City of Edmonds

Inflow / Infiltration Study

June 2010

BHC CONSULTANTS
1601 5th Ave Suite 500
Seattle, WA 98101
(206) 505-3400

TETRA TECH
Infrastructure Group
1420 Fifth Avenue, Suite 600, Seattle, Washington 98101
Tel 206.883.9300 Fax 206.883.9301 www.tetratech.com

City of Edmonds

INFLOW / INFILTRATION STUDY

June 2010

City Council

Michael Plunkett – Position #1
Strom Peterson – Position #2
Adrienne Fraley-Monillas – Position #3
Diane Buckshnis – Position #4
D.J. Wilson – Position #5
Steve Bernheim – Position #6
David Orvis – Position #7

Director of Public Works
Noel Miller, P.E.

City Engineer
Rob English, P.E.

Maintenance & Operation
Jim Waite
Steve Koho

This Document was prepared
Under the direct supervision of

Craig P. Chambers, P.E.
Director of Engineering, BHC Consultants

City of Edmonds
Inflow and Infiltration Study

	Section	Page
I.	Introduction	1
II.	Basin Delineation	2
III.	Rainfall and Flow Data Reduction	9
IV.	Presentation of Historical Data	10
V.	Recommendations for Smoke Testing	15
VI.	Capital Improvement Projects	18
VII.	Proposed Standards, Policies and Guidelines	24

APPENDICES

A. Flow Data for August 2008, April 2008, December 2006 and December 2007 for the following Meters:
   a. Meter 1
   b. Meter 2
   c. Meter 3
   d. Meter A
   e. Meter B
   f. Meter C
   g. Meter D
   h. Meter E
   i. Edmonds - WWTP Meter
   j. MLT – WWTP Meter
   k. Pump Station No. 1

B. Proposed Standards, Policies and Guidelines

Standards

a. S-1 Storm Drainage Connections to the Sanitary Sewer System
b. S-2 Connections to Existing Sewer System
c. S-3 Allowable Connections to Side Sewers
d. S-4 Visual Inspection of Manholes for SSES Investigations
e. S-5 CCTV Inspections of Sewers for SSES Investigations
f. S-6 Smoke Testing for SSES Investigations
g. S-7 Dye Testing for SSES Investigations
h. S-8 Design Capacity for Pipeline Rehabilitation Projects
i. S-9 Sewers on Steep Slopes
j. S-10 Manhole Locations and Covers
k. S-11 Manhole Size
l. S-12 Sewer System Design
m. S-13 Manhole Joints
n. S-14 Side Sewer Connection Location and Taps
o. S-15 Abandonment Requirements
p. S-16 Pipe Materials
q. S-17 Pipe Rehabilitation Methods
r. S-18 Inspection Wyes/Cleanouts
s. S-19 Inspection of Pipe Installation and Backfill
t. S-20 Pipe Zone Bedding and Trench Backfill (Side Sewers)
u. S-21 Manhole Leveling Rings
v. S-22 Root Intrusion
w. S-23 Root Intrusion (Side Sewers)
x. S-24 Pipeline Leak Testing
y. S-25 Sanitary Side Sewer Inspection
z. S-26 Side Sewer/Lateral Leak Testing
aa. S-27 Manhole Leak Inspection
bb. S-28 Product Specific Inspection
cc. S-29 Product Specific Inspection (Side Sewer)
dd. S-30 CCTV Inspection
ee. S-31 CCTV Inspection (Side Sewers)
ff. S-32 Certification, Warranty and Qualifications
gg. S-33 Bonding and Warrant Inspection

Policies

a. P-1 Community Education and Involvement
b. P-2 Responsibility for Community Education
c. P-3 Public Funding
d. P-4 Rates, Incentives and Surcharges
e. P-5 Cost Sharing
f. P-6 Stormwater Drainage Ordinances
g. P-7 On-site Storm Drainage Management
h. P-8 Infeasible or Prohibitively Expensive Modifications
i. P-9 Contractor Qualifications

j. P-10 Required Permits
k. P-11 Inspection and Testing
l. P-12 Property Restoration
m. P-13 Contractor Bonding, Licensing and Warranty
n. P-14 Access to Private Property
o. P-15 Limiting Liability
p. P-16 Legislative Action Requirements
q. P-17 Side Sewer Ownership and Responsibility

Guidelines
a. G-1 Modeling and Engineering Analysis
b. G-2 Lateral and Side Sewer Rehabilitation Methods
c. G-3 Pipe Protection - Depth of Cover
d. G-4 Manhole Rehabilitation
e. G-5 Spot Repairs
f. G-6 Spot Repairs (Side Sewers)
g. G-7 Manhole Lids/Inserts

I. Introduction

In recent years during significant storm events, flows at the City's wastewater treatment plant were recorded at levels previously not experienced. These peak flows reportedly created surcharged conditions, though the surcharging hasn't resulted in reported overflows.

Historically, peak flows in the City's sanitary sewer system have been recorded as progressively increasing in response to wet weather events. These trends exceed the expected flows resulting from new connections.

In an effort to be proactive, the City wants to identify and correct the most egregious sources of Inflow and Infiltration (I/I). It is understood that this focus will require an on-going effort that may well extend beyond a single year's activities.

Though the goal is to find and fix the most severe problems, it is likely that some of the identified sources will have a secondary element that will prohibit the separation of the I/I. For instance, those sources that will result in significant environmental and/or permitting issues will be identified and logged but will not be slated for immediate correction. Similarly, those circumstances that include the disconnection of downspouts and that result in saturation of hillsides, the potential creation of unsafe stability issues and downstream flooding will similarly be placed in abeyance.

Throughout the creation of this report, both BHC and City staff have worked jointly together to assemble, refine and analyze the existing rainfall and flow data. Similarly, this report sought to estimate the volume of I/I within selected drainage basins, present a proposed solution for I/I separation and estimate the associated costs of I/I separation. This report also developed City Standards, Procedures, Policies and Guidelines that provide direct benefit in the long-term reduction of I/I into the City collection system. And lastly, this report also includes the identification and assessment of egregious pipe conditions found in the City collection systems due to root intrusion or other City identified conditions.

During this I/I assessment phase, the report also prioritizes and selects I/I reduction projects from the project areas. In doing so the report prepares a Capital Improvement Plan for I/I rehabilitation and root intrusion impacted collection systems.

BHC Consultants, as the Prime Consultant and Program Manager, lead and coordinated the work performed.

Based on historical flow data, peaking factors at the Wastewater Treatment Plant (WWTP) have been in the order of 4.0 for a typical spring storm to as high as 7.6

for the December 2006 storm event.. Peaking factors are defined as the peak hourly flows divided by the average annual flows. These values, when compared to other western Washington WWTP are not particularly out of line. This does not suggest that the peaks experienced at the plant are inconsequential and should be ignored. These high flow events have twice nearly resulted in bypassing the biological treatment portion of the plant, which most certainly would have occurred had there not been a mechanical failure in one of the upstream pump stations. However, flows to the WWTP are complicated by the flow swapping agreement that Edmonds has with King County. This flow swapping, in some ways, masks the severity of the I/I problems. This, coupled with a troubling trend that suggests that the peaking factors are continuing to increase, has caused the City to analyze, identify and correct I/I sources now before the hydraulic capacity of the plant is exceeded. By initiating a proactive program of identifying and removing I/I the City may be able to postpone or eliminate costly hydraulic expansions of the WWTP. Furthermore, the City's new NPDES permit requires an annual report that summarizes I/I removal measures that have been taken.

In an effort to identify the suspected worst basins, two standard comparative measurements were used to judge the severity of I/I within the catchment basins and also allow comparison with other agencies that have completed independent I/I studies previously. These measurements are:

- Gallons I/I per acre per day
- Gallons I/I per inch-diameter-mile per day

Based on City-provided data for the length and sizes of sewer mains within each catchment area, similar data from the tributary areas from the City of Mountlake Terrace and Ronald Sewer District, this analysis will be able to identify the most likely basins with the most severe I/I.

II. Basin Delineation

From the 2006 Comprehensive Sewer Plan and basin boundary information provided by the City staff, the drainage basins which are tributary to the City's WWTP were identified. These basins were confirmed with the O&M staff to verify that the basins are correctly represented.

Using existing data for parcels, streets and public right-of-ways, and City sewer mapping and manhole information a base map was created identifying the catchment areas for each basin.

The delineation of the basins is defined by two determining conditions or criteria, 1) area directly tributary to permanent flow meters that are in place and 2) area directly tributary to pump stations. The pump stations are not equipped with flow

meters and the determination of flows was derived from the pump run records and a verification of the pumping capacity.

Flow data from the following flow meters and pump stations were used in this analysis:

- Meter A
- Meter B
- Meter C
- Meter D
- Meter E
- Meter 1
- Meter 2
- Meter 3
- Pump Station No. 1
- WWTP Flow Meter - MLT
- WWTP Flow Meter - Edmonds

The direct use of this flow data (or in some cases the subtraction of flow data between adjacent flow meters) provided the basis for defining flows from discrete basins which are schematically represented in Figure 1 and graphically presented in Figure 2.

With the basins delineated an inventory of the existing piping systems was developed. Table 1 includes an individual basin breakdown of the catchment acreage, estimated length of main line sewer, the average diameter of those pipes and the inch - diameter - mile of pipe in each catchment area. This baseline data forms the foundation for determining the metric of comparison between basins (i.e. gallons I/I per acre per day and gallons I/I per inch-diameter-mile per day).

It should be also noted that the City contracts with the following agencies for wastewater conveyance and treatment services:

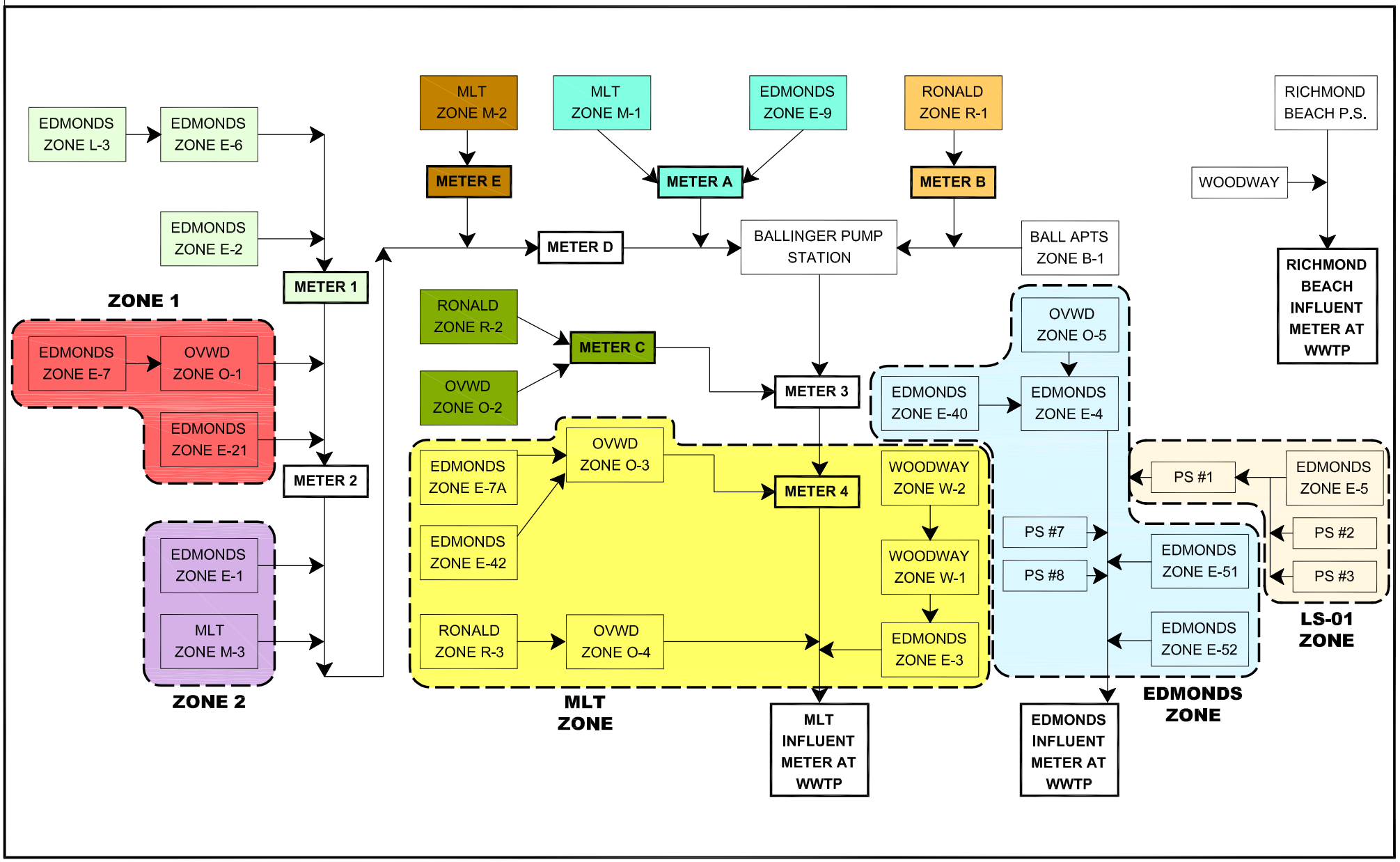
- City of Mountlake Terrace
- Ronald Sewer District
- Olympic View Water and Sewer District
- King County

The meter configuration allows a direct analysis of I/I contributions from Mountlake Terrace and Ronald Sewer District. Similarly, the flows that originate from Olympic View Water and Sewer District cannot be separated or isolated from the Edmonds flows without additional flow meter installation.

Flows from the Richmond Beach Pump Station include flows from the Town of Woodway and King County.

FILE NAME (UPDATED BY)	PLOT DATE & TIME
S:\CAD\EDMONDS\09-10166\DWG\F09-10166_FLOW DIA.DWG (GOC)	MAR 26 2010 13:54:45

XREFS: NONE



BHC CONSULTANTS

BHC Consultants, LLC
1601 Fifth Avenue, Suite 500
Seattle, Washington 98101

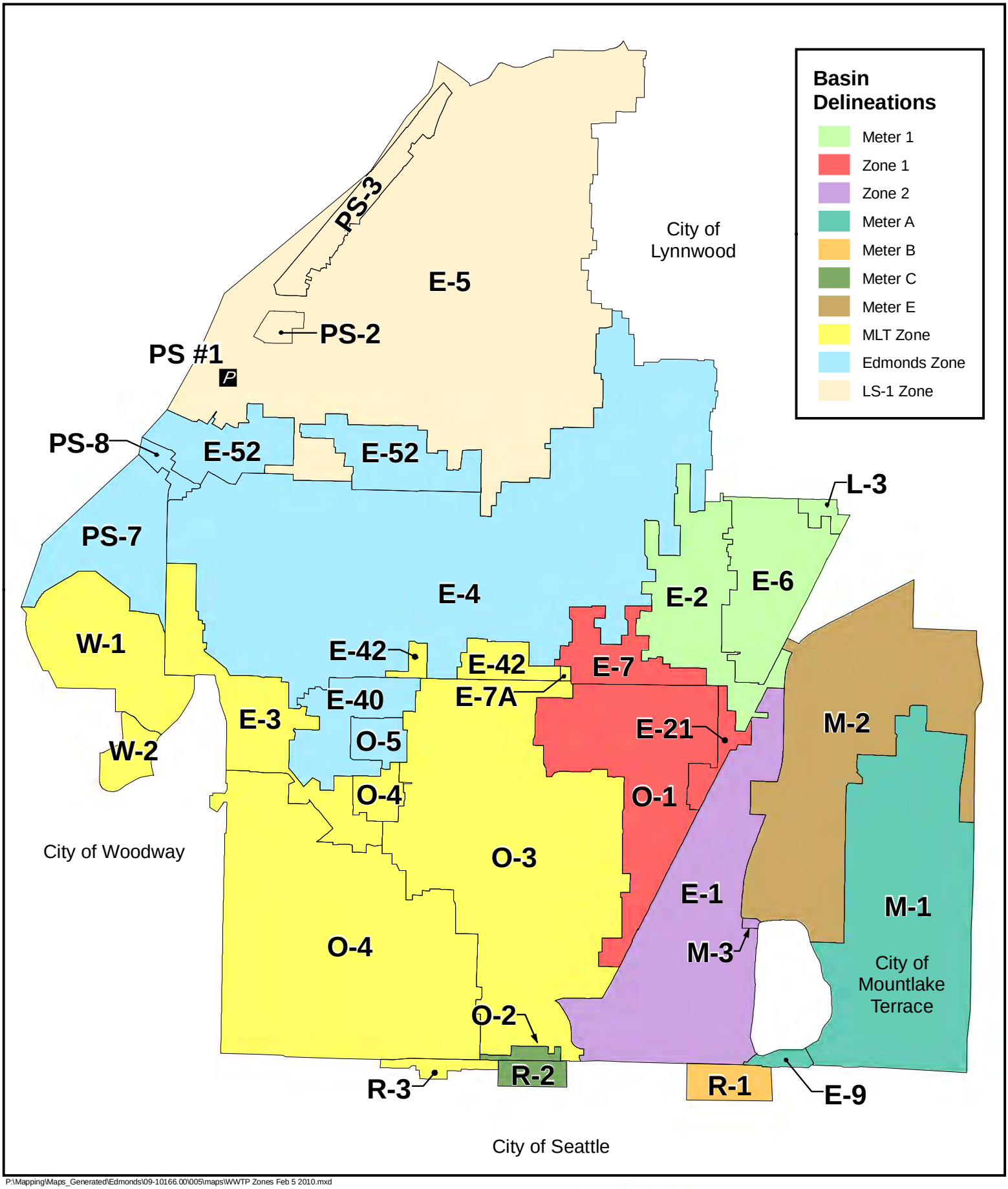
206.505.3400
206.505.3406 (fax)
www.bhcconsultants.com

Schematic Flow Diagram

Edmonds I / I Study
Edmonds, Washington

Figure

1



P:\Mapping\Maps_Generated\Edmonds\09-10166.00\005\maps\WWTP Zones Feb 5 2010.mxd

BHC Consultants, LLC
1601 Fifth Avenue, Suite 500
Seattle, WA 98101
T 206 505 3400
F 206 505 3406
www.bhcconsultants.com

N W E S

Not To Scale

Basin Delineations

Edmonds I/I Study
Edmonds, Washington

Figure 2

Table 1
Catchment and Tributary Areas

Metering Location	Subarea catchments			Area (acres)	Feet of pipe*		Aver Dia (inches)		Feet-inches of pipe	Inch Dia - Mile of pipe
Meter A										
(MLT)	M-1			1593.1	240,355		9.01		2,166,170	410.26
	E-9			9.3	1,578	+	28.82		45,478	8.61
	Total			1602.4	241,933				2,211,648	418.87
Meter B										
(RSD)	R-1			555.0	69,100		8.00		552,800	104.70
	Total			555.0	69,100				552,800	104.70
Meter C										
(RSD)	O-2			8.3	3,625	+	8.00		29,000	5.49
	R-2			135.0	19,700		8.00		157,600	29.85
	Total			143.3	23,325				186,600	35.34
Meter D										
	M-2	Meter E		663.0	49,442		7.78		384,659	72.85
	E-1	Zone 2		356.9	54,211		9.50	^	515,005	97.54
	M-3	Zone 2		1.6	363		23.21		8,425	1.60
	E-2	Meter 1	Meter 2	152.8	22,150		7.77	^	172,106	32.60
	L-3	Meter 1	Meter 2	10.5	93		8.00		744	0.14
	E-6	Meter 1	Meter 2	139.8	13,965		7.82	^	109,206	20.68
	E-7	Meter 2 - Meter 1 (Zone 1)	Meter 2	62.2	10,000		7.70	^	77,000	14.58
	O-1	Meter 2 - Meter 1 (Zone 1)	Meter 2	238.7	30,273		7.87	^	238,249	45.12
	E-21	Meter 2 - Meter 1 (Zone 1)	Meter 2	23.4	3,035		7.50	^	22,763	4.31
	Total			1648.8	183,532				1,528,155	289.42
Meter E										
	M-2			663.0	49,442		7.78		384,760	72.87
	Total			663.0	49,442				384,760	72.87
Meter 1										
	E-2			152.8	22,150		7.77	^	172,106	32.60
	L-3			10.5	93		8.00		744	0.14
	E-6			139.8	13,965		7.82	^	109,206	20.68
	Total			303.1	36,208				282,056	53.42

Table 1
Catchment and Tributary Areas

Metering Location	Subarea catchments				Area (acres)	Feet of pipe*		Aver Dia (inches)		Feet-inches of pipe	Inch Dia - Mile of pipe
Meter 2											
	E-2	Meter 1			152.8	22,150		7.77	^	172,106	32.60
	L-3	Meter 1			10.5	93		8.00		744	0.14
	E-6	Meter 1			139.8	13,965		7.82	^	109,206	20.68
	E-7	Meter 2 - Meter 1 (Zone 1)			62.2	10,000		7.70	^	77,000	14.58
	O-1	Meter 2 - Meter 1 (Zone 1)			238.7	30,273		7.87	^	238,249	45.12
	E-21	Meter 2 - Meter 1 (Zone 1)			23.4	3,035		7.50	^	22,763	4.31
	Total				627.4	79,516				620,067	117.44
Meter 3											
	M-1	Basin A			1593.1	240,355		9.01		2,166,170	410.26
	E-9	Basin A			9.3	1,578	+	28.82	^	45,478	8.61
	R-1	Basin B			555.0	69,100		8.00		552,800	104.70
	O-2	Basin C			8.3	3,625	+	8.00		29,000	5.49
	R-2	Basin C			135.0	19,700		8.00		157,600	29.85
	M-2	Meter E		Meter D	663.0	49,442		7.78		384,659	72.85
	E-1	Zone 2		Meter D	356.9	54,211		9.50	^	515,005	97.54
	M-3	Zone 2		Meter D	1.6	363		23.21		8,425	1.60
	E-2	Meter 1	Meter 2	Meter D	152.8	22,150		7.77	^	172,106	32.60
	L-3	Meter 1	Meter 2	Meter D	10.5	93		8.00		744	0.14
	E-6	Meter 1	Meter 2	Meter D	139.8	13,965		7.82	^	109,206	20.68
	E-7	Meter 2 - Meter 1 (Zone 1)	Meter 2	Meter D	62.2	10,000		7.70	^	77,000	14.58
	O-1	Meter 2 - Meter 1 (Zone 1)	Meter 2	Meter D	238.7	30,273		7.87	^	238,249	45.12
	E-21	Meter 2 - Meter 1 (Zone 1)	Meter 2	Meter D	23.4	3,035		7.50	^	22,763	4.31
	Total				3949.5	517,890				4,479,203	848.33
Lift Station No. 1											
	E-5	LS-01			1035.6	166,209		7.98	^	1,326,348	251.20
	PS #2	LS-01			12.0	1,526		8.43		12,864	2.44
	PS #3	LS-01			59.0	7,125		7.29	^	51,941	9.84
	Total				1106.6	174,860				1,391,153	263.48
Edmonds Meter											
	E-5	PS #1			1035.6	166,209		7.98	^	1,326,348	251.20
	PS #2	PS #1			12.0	1,526		8.43		12,864	2.44
	PS #3	PS #1			59.0	7,125		7.29	^	51,941	9.84

Table 1
Catchment and Tributary Areas

Metering Location	Subarea catchments					Area (acres)	Feet of pipe*		Aver Dia (inches)		Feet-inches of pipe	Inch Dia - Mile of pipe
	E-4	Edmonds Zone				1009.3	165,043		8.30	^	1,369,857	259.44
	E-40					81.8	11,505		7.24	^	83,296	15.78
	O-5					24.5	3,865		8.00	^	30,920	5.86
	E-52					156.2	27,288		8.11	^	221,306	41.91
	PS #7					130.7	4,007		7.27	^	29,131	5.52
	PS #8					13.3	1,616		14.14	^	22,850	4.33
	Total					2522.4	388,184				3,148,513	596.31
MLT Meter												
	M-1	Basin A			Meter 3	1593.1	240,355		9.01		2,166,170	410.26
	E-9					9.3	1,578	+	28.82	^	45,478	8.61
	R-1	Basin B				555.0	69,100		8.00		552,800	104.70
	O-2	Basin C				8.3	3,625	+	8.00		29,000	5.49
	R-2					135.0	19,700		8.00		157,600	29.85
	M-2	Meter E		Meter D		663.0	49,442		7.78		384,659	72.85
	E-1	Zone 2				356.9	54,211		9.50	^	515,005	97.54
	M-3					1.6	363		23.21		8,425	1.60
	E-2	Meter 1	Meter 2			152.8	22,150		7.77	^	172,106	32.60
	L-3					10.5	93		8.00		744	0.14
	E-6					139.8	13,965		7.82	^	109,206	20.68
	E-7	Meter 2 - Meter 1 (Zone 1)				62.2	10,000		7.70	^	77,000	14.58
	O-1					238.7	30,273		7.87	^	238,249	45.12
	E-21					23.4	3,035		7.50	^	22,763	4.31
	E-7A	MLT Zone				1.5	171		8.00		1,368	0.26
	E-42					39.2	3,753		7.99		29,986	5.68
	O-3					604.1	88,995		9.03	^	803,625	152.20
	W-1					155.4	10,911		8.00	^	87,288	16.53
	W-2					28.0	2,081		8.00	^	16,648	3.15
	E-3					146.9	23,872		13.39	^	319,646	60.54
	O-4					543.4	73,430		7.99	^	586,706	111.12
	R-3					14.3	895		8.00	^	7,160	1.36
	HS					41.1					-	-
	Total					5523.5	721,998				6,331,630	1,199.17

* Includes mainline only, no side sewers or laterals included
\+ Estimated length of pipe
^ Estimated pipe diameter to be 8" when no other information was available

III. Rainfall and Flow Data Reduction

The City's continuous flow meter readings for certain catchment areas, pump run records for the stations tributary to the City's WWTP and rainfall data as collected at the WWTP forms the basis for this analysis.

Flow and rainfall data for the period beginning in June 2006 and ending in December of 2008 were reviewed for all 10 flow meters and Lift Station 1. All rainfall data was reviewed in order to capsulate and segregate four flow and climatic conditions. Specifically the goal was to capture the following scenarios:

- *Dry weather flow during a period of low groundwater*. This condition reflects our baseline domestic flows with little or no infiltration or inflow
- *Minimal rain during a high groundwater period.* This condition was intended to capture and reflect infiltration coming from the groundwater without a significant inflow component.
- *Significant wet weather storm following a generally wet period.* This set of circumstances captures inflow component when the groundwater is already elevated.
- *Significant winter storm following a relative dry period.* This was intended to identify the inflow component.

The following time periods were selected to satisfy the conditions presented above:

- August 2008. The period was identified as a period of no or very little rain (low groundwater levels) leading up to August 18-20, 2008.
- April 2008. This time period was selected because of the sustained wet period through the spring of 2008. The supposition is that the groundwater level was elevated and sources of infiltration would manifest itself in similarly elevated base flows.
- December 25-30 2006. This time period contained the last of a series of "typical" December rain events. This rain event produced 1.39 inches of rain at the Edmonds WWTP on December 26-27.
- December 2-5, 2007. This was a significant rainfall event that produced 5.65 inches of rain at the WWTP between December 2nd and December 5th. This rain event led to widespread flooding and surcharging throughout the western Washington area. Some accounts have labeled this storm as a 50 year event.

Rainfall and flow data for these four storms for all 10 meters and Lift Station #1 were prepared and included in Appendix A.

The flow data from the drainage basin meters was reduced from 5 minute increments to hourly flow totals. Hourly rainfall data was prepared from data gathered from the rain gauge at the Edmonds WWTP.

The baseline flow data (i.e. no rain with low groundwater levels) of August 2008 show regular diurnal flow patterns and slight reaction to moderate summer showers. It is also interesting to note the variance between the weekend and weekday flow patterns. Weekend diurnal flow patterns tend to be slightly delayed and slightly higher than that seen during weekdays. This pattern is reflective of residents being at home on the weekends.

The April 2008 flow patterns show the same diurnal and weekend/weekday patterns as described above, however, the baseline is increased due to the higher groundwater levels. The response to the April 5th storm was immediate, but the baseline flows quickly returned to pre-storm levels. Minor storms that extended for approximately a day resulted in a response that quickly returned to baseline at the conclusion of the rain event. The basins appear to be insensitive to isolated and small showers.

The December 25th through 30th 2006 storms resulted in a significant response in increased flows at every metering station. The antecedent rainfall preceding December 25th delivered a significant amount of rain to the system. Rainfall continued through December 27th after which all rainfall ceased. The system slowly returned to normal over the course of the following five days.

The volume of water delivered during the December 2nd through 5th 2007 storm was unique in that the preceding period was very dry, but the storm was very intense for a two day period. The response was immediate, returning to pre-storm conditions over the course of two to three days. Storms later in that same month were characterized by a gradual increase in the baseline.

IV. Presentation of Historical Data

The measurement of I/I in terms of gallons per day per acre (gpad) and gallons per day per inch-diameter-mile (gpdpidm) was determined by calculating the average flows for the time period in question. For instance, the flow value for April and August were the average flows for the entire month. The average flow for the December 25th through 30th was the average for that six day period and similarly the average flow for the December 2nd through the 5th was determined by taking the total flow for that four day period and deriving the average for that period.

Those respective values were then divided by the total acreage for gpad and by the total inch-diameter-miles for gpdpidm. The results of those calculations are presented in Table 2. Table 2 also includes the average dry weather flows and the peak hour flows for the April and December storms.

Table 2
Basin Values

Basin/ Meter	Gallons/acre/day				Gallons/day/inch-diameter-mile				Flow, mgd			
										Peak Hour		
	August 2008	April 2008	December 25-30, 2006	December 2-5, 2007	August 2008	April 2008	December 25-30, 2006	December 2-5, 2007	Average Dry Month	April 2008	Dec 2006	Dec 2007
1	489	542	971	1,255	2,776	3,073	5,506	7,117	0.15	0.28	0.58	0.98
2	406	560	1,468	2,055	2,170	2,992	7,843	10,980	0.25	0.69	1.90	2.52
3	606	767	1,559	2,042	2,823	3,570	7,256	9,508	0.89	6.13	6.83	6.56
A	439	662	1,570	1,661	1,681	2,534	6,006	6,353	0.70	2.05	4.25	4.78
B	381	483	1,077	1,693	2,022	2,558	5,712	8,974	0.21	0.57	1.21	2.19
C	502	924	2,413	2,844	2,037	3,749	9,786	11,531	0.07	0.27	0.68	1.13
D	805	939	1,574	1,954	4,587	5,348	8,966	11,134	1.33	3.24	4.81	5.74
E	910	1,049	1,361	1,529	8,280	9,545	12,380	13,908	0.60	1.64	2.07	2.53
MLT at WWTP	292	767	1,021	903	1,343	3,535	4,701	4,158	1.44	7.50	8.35	9.76
LS-01	497	616	1,518	1,856	1,557	2,847	5,816	8,289	0.55	1.71	2.90	2.90
Edmonds at WWTP	605	737	1,499	1,968	2,560	3,116	6,341	8,324	1.49	4.55	14.02	11.59
Zone 1 (Meter 2 - Meter 1)	329	577	1,933	2,804	1,524	2,924	9,791	14,202	0.11	0.41	1.32	1.54
Zone 2 (Meter D-Meter E-Meter 2)	1,309	1,398	2,153	2,566	4,826	5,055	7,787	9,279	0.47	0.91	0.84	0.69
Edmonds Zone (EdMeter-LS-01)	665	801	1,423	1,976	2,830	3,409	6,055	8,404	0.94	2.84	11.12	8.69
MLT Zone (MLT Meter-Meter 3)	357	508	948	1,125	1,560	2,222	4,142	4,918	0.55	1.37	1.52	3.20

It is interesting to note that King County and other agencies have frequently used the measurement of gallons per acre per day to determine excessiveness of I/I. In fact, King County has used this measurement since 1961 with their component agencies that are tributary to their system. The threshold value permitted by their interlocal agreement is set at 1,100 gpad. During the County's Regional I/I program more than 800 flow meters were installed to measure the I/I values. Of those measured basins only a few dozen basins met the 1,100 gpad maximum allowable threshold. As a result the County considered, but has not yet adopted, a revised threshold of 1,500 gpad. The measurement of that threshold is generally defined as the flow volumes for any 30-minute period that exceeds 1,100 gpad. The values presented in Table 3 represent the calculated volume of I/I in excess of the summertime, dry weather baseline flows. This volume of I/I was determined by subtracting the August 2008 flows from the April 2008, December 2006 and December 2007 flows. This net increase in flows was the additional I/I components based on an average day, not the 30-minute event.

The larger sub-basins (Zone 1, Zone 2, MLT Zone, and Edmonds Zone) results were calculated by subtracting meter data and dividing by sub basin area or inch-diameter mile data for the sub-basin. When a subtraction process is used to determine results for a sub-basin, each meter subtraction reduces the reliability of the data. It should be noted that the data shown for the MLT meter at the treatment plant do not take into account the additional flows from the Ballinger pump station that is routed to the King County treatment system. The data is presented this way solely to facilitate the calculation of the results for the MLT Zone.

Average daily flows in August 2008 are assumed to be baseline domestic wastewater flows in all basins. Because average daily flow in April 2008 appears relatively insensitive to the minor rain events, the April 2008 flows were assumed to have the baseline wastewater flow plus the volume of infiltration water. Average daily August waste water flow was subtracted from average daily wastewater flow in April of 2008 to obtain the average daily flow of infiltration water. This was done for all metered basins. Additionally, August 2008 flows were subtracted from the December 2006 and December 2007 storms in order to estimate the total inflow and infiltration. The results of these calculations are shown in Table 3.

Peaking factors were calculated for April 2008, December 2007, and December 2006 rain events. The peaking factors were calculated using two sets of data. The first set was a peaking factor derived by dividing average gallon per acre-day flow by the August 2008 corresponding value. The second set of peaking factors was determined by taking the average dry weather flow divided into the peak hour flows for the April and December storms. These results are shown in Table 4.

Table 3
I/I Values

Basin / Meter	Gallons/acre/day			Gallons/in-mile-day		
	April 2008 - August 2008	December 2006 - August 2008	December 2007 - August 2008	April 2008 - August 2008	December 2006 - August 2008	December 2007 - August 2008
1	52	481	765	296	2,730	4,341
2	154	1,062	1,649	822	5,672	8,810
3	161	952	1,436	747	4,434	6,685
A	223	1,131	1,221	853	4,325	4,672
B	101	696	1,312	536	3,690	6,952
C	422	1,911	2,341	1,711	7,749	9,494
D	134	769	1,149	761	4,379	6,547
E	139	451	619	1,265	4,100	5,628
MLT at WWTP	476	729	611	2,192	3,358	2,815
LS-01	118	1,021	1,359	1,291	4,259	6,732
Edmonds at WWTP	131	894	1,363	556	3,781	5,764
Zone 1 (Meter 2 - Meter 1)	249	1,604	2,475	1,400	8,267	12,678
Zone 2 (Meter D- Meter E- Meter 2)	88	844	1,256	229	2,961	4,453
Edmonds Zone (EdMeter - LS-01)	136	758	1,310	579	3,225	5,574
MLT Zone (MLT Meter - Meter 3)	151	591	769	662	2,583	3,358

Table 4
I/I Peaking Factors

Basin / Meter	Ratio of I/I values (gpad)			Ratio of Peak Flows		
	April 2008 / August 2008	December 2006 / August 2008	December 2007 / August 2008	April 2008 / August 2008	December 2006 / August 2008	December 2007 / August 2008
1	1.1	2.0	2.6	1.9	3.9	6.5
2	1.4	3.6	5.1	2.7	7.5	9.9
3	1.3	2.6	3.4	6.9	7.7	7.4
A	1.5	3.6	3.8	2.9	6.0	6.8
B	1.3	2.8	4.4	2.7	5.7	10.4
C	1.8	4.8	5.7	3.7	9.4	15.7
D	1.2	2.0	2.4	2.4	3.6	4.3
E	1.2	1.5	1.7	2.7	3.4	4.2
MLT at WWTP	2.6	3.5	3.1	5.2	5.8	6.8
LS-01	1.2	3.1	3.7	3.1	5.3	5.3
Edmonds at WWTP	1.2	2.5	3.3	3.1	9.4	7.8
Zone 1 (Meter 2 - Meter 1)	1.8	5.9	8.5	3.9	12.4	13.1
Zone 2 (Meter D- Meter E- Meter 2)	1.1	1.6	2.0	1.9	1.8	1.5
Edmonds Zone (EdMeter - LS-01)	1.2	2.1	3.0	3.0	11.8	9.2
MLT Zone (MLT Meter - Meter 3)	1.4	2.7	3.2	2.5	2.8	5.8

The data presented in Tables 2, 3 and 4 include all flow measurement locations. Some of this data captures flow from several areas. Though the data is reliable, the larger catchment area tends to mask the specific origin and the severity of the I/I.

