City of Hackensack

SEWER SYSTEM CHARACTERIZATION REPORT

NJPDES Permit No. NJ0108766

June 2018

SEWER SYSTEM CHARACTERIZATION REPORT

NJPDES Permit No. NJ0108766

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CONTENTS

Acronyms and Abbreviations v
Executive Summary 1
1 Introduction 1
1.1 Coordination with Hydraulically Connected Communities 1
1.2 Description of the City's CSS 1
2 Project Goals 3
3 Sewer System Characterization and Monitoring 4
3.1 Service Area Land Use Data 4
3.2 Monitoring of Background Conditions 5
3.2.1 Rainfall Monitoring 5
3.2.2 CSO Flow Monitoring 5
3.2.3 Water Quality Sampling 6
3.2.4 Monitoring Program Results and Conclusions 7
3.2.5 Justification for Use of Previous Monitoring Data 7
4 Combined Sewer System Updated Characteristics 8
4.1 Sewer System Updates or Modifications 8
4.2 CSO Regulators and Control Facilities 8
4.2.1 Anderson Street CSO Facility 8
4.2.2 Court Street CSO Facility 9
4.3 Recent Reports or Plans 9
5 Model Development 12
5.1 Model Framework 13
5.1.1 Model Components and their Naming Conventions 13
5.1.2 Advantages of PCSWMM 14
5.1.3 Model Capabilities 14
5.2 Dry Weather Flow Characteristics 14
5.3 Wet Weather Flow and Subcatchment Characteristics 15
6 Model Calibration and Verification 17

6.1 Calibration Criteria 18
6.2 Dry Weather Calibration 18
6.3 Wet Weather Calibration 18
6.4 Model Verification 19
6.5 Model Assessment 20
6.5.1 Calibration Evaluation 20
6.5.2 Sensitivity Analysis 20
6.5.2.1 Vortex Valve Rating Curves 21
6.5.2.2 Percent Impervious 21
6.5.2.3 Subcatchment Area 21
6.5.2.4 Conduit Roughness Coefficient 21
6.5.3 Conclusions 22
7 Consideration of Sensitive Areas 23
7.1 Introduction 23
7.2 General Assessment 23
8 CSO Analysis and 2004 Typical Year Simulation 24
9 Recommendations 29

TABLES

Table 3-1. A Comparison of the City's Impervious Area and Urban Land Use Area from 1995 to 2012 4
Table 4-1. City of Hackensack Drawings and Reports 10
Table 5-1. Average Reduction in DWF at Court and Anderson Metering Stations - BCUA Data 15
Table 5-2. Subcatchment Characteristics 16
Table 6-1. Summary of Calibration and Verification Events 17
Table 6-2. Vortex Valve Rating Curves 19
Table 8-1. Criteria for Typical Year Analysis 24
Table 8-2. Summary of the Recommended Typical Rainfall Year – 2004 25
Table 8-3. Top 20 Rainfall Events in 2004 by Depth 26
Table 8-4. Anderson Street Typical Year Simulation Results & Wasteloads 27
Table 8-5. Court Street Typical Year Simulation Results and Wasteloads 28

FIGURES

Figure 3-1A. 2006 Monitoring Program Locations and CSS System-wide Model Extents……....5

Figure 3-1B. Hackensack Storm and CSS Subdrainage Areas & Areas Prone to Flooding…….5

Figure 3-2. 2006 Monitoring Program – Anderson Street Flow Meter Configuration – Plan ……5

Figure 3-3. 2006 Monitoring Program – Anderson Street Flow Meter Configuration – Section…….5

Figure 3-4. 2006 Monitoring Program – Court Street Flow Meter Configuration – Plan ……...5

Figure 3-5. 2006 Monitoring Program – Court Street Flow Meter Configuration – Section ……..5

Figure 4-1. Combined Sewer System Configuration Process Flow Diagram ……11

Figure 4-2. Anderson Street Facility Process Flow Schematic……11

Figure 4-3. Court Street Facility Process Flow Schematic……....11

Figure 5-1. Model Hydrologic and Hydraulic Components – Anderson Street Subdrainage Area……13

Figure 5-2. Model Hydrologic and Hydraulic Components – Court Street Subdrainage Area ……13

Figure 6-1. Flow at Meter A2 – Dry Weather Flow – Anderson Street Subdrainage Area……..18

Figure 6-2. Flow at Meter C2 – Dry Weather Flow – Court Street Subdrainage Area……18

Figure 6-3. Flow at Meter A1 – June 2, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-4. Flow at Meter A2 – June 2, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-5. Flow at Meter C1 – June 2, 2006 Storm Event – Court Street Subdrainage Area……...19

Figure 6-6. Flow at Meter C2 – June 2, 2006 Storm Event – Court Street Subdrainage Area……19

Figure 6-7. Stage Depth at Meter A1 – June 2, 2006 Storm Event – Anderson Street Subdrainage Area..19

Figure 6-8. Stage Depth at Meter C1 – June 2, 2006 Storm Event – Court Street Subdrainage Area…….19

Figure 6-9. Flow at Meter A1 – July 5, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-10. Flow at Meter A2 – July 5, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-11. Flow at Meter C1 – July 5, 2006 Storm Event – Court Street Subdrainage Area….....19

Figure 6-12. Flow at Meter C2 – July 5, 2006 Storm Event – Court Street Subdrainage Area….....…19

Figure 6-13. Stage Depth at Meter A1 – July 5, 2006 Storm Event – Anderson Street Subdrainage Area..19

Figure 6-14. Stage Depth at Meter C1 – July 5, 2006 Storm Event – Court Street Subdrainage Area…….19

Figure 6-15. Flow at Meter A1 – June 7, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-16. Flow at Meter A2 – June 7, 2006 Storm Event – Anderson Street Subdrainage Area……19

Figure 6-17. Flow at Meter C1 – June 7, 2006 Storm Event – Court Street Subdrainage Area….....19

Figure 6-18. Flow at Meter C2 – June 7, 2006 Storm Event – Court Street Subdrainage Area……..…19

Figure 6-19. Stage Depth at Meter A1 – June 7, 2006 Storm Event – Anderson Street Subdrainage Area……..19
Figure 6-20. Stage Depth at Meter C1 – June 7, 2006 Storm Event – Court Street Subdrainage Area.…19
Figure 6-21. A Comparison of Monitored versus Modeled Volume Conditions …….....20
Figure 6-22. A Comparison of Monitored versus Modeled Flow Conditions …….....20
Figure 6-23. A Comparison of Monitored versus Modeled Stage Depth Conditions …….....20
Figure 6-24. The Distribution of Ranges of Variation between Monitored versus Modeled Total Volume Conditions…….....20
Figure 6-25. The Distribution of Ranges of Variation between Monitored versus Modeled Peak Flow Conditions…….....20
Figure 6-26. The Distribution of Ranges of Variation between Monitored versus Modeled Stage Depth Conditions…….....20

APPENDICES

Appendix A 2006 Rain Gauge Monitoring Data (CD)
Appendix B 2006 Flow Meter Monitoring Data (CD)
Appendix C 2006 Tide Data (CD)
Appendix D 2006 Water Quality Sampling Data (CD)
Appendix E Model Hydraulic Component Tables: Manholes and Conduits
Appendix F Daily Overflow Volumes and Wasteloads for Typical Year Simulation

ACRONYMS AND ABBREVIATIONS

2005 Work Plan	City of Hackensack CSO Discharge Characterization Study – Combined Sewer System Monitoring Program Proposal and Work Plan
2016 Work Plan	City of Hackensack Sewer System Characterization Work Plan for the Long Term Control Plan
BCUA	Bergen County Utilities Authority
CBOD5	Five-day Carbonaceous Biochemical Oxygen Demand
City	City of Hackensack
COD	Chemical Oxygen Demand
CSM	Combined Sewer Management
CSO	Combined Sewer Overflows
CSS	Combined Sewer System
DWF	Dry Weather Flow
EPA	United States Environmental Protection Agency
FC	Fecal Coliform
LTCP	Long Term Control Plan
MGD	Million Gallons per Day
MPN	Most-probable Number
NAVD88	North American Vertical Datum of 1988
NCDC	NOAA's National Climatic Data Center
NGVD29	National Geodetic Vertical Datum of 1929
NH3-H	Ammonia
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NMS	National Marine Sanctuaries
NO2 & NO3	Nitrites and Nitrates
NOAA	National Oceanic and Atmospheric Administration
ONRW	Outstanding National Resource Waters
Permit	NJDPES Permit No. NJ0108766 for the City of Hackensack
PPP Report	Public Participation Process Report prepared by Arcadis U.S., Inc.
POTW	Publicly Owned Treatment Works

PVSC	Passaic Valley Sewerage Commission
SIU	Significant Indirect User
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WPCF	Water Pollution Control Facility
WWF	Wet Weather Flow

EXECUTIVE SUMMARY

Pursuant to the City of Hackensack's (City) New Jersey Pollution Discharge Elimination System (NJPDES) Permit No. NJ0108766 (Permit), this Sewer System Characterization Report (Characterization Report) aims to characterize the City's combined sewer system (CSS) based on records review, monitoring, and modeling of the system. The City executed a characterization study in accordance with the *Hackensack Sewer System Characterization Work Plan for the LTCP*, which was prepared by Arcadis U.S., Inc., was submitted to the New Jersey Department of Environmental Protection (NJDEP) on June 21, 2016, and was approved by the NJDEP in a letter dated July 27, 2016.

The City's CSS consists of two subdrainage areas, which are referred to as Anderson and Court Street. The Anderson Street subdrainage area serves an area of approximately 470 square miles and conveys sanitary and combined sewage to a regulator facility at Anderson Street. The Court Street subdrainage area serves an area of approximately 440 square miles and conveys sewage to a regulator facility at Court Street. The regulators at Court Street and Anderson Street both overflow to the Hackensack River when the sewers have reached their wet weather capacities (referred to as combined sewer overflows, or CSO). The sanitary flow from the City's CSS is conveyed to the Bergen County Utilities Authority (BCUA) Water Pollution Control Facility (WPCF) in Little Ferry, NJ.

The City undertook a monitoring program in 2006 that included rainfall, combined sewer flow, and water quality monitoring. The monitoring program was performed over a three-month data collection period. The results of the rainfall monitoring portion were used to evaluate a "typical" rainfall event and to recommend specific rainfall events for use in development of a CSS computer model. The CSO flow monitoring program provided information on the frequency and duration of overflows in the system relative to the amount of rainfall in a wet weather event; it also provided data for calibration of a computer model of the CSS. Water quality sampling provided information on pollutant wasteloads from the CSO activity.

A computer model of the City's CSS was developed in 2007 using XP-SWMM software and updated and recalibrated in 2017 using PCSWMM software. The model was based on a 1970 set of survey drawings of the City's sewers and used the 2006 monitoring program data to calibrate and verify the model (in both 2007 and 2017). It was determined that the 2006 monitoring program data was sufficient for calibration in 2017 because there was minimal population change and minimal increase in impervious areas in the City since 2006. The updated model incorporated new condition assessment and survey data that were collected in a 2015 condition assessment program.

This report presents graphs comparing the model results in the updated, recalibrated PCSWMM model to the original XP-SWMM model and the 2006 monitoring program data. The graphs show that the results generally met the calibration criteria for two calibration events and one verification event, as required by the NJDEP approved 2016 Work Plan. 92% of the volume calibration observations were within the targeted range. 92% of the peak flow calibration observations were within the targeted range of -15% and 25% or conservatively above 25%. 33% of the stage depth difference calibration observations were within the targeted range of -15% and 30%. Sensitivity analyses were performed on the updated model and indicated that the results are sensitive to the vortex valve rating curves that are used in the model simulation. Further, the results are sensitive to the percent impervious, subcatchment area, and conduit

roughness coefficient parameters when these parameters are changed significantly; it is noted that these parameters are unlikely to change in any significant manner.

The Passaic Valley Sewerage Commission (PVSC) completed sensitive area analysis and typical rain year analysis on behalf of the NJ CSO Group, which includes the City of Hackensack. Sensitive area analyses were performed for the sensitive area categories that are listed in Part IV Section G.3.a of the Permit. PVSC's sensitive area analysis determined that no sensitive areas are in close proximity to the City's outfalls.

The PVSC typical year rainfall analysis was conducted to identify a "typical" rainfall year that applies to the region of the members of the NJ CSO Group. Based on analysis of rainfall records for Newark International Airport, the analysis determined that 2004 was a typical rainfall year. The updated, recalibrated model was run using the rainfall data for the 2004 calendar year, and the results were used in coordination with 2006 water quality monitoring data to estimate pollutant wasteloads into the Hackensack River.

1 INTRODUCTION

The New Jersey Pollutant Discharge Elimination System (NJPDES) Permit Number NJ0108766 for Combined Sewer Management (CSM) regulates the activities of various components of the City of Hackensack (City) combined sewer system (CSS) and authorizes/controls the release of combined sewer overflow (CSO) discharges into receiving waters. The Final Surface Water Renewal Permit Action (Permit) was issued by the New Jersey Department of Environmental Protection (NJDEP) to the City with an effective date of July 1, 2015 and an expiration date of June 30, 2020.

Part IV of the Permit establishes the requirements for development of a Long Term Control Plan (LTCP) aimed at minimizing the impacts of CSOs on their receiving water bodies. This Sewer System Characterization Report (Characterization Report), along with the separately submitted Public Participation Process Report (PPP Report), addresses the first three elements of the LTCP: Characterization, Monitoring, & Modeling; Public Participation; and Consideration of Sensitive Areas. This Characterization Report presents the results of past monitoring and modeling efforts related to the City's CSS. It was prepared in accordance with the previously submitted and approved *Sewer System Characterization Work Plan* (2016 Work Plan) and the submittal requirements set forth in Permit Part IV Section D.3.b.ii & iv. The remaining LTCP elements will be addressed in future submittals in accordance with the schedule outlined in Permit Part IV Section D.3.b.v through vii.

1.1 Coordination with Hydraulically Connected Communities

The City of Hackensack's combined sewers convey raw sewage to the Bergen County Utilities Authority (BCUA) system, and the combined sewage is treated at the BCUA Water Pollution Control Facility (WPCF) in Little Ferry, NJ. The Village of Ridgefield Park (Ridgefield Park) and the Borough of Fort Lee (Fort Lee) each operate combined sewer systems that also convey sewage to the BCUA system. The BCUA, Hackensack, Ridgefield Park, and Fort Lee combined sewer systems are each regulated under separate NJPDES permits. However, as stated in Permit Part IV Section D.3.a, the NJDEP encourages municipalities in a hydraulically connected CSS to cooperate in developing and submitting a LTCP. Accordingly, these entities have established the BCUA Supplemental CSO Group to facilitate the sharing of information and ideas related to the LTCP (see the BCUA *Public Participation Program Report* for details). The City's Characterization Report and the separately submitted PPP Report were developed through coordination with BCUA and the other hydraulically connected systems. Collaboration with the BCUA Supplemental CSO Group will continue throughout the LTCP process.

1.2 Description of the City's CSS

Much of the City's sewer system was constructed in the 19th century. The main trunk sewers in the downtown area transported combined sewage toward the Hackensack River through two treatment facilities, one at Anderson Street and Court Street, each. A secondary treatment plant was constructed at Court Street around 1940 to replace the two facilities. An interceptor was also constructed, carrying combined sewage from the Anderson Street outfall to the new Court Street plant. In 1960, the BCUA constructed a 96-inch trunk sewer through Hackensack. The Court Street treatment plant was abandoned, and sewage at Court Street and Anderson Street was redirected to the BCUA treatment plant

in Little Ferry. In 1991, construction of new facilities was completed at Anderson and Court Streets, with a CSO regulator and outfall at each.

Today, the City of Hackensack has approximately 31 miles of combined sewer and 39 miles of sanitary sewer. The CSS consists of two subdrainage areas that convey flow to the Anderson and Court Street facilities, respectively. The Anderson Street CSS includes about 14 miles of sewer and serves approximately 9,000 people, draining an area of 470 acres. This system provides 0.75 million gallons of in-pipe storage prior to overflow. The Court Street CSS includes about 17 miles of sewers and serves a population of about 10,500, draining an area of 440 acres. This system provides 1.2 million gallons of in-pipe storage prior to overflow[1]. Both CSOs discharge into the Hackensack River during wet weather.

[1] City of Hackensack CSO Discharge Characterization Study Monitoring Program Proposal and Work Plan Report. Clinton Bogert Associates, February 1996.

2 PROJECT GOALS

The primary goal of this Characterization Report is to identify and describe the existing baseline conditions in the CSS against which long-term goals will be set. As stipulated in Permit Part IV Section G.1.a, the characterization process included records review, monitoring, and modeling of the CSS to provide an understanding of the system's baseline conditions.

Specific objectives of the CSS characterization tasks included the following:

1. Review data for sewer flows, depths, precipitation, and combined sewer wastewater quality under both wet and dry weather conditions collected in 2006,
2. Identify the number, location, frequency and characteristics of CSOs relative to their response to variable precipitation events and to estimate water quality impacts,
3. Assemble an updated, calibrated, validated dynamic hydrologic and hydraulic model approvable by the NJDEP and the United States Environmental Protection Agency (EPA) (such as PCSWMM or SWMM5) that has been calibrated for the CSO volumes, flows, and depths measured from 3 representative precipitation events identified in Item 2 above,
4. Model waste loads from the City's CSS to establish baseline conditions,
5. Develop this Characterization Report presenting the results of the characterization study, which can be used in conjunction with the calibrated model to evaluate the efficacy of identified CSO technology-based controls in the future steps of the LTCP process as defined in the permit, and
6. Coordinate efforts with the City's hydraulically connected communities – the BCUA, Ridgefield Park, and Fort Lee – so that this Characterization Report can be used as a component of a single, coordinated Long Term Control Plan.

3 SEWER SYSTEM CHARACTERIZATION AND MONITORING

3.1 Service Area Land Use Data

The City of Hackensack is approximately 4.1 square miles in area and is located along the west bank of the Hackensack River in central Bergen County, New Jersey. Dutch and English settlers arrived in the area, which was previously a Native American village, in the 17th century. By the end of the 19th century, Hackensack's population was approximately 9,400. The City's population was approximately 42,677 in the year 2000 and increased insignificantly by approximately 0.8% to reach 43,010 by 2010. In 2010, the average household size was 2.30 and the average family size was 3.26.

As discussed in Section 1, the City's CSS consists of two subdrainage areas that are referred to as the Anderson Street subdrainage area and Court Street subdrainage area. The Anderson and Court Street systems have drainage areas of approximately 470 acres and 440 acres, respectively.

The NJDEP Bureau of GIS "2012 Land Use/Land Cover Update 2/17/15" dataset, which was updated in 2015 with data recorded through 2012, was used to analyze the land use in the City of Hackensack. Based on the NJDEP data, Table 3-1 summarizes and compares the urban impervious area in each subdrainage area and in the City overall in 1995 and 2012. As Table 3-1 shows, there were minimal increases in impervious areas within the Anderson and Court street subdrainage areas, with 0.85% and 0.15% increases, respectively.

Land use information has implications for modeling a CSS because the amount of impervious area affects the volume of rainfall that enters combined sewers, thus influencing the volume of wet weather flow. As discussed in Section 3.2.5, the minimal change in land use, as shown in Table 3-1 below, supports the use of previous monitoring data in the updated, recalibrated CSS model.

Table 3-1. A Comparison of the City's Impervious Area and Urban Land Use Area from 1995 to 2012

Area	1995 Impervious Area, Acres	2012 Impervious Area, Acres	Percent of Change Impervious Area from 1995 to 2012	1995 Land Use Area, Acres	2012 Land Use Area, Acres	Percent of Change in Urban Land Use Area from 1995 to 2012
URBAN GENERAL LAND USE for Court and Anderson	**643.6**	**646.3**	**0.42%**	**1039.3**	**1040.6**	**0.13%**
Anderson	246.2	248.3	0.85%	468.7	467.3	-0.3%
Court	397.4	398.1	0.15%	570.6	573.3	0.5%
Forests & Barren land	**0.8**	**0.3**	**-62.5%**	**10.2**	**8.8**	**-13.73%**
Total Areas	**644.4**	**646.7**	**0.34%**	**1049.5**	**1049.5**	**0%**

3.2 Monitoring of Background Conditions

Malcolm Pirnie, Inc. (now Arcadis U.S., Inc.) was contracted by the City to conduct a monitoring program of the City's CSS to meet the requirements of the NJPDES Permit No. NJ0105023, which was issued June 30, 2004 and became effective August 1, 2004. In 2006, Malcolm Pirnie executed a monitoring program that included monitoring of rainfall, combined sewer flow, and water quality conditions over a data collection period from April 28, 2006 through July 28, 2006 (a three-month period). The program included rainfall data collection from four local rain gauges, installation of two flow meters for each subdrainage area (two for Court and Anderson, each), installation of two wastewater samplers (one for Court and Anderson, each), and analysis of data collected. The monitoring program was executed in accordance with the 2005 *City of Hackensack CSO Discharge Characterization Study – Combined Sewer System Monitoring Program Proposal and Work Plan* (2005 Work Plan), which was previously approved by the NJDEP.

The results and analyses of the 2006 monitoring program were submitted to the NJDEP in the report *City of Hackensack Rainfall and CSO Monitoring* Study, prepared by Malcolm Pirnie and dated December 2006. The following sections provide summaries of the information and results that were presented in the 2005 Work Plan and in the monitoring program report.

3.2.1 Rainfall Monitoring

The locations of the four rain gauges that collected rainfall data during the 2006 monitoring program are shown in Figure 3-1A; as shown in the figure, the rain gauge placement was distributed across the two subdrainage areas. The rain gauges were calibrated and checked prior to collection of rainfall data. Data were continuously collected at five-minute intervals throughout the collection period. Appendix A, included as a CD-ROM, contains the data collected from the four rain gauges.

The monitoring program scope also included analysis of long-term historic rainfall records. Historic rainfall records were obtained from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) databases for rain gauges at Newark International Airport and Teterboro Airport. The historic rainfall records were evaluated for storm intensity, duration, and frequency in the area, which was useful for characterizing the rainfall events that occurred during the three-month 2006 monitoring period.

As per NJDEP's request in response to the 2016 Work Plan, Figure 3-1B shows the areas of the City that are prone to flooding during extreme rainfall events, as determined from the historic rainfall records.

3.2.2 CSO Flow Monitoring

Sewage depth and velocity measurements were also continuously collected by flow meters at five-minute intervals. For each subdrainage area, one flow meter was placed in the trunk sewer and one flow meter was placed in the interceptor sewer to BCUA, for a total of four meters: A-1, A-2, C-1, and C-2 (Anderson = A, Court = C). The flow meter installation locations, which are shown in Figure 3-1A, were approved by the NJDEP during a 2006 site inspection. Figures 3-2 through 3-5 are plan and section views that show the flow monitoring locations for each regulator. During the monitoring program, a subcontractor was responsible for installing, calibrating, and maintaining the four flow meters, and for uploading the depth, velocity, and flow data. The outfall flow for Anderson and Court, each, was calculated as the difference between the flow measured in the trunk sewer and the flow measured in the interceptor sewer. Appendix

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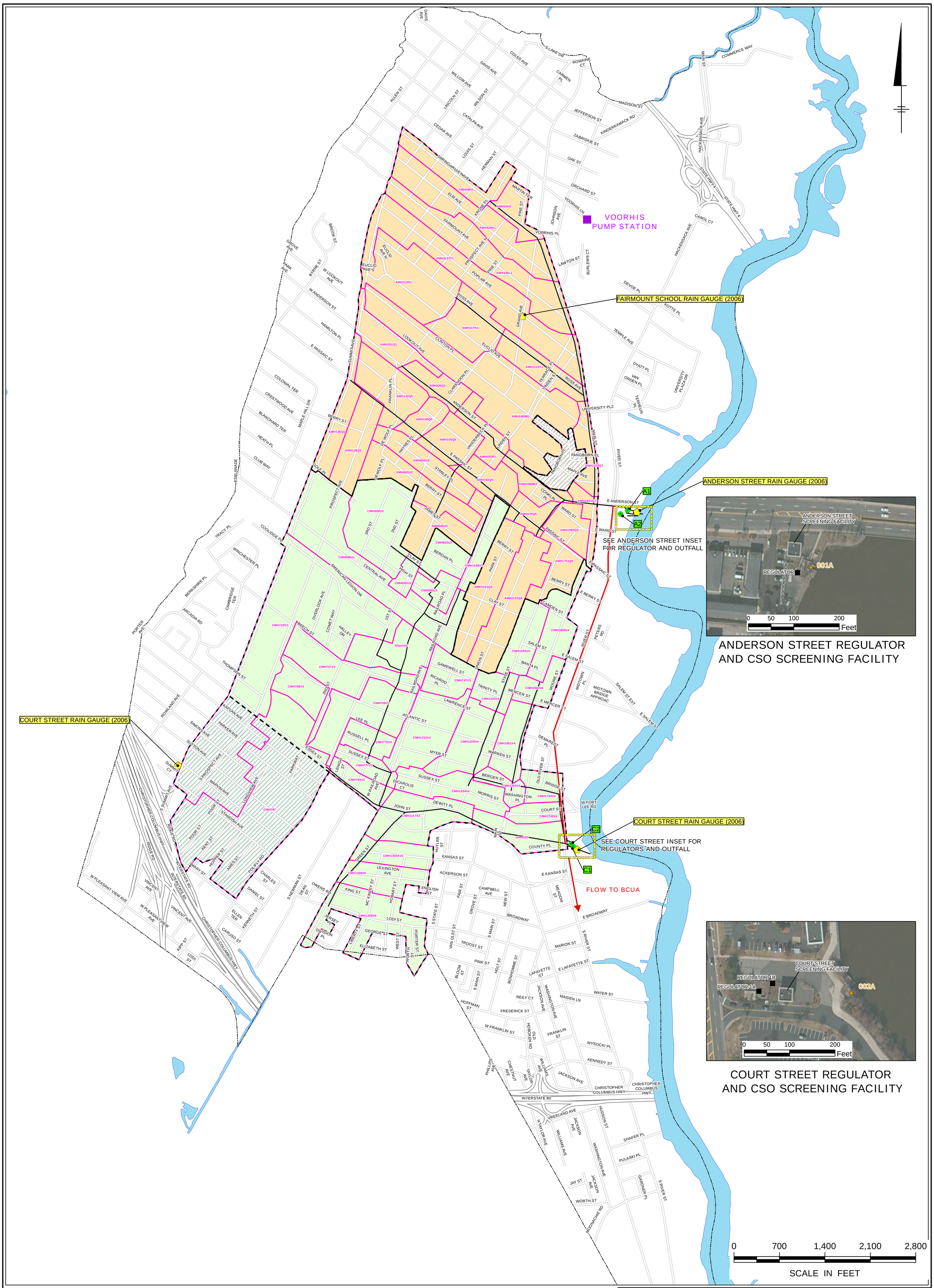

Legend

- REGULATOR
- OUTFALL
- 2006 RAIN GAUGE LOCATION
- PUMP STATION
- 2006 FLOW METER LOCATION

PIPES TO BE MODELED

- COMBINED SEWER PIPE
- BCUA TRUNK SEWER
- SUBCATCHMENT AND NUMBER
- MUNICIPALITY BOUNDARY
- WATERBODY

SUBDRAINAGE AREA

- ANDERSON STREET SUBDRAINAGE AREA - COMBINED
- ANDERSON STREET SUBDRAINAGE AREA - SEPARATED
- COURT STREET SUBDRAINAGE AREA - COMBINED
- COURT STREET SUBDRAINAGE AREA - SEPARATED

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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HACKENSACK 2006 MONITORING PROGRAM LOCATIONS AND CSS SYSTEM WIDE MODEL EXTENTS

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FIGURE
3-1A

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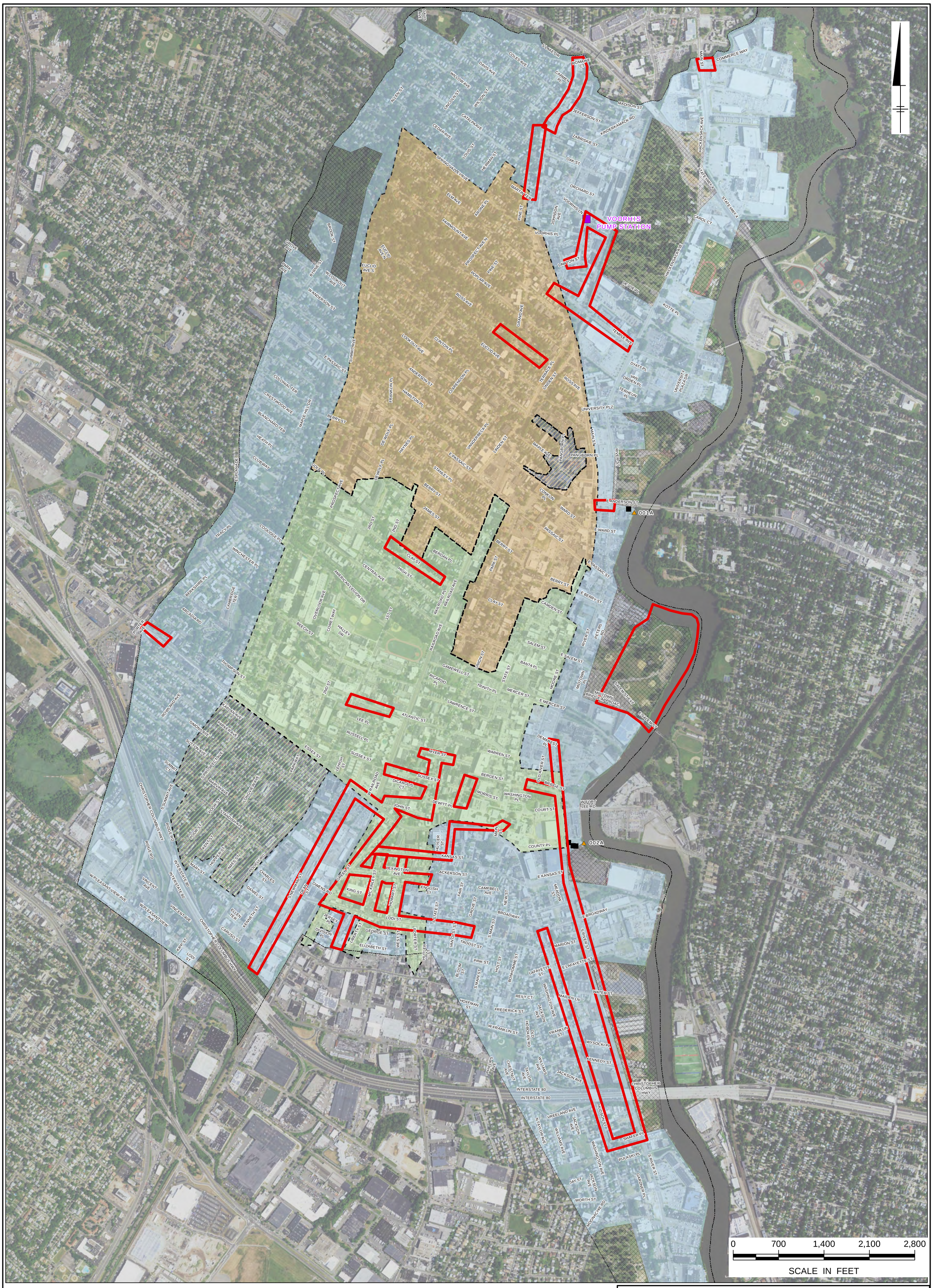

Legend

- REGULATOR
- OUTFALL
- PUMP STATION
- NON POINT SOURCE RUNOFF AREA
- SEPARATED AREA (OUTSIDE OF CSS BOUNDARY)
- SUBCATCHMENT AND NUMBER
- MUNICIPALITY BOUNDARY

SUBDRAINAGE AREA

- ANDERSON STREET SUBDRAINAGE AREA - COMBINED
- ANDERSON STREET SUBDRAINAGE AREA - SEPARATED
- COURT STREET SUBDRAINAGE AREA - COMBINED
- COURT STREET SUBDRAINAGE AREA - SEPARATED
- FLOOD SENSITIVE AREAS (IDENTIFIED 2006)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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HACKENSACK STORM AND CSS SUBDRAINAGE AREAS AND AREAS PRONE TO FLOODING

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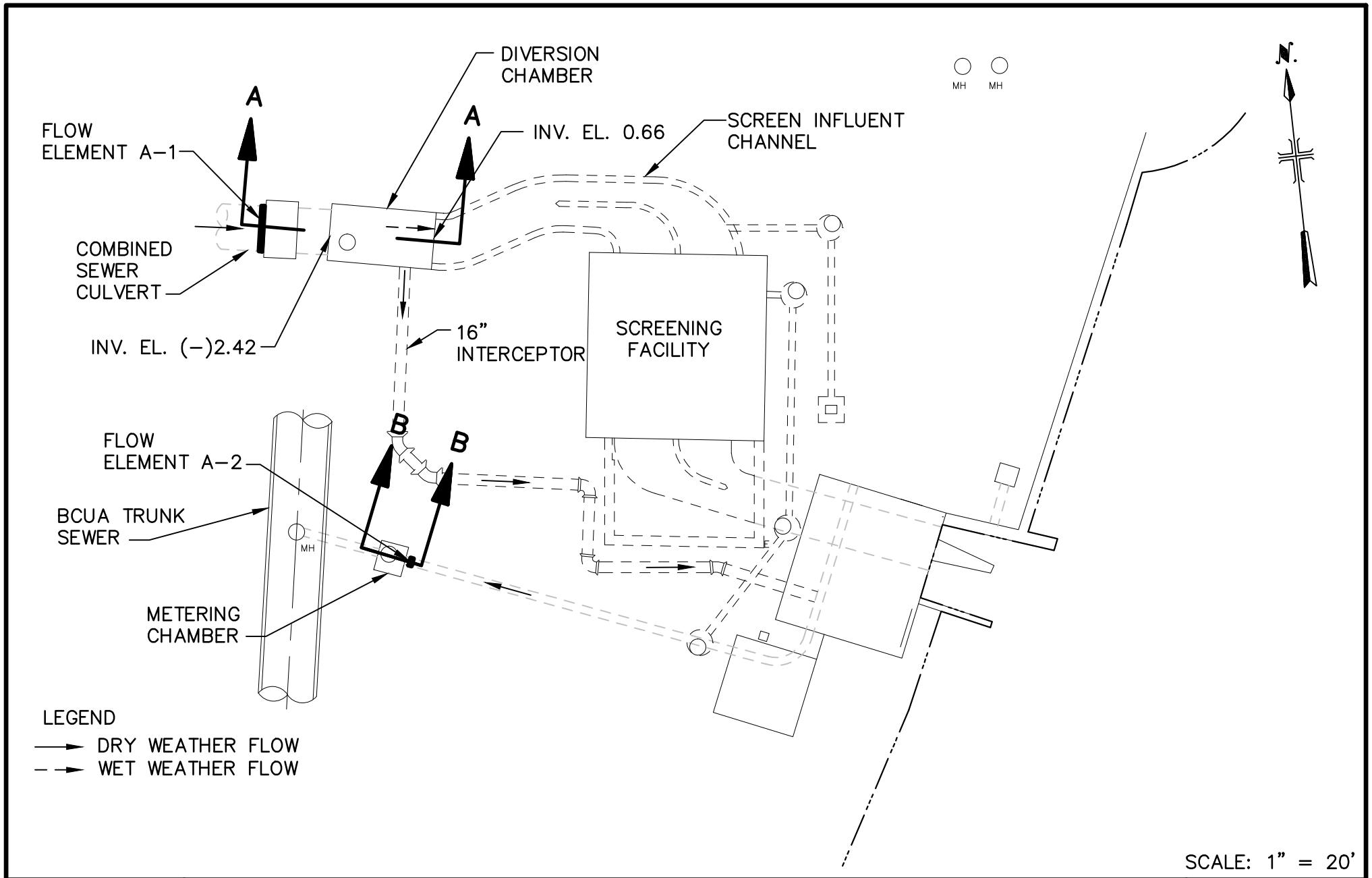
FIGURE
3-1B



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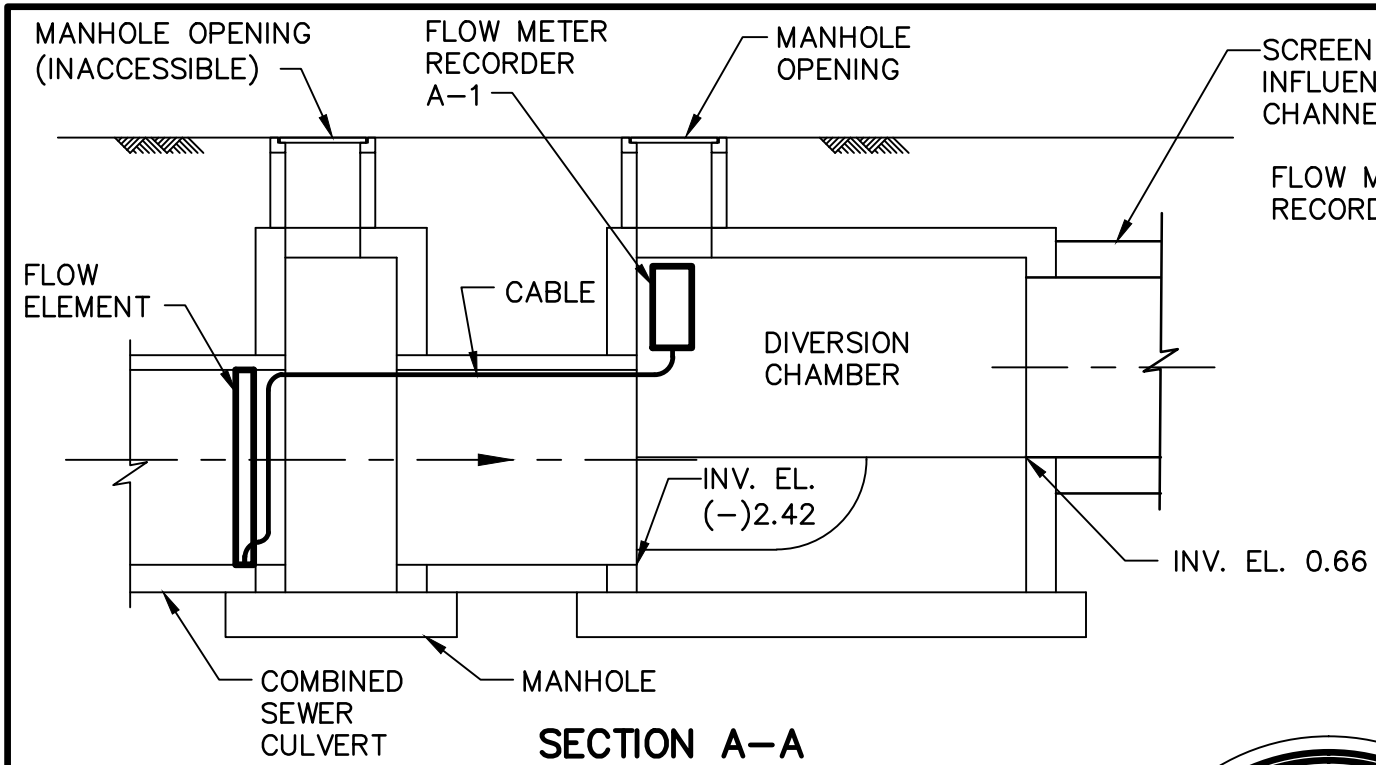
ANDERSON STREET FLOW METER CONFIGURATION FOR 2006 MONITORING PROGRAM - PLAN

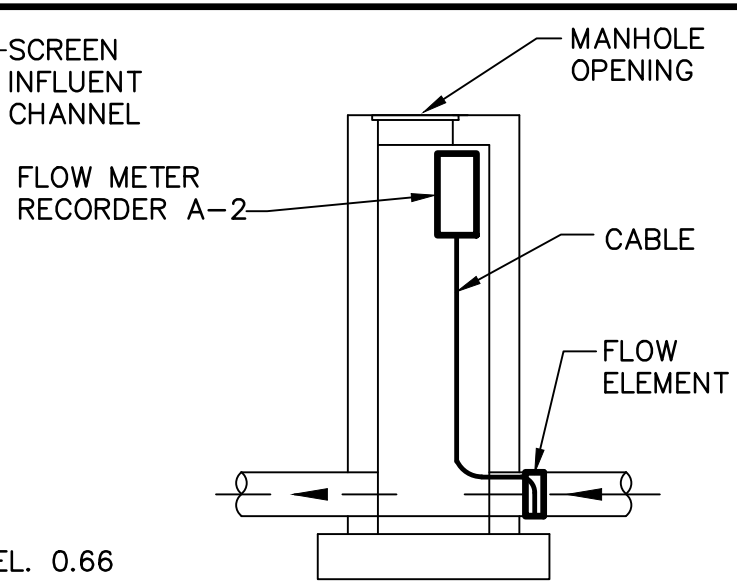
ARCADIS US, INC.

