Haverhill

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Water/Wastewater Division
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April 28, 2017

Water Technical Unit (OES04-3)
U.S. EPA - New England, Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912
Attn: Ms. Joy Hilton

Subject: City of Haverhill, MA NPDES Permit # MA 0101621
Consent Decree Submitted (Civil Action 16-11698-IT)
Combined Sewer Overflow Annual Report 2016

Dear Ms. Hilton:

In accordance with Part I.D.3.of the City of Haverhill's NPDES Permit and the Consent Decree Item VII.M.51, we are providing this annual report for the 2016 calendar year.

Enclosed is the certification statement required by paragraph 99 of the Consent Decree.

If you require additional information, please call me at (978) 374-2382.

Sincerely,

Robert E. Ward
Deputy DPW Director

Enclosure

cc: Chief, Environmental Enforcement Section, U.S. DOJ
Susan Poswistilo, U.S. Attorney, MA District
Michael Wagner, USEPA, wagner.michael@epa.gov
Kevin Brander, DEP, kevin.brander@state.ma.us
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Fred Haffty, WWTP Facility Manager, fhaffty@haverhillwater.com

Certification Statement

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Robert E. Ward
Deputy DPW Director
City of Haverhill

4/28/17
(date)

City of Haverhill

Department of Public Works
Wastewater Division

Annual Combined Sewer Overflow Report
Calendar Year 2016

NPDES Permit No. MA 0101621

Purpose

This report has been prepared in accordance with Part I, Section D of NPDES Permit No. MA0101621 issued to the City of Haverhill effective February 1, 2008. The permit authorizes the City to discharge flow from twenty (20) Combined Sewer Overflows (CSO) located in twenty-three (23) regulator structures to the receiving water bodies named in the Merrimack and Little Rivers. The report also satisfies the requirements of Item VII.M.51 of the Consent Decree (Civil Action No. 16-11698-IT) between the United States, Commonwealth of Massachusetts and the City of Haverhill.

As required by the NPDES permit and Consent Decree this report includes

- Information related to each combined sewer overflow event for each outfall including date and time the overflow started and stopped, the volume of the overflow for each event, the amount of precipitation associated with each overflow event, the total volume discharged from each outfall for the year, and the total volume discharged for the year
- Daily precipitation information including total precipitation, peak intensity, and average intensity.
- Certification that monthly inspections were completed
- Information related to the Nine Minimum Controls

CSO Regulators/Structures

Haverhill currently has 15 active CSO regulators/structures that are connected to 13 outfalls. Of the 13 outfalls, five discharge to the Little River, and eight discharge to the Merrimack River. Figure 1 shows the outfall locations. Two sets of two regulators share an outfall: Broadway and High Street CSO share the High Street (038) outfall and Winter/Hale and Winter Street CSOs share the Winter Street (021H) outfall.

Each of these CSO regulators is currently monitored by a set of depth and depth/velocity flow meters. The data is reported to a website maintained by the flow metering subcontractor, who also maintains the meters to make sure good flow data is collected.

Five of the CSO regulators structures also function as flood diversion structures. Sluice gates exist within the flood diversion structures to provide system flood protection and emergency relief to the collection system under high river flood conditions. Each sluice gate remains fully open unless the city is under a river flood condition.

Table 1 lists Haverhill's CSO outfalls and regulators along with their closed/open and metered status. In 2016, the City closed Little River North - 021D, Little River South- 021E, and Marginal PS 021M. Since 2012, the City has closed 13 CSO outfalls/regulators.

City Of Haverhill Combined Sewer Overflow

Outfall Locations

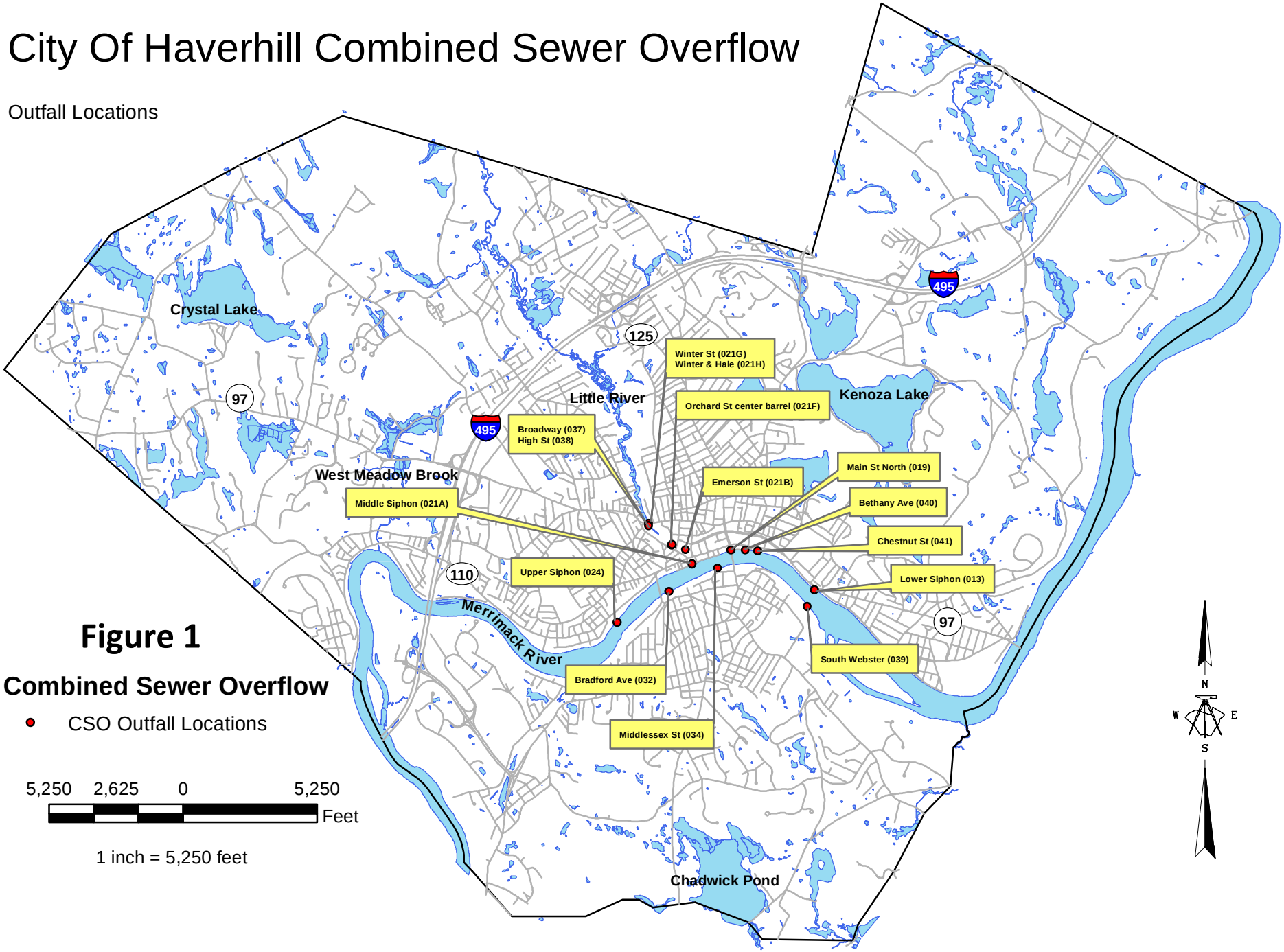

Figure 1

Combined Sewer Overflow

- CSO Outfall Locations

5,250 2,625 0 5,250

Feet

1 inch = 5,250 feet

11/16/2016

Table 1
CSO Outfalls and Regulators

NPDES ID	CSO Outfall Name	CSO Regulators (if more than 1)	CSO Closed Date	Monitored by Flow Meters
Lower Siphon CSOs				
001	Bates Bridge		07/24/2013	
010	Boardman Street		08/14/2013	
016	Fire Station		08/07/2013	
019	Main Street North			X
013	Lower Siphon			X
039	Bethany Avenue			X
040	Chestnut Street			X
Middle Siphon CSOs				
038	High Street	Broadway (038)		X
		High Street (038)		X
021B	Emerson Street			X
021H	Winter Street	Winter Street (021G)		X
		Winter/Hale Street (021H)		X
021D	Little River North	Orchard Street Center Barrel (021F)		X
		Little River North (12-in) (021D)	10/08/2016	X
021E	Little River South (18-in)		10/06/2016	X
021A	Middle Siphon	Middle CSO (021A)		X
		Marginal PS (021M)	09/01/2016	X
Upper Siphon CSOs				
022	Railroad Bridge		03/31/2012	
023	River Street		08/14/2013	
025	Beach Street		03/19/2014	
024	Upper Siphon			X
South-Side CSOs				
031	Front Street		07/10/2013	
032	Bradford Avenue			X
033	South Prospect Street		07/19/2013	
034	Middlesex Street			X
035	Main Street South		07/31/2013	
036	Ferry Street		08/15/2013	
041	South Webster			X

Haverhill's CSO Program Progress

The City has been making progress on its CSO abatement program for more than 20 years. In August 2002, a Final Phase I CSO Long Term Control Plan (FLTCP) was submitted to the EPA and the Massachusetts Department of Environmental Protection (DEP). The recommended plan included improvements to increase treatment capacity at the WWTP, influent pump station upgrades to handle additional wet weather flow, and regulator modifications to the five Bradford-side CSOs on the south bank of the Merrimack River.