V. Recommendation for Smoke Testing

The following meters and their associated data, include data from combined basins:

- Meter 2
- Meter 3
- Meter D
- MLT flow meter at the WWTP
- Edmonds flow meter at the WWTP

Consequently, this data will be used to refine the catchment area by subtracting it from an upstream meter. This means that the data will be used in the following manner.

Direct read data:

- Meter 1
- Meter A
- Meter B
- Meter C
- Meter E
- LS-01

Single basin subtraction:

- Zone 1 (Meter 2 minus Meter 1)
- Edmonds Zone (Edmonds meter at WWTP minus LS-01)
- MLT Zone (MLT flow meter at WWTP minus Meter 3)

Double basin subtractions

- Zone 2 (Meter D minus Meter E minus Meter 2)

The direct read flow data will generally be considered the most reliable and the single basin subtraction data more reliable than the double basin subtraction data. However, all ten basins will be evaluated.

The other variable in analyzing the flow data is restricting the focus to those basins that collect flow only from, or predominately from, City of Edmonds customers. The non-Edmonds collection lines are of interest in determining the worst areas, however, those contract customers (i.e. Ronald S.D., Olympic View and Mountlake Terrace) are charged based on volume of flow delivered to the

Edmond's system. Consequently, the burden and incentive to correct extraneous I/I rests with the contract agencies, not the City of Edmonds.

With these constraints, the analysis has been confined to those basins that are exclusively or substantially within the City's control and jurisdiction.

The following listing defines the percentage of the basin that is owned and controlled by the City of Edmonds:

Basin / Meter	Percentage within Edmonds jurisdiction
• Meter 1	97%
• Meter A	0%
• Meter C	0%
• Meter E	0%
• LS-01	100%
• Zone 1	26%
• Edmonds Zone	98%
• MLT Zone	12%
• Zone 2	99%

The focus of our evaluation will be on those four basins that largely fall under the control and ownership of Edmonds and to a lesser degree those basins that partially include Edmonds' lines. Specifically this includes basins Meter 1, LS-01, Zone 1, Edmonds Zone, MLT Zone and Zone 2. The I/I values and peaking factors are restated in Table 5 for these six basins.

A comparison of these six basins seems to point to Zone 1 as having the highest values. The second worst or critical basin is not as easily determined. Basin LS-01 shows the next worst values in terms of I/I volume as measured by the gallons per acre per day, gallons per inch-diameter-mile and the peaking factors associated with those values. Keep in mind that those values are determined based on the average volume of I/I over the course of the storm. The other metric is the peaking factor associated with peak flows. Using this metric the Edmonds Zone basin would be considered the next most critical basin.

Zone 1 has approximately 43,300 linear feet of pipe; however, LS-01 has nearly 175,000 feet. The rule of thumb that we have found to be a good threshold is to limit the footage of pipe to 20,000 to 40,000 when trying to define the sources through smoke testing. Basins with footage much greater than this range tends to be difficult to trace down the source of I/I. Smoke testing in Zone 1 seems to be reasonably close to limit and it is expected to identify the individual sources. LS-01, however, is significantly greater than this threshold and is likely to create some challenges in refining the origins of the I/I sources.

Table 5
I/I Values and Peaking Factors for Six Edmonds Basins

Basin / Meter	Gallons/acre/day			Gallons/in-mile-day			Peaking factors (gpad)			Peaking factors (flow)		
	Apr 2008 - Aug 2008	Dec 2006 - Aug 2008	Dec 2007 - Aug 2008	Apr 2008 - Aug 2008	Dec 2006 - Aug 2008	Dec 2007 - Aug 2008	Apr 2008 / Aug 2008	Dec 2006 / Aug 2008	Dec 2007 / Aug 2008	Apr 2008 / Aug 2008	Dec 2006 / Aug 2008	Dec 2007 / Aug 2008
1	52	481	765	296	2,730	4,341	1.1	2.0	2.6	1.9	3.9	6.5
LS-01	118	1,021	1,359	1,291	4,259	6,732	1.2	3.1	3.7	3.1	5.3	5.3
Zone 1 (Meter 2 - Meter 1)	249	1,604	2,475	1,400	8,267	12,678	1.8	5.9	8.5	3.9	12.4	13.1
Zone 2 (Meter D- Meter E- Meter 2)	88	844	1,256	229	2,961	4,453	1.1	1.6	2.0	1.9	1.8	1.5
Edmonds Zone (EdMeter - LS-01)	136	758	1,310	579	3,225	5,574	1.2	2.1	3.0	3.0	11.8	9.2
MLT Zone (MLT Meter - Meter 3)	151	591	769	662	2,583	3,358	1.4	2.7	3.2	2.5	2.8	5.8

Worst Basin
2nd Worst Basin
3rd Worst Basin

The recommendation of this report is to smoke test Zone 1. It is recognized that only 26% of this basin is under the jurisdiction of the City, but it is a discrete basin with likely identifiable sources of I/I that are tributary to the City's plant. If the City elects to focus their attention to another basin that includes a greater percentage of City infrastructure, then efforts should be directed to Basin LS-01 or the Edmonds Zone basin.

VI. Capital Improvement Projects

The proposed Capital Improvement List consists of three components:

1. Initial and subsequent smoke testing and resulting CIP
2. Correction of chronic and frequent flooding areas
3. Correction of chronic and routine maintenance efforts

Smoke Testing Recommendations and Resulting CIP

The recommendation is to smoke test Zone 1. It is clear that only a minor portion of Zone 1 falls within the jurisdiction of the City. However, preliminary discussions with the Olympic View Water and Sewer District (OV) seems to indicate their willingness to perform the smoke testing on their portion of this Zone. OV has experienced some surcharging and localized flooding issues in this same basin. Their interest is two-fold. First to relieve the surcharging conditions and thereby avoid or postpone a capital project for added capacity and secondly to reduce treatment capacity charges to the City.

Correction of chronic and frequent flooding areas

In addition to the identified I/I sources resulting from the smoke testing, the City staff has also identified other known problem areas that frequently surcharge or result in flooding. These reoccurring problems are well known to the City staff. Some of these flooding areas can be resolved with a local CIP project as noted in Table 6.

These chronic problem areas are identified below. The corresponding numbers of the descriptions below match with the presentation numbers on Figure 3:

1. 727 Melody Lane, MH 244-8, surcharges and overflows down customers driveway during heavy storms. Preventing overflows at this location will flood houses. Downstream flow constriction will require a basin hydraulic analysis.
2. 1111 Brookmere, MH 265-8, house floods out of basement plumbing and MH surcharges during heavy storms
3. 224th St. SW & 77 Ave W, MH 4-13, surcharges during hard storms and needs to be bypass pumped into a MH at the end of 77th Ave W so sewer does not back up into homes on 224th.

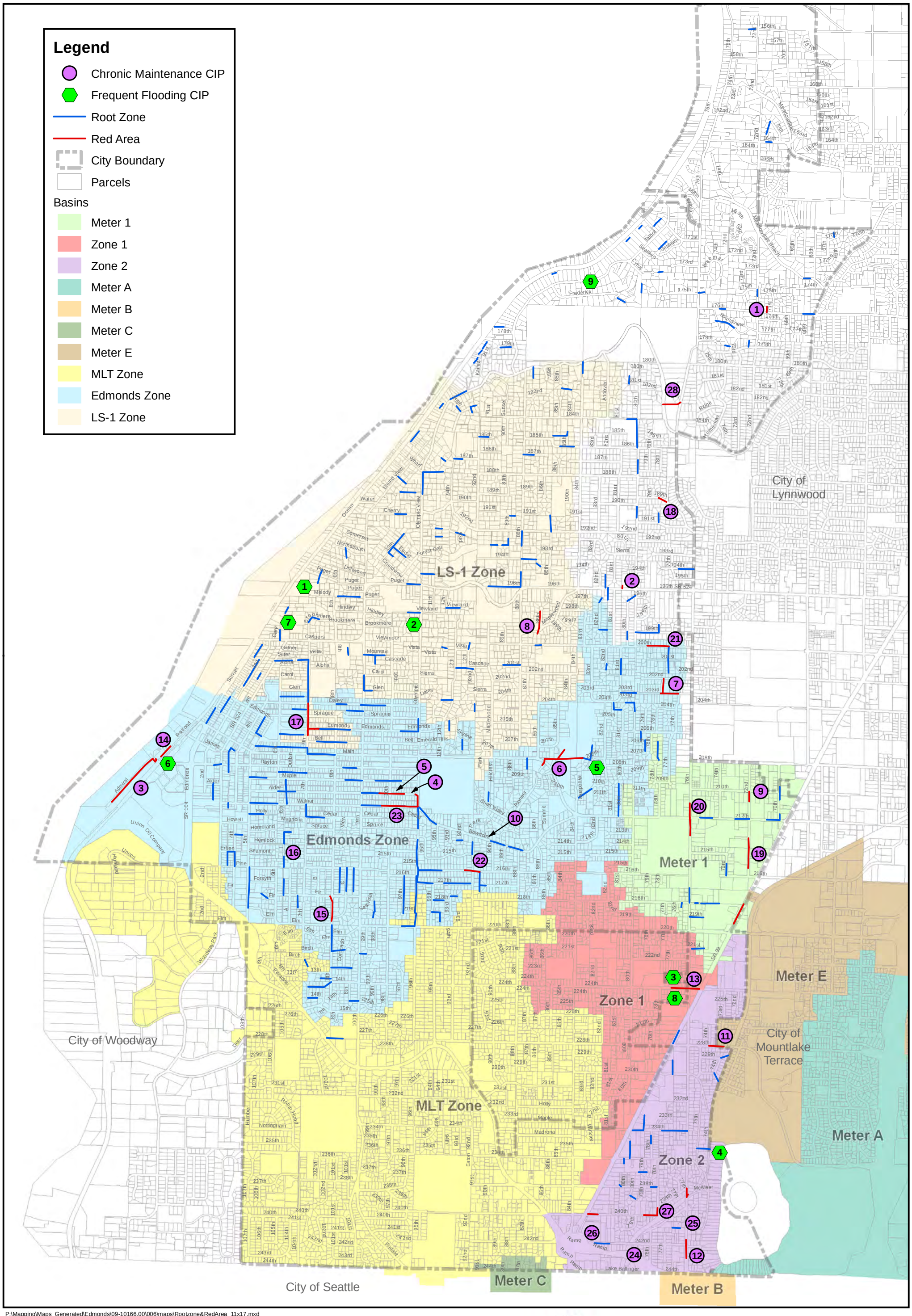
Table 6
Capital Improvement Projects

	Category	Year							
		2010	2011	2012	2013	2014	2015	2016	2017
	Smoke Testing and Resulting CIP								
	Smoke Test Zone 1 (Edmonds portion only)	$ 25,000							
	CIP from Zone 1 (Edmonds portion only)**		$ 700,000						
	Meter Installations in Basin LS-01			$ 20,000					
	Smoke Test in Basin LS-01				$ 75,000				
	CIP in Basin LS-01 **					$ 700,000			
	Meter Installation in Basin Edmonds Zone					$ 20,000			
	Smoke Testing in Edmonds Zone						$ 100,000		
	CIP in Edmonds Zone **							$ 700,000	
	Chronic and Frequent Flooding								
1	MH 244-8 overflow - downstream hydraulic analysis req'd		+++						
2	In-line check valve on side sewer (1111 Brookmere)		$ 1,500						
3	In-line check valve on side sewer (along 224th)		$ 1,500						
4	Gasketed ring and cover at MH 48-17		+++						
5	Gasketed ring and cover at MH 224-9		+++						
6	Gasketed ring and cover at MH 15 and 16			$ 1,500					
7	Gasketed ring and cover at MH 298 and 299			$ 1,500					
8	Flow meter at MH 152A-13				$ 20,000				
9	Gasketed ring and cover (or rainstop) at MH 80-2				$ 1,500				
	Reoccuring Maintenance Issues								
1	7117 176th Street SW. 30 foot belly and 150 feet of roots						$ 100,000		
2	8015 196th Street SW. Sixty feet of 6-inch line.						$ 30,000		
3	465 Admiral Way. 1500 feet of 8-inch line.						$ 750,000		
4	1053 Alder Street. 330 feet of 8-inch line.						$ 170,000		
5	949 Alder St. 600 feet of 8-inch line. Also see Comprehensive Sewer Plan Problem 7		$ 35,000	$ 345,000					
6	Pine Ridge Park, 8610 Main St, 8529 Main St and 8400 204th St SW. 1,325 feet 8- and 10-inch line.								$ 650,000
7	7703 203rd Street. 700 feet of 8-inch line.								$ 350,000
8	8705 Maplewood Ln. 350 feet of 8-inch line.								$ 175,000
9	7122 210th St. 300 feet of 8-inch line.								$ 150,000
10	9126 Bowdoin St. 120 feet of 6-inch lateral.								$ 60,000
11	7313 228th St SW. 350 feet of 8-inch line								$ 175,000
12	7530 242nd Pl SW. 350 feet of 8-inch line								$ 175,000
13	Sanitary Sewer Comprehensive Plan – Problem 11. On 224th St at 76th Ave. 800 feet of 8-inch pipe		$ 30,000	$ 290,000					

Table 6
Capital Improvement Projects

Category	Year							
	2010	2011	2012	2013	2014	2015	2016	2017
14 Sanitary Sewer Comprehensive Plan – Problem 12. On Beach at Dayton St. Approximately 350 feet of 6-inch pipe replaced with 8-inch		$ 15,000	$ 155,000					
15 Sanitary Sewer Comprehensive Plan – Problem 18. On 8th Ave S between Fir and Elm St. 600 feet of 8-inch line			$ 26,000	$ 234,000				
16 Sanitary Sewer Comprehensive Plan – Problem 19. On Hemlock St. 800 feet of 8-inch line			$ 40,000	$ 365,000				
17 Sanitary Sewer Comprehensive Plan – Problem 20. On 7th Ave N. 500 feet of 8-inch line			$ 50,000	$ 450,000				
18 Sanitary Sewer Comprehensive Plan – Problem 21. On Dellwood Dr. 500 feet of 8-inch line		$ 20,000	$ 200,000					
19 Sanitary Sewer Comprehensive Plan – Problem 22. On 72nd Ave W. 500 feet of 8-inch line			$ 25,000	$ 225,000				
20 Sanitary Sewer Comprehensive Plan – Problem 23. On 76th Ave W. 500 feet of 8-inch line			$ 25,000	$ 225,000				
21 Sanitary Sewer Comprehensive Plan – Problem 24. On 200th St SW. 250 feet of 8-inch line			$ 20,000	$ 225,000				
22 Sanitary Sewer Comprehensive Plan – Problem 25. On 216th St SW. 350 feet of 8-inch line			$ 15,000	$ 155,000				
23 Sanitary Sewer Comprehensive Plan – Problem 26. On Walnut at 96th Ave. 1000 feet of 8-inch line					$ 45,000	$ 405,000		
24 Sanitary Sewer Comprehensive Plan – Problem 27. On Northwest Traction right-of-way. 700 feet of 8-inch line					$ 30,000	$ 330,000		
25 Sanitary Sewer Comprehensive Plan – Problem 28. On 76th Ave W. 150 feet of 8-inch line					$ 5,000	$ 80,000		
26 Sanitary Sewer Comprehensive Plan – Problem 29. On 240th St SW. 250 feet of 8-inch line					$ 10,000	$ 120,000		
27 Sanitary Sewer Comprehensive Plan – Problem 30. On 238th St SW. 800 feet of 8-inch line						$ 40,000	$ 390,000	
28 Sanitary Sewer Comprehensive Plan – Problem 31. Off of Olympic View Dr at 76th Ave. 400 feet of 8-inch line							$ 250,000	
TOTAL	$25,000	$803,000	$1,214,000	$1,975,500	$810,000	$2,125,000	$1,340,000	$1,735,000

** Placeholder amount. Final amount is dependent on results of the smoke testing.
+++ Downstream Hydraulic Analysis required to prevent surcharging at this MH.



P:\Mapping\Maps_Generated\Edmonds\09-10166.00\006\maps\Rootzone&RedArea_11x17.mxd

BHC Consultants, LLC
1601 Fifth Avenue, Suite 500
Seattle, WA 98101

T 206 505 3400
F 206 505 3406
www.bhcconsultants.com

N W E S

0 1,000 2,000 Feet

CITY OF EDMONDS Inc. 1890

Root Zones and Red Areas

Edmonds I/I Study
Edmonds, Washington
May 12, 2010

Figure 3

P:\Mapping\Maps_Generated\Edmonds\09-10166.00\006\maps\Fig 3 Rootzone & Red Area 11x17.mxd

4. 23615 74th Ave W, MH 48-17, when lake rises during hard storms the manhole surcharges flowing sewage into the lake, then takes inflow from the lake into the manhole as the lake rises over the manhole and the sewer recedes in the main line. Preventing overflows at this location will flood houses. Downstream flow constriction will require a basin hydraulic analysis.
5. 20830 Woodlake Dr., MH 224-9, pond rises and MH goes under water backing sewage out of a cleanout at 20830. Preventing overflows at this location will flood houses. Downstream flow constriction will require a basin hydraulic analysis.
6. Between SR104 and Railroad Ave. on Dayton, MH 15 & 16 flood when the street floods during hard storms.
7. 832 and 828 Cary Rd., MH 298-8 and 299-8 go under water during hard storms when the creek floods.
8. MH 152A-13 (between 82nd and 83rd Avenue on 220th Street) could use a flow meter to calculate flows going into the Olympic View service area to see if we are contributing to their high flows on 224th and 77th Ave W.
9. MH 80-2, MH 78-2, 8403 and 8307 Talbot Rd. Manholes under water during storms.

<u>Correction of chronic and routine maintenance efforts</u>

There are dozens of regular and reoccurring maintenance efforts throughout the City. These areas include those pipe segments that are on the City's routine maintenance schedule and might include flushing of the lines that have sags in the alignment, root intrusion and grease accumulations. The City staff has characterized these chronic areas as the Red Area problems (which are the highest priority) and the Root Zone which require attention but generally on a less frequent basis. These areas are graphically presented on Figure 3.

The following are a brief description of the Red Area problems, corresponding numbers are shown on Figure 3. Problem areas 1 through 12 were collected from the maintenance staff and problems 13 through 26 were included in the previous Sanitary Sewer Comprehensive Plan.

1. 7117 176th Street SW. Thirty foot belly and 150 feet of roots (Sheet 3-93 to Sheet 3-94 c/o).
2. 8015 196th Street SW. Sixty feet of 6-inch line with belly and sag (Sheet 5-334A).
3. 465 Admiral Way. Approximately 1500 feet of 8-inch line beginning at MH 2 through MH 6 with bellies, flat grade and grease accumulations (Sheet 7).
4. 1053 Alder Street. 330 feet of 8-inch line with flat grade and bellies (Sheet 8-32B to Sheet 12-2 and Sheet 8-32A to Sheet 8-32B).

5. 949 Alder Street. Approximately 600 feet of 8-inch line with flat grades and bellies (Sheet 8-30 to Sheet 8-31 and Sheet 8-31 to Sheet 8-32). Also refer to Comprehensive Sewer Plan Problem 7.
6. Pine Ridge Park area, 8610 Main Street, 8529 Main Street and 8400 204th Street SW. Approximately 1,325 feet 8- and 10-inch line. Manholes 9-18, 9-19, 9-20, 9-201, 9-202 and 9-224.
7. 7703 203rd Street. Approximately 700 feet of 8-inch line with bellies and flat grade (Sheet 9-314 to Sheet 9-313 and Sheet 9-366 Sheet 9-314).
8. 8705 Maplewood Lane. Approximately 350 feet of 8-inch line with bellies and flat grade (Sheet 9-137 to Sheet 9-138).
9. 7122 210th Street. Approximately 300 feet of 8-inch line with bellies and grease accumulation (Sheet 10-23 to Sheet 10-25).
10. 9126 Bowdoin Street. Approximately 120 feet of 6-inch lateral with flat grade and root intrusion.
11. 7313 228th Street SW. Approximately 350 feet of 8-inch line with bellies (Sheet 14-65 to Sheet 14-66).
12. 7530 242nd Pl SW. Approximately 350 feet of 8-inch line with bellies (Sheet 17-81 to Sheet 17-80).
13. Sanitary Sewer Comprehensive Plan – Problem 11. On 224th at the intersection with 76th Avenue. Approximately 800 feet of 8-inch pipe.
14. Sanitary Sewer Comprehensive Plan – Problem 12.On Beach Place at the intersection with Dayton Street. Replace approximately 350 feet of 6-inch line with 8-inch pipe.
15. Sanitary Sewer Comprehensive Plan – Problem 18. On 8th Avenue South between Fir and Elm Street. Approximately 600 feet of 8-inch line with flat grade.
16. Sanitary Sewer Comprehensive Plan – Problem 19. On Hemlock Street. Approximately 800 feet of 8-inch line with numerous bellies.
17. Sanitary Sewer Comprehensive Plan – Problem 20. On Seventh Avenue North. Approximately 500 feet of 8-inch line with numerous bellies.
18. Sanitary Sewer Comprehensive Plan – Problem 21. On Dellwood Drive. Approximately 500 feet of 8-inch line with numerous bellies and accumulation of grease.
19. Sanitary Sewer Comprehensive Plan – Problem 22. On 72nd Avenue West. Approximately 500 feet of 8-inch line with numerous bellies and accumulation of grease.
20. Sanitary Sewer Comprehensive Plan – Problem 23. On 76th Avenue West. Approximately 500 feet of 8-inch line with numerous bellies and accumulation of grease.
21. Sanitary Sewer Comprehensive Plan – Problem 24. On 200th Street SW. Approximately 250 feet of 8-inch line with numerous bellies, flat grade and accumulation of solids.
22. Sanitary Sewer Comprehensive Plan – Problem 25. On 216th Street SW. Approximately 350 feet of 8-inch line with numerous bellies and accumulation of grease.

23. Sanitary Sewer Comprehensive Plan – Problem 26. On Walnut between 96th Avenue and 9th Avenue South. Approximately 1000 feet of 8-inch line with flat grade and accumulation of solids.
24. Sanitary Sewer Comprehensive Plan – Problem 27. On Northwest Traction right-of-way. Approximately 700 feet of 8-inch line with flat grade, bellies and accumulation of solids and grease.
25. Sanitary Sewer Comprehensive Plan – Problem 28. On 76th Avenue West. Approximately 150 feet of 8-inch line with flat grade.
26. Sanitary Sewer Comprehensive Plan – Problem 29. On 240th Street SW. Approximately 250 feet of 8-inch line with bellies and grease accumulation.
27. Sanitary Sewer Comprehensive Plan – Problem 30. On 238th Street SW. Approximately 800 feet of 8-inch line with bellies and grease accumulation.
28. Sanitary Sewer Comprehensive Plan – Problem 31. Off of Olympic View Drive at 76th Avenue. Approximately 400 feet of 8-inch line with bellies and root intrusion.

VII. Proposed Standards, Policies and Guidelines

The proposed standards, policies and guidelines described herein address a wide range of topics, including sewer evaluations, connections to side sewers, pipeline and manhole leak inspections, system maintenance, and construction practices and materials for I/I control projects.

They are intended to:

- Guide the engineering and construction of future system infrastructure (both new and rehabilitated) to achieve long-term I/I control

- Limit system degradation and I/I increases over time

Some of the subjects covered are as follows:

- Establish proper construction practices and materials for I/I repair and rehabilitation projects

- Encourage appropriate inspection and testing prior to acceptance of new or rehabilitated sections of sewer

- Develop inspection and repair standards for new and existing structures on private property

- Encourage appropriate system maintenance

- Provide appropriate predesign, investigation of I/I conditions, inspection of construction, and enforcement of standards.

The proposed standards, policies and guidelines address only features of the public and private sewer systems associated with I/I. They are intended to augment and emphasize individual City standards which outline requirements for overall sewer system design, construction and rehabilitation.

A total of 33 Standards, 17 Policies and 7 Guidelines have been developed for the City's consideration in formulating an effective, on-going I/I Control Program for City-wide implementation as needed. They are derived from a set of similar draft requirements prepared for King County under its Regional I/I Control Program. The County's draft standards and policies reflect extensive input from the Engineering & Planning Subcommittee of the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC), of which the City of Edmonds is one of the 34 member agencies.

Funding Options
While the overall objective of an I/I program would be reduction of capital and O&M costs, with the potential reduction in rates, options for ensuring compliance with I/I standards include whether or not surcharges or incentives should be established.

Surcharges are an additional fee that could be charged to City customers for exceeding a predetermined I/I threshold or for causing increased costs related to conveying and treating I/I.

Incentives provide financial rewards, in the form of lower rates or rebates, to City customers for reducing I/I flow.

Cost sharing can spread the cost of a project among the City, State and Ratepayers through a variety of options.

Private Property
The cost and potential disruption associated with reducing I/I from private property sources are considerable and affect the ability and willingness of property owners to undertake corrective actions.

There are also constraints, including issues of legality and equity that the City must address if public funding is used to defray some or all of the cost of private sewer rehabilitation.

Public Education
Experience elsewhere indicates that property owner participation increases with knowledge about I/I and its impacts on the cost of wastewater conveyance,

treatment and disposal. Implementation of an I/I reduction/control program, especially as it includes private property and/or rate issues, necessitates some amount of public education and involvement.

PROPOSED STANDARDS, POLICIES & GUIDELINES

Each standard, policy or guideline is listed in Appendix B, and consists of the following:

- **Title** – A brief name of the Standard
- **Control Measure Description** – A description of why the Standard is being proposed
- **Standard/Policy/Guideline** – A description in sufficient detail for engineers and City representatives to compare with existing standards
- **Potential City Impacts** – Indicates the potential impact on the City, including additional staffing requirements and other aspects of daily operations. Elements that could add or reduce costs to normal processes are listed.
- **Potential Impacts to Ratepayers** – Indicates potential impact to Ratepayers on private property. Elements that could add or reduce costs to normal processes are listed.

The following table provides a summary and brief description of the proposed Standards, Policies and Guidelines (See Appendix B for a detailed description of the proposed action).

SUMMARY OF PROPOSED STANDARDS, POLICIES & GUIDELINES

Number	Title	Rehab Projects Only	Both New & Rehab
STANDARDS			
Standard 1	Storm Drainage Connections to the Sanitary Sewer		√
Standard 2	Connections to Existing System		√
Standard 3	Allowable Connections to Side Sewers		√
Standard 4	Visual Inspection of Manholes for SSES Investigations	√	

Number	Title	Rehab Projects Only	Both New & Rehab
Standard 5	Closed Circuit Television (CCTV) Inspection of Sewers for SSES Investigation	√	
Standard 6	Smoke Testing for SSES Investigations	√	
Standard 7	Dye Testing for SSES Investigations	√	
Standard 8	Design Capacity for Pipeline Rehabilitation Projects	√	
Standard 9	Pipe Anchoring		√
Standard 10	Manhole Location & Covers		√
Standard 11	Manhole Size		√
Standard 12	Sewer System Design		√
Standard 13	Manhole Joints		√
Standard 14	Side Sewer Connection Location & Taps		√
Standard 15	Abandonment Requirements		√
Standard 16	Pipe Materials		√
Standard 17	Pipe Rehabilitation Methods	√	
Standard 18	Inspection Wyes / Cleanouts		√
Standard 19	Inspection of Pipe Installation & Backfill		√
Standard 20	Pipe Zone Bedding & Trench Backfill		√
Standard 21	Manhole Leveling Rings		√
Standard 22	Root Intrusion	√	
Standard 23	Root Intrusion (Private Property)	√	
Standard 24	Pipeline Leak Testing		√
Standard 25	Side Sewer Visual Inspection		√
Standard 26	Side Sewer/Lateral Leak Testing		√
Standard 27	Manhole Leak Testing		√

Number	Title	Rehab Projects Only	Both New & Rehab
Standard 28	Product Specific Inspection		√
Standard 29	Product Specific Inspection (Private Property)		√
Standard 30	CCTV Inspection		√
Standard 31	Side Sewer CCTV Requirements		√
Standard 32	Certification, Warranty & Qualifications		√
Standard 33	Bonding & Warranty Inspections		√

POLICIES

Policy 1	Public Awareness of I/I: Educational Materials		√
Policy 2	Responsibility for Community		√
Policy 3	Public Funding for I/I Reduction Projects		√
Policy 4	Rates, Incentives & Surcharges		√
Policy 5	Cost Sharing		√
Policy 6	Storm Water Drainage Ordinances		√
Policy 7	Responsibility for Storm Water Drainage		√
Policy 8	Infeasible or Prohibitively Expensive Modifications		√
Policy 9	Contractor Qualifications		√
Policy 10	Required Permits		√
Policy 11	Inspection Training		√
Policy 12	Property Restoration	√	
Policy 13	Bonding, Licensing, Insurance and Warranty Provisions		√
Policy 14	Access to Private Property		√
Policy 15	Limiting Liability		√
Policy 16	Legislative Action Requirements		√

Number	Title	Rehab Projects Only	Both New & Rehab
Policy 17	Side Sewer Ownership & Responsibility		√

GUIDELINES

Guideline1	Modeling and Engineering Analysis		√
Guideline 2	Lateral and Side Sewer Rehabilitation Methods	√	
Guideline 3	Pipe Protection / Depth of Cover		√
Guideline 4	Manhole Rehabilitation	√	
Guideline 5	Spot Repairs	√	
Guideline 6	Spot Repairs (Private Property)	√	
Guideline 7	Manhole Lids/Inserts	√	

Adoption of these standards, policies and guidelines should be prioritized to facilitate a systematic incorporation of the governance surrounding these I/I issues. Table 7 that follows has divided the standards, policies and guidelines into five categories:

1. Public Education
2. Implementation
3. Planning and Design
4. New Construction
5. Existing Facilities

It is recommended that those standards, policies and guidelines that are bolded and shaded should be incorporated first.

Table 7
Prioritzation of Standards, Policies and Guidelines

Major Category	Application	Item No.		I/I Reduction Potential	City Staffing Impact
EDUCATION	All	**P1**	**Public Awareness: Educational Materials**	Long Term	Low
		P2	**Responsibility for Community Education**	Long Term	Low
IMPLEMENTATION (COUNCIL ACTION)	All	**P3**	**Public Funding for I/I Reduction Projects**		
		P4	**Rates, Incentives & Surcharges**		Medium
		P17	**Side Sewer Ownership & Responsibility**		
		P5	Cost Sharing		
PLANNING/DESIGN	All	**P9**	**Contractor Qualifications**	Long Term	
		P11	**Inspection Training**		Medium
		P6	Stormwater Drainage Ordinances		
		P10	Required Permits		
		P16	Legislative Action Requirements		
NEW CONSTRUCTION	All	**S19**	**Inspection of Pipe Installation & Backfill**	Long Term	Low
		S32	**Certification, Warranty & Qualifications**	Long Term	Low
		P7	Responsibility for Stormwater Drainage		
		S9	Pipe Anchoring		
		S16	Pipe Materials		
	PUBLIC Only	**S24**	**Pipeline Leak Testing**	Long Term	Low
		S27	**Manhole Leak Testing**	Long Term	Low
		S30	**CCTV Inspection**	Long Term	Medium
		S1	**Storm Drainage Connections to Sanitary Sewer**	Long Term	Low
		G1	Modeling & Engineering Analysis		
		S10	Manhole Location & Covers		
		S11	Manhole Size		
		S12	Sewer System Design		
		S13	Manhole Joints		
		S21	Manhole Leveling Rings		
		S28	Product Specific Inspection		
	PRIVATE Only	**S3**	**Allowable Connections to Side Sewers**	Long Term	Medium
		S14	**Side Sewer Connection Location & Taps**		Low
		S20	**Pipe Zone Bedding & Trench Backfill**	Long Term	Low
		S25	**Side Sewer Visual Inspection**		Low
		S26	**Side Sewer/Lateral Leak Testing**	Long Term	
		S31	**Side Sewer CCTV Requirements**	Long Term	Low
		P8	Infeasible or Prohibitively Expensive Modifications		
		S18	Inspection Wyes/Cleanouts		
		G3	Pipe Protection/Depth of Cover		
		S29	Product Specific Inspection (Private Property)		
		S33	Bonding & Warranty Inspections		
EXISTING CONSTRUCTION	All	**S5**	**CCTV Inspection of Sewers for SSES**	Long Term	Low
		S6	**Smoke Testing for SSES**		Low
		S7	**Dye Testing for SSES**		Low
		S19	**Inspection of Pipe Installation & Backfill**	Long Term	Low
		P7	Responsibility for Storm Drainage		
		P13	Bonding, Licensing, Insurance & Warranty		
		S8	Design Capacity for Pipeline Rehab Projects		
		S15	Abandonment Requirements		
		S16	Pipe Materials		
		S17	Pipe Rehabilitation Methods		
		S22	Root Intrusion		
		S32	Certification, Warranty & Qualifications		
	PUBLIC Only	**S2**	**Connections to Existing Systems**		
		G5	**Spot Repairs**	Medium	Low
		S24	**Pipeline Leak Testing**	Long Term	
		S30	**CCTV Inspection**	Long Term	Medium
		S4	Visual Inspection of Maholes for SSES		
		G1	Modeling & Engineering Analysis		
		G4	Manhole Rehabilitation		
		S21	Manhole Leveling Rings		
		G7	Manhole Lids/Inserts		
		S28	Product Specific Inspection		
	PRIVATE Only	**P14**	**Access to Private Property**		Low
		S3	**Allowable Connections to Side Sewers**	Long Term	Medium
		S14	**Side Sewer Connection Location & Taps**		Low
		S20	**Pipe Zone Bedding & Trench Backfill**	Long Term	Low
		S31	**Side Sewer CCTV Requirements**	Long Term	Low
		P8	Infeasible or Prohibitively Expensive Modifications		
		P12	Property Restoration		
		P15	Limiting Liability		
		G2	Lateral & Side Sewer Rehabilitation Methods		
		S18	Inspection Wyes/Cleanouts		
		G3	Pipe Protection/Depth of Cover		
		G6	Spot Repairs (Private Property)		
		S33	Bonding & Warranty Inspections		

