Jersey City Municipal Utilities Authority

SYSTEM CHARACTERIZATION REPORT

NJPDES Permit No. NJ0108723

June 2018

SYSTEM CHARACTERIZATION REPORT

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ACRONYMS AND ABBREVIATIONS

CHI	Computational Hydraulics International
CIWEM	Chartered Institute of Water and Environmental Management
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
EPA	Environmental Protection Agency
JCMUA	Jersey City Municipal Utilities Authority
JCSA	Jersey City Sewerage Authority
LTCP	Long Term Control Plan
Modeling Report	Combined Sewer System Modeling Report
NJPDES	New Jersey Pollutant Discharge Elimination System
NJDEP	New Jersey Department of Environmental Protection
PVSC	Passaic Valley Sewerage Commission
2016 Work Plan	2016 JCMUA Sewer System Characterization Work Plan

1 INTRODUCTION AND OBJECTIVES

1.1 Introduction

In accordance with the New Jersey Pollutant Discharge Elimination System (NJPDES) General Permit (Permit) issued in 2015 by the New Jersey Department of Environmental Protection (NJDEP) for the Jersey City Municipal Utilities Authority (JCMUA) combined sewer system (CSS), this System Characterization Report has been prepared as the basis for development and implementation of the Long Term Control Plan (LTCP). This report is a culmination of various record review, monitoring, and modelling efforts, as well as coordination with communities hydraulically connected to the JCMUA CSS. This report has been prepared in accordance with the 2016 JCMUA Sewer System Characterization Work Plan (2016 Work Plan) as approved by NJDEP in August 2016. The list below summarizes the elements that have been submitted under the current permit to date:

- GPS latitude and longitude for pump stations, CSO regulators and CSO outfalls (December 2015)
- JCMUA Sewer System Characterization Work Plan for the Long Term Control Plan (December 2015, revised April and June 2016, approved August 2016)
- JCMUA Sewer System Rain Gauge & Flow Meter QAPP (December 2015, revised April and June 2016, approved August 2016) Map of combined and separate sewer areas (June 2016)
- Asset Management Plan (on site at the JCMUA as of July 2017)
- Public Participation Process Plan (to be submitted by Passaic Valley Sewerage Commission - PVSC, certified by the JCMUA)
- Consideration of Sensitive Areas Plan (to be submitted by PVSC, certified by the JCMUA)

These elements will be used to develop the Development and Evaluation of Alternatives Report, which will in turn be used to prepare the final permit required submittal – the Long Term Control Plan, which will be a coordinated effort between the hydraulically connected CSO permittees in Passaic Valley Sewerage Commissioners' service area.

1.2 Objectives

The objective of this system characterization report is to address the requirements outlined in Section G of the permit. These objectives include the following:

- Evaluate the rainfall record for the area and evaluate flow variations due to precipitation events (which required the selection of a typical year, and is currently being addressed with DMR reporting using the rain gage at Liberty Science Center)
- Review the entire collection system to address the response of the system to various precipitation events (which required a review of the existing model to determine where improvements had been made since the calibration completed under the previous permit)
- Monitor CSOs – develop a monitoring program that measures the frequency, duration, flow rate, and pollutant volume of CSO discharges (which required the development of the 2016 Supplemental Modeling and Monitoring Plan)

- Modeling – calibrate and verify a model to aid with characterization (this required converting the existing JCMUA model from XP-SWMM to PCSWMM; modifying, upgrading and expanding the PCSWMM model to include system improvements and modeling data obtained during the 2016 Supplemental Modeling and Monitoring Program).
- Apply the model to simulate the JCMUA CSS response to rainfall during a typical year of precipitation events (i.e. – 2004) and extreme storm events to predict the flows, volumes, depths, and pollutant loads from the CSS during both typical and extreme precipitation events.
- Identify sensitive areas where CSOs occur, where sensitive areas are defined as areas designated as Outstanding National resource Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters used for primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds.

Each of these objectives has been addressed, either by the JCMUA or in concert with PVSC, and will be described in the text of this report.

2 COLLECTION SYSTEM DESCRIPTION AND MODEL BACKGROUND

2.1 System Description

The Jersey City Combined Sewer Collection System is comprised of gravity sewers, CSO regulators and outfalls, interceptor sewers, netting facilities, two pumping stations and a force main system.

The gravity sewers, consisting of trunk and lateral sewers, are broken down into tributary areas or basins which transport flow to the CSO regulator and outfall system. The regulators allow concentrated sanitary sewage flow direct passage to the interceptors during dry weather but limit diluted storm water flow to the treatment plant by diverting it into a discharge outfall. The interceptor sewers carry the dry weather flow, by gravity, from the regulators to either the East Side or the West Side Pumping Stations. There is one siphon within the interceptor sewer system which transports the sewerage underneath two large water mains.

From the pumping stations, sewage is transported, through the force main system, to the PVSC Treatment Plant in Newark, NJ for treatment. A schematic of the system is provided in Figure 2-1.

2.1.1 Force Main

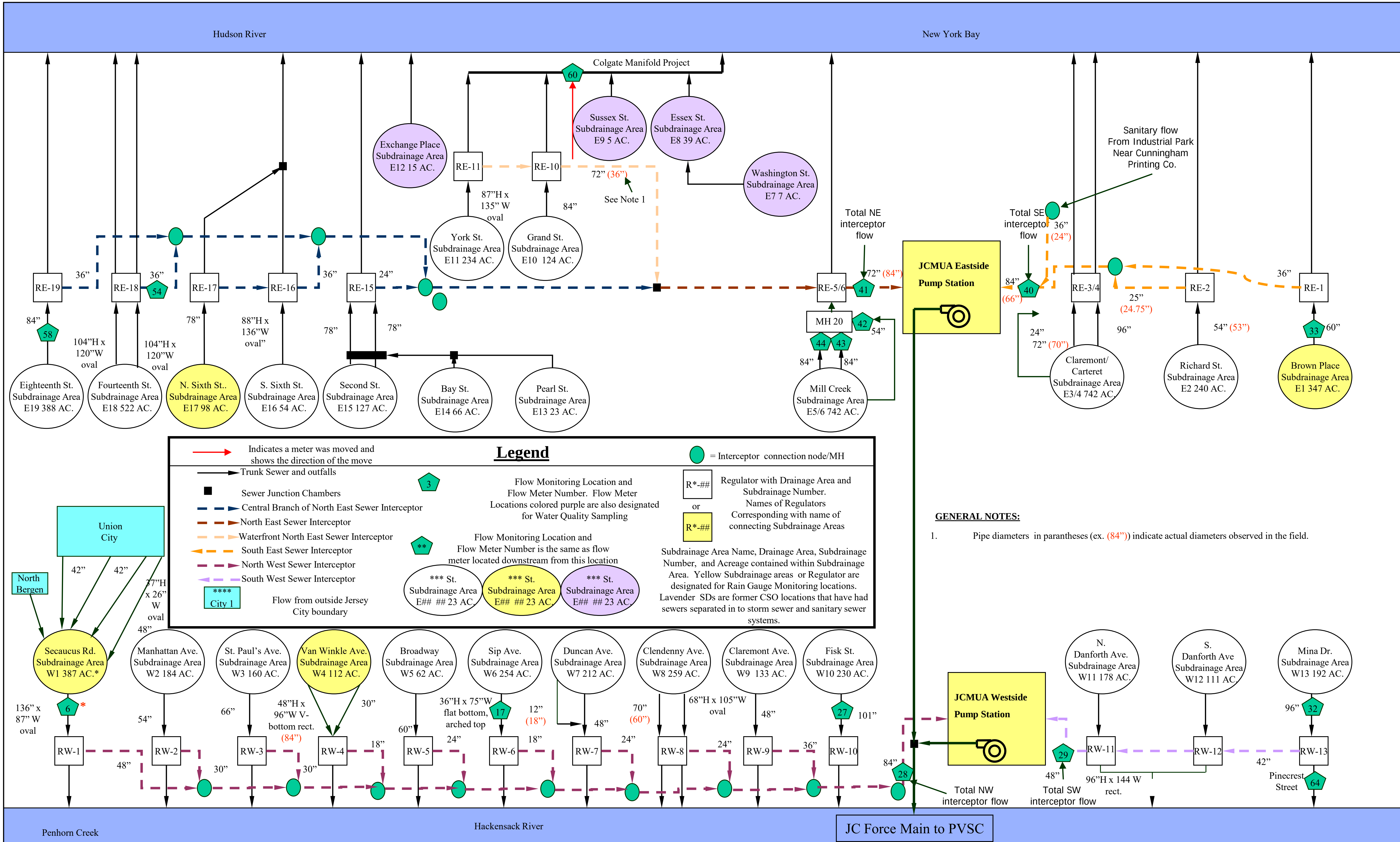
Construction of the Jersey City force main system began in February of 1987 and the system went on line in September of 1989. It was built to transport sewage, under pressure, from the Jersey City East and West pumping stations to the Passaic Valley Sewerage Commissioners (PVSC) plant for treatment. The force main carries flow from Jersey City, North Bergen (which ties into the JCMUA's interceptor, as well as having direct connections to the JCMUA's trunk sewers in the Secaucus Road subdrainage area) and Union City (which ties into the JCMUA's trunk sewers in the Secaucus Road subdrainage area) and picks up flow from Bayonne and Kearny before delivering flow to PVSC. The force main runs underneath Newark Bay at the confluence of the Hackensack and Passaic Rivers and finally into PVSC. The location of the force main is shown on Figure 2-2.

2.1.2 Regulators

There are 25 regulators in the JCMUA's system. Regulators are chambers that direct flow to either the interceptor or to an outfall. Under dry weather flow conditions, flow passes through the regulator and enters the interceptor. Under wet weather flow conditions, flow passes through the regulator and enters the interceptor until the level of flow passes over a weir and is conveyed to a netting facility. It should be noted that all the JCMUA's regulators have tide gates to prevent backflow. The locations of the regulators are shown on Figure 2-2.

2.1.3 Interceptors

The east and west sides of the interceptor sewer system were placed into service in 1957. The interceptor sewers carry the intercepted dry weather flow, by gravity, from the regulators to either the



ARCADIS Design & Consultancy for natural and built assets

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
JERSEY CITY, NJ
COMBINED SEWER SYSTEM CONFIGURATION
PROCESS FLOW DIAGRAM for 2016

FIGURE 2-1

BAYONNE INTERCONNECTION

Legend

- REGULATOR
- CSO OUTFALL
- RAIN GAGE
- PUMP STATION

FLOW METERS

- 2016 FLOW METER
- MUNICIPAL BOUNDARY
- DRAINAGE AREA BOUNDARY
- SUBDRAINAGE AREA AND NUMBER
- SUBCATCHMENT AND NUMBER

PIPES TO BE MODELED

- FORCE MAIN (JCMUA)
- INTERCEPTOR
- COMBINED SEWER PIPE

0 500 1,000 1,500 2,000

SCALE IN FEET

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
JERSEY CITY, NEW JERSEY

COMBINED SEWER SYSTEM MODELING REPORT

2016 MONITORING LOCATIONS

ARCADIS

FIGURE
2-2

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West Side or the East Side Pumping Stations. From there the intercepted sewage is transported, through the force main system, to the Passaic Valley Sewerage Commissioners (PVSC) plant for treatment.

The interceptor sewers are constructed primarily of reinforced concrete circular pipe ranging from 24 to 84 inches in diameter on the East Side and from 24 to 84 inches on the West Side. The East Side interceptor sewers total approximately 36,620 feet in length. The West Side interceptor sewers total approximately 35,480 feet in length. The interceptors are shown on Figure 2-2.

2.1.4 Netting and Screening Facilities and Combined Sewer Overflows

There are 20 netting facilities and one mechanical screening facility in the JCMUA's system. The netting facilities consist of nets and static screens that capture solids and floatables that would otherwise enter the receiving waters. Similarly, there is a mechanical screen with nets to achieve the same goal at the Eighteenth Street location, NF-029. These facilities are inspected on a regular basis, and solids and floatables are removed and disposed . Each of the JCMUA's 21 CSO outfalls are equipped with solids and floatables removal facilities. The locations of the facilities are shown on the Figure presented in Appendix F, which was prepared to meet permit's GPS requirements.

2.1.5 Pump Stations

The JCMUA's system has two main pump stations. These pump stations, the East Side and West Side Pump Stations, are located at the sites of the JCMUA's former treatment plants and convey flow to PVSC. The locations of these two pump stations are shown on Figure 2-2.

2.1.5.1 East Side Pump Station

The East Side Pump Station is located at the intersection of Jersey City Boulevard and Phillips Street. It was constructed in 1986. Wastewater from the northeast and southeast interceptors enters the facility, where it is screened, and grit is removed. The pump station has four 16.4 MGD variable speed pumps, two of which are used for normal operation, with a third for peak flow and a fourth for redundancy. These pumps convey flow across town through a 54" force main.

2.1.5.2 West Side Pump Station

The West Side Pump Station is located at 555 Route 440, just south of the Fisk Street. It was constructed in 1986. Wastewater from the northwest (including flow from North Bergen) and southwest interceptors enters the facility, where flow is screened, and grit is removed. The pump station has four 14.4 MGD variable speed pumps, two of which are used for normal operation, with a third for peak flow and a fourth for redundancy. These pumps convey flow through a 36" force main. This 36" force main connects at the location shown in the "Bayonne interconnection" call out on Figure 2-2. The combined flow from the two pump stations is conveyed to PVSC in Newark for treatment.

2.2 History of Model Development

Development of the JCMUA model began in 1998 and continues to date. The model has been through various stages of development and has been used for studies, design, and construction. The software used to construct the model was developed by XP-SWMM (briefly known as CAICE's Hydro Works before returning to the name XP-SWMM in 1999). The list below contains information on the two phases and various stages of development including the version of the software used, the projects for which the model was used, area and component limits, and purpose or objective of each stage of model development.

Phase I - Initial Model development and growth: In 1996 the JCMUA, formerly the JCSA, submitted their initial *CSO Discharge Characterization Study Part A: JCSA Monitoring Proposal and Work Plan, July 1996*, which was one of the first requirements of the initial NJDEP CSO General Permit issued at that time. NJDEP's review of the document continued until 2004. During the period between from 1996 to 2004, the JCMUA had several modeling needs that were completed using uncalibrated XPSWMM models to address several special projects. The JCMUA Proposal and Work Plan proposed extensive model calibration, but the monitoring program with 63 flow meters and 6 Rain gauges was nearly $300,000, and the JCMUA did not want to proceed with calibration during that period without NJDEP approval of the monitoring program. Based on these circumstances, an uncalibrated, field-verified, XPSWMM model was used to conservatively determine peak flows for facilities. It was also used to determine the impacts of various alternatives for other designs such as the netting facilities and regulator weir modifications, as an uncalibrated model was still the best tool available for this purpose. Between 1998 and 2006, the following stages of model component development and eventual integration took place during Phase I:

- **The Outfall Model:** The first model was created 1998 and was an uncalibrated, verified XP-SWMM model (Version 2.23) in a DOS operating system. It consisted of the CSO outfall hydraulic components and subdrainage area hydrologic components in Jersey City. The purpose of this model was to determine the peak flows generated at each of Jersey City's 26 CSO outfalls using one of the highest intensity storms from Newark Airport's precipitation record. This storm (referred to as Newark's Worst Storm) has a one-hour rainfall intensity of 0.6 inches per hour (in/hour) followed by a 2.04 in/hour rainfall intensity (a 10-year, 1-hour storm). The combined effect of this storm was a precipitation event that was rarer than a 10-year, 1-hour storm event (a storm event with a 10% chance of occurring during any given year). This model was used in the sizing and design of the CSO Corrections Project's 26 netting facilities (NF-001 to NF-029).

- **The Eighteenth Street Model:** This XP-SWMM model was a modification of the outfall model. It was created in 1998 to aid in the prevention of continuous dry weather overflows at the Eighteen Street Regulator (as reported in the 1995 CSO Abatement Study). The model was used to increase weir heights by 12 to 18 inches and relocate a coarse bar screen that became clogged frequently upstream.

- **The Colgate Interceptor:** This model was a modification of the Eighteenth Street model. The hydraulic components for the Colgate Interceptor were added and was used to determine the impacts of sewer flows from future developments on this subsection of the interceptor system.

- **The Van Winkle Regulator Relocation Project:** This model was created in 1999 and was the only uncalibrated, verified CAICE Hydro Works Version of the model. It was the first model used in a Windows operating system. It consisted of the Van Winkle Regulator's CSO outfall hydraulic components and this subdrainage area's hydrologic components. The purpose of this model was to determine the peak flows generated in the Van Winkle Outfall using Newark's Worst Storm and to use these flows to redesign and upgrade the Van Winkle outfall to assist the NJDOT in relocating the Van Winkle regulator as well as lowering the regulator elevation by 3 feet.

- **The Initial, Uncalibrated JCMUA Systemwide Model:** This model was created in 1999 and was the first Windows based version of the model to be developed using XP-SWMM (Version 7). During this time, the previous outfall model was expanded to include the entire JCMUA interceptor system (otherwise known as the "spine" model). It remained uncalibrated but was expanded with the addition of trunk sewers 30 inches in diameter and larger. Subcatchment hydrologic components were added to the model one subdrainage area at a time. Numerous site visits were made to the JCMUA CSS to field verify unusual inverts, pipe sizes, reverse slopes and other features. As a secondary measure to confirm the model's results, presentations were made to the JCMUA staff for verification purposes. This process continued until the first system-wide model was completed. Additional features were added to test how high weirs could be raised without adverse hydraulic interference and the impact of adding automated regulator orifice links. By 2002, the initial system-wide model was completed and ready for calibration; however, it could not be calibrated because calibration data had not yet been collected.

- **Model update to address construction related and other JCMUA requested issues:** During the course of construction of the JCMUA netting facilities between 2003 and 2005, 3 to 5 system bypass options were evaluated using the Initial JCMUA System-Wide Model. The model was used to check the adequacy of the flow bypass methods proposed by the contractor. The JCMUA later requested the use of this model to resolve issues regarding flooding on York Street and Sip Avenue. During these analyses, the model was upgraded to XP-SWMM Version 8.52.

- **The Calibrated XP-SWMM JCMUA System-wide Model:** NJDEP approval of the Monitoring Proposal and Work Plan was granted in September 2004. Since the Monitoring Program could not have been completed before January 2005, the calibration event results could not be obtained until the fall 2005. After a 90-day review period passed without any comment from NJDEP, it was determined that calibration of the model should proceed. Model calibration began in January of 2006 (using XP-SWMM Version 9.51) and was completed as of the July 2007 Modeling Study Report.

Phase II – Calibration, expansion, and upgrade of the JCMUA Systemwide Model: On September 10, 2004, the NJDEP issued an Authorization to Proceed with the JCMUA CSS Monitoring Program's Supplemental Proposal and Work Plan. After completion of the Monitoring Program in January 2005, the flow and rainfall data were used to calibrate the JCMUA, systemwide XPSWMM model. The following five stages of the development of the calibrated model with the expansions and upgrades occurred from 2005 to the present:

- **XP-SWMM to PCSWMM Model Conversion:** As per the Phase IV Combined Sewer Capacity and Condition Assessment Study Report in January 2012, the model was converted from XP-SWMM software to a format that is more compatible with the EPA's SWMM 5 application. SWMM 5 is the basis of CHI's PCSWMM software package and provides many useful reporting features and easy integration of GIS features that were not available in XP-SWMM. The XP-SWMM model was exported to a file format that could be opened using PCSWMM. After conversion, the components were quality checked for inconsistencies. The new PCSWMM was not calibrated but was run for dry weather and wet weather analyses to check that the conversion process was successful.

After the JCMUA's Calibrated XPSWMM Systemwide Model was developed in 2007 it was used for the following study and design applications:

- In 2007 the JCMUA Cost and Performance Report was submitted for CSO abatement in accordance with NJDEP General Permit.
- In 2008 a modeling study was completed that evaluated which parts of the CSS were most likely to be operating over capacity or causing flooded conditions. Alternative solutions to remedy those conditions were recommended during the Phase I Sewer System Capacity and Condition Assessment.
- In 2008, the model was used to determine peak flow and depth conditions to size the Second Street Netting Facility and 18th Street Screening Facility.
- In 2011, Mina Drive Sewer Separation Study was completed to examine the flooding in the Country Village subcatchment within the W-13 subdrainage area. Sewer separation and pumping options were explored.
- In 2012, the Downtown Flooding Feasibility Study was completed in a manner similar to the Mina Drive Sewer Separation Study.
- In 2013, the CSO Telemetry Pilot Study was completed as a requirement of the JCMUA's CSO Consent Decree with the EPA. This study determined the feasibility of implementation of a full-scale telemetry system on Jersey City's CSOs and to check the correlation of telemetry overflow data with the JCMUA XPSWMM model's predictions. The Study concluded that the use of telemetry to monitor CSOs has a high cost to benefit ratio and had various unavoidable reliability issues. This led to a recommendation not to implement a full-scale telemetry system. The telemetry pilot study, however, also indicated overflows when the model did within acceptable tolerances to satisfy the EPA's concern whether the model alone could adequately predict overflows.

- **Model Modifications and Expansions from Phase IV:** In the Phase IV Combined Sewer Capacity and Condition Assessment Study Report in January 2012, the model was expanded, and a surveyor was contracted to obtain rim and invert information for fifty manholes throughout the JCMUA's system. These manholes, which were inspected during Phases I, II and III, were then added to the converted PCSWMM model.
  In addition, pump station operation protocols increased the maximum wet weather pump capacity of the West Side Pump Station to between 40 and 50 MGD and the East Side to between 40 and 45 MGD. After reviewing flow and depth data from the 2005 JCMUA Rainfall and Flow

Monitoring Study and the new information provided by the JCMUA, the pump curves in the model were scaled up to more accurately represent current operating conditions.

- **Model Modifications and Expansions from Phase VI:** As per the Phase VI Combined Sewer Capacity and Condition Assessment Study Report in March 2014, model expansion continued. A surveyor was subcontracted to obtain rim and invert information for approximately 345 manholes that were inspected during Phase V. The manholes selected from Phase V include both manholes on pipe segments not previously in the Model, and intermediate manholes located between nodes already in the model. The model, which originally consisted of 576 pipes after conversion in 2012, was expanded to contain 1,267 pipe segments. Of the 1,267 pipes, 471 were smaller than 30 inches in diameter, which was the minimum pipe diameter in the original model. This model expansion would allow for more localized analysis in future modeling scenarios, specifically upon recalibration.

- **Calibrated, Upgraded, Modified and Expanded PCSWMM JCMUA System-wide Model:** As per this Modeling Report, the PCSWMM continued its expansion and completed calibration of selected storm events from the 2016 Supplemental Monitoring Study. The expansion upgrades, modifications and calibration process are presented in Sections 3.3 and 6 of this report, respectively.

3 MODEL CONVERSION AND IMPROVEMENT UPDATES

3.1 Model Conversion

As mentioned in Section 2.1 of this report, the JCMUA's existing model was previously converted to PCSWMM by exporting the model directly from XP-SWMM to a SWMM5-compatible format during the Phase IV Combined Sewer Capacity and Condition Assessment Study (January 2012). The goal of model conversion was to take the existing XP-SWMM model and convert it to a format that is more compatible with the Environmental Protection Agency's (EPA) SWMM 5 application. SWMM 5 is the basis of Computational Hydraulics International's (CHI) PCSWMM software package. This software provides many useful reporting features and easy integration of GIS features that were not available in XP-SWMM. Features of PCSWMM include:

- Shorter run times than XP-SWMM (annual simulation can be completed in half the time)
- The ability to integrate more than one background feature at a time (roads and orthoimagery, for example)
- Multiple data series can be presented on one graph (example: all overflow data for all the outfalls in the model)
- Simple data entry methods (like Excel and other spreadsheet programs)
- Simple point and click data export methods
- PCSWMM models can be run using the USEPA's free SWMM 5 software, compared to XP-SWMM models that can only be run in the XP-SWMM software itself. PCSWMM also uses the original version of SWMM5, where the JCMUA's XP-SWMM model uses a modified version of the SWMM4 engine for its calculations.

The process for converting the model from XP-SWMM to PCSWMM started with exporting it from its current format to a file format accepted by PCSWMM. This file format, called an INP file, can be read by SWMM 5 and PCSWMM. After the export, the individual components of the exported model were compared to the previous version. Tables were created to check all attribute information, including pipe shape and size, manhole depth and pump information. The following inconsistencies were found and corrected as noted below:

- Custom pipe shapes (i.e. nonstandard cross sections) describing model elements required special efforts to get these components converted. These cross sections, which represent model elements such as netting facilities, and non-standard pipe shapes (such as eggs or ellipses), were re-entered in the format accepted by SWMM5.
- Sediment must be entered in the SWMM5 model in a different format for circular pipes and cannot be entered at all for non-circular pipes. In PCSWMM, a round pipe containing sediment is modeled as a different type of pipe than a round pipe without sediment. Sediment was re-entered for circular pipes, and it was determined that the number of non-circular pipes that had contained sediment in the existing model was not significant when compared to the total number of pipes in the model.
- Regulators are represented differently in SWMM5. The tables describing the relationship between depth of flow and orifice capacity were re-entered, and the regulators were set up as

orifices with logic controls. These logic controls tell the model to constantly refer to the table that describes the depth/capacity table to simulate regulator function.

- Pipes cannot be ‘turned off’ in PCSWMM. The Sixth Street Outfall is an inactive pipe in the XP-SWMM model. This pipe has been represented as a 1-foot diameter pipe to limit the flow that can discharge from this outfall.
- Global data, such as rain gage information and infiltration information did not come across in the conversion; as data is stored in a different form. This information was reentered into the new model. The PCSWMM model, like the XP-SWMM model, uses the Horton Infiltration Model.

After it was verified that all of parameters present in the XP-SWMM model had been brought into the PCSWMM model, the model was run for a storm that had previously been run in the XP-SWMM model. The modeling results were compared at key points in the model (locations of the flow meters in initial calibration). This process allowed for comparison of modeling results between the two pieces of software. This process is not considered calibration, rather an exercise in learning what type of results could be expected from the PCSWMM model. Results indicated that the two models produced similar results, in terms of peak flows and volumes, indicating a successful model conversion.

3.2 Components and Naming Conventions

The JCMUA PCSWMM model contains the following number of components:

- Drainage Areas:
  - East Side
  - West Side
- Subdrainage Areas:
  - West - W1 through W13
  - East - E1 through E19, E21, and E22
- 395 Subcatchment Areas:
  - Flow area and percent impervious
  - Overland slope and width
  - Infiltration rates and depression storage
- Hydraulic Components:
  - 1478 Pipes with length, shape and roughness
  - 13 Weirs and 28 orifices
  - 21 Netting facilities and 25 CSO regulators
  - 4 Pumps
  - 21 Outfalls

Each component of the model was given a specific name. This was intended to give future model users the ability to quickly and easily identify a model component’s location and type from its coded name. Model naming conventions, extensively explained in the Phase IV Combined Sewer Capacity and Condition Assessment Study Report in January 2012, are divided into the following categories and summarized:

- **Drainage Areas, Subdrainage Areas, Subcatchment Areas:** Drainage Areas are designated either "W" for the West Side Drainage Area or "E" for East Side Drainage Area. The West Side Drainage Area is subdivided into 13 subdrainage areas numbering from 1 to 13 (north to south). The East Side Drainage Area is subdivided into 19 subdrainage areas numbered from 1 to 19 (south to north), where six are stormwater or consolidated subdrainage areas. Each subdrainage area is further subdivided into several subcatchments. The subcatchment areas are named after the most downstream node in the subcatchment.

- **Nodes (manholes, wet wells, storage tanks, outfalls, static waterbodies, etc.):** Six rules form the naming convention for nodes. The first character of a node's name (except in the case of outfall nodes) is one of the following:
  - 'E' for all trunk sewer nodes in the East Side Drainage Area.
  - 'W' for all trunk sewer nodes in the West Side Drainage Area.
  - 'I' for all interceptor nodes.
  - 'F' for all nodes associated with the force main to PVSC.
  - 'R' for all regulator nodes.

  The second set of characters is one of the following:
  - If the first character is 'E' or 'W', the second set of characters is one or two numbers that designate the subdrainage area in which the node is located. The designation 'E19', for example, would indicate that the node is in the East Side Drainage Area 19, which is associated with RE-19, the Eighteenth Street regulator. The designation 'W1' would indicate that the node is in West Side Drainage Area 1, which is associated with RW-1, the Secaucus Road regulator.
  - If the first character is an 'I', the second set of characters designates an interceptor branch in Jersey City:
    - 'NW' refers to the Northwest Interceptor which consists of the portion of interceptor between regulators RW-1 and RW-10.
    - 'SW' refers to the Southwest Interceptor which consists of the portion of interceptor between regulators RW-11 and RW-13.
    - 'SE' refers to the Southeast Interceptor which consists of the portion of interceptor between regulators RE-1 and RE-3/4.
    - 'NE' refers to the 84-inch diameter section of the Northeast Interceptor, located between the East Side Pump Station and the split between the SNE and NNE interceptors.
    - 'SNE' refers to the south branch of the Northeast Interceptor which consists of the portion of interceptor between RE-7 and RE-12.
    - 'NNE' refers to the north branch of the Northeast Interceptor, which consists of the portion of interceptor between RE-13 and RE-19.
    - If the first character is 'F', the second set of characters will be '1X', where 'X' represents a number up to the maximum needed to represent dummy nodes on the force main as needed for modeling purposes.

- If the first character is ‘R’, the remaining characters will designate the number of the regulator. Examples include RE18 (the Fourteenth Street Regulator) and RW1 (the Secaucus Road regulator.

The third character is one of the following:

- “N" to designate standard manholes.
- "S" to designate storage nodes.
- "G" to designate "ghost" nodes that have been incorporated into the model network strictly for modeling purposes (such as to represent the connection of two pipe segments with different characteristics) that do not exist in the physical system.
- "C" to designate runoff catchment nodes.

The last four characters will be the manhole number as noted on JCMUA sewer or interceptor maps and drawings.

It should be noted that the nodes representing the East Side Pump Station and West Side Pump Station are named "JCEPS" AND JCWPS", respectively.

Outfall Node: If a node is an outfall, the first letter of the node name will start with "OF" and the regulator of the number, the second set will be a "W" or "E" for West Side or East Side, and the last set of characters will be the number of the outfall as it corresponds to its regulator number. Ghost nodes required for outfalls are numbered in sequence

- **Links (trunk sewers, interceptor sewers, pipes, channels, ditches, conduits, weirs, orifices, pumps, gates, etc.):** The links were named based on the names of their upstream and downstream nodes. The following rules were used:
  - A Single Link’s name begins with the name of the upstream node to which it is connected.
  - A Multi Link’s name begins with the name of the upstream node to which it is connected. This will be followed by one of the following:
    - ‘W’ if the Multi Link represents a weir
    - ‘O’ if the Multi Link represents an orifice
    - ‘P’ if the Multi Link represents a pump
    - ‘S’ if the Multi Link represents a model component not defined as a weir, orifice or pump or if the Multi Link which is a complex link composed of two or more of the components listed above.
  - The last character in a link name is the last digit of the downstream node to which it is connected.

It should be noted that model elements that have been added to the model from as-built drawings retain the names shown on those as-builts. The remainder of the elements are named using the naming conventions described above.

3.3 Model Improvement Updates

As indicated in the 2016 JCMUA Sewer System Characterization Work Plan (2016 Work Plan), the JCMUA has performed a number of modifications and improvements to their CSS. These model improvements, or expansions/modifications, proved to be a sizable portion of the model upgrade prior to calibration. The following improvements stated in the 2016 Work Plan were implemented into the PCSWMM model:

- Sewer invert elevation changes & pipe diameter corrections
- Updated sediment depths
- East Side and West Side Pump Stations modifications
- Mina Drive & York/Grand Pump Station addition
- Sip Avenue trunk sewer & netting facility modifications
- 18th Street Screening Facility
- Brown Place sewer modifications
- North Bergen flow information updates
- Duncan Avenue outfall pipe modifications
- 8th, 9th & 10th Street sewer modifications

Additionally, the JCMUA identified the following modifications and improvements that were also incorporated into the PCSWMM model:

- 2nd Street Netting Facility
- Grand Street Project sewer & sediment updates
- Trenton Street & Newark Avenue sewer additions
- Paterson Plank Road Pump Station addition

3.4 Subcatchment Redelineation

Modifications to the hydraulic portion of the model, including the addition of pipes during the various condition assessment projects and the improvements and expansions listed in Section 3.3, required an adjustment to the hydrologic portion of the model. Existing subcatchments were subdivided where new pipes had been added to the model. Slope, width, and percent impervious were assigned to each of the subdivided subcatchments. Slope was based on topographic mapping, and width was measured in ArcGIS. For those redelineated subcatchments located in subdrainage areas that had meters installed during the 2016 monitoring period, percent impervious was recalculated from the 2012 Land Use/Land Cover dataset available from NJDEP. Those redelineated subcatchments located in subdrainage areas that did not have a meter installed during the 2016 monitoring period retained the percent impervious assigned during the previous calibration. This process was undertaken to preserve the level of calibration obtained during the previous modeling study for those subdrainage areas that were not re-metered individually, and to provide a starting point for improved calibration of those subdrainage areas that were re-metered. Meter location was explained in depth in the approved 2016 Work Plan. Tables 3-1 and 3-2 contains information on the attributes of each of the subcatchments on the west side and east side of the model, respectively.

3.5 Dry Weather Flow Reallocation

In order to add dry weather flow to the new pipes, the base flow and infiltration in the model was reallocated. The population of the subcatchments delineated as described in Section 3.4 was determined using 2010 Census GIS data obtained from NJDEP's Bureau of GIS. Dry weather flow was allocated to pipe endpoints in each of the subcatchments. New diurnal patterns were created based on the meter data, and the flow was assigned accordingly. Subdrainage area specific patterns were created for the Secaucus Road (W1), Sip Avenue (W6), Fisk Street (W10), Mina Drive, (W13), Brown Place (E1), Mill Creek (E5/6), and Eighteenth Street (E19) subdrainage areas. Diurnal patterns for the remaining areas were created by subtracting the meters from downstream interceptor meters (28, 29, 40 and 41).

3.6 North Bergen Flows

Flows from North Bergen's Central Treatment Plant enter the JCMUA's northwest interceptor via a force main connection near the Manhattan Avenue Regulator. Flow data obtained from Passaic Valley Sewerage Commission was analyzed and used to develop average dry weather flow values and a diurnal pattern. This information was added to the model.

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Table 3-1: West Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
W-1 Secaucus Road	RW1C	3.0	273.8	50	2.4	709
	W1C110#1	20.0		43	0.7	1000
	W1C110.1#1	85.0		63	1.6	1500
	W1C110.2#1	9.1		71	4	661
	W1C20.1#1	27.0		65	3.2	1176
	W1C218#1	2.9		80	8.2	319
	W1C44#1	3.5		45	4.2	156
	W1C628#1	4.0		87	1.25	433
	W1C74#1	1.2		85	0.4	210
	W1C74.1#1	60.0		68	2.13	1000
	W1C92#1	3.5		85	0.41	382
	W1N370#1	8.0		51	8.3	577
	W1N40#1	5.5		45	6.2	255
	W1N443#1	9.7		20	4.3	400
	W1N463#1	4.5		45	3	247
	W1N468#1	5.1		65	2.2	285
	W1N522#1	5.1		51	4.3	235
	W1N530#1	5.2		48	5	261
	W1N540#1	4.6		45	4.5	256
	W1N561#1	4.2		64	2	247
	W1N594#1	2.7		80	3.8	379
W-2 Manhattan Avenue	W2C204#1	10.1	93.78	82	2.2	439
	W2C224#1	8.2		72	5	598
	W2C32#1	7.3		68	6	580
	W2C344#1	17.4		85	3.76	892
	W2C52#1	13.7		83	2.14	855
	W2C546#1	20.2		85	4	878
	W2C64#1	13.2		85	1.07	766
	W2G9028#1	3.7		89	7.25	399
W-3 St. Paul's Avenue	W3C106#1	7.2	72.0	40	3.29	445
	W3C18#1	19.3		80	3.89	934
	W3C218#1	1.5		75	3	480
	W3C48#1	6.4		47	2.86	400
	W3C58#1	5.0		56	1.67	250
	W3C58#2	1.5		82	2	400
	W3C64#1	9.4		81	0.61	440
	W3C64#2	2.2		82	0.18	175
	W3C70#1	4.9		83	1.14	500
	W3C76#1	14.5		75	1.38	870
W-4 Van Winkle	W4C110#1	2.6	64.2	87	0.83	200
	W4C124#1	2.8		76	0.2	200
	W4C174#1	40.3		85	3.5	878
	W4C206#1	0.8		67	1.9	200
	W4C228#1	2.4		87	1.67	240
	W4C228#2	2.4		81	0.84	520
	W4C26#1	9.2		85	3.5	401
	W4C294#1	1.1		78	2	400
	W4C50#1	2.8		87	2.5	0

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Table 3-1: West Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
W-5 Broadway	W5C20#1	48.3	49.6	88	1.05	1194
	W5NMH3#1	1.4		95	0.08	46.1
W-6 Sip Avenue	W6C#1	40.0	116.68	60	0.55	1000
	W6C230#1	15.4		80	2	669
	W6C434#1	21.7		75	1.58	993
	W6C48#1	18.8		69	1.82	745
	W6C50#1	20.8		78	1.43	648
W-7 Duncan Avenue	RW7C	16.0	177.8	70	0.5	830
	W7C166#1	7.0		30	1	350
	W7C210#1	17.5		70	2	500
	W7C254#1	10.6		70	2	200
	W7C268#1	32.8		70	1	673
	W7C308#1	7.3		70	2	200
	W7C32#1	4.7		30	0.74	176
	W7C48#1	5.6		30	1	250
	W7C50#1	7.5		30	1	300
	W7C52#1	6.7		30	1	300
	W7C54#1	6.1		30	1	250
	W7C58#1	8.5		30	1	300
	W7C60#1	47.5		70	2	1294
W-8 Clendenny Avenue	W8C20#1	19.8	250.2	85	1.85	1000
	W8C46#1	20.3		85	2.45	1225
	W8C46#2	11.1		85	2.45	1225
	W8C530#1	12.8		85	2.98	770
	W8C540#1	36.9		30	2	670
	W8C568#1	30.9		50	2	1150
	W8C628#1	15.1		85	2	546
	W8C66#1	83.4		85	0.29	2074.9
	W8C686#1	11.9		85	2	546
	W8C750#1	8.1		85	1	300
W-9 Claremont Avenue	W9C180#1	15.4	97.3	85	0.94	791
	W9C250#1	15.0		87	2.35	768
	W9C260#1	16.4		85	2.35	838
	W9C52#1	35.3		85	1.65	1336
	W9C72#1	2.5		85	3.43	305
	W9G9003#1	12.8		83	1	695
W-10 Fisk Street	RW10C#1	6.0	114.7	80	1.67	145.2
	W10C234#1	16.3		70	2.35	861
	W10C32#1	28.4		75	1	619
	W10C76#1	43.7		69	1.5	952
	W10CD10#1	20.3		75	2.22	937

Table 3-1: West Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
W-11/12 Danforth Avenue	W11C26#1_2	30.0	205.8	71	0.6	1131
	W11C328#1	16.7		73	3.5	1324
	W11C38#1	27.6		79	2	1604
	W11C484#1	9.4		71	3.5	291
	W11C52#1	35.7		75	2	2073
	W11N430#1	8.2		73	0.5	203
	W11N496#1	2.1		83	2.2	341
	W12C170#1	25.6		77	0.6	1486
	W12C180#1	13.0		76	8	1113
	W12C190#1	5.4		72	3.4	303
	W12C34#1	10.7		85	2.9	500
	W12C52#1	12.1		75	1.43	850
	W12N204#1	9.3		80	5	500
W-13 Mina Drive	W13C20#1	3.2	159.2	20	0.05	230
	W13C204#1	38.0		78	1.8	781
	W13C226#1	39.0		70	0.33	1266
	W13C26#1	1.0		69	0.7	250
	W13C26_1#1	1.5		25	5	300
	W13C32#1	0.6		69	5	185
	W13C541#1	2.8		30	0.1	300
	W13C550#1	4.0		30	0.1	400
	W13C554#1	1.9		57	0.2	190
	W13C560#1	1.3		30	0.1	233
	W13C567#1	0.5		30	0.1	100
	W13C569#1	1.8		30	0.1	120
	W13C572#1	2.0		30	0.1	200
	W13C590#1	3.8		66	0.2	477
	W13C600#1	2.4		66	0.2	240
	W13C604#1	2.1		30	0.1	225
	W13C618#1	1.0		63	0.3	200
	W13C66#1	27.9		71	2.3	938
	W13C672#1	1.9		30	0.1	275
	W13C692#1	1.1		30	0.1	233
	W13N104#1	12.5		65	2.7	700
	W13N290#1	8.9		53	0.5	335

Statistics	**Average**	13.5	139.6	66.0	2.1	585.5
	Minimum	0.5	49.6	20.0	0.1	0.0
	Maximum	85.0	273.8	95.0	8.3	2074.9
	Median	8.2	115.7	71.0	2.0	442.5

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Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-1 Brown Place	E1C104#1	13.4	209.1	61	1	1170
	E1C130#1	4.7		74	0.6	273
	E1C18#1	11.8		45	1.5	535
	E1C32#1	7.2		72	0.4	500
	E1C330#1	5.0		50	1.8	530
	E1C376#1	7.8		62	1.4	330
	E1C384#1	17.4		66	1.1	400
	E1C400#1	8.1		65	1.2	615
	E1C406#1	29.8		65	0.2	1363
	E1C418#1	4.7		71	0.3	302
	E1C460#1	20.3		67	0.7	780
	E1C580#1	38.7		62	0.4	521
	E1C588#1	23.0		65	0.3	610
	E1C97#1	17.0		75	0.25	1237
E-2 Richard Street	E2C108#1	15.3	162.2	85	2.3	444
	E2C118#1	15.9		85	2.3	461
	E2C32#1	33.1		50	1	1500
	E2C32#2	15.7		70	571	571
	E2C370#1	16.7		87	2.8	607
	E2C472#1	14.5		85	2.2	573
	E2C48#1	2.3		85	1.9	123
	E2C506#1	9.3		80	0.5	406
	E2C54#1	1.4		71	1.67	139
	E2C634#1	14.4		85	2.3	522
	E2N60#1	0.5		71	1.67	60
	E2N724#1	14.2		50	1	502
	E2N782#1	8.9		50	1	502
E-3/4 Claremont / Carteret	E34N240#1	4.8	308.6	80	0.81	886
	E3C100#1	4.5		67	2	390
	E3C108#1	1.9		67	2.8	296
	E3C1416#1	13.5		55	0.001	533
	E3C1420#1	27.6		45	0.001	924
	E3C1438#1	57.4		50	0.001	1785
	E3C146#1	2.6		72	2.29	234
	E3C1500#1	11.9		30	0.01	752
	E3C1508#1	30.7		40	0.01	1335
	E3C1522#1	11.9		40	0.01	493
	E3C181#1	10.2		72	1.5	686
	E3C872#1	0.1		72	2.29	25
	E3C922#1	4.7		63	2.7	372
	E3C940#1	6.3		63	5	495
	E3C960#1	6.6		63	0.87	501
	E3N940#1	7.9		80	0.95	250
	E4C1260#1	10.3		80	1	887
	E4C174#1	4.6		65	1.1	447
	E4C192#1	28.5		80	0.81	886
	E4C268#1	9.6		80	6.67	560
	E4C416#1	16.6		80	0.95	250
	E4C659#1	29.6		70	1.2	613
	E4N426#1	7.0		80	0.95	250

Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-5/6 Mill Creek	E56C1470#1	25.7	609.9	76	1	540
	E56C1602#1	23.4		65	1.5	1000
	E56C1630#1	14.2		75	1	400
	E56C268#1	25.0		78	1.8	350
	E56C326#1	33.7		75	0.01	500
	E56C5032#1	30.5		75	1.5	1050
	E56C814#1	3.0		75	0.5	200
	E56G10069#1	3.2		77	0.5	280
	E56G9925#1	3.9		70	0.1	600
	E56G9954#1	2.9		59	0.2	205
	E56G9954#2	1.4		80	0.2	189
	E56G9955#1	1.9		80	0.1	250
	E56G9958#1	3.7		78	0.1	339
	E56N1036#1	2.1		74	0.1	330
	E56N104#1	2.3		74	0.35	194
	E56N1046#1	4.0		64	0.1	335
	E56N106#1	7.0		68	1.2	250
	E56N1098#1	4.3		59	0.5	210
	E56N1196#1	6.6		70	1.5	690
	E56N1232#1	28.4		53	2.1	700
	E56N1326#1	7.0		53	2.1	390
	E56N1378#1	3.5		70	1.7	242
	E56N1396#1	5.4		73	1.1	260
	E56N1420#1	6.0		76	0.7	240
	E56N1506#1	10.0		69	1.5	690
	E56N151#1	4.2		75	1	340
	E56N1676#1	4.7		63	0.2	314
	E56N1676#2	2.4		79	0.2	333
	E56N1776#1	3.3		62	0.7	500
	E56N1784#1	1.0		55	0.1	220
	E56N1806#1	5.3		70	0.1	368
	E56N1874#1	7.2		55	0.25	280
	E56N1874#2	2.0		55	0.25	186
	E56N1929#1	13.4		56	0.4	530
	E56N1960#1	5.2		75	0.9	600
	E56N1971#1	2.8		72	0.8	250
	E56N2004#1	5.8		55	0.5	240
	E56N2008#1	3.8		70	0.9	150
	E56N2286#1	1.5		67	0.1	250
	E56N2334#1	5.7		64	0.1	360
	E56N2588#1	2.6		67	0.3	320
	E56N2610#1	6.6		60	0.1	390
	E56N2634#1	4.0		58	0.1	200
	E56N2678#1	9.1		64	0.2	300
	E56N2716	3.1		70	0.1	280
	E56N3274#1	2.0		64	0.72	272
	E56N3339#1	1.9		79	0.5	200
	E56N360#1	4.7		78	0.1	400
	E56N366#1	2.1		80	0.1	250
	E56N374#1	3.3		76	0.1	370
	E56N374#2	2.1		83	0.1	110
	E56N444#1	2.9		55	0.1	300
	E56N496#1	5.4		56	0.1	420
	E56N550#1	4.4		56	1.9	271

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Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-5/6 Mill Creek (continued)	E56N564#1	5.3		68	0.1	460
	E56N572#1	3.4		69	1.12	425
	E56N70#1	7.0		68	1	460
	E56N734#1	4.0		50	3	430
	E56N824#1	6.0		76	2.8	440
	E56N882#1	5.7		61	0.3	315
	E56N90#1	3.1		64	0.5	319
	E56N916#1	2.2		57	0.1	300
	E56N934#1	3.1		61	1.2	515
	E56N934#2	3.3		60	0.1	350
	E56N934#3	3.8		60	0.1	400
	E56N956#1	0.9		79	0.1	220
	E56N988#1	3.4		59	3.3	260
	E5C1642#1	15.9		58	0.25	400
	E5C1650#1	10.8		74	0.1	350
	E5C2190#1	8.0		75	0.1	350
	E5C2262#1	9.0		60	0.1	322
	E5C2360#1	24.0		66	0.1	830
	E5C2380#1	43.0		60	0.1	1500
	E5C2532#1	4.7		66	1.5	370
	E6C1004#1	11.8		71	0.5	350
	E6C1004#2	3.7		71	0.5	200
	E6C748#1	24.6		74	1.5	1150
	E6C8040#1	11.0		72	0.1	600
	E6N854#1	10.7		71	0.1	640
E-10/11 Grand Street / York Street	E10C110#1	5.5	221.6	85	0.3	399
	E10C274#1	6.7		70	0.6	600
	E10C294#1	2.1		76	1.82	230
	E10C314#1	2.0		70	0.53	285
	E10C32#1	3.4		83	0.73	263
	E10C348#1	26.0		65	0.53	1080
	E10C400#1	21.4		50	0.43	1180
	E10C60#1	1.8		85	1.1	170
	E10C76#1	2.0		85	0.15	289
	E10C88#1	3.5		85	0.6	308
	E11C140#1	1.2		85	0.56	220
	E11C194#1	1.5		85	0.31	270
	E11C224#1	1.4		85	0.44	250
	E11C262#1	12.1		84	0.2	420
	E11C336#1	10.0		85	0.17	727
	E11C396#1	0.5		45	0.67	200
	E11C464#1	1.7		85	5.7	150
	E11C490#1	1.1		85	0.43	200
	E11C50#1	2.2		85	0.53	260
	E11C50#2	4.1		90	0.33	170
	E11C510#1	2.3		87	0.5	530
	E11C568#1	4.6		78	1.09	335
	E11C578#1	5.5		87	0.63	477
	E11C600#1	10.1		87	0.41	470
	E11C632#1	12.0		75	1	697

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Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-10/11 Grand Street / York Street (continued)	E11C691#1	20.2		80	1.06	1150
	E11C72#1	3.5		87	0.26	258
	E11C720#1	8.8		85	2.9	545
	E11C82#1	6.3		85	0.88	330
	E11C870#1	1.2		87	1.08	150
	E11C894#1	1.4		87	0.35	135
	E11C94#1	10.8		85	0.1	360
	E11CC11#1	15.9		83	2.84	771
	RE10&9C#1	5.5		96	1.61	300
	RE8(STORM)#1	3.3		87	1.24	357
RE-15 Second Street	E13C206#1	12.6	115.3	80	1.2	643
	E14C218#1	13.6		85	0.18	1186
	E14C242#1	1.4		85	1.3	300
	E14C270#1	1.3		85	0.69	200
	E14C62#1	6.6		87	1.04	390
	E14CM12#1	2.0		90	0.29	200
	E14CM8#1	5.9		90	0.11	400
	E15C136#1	1.3		85	1.3	150
	E15C154#1	0.5		65	1.3	140
	E15C192#1	1.2		85	0.67	150
	E15C300#1	2.0		85	0.4	438
	E15C308#1	6.7		87	0.13	340
	E15C324#1	7.2		87	0.12	350
	E15C342#1	4.6		70	0.65	465
	E15C35#1	6.6		85	0.33	229
	E15C354#1	1.5		70	0.44	260
	E15C354#2	5.3		40	2.4	420
	E15C388#1	1.2		70	0.57	180
	E15C463#1	0.5		87	1.1	160
	E15C472#1	1.4		87	0.23	180
	E15C486#1	0.6		87	1.05	175
	E15C52#1	7.2		85	0.3	300
	E15C520#1	1.8		87	0.25	225
	E15C562#1	1.3		87	0.33	210
	E15C580#1	2.5		70	0.62	265
	E15C68#1	2.0		65	0.63	380
	E15C76#1	6.8		65	0.6	550
	E15CBD#1	9.6		50	0.49	700
E-16/17 Sixth Street	E16C118#1	0.7	81.0	70	0.56	180
	E16C136#1	3.9		70	1.8	245
	E16C154#1	1.3		55	0.4	200
	E16C192#1	0.6		50	0.56	115
	E16C44#1	9.1		70	0.62	440
	E16C60#1	6.9		50	0.075	300
	E16C84#1	3.2		70	0.22	350
	E16C94#1	6.4		70	0.81	420
	E17C114#1	1.3		85	0.28	200
	E17C124#1	0.7		85	1	145
	E17C136#1	1.7		85	0.2	180
	E17C174#1	0.8		85	0.27	130

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Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-16/17 Sixth Street (continued)	E17C202#1	0.3		55	0.7	75
	E17C230#1	2.7		70	0.7	970
	E17C276#1	5.6		60	0.11	450
	E17C304#1	5.0		60	0.21	354
	E17C314#1	10.1		70	2.5	787
	E17C40#1	1.7		65	0.2	318
	E17C438#1	0.7		60	0.57	100
	E17C48#1	7.3		55	0.56	450
	E17C64#1	5.5		85	0.22	330
	E17C82#1	3.9		60	0.33	430
	RE17C#1	1.9		60	1.52	559
E-18 Fourteenth Street	E18C1028#1	7.6	254.6	60	0.48	500
	E18C1088#1	1.7		60	0.22	250
	E18C110#1	5.8		50	3.5	500
	E18C1103#1	1.4		60	2.17	160
	E18C1128#1	1.6		60	1.3	150
	E18C164#1	42.1		72	0.44	1357
	E18C192#1	3.2		70	1.1	400
	E18C232#1	31.0		35	1	965
	E18C348#1	13.7		51	1	796
	E18C4002#1	5.8		50	5.5	320
	E18C494#1	3.3		70	1.7	340
	E18C504#1	17.3		70	1.5	1300
	E18C800#1	9.9		60	3	630
	E18C830#1	9.0		70	1.4	500
	E18C850#1	2.8		70	0.1	340
	E18C864#1	1.1		60	1.08	150
	E18C870#1	2.3		60	1	600
	E18C9010#1	5.5		60	1.38	450
	E18C9011#1	5.3		60	2.2	400
	E18C942#1	10.1		60	0.69	625
	E18C972#1	2.7		60	0.15	300
	E18C9864#1	1.2		60	1	200
	E18C994#1	2.3		60	0.32	270
	E18G9010#2	3.3		60	1.23	300
	E18NH18#1	20.4		65	0.3	1187
	E21C320#1	32.8		50	3.25	1192
	rE18OLD#1	11.5		20	0.2	998

Table 3-2: East Side Subcatchment Characteristics

	Name	Area (ac)	Subdrainage Area (acres)	Percent Impervious	Slope (%)	Width (ft)
E-19 Eighteenth Street	E19C102#1	1.3	340.7	70	0.24	200
	E19C1068#1	28.6		57	3.1	1350
	E19C1094#1	4.0		45	0.23	350
	E19C1110#1	21.0		60	0.8	1573
	E19C1530#1	19.7		43	3	1080
	E19C26#1	4.0		75	0.06	205
	E19C510#1	36.4		67	0.9	1211
	E19C520#1	10.9		64	0.9	476
	E19C60S#1	17.1		70	1.6	1100
	E19C692#1	16.5		65	3	1360
	E19C77#1	2.0		65	0.4	200
	E19C828#1	29.3		67	3.2	763
	E19C92#1	1.5		65	0.3	200
	E19C966#1	20.4		70	2.1	1105
	E19N320#1	3.4		66	1.8	571
	E19N602#1	15.3		65	2.9	602
	E19N662#1	4.1		37	3	438
	E19N740#1	1.8		40	4.1	445
	E19N84#1	48.4		61	1.2	700
	E19N94#1	4.1		48	1.2	310
	E22G9098#1	17.0		51	0.2	450
	E22G9098#2	6.7		50	0.5	230
	E22G9098#3	2.2		45	2.2	209
	E22N1320#1	6.2		45	1	650
	E22N592#1	2.2		64	2.2	120
	E22N608#1	16.7		56	2.7	1334

Statistics	**Average**	8.6	255.9	68.5	3.1	466.7
	Minimum	0.1	81.0	20.0	0.0	25.0
	Maximum	57.4	609.9	96.0	571.0	1785.0
	Median	5.3	221.6	70.0	0.6	364.0

4 XP-SWMM AND PCSWMM MODEL CONVERSION VERIFICATION

4.1 2005 Model Calibration and Verification

The 2004-2005 Monitoring Program consisted of 63 meters and six rain gages collecting data for a period of approximately three months. Data from the monitoring period was reviewed. Three storms were chosen for calibration (11/04/2004, 12/01/2004, and 12/07/2004). An additional storm was selected for validation (11/28/2004). Information concerning the four storms is presented in Table 4-1 below.

Table 4-1. Summary of Calibration and Verification Events (2005 Monitoring Period)

Date	1-hour Rainfall (in.)		Duration (hours)		Return Period (months) at Storm Duration	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Calibration						
11/04/2004	1.10	1.30	8.00	9.75	3.70	4.80
12/01/2004	0.80	1.30	8.50	11.00	2.20	4.20
12/07/2004	1.00	1.10	38.75	45.00	2.60	3.00
Verification						
11/28/2004	1.90	3.10	10.50	11.00	4.10	5.30

Peak flow, volume, and depth comparison statistics were prepared for each of the meters used in calibration, and the results were summarized in The JCMUA's Combined Sewer System Modeling Study (July 2007).

4.2 2017 Model Conversion Comparison and Verification

After the calibrated XP-SWMM model was converted to PCSWMM as described in Section 3, the model was run for the calibration and verification events from the 2005 monitoring period. Peak flow and volume results from this model run was compared to peak flow and volume results from the converted model. In addition to these statistics, a review of each model's tendency to overpredict (model predicts more than the metered value) or underpredict (model predicts less than the metered value) flow and volume was completed. The results of this comparison are presented in Tables 4-2 and 4-3 below.

Table 4-2. XP-SWMM vs. PCSWMM - Percentage of Meters Overpredicting and Underpredicting Peak Flow

	Peak Flow			
	Underpredictions		Overpredictions	
	XPSWMM	PCSWMM	XPSWMM	PCSWMM
11/4/2004	38%	45%	61%	54%
11/28/2004	66%	48%	34%	52%
12/1/2004	52%	54%	45%	45%
12/7/2004	63%	63%	38%	38%
Average	**54%**	**52%**	**44%**	**47%**

Table 4-3. XP-SWMM vs. PCSWMM - Percentage of Meters Overpredicting and Underpredicting Volume

	Volume			
	Underpredictions		Overpredictions	
	XPSWMM	PCSWMM	XPSWMM	PCSWMM
11/4/2004	18%	25%	80%	73%
11/28/2004	27%	20%	73%	80%
12/1/2004	34%	23%	63%	73%
12/7/2004	27%	23%	73%	77%
Average	**26%**	**23%**	**72%**	**76%**

As shown in Table 4-2, Both software packages have a slight tendency to underpredict peak flow more often than they tend to overpredict, though the split between overpredicting and underpredicting is quite small. Table 4-3 shows that both models have a clear tendency to overpredict the total volume during storm events. It should be noted that both analyses focus on the frequency of overprediction and underprediction rather than the magnitude of those qualities. This analysis of the converted PCSWMM model showed that its tendency to overpredict/underpredict is consistent with that of the calibrated XP-SWMM model. Each of the models' outputs are verified by the other's results. Appendix A contains additional detail concerning this verification analysis.

5 FLOW MONITORING PROGRAM

In November 2005, the JCMUA submitted the three-volume JCMUA Rainfall and CSO Monitoring Study to the NJDEP. This study presented the findings, conclusions, and recommendations of the JCMUA Monitoring Program that was conducted from October 29, 2004 through January 21, 2005 in accordance with the final consolidated “JCMUA Combined Sewer System Supplemental Monitoring Proposal and Work Plan”.

The 2004 study required the installation of 6 rain gauges, including the 2 existing signal rain gauges at East Side and West Side Pump Stations, and 63 flow meters at each CSO regulator, installation of wastewater samplers at some regulators, and analysis of the collected data. Flow, flow depth, velocity and was recorded in a tabular computer file format for model calibration purposes. The primary intent of the monitoring program was to obtain data which was representative of “typical” conditions to develop a SWMM model that was designed and calibrated to simulate storm conditions with a return frequency from 3 months to 2 years over 24 hours. The secondary intent of the modeling effort was to simulate more infrequent storm occurrences such as 10 to 50-year storm events.

Presented in the 2016 Work Plan, a recent analysis of demographics and NJDEP Land Use data was performed. The percent of change to impervious area for all Land Uses from 1995 to 2012 was an increase of approximately 4 percent. The population increased by approximately 7,542 persons from 2000 to 2010. Although the population, land use and impervious cover did not drastically change, a Supplemental Flow Monitoring Program was proposed and performed in 2016 to provide sufficient and recent data to recalibrate the updated PCSWMM model.

5.1 2016 Supplemental Flow Monitoring Program Components

The 2016 Supplemental Flow Monitoring Program was performed from September 20, 2016 through January 5, 2017 and included the following components:

- 6 Rain gauges including the 2 existing rain gauges at East Side and West Side Pump Stations
- 16 Ultrasonic flow meters
- 8 Inclinometers at tide gates

The Supplemental Flow Monitoring Program was kept similar to the 2004 program and the critical details are as follow:

- 2004 procedures and protocols described in the 2016 Work Plan were used for all rain gauges and flow meters.
- A schematic of the 16 flow meters and 6 rain gauges included in the Supplemental Monitoring Program is shown on Figure 5-1 and their locations are shown on Figure 2-2.
- Rain gauges and meters were checked and maintained as needed a minimum of weekly plus 3 extra visits.

Arcadis also performed remote monitoring checks of each device by use of telemetry. Remote monitoring helped detect problems in near real time earlier rather than weekly only checkups, and if necessary more immediate checks were made. This would not have been possible without remote monitoring. Additional details for the items covered by Arcadis' flow monitoring subconsultant during their weekly visits can be found in the Appendix B.

5.1.1 Rain Gauges

The locations of the rain gauges remained the same as presented in the 2004 Monitoring Program. The rain gauge data collection frequency was every 5-minutes over the full monitoring period. In the 2016 Supplemental Monitoring Program, four of the six rain gauges had remote monitoring. The JCMUA, with assistance from the Arcadis/Flow Assessment Monitoring Team were able to monitor the rain gauges remotely. Four of the six rain gauges and flow meters were equipped with telemetry to upload the data to the website approximately every 8 hours in dry weather, every hour during wet weather, and more frequently as the battery charge and other site conditions permitted. The uploaded data was accessed through a password protected website where the data from the 4 rain gauges was collected and stored. This feature provided better QA/QC tools since the type and magnitude of the storm that occurs can be determined more quickly in only a few hours.

5.1.2 Flow Meters

Flow monitoring was provided at 16 temporary flow meter locations shown on Figure 2-1 and 2-2. These 16 flow meters were installed to monitor the depth and velocity at each select location. The flow meter data collection frequency was every 5-minutes over the full monitoring period. Like the rain gauges, all flow meters had remote monitoring. The flow rate, velocity and depth data were uploaded to the website approximately every 8 hours in dry weather, every hour during wet weather, and more frequently as the battery charge and other site conditions permitted. The uploaded data was accessed through the password protected website which provided better QA/QC tools since the type and magnitude of the storm that occurs can be determined more quickly in only a few hours.

Flow meter locations were selected for several reasons. Meters were selected based upon the following:

- The need to capture total interceptor flow
    - Meter 28 – Total Northwest Interceptor
    - Meter 29 – Total Southwest Interceptor
    - Meter 40 – Total Southeast Interceptor
    - Meter 41 – Total Northeast Interceptor
    - Meter 54 – Northeast Interceptor – upstream condition check, not used for direct calibration
- Upstream boundary condition flow
    - Meter 6 – Secaucus Road (most upstream subdrainage area – Northwest Interceptor)
    - Meter 32 – Mina Drive (most upstream subdrainage area – Southwest Interceptor)
    - Meter 33 – Brown Place (most upstream subdrainage area – Southeast Interceptor)
    - Meter 58 – Eighteenth Street (most upstream subdrainage area – Northeast Interceptor)
- Subdrainage areas known to be most critical to combined sewer system operations
    - Meter 27 – Fisk Street (most downstream regulator on the Northwest Interceptor)

   - Meters 42, 43 and 44 – Mill Creek (largest subdrainage area in the collection system, most downstream subdrainage area on the Northeast Interceptor). Meters 43 and 44 are installed on parallel pipes.
- Subdrainage areas where significant changes in infrastructure (or other changes) may have occurred
   - Meter 17 – Sip Avenue (trunk sewer and regulator replaced since previous model calibration)
   - Meter 60 – Associated with the Colgate Manifold Outfall and Pump Station – used for observation, not direct calibration
   - Meter 64 – Associated with the Mina Drive Outfall and Pump Station – used for observation, not direct calibration

Additional details and site sketches created for each of the meter locations can be found in Appendix C; all rain gage and flow meter data can be found in Appendix D.

5.1.3 Wet Weather Calibration and Verification Events Selection

After the Supplemental Monitoring Period concluded, the data was analyzed and assessed to determine the recommended storm events for calibration and verification of the updated PCSWMM model. The storm events were selected by choosing the most complete data sets that had limited disruptions and device malfunctions during those events. Three storm events were needed for calibration and verification. Specifically, two were needed for calibration and one for verification.

The three storm events selected were to represent a small, medium and large event, in accordance with NJDEP's comments on the 2016 Work Plan. A small storm event was assumed to have an estimated 0.5-inches of rainfall. A medium storm event was assumed to have an estimated 1.0-inches of rainfall. A large storm event was assumed to have rainfall greater than 2.0 inches.

It was important to explore a range of storms, including the following: low intensity, long duration storms; high intensity storms and short duration storms. Another factor to assess during the analysis was to ensure that no snowfall was involved in any storm event. Table 5-1 presents the events selected from the Supplemental Monitoring Period.

Table 5-1. Summary of Calibration and Verification Events (2016 Monitoring Period)

Date	Approximate Storm Size	Maximum Duration (Hours)	Maximum Peak 1-hour Rainfall (in.)	Total Maximum Rainfall for Event (in.)
10/21/2016	Medium	27.9	0.50	1.11
11/29/2016	Large	13.7	0.51	2.59
12/06/2016	Small	16.2	0.22	0.55

6 MODEL CALIBRATION

6.1 Calibration Process

The purpose of model calibration is to adjust parameters in the hydraulic and hydrologic portions of the model until model results at defined points in the system match monitored data. Two sets of calibration are performed: dry weather and wet weather.

Dry weather flows are introduced to the model at several manholes in the system, and the model is simulated for dry weather conditions only. The model results downstream of the dry weather flow input points are checked against the dry weather inputs themselves and identified problem areas are fixed using field investigations and system mapping.

Wet weather calibration is the process by which hydrologic parameters in the model are adjusted until model results match monitored data during wet weather events as closely as possible. Typical hydrologic parameters that are changed include drainage area, width, imperviousness, slope, and soil characteristics such as rate of infiltration and depression storage. The goal of dry weather calibration is to identify areas that are not configured properly in the hydraulic network.

6.2 Calibration Goals

Calibration helps to gauge how well the model represents real world conditions and serves to validate the model results and to quantify the model's "uncertainties" so that the Owner of the sewer system can interpret the model's results more accurately.

Dry weather calibration was evaluated based on a visual comparison of model-predicted flow hydrographs to monitored data at all flow monitoring locations. Formal "percentage" goals are not required for dry weather calibration.

Wet weather calibration goals are more rigorous, for in a combined system, it is the wet weather response which tends to form the focus of many combined sewer studies. The flow and volume calibration goals are based on the latest (2017) Chartered Institution of Water and Environmental Management (CIWEM – formerly known as WaPUG – Wastewater Planning Users Group) Code for the Practice for the Hydraulic Modeling of Urban Drainage. Wet weather calibration was evaluated based on three criteria:

- A percentage goal to match model-predicted flow volume to within -10% to 20% of monitored data (CIWEM)
- A percentage goal to match model-predicted peak flow rate to within -15% to 25% of monitored data (CIWEM)
- A visual comparison of model-predicted hydrographs to monitored data to match shape and timing

The upper limit is farther from a perfect calibration than the lower limit. This is because a model that overpredicts and provides conservative results is better for design purposes than a model that underpredicts. Most of the effort is focused on achieving these primary wet weather calibration goals because estimation of peak flows and total volume is very important for a Long Term Control Plan (LTCP).

It should be noted that these calibration goals are targets and may not be satisfied at all meters for all events. These calibration goals provide a set of boundaries from which an interpretation can be made of the calibrated model's ability to predict system-wide response for events of concern.

6.3 Calibration Results

To achieve the calibration goals, the following four types of time series graphs were used to compare the monitored data to the model results:

- Dry weather flow versus time series graphs (Appendix E1)
- Wet weather flow versus time series graphs (for the 3 selected wet weather events): There are 3 sets of wet weather flow versus time graphs, one set for each of the 3 wet weather events: October 21, November 29, and December 6, 2016 (Appendices E2, E3, and E4 respectively). These hydrographs are the primary means of comparing the wet weather monitor data and model-predicted flows and volumes at each monitoring location.
- Wet weather depth versus time series graphs (for the 3 selected wet weather events): There are 3 sets of these wet weather flow verses time graphs for each of the 3 wet weather events: October 21, November 29, and December 6, 2016 (Appendices E5, E6, and E7, respectively). These graphs are the primary means comparing the monitored data and model-predicted depth at each monitored location.
- Selected depth and velocity versus time series graphs during wet weather events.

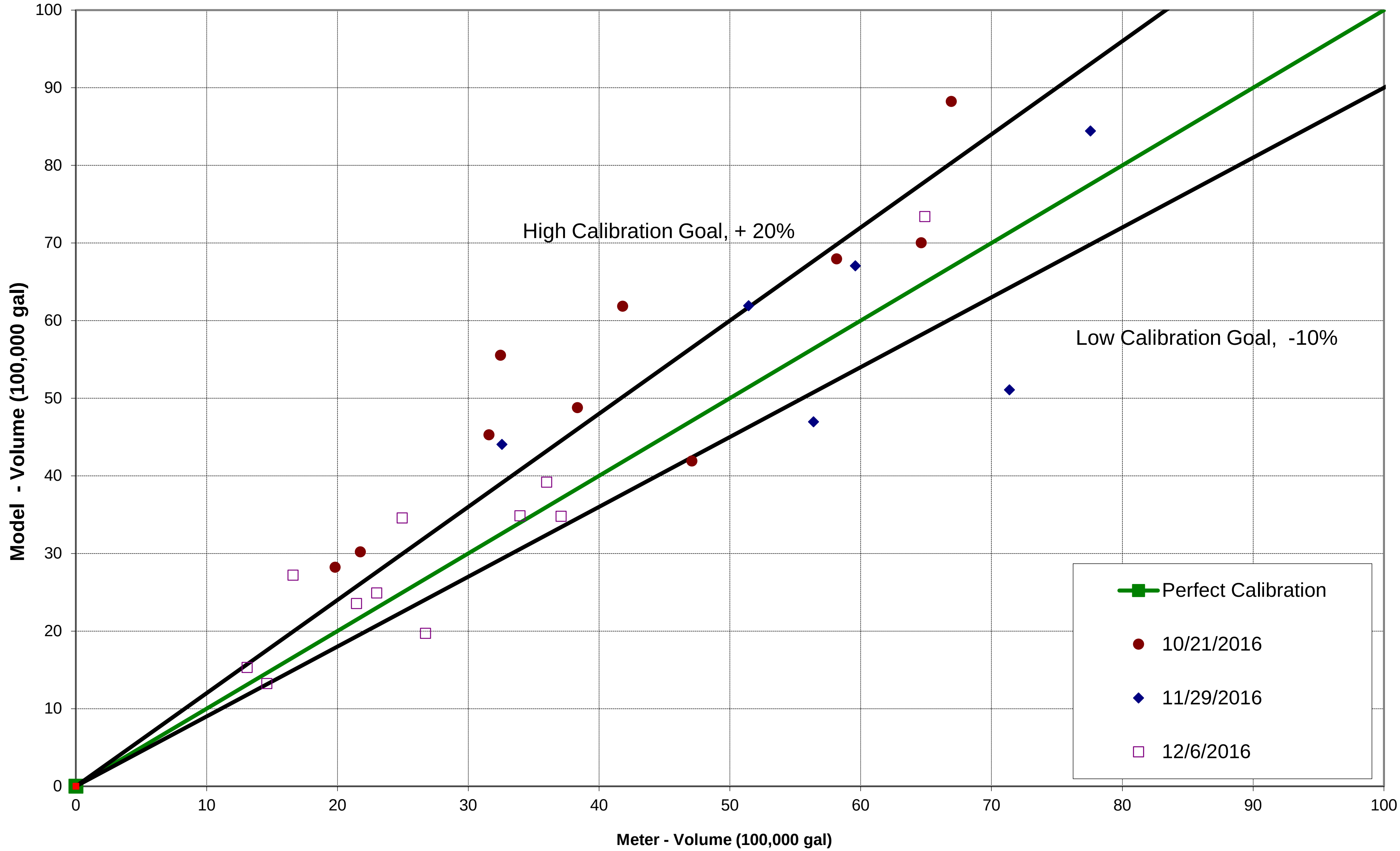
The model results are also compared to monitored data by use of the following two types of graphs:

- Three wet weather scatter graphs of monitored data versus modeled results for volume, peak flow, and peak depth are presented in Figures 6-1, 6-2, and 6-3 respectively.
- Figures 6-4, 6-5, and 6-6 are histograms that show the distribution of the percentage that the modeled results varied from the monitored data for volume, peak flow, and peak depth, respectively. The figures show the percent of meters from the four wet weather events that have a calibration percentage within each of the bracketed ranges shown for monitored versus modeled volume, peak flow, and peak depth.

6.3.1 Overall Modelled Result Tolerances

The scatter plots presented in Figures 6-1 through 6-3 compare the monitored data with the modeled result for each flow meter. If the model results matched the monitored data, the points would form a central line with a slope of one, which would be perfect calibration. If the model results are higher than the monitored data (i.e. the model is conservative), points will lie above the central line which is said to be "overpredicting". If the results are below this line, the modeled results are lower than the monitoring data and the model is said to be "underpredicting".

The two outer straight-line bands on the scatter plots define the calibration goals described in Section 6-2 (-10% to 20% for flow volume, -15% to 25% for peak flow rate). The optimal result would be to obtain all or most of the points between these lines. During this model's calibration, calibration goals for peak flow



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure 6-1: A Comparison of Monitored versus Modeled Volume Conditions

Jersey City Municipal Utilities Authority (JCMUA)

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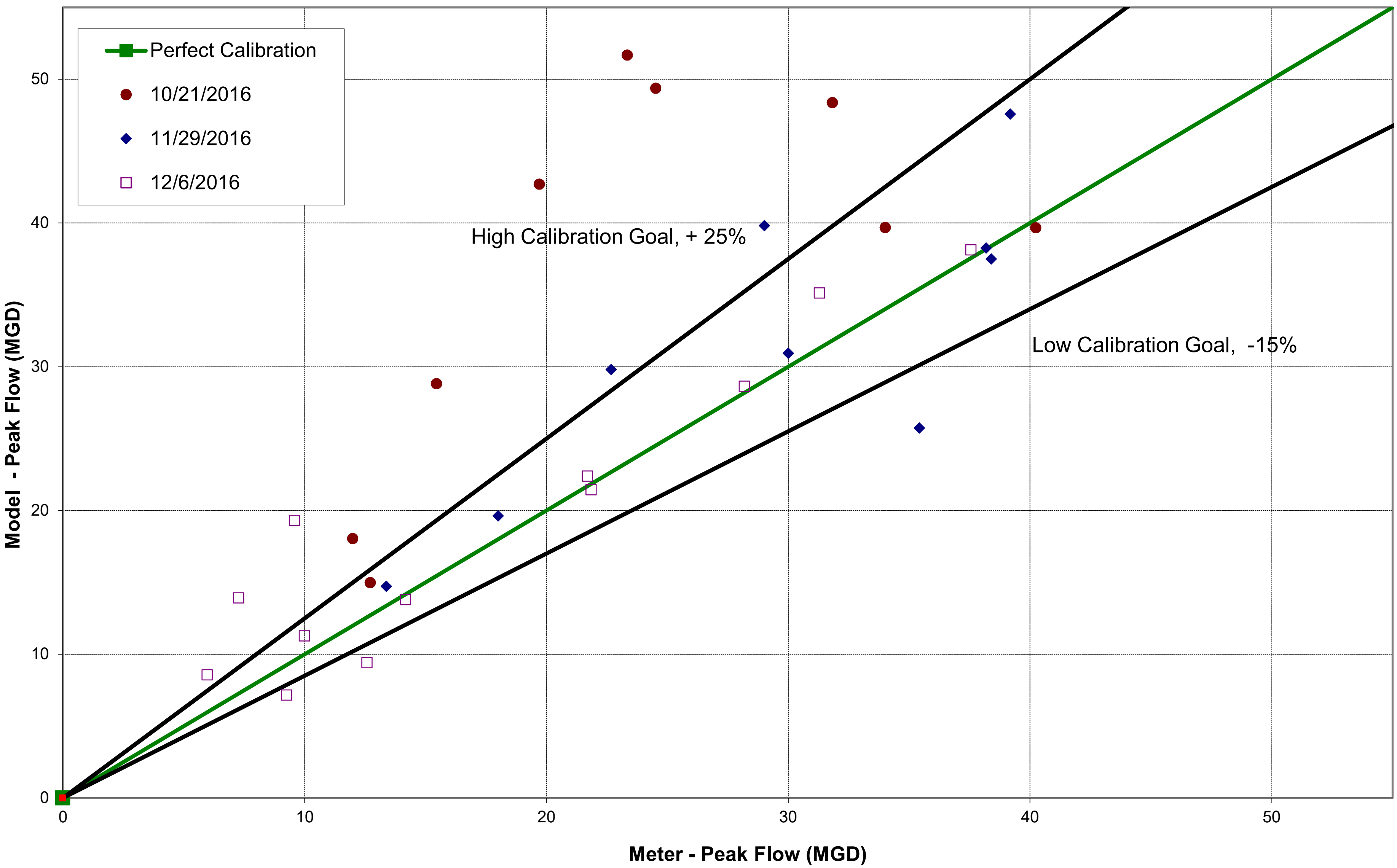

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JCMUA Combined Sewer System Modeling Report
Figure 6-2: A Comparison of Monitored versus Modeled Peak Flow Conditions

Jersey City Municipal Utilities Authority (JCMUA)

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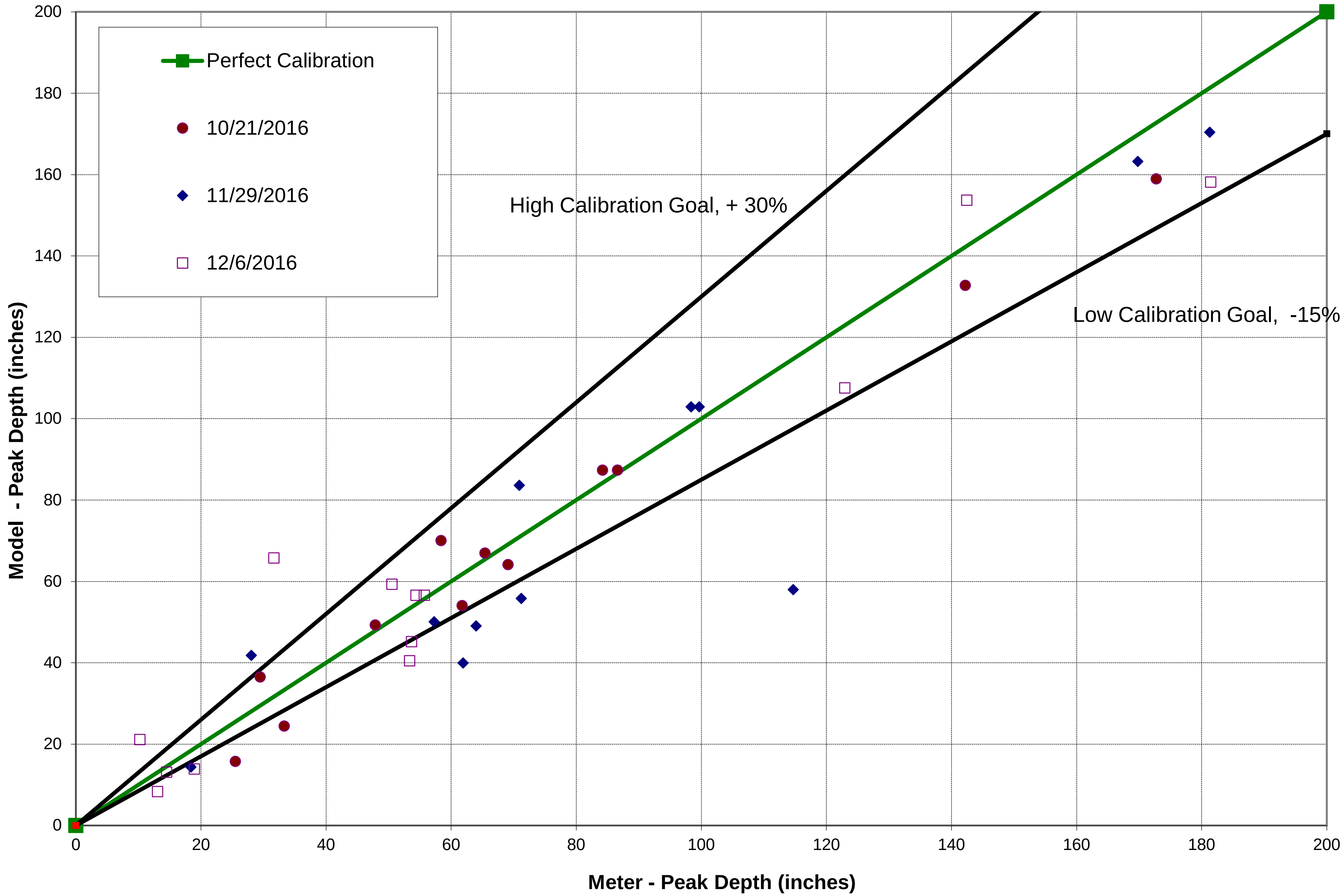

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JCMUA Combined Sewer System Modeling Report
Figure 6-3: A Comparison of Monitored versus Modeled Peak Depth Conditions

Jersey City Municipal Utilities Authority (JCMUA)

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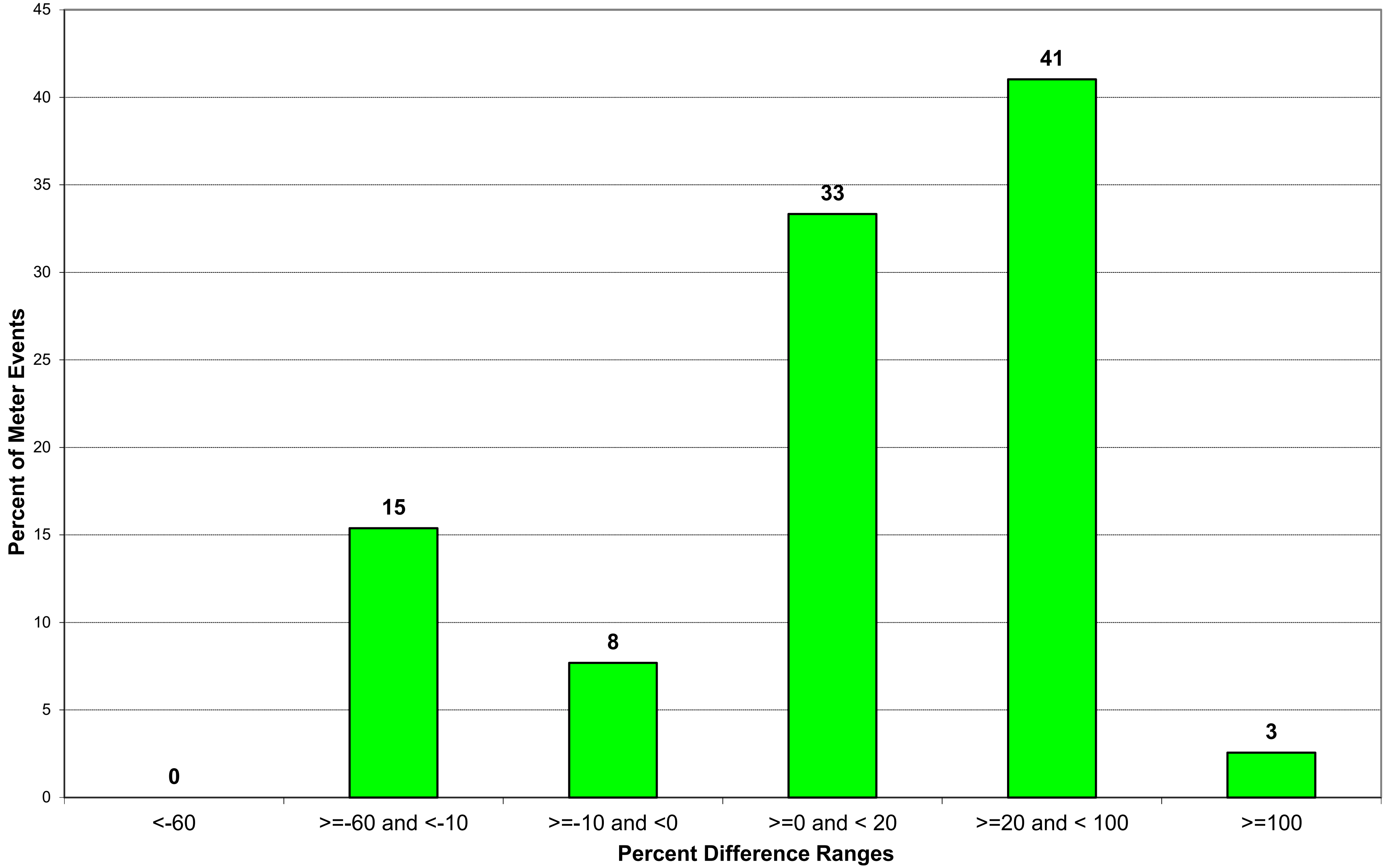

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JCMUA Combined Sewer System Modeling Report
Figure 6-4: The Distribution of Ranges of Variation between Monitored versus Modeled Volume Conditions

Jersey City Municipal Utilities Authority (JCMUA)

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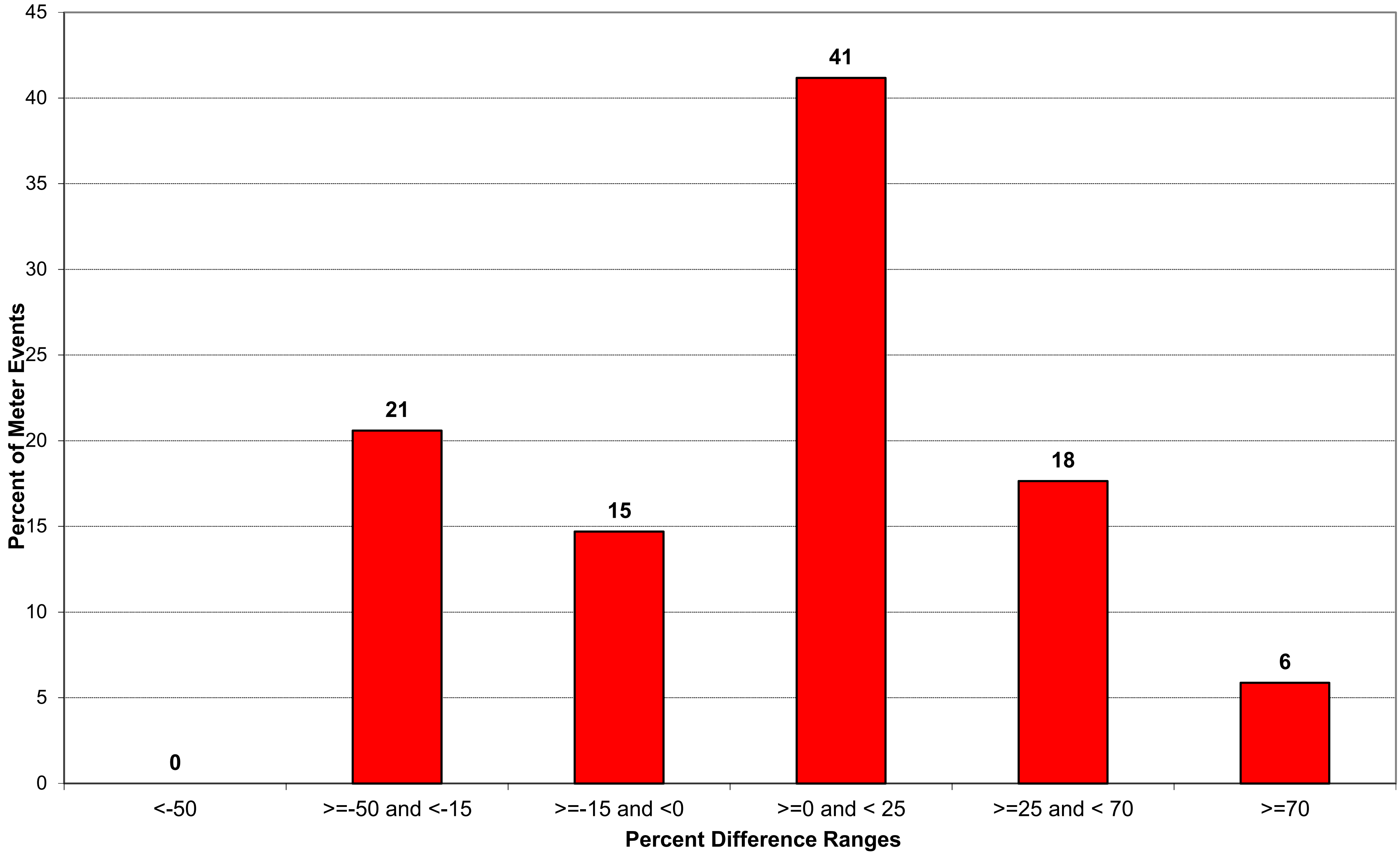

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JCMUA Combined Sewer System Modeling Report
Figure 6-5: The Distribution of Ranges of Variation between Monitored versus Modeled Peak Flow Conditions

Jersey City Municipal Utilities Authority (JCMUA)

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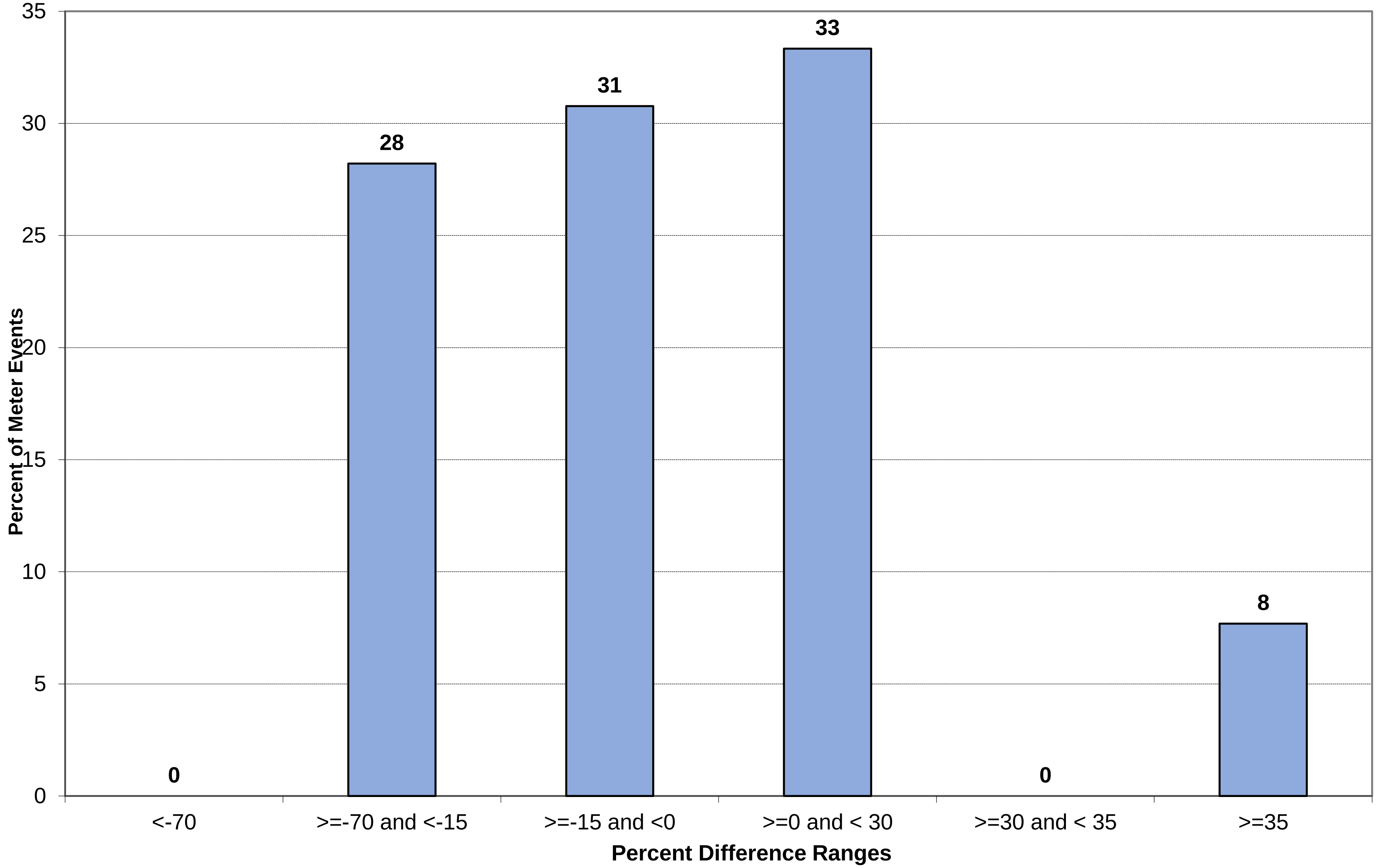

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JCMUA Combined Sewer System Modeling Report
Figure 6-6: The Distribution of Ranges of Variation between Monitored versus Modeled Peak Depth Conditions

Jersey City Municipal Utilities Authority (JCMUA)

G:\Project\01129_JCMUA\01129178_CSO_permit_Complinance_Updating_Model\Modeling\Calibration\Calibration Statistics.xlsx\Peak Depth rate were achieved for more than 56% of these comparisons. The model's peak flows were higher than the 25% bound (overprediction) 24% of the time, and below the -15% bound (underprediction) 21% of the time.

If the majority of points on the scatter plots are above the line, one can infer that either the model has a tendency to overpredict results, or that the modeled result is higher than the monitored data. If the majority of the points fall below the line, one can infer that either the model has a tendency to under predict results or that the modeled result is lower than the monitored data. As a general rule in modeling, overprediction is conservative and better for sizing facilities as follows:

- When a model overpredicts for volume, storage facilities are more likely to be of sufficient size than a model that underpredicts. Overprediction is the preferred result rather than underprediction. Overprediction is generally safer for design of long term control facilities.
- When a model overpredicts peak flows, pipe capacities and disinfection systems are more likely to be of sufficient size.

It is important that the model user take these model underpredicted and overpredicted variations into consideration when interpreting any result from the model since any model will underpredict or overpredict to some degree. Using the modeled results without taking these variations into consideration is therefore not recommended. One objective of the calibration process is to more clearly define the parameters and region in the model with higher confidence and lower confidence or "Uncertainty".

6.3.2 Overall Modelled Result Distribution

In addition to the scatter graphs, calibration histograms are presented in Figures 6-4 through 6-6, for total wet weather volume, peak flow, and peak depth, respectively. These histograms are another tool to determine whether the model will generally underpredict or overpredict a selected parameter (i.e.- Volume, Peak Flow, or Peak Depth). In addition, these figures show the number of locations where the percent difference between the model results and the monitored data falls within the specified ranges. If the majority of the percent differences fall within the positive ranges, that indicates that the model tends to overpredict. If the majority of the percent differences fall within the negative ranges, that indicates that the model tends to underpredict. The majority of the meters fall within a calibration bands, which indicates that the model tends to reasonably replicate monitored data, and therefore, real world conditions.

6.4 Model Calibration – Special Cases

Several special circumstances were encountered during model calibration and data review that warranted further explanation. The sections that follow offer more detail.

6.4.1 October 21, 2016 Event Peak Flow Discrepancy

The storm with the least favorable peak flow calibration was the October 21, 2016 storm. The peak flow predicted by the model is much higher than then metered value for 7 of the 13 meters. This storm has a peak five-minute rainfall intensity of 0.2 inches. Combined sewer systems respond quickly (i.e. – one to two minutes) to high intensity precipitation, closing controls gates, etc.; and it is possible that a meter recording on a five-minute interval may have missed recording the peak flow. The general shape of the hydrograph is the same, which is an important qualitative observation for model calibration, but the peak in the meter data shows a lower value. The similar shapes of the hydrographs, as shown on the October 21 flow graphs, validates the model for this event.

6.4.2 Meter 43 and Meter 44 Calibration

Meters 43 and 44 are located on twin 84" pipes that carry flow from Chamber 8040 on Grand Street to Manhole 20, upstream of the Mill Creek regulator. No additional flow is known to enter these pipes after chamber 8040. Dry weather flow calibration for these two meters was completed using a combined flow, as they carry the flow from the northern portion of the Mill Creek subdrainage area equally in the model.

The flow metering subconsultant, Flow Assessment, conducted data reviews throughout the monitoring period, and determined that they could obtain better data for Meters 43 and 44 if they moved them upstream. They added two additional meters – Meters 43A and 44A – one manhole upstream from the original meters. The meters were installed on November 17, 2016, as described in the report accompanying the flow monitoring data provided in Appendix D. Flow Assessment determined that 43A and 44A provided higher quality data than the original meters. The October 21, 2016 storm data was from the original two meters, but the November 29, 2016 and December 6, 2016 storm datasets are from meters 43A and 44A.

6.4.3 Meter 60 and 64 Data Usage

Meters 60 and 64 captured the flow from the outfall pumps at the Colgate Pump Station at the York Grand Outfall and the Mina Drive Outfall, respectively. The data from these two meters was reviewed to determine the pump flow impacts on the system and was also used to set up the pumps on Mina and the Colgate outfalls. Data review showed that the pumps turn on periodically to help prevent flooding in upstream areas, but the volume and rate at which the flow is pumped does not affect the flow at other meters in the system. These meters were not used for calibration purposes due to tidal fluctuations in the overflow chambers.

7 SEWER FLOOD MODEL SIMULATIONS AND ANALYSIS AND CONDITION ASSESSMENT

This chapter addresses the NJDEP request in Section 3 of the Work Plan for an updated sewer surcharge and street flooding analysis using the new calibrated and verified JCMUA System-Wide PCSWMM mode and a summary of the JCMUA Sewer Capacity and Condition Assessment Phases I through VII.

7.1 JCMUA Sewer System Flooding Analysis

This section describes the methods used to conduct the flooding analysis and presents its results and conclusions.

7.1.1 JCMUA Flood Analysis Method

The flooding analysis method consists of the following sequence of activities:

- The JCMUA System-wide PCSWMM model was setup to run simulations for a series of 1-hour duration flash flood storm events with probability of occurrence of a 5%, 10%, 20%, 50%, 100%, and 400% on any given day in any given year. These storms are also known by their return periods as the 50, 10, 5, 2, 1, and 0.25-year 1-hour duration storm events, respectively. The total rainfall and peak hour for each of these storms are shown below in Table 7-1:

Table 7-1: Rainfall intensity per 1-hour Duration Extreme Storm Events of Varied Probabilities of Occurrence and Return Period

Probability of Occurrence of the 1- hour duration storm	Return Period of the 1-hour duration storm, Years	Total Rainfall, inches	Peak Hour Rainfall
5%	50*	3.23	2.63
10%	10*	3.17	1.82
20%	5*	3.1	1.7
50%	2	1.37	1.37
100%	1	1.12	1.12
400%	0.25 (3-month)	0.59	0.59

*indicates the storm is from the Newark Airport rainfall record. Remaining storms are based on intensity, duration, frequency data from the National Oceanic and Atmospheric Administration (NOAA)

- After the simulation of the model's 1,509 sewer pipes was completed for the six different storm events, the maximum hydraulic grade line (HGL or water elevation) results were evaluated to determine the following high water level conditions for each event:
  - **Street Flooding:** When a pipe's maximum HGL exceeds the rim or street elevation at the pipes location which results in street ponding until the flood wave recedes.

- o **Sewer Surcharged Condition:** When a pipe's maximum HGL is operated above the design capacity of the pipe in a pressurized state that is above the crown (top) of the pipe
- A database of pipe characteristics and modeled HGL results for each of the 1,509 modeled pipes during the each of the six extreme storm conditions is then compiled and analyzed for the maximum probability of occurrence of each of the 1,509 sewer pipes.
- The results of the analysis are shown in Table 7-2.

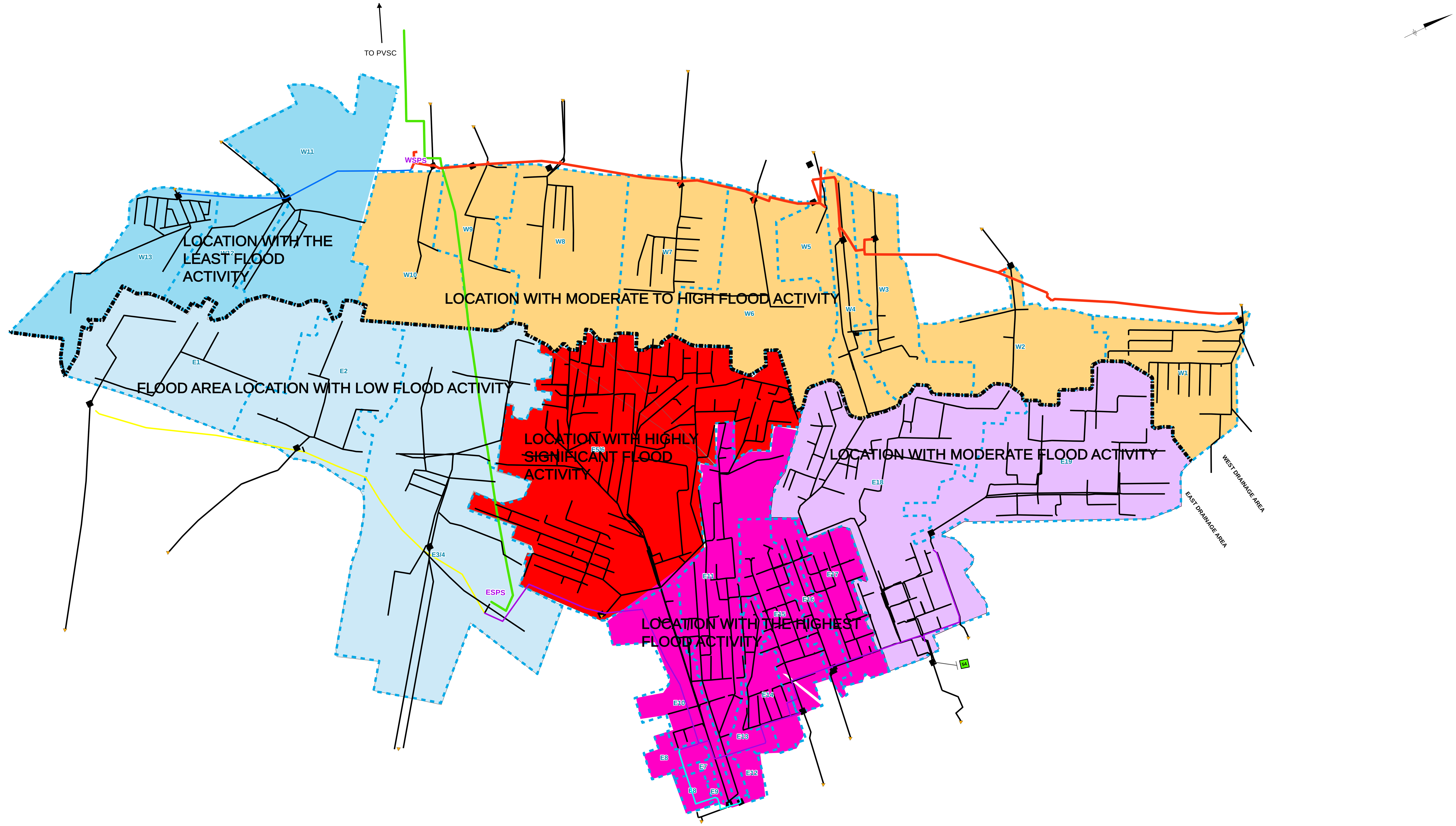
7.1.2 JCMUA Flood Analysis Results

Table 7-2 contains the results of the flood analysis that was completed described in the previous section. There are four sections in Table 7-2 which present the results for this flood analysis. Descriptions of the table sections are presented below:

- **Flood area locations:** Since it is critical to know where the various type of flooding occurs, three types of areas have been presented for this purpose: east and west drainage areas, subdrainage areas W-1 through W-13 and E-1 through E-22, and Flood Location Areas. An additional section defines the Flood Area Locations in more detail.
- **High Water Conditions:** Street flooding occurs when the sewer levels rise above the manhole cover and pond on the street or surface, or runoff on to pervious surfaces. Surcharged sewers operate with the water level above the crown of the pipe, which means it is beyond its capacity and the pipe is operating under potentially hazardous pressurized conditions. During these conditions, manhole covers may blow off. Pipe damage can occur over long term use under repeated surcharging conditions.
- **Percentage of High Water Conditions during a 10-year, 1-hour Storm:** Table 7-2 shows the percentage of pipes that are predicted to reach the flooding or surcharged high water level conditions during a 10-year, 1-hour rainfall event. A 10-year, 1-hour storm is a standard design storm used across the nation to design wet weather sewers and facilities. This storm magnitude is the implied design standard for Jersey City and has been used on outfall designs for more than 20 years.
- **Flood Scores:** The flood scores are a selected method to measure and prioritize a location based on the likelihood of having one or both high water conditions and how may pipes are impacted. It is calculated as the sum of the products of the number of pipes having each high water condition multiplied by their respective probabilities of occurrence per year as shown on Table 7-2.

7.1.2.1 Flood Area Locations

Table 7-2 is a one-page summary of the results from the 9,054 record database of modeled HGL elevations in relative comparison to each of the 1,509 pipes' rim and crown elevations. The table is organized into specific functional locations which are known by the JCMUA staff as drainage areas, subdrainage area, interceptor sewer systems, and other areas which are referred to in this report as flood area locations. The locations of the drainage areas, subdrainage area, interceptor sewer systems are discussed in Section 5 and shown on schematically on Figure 2-1 and geographically on Figure 2-2. The flood area locations in this report are shown on Figure 7-1 and are combinations of the subdrainage areas and interceptor systems which are described as follows:



Legend

- Northeast Interceptor Southern Branch
- Northeast Interceptors
- Southwest Interceptor
- Northwest Interceptor
- REGULATOR

PIPES TO BE MODELED

- FORCE MAIN (JCMUA)
- INTERCEPTOR
- COMBINED SEWER PIPE
- DRAINAGE AREA BOUNDARY
- SUBDRAINAGE AREA AND NUMBER
- Northeast Uptown Flood Area Location
- Northeast Downtown Flood Area Location
- Northeast Flood Area Location
- Southeast Flood Area Location
- Southwest Flood Area Location
- Northwest Flood Area Location

0 500 1,000 1,500 2,000

SCALE IN FEET

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
JERSEY CITY, NEW JERSEY

COMBINED SEWER SYSTEM MODELING REPORT

The 6 Flood Areas in Jersey City

ARCADIS Design & Consultancy for natural and built assets

FIGURE **7-1**

Table 7-2: 2018 Sewer Pipe Flood Analysis With The JCMUA System-Wide PCSWMM Model

SDA	Subdrainage Areas and Flood Area Locations	No. Pipes in SDA	The Number of Pipes which have Specified High Water Condtion during the Storm Magnitude												Percent of pipes that exceed the specified High Water Type during a Storm with a 10% chance of occurrence per year (10 Year 1 hour Storm event*)		Flood Scores (Probability of Occurrence multiplied by the No. of pipes at that High Water Condition)		Total Flood score
			Street Flooding						Surcharged Sewers										
			Hourly Rainfall intensity, Frequency or Probability of Occurrence & (Return Period)						Hourly Rainfall intensity, Frequency or Probability of Occurrence & (Return Period)										
			0.59" per hour - 4 or more times per year (3 month - 1 hour Storm)	1.12" per hour - Once a year (1 year -1 hour Storm)	1.37" per hour - 50% (2 year- 1 hour Storm)	1.7" per hour - 20% (5 year- 1 hour Storm)	1.82" per hour - 10% (10 year- 1 hour Storm)	2.63" per hour - 5% (50 year- 1 hour Storm)	0.59" per hour - 4 or more times per year (3 month - 1 hour Storm)	1.12" per hour - Once a year (1 year -1 hour Storm)	1.37" per hour - 50% (2 year- 1 hour Storm)	1.7" per hour - 20% (5 year- 1 hour Storm)	1.82" per hour - 10% (10 year- 1 hour Storm)	2.63" per hour - 5% (50 year- 1 hour Storm)	Street flooding	Surcharged Flood (above the Crown of the Pipe)	Street flooding	Surcharged Flood (above the Crown of the Pipe)	
E56	North East	327	9	55	92	120	163	163	48	154	168	184	229	229	50%	70%	110	313	423
INW	North West	51	21	28	30	33	33	33	40	40	40	43	43	43	60%	80%	93	161	253
E11	NE - Downtown	80	15	21	30	51	51	51	25	39	51	59	61	61	60%	80%	75	122	197
E18	NE - Uptown	100	13	23	28	32	38	38	19	27	35	37	53	53	40%	50%	66	90	156
INNE	North East	17	8	17	17	17	17	17	17	17	17	17	17	17	100%	100%	41	68	109
E19	NE - Uptown	79	8	9	9	14	30	30	11	30	37	42	59	59	40%	70%	36	69	105
E15	NE - Downtown	62	3	5	18	37	38	38	12	33	50	57	61	61	60%	100%	24	79	104
E10	NE - Downtown	97	4	7	9	17	23	23	11	28	41	78	79	79	20%	80%	22	75	97
W7	North West	33	8	8	8	9	9	9	8	8	8	9	11	11	30%	30%	32	32	65
E21	NE - Uptown	43	0	10	16	17	20	20	4	36	41	41	43	43	50%	100%	14	51	64
E34	South East	63	3	11	14	35	42	42	4	18	22	43	45	45	70%	70%	26	36	63
ISE	South East	11	5	7	8	9	9	9	9	11	11	11	11	11	80%	100%	23	38	61
E1	South East	46	1	9	12	18	31	31	3	26	28	36	40	40	70%	90%	16	38	54
E17	NE - Downtown	47	0	7	7	11	16	16	1	26	41	47	47	47	30%	100%	8	38	46
ISNE	NE - Downtown	8	2	8	8	8	8	8	8	8	8	8	8	8	100%	100%	14	32	46
E9	NE - Downtown	13	0	0	0	0	0	0	10	10	11	11	11	11	0%	80%	0	41	41
W8	North West	25	4	6	8	9	10	10	4	8	8	9	14	14	40%	60%	19	21	40
ISW	South West	6	4	4	4	4	4	4	6	6	6	6	6	6	70%	100%	16	24	40
INE	North East	8	0	5	6	6	6	6	8	8	8	8	8	8	80%	100%	6	32	38
W13	South West	72	0	2	2	2	24	24	2	15	23	43	66	66	30%	90%	4	31	36
W2	North West	12	3	4	4	6	6	6	3	6	8	8	8	8	50%	70%	13	16	29
E2	South East	26	0	4	4	7	11	11	4	5	5	12	17	17	40%	70%	5	19	24
E16	NE - Downtown	27	1	1	4	5	13	13	2	2	11	23	24	24	50%	90%	7	15	22
W4	North West	50	1	6	6	6	6	6	1	7	7	7	7	7	10%	10%	9	10	19
E14	NE - Downtown	22	0	4	5	13	20	20	0	6	14	16	20	20	90%	90%	7	11	18
W9	North West	17	0	1	8	8	9	9	0	10	10	10	11	11	50%	60%	5	10	15
W5	North West	8	1	1	1	1	1	1	1	4	4	4	4	4	10%	50%	4	7	11
E22	NE - Uptown	22	0	1	1	1	7	7	1	1	4	9	15	15	30%	70%	2	7	9
W12	South West	9	1	1	1	1	1	1	1	1	2	2	2	2	10%	20%	4	5	9
W3	North West	20	1	1	1	1	1	1	1	1	1	1	1	1	10%	10%	4	4	8
E13	NE - Downtown	3	0	0	2	3	3	3	0	2	3	3	3	3	100%	100%	1	3	4
w1	North West	62	0	0	0	0	11	11	0	0	0	0	13	13	20%	20%	1	1	2
W6	North West	13	0	0	0	0	3	3	0	0	2	2	8	8	20%	60%	0	2	2
w11	South West	18	0	0	0	0	1	1	0	0	0	0	7	7	10%	40%	0	1	1
w10	North West	11	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0	0	0
E8	NE - Downtown	1	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0	0	0
	NE - Downtown	**360**	**25**	**53**	**83**	**145**	**172**	**172**	**69**	**154**	**230**	**302**	**314**	**314**	**48%**	**48%**	**158**	**415**	**573**
	North East	**352**	**17**	**77**	**115**	**143**	**186**	**186**	**73**	**179**	**193**	**209**	**254**	**254**	**53%**	**53%**	**157**	**413**	**570**
	North West	**302**	**39**	**55**	**66**	**73**	**89**	**89**	**0**	**84**	**88**	**93**	**120**	**120**	**29%**	**29%**	**181**	**264**	**444**
	NE - Uptown	**244**	**21**	**43**	**54**	**64**	**95**	**95**	**35**	**94**	**117**	**129**	**170**	**170**	**39%**	**39%**	**117**	**217**	**334**
	South East	**146**	**9**	**31**	**38**	**69**	**93**	**93**	**20**	**60**	**66**	**102**	**113**	**113**	**64%**	**64%**	**70**	**131**	**201**
	South West	**105**	**5**	**7**	**7**	**7**	**30**	**30**	**9**	**22**	**31**	**51**	**81**	**81**	**29%**	**29%**	**24**	**61**	**85**
	Totals	**1509**	**116**	**266**	**363**	**501**	**665**	**665**	**206**	**593**	**725**	**886**	**1052**	**1052**					
	Percent of Model Sewer with this Flood conditon	**100%**	**8%**	**18%**	**24%**	**33%**	**44%**	**44%**	**14%**	**39%**	**48%**	**59%**	**70%**	**70%**					

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- **Northwest Flood Area Location:** This Flood Area Location consists of the subdrainage areas located north of the West Side Pump Station from Secaucus Road (W-1), through Fisk Street (W-10), and includes the Northwest Interceptor (INW) that intercepts flow from subdrainage areas W-1 through W-10.
- **Southwest Flood Area Location:** This Flood Area Location consists of the subdrainage areas located south of the West Side Pump Station from Danforth Avenue (W-11/12) and Mina Drive (W-13). It also includes the Southwest Interceptor (ISW) that intercepts flow from subdrainage areas W-11 through W-13.
- **Southeast Flood Area Location:** This Flood Area Location consists of the subdrainage areas located south of the East Side Pump Station from Brown Place (E-1) through Claremont/Carteret (E-3/4), and also including the South East Interceptor (ISW) that intercepts flows from subdrainage areas E-1 through E-3/4.
- **Northeast Flood Area Location:** This Flood Area Location consists of only the Mill Creek (E-5/6) subdrainage area and the Northeast interceptors, INE and INNE located north of the East Side Pump Station. The INE interceptor collects flow from the subdrainage areas from Mill Creek to Eighteenth Street (E-19) by a connection to the INNE interceptor which intercepts the flow from Pearl Street (E-13) through E-19. The flow from the Essex Street (E-8), through York Street (E-11), subdrainage areas flows to the INE via the Southern Branch of the North East (INSE) interceptor.
- **Northeast “Downtown” Flood Area Location:** This Flood Area Location consists of subdrainage areas from Essex (E-8), through Sixth Street (E-16/17), and the Southern Branch of the Northeast (INSE) interceptor up to the point where it connects to the North East (INE) Interceptor where all are located north of the East Side Pump Station. This flood area is a subsection of the Northeast Drainage Area was identified by the JCMUA during substantial flooding that had occurred in Jersey City during the August 8, 2007 storm event, which was of great concern to many in Jersey City. This August 8, 2007 event was the last storm 10-year, 1-hour event to occur in the area.
- **Northeast “Uptown Flood Area Location :** This Flood Area Location consists of subdrainage areas from Fourteenth Street (E-18) through Eighteenth Street (E-22), The Heights which are located north of both the “Downtown” Flood Area and the East Side Pump Station.