The benefits of the Phase I CSO Abatement Program improvements included a modeled reduction of annual CSO volume from 70 million to 30 million gallons and an increase of the percent capture of wet weather flow from 92 to 97 percent.

These improvements were all implemented by 2006 and cost $22 million.

In July 2011, the city's Phase II CSO LTCP was submitted to the USEPA and DEP. Based on EPA and DEP comments, the city revised its Phase II CSO Long Term Control Plan (LTCP) and submitted it to the EPA and DEP in June 2013. The plan documented the effectiveness of Phase I CSO controls and improvements, and recommended a plan to continue to address the remaining CSOs. The revised plan included the permanent closure of 13 CSOs, raising of weirs at three CSO regulators, and implementation of the Wet Weather System Maximization/CSO Structure Modifications project which included CSO regulator modifications, a new diversion sewer, and installation of a real-time automated flow system to further increase CSO discharge control.

These system improvements have been implemented and will be fully completed by March 2017. The improvements are expected to reduce annual CSO volume to approximately 20 million gallons, eliminate or reduce the frequency of CSOs from a number of outfalls, and increase the percent capture of wet weather flow to about 98 percent. The cost of Phase II was $12 million.

In February 2017, the city completed and submitted an Integrated Final LTCP which encompasses Capacity Maintenance Operation Management (CMOM) for the collection system; a Wastewater Comprehensive Plant Evaluation (CPE); Infiltration Inflow Assessment (I/I); Green Infrastructure; SWMM model calibration to include refinement of the combine and separate catchment acreage.

CSO Outfall Activation Frequency and Discharge Volume

Activation frequency and discharge volume is measured by depth and depth/velocity meters installed by the City's consultant, CDM Smith and sub-contractor Flow Assessment. Flow Assessment provides necessary maintenance on all CSO flow meters throughout the year. These flow meters are accessible through the internet with a user ID and password.

Each flow meter is queried to obtain 5-minute readings, exported to Excel, and all non-reporting times are removed, leaving with 1,787,040 data points. Every CSO meter is recorded in this manner and has its own separate tab in Excel. CSO volumes are created for each CSO Flow meter recording to provide the information in Appendix A.

Flow Assessment has sent the City monthly and yearly flow data so that an error is less likely to happen. The City used this summation to manipulate the sent data into the correct format. The yearly CSO totals were cross reference with the original Flow Assessment file.

Table 2 shows the total combined sewer discharged from each outfall for 2016 and the total from all outfalls for the year.

Appendix A shows activation frequency and discharge volume for each CSO during the 2016 calendar year for each of the CSO discharge outfalls.

Table 2
CSO Flow Meter Summary per Outfall

NPDES ID	NPDES Description	Total Gallons
013	Lower Siphon	4,373,730
021A	Middle Siphon	3,178,814
021B	Emerson Street	33,075
021D	Locke Street South (12-inch siphon)	466,262
021E	Locke Street South (18-inch siphon)	137,572
021F	Middle Barrel Radio Market	3,974,702
021G	Winter street	98,384
021H	Winter and Hale	1,457,399
021M	Marginal Pump Station	941,618
024	Upper siphon	3,125,486
032	Bradford Avenue	1,040,930
034	Middlesex Street	1,333,607
039	South Webster Street	267,008
040	Bethany Avenue	758,411
041	Chestnut Street	244,733
Grand Total		**21,431,731**

Precipitation

Rain data is collected at the City of Haverhill Wastewater Treatment Plant using a RainWise, Inc., rain gage. The rain is measured in 15-minute intervals to within 0.01 inches. NetStorm utilizes the rain gauge information and develops rainfall statistics per storm event. NetStorm data was used to develop Appendix A and Appendix B.

Appendix B shows precipitation during the previous year for each day, including total rainfall (expressed in inches), peak intensity (highest 15 minute sample multiplied by four to convert to inches per hour), and average intensity. Note that some storm durations last longer than one day, for an example, the storm on 10/01/2016 lasted for 31.75 hours. The City received 33.81 inches of rainfall for calendar year 2016. The average rainfall amount is 42.91 inches.

Nine Minimum Controls

Appendix C provides an update on the City's implementation of the Nine Minimum Controls. This update is taken from Section 3.2 of the "*Integrated Final Combined Sewer Overflow (CSO) Long-Term Control Plan/Supplemental Environmental Impact Report (EOEA#12088)"* which was submitted by the City in February 2017. The City expects to continue this NMC program in 2017.

The City's Public Notification Program, (required by the NMC), consists of public education about CSO discharges and their impacts. "Real-Time" notification of the receiving water impacts or use restrictions during the activation of the CSO discharge is not feasible (due to its transient and intermittent occurrences). Accordingly, the City relies on a general education program and the City's official web site to keep the public aware of the possible health risks.

The address below is the City's CSO web site: http://www.ci.haverhill.ma.us/departments/public_works_department/water_wastewater/wastewater/wastewater_collection_system/combined_sewer_overflows_%28cso%29/index.php

Part of the public notification program includes an email notification to the list in Appendix D within 24-hours of a CSO occurrence.

The City has compiled all block check results and plotted these results with available Supervisory Control and Data Acquisition (SCADA) influent flows along with available rainfall data from 2008 through 2010; found that when the City receives 0.10 inches of rain the City could expect a CSO occurrence. Calendar year 2014 the lowest rainfall event that triggered a CSO occurrence was 0.10 inches. For calendar year 2016; 0.04-inches was the lowest that a CSO occurred 61 gallons see appendix A (August 16, 2016 storm) for more details.