FIGURE 3-2



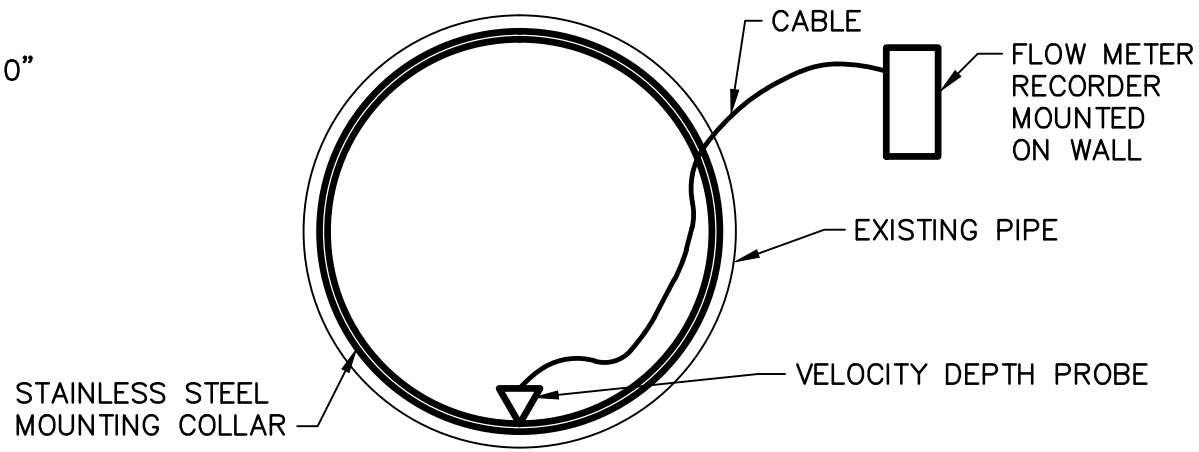
SECTION A-A

SCALE: 3/16" = 1'-0"



SECTION B-B

SCALE: 3/16" = 1'-0"



FLOW ELEMENT DETAIL

NOT TO SCALE

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ANDERSON STREET FLOW METER CONFIGURATION FOR 2006 MONITORING PROGRAM - SECTIONS AND DETAIL

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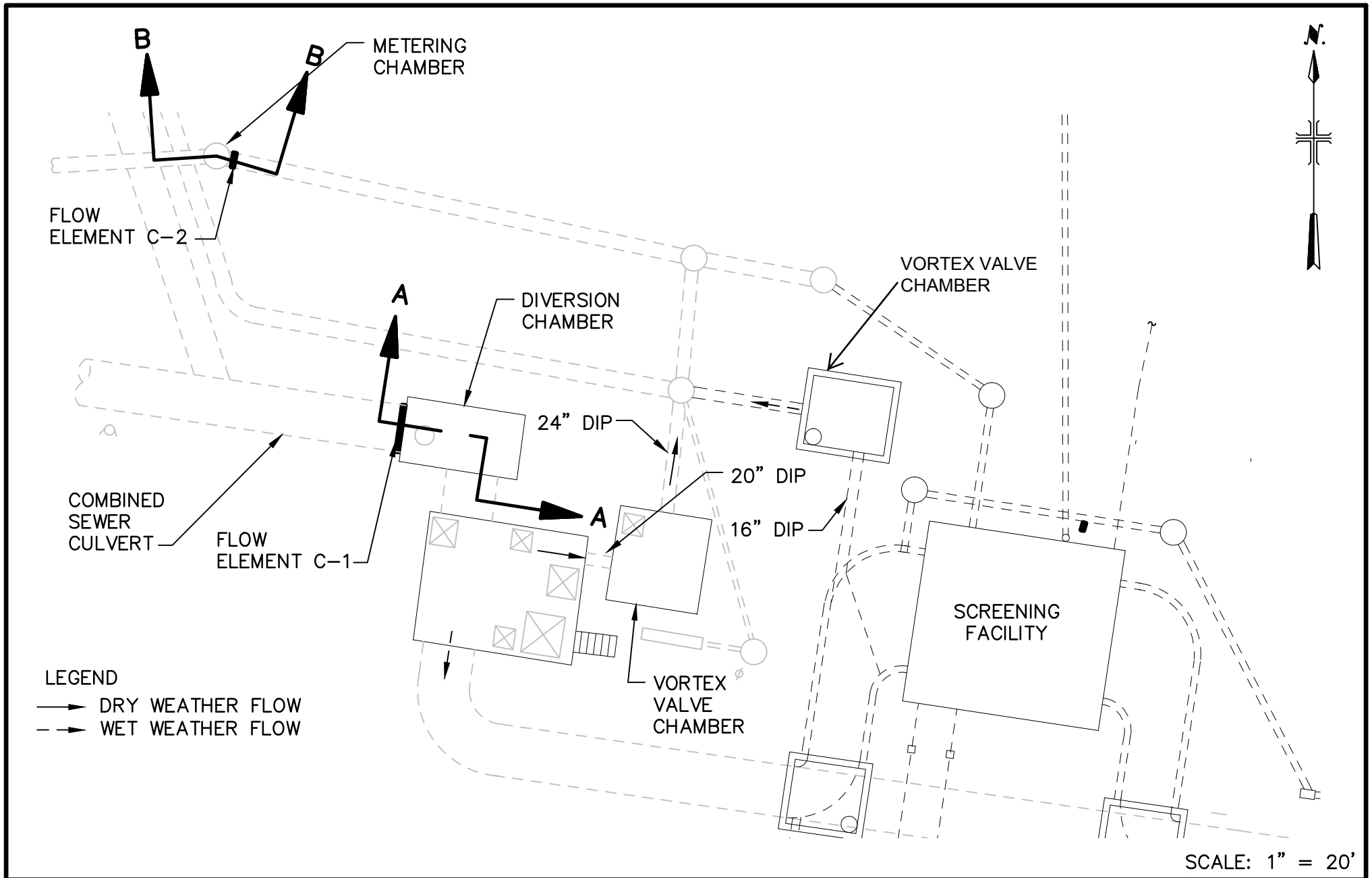
FIGURE 3-3



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COURT STREET FLOW METER CONFIGURATION FOR 2006 MONITORING PROGRAM - PLAN

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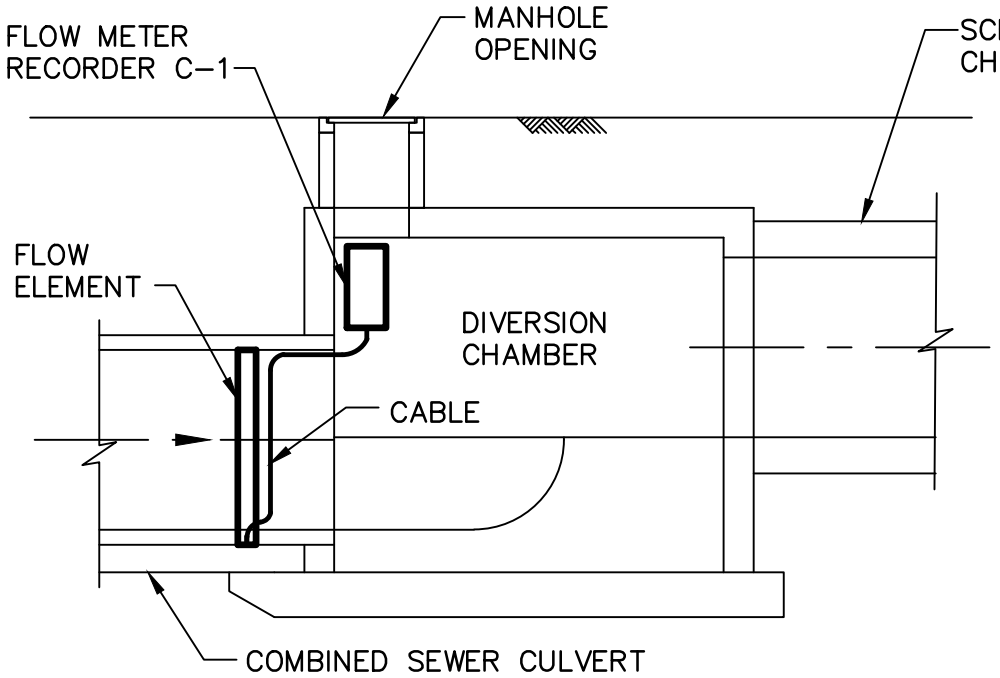
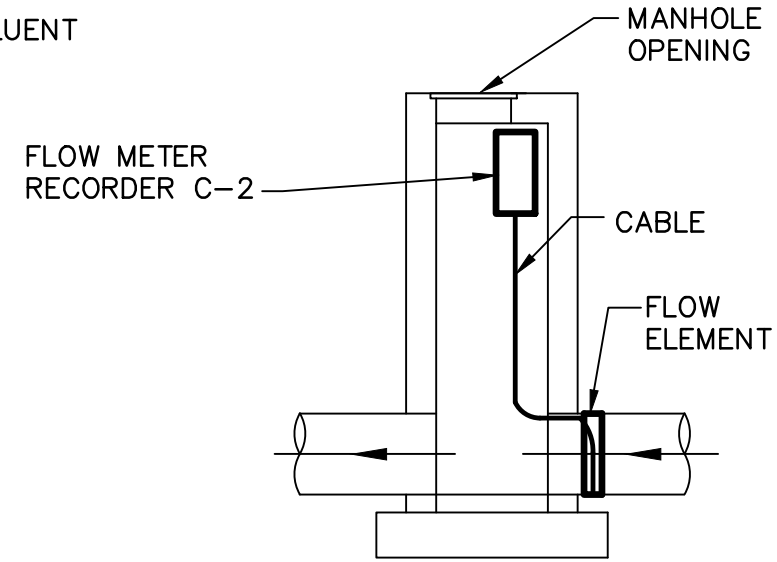
FIGURE 3-4



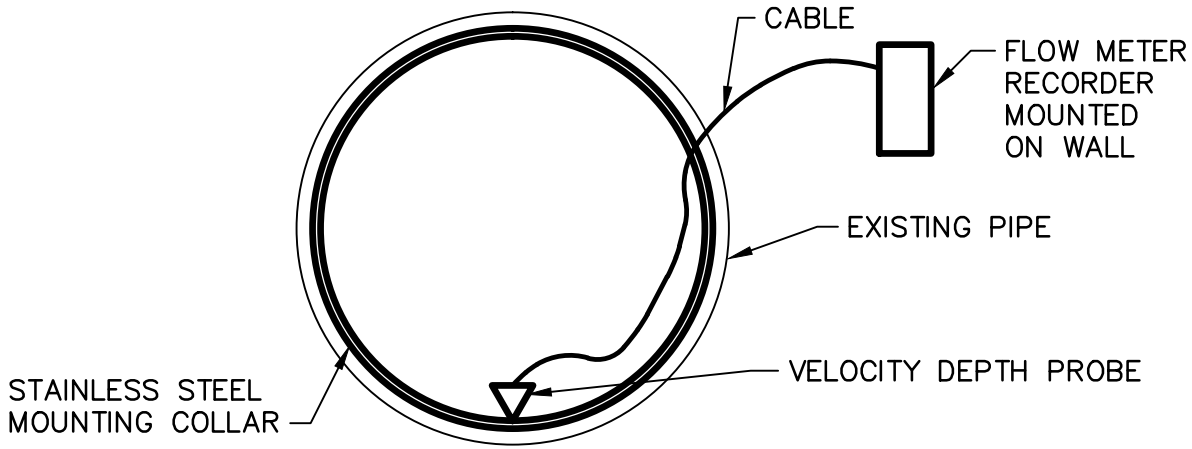
SECTION A–A

SCALE: 3/16" = 1'–0"



SECTION B–B

SCALE: 3/16" = 1'–0"



FLOW ELEMENT DETAIL

NOT TO SCALE

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CITY OF HACKENSACK
HACKENSACK, NEW JERSEY
SEWER SYSTEM CHARACTERIZATION REPORT
COURT STREET FLOW METER CONFIGURATION FOR 2006 MONITORING PROGRAM - SECTIONS AND DETAIL

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FIGURE 3-5

B, included as a CD-ROM, contains the data collected at the four flow meter locations. Appendix C, also on the CD-ROM, contains tide data utilized for the modeling effort, as discussed in Section 5.3.

3.2.3 Water Quality Sampling

The water quality monitoring component of the 2006 monitoring program included a combination of grab and composite sampling methods to characterize the water quality impacts of overflows to the receiving waters. Water samples were collected by a field team, and chemical and biological testing of the samples was completed by BCUA and their certified subcontractor laboratories.

Wet weather water samples were obtained as manual grab samples at 15-minute intervals for each regulator during storm events. During dry weather, 24-hour composite samples were obtained using automatic water quality samplers at each regulator; these samples were analyzed for non-microbiological parameters. The dry weather sampling also included four manual grab samples at each regulator on two days of the monitoring period, each; these samples were analyzed for fecal coliform and enterococci.

Each sample was analyzed for the following parameters:

- Chemical Oxygen Demand (COD)
- Five-Day Carbonaceous Biochemical Oxygen Demand (CBOD5)
- Total Suspended Solids (TSS)
- Total Settleable Solids
- Total Dissolved Solids (TDS)
- Ammonia (NH3-H)
- Nitrites and Nitrates (NO2 & NO3)
- Total Kjeldahl Nitrogen (TKN)
- Total Phosphorus
- Ortho-Phosphorus
- Temperature (field measurement)
- pH (field measurement)
- Hardness
- Salinity (field measurement)
- Fecal coliform (FC)
- Enterococci

All sampling procedures employed in the 2006 monitoring program were developed in accordance with the NJDEP *Field Sampling Procedures Manual* (May 1992). During execution, the team members closely adhered to the quality assurance guidelines outlined in the 2005 Work Plan.

The data from the water quality sampling events are included on the attached CD-ROM as Appendix D.

3.2.4 Monitoring Program Results and Conclusions

A summary of the key conclusions of the 2006 monitoring program is provided below:

- Overflows in the City's system were triggered by rainfall intensities of 0.23 inches/hr and higher
- The rainfall data was analyzed to select specific rainfall events for use in the CSS model wet weather calibration.

  The following criteria were used in the rainfall data analysis:

  - Data set completeness: A rainfall event to be used for calibration should have acceptable data completeness for the measured parameters. The event is free from any significant number of mechanical errors or other abnormalities that may accidentally occur during the flow, rainfall, and sample monitoring. These significant abnormalities are defined as, but are not limited to, the following: more than 15 percent of the depth/velocity probes, sample lines, and/or samplers, etc. become jammed, clogged, or inoperative
  - Probability of occurrence: A rainfall event to be used for calibration should have a relatively high probability of occurrence and should be a "typical" event rather than an "extreme" event. Based on the analysis of historic rainfall records for Newark International Airport, rainfall events with a peak hourly intensity between 0.1 to 0.6 inches per hour could be considered to be "typical" storms since long term rainfall records at Newark Airport indicate that 95% to 100% of the storms in this geographic region fall into this category

  Based on the criteria above, the two rainfall events that were selected for model calibration and verification out of fourteen rainfall events in the monitoring period were June 2, 2006 and June 7, 2006. These events were separated by a dry period, except for 0.05 inches of rainfall that occurred around 22:00 on June 4, 2006.

As described in Section 5, the 2006 monitoring program results were used in the initial 2007 calibration of a CSS model for the City and in the 2017 recalibration and update of the CSS model. Section 3.2.5 provides justification for the use of the 2006 monitoring data in the updated CSS model.

3.2.5 Justification for Use of Previous Monitoring Data

It was determined that the 2006 monitoring data was sufficient to complete recalibration of the City's CSS model in 2017. (See Sections 5 and 6 for details on the model update and recalibration.) Justification for the determination that no additional monitoring data was needed includes the following:

- There was little to no significant change in urban development in the City, which would increase runoff quantity or influence runoff patterns. Therefore, the flow monitoring data that was collected in 2006 would be applicable for model calibration purposes in 2017.
- No significant increase in the sanitary flow component of the City's combined sewage is anticipated to have occurred because there were no significant population changes in the City from 2005 to 2015. The City's population is currently estimated at 44,519, a 4% increase from the 42,657 population in 2005. The only Significant Indirect User (SIU) in the City, which is the Hackensack University Medical Center, was present in 2005, so the industrial flows have not changed significantly since 2005.
- There was no significant change in land use in the City from 2005 to 2012, as shown in Table 3-1.

4 COMBINED SEWER SYSTEM UPDATED CHARACTERISTICS

4.1 Sewer System Updates or Modifications

There have not been any significant updates or modifications to the City's CSS since submission of the 2016 Work Plan to the NJDEP.

4.2 CSO Regulators and Control Facilities

The geographic locations of the Anderson Street and Court Street facilities are shown in Figure 3-1A. A schematic of the City's CSS is presented in Figure 4-1. The following sections describe the flow processes in the two facilities.

4.2.1 Anderson Street CSO Facility

Flow enters the Anderson Street facility through the existing 84-inch by 96-inch concrete culvert that runs beneath Anderson Street to the diversion chamber.

During dry weather, sewage enters the diversion chamber, is diverted through a 16-inch diameter ductile iron pipe, goes to the vortex chamber (which has been sealed off from the in-line storage module), and is routed through a 20-inch pipe into the BCUA 96-inch trunk sewer. The vortex valve (also referred to as the regulator) is specified to allow a maximum flow of 4.09 MGD to enter the BCUA trunk sewer.

The flow process is the same as that in dry weather during wet weather events until the maximum allowable flow (4.09 MGD) through the vortex valve is reached. At that point, sewage depth begins to accumulate upstream of the vortex valve into the diversion chamber. Once the water depth in the diversion chamber exceeds the height of the diversion wall, which functions similarly to a weir, flow enters the screening facility, where solids and floatables are removed. Screened flow then enters another 84-inch diameter concrete pipe that leads to a concrete structure containing an 84-inch tide gate. The structure includes wing walls, a concrete apron, riprap, and bituminous paving in order to stabilize the outfall at the Hackensack River. This structure formerly acted as an in-line storage module, but due to the location and the construction of the new screening facility upstream, the hydraulically operated flap gate in the storage module is normally kept in the open position. Flow now passes through the former storage module and is discharged to the Hackensack River.

The small quantity of water used to remove solids and floatables in the screening facility is routed to a foul sewer, which flows directly into the BCUA trunk sewer. The flow rate from the foul sewer to the BCUA trunk sewer is less than 60 gallons per minute, or around 3 percent of the total flow entering the CSO facility.

Figure 4-2 shows a visual representation of the Anderson Street CSO facility process flow.

4.2.2 Court Street CSO Facility

The configuration of the Court Street CSO facility varies from that of the Anderson Street facility. Flow enters the site through a 96-inch by 87-inch concrete culvert that runs under River Street approximately 400 feet south of Court Street, and then flows to a 96-inch diameter pipe to an in-line storage module. The storage module contains a 102-inch by 106-inch hydraulically operated flap gate and a 20-inch pipe with a knife gate.

During dry weather, flow enters the in-line storage module, is diverted to the 20-inch pipe with knife gate, flows into a vortex chamber attached to the in-line storage module, and is routed to the BCUA's 96-inch trunk sewer. The vortex valve (regulator 1A) is specified to allow a maximum flow of 6.49 MGD.

During a wet weather (rainfall) event, once the maximum allowable flow through the vortex valve (1A) of 6.49 MGD is reached, the combined sewage begins to accumulate upstream of the vortex valve into the in-line storage module. Once the level in the storage module reaches an elevation of +4.0 feet, the hydraulic flap gate opens and the knife gate closes. The combined sewage passes through the flap gate, flows into a diversion chamber, and then flows through a second vortex chamber (regulator 1B) and into the BCUA trunk sewer. Once the flow through regulator 1B has reached 6.49 MGD, the combined sewage begins to accumulate upstream of the vortex valve (1B) into the diversion chamber. Once the water depth in the diversion chamber exceeds the height of the diversion wall, which functions as a weir, the combined sewage flows into a screening facility for removal of solids and floatables. The screened sewage passes through a tide chamber and is released to the Hackensack River.

Water used to remove solids and floatables in the screening facility is also routed to a foul sewer to flow into the BCUA trunk sewer.

Figure 4-3 shows a visual representation of the Court Street CSO facility process flow.

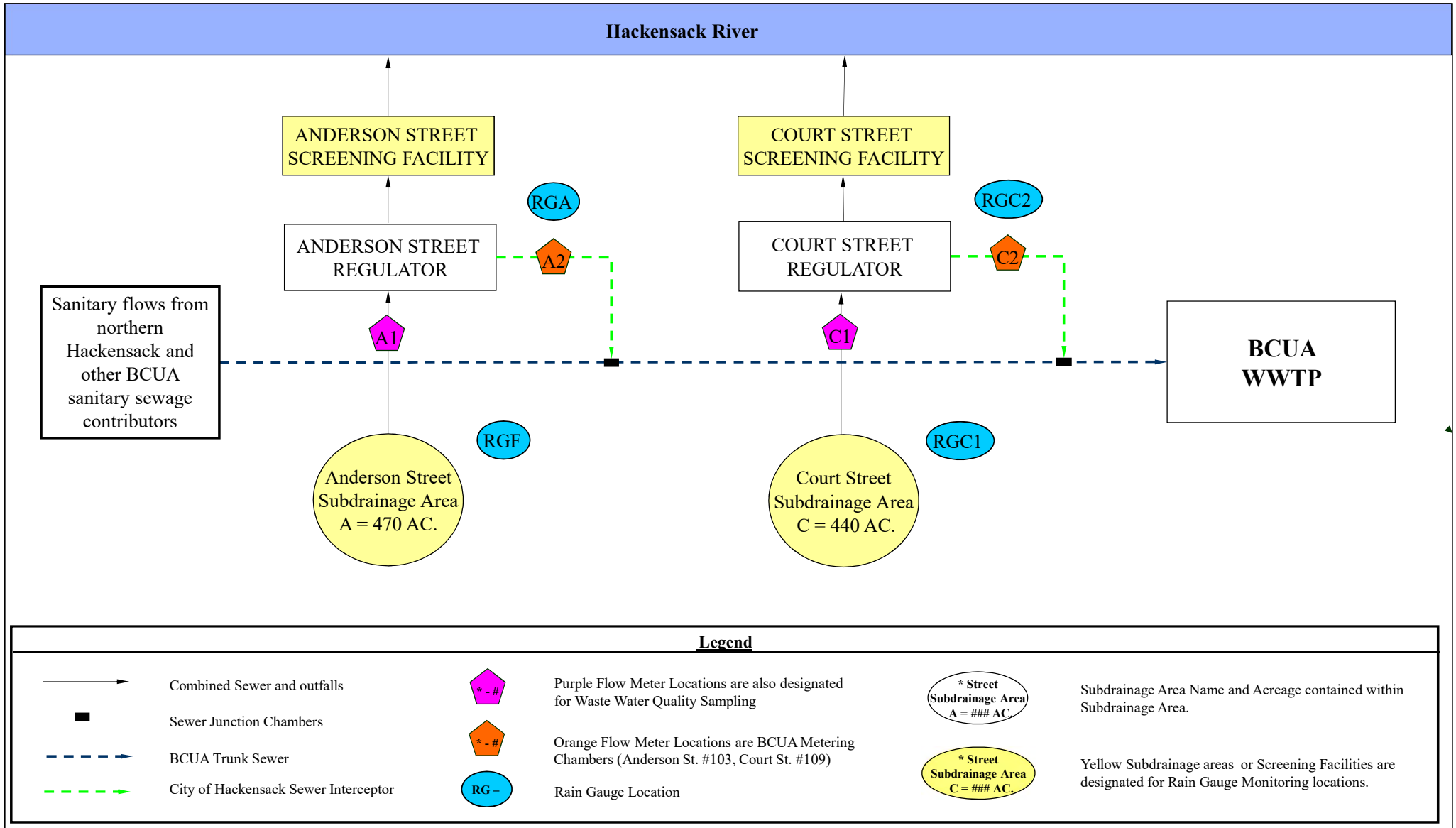
4.3 Recent Reports or Plans

Other than this Characterization Report and the separately submitted PPP Report, no additional reports or updated plans have been developed for the City's CSS since submission of the 2016 Work Plan to the NJDEP. Table 4-1 on the following pages summarizes the available drawings, work plans, and reports regarding the City's CSS, including the current Characterization Report and PPP Report.

Table 4-1. City of Hackensack Drawings and Reports

Category	Title	Author	No. of Sheets	Date of Issue	Description
Drawings	DPW Sewer Locations, City of Hackensack, NJ	City of Hackensack DPW	6	1977	Primary source: sewer maps
Drawings	Anderson Street and Court Street Overflow Abatement Facilities – Contract 1	Clinton Bogert Associates	23	11/1989	Site plans, profiles, in-line storage module and outfall structure, elevation and details, soil erosion plan
Drawings	City of Hackensack 1995 Sewer Study, CSO S/F	Job and Job	8	1995	Secondary source: sewer maps
Report	City of Hackensack Service Area Drainage and Land Use Report	--	N/A	2/1996	--
Report	City of Hackensack Facility Inventories and Assessment Analysis	Malcolm Pirnie	N/A	8/1996	--
Drawings	Combined Sewage Solids and Floatables Interception Facilities at Court Street and Anderson Street	Malcolm Pirnie	39	3/1997	General, architectural, structural, electrical, and HVAC details
Work Plan	City of Hackensack Combined Sewer System Public Participation Work Plan	Malcolm Pirnie	N/A	5/2005	A work plan required by the NJDEP General Permit that presents the actions that will be taken to engage the public in the LTCP process
Work Plan	City of Hackensack CSO Discharge Characterization Study, Combined Sewer System Monitoring Program Proposal and Work Plan	Malcolm Pirnie	N/A	11/2005	A work plan required by the NJDEP General Permit that details the components and procedures planned for the characterization study and monitoring program of the City's CSS
Report	City of Hackensack Rainfall and CSO Monitoring Study	Malcolm Pirnie	N/A	12/2006	A report required by the NJDEP General Permit that presents the rainfall, flow, and water quality data collected from 4/28/2006 through 7/28/2006

Category	Title	Author	No. of Sheets	Date of Issue	Description
Report	City of Hackensack Cost and Performance Analysis Report	Malcolm Pirnie	N/A	4/2007	A report required by the NJDEP General Permit that presents the process of calibration and verification of the 2007 XPSWMM model and provides the CSO volume generated in the 1988 Average Annual Rainfall year
Report	City of Hackensack Combined Sewer System Modeling Study	Malcolm Pirnie	N/A	8/2007	A report required by the NJDEP General Permit that presents the CSO control alternatives and the relationships between the performance and cost for each of the permittee's CSO locations and/or conveyance facilities
Work Plan	Hackensack Sewer System Characterization Work Plan for the LTCP	Arcadis U.S., Inc.	N/A	6/2016	A work plan required by the NJDEP renewal permit action that outlines the tasks for the characterization stage of the LTCP
Report	City of Hackensack Sewer System Characterization Report	Arcadis U.S., Inc.	N/A	6/2018	A report required by the NJDEP renewal permit action that presents the results/analysis of the characterization efforts, including records/document review, monitoring, and modeling of the CSS
Report	City of Hackensack Public Participation Process Report	Arcadis U.S., Inc.	N/A	6/2018	A report required by the NJDEP renewal permit action that supplements the Public Participation Program Report submitted by BCUA and details actions taken and planned by the City to involve the affected public in the LTCP process



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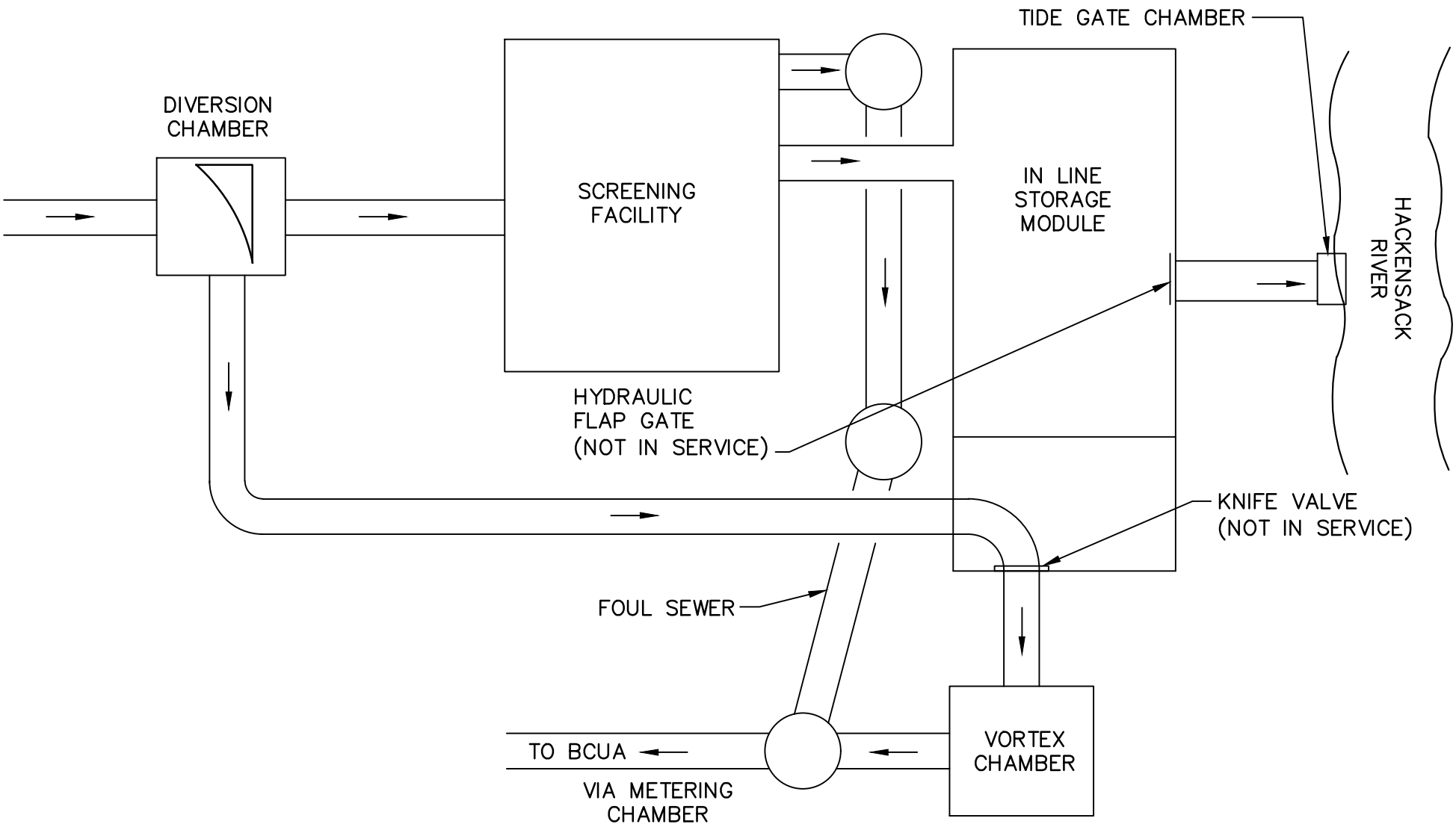
SEWER SYSTEM CHARACTERIZATION REPORT
HACKENSACK, NEW JERSEY
COMBINED SEWER SYSTEM CONFIGURATION PROCESS FLOW DIAGRAM