The first three columns in Table 7-2 show the names of each of the individual subdrainage areas, the flood area locations described above, and the total number of pipes that have been modeled in the PCSWMM model for these areas.

7.1.2.2 High Water Level Conditions

Table 7-2 is arranged by the two high water levels conditions: Street Flooding and Surcharged Sewers. Each of the two high water level conditions has six columns that show how many pipes can be expected to experience that hydraulic condition for the six extreme storm events analysed. A description of the results can be interpreted in the following ways:

- Based on the Subdrainage Areas or Flood Area Location shown to the left on Table 7-2, the number of pipes that will have street flooding or surcharging is shown in one of six columns with the frequency at which the high water condition will occur (street flooding or surcharging).

- Table 7-2 also shows the number of pipes that will be surcharged or flooded when the specified rainfall per hour occurs.

7.1.3 Flooding Location Prioritization

The results for each of the Subdrainage Areas in Table 7-2 have been sorted by the Total Flood Score (last column on the right), which was calculated as described in Section 7.1.2. This score designed to indicate the number of pipes that reach one or both of the high water conditions that occur and the frequency at which the flooding occurs. The higher the flood score, the more surcharging and street flooding conditions are expected relative to the other subdrainage areas. The subdrainage areas have been divided into four quartiles as indicated by the colors in the table. The colors indicate the following:

- **Magenta:** Subdrainage Areas (SDA) with the most street flooding and surcharging based on those SDAs having most pipes that occur with these high water conditions and also the highest frequency of occurrence. In this quartile, significant high water levels are predicted even at the lower hour rainfalls (i.e. 0.59 to 1.37 inches/hour) which are also the more frequent extreme rainfalls modeled (i.e. 1 to 4 times year).
- **Gold**: Subdrainage areas where a high degree of street flooding and surcharging occurs, but where lower numbers of pipes experience these conditions at the lower hourly and more frequent rainfalls
- **Violet**: Subdrainage areas with some street flooding and surcharging but where lower numbers of pipes experience these conditions at the lower hourly and more frequent rainfalls.
- **Blue**: Subdrainage areas with fewer street flooding and surcharging occurrences where these conditions rarely occur at the lower hourly and more frequent rainfalls

A summation of the results of in the colored part of Table 7-2, is at the bottom of the table in white. The bottom portion of Table 7-2 represents the sum of the pipes which have the flood condition shown at the top of the table for all of the Subdrainage Areas and Interceptors that are within the specified Flood Area Locations shown in the second column of Table 7-2. The Flood Area Location summary is another way prioritizing areas into areas which are larger than subdrainage areas and more commonly discussed by JCMUA Staff and other City Officials as be similar to term as “Neighborhood”.

7.1.4 Conclusions

Conclusions from the results on Table 7-2, are as follows:

- The Mill Creek (E-5/6), subdrainage area has the greatest number of pipes that flood and flood the most frequently. The same conclusion was determined in the 2008 Phase I Capacity and Condition Assessment Study flood analysis.
- The “Downtown” flood area location has the highest priority flood score for flooding and surcharging. This is also the same conclusion found in the 2008 study.
- More than 33% and 59% of the JCMUA’s modeled CSS experiences street flooding and surcharging of sewers, respectively, during storms smaller than the 10-year, 1-hour storm event (1.82 in/hr), the current implied design storm for wet weather facilities in Jersey City.

7.2 JCMUA Sewer Condition Assessment Results

From 2007 to the present, the JCMUA has been conducting rapid camera inspections of their sewers based upon the NASSCO Pipeline Assessment Certification Programs (PACP) grading method for determination of sewer defects in a prioritized manner. Currently Phases I through VII of this assessment have been completed and Phase VIII is now proceeding. Tables 7-3 and 7-4 contain information on the grading systems and their definitions. A pipe's rating was assigned based on the highest grade defect or observation in the pipe segment. Notes regarding defects were made when necessary.

Table 7-3. PACP O&M Grading System

Grade	Definition
5	Defect requires immediate attention. Blockage or blockage imminent
4	Severe defect blockage likely in foreseeable future
3	Blockage unlikely in near future, but possibility that the situation may further deteriorate
2	Minimal Blockage risk in short term, but potential for further deteriorating situation
1	No potential blockage observed

Table 7-4. PACP Structural Grading System

Grade	Definition
5	Require immediate attention. Failed or likely to fail in the next 5 years
4	Severe defect that will become Grade 5. Failure probably in 5 to 10 years
3	Moderate defects that will continue to deteriorate. Failure likely in 10 to 20 years
2	Defects that have not begun to deteriorate. Failure unlikely for at least 20 years
1	Minor defects. Failure unlikely in foreseeable future

A total of 6,926 pipe segments were inspected during Phases I through VII (approximately 72% of the pipes in the system). Tables 7-5 and 7-6 summarize the pipe inspections.

Table 7-5. O&M Grades for Inspected Pipes – Phases I through VII

Grade	Number of Segments	Percentage of Total Segments
5	1308	19%
4	966	14%
3	1497	22%
2	1648	24%
1	1462	21%
0*	45	< 1%
Total	**6926**	**100%**

*O&M "0" Classification: If the view of the pipe was limited such that the pipe could not be inspected for O&M purposes, or if the video file was corrupt or missing, then it was assigned a grade of "0".

Table 7-6. Structural Conditions for Inspected Pipes – Phases I through VII

Grade	Number of Segments	Percentage of Total Segments
5	415	6%
4	513	7%
3	1385	20%
2	710	10%
1	3691	53%
0**	212	3%
Total	**6926**	**100%**

**Structural "0" Classification: Structural Grade "0" was assigned if one or more of the following conditions were present:

- Sediment had built up in the manholes beyond the crown of the pipe such that the pipe could not be observed. If obstructions and objects were in the pipe it is possible that the pipe was assigned a grade 5 for its O&M Grade but also a "0" for structural condition grade due to its condition.
- When the view of the pipe was limited by a significant offset from the centerline of the pipe, obstructions, objects, or other conditions that prevented the pipe from being seen clear enough for an inspection.
- The video file was corrupt or missing.

8 CONSIDERATION OF SENSITIVE AREAS

The permit-identified sensitive areas include Outstanding National resource Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters used for primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds.

Passaic Valley Sewerage Commission prepared and submitted a report entitled “Identification of Sensitive Areas Report” as part of their permit requirements. This report was prepared on behalf of the members of the NJ CSO Group, and identifies all the sensitive areas that are located within the study area of the report, which includes the combined sewer service areas of all member entities including the JCMUA.

Email correspondence with NJDEP confirmed that the Department found the report to meet the submittal requirements of the permit at D.3.b.iv., assuming the JCMUA certified the report and attached it to their Characterization Report. Since that email, the JCMUA has certified the “Identification of Sensitive Areas Report” and it is in Appendix I. The sensitive areas requirement of the permit has been met. The JCMUA’s summary analysis of possible sensitive areas, which agrees with PVSC’s analysis, is presented below.

8.1 Outstanding National Resource Waters

The Surface Water Quality Standards (N.J.A.C. 7:9B) define ‘Outstanding National Resource Waters’ as those classified as FW1 or PL. FW1 waters are further defined in N.J.A.C. 7:9B-1.4 as waters “that are to be maintained in their natural state of quality (set aside for posterity) and not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities.” PL waters are defined as those Pinelands Waters. A cursory review of the mapping data and the list of waterbody designations provided in the Surface Water Quality Standards reveals that there are no FW1 or PL waters in or around JCMUA’s sewer service area, thus they are not a sensitive area.

8.2 National Marine Sanctuaries

The National Marine Sanctuaries System consists of 15 marine sanctuaries throughout the United States. There are no National Marine Sanctuaries in New Jersey. None of the waterbodies receiving discharge from the JCMUA’s CSOs are classified as National Marine Sanctuaries, thus this type of sensitive area is not a concern in the development of the Long Term Control Plan.

8.3 Waters with Threatened or Endangered Species and their Habitat

PVSC addresses the species in this section in detail in the “Identification of Sensitive Areas Report” which the JCMUA has certified. While several species were discussed in the Sensitive Area Report, none of them were identified as being necessary for further consideration as it relates the JCMUA’s CSOs. Early in the study, Atlantic and Shortnose Sturgeon were the primary species of concern; however, the conclusions of the report and the findings of the JCMUA’s research indicate that there are no concerns as it relates to CSO discharges in to the Hudson River. In summary, the findings on page 45 and 46 of the subject report indicated the concerns are no longer applicable to CSOs due the following:

- NOAA concluded that commercial bycatch and decades of prior environmental degradation are the biggest threats to Atlantic sturgeon recovery in the New York Bight.
- Water quality in the Hudson River and New York Bight has improved in recent decades, and no longer appears to present a significant threat to Atlantic Sturgeon recovery.
- substantial water flow and depth in these areas also protects the bottom-dwelling sturgeon populations from contact with these human enteric pathogens from both CSO and other sources.
- Atlantic Surgeon are likely to pass through this segment of the Hudson, but are thought to travel in deep channel waters, reducing vulnerabilities to nearshore discharges and intermittent CSO discharges.

8.4 Primary Contact Recreation Waters

The Hackensack River, Hudson River, and their tributaries (including Penhorn Creek) in the area near Jersey City are classified as FW2-NT/SE2, SE2, and SE3 by the Surface Water Quality Standards. SE2 and SE3 waters do not list primary contact recreation as a designated use. This will be considered during the preparation of the Long Term Control Plan. SE2 and SE3 waters do not list primary contact recreation as a designated use. The JCMUA agrees with PVSC's statement that kayaking is a secondary contact usage. None of the waters receiving discharge from the JCMUA's CSOs are classified as primary recreation waters.

8.5 Public Drinking Water Intakes or their Designated Protection Areas

Arcadis reviewed the *New Jersey Source Water Assessment Program Statewide Summary* (December 2004) to determine whether there were drinking water intakes located in the waterbodies receiving discharge from JCMUA CSOs. The mapping did not show any drinking water intakes in these waters. Further review of data available in *NOAA's Environmental Sensitivity Index Maps: A Guide to Coastal Resources at Risk to Spilled Oil (New York/New Jersey Metro, Hudson River and South Long Island: Volume 1 – February 2016)* confirmed this assertion.

8.6 Shellfish Beds

A cursory review of the Shellfish Growing Water Classification regulations (N.J.A.C. 7:12) revealed that growing shellfish is prohibited in all waters north and west of Raritan Bay, including the Hackensack River and all tributaries thereof (N.J.A.C. 7:12-2.1-(a)2). All the waters receiving discharge from the JCMUA's CSOs are in the aforementioned area, thus shellfish beds are not considered a sensitive area with regard to the JCMUA's service area.

9 TYPICAL YEAR MODEL SIMULATION AND ANALYSIS

9.1 Typical Year Selection

In order to determine the typical hydrologic year, Passaic Valley Sewerage Commission reviewed the rainfall record from Newark's Liberty International Airport for the period between 1970 and 2015. Hourly precipitation from the National Climatic Data Center's gage, as well as daily precipitation totals, were used to analyze annual and seasonal precipitation amounts.

PVSC developed a system of weighted ranking parameters that were used to assess each year's representativeness based on a number of factors. These factors were selected based on requirements of the presumption approach and the demonstration approach, as well as potential operations and maintenance concerns. Those factors and their weights are shown in Table 9-1 below.

Table 9-1. Typical Hydrologic Year Ranking Parameters

Criteria Parameter	Description / Importance	Weighing Factor
Annual rainfall depth	Impacting annual overflow volume and storage volume	**30%**
# of events with rainfall depth ≥ 0.2 in	Rainfall depth to trigger overflow in existing system	**10%**
# of events with rainfall depth ≥ 0.1 in	Rainfall depth to trigger surface runoff	**5%**
5TH largest storm volume	Determining max storage capacity or WWTP capacity	**5%**
Rainfall volume for 85% captured	Determining max storage capacity or WWTP capacity	**5%**
# of back-to-back rainfall events	Determining antecedent conditions and potential storage facility operation	**10%**
Maximum peak intensities of the 5th largest storm and less	Determining the sizing of conveyance pipes, diversions, regulators, pumps, etc.	**5%**
# of storms with return frequency ≥ 1-year	Extremely large storms to be avoid	**5%**
Average Rainfall Duration	Determining storage capacity	**15%**
Average Rainfall Intensity	Determining storage capacity including pipes, regulators, diversions, etc.	**10%**
TOTAL		**100%**

Source: Typical Hydrologic Year Report, Passaic Valley Sewerage Commission (May 2018)

After the weighted factor analysis, five years were chosen as candidates as the typical year (ranked from highest to lowest): 2004, 2014, 1973, 2008, and 2006.

9.2 Recommendation of Typical Year

PVSC completed a hydrologic and hydraulic model simulation for the period from 1996 to 2015. Results from this model were analyzed to determine average overflow volumes. The results of this simulation showed that 2004 was the closest to the average of the 20-year simulation. The results of PVSC's criteria-based analysis for 2004 are presented in Table 9-3. The year 2014, which was ranked second after the weighted ranking analysis, was also close to the average but was eliminated due to the presence of a ten-year storm. The analysis of 2004's rainfall based on PVSC's criteria is presented in Table 9-2.

Table 9-2. Summary of the Recommended Typical Year – 2004

Parameter	2004
Annual rainfall depth	48.37 in (4.5% greater than average 46.27)
# of events with rainfall depth ≥ 0.2 in	54 (5% greater than average 51.2)
# of events with rainfall depth ≥ 0.1 in	73 (11% greater than average 66)
5TH largest storm volume	1.63 in (5% less than average 1.70)
Rainfall volume for 85% captured	1.18 in (12% less than average 1.35)
# of back-to-back rainfall events	12 (14% greater than average 10.5)
Maximum peak intensities of the 5th largest storm and less	0.99 in/hr (9.5% greater than average 0.90)
# of storms with return frequency ≥ 1-year	1 Year Storm (2) 2 Year Storm (1)
Average Rainfall Duration	10.3 hr (4.8% less than average 10.8)
Average Rainfall Intensity	0.084 in/hr (3.8% greater than average 0.081)

Source: Typical Hydrologic Year Report, Passaic Valley Sewerage Commission (May 2018)

The top 20 storms of 2004 are categorized in the Table 9.3 below. The year 2004 was selected and approved by NJDEP. The JCMUA certified PVSC's Typical Hydrologic Year Report.

Table 9-3. Top 20 Rainfall events by Depth in 2004

2004 Event	Event Start	Duration (hr)	Precipitation Depth (in)	Max Rainfall Intensity (in/hr)	Average rainfall Intensity (in/hr)	Return Frequency
1	9/28/2004 1:00	28	3.68	0.53	0.13	2-yr, 24-hr
2	9/8/2004 4:00	25	2.21	0.63	0.09	1-yr, 6-hr
3	7/12/2004 9:00	27	1.99	0.32	0.07	
4	4/12/2004 17:00	30	1.67	0.25	0.06	
5	4/25/2004 14:00	35	1.67	0.25	0.05	
6	7/23/2004 10:00	24	1.66	0.33	0.07	
7	2/6/2004 5:00	33	1.63	0.33	0.05	
8	7/18/2004 16:00	14	1.60	0.64	0.11	
9	11/28/2004 2:00	12	1.50	0.85	0.13	
10	7/27/2004 15:00	18	1.45	0.41	0.08	
11	9/17/2004 22:00	12	1.44	1.33	0.12	1-yr, 2-hr 2-yr, 1-hr
12	6/25/2004 17:00	5	1.39	0.40	0.28	
13	11/12/2004 7:00	23	1.08	0.10	0.05	
14	5/12/2004 16:00	2	1.08	0.99	0.54	
15	11/4/2004 14:00	16	1.03	0.20	0.06	
16	7/5/2004 3:00	12	1.00	0.69	0.08	
17	12/1/2004 4:00	10	1.00	0.18	0.10	
18	8/16/2004 0:00	21	0.94	0.60	0.04	
19	8/21/2004 14:00	3	0.84	0.81	0.28	
20	12/6/2004 12:00	39	0.83	0.20	0.02	

Source: Typical Hydrologic Year Report, Passaic Valley Sewerage Commission (May 2018)

9.3 Typical Year Analysis

PVSC provided a five-minute rainfall data set for 2004 for use in analysis of the typical year. A few of the precipitation events in the 2004 precipitation dataset consisted of snowfall, which are not rainfall events that produced runoff. The precipitation events on January 15, 2004 and March 16 through March 18, 2004 were modeled as zero rainfall events that did not produce runoff, which in turn reduced the number and volume of overflows that occurred in Typical Year 2004. Snowfall does not behave like a true rainfall event that produces enough runoff to produce overflows. Instead, it releases the runoff slowly during the snowmelt process, which does not produce overflows but is captured by the JCMUA CSS and pumped to the POTW.

After finalization of the dataset, the model was run with the modified 2004 rainfall. Overflow volumes and wasteload calculations were completed for the following parameters at each of the JCMUA's 21 outfalls: carbonaceous biochemical oxygen demand (CBOD), total Kjehldahl nitrogen (TKN), total phosphorous (TP), total nitrogen (TN), total suspended solids (TSS), fecal coliform, and Enterococci. Wet weather water quality data from the 2004-2005 monitoring period was analyzed at each of the two monitoring locations – one on the west side of the JCMUA's service area at the Secaucus Road (RW-1) regulator, and one on the east side of the JCMUA's service area at the Eighteenth Street (RE-19) regulator (reuse of the 2004-2005 water quality data was approved as part of the JCMUA's Work Plan). Average values were determined, and overflow volumes were used to estimate the wasteload from each of the outfalls. A table summarizing the annual wasteload and overflow volume for each outfall is presented in Appendix G. A summary of daily values is also presented in Appendix H.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

Conclusions of the flow monitoring and model calibration are as follows:

- Based on the results of the 2017 model conversion, comparison and verification results, the new PCSWMM model has a slight tendency to overpredict more and underpredict less than the XP-SWMM model for both volume and peak flow. These conditions make the PCSWMM model slightly more conservative with its predictions, which is preferable to underprediction for the sizing of various LTCP alternatives.
- The meters with the best calibration, or highest location ratings, are Meter 28 (Northwest Interceptor), Meter 33 (Brown Place), and Meter 44 (Mill Creek).
- The calibrated PCSWMM model tends to predict peak flows within the desired tolerance (-15% to 25%), or overpredict. This avoids undersizing of facilities.
- The Northeast Interceptor (Meter 41) had the least favorable calibration of the interceptors. This was to be expected, as extensive surcharging and flooding in this interceptor has been field verified by both Arcadis and JCMUA staff which makes the process of getting the most reliable data very difficult due to 'indeterminate' rather than invalid conditions.
- The Northwest Interceptor (Meter 28) had the most favorable calibration of the interceptor meters. The Northwest Interceptor does not experience the degree of surcharging observed in the Northeast Interceptor, supporting the very good calibration results.
- Brown Place (Meter 33) had the most favorable calibration of the trunk sewer meters, which was expected as it was one of the most upstream subdrainage areas.
- This model has a median location rating of 81%, which is an improvement over the XP-SWMM model calibrated during the previous permit cycle (72%).
- Of the four main hydrologic parameters assigned to each subcatchments (area, slope, percent imperviousness and width), the PCSWMM model, like the XP-SWMM model, is most sensitive to changes in area. Changes in the other parameters affect the observed flows, but to a lesser extent than area adjustments.
- The pumps installed in the Colgate Manifold (Meter 60) and Mina Drive (Meter 64) pump stations do provide upstream flooding and surcharging relief.

10.2 Recommendations

ARCADIS recommends the following actions

- Since the model has been calibrated, and the System Characterization Report, including discussion of relevant sensitive areas, completion of an annual simulation for typical year 2004, and a flood analysis of the CSS is now completed, the next step in the process, Development and Evaluation of Alternatives of the LTCP, should be completed by the deadline of July 1, 2019. This step will require continued coordination with PVSC and the other members in our hydraulically connected system and as a result it is recommended that the preliminary list of alternatives that the JCMUA is considering for implementation in the coordinated LTCP be presented to PVSC and the other members by the end of 2018. It is recommended that the work on the selection and implementation of the LTCP be authorized to begin immediately.

- The final selection and implementation of the LTCP is recommended be authorized sometime before July 1, 2019 since this final stage in the process is required to be completed by July 1, 2020 and it will require significant coordination with PVSC, members of hydraulically connected system, Supplemental CSO Team Members, the residents of Jersey City and the public in general.
- It is also recommended that a more intensive field investigation process and recalibration occur with each final design project undertaken by the JCMUA both for implementation of the LTCP and other sewer maintenance and upgrade projects needed by the Jersey City CSS as outlined in the JCMUA Asset Management Plan, 2017.

APPENDIX A

XP-SWMM and PCSWMM Model Comparison Tables

Jersey City Municipal Utilties Authority
Combined Sewer System Modeling Report
Table A-1: November 4, 2004 Model Comparison

	Total Volume (MG)						Peak Flow (MGD)					
Meter	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results
FM3	1.82	1.81	1.87	0%	3%	3%	10.50	8.98	9.15	-14%	-13%	2%
FM4	0.70	0.88	0.84	26%	20%	-5%	3.17	4.53	4.23	43%	33%	-7%
FM2 and 5	2.13	1.77	1.96	-17%	-8%	11%	10.27	11.60	11.87	13%	16%	2%
FM6	6.06	6.55	6.67	8%	10%	2%	29.77	31.85	31.91	7%	7%	0%
FM7	2.08	2.00	2.94	-4%	41%	47%	7.41	5.71	8.12	-23%	10%	42%
FM8	1.87	2.53	2.61	35%	40%	3%	10.86	14.11	14.75	30%	36%	5%
FM9	1.53	1.58	1.33	3%	-13%	-16%	5.86	5.97	4.12	2%	-30%	-31%
FM10	1.46	1.90	1.96	30%	34%	3%	9.82	9.81	10.23	0%	4%	4%
FM11	0.52	0.98	0.99	87%	90%	1%	4.28	4.28	4.08	0%	-5%	-5%
FM12	0.67	0.71	0.73	6%	9%	2%	3.60	3.62	3.69	1%	3%	2%
FM13	1.15	1.15	1.10	0%	-4%	-5%	5.89	6.20	6.09	5%	3%	-2%
FM14	0.92	1.02	0.91	10%	-1%	-10%	3.92	3.15	2.67	-20%	-32%	-15%
FM15	0.64	1.28	1.24	99%	93%	-3%	6.86	7.47	7.20	9%	5%	-4%
FM16	0.44	0.76	0.66	72%	49%	-13%	2.78	2.85	2.36	2%	-15%	-17%
FM17	0.85	2.26	2.44	165%	186%	8%	8.43	11.84	11.84	40%	40%	0%
FM18	0.12	0.18	0.19	47%	51%	3%	2.49	2.93	1.99	18%	-20%	-32%
FM19 and 20	2.46	2.67	2.75	8%	12%	3%	15.15	14.69	14.98	-3%	-1%	2%
FM21	1.89	2.04	2.19	8%	16%	7%	9.58	8.01	7.36	-16%	-23%	-8%
FM22	0.98	1.31	-1.77	34%	-280%	-235%	5.39	6.27	1.78	16%	-67%	-72%
FM23	2.63	4.34	7.62	65%	190%	76%	20.88	23.44	39.80	12%	91%	70%
FM24	0.22	0.23	0.26	6%	21%	13%	5.13	3.78	3.80	-26%	-26%	1%
FM25	2.07	2.71	2.68	31%	30%	-1%	11.14	14.20	13.86	27%	24%	-2%
FM26	0.52	0.55	0.33	6%	-36%	-40%	2.48	2.66	1.55	7%	-37%	-42%
FM27	2.17	2.71	2.82	25%	30%	4%	13.10	14.97	15.33	14%	17%	2%
FM28	4.44	8.00	8.47	80%	91%	6%	21.01	23.30	24.24	11%	15%	4%
FM29	1.54	1.75	1.39	14%	-10%	-21%	6.09	6.85	5.26	12%	-14%	-23%
FM30	2.33	4.55	4.62	95%	98%	2%	22.40	27.00	26.60	21%	19%	-1%
FM31	1.42	1.71	1.29	20%	-9%	-24%	5.56	5.74	4.09	3%	-26%	-29%
FM32	2.35	2.51	2.77	7%	18%	10%	13.09	12.74	13.20	-3%	1%	4%
FM33	3.77	3.31	4.35	-12%	15%	31%	18.77	16.92	22.76	-10%	21%	35%
FM34	2.18	2.34	2.14	7%	-2%	-8%	7.76	6.32	7.19	-19%	-7%	14%
FM35	1.52	2.40	3.48	58%	128%	45%	11.19	11.20	17.24	0%	54%	54%
FM36	2.79	2.84	3.34	2%	20%	17%	18.23	10.46	10.94	-43%	-40%	5%
FM37	2.90	4.01	4.39	38%	51%	10%	20.78	18.71	20.97	-10%	1%	12%
FM38	0.62	0.61	0.74	-1%	20%	20%	6.48	5.25	4.73	-19%	-27%	-10%
FM39	0.00	0.00	0.00	-	-	-	0.10	0.00	0.00	-	-	-
FM40	5.68	2.88	4.02	-49%	-29%	40%	21.02	16.45	17.78	-22%	-15%	8%
FM41	3.82	9.68	8.24	153%	116%	-15%	31.87	32.63	26.14	2%	-18%	-20%
FM42	1.48	2.13	2.21	44%	49%	4%	9.18	32.63	26.14	256%	185%	-20%
FM43	2.76	6.33	6.50	129%	135%	3%	42.69	34.88	34.11	-18%	-20%	-2%
FM44	1.56	6.73	7.03	331%	350%	4%	24.00	34.44	35.41	44%	48%	3%
FM45	0.85	0.29	0.41	-66%	-51%	42%	8.33	4.25	4.32	-49%	-48%	2%
FM46	0.71	1.10	0.96	53%	35%	-12%	5.86	5.25	4.41	-10%	-25%	-16%
FM47	2.04	3.93	3.77	93%	85%	-4%	17.09	19.24	18.62	13%	9%	-3%
FM48	0.17	0.17	0.01	0%	-92%	-92%	8.70	2.73	0.61	-69%	-93%	-78%
FM49	1.05	2.16	1.51	106%	43%	-30%	7.85	17.07	14.32	118%	82%	-16%
FM50	0.07	0.86	1.05	1103%	1373%	22%	2.34	5.89	6.52	152%	179%	11%
FM51	0.77	0.70	1.75	-10%	126%	151%	5.30	6.51	6.18	23%	17%	-5%
FM52	0.21	0.23	1.13	12%	441%	384%	4.48	6.31	6.33	41%	41%	0%
FM53	0.21	0.58	0.73	182%	250%	24%	1.56	5.33	5.45	242%	249%	2%
FM54	0.73	1.54	0.51	110%	-30%	-67%	10.33	10.21	9.43	-1%	-9%	-8%
FM55	1.03	2.33	2.72	126%	164%	17%	16.13	12.91	13.22	-20%	-18%	2%
FM56	1.19	2.33	2.72	95%	128%	17%	9.92	12.91	13.22	30%	33%	2%
FM57	1.71	1.85	0.88	8%	-49%	-53%	9.40	9.37	3.98	0%	-58%	-58%
FM58	6.51	7.40	7.60	14%	17%	3%	37.75	38.67	39.08	2%	4%	1%
FM59	0.82	0.77	1.58	-6%	93%	105%	3.88	4.22	8.69	9%	124%	106%

Jersey City Municipal Utilties Authority
Combined Sewer System Modeling Report
Table A-2: November 28, 2004 Model Comparison

	Total Volume (MG)						**Peak Flow (MGD)**					
Meter	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results
FM3	2.18	2.09	2.53	-4%	16%	21%	14.18	8.82	17.81	-38%	26%	102%
FM4	1.14	1.00	1.14	-12%	0%	13%	8.49	4.46	8.53	-47%	0%	91%
FM2 and 5	2.81	11.41	21.80	305%	675%	91%	17.99	11.41	21.80	-37%	21%	91%
FM6	5.94	7.69	9.06	29%	53%	18%	33.86	31.05	59.86	-8%	77%	93%
FM7	2.29	3.27	4.12	43%	79%	26%	6.99	5.76	8.62	-18%	23%	50%
FM8	2.74	2.71	3.61	-1%	32%	33%	20.97	14.02	31.96	-33%	52%	128%
FM9	1.80	1.86	1.49	3%	-18%	-20%	6.72	5.91	4.44	-12%	-34%	-25%
FM10	2.26	2.31	2.76	2%	22%	20%	23.38	9.92	21.19	-58%	-9%	114%
FM11	1.40	1.39	1.27	0%	-9%	-9%	6.78	4.31	4.15	-36%	-39%	-4%
FM12	0.74	0.86	1.05	17%	41%	21%	6.74	3.64	6.96	-46%	3%	91%
FM13	1.35	1.26	1.55	-7%	15%	23%	12.81	6.26	12.66	-51%	-1%	102%
FM14	0.97	1.28	1.12	32%	15%	-13%	3.71	3.12	2.74	-16%	-26%	-12%
FM15	1.25	1.36	1.68	9%	35%	24%	29.05	7.44	12.87	-74%	-56%	73%
FM16	0.67	0.85	0.65	26%	-4%	-24%	5.96	2.84	2.48	-52%	-58%	-13%
FM17	2.72	2.73	3.47	1%	28%	27%	16.73	11.56	19.48	-31%	16%	69%
FM18	0.09	0.62	0.77	612%	790%	25%	2.44	2.82	1.98	16%	-19%	-30%
FM19 and 20	2.42	3.01	3.86	24%	59%	28%	12.86	14.78	29.46	15%	129%	99%
FM21	2.48	2.39	2.65	-4%	7%	11%	13.39	8.30	10.34	-38%	-23%	25%
FM22	0.81	1.41	-1.77	73%	-317%	-225%	13.83	6.35	1.06	-54%	-92%	-83%
FM23	4.66	4.81	9.47	3%	103%	97%	40.88	23.31	88.61	-43%	117%	280%
FM24	0.42	2.93	1.07	602%	157%	-63%	5.65	23.78	3.89	321%	-31%	-84%
FM25	2.53	2.99	3.47	18%	37%	16%	19.82	14.21	35.66	-28%	80%	151%
FM26	0.63	0.83	0.65	33%	3%	-22%	3.16	2.75	1.59	-13%	-50%	-42%
FM27	0.43	2.92	3.68	578%	754%	26%	13.17	15.00	36.29	14%	176%	142%
FM28	6.91	12.18	12.90	76%	87%	6%	18.92	24.28	25.13	28%	33%	4%
FM29	1.68	2.58	1.94	53%	15%	-25%	7.81	6.69	5.28	-14%	-32%	-21%
FM30	2.82	4.47	5.75	58%	104%	29%	66.25	27.23	53.26	-59%	-20%	96%
FM31	1.70	2.49	1.71	46%	0%	-31%	8.51	5.75	4.01	-32%	-53%	-30%
FM32	3.37	3.39	3.55	0%	5%	5%	36.99	12.98	28.50	-65%	-23%	120%
FM33	4.55	4.48	5.68	-2%	25%	27%	35.70	41.42	59.73	16%	67%	44%
FM34	1.86	2.62	2.31	41%	24%	-12%	6.99	7.43	7.09	6%	1%	-5%
FM35	2.67	3.48	4.69	31%	76%	35%	35.09	25.97	39.34	-26%	12%	51%
FM36	2.89	3.37	3.59	17%	24%	7%	17.73	14.25	14.14	-20%	-20%	-1%
FM37	5.18	5.18	5.59	0%	8%	8%	46.93	32.11	33.27	-32%	-29%	4%
FM38	0.21	0.81	0.84	288%	305%	4%	15.05	12.46	8.85	-17%	-41%	-29%
FM39	0.01	0.02	0.02	189%	189%	0%	0.58	5.64	5.64	872%	872%	0%
FM40	7.26	5.24	6.60	-28%	-9%	26%	22.70	22.91	24.48	1%	8%	7%
FM41	7.94	14.65	12.81	85%	61%	-13%	29.46	38.86	26.88	32%	-9%	-31%
FM42	1.91	2.51	2.59	31%	36%	3%	16.75	19.40	18.97	16%	13%	-2%
FM43	3.24	7.47	7.83	131%	142%	5%	41.86	56.17	53.32	34%	27%	-5%
FM44	6.46	8.55	8.64	32%	34%	1%	63.63	55.78	54.84	-12%	-14%	-2%
FM45	1.23	0.70	0.78	-43%	-36%	12%	9.20	3.35	3.48	-64%	-62%	4%
FM46	1.65	1.24	1.14	-24%	-31%	-8%	14.94	6.28	6.78	-58%	-55%	8%
FM47	0.21	4.86	4.47	2258%	2068%	-8%	7.94	29.78	27.51	275%	246%	-8%
FM48	0.36	0.46	0.16	29%	-57%	-67%	5.88	2.73	0.62	-54%	-89%	-77%
FM49	0.54	2.91	2.06	436%	280%	-29%	6.22	39.11	22.56	528%	262%	-42%
FM50	1.54	1.04	1.22	-33%	-20%	18%	14.28	11.56	17.23	-19%	21%	49%
FM51	1.23	1.10	2.10	-11%	71%	92%	6.72	4.46	6.04	-34%	-10%	35%
FM52	0.63	0.11	1.36	-83%	117%	1173%	5.24	6.06	8.57	16%	63%	41%
FM53	0.14	0.84	0.88	489%	521%	5%	2.36	11.63	7.63	392%	223%	-34%
FM54	1.08	1.83	1.06	70%	-2%	-42%	14.19	7.54	4.91	-47%	-65%	-35%
FM55	2.65	3.02	3.22	14%	22%	7%	24.05	23.22	24.42	-3%	2%	5%
FM56	2.28	3.02	3.22	32%	41%	7%	17.08	23.22	24.42	36%	43%	5%
FM57	2.57	2.52	1.58	-2%	-39%	-37%	11.50	5.74	3.59	-50%	-69%	-37%
FM58	8.10	8.76	8.75	8%	8%	0%	51.57	86.03	82.37	67%	60%	-4%
FM59	0.81	0.91	1.83	12%	125%	102%	5.11	7.81	17.46	53%	242%	124%

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Table A-3: December 1, 2004 Model Comparison

	Total Volume (MG)						**Peak Flow (MGD)**					
Meter	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results
FM3	1.95	1.97	2.05	1%	5%	4%	8.94	10.82	11.43	21%	28%	6%
FM4	0.98	0.54	0.92	-45%	-6%	71%	5.39	2.37	5.53	-56%	3%	133%
FM2 and 5	2.41	0.00	0.00	-	-	-	14.42	0.00	0.00	-	-	-
FM6	6.12	6.69	7.26	9%	19%	9%	39.83	34.91	39.48	-12%	-1%	13%
FM7	1.93	2.29	3.24	19%	68%	41%	7.78	5.90	8.28	-24%	6%	40%
FM8	2.14	2.37	2.52	11%	18%	6%	13.51	14.38	15.19	6%	12%	6%
FM9	1.71	1.54	1.43	-10%	-16%	-7%	6.17	5.33	4.15	-14%	-33%	-22%
FM10	1.83	1.91	1.89	4%	3%	-1%	11.57	5.33	4.15	-54%	-64%	-22%
FM11	0.81	1.19	0.97	46%	19%	-18%	5.77	4.33	4.09	-25%	-29%	-6%
FM12	0.74	0.71	0.73	-3%	-1%	2%	2.87	3.53	3.84	23%	34%	9%
FM13	1.15	0.63	1.07	-46%	-7%	71%	6.37	2.81	6.13	-56%	-4%	118%
FM14	0.79	1.06	0.98	34%	24%	-8%	3.88	3.10	2.66	-20%	-32%	-14%
FM15	0.88	0.63	1.20	-28%	37%	90%	18.97	2.32	6.73	-88%	-65%	190%
FM16	0.00	0.62	0.67	-	-	-	0.00	2.07	2.45	-	-	-
FM17	1.68	2.25	2.39	34%	42%	6%	10.63	11.43	11.92	8%	12%	4%
FM18	0.01	0.24	0.24	2335%	2366%	1%	0.80	2.86	1.98	257%	147%	-31%
FM19 and 20	2.35	2.60	2.66	11%	13%	2%	12.47	14.04	15.07	13%	21%	7%
FM21	2.31	2.15	2.35	-7%	2%	10%	9.10	8.38	8.59	-8%	-6%	2%
FM22	0.78	1.44	-1.89	84%	-342%	-231%	5.33	7.07	1.24	33%	-77%	-82%
FM23	4.91	4.79	8.25	-2%	68%	72%	31.82	26.78	44.20	-16%	39%	65%
FM24	0.19	0.30	0.28	60%	49%	-7%	5.62	4.28	3.83	-24%	-32%	-10%
FM25	2.32	2.98	2.88	28%	24%	-3%	14.54	16.09	16.37	11%	13%	2%
FM26	0.36	0.67	0.37	86%	2%	-45%	2.46	3.06	1.58	24%	-36%	-49%
FM27	2.75	3.01	3.06	9%	11%	2%	17.52	17.32	17.20	-1%	-2%	-1%
FM28	5.33	8.89	9.33	67%	75%	5%	18.92	23.96	23.84	27%	26%	0%
FM29	1.54	2.19	1.66	42%	8%	-24%	6.42	7.36	5.33	15%	-17%	-28%
FM30	1.12	4.84	4.94	332%	340%	2%	16.40	31.79	30.92	94%	89%	-3%
FM31	0.95	2.10	1.50	120%	57%	-29%	4.06	6.04	4.05	49%	0%	-33%
FM32	1.52	2.85	2.83	88%	86%	-1%	9.51	12.95	14.05	36%	48%	8%
FM33	4.31	3.57	4.58	-17%	6%	28%	18.71	18.10	25.49	-3%	36%	41%
FM34	2.69	2.64	2.33	-2%	-13%	-12%	8.40	7.83	6.10	-7%	-27%	-22%
FM35	2.68	2.68	3.72	0%	39%	39%	19.21	11.73	18.97	-39%	-1%	62%
FM36	3.17	3.20	3.65	1%	15%	14%	18.15	10.52	11.09	-42%	-39%	5%
FM37	4.38	2.85	2.90	-35%	-34%	2%	23.92	22.94	10.30	-4%	-57%	-55%
FM38	0.07	0.18	0.31	177%	375%	72%	5.65	2.06	1.73	-64%	-69%	-16%
FM39	0.01	-0.03	-0.03	-755%	-755%	0%	0.33	0.78	0.78	134%	134%	0%
FM40	6.70	2.56	3.46	-62%	-48%	35%	21.85	11.87	16.03	-46%	-27%	35%
FM41	2.16	11.40	10.23	428%	374%	-10%	29.88	28.88	28.10	-3%	-6%	-3%
FM42	1.76	1.15	1.21	-34%	-31%	5%	8.05	4.35	5.18	-46%	-36%	19%
FM43	1.23	3.30	3.55	168%	189%	8%	19.03	13.90	14.40	-27%	-24%	4%
FM44	4.72	3.93	4.15	-17%	-12%	6%	32.34	15.01	15.93	-54%	-51%	6%
FM45	0.58	0.39	0.66	-32%	15%	69%	7.77	4.44	4.43	-43%	-43%	0%
FM46	1.52	1.09	1.11	-28%	-27%	1%	10.31	4.57	4.61	-56%	-55%	1%
FM47	1.16	4.21	4.10	261%	252%	-2%	17.64	19.05	20.15	8%	14%	6%
FM48	0.37	0.26	0.01	-28%	-97%	-96%	6.08	2.77	0.37	-54%	-94%	-87%
FM49	0.57	2.24	1.49	292%	160%	-34%	13.78	19.36	12.78	41%	-7%	-34%
FM50	0.12	0.92	1.21	691%	947%	32%	3.10	7.17	8.59	131%	177%	20%
FM51	0.49	1.05	2.39	113%	386%	128%	5.83	7.00	7.93	20%	36%	13%
FM52	0.22	0.31	1.52	41%	589%	388%	4.43	7.39	8.22	67%	85%	11%
FM53	0.11	0.57	0.86	440%	721%	52%	2.73	5.42	7.90	98%	189%	46%
FM54	0.70	2.48	1.54	252%	118%	-38%	14.40	11.49	9.61	-20%	-33%	-16%
FM55	0.21	2.59	2.93	1117%	1274%	13%	6.88	14.86	14.38	116%	109%	-3%
FM56	0.56	2.59	2.93	360%	419%	13%	9.11	14.86	14.38	63%	58%	-3%
FM57	0.89	2.33	1.15	162%	29%	-51%	6.72	9.39	3.91	40%	-42%	-58%
FM58	6.40	8.16	8.23	28%	29%	1%	41.02	45.53	47.63	11%	16%	5%
FM59	0.77	0.44	0.82	-43%	8%	89%	3.37	1.93	3.92	-43%	16%	103%

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Jersey City Municipal Utilties Authority
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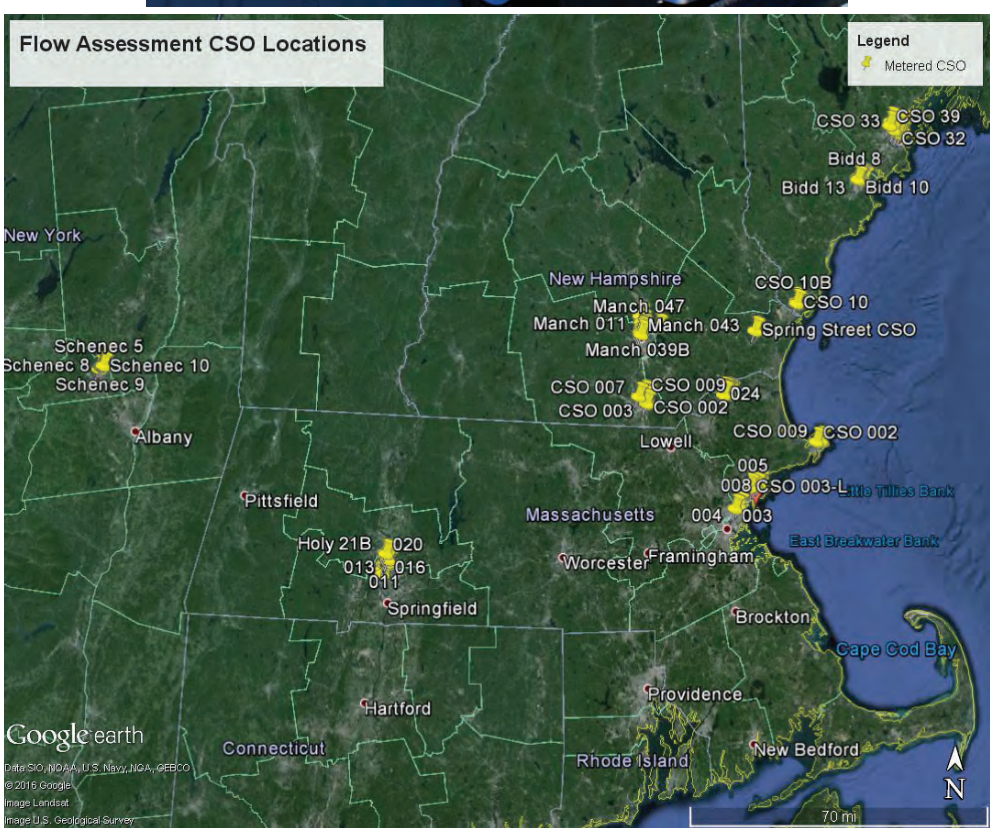
Table A-4: December 7, 2004 Model Comparison

	Total Volume (MG)						Peak Flow (MGD)					
Meter	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results	Meter Data	XPSWMM Model Results	PCSWMM Model Results	Percent Difference - XPSWMM Model and Meter Data	Percent Difference - PCSWMM Model and Meter Data	Percent Difference - PCSWMM and XPSWMM Results
FM3	2.94	3.06	3.30	4%	12%	8%	7.60	8.09	9.59	6%	26%	19%
FM4	1.58	1.41	1.52	-11%	-4%	8%	4.04	3.81	4.66	-6%	15%	22%
FM2 and 5	4.38	4.51	4.79	3%	9%	6%	11.07	3.87	11.73	-65%	6%	203%
FM6	9.48	11.62	12.46	23%	31%	7%	27.87	30.37	32.73	9%	17%	8%
FM7	8.51	8.02	10.30	-6%	21%	28%	7.83	5.42	8.13	-31%	4%	50%
FM8	3.82	3.45	3.85	-10%	1%	12%	11.56	12.44	14.16	8%	22%	14%
FM9	3.42	3.24	3.45	-5%	1%	6%	6.35	4.91	3.98	-23%	-37%	-19%
FM10	2.73	3.57	3.66	31%	34%	2%	5.47	4.91	3.98	-10%	-27%	-19%
FM11	1.74	3.43	3.49	96%	100%	2%	4.28	4.31	4.09	1%	-4%	-5%
FM12	1.49	1.33	1.38	-11%	-7%	4%	3.14	3.29	3.50	5%	11%	6%
FM13	1.11	1.26	1.55	14%	40%	23%	5.74	4.39	5.68	-24%	-1%	30%
FM14	2.30	2.45	2.61	6%	13%	7%	3.56	3.09	2.66	-13%	-25%	-14%
FM15	0.34	0.68	1.07	100%	214%	57%	1.42	3.20	5.61	126%	296%	75%
FM16	0.94	0.68	1.01	-28%	8%	49%	2.47	2.71	2.43	10%	-2%	-11%
FM17	1.16	4.70	5.02	306%	334%	7%	14.29	10.54	10.74	-26%	-25%	2%
FM18	0.07	3.64	2.48	5342%	3602%	-32%	2.81	2.96	1.98	5%	-29%	-33%
FM19 and 20	3.24	3.89	4.17	20%	29%	7%	9.76	13.32	13.75	36%	41%	3%
FM21	2.75	3.76	4.07	37%	48%	8%	7.53	7.55	7.58	0%	1%	0%
FM22	0.45	1.30	-0.75	189%	-267%	-158%	6.66	5.36	0.98	-20%	-85%	-82%
FM23	4.75	5.20	7.96	10%	68%	53%	20.02	19.18	31.41	-4%	57%	64%
FM24	1.36	2.82	3.16	107%	133%	12%	4.45	3.96	3.78	-11%	-15%	-5%
FM25	3.43	3.21	3.24	-6%	-5%	1%	14.83	12.58	11.98	-15%	-19%	-5%
FM26	2.24	2.45	1.77	9%	-21%	-28%	3.21	2.77	1.53	-14%	-52%	-45%
FM27	1.60	2.60	2.90	63%	82%	11%	11.21	12.65	12.31	13%	10%	-3%
FM28	20.15	32.30	33.60	60%	67%	4%	20.07	29.63	23.11	48%	15%	-22%
FM29	5.86	5.45	6.99	-7%	19%	28%	6.71	6.69	4.94	0%	-26%	-26%
FM30	0.90	3.29	3.52	265%	290%	7%	31.57	26.16	25.68	-17%	-19%	-2%
FM31	4.78	5.07	6.24	6%	31%	23%	7.34	5.90	4.07	-20%	-44%	-31%
FM32	4.34	5.08	4.56	17%	5%	-10%	8.85	8.83	11.66	0%	32%	32%
FM33	7.73	5.38	6.47	-30%	-16%	20%	22.05	15.82	20.59	-28%	-7%	30%
FM34	4.69	5.44	5.76	16%	23%	6%	8.24	6.42	6.02	-22%	-27%	-6%
FM35	4.30	5.24	6.22	22%	45%	19%	28.78	10.56	15.20	-63%	-47%	44%
FM36	4.49	5.88	6.85	31%	53%	17%	17.23	10.37	10.78	-40%	-37%	4%
FM37	2.52	7.33	7.89	191%	213%	8%	16.70	14.63	14.34	-12%	-14%	-2%
FM38	0.04	0.36	0.62	745%	1358%	73%	2.06	5.26	3.73	156%	81%	-29%
FM39	0.01	0.16	0.16	2581%	2581%	0%	0.17	13.97	13.97	8208%	8208%	0%
FM40	15.94	14.04	14.25	-12%	-11%	1%	17.22	17.72	16.26	3%	-6%	-8%
FM41	19.16	39.27	38.66	105%	102%	-2%	31.47	33.01	26.36	5%	-16%	-20%
FM42	2.33	2.30	2.61	-1%	12%	13%	50.39	7.67	8.27	-85%	-84%	8%
FM43	1.27	5.99	7.69	372%	505%	28%	30.72	15.53	19.35	-49%	-37%	25%
FM44	4.89	9.58	9.77	96%	100%	2%	46.42	17.81	21.44	-62%	-54%	20%
FM45	4.06	3.14	4.06	-23%	0%	29%	7.68	4.25	4.03	-45%	-48%	-5%
FM46	1.84	1.28	1.35	-30%	-26%	6%	7.99	2.98	2.98	-63%	-63%	0%
FM47	7.67	5.64	5.80	-26%	-24%	3%	316.19	12.25	12.16	-96%	-96%	-1%
FM48	0.16	1.99	0.06	1119%	-66%	-97%	2.96	2.74	1.11	-8%	-62%	-59%
FM49	1.15	2.86	0.99	149%	-14%	-65%	24.51	6.18	6.84	-75%	-72%	11%
FM50	0.50	1.37	1.72	173%	242%	25%	11.17	2.36	6.07	-79%	-46%	158%
FM51	1.39	3.78	6.17	172%	343%	63%	3.37	4.62	6.52	37%	94%	41%
FM52	0.60	2.52	4.76	319%	690%	89%	3.74	10.91	6.40	192%	71%	-41%
FM53	0.16	0.93	1.29	469%	691%	39%	1.23	1.72	1.91	40%	56%	11%
FM54	5.78	7.49	6.83	30%	18%	-9%	19.32	7.76	8.25	-60%	-57%	6%
FM55	1.19	3.97	4.47	234%	276%	13%	14.77	4.44	9.92	-70%	-33%	124%
FM56	0.87	3.97	4.47	354%	411%	13%	8.86	4.44	9.92	-50%	12%	124%
FM57	5.97	8.01	5.34	34%	-11%	-33%	8.63	9.42	3.94	9%	-54%	-58%
FM58	8.19	10.11	10.72	24%	31%	6%	38.60	29.77	32.46	-23%	-16%	9%
FM59	1.27	0.91	1.60	-28%	26%	75%	2.94	3.01	6.32	3%	115%	110%

APPENDIX B

2016 Supplemental Flow Monitoring Program Data Quality Assurance Information

Flow & CSO Data Quality Assurance and Reporting



Flow Data Analysis and Data Quality Assurance

Flow Assessment Services, LLC is the largest and most experienced independent flow service provider in New England and the Mid-Atlantic Region. Our data quality has provided value to professional engineers, hydraulic modelers, municipalities and others in the collection system sector for nearly two decades. Our average uptime exceeds 95%, and we guarantee our performance.

Our data quality program is a multi-step disciplined approach that starts in the field, partners between the field and our tech group, and culminates with our data QA/QC process. A tremendous amount of hands-on experience is applied to each step, as described in this document.

Flow Site Selection

Flow Assessment crew chiefs have the experience to spot flow metering site issues. It is the first thing we do for every new flow monitoring installation, and the most important service we offer to our client.

Using the maps supplied by our client, Flow Assessment field crews check each selected site for hydraulic suitability. Some sites may look good on paper, or on GIS, but in the field have problems such as dropped flow, sideline flow, swirling flow from obstructions, or other complications that ruin the vectors for velocity or level measurement. Our field crews are expert at culling these. And at providing good alternative metering sites if at all possible.

Our experience has shown that we cannot squeeze good data from bad hydraulics. We have intimate knowledge of the limitations of the flow monitoring technology available today, and we know how to work within them. So we will not waste your money, or your client's money, trying to monitor a bad collection system site.

Essentially we are looking for places where the velocity vector is fairly perpendicular to our point of measurement in the horizontal plane. Levels of 2" or more would be ideal, but we have tools to work with lower levels. Velocities of 0.5 feet/second would be best, but we have tools to work with low velocities; on a similar note we have tools to work with high velocities.

Flow Assessment field crews investigate each site from the ground and/or from the level of the flow. Final choices are made with our clients. Full documentation is provided with photographs of the flow profile, sensor installation, sketches of the flow monitor deployment, street view, and GIS information of the location.

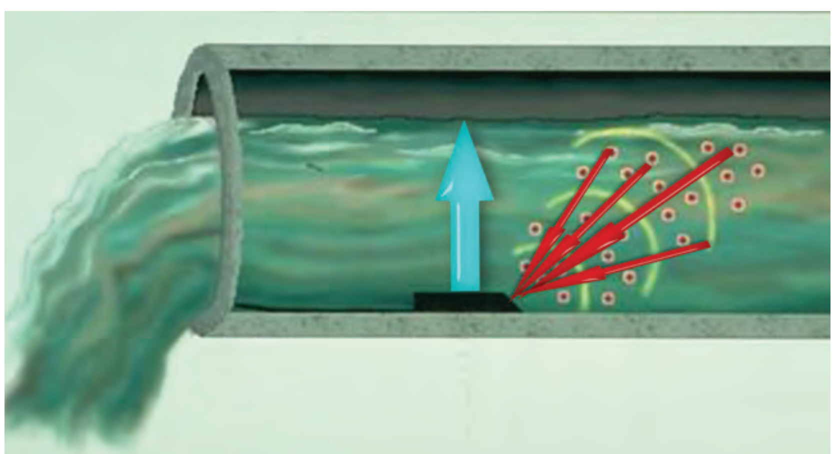
The Right Tools for Each Site

Once we choose a good metering site, we apply the right flow metering technology. This is where our independence becomes valuable to our clients. Flow Assessment owns and applies technology from all of the major flow meter manufacturers in the United States, and some companies that are not so well known. We are constantly watching for emerging technology, and testing it in the field for performance & reliability before deploying with our clients. Many of the major manufacturers seek us out to assist with field beta testing and to consult with practical design considerations.

This breadth and versatility allows us at Flow Assessment to recommend and install the right equipment, or combination of technologies, that will provide the best measurement at each location.

For most installations we will use an area-velocity flow meter, also known as a depth and velocity flow meter.

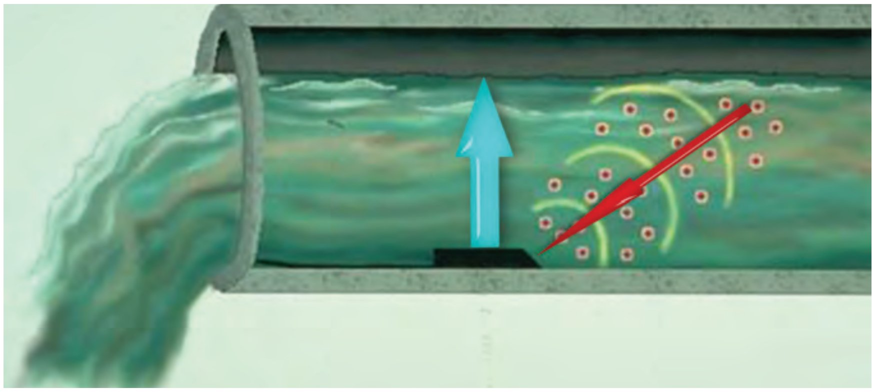
In this picture the continuous wave area-velocity flow meter is sending and receiving a Doppler ultrasonic signal simultaneously to measure velocity and using a microprocessor based pressure sensor to measure level. The meter is processing Doppler reflections from all over the flow profile



to provide a true average of the velocity. The level sensor is a surrogate for area, so the meter is solving the flow equation:

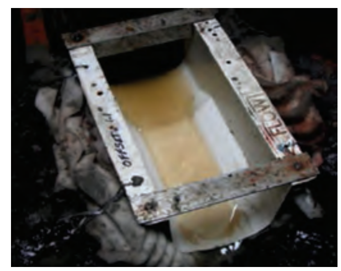
$$Q_{flow} = \text{Area} \times \text{Velocity}$$

This is a similar continuous wave area-velocity flow meter, but instead of providing a continuous

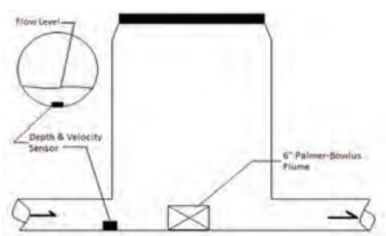


average of the velocity profile it measures peak velocity and multiplies it by a pre-measured factor.

Most area-velocity flow meters have a lower limit of ~1” of level and ~0.5 feet/second velocity. If flow at the selected site regularly hit the push the lower limit of the area-velocity meter, we will deploy an insert Palmer-Bowlus Flume. This will catch the very low flows up to approximately ½ pipe.

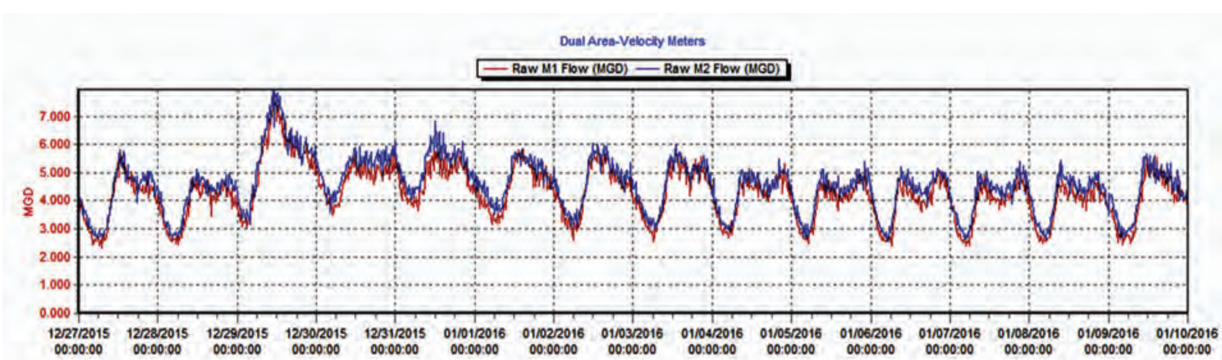


If flows range from very low to very high (or even full pipe), we will deploy the area-velocity meter and the Palmer-Bowlus Flume in series.



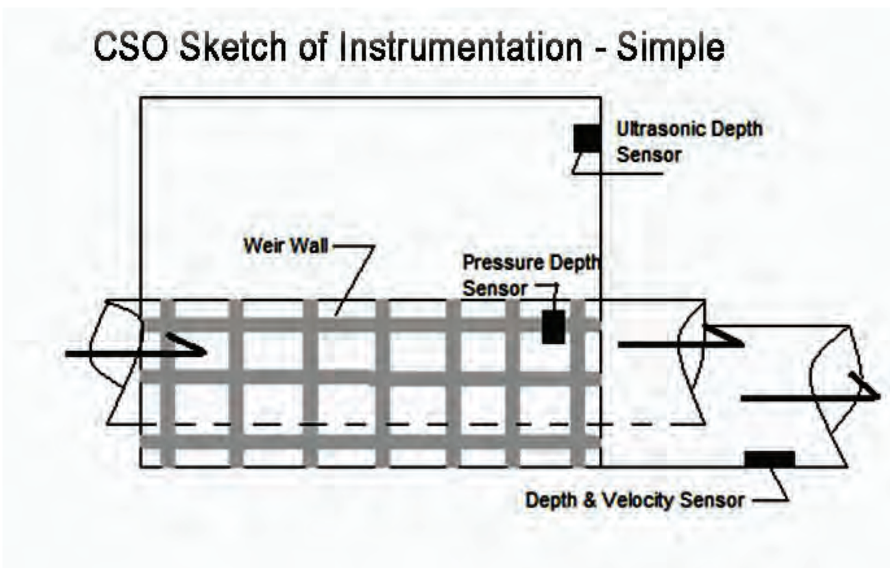
This allows us to accurately measure the low flows with the flume, and the high-to-surcharge flows with the area-velocity meter. In-between we enjoy having redundant flow meters which give us a very high degree of confidence in the flow meter readings.

One of the continuous wave area-velocity meters we use allows us to install multiple sensors in the same application. This is valuable for sensitive sites where data quality and verification are crucial. Statistically the chances of independent redundant flow sensors erring in agreement are miniscule.



For fast, shallow flows or for very high velocity applications we have had success with the newer laser technology. We also own the non-contact radar technology flow meters.

For combined sewer overflows (CSO), Flow Assessment personnel have been monitoring outfalls that are tidally influenced for nearly two decades. Here experience has taught us that each outfall is unique, and each one presents its own challenges. Our field and technical group work closely for the best strategic deployment of sensors to provide us with the information to determine what is occurring during an overflow event. Knowing the dry weather flow to a regulator, the dry weather flow out of a regulator, the overflow from the regulator, the angularity (or other control indication) of the tide gate, the velocity vector of each segment, the tide, and a large series of real-time levels is crucial to making decisions at our data analysis group. Flow Assessment has developed and maintained a large toolbox of level, velocity, flow and angularity (inclinometer) sensors along with local recording telemetry units that allow us to gather data in a dynamic and malleable way that has proven suitable for even the most complex CSO outfalls.



Expert Installation

Maintaining a better than 95% uptime average starts with expert installation. For area-velocity sensors we use a mounting band of our own manufacture that allows us to strap all cables down to minimize catching debris. If we deploy a flume, we assure it being level & true with sufficient high-density foam (for temporary installations) under the flume to compensate for imperfections in the manhole. Any other sensor is installed with proper hardware to withstand corrosion, stay out of debris flow, and look professional.

Even though our sensors are pre-calibrated, we calibrate each sensor in-situ. Each level sensor is carefully checked against the reading, and calibrated if needed. Each velocity sensor is carefully checked against an electronic handheld instrument, and the appropriate average velocity is checked against the meter reading. If any flow meter or sensor readings do not calibrate to tolerance, they are removed and replaced on the spot.

Within the first 24-48 hours of installation, we return to the new sites to make sure each is operating as we left it. The sensors are checked again for calibration. Our field crews download the stored data and look for any anomalies. Any equipment that is questionable is replaced on the spot. If the data download indicates that a change of flow metering equipment is needed or that a supplement of the installed flow metering equipment is needed, we install it on the spot.

Maintenance Visit with Field Data Analysis

Flow Assessment provides a unique advantage during our flow meter site maintenance visits. Not only do our field crews enter the manhole or other confined space to inspect each sensor and physically calibrate the level, but they download and analyze the data in the field. This distinctive skill and level of training can save as many as 4 weeks of data downtime.

Typically we return to each of our flow metering sites on a weekly basis to:

- Enter the manhole
- Inspect the sensors for damage or debris
    - Inspect all cabling for damage or debris
- Physically measure the flow level and compare this to the sensor reading
    - Adjust the sensor if needed
        - Note any changes in our proprietary online database
- Physically measure the average velocity if needed
- Download and analyze the data in the field
    - Look for changes in the flow that need to be addressed with immediate equipment changes
    - Look for issues in the equipment that require immediate changes
    - Analyze patterns that offer ways to improve measurement
        - Such as repositioning sensors
            - Or adding sensors

Rather than have our field crews simply download data from the flow metering equipment, send that data to the data analyst, and wait for the data analyst to determine if changes are needed, Flow Assessment crews are trained and experienced in reading data in the field for that purpose. All crews have sufficient spares on hand to swap equipment as needed to minimize downtime. If changes are needed, then the changes are made on the spot and not 2-4 weeks later.

Data Quality Analyis, Assurance and Reporting

Final data QA/QC (quality analysis and quality control) is our method of overseeing that the rigorous field work has been successful. At the front end of this process we:

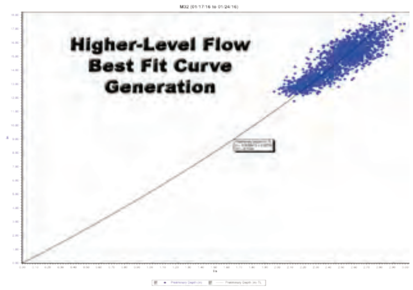
- ✓ Analyze the data point-by-point for logical completeness
    - o Does each data point represent reasonable quality?
    - o Are there any data gaps?
        - ▪ If so, why?
            - Can the gaps be filled using unique individual pipe curves?
    - o Are there any outliers?
        - ▪ Can the outliers be explained, and logically edited into a best-fit curve?
- ✓ Levels versus velocities – do these values correlate as they should?
    - o How do the redundant levels (if employed) line-up?
- ✓ Flow balance – do the meter site flows balance?

Generally our careful work in the field: installation, calibration and frequent maintenance yield data that is accurate and complete. But periodically we find that level sensors will drift and indicate the need for a slight adjustment of the level data set to compensate; we do fully document this adjustment and maintain the original raw data. The average velocity from the continuous wave area-velocity meter may not agree with our field measurement of average velocity, especially in some larger pipes where the velocity sensor doesn't have the power to read into higher levels; here an adjustment of the velocity data set is indicated. We fully document this adjustment and maintain the original raw data.

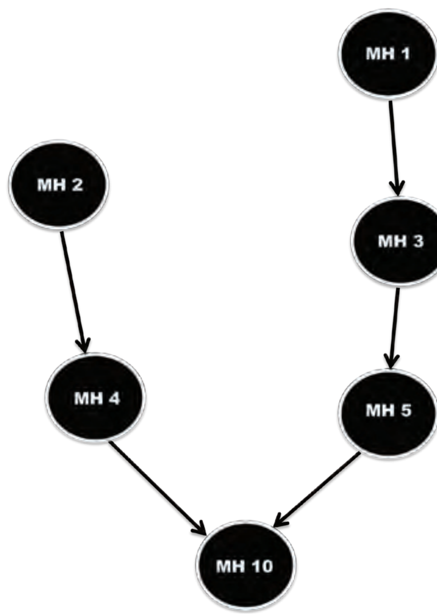
If it is necessary to move outliers due to "pops" caused by debris moving across the sensor or hydraulic transients, then we use best fit curves and/or individual pipe rating curves as our primary calculation. Manning equation estimates are an absolute last resort and rarely employed by us.

Our trained data analysts can see a wealth of information from the diurnal level-versus-velocity hydrograph at most sites. For well-developed flow these data sets will move in a nice correlated pattern. During surcharge they will move apart in a classic pattern. But we supplement this diurnal pattern analysis with a series of flow data analysis tools that Flow Assessment personnel have developed and honed over two decades of flow data reporting.

We develop rating curves for each site over short periods of time; typically one week. For some sites we will develop 3 rating curves for each site: one for very low flows, one for average flows, and one for high flows. We find this can be important if the flow characteristics change radically in the 3 flow regimes. All data from the short time period is compared to the rating curve, and adjustment decisions are made using this comparison and the extensive field notes conveyed online via Flow Assessment's proprietary *FieldSynch* database.



Finally, looking at the sewer map and flow vectors, do the flows balance? In other words, do the flows increase as they travel downstream, and do they increase logically? This is part of the overall QA/QC performed by the Flow Assessment data analysis team for typical collection system flow monitoring.



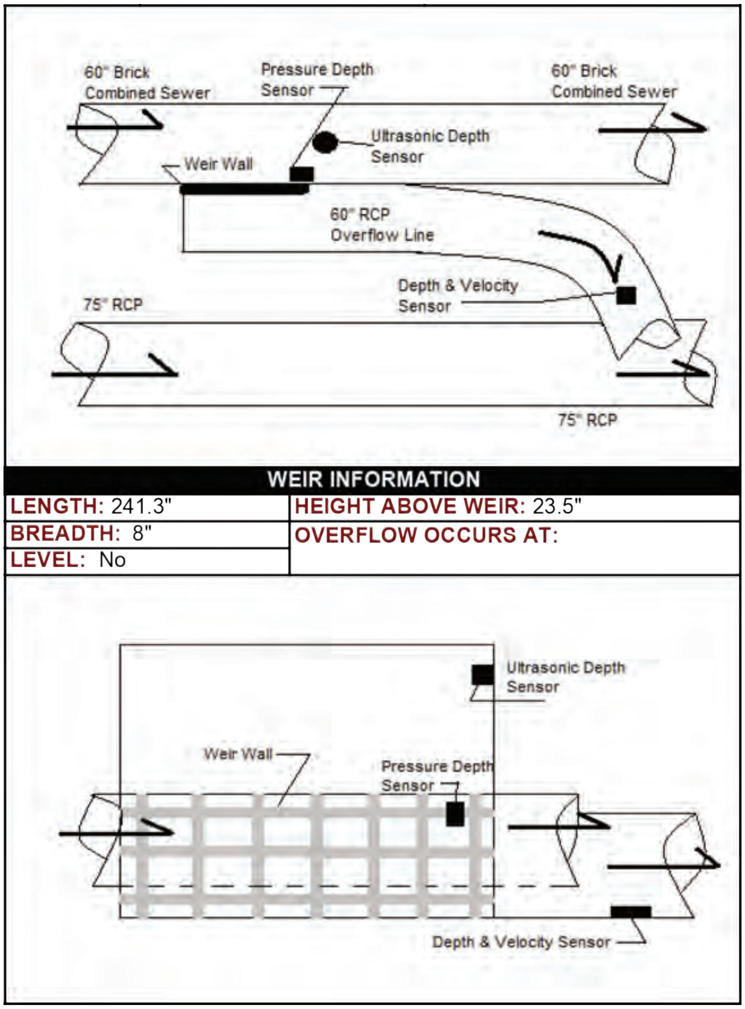
CSO OUTFALL DATA ANALYSIS

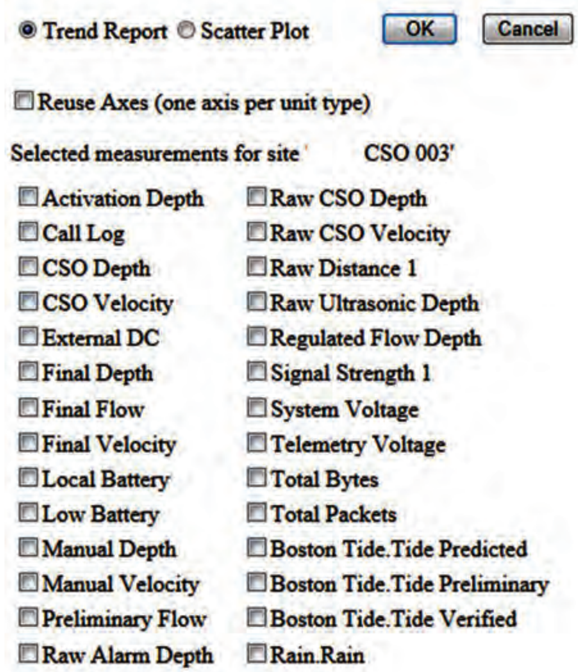
Based on our nearly two decades of experience, CSO outfall monitoring is an art and a science. Our practice is to deploy as many sensors as we can to obtain logical and strategic measurements, and then use the data to determine exactly what is happening during overflow events (or apparent events). Combined sewer overflows are typically short-duration high turbulence actions that can be very challenging to measure. We break each regulator chamber and outfall into component parts and apply strategic measurement sensors so our data analysts can provide fully defensible information about time, duration and volume of each event.

Typical combined sewer regulators and outfalls were designed & built about a century ago with only one goal: relieve the sewer if the level exceeds a certain value. Since most of these are not made for metering, we have to find places to measure level, velocity, angularity, salinity, differential level, level over a weir, area x velocity, rainfall, tide, or any other information that our data analysts can assimilate to verify that a combined sewer has discharged. And we need to use that information to determine volume & duration in a way that is fully defensible to the local, state and federal authorities.

In many cases these multiple sensor measurements will provide other valuable data as well. Some examples of this are shown below.

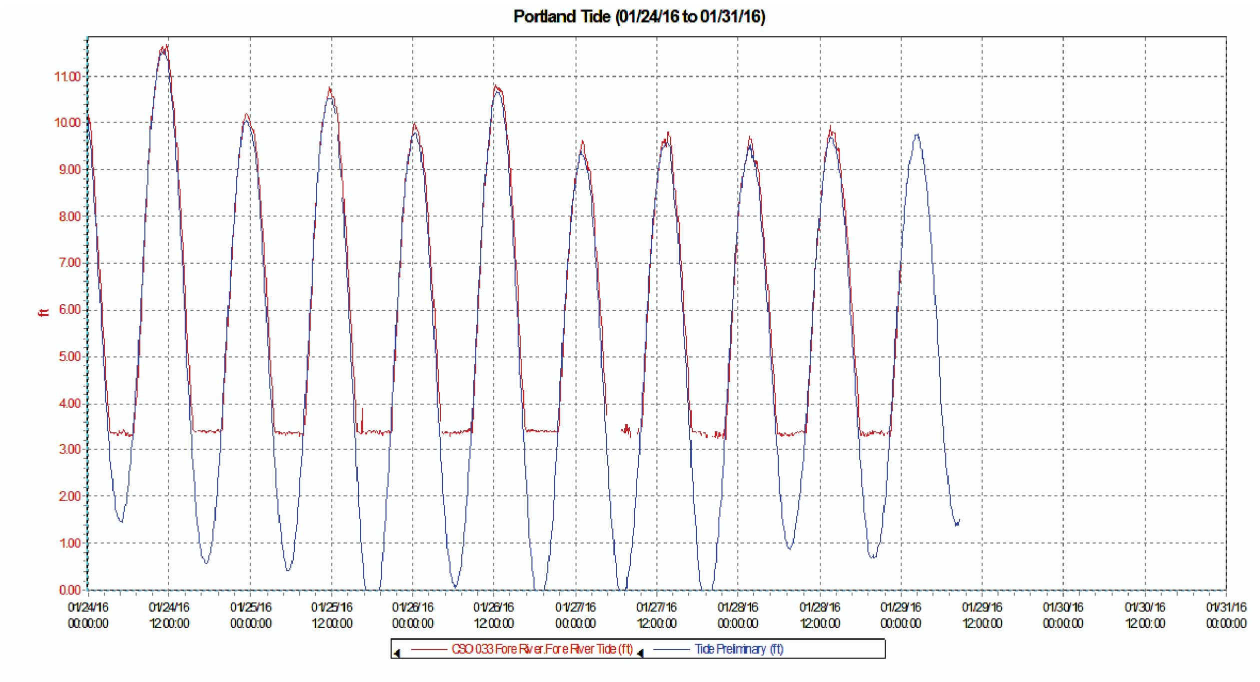
One example of a chamber and the data used for analysis can help illustrate the strategic deployment of measurement sensors and the data that can come from them:



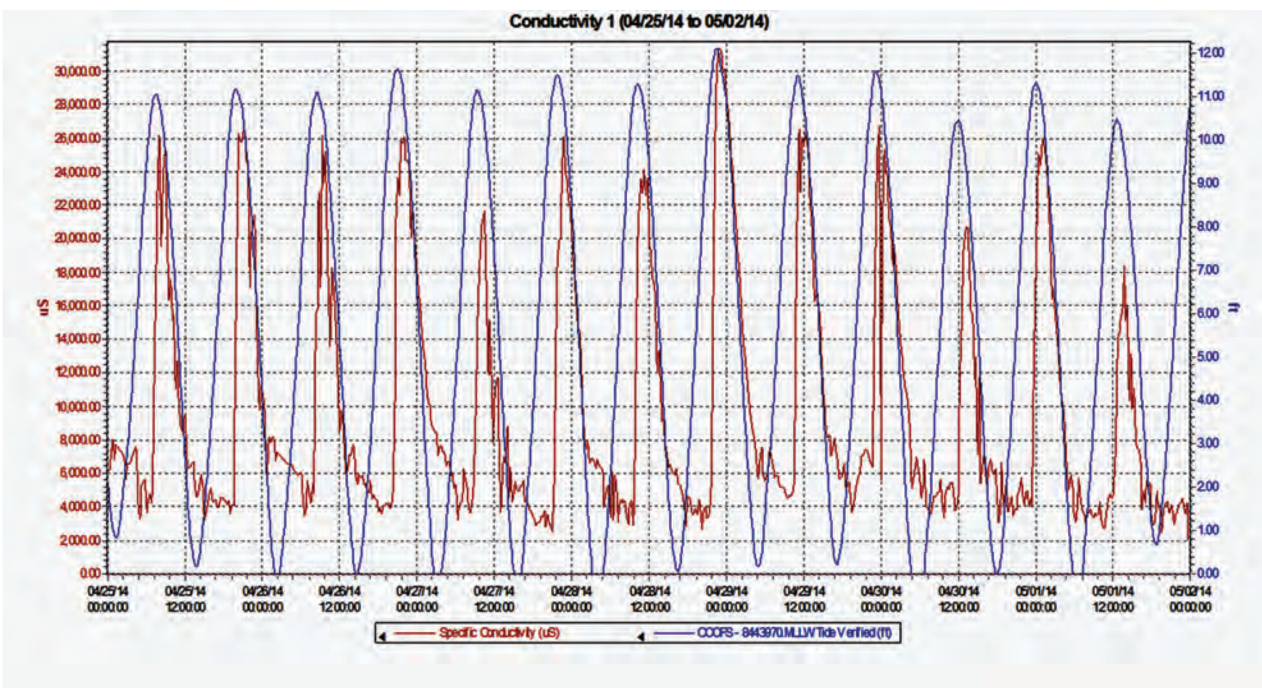


With our enterprise data system we have a data module that allows us to link directly to the NOAA data server. The tide data is automatically imported into the project's database. We capture the predicted, preliminary and verified tide data (the verified data is populated after NOAA reviews it). The NOAA data is recorded in 6 minute intervals. We do monitor tide but often the NOAA data is sufficient.

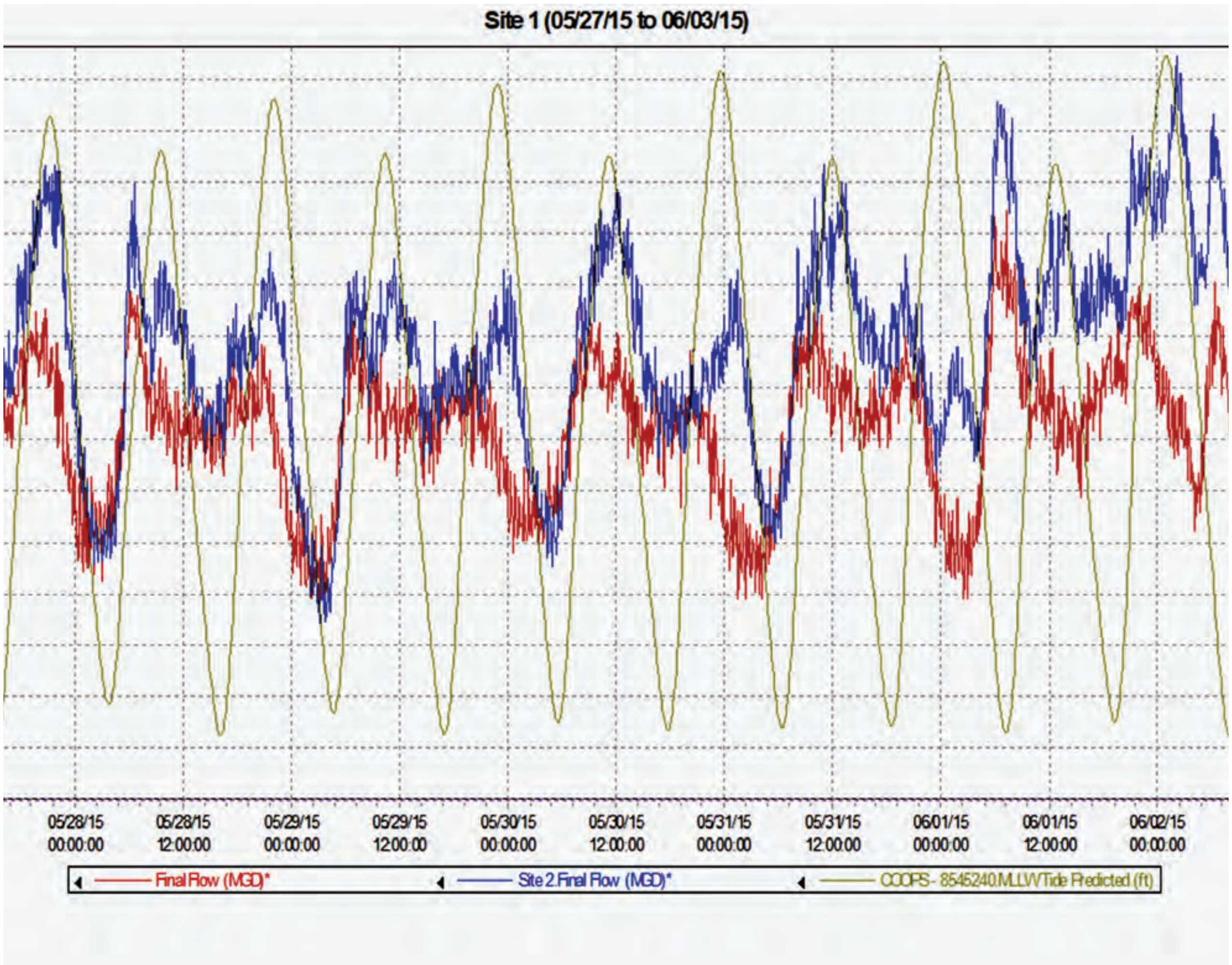
We have a site in Maine where we are monitoring a CSO in the overflow structure. We have the ability to monitor most of the tide cycle in that structure but miss the minimums. The intent here is to monitor backwater effects and to see the correlation between NOAA data and this location. The sensor in this example is an ultrasonic sensor, but we have deployed some redundant pressure level sensors as well. Below is a graph from one week comparing our tide data vs. the NOAA preliminary data. You can see our data bottoms out at 3.4 feet due to the structure's invert. NOAA data is in blue, and ours is in red.



Here is an example where the tide trend is needed more than the elevation. It is a graph of the conductivity vs. the tide. On this project we used logging conductivity sensors looking for tide infiltration. We leapfrogged them up a sewer line every other week and were able to identify side lines that were contributing tidal infiltration.



Another example where the tide trend is needed more than the elevation. In this example Site 1 flows into Site 2. Our goal was to identify infiltration. The regularity of the flow pattern suggested a tidal influence. This site is 30 miles upriver from the City of Philadelphia, so the Philadelphia tide data was slightly time-delayed at this measurement point. We overlaid the tide onto our flow data, time shifted it, and it proved we were seeing a tidal issue. Our field investigation discovered a failed manhole corbel that was taking on water at high tide between Site 1 and Site 2, so a major find.



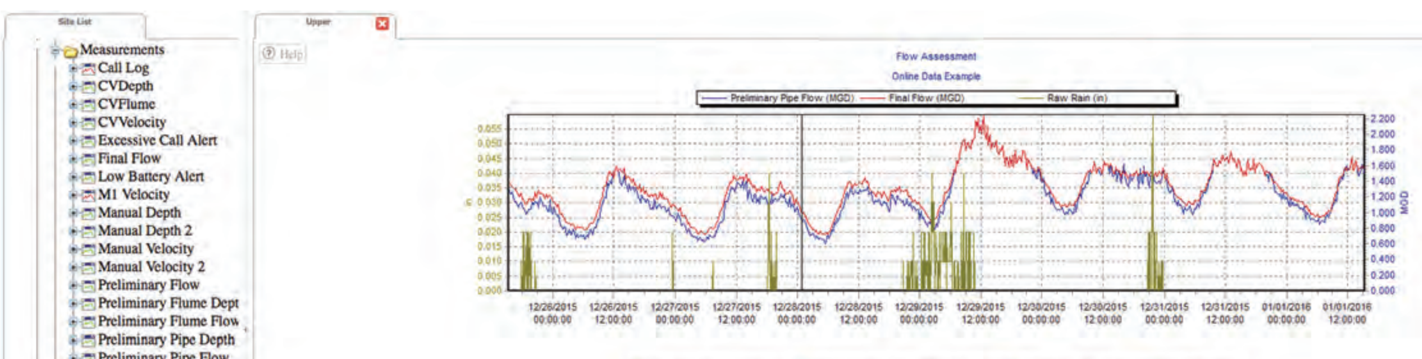
Online Data: Raw + Preliminary + Final

During the course of our flow monitoring, and for an indefinite period of time, the progressive data for the project will be posted online. The user will be able to see raw data sets such as level, velocity, flow (rate and total), and other parameters measured such as rainfall. When telemetry is employed, the raw data is uploaded directly from each sensor in near-real-time (about every 4 hours for battery conservation).

In some cases, we will apply offsets to the sensors to enhance performance. In our dataset marked "preliminary" we will show the early data with the offsets stripped. Over time the preliminary data will begin to show some early QA/QC.

At the end of a short-term project, and at agreed intervals of a longer-term or permanent project, Flow Assessment will post final data that can be read on the same X and Y coordinates with the raw data.

We maintain raw, preliminary and final data for you indefinitely; way beyond the end of the contract period.



	#	Timestamp	Preliminary Pipe Flow (MGD)	Final Flow (MGD)	Raw Rain (in)
	688	12/28/2015 00:35:00	---	---	0.000
	689	12/28/2015 00:40:00	---	---	0.000
	690	12/28/2015 00:45:00	0.943	1.006	0.000
	691	**12/28/2015 00:50:00**	**---**	**---**	**0.000**
	692	12/28/2015 00:55:00	---	---	0.000
	693	12/28/2015 01:00:00	0.886	0.996	0.000
	694	12/28/2015 01:05:00	---	---	0.000
		Minimum	**0.603**	**0.721**	**0.000**
		Average	**1.226**	**1.300**	**0.001**
		Maximum	**2.256**	**2.256**	**0.060**
		Total	**8.581 (mg)**	**9.098 (mg)**	**1.920**
		Time of Min	**12/28/2015 05:30:00**	**12/28/2015 05:30:00**	**12/25/2015 15:20:00**
		Time of Max	**12/29/2015 12:30:00**	**12/29/2015 12:30:00**	**12/30/2015 21:45:00**

GENERAL APPROACH TO FLOW MONITORING

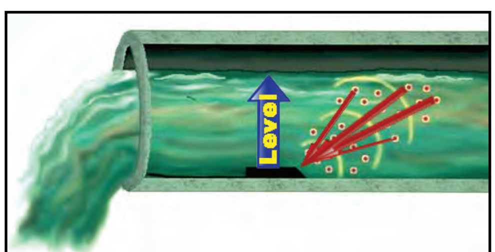
Based on our numerous years of field experience, and work with the top engineering firms in the North-east and Mid-Atlantic States, we have found that the following are important to an accurate flow monitoring project:

- Proper site selection
- Matching flow metering equipment to flow conditions
- Rigorous measurement and calibration on installation
- Weekly maintenance visits with:
    - Field crew review of previous period's data
    - Thorough inspection of sensors and logging equipment
    - Field data analysis for signs of trouble
    - Calibration checks
- Expert data analysis using our proprietary software and trained data analysts

Proper Site Selection: all flow monitoring devices provide their best information when installed in an area with a fully-developed flow profile. In sewer flow, we try to help our client weed-out measurement locations with excessive turbulence such as: swirling flow from a nearby bend, churning flow from a nearby confluence of lines, or unwanted vertical flow from a nearby elevated flow line (dropped flow). Sometimes these poor conditions can be spotted from street level, but the final judgment of each site comes from a manhole entry and, eventually, from observations of the flow meter data.

Matching Flow Metering Equipment to Flow Conditions: each site presents a unique situation, and no single flow monitor is right for every location. Flow Assessment maintains a large arsenal of equipment to provide the best match, and will often use combinations of different flow monitoring principles to span flow extremes.

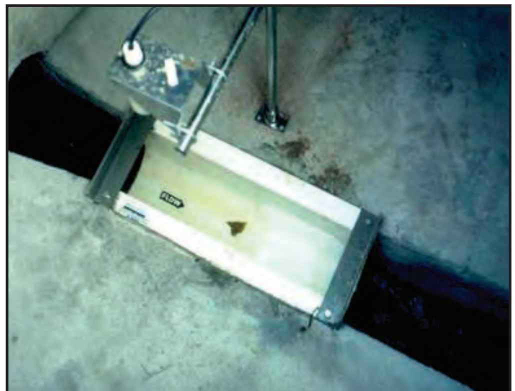
For most applications we use a continuous wave area-velocity flow monitor as manufactured by Teledyne Isco, ADS or Hach Sigma. These measure flow velocity and flow area simultaneously, solving the equation **$Q_{(flow)}$ = Velocity X Area**. For velocity measurement these meters use a continuous wave Doppler ultrasonic beam; the Isco meters provide an average of the entire flow profile. Flow area is derived from the level, or head, of the flow. This is measured with a microprocessor-based pressure level sensor that reduces drift. The pressure level sensor has the added advantage of measuring surcharge levels, and will oper-



Area-Velocity Flow Meter Showing Level + Velocity Return

ate accurately even if covered with debris. These meters can be supplemented with an independent ultrasonic down-looking sensor to provide either redundant level or information about adjacent sewer levels (such as overflows).

Most continuous wave area-velocity meters require >1" of level to provide an accurate measurement, but some residential areas drop below this for significant periods of time. The Palmer-Bowlus Flume is a good choice for areas with low flows because we can install these temporarily (or permanently) in manhole inverts. We measure the levels in these flumes primarily by using an ultrasonic down-looking sensor connected to a flow logger. This provides us with an electronic digital record of the flow rate at selected time intervals (typically every 15 minutes, but can be as often as every 15 seconds).

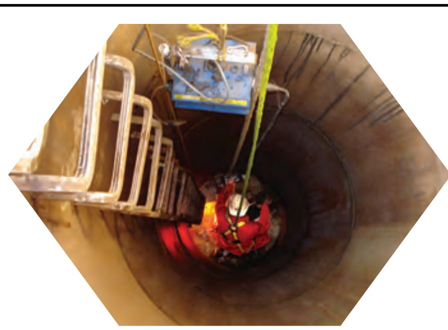


Insert Palmer-Bowlus Flume

The continuous wave area-velocity meter provides very goo d accuracy and very good repeatability at reasonable prices. However, for some larger pipes, we can provide greater accuracy using an ADFM (accoustic Doppler) principle flow meter. These are considerably more expensive, but offer a more powerful pulsed Doppler signal in multiple paths. The stronger Doppler signals can reach further into the flow profile of very deep flows.

Flow Assessment will help guide our client on *flow meter versus cost* decisions for large pipes, and the flow monitoring purpose will steer our choice. For an I/I study (inflow & infiltration), the repeatability of the lower-cost continuous wave area-velocity meter is the most important consideration. For a capacity study the continuous wave meter is probably sufficient, especially after a meticulous installation and calibration by our experienced field crew. For a billing situation, the more expensive flow metering equipment may be merited.

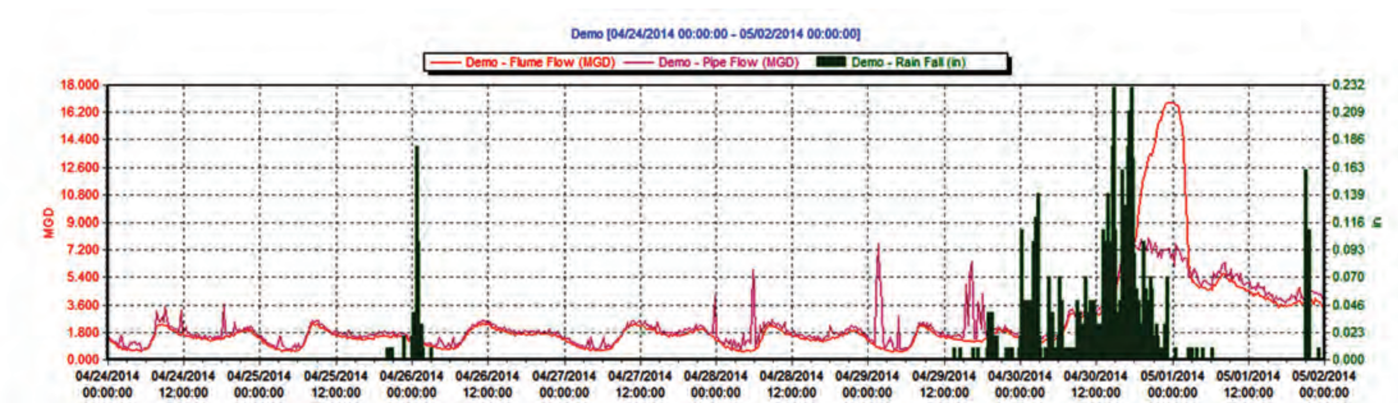
Rigorous Measurement and Calibration on Installation: since flow area is derived from level, it is important that the pipe dimensions be exact. Flow Assessment crews measure the sewer pipe carefully to provide the best level-to-area calculation. The level reading of the flow monitoring equipment is carefully adjusted to the actual level at the point of measurement. Flow Assessment crews measure flow velocity at multiple points (the number of points is dictated by the pipe size and velocity conditions), and the average velocity is compared to the flow monitor. Flow Assessment crews will allow the equipment to run for a few hours, and will download the stored data to insure that everything is running as it should.



FLOW
ASSESSMENT SERVICES

Weekly Maintenance Visits: we have found that aggressive maintenance of each site is the key to high-quality flow data. Flow Assessment field personnel visit each installation on a weekly basis. On each visit they enter the manhole (using proper confined space procedures and equipment) to visually inspect the sensors and logging equipment. Although sensor fouling is rare, this is the time the crews will clear any debris that may block a velocity measurement. The crews will take an actual level measurement and compare it to the flow meter reading; any deviation is corrected and noted for our data analysts. Flow Assessment field crews will then download the previous week's data and perform a field analysis. This analysis will determine whether flow conditions have changed, possibly mandating a change of equipment or a supplement with an additional flow meter. If the flow metering equipment needs update or repair, we do that on the spot to minimize downtime. Batteries are checked and changed well before they are depleted.

Expert Data Analysis Using our Proprietary Software and Trained Data Analysts: Flow Assessment data analysts review all data for outliers. They apply field observations, experience and our proprietary software to provide accurate data that modelers find valuable. After QA/QC our data is posted to an internet website; anyone with the proper user name and password can view the data in graphical (hydrograph or scatter graph) or tabular format. Final data reports can be in almost any format desired.



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Open-Channel Flow Meters

Innovative Technology for a Wide Range of Applications

HACH®

Be Right™

Innovative Technology

Flow measurement accuracy requires flexible technology, tailored to your site conditions. That's why Hach flow meters give you four ways to measure flow; ultrasonic, submerged pressure sensors, bubbler, and area velocity. The flow meters covered in this brochure have been configured to provide you with a choice of state-of-the-art features and options. (See the table on page opposite.)

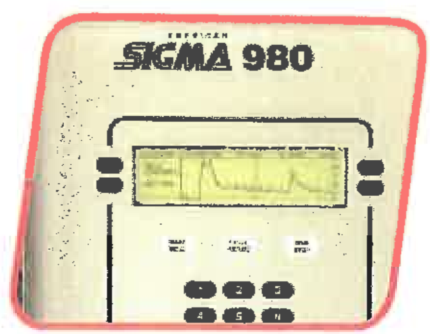
Direct Average Velocity. The Hach Doppler weighted-average method collects and averages the velocities of multiple points in the cross-sectional area of the channel. This eliminates the need for on-site velocity calibration, thereby reducing installation and maintenance requirements, and time in the manhole.

1 Megahertz Doppler Velocity Technology. The Hach Doppler sensors feature a high frequency, which provides higher data resolution by detecting smaller particles.

Multiple-Level and Velocity Sensors. Some flow meter models offer an optional second- and third-level measurement or velocity measurement sensor; this allows one flow meter to either monitor multiple channels or to take multiple measurements of the same channel.

Low Profile Probe. The standard Hach submerged AV probe is the smallest probe of its type currently available. A low profile means less turbulence, which results in more accurate velocity measurements, especially in low-flow situations. The Hach wafer velocity probe, which measures 0.44" H x 1.5" W x 2.7" L, used in combination with the In-pipe Ultrasonic sensor can measure flow in low-level, high-velocity applications.

In-Pipe Ultrasonic Sensor. Reduces the ultrasonic deadband, thereby providing a greater percentage of level capture. This permits the use of the more accurate ultrasonic technology in pipes or in situations that would normally require a submerged pressure transducer.



Intrinsically Safe Options. The model 911 and 940 flow meters can be used in hazardous or potentially hazardous environments.

Water Quality Parameters. The model 950 can monitor pH, conductivity, ORP, and DO. The model 980 can monitor pH. Other measurements include rainfall and temperature.

Easy-to-Read Graphics Display. Provides maximum amount of graphed or tabular data at a glance. In the field, the display allows for quick review of data.

Patented Drawdown Correction. Compensates for effects of velocity on submerged pressure level measurement.

Hach offers a versatile line of flow meters that allows you to choose the right meter for your application or site condition and to upgrade as your needs change.

Open Channel Flow Meter Model Guide

Features	910	911	920	930	940	950	950AV	950 OptiFlow	950 OptiFlow AV	980	980AV
Page	4	5	6	8	7	9	10	9	9	12	13
Portable/Field*	•	•	•	•	•	•	•	•	•		
Permanent			•	•		•	•	•	•	•	•
Interface via computer	•	•	•	•	•	•	•	•	•	•	•
User Interface: keypad + LCD						•	•	•	•	•	•
Data Transfer Unit	•		•	•		•	•	•	•	•	•
Battery Life (in days) @ 15 minute intervals**	• (60)	• (65)	• (90)	• (365)	• (365)	• (150)	• (150)	(150)	(150)		
AC Power Capability			•		•	•	•	•	•	•	•
Level/Flow Measurement:											
1 level only channel						•		•		•	
1 level and/or velocity channel	•	•					•		•		•
2 level and/or velocity channels			•		•						
3 level and/or velocity channels				•							
Bubbler						•	•	•	•		
Submerged Pressure	•	•	•	•	•	•	•	•	•		•
Ultra Sonic			•	•	•	•	•	•	•	•	•
Area Velocity	•	•	•	•	•		•		•		•
Intrinsic Safety		•			•						
NEMA Rating 6P	•	•	•	•	•						
4X, 6						•	•	•	•		
4X (IP66)										•	•
Optional Features pH/Temp Only						•	•	•	•	•	•
pH/Temp/ORP						•	•	•	•		
DO/Conductivity						•	•	•	•		
Rain Gauge			•	•		•	•	•	•	•	•
4-20 mA Outputs						•	•	•	•	•	•
Alarm Relays						•	•	•	•	•	•
Analog Inputs						•	•	•	•	•	•
RS-232	•	•	•	•	•	•	•	•	•	•	•
Modem (USA, Canada only)			•	•	•	•	•	•	•	•	•
Sampler Pacing		•	•	•	•	•	•	•	•	•	•
Mechanical Totalizer						•	•	•	•		

** May be affected by site conditions.

Rain Gauge or Rain Gauge with Rain Logger

Built to National Weather Service standards, the Rain Gauge accurately measures rainfall in 0.01" increments. The rain gauge can be connected to a Hach Flow Meter, or the Rain Logger can be used for stand-alone or long-term rainfall recording, as well as for portable use in storm water runoff monitoring.

Portable Field or Permanent Models

Models include: "blind" flow meters (no keypad or display), and flow meters with graphic display: the 950 (shown upper right) has both AC and battery power making it suitable for use in the field or for permanent installation; the 980 (shown upper left) is for permanent installation.

* See page 11 for information on the hand-held Portable Flow Velocity Meter

910 Portable Area Velocity Flow Meter

*Hach's **Sigma 910** is our most popular meter for economical, short-term, single-channel collection system monitoring.*

The 910 measures average velocity directly, without the need for time consuming flow profiling, significantly reducing the cost of installation and operation. A compact 4 ½ x 18 in. design and a weight of less than 8 lbs (with battery) make the 910 one of your best options for remote environments. This meter will log level and velocity data for more than 60 days without changing a battery, and its sealed design provides superior system protection against surcharge conditions.

- Low-profile probe reduces maintenance and is detachable/interchangeable for ultimate flexibility.
- Easy installation with a small, 4 ½ in. diameter and no velocity calibration required.
- NEMA 6P sealed to withstand submergence and prolonged surcharge conditions.
- Advanced, ultrasonic one-MHz Doppler technology avoids signal dropouts and ensures, without the need for on-site calibration, high levels of accuracy in low-flow, full-pipe, or reversed-flow conditions.
- A higher level of accuracy, since the 910 automatically corrects the effects of temperature on level measurement.
- Patented Drawdown Correction feature corrects the effects of velocity on accurate level measurement.

Ideal for:

- Short Term Flow Studies
- Sanitary Sewer Evaluation Studies

910 Design Specifications

- **Dimensions:** 4.5" diameter X 17.625" L, (11.4 cm diameter x 44.8 cm L)
- **Weight:** 7.8 lbs. (3.54 kg) with battery
- **Enclosure Material:** PVC
- **Enclosure Rating:** NEMA 6P (IP67)
- **Operating Temperature Range:** 0 to 140°F, (-18° to 60°C)
- **Storage Temperature Range:** -40° to 140°F, (-40° to 60°C)
- **Power Source:** One (6V) Alkaline Lantern Battery
- **Battery Life:** 60 days typical with a 15-minute recording interval, 1 level and 1 velocity, data download once per week, at 50°F (10°C) (also affected by site conditions)
- **User Interface:** IBM-compatible PC
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60-minutes
- **Program Memory:** Non-volatile programmable flash, can be updated via RS-232 port
- **Time-Based Accuracy:** ±1 second per day
- **Units of Measurement:**
  Level: in., m, cm, ft.
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D
  Totalized Flow: gal., $ft.^3$, acre-ft., L, m^3
- **Data Storage:**
  Capacity: 90 days of 1 level reading and 1 velocity reading at a 15-minute recording interval
  Data Types: Level and velocity
  Storage Mode: Wrap or slate
- **Communications:** Serial connection to IBM-compatible computer with Hach Data Management Software

Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement:**
  (Non-linearity and Hysteresis): Standard – .018' to 11.5' ±.023', (.005 to 3.5 m ± .007 m); Extended – .018' to 34.6' ± .07', (.005 to 10.5 m ± .021 m)
  Maximum Allowable Level: 3x over pressure
  Operating Temperature Range: 32° to 160°F, (0 to 71°C)
  Compensated Temperature Range: 32° to 86°F, (0 to 30°C)
  Temperature Error: 0.018' to 11.5' ±.004'/°F, (.005 to 3.5 m ± .0022 m/°C) .018' to 34.6' ±.012'/°F, (.018 to 10.5 m ±.006 m/°C) (maximum error within compensated temperature range – per degree of change)
  Velocity-Induced Error on Depth (patent pending): 0 to 10'/sec. (0 to 3.05 m/s) = .085% of reading
  Air Intake: Atmospheric pressure reference is desiccant protected
- **Velocity Measurement:**
  Method: Doppler ultrasonic
  Transducer Type: Twin 1 MHz piezoelectric crystals
  Typical Minimum Depth for Velocity: .8", (2 cm)
  Range: -5 to 20 fps, (-1.52 to 6.10 m/s)
  Zero Stability: <.05 fps, (.015 m/s)
  Accuracy: ±2% of reading
  Operating Temperature: 0 to 140°F, (-18° to 60°C)
- **General:**
  Material: Polymer body with stainless steel diaphragm
  Cable: Urethane sensor cable with air vent
  Cable Length: 25' (7.6 m) standard. 250' (76 m) maximum
  Dimensions (combination sensor): .8" H x 1.5" W x 5" L, (2 cm H x 3.8 cm W x 12.7 cm L)

911 Intrinsically Safe Portable Area Velocity Flow Meter

With quick installation and minimum maintenance, the 911 is ideal for short-term flow studies in hazardous or potentially hazardous environments. Hach's advanced Doppler technology is accurate, even in low-flow, full-pipe, and reversed-flow conditions. There is no need for profiling to establish accurate average velocity. The 911's accuracy is further enhanced by a proprietary technology that corrects for the effects of temperature and velocity on level measurement.

- CSA-NRTL/C certified for operation in Class I, Division I, Groups C & D hazardous locations. DEMKO listed.
- Low profile, non-fouling probe reduces your need for maintenance and is detachable/interchangeable for ultimate flexibility.
- Easy installation with a slender 6.5 in. diameter, no profiling required.
- NEMA 6P sealed to withstand submergence and prolonged surcharge conditions.
- Advanced, ultrasonic one-MHz Doppler technology avoids signal dropouts and ensures high levels of accuracy in low-flow, full-pipe or reversed-flow conditions, without the need for on-site calibration.
- A higher level of accuracy, since the 911 automatically corrects the effects of temperature on level measurement.
- Patented Drawdown Correction feature corrects the effects of velocity on accurate level measurement.

Ideal for:

- Short Term Flow Studies in Hazardous or Potentially Hazardous Areas
- Sanitary Sewer Evaluation Studies
- CSO Studies and Monitoring

Are there hazardous gasses at your monitoring site?
*Be sure you're safe with an affordable **Sigma 911** intrinsically safe flow meter.*

911 Design Specifications

- **Dimensions:** 6.5" diameter x 22.5" L (16.5 cm D x 57 cm L) with 12 Ah battery
- **Weight:** 17.5 lb. (8 kg) with 12 Ah battery
- **Enclosure Material:** PVC
- **Enclosure Rating:** NEMA 6P (IP67)
- **Certification:** CSA-NRTL/C-Class 1, Div. 1, Groups C & D; Intrinsically Safe. CENELEC approved, EEx ia IIB T3
- **Operating Temperature Range:** 0 to 140°F, (-18° to 60°C)
- **Storage Temperature Range:** -40° to 140°F (-40° to 60°C)
- **Power Source:** One 12V, 12 Ah lead-acid rechargeable
- **Battery Life:** With 12 Ah battery, 240 days typical with a 15-minute recording interval. Assumes data download once per week, at 50°F/10°C, also affected by site conditions
- **User Interface:** Optically isolated IBM compatible PC
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60-minutes
- **Program Memory:** Non-volatile, programmable flash, can be updated via RS-232 port
- **Time Based Accuracy:** ±1 second per day
- **Units of measurement:**
  Level: in., m, cm, ft.
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D
  Totalized flow: gal., ft³, acre-ft., L, m³
- **Optically Isolated Sampler Output:** 6-12 VDC pulse, 100 mA max, at 500 ms duration flow proportional
- **Data Storage:**
  Capacity: 90 days of 1 level reading and 1 velocity reading at a 15-minute recording interval
  Data Types: Level and velocity
  Storage Mode: Wrap or slate
- **Communications:** Serial connection via optically isolated interface to IBM compatible computer with Hach data analysis software

Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement:**
  (Non-linearity and Hysteresis): .018' to 11.5' ±.023' (±.005 m to 3.5 m ±.007 m)
  Maximum Allowable Pressure: 3x over pressure
  Operating Temperature Range: 32° to 160°F, (0 to 71°C)
  Compensated Temperature Range: 32° to 86°F, (0 to 30°C)
  Temperature Error: .018' to 11.5' (±.004'./°F, (.005 m to 3.5 m ± .0022 m/°C) (maximum error within compensated temperature range – per degree of change)
  Velocity Induced Error on Depth (patent pending): 0 to 10'/sec., (0 to 3.05 m/s) = .085% of reading
  Air Intake: Atmospheric pressure reference is desiccant protected
- **Velocity Measurement:**
  Method: Doppler ultrasonic
  Transducer Type: Twin 1 MHz piezoelectric crystals
  Typical minimum depth for velocity: 0.8", (2 cm)
  Zero Stability: <.05 fps, (.015 m/s)
  Range: -5 to 20 fps, (-1.52 to 6.10 m/s)
  Accuracy: ±2% of reading
  Operating Temperature: 0 to 140°F, (-18° to 60°C)
- **General:**
  Material: Polymer body with stainless steel diaphragm
  Cable: Urethane sensor cable with air vent
  Cable Length: 25' (7.5 m) standard; 100' (30.5 m) maximum
  Dimensions (combination sensor): 0.8" H x 1.5" W x 5" L (2 cm H x 3.8 cm W x 12.7 cm L)

920 Area Velocity Flow Meter

The 920 meter can be used in portable or permanent applications and is available with up to two independent level/velocity channels. You can measure level and velocity in two channels or velocity in one and level in another. And, with Hach's pager communication, you can be alerted to overflows, bypasses, or a change in the flow pattern. Choose from submerged pressure transducer/velocity sensor or Hach's Sigma In-Pipe Ultrasonic Depth Sensor (patent pending) combined with a "wafer-thin" velocity sensor that provides greater accuracy in shallow flows.

- Multiple sensors for redundancy, averaging and multiple pipe monitoring.
- Easy installation with fast setup and no velocity calibration required.
- Sampler pacing capabilities, ideal for CSO and storm water.
- Optional rainfall logging feature records and characterizes rain events, a true innovation in water monitoring.
- Optional internal modem automates data retrieval, paging and reporting.
- NEMA 6P sealed to withstand submergence and prolonged surcharge conditions.
- Low power draw creates an extended 90-day battery life.
- Advanced, ultrasonic one-MHz Doppler technology avoids signal dropouts and ensures high levels of accuracy in low-flow, full-pipe or reversed-flow conditions, without the need for on-site calibration.
- A higher level of accuracy, since the 920 automatically corrects the effects of temperature on level measurement.
- Patented Drawdown Correction feature corrects the effects of velocity on accurate level measurement.