Appendix A

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
034	Middlesex ST	01/07/2016	19:15	01/07/2016	19:20	1,910	0.08	no rain	snow melt		
				STORM TOTALS:		**1,910**					
040	Bethany Avenue	01/10/2016	11:55	01/10/2016	16:25	22,651	4.50	1.62	0.13	15.25	0.11
021E	Locke ST So. (12-in siphon)				16:25	412	0.08	1.62	0.13	15.25	0.11
041	Chestnut ST	01/10/2016	11:55	01/10/2016	16:30	33,513	4.58	1.62	0.13	15.25	0.11
034	Middlesex ST	01/10/2016	12:00	01/10/2016	16:30	103,933	4.50	1.62	0.13	15.25	0.11
032	Bradford Avenue	01/10/2016	12:00	01/10/2016	16:35	420,730	4.58	1.62	0.13	15.25	0.11
039	South Webster ST	01/10/2016	11:55	01/10/2016	16:40	78,090	4.75	1.62	0.13	15.25	0.11
021H	Winter and Hale	01/10/2016	12:00	01/10/2016	16:40	93,786	4.67	1.62	0.13	15.25	0.11
024	Upper Siphon	01/10/2016	13:35	01/10/2016	16:40	72,393	3.08	1.62	0.13	15.25	0.11
021F	Middle Barrel Radio Market	01/10/2016	11:40	01/10/2016	16:55	455,700	5.25	1.62	0.13	15.25	0.11
021A	Middle Siphon	01/10/2016	12:20	01/10/2016	16:55	807,475	4.58	1.62	0.13	15.25	0.11
021D	Locke ST So. (12-in siphon)	01/10/2016	9:15	01/10/2016	17:00	103,428	7.75	1.62	0.13	15.25	0.11
021M	Marginal Pump Station	01/10/2016	9:40	01/10/2016	17:35	209,126	7.92	1.62	0.13	15.25	0.11
013	Lower Siphon	01/10/2016	12:25	01/10/2016	17:40	1,771,249	5.25	1.62	0.13	15.25	0.11
				STORM TOTALS:		**4,172,486**					
021D	Locke ST So. (12-in siphon)	01/16/2016	7:10	01/16/2016	13:30	5,011	6.33	0.49	0.03	7.75	0.06
021M	Marginal Pump Station	01/16/2016	7:45	01/16/2016	13:45	12,599	6.00	0.49	0.03	7.75	0.06
				STORM TOTALS:		**17,611**					
021D	Locke ST So. (12-in siphon)	02/05/2016	6:00	02/05/2016	6:10	365	0.17	0.79	0.04	12.75	0.06
040	Bethany Avenue				17:05	142	0.08	0.47	0.05	6.75	0.07
021F	Middle Barrel Radio Market	02/16/2016	17:20	02/16/2016	18:45	127,090	1.42	0.37	0.05	6.25	0.06
021D	Locke ST So. (12-in siphon)	02/16/2016	13:40	02/16/2016	20:00	39,041	6.33	0.37	0.05	6.25	0.06
021M	Marginal Pump Station	02/16/2016	14:30	02/16/2016	20:50	115,852	6.33	0.37	0.05	6.25	0.06
				STORM TOTALS:		**282,490**					
021M	Marginal Pump Station	02/24/2016	15:35	02/24/2016	16:50	34,324	1.25	1.08	0.19	27.00	0.04
041	Chestnut ST	02/25/2016	3:15	02/25/2016	3:25	4,346	0.17	1.08	0.19	27.00	0.04
039	South Webster ST	02/25/2016	3:20	02/25/2016	3:30	3,561	0.17	1.08	0.19	27.00	0.04
021F	Middle Barrel Radio Market	02/24/2017	15:20	02/25/2016	4:05	57,126	12.75	1.08	0.19	27.00	0.04
021D	Locke ST So. (12-inch siphon)	02/24/2017	15:25	02/25/2016	4:15	23,220	12.83	1.08	0.19	27.00	0.04
021M	Marginal Pump Station	02/25/2017	3:55	02/25/2017	5:00	40,017	1.08	1.08	0.19	27.00	0.04
				STORM TOTALS:		**162,594**					
021D	Locke ST So. (12-in siphon)	03/02/2017	1:40	03/02/2017	9:30	8,396	7.83	0.44	0.04	9.00	0.05
021M	Marginal Pump Station	03/02/2017	8:20	03/02/2017	9:50	9,927	1.50	0.44	0.04	9.00	0.05
				STORM TOTALS:		**18,323**					
021D	Locke ST So. (12-in siphon)	03/10/2017	21:25	03/10/2017	21:40	939	0.25	0.66	0.03	19.25	0.03
				STORM TOTALS:		**939**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
040	Bethany Avenue				4:50	1,081	0.08	0.91	0.06	25.75	0.04
021F	Middle Barrel Radio Market	03/15/2017	4:55	03/15/2017	5:10	13,099	0.25	0.91	0.06	25.75	0.04
021M	Marginal Pump Station	03/15/2017	5:10	03/15/2017	6:20	28,515	1.17	0.91	0.06	25.75	0.04
021D	Locke ST So. (12-in siphon)	03/15/2017	5:15	03/15/2017	9:35	3,443	4.33	0.91	0.06	25.75	0.04
				STORM TOTALS:		**46,138**					
040	Bethany Avenue	03/17/2017	0:45	03/17/2017	0:55	4,980	0.17	0.18	0.12	4.00	0.05
021F	Middle Barrel Radio Market	03/17/2017	0:55	03/17/2017	1:00	5,971	0.08	0.18	0.12	4.00	0.05
021M	Marginal Pump Station	03/17/2017	0:55	03/17/2017	1:15	4,632	0.33	0.18	0.12	4.00	0.05
				STORM TOTALS:		**15,583**					
021D	Locke ST So. (12-in siphon)	03/25/2017	8:45	03/25/2017	9:40	2,415	0.92	0.18	0.05	14.25	0.01
021M	Marginal Pump Station	03/25/2017	9:05	03/25/2017	9:55	7,726	0.83	0.18	0.05	14.25	0.01
				STORM TOTALS:		**10,141**					
021F	Middle Barrel Radio Market	03/28/2017	14:55	03/28/2017	15:25	29,420	0.50	0.70	0.06	10.00	0.07
021D	Locke ST So. (12-in siphon)	03/28/2017	8:05	03/28/2017	15:40	7,430	7.58	0.70	0.06	10.00	0.07
021M	Marginal Pump Station	03/28/2017	8:30	03/28/2017	16:30	39,531	8.00	0.70	0.06	10.00	0.07
				STORM TOTALS:		**76,381**					
032	Bradford Avenue			04/01/2017	19:30	14,550	0.08	1.20	0.10	8.50	0.14
034	Middlesex ST			04/01/2017	19:30	17,356	0.08	0.15	0.12	0.50	0.30
040	Bethany Avenue			04/01/2017	19:30	6,035	0.08	0.15	0.12	0.5	0.3
041	Chestnut ST			04/01/2017	19:30	413	0.08	0.15	0.12	0.5	0.3
039	South Webster ST	04/01/2017	19:30	04/01/2017	19:35	4,053	0.08	0.15	0.12	0.50	0.30
021D	Locke ST So. (12-in siphon)	04/01/2017	19:40	04/01/2017	19:45	671	0.08	0.15	0.12	0.50	0.30
021M	Marginal Pump Station	04/01/2017	19:40	04/01/2017	20:00	7,846	0.33	0.15	0.12	0.50	0.30
				STORM TOTALS:		**50,924**					
021D	Locke ST So. (12-inch siphon)	04/02/2017	18:45	04/02/2017	18:50	790	0.08	0.18	0.05	10.75	0.02
				STORM TOTALS:		**790**					
034	Middlesex ST	04/07/2017	15:10	04/07/2017	15:15	22,687	0.08	1.20	0.10	8.50	0.14
041	Chestnut ST	04/07/2017	14:05	04/07/2017	15:30	10,118	1.42	0.15	0.12	0.50	0.30
032	Bradford Avenue	04/07/2017	15:10	04/07/2017	15:35	61,478	0.42	0.15	0.12	0.50	0.30
021H	Winter and Hale	04/07/2017	15:20	04/07/2017	15:40	5,765	0.33	1.20	0.10	8.50	0.14
040	Bethany Avenue	04/07/2017	10:30	04/07/2017	15:50	63,491	5.33	0.15	0.12	0.50	0.30
039	South Webster ST	04/07/2017	15:10	04/07/2017	15:55	16,309	0.75	1.20	0.10	8.50	0.14
021F	Middle Barrel Radio Market	04/07/2017	10:35	04/07/2017	16:45	285,918	6.17	0.15	0.12	0.50	0.30
021M	Marginal Pump Station	04/07/2017	11:00	04/07/2017	17:00	126,356	6.00	0.15	0.12	0.50	0.30