FIGURE 4-1

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\Project\02976055.0000 - CSO Permit Compliance\6.0 Studies and Reports\6.10 Characterization Report\Figures and Tables\NEW\ANDERSON-SCHEMATIC.dwg LAYOUT: LAYOUT1 SAVED: 6/19/2018 12:33 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: MPI FULL MONO.CTB
PLOTTED: 6/19/2018 2:56 PM BY: BUSHLOW, MEGAN
XREFS: IMAGES: PROJECTNAME: ----
ARCADIS_LOGO_SHORT.jpg



REVISED 10/20/08

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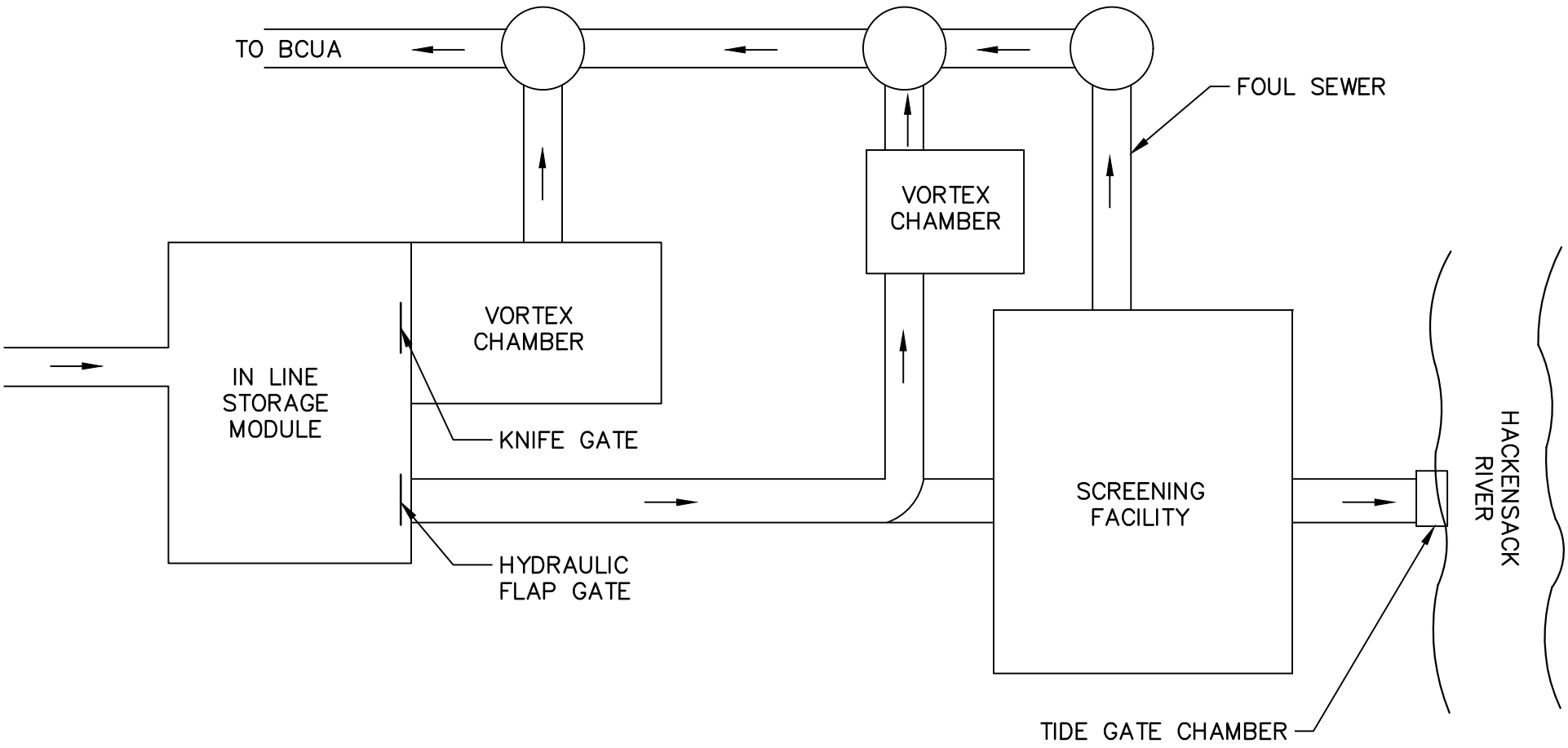
BERGEN COUNTY, NEW JERSEY

ANDERSON STREET - SCHEMATIC

FIGURE 4-2

XREFS: IMAGES: None
User: MCKENNA Spec: PIRNIE STANDARD File: I:\2976038\COURT-SCHEMATIC.DWG Scale: 1:1 Date: 03/26/2009 Time: 10:35 Layout: Layout1



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CITY OF HACKENSACK
BERGEN COUNTY, NEW JERSEY

COURT STREET - SCHEMATIC

FIGURE 4-3

5 MODEL DEVELOPMENT

In accordance with Part IV Section G.1.d.iv of the Permit, the City employed an approved CSS model to support the characterization study. The City contracted Malcolm Pirnie in 2007 to develop a CSS computer model to comply with the requirements of the previous NJPDES General Permit that became effective on August 1, 2004. The computer model was developed in XP-SWMM software based upon 1970 survey drawings. Several manhole inverts and surface elevations that were shown in the 1970 drawings were spot checked in 2007 to ensure that use of the drawings was valid. Inverts of manholes reported as “too deep to measure” on the 1970 drawings were re-surveyed during the 2007 model development. The 2007 model utilized the National Geodetic Vertical Datum of 1929 (NGVD 29) for the elevation data. The model was calibrated using the precipitation, flow, volume, and depth data that was collected through the 2006 Monitoring Program using the procedures summarized in Section 6. The report, *City of Hackensack Combined Sewer System Modeling Study*, was prepared by Malcom Pirnie with the date August 2007 to detail the methods for model development and model analyses.

The City contracted Arcadis in 2016 to update and recalibrate the 2007 model. The objectives of the model update were as follows:

- Convert the existing model from XP Solutions’ XP-SWMM (Version 10) software to CHI’s new PCSWMM 2016 software. PCSWMM uses USEPA’s SWMM 5 model, making it much more versatile than the existing model in terms of accessibility.
- Recalibrate the converted PCSWMM model using the 2006 flow monitoring data and existing calibration parameters. The approval comments from the July 27, 2016 NJDEP approval letter of the 2016 Work Plan required that, under Part IV Section G.1.d.iv of the permit, the model be calibrated to two rainfall events and verified by a third rainfall event.
- Develop comparative graphs and tables of the results from both the XP-SWMM and new PCSWMM model for a better understanding of the possible variations in results.

The model was converted by exporting it directly from XPSWMM to a SWMM5-compatible format. The SWMM5-compatible format was then imported into PCSWMM. The number, size, and hydrologic characteristics of original subcatchment areas and pipe hydraulics from the 2007 model were carried over to the new model (subcatchment areas subdivide the larger Court and Anderson subdrainage areas).

The North American Vertical Datum of 1988 (NAVD 88) has since replaced the NGVD 29 datum that was used for the 2007 model. All elevations in the City’s new model (e.g. elevations of manholes and pipe junctions) were converted from NGVD 29 datum to NAVD 88 datum using the conversion factor of -1.01 feet.

In addition to converting the vertical datum of the model to NAVD88, updated invert depth and pipe length information from a combined sewer system condition study was input into the model for all applicable manholes and pipe junctions. The condition assessment was performed in 2015 by a subcontractor for the City and included gathering data on the depth of the manhole from the rim to the pipe invert for 255 of the 285 manholes that are represented in the City’s model. After the condition assessment was completed, the City contracted a surveyor to survey the 285 CSS manholes (using the NAVD 88 datum). The condition assessment also included observations of sediment within pipes. Of 67 circular pipes in the City’s CSS, sediment was only observed within five pipes. Since sediment was observed in less than 20%

of the circular pipes, it was determined that sediment is not a key factor in modeling the system, and sediment was not added within the model. Sediment was not added for egg-shaped pipes in the model because PCSWMM does not have a straightforward way to represent sediment in pipes of that shape.

It should be noted that the previously calibrated model from 2007 included both sanitary and stormwater flow from an area in the Court Street subdrainage area that was later determined to only contribute sanitary flow. In the converted model, the sanitary flow was preserved, and the stormwater flow was removed from the model in order to accurately reflect the system's configuration. This was done by separating the area into two subcatchments, CMH719V1#1 and CMH787V2#1, and adjusting the impervious area to reduce the impact of stormwater flow.

The following sections describe the model capabilities and functions and the methods for constructing the combined sewer system hydraulics, determining dry weather flow (DWF) inputs, simulating wet weather flows (WWF), and determining downstream boundary conditions within the CSS area.

5.1 Model Framework

5.1.1 Model Components and their Naming Conventions

The model consists of links and nodes. Nodes represent manholes and pipe junctions. Links can represent trunk sewers, interceptor sewers, pipes, channels, ditches, conduits, weirs, orifices, pumps and gates.

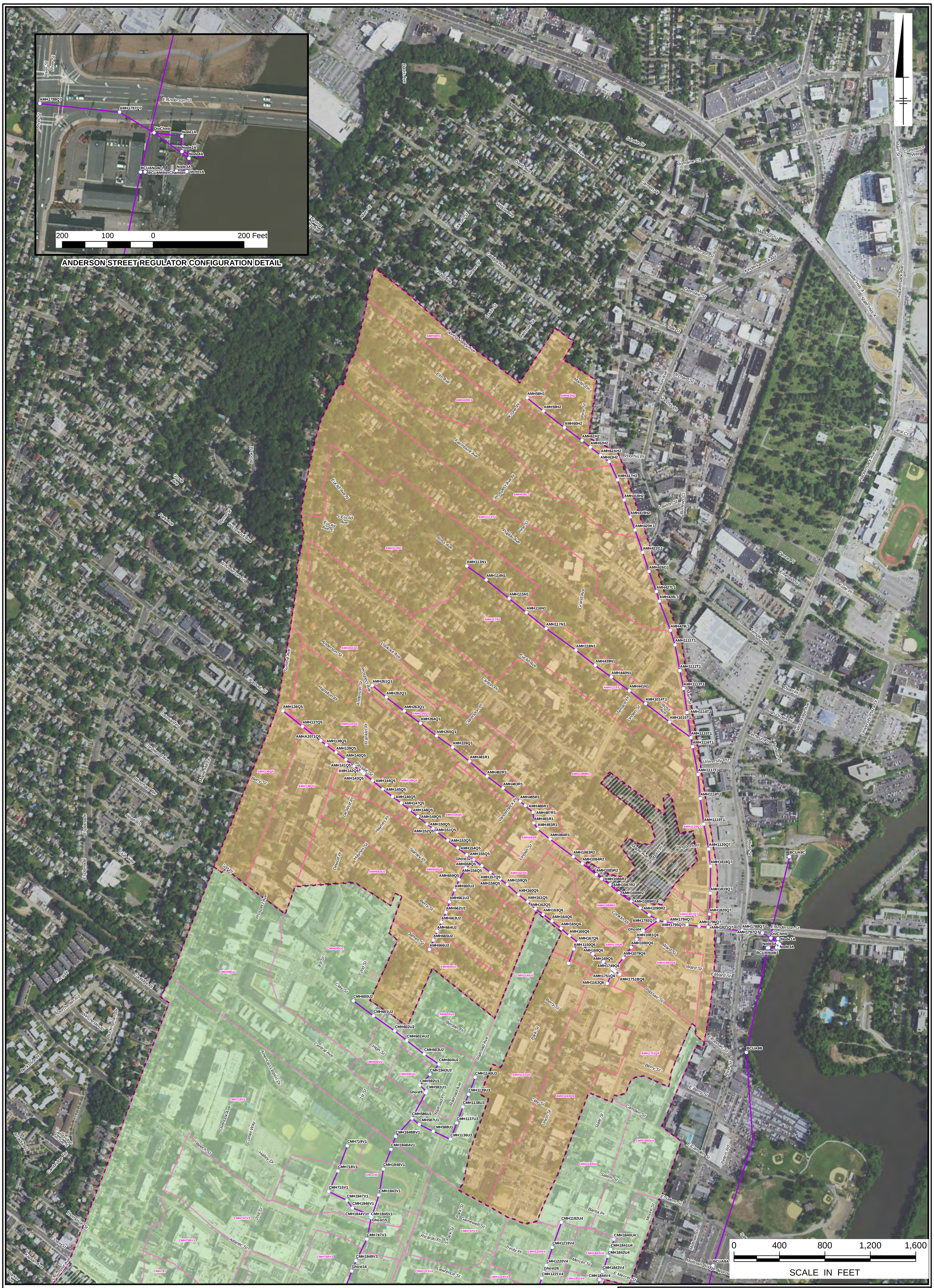
All nodes in the model were given a specific identification number. This was intended to give future model users the ability to quickly and easily identify a node's location. The majority of nodes in the model are named as follows:

- The first three characters of each node's identification number are AMH if it represents a manhole located in the Anderson Street subdrainage area or CMH if it represents a manhole located in the Court Street subdrainage area
- The next set of characters, consisting of two to four numbers, represents the manhole's number on the 1970 drawings
- The final two characters, a letter and a number, represent the subcatchment in which the node is located (according to the 1970 drawings)
- Example: Node CMH1860X2 would be manhole 1860 in the Court Street subdrainage area located in subcatchment X2 on the 1970 drawings

Nodes not identified in this format are ghost nodes (nodes that represent a junction between two sewers with no manhole), nodes representing outfalls, or nodes forming parts of the regulators and vortexes.

Links in the model do not have descriptive identifications.

Figures 5-1 and 5-2 are maps showing the physical locations of the model's components in the Anderson and Court Street subdrainage areas, respectively. Note that node and link locations are not precisely located as shown on the City's sewer maps in some cases. While the figures show some mapping



Legend

- MODEL NODE
- MODEL CONDUIT

SUBDRAINAGE AREA

- ANDERSON STREET SUBDRAINAGE AREA - COMBINED
- ANDERSON STREET SUBDRAINAGE AREA - SEPARATED
- COURT STREET SUBDRAINAGE AREA - COMBINED
- COURT STREET SUBDRAINAGE AREA - COMBINED BUT SHEET FLOW ESCAPES THE SUBCATCHMENT
- SUBCATCHMENT AND NUMBER

CITY OF HACKENSACK
HACKENSACK, NEW JERSEY

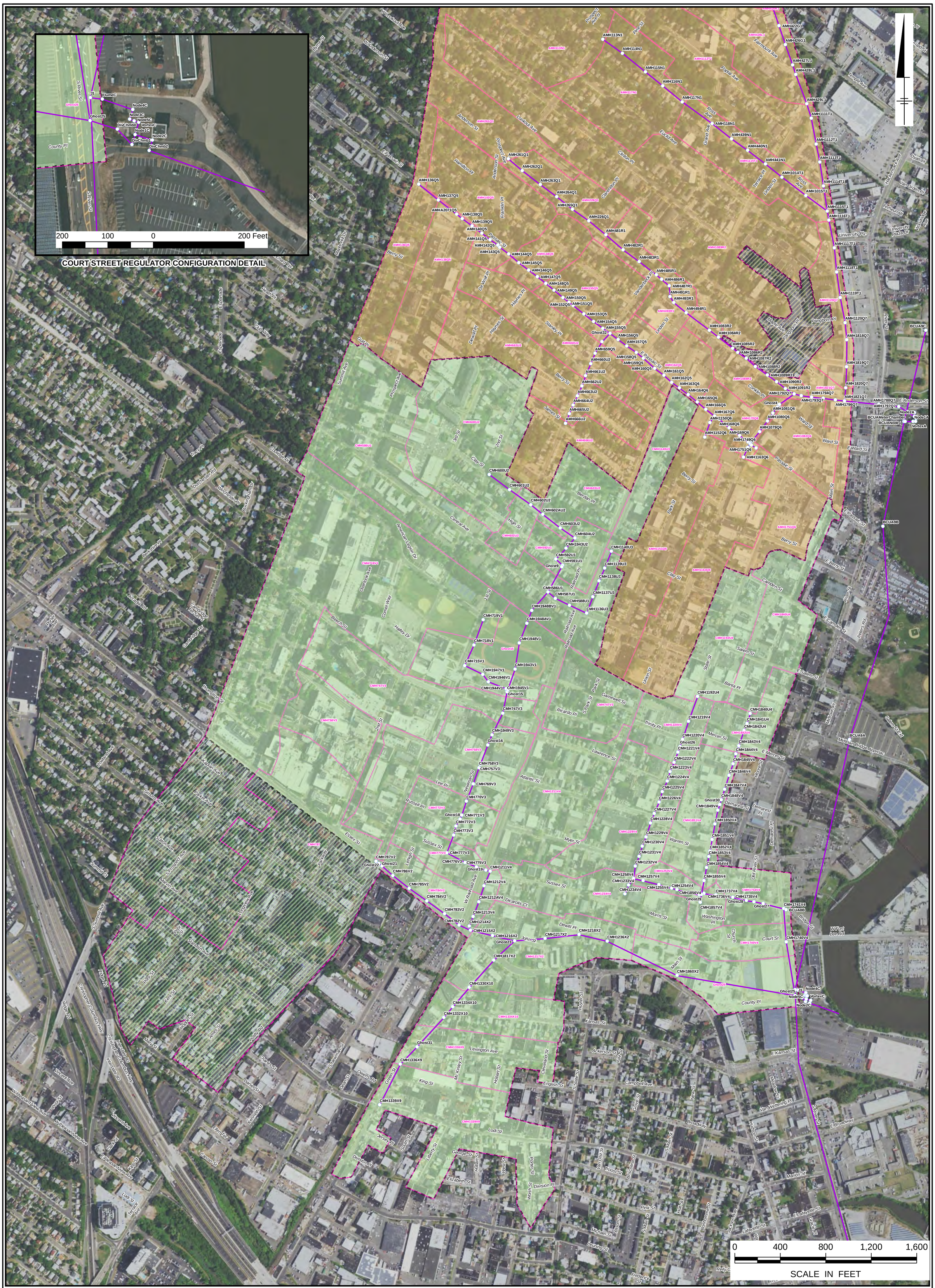
SEWER SYSTEM CHARACTERIZATION REPORT

MODEL HYDROLOGIC AND HYDRAULIC COMPONENTS - ANDERSON STREET SUBDRAINAGE AREA

ARCADIS Design & Consultancy for natural and built assets

FIGURE

5-1



Legend

- MODEL NODE
- MODEL CONDUIT

SUBDRAINAGE AREA

- ANDERSON STREET SUBDRAINAGE AREA - COMBINED
- ANDERSON STREET SUBDRAINAGE AREA - SEPARATED
- COURT STREET SUBDRAINAGE AREA - COMBINED
- COURT STREET SUBDRAINAGE AREA - COMBINED BUT SHEET FLOW ESCAPES THE SUBCATCHMENT
- SUBCATCHMENT AND NUMBER

CITY OF HACKENSACK
HACKENSACK, NEW JERSEY

SEWER SYSTEM CHARACTERIZATION REPORT

MODEL HYDROLOGIC AND HYDRAULIC COMPONENTS - COURT STREET SUBDRAINAGE AREA

ARCADIS Design & Consultancy for natural and built assets

FIGURE

5-2

features, it is important to note that they are schematics of the model scaled on an aerial. The hydraulic components of the model are summarized as follows:

- 285 links (including a portion of the BCUA interceptor and two screening facilities)
- 285 nodes
- 2 user-defined vortex valve rating curves
- 2 outfalls with tide gates

An internal rating curve based on flow monitoring data was used to simulate flows and depths at the vortex chambers, as shown in Section 6.3. A gated outlet structure was used at both outfalls.

Appendix E provides a detailed list of the model's hydraulic components, including the links (conduits) and nodes (manholes), which was extracted from the PCSWMM model.

5.1.2 Advantages of PCSWMM

Many advances in modeling software packages have occurred within the past 5 to 10 years. PCSWMM is one example of a model package that is available with an interface that is more user friendly, better integrated with GIS systems, better at data interpretation and mapping, and that has more flexible licensing arrangements and costs. PCSWMM is a powerful interpretation tool that interfaces with the standard, free, public domain EPA SWMM 5 Model and Engine software, allowing for ease of access.

5.1.3 Model Capabilities

As noted above, PCSWMM is a versatile and robust software package. A variety of backwater conditions are available at outfall nodes, including free, fixed elevation, tidal, normal, and timeseries. Outfalls can be modeled with or without a tide gate, allowing for representation of tidal influence. Surcharging can be modeled, as can flooding (with the option of ponding). Flow reversal can be modeled and seen in both the dynamic profiles and the system numerical data for export. The wide range of data processing capabilities and scenario management options are well suited to the analyses that have been and will be completed during the preparation of the LTCP.

5.2 Dry Weather Flow Characteristics

The DWF component in the CSS consists of sanitary sewage coming from residential, commercial, institutional, or industrial areas, plus long-term groundwater infiltration, if present, entering through pipe and manhole defects. These flows are present throughout the collection system network.

In development of the 2007 model, a diurnal (daily) flow pattern was developed for dry weather flow. Periods of dry weather within the 2006 monitoring period were selected by screening the 2006 rainfall data for days where no rainfall occurred for the preceding 48 hours. The period selected to determine the diurnal flow pattern for each meter location was June 12, 2006 to June 23, 2006. As the diurnal pattern of sanitary flows can be related to water usage, average 24-hour flow multiplier coefficients were estimated from the June 12 to June 23, 2006 flow data for a typical day. The average day DWF for the system was distributed to each subcatchment by multiplying the percentage of population for the subcatchment by the total population tributary to the meter (populations were based on 2000 Census data). Each

subcatchment is a load point in the model and was also assigned the corresponding diurnal pattern. The average flow was then multiplied by this diurnal pattern so that the DWF input to the model was correctly adjusted for the time of day. Since the DWF pattern was based on metered data at the trunk sewers, long-term groundwater infiltration is included in the modeled flows for both dry weather and wet weather.

The diurnal pattern for DWF that was developed in 2007 was carried over into the updated, re-calibrated PCSWMM model completed in 2017, with the flows distributed to subcatchments based on 2010 Census data rather than 2000 Census data. The period selected from the 2006 data is an appropriate, if not conservative, representation of current DWF conditions because, as described in Section 3.2.5, there has been no significant increase in population in the City since 2006. Furthermore, as shown in Table 5-1, BCUA flow monitoring data indicate that DWF decreased at the Anderson and Court continuous metering stations from 2006 to 2015 (by 0.29 MGD and 1.12 MGD, or 16% and 24%, respectively). This reduction in DWF may be a consequence of multiple factors, including the fact that the year 2015 was low in rainfall, which would have reduced the flow from inflow and infiltration, as well as the more widespread use of low-flow water fixtures in homes.

Table 5-1. Average Reduction in DWF at Court and Anderson Metering Stations - BCUA Data[2]

Flow Meter	2006 DWF, MGD	2015 DWF, MGD	DWF Reduction, MGD
Anderson (No. 103)	1.82	1.53	0.29
Court (No. 109)	4.70	3.58	1.12

5.3 Wet Weather Flow and Subcatchment Characteristics

WWF refers to the combined sewage that occurs during rainfall events when stormwater runoff enters the CSS and combines with sanitary sewage. Wet weather flow is primarily driven by the following parameters:

- Subdrainage areas
- Time of concentration (drainage width and slope)
- Impervious areas
- Infiltration rates

In the model, WWF are simulated as a response to rainfall data inputs, which is determined by subcatchment characteristics and rainfall/runoff processes applied in the model. It is noted that the same subcatchments and subcatchment characteristics are used for modeling DWF and WWF. GIS was used to determine the following parameters: subcatchment areas, subcatchment width and slope, and impervious areas. These values were in turn used to calculate the hydrologic subcatchment

[2] Please note that the 2016 Work Plan and the Arcadis Response to Comments letter to the NJDEP on June 21, 2016 presented Flow Meter 103 as Court Street and Flow Meter 109 as Anderson Street. This is incorrect and the meter numbers were reversed in these documents. It was confirmed that meter 103 is at Anderson Street and meter 109 is at Court Street, as depicted in Table 5-1 in this report.

characteristics of the model. These characteristics determine the amount of flow that enters the CSS for varying wet weather (rainfall) events. Infiltration rates in the City's model are incorporated into the dry weather baseflows.

Table 5-2 contains information on each of the subcatchments and their specific hydrologic characteristics.

The model allows the user to specify the type of outfall and tide gates used to represent both Anderson and Court outfalls. Measured hourly tidal elevations were used to specify the downstream boundary condition determining whether flow could discharge from the CSO facilities. The tide data is included as Appendix C in the attached CD-ROM.

City of Hackensack
Sewer System Characterization Report
Table 5-2: Subcatchment Characteristics

Name	Width (ft)	Slope (%)	Impervious Percentage %	Area (ac)
AMH1082Q6#1	402	0.5	53.4	8.72
AMH1088R2#1	690	0.5	44.1	7.12
AMH1089R2#1	446	0.5	29.6	56.45
AMH1112T1#1	323	0.5	24.9	41.84
AMH1115T1#1	1525	0.5	23.2	12.51
AMH1120Q7#1	721	0.5	52.2	7.7
AMH113N1#1	581	0.5	19.7	28.8
AMH1151Q6#1	277	0.5	38.9	20.01
AMH1163Q6#1	319	0.5	42.9	23.05
AMH117N1#1	797	0.5	20.3	17.43
AMH136Q5#1	798	0.5	22.6	11.91
AMH138Q5#1	302	0.5	42.9	14.21
AMH142Q5#1	429	0.5	24.4	17.3
AMH148Q5#1	353	0.5	21.5	6.36
AMH155Q5#1	668	0.5	26.1	11.26
AMH162Q5#1	774	0.5	50.5	9.75
AMH170Q6#1	348	0.5	44.7	6.73
AMH1751Q6#1	425	0.5	51.6	10.18
AMH1821Q7#1	399	0.5	55.1	5.17
AMH226Q1#1	887	0.5	28.4	8.29
AMH261Q1#1	323	0.5	22	11.5
AMH420K1#1	287	0.5	24.9	27.92
AMH428L1#1	276	0.5	26.7	31.09
AMH493R1#1	709	0.5	42.9	8.6
AMH58H1#1	219	0.5	20.3	12.42
AMH62H2#1	398	0.5	24.9	8.06
AMH660U2#1	298	0.5	25.5	13.21
AMH663U2#1	379	0.5	30.2	17.12
AMH666U2#1	614	0.5	26.7	14.18
Anderson Street Subdraininage Area (acres)				**468.89**
CMH1140U3#1	296	0.7	63.9	7.87
CMH1192U4#1	295	0.7	78.3	11.64
CMH1211V4#1	502	0.7	66.6	21.99
CMH1217X2#1	1003	0.7	69.3	20.19
CMH1220V4#1	481	0.7	84.6	7.77
CMH1229V4#1	659	0.7	81	17.66
CMH1234V4#1	431	0.7	74.7	15.88
CMH1253V4#1	373	0.7	83.7	5.05
CMH1334X10#1	325	0.7	70.2	10.18
CMH1734V4#1	647	0.7	71.1	6.69
CMH1740V4#1	228	0.7	58.5	5.9
CMH1840U4#1	224	0.7	85.5	14.26
CMH1842U4#1	711	0.7	85.5	7.37
CMH1851V4#1	1006	0.7	86.4	11.09
CMH586U1#1	523	0.7	56.7	43.35
CMH592U1#1	614	0.7	54	6.64
CMH600U2#1	749	0.7	48.6	27.75
CMH602U2#1	233	0.7	72.9	3.79
CMH603U2#1	389	0.7	37.8	8.9
CMH719V1#1	1000	0.7	48.6	66.33
CMH747V3#1	528	0.7	63.9	31.42
CMH758V3#1	572	0.7	76.5	31.42
CMH772V3#1	468	0.7	70.2	7.29
CMH777V3#1	218	0.7	76.5	6.52
CMH784V2#1	230	0.7	80.1	7.13
CMH787V2#1	500	0.7	46.8	11.48
Ghost15#1	587	0.7	37.8	15.84
Ghost25#1	256	0.7	73.8	12.56
Court Street Subdraininage Area (acres)				**443.96**

6 MODEL CALIBRATION AND VERIFICATION

A calibrated model provides a better understanding of how the City's CSS responds to a variety of rainfall events. Calibration of the hydrologic and hydraulic model consisted of interpreting and adjusting the model predictions based on comparisons to the 2006 monitoring program data. In order to achieve the desired match between monitored and modeled hydrographs, this process included an adjustment to specific parameters to account for (Wallingford, 1998):

- Time-shift differences
- Dry weather flow differences
- Hydrograph volume differences
- Hydrograph attenuation differences

While it is important to understand the adjustment process, it is also important to recognize that calibration parameters cannot be adjusted casually. If the calibration process generated parameters outside acceptable ranges, the model configuration and/or monitoring data was investigated.

Model calibration may consist of adjusting basin hydrologic and collection system attribute information within reasonable ranges to obtain simulated results that closely replicate actual measured flows and depths during storm events. Model calibration can also include comparison of simulated results with existing historical operational or even anecdotal information (e.g. observed flooding). The calibration process ensures that the model representation of the collection system predicts system performance under single event and long-term hydrologic conditions as close to reality as possible.

As described in Section 5, per the approved 2016 Work Plan, two calibration events and one verification event were analyzed. The two calibration events were selected from the rainfall data collected through the 2006 monitoring program using the selection criteria described in Section 3.2.4. Table 6-1 presents information on the three precipitation events selected for calibration and verification. The two calibration events took place on June 2, 2006 and July 5, 2006. The verification event took place on June 7, 2006. Detailed data records of the rainfall data collected in 2006 are included in a CD-ROM as Appendix A. The flow monitoring data that were used in calibration (for both dry and wet weather) are included in a CD-ROM as Appendix B.

Table 6-1. Summary of Calibration and Verification Events

Date	Total Rainfall (in.)	Largest 24-hour Rainfall (in.)	1-hour Rainfall (in.)		Maximum Duration (hours)	Return Period Duration (months)	
			Minimum	Maximum		24-hour	1-hour
6/2/2006 (Calibration)	2.44	2.31	0.55	0.83	76.2	9.0	5.8
7/5/2006 (Calibration)	0.91	0.90	0.23	0.29	29.4	2.4	1.3
6/7/2006 (Verification)	1.49	1.33	0.19	0.41	35.0	3.6	1.9

6.1 Calibration Criteria

Model calibration is not typically measured as a mathematical fit between two curves. Many reasons can explain differences between modeled and monitored data that cannot be correlated in a simple mathematical test. There is a traditional measure of fitness that can be applied to better quantify the model calibration. This method consists of applying a range of tolerances to specific parameters (Wallingford 1998). For the modeling effort, the model calibration goals consisted of the following (CIWEM 2017):

- Flow Volume: modeled volume within -10% to +20% of monitored volume
- Peak Flows: modeled peak flows within -15% to +25% of monitored peak flows
- Stage Depths: modeled depths within -15% to +30% of monitored depths

6.2 Dry Weather Calibration

The DWF calibration of the City's model was performed using the 2006 monitoring program rainfall (to determine dry weather periods) and flow meter data, which are included for reference in Appendices A and B. (See Section 3.2.5 for a justification of the reuse of 2006 monitoring program data in the model update.) The calibration process involved applying the DWF for the 12-day simulation period of June 12 to June 23, 2006, as described in Section 5.2. The DWF hydrograph from each meter site from the 2006 monitoring program was compared to the simulated flows at each outfall to confirm an acceptable match. The goal of dry weather calibration is to match the peak flows and response times as closely as possible.

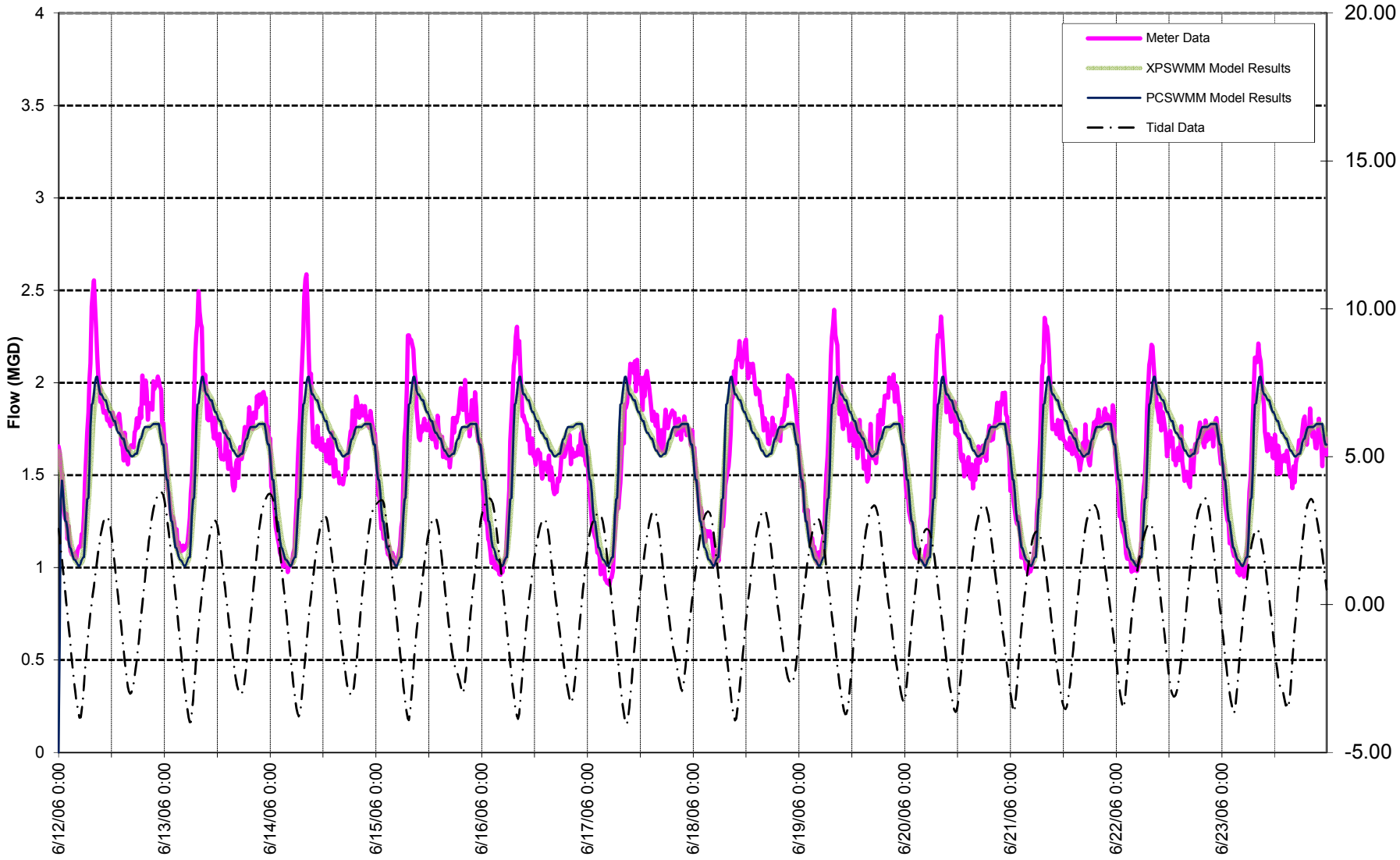
The comparison for dry weather simulation at each outfall is presented in Figures 6-1 and 6-2. Specifically, Figures 6-1 and 6-2 show the comparison of the superseded XP-SWMM model versus the PCSWMM model results and the flow monitoring meter results. The results illustrate that the calibration goals were met for dry weather conditions.

6.3 Wet Weather Calibration

Wet weather calibration is accomplished by modifying subcatchment characteristics to adjust the rate and volume of runoff generated during a particular storm. Each of these parameters was adjusted as required to meet the calibration requirements as closely as possible.