APPENDIX A

Flow Data from

August 2008, April 2008, December 2006 and December 2007

Meter 1

Meter 2

Meter 3

Meter A

Meter B

Meter C

Meter D

Meter E

Edmonds Meter

MLT Meter

Lift Station No. 1

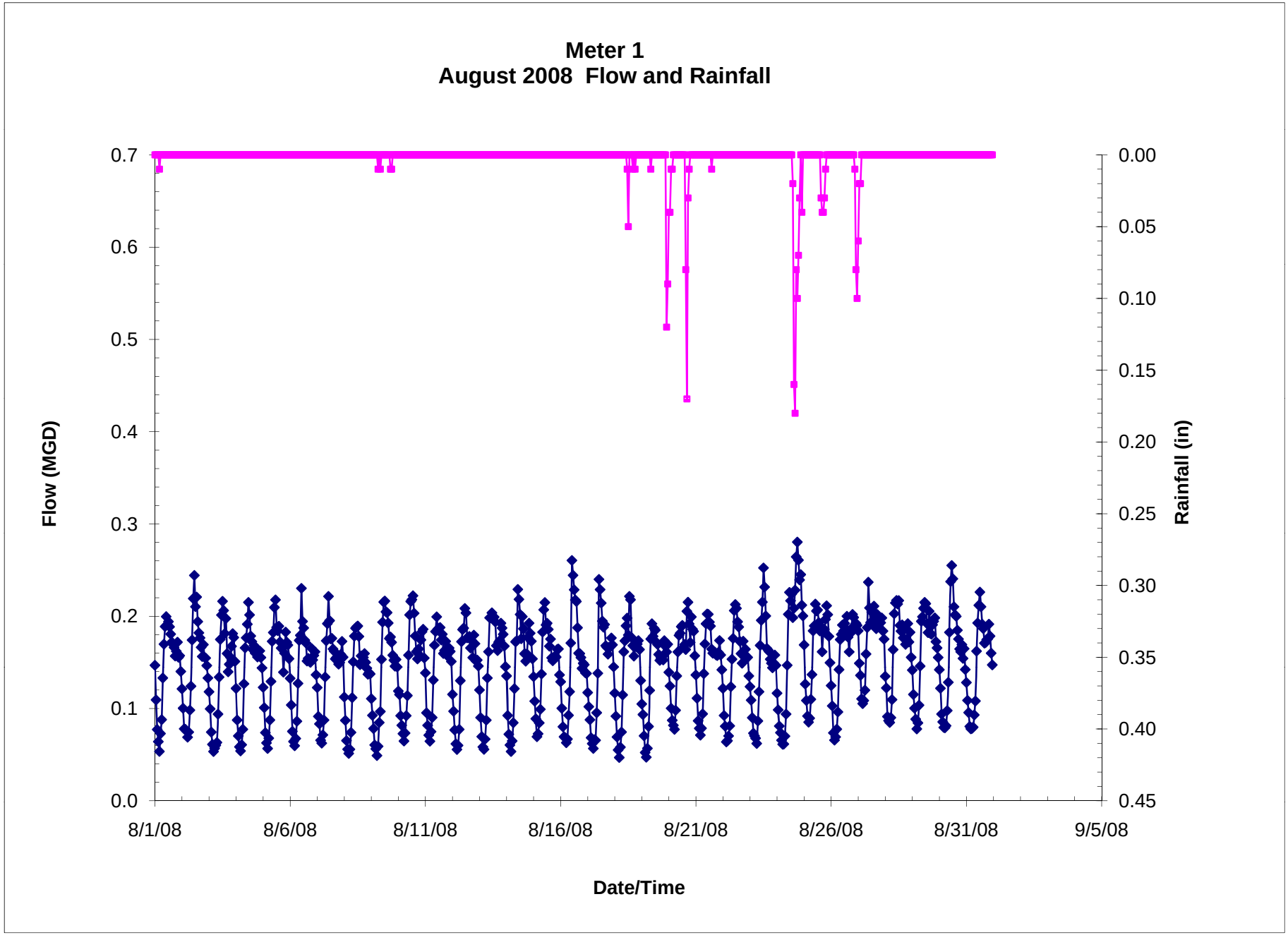
Meter 1

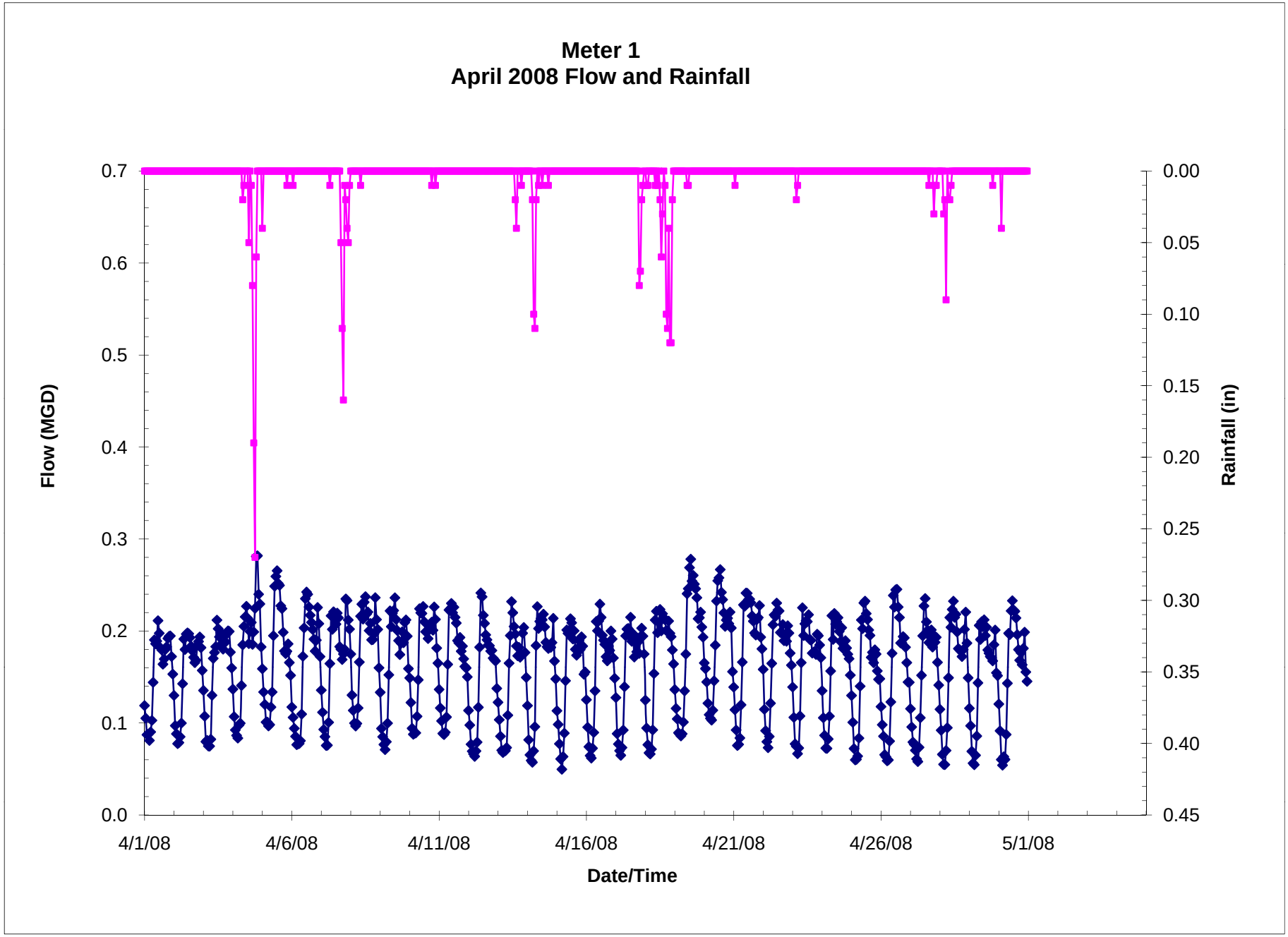
August 2008

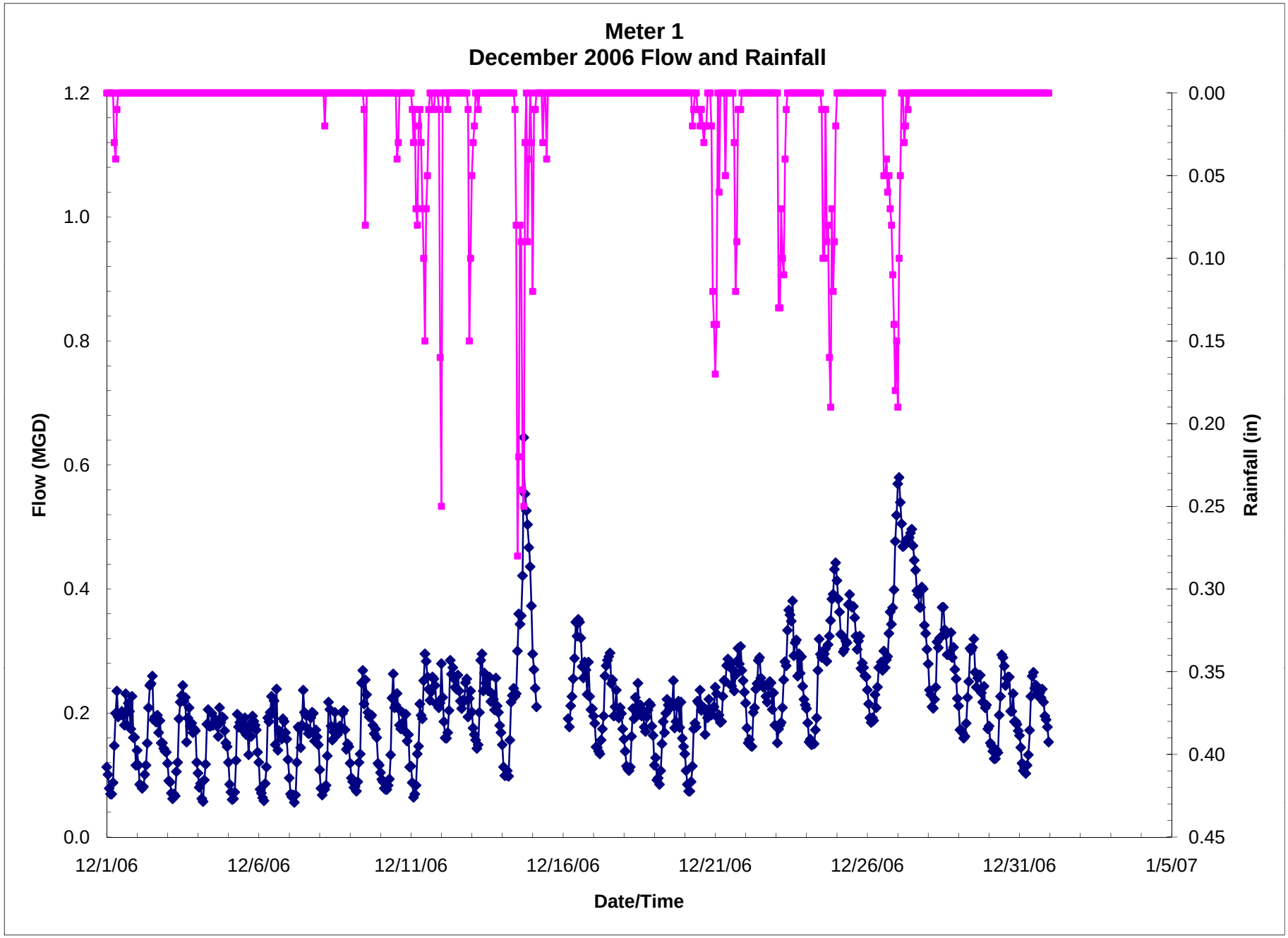
April 2008

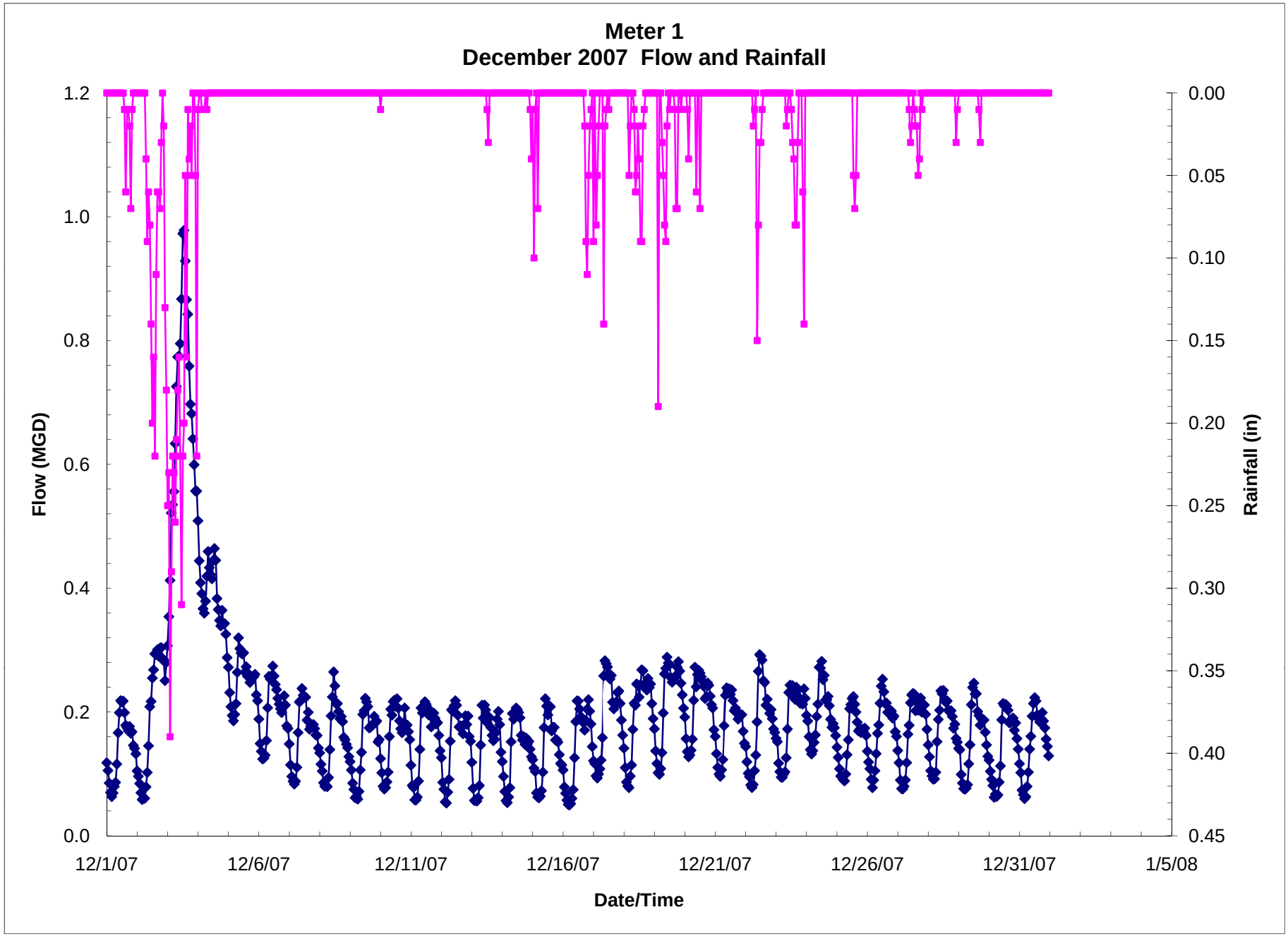
December 2006

December 2007


Meter 1
August 2008 Flow and Rainfall
Flow (MGD)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08
Date/Time


Meter 1
April 2008 Flow and Rainfall
Flow (MGD)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
Date/Time


Meter 1
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter 1
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

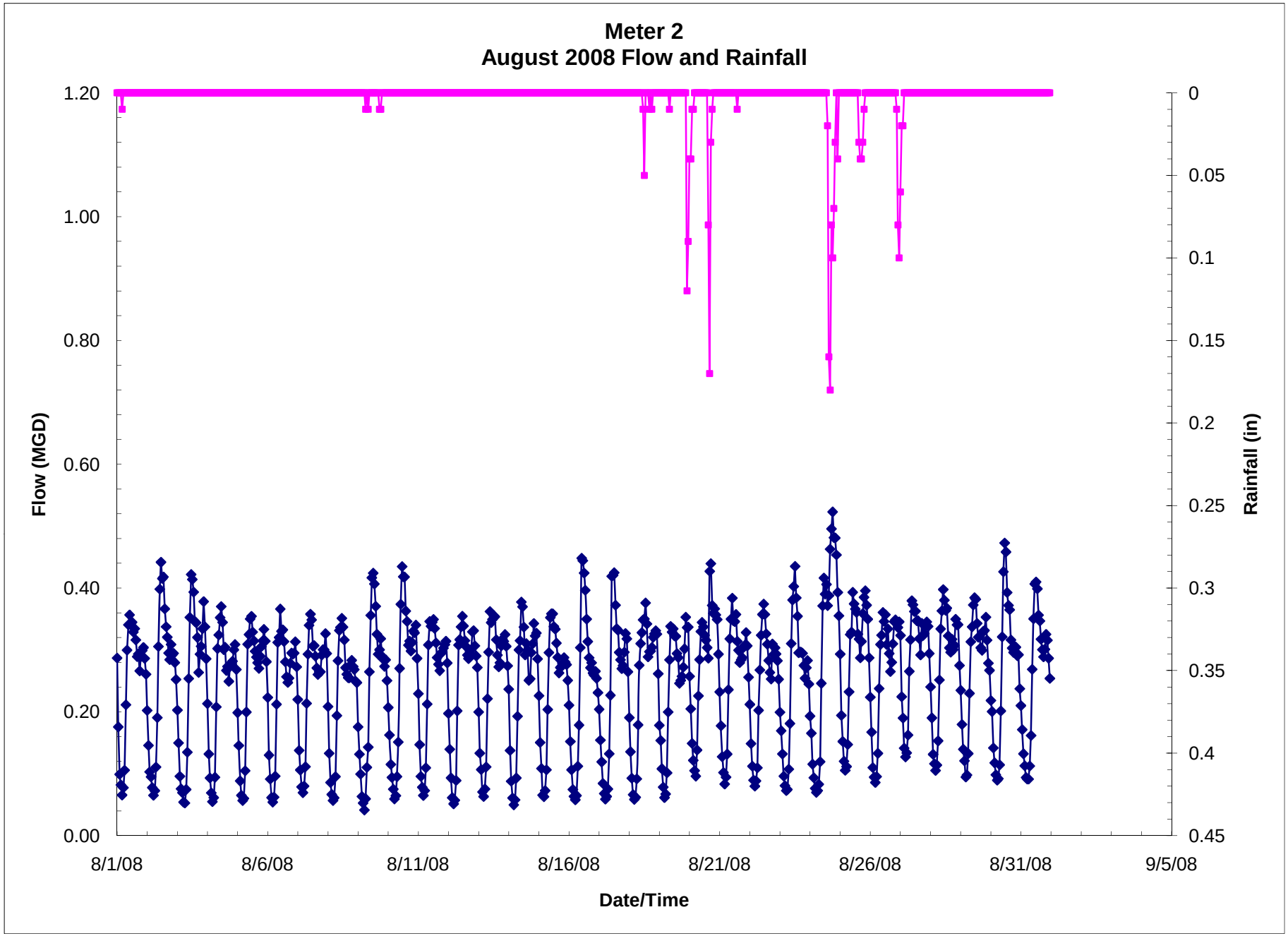
Meter 2

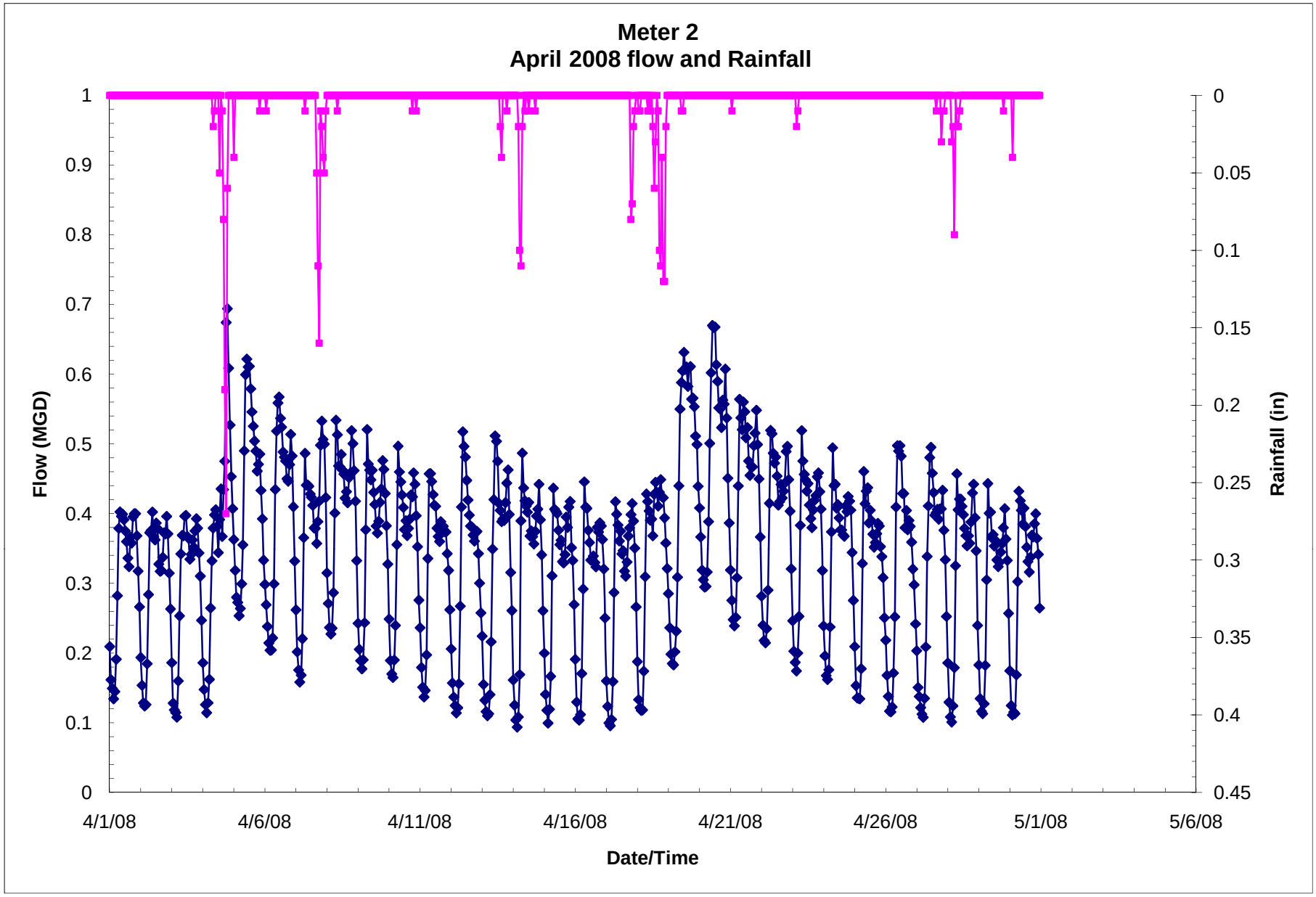
August 2008

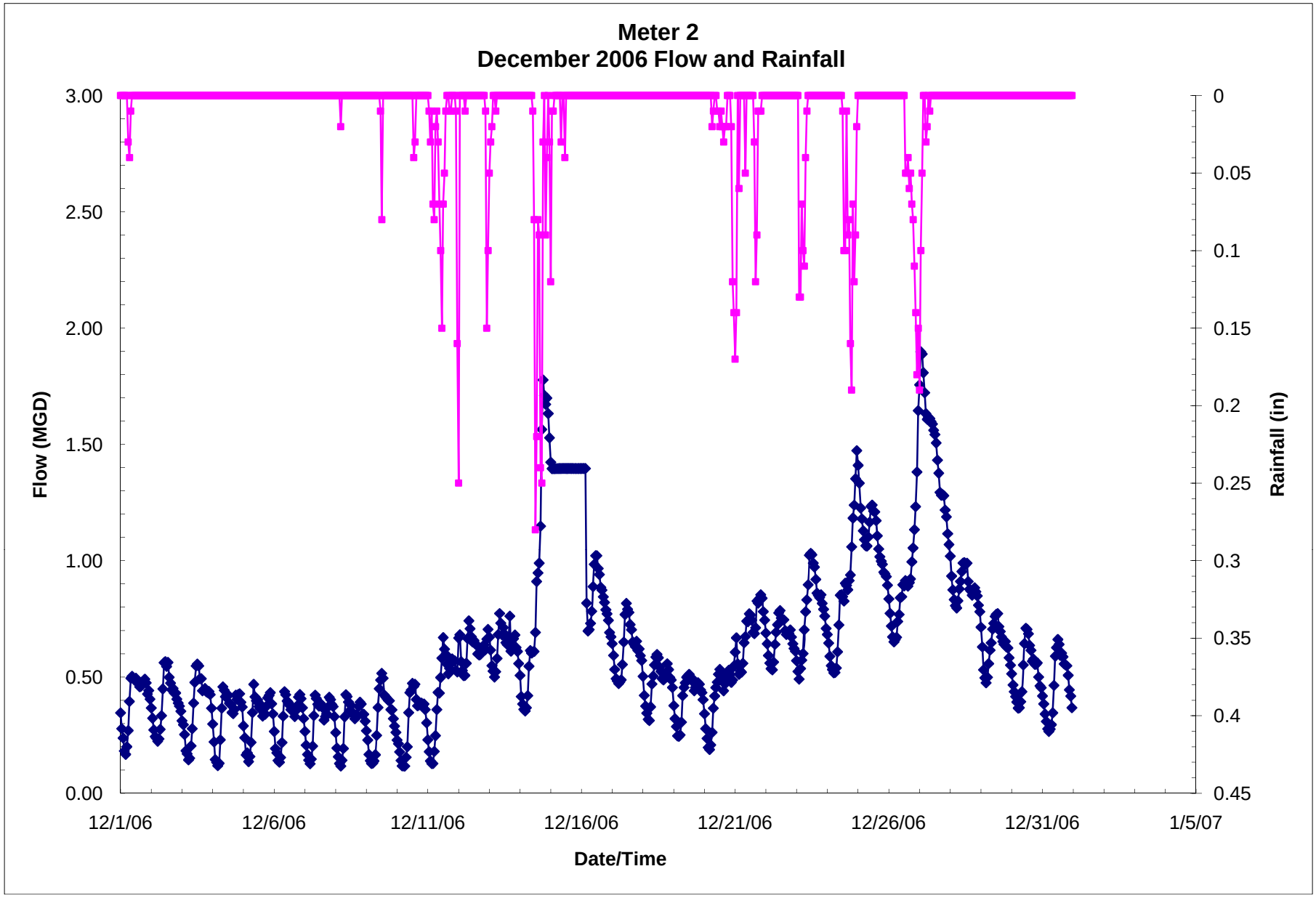
April 2008

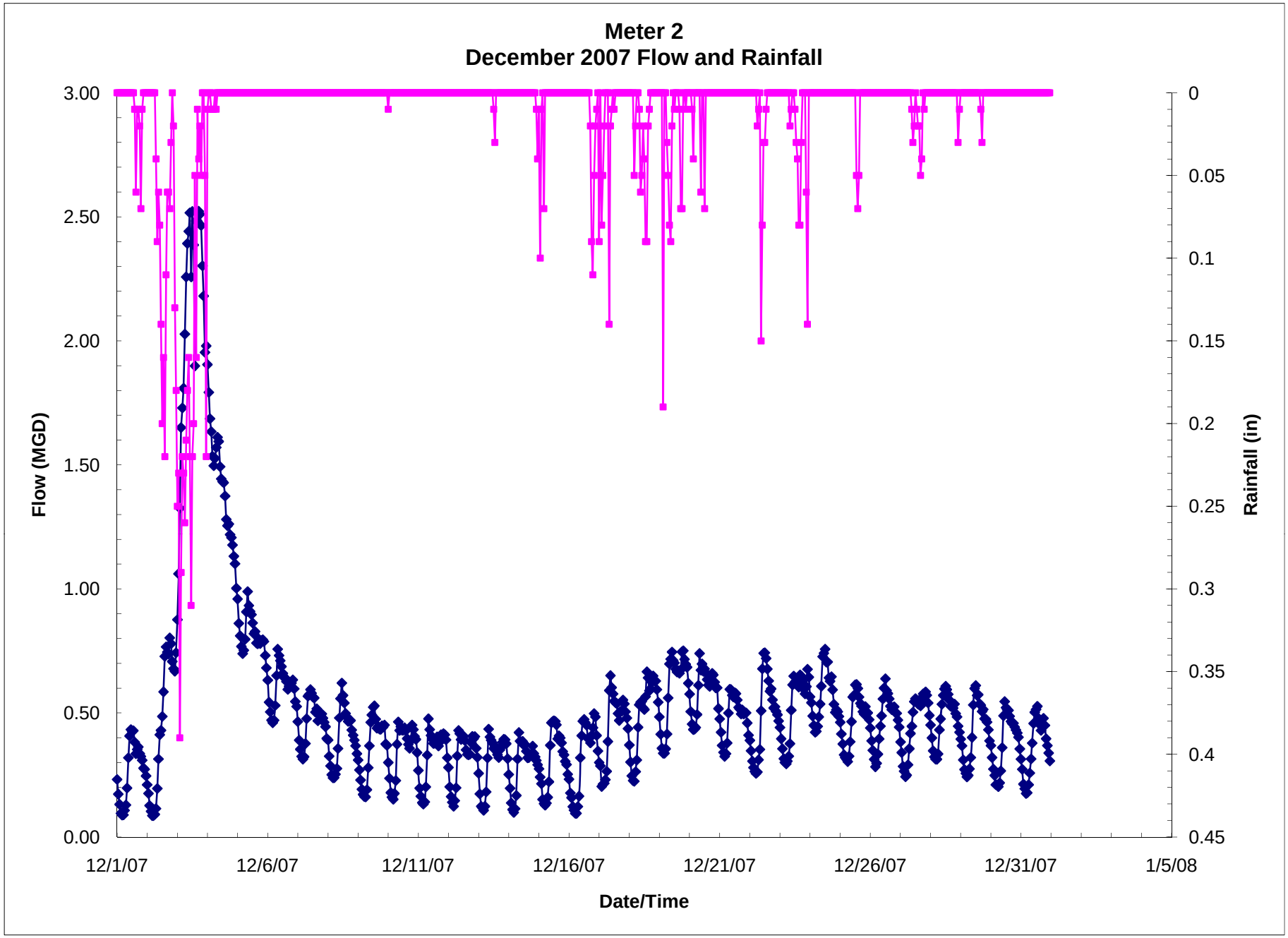
December 2006

December 2007


Meter 2
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter 2
April 2008 flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter 2
December 2006 Flow and Rainfall
Flow (MGD)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall (in)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07
Date/Time


Meter 2
December 2007 Flow and Rainfall
Flow (MGD)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall (in)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08
Date/Time