013	Lower Siphon	04/07/2017	15:40	04/07/2017	17:00	278,445	1.33	1.20	0.10	8.50	0.14
021D	Locke ST So. (12-in siphon)	04/07/2017	12:00	04/07/2017	17:55	3,713	5.92	0.15	0.12	0.50	0.30
				STORM TOTALS:		**874,281**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
021D	Locke ST So. (12-in siphon)	04/26/2016	11:15	04/26/2016	11:55	3,035	0.67	0.26	0.02	1.75	0.04
021M	Marginal Pump Station	04/26/2016	11:45	04/26/2016	12:00	885	0.25	0.26	0.02	1.75	0.04
				STORM TOTALS:		**3,920**					
040	Bethany Avenue	05/02/2017	12:00	05/02/2017	12:05	8,523	0.08	0.26	0.02	1.75	0.04
021F	Middle Barrel Radio Market	05/02/2017	12:00	05/02/2017	12:15	10,663	0.25	0.26	0.02	1.75	0.04
021D	Locke ST So. (12-in siphon)	05/02/2017	11:45	05/02/2017	12:20	4,010	0.58	0.26	0.02	1.75	0.04
021M	Marginal Pump Station	05/02/2017	12:00	05/02/2017	12:30	22,909	0.50	0.26	0.02	1.75	0.04
				STORM TOTALS:		**46,105**					
032	Bradford Avenue				20:35	2,226	0.08	0.17	0.03	5.75	0.03
034	Middlesex ST				20:35	11,877	0.08	0.17	0.03	5.75	0.03
039	South Webster ST				20:35	199	0.08	0.17	0.03	5.75	0.03
040	Bethany Avenue				20:35	6,094	0.08	0.17	0.03	5.75	0.03
021F	Middle Barrel Radio Market	05/06/2017	20:35	05/06/2017	20:50	10,125	0.25	0.26	0.02	1.75	0.04
021D	Locke ST So. (12-in siphon)	05/06/2017	20:30	05/06/2017	20:55	6,443	0.42	0.26	0.02	1.75	0.04
021M	Marginal Pump Station	05/06/2017	20:40	05/06/2017	21:00	26,326	0.33	0.26	0.02	1.75	0.04
				STORM TOTALS:		**63,290**					
021D	Locke ST So. (12-in siphon)	05/24/2017	7:20	05/24/2017	8:00	3,656	0.67	0.26	0.02	1.75	0.04
021G	Winter ST	06/05/2017	20:40	06/05/2017	20:45	7260	0.08	1.14	0.03	7.00	0.16
				STORM TOTALS:		**10,916**					
040	Bethany Avenue	06/05/2017	17:15	06/05/2017	20:50	133,907	3.58	0.26	0.02	1.75	0.04
034	Middlesex ST	06/05/2017	17:20	06/05/2017	20:50	78,041	3.50	1.14	0.03	7.00	0.16
021E	Locke ST So. (12-in siphon)	06/05/2017	20:40	06/05/2017	20:50	29,496	0.17	0.26	0.02	1.75	0.04
032	Bradford Avenue	06/05/2017	17:25	06/05/2017	20:55	178,868	3.50	0.17	0.11	0.08	0.23
021A	Middle Siphon	06/05/2017	20:40	06/05/2017	20:55	79,441	0.25	1.14	0.03	7.00	0.16
041	Chestnut ST	06/05/2017	17:20	06/05/2017	21:00	33,630	3.67	0.26	0.02	1.75	0.04
021H	Winter and Hale	06/05/2017	17:25	06/05/2017	21:00	152,222	3.58	1.20	0.10	8.50	0.14
039	South Webster ST	06/05/2017	17:25	06/05/2017	21:00	22,563	3.58	1.14	0.03	7.00	0.16
024	Upper siphon	06/05/2017	20:45	06/05/2017	21:00	70,070	0.25	1.14	0.03	7.00	0.16
021F	Middle Barrel Radio Market	06/05/2017	17:20	06/05/2017	21:10	277,989	3.83	0.26	0.02	1.75	0.04
013	Lower Siphon	06/05/2017	21:20	06/05/2017	21:25	1,164	0.08	1.14	0.03	7.00	0.16
021D	Locke ST So. (12-in siphon)	06/05/2017	16:40	06/05/2017	21:30	52,081	4.83	0.26	0.02	1.75	0.04
021M	Marginal Pump Station	06/05/2017	17:00	06/05/2017	21:30	124,897	4.50	0.26	0.02	1.75	0.04
				STORM TOTALS:		**1,234,368**					
021D	Locke ST So. (12-in siphon)	06/07/2017	5:55	06/07/2017	6:05	1,976	0.17	0.05	0.03	1.50	0.03
				STORM TOTALS:		**1,976**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
040	Bethany Avenue	06/21/2017	3:00	06/21/2017	3:10	23,964	0.17	0.26	0.02	1.75	0.04
034	Middlesex ST	06/21/2017	3:05	06/21/2017	3:10	18,211	0.08	0.17	0.11	0.08	0.23
032	Bradford Avenue				3:10	7,146	0.08	0.17	0.11	0.75	0.23
039	South Webster ST				3:10	393	0.08	0.17	0.11	0.08	0.23
021H	Winter and Hale	06/21/2017	3:10	06/21/2017	3:15	1,560	0.08	0.17	0.11	0.08	0.23
041	Chestnut ST	06/21/2017	3:05	06/21/2017	3:20	11,599	0.25	0.26	0.02	1.75	0.04
021F	Middle Barrel Radio Market	06/21/2017	3:00	06/21/2017	3:30	40,041	0.50	0.26	0.02	1.75	0.04
021D	Locke ST So. (12-in siphon)	06/21/2017	2:50	06/21/2017	3:35	9,702	0.75	0.26	0.02	1.75	0.04
021M	Marginal Pump Station	06/21/2017	3:10	06/21/2017	3:40	58,037	0.50	0.26	0.02	1.75	0.04
				STORM TOTALS:		**170,653**					
021F	Middle Barrel Radio Market	07/01/2017	21:20	07/01/2017	21:35	11,123	0.25	0.23	0.03	3.25	0.07
021D	Locke ST So. (12-in siphon)	07/01/2017	21:00	07/01/2017	21:45	4,749	0.75	0.23	0.03	3.25	0.07
021M	Marginal Pump Station	07/01/2017	21:45	07/01/2017	22:25	29,652	0.67	0.23	0.03	3.25	0.07
				STORM TOTALS:		**45,524**					
040	Bethany Avenue				19:20	349	0.08	0.29	0.02	11	0.03
041	Chestnut ST	07/09/2017	19:20	07/09/2017	19:30	1,362	0.17	0.29	0.02	11.00	0.03
021F	Middle Barrel Radio Market	07/09/2017	19:20	07/09/2017	19:35	17,159	0.25	0.29	0.02	11.00	0.03
021D	Locke ST So. (12-in siphon)	07/09/2017	19:10	07/09/2017	19:40	4,419	0.50	0.29	0.02	11.00	0.03
021M	Marginal Pump Station	07/09/2017	19:25	07/09/2017	19:50	29,093	0.42	0.29	0.02	11.00	0.03
				STORM TOTALS:		**52,382**					
034	Middlesex ST				14:30	12,643	0.08	0.65	0.04	13.25	0.05
039	South Webster ST				15:10	18,735	0.08	0.65	0.04	13.25	0.05
021D	Locke ST So. (12-in siphon)	07/18/2017	14:25	07/18/2017	15:15	3,242	0.83	0.65	0.04	13.25	0.05
021M	Marginal Pump Station	07/18/2017	15:00	07/18/2017	15:20	13,368	0.33	0.65	0.04	13.25	0.05
				STORM TOTALS:		**47,989**					
021D	Locke ST So. (12-in siphon)	07/24/2017	6:45	07/24/2017	6:50	169	0.08	0.05	0.04	13.25	0.05
				STORM TOTALS:		**169**					
040	Bethany Avenue	08/10/2017	9:10	08/10/2017	9:50	7,568	0.67	0.65	0.04	13.25	0.05
041	Chestnut ST	08/10/2017	9:50	08/10/2017	9:55	2,844	0.08	0.65	0.04	13.25	0.05
021F	Middle Barrel Radio Market	08/10/2017	9:10	08/10/2017	10:15	91,628	1.08	0.65	0.04	13.25	0.05
021D	Locke ST So. (12-in siphon)	08/10/2017	8:55	08/10/2017	10:25	14,840	1.50	0.65	0.04	13.25	0.05
				STORM TOTALS:		**116,880**					
040	Bethany Avenue				21:20	4,963	0.08	0.47	0.09	3.75	0.13
041	Chestnut ST	08/13/2017	21:15	08/13/2017	21:25	3,233	0.17	0.47	0.09	3.75	0.13
021F	Middle Barrel Radio Market	08/13/2017	21:20	08/13/2017	22:00	64,082	0.67	0.47	0.09	3.75	0.13