The wet weather model calibration procedure used in the 2007 model development was as follows:

- Rainfall data was converted into a file for use in model simulations
- Recorded flow data from the 2006 monitoring program for each meter for selected events were converted into a file format that enabled a direct comparison with the model results
- Two calibration rainfall events were simulated by the model and the results were subsequently compared with the recorded data
- Based upon the "metered to modeled" comparisons for all the calibration events, the calibration parameters described above were adjusted



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Sewer System Characterization Report
Figure 6-1: Flow at Meter A2
Dry Weather Flow
Anderson Street Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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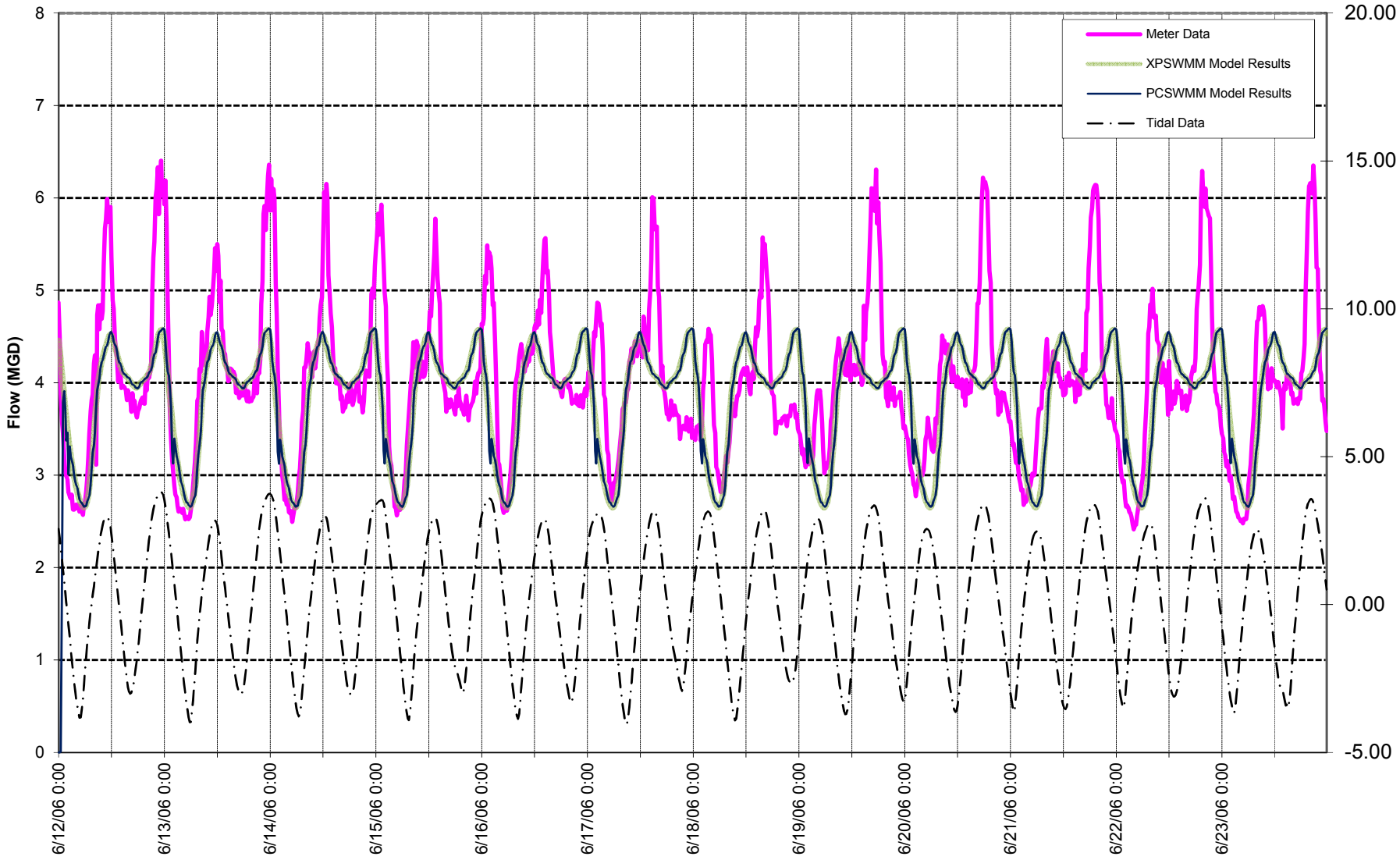

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Sewer System Characterization Report
Figure 6-2: Flow at Meter C2
Dry Weather Flow
Court Street Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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- Following the adjustments to the model, the events were re-simulated, the results compared again, and further fine-tuning adjustments were made to the subbasin hydrologic and pipe network hydraulic attributes
- After final adjustments, a third event was simulated for verification

The average Court and Anderson impervious area percentages are 49% and 33%, respectively. For the 2007 model development, impervious area percentages were adjusted until peak flows and volumes more closely matched the recorded data. The impervious area percentages were not altered from the XP-SWMM model to the converted PCSWMM model. Figures 6-3 to 6-14 compare monitored and modeled flows and depths during the two calibration events on June 2 and July 5, 2006.

Vortex valve rating curves were used to simulate the flows into the metering chambers at Court and Anderson CSO facilities and are presented in Table 6-2. Flow monitoring data was analyzed to estimate the flow and head loss values at the metering chambers. After implementation, the vortex valve rating curves were adjusted until peak flows and volumes more closely matched the recorded data.

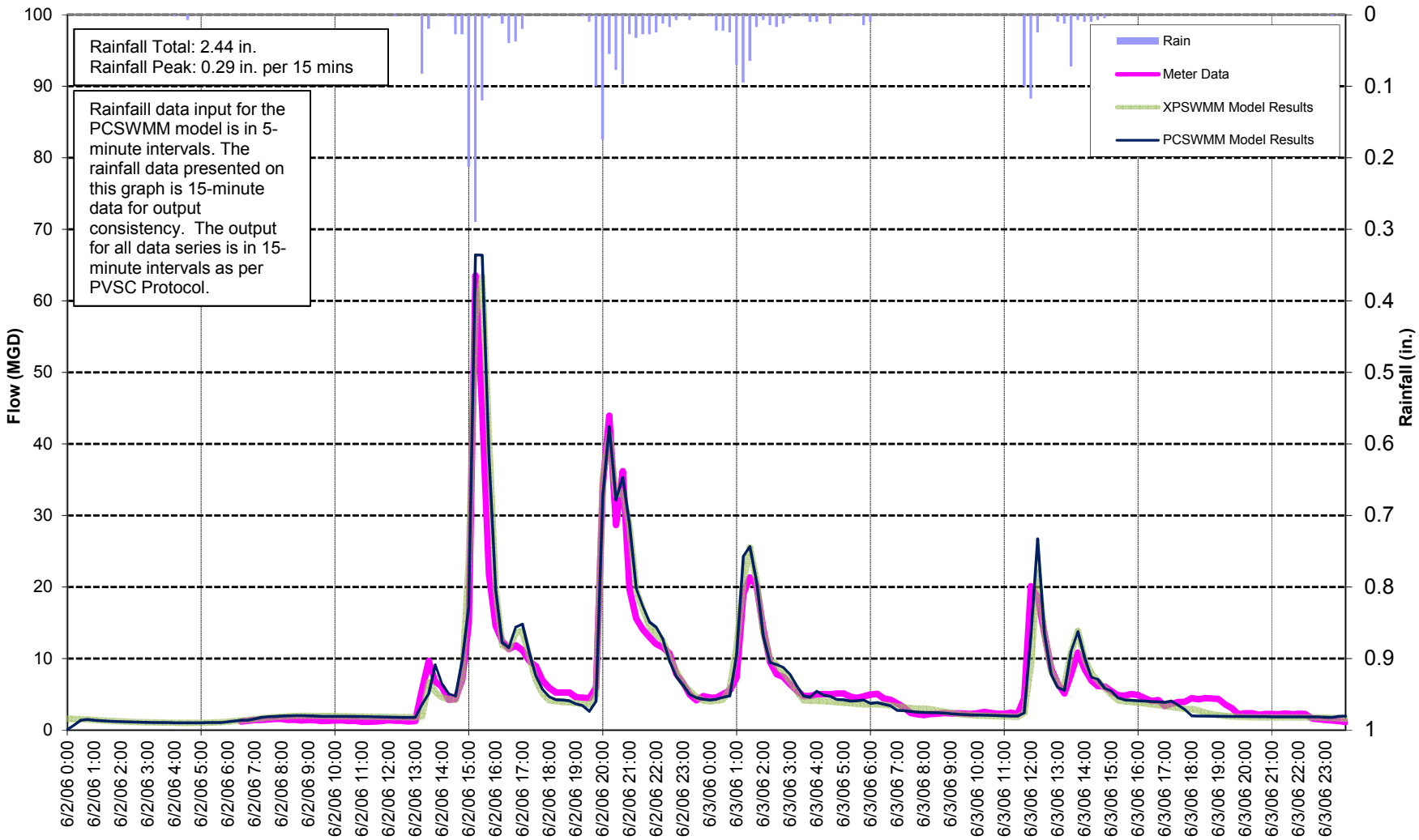
Table 6-2. Vortex Valve Rating Curves

Anderson Vortex Valve Rating Curve		Court Vortex Valve Rating Curve	
Depth (ft)	**Flow (MGD)**	**Depth (ft)**	**Flow (MGD)**
1.0	0.0	0.8	0.0
1.1	0.2	1	2.3
1.6	2.0	1.5	7.4
2.1	3.4	2	10.6
2.6	4.5	2.5	12.5
3.1	5.3	3	13.5
3.6	5.8	3.5	14.5
4.1	6.3	4	15.5
4.6	6.7	5	17.5

6.4 Model Verification

The wet weather verification event selected took place on June 7, 2006. Figures 6-15 through 6-20 compare monitored and modeled flows and depths for the verification event. These figures demonstrate that the calibration stage was successful.

Model results indicated a few nodes in the Court collection system surcharged above rim elevations and that a portion of the flow volume drained overland and did not reenter the pipe network. As an additional verification measure, flooding maps were reviewed and confirmed these areas are prone to street flooding. Smaller rainfall events were simulated to verify the model predicted flow volumes when no flow escaped the system.



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Sewer System Characterization Report
Figure 6-3: Flow at Meter A1
June 2, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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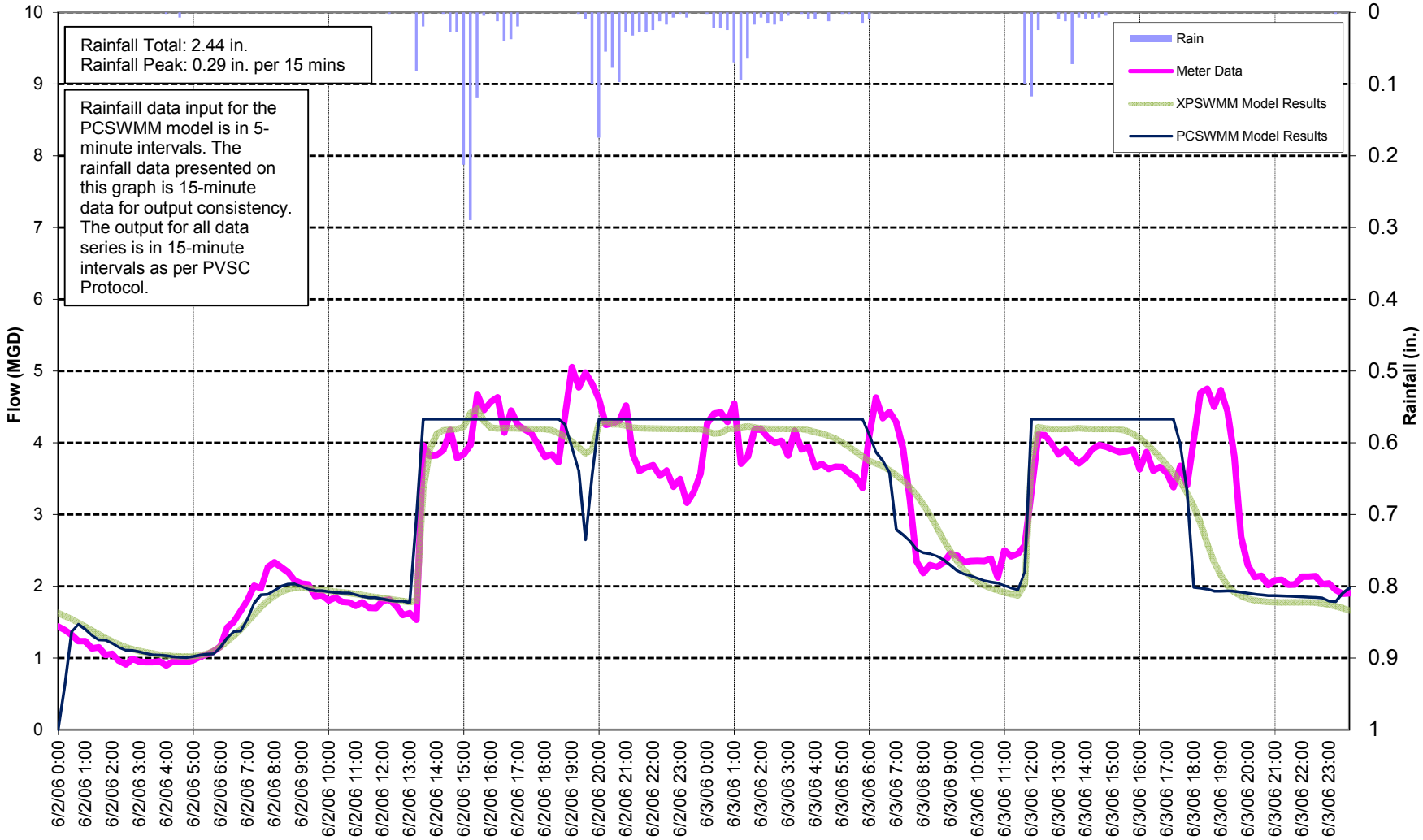

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Sewer System Characterization Report
Figure 6-4: Flow at Meter A2
June 2, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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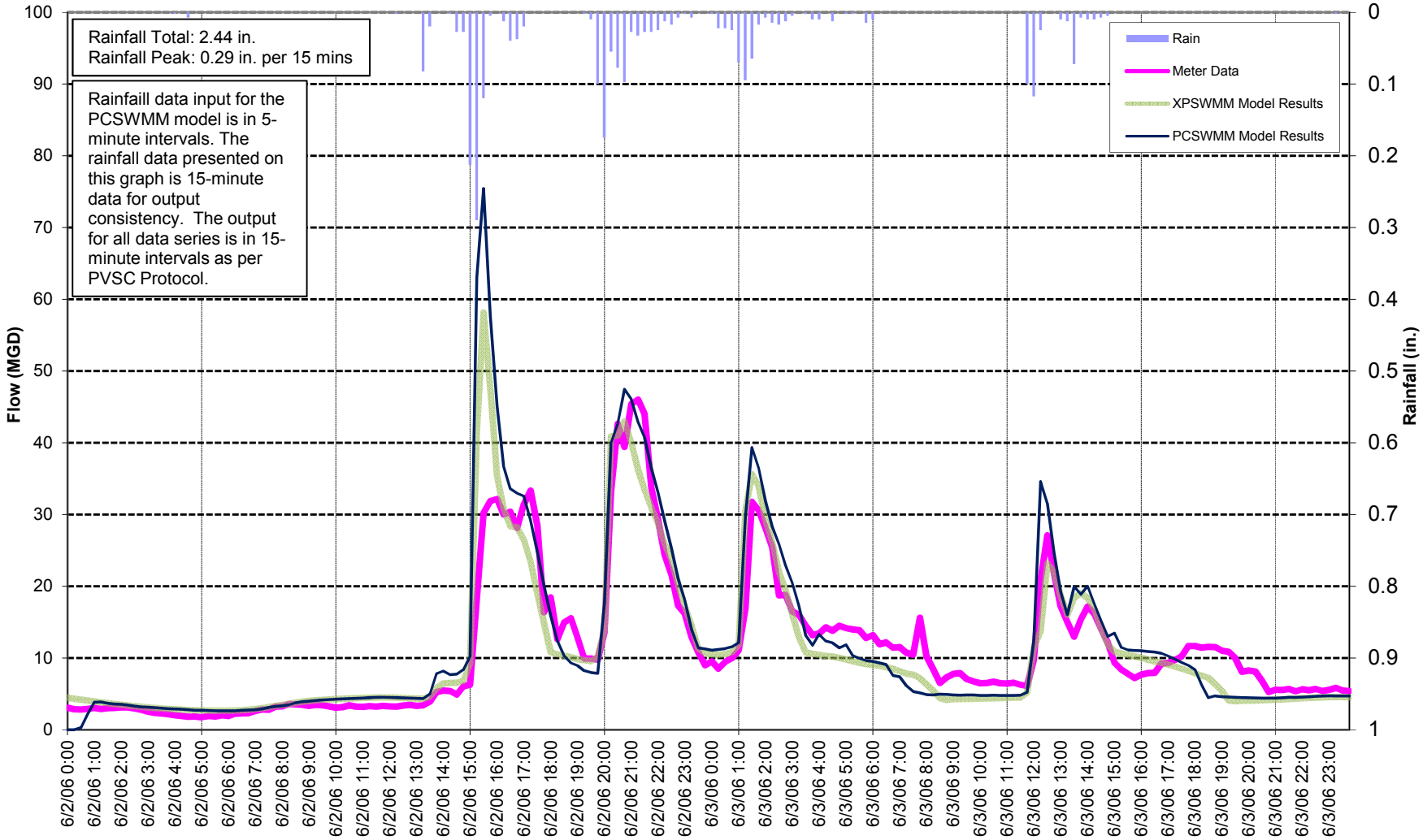

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Sewer System Characterization Report
Figure 6-5: Flow at Meter C1
June 2, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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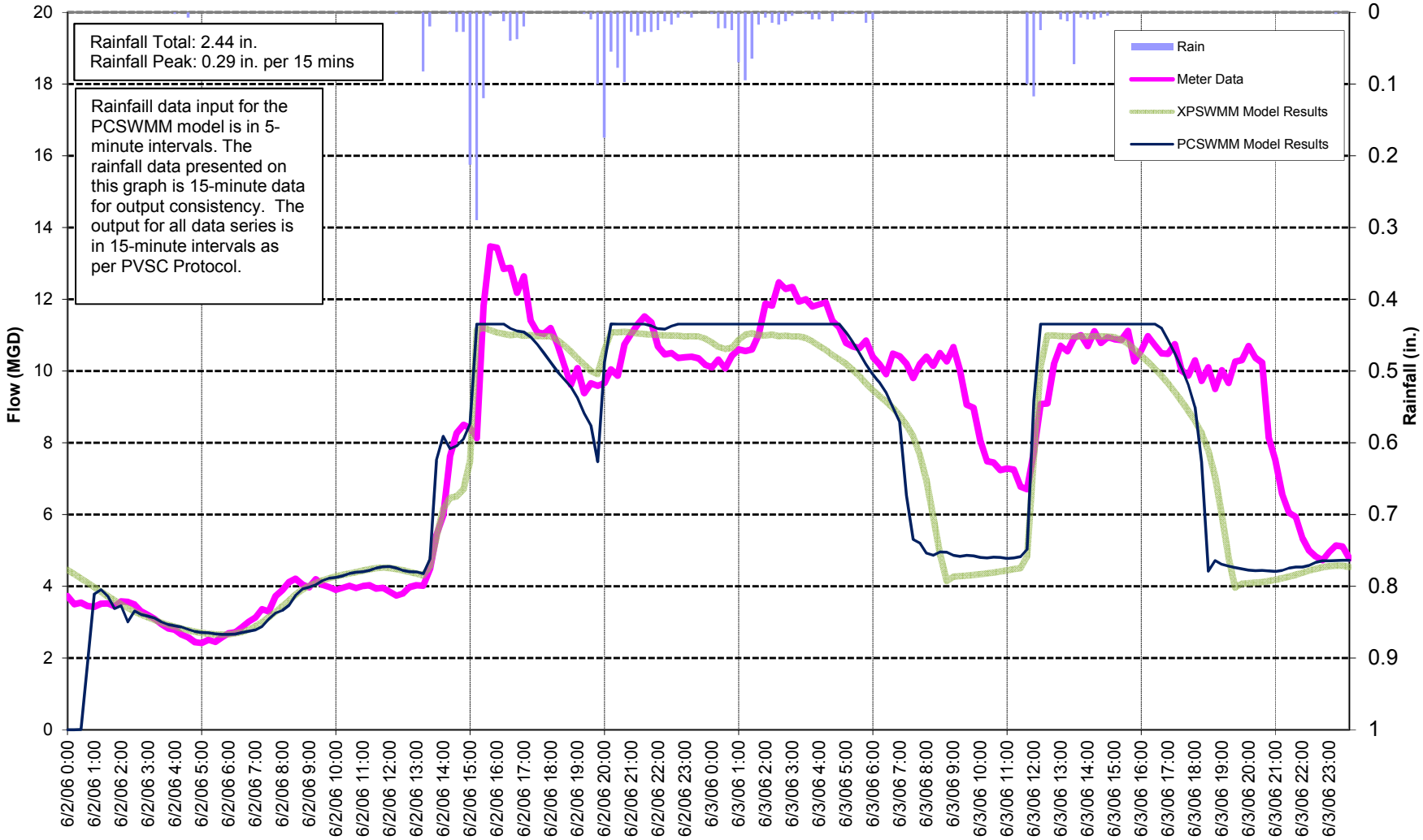

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Sewer System Characterization Report
Figure 6-6: Flow at Meter C2
June 2, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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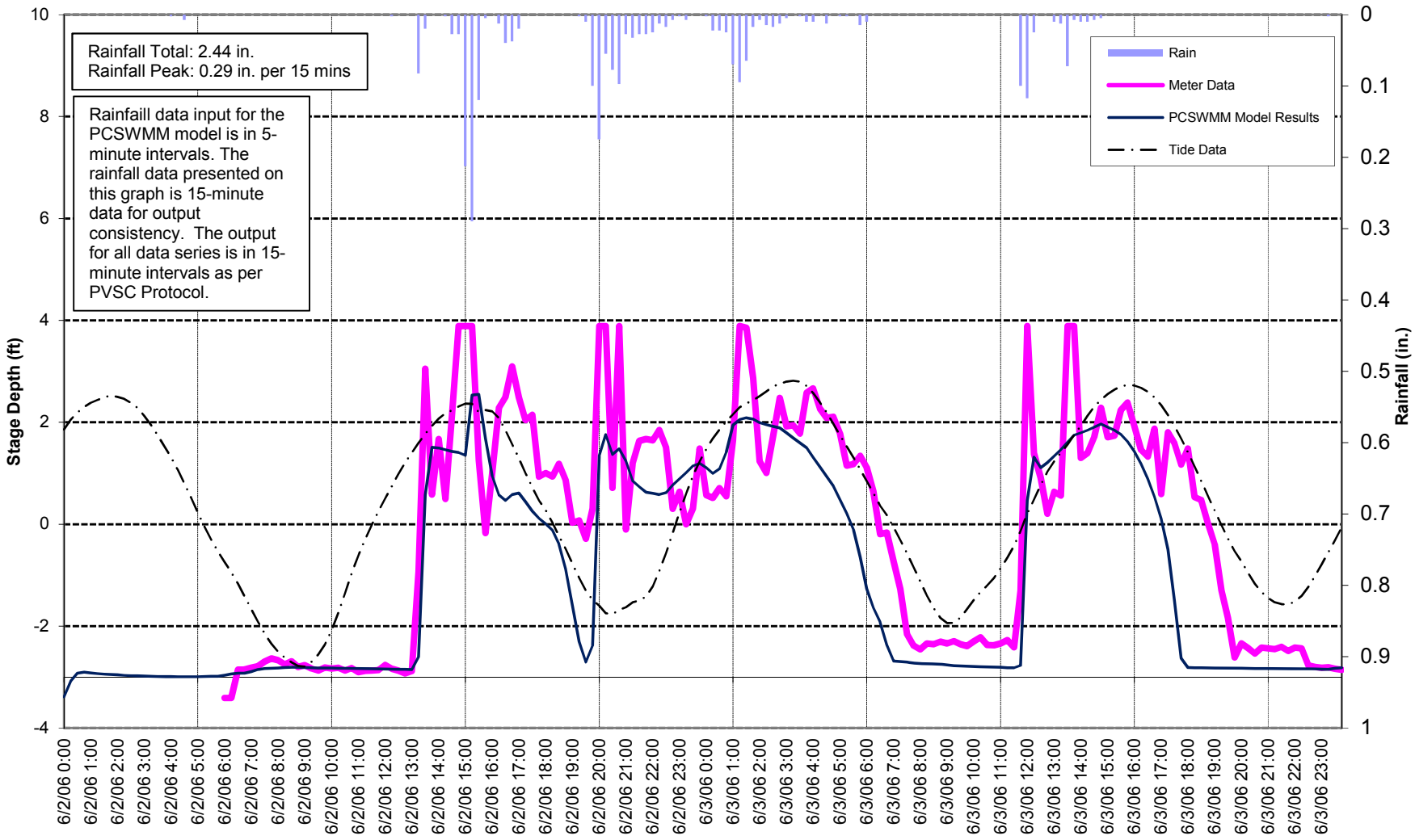

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Sewer System Characterization Report
Figure 6-7: Stage Depth at Meter A1
June 2, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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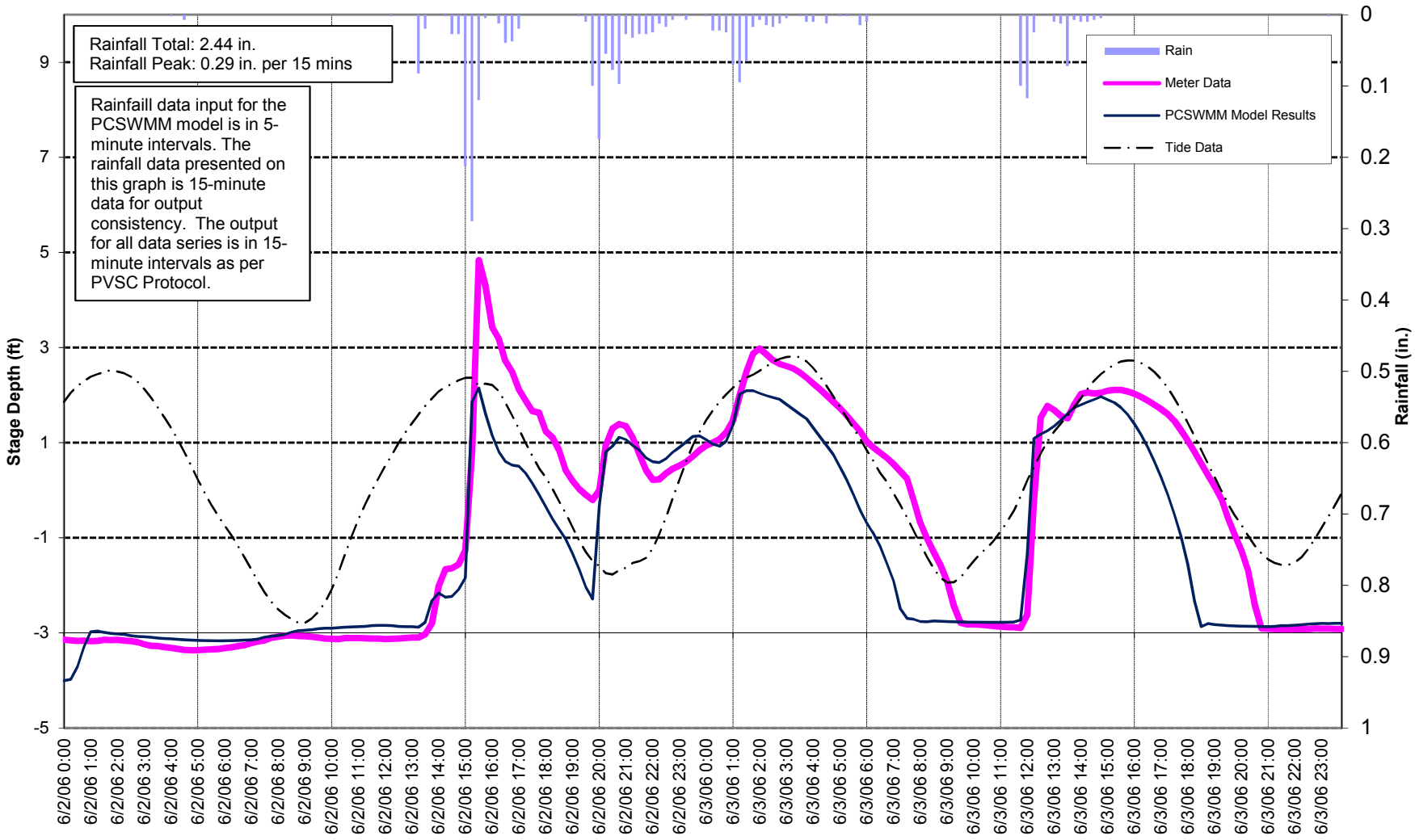

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Sewer System Characterization Report
Figure 6-8: Stage Depth at Meter C1
June 2, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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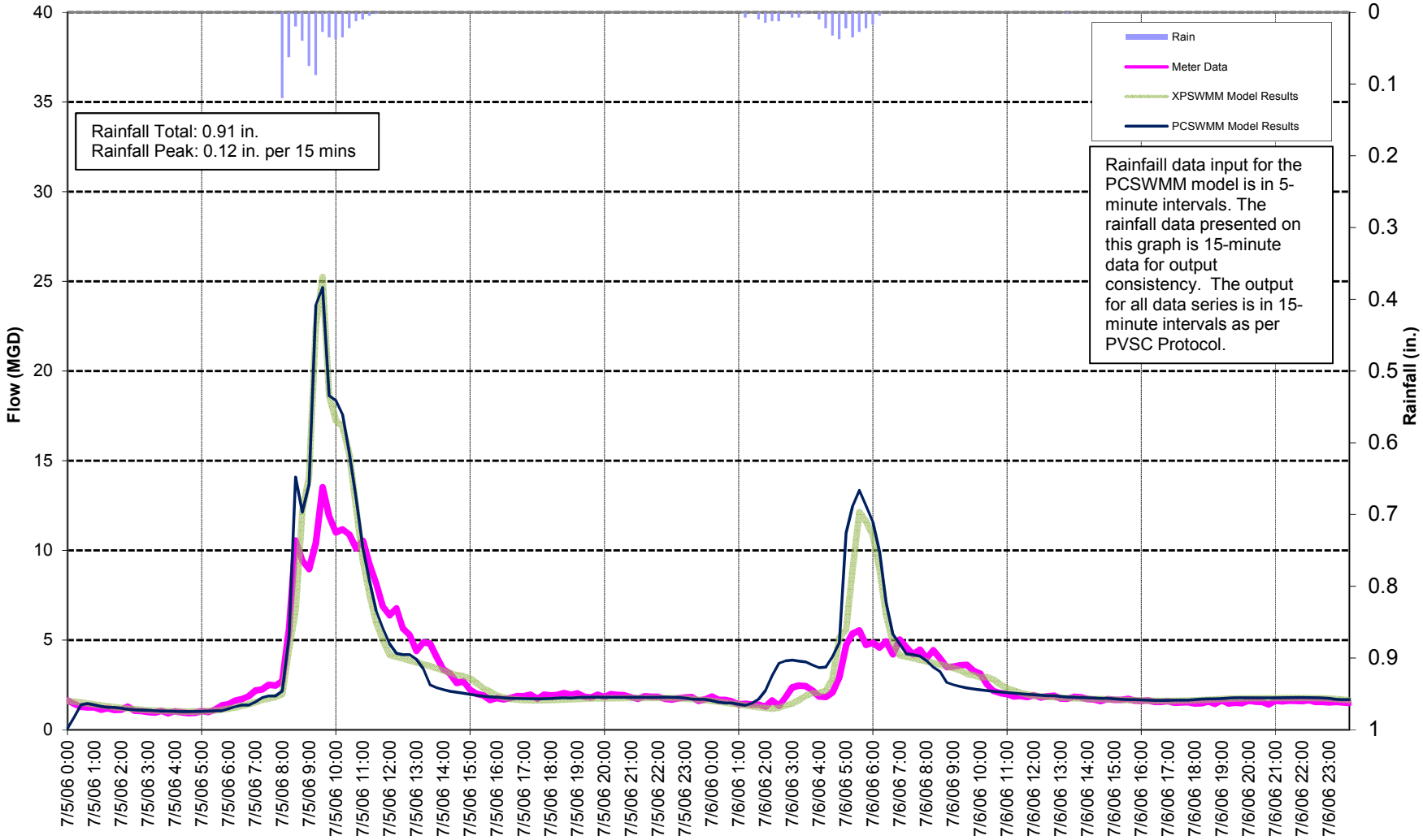

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Sewer System Characterization Report
Figure 6-9: Flow at Meter A1
July 5, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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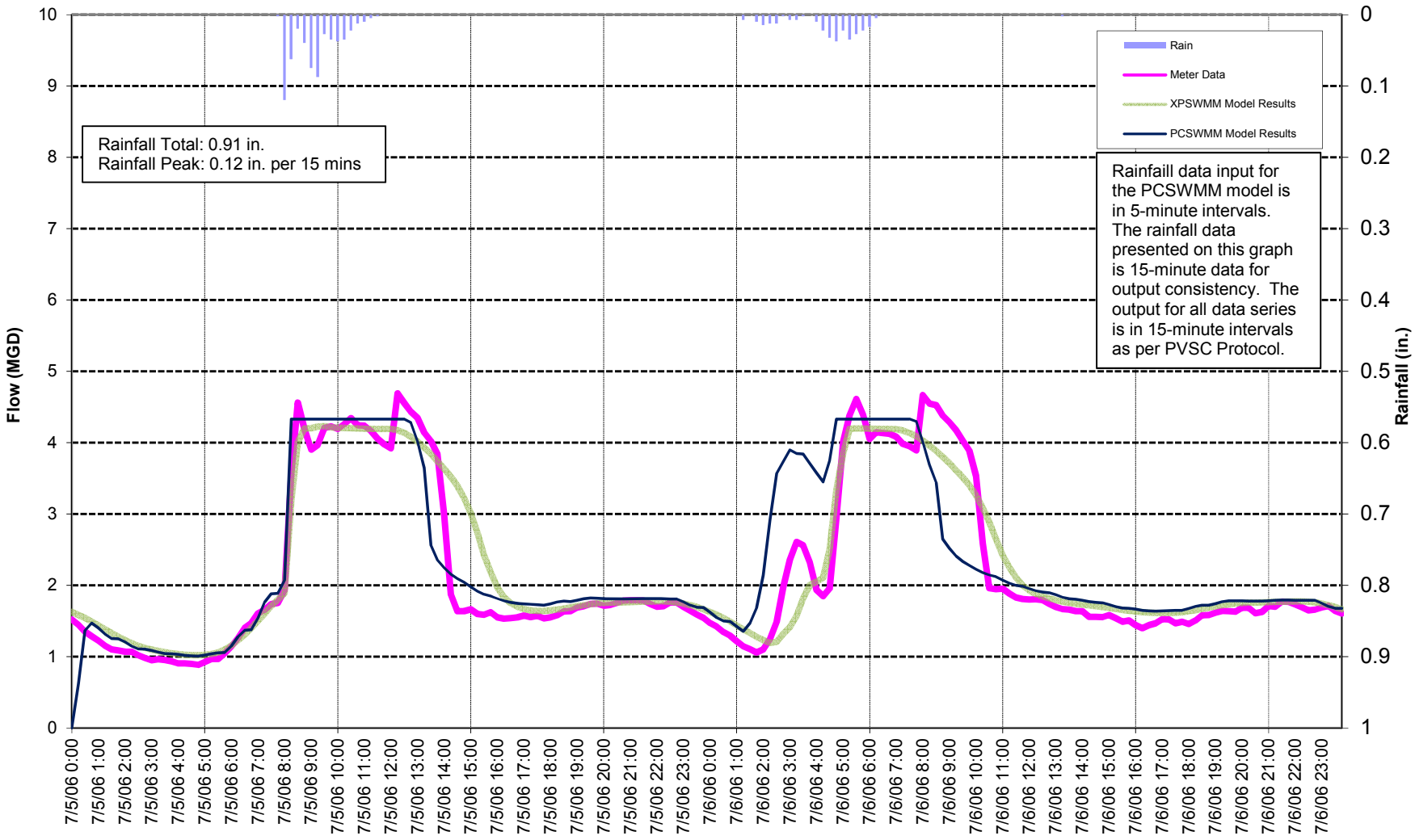