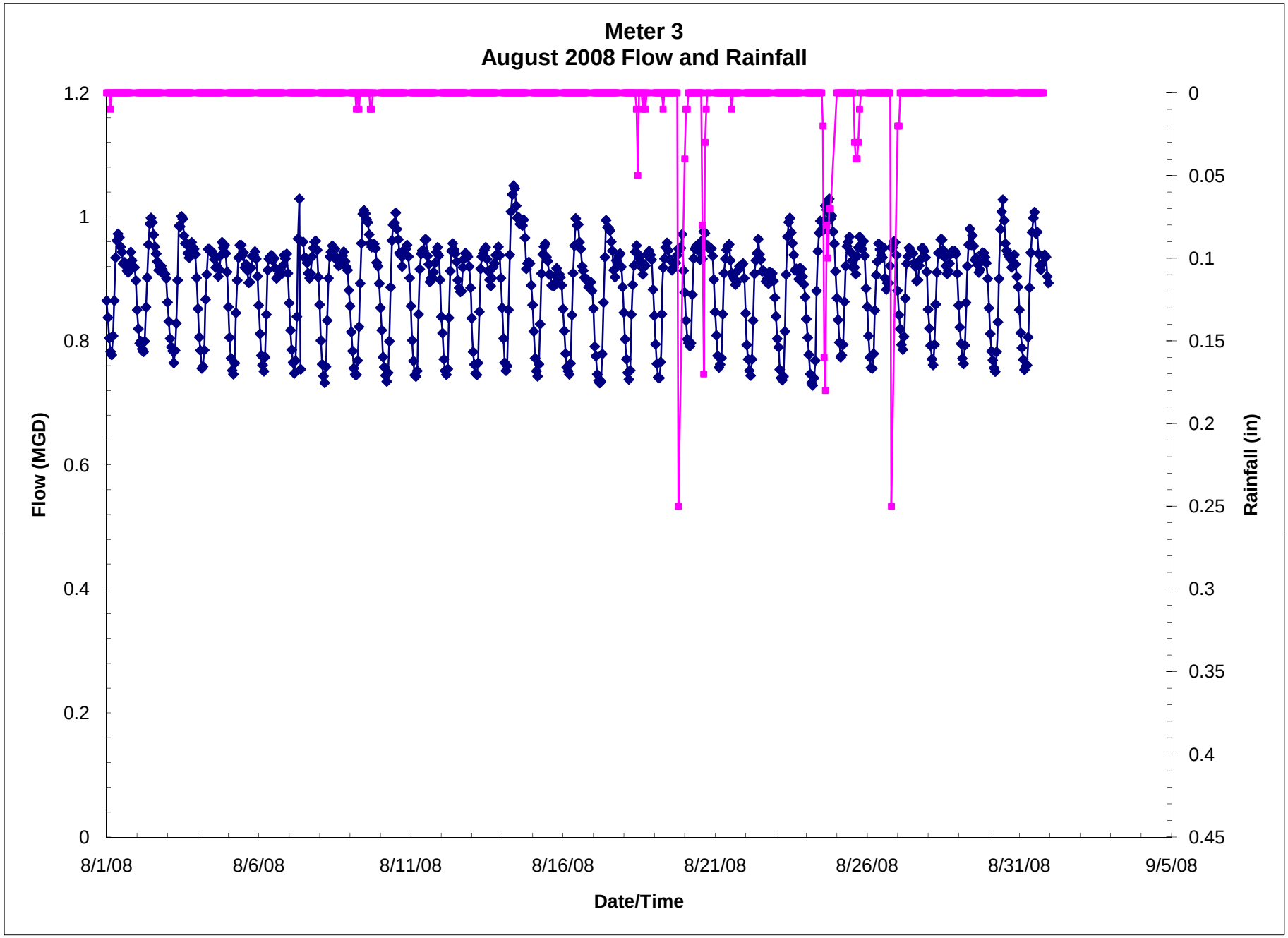
Meter 3

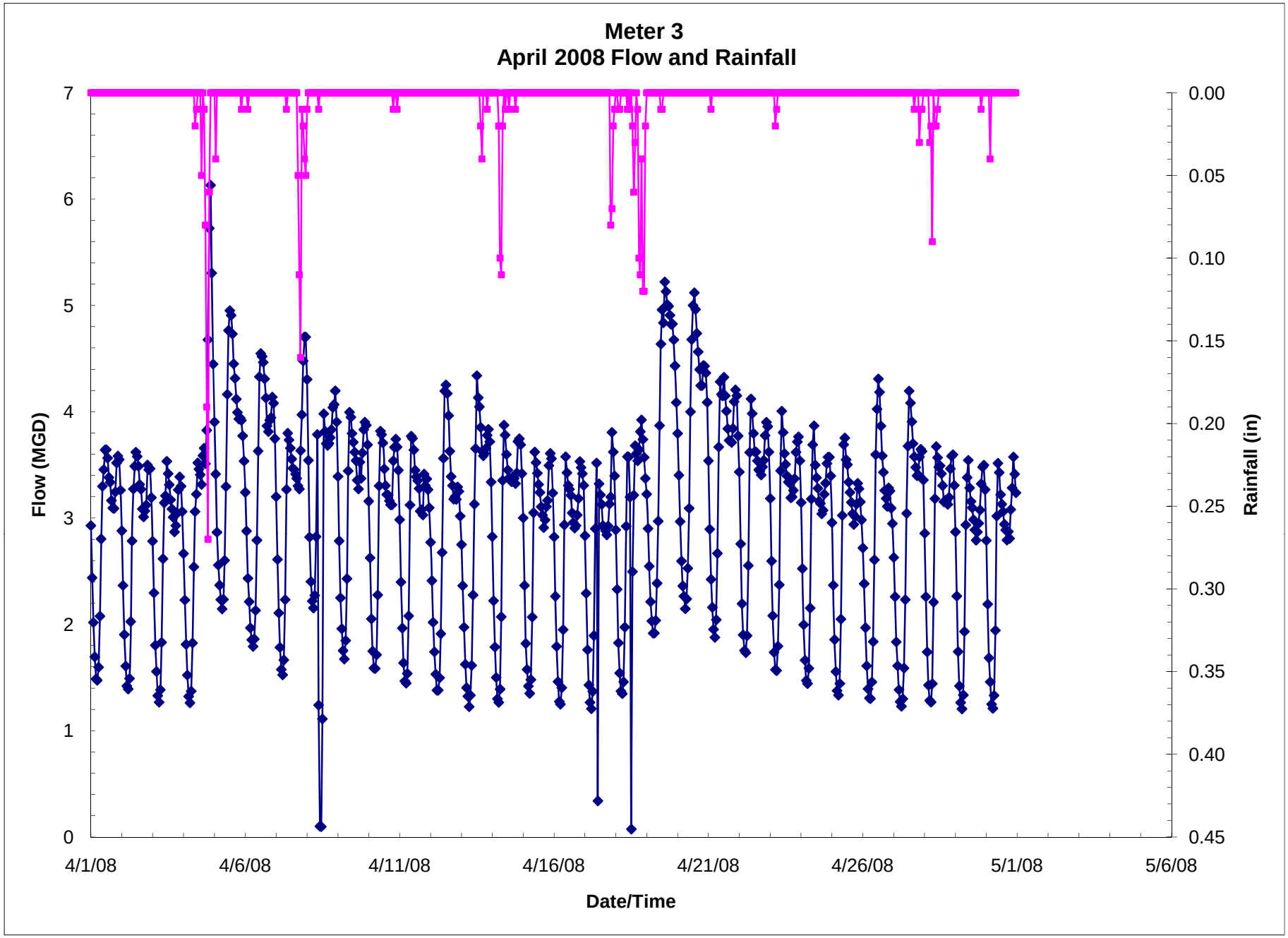
August 2008

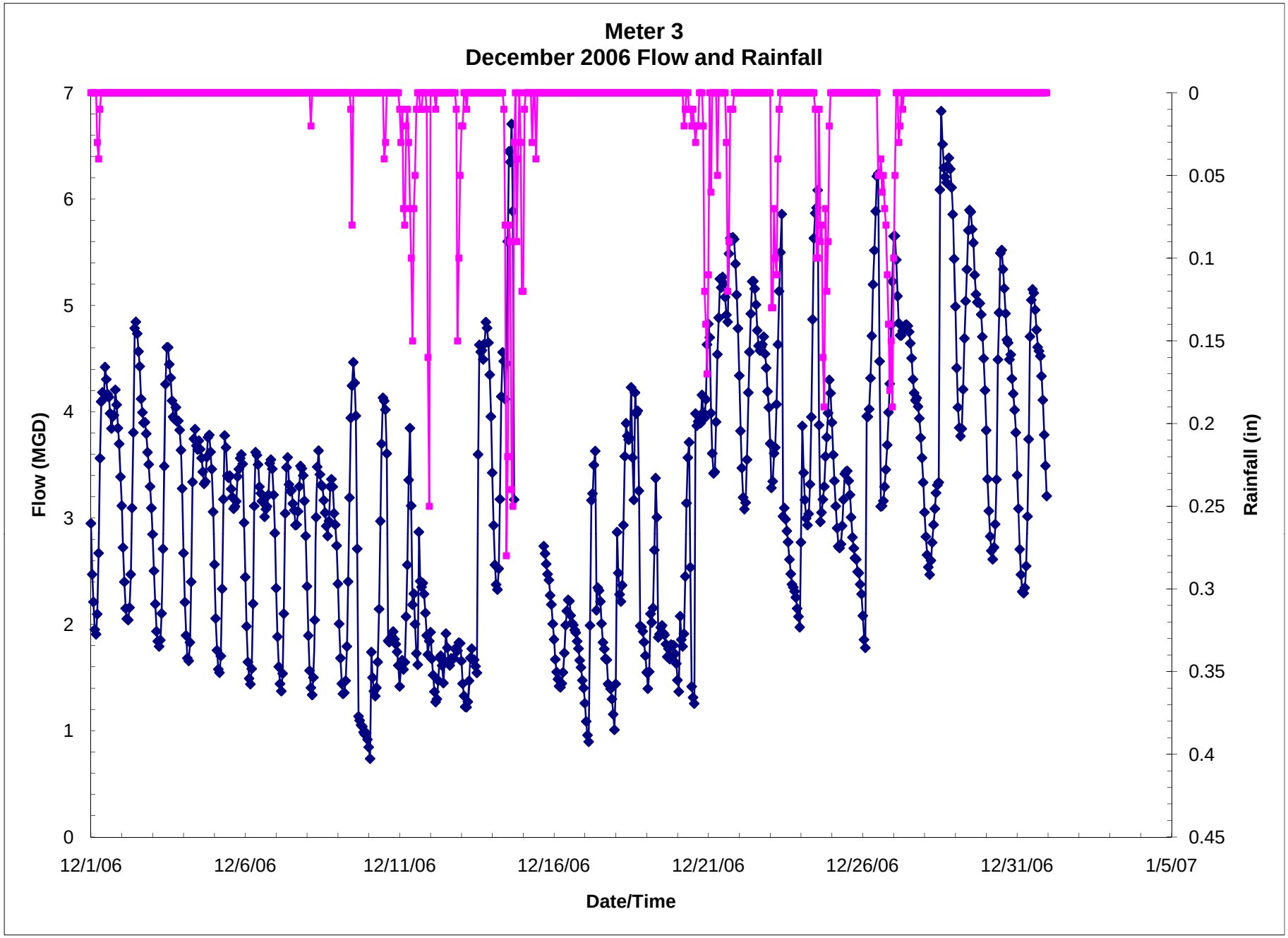
April 2008

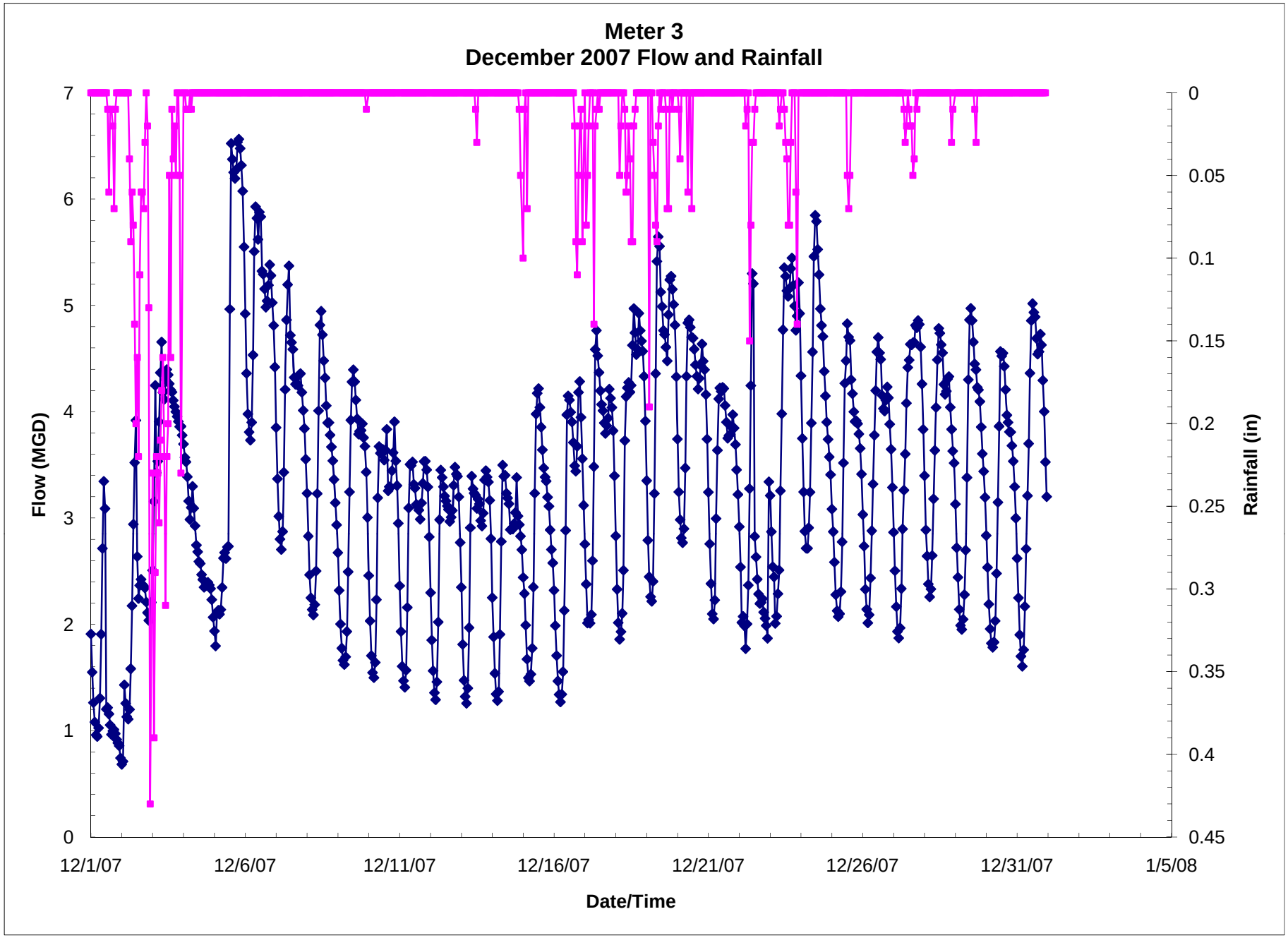
December 2006

December 2007


Meter 3
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.2
1
0.8
0.6
0.4
0.2
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter 3
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0
1
2
3
4
5
6
7
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter 3
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0
1
2
3
4
5
6
7
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter 3
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0
1
2
3
4
5
6
7
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

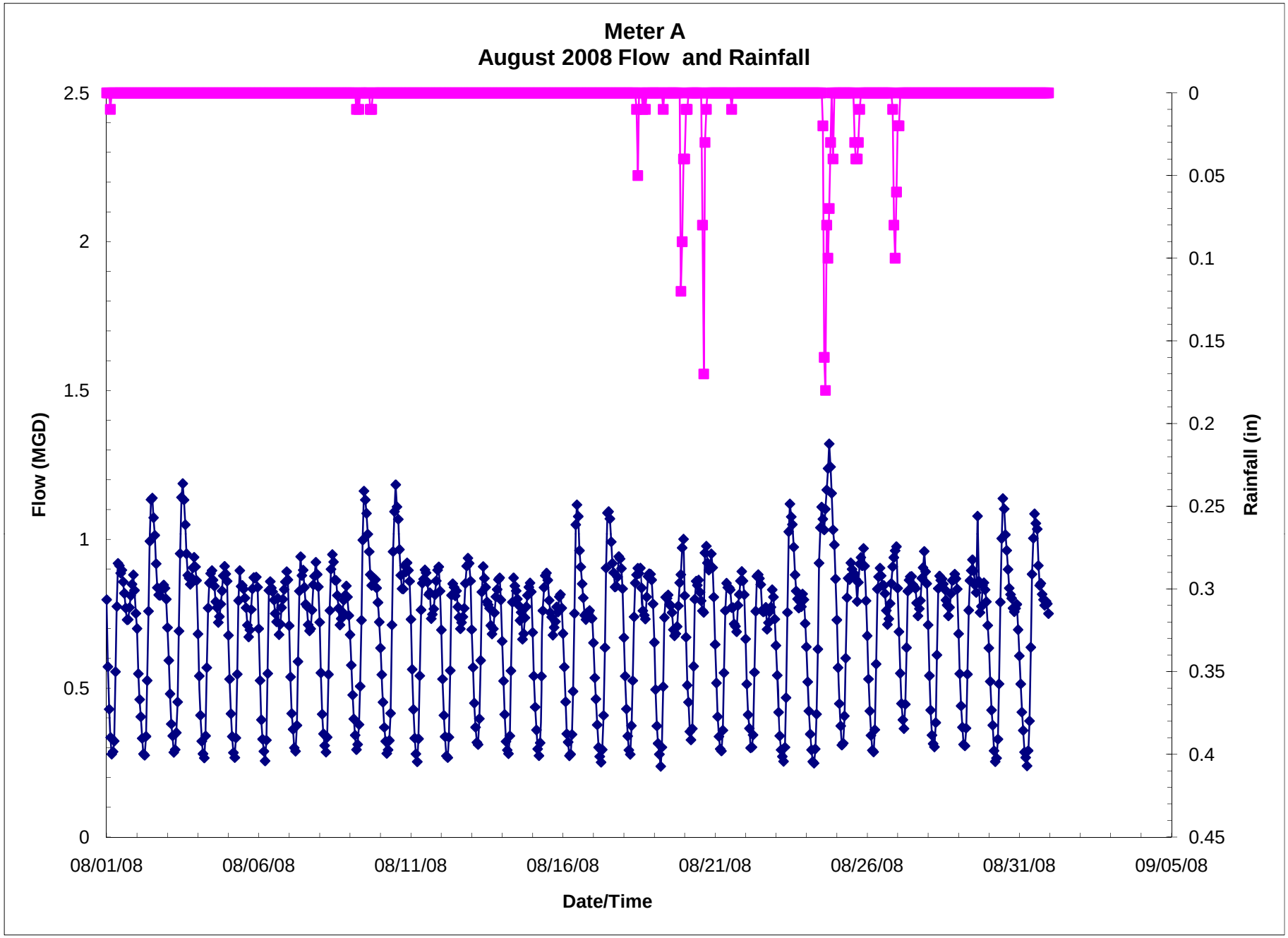
Meter A

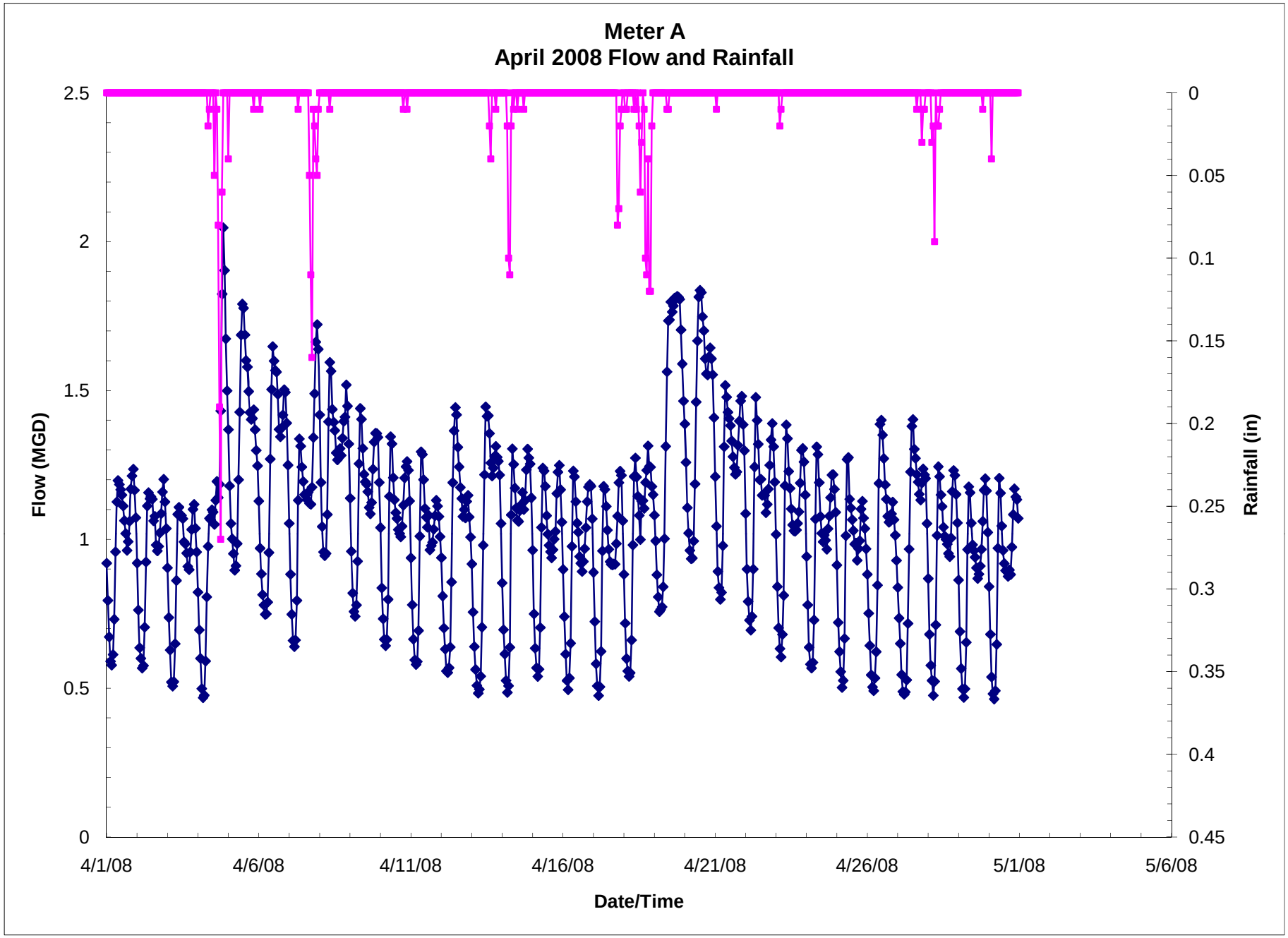
August 2008

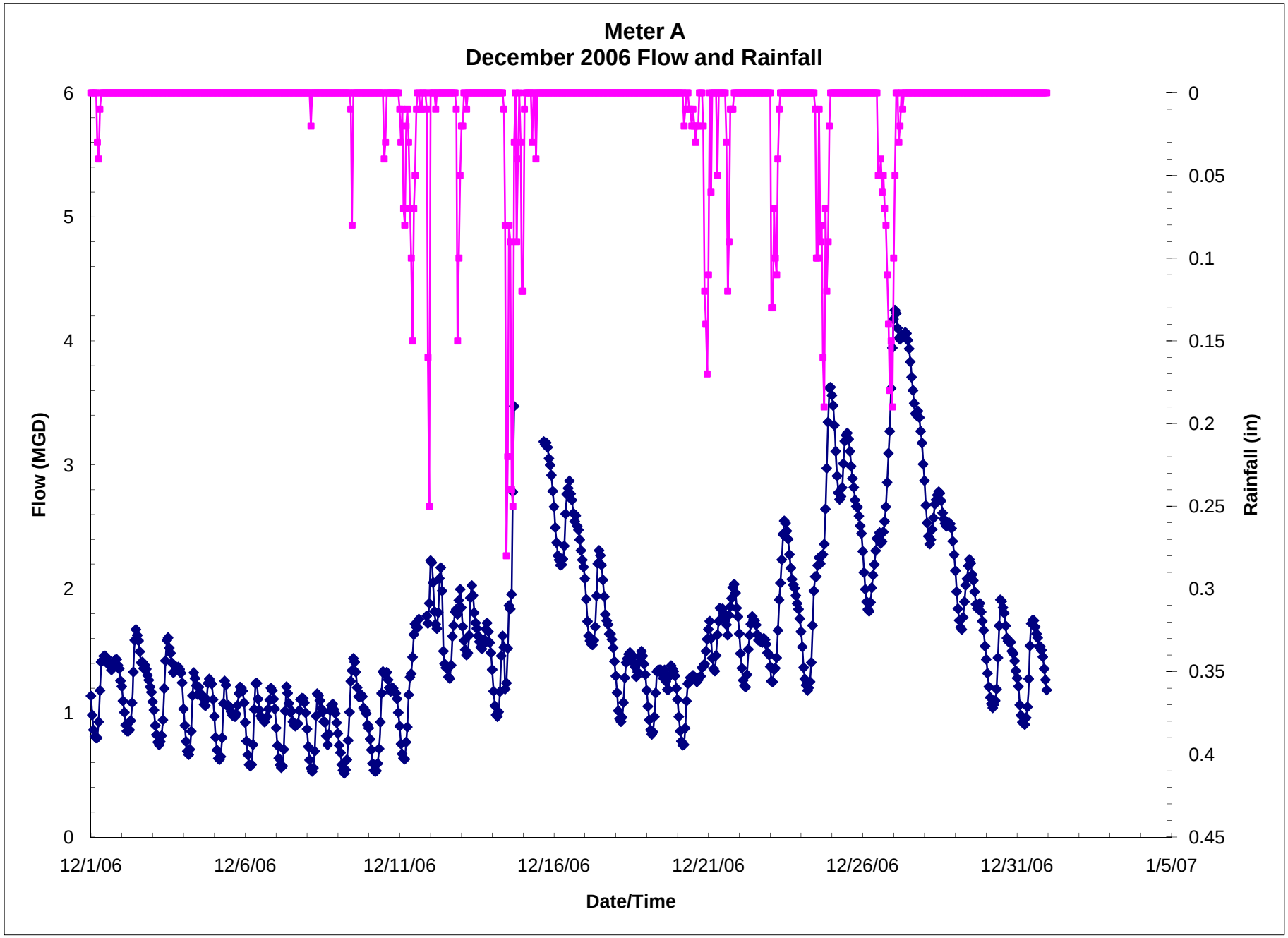
April 2008

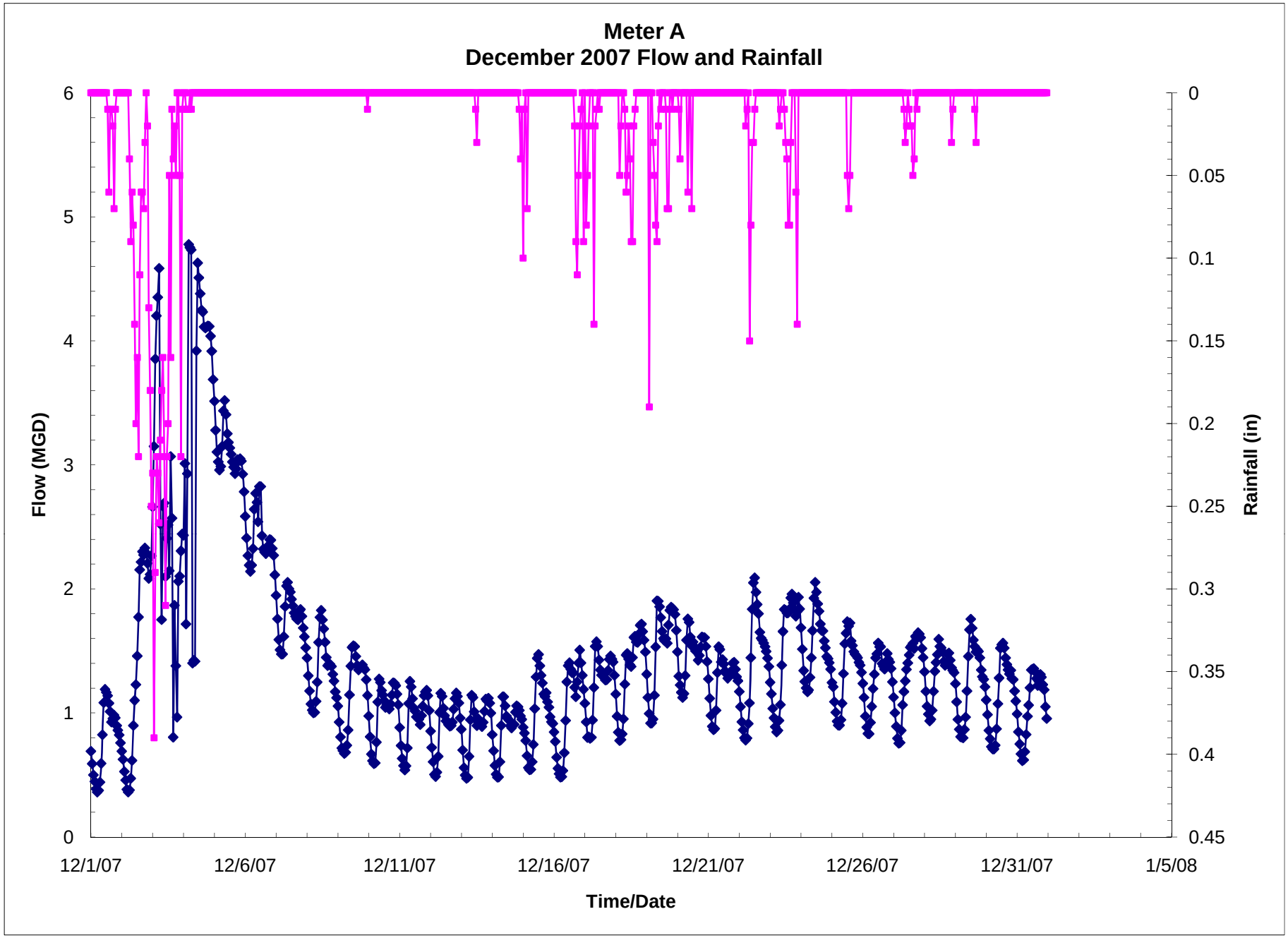
December 2006

December 2007


Meter A
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
08/01/08
08/06/08
08/11/08
08/16/08
08/21/08
08/26/08
08/31/08
09/05/08


Meter A
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter A
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0
1
2
3
4
5
6
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter A
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Time/Date
0
1
2
3
4
5
6
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

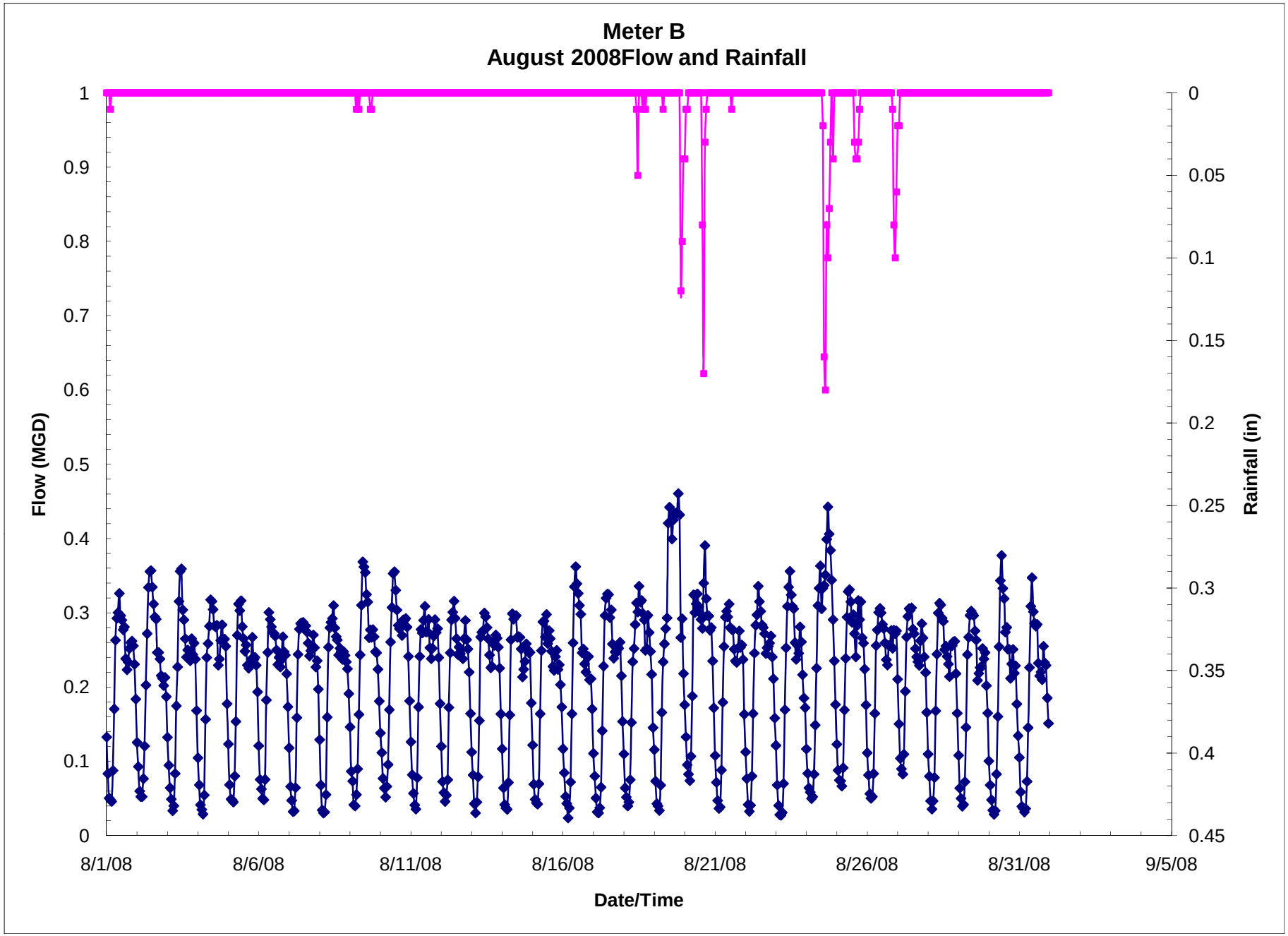
Meter B

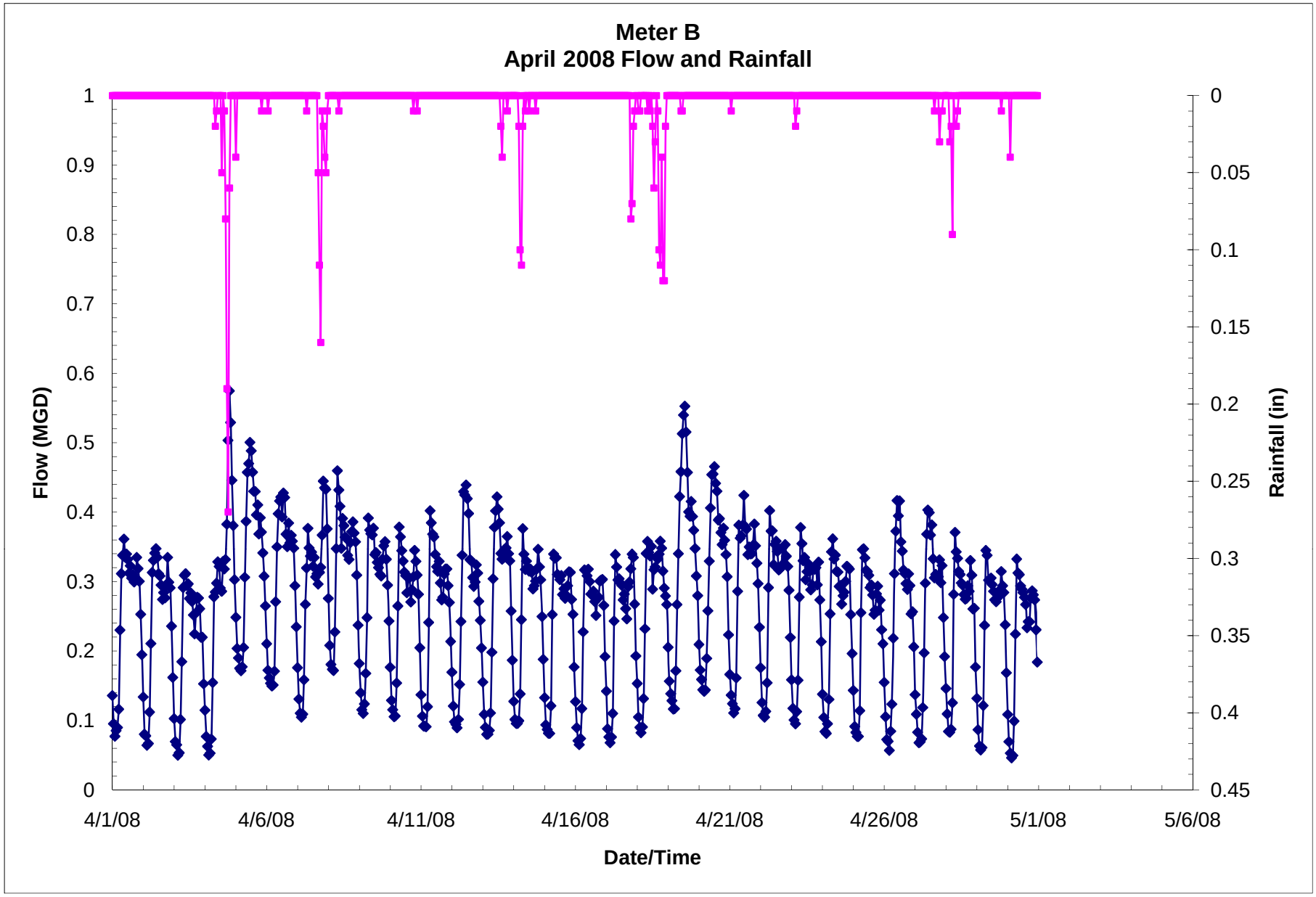
August 2008

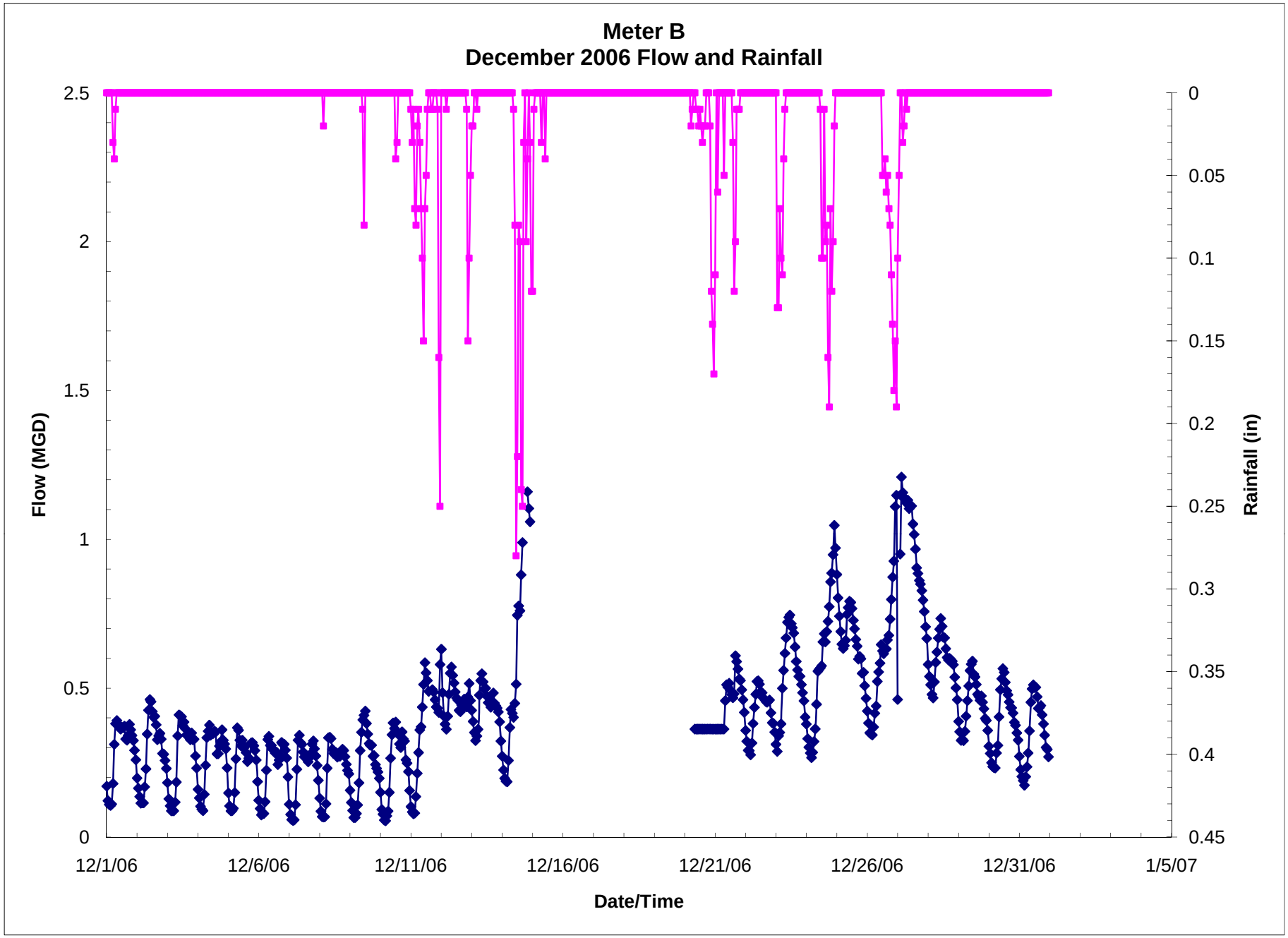
April 2008

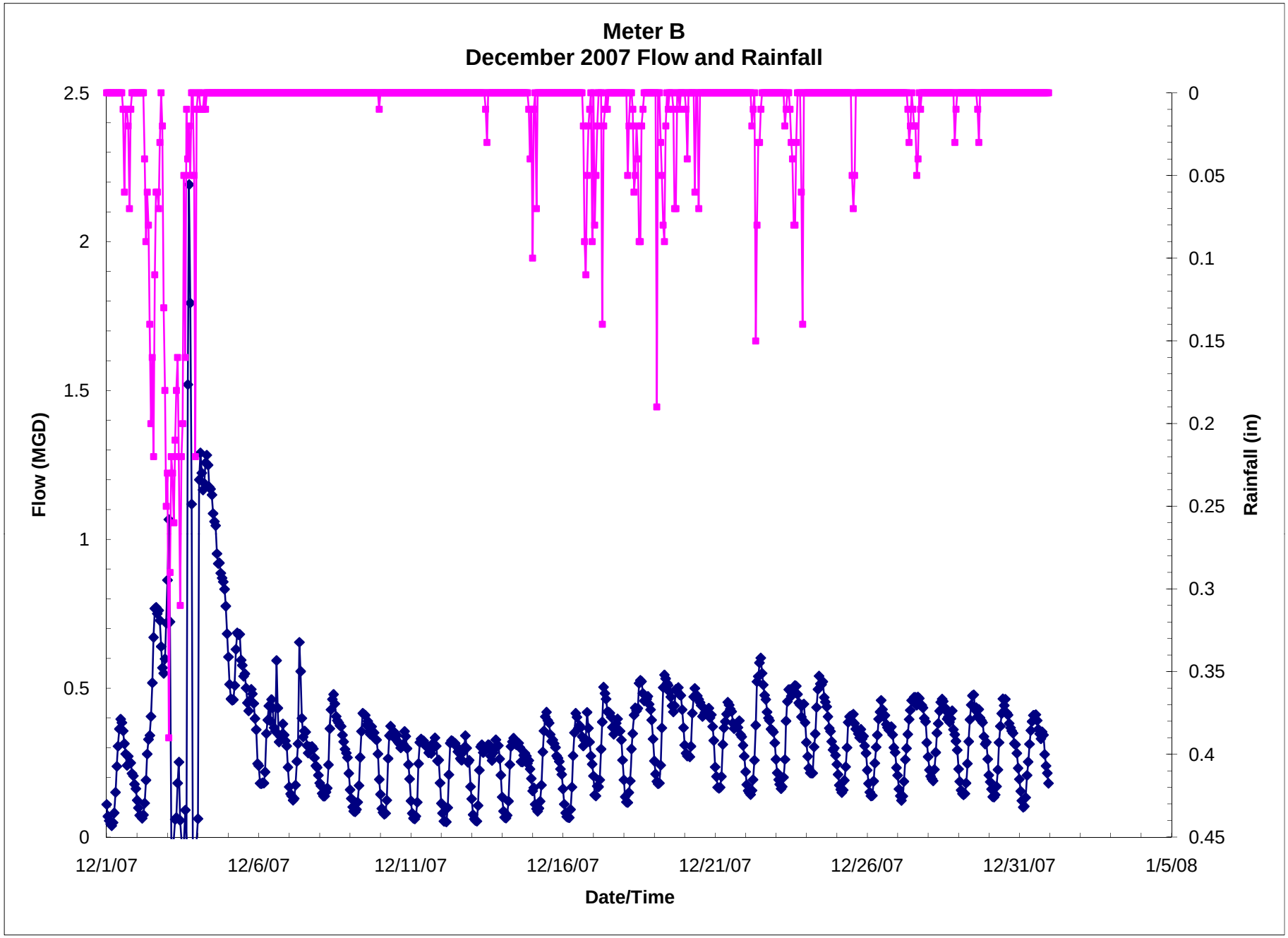
December 2006

December 2007


Meter B
August 2008Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter B
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter B
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter B
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