021D	Locke ST So. (12-in siphon)	08/13/2017	21:10	08/13/2017	22:10	10,302	1.00	0.47	0.09	3.75	0.13
				STORM TOTALS:		**82,580**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
021D	Locke ST So. (12-in siphon)				15:55	61	0.08	0.04	0.01	0.25	0.16
				STORM TOTALS:		**61**					
021D	Locke ST So. (12-in siphon)	08/17/2017	7:50	08/17/2017	20:00	28,833	12.17		SSO-16-18		
021G	Winter ST				3:00	914	0.08	0.9	0.29	4	0.23
040	Bethany Avenue	08/22/2017	2:35	08/22/2017	3:15	61,644	0.67	0.90	0.29	4.00	0.23
034	Middlesex ST	08/22/2017	2:40	08/22/2017	3:15	43,520	0.58	0.90	0.29	4.00	0.23
039	South Webster ST	08/22/2017	2:40	08/22/2017	3:20	11,876	0.67	0.90	0.29	4.00	0.23
021H	Winter and Hale	08/22/2017	2:35	08/22/2017	3:25	251,493	0.83	0.90	0.29	4.00	0.23
021E	Locke ST So. (12-in siphon)	08/22/2017	2:45	08/22/2017	3:25	107,664	0.67	0.90	0.29	4.00	0.23
024	Upper siphon	08/22/2017	2:50	08/22/2017	3:25	353,835	0.58	0.90	0.29	4.00	0.23
021D	Locke ST So. (12-in siphon)	08/22/2017	2:15	08/22/2017	3:40	49,352	1.42	0.90	0.29	4.00	0.23
021F	Middle Barrel Radio Market	08/22/2017	2:15	08/22/2017	3:40	705,202	1.42	0.90	0.29	4.00	0.23
041	Chestnut ST	08/22/2017	2:30	08/22/2017	3:40	48,913	1.17	0.90	0.29	4.00	0.23
013	Lower Siphon	08/22/2017	3:05	08/22/2017	4:30	146,366	1.42	0.90	0.29	4.00	0.23
				STORM TOTALS:		**1,780,778**					
041	Chestnut ST	09/01/2017	6:40	09/01/2017	7:25	1,266	0.75		SSO-16-19		
040	Bethany Avenue	09/01/2017	9:20		9:25	31,505	0.08	0.17	0.10	1.75	0.10
021G	Winter ST				9:25	262	0.08	0.17	0.1	1.75	0.1
034	Middlesex ST				9:25	13,420	0.08	0.17	0.1	1.75	0.1
039	South Webster ST				9:30	166	0.08	0.17	0.1	1.75	0.1
021H	Winter and Hale	09/11/2016	9:25	09/11/2016	9:35	15,305	0.17	0.17	0.10	1.75	0.10
021F	Middle Barrel Radio Market	09/11/2016	9:25	09/11/2016	9:40	24,130	0.25	0.17	0.10	1.75	0.10
021D	Locke ST So. (12-in siphon)	09/11/2016	9:25	09/11/2016	9:45	9,053	0.33	0.17	0.10	1.75	0.10
				STORM TOTALS:		**93,841**					
021G	Winter ST			09/19/2016	2:20	7,016	0.08	1.05	0.25	12.75	0.08
041	Chestnut ST	09/11/2016	9:25	09/19/2016	5:45	25,664	188.33	0.17	0.10	1.75	0.10
034	Middlesex ST	09/19/2016	2:20	09/19/2016	5:50	41,022	3.50	1.05	0.25	12.75	0.08
040	Bethany Avenue	09/19/2016	2:20	09/19/2016	5:50	84,431	3.50	1.05	0.25	12.75	0.08
021A	Middle Siphon			09/19/2016	5:50	2,338	0.08	1.05	0.25	12.75	0.08
021H	Winter and Hale	09/19/2016	2:20	09/19/2016	6:00	96,304	3.67	1.05	0.25	12.75	0.08
039	South Webster ST	09/19/2016	2:20	09/19/2016	6:05	15,558	3.75	1.05	0.25	12.75	0.08
021F	Middle Barrel Radio Market	09/19/2016	2:20	09/19/2016	6:15	138,042	3.92	1.05	0.25	12.75	0.08
021D	Locke ST So. (12-in siphon)	09/19/2016	2:25	09/19/2016	6:20	31,528	3.92	1.05	0.25	12.75	0.08
				STORM TOTALS:		**441,903**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	Daily Avg. Intensity (in./hr.)
041	Chestnut ST			09/23/2017	19:15	984	0.08	0.68	0.22	5	0.14
040	Bethany Avenue	09/23/2017	19:15	09/23/2017	19:30	15,837	0.25	0.68	0.22	5.00	0.14
034	Middlesex ST	09/23/2017	19:20	09/23/2017	19:30	21,838	0.17	0.68	0.22	5.00	0.14
021H	Winter and Hale	09/23/2017	19:15	09/23/2017	19:35	20,697	0.33	0.68	0.22	5.00	0.14
039	South Webster ST	09/23/2017	19:20	09/23/2017	19:40	12,570	0.33	0.68	0.22	5.00	0.14
021F	Middle Barrel Radio Market	09/23/2017	19:10	09/23/2017	20:45	18,524	1.58	0.68	0.22	5.00	0.14
021D	Locke ST So. (12-in siphon)	09/23/2017	19:05	09/23/2017	21:00	25,975	1.92	0.68	0.22	5.00	0.14
				STORM TOTALS:		**116,424**					
040	Bethany Avenue			10/01/2017	4:30	1,123	0.08	0.87	0.13	0.75	0.03
039	South Webster ST	10/01/2017	4:35	10/01/2017	4:45	3,670	0.17	0.87	0.13	31.75	0.03
021F	Middle Barrel Radio Market	10/01/2017	4:45	10/01/2017	4:55	11,239	0.17	0.87	0.13	31.75	0.03
021D	Locke ST So. (12-in siphon)	10/01/2017	4:30	10/01/2017	5:00	3,974	0.50	0.87	0.13	31.75	0.03
				STORM TOTALS:		**20,006**					
040	Bethany Avenue	10/09/2017	3:35	10/09/2017	3:40	18,576	0.08	1.64	0.08	21.25	0.08
021H	Winter and Hale	10/09/2017	3:40	10/09/2017	3:45	3,146	0.08	1.64	0.08	21.25	0.08
021F	Middle Barrel Radio Market	10/09/2017	3:40	10/09/2017	4:00	7,402	0.33	1.64	0.08	21.25	0.08
				STORM TOTALS:		**29,124**					
040	Bethany Avenue			10/20/2017	23:10	8,854	0.08	0.24	0.08	5.75	0.04
021H	Winter and Hale			10/20/2017	23:20	77	0.08	0.24	0.08	5.75	0.04
021F	Middle Barrel Radio Market	10/20/2017	23:10	10/20/2017	23:25	6,053	0.25	2.91	0.49	23.25	0.13
				STORM TOTALS:		**14,984**					
021B	Emerson ST	10/21/2017	20:35	10/21/2017	20:40	33,075	0.08	2.91	0.49	23.25	0.13
032	Bradford Avenue	10/21/2017	20:25	10/21/2017	21:15	355,931	0.83	2.91	0.49	23.25	0.13
041	Chestnut ST	10/21/2017	23:10	10/21/2017	21:25	66,850	22.25	2.91	0.49	23.25	0.13
040	Bethany Avenue	10/21/2017	18:00	10/21/2017	21:25	252,692	3.42	2.91	0.49	23.25	0.13
021G	Winter ST	10/21/2017	20:05	10/21/2017	21:25	82,932	1.33	2.91	0.49	23.25	0.13
039	South Webster ST	10/21/2017	18:05	10/21/2017	21:45	75,246	3.67	2.91	0.49	23.25	0.13
024	Upper siphon	10/21/2017	20:15	10/21/2017	21:50	2,629,189	1.58	2.91	0.49	23.25	0.13
021H	Winter and Hale	10/21/2017	18:10	10/21/2017	21:55	812,044	3.75	2.91	0.49	23.25	0.13
034	Middlesex ST	10/21/2017	18:05	10/21/2017	22:05	930,009	4.00	2.91	0.49	23.25	0.13
021A	Middle Siphon	10/21/2017	20:05	10/21/2017	22:35	2,289,559	2.50	2.91	0.49	23.25	0.13
021F	Middle Barrel Radio Market	10/21/2017	18:05	10/21/2017	22:50	1,118,365	4.75	2.91	0.49	23.25	0.13
013	Lower Siphon	10/21/2017	20:20	10/21/2017	23:15	2,176,506	2.92	2.91	0.49	23.25	0.13
				STORM TOTALS:		**10,822,398**					
021F	Middle Barrel Radio Market	10/28/2017	3:25	10/28/2017	6:00	17,865	2.58	1.52	0.08	25.75	0.06
				STORM TOTALS:		**17,865**					