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Sewer System Characterization Report
Figure 6-10: Flow at Meter A2
July 5, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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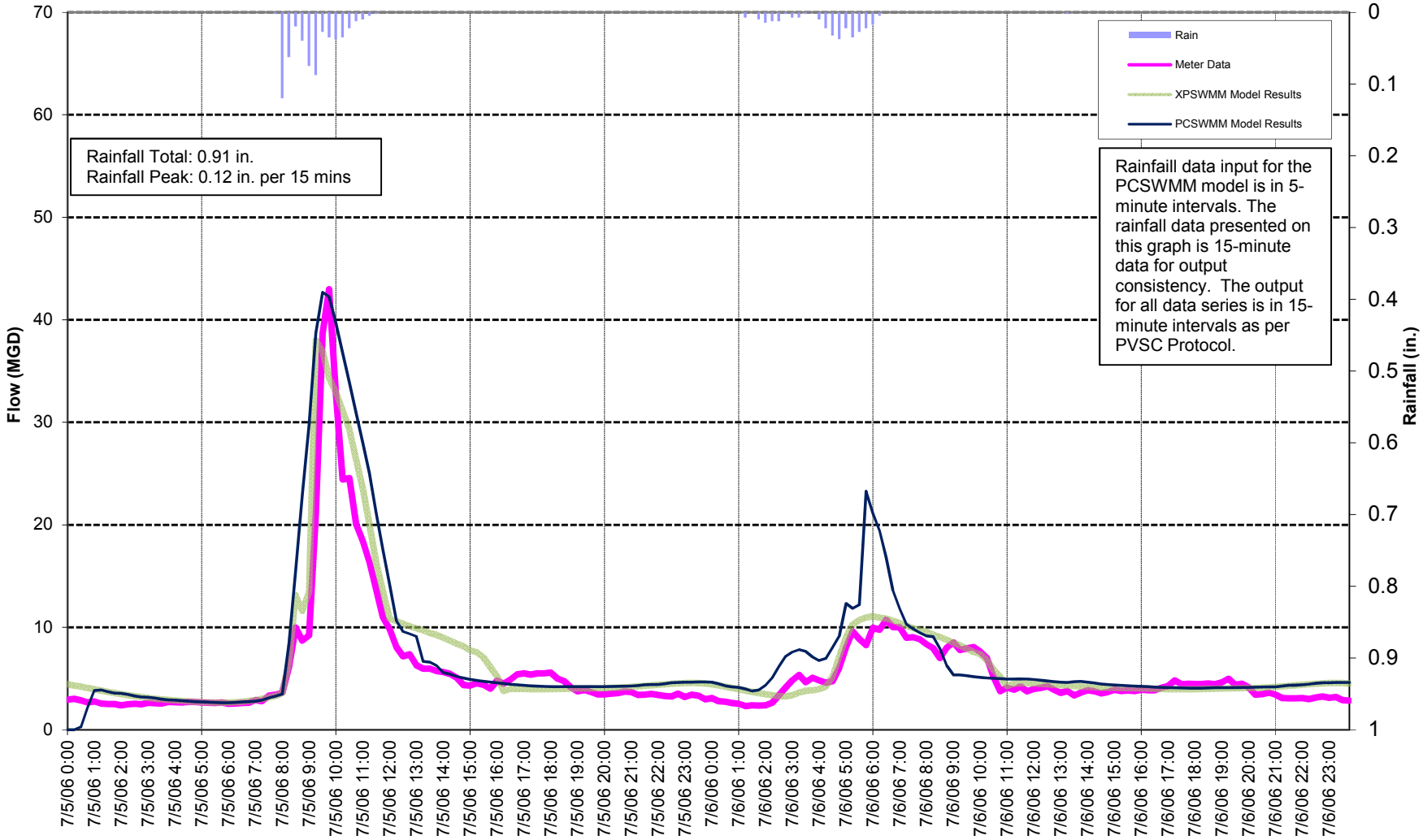

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Sewer System Characterization Report
Figure 6-11: Flow at Meter C1
July 5, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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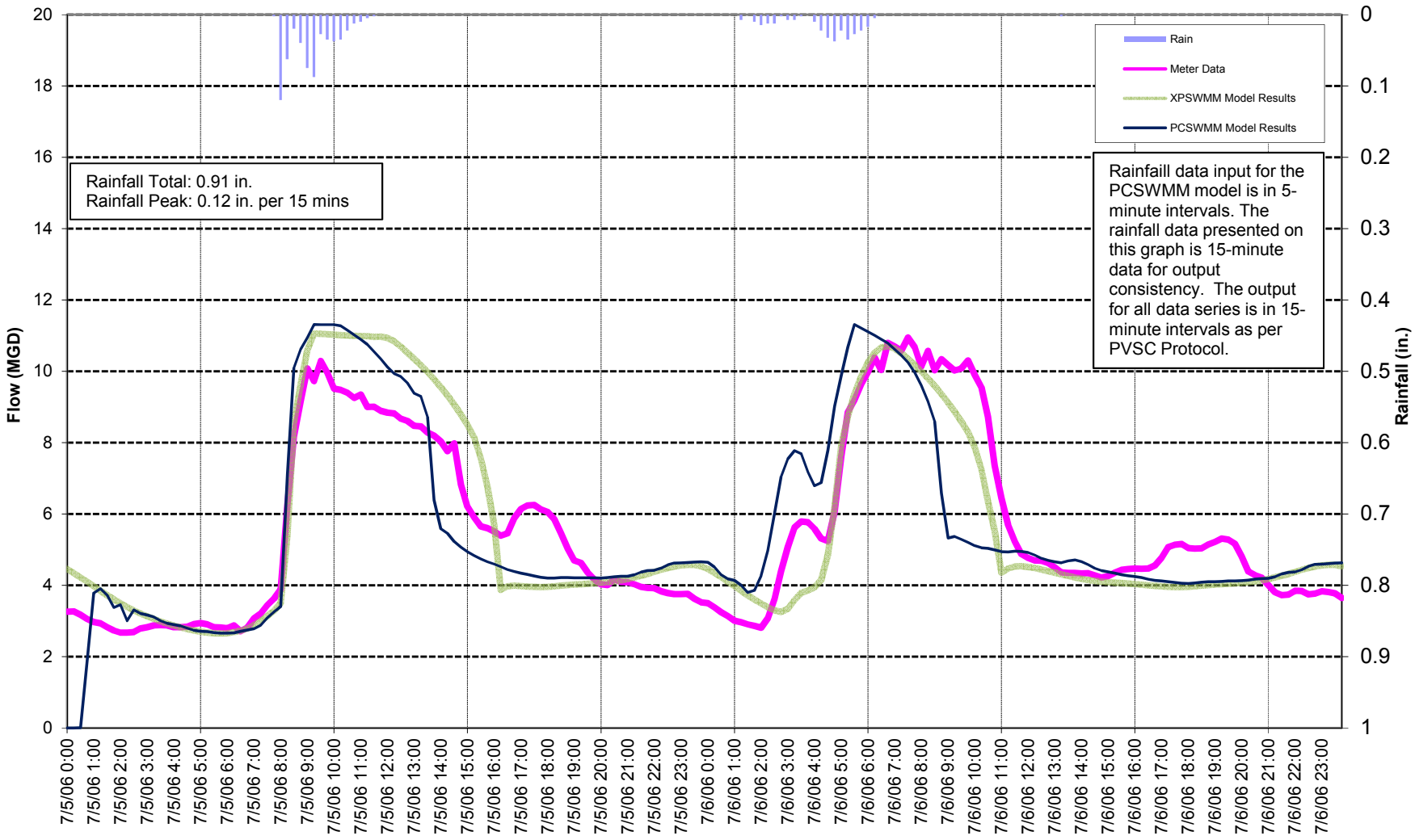

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Sewer System Characterization Report
Figure 6-12: Flow at Meter C2
July 5, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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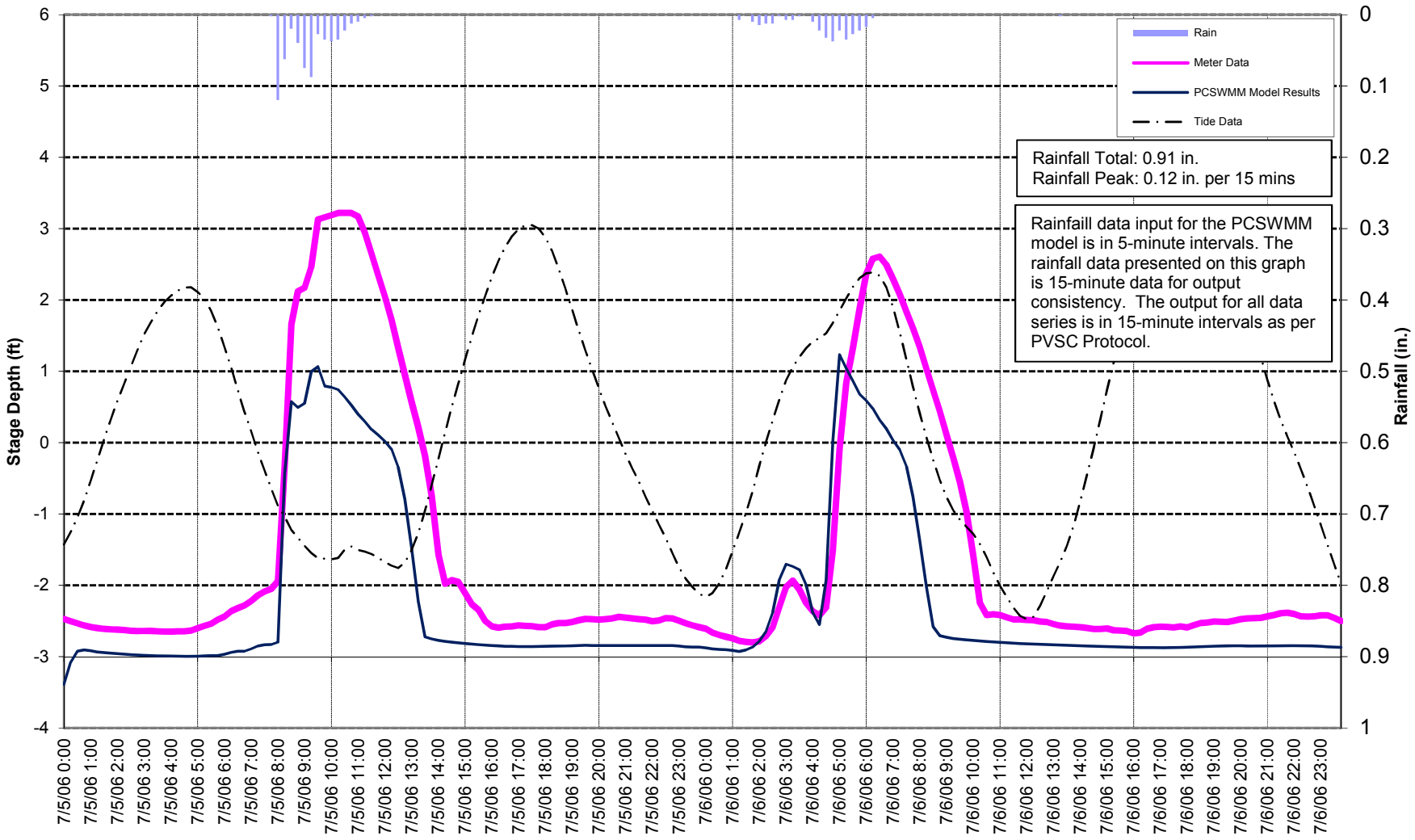

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Sewer System Characterization Report
Figure 6-13: Stage Depth at Meter A1
July 5, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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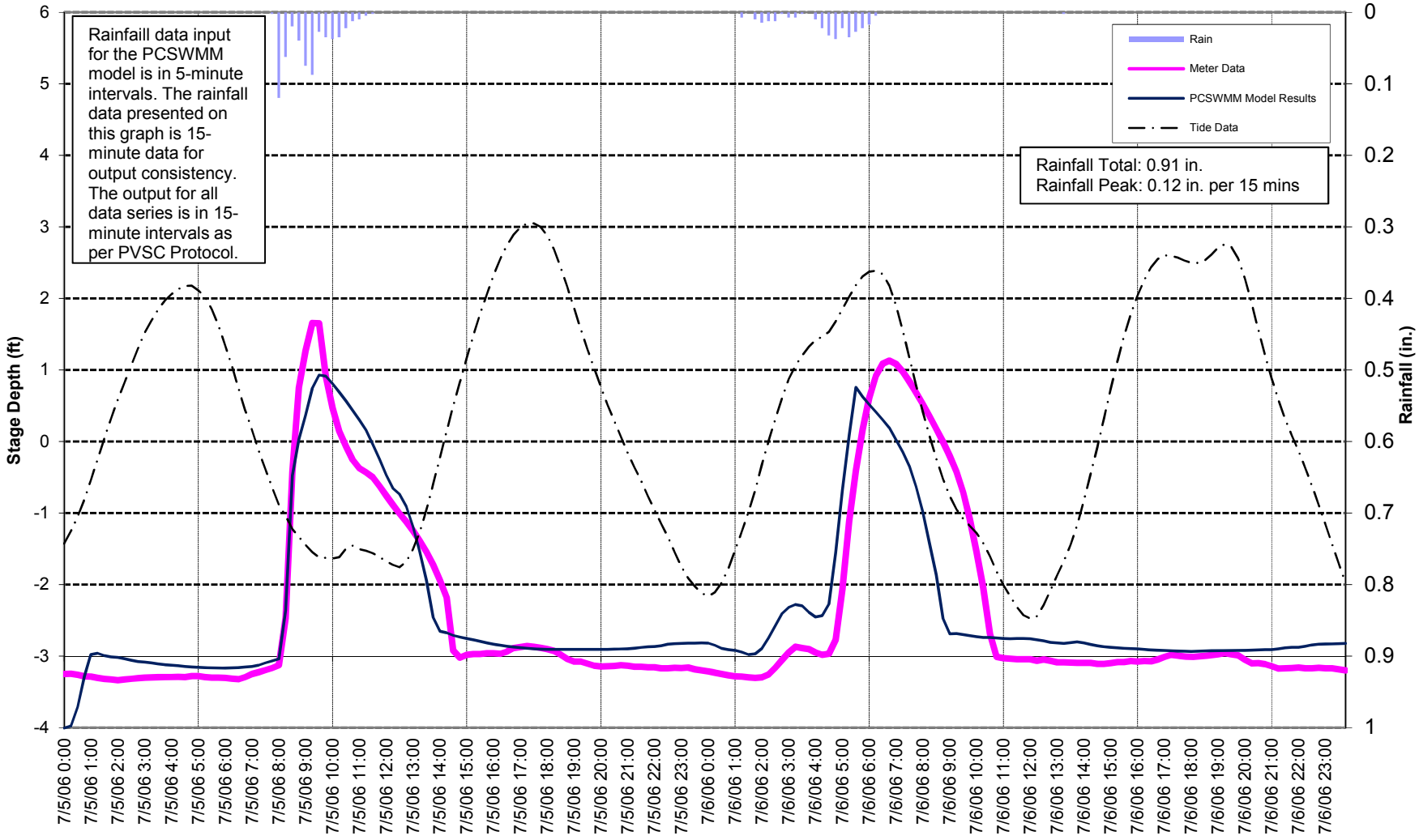

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Sewer System Characterization Report
Figure 6-14: Stage Depth at Meter C1
July 5, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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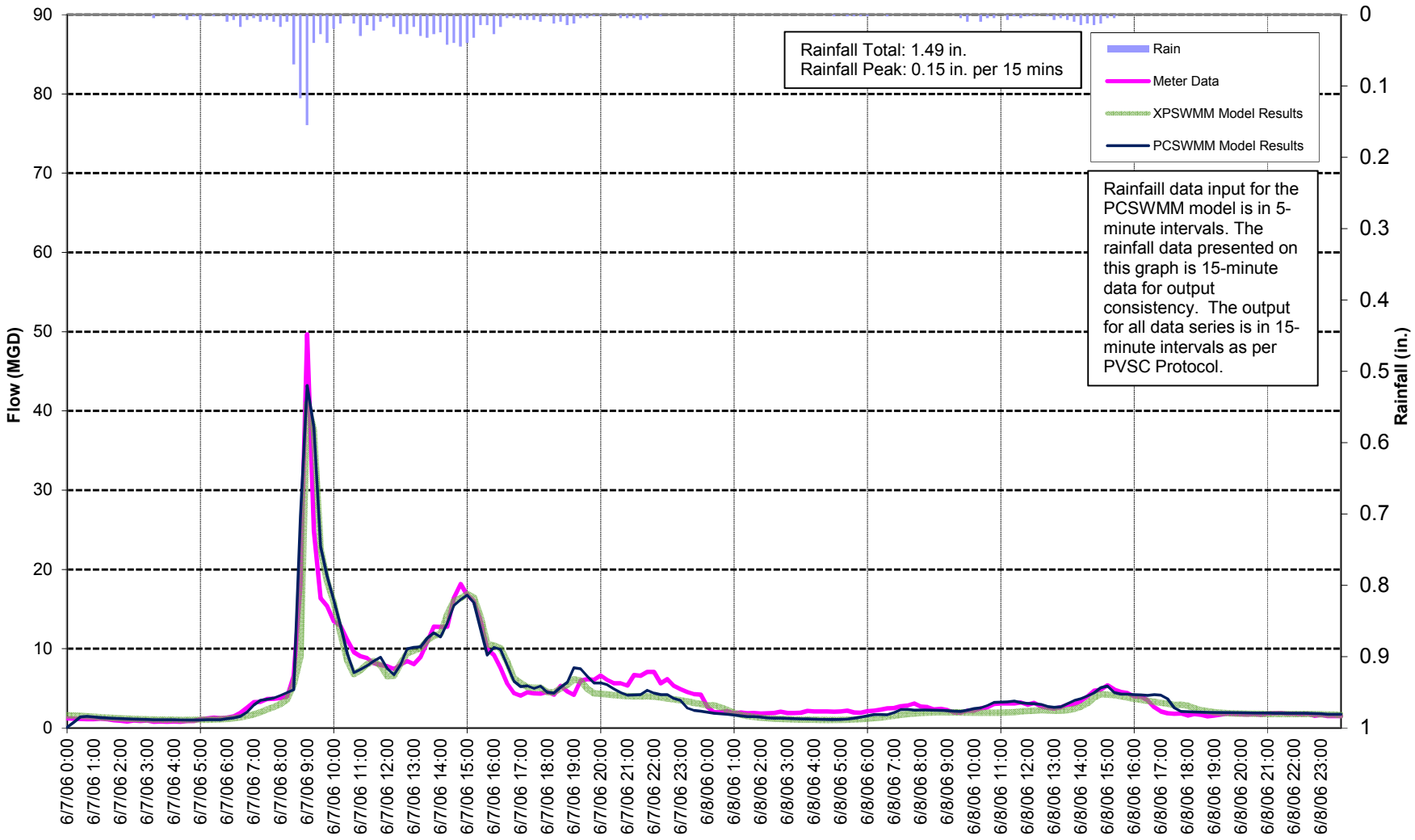

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Sewer System Characterization Report
Figure 6-15: Flow at Meter A1
June 7, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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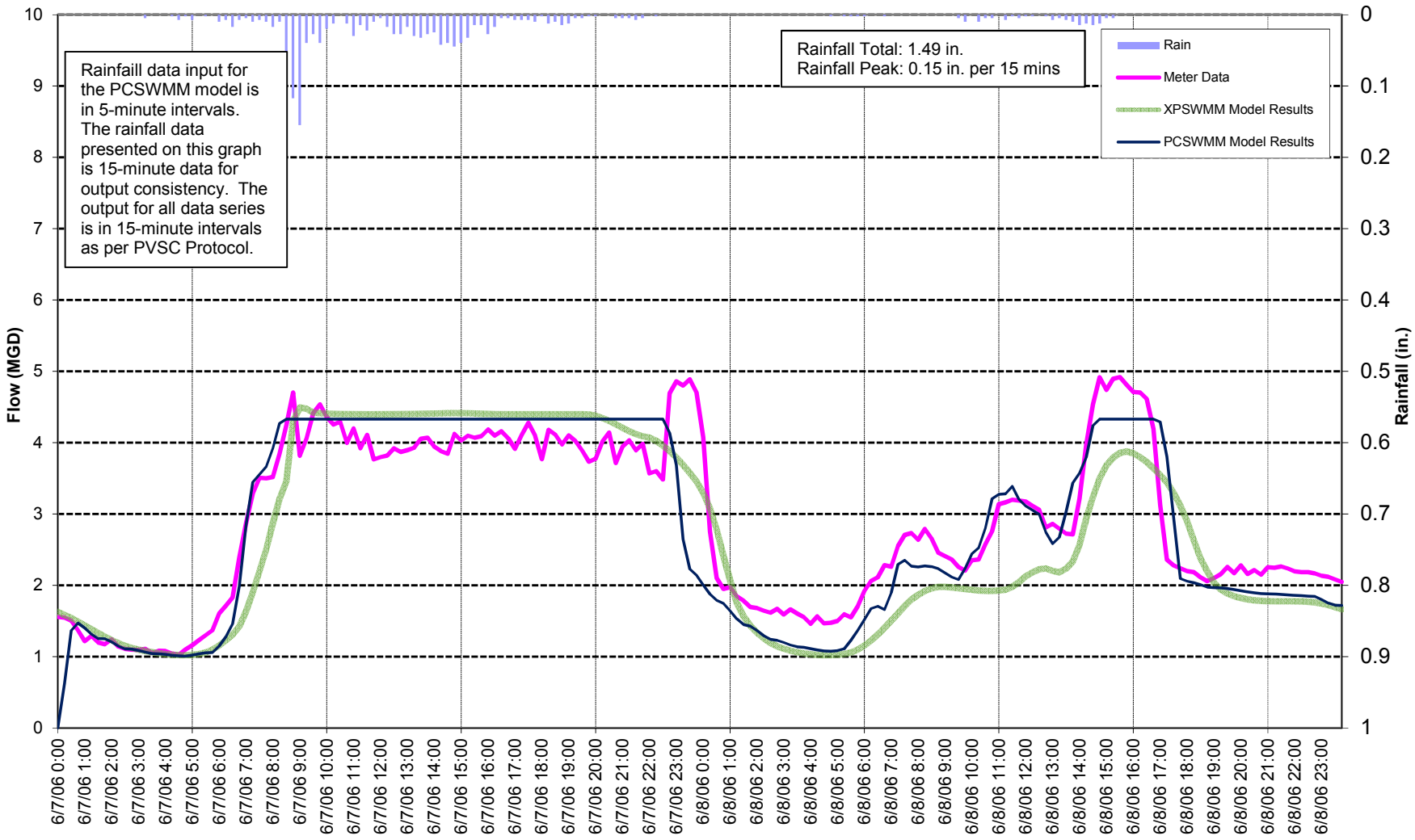

ARCADIS

Sewer System Characterization Report
Figure 6-16: Flow at Meter A2
June 7, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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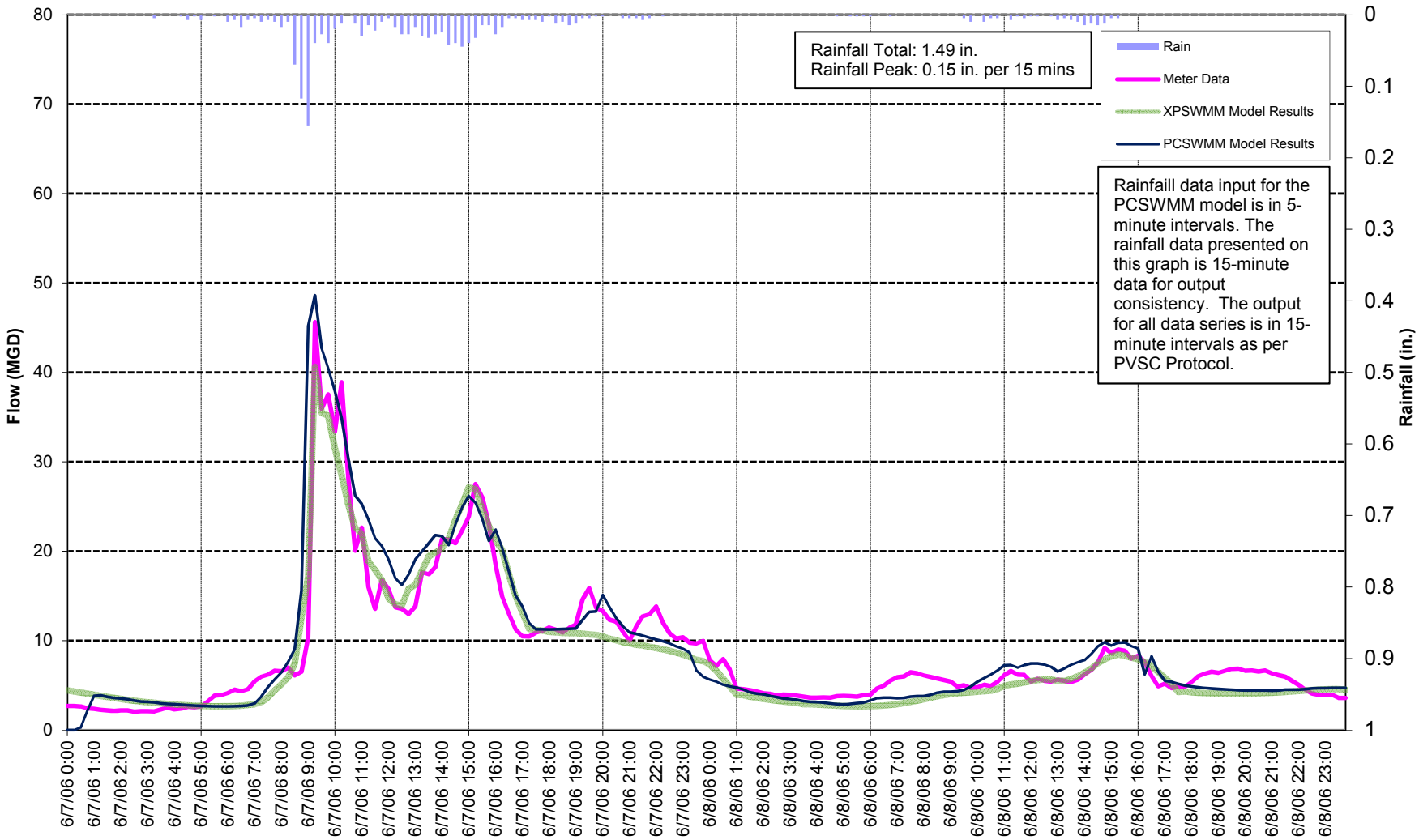

ARCADIS

Sewer System Characterization Report
Figure 6-17: Flow at Meter C1
June 7, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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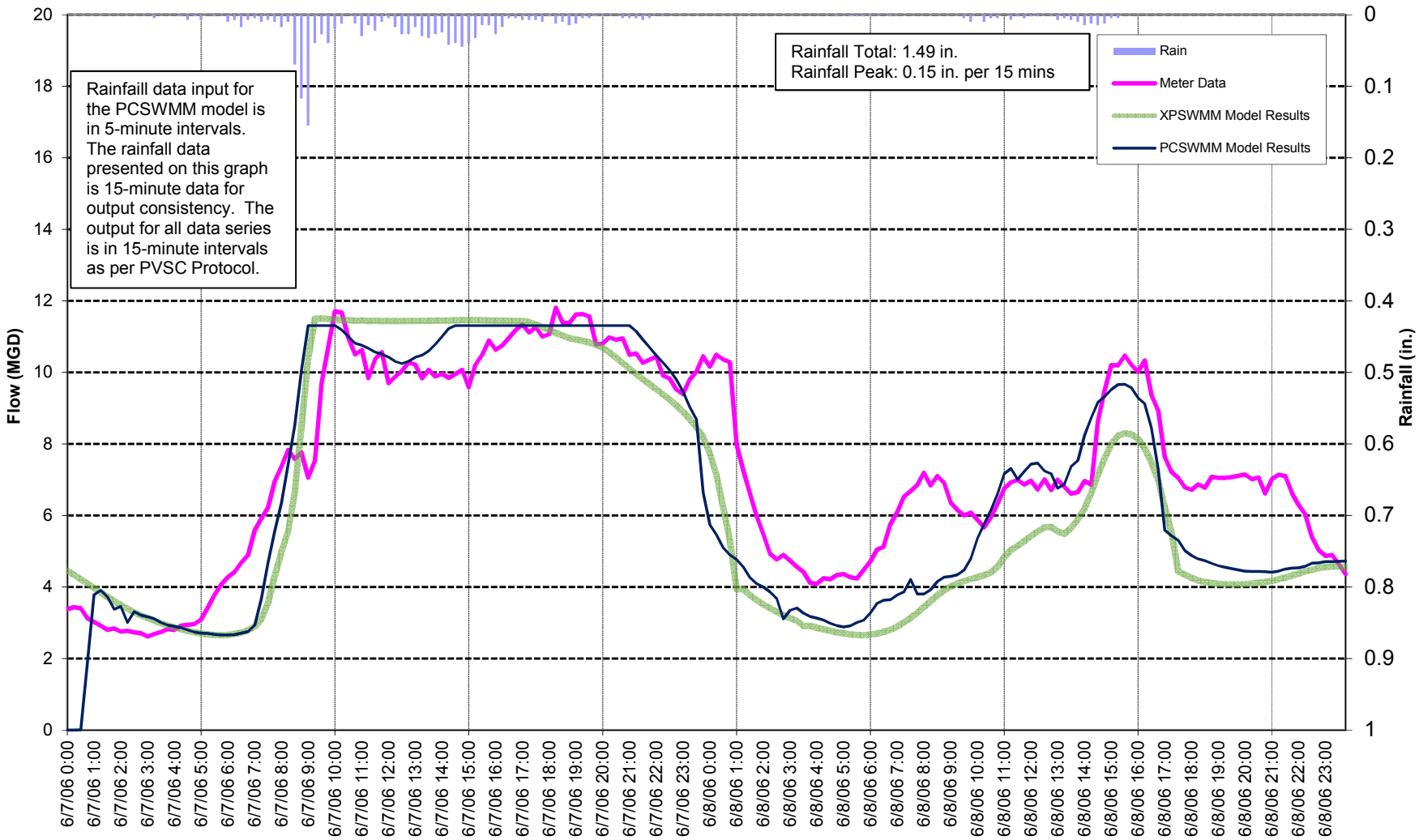

ARCADIS

Sewer System Characterization Report
Figure 6-18: Flow at Meter C2
June 7, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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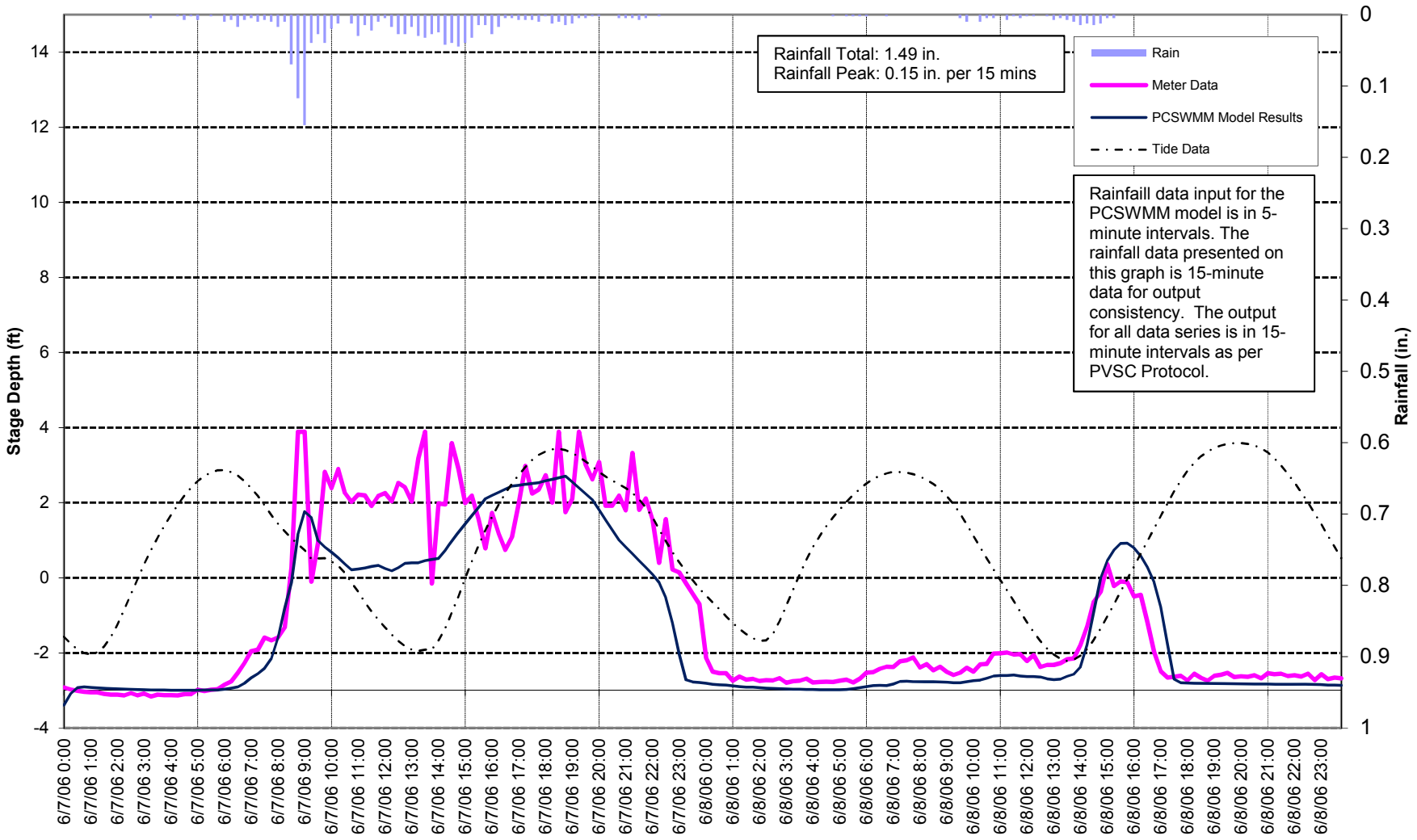

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Sewer System Characterization Report
Figure 6-19: Stage Depth at Meter A1
June 7, 2006 Storm Event
Anderson Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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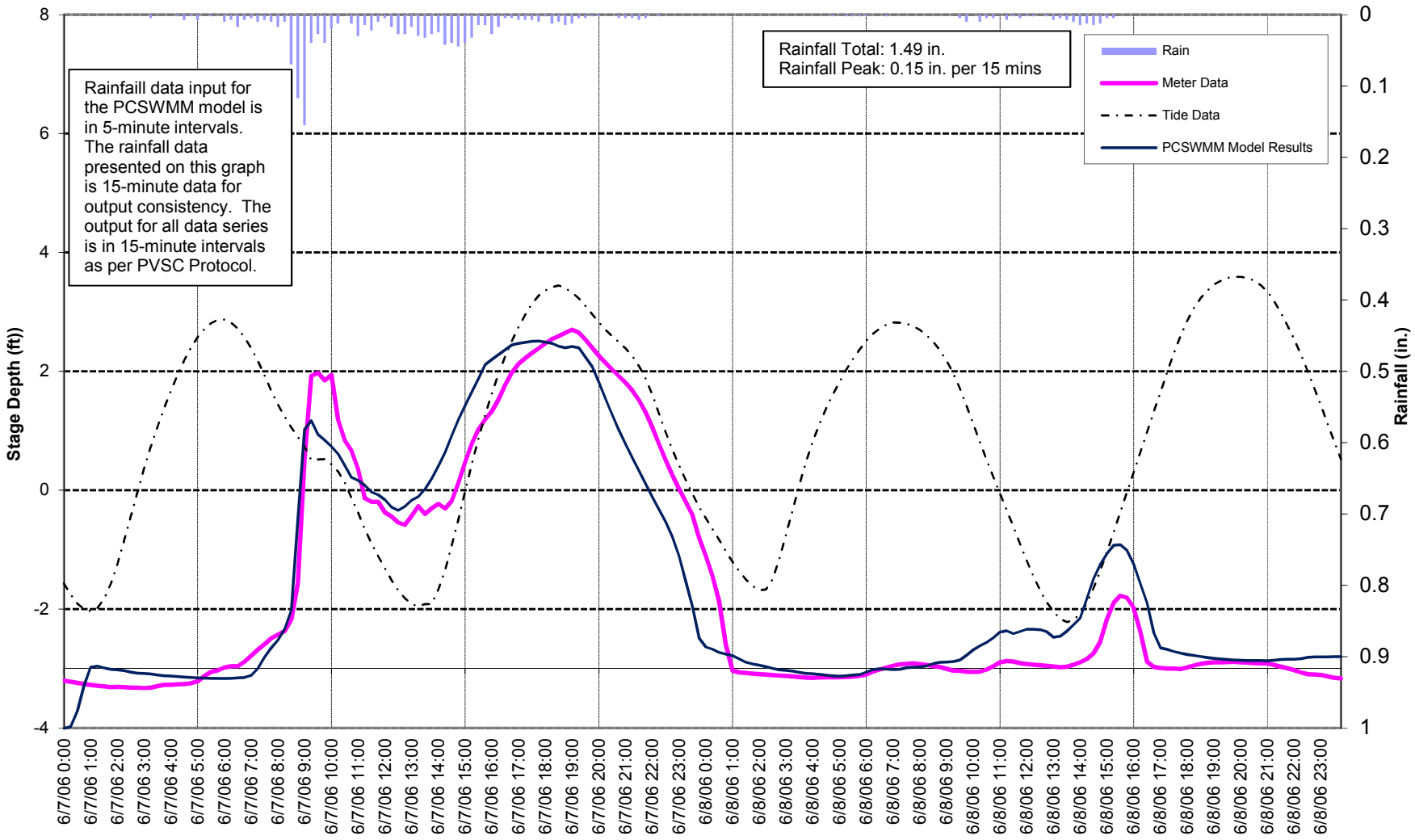

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Sewer System Characterization Report
Figure 6-20: Stage Depth at Meter C1
June 7, 2006 Storm Event
Court Subdrainage Area
Combined Sewer System Model Update

City of Hackensack

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6.5 Model Assessment

6.5.1 Calibration Evaluation

It is stressed that the interpreter of the model results examine all results considering the reality that all models are inherently imperfect, although they are the best predictive tools available when applied properly. Proper application of the model results involves interpreting the results in conjunction with the certainties and uncertainties that are quantified in the calibration reports such as this one. The model results alone should not be assessed; results should be interpreted based upon the modeling report results and on practical experiences. A model is an engineering tool that is only as effective as the individual using the tool.