Ideal for:

- Short Term Flow Studies
- Sanitary Sewer Evaluation Studies
- CSO Studies and monitoring
- NPDES Stormwater Compliance

*Hach's **Sigma 920** allows two-channel monitoring, has a longer battery life, and increased data storage, and offers optional sampler, modem, and pager interfaces.*

920 Design Specifications

- **Dimensions:** 6.625" diameter x 17.625" L, (16.8 cm diameter x 44.7 cm L)
- **Weight:** 16.5 lbs. (7.5 kg) with batteries
- **Enclosure Material:** PVC
- **Enclosure Rating:** NEMA 6P (IP67)
- **Operating Temperature Range:** 0 to 140°F, (-18° to 60°C)
- **Storage Temperature Range:** -40° to 140°F, (-40° to 60°C)
- **Power Source:** Two (6V) Alkaline Lantern Batteries
- **Battery Life:** 90 days typical with a 15-minute recording interval, 1 level and 1 velocity, data download once per week, at 50°F, (10°C) (also affected by site conditions)
- **User Interface:** IBM-compatible PC
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60-minutes
- **Program Memory:** Non-volatile, programmable flash, can be updated via RS-232 port
- **Time-Based Accuracy**: ±1 second per day
- **Units of Measurement:**
  Level: in., m, cm, ft.
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D
  Totalized Flow: gal., ft.³, acre-ft., L, m³
- **Data Storage Capacity (optional):** 240 days of 2 level readings, 2 velocity readings and rain at a 15-minute recording interval
  Data Types: Level, velocity and rainfall
  Storage Mode: Wrap or slate
- **Sampler Output Conditions (optional):** Set point on level, velocity, rainfall, flow, or flow rate of change
- **Sampler Output (optional):** 6-12 VDC pulse, 100 mA max. at 500 ms duration flow proportional.
- **Communications:** RS-232 serial connection to IBM-compatible computer with Hach Data Management Software
  Optional Modem: Bell 212
  Baud: 14400
  Transfer protocol: Binary -OR- 14400, V.32 bis, V.42, MNP2-4 error correction. V.42 bis, MNP5 data compression. MNP10EC Cellular Protocol
  Local Terminal: RS-232 at 19.2k baud

Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement:**
  (Non-linearity and Hysteresis): Standard – .018' to 11.5' ±.023', (.005 to 3.5 m ± .007 m); Extended – .018' to 34.6' ±.07', (.005 to 10.5 m ± .021 m)
  Maximum Allowable Level: 3x over pressure
  Operating Temperature Range: 32° to 160°F, (0° to 71°C)
  Compensated Temperature Range: 32° to 86°F, (0° to 30°C)
  Temperature Error: .018' to 11.5' ±.004'/°F, (.005 to 3.5 m ±.0022 m/°C) .018' to 34.6' ±.012'/°F, (.018 to 10.5 m ±.006m/°C) (maximum error within compensated temperature range – per degree of change)
  Velocity Induced Error on Depth (patent pending): 0 to 10'/sec. (0 to 3.05 m/s) = .085% of reading
  Air Intake: Atmospheric pressure reference is desiccant protected
- **Velocity Measurement:**
  Method: Doppler ultrasonic
  Transducer Type: Twin 1 MHz piezoelectric crystals
  Typical minimum depth for velocity: .8", (2 cm)
  Range: -5 to 20 fps, (-1.52 to 6.10 m/s)
  Zero Stability: <.05 fps, (.015 m/s)
  Accuracy: ±2% of reading
  Operating Temperature: 0 to 140°F, (-18° to 60°C)
- **General:**
  Material: Polymer body with stainless steel diaphragm
  Cable: Urethane sensor cable with air vent
  Cable Length: 25' (7.6 m) standard 250' (76 m) maximum
  Dimensions (combination sensor): .8" H x 1.5" W x 5" L (2 cm H x 3.8 cm W x 12.7 cm L)

Optional In-Pipe Ultrasonic Level and Velocity Sensor Accuracy:

- **Velocity Sensor:**
  Dimensions: .44" H x 1.5" W x 2.7" L, (1.12 cm H x 3.81 cm W x 6.86 cm L)
  Nose Angle: 20 degrees from horizontal
  Cable Length: Standard range probe 25' (7.6 m); custom cable lengths to 250' (76 m); cable diameter .225" (.57 cm)
  Materials: Sensor – polymer; cable – urethane; sensor-mounting hardware – stainless steel
- **Ultrasonic Level Sensor (In-pipe):**
  Accuracy: At 72°F (22°C) still air, 40-70% relative humidity from .125 to 15' ±.01', (.038 to 4.57 m ± .003 m)
  Range: Minimum distance from sensor to liquid 0" (0 cm). Maximum distance from sensor to liquid 15' (4.57 m)
  Span: .125' to 15', (.038 to 4.57 m)
  Ambient Operating Temperature: 0 to 140°F, (-18° to 60°C)
  Temperature Error: ±.0001'/°F, (±.00005 m/°C) (maximum error within compensated temperature range – per degree of change)
  Resolution: .0075", (.019 cm)
  Material: Stainless steel housing with PVC acoustic window
  Cable: 4 conductor
  Cable Length: 25' (7.6 m) standard, 1,000' (305 m) using RS-485 two-wire remote sensor option
  Crystal Specification: 75 KHz, 7° beam angle
  Dimensions: 1.5" diameter x 12" L, (3.81 cm diameter x 30 cm L)

940 Intrinsically Safe Area Velocity Flow Meter

Hach's **Sigma 940** *intrinsically-safe flow meter supports dual sensors, interfaces with samplers, has a long battery life, and offers increased data storage and optional modem capability.*

The 940 is the safest investment for your sewer and your budget. With the 940, remote monitoring becomes a way of life. Its rugged design, low-profile probes and long battery life significantly reduce site visits. Choose up to two area velocity sensors, or one area velocity and one level backup. Whether you're experiencing redundancy in a single pipe or level and velocity in separate pipes, you'll profit from new performance levels in a single meter.

Industry standard MODBUS ASCII protocol has been incorporated into Hach's Sigma 940 Flow Meter. The implementation of the MODBUS protocol will allow your MMI, SCADA or DCS system to directly communicate with the 940 Flow Meter without the use (or additional cost) of a PLC. Now you can have real-time, read-only access to all available data channels in the 940 Flow Meter.

- CSA-NRTL/C DEMKO listed and certified for operation in Class I, Division I, Groups C & D hazardous locations.
- Multiple sensors for redundancy, averaging and multiple pipe monitoring.
- Telephone and pager alarms for quick notification of system changes.
- Low power draw, with a long, one-year battery life.
- NEMA 6P sealed to withstand submergence and prolonged surcharge conditions.
- Sampler pacing capabilities, to document the extent of overflow problems.
- Advanced, ultrasonic one-MHz Doppler technology avoids signal dropouts and ensures high levels of accuracy in low-flow, full-pipe or reversed-flow conditions, without the need for on-site calibration.
- A higher level of accuracy, since the 940 automatically corrects the effects of temperature on level measurement.
- Patented Drawdown Correction feature corrects the effects of velocity on accurate level measurement.

Ideal for:

- Long Term Flow Monitoring in Hazardous or Potentially Hazardous Areas
- Sanitary Sewer Evaluation Studies
- CSO Studies and Monitoring

940 Design Specifications

- **Dimensions:** 8.625" diameter x 23.625" L (21.9 cm diameter x 60 cm L)
- **Weight:** 17.52 lbs. (7.95 kg) with batteries
- **Enclosure Material:** PVC
- **Enclosure Rating:** NEMA 6P (IP67)
- **Certification:** CSA-NRTL/C-Class 1, Div. 1, Groups C & D Intrinsically Safe; CENELEC approved, EEx ia IIB T3
- **Operating Temperature Range:** 0 to 140°F (-18° to 60°C)
- **Storage Temperature Range:** -40° to 140°F (-40° to 60°C)
- **Power Source:** One (12V) 25Ah lithium battery pack or A/C power adapter
- **Battery Life:** 365 days typical with a 15-minute recording interval, 1 level and 1 velocity, data download once per week, at 50°F (10°C) (also affected by site conditions)
- **User Interface:** Optically isolated, IBM-compatible PC
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60-minutes
- **Program Memory:** Non-volatile programmable flash, can be updated via RS-232 port, in non-hazardous area
- **Time-Based Accuracy:** ±1 second per day.
- **Units of Measurement:**
  Level: in., m, cm, ft.
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D
  Totalized Flow: gal., ft.^{3}, acre-ft., L, m^3
- **Data Storage:**
  Capacity: 306 days of 2 level readings, 2 velocity readings at a 15-minute recording interval
  Data Types: Level and velocity
  Storage Mode: Wrap or slate
- **Sampler Output Conditions (optional):** Set point on level, velocity, flow, or flow rate of change
- **Sampler Output (optional):** 6-12 VDC pulse, 100 mA max. at 500 ms duration with approved interface
- **Communications:** RS-232 serial connection via optically isolated interface to IBM-compatible computer with Hach data analysis software
  Optional Modem: External with fiber optic interface 14400, V.32 bis,V.42, MNP2-4 error correction. V.42 bis, MNP5 data compression. MNP10EC
  Local Terminal: RS-232 at 19.2k baud
  SCADA Modbus communication protocol via RS-232 or optional modem

Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement:**
  (Non-linearity and Hysteresis): .018' to 11.5' ±.023', (.005 to 3.5 m ± .007 m)
  Maximum Allowable Level: 3x over pressure
  Operating Temperature Range: 32° to 160°F (0 to 71°C)
  Compensated Temperature Range: 32 to 86°F (0 to 30°C)
  Temperature Error: .018' to 11.5' ±.004'/°F, (.005 to 3.5 m ±.0022 m/°C) (maximum error within compensated temperature range – per degree of change)
  Velocity Induced Error on Depth (patent pending): 0 to 10'/sec., (0 to 3.05 m/s) = .085% of reading
  Air Intake: Atmospheric pressure reference is desiccant protected
- **Velocity Measurement:**
  Method: Doppler ultrasonic
  Transducer Type: Twin 1 MHz piezoelectric crystals
  Typical Minimum Depth for Velocity: .8", (2 cm)
  Range: -5 to 20 fps, (-1.52 to 6.10 m/s)
  Zero Stability: <.05 fps, (.015 m/s)
  Accuracy: ±2% of reading
  Operating Temperature: 0 to 140°F, (-18 to 60°C)
- **General:**
  Material: Polymer body with stainless steel diaphragm
  Cable: Urethane sensor cable with air vent.
  Cable Length: 25' (7.6 m) standard. 100' (30.5 m) maximum
  Dimensions (combination sensor): 0.8" H x 1.5" W x 5" L, (2 cm H x 3.8 cm W x 12.7 cm L)

In-Pipe Ultrasonic Level and Velocity Sensor Accuracy:

- **Velocity Sensor:**
  Dimensions: .44" H x 1.5" W x 2.7" L, (1.12 cm H x 3.81 cm W x 6.86 cm L)
  Nose Angle: 20 degrees from horizontal
  Cable Length: 25', (7.6 m) standard, 100' (30.5 m) maximum; cable diameter 0.23" (0.57 cm.)
  Materials: Sensor – polymer; Cable – urethane; Sensor-mounting hardware – stainless steel
- **Ultrasonic Level Sensor (In-pipe):**
  Accuracy: At 72°F (22°C) still air, 40 to 70% relative humidity from .125' to 15' ±.01', (.038 to 4.57 m ±.003 m)
  Range: Minimum distance from sensor to liquid 0", (0 cm). Maximum distance from sensor to liquid 7', (2.13 m)
  Span: .125' to 7', (.038 to 2.13 m)
  Ambient Operating Temperature: 0 to 140°F, (-18° to 60°C)
  Temperature Error: ±.0001'/°F, (±.00005 m/°C) (maximum error within compensated temperature range – per degree of change)
  Resolution: .0075", (.019 cm)
  Material: Stainless steel housing with PVC acoustic window
  Cable: 4 conductor
  Cable Length: 25', (7.6 m) standard
  Crystal Specification: 75 kHz, 7° beam angle
  Dimensions: 1.5" diameter X 12" L, (3.81 cm diameter x 30 cm L)

930 Long-Term Area Velocity Flow Meter

*The **Sigma 930** is Hach's most advanced flow meter–supports three interchangeable sensors, long battery life, increased data storage and offers optional interfaces with samplers, and modem capability.*

930 Design Specifications

- **Dimensions:** 8.625" diameter x 23.625" L, (21.9 cm diameter x 60 cm L)
- **Weight:** 35.7 lbs. (16.2 kg) with batteries
- **Enclosure Material:** PVC
- **Enclosure Rating:** NEMA 6P (IP67)
- **Operating Temperature Range:** 0 to 140°F, (-18° to 60°C)
- **Storage Temperature Range:** -40° to 140°F, (-40° to 60°C)
- **Power Source:** Six (6V) Alkaline Lantern Batteries
- **Battery Life:** 365 days typical with a 15-minute recording interval, 1 level and 1 velocity, data download once per week, at 50°F (10°C) (also affected by site conditions)
- **User Interface:** IBM-compatible PC
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60-minutes
- **Program Memory:** Non-volatile, programmable flash, can be updated via RS-232 port
- **Time Based Accuracy:** ±1 second per day
- **Units of Measurement:**
  Level: in., m, cm, ft.
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D
  Totalized Flow: gal., ft.^{3}, acre-ft., L, m^3
- **Data Storage:**
  Capacity: 175 days of 3 level readings, 3 velocity readings and rain at a 15-minute recording interval
  Data Types: Level, velocity, rainfall
  Storage Mode: Wrap or slate
- **Output Conditions (optional):** Set point on level, velocity, rainfall, flow, or flow rate of change
- **Sampler Output (optional):** 6-12 VDC pulse, 100 mA max. at 500 ms duration
- **Communications:** RS-232 serial connection to IBM-compatible computer with Hach Data Management Software
  Optional Modem: Bell 212
  Baud: 14400
  Transfer protocol: Binary -OR- 14400, V.32 bis, V.42, MNP2-4 error correction. V.42 bis, MNP5 data compression. MNP10EC Cellular Protocol
  Local Terminal: RS-232 at 19.2k baud

Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement:**
  (Non-linearity and Hysteresis): Standard – .018' to 11.5' ±.023', (.005 to 3.5 m ±.007 m); Extended – .018' to 34.6' ±.07', (.005 to 10.5 m ±.021 m)
  Maximum Allowable Level: 3x over pressure
  Operating Temperature Range: 32° to 160°F, (0 to 71°C)
  Compensated Temperature Range: 32° to 86°F, (0 to 30°C)
  Temperature Error: .018' to 11.5' ±.004'/°F, (.005 to 3.5 m ±.0022 m/°C) .018' to 34.6' ±.012'/°F, (.018 to 10.5 m ±.006 m/°C) (maximum error within compensated temperature range – per degree of change)
  Velocity Induced Error on Depth (patent pending): 0 to 10'/sec. (0 to 3.05 m/s) = .085% of reading
  Air Intake: Atmospheric pressure reference is desiccant protected
- **Velocity Measurement:**
  Method: Doppler ultrasonic
  Transducer Type: Twin 1 MHz piezoelectric crystals
  Typical minimum depth for velocity: .8"., (2 cm)
  Range: -5 to 20 fps., (-1.52 to 6.10 m/s)
  Zero Stability: <.05 fps., (.015 m/s)
  Accuracy: ±2% of reading
  Operating Temperature: 0 to 140°F, (-18° to 60°C)
- **General:**
  Material: Polymer body with stainless steel diaphragm
  Cable: Urethane sensor cable with air vent
  Cable Length: 25' (7.6 m) standard. 250' (76 m) maximum
  Dimensions (combination sensor): .8" H x 1.5" W x 5" L (2 cm x 3.8 cm x 12.7 cm)

In-Pipe Ultrasonic Level and Velocity Sensor Accuracy:

- **Velocity Sensor:**
  Dimensions: .44" H x 1.5" W x 2.7". L, (1.12 cm x 3.81 cm x 6.86 cm)
  Nose Angle: 20 degrees from horizontal
  Cable Length: Standard range probe 25' (7.6 m); custom cable lengths to 250' (76 m); cable diameter .225" (.57 cm)
  Materials: Sensor – polymer; cable – urethane; sensor mounting hardware – stainless steel
- **Ultrasonic Level Sensor (In-pipe):**
  Accuracy: At 72°F (22°C) still air, 40 to 70% relative humidity from .125' to 15' ±.01', (.038 to 4.57 m ±.003 m)
  Range: Minimum distance from sensor to liquid 0" (0 cm). Maximum distance from sensor to liquid 15' (4.57 m)
  Span: .125 to 15', (.038 to 4.57 m)
  Ambient Operating Temperature: 0 to 140°F, (-18° to 60°C)
  Temperature Error: ±.0001'/°F, (±.00005 m/°C) (maximum error within compensated temperature range – per degree of change)
  Resolution: .0075", (.019 cm)
  Material: Stainless steel housing with PVC acoustic window
  Cable: 4 conductor
  Cable Length: 25' (7.6 m) standard, 1,000' (305 m) using RS-485 two-wire remote sensor option
  Crystal Specification: 75 KHz, 7° beam angle
  Dimensions: 1.5" diameter x 12" L, (3.81 cm diameter x 30 cm L)

The Hach's Sigma 930 is designed for long-term/permanent flow studies with approximately 365-day battery life and a strong NEMA 6P PVC enclosure. Permanent collection system monitoring can now be done confidently, within an affordable budget.

- Multi-point and/or redundant monitoring with a single meter.
- Up to three level and velocity sensors.
- Low power draw creates an extended year-long battery life.
- Optional rainfall logging feature records and characterizes rain events, a true innovation in water monitoring.
- Optional internal modem automates data retrieval, paging and reporting.
- Optional sampler pacing capabilities, ideal for CSO and Stormwater.
- NEMA 6P sealed to withstand submergence and prolonged surcharge conditions.
- Advanced, ultrasonic one-MHz Doppler technology avoids signal dropouts and ensures high levels of accuracy in low-flow, full-pipe or reversed-flow conditions, without the need for on-site calibration.
- A higher level of accuracy, since the 930 automatically corrects the effects of temperature on level measurement.
- Patented drawdown correction feature corrects the effects of velocity on accurate level measurement.
- Multiple sensors for redundancy, averaging and multiple pipe monitoring.

Ideal for:

- Long-Term Flow Monitoring
- Sanitary Sewer Evaluation Studies
- CSO Studies and Monitoring
- NPDES Stormwater Compliance
- Permanent Collection System Monitoring

950 Series Flow & Water Quality Meter

For applications requiring more than flow, the 950 optionally monitors rainfall, pH, temperature, ORP, dissolved oxygen and/or conductivity. In addition, the 950 has analog inputs for datalogging from other instruments, for example, total suspended solids monitors. You can also control samplers, pumps, or other equipment based on flow or selected parameter(s) exceeding high/low set points with relay outputs.

Meters in the 950 Series are versatile to meet your needs - customize your meter to specific site conditions easily. The large LCD graphics display lets you quickly see the information you need quickly, on-site, in your choice of 10 languages, and without the inconvenience of outdated paper charts; you'll no longer need to replace pens, paper, or service mechanical recorders.

Industry standard SCADA MODBUS ASCII protocol is included in Hach's Sigma 950 Flow Meter Series. 4-20 mA outputs are also available: this allows flexible integration with a SCADA system. You can have real-time, read-only access to all available data channels in the 950 Flow Meter.

- Keypad and large graphics display makes using laptops in the field optional. A single keystroke provides an instantaneous flow summary and review of all program settings.
- Three level measurement technologies available: ultrasonic, submerged, or bubbler.
- Battery or AC powered.
- Water quality data helps identify upsets that may affect your plant.
- An OptiFlow model provides maximum flexibility with three different level technology choices plus velocity.
- Doppler area velocity flow measurement.
- Sampler pacing ability to document the extent of overflow problems.
- Optional rainfall logging to record and characterize rain events.
- Remote communications capability via modem or RS-232.
- Enough memory to log more than 18,000 data points–expandable to 116,000 data points or over one year of flow data at a 5-minute logging interval.
- Flash memory allows software enhancements without replacing e-proms or returning meter to factory.
- Optional four user-assignable alarm relays.
- Optional two user-assignable 4-20 mA outputs, allowing the meter to be part of a current loop able to drive recorders, samplers, metering pumps, chlorinators, and other devices or SCADA integration.

*The **950** and **950 AV** provide portable and/or permanent single-channel monitoring plus water quality testing, process control interface, and a digital display. The **950** and **950 AV Optiflow** models offer maximum flexibility for multiple applications. Up to three different level sensor technologies and velocity are available **in one meter**.*

- Rugged, environmentally sealed: the 950 is NEMA 4X-6 rated and can survive submersion and corrosive gases–even with the door open.
- Data can be downloaded in any of three ways: (1) palm-sized Data Transfer Unit (DTU); (2) built-in modem to transmit data over telephone lines; and (3) direct RS-232 link to a PC utilizing data analysis software.

Ideal for:

- Long Term or Permanent Flow Studies
- Sanitary Sewer Evaluation Studies
- CSO Studies and Monitoring
- NPDES Stormwater Compliance
- Industrial Compliance Monitoring
- Applications involving frequent moving of meter to different site conditions (Optiflow models)

950 Design Specifications

General:

- **Dimensions:** 13.5" H x 10.0" W x 9.5" D, (34.3 cm x 25.4 cm x 24.1 cm)
- **Weight:** 15 lbs. (6.8 kg) including power source
- **Enclosure Material:** ABS, UV resistant, stable from -40° to 176°F (-40°C to 80°C)
- **Enclosure Rating:** NEMA 4X,6 with front cover open or closed
- **Operating Temperature Range:** +14° to 150°F, (-10°C to 65.5°C)
- **Storage Temperature Range:** -40° to 176°F, (-40°C to 80°C)
- **Power:** 12 VDC
- **Power Options:** 6 amp-hr. gel electrolyte rechargeable battery, 4 amp-hr. Ni-Cad rechargeable battery, lantern battery case with (2) 6-Volt lantern batteries, 115 VAC, 230 VAC or 100 VAC power converter w/battery charger
- **Graphics Display:** Back lit LCD, auto-off when not in use. 8 line x 40 character in ASCII mode, 60 dot x 240 dot in graphics mode. Dimensions 1.5" H x 5" W (3.8 cm x 12.7 cm); displays level vs. time, flow vs. time. Optionally, may display rainfall, pH, ORP, temperature, DO, conductivity vs. time, sampler events and alarm events
- **Keypad:** 21 position sealed membrane switch with blinking green LED to indicate power on; 4 "soft keys", functions defined by display
- **Totalizers:** 8-digit resettable and 8-digit non-resettable LCD software totalizer; 6-digit non-resettable mechanical totalizer optional
- **Time Based Accuracy:** ±1 second per day
- **Battery Life:** 150 days typical with a 15 minute recording interval, 1 level and 1 velocity, data download once per week, at 50°F (10°C) (also affected by site conditions)
- **Units of Measurement:**
  Flow: GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, CMS, CMM, CMH, CMD
  Totalized Flow: gal., ft.^{3}, acre-ft., lit., m^3.
- **Primary Devices:**
  Flumes: Parshall, Palmer Bowlus, Leopold-Lagco, H, HL, HS, Trapezoidal
  Weirs: V-notch (15 - 120°) Contracted/Non-contracted rectangular, Thelmar, compound Cipolletti
  Manning Equation: Round, U and Rectangular Trapezoidal Channels
  Flow Nozzles: Kennison, Parabolic, California Pipe
  Head vs. Flow: Custom programmable curve of up to 99 points
- **Datalogging:**
  Capacity: Up to 512k bytes: 402 days of level, velocity and rainfall readings at 15 minute intervals plus 300 events
  Monitoring Intervals: 1, 2, 3, 5, 15, 30 or 60-minute intervals
- **Program Memory:** Non-volatile, programmable flash; can be updated via RS-232 port
- **Sampler Output:** 12-17 VDC pulse, 100 mA max at 500 ms duration
- **Communications:**
  RS-232: up to 19,200 baud
  SCADA Modbus communication protocol via RS-232 or optional modem
  Modem (optional): 14,400 baud
  Cellular Communications (optional): 14,400 bps, MNP 10-EC Cellular Protocol
  Pager Alarms

950 Design Specifications (Continued)

950 Bubbler:

> **Level Measurement Accuracy:**
(linearity and hysteresis at 72°F, 22°C) from .01 to 11.75' - ±0.011' (±0.003m)
Range: .01 to 11.75', (.003 - 3.6 m)
Ambient Operating Temperature Range: 0° to 145°F, (-18° to 63°C)
Compensated Temperature Range: 32° to 138°F ,(0° to 59°C)
Temperature Error: ±.0003'/°F (maximum error within compensated temperature range – per degree of change)
Air Intakes: Bubble source and reference port desiccant protected. Fittings provided for remote intakes
Filters: 10 micron on bubble source intake
Line Purge: Bubble line is high pressure purged at programmed intervals, or in manual mode on demand
Line Size: 1/8", (.32 cm) ID standard

950 Ultrasonic:

50 kHz Ultrasonic Transducer:

> **Level Measurement Accuracy:**
(at 72°F, 22°C, still air, 40 - 70% relative humidity) from 1 to 10' ± .01'.)(±.003 m)
Range: Minimum distance from sensor to liquid 15" (38.1 cm). Maximum distance from sensor to liquid 30' (9.1 m)
Span: 50kHz, 0 - 29'
Ambient Operating Temperature Range: 0° to 140°F, (-18° to 60°C)
Temperature Error: ±.000047'/F° (maximum error within compensated temperature range – per degree of change)
Resolution: .0011'
Material: PVC housing with Buna-N acoustic window
Cable: 4 conductor with integral stainless steel support cable
Cable Length: 25' (7.6 m) standard
Crystal Specification: 50 kHz, 11.5° included beam angle
Dimensions: 3.75" H x 2.75" D, (9.5 cm x 7 cm)
Weight: 1.5 lbs.

75kHz Ultrasonic Transducer:

> **Level Measurement Accuracy:**
(at 72°F, 22°C, still air, 40 - 70% relative humidity) from 1 to 10'. ± .01')(±.003 m)
Range: Minimum distance from sensor to liquid 14". (23 cm). Maximum distance from sensor to liquid 1' (3.3 m)
Span: 0 – 15'
Ambient Operating Temperature Range: 0° to 140°F, (-18° to 60°C)
Temperature Error: ±.000047'/F° (maximum error within compensated temperature range - per degree of change)
Resolution: .0011'
Material: PVC housing with Buna-N acoustic window
Cable: 4 conductor with integral stainless steel support cable
Cable Length: 25' (7.6 m) standard
Crystal Specification: 5° beam angle with horn
Dimensions: 75 kHz, 5.0" H x 2.25" D, (12.7 cm x 5.7 cm)
Weight: 1.5 lbs.

In-Pipe Ultrasonic:

> **75 kHz Ultrasonic Level Sensor (In-Pipe):**
Accuracy: At 72°F (22°C), still air, 40-70% relative humidity from .125 to 15' - ±.01' (.038 to 4.57 m ±.003 m)
Range: 0" (0 cm) - 11' (3.35 m)
Span: .125 - 15', (.038 - 4.57 m)
Ambient Operating Temperature: 0 to 140°F, (-18 to 60°C)
Temperature Error: ±.0001'/°F (±.00005 m/°C) (maximum error within compensated temperature range – per degree of change)
Resolution: .0075" (.019 cm)
Material: Stainless steel housing with Buna-N acoustic window
Cable: 4 conductor
Cable Length: 25' (7.6 m) standard, 1000' (305 m) using RS-485 two wire remote sensor option
Crystal Specification: 75 kHz, 7° included beam angle
Dimensions: 2.0" diameter x 12" L (3.81 x 30 cm)

950 Submerged Pressure:

> **Level Measurement Accuracy:**
(non-linearity and hysteresis) ±0.1% full scale
Transducer Type: Differential piezo resistive with balanced bridge
Transducer Orientation: Inverted
Maximum Range:
P/N 1379: 2.5 psi .04 - 5.75', (.01 m - 1.75 m)
P/N 2343: 5.0 psi .04 - 11.75', (.01 m - 3.58 m)
P/N 2333: 10.0 psi .04 - 23', (.01 m - 7.0 m)
Maximum Allowable Level: 6x over pressure
Operating Temperature Range: 32° to 160°F, (0 to 71°C)
Compensated Temperature Range: 32° to 96°F, (0 to 36°C)
Temperature Error:
P/N 1379: .04 to 5.75' ±.006'/F°
P/N 2343: .04 to 11.75' ±.0012'/F°
P/N 2333: .04 to 23' ±.0024'/F°
(Maximum error within compensated temperature range – per degree of change)
Air Intake: Atmospheric pressure reference is desiccant protected
Material: 316 stainless steel body with titanium diaphragm
Cable: 4 conductor polyurethane sensor cable with air vent
Cable Length: 25' (7.6 m) standard. 250' (76 m) maximum
Dimensions: 1" D x 6.75" L, (2.54 cm x 17.2 cm)
Probe Frontal Area: 0.875 in^2
Weight: 1.5 lbs.

950 Area x Velocity:

Submerged Depth/Area Velocity Sensor:
***Method:* Doppler Principle/Pressure Transducer**

> **Level Measurement**
(non-linearity and hysteresis): Standard .018 to 11.5'. ±.023' (.005 m - 3.5 m ±.007 m)
Extended: .018 to 34.6' ± .07' (.005 - 10.5 m ± .021 m)
Maximum Allowable Level: 3x over pressure
Operating Temperature Range: 32 to 160°F, (0 to 71°C)
Compensated Temperature Range: 32 to 86°F, (0 to 30°C)
Temperature Error: .018 - 11.5'. ±.004'/°F (.005 m - 3.5 m ± .0022 m/°C). .018 - 34.6' ±.012'/°F (.018 - 10.5 m ±.006 m/°C) (maximum error within compensated temperature range – per degree of change)
Velocity Induced Error on Depth (patent pending): 0 to 10'/sec. (0 to 3.05 m/s) = .085% of reading.
Air Intake: Atmospheric pressure reference is desiccant protected

> **Velocity Measurement:**
Method: Doppler Ultrasonic
Transducer Type: Twin 1 MHz piezoelectric Crystals
Typical minimum depth for velocity: 0.8" (2 cm)
Range: -5 to +20 fps (-1.52 to 6.10 m/s)
Zero stability: <.05 fps (.015 m/s)
Accuracy: ±2% of reading
Operating Temperature: 0 to 140°F, (-18 to 60°C)

> **General:**
Material: Polymer body with stainless steel diaphragm
Cable: Urethane sensor cable with air vent.
Cable Length: 25' (7.6 m) standard. 250' (76 m) maximum
Dimensions (combination sensor): .8" H x 1.5" W x 5" L, (2 cm x 3.8 cm x 12.7 cm)

Bubbler Level/Area Velocity Sensor:
***Method:* Doppler Principle/Pressure Transducer**

> **Level Measurement**
(linearity and hysteresis at 72°F, 22°C): from .01 to 11.75' - ±0.011' (.033 m)
Range: .01 to 11.75' (.003 - 3.6 m)
Ambient Operating Temperature Range: 0 - 145°F, (-18 - 63°C)
Compensated for changes in ambient Temperature Range: 32 - 138°F (0 - 59°C)
Temperature Error: ±.0003'/°F (maximum error within compensated temperature range – per degree of change)
Air Intakes: Bubble source and reference port desiccant protected. Fittings provided for remote intakes
Filters: 10 micron on bubble source intake
Line Purge: Bubble line is high pressure purged at programmed intervals, or in manual mode on demand

> **Velocity Measurement:**
Method: Doppler Ultrasonic
Transducer Type: Twin 1 MHz piezoelectric Crystals
Typical minimum depth for velocity: 0.8" (2 cm)
Range: -5 to +20 fps (-1.52 to 6.10 m/s)
Zero stability: <.05 fps (.015 m/s)
Accuracy: ±2% of reading
Operating Temperature: 0 to 140°F, (-18 to 60°C)

> **General:**
Cable Length: 25' (7.6m) standard, 250' maximum
Cable Diameter: 0.4" (1cm)
Dimensions (combination sensor): 0.8" H x 1.5" W x 3.7" L, (2 cm x 3.8 cm x 9.7 cm)

Velocity Sensor
***Method:* Doppler Principle**

Accuracy: ±2% of reading; Zero Stability: ±0.05 fps (±1.52 cm)
Dimensions: .44" H x 1.5" W x 2.7" L, (1.12 cm x 3.81 cm x 6.86 cm)
Nose Angle: 20 deg from horizontal
Cable Length: Standard range probe - 25' (7.6 m); custom cable lengths to 250' (76 m); cable diameter - .225" (.57 cm)
Materials: Sensor - polymer; cable - urethane; sensor mounting hardware - stainless steel
Dimensions: 0.5"H x 1.5" W x 3.7"L (1.5 cm x 3.8 cm x 9.7 cm)

950 Design Specifications (Continued)

Sigma 950 Factory Installed Options:

> **pH-Temperature/ORP Meter:**
Control/Logging: Field selectable to log pH-Temperature or ORP independent of flow or in conjunction with flow; also controls sample collection in response to value exceeding low/high set points
Recording Intervals: 1, 2, 3, 5, 6, 10, 12, 15, 30, and 60 minutes
Probe Pre-Amplifier/Junction Box: NEMA 4X with labeled terminal strip
pH/Temperature Sensor: Temperature compensated; impact resistant ABS plastic body; combination electrode with porous Teflon® junction
Measurement Range: 2 to 12 pH within specifications, 0 to 14 pH maximum range
Operating Temperature Range: 0 to 176°F, (-18°C to 80°C)
Dimensions: 0.75" diameter x 6" long with .75" mpt cable end (1.9 cm x 15.2 cm long with1.9 cm mpt cable end)

> **Integral Dissolved Oxygen/ Temperature Meter:**
Control/Logging: Field selectable to log dissolved oxygen independent of flow or in conjunction with flow; also controls sample collection in response to value exceeding low/high set points
Recording Intervals: 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60 minutes
Measurement Method: Polargraphic
Sensor: Temperature compensated; impact resistant polypropylene body
Range: 0-20 mg/L
Resolution: .01 mg/L
Accuracy: ±0.2 mg/L
Operating Temperature Range: 32 to 122°F, (0 to 50°C)
Dimensions: 0.65" diameter x 5" long with .75" mpt cable end, (1.65 cm diameter x 12.7 cm long with 1.9 cm mpt cable end)

> **Integral Conductivity/ Temperature Meter:**
Control/Logging: Field selectable to log conductivity independent of flow or in conjunction with flow, also controls sample collection in response to value exceeding low/high set points
Recording Intervals: 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, and 60 minutes
Sensor: Temperature compensated; impact resistant polypropylene body
Range: 0-20 mS/cm
Resolution: 0.01 mS/cm or 0.01 µS/cm (user selected)
Accuracy: ±1% of reading +0.05 mS/cm
Operating Temperature Range: 32 to 122°F, (0 to 50°C)
Dimensions: 0.67" diameter x 5" long with .75" mpt cable end, (1.70 cm diameter x 12.7 cm long with 1.9 cm mpt cable end)

> **Rain Gauge Input:** For use with Hach Tipping Bucket Rain Gauge. Flow Meter records rainfall data in 0.01" increments. Flow measurement can be initiated based upon field selectable rate of rain.

> **Analog Input Data-logging Channels:** Up to seven additional data-logging channels record data from external sources; field assignable channel name(s) and units; - 4 to +4 VDC 0 – 20 mA, ±0.5% full scale voltage accuracy, ±0.2% full scale 4-20 mA accuracy with 200 ohm impedance

> **4 - 20 mA Outputs:** Up to 2 integral field assignable outputs, optically isolated, up to 600 ohm load, per output 0.1 % FS error.

> **Mechanical Totalizer:** 6-digit non-resettable mechanical totalizer; selectable units: gal., lit., ft.³, m³, acre-ft.

> **Alarm Relays:** Up to 4 integral alarm relays, 10 amp, Form C, user assignable to any internal or external data channel.

> **Modem:** 14,400 baud rate, CRC auto to check sum, FCC approved, cellular compatible.

> **Expanded Memory:** Increase memory from 18,432 data points to 116,736 data points.

> **AC Power Backup:** Provides power in the event of an AC power failure; internal trickle charger maintains 6 amp-hour battery.

Teflon is a registered trademark of E.I. Dupont de Nemours Inc.

PVM Portable Flow Velocity Meter

This lightweight (3 lb.), rugged field unit uses a Doppler velocity sensor to measure bi-directional velocity to ±10 feet/second. **Hach's Sigma PVM** *also features true-time averaging for higher accuracy in turbulent flows.*

This rugged, easy-to-operate unit is ideal for checking and calibrating primary devices and flow meters, and for spot measurements in sewers, streams and irrigation channels. The PVM Meter quickly determines fluid point velocity or time averaging using a Doppler ultrasonic sensor. Velocity information is then processed for computing flow and controlling analog and display outputs.

> Doppler Technology for fluid point velocity or time average velocity.

> Digital circuitry samples velocity 15 times per second.

> Computes forward and reverse flow.

> 12-hour battery life.

PVM Design Specifications

> **Included:** Portable velocity meter, velocity probe with 25' (7.6m) cable, nylon shoulder strap, battery charger, rechargeable nickel cadmium battery, swivel head probe holder, two extension rods, and carrying case.

> **Velocity Sensor:** Ultrasonic Doppler

> **Velocity Ranges:** 0.05' to ± 10'/sec. (0.015 to ±3 m/s); bi-directional measurement

> **Velocity Accuracy:** ±1% of full scale

> **Resolution:** .01'/sec, (.003 m/s)

> **Minimum Depth:** 1.0", (25mm)

> **Minimum Particulate Level:** 100 micron @ 100 PPM

> **Display:** 4 line x 20 character LCD with contrast adjustment

> **Recorder Output:** -2 to +2 VDC corresponding to -10' to +10'/sec. (-3 to +3 m/s) (optional)

> **Power Source:** Internal rechargeable 6-cell 1500 mA-H Ni-Cad pack (internal to PVM)

> **Recharge Time:** 10 hours

> **Charger Power Requirements:** 115 VAC for AC to 12 VDC converter, 10-15 VDC from automobile lighter socket

> **Operating Time:**
Normal use: 4 weeks
Continuous use: 12 hours

> **Operating Temperature:** 32°to 122°F, (0 to 50°C)

> **Sensor Cable Length:** 25' (7.6 m) standard

> **Dimensions:** 4.5" H x 7" W x 6" diameter, (11.4 cm x 17.8 cm x 15.2 cm)

> **Weight:** 3 lbs. (1.4 kg) without carrying case

> **Probe Dimensions:** 1.0" H x 1.5" W x 1.5" diameter, (25 mm x 38 mm x 38 mm)

> **Probe Materials:** Urethane and epoxy polymers; stainless steel

> **Extension Rod:** Telescopic from 1.5' to 6', (0.5 to 1.8 m)

980 Open-Channel Permanent Flow Meter

The 980 Flow Meter provides the versatility needed to handle a wide range of applications and site conditions. It has been designed to use three different sensing technologies so that you can choose the most appropriate one for your specific flow situation. In addition, you can also monitor rainfall and several water quality parameters.

The unique backlit display allows you to easily review either a graph of any logged channel for any time period up to one day or to review minimum, maximum, and total flow values of any logged channel in hourly, daily, or other intervals of your choice.

> **Three Different Level/Flow Sensing Technologies:** Non-contacting ultrasonic; submerged pressure; Doppler velocity.

> **Advanced Monitoring:** Measures flow, level, pH, temperature, rainfall, and more.

> **Large, Easy-to-Read Graphics Display:** Provides maximum amount of graphed or tabular data at a glance.

> **Flexible Power Supply:** Automatically regulates input voltage (100 to 230 VAC, 50/60 Hz).

> **Data Logging:** Minimum of 396 days of three channels of user-selected readings at 15-minute intervals. Up to 300 events.

> **Numeric Keypad:** Sealed-membrane switch keypad. Audio signal confirms keystroke has registered.

> **Built-in Flow Equations:** Simply select the primary device. Or use the Manning Equation. For custom applications, enter up to 99 head-versus-flow data points. You select the level and flow units.

> **Seven External Analog Inputs:** Consolidate 4-20 outputs from other monitoring equipment into a standard format.

> **Simple Documentation:** Generate charts, graphs, and reports with Hach's software package.

> **Alarm Relays:** Four user-assignable, setpoint and trouble alarms.

> **Pacing:** Will pace samplers or other equipment in proportion to flow.

> **Water-Resistant Enclosure:** Environmentally sealed NEMA 4X case for longer life and minimal service.

> **Modbus® SCADA Communications:** The 980 incorporates MODBUS Protocol for use in SCADA (Supervisory Control and Data Acquisition) systems.

(MODBUS is a trademark of Scheider Automation, Inc.)

*The **980** is a permanent, A/C powered, wall-mounted meter with three different level/flow sensing technologies and easy-to-read graphic display.*

Ideal for:

> Surcharge flows or reversed flow conditions

> Weirs and flumes

> Small-to-large channels

980 Design Specifications

> **Dimensions:** 14.62" H x 11.88" W x 8.26" D (37.13 cm x 30.18 cm x 20.98 cm)

> **Weight:** 16.80 lbs (7.62 kg)

> **Enclosure:** NEMA 4X, IP66 with front cover closed, UV resistant, -40 to 176°F, (-40 to 80°C)

> **Mounting:** Wall, Rail / Pole mount

> **Graphics Display:** Backlit liquid crystal display (LCD). 8-line x 40-character in text mode, 64 x 240 pixels in graphics mode. Displays level vs. time, flow vs. time, rainfall vs. time, pH and temperature.

> **Keypad:** 19-position, sealed-membrane switch including four "soft keys," functions defined by display.

> **Totalizers:** 8-digit resettable and 8-digit non-resettable software. *Units:* ft³, gal, m³, liter, acre-ft.

> **Measurement Modes:**
Flumes: Parshall, Palmer Bowlus, Leopold-Lagco, H, HL, HS, Trapezoidal
Weirs: V-notch, Contracted/Non-contracted rectangular, Thel-Mar, Compound Cipolletti, Compound V-notch
Manning Equation: Round, U, Rectangular, and Trapezoidal Channels
Head vs. Flow: Two independent user-entered, look-up tables of up to 100 points each.
Level Only: Inches, feet, centimeters, meters
Area Velocity: Level-area table, circular pipe, U-shaped channel, trapezoidal channel, rectangular channel.
Power Equation: $Q = K_1H^{n_1} \pm K_2H^{n_2}$

> **Data Logging:**
Capacity: Up to 456k bytes, 396 days of three channels of user-selected readings at 15 minute intervals. Plus 300 events.
Memory Mode: Wrap-around
Data Points: 116,000 data points
Daily Statistics: Available for up to 32 days
Recording Intervals: 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, or 60-minutes
Time Base Accuracy: ± 6 seconds (0.007%) per day

> **Electrical:**
Power Specifications: 0.25 amp maximum
Power Requirements: 100-230 VAC, 50/60 Hz, single phase, 15 W max (0.25 amp max)
Installation Category: II
Electrical Connection: Seven 0.5" hubs, one 1.0" hub.
Relay Contact Ratings: 5 amps (30- 230 AC)
Sampler Output: 15 VDC, 100 mA at 500 ms duration

> **Environmental:**
Temperature Ranges:
Storage: -4°F to 158°F, (-20°C to 70°C)
Operating: -4°F to 122°F, (-20°C to 50°C)
Humidity: 0-90%, non-condensing

980 Design Specifications (continued)

> **Ultrasonic Transducer:**
Operating Frequency: 75 kHz
Beam Angle: ±12° (-10 dB)
Range: 11.5 in. minimum to 10.7 ft. maximum, @ 20°C., still air, ideal target, 50 ft. cable.
Accuracy: ±0.03 ft. over 2-ft. change in head, @ 20°C still air, ideal target, 50-ft. cable.
Operating Temperature Range: -4°F to 122°F, (-20°C to 50°C)
Material: PVC housing with acoustic window
Cable: Low-loss cable, coax cable RG 62/U
Cable Length: 25 ft. (7.6 m) standard, custom lengths to 500 ft. (contact manufacturer for performance information at custom lengths)
Mounting: Permanent and adjustable mounting brackets
Dimensions (transducer only): 5.0" H x 2.25" D, (12.7 cm x 5.7 cm)
Weight: 1.5 lbs.
Connection: Bare wire lead connection via terminal blocks

> **Velocity Sensor:**
Method: Doppler Principle
Accuracy: ±2% of reading; Zero Stability: ±1.52 cms (± 0.05 fps)
Range: -5 to +20 fps (-1.52 to 6.1 m/s)
Resolution: 0.01 fps (0.3 cm/s)
Response Time: 4.8 seconds
Profile Time: 4.8 seconds
Length: 2.7" (6.9 cm)
Width: 1.5" (3.81 cm)
Height: 0.44" (1.1 cm)
Cable: Urethane sensor cable, shielded
Cable Length: 25 ft. (7.6 m), custom cable lengths up to 100 ft.
Mounting: Dedicated mounting rings (mounting clips recommended for pipe diameters 8" or under), Mounting Plate (for permanent mounting-drills to pipe wall), Adjustable Mounting Band Kit
Connection: Sensor connector to quick-connect hub or bare leads connection via terminal block

> **In-Pipe Ultrasonic Sensor:**
Operating Frequency: 75 kHz
Beam Angle: 5° (-10 dB)
Accuracy: ±0.014 ft. for sensor-to-liquid distance between 2.86 inches and 13.5 ft ± 1 ft change in head from calibration point, 20°C still air, ideal target, 50 ft cable.
Range: Distance from liquid sensor: 0.64 inches (minimum) to 13.5 feet (maximum), @ 20°C still air, ideal target, 50 ft cable.
Operating Temperature Range: -4°F to 140°F, (-20°C to 60°C)
Material: StatCon A-E ABS plastic
Cable: Low-loss cable, coax cable RG 62/U
Cable Length: 25 ft. (7.6 m) standard, custom lengths up to 500 ft. (contact manufacturer for performance information at custom lengths)
Dimensions (transducer only): 1.75" (4.44 cm), maximum diameter x 12.375" (31.435 cm) long.
Mounting: Dedicated Mounting Rings, Permanent Mounting Bracket (installs directly to pipe wall), Adjustable Mounting Band Kit
Connection: Bare lead connection via terminal blocks

> **Submerged Area Velocity Sensor:**
Method: Doppler Principle / Pressure Transducer
Material: Polyurethane body, 316 series stainless steel diaphragm
Cable: Urethane sensor cable with air vent, shielded
Cable Length: 25 ft. (7.6 m) standard, custom cable lengths up to 100 ft.
Length: 5" (12.7 cm)
Width: 1.5" (3.81 cm
Height: 0.8" (2.03 cm)
Mounting: Dedicated mounting rings (mounting clips recommended for pipe diameters 8" or under), Mounting Plate (for permanent mounting screws to pipe wall), Adjustable Mounting Band Kit
Connection: Sensor connector to quick-connect hub, bare lead connection via terminal block or bare lead connection to junction box with bare lead junction box via terminal block

Velocity:
Velocity Accuracy: ± 2% of reading; Zero Stability: <0.05 fps (<0.015 m/s)
Response time: 4.8 sec.
Profile Time: 4.8 sec.
Range: -5 to +20 fps, (-1.52 to 6.1 m/s)
Resolution: 0.01 fps, (0.0028 m/s)
Operating temperature: 0° to 140°F, (-18° to 60°C)

Depth:
Depth Accuracy: ±2% of reading at 10 in. of depth.
Maximum Allowable Level: 3X over pressure
Operating Temperature Range: 32° to 160°F, (0° to 71°C)
Compensated Temperature Range: 32° to 86°F, (0 to 30°C)
Temperature Error:
0.018 to 11.5 ft. ±0.004 ft./°F (0.005 to 3.5 m ±0.0022 m/°C)
0.018 to 34.6 ft. ±0.012 ft./°F (0.005 to 10.5 m ±0.006 m/°C)
(maximum error within compensated temperature range - per degree of change)
Draw down connection:* 0 to 10 fps (0 to 3.05 m/s) = 0.085% of reading
Air Intake: Atmospheric pressure reference is desiccant protected

> **Integral pH Meter:**
Control/Logging: Field selectable to log pH independent of flow or in conjunction with flow; also controls sample collection in response to value of low/high stipends
pH Sensor: Temperature compensated; impact resistant ABS plastic body. Combination electrode with porous Teflon junction.
Measurement Range: 2 to 12 pH
Operating Temperature Range: 0 to 176°F, (-18 to 80°C)
Dimensions: 0.75" diameter x 6" long (19.5 mm x 15.24 cm) with 0.75" (19.5 mm) mpt cable end

> **Rain Gauge Input:**
General Information: For use with Hach Tipping Bucket Rain Gauge. Flow measurement can be initiated upon field selectable rate of rain. Flow meter records rainfall data. Shielded cable, 100' length maximum. Each tip = 0.01" (0.25 mm) of rain.

> **Analog Input Channels:**
General Information: Up to seven additional data logging channels record data from external source(s). Four channels with -4.5 to 4.5 VDC input with 1 meg ohm input impedance on each channel and three channels with 4-20 mA input.

> **4-20 mA Output:**
General Information: Two isolated output signals available. User assignable
Maximum Resistive Load: 600 ohms
Output Voltage: 24 VDC – no load

> **Alarm Relays:**
General Information: Four integral alarm relays; form C (common, normally open, normally closed), 5 amp. Connection to instrument through terminal blocks.
Relay Contact Ratings: 5 amps, (30-230 VAC)

> **Communications:**
General Information:
RS-232: up to 19,200 baud
Modem: 14400 bps., V.32 bis, V.42, MNP2-4 error correction. V.42 bis MNP5 data compression. MNP 10-EC Cellular Protocol; Pager; SCADA-Modbus® communication protocol (standard) via RS-232 or optional modem

Hach offers more than 20 years experience in matching the right product for your specific application. The guide below is intended to make some of that experience available to our customers. Since field and application conditions can vary from site to site, to optimize performance of a system under unique site conditions we suggest contacting a Hach Technical or Sales representative for their recommendations and the latest specifications.

Open-Channel Flow Measurement Technology Guide†††

	Submerged Pressure Area Velocity	Doppler Submerged Pressure Area Velocity	Wafer Velocity (with ultrasonic Sensor*)	Standard Ultrasonic	In-Pipe Ultrasonic	Submerged Pressure Depth Only	Bubbler	Area Velocity Bubbler
Applications								
Weirs and flumes	NR†	NR	NR	Excellent	NR	Excellent	Excellent	NR
Pipes/Channels < 6 in. (150 mm)	Contact Factory							
Pipes/Channels 6 to 8 in. (150 to 200 mm)	Good	Good	Very Good	NR	NR	Excellent	Excellent	Good
Pipes/Channels 10 to 15 in. (250 to 375 mm)	Excellent	Excellent	Excellent	NR	Good†††	Excellent	Excellent	Excellent
Pipes/Channels 15 to 96 in. (375 to 2500 mm)	Excellent	Excellent	Excellent	Very Good†††	Excellent†††	Excellent	Excellent	Excellent
Overflow Channels (normally dry)	NR	NR	Very Good	Excellent	Excellent	NR	Very Good	Very Good
Site Conditions								
Backwater flow	Excellent	Excellent	Excellent†††	Excellent*	Excellent*	Excellent*	Excellent*	Excellent*
Full pipe, surcharged flow	Excellent	Excellent	Excellent	NR	NR	Excellent*	Excellent*	Excellent*
Reverse flow	Excellent	Excellent	Excellent	Excellent*	Excellent*	Excellent*	Excellent*	Excellent*
Low depth, < 2 in. (50 mm)	NR	NR	Good	Excellent	Excellent	Good	Very Good	NR
Low Velocity, 0.2 to 0.8 fps (0.06 to 0.24 m/s)	Good	Very Good	Good	Excellent	Excellent	Excellent	Excellent	Good
Highly Erosive Conditions (high velocity with abrasive content present)	Very Good	NR	Good	Excellent	Excellent	Excellent	Excellent	Good
Low suspended solids, 50 to 100 ppm	Good	Very Good	Good	Excellent	Excellent	Excellent	Excellent	Good
Low suspended solids, < 50 ppm	NR	NR	NR	Excellent	Excellent	Excellent	Excellent	NR
Air temperature fluctuations	Excellent	Excellent	Excellent	Good	Good	Excellent	Very Good	Very Good
Liquid temperature fluctuations	Very Good	Very Good	Very Good	Excellent	Excellent	Very Good	Excellent	Excellent
Water Temp 100-140°F	Good	Good	Excellent	Good†††	Good†††	Good	Excellent	Good
Silt**	NR	NR	NR	Excellent	Excellent	Very Good	Very Good	NR
Suspended solids	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Suspended grease**	Good	Good	Good	Excellent	Excellent	Good	Good	Good
Floating oil, grease, or debris	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Surface turbulence	Excellent	Excellent	Excellent	NR	NR	Excellent	Excellent	Excellent
Boiling turbulence	NR	NR	NR	NR	NR	Very Good	Excellent	NR
Foam on liquid	Excellent	Excellent	Excellent	NR	NR	Excellent	Excellent	Excellent
Steam above liquid	Excellent	Excellent	Excellent	NR	NR	Excellent	Excellent	Excellent
Strong wind	Excellent	Excellent	Excellent	NR	NR	Excellent	Excellent	Excellent

† Not Recommended *When used with Wafer Velocity ** For optimum results, velocity sensor must be unobstructed. ††† Application may depend on local site conditions. Contact factory for application advice.

New

An Introduction to Open-Channel Flow Measurement Technology

To further assist you in determining the right equipment for your specific site conditions, Hach has prepared a handbook on the basics of flow measurement. It provides information regarding types of open-channel flow measurement, technologies currently employed, applications, and general guidelines for successful flow measurement. A detailed "Technology Guide" to help users choose the right instrumentation for their application is included.

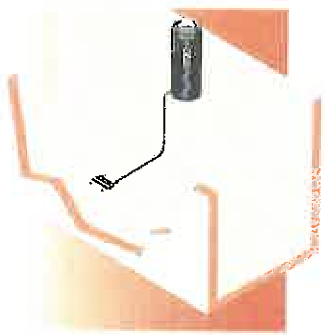
- > Municipal treatment
- > Pretreatment
- > Combined sewer overflow (CSO)
- > Sanitary sewer overflow (SSO)
- > Municipal stormwater
- > Nonpoint source runoff
- > Industrial discharge
- > Stormwater
- > Hazardous and difficult locations

Area Velocity (Doppler) Applications

The unsurpassed flexibility of Hach's Sigma Flow Meters makes it possible to configure a meter for virtually any application. This versatility is illustrated by Hach's Sigma Doppler Applications.

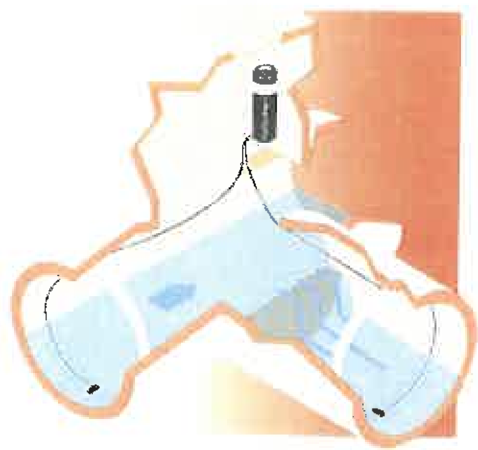
Redundant measurements.

Frequently, critical applications such as custody transfer or inter-agency billing demand redundant measurement. At this site, one 920 is providing ultrasonic measurement in a parshall flume while also measuring flow upstream using the Continuity Equation, Q=AxV. This assures no lost data in a submerged flow condition.



Allows setup in dry pipe.

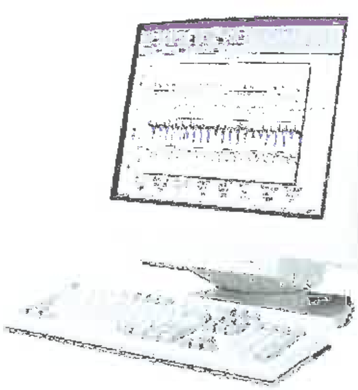
Hach area velocity flow meters do not require on-site manual velocity calibration to establish average velocity, allowing setup in a dry pipe. Rapid signal processing and temperature compensation accurately record the change from dry to wet conditions.



Measure flow in two pipes with one meter.

When CSO outfall is conducive to accurate flow measurement, the 920 can measure depth and velocity in the primary channel, as well as overflow.

Data Management and Analysis Software



Hach's analysis software lets you quickly and easily program your Hach data logger, download data, and turn it into useful information.

- Easy-to-use graphical Windows-like screen.
- Pull-down menus and a quick-click toolbar allows even inexperienced users to quickly learn the program.
- View current data at the monitoring site and download all files in an instant.
- Automates remote data collection by scheduling multiple loggers for unattended retrieval via modem.
- Site files can be viewed as text or graphs, and reported on screen and printed. Graphs can be exported to a spreadsheet.
- Data editing enables you to correct for site or equipment anomalies.
- Data is stored in dual files to assure data integrity. The data is stored in individual site files from each download—as well as in a common database file which merges all data from a single site. The result is simpler, more efficient analysis.

Feature Summary:

- Real time view of logger status.
- Multiple sensor support.
- Remote programming.
- Modem scheduling.
- Alarms.

For detailed information on Hach software, please visit www.hach.com.

All Hach Area Velocity Flow Meters Use Advanced 1 Megahertz Doppler Technology

- > **Direct Average Velocity**
- > **Active Probe Electronics**
- > **Stronger Signal Frequency**
- > **Faster Signal Processing**
- > **Quicker Response Time**
- > **Low Profile Probe**
- > **Reverse Flow Measurement**
- > **Drawdown correction: Compensates for effects of velocity on level measurement.**

Technical Training Programs

Training is vital to the success of your monitoring program. Hach offers workshops in general analytical theory and procedure, and in the specific application of samplers and flow meters, to help organizations support a strong testing program, and to help individuals build a sound foundation for professional development.

We provide training at our facilities in Loveland, Colorado, USA, at scheduled regional training sessions held around the country, and in customized sessions designed to meet your specific needs and schedule. All our workshops are self-contained and have no prerequisite requirements. Continuing Education Units are available.

The flow and sampling two-day workshop covers theory, practical applications, and hands-on experience, including:

- > Flow meter programming
- > Sampler programming
- > Doppler velocity measurement
- > Submerged pressure transducers
- > Ultrasonic transducers
- > Peristaltic pumps
- > Data analysis
- > Site selection
- > Routine maintenance

For details (including schedule, registration, cost), call 1-800-227-4224, or visit http://www.hach.com and click on 'Technical Training'.

Your Representative/Distributor is:

For current price information, technical support, and ordering assistance, contact the Hach office or distributor serving your area.

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Isco Product Data

Isco 2150 Area Velocity Flow Module

The sleek 2150 Series Area Velocity Flow Module combines Isco's proven area velocity flow measurement technology with the flexibility and versatility of a modular design. The 2150 is a self-contained, field-interchangeable measurement and data storage system in an environmentally sealed enclosure. Now, you can configure a monitoring system to meet your specific needs.

- Stack modules you need to build a compact, integrated system.
- Monitor multiple flow streams at the same time.
- Obtain redundant measurements to guarantee integrity.
- Remotely locate modules and connect them via cable.
- Expand your monitoring system as your requirements evolve.

All without returning your meter to the factory. The possibilities are limitless!

You can stack Flow Modules for multi-point or redundant monitoring.

Large, Secure Memory

The 2150's large memory and extremely long battery life substantially reduce the need to visit monitoring sites to retrieve data and replace batteries. Each 2150 stores up to 65,000 readings in a database at intervals from 15 seconds to 24 hours. For example, you can store 9 months of level and velocity readings at 15 minute intervals.

The 2150 Flow Module features rollover memory with variable rate data storage, allowing you to change the data storage interval when programmed conditions occur. For example, for Inflow & Infiltration (I&I) Studies, you can set up your 2150s to store data more frequently when the flow rate increases.

All data is stored in "flash" memory, protecting your data against glitches that can cause other storage technologies to lose your valuable data forever.

Stored data is retrieved and analyzed using Flowlink 4 Software on your PC. The 2150 communicates at a brisk 38.4k baud rate, minimizing your time in the field.

Up to One Year Battery Life

Power is provided by the 2191 Battery Module, which uses 2 standard alkaline lantern batteries or 2 rechargeable lead-acid lantern batteries. The highly efficient power management system in the 2150 provides battery life up to 15 months (two alkaline batteries and 15 minute data storage interval). And the 2150 stores battery voltage to let you know when to change batteries.

Rugged, Submersible Enclosures

The 2150 Flow Module is permanently sealed to meet NEMA 4X, 6P and IP68 requirements for prolonged submersion and watertight, dust-tight and corrosion resistant operation. This ensures dependable operation in the harshest environments.

The 2150 is permanently sealed to survive the most demanding conditions.

Two alkaline lantern batteries provide power for up to 15 months.

Easy to Upgrade

Non-volatile "flash" memory makes it easy to use the latest software in your 2150s. You can easily reprogram this memory using a PC, without opening the Flow Module or returning it to the factory. The 2150 retains its program and all stored data during software updates.

Advanced Area Velocity Technology

The new Isco area velocity sensor is engineered to meet the increasing demand to measure shallow flows in small pipes. Its streamlined, low profile design minimizes flow stream obstruction, while its patented* Doppler technology senses velocity in flows down to 1 inch (25 mm) in depth. The Isco sensor is encapsulated in epoxy to give you improved chemical compatibility in tough applications.

*US Patent No. 5,371,686

Maximum Accuracy

Isco's area velocity sensor mounts at the bottom of the channel and uses Doppler technology to directly measure average velocity in the flow stream. An integral pressure transducer measures liquid depth to determine flow area. Flow rate is then calculated by multiplying the area of the flow stream by its average velocity.

The area velocity method gives you greater accuracy where weirs and flumes are not practical, and where submerged, full pipe, surcharged and reverse flow conditions may occur. You don't have to estimate the slope and roughness of the channel, and silt correction allows you to compensate for debris that accumulates on the bottom of the channel.

The pressure transducer's venting system automatically compensates for changes in atmospheric pressure to maintain accuracy. An exclusive, high-capacity internal desiccant cartridge keeps the vent free of moisture during normal operation, while a replaceable hydrophobic filter protects the vent against the intrusion of water during submersion.

The 2150's quick connect sensor makes setup a snap. The area velocity sensor can be easily removed and interchanged in the field for maximum convenience.

Easy Setup

Isco's Doppler system eliminates the problems of electromagnetic probes by continuously sensing the velocity profile of the flow stream. This saves you time, eliminating the manual profiling and calibration required by electromagnetic systems. And the 2150 stores sensor diagnostics to assist with troubleshooting.

Unlike electromagnetic probes, sealed Isco sensors resist fouling by oil and grease, so you're not bothered by frequent cleanings. You can count on the Isco area velocity sensor for long term, dependable operation.

Isco's 500 KHz Doppler is ideal for applications such as sewer flow monitoring, I&I Studies, combined sewer overflow (CSO) monitoring, and storm water runoff monitoring.

Our 500 KHz signal provides a longer wavelength that penetrates farther into deep flow streams than 1 MHz systems, whose shorter wavelength can cause their Doppler systems to be "nearsighted" in typical wastewater applications.

Flowlink® 4 Software

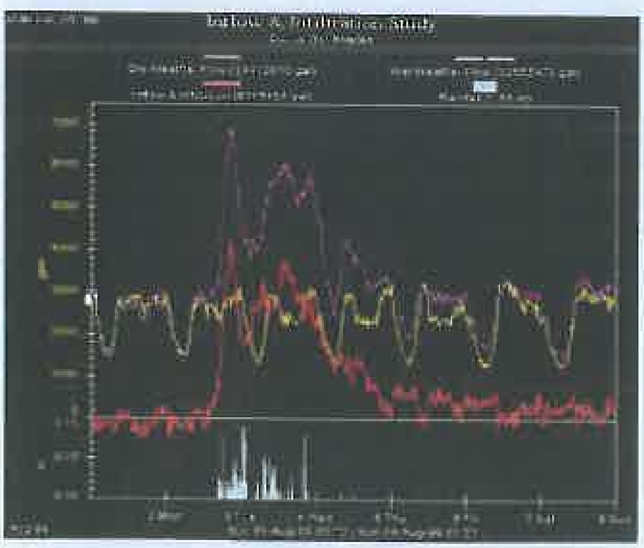
Isco's Flowlink 4 Software, on a PC, is used to set up 2150 Flow Modules, and to retrieve and analyze stored data. Flowlink 4 harnesses the power of *Microsoft Windows* to streamline your flow monitoring program, allowing you to conduct advanced studies and generate sophisticated reports.

Flowlink also retrieves and analyzes stored data from Isco 4100 Series Flow Loggers, 4200 Series Flow Meters, 6700 Series Samplers with 700 Modules, and 675 Logging Rain Gauges. In addition, Flowlink imports data from spreadsheet files. All data is stored in an industry-standard *Microsoft Access* database.

Advanced Data Analysis and Reporting

Flowlink generates a variety of informative graphs and tables. You can display simple graphs with a single mouse click, or conduct very sophisticated analyses of your data. Flowlink offers a number of advanced capabilities designed specifically for managing flow data.

- ➤ Compare data from multiple sites
- ➤ Display wet and dry weather flows
- ➤ Compare flows based on the Continuity Equation and the Manning formula
- ➤ Analyze flow, rainfall and sample data together
- ➤ Add, subtract, multiply and divide data



Compare dry and wet weather flows, plus rainfall, for Inflow & Infiltration Studies.

Flowlink also allows you to:

- ➤ Include graphs and tables in *Microsoft Word, Excel* and *PowerPoint*
- ➤ Schedule tasks to automate your monitoring system
- ➤ Export data to ASCII spreadsheet files
- ➤ Edit, archive and back up your data

Please refer to Flowlink 4 literature for specifications and additional information.

Free Program Preview CD

To receive a free CD demonstrating the many powerful features in Flowlink 4, contact Isco or your local Isco representative.

Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	Total Flow (gal)
1107	591	1495	[illegible]
[illegible]	[illegible]	1496	1602125
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	739	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1711	[illegible]
1177	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1507	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1707	[illegible]
1165	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	Average Total Flow (gal)
[illegible]	[illegible]	[illegible]	[illegible]
Total [illegible] gal			Total [illegible] gal

Any graph can quickly be converted to a table, including average, minimum, maximum and total values.

Isco 2150 Specifications

2150 Area Velocity Flow Module

Size *(H x W x D)*	2.9 x 11.3 x 7.5 in	7.4 x 28.7 x 19.1 cm
Weight	2.0 lbs	0.9 kg
Material	High-impact molded polystyrene	
Operating temperature	0° to 140° F	-18° to 60° C
Storage temperature	-40° to 140° F	-40° to 60° C
Enclosure *(self-certified)*	NEMA 4X, 6P	IP68
Power	7.0 to 16.6V DC, 100 mA typical at 12V DC, 1 mA standby	
Typical Battery Life *(with 1 module)*	**Data Storage Interval** / **Alkaline Lantern Batteries** / **Lead-Acid Lantern Batteries**	
	15 minutes / 15 months / 2½ months	
	5 minutes / 8 months / 1½ months	
	1 minute / 2 months / 11 days	
Program Memory	Non-volatile, programmable flash; can be updated using PC without opening enclosure; retains user program after updating	
Number of Modules Connected Together	Up to 4, field interchangeable	
Maximum Distance Between Modules	3300 ft	1000 m
Wiring Between Remote Modules	Twisted pair for communication, pair for power, gauge dependent on distance	
Flow Rate Conversions	Up to 2 independent level-to-area conversions and/or level-to-flow rate conversions	
Level-to-Area Conversions		
Channel Shapes	Round, U-shaped, rectangular, trapezoidal, elliptical, with silt correction	
Data Points	Up to 50 level-area points	
Level-to-Flow Rate Conversions		
Weirs	V-notch, rectangular, Cipolletti, Isco Flow Metering Inserts, Thel-Mar	
Flumes	Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, HL	
Manning Formula	Round, U-shaped, rectangular, trapezoidal	
Data Points	Up to 50 level-flow rate points	
Equation	2-term polynominal	
Total Flow Calculations	Up to 2 independent, net, positive or negative, based on either flow rate conversion	
Data Storage Memory	Non-volatile flash; retains stored data during program updates	
Capacity	395,000 bytes (up to 79,000 readings, equal to over 270 days of level and velocity readings at 15 minute intervals, plus total flow and input voltage readings at 24 hour intervals)	
Data Types	Level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, input voltage	
Storage Mode	Rollover with variable rate data storage based on level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, or input voltage	
Storage Interval	15 or 30 seconds; 1, 5, 15, or 30 minutes; or 1, 2, 4, 12, or 24 hours	
Bytes Per Reading	5	
Setup and Data Retrieval	Serial connection to IBM PC or compatible computer with Isco Flowlink for Windows Software Version 4.1	
Baud Rate	38,400	

Area Velocity Sensor

Size *(H x W x L)*	0.75 x 1.31 x 6.00 in	1.9 x 3.3 x 15.2 cm
Cable Length	25 ft	7.6 m
Cable Diameter	0.37 in	0.9 cm
Weight *(including cable)*	2.2 lbs	1.02 kg
Materials	Sensor - Epoxy, chlorinated polyvinyl chloride (CPVC), stainless steel; Cable - Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC).	
Operating Temperature	17° to 140°F	-10° to 60°C
Level Measurement		
Method	Submerged pressure transducer mounted in the flow stream	
Transducer Type	Differential linear integrated circuit pressure transducer	
Range	0.033 to 10 ft	0.010 to 3.05 m
Maximum Allowable Level	34 ft	10.5 m
Accuracy[1]	0.033 to 10 ft (0.010 to 3.05 m)	±0.008 ft (±0.003 m)
Long-term Stability	0.007 m/yr	
Compensated Range	32° to 122° F	0° to 50° C
Velocity Measurement		
Method	Doppler ultrasonic	
Frequency	500 kHz	
Transmission Angle	20° from horizontal	
Typical Minimum Depth	0.08 ft.	25 mm
Range	-5 to +20 ft./s	-1.5 to +6.1 m/s
Accuracy[2]	-5 to +5 ft./s (-1.5 to +1.5 m/s)	±0.1 ft./s (±0.03 m/s)
	5 to 20 ft./s (1.5 to 6.1 m/s)	±2% of reading
Temperature Measurement		
Accuracy	± 3.6° F	± 2° C

2191 Battery Module

Size *(H x W x D)*	6.0 x 9.6 x 7.6 in	15.2 x 24.4 x 19.3 cm
Weight *(without batteries)*	3.2 lbs	1.4 kg
Material	High-impact molded polystyrene	
Enclosure *(self-certified)*	NEMA 4X, 6P	IP68
Batteries	6V alkaline lantern or lead-acid lantern, quantity 2	
Capacity		
Alkaline Lantern Batteries	25 Ahrs	
Lead-Acid Lantern Batteries	5 Ahrs	

[1] *Maximum non-linearity, hysteresis, and temperature error from actual liquid level.*
[2] *In water with a uniform velocity profile and a speed of sound of 4850 ft./s (1480 m/s), for indicated velocity range.*

Contact the factory or your Isco representative for additional specifications.

With the Isco Street Level Installation Tool, you can install your monitoring system from ground level, eliminating the costs and hazards of entering manholes. Other Isco mounting rings make it easy to install the area velocity sensor in round pipes, manhole inverts, and other open channels.

Ordering Information

Description	Part Number
2150 Area Velocity Flow Module with 2191 Battery Module	68-2050-002
Additional 2150 Flow Modules	68-2050-001
Batteries *(2 required)*	
Alkaline Lantern Battery	340-2006-02
Lead-Acid Lantern Battery	60-2004-041
Flowlink 4® Software	60-2544-052
Communication Cable	60-2004-035

Isco Flowlink Software is licensed under U.S. Patent Nos. 4,070,563; 4,211,111; 4,295,197; 4,344,329; and 4,407,158.
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ISCO®
Water is life. Protect it.

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USA & Canada: (800) 228-4373
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e-mail: info@isco.com
Website: www.isco.com

APPENDIX C

Flow Monitoring Site Sketches and Details

RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: Nelson Avenue and North Street		
COMMENTS: 40.755567, -74.051716		

LOCATION

RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: Troy Street		
COMMENTS: 40.741782, -74.056974		

LOCATION

RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 14, 2016	**JOB#:** 16093
LOCATION: 555 New Jersey 440		
COMMENTS: 40.715204, -74.097493		

LOCATION

RAIN GAUGE SITE INFORMATION FIELD LOG

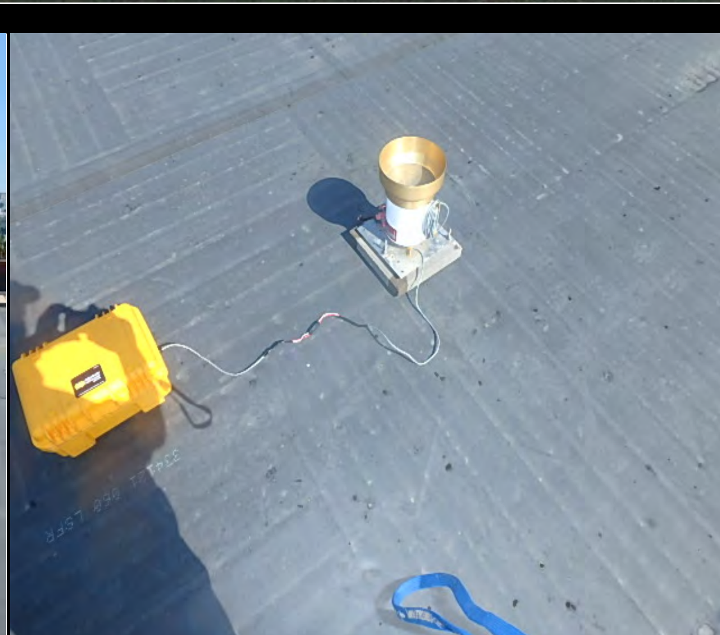
PROJECT: Jersey City, NJ	**DATE:** September 8, 2016	**JOB#:** 16093
LOCATION: 152 Linden Avenue (Fire House)		
COMMENTS: 40.696533, -74.092409		

LOCATION

RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 13, 2016	**JOB#:** 16093
LOCATION: 235 Jersey City Boulevard		
COMMENTS: 40.706674, -74.059182		

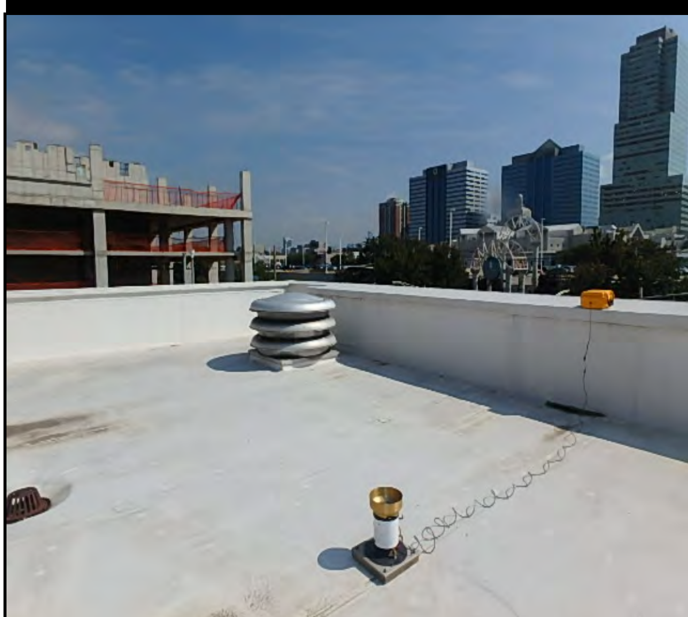
LOCATION

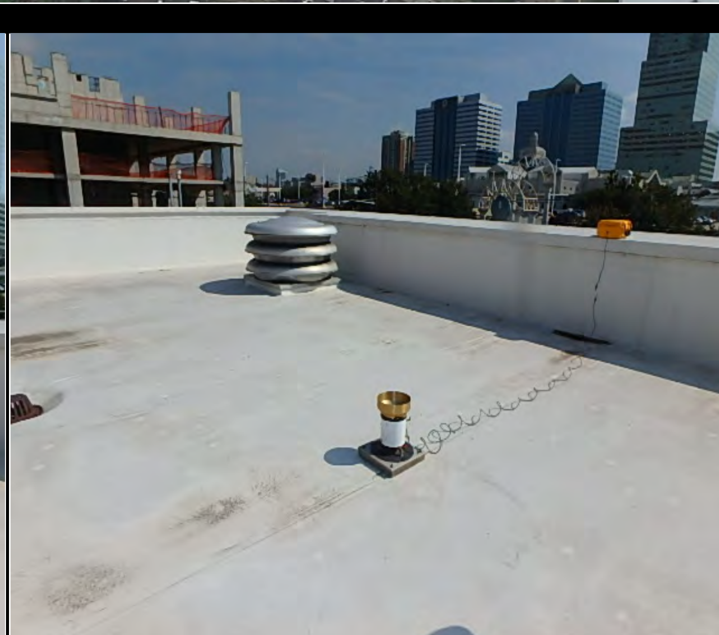


RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 8, 2016	**JOB#:** 16093
LOCATION: 4652 Marin Boulevard, Fire Department Headquarters		
COMMENTS: 40.726332, -74.040606		

LOCATION

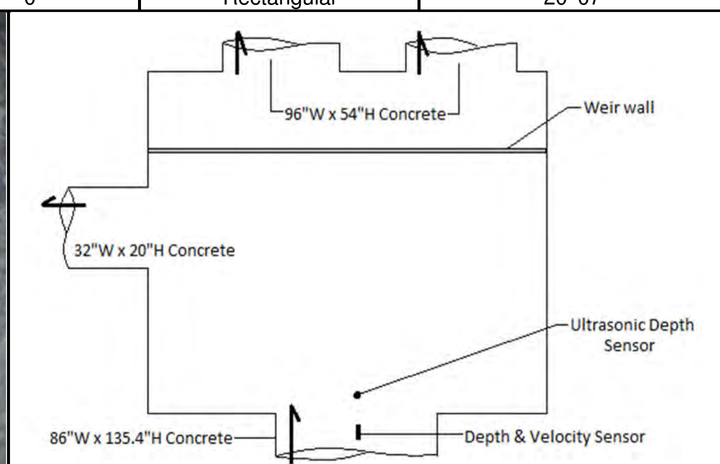




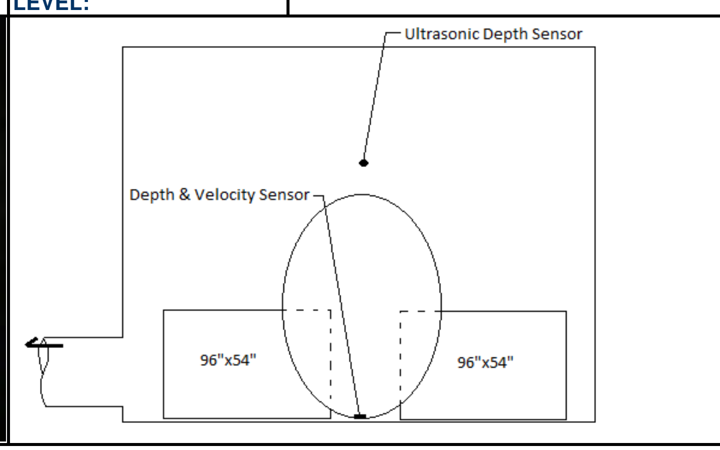
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 21, 2016	**JOB#:** 16093
LOCATION: Dell Avenue R.O.W.	**MH#:**	**METER SITE:** 6
GPS/COMMENTS: 40.760290, -74.052090		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	135.4x86	Concrete	5	0	Oval	17' 05"
Outgoing	32x20	Concrete	10	0	Rectangular	18' 01"
Overflow	96x54	Concrete	4	0	Rectangular	20' 07"
Overflow	96x54	Concrete	4	0	Rectangular	20' 07"



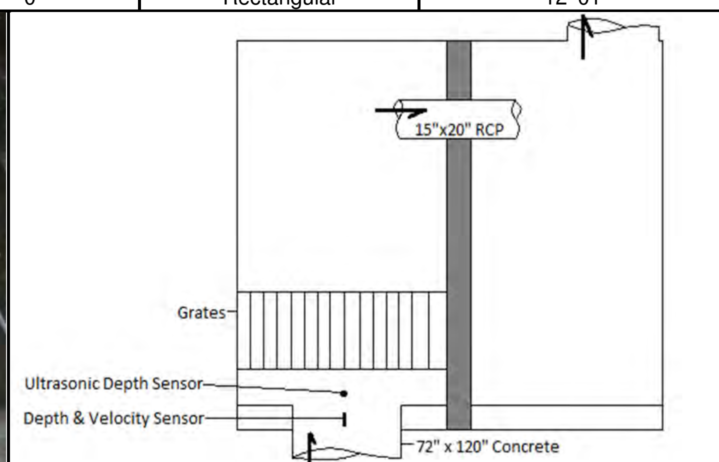
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



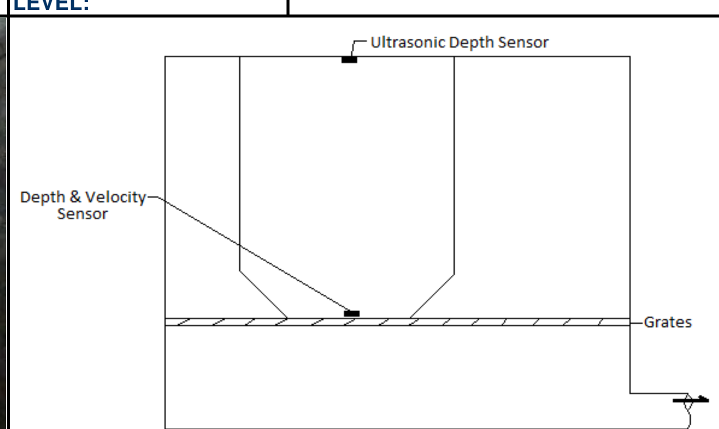
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: 433 Sip Avenue	**MH#:**	**METER SITE:** 17
GPS/COMMENTS: 40.734363, -74.080584		


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	72x120	Concrete	5	2	Trapezoid	12' 00"
Outgoing						
Regulator	15x20	RCP	5	0	Rectangular	13' 00"
Tide Gate	72x120	Metal	1	0	Rectangular	12' 01"

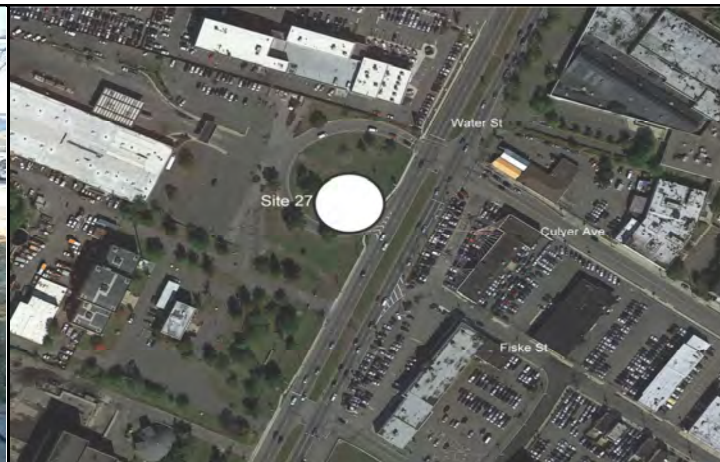


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 10'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

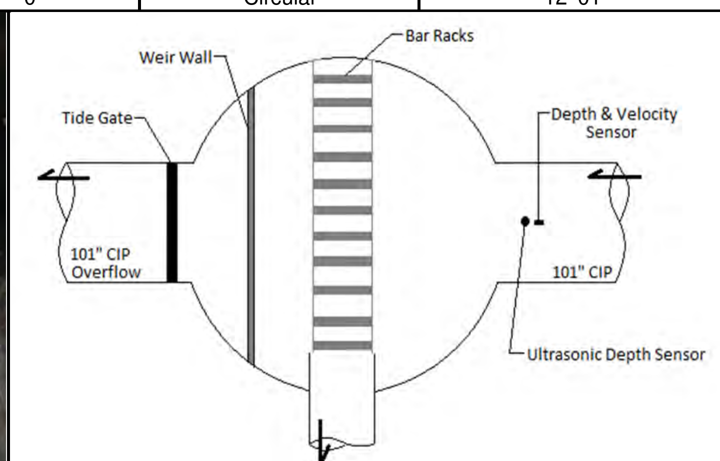


METER SITE INFORMATION FIELD LOG

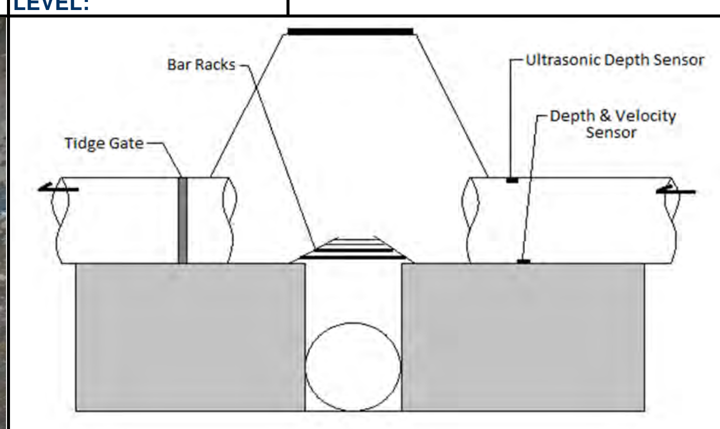
PROJECT: Jersey City, NJ	**DATE:** September 14, 2016	**JOB#:** 16093
LOCATION: 36 Water Street (Across from Hudson Kia)	**MH#:**	**METER SITE:** 27
GPS/COMMENTS: 40.715931, -74.096220		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	101	CIP	4	0	Circular	11' 09"
Incoming						
Outgoing	Unknown	Unknown	4	0	Circular	21' 10"
Overflow	101	CIP	4	0	Circular	12' 01"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

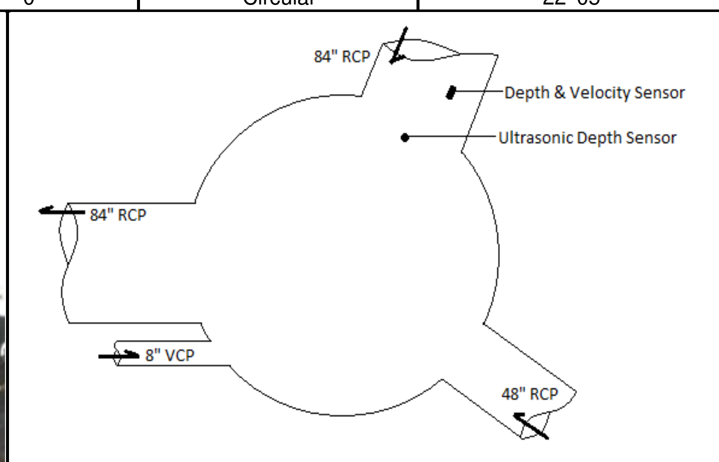


FLOW ASSESSMENT SERVICES

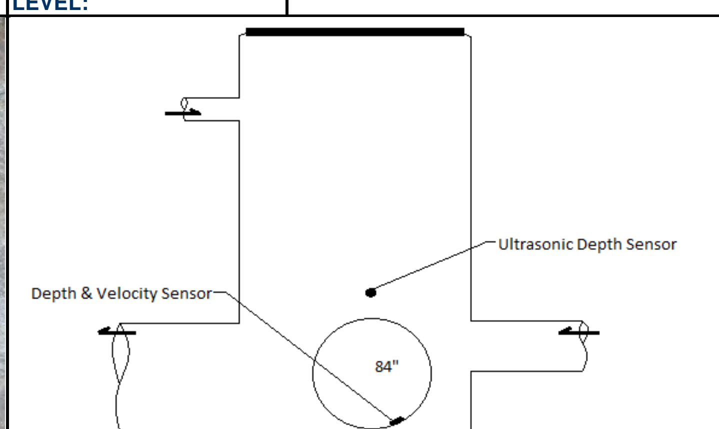
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 14, 2016	**JOB#:** 16093
LOCATION: 555 NJ 440	**MH#:**	**METER SITE:** 28
GPS/COMMENTS: 40.714873, -74.097173		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	22	0	Circular	22' 04"
Incoming	48	RCP	8	0	Circular	20' 09"
Incoming	8	VCP	0.25	8	Circular	09' 09"
Outgoing	84	RCP	22	0	Circular	22' 05"

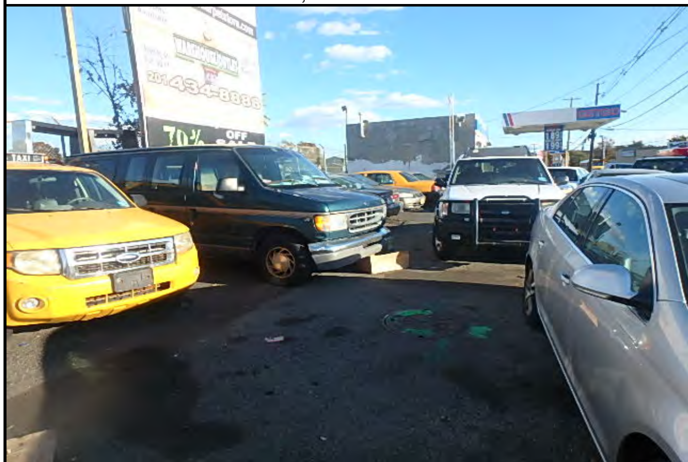


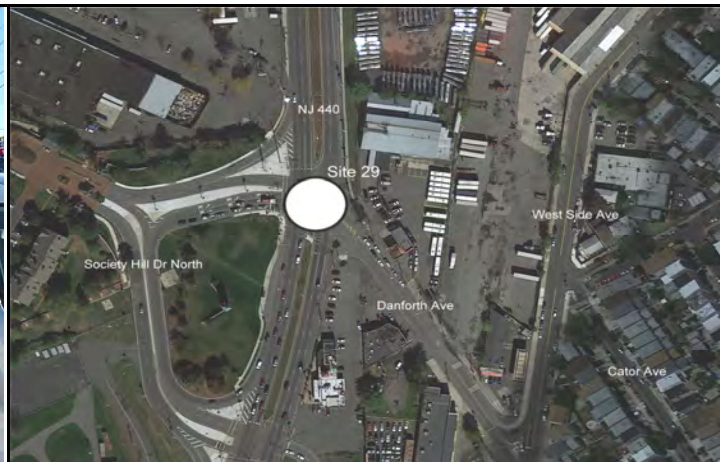
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 12'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



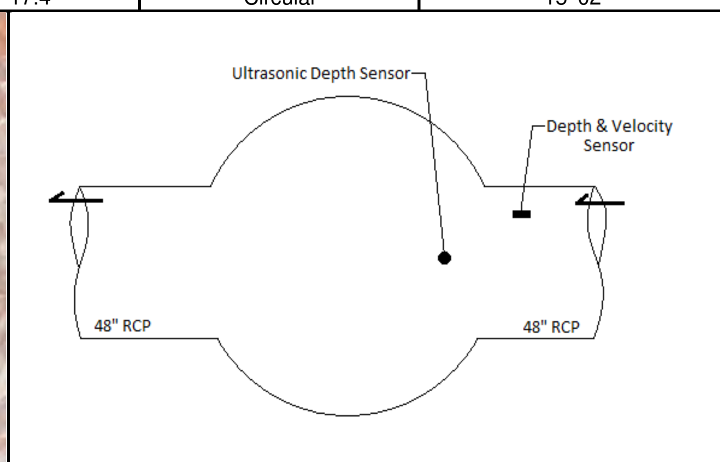
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 13, 2016	**JOB#:** 16093
LOCATION: 432 Danforth Avenue	**MH#:**	**METER SITE:** 29
GPS/COMMENTS: 40.706193, -74.099721		

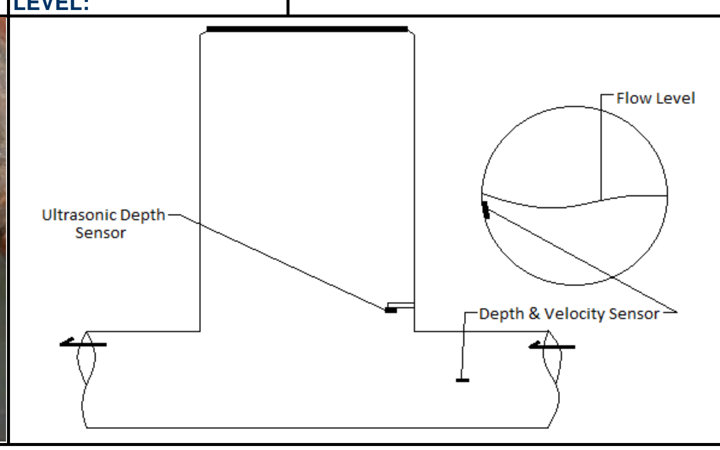




	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	48	RCP	5.8	17.4	Circular	15' 01"
Incoming						
Incoming						
Outgoing	48	RCP	5.8	17.4	Circular	15' 02"

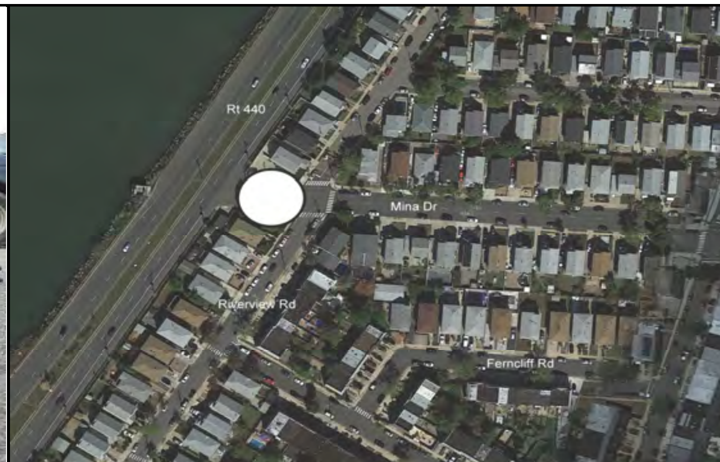


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 9'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

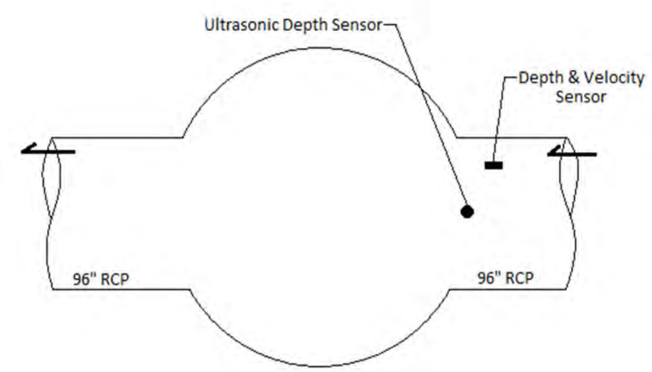


METER SITE INFORMATION FIELD LOG

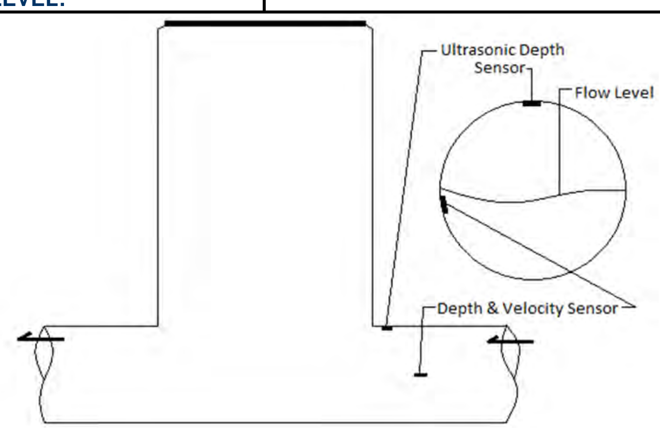
PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: Mina Drive near Route 440	**MH#:**	**METER SITE:** 32
GPS/COMMENTS: 40.699543, -74.103699		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	96	RCP	32.8	11.8	Circular	15' 09"
Incoming						
Incoming						
Outgoing	96	RCP	32.8	11.8	Circular	15' 10"



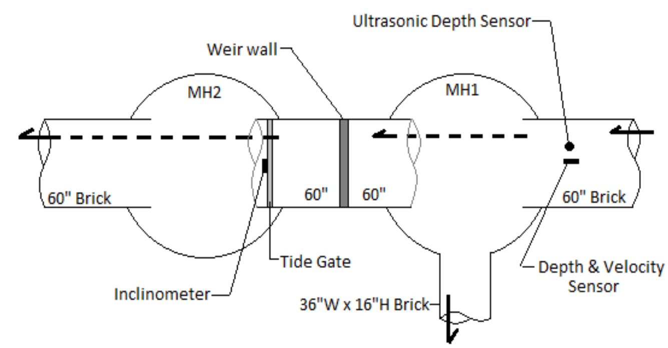
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



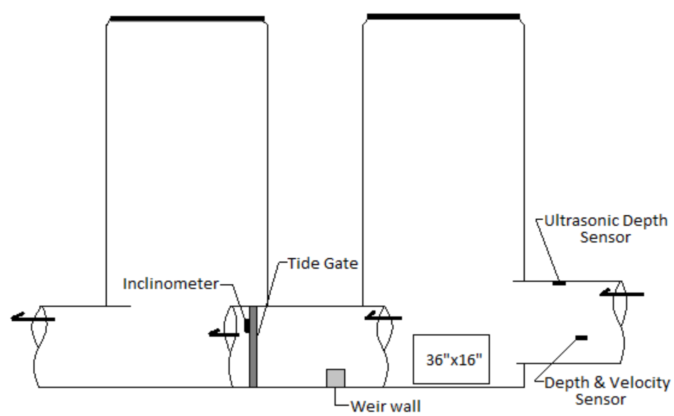
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 13, 2016	**JOB#:** 16093
LOCATION: 13 Linden Avenue East	**MH#:**	**METER SITE:** 33
GPS/COMMENTS: 40.687876, -74.090759		

	Size ('')	Material	Flow Depth ('')	Debris	Shape	MH Depth
Incoming	60	Brick	5	0	Circular	09' 05"
Incoming	60	Brick	4	0	Circular	09' 09"
Outgoing	60	Brick	4	0	Circular	09' 09"
Outgoing	36x16	Brick	5	0	Rectangular	10' 08"
Outgoing	60	CIP	0	0	Circular	09' 07"



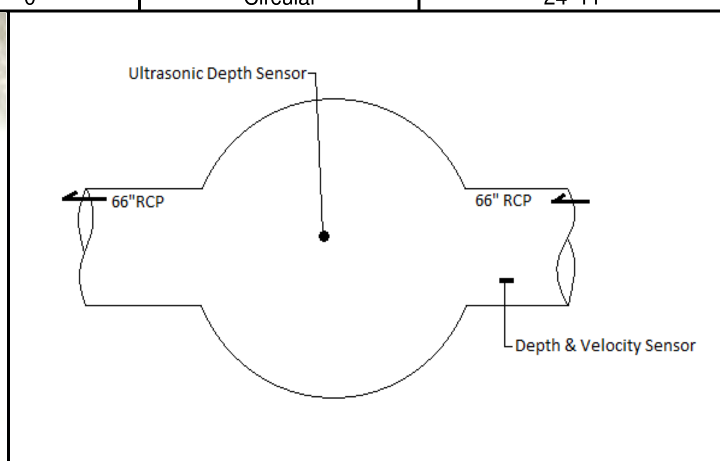
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



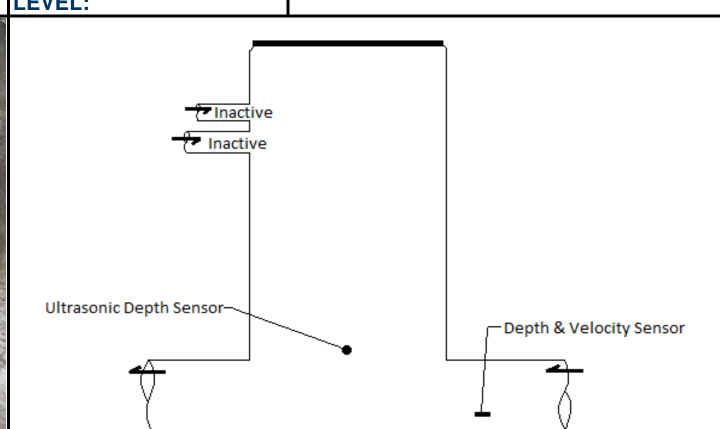
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 13, 2016	**JOB#:** 16093
LOCATION: 235 Jersey City Boulevard	**MH#:**	**METER SITE:** 40
GPS/COMMENTS: 40.705873, -74.060427		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	66	RCP	12	0	Circular	24' 10"
INACTIVE	6	CIP	0	6	Circular	06' 04"
INACTIVE	8	VCP	0	8	Circular	11' 00"
Outgoing	66	RCP	12	0	Circular	24' 11"

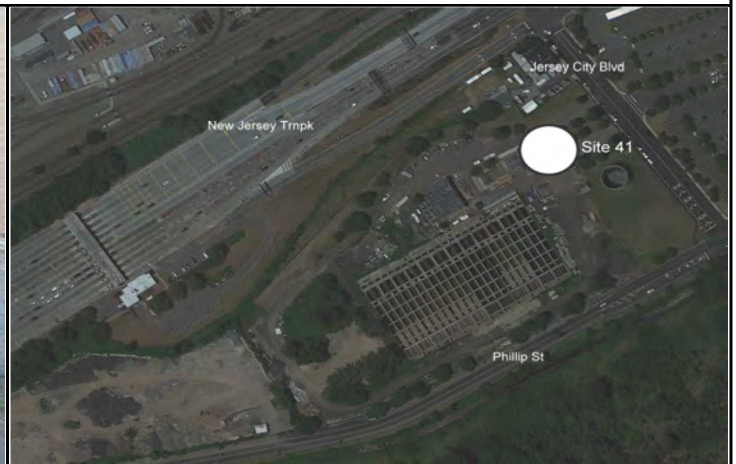


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

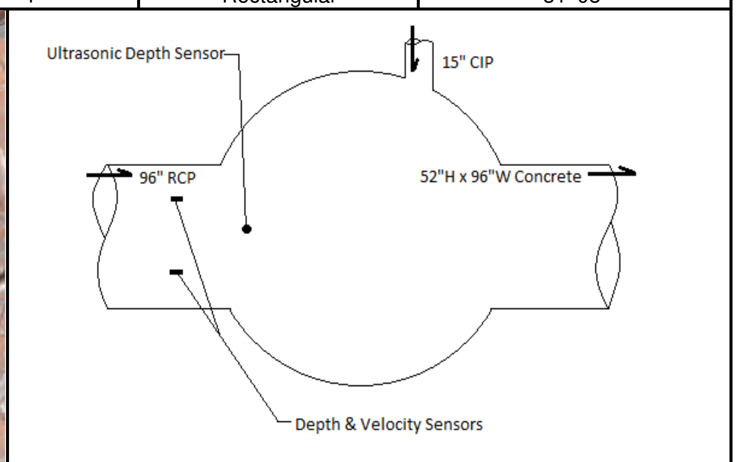


METER SITE INFORMATION FIELD LOG

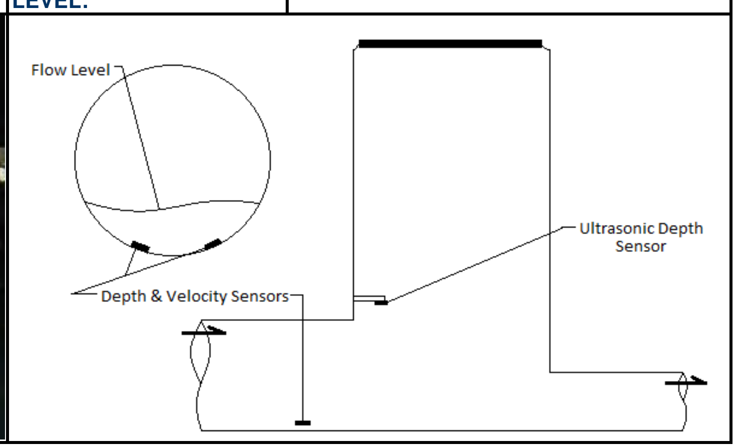
PROJECT: Jersey City, NJ	**DATE:** September 12, 2016	**JOB#:** 16093
LOCATION: 235 Jersey City Boulevard	**MH#:**	**METER SITE:** 41
GPS/COMMENTS: 40.706912, -74.058386		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	96	RCP	24	0	Circular	31' 08"
Incoming	15	CIP	0	0	Circular	06' 11"
Incoming						
Outgoing	52x96	Concrete	24	4	Rectangular	31' 08"



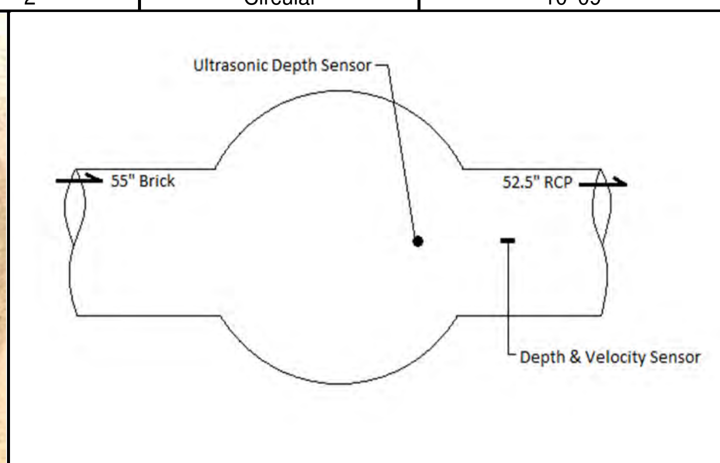
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 28'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



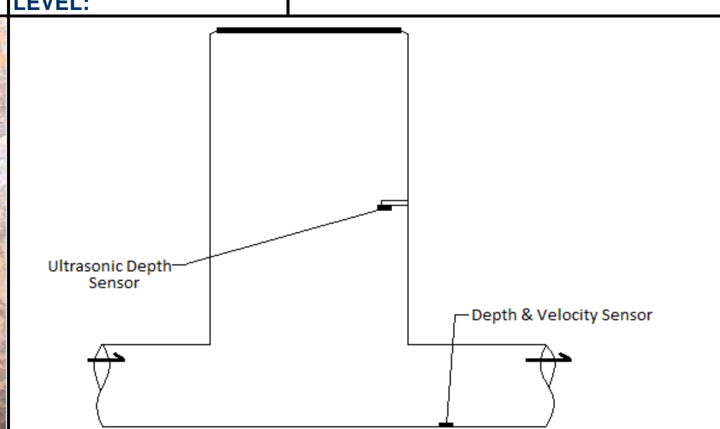
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 8, 2016	**JOB#:** 16093
LOCATION: Pacific Avenue R.O.W. near NJ Turnpike	**MH#:**	**METER SITE:** 42
GPS/COMMENTS: 40.714122, -74.055677		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	55	Brick	8	2.5	Elliptical	10' 09"
Incoming						
Incoming						
Outgoing	52.5	RCP	10	2	Circular	10' 09"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 10' 09"	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

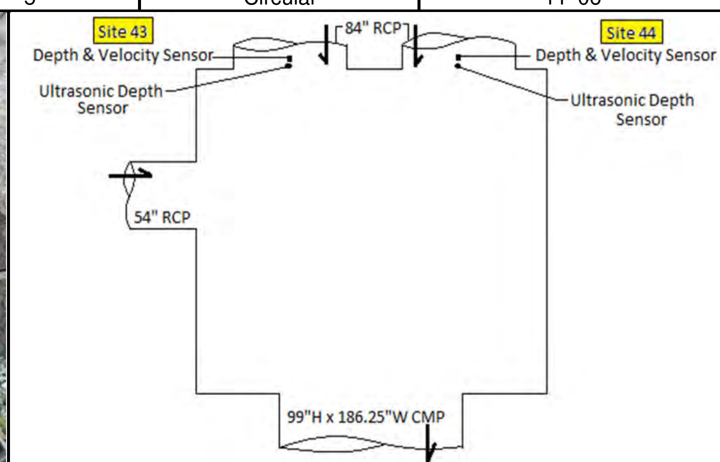


FLOW ASSESSMENT SERVICES

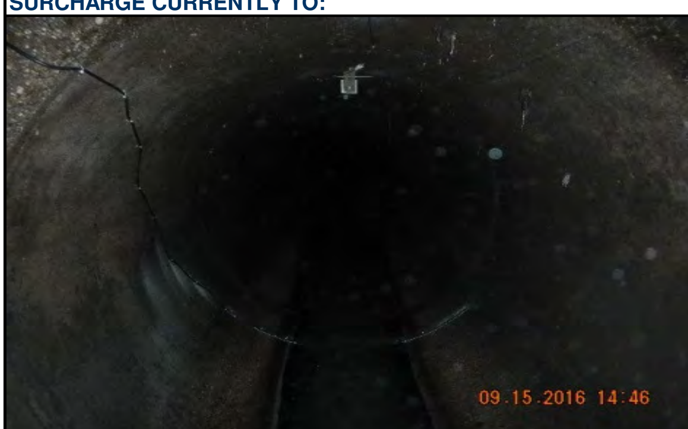
METER SITE INFORMATION FIELD LOG

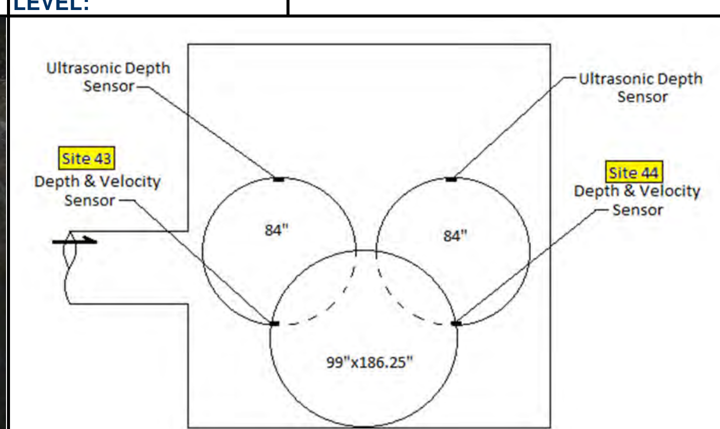
PROJECT: Jersey City, NJ	**DATE:** September 15, 2016	**JOB#:** 16093
LOCATION: Pacific Avenue access road	**MH#:**	**METER SITE:** 43
GPS/COMMENTS: 40.714341, -74.054451		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	21.5	0	Circular	09' 02"
Incoming	84	RCP	4	0	Circular	09' 04"
Incoming	54	RCP	4	0	Circular	07' 06"
Outgoing	99x186.25	CMP	20	5	Circular	11' 06"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