Appendix A: CSO Flow Meter Summary

NPDES ID	CSO Identification	Start Date	Start Time	End Date	End Time	Total Vol (gals.) /event	CSO Duration (hr.)	Rain Total (in.)	Peak Hr Depth Intensity (in./hr.)	Storm Duration (hr.)	1.00
034	Middlesex ST	11/15/2017	19:15	11/15/2017	19:20	17,141	0.08	1.18	0.11	14.75	0.08
021H	Winter and Hale	11/15/2017	18:45	11/15/2017	19:25	656	0.67	1.18	0.11	14.75	0.08
039	South Webster ST	11/15/2017	18:45	11/15/2017	19:30	2,738	0.75	1.18	0.11	14.75	0.08
021F	Middle Barrel Radio Market	11/15/2017	17:15	11/15/2017	19:45	172,133	2.50	1.18	0.11	14.75	0.08
				STORM TOTALS:		**192,668**					
021F	Middle Barrel Radio Market	11/30/2017	23:45	11/30/2017	23:55	11,429	0.17	0.52	0.05	12.5	0.04
				STORM TOTALS:		**11,429**					
021H	Winter and Hale	12/01/2017	2:05	12/01/2017	2:15	4,344	0.17	1.18	0.11	14.75	0.08
021F	Middle Barrel Radio Market	12/01/2017	0:00	12/01/2017	2:30	86,298	2.50	0.52	0.05	12.5	0.04
				STORM TOTALS:		**90,642**					
039	South Webster ST	12/29/2017	18:55	12/29/2017	19:25	1,281	0.50	1.16	0.01	9.5	12
021F	Middle Barrel Radio Market	12/29/2017	18:35	12/29/2017	19:55	160,886	1.33		0.01	9.5	12
				STORM TOTALS:		**162,167**		**152.19**			

Appendix B

Appendix B

Calendar Year 2016 Rainfall Data

Storm Date	Rain Total (in.)	Peak Hour Depth Intensity (in./hr.)	Duration (hours)	Daily Avg. Intensity (in./hr.)
01/09/2016	0.01	0.01	0.25	0.04
01/10/2016	1.62	0.13	15.25	0.11
01/12/2016	0.10	0.04	1.25	0.08
01/16/2016	0.01	0.01	0.25	0.04
01/16/2016	0.49	0.03	7.75	0.06
01/18/2016	0.06	0.01	4.50	0.01
02/03/2016	0.20	0.02	10.75	0.02
02/05/2016	0.79	0.04	12.75	0.06
02/08/2016	0.31	0.02	12.50	0.02
02/15/2016	0.47	0.05	6.75	0.07
02/16/2016	0.37	0.05	6.25	0.06
02/24/2016	1.08	0.19	27.00	0.04
03/02/2016	0.44	0.04	9.00	0.05
03/04/2016	0.01	0.01	0.25	0.04
03/10/2016	0.66	0.03	19.25	0.03
03/14/2016	0.91	0.06	25.75	0.04
03/16/2016	0.18	0.12	4.00	0.05
03/17/2016	0.06	0.02	1.25	0.05
03/21/2016	0.36	0.03	6.50	0.06
03/23/2016	0.01	0.01	0.25	0.04
03/25/2016	0.18	0.05	14.25	0.01
03/28/2016	0.70	0.06	10.00	0.07
04/01/2016	0.01	0.01	0.25	0.04
04/01/2016	0.15	0.12	0.50	0.30
04/02/2016	0.18	0.05	10.75	0.02
04/03/2016	0.14	0.03	2.50	0.06
04/04/2016	0.26	0.02	6.75	0.04
04/07/2016	1.20	0.10	8.50	0.14
04/11/2016	0.02	0.01	1.25	0.02
04/11/2016	0.04	0.01	2.00	0.02
04/12/2016	0.18	0.02	4.75	0.04
04/13/2016	0.04	0.02	0.50	0.08
04/19/2016	0.02	0.01	0.50	0.04
04/22/2016	0.01	0.01	0.25	0.04
04/23/2016	0.07	0.02	1.75	0.04
04/26/2016	0.26	0.02	6.75	0.04
04/28/2016	0.03	0.01	1.75	0.02
05/01/2016	0.03	0.01	1.75	0.02
05/02/2016	0.30	0.06	18.50	0.02
05/03/2016	0.01	0.01	0.25	0.04

Appendix B

Calendar Year 2016 Rainfall Data

Storm Date	Rain Total (in.)	Peak Hour Depth Intensity (in./hr.)	Duration (hours)	Daily Avg. Intensity (in./hr.)
05/04/2016	0.25	0.02	12.75	0.02
05/05/2016	0.17	0.03	5.75	0.03
05/06/2016	0.16	0.05	9.50	0.02
05/08/2016	0.02	0.01	0.75	0.03
05/09/2016	0.02	0.01	0.50	0.04
05/13/2016	0.13	0.02	6.00	0.02
05/19/2016	0.01	0.01	0.25	0.04
05/24/2016	0.18	0.05	4.00	0.05
05/25/2016	0.01	0.01	0.25	0.04
05/30/2016	0.21	0.03	14.00	0.02
06/05/2016	1.14	0.03	7.00	0.16
06/07/2016	0.05	0.03	1.50	0.03
06/08/2016	0.04	0.03	0.75	0.05
06/21/2016	0.17	0.11	0.75	0.23
06/22/2016	0.01	0.01	0.25	0.04
06/28/2016	0.05	0.02	2.00	0.03
06/29/2016	0.04	0.01	5.25	0.01
07/01/2016	0.23	0.03	3.25	0.07
07/05/2016	0.08	0.01	3.25	0.02
07/09/2016	0.29	0.02	11.00	0.03
07/18/2016	0.65	0.04	13.25	0.05
07/23/2016	0.05	0.04	13.25	0.00
07/29/2016	0.04	0.01	6.25	0.01
07/31/2016	0.01	0.01	0.25	0.04
07/31/2016	0.01	0.01	0.25	0.04
08/01/2016	0.01	0.01	0.25	0.04
08/04/2016	0.03	0.01	0.25	0.12
08/06/2016	0.10	0.08	1.75	0.06
08/07/2016	0.02	0.01	0.25	0.08
08/10/2016	0.55	0.09	3.50	0.16
08/13/2016	0.47	0.09	3.75	0.13
08/16/2016	0.04	0.01	0.25	0.16
08/22/2016	0.90	0.29	4.00	0.23
09/05/2016	0.29	0.02	13.75	0.02
09/07/2016	0.05	0.02	13.75	0.00
09/11/2016	0.17	0.10	1.75	0.10
09/18/2016	0.04	0.01	1.75	0.02
09/19/2016	1.05	0.25	12.75	0.08
09/23/2016	0.68	0.22	5.00	0.14
09/27/2016	0.21	0.04	3.25	0.06
09/30/2016	0.87	0.13	31.75	0.03

Appendix B

Calendar Year 2016 Rainfall Data

Storm Date	Rain Total (in.)	Peak Hour Depth Intensity (in./hr.)	Duration (hours)	Daily Avg. Intensity (in./hr.)
10/04/2016	0.02	0.01	0.75	0.03
10/09/2016	1.64	0.08	21.25	0.08
10/18/2016	0.06	0.02	3.75	0.02
10/21/2016	0.24	0.08	5.75	0.04
10/21/2016	2.91	0.49	23.25	0.13
10/23/2016	0.01	0.01	0.25	0.04
10/27/2016	1.52	0.08	25.75	0.06
10/29/2016	0.01	0.01	0.25	0.04
10/30/2016	0.03	0.01	2.00	0.02
11/03/2016	0.02	0.01	1.25	0.02
11/06/2016	0.03	0.01	5.50	0.01
11/09/2016	0.01	0.01	0.25	0.04
11/15/2016	1.18	0.11	14.75	0.08
11/20/2016	0.09	0.04	3.25	0.03
11/24/2016	0.13	0.02	18.75	0.01
11/29/2016	0.52	0.05	12.50	0.04
11/30/2016	1.18	0.11	14.75	0.08
12/05/2016	0.17	0.02	6.50	0.03
12/07/2016	0.03	0.01	1.25	0.02
12/12/2016	0.41	0.04	9.50	0.04
12/17/2016	0.49	0.04	8.50	0.06
12/18/2016	0.05	0.02	6.25	0.01
12/22/2016	0.03	0.01	1.50	0.02
12/24/2016	0.29	0.03	4.50	0.06
12/26/2016	0.01	0.01	0.25	0.04
12/29/2016	1.16	0.01	9.50	0.12
12/31/2016	0.10	0.02	2.00	0.05
	33.81	4.96		

Appendix C

Section 3
LTCP Progress

3.1 General

Since the submittal of its Phase I LTCP in 2002, Haverhill has implemented many system improvements to reduce CSO discharges to the Merrimack River and the Little River. The city has spent approximately $34 million on planning, design, and construction of WWTP capacity improvements, interceptor storage maximization, CSO regulator improvements and instrumentation and controls equipment to achieve greater CSO control. The city captures 98 percent of the wet weather generated by its combined sewer system (as of March 2017).