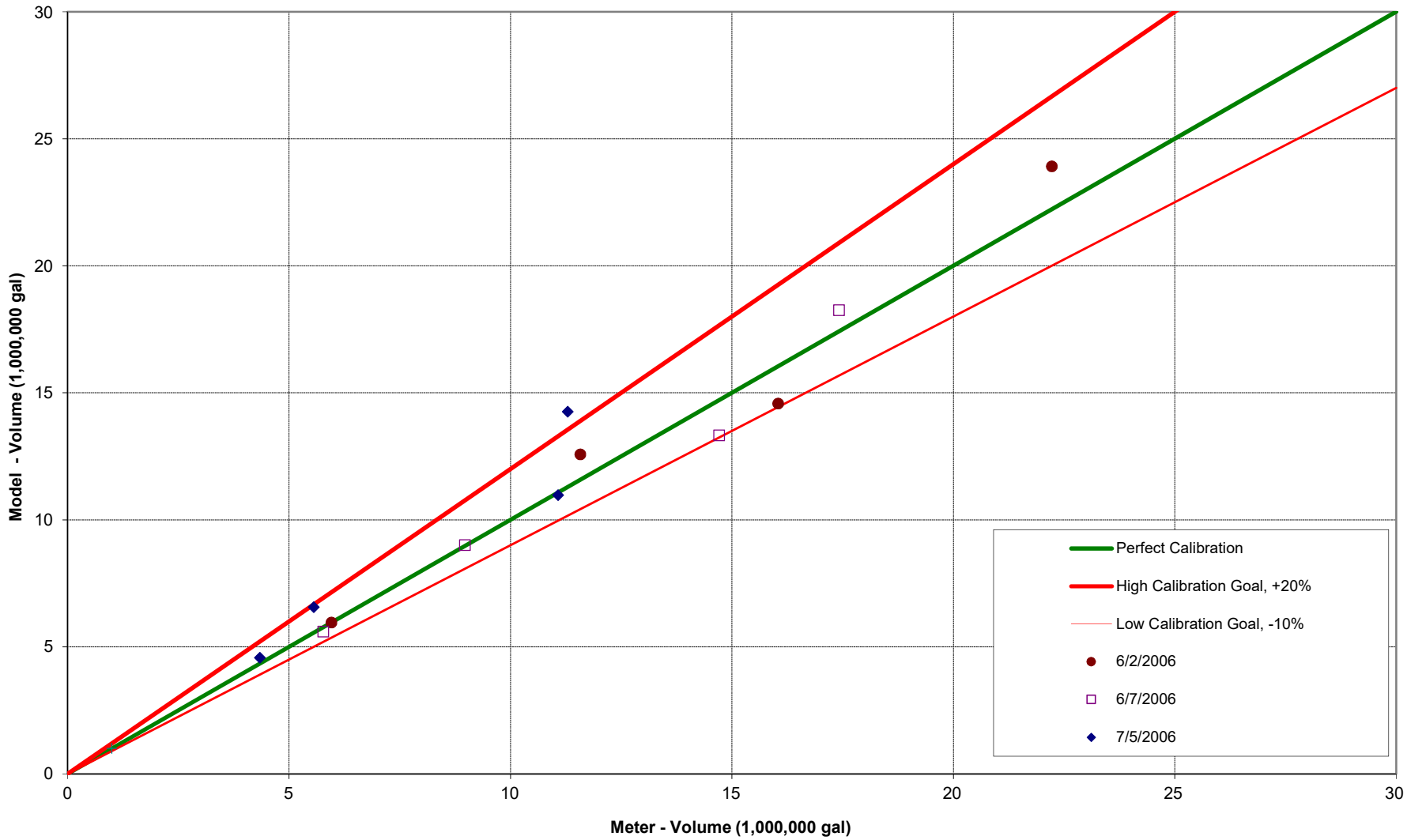
Figures 6-21 through 6-26 provide more detail regarding the distributions of the calibration results.

The distribution of the calibration results indicates the following:

- 92% and 75% of the volume and peak flow calibration observations, as presented in Figures 6-24 and 6-25, respectively, were within the targeted ranges. Due to uncertainties in the model, it can be expected that the model results be within the targeted ranges for the majority of model simulations with regard to volume and 75% of the time with regards to the peak flow observations.
- 92% of the peak flow calibration observations were within the targeted range of -15% and 25% or conservatively above 25%, as presented in Figure 6-25, which is good to assure that sizing utilizing the model will generally result in larger than needed controls as opposed to undersized.
- Three calibration event results were outside of the targeted range for peak flow as presented in Figure 6-22. Of the three events, two are conservative and one is under the low calibration goal.
- 33% of the stage depth difference calibration observations were within the targeted range of -15% and 30% as presented in Figure 6-26. Due to uncertainties in the model, it can be expected that the model results will be within the targeted range (-15% and 30%) 33% of the time with regards to the stage depth difference observations.
- Four calibration event results were outside of the targeted range (-15% and 30%) for stage depth as presented in Figure 6-23. The four results are all under the low calibration goal.

6.5.2 Sensitivity Analysis

A sensitivity analysis was performed for critical parameters to determine what parameters affect results in the model. There are many parameters within the model that can be adjusted to determine the model's sensitivity to that parameter and how the adjustment affected the results. These parameters include, but are not limited to: sediment depth, conduit roughness, subcatchment infiltration parameters, percent impervious, slope, depression storage, area, and the rating curves that represent the vortex valves that allow flow into the BCUA trunk sewer. The following sections present the results of sensitivity analyses involving several of these parameters.



ARCADIS

City of Hackensack Sewer System Characterization Study
Figure 6-21: A Comparison of Monitored versus Modeled Volume Conditions

City of Hackensack

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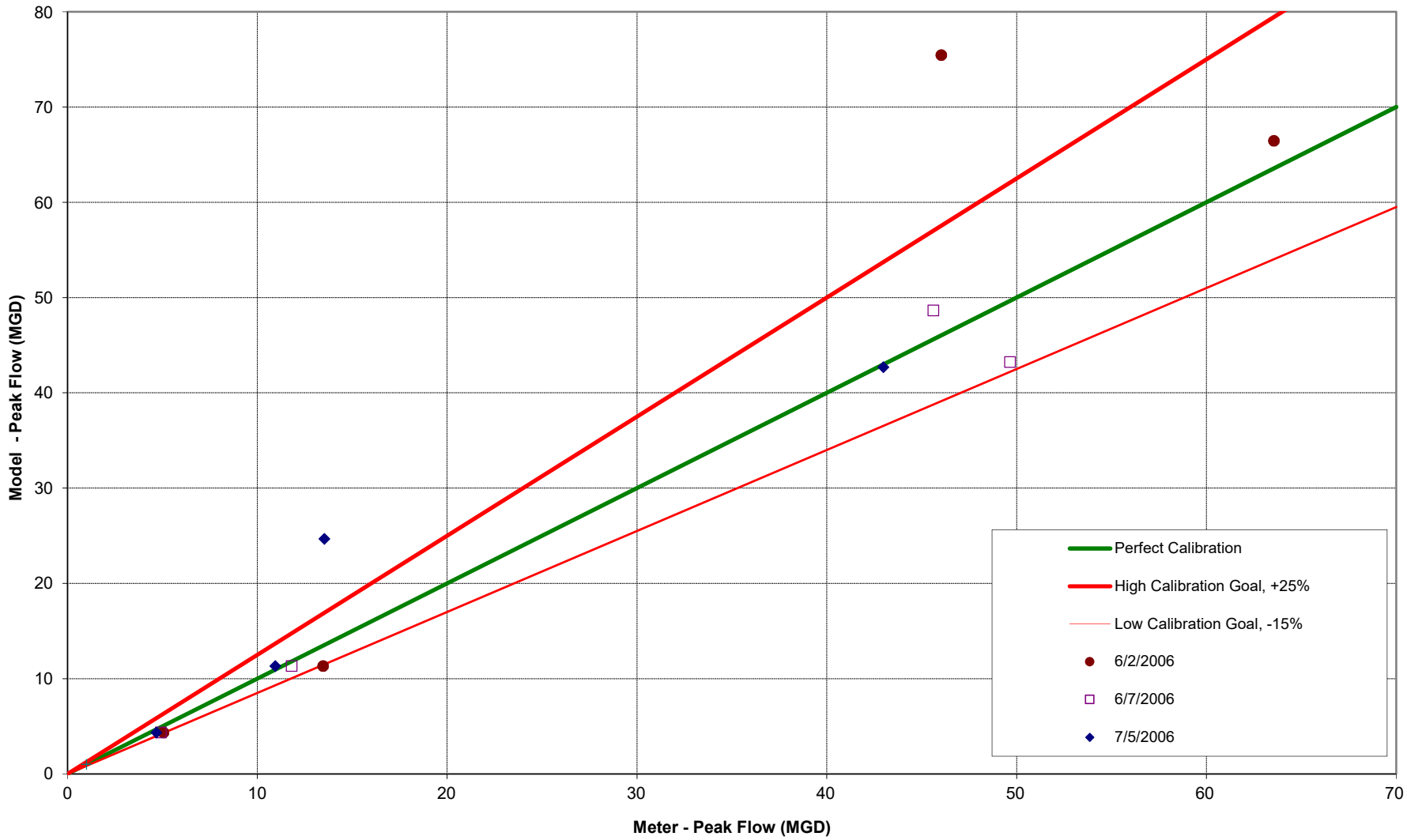

ARCADIS

City of Hackensack Sewer System Characterization Study
Figure 6-22: A Comparison of Monitored versus Modeled Flow Conditions

City of Hackensack

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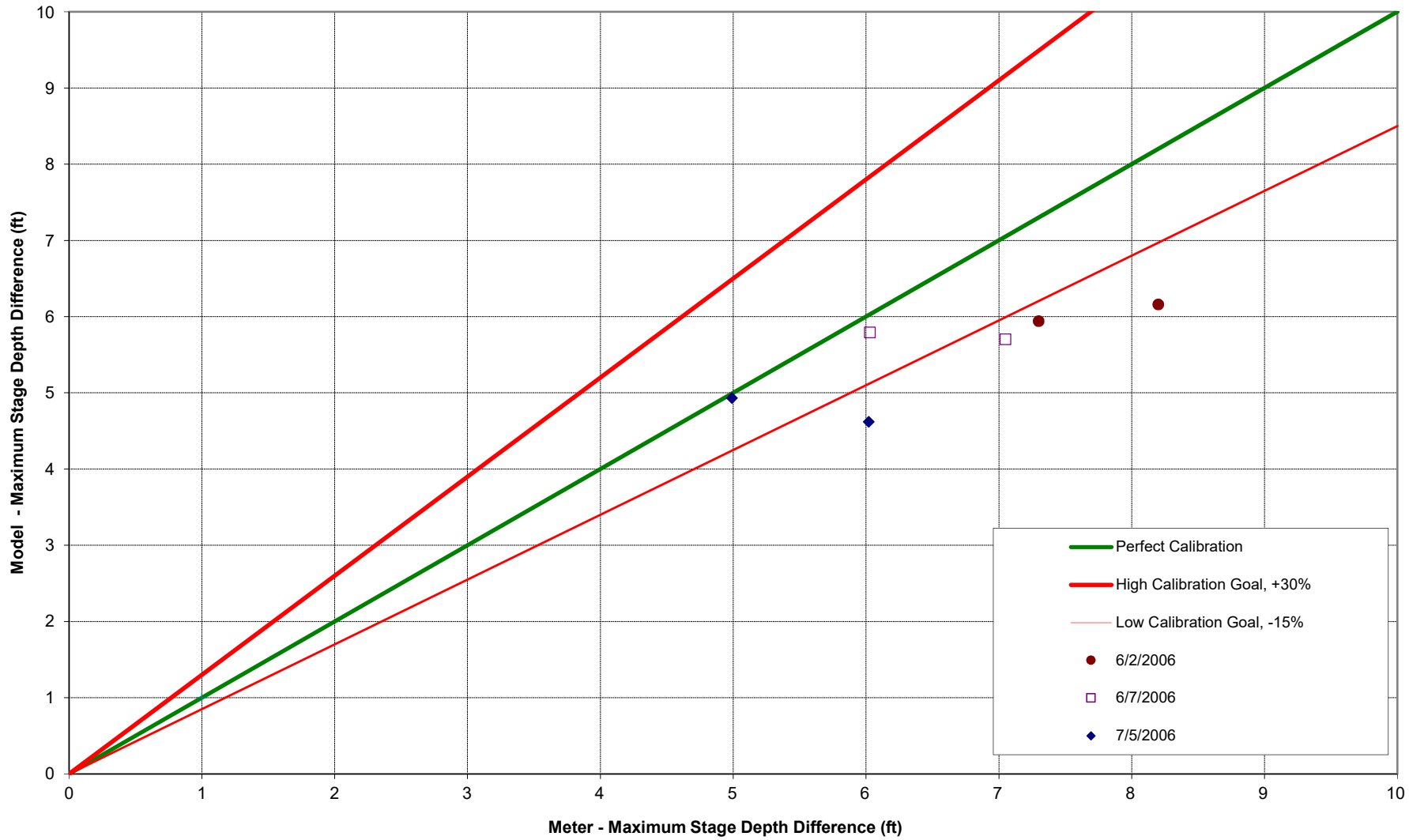

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City of Hackensack Sewer System Characterization Study
Figure 6-23: A Comparison of Monitored versus Modeled Stage Depth Conditions

City of Hackensack

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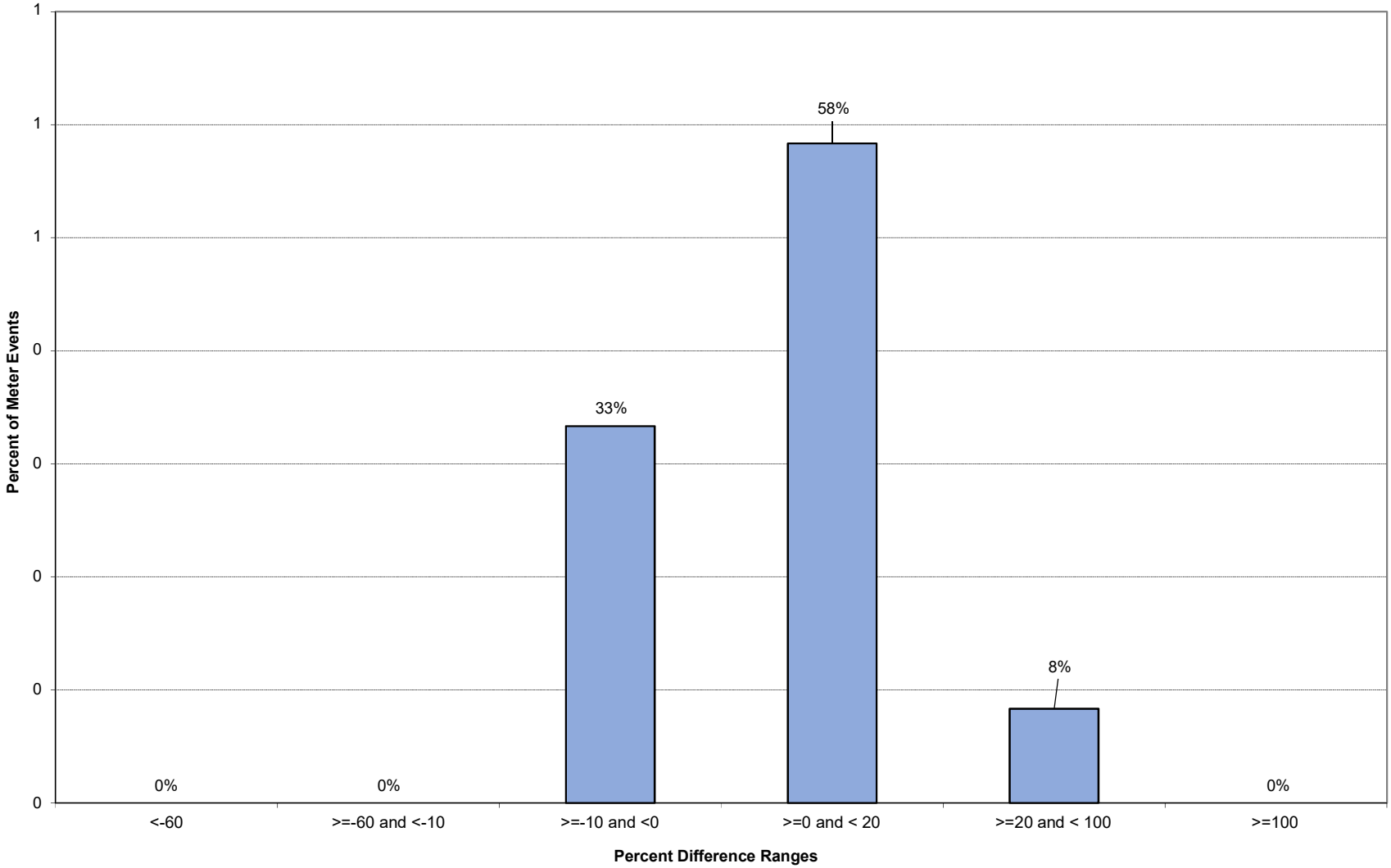
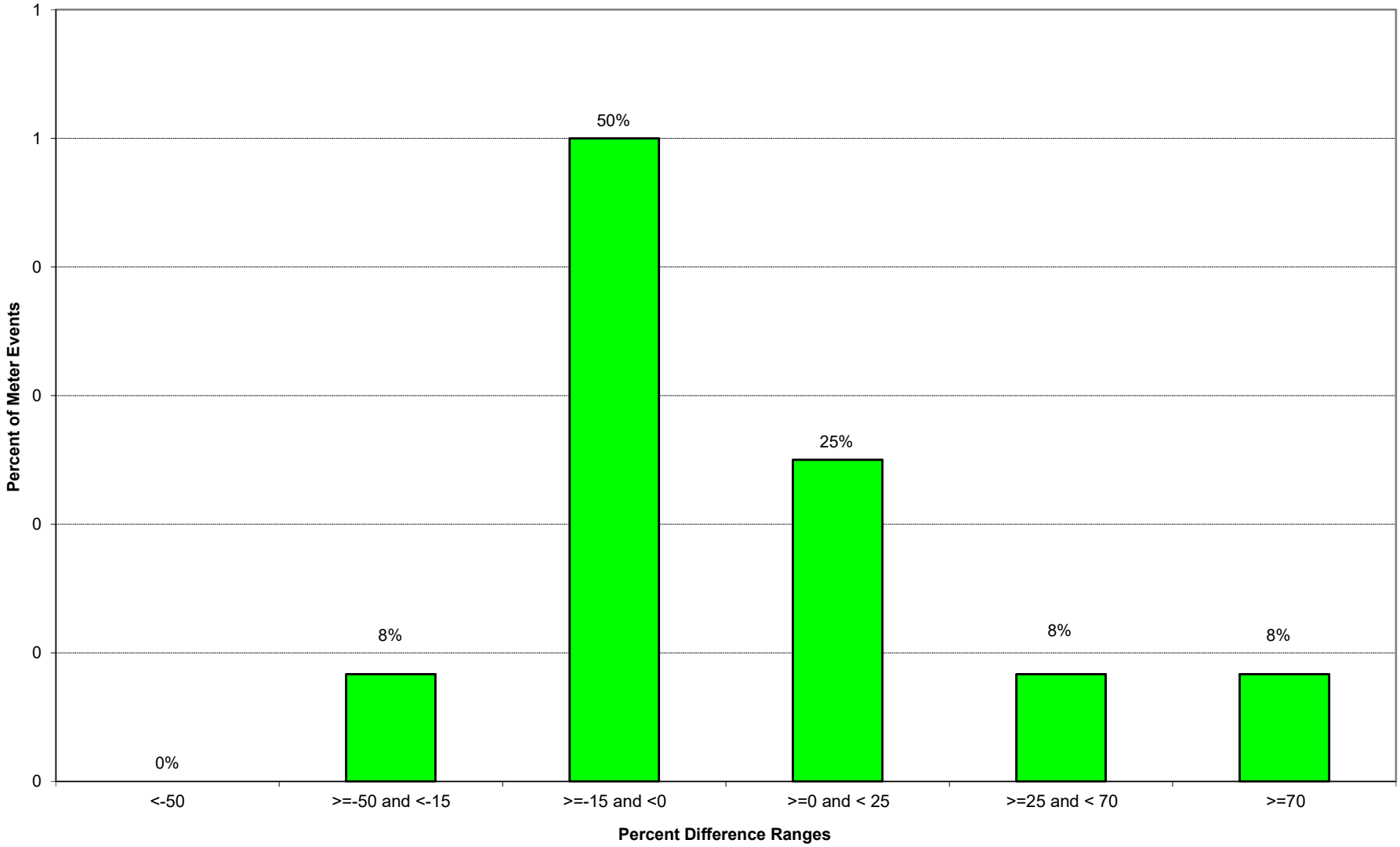


ARCADIS

City of Hackensack Sewer System Characterization Study
Figure 6-24: The Distribution of Ranges of Variation between Monitored versus Modeled Total Volume Conditions

City of Hackensack



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City of Hackensack Sewer System Characterization Study
Figure 6-25: The Distribution of Ranges of Variation between Monitored versus Modeled Peak Flow Conditions

City of Hackensack

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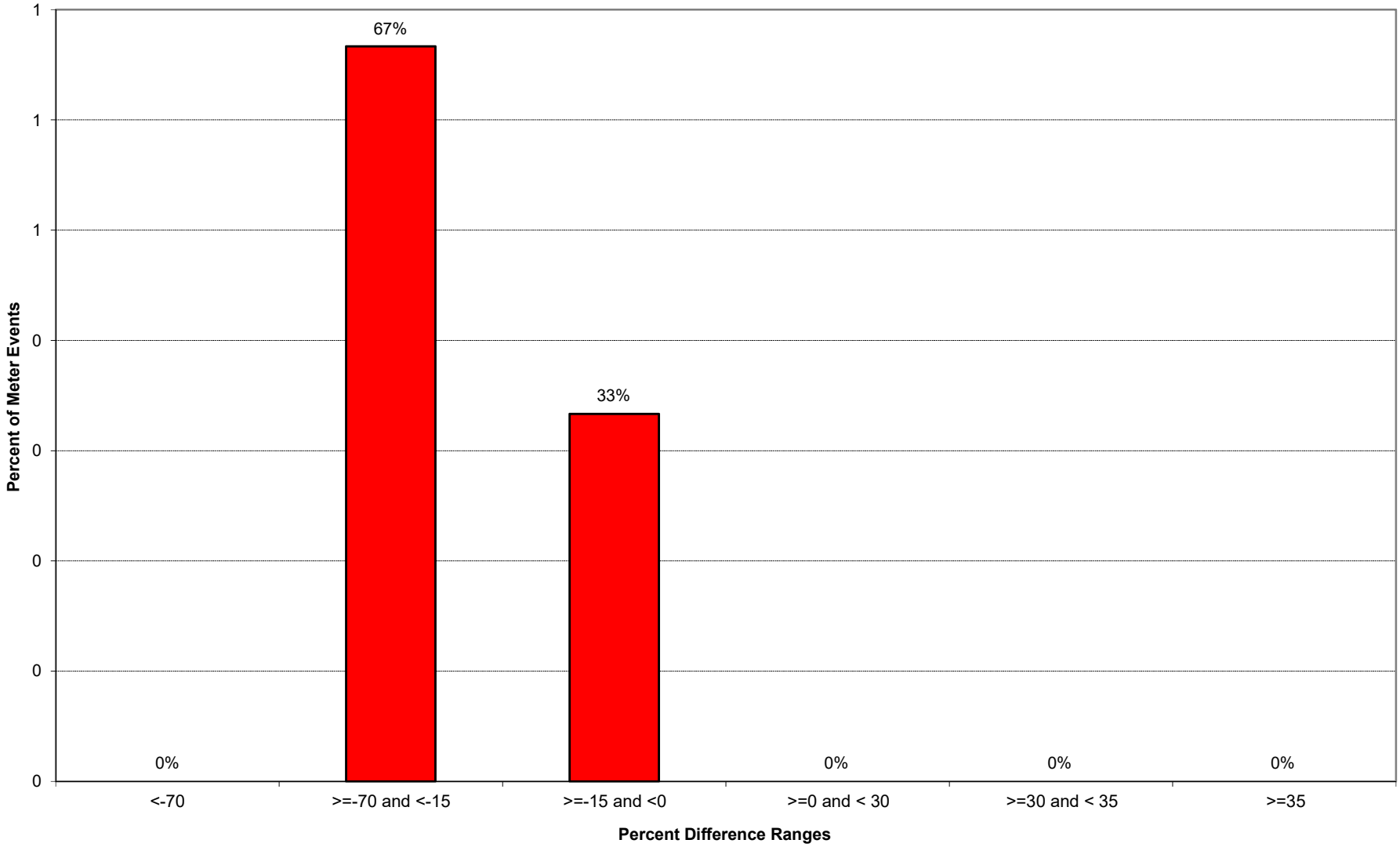

ARCADIS

City of Hackensack Sewer System Characterization Study
Figure 6-26: The Distribution of Ranges of Variation between Monitored versus Modeled Peak Stage Depth Conditions

City of Hackensack

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6.5.2.1 Vortex Valve Rating Curves

Adjusting the vortex valve rating curves dramatically changed the depth of sewage in the sewers. The rating curve adjustment was sensitive to the model's depth results, particularly in the sewers directly upstream and downstream of the vortex chambers. By decreasing the values in the rating curves, the depths also decreased. The stage depths for each storm event are presented in Figures 6-7, 6-8, 6-13, 6-14, 6-19 and 6-20. In summary, the sensitivity of the vortex valve rating curve was an important factor during the calibration of the PCSWMM model.

6.5.2.2 Percent Impervious

Percent impervious represents the amount of impervious area in a subcatchment. Each subcatchment's impervious area was hypothetically increased and decreased by 10% to further evaluate the model's sensitivity to this parameter. The June 2, 2006 storm event with 15-minute rainfall data was modeled with these conditions. In total, the change in peak flow ranged from +7.0% to -7.9% for the Anderson Street subdrainage area for the increase and decrease in percent impervious, respectively. The change in peak flow for the Court Street subdrainage area ranged from +9.9% to -17.5%. Additionally, the change in total volume for the Anderson Street subdrainage area ranged from +7.1% to -7.0%, and the change in total volume for the Court Street subdrainage area ranged from +5.8% to -5.8%. Therefore, percent impervious appears to be more sensitive to peak flows than total volume. It is unlikely that a 10% change of total impervious area across all the subcatchments would occur. In summary, the percent impervious parameter is a relatively unsensitive parameter for the model.

6.5.2.3 Subcatchment Area

Total subcatchment area was another parameter evaluated for sensitivity. As was done for the percent impervious parameter, each subcatchment's total area was hypothetically increased and decreased by 10%. The June 2, 2006 storm event was modeled with these conditions. The results were very similar to the percent impervious parameter results; in summary, the total subcatchment area parameter may be sensitive if altered in large quantities, but in reality, it is a less sensitive parameter for the model.

6.5.2.4 Conduit Roughness Coefficient

The conduit roughness coefficient was also a parameter evaluated for sensitivity. The coefficient for the model is typically set at 0.014. The roughness coefficient was increased to 0.019 and decreased to 0.009 to evaluate the sensitivity. The June 2, 2006 storm event was modeled with these conditions. The results determined that the change in peak flow ranged from -3.9% to +6.5% for the Anderson Street subdrainage area for the increase and decrease in percent impervious, respectively. The change in peak flow for the Court Street subdrainage area ranged from -19.8% to +21.9%. Additionally, the change in total volume for the Anderson Street subdrainage area ranged from -0.2% to +3.4%, and the change in total volume for the Court Street subdrainage area ranged from -4.6% to +5.7%. In summary, the roughness coefficient is more sensitive to peak flow than total volume. However, the overall effect of adjusting the roughness coefficient is minor in reality for the model.

6.5.3 Conclusions

The general conclusions of the model calibration efforts are as follows:

- The Volume calibration category is most often within the targeted range or overpredicted by the model, which is safer for most planning applications, including the Long Term Control Plan.
- The Peak Flow Rate calibration category is within the targeted range or overpredicted by the model 92% of the time. This is an adequate result for calibration, but it is to be noted that underprediction could occur approximately 8% of the time and slight caution is advised when interpreting the model results.
- Stage Depth calibration, the lowest priority goal of the three, shows that the model is most often underpredicting or within the targeted range. Caution is advised when interpreting the model results for stage depth.

7 CONSIDERATION OF SENSITIVE AREAS

The City, as part of the NJ CSO Group, contracted Greeley & Hansen and CDM Smith through the Passaic Valley Sewerage Commission (PVSC) to perform a detailed sensitive area analysis that included evaluation for the Hackensack River, which is the receiving water body of the City's CSOs. This section provides background on the Permit requirements for consideration of sensitive areas and summarizes the results of PVSC's sensitive areas analysis.

7.1 Introduction

Under Part IV Section G.3 of the City's Permit, the follow requirements, among others, are stipulated for consideration of sensitive areas:

1. The permittee must characterize CSOs from the system and identify sensitive areas that are located where CSOs occur;
2. In efforts to control and minimize overflows, the permittee must give highest priority to those overflows that affect sensitive areas; and
3. Permittee must incorporate consideration of sensitive areas into the LTCP

7.2 General Assessment

To satisfy the Permit requirements for sensitive areas on behalf of the permittees of the NJ CSO Group, PVSC has submitted a separate report detailing the results of the sensitive areas analysis, entitled *Identification of Sensitive Areas Report: CSO Long Term Control Plan* and dated June 2018. The sensitive area analysis efforts included letters to regulatory agencies, review of online resources, and observation studies to identify within the study area any Outstanding National Resource Waters (ONRW), National Marine Sanctuaries (NMS), threatened or endangered species, primary contact recreation activities, drinking water intakes, and shellfish beds. The results determined that there are no sensitive areas in proximity to the City's combined sewer outfalls. The City has reviewed and certified the sensitive areas report.

8 CSO ANALYSIS AND 2004 TYPICAL YEAR SIMULATION

The City, along with other CSS permittees in the region, contracted PVSC to perform an analysis to select a typical rainfall year that is representative of rainfall events in the region. The results of the analysis are presented in PVSC's report *Typical Hydrologic Year Report*, dated May 2018. A summary of the analysis is provided in the paragraphs that follow.

To determine the typical hydrologic year, PVSC reviewed the rainfall records from Newark's Liberty International Airport for the period between 1970 and 2015. Hourly precipitation from the NCDC gauge, 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 several factors. These factors were selected based on requirements of the presumptive approach and the demonstrative approach, as well as potential operations and maintenance concerns. Those factors and their weights are shown in Table 8-1.

Table 8-1. Criteria for Typical Year Analysis

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 POTW capacity	**5%**
Rainfall volume for 85% captured	Determining max storage capacity or POTW 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.

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 year 2014, which was

ranked second in the weighted ranking analysis, was also close to the average but was eliminated due to the presence of a ten-year storm. The year 2004 was selected and approved by NJDEP as the typical year. The City of Hackensack certified PVSC's *Typical Hydrologic Year Report*.

Table 8-2 provides a summary of the rainfall characteristics for 2004 in comparison to the historic average for the parameters presented in Table 8-1. Table 8-3 shows characteristics of the 20 rainfall events with the highest depths for the year 2004.