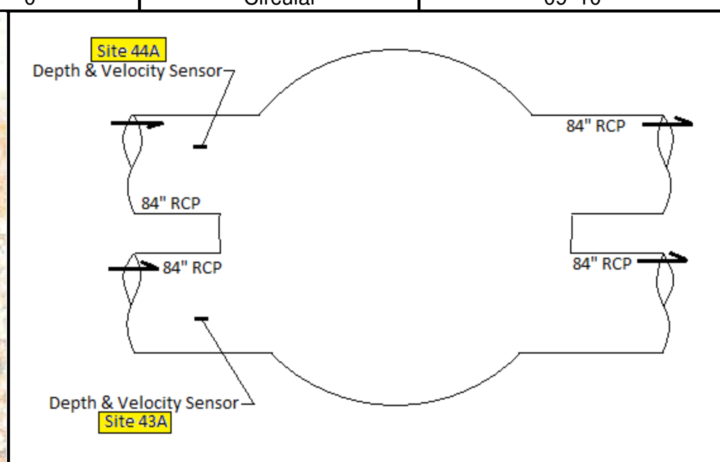




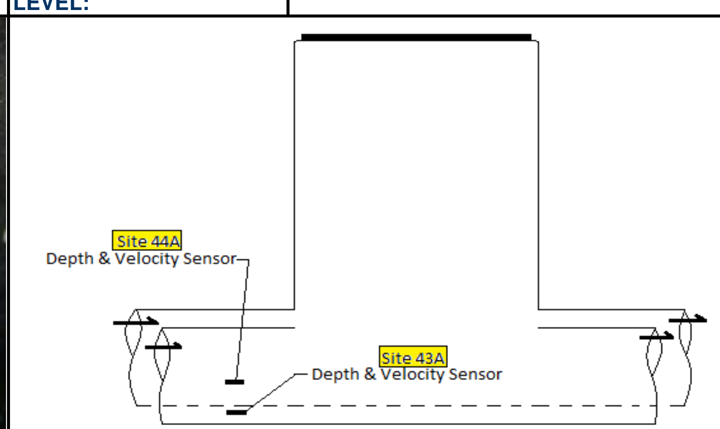
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** November 17, 2016	**JOB#:** 16093
LOCATION: Pacific Avenue access road	**MH#:**	**METER SITE:** 43A
GPS/COMMENTS: 40.714935, -74.054665		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	6.5	2	Circular	09' 10"
Incoming	84	RCP	6.5	0	Circular	09' 10"
Outgoing	84	RCP	4	2	Circular	09' 10"
Outgoing	84	RCP	4	0	Circular	09' 10"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

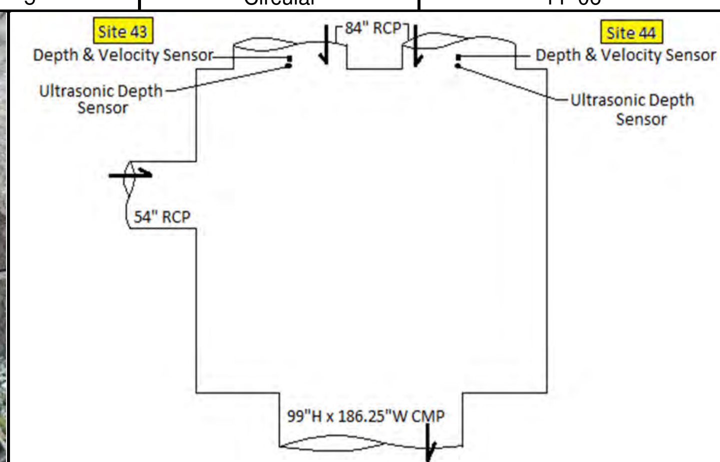


FLOW ASSESSMENT SERVICES

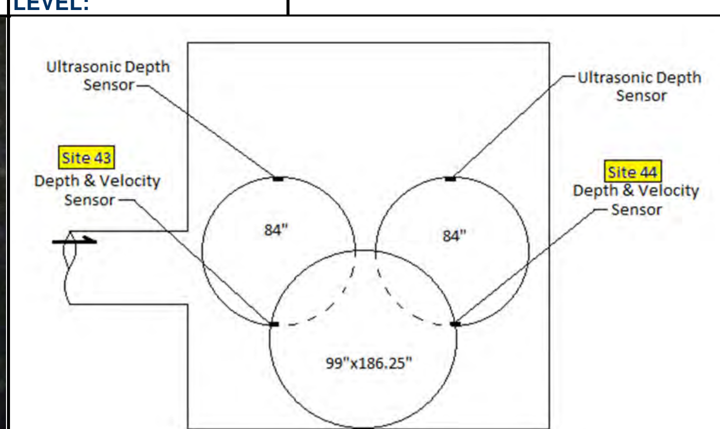
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 15, 2016	**JOB#:** 16093
LOCATION: Pacific Avenue access road	**MH#:**	**METER SITE:** 44
GPS/COMMENTS: 40.714341, -74.054451		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	21.5	0	Circular	09' 02"
Incoming	84	RCP	4	0	Circular	09' 04"
Incoming	54	RCP	4	0	Circular	07' 06"
Outgoing	99x186.25	CMP	20	5	Circular	11' 06"

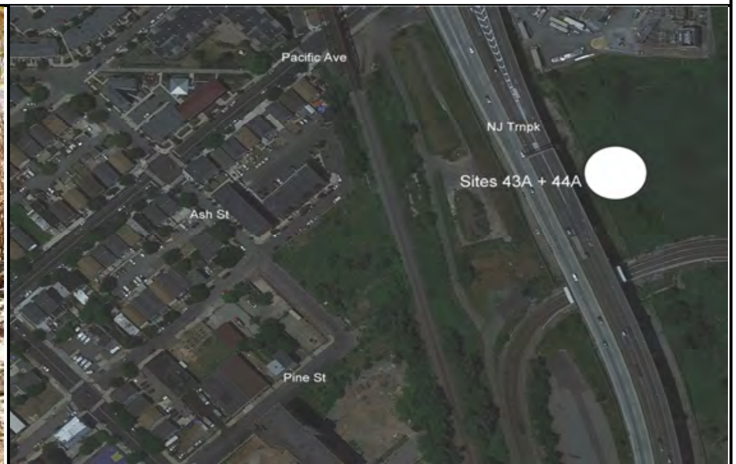


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

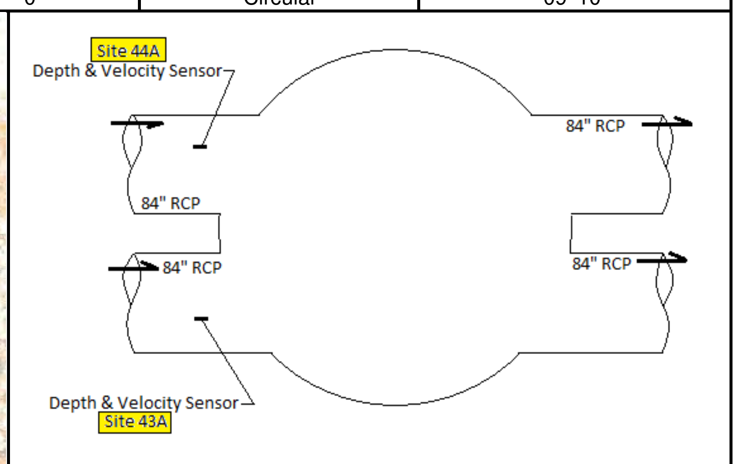


METER SITE INFORMATION FIELD LOG

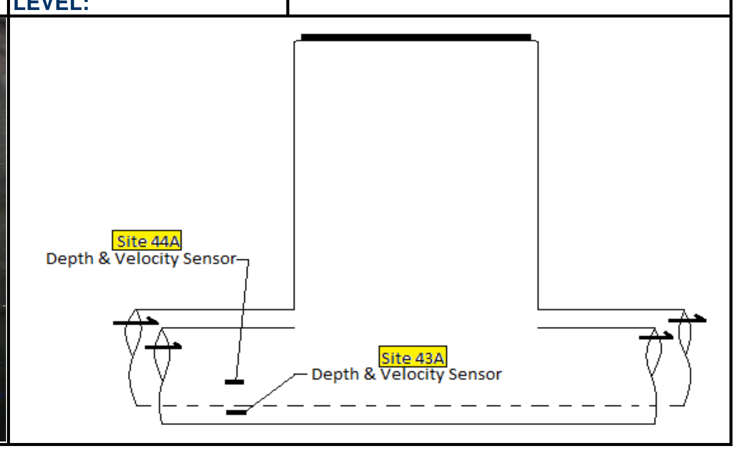
PROJECT: Jersey City, NJ	**DATE:** November 17, 2016	**JOB#:** 16093
LOCATION: Pacific Avenue access road	**MH#:**	**METER SITE:** 44A
GPS/COMMENTS: 40.714935, -74.054665		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	6.5	2	Circular	09' 10"
Incoming	84	RCP	6.5	0	Circular	09' 10"
Outgoing	84	RCP	4	2	Circular	09' 10"
Outgoing	84	RCP	4	0	Circular	09' 10"

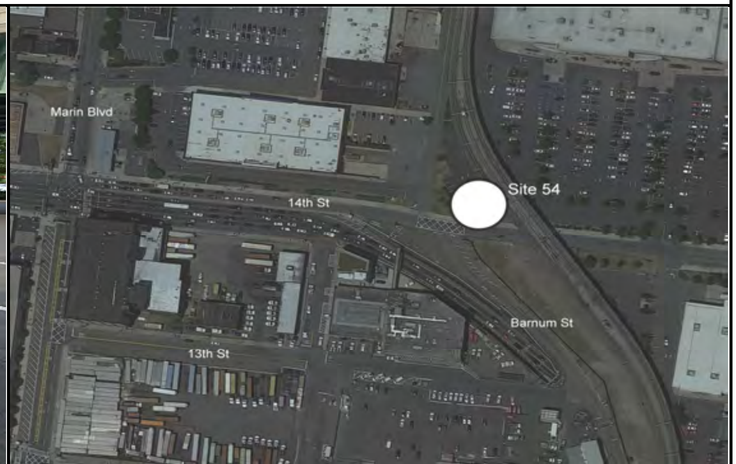


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

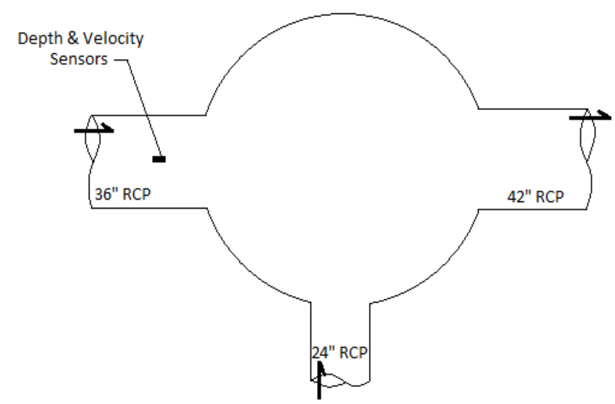


METER SITE INFORMATION FIELD LOG

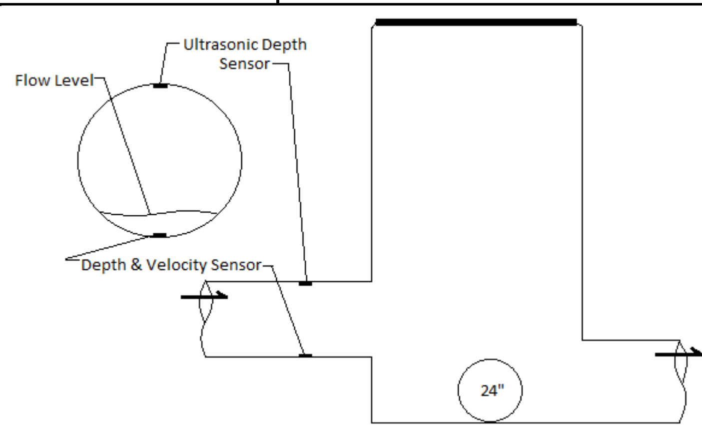
PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: 14th Street, Southwest corner of Target Store	**MH#:**	**METER SITE:** 54
GPS/COMMENTS: 40.731457, -74.036864		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	36	RCP	6	0	Circular	15' 04"
Incoming	24	RCP	10	0	Circular	16' 01"
Incoming						
Outgoing	42	RCP	8	0	Circular	16' 02"



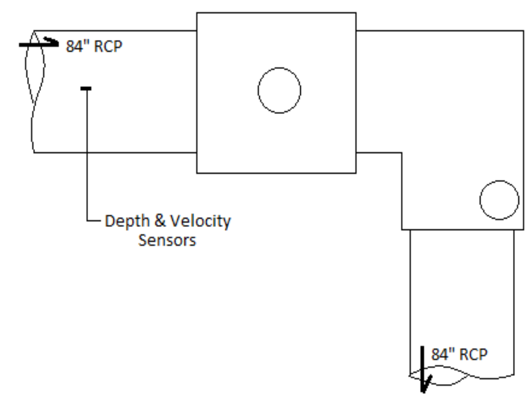
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 13'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



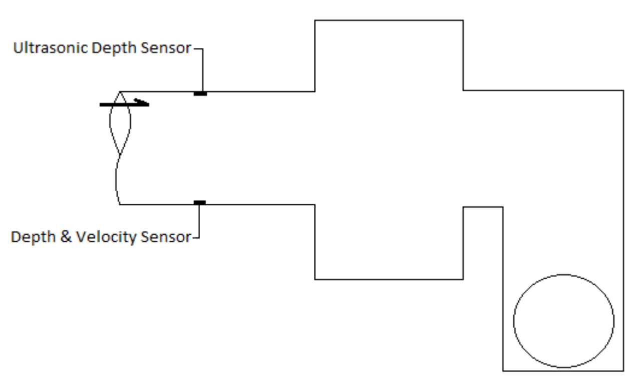
METER SITE INFORMATION FIELD LOG

PROJECT: Jersey City, NJ	**DATE:** September 21, 2016	**JOB#:** 16093
LOCATION: New York Avenue (at hairpin turn)	**MH#:**	**METER SITE:** 58
GPS/COMMENTS: 40.737364, -74.047010		

	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	84	RCP	5	0	Circular	08' 10"
Incoming						
Incoming						
Outgoing	84	RCP	4	0	Circular	10' 06"

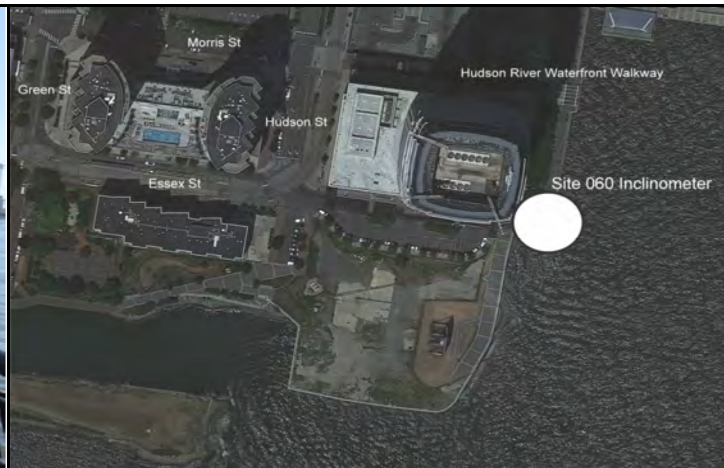


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

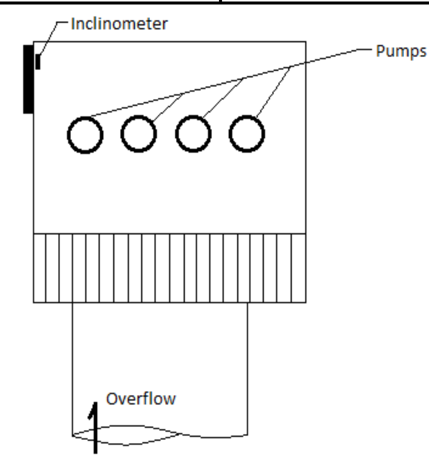


METER SITE INFORMATION FIELD LOG

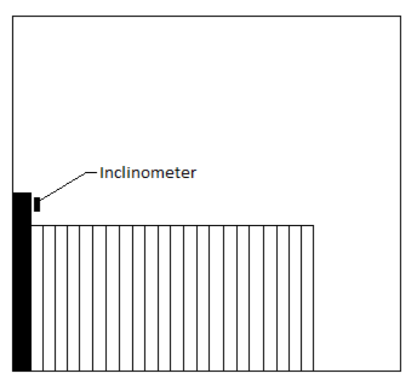
PROJECT: Jersey City, NJ	**DATE:** October 11, 2016	**JOB#:** 16093
LOCATION: Essex Street at waters edge	**MH#:**	**METER SITE:** 60 Inclinometer
GPS/COMMENTS: 40.712579, -74.033284		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming						
Incoming						
Incoming						
Outgoing						

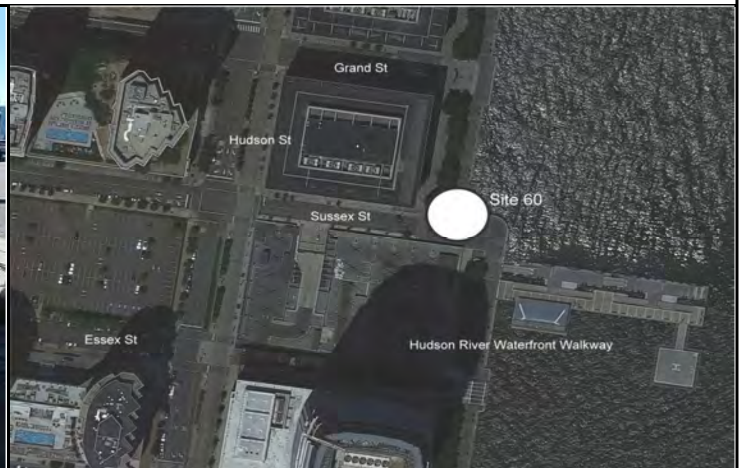


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

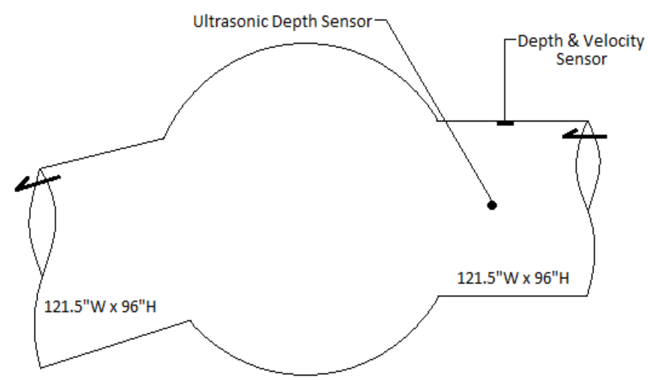


METER SITE INFORMATION FIELD LOG

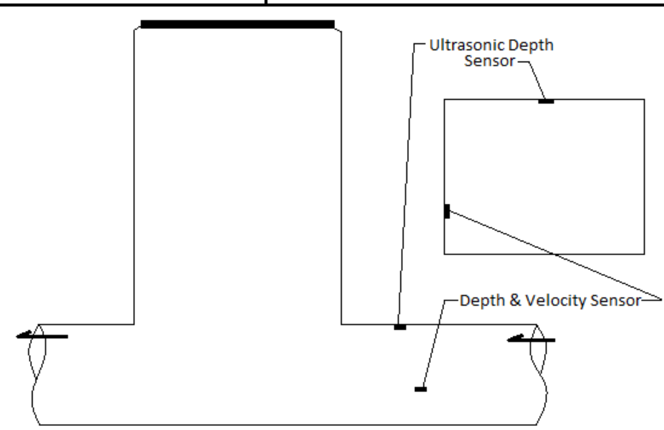
PROJECT: Jersey City, NJ	**DATE:** September 21, 2016	**JOB#:** 16093
LOCATION: 70 Hudson Street	**MH#:**	**METER SITE:** 60
GPS/COMMENTS: 40.714097, -74.033248		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	121.5x96	Concrete	22.8	12	Rectangular	15' 04"
Incoming						
Incoming						
Outgoing	121.5x96	Concrete	22.8	12	Rectangular	15' 05"

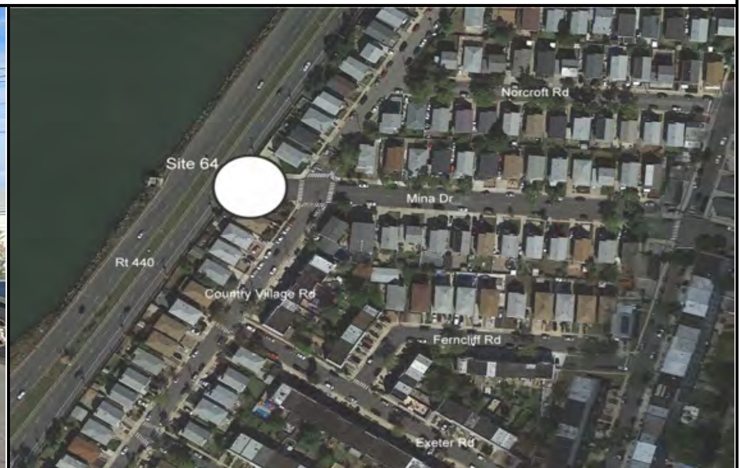


SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

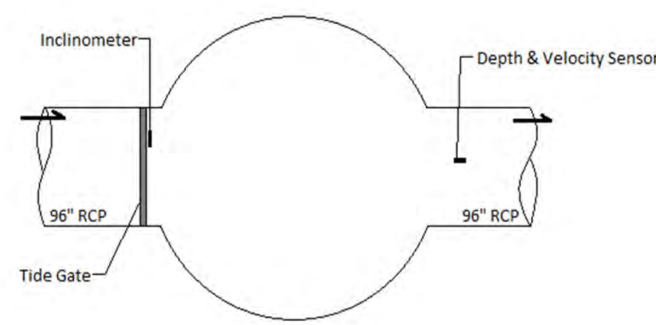


METER SITE INFORMATION FIELD LOG

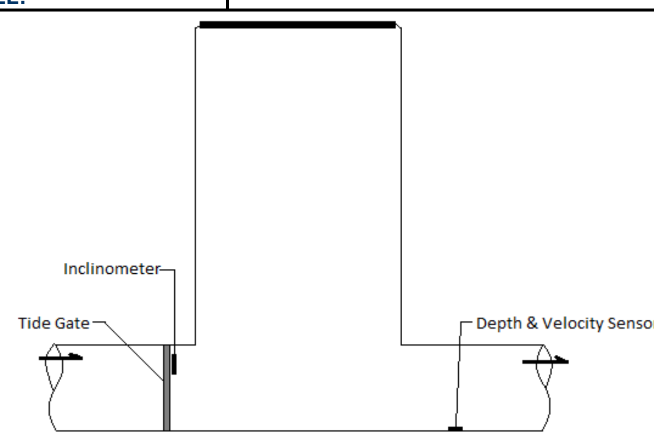
PROJECT: Jersey City, NJ	**DATE:** September 20, 2016	**JOB#:** 16093
LOCATION: Mina Drive near Route 440	**MH#:**	**METER SITE:** 64
GPS/COMMENTS: 40.699560, -74.103882		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	96	RCP	23	0	Circular	14' 03"
Incoming						
Incoming						
Outgoing	96	RCP	23	0	Circular	14' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Top	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



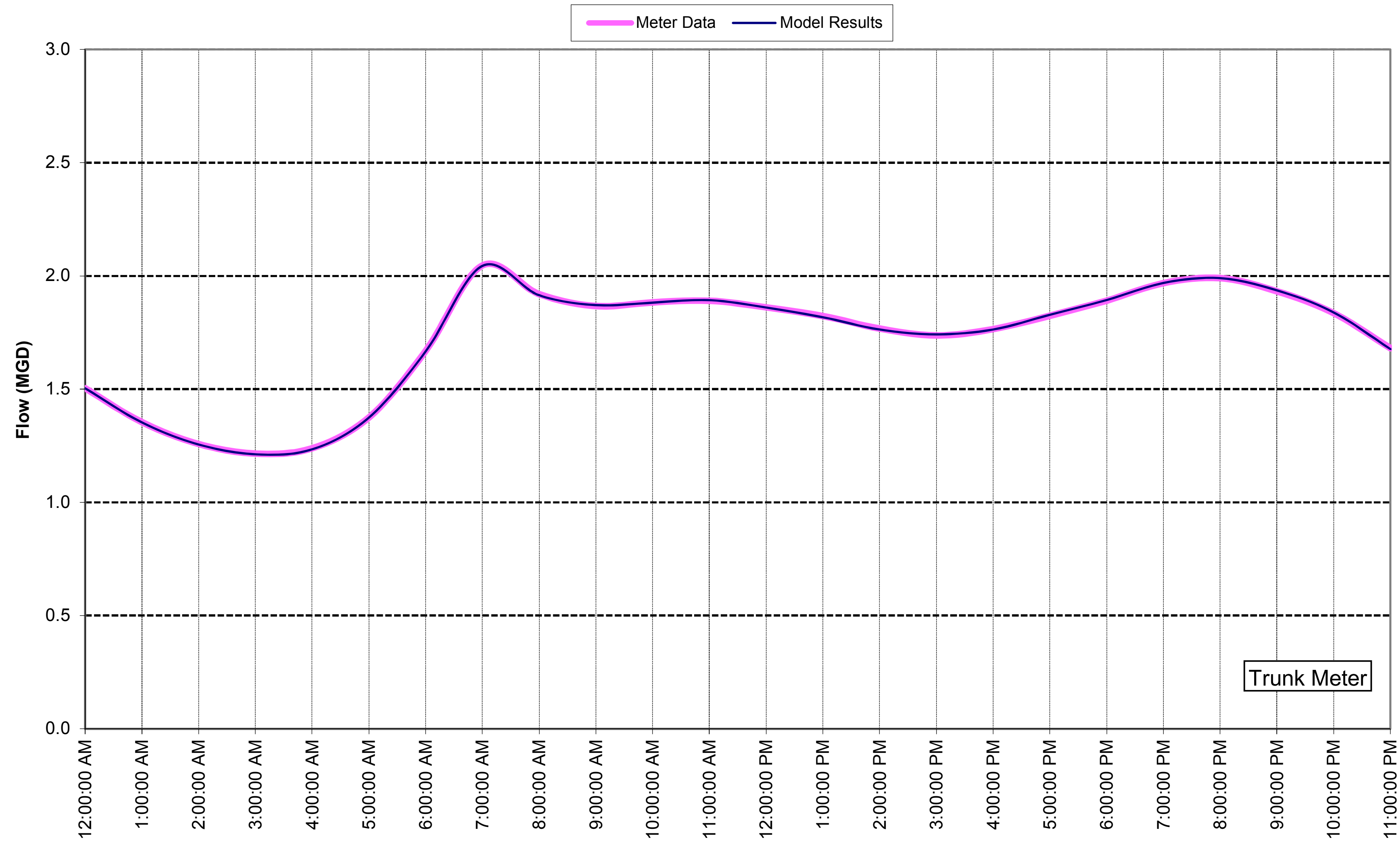
APPENDIX D

2016 Supplemental Flow Monitoring Program Data

APPENDIX E1

Dry Weather Calibration Graphs

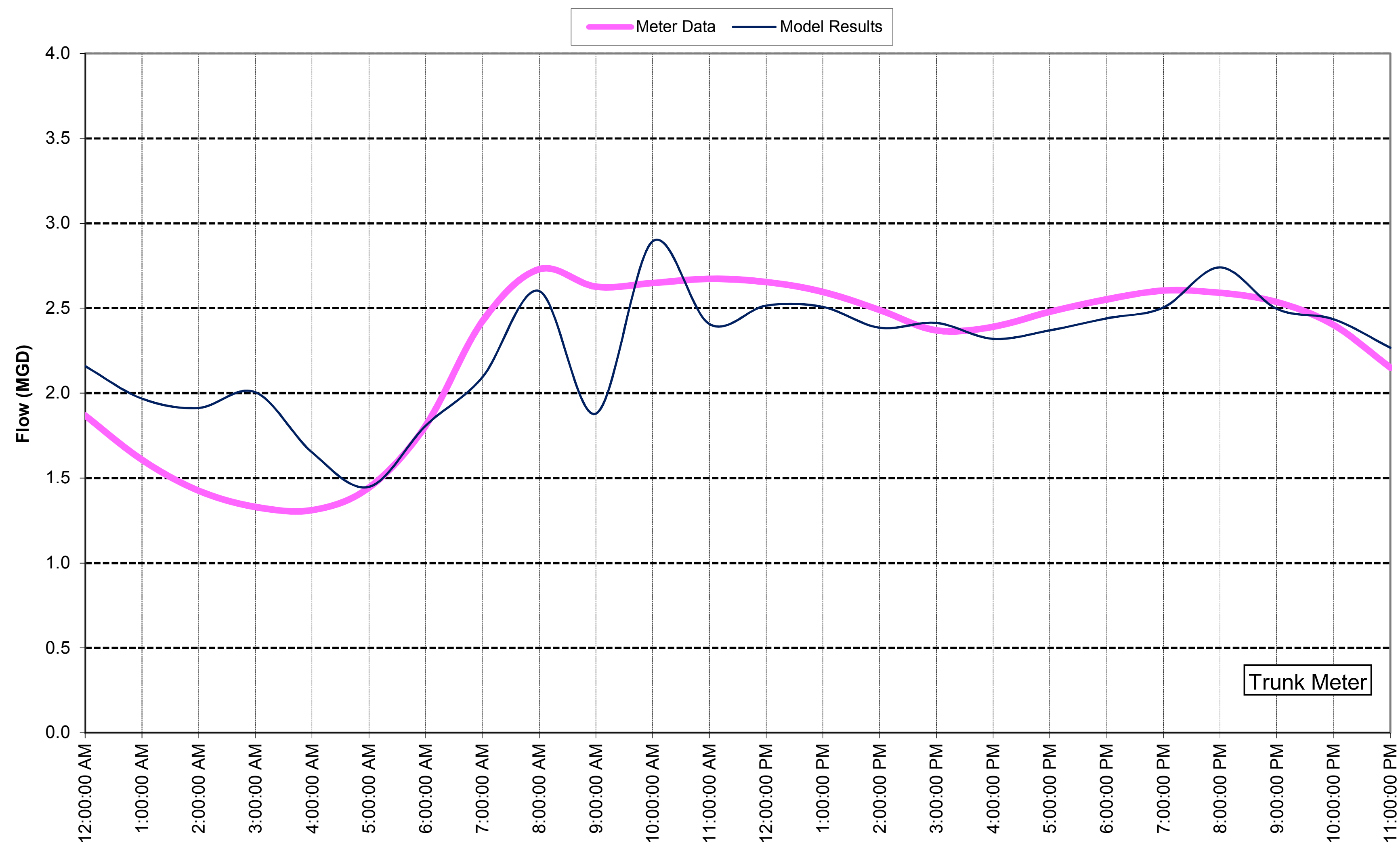
Appendix E1 - Dry Weather Calibration Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-1: Dry Weather Flow Calibration for Meter 6
Secaucus Road Subdrainage Area (RW-1)

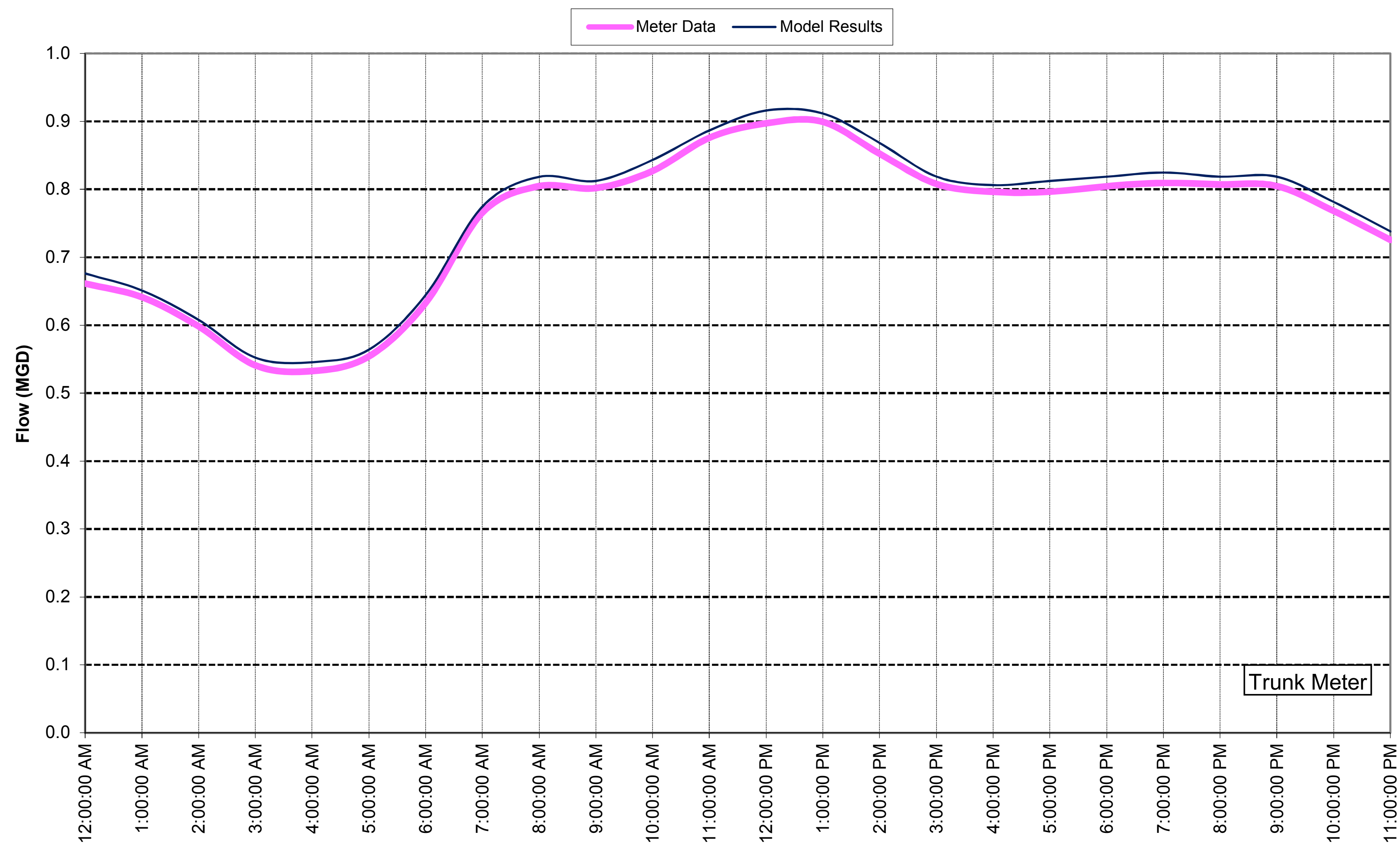
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-2: Dry Weather Flow Calibration for Meter 17
Sip Avenue Subdrainage Area (RW-6)

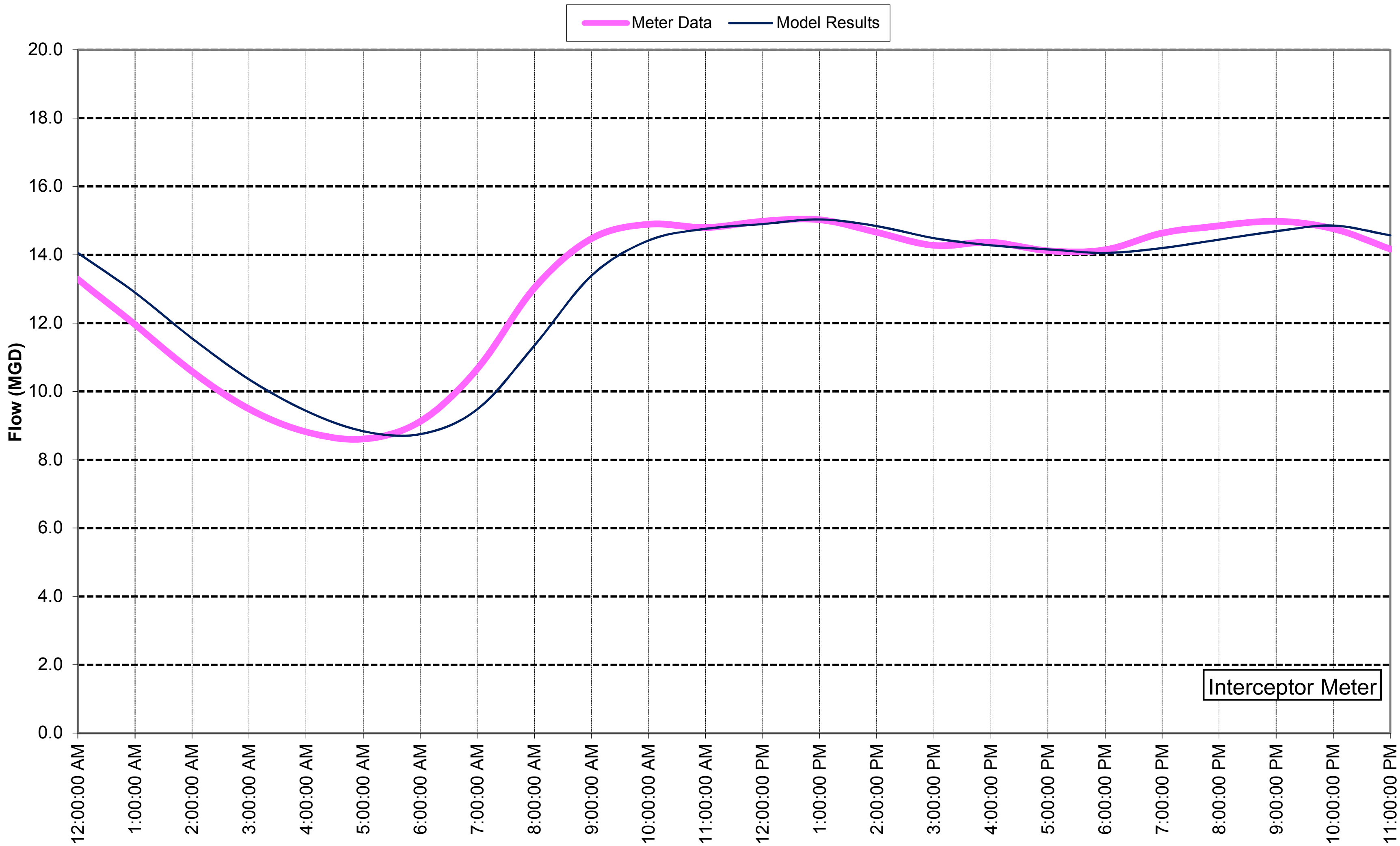
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-3: Dry Weather Flow Calibration for Meter 27
Fisk Street Subdrainage Area (RW-10)

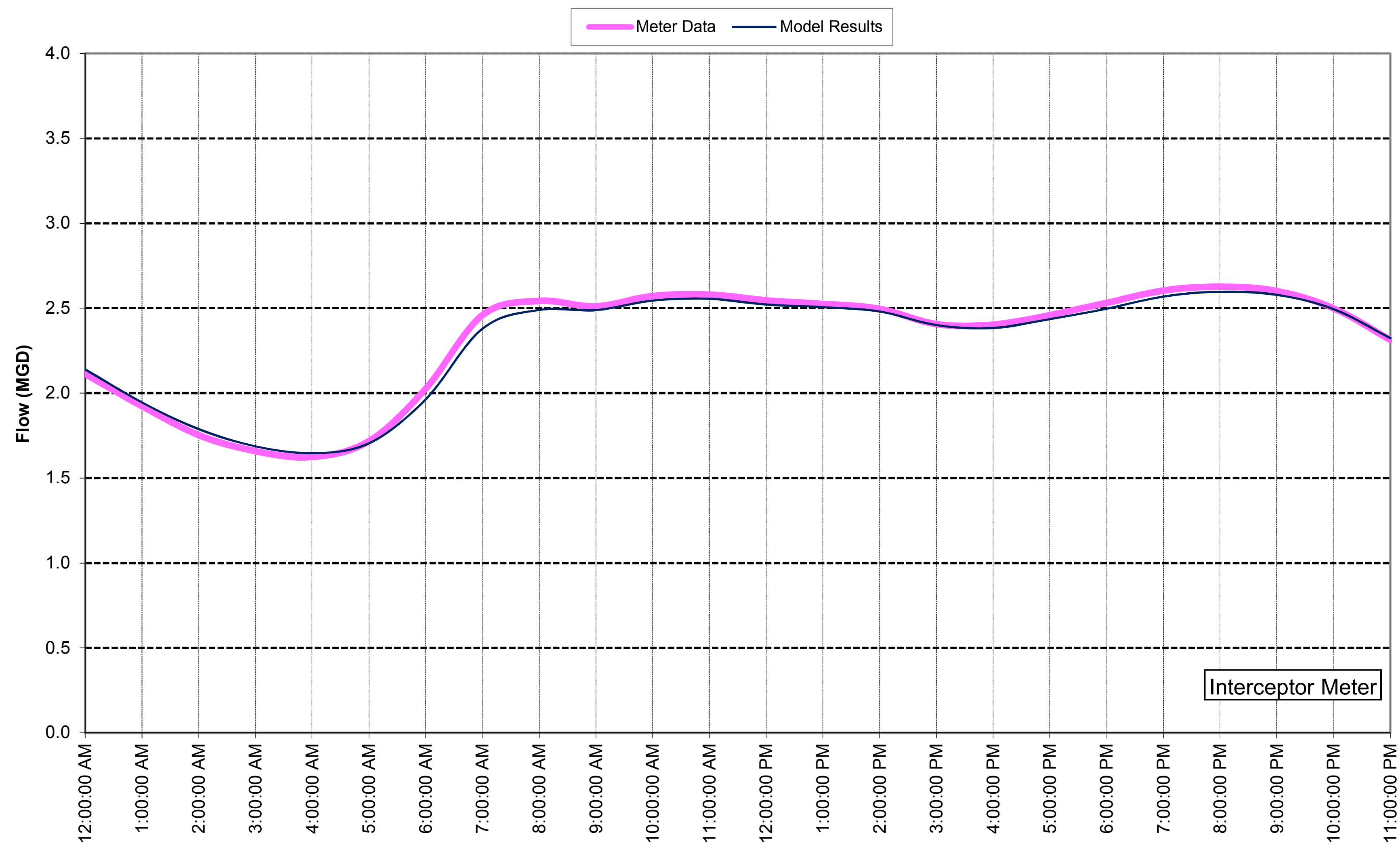
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-4: Dry Weather Flow Calibration for Meter 28
Total Northwest Interceptor Flow

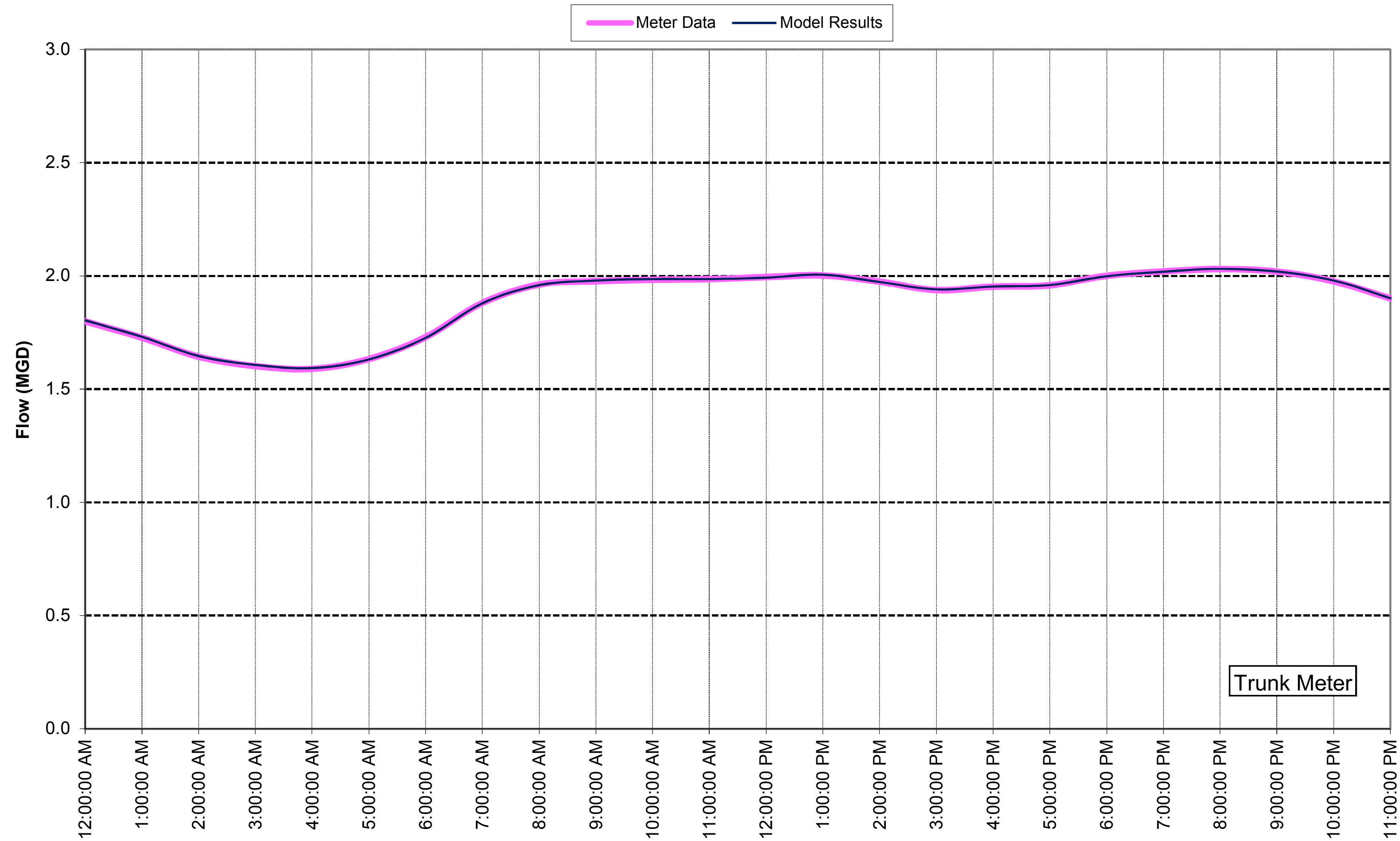
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-5: Dry Weather Flow Calibration for Meter 29
Total Southwest Interceptor Flow

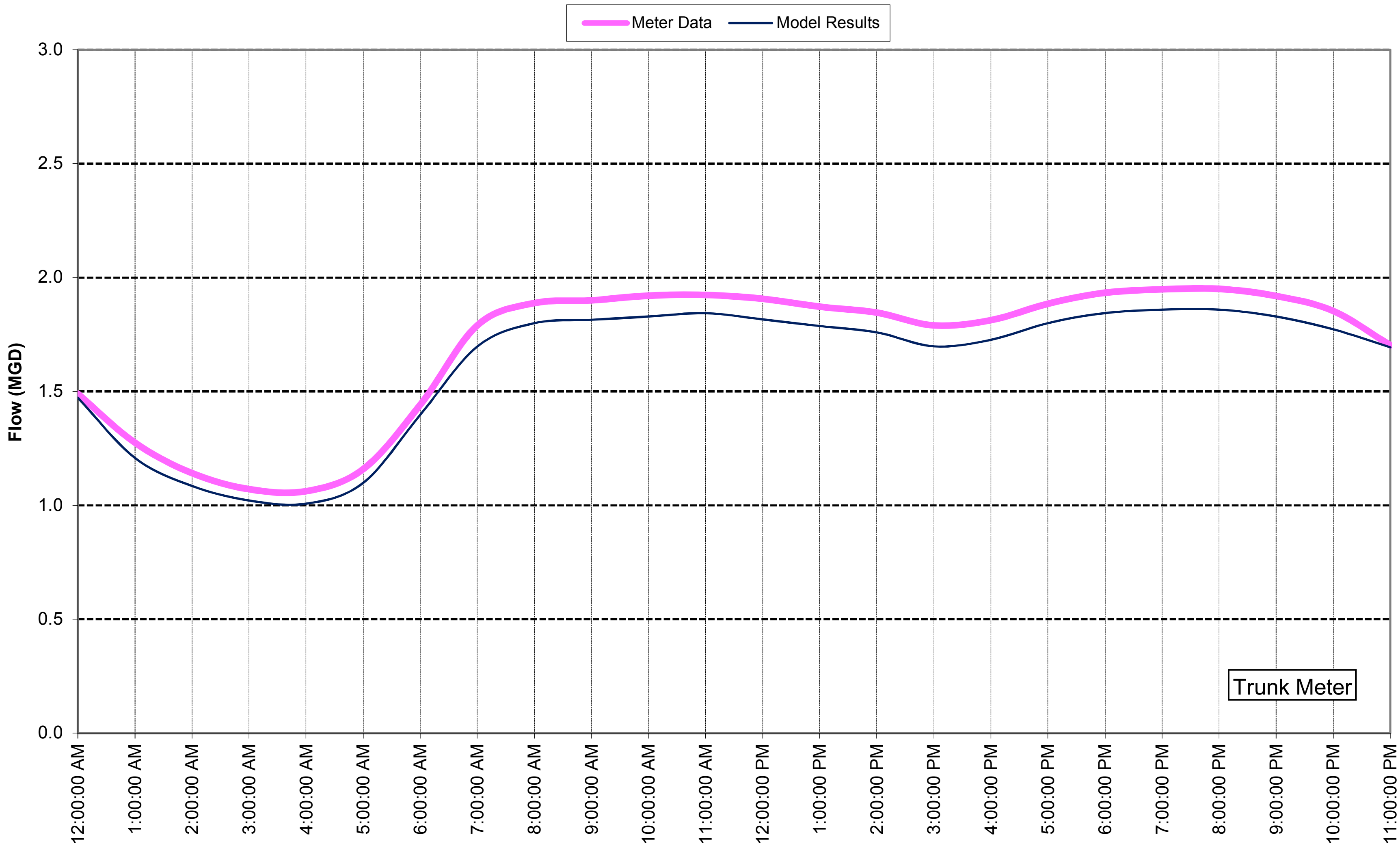
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-6: Dry Weather Flow Calibration for Meter 32
Mina Drive Subdrainage Area (RW-13)

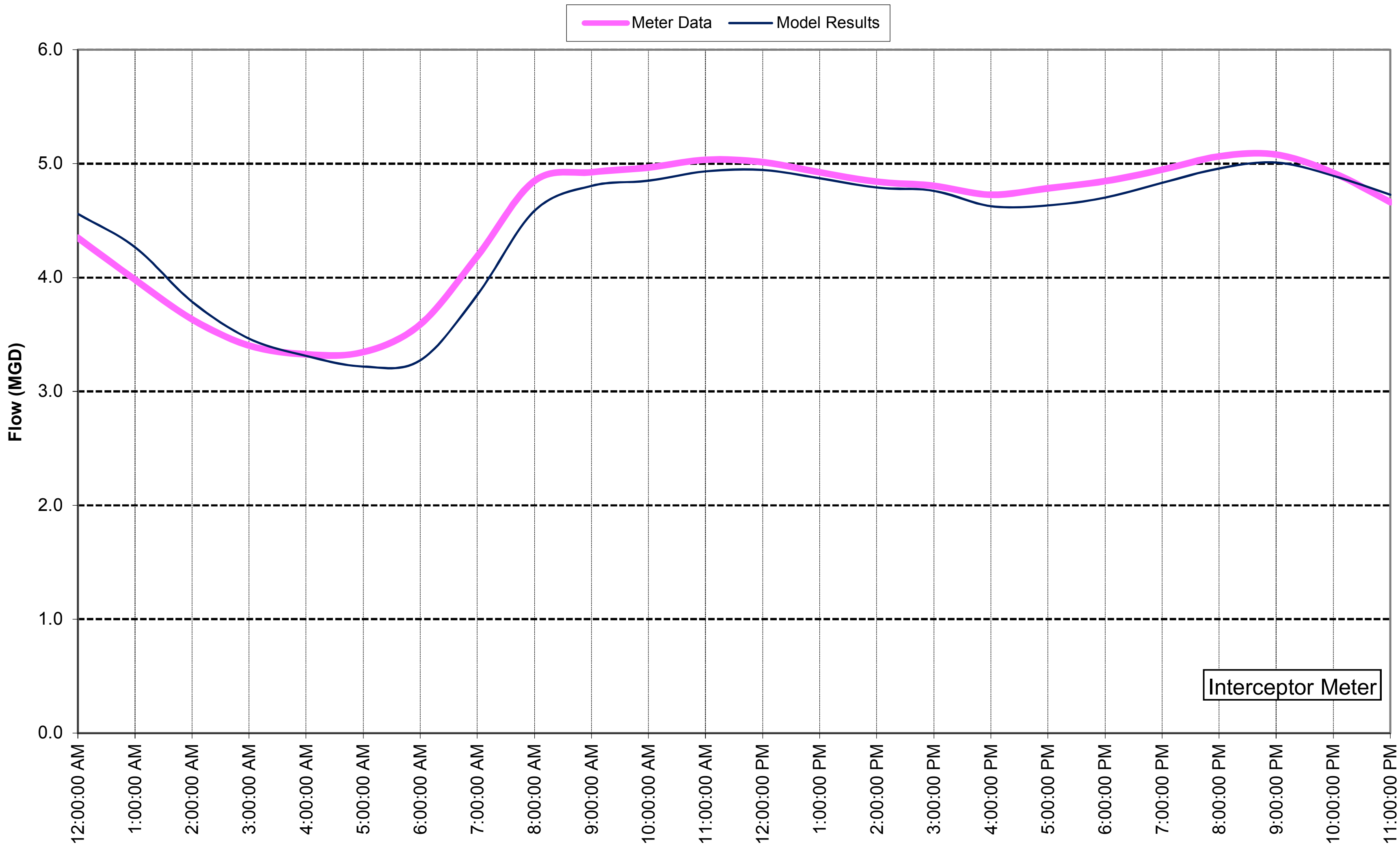
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-7: Dry Weather Flow Calibration for Meter 33
Brown Place Subdrainage Area (RE-1)

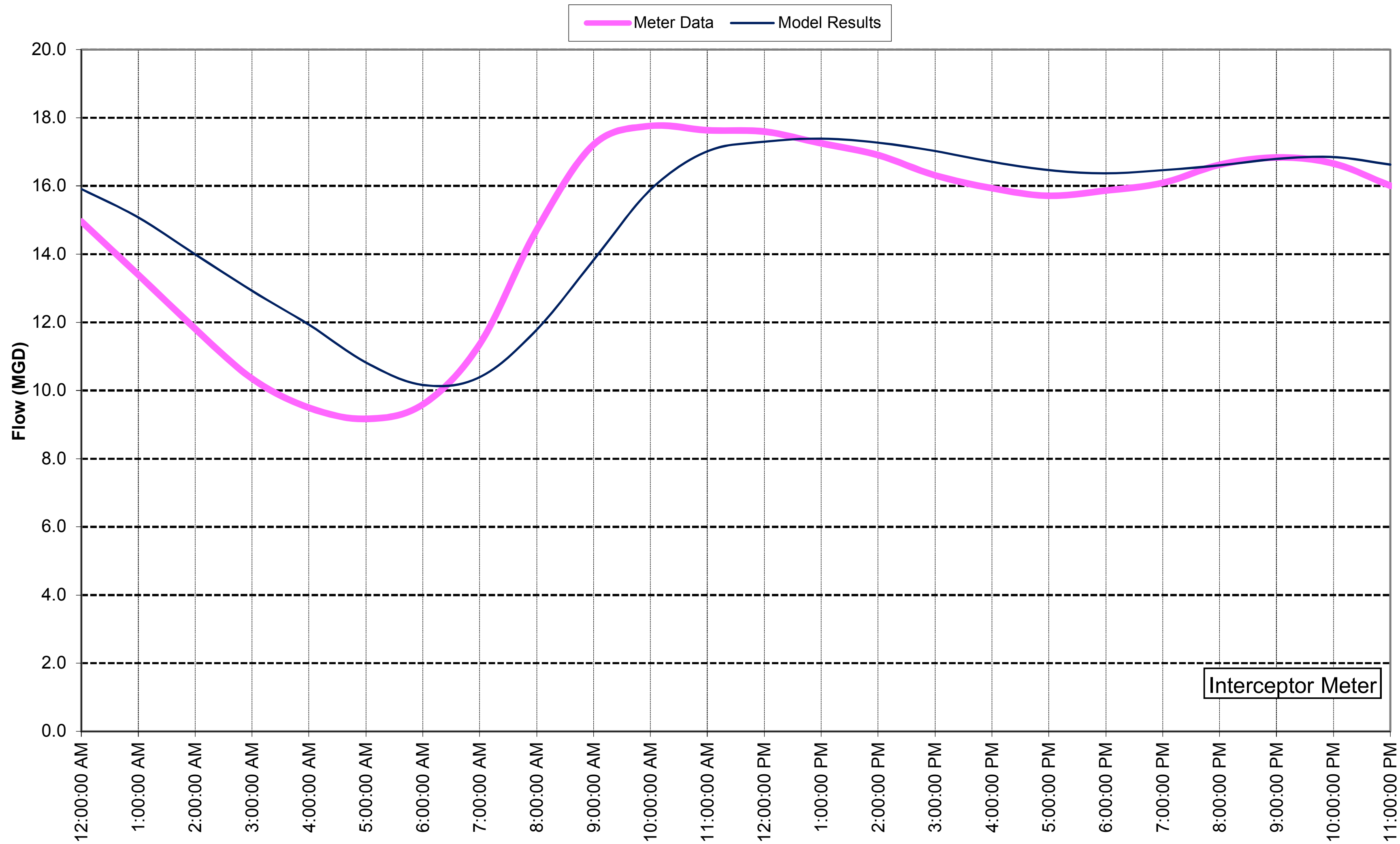
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-8: Dry Weather Flow Calibration for Meter 40
Total Southeast Interceptor Flow

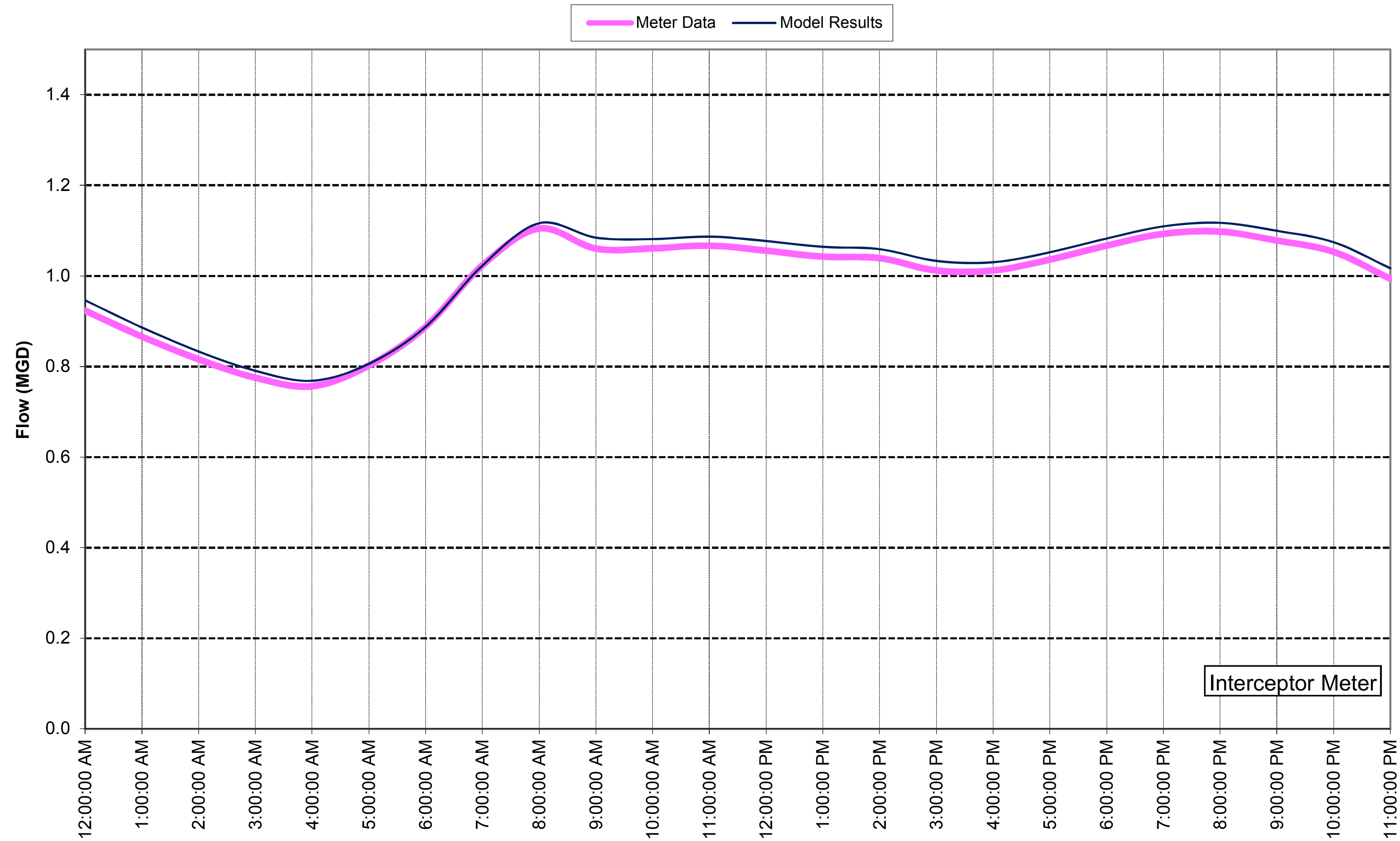
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-9: Dry Weather Flow Calibration for Meter 41
Total Northeast Interceptor Flow

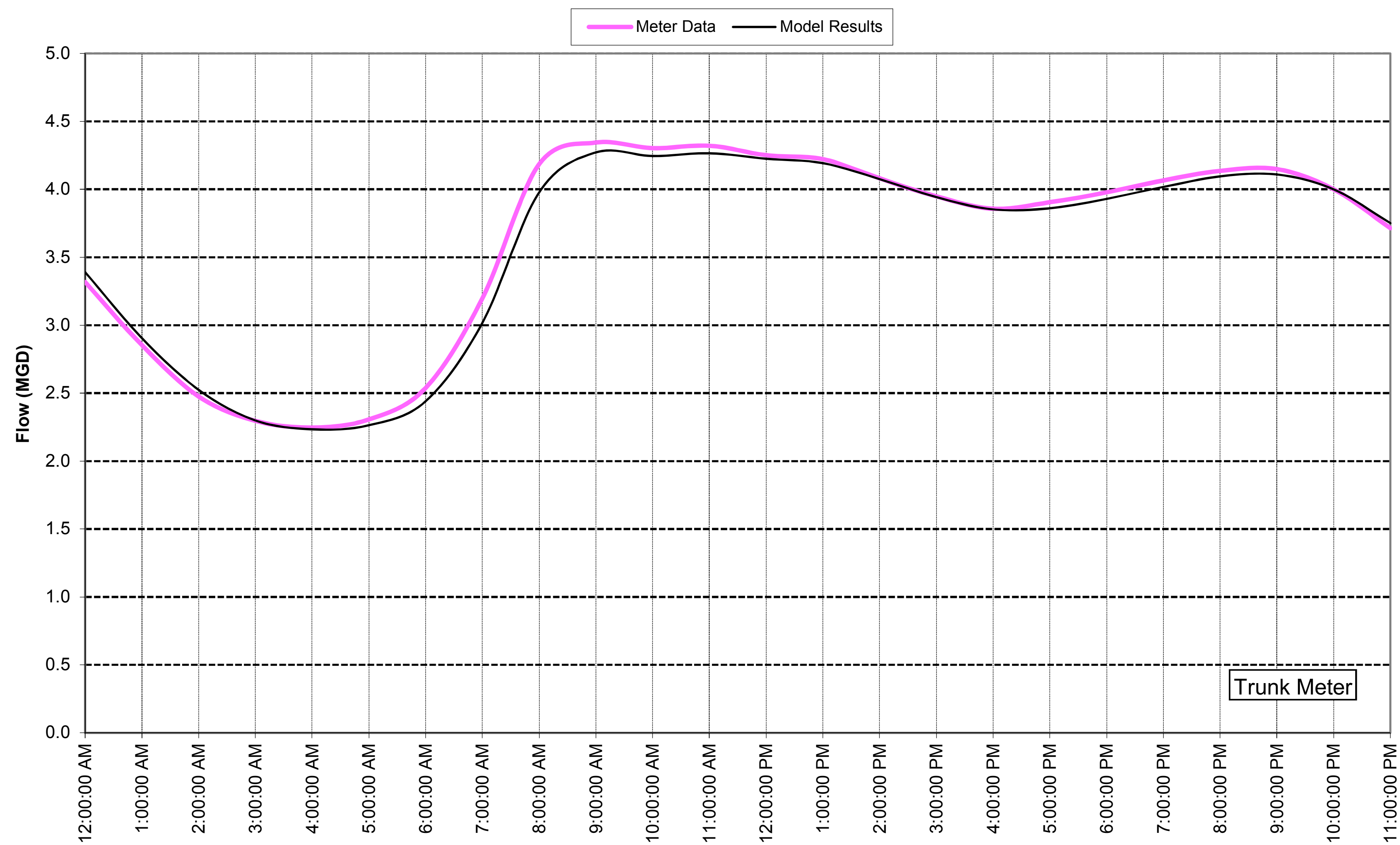
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-10: Dry Weather Flow Calibration for Meter 42
Mill Creek Subdrainage Area (RE-5/6)

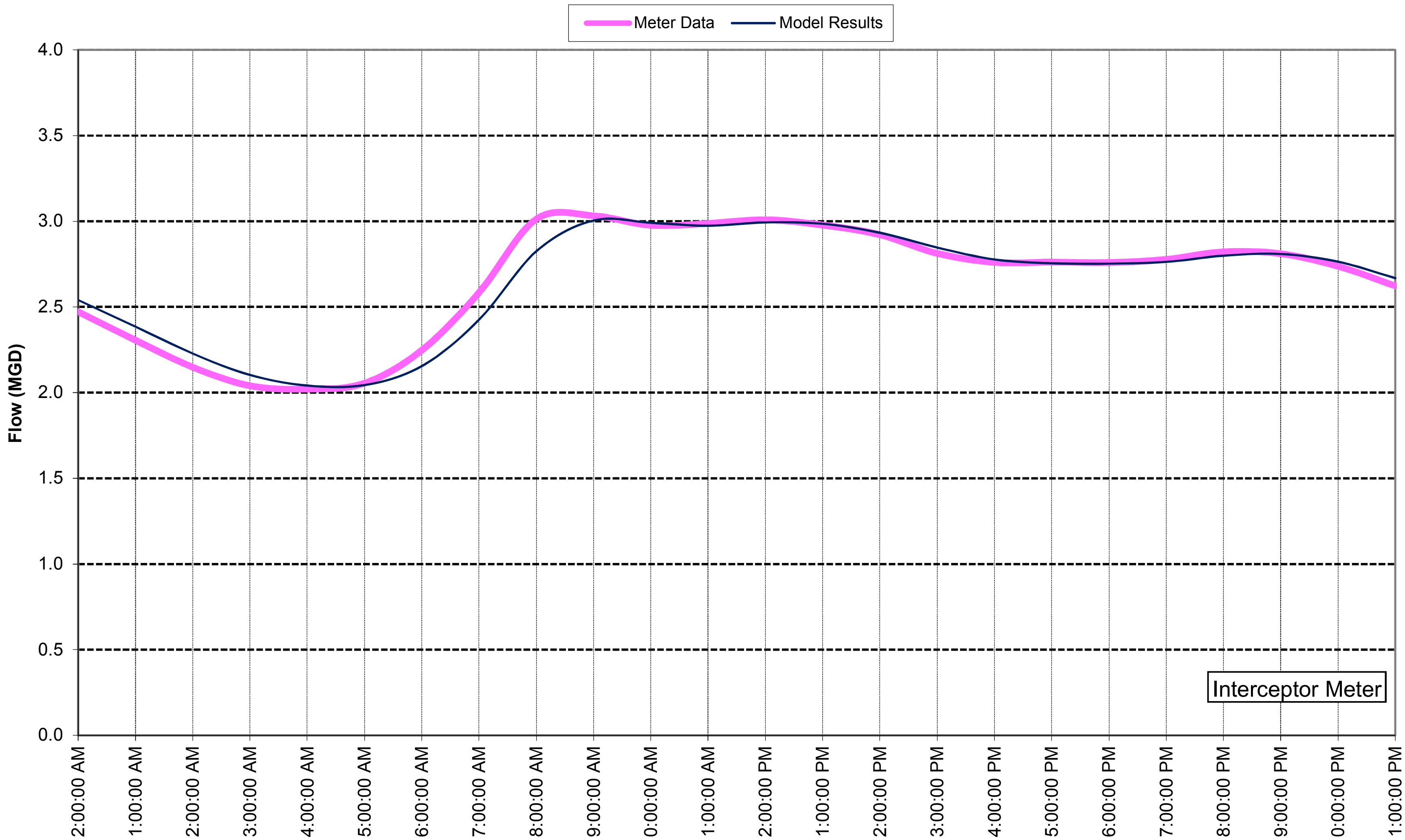
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-11: Dry Weather Flow Calibration for Meters 43 and 44
Mill Creek Subdrainage Area (RE-5/6)

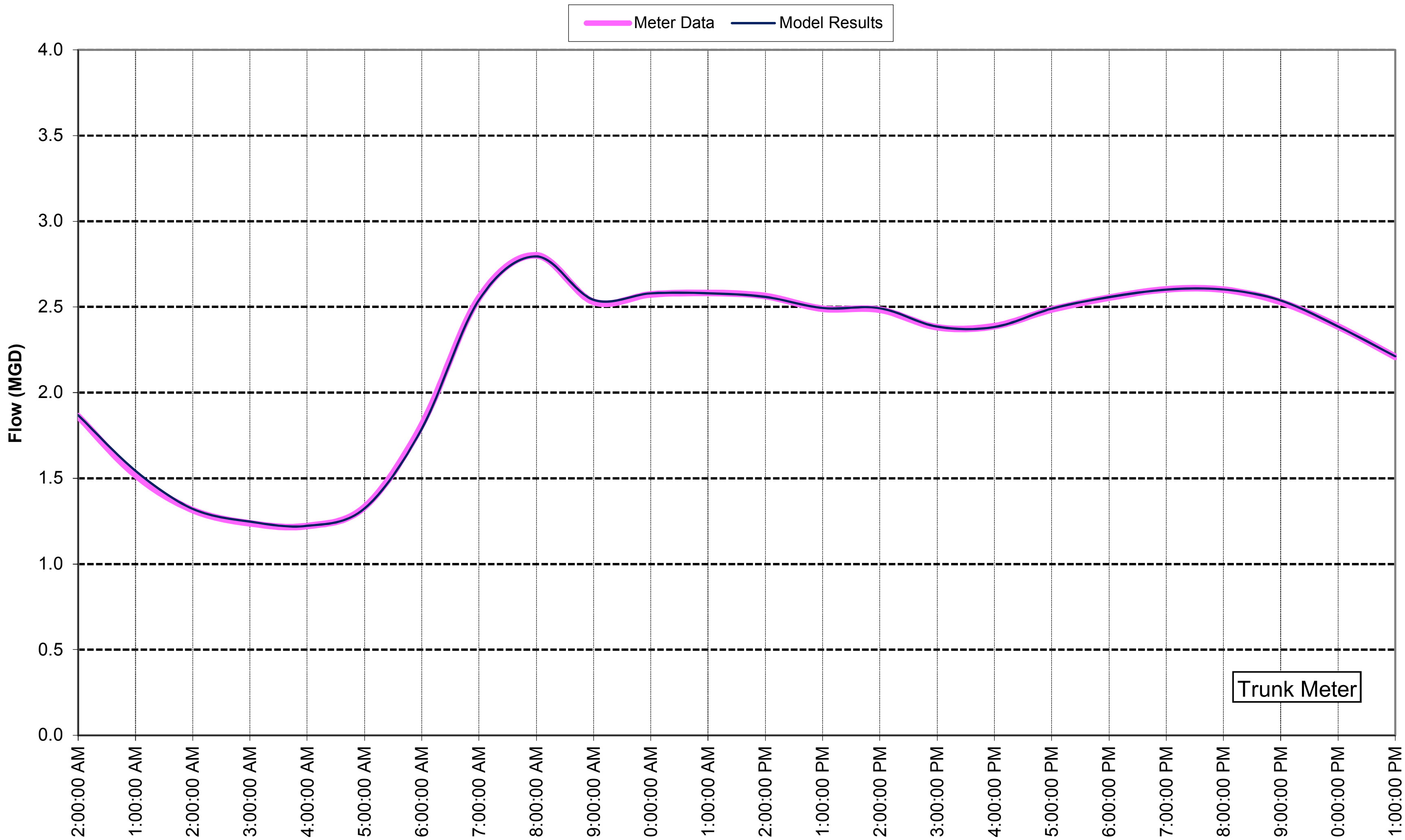
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E1-12: Dry Weather Flow Observation for Meter 54
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

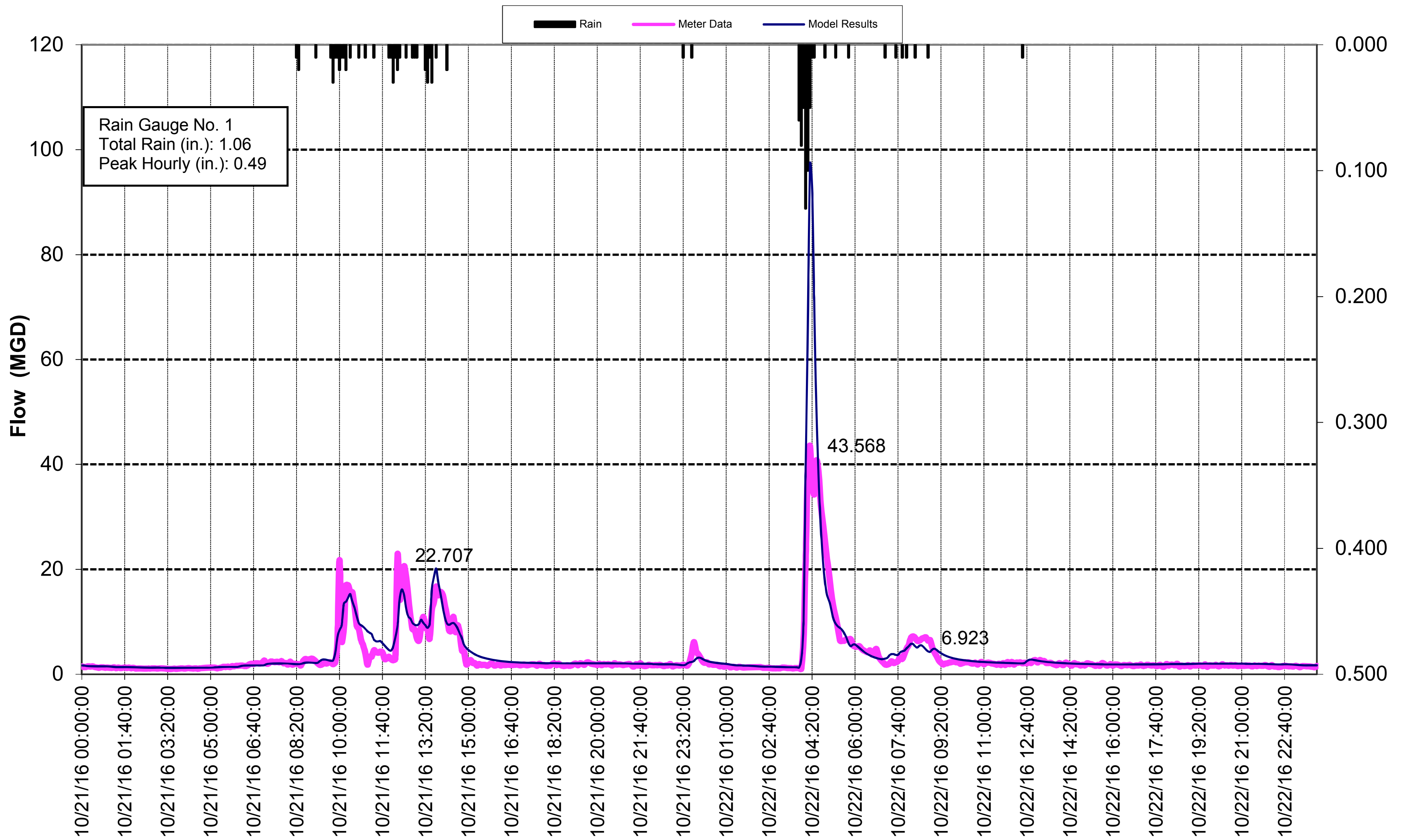
JCMUA Combined Sewer System Modeling Report
Figure E1-13: Dry Weather Flow Calibration for Meter 58
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E2

October 21, 2016 Event Flow Graphs

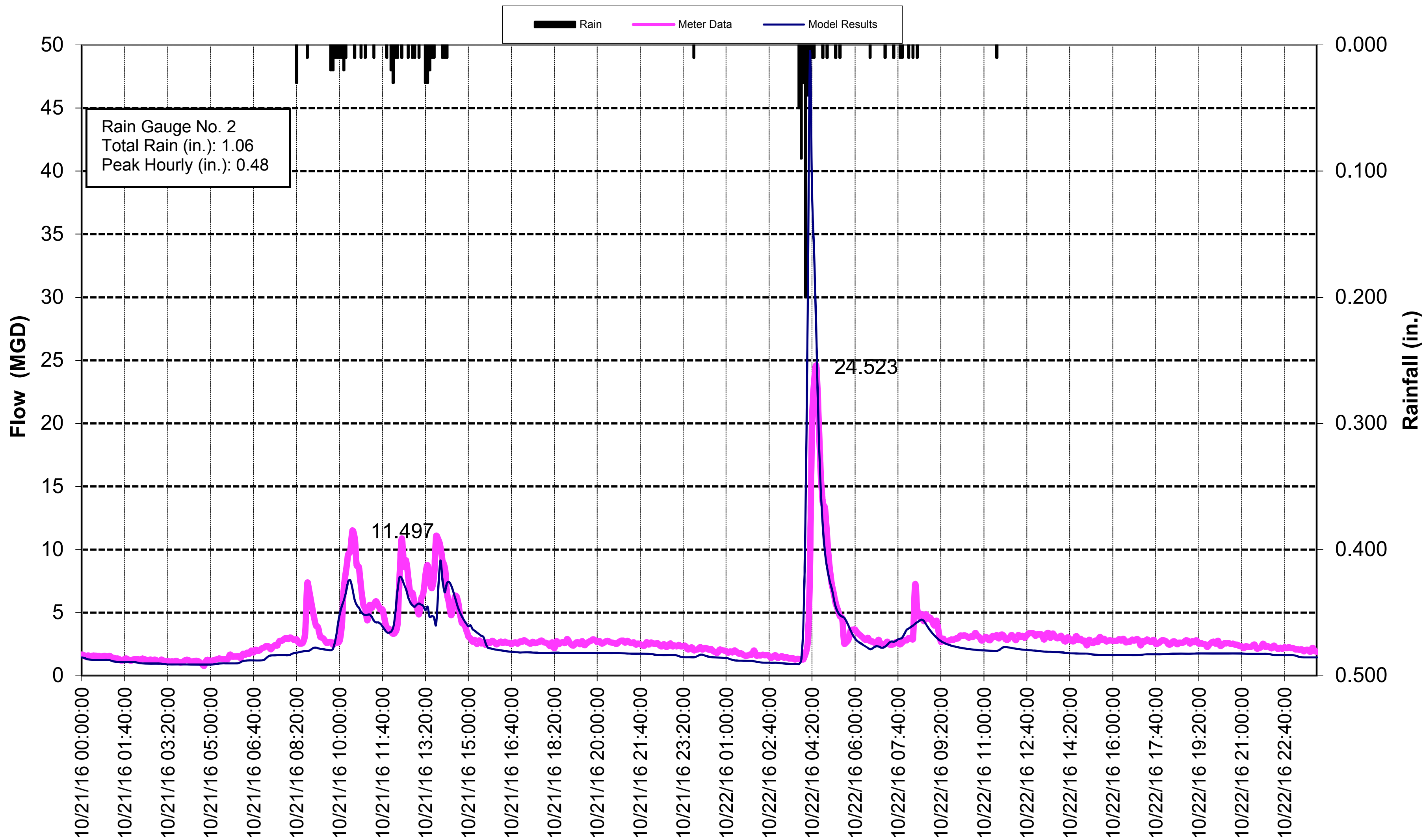
Appendix E2 - October 21, 2016 Event Flow Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-1: Flow at Meter 6
October 21, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

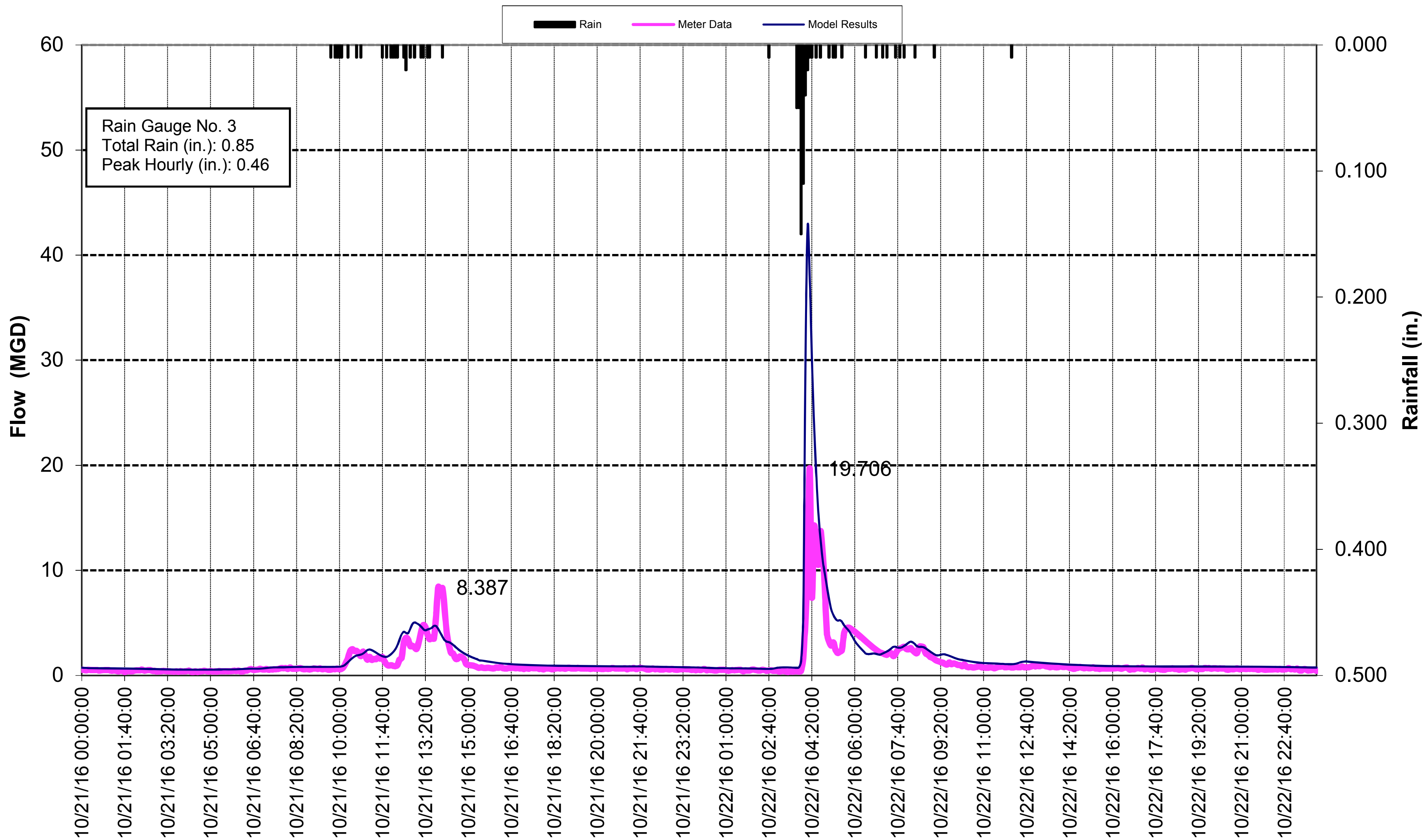
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-2: Flow at Meter 17
October 21, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

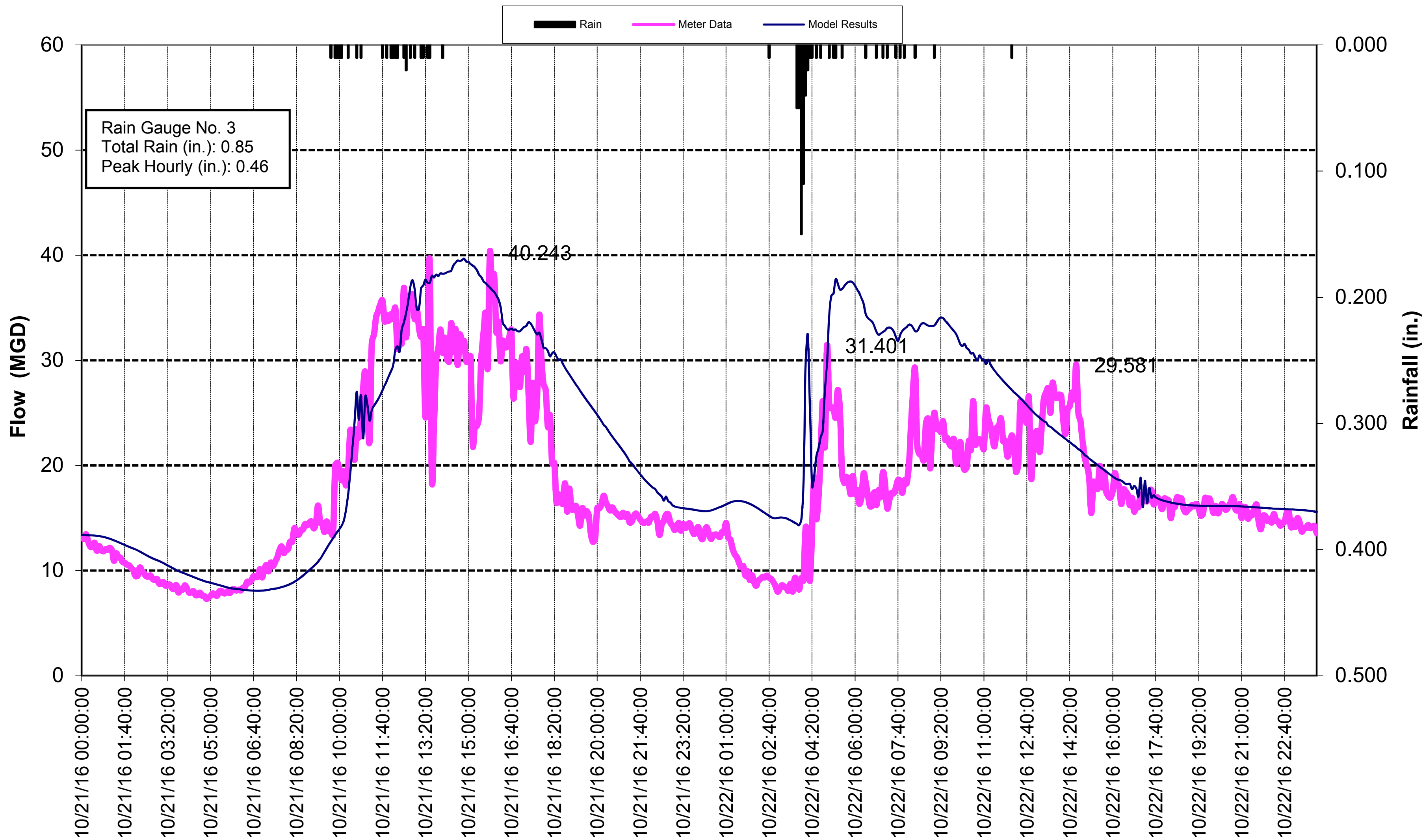
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-3: Flow at Meter 27
October 21, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

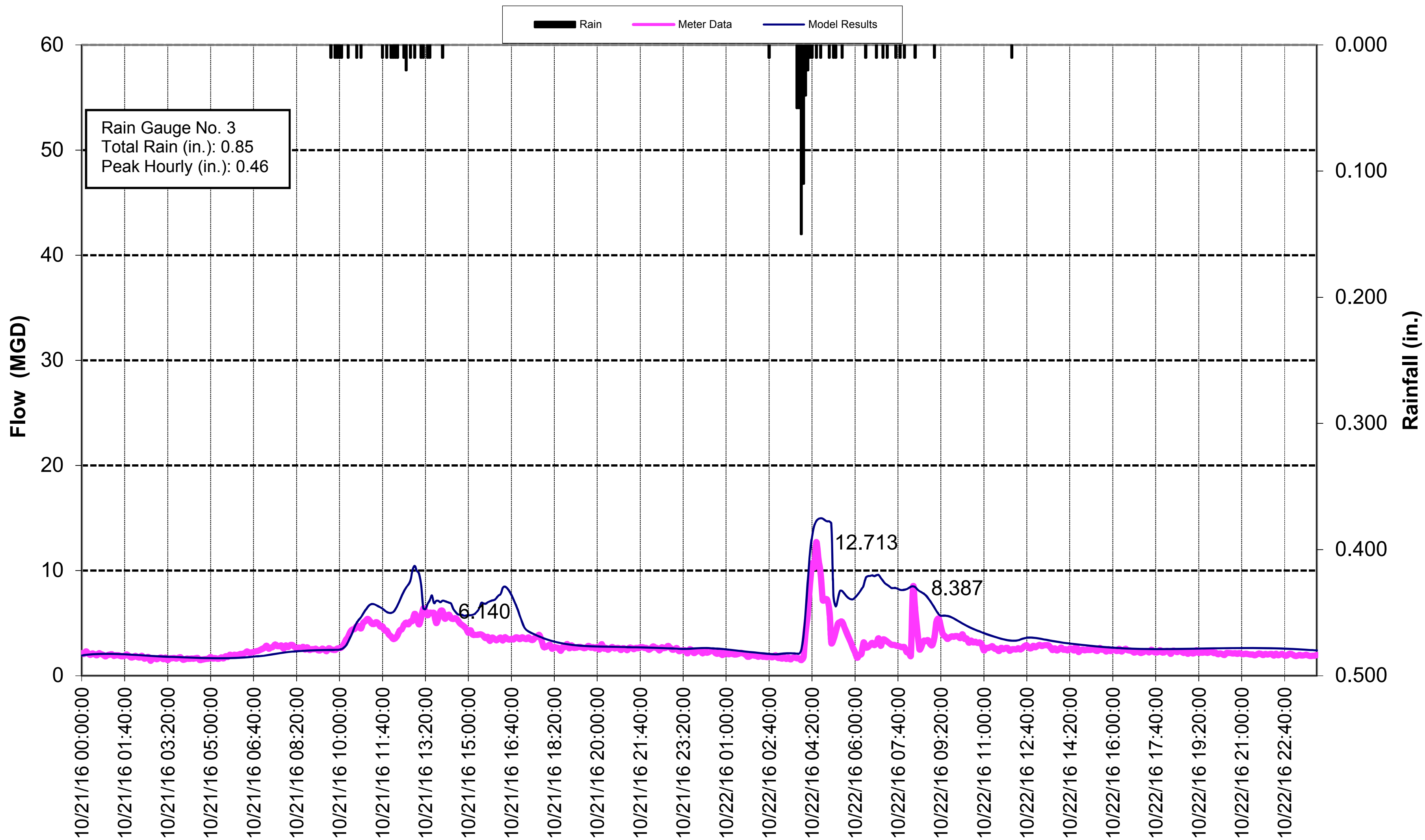
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-4: Flow at Meter 28
October 21, 2016 Storm Event
Total Northwest Interceptor Flow

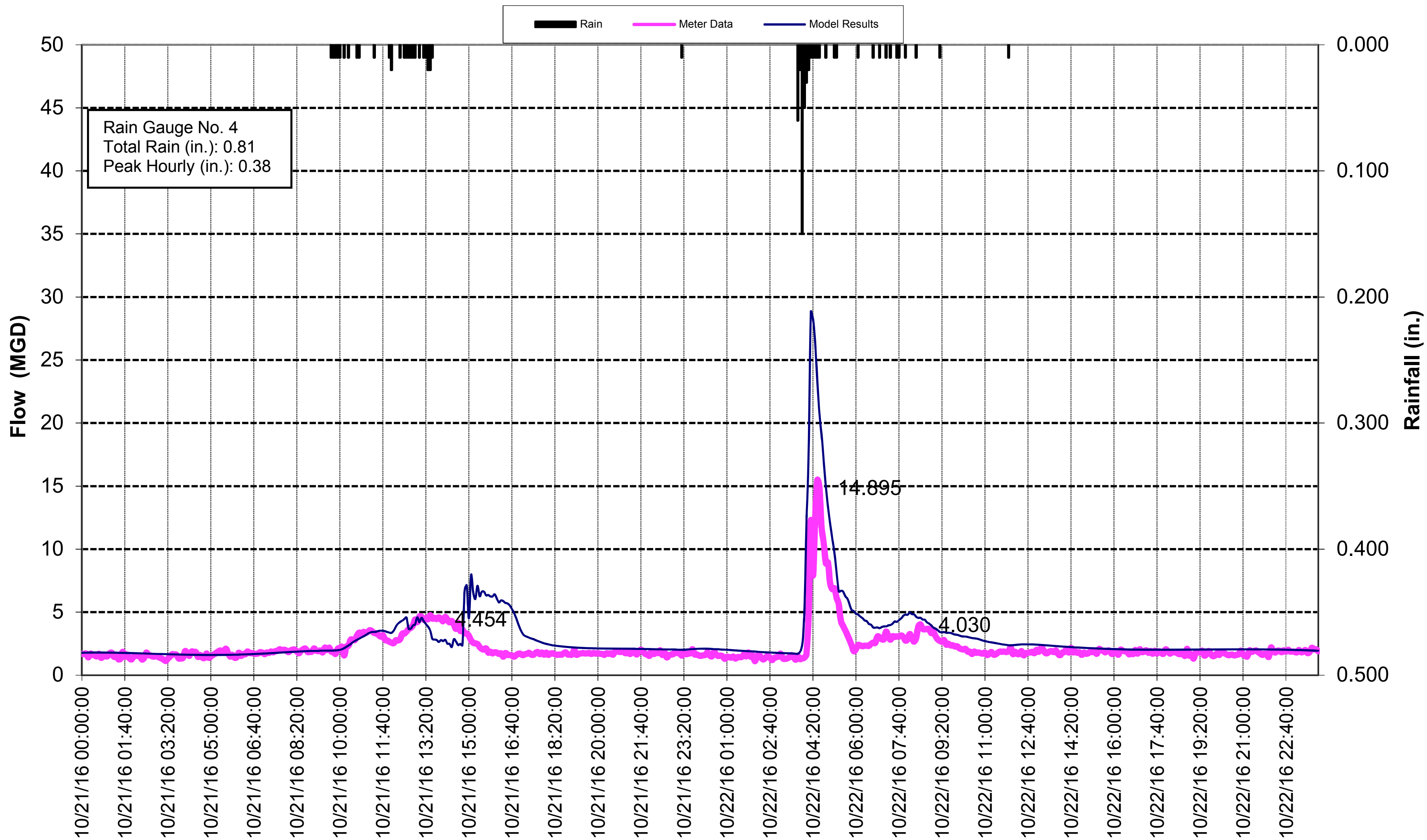
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-5: Flow at Meter 29
October 21, 2016 Storm Event
Total Southwest Interceptor Flow

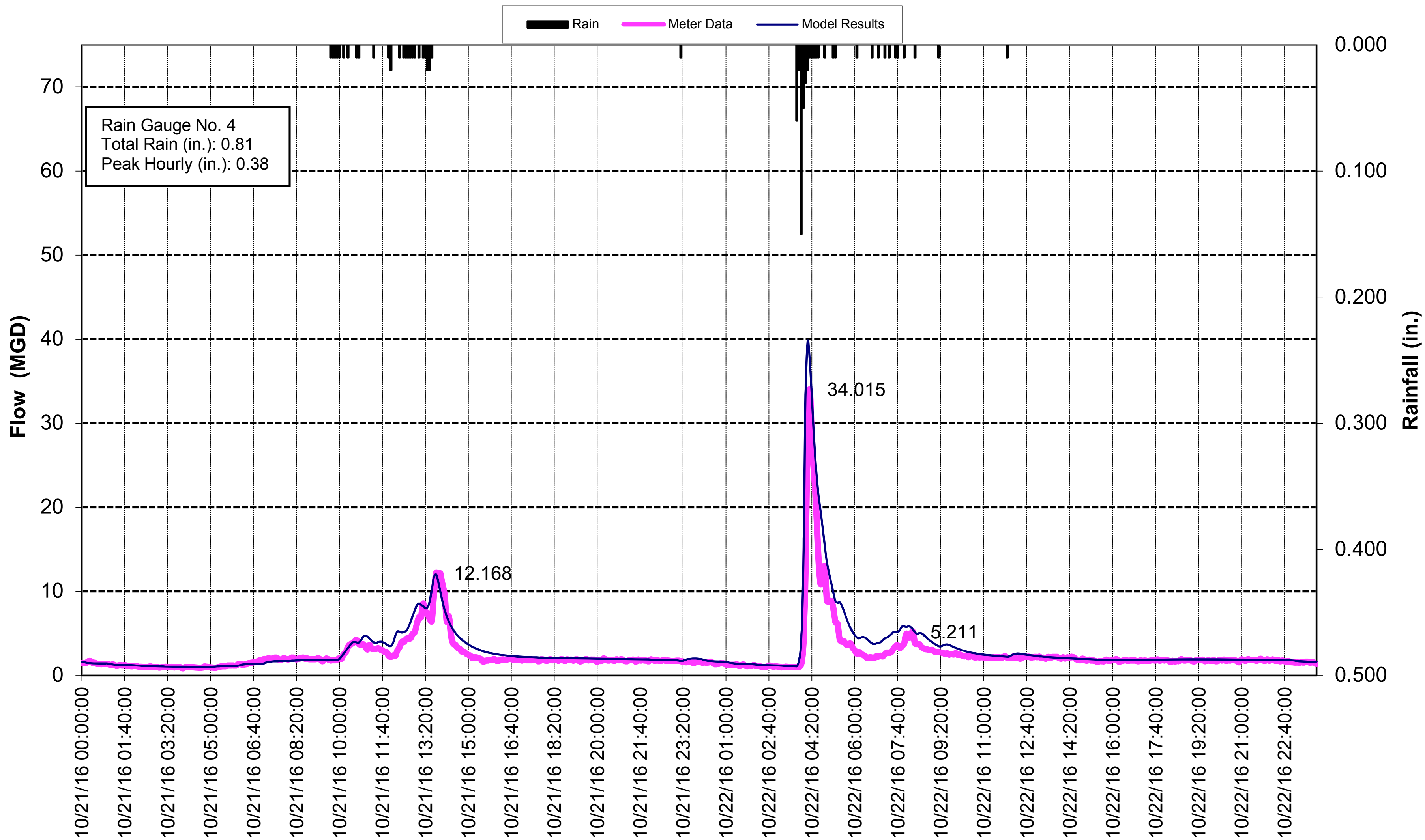
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-6: Flow at Meter 32
October 21, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

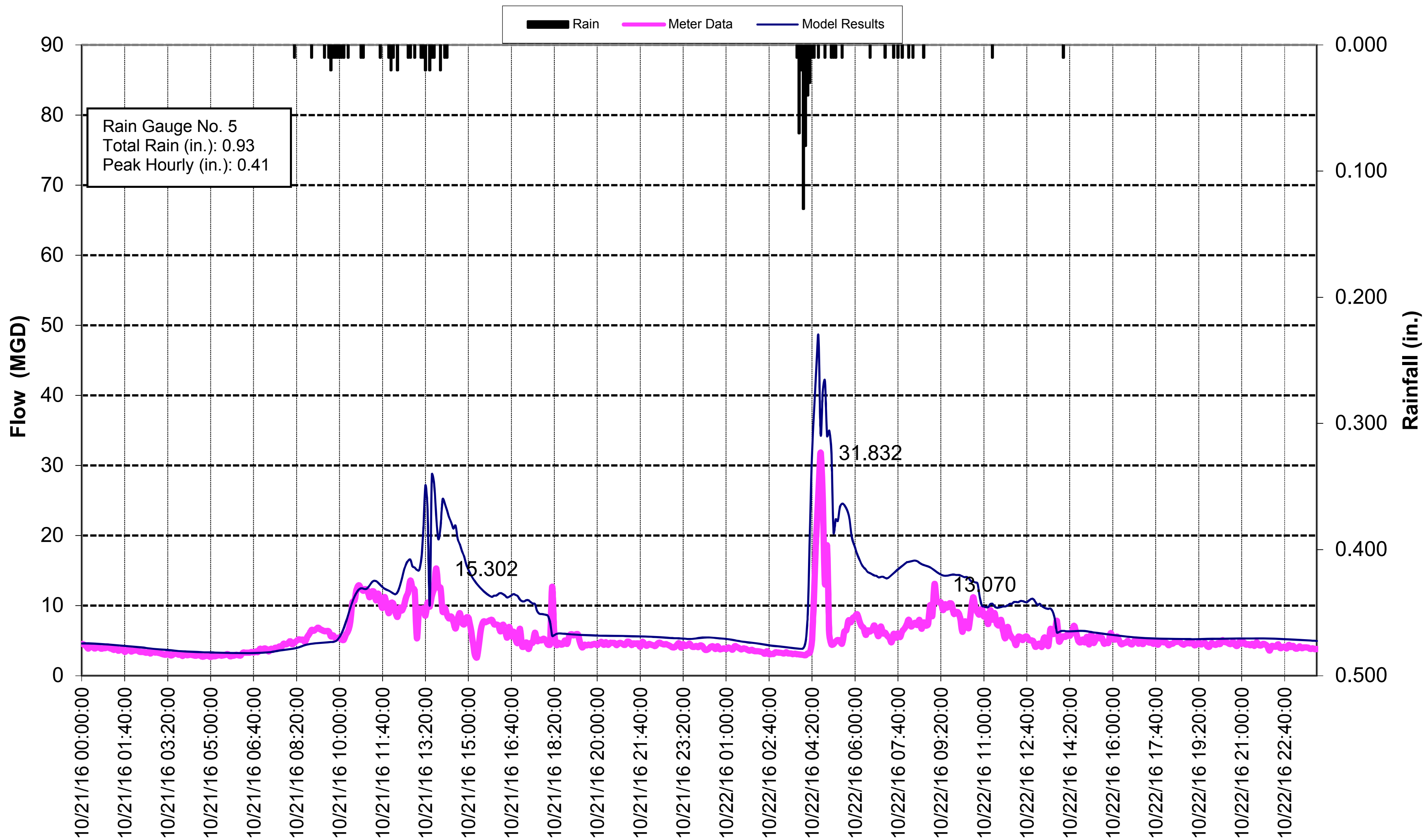
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-7: Flow at Meter 33
October 21, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

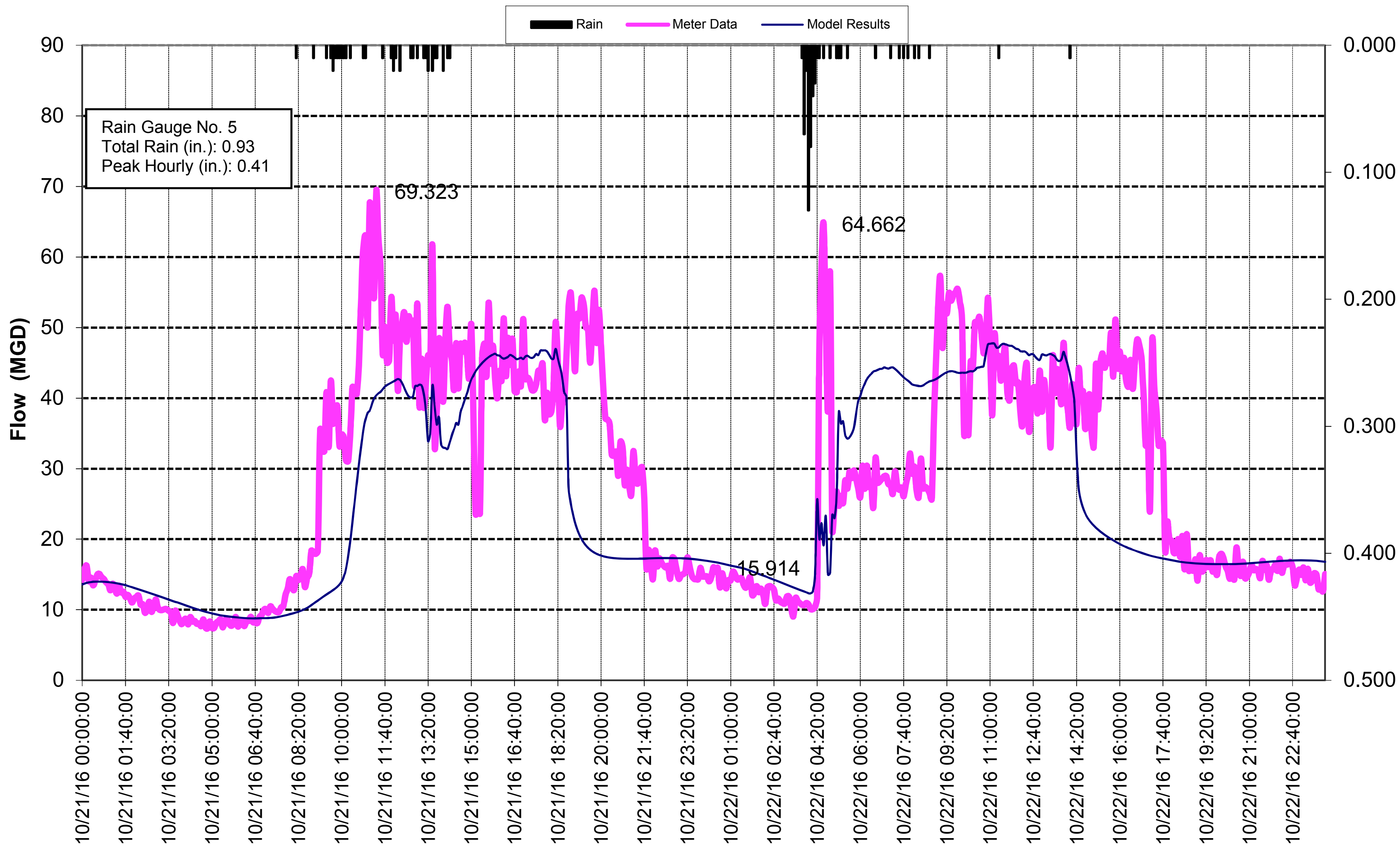
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-8: Flow at Meter 40
October 21, 2016 Storm Event
Total Southeast Interceptor Flow

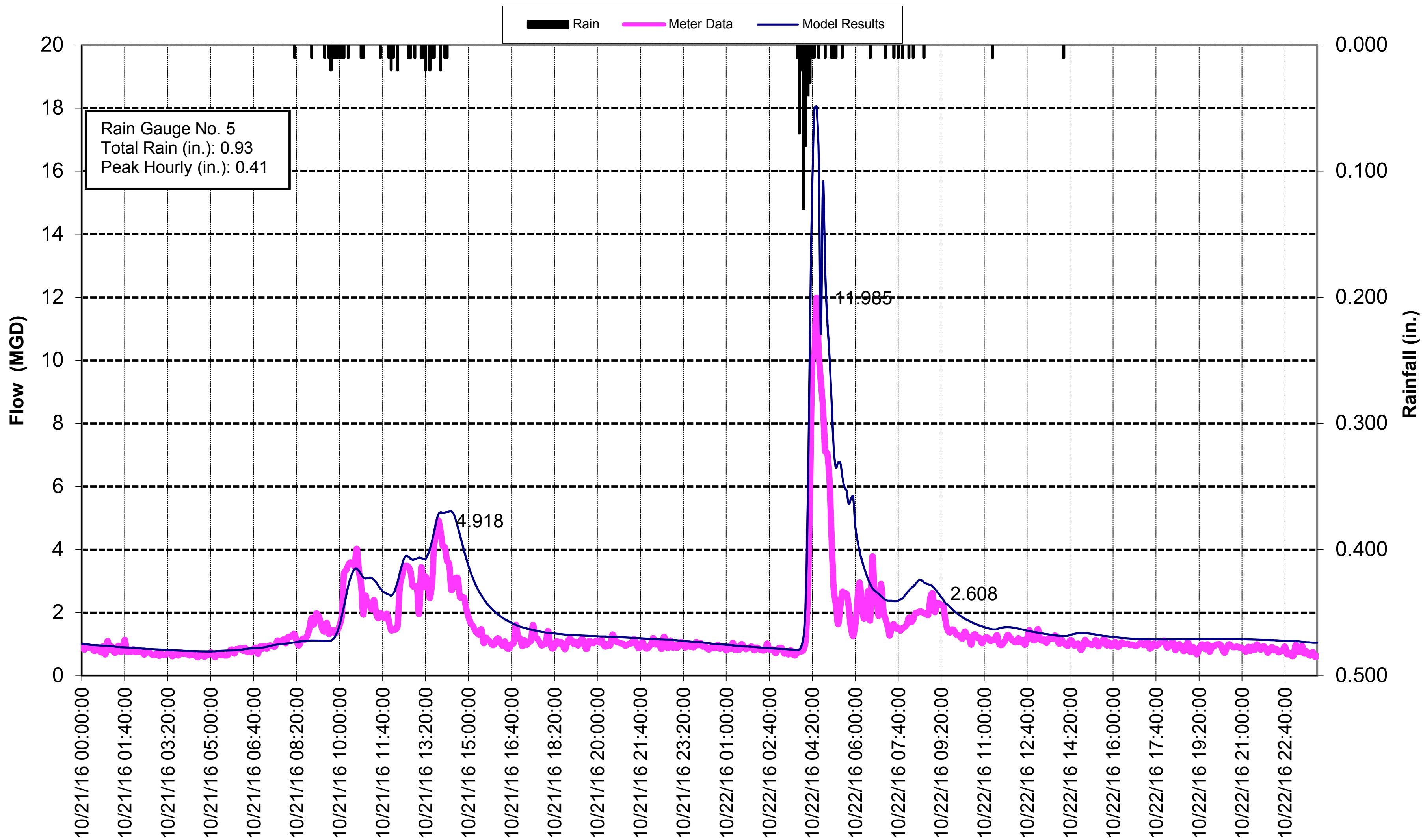
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-9: Flow at Meter 41
October 21, 2016 Storm Event
Total Northeast Interceptor Flow

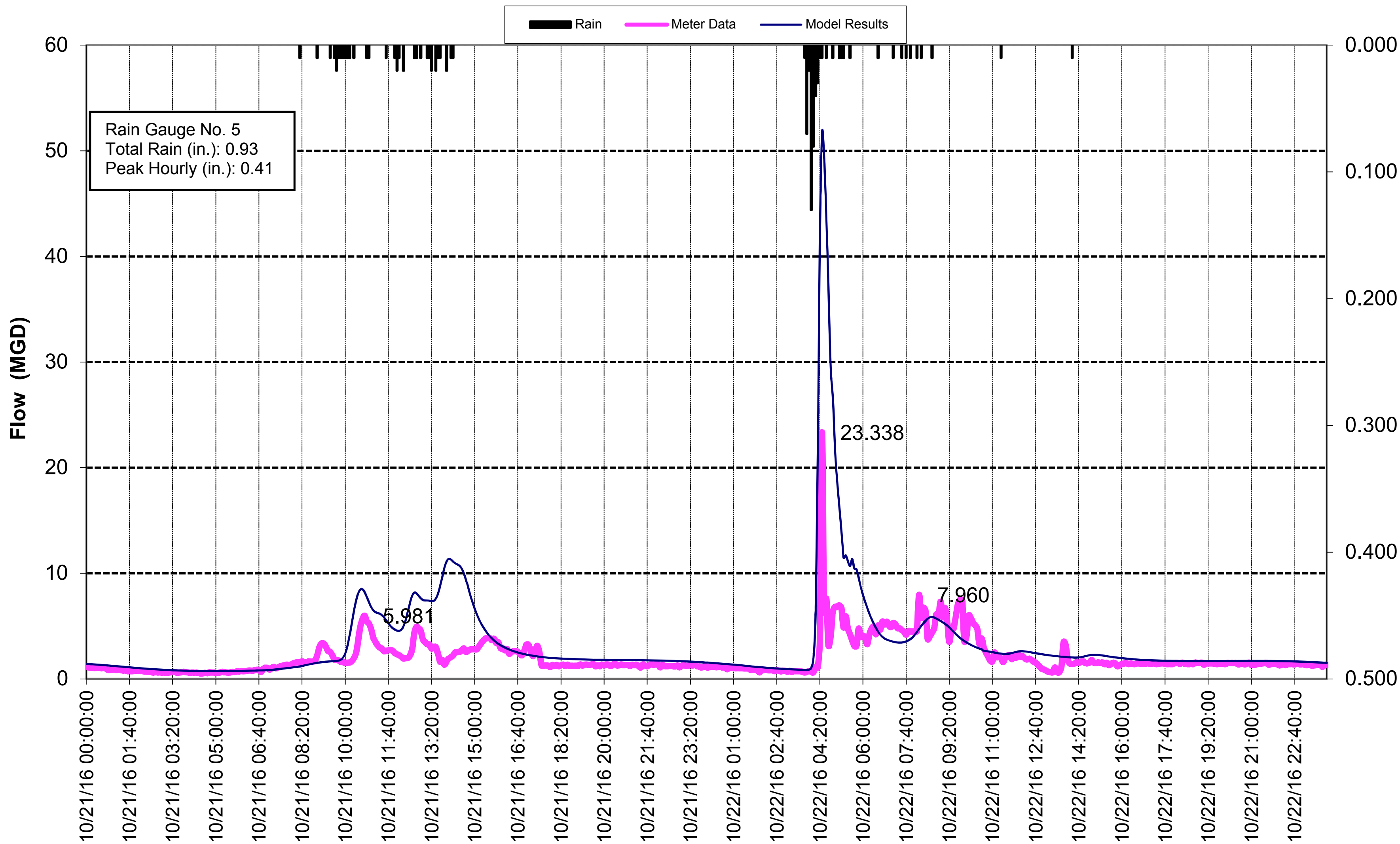
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-10: Flow at Meter 42
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