This section provides a summary of the capital spending, planning programs, and compliance activities that the city of Haverhill has undertaken over the last 15 years since the Phase I LTCP program was first submitted to the agencies.

Table 3-1 summarizes the CSO reduction that the city has achieved.

Table 3-1 CSO Reduction Achieved by Haverhill's CSO Control Program

	Pre-Phase 1	Phase 1	Phase 2
City Expenditures		$22	$12
CSO Volume (MG)	71	30	20
Percent Capture	92%	97%	98%

3.2 Nine Minimum Control Measures

Nine minimum controls (NMC) for combined sewer systems are controls that can reduce CSOs and their effects on receiving water quality without requiring significant engineering studies or major construction and can be implemented in a short period of time. The city's NPDES permit requires the implementation of the NMCs as a first step to controlling CSO discharges. Haverhill continues to implement all aspects of the nine minimum control program submitted to the EPA in 1996. In its NPDES permit Annual Report the city summarizes any modifications to their approved NMC program and a description on the NMC to be implemented the following year.

Proper operation and regular maintenance programs for the sewer system and CSO outfalls

The city uses its Computerized Maintenance Management System (CMMS) MaintStar to track and manage the maintenance of their combined sewer system including inspection and cleaning of sewers, drains, pumping stations, CSO regulators and outfalls. Collection system inspection and cleaning is periodically done by outside contractors for the city. Sewer segments with frequent problems are added to a list in CMMS to receive more regular maintenance by the city's crew.

The city's goal is to inspect sewer pumping stations about once per week and complete preventive maintenance quarterly. Cleaning and maintenance of the interceptor system and siphons is performed on an as-needed basis. Collection system personnel perform monthly inspections of the CSO regulators and outfall. In addition, CSO regulators are monitored by flow meter that notify wastewater

managers when an activation occurs. If an activation notice is received during dry weather, collection system operators are dispatched to investigate immediately.

Maximize the use of the collection system for storage

The city's CSO regulators are controlled by weirs. As recommended by 2011 LTCP, weirs were raised at six of the CSO regulators to increase the amount of wet weather flow capture. In addition, the city closed thirteen other CSO regulators since 2011, which effectively increases the use of the collection system for wet weather storage.

The city is currently installing modulating CSO control gates at the Upper Siphon and Lower Siphon CSO regulators, along with instrumentation. The instrumentation controls and new gates will give the city real-time and automatic control to maximize the use of the Upper Siphon and Lower Siphon Interceptors for inline storage of wet weather flow to minimize CSO discharges.

Review and modification of pretreatment requirements to ensure the CSO impacts are minimized

The purpose of this control is to minimize impacts of discharges in the combined sewer system from non- domestic sources during wet weather events. The city of Haverhill maintains an industrial pretreatment program (IPP) that monitors significant industrial users (SIU) that discharge to the city's sewer system. The city's sewer use regulations prohibit any discharge to the collection system that may be detrimental to the wastewater treatment process or to the receiving water. These regulations establish limits for the amount of pollutant loads that can be discharged to the sewer system. All industrial discharges to the city's sewer system are required to adhere to the requirements of the city's IPP program.

The 2017 WWTP CPE noted that the city's WWTP has experienced some adverse operating characteristics that could be the results of inappropriate industrial discharges. The city has hired a new Industrial Pretreatment Program (IPP) supervisor to enhance its efforts on control of these discharges into the sewer system. In addition, the city has engaged an engineering consultant to review the IPP program.

Maximization of flow to the publicly owned treatment works (POTW) for treatment

The fourth minimum control is focused on minimal modifications to the collection system and WWTP to enable as much wet weather flow as possible to reach the treatment facility with the ultimate goal of reducing the magnitude, frequency and duration of CSOs to receiving waters. The city has implemented many measures to maximize flow to the WWTP, including raising weirs and adding CSO control gates that will allow real time control to minimize CSO discharge. In addition, in 2006, the city increased the wet weather treatment capacity at the WWTP by increasing its influent pumping capacity and adding a secondary bypass pipe to allow for primary treatment and disinfection of wet weather flow. In 2016, the city also modified the Bradford Avenue CSO and the Middle Siphon Inlet Structure to improve the flow capacity into its interceptor system to maximize flow the WWTP.

Elimination of overflows during dry weather

Overflows from the CSO discharge outfalls are prohibited under the NPDES permit. The city's CSO regulators are monitored to ensure that there are no known dry weather overflows (DWOs). Flow meter in the regulators notify wastewater managers when an activation occurs. If an activation notice is received during dry weather, collection system operators are dispatched to investigate.

There have been five dry weather discharges from the city's CSO regulators over the last 3 years. Four occurred at Locke St South (NPDES #021D) with three occurring in June 2014 and one occurring in August 2016. These dry weather discharges were caused by debris in the downstream 12-inch siphon, which conveys flow under the Little River conduit at Locke Street. This CSO (#021D) was permanently closed in Fall 2016 and the city has increased its maintenance of the siphon. The fifth dry weather discharge occurred in August 2016 at the Chestnut Street (NPDES #041). This was due to debris in the downstream sewer pipe and the city has increased its maintenance of this pipe. An SSO report was prepared and submitted to the USEPA and MADEP for each dry weather discharge (reports SSO-14-10, SSO-14-11, SSO 14-12, SSO 16-18, and SSO 16-19.

Control of solid material and floatable material in CSOs

Under this minimum control, visible floatables and solids should be controlled from being discharged to local receiving waters in the CSOs. The minimum control requires communities to identify low-cost, easily implementable, actions that could reduce or eliminate floatables in the CSO discharges.

Under the Wet Weather System Maximization/CSO Structure Modifications project, the city is maximizing its capture of wet weather flow for eventual treatment at the WWTP, which maximizes floatables control. The city has also raised weirs to capture more wet weather flow, and floatables in the first flush, during storm events. As part of the Integrated FLTCP, CDM Smith evaluated other potential solids and floatables controls options that could be implemented at the CSO regulators. The *Solids and Floatables Control Memo* summarizes this evaluation and is included in Appendix D.

It was determined that there are no easy and cost-effective approaches to capturing solids and floatables at the city's CSO regulators for a variety of reasons including the constrained space within the regulators to install new screens, trash racks, or baffles, the lack of available land (most of the outfalls are situated directly on the river with no reasonable room for inline screens along the outfall pipe), and river/flow conditions that would preclude outfall technologies (like booms or netting systems).

The city relies on regular cleaning of catch basins and street sweeping near CSO regulators as a preventive measure for the reduction of floatables to its combined system and receiving waters. The city is also considering increasing the frequency of catch basin cleaning and street sweeping to improves its floatables capture.

Pollution prevention programs to reduce contaminants in CSOs

Pollution prevention programs can help reduce the amount of contaminants that enter the combined sewer system. Such measures include street sweeping, catch basin cleaning, litter control, public education, etc. Haverhill has adopted city ordinances that prohibit litter and debris from being deposited on the street and within the watershed area. The city also performs regular cleaning of catch basins and street sweeping near CSO regulators as a preventive measure for the reduction of pollutants into the combined system. Finally, the city has an IPP program and is developing an enhanced fat, oil, and grease (FOG) control program that will help to minimize the amount of pollutants in the city CSO discharges.

Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts

The purpose of this NMC is to inform the public of the location of CSO outfalls, the actual occurrence of CSOs, the possible health and environmental effects of CSOs and the curtailing of recreational activities due to CSO discharges. Each of the CSO regulators and outfalls has signage that identifies the CSO outfall. Within 24-hours of a CSO occurrence, an email notification is sent to downstream communities, local Board of Health, harbor master, and local drinking water authorities. The city also maintains CSO information on its website.

Monitoring to effectively characterize CSO impacts and the efficiency of CSO controls

In 2014, the city contracted with a flow metering subcontractor, to install and maintain depth and depth/velocity meters at each of its CSO regulators. These gauges monitor overflow activations and measure CSO flow rates and volumes.