Table 8-2. Summary of the Recommended Typical Rainfall Year – 2004

Parameter	2004 Characteristic	Average	Percent Difference
Annual precipitation* (inches)	48.37	46.27	4.5%
Number of events ≥ 0.2 inches rainfall depth	54	51.2	5%
Number of events ≥ 0.1 inches rainfall depth	73	66	11%
5th largest storm volume (inches)	1.63	1.70	-5%
Rainfall volume for 85% capture (inches)	1.18	1.35	-1.18
Number of back-to-back storm events	12	10.5	14%
Maximum peak intensity of 5th largest storm & smaller (in/hr)	0.99	0.90	9.5%
Extreme storms	2 1-year storms 1 2-year storm	N/A	N/A
Average rainfall duration (hrs)	10.3	10.8	-4.8%
Average rainfall intensity (in/hr)	0.084	0.081	3.8%

*Note: Includes snowfall
N/A = Not applicable
Source: Typical Hydrologic Year Report, Passaic Valley Sewerage Commission (May 2018)

Table 8-3. Top 20 Rainfall Events in 2004 by Depth

Event #	Event Start	Duration (hr)	Precipitation Depth (in)	Max Rainfall Intensity (in/hr)	Average Rainfall Intensity (in/hr)	Return Frequency
1	09/28/2004 1:00	28	3.68	0.53	0.13	2-yr – 24 hr
2	09/08/2004 4:00	25	2.21	0.63	0.09	1-yr – 6 hr
3	07/12/2004 9:00	27	1.99	0.32	0.07	
4	04/12/2004 17:00	30	1.67	0.25	0.06	
5	04/25/2004 14:00	35	1.67	0.25	0.05	
6	07/23/2004 10:00	24	1.66	0.33	0.07	
7	02/06/2004 5:00	33	1.63	0.33	0.05	
8	07/18/2004 16:00	14	1.60	0.64	0.11	
9	11/28/2004 2:00	12	1.50	0.85	0.13	
10	07/27/2004 15:00	18	1.45	0.41	0.08	
11	09/17/2004 22:00	12	1.44	1.33	0.12	1-yr – 2 hr 2-yr – 1 hr
12	06/25/2004 17:00	5	1.39	0.40	0.28	
13	11/12/2004 7:00	23	1.08	0.10	0.05	
14	05/12/2004 16:00	2	1.08	0.99	0.54	
15	11/04/2004 14:00	16	1.03	0.20	0.06	
16	07/05/2004 3:00	12	1.00	0.69	0.08	
17	12/01/2004 4:00	10	1.00	0.18	0.10	
18	08/16/2004 0:00	21	0.94	0.60	0.04	
19	08/21/2004 14:00	3	0.84	0.81	0.28	
20	12/06/2004 12:00	39	0.83	0.20	0.02	

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

PVSC provided a five-minute rainfall data set for 2004 for use in analysis of the typical year. The updated, calibrated model was run using the provided dataset. It should be noted that several of the precipitation events in the 2004 precipitation dataset consisted of snowfall, which are not rainfall events that produce runoff. Snowfall does not behave like a true rainfall event that produces enough runoff to produce overflows. Instead, snowfall releases the runoff slowly during the snowmelt process, which does not

produce overflows and is captured by the POTW. Therefore, the precipitation events on January 15, 2004 and March 16 through March 18, 2004, which consisted of snowfall, were modeled as zero rainfall events.

Overflow volumes and wasteload calculations were completed for the following parameters at each of the City's two outfalls: carbonaceous biochemical oxygen demand (CBOD), total Kjeldahl nitrogen (TKN), total phosphorous (TP), total nitrogen (TN), total suspended solids (TSS), fecal coliform, and Enterococci. Wet weather water quality data from the 2006 monitoring program was analyzed at each of the two outfalls; average pollutant concentration values were determined from the 2006 data, and overflow volumes from the model run were used to estimate the pollutant wasteloads from each of the outfalls. Tables 8-4 and 8-5 show the monthly overflow volume and wasteload results for the Anderson and Court Street facilities, respectively. A table showing the daily overflow volume and wasteload results for both facilities is included in Appendix F.

Table 8-4. Anderson Street Typical Year Simulation Results & Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Over-flow**	**Volume (MG)**	**% of Annual Volume**	**Fecal**	**Enterococci**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
Jan.	4	1.65	1.6%	1.21E+14	7.32E+13	1,050.6	745.4	27.4	756.6	1,182.3
Feb.	2	6.03	5.7%	4.43E+14	2.68E+14	3,848.6	2,730.7	100.2	2,771.6	4,331.1
March	5	1.42	1.3%	1.04E+14	6.30E+13	903.6	641.1	23.5	650.7	1,016.9
April	7	9.21	8.7%	6.76E+14	4.09E+14	5,873.3	4,167.2	153.0	4,229.6	6,609.5
May	11	9.07	8.6%	6.67E+14	4.04E+14	5,788.8	4,107.3	150.8	4,168.8	6,514.5
June	6	6.93	6.6%	5.09E+14	3.08E+14	4,420.7	3,136.6	115.1	3,183.6	4,974.9
July	9	23.27	22.1%	1.71E+15	1.03E+15	14,846.0	10,533.6	386.7	10,691.4	16,707.1
Aug.	8	8.60	8.2%	6.32E+14	3.83E+14	5,489.1	3,894.7	143.0	3,953.0	6,177.2
Sept.	7	23.48	22.3%	1.72E+15	1.04E+15	14,976.3	10,626.1	390.1	10,785.2	16,853.7
Oct.	3	0.79	0.7%	5.79E+13	3.51E+13	503.0	356.9	13.1	362.3	566.1
Nov.	8	9.31	8.8%	6.84E+14	4.14E+14	5,938.7	4,213.6	154.7	4,276.7	6,683.1
Dec.	6	5.69	5.4%	4.18E+14	2.53E+14	3,628.1	2,574.3	94.5	2,612.8	4,082.9
Annual	76	105.45	1	7.75E+15	4.69E+15	67,266.8	47,727.6	1,752.0	48,442.4	75,699.3

Note: For pollutant loadings, Fecal and Enterococci are in most-probably number (MPN) units, while all remaining numbers are in pounds.

Table 8-5. Court Street Typical Year Simulation Results and Wasteloads

	Total (All CSO Events)			Pollutant Loadings						
Month	**Days of Overflow**	**Volume (MG)**	**% of Annual Volume**	**Fecal**	**Enterococci**	**CBOD**	**TKN**	**TP**	**TN**	**TSS**
January	3	1.97	1.3%	1.41E+14	8.31E+13	1,177.2	190.8	32.2	179.1	2,116.9
February	3	10.22	6.7%	7.33E+14	4.30E+14	6,096.6	987.9	167.0	927.5	10,963.1
March	7	1.67	1.1%	1.19E+14	7.01E+13	994.0	161.1	27.2	151.2	1,787.4
April	7	14.57	9.6%	1.04E+15	6.13E+14	8,691.5	1,408.4	238.1	1,322.3	15,629.2
May	10	11.11	7.3%	7.96E+14	4.68E+14	6,627.6	1,073.9	181.5	1,008.3	11,917.8
June	7	9.24	6.1%	6.62E+14	3.89E+14	5,509.9	892.8	150.9	838.2	9,907.9
July	10	34.84	23.0%	2.50E+15	1.47E+15	20,785.0	3,368.0	569.3	3,162.1	37,375.9
August	7	11.57	7.6%	8.29E+14	4.87E+14	6,902.7	1,118.5	189.1	1,050.1	12,412.5
September	6	32.28	21.3%	2.31E+15	1.36E+15	19,258.3	3,120.6	527.5	2,929.8	34,630.6
October	3	0.96	0.6%	6.91E+13	4.06E+13	575.0	93.2	15.7	87.5	1,033.9
November	7	13.72	9.1%	9.84E+14	5.78E+14	8,185.3	1,326.3	224.2	1,245.2	14,718.8
December	6	9.31	6.1%	6.67E+14	3.92E+14	5,554.1	900.0	152.1	845.0	9,987.5
Annual	76	151.47	100.0%	1.09E+16	6.38E+15	90,357.1	14,641.5	2,475.1	13,746.2	162,481.5

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

9 RECOMMENDATIONS

In accordance with its Permit No. NJ0108766 for Combined Sewer Management, the City has employed a calibrated model, prepared this Characterization Report, prepared the separately submitted PPP Report, and coordinated with PVSC for analysis of sensitive areas and typical rainfall year analysis. The next stage in the LTCP process involves development of a list of control measure alternatives for the City's CSS and evaluation of the feasibility of the alternatives, culminating in submission of the Development and Evaluation of Alternatives Report to NJDEP by July 1, 2019. This step will require continued coordination with BCUA, Ridgefield Park, and Fort Lee; therefore, it is recommended that a preliminary list of alternatives under consideration be presented to the hydraulically connected communities by the end of 2018.

It is also recommended that the City continue to keep up-to-date records on sewer maintenance and upgrade projects as the LTCP is developed, and to update and recalibrate the PCSWMM CSS model as needed to reflect improvements to the CSS.

APPENDIX A

2006 Rain Gauge Monitoring Data (CD)

APPENDIX B

2006 Flow Meter Monitoring Data (CD)

APPENDIX C

2006 Tide Data (CD)

APPENDIX D

2006 Water Quality Sampling Data (CD)

APPENDIX E

Model Hydraulic Component Tables: Manholes and Conduits

Inlet Node	Outlet Node	Length (ft)	Roughness	Cross-Section	Size / Diameter (ft)	Width (ft)	Slope (ft/ft)
AMH1014T1	AMH1015T1	263	0.014	EGG	3	0	0.00499
AMH1015T1	AMH1115T1	243	0.014	EGG	3	0	0.00658
AMH1078Q6	AMH1079Q6	99	0.014	EGG	4	0	0.0004
AMH1079Q6	AMH1080Q6	101	0.014	EGG	4	0	0.00258
AMH1080Q6	AMH1081Q6	101	0.014	EGG	4	0	0.00385
AMH1081Q6	Ghost4	50	0.014	EGG	4	0	0.0018
AMH1082Q6	AMH1792Q7	200	0.014	EGG	4	0	0.0005
AMH1083R2	AMH1084R2	93	0.014	EGG	2.5	0	0.00602
AMH1084R2	AMH1085R2	101	0.014	EGG	3	0	0.00911
AMH1085R2	AMH1086R2	101	0.014	EGG	3	0	0.00446
AMH1086R2	AMH1087R2	87	0.014	EGG	4	0	0.0092
AMH1087R2	AMH1088R2	100	0.014	EGG	4	0	0.0049
AMH1088R2	AMH1089R2	100	0.014	EGG	4	0	0.0077
AMH1089R2	AMH1090R2	100	0.014	EGG	4	0	0.0069
AMH1090R2	AMH1091R2	100	0.014	EGG	4	0	0.0069
AMH1091R2	AMH1792Q7	94	0.014	EGG	4	0	0.00532
AMH1111T1	AMH1112T1	200	0.014	EGG	4.33	0	0.0008
AMH1112T1	AMH1113T1	238	0.014	EGG	4.33	0	0.00193
AMH1113T1	AMH1114T1	233	0.014	EGG	5	0	0.00189
AMH1114T1	AMH1115T1	126	0.014	EGG	5	0	0.00546
AMH1115T1	AMH1116T1	96	0.014	EGG	5	0	-0.00177
AMH1116T1	AMH1117T1	207	0.014	EGG	5	0	0.00189
AMH1117T1	AMH1118T1	232	0.014	EGG	5	0	0.00073
AMH1118T1	AMH1119T1	231	0.014	EGG	5	0	0.00208
AMH1119T1	AMH1120Q7	219	0.014	EGG	5	0	0.00146
AMH1120Q7	AMH1818Q7	272	0.014	EGG	5	0	0.0007
AMH113N1	AMH114N1	217	0.014	EGG	3	0	0.00572
AMH114N1	AMH115N1	223	0.014	EGG	3	0	0.00412
AMH1150Q6	AMH167Q6	36	0.014	CIRCULAR	1.5	0	0.00168
AMH1152Q6	AMH1150Q6	196	0.014	CIRCULAR	1.5	0	0.00138
AMH115N1	AMH116N1	224	0.014	EGG	3	0	0.00545
AMH1162Q6	AMH1749Q6	42	0.014	CIRCULAR	2	0	0.03454
AMH1163Q6	AMH1162Q6	56	0.014	CIRCULAR	2	0	0.05166
AMH116N1	AMH117N1	223	0.014	EGG	3	0	0.00461
AMH117N1	AMH118N1	326	0.014	EGG	3	0	0.00458
AMH118N1	AMH439N1	193	0.014	EGG	3	0	0.00419
AMH136Q5	AMH137Q5	244	0.014	CIRCULAR	2	0	0.01665
AMH137Q5	AMHA2071Q5	175	0.014	CIRCULAR	3	0	0.05944
AMH138Q5	AMH139Q5	100	0.014	EGG	2.5	0	0.04685
AMH139Q5	AMH140Q5	100	0.014	EGG	2.5	0	0.0405
AMH140Q5	AMH141Q5	100	0.014	EGG	2.5	0	0.05608
AMH141Q5	AMH142Q5	60	0.014	EGG	2.5	0	0.04361
AMH142Q5	AMH143Q5	40	0.014	EGG	2.5	0	0.03082
AMH143Q5	AMH144Q5	100	0.014	EGG	2.5	0	0.02483
AMH144Q5	AMH145Q5	100	0.014	EGG	2.5	0	0.01597
AMH145Q5	AMH146Q5	101	0.014	EGG	2.5	0	0.00984
AMH146Q5	AMH147Q5	99	0.014	EGG	2.5	0	0.00966
AMH147Q5	AMH148Q5	100	0.01	EGG	2.5	0	0.01477
AMH148Q5	AMH149Q5	100	0.014	EGG	2.5	0	0.0132
AMH149Q5	AMH150Q5	99	0.014	EGG	2.5	0	0.00715
AMH150Q5	AMH151Q5	101	0.014	EGG	2.5	0	0.01241
AMH151Q5	AMH152Q5	100	0.014	EGG	2.5	0	0.01376
AMH152Q5	AMH153Q5	100	0.014	EGG	2.5	0	0.012
AMH153Q5	AMH154Q5	101	0.014	EGG	2.5	0	0.01172
AMH154Q5	AMH155Q5	100	0.014	EGG	2.5	0	0.00722
AMH155Q5	Ghost32	50	0.014	EGG	2.5	0	-0.0024
AMH156Q5	AMH157Q5	100	0.014	EGG	4	0	0.00369

Inlet Node	Outlet Node	Length (ft)	Roughness	Cross-Section	Size / Diameter (ft)	Width (ft)	Slope (ft/ft)
AMH157Q5	AMH158Q5	100	0.014	EGG	4	0	0.00511
AMH158Q5	AMH159Q5	99	0.014	EGG	4	0	0.00081
AMH159Q5	AMH160Q5	100	0.014	EGG	4	0	0.00141
AMH160Q5	AMH161Q5	101	0.014	EGG	4	0	0.00179
AMH161Q5	AMH162Q5	96	0.014	EGG	4	0	0.00555
AMH162Q5	AMH163Q6	100	0.014	EGG	4	0	0.0009
AMH163Q6	AMH164Q6	100	0.014	EGG	4	0	0.001
AMH164Q6	AMH165Q6	100	0.014	EGG	4	0	0.0009
AMH165Q6	AMH166Q6	100	0.014	EGG	4	0	0.001
AMH166Q6	AMH167Q6	103	0.014	EGG	4	0	0.00175
AMH167Q6	AMH168Q6	64	0.014	EGG	4	0	0.00661
AMH168Q6	AMH169Q6	74	0.014	EGG	4	0	0.00484
AMH169Q6	AMH170Q6	101	0.014	EGG	4	0	0.00494
AMH170Q6	AMH171Q6	110	0.014	EGG	4	0	0.00118
AMH171Q6	AMH1749Q6	61	0.014	EGG	4	0	0.02007
AMH1749Q6	AMH1078Q6	33	0.014	EGG	4	0	0.00092
AMH1750Q6	AMH1749Q6	19	0.014	CIRCULAR	1.25	0	0.02032
AMH1751BQ6	AMH1751Q6	189	0.014	CIRCULAR	2	0	0.0153
AMH1751Q6	AMH1750Q6	27	0.014	CIRCULAR	1.25	0	0.14771
AMH1788Q7	AMH1797Q7	163	0.014	RECT_CLOSED	7	8	0.00098
AMH1792Q7	AMH1793Q7	88	0.014	EGG	5	0	0.00341
AMH1793Q7	AMH1794Q7	105	0.014	EGG	5	0	0.0019
AMH1794Q7	AMH1795Q7	95	0.014	EGG	5	0	0
AMH1795Q7	AMH1796Q7	100	0.014	EGG	5	0	0
AMH1796Q7	AMH1821Q7	75	0.014	EGG	5	0	0.00667
AMH1797Q7	DivChmb	88	0.014	RECT_CLOSED	7	8	0
AMH1818Q7	AMH1819Q7	106	0.014	EGG	5	0	0.00573
AMH1819Q7	AMH1820Q7	209	0.014	EGG	5	0	0.00153
AMH1820Q7	AMH1821Q7	111	0.014	EGG	5	0	-0.00018
AMH1821Q7	AMH1788Q7	290	0.014	CIRCULAR	5	0	0.00241
AMH226Q1	AMH481R1	185	0.014	EGG	2.25	0	0.0027
AMH261Q1	AMH262Q1	177	0.014	EGG	2.25	0	0.0026
AMH262Q1	AMH263Q1	178	0.014	EGG	2.25	0	0.00303
AMH263Q1	AMH264Q1	179	0.014	EGG	2.25	0	0.0033
AMH264Q1	AMH265Q1	177	0.014	EGG	2.25	0	0.00288
AMH265Q1	AMH226Q1	175	0.014	EGG	2.25	0	0.00217
AMH417H2	AMH418H2	156	0.014	EGG	3.5	0	0.00109
AMH418H2	AMH419H2	165	0.014	EGG	3.5	0	0.00249
AMH419H2	AMH420K1	154	0.014	EGG	3.5	0	0.00221
AMH420K1	AMH422G1	186	0.014	EGG	4	0	0.0036
AMH422G1	AMH426G1	164	0.014	EGG	4	0	0.0014
AMH426G1	AMH427L1	180	0.014	EGG	4	0	0.00116
AMH427L1	AMH428L1	145	0.014	EGG	4	0	0.00179
AMH428L1	AMH429L1	218	0.014	EGG	4	0	0.00133
AMH429L1	AMH1111T1	209	0.014	EGG	4.33	0	0.00206
AMH439N1	AMH440N1	194	0.014	EGG	3	0	0.00473
AMH440N1	AMH441N1	193	0.014	EGG	3	0	0.00457
AMH441N1	AMH1014T1	193	0.014	EGG	3	0	0.0041
AMH481R1	AMH482R1	183	0.014	EGG	2.25	0	0.00208
AMH482R1	AMH483R1	183	0.014	EGG	2.25	0	0.00377
AMH483R1	AMH485R1	188	0.014	EGG	2.25	0	0.00191
AMH485R1	AMH486R1	166	0.014	EGG	2	0	0.0523
AMH486R1	AMH487R1	153	0.014	EGG	2	0	0.05006
AMH487R1	AMH491R1	125	0.014	EGG	2	0	0.01832
AMH491R1	AMH493R1	50	0.014	EGG	2	0	0.0198
AMH493R1	AMH494R1	100	0.014	EGG	2.5	0	0.0099
AMH494R1	AMH1083R2	200	0.014	EGG	2.5	0	0.00975

Inlet Node	Outlet Node	Length (ft)	Roughness	Cross-Section	Size / Diameter (ft)	Width (ft)	Slope (ft/ft)
AMH58H1	AMH59H2	208	0.014	EGG	2	0	0.00374
AMH59H2	AMH60H2	209	0.014	EGG	2	0	0.00459
AMH60H2	AMH61H2	197	0.014	EGG	2	0	0.03264
AMH61H2	AMH62H2	70	0.014	EGG	2.5	0	0.00285
AMH62AH2	AMH63H2	123	0.014	EGG	3	0	0.01541
AMH62H2	AMH62AH2	118	0.014	EGG	2.67	0	0.00195
AMH63H2	AMH417H2	174	0.01	CIRCULAR	3	0	0.00571
AMH658Q5	Ghost32	104	0.014	CIRCULAR	2	0	0.00402
AMH659Q5	AMH658Q5	100	0.014	CIRCULAR	2	0	-0.0009
AMH660U2	AMH659Q5	101	0.014	CIRCULAR	2	0	0
AMH661U2	AMH660U2	79	0.014	CIRCULAR	2	0	0.00481
AMH662U2	AMH661U2	100	0.014	CIRCULAR	2	0	0.00281
AMH663U2	AMH662U2	100	0.014	CIRCULAR	2	0	0.00331
AMH664U2	AMH663U2	101	0.014	CIRCULAR	1.5	0	0.00218
AMH665U2	AMH664U2	100	0.014	CIRCULAR	1.5	0	-0.0005
AMH666U2	AMH665U2	100	0.014	CIRCULAR	1.5	0	0.0008
AMHA2071Q5	AMH138Q5	76	0.014	CIRCULAR	3	0	0.06008
BCUA9A	J1	2252	0.014	CIRCULAR	8	0	0.00011
BCUA9B	BCUA9A	1933	0.014	CIRCULAR	8	0	0.00023
BCUA9C	BCUANode1	825	0.014	CIRCULAR	8	0	0.00018
BCUAMeterChamber	BCUANode1	10	0.014	CIRCULAR	2	0	0.003
BCUANode1	BCUA9B	940	0.014	CIRCULAR	8	0	0.00033
CMH1136U3	CMH588U1	164	0.014	CIRCULAR	2	0	0.00159
CMH1137U3	CMH1136U3	149	0.014	CIRCULAR	2	0	0.00302
CMH1138U3	CMH1137U3	151	0.014	CIRCULAR	2	0	0.00305
CMH1139U3	CMH1138U3	137	0.014	CIRCULAR	2	0	0.00307
CMH1140U3	CMH1139U3	136	0.014	CIRCULAR	2	0	0.00096
CMH1192U4	CMH1219V4	301	0.014	EGG	3.7	0	0.00531
CMH1211V4	CMH1212V4	125	0.014	RECT_CLOSED	3.5	5	0.0024
CMH1212AV4	CMH1213V4	127	0.014	RECT_CLOSED	3.5	5	0.00016
CMH1212V4	CMH1212AV4	127	0.014	RECT_CLOSED	3.5	5	0.00111
CMH1213V4	CMH1214X2	119	0.014	RECT_CLOSED	3.5	5	0.00193
CMH1214X2	CMH1215X2	50	0.014	RECT_CLOSED	3.5	5	0.0044
CMH1215X2	CMH1216X2	175	0.014	EGG	3	0	0.00126
CMH1216X2	Ghost23	187	0.014	EGG	3	0	-0.00027
CMH1217X2	CMH1218X2	348	0.014	RECT_CLOSED	4	5	0.00149
CMH1218X2	CMH1236X2	262	0.014	RECT_CLOSED	4	5	0.00145
CMH1219V4	CMH1220V4	100	0.014	EGG	3.7	0	0.0021
CMH1220V4	Ghost26	50	0.014	EGG	3.7	0	0.0014
CMH1221V4	CMH1222V4	98	0.014	EGG	3.7	0	0.00203
CMH1222V4	CMH1223V4	100	0.014	EGG	3.7	0	0.00432
CMH1223V4	CMH1224V4	98	0.014	EGG	3.7	0	0.00224
CMH1224V4	CMH1225V4	103	0.014	EGG	3.7	0	0.00652
CMH1225V4	CMH1226V4	99	0.014	EGG	3.7	0	0.00332
CMH1226V4	CMH1227V4	100	0.014	EGG	3.7	0	0.00569
CMH1227V4	CMH1228V4	102	0.014	EGG	3.7	0	0.00362
CMH1228V4	CMH1229V4	99	0.014	EGG	3.7	0	0.00524
CMH1229V4	CMH1230V4	101	0.014	EGG	3.7	0	0.00406
CMH1230V4	CMH1231V4	100	0.014	EGG	3.7	0	0.00291
CMH1231V4	CMH1232V4	94	0.014	EGG	3.7	0	0.00139
CMH1232V4	CMH1258V4	126	0.014	EGG	3.7	0	0.00469
CMH1233V4	CMH1258V4	108	0.014	EGG	3	0	0.00316
CMH1234V4	CMH1233V4	100	0.014	EGG	3	0	0.00279
CMH1236X2	CMH1860X2	965	0.014	RECT_CLOSED	4	5	0.00115
CMH1252V4	Ghost29	37	0.014	EGG	3.7	0	0.00054
CMH1253V4	CMH1252V4	117	0.014	EGG	3.7	0	0.00049
CMH1254V4	CMH1253V4	92	0.014	EGG	3.7	0	0.0012

Inlet Node	Outlet Node	Length (ft)	Roughness	Cross-Section	Size / Diameter (ft)	Width (ft)	Slope (ft/ft)
CMH1255V4	CMH1254V4	27	0.014	EGG	3.7	0	-0.00296
CMH1256V4	CMH1255V4	114	0.014	EGG	3.7	0	0.00061
CMH1257V4	CMH1256V4	115	0.014	EGG	3.7	0	-9.00E-05
CMH1258V4	CMH1257V4	118	0.014	EGG	3.7	0	-0.00034
CMH1330X10	CMH1817X2	320	0.014	RECT_CLOSED	3	5	0.00044
CMH1332X10	CMH1334X10	115	0.014	CIRCULAR	2.5	0	0.00043
CMH1334X10	CMH1330X10	220	0.014	CIRCULAR	2.5	2	0.0005
CMH1336X9	Ghost31	250	0.014	CIRCULAR	2.5	0	0.00096
CMH1339X9	CMH1336X9	275	0.014	CIRCULAR	2.5	0	0.00084
CMH1734V4	CMH1741V4	187	0.014	EGG	5	0	0.0038
CMH1735V4	Ghost27	64	0.014	EGG	5	0	0
CMH1736V4	CMH1735V4	125	0.014	EGG	5	0	8.00E-05
CMH1737V4	Ghost28	75	0.014	EGG	5	0	0
CMH1740V4	Ghost25	450	0.014	EGG	5.25	0	0.00038
CMH1741V4	CMH1740V4	275	0.014	EGG	5.25	0	0.00185
CMH1817X2	Ghost23	200	0.014	RECT_CLOSED	3	5	0.0008
CMH1840U4	CMH1841U4	98	0.014	EGG	3	0	0.00754
CMH1841U4	CMH1842U4	100	0.014	EGG	3	0	0.00332
CMH1842U4	CMH1843V4	196	0.014	EGG	3	0	0.00687
CMH1843V4	CMH1844V4	101	0.014	EGG	3	0	0.0003
CMH1844V4	CMH1845V4	101	0.014	EGG	3	0	0.00636
CMH1845V4	CMH1846V4	102	0.014	EGG	3	0	0.00529
CMH1846V4	CMH1847V4	98	0.014	EGG	3	0	0.00765
CMH1847V4	CMH1848V4	100	0.014	EGG	3	0	0.0005
CMH1848V4	Ghost30	49	0.014	EGG	3	0	0.01258
CMH1849V4	CMH1850V4	100	0.014	EGG	3	0	0.00209
CMH1850V4	CMH1851V4	104	0.014	EGG	3	0	0.00125
CMH1851V4	CMH1852V4	99	0.014	EGG	3	0	0.00687
CMH1852V4	CMH1853V4	73	0.014	EGG	3	0	0.0064
CMH1853V4	CMH1854V4	158	0.014	EGG	3	0	0.00234
CMH1854V4	CMH1855V4	73	0.014	EGG	3	0	-0.00041
CMH1855V4	Ghost29	136	0.014	EGG	3	0	0.00478
CMH1856V4	CMH1737V4	116	0.014	EGG	5	0	-9.00E-05
CMH1857V4	Ghost29	68	0.014	EGG	3	0	0.00044
CMH1860X2	Ghost25	1000	0.014	RECT_CLOSED	4	5	0.001
CMH1943U2	CMH592U1	109	0.014	RECT_CLOSED	3.5	5	0.00211
CMH1943V1	Ghost15	217	0.01	RECT_CLOSED	3.5	5	-5.00E-05
CMH1944V1	Ghost15	25	0.014	CIRCULAR	2	0	-0.0088
CMH1945V1	CMH747V3	196	0.014	RECT_CLOSED	3.5	5	0.00469
CMH1946V1	CMH1944V1	168	0.014	CIRCULAR	2	0	0.00036
CMH1947V1	CMH1946V1	82	0.014	CIRCULAR	2	0	0.0033
CMH1948AV1	CMH1948V1	124	0.014	RECT_CLOSED	3.5	5	0.00242
CMH1948BV1	CMH1948AV1	124	0.014	RECT_CLOSED	3.5	5	0.00242
CMH1948V1	CMH1943V1	154	0.014	RECT_CLOSED	3.5	5	0
CMH1949V3	Ghost16	108	0.014	RECT_CLOSED	3.5	5	-0.00037
CMH586U1	CMH1948BV1	206	0.014	RECT_CLOSED	3.5	5	0.00344
CMH587U1	CMH586U1	76	0.014	CIRCULAR	2	0	0.00382
CMH588U1	CMH587U1	133	0.01	CIRCULAR	2	0	0.00053
CMH591U1	Ghost9	135	0.014	RECT_CLOSED	3.5	5	0.00052
CMH592U1	CMH591U1	94	0.014	RECT_CLOSED	3.5	5	0.00626
CMH600U2	CMH601U2	223	0.014	CIRCULAR	3	0	-0.00215
CMH601U2	CMH602U2	229	0.014	CIRCULAR	3	0	0.00512
CMH602AU2	CMH603U2	200	0.01	CIRCULAR	3.5	0	0.0003
CMH602U2	CMH602AU2	81	0.014	CIRCULAR	3.5	0	0.00098
CMH603U2	CMH604U2	113	0.014	CIRCULAR	3.5	0	0.00462
CMH604U2	CMH1943U2	136	0.014	RECT_CLOSED	3.5	5	-7.00E-05
CMH715V1	CMH1947V1	171	0.014	CIRCULAR	2	0	0.00123

Inlet Node	Outlet Node	Length (ft)	Roughness	Cross-Section	Size / Diameter (ft)	Width (ft)	Slope (ft/ft)
CMH718V1	CMH715V1	269	0.014	CIRCULAR	2	0	0.00171
CMH719V1	CMH718V1	199	0.014	CIRCULAR	2	0	5.00E-05
CMH747V3	CMH1949V3	175	0.014	RECT_CLOSED	3.5	5	0.00206
CMH757V3	CMH758V3	33	0.014	RECT_CLOSED	3.5	5	-0.00121
CMH758V3	CMH769V3	180	0.014	RECT_CLOSED	3.5	5	0.00344
CMH769V3	CMH770V3	140	0.014	RECT_CLOSED	3.5	5	0.00429
CMH770V3	CMH771V3	130	0.014	RECT_CLOSED	3.5	5	0.00023
CMH771V3	Ghost18	41	0.014	RECT_CLOSED	3.5	5	0
CMH772V3	CMH773V3	87	0.014	RECT_CLOSED	3.5	5	0.00414
CMH773V3	CMH777V3	172	0.014	RECT_CLOSED	3.5	5	0.00035
CMH775V3	Ghost19	60	0.014	RECT_CLOSED	3.5	5	0.00967
CMH776V3	CMH775V3	130	0.014	RECT_CLOSED	3.5	5	0.00069
CMH777V3	CMH776V3	175	0.014	RECT_CLOSED	3.5	5	0.0004
CMH782V2	CMH1215X2	120	0.014	RECT_CLOSED	3.5	2	0.00492
CMH783V2	CMH782V2	174	0.014	RECT_CLOSED	3.5	2	0.00672
CMH784V2	CMH783V2	170	0.014	RECT_CLOSED	3	2	0.00487
CMH785V2	CMH784V2	189	0.014	RECT_CLOSED	3	2	0.00333
CMH786V2	CMH785V2	189	0.014	CIRCULAR	3	0	0.00254
CMH787V2	Ghost21	25	0.014	CIRCULAR	3	0	0.2971
DivChmb	Node4A	95	0.014	CIRCULAR	1.33	0	0.01102
DivChmb	Node1A	62	0.014	RECT_CLOSED	6	9	-0.0047
DivChmb0	DivChmb1	100	0.014	CIRCULAR	8	8	-0.0002
DivChmb1	Node1C	31	0.014	CIRCULAR	8	8	0.00065
DivChmb2	OutfallC	128	0.014	CIRCULAR	8	8	-0.00734
FlumeC	J1	36	0.014	CIRCULAR	2	0	0.19176
Ghost15	CMH1945V1	38	0.014	RECT_CLOSED	3.5	5	0
Ghost16	CMH757V3	108	0.014	RECT_CLOSED	3.5	5	-0.00037
Ghost18	CMH772V3	41	0.014	RECT_CLOSED	3.5	5	0
Ghost19	CMH1211V4	60	0.014	RECT_CLOSED	3.5	5	0.00433
Ghost21	Ghost22	25	0.014	CIRCULAR	3	0	0.0084
Ghost22	CMH786V2	153	0.014	CIRCULAR	3	0	0.04895
Ghost23	CMH1217X2	396	0.014	RECT_CLOSED	4	5	0.00141
Ghost25	DivChmb0	40	0.014	RECT_CLOSED	7	8	0
Ghost26	CMH1221V4	50	0.014	EGG	3.7	0	0.0092
Ghost27	CMH1734V4	64	0.014	EGG	5	0	-0.00047
Ghost28	CMH1736V4	58	0.014	EGG	5	0	-0.00172
Ghost29	CMH1856V4	30	0.014	EGG	5	0	0.01333
Ghost30	CMH1849V4	49	0.014	EGG	3	0	0.00454
Ghost31	CMH1332X10	387	0.014	CIRCULAR	2.5	0	0.00096
Ghost32	AMH156Q5	50	0.014	EGG	4	0	0.0032
Ghost4	AMH1082Q6	50	0.014	EGG	4	0	0.0072
Ghost9	CMH586U1	135	0.014	RECT_CLOSED	3.5	5	-0.00185
J1	BCUA8A	2575	0.014	CIRCULAR	8	0	0.00039
Node1A	Node2A	30	0.014	RECT_CLOSED	5	4	0
Node1A	Node2A	30	0.014	RECT_CLOSED	5	4	0
Node1C	VortexC	22	0.014	CIRCULAR	1.33	0	0.00182
Node1C	Node2C	30	0.014	RECT_CLOSED	5	4	0
Node1C	Node2C	30	0.014	RECT_CLOSED	5	4	0
Node2A	OutfallA	47	0.014	CIRCULAR	7	7	-0.02145
Node2C	DivChmb2	31	0.014	CIRCULAR	8	8	0.00065
Node3A	BCUAMeterChamber	69	0.014	CIRCULAR	1.33	0	0.00869
Node3C	Node4C	20	0.014	CIRCULAR	2	0	0.008
Node4A	VortexA	30	0.014	CIRCULAR	1.67	0	0.05217
Node4C	FlumeC	72	0.014	CIRCULAR	2.25	0	-0.00806
Node5C	Node3C	20	0.014	CIRCULAR	2	0	0.001

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
AMH1014T1	4.56	16.55	11.99
AMH1015T1	3.24	17.84	14.6
AMH1078Q6	1.58	21.53	19.95
AMH1079Q6	1.54	21.74	20.2
AMH1080Q6	1.28	21.48	20.2
AMH1081Q6	0.89	21.19	20.3
AMH1082Q6	0.44	20.74	20.3
AMH1083R2	6.86	18.56	11.7
AMH1084R2	6.2	17.88	11.68
AMH1085R2	5.23	17.23	12
AMH1086R2	4.72	16.96	12.24
AMH1087R2	3.87	17.62	13.75
AMH1088R2	3.35	18.47	15.12
AMH1089R2	2.58	19.02	16.44
AMH1090R2	1.89	20.59	18.7
AMH1091R2	1.19	20.06	18.87
AMH1111T1	2.8	12.5	9.7
AMH1112T1	2.6	13.9	11.3
AMH1113T1	2.11	17.31	15.2
AMH1114T1	1.67	19.57	17.9
AMH1115T1	0.98	19.78	18.8
AMH1116T1	1.15	20.35	19.2
AMH1117T1	0.76	20.86	20.1
AMH1118T1	0.59	21.81	21.22
AMH1119T1	0.11	22.21	22.1
AMH1120Q7	-0.21	22.49	22.7
AMH113N1	14.2	22.8	8.6
AMH114N1	12.95	21.05	8.1
AMH1150Q6	5.09	20.69	15.6
AMH1152Q6	5.38	21.58	16.2
AMH115N1	12.01	19.41	7.4
AMH1162Q6	3.97	21.57	17.6
AMH1163Q6	6.89	22.19	15.3
AMH116N1	10.67	18.07	7.4
AMH117N1	9.59	17.39	7.8
AMH118N1	8.09	19.79	11.7
AMH136Q5	60.65	73.35	12.7
AMH137Q5	56.39	63.79	7.4
AMH138Q5	41.39	52.29	10.9
AMH139Q5	36.69	46.29	9.6
AMH140Q5	32.61	40.51	7.9
AMH141Q5	26.93	34.83	7.9
AMH142Q5	24.12	33.02	8.9
AMH143Q5	22.84	32.24	9.4
AMH144Q5	20.31	30.11	9.8
AMH145Q5	18.66	28.26	9.6