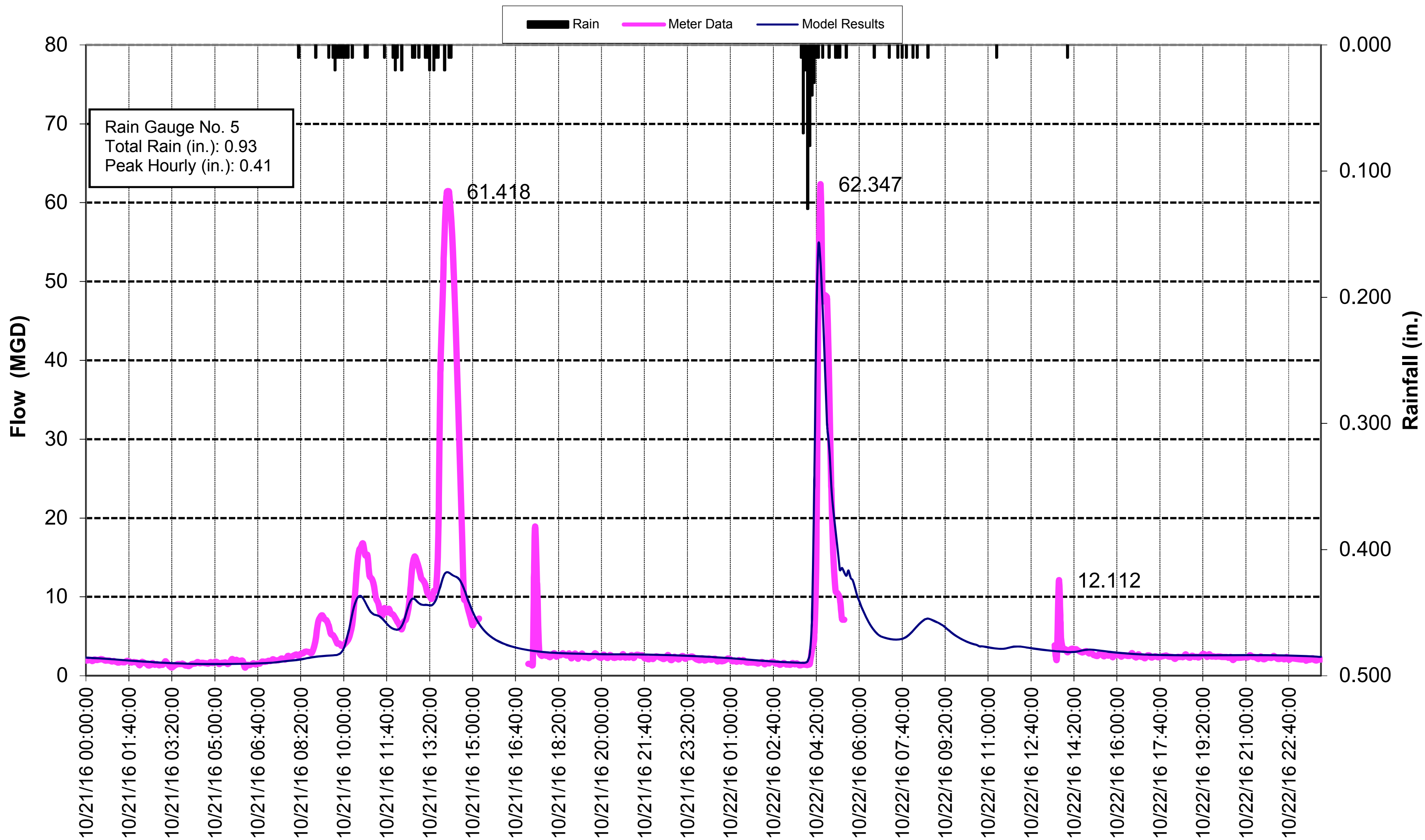
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-11: Flow at Meter 43
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

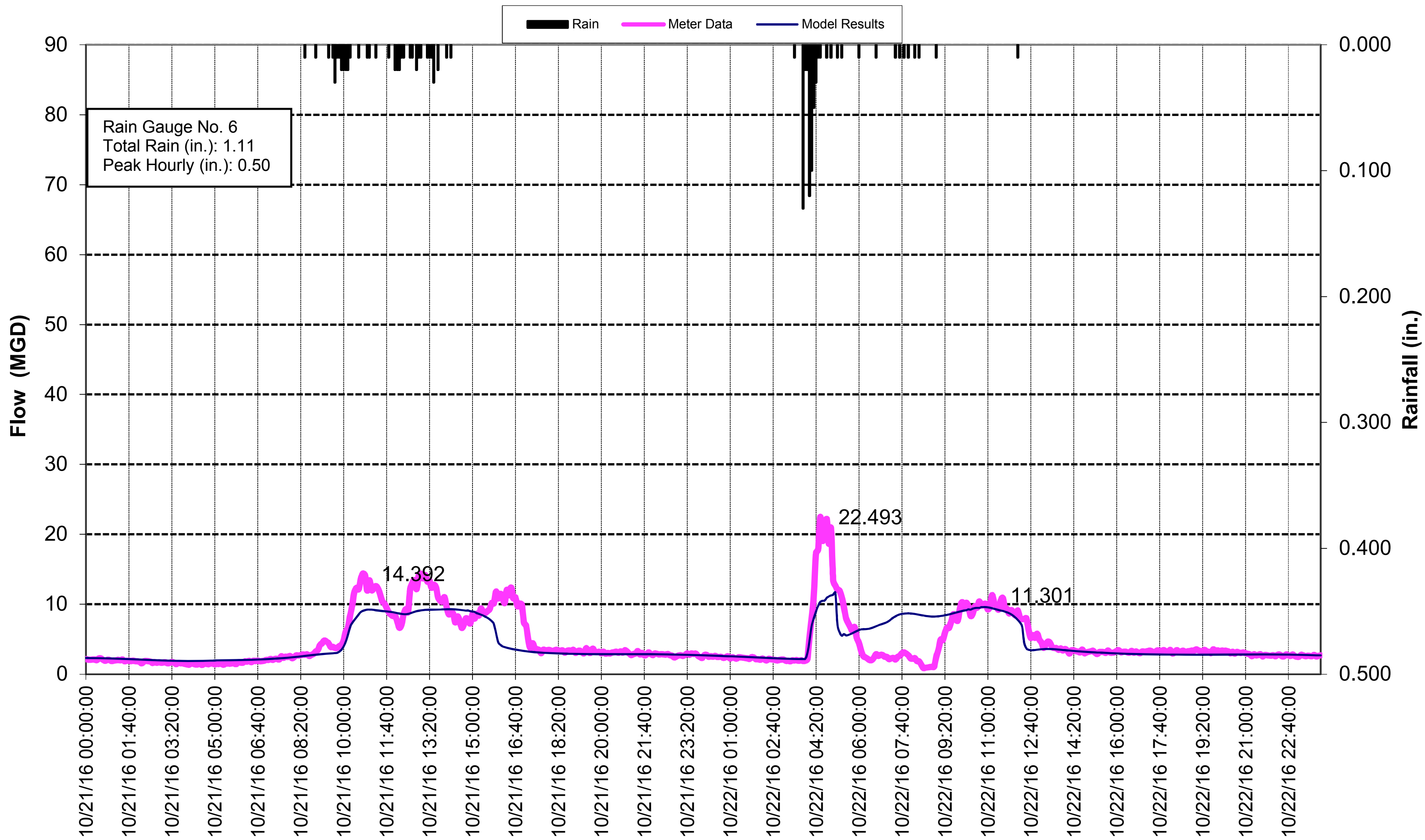
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-12: Flow at Meter 44
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

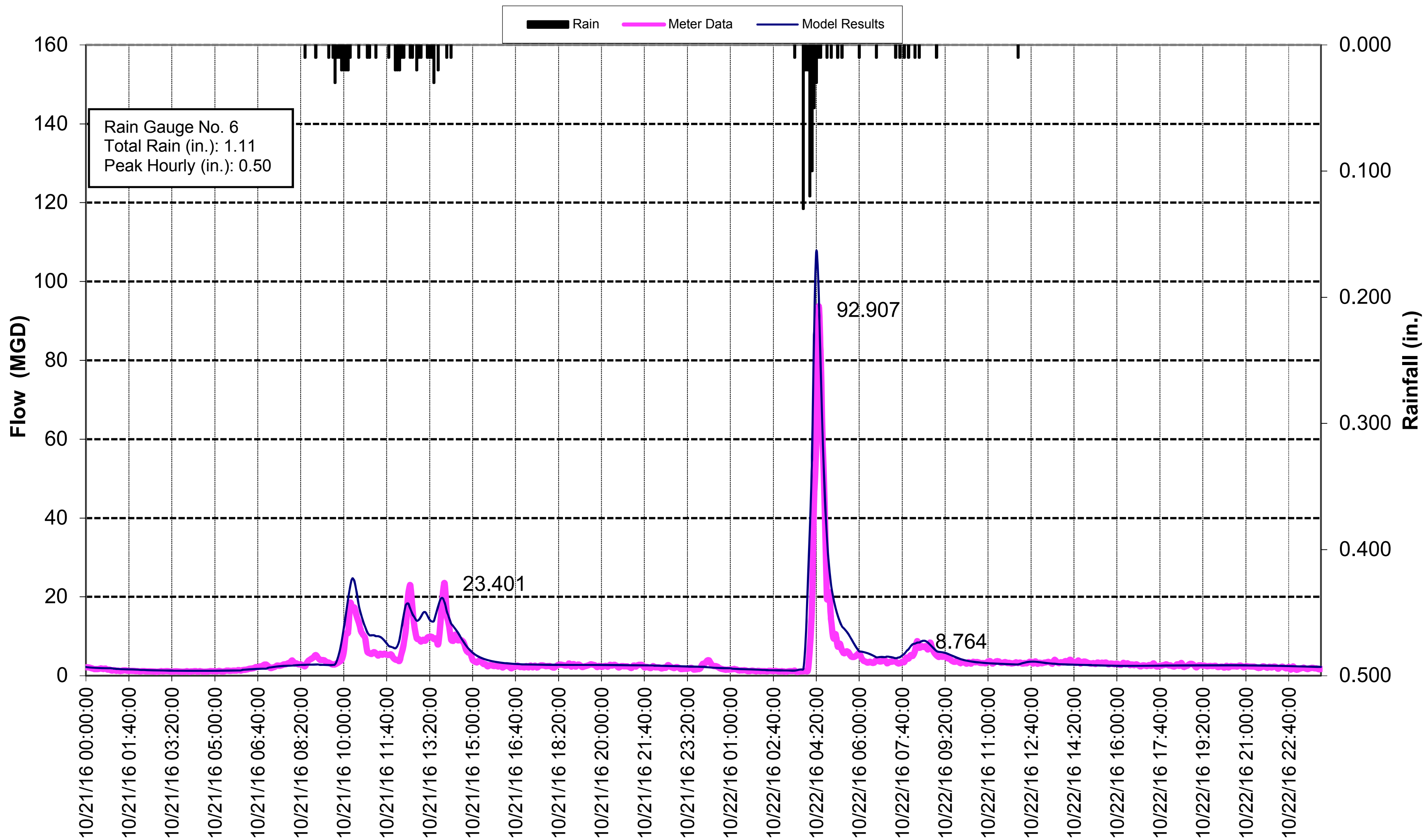
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E2-13: Flow at Meter 54
October 21, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

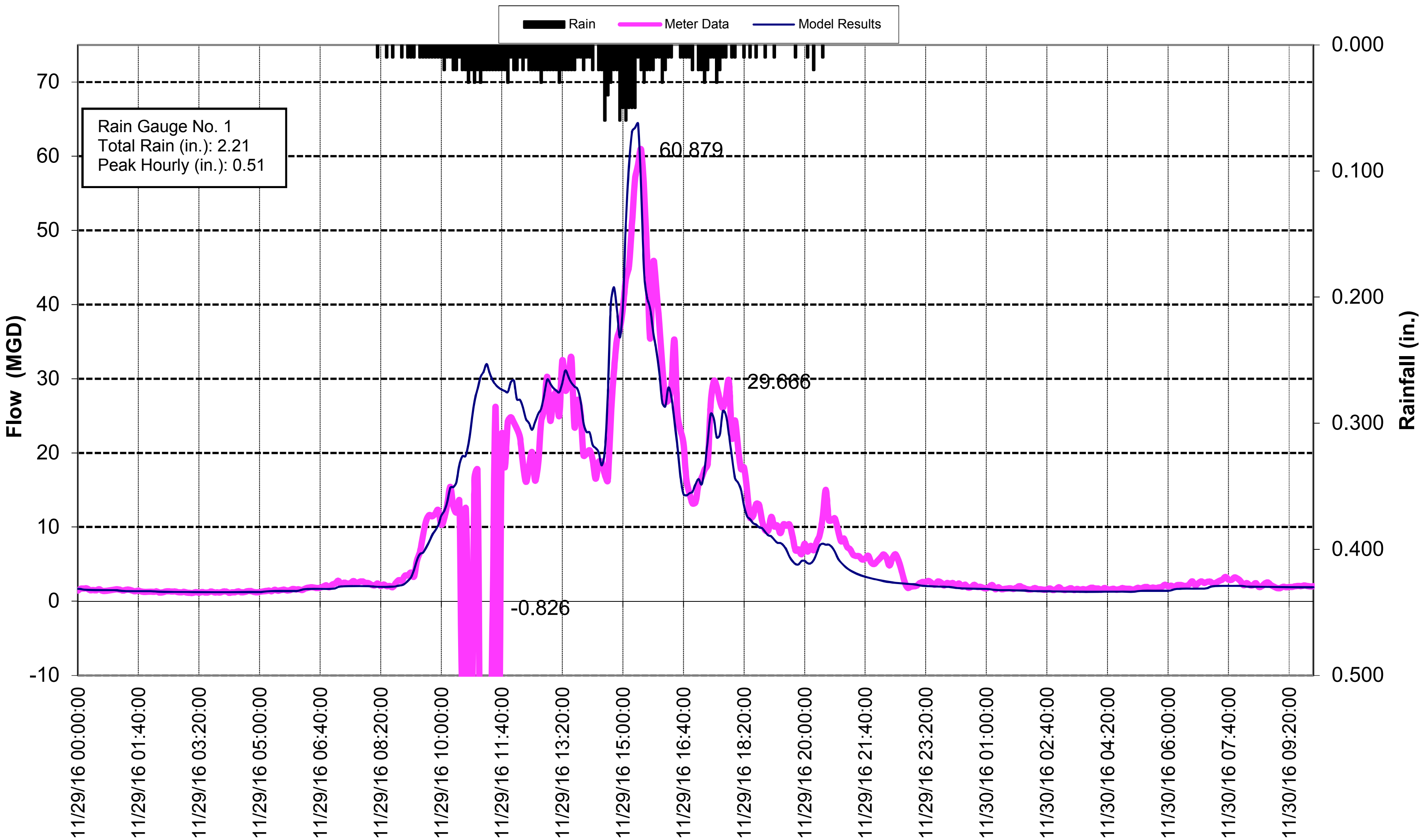
JCMUA Combined Sewer System Modeling Report
Figure E2-14: Flow at Meter 58
October 21, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E3

November 29, 2016 Event Flow Graphs

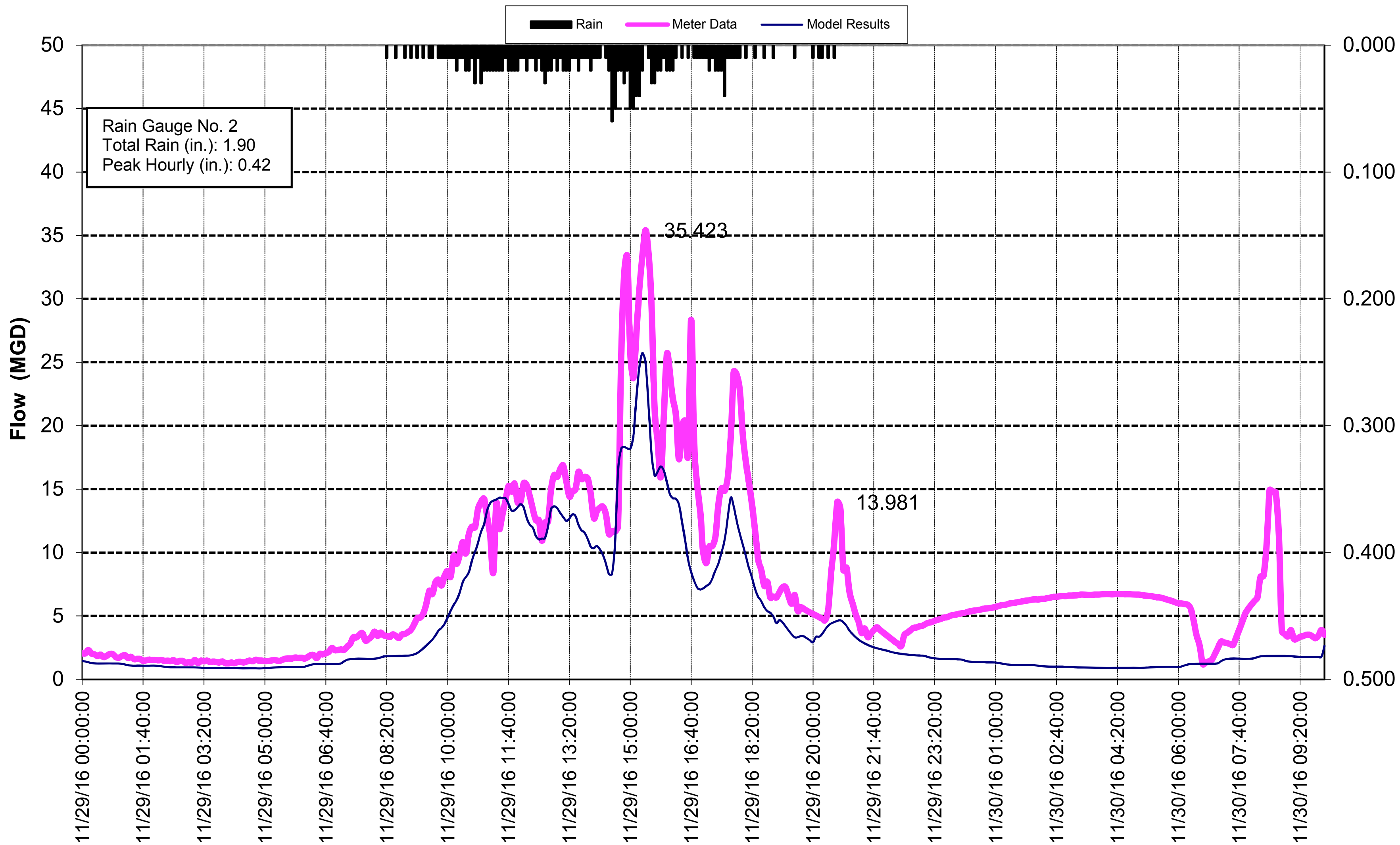
Appendix E3 - November 29, 2016 Event Flow Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-1: Flow at Meter 6
November 29, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

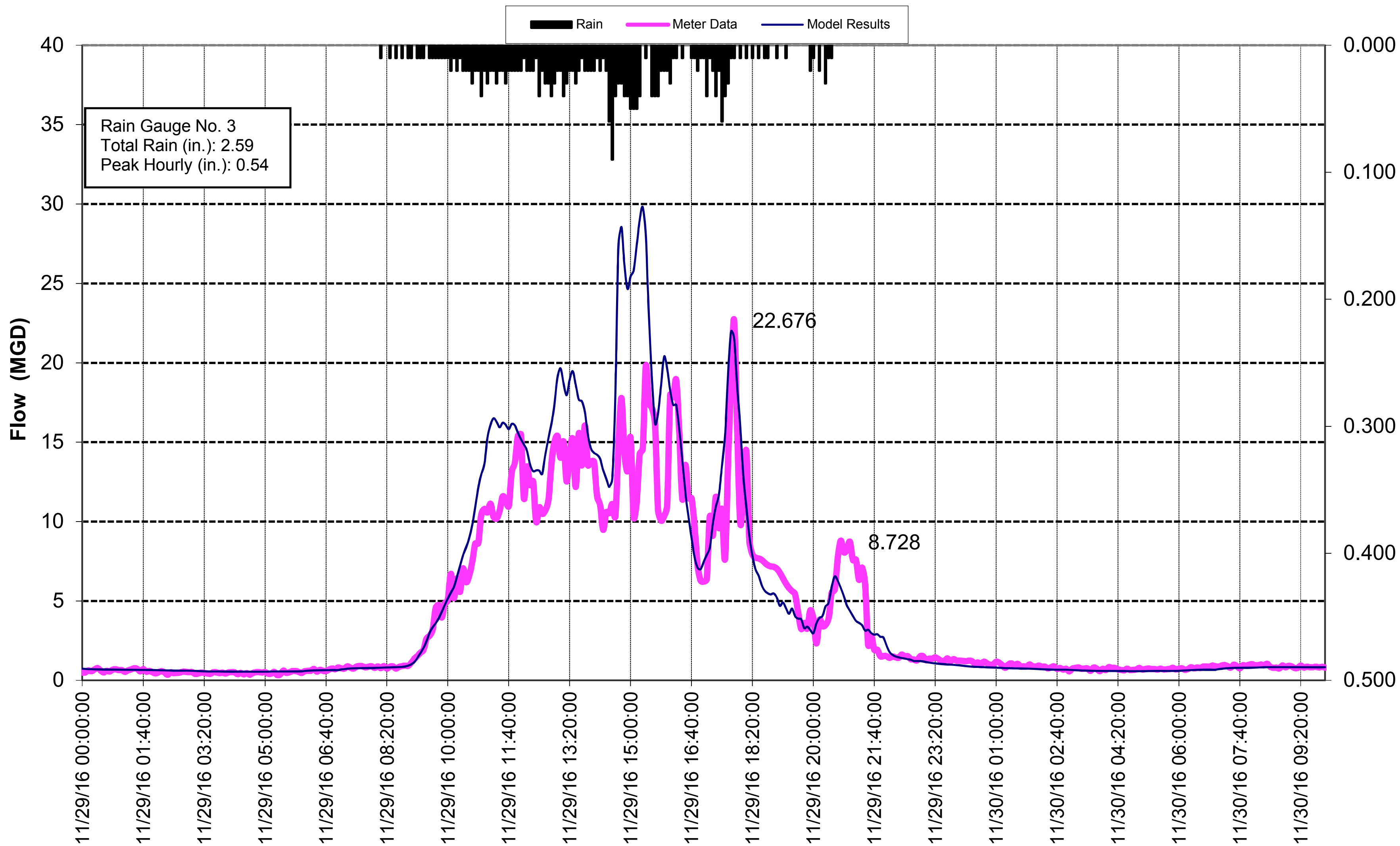
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-2: Flow at Meter 17
November 29, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

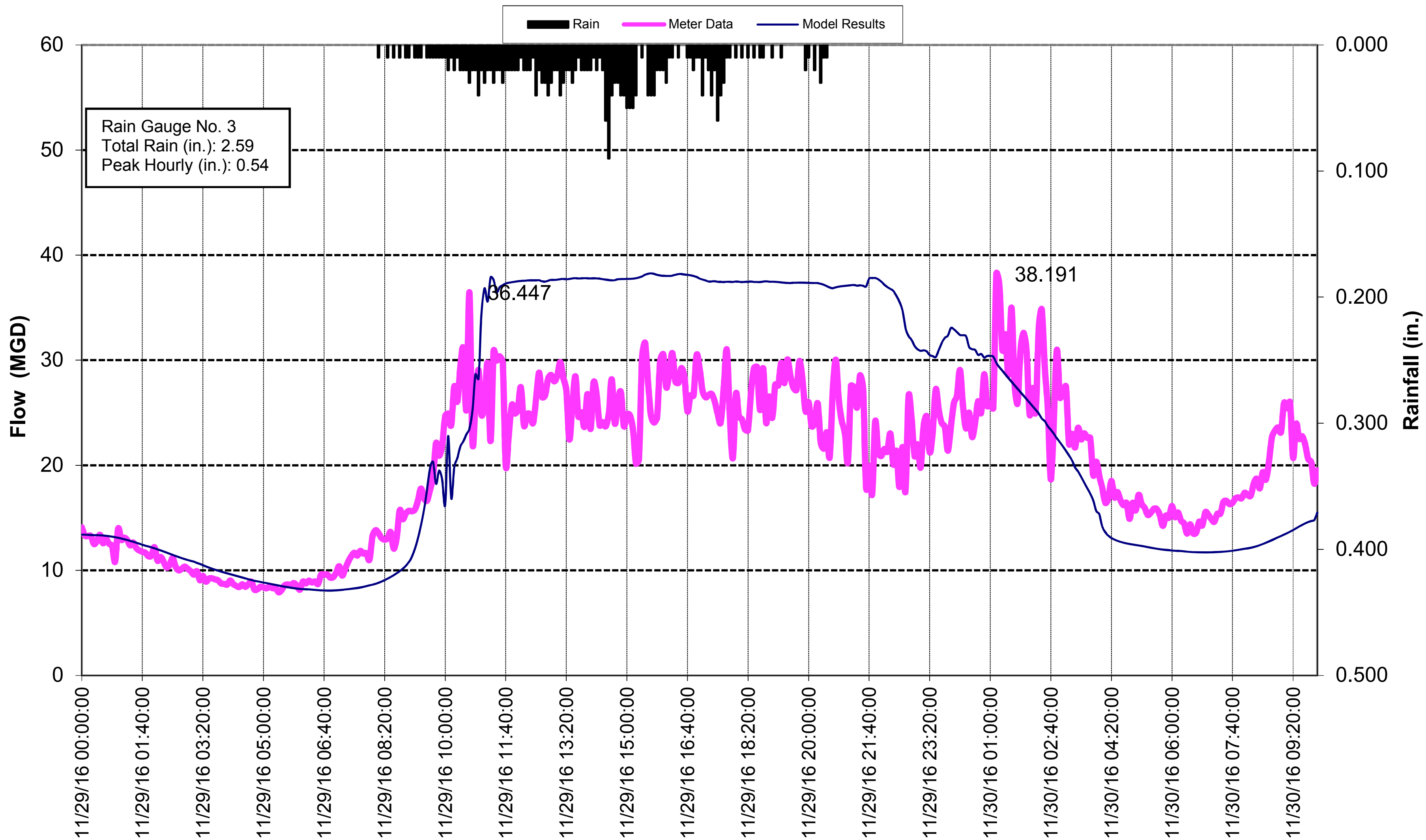
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-3: Flow at Meter 27
November 29, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

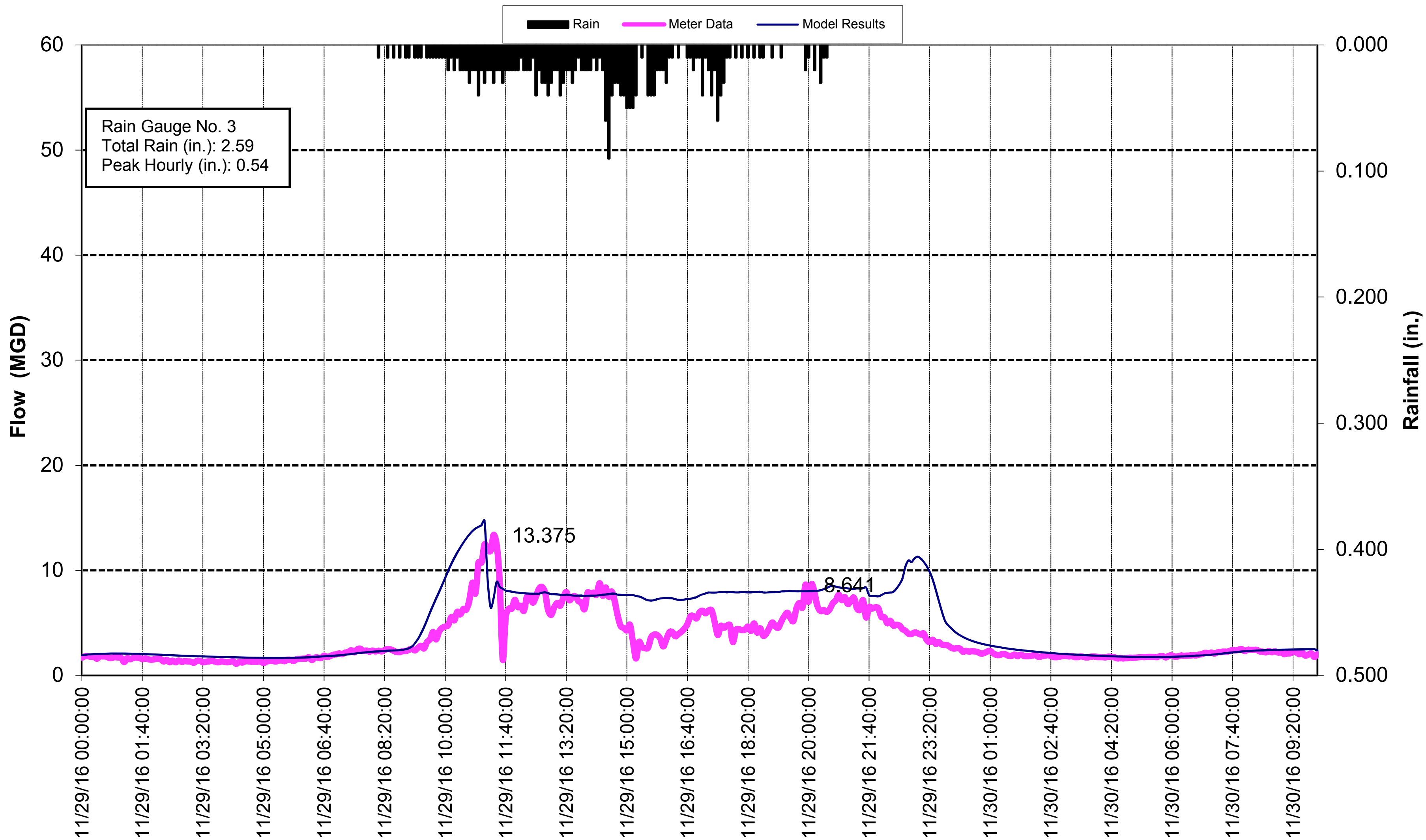
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-4: Flow at Meter 28
November 29, 2016 Storm Event
Total Northwest Interceptor Flow

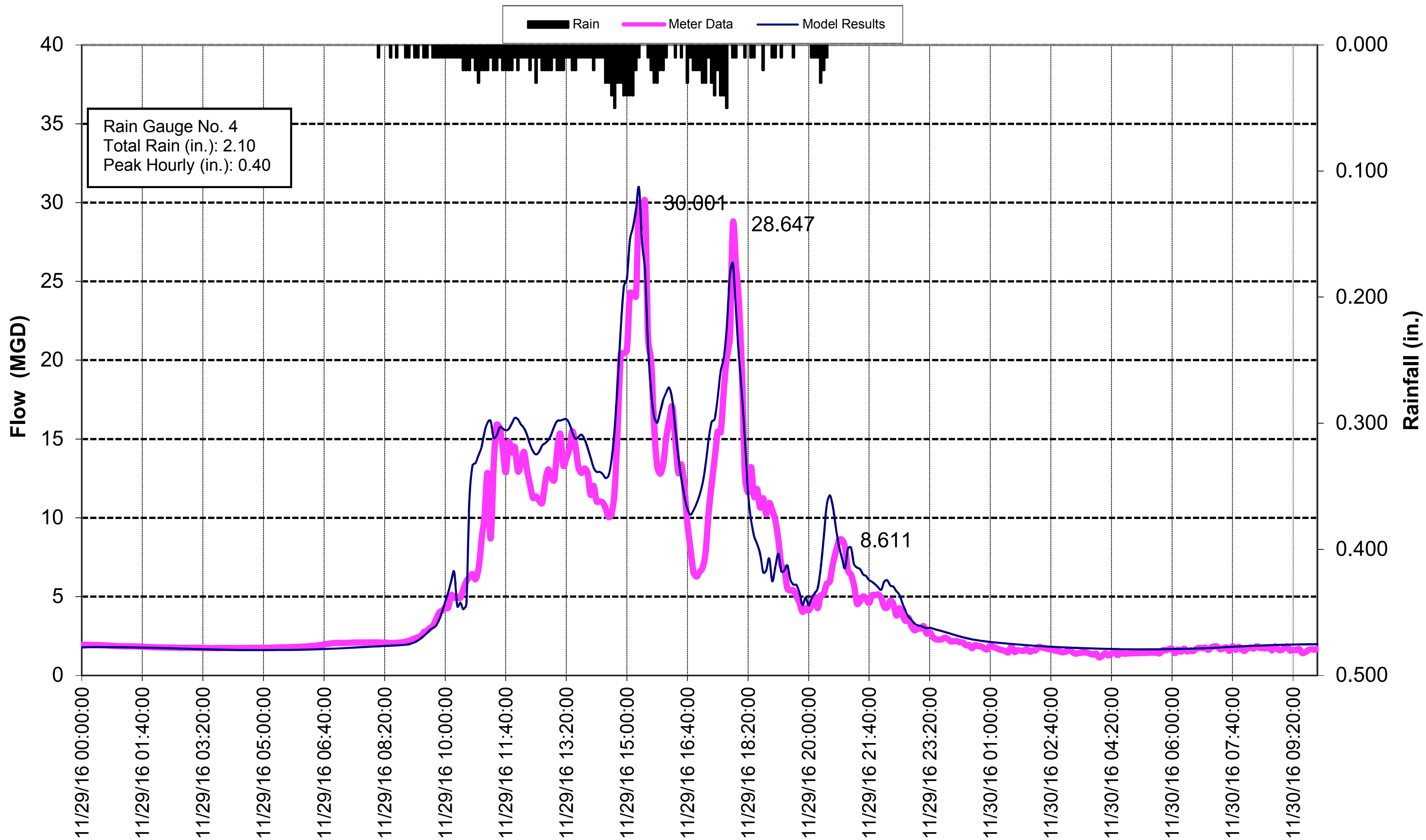
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-5: Flow at Meter 29
November 29, 2016 Storm Event
Total Southwest Interceptor Flow

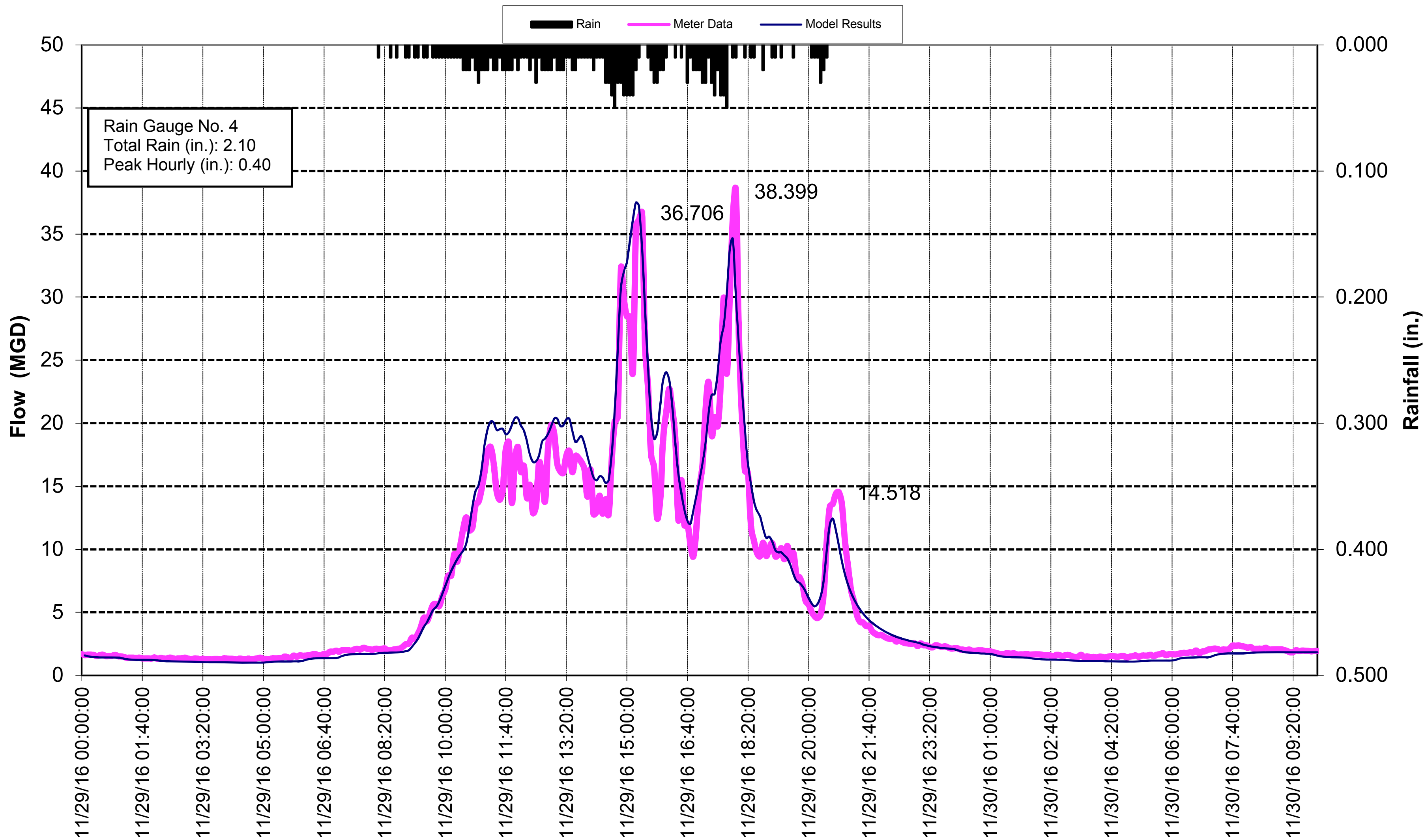
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-6: Flow at Meter 32
November 29, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

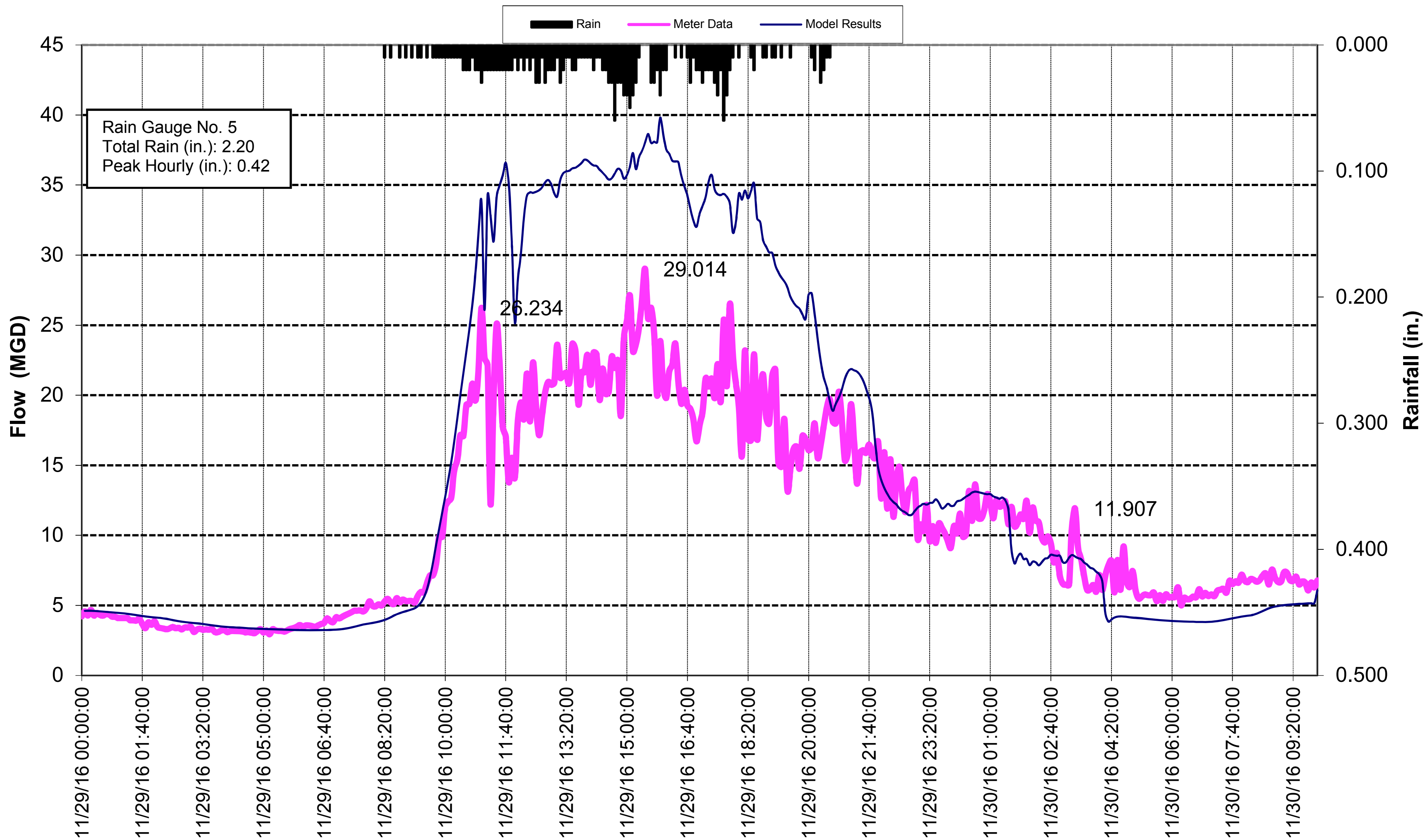
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-7: Flow at Meter 33
November 29, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

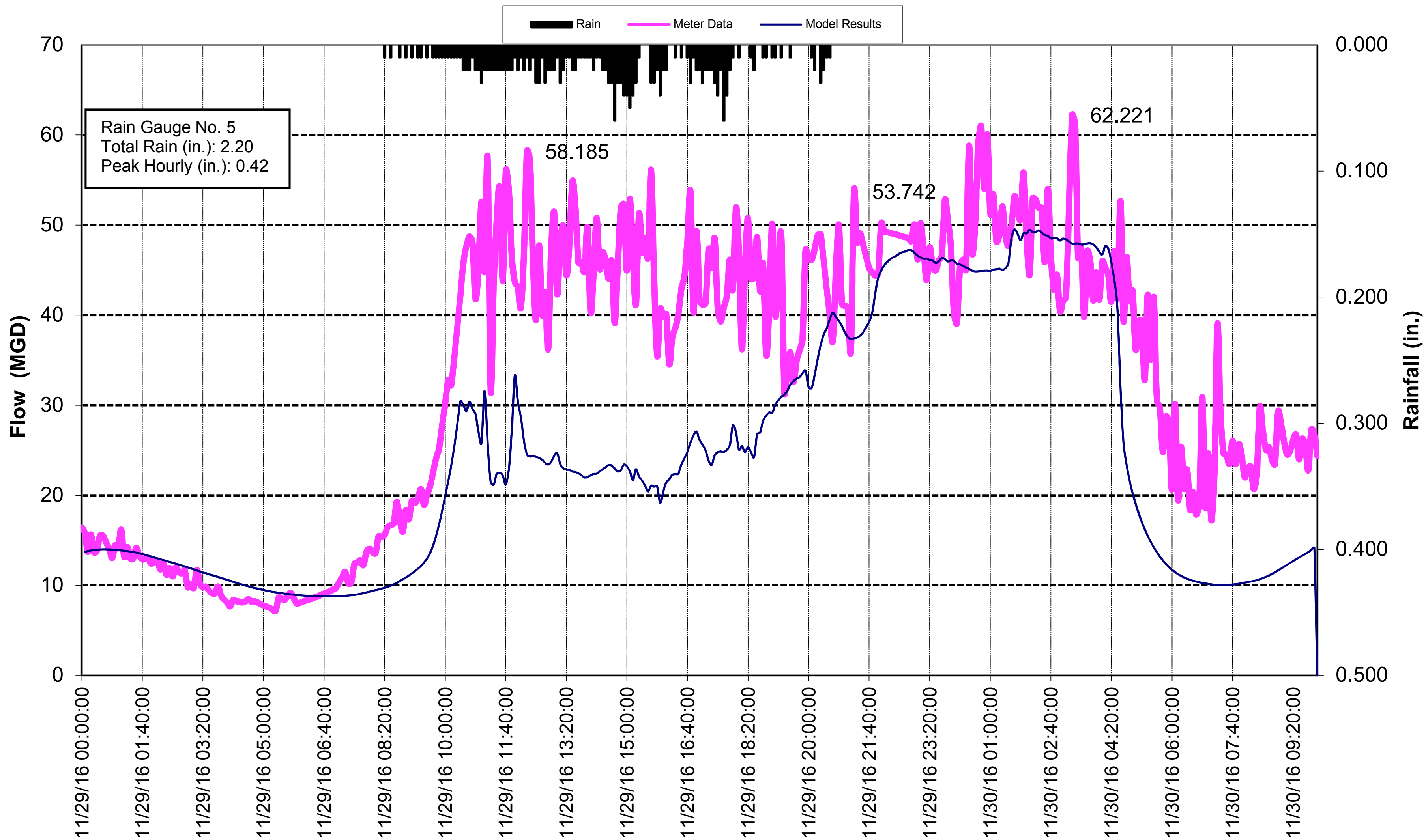
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-8: Flow at Meter 40
November 29, 2016 Storm Event
Total Southeast Interceptor Flow

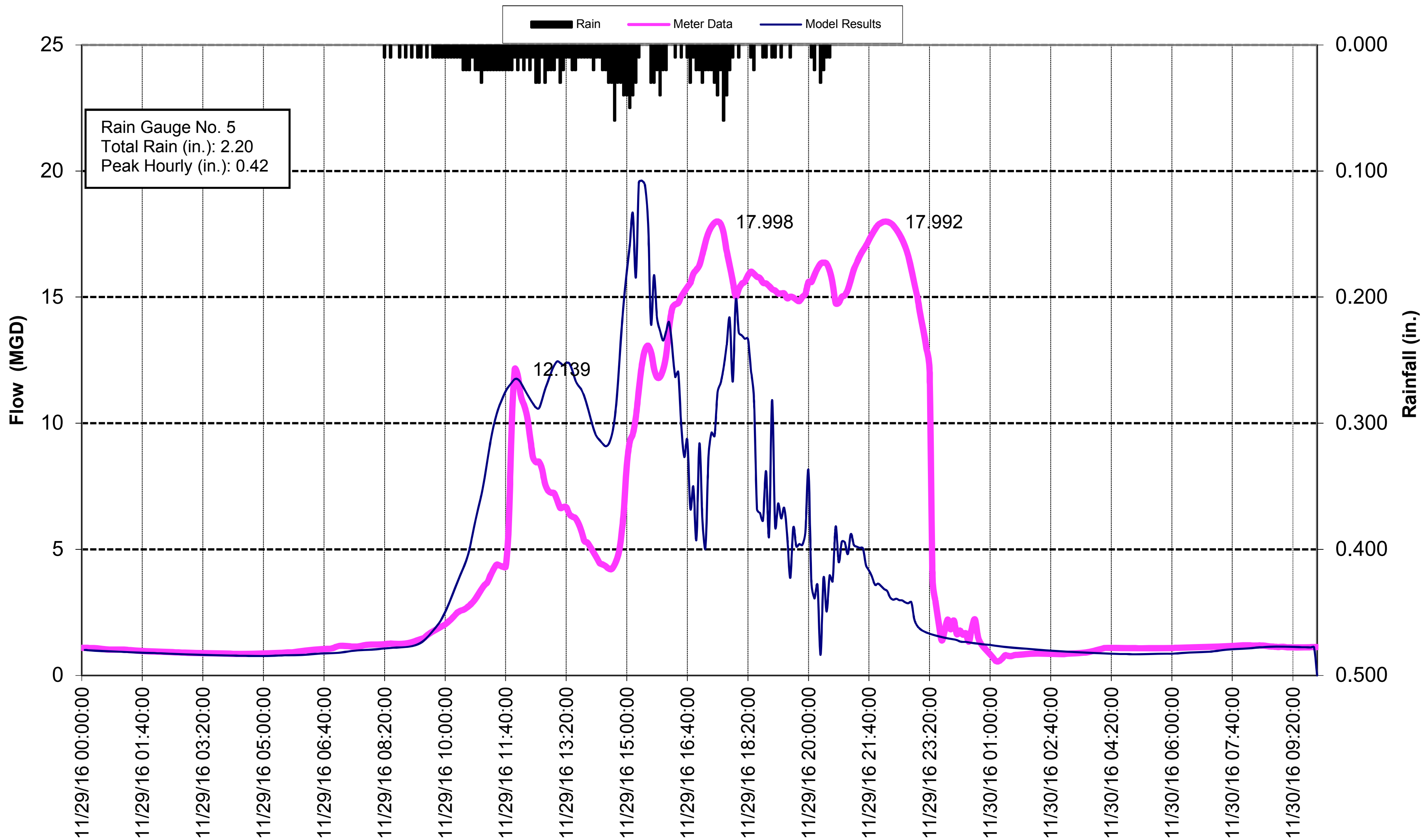
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-9: Flow at Meter 41
November 29, 2016 Storm Event
Total Northeast Interceptor Flow

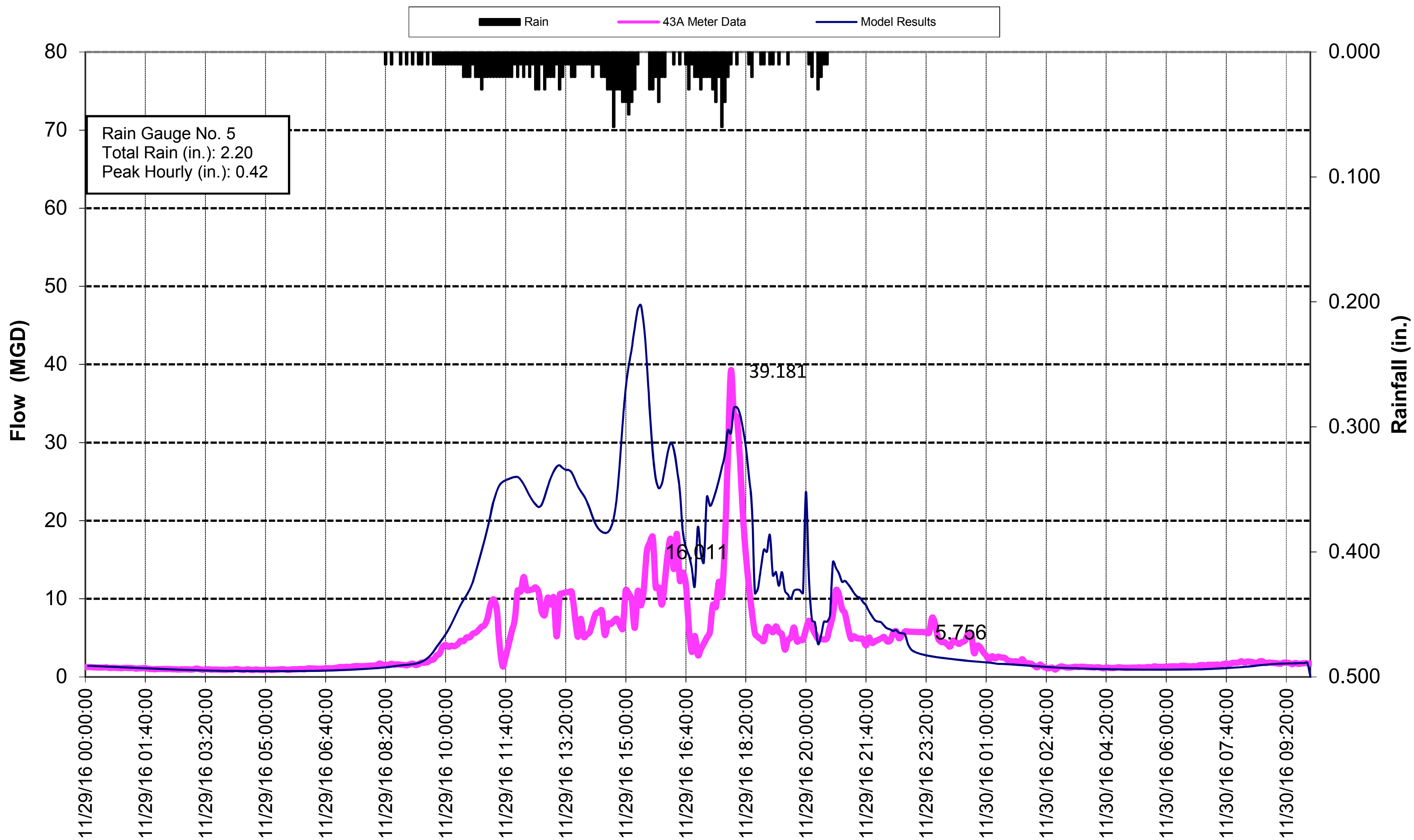
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-10: Flow at Meter 42
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

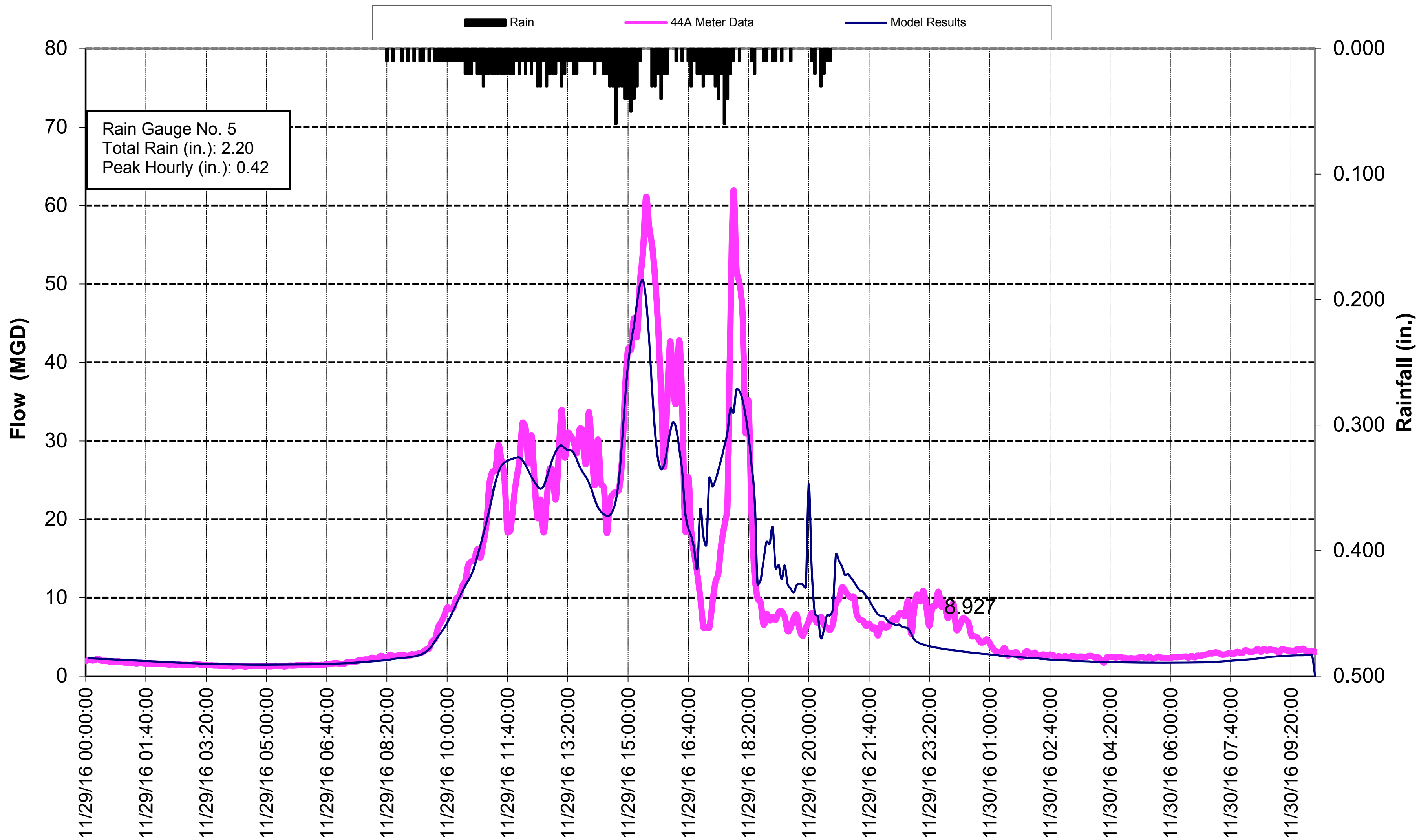
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-11: Flow at Meter 43A
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

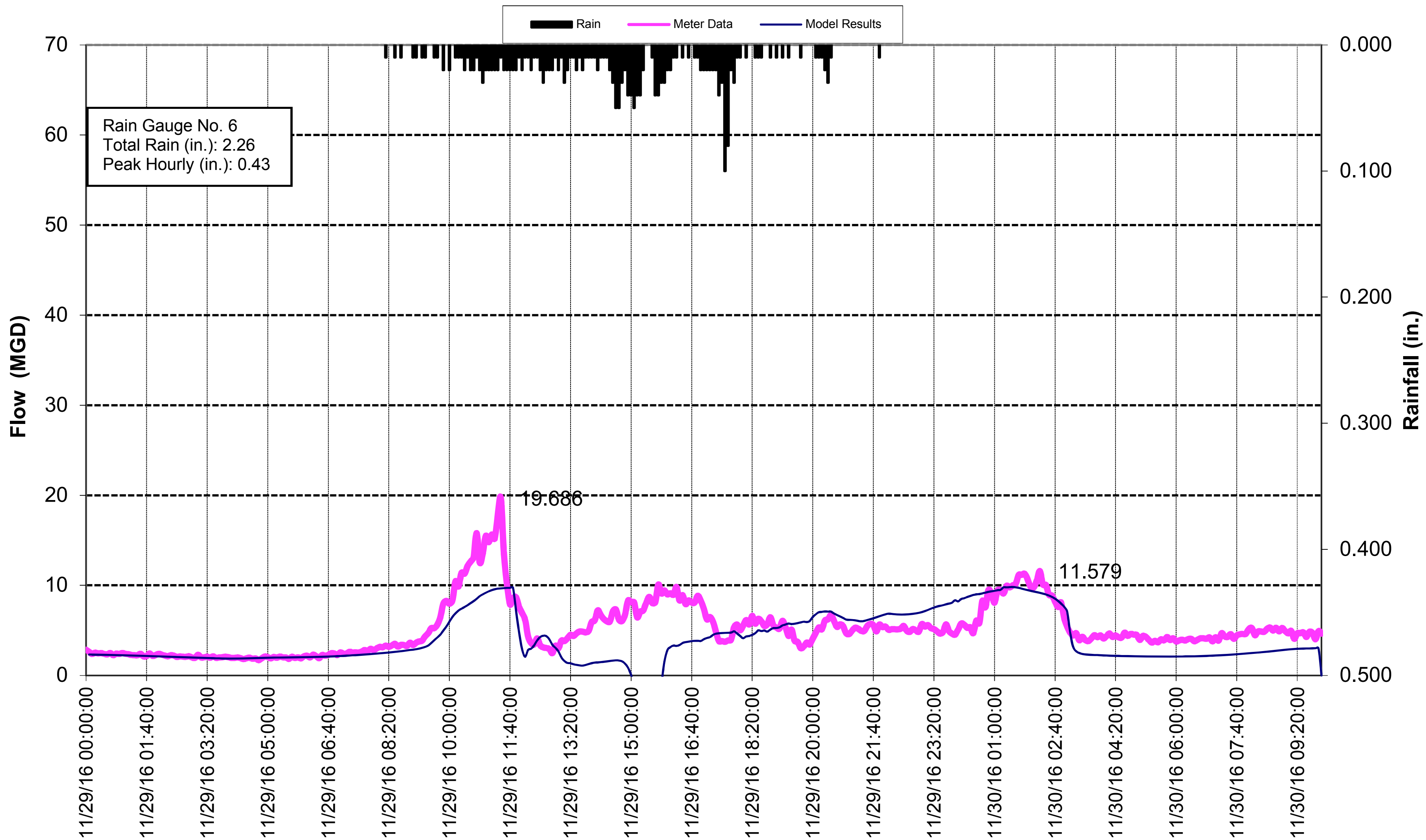
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-12: Flow at Meter 44A
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

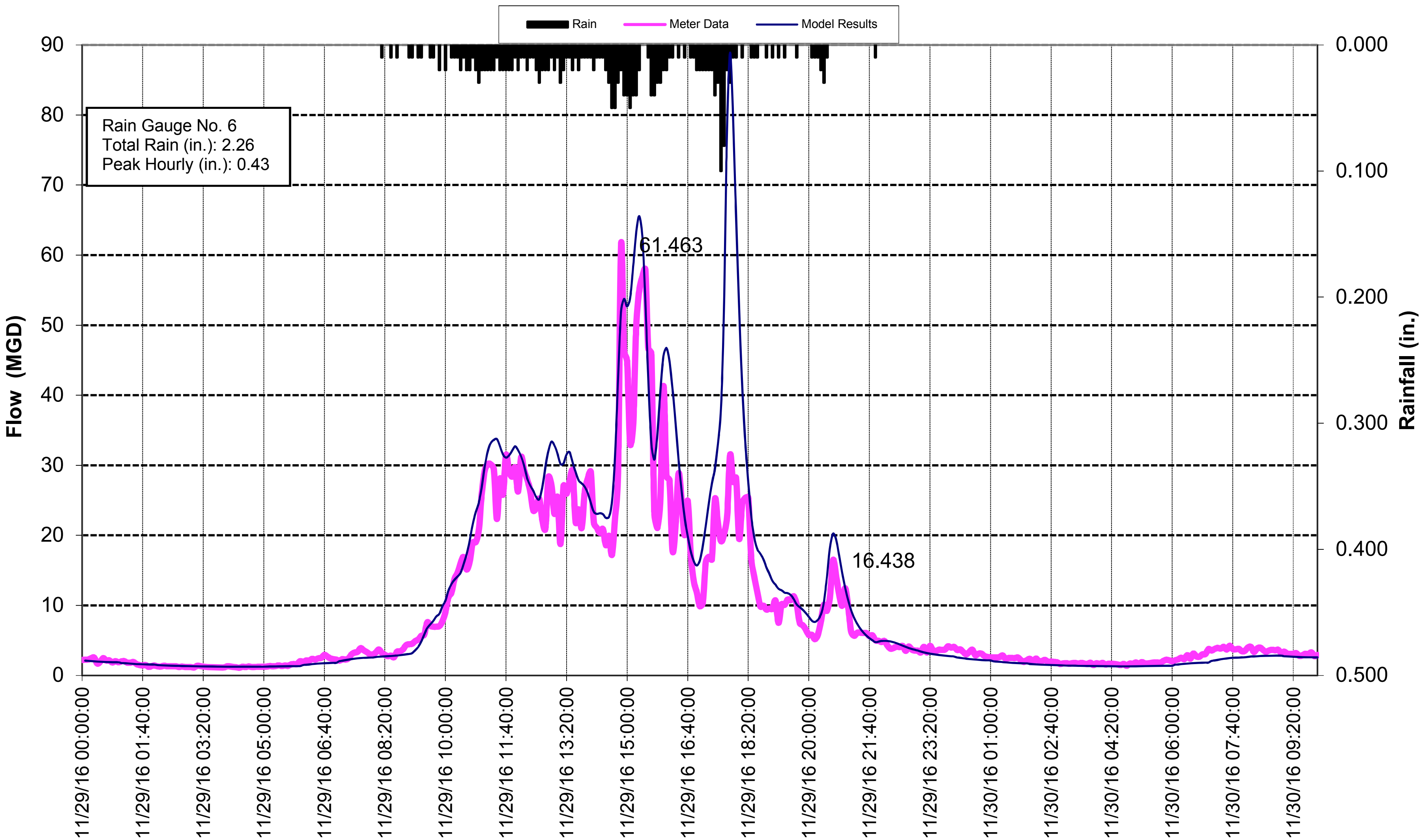
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E3-13: Flow at Meter 54
November 29, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

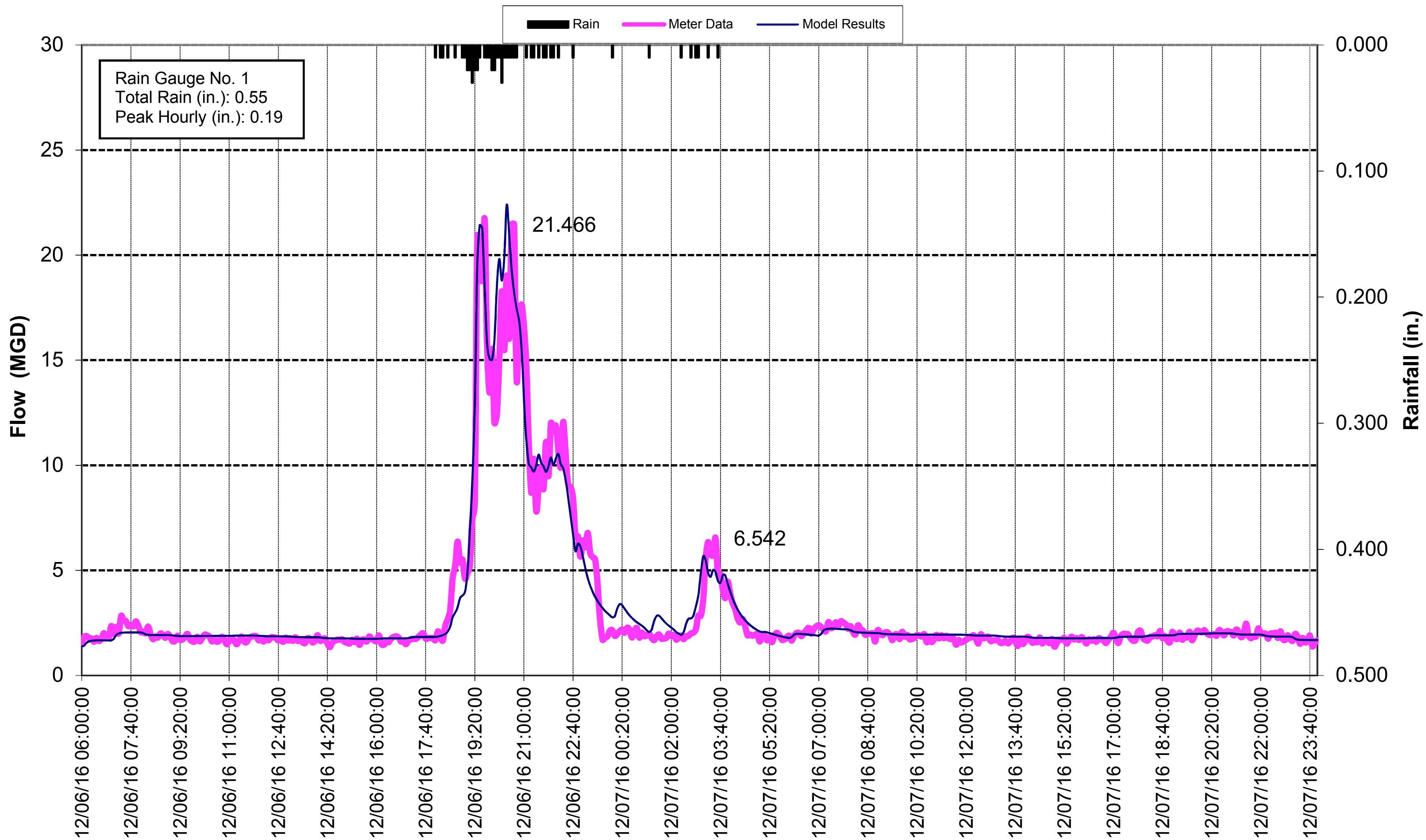
JCMUA Combined Sewer System Modeling Report
Figure E3-14: Flow at Meter 58
November 29, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E4

December 6, 2016 Event Flow Graphs

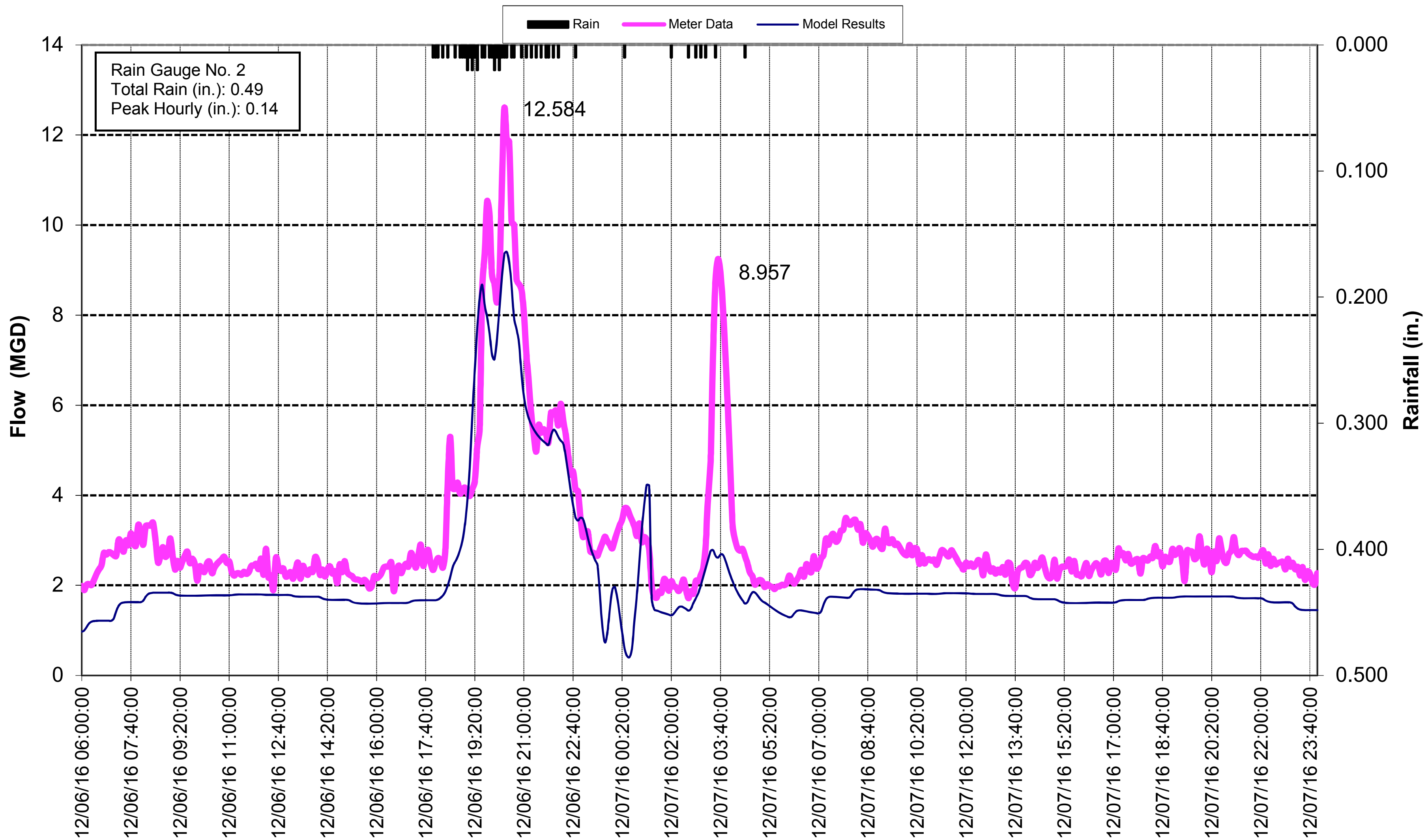
<u>Appendix E4 - December 6, 2016 Event Flow Graphs</u>



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-1: Flow at Meter 6
December 6, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

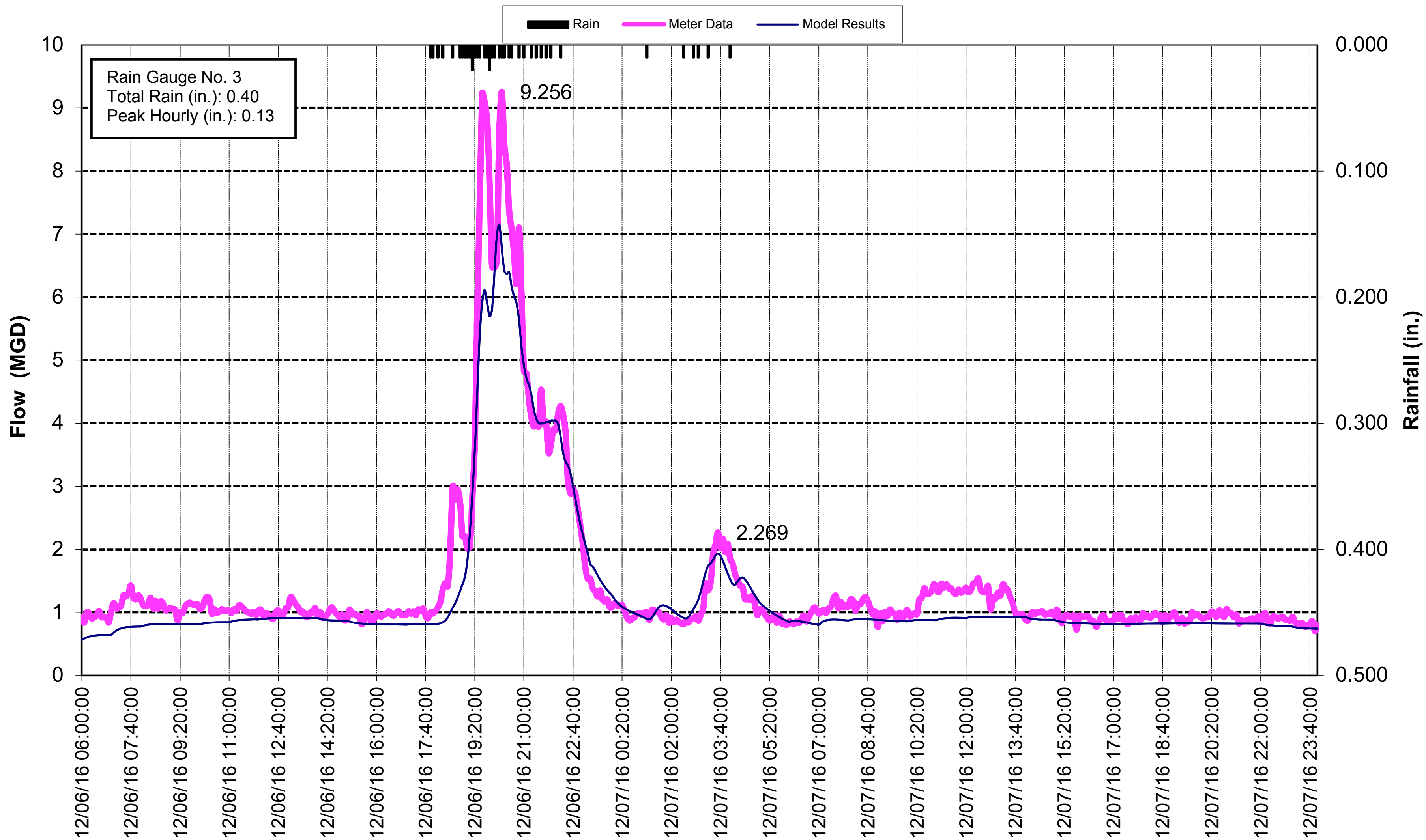
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-2: Flow at Meter 17
December 6, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

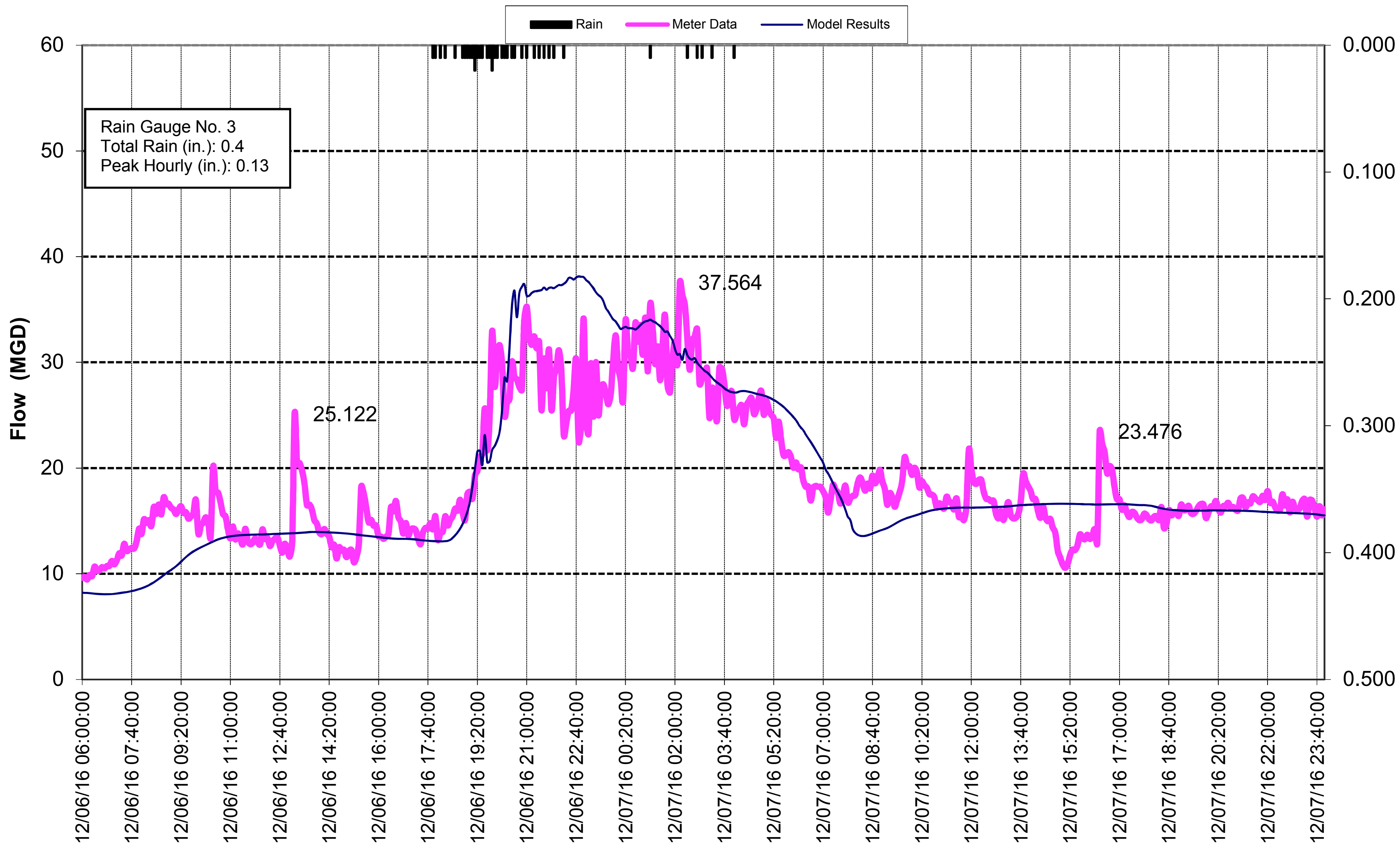
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-3: Flow at Meter 27
December 6, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

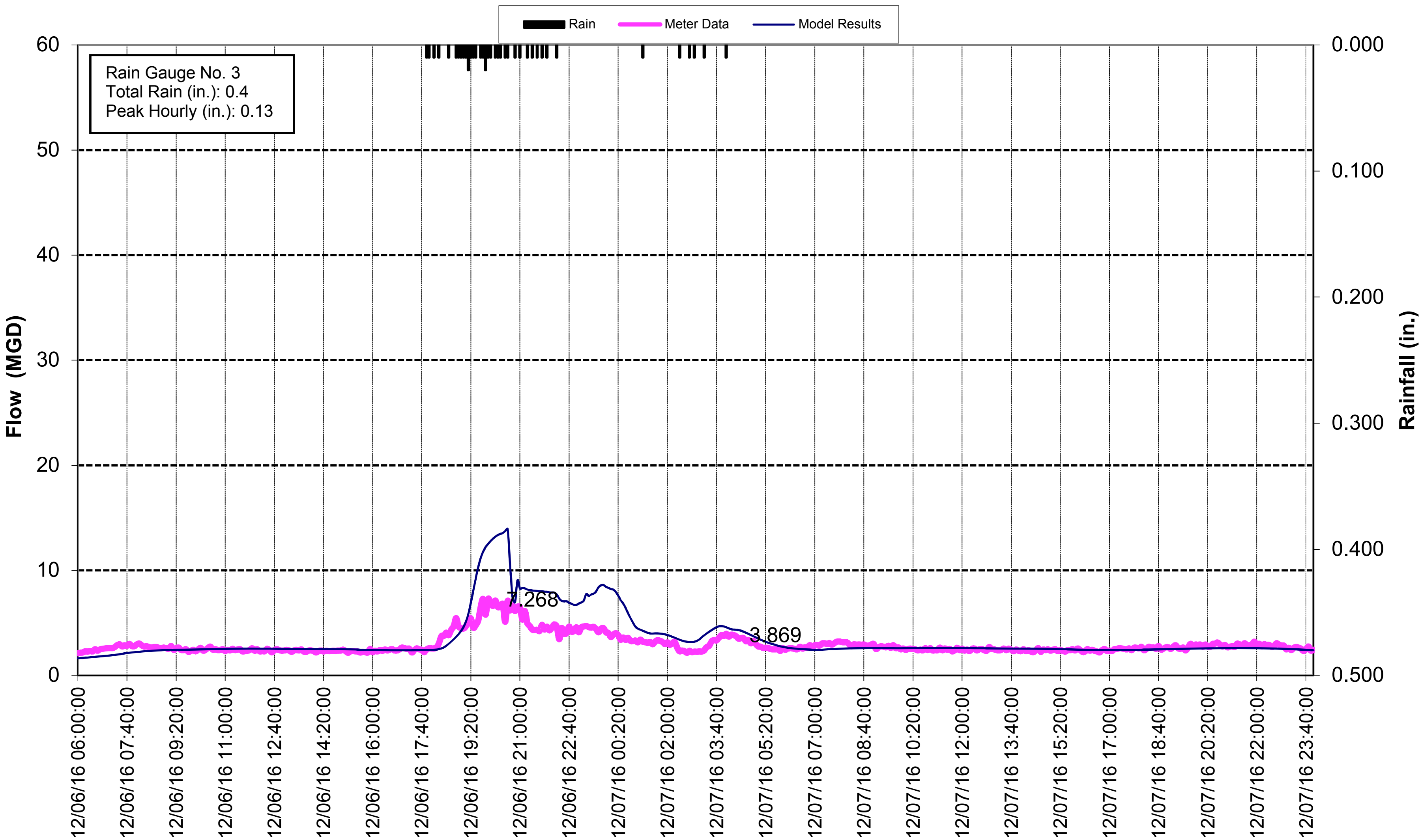
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-4: Flow at Meter 28
December 6, 2016 Storm Event
Total Northwest Interceptor Flow

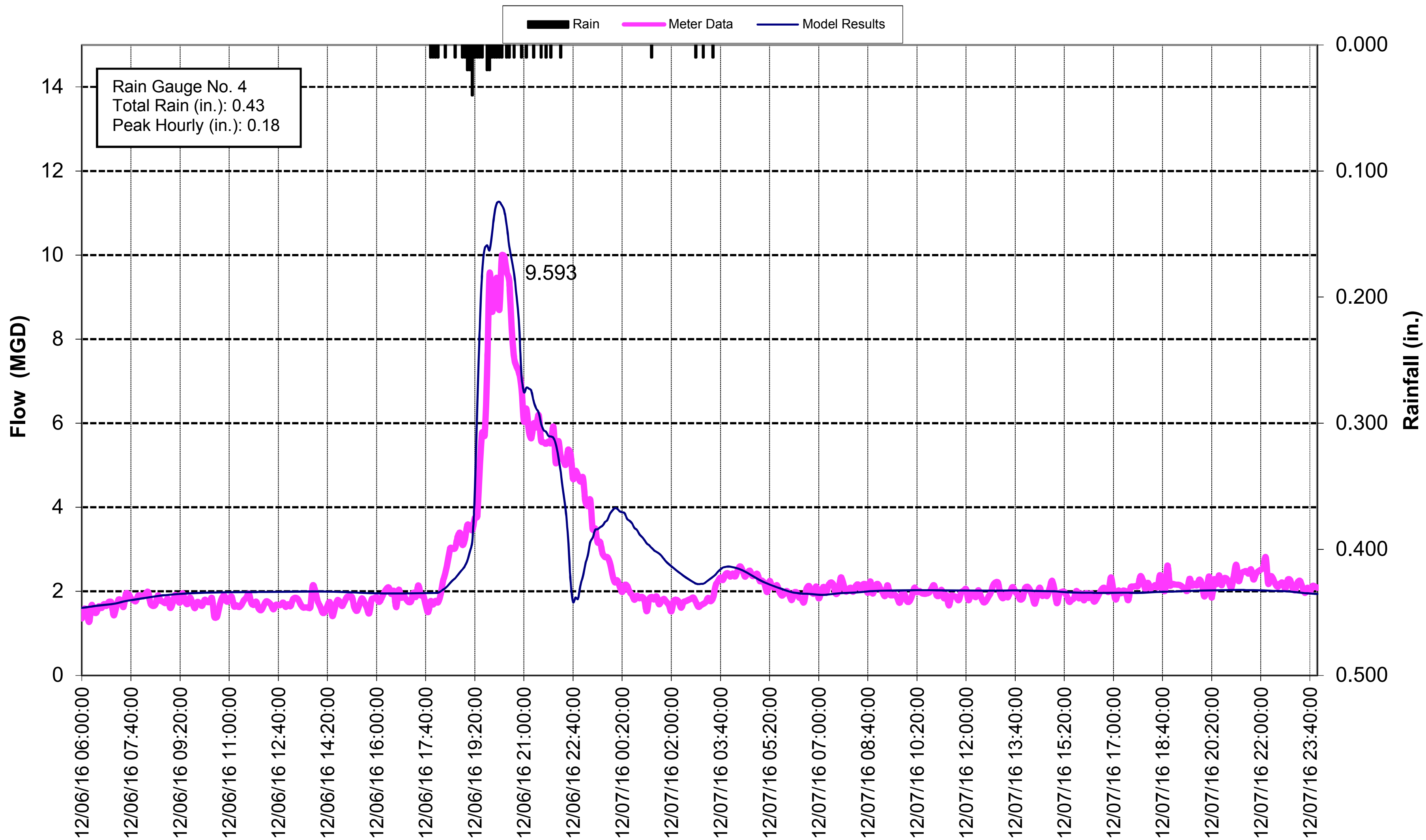
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-5: Flow at Meter 29
December 6, 2016 Storm Event
Total Southwest Interceptor Flow

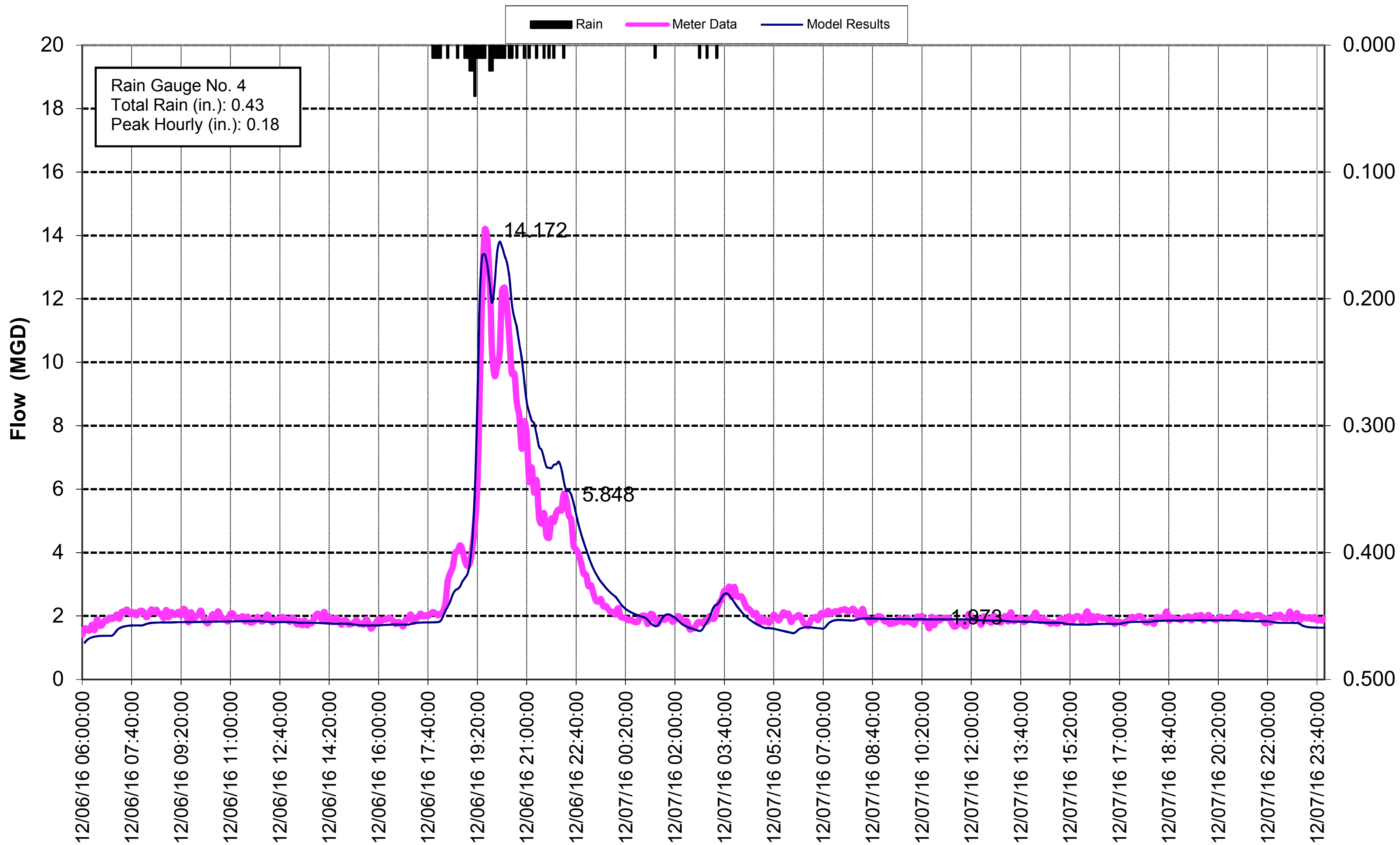
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-6: Flow at Meter 32
December 6, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

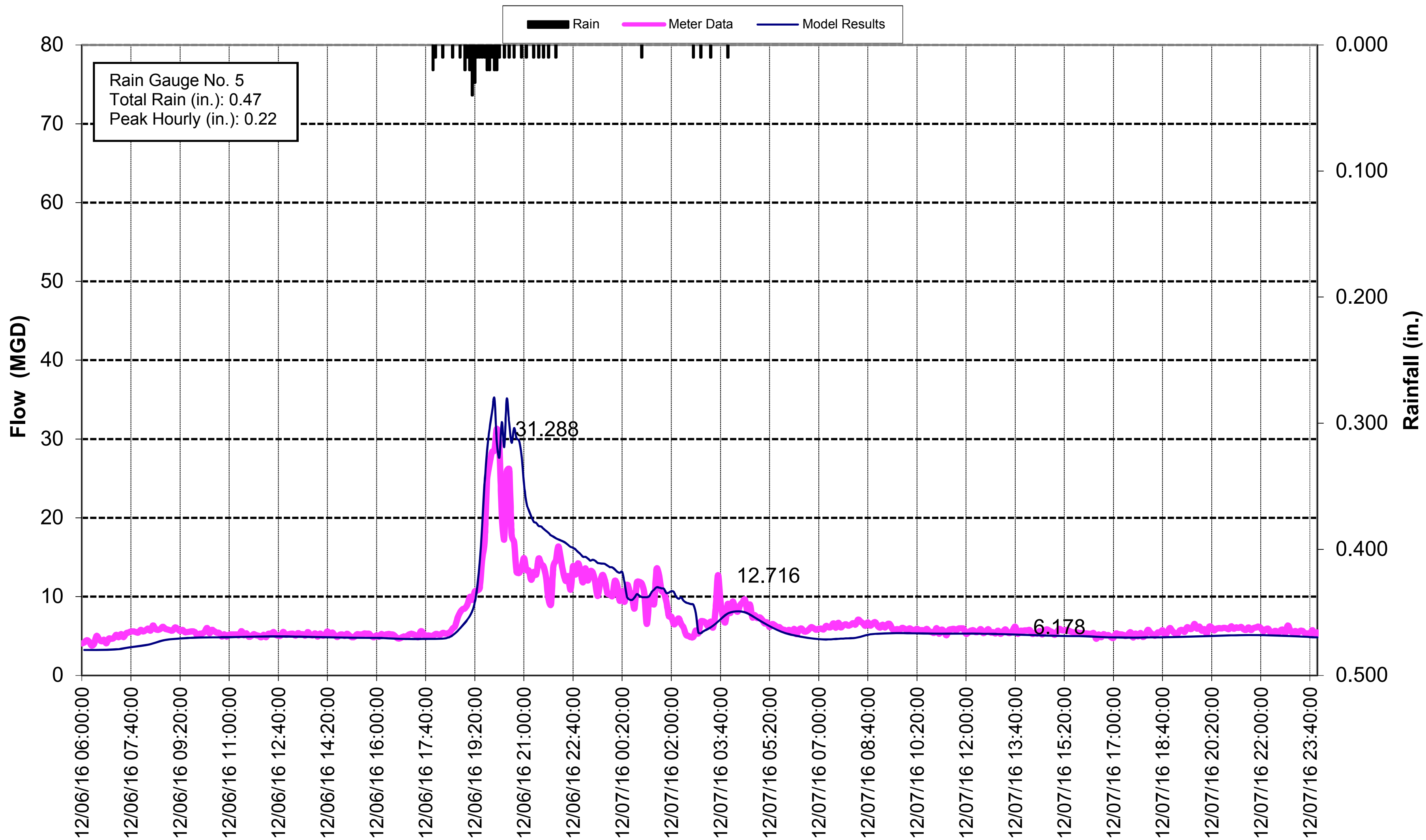
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-7: Flow at Meter 33
December 6, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

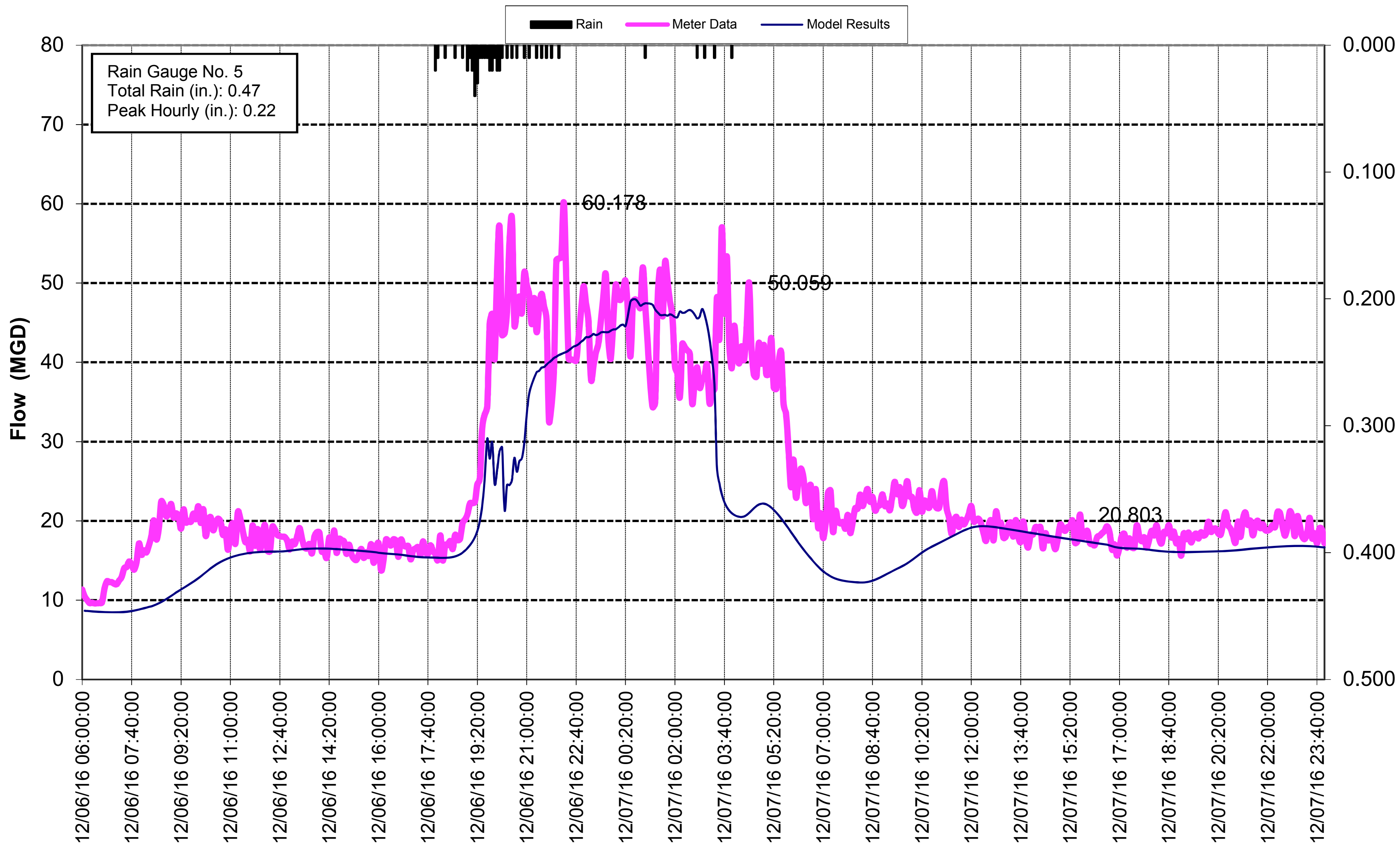
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-8: Flow at Meter 40
December 6, 2016 Storm Event
Total Southeast Interceptor Flow

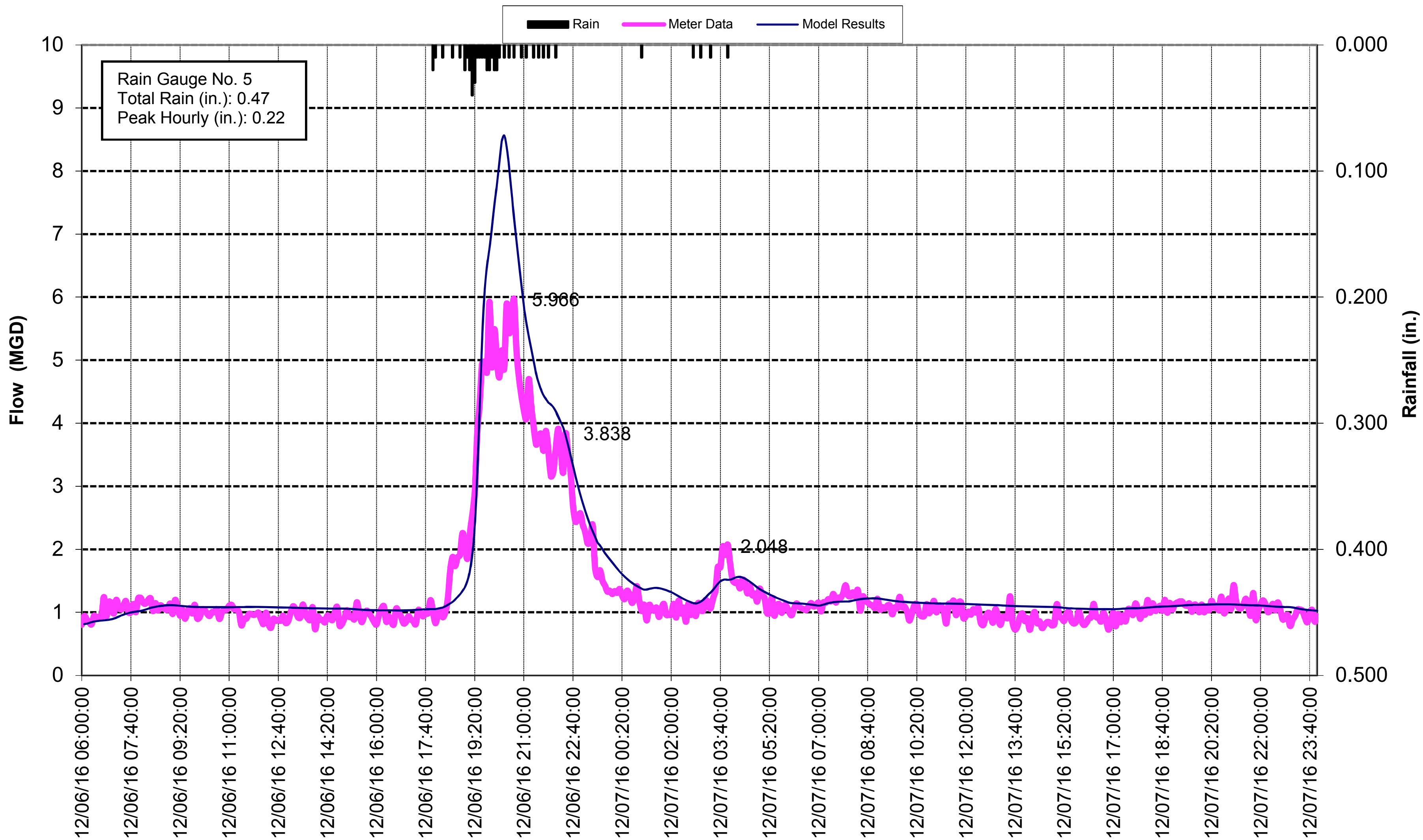
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-9: Flow at Meter 41
December 6, 2016 Storm Event
Total Northeast Interceptor Flow

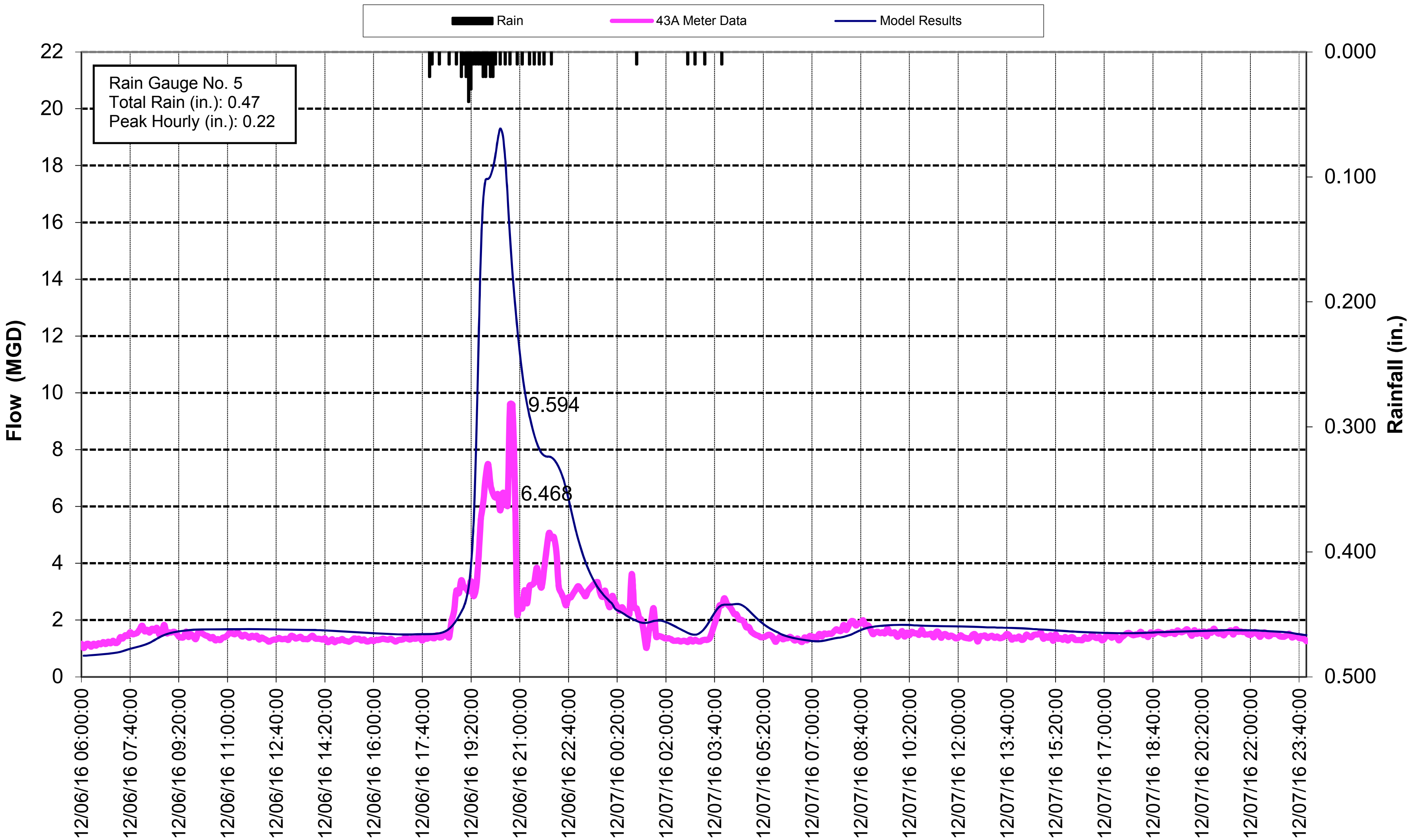
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-10: Flow at Meter 42
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

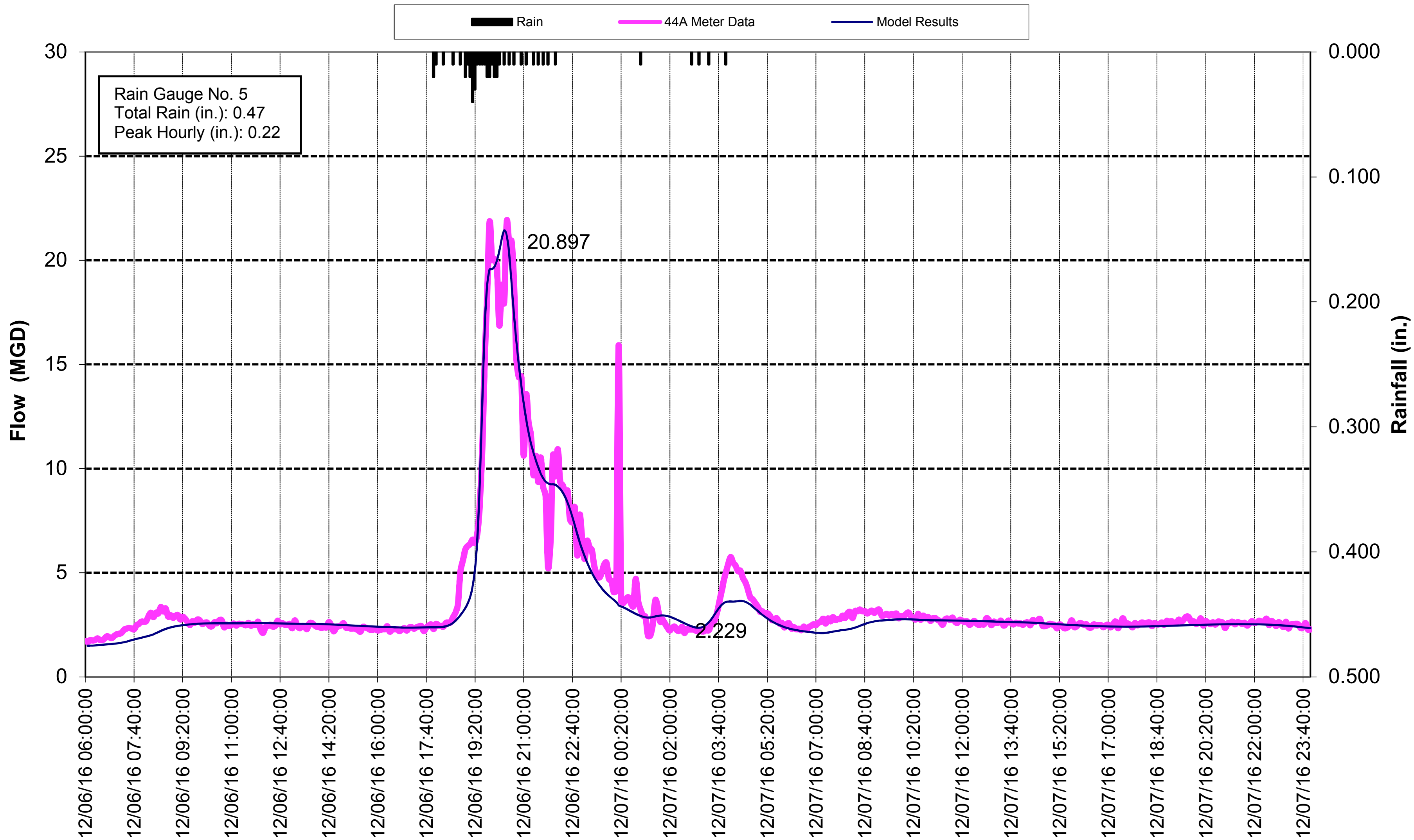
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-11: Flow at Meter 43A
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