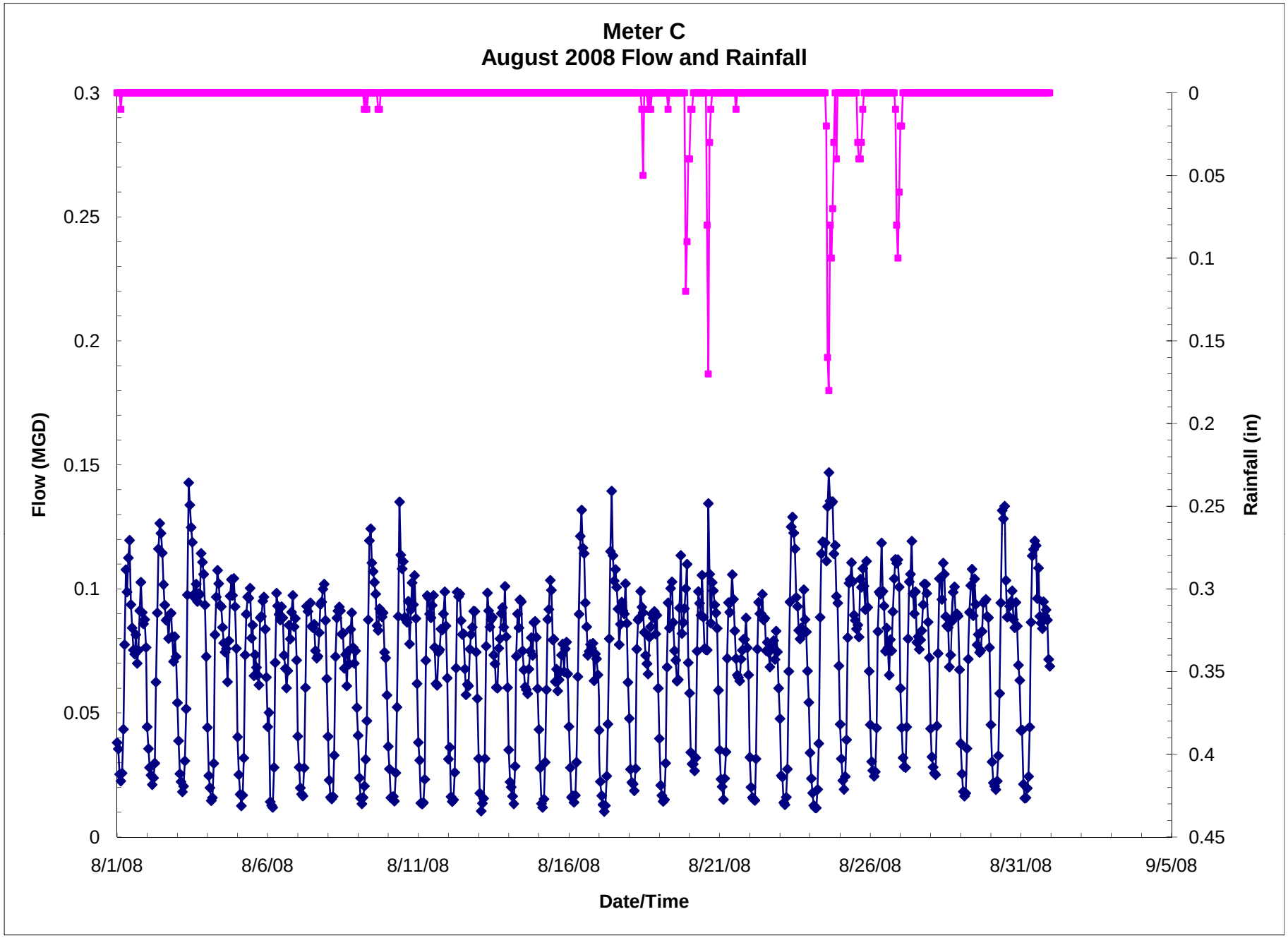
Meter C

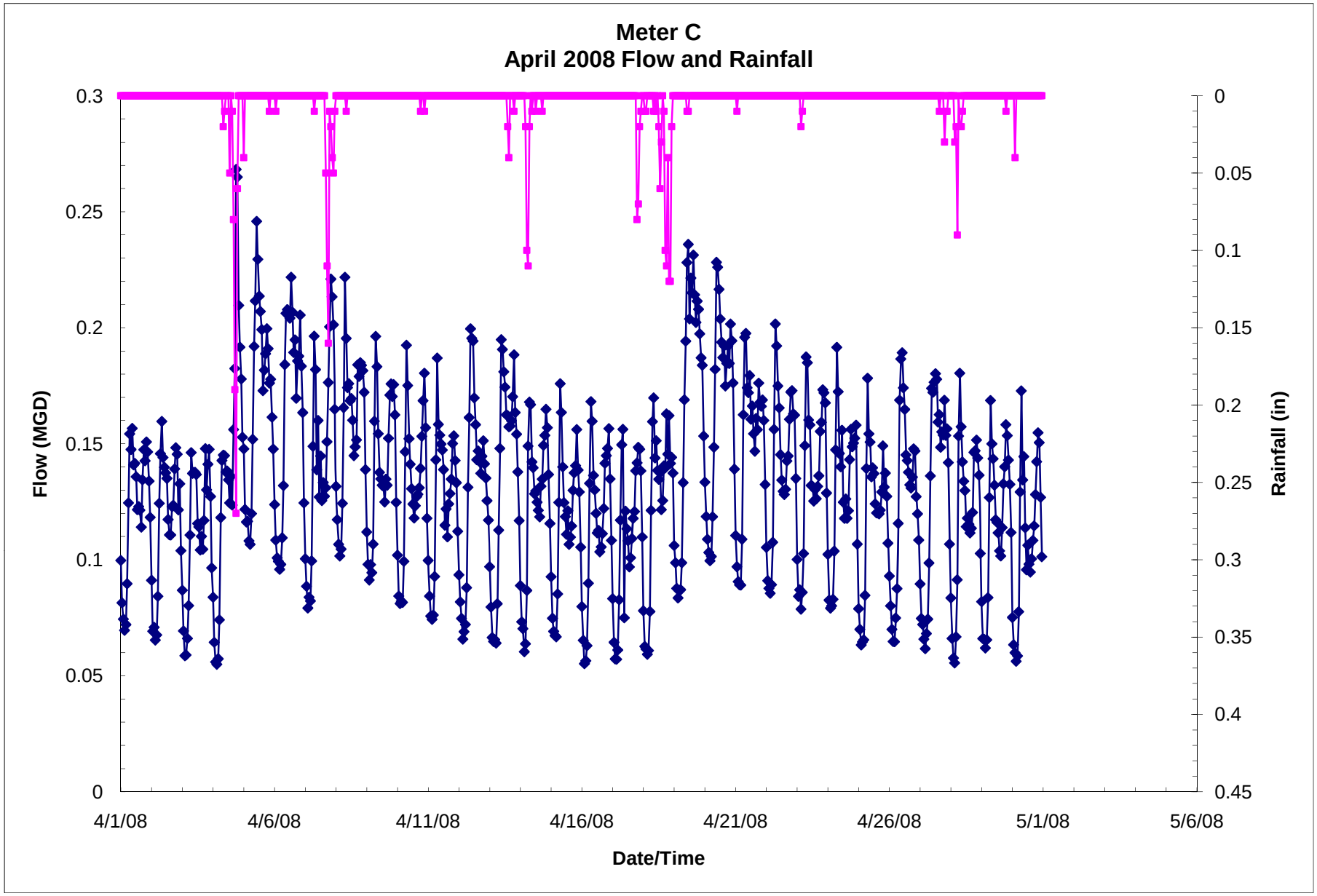
August 2008

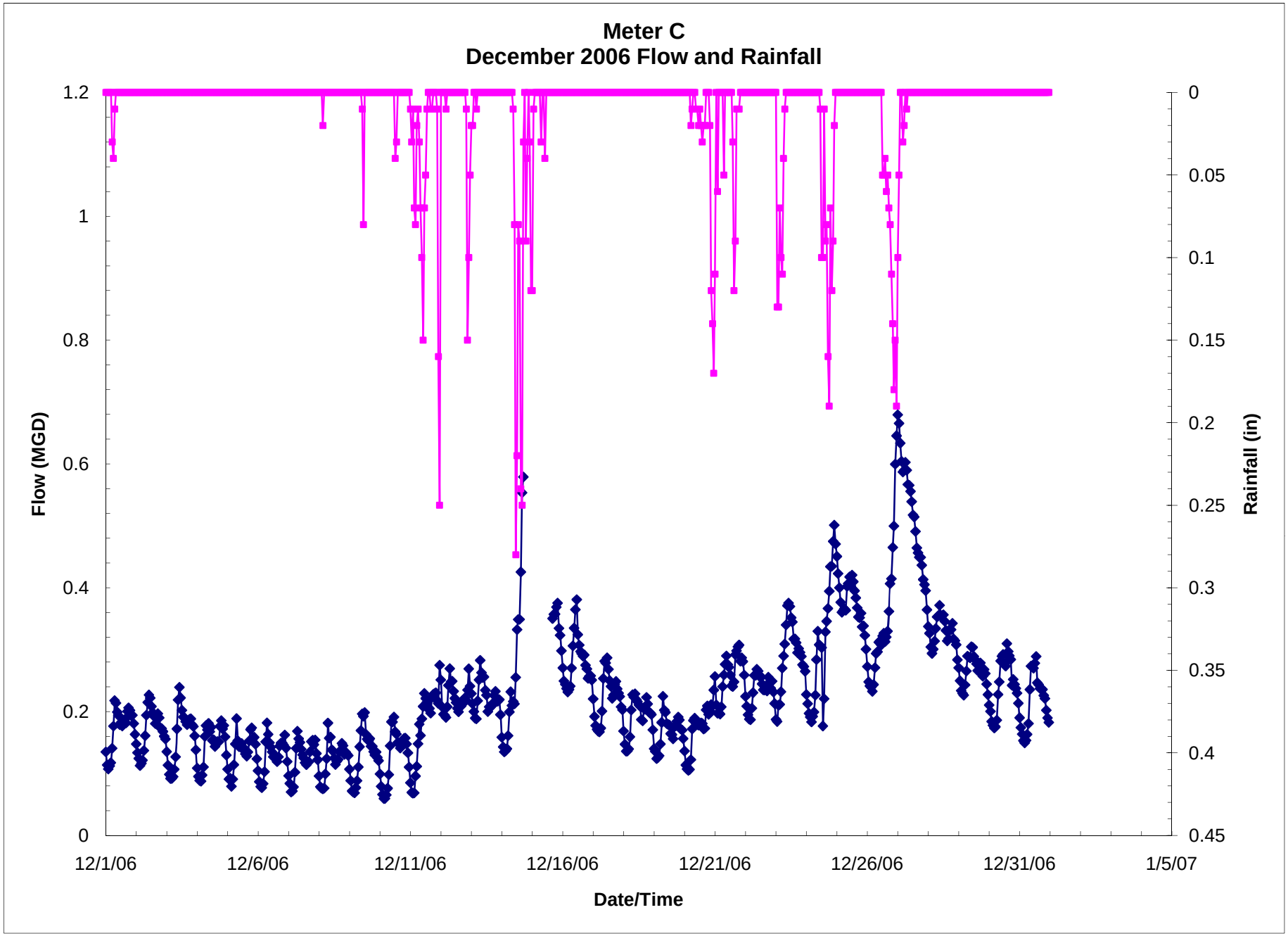
April 2008

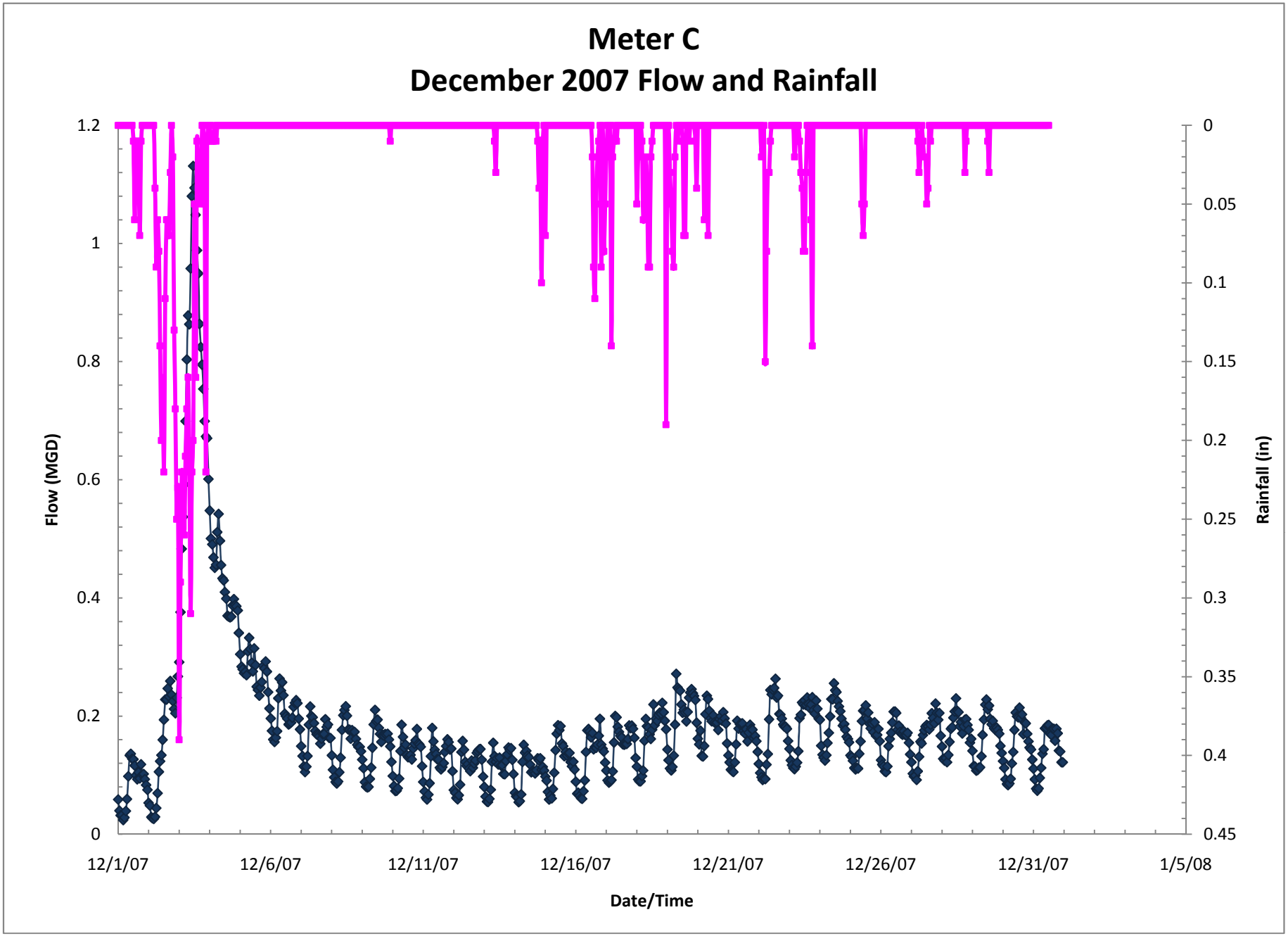
December 2006

December 2007


Meter C
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter C
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter C
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.2
1
0.8
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter C
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.2
1
0.8
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

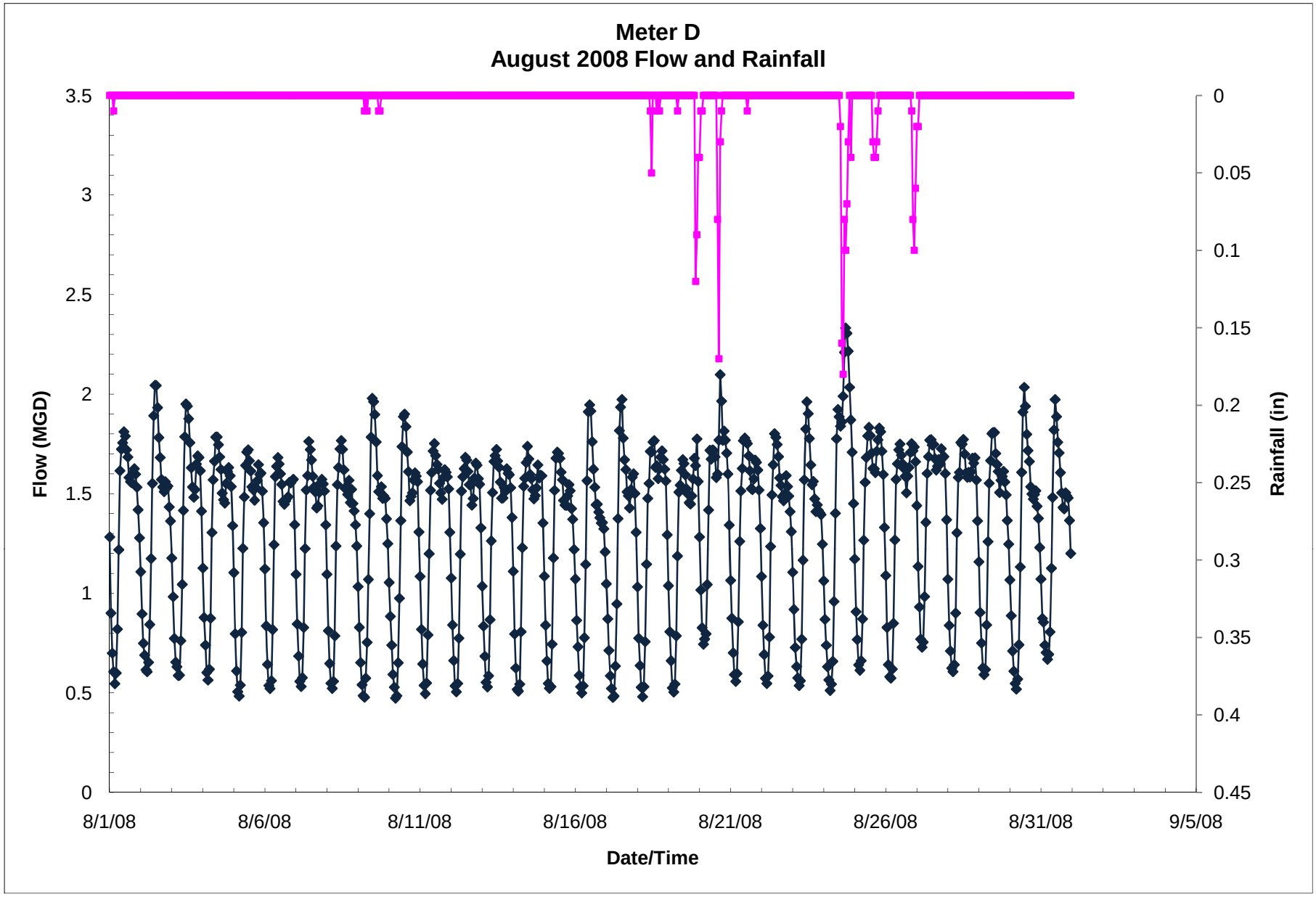
Meter D

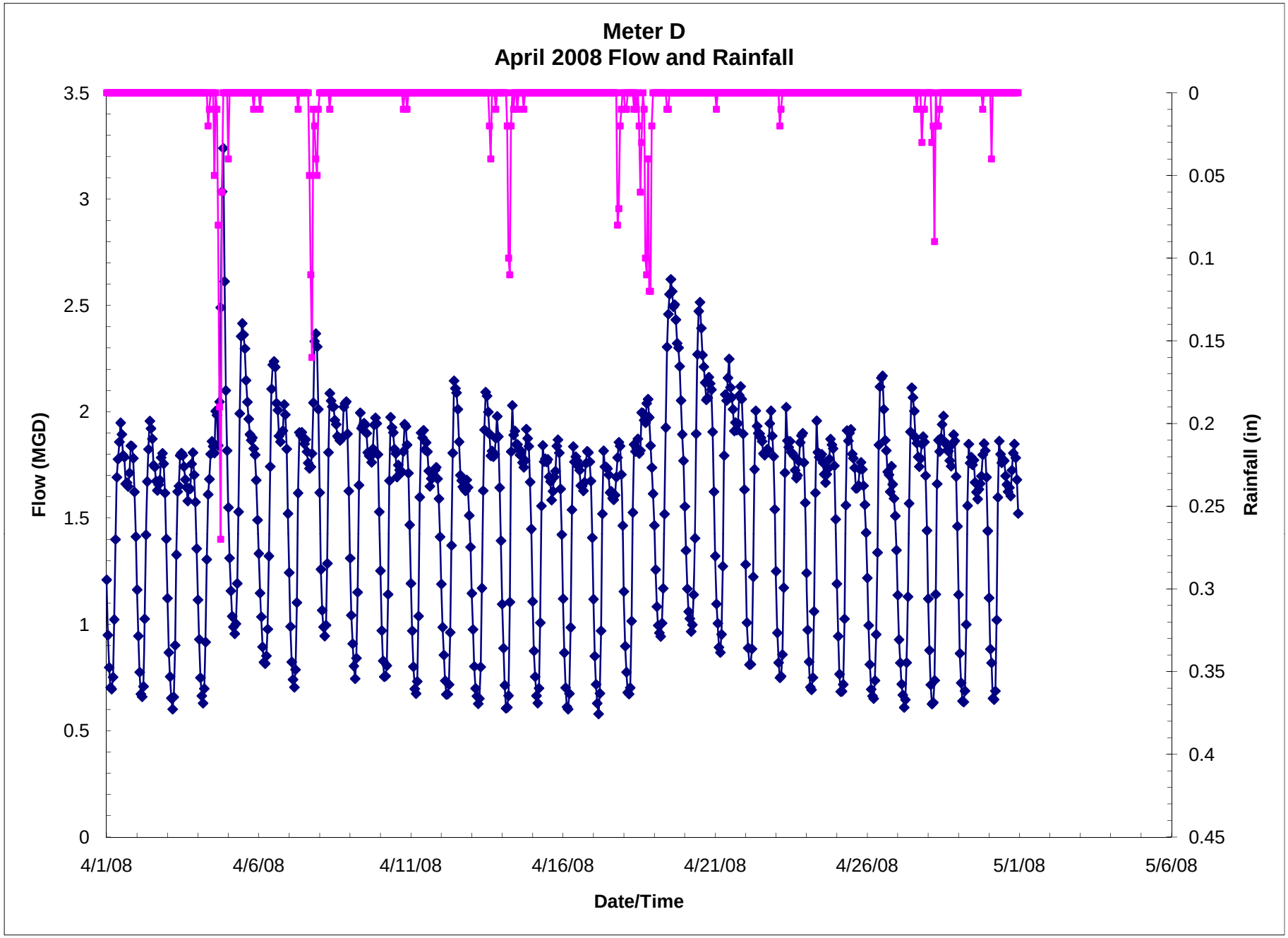
August 2008

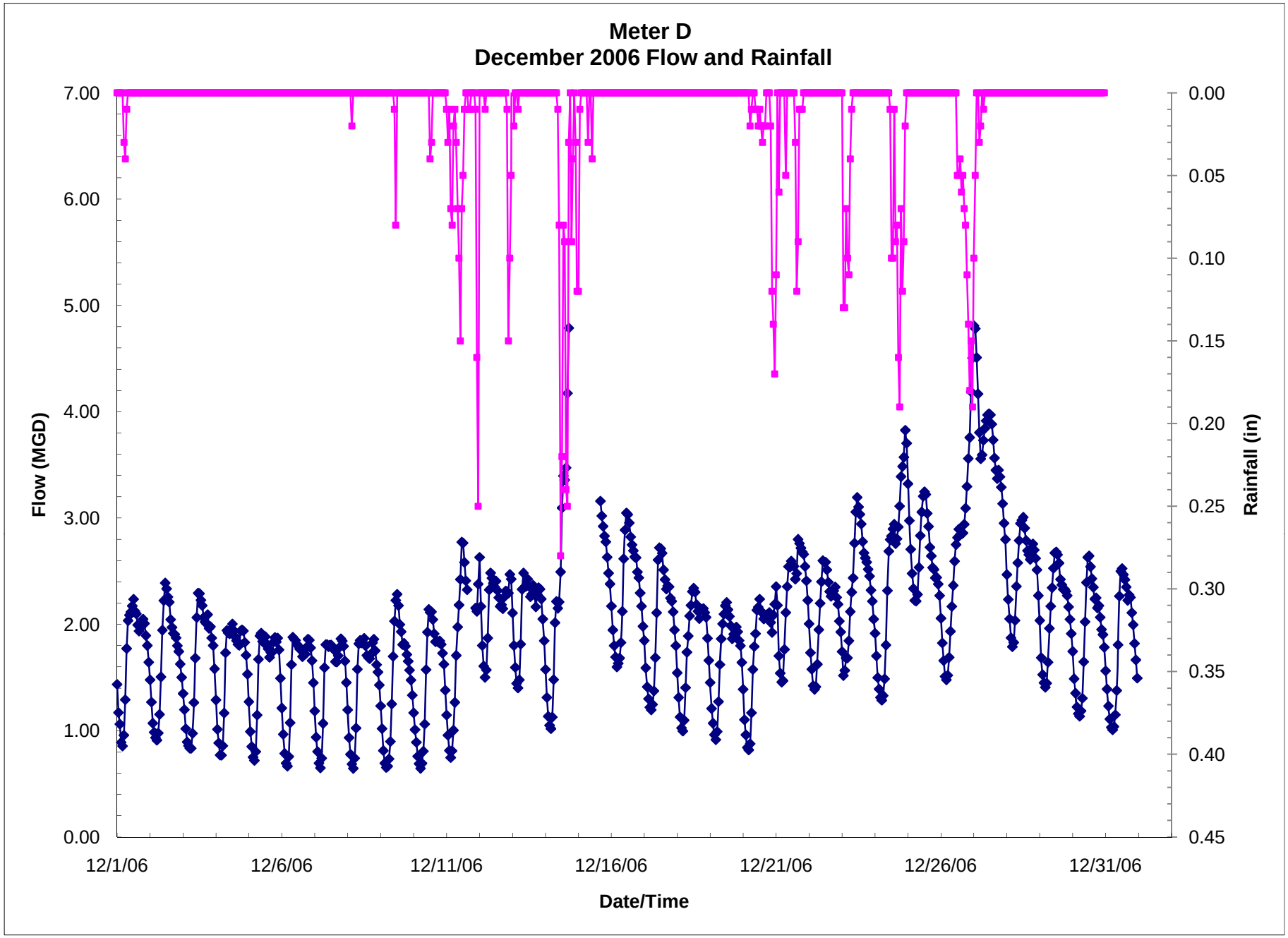
April 2008

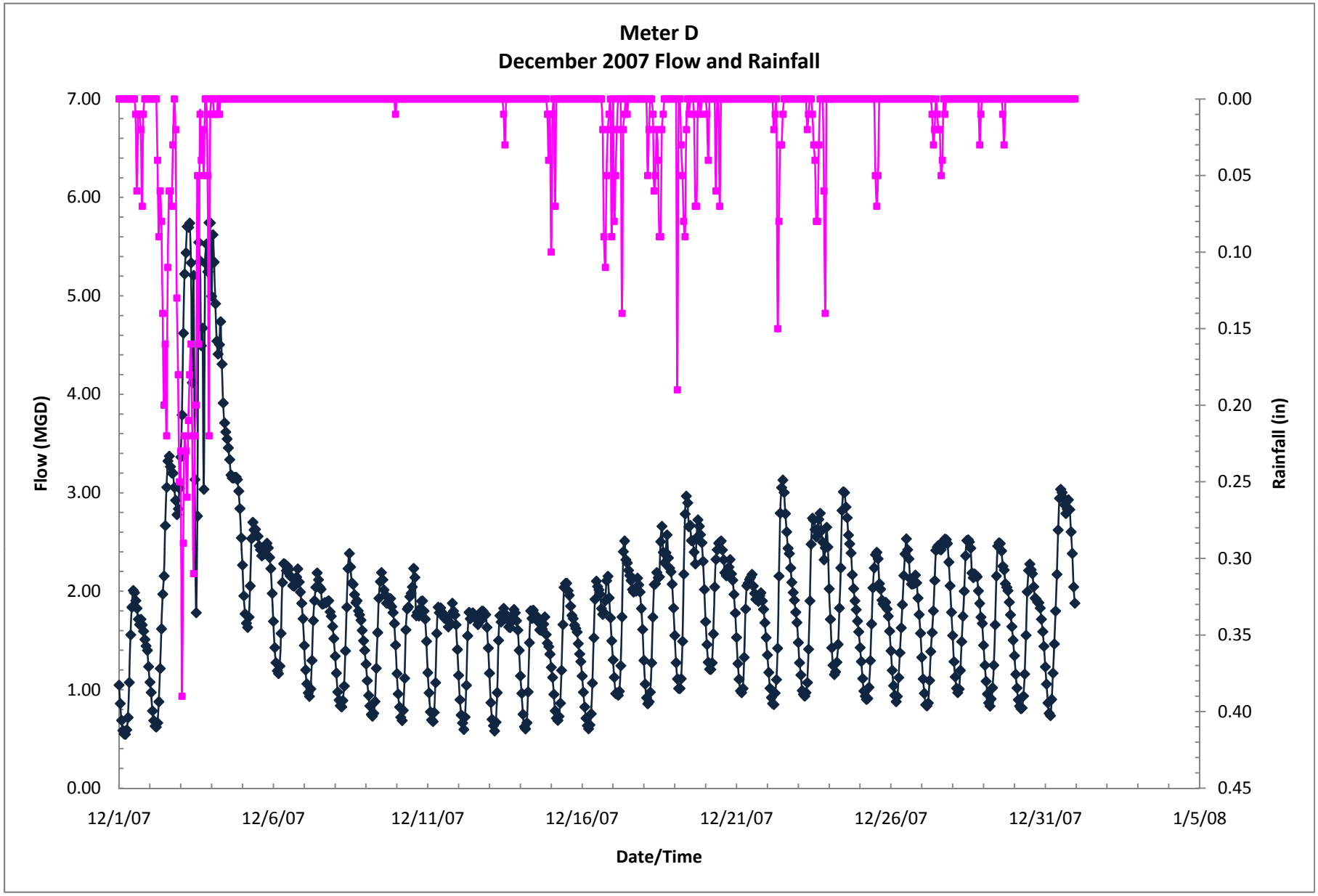
December 2006

December 2007


Meter D
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter D
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter D
December 2006 Flow and Rainfall
Flow (MGD)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Rainfall (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
Date/Time