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
AMH146Q5	17.6	27.2	9.6
AMH147Q5	16.59	26.09	9.5
AMH148Q5	15.06	25.06	10
AMH149Q5	13.71	23.91	10.2
AMH150Q5	12.94	23.44	10.5
AMH151Q5	11.66	22.66	11
AMH152Q5	10.29	21.99	11.7
AMH153Q5	9.02	21.42	12.4
AMH154Q5	7.79	20.79	13
AMH155Q5	7.07	20.07	13
AMH156Q5	7.03	19.73	12.7
AMH157Q5	6.66	19.36	12.7
AMH158Q5	6.15	19.05	12.9
AMH159Q5	6	21.82	15.82
AMH160Q5	5.8	17.86	12.06
AMH161Q5	5.6	17.27	11.67
AMH162Q5	5.04	18.82	13.78
AMH163Q6	4.95	18.99	14.04
AMH164Q6	4.85	19.49	14.64
AMH165Q6	4.76	19.49	14.73
AMH166Q6	4.66	20.21	15.55
AMH167Q6	4.48	20.42	15.94
AMH168Q6	3.96	21.06	17.1
AMH169Q6	3.56	21.26	17.7
AMH170Q6	2.96	21.76	18.8
AMH171Q6	2.83	22.13	19.3
AMH1749Q6	1.61	22.01	20.4
AMH1750Q6	3	22.3	19.3
AMH1751BQ6	10.32	23.22	12.9
AMH1751Q6	7.36	22.36	15
AMH1788Q7	-2.9	12.8	15.7
AMH1792Q7	-0.31	20.23	20.54
AMH1793Q7	-0.61	19.69	20.3
AMH1794Q7	-0.81	19.2	20.01
AMH1795Q7	-0.81	18.89	19.7
AMH1796Q7	-0.81	18.4	19.21
AMH1797Q7	-3.41	10.49	13.9
AMH1818Q7	-0.4	21.47	21.87
AMH1819Q7	-1.01	20.59	21.6
AMH1820Q7	-1.33	18.87	20.2
AMH1821Q7	-1.31	18.11	19.42
AMH226Q1	31.91	47.27	15.36
AMH261Q1	34.45	43.33	8.88
AMH262Q1	33.97	44.05	10.08
AMH263Q1	33.41	44.81	11.4
AMH264Q1	32.81	45.74	12.93

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
AMH265Q1	32.29	46.51	14.22
AMH417H2	6.05	12.95	6.9
AMH418H2	5.87	12.47	6.6
AMH419H2	5.44	12.14	6.7
AMH420K1	5.09	11.89	6.8
AMH422G1	4.39	11.79	7.4
AMH426G1	4.1	12.1	8
AMH427L1	3.88	12.48	8.6
AMH428L1	3.61	12.71	9.1
AMH429L1	3.27	12.37	9.1
AMH439N1	7.26	18.36	11.1
AMH440N1	6.27	17.37	11.1
AMH441N1	5.38	16.38	11
AMH481R1	31.32	47.81	16.49
AMH482R1	30.91	46.77	15.86
AMH483R1	30.2	43.45	13.25
AMH485R1	29.74	38.72	8.98
AMH486R1	20.96	32.23	11.27
AMH487R1	13.3	24.91	11.61
AMH491R1	10.98	23.25	12.27
AMH493R1	9.91	22.21	12.3
AMH494R1	8.91	20.71	11.8
AMH58H1	17.73	27.83	10.1
AMH59H2	16.88	27.18	10.3
AMH60H2	15.88	25.18	9.3
AMH61H2	9.42	18.72	9.3
AMH62AH2	8.96	16.46	7.5
AMH62H2	9.2	18.3	9.1
AMH63H2	7.05	14.25	7.2
AMH658Q5	7.61	19.81	12.2
AMH659Q5	7.52	19.42	11.9
AMH660U2	7.52	18.92	11.4
AMH661U2	7.93	18.23	10.3
AMH662U2	8.3	17.7	9.4
AMH663U2	8.65	17.35	8.7
AMH664U2	8.98	17.08	8.1
AMH665U2	9	16.6	7.6
AMH666U2	9.09	16.19	7.1
AMHA2071Q5	45.98	55.48	9.5
BCUA8B	-1.01	-1.01	0
BCUA9A	-16.26	8	24.26
BCUA9B	-15.81	8	23.81
BCUA9C	-15.35	6.6	21.95
BCUAMeterChamber	-5.8	11	16.8
BCUANode1	-15.5	11	26.5
CMH1136U3	7.5	17.18	9.68

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
CMH1137U3	7.95	15.45	7.5
CMH1138U3	8.48	15.18	6.7
CMH1139U3	8.97	15.74	6.77
CMH1140U3	9.21	16.31	7.1
CMH1192U4	6.76	19.16	12.4
CMH1211V4	1.58	8.58	7
CMH1212AV4	1.14	7.74	6.6
CMH1212V4	1.28	7.98	6.7
CMH1213V4	1.12	7.62	6.5
CMH1214X2	0.89	7.53	6.64
CMH1215X2	0.67	8.07	7.4
CMH1216X2	0.44	7.54	7.1
CMH1217X2	-0.07	8.23	8.3
CMH1218X2	-0.59	8.13	8.72
CMH1219V4	5.06	16.96	11.9
CMH1220V4	4.79	16.59	11.8
CMH1221V4	4.17	15.97	11.8
CMH1222V4	3.96	15.46	11.5
CMH1223V4	3.52	14.92	11.4
CMH1224V4	3.25	14.25	11
CMH1225V4	2.54	13.74	11.2
CMH1226V4	2.19	13.09	10.9
CMH1227V4	1.59	12.59	11
CMH1228V4	1.2	11.9	10.7
CMH1229V4	0.65	11.45	10.8
CMH1230V4	0.21	11.01	10.8
CMH1231V4	-0.11	10.49	10.6
CMH1232V4	-0.24	9.9	10.14
CMH1233V4	-0.56	8.84	9.4
CMH1234V4	-0.24	8.54	8.78
CMH1236X2	-0.97	7.11	8.08
CMH1252V4	-1.21	11.26	12.47
CMH1253V4	-1.15	11.15	12.3
CMH1254V4	-0.94	10.51	11.45
CMH1255V4	-1	10.55	11.55
CMH1256V4	-0.91	10.03	10.94
CMH1257V4	-0.9	9.56	10.46
CMH1258V4	-0.9	9.2	10.1
CMH1330X10	0.79	6.21	5.42
CMH1332X10	0.95	5.32	4.37
CMH1334X10	0.9	5.56	4.66
CMH1336X9	1.56	5.71	4.15
CMH1339X9	1.84	5.78	3.94
CMH1734V4	-1.69	7.92	9.61
CMH1735V4	-1.71	8.69	10.4
CMH1736V4	-1.69	9.71	11.4

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
CMH1737V4	-1.69	10.41	12.1
CMH1740V4	-2.91	5.26	8.17
CMH1741V4	-2.4	5.8	8.2
CMH1817X2	0.65	6.59	5.94
CMH1840U4	6.97	17.27	10.3
CMH1841U4	6.19	16.79	10.6
CMH1842U4	5.85	16.55	10.7
CMH1843V4	4.5	16.3	11.8
CMH1844V4	4.47	15.27	10.8
CMH1845V4	3.82	14.52	10.7
CMH1846V4	3.27	13.37	10.1
CMH1847V4	2.51	12.51	10
CMH1848V4	2.45	11.75	9.3
CMH1849V4	1.61	10.91	9.3
CMH1850V4	1.36	11.36	10
CMH1851V4	1.22	11.82	10.6
CMH1852V4	0.53	11.43	10.9
CMH1853V4	0.05	11.65	11.6
CMH1854V4	-0.32	11.68	12
CMH1855V4	-0.34	11.66	12
CMH1856V4	-1.69	11.31	13
CMH1857V4	-0.88	10.87	11.75
CMH1860X2	-2.08	5.56	7.64
CMH1943U2	7.38	13.77	6.39
CMH1943V1	5.41	14.47	9.06
CMH1944V1	5.6	14.46	8.86
CMH1945V1	5.41	15.31	9.9
CMH1946V1	5.7	14.9	9.2
CMH1947V1	6.02	15.02	9
CMH1948AV1	5.72	13.55	7.83
CMH1948BV1	6.02	13.55	7.53
CMH1948V1	5.42	13.62	8.2
CMH1949V3	4.13	10.63	6.5
CMH586U1	6.74	13.74	7
CMH587U1	7.06	13.64	6.58
CMH588U1	7.23	15.23	8
CMH591U1	6.56	13.46	6.9
CMH592U1	7.15	13.85	6.7
CMH600U2	8.77	18.57	9.8
CMH601U2	9.2	17.89	8.69
CMH602AU2	7.95	16.35	8.4
CMH602U2	8.03	18.03	10
CMH603U2	7.89	13.89	6
CMH604U2	7.37	13.97	6.6
CMH715V1	6.23	13.63	7.4
CMH718V1	6.79	12.59	5.8

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
CMH719V1	6.8	13.4	6.6
CMH747V3	4.49	11.09	6.6
CMH757V3	4.21	10.47	6.26
CMH758V3	4.25	10.3	6.05
CMH769V3	3.63	9.93	6.3
CMH770V3	3.03	9.89	6.86
CMH771V3	3	10	7
CMH772V3	3	9.95	6.95
CMH773V3	2.64	9.99	7.35
CMH775V3	2.42	8.92	6.5
CMH776V3	2.51	9.01	6.5
CMH777V3	2.58	9.28	6.7
CMH782V2	1.29	8.69	7.4
CMH783V2	2.46	9.76	7.3
CMH784V2	3.34	11.94	8.6
CMH785V2	3.97	13.97	10
CMH786V2	4.65	16.85	12.2
CMH787V2	19.46	28.86	9.4
DivChmb	-3.41	10.29	13.7
DivChmb0	-4.01	8.05	12.06
DivChmb1	-3.99	6.59	10.58
DivChmb2	-4.03	6.14	10.17
FlumeC	-6	7.53	13.53
Ghost15	5.41	14.47	9.06
Ghost16	4.17	10.47	6.3
Ghost18	3	9.98	6.98
Ghost19	1.84	8.79	6.95
Ghost21	12.34	26.99	14.65
Ghost22	12.13	26.49	14.36
Ghost23	0.49	7.47	6.98
Ghost25	-3.08	7.99	11.07
Ghost26	4.72	16.295	11.575
Ghost27	-1.71	8.3	10.01
Ghost28	-1.69	9.97	11.66
Ghost29	-1.23	11.26	12.49
Ghost30	1.84	11.12	9.28
Ghost31	1.32	5.52	4.2
Ghost32	7.19	19.92	12.73
Ghost4	0.8	20.62	19.82
Ghost9	6.49	13.41	6.92
J1	-16.5	3.82	20.32
Node1A	-0.51	9.99	10.5
Node1C	-4.16	8.99	13.15
Node2A	-3.74	9.99	13.73
Node2C	-4.01	8.99	13
Node3A	-5.2	11	16.2

Appendix E-2: Manholes

Manhole Name	Invert Elev. (ft)	Rim Elev. (ft)	Depth (ft)
Node3C	-5.65	7.41	13.06
Node4A	-4.66	8.49	13.15
Node4C	-6.58	7.01	13.59
Node5C	-5.63	7.59	13.22
VortexA	-6.21	9.99	16.2
VortexC	-5.63	7.59	13.22

APPENDIX F

Daily Overflow Volumes and Wasteload Results for Typical Year Simulation

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
1/1/2004	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
1/3/2004	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/4/2004	0.29	0.09	0.21	1.53E+13	9.24E+12	132.60	94.09	3.45	95.49	149.23	0.33	2.37E+13	1.39E+13	197.15	31.95	5.40	29.99	354.51
1/5/2004	0.40	0.07	0.41	2.98E+13	1.80E+13	258.55	183.45	6.73	186.19	290.96	0.60	4.29E+13	2.52E+13	356.76	57.81	9.77	54.27	641.53
1/6/2004	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
1/8/2004	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
1/10/2004	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
1/12/2004	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
1/14/2004	0.07	0.02	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
1/16/2004	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
1/18/2004	0.55	0.08	0.84	6.20E+13	3.75E+13	538.01	381.73	14.01	387.45	605.45	1.04	7.49E+13	4.40E+13	623.31	101.00	17.07	94.83	1120.85
1/19/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/20/2004	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
1/22/2004	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
1/24/2004	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
1/26/2004	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	0.19	1.40E+13	8.47E+12	121.47	86.18	3.16	87.47	136.69	0	0	0	0	0	0	0	0
1/28/2004	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/29/2004	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
1/31/2004	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
2/2/2004	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	1.90	1.40E+14	8.46E+13	1214.17	861.48	31.62	874.39	1366.37	3.33	2.39E+14	1.40E+14	1987.93	322.12	54.45	302.43	3574.73
2/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/5/2004	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	4.13	3.03E+14	1.84E+14	2634.44	1869.21	68.62	1897.20	2964.69	6.88	4.93E+14	2.90E+14	4102.76	664.81	112.38	624.16	7377.64
2/7/2004	0.05	0.02	0	0	0	0	0	0	0	0	0.01	7.14E+11	4.19E+11	5.94	0.96	0.16	0.90	10.69
2/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/9/2004	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
2/11/2004	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
2/13/2004	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

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
2/15/2004	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
2/17/2004	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
2/19/2004	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
2/21/2004	0.01	0.01	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
2/23/2004	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
2/25/2004	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
2/27/2004	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
2/29/2004	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
3/2/2004	0.03	0.03	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
3/4/2004	0.23	0.09	0.24	1.77E+13	1.07E+13	153.50	108.91	4.00	110.54	172.74	0.12	8.54E+12	5.01E+12	71.04	11.51	1.95	10.81	127.74
3/5/2004	0.02	0.01	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	0.01	8.43E+11	4.95E+11	7.02	1.14	0.19	1.07	12.62
3/7/2004	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	0.33	2.46E+13	1.49E+13	213.34	151.37	5.56	153.64	240.08	0.36	2.56E+13	1.51E+13	213.42	34.58	5.85	32.47	383.78
3/9/2004	0.04	0.02	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
3/11/2004	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
3/13/2004	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
3/15/2004	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	0.08	6.17E+12	3.74E+12	53.58	38.02	1.40	38.59	60.30	0.06	4.63E+12	2.72E+12	38.55	6.25	1.06	5.87	69.33
3/17/2004	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
3/19/2004	0.25	0.06	0	0	0	0	0	0	0	0	0.01	3.78E+11	2.22E+11	3.15	0.51	0.09	0.48	5.66
3/20/2004	0.04	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/21/2004	0.11	0.06	0.05	3.33E+12	2.01E+12	28.89	20.50	0.75	20.81	32.52	0.06	4.26E+12	2.50E+12	35.49	5.75	0.97	5.40	63.82
3/22/2004	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
3/24/2004	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	0	0	0	0
3/26/2004	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	0	0	0	0
3/28/2004	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
3/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
3/31/2004	0.41	0.23	0.71	5.23E+13	3.17E+13	454.28	322.32	11.83	327.15	511.23	1.05	7.51E+13	4.41E+13	625.33	101.33	17.13	95.13	1124.48
4/1/2004	0.51	0.24	1.34	9.83E+13	5.95E+13	853.28	605.42	22.22	614.49	960.24	1.92	1.37E+14	8.07E+13	1142.98	185.21	31.31	173.88	2055.32
4/2/2004	0.08	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/3/2004	0.10	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/4/2004	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/5/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/6/2004	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
4/8/2004	0.14	0.05	0.05	3.98E+12	2.41E+12	34.52	24.49	0.90	24.86	38.85	0.05	3.52E+12	2.07E+12	29.29	4.75	0.80	4.46	52.68
4/9/2004	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
4/11/2004	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	1.04	7.67E+13	4.64E+13	665.74	472.36	17.34	479.44	749.20	1.77	1.27E+14	7.46E+13	1057.74	171.40	28.97	160.92	1902.05
4/13/2004	1.09	0.25	2.69	1.97E+14	1.20E+14	1714.78	1216.68	44.66	1234.90	1929.74	4.28	3.07E+14	1.80E+14	2552.03	413.53	69.91	388.25	4589.10
4/14/2004	0.42	0.24	0.79	5.83E+13	3.53E+13	506.50	359.37	13.19	364.75	569.99	1.18	8.45E+13	4.96E+13	703.32	113.97	19.27	107.00	1264.71
4/15/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/16/2004	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
4/18/2004	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
4/20/2004	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
4/22/2004	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	0	0	0	0
4/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/25/2004	0.09	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/26/2004	1.57	0.23	2.99	2.20E+14	1.33E+14	1908.34	1354.02	49.70	1374.30	2147.56	4.71	3.38E+14	1.98E+14	2809.95	455.33	76.97	427.48	5052.90
4/27/2004	0.01	0.01	0.30	2.19E+13	1.33E+13	190.11	134.89	4.95	136.91	213.94	0.66	4.76E+13	2.80E+13	396.21	64.20	10.85	60.28	712.47
4/28/2004	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/29/2004	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
5/1/2004	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	0	0	0	0	0	0	0	0	0
5/3/2004	0.37	0.08	0.08	5.54E+12	3.35E+12	48.10	34.13	1.25	34.64	54.13	0.02	1.10E+12	6.45E+11	9.14	1.48	0.25	1.39	16.43
5/4/2004	0	0	0	0	0	0	0	0	0	0	0.01	5.44E+11	3.20E+11	4.53	0.73	0.12	0.69	8.14
5/5/2004	0.01	0.01	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
5/7/2004	0.20	0.08	0.15	1.13E+13	6.83E+12	97.94	69.49	2.55	70.53	110.22	0.17	1.24E+13	7.26E+12	102.93	16.68	2.82	15.66	185.09
5/8/2004	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
5/10/2004	0.14	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/11/2004	0.61	0.43	2.11	1.55E+14	9.37E+13	1344.62	954.05	35.02	968.34	1513.18	2.70	1.94E+14	1.14E+14	1610.61	260.98	44.12	245.03	2896.22
5/12/2004	1.08	0.69	3.47	2.55E+14	1.54E+14	2214.66	1571.36	57.68	1594.90	2492.29	3.58	2.57E+14	1.51E+14	2137.64	346.38	58.55	325.20	3843.93
5/13/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/14/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
5/15/2004	0.73	0.37	1.93	1.42E+14	8.59E+13	1232.15	874.24	32.09	887.33	1386.61	2.57	1.84E+14	1.08E+14	1534.14	248.59	42.02	233.39	2758.71
5/16/2004	0.06	0.06	0.45	3.30E+13	2.00E+13	286.36	203.18	7.46	206.23	322.26	1.44	1.03E+14	6.08E+13	861.36	139.57	23.59	131.04	1548.90
5/17/2004	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
5/19/2004	0.13	0.06	0.01	4.96E+11	3.00E+11	4.31	3.06	0.11	3.10	4.85	0	0	0	0	0	0	0	0
5/20/2004	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
5/22/2004	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
5/24/2004	0.05	0.05	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
5/26/2004	0.17	0.15	0.20	1.46E+13	8.82E+12	126.58	89.81	3.30	91.16	142.45	0.22	1.59E+13	9.32E+12	132.08	21.40	3.62	20.09	237.51
5/27/2004	0.19	0.11	0.13	9.26E+12	5.60E+12	80.39	57.04	2.09	57.89	90.47	0	0	0	0	0	0	0	0
5/28/2004	0.33	0.23	0.27	1.96E+13	1.19E+13	170.32	120.84	4.44	122.65	191.67	0.32	2.27E+13	1.33E+13	188.61	30.56	5.17	28.69	339.16
5/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/30/2004	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	0.29	2.11E+13	1.28E+13	183.34	130.09	4.78	132.04	206.33	0.08	5.59E+12	3.28E+12	46.55	7.54	1.28	7.08	83.70
6/1/2004	0.24	0.11	0.07	4.82E+12	2.92E+12	41.89	29.72	1.09	30.16	47.14	0.09	6.19E+12	3.64E+12	51.51	8.35	1.41	7.84	92.63
6/2/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/3/2004	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/5/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/6/2004	0.15	0.09	0.09	6.48E+12	3.92E+12	56.26	39.92	1.47	40.52	63.31	0	0	0	0	0	0	0	0
6/7/2004	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
6/9/2004	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
6/11/2004	0.14	0.09	0	0	0	0	0	0	0	0	0.01	4.99E+11	2.93E+11	4.16	0.67	0.11	0.63	7.47
6/12/2004	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
6/14/2004	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
6/16/2004	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	0.26	1.91E+13	1.16E+13	165.89	117.70	4.32	119.47	186.68	0.05	3.41E+12	2.00E+12	28.36	4.60	0.78	4.31	51.00
6/18/2004	0	0	0	0	0	0	0	0	0	0	0.01	6.29E+11	3.70E+11	5.24	0.85	0.14	0.80	9.42
6/19/2004	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
6/21/2004	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	1.50	1.10E+14	6.69E+13	959.22	680.59	24.98	690.79	1079.47	2.10	1.51E+14	8.85E+13	1254.71	203.31	34.37	190.88	2256.24
6/23/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24/2004	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	4.71	3.46E+14	2.09E+14	3005.09	2132.19	78.27	2164.13	3381.81	6.49	4.65E+14	2.73E+14	3871.59	627.35	106.05	588.99	6961.96
6/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27/2004	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

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
6/29/2004	0.20	0.18	0.30	2.22E+13	1.34E+13	192.39	136.51	5.01	138.55	216.51	0.49	3.54E+13	2.08E+13	294.29	47.69	8.06	44.77	529.19
6/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1/2004	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
7/3/2004	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
7/5/2004	1.00	0.71	2.99	2.20E+14	1.33E+14	1907.13	1353.16	49.67	1373.42	2146.20	3.26	2.34E+14	1.37E+14	1947.29	315.54	53.34	296.25	3501.65
7/6/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7/2004	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
7/9/2004	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
7/11/2004	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	4.09	3.01E+14	1.82E+14	2610.84	1852.46	68.00	1880.20	2938.12	6.75	4.84E+14	2.84E+14	4026.11	652.39	110.28	612.50	7239.80
7/13/2004	0.43	0.11	0.67	4.92E+13	2.98E+13	427.13	303.06	11.12	307.60	480.67	1.15	8.27E+13	4.86E+13	688.23	111.52	18.85	104.70	1237.59
7/14/2004	0.38	0.29	0.65	4.75E+13	2.87E+13	412.26	292.51	10.74	296.89	463.94	0.61	4.39E+13	2.58E+13	365.76	59.27	10.02	55.64	657.71
7/15/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/16/2004	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
7/18/2004	1.58	0.54	5.09	3.74E+14	2.26E+14	3246.75	2303.66	84.56	2338.16	3653.76	6.33	4.54E+14	2.67E+14	3777.38	612.09	103.47	574.66	6792.54
7/19/2004	0.02	0.01	0	0	0	0	0	0	0	0	0.01	5.10E+11	3.00E+11	4.25	0.69	0.12	0.65	7.63
7/20/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21/2004	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
7/23/2004	1.63	0.35	4.82	3.54E+14	2.14E+14	3073.28	2180.57	80.05	2213.23	3458.54	8.29	5.94E+14	3.49E+14	4944.57	801.22	135.44	752.23	8891.41
7/24/2004	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/25/2004	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
7/27/2004	1.39	0.36	3.99	2.93E+14	1.77E+14	2544.22	1805.19	66.27	1832.23	2863.16	6.40	4.59E+14	2.70E+14	3819.34	618.89	104.62	581.05	6868.00
7/28/2004	0.06	0.03	0.16	1.20E+13	7.25E+12	103.99	73.78	2.71	74.89	117.02	0.65	4.65E+13	2.73E+13	387.13	62.73	10.60	58.90	696.15
7/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/30/2004	0.31	0.26	0.82	5.99E+13	3.63E+13	520.42	369.25	13.55	374.78	585.66	1.38	9.91E+13	5.82E+13	824.93	133.67	22.60	125.50	1483.40
7/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/2004	0.28	0.10	0.39	2.90E+13	1.75E+13	251.70	178.59	6.56	181.26	283.25	0.37	2.68E+13	1.57E+13	222.64	36.08	6.10	33.87	400.35
8/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/3/2004	0.03	0.03	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
8/5/2004	0.03	0.03	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
8/7/2004	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
8/9/2004	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
8/11/2004	0.61	0.25	1.43	1.05E+14	6.38E+13	914.60	648.94	23.82	658.65	1029.26	2.28	1.63E+14	9.60E+13	1360.18	220.40	37.26	206.93	2445.90
8/12/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
8/13/2004	0.20	0.12	0.18	1.29E+13	7.81E+12	112.07	79.52	2.92	80.71	126.12	0	0	0	0	0	0	0	0
8/14/2004	0.21	0.13	0.27	1.98E+13	1.20E+13	171.72	121.84	4.47	123.66	193.25	0.40	2.87E+13	1.69E+13	239.11	38.75	6.55	36.38	429.97
8/15/2004	0.31	0.11	0.73	5.33E+13	3.23E+13	463.22	328.67	12.06	333.59	521.29	1.58	1.13E+14	6.65E+13	942.07	152.65	25.81	143.32	1694.04
8/16/2004	0.95	0.56	2.62	1.92E+14	1.16E+14	1670.50	1185.26	43.51	1203.01	1879.91	3.58	2.57E+14	1.51E+14	2136.98	346.28	58.54	325.10	3842.75
8/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/18/2004	0.05	0.04	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
8/20/2004	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	2.93	2.15E+14	1.30E+14	1870.81	1327.39	48.73	1347.27	2105.33	3.33	2.39E+14	1.40E+14	1989.16	322.32	54.49	302.62	3576.94
8/22/2004	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
8/24/2004	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
8/26/2004	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
8/28/2004	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
8/30/2004	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	0.05	3.97E+12	2.40E+12	34.48	24.46	0.90	24.83	38.80	0.02	1.50E+12	8.83E+11	12.52	2.03	0.34	1.90	22.51
9/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2/2004	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
9/4/2004	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
9/6/2004	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
9/8/2004	2.08	0.48	6.69	4.91E+14	2.97E+14	4266.14	3026.93	111.11	3072.27	4800.93	8.78	6.29E+14	3.70E+14	5238.42	848.84	143.49	796.93	9419.81
9/9/2004	0.29	0.16	0.25	1.87E+13	1.13E+13	162.48	115.28	4.23	117.01	182.85	0.09	6.27E+12	3.68E+12	52.19	8.46	1.43	7.94	93.85
9/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/11/2004	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
9/13/2004	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
9/15/2004	0.38	0.26	0.83	6.08E+13	3.68E+13	527.70	374.42	13.74	380.02	593.85	1.07	7.70E+13	4.52E+13	640.85	103.84	17.55	97.49	1152.39
9/16/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/17/2004	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2004	1.41	1.32	4.08	3.00E+14	1.82E+14	2603.68	1847.38	67.81	1875.05	2930.07	3.85	2.76E+14	1.62E+14	2294.20	371.75	62.84	349.02	4125.47
9/19/2004	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
9/21/2004	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
9/23/2004	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
9/25/2004	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

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
9/27/2004	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	9.54	7.01E+14	4.24E+14	6084.23	4316.92	158.47	4381.58	6846.94	14.16	1.01E+15	5.96E+14	8446.11	1368.61	231.36	1284.93	15187.92
9/29/2004	0.60	0.24	2.03	1.49E+14	9.02E+13	1293.53	917.79	33.69	931.54	1455.68	4.34	3.11E+14	1.83E+14	2586.56	419.13	70.85	393.50	4651.19
9/30/2004	0.11	0.06	0.06	4.44E+12	2.69E+12	38.54	27.35	1.00	27.76	43.38	0	0	0	0	0	0	0	0
10/1/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/2/2004	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
10/4/2004	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
10/6/2004	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
10/8/2004	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
10/10/2004	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
10/12/2004	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
10/14/2004	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/2004	0.19	0.05	0.08	5.56E+12	3.37E+12	48.28	34.26	1.26	34.77	54.34	0.02	1.27E+12	7.45E+11	10.55	1.71	0.29	1.61	18.97
10/16/2004	0.01	0.01	0.01	4.07E+11	2.47E+11	3.54	2.51	0.09	2.55	3.98	0.01	6.91E+11	4.06E+11	5.75	0.93	0.16	0.88	10.35
10/17/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/18/2004	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/19/2004	0.53	0.13	0.71	5.20E+13	3.15E+13	451.22	320.15	11.75	324.95	507.79	0.94	6.71E+13	3.94E+13	558.65	90.52	15.30	84.99	1004.57
10/20/2004	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
10/22/2004	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
10/24/2004	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
10/26/2004	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
10/28/2004	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
10/30/2004	0.04	0.03	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
11/1/2004	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
11/3/2004	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	2.69	1.98E+14	1.20E+14	1716.84	1218.15	44.72	1236.39	1932.06	5.06	3.63E+14	2.13E+14	3017.51	488.96	82.66	459.06	5426.13
11/5/2004	0.03	0.02	0.01	3.81E+11	2.31E+11	3.31	2.35	0.09	2.38	3.72	0.01	5.58E+11	3.28E+11	4.65	0.75	0.13	0.71	8.35
11/6/2004	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
11/8/2004	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
11/10/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
11/11/2004	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	1.52	1.12E+14	6.76E+13	970.28	688.44	25.27	698.75	1091.92	2.48	1.78E+14	1.04E+14	1480.70	239.93	40.56	225.26	2662.61
11/13/2004	0.15	0.05	0.14	9.97E+12	6.03E+12	86.56	61.42	2.25	62.34	97.41	0.35	2.47E+13	1.45E+13	205.84	33.35	5.64	31.31	370.14
11/14/2004	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
11/16/2004	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
11/18/2004	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
11/20/2004	0.27	0.08	0.32	2.33E+13	1.41E+13	202.13	143.42	5.26	145.57	227.47	0.54	3.87E+13	2.27E+13	321.75	52.14	8.81	48.95	578.57
11/21/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/22/2004	0.04	0.04	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
11/24/2004	0.21	0.05	0.01	6.56E+11	3.97E+11	5.69	4.04	0.15	4.10	6.41	0	0	0	0	0	0	0	0
11/25/2004	0.22	0.08	0.10	7.35E+12	4.45E+12	63.84	45.29	1.66	45.97	71.84	0.06	4.20E+12	2.47E+12	34.94	5.66	0.96	5.32	62.84
11/26/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/27/2004	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	4.53	3.33E+14	2.01E+14	2890.00	2050.53	75.27	2081.24	3252.29	5.23	3.75E+14	2.20E+14	3119.88	505.55	85.46	474.63	5610.22
11/29/2004	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
12/1/2004	1.00	0.18	2.61	1.91E+14	1.16E+14	1661.90	1179.16	43.29	1196.82	1870.23	4.48	3.21E+14	1.89E+14	2673.54	433.22	73.23	406.73	4807.59
12/2/2004	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
12/4/2004	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
12/6/2004	0.19	0.05	0.02	1.20E+12	7.24E+11	10.38	7.37	0.27	7.48	11.69	0	0	0	0	0	0	0	0
12/7/2004	0.57	0.20	0.79	5.79E+13	3.51E+13	503.08	356.95	13.10	362.29	566.14	1.23	8.79E+13	5.16E+13	731.41	118.52	20.04	111.27	1315.24
12/8/2004	0.07	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/9/2004	0.39	0.10	0.44	3.22E+13	1.95E+13	279.85	198.56	7.29	201.53	314.93	0.63	4.50E+13	2.65E+13	374.88	60.75	10.27	57.03	674.12
12/10/2004	0.35	0.07	0.37	2.68E+13	1.62E+13	232.84	165.21	6.06	167.68	262.03	0.81	5.83E+13	3.42E+13	484.95	78.58	13.28	73.78	872.04
12/11/2004	0.01	0.01	0	0	0	0	0	0	0	0	0.01	3.84E+11	2.26E+11	3.20	0.52	0.09	0.49	5.75
12/12/2004	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
12/14/2004	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
12/16/2004	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
12/18/2004	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
12/20/2004	0.04	0.01	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
12/22/2004	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	1.47	1.08E+14	6.55E+13	940.08	667.01	24.49	677.00	1057.93	2.16	1.55E+14	9.08E+13	1286.12	208.40	35.23	195.66	2312.73
12/24/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/25/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Row Labels	Daily Rainfall Total (inches)	Daily Rainfall - Max Hour (inches)	Anderson Daily Overflow Volume (MG)	Anderson Fecal (cfu/day)	Anderson Enterococci (cfu/day)	Anderson CBOD (lbs/day)	Anderson TKN (lbs/day)	Anderson TP (lbs/day)	Anderson TN (lbs/day)	Anderson TSS (lbs/day)	Court Daily Overflow Volume (MG)	Court Fecal (cfu/day)	Court Enterococci (cfu/day)	Court CBOD (lbs/day)	Court TKN (lbs/day)	Court TP (lbs/day)	Court TN (lbs/day)	Court TSS (lbs/day)
12/26/2004	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
12/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/29/2004	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
12/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANNUAL TOTAL	**47.54**	**1.32**	**105.45**	**7.75E+15**	**4.69E+15**	**67266.85**	**47727.59**	**1752.02**	**48442.44**	**75699.28**	**151.47**	**1.09E+16**	**6.38E+15**	**90357.10**	**14641.49**	**2475.09**	**13746.24**	**162481.48**
January Totals	1.67	0.09	1.65	1.21E+14	7.32E+13	1050.62	745.45	27.36	756.61	1182.33	1.97	1.41E+14	8.31E+13	1177.22	190.76	32.25	179.09	2116.89
February Totals	2.43	0.30	6.03	4.43E+14	2.68E+14	3848.61	2730.69	100.24	2771.59	4331.06	10.22	7.33E+14	4.30E+14	6096.63	987.90	167.00	927.49	10963.05
March Totals	2.36	0.23	1.42	1.04E+14	6.30E+13	903.59	641.12	23.53	650.72	1016.86	1.67	1.19E+14	7.01E+13	994.00	161.07	27.23	151.22	1787.42
April Totals	4.84	0.25	9.21	6.76E+14	4.09E+14	5873.26	4167.23	152.97	4229.65	6609.52	14.57	1.04E+15	6.13E+14	8691.52	1408.38	238.08	1322.26	15629.23
May Totals	4.59	0.69	9.07	6.67E+14	4.04E+14	5788.78	4107.29	150.77	4168.81	6514.45	11.11	7.96E+14	4.68E+14	6627.57	1073.93	181.54	1008.27	11917.80
June Totals	2.96	0.51	6.93	5.09E+14	3.08E+14	4420.74	3136.63	115.14	3183.61	4974.92	9.24	6.62E+14	3.89E+14	5509.86	892.82	150.93	838.23	9907.91
July Totals	8.39	0.71	23.27	1.71E+15	1.03E+15	14846.01	10533.63	386.68	10691.40	16707.07	34.84	2.50E+15	1.47E+15	20784.99	3368.01	569.35	3162.07	37375.89
August Totals	3.70	0.80	8.60	6.32E+14	3.83E+14	5489.09	3894.66	142.97	3952.99	6177.20	11.57	8.29E+14	4.87E+14	6902.66	1118.51	189.08	1050.12	12412.47
September Totals	8.02	1.32	23.48	1.72E+15	1.04E+15	14976.30	10626.08	390.07	10785.23	16853.69	32.28	2.31E+15	1.36E+15	19258.33	3120.63	527.53	2929.81	34630.62
October Totals	0.86	0.13	0.79	5.79E+13	3.51E+13	503.04	356.92	13.10	362.27	566.10	0.96	6.91E+13	4.06E+13	574.95	93.17	15.75	87.47	1033.89
November Totals	4.35	0.78	9.31	6.84E+14	4.14E+14	5938.67	4213.64	154.68	4276.75	6683.12	13.72	9.84E+14	5.78E+14	8185.26	1326.34	224.21	1245.24	14718.85
December Totals	3.37	0.30	5.69	4.18E+14	2.53E+14	3628.13	2574.25	94.50	2612.81	4082.95	9.31	6.67E+14	3.92E+14	5554.10	899.99	152.14	844.96	9987.47

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