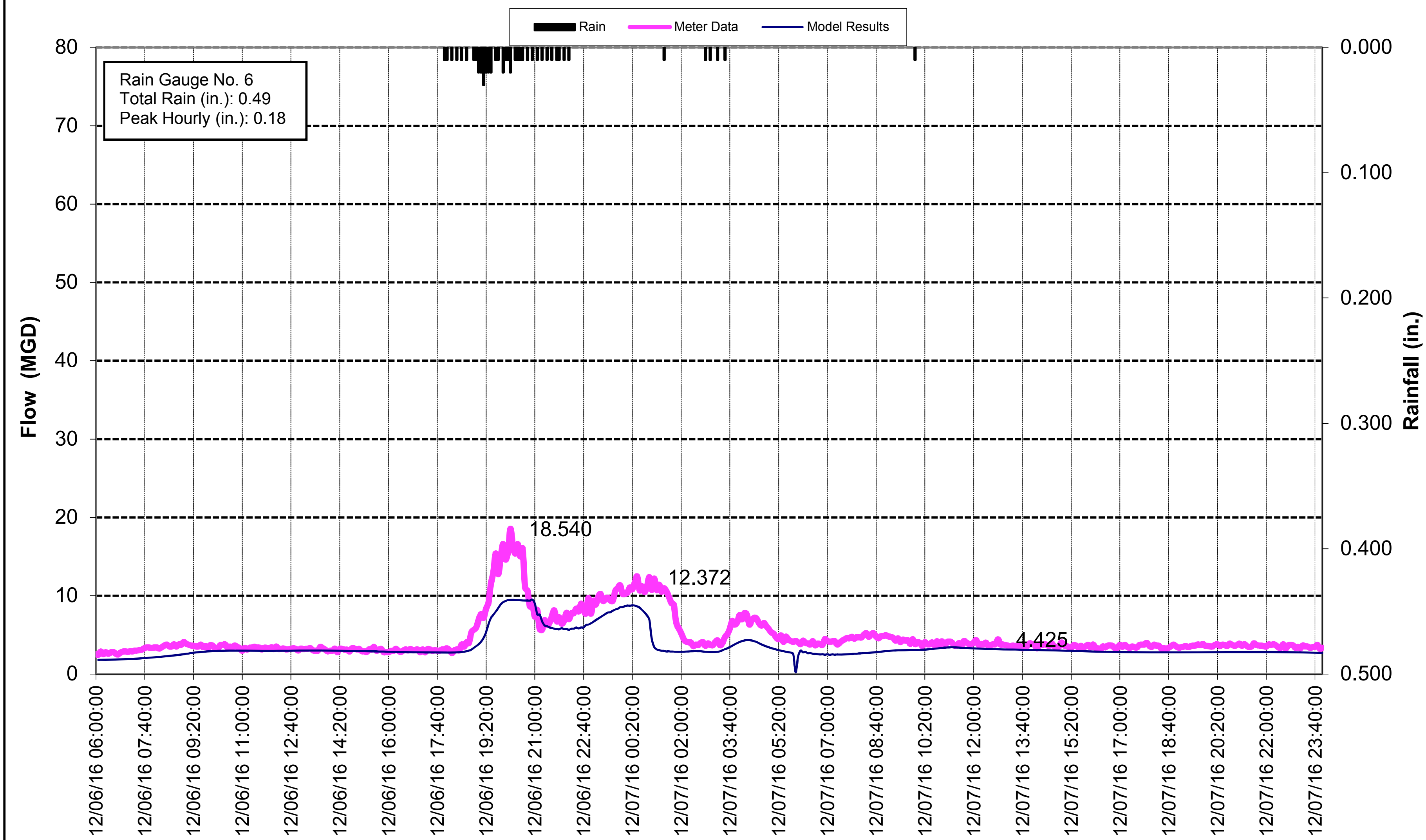
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-12: Flow at Meter 44A
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

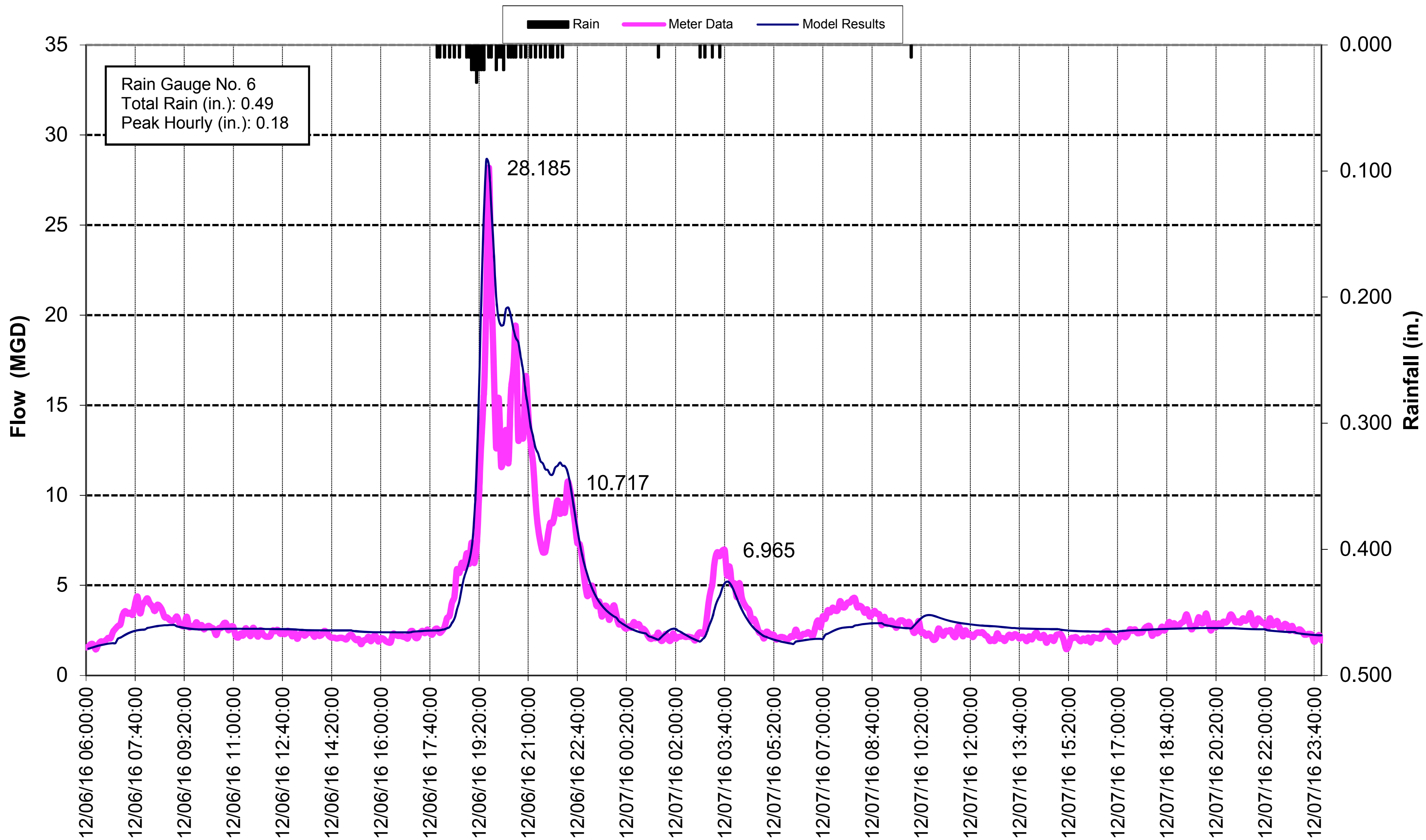
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E4-13: Flow at Meter 54
December 6, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

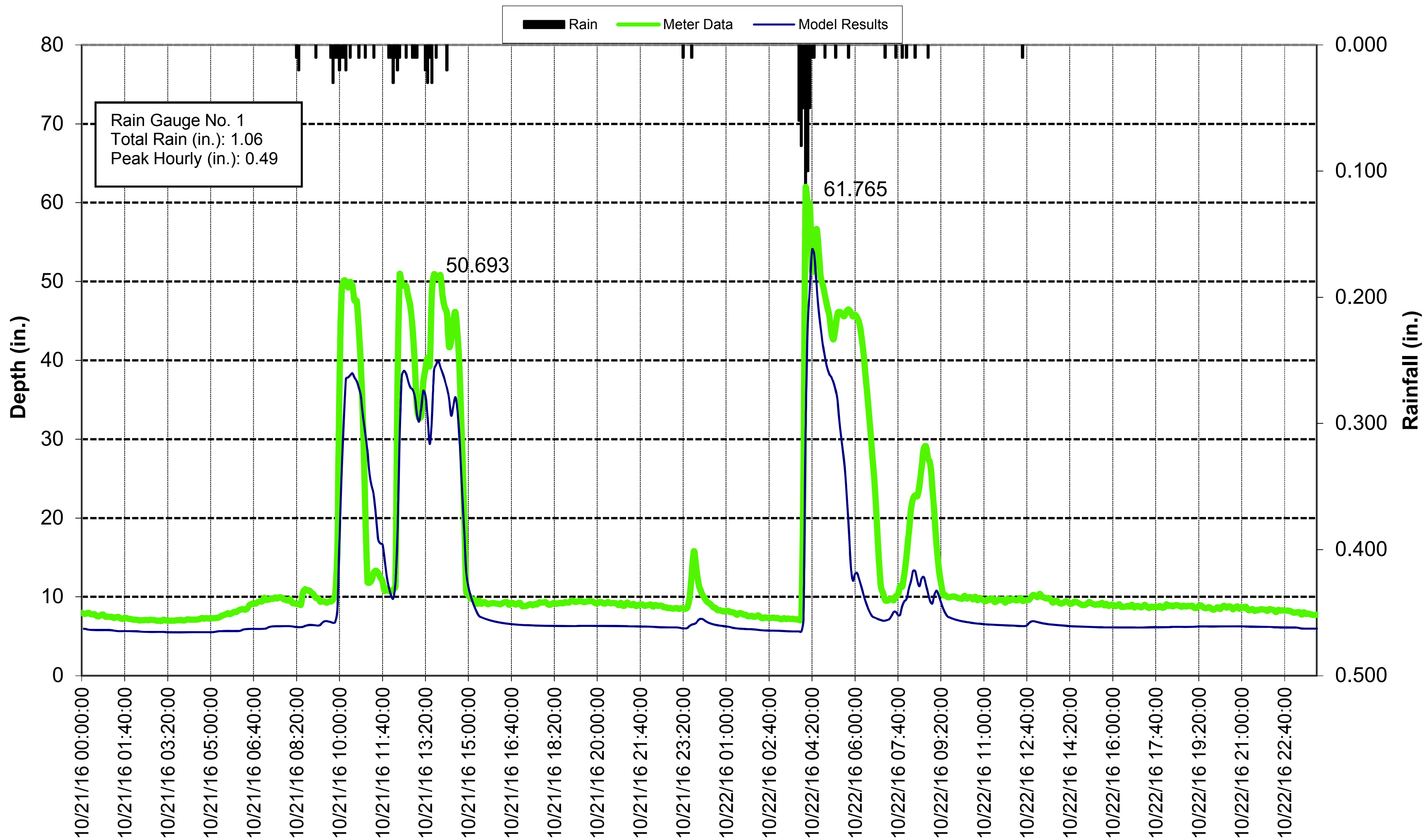
JCMUA Combined Sewer System Modeling Report
Figure E4-14: Flow at Meter 58
December 6, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E5

October 21, 2016 Event Depth Graphs

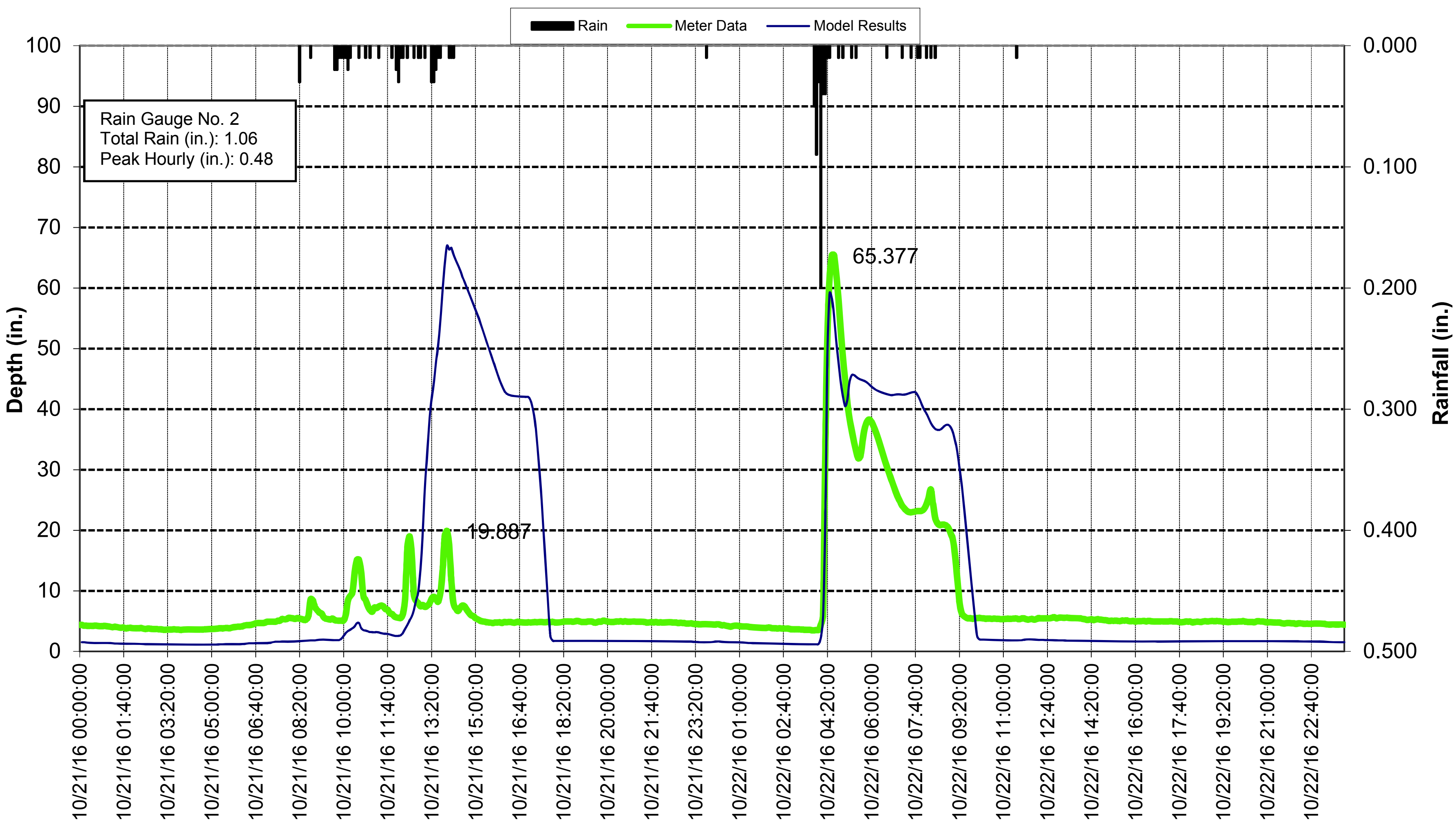
Appendix E5 - October 21, 2016 Event Depth Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-1: Depth at Meter 6
October 21, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

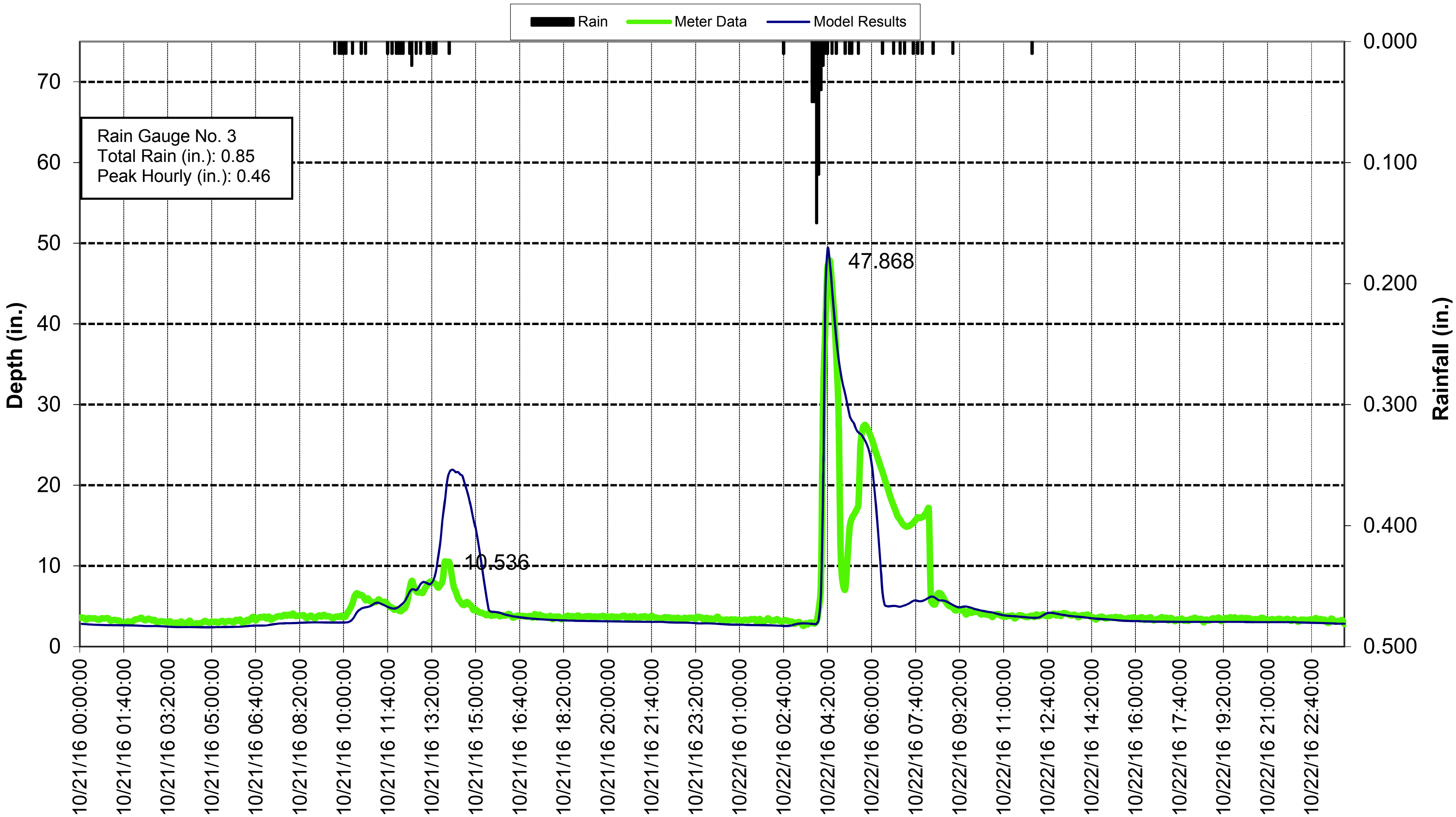
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-2: Depth at Meter 17
October 21, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

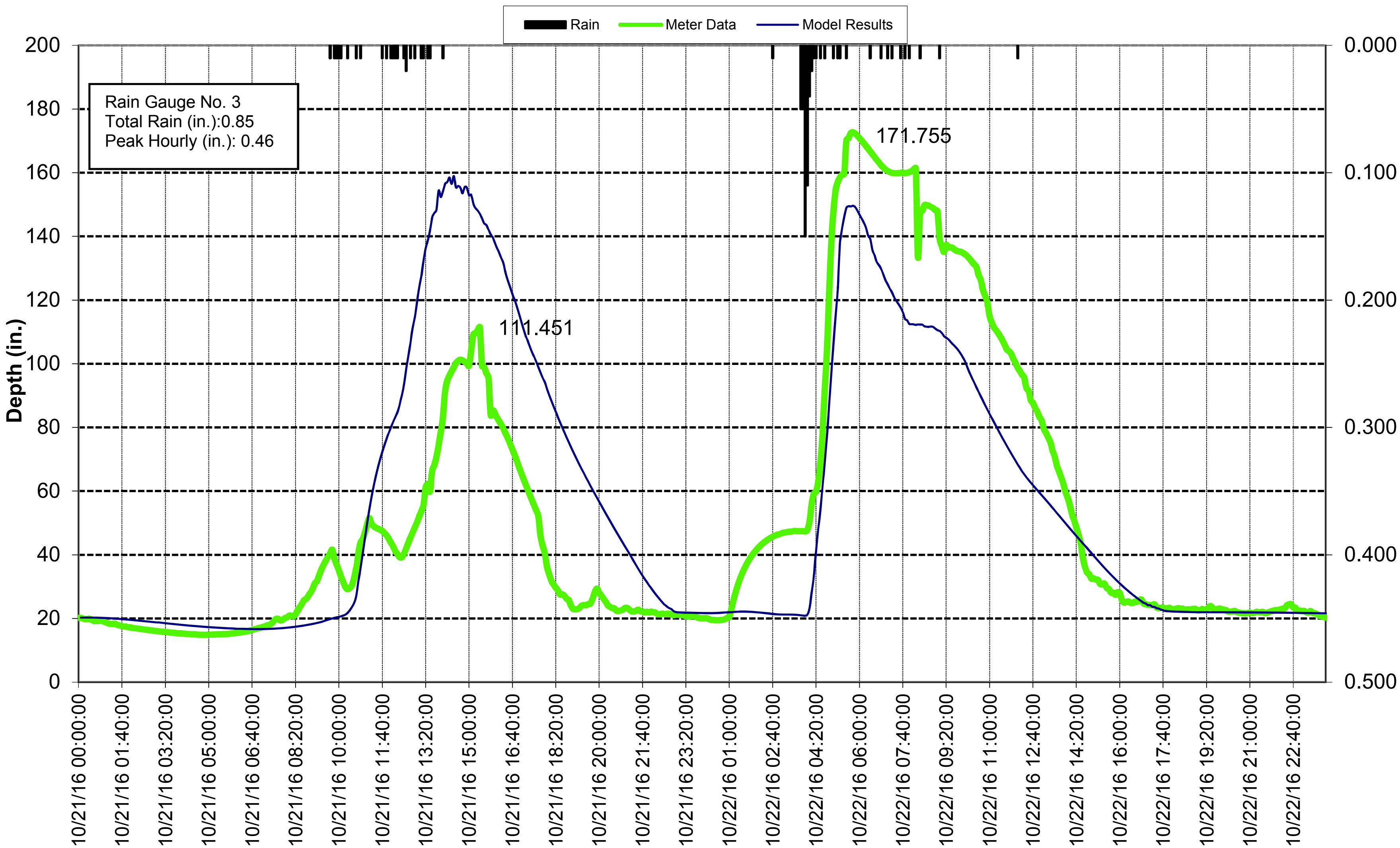
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-3: Depth at Meter 27
October 21, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

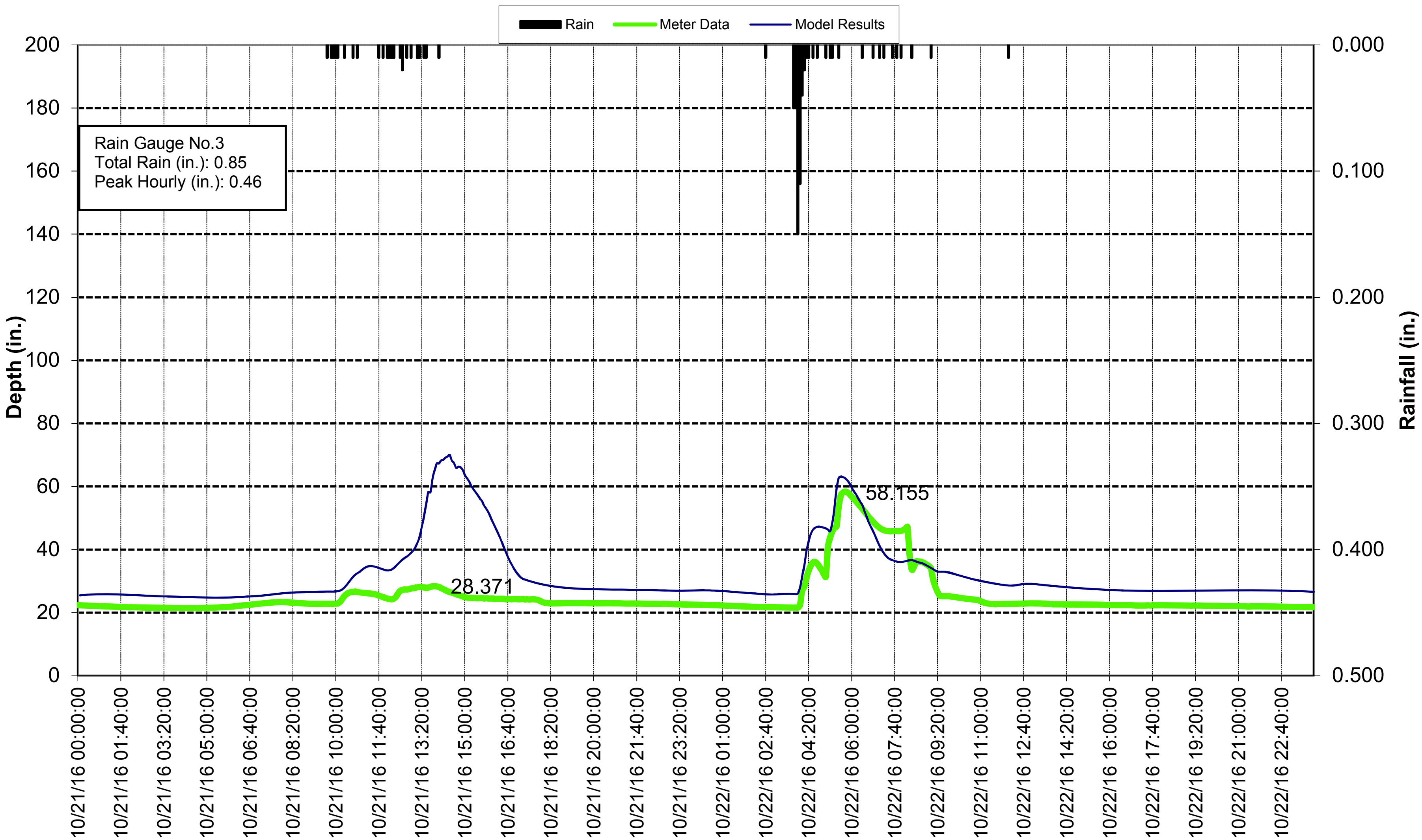
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-4: Depth at Meter 28
October 21, 2016 Storm Event
Total Northwest Interceptor Flow

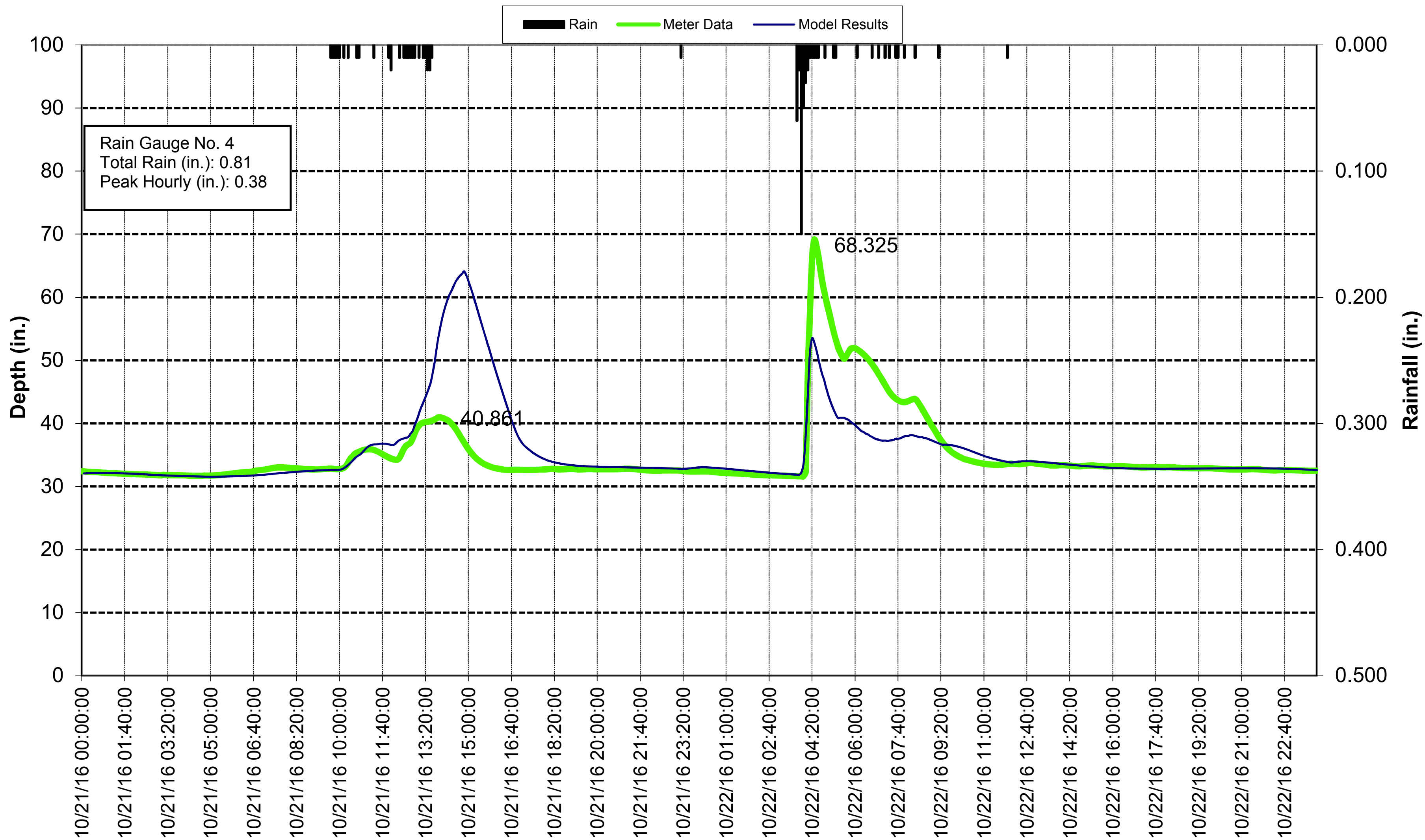
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-5: Depth at Meter 29
October 21, 2016 Storm Event
Total Southwest Interceptor Flow

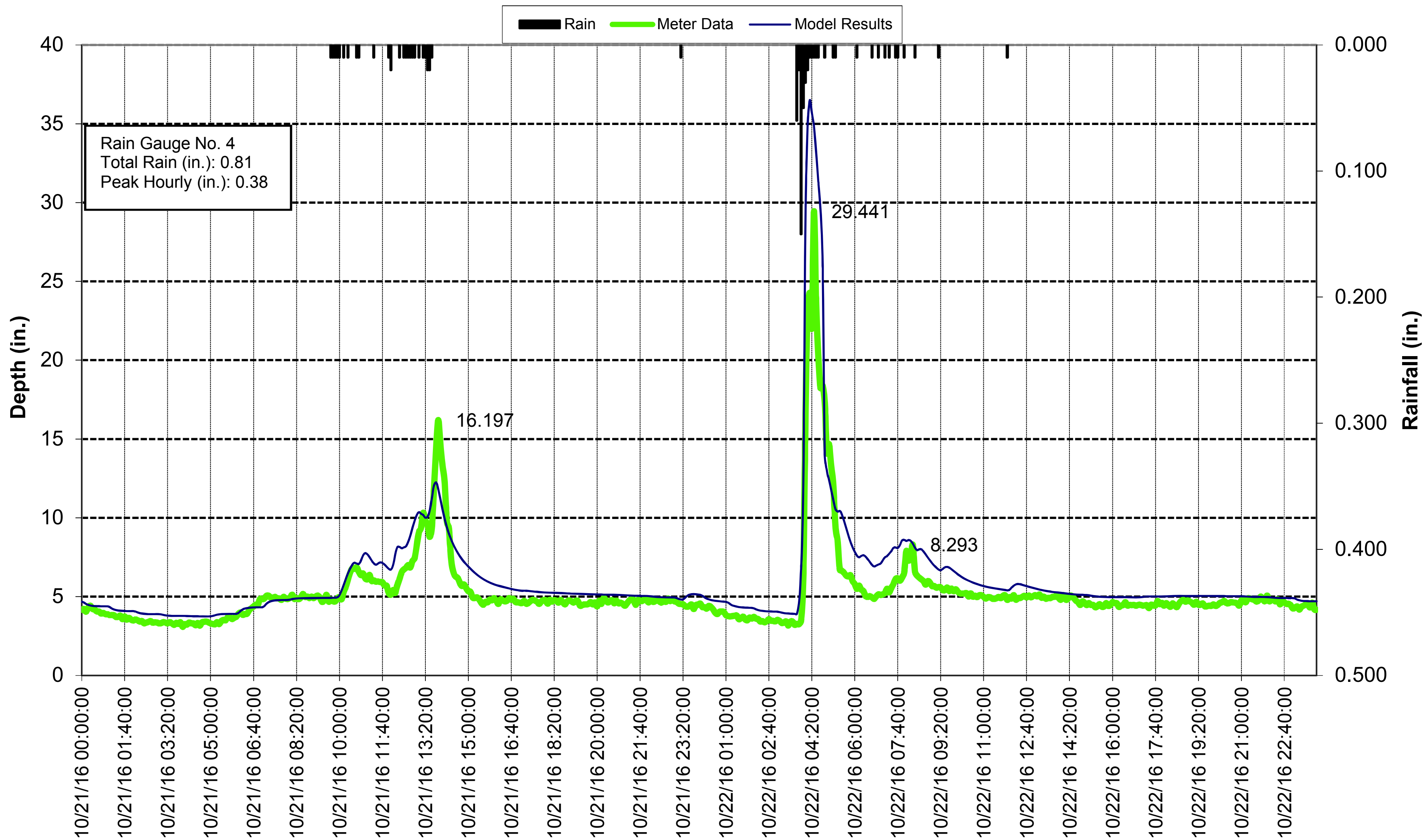
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-6: Depth at Meter 32
October 21, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

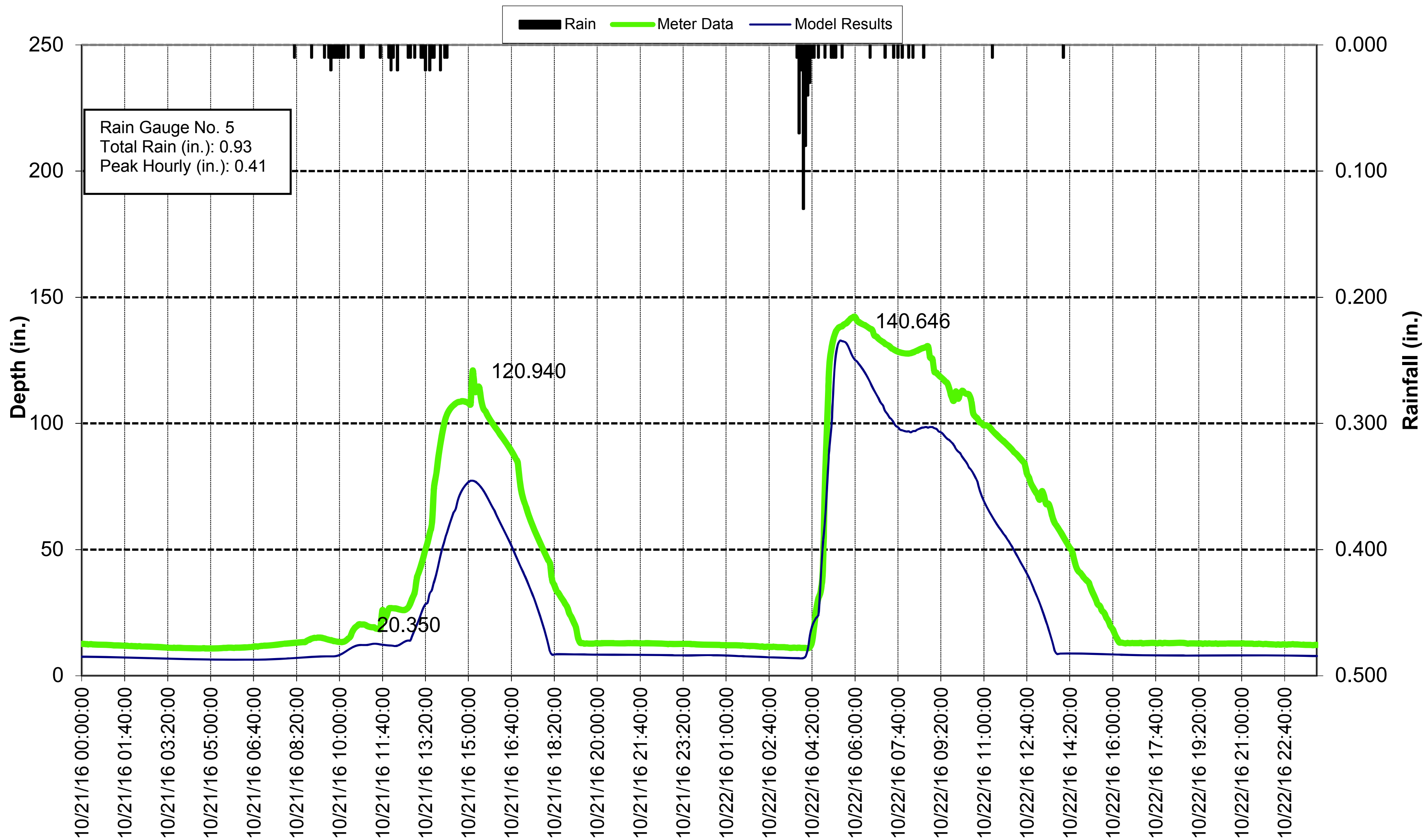
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-7: Depth at Meter 33
October 21, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

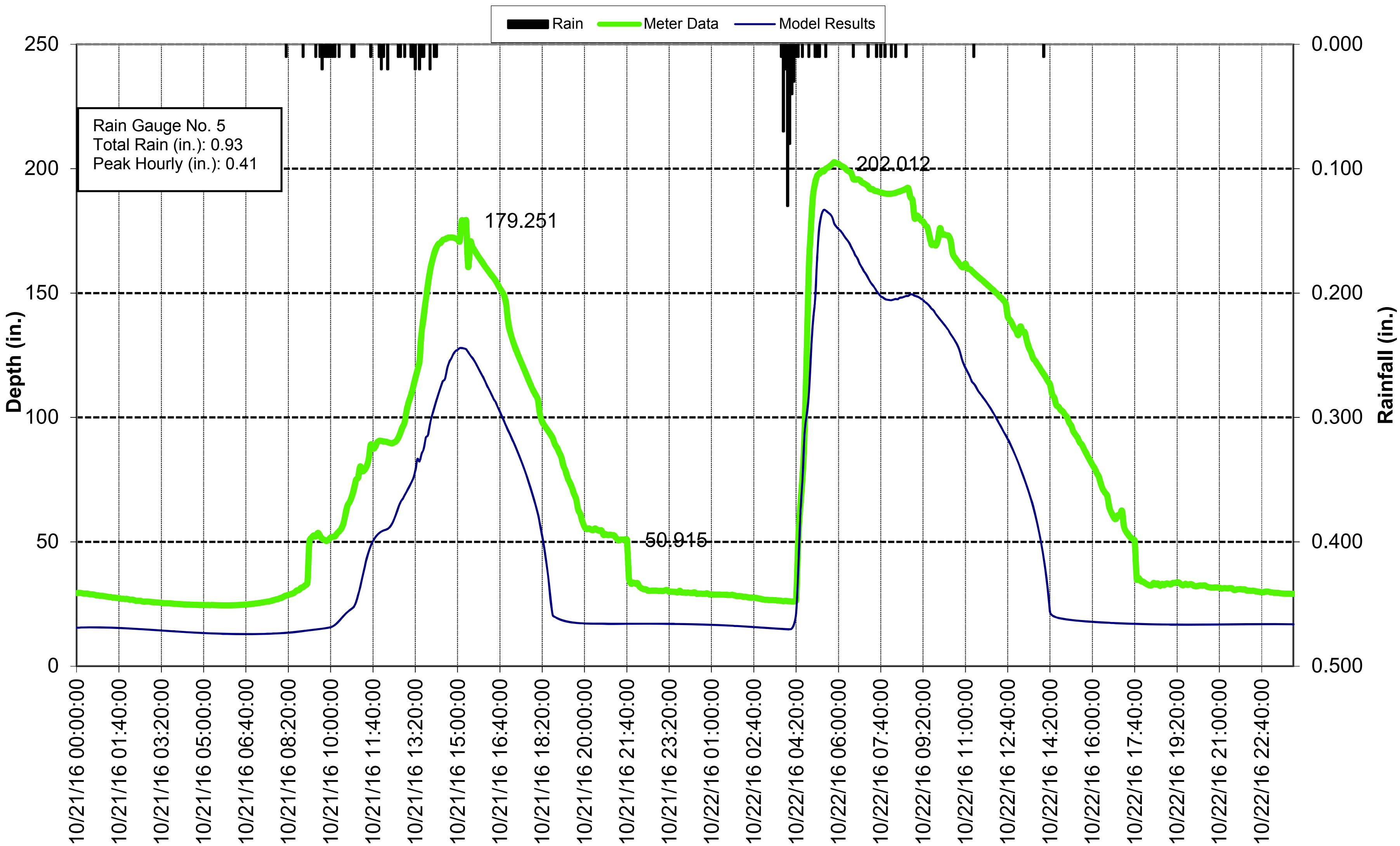
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-8: Depth at Meter 40
October 21, 2016 Storm Event
Total Southeast Interceptor Flow

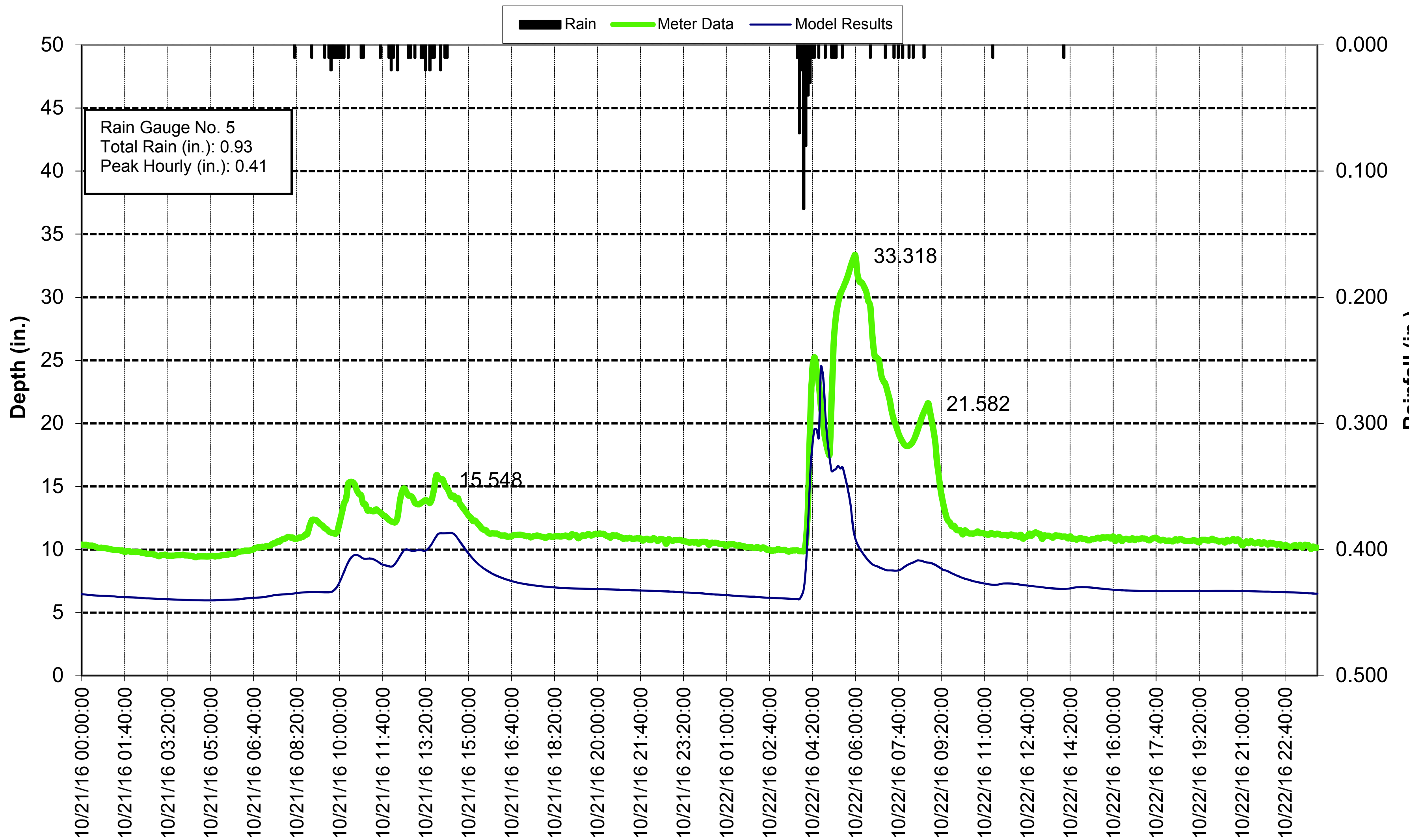
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-9: Depth at Meter 41
October 21, 2016 Storm Event
Total Northeast Interceptor Flow

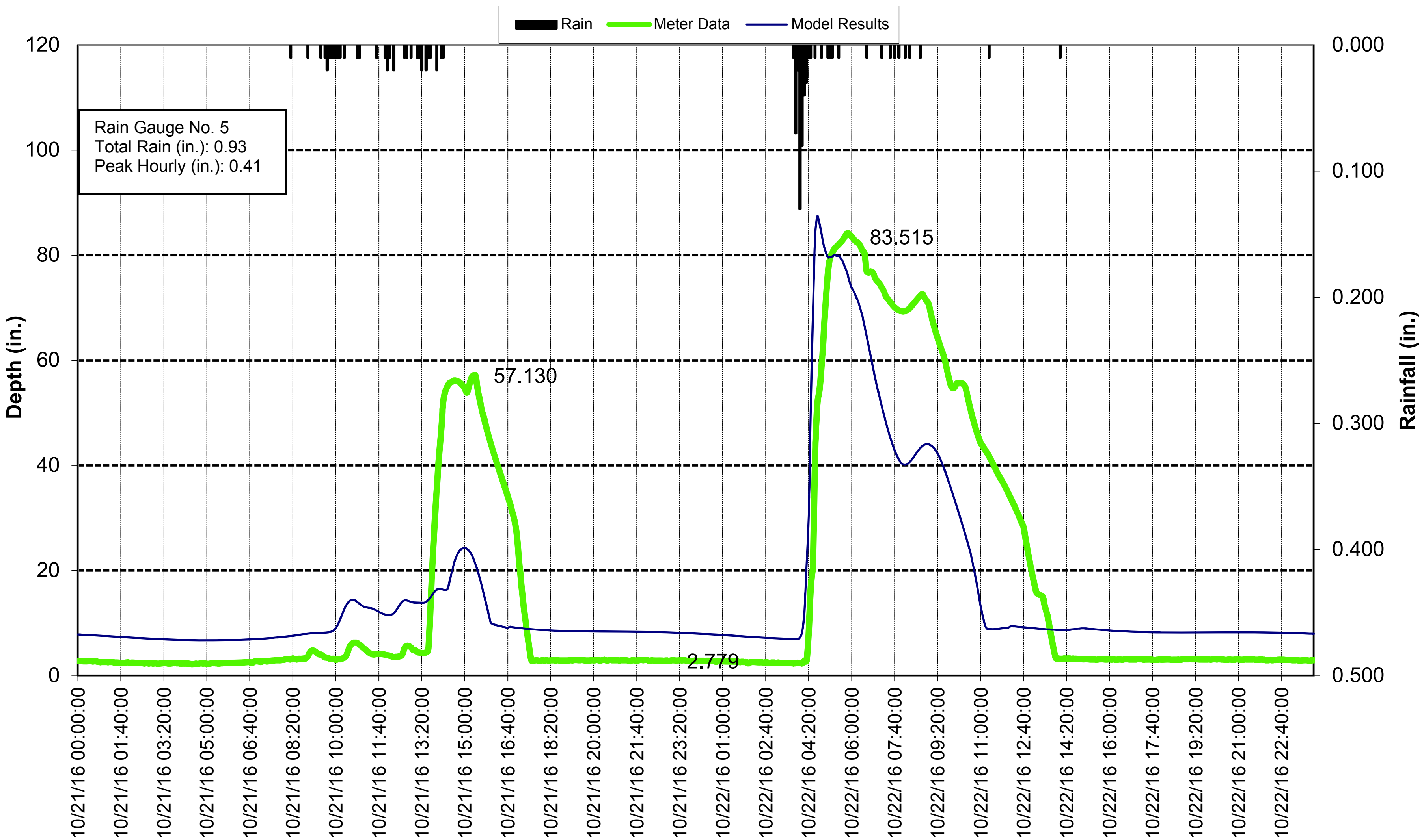
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-10: Depth at Meter 42
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

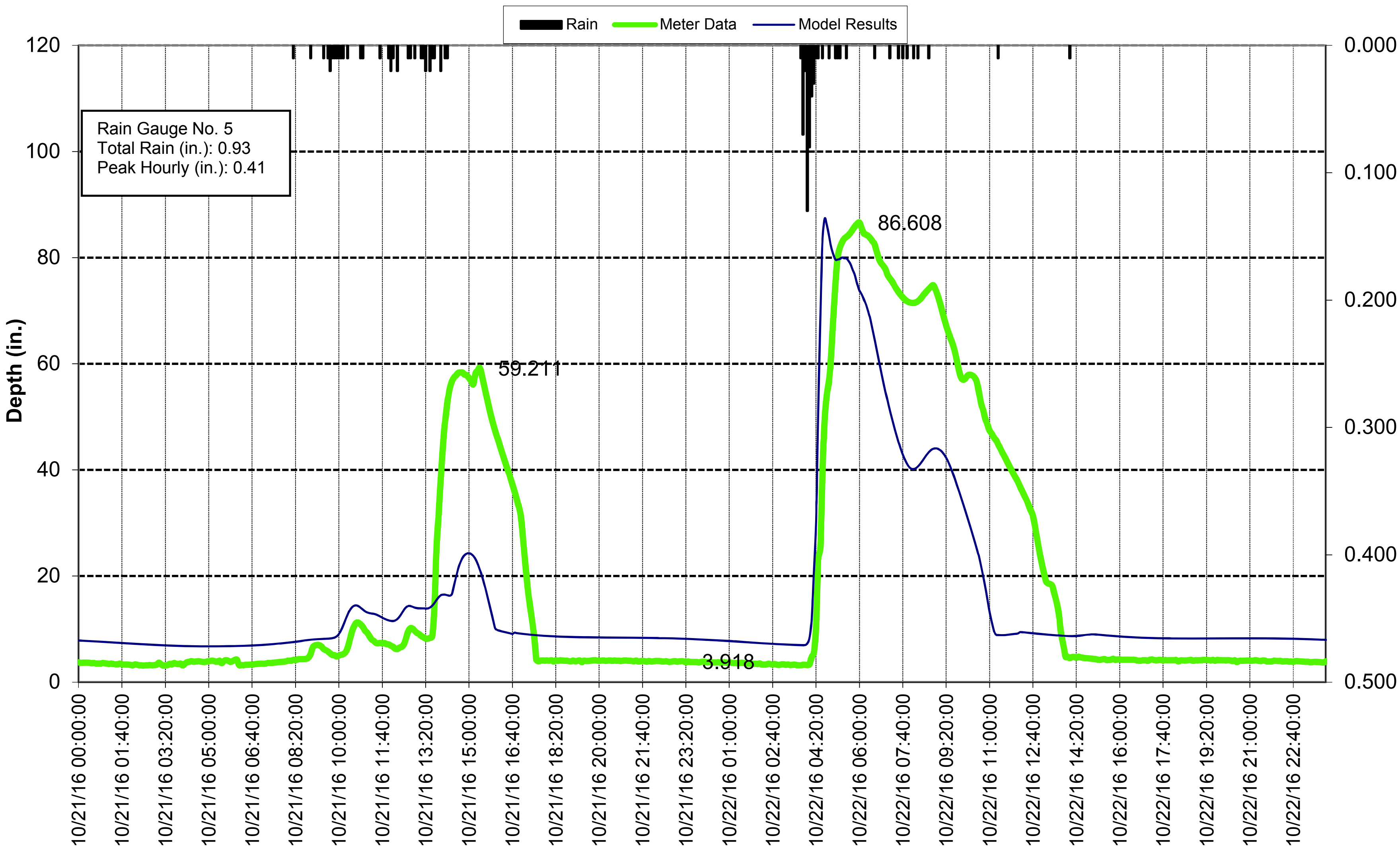
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-11: Depth at Meter 43
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

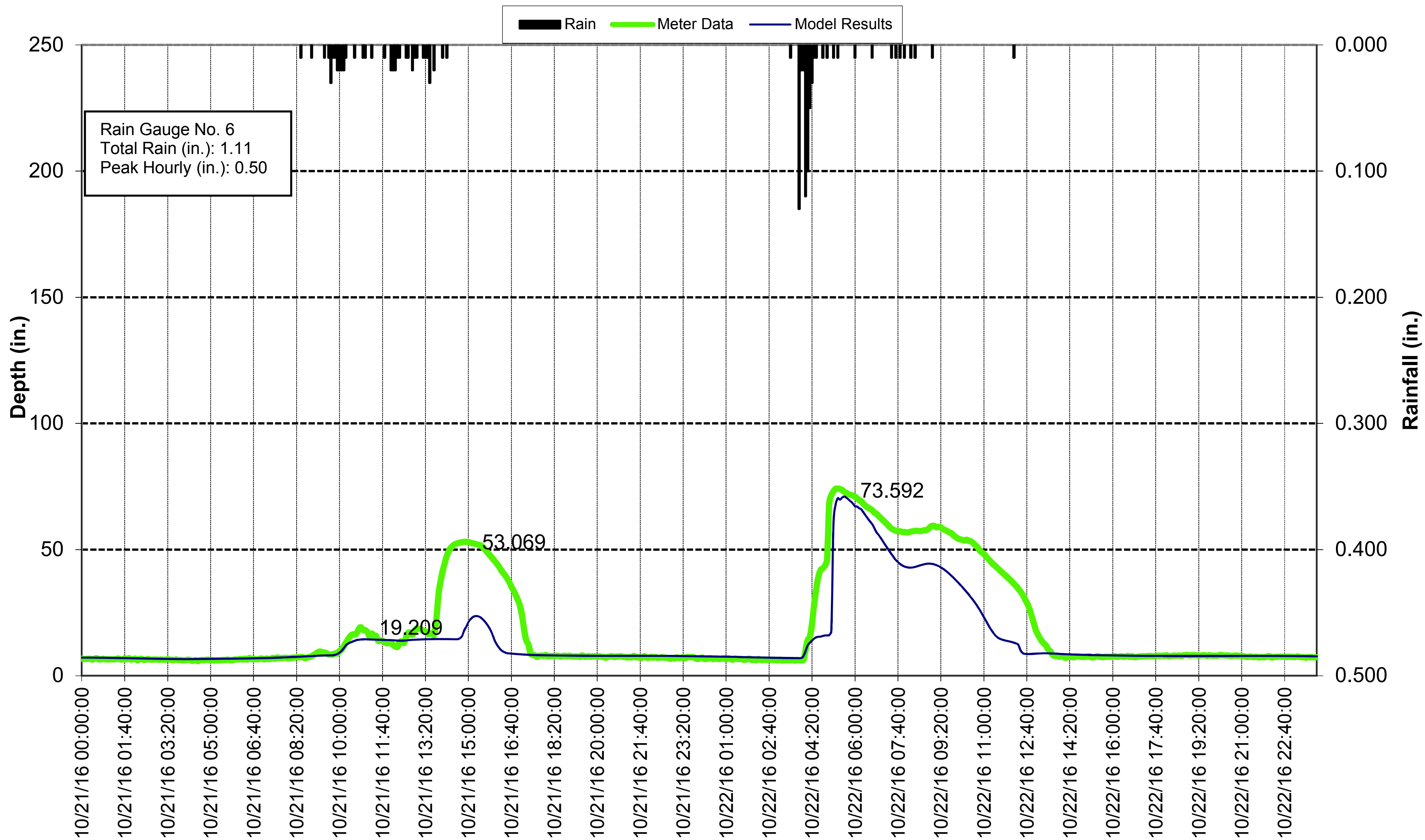
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-12: Depth at Meter 44
October 21, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

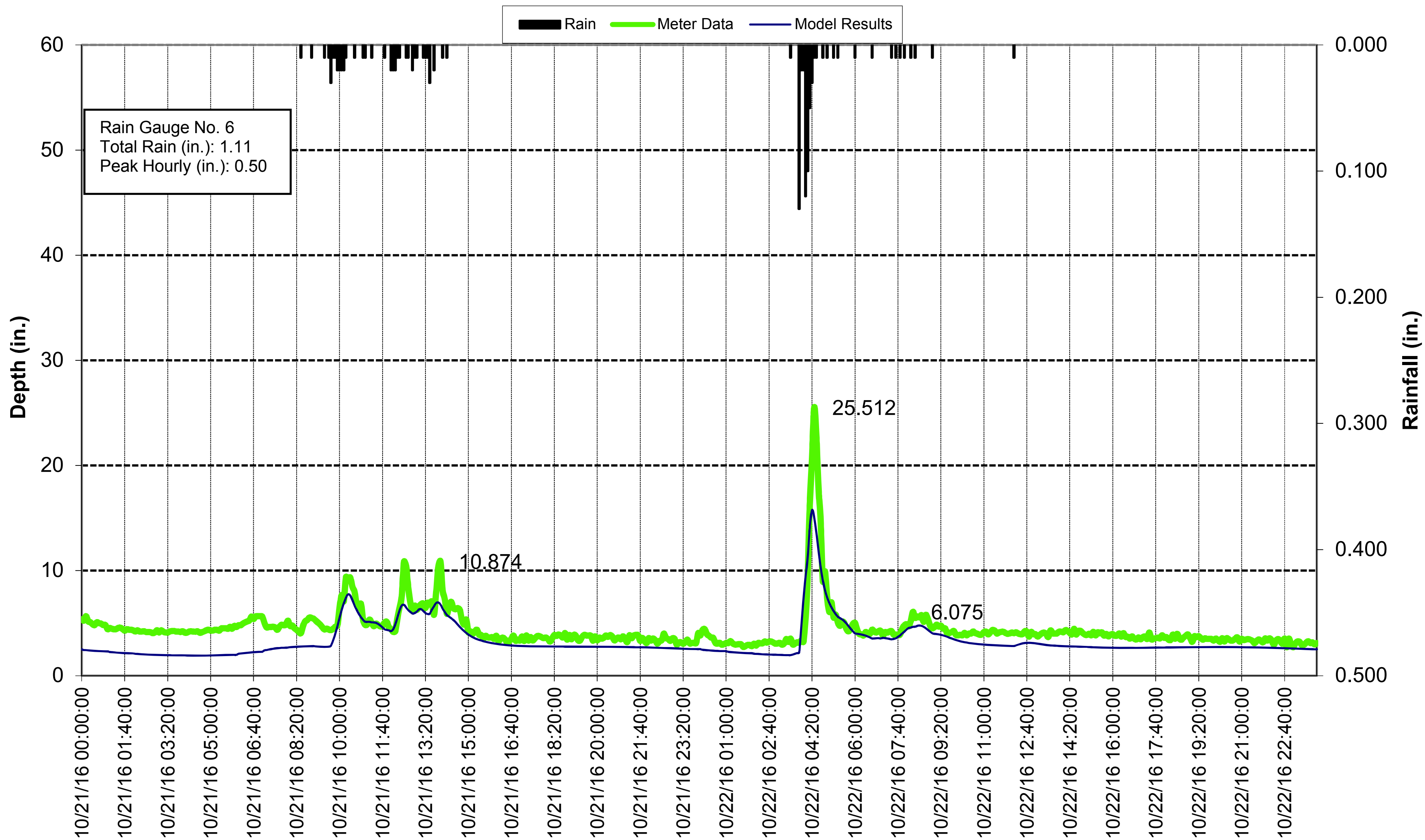
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E5-13: Depth at Meter 54
October 21, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

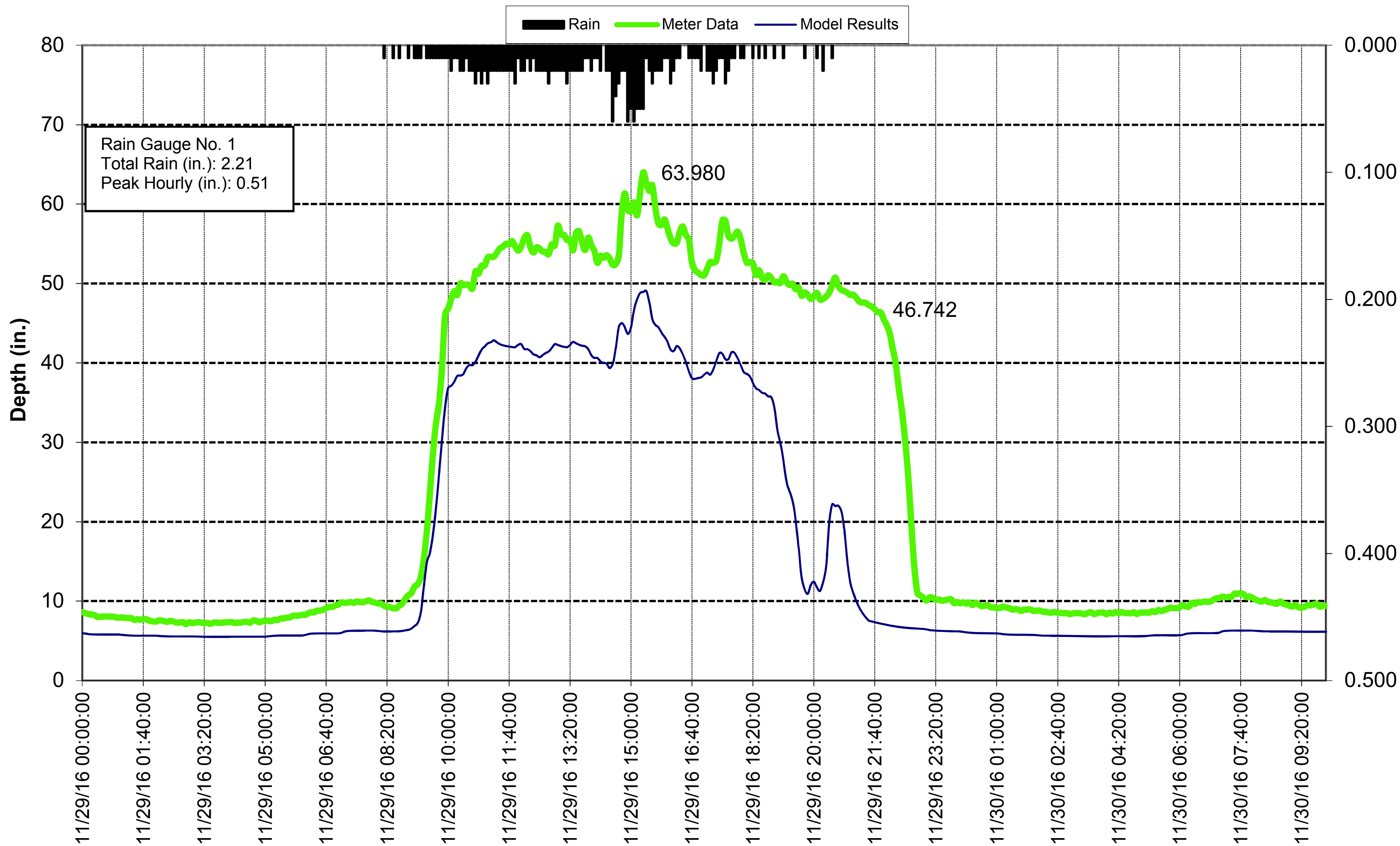
JCMUA Combined Sewer System Modeling Report
Figure E5-14: Depth at Meter 58
October 21, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E6

November 29, 2016 Event Depth Graphs

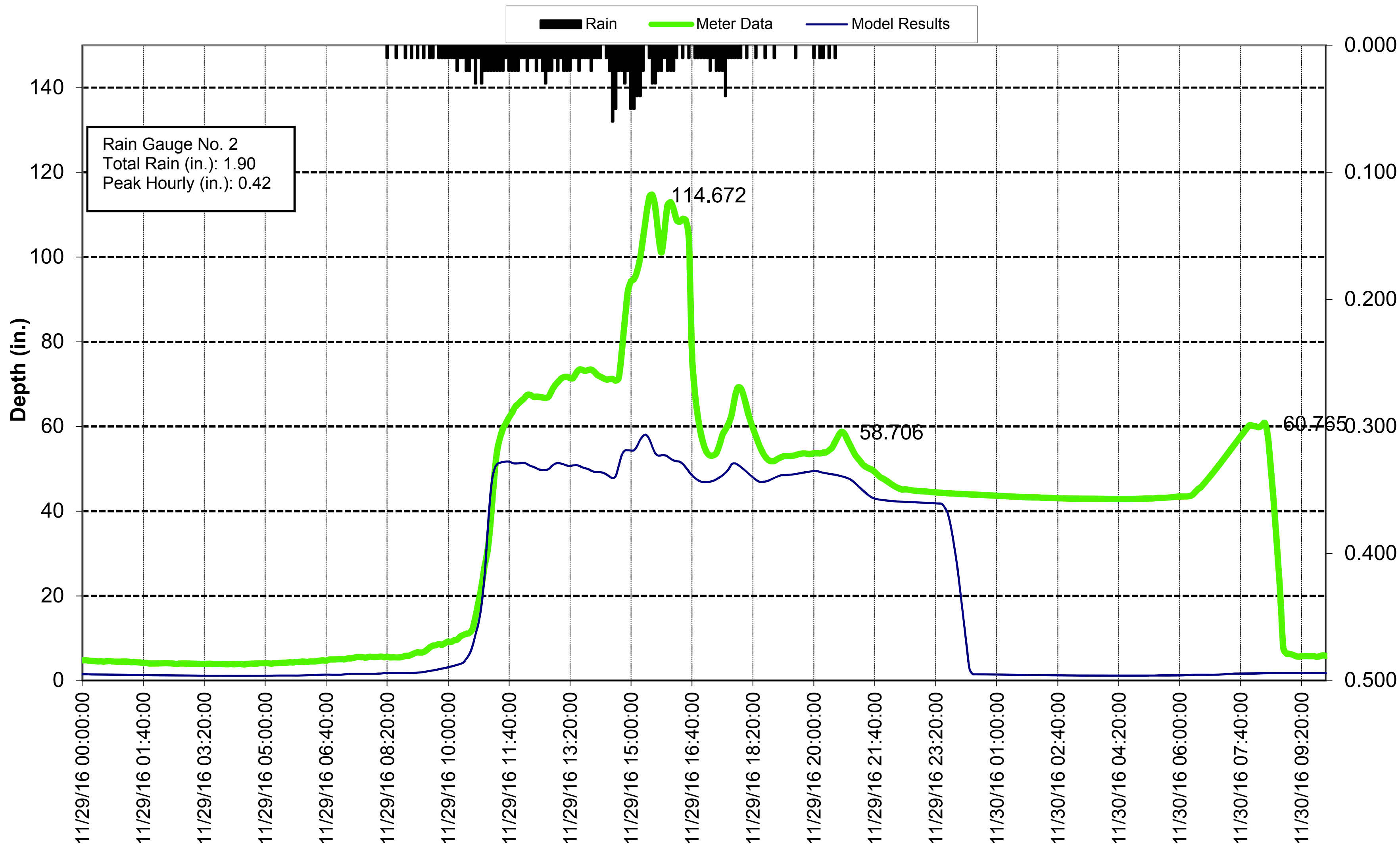
Appendix E6 - November 29, 2016 Event Depth Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-1: Depth at Meter 6
November 29, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

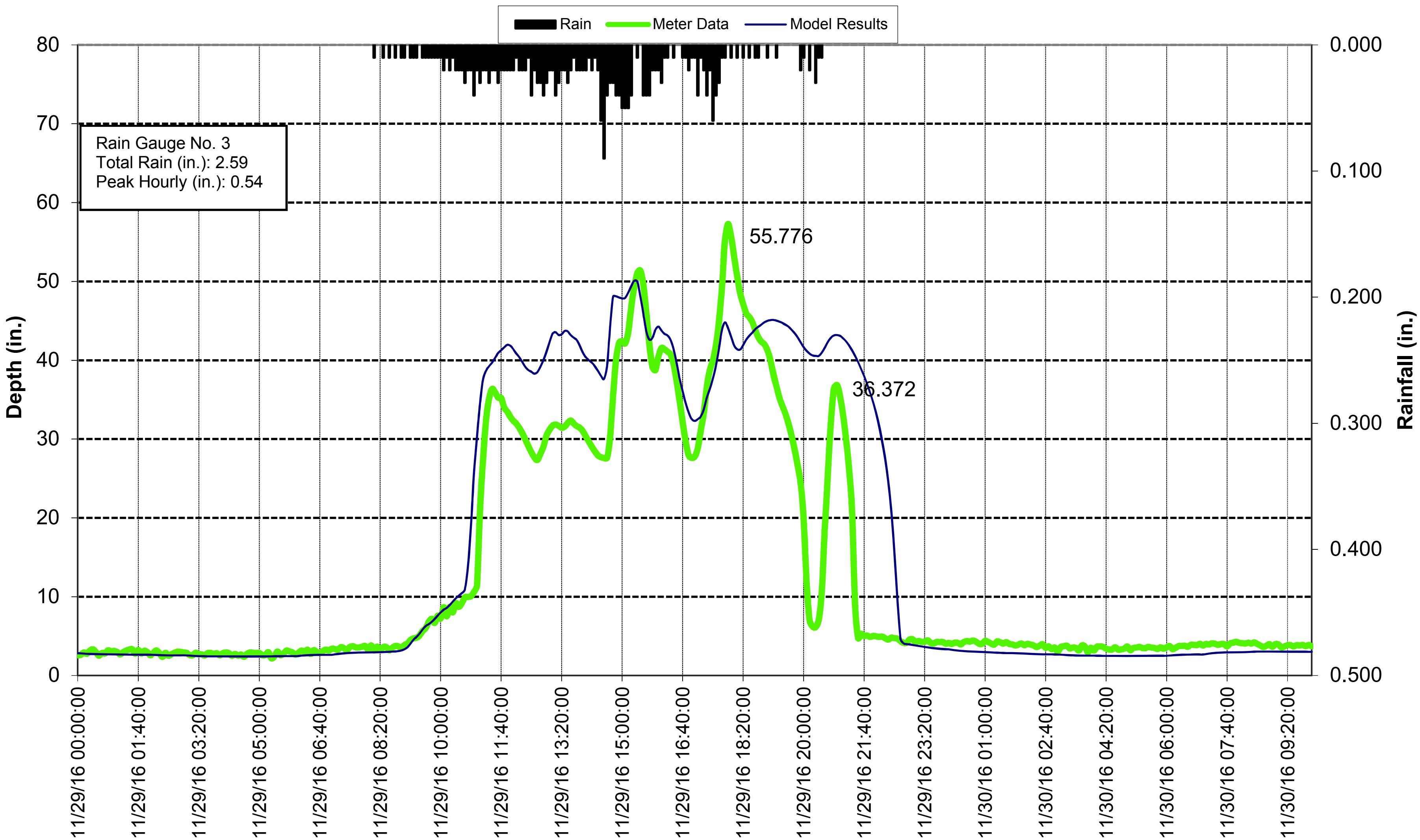
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-2: Depth at Meter 17
November 29, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

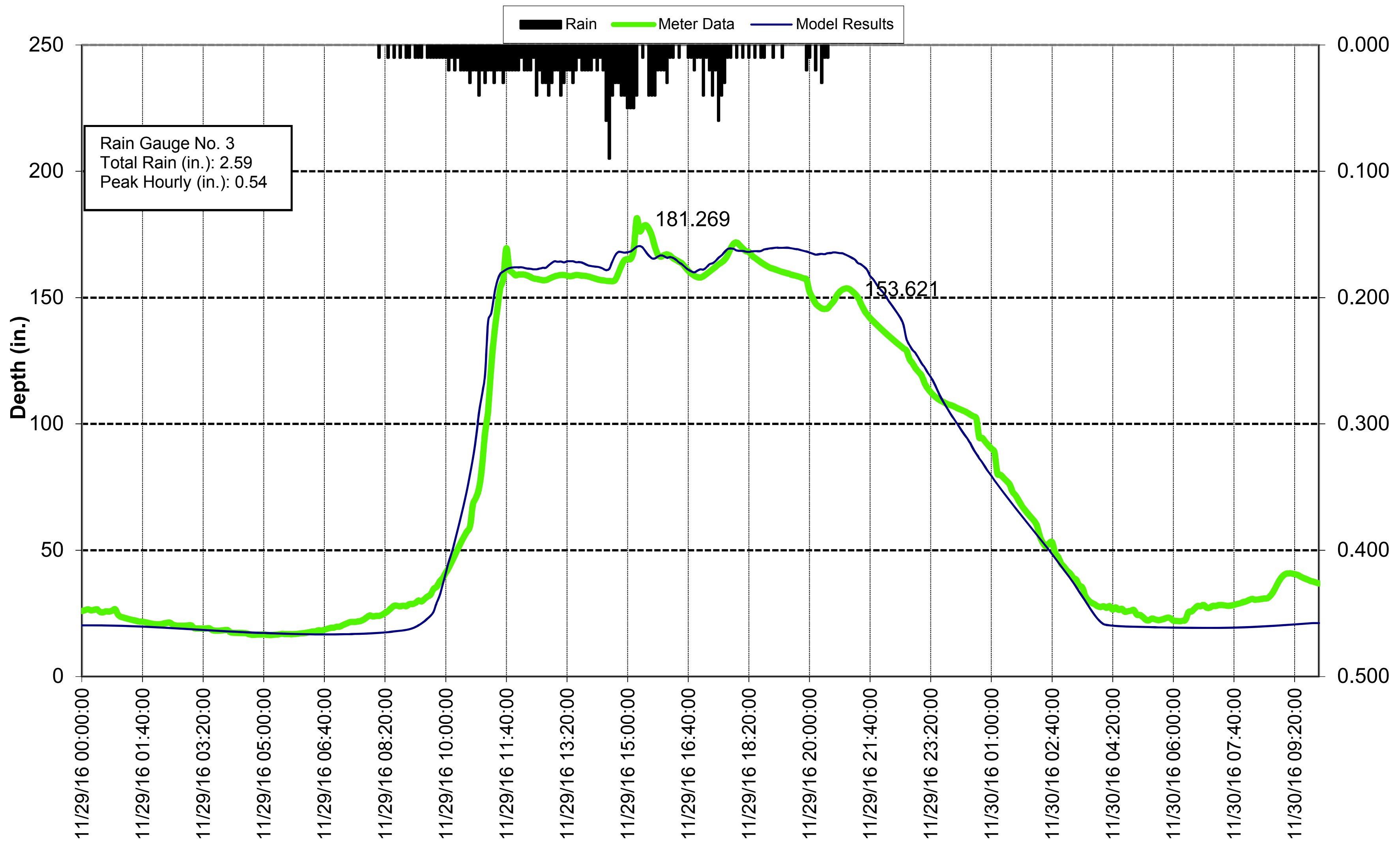
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-3: Depth at Meter 27
November 29, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

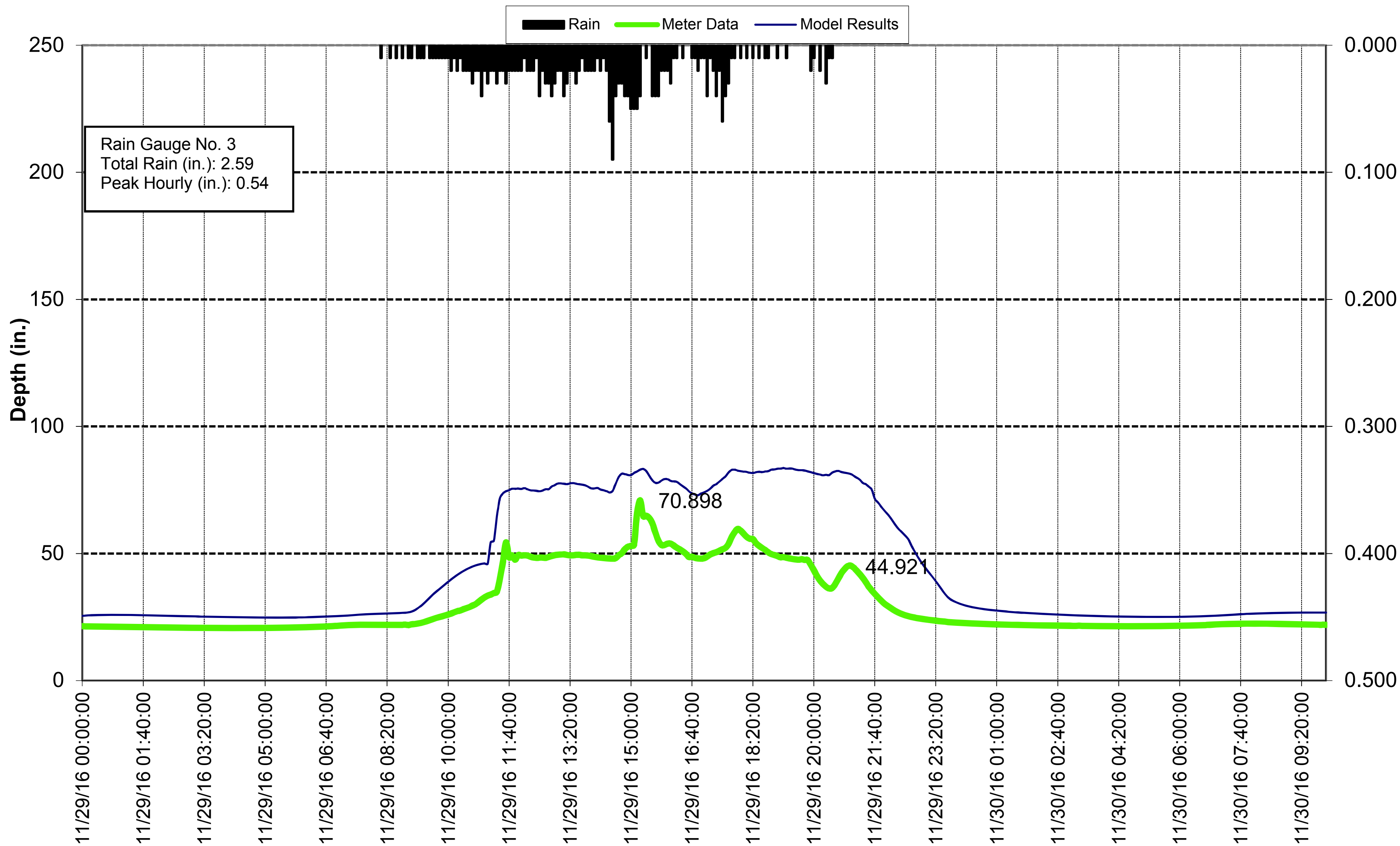
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-4: Depth at Meter 28
November 29, 2016 Storm Event
Total Northwest Interceptor Flow

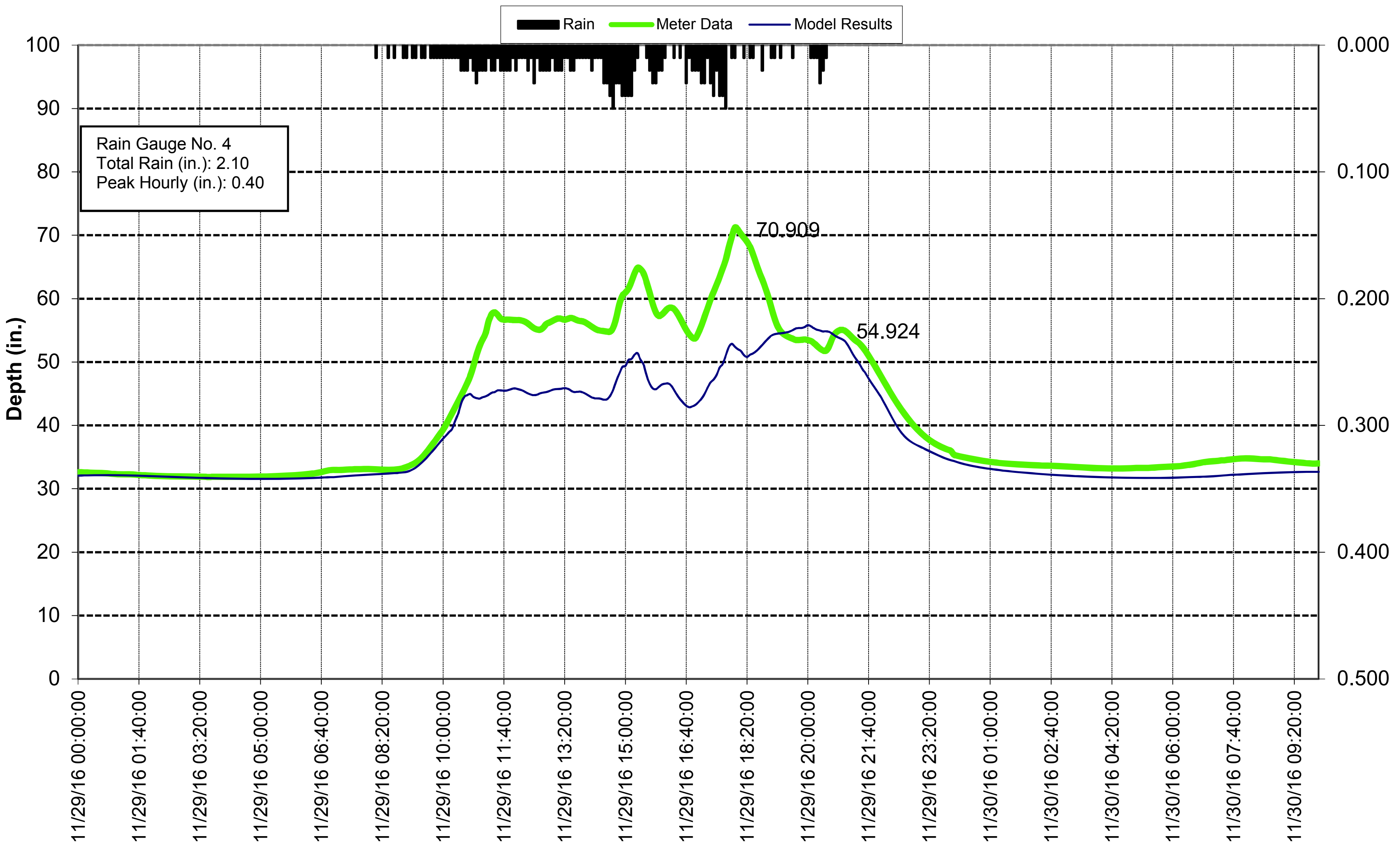
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-5: Depth at Meter 29
November 29, 2016 Storm Event
Total Southwest Interceptor Flow

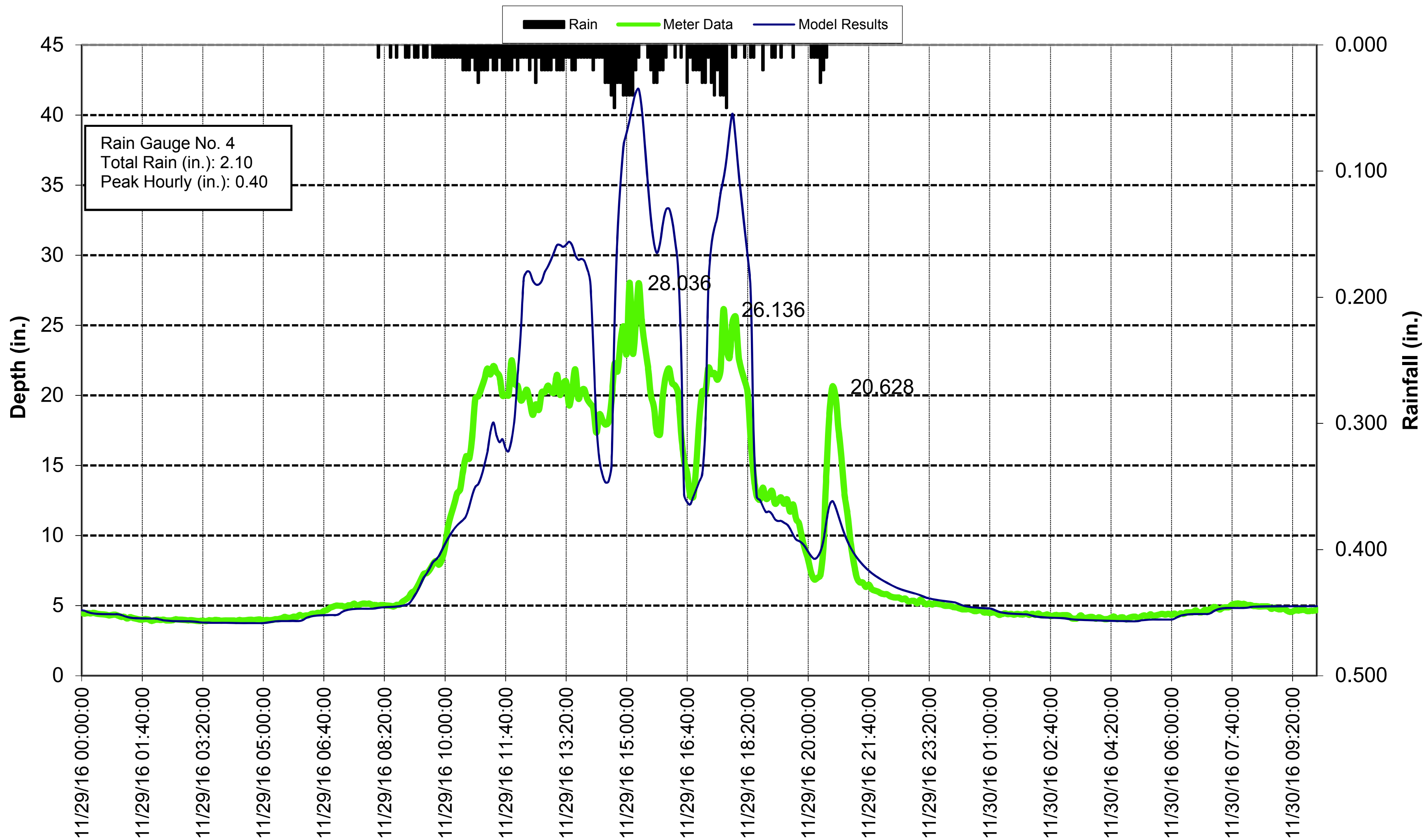
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-6: Depth at Meter 32
November 29, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

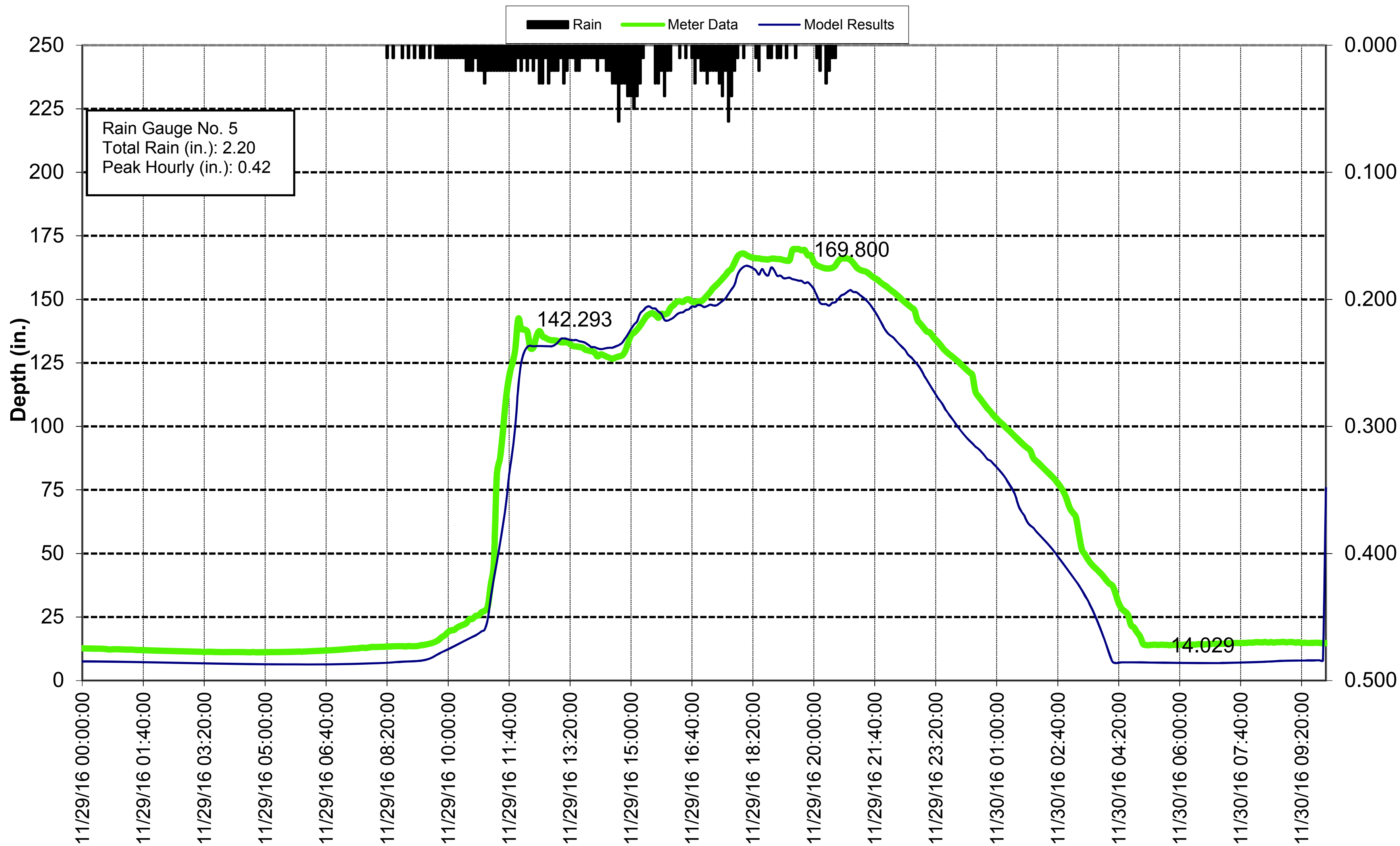
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-7: Depth at Meter 33
November 29, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

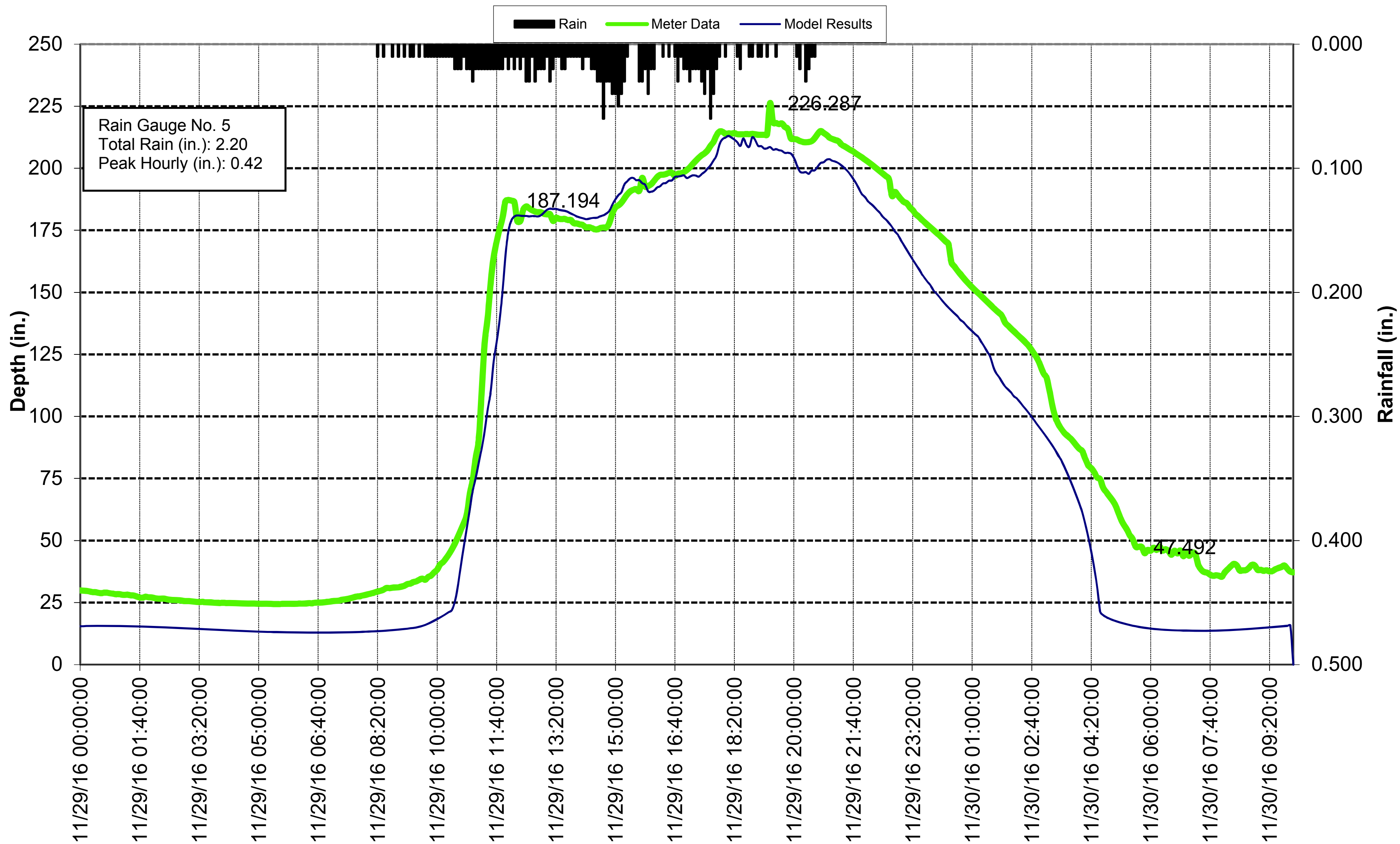
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-8: Depth at Meter 40
November 29, 2016 Storm Event
Total Southeast Interceptor Flow

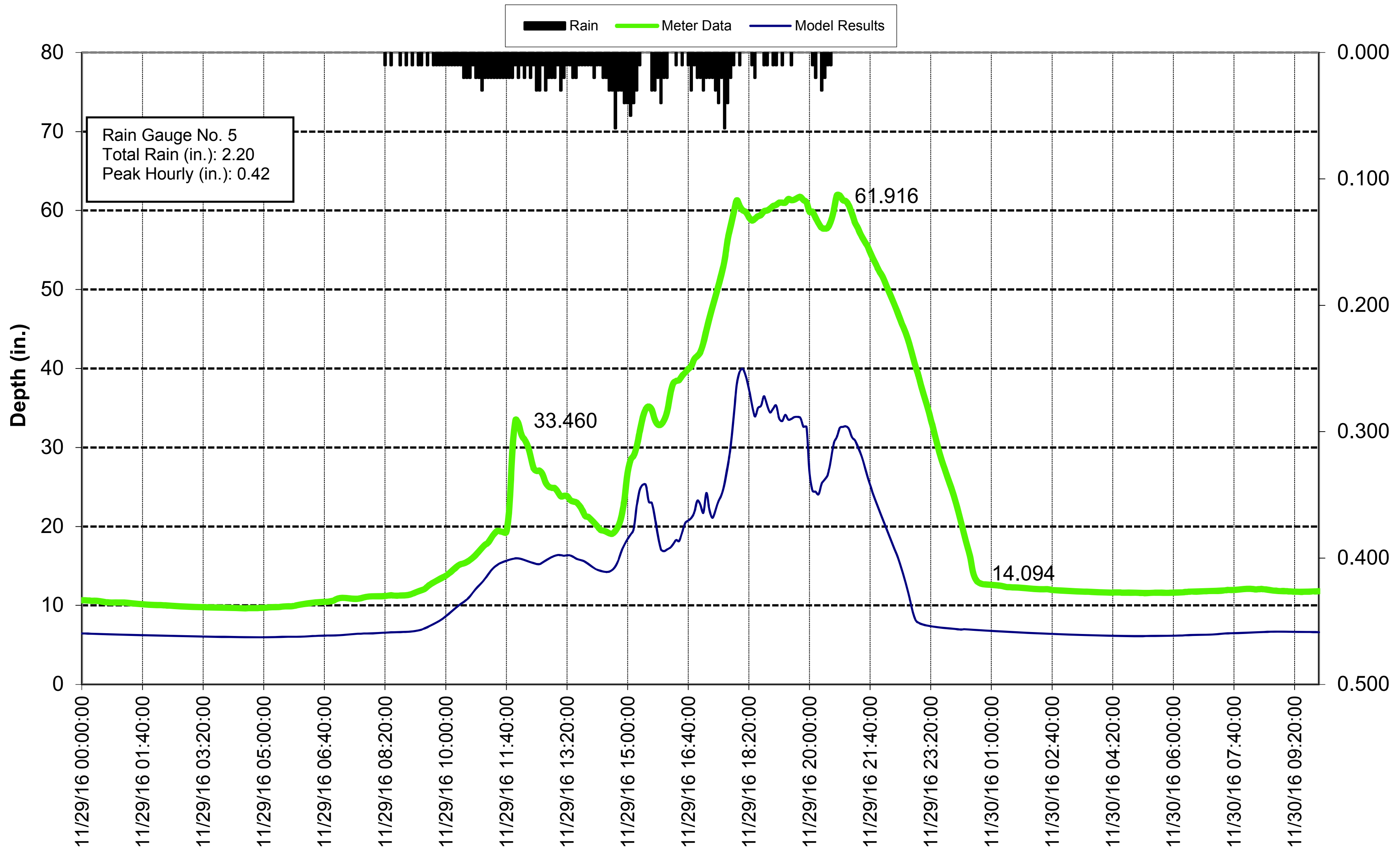
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-9: Depth at Meter 41
November 29, 2016 Storm Event
Total Northeast Interceptor Flow

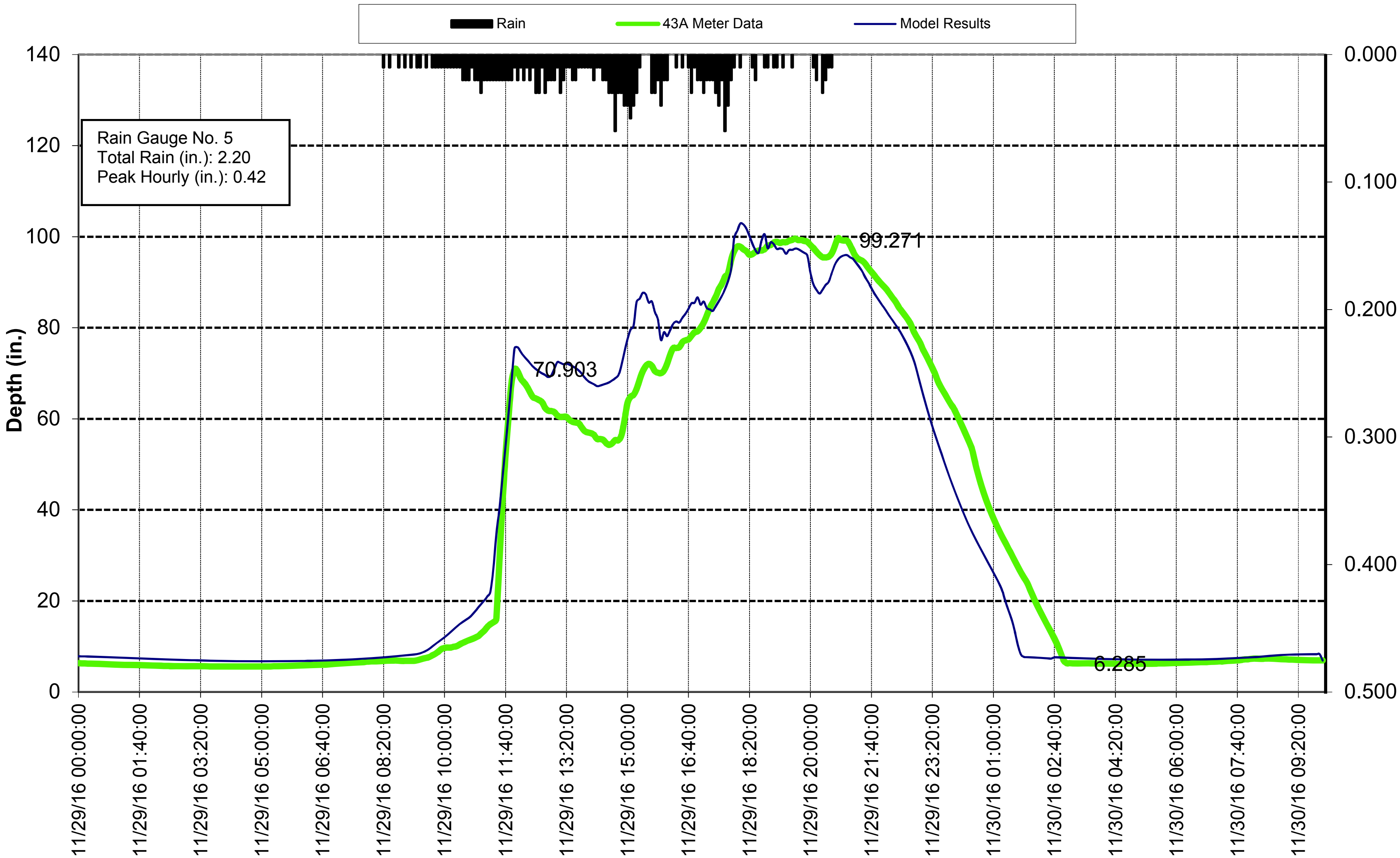
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-10: Depth at Meter 42
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

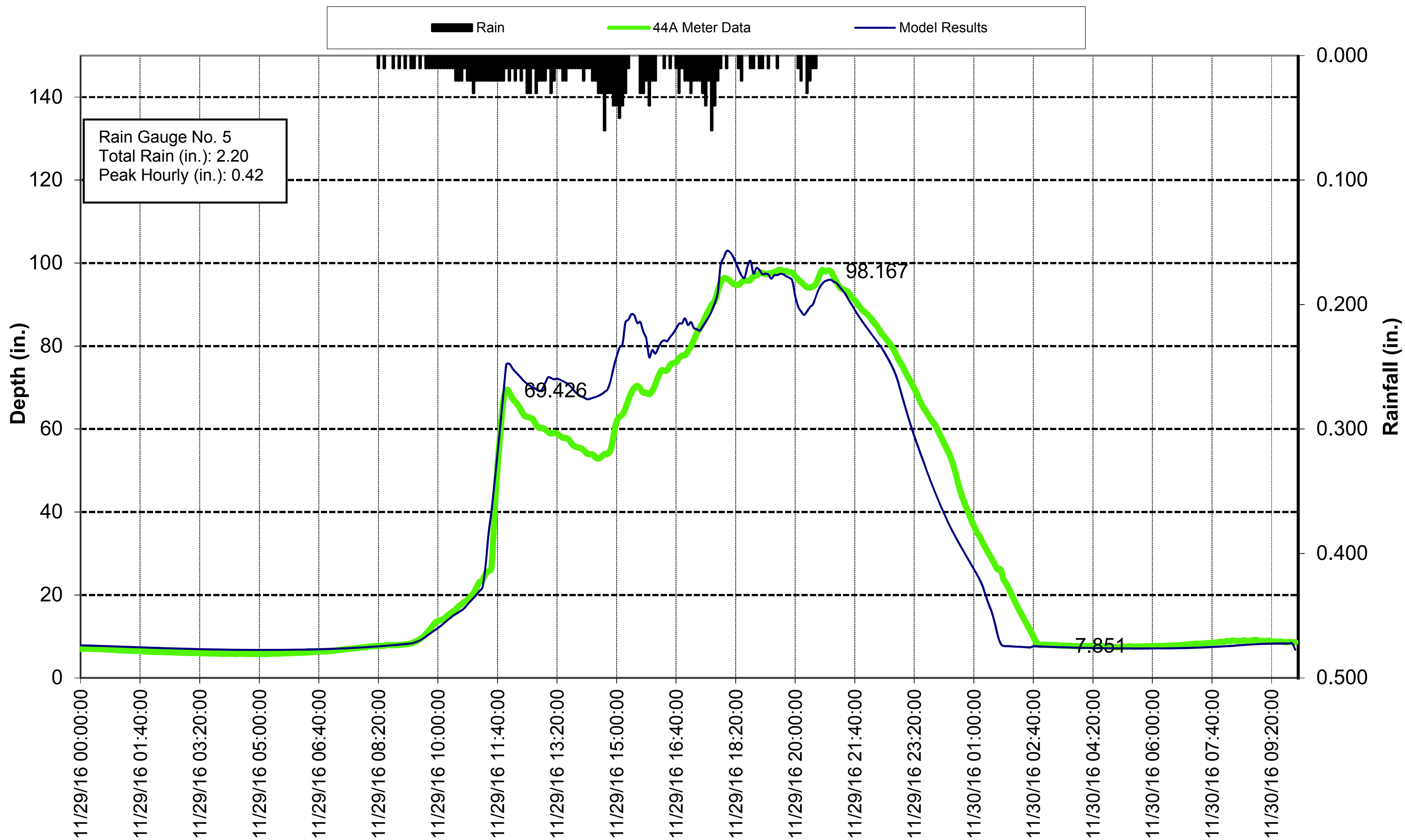
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-11: Depth at Meter 43A
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

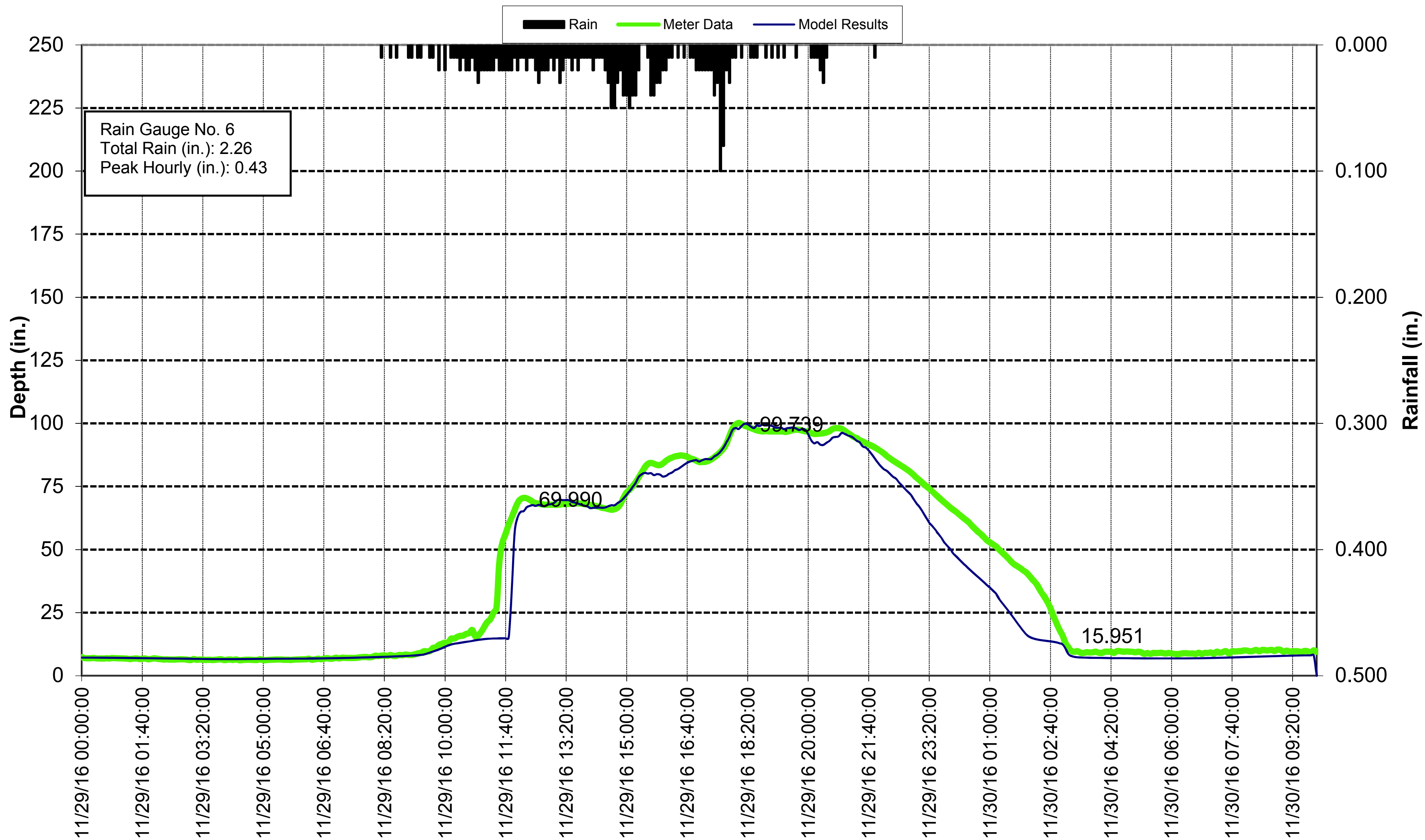
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-12: Depth at Meter 44A
November 29, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

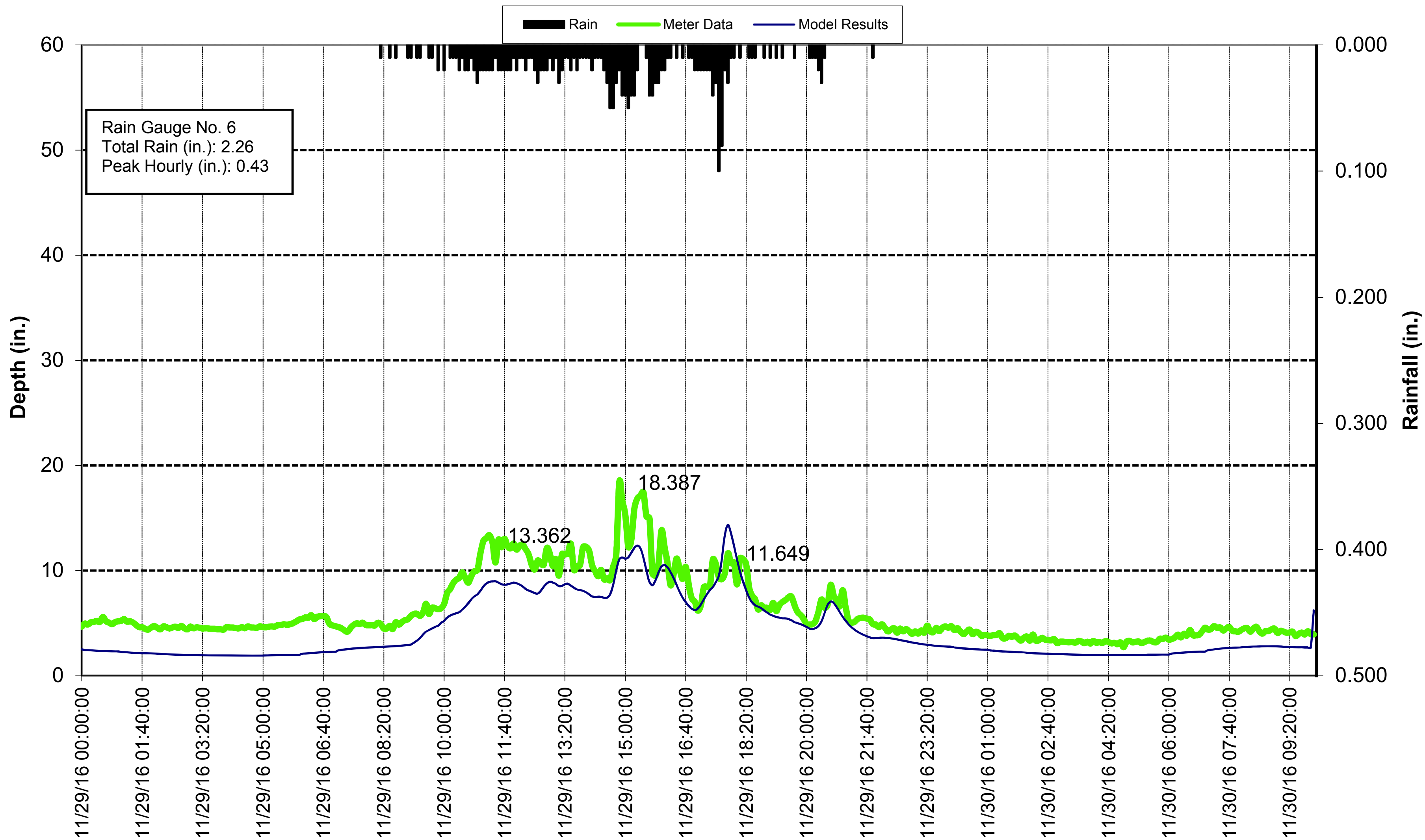
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E6-13: Depth at Meter 54
November 29, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

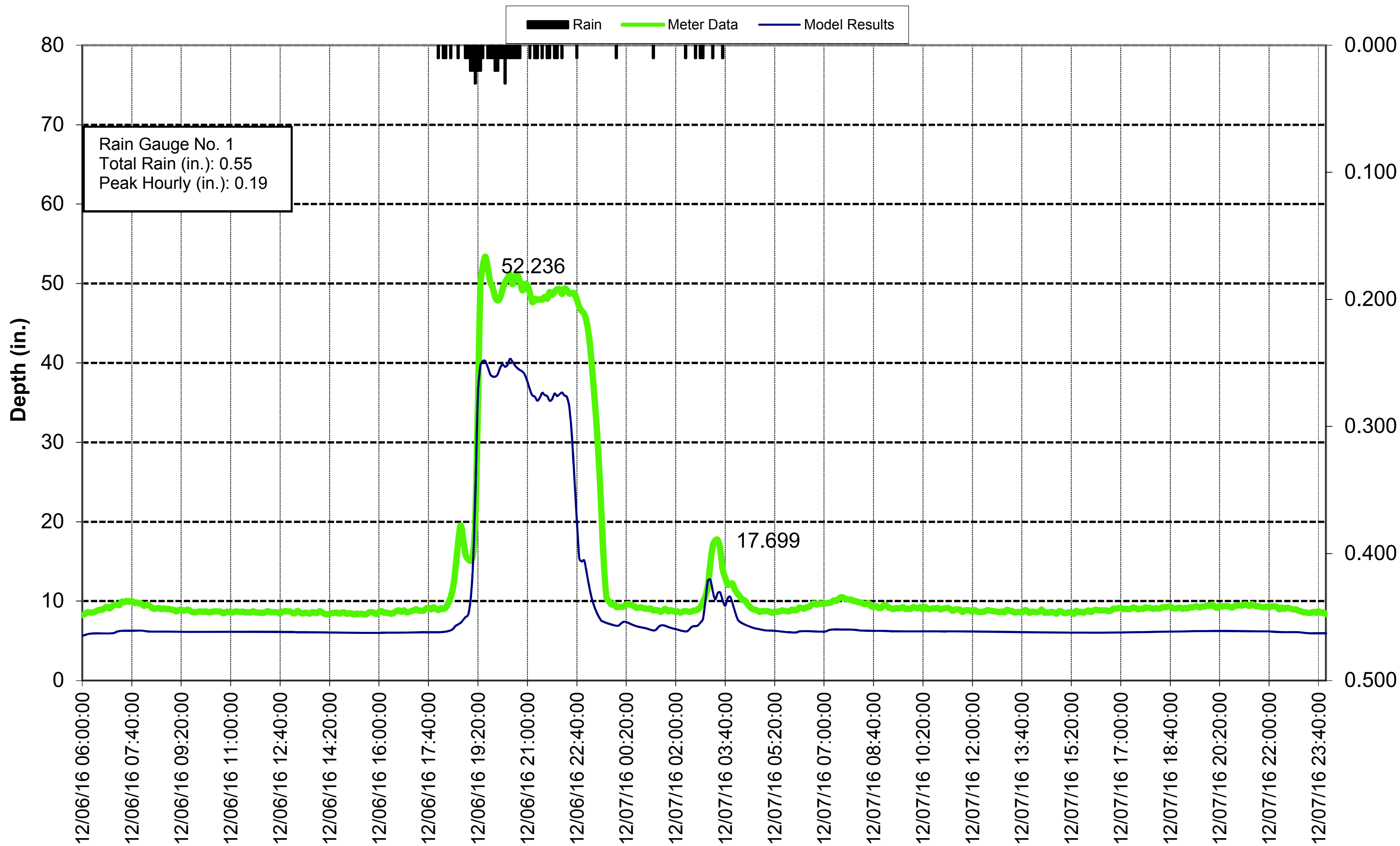
JCMUA Combined Sewer System Modeling Report
Figure E6-14: Depth at Meter 58
November 29, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX E7

December 6, 2016 Event Depth Graphs

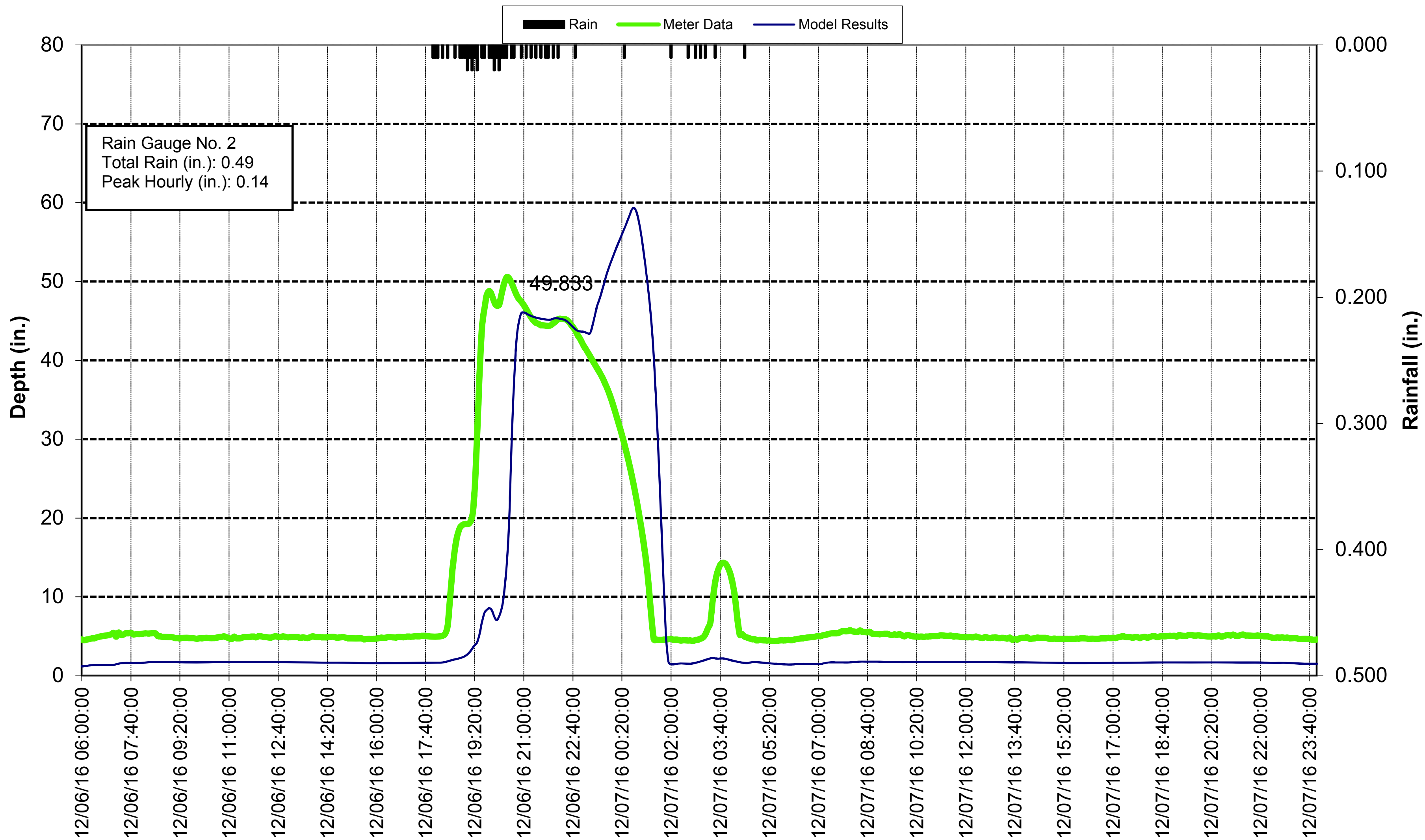
Appendix E7 - December 6, 2016 Event Depth Graphs



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-1: Depth at Meter 6
December 6, 2016 Storm Event
Secaucus Road Subdrainage Area (RW-1)

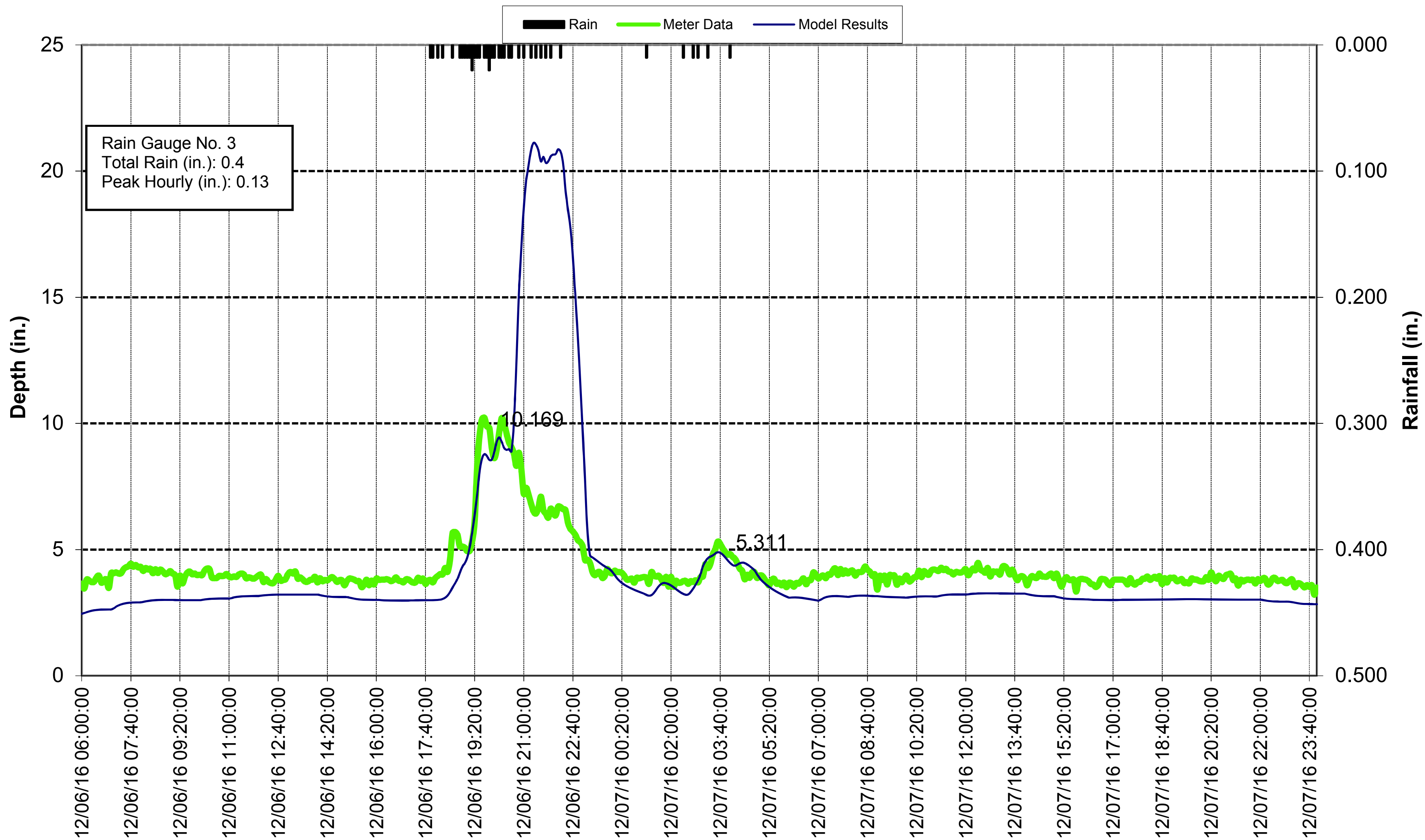
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-2: Depth at Meter 17
December 6, 2016 Storm Event
Sip Avenue Subdrainage Area (RW-6)

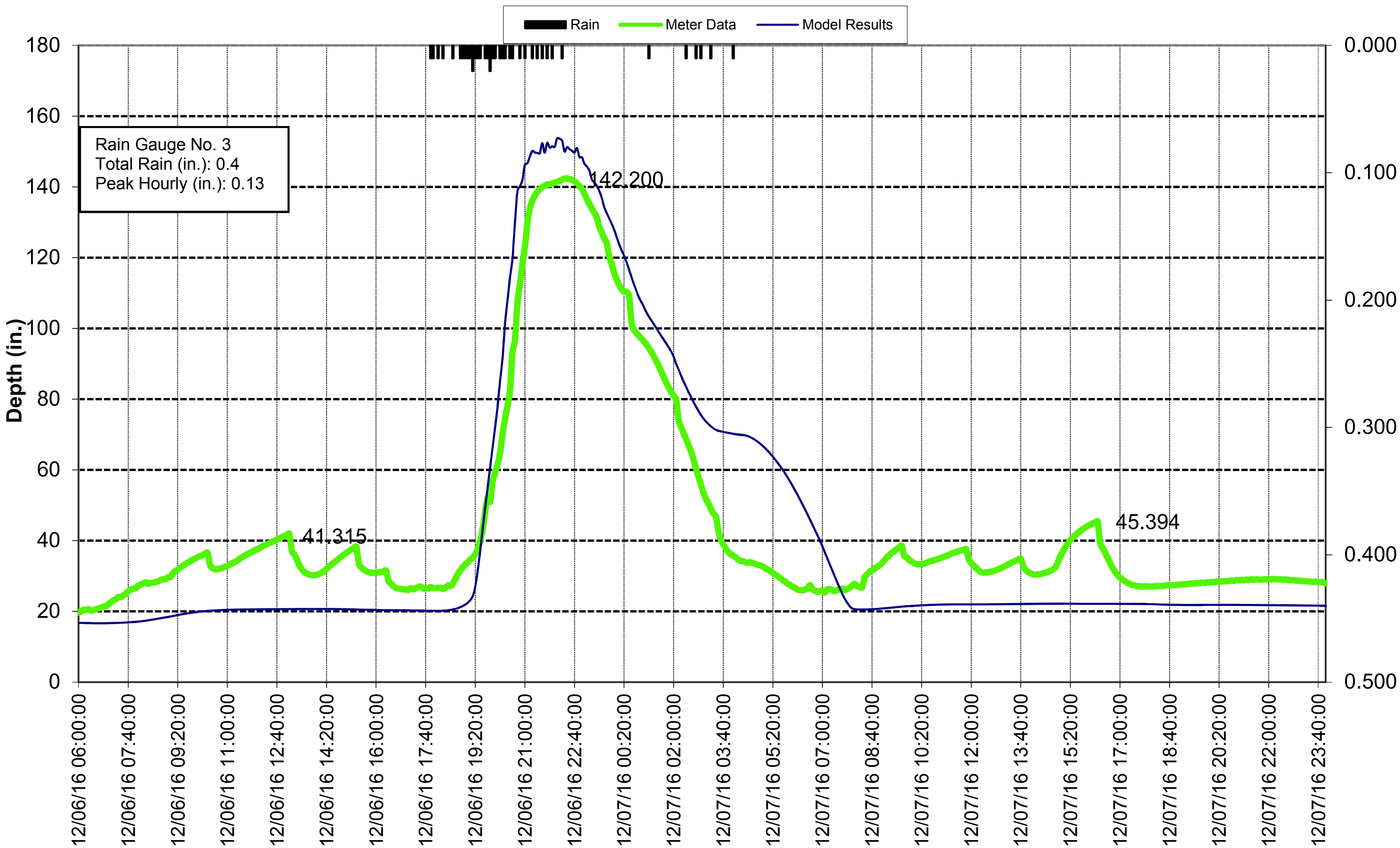
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-3: Depth at Meter 27
December 6, 2016 Storm Event
Fisk Street Subdrainage Area (RW-10)

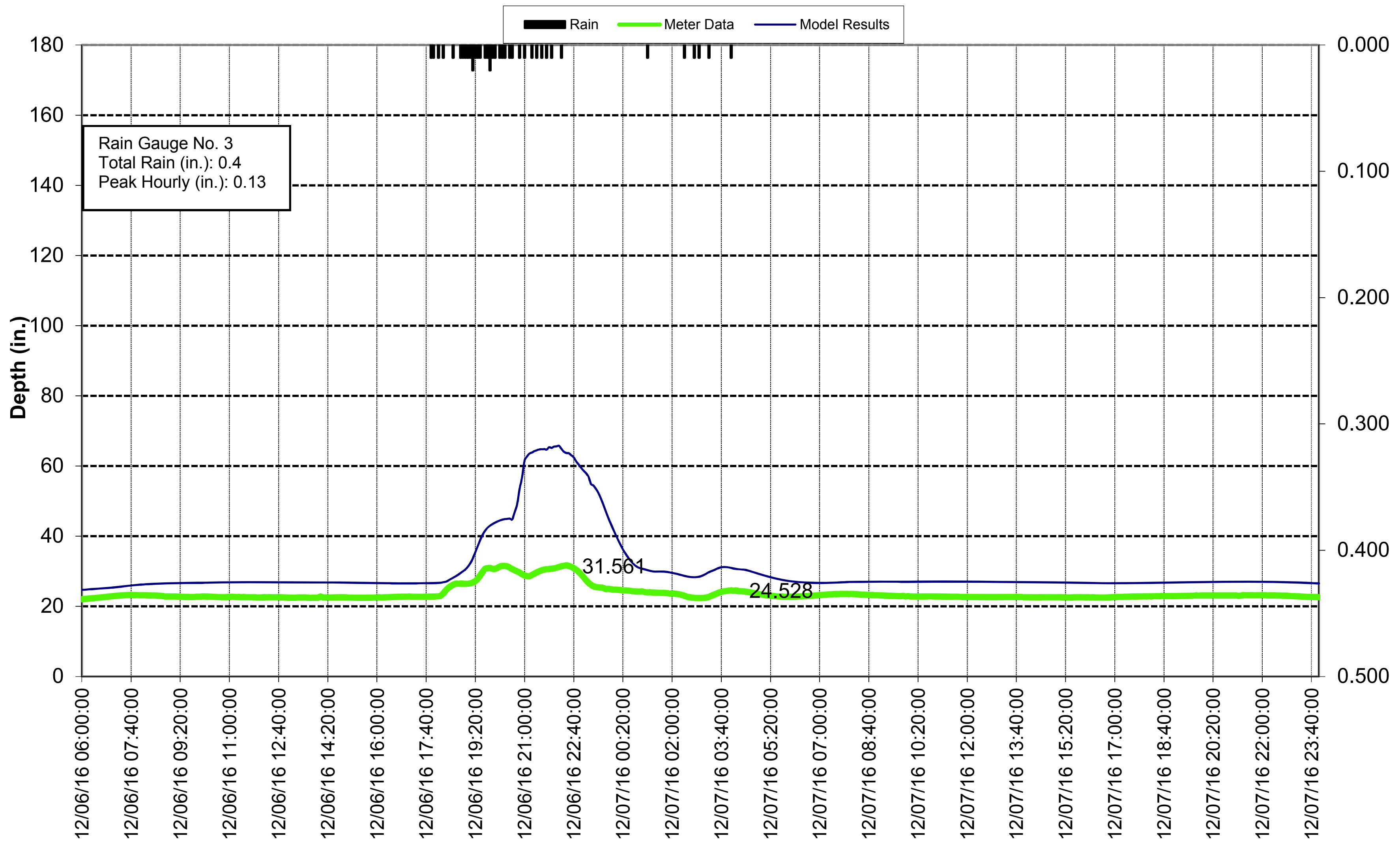
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-4: Depth at Meter 28
December 6, 2016 Storm Event
Total Northwest Interceptor Flow

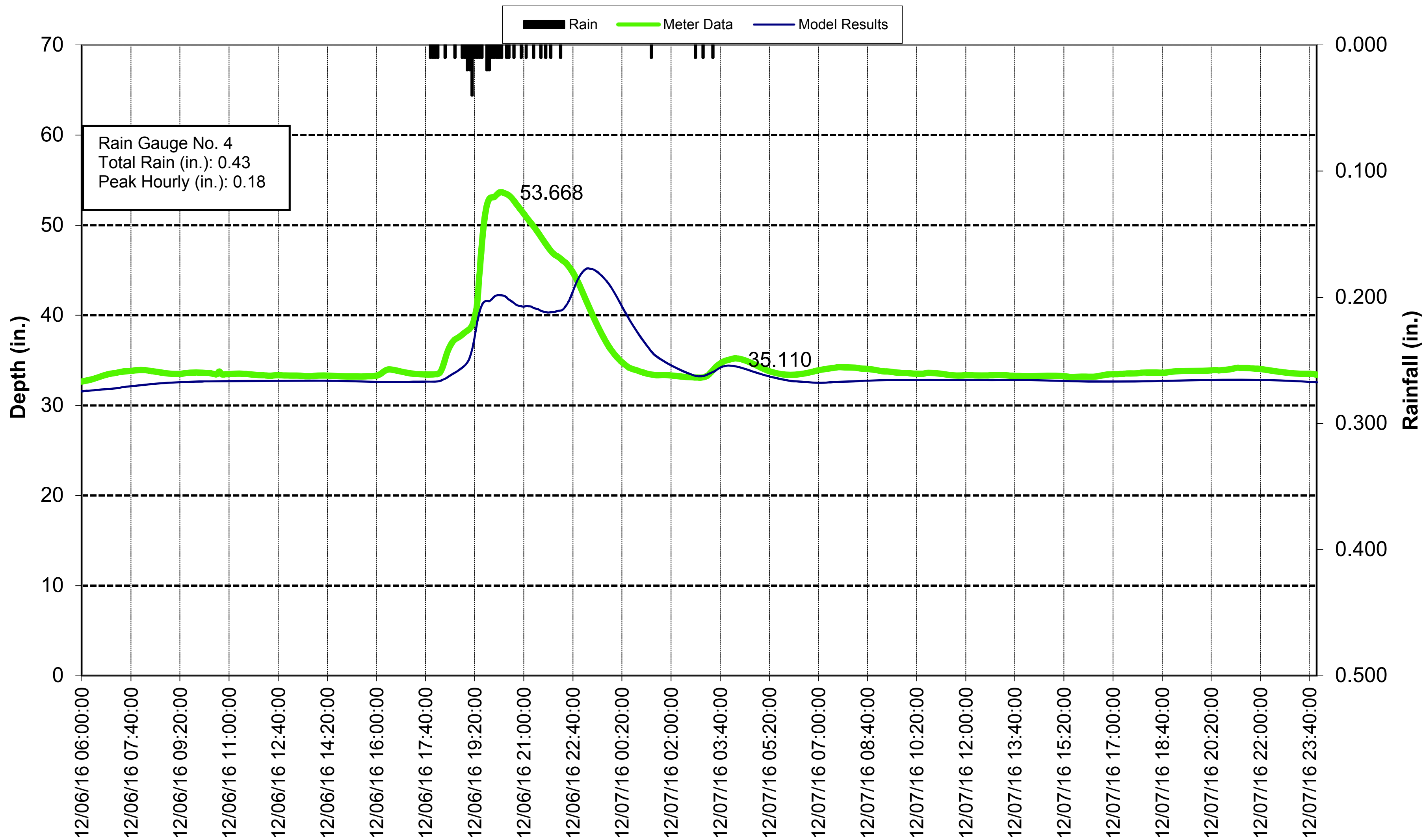
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-5: Depth at Meter 29
December 6, 2016 Storm Event
Total Southwest Interceptor Flow

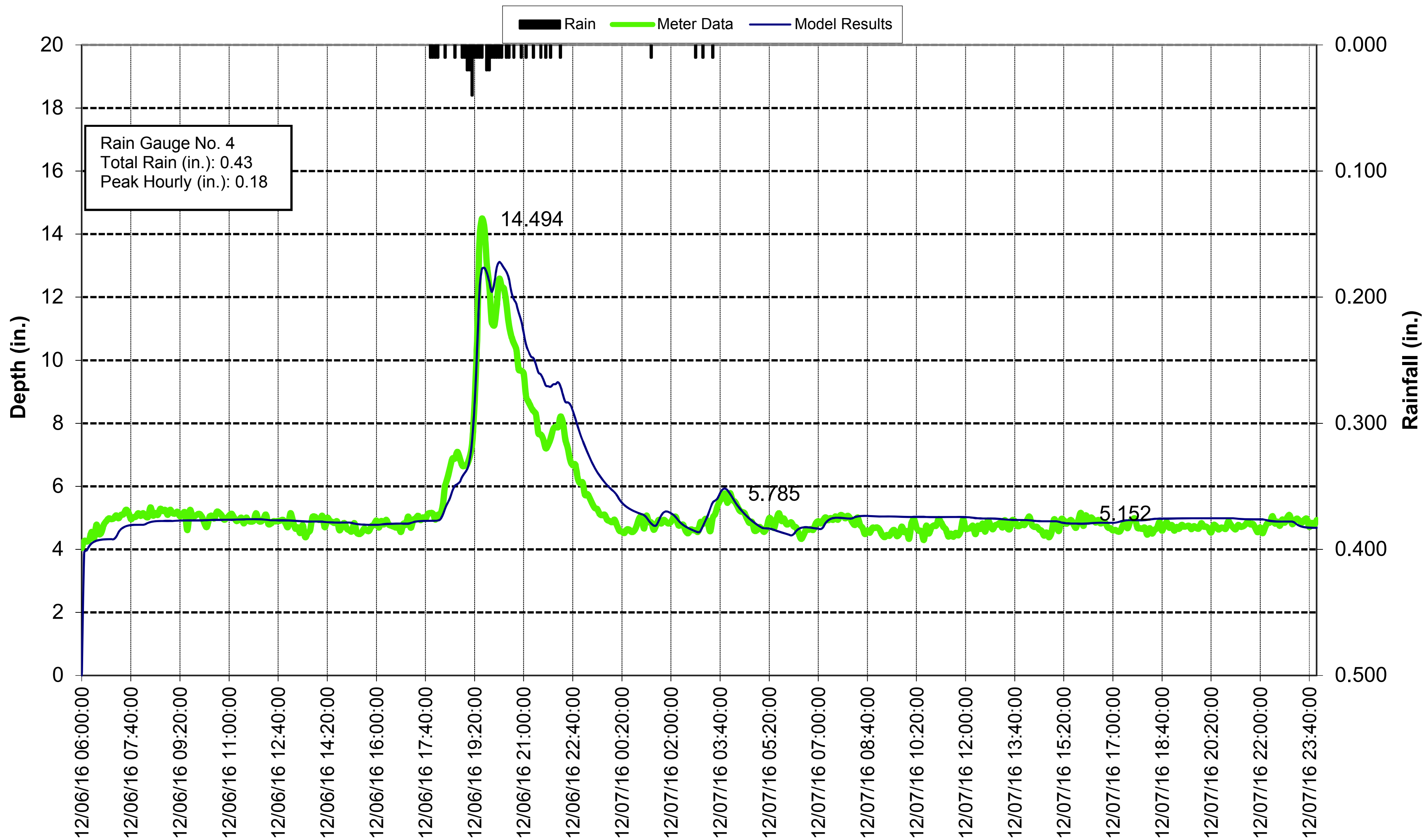
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-6: Depth at Meter 32
December 6, 2016 Storm Event
Mina Drive Subdrainage Area (RW-13)

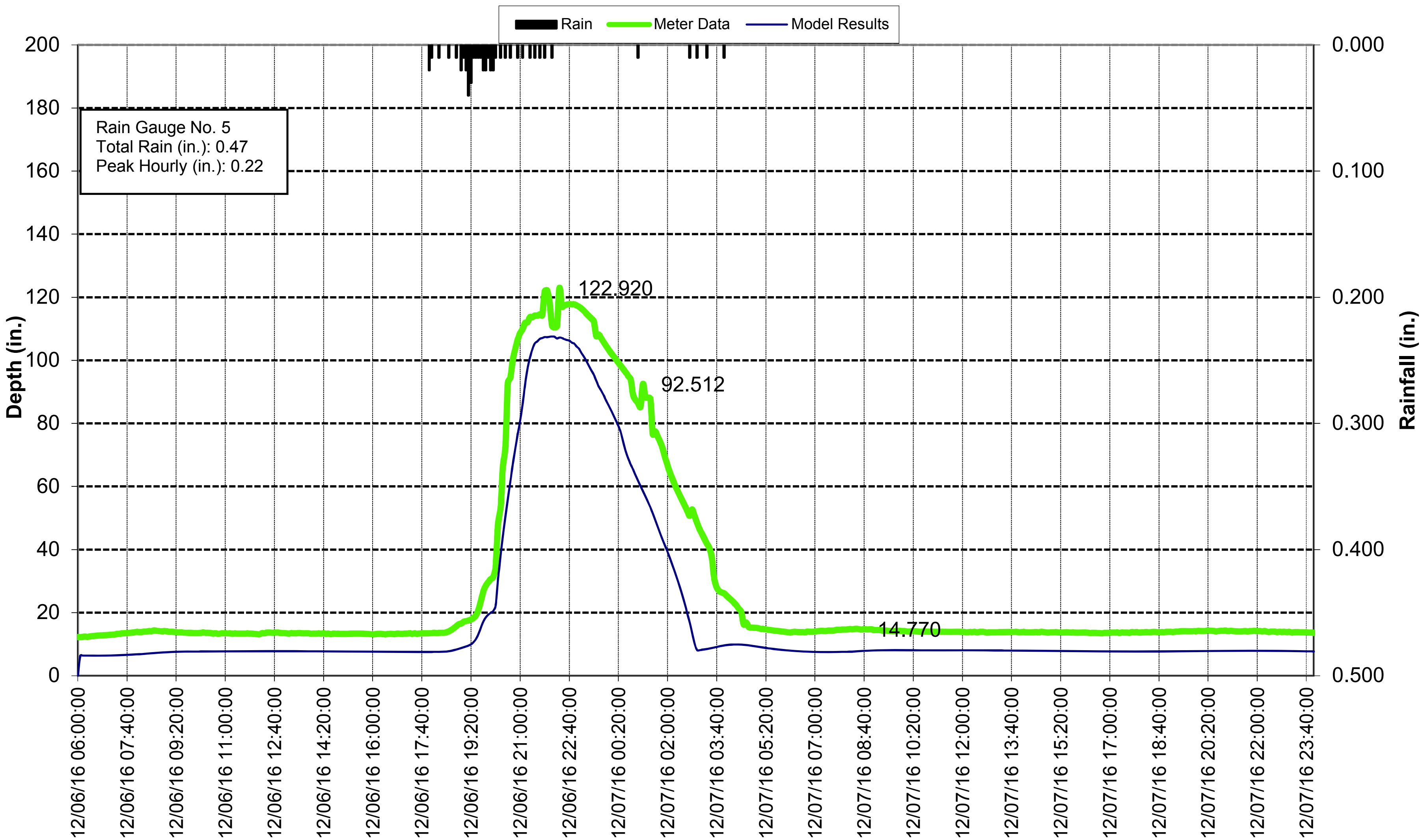
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-7: Depth at Meter 33
December 6, 2016 Storm Event
Brown Place Subdrainage Area (RE-1)

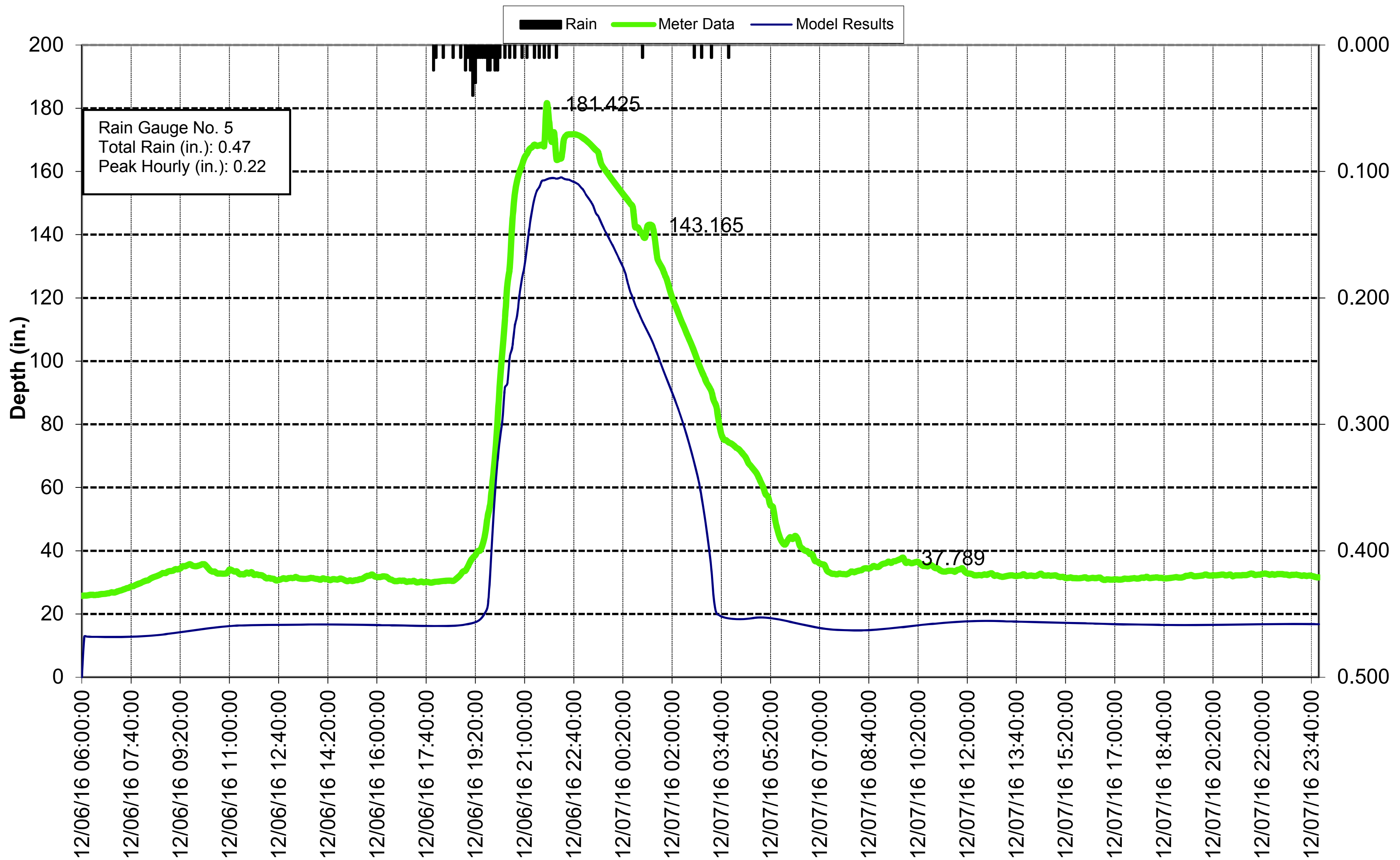
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure 7-8: Depth at Meter 40
December 6, 2016 Storm Event
Total Southeast Interceptor Flow

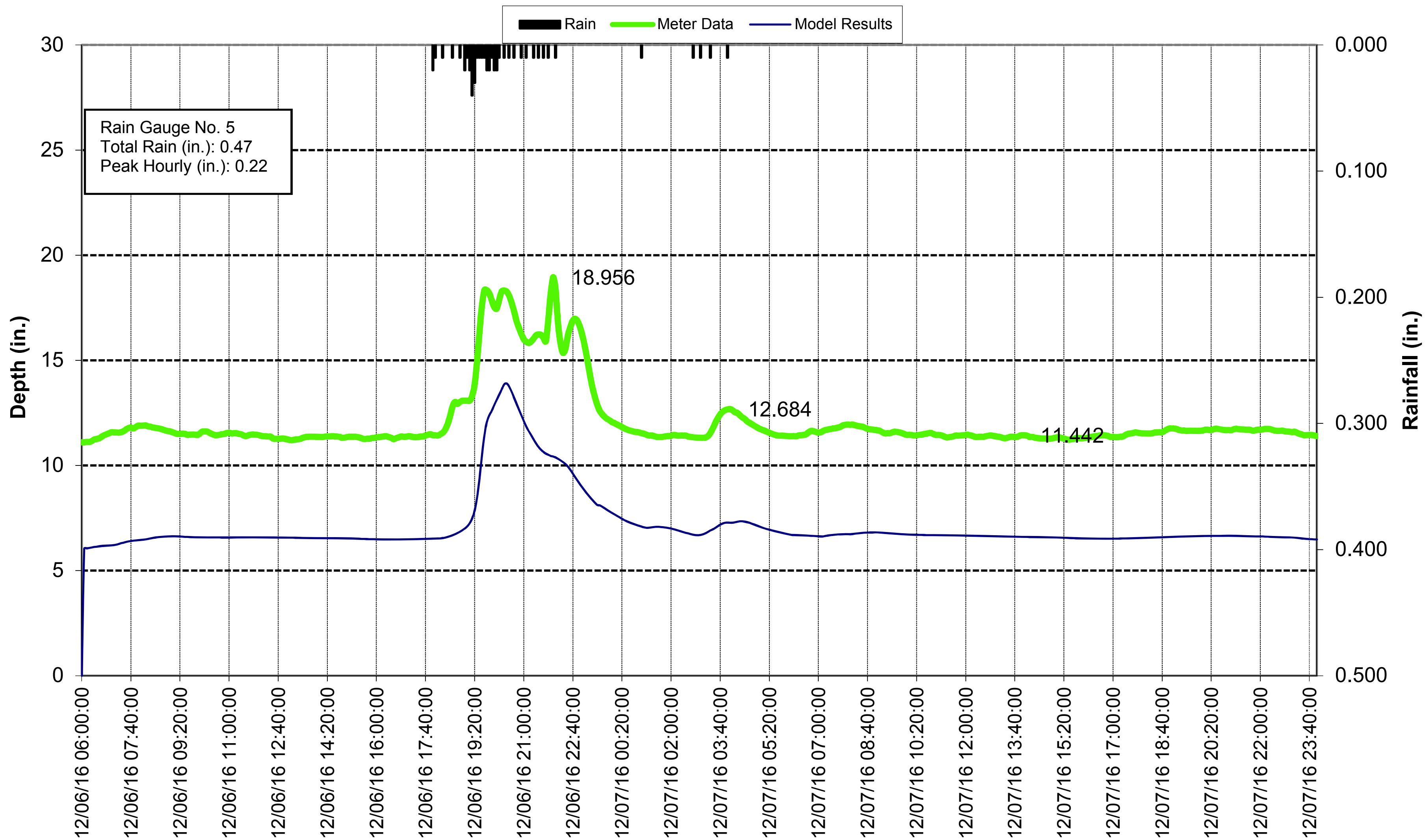
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-9: Depth at Meter 41
December 6, 2016 Storm Event
Total Northeast Interceptor Flow

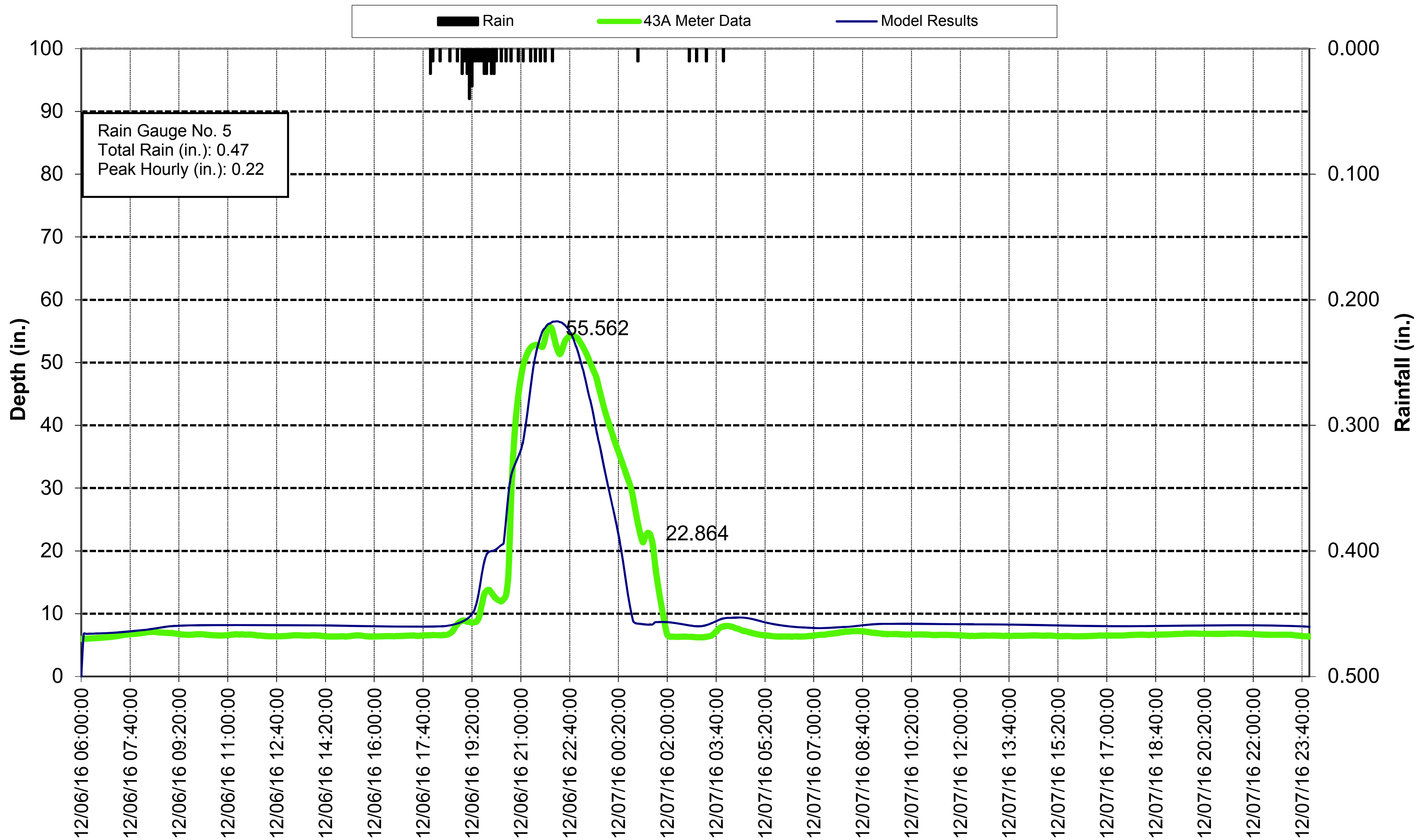
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-10: Depth at Meter 42
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

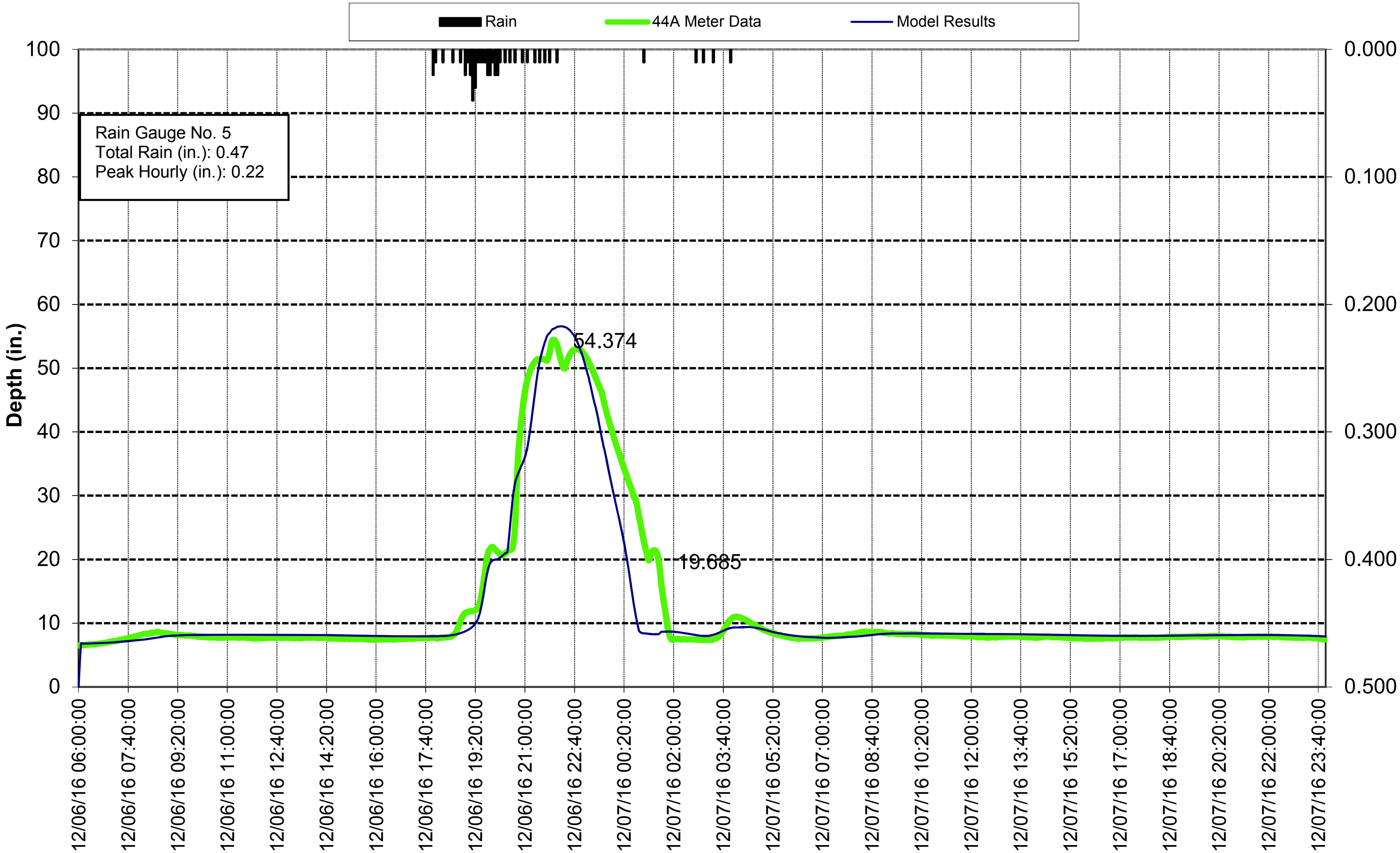
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-11: Depth at Meter 43A
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

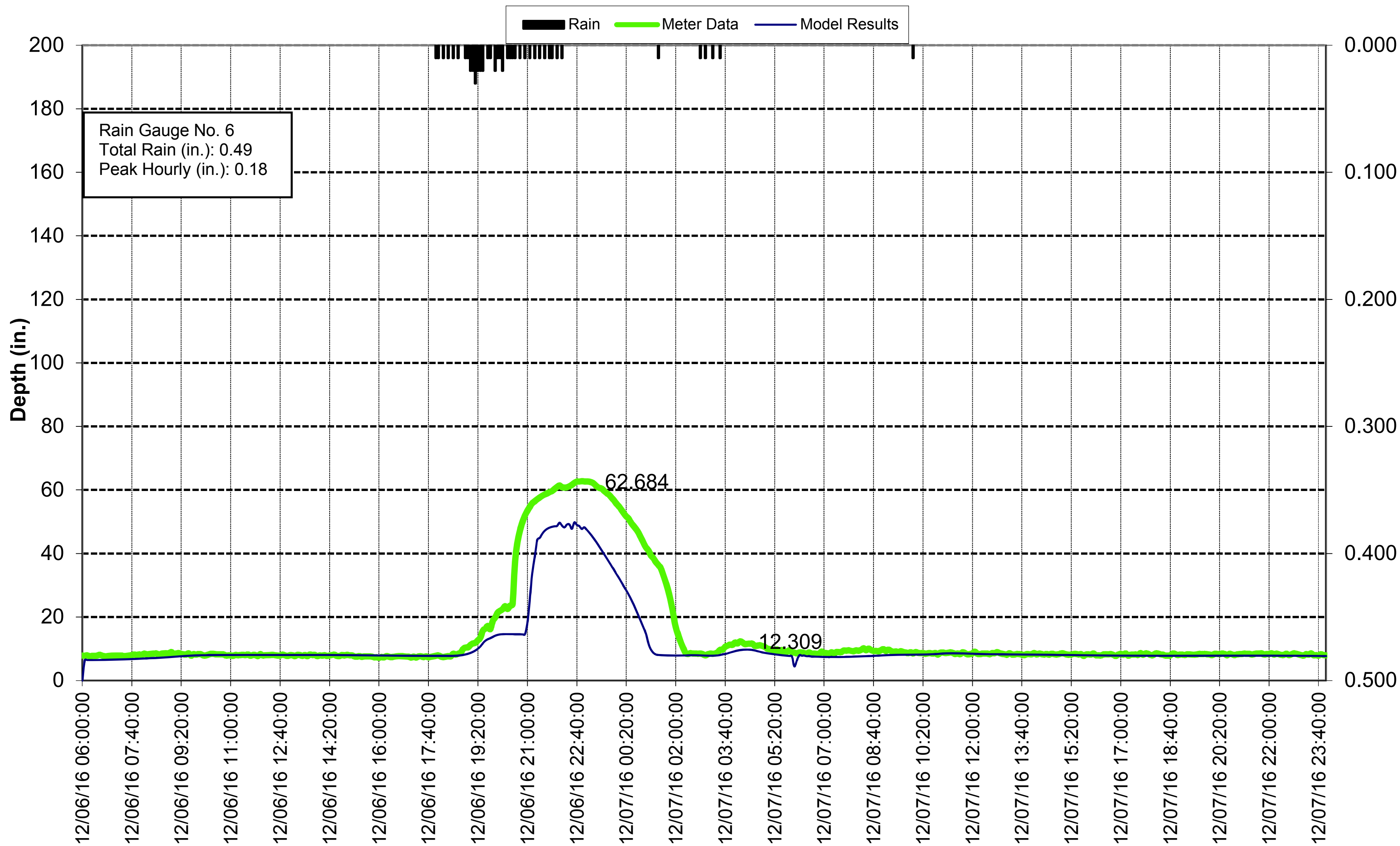
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-12: Depth at Meter 44A
December 6, 2016 Storm Event
Mill Creek Subdrainage Area (RE-5/6)

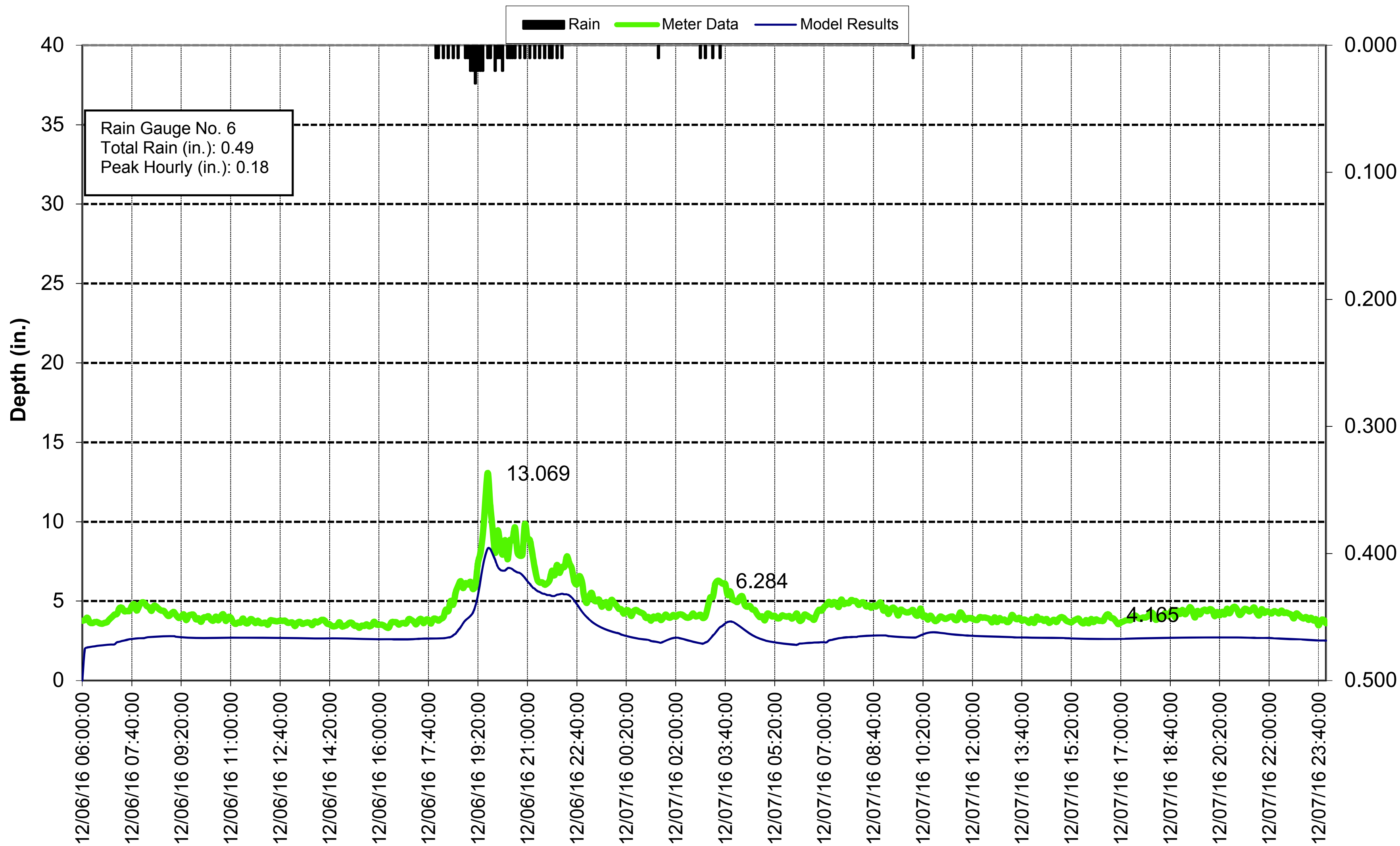
Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-13: Depth at Meter 54
December 6, 2016 Storm Event
Fourteenth Street Subdrainage Area (RE-18)

Jersey City Municipal Utilities Authority (JCMUA)



ARCADIS

JCMUA Combined Sewer System Modeling Report
Figure E7-14: Depth at Meter 58
December 6, 2016 Storm Event
Eighteenth Street Subdrainage Area (RE-19)

Jersey City Municipal Utilities Authority (JCMUA)

APPENDIX F

CSO Regulators, Outfalls, Pump Stations, and Netting/Screening Facilities

G:\GIS\JCMUA\Figures\CSO_Permit_Map.mxd

JCMUA Regulators *			
CSO Regulator Number	**Regulator Name**	**Latitiude**	**Longitude**
RE-1	Brown Place	40d 41m 16.58s	74d 05m 26.67s
RE-2	Richard Street	40d 41m 57.06s	74d 04m 44.33s
RE-3/4	Claremont and Carteret	40d 42m 15.52s	74d 03m 56.99s
RE-5/6	Mill Creek and Pine	40d 42m 45.80s	74d 03m 13.21s
RE-10	Grand Street	40d 42m 53.28s	74d 02m 00.65s
RE-11	York Street	40d 42m 55.93s	74d 01m 59.63s
RE-15	Second Street	40d 43m 19.41s	74d 02m 17.02s
RE-16	South Sixth Street	40d 43m 30.48s	74d 02m 24.18s
RE-17	North Sixth Street	40d 43m 30.97s	74d 02m 24.97s
RE-18	Fourteenth Street	40d 43m 53.20s	74d 02m 12.55s
RE-19	Eighteenth Street	40d 44m 06.66s	74d 02m 50.02s
RW-1	Secaucus Road	40d 45m 37.15s	74d 03m 07.50s
RW-2	Manhattan Avenue	40d 44m 52.98s	74d 03m 55.49s
RW-3	St. Paul's Avenue	40d 44m 26.11s	74d 04m 23.01s
RW-4	Van Winkle Avenue	40d 44m 19.06s	74d 04m 26.59s
RW-5-1	Broadway	40d 44m 16.44s	74d 04m 41.50s
RW-5-2	Broadway	40d 44m 20.00s	74d 04m 53.58s
RW-6	Sip Avenue	40d 44m 03.67s	74d 04m 50.79s
RW-7	Duncan Avenue	40d 43m 49.28s	74d 05m 05.54s
RW-8	Clendenny Avenue	40d 43m 22.47s	74d 05m 29.44s
RW-9	Claremont Avenue	40d 43m 05.91s	74d 05m 40.73s
RW-10	Fisk Street	40d 42m 57.19s	74d 05m 46.46s
RW-11	North Danforth Avenue	40d 42m 22.11s	74d 05m 57.26s
RW-12	South Danforth Avenue	40d 42m 21.56s	74d 05m 57.53s
RW-13	Mina Drive	40d 41m 58.41s	74d 06m 13.64s

* All JCMUA Regulators are equipped with tide gate(s)which were added as the secondary means of tidal intrusion prevention

JCMUA CSO Outfalls			
CSO Outfall	**Associated CSO Regulator(s)**	**Latitiude**	**Longitude**
001A CSO	RW-1	40d 45m 39.20s	74d 03m 11.53s
002A CSO	RW-2	40d 44m 50.66s	74d 04m 10.26s
003A CSO	RW-3	40d 44m 31.02s	74d 04m 36.86s
004A CSO	RW-4	40d 44m 24.33s	74d 04m 44.27s
005A CSO	RW-5	40d 44m 22.17s	74d 04m 56.16s
006A CSO	RW-6	40d 44m 04.25s	74d 04m 53.07s
007A CSO	RW-7	40d 44m 03.44s	74d 05m 37.30s
008A CSO	RW-8	40d 43m 32.97s	74d 05m 46.72s
009A CSO	RW-9	40d 43m 10.58s	74d 05m 51.81s
010A CSO	RW-10	40d 43m 03.59s	74d 06m 04.47s
011A CSO	RW-11, RW-12	40d 42m 13.77s	74d 06m 23.16s
013A CSO	RW-13	40d 41m 58.49s	74d 06m 16.24s
014A CSO	RE-1	40d 40m 46.86s	74d 04m 25.09s
015A CSO	RE-2	40d 41m 17.78s	74d 04m 32.70s
016A CSO	RE-3/4	40d 41m 46.99s	74d 03m 03.59s
018A CSO	RE-5/6	40d 42m 45.72s	74d 03m 12.92s
020A CSO	RE-10, RE-11	40d 42m 45.39s	74d 01m 59.67s
025A CSO	RE-15	40d 43m 15.99s	74d 01m 53.00s
026A CSO	RE-16, RE-17	40d 43m 26.90s	74d 02m 02.49s
028A CSO	RE-18	40d 43m 52.83s	74d 01m 51.48s
029A CSO	RE-19	40d 44m 03.57s	74d 02m 14.59s

JCMUA Pump Stations		
Pump Station	**Latitude**	**Longitude**
West Side Pump Station	40d 42m 55.47s	74d 5m 52.54s
East Side Pump Station	40d 42m 23.75s	74d 3m 32.95s
Pump Station 1	40d 40m 36.94s	74d 5m 14.6s
Pump Station 2	40d 40m 50.49s	74d 5m 51.91s
Pump Station 3	40d 41m 32.00s	74d 4m 51.41s
Pump Station 3B	40d 41m 15.01s	74d 4m 27.16s
Pump Station 3C	40d 41m 26.60s	74d 4m 15.37s
Pump Station 3D	40d 41m 24.87s	74d 4m 37.58s
Pump Station 4	40d 43m 20.51s	74d 3m 18.28s
Pump Station 5	40d 44m 54.01s	74d 2m 22.29s
Pump Station 5A	40d 44m 53.48s	74d 2m 22.80s
Pump Station 6	40d 43m 42.35s	74d 3m 49.53s
Pump Station 6A	40d 43m 43.45s	74d 3m 47.96s
Pump Station 7	40d 44m 29.47s	74d 3m 15.78s
Pump Station Bayside Park	40d 41m 53.21s	74d 4m 49.24s

JCMUA Netting and Screening Facilities **		
Name	**Latitiude**	**Longitude**
NF-001	40d 31m 25.01s	74d 3m 16.25s
NF-002	40d 30m 50.77s	74d 4m 01.56s
NF-003	40d 30m 24.70s	74d 4m 36.05s
NF-004	40d 30m 14.59s	74d 4m 49.42s
NF-005	40d 30m 05.68s	74d 5m 01.21s
NF-006	40d 30m 08.16s	74d 4m 57.92s
NF-007	40d 29m 35.03s	74d 5m 41.73s
NF-008	40d 29m 39.44s	74d 5m 35.89s
NF-009	40d 29m 24.04s	74d 5m 56.26s
NF-010	40d 29m 14.16s	74d 6m 09.31s
NF-011/012	40d 29m 15.85s	74d 6m 07.07s
NF-013	40d 29m 05.74s	74d 6m 20.44s
NF-014	40d 30m 12.35s	74d 4m 52.37s
NF-015	40d 30m 17.50s	74d 4m 45.57s
NF-016/017	40d 30m 50.98s	74d 4m 01.27s
NF-018	40d 31m 24.36s	74d 3m 17.10s
NF-021/022	40d 32m 19.39s	74d 2m 04.23s
NF-025	40d 32m 23.25s	74d 1m 59.12s
NF-026/027	40d 32m 14.90s	74d 2m 10.18s
NF-028	40d 32m 25.30s	74d 1m 56.40s
NF-029	40d 31m 41.27s	74d 2m 54.72s

** All JCMUA Netting Facilities are equipped with tide gate(s) which add as the primary means of tidal intrusion prevention

Legend

- Netting/Screening Facility
- Pump Station
- CSO Outfall
- CSO Regulator
- Municipal Boundary

Sources:

Municipal Boundaries: New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS) - last Updated January 2, 2013

Road Centerlines: New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS) - Last Updated March 9, 2015

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
JERSEY CITY, NEW JERSEY

CSO REGULATORS, OUTFALLS, PUMP STATIONS AND NETTING/SCREENING FACILITIES

ARCADIS Design & Consultancy for natural and built assets

APPENDIX G

2004 Wasteload Tables – Individual Outfalls

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Brown Place (RE-1) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
February	2	0.55	2.4%	1.96E+13	4.95E+12	359.6	46.9	12.8	50.4	470.4
March	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
April	3	0.37	1.6%	1.34E+13	3.38E+12	245.8	32.0	8.8	34.4	321.4
May	4	2.56	11.3%	9.19E+13	2.32E+13	1,687.8	220.0	60.3	236.4	2,207.5
June	2	2.07	9.2%	7.44E+13	1.88E+13	1,366.7	178.1	48.8	191.4	1,787.5
July	7	5.33	23.6%	1.91E+14	4.84E+13	3,513.0	457.9	125.4	492.0	4,594.8
August	3	2.39	10.6%	8.57E+13	2.17E+13	1,573.6	205.1	56.2	220.4	2,058.2
September	4	7.13	31.5%	2.56E+14	6.46E+13	4,694.2	611.8	167.6	657.4	6,139.7
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	2	1.90	8.4%	6.82E+13	1.72E+13	1,251.7	163.1	44.7	175.3	1,637.1
December	1	0.32	1.4%	1.13E+13	2.87E+12	208.2	27.1	7.4	29.2	272.3
Annual	28	22.62	100%	8.11E+14	2.05E+14	14,900.6	1,942.2	532.0	2,086.7	19,489.0

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Richard Street (RE-2) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
February	2	0.75	2.5%	2.71E+13	6.85E+12	497.1	64.8	17.7	69.6	650.2
March	1	0.11	0.4%	3.95E+12	9.98E+11	72.5	9.4	2.6	10.1	94.8
April	5	1.17	3.9%	4.20E+13	1.06E+13	771.7	100.6	27.6	108.1	1,009.4
May	4	3.51	11.7%	1.26E+14	3.18E+13	2,308.7	300.9	82.4	323.3	3,019.6
June	2	2.59	8.6%	9.29E+13	2.35E+13	1,705.5	222.3	60.9	238.8	2,230.7
July	7	7.98	26.6%	2.86E+14	7.24E+13	5,253.9	684.8	187.6	735.8	6,871.7
August	3	2.92	9.7%	1.05E+14	2.65E+13	1,925.3	251.0	68.7	269.6	2,518.2
September	6	8.66	28.8%	3.11E+14	7.85E+13	5,702.5	743.3	203.6	798.6	7,458.5
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	2	1.84	6.1%	6.60E+13	1.67E+13	1,211.9	158.0	43.3	169.7	1,585.1
December	3	0.51	1.7%	1.83E+13	4.63E+12	335.9	43.8	12.0	47.0	439.3
Annual	35	30.04	100%	1.08E+15	2.72E+14	19,785.0	2,578.8	706.3	2,770.8	25,877.4

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Claremont/Carteret (RE-3/4) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	1	0.28	0.4%	1.01E+13	2.56E+12	186.1	24.3	6.6	26.1	243.4
February	2	5.28	6.9%	1.89E+14	4.79E+13	3,479.4	453.5	124.2	487.3	4,550.9
March	1	0.28	0.4%	9.98E+12	2.52E+12	183.3	23.9	6.5	25.7	239.7
April	6	5.72	7.5%	2.05E+14	5.19E+13	3,769.2	491.3	134.6	527.9	4,929.9
May	4	5.61	7.4%	2.01E+14	5.09E+13	3,696.1	481.8	132.0	517.6	4,834.3
June	2	4.72	6.2%	1.69E+14	4.28E+13	3,108.4	405.2	111.0	435.3	4,065.6
July	9	18.77	24.6%	6.73E+14	1.70E+14	12,363.6	1,611.5	441.4	1,731.4	16,170.7
August	4	5.04	6.6%	1.81E+14	4.57E+13	3,319.9	432.7	118.5	464.9	4,342.2
September	5	19.98	26.2%	7.17E+14	1.81E+14	13,162.6	1,715.6	469.9	1,843.3	17,215.8
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	4	6.57	8.6%	2.36E+14	5.96E+13	4,327.7	564.1	154.5	606.1	5,660.3
December	4	3.90	5.1%	1.40E+14	3.54E+13	2,570.4	335.0	91.8	360.0	3,361.9
Annual	42	76.17	100%	2.73E+15	6.91E+14	50,166.7	6,538.8	1,791.0	7,025.5	65,614.6

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Mill Creek (RE-5/6) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
February	2	7.40	4.3%	2.65E+14	6.71E+13	4,872.6	635.1	174.0	682.4	6,373.1
March	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
April	5	11.21	6.6%	4.02E+14	1.02E+14	7,380.8	962.0	263.5	1,033.6	9,653.6
May	4	13.26	7.8%	4.76E+14	1.20E+14	8,734.6	1,138.5	311.8	1,223.2	11,424.3
June	2	10.26	6.0%	3.68E+14	9.31E+13	6,759.8	881.1	241.3	946.7	8,841.3
July	8	44.26	26.0%	1.59E+15	4.01E+14	29,153.3	3,799.9	1,040.8	4,082.7	38,130.5
August	4	11.43	6.7%	4.10E+14	1.04E+14	7,530.5	981.5	268.8	1,054.6	9,849.4
September	4	52.75	31.0%	1.89E+15	4.78E+14	34,743.4	4,528.5	1,240.4	4,865.6	45,441.9
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	3	14.23	8.4%	5.10E+14	1.29E+14	9,372.6	1,221.6	334.6	1,312.6	12,258.7
December	2	5.46	3.2%	1.96E+14	4.95E+13	3,597.6	468.9	128.4	503.8	4,705.4
Annual	34	170.26	100%	6.11E+15	1.54E+15	112,145.1	14,617.2	4,003.6	15,705.2	146,678.2

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - York/Grand (RE-10/11) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	1	0.06	0.1%	2.22E+12	5.60E+11	40.7	5.3	1.5	5.7	53.2
February	4	4.98	7.0%	1.78E+14	4.51E+13	3,277.6	427.2	117.0	459.0	4,286.9
March	1	0.02	0.0%	7.05E+11	1.78E+11	13.0	1.7	0.5	1.8	16.9
April	5	1.65	2.3%	5.93E+13	1.50E+13	1,088.6	141.9	38.9	152.4	1,423.8
May	7	5.68	8.0%	2.04E+14	5.15E+13	3,738.1	487.2	133.5	523.5	4,889.2
June	4	5.02	7.1%	1.80E+14	4.56E+13	3,309.4	431.4	118.1	463.5	4,328.5
July	11	18.98	26.9%	6.81E+14	1.72E+14	12,499.7	1,629.2	446.2	1,750.5	16,348.7
August	6	5.37	7.6%	1.93E+14	4.87E+13	3,536.1	460.9	126.2	495.2	4,625.0
September	5	20.25	28.6%	7.26E+14	1.84E+14	13,337.1	1,738.4	476.1	1,867.8	17,444.0
October	2	0.02	0.0%	7.80E+11	1.97E+11	14.3	1.9	0.5	2.0	18.7
November	5	6.04	8.5%	2.17E+14	5.48E+13	3,978.4	518.6	142.0	557.1	5,203.5
December	7	2.61	3.7%	9.37E+13	2.37E+13	1,720.5	224.2	61.4	240.9	2,250.2
Annual	58	70.68	100%	2.54E+15	6.41E+14	46,553.5	6,067.9	1,662.0	6,519.5	60,888.7

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Second Street (RE-15) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	1	0.15	0.3%	5.21E+12	1.32E+12	95.6	12.5	3.4	13.4	125.1
February	2	3.22	7.0%	1.15E+14	2.92E+13	2,120.4	276.4	75.7	296.9	2,773.3
March	1	0.08	0.2%	2.82E+12	7.13E+11	51.8	6.8	1.8	7.3	67.7
April	6	1.47	3.2%	5.26E+13	1.33E+13	966.5	126.0	34.5	135.3	1,264.1
May	5	2.93	6.4%	1.05E+14	2.66E+13	1,928.3	251.3	68.8	270.0	2,522.0
June	2	3.40	7.4%	1.22E+14	3.08E+13	2,238.8	291.8	79.9	313.5	2,928.2
July	12	11.65	25.3%	4.18E+14	1.06E+14	7,672.3	1,000.0	273.9	1,074.5	10,034.8
August	4	2.70	5.9%	9.69E+13	2.45E+13	1,778.7	231.8	63.5	249.1	2,326.4
September	6	14.79	32.1%	5.30E+14	1.34E+14	9,738.9	1,269.4	347.7	1,363.9	12,737.8
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	4	3.53	7.7%	1.26E+14	3.20E+13	2,322.8	302.8	82.9	325.3	3,038.1
December	5	2.11	4.6%	7.56E+13	1.91E+13	1,388.4	181.0	49.6	194.4	1,815.9
Annual	48	46.01	100%	1.65E+15	4.17E+14	30,302.3	3,949.7	1,081.8	4,243.6	39,633.4

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Sixth Street (RE-16/17) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	3	0.25	2.4%	8.97E+12	2.27E+12	164.7	21.5	5.9	23.1	215.4
February	5	0.61	5.8%	2.19E+13	5.53E+12	401.6	52.3	14.3	56.2	525.3
March	1	0.11	1.1%	4.05E+12	1.03E+12	74.5	9.7	2.7	10.4	97.4
April	17	1.26	12.0%	4.53E+13	1.15E+13	832.5	108.5	29.7	116.6	1,088.8
May	18	1.07	10.1%	3.82E+13	9.67E+12	702.1	91.5	25.1	98.3	918.3
June	11	0.68	6.4%	2.44E+13	6.16E+12	447.4	58.3	16.0	62.7	585.1
July	17	2.00	18.9%	7.17E+13	1.81E+13	1,317.5	171.7	47.0	184.5	1,723.2
August	18	0.96	9.1%	3.45E+13	8.72E+12	633.4	82.6	22.6	88.7	828.4
September	10	1.76	16.7%	6.32E+13	1.60E+13	1,161.5	151.4	41.5	162.7	1,519.1
October	5	0.10	1.0%	3.73E+12	9.43E+11	68.5	8.9	2.4	9.6	89.6
November	15	0.93	8.8%	3.34E+13	8.46E+12	614.0	80.0	21.9	86.0	803.1
December	13	0.82	7.8%	2.96E+13	7.47E+12	542.7	70.7	19.4	76.0	709.8
Annual	133	10.57	100%	3.79E+14	9.58E+13	6,960.2	907.2	248.5	974.7	9,103.5

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Fourteenth Street (RE-18)

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	2	0.25	0.3%	9.14E+12	2.31E+12	167.8	21.9	6.0	23.5	219.5
February	2	6.08	7.2%	2.18E+14	5.52E+13	4,007.4	522.3	143.1	561.2	5,241.4
March	2	0.53	0.6%	1.89E+13	4.79E+12	347.8	45.3	12.4	48.7	454.9
April	7	4.49	5.3%	1.61E+14	4.08E+13	2,959.9	385.8	105.7	414.5	3,871.3
May	9	6.84	8.1%	2.45E+14	6.20E+13	4,502.0	586.8	160.7	630.5	5,888.3
June	7	6.04	7.1%	2.17E+14	5.48E+13	3,976.8	518.3	142.0	556.9	5,201.4
July	12	21.20	25.1%	7.60E+14	1.92E+14	13,964.6	1,820.2	498.5	1,955.6	18,264.7
August	8	5.99	7.1%	2.15E+14	5.44E+13	3,946.7	514.4	140.9	552.7	5,162.1
September	6	22.38	26.5%	8.03E+14	2.03E+14	14,739.5	1,921.2	526.2	2,064.2	19,278.3
October	2	0.08	0.1%	2.83E+12	7.17E+11	52.1	6.8	1.9	7.3	68.1
November	6	6.53	7.7%	2.34E+14	5.92E+13	4,298.0	560.2	153.4	601.9	5,621.5
December	6	4.15	4.9%	1.49E+14	3.77E+13	2,734.8	356.5	97.6	383.0	3,576.9
Annual	69	84.56	100%	3.03E+15	7.67E+14	55,697.4	7,259.7	1,988.4	7,800.0	72,848.4

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Eighteenth Street (RE-19) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	5	5.77	2.7%	2.07E+14	5.24E+13	3,803.1	495.7	135.8	532.6	4,974.2
February	3	10.89	5.0%	3.91E+14	9.88E+13	7,171.9	934.8	256.0	1,004.4	9,380.3
March	10	5.84	2.7%	2.10E+14	5.30E+13	3,848.0	501.6	137.4	538.9	5,033.0
April	13	20.47	9.5%	7.34E+14	1.86E+14	13,482.7	1,757.4	481.3	1,888.2	17,634.4
May	14	21.79	10.1%	7.81E+14	1.98E+14	14,349.9	1,870.4	512.3	2,009.6	18,768.7
June	9	14.50	6.7%	5.20E+14	1.31E+14	9,547.5	1,244.4	340.9	1,337.1	12,487.4
July	12	42.81	19.8%	1.54E+15	3.88E+14	28,195.8	3,675.1	1,006.6	3,948.6	36,878.2
August	9	16.94	7.8%	6.07E+14	1.54E+14	11,155.0	1,454.0	398.2	1,562.2	14,590.0
September	8	41.82	19.4%	1.50E+15	3.79E+14	27,542.4	3,589.9	983.3	3,857.1	36,023.6
October	5	2.24	1.0%	8.05E+13	2.04E+13	1,478.2	192.7	52.8	207.0	1,933.4
November	10	18.78	8.7%	6.74E+14	1.70E+14	12,370.1	1,612.3	441.6	1,732.3	16,179.2
December	7	13.94	6.5%	5.00E+14	1.26E+14	9,179.3	1,196.4	327.7	1,285.5	12,005.9
Annual	105	215.78	100%	7.74E+15	1.96E+15	142,123.8	18,524.7	5,073.9	19,903.5	185,888.2

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Secaucus Road (RW-1) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	4	0.10	0.1%	2.54E+12	7.64E+11	75.5	10.5	1.1	11.3	506.9
February	2	3.93	4.6%	9.86E+13	2.97E+13	2,930.9	408.9	43.9	437.1	19,687.9
March	3	0.69	0.8%	1.72E+13	5.18E+12	511.5	71.4	7.7	76.3	3,436.0
April	6	5.88	6.9%	1.48E+14	4.45E+13	4,393.3	612.9	65.8	655.1	29,510.9
May	11	8.77	10.3%	2.20E+14	6.63E+13	6,550.4	913.8	98.1	976.8	44,001.0
June	6	6.42	7.5%	1.61E+14	4.85E+13	4,795.4	669.0	71.8	715.1	32,211.9
July	9	19.91	23.3%	5.00E+14	1.50E+14	14,867.0	2,074.0	222.7	2,217.0	99,866.5
August	7	7.33	8.6%	1.84E+14	5.54E+13	5,474.8	763.7	82.0	816.4	36,776.1
September	7	23.07	27.0%	5.80E+14	1.74E+14	17,223.6	2,402.7	258.0	2,568.4	115,696.3
October	1	0.13	0.1%	3.15E+12	9.46E+11	93.5	13.0	1.4	13.9	627.9
November	4	6.07	7.1%	1.53E+14	4.59E+13	4,534.8	632.6	67.9	676.2	30,461.4
December	5	3.13	3.7%	7.87E+13	2.37E+13	2,338.6	326.2	35.0	348.7	15,709.1
Annual	65	85.44	100%	2.15E+15	6.45E+14	63,789.3	8,898.7	955.5	9,512.2	428,492.1

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Manhattan Avenue (RW-2) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
February	2	2.11	5.8%	5.31E+13	1.60E+13	1,578.6	220.2	23.6	235.4	10,604.2
March	1	0.25	0.7%	6.27E+12	1.89E+12	186.4	26.0	2.8	27.8	1,252.3
April	6	2.66	7.3%	6.69E+13	2.01E+13	1,988.1	277.3	29.8	296.5	13,354.9
May	8	3.32	9.1%	8.34E+13	2.51E+13	2,479.2	345.8	37.1	369.7	16,653.4
June	4	2.86	7.8%	7.19E+13	2.16E+13	2,137.1	298.1	32.0	318.7	14,355.7
July	9	9.07	24.9%	2.28E+14	6.85E+13	6,769.1	944.3	101.4	1,009.4	45,470.2
August	7	2.67	7.3%	6.71E+13	2.02E+13	1,992.8	278.0	29.9	297.2	13,386.3
September	6	9.25	25.3%	2.32E+14	6.98E+13	6,902.6	962.9	103.4	1,029.3	46,367.0
October	1	0.03	0.1%	6.54E+11	1.97E+11	19.4	2.7	0.3	2.9	130.7
November	4	2.55	7.0%	6.40E+13	1.93E+13	1,903.1	265.5	28.5	283.8	12,783.9
December	5	1.71	4.7%	4.30E+13	1.29E+13	1,278.7	178.4	19.2	190.7	8,589.2
Annual	53	36.48	100%	9.16E+14	2.76E+14	27,235.3	3,799.4	408.0	4,061.3	182,947.8

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - St. Paul's Avenue (RW-3) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	2	0.48	0.9%	1.21E+13	3.63E+12	358.6	50.0	5.4	53.5	2,408.6
February	2	4.30	8.1%	1.08E+14	3.25E+13	3,210.6	447.9	48.1	478.8	21,566.5
March	2	0.35	0.7%	8.80E+12	2.65E+12	261.5	36.5	3.9	39.0	1,756.5
April	6	4.72	8.9%	1.18E+14	3.56E+13	3,520.6	491.1	52.7	525.0	23,648.9
May	9	3.54	6.6%	8.90E+13	2.68E+13	2,644.6	368.9	39.6	394.4	17,764.9
June	4	2.78	5.2%	6.99E+13	2.10E+13	2,078.2	289.9	31.1	309.9	13,959.8
July	9	12.39	23.3%	3.11E+14	9.36E+13	9,253.0	1,290.8	138.6	1,379.8	62,154.9
August	7	3.63	6.8%	9.12E+13	2.74E+13	2,709.3	378.0	40.6	404.0	18,199.3
September	6	10.84	20.4%	2.72E+14	8.19E+13	8,094.1	1,129.1	121.2	1,207.0	54,370.4
October	1	0.02	0.0%	5.86E+11	1.76E+11	17.4	2.4	0.3	2.6	117.0
November	5	5.92	11.1%	1.49E+14	4.48E+13	4,423.4	617.1	66.3	659.6	29,713.2
December	5	4.29	8.0%	1.08E+14	3.24E+13	3,200.6	446.5	47.9	477.3	21,499.2
Annual	58	53.27	100%	1.34E+15	4.02E+14	39,771.8	5,548.2	595.8	5,930.7	267,159.2

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Van Winkle Avenue (RW-4) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
February	2	1.40	5.5%	3.52E+13	1.06E+13	1,046.8	146.0	15.7	156.1	7,032.0
March	1	0.17	0.6%	4.15E+12	1.25E+12	123.4	17.2	1.8	18.4	828.9
April	6	1.71	6.7%	4.29E+13	1.29E+13	1,275.1	177.9	19.1	190.1	8,565.3
May	8	2.35	9.2%	5.91E+13	1.78E+13	1,756.1	245.0	26.3	261.9	11,796.4
June	4	1.90	7.4%	4.78E+13	1.44E+13	1,420.9	198.2	21.3	211.9	9,544.5
July	9	6.53	25.5%	1.64E+14	4.93E+13	4,874.2	680.0	73.0	726.8	32,741.6
August	6	1.93	7.5%	4.85E+13	1.46E+13	1,442.6	201.2	21.6	215.1	9,690.5
September	6	6.81	26.6%	1.71E+14	5.15E+13	5,087.9	709.8	76.2	758.7	34,177.2
October	1	0.01	0.0%	1.43E+11	4.29E+10	4.2	0.6	0.1	0.6	28.5
November	4	1.71	6.7%	4.30E+13	1.29E+13	1,278.9	178.4	19.2	190.7	8,590.7
December	5	1.08	4.2%	2.72E+13	8.17E+12	807.9	112.7	12.1	120.5	5,426.8
Annual	52	25.61	100%	6.43E+14	1.93E+14	19,118.1	2,667.0	286.4	2,850.9	128,422.4

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Broadway (RW-5) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	3	0.18	1.4%	4.49E+12	1.35E+12	133.3	18.6	2.0	19.9	895.5
February	2	1.20	9.7%	3.02E+13	9.09E+12	898.8	125.4	13.5	134.0	6,037.4
March	2	0.07	0.6%	1.79E+12	5.40E+11	53.3	7.4	0.8	8.0	358.3
April	6	1.00	8.0%	2.51E+13	7.54E+12	744.8	103.9	11.2	111.1	5,003.0
May	7	0.68	5.5%	1.71E+13	5.14E+12	507.6	70.8	7.6	75.7	3,409.7
June	3	0.80	6.5%	2.01E+13	6.05E+12	598.2	83.5	9.0	89.2	4,018.4
July	9	2.80	22.6%	7.03E+13	2.11E+13	2,089.7	291.5	31.3	311.6	14,037.0
August	5	0.79	6.3%	1.98E+13	5.95E+12	588.0	82.0	8.8	87.7	3,950.1
September	5	2.95	23.8%	7.40E+13	2.23E+13	2,200.1	306.9	33.0	328.1	14,778.5
October	1	0.04	0.3%	8.85E+11	2.66E+11	26.3	3.7	0.4	3.9	176.7
November	4	1.39	11.2%	3.49E+13	1.05E+13	1,037.4	144.7	15.5	154.7	6,968.6
December	5	0.51	4.1%	1.29E+13	3.88E+12	383.4	53.5	5.7	57.2	2,575.1
Annual	52	12.40	100%	3.12E+14	9.37E+13	9,260.9	1,291.9	138.7	1,381.0	62,208.4

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Sip Avenue (RW-6) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	5	2.38	2.8%	5.97E+13	1.79E+13	1,773.3	247.4	26.6	264.4	11,912.0
February	2	5.84	6.9%	1.47E+14	4.41E+13	4,361.0	608.4	65.3	650.3	29,294.2
March	3	1.25	1.5%	3.15E+13	9.47E+12	935.8	130.6	14.0	139.6	6,286.4
April	6	9.65	11.3%	2.42E+14	7.29E+13	7,202.5	1,004.8	107.9	1,074.0	48,381.7
May	7	5.86	6.9%	1.47E+14	4.43E+13	4,373.6	610.1	65.5	652.2	29,378.7
June	4	4.32	5.1%	1.09E+14	3.27E+13	3,227.9	450.3	48.4	481.3	21,683.0
July	10	18.14	21.3%	4.56E+14	1.37E+14	13,545.1	1,889.6	202.9	2,019.8	90,986.9
August	6	5.66	6.6%	1.42E+14	4.28E+13	4,224.9	589.4	63.3	630.0	28,380.3
September	5	16.46	19.3%	4.14E+14	1.24E+14	12,289.4	1,714.4	184.1	1,832.6	82,551.8
October	1	1.00	1.2%	2.51E+13	7.54E+12	745.1	103.9	11.2	111.1	5,005.3
November	6	8.95	10.5%	2.25E+14	6.76E+13	6,685.5	932.6	100.1	996.9	44,908.7
December	5	5.71	6.7%	1.43E+14	4.32E+13	4,264.7	594.9	63.9	636.0	28,647.5
Annual	60	85.23	100%	2.14E+15	6.44E+14	63,629.1	8,876.3	953.1	9,488.3	427,416.3

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Duncan Avenue (RW-7) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	3	0.25	0.6%	6.16E+12	1.85E+12	183.0	25.5	2.7	27.3	1,229.2
February	2	3.07	7.4%	7.71E+13	2.32E+13	2,292.2	319.8	34.3	341.8	15,397.5
March	2	0.30	0.7%	7.63E+12	2.29E+12	226.8	31.6	3.4	33.8	1,523.2
April	6	3.94	9.5%	9.91E+13	2.98E+13	2,943.9	410.7	44.1	439.0	19,774.9
May	7	3.16	7.6%	7.94E+13	2.39E+13	2,358.5	329.0	35.3	351.7	15,842.7
June	4	2.47	6.0%	6.22E+13	1.87E+13	1,847.7	257.8	27.7	275.5	12,411.6
July	9	9.80	23.6%	2.46E+14	7.41E+13	7,318.1	1,020.9	109.6	1,091.3	49,158.1
August	5	2.45	5.9%	6.16E+13	1.85E+13	1,831.7	255.5	27.4	273.1	12,304.0
September	6	10.19	24.6%	2.56E+14	7.70E+13	7,607.4	1,061.2	114.0	1,134.4	51,101.3
October	1	0.02	0.0%	3.77E+11	1.13E+11	11.2	1.6	0.2	1.7	75.3
November	4	3.57	8.6%	8.96E+13	2.70E+13	2,664.3	371.7	39.9	397.3	17,896.8
December	5	2.25	5.4%	5.66E+13	1.70E+13	1,682.4	234.7	25.2	250.9	11,301.2
Annual	54	41.48	100%	1.04E+15	3.13E+14	30,967.2	4,320.0	463.9	4,617.8	208,015.9

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Clendenny Avenue (RW-8) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	5	1.42	1.1%	3.58E+13	1.08E+13	1,063.8	148.4	15.9	158.6	7,145.9
February	3	7.75	6.2%	1.95E+14	5.86E+13	5,789.0	807.6	86.7	863.3	38,886.6
March	3	1.06	0.8%	2.65E+13	7.98E+12	788.7	110.0	11.8	117.6	5,297.8
April	6	10.86	8.7%	2.73E+14	8.20E+13	8,107.5	1,131.0	121.4	1,209.0	54,460.3
May	11	10.51	8.4%	2.64E+14	7.94E+13	7,847.5	1,094.7	117.5	1,170.2	52,713.8
June	8	8.04	6.4%	2.02E+14	6.08E+13	6,003.8	837.5	89.9	895.3	40,329.6
July	13	28.60	22.9%	7.18E+14	2.16E+14	21,350.4	2,978.4	319.8	3,183.8	143,417.1
August	7	9.64	7.7%	2.42E+14	7.28E+13	7,197.2	1,004.0	107.8	1,073.2	48,345.5
September	8	29.05	23.3%	7.30E+14	2.19E+14	21,686.1	3,025.2	324.8	3,233.8	145,672.4
October	3	0.58	0.5%	1.45E+13	4.37E+12	432.1	60.3	6.5	64.4	2,902.2
November	8	10.68	8.5%	2.68E+14	8.06E+13	7,970.1	1,111.8	119.4	1,188.5	53,537.5
December	5	6.72	5.4%	1.69E+14	5.08E+13	5,019.7	700.3	75.2	748.5	33,719.0
Annual	80	124.91	100%	3.14E+15	9.44E+14	93,255.8	13,009.3	1,396.9	13,906.2	626,427.6

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Claremont Avenue (RW-9) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	4	0.25	0.5%	6.34E+12	1.91E+12	188.5	26.3	2.8	28.1	1,266.3
February	2	2.83	5.9%	7.12E+13	2.14E+13	2,115.1	295.1	31.7	315.4	14,207.9
March	2	0.47	1.0%	1.18E+13	3.56E+12	351.8	49.1	5.3	52.5	2,363.0
April	6	4.06	8.4%	1.02E+14	3.07E+13	3,029.8	422.7	45.4	451.8	20,351.8
May	9	4.27	8.8%	1.07E+14	3.23E+13	3,189.5	444.9	47.8	475.6	21,425.0
June	5	3.35	6.9%	8.40E+13	2.53E+13	2,497.5	348.4	37.4	372.4	16,776.5
July	9	11.59	23.9%	2.91E+14	8.76E+13	8,653.9	1,207.2	129.6	1,290.5	58,131.2
August	7	3.66	7.6%	9.20E+13	2.77E+13	2,733.4	381.3	40.9	407.6	18,361.1
September	6	11.87	24.5%	2.98E+14	8.96E+13	8,859.4	1,235.9	132.7	1,321.1	59,511.0
October	1	0.04	0.1%	1.08E+12	3.25E+11	32.1	4.5	0.5	4.8	215.9
November	5	3.63	7.5%	9.13E+13	2.75E+13	2,713.8	378.6	40.7	404.7	18,229.2
December	5	2.38	4.9%	5.99E+13	1.80E+13	1,778.8	248.1	26.6	265.2	11,948.5
Annual	61	48.41	100%	1.22E+15	3.66E+14	36,143.5	5,042.1	541.4	5,389.7	242,787.3

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Fisk Street (RW-10) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	1	0.01	0.0%	3.37E+11	1.01E+11	10.0	1.4	0.1	1.5	67.2
February	2	1.75	5.1%	4.41E+13	1.32E+13	1,309.2	182.6	19.6	195.2	8,794.2
March	1	0.06	0.2%	1.50E+12	4.50E+11	44.5	6.2	0.7	6.6	298.6
April	6	1.94	5.6%	4.89E+13	1.47E+13	1,452.0	202.6	21.8	216.5	9,753.9
May	6	3.17	9.1%	7.97E+13	2.40E+13	2,369.4	330.5	35.5	353.3	15,916.3
June	2	2.40	6.9%	6.03E+13	1.81E+13	1,791.6	249.9	26.8	267.2	12,035.0
July	9	8.20	23.6%	2.06E+14	6.20E+13	6,123.1	854.2	91.7	913.1	41,130.6
August	4	2.82	8.1%	7.09E+13	2.13E+13	2,106.0	293.8	31.5	314.0	14,146.8
September	5	10.23	29.5%	2.57E+14	7.72E+13	7,634.2	1,065.0	114.4	1,138.4	51,281.2
October	0	0.00	0.0%	0.00E+00	0.00E+00	-	-	-	-	-
November	3	2.95	8.5%	7.40E+13	2.23E+13	2,200.4	307.0	33.0	328.1	14,780.8
December	5	1.15	3.3%	2.89E+13	8.69E+12	859.2	119.9	12.9	128.1	5,771.3
Annual	44	34.69	100%	8.71E+14	2.62E+14	25,899.7	3,613.0	388.0	3,862.1	173,975.9

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - North and South Danforth Avenue (RW-11/12) Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	2	0.09	0.1%	2.37E+12	7.13E+11	70.5	9.8	1.1	10.5	473.2
February	5	4.16	5.5%	1.04E+14	3.14E+13	3,103.2	432.9	46.5	462.8	20,845.5
March	1	0.18	0.2%	4.65E+12	1.40E+12	138.1	19.3	2.1	20.6	927.5
April	11	3.55	4.7%	8.91E+13	2.68E+13	2,647.2	369.3	39.7	394.7	17,782.1
May	10	6.91	9.1%	1.74E+14	5.22E+13	5,157.1	719.4	77.3	769.0	34,641.9
June	10	5.46	7.2%	1.37E+14	4.13E+13	4,079.1	569.0	61.1	608.3	27,400.3
July	16	17.49	23.1%	4.39E+14	1.32E+14	13,060.7	1,822.0	195.6	1,947.6	87,733.0
August	9	6.32	8.3%	1.59E+14	4.77E+13	4,715.1	657.8	70.6	703.1	31,672.8
September	8	21.83	28.8%	5.48E+14	1.65E+14	16,298.1	2,273.6	244.1	2,430.4	109,479.4
October	3	0.11	0.1%	2.80E+12	8.42E+11	83.2	11.6	1.2	12.4	558.7
November	6	7.03	9.3%	1.77E+14	5.31E+13	5,249.0	732.2	78.6	782.7	35,259.0
December	8	2.73	3.6%	6.85E+13	2.06E+13	2,036.8	284.1	30.5	303.7	13,681.8
Annual	89	75.86	100%	1.91E+15	5.73E+14	56,638.0	7,901.1	848.4	8,445.8	380,455.1

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Typical Year Analysis - Mina Drive (RW-13) Wasteloads

	Total (All CSO Events)			**Pollutant Loadings**						
Month	**Days of Overflow**	**Volume (MG)**	**% of Annual Volume**	**Fecal**	**Entero**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	5	1.73	1.9%	4.35E+13	1.31E+13	1,293.9	180.5	19.4	193.0	8,691.8
February	2	6.04	6.5%	1.52E+14	4.57E+13	4,512.3	629.5	67.6	672.9	30,310.4
March	9	1.49	1.6%	3.73E+13	1.12E+13	1,109.0	154.7	16.6	165.4	7,449.8
April	10	9.10	9.7%	2.29E+14	6.88E+13	6,797.0	948.2	101.8	1,013.6	45,657.5
May	12	7.31	7.8%	1.84E+14	5.52E+13	5,454.2	760.9	81.7	813.3	36,637.8
June	8	5.60	6.0%	1.41E+14	4.23E+13	4,182.3	583.4	62.6	623.7	28,093.8
July	10	20.24	21.6%	5.08E+14	1.53E+14	15,112.1	2,108.2	226.4	2,253.5	101,512.6
August	8	7.15	7.6%	1.80E+14	5.40E+13	5,335.8	744.3	79.9	795.7	35,842.0
September	8	19.20	20.5%	4.82E+14	1.45E+14	14,335.0	1,999.7	214.7	2,137.6	96,292.4
October	2	0.86	0.9%	2.16E+13	6.50E+12	642.3	89.6	9.6	95.8	4,314.8
November	9	8.99	9.6%	2.26E+14	6.79E+13	6,708.2	935.8	100.5	1,000.3	45,061.1
December	7	5.89	6.3%	1.48E+14	4.45E+13	4,396.2	613.3	65.9	655.6	29,530.7
Annual	90	93.60	100%	2.35E+15	7.07E+14	69,878.4	9,748.1	1,046.7	10,420.2	469,394.6

Note: For pollutant loadings, Fecal and Entero are in MPN units, while all remaining numbers are in pounds.

APPENDIX H

2004 Wasteload Tables – Daily Values

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
1/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/3/2004	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/4/2004	0.29	0.09	0.02	0	0	0	0	0.16	0	0.07	0	0	0	0.22	0.47	1.19E+13	3.58E+12	354.00	52.79	5.30	52.79	2377.95
1/5/2004	0.40	0.07	0.01	0	0.02	0	0.05	0.51	0.02	0.31	0.03	0	0	0.43	1.37	3.43E+13	1.03E+13	1019.81	152.07	15.28	152.07	6850.39
1/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/13/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/14/2004	0.07	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/18/2004	0.55	0.08	0	0	0.46	0	0.11	1.41	0.22	0.93	0.18	0.01	0.01	1.02	4.38	1.10E+14	3.31E+13	3266.77	487.14	48.93	487.14	21943.92
1/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.08	2.04E+12	6.12E+11	60.50	9.02	0.91	9.02	406.37
1/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/27/2004	0.26	0.09	0.06	0	0	0	0.02	0.09	0.01	0.11	0.04	0	0	0.04	0.38	9.60E+12	2.89E+12	285.34	42.55	4.27	42.55	1916.72
1/28/2004	0.06	0.03	0.01	0	0	0	0	0.21	0	0.01	0	0	0	0.01	0.24	6.01E+12	1.81E+12	178.63	26.64	2.68	26.64	1199.94
1/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/3/2004	0.77	0.23	1.37	0.78	1.84	0.53	0.18	1.79	1.00	2.43	0.95	0.41	0.95	1.92	14.15	3.55E+14	1.07E+14	10564.64	1575.39	158.25	1575.39	70965.93
2/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0.10	2.48E+12	7.46E+11	73.76	11.00	1.10	11.00	495.44
2/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/6/2004	1.58	0.30	2.56	1.34	2.46	0.87	1.02	4.05	2.07	5.32	1.88	1.35	2.89	4.12	29.93	7.52E+14	2.26E+14	22347.82	3332.49	334.76	3332.49	150117.17
2/7/2004	0.05	0.02	0	0	0	0	0	0	0	0	0	0	0.16	0	0.16	4.12E+12	1.24E+12	122.46	18.26	1.83	18.26	822.62
2/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0	0.06	1.50E+12	4.52E+11	44.72	6.67	0.67	6.67	300.38
2/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
2/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/21/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/24/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/2/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/4/2004	0.23	0.09	0.01	0	0	0	0	0.09	0	0	0	0	0	0.18	0.28	7.15E+12	2.15E+12	212.48	31.68	3.18	31.68	1427.29
3/5/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/6/2004	0.30	0.06	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	1.34E+12	4.04E+11	39.93	5.95	0.60	5.95	268.20
3/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/8/2004	0.58	0.10	0.10	0	0.04	0	0.03	0.59	0.02	0.29	0.12	0	0	0.35	1.55	3.89E+13	1.17E+13	1155.95	172.37	17.32	172.37	7764.84
3/9/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/16/2004	0.13	0.06	0	0	0	0	0	0	0	0	0	0	0	0.10	0.10	2.58E+12	7.77E+11	76.76	11.45	1.15	11.45	515.60
3/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/19/2004	0.25	0.06	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	1.23E+12	3.71E+11	36.66	5.47	0.55	5.47	246.26
3/20/2004	0.04	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/21/2004	0.11	0.06	0	0	0	0	0	0	0	0	0	0	0	0.10	0.10	2.48E+12	7.47E+11	73.83	11.01	1.11	11.01	495.96
3/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/25/2004	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0	0.02	0.02	3.79E+11	1.14E+11	11.26	1.68	0.17	1.68	75.64
3/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/27/2004	0.14	0.05	0	0	0	0	0	0	0	0	0	0	0	0.02	0.02	6.13E+11	1.84E+11	18.21	2.71	0.27	2.71	122.29
3/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/31/2004	0.41	0.23	0.57	0.25	0.31	0.17	0.04	0.57	0.28	0.77	0.35	0.06	0.18	0.62	4.16	1.05E+14	3.14E+13	3108.06	463.47	46.56	463.47	20877.82
4/1/2004	0.51	0.24	1.17	0.47	0.44	0.27	0.02	0.89	0.46	1.40	0.59	0.25	0.54	1.18	7.67	1.93E+14	5.80E+13	5727.84	854.13	85.80	854.13	38475.67
4/2/2004	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0.02	0	0.03	6.64E+11	2.00E+11	19.72	2.94	0.30	2.94	132.48
4/3/2004	0.10	0.04	0	0	0	0	0	0	0	0	0	0	0.04	0.02	0.07	1.65E+12	4.95E+11	48.95	7.30	0.73	7.30	328.80
4/4/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03	7.69E+11	2.31E+11	22.84	3.41	0.34	3.41	153.43
4/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0	0.09	2.36E+12	7.10E+11	70.21	10.47	1.05	10.47	471.62

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
4/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/8/2004	0.14	0.05	0	0	0	0	0	0	0	0	0	0	0	0.10	0.10	2.51E+12	7.56E+11	74.67	11.13	1.12	11.13	501.55
4/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/12/2004	0.58	0.12	0.47	0.17	0.51	0.07	0.22	0.98	0.33	1.22	0.37	0.13	0	1.12	5.59	1.40E+14	4.22E+13	4170.77	621.94	62.48	621.94	28016.36
4/13/2004	1.09	0.25	2.05	1.01	1.64	0.69	0.23	3.10	1.33	3.38	1.35	0.65	1.19	2.57	19.21	4.82E+14	1.45E+14	14338.69	2138.17	214.78	2138.17	96317.39
4/14/2004	0.42	0.24	0.58	0.26	0.24	0.18	0.03	0.82	0.36	0.93	0.39	0.13	0.31	0.77	5.01	1.26E+14	3.79E+13	3743.53	558.23	56.08	558.23	25146.42
4/15/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	1.02E+12	3.06E+11	30.26	4.51	0.45	4.51	203.26
4/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/21/2004	0.05	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/23/2004	0.11	0.04	0	0	0	0	0	0	0	0	0	0	0	0.02	0.02	5.55E+11	1.67E+11	16.49	2.46	0.25	2.46	110.75
4/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	1.58E+11	4.74E+10	4.68	0.70	0.07	0.70	31.45
4/25/2004	0.09	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/26/2004	1.57	0.23	1.59	0.65	1.55	0.43	0.48	3.40	1.27	3.54	1.22	0.68	1.01	3.02	18.83	4.73E+14	1.42E+14	14058.64	2096.41	210.59	2096.41	94436.19
4/27/2004	0.01	0.01	0.02	0.11	0.32	0.06	0.01	0.46	0.18	0.38	0.14	0.11	0.20	0.30	2.32	5.82E+13	1.75E+13	1729.35	257.88	25.90	257.88	11616.57
4/28/2004	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0.07	0	0.07	1.85E+12	5.58E+11	55.11	8.22	0.83	8.22	370.22
4/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/2/2004	0.12	0.09	0.02	0	0	0	0	0	0	0	0	0	0	0.02	0.04	1.07E+12	3.21E+11	31.70	4.73	0.47	4.73	212.93
5/3/2004	0.37	0.08	0	0	0	0	0	0	0	0	0	0	0.03	0.09	0.12	3.14E+12	9.44E+11	93.31	13.91	1.40	13.91	626.77
5/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	1.01E+12	3.04E+11	30.08	4.49	0.45	4.49	202.06
5/5/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/7/2004	0.20	0.08	0.08	0	0.01	0.01	0	0	0	0.09	0.02	0	0.01	0.18	0.40	1.01E+13	3.03E+12	299.25	44.62	4.48	44.62	2010.18
5/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/9/2004	0.05	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/10/2004	0.14	0.14	0.18	0	0	0	0	0	0	0	0	0	0	0	0.18	4.64E+12	1.39E+12	137.82	20.55	2.06	20.55	925.79
5/11/2004	0.61	0.43	2.01	0.99	0.89	0.69	0.08	1.34	0.90	2.71	1.15	0.71	1.74	1.77	14.99	3.76E+14	1.13E+14	11189.01	1668.50	167.60	1668.50	75160.03
5/12/2004	1.08	0.69	3.55	1.09	1.26	0.92	0.09	2.16	0.99	3.99	1.61	1.61	2.77	2.78	22.84	5.74E+14	1.73E+14	17053.23	2542.96	255.45	2542.96	114551.77
5/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.04	8.81E+11	2.65E+11	26.17	3.90	0.39	3.90	175.79
5/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/15/2004	0.73	0.37	2.14	0.85	0.78	0.59	0.25	1.00	0.79	2.32	1.02	0.67	1.73	1.46	13.58	3.41E+14	1.03E+14	10138.70	1511.87	151.87	1511.87	68104.76
5/16/2004	0.06	0.06	0.06	0.10	0.33	0.05	0.21	0.52	0.24	0.58	0.15	0.15	0.29	0.52	3.20	8.05E+13	2.42E+13	2392.65	356.79	35.84	356.79	16072.19
5/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/19/2004	0.13	0.06	0	0	0	0	0	0	0	0	0	0	0	0.04	0.04	1.03E+12	3.09E+11	30.56	4.56	0.46	4.56	205.30
5/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
5/24/2004	0.05	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/26/2004	0.17	0.15	0.13	0.03	0.02	0.02	0	0	0.01	0.14	0.03	0	0	0.19	0.57	1.44E+13	4.34E+12	428.90	63.96	6.42	63.96	2881.07
5/27/2004	0.19	0.11	0.08	0.02	0.01	0	0.01	0.07	0	0.01	0.03	0	0	0.02	0.27	6.75E+12	2.03E+12	200.75	29.94	3.01	29.94	1348.51
5/28/2004	0.33	0.23	0.39	0.19	0.09	0.07	0.01	0.19	0.10	0.44	0.15	0.01	0.15	0.07	1.87	4.71E+13	1.42E+13	1399.16	208.64	20.96	208.64	9398.58
5/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0.10	2.57E+12	7.73E+11	76.41	11.39	1.14	11.39	513.25
5/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/31/2004	0.35	0.14	0.13	0.05	0.15	0.01	0.03	0.57	0.13	0.23	0.10	0.01	0	0.16	1.57	3.94E+13	1.19E+13	1172.35	174.82	17.56	174.82	7875.07
6/1/2004	0.24	0.11	0.05	0	0	0	0	0	0	0.02	0	0	0.04	0.12	0.23	5.76E+12	1.73E+12	171.14	25.52	2.56	25.52	1149.58
6/2/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.06	0	0.07	1.69E+12	5.08E+11	50.18	7.48	0.75	7.48	337.10
6/3/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	1.13E+12	3.38E+11	33.45	4.99	0.50	4.99	224.68
6/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03	8.27E+11	2.49E+11	24.59	3.67	0.37	3.67	165.18
6/5/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/6/2004	0.15	0.09	0.01	0	0	0	0	0	0	0	0	0	0	0.09	0.10	2.42E+12	7.27E+11	71.88	10.72	1.08	10.72	482.85
6/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/10/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/11/2004	0.14	0.09	0	0	0	0	0	0	0	0	0	0	0	0.02	0.02	4.58E+11	1.38E+11	13.60	2.03	0.20	2.03	91.37
6/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/17/2004	0.22	0.10	0.24	0.06	0.03	0.03	0.02	0.22	0.02	0.10	0.07	0	0	0.04	0.83	2.08E+13	6.25E+12	617.44	92.07	9.25	92.07	4147.51
6/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.02	5.16E+11	1.55E+11	15.34	2.29	0.23	2.29	103.07
6/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/22/2004	0.57	0.41	1.45	0.63	0.66	0.42	0.04	1.12	0.52	1.85	0.77	0.45	0.71	1.32	9.96	2.50E+14	7.53E+13	7437.30	1109.04	111.41	1109.04	49958.61
6/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	1.06E+12	3.18E+11	31.45	4.69	0.47	4.69	211.26
6/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25/2004	1.39	0.51	4.46	2.09	2.04	1.41	0.74	2.97	1.91	5.80	2.42	1.95	4.31	3.73	33.81	8.49E+14	2.55E+14	25238.14	3763.49	378.05	3763.49	169532.33
6/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.09	2.24E+12	6.75E+11	66.69	9.95	1.00	9.95	448.01
6/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29/2004	0.20	0.18	0.22	0.08	0.05	0.05	0	0.01	0.03	0.28	0.08	0	0.13	0.27	1.20	3.01E+13	9.05E+12	894.54	133.39	13.40	133.39	6008.91
6/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	3.04E+11	9.13E+10	9.02	1.35	0.14	1.35	60.60
7/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5/2004	1.00	0.71	3.46	0.98	1.12	0.81	0.14	1.33	0.83	3.44	1.39	0.94	1.84	2.25	18.53	4.65E+14	1.40E+14	13831.33	2062.52	207.18	2062.52	92909.33
7/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.07	0	0.07	1.66E+12	4.99E+11	49.28	7.35	0.74	7.35	331.04
7/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
7/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12/2004	1.56	0.31	2.90	1.57	3.00	1.17	0.51	3.53	2.13	5.25	2.05	1.45	2.90	3.90	30.34	7.62E+14	2.29E+14	22653.29	3378.04	339.33	3378.04	152169.14
7/13/2004	0.43	0.11	0.19	0.13	0.64	0.06	0.16	1.21	0.34	1.00	0.28	0.11	0.54	0.94	5.62	1.41E+14	4.25E+13	4196.93	625.84	62.87	625.84	28192.04
7/14/2004	0.38	0.29	0.45	0.29	0.21	0.25	0.03	0.77	0.20	0.43	0.35	0.06	0.05	0.46	3.54	8.88E+13	2.67E+13	2639.94	393.67	39.54	393.67	17733.31
7/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0.10	2.49E+12	7.50E+11	74.14	11.06	1.11	11.06	498.00
7/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18/2004	1.58	0.54	5.14	2.15	1.99	1.61	0.34	3.52	1.88	6.26	2.71	2.11	3.77	4.16	35.64	8.95E+14	2.69E+14	26609.73	3968.02	398.60	3968.02	178745.72
7/19/2004	0.02	0.01	0.01	0	0	0	0	0.11	0	0.01	0	0	0.12	0.14	0.39	9.81E+12	2.95E+12	291.53	43.47	4.37	43.47	1958.31
7/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	9.46E+11	2.85E+11	28.12	4.19	0.42	4.19	188.90
7/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23/2004	1.63	0.35	3.78	1.94	2.48	1.29	0.87	3.97	2.34	6.18	2.41	1.80	3.50	4.14	34.71	8.72E+14	2.62E+14	25911.35	3863.88	388.14	3863.88	174054.50
7/24/2004	0.03	0.01	0	0	0	0	0	0	0	0.01	0	0	0.21	0	0.23	5.66E+12	1.70E+12	168.17	25.08	2.52	25.08	1129.63
7/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/27/2004	1.39	0.36	3.51	1.68	2.61	1.13	0.63	3.06	1.85	5.14	2.05	1.50	3.57	3.45	30.17	7.58E+14	2.28E+14	22524.58	3358.84	337.40	3358.84	151304.52
7/28/2004	0.06	0.03	0	0.03	0.15	0.01	0.08	0.29	0.07	0.21	0.04	0.04	0.11	0.24	1.28	3.22E+13	9.67E+12	955.58	142.50	14.31	142.50	6418.94
7/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	2.05E+11	6.18E+10	6.10	0.91	0.09	0.91	41.01
7/30/2004	0.31	0.26	0.47	0.29	0.21	0.20	0.02	0.35	0.15	0.69	0.30	0.20	0.61	0.56	4.06	1.02E+14	3.06E+13	3028.19	451.56	45.36	451.56	20341.26
7/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.08	2.07E+12	6.22E+11	61.47	9.17	0.92	9.17	412.90
8/1/2004	0.28	0.10	0.20	0.03	0.07	0.01	0.03	0.39	0.04	0.17	0.06	0	0.02	0.35	1.36	3.42E+13	1.03E+13	1015.30	151.40	15.21	151.40	6820.09
8/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	9.65E+11	2.90E+11	28.68	4.28	0.43	4.28	192.66
8/3/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/4/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/11/2004	0.61	0.25	0.98	0.50	0.73	0.28	0.12	1.01	0.55	1.78	0.64	0.34	0.62	1.23	8.80	2.21E+14	6.65E+13	6567.06	979.27	98.37	979.27	44112.94
8/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0	0.02	5.93E+11	1.78E+11	17.64	2.63	0.26	2.63	118.48
8/13/2004	0.20	0.12	0.13	0.02	0.01	0	0	0.14	0	0.07	0.02	0	0	0.08	0.47	1.19E+13	3.59E+12	354.40	52.85	5.31	52.85	2380.61
8/14/2004	0.21	0.13	0.14	0.04	0.02	0.02	0	0	0	0.18	0.05	0	0.08	0.22	0.74	1.86E+13	5.60E+12	553.27	82.50	8.29	82.50	3716.48
8/15/2004	0.31	0.11	0.19	0.14	0.56	0.06	0.30	0.90	0.35	1.00	0.31	0.11	0.49	0.86	5.28	1.33E+14	3.99E+13	3939.39	587.44	59.01	587.44	26462.07
8/16/2004	0.95	0.56	2.67	1.08	0.98	0.84	0.29	1.46	0.88	3.17	1.37	1.09	2.25	2.07	18.14	4.56E+14	1.37E+14	13541.41	2019.28	202.84	2019.28	90961.83
8/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.05	1.16E+12	3.48E+11	34.37	5.13	0.51	5.13	230.90
8/18/2004	0.05	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/2004	0.85	0.80	3.01	0.87	1.25	0.72	0.05	1.76	0.64	3.27	1.23	1.28	2.76	2.23	19.07	4.79E+14	1.44E+14	14233.76	2122.52	213.21	2122.52	95612.52
8/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
8/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/31/2004	0.17	0.06	0	0	0	0	0	0	0	0	0	0	0	0.10	0.10	2.51E+12	7.55E+11	74.60	11.12	1.12	11.12	501.08
9/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	2.57E+11	7.74E+10	7.65	1.14	0.11	1.14	51.40
9/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/7/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/8/2004	2.08	0.48	6.33	2.58	3.04	1.99	0.93	4.48	2.66	8.14	3.46	3.18	6.31	5.40	48.51	1.22E+15	3.67E+14	36220.10	5401.11	542.55	5401.11	243301.54
9/9/2004	0.29	0.16	0.33	0.13	0.07	0.06	0	0	0.04	0.29	0.10	0	0.10	0.13	1.26	3.15E+13	9.48E+12	937.20	139.75	14.04	139.75	6295.45
9/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	3.14E+11	9.45E+10	9.34	1.39	0.14	1.39	62.74
9/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/15/2004	0.38	0.26	0.72	0.32	0.19	0.17	0.04	0.67	0.33	0.85	0.37	0.05	0	0.52	4.23	1.06E+14	3.20E+13	3159.69	471.17	47.33	471.17	21224.64
9/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0.04	0.34	8.53E+12	2.57E+12	253.51	37.80	3.80	37.80	1702.91
9/17/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2004	1.41	1.32	5.36	1.08	1.57	1.18	0.04	2.99	1.27	4.55	1.77	2.34	4.67	3.42	30.25	7.60E+14	2.28E+14	22581.34	3367.31	338.25	3367.31	151685.82
9/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/28/2004	3.08	0.50	8.95	4.32	4.53	2.87	1.25	6.58	4.64	12.49	5.12	3.84	8.28	7.66	70.53	1.77E+15	5.33E+14	52657.41	7852.22	788.77	7852.22	353715.99
9/29/2004	0.60	0.24	1.35	0.82	1.43	0.54	0.69	1.73	1.26	2.73	1.03	0.81	2.15	1.97	16.51	4.15E+14	1.25E+14	12325.27	1837.93	184.62	1837.93	82792.61
9/30/2004	0.11	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0.06	0.09	2.38E+12	7.16E+11	70.75	10.55	1.06	10.55	475.22
10/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.05	1.21E+12	3.63E+11	35.90	5.35	0.54	5.35	241.14
10/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/14/2004	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
10/15/2004	0.19	0.05	0	0	0	0	0	0	0	0.01	0	0	0	0.10	0.11	2.78E+12	8.35E+11	82.47	12.30	1.24	12.30	554.00
10/16/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.06	0	0.06	1.59E+12	4.78E+11	47.26	7.05	0.71	7.05	317.46
10/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	2.30E+11	6.91E+10	6.83	1.02	0.10	1.02	45.87
10/18/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/19/2004	0.53	0.13	0.13	0.03	0.02	0.01	0.04	1.00	0.02	0.57	0.04	0	0	0.76	2.60	6.53E+13	1.96E+13	1941.02	289.44	29.08	289.44	13038.43
10/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/21/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/30/2004	0.04	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/2004	1.00	0.22	1.57	0.90	1.82	0.52	0.56	2.39	1.43	3.42	1.23	0.82	1.67	2.62	18.94	4.76E+14	1.43E+14	14143.91	2109.13	211.87	2109.13	95008.99
11/5/2004	0.03	0.02	0	0	0	0	0	0	0	0	0	0	0.19	0.01	0.20	5.04E+12	1.52E+12	149.74	22.33	2.24	22.33	1005.82
11/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/2004	0.93	0.09	0.15	0.12	0.82	0.03	0.37	2.45	0.43	1.67	0.37	0.07	0.20	1.84	8.52	2.14E+14	6.43E+13	6358.58	948.19	95.25	948.19	42712.51
11/13/2004	0.15	0.05	0	0	0.05	0	0.07	0.55	0.02	0.19	0.02	0	0.14	0.33	1.36	3.41E+13	1.03E+13	1014.41	151.27	15.20	151.27	6814.13
11/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/20/2004	0.27	0.08	0.10	0.01	0.01	0.01	0	0.17	0	0.21	0.01	0	0	0.29	0.82	2.06E+13	6.19E+12	611.39	91.17	9.16	91.17	4106.92
11/21/2004	0	0	0	0	0	0	0	0.08	0	0	0	0	0	0.02	0.10	2.47E+12	7.43E+11	73.40	10.95	1.10	10.95	493.04
11/22/2004	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/24/2004	0.21	0.05	0	0	0	0	0	0	0	0	0	0	0	0.07	0.07	1.76E+12	5.29E+11	52.25	7.79	0.78	7.79	351.00
11/25/2004	0.22	0.08	0	0	0	0	0	0	0	0	0	0	0	0.15	0.15	3.80E+12	1.14E+12	112.98	16.85	1.69	16.85	758.94
11/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0	0.06	1.51E+12	4.54E+11	44.84	6.69	0.67	6.69	301.21
11/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/2004	1.50	0.78	4.26	1.53	3.23	1.16	0.38	3.31	1.69	5.19	2.00	2.05	4.77	3.66	33.23	8.35E+14	2.51E+14	24808.68	3699.45	371.62	3699.45	166647.50
11/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/1/2004	1.00	0.18	1.64	0.95	2.59	0.63	0.17	2.40	1.21	3.23	1.16	0.48	1.44	2.62	18.54	4.66E+14	1.40E+14	13842.70	2064.21	207.35	2064.21	92985.70

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Daily Wasteloads - West Side

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RW-1 Daily Overflow Volume (MG)	RW-2 Daily Overflow Volume (MG)	RW-3 Daily Overflow Volume (MG)	RW-4 Daily Overflow Volume (MG)	RW-5 Daily Overflow Volume (MG)	RW-6 Daily Overflow Volume (MG)	RW-7 Daily Overflow Volume (MG)	RW-8 Daily Overflow Volume (MG)	RW-9 Daily Overflow Volume (MG)	RW-10 Daily Overflow Volume (MG)	RW-11/12 Daily Overflow Volume (MG)	RW-13 Daily Overflow Volume (MG)	West Side Daily Overflow Volume (MG)	West Side Fecal (cfu)	West Side Entero (cfu)	West Side CBOD (lbs)	TKN (lbs)	West Side TP (lbs)	West Side TN (lbs)	West Side TSS (lbs)
12/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/6/2004	0.19	0.05	0	0	0	0	0	0	0	0	0	0	0	0.03	0.03	6.76E+11	2.03E+11	20.10	3.00	0.30	3.00	134.99
12/7/2004	0.57	0.20	0.45	0.18	0.33	0.12	0.06	1.04	0.31	0.91	0.33	0.11	0.09	0.81	4.75	1.19E+14	3.59E+13	3548.24	529.11	53.15	529.11	23834.63
12/8/2004	0.07	0.05	0	0	0	0	0	0	0	0	0	0	0.13	0.02	0.15	3.80E+12	1.14E+12	113.08	16.86	1.69	16.86	759.56
12/9/2004	0.39	0.10	0.15	0.02	0.11	0.01	0.08	0.32	0.13	0.42	0.13	0.01	0	0.45	1.84	4.61E+13	1.39E+13	1370.04	204.30	20.52	204.30	9203.00
12/10/2004	0.35	0.07	0.02	0.06	0.38	0.02	0.14	0.59	0.16	0.53	0.13	0.05	0	0.54	2.61	6.57E+13	1.98E+13	1952.09	291.09	29.24	291.09	13112.82
12/11/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.11	0	0.12	3.01E+12	9.06E+11	89.57	13.36	1.34	13.36	601.70
12/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0.04	1.00E+12	3.02E+11	29.83	4.45	0.45	4.45	200.39
12/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/19/2004	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/20/2004	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/23/2004	0.62	0.30	0.87	0.50	0.88	0.30	0.07	1.35	0.45	1.62	0.63	0.50	0.86	1.41	9.45	2.37E+14	7.14E+13	7054.81	1052.01	105.68	1052.01	47389.36
12/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0	0.02	4.78E+11	1.44E+11	14.20	2.12	0.21	2.12	95.39
12/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/27/2004	0.09	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03	7.05E+11	2.12E+11	20.95	3.12	0.31	3.12	140.73
12/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANNUAL TOTAL	**47.54**	**18.42**	**85.45**	**36.49**	**53.28**	**25.62**	**12.47**	**85.23**	**41.48**	**124.91**	**48.41**	**34.69**	**75.87**	**93.65**	**717.55**	**1.80E+16**	**5.42E+15**	**535,689.29**	**79,881.51**	**8,024.28**	**79,881.51**	**3,598,389.76**
January Totals	1.67	0.40	0.11	0.01	0.48	0	0.18	2.38	0.25	1.42	0.25	0.01	0.09	1.74	6.92	1.74E+14	5.23E+13	5,165.06	770.21	77.37	770.21	34,695.29
February Totals	2.43	0.57	3.93	2.11	4.30	1.40	1.21	5.84	3.07	7.75	2.83	1.75	4.16	6.05	44.41	1.12E+15	3.35E+14	33,153.39	4,943.80	496.62	4,943.80	222,701.53
March Totals	2.36	0.84	0.69	0.25	0.35	0.17	0.07	1.25	0.30	1.06	0.47	0.06	0.18	1.49	6.35	1.59E+14	4.79E+13	4,733.13	705.80	70.90	705.80	31,793.91
April Totals	4.84	1.41	5.88	2.66	4.72	1.71	1.01	9.65	3.94	10.86	4.06	1.94	3.55	9.11	59.09	1.48E+15	4.46E+14	44,111.74	6,577.90	660.77	6,577.90	296,312.14
May Totals	4.59	2.72	8.77	3.32	3.54	2.36	0.68	5.86	3.16	10.51	4.27	3.17	6.91	7.31	59.87	1.50E+15	4.52E+14	44,700.06	6,665.63	669.58	6,665.63	300,264.07
June Totals	2.96	1.53	6.42	2.86	2.79	1.90	0.81	4.32	2.47	8.04	3.35	2.40	5.46	5.61	46.44	1.17E+15	3.51E+14	34,674.76	5,170.67	519.41	5,170.67	232,921.06
July Totals	8.39	2.98	19.91	9.07	12.39	6.53	2.81	18.14	9.80	28.60	11.59	8.20	17.49	20.25	164.79	4.14E+15	1.24E+15	123,029.73	18,346.08	1,842.91	18,346.08	826,428.56
August Totals	3.70	2.24	7.33	2.67	3.63	1.94	0.79	5.66	2.45	9.64	3.66	2.82	6.32	7.15	54.06	1.36E+15	4.08E+14	40,359.87	6,018.43	604.57	6,018.43	271,109.67
September Totals	8.02	3.07	23.07	9.25	10.84	6.81	2.95	16.46	10.19	29.05	11.87	10.23	21.83	19.20	171.75	4.31E+15	1.30E+15	128,222.25	19,120.39	1,920.69	19,120.39	861,308.31
October Totals	0.86	0.27	0.13	0.03	0.02	0.01	0.04	1.00	0.02	0.58	0.04	0	0.11	0.87	2.84	7.11E+13	2.14E+13	2,113.48	315.16	31.66	315.16	14,196.89
November Totals	4.35	1.41	6.07	2.55	5.92	1.71	1.39	8.95	3.57	10.68	3.63	2.95	7.04	8.99	63.46	1.59E+15	4.79E+14	47,370.18	7,063.80	709.58	7,063.80	318,200.06
December Totals	3.37	0.99	3.13	1.71	4.29	1.08	0.52	5.71	2.25	6.72	2.38	1.15	2.73	5.89	37.58	9.44E+14	2.84E+14	28,055.63	4,183.63	420.26	4,183.63	188,458.27

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
1/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/3/2004	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/4/2004	0.29	0.09	0	0	0	0	0	0	0	0	0.61	0.61	2.20E+13	5.57E+12	404.26	56.61	14.43	56.61	528.75
1/5/2004	0.40	0.07	0	0	0	0	0	0	0	0	1.11	1.11	3.98E+13	1.01E+13	731.55	102.45	26.12	102.45	956.82
1/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/13/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/14/2004	0.07	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/18/2004	0.55	0.08	0	0	0.28	0	0	0.15	0.21	0.24	2.56	3.44	1.23E+14	3.12E+13	2265.26	317.23	80.87	317.23	2962.80
1/19/2004	0	0	0	0	0	0	0.06	0	0.03	0	0	0.09	3.35E+12	8.48E+11	61.60	8.63	2.20	8.63	80.57
1/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/27/2004	0.26	0.09	0	0	0	0	0	0	0	0.02	0.74	0.76	2.73E+13	6.91E+12	501.82	70.28	17.92	70.28	656.34
1/28/2004	0.06	0.03	0	0	0	0	0	0	0.01	0	0.75	0.75	2.70E+13	6.83E+12	495.91	69.45	17.70	69.45	648.62
1/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/3/2004	0.77	0.23	0.04	0.13	1.54	1.53	1.21	0.94	0.22	1.80	3.67	11.08	3.97E+14	1.01E+14	7298.54	1022.11	260.56	1022.11	9545.99
2/4/2004	0	0	0	0	0	0	0.03	0	0.02	0	0	0.04	1.47E+12	3.71E+11	26.95	3.77	0.96	3.77	35.25
2/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/6/2004	1.58	0.30	0.50	0.63	3.74	5.87	3.68	2.28	0.34	4.28	7.21	28.54	1.02E+15	2.59E+14	18797.16	2632.42	671.07	2632.42	24585.40
2/7/2004	0.05	0.02	0	0	0	0	0	0	0.02	0	0.01	0.03	9.42E+11	2.38E+11	17.30	2.42	0.62	2.42	22.63
2/8/2004	0	0	0	0	0	0	0.06	0	0.01	0	0	0.07	2.60E+12	6.58E+11	47.75	6.69	1.70	6.69	62.46
2/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
2/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/21/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/24/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/2/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/4/2004	0.23	0.09	0	0	0	0	0	0	0	0	0.81	0.81	2.90E+13	7.33E+12	532.26	74.54	19.00	74.54	696.16
3/5/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/6/2004	0.30	0.06	0	0	0	0	0	0	0	0	0.52	0.53	1.89E+13	4.77E+12	346.56	48.53	12.37	48.53	453.28
3/7/2004	0	0	0	0	0	0	0.02	0	0	0	0	0.02	7.55E+11	1.91E+11	13.87	1.94	0.50	1.94	18.14
3/8/2004	0.58	0.10	0	0	0	0	0	0	0	0.05	1.45	1.51	5.41E+13	1.37E+13	993.63	139.15	35.47	139.15	1299.60
3/9/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/16/2004	0.13	0.06	0	0	0	0	0	0	0	0	0.40	0.40	1.42E+13	3.59E+12	260.96	36.55	9.32	36.55	341.32
3/17/2004	0	0	0	0	0	0	0	0	0	0	0.01	0.01	2.83E+11	7.16E+10	5.20	0.73	0.19	0.73	6.80
3/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/19/2004	0.25	0.06	0	0	0	0	0	0	0	0	0.43	0.43	1.53E+13	3.88E+12	281.77	39.46	10.06	39.46	368.54
3/20/2004	0.04	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/21/2004	0.11	0.06	0	0	0	0	0	0	0	0	0.28	0.28	1.02E+13	2.58E+12	187.70	26.29	6.70	26.29	245.49
3/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
3/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/25/2004	0.08	0.04	0	0	0	0	0	0	0	0	0.10	0.10	3.74E+12	9.46E+11	68.69	9.62	2.45	9.62	89.84
3/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/27/2004	0.14	0.05	0	0	0	0	0	0	0	0	0.10	0.11	3.81E+12	9.63E+11	69.94	9.79	2.50	9.79	91.48
3/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/31/2004	0.41	0.23	0	0.11	0.28	0	0	0.08	0.11	0.47	1.74	2.79	1.00E+14	2.53E+13	1840.79	257.79	65.72	257.79	2407.63
4/1/2004	0.51	0.24	0.10	0.34	0.55	0.69	0.16	0.15	0.15	0.54	1.83	4.51	1.62E+14	4.09E+13	2968.24	415.68	105.97	415.68	3882.26
4/2/2004	0.08	0.04	0	0	0	0	0	0	0.03	0.05	0.01	0.09	3.21E+12	8.13E+11	59.02	8.27	2.11	8.27	77.19
4/3/2004	0.10	0.04	0	0	0	0	0	0	0.02	0	0.06	0.08	2.85E+12	7.22E+11	52.40	7.34	1.87	7.34	68.53
4/4/2004	0.04	0.02	0	0	0	0	0	0	0.02	0	0	0.02	7.27E+11	1.84E+11	13.34	1.87	0.48	1.87	17.45
4/5/2004	0	0	0	0	0	0	0.04	0	0.01	0	0	0.05	1.71E+12	4.32E+11	31.37	4.39	1.12	4.39	41.03
4/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/8/2004	0.14	0.05	0	0	0	0	0	0	0.01	0	0.35	0.36	1.29E+13	3.27E+12	237.55	33.27	8.48	33.27	310.70
4/9/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	4.72E+11	1.19E+11	8.67	1.21	0.31	1.21	11.33
4/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/12/2004	0.58	0.12	0	0	0.48	0.25	0.20	0.15	0.07	0.50	2.10	3.75	1.35E+14	3.40E+13	2471.81	346.16	88.25	346.16	3232.96
4/13/2004	1.09	0.25	0.23	0.53	2.28	5.82	0.84	0.59	0.30	1.64	6.81	19.04	6.83E+14	1.73E+14	12541.92	1756.41	447.75	1756.41	16403.98
4/14/2004	0.42	0.24	0	0.09	0.27	0	0	0.09	0.11	0.37	2.01	2.94	1.06E+14	2.67E+13	1939.36	271.59	69.24	271.59	2536.55
4/15/2004	0.01	0.01	0	0	0	0	0	0	0.04	0	0	0.04	1.27E+12	3.21E+11	23.28	3.26	0.83	3.26	30.45
4/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/21/2004	0.05	0.04	0	0	0	0	0	0	0.01	0	0.02	0.03	1.16E+12	2.94E+11	21.36	2.99	0.76	2.99	27.94
4/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/23/2004	0.11	0.04	0	0	0	0	0	0	0	0	0.16	0.16	5.89E+12	1.49E+12	108.17	15.15	3.86	15.15	141.48
4/24/2004	0	0	0	0	0	0	0	0	0.06	0	0.01	0.07	2.46E+12	6.21E+11	45.08	6.31	1.61	6.31	58.97
4/25/2004	0.09	0.04	0	0	0	0	0	0	0.01	0	0.09	0.10	3.64E+12	9.20E+11	66.77	9.35	2.38	9.35	87.33
4/26/2004	1.57	0.23	0.04	0.20	1.62	2.76	0.42	0.46	0.34	1.27	5.94	13.04	4.68E+14	1.18E+14	8590.22	1203.00	306.68	1203.00	11235.43
4/27/2004	0.01	0.01	0	0.01	0.52	1.69	0	0.04	0.05	0.12	1.07	3.50	1.25E+14	3.17E+13	2302.21	322.41	82.19	322.41	3011.13
4/28/2004	0.04	0.04	0	0	0	0	0	0	0.03	0	0	0.03	1.13E+12	2.86E+11	20.79	2.91	0.74	2.91	27.19
4/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/2/2004	0.12	0.09	0	0	0	0	0	0	0.01	0	0.23	0.24	8.55E+12	2.16E+12	157.08	22.00	5.61	22.00	205.44

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
5/3/2004	0.37	0.08	0	0	0	0	0.02	0	0.01	0	1.32	1.35	4.83E+13	1.22E+13	887.04	124.22	31.67	124.22	1160.19
5/4/2004	0	0	0	0	0	0	0.05	0	0.01	0	0	0.06	2.16E+12	5.45E+11	39.61	5.55	1.41	5.55	51.81
5/5/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/6/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	2.13E+11	5.39E+10	3.91	0.55	0.14	0.55	5.11
5/7/2004	0.20	0.08	0	0	0	0	0.01	0	0.01	0	0.52	0.54	1.94E+13	4.90E+12	355.74	49.82	12.70	49.82	465.29
5/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/9/2004	0.05	0.03	0	0	0	0	0	0	0	0	0.01	0.01	4.69E+11	1.18E+11	8.60	1.20	0.31	1.20	11.25
5/10/2004	0.14	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/11/2004	0.61	0.43	0.71	0.97	1.22	3.36	0.51	0.23	0.24	1.15	4.17	12.57	4.51E+14	1.14E+14	8278.48	1159.34	295.55	1159.34	10827.68
5/12/2004	1.08	0.69	1.44	1.59	2.62	6.74	2.54	1.38	0.32	2.81	5.65	25.09	9.00E+14	2.28E+14	16525.87	2314.34	589.98	2314.34	21614.71
5/13/2004	0	0	0	0	0	0	0	0	0.02	0.03	0	0.05	1.68E+12	4.25E+11	30.89	4.33	1.10	4.33	40.40
5/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/15/2004	0.73	0.37	0.40	0.83	1.03	1.37	1.50	0.61	0.18	1.59	3.26	10.77	3.86E+14	9.77E+13	7095.08	993.62	253.30	993.62	9279.88
5/16/2004	0.06	0.06	0.01	0	0.75	1.79	1.04	0.69	0.10	0.91	0.59	5.87	2.11E+14	5.33E+13	3868.20	541.71	138.10	541.71	5059.34
5/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/19/2004	0.13	0.06	0	0	0	0	0	0	0.01	0	0.20	0.21	7.68E+12	1.94E+12	141.05	19.75	5.04	19.75	184.48
5/20/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	4.05E+11	1.03E+11	7.44	1.04	0.27	1.04	9.74
5/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/24/2004	0.05	0.05	0	0	0	0	0	0	0	0	0.04	0.04	1.47E+12	3.73E+11	27.06	3.79	0.97	3.79	35.39
5/25/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	3.15E+11	7.96E+10	5.78	0.81	0.21	0.81	7.56
5/26/2004	0.17	0.15	0	0	0	0	0	0	0.01	0.03	0.60	0.63	2.28E+13	5.76E+12	418.03	58.54	14.92	58.54	546.76
5/27/2004	0.19	0.11	0	0	0	0	0	0	0.03	0.04	1.31	1.39	4.98E+13	1.26E+13	914.35	128.05	32.64	128.05	1195.91
5/28/2004	0.33	0.23	0	0.12	0	0	0	0.02	0.06	0.18	1.97	2.35	8.41E+13	2.13E+13	1544.67	216.32	55.15	216.32	2020.32
5/29/2004	0	0	0	0	0	0	0	0	0.02	0	0	0.02	8.83E+11	2.23E+11	16.22	2.27	0.58	2.27	21.21
5/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/31/2004	0.35	0.14	0	0	0	0	0	0	0.03	0.10	1.90	2.02	7.25E+13	1.83E+13	1331.38	186.45	47.53	186.45	1741.35
6/1/2004	0.24	0.11	0	0	0	0	0	0	0.04	0.05	1.28	1.37	4.92E+13	1.24E+13	903.36	126.51	32.25	126.51	1181.54
6/2/2004	0.01	0.01	0	0	0	0	0	0	0.02	0	0.01	0.03	1.23E+12	3.11E+11	22.60	3.16	0.81	3.16	29.56
6/3/2004	0.02	0.01	0	0	0	0	0	0	0.02	0	0	0.02	6.56E+11	1.66E+11	12.05	1.69	0.43	1.69	15.77
6/4/2004	0	0	0	0	0	0	0.05	0	0	0	0	0.05	1.79E+12	4.51E+11	32.78	4.59	1.17	4.59	42.88
6/5/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/6/2004	0.15	0.09	0	0	0	0	0	0	0.01	0	0.71	0.72	2.58E+13	6.53E+12	474.03	66.38	16.92	66.38	620.00
6/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/10/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/11/2004	0.14	0.09	0	0	0	0	0	0	0.01	0	0.31	0.32	1.15E+13	2.90E+12	210.58	29.49	7.52	29.49	275.43
6/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
6/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/17/2004	0.22	0.10	0	0	0	0	0	0	0	0.12	1.72	1.84	6.60E+13	1.67E+13	1211.38	169.65	43.25	169.65	1584.40
6/18/2004	0	0	0	0	0	0	0	0	0.04	0	0.03	0.06	2.30E+12	5.81E+11	42.19	5.91	1.51	5.91	55.18
6/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/22/2004	0.57	0.41	0.36	0.58	0.95	1.62	0.32	0.29	0.19	0.65	2.58	7.54	2.71E+14	6.84E+13	4968.98	695.87	177.40	695.87	6499.09
6/23/2004	0	0	0	0	0	0	0	0	0.03	0.02	0	0.05	1.92E+12	4.86E+11	35.29	4.94	1.26	4.94	46.16
6/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25/2004	1.39	0.51	1.72	2.01	3.77	8.65	4.65	3.11	0.27	5.10	7.11	36.38	1.30E+15	3.30E+14	23961.18	3355.60	855.43	3355.60	31339.59
6/26/2004	0	0	0	0	0	0	0	0	0.03	0.01	0	0.04	1.31E+12	3.31E+11	24.07	3.37	0.86	3.37	31.48
6/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29/2004	0.20	0.18	0	0	0	0	0	0	0.03	0.08	0.74	0.85	3.06E+13	7.74E+12	561.71	78.66	20.05	78.66	734.68
6/30/2004	0	0	0	0	0	0	0.01	0	0	0	0	0.01	3.93E+11	9.94E+10	7.22	1.01	0.26	1.01	9.44
7/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5/2004	1.00	0.71	1.17	1.63	1.78	6.11	2.31	1.02	0.24	2.93	4.18	21.36	7.66E+14	1.94E+14	14069.93	1970.40	502.30	1970.40	18402.50
7/6/2004	0	0	0	0	0	0	0.01	0.01	0.02	0	0	0.04	1.38E+12	3.50E+11	25.41	3.56	0.91	3.56	33.23
7/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12/2004	1.56	0.31	0.58	0.81	3.63	7.44	3.67	2.45	0.33	3.77	8.29	30.96	1.11E+15	2.81E+14	20393.16	2855.92	728.05	2855.92	26672.86
7/13/2004	0.43	0.11	0	0	0.90	1.20	0.40	0.24	0.05	0.48	1.89	5.17	1.85E+14	4.69E+13	3402.90	476.55	121.49	476.55	4450.76
7/14/2004	0.38	0.29	0.05	0.31	0	0	0	0.01	0.09	0.27	2.75	3.50	1.25E+14	3.17E+13	2302.75	322.48	82.21	322.48	3011.84
7/15/2004	0	0	0	0	0	0	0	0	0.03	0.04	0.02	0.09	3.13E+12	7.90E+11	57.40	8.04	2.05	8.04	75.07
7/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18/2004	1.58	0.54	2.20	2.46	3.90	14.56	2.65	1.70	0.39	3.20	8.56	39.63	1.42E+15	3.59E+14	26099.92	3655.12	931.78	3655.12	34136.91
7/19/2004	0.02	0.01	0	0	0.13	0	0.86	0.64	0.03	0.71	0.11	2.49	8.93E+13	2.26E+13	1639.42	229.59	58.53	229.59	2144.24
7/20/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	2.16E+11	5.47E+10	3.97	0.56	0.14	0.56	5.20
7/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23/2004	1.63	0.35	0.59	1.25	4.41	8.46	4.43	2.70	0.32	4.62	8.37	35.15	1.26E+15	3.19E+14	23151.83	3242.26	826.53	3242.26	30281.01

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
7/24/2004	0.03	0.01	0	0	0	0	0	0	0.03	0.05	0.02	0.11	3.86E+12	9.77E+11	70.94	9.93	2.53	9.93	92.78
7/25/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	4.13E+11	1.04E+11	7.59	1.06	0.27	1.06	9.92
7/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/27/2004	1.39	0.36	0.62	1.33	3.67	6.05	4.05	2.72	0.30	4.39	7.01	30.15	1.08E+15	2.73E+14	19857.02	2780.84	708.91	2780.84	25971.63
7/28/2004	0.06	0.03	0	0	0.28	0.44	0.24	0.10	0.05	0.23	0.29	1.63	5.84E+13	1.48E+13	1072.30	150.17	38.28	150.17	1402.50
7/29/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	3.57E+11	9.02E+10	6.55	0.92	0.23	0.92	8.57
7/30/2004	0.31	0.26	0.13	0.19	0.07	0.01	0.34	0.03	0.07	0.50	1.30	2.63	9.45E+13	2.39E+13	1735.26	243.01	61.95	243.01	2269.60
7/31/2004	0	0	0	0	0	0	0.03	0.01	0.02	0	0	0.06	2.03E+12	5.14E+11	37.32	5.23	1.33	5.23	48.82
8/1/2004	0.28	0.10	0	0	0	0	0.01	0	0.03	0.12	1.69	1.85	6.64E+13	1.68E+13	1219.53	170.79	43.54	170.79	1595.06
8/2/2004	0	0	0	0	0	0	0.04	0	0.02	0	0	0.05	1.89E+12	4.77E+11	34.66	4.85	1.24	4.85	45.34
8/3/2004	0.03	0.03	0	0	0	0	0	0	0.01	0	0	0.01	2.00E+11	5.06E+10	3.68	0.52	0.13	0.52	4.81
8/4/2004	0.01	0.01	0	0	0	0	0	0	0.01	0	0	0.01	4.77E+11	1.21E+11	8.76	1.23	0.31	1.23	11.46
8/5/2004	0.03	0.03	0	0	0	0	0	0	0.01	0	0	0.01	4.83E+11	1.22E+11	8.88	1.24	0.32	1.24	11.61
8/6/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	3.04E+11	7.70E+10	5.59	0.78	0.20	0.78	7.31
8/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/11/2004	0.61	0.25	0.03	0.25	0.66	0.54	0.52	0.21	0.12	0.61	3.22	6.15	2.21E+14	5.58E+13	4052.41	567.51	144.67	567.51	5300.27
8/12/2004	0	0	0	0	0	0	0	0	0.02	0.04	0	0.06	2.27E+12	5.74E+11	41.66	5.83	1.49	5.83	54.49
8/13/2004	0.20	0.12	0	0	0	0	0	0	0.01	0	0.95	0.96	3.45E+13	8.74E+12	634.45	88.85	22.65	88.85	829.81
8/14/2004	0.21	0.13	0	0	0	0	0	0	0.02	0.05	0.70	0.78	2.79E+13	7.06E+12	512.52	71.78	18.30	71.78	670.34
8/15/2004	0.31	0.11	0	0	0.34	0.70	0.60	0.07	0.13	0.51	1.24	3.60	1.29E+14	3.27E+13	2372.54	332.26	84.70	332.26	3103.12
8/16/2004	0.95	0.56	1.04	1.34	1.90	5.38	2.36	1.14	0.27	2.75	4.16	20.34	7.30E+14	1.85E+14	13397.83	1876.28	478.31	1876.28	17523.45
8/17/2004	0	0	0	0	0	0	0	0	0.03	0	0	0.03	9.03E+11	2.28E+11	16.59	2.32	0.59	2.32	21.70
8/18/2004	0.05	0.04	0	0	0	0	0	0	0.01	0	0.04	0.04	1.61E+12	4.08E+11	29.62	4.15	1.06	4.15	38.74
8/19/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	3.75E+11	9.48E+10	6.88	0.96	0.25	0.96	9.00
8/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/2004	0.85	0.80	1.33	1.34	2.14	4.82	1.83	1.27	0.22	1.89	4.63	19.46	6.98E+14	1.76E+14	12814.63	1794.60	457.49	1794.60	16760.67
8/22/2004	0	0	0	0	0	0	0	0	0.02	0.03	0	0.06	2.01E+12	5.09E+11	36.95	5.18	1.32	5.18	48.33
8/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/31/2004	0.17	0.06	0	0	0	0	0	0	0.01	0	0.30	0.31	1.12E+13	2.82E+12	205.07	28.72	7.32	28.72	268.22
9/1/2004	0	0	0	0	0	0	0.01	0	0	0	0	0.02	5.96E+11	1.51E+11	10.95	1.53	0.39	1.53	14.32
9/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
9/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/7/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/8/2004	2.08	0.48	2.74	3.02	5.38	15.77	6.24	4.74	0.37	7.06	10.37	55.69	2.00E+15	5.05E+14	36682.38	5137.12	1309.58	5137.12	47978.05
9/9/2004	0.29	0.16	0	0.05	0	0	0	0	0.04	0.06	2.54	2.70	9.68E+13	2.45E+13	1777.35	248.91	63.45	248.91	2324.65
9/10/2004	0	0	0	0	0	0	0	0	0.03	0	0	0.04	1.32E+12	3.33E+11	24.18	3.39	0.86	3.39	31.63
9/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/15/2004	0.38	0.26	0	0.10	0.28	0	0	0.15	0.10	0.36	1.47	2.45	8.78E+13	2.22E+13	1612.71	225.85	57.57	225.85	2109.32
9/16/2004	0	0	0	0	0	0	0	0	0.02	0	0.01	0.03	1.12E+12	2.84E+11	20.62	2.89	0.74	2.89	26.97
9/17/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2004	1.41	1.32	1.84	2.04	3.29	9.06	1.80	1.24	0.43	2.36	8.34	30.39	1.09E+15	2.76E+14	20018.81	2803.50	714.68	2803.50	26183.23
9/19/2004	0	0	0	0	0	0	0	0	0.02	0	0	0.02	6.44E+11	1.63E+11	11.83	1.66	0.42	1.66	15.47
9/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/28/2004	3.08	0.50	2.43	3.19	8.27	20.66	8.22	5.44	0.65	8.62	15.78	73.28	2.63E+15	6.65E+14	48264.42	6759.11	1723.07	6759.11	63126.57
9/29/2004	0.60	0.24	0.12	0.26	2.76	7.26	3.98	3.20	0.08	3.91	3.03	24.60	8.82E+14	2.23E+14	16202.83	2269.10	578.45	2269.10	21192.19
9/30/2004	0.11	0.06	0	0	0	0	0	0.02	0.02	0	0.27	0.31	1.10E+13	2.78E+12	201.56	28.23	7.20	28.23	263.63
10/1/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	4.05E+11	1.02E+11	7.43	1.04	0.27	1.04	9.72
10/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
10/14/2004	0.07	0.03	0	0	0	0	0	0	0	0	0.03	0.03	1.05E+12	2.64E+11	19.20	2.69	0.69	2.69	25.11
10/15/2004	0.19	0.05	0	0	0	0	0	0	0	0.02	0.46	0.48	1.73E+13	4.38E+12	318.03	44.54	11.35	44.54	415.97
10/16/2004	0.01	0.01	0	0	0	0	0.01	0	0	0	0.04	0.05	1.97E+12	4.97E+11	36.09	5.05	1.29	5.05	47.20
10/17/2004	0	0	0	0	0	0	0.01	0	0	0	0	0.01	3.68E+11	9.30E+10	6.75	0.95	0.24	0.95	8.83
10/18/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/19/2004	0.53	0.13	0	0	0	0	0	0	0.05	0.06	1.72	1.82	6.54E+13	1.65E+13	1201.79	168.30	42.90	168.30	1571.86
10/20/2004	0	0	0	0	0	0	0	0	0.02	0	0.01	0.03	9.81E+11	2.48E+11	18.02	2.52	0.64	2.52	23.56
10/21/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/22/2004	0	0	0	0	0	0	0	0	0.02	0	0	0.02	5.87E+11	1.48E+11	10.77	1.51	0.38	1.51	14.09
10/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/30/2004	0.04	0.03	0	0	0	0	0	0	0.01	0	0	0.01	1.81E+11	4.57E+10	3.32	0.47	0.12	0.47	4.34
10/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/2004	1.00	0.22	0.05	0.14	2.06	4.07	1.59	0.43	0.23	1.54	4.91	15.03	5.39E+14	1.36E+14	9897.59	1386.09	353.35	1386.09	12945.37
11/5/2004	0.03	0.02	0	0	0	0	0	0	0.02	0	0.05	0.07	2.55E+12	6.44E+11	46.75	6.55	1.67	6.55	61.15
11/6/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	2.60E+11	6.59E+10	4.78	0.67	0.17	0.67	6.25
11/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/9/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/11/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/2004	0.93	0.09	0	0	0.62	0.55	0.52	0.12	0.10	0.60	3.26	5.76	2.07E+14	5.22E+13	3792.88	531.17	135.41	531.17	4960.82
11/13/2004	0.15	0.05	0	0	0.29	0	0.28	0.03	0.04	0.20	0.34	1.18	4.24E+13	1.07E+13	779.01	109.09	27.81	109.09	1018.89
11/14/2004	0	0	0	0	0	0	0	0	0.01	0	0	0.01	2.29E+11	5.78E+10	4.20	0.59	0.15	0.59	5.49
11/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/20/2004	0.27	0.08	0	0	0	0	0	0	0.02	0.01	0.75	0.78	2.79E+13	7.07E+12	513.26	71.88	18.32	71.88	671.30
11/21/2004	0	0	0	0	0	0	0	0	0.07	0	0.02	0.09	3.21E+12	8.13E+11	59.02	8.27	2.11	8.27	77.20
11/22/2004	0.04	0.04	0	0	0	0	0	0	0.01	0	0.01	0.01	5.28E+11	1.33E+11	9.69	1.36	0.35	1.36	12.67
11/23/2004	0	0	0	0	0	0	0	0	0.02	0	0	0.02	6.43E+11	1.63E+11	11.81	1.65	0.42	1.65	15.44

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
11/24/2004	0.21	0.05	0	0	0	0	0	0	0.01	0	0.51	0.52	1.86E+13	4.70E+12	341.38	47.81	12.19	47.81	446.50
11/25/2004	0.22	0.08	0	0	0	0	0	0	0.01	0	0.59	0.61	2.18E+13	5.50E+12	399.70	55.98	14.27	55.98	522.78
11/26/2004	0	0	0	0	0	0	0.06	0	0.01	0	0	0.07	2.48E+12	6.27E+11	45.53	6.38	1.63	6.38	59.55
11/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/2004	1.50	0.78	1.85	1.70	3.60	9.60	3.60	2.94	0.37	4.16	8.34	36.16	1.30E+15	3.28E+14	23818.71	3335.65	850.34	3335.65	31153.24
11/29/2004	0	0	0	0	0	0	0	0	0.02	0.01	0	0.03	1.24E+12	3.15E+11	22.85	3.20	0.82	3.20	29.88
11/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/1/2004	1.00	0.18	0	0.09	2.44	4.76	1.93	1.53	0.29	2.36	5.63	19.02	6.82E+14	1.73E+14	12527.46	1754.39	447.24	1754.39	16385.06
12/2/2004	0	0	0	0	0	0	0	0	0.02	0	0	0.02	7.91E+11	2.00E+11	14.53	2.04	0.52	2.04	19.01
12/3/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/6/2004	0.19	0.05	0	0	0	0	0	0	0.01	0	0.55	0.55	1.98E+13	5.01E+12	363.83	50.95	12.99	50.95	475.87
12/7/2004	0.57	0.20	0	0.04	0.38	0	0	0.10	0.10	0.45	2.68	3.75	1.34E+14	3.40E+13	2467.49	345.55	88.09	345.55	3227.30
12/8/2004	0.07	0.05	0	0	0	0	0.02	0	0.04	0.06	0.11	0.23	8.38E+12	2.12E+12	153.94	21.56	5.50	21.56	201.34
12/9/2004	0.39	0.10	0	0	0	0	0.03	0	0.01	0.05	1.10	1.20	4.29E+13	1.08E+13	787.45	110.28	28.11	110.28	1029.94
12/10/2004	0.35	0.07	0	0	0.16	0	0.06	0.05	0.10	0.26	0.95	1.59	5.69E+13	1.44E+13	1044.17	146.23	37.28	146.23	1365.70
12/11/2004	0.01	0.01	0	0	0	0	0	0.06	0.03	0	0	0.10	3.48E+12	8.79E+11	63.82	8.94	2.28	8.94	83.47
12/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/18/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/19/2004	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/20/2004	0.04	0.01	0	0	0	0	0	0	0.01	0	0	0.01	2.17E+11	5.50E+10	3.99	0.56	0.14	0.56	5.22
12/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/22/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/23/2004	0.62	0.30	0.32	0.38	0.93	0.71	0.50	0.36	0.16	0.97	2.93	7.26	2.60E+14	6.58E+13	4778.94	669.26	170.61	669.26	6250.53
12/24/2004	0	0	0	0	0	0	0.02	0	0.03	0	0	0.05	1.81E+12	4.59E+11	33.31	4.66	1.19	4.66	43.57
12/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/27/2004	0.09	0.01	0	0	0	0	0	0	0.02	0	0	0.02	5.54E+11	1.40E+11	10.18	1.43	0.36	1.43	13.32
12/28/2004	0	0	0	0	0	0	0.05	0	0.01	0	0	0.06	1.98E+12	5.00E+11	36.33	5.09	1.30	5.09	47.52
12/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANNUAL TOTAL	**47.54**	**18.42**	**22.63**	**30.04**	**76.17**	**170.26**	**70.68**	**46.01**	**10.67**	**84.58**	**215.79**	**726.83**	**2.61E+16**	**6.59E+15**	**4.79E+05**	**67037.66**	**17089.60**	**67037.66**	**626097.10**

Jersey City Municipal Utilties Authority
System Characterization Report
2004 Daily Wasteloads - East Side

Date	Daily Rainfall Total, Inches	Daily Rainfall - Max Hour, Inches	RE-1 Daily Overflow Volume (MG)	RE-2 Daily Overflow Volume (MG)	RE-3/4 Daily Overflow Volume (MG)	RE-5/6 Daily Overflow Volume (MG)	RE-10/11 Daily Overflow Volume (MG)	RE-15 Daily Overflow Volume (MG)	RE-16/17 Daily Overflow Volume (MG)	RE-18 Daily Overflow Volume (MG)	RE-19 Daily Overflow Volume (MG)	East Side Daily Overflow Volume (MG)	East Side Fecal (cfu)	East Side Entero (cfu)	East Side CBOD (lbs)	East Side TKN (lbs)	East Side TP (lbs)	East Side TN (lbs)	East Side TSS (lbs)
January Totals	1.67	0.40	0	0	0.28	0	0.06	0.15	0.26	0.25	5.78	6.78	2.43E+14	6.14E+13	4,460.40	624.65	159.24	624.65	5,833.90
February Totals	2.43	0.57	0.55	0.75	5.28	7.40	4.98	3.22	0.62	6.08	10.89	39.77	1.43E+15	3.61E+14	26,187.70	3,667.41	934.92	3,667.41	34,251.72
March Totals	2.36	0.84	0	0.11	0.28	0	0.02	0.08	0.14	0.53	5.84	7.00	2.51E+14	6.34E+13	4,601.37	644.39	164.27	644.39	6,018.28
April Totals	4.84	1.41	0.37	1.17	5.72	11.21	1.65	1.47	1.27	4.49	20.47	47.83	1.72E+15	4.34E+14	31,501.57	4,411.58	1,124.62	4,411.58	41,201.90
May Totals	4.59	2.72	2.56	3.51	5.61	13.26	5.68	2.93	1.08	6.84	21.79	63.25	2.27E+15	5.74E+14	41,656.47	5,833.71	1,487.16	5,833.71	54,483.82
June Totals	2.96	1.53	2.07	2.59	4.72	10.26	5.02	3.40	0.69	6.04	14.50	49.30	1.77E+15	4.47E+14	32,467.44	4,546.85	1,159.11	4,546.85	42,465.20
July Totals	8.39	2.98	5.33	7.98	18.77	44.26	18.98	11.65	2.00	21.20	42.81	172.98	6.20E+15	1.57E+15	113,933.65	15,955.64	4,067.50	15,955.64	149,017.44
August Totals	3.70	2.24	2.39	2.92	5.04	11.43	5.37	2.70	0.96	6.00	16.94	53.75	1.93E+15	4.88E+14	35,402.26	4,957.85	1,263.88	4,957.85	46,303.74
September Totals	8.02	3.07	7.13	8.66	19.98	52.75	20.25	14.79	1.77	22.38	41.82	189.53	6.80E+15	1.72E+15	124,827.64	17,481.27	4,456.42	17,481.27	163,266.03
October Totals	0.86	0.27	0	0	0	0	0.02	0	0.12	0.08	2.24	2.46	8.83E+13	2.23E+13	1,621.40	227.07	57.88	227.07	2,120.68
November Totals	4.35	1.41	1.90	1.84	6.57	14.23	6.04	3.53	0.93	6.53	18.78	60.35	2.16E+15	5.47E+14	39,747.15	5,566.32	1,419.00	5,566.32	51,986.55
December Totals	3.37	0.99	0.32	0.51	3.90	5.46	2.61	2.11	0.83	4.16	13.94	33.84	1.21E+15	3.07E+14	22,285.44	3,120.93	795.60	3,120.93	29,147.84

APPENDIX I

Identification of Sensitive Areas Report

IDENTIFICATION OF SENSITIVE AREAS REPORT
CSO Long Term Control Plan

Submitted on behalf of the participating permittees by the Passaic Valley Sewerage Commission (NJ0021016) to Satisfy Permit Condition Part IV.D.3.b.iv:

Passaic Valley Sewerage Commissioners (NJ0021016)
Bayonne City (NJ0109240)
East Newark Borough (NJ0117846)
Harrison Town (NJ0108871)
Jersey City MUA (NJ0108723)
Kearny Town (NJ0111244)
City of Newark (NJ0108758)
North Bergen MUA (NJ0108898)
City of Paterson (NJ0108880)
Joint Meeting of Essex and Union Counties (NJ0024741)
Middlesex County Utilities Authority (NJ0020141)
North Bergen MUA (Woodcliff) (NJ029084)
Town of Guttenberg (NJ0108715)
North Hudson Sewage Authority (NJ0026085)
Borough of Fort Lee (NJ0034517)
City of Hackensack (NJ0108766)
Ridgefield Park Village (NJ0109118)
City of Elizabeth (NJ0108782)
Perth Amboy City (NJ0156132)
Bergen County Utilities Authority (NJ0020028)

Passaic Valley Sewerage Commission
Essex County
600 Wilson Avenue
Newark, New Jersey

"Protecting Public Health and the Environment"

June 2018

ES-1 Background

The United States Environmental Protection Agency's (USEPA) Combined Sewer Overflow (CSO) Control Policy (Federal Register 59 [April 19, 1994]: 18688-18698) "expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas" (Section II.C.3). The purpose of this report is to document the State and Federal Agencies that were researched and other means utilized in order to identify the location of potential sensitive areas as they may relate to the development of the CSO Long Term Control Plan (LTCP). This will allow the Permittees to develop a plan that incorporates consideration ofthese areas as physically possible and economically achievable.

The Permitees included in the Report are in the process of developing a LTCP which follows the framework established by the USEPA. The Passaic Valley Seweage Comission (PVSC) has prepared this report on behalf of the Permittees of the NJ CSO Group to identify all Sensitive Areas that are impacted by CSOs within the Study Area, which includes the receiving surface waters as well as the adjacent waters.

For the purposes of this report, the Sensitive Areas Study Area (Study Area) includes the combined sewer service areas, including all receiving and adjacent downstream waters that may be potentially affected by CSOs, from the various combined sewer service areas of the NJ CSO Group. Affected waters include the Passaic River, Hackensack River, Newark Bay, Hudson River, Kill Van Kull, Arthur Kill, Raritan River or Raritan Bay as well as their tributaries within the Study Area of this report.

ES-2 Sensitive Areas Summary

A comprehensive review of online databases, direct observations and correspondence with regulatory agencies and local environmental organizations was conducted to identify potential Sensitive Areas within the combined sewer system portion of the collection system and in the associated receiving waters.

Outstanding National Resource Waters (ONRW) are maintained and protected by Tier 3 of the USEPA's Anti-degradation Policy. Only waters of "exceptional ecological significance" qualify as ONRWs, as determined by States and Tribes. No Outstanding National Resource Waters were located within the project boundaries.

The Office of National Marine Sanctuaries (ONMS) is the trustee of all national marine sanctuaries which currently recognizes fourteen (14) national marine sanctuaries, none of which are located within the Study Area.

The US Fish and Wildlife Service, National Oceanic and Atmospheric Administration (NOAA), New Jersey Heritage Program (NJHP), and New Jersey DEP Division of Fish and Wildlife identified several Endangered or Threatened species which potentially could live in the project area. All species listed by United States Fish and Wildlife Service are included in NJDEP's lists. NOAA maps show potential areas that may have endangered or threatened species during parts of the year. However, both NJHP and NJDEP's correspondence indicate there are no critical habitats for these species found in the waters of the Study Area. No species identified on the NOAA maps has been confirmed to live, eat, and breed near a CSO in the study area. The endangered Atlantic and Shortnose sturgeon populations cited in the study area have been recovering since the 1970s, suggesting the current protections for water quality are sufficient – even near a heavily populated area. As such, there have been no sensitive areas determined as a result from waters with threatended and endangered species and their habits.

No primary contact recreation activities were witnessed in any waterbody at any time. Secondary contact recreation activities, including jet skiing, kayaking, and fishing, were observed in the Hudson River, Upper Bay, Passaic River, Newark Bay, Kill Van Kull, Arthur Kill, and Hackensack River. Therefore, Sensitive Areas, as may be indicated by waters with primary contact recreation, have not been identified within the Study Area.

One drinking water intake was identified on the Hackensack River half a mile downstream to a Hackensack City CSO. This drinking water intake was decommissioned decades ago, and the current utility provider of the area has no current interest to reopen the intake due to the tidal nature of the Hackensack River at this location. Therefore, no sensitive areas have been determined from public drinking water intakes or their designated protection areas.

The only commercial shellfish harvesting area operating within the Study Area is the restricted zone in the Raritan Bay and is separated by a few miles from the nearest Study Area CSO. No sensitive areas have been determined as a result of the location of shellfish beds.

SECTION A - PROJECT MANAGEMENT

A.0 SUMMARY OF CHANGES

This Report is for the Identification of Sensitive Areas to be utilized by the NJ CSO Group. This Report describes the methodology that was utilized for the identification of sensitive areas, the analysis that was completed, and the recommended Sensitive Areas to be used in the development of a CSO Long Term Control Plan (LTCP). In future versions, this section will include summaries of changes and when they were incorporated as appropriate:

A.1 TITLE OF PLAN AND APPROVAL

Title: Identification of Sensitive Areas Report

Preparer:

Identification of Sensitive Areas Project Officer: ______________ 6/20/18
Michael J. Hope, P.E., Greeley and Hansen LLC — Date

Identification of Sensitive Areas QA Officer: ______________ 6/20/18
Timothy J. Dupuis, P.E., CDM Smith — Date

PVSC LTCP Consultants

LTCP Consultant Project Officer: ______________ 6/20/18
Michael J. Hope, P.E., Greeley and Hansen LLC — Date

LTCP Consultant QA Officer: ______________ 6/20/18
Timothy J. Dupuis, P.E., CDM Smith — Date

Passaic Valley Sewerage Commission

PVSC Program Manager: ______________ 06/20/2018
Bridget McKenna, Chief Operating Officer, PVSC — Date

PVSC QA Officer: Marques Eley 6/20/2018
Marques Eley, PVSC — Date

New Jersey Department of Environmental Protection

DEP Permits:	Joseph Mannick, CSO Coordinator	Date
DEP BEARS:	Biswarup Guha, Bureau of Environmental Analysis Restoration and Standards (BEARS)	Date

Identification of Sensitive Areas for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0021016 (Passaic Valley Sewage Commission)

Approval of Report:

Permittee: ______________________________ 06/20/2018

Bridget McKenna — Date
Chief Operating Officer, Passaic Valley Sewerage Commission

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________________ 06/20/2018

Bridget McKenna — Date
Chief Operating Officer, Passaic Valley Sewerage Commission

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0109240 (Bayonne City)

Approval of Report:

Permittee: 6.19.18

Timothy Boyle — Date
Superintendent, City of Bayonne Department of Public Works

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: 6.19.18

Timothy Boyle — Date
Superintendent, City of Bayonne Department of Public Works

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0117846 (East Newark)

Approval of Report:

Permittee: ______________________________ 6/25/18
Frank Pestana — Date
Licensed Operator, Borough of East Newark

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________________ 6/25/18
Frank Pestana — Date
Licensed Operator, Borough of East Newark

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108871 (Harrison)

Approval of Report:

Permittee: ______________________ 6/22/18
Rocco Russomano — Date
Town Engineer, Town of Harrison

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________ 6/22/18
Rocco Russomano — Date
Town Engineer, Town of Harrison

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108723 (Jersey City MUA)

Approval of Report:

Permittee: Richard Haytas 6/13/18

Rich Haytas
Senior Engineer, Jersey City MUA
Date

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: Richard Haytas 6/13/18

Rich Haytas
Senior Engineer, Jersey City MUA
Date

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0111244 (Kearny)

Approval of Report:

Permittee: 6/20/18

Robert J.Smith
Town Administrator, Town of Kearny

Date

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: 6/20/18

Robert J. Smith
Town Administrator, Town of Kearny

Date

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108758 (Newark)

Approval of Report:

Permittee: ______________________________ 6/25/18
Ras J Baraka Date
Mayor, City of Newark

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________________ 6/25/18
Ras J Baraka Date
Mayor, City of Newark

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108898 (North Bergen MUA)

Approval of Report:

Permittee: _____________________ 6/25/18
Frank Pestana — Date
Exec. Director, North Bergen MUA

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: _____________________ 6/25/18
Frank Pestana — Date
Exec. Director, North Bergen MUA

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108880 (Paterson)

Approval of Report:

Permittee: ______________________ 6/19/18

Manny Ojeda
Director Public Works, City of Paterson

Date

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________ 6/19/18

Manny Ojeda
Director Public Works, City of Paterson

Date

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0024741 (Joint Meeting of Essex and Union Counties)

Approval of Report:

Permittee: ______________________ 6/21/18

Samuel McGhee Date
Executive Director, Joint Meeting of Essex and Union Counties

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________ 6/21/18

Samuel McGhee Date
Executive Director, Joint Meeting of Essex and Union Counties

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0020141 (Middlesex County UA)

Approval of Report:

Permittee: ______________________ 6/19/18
Joseph Cryan — Date
Executive Director, Middlesex County Utilities Authority

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________ 6/19/18
Joseph Cryan — Date
Executive Director, Middlesex County Utilities Authority

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0029084 (North Bergen Woodcliff)

Approval of Report:

Permittee: 6/25/18

Frank Pestana — Date
Exec. Director, North Bergen MUA

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: 6/25/18

Frank Pestana — Date
Exec. Director, North Bergen MUA

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108715 (Town of Guttenberg)

Approval of Report:

Permittee: ______________________ 6/25/18

Frank Pestana — Date
Licensed Operator, Town of Guttenberg

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________ 6/25/18

Frank Pestana — Date
Licensed Operator, Town of Guttenberg

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0025321 (North Hudson Sewerage Authority)

Approval of Report:

Permittee: Fredric J. Pocci 6/19/2018

Fredric J. Pocci, P.E. Date
Authority Engineer, North Hudson Sewerage Authority

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: Fredric J. Pocci 6/19/2018

Fredric J. Pocci, P.E. Date
Authority Engineer, North Hudson Sewerage Authority

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0034517 (Borough of Fort Lee)

Approval of Report:

Permittee: ______________________________ 6-21-18
Alfred R. Restaino — Date
Borough Administrator, Borough of Fort Lee

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________________ 6-21-18
Alfred R. Restaino — Date
Borough Administrator, Borough of Fort Lee

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108766 (City of Hackensack)

Approval of Report:

Permittee: Wayne Vriesema, Project Manager, City of Hackensack — Date: 6/20/18

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: Wayne Vriesema, Project Manager, City of Hackensack — Date: 6/20/18

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0109118 (Ridgefield Park Village)

Approval of Report:

Permittee: [signature] 6/27/18
Alan O'Grady — Date
Superintendent, Ridgefield Park Village

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: [signature] 6/27/18
Alan O'Grady — Date
Superintendent, Ridgefield Park Village

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0108782 (City of Elizabeth)

Approval of Report:

Permittee: 6/20/2018

Daniel Loomis, P.E. — Date
City Engineer, City of Elizabeth

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: 6/20/2018

Daniel Loomis, P.E. — Date
City Engineer, City of Elizabeth

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0156132 (Perth Amboy City)

Approval of Report:

Permittee: Luis C. Perezjimenez 6/19/18

Luis Perez-Jimenez
Director of Water Operations, Perth Amboy City

Date

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision; or (b) as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: Luis C. Perezjimenez 6/19/18

Luis Perez-Jimenez
Director of Water Operations, Perth Amboy City

Date

Identification of Sensitive Areas Report for the NJ CSO Group

Submitted on behalf of the following participating Permittee by Passaic Valley Sewerage Commission on behalf of the NJ CSO Group

NJPDES Number NJ0020028 (Bergen County Utilities Authority)

Approval of Data Report:

Permittee: ______________________________ 5/25/18

Robert Laux — Date
Executive Director, Bergen County Utilities Authority

NJPDES Certification:

Without prejudice to any objections timely made to permit conditions, I certify under penalty of law that this document and all attachments were prepared as part of a cooperation performed by members of the NJ CSO group effort in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information. Based on my inquiry of the person or persons who reviewed this report, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Permittee: ______________________________ 6/25/18

Robert Laux — Date
Executive Director, Bergen County Utilities Authority

A.2 DISTRIBUTION LIST

Passaic Valley Sewerage Commission

Bridget McKenna

Marques Eley

Other Entities Participating by Associated Sewage Treatment Plant

Passaic Valley Sewerage Commission (PVSC): Paterson; Newark; Kearny; Harrison; Bayonne MUA; Jersey City MUA; North Bergen MUA

Bergen County Utility Authority (BCUA): Ridgefield Park; Fort Lee; Hackensack

Joint Meeting of Essex and Union Counties: Elizabeth City

North Bergen MUA – Woodcliff Plant: North Bergen Township; Guttenberg; Union City

North Hudson Sewerage Authority (NHSA) – River Road STP: Weehawken; West New York;
Union City

North Hudson Sewerage Authority (NHSA) – Adams Street STP: Hoboken

Middlesex County Utilities Authority (MCUA): Perth Amboy

New Jersey Department of Environmental Protection

Marzooq Alebus, Surface Water Permitting

Nancy Kempel, Surface Water Permitting

Dwayne Kobesky, Surface Water Permitting

Joseph Mannick, Surface Water Permitting

Marc Ferko, Office of Quality Assurance

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SECTION B - INTRODUCTION

B.1 IDENTIFICATION OF SENSITIVE AREA OBJECTIVES FOR CSO LTCP DEVELOPMENT

The USEPA's CSO Control Policy (Federal Register 59 [April 19, 1994]: 18688-18698) "expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas" (Section II.C.3). The purpose of this report is to document the State and Federal Agencies that were researched and other means utilized in order to identify the location of potential sensitive areas as they may relate to the development of the CSO LTCP.

For the purposes of this report, the Sensitive Areas Study Area (Study Area) includes the combined sewer service areas, including all receiving and adjacent downstream waters that may be potentially affected by CSOs, from the various combined sewer service areas of the NJ CSO Group. Affected waters include the Passaic River, Hackensack River, Newark Bay, Hudson River, Kill Van Kull, Arthur Kill, Raritan River or Raritan Bay as well as their tributaries on the Study Area of this report is shown in Figure B-1.

B.2 PRINCIPAL DATA USERS

The principal users of the identification of sensitive areas will be the permittees of the NJ CSO Group, hydraulically connected member municipalities of the NJ CSO Group, the LTCP engineering consultants supporting the Permittees of the NJ CSO Group, and other CSO municipalities who elect to utilize the identification of sensitive areas. PVSC is sharing the data generated for the identification of the sensitive areas with the cooperating members of the NJ CSO Group and, therefore, the NJ CSO Group members may use the data to satisfy certain NJPDES permit requirements related to the requirements of their NJPDES Permits. Table B-1 defines the list of primary data users.

Secondary users of the data, such as the New Jersey Department of Environmental Protection (NJDEP), are responsible for evaluating the data using quality criteria appropriate for their use and/or decision making process.

B.3 PROBLEM DEFINITION AND BACKGROUND

The NJ CSO Group was originally formed to work cooperatively to fulfill the requirements of the last CSO General Permit. The group was recently expanded to include more permittees that discharge to the tidally connected waterbodies in the NY/NJ Harbor Estuary. Member utilities provide service to multiple municipalities, and the interrelationships are numerous and varied as shown on Figure B-2.

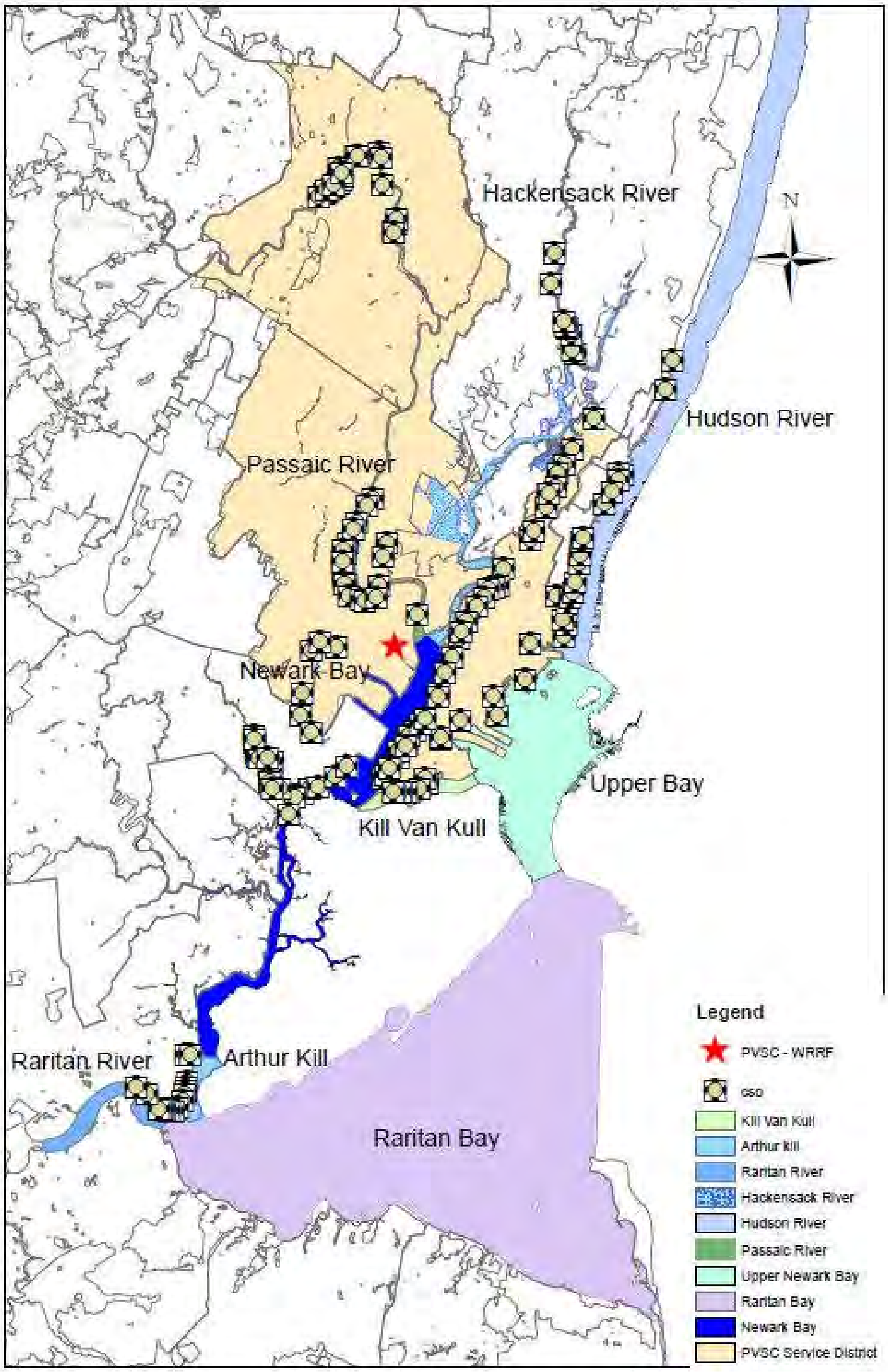

Figure B-1: Study Area Waterbodies

Table B-1: List of Primary Data Users

Central Sewage Treatment Facility	Hydraulically Connected CSO Municipalities and Permittees
Passaic Valley Sewage Commission (PVSC)	Paterson City[1]; Newark City[1]; Kearny Town[1]; Harrison Town[1]; East Newark Borough[1]; Bayonne MUA[1]; Jersey City MUA[1]; North Bergen MUA[1]
Bergen County Utility Authority (BCUA)	Village of Ridgefield Park[1] Fort Lee City[1] Hackensack City[1]
Joint Meeting of Essex and Union Counties[1] (JMEUC)	Elizabeth City[1]
North Bergen Municipal Utility Authority (NBMUA)[1] – Woodcliff Plant	North Bergen MUA[1] Guttenberg Town[1]
North Hudson Sewerage Authority (NHSA)-River Road STP	Weehawken Township[2] West New York Town[2] Union City[2]
North Hudson Sewerage Authority (NHSA) –Adams Street STP	Hoboken City[2] Union City[2]
Middlesex County Utilities Authority (MCUA)	Perth Amboy City[1]

[1] Owns CSO Permitted outfalls discharging to modeled receiving waters. [2]Municipality with CSOs within their limits but not a permit holder

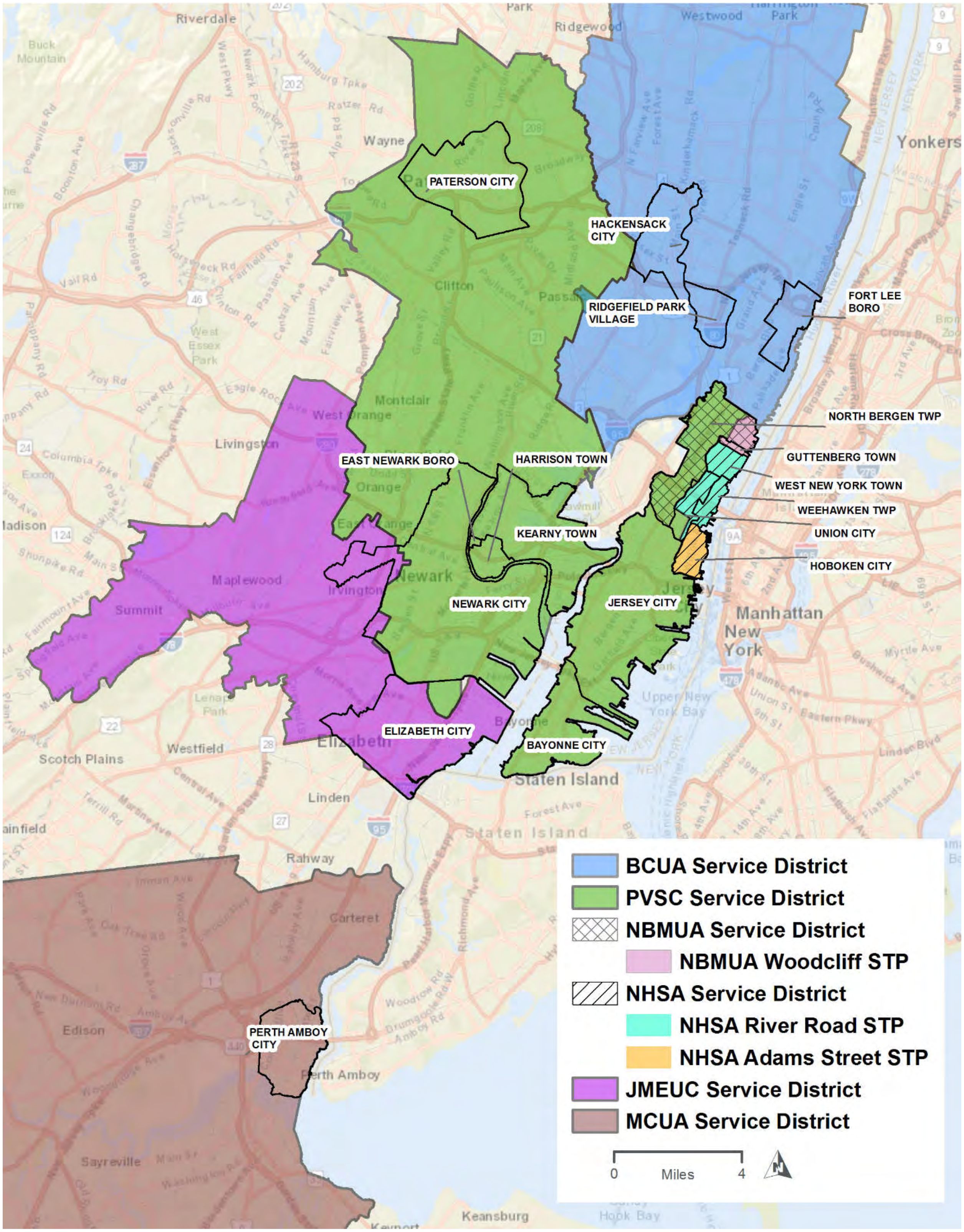

Figure B-2: Participating NJCSO Group Members and Associated Central Sewage Treatment Facilities

For example:

- The utilities responsible for providing treatment may not have permitted CSOs, which are the responsibility of the municipalities;
- The municipalities with permitted CSOs may not be able to reduce their discharges without the treatment utility modifying its treatment and/or conveyance system;
- Certain municipalities own and operate their own combined sewer systems, interceptors, CSO control facilities, and pumping stations, while others do not own their collection systems; and
- Combinations of utilities and municipalities may jointly own force mains, pumping stations, and other appurtenances but remain independently permitted by the State of New Jersey.

Because of these complex interrelationships, the NJ CSO Group elected to have PVSC lead the technical work required for CSO permit compliance relative to the identification of the sensitive areas. Participating members may use the results generated by the identification of sensitive areas for assessing CSO impacts and potential mitigation strategies.

SECTION C - IDENTIFICATION OF SENSITIVE AREAS

C.1 REGULATORY REQUIREMENTS

C.1.1 Requirements of the USEPA's CSO Control Policy and Sensitive Areas Definition

The USEPA's CSO Control Policy (Federal Register 59 [April 19, 1994]: 18688-18698) "expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas" (Section II.C.3).

The CSO Control Policy states the six (6) criteria for defining an area as a "Sensitive Area" include:

1. Designated Outstanding National Resource Waters
2. National Marine Sanctuaries
3. Waters with threatened or endangered species and their habitat
4. Waters with primary contact recreation
5. Public drinking water intakes or their designated protected areas
6. Shellfish beds

The CSO Control Policy states that if Sensitive Areas are present and impacted, the LTCP should include provisions to:

- Prohibit new or significantly increased overflows
- Eliminate or relocate overflows wherever physically possible and economically achievable
- Treat overflows where necessary
- Where elimination or treatment is not achievable, reassess impacts each permit cycle

Sensitive Areas should be considered prior to the evaluation of CSO control alternatives. This allows a CSO community to identify and estimate costs for controls that could eliminate or relocate CSOs from Sensitive Areas where pollutant loadings pose a high environmental or public health risk and where control efforts should be focused. The cost of these controls can then be considered, along with the community's financial capability, to evaluate cost-effective controls for all of the receiving waters.

C.1.2 Requirements of the NJPDES Permits

The NJPDES permits indicate that the permittee's LTCP shall give the highest priority to controlling overflows to sensitive areas. The NJPDES Permit further states that "Sensitive areas include designated Outstanding National Resource Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters used for primary contact recreation (including but not limited to bathing beaches), public drinking water intakes or their designated protection areas, and shellfish beds."

The NJPDES Permits indicate that if Sensitive Areas are present and impacted, the following requirements will apply:

- Prohibit new or significantly increased CSOs.

- Eliminate or relocate CSOs that discharge to sensitive areas wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment.
- Where elimination or relocation is not physically possible and economically achievable, or would provide less environmental protection than additional treatment, the permittee shall provide the level of treatment for remaining CSOs deemed necessary to meet WQS for full protection of existing and designated uses.

C.2 ASSESSMENT OF SENSITIVE AREAS

The six criteria for Sensitive Areas identified in the CSO policy were evaluated for the waterbodies in the Study Area including reaches upstream of the CSOs. Special consideration was given to areas downstream and within the tidal influence of the CSOs, as any potential Sensitive Areas within hydraulic proximity to outfalls may be impacted by their discharge.

C.2.1 Methodology

In order to develop a comprehensive understanding of the presence of possible Sensitive Areas within the Study Area, multiple strategies were used to complete these investigations including searching online data resources, sending letters to regulatory agencies and environmental organizations, and conducting an observation survey. The goal of this multi-faceted approach was to gain a thorough understanding of the presence of factors that may be considered for the determination of potential Sensitive Areas to support the development of future CSO control alternatives.

Correspondance with Regulatory Agencies

Open Public Record Act Requests were drafted and issued to key regulatory agencies at the federal and state levels, and environmental organizations at the state and local levels. Contacts were identified based on their governance over the waterbodies of concern. Table C-1 lists the agencies which received requests for information. Follow-up telephone calls were made to all agencies that had not responded by April 15, 2017.

Table C-1: Letters Issued to Agencies and Organizations

Agency	Contact	Department	Date Sent	Response
US Department of the Interior	Robert Anderson	Fish and Wildlife	3/20/17	Directed to Nj.gov/dep/fwl/ensp/
New Jersey Department of Environmental Protection (NJDEP)	Elizabeth Semple	Coastal and Land Use Planning	3/20/17	Email Response Received
NJDEP	N/A	Division of Land Use Regulation	3/20/17	No Response

Agency	Contact	Department	Date Sent	Response
NJDEP	Bruce Friedman	Water Monitoring and Standards	3/20/17	Directed to http://www.nj.gov/dep/watersupply/swap/
NJDEP	Michele Putnam	Division of Water Quality	3/20/17	Request too broad
NJDEP	N/A	State Park Service	3/20/17	Request too broad
NJDEP	Dr. Gary Buchanan	Division of Science, Research and Environmental Health	3/20/17	Directed to Nj.gov/dep/gis/landscape
NJDEP	N/A	Division of Water Supply and Geoscience	3/20/17	Directed to www13.state.nj.us/dataminer; www.nj.gov/dep/swapsurfacewatersystems
New Jersey Department of Environmental Protection (NJDEP)	David Chanda	Director Fish and Wildlife	3/20/17	Use Nj.gov/dep/fwl/ensp/

Each letter requested information related to all six Sensitive Area criteria with the exception of the letter to the U.S. Fish and Wildlife Service, which was tailored based on telephone conversations held prior to issuance of the letter. Copies of the letters issued requesting information and the responses are included in Appendix A. Some requests were unable to be processed due to “request too broad”. These agencies can only provide information for specific facilities, lots, owners, etc. and are not available for large areas such as the Study Area for this report. The NJDEP Division of Land Use Regulation had no response, based on a written request and telephone calls. These responses are shown in Appendix A.

Online Database Searches

An abundance of information is available online regarding the waterbodies in the Study Area. The following entities and on-line databases were searched for information related to Sensitive Areas within the Study Area boundary:

- National Oceanic and Atmospheric Administration (NOAA)
  - NOAA 2017 Environmental Sensitivity Index Maps
- United States Environmental Protection Agency
  - Anti-degradation Policy - Outstanding Natural Resource Water
- United States Fish and Wildlife Service (USFWS)
- New Jersey Department of Environmental Protection (NJDEP)
- Office of National Marine Sanctuaries

The results of these searches were used to determine the presence of Sensitive Areas located within the Study Area boundaries.

C.2.2 Outstanding National Resource Waters

Outstanding National Resource Waters (ONRW) are maintained and protected by Tier 3 of the USEPA's Anti-degradation Policy which can be accessed through the Agency's website listed in the reference section. Only waters of "exceptional ecological significance" qualify as ONRWs. Only States and Tribes determine whether or not a water body will be classified as such. No such waterbody in or adjacent to New Jersey, and/or the Study Area, is listed.

C.2.3 National Marine Sanctuaries

The goal of the National Marine Sanctuaries Act (Title 16, Chapter 32, Section 1431 last amended in November 2000) is to identify and designate National Marine Sanctuaries (NMS) areas of the marine environment which are of special national significance and to manage these areas as the National Marine Sanctuary System. Receiving this designation results in the conservation and management of these special habitats, support of the natural biological communities through protection and restoration, enhances the public's awareness, understanding and appreciation for the marine sanctuary, and supports the vitality of these communities through research and Federal, State and Local government collaboration.

In order for a marine environment to be designated a National Marine Sanctuary, the United States Secretary of Commerce will determine if any of the following criteria apply:

> *"Criteria 1*
> *The area's natural resources and ecological qualities are of special significance and contribute to: biological productivity or diversity; maintenance or enhancement of ecosystem structure and function; maintenance of ecologically or commercially important species or species assemblages, or both; or maintenance or enhancement of connectivity to other ecologically significant resources.*
>
> *Criteria 2*
> *The area contains submerged maritime heritage resources of special historical, cultural, or archaeological significance, that: individually or collectively are consistent with the criteria of eligibility for listing on the National Register of Historic Places; have met or which would meet the criteria for designation as a National Historic Landmark; or have special or sacred meaning to the indigenous people of the region or nation.*
>
> *Criteria 3*
> *The area supports present and potential economic uses, such as: tourism; commercial and recreational fishing; subsistence and traditional uses; diving; and other recreational uses that depend on conservation and management of the area's resources.*
>
> *Criteria 4*
> *The publically-derived benefits of the area, such as aesthetic value, public recreation, and access to places depend on conservation and management of the area's resources."*

The above criteria for National Marine Sanctuaries was taken directly from the Sanctuary Nomination Process Guide, which can be found on the NMS website listed in the Reference Section.

The Office of National Marine Sanctuaries (ONMS) is the trustee of all national marine sanctuaries and as such, it currently recognizes fourteen (14) national marine sanctuaries, none of which are located within New Jersey or adjacent waters. Therefore, none of the Study Area's receiving or surrounding waters are considered to be a National Marine Sanctuary.

C.2.4 Threatened or Endangerd Species Criterion

The Federal CSO Policy states "waters with threatened or endangered species and their habitat" are considered a Sensitive Area. The US Fish and Wildlife Service (USFWS), NJ Heritage Program (NJHP) and NJDEP Division of Fish and Wildlife (NJDFW) were contacted and response letters were received. In addition, the National Oceanic and Atmospheric Administration (NOAA) Environmental Sensitivity Index maps were obtained online and reviewed to identify any threatened or endangered species with habitats located within the Study Area. The NOAA maps outline the critical habitat areas based on the requirements of each species. When the USFWS proposes an animal or plant for listing as endangered or threatened under the Endangered Species Act (ESA), the specific areas that contain the physical or biological features essential to its conservation are identifed. This is the species' "Critical Habitat". The ESA requires the designation of Critical Habitat when it is both "prudent and determinable." It considers physical and biological features that a species needs for life processes and successful reproduction including:

- Space for individual and overall population growth, and for normal behavior;
- Cover or shelter;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Sites for breeding and rearing offspring, germination, or seed dispersal;
- Habitats that are protected from disturbances or are representative of the historical geographical and ecological distributions of the species.

The threatened and endangered species that could potentially be present within the project Study Area waterbodies are listed in Tables C-2, C-3 and C-4. As per the USEPA CSO Control Policy, only endangered and threatened designations are documented in this section; special concern, vulnerable, or any other status are not included. If any habitat of an endangered or threatened species by either federal or state classification is overlapping with a CSO location this area was further evaluated to determine if it should be considered a Sensitive Area.

Federal Level Research

At the federal level, USFWS and NOAA were utilized to analyze the Study Area for federally listed endangered and threatened species. USFWS responded with a letter as shown in Appendix A. The response letter addresses each USFWS designated site individually by showing maps of the area. Areas included are Dundee Canal and Island, Dundee Island Park and Pulaski Park, Essex County Branch Brook Park, Kearny Point, Oak Island Yards, Harrison Marsh Phase 1, Meadowland Marsh, Metro Media Tract and Harrison Marsh Phase 2. Each location returned a response that no endangered species were found in the Study Area for federally-listed threatened and endangered species.

The NOAA Environmental Sensitivity Index Maps for the project area, ESI-19 through ESI-25, were reviewed to locate specific habitat for the listed species. The NOAA maps that show endangered or threatened species in the Study Area are included as Appendix C.

Table C-2: Federally-Listed Threatened and Endangered Species from NOAA

Species	Status	Waterbody	Months Present	NOAA Map
Atlantic Sturgeon	Endangered	Hudson River	Nov-Apr	21A
Short nose Sturgeon	Endangered	Hudson River	Jan-Dec	21A
Loggerhead Sea Turtle	Endangered	Lower Bay	May-Nov	21D
Humpback Whale	Endangered	Lower Bay	Apr-Nov	21D

The federally listed species in Table C-2 may potentially use the Study Area waters as a habitat during the months shown. Only the short nose sturgeon may be present year round. In Appendix C, Figures C-1 through C-7 show where NOAA designated habitats of both federal and state listed species are located relative to the CSO outfalls.

State Level Research

NJDEP's Division of Fish and Wildlife (DFW) does not have a map for a specific location; instead it lists the endangered and threatened species for the state as a whole. Therefore, the New Jersey National Heritage Program (NJNHP) and NOAA were used for New Jersey State level information. These both allow an inquiry to be specific to a project area and the vicinity around it, rather than to the state as a whole. The NJNHP response can be found in Appendix A. The following is a list of the reported state level endangered and threatened species that were evaluated in this report.

Table C-3: State-Listed Threatened and Endangered Species from NJNHP

Species	Status	Location
Bald Eagle	Endangered	Meadowlark Marsh, Metro Media Tract
Black Crowned Night Heron	Threatened	Kearny Point, Oak Island Yards
Cattle Egret	Threatened	Meadowlark Marsh
Northern Diamondback	Endangered	Harrison Marsh Phase 2
Northern Harrier	Endangered	Metro Media Tract, Harrison Marsh Phase 2
Peregrine Falcon	Endangered	Oak Island yards, Meadlowlark Marsh, Metro Media Tract, Harrison Marsh Phase 2
Yellow Crowned Night Heron	Endangered	Meadowland Marsh, Metro Media Tract, Harrison Marsh Phase 2

The NJNHP locations listed in Table C-3 are within the greater waterbodies identified in the Study Area. Kearny Point is located in the southern part of Kearny in between the Hackensack and Passaic River. Oak Island Yards is the rail yard in eastern Newark which is adjacent to Newark Bay. Meadowlark Marsh is east of Ridgefield bordering the Hackensack River. Metro Media Tract and Harrison Marsh Phase 2 are both east of Carlstadt bordering the Hackensack River.

NJNHP found no critical habitats within the limits of the Study Area.

Table C-4: State-Listed Threatened and Endangered Species from NOAA

Species	NJ Status	NOAA Maps	Waterbodies
Atlantic Sturgeon	Endangered	20C, 21A, 21B	Hudson River
BC Night Heron	Threatened	20C, 21B, 21D	Hackensack River, Upper Bay
Cattle Egret	Threatened	22B	Newark Bay
Green Sea Turtle	Threatened	21A	Upper Bay
Humpback Whale	Endangered	21D	Lower Bay
K. Ridley Sea Turtle	Endangered	21A	Upper Bay
Least Tern	Endangered	20C, 21D	Hackensack River, Upper Bay
Leatherback Turtle	Endangered	21D	Lower Bay
Loggerhead Sea Turtle	Endangered	21A	Upper Bay
Northern Harrier	Endangered	20C	Hackensack River
Raptor 1	Endangered	20C, 21D, 22A, 22B, 24B	Hudson River, Hackensack River, Upper Bay, Passaic River, Kill Van Kull, Arthur Kill, Raritan River, Elizabeth River
Raptor 2	Endangered	20C	Hackensack River
Shortnose Sturgeon	Endangered	20C, 21A, 21B	Hudson River
YC Night Heron	Threatened	20C, 21D	Hackensack River, Upper Bay, Arthur Kill

The NOAA maps included both federal and state species on the same map and show critical habitat areas. Critical habitat areas differ in size depending on the species. Some species require large areas, with critical habitats shown to be polygonal areas, while others remain within a small radius and have critical habitats denoted as a circular marker.

Each of these agencies list different species depending on their criteria for listing, and the purpose of the inquiry. USFWS identifies any threatened or endangered species in the area. NJNHP requests are typically used for smaller-scale projects, and cannot, therefore, cover the entire study area. The selected sites were used as a measure of the endangered or threatened species in the area. The selected sites also extend an additional ¼ mile outside of the site boundaries to account for additional disturbances. NOAA maps are a quick reference to identify the species most susceptible in the event of an oil spill. To avoid the risk of vandalism and to protect endangered or threatened species, the NOAA maps can include the species' markers in an undisclosed radius from the real habitat areas. This is purposely done to make a species' exact location difficult to find, especially when these maps may not be as current as a detailed request to the USFWS or NJNHP.

Threatened or endangered species and their habitat, have been identified within the Study Area and are shown in Figures C-1 to C-7 in Appendix C. The figures identify 13 locations where threatened or endangered species have critical habitats within the Study Area. Note that figures may overlap in the area covered. Table C-5 below lists the areas where CSO outfalls are located inside the critical habitat of an endangered or threatened species. As such, these areas were evaluated further to determine if CSOs are having an impact on the species and critical habitats for the purposes of determining if any of these areas should be considered a sensitive area.

Table C-5: State-Listed Threatened and Endangered Species from NOAA

Species	NOAA Map - Number	Waterbody	# of CSO in Critical Habitat
Atlantic/Shortnose Sturgeon	499	Hudson River	15
Raptor 1	24B - 290	Raritan River	1
Raptor 1	22B - 129	Elizabeth River	1
Raptor 1	22A - 129	Passaic River	4
Wading Bird - Various	21D - 277	Upper Bay	1
Wading Bird – Various	21D - 295	Newark Bay	1
Wading Bird - Various	21B - 266	Marshes of Hackensack River	1

Six critical habitat areas are identified for various birds including the Raritan River, Elizabeth River, Passaic River, Upper Bay, Newark Bay and the marshes of the Hackensack River. Each of these critical habitat areas have one CSO per area, except the Passaic River location that has four CSO outfalls clustered together near the Raptor 1. Endangered species that are in the Study Area that do not specifically have a habitat in the receiving waters (i.e. birds) near CSO locations will not be considered. The migratory patterns of many species also mean sightings listed in an area are not enough evidence to surmise a habitat. Additionally, a species may not consider an entire area as a temporary cover or shelter during the time spent there. Many species of birds are relevant for this reason; they do not live in the water, migrate to warmer climates during winter to breed, and are not restricted to eating only aquatic life found in the rivers and streams. If a species lives, propagates, and eats in an area, the area can be considered its habitat. Otherwise, it is unclear if the identified area alone is critical for a species' conservation when other areas are providing similar if not additional needs. For this reason, CSOs located in these areas are not being considered to disrupt any of the birds above in their critical habitats and are, therefore, not sensitive areas.

The Atlantic and Shortnose Sturgeon critical habitats extend throughout the Hudson River. Both species are susceptible to environmental contamination due to their benthic foraging behavior and long life span. A total of 15 CSO outfalls discharge to the Hudson River and were further reviewed to determine if there are any impacts on the Sturgeon. A status review of Atlantic Sturgeon by NOAA concluded that commercial bycatch and decades of prior environmental degradation are the biggest threats to Atlantic sturgeon recovery in the New York Bight. The water quality in the Hudson River and New York Bight has improved in recent decades, and no longer appears to present a significant threat to Atlantic Sturgeon recovery. The review also does not specifically mention human enteric pathogens as a cause for poor water quality, referring only to sewer discharge as one of many point and non-point sources contributing to a low dissolved oxygen level. This document can be found in Appendix B. A separate review of the available published scientific articles, reports, and data by the Great Lakes Environmental Center specifically examined the impact of human enteric pathogens to find any specific effects on Atlantic sturgeon. Surface water conditions for the indicator bacteria used (fecal coliform, enterococcus, and E. Coli) make it significantly more difficult for survival outside of the mammillian digestive tracts where these bacteria usually live. Water temparatures of around 70°F instead of 100°F and a higher salinity from the tidal nature of the Lower Hudson River makes long-term survival difficult. The substantial water flow and depth in these areas also protects the bottom-dwelling sturgeon populations from contact with these bacteria. These conditions make extended human pathogen exposure to Atlantic sturgeon unlikely. The review also did not find any specific information to suggest any negative effects these pathogen have on Atlantic Sturgeon at any life stage of the fish, both now and in the future. This may be related to the lack of documented presence of Atlantic Sturgeon in the New Jersey portion of the lower Hudson River for feeding, osmotic acclimation, or any other purposes. Atlantic Surgeon are likely to pass through this segment of the Hudson, but are thought to travel in deep channel waters, reducing vulnerabilities to nearshore discharges and intermittent CSO discharges. This review is found in Appendix D. The adult population of Shortnose sturgeon in the Hudson River has also been increasing at rates higher than those expected by recovery criteria according to the population research study "Recovery of a US Endangered Fish" by Cornell University. Shortnose sturgeon population estimated in the late 1990s had increased more than 400% from the 1970s estimates, and mainly in the adult segment of the population. The sizes of Shortnose sturgeon marked in the estimate were larger than other estimated populations as well. The estimate's results suggest the current level of habitat protection is adequate toward growing and maintaining healthy sturgeon population. This study can be found in Appendix E. From these conclusions, these areas are not considered sensitive areas as they relate to the Sturgeon.

The Loggerhead Sea Turtle and Humpback Whale are located in the Lower Bay portion of the Raritan Bay, but outside of the Study Area's immediate water bodies adjacent to CSO discharges. The Green and Loggerhead sea turtles are similarly listed in the waters between the coasts of Manhattan and Long Islands, and their habitats do not appear to be relevant for the Study Area. Therefore, these areas are not considered sensitive areas as they relate to the Loggerhead Sea Turtle and Humpback Whale.

C.2.5 Primary Contact Recreation Criterion

The Study Area is located in a densely populated urban area with a mix of recreational uses including boating, fishing, and other uses by the public. The New Jersey Administrative Code (NJAC) defines "primary contact recreation" as water related recreational activities that involve significant ingestion risk including but not limited to wading, swimming, diving, surfing and water skiing. NJAC defines "secondary contact recreation" as water related activities where the probability of water ingestion is minimal and includes, but is not limited to, boating, kayaking, and fishing. The waters in the Study Area are differentiated as either fresh water or saline waters. The upstream portion of the Passaic River is rated as suitable for primary contact as shown in green highlight on the NOAA GIS map in Figure C-1.

The Passaic River is freshwater downstream to Dundee Dam which is just southeast of Paterson City and Dundee Lake, and coincides with where the green outline changes to orange in Figure C-1. Only the green delineation of FW2-NT (Fresh Water 2 – Non-Trout) is classified as primary contact on the NOAA GIS maps. All waters delineated orange and downstream in the Study Area are a mix of salt and fresh water. The mix varies based on tide, rainfall and river flow. For the purpose of this report, downstream of Dundee Dam is considered saline. Special water

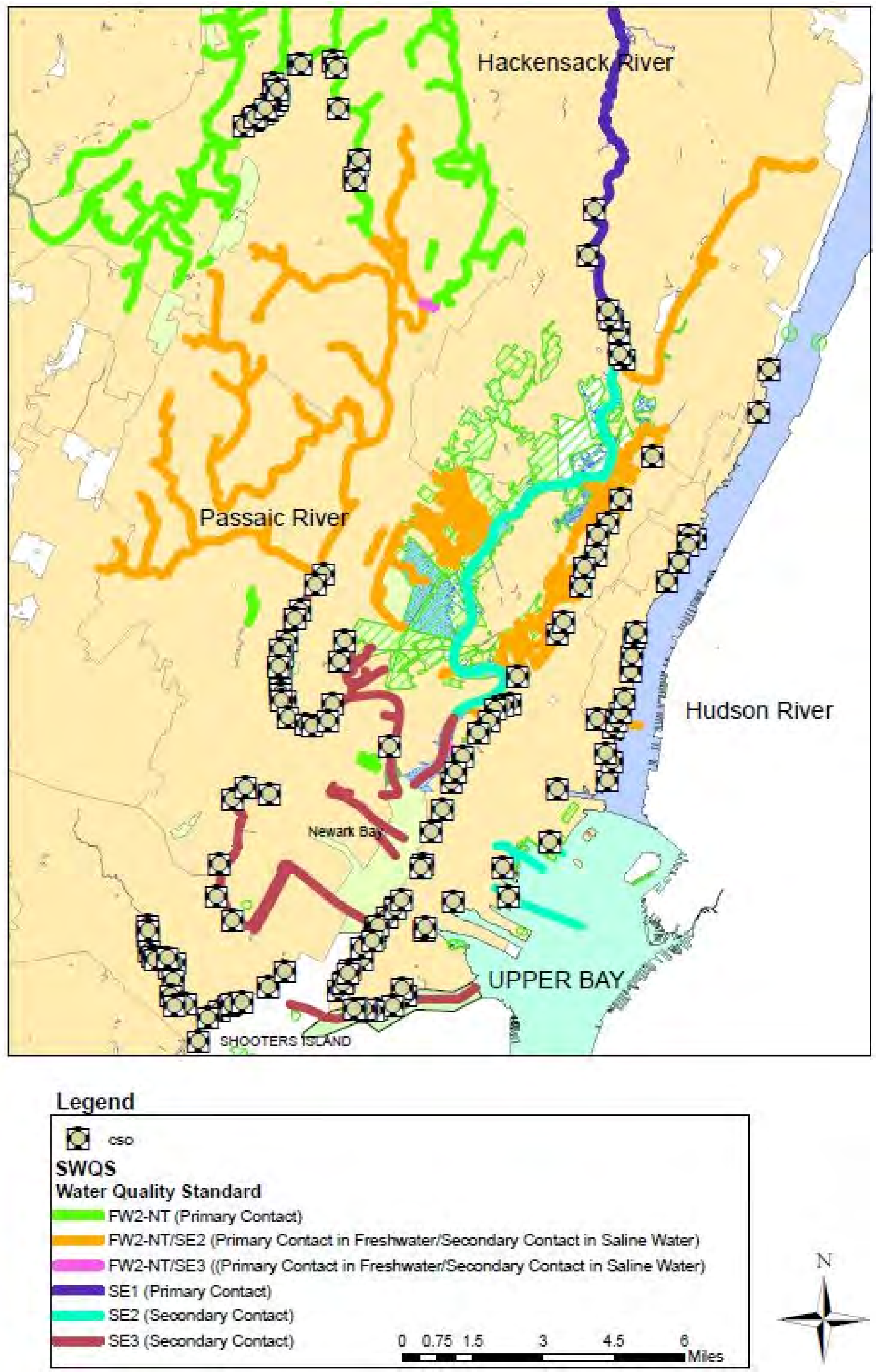

Figure C-1: CSOs in Primary Contact Waters

quality standards are used for water contact areas in order to protect the public from being exposed to waterborne diseases. All of Paterson's 24 CSO discharges occur in the area designated for primary contact. However, there are no beaches or other access ways to the Passaic River in Paterson that exist to facilitate primary contact recreation. Dundee Lake is also designated for primary contact, but there are no CSOs discharging into the water at this location.

Additionally, for the purposes of this report, the Hackensack River is identified as Upper and Lower segments at Overpeck Creek, where the river respectively switches from primary contact to secondary contact classification. The Upper Hackensack River segment relevant for the study area extends up to the Oradell Reservoir and contains 5 CSO discharge locations. Like Paterson, this segment of the Hackensack River does not have any designated beaches or other methods for riverside access for primary contact recreation. Overpeck Creek has 2 CSOs immediately prior to connecting to the Lower Hackensack River as a tributary. These CSOs are considered to be in the saline portion of Overpeck Creek and are thereby classified for secondary contact.

In addition, a tracking survey of primary and secondary recreation was conducted by the sampling team for the NJ CSO Group Baseline Compliance Monitoring Program. The results of this survey are summarized in Table C-6. The sampling crews recorded any recreational activity that they observed while they collected samples in the waterbodies throughout the Study Area. No primary contact recreation activities were witnessed in any waterbody at any time. Secondary contact recreation activities including jet skiing, kayaking, and fishing, were observed in the Hudson River, Upper Bay, Passaic River, Newark Bay, Kill Van Kull, Arthur Kill, and Hackensack River. Therefore, Sensitive Areas, as may be indicated by waters with primary contact recreation, have not been identified within the Study Area.

Table C-6: Observations of Recreational Contact During Sampling in 2016

Waterbody	Designation	Observed Primary Contact	Observed Secondary Contact
Hudson River	Secondary Contact	No	Yes
Upper Bay	Secondary Contact	No	Yes
Passaic River	Primary Contact	No	Yes
Newark Bay	Secondary Contact	No	Yes
Kill Van Kull	Secondary Contact	No	Yes
Arthur Kill	Secondary Contact	No	Yes
Raritan River	Secondary Contact	No	No
Overpeck Creek	Secondary Contact	No	No
Elizabeth River	Secondary Contact	No	No
Lower Hackensack River	Secondary Contact	No	Yes
Upper Hackensack River	Primary Contact	No	Yes

Although waters with primary contact recreation have not been identified, it is noted that there are existing beaches located on the north shore of the Raritan Bay, near the confluence of the Raritan River and the Arthur Kill, at the southeastern boundary of the of the City of Perth Amboy (see Figure C-2). These beaches are not currently designated by the City of Perth Amboy for recreational bathing use due to water quality concerns. Signs are installed at these beaches in order to advise the public not to swim or enter the water in this area. It is noted that there has been public interest in restoring these beaches for use as recreational bathing beaches and the City of Perth Amboy plans to evaluate the feasibility of accomplishing this objective. Although this area does not currently meet the requirements for a Sensitive Area, the Sensitive Area status will be revisited in the future if the City determines that it is feasible to support the safe public use of the beach in this area for recreational bathing.

C.2.6 Drinking Water Intakes

Drinking water intake locations were identified from the NOAA maps and several drinking water providers are located within the Study Area. The majority of the Study Area is served by Passaic Valley Water Commission (PVWC). PVWS supplies an average of 83 MGD of water to Passaic, Bergen, Essex, Hudson and Morris Counties. Water intakes for PVWS comes from four reservoirs including Great Notch, New Street, Levine, and Point View. None of these are within the Study Area of waterbodies and are therefore not affected by CSO discharges.

Only NOAA Map #20 shows a water intake from a waterbody in the Study Area. Figure C-3 shows water intake locations that were identified from the NOAA maps. ID# 21 has SUEZ North America intakes located in the Hackensack River near Hackensack, Bogota and Teaneck. A CSO outfall is located approximately a half mile upstream of this water intake. Therefore, this water intake location was further evaluated. A representative from SUEZ North America, the drinking water provider for this intake, stated that all wells and intakes for Bogota, NJ have been decommissioned after they had purchased the Bogota Water Authority approximately 30 years ago. The river is also tidal, and SUEZ indicated that they have no current interest in drawing from the Hackensack River in the future for its drinking water. As such, there are no Sensitive Areas as a result of drinking water intakes.

C.2.7 Shellfish Beds

One of the National Shellfish Sanitation Program's (NSSP) goals is to control the safety of shellfish for human consumption by prevening shellfish harvests from contaminated growing areas. Shellfish concentrate microorganisms and poisonous or deleterious substances during their normal feeding process, and poisonous or deleterious substances from direct discharge points, disposal sites, or other non-point sources of pollution. In the interest of public safety of shellfish growing areas, a sanitary survey collects and evaluates information concerning actual and potential pollution sources that may adversely affect the water quality, and must be updated periodically. The report from this survey is used with other relevant resources to determine an appropriate classification of an area.

Figure C-2: Perth Amboy Existing Beach Area

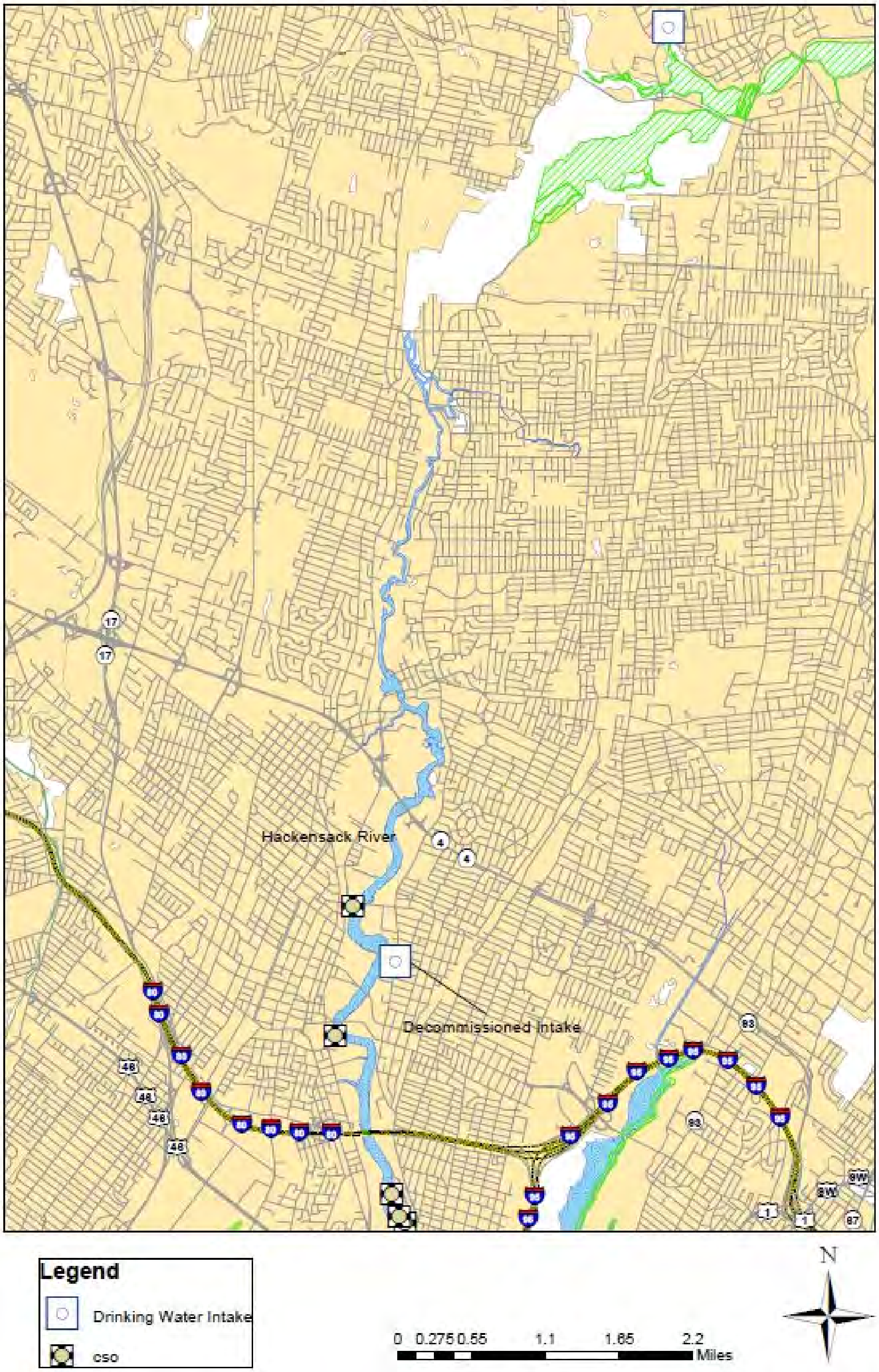

Figure C-3: Drinking Water Intake Locations

The only commercial shellfish beds classified by the NSSP for harvesting within the study area are restricted areas located in Raritan Bay, as shown in Figure C-4. However, this area is downstream of the closest CSO by a few miles. The influence of tidal mixing and dilution coupled with the separation between the most downstream discharge point and beginning of the shellfish harvest zone result in the CSO discharge having a negligible impact on the shellfish beds. Shellfish beds also extend up the Raritan River near Perth Amboy CSOs, but these are designated by the NSSP as prohibited harvesting locations and are only approved for depuration. Therefore, there are no Sensitive Areas due to the presence of shellfish beds in the Study Area.

C.2.8 Summary of Sensitive Areas

A comprehensive review of online databases, correspondence with regulatory agencies, direct observations and local environmental organizations was conducted to identify potential Sensitive Areas impacted by CSO's within the Study Area. The evaluation areas identified by this report can be found in Figure C-5. There are no Outstanding Natural Resource Waters or National Marine Sanctuaries in the Study Area. There were also no sensitive areas identified as it is related to waters with threatened or endangered species and their habitats. The Atlantic and Shortnose sturgeon populations in the Hudson River have both been successfully recovering since the species have been listed as endangered, and the coinciding improvements in water quality since the 1970s have had a positive impact. The current level of CSO discharge is not preventing the recovery of a healthy adult sturgeon population for either species. Primary contact recreation was also not observed in the Study Area, and are therefore there are no Sensitive Areas as a result of waters with primary contact recreation. The drinking water intake identified on the Hackensack River has been decommissioned decades ago and has no future plans for reopening. Also, there does not appear to be any measurable impact of any CSOs in the study area on shellfish beds due to the distance separating the structures from the harvesting location located in the Raritan Bay.

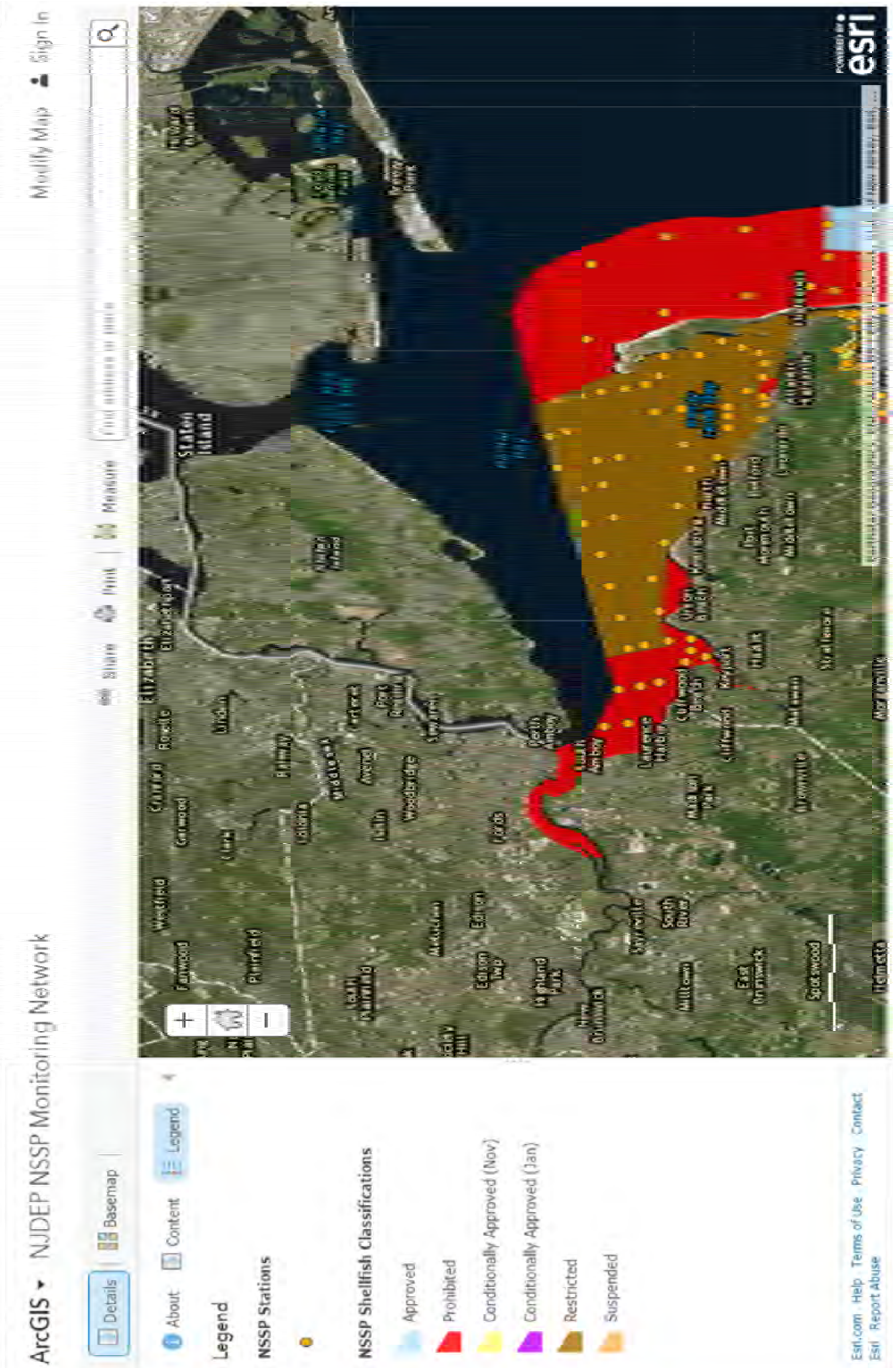

Figure C-4: Shellfish Harvesting Areas in Raritan Bay

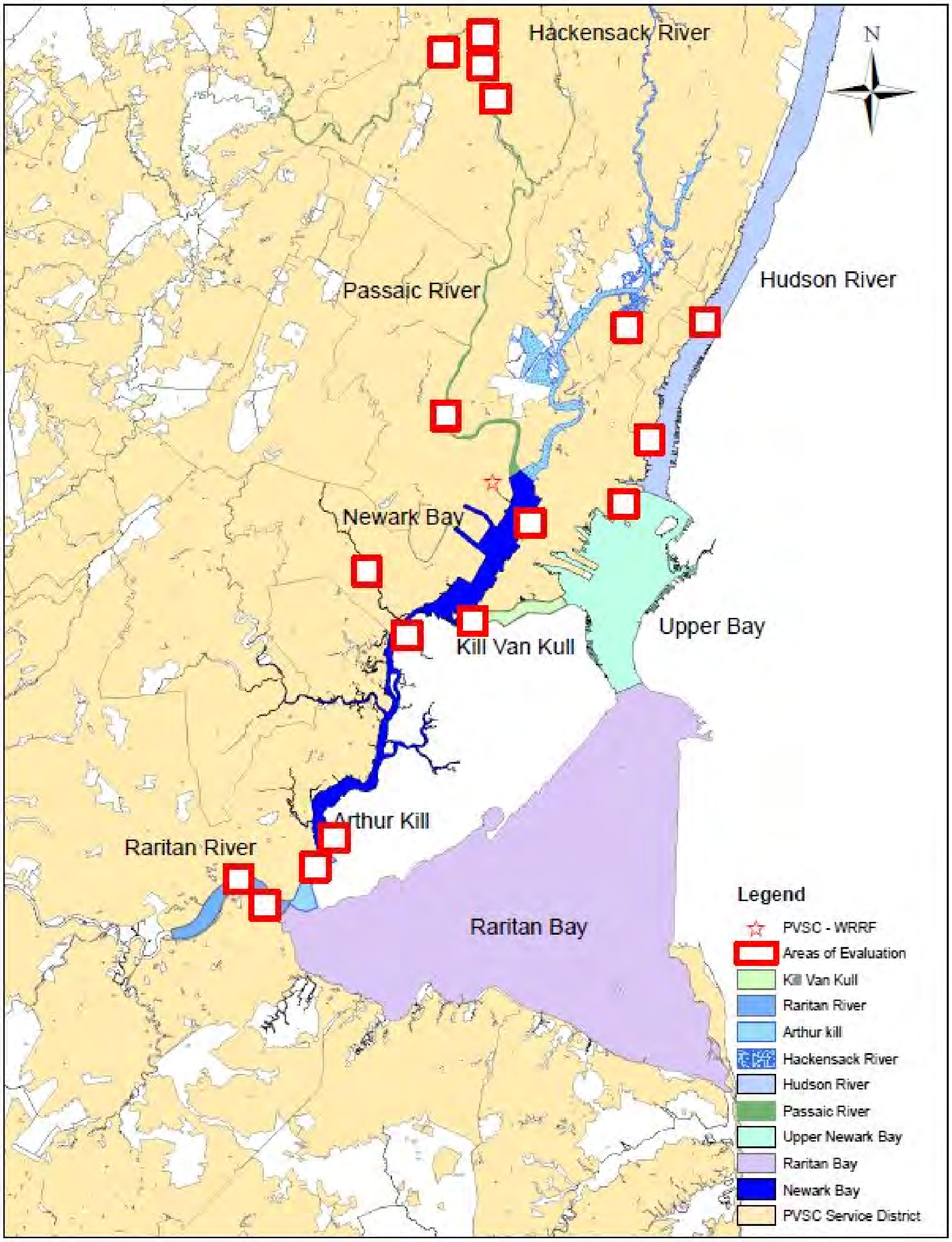

Figure C-5: Evaluation Area Locations

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