Meter D
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

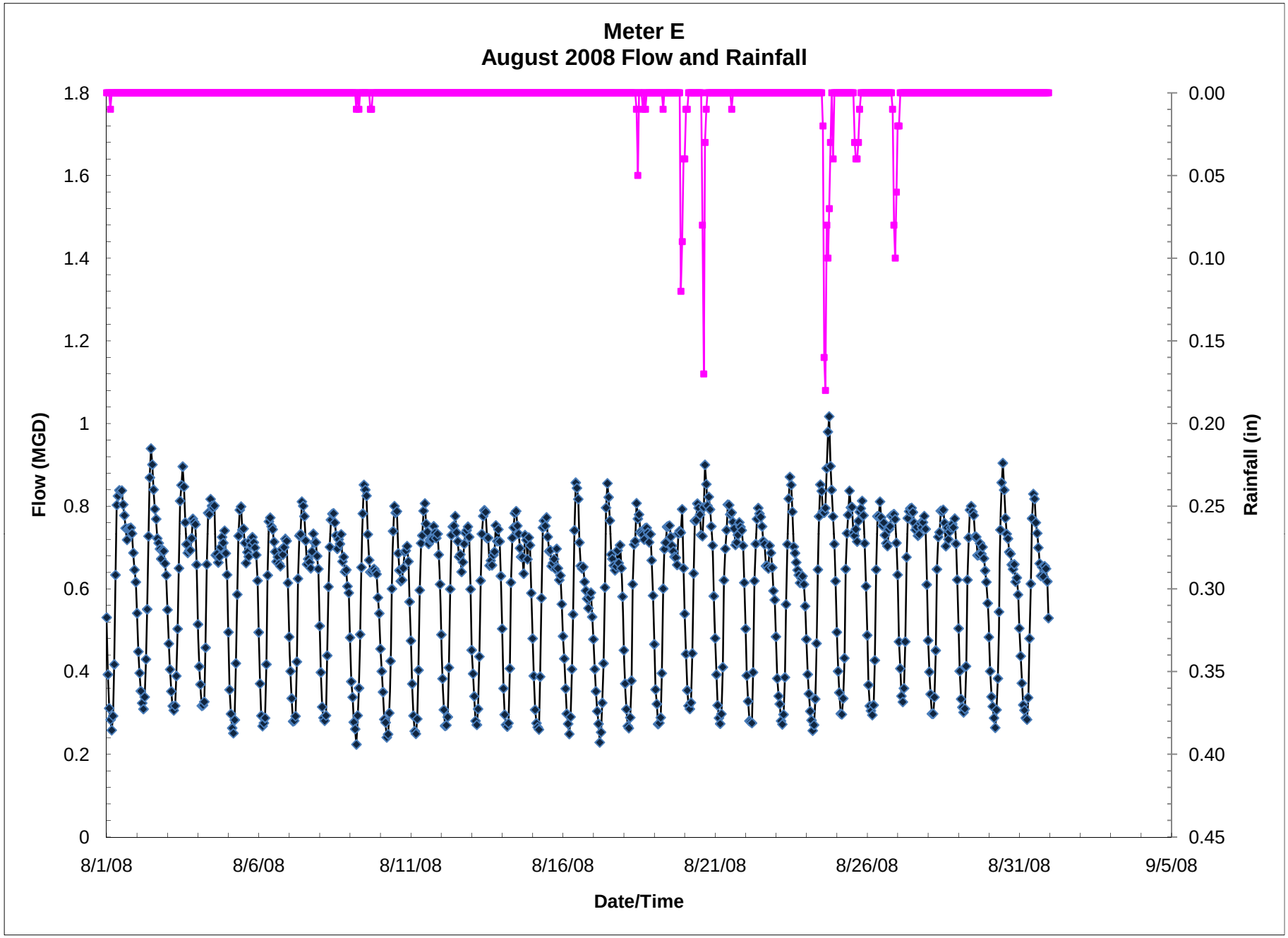
Meter E

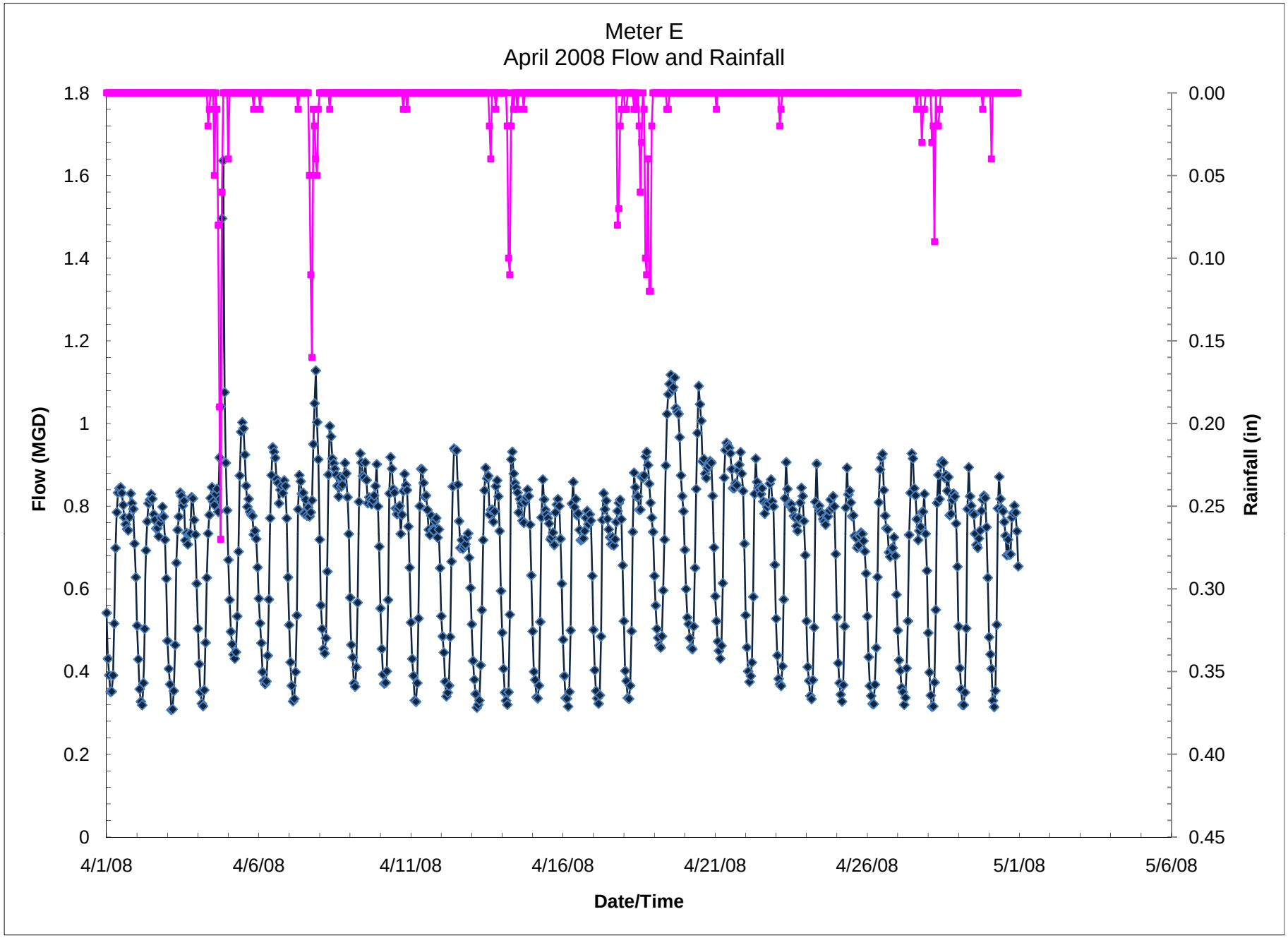
August 2008

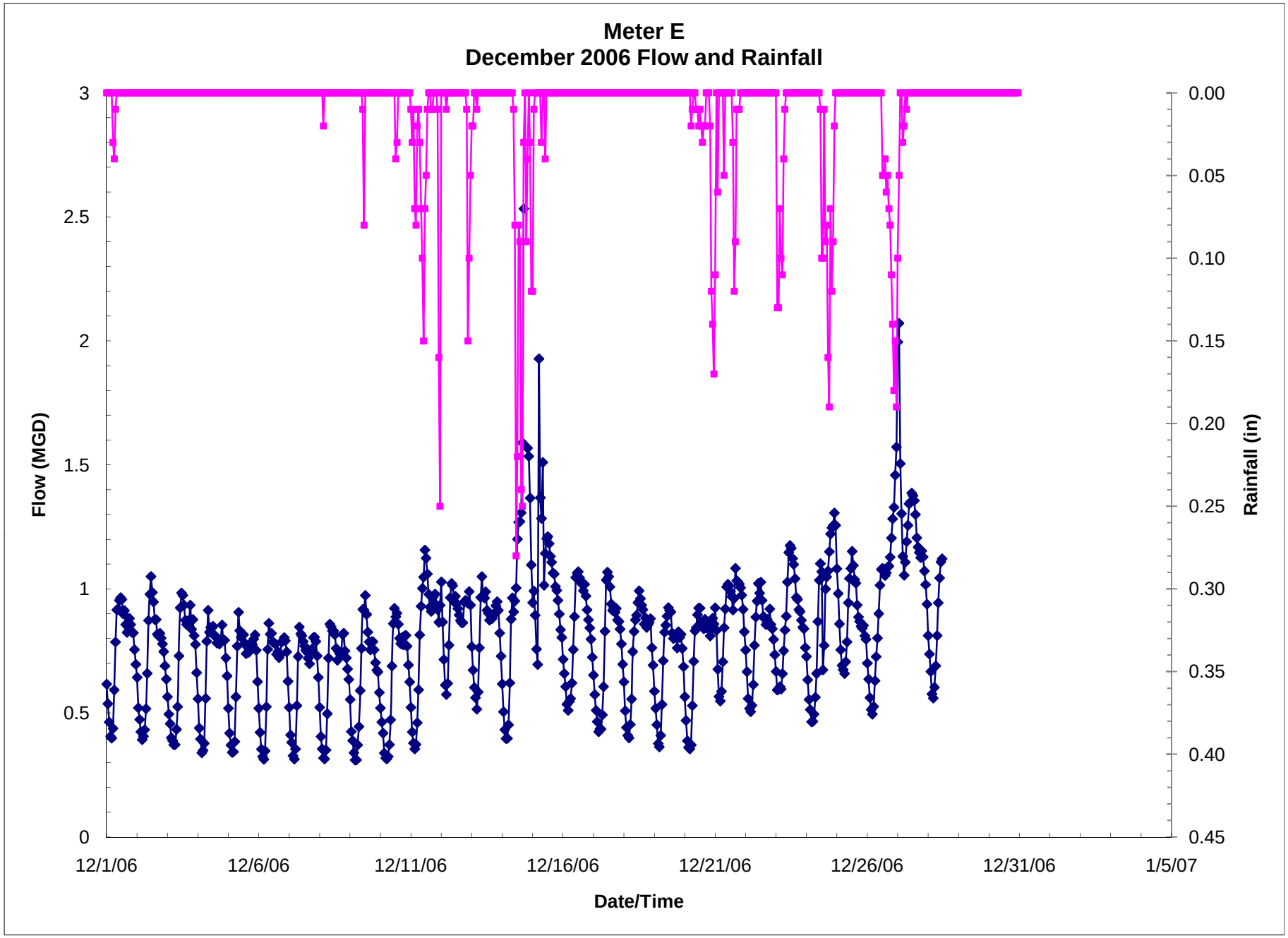
April 2008

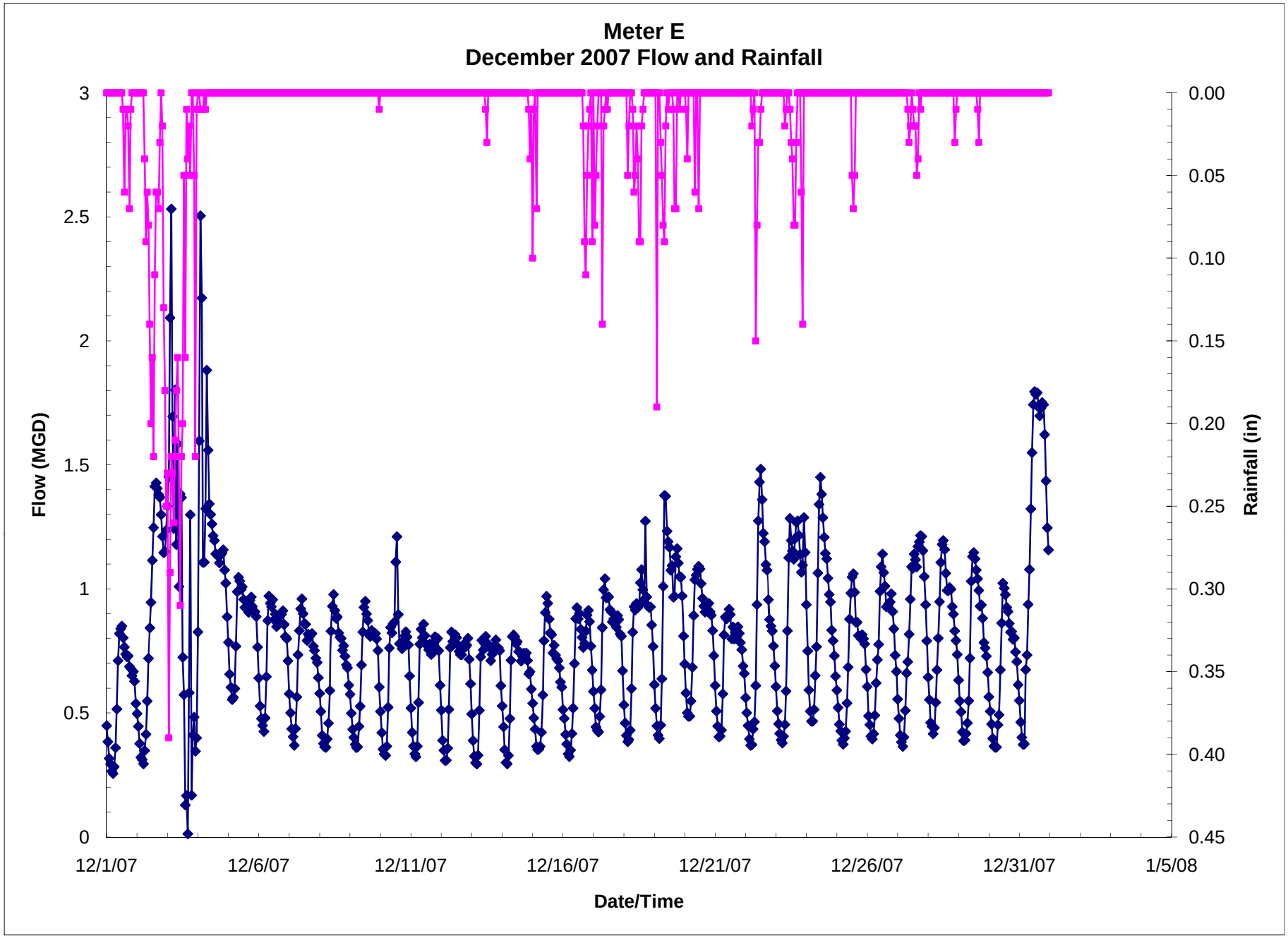
December 2006

December 2007


Meter E
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08


Meter E
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Meter E
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
3
2.5
2
1.5
1
0.5
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


Meter E
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
3
2.5
2
1.5
1
0.5
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

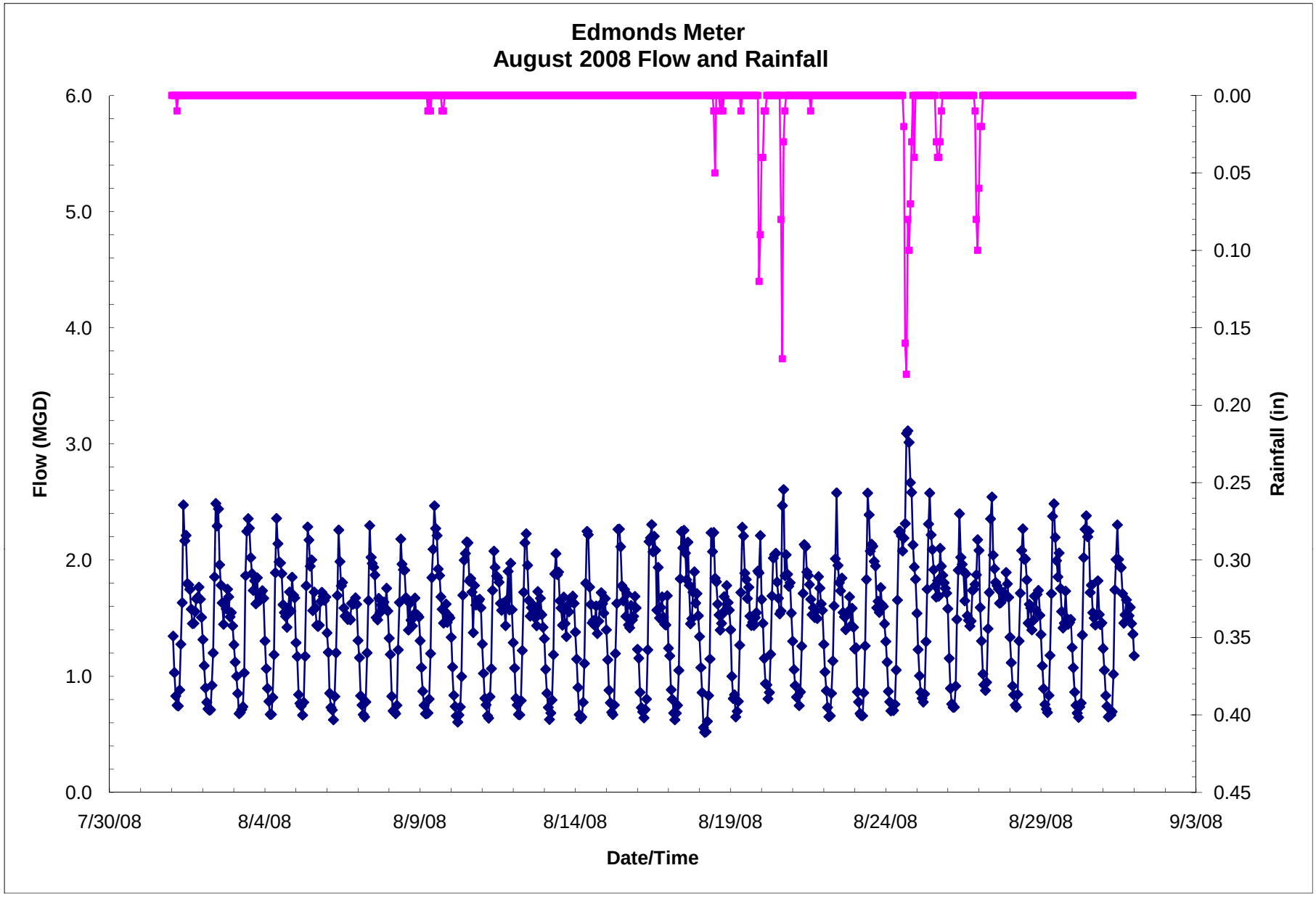
Edmonds Meter

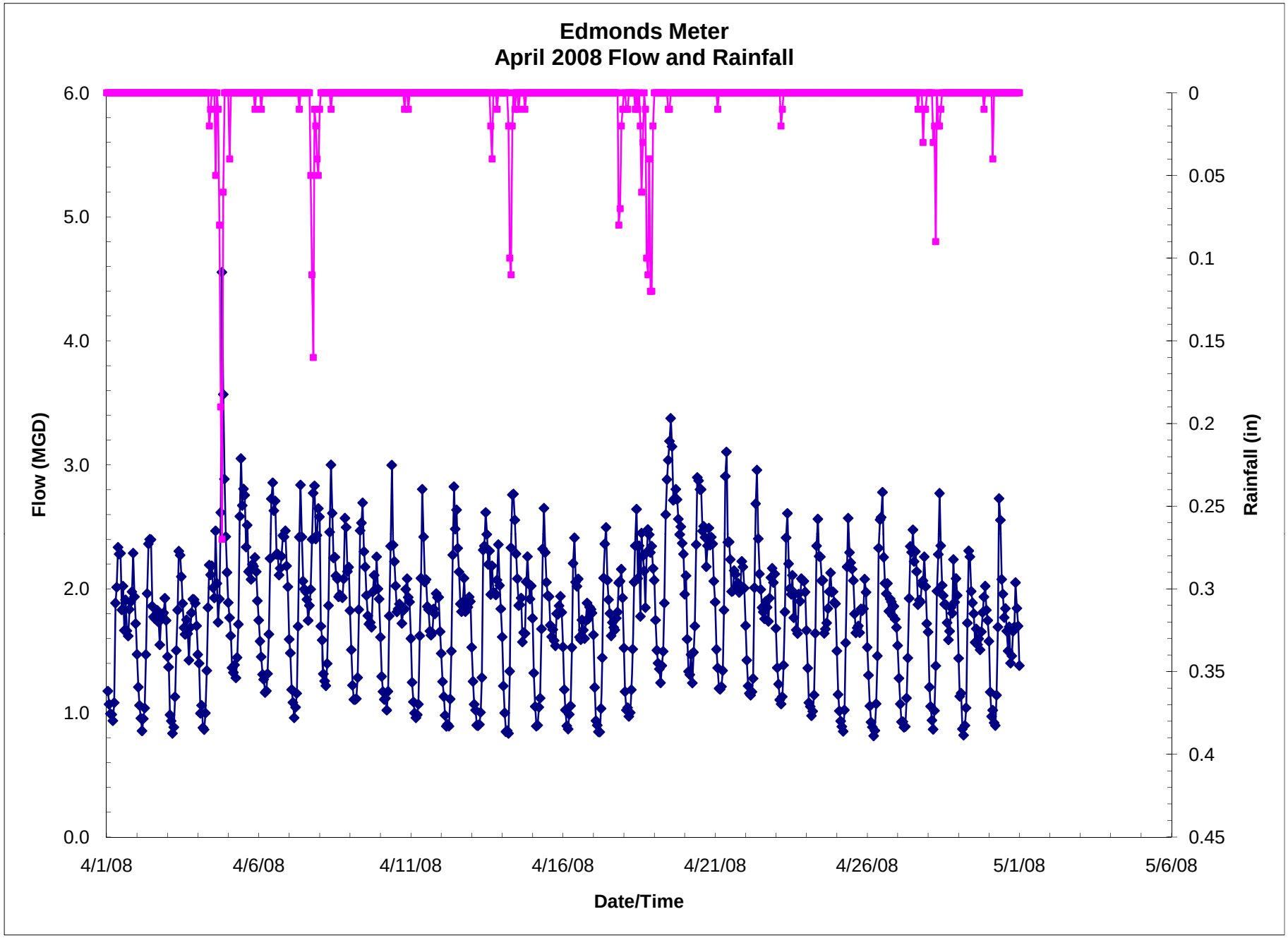
August 2008

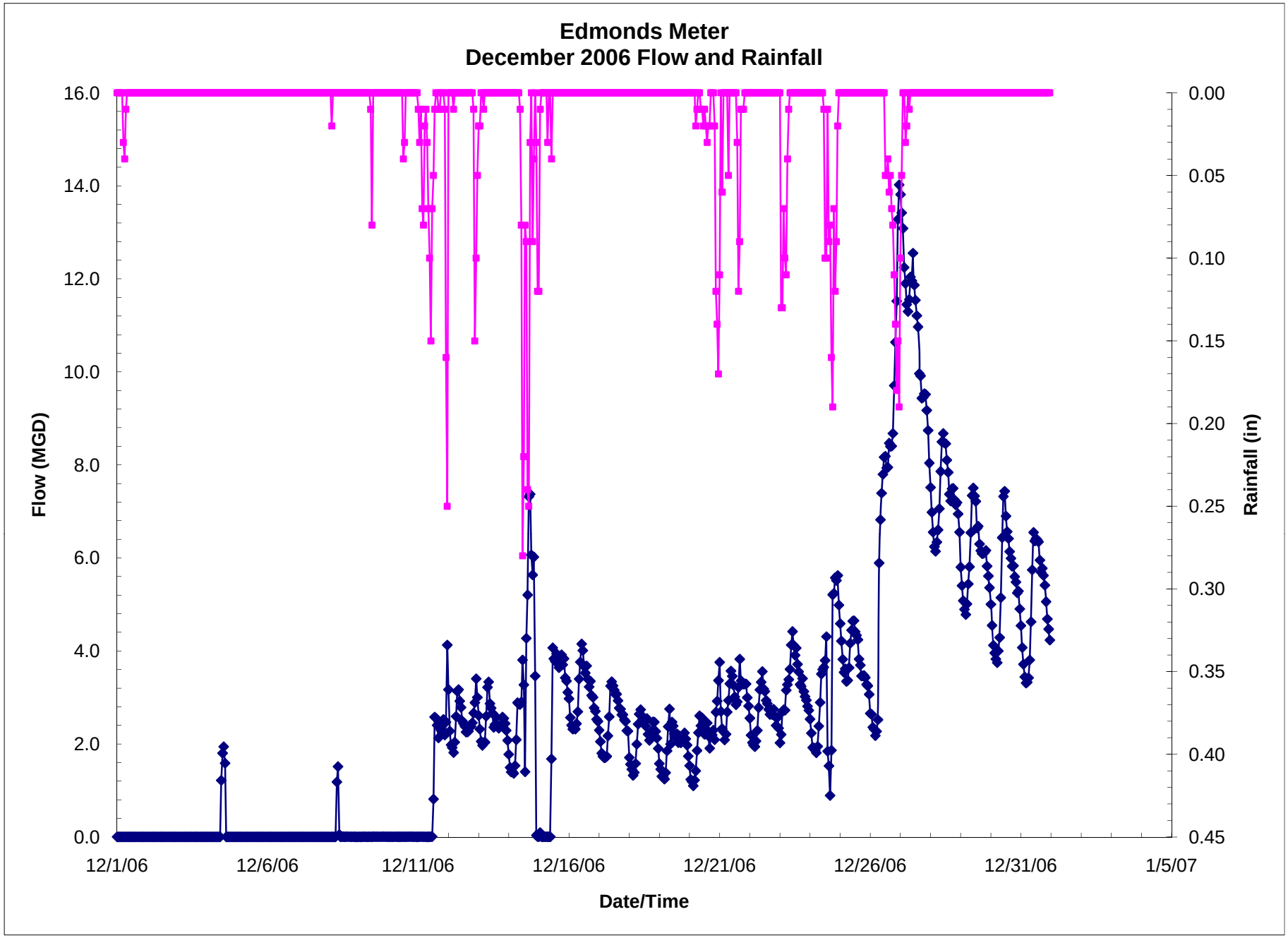
April 2008

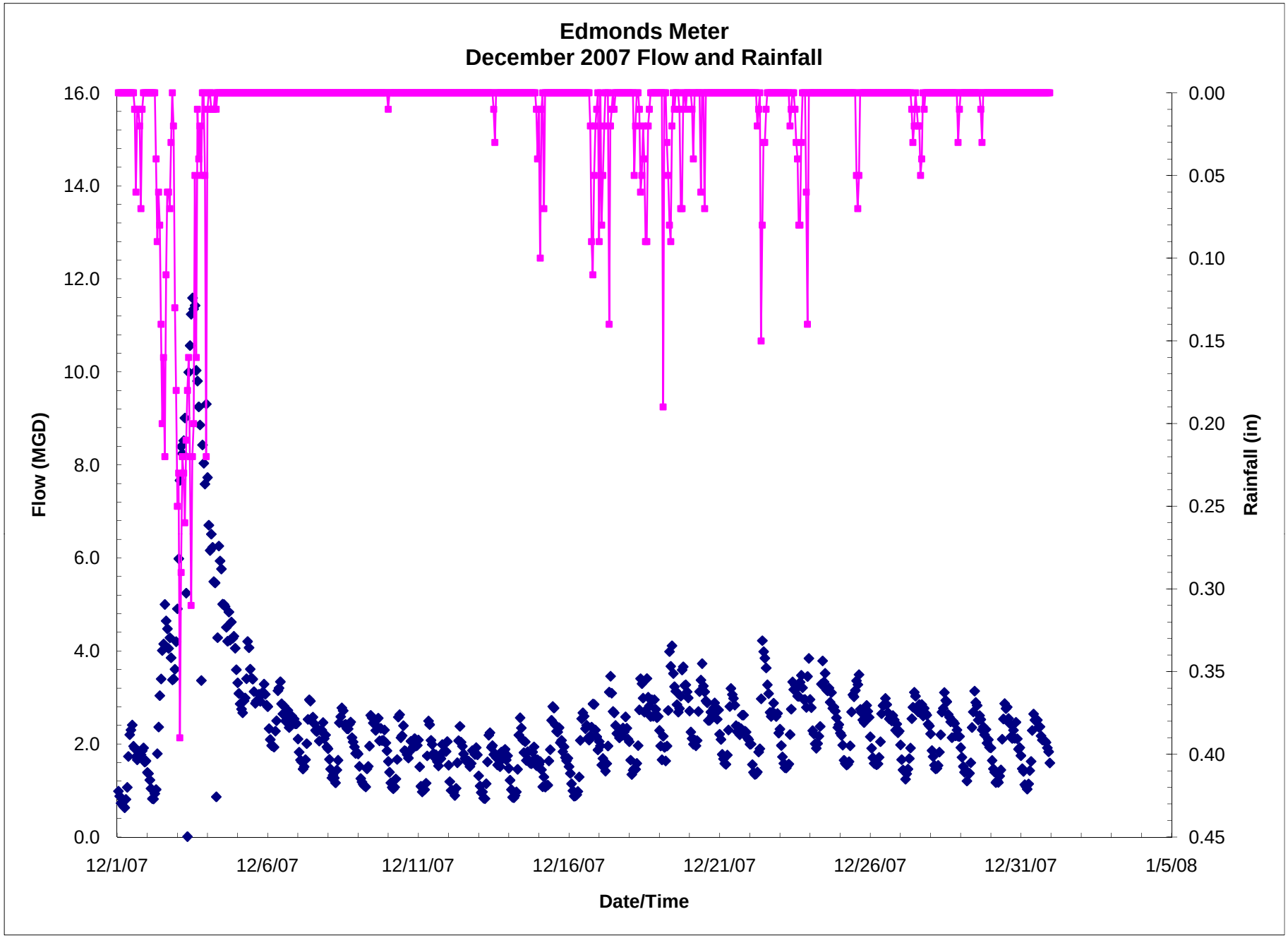
December 2006

December 2007


Edmonds Meter
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
7/30/08
8/4/08
8/9/08
8/14/08
8/19/08
8/24/08
8/29/08
9/3/08


Edmonds Meter
April 2008 Flow and Rainfall
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Rainfall (in)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08
Date/Time


Edmonds Meter
December 2006 Flow and Rainfall
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Rainfall (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07
Date/Time


Edmonds Meter
December 2007 Flow and Rainfall
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Rainfall (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08
Date/Time

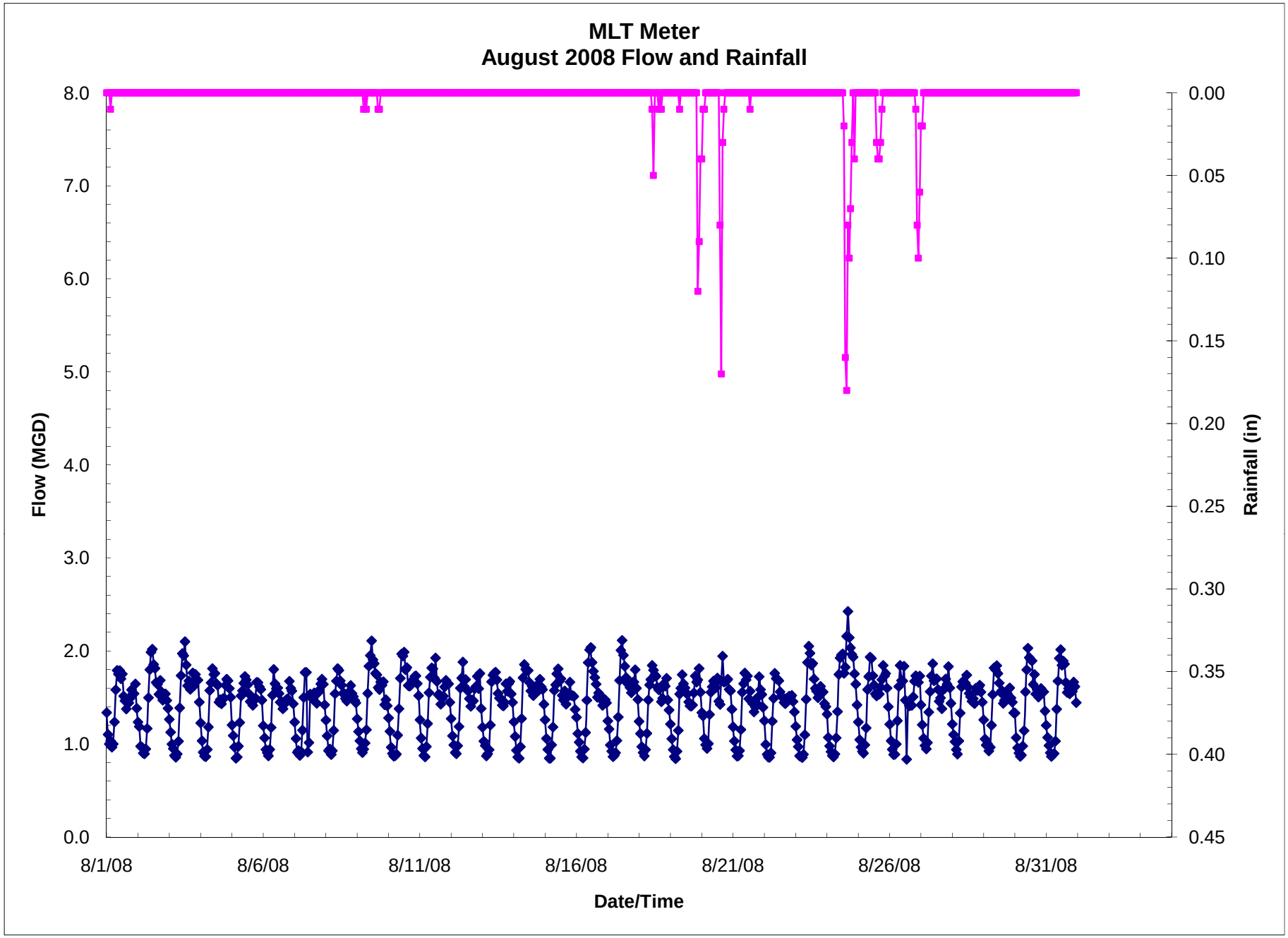
MLT Meter

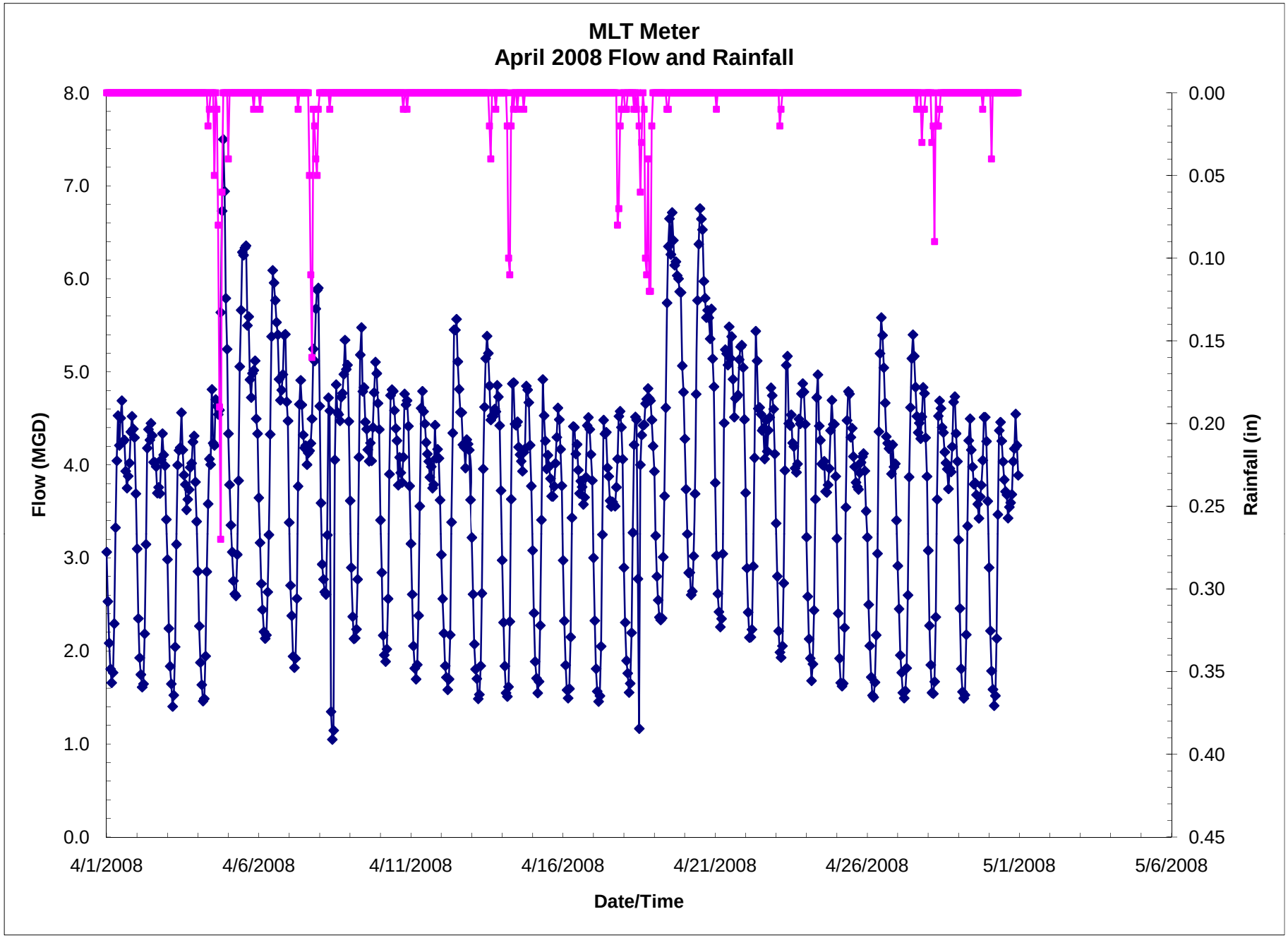
August 2008

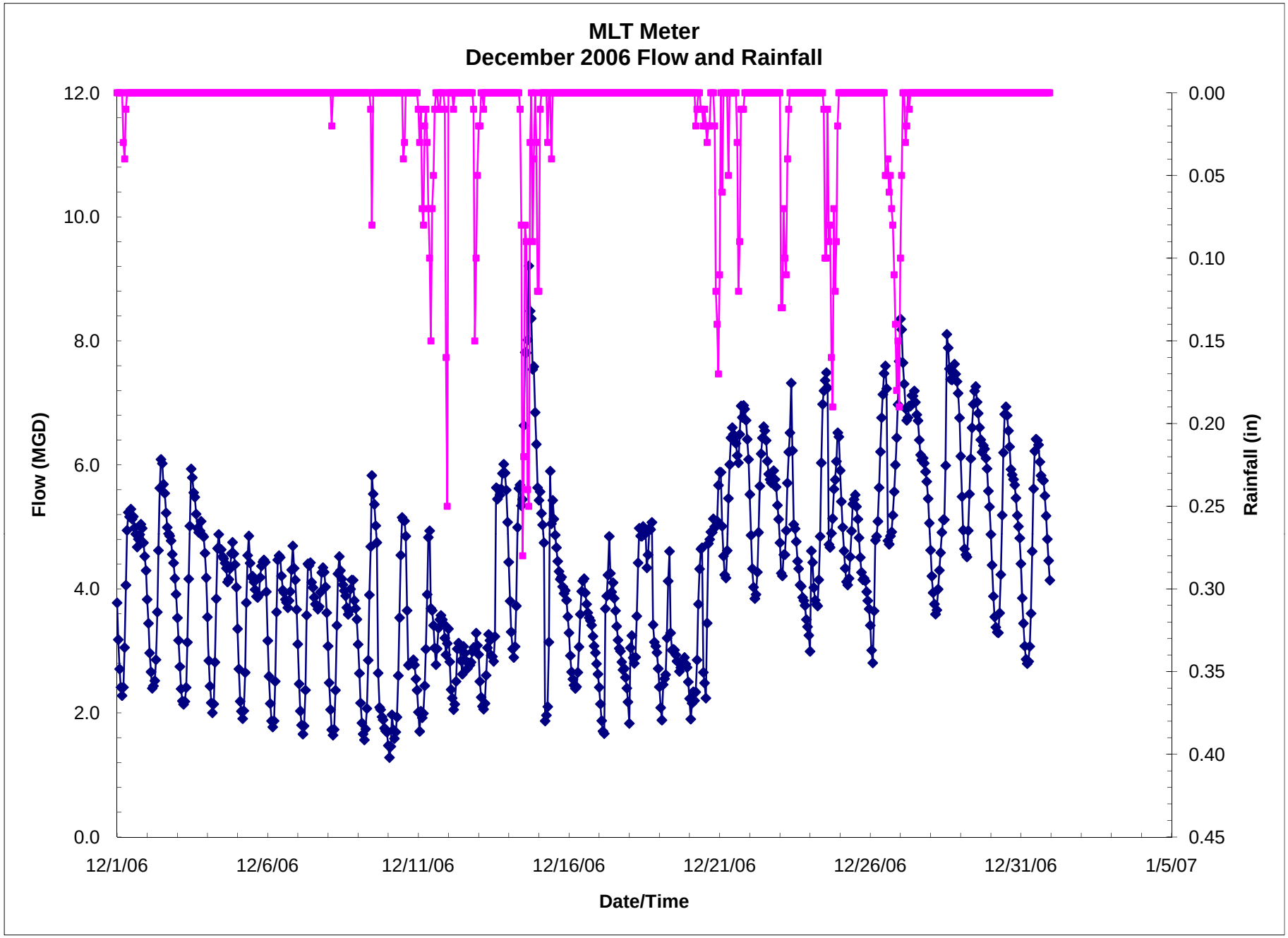
April 2008

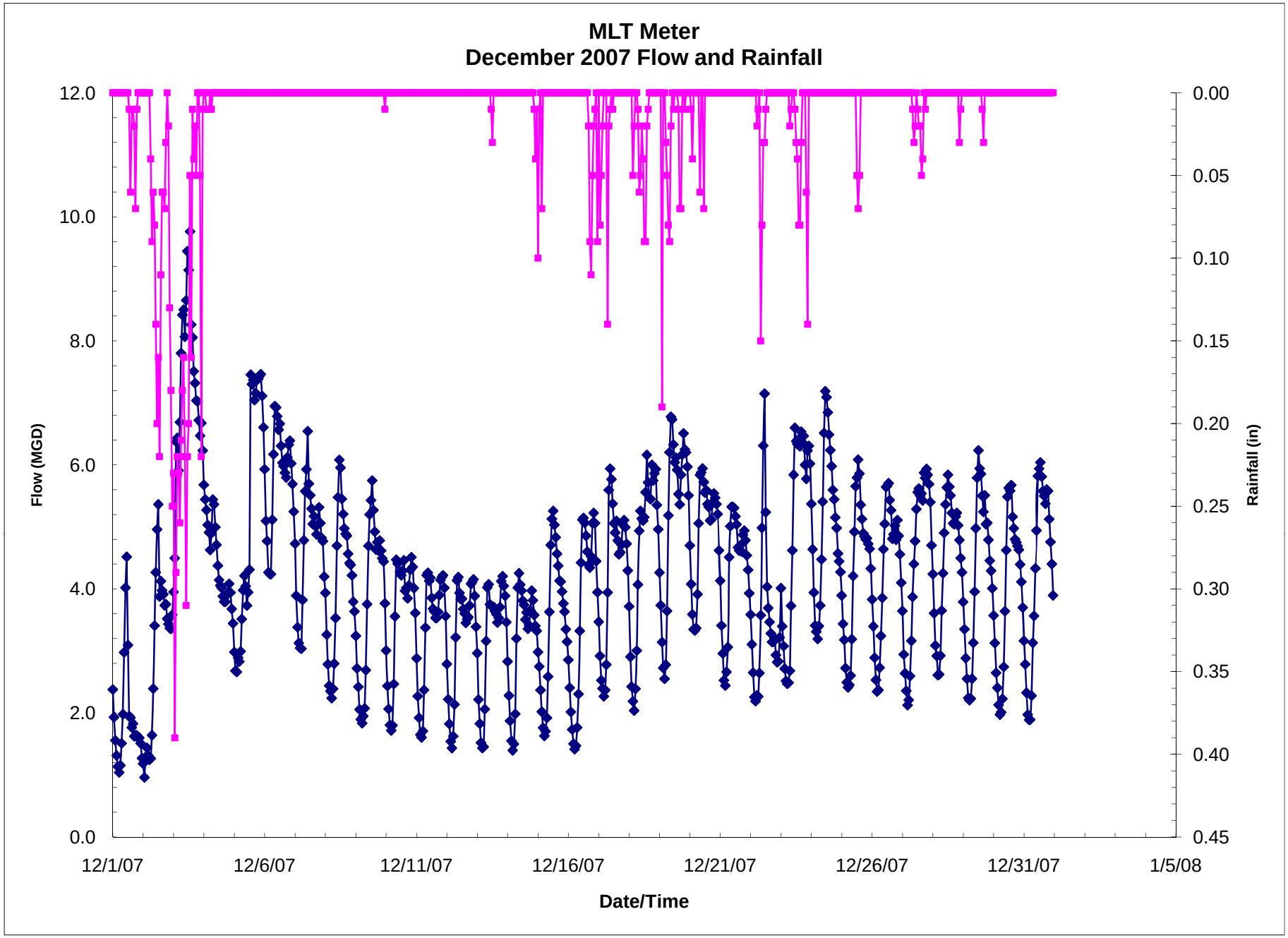
December 2006

December 2007


MLT Meter
August 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08


MLT Meter
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
4/1/2008
4/6/2008
4/11/2008
4/16/2008
4/21/2008
4/26/2008
5/1/2008
5/6/2008


MLT Meter
December 2006 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06
1/5/07


MLT Meter
December 2007 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07
1/5/08

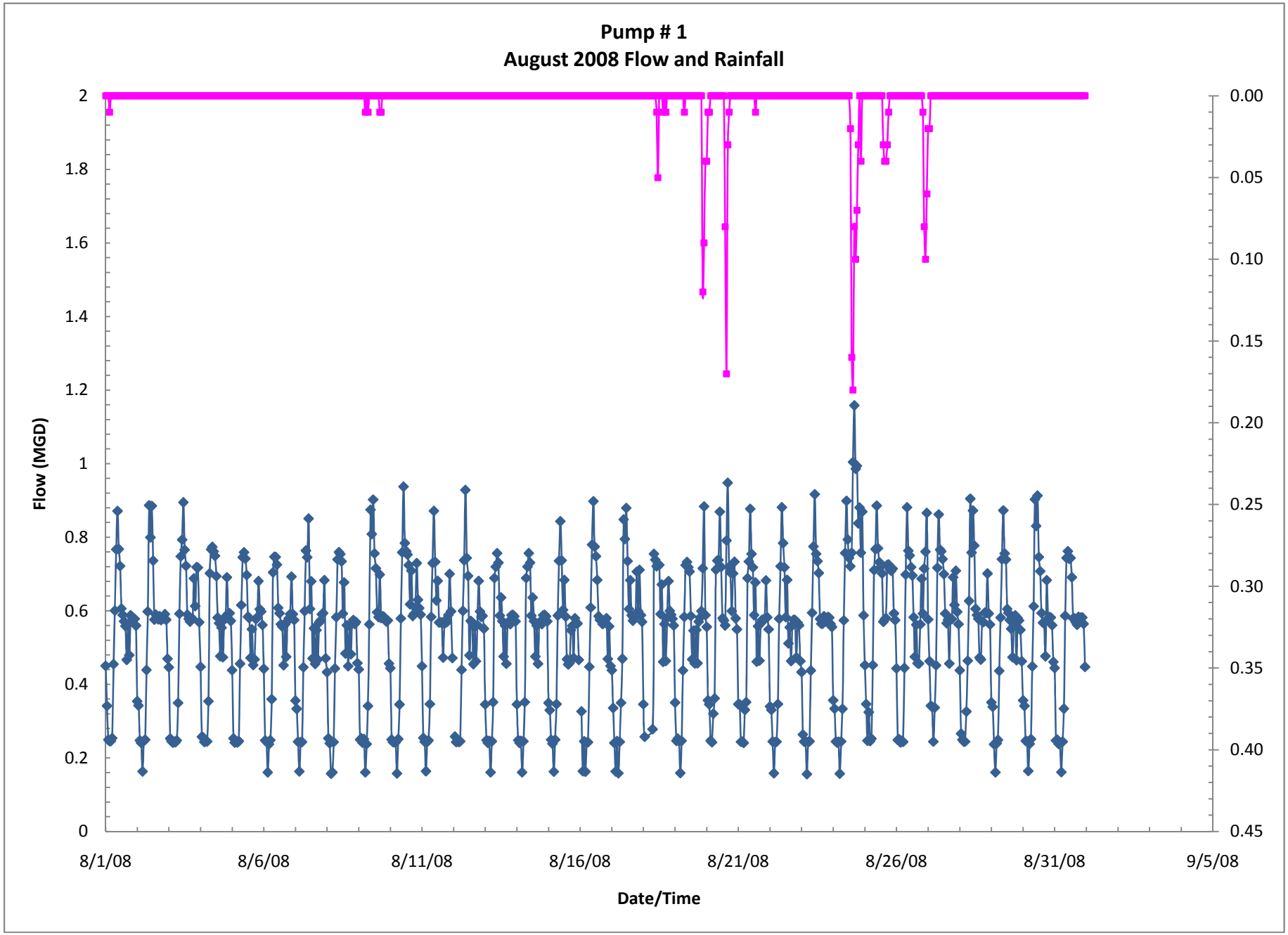
Lift Station No. 1

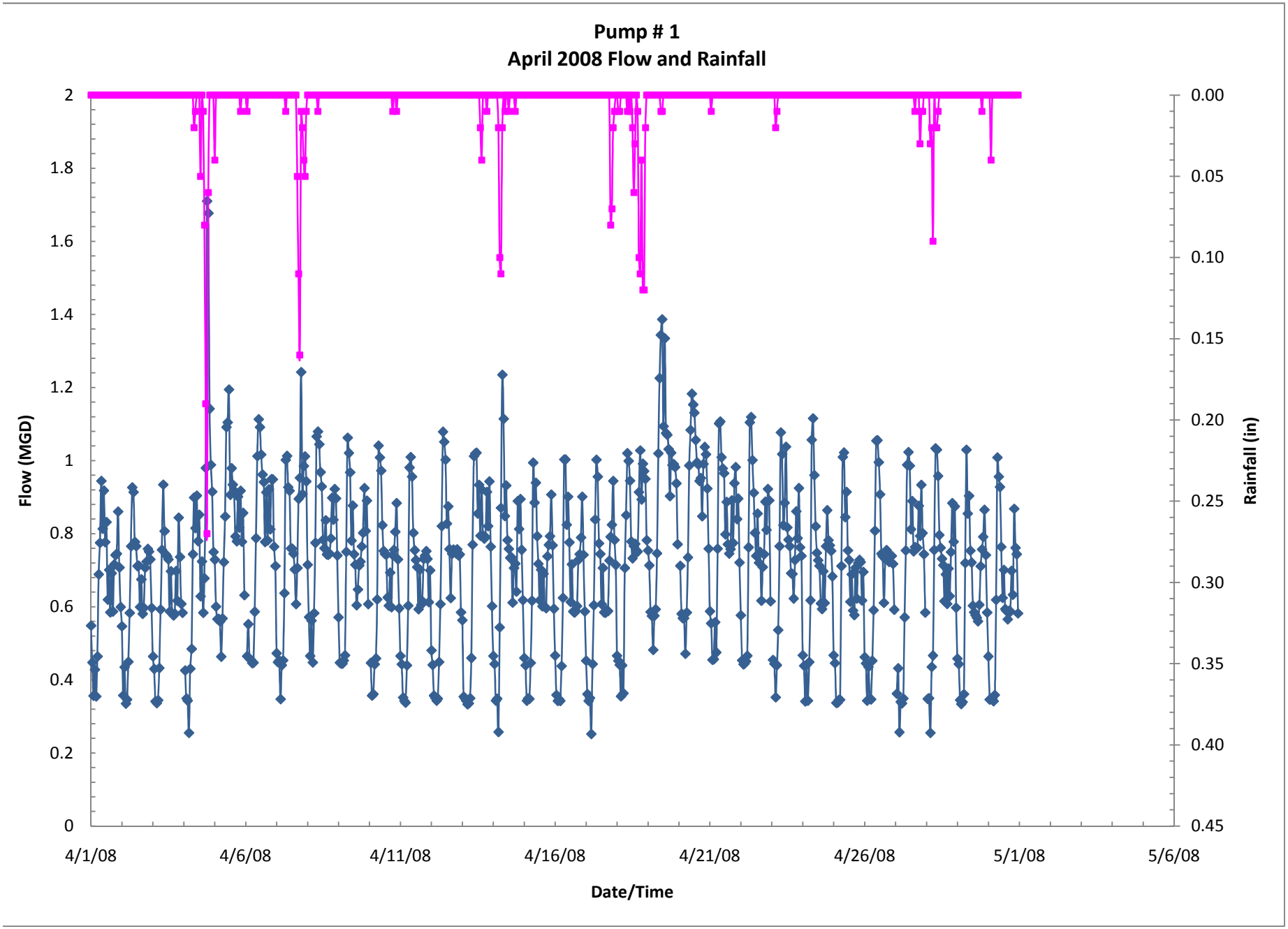
August 2008

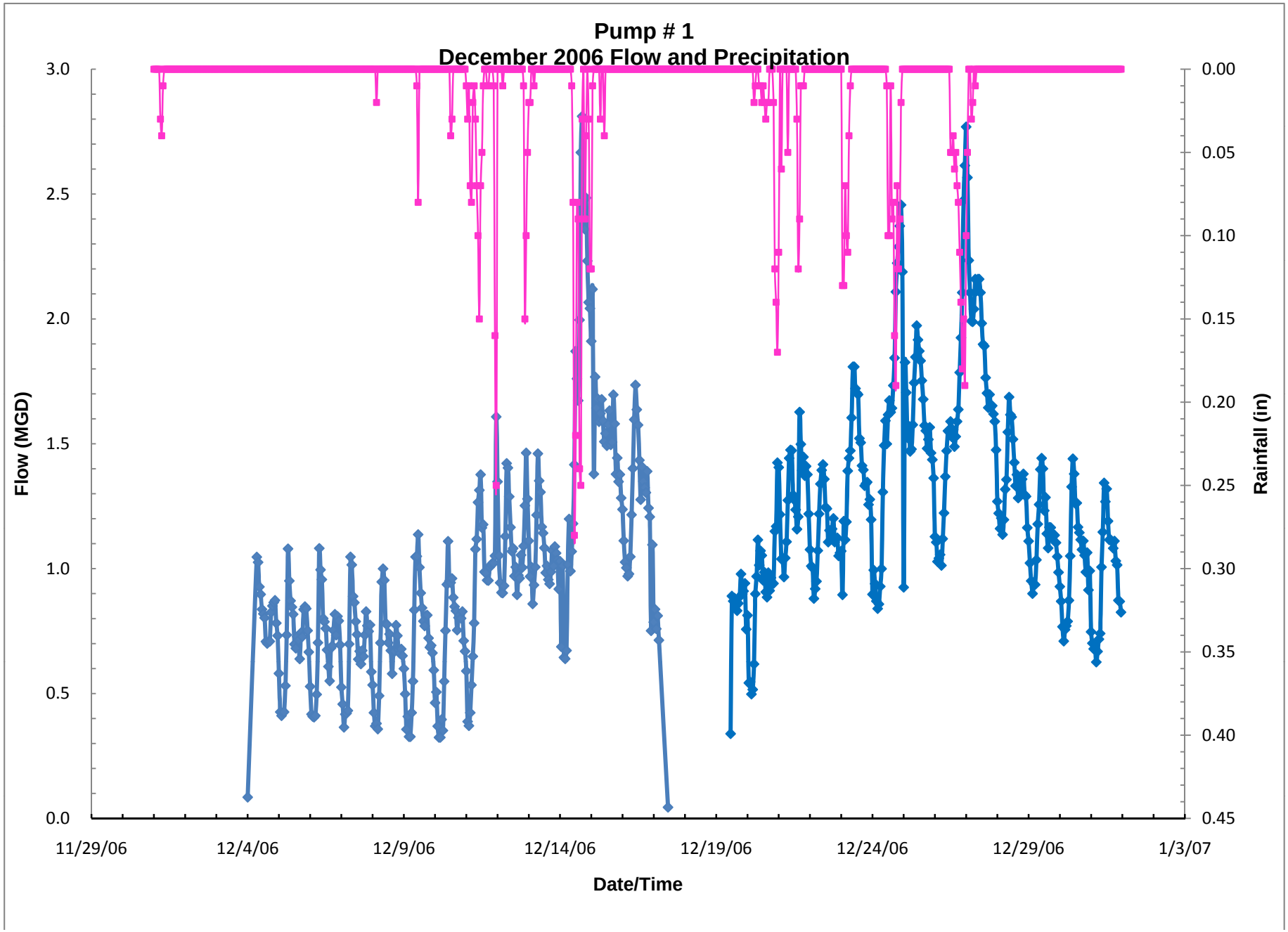
April 2008

December 2006

December 2007


Pump # 1
August 2008 Flow and Rainfall
Flow (MGD)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08
9/5/08
Date/Time


Pump # 1
April 2008 Flow and Rainfall
Flow (MGD)
Rainfall (in)
Date/Time
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08
5/1/08
5/6/08


Pump # 1
December 2006 Flow and Precipitation
Flow (MGD)
Rainfall (in)
Date/Time
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
11/29/06
12/4/06
12/9/06
12/14/06
12/19/06
12/24/06
12/29/06
1/3/07

Appendix B

Proposed Standards, Policies and Guidelines

Standards

a.	S-1	Storm Drainage Connections to the Sanitary Sewer System
b.	S-2	Connections to Existing Sewer System
c.	S-3	Allowable Connections to Side Sewers
d.	S-4	Visual Inspection of Manholes for SSES Investigations
e.	S-5	CCTV Inspections of Sewers for SSES Investigations
f.	S-6	Smoke Testing for SSES Investigations
g.	S-7	Dye Testing for SSES Investigations
h.	S-8	Design Capacity for Pipeline Rehabilitation Projects
i.	S-9	Sewers on Steep Slopes
j.	S-10	Manhole Locations and Covers
k.	S-11	Manhole Size
l.	S-12	Sewer System Design
m.	S-13	Manhole Joints
n.	S-14	Side Sewer Connection Location and Taps
o.	S-15	Abandonment Requirements
p.	S-16	Pipe Materials
q.	S-17	Pipe Rehabilitation Methods
r.	S-18	Inspection Wyes/Cleanouts
s.	S-19	Inspection of Pipe Installation and Backfill
t.	S-20	Pipe Zone Bedding and Trench Backfill (Side Sewers)
u.	S-21	Manhole Leveling Rings
v.	S-22	Root Intrusion
w.	S-23	Root Intrusion (Side Sewers)
x.	S-24	Pipeline Leak Testing
y.	S-25	Sanitary Side Sewer Inspection
z.	S-26	Side Sewer/Lateral Leak Testing
aa.	S-27	Manhole Leak Inspection
bb.	S-28	Product Specific Inspection
cc.	S-29	Product Specific Inspection (Side Sewer)
dd.	S-30	CCTV Inspection
ee.	S-31	CCTV Inspection (Side Sewers)
ff.	S-32	Certification, Warranty and Qualifications
gg.	S-33	Bonding and Warrant Inspection

Policies

a.	P-1	Community Education and Involvement
b.	P-2	Responsibility for Community Education
c.	P-3	Public Funding
d.	P-4	Rates, Incentives and Surcharges
e.	P-5	Cost Sharing

f. P-6 Stormwater Drainage Ordinances
g. P-7 On-site Storm Drainage Management
h. P-8 Infeasible or Prohibitively Expensive Modifications
i. P-9 Contractor Qualifications
j. P-10 Required Permits
k. P-11 Inspection and Testing
l. P-12 Property Restoration
m. P-13 Contractor Bonding, Licensing and Warranty
n. P-14 Access to Private Property
o. P-15 Limiting Liability
p. P-16 Legislative Action Requirements
q. P-17 Side Sewer Ownership and Responsibility

Guidelines

a. G-1 Modeling and Engineering Analysis
b. G-2 Lateral and Side Sewer Rehabilitation Methods
c. G-3 Pipe Protection - Depth of Cover
d. G-4 Manhole Rehabilitation
e. G-5 Spot Repairs
f. G-6 Spot Repairs (Side Sewers)
g. G-7 Manhole Lids/Inserts

I/I DISCHARGE SITE CONDITIONS

TITLE: Storm Drainage Connections to the Sanitary Sewer System

STANDARD NO. S-1

I/I CONTROL MEASURE ISSUE:
Direct connection of storm water collection systems to the sanitary sewer system reduces the capacity of the sewer system and increases surcharging potential of the pipe, which can contribute to sewer deterioration and increase the potential for pipeline collapse. Some agencies allow surface water runoff collected from areas subject to high pollutant loading to discharge to the sanitary sewer. Numerous connections of this type can overload the Edmonds sanitary sewer collection system.

STANDARD

- No storm drainage connections shall be made to the sanitary sewer system unless approved by the City of Edmonds, and only under special circumstances. The discharges shall be defined by discharge permit, contract or other such document.

POTENTIAL EDMONDS IMPACTS

- Provisions will need to be addressed for water quality treatment from surface water collection areas subject to high pollutant loading that the City may have previously connected to the sanitary sewer system.
- Requests to connect storm water collection areas to the sanitary sewer system will have to be reviewed for conformance with the special circumstances developed by the City.
- Special fee structures may be adopted for connection of storm drainage sources to the sanitary sewer system.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Connections to Existing Sewer System

STANDARD NO. S-2

I/I CONTROL MEASURE ISSUE:
When new connections are made to the existing sewer system, I/I potential exists from three general locations: 1) the connection itself leaks, 2) the system being added has leaks, and/or 3) the system being added has illegal connections that are inflow sources.

STANDARD

- Connections to the existing sewer system will only be allowed at manholes, to a main via an existing tee or a tap, or to the end of an existing pipe that meets all applicable I/I Standards.
- Where a new manhole is being installed in an existing system, the I/I Standards for new manholes shall apply.

Testing and inspection:

- The new conveyance system to be connected shall be inspected to confirm that no illicit connections contributing inflow have been added.
- At manhole locations, the connection at the existing manhole shall be visually inspected for water tightness after the pipe has been completely backfilled and groundwater has returned to its natural elevation. The new line shall not be put into service until the connection has been inspected and approved.

POTENTIAL EDMONDS IMPACTS

- Inspection requirements to confirm work performed correctly.

POTENTIAL PRIVATE PROPERTY / RATEPAYER IMPACTS

- No impact.

TITLE: Allowable Connections to Side Sewers

STANDARD NO. S-3

I/I CONTROL MEASURE ISSUE:
A description is given of allowable and disallowable connections to side sewers for the purpose of eliminating clean surface and subsurface drainage flow to the City of Edmonds sewer system.

STANDARD

- Side sewers discharging to the sewer system shall convey sanitary sewage only. Sanitary sewage sources are limited to:
  - Building plumbing outlets.
  - Sump Pumps conveying sanitary sewage.
- Sources of clean water flow shall not be conveyed by side sewers discharging to the sewer system, including:
  - Downspouts.
  - Foundation drains.
  - Catch basins.
  - Storm water inlets and trench drains.
  - Structure or landscaping under-drain systems.
  - Sump pumps discharging surface runoff or subsurface drainage flow.

POTENTIAL EDMONDS IMPACTS

- Allowable connections to side sewers shall be in conformance with applicable plumbing codes.
- Newly developing building sites will be required to establish separate surface and sub surface drainage systems compatible with the developed site grading, soil conditions, groundwater table, and adjacent environmentally sensitive areas. Comprehensive monitoring for disallowable side sewer connections will be required, particularly where alternate disposal requirements for drainage are onerous to the property owner.
- It is expected that some existing building sites will be found to be discharging clean water to the side sewer, either as a result of partial failure of side sewers, or as a result of illicit connections. When implementing corrective measures for these sites, consideration must be given to disposition of the resulting displaced flows. New site drainage systems implemented for this purpose must be compatible with the developed site grading, soil conditions, groundwater table, and adjacent environmentally sensitive areas.
- Requirements for newly developing sites are consistent with most current development regulations and should not result in development costs above and beyond current requirements.
- Repair of failed side sewers will result in varying levels of cost on a per site basis. Incremental cost impacts will be associated with the following factors:
  - Side sewer length.
  - Site development features (i.e. structures, landscaping, pavement, etc.).
  - Site accessibility (i.e. slope, overgrowth, sensitive areas, etc.).
- Disconnection of clean water sources from side sewers on developed sites will result in varying levels of cost on a per site basis. Incremental cost impacts will be associated with the following factors:
  - Distance to alternative discharge point for clean water flows.
  - Presence of environmentally sensitive areas.
  - Relative elevation of property to alternative discharge point.
  - Ground water elevation.
  - Site elevation relative to surrounding areas.

- Proportion of impermeable area on the site.

- Testing to determine the presence of failed side sewer conditions that might allow clean water to enter the system cannot be comprehensively achieved except during wet weather conditions that result in saturated ground conditions. Testing for this purpose is best achieved on a basin wide basis through flow monitoring and analysis, or potentially through television inspection.
- Testing for illicit downspout connections and certain area drain connections can be achieved, under favorable conditions, through smoke testing. Some illicit connections of surface or subsurface drainage will not be detected through smoke testing, but might be detectable using dye testing.
- Generally, basin wide testing for illicit connections is implemented prior to the implementation phase to determine where remedial actions may be required. Site specific testing during implementation of the remedial work may be helpful in determining the effectiveness and completeness of the work being undertaken.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Dependent on implementation of City-funded activities. See Policy 3.

PRELIMINARY ENGINEERING

TITLE: Visual Inspection of Manholes for SSES Investigations

STANDARD NO. S-4

I/I CONTROL MEASURE ISSUE:
Manhole inspections are one of the most important efforts of a sewer system evaluation survey (SSES) investigation because manholes can account for a significant amount of the I/I entering a sanitary sewer system. The inspection provides a means for viewing the manhole internally to assist in:

- Determining whether the cover is subject to ponding or surface water runoff.
- Inspecting for internal leaks.
- Analyzing structural deficiencies in the manhole structure.
- Estimating I/I quantities in the manhole.

Investigation of the internal condition of a manhole should be conducted from the inside of the manhole. Performing the investigation only from the surface and failing to thoroughly check the manhole interior commonly results in an inadequate inspection. Leaks around taps in the manhole are often confused with flow from the tap itself. If not closely inspected, leaks on the floor, in the channel, and around the pipe seals are often misidentified as eddies in the normal pipe flow.

STANDARD

- Visual inspection of manholes shall be performed by experienced personnel trained in the proper safety measures for performing the inspection including, but not limited to, confined space entry and traffic control measures. It is recommended that the visual internal inspection be performed during the wet season when surrounding soils are fully saturated. Results of the manhole inspections shall be documented on a standard form which contains the following information:
    - Manhole identification or reference number and street location.
    - The date of the inspection.
    - Name of the inspector.
    - Pavement surface type and condition.
    - Whether the manhole cover is depressed below the adjacent surface grade and whether its location makes it subject to surface water flows or ponding.
    - Significant site features that may affect rehabilitation access or methods, including whether the manhole is located on private property or is located near sensitive habitat.
    - Cover information including size, number of pick holes, gasket condition, if present, and whether the cover is locking or not.
    - Frame information including size, grade, condition and presence and condition of an internal boot.
    - Chimney information including material and condition, diameter, height, seal condition at cone or top slab, presence and location of manhole steps, and evidence of infiltration.
    - Cone information including type and condition, seal at barrel and evidence of infiltration.
    - Barrel information including type, lateral locations, diameter and condition, seal at bench and bottom slab, and evidence of infiltration. Location and size of cracks and leak locations shall be documented.
    - Condition of channel and bench concrete and location of infiltration at the flow line and bench.
    - Presence, location and condition of drop connections.
- Manhole inspection results shall be archived by the City of Edmonds.

POTENTIAL EDMONDS IMPACTS • Training and upgrading of staffing skills to perform the manhole inspections and interpret results, if not contracted with outside vendors. • Additional staff resources (FTEs) may be required. • Additional staff time for conducting inspections, interpreting results, reporting and archiving of data.
POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS • No impacts.

TITLE: Closed Circuit Television (CCTV) Inspection of Sewers for SSES Investigations

STANDARD NO. S-5

I/I CONTROL MEASURE ISSUE:
CCTV inspection during a sewer system evaluation survey (SSES) provides a safe, low-cost and rapid means for viewing the sewer line internally to assist in:

- Determining the physical condition of pipe joints.
- Analyzing structural deficiencies and corrosion in pipelines.
- Identifying sources of I/I.
- Estimating quantity of infiltration.
- Identifying changes in the sewer from the last CCTV inspection.

STANDARD

CCTV inspection of sewers for an SSES investigation shall include a complete television inspection of the sewer main and may include laterals and side sewers that connect to the main. It is recommended that the CCTV inspection be performed during the wet season when surrounding soils are fully saturated. The decision to CCTV inspect laterals and side sewers shall be based on evidence that a significant source of the I/I originates from the laterals or side sewers. The factors that shall be considered include:

- Flow monitoring data that suggests rapid infiltration.
- Lack of I/I sources identified from CCTV inspection of the sewer main or smoke testing.

Sewer cleaning shall be performed before beginning television inspection of sewer mains, laterals and side sewers. Television inspection shall be accomplished using a closed-circuit system specifically designed for sewer inspections. For each pipeline inspected, records shall be collected both digitally and on a field form. The digital record shall include the date of the inspection and a brief narrative description of the pipeline being inspected (manhole to manhole run, or service address) and discuss each defect that is observed. Field forms for sewer main inspections shall contain the following information:

- The date of the inspection.
- Name of CCTV crew members and their company or agency.
- The reason for the inspection.
- The location of the pipeline and the upstream and downstream manhole numbers.
- The direction of the camera's travel.
- The pipe size, type, pipe joint length, and overall footage of the inspected sewer.
- The location and a description of each service connection.
- A description of each defect observed and its distance from the point at which the viewing began.
- Severity of I/I at each defect location.

Field forms for lateral and side sewer inspections shall contain the following information:

- The date of the inspection.
- Name of CCTV crew members and their company or agency.
- The reason for the inspection.
- The service address.
- The pipe size, type, pipe joint length, and overall footage of the inspected lateral/side sewer.
- A description of each defect observed and its distance from the point at which the viewing began.

- Severity of I/I at each defect location.
- The location and a description of any observed connections to the lateral/side sewer.

Field forms and digital record of inspections shall be archived by the City of Edmonds so that they may be compared to subsequent CCTV inspections that are performed on the same portions of the line. Videotaped footage of the CCTV inspection is an acceptable alternative to digital footage.

POTENTIAL EDMONDS IMPACTS

- Training and upgrading of staffing skills to perform the CCTV inspections and interpret results, if not contracted with outside vendors.
- Additional staff resources (FTEs) may be required.
- Acquisition of CCTV inspection equipment and vehicles, or contracting with outside vendors.
- Additional staff time for conducting inspections, interpreting results, reporting and archiving of data.
- Additional cost for CCTV of laterals/side sewers.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Smoke Testing for SSES Investigations

STANDARD NO. S-6

I/I CONTROL MEASURE ISSUE:
Smoke testing is the process of blowing a nontoxic smoke made from mineral oil at low pressure into the sewer system. Smoke testing provides a low-cost and rapid means for determining direct connections of inflow and rainfall-induced infiltration sources, such as:

- Roof drains
- Foundation drains
- Catch basins
- Area drains
- Abandoned building sewers
- Uncapped cleanouts
- Illegal connections
- Storm sewer cross connections

STANDARD

Smoke testing for sewer system evaluation survey (SSES) investigations shall be performed by experienced personnel who know the effects of groundwater table, frozen ground, wind, rain, trapped service connections and snow cover on the test findings. Smoke used for the testing shall be non-toxic, odorless and non-staining. Blower capacity shall be determined based on the size of area to be tested, but in no case shall it be less than 1,750 cfm. The vacuum effect of flowing water drawing smoke downstream shall be taken into account. Police and fire departments shall be notified daily of test locations, and residents shall be notified in advance of the testing by a written testing notice. Residents shall also be informed individually on the day of testing by personnel having proper identification. The following chronological steps shall be used for smoke testing:

- Isolate the sewer main line to be tested with plugging up to 400 feet at a time noting any surcharged line sections. Smoke will not pass through a flooded section.
- Prepare a basic smoke sketch of the area being tested including location, date and the name of the company or agency and personnel performing the test.
- Commence smoke testing using one blower at each manhole and enough smoke bombs to ensure smoke travels throughout the entire test section. Smoke shall be continuously generated while visual inspection and photography are in progress.
- Visually inspect the entire area by walking around front and back yards and around buildings. Watch for smoke leaks; typical sources are roof leaders, area drains, foundation drains, house foundations, holes in the ground over the sewer or services, areas around manholes, and catch basins. Roof vents are not to be considered as smoke leaks.
- Document whether or not smoke is observed to be discharging through the roof vents for each house and building included in the test area.
- Photograph all smoke leaks.
- Show the location of each leak on a sketch. Include the photograph number and compass directions taken, and a description of the leak including address. Provide dimensions to the leak from at least two easily identified site features and the estimated area (square footage) and surface type (i.e., grass, pavement, etc.) drained by the leak.
- Photographs shall show the maximum amount of smoke emitted from the leak and the exact source of the leak. Photographs shall be taken from far enough back to provide a physical reference to the location of the smoke. They shall be numbered consecutively to ensure leaks can be identified at a later date.

POTENTIAL EDMONDS IMPACTS • Time and resources to conduct smoke testing, if not already part of City procedures. • Acquisition of smoke testing equipment, if not already owned. • Cost for additional staff workload, or contract with outside vendor.
POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS • Identified defects and illicit connections on private property may need to be corrected by the property owner.

TITLE: Dye Testing for SSES Investigations

STANDARD NO. S-7

I/I CONTROL MEASURE ISSUE:
Dye testing is a rainfall simulation technique used to identify specific defects that can contribute I/I during rainfall or snowmelt. Dye testing can also be effective in quantifying the amount of I/I that can enter a section of sewer or specific defect under a controlled runoff situation. Depending on the sources of I/I to be identified and the configuration of the runoff situation being simulated, the procedures for dye testing differ. Five examples of dye testing situations are as follows:

- **Determining Conditions Caused by Storm Drains**—Storm drains that parallel or cross sanitary sewer pipes and have an invert elevation higher than the crown elevation of the sanitary sewer can be a source of rainfall-induced infiltration or inflow. They are inflow sources if there are cross connections between the storm drain and the sanitary sewer; they are infiltration sources if stormwater can exfiltrate from them, percolate through soil, and enter the sanitary sewer through pipe or joint defects.
- **Determining Conditions Caused by Stream or Ditch Sections**—Streams and stormwater ditches are inflow sources if there are cross connections between them and the sanitary sewer; they are infiltration sources if the surface water can percolate through soil and enter the sanitary sewer through pipe or joint defects.
- **Identifying I/I Sources from Private Property**—Roof leaders; basement, yard and area drains; foundation drains; abandoned building sewers; and faulty connections are sources of private property defects that can be identified by dye testing.
- **Identifying Structurally Damaged Manholes**—Dye testing can be used to verify structurally damaged manholes that leak when subjected to flooding or when groundwater elevations are high.
- **Verifying Sources Found by Other Testing Means**—Dye testing can verify suspected sources of I/I identified in a visual survey or smoke testing study. Examples include manholes affected by surface water runoff, holes in the ground smoking over services or sewer mains, and cracks in the street pavement that are smoking.

STANDARD

- Dye testing for sewer system evaluation survey (SSES) investigations shall be performed by experienced personnel trained in the proper safety measures for performing the testing including, but not limited to, confined space entry into storm drain and sanitary sewer manholes, measures for controlling water head buildup behind plugs, and traffic control measures. A fluorescent dye having a distinct color readily detectible by eye shall be used for dye testing. The dye shall be safe to handle, visible in low concentrations, miscible in water, biodegradable and inert to solids and debris in the sewer. Procedures for dye testing shall be as follows:

Determining Conditions Caused by Storm Drain

1. Plug both ends of the storm drain section to be tested with sand bags or sewer plugs and block all overflow and bypass points in the storm drain section. Bypass flow around the section under test if necessary.
2. Fill the storm drain section and stormwater inlets or catch basins to just below the grate with water. Add dye to the water.
3. Monitor the next downstream manhole in the sanitary sewer system for evidence of dyed water.
4. Measure the flow in the sanitary sewer manhole before and during dye testing. As an alternative, measure flow simultaneously at both the upstream and downstream sanitary

manholes during the test.

5. Record the location of storm drain and sanitary sewer lines being tested; the time and duration of the tests; the manholes where the flows are monitored; the observed presence, concentration and travel time of the dyed water to the flow monitoring manholes; and the soil characteristics.

Determining Conditions Caused by Streams or Ditch Sections

1. Plug or dam stream sections, ditch sections or ponded areas to be tested and fill to desired level with dyed water. Bypass flow around the section under test if necessary.
2. Follow steps 3 through 5 above.

Identifying Sources on Private Property

1. Notify property owners and receive permission for testing in advance of testing.
2. Insert dyed water into suspected inflow source and monitor closest downstream sanitary sewer manhole for evidence of dyed water.
3. Record the date of the test; address and type of the inflow source; duration of the test; the manholes where the flows are monitored; and the observed presence, concentration and travel time of the dyed water to the flow monitoring manholes.

Identifying Structurally Damaged Manholes

1. Flood the area around suspected manholes with dyed water.
2. Monitor manhole frame, chimney, cone and manhole walls for entry of dyed water.
3. Record the date of the test; manhole number; duration of the test; and the observed presence, concentration and travel time of the dyed water into the manhole.

Verifying Sources Found by Other Testing Means

1. Notify property owners and receive permission for testing in advance of testing if performed on private property.
2. Flood the area where visual survey or smoke testing study revealed potential I/I source. It may be necessary to restrict runoff from the area with sand bags to allow the area to become saturated.
3. Monitor the next downstream manhole in the sanitary sewer system for evidence of dyed water.
4. Measure the flow in the sanitary sewer manhole before and during dye testing. As an alternative, measure flow simultaneously at both the upstream and downstream sanitary manholes during the test.
5. Record the location of sources being tested, including address if on private property; the time and duration of the tests; the manholes where the flows are monitored; the observed presence, concentration and travel time of the dyed water to the flow monitoring manholes; and the soil characteristics.

- A field log shall be filled out for all dye tests that are performed, regardless of whether a positive transference to the sanitary sewer is observed. A sketch of each testing setup shall be prepared showing testing location, manholes checked, dye transference information, and flooding time. The sketch shall also include the date and time of the test and the names of personnel. A photograph of each testing setup shall be taken and numbered. Photographs of the testing setup shall be referenced on the setup sketch. The appropriate agencies shall be notified of impending dye testing prior to test commencement.

POTENTIAL EDMONDS IMPACTS

- Obtaining required permits for handling and disposal of test water volumes.
- Obtaining and appropriately disposing of test water volumes.
- Cost for additional staff workload, or contract with outside vendor.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Property owners need to provide permission to perform testing on private property.
- Some disturbance to yards/landscaping could occur during testing.

DESIGN

TITLE: Design Capacity for Pipeline Rehabilitation Projects

STANDARD NO. S-8

I/I CONTROL MEASURE ISSUE:
Many pipeline rehabilitation techniques for I/I control involve some loss in the hydraulic capacity of the system because the technique reduces the effective internal diameter of the pipe. Hydraulic capacity loss can range from moderate for techniques such as CIPP to high for techniques such as sliplining. Surcharging and sanitary sewer overflows can result if the hydraulic capacity is reduced below the required service capacity of the line.

STANDARD

- The design of pipeline rehabilitation projects for I/I control shall consider any loss in the hydraulic capacity of the system resulting from a decrease in the effective internal diameter of a pipeline. A Professional Civil Engineer shall verify that the rehabilitated pipe maintains the required hydraulic capacity to service peak demand flow projections for the area tributary to the pipeline.

POTENTIAL EDMONDS IMPACTS

- The City will need to verify that the project designer has addressed the hydraulic capacity of the pipeline.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Sewers on Steep Slopes

STANDARD NO. S-9

I/I CONTROL MEASURE ISSUE:
Pipe that is installed on steep slopes is more susceptible to movement, breakage, and slipped joints, which may allow I/I into the system. Special measures to anchor pipes installed on steep slopes may be required depending on the stability of the existing soils, local groundwater conditions, and the quality of the bedding and backfill construction during pipe installation.

STANDARD

- Sewer mains on steep slopes shall be designed by a Professional Engineer to ensure the integrity of the system to prevent leakage and minimize I/I.

POTENTIAL EDMONDS IMPACTS

- Verify that a Professional Engineer has addressed pipe anchoring requirements on steep slopes.
- Additional cost for pipe anchors that are typically a requirement on steep slope pipeline installations.
- Inspectors will need to verify that anchors are installed as designed.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Manhole Location and Covers

STANDARD NO. S-10

I/I CONTROL MEASURE ISSUE:

Placement of manholes is important for two reasons:

- the potential for I/I will decrease by not placing it in a location subject to surface water flows or ponding
- proper location can improve the City's ability to inspect and maintain the system, thus reducing I/I.

When manholes must be placed in areas subject to surface water flows, inflow can be prevented by providing a watertight frame and cover system.

STANDARD

- Manholes shall not be installed in areas subject to surface inundation such as pavement depressions and gutters. If this cannot be avoided, then the entire manhole, including cover, shall be designed as a watertight system. Buoyancy of the watertight manhole shall be accounted for in the design. For manholes placed in lakes or ponds a special watertight manhole, including access system, shall be designed to prevent leakage and to insure maintainability.
- For manholes located in paved roadways, parking lots, or other areas that become subject to channelized stormwater flow due to re-grading, the manhole shall be retrofit with a watertight frame and cover system to prevent inflow.
- Watertight frame and covers shall consist of a solid, gasketed cover or an approved manhole cover insert that stops the inflow of surface water into the manhole. Manhole cover inserts may be installed beneath a standard cover. Manhole cover inserts shall be in conformance with Standard Detail MH-3.

POTENTIAL EDMONDS IMPACTS

- Added cost for watertight design in areas that may not now be required to be watertight.
- Sewer system plan review would need to include an assessment of locations where manhole cover inserts are required.
- Field inspection to ensure watertight manhole covers are installed where specified would be required.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potentially higher ratepayer cost for watertight design.

TITLE: Manhole Size

STANDARD NO. S-11

I/I CONTROL MEASURE ISSUE:
Providing a watertight seal at pipe penetrations is difficult when new or existing manholes are too small to accommodate all penetrations for incoming and outgoing pipes. Provisions to provide a minimum distance between manhole knockouts and minimum manhole sizes based on pipe size ensure a watertight pipe connection can be made and help prevent structural failure of the manhole.

STANDARD

- New manholes shall be sized so that the minimum distance between knockouts is in accordance with the requirements of the WSDOT/APWA Standard Specifications and the manhole manufacturers' standards. A connection detail stamped and signed by a Professional Civil Engineer and approved by the manhole manufacturer shall be provided where the minimum distance between openings cannot be maintained.

POTENTIAL EDMONDS IMPACTS

- Review of manhole shop drawings is required to ensure that the minimum sizing and spacing requirements are being met, or that a connection detail prepared by a Professional Engineer is being provided.
- Manhole construction costs may increase moderately if the City has previously allowed contractors to make connections to existing manholes or size new manholes without requiring the specified minimum sizes or distance between knockouts and adjacent pipe connections.
- Inspection of manhole construction is required to insure that the pipe locations and connections are as detailed and not field modified.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potentially higher ratepayer costs if the City has not previously required minimum distances between knockouts.

TITLE: Sewer System Design

STANDARD NO. S-12

I/I CONTROL MEASURE ISSUE:

Structural failure of pipe and manholes can lead to infiltration of groundwater. The following key factors contribute to the impairment of a sewer system's structural abilities, resulting in I/I:

- Sewer mains, manholes, laterals and side sewers that are not properly supported are subject to vertical displacements over time, causing joints to open and pipeline trenches to settle, producing cracks or breaks in sections of the pipe.
- Materials must be appropriate for design conditions and the ground conditions present. Pipeline failures often occur due to the misuse of materials.
- Deep cuts and poor ground conditions often result in a larger than necessary excavation, leading to unequal settlement if uniform support is not provided for the pipe and manhole. Inadequate support often causes failure of the pipe in shear at the manhole and provides a point of entry for groundwater.

Recognizing past situations that have allowed extraneous flows to enter the system and requiring sound and appropriate design measures to prevent these deficiencies on future projects can greatly reduce future I/I.

STANDARD

- Sewer system design shall be performed by a Professional Civil Engineer licensed in the State of Washington. The designer shall verify that sound and appropriate standards and measures have been employed in the design of new sewer systems. This shall include the choice of sewer materials for the design conditions, pipe bedding and backfill requirements, and the evaluation for pipe casing requirements.

POTENTIAL EDMONDS IMPACTS

- The City will need to verify that the designer has adequately addressed elements of the sewer design that relate to the structural integrity of the system.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impacts.

CONSTRUCTION & INSPECTION

TITLE: Manhole Joints

STANDARD NO. S-13

I/I CONTROL MEASURE ISSUE:
Joints in manholes present potential sources of I/I from the precast concrete manhole segments, adjustments rings and pipe penetrations.

STANDARD

- All manholes shall be completely watertight from the top of the casting down.
- Manholes materials and construction shall be in accordance with WSDOT/APWA Standard Specifications except as modified by this standard and Standard Details MH-1 and MH-2.
- Precast concrete manhole sections shall be joined with either rubber or flexible plastic gaskets.
- All lifting holes shall be completely filled with non-shrink grout.
- Typical pipe penetrations through precast concrete sections shall be either factory knockouts or core drilled (not line drilled or rough broken) cutouts. Pipe shall enter the manhole through a rubber gasketed entry coupling specifically design for a flexible, watertight connection either cast into the manhole section or grouted in place with non-shrink grout.
- Where a new manhole is being constructed as a “saddle manhole”, which is built around an existing sewer main, the manhole shall be designed by a Professional Civil Engineer. The saddle manhole shall be of sufficient diameter to provide a watertight connection between the manhole and the wall of the existing pipe.

POTENTIAL EDMONDS IMPACTS

- No major impact because the City currently meets this standard.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impacts.

TITLE: Side Sewer Connection Location and Taps

STANDARD NO. S-14

I/I CONTROL MEASURE ISSUE:
The location of a side sewer connection to a mainline in an area with difficult access or in such a manner as to induce unnecessary stress on the system can make it more prone to damage and less apt to be maintained, thus resulting in I/I. Good construction techniques and proper selection of materials for side sewer taps can reduce I/I by protecting the mainline from damage by providing a watertight seal.

Standard

- No side sewers shall be connected to a main located in a lake or similar body of water except under special circumstances.
- If a side sewer must be connected at a manhole, then it shall penetrate the manhole wall through a watertight rubber gasketed factory manhole adapter specially designed for the side sewer material type. A mortared connection at a manhole will not be permitted unless the structure is constructed as a saddle manhole.
- All connections to existing mains shall be made at an existing tee fitting or by core drilling a hole in the existing sewer main and installing an approved gasketed factory sewer saddle or cutting in a gasketed factory tee. The City of Edmonds may consider other connection alternatives if the method can be demonstrated to provide a watertight connection. Line drilling or rough breakouts shall not be used.
- For a tapped connection to the mainline, the hole shall be as small as possible to accommodate the outside diameter of the side sewer pipe with adequate space for minor angle alignment adjustments of the side sewer. The connection shall be made with a factory saddle specifically designed for side sewer connections and fabricated of corrosion resistant materials and mechanically attached to the pipe to withstand the anticipated loads. The saddle shall provide a rubber gasketed joint between the sewer main and the saddle.
- Factory tees shall be appropriate for the soil conditions encountered in the connection location and shall have rubber gasketed joints. Material selection shall take into account the soil corrosistivity, compatibility of materials with the existing pipe, strength requirements, and bedding/backfill conditions. The tee shall be connected to the existing sewer main pipe by short sections of plain end pipe and an approved stainless steel repair clamp. The short sections of pipe shall match the sewer main pipe material and shall meet or exceed the strength of the existing system. Stainless steel repair clamps shall be gasketed, with a minimum length of two pipe diameters, and assembled with all stainless steel bolts and nuts.

Potential Edmonds Impacts

- Inspection requirements to confirm compliance with standards or do tap itself.
- Moderate cost of using saddles.
- High cost of using cut in tees and dealing with active sewer line.

Potential Private Property/Ratepayer Impacts

- Higher ratepayer costs for using tees.

TITLE: Abandonment Requirements

STANDARD NO. S-15

I/I CONTROL MEASURE ISSUE:
Abandoned sewer pipes and manholes that are not completely isolated from the remaining system pose potential sources for I/I. Abandoned sewer mains are defined as any section of pipe extended beyond a manhole with no services attached and no plan for future extension or service connection(s). Abandoned side sewers fall into two categories. If no future connection is anticipated, then the entire side sewer from the main is considered abandoned. If a future connection is anticipated, then the side sewer shall be considered abandoned at the property line.

STANDARD

- Manholes: Manholes shall not be abandoned if they are on the end of an active sewer main. If the manhole is part of an abandoned pipe system, then it shall be completely filled and all pipes physically connected to the manhole shall be plugged.
- Sewer Main Pipe: Abandoned sewer main pipes shall be plugged with a minimum of length of 3 pipe diameters with a non-shrink grout or other impermeable material at the manhole. The pipe shall be prepared to provide a watertight bond between the plug material and existing pipe.
- Sewer Main Abandonment Inspection: The plug shall be visually inspected for any leaks during the wet season while under warranty.
- Side Sewers: Abandoned side sewer pipe shall be capped with a watertight plug for future use or plugged with a minimum of length of 3 pipe diameters with a non-shrink grout or other impermeable material. The pipe shall be prepared to provide a watertight bond between the plug material and existing pipe.
- Side Sewer Abandonment Inspection: Plugged side sewers shall be CCTV inspected for leakage at the sewer main connection during the wet season while under warranty.

POTENTIAL EDMONDS IMPACTS

- Inspection requirements to confirm that the work was done correctly.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potentially higher ratepayer costs for increased inspection costs.

TITLE: Pipe Materials

STANDARD NO. S-16

I/I CONTROL MEASURE ISSUE:
Pipe breakage and joint failures may occur because of improperly selected side sewer/lateral pipe materials and/or installation procedures, resulting in infiltration. Proper selection of pipe materials and joint systems is an important component of side sewer design and construction that will result in reduced immediate and future infiltration.

Standard

- Side sewer/lateral pipe materials shall be selected based on external loading and soil corrosion potential. Pipe materials used shall have strength characteristics consistent with the earth load and surcharge conditions anticipated. Vehicle live loads, overburden, soil characteristics, and slope conditions shall be considered. Side sewers shall be installed below the frost line and at a depth consistent with the published load bearing capacity of the pipe material used. Pipe materials used shall have corrosion resistant characteristics consistent with the corrosivity of the environment in which they are to be installed.
- Side sewer/lateral pipe materials shall employ gasketed joints and standard manufactured fittings designed for use with the pipe material installed. Deflection of joints shall be limited to 80% of the published maximum deflection for the gasketed joint. Flexible pipe materials used shall be properly bedded and backfilled to ensure that deflection of the pipe beyond its structural capacity will not occur and that deflection "out of round" beyond the capability of the pipe joints to remain sealed does not occur.
- Connection between the side sewer/lateral and dissimilar building plumbing piping shall be accomplished using approved flexible water tight couplings specifically designed for the pipe materials joined. Butt joints wrapped and/or encased in concrete or mortar joint will not be allowed. Connection of pressure discharges from building plumbing to gravity side sewers/laterals shall be accomplished using standard pressure fittings and shall be anchored to ensure against movement during pressurization cycles.

Potential Edmonds Impacts

- Site inspection of side sewer/lateral material and joint installation insuring requirements are met.
- Additional inspection and review time would be required if the City is not currently inspecting side sewer installations and reviewing material submittals.
- Integrity of the installed pipe material and joints must be determined through water, air, or vacuum testing (see testing standards). Testing to confirm integrity of side sewers/laterals should be required prior to acceptance of the installation following construction and following a one-year warranty period.

Potential Private Property/Ratepayer Impacts

- May be added costs to property owner/developers if their practices change due to standards for pipe material and joint systems being more strictly enforced.

TITLE: Pipe Rehabilitation Methods

STANDARD NO. S-17

I/I CONTROL MEASURE ISSUE:
Once the decision has been made to rehabilitate a sewer to control I/I, several alternatives may be used to replace the existing sewer. These include trenchless rehabilitation techniques such as cure-in-place lining or pipe bursting, as well as conventional dig and replace. An evaluation should be made to determine suitability (technical and cost-effectiveness) of trenchless methods versus conventional dig and replacement of the sewer. The technical evaluation should assess specific issues such as the sewer location, alignment, condition of the pipe being replaced, and future service requirements for the sewer. If the rehabilitation technique will reduce the cross sectional flow area of the pipe the technical evaluation should consider loss in hydraulic capacity of the line in accordance with the I/I Capacity for Pipeline Standard S-4. The alternative pipe rehabilitation methods that should be considered include:

Pipe bursting is a trenchless pipeline rehabilitation method that can be used to replace sewer pipes. It is possible to increase the size of the pipe; however, site specific constraints may limit the ability to increase the size. Using pipe bursting to replace a pipe may be restricted depending upon adjacent utilities, proximity to a road surface, the type of existing pipe being replaced, and soil conditions. There are a number of variations on pipe bursting such as pneumatic, hydraulic expansion, and static pull systems. All of these displace the old pipe into the adjacent ground and pull a new pipe in to replace the old pipe. There are also related processes such as pipe reaming, which is a variation of horizontal directional drilling, where pieces of the old pipe are removed rather than pushing them into the adjacent soil. Pipe bursting may be used for mainline, lateral, and side sewer repair. The most common pipe material used is HDPE but other types of pipe material such as cast iron, MDPE, and ABS can be used for the replacement pipe.

Cure-in-place pipe (CIPP) liner is a trenchless pipeline rehabilitation method that can be used to repair existing sewer pipes. CIPP liner involves inverting an epoxy-resin-impregnated flexible tube into an existing line using hydrostatic head. The resin is then cured using heat to produce a pipe inside the existing pipe. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size.

Slip lining is a trenchless pipeline rehabilitation method that can be used to replace sewer pipes. Slip lining involves pushing or pulling a replacement pipe into an existing pipe. The outside diameter of the replacement pipe is smaller than the inside diameter of the existing pipe to allow the replacement pipe to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size. A variety of pipe materials may be used for slip lining including HDPE, ductile iron, PVC, concrete and fiberglass. The annular space should be grouted unless there are project specific reasons to do otherwise.

Fold and form lining is a trenchless pipeline rehabilitation method that can be used to repair existing sewer pipes. The fold-and-form process involves inserting a heated PVC or HDPE thermoplastic liner, folded or deformed into a U-shape, into an existing sewer and re-rounding the liner using heat and pressure to produce a pipe inside the existing pipe. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size.

Standard

- Construction standards for pipe bursting, cure-in-place lining, slip-lining and folded and formed liners shall be as follows:
- Pipe Bursting:
  - Pipe bursting shall meet the requirements of the City's Inflow and Infiltration Control Program Guide Specifications.
- Cure-in-Place Lining:
  - Cure-in-place-lining shall meet the requirements of the City's Inflow and Infiltration Control Program Guide Specifications.
  - Service connections to the new lined pipe shall be made water tight by grouting the area where the service connection enters the lined pipe or by installing a service connection rehabilitation liner in conformance with the City's Inflow and Infiltration Control Program Guide Specifications.
- Slip Lining:
  - Slip lining shall conform to ASTM F585-94 – "Standard Practice for Insertion of Flexible Polyethylene Pipe Into Existing Sewers".
  - The type of replacement pipe used shall meet or exceed the requirements for sewer pipe materials in I/I Pipe Materials Guideline G-6Standard and shall be suitable for the slip lining process being used.
  - New pipe connections to manholes shall provide a water tight connection suitable for the type of replacement pipe being used and in accordance with the I/I Connections to Existing System Standard S-2. Acceptable manhole connections may include commercially available manhole connection boots or the pipe grouted into the manhole pipe penetration with a seep ring on the pipe.
  - Lateral connections to the new pipe shall also be made using commercially available fittings suitable for the type of replacement pipe. For HDPE pipe, lateral wyes or tees shall be made using manufacturer provided fusion welded fittings or other City-approved fittings specifically manufactured for HDPE pipe.
  - The annular space shall be grouted unless there are project specific reasons to do otherwise. Issues to be considered relative to the annular space grouting include grouting pressures and pipe restraint to prevent floatation.
- Fold and Form:
  - Fold and form-lining shall meet the requirements of the City's I/I Control Program Guide Specifications.

Potential Edmonds Impacts

- Inspection requirements to confirm that the trenchless rehabilitation is done correctly.

Potential Private Property/Ratepayer Impacts

- No impact.

TITLE: Inspection Wyes/Cleanouts

STANDARD NO. S-18

I/I CONTROL MEASURE ISSUE:
Pipe breakage and joint failures may occur during the service life of a side sewer pipe, resulting in infiltration. Installation of inspection wyes/cleanouts at the upstream end of the side sewer allows for the future preparation and inspection to identify infiltration problems and their specific sources.

Standard

- An inspection wye/cleanout shall be installed in each new and rehabilitated side sewer immediately down stream of the connection between the building plumbing outlet and the side sewer per Standard Detail SS-1. The inspection wye/cleanout shall meet the requirements of Standard Detail SS-4. Inspection wyes/cleanouts shall be installed no less than 2 feet and no more than 5 feet beyond the face of the building for new side sewer installations. For rehabilitation projects, the inspection wye/cleanout shall be located within 2 feet of the termination of the rehabilitation. Inspection wyes/cleanouts shall be located, to the greatest extent possible, to ensure CCTV accessibility in the future throughout the entire side sewer.
- When any work is done to rehabilitate a side sewer that involves excavating to expose and gain entry to the pipe outside of an existing inspection wye/cleanout, the entire side sewer from the property line to the building(s) must be upgraded to meet this standard.
- Connection of inspection wye/cleanout assemblies to the existing pipe system shall be made with an approved rubber gasketed pipe coupling.

Potential Edmonds Impacts

- Inspection of inspection wye/cleanout installations to ensure that requirements are met. Documentation and record keeping to facilitate future location and use of the inspection wyes/cleanouts.
- Property access issues allowing use of inspection wyes/cleanouts by the City to assess condition of the side sewer/lateral in the future. May require side sewer permit/utility ordinance clause modifications.
- Additional administrative costs to initially record and maintain records of inspection wye/cleanout locations.
- Additional costs associated with permit language and/or ordinance modifications required to establish legal right for Edmonds to access inspection wyes/cleanouts on private property.
- Additional cost associated with ongoing program of periodic monitoring of side sewer integrity and performance using the inspection wyes/cleanouts.
- Inspection wye/cleanout testing will be accomplished integrally with the side sewer/lateral test.

Potential Private Property/Ratepayer Impacts

- Increased costs for added fittings and installation requirements, as well as inspections where standard requirements exceed current requirements
- Restrictions on development and landscaping required to maintain accessibility to inspection wye/cleanout in the future.

TITLE: Inspection of Pipe Installation and Backfill

STANDARD NO. S-19

I/I CONTROL MEASURE ISSUE:
Inspection of pipe and bedding materials including foundation conditions, pipe laying, bedding and backfill operations is necessary to ensure conformance with the required standards. A visual inspection of connections to the new main line should be performed to verify that no disallowed connections, such as from storm water collection sources, are being made to the system. Without adequate inspection, contractors may take construction shortcuts that result in a substandard pipeline installation.

Standard

- The City of Edmonds shall perform the following inspection activities on pipeline installations:
  - Inspection of foundation conditions in areas of questionable soils to verify whether over-excavation is required.
  - Visual inspection of pipe materials and bedding and backfill materials for conformance with standards.
  - Measurement of compaction and density for conformance with bedding and backfill standards.
  - Visual inspection of pipe laying operations to ensure pipe has full, uniform support, pipe-jointing process is being properly performed, and compaction operations are not damaging the pipe.
  - Visual inspection of service connections to the mainline and manholes to verify no surface water collection sources are being connected to the sanitary sewer system.
- A minimum of 10% of the pipe length for each project should be inspected as noted above.
- Above and beyond the minimum inspection, the City shall make the determination on the required frequency of the inspection based on the qualifications and quality of the contractor performing the work.

Potential Edmonds Impacts

- City will need the inspection resources to adequately cover sewer construction work occurring within the agency.
- Administrative costs for on-site inspection will increase if the City is not currently inspecting pipe installation and backfill operations.
- Inspection of pipe installation and backfill operations ensures installation according to the standards, resulting in a more long-lasting and dependable facility. In the long-term, proper inspection of critical pipeline installation operations can save future maintenance, rehabilitation and replacement costs.

Potential Private Property/Ratepayer Impacts

- Potential higher ratepayer costs where inspection is not currently being performed.

TITLE: Pipe Zone Bedding and Trench Backfill (Side Sewers)

STANDARD NO. S-20

I/I CONTROL MEASURE ISSUE:
Side sewers not laid in granular bedding material are subject to potential point loading and/or deflection over time, leading to subsequent damage to the pipe or pipe joint.

Standard

- Side sewer/lateral pipe zone bedding material shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. Bedding material shall be granular material meeting the requirements of Standard Detail S-1. The installed pipe zone bedding material shall effectively separate the side sewer from contact with the native ground and any rocks, pebbles, roots, or other materials that might impose a point load on the side sewer. The pipe zone bedding material shall extend a minimum of 4 inches beyond the outside dimension of the side sewer pipe in all directions. All adjustments to line and grade shall be made by scraping away bedding material or filling with bedding material under the body of the pipe and not be accomplished by blocking or wedging. Disturbed bedding shall be reconsolidated prior to backfill. Pipe zone bedding material shall be compacted to 95 percent maximum density per ASTM D-1557. Bedding shall be placed, spread, and compacted before the pipe is installed so that the pipe is uniformly supported along the barrel. Material shall be worked carefully under and around the pipe haunches and then compacted.
- Deviation from the installation requirements noted above is acceptable where written recommendations have been provided by the pipe manufacturer.

Potential Edmonds Impacts

- Site inspection of side sewer bedding and backfill material and installation will be required to insure that requirements are met.
- Additional inspection and review time would be required if the City is not currently inspecting side sewer installations and reviewing material submittals.

Potential Private Property/Ratepayer Impacts

- Potentially higher costs if builder/developer does not now use good practices in installing side sewers.
- Potentially higher permit costs for inspections and testing.

TITLE: Manhole Leveling Rings

STANDARD NO. S-21

I/I CONTROL MEASURE ISSUE:
The manhole grade-adjustment rings for the frame and cover can be a source of infiltration.

Standard

- Materials for grade adjustment of manholes shall consist of precast concrete rings specifically designed for the diameter of the manhole entrance and anticipated loads. Other materials for the rings may be considered provided they provide adequate support, are impermeable, provide a watertight seal, and have a serviceable life expectancy of 50 years or over.
- Adjustments of the frame and cover shall be made with precast concrete rings and joined with mortar meeting the requirements of Section 9-04.3 of the WSDOT/APWA Standard Specifications or flexible plastic/mastic gaskets. If leveling rings are used that are manufactured from materials other than concrete, the installation of the rings and adjustment to grade shall be in accordance with the manufacturer's recommendations.
- If mortar joints are used, consideration shall be given to infiltration leakage that could occur through the rings. This may include wrapping the full height of the exterior of the manhole rings with a membrane sealing system.
- Testing and inspection: If mortar joints are used, they shall be inspected before backfilling.

Potential Edmonds Impacts

- Additional cost of inspection and testing of the manhole.

Potential Private Property/Ratepayer Impacts

- No impacts.

TITLE: Root Intrusion

STANDARD NO. S-22

I/I CONTROL MEASURE ISSUE:
Pipelines that have roots protruding into the pipe have a breach in the piping system at a joint and/or a break in the pipe. This breach is a potential source for infiltration. Cutting of the roots inside the pipe and treatment with a root-inhibiting chemical will not remove infiltration. Root intrusion can cause operational problems by plugging the sewer and will likely need to be corrected to address this problem.

Standard

- When roots are found in sewer piping and manholes, the point of entry shall be located by CCTV. If infiltration occurs at the point of root intrusion it shall be evaluated for removal during the wet season when surrounding soils are fully saturated. Correction of infiltration caused by roots can be accomplished by performing a spot repair by either a conventional dig and repair or using a trenchless repair method.
- If the segment of sewer indicates potential for additional root intrusion, consideration shall be given to replacing the sewer using either dig and replace or trenchless methods.

Potential Edmonds Impacts

- Added cost to test and repair the entire section of main from manhole-to-manhole.

Potential Private Property/Ratepayer Impacts

- Added cost due to increased cost to maintain system.

TITLE: Root Intrusion (Side Sewers)

STANDARD NO. S-23

I/I CONTROL MEASURE ISSUE:
Side sewers that have roots protruding in the pipe have a breach in the piping system either at a joint and/or a break in the pipe. This breach is a potential source for infiltration.

STANDARD

- For any sewer system rehabilitation work on side sewers or laterals, root intrusion shall be addressed by evaluating removal of the roots and repair or replacement of the side sewer/lateral at the point of root intrusion.

POTENTIAL EDMONDS IMPACTS

- The costs of pipe repair will be incurred if the rehabilitation is financed by the City.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Pipe repair activities may cause inconveniences from service disruptions or construction activities.
- The cost of rehabilitation will be incurred if financed by the property owner.

TITLE: Pipeline Leak Testing

STANDARD NO. S-24

I/I CONTROL MEASURE ISSUE:
Several aspects of sewer main pipe installation, if not properly designed and constructed, may result in infiltration entering the finished pipeline. Leakage testing of the assembled sewer pipeline immediately following construction is one of the final opportunities for verification that the pipeline meets acceptable I/I criteria prior to being placed into service.

Leakage testing of newly installed replacement sewer mains may not be feasible because active side sewers are being installed on the new line as construction progresses. For these cases, CCTV inspection of the completed line will be required in lieu of a leakage test.

STANDARD

- Acceptance criteria for substantial completion following construction of new and rehabilitated pipelines shall include testing requirements to ensure that the sewer pipelines and connections to the sewer pipelines, as constructed, meet specified leakage limitations. Where new sewer mains can be isolated from active flow, the pipeline shall be tested by either a water test or a low pressure air test. For those cases where flow cannot be routed around the new main, the pipeline shall be CCTV inspected for leakage.
- The water test shall be an infiltration test if the sewer main is installed below the groundwater level. The water test shall be an exfiltration test if the sewer main is installed above the groundwater level. Testing shall be in accordance with the WSDOT/APWA Standard Specifications.
- Low pressure air testing shall conform to the requirements of the WSDOT/APWA Standard Specifications.
- Where wastewater flow cannot be routed around the new main as construction progresses, the pipeline shall be CCTV inspected for leakage. While under warranty, it is recommended that a visual inspection for leakage be performed during the wet season when surrounding soils are fully saturated.

POTENTIAL EDMONDS IMPACTS

- Possible additional cost and additional staffing requirements for acceptance and inspection verification.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potentially higher ratepayer costs for increased visual inspection/verification requirements.

TITLE: Sanitary Side Sewer Inspection

STANDARD NO. S-25

I/I CONTROL MEASURE ISSUE:
A visual inspection of the private side sewer is needed before it is backfilled or covered to ensure that pipe materials meet specifications, the pipe is properly supported, and that storm water drains and subsoil drains are not connected to the sanitary sewer.

Standard

- No trench shall be filled nor any side sewer covered until the work has been inspected, tested and approved by the City of Edmonds. The City may require that any work covered be uncovered, or tested by a recognized independent testing laboratory (at the expense of the permittee), to ensure that the work has been accomplished in accordance with the permit.

Potential Edmonds Impacts

- Inspection standards for private side sewers would need to include a provision for a visual inspection of each side sewer before it is backfilled or covered. Additional inspection effort would be required if the City is not currently inspecting each side sewer. City inspection forms should include verification of the visual inspection including date, time and the name of the inspector.
- Tighter coordination of inspection timing may be required.

Potential Private Property/Ratepayer Impacts

- Permit fees for side sewer installation could increase to finance inspection costs.

TITLE: Side Sewer/Lateral Leak Testing

STANDARD NO. S-26

I/I CONTROL MEASURE ISSUE:
Several aspects of side sewer/lateral pipe installation, if not properly designed and constructed, may result in infiltration entering the finished pipeline. Leakage testing of the assembled side sewer/lateral immediately following construction is the final opportunity for verification that the pipeline meets acceptable I/I criteria prior to being placed into service.

It is also beneficial to test side sewer/lateral pipelines after a significant period of service to confirm that as-built conditions have not degraded due to material failures, bedding or backfill settlement, or other causes.

Standard

- Acceptance criteria following construