with BWSC to investigate flow spikes measured in dry weather that may contribute to overflows in wet weather.
Lower Inner Harbor	BOS003	Investigation underway with BWSC of a potential hydraulic restriction in the regulator connection to the MWRA interceptor.
Fort Point Channel	BOS062	No activations occurred during the 2019 monitoring period. Discharges in 2018 were affected by larger number and intensity of storms.
	BOS064	No activations occurred during the 2019 monitoring period. Discharges in 2018 were affected by larger number and intensity of storms.
	BOS065	Coordination with BWSC is underway to investigate higher discharges.
	BOS070	Discussions with BWSC identified a maintenance weir and sediment in the South Boston Interceptor that will be removed under a BWSC maintenance contract now underway.

Table 5-2. Overflow Activity Investigation (Continued)

Receiving Water	Outfall	Summary of Investigation
Upper Charles River	CAM005	Based on needed model adjustments to simulate measured flows and depths, hydraulic restrictions are suspected in this regulator impeding flows to the interceptor. Coordination with the City of Cambridge is underway to investigate further.
Lower Charles River	CAM017	Field investigations and coordination with City of Cambridge were conducted to understand and evaluate the metering configuration and bending weir operation at this location. Further investigation and coordination are underway.
	MWR201 (Cottage Farm Facility)	Coordination with City of Cambridge to evaluate the hydraulic benefits of additional stormwater removal proposed by Cambridge. MWRA recently approved, on a trial basis, Cambridge's proposal for "partial sewer separation," whereby Cambridge would significantly reduce recently separated stormwater flows that enter the sewer system and redirect a portion of the stormwater to the Charles River during storms that contribute to CSO discharges. This approach is necessary to attain the LTCP levels of control while limiting the stormwater's phosphorus loading to the river.
	MWR018	MWRA is currently investigating higher summer activations in 2018. No activations observed during the 2019 monitoring period.
	MWR019	MWRA is currently investigating higher summer activations in 2018. No activations observed during the 2019 monitoring period.
	MWR020	MWRA is currently investigating higher summer activations in 2018. No activations observed during the 2019 monitoring period.
	MWR023	Coordination with BWSC is underway to evaluate higher overflows at a few of the upstream regulators that discharge to the Stony Brook Conduit.
Back Bay Fens	BOS046	The BOS046 gate at Gatehouse No. 1 operation is under investigation.

5.3 Overflow Activity Investigation by Sub-System

5.3.1 Alewife Brook Interceptor System

Outfalls CAM002 and SOM001A: One of the benefits of extending the temporary metering program into 2019 (and through the first half of 2020) at regulators that overflow to the Alewife Brook is the ability to measure the benefits of wastewater system modifications that were made at the City of Cambridge's Outfall CAM002 and the City of Somerville's Outfall SOM01A in early 2019. At CAM002, Cambridge removed temporary steel plates it had installed when it constructed the LTCP project improvements at this location in 2010 pending completion of Cambridge's CAM004 (Huron Ave./Concord Ave.) sewer separation project (completed in December 2015). Removal of the plates resulted in providing a second connection to MWRA's sewer system, thereby increasing flows to the sewer system and reducing overflows to Alewife Brook. At SOM001A, MWRA removed a temporary orifice plate that had restricted the capacity of the connection to the sewer system pending completion of Cambridge's CAM004 (Huron Ave./Concord Ave.) sewer separation project (completed in December 2015) and construction of upgrades to MWRA's Alewife Brook Pumping Station (completed in early 2019). Removing the orifice plate increased the dry weather flow connection to the interceptor from a 24-inch diameter opening to a 36-inch equivalent diameter opening. MWRA also removed an obstruction that had further restricted the dry weather connection capacity. The improvements at CAM002 and SOM001A, while reducing overflows from these outfalls, increase flows to the MWRA interceptor system, which may affect the activation frequency and discharge volumes at other regulators and outfalls along Alewife Brook. MWRA will continue to monitor data from depth and flow meters at the Alewife Brook regulators and within the MWRA system to assess the benefits and potential impacts of these modifications.

At SOM001A, meter data collected in 2018 also indicated that wet weather flows conveyed by Somerville's Tannery Brook to the SOM001A regulator have increased since the MWRA model was initially developed and calibrated in the 1990s. This increase in wet weather flow may be contributing to higher overflow frequency and volumes at SOM001A. MWRA is coordinating with Somerville to investigate possible reasons for the higher flows, and the City is separately undertaking an investigation of its stormwater and combined sewer systems that contribute flows to the Tannery Brook.

Outfall CAM401A receives flow from regulator RE-401. Flow metering during the 2018 and 2019 monitoring periods suggested that the activation frequency at this location may not meet the LTCP Typical Year level of control. This regulator is equipped with brushes at the top of the overflow weir to control floatable materials. Following discussions with the City of Cambridge to incorporate their system knowledge and identify factors that may be contributing to the higher-than-expected CSO discharges, the CAM401A system detail in Cambridge's hydraulic model was incorporated into the MWRA model. The City also provided weir coefficients that may account for the head losses through the brushes. MWRA continues to coordinate with the City of Cambridge to further investigate the activation frequencies at this location and ensure that Cambridge's and MWRA's hydraulic models are accurately simulating hydraulic conditions.

5.3.2 Somerville Marginal CSO Facility Discharges

Outfall MWR205A/SOM007A is the only CSO outfall discharging to the Upper Mystic River. It discharges treated CSO from MWRA's Somerville Marginal CSO treatment facility and City of Somerville stormwater to the Mystic River Basin upstream of Amelia Earhart Dam when the primary discharge to the tidal portion of the Mystic River at Outfall MWR205 is limited by higher tide. The 2018 metering data showed relatively high activity, and tidal impacts were observed in the metering data. This remained true for the 2019 metering period. The City of Somerville provided its hydraulic model, and a portion of the area tributary to the MWR205A/SOM007A system was incorporated into the MWRA's model, providing more detailed information on the stormwater subcatchments that may be contributing to the higher volume, if not frequency, of CSO and stormwater discharges. The CSO component of discharges through Outfall MWR205A/SOM007A is directly related to the frequency and volume of CSO that is treated at the upstream Somerville Marginal Facility, discussed below. MWRA is also investigating a potentially faulty tide gate at the end of Outfall MWR205 and its CSO impacts.

Outfall MWR205 (Somerville Marginal Conduit) is located immediately downstream of the Amelia Earhart Dam and discharges CSO that passes through the treatment works at the Somerville Marginal Facility, along with separate stormwater from nearby drainage areas in Somerville that enters the Somerville Marginal Conduit. The facility activated relatively frequently in 2018. As mentioned above, MWRA has incorporated portions of the City of Somerville's recently developed hydraulic model into the MWRA model, which will help improve the characterization and quantification of stormwater flow contributions to the Somerville Marginal Facility and the Somerville Marginal Conduit. In addition, the Alewife Brook/Upper Mystic River CSO Variance issued by DEP on September 1, 2019, includes a condition requiring MWRA to commence, by December 2020, the evaluation of specific projects that may reduce overflows to the Somerville Marginal Facility and discharges from outfalls MWR205 and MWR205A/SOM007A.

5.3.3 East Boston Outfalls

Outfall BOS003 receives flow from BWSC regulators RE003-2, RE003-7, and RE003-12. Metering data collected in 2018 and 2019 suggest that discharges at Outfall BOS003 may not meet the LTCP frequency and volume targets, with Regulator RE003-12 contributing the highest activations and volumes of CSO. At this and other East Boston regulators, discussed below, BWSC record drawings indicate that nozzle restrictions may exist in the dry weather flow connections (see Figure 5-1 on the next page). The nozzles restrict flow entering the MWRA's East Boston Branch Sewer and contribute to higher overflows and CSO discharges. Field investigations found that the most restrictive nozzle is located at RE003-12. This nozzle can become plugged, resulting in the risk of higher wastewater levels in the upstream BWSC sewer system, and dry weather overflows, in addition to higher wet weather overflows. In response, BWSC spends significant maintenance time and resources on a regular basis to keep this nozzle clear and minimize the risks of dry weather overflows and upstream system flooding.

Removing the nozzle restrictions at this and other East Boston regulators could reduce the CSO activation frequency and volume, but only to the extent that the East Boston Branch Sewer and the downstream MWRA Caruso Pumping Station have available capacity to accommodate the additional flow. Also, allowing more flow into the MWRA interceptor at one regulator can limit inflows and cause higher overflows at other regulators. MWRA recently performed hydraulic model runs that simulated the effects of replacing the existing dry weather flow connection and nozzle restriction at RE003-12 with new pipe of various sizes. The model results suggest that opening the RE003-12 dry weather flow connection can significantly reduce the activation frequency and volume of overflows at this regulator without causing significant impacts at the other East Boston regulators. However, the additional flow entering the East Boston Branch Sewer will increase hydraulic grades in the MWRA interceptor. MWRA and BWSC are conducting further review to determine an optimized solution that maximizes CSO control at this location and avoids significant adverse hydraulic grade impacts.

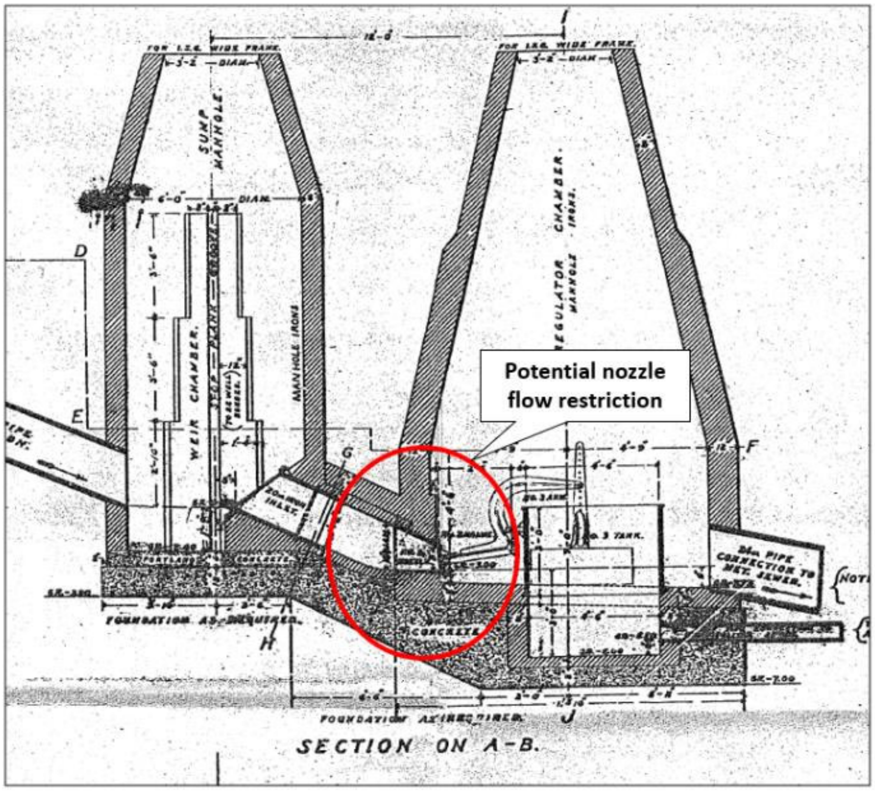


Figure 5-1. Record Drawing of Nozzle Restriction

<u>Outfalls BOS009, BOS010, BOS012, BOS013 and BOS014</u> are located along the shoreline of East Boston. Outfalls BOS009, BOS010 and BOS012 discharge to the Upper Inner Harbor, and outfalls BOS013 and BOS014 discharge to Chelsea Creek. These outfalls receive overflow from BWSC regulators RE009-2, RE010-2, RE012-2, RE013-1 and RE014-2, respectively. Metering data collected in 2018 and the first half of 2019 showed relatively high overflow activity. However, 2018 and the first half of 2019 saw higher numbers of storms and amounts of rainfall than in the Typical Year. MWRA's hydraulic model now undergoing improved calibration will be used to confirm whether the discharges meet the LTCP levels of control.

Based on the 2018 metering data, MWRA conducted an initial assessment that indicated that the Caruso Pumping Station, which collects flows from the combined sewer areas of East Boston, as well as flows in MWRA's Chelsea Branch Sewer, is not causing backwater that is a contributing factor to these overflows. This suggests that there may be capacity in MWRA's interceptor and pumping system to accept more flow from BWSC's East Boston systems. BWSC historical record drawings indicate that restrictive nozzles may exist within the dry weather flow connections at most of these regulators (see further discussion of the East Boston nozzle restrictions and Figure 5-1, above). The hydraulic impacts of the nozzles are accounted for in the ongoing calibration of MWRA's hydraulic model using the 2018 meter data.

BWSC has developed plans to separate its combined sewer systems in parts of East Boston. Early phases of these plans are now in construction, and others are in design. MWRA plans to utilize its calibrated hydraulic model to assess the benefits of BWSC's ongoing and planned sewer separation projects and evaluate other system improvement alternatives, including the removal of nozzle restrictions, that may help bring the East Boston discharges into compliance with the LTCP or provide further improvement.

5.3.4 Other Mystic/Chelsea Confluence Outfalls

Outfall BOS017 is located in Charlestown, downstream of the Alford Street (Route 99) bridge over the tidal reach of the Mystic River. The outfall receives overflow from BWSC regulator RE017-3. In July 2018, MWRA installed flow meters in the influent and overflow lines and a depth sensor on the overflow weir to more accurately measure overflow activations. Flow metering data collected in 2018 suggested that 2.5 million gallons per day (MGD) of tidal inflow may have been entering the influent lines and contributing to the measured activation frequency at this location. MWRA is coordinating with BWSC to further investigate the tidal influence at this regulator. Meanwhile, MWRA's hydraulic model has been updated to simulate the tidal inflow impacts in the meter data.

Outfalls CHE004 and CHE008 are City of Chelsea outfalls that discharge to Chelsea Creek. Outfall CHE004 receives flow from regulator RE041, which connects to a City of Chelsea trunk sewer, and Outfall CHE008 receives flow from regulator RE081, which connects to MWRA's Chelsea Branch Sewer. The City's trunk sewer connects to MWRA's North Metropolitan Trunk Sewer upstream of the Chelsea Creek Headworks, and the Chelsea Branch Sewer connects to MWRA's Chelsea Screenhouse, which sends flow to Caruso Pumping Station in East Boston. The 2018 metering data suggested that CSO discharges at CHE004 and CH008 may not meet the LTCP targets. Metering data collected in 2019 also suggests that further control is necessary to achieve the LTCP targets. While the measured activations in the period January-June 2019 suggest that LTCP Typical Year levels of control may not be met, only two of nine measured activations at CHE004 and three of the eight measured activations at CHE008 exceeded 0.01 million gallons (MG) of discharge. Available information, including record drawings, field inspection data, and meter data were reviewed as part of the model calibration efforts. An assessment of flows into Chelsea Creek Headworks indicates that the capacity limit at the headworks is not likely a factor in the higher-than-expected overflow frequency at CHE004. MWRA permanent meter data collected during these activation events suggest that there is available capacity in the MWRA interceptor system to accommodate more flow from these regulators. MWRA is conducting further assessment of the hydraulic conditions in the regulator structures and in the dry weather flow connections for the potential to increase flows from these regulators to the trunk sewer.

MWRA is coordinating evaluations of the performance of these regulators with the City of Chelsea. The City is developing a hydraulic model of its sewer system, which will further inform the understanding of upstream system hydraulic conditions and the City's sewer separation planning efforts.

5.3.5 Other Inner Harbor Outfalls

Outfalls BOS057 and BOS060 discharge CSO to Boston Inner Harbor along the Downtown Waterfront. Regulators for these outfalls connect to BWSC's New East Side Interceptor, which conveys flows from much of the Downtown and Downtown Waterfront areas of Boston to MWRA's Columbus Park Headworks. Outfall BOS057 receives flow from BWSC regulator RE057-6, and Outfall BOS060 receives flow from BWSC regulators RE060-7 and RE060-20. Flow metering data showed tidal inflow at one of the influent flow meters at Regulator RE057-6 (Outfall BOS057). At Outfall BOS060, periodic spikes of flow resulted in an increase of up to 15 inches of depth at RE060-20, which may be affecting the observed CSO activations. MWRA is coordinating its review of the performance of these regulators with BWSC, and BWSC is investigating potential sources for the flow spikes and tidal inflow observed in the flow monitoring data.

5.3.6 Fort Point Channel Outfalls

Outfalls BOS062, BOS064, and BOS065 have regulators that direct dry weather flow to BWSC's New East Side Interceptor. Outfall BOS062 receives flow from regulator RE062-4, outfall BOS064 receives flow from regulators RE64-4 and RE064-5, and outfall BOS065 receives flow from regulator RE065-2. Coordination with BWSC is underway to evaluate CSO activations at these outfalls, including possible hydraulic interactions with the systems that overflow to the Union Park CSO treatment facility and pumping station. MWRA is reviewing Union Park facility operational records.

Outfall BOS070 receives overflows from multiple regulators, four of which (RE070/8-3, RE070/8-7, RE070/9-4, and RE070/7-2), based on metering data collected in 2018, overflowed more frequently than expected. The 2019 metering data showed relatively high CSO activity at regulators RE070/8-3, RE070/8-7, RE070/9-4, and RE070/7-2, as well as RE070/8-13. Regulators RE070/8-3, RE070/8-7, and RE070/9-4 are located along Dorchester Avenue in South Boston. Discussions with BWSC revealed that a maintenance weir was located in the South Boston Interceptor on Dorchester Avenue, as shown in Figure 5-2, during the metering period, and that a significant depth of sediment had accumulated in the interceptor upstream of the weir. A BWSC maintenance contract that includes removal of the weir and sediment is currently underway.

Figure 5-2. Weir Restriction on Dorchester Ave.

Regulator RE070/7-2 is located on BWSC's Dorchester Brook Sewer and was reconstructed as part of BWSC's Lower Dorchester Brook Sewer separation project. During dry weather, the flow enters BWSC's Boston Main Interceptor (BMI) where it is conveyed to MWRA's Columbus Park Headworks. During larger storms, the regulator overflows to BWSC's Dorchester Brook Conduit, a large storm drain and overflow conduit that discharges to Fort Point Channel. Flow monitoring data indicated a large number of small-volume activations, suggesting that flow in the Dorchester Brook Sewer may be "sloshing" over the weir. Additional investigation is planned to better understand the cause of the higher activation frequency and to develop mitigation measures.

5.3.7 Charles River Outfalls

Outfall CAM005 receives overflow from the City of Cambridge's Regulator RE051. The 2018 and 2019 metering data showed relatively high CSO activity at the CAM005 regulator. MWRA has incorporated Cambridge's hydraulic model in the area of this regulator into the MWRA model. Model adjustments made to simulate measured flows and depths at CAM005 suggests possible hydraulic restrictions in the regulator that could impede flows getting to the MWRA's North Charles Metropolitan Sewer. Ongoing model calibration has incorporated these hydraulic losses. MWRA is coordinating with Cambridge to investigate these potential restrictions. The higher-than-expected overflow frequency may also be due to backflow in the MWRA interceptor when flows exceed downstream interceptor capacity. Additional investigation is underway into the hydraulic conditions of the MWRA interceptor downstream of regulator RE051 and their potential impact on the regulator.

Cottage Farm CSO Facility (Outfall MWR201) Metering data collected in 2018 suggested that the LTCP Typical Year activation frequency of treated CSO discharges from the Cottage Farm CSO Facility may not be met, but 2018 was wetter than the Typical Year. In contrast, meter data from the first half of 2019 indicate that the LTCP Typical Year activation frequency could be met, but the Typical Year volume of CSO discharge may not be met. Investigation into the activation volume suggests that the flow in some of the sewer interceptors tributary to Cottage Farm may have a strong seasonal infiltration component (groundwater entering the sewers), which may contribute to the higher-than-expected CSO volumes. The City of Cambridge continues to separate combined sewer areas outside of the LTCP. Cambridge has completed the separation of sewers in the Cambridgeport area, the benefit of which supports achieving LTCP levels of control for Cottage Farm. MWRA recently approved, on a trial basis, Cambridge's proposal for "partial sewer separation," whereby Cambridge would significantly reduce separated stormwater flows that continue to enter the sewer system. Most of the separated stormwater would be discharged to the Charles River during storms that contribute to CSO discharges, but a fraction of the stormwater flow would remain tributary to the combined sewer system. This approach is necessary to attain the LTCP levels of control while limiting the stormwater's phosphorus loading to the river.

Outfall MWR023 receives flow from 11 CSO regulators that can discharge to BWSC's Stony Brook Conduit in large storms. The 2018 metering data showed relatively high CSO activity at some of the regulators, but 2018 was wetter than the Typical Year. Additionally, activation frequencies in the 2018 monitoring period may have been higher due to a blockage in the BWSC system, which has since been removed. Metering data in the 2019 period was inconclusive as to whether the activation frequency may not meet the LTCP target. The temporary meters remain in place at these regulators, and MWRA continues to collect and evaluate data and coordination the investigation with BWSC.

Outfalls MWR018, MWR019, and MWR020 can discharge overflows from MWRA's Boston Marginal Conduit (BMC) to the Charles River Basin in large storms. Otherwise, the BMC conveys CSO and stormwater flows to MWRA's Prison Point CSO treatment facility. Metering data collected in the 2018 metering period showed that each outfall activated twice. Data collected in the period January 1 through June 30, 2019 indicate that these outfalls did not activate in this period. While the activation frequency observed in 2018 may be attributable to more rainfall than the Typical Year, MWRA is further investigating the reasons for activations at these locations.

Outfall CAM017 is a complex regulator configuration with three bending weirs and multiple meters, including an inclinometer. A level sensor operated by the MWRA appears to produce reliable results and therefore this sensor was used to assess whether an overflow occurred. While Semiannual Report No.2 reported zero activations during the 2018 monitoring period, additional field survey and further review of the data indicate that three activations occurred on July 17, 2018, August 12, 2018, and September 18, 2018. The MWRA meter indicated no overflows in the January to June 2019 monitoring period.

5.3.8 Back Bay Fens

The Back Bay Fens receives overflow from upstream BOS046 regulators when gates within the Boston Gatehouse No. 1 (BOS046) are overtopped or when these gates are manually opened. In the past, the gates at Boston Gatehouse No. 1 were normally kept closed. In 2018, to reduce the risk of upstream flooding during severe storm events, BWSC kept the gates open during the summer months. The 2018 metering data indicated that a few of the upstream RE046 regulators activated when the gates were open. As a result, some of the CSO from those regulators discharged at Outfall BOS046 to the Back Bay Fens/Muddy River, and some of the CSO continued past the Gatehouse connection and discharged to the Charles River Basin via the Stony Brook Conduit and Outfall MWR023. The CSO discharged at BOS046 was estimated based on the hydraulic model, as no metering was conducted at this location. The gate remained closed during the January 1 – June 30, 2019 metering period. MWRA and BWSC are investigating how best to manage the gate at Gatehouse No. 1 to meet the LTCP level of control and minimize the risk of upstream flooding in severe storms.

6. Receiving Water Quality Model for Lower Charles/Charles Basin and Alewife Brook/Upper Mystic River

6.1. Receiving Water Model Program and Schedule

Two receiving water bodies are the subject of variances of bacterial and aesthetic water quality standards. The CSO Variances, issued by the Massachusetts Department of Environmental Protection (MassDEP), authorize limited CSO discharges provided that MWRA and the Cities of Cambridge and Somerville are meeting certain conditions and conducting additional work. The CSO Variances require that the MWRA develop receiving water quality models for the two regions with CSO Variances, the Lower Charles River/Charles Basin and the Upper Mystic River/Alewife Brook. The required bacterial water quality models will be developed, calibrated and applied consistent with the requirements in the CSO Variances and as part of the MWRA's CSO Performance Assessment which is required by Court order.

The specific objectives of the models are to:

- Assess whether remaining CSOs (as opposed to other pollutant sources) preclude attainment of bacterial water quality standards in the Typical Year and comply with the water quality-based requirements of the Clean Water Act.
- Assess the performance of the completed Long Term Control Plan (LTCP) controls relative to the CSO impact reduction and water quality improvement predictions that supported the LTCP.

These objectives, combined with other hydraulic modeling, address the needs of the CSO Performance Assessment. In addition, the models will be used to evaluate the potential benefits of additional CSO control. Specific items to be included in the deliverables under this Task are:

- Summary of the water quality observations and estimated flows used for (a) upstream boundary conditions, (b) stormwater, and (c) CSO discharges.
- Explanations of how receiving water quality observations were used to calibrate the models.
- For the three-month and one-year storms, and the Typical Year:
  - Plots of water quality results at selected times during the simulations.
  - Tabulations of hours of bacterial water quality standards violations, distinguishing time due to bacteria loads from upstream, stormwater, and CSO sources.
- Analyses of model sensitivity to the values of the bacterial counts used for upstream, stormwater, and CSO sources.
- Reporting on the modeled impact from remaining CSO discharges on bacteria concentrations over time and distance from the CSO discharge points in the Variance waterbodies.

The models will utilize the previously-used CE-QUAL / Riv 1 / MIKE 2 platforms and upgrade these to Infoworks ICM (for Alewife/Mystic) and Delft3D (using 2 D model platform for the Charles).

The schedule of deliverables for this work is as follows:

- Monitoring Data Technical Memorandum - - October 31, 2019
- Model Development and Calibration Technical Memorandum - - October 1, 2020
- Water Quality Assessment Report - - September 30, 2021
- Alternatives Simulations Report - - December 1, 2021

The workplan for this modeling effort can be downloaded from MassDEP's web site for the Variances:

- https://www.mass.gov/files/documents/2019/09/04/mwrareceivingwatermodelwp.pdf

6.2. Water Quality Sampling

To support the development of these models, water quality data will be utilized including:

- Results from MWRA's long term instream sampling program, initiated in 1989. This receiving water monitoring program has been updated in 2016 and 2017 to include additional sample collection following rain events. The updated sampling plan for the receiving water can be downloaded from MassDEP's web site for the Variances:
    - https://www.mass.gov/files/documents/2019/09/04/mwrawqmonitoring1132017.pdf
- Results from a limited CSO and Stormwater Outfall monitoring program. This plan was initiated in August 2019 and is weather dependent. Samples will be collected through June 2020. This sampling program can be downloaded from MassDEP's web site for the Variances:
    - https://www.mass.gov/files/documents/2019/09/04/receivingwatermodelingwp-sw-cso.pdf
    - https://www.mass.gov/files/documents/2019/09/04/attachmentsforrwm-mwp.pdf

7. Progress Toward the Fourth Semiannual Report

MWRA plans to issue the next semiannual report (Semiannual CSO Discharge Report No. 4) in April 2020. The following efforts are underway or are planned to be conducted over the next several months.

- MWRA will continue to investigate system and regulator conditions and work with member CSO communities to better understand the measured CSO discharges.

- MWRA will continue to collect data from rainfall gauges, CSO and sewer system meters, and facility operational records for all rainfall events. MWRA will continue to quantify and validate CSO discharges from the meter data collected at the 36 CSO regulators where meters remain in place.

- Data analyses are being conducted for the period July 1 through December 31, 2019, and findings will be presented in Semiannual Report No. 4. Temporary meters are currently installed at 36 CSO regulators where additional data will support evaluation of changes to system configurations or to support receiving water quality evaluations for the CSO variance waters.

- MWRA will continue to conduct receiving water quality monitoring in waters potentially impacted by CSO, with a focus on the storm impacts and recovery times in the Variance waters (Lower Charles River/Charles Basin and Alewife Brook/Upper Mystic River).

- MWRA will complete and verify model calibration over the next several weeks following submittal of this report and will then use the calibrated model to predict CSO discharges in the storms during the 2018 and 2019 metering period, and compare the model predictions to the CSO estimates quantified from the meter data. MWRA will also model Typical Year rainfall and current system conditions and compare the results to the LTCP levels of control.

- MWRA will continue to develop the receiving water quality models for the Lower Charles River/Charles Basin and the Alewife Brook/Upper Mystic River and will continue to collect receiving water, stormwater and CSO quality data to support calibration of the models.

Appendix A Rainfall Data for January 1 through June 30, 2019

Appendix B Rainfall Summary Tables

AECOM Imagine it. Delivered.

Rain Gauge 1: Allston

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.31	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 16:00	2.5	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
3	1/9/2019 4:00	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
4	1/19/2019 18:00	20.25	0.8	0.04	0.13	0.03	0.02	<3m	<3m	N/A
5	1/24/2019 12:15	6.25	0.47	0.08	0.00	0.02	0.01	<3m	<3m	N/A
6	2/6/2019 20:30	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
7	2/12/2019 15:00	13.5	0.56	0.04	0.11	0.02	0.01	<3m	<3m	N/A
8	2/18/2019 1:15	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
9	2/21/2019 0:00	3.75	0.14	0.04	0.09	0.01	0.00	<3m	<3m	N/A
10	2/24/2019 8:45	4.25	0.04	0.01	0	0.00	0.00	<3m	<3m	N/A
11	2/28/2019 1:15	1.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
12	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
13	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
14	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
15	3/15/2019 9:15	14	0.12	0.01	0.09	0.01	0.00	<3m	<3m	N/A
16	3/22/2019 0:00	31	0.92	0.03	0.25	0.04	0.02	<3m	<3m	N/A
17	3/29/2019 13:15	2.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
18	3/31/2019 14:00	5	0.14	0.03	0.06	0.01	0.00	<3m	<3m	N/A
19	4/2/2019 23:00	7	0.41	0.06	0.09	0.02	0.01	<3m	<3m	N/A
20	4/5/2019 20:00	7	0.22	0.03	0.05	0.01	0.00	<3m	<3m	N/A
21	4/8/2019 3:00	9.75	0.43	0.04	0.16	0.02	0.01	<3m	<3m	N/A
22	4/9/2019 17:30	11.5	0.06	0.01	0.05	0.00	0.01	<3m	<3m	N/A
23	4/12/2019 22:00	11	0.44	0.04	0.1	0.02	0.01	<3m	<3m	N/A
24	4/14/2019 23:45	15.5	0.77	0.05	0.54	0.03	0.02	3m	<3m	N/A
25	4/19/2019 23:15	25.75	0.3	0.01	0.13	0.01	0.01	<3m	<3m	N/A
26	4/21/2019 13:00	0.25	0.01	0.04	0.01	0.01	0.01	<3m	<3m	N/A
27	4/22/2019 12:30	20.5	2.35	0.11	0.3	0.10	0.05	<3m	6m	N/A
28	4/23/2019 22:15	2	0.1	0.05	0.09	0.01	0.05	<3m	<3m	N/A
29	4/26/2019 6:30	28	1.4	0.05	0.41	0.06	0.03	<3m	<3m	N/A
30	4/28/2019 17:30	0.75	0.02	0.03	0.02	0.00	0.03	<3m	<3m	N/A
31	4/30/2019 1:15	8	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
32	5/2/2019 1:30	12.75	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
33	5/3/2019 13:30	15.75	0.24	0.02	0.1	0.01	0.01	<3m	<3m	N/A
34	5/5/2019 4:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
35	5/7/2019 18:30	3.5	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
36	5/10/2019 23:15	2.25	0.03	0.01	0.27	0.00	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
37	5/12/2019 6:45	13.5	0.49	0.04	0.06	0.02	0.01	<3m	<3m	N/A
38	5/13/2019 16:30	16.25	0.93	0.06	0.27	0.04	0.03	<3m	<3m	N/A
39	5/15/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
40	5/17/2019 8:00	8	0.24	0.03	0.07	0.01	0.01	<3m	<3m	N/A
41	5/19/2019 10:15	1.75	0.16	0.09	0.13	0.01	0.01	<3m	<3m	N/A
42	5/20/2019 1:15	3	0.18	0.06	0.17	0.01	0.01	<3m	<3m	N/A
43	5/23/2019 22:45	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
44	5/25/2019 23:30	2	0.33	0.17	0.27	0.01	0.01	<3m	<3m	N/A
45	5/28/2019 11:45	9.5	0.33	0.03	0.11	0.01	0.01	<3m	<3m	N/A
46	5/30/2019 21:30	3	0.29	0.10	0.15	0.01	0.01	<3m	<3m	N/A
47	6/2/2019 22:15	2.25	0.08	0.04	0.04	0.00	0.00	<3m	<3m	N/A
48	6/5/2019 22:45	7	0.07	0.01	0.06	0.00	0.00	<3m	<3m	N/A
49	6/10/2019 22:45	11.25	0.75	0.07	0.23	0.03	0.02	<3m	<3m	N/A
50	6/13/2019 7:45	10.75	0.66	0.06	0.21	0.03	0.01	<3m	<3m	N/A
51	6/16/2019 3:30	18	0.12	0.01	0.59	0.01	0.00	3m	<3m	N/A
52	6/18/2019 13:15	3.25	0.09	0.03	0.06	0.00	0.00	<3m	<3m	N/A
53	6/20/2019 5:45	7.75	0.32	0.04	0.23	0.01	0.01	<3m	<3m	N/A
54	6/21/2019 1:45	6.5	0.76	0.12	0.59	0.04	0.02	3m	<3m	N/A
55	6/27/2019 8:00	7.25	0.02	0.00	0.01	0.00	0.00	<3m	<3m	N/A
56	6/28/2019 7:30	0.5	0.04	0.08	0.04	0.00	0.00	<3m	<3m	N/A
57	6/29/2019 4:30	11.5	0.7	0.06	0.34	0.03	0.02	<3m	<3m	N/A
58	6/30/2019 14:00	4.25	0.09	0.02	0.07	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 2: Ward Street

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.33	0.07	0.14	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 8:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
4	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
5	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
6	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
7	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
8	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
9	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
10	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
11	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
12	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
19	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
20	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 10:45	12.5	0.27	0.02	0.24	0.01	0.01	<3m	<3m	N/A
22	3/22/2019 0:00	28.25	0.87	0.03	0.24	0.03	0.02	<3m	<3m	N/A
23	3/29/2019 13:30	2.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.13	0.03	0.05	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:00	6.75	0.41	0.06	0.1	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	6.75	0.17	0.03	0.04	0.01	0.00	<3m	<3m	N/A
27	4/8/2019 3:00	10.5	0.41	0.04	0.14	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:30	1	0.06	0.06	0.06	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:00	10	0.4	0.04	0.1	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 21:30	17.75	0.93	0.05	0.65	0.04	0.02	3-6m	<3m	N/A
31	4/19/2019 23:15	26	0.27	0.01	0.12	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:30	17.75	2.66	0.15	0.36	0.11	0.06	<3m	1-2yr	N/A
33	4/23/2019 22:15	2.5	0.12	0.05	0.09	0.02	0.06	<3m	<3m	N/A
34	4/26/2019 6:45	27.75	1.66	0.06	0.48	0.07	0.03	<3m	<3m	N/A
35	4/28/2019 17:45	0.75	0.02	0.03	0.02	0.00	0.03	<3m	<3m	N/A
36	4/30/2019 1:45	8	0.14	0.02	0.04	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 1:15	13	0.05	0.00	0.02	0.00	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
38	5/3/2019 13:30	16.25	0.26	0.02	0.12	0.01	0.01	<3m	<3m	N/A
39	5/5/2019 4:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
40	5/7/2019 18:30	3.25	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
41	5/11/2019 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 7:00	13	0.49	0.04	0.08	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:30	16.75	0.98	0.06	0.31	0.04	0.03	<3m	<3m	N/A
44	5/16/2019 0:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:15	7.75	0.24	0.03	0.07	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:15	2	0.16	0.08	0.14	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:15	3	0.15	0.05	0.14	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 22:45	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:30	2.25	0.3	0.13	0.24	0.01	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	12	0.35	0.03	0.11	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:45	2.75	0.31	0.11	0.18	0.01	0.01	<3m	<3m	N/A
52	6/2/2019 22:15	2.75	0.08	0.03	0.05	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:30	0.5	0.04	0.08	0.04	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:45	11.5	0.88	0.08	0.24	0.04	0.02	<3m	<3m	N/A
55	6/13/2019 8:00	10	0.71	0.07	0.23	0.03	0.01	<3m	<3m	N/A
56	6/16/2019 10:00	9.25	0.09	0.01	0.03	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	3.5	0.1	0.03	0.07	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 5:45	6.5	0.34	0.05	0.26	0.01	0.01	<3m	<3m	N/A
59	6/21/2019 1:45	13.25	0.83	0.06	0.64	0.05	0.02	3-6m	<3m	N/A
60	6/25/2019 12:45	8	0.12	0.02	0.05	0.01	0.00	<3m	<3m	N/A
61	6/29/2019 4:30	11.5	0.74	0.06	0.36	0.03	0.02	<3m	<3m	N/A
62	6/30/2019 14:00	4.25	0.08	0.02	0.06	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 3: Columbus Park

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.32	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
4	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
5	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
6	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
7	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
8	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
9	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
10	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
11	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
12	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
19	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
20	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 11:15	11.75	0.16	0.01	0.13	0.01	0.00	<3m	<3m	N/A
22	3/22/2019 0:00	30.5	1.1	0.04	0.3	0.04	0.02	<3m	<3m	N/A
23	3/29/2019 15:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:30	4	0.08	0.02	0.04	0.00	0.00	<3m	<3m	N/A
25	4/1/2019 4:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
26	4/2/2019 23:15	14.5	0.49	0.03	0.11	0.02	0.01	<3m	<3m	N/A
27	4/5/2019 20:15	7	0.19	0.03	0.05	0.01	0.00	<3m	<3m	N/A
28	4/8/2019 3:00	9.25	0.45	0.05	0.16	0.02	0.01	<3m	<3m	N/A
29	4/9/2019 17:15	12.75	0.08	0.01	0.06	0.00	0.01	<3m	<3m	N/A
30	4/12/2019 22:00	10.25	0.36	0.04	0.09	0.02	0.01	<3m	<3m	N/A
31	4/14/2019 21:30	17.5	0.77	0.04	0.54	0.03	0.02	3m	<3m	N/A
32	4/19/2019 23:30	25.5	0.22	0.01	0.13	0.01	0.00	<3m	<3m	N/A
33	4/22/2019 12:00	17	2.59	0.15	0.4	0.11	0.05	<3m	6m-1yr	N/A
34	4/23/2019 22:15	4.25	0.11	0.03	0.09	0.01	0.06	<3m	<3m	N/A
35	4/26/2019 7:00	21.5	1.49	0.07	0.01	0.06	0.03	<3m	<3m	N/A
36	4/28/2019 17:30	0.25	0.01	0.04	0.01	0.00	0.03	<3m	<3m	N/A
37	4/30/2019 1:15	5.5	0.15	0.03	0.01	0.01	0.00	<3m	<3m	N/A
38	5/2/2019 1:30	12.75	0.05	0.00	0.02	0.00	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [(1)]		
								1-hr	24-hr	48-hr
39	5/3/2019 13:30	16	0.22	0.01	0.1	0.01	0.01	<3m	<3m	N/A
40	5/5/2019 5:00	0.75	0.02	0.03	0.02	0.00	0.01	<3m	<3m	N/A
41	5/7/2019 19:00	2.25	0.06	0.03	0.05	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 6:45	13.25	0.51	0.04	0.07	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:45	16	1.04	0.07	0.23	0.04	0.03	<3m	<3m	N/A
44	5/14/2019 23:00	0.5	0.02	0.04	0.02	0.01	0.02	<3m	<3m	N/A
45	5/16/2019 0:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
46	5/17/2019 8:00	8.5	0.25	0.03	0.08	0.01	0.01	<3m	<3m	N/A
47	5/19/2019 10:15	1.25	0.16	0.13	0.15	0.01	0.01	<3m	<3m	N/A
48	5/20/2019 1:30	1	0.09	0.09	0.02	0.01	0.01	<3m	<3m	N/A
49	5/20/2019 17:00	0.25	0.01	0.04	0.02	0.00	0.01	<3m	<3m	N/A
50	5/23/2019 22:45	0.75	0.14	0.19	0.02	0.01	0.00	<3m	<3m	N/A
51	5/25/2019 23:30	6	0.31	0.05	0.02	0.01	0.01	<3m	<3m	N/A
52	5/28/2019 12:15	10	0.31	0.03	0.02	0.01	0.01	<3m	<3m	N/A
53	5/30/2019 21:45	10.75	0.37	0.03	0.02	0.02	0.01	<3m	<3m	N/A
54	6/2/2019 23:45	1.75	0.03	0.02	0.02	0.00	0.00	<3m	<3m	N/A
55	6/5/2019 22:45	1.75	0.05	0.03	0.03	0.00	0.00	<3m	<3m	N/A
56	6/10/2019 22:30	11.75	0.8	0.07	0.17	0.03	0.02	<3m	<3m	N/A
57	6/13/2019 7:45	9.75	0.8	0.08	0.26	0.03	0.02	<3m	<3m	N/A
58	6/16/2019 10:00	13	0.07	0.01	0.02	0.00	0.00	<3m	<3m	N/A
59	6/18/2019 13:15	4.25	0.12	0.03	0.06	0.01	0.00	<3m	<3m	N/A
60	6/20/2019 6:15	7.25	0.34	0.05	0.26	0.01	0.01	<3m	<3m	N/A
61	6/21/2019 2:45	13	1.03	0.08	0.79	0.05	0.03	6m-1yr	<3m	N/A
62	6/25/2019 12:30	8.25	0.11	0.01	0.04	0.00	0.00	<3m	<3m	N/A
63	6/29/2019 5:15	19.75	0.67	0.03	0.28	0.03	0.01	<3m	<3m	N/A
64	6/30/2019 13:45	6.5	0.37	0.06	0.02	0.03	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 4: Charlestown

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.32	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	14	0.45	0.03	0.10	0.02	0.01	<3m	<3m	N/A
3	1/8/2019 21:15	16.25	0.16	0.01	0.06	0.01	0.00	<3m	<3m	N/A
4	1/19/2019 17:30	22.5	1.27	0.06	0.21	0.05	0.03	<3m	<3m	N/A
5	1/23/2019 11:15	5.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
6	1/24/2019 10:00	1	0.06	0.06	0.06	0.00	0.00	<3m	<3m	N/A
7	1/29/2019 22:45	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
8	2/6/2019 20:15	11.25	0.49	0.04	0.12	0.02	0.01	<3m	<3m	N/A
9	2/7/2019 23:15	19.25	0.1	0.01	0.04	0.01	0.01	<3m	<3m	N/A
10	2/12/2019 15:45	13	1.03	0.08	0.17	0.04	0.02	<3m	<3m	N/A
11	2/13/2019 16:45	0.25	0.01	0.04	0.01	0.04	0.02	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.08	0.03	0.06	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 1:45	13	0.25	0.02	0.08	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:15	8	0.46	0.06	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.4	0.04	0.09	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 2:30	7.5	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
18	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
19	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 21:15	13.75	0.18	0.01	0.15	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	33	0.87	0.03	0.2	0.03	0.02	<3m	<3m	N/A
22	3/28/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
23	3/29/2019 13:45	2.25	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.14	0.03	0.06	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:15	6.5	0.37	0.06	0.09	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	8	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
27	4/8/2019 3:00	9.25	0.37	0.04	0.14	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:15	1.25	0.07	0.06	0.06	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:15	9.75	0.39	0.04	0.1	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 21:30	17	0.77	0.05	0.53	0.03	0.02	3m	<3m	N/A
31	4/19/2019 23:15	26	0.27	0.01	0.12	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:15	16	2.24	0.14	0.36	0.09	0.05	<3m	3-6m	N/A
33	4/23/2019 22:15	4.75	0.14	0.03	0.1	0.01	0.05	<3m	<3m	N/A
34	4/26/2019 6:45	26.25	1.27	0.05	0.43	0.05	0.03	<3m	<3m	N/A
35	4/28/2019 18:15	0.25	0.01	0.04	0.01	0.00	0.02	<3m	<3m	N/A
36	4/30/2019 1:30	8.75	0.15	0.02	0.05	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 2:00	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:30	15.75	0.24	0.02	0.09	0.01	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
39	5/5/2019 5:15	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
40	5/7/2019 18:15	3.25	0.1	0.03	0.06	0.00	0.00	<3m	<3m	N/A
41	5/10/2019 23:15	2.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 7:00	13	0.33	0.03	0.06	0.01	0.01	<3m	<3m	N/A
43	5/13/2019 16:30	19.25	0.86	0.04	0.23	0.04	0.02	<3m	<3m	N/A
44	5/16/2019 1:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:00	7.75	0.25	0.03	0.08	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:15	2	0.21	0.11	0.12	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:30	1.25	0.21	0.17	0.2	0.02	0.01	<3m	<3m	N/A
48	5/20/2019 17:00	0.25	0.01	0.04	0.01	0.01	0.01	<3m	<3m	N/A
49	5/23/2019 22:45	0.75	0.12	0.16	0.12	0.01	0.00	<3m	<3m	N/A
50	5/25/2019 23:30	2	0.23	0.12	0.18	0.01	0.00	<3m	<3m	N/A
51	5/28/2019 12:00	9.25	0.32	0.03	0.1	0.01	0.01	<3m	<3m	N/A
52	5/30/2019 21:30	3	0.24	0.08	0.16	0.01	0.01	<3m	<3m	N/A
53	6/2/2019 22:30	2.75	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
54	6/5/2019 22:45	3.5	0.12	0.03	0.09	0.01	0.00	<3m	<3m	N/A
55	6/10/2019 22:45	11.25	0.73	0.06	0.21	0.03	0.02	<3m	<3m	N/A
56	6/13/2019 8:00	10	0.64	0.06	0.19	0.03	0.01	<3m	<3m	N/A
57	6/16/2019 10:00	10.75	0.16	0.01	0.05	0.01	0.00	<3m	<3m	N/A
58	6/18/2019 13:15	3.5	0.1	0.03	0.06	0.00	0.00	<3m	<3m	N/A
59	6/20/2019 6:15	5.5	0.37	0.07	0.28	0.02	0.01	<3m	<3m	N/A
60	6/21/2019 1:45	3.25	0.76	0.23	0.65	0.05	0.02	3-6m	<3m	N/A
61	6/27/2019 8:00	8.25	0.02	0.00	0.01	0.00	0.00	<3m	<3m	N/A
62	6/28/2019 11:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
63	6/29/2019 4:15	11.75	1.43	0.12	1.17	0.06	0.03	2	<3m	N/A
64	6/30/2019 10:00	5.5	0.28	0.05	0.23	0.06	0.04	<3m	<3m	N/A

(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-1yr) or the nearest year.

Rain Gauge 5: Chelsea Creek

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	5.5	0.35	0.06	0.14	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	14	0.45	0.03	0.10	0.02	0.01	<3m	<3m	N/A
3	1/8/2019 21:15	16.25	0.16	0.01	0.06	0.01	0.00	<3m	<3m	N/A
4	1/19/2019 17:30	22.5	1.27	0.06	0.21	0.05	0.03	<3m	<3m	N/A
5	1/23/2019 11:15	5.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
6	1/24/2019 10:00	1	0.06	0.06	0.06	0.00	0.00	<3m	<3m	N/A
7	1/29/2019 22:45	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
8	2/6/2019 20:15	11.25	0.49	0.04	0.12	0.02	0.01	<3m	<3m	N/A
9	2/7/2019 23:15	19.25	0.1	0.01	0.04	0.01	0.01	<3m	<3m	N/A
10	2/12/2019 15:45	13	1.03	0.08	0.17	0.04	0.02	<3m	<3m	N/A
11	2/13/2019 16:45	0.25	0.01	0.04	0.01	0.04	0.02	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.08	0.03	0.06	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 1:45	13	0.25	0.02	0.08	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:15	8	0.46	0.06	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.4	0.04	0.09	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 2:30	7.5	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:45	7	0.21	0.03	0.06	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 22:00	13.75	1.24	0.09	0.21	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:45	10	0.49	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 21:15	2.25	0.19	0.08	0.16	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	26.5	0.89	0.03	0.22	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 11:30	5.25	0.04	0.01	0.02	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:30	4	0.11	0.03	0.06	0.00	0.00	<3m	<3m	N/A
24	4/1/2019 2:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
25	4/2/2019 23:15	6.25	0.33	0.05	0.08	0.01	0.01	<3m	<3m	N/A
26	4/5/2019 6:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
27	4/5/2019 20:15	7	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
28	4/8/2019 3:45	7.5	0.27	0.04	0.13	0.01	0.01	<3m	<3m	N/A
29	4/9/2019 17:30	0.75	0.05	0.07	0.05	0.00	0.01	<3m	<3m	N/A
30	4/11/2019 6:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
31	4/12/2019 9:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
32	4/12/2019 22:15	10	0.38	0.04	0.11	0.02	0.01	<3m	<3m	N/A
33	4/14/2019 21:45	16.75	0.78	0.05	0.55	0.03	0.02	3m	<3m	N/A
34	4/18/2019 15:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
35	4/19/2019 23:15	26	0.27	0.01	0.15	0.01	0.01	<3m	<3m	N/A
36	4/22/2019 12:00	18.75	2.63	0.14	0.44	0.11	0.05	<3m	6m-1yr	N/A
37	4/23/2019 22:15	5	0.17	0.03	0.1	0.02	0.06	<3m	<3m	N/A
38	4/26/2019 6:45	21.75	1.47	0.07	0.48	0.06	0.03	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	4/30/2019 1:45	8.25	0.12	0.01	0.04	0.01	0.00	<3m	<3m	N/A
40	5/2/2019 1:45	12.5	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
41	5/3/2019 13:30	16	0.27	0.02	0.1	0.01	0.01	<3m	<3m	N/A
42	5/5/2019 5:30	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
43	5/7/2019 18:15	12	0.13	0.01	0.08	0.01	0.00	<3m	<3m	N/A
44	5/10/2019 23:15	2.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
45	5/12/2019 7:00	14.25	0.29	0.02	0.05	0.01	0.01	<3m	<3m	N/A
46	5/13/2019 16:45	16.75	1.03	0.06	0.32	0.04	0.03	<3m	<3m	N/A
47	5/14/2019 22:45	0.25	0.01	0.04	0.01	0.01	0.02	<3m	<3m	N/A
48	5/16/2019 1:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
49	5/17/2019 7:30	8.25	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
50	5/19/2019 10:15	1.75	0.24	0.14	0.15	0.01	0.01	<3m	<3m	N/A
51	5/20/2019 1:30	1	0.22	0.22	0.22	0.02	0.01	<3m	<3m	N/A
52	5/20/2019 17:00	0.75	0.03	0.04	0.03	0.01	0.01	<3m	<3m	N/A
54	5/22/2019 13:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
55	5/23/2019 22:45	0.75	0.15	0.20	0.15	0.01	0.00	<3m	<3m	N/A
56	5/25/2019 23:30	2	0.26	0.13	0.23	0.01	0.01	<3m	<3m	N/A
57	5/28/2019 12:00	10	0.32	0.03	0.1	0.01	0.01	<3m	<3m	N/A
58	5/30/2019 21:30	3.25	0.23	0.07	0.16	0.01	0.00	<3m	<3m	N/A
59	6/2/2019 22:30	2.25	0.08	0.04	0.05	0.00	0.00	<3m	<3m	N/A
60	6/5/2019 23:15	3.25	0.08	0.02	0.06	0.00	0.00	<3m	<3m	N/A
61	6/10/2019 22:45	11.5	0.73	0.06	0.19	0.03	0.02	<3m	<3m	N/A
62	6/13/2019 7:15	11.25	0.68	0.06	0.22	0.03	0.01	<3m	<3m	N/A
63	6/16/2019 10:15	10.5	0.18	0.02	0.06	0.01	0.00	<3m	<3m	N/A
64	6/18/2019 13:15	3.5	0.11	0.03	0.07	0.00	0.00	<3m	<3m	N/A
65	6/20/2019 6:15	33.5	1.28	0.04	0.68	0.05	0.03	3-6m	<3m	N/A
66	6/25/2019 12:45	8	0.14	0.02	0.06	0.01	0.00	<3m	<3m	N/A
67	6/29/2019 4:30	11.5	1.82	0.16	1.67	0.08	0.04	7	3m	N/A
68	6/30/2019 13:45	6.25	0.19	0.03	0.15	0.08	0.04	<3m	3m	N/A

(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-1yr) or the nearest year.

Rain Gauge 6: Dorchester-Adams

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.34	0.07	0.14	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
3	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
4	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
6	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
7	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
8	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	13.75	0.19	0.01	0.16	0.01	0.00	<3m	<3m	N/A
21	3/21/2019 23:45	32	0.94	0.03	0.26	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 14:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:15	4.75	0.13	0.03	0.06	0.01	0.00	<3m	<3m	N/A
24	4/2/2019 23:00	7	0.44	0.06	0.09	0.02	0.01	<3m	<3m	N/A
25	4/5/2019 20:15	7	0.2	0.03	0.05	0.01	0.00	<3m	<3m	N/A
26	4/8/2019 3:00	9.75	0.43	0.04	0.15	0.02	0.01	<3m	<3m	N/A
27	4/9/2019 17:30	1	0.06	0.06	0.06	0.00	0.01	<3m	<3m	N/A
28	4/12/2019 22:00	10.25	0.41	0.04	0.1	0.02	0.01	<3m	<3m	N/A
29	4/14/2019 20:45	18.25	0.84	0.05	0.55	0.04	0.02	3m	<3m	N/A
30	4/19/2019 23:15	26.25	0.29	0.01	0.13	0.01	0.01	<3m	<3m	N/A
31	4/22/2019 12:15	18.25	2.48	0.14	0.38	0.10	0.05	<3m	6m-1yr	N/A
32	4/23/2019 22:15	4.5	0.11	0.02	0.09	0.01	0.05	<3m	<3m	N/A
33	4/26/2019 6:45	21.5	1.58	0.07	0.48	0.07	0.03	<3m	<3m	N/A
34	4/28/2019 16:30	1.5	0.02	0.01	0.01	0.00	0.03	<3m	<3m	N/A
35	4/30/2019 1:00	6	0.15	0.03	0.05	0.01	0.00	<3m	<3m	N/A
36	5/2/2019 2:00	12	0.03	0.00	0.02	0.00	0.00	<3m	<3m	N/A
37	5/3/2019 13:30	1.75	0.11	0.06	0.1	0.00	0.00	<3m	<3m	N/A
38	5/4/2019 3:15	2	0.09	0.05	0.05	0.01	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
39	5/5/2019 5:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
40	5/5/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/7/2019 19:00	2.5	0.07	0.03	0.06	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 6:45	13.25	0.59	0.04	0.07	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:15	25.25	0.97	0.04	0.25	0.04	0.03	<3m	<3m	N/A
44	5/17/2019 6:45	19	0.17	0.01	0.07	0.01	0.00	<3m	<3m	N/A
45	5/19/2019 10:15	1	0.12	0.12	0.12	0.01	0.00	<3m	<3m	N/A
46	5/20/2019 1:30	1	0.06	0.06	0.06	0.01	0.00	<3m	<3m	N/A
47	5/20/2019 17:00	0.5	0.09	0.18	0.09	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 19:30	4.25	0.15	0.04	0.13	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:15	6.25	0.46	0.07	0.36	0.02	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	12	0.33	0.03	0.12	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:30	4.25	0.4	0.09	0.18	0.02	0.01	<3m	<3m	N/A
52	6/3/2019 0:15	1.25	0.03	0.02	0.02	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:30	11.25	0.81	0.07	0.2	0.03	0.02	<3m	<3m	N/A
55	6/13/2019 7:15	11	0.8	0.07	0.3	0.03	0.02	<3m	<3m	N/A
56	6/16/2019 3:00	26	0.09	0.00	0.02	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	1.5	0.09	0.06	0.07	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 5:30	6.25	0.32	0.05	0.22	0.01	0.01	<3m	<3m	N/A
59	6/21/2019 2:00	13.25	1.17	0.09	1	0.06	0.03	1.3	<3m	N/A
60	6/25/2019 12:00	10.75	0.23	0.02	0.09	0.01	0.00	<3m	<3m	N/A
61	6/29/2019 5:15	11	1.25	0.11	0.68	0.05	0.03	3-6m	<3m	N/A
62	6/30/2019 14:30	4.25	0.07	0.02	0.04	0.02	0.03	<3m	<3m	N/A

(2) 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-1yr) or the nearest year.

Rain Gauge 7: Dorchester-Talbot

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.34	0.07	0.14	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
3	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
4	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
6	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
7	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
8	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	13.75	0.19	0.01	0.16	0.01	0.00	<3m	<3m	N/A
21	3/21/2019 23:45	32	0.94	0.03	0.26	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 14:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:15	4.75	0.13	0.03	0.06	0.01	0.00	<3m	<3m	N/A
24	4/2/2019 23:00	7	0.44	0.06	0.09	0.02	0.01	<3m	<3m	N/A
25	4/5/2019 20:15	7	0.2	0.03	0.05	0.01	0.00	<3m	<3m	N/A
26	4/8/2019 3:00	9.75	0.43	0.04	0.15	0.02	0.01	<3m	<3m	N/A
27	4/9/2019 17:30	1	0.06	0.06	0.06	0.00	0.01	<3m	<3m	N/A
28	4/12/2019 22:00	10.25	0.41	0.04	0.1	0.02	0.01	<3m	<3m	N/A
29	4/14/2019 20:45	18.25	0.84	0.05	0.55	0.04	0.02	3m	<3m	N/A
30	4/19/2019 23:15	26.25	0.29	0.01	0.13	0.01	0.01	<3m	<3m	N/A
31	4/22/2019 12:15	18.25	2.48	0.14	0.38	0.10	0.05	<3m	6m-1yr	N/A
32	4/23/2019 22:15	4.5	0.11	0.02	0.09	0.01	0.05	<3m	<3m	N/A
33	4/26/2019 6:45	21.5	1.58	0.07	0.48	0.07	0.03	<3m	<3m	N/A
34	4/28/2019 16:30	1.5	0.02	0.01	0.01	0.00	0.03	<3m	<3m	N/A
35	4/30/2019 1:00	6	0.15	0.03	0.05	0.01	0.00	<3m	<3m	N/A
36	5/2/2019 2:00	12	0.03	0.00	0.02	0.00	0.00	<3m	<3m	N/A
37	5/3/2019 13:30	1.75	0.11	0.06	0.1	0.00	0.00	<3m	<3m	N/A
38	5/4/2019 3:15	2	0.09	0.05	0.05	0.01	0.00	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
39	5/5/2019 5:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
40	5/5/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/7/2019 19:00	2.5	0.07	0.03	0.06	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 6:45	13.25	0.59	0.04	0.07	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:15	25.25	0.97	0.04	0.25	0.04	0.03	<3m	<3m	N/A
44	5/17/2019 6:45	19	0.17	0.01	0.07	0.01	0.00	<3m	<3m	N/A
45	5/19/2019 10:15	1	0.12	0.12	0.12	0.01	0.00	<3m	<3m	N/A
46	5/20/2019 1:30	1	0.06	0.06	0.06	0.01	0.00	<3m	<3m	N/A
47	5/20/2019 17:00	0.5	0.09	0.18	0.09	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 19:30	4.25	0.15	0.04	0.13	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:15	6.25	0.46	0.07	0.36	0.02	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	12	0.33	0.03	0.12	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:30	4.25	0.4	0.09	0.18	0.02	0.01	<3m	<3m	N/A
52	6/3/2019 0:15	1.25	0.03	0.02	0.02	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:30	11.25	0.81	0.07	0.2	0.03	0.02	<3m	<3m	N/A
55	6/13/2019 7:15	11	0.8	0.07	0.3	0.03	0.02	<3m	<3m	N/A
56	6/16/2019 3:00	26	0.09	0.00	0.02	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	1.5	0.09	0.06	0.07	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 5:30	6.25	0.32	0.05	0.22	0.01	0.01	<3m	<3m	N/A
59	6/21/2019 2:00	13.25	1.17	0.09	1	0.06	0.03	1.3	<3m	N/A
60	6/25/2019 12:00	10.75	0.23	0.02	0.09	0.01	0.00	<3m	<3m	N/A
51	6/29/2019 5:15	11	1.25	0.11	0.68	0.05	0.03	3-6m	<3m	N/A
62	6/30/2019 14:30	4.25	0.07	0.02	0.04	0.02	0.03	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Rain Gauge 8: East Boston

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.34	0.07	0.14	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	14	0.45	0.03	0.10	0.02	0.01	<3m	<3m	N/A
3	1/8/2019 21:15	16.25	0.16	0.01	0.06	0.01	0.00	<3m	<3m	N/A
4	1/19/2019 17:30	22.5	1.27	0.06	0.21	0.05	0.03	<3m	<3m	N/A
5	1/23/2019 11:15	5.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
6	1/24/2019 10:00	1	0.06	0.06	0.06	0.00	0.00	<3m	<3m	N/A
7	1/29/2019 22:45	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
8	2/6/2019 20:15	11.25	0.49	0.04	0.12	0.02	0.01	<3m	<3m	N/A
9	2/7/2019 23:15	19.25	0.1	0.01	0.04	0.01	0.01	<3m	<3m	N/A
10	2/12/2019 15:45	13	1.03	0.08	0.17	0.04	0.02	<3m	<3m	N/A
11	2/13/2019 16:45	0.25	0.01	0.04	0.01	0.04	0.02	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.08	0.03	0.06	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 1:45	13	0.25	0.02	0.08	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:15	8	0.46	0.06	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.4	0.04	0.09	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 2:30	7.5	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
18	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
19	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 21:15	1.75	0.21	0.12	0.19	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	26.5	1	0.04	0.22	0.04	0.02	<3m	<3m	N/A
22	3/28/2019 23:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
23	3/29/2019 14:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.12	0.03	0.06	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:15	6.5	0.44	0.07	0.11	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	7	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
27	4/8/2019 3:00	9.75	0.39	0.04	0.15	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:30	12.25	0.08	0.01	0.07	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:15	9.75	0.39	0.04	0.1	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 21:30	18.25	0.87	0.05	0.56	0.04	0.02	3m	<3m	N/A
31	4/19/2019 23:15	26	0.24	0.01	0.13	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:00	18.75	2.53	0.13	0.41	0.11	0.05	<3m	6m-1yr	N/A
33	4/23/2019 22:15	3.75	0.14	0.04	0.09	0.01	0.06	<3m	<3m	N/A
34	4/26/2019 6:45	21.75	1.47	0.07	0.47	0.06	0.03	<3m	<3m	N/A
35	4/28/2019 18:15	0.25	0.01	0.04	0.01	0.00	0.03	<3m	<3m	N/A
36	4/30/2019 1:45	8.25	0.13	0.02	0.04	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 2:00	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:30	16.25	0.25	0.02	0.09	0.01	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/7/2019 18:15	3.5	0.11	0.03	0.07	0.00	0.00	<3m	<3m	N/A
40	5/11/2019 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/12/2019 6:45	12.75	0.32	0.03	0.05	0.01	0.01	<3m	<3m	N/A
42	5/13/2019 16:30	17	0.97	0.06	0.31	0.04	0.03	<3m	<3m	N/A
43	5/14/2019 22:45	0.25	0.01	0.04	0.01	0.01	0.02	<3m	<3m	N/A
44	5/16/2019 1:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:15	7.5	0.23	0.03	0.07	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:15	1.75	0.2	0.11	0.12	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:30	1.25	0.22	0.18	0.21	0.02	0.01	<3m	<3m	N/A
48	5/23/2019 22:45	2.25	0.12	0.05	0.11	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:30	2	0.23	0.12	0.18	0.01	0.00	<3m	<3m	N/A
50	5/28/2019 12:00	9.75	0.31	0.03	0.09	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 22:00	2.75	0.27	0.10	0.17	0.01	0.01	<3m	<3m	N/A
52	6/2/2019 22:30	2.5	0.09	0.04	0.05	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:00	7.25	0.07	0.01	0.06	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:45	11.25	0.74	0.07	0.19	0.03	0.02	<3m	<3m	N/A
55	6/13/2019 7:45	11.25	0.67	0.06	0.21	0.03	0.01	<3m	<3m	N/A
56	6/16/2019 10:15	10.75	0.14	0.01	0.05	0.01	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	3.5	0.1	0.03	0.06	0.00	0.00	<3m	<3m	N/A
58	6/19/2019 11:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
59	6/20/2019 6:15	5.5	0.39	0.07	0.29	0.02	0.01	<3m	<3m	N/A
60	6/21/2019 2:45	13	1.02	0.08	0.8	0.05	0.03	6m-1yr	<3m	N/A
61	6/25/2019 12:45	8.25	0.16	0.02	0.08	0.01	0.00	<3m	<3m	N/A
62	6/29/2019 4:15	12	2.2	0.18	1.97	0.09	0.05	15.7	3-6m	N/A
63	6/30/2019 13:45	4.5	0.16	0.04	0.12	0.09	0.05	<3m	3-6m	N/A

(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-1yr) or the nearest year.

Rain Gauge 9: Hanscom AFB

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.3	0.06	0.12	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 9:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 16:00	2.5	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
4	1/9/2019 4:00	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
5	1/19/2019 18:00	20.25	0.8	0.04	0.13	0.03	0.02	<3m	<3m	N/A
6	1/24/2019 12:15	6.25	0.47	0.08	0.18	0.02	0.01	<3m	<3m	N/A
7	2/6/2019 20:30	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
8	2/12/2019 15:00	13.5	0.56	0.04	0.11	0.02	0.01	<3m	<3m	N/A
9	2/18/2019 1:15	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
10	2/21/2019 0:00	3.75	0.14	0.04	0.09	0.01	0.00	<3m	<3m	N/A
11	2/24/2019 8:45	4.25	0.04	0.01	0.01	0.00	0.00	<3m	<3m	N/A
12	2/28/2019 1:15	1.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
13	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
14	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
15	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
16	3/15/2019 8:30	14.5	0.28	0.02	0.23	0.01	0.01	<3m	<3m	N/A
17	3/22/2019 0:15	32	0.79	0.02	0.18	0.03	0.02	<3m	<3m	N/A
18	3/29/2019 15:00	0.75	0.02	0.03	0.02	0.00	0.00	<3m	<3m	N/A
19	3/31/2019 4:15	14.5	0.2	0.01	0.09	0.01	0.00	<3m	<3m	N/A
20	4/2/2019 23:45	7.75	0.38	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	4/5/2019 20:15	8	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
22	4/8/2019 3:00	8.75	0.42	0.05	0.11	0.02	0.01	<3m	<3m	N/A
23	4/9/2019 17:00	13	0.13	0.01	0.09	0.01	0.01	<3m	<3m	N/A
24	4/12/2019 22:15	8.25	0.45	0.05	0.11	0.02	0.01	<3m	<3m	N/A
25	4/14/2019 23:00	13.25	0.84	0.06	0.51	0.04	0.02	<3m	<3m	N/A
26	4/19/2019 20:30	29	0.46	0.02	0.13	0.02	0.01	<3m	<3m	N/A
27	4/22/2019 12:30	20.25	2.5	0.12	0.39	0.10	0.05	<3m	6m-1yr	N/A
28	4/23/2019 22:15	3.5	0.14	0.04	0.1	0.02	0.05	<3m	<3m	N/A
29	4/26/2019 5:45	22.75	1.52	0.07	0.52	0.06	0.03	<3m	<3m	N/A
30	4/28/2019 17:30	1.25	0.02	0.02	0.01	0.00	0.03	<3m	<3m	N/A
31	4/30/2019 1:15	5.5	0.13	0.02	0.04	0.01	0.00	<3m	<3m	N/A
32	5/2/2019 12:30	0.25	0.07	0.28	0.07	0.00	0.00	<3m	<3m	N/A
33	5/3/2019 13:15	17.75	0.25	0.01	0.09	0.01	0.01	<3m	<3m	N/A
34	5/5/2019 4:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
35	5/7/2019 17:00	4.75	0.23	0.05	0.09	0.01	0.00	<3m	<3m	N/A
36	5/10/2019 13:00	2.25	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
37	5/12/2019 7:30	12.25	0.28	0.02	0.06	0.01	0.01	<3m	<3m	N/A
38	5/13/2019 16:30	17.25	0.78	0.05	0.15	0.03	0.02	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
39	5/14/2019 22:45	6	0.02	0.00	0.01	0.01	0.02	<3m	<3m	N/A
40	5/16/2019 1:15	1.25	0.02	0.02	0.01	0.00	0.00	<3m	<3m	N/A
41	5/17/2019 7:30	8	0.28	0.04	0.08	0.01	0.01	<3m	<3m	N/A
42	5/19/2019 10:00	2.25	0.35	0.16	0.23	0.01	0.01	<3m	<3m	N/A
43	5/20/2019 1:15	1	0.13	0.13	0.13	0.02	0.01	<3m	<3m	N/A
44	5/20/2019 15:15	1.75	0.07	0.04	0.04	0.01	0.01	<3m	<3m	N/A
45	5/23/2019 22:45	0.75	0.13	0.17	0.13	0.01	0.00	<3m	<3m	N/A
46	5/25/2019 23:30	1.5	0.26	0.17	0.23	0.01	0.01	<3m	<3m	N/A
47	5/27/2019 17:15	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
48	5/28/2019 12:00	11	0.35	0.03	0.11	0.01	0.01	<3m	<3m	N/A
49	5/30/2019 22:30	5.25	0.08	0.02	0.06	0.00	0.00	<3m	<3m	N/A
50	6/2/2019 17:30	7.25	0.32	0.04	0.22	0.01	0.01	<3m	<3m	N/A
51	6/5/2019 22:30	7.75	0.22	0.03	0.17	0.01	0.00	<3m	<3m	N/A
52	6/10/2019 22:45	11.75	1.15	0.10	0.42	0.05	0.02	<3m	<3m	N/A
53	6/13/2019 8:15	11	0.63	0.06	0.36	0.03	0.01	<3m	<3m	N/A
54	6/16/2019 2:30	18.25	0.26	0.01	0.05	0.01	0.01	<3m	<3m	N/A
55	6/18/2019 13:15	3.25	0.08	0.02	0.04	0.00	0.00	<3m	<3m	N/A
56	6/20/2019 5:45	23.25	0.91	0.04	0.61	0.04	0.02	3-6m	<3m	N/A
57	6/22/2019 14:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
58	6/25/2019 12:30	10.25	0.33	0.03	0.24	0.01	0.01	<3m	<3m	N/A
59	6/29/2019 4:15	11.5	0.31	0.03	0.2	0.01	0.01	<3m	<3m	N/A
60	6/30/2019 9:45	8.75	0.64	0.07	0.31	0.03	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 10: Hyde Park

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	5.75	0.28	0.05	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
3	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
4	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
6	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
7	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
8	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	14.25	0.23	0.02	0.2	0.01	0.00	<3m	<3m	N/A
21	3/21/2019 23:45	32.5	1.05	0.03	0.31	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 13:30	2.75	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:15	4.75	0.12	0.03	0.05	0.01	0.00	<3m	<3m	N/A
24	4/2/2019 23:00	7.25	0.44	0.06	0.1	0.02	0.01	<3m	<3m	N/A
25	4/5/2019 20:00	7.75	0.2	0.03	0.05	0.01	0.00	<3m	<3m	N/A
26	4/8/2019 3:15	9.75	0.48	0.05	0.15	0.02	0.01	<3m	<3m	N/A
27	4/9/2019 17:30	1	0.05	0.05	0.05	0.00	0.01	<3m	<3m	N/A
28	4/12/2019 22:00	10.25	0.46	0.04	0.11	0.02	0.01	<3m	<3m	N/A
29	4/14/2019 21:30	18.25	1.05	0.06	0.64	0.04	0.02	3-6m	<3m	N/A
30	4/19/2019 23:15	25.75	0.3	0.01	0.1	0.01	0.01	<3m	<3m	N/A
31	4/22/2019 12:15	20.25	3.15	0.16	0.51	0.13	0.07	<3m	1.5	N/A
32	4/23/2019 23:30	2.75	0.11	0.04	0.09	0.01	0.07	<3m	<3m	N/A
33	4/26/2019 6:30	22.5	1.5	0.07	0.41	0.06	0.03	<3m	<3m	N/A
34	4/28/2019 16:15	2.5	0.05	0.02	0.03	0.00	0.03	<3m	<3m	N/A
35	4/30/2019 1:00	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
36	5/2/2019 2:00	12	0.02	0.00	0.01	0.00	0.00	<3m	<3m	N/A
37	5/3/2019 13:30	1.5	0.09	0.06	0.08	0.00	0.00	<3m	<3m	N/A
38	5/4/2019 3:15	2	0.06	0.03	0.04	0.01	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [(1)]		
								1-hr	24-hr	48-hr
39	5/5/2019 5:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
40	5/5/2019 20:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/7/2019 19:00	3.25	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
42	5/10/2019 22:30	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
43	5/12/2019 7:00	13.75	0.64	0.05	0.08	0.03	0.01	<3m	<3m	N/A
44	5/13/2019 16:30	21	0.93	0.04	0.21	0.04	0.03	<3m	<3m	N/A
45	5/17/2019 7:30	8.75	0.15	0.02	0.06	0.01	0.00	<3m	<3m	N/A
46	5/19/2019 10:15	1	0.09	0.09	0.09	0.00	0.00	<3m	<3m	N/A
47	5/20/2019 1:30	0.5	0.03	0.06	0.03	0.01	0.00	<3m	<3m	N/A
48	5/20/2019 15:00	2.5	0.36	0.14	0.21	0.02	0.01	<3m	<3m	N/A
49	5/23/2019 19:30	5.75	0.2	0.03	0.17	0.01	0.00	<3m	<3m	N/A
50	5/25/2019 23:15	2.25	0.45	0.20	0.3	0.02	0.01	<3m	<3m	N/A
51	5/28/2019 11:45	11.5	0.34	0.03	0.12	0.01	0.01	<3m	<3m	N/A
52	5/29/2019 19:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
53	5/30/2019 21:15	3.75	0.41	0.11	0.2	0.02	0.01	<3m	<3m	N/A
54	6/2/2019 23:30	2	0.05	0.03	0.03	0.00	0.00	<3m	<3m	N/A
55	6/5/2019 23:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
56	6/10/2019 22:30	12	0.84	0.07	0.2	0.04	0.02	<3m	<3m	N/A
57	6/13/2019 7:30	10.25	0.78	0.08	0.27	0.03	0.02	<3m	<3m	N/A
58	6/16/2019 3:00	16.25	0.1	0.01	0.03	0.00	0.00	<3m	<3m	N/A
59	6/18/2019 13:00	1.75	0.14	0.08	0.12	0.01	0.00	<3m	<3m	N/A
60	6/20/2019 5:30	6.25	0.32	0.05	0.22	0.01	0.01	<3m	<3m	N/A
61	6/21/2019 2:00	13.25	1.17	0.09	1	0.06	0.03	1.2	<3m	N/A
62	6/25/2019 12:00	10.75	0.23	0.02	0.09	0.01	0.00	<3m	<3m	N/A
63	6/29/2019 4:30	11.75	0.59	0.05	0.37	0.02	0.01	<3m	<3m	N/A
64	6/30/2019 14:30	4	0.12	0.03	0.09	0.01	0.01	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 11: Lexington Farm

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.3	0.06	0.12	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 9:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 16:00	2.5	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
4	1/9/2019 4:00	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
5	1/19/2019 18:00	20.25	0.8	0.04	0.13	0.03	0.02	<3m	<3m	N/A
6	1/24/2019 12:15	6.25	0.47	0.08	0.18	0.02	0.01	<3m	<3m	N/A
7	2/6/2019 20:30	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
8	2/12/2019 15:00	13.5	0.56	0.04	0.11	0.02	0.01	<3m	<3m	N/A
9	2/18/2019 1:15	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
10	2/21/2019 0:00	3.75	0.14	0.04	0.09	0.01	0.00	<3m	<3m	N/A
11	2/24/2019 8:45	4.25	0.04	0.01	0.01	0.00	0.00	<3m	<3m	N/A
12	2/28/2019 1:15	1.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
13	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
14	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
15	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
16	3/15/2019 8:30	14.5	0.28	0.02	0.23	0.01	0.01	<3m	<3m	N/A
17	3/22/2019 0:15	32	0.79	0.02	0.18	0.03	0.02	<3m	<3m	N/A
18	3/29/2019 15:00	0.75	0.02	0.03	0.02	0.00	0.00	<3m	<3m	N/A
19	3/31/2019 4:15	14.5	0.2	0.01	0.09	0.01	0.00	<3m	<3m	N/A
20	4/2/2019 23:45	7.75	0.38	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	4/5/2019 20:15	8	0.24	0.03	0.06	0.01	0.01	<3m	<3m	N/A
22	4/8/2019 3:00	8.75	0.42	0.05	0.11	0.02	0.01	<3m	<3m	N/A
23	4/9/2019 17:00	13	0.13	0.01	0.09	0.01	0.01	<3m	<3m	N/A
24	4/12/2019 22:15	8.25	0.45	0.05	0.11	0.02	0.01	<3m	<3m	N/A
25	4/14/2019 23:00	13.25	0.84	0.06	0.51	0.04	0.02	<3m	<3m	N/A
26	4/20/2019 0:30	26	0.34	0.01	0.14	0.01	0.01	<3m	<3m	N/A
27	4/22/2019 13:30	18.5	2.15	0.12	0.47	0.09	0.04	<3m	3-6m	N/A
28	4/23/2019 23:15	4	0.12	0.03	0.06	0.01	0.05	<3m	<3m	N/A
29	4/26/2019 8:00	22	0.97	0.04	0.31	0.04	0.02	<3m	<3m	N/A
30	4/28/2019 19:00	0.25	0.01	0.04	0.01	0.00	0.02	<3m	<3m	N/A
31	4/30/2019 2:30	7.25	0.12	0.02	0.03	0.01	0.00	<3m	<3m	N/A
32	5/2/2019 12:30	0.25	0.07	0.28	0.07	0.00	0.00	<3m	<3m	N/A
33	5/3/2019 13:15	17.75	0.25	0.01	0.09	0.01	0.01	<3m	<3m	N/A
34	5/5/2019 4:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
35	5/7/2019 17:00	4.75	0.23	0.05	0.09	0.01	0.00	<3m	<3m	N/A
36	5/10/2019 13:00	2.25	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
37	5/12/2019 7:30	12.25	0.28	0.02	0.06	0.01	0.01	<3m	<3m	N/A
38	5/13/2019 16:30	17.25	0.78	0.05	0.15	0.03	0.02	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [1]		
								1-hr	24-hr	48-hr
39	5/14/2019 22:45	6	0.02	0.00	0.01	0.01	0.02	<3m	<3m	N/A
40	5/16/2019 1:15	1.25	0.02	0.02	0.01	0.00	0.00	<3m	<3m	N/A
41	5/17/2019 7:30	8	0.28	0.04	0.08	0.01	0.01	<3m	<3m	N/A
42	5/19/2019 10:00	2.25	0.35	0.16	0.23	0.01	0.01	<3m	<3m	N/A
43	5/20/2019 1:15	1	0.13	0.13	0.13	0.02	0.01	<3m	<3m	N/A
44	5/20/2019 15:15	1.75	0.07	0.04	0.04	0.01	0.01	<3m	<3m	N/A
45	5/23/2019 22:45	0.75	0.13	0.17	0.13	0.01	0.00	<3m	<3m	N/A
46	5/25/2019 23:30	1.5	0.26	0.17	0.23	0.01	0.01	<3m	<3m	N/A
47	5/27/2019 17:15	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
48	5/28/2019 12:00	11	0.35	0.03	0.11	0.01	0.01	<3m	<3m	N/A
49	5/30/2019 22:30	5.25	0.08	0.02	0.06	0.00	0.00	<3m	<3m	N/A
50	6/2/2019 17:30	7.25	0.32	0.04	0.22	0.01	0.01	<3m	<3m	N/A
51	6/5/2019 22:30	7.75	0.22	0.03	0.17	0.01	0.00	<3m	<3m	N/A
52	6/10/2019 22:45	11.75	1.15	0.10	0.42	0.05	0.02	<3m	<3m	N/A
53	6/13/2019 8:15	11	0.63	0.06	0.36	0.03	0.01	<3m	<3m	N/A
54	6/16/2019 2:30	18.25	0.26	0.01	0.05	0.01	0.01	<3m	<3m	N/A
55	6/18/2019 13:15	3.25	0.08	0.02	0.04	0.00	0.00	<3m	<3m	N/A
56	6/20/2019 5:45	23.25	0.91	0.04	0.61	0.04	0.02	3-6m	<3m	N/A
57	6/22/2019 14:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
58	6/25/2019 12:30	10.25	0.33	0.03	0.24	0.01	0.01	<3m	<3m	N/A
59	6/29/2019 4:15	11.5	0.31	0.03	0.2	0.03	0.02	<3m	<3m	N/A
60	6/30/2019 9:45	8.75	0.64	0.07	0.07	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 12: Longwood

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.31	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
3	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
4	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
6	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
7	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
8	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	14	0.12	0.01	0.09	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	31	0.92	0.03	0.25	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 13:15	2.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:00	5	0.14	0.03	0.06	0.01	0.00	<3m	<3m	N/A
24	4/2/2019 23:00	7	0.41	0.06	0.09	0.02	0.01	<3m	<3m	N/A
25	4/5/2019 20:00	7	0.22	0.03	0.05	0.01	0.00	<3m	<3m	N/A
26	4/8/2019 3:00	9.75	0.43	0.04	0.16	0.02	0.01	<3m	<3m	N/A
27	4/9/2019 17:30	11.5	0.06	0.01	0.05	0.00	0.01	<3m	<3m	N/A
28	4/12/2019 22:00	11	0.44	0.04	0.1	0.02	0.01	<3m	<3m	N/A
29	4/14/2019 23:45	15.5	0.77	0.05	0.54	0.03	0.02	3m	<3m	N/A
30	4/19/2019 23:15	25.75	0.3	0.01	0.13	0.01	0.01	<3m	<3m	N/A
31	4/21/2019 13:00	0.25	0.01	0.04	0.01	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:30	20.5	2.35	0.11	0.3	0.10	0.05	<3m	6m	N/A
33	4/23/2019 22:15	2	0.1	0.05	0.09	0.01	0.05	<3m	<3m	N/A
34	4/26/2019 6:30	28	1.4	0.05	0.41	0.06	0.03	<3m	<3m	N/A
35	4/28/2019 17:30	0.75	0.02	0.03	0.02	0.00	0.03	<3m	<3m	N/A
36	5/2/2019 1:30	12.75	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
37	5/3/2019 13:30	15.75	0.24	0.02	0.1	0.01	0.01	<3m	<3m	N/A
38	5/5/2019 4:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/7/2019 18:30	3.5	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
40	5/10/2019 23:15	2.25	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
41	5/12/2019 6:45	13.5	0.49	0.04	0.06	0.02	0.01	<3m	<3m	N/A
42	5/13/2019 16:30	16.25	0.93	0.06	0.27	0.04	0.03	<3m	<3m	N/A
43	5/15/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
44	5/17/2019 8:00	8	0.24	0.03	0.07	0.01	0.01	<3m	<3m	N/A
45	5/19/2019 10:15	1.75	0.16	0.09	0.13	0.01	0.01	<3m	<3m	N/A
46	5/20/2019 1:15	3	0.18	0.06	0.17	0.01	0.01	<3m	<3m	N/A
47	5/23/2019 22:45	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
48	5/25/2019 23:30	2	0.33	0.17	0.27	0.01	0.01	<3m	<3m	N/A
49	5/28/2019 11:45	9.5	0.33	0.03	0.11	0.01	0.01	<3m	<3m	N/A
50	5/30/2019 21:30	3	0.29	0.10	0.15	0.01	0.01	<3m	<3m	N/A
51	6/2/2019 22:15	2.25	0.08	0.04	0.04	0.00	0.00	<3m	<3m	N/A
52	6/5/2019 22:45	7	0.07	0.01	0.06	0.00	0.00	<3m	<3m	N/A
53	6/10/2019 22:45	11.25	0.75	0.07	0.23	0.03	0.02	<3m	<3m	N/A
54	6/13/2019 7:45	10.75	0.66	0.06	0.21	0.03	0.01	<3m	<3m	N/A
55	6/16/2019 3:30	18	0.12	0.01	0.03	0.01	0.00	<3m	<3m	N/A
56	6/18/2019 13:15	3.25	0.09	0.03	0.06	0.00	0.00	<3m	<3m	N/A
57	6/20/2019 5:45	7.75	0.32	0.04	0.23	0.01	0.01	<3m	<3m	N/A
58	6/21/2019 1:45	6.5	0.76	0.12	0.59	0.04	0.02	3m	<3m	N/A
59	6/27/2019 8:00	7.25	0.02	0.00	0.01	0.00	0.00	<3m	<3m	N/A
60	6/28/2019 7:30	0.5	0.04	0.08	0.04	0.00	0.00	<3m	<3m	N/A
61	6/29/2019 4:30	11.5	0.7	0.06	0.34	0.03	0.02	<3m	<3m	N/A
62	6/30/2019 14:00	4.25	0.09	0.02	0.07	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

Rain Gauge 13: Hayes Pump Station

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	13.5	0.36	0.03	0.21	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	14	0.45	0.03	0.10	0.02	0.01	<3m	<3m	N/A
3	1/8/2019 21:15	16.25	0.16	0.01	0.06	0.01	0.00	<3m	<3m	N/A
4	1/19/2019 17:30	22.5	1.27	0.06	0.21	0.05	0.03	<3m	<3m	N/A
5	1/23/2019 11:15	5.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
6	1/24/2019 10:00	1	0.06	0.06	0.06	0.00	0.00	<3m	<3m	N/A
7	1/29/2019 22:45	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
8	2/6/2019 20:15	11.25	0.49	0.04	0.12	0.02	0.01	<3m	<3m	N/A
9	2/7/2019 23:15	19.25	0.1	0.01	0.04	0.01	0.01	<3m	<3m	N/A
10	2/12/2019 15:45	13	1.03	0.08	0.17	0.04	0.02	<3m	<3m	N/A
11	2/13/2019 16:45	0.25	0.01	0.04	0.01	0.04	0.02	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.08	0.03	0.06	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 1:45	13	0.25	0.02	0.08	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:15	8	0.46	0.06	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.4	0.04	0.09	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 2:30	7.5	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	14	0.12	0.01	0.32	0.01	0.01	<3m	<3m	N/A
21	3/22/2019 0:00	31	0.92	0.03	0.15	0.03	0.01	<3m	<3m	N/A
22	3/29/2019 13:15	2.75	0.03	0.01	0	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:00	5	0.14	0.03	0.09	0.01	0.00	<3m	<3m	N/A
24	4/1/2019 3:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
25	4/2/2019 23:30	7.75	0.29	0.04	0.07	0.01	0.01	<3m	<3m	N/A
26	4/5/2019 20:30	6.5	0.25	0.04	0.06	0.01	0.01	<3m	<3m	N/A
27	4/8/2019 3:00	12.25	0.3	0.02	0.07	0.01	0.01	<3m	<3m	N/A
28	4/9/2019 17:00	5.25	0.15	0.03	0.13	0.01	0.01	<3m	<3m	N/A
29	4/12/2019 22:15	8	0.36	0.05	0.1	0.02	0.01	<3m	<3m	N/A
30	4/15/2019 0:00	15	1.14	0.08	0.82	0.05	0.02	6m-1yr	<3m	N/A
31	4/19/2019 23:30	25.75	0.25	0.01	0.11	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:30	13	1.61	0.12	0.3	0.07	0.03	<3m	<3m	N/A
33	4/23/2019 22:15	4	0.19	0.05	0.1	0.01	0.04	<3m	<3m	N/A
34	4/26/2019 7:15	22	1.3	0.06	0.37	0.05	0.03	<3m	<3m	N/A
35	4/30/2019 1:15	7.75	0.11	0.01	0.05	0.00	0.00	<3m	<3m	N/A
36	5/2/2019 1:45	12.5	0.12	0.01	0.06	0.01	0.00	<3m	<3m	N/A
37	5/3/2019 13:15	16	0.23	0.01	0.07	0.01	0.01	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
38	5/5/2019 3:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
39	5/7/2019 16:45	3.25	0.28	0.09	0.11	0.01	0.01	<3m	<3m	N/A
40	5/12/2019 12:15	6.75	0.03	0.00	0.01	0.00	0.00	<3m	<3m	N/A
41	5/13/2019 16:45	16.5	0.83	0.05	0.2	0.03	0.02	<3m	<3m	N/A
42	5/17/2019 8:30	7	0.14	0.02	0.06	0.01	0.00	<3m	<3m	N/A
43	5/19/2019 9:45	1.75	0.13	0.07	0.08	0.01	0.00	<3m	<3m	N/A
44	5/20/2019 1:30	1	0.08	0.08	0.08	0.01	0.00	<3m	<3m	N/A
45	5/23/2019 22:30	0.75	0.19	0.25	0.19	0.01	0.00	<3m	<3m	N/A
46	5/26/2019 0:15	0.75	0.07	0.09	0.07	0.00	0.00	<3m	<3m	N/A
47	5/28/2019 12:00	9.5	0.4	0.04	0.12	0.02	0.01	<3m	<3m	N/A
48	5/29/2019 11:45	0.25	0.01	0.04	0.01	0.02	0.01	<3m	<3m	N/A
49	6/2/2019 17:15	7.25	0.24	0.03	0.16	0.01	0.01	<3m	<3m	N/A
50	6/5/2019 22:30	9.75	0.42	0.04	0.24	0.02	0.01	<3m	<3m	N/A
51	6/10/2019 23:15	10.75	0.83	0.08	0.28	0.03	0.02	<3m	<3m	N/A
52	6/13/2019 10:00	6.75	0.43	0.06	0.27	0.02	0.01	<3m	<3m	N/A
53	6/16/2019 2:15	18	0.22	0.01	0.05	0.01	0.00	<3m	<3m	N/A
54	6/18/2019 13:45	3	0.09	0.03	0.06	0.00	0.00	<3m	<3m	N/A
55	6/20/2019 6:00	6.25	0.84	0.13	0.62	0.04	0.02	3-6m	<3m	N/A
56	6/21/2019 2:45	12.75	0.33	0.03	0.16	0.04	0.02	<3m	<3m	N/A
57	6/25/2019 12:00	8.5	0.31	0.04	0.23	0.01	0.01	<3m	<3m	N/A
58	6/29/2019 4:00	18.25	0.38	0.02	0.2	0.02	0.01	<3m	<3m	N/A
59	6/30/2019 13:15	4.5	0.42	0.09	0.4	0.03	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

Rain Gauge 14: Roslindale

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.31	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
4	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
5	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
6	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
7	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
8	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
9	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
10	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
11	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
12	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
19	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
20	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 9:15	14	0.12	0.01	0.14	0.01	0.00	<3m	<3m	N/A
22	3/22/2019 0:00	31	0.92	0.03	0.3	0.04	0.02	<3m	<3m	N/A
23	3/29/2019 13:15	2.75	0.03	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:00	5	0.14	0.03	0.05	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:00	7.25	0.45	0.06	0.1	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:00	8.25	0.19	0.02	0.04	0.01	0.00	<3m	<3m	N/A
27	4/8/2019 3:00	9.5	0.47	0.05	0.16	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:30	1	0.05	0.05	0.05	0.00	0.01	<3m	<3m	N/A
29	4/10/2019 6:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
30	4/12/2019 22:00	10	0.43	0.04	0.11	0.02	0.01	<3m	<3m	N/A
31	4/14/2019 18:30	21.25	0.9	0.04	0.6	0.04	0.02	3m	<3m	N/A
32	4/19/2019 23:15	25.75	0.29	0.01	0.12	0.01	0.01	<3m	<3m	N/A
33	4/22/2019 12:00	19.25	2.99	0.16	0.67	0.12	0.06	3-6m	1.5	N/A
34	4/23/2019 22:00	3.75	0.12	0.03	0.1	0.02	0.06	<3m	<3m	N/A
35	4/26/2019 6:00	22.5	1.49	0.07	0.4	0.06	0.03	<3m	<3m	N/A
36	4/28/2019 16:15	2	0.03	0.02	0.02	0.00	0.03	<3m	<3m	N/A
37	4/30/2019 1:15	6	0.15	0.03	0.04	0.01	0.00	<3m	<3m	N/A
38	5/2/2019 2:00	12	0.03	0.00	0.02	0.00	0.00	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/3/2019 13:30	1.75	0.11	0.06	0.1	0.00	0.00	<3m	<3m	N/A
40	5/4/2019 3:15	2	0.09	0.05	0.05	0.01	0.00	<3m	<3m	N/A
41	5/5/2019 5:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
42	5/5/2019 23:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
43	5/7/2019 19:00	2.5	0.07	0.03	0.06	0.00	0.00	<3m	<3m	N/A
44	5/12/2019 6:45	13.25	0.59	0.04	0.07	0.02	0.01	<3m	<3m	N/A
45	5/13/2019 16:15	25.25	0.97	0.04	0.25	0.04	0.03	<3m	<3m	N/A
46	5/17/2019 6:45	19	0.17	0.01	0.07	0.01	0.00	<3m	<3m	N/A
47	5/19/2019 10:15	1	0.12	0.12	0.12	0.01	0.00	<3m	<3m	N/A
48	5/20/2019 1:30	1	0.06	0.06	0.06	0.01	0.00	<3m	<3m	N/A
49	5/20/2019 17:00	0.5	0.09	0.18	0.09	0.01	0.01	<3m	<3m	N/A
50	5/23/2019 19:30	4.25	0.15	0.04	0.13	0.01	0.00	<3m	<3m	N/A
51	5/25/2019 23:15	6.25	0.46	0.07	0.36	0.02	0.01	<3m	<3m	N/A
52	5/28/2019 11:45	12	0.33	0.03	0.12	0.01	0.01	<3m	<3m	N/A
53	5/30/2019 21:30	4.25	0.4	0.09	0.18	0.02	0.01	<3m	<3m	N/A
54	6/3/2019 0:15	1.25	0.03	0.02	0.02	0.00	0.00	<3m	<3m	N/A
55	6/5/2019 23:30	0.25	0.03	0.12	0.03	0.00	0.00	<3m	<3m	N/A
56	6/10/2019 22:30	11.25	0.81	0.07	0.2	0.03	0.02	<3m	<3m	N/A
57	6/13/2019 7:15	11	0.8	0.07	0.3	0.03	0.02	<3m	<3m	N/A
58	6/16/2019 3:00	26	0.09	0.00	0.02	0.00	0.00	<3m	<3m	N/A
59	6/18/2019 13:15	1.5	0.09	0.06	0.07	0.00	0.00	<3m	<3m	N/A
60	6/20/2019 5:30	6.25	0.32	0.05	0.22	0.01	0.01	<3m	<3m	N/A
61	6/21/2019 2:00	13.25	1.17	0.09	1	0.06	0.03	1.2	<3m	N/A
62	6/25/2019 12:00	10.75	0.23	0.02	0.09	0.01	0.00	<3m	<3m	N/A
63	6/29/2019 5:15	11	1.25	0.11	0.68	0.05	0.03	3-6m	<3m	N/A
64	6/30/2019 14:30	4.25	0.07	0.02	0.04	0.02	0.03	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 15: Roxbury

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.34	0.07	0.14	0.14	0.14	0.00	<3m	<3m
2	1/3/2019 8:15	0.25	0.01	0.04	0.01	0.01	0.01	0.00	<3m	<3m
3	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.15	0.15	0.03	<3m	<3m
4	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.01	0.01	0.00	<3m	<3m
5	1/8/2019 21:30	16	0.17	0.01	0.06	0.06	0.06	0.01	<3m	<3m
6	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.24	0.24	0.02	<3m	<3m
7	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.04	0.04	0.01	<3m	<3m
8	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.09	0.09	0.03	<3m	<3m
9	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.05	0.05	0.01	<3m	<3m
10	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
11	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
12	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
19	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
20	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 9:15	13.75	0.19	0.01	0.16	0.01	0.00	<3m	<3m	N/A
22	3/21/2019 23:45	32	0.94	0.03	0.26	0.04	0.02	<3m	<3m	N/A
23	3/29/2019 14:00	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.13	0.03	0.06	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:00	7	0.44	0.06	0.09	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	7	0.2	0.03	0.05	0.01	0.00	<3m	<3m	N/A
27	4/8/2019 3:00	9.75	0.43	0.04	0.15	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:30	1	0.06	0.06	0.06	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:00	10.25	0.41	0.04	0.1	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 20:45	18.25	0.84	0.05	0.55	0.04	0.02	3m	<3m	N/A
31	4/19/2019 23:15	26.25	0.29	0.01	0.13	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:15	18.25	2.48	0.14	0.38	0.10	0.05	<3m	6m-1yr	N/A
33	4/23/2019 22:15	4.5	0.11	0.02	0.09	0.01	0.05	<3m	<3m	N/A
34	4/26/2019 6:45	21.5	1.58	0.07	0.48	0.07	0.03	<3m	<3m	N/A
35	4/28/2019 16:30	1.5	0.02	0.01	0.01	0.00	0.03	<3m	<3m	N/A
36	4/30/2019 1:00	6	0.15	0.03	0.05	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 1:15	13	0.05	0.00	0.02	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:30	16.25	0.26	0.02	0.12	0.01	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/5/2019 4:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
40	5/7/2019 18:30	3.25	0.08	0.02	0.05	0.00	0.00	<3m	<3m	N/A
41	5/11/2019 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 7:00	13	0.49	0.04	0.08	0.02	0.01	<3m	<3m	N/A
43	5/13/2019 16:30	16.75	0.98	0.06	0.31	0.04	0.03	<3m	<3m	N/A
44	5/16/2019 0:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:15	7.75	0.24	0.03	0.07	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:15	2	0.16	0.08	0.14	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:15	3	0.15	0.05	0.14	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 22:45	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:30	2.25	0.3	0.13	0.24	0.01	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	12	0.35	0.03	0.11	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:45	2.75	0.31	0.11	0.18	0.01	0.01	<3m	<3m	N/A
52	6/2/2019 23:30	2	0.04	0.02	0.02	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:00	7.25	0.05	0.01	0.04	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:45	11.25	0.74	0.07	0.19	0.03	0.02	<3m	<3m	N/A
55	6/13/2019 7:15	10.75	0.78	0.07	0.28	0.03	0.02	<3m	<3m	N/A
56	6/16/2019 3:15	16.25	0.08	0.00	0.02	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:00	3.75	0.1	0.03	0.06	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 5:45	7.5	0.34	0.05	0.22	0.01	0.01	<3m	<3m	N/A
59	6/21/2019 1:45	13.25	0.97	0.07	0.81	0.05	0.03	6m-1yr	<3m	N/A
60	6/25/2019 12:15	9	0.15	0.02	0.05	0.01	0.00	<3m	<3m	N/A
61	6/29/2019 5:15	10.75	0.82	0.08	0.46	0.03	0.02	<3m	<3m	N/A
62	6/30/2019 14:15	4.25	0.08	0.02	0.06	0.01	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 16: Somerville

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.32	0.07	0.04	0.04	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	14	0.45	0.03	0.03	0.03	0.00	<3m	<3m	N/A
3	1/8/2019 21:15	16.25	0.16	0.01	0.04	0.04	0.00	<3m	<3m	N/A
4	1/19/2019 17:30	22.5	1.27	0.06	0.06	0.06	0.00	<3m	<3m	N/A
5	1/23/2019 11:15	5.75	0.03	0.01	0.01	0.01	0.00	<3m	<3m	N/A
6	1/24/2019 10:00	1	0.06	0.06	0.03	0.03	0.00	<3m	<3m	N/A
7	1/29/2019 22:45	6	0.17	0.03	0.02	0.02	0.00	<3m	<3m	N/A
8	2/6/2019 20:15	11.25	0.49	0.04	0.04	0.02	0.01	<3m	<3m	N/A
9	2/7/2019 23:15	19.25	0.1	0.01	0.02	0.01	0.01	<3m	<3m	N/A
10	2/12/2019 15:45	13	1.03	0.08	0.06	0.04	0.02	<3m	<3m	N/A
11	2/13/2019 16:45	0.25	0.01	0.04	0	0.04	0.02	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.08	0.03	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 1:45	13	0.25	0.02	0.02	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:15	8	0.46	0.06	0.05	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.4	0.04	0.03	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 2:30	7.5	0.16	0.02	0.01	0.00	0.00	<3m	<3m	N/A
17	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
18	3/4/2019 1:45	5.25	0.45	0.09	0.05	0.02	0.01	<3m	<3m	N/A
19	3/10/2019 9:15	10.25	0.49	0.05	0.04	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 21:15	13.75	0.18	0.01	0.01	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	33	0.87	0.03	0.08	0.03	0.02	<3m	<3m	N/A
22	3/28/2019 23:30	0.25	0.01	0.04	0	0.00	0.00	<3m	<3m	N/A
23	3/29/2019 13:45	2.25	0.03	0.01	0.01	0.00	0.00	<3m	<3m	N/A
24	3/31/2019 14:15	4.75	0.14	0.03	0.02	0.01	0.00	<3m	<3m	N/A
25	4/2/2019 23:15	6.5	0.37	0.06	0.03	0.02	0.01	<3m	<3m	N/A
26	4/5/2019 20:15	8	0.24	0.03	0.03	0.01	0.01	<3m	<3m	N/A
27	4/8/2019 3:00	9.25	0.37	0.04	0.05	0.02	0.01	<3m	<3m	N/A
28	4/9/2019 17:15	1.25	0.07	0.06	0.02	0.00	0.01	<3m	<3m	N/A
29	4/12/2019 22:15	9.75	0.41	0.04	0.04	0.02	0.01	<3m	<3m	N/A
30	4/14/2019 22:15	17	0.82	0.05	0.24	0.03	0.02	<3m	<3m	N/A
31	4/19/2019 23:15	26	0.25	0.01	0.06	0.01	0.01	<3m	<3m	N/A
32	4/22/2019 12:15	16	1.93	0.12	0.12	0.08	0.04	<3m	3m	N/A
33	4/23/2019 22:15	4.5	0.17	0.04	0.05	0.01	0.04	<3m	<3m	N/A
34	4/26/2019 6:45	22	1.44	0.07	0.21	0.06	0.03	<3m	<3m	N/A
35	4/30/2019 1:15	7.5	0.13	0.02	0.02	0.01	0.00	<3m	<3m	N/A
36	4/30/2019 23:15	0.25	0.01	0.04	0.01	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 1:45	12.5	0.05	0.00	0.01	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:30	18	0.21	0.01	0.02	0.01	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/7/2019 18:00	4	0.14	0.04	0.03	0.01	0.00	<3m	<3m	N/A
40	5/10/2019 13:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/11/2019 1:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 6:45	13	0.29	0.02	0.02	0.01	0.01	<3m	<3m	N/A
43	5/13/2019 16:30	15.25	0.76	0.05	0.06	0.03	0.02	<3m	<3m	N/A
44	5/15/2019 23:15	9	0.02	0.00	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 7:45	8	0.24	0.03	0.03	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:00	31.25	0.55	0.02	0.09	0.02	0.01	<3m	<3m	N/A
47	5/23/2019 22:45	0.75	0.17	0.23	0.08	0.01	0.00	<3m	<3m	N/A
48	5/25/2019 23:30	2.25	0.21	0.09	0.09	0.01	0.00	<3m	<3m	N/A
49	5/28/2019 12:00	12.5	0.29	0.02	0.05	0.01	0.01	<3m	<3m	N/A
50	5/30/2019 22:30	2	0.16	0.08	0.04	0.01	0.00	<3m	<3m	N/A
51	6/2/2019 22:15	2.5	0.07	0.03	0.02	0.00	0.00	<3m	<3m	N/A
52	6/5/2019 22:45	7.5	0.1	0.01	0.03	0.00	0.00	<3m	<3m	N/A
53	6/10/2019 22:45	11.25	0.63	0.06	0.1	0.03	0.01	<3m	<3m	N/A
54	6/13/2019 9:15	8	0.59	0.07	0.07	0.02	0.01	<3m	<3m	N/A
55	6/16/2019 3:45	17.25	0.18	0.01	0.02	0.01	0.00	<3m	<3m	N/A
56	6/18/2019 13:00	3.75	0.11	0.03	0.02	0.00	0.00	<3m	<3m	N/A
57	6/20/2019 7:45	4.5	0.57	0.13	0.27	0.02	0.01	<3m	<3m	N/A
58	6/21/2019 2:45	17.5	0.54	0.03	0.15	0.04	0.02	<3m	<3m	N/A
59	6/25/2019 12:45	8	0.16	0.02	0.05	0.00	0.00	<3m	<3m	N/A
60	6/29/2019 4:15	11.75	1.13	0.10	0.34	0.03	0.02	<3m	<3m	N/A
61	6/30/2019 13:45	4.5	0.4	0.09	0.07	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

Rain Gauge 17: Spot Pond

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [(1)]		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	5	0.33	0.07	0.16	0.00	0.00	<3m	<3m	N/A
2	1/3/2019 8:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
3	1/5/2019 6:00	14	0.45	0.03	0.10	0.02	0.01	<3m	<3m	N/A
4	1/8/2019 21:15	16.25	0.16	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/19/2019 17:30	22.5	1.27	0.06	0.21	0.05	0.03	<3m	<3m	N/A
6	1/23/2019 11:15	5.75	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
7	1/24/2019 10:00	1	0.06	0.06	0.06	0.00	0.00	<3m	<3m	N/A
8	1/29/2019 22:45	6	0.17	0.03	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:15	11.25	0.49	0.04	0.12	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	19.25	0.1	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 15:45	13	1.03	0.08	0.17	0.04	0.02	<3m	<3m	N/A
12	2/13/2019 16:45	0.25	0.01	0.04	0.01	0.04	0.02	<3m	<3m	N/A
13	2/15/2019 10:45	3	0.08	0.03	0.06	0.00	0.00	<3m	<3m	N/A
14	2/18/2019 1:45	13	0.25	0.02	0.08	0.01	0.01	<3m	<3m	N/A
15	2/20/2019 22:15	8	0.46	0.06	0.17	0.02	0.01	<3m	<3m	N/A
16	2/24/2019 5:45	9.75	0.4	0.04	0.09	0.02	0.01	<3m	<3m	N/A
17	2/28/2019 2:30	7.5	0.16	0.02	0.05	0.01	0.00	<3m	<3m	N/A
18	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
19	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
20	3/10/2019 9:15	16.5	0.5	0.03	0.09	0.02	0.01	<3m	<3m	N/A
21	3/15/2019 11:15	12.75	0.19	0.01	0.14	0.01	0.00	<3m	<3m	N/A
22	3/22/2019 0:15	25	0.77	0.03	0.19	0.03	0.02	<3m	<3m	N/A
23	3/29/2019 0:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
24	3/29/2019 15:00	1	0.02	0.02	0.02	0.00	0.00	<3m	<3m	N/A
25	3/31/2019 14:15	5	0.14	0.03	0.06	0.01	0.00	<3m	<3m	N/A
26	4/2/2019 23:45	7.75	0.35	0.05	0.07	0.01	0.01	<3m	<3m	N/A
27	4/5/2019 20:30	11.25	0.22	0.02	0.03	0.01	0.00	<3m	<3m	N/A
28	4/8/2019 3:00	9.5	0.39	0.04	0.09	0.02	0.01	<3m	<3m	N/A
29	4/9/2019 17:30	7	0.14	0.02	0.04	0.01	0.01	<3m	<3m	N/A
30	4/12/2019 22:45	12.5	0.44	0.04	0.06	0.02	0.01	<3m	<3m	N/A
31	4/14/2019 22:15	17	0.82	0.05	0.57	0.03	0.02	3m	<3m	N/A
32	4/19/2019 23:15	26	0.25	0.01	0.12	0.01	0.01	<3m	<3m	N/A
33	4/22/2019 12:15	16	1.93	0.12	0.36	0.08	0.04	<3m	3m	N/A
34	4/23/2019 22:30	9.25	0.16	0.02	0.1	0.01	0.04	<3m	<3m	N/A
35	4/26/2019 7:00	21.75	1.09	0.05	0.34	0.05	0.02	<3m	<3m	N/A
36	4/30/2019 1:30	7.5	0.12	0.02	0.05	0.01	0.00	<3m	<3m	N/A
37	5/2/2019 7:00	7.25	0.07	0.01	0.04	0.00	0.00	<3m	<3m	N/A
38	5/3/2019 13:15	16	0.23	0.01	0.07	0.01	0.01	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval [(1)]		
								1-hr	24-hr	48-hr
39	5/5/2019 4:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
40	5/7/2019 17:00	4.5	0.28	0.06	0.12	0.01	0.01	<3m	<3m	N/A
41	5/10/2019 13:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
42	5/12/2019 7:45	11.75	0.16	0.01	0.05	0.01	0.00	<3m	<3m	N/A
43	5/13/2019 16:45	16.5	0.86	0.05	0.25	0.04	0.02	<3m	<3m	N/A
44	5/14/2019 21:45	0.25	0.01	0.04	0.01	0.02	0.02	<3m	<3m	N/A
45	5/17/2019 5:45	10.25	0.31	0.03	0.11	0.01	0.01	<3m	<3m	N/A
46	5/19/2019 10:00	2	0.26	0.13	0.17	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:30	1	0.15	0.15	0.15	0.02	0.01	<3m	<3m	N/A
48	5/20/2019 15:30	1.75	0.04	0.02	0.02	0.01	0.01	<3m	<3m	N/A
49	5/23/2019 22:45	0.75	0.11	0.15	0.11	0.00	0.00	<3m	<3m	N/A
50	5/25/2019 23:45	6.75	0.19	0.03	0.16	0.01	0.00	<3m	<3m	N/A
51	5/28/2019 12:00	13.25	0.45	0.03	0.13	0.02	0.01	<3m	<3m	N/A
52	5/30/2019 22:15	1.5	0.05	0.03	0.04	0.00	0.00	<3m	<3m	N/A
53	6/2/2019 17:45	7	0.24	0.03	0.15	0.01	0.01	<3m	<3m	N/A
54	6/5/2019 22:45	11	0.36	0.03	0.3	0.02	0.01	<3m	<3m	N/A
55	6/10/2019 23:00	11	0.73	0.07	0.24	0.03	0.02	<3m	<3m	N/A
56	6/13/2019 8:30	9.5	0.62	0.07	0.28	0.03	0.01	<3m	<3m	N/A
57	6/16/2019 2:45	18	0.24	0.01	0.05	0.01	0.01	<3m	<3m	N/A
58	6/18/2019 13:15	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
59	6/20/2019 7:45	4.5	0.57	0.13	0.45	0.02	0.01	<3m	<3m	N/A
60	6/21/2019 2:45	17.5	0.54	0.03	0.4	0.04	0.02	<3m	<3m	N/A
61	6/24/2019 13:00	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
62	6/25/2019 12:30	8	0.32	0.04	0.25	0.01	0.01	<3m	<3m	N/A
63	6/29/2019 4:15	11.75	0.87	0.07	0.75	0.04	0.02	6m-1yr	<3m	N/A
64	6/30/2019 9:45	8.5	0.34	0.04	0.3	0.05	0.03	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Rain Gauge 18: Union Park

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	4.75	0.32	0.07	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 6:00	13.75	0.6	0.04	0.15	0.03	0.01	<3m	<3m	N/A
3	1/8/2019 8:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
4	1/8/2019 21:30	16	0.17	0.01	0.06	0.01	0.00	<3m	<3m	N/A
5	1/20/2019 5:00	15.75	0.37	0.02	0.24	0.02	0.01	<3m	<3m	N/A
6	1/22/2019 9:45	5.5	0.14	0.03	0.04	0.01	0.00	<3m	<3m	N/A
7	1/23/2019 13:15	31.5	0.69	0.02	0.09	0.03	0.02	<3m	<3m	N/A
8	1/29/2019 22:45	10.75	0.18	0.02	0.05	0.01	0.00	<3m	<3m	N/A
9	2/6/2019 20:00	11.25	0.56	0.05	0.13	0.02	0.01	<3m	<3m	N/A
10	2/7/2019 23:15	13.75	0.08	0.01	0.04	0.01	0.01	<3m	<3m	N/A
11	2/12/2019 14:30	15.5	1.28	0.08	0.23	0.05	0.03	<3m	<3m	N/A
12	2/15/2019 10:45	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
13	2/18/2019 0:45	13.25	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
14	2/20/2019 22:00	11.25	0.5	0.04	0.17	0.02	0.01	<3m	<3m	N/A
15	2/24/2019 5:45	9.75	0.46	0.05	0.1	0.02	0.01	<3m	<3m	N/A
16	2/28/2019 3:00	8	0.17	0.02	0.03	0.01	0.00	<3m	<3m	N/A
17	3/2/2019 7:30	6.5	0.23	0.04	0.07	0.01	0.00	<3m	<3m	N/A
18	3/3/2019 21:45	18.5	1.25	0.07	0.17	0.05	0.03	<3m	<3m	N/A
19	3/10/2019 8:30	10.5	0.53	0.05	0.1	0.02	0.01	<3m	<3m	N/A
20	3/15/2019 9:15	13.5	0.18	0.01	0.15	0.01	0.00	<3m	<3m	N/A
21	3/22/2019 0:00	27	1	0.04	0.27	0.04	0.02	<3m	<3m	N/A
22	3/29/2019 13:30	2.25	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
23	3/31/2019 14:00	4.75	0.12	0.03	0.05	0.01	0.00	<3m	<3m	N/A
24	4/2/2019 23:00	6.75	0.42	0.06	0.1	0.02	0.01	<3m	<3m	N/A
25	4/5/2019 20:15	6.75	0.2	0.03	0.05	0.01	0.00	<3m	<3m	N/A
26	4/8/2019 3:00	9.25	0.4	0.04	0.15	0.02	0.01	<3m	<3m	N/A
27	4/9/2019 17:30	12.5	0.08	0.01	0.07	0.00	0.01	<3m	<3m	N/A
28	4/12/2019 22:00	10	0.38	0.04	0.09	0.02	0.01	<3m	<3m	N/A
29	4/14/2019 21:30	17.5	0.79	0.05	0.49	0.03	0.02	<3m	<3m	N/A
30	4/19/2019 23:15	31.5	0.26	0.01	0.13	0.01	0.01	<3m	<3m	N/A
31	4/22/2019 12:15	16.75	2.34	0.14	0.36	0.10	0.05	<3m	6m	N/A
32	4/23/2019 22:15	2	0.11	0.06	0.09	0.01	0.05	<3m	<3m	N/A
33	4/26/2019 6:30	29	1.31	0.05	0.41	0.05	0.03	<3m	<3m	N/A
34	4/28/2019 16:45	1.5	0.02	0.01	0.01	0.00	0.03	<3m	<3m	N/A
35	4/30/2019 1:30	5.5	0.16	0.03	0.05	0.01	0.00	<3m	<3m	N/A
36	5/2/2019 1:30	12.75	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
37	5/3/2019 13:30	16.75	0.24	0.01	0.11	0.01	0.01	<3m	<3m	N/A
38	5/5/2019 5:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/7/2019 18:30	3	0.07	0.02	0.04	0.00	0.00	<3m	<3m	N/A
40	5/11/2019 1:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
41	5/12/2019 6:45	12.75	0.45	0.04	0.07	0.02	0.01	<3m	<3m	N/A
42	5/13/2019 16:30	17	0.92	0.05	0.24	0.04	0.03	<3m	<3m	N/A
43	5/15/2019 4:15	0.25	0.01	0.04	0.01	0.00	0.02	<3m	<3m	N/A
44	5/16/2019 0:30	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
45	5/17/2019 8:15	7.75	0.22	0.03	0.08	0.01	0.00	<3m	<3m	N/A
46	5/19/2019 10:15	2	0.18	0.09	0.14	0.01	0.01	<3m	<3m	N/A
47	5/20/2019 1:30	1	0.14	0.14	0.14	0.01	0.01	<3m	<3m	N/A
48	5/23/2019 22:45	0.75	0.13	0.17	0.13	0.01	0.00	<3m	<3m	N/A
49	5/25/2019 23:30	2.25	0.28	0.12	0.24	0.01	0.01	<3m	<3m	N/A
50	5/28/2019 11:45	11.25	0.33	0.03	0.1	0.01	0.01	<3m	<3m	N/A
51	5/30/2019 21:45	3.5	0.3	0.09	0.16	0.01	0.01	<3m	<3m	N/A
52	6/2/2019 22:30	2.75	0.07	0.03	0.03	0.00	0.00	<3m	<3m	N/A
53	6/5/2019 23:30	0.75	0.04	0.05	0.04	0.00	0.00	<3m	<3m	N/A
54	6/10/2019 22:30	11.75	0.76	0.06	0.19	0.03	0.02	<3m	<3m	N/A
55	6/13/2019 7:00	11.5	0.77	0.07	0.23	0.03	0.02	<3m	<3m	N/A
56	6/16/2019 10:00	12.25	0.09	0.01	0.03	0.00	0.00	<3m	<3m	N/A
57	6/18/2019 13:15	4	0.11	0.03	0.06	0.00	0.00	<3m	<3m	N/A
58	6/20/2019 6:00	7.5	0.36	0.05	0.25	0.02	0.01	<3m	<3m	N/A
59	6/21/2019 2:15	3.75	0.91	0.24	0.8	0.05	0.03	6m-1yr	<3m	N/A
60	6/27/2019 8:00	2.5	0.19	0.08	0.01	0.00	0.00	<3m	<3m	N/A
61	6/29/2019 5:15	10.75	0.77	0.07	0.34	0.03	0.02	<3m	<3m	N/A
62	6/30/2019 13:45	1.5	0.33	0.22	0.3	0.03	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 19: USGS Fresh Pond

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	2.75	0.11	0.04	0.05	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 16:00	2.5	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
3	1/9/2019 4:00	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
4	1/19/2019 18:00	20.25	0.8	0.04	0.13	0.03	0.02	<3m	<3m	N/A
5	1/24/2019 12:15	6.25	0.47	0.08	0.18	0.02	0.01	<3m	<3m	N/A
6	2/6/2019 20:30	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
7	2/12/2019 15:00	13.5	0.56	0.04	0.11	0.02	0.01	<3m	<3m	N/A
8	2/18/2019 1:15	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
9	2/21/2019 0:00	3.75	0.14	0.04	0.09	0.01	0.00	<3m	<3m	N/A
10	2/24/2019 8:45	4.25	0.04	0.01	0.01	0.00	0.00	<3m	<3m	N/A
11	2/28/2019 1:15	1.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
12	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
13	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
14	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
15	3/15/2019 12:15	12.5	0.13	0.01	0.09	0.01	0.00	<3m	<3m	N/A
16	3/22/2019 1:15	29	0.72	0.02	0.2	0.03	0.02	<3m	<3m	N/A
17	3/29/2019 0:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
18	3/29/2019 15:15	2	0.03	0.02	0.02	0.00	0.00	<3m	<3m	N/A
19	3/31/2019 15:15	4.75	0.15	0.03	0.07	0.01	0.00	<3m	<3m	N/A
20	4/3/2019 0:30	6.5	0.3	0.05	0.09	0.01	0.01	<3m	<3m	N/A
21	4/5/2019 21:30	6.5	0.22	0.03	0.07	0.01	0.00	<3m	<3m	N/A
22	4/8/2019 4:15	9.25	0.41	0.04	0.13	0.02	0.01	<3m	<3m	N/A
23	4/9/2019 18:30	12.5	0.08	0.01	0.07	0.00	0.01	<3m	<3m	N/A
24	4/13/2019 0:00	9	0.39	0.04	0.13	0.02	0.01	<3m	<3m	N/A
25	4/15/2019 0:00	17.25	0.86	0.05	0.65	0.04	0.02	3-6m	<3m	N/A
26	4/20/2019 0:30	26	0.34	0.01	0.14	0.01	0.01	<3m	<3m	N/A
27	4/22/2019 13:30	18.5	2.15	0.12	0.47	0.09	0.04	<3m	3-6m	N/A
28	4/23/2019 23:15	4	0.12	0.03	0.06	0.01	0.05	<3m	<3m	N/A
29	4/26/2019 8:00	22	0.97	0.04	0.31	0.04	0.02	<3m	<3m	N/A
30	4/28/2019 19:00	0.25	0.01	0.04	0.01	0.00	0.02	<3m	<3m	N/A
31	4/30/2019 2:30	7.25	0.12	0.02	0.03	0.01	0.00	<3m	<3m	N/A
32	5/2/2019 2:30	12.75	0.05	0.00	0.02	0.00	0.00	<3m	<3m	N/A
33	5/3/2019 14:30	16.5	0.23	0.01	0.07	0.01	0.01	<3m	<3m	N/A
34	5/5/2019 6:00	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
35	5/7/2019 19:15	4	0.13	0.03	0.07	0.01	0.00	<3m	<3m	N/A
36	5/10/2019 14:15	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
37	5/11/2019 2:30	0.25	0.02	0.08	0.02	0.00	0.00	<3m	<3m	N/A
38	5/12/2019 8:00	13	0.41	0.03	0.07	0.02	0.01	<3m	<3m	N/A

AECOM Imagine it. Delivered.

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/13/2019 17:45	19.5	0.72	0.04	0.2	0.03	0.02	<3m	<3m	N/A
40	5/16/2019 0:15	2.75	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
41	5/17/2019 8:00	9	0.26	0.03	0.08	0.01	0.01	<3m	<3m	N/A
42	5/19/2019 11:15	2	0.21	0.11	0.11	0.01	0.01	<3m	<3m	N/A
43	5/20/2019 2:30	15.75	0.33	0.02	0.19	0.02	0.01	<3m	<3m	N/A
44	5/24/2019 0:00	0.75	0.14	0.19	0.14	0.01	0.00	<3m	<3m	N/A
45	5/26/2019 0:45	2.75	0.2	0.07	0.17	0.01	0.01	<3m	<3m	N/A
46	5/28/2019 13:00	10	0.28	0.03	0.1	0.01	0.01	<3m	<3m	N/A
47	5/30/2019 22:45	3	0.14	0.05	0.1	0.01	0.01	<3m	<3m	N/A
48	6/2/2019 23:30	2.5	0.05	0.02	0.04	0.00	0.00	<3m	<3m	N/A
49	6/6/2019 0:00	7.25	0.17	0.02	0.14	0.01	0.00	<3m	<3m	N/A
50	6/11/2019 0:00	11.5	0.73	0.06	0.34	0.03	0.02	<3m	<3m	N/A
51	6/13/2019 9:30	9.25	0.51	0.06	0.24	0.02	0.01	<3m	<3m	N/A
52	6/16/2019 4:45	16	0.21	0.01	0.06	0.01	0.00	<3m	<3m	N/A
53	6/18/2019 14:15	4.25	0.12	0.03	0.07	0.01	0.00	<3m	<3m	N/A
54	6/20/2019 7:15	33	1.02	0.03	0.44	0.04	0.02	<3m	<3m	N/A
55	6/22/2019 15:45	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
56	6/25/2019 13:30	8.75	0.5	0.06	0.39	0.02	0.01	<3m	<3m	N/A
57	6/29/2019 5:30	11	0.62	0.06	0.3	0.03	0.01	<3m	<3m	N/A
58	6/30/2019 10:45	8.75	0.14	0.02	0.08	0.02	0.02	<3m	<3m	N/A

(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-1yr) or the nearest year.

AECOM Imagine it. Delivered.

Rain Gauge 20: Waltham Farm

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
1	1/1/2019 0:15	2.75	0.3	0.11	0.13	0.00	0.00	<3m	<3m	N/A
2	1/5/2019 16:00	2.5	0.1	0.04	0.06	0.00	0.00	<3m	<3m	N/A
3	1/9/2019 4:00	0.5	0.02	0.04	0.02	0.00	0.00	<3m	<3m	N/A
4	1/19/2019 18:00	20.25	0.8	0.04	0.13	0.03	0.02	<3m	<3m	N/A
5	1/24/2019 12:15	6.25	0.47	0.08	0.18	0.02	0.01	<3m	<3m	N/A
6	2/6/2019 20:30	3.5	0.09	0.03	0.04	0.00	0.00	<3m	<3m	N/A
7	2/12/2019 15:00	13.5	0.56	0.04	0.11	0.02	0.01	<3m	<3m	N/A
8	2/18/2019 1:15	12.25	0.05	0.00	0.03	0.00	0.00	<3m	<3m	N/A
9	2/21/2019 0:00	3.75	0.14	0.04	0.09	0.01	0.00	<3m	<3m	N/A
10	2/24/2019 8:45	4.25	0.04	0.01	0.01	0.00	0.00	<3m	<3m	N/A
11	2/28/2019 1:15	1.5	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
12	3/2/2019 9:15	2	0.02	0.01	0.01	0.00	0.00	<3m	<3m	N/A
13	3/4/2019 1:45	5.25	0.45	0.09	0.15	0.02	0.01	<3m	<3m	N/A
14	3/10/2019 9:15	10.25	0.49	0.05	0.09	0.02	0.01	<3m	<3m	N/A
15	3/15/2019 11:00	22.25	0.2	0.01	0.15	0.01	0.00	<3m	<3m	N/A
16	3/22/2019 0:00	32.25	0.87	0.03	0.24	0.03	0.02	<3m	<3m	N/A
17	3/29/2019 13:30	2.75	0.05	0.02	0.03	0.00	0.00	<3m	<3m	N/A
18	3/31/2019 14:00	6.75	0.19	0.03	0.09	0.01	0.00	<3m	<3m	N/A
19	4/2/2019 23:30	6.75	0.39	0.06	0.1	0.02	0.01	<3m	<3m	N/A
20	4/5/2019 20:00	8.5	0.25	0.03	0.07	0.01	0.01	<3m	<3m	N/A
21	4/8/2019 3:00	9.25	0.5	0.05	0.15	0.02	0.01	<3m	<3m	N/A
22	4/9/2019 17:15	2	0.11	0.06	0.1	0.00	0.01	<3m	<3m	N/A
23	4/12/2019 22:00	9.25	0.52	0.06	0.14	0.02	0.01	<3m	<3m	N/A
24	4/14/2019 22:45	16.75	0.98	0.06	0.76	0.04	0.02	6m-1yr	<3m	N/A
25	4/19/2019 20:30	29	0.46	0.02	0.13	0.02	0.01	<3m	<3m	N/A
26	4/22/2019 12:30	20.25	2.5	0.12	0.39	0.10	0.05	<3m	6m-1yr	N/A
27	4/23/2019 22:15	3.5	0.14	0.04	0.1	0.02	0.05	<3m	<3m	N/A
28	4/26/2019 5:45	22.75	1.52	0.07	0.52	0.06	0.03	<3m	<3m	N/A
29	4/28/2019 17:30	1.25	0.02	0.02	0.01	0.00	0.03	<3m	<3m	N/A
30	4/30/2019 1:15	5.5	0.13	0.02	0.04	0.01	0.00	<3m	<3m	N/A
31	5/1/2019 7:45	0.25	0.01	0.04	0.01	0.00	0.00	<3m	<3m	N/A
32	5/2/2019 1:30	12.75	0.06	0.00	0.03	0.00	0.00	<3m	<3m	N/A
33	5/3/2019 13:15	18.5	0.28	0.02	0.09	0.01	0.01	<3m	<3m	N/A
34	5/5/2019 5:00	1.5	0.02	0.01	0.01	0.00	0.01	<3m	<3m	N/A
35	5/7/2019 18:15	4	0.11	0.03	0.06	0.00	0.00	<3m	<3m	N/A
36	5/10/2019 23:00	2.5	0.03	0.01	0.02	0.00	0.00	<3m	<3m	N/A
37	5/13/2019 16:30	16.5	0.89	0.05	0.18	0.04	0.02	<3m	<3m	N/A
38	5/14/2019 22:30	0.25	0.01	0.04	0.01	0.01	0.02	<3m	<3m	N/A

Event	Date & Start Time	Duration (hr)	Volume (in)	Average Intensity (in/hr)	Peak 1-hr Intensity (in/hr)	Peak 24-hr Intensity (in/hr)	Peak 48-hr Intensity (in/hr)	Storm Recurrence Interval (1)		
								1-hr	24-hr	48-hr
39	5/15/2019 23:00	3	0.04	0.01	0.02	0.00	0.00	<3m	<3m	N/A
40	5/17/2019 6:45	9	0.3	0.03	0.1	0.01	0.01	<3m	<3m	N/A
41	5/19/2019 10:00	2	0.22	0.11	0.14	0.01	0.01	<3m	<3m	N/A
42	5/20/2019 1:30	1.75	0.13	0.07	0.12	0.01	0.01	<3m	<3m	N/A
43	5/20/2019 15:15	1.75	0.2	0.11	0.18	0.01	0.01	<3m	<3m	N/A
44	5/23/2019 22:45	0.75	0.15	0.20	0.15	0.01	0.00	<3m	<3m	N/A
45	5/25/2019 23:30	2	0.27	0.14	0.22	0.01	0.01	<3m	<3m	N/A
46	5/28/2019 11:45	10.25	0.36	0.04	0.1	0.02	0.01	<3m	<3m	N/A
47	5/29/2019 19:30	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
48	5/30/2019 22:15	1.75	0.12	0.07	0.01	0.00	0.01	<3m	<3m	N/A
49	6/2/2019 19:15	5.25	0.16	0.03	0.1	0.01	0.00	<3m	<3m	N/A
50	6/5/2019 22:30	7.75	0.26	0.03	0.21	0.01	0.01	<3m	<3m	N/A
51	6/10/2019 22:45	11.5	1.05	0.09	0.44	0.04	0.02	<3m	<3m	N/A
52	6/13/2019 8:00	11.75	0.69	0.06	0.38	0.03	0.01	<3m	<3m	N/A
53	6/16/2019 3:30	19.5	0.23	0.01	0.06	0.01	0.00	<3m	<3m	N/A
54	6/18/2019 13:15	3.25	0.1	0.03	0.07	0.00	0.00	<3m	<3m	N/A
55	6/20/2019 5:45	33.5	1.21	0.04	0.45	0.05	0.03	<3m	<3m	N/A
56	6/22/2019 14:30	0.25	0.01	0.04	0.01	0.00	0.01	<3m	<3m	N/A
57	6/25/2019 12:15	9.75	0.4	0.04	0.29	0.02	0.01	<3m	<3m	N/A
58	6/29/2019 4:15	2.5	0.45	0.18	0.4	0.02	0.01	<3m	<3m	N/A
59	6/30/2019 14:15	4.25	0.15	0.04	0.09	0.01	0.01	<3m	<3m	N/A

(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-1yr) or the nearest year.

Appendix C Rainfall Hyetographs

AECOM Imagine it. Delivered.

All hyetographs are plotted using 15-minute peak intensities.

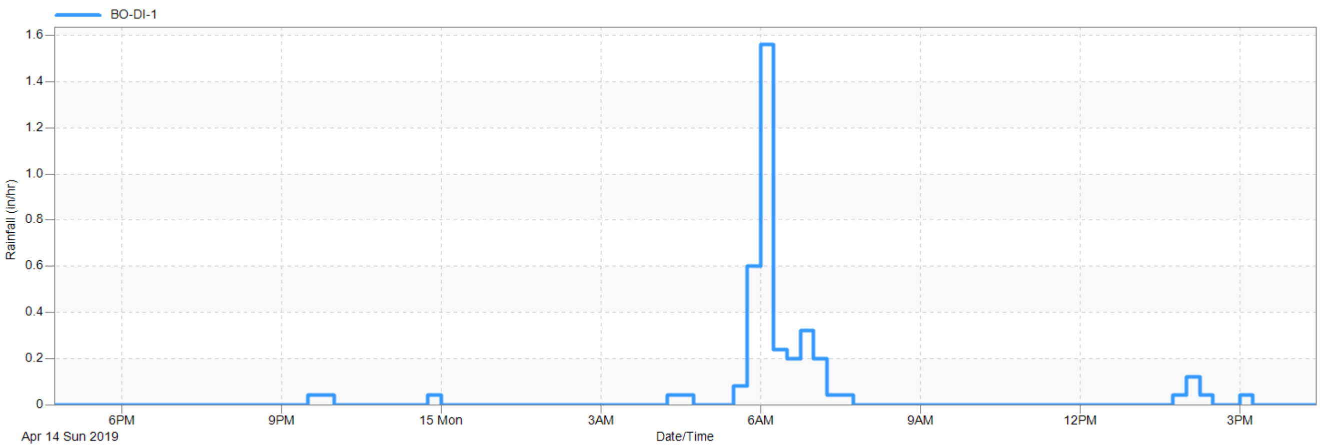


Figure 1. Ward Street April 14, 2019

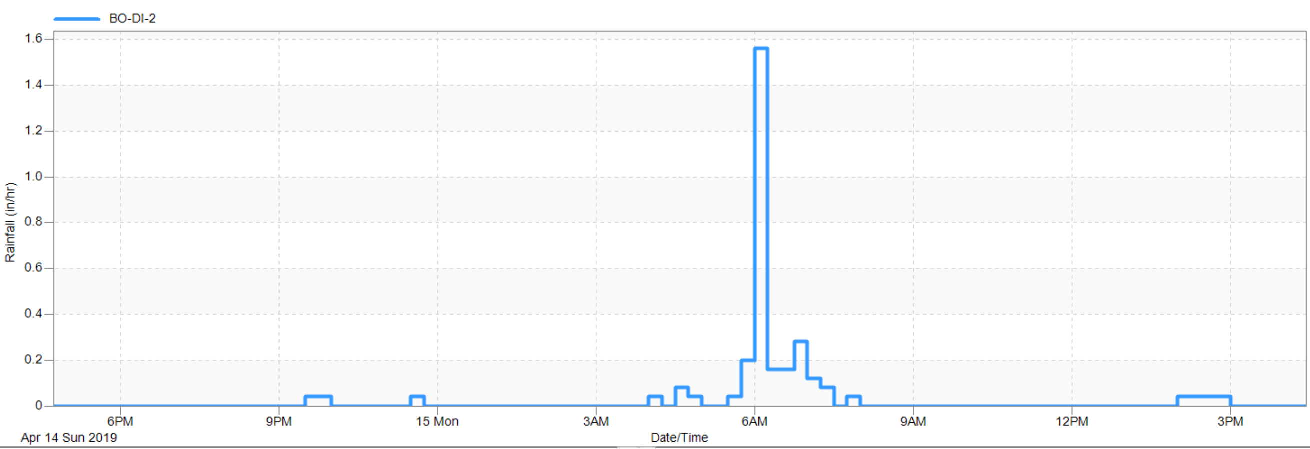


Figure 2. BO-DI-2 April 14, 2019

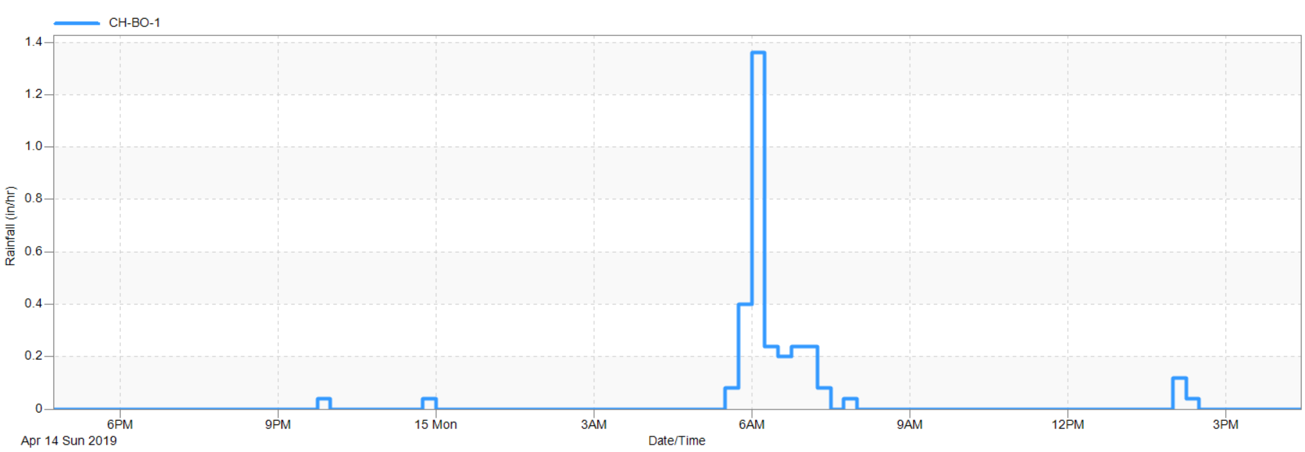


Figure 3. CH-BO-1 April 14, 2019

AECOM Imagine it. Delivered.

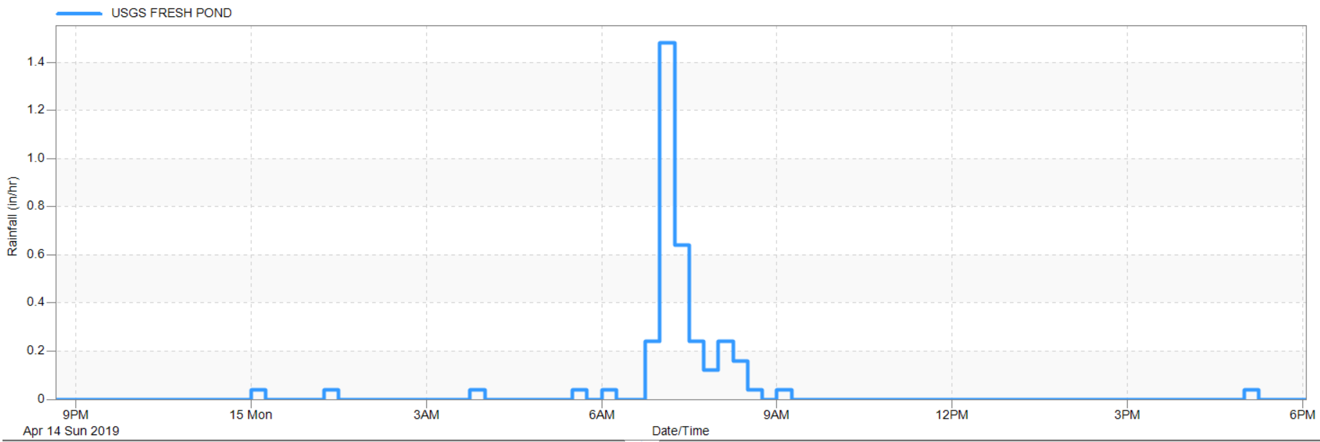


Figure 4. USGS Fresh Pond April 15, 2019

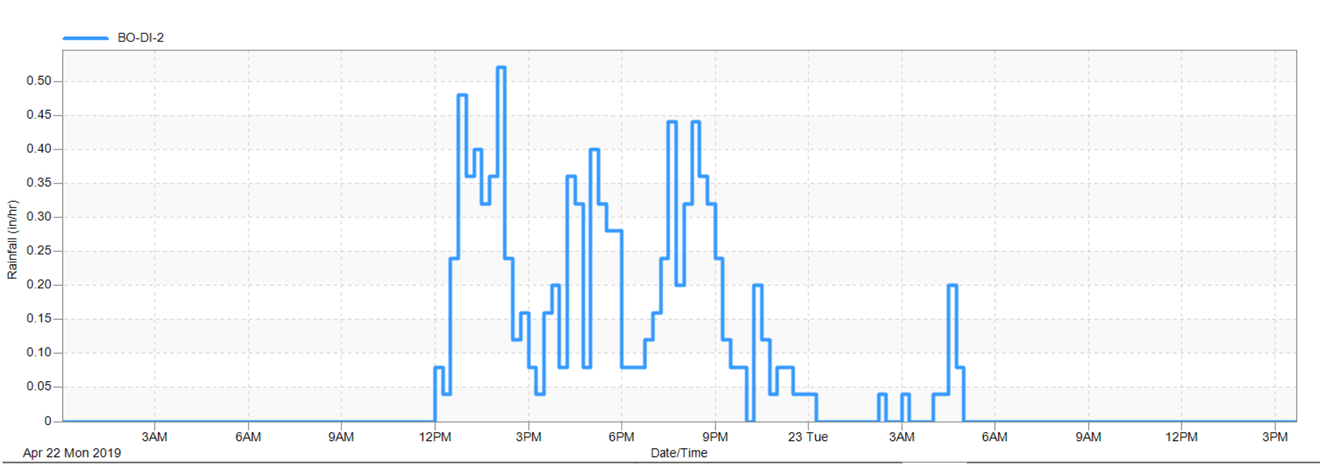


Figure 5. BO-DI-2 April 22, 2019

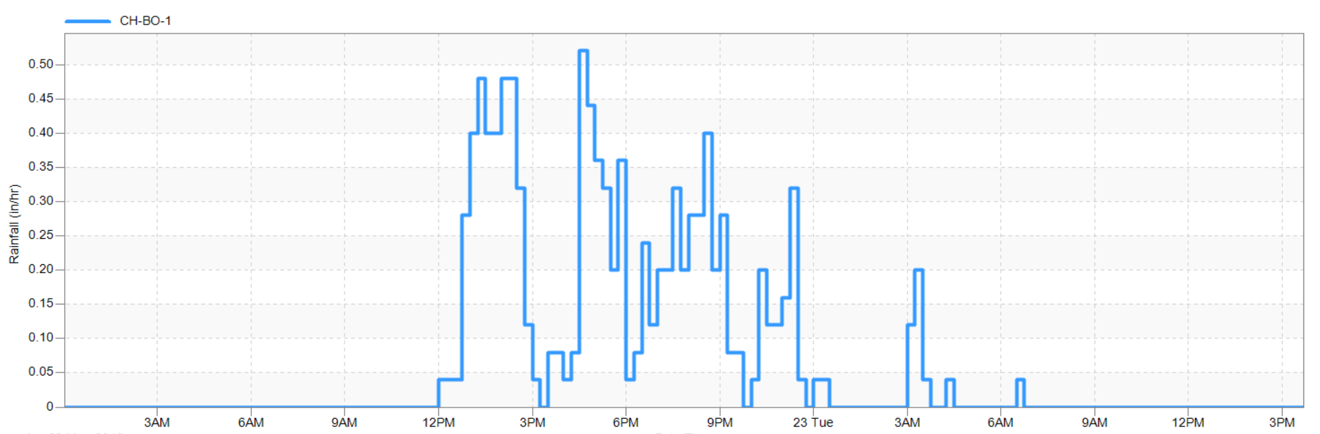


Figure 6. CH-BO-1 April 22, 2019

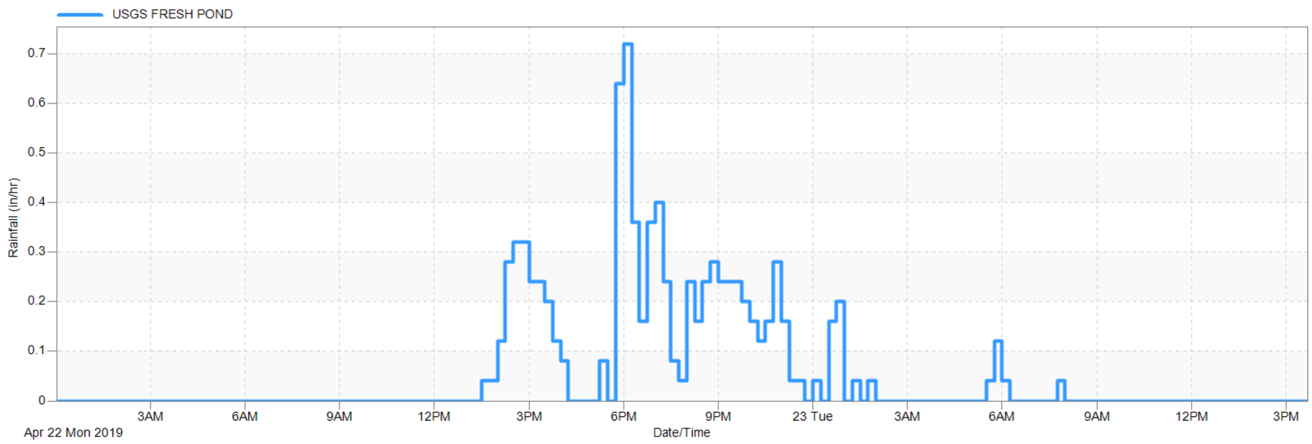


Figure 7. USGS Fresh Pond April 22, 2019

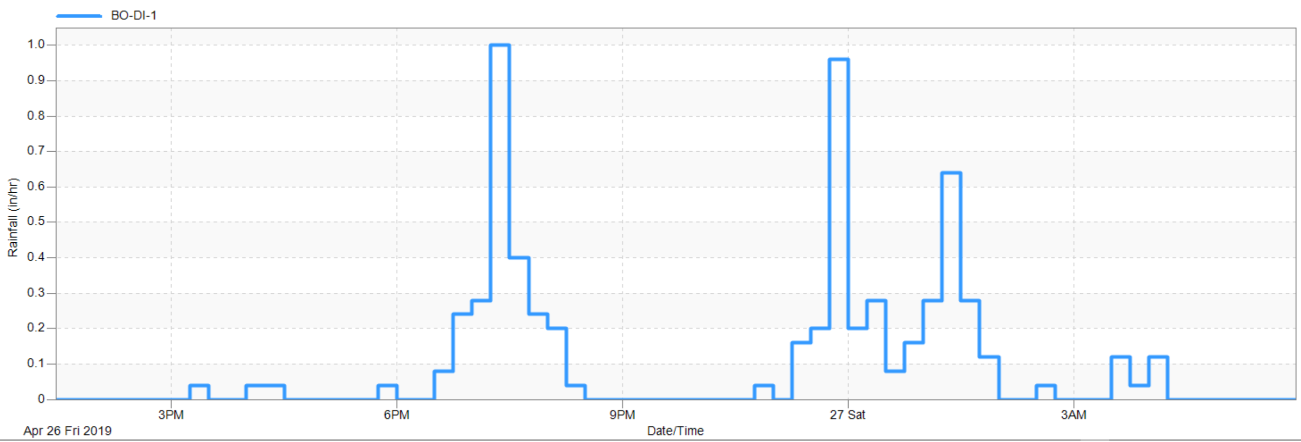


Figure 8. BO-DI-1 April 26, 2019

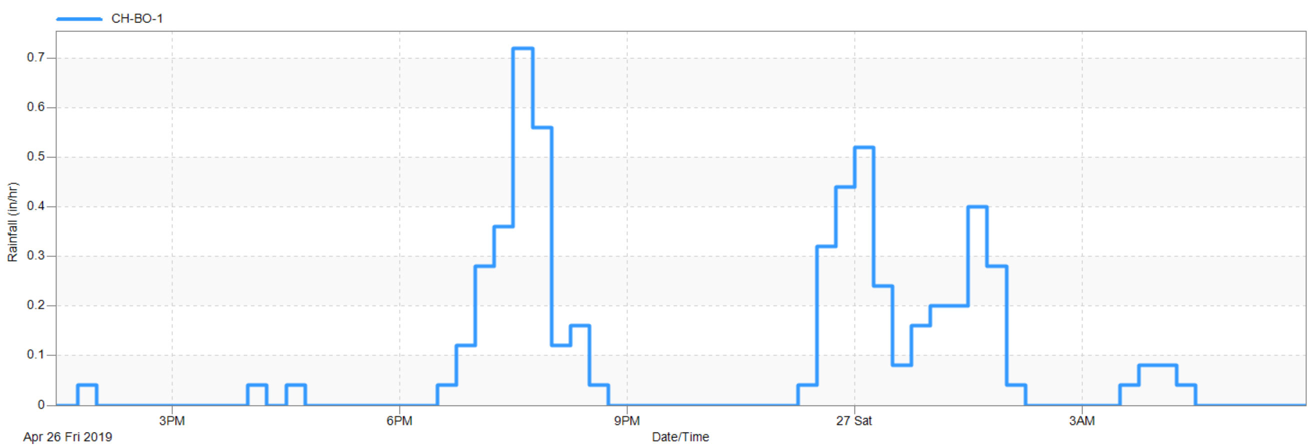


Figure 9. CH-BO-1 April 26, 2019

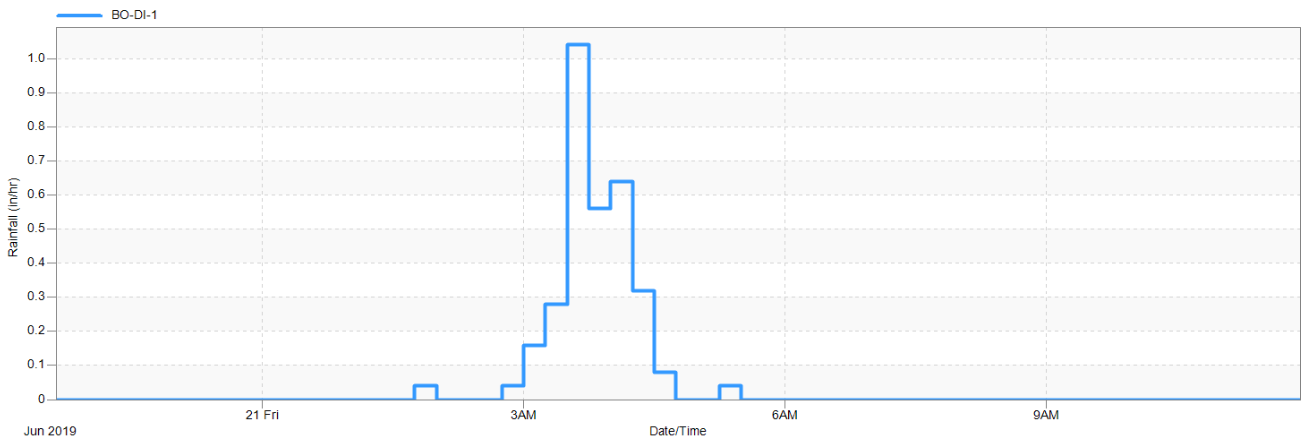


Figure 10. BO-DI-1 June 21, 2019

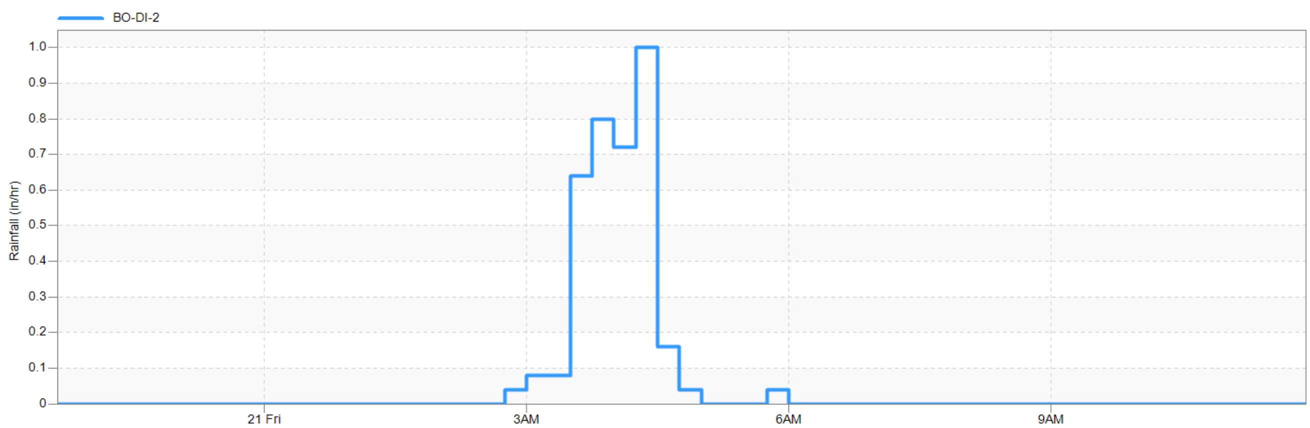


Figure 11. BO-DI-2 June 21, 2019

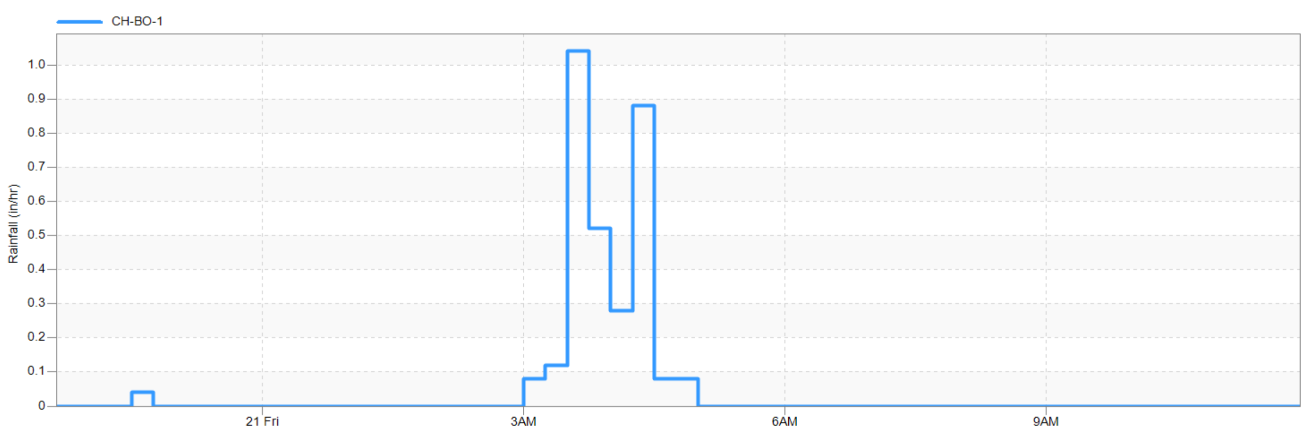


Figure 12. CH-BO-1 June 20, 2019

AECOM Imagine it. Delivered.