3.3 CSO Improvements/Baseline Condition

Since the submittal of its first CSO Long Term Control Plan, the city has completed many improvements to reduce CSO discharges. The city has made WWTP improvements to increase wet weather treatment capacity, completed improvements to the CSO regulators to allow in-line storage and interceptor maximization, eliminated CSO regulators, and cleaned the sewers and siphons in the Locke Street area to improve conveyance in that area. The city has engaged a contractor to clean the Upper Siphon and is planning to finish cleaning its other large system siphons in a systematic schedule. To-date, the city has also closed and eliminated 13 of its CSO regulators since 2011.

These improvements should reduce the city's CSO average annual discharge to approximately 20 million gallons (MG), which equates to a capture rate of about 98 percent of the wet weather flow generated by the combined sewer system.

3.3.1 WWTP Improvements

The Haverhill Wastewater Treatment Plant was constructed in the late 1970s. The plant was designed to treat an average daily flow of 18 mgd and a peak flow of 46 mgd. In 2006 upgrades were made to the plant to increase capacity and dependability of operations during wet weather conditions. The plant was upgraded to provide primary treatment for wet weather flow up to 65 mgd. The upgrades included, modifications to the primary settling tanks, construction of a new grit facility, a new secondary bypass conduit and associated control gates, instrumentation, and separate disinfection diffuser were also constructed. Upgrades were also made to the WWTP influent pumping station to allow for an increase in plant wet-weather flow, a new modulation control gate, new screening equipment and larger pumps were installed.

These improvements lowered the average annual CSO volume from 70 MG to 30 MG (in conjunction with other improvements at the CSO regulators) in the Phase I program.

In conjunction with the Integrated FLTCP, the city also completed a CPE of the WWTP. The CPE assessed the existing physical and process conditions at the plant and made recommendations for the rehabilitation of the plant and any enhancements to improve operations. The CPE will be submitted under separate cover.

Appendix D

Appendix D Downstream Notification List

First Name	Last Name	Job Title	Company	Address	City	Business Phone	E-mail
Robert	Desmarais	Director Public Works	Amesbury	62 Friends Street	Amesbury, MA 01913	(978) 388-8127	rob@amesburyma.gov
Gary	Field	Assistant Chief Operator	Amesbury	19 Merrimack Street	Amesbury, MA 01913	(978) 388-1912	fieldg@amesburyma.gov
Jeff	Mason	Water System Manager	Amesbury	62 Freinds Street	Amesbury, MA 01913	(978) 388-0853	masonj@amesburyma.gov
Jack	Morris	Regional Health Director	Amesbury	9 School Street	Amesbury, MA 01913	(978) 388-8134 x752	morrisj@amesburyma.gov
James	Drake	Project Manager	CDM	670 N.Commercial St, Suite 201	Manchester, NH 03101	(603) 222-8336	DrakeJS@cdmsmith.com
John	Sokol	Flow Assessment	Contractor	19 Harvey Road, Unit 22	Bedford, NH 03110	(603) 656-9799	jsokol@flowassessment.com
Joy	Hilton	Engineer, Water Tech Unit	EPA	5 Post Office Square, Suite 100	Boston, MA 02109-3912	(617) 918-1877	hilton.joy@epa.gov
Lori	Bentsen	Admin Asst. Board of Health	Groveland	183 Main St	Groveland, MA 01834	(978) 556-7210	lbentsen@grovelandma.com
Tom	Cusick	Superintendent	Groveland	183 Main Street	Groveland, MA 01834	(978) 556-7200 x219	Tcusick@grovelandma.com
Mike	Stankovich	DPW Director	Haverhill	500 Primrose Street	Haverhill, MA 01830	(978) 374-2360	mstankovich@cityofhaverhill.com
john	D'Aoust	Water Facility Manager	Haverhill	131 Amesbury Road	Haverhill, MA 01830	(978) 374-2385	jdaoust@haverhillwater.com
Bonnie	Dusfrene	Board of Health	Haverhill	4 Summer street	Haverhill MA 01830	(978) 374-2325	bdufresne@cityofhaverhill.com
Fred	Haffty	Wastewater Facility Manager	Haverhill	40 South Porter Street	Haverhill MA 01835	(978) 374-2382	fhaffty@haverhillwater.com
Paul	Jessel	Collection System Supervisor	Haverhill	40 South Porter Street	Haverhill MA 01835	(978) 374-2382	pjessel@haverhillwater.com
David	Shaw	SR Collection System Operator	Haverhill	40 South Porter Street	Haverhill MA 01835	(978) 374-2382	dshaw@haverhillwater.com
Mike	Vetz	Habor Master	Haverhill	72 Coffin Avenue	Haverhill, MA 01830	(978) 374-2100	vetsm@comcast.net
Robert	Ward	Deputy DPW Director	Haverhill	40 South Porter Street	Haverhill MA 01835	(978) 374-2382	rward@haverhillwater.com
Nihar	Mohanty	DEP NERO	MASSDEP	205B Lowell Street	Wilmington, MA 01887	(978) 694-3237	nihar.mohanty@state.ma.us
Kevin	Brander	WW/Mgt Section	MDEP	205B Lowell Street	Wilmington, MA 01887	(978) 694-3236	Kevin.Brander@state.ma.us
Berni	Angelo	Admin Asst.Board of Health	Merrimac	4 School St	Merrimac, MA 01860	(978) 346-4066	BOH@townofmerrimac.com
Mike	Buzzell	Wastewater Chief Operator	Merrimac	Federal Way	Merrimac, MA 01860	(978) 346-7857	mbmwwtf@comcast.net
Robert	Sinibaldi	DPW Director	Merrimac	4 School St	Merrimac, MA 01860	(978) 346-0612	dpwdir@townofmerrimac.com
Gary	Tuck	Water Foreman	Merrimac	School St	Merrimac, MA 01860	(978) 346-8407	gtuck@townofmerrimac.com
Eileen	Hurley	Board of Health	Merrimack	2 School Street	Merrimac, MA 01860	(978) 346-4066	boh@townofmerrimac.com
Alba	Gouldthrope	Board of Health	Newbury	25 High Road	Newbury MA 01951	(978) 499-3898	boardofhealth@townofnewbury.org
Joe	Dugan	Wastewater Chief Operator	Newburyport	157 Water Street	Newburyport, MA 01950	(978) 465-4464	jdugan@CityofNewburyport.com
Frank	Giacalone	Director of Public Health	Newburyport	60 Pleasant Street	Newburyport, MA 01950	(978) 465-4410	fgiacalone@cityofnewburyport.com
Donna	Holaday	Mayor	Newburyport	60 Pleasent Street	Newburyport MA 01950	(978) 465-4413	DHoladay@CityofNewburyport.com
Paul	Hogg	Habor Master	Newburyport	PO Box 550	Newburyport, MA 01950	(978) 462-3746	phogg@cityofnewburyport.com
Jeff	Kennedy	SR Marine Fisheries Biologists	Newburyport	30 Emerson Ave	Gloucester, MA 01930	(978) 282-0308 x165	jeff.kennedy@state.ma.us
David	Roach	Newbury Shell Fish Purification	Newburyport	84 82nd Street	Newburyport, MA 01950	(978) 465-3553	dave.roach@state.ma.us
Thomas	Smolski	Water Superintendent	Newburyport	7 Spring Lane	Newburyport, MA 0195	(978) 465-4466	Tsmolski@cityofnewburyport.com
Mark	Tolman	Director of Public Health	Newburyport	60 Pleasent Street	Newburyport MA 01950	(978) 465-4410	mtolman@CityofNewburyport.com
Andrea	Brouchu	Board of Health	Sailsbury	P.P. Box 5072	Sailsbury, MA 01952	(978) 462-3430	abrochu@salisburyma.gov
Jeff	Ingalls	Chief Operator	Sailsbury	P.O. Box 5221	Salisbury MA 01950	(978) 465-4058	wwtp@sailsburyma.gov
Donald	Levesque	Director of Public Works	Sailsbury	39 Lafayette Road	Salisbury, MA 01952	(978) 462-7611	dlevesque@salisburyma.gov
Ray	Pike	Harbor Master	Sailsbury	5 Beach Road	Sailsbury, MA 01952	(978) 499-0740	harbormaster@salisburyma.gov
Paul	Sevigny	Health Agent	W Newbury	381 Main Street	W. Newbury, MA 01985	(978) 363-1100 x19	psevigny@town.west-newbury.ma.us
							shellfish.newburyport@state.ma.us
Rusty	Russell	Merrimack Rivershed Council		60 Island Street, Suite 211-E	Lawrence, MA 01840	(978) 655-4742	rrussell@merrimack.org