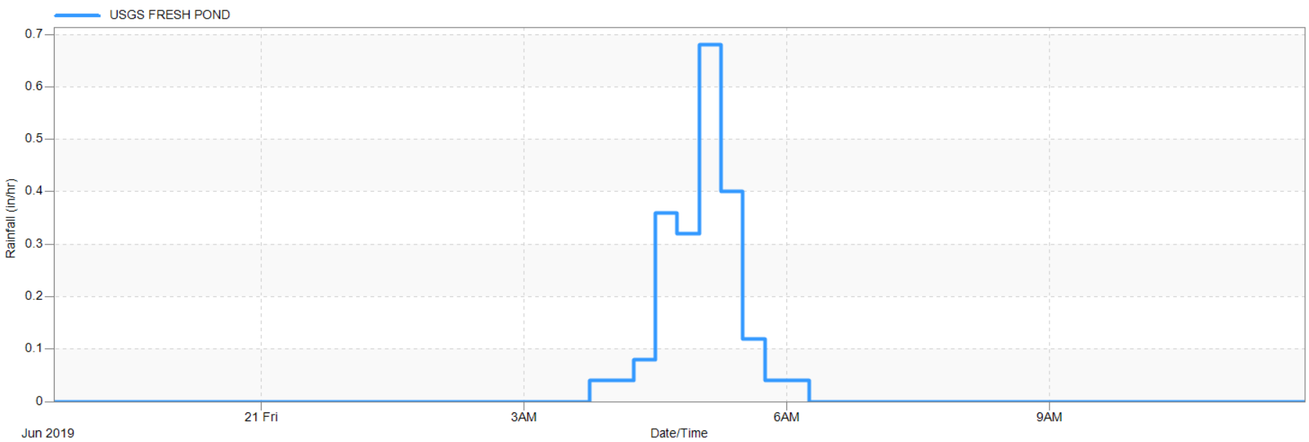


Figure 13. USGS Fresh Pond June 20, 2019

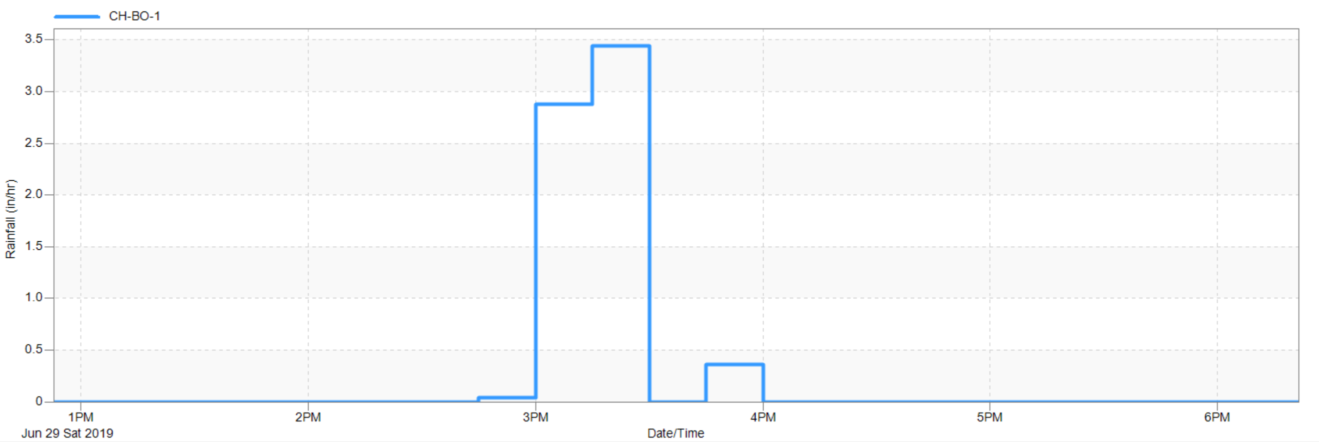
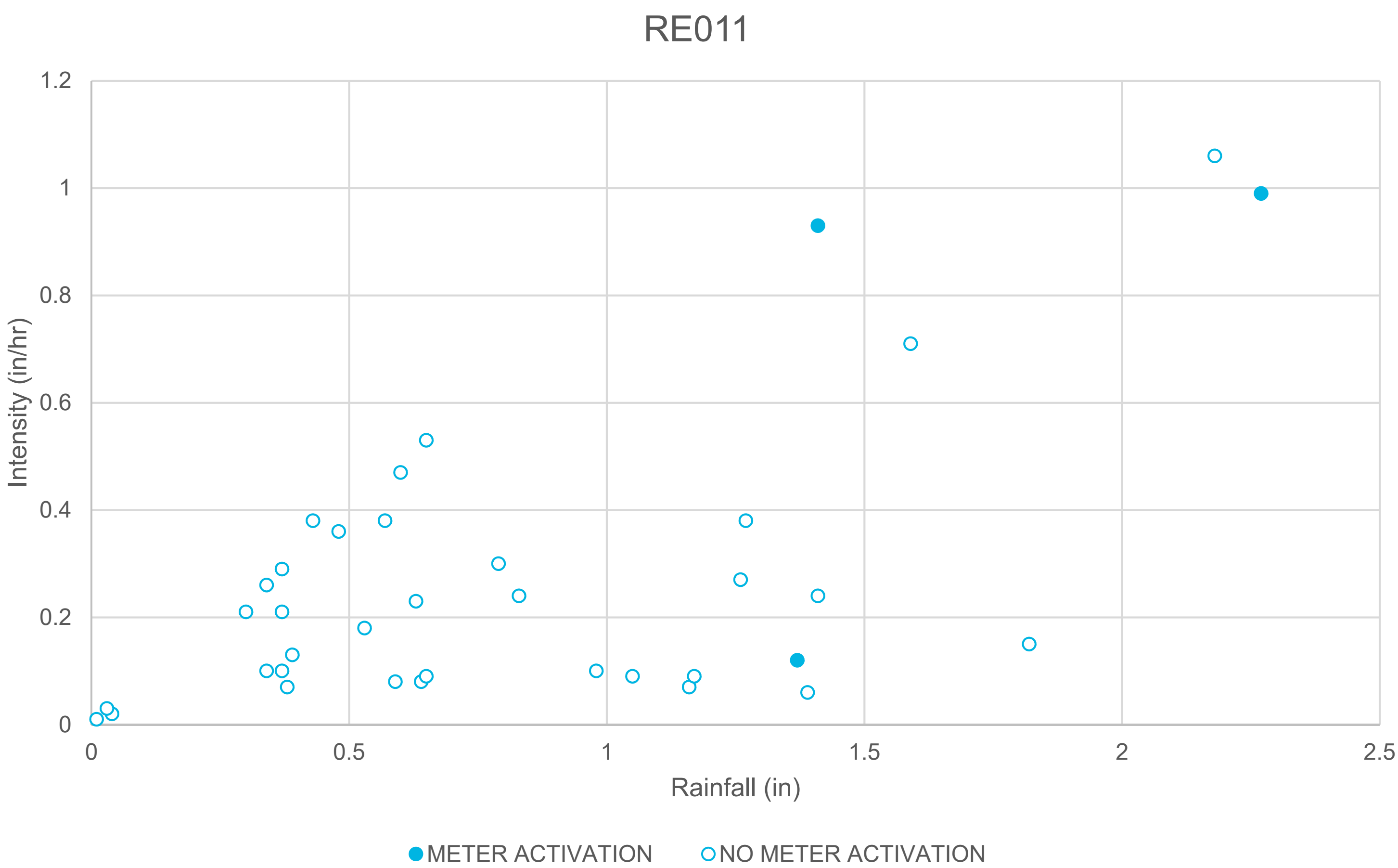


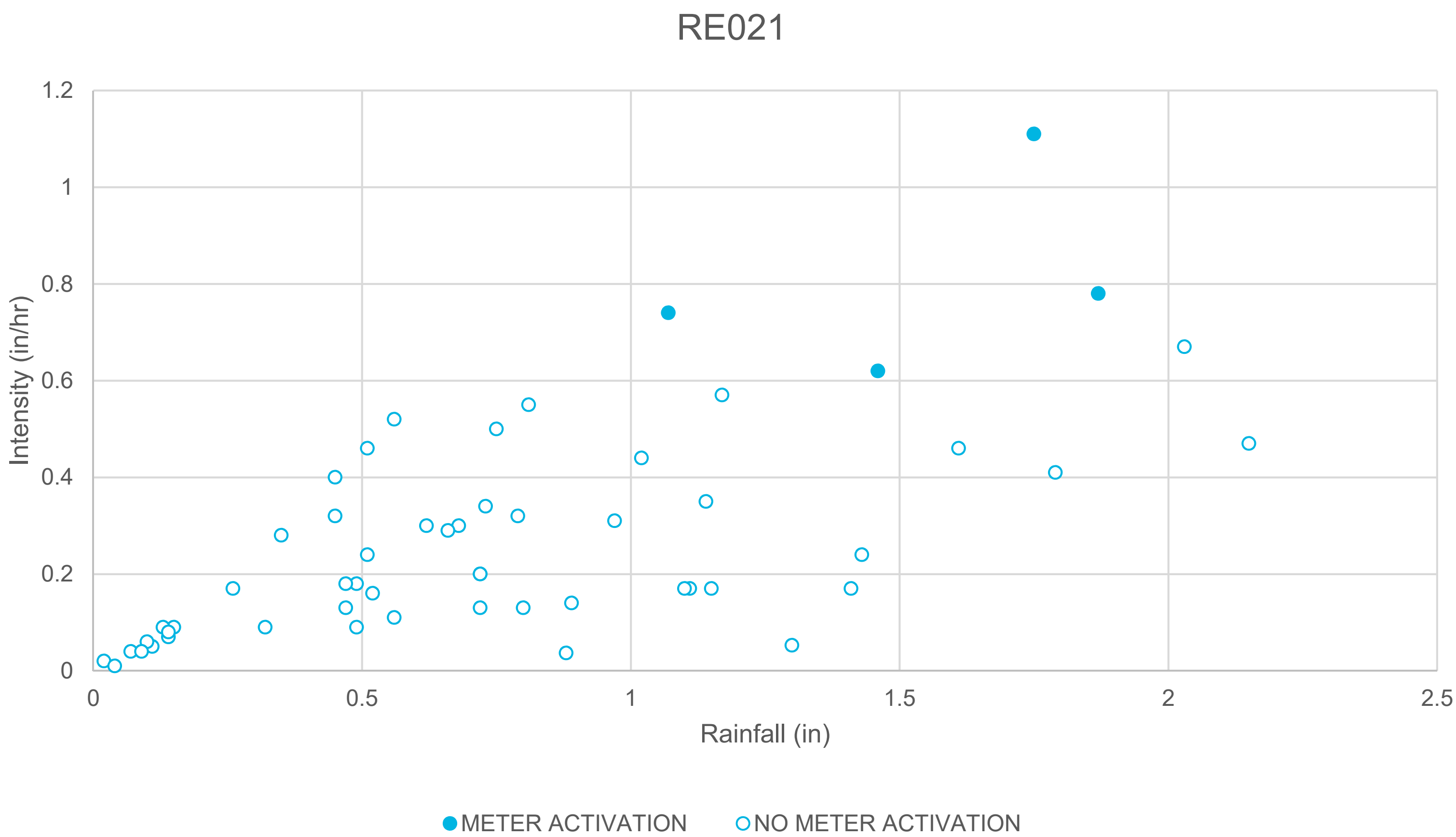
Figure 14. CH-BO-1 June 29, 2019

Appendix D Meter Data Scattergraphs

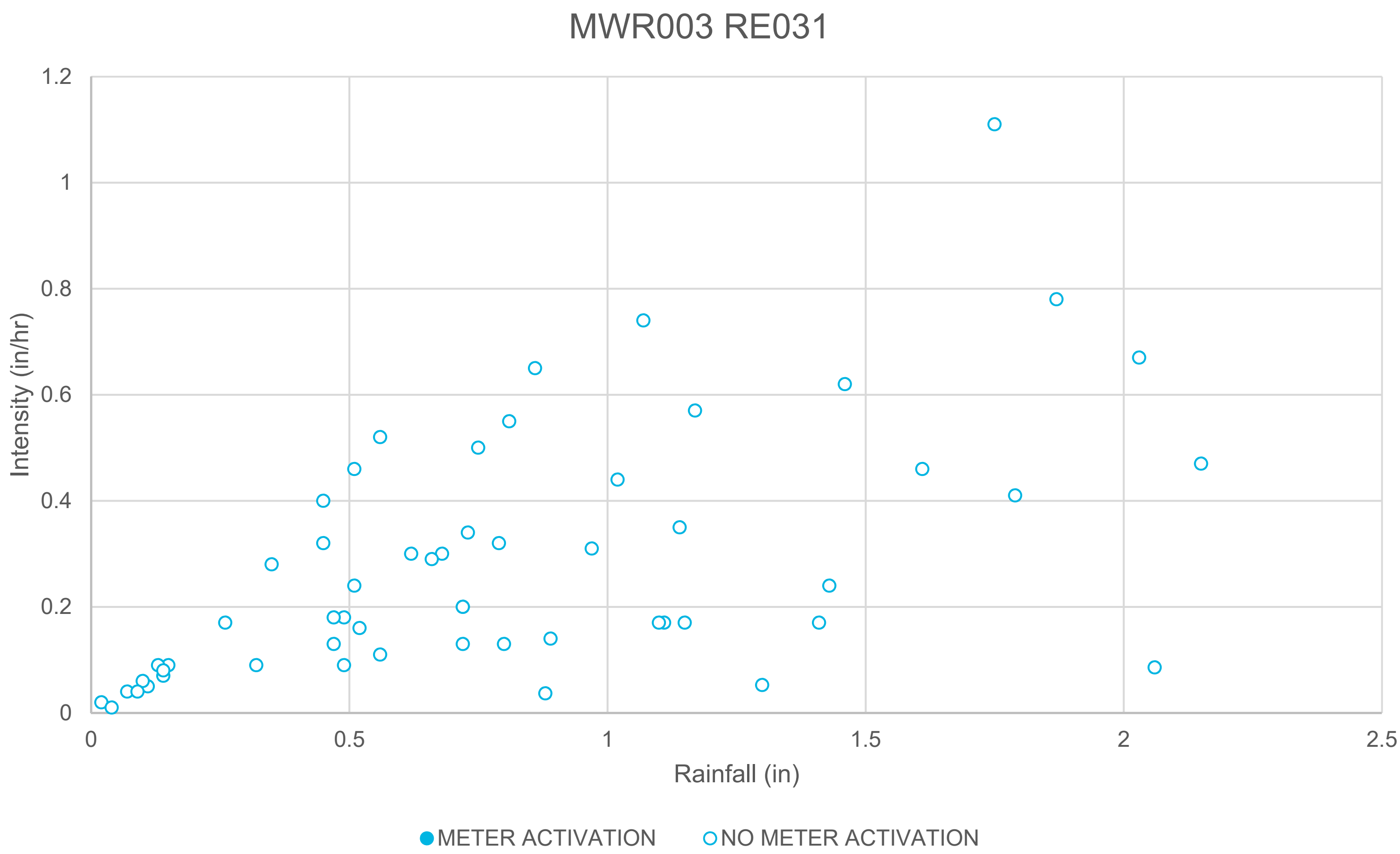
Outfall: CAM001
Regulator: RE011
Related Rain Gauge: 16



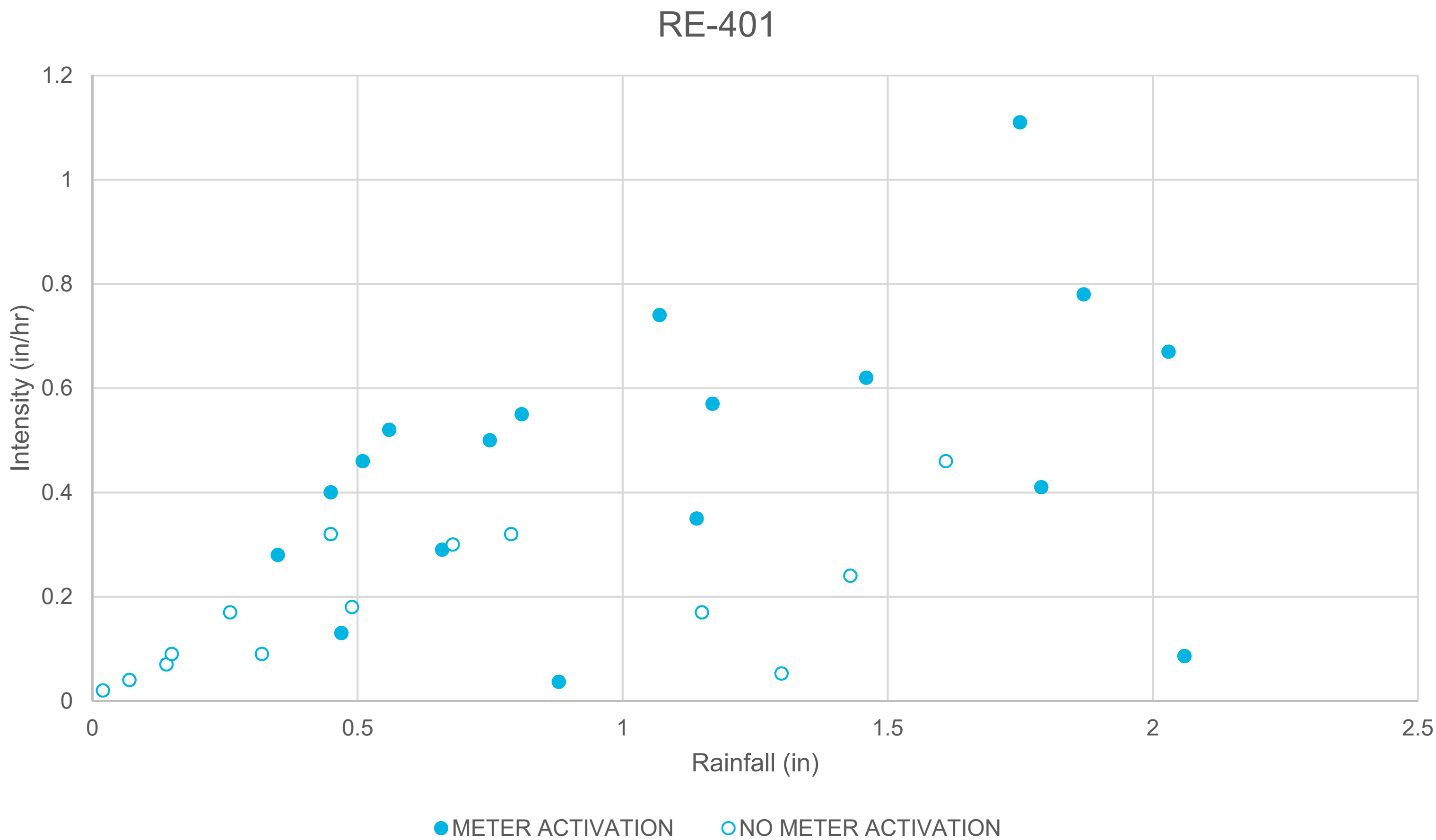
Outfall:CAM002
Regulator: RE021
Related Rain Gauge: 19



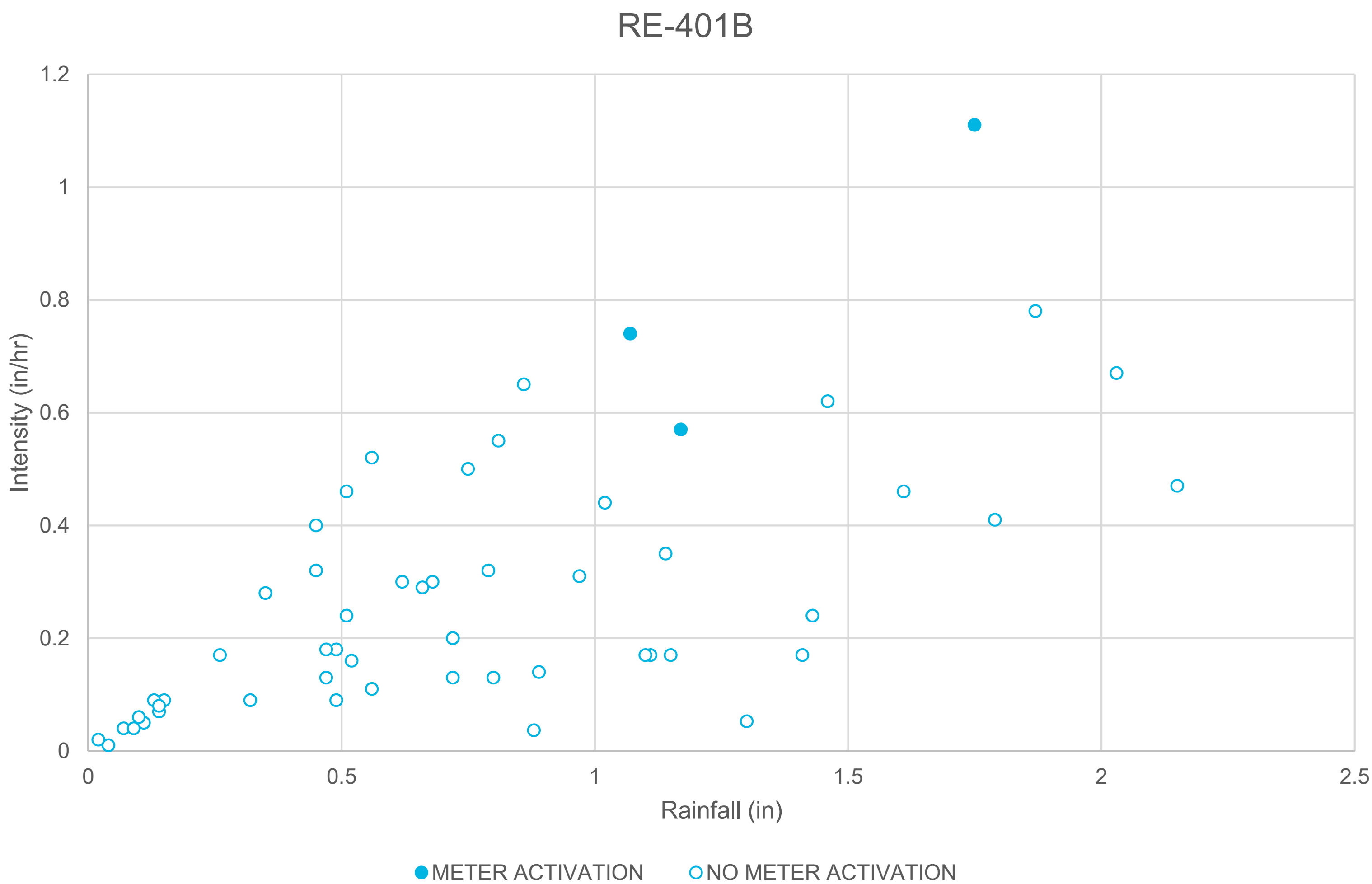
Outfall:MWR003
Regulator: RE031
Related Rain Gauge: 19



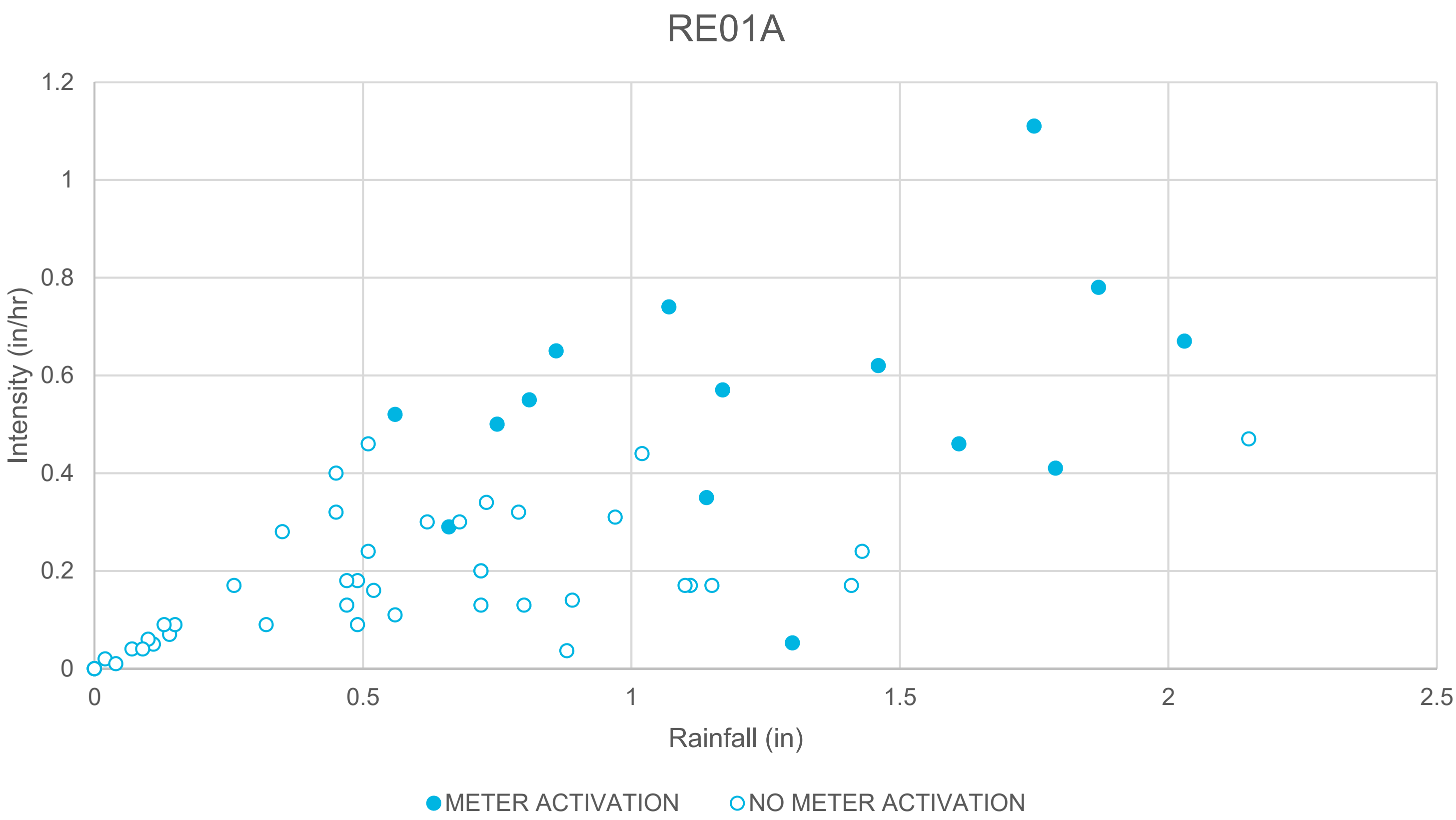
Outfall:CAM401a
Regulator: RE401
Related Rain Gauge: 19



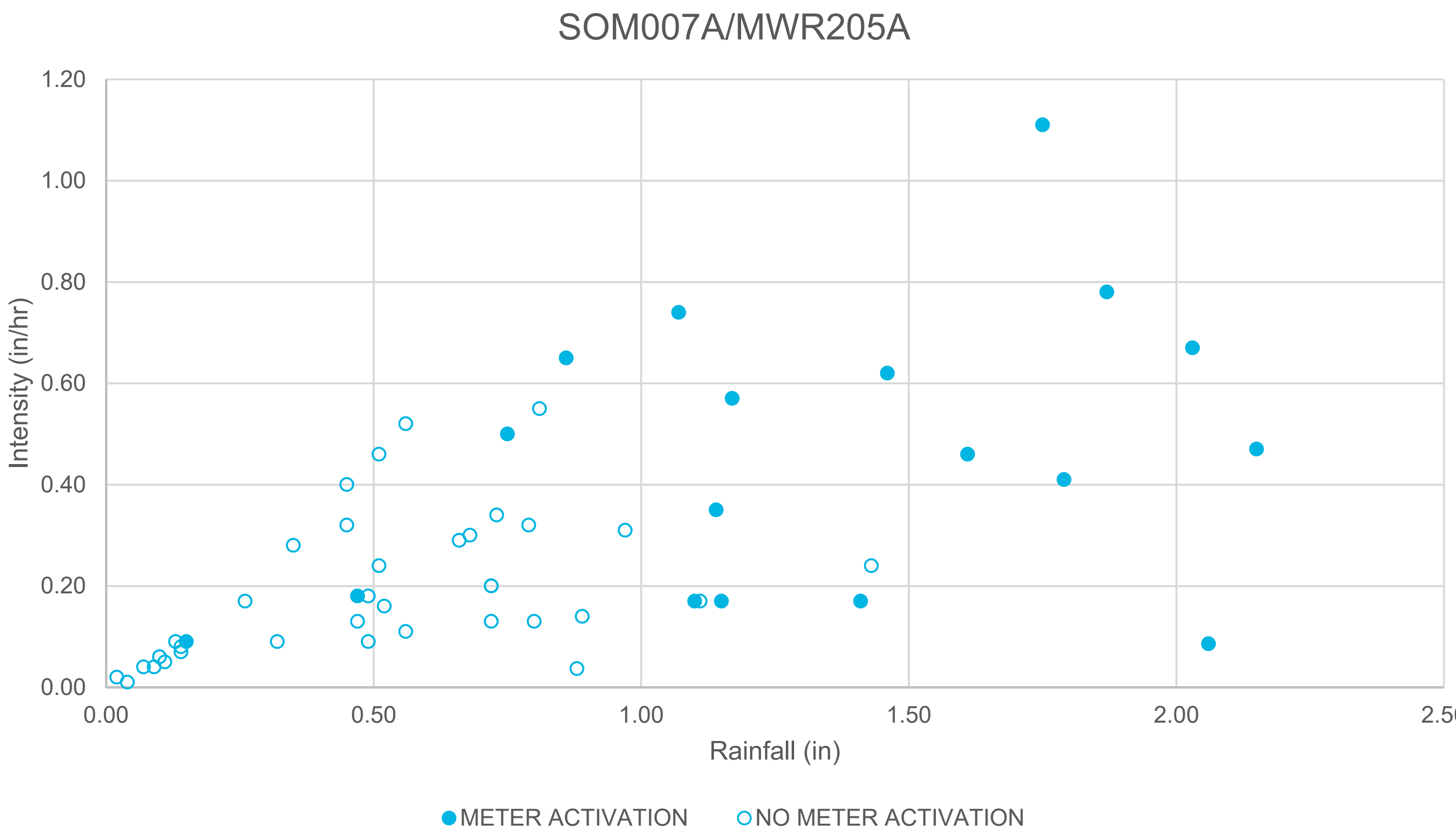
Outfall:CAM401B
Regulator: RE401B
Related Rain Gauge: 19



Outfall:SOM001A
Regulator: RE01A
Related Rain Gauge: 19

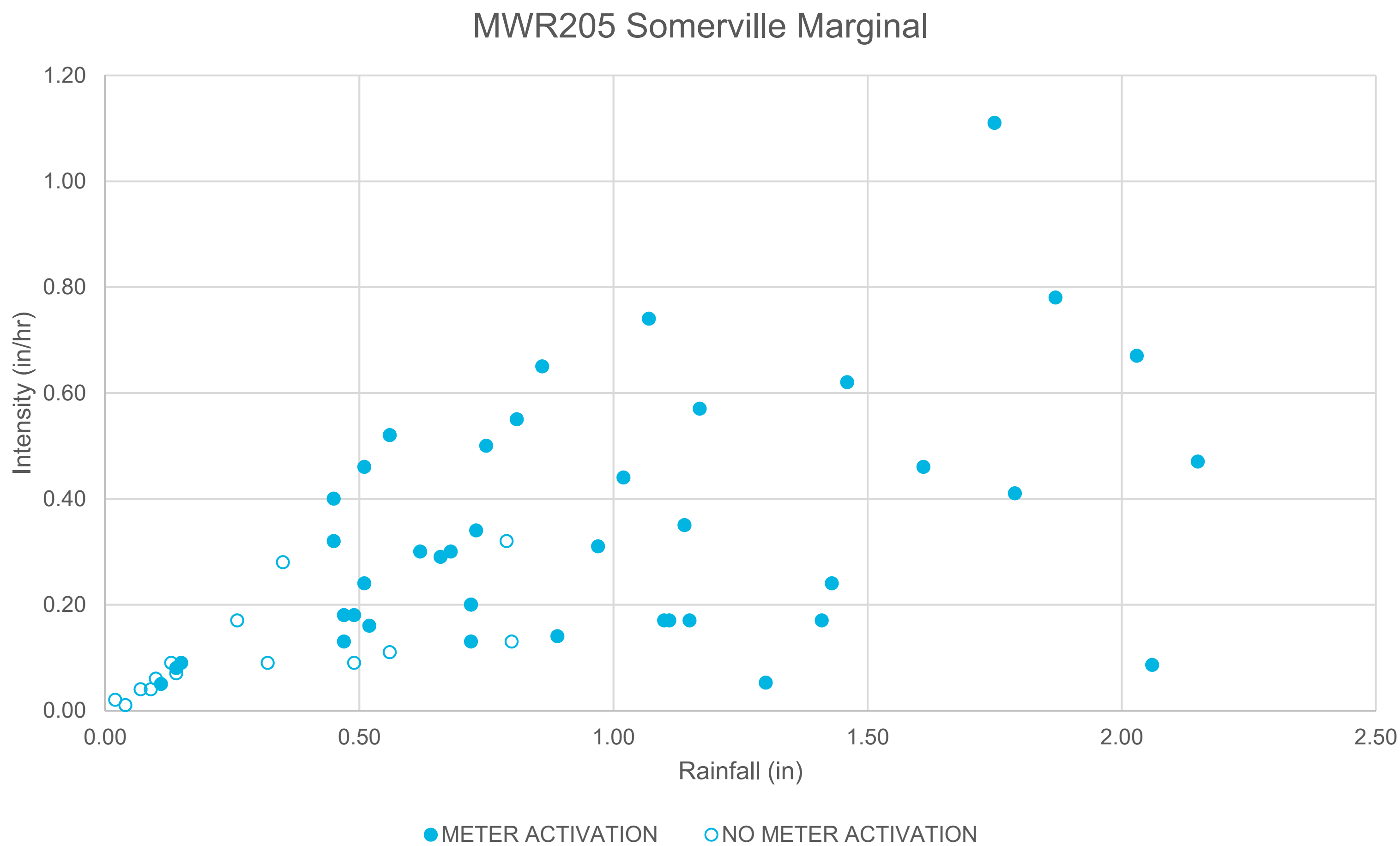


Outfall:SOM007A/MWR205A
Related Rain Gauge: 19

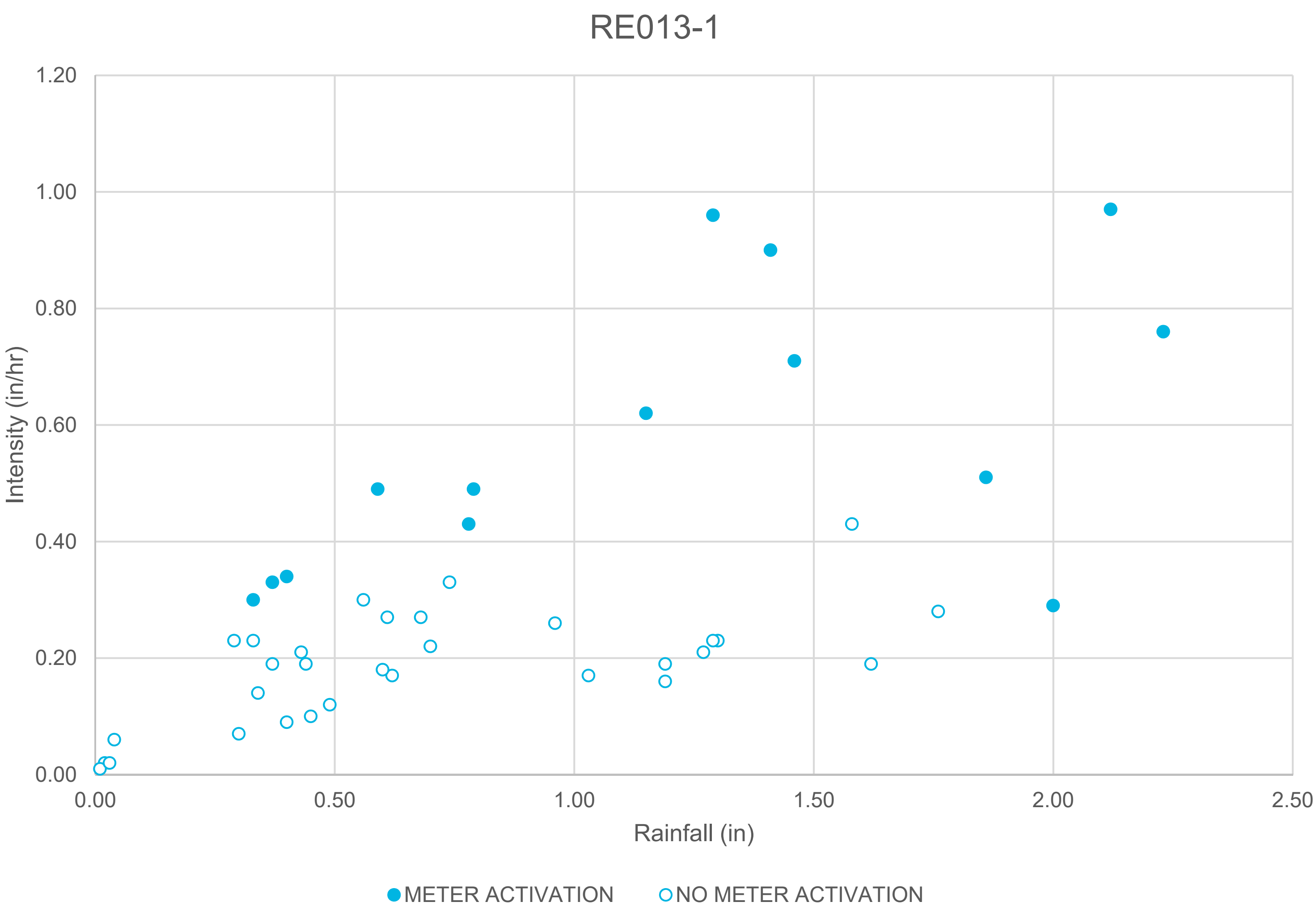


Outfall:MWR205A (Somerville Marginal)

Related Rain Gauge: 19

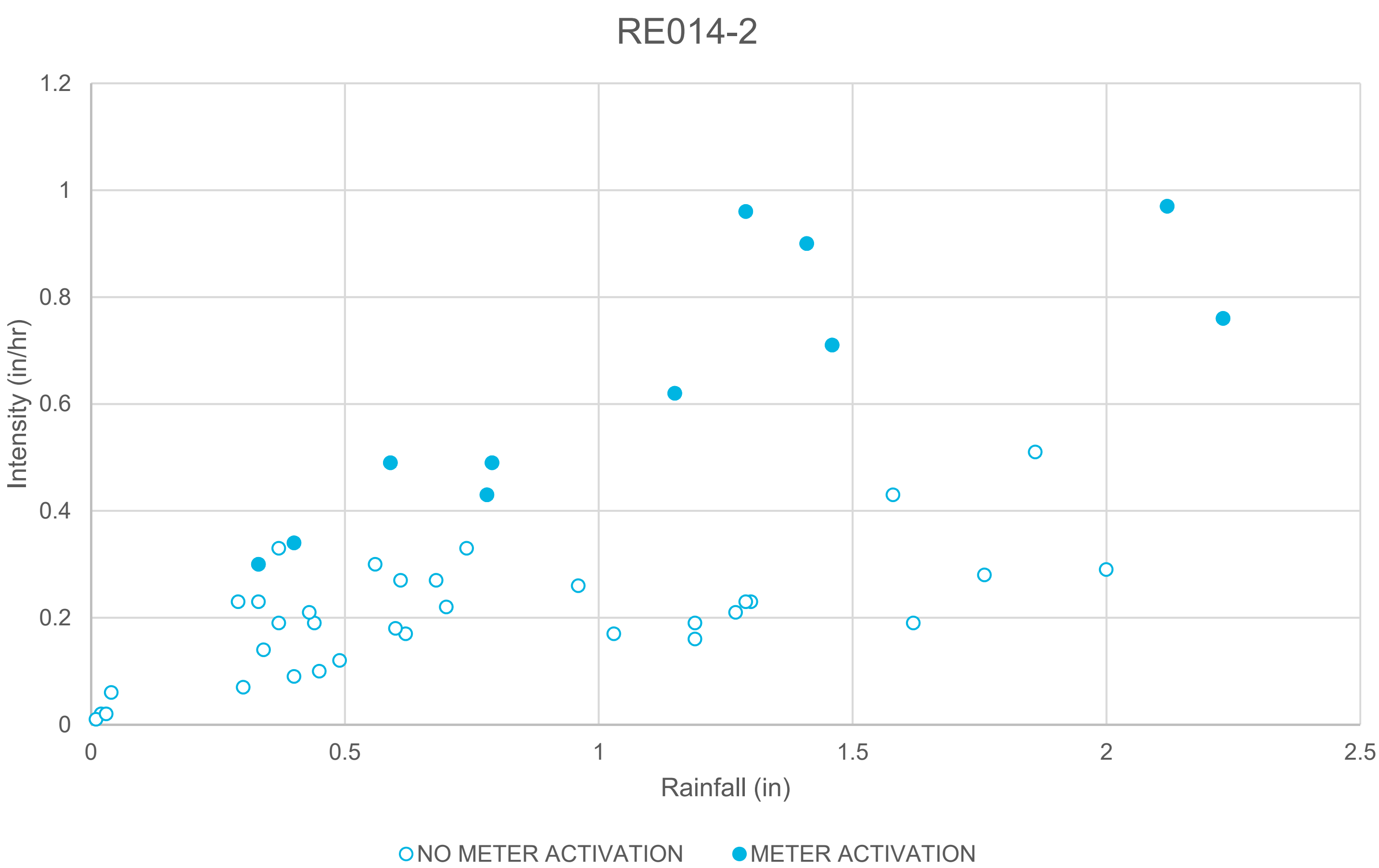


Outfall: BOS013
Regulator: RE013-1
Related Rain Gauge: 8



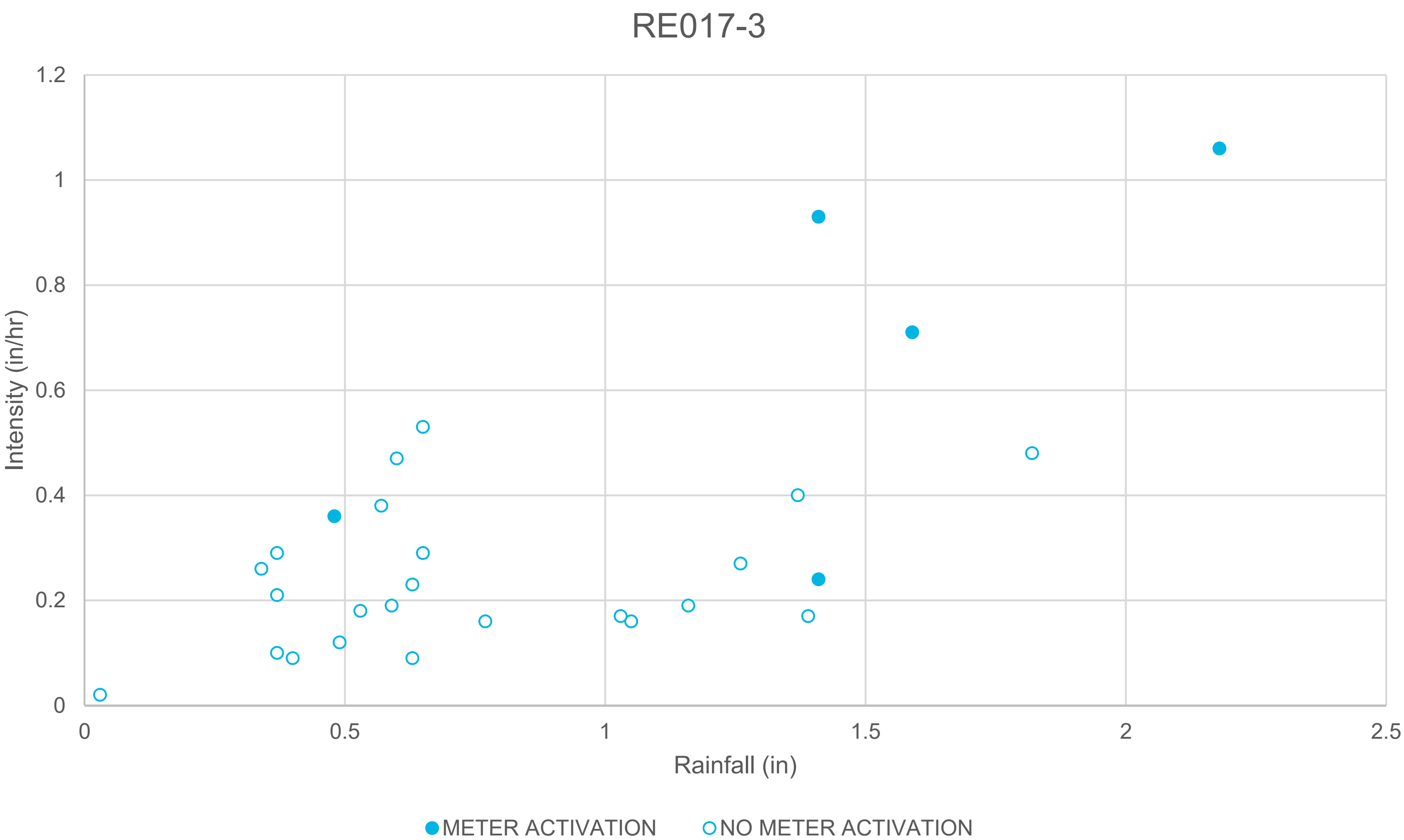
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS014
Regulator: RE014-2
Related Rain Gauge: 8



Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

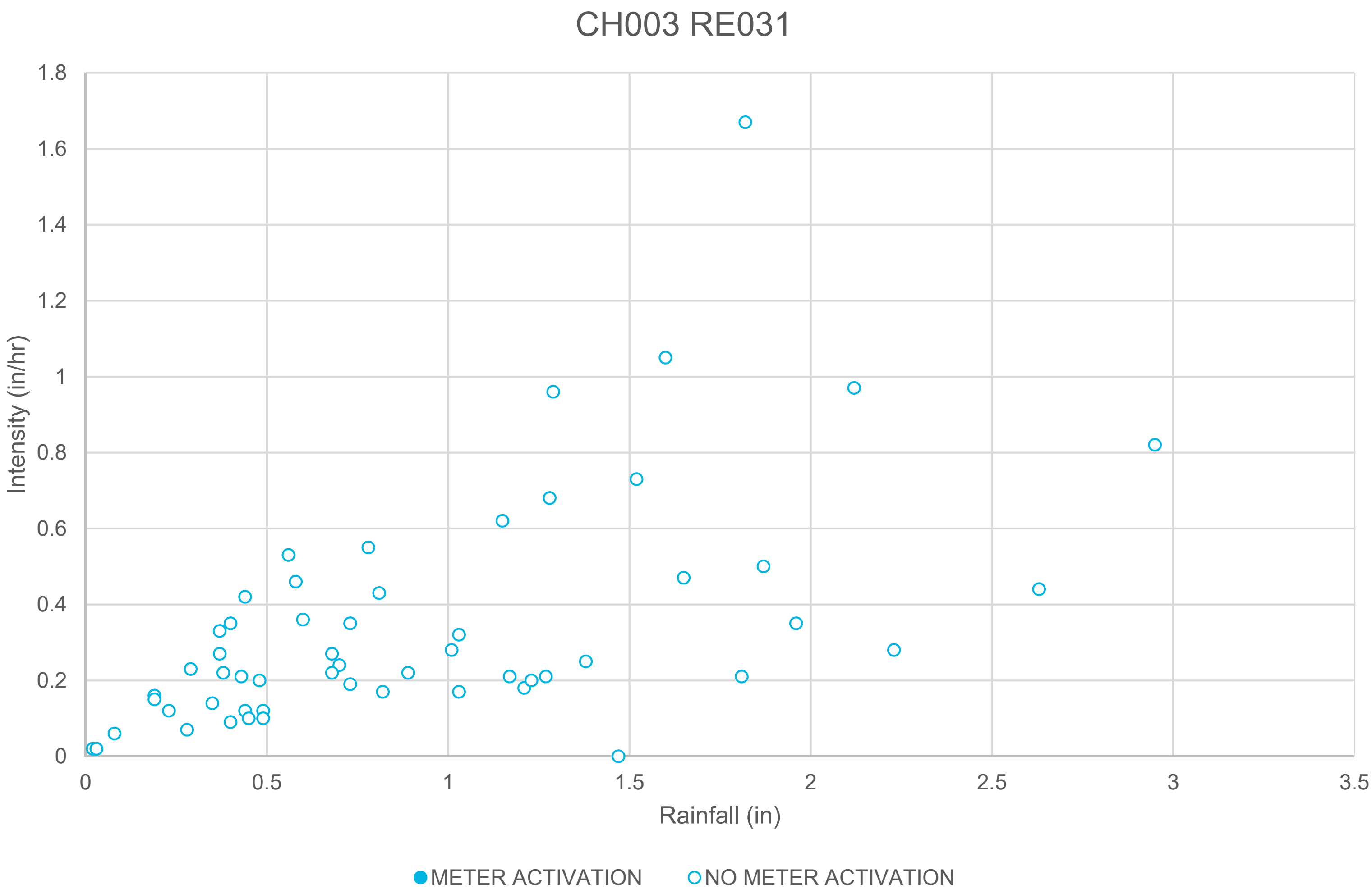
Outfall: BOS017
Regulator: RE017-3
Related Rain Gauge: 4



Does not include activations from April 15-July 18. After July 18 an inclinometer was added providing increased confidence in CSO activations

Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

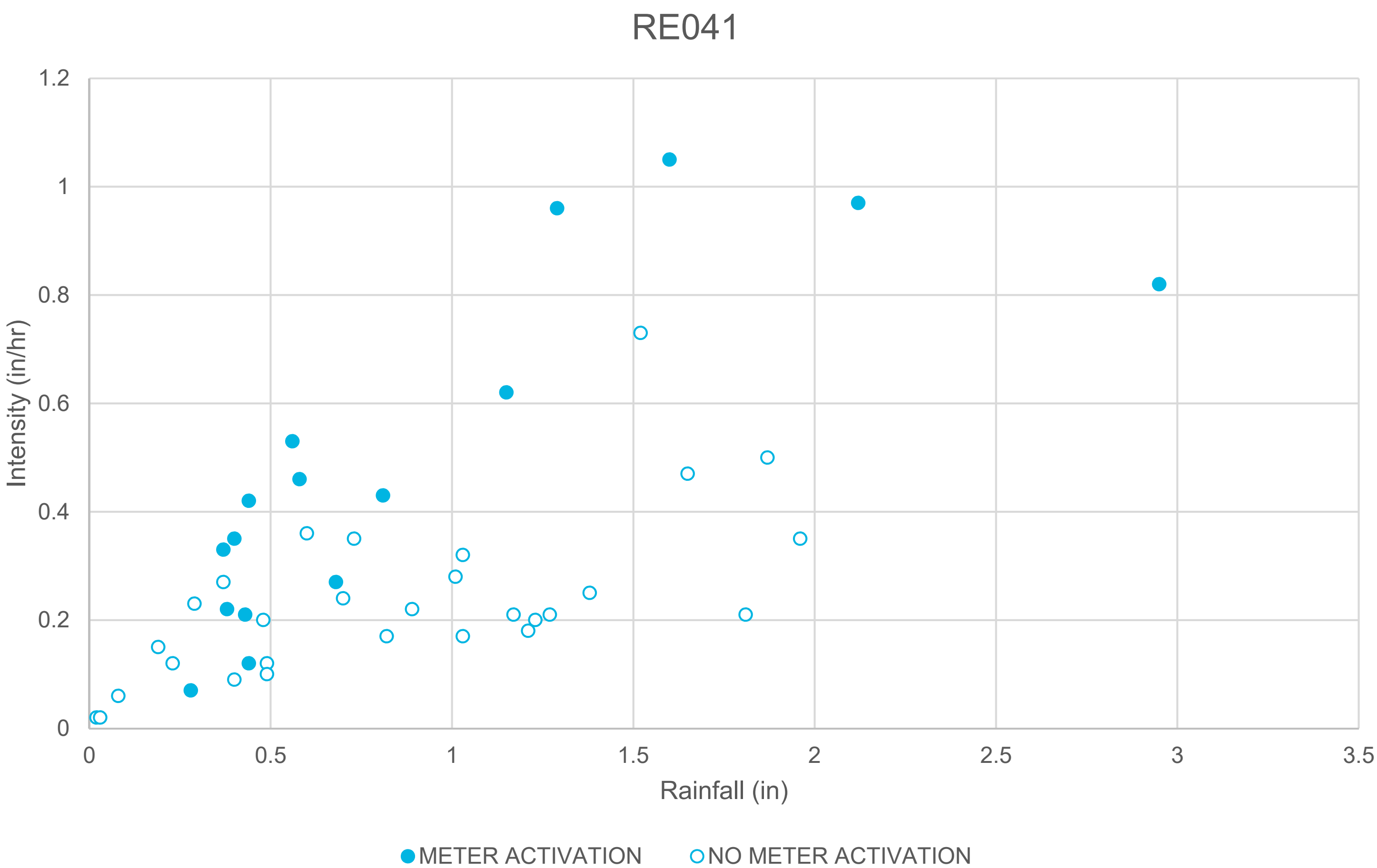
Outfall: CHE003
Regulator: RE031
Related Rain Gauge: 5



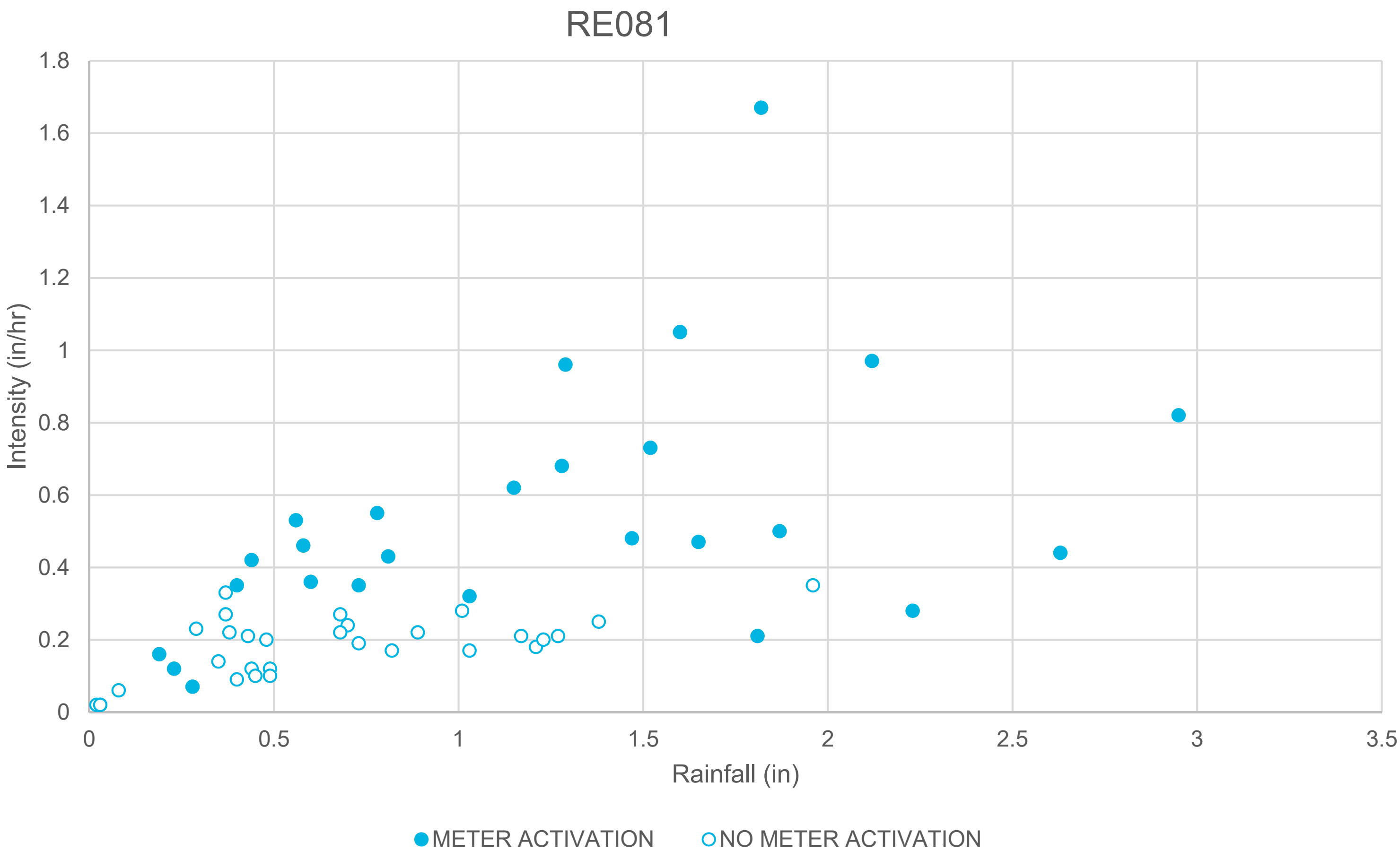
Outfall: CHE004

Regulator: RE041

Related Rain Gauge: 5



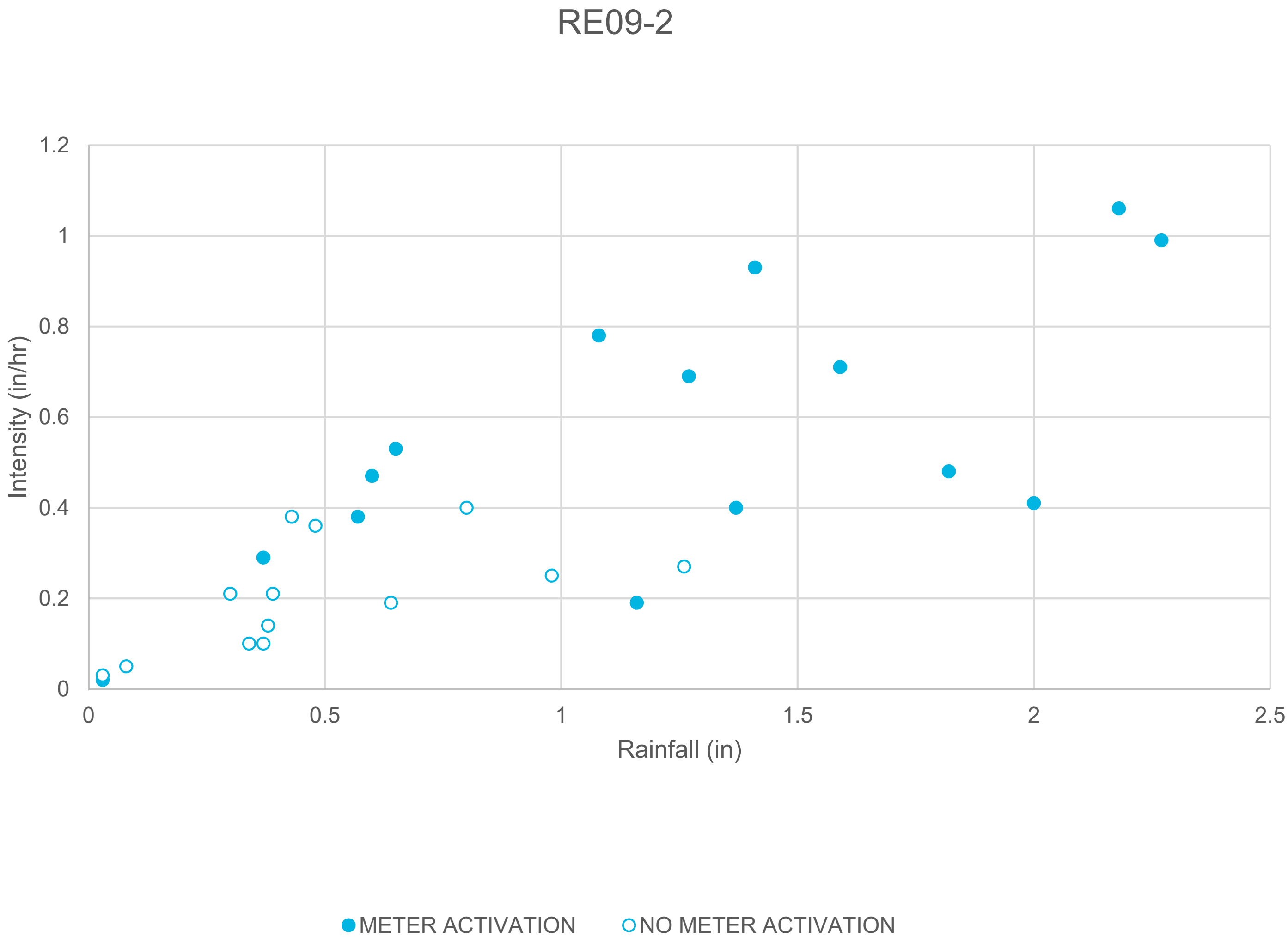
Outfall: CHE008
Regulator: RE081
Related Rain Gauge: 5



Outfall: BOS09

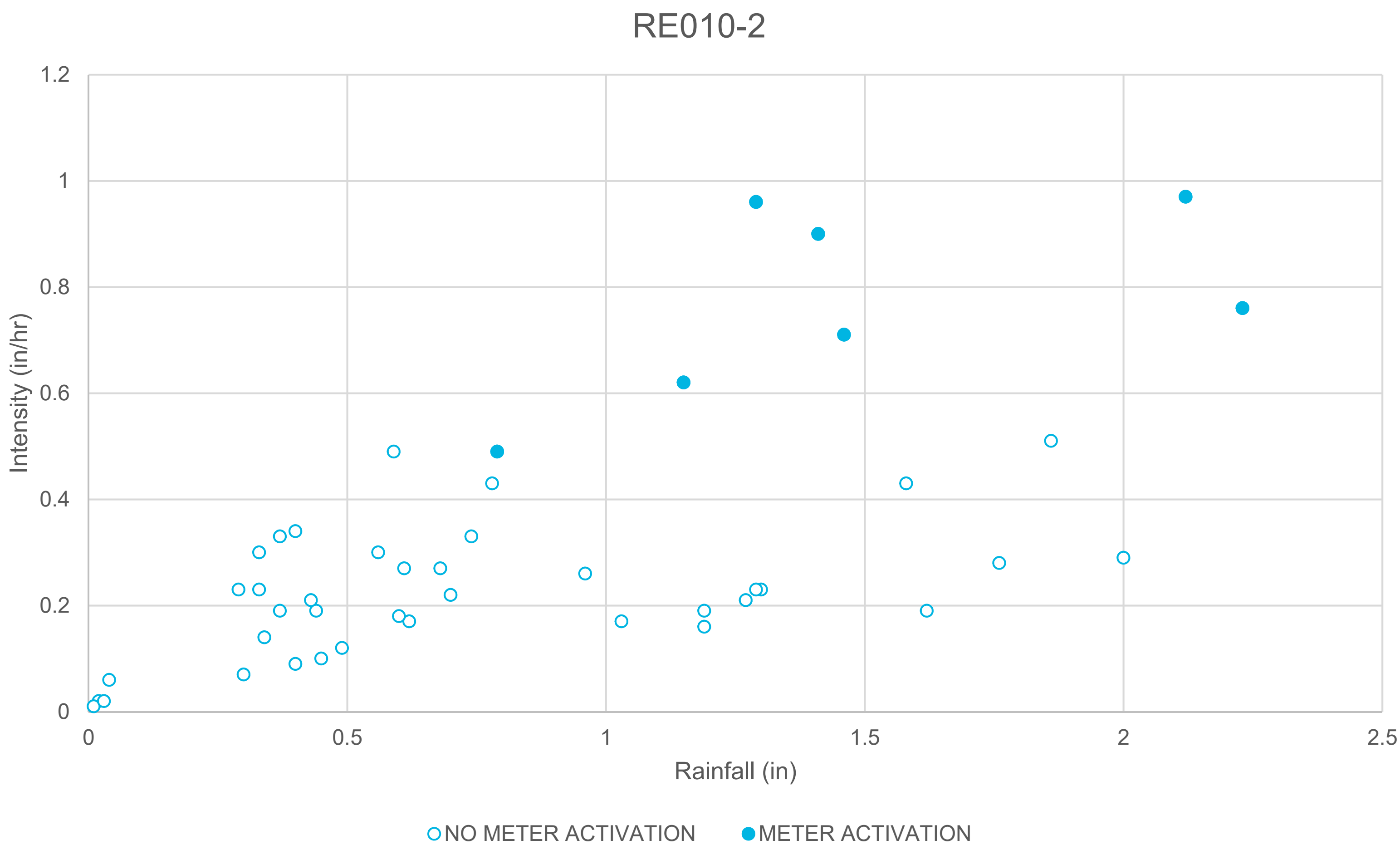
Regulator: RE09-2

Related Rain Gauge: 4



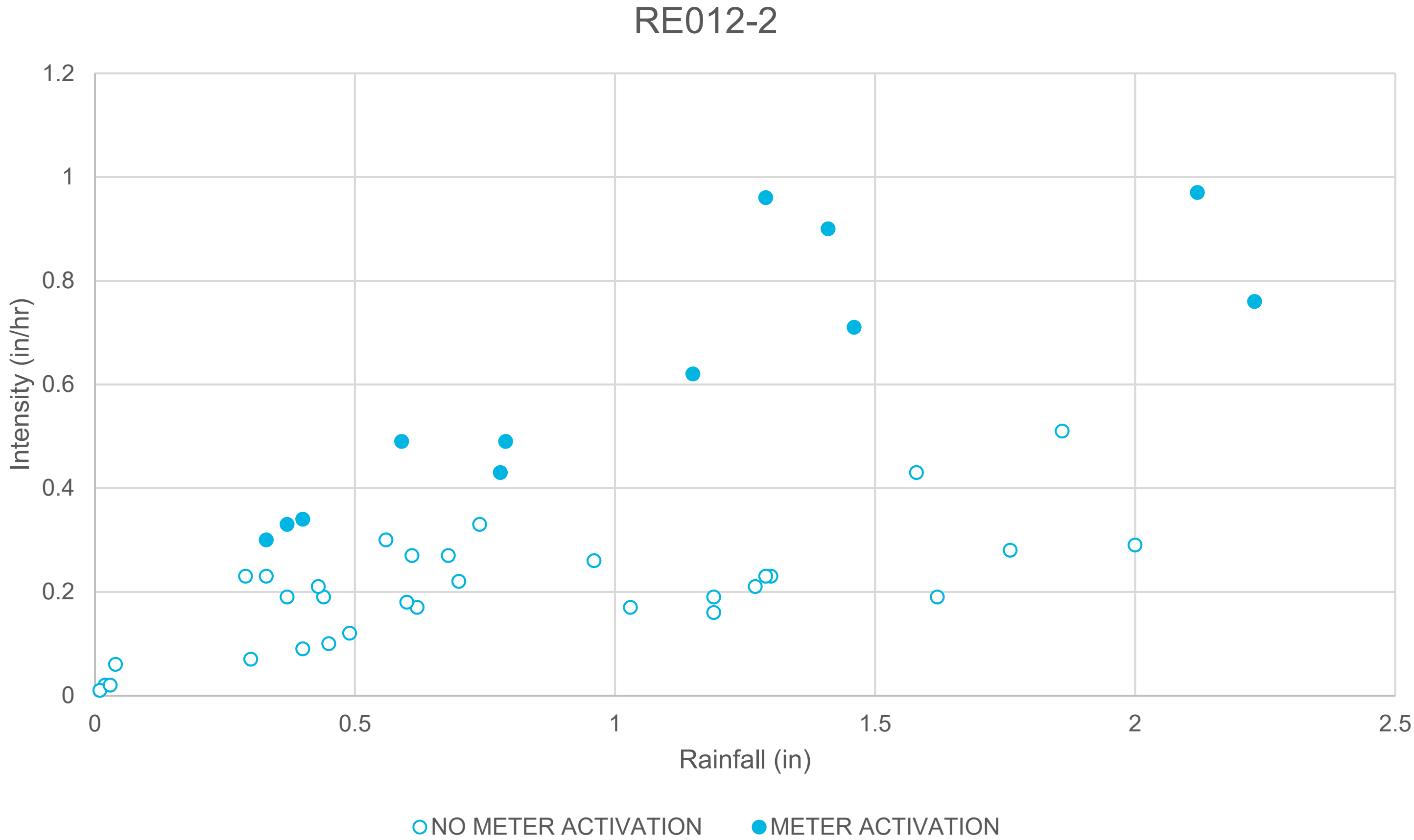
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS010
Regulator: RE010-2
Related Rain Gauge: 8



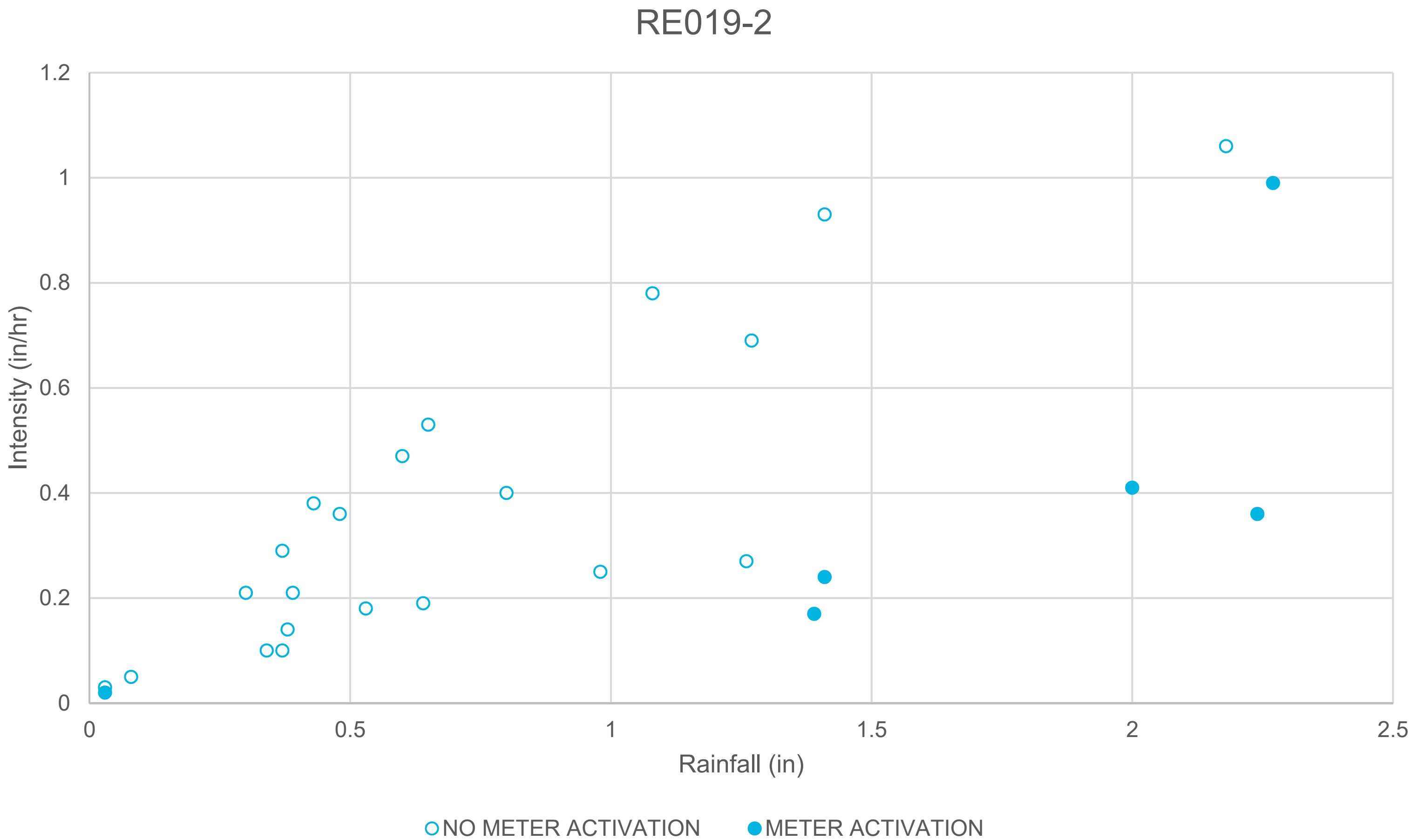
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS012
Regulator: RE012-2
Related Rain Gauge: 8

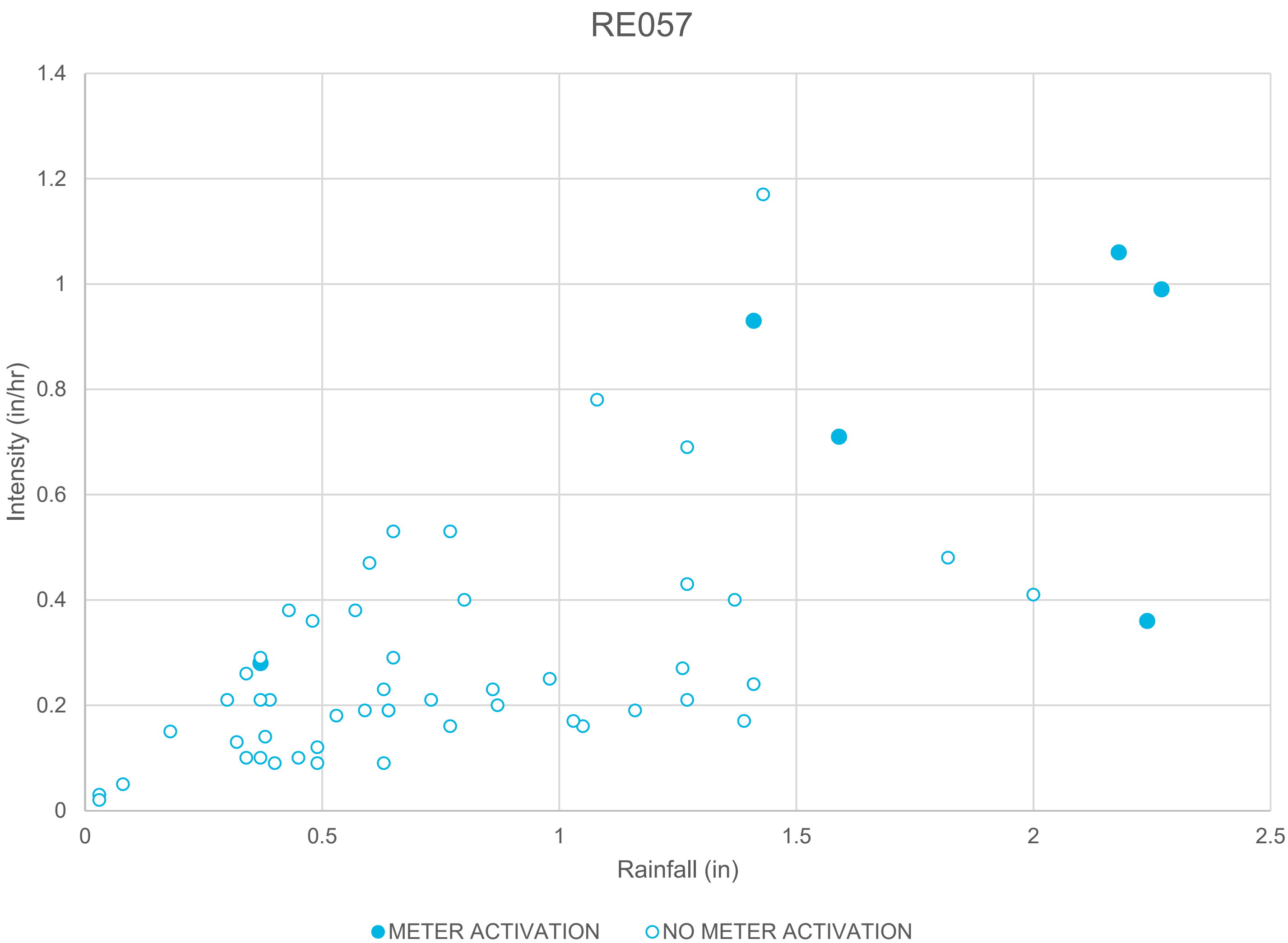


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS019
Regulator: RE019-2
Related Rain Gauge: 4



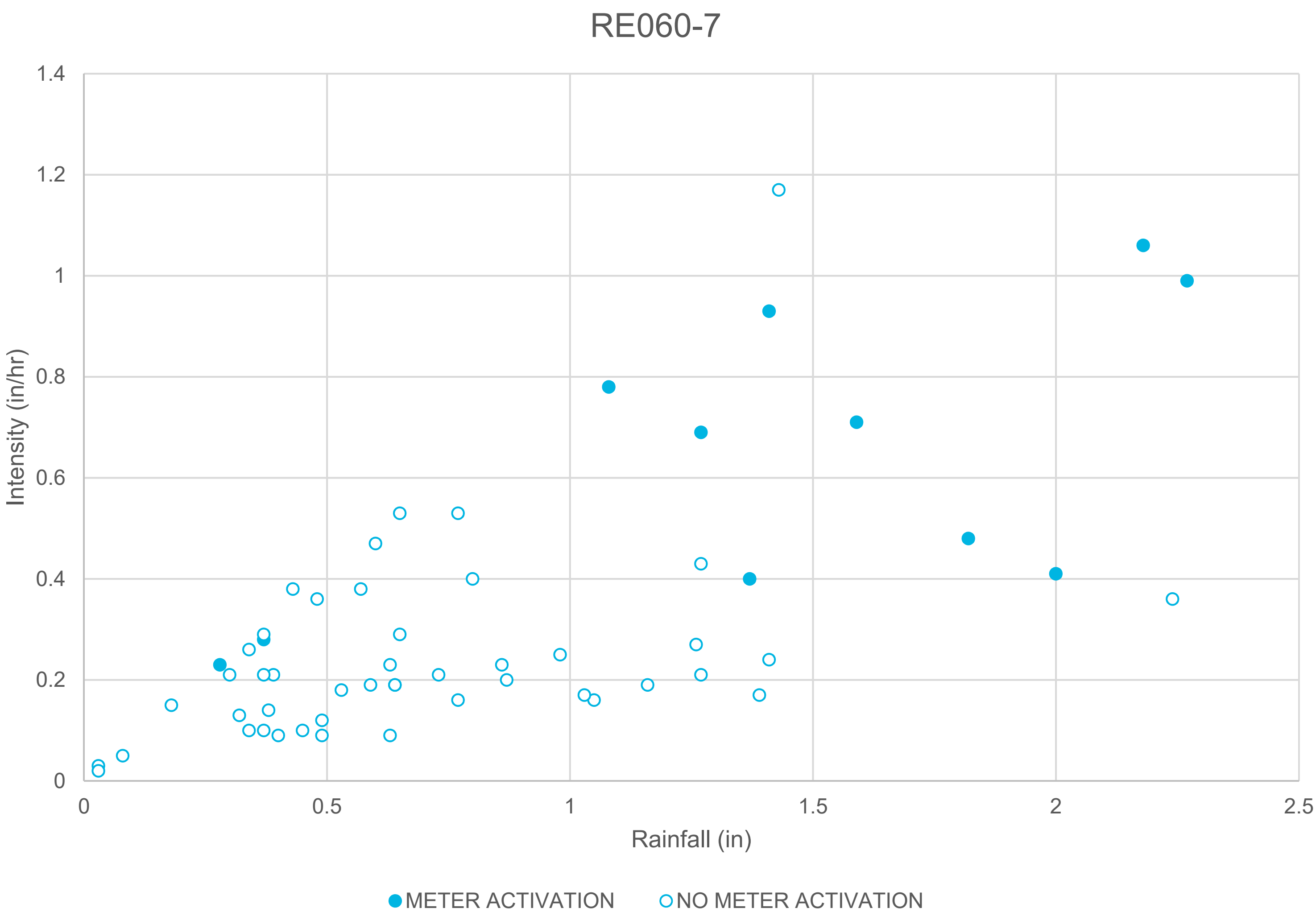
Outfall: BOS057
Regulator: RE057
Related Rain Gauge: 4



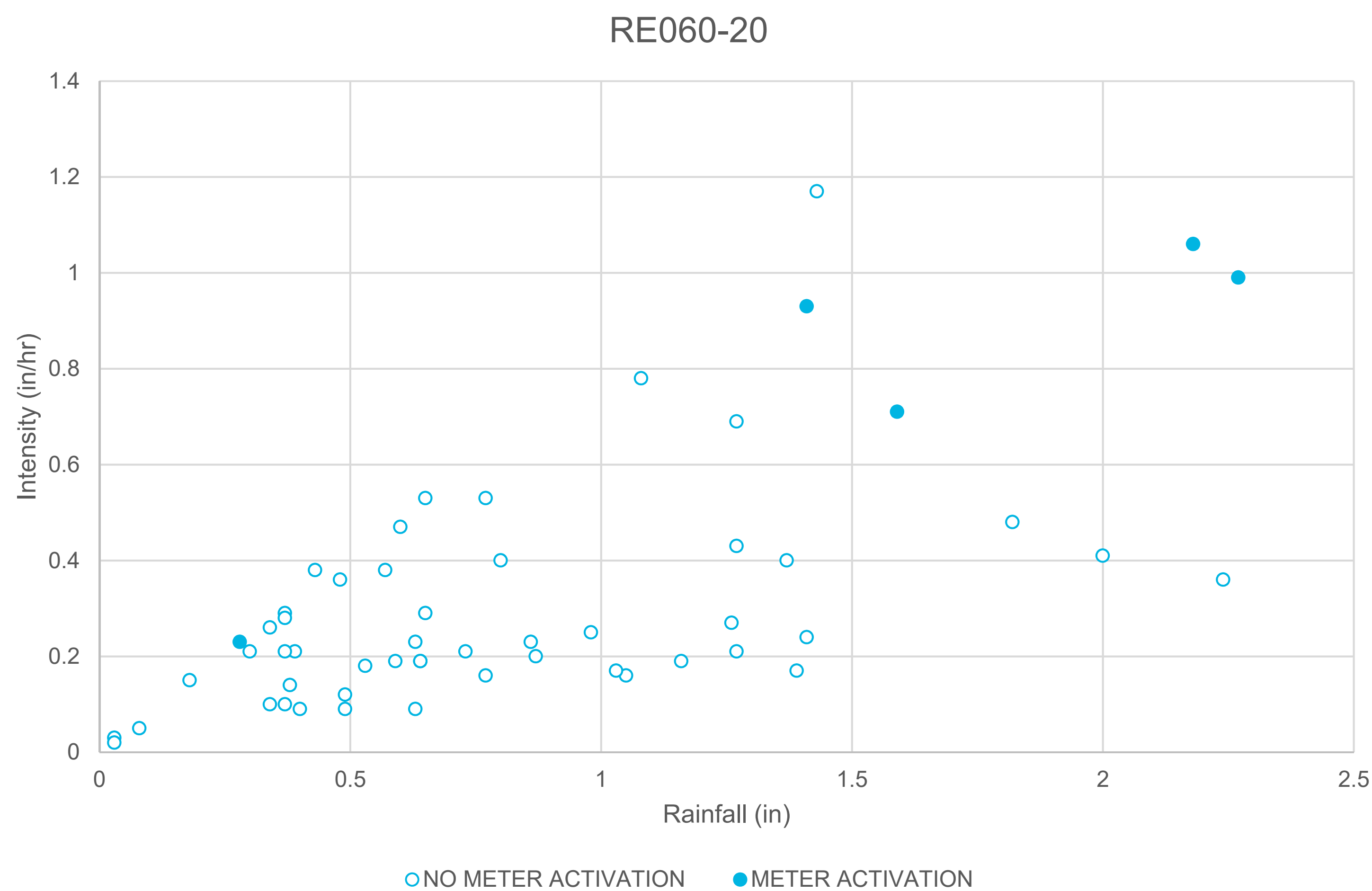
Outfall: BOS060

Regulator: RE060-7

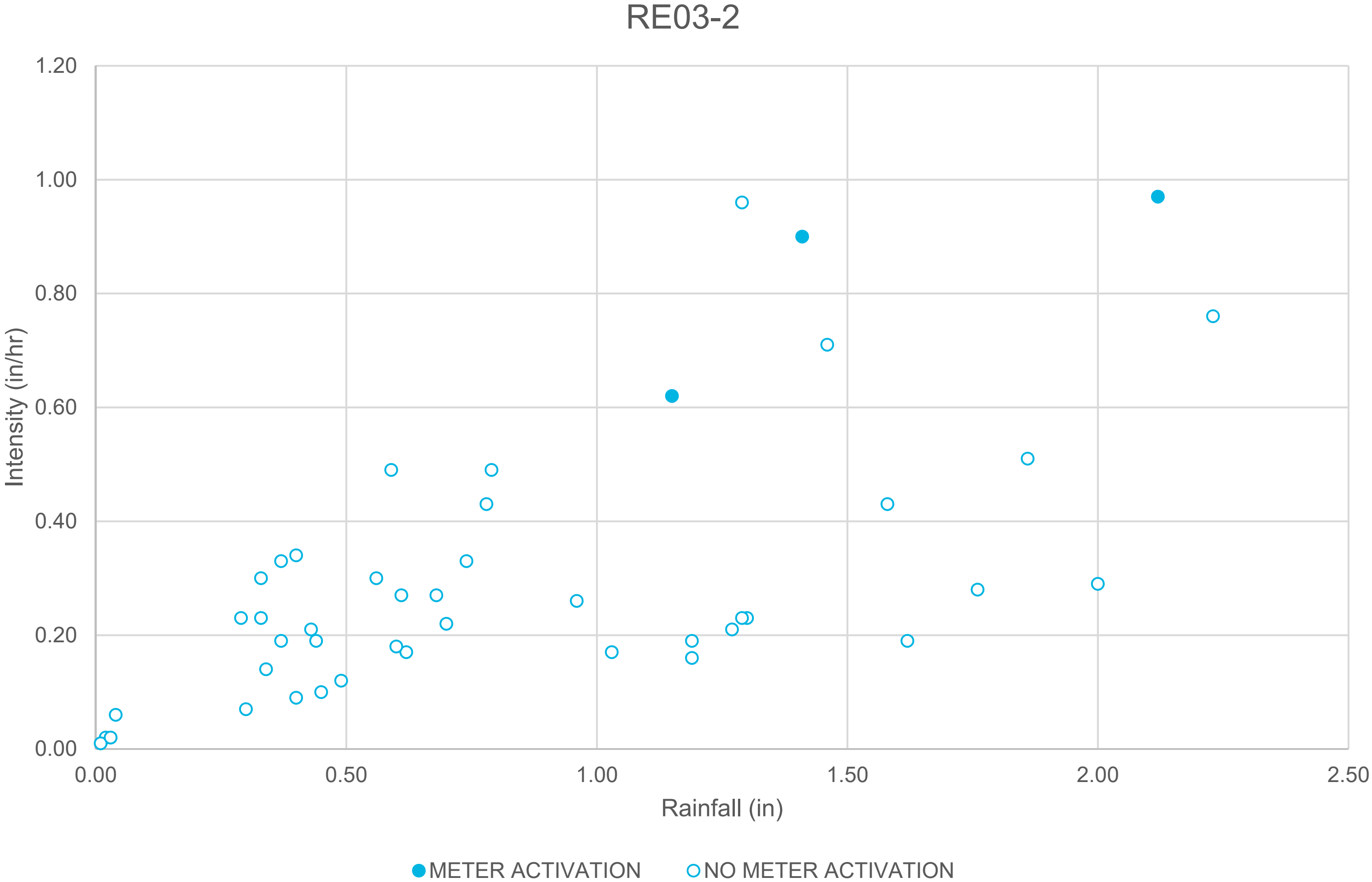
Related Rain Gauge: 4



Outfall: BOS060
Regulator: RE060-20
Related Rain Gauge: 4

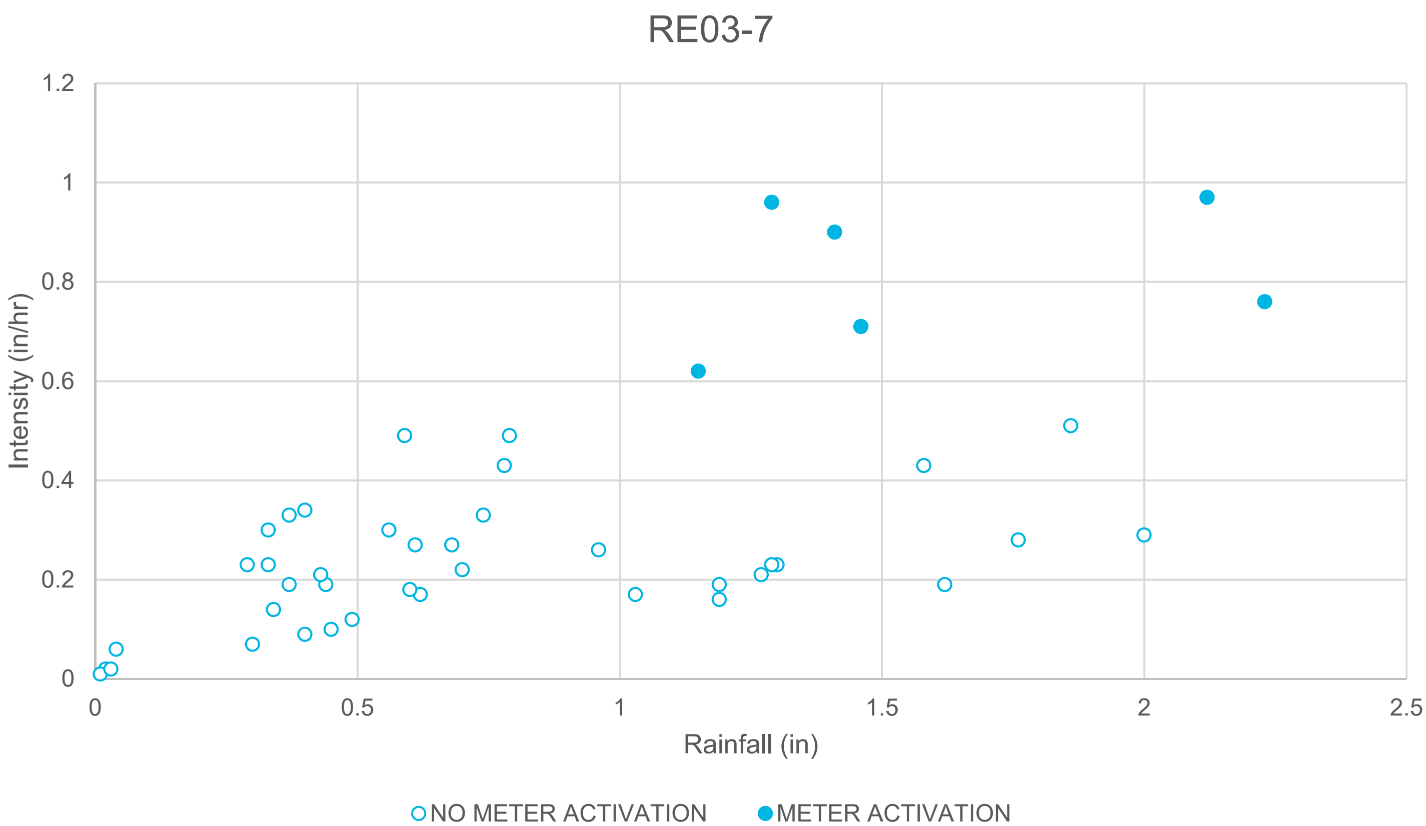


Outfall: BOS003
Regulator: RE03-2
Related Rain Gauge: 8



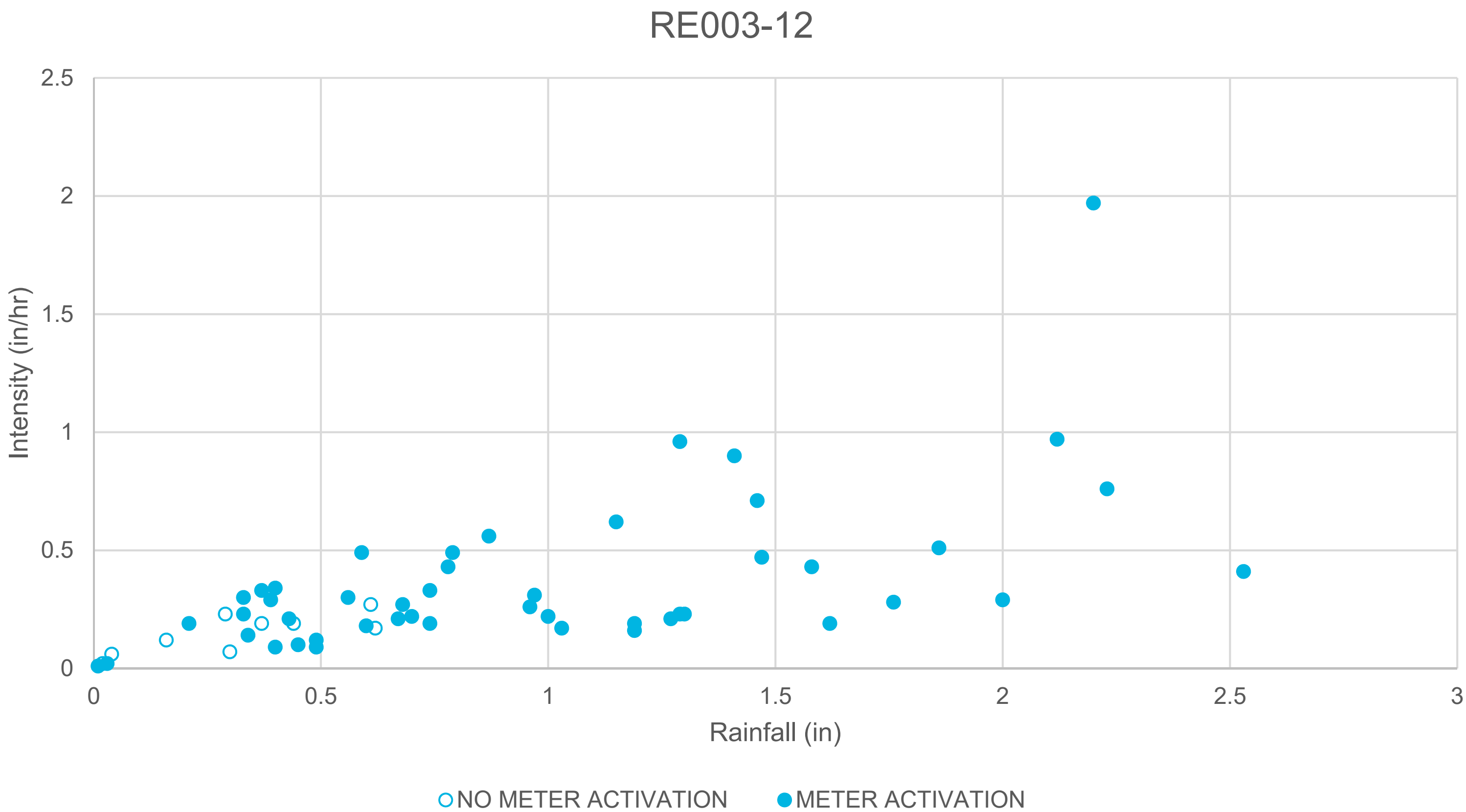
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS003
Regulator: RE03-7
Related Rain Gauge: 8

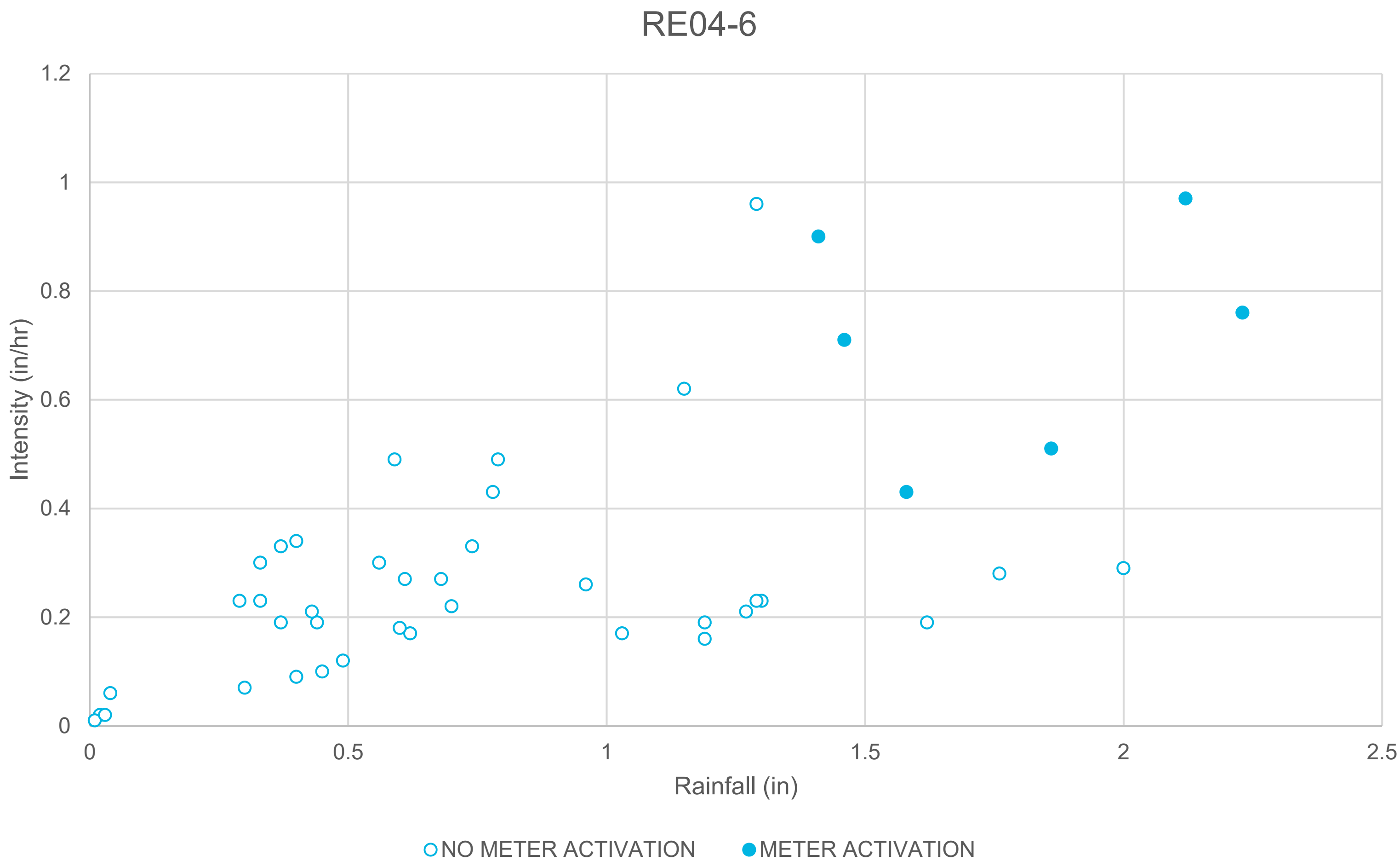


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS003
Regulator: RE03-12
Related Rain Gauge: 8

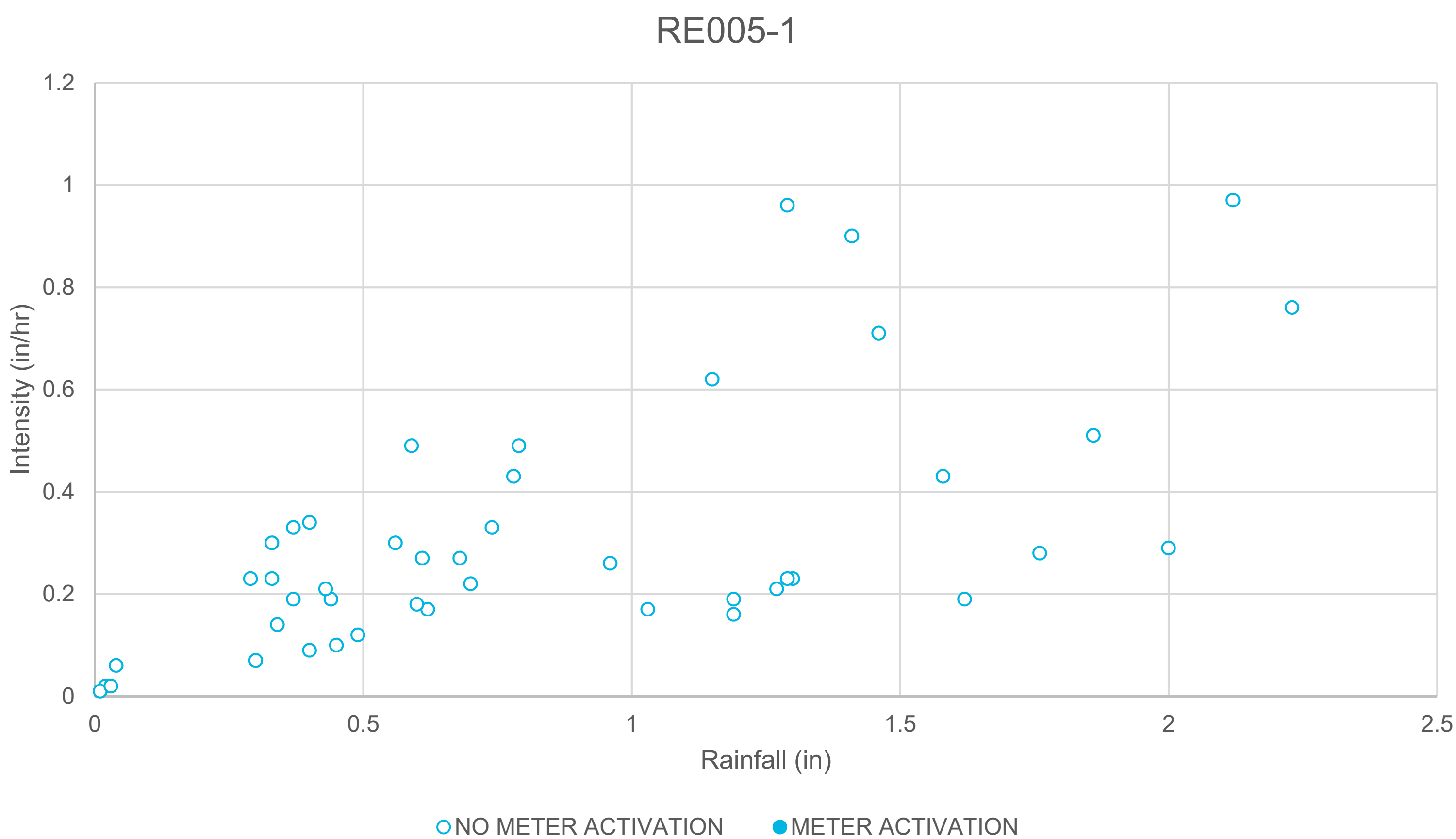


Outfall: BOS004
Regulator: RE04-6
Related Rain Gauge: 8



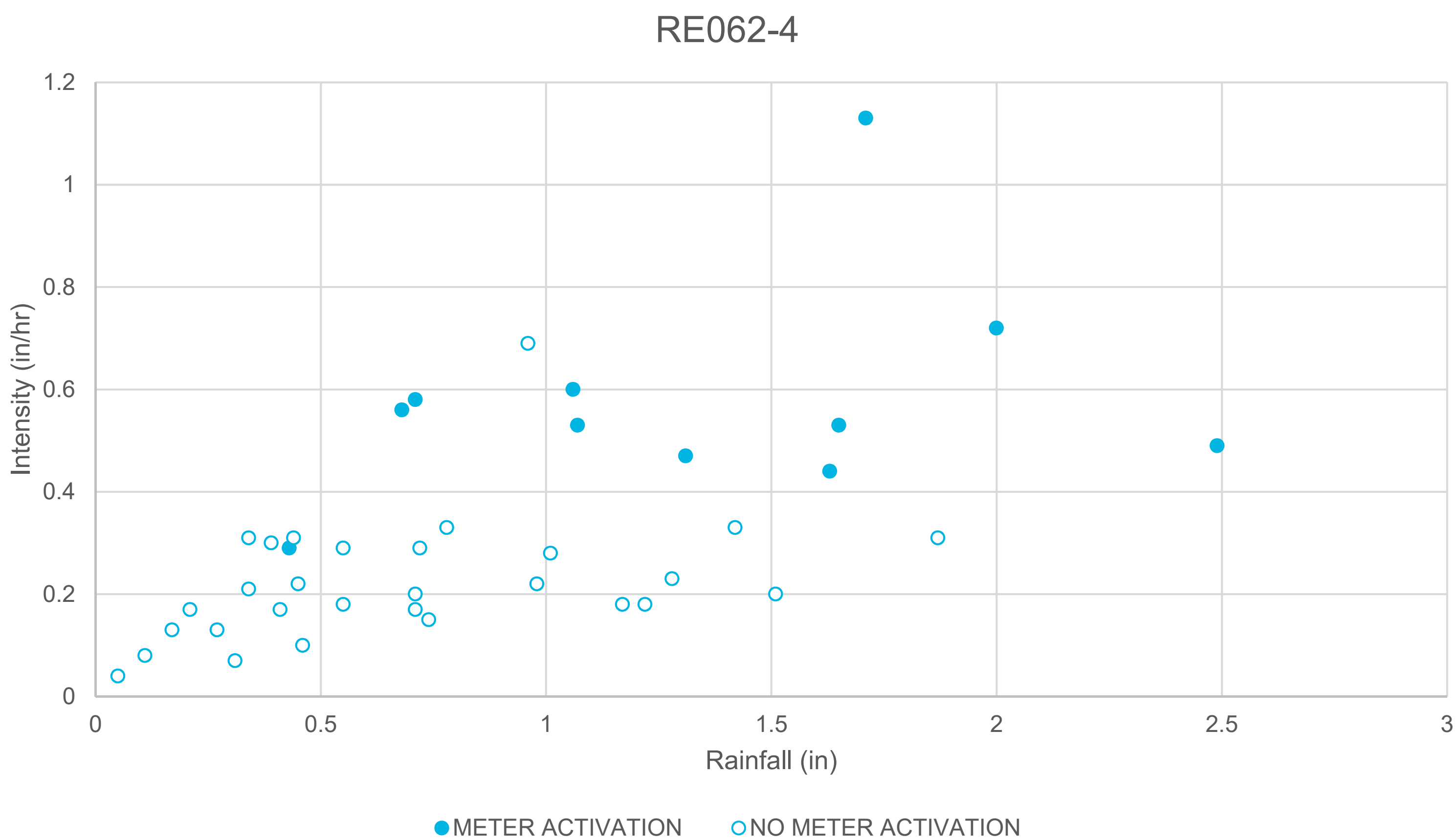
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS005
Regulator: RE05-1
Related Rain Gauge: 8



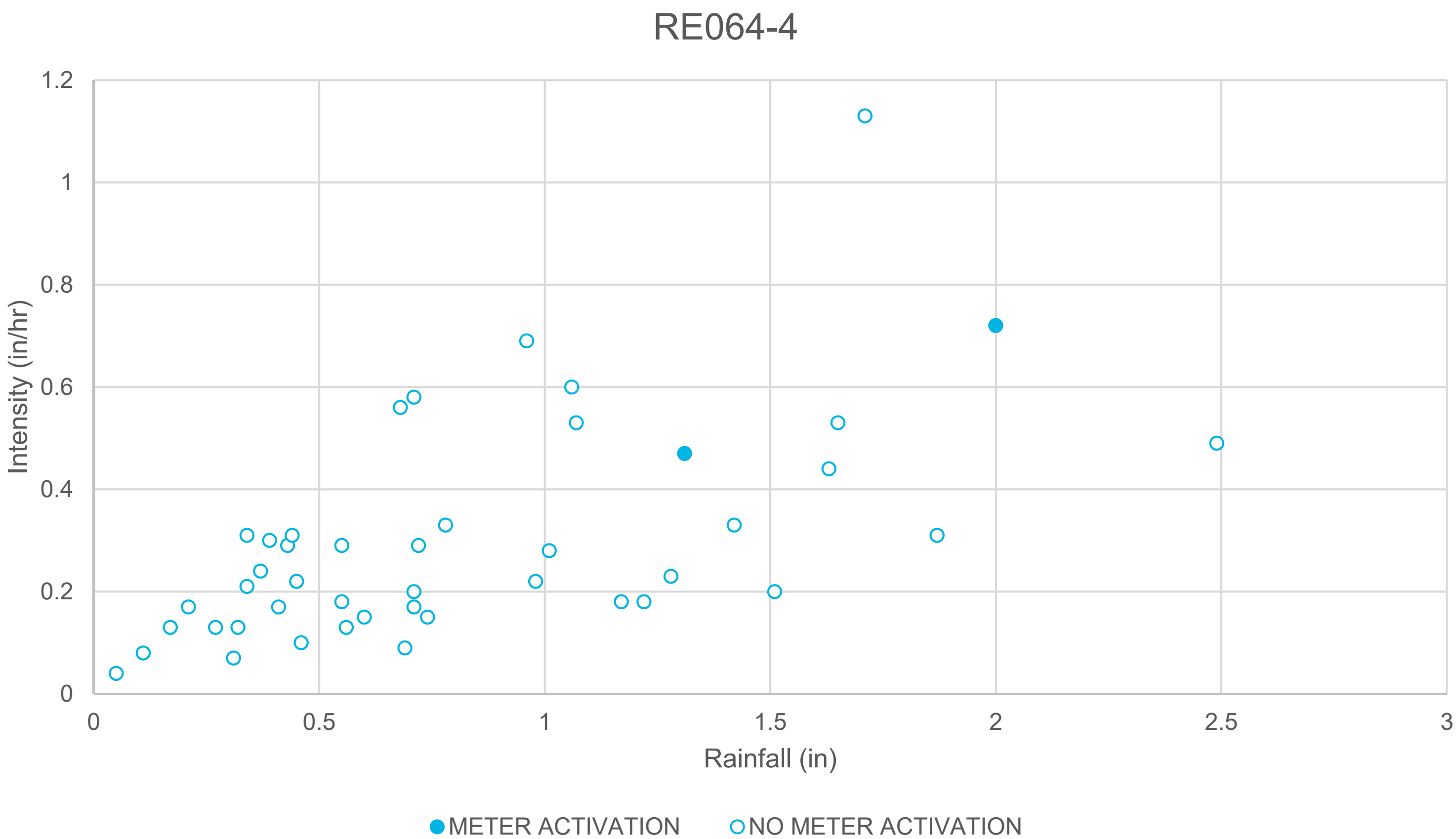
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall:BOS062
Regulator: RE62-4
Related Rain Gauge: 18



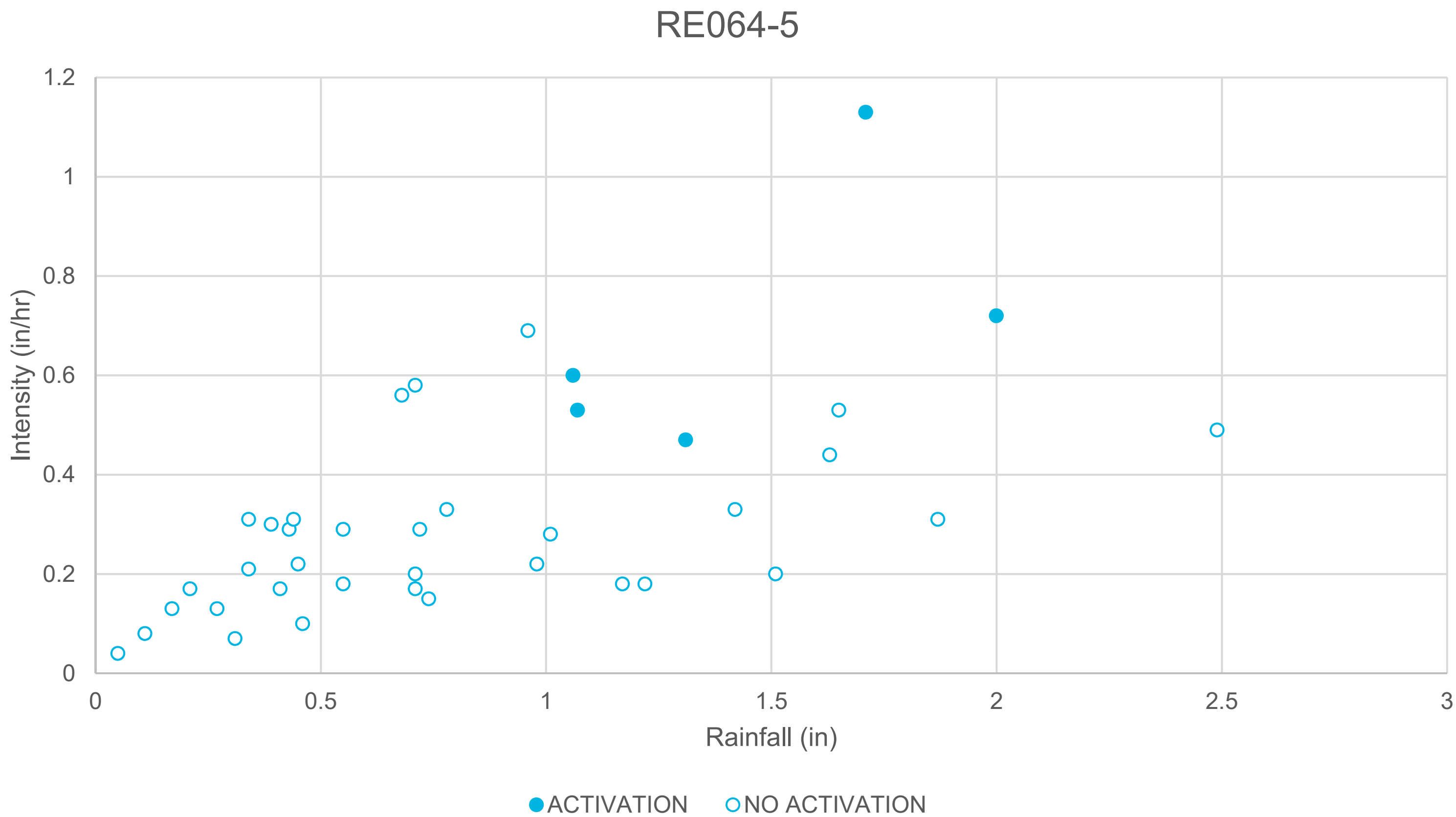
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall:BOS064
Regulator: RE64-4
Related Rain Gauge: 18



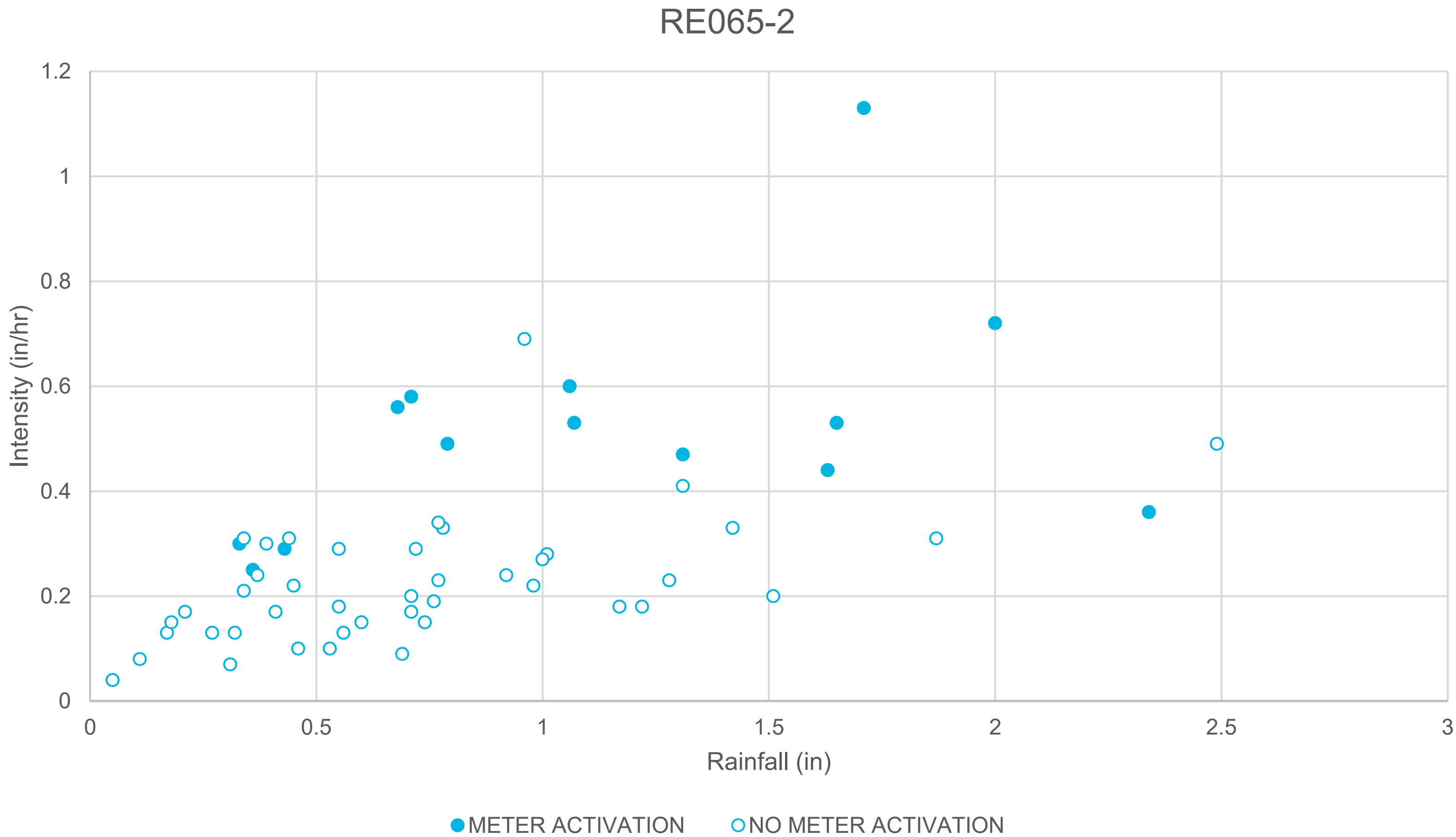
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall:BOS064
Regulator: RE64-5
Related Rain Gauge: 18

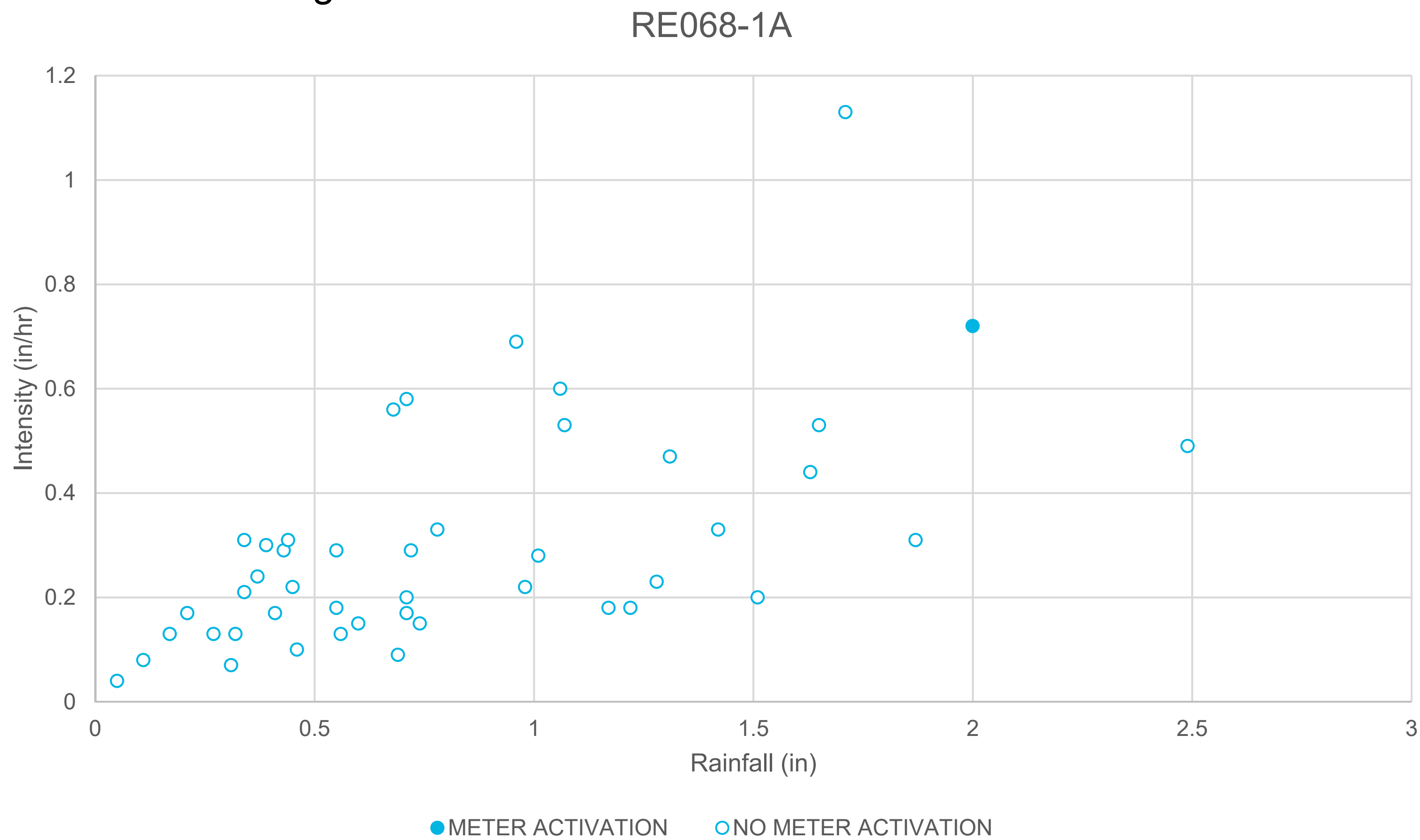


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall:BOS065
Regulator: RE65-2
Related Rain Gauge: 18

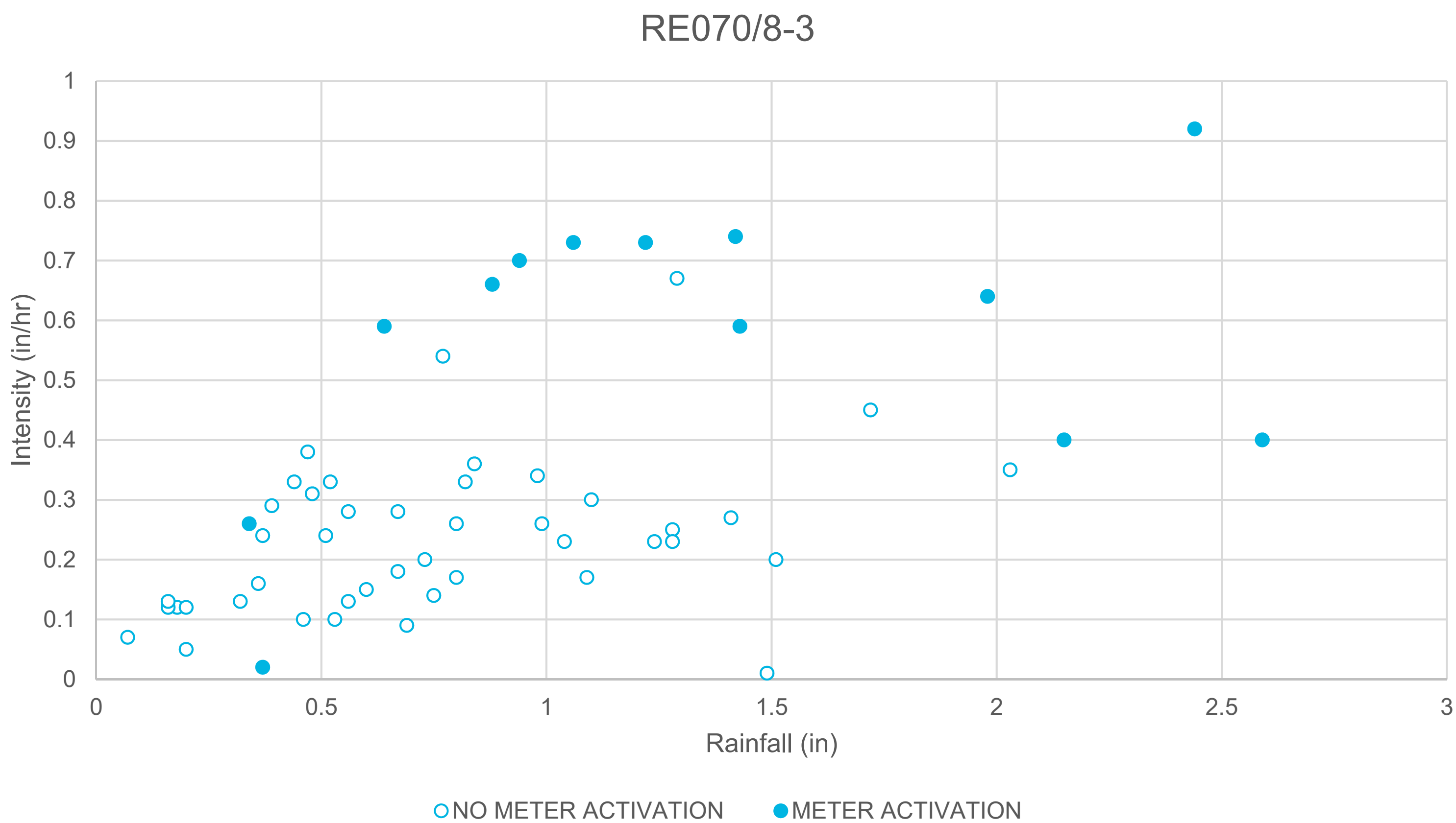


Outfall:BOS068
Regulator: RE68-1A
Related Rain Gauge: 18

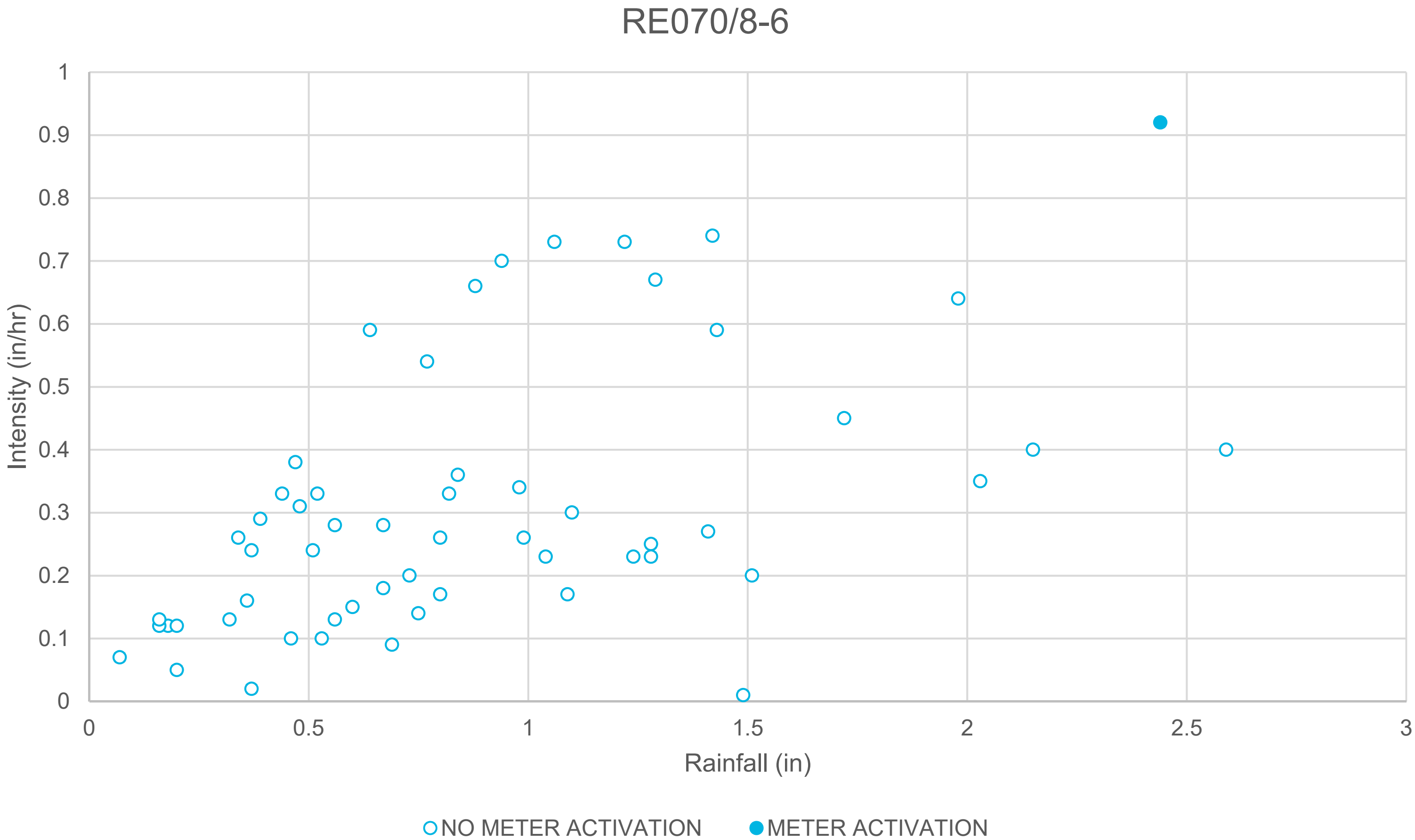


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

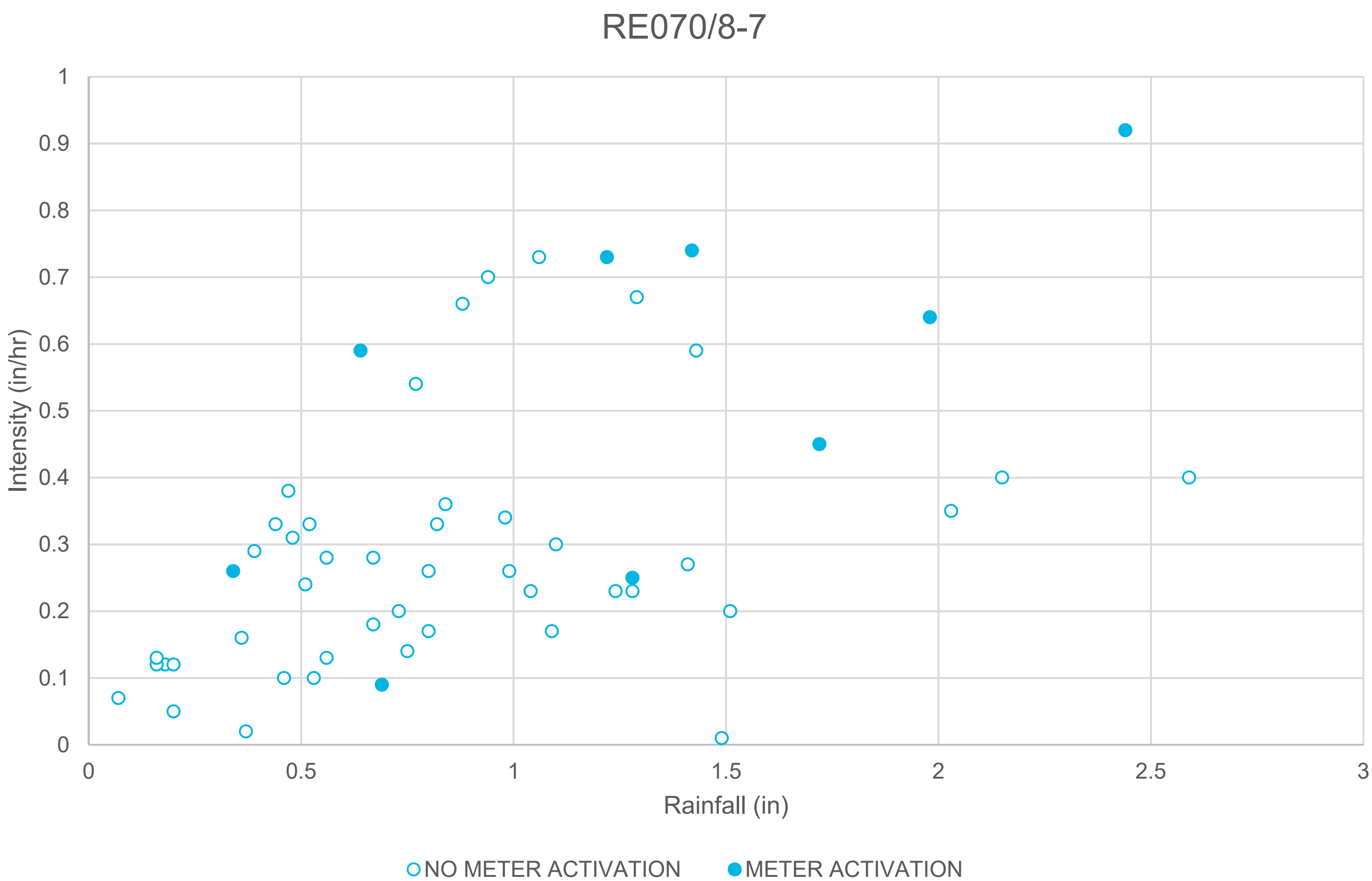
Outfall:BOS70/DBC
Regulator: RE070/8-3
Related Rain Gauge: 3



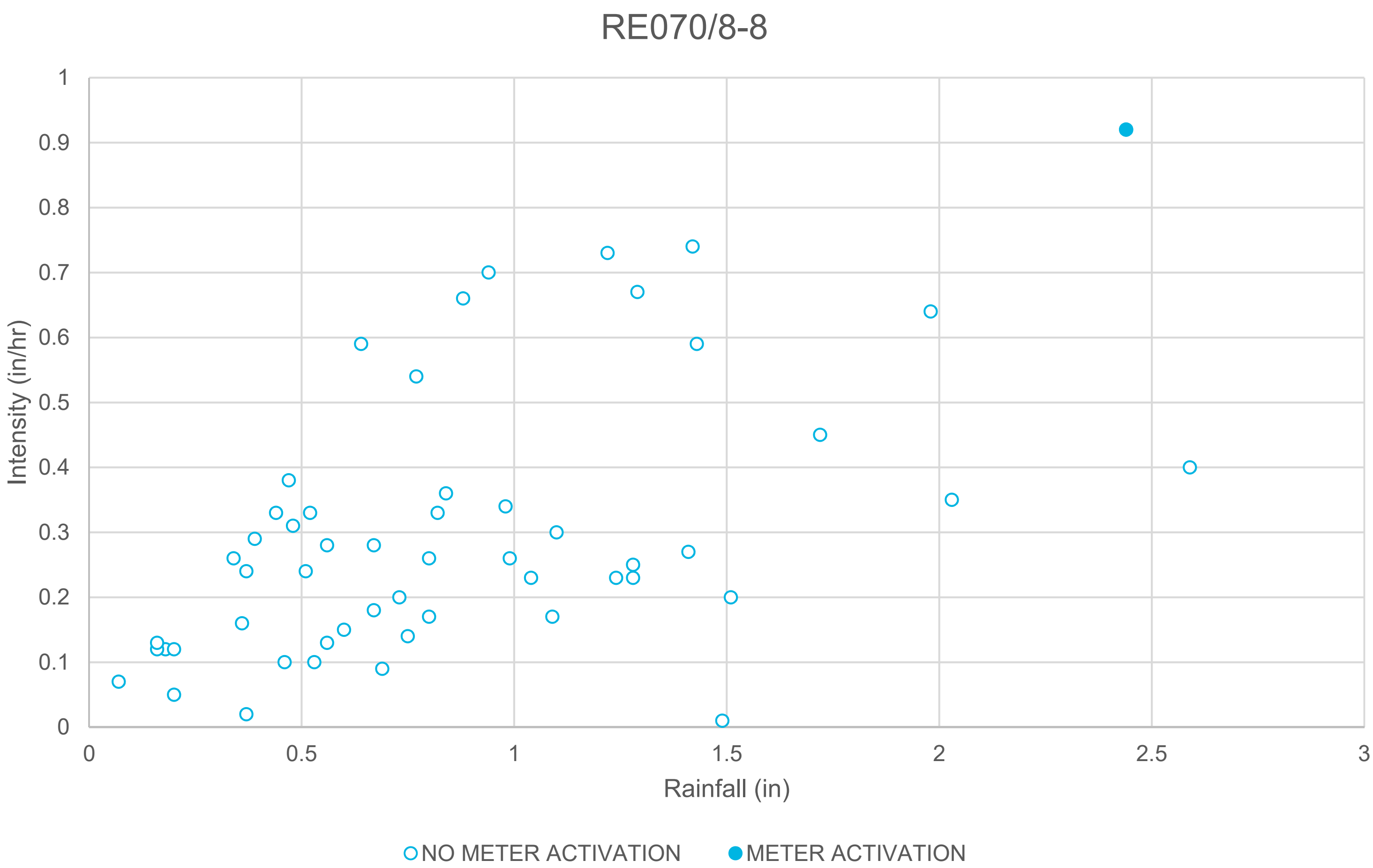
Outfall:BOS70/DBC
Regulator: RE070/8-6
Related Rain Gauge: 3



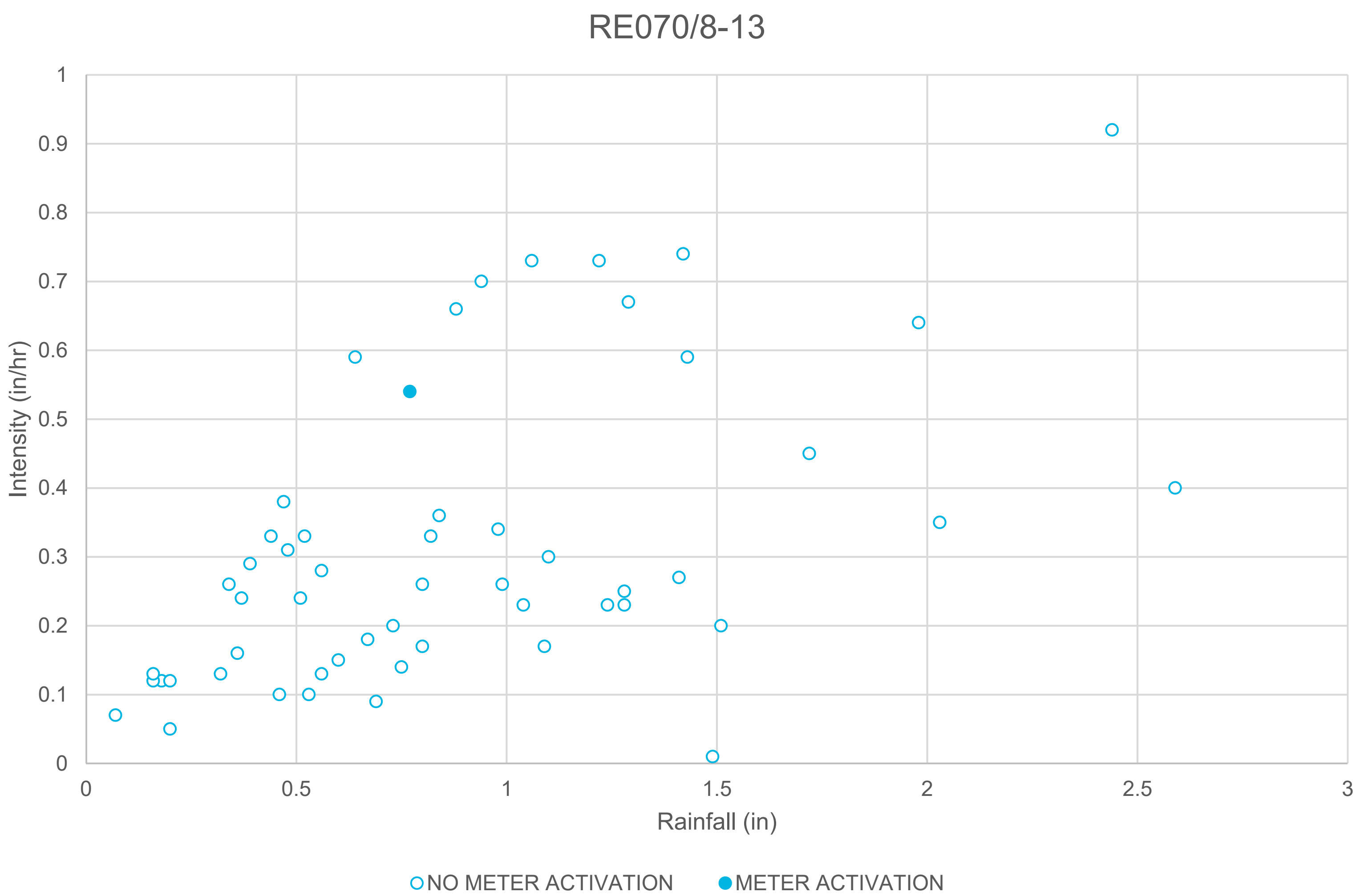
Outfall:BOS70/DBC
Regulator: RE070/8-7
Related Rain Gauge: 3



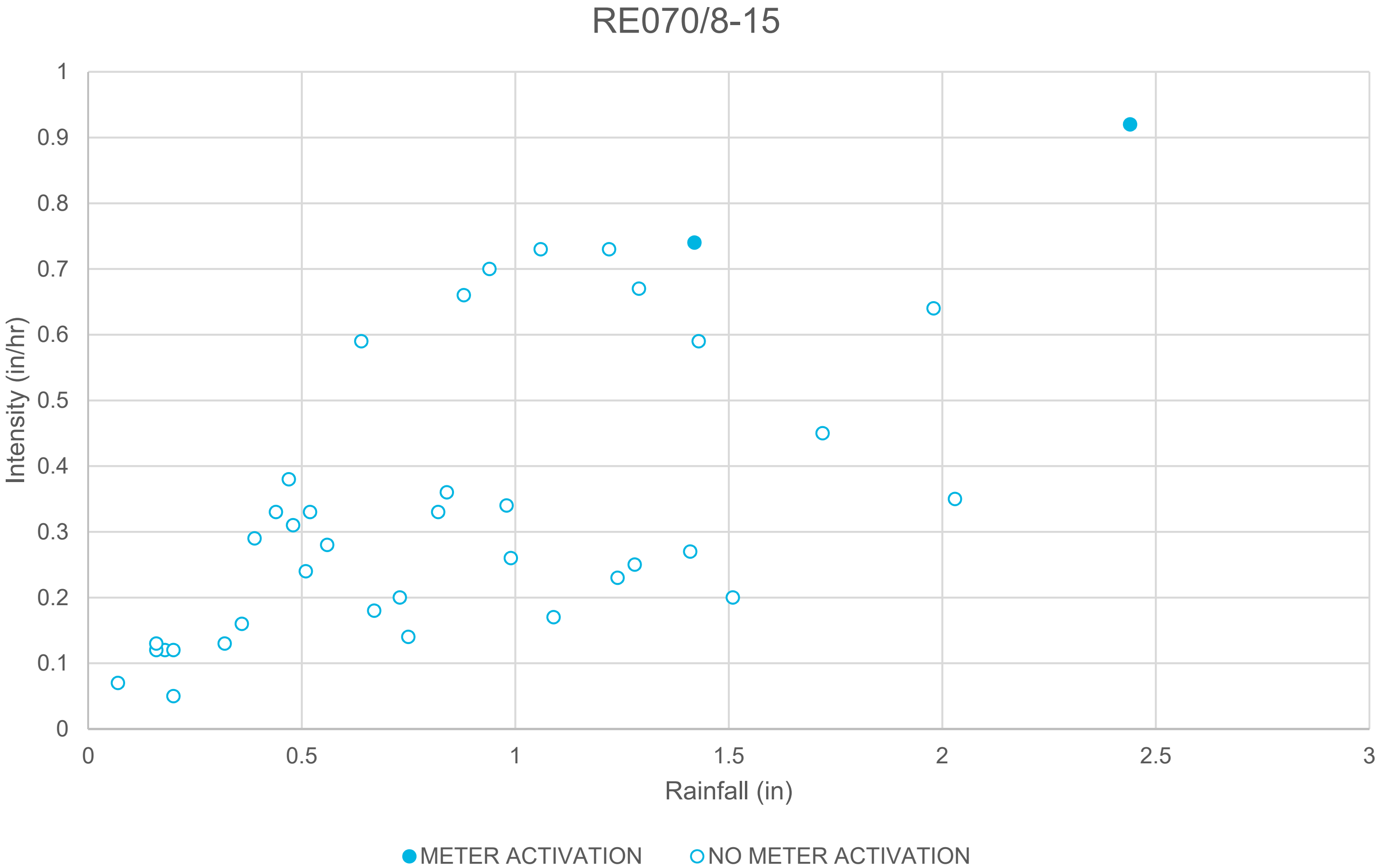
Outfall:BOS70/DBC
Regulator: RE070/8-8
Related Rain Gauge: 3



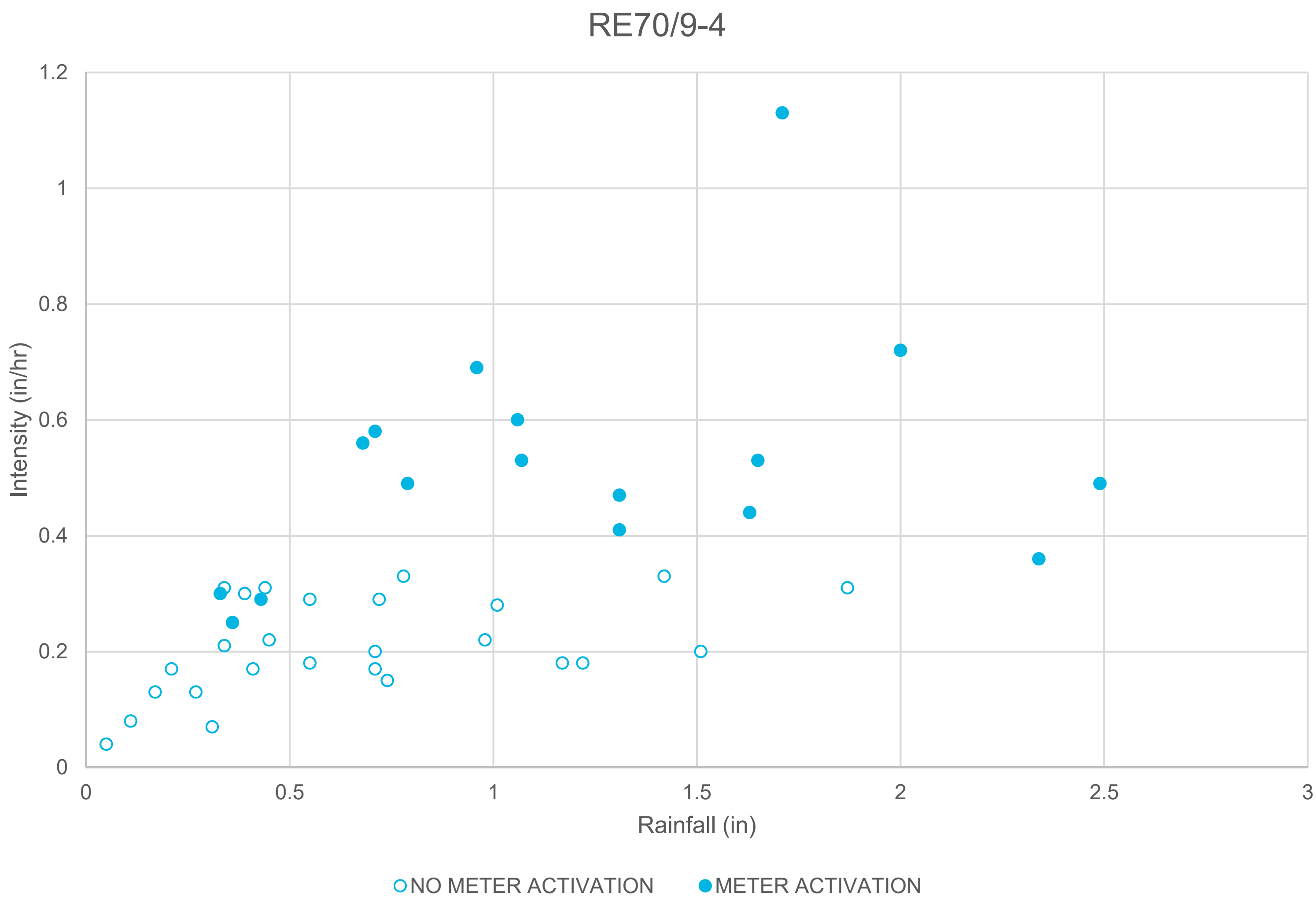
Outfall:BOS70/DBC
Regulator: RE070/8-13
Related Rain Gauge: 3



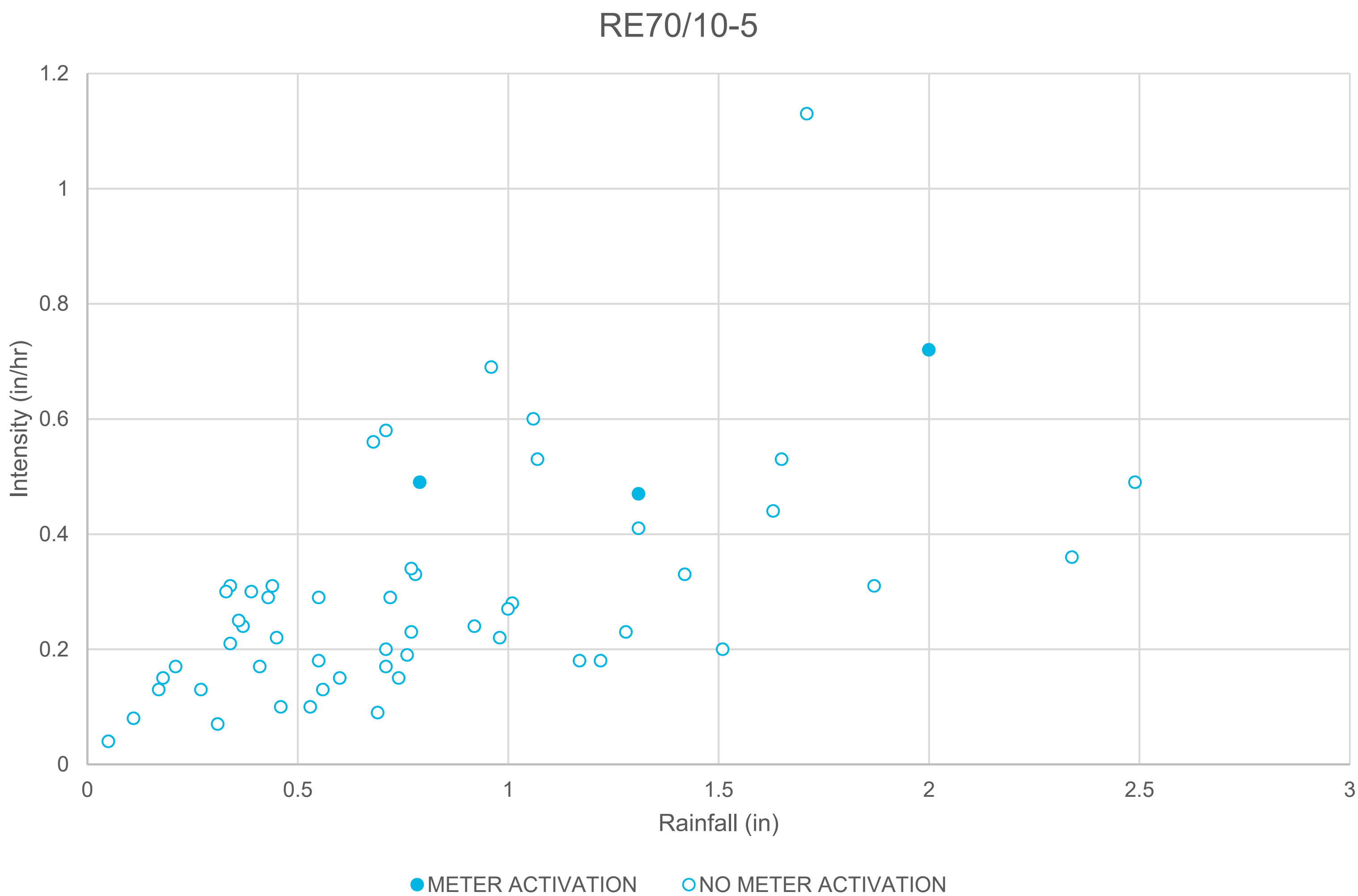
Outfall:BOS70/DBC
Regulator: RE070/8-15
Related Rain Gauge: 3



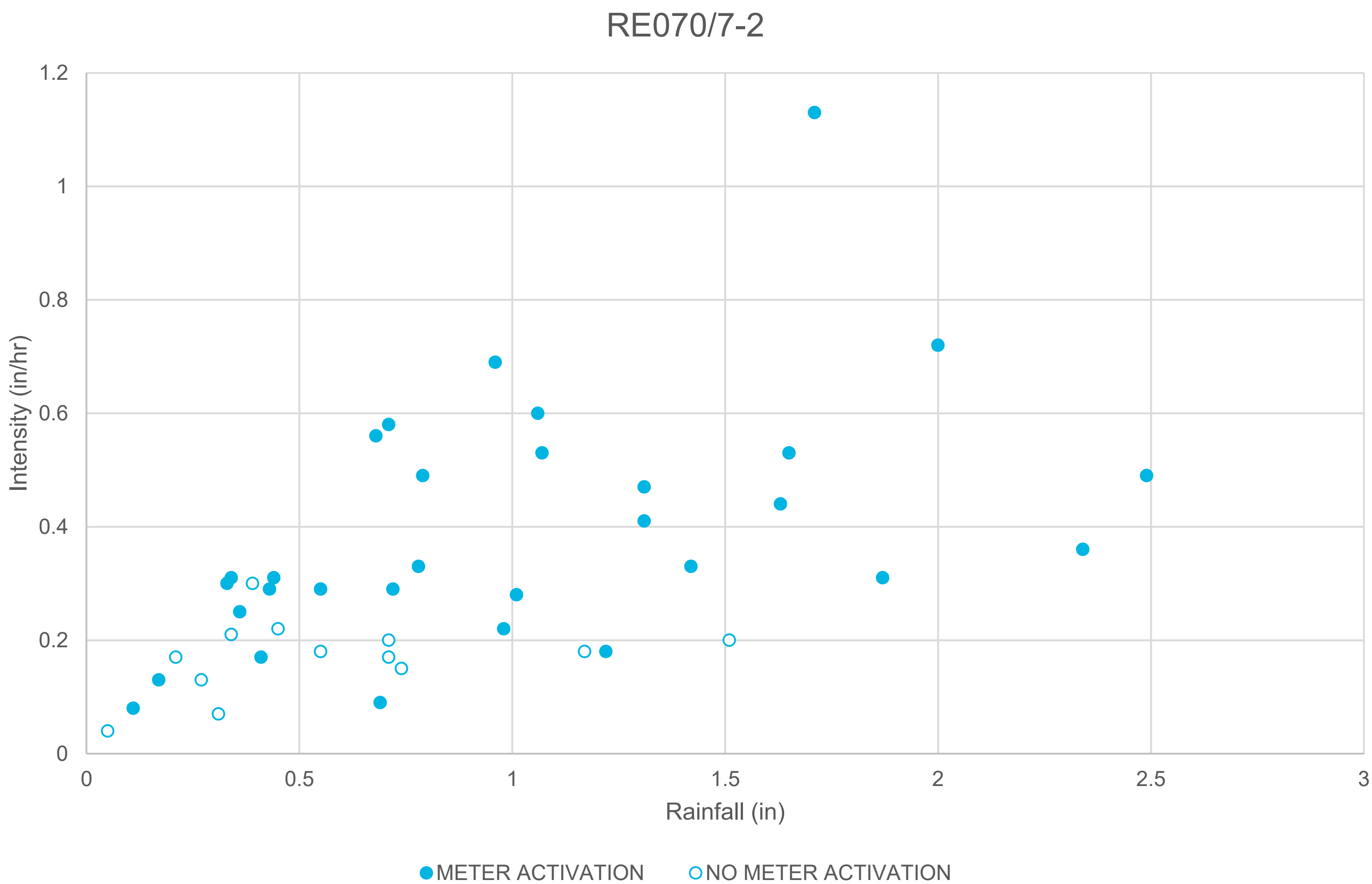
Outfall:BOS070/DBC
Regulator: RE70/9-4
Related Rain Gauge: 18



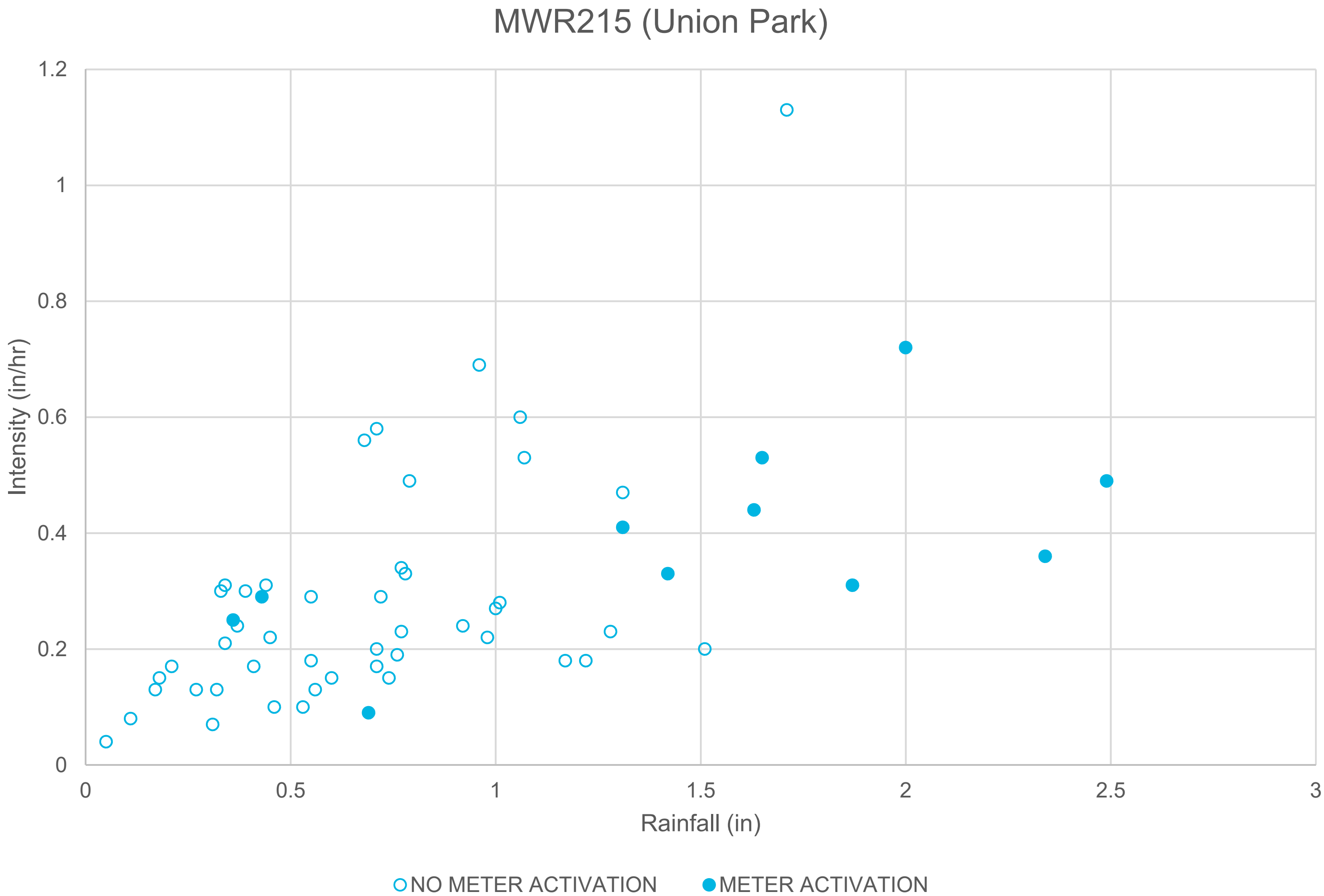
Outfall:BOS070/DBC
Regulator: RE70/10-5
Related Rain Gauge: 18



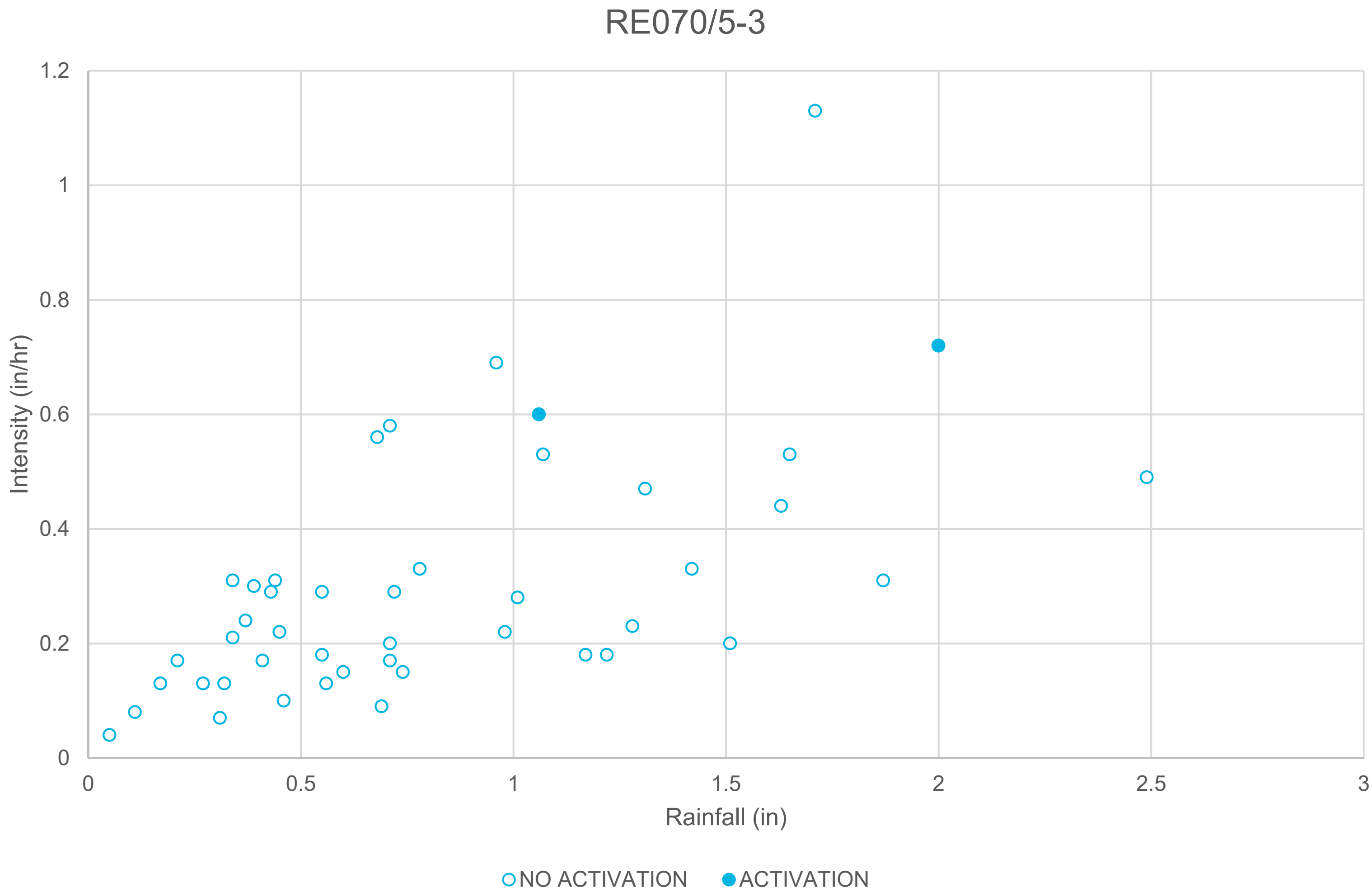
Outfall:BOS070/DBC
Regulator: RE70/7-2
Related Rain Gauge: 18



Outfall:MWR215 (Union Park)
Regulator: N/A
Related Rain Gauge: 18

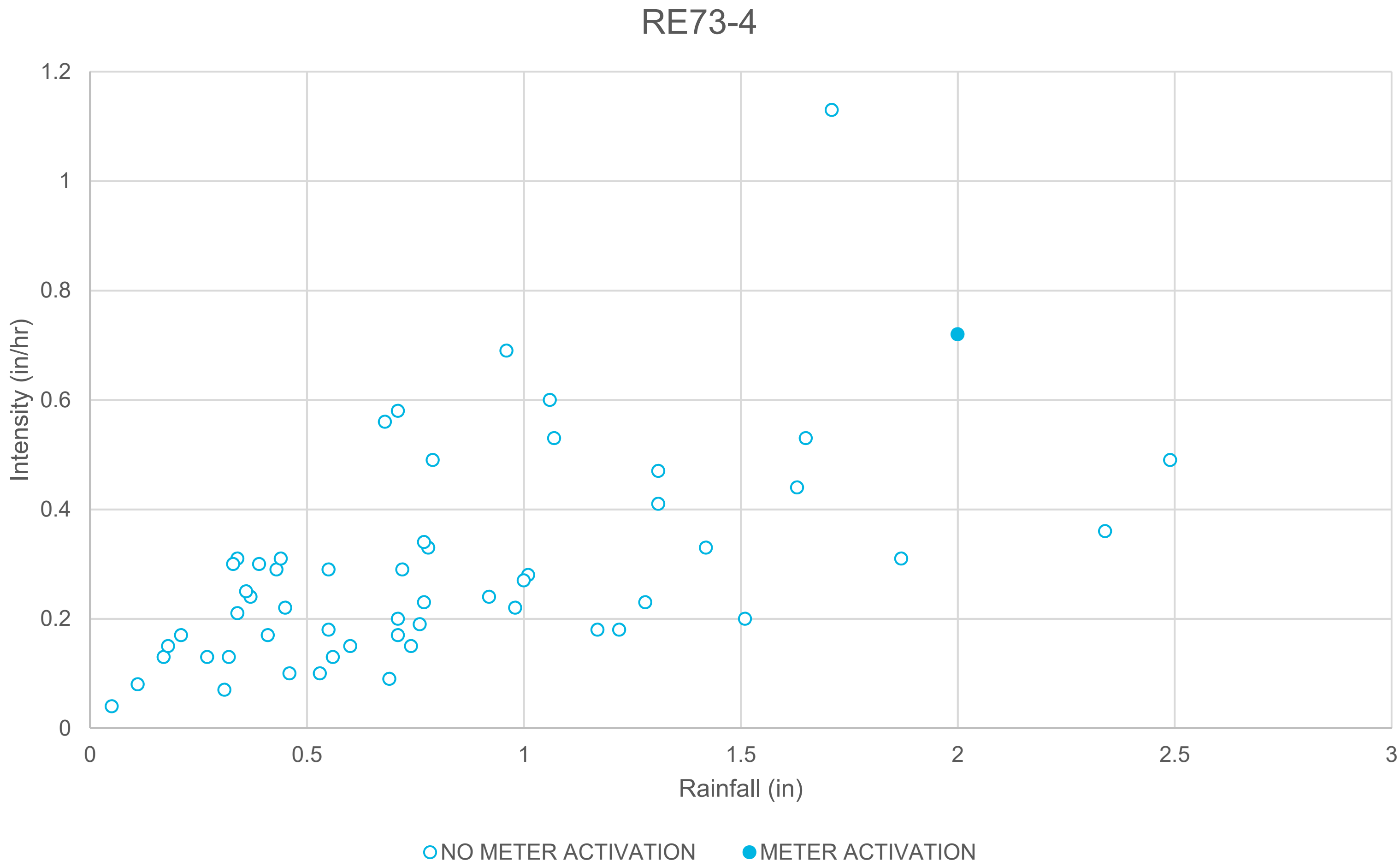


Outfall:BOS070/RRCC
Regulator: RE70/5-3
Related Rain Gauge: 18

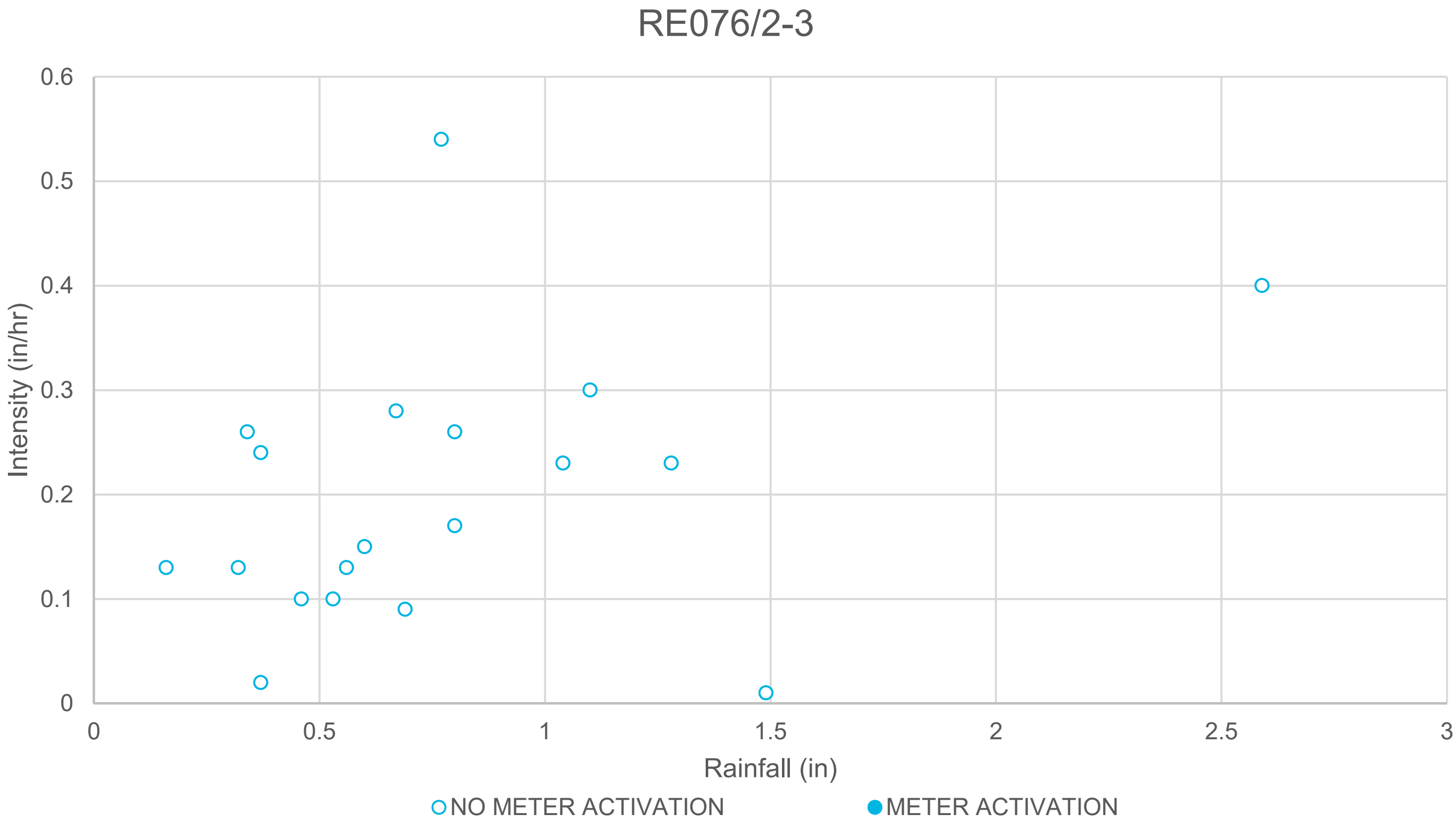


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

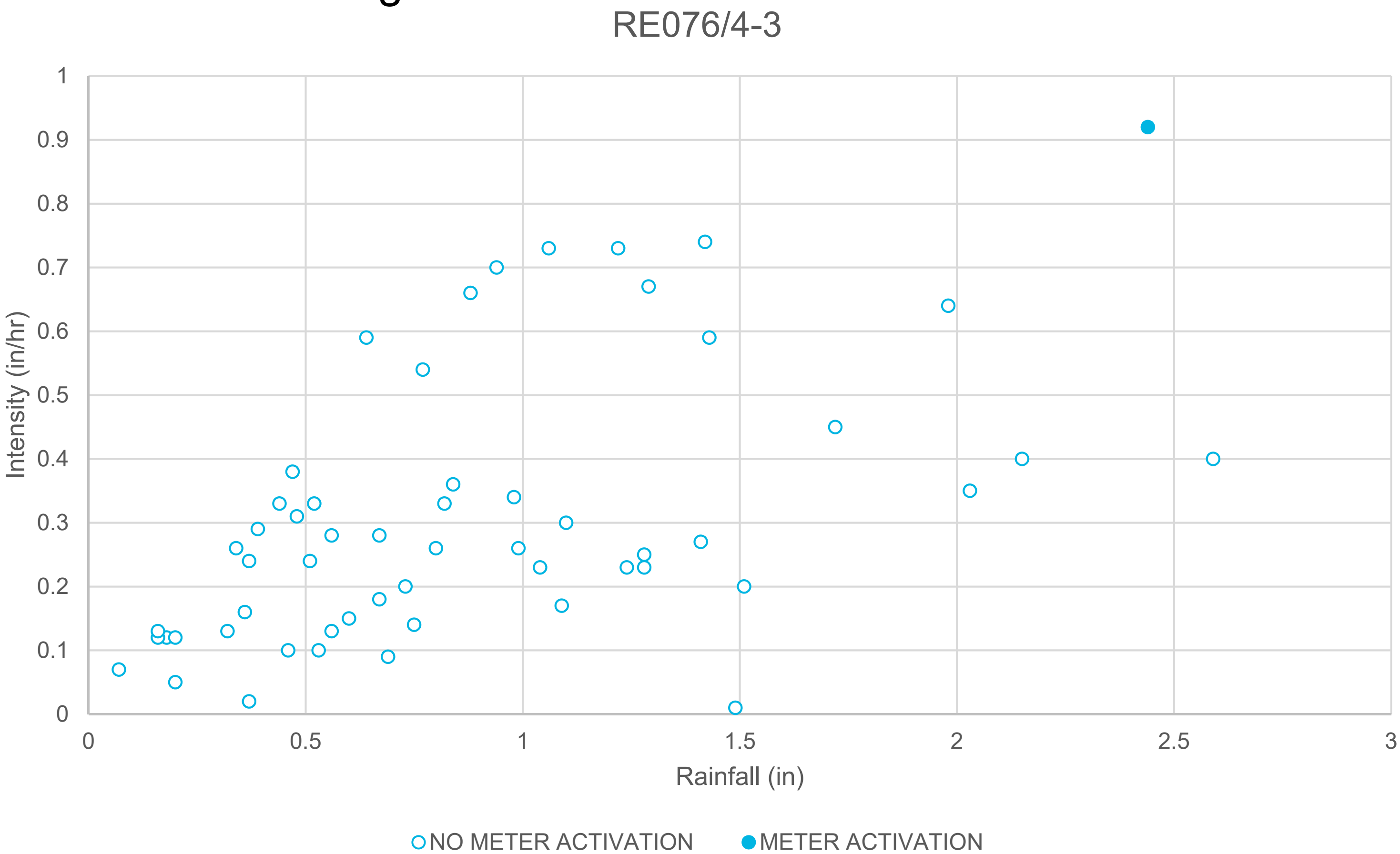
Outfall:BOS073
Regulator: RE073-4
Related Rain Gauge: 18



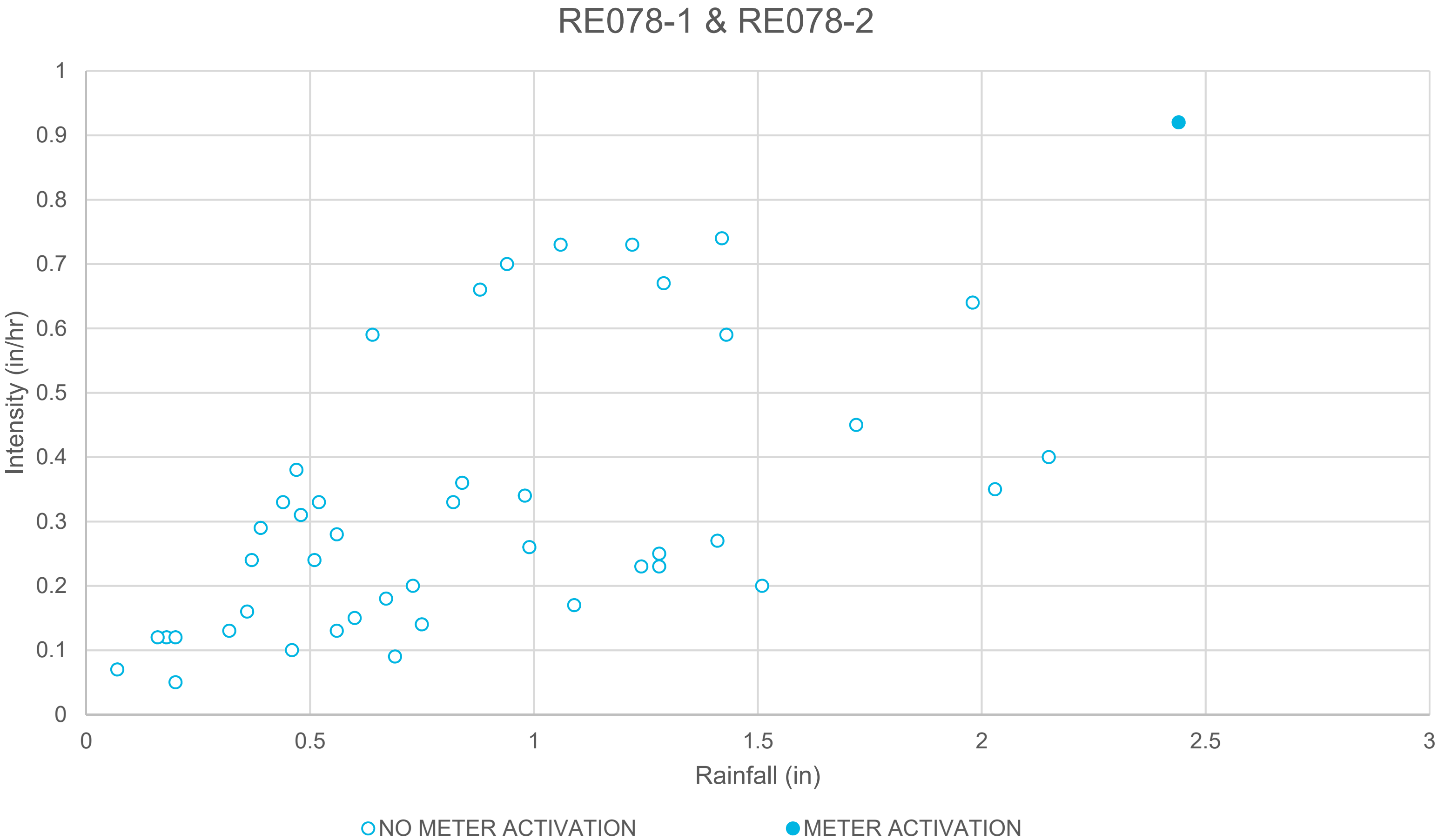
Outfall: BOS076
Regulator: RE076/2-3
Related Rain Gauge: 3



Outfall: BOS076
Regulator: RE076/4-3
Related Rain Gauge: 3

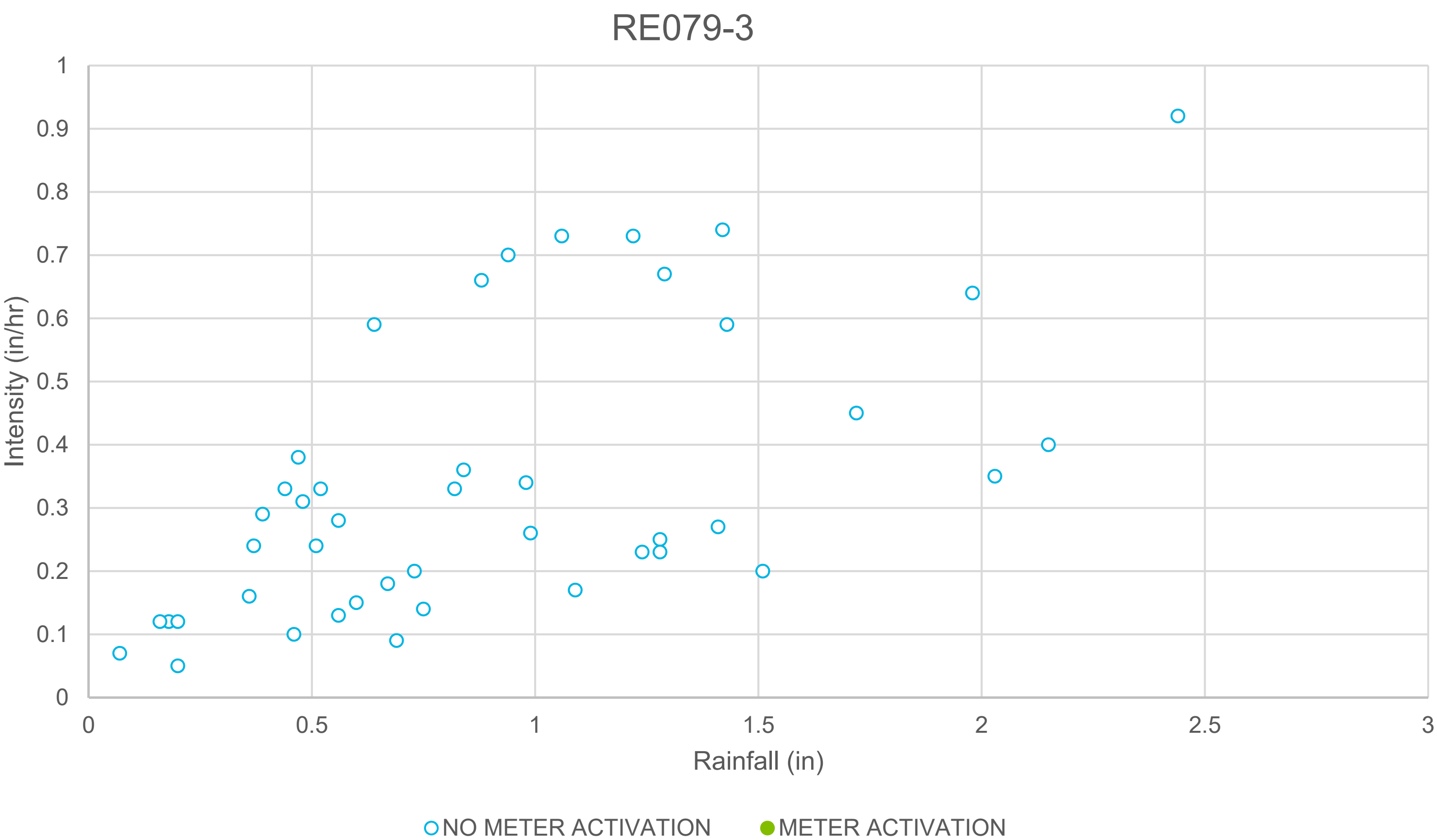


Outfall: BOS078
Regulator: RE078-1 & RE078-2
Related Rain Gauge: 3



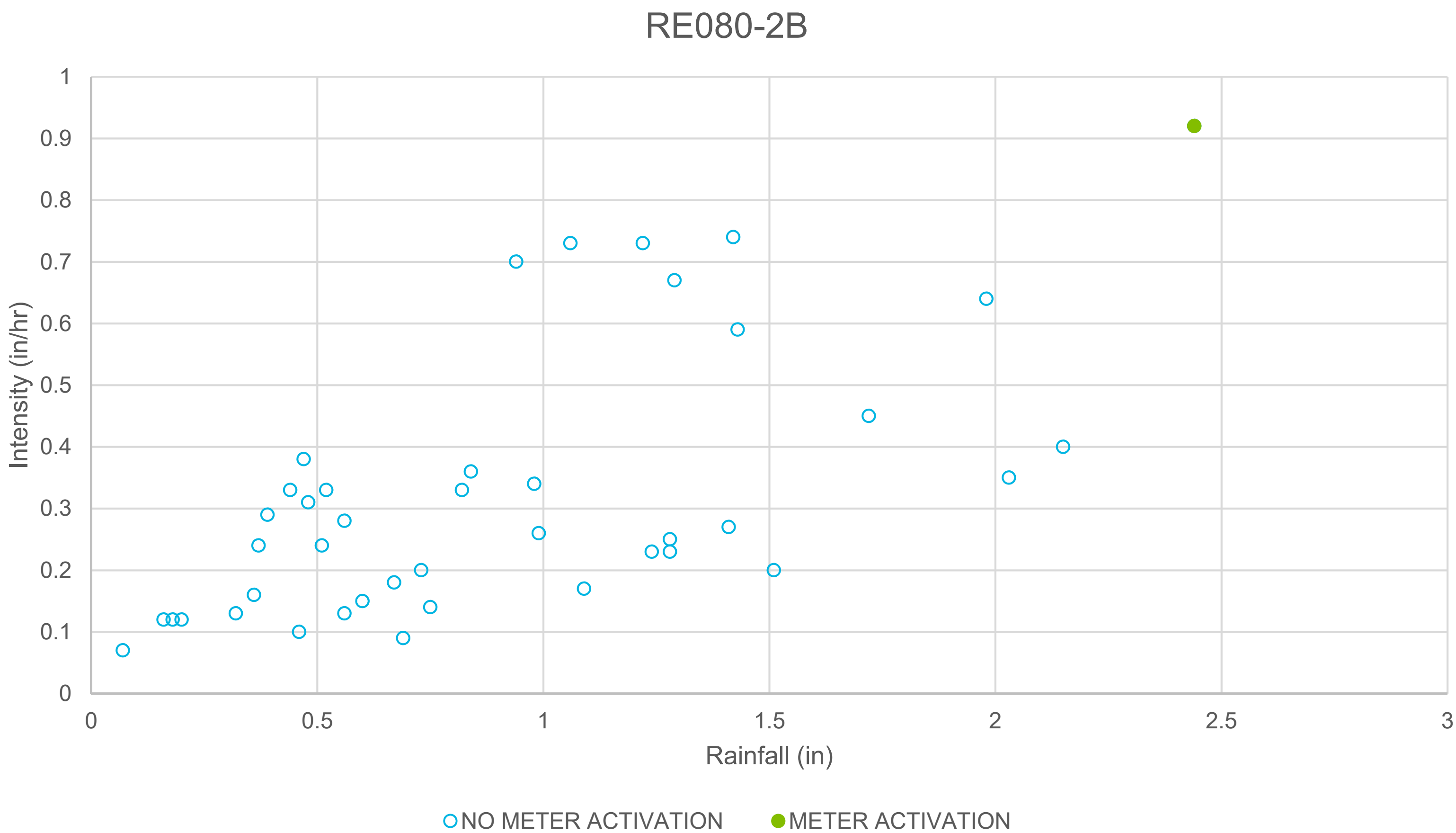
Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

Outfall: BOS079
Regulator: RE079-3
Related Rain Gauge: 3

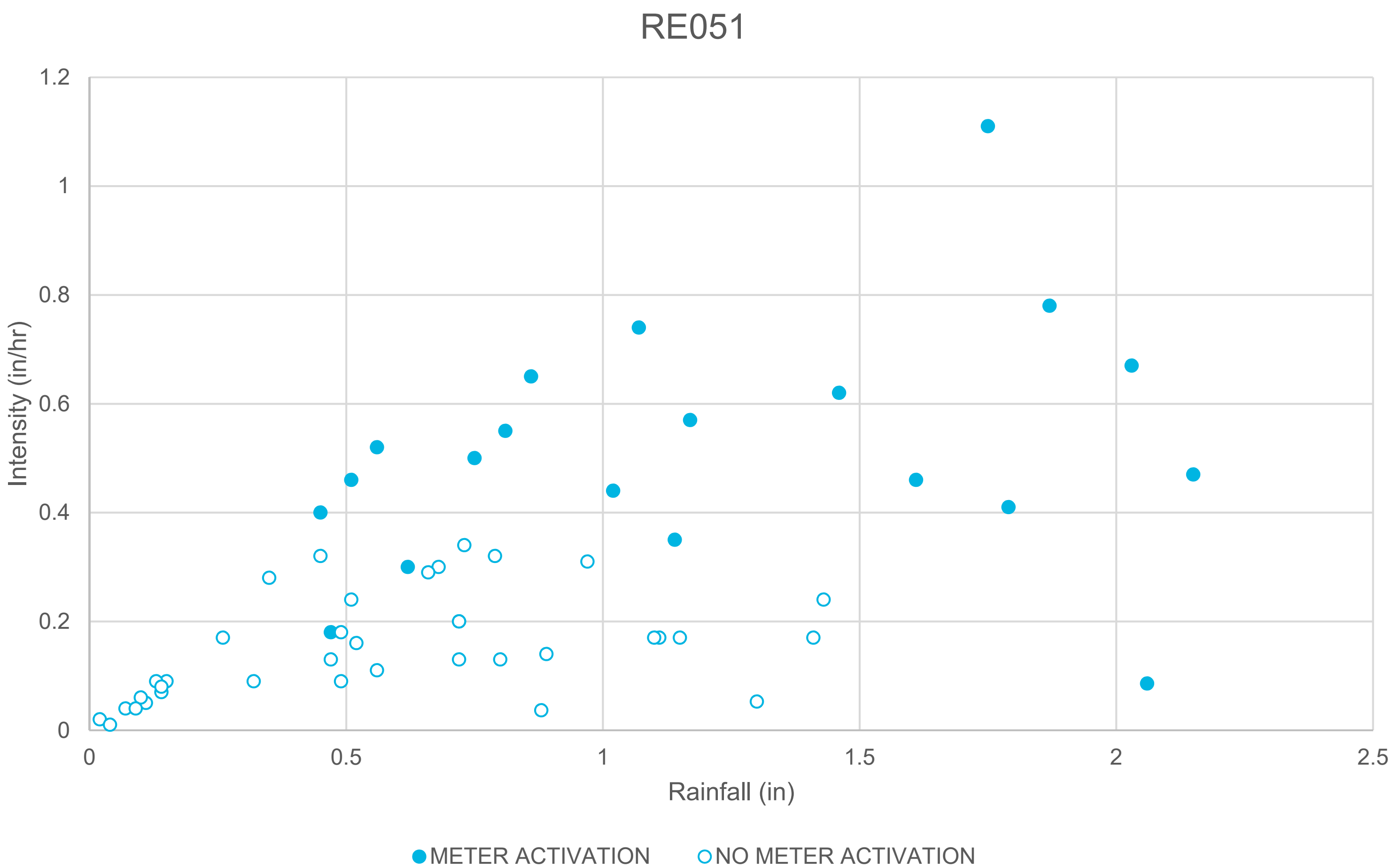


Meter was removed as of March 1, 2019. No activations were assessed following March 1, 2019.

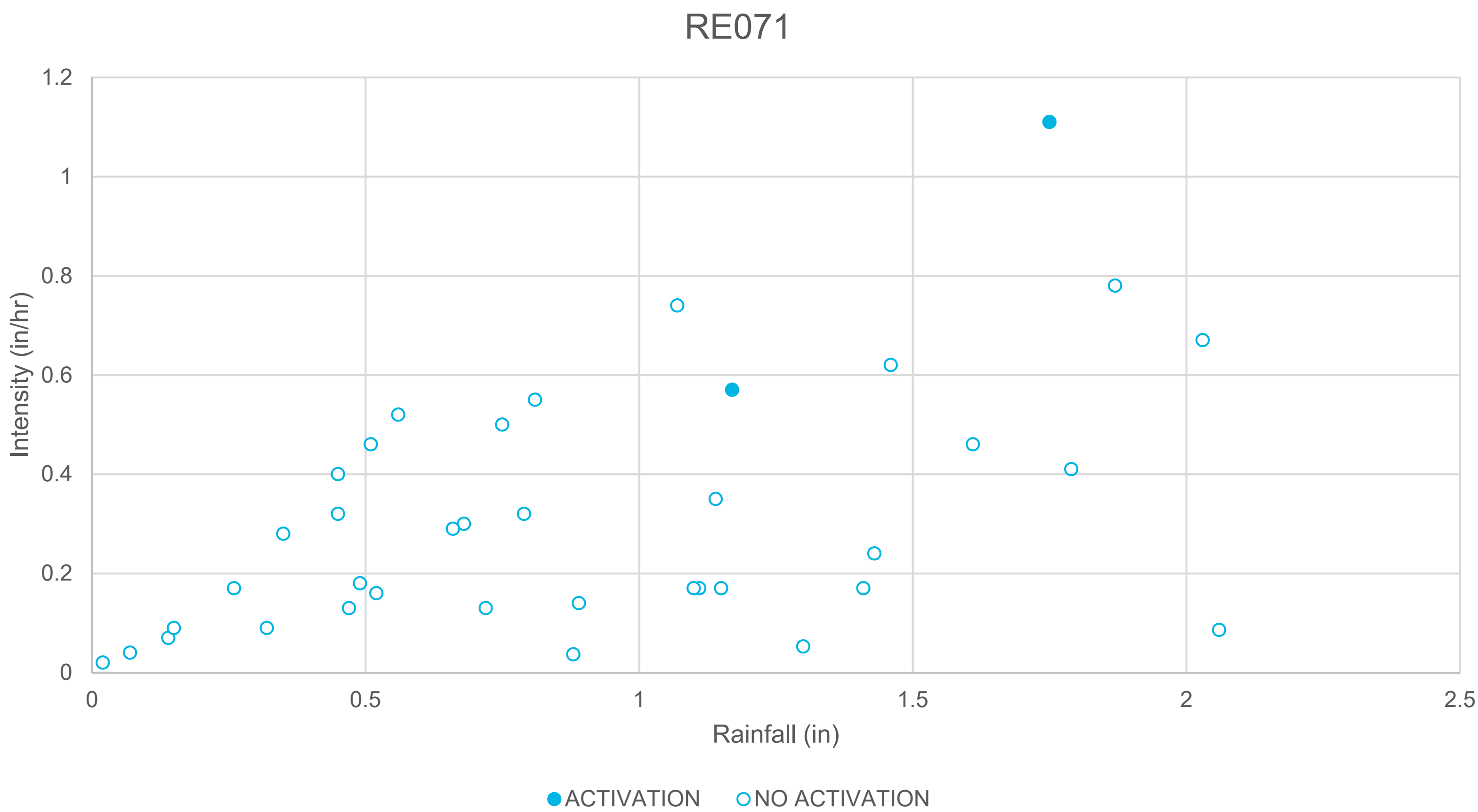
Outfall: BOS080
Regulator: RE080-2B
Related Rain Gauge: 3



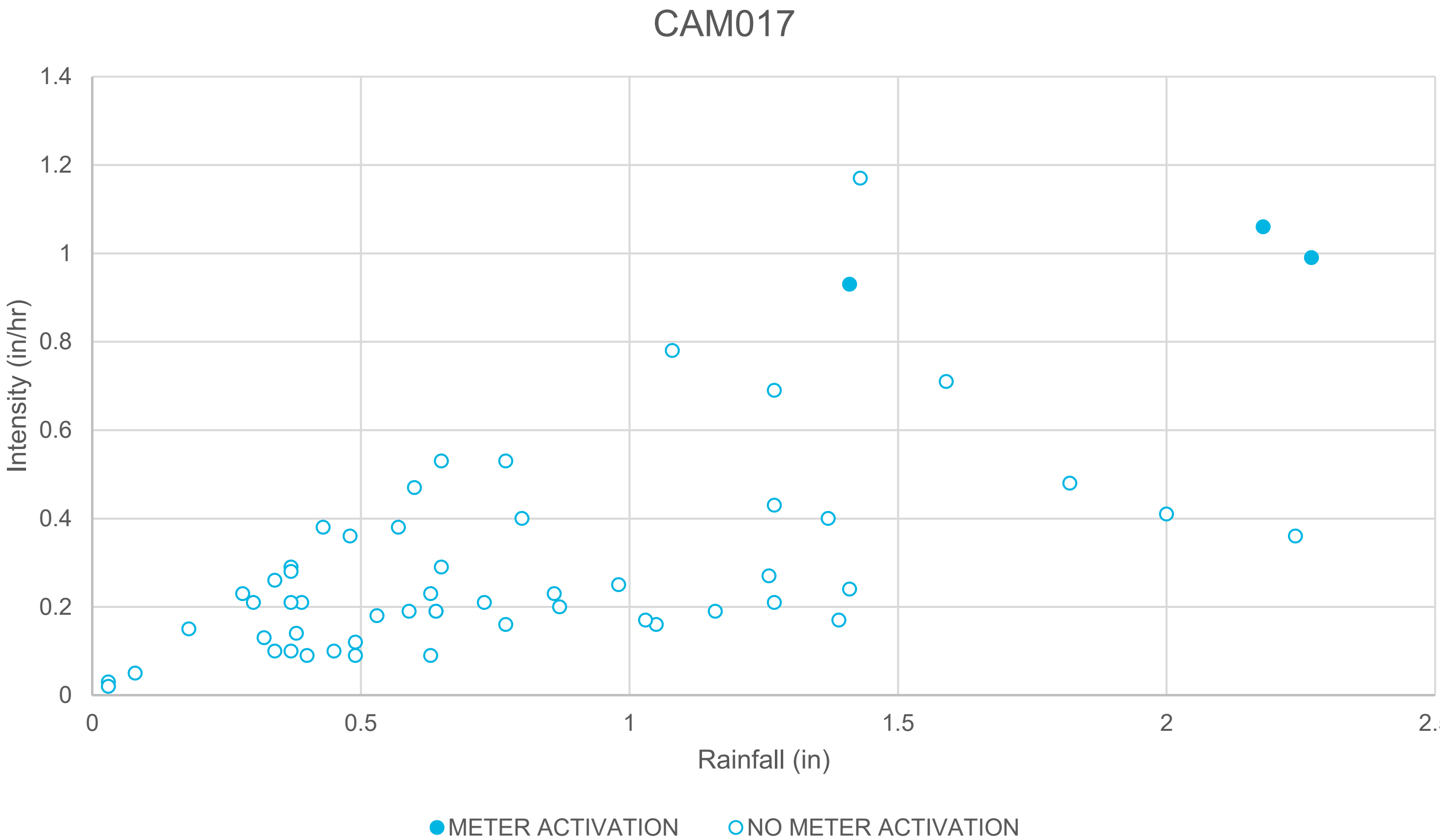
Outfall:CAM005
Regulator: RE051
Related Rain Gauge: 19



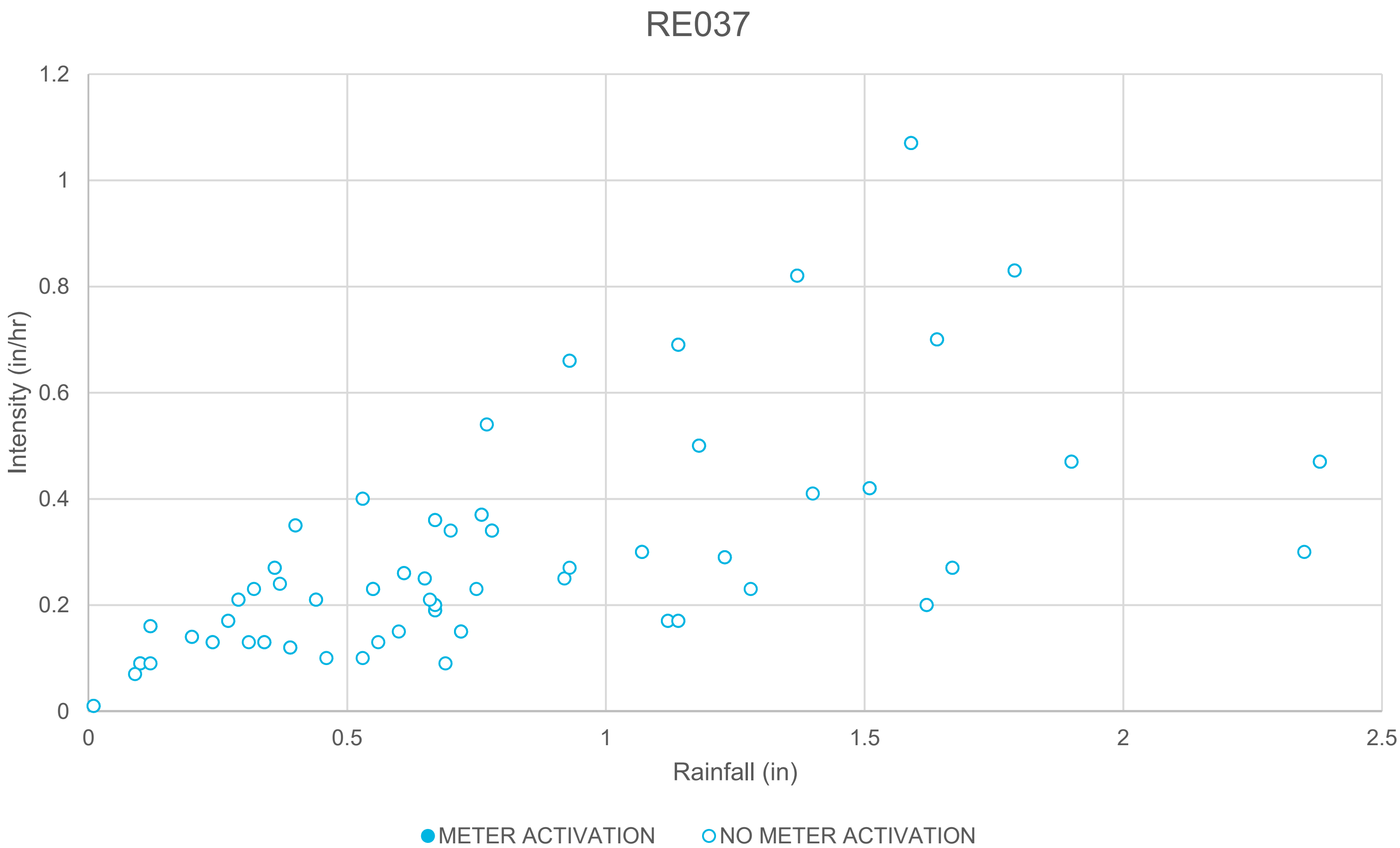
Outfall:CAM007
Regulator: RE071
Related Rain Gauge: 19



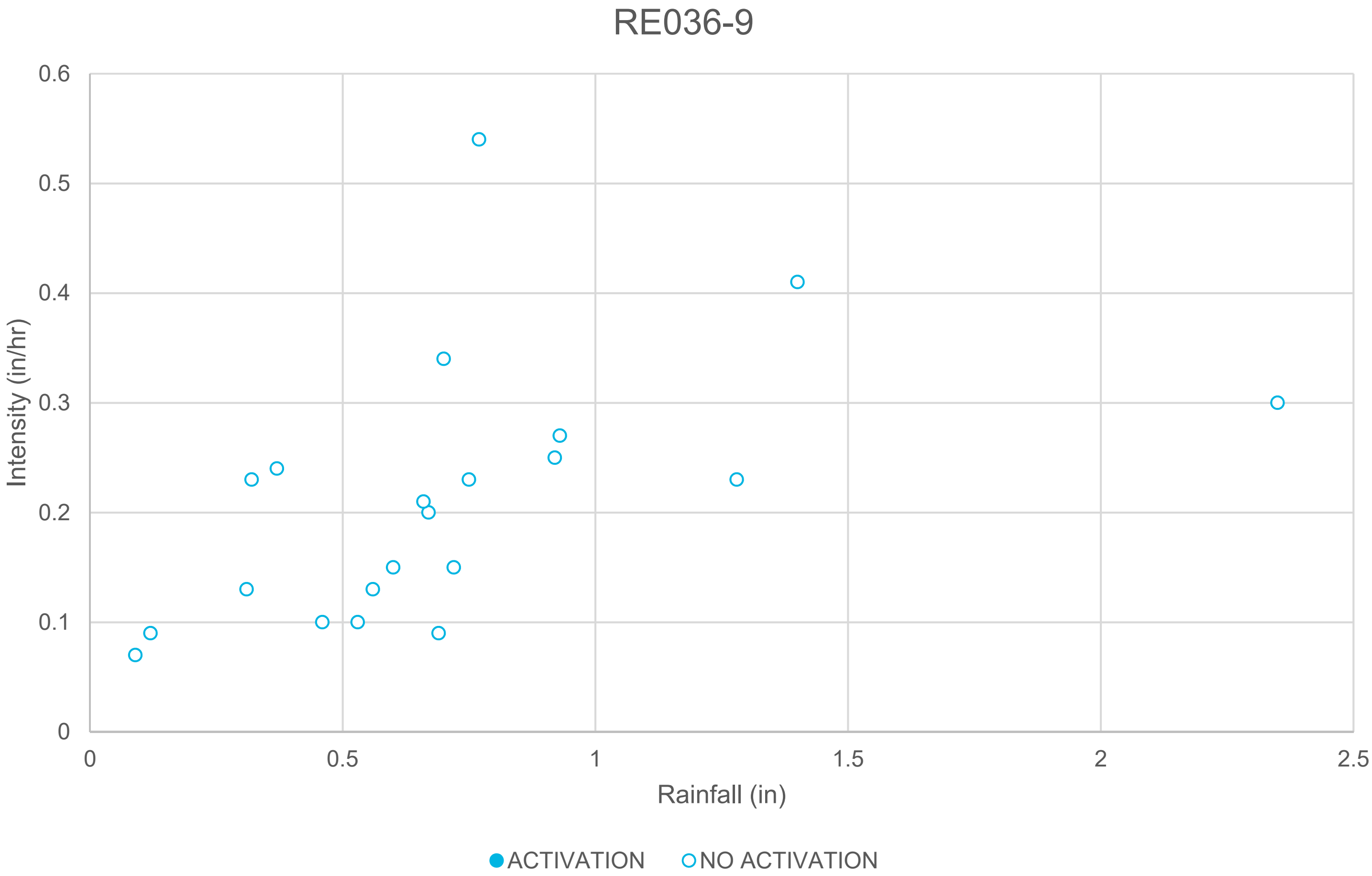
Outfall: CAM017
Regulator: CAM017
Related Rain Gauge: 4



Outfall: MWR010
Regulator: RE037
Related Rain Gauge: 12

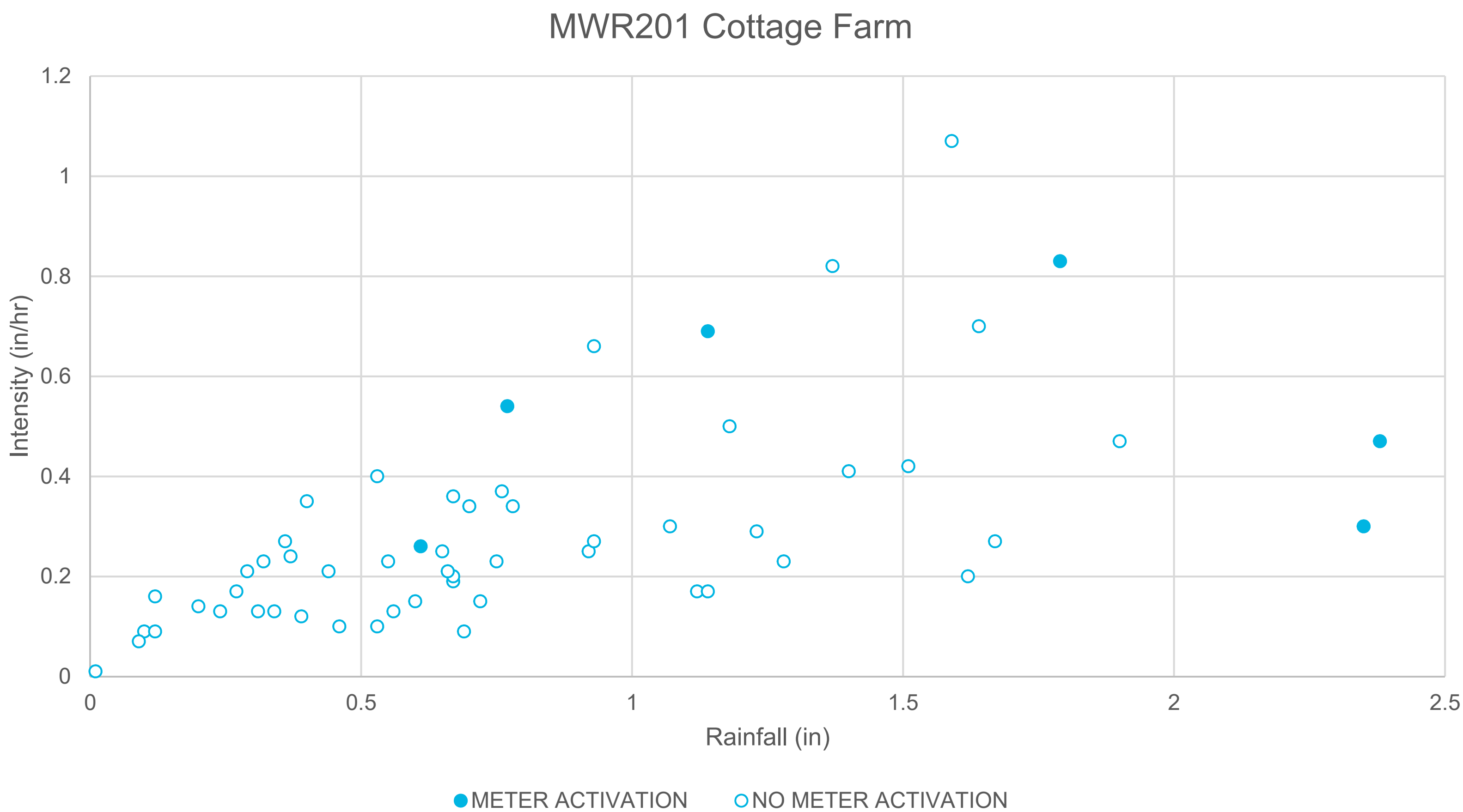


Outfall: MWR010
Regulator: RE036-9
Related Rain Gauge: 12

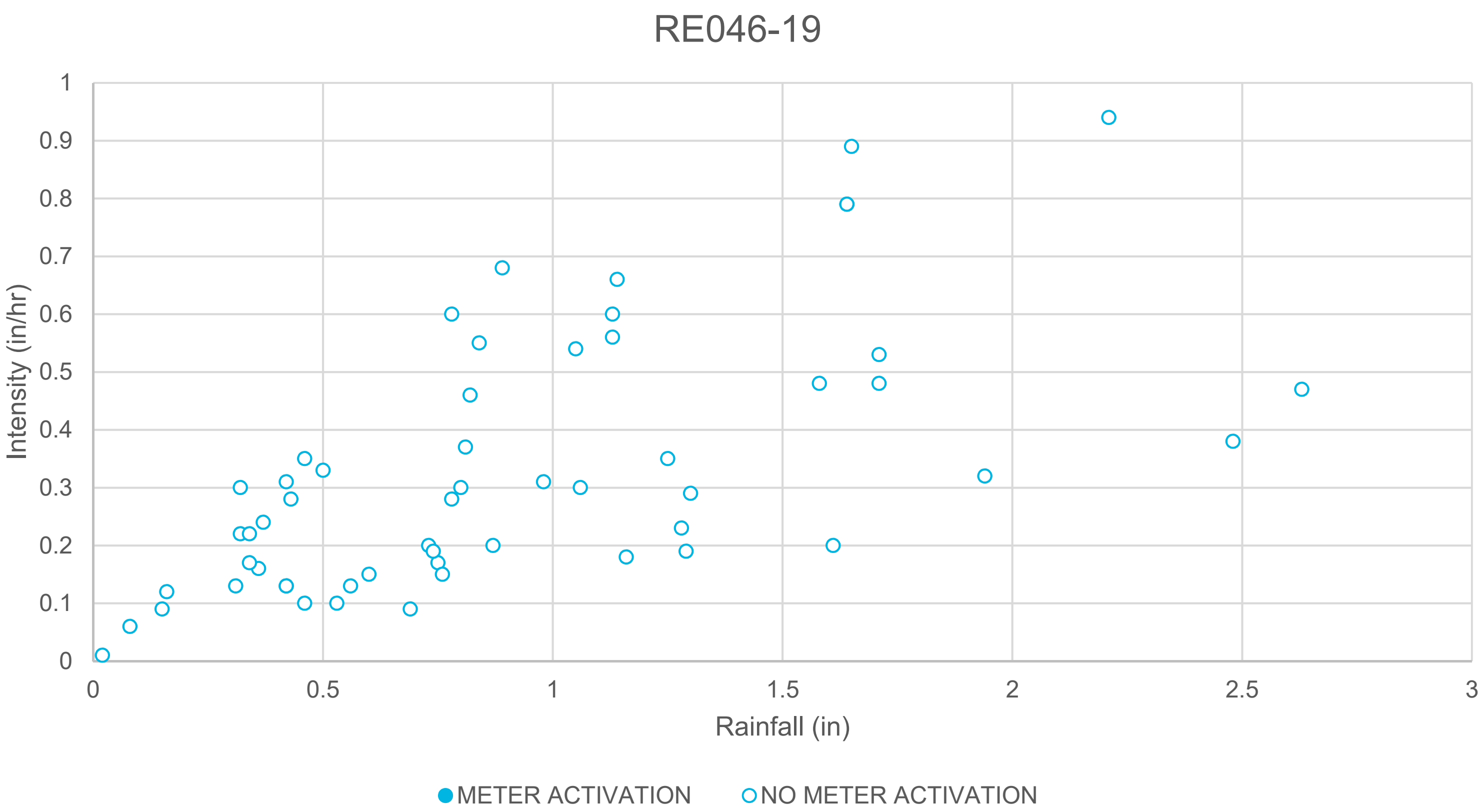


Metering data not available until December, 2018

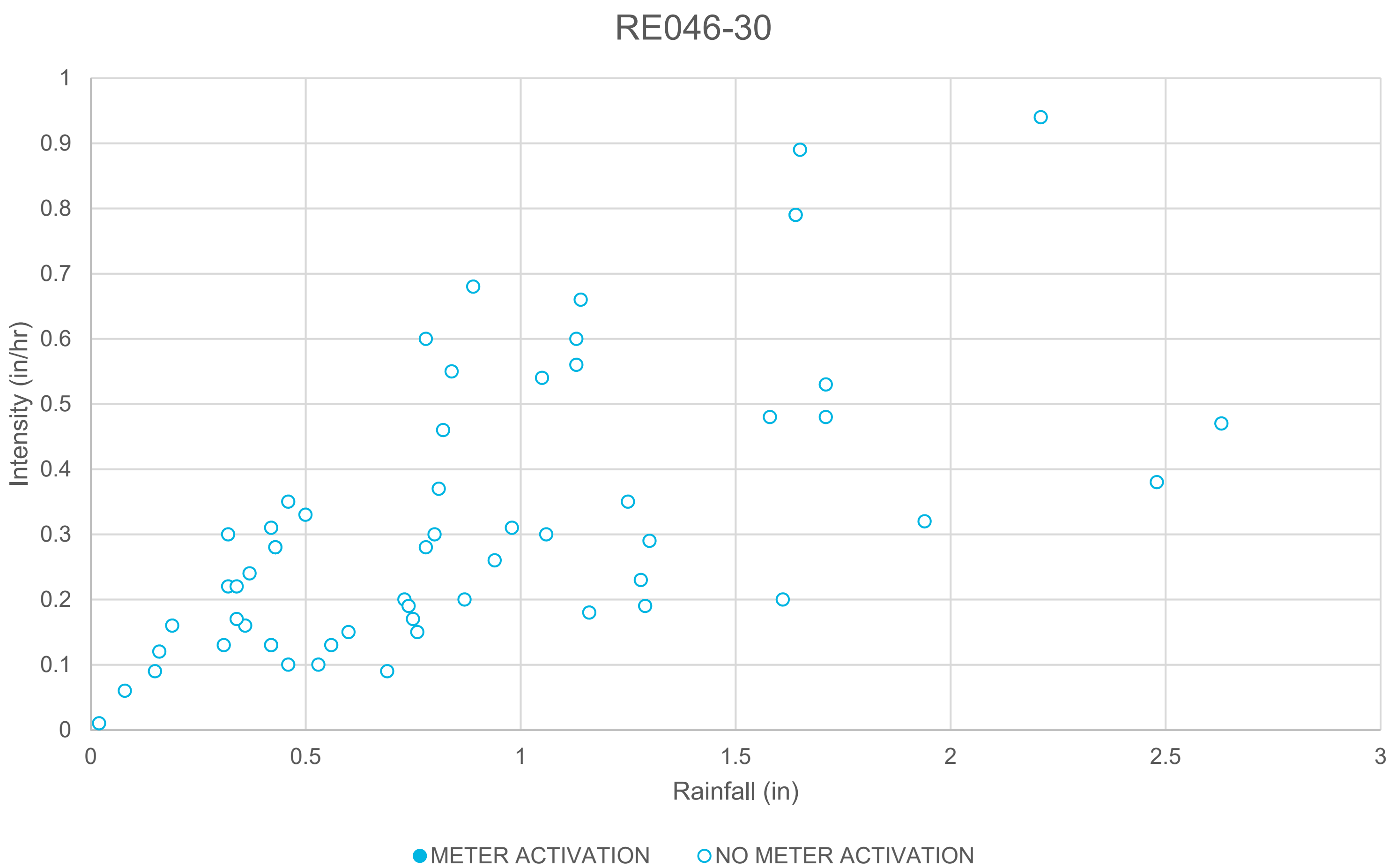
Outfall: MWR201 (Cottage Farm)
Regulator: N/A
Related Rain Gauge: 12



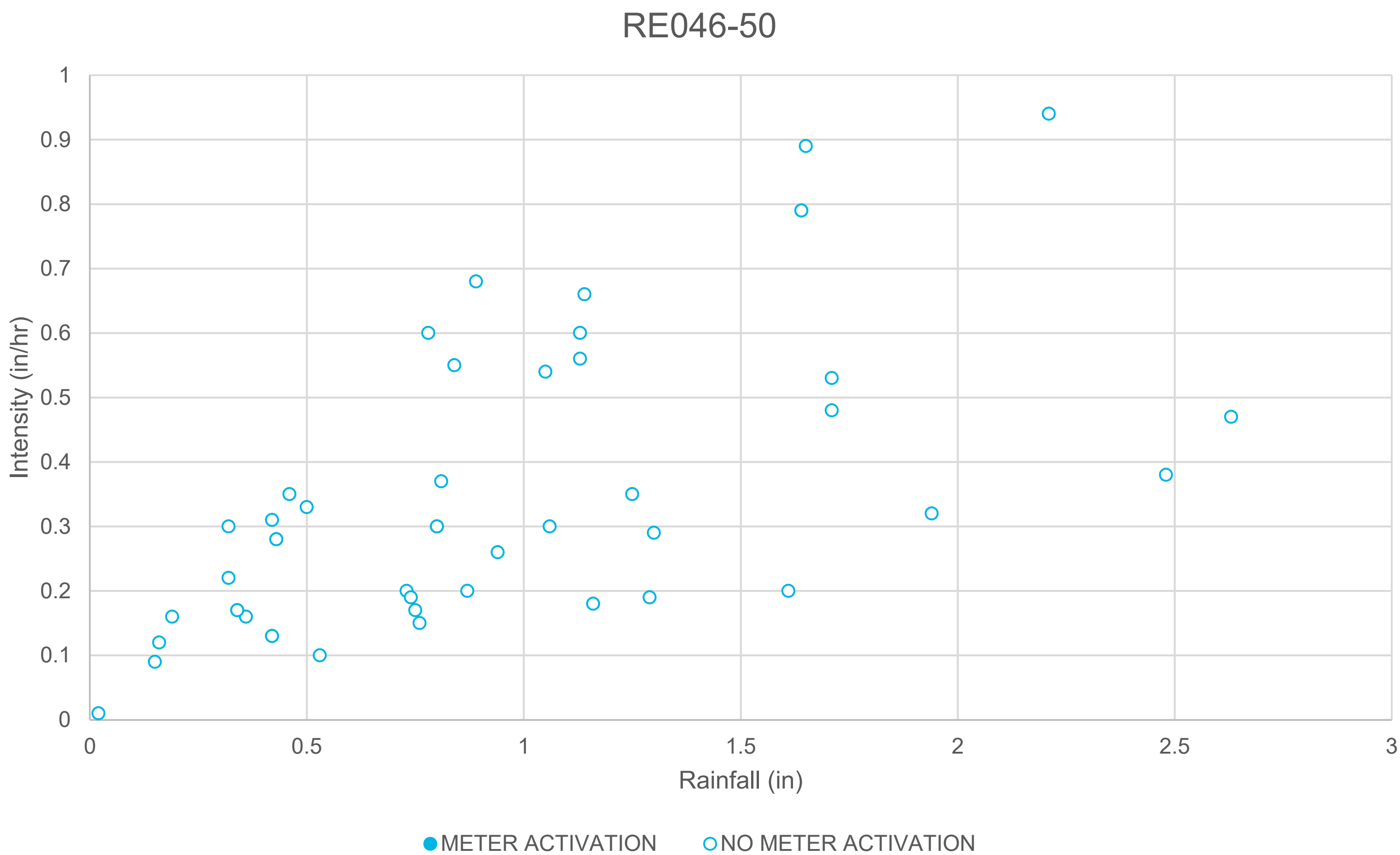
Outfall: MWR023
Regulator: RE046-19
Related Rain Gauge: 15



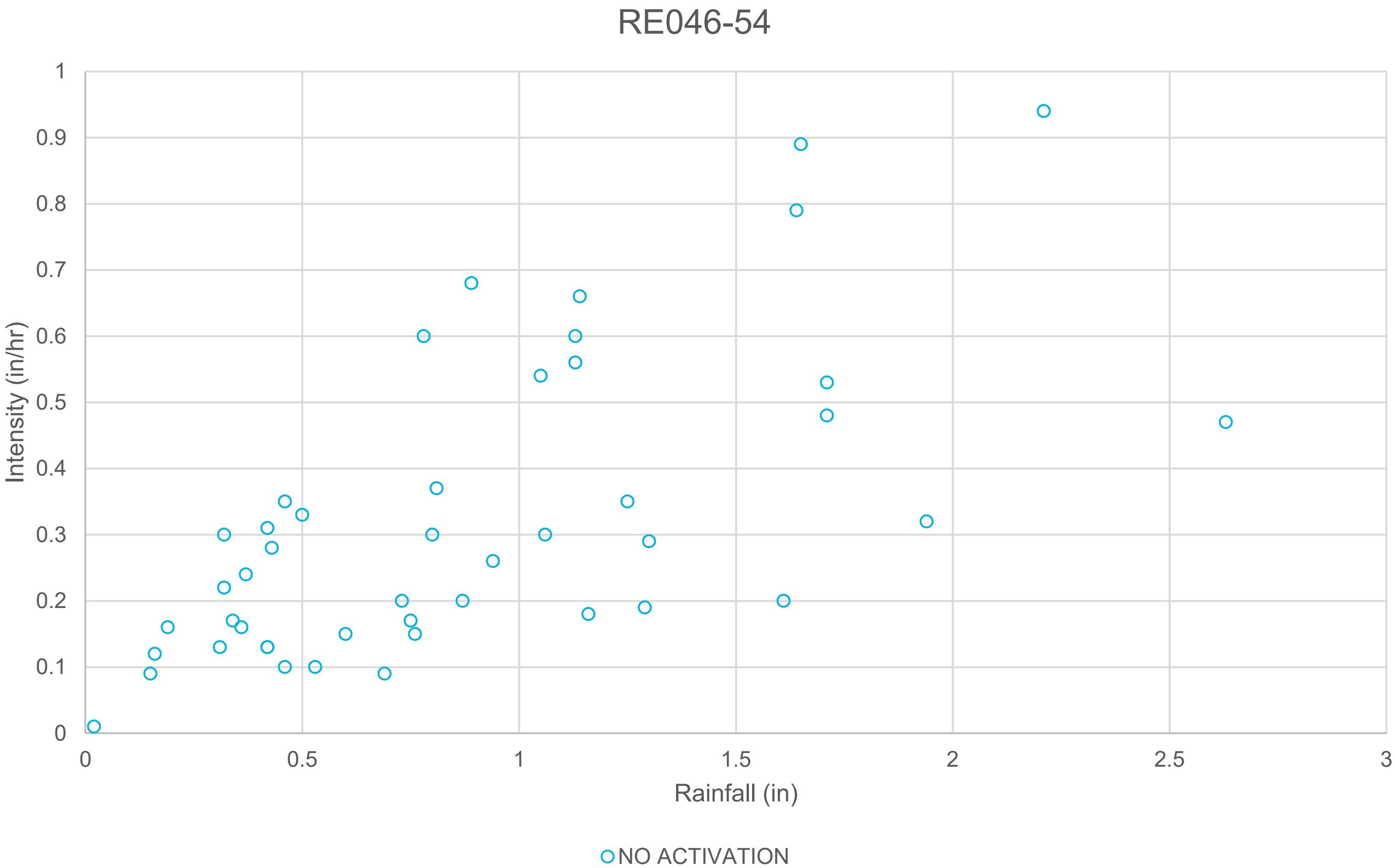
Outfall: MWR023
Regulator: RE046-30
Related Rain Gauge: 15



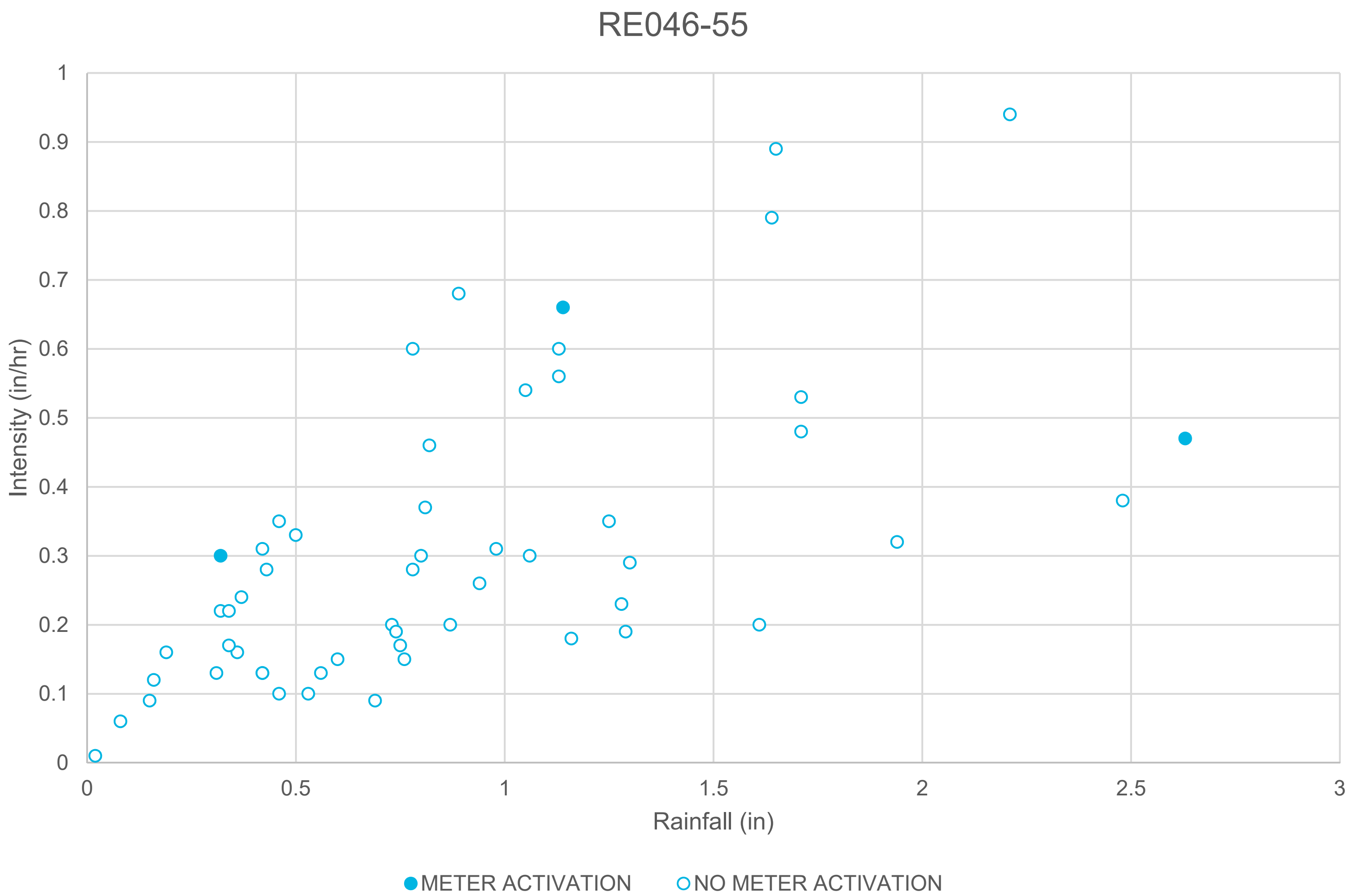
Outfall: MWR023
Regulator: RE046-50
Related Rain Gauge: 15



Outfall: MWR023
Regulator: RE046-54
Related Rain Gauge: 15

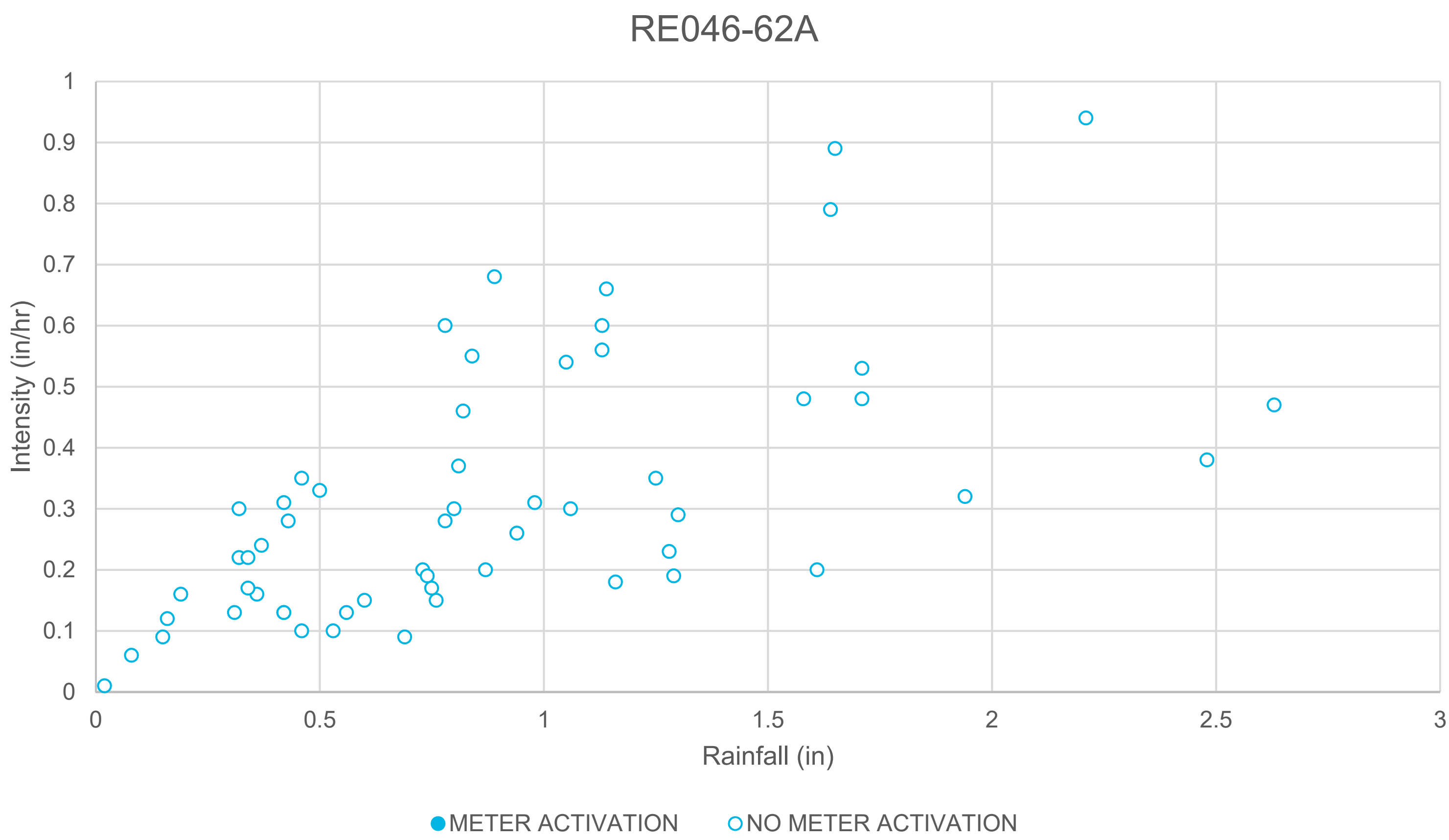


Outfall: MWR023
Regulator: RE046-55
Related Rain Gauge: 15

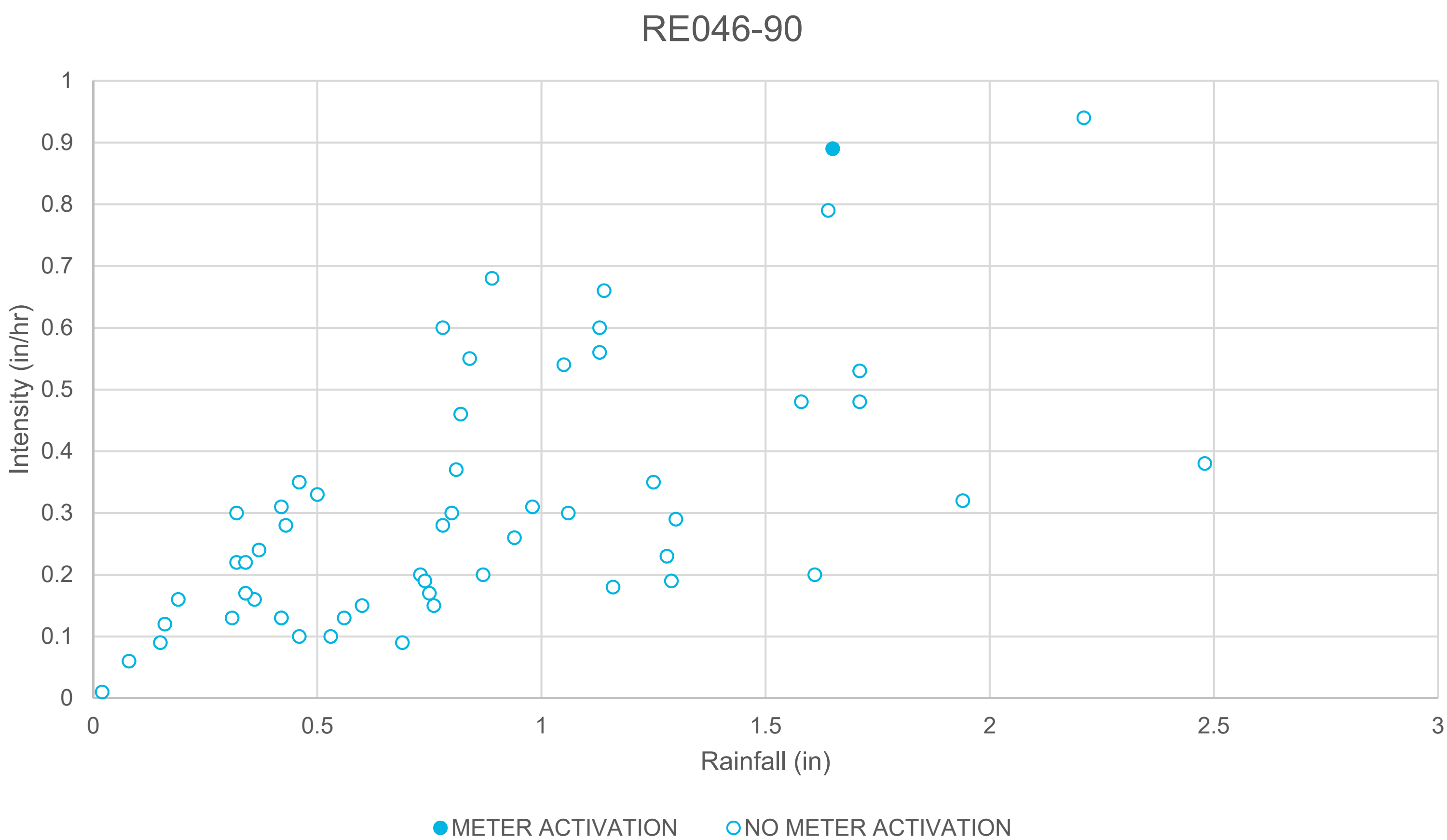


Blockage may have contributed to some activations prior to June 21, 2018.

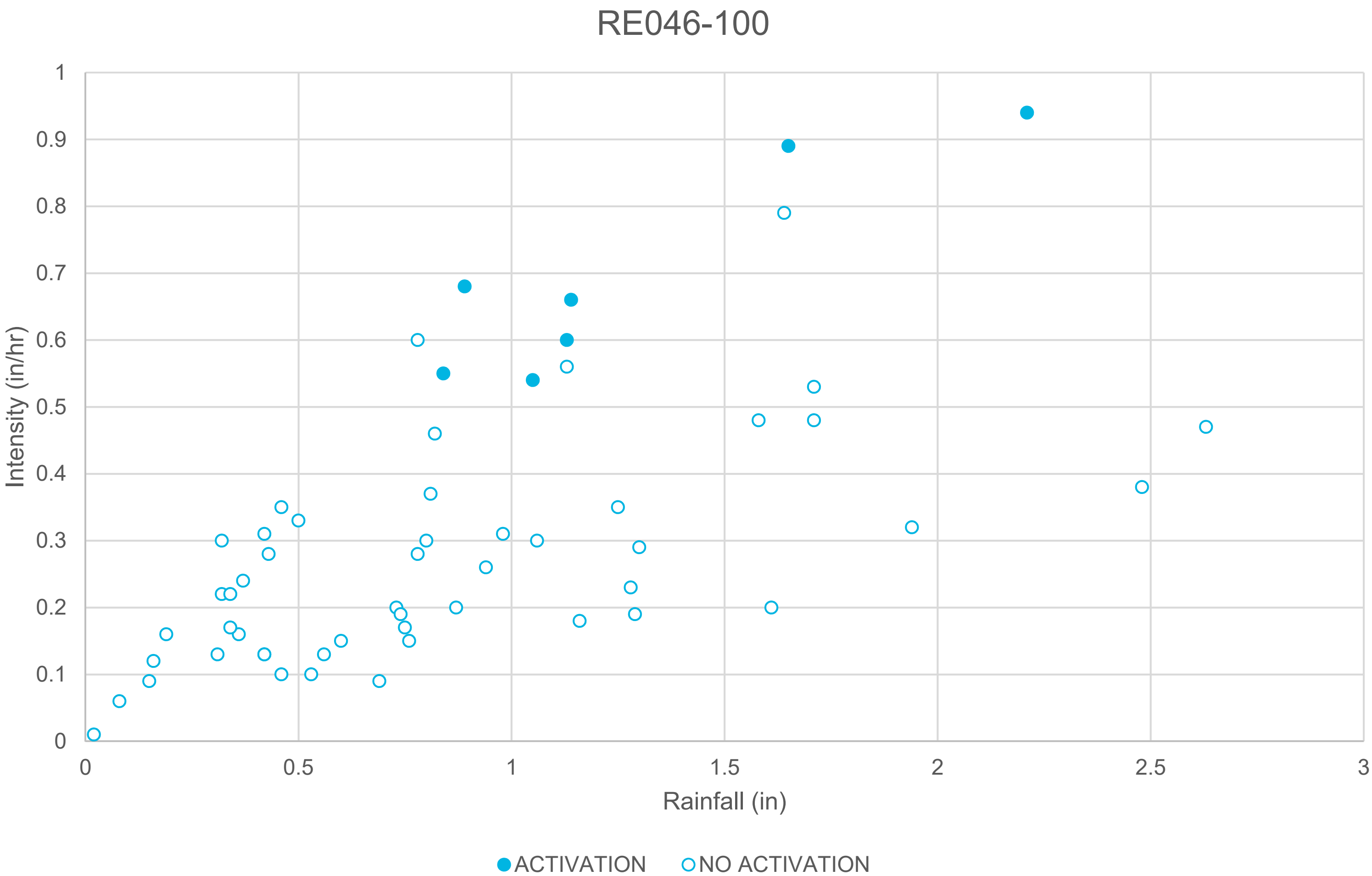
Outfall: MWR023
Regulator: RE046-62A
Related Rain Gauge: 15



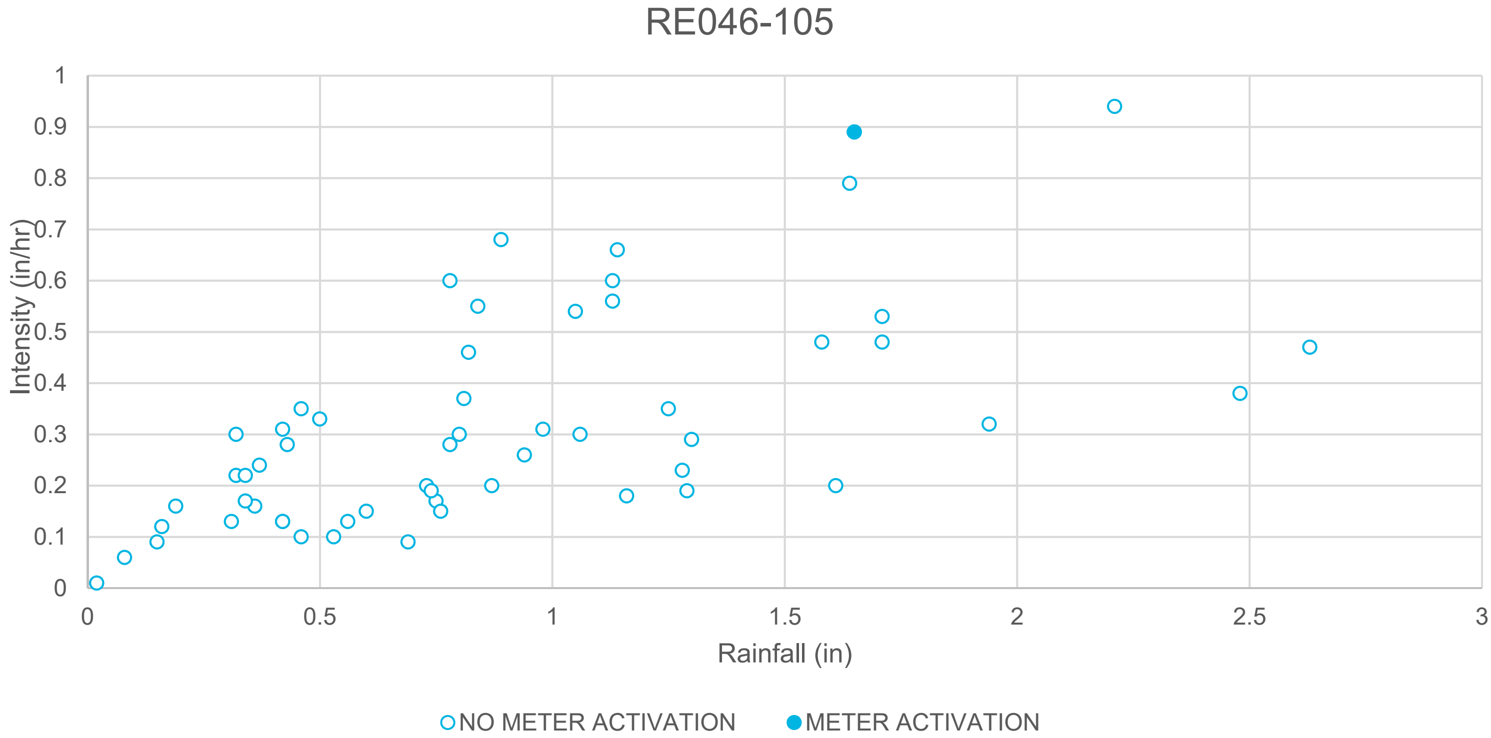
Outfall: MWR023
Regulator: RE046-90
Related Rain Gauge: 15



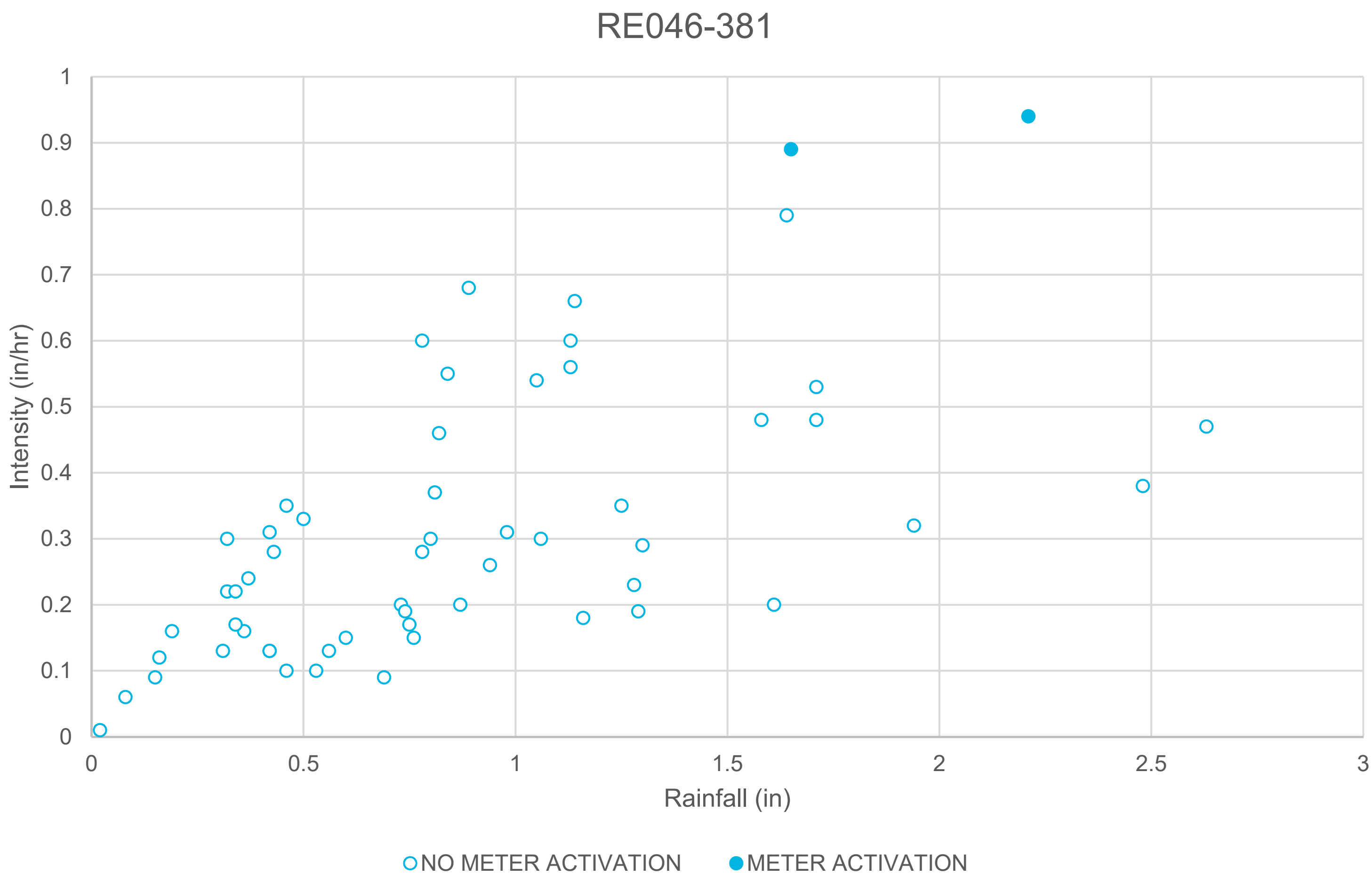
Outfall: MWR023
Regulator: RE046-100
Related Rain Gauge: 15



Outfall: MWR023
Regulator: RE046-105
Related Rain Gauge: 15



Outfall: MWR023
Regulator: RE046-381
Related Rain Gauge: 15



Outfall: MWR023
Regulator: RE046-192
Related Rain Gauge: 2

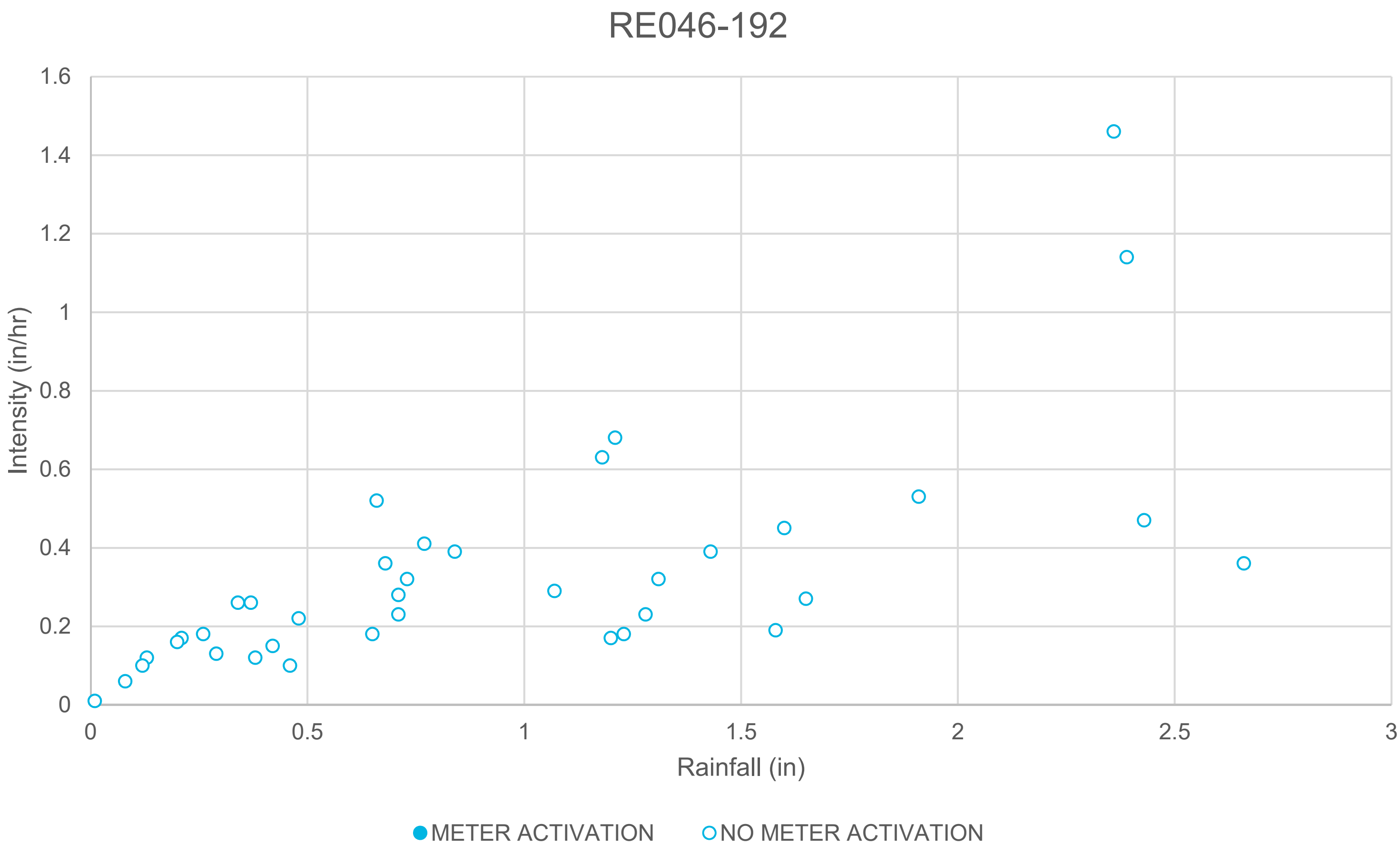


EXHIBIT B

UNITED STATES DISTRICT COURT
for the
DISTRICT OF MASSACHUSETTS

UNITED STATES OF AMERICA, Plaintiff, v. METROPOLITAN DISTRICT COMMISSION, et al., Defendants.	CIVIL ACTION No. 85-0489-RGS
CONSERVATION LAW FOUNDATION OF NEW ENGLAND, INC., Plaintiff, v. METROPOLITAN DISTRICT COMMISSION, Defendants.	CIVIL ACTION No. 83-1614-RGS

SECOND STIPULATION OF THE UNITED STATES
AND THE MASSACHUSETTS WATER RESOURCES AUTHORITY
ON RESPONSIBILITY AND LEGAL LIABILITY FOR
COMBINED SEWER OVERFLOW CONTROL

The Massachusetts Water Resources Authority ("Authority") and the United States, on behalf of the Environmental Protection Agency ("EPA"), hereby agree and stipulate as follows:

1. The purpose of this Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control ("Second Stipulation") is to terminate the February 27, 1987, Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflows (the "1987 Stipulation") and replace it with this Second Stipulation that reflects developments and progress in the control of combined sewer overflow ("CSO") discharges to Boston Harbor and its tributaries that have taken place since 1987. The 1987 Stipulation shall remain in effect until this Second Stipulation goes into effect. This Second Stipulation shall take effect, and the 1987 Stipulation shall terminate, upon approval by the Court in the above-captioned action of the Joint Motion of the United States and the Massachusetts Water Resources Authority To Amend Schedule Six with Respect to The Charles River, Alewife Brook and East Boston.

2. The Authority's Long-Term Combined Sewer Overflow ("CSO") Control Plan ("LTCP") presently consists of the Authority's July 31, 1997, Final Combined Sewer Overflow Facilities Plan and Environmental Impact Report (the "1997 Facilities Plan"), as modified by the planning documents identified in the attached Exhibit "A," entitled, MWRA Long-Term CSO Control Plan Facilities Planning Documentation.

3. The CSO outfalls that are the subject of the Authority's LTCP include the outfalls listed in Exhibit "B" hereto, entitled, "Summary of Typical

Year CSO Activation Frequency and Volume." The CSO outfalls identified with the prefix "MWR" are owned or operated by the Authority. The CSO outfalls identified with a prefix "BOS," "CAM," "CHE," or "SOM," are owned and operated by member municipalities (Boston, Cambridge, Chelsea, or Somerville, respectively), except that the Union Park Pump Station ("UPPS") is jointly operated by the Authority and the City of Boston.

4. With respect to all of the CSO outfalls within or hydraulically connected to the Authority's sewer system, including the outfalls identified in Exhibit "B" hereto, the Authority accepts legal liability to undertake such corrective action as may be necessary to implement the CSO control requirements set forth in Schedule Six and related orders of the Court in the above-captioned action, and to meet the levels of CSO control (including as to frequency of CSO activation and as to volume of CSO discharge) described in the Authority's Long-Term CSO Control Plan. Whether the Authority has met the levels of CSO control in its Long-Term CSO Control Plan shall be determined by the EPA and the Massachusetts Department of Environmental Protection. With respect to all CSO outfalls owned or operated by the Authority, including the CSO outfalls identified in Exhibit "B" identified with the prefix "MWR," and including the Union Park Pump Station, the Authority also accepts legal liability to undertake such future corrective action as may be necessary to meet the CSO control requirements of the Clean Water Act, 33 U.S.C. § 1251 et seq. The Authority does not accept liability for alleged past

violations of the CSO provisions of NPDES Permit No. MA0102351 (issued in 1976 and transferred to the Authority in 1985) prior to February 27, 1987.

5. This stipulation is not intended to and does not limit the Court's power to find, or any party's right to seek, liability for past or continuing violations of federal law or to enforce compliance with that law.

By its attorneys,

Massachusetts Water Resources Authority

By its attorneys,

John M. Stevens (BBO #480140)
Foley, Hoag LLP
155 Seaport Boulevard
Boston, Massachusetts 02210
(617) 832-1000

Of Counsel:

Steven A. Remsberg,
General Counsel
Christopher L. John,
Senior Staff Counsel
Massachusetts Water Resources Authority
100 First Avenue
Boston, MA 02109
(617) 242-6000

United States of America

Michael J. Sullivan
United States Attorney

George B. Henderson, II
Assistant U.S. Attorney
John J. Moakley U.S. Courthouse
One Courthouse Way, Suite 9200
Boston, Massachusetts 02210
(617) 748-3282

Of Counsel:

Michael Wagner, Esq.
U.S. Environmental Protection Agency
Boston, MA 02203
(617) 918-1735

Dated: March 15, 2006

B3131253.1

Exhibit A
to Second Stipulation

MWRA Long-Term CSO Control Plan Facilities Planning Documentation

Planning Document	Project	Receiving Water
Final Combined Sewer Overflow Facilities Plan and Environmental Impact Report, July 31, 1997	Hydraulic Relief for CAM005	Upper and Lower Charles River Basin
	Stony Brook Sewer Separation	
	Floatables Control at CAM007, CAM009, CAM011 and CAM017	
	Baffle Manhole Separation at SOM 001 and SOM 006-007	Alewife Brook/Upper Mystic River
	Hydraulic Relief for BOS 017(1)	Mystic/Chelsea Confluence
	Chelsea Branch Relief Sewer	
Minor modifications were addressed in Notice of Project Change, March 1999	Trunk Sewer Relief for CHE 002-004	
	Outfall Repairs and Floatables Control at CHE 008	
	Storage Conduit for BOS 019	Upper Inner Harbor
	Detention/Treatment Facility at Union Park Pump Station	Fort Point Channel
	South Dorchester Bay Sewer Separation	South Dorchester Bay
	Constitution Beach Sewer Separation	Constitution Beach
	Neponset River Sewer Separation	Neponset River
The following reports <u>supplement</u> information in the Final CSO Facilities Plan and Environmental Impact Report, July 31, 1997		
Upgrades to Existing CSO Facilities, Supplemental Environmental Impact Report, September 30, 1998	Cottage Farm Facility Upgrade	Upper Charles River Basin
	Prison Point Facility Upgrade	Upper Inner Harbor
	Somerville Marginal Facility Upgrade	Upper Mystic River; Mystic/Chelsea Confluence
	Commercial Point Facility Upgrade	South Dorchester Bay
Upgrades to the Fox Point CSO Treatment Facility, Supplemental Environmental Impact Report, December 31, 1998	Fox Point Facility Upgrade	South Dorchester Bay
Fort Point Channel CSO Storage Conduit Notice of Project Change, June 2003, and MWRA Long Term CSO Control Plan, Fort Point Channel Sewer Separation and System Optimization Project, Level of Control at CSO Outfalls BOS072 and BOS073, June 7, 2004.	Sewer Separation for BOS072 and BOS073	Fort Point Channel

Exhibit A
to Second Stipulation

MWRA Long-Term CSO Control Plan Facilities Planning Documentation

Planning Document	Project	Receiving Water
Re-Assessing Long Term Floatables Control for Outfalls MWR018, 019 and 020, February 2001 Report on Re-Assessment of CSO Activation Frequency and Volume for Outfall MWR010, April 2001, and supplemental letter report (Metcalf & Eddy, Inc.), May 31, 2001	Regionwide Floatables Controls and Outfall Closing Projects	Regionwide
Final Variance Report for Alewife Brook and the Upper Mystic River, July 2003, and supplemental letter report (Metcalf & Eddy, Inc.), July 8, 2003	Sewer Separation at CAM004 and CAM400	Alewife Brook
	Interceptor Connection Relief and Floatables Control at CAM002, CAM401B and SOM01A, and Floatables Control at CAM001 and CAM401A	
	Control Gate/Floatables Control at Outfall MWR003 and MWRA Rindge Avenue Siphon Relief	
East Boston Branch Sewer Relief Project Reevaluation Report, February 2004 Recommendations and Proposed Schedule for Long-Term CSO Control for the Charles River, Alewife Brook and East Boston, August 2, 2005	Interceptor Relief For BOS003-014	Mystic/Chelsea Confluence; Upper and Lower Inner Harbor
Supplemental Facilities Plan and Environmental Impact Report on the Long-term CSO Control Plan for North Dorchester Bay and Reserved Channel, April 27, 2004	North Dorchester Bay Storage Tunnel and Related Facilities	North Dorchester Bay
	Pleasure Bay Storm Drain Improvements	
	Morrissey Boulevard Storm Drain	
	Reserved Channel Sewer Separation	Reserved Channel
Recommendations and Proposed Schedule for Long-Term CSO Control for the Charles River, Alewife Brook and East Boston, August 2, 2005, and MWRA Revised Recommended CSO Control Plan for the Charles River, Typical Year CSO Discharge Activations and Volumes, November 15, 2005	Brookline Connection, Cottage Farm Overflow Chamber Interconnection and Cottage Farm Gate Control	Upper and Lower Charles River Basin
	Brookline Sewer Separation	
	Bulfinch Triangle Sewer Separation	
	Charles River Valley/South Charles Relief Sewer Gate Controls	
	Evaluation of Additional Charles River Interceptor Interconnection Alternatives	

**Exhibit A
to Second Stipulation**

MWRA Long-Term CSO Control Plan Facilities Planning Documentation

Prison Point Optimization Study, March 30, 2007 Proposed Modification of Long-Term Level of Control for the Prison Point CSO Facility, April 2008	Prison Point CSO Facility Optimization	Upper Inner Harbor

(1) Also "MWRA Long-Term CSO Control Plan Target CSO Activation Frequency and Volume by Outfall," letter dated December 9, 2005.

Exhibit B
to Second Stipulation

SUMMARY OF TYPICAL YEAR CSO ACTIVATION FREQUENCY AND VOLUME

OUTFALL	TYPICAL YEAR		REFERENCE[*]
	LONG TERM CONTROL PLAN 2005 [*]		
	Activation Frequency	Volume (MG)	
ALEWIFE BROOK[1]			
CAM001	5	0.19	5
CAM002	4	0.69	5
MWR003	5	0.98	5
CAM004	To be closed	N/A	5
CAM400	To be closed	N/A	5
CAM401A	5	1.61	5
CAM401B	7	2.15	5
SOM001A	3	1.67	5
SOM001	Closed	N/A	
SOM002A	Closed	N/A	
SOM003	Closed	N/A	
SOM004	Closed	N/A	
TOTAL		**7.29**	
UPPER MYSTIC RIVER			
SOM007A/MWR205A (Somerville Marginal)	3	3.48	
SOM007	Closed	N/A	
TOTAL		**3.48**	
MYSTIC / CHELSEA CONFLUENCE			
MWR205 (Somerville Marginal)	39	60.58	
BOS013	4	0.54	6
BOS014	0	0.00	6
BOS015	Closed	N/A	6
BOS017	1	0.02	9
CHE002	4	0.22	
CHE003	3	0.04	
CHE004	3	0.32	
CHE008	0	0.00	
TOTAL		**61.72**	
UPPER INNER HARBOR			
BOS009	5	0.59	6
BOS010	4	0.72	6
BOS012	5	0.72	6
BOS019	2	0.58	
BOS050	Closed	N/A	
BOS052	Closed	N/A	
BOS057	1	0.43	
BOS058	Closed	N/A	
BOS060	0	0.00	
MWR203 (Prison Point)	17	243.00	10
TOTAL		**246.04**	
LOWER INNER HARBOR			
BOS003	4	2.87	6
BOS004	5	1.84	6
BOS005	1	0.01	6
BOS006	4	0.24	6
BOS007	6	1.05	6
TOTAL		**6.01**	

Exhibit B
to Second Stipulation

SUMMARY OF TYPICAL YEAR CSO ACTIVATION FREQUENCY AND VOLUME

OUTFALL	TYPICAL YEAR		REFERENCE(*)
	LONG TERM CONTROL PLAN 2005 (*)		
	Activation Frequency	Volume (MG)	
CONSTITUTION BEACH			
MWR207	Closed	N/A	
TOTAL		**0.00**	
FORT POINT CHANNEL			
BOS062	1	0.01	
BOS064	0	0.00	
BOS065	1	0.06	
BOS068	0	0.00	
BOS070			
BOS070/DBC	3	2.19	3
UPPS	17	71.37	
BOS070/RCC	2	0.26	
BOS072	0	0.00	4
BOS073	0	0.00	4
TOTAL		**73.89**	
RESERVED CHANNEL			
BOS076	3	0.91	7
BOS078	3	0.28	7
BOS079	1	0.04	7
BOS080	3	0.25	7
TOTAL		**1.48**	
NORTHERN DORCHESTER BAY			
BOS081	0 / 25 year	N/A	
BOS082	0 / 25 year	N/A	
BOS083	0 / 25 year	N/A	
BOS084	0 / 25 year	N/A	
BOS085	0 / 25 year	N/A	
BOS086	0 / 25 year	N/A	
BOS087	0 / 25 year	N/A	
TOTAL		**0.00**	
SOUTHERN DORCHESTER BAY			
BOS088	To be closed	N/A	
BOS089 (Fox Point)	To be closed	N/A	
BOS090 (Commercial Point)	To be closed	N/A	
TOTAL		**0.00**	
UPPER CHARLES			
BOS032	Closed	N/A	
BOS033	Closed	N/A	
CAM005	3	0.84	8
CAM007	1	0.03	8
CAM009	2	0.01	8
CAM011	0	0.00	8
TOTAL		**0.88**	

Exhibit B
to Second Stipulation

SUMMARY OF TYPICAL YEAR CSO ACTIVATION FREQUENCY AND VOLUME

OUTFALL	TYPICAL YEAR LONG TERM CONTROL PLAN 2005 (*) Activation Frequency	Volume (MG)	REFERENCE(*)
LOWER CHARLES			
BOS028	Closed	N/A	
BOS042	Closed	N/A	
BOS049	To be closed	N/A	
CAM017	1	0.45	8
MWR010	0	0.00	2
MWR018	0	0.00	1
MWR019	0	0.00	1
MWR020	0	0.00	1
MWR021	Closed	N/A	
MWR022	Closed	N/A	
MWR201 (Cottage Farm)	2	6.30	8
MWR023	2	0.13	
SOM010	Closed	N/A	
TOTAL		**6.88**	
NEPONSET RIVER			
BOS093	Closed	N/A	
BOS095	Closed	N/A	
TOTAL		**0.00**	
BACK BAY FENS			
BOS046	2	5.38	
TOTAL		**5.38**	

(*) Long-term Control Plan activation frequency and volumes were established in the 1997 CSO Facilities Plan and Enviromental Impact Report or as noted in the "Reference" column.

1- Re-assessing Long Term Floatables Control for Outfalls MWR018, 019 and 020, February 2001.

2- Report on Re-Assessment of CSO Activation Frequency and Volume for Outfall MWR010, April 2001, and supplemental letter report (Metcalf & Eddy, Inc.), May 31, 2001.

3- Report on Re-Assessment of CSO Activation Frequency and Volume to Dorchester Brook Conduit and Outfall BOS086, January 2001 and supplemental letter report (Metcalf & Eddy, Inc.), June 28, 2001.

4- MWRA Long Term CSO Control Plan, Fort Point Channel Sewer Separation and System Optimization Project, Level of Control at CSO Outfalls BOS072 and BOS073, June 7, 2004.

5- Final Variance Report for Alewife Brook and the Upper Mystic River, July 2003, and supplemental letter report (Metcalf &Eddy, Inc.), July 8, 2003.

6- East Boston Branch Sewer Relief Project Reevaluation Report, February 2004.

7- Supplemental Facilities Plan and Environmental Impact Report on the Long-term CSO Control Plan for North Dorchester Bay and Reserved Channel, April 27, 2004.

8- Recommendations and Proposed Schedule for Long-Term CSO Control for the Charles River, Alewife Brook and East Boston, August 2, 2005; MWRA Revised Recommended CSO Control Plan for the Charles River, Typical Year CSO Discharge Activations and Volumes, November 15, 2005; MWRA Long-Term CSO Control Plan, Response to Additional EPA Questions Reagarding Prison Point Discharges, January 9, 2005 (2006).

9- MWRA Long Term CSO Control Plan Target CSO Activation Frequency and Volume by Outfall, December 9, 2005.

10- Prison Point Optimization Study, March 30, 2007; Proposed Modification of Long-Term Level of Control for the Prison Point CSO Facility, April 2008

EXHIBIT C

Table C1 - Accepted Typical Year Model Results

CSO Outfall	Typical Year Rainfall 2019 System Conditions (after model calibration)		Typical Year Rainfall Long Term Control Plan (2006 Agreement)	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Alewife Brook				
CAM001	1	0.02	5	0.19
CAM002	0	0.00	4	0.69
CAM004	Closed	N/A	Closed	N/A
CAM400	Closed	N/A	Closed	N/A
CAM401A	14	4.40	5	1.61
SOM001A	6	3.92	3	1.67
SOM001	Closed	N/A	Closed	N/A
SOM002 (1)	Closed	N/A	Closed	N/A
SOM002A	Closed	N/A	Closed	N/A
SOM003	Closed	N/A	Closed	N/A
SOM004	Closed	N/A	Closed	N/A
Upper Mystic River				
SOM007A/MWR205A	6	4.85	3	3.48
SOM006 (1)	Closed	N/A	Closed	N/A
SOM007	Closed	N/A	Closed	N/A
Mystic/Chelsea Confluence				
MWR205 (Somerville Marginal Facility)	39	110.14	39	60.58
BOS013	10	0.74	4	0.54
BOS014	8	1.38	0	0
BOS015	Closed	N/A	Closed	N/A
BOS017	7	0.44	1	0.02
CHE002	Closed	N/A	4	0.22
CHE003	0	0.00	3	0.04
CHE008	11	3.81	0	0
Upper Inner Harbor				
BOS009	10	0.70	5	0.59
BOS010	9	1.05	4	0.72
BOS012	13	1.34	5	0.72
BOS019	1	0.09	2	0.58
BOS050	Closed	N/A	Closed	N/A
BOS052	Closed	N/A	Closed	N/A
BOS057	2	1.41	1	0.43
BOS058	Closed	N/A	Closed	N/A
Lower Inner Harbor				
BOS003	25	17.41	4	2.87
BOS004	0	0.00	5	1.84
BOS005	0	0.00	1	0.01
BOS006	Closed	N/A	4	0.24
BOS007	Closed	N/A	6	1.05
Constitution Beach				
MWR207 (Consitution Beach)	Closed	N/A	Closed	Closed

Table C1 - Accepted Typical Year Model Results

CSO Outfall	Typical Year Rainfall 2019 System Conditions (after model calibration)		Typical Year Rainfall Long Term Control Plan (2006 Agreement)	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Fort Point Channel				
BOS062	4	0.99	1	0.01
BOS064	1	0.01	0	0
BOS065	3	0.86	1	0.06
BOS068	0	0.00	0	0
MWR215 (Union Park)	10	26.90	17	71.37
BOS070/RCC	0	0.00	2	0.26
BOS072	Closed	N/A	0	0.00
BOS073	0	0.00	0	0
Reserved Channel				
BOS076	2	0.25	3	0.91
BOS078	0	0.00	3	0.28
BOS079	0	0.00	1	0.04
BOS080	0	0.00	3	0.25
Northern Dorchester Bay				
BOS081	0	0.00	0/25 year	N/A
BOS082	0	0.00	0/25 year	N/A
BOS083	Closed	N/A	0/25 year	N/A
BOS084	0	0.00	0/25 year	N/A
BOS085	0	0.00	0/25 year	N/A
BOS086	0	0.00	0/25 year	N/A
BOS087	Closed	N/A	0/25 year	N/A
Southern Dorchester Bay				
BOS088	Closed	N/A	Closed	N/A
BOS089 (Fox Point)	Closed	N/A	Closed	N/A
BOS090 (Commercial Point)	Closed	N/A	Closed	N/A
Upper Charles				
BOS032	Closed	N/A	Closed	N/A
BOS033	Closed	N/A	Closed	N/A
CAM005	8	0.63	3	0.84
CAM007	0	0.00	1	0.03
CAM009 (2)	Closed	N/A	2	0.01
CAM011 (2)	Closed	N/A	0	0.00

Table C1 - Accepted Typical Year Model Results

CSO Outfall	Typical Year Rainfall 2019 System Conditions (after model calibration)		Typical Year Rainfall Long Term Control Plan (2006 Agreement)	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Lower Charles				
BOS028	Closed	N/A	Closed	N/A
BOS042	Closed	N/A	Closed	N/A
BOS049	Closed	N/A	Closed	N/A
CAM017	0	0.00	1	0.45
MWR010	0	0.00	0	0.00
MWR021	Closed	N/A	Closed	N/A
MWR022	Closed	N/A	Closed	N/A
MWR023	1	0.14	2	0.13
SOM010	Closed	N/A	Closed	N/A
Neponset River				
BOS093	Closed	N/A	Closed	N/A
BOS095	Closed	N/A	Closed	N/A
Back Bay Fens				
BOS046	0	0.00	2	5.38

(1) --- Not listed in the the May 15, 2006 Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control, Exhibit B, as amended in April 2008.

(2) ---The City of Cambridge maintains these outfalls in a closed condition while it continues to evaluate hydraulic conditions prior to making a decision to close these outfalls permanently.

Table C2 - Modeled Outfalls Under Further Evaluation

CSO Outfall	Typical Year Rainfall Long Term Control Plan (2006 Agreement)	
	Activation Frequency	Volume (MG)
Alewife Brook		
MWR003	5	0.98
CAM401B	7	2.15
Mystic/Chelsea Confluence		
CHE004	3	0.32
Upper Inner Harbor		
BOS060	0	0
MWR203 (Prison Point)	17	243
Fort Point Channel		
BOS070/DBC	3	2.19
Lower Charles		
MWR018	0	0
MWR019	0	0
MWR020	0	0
MWR201 (Cottage Farm)	2	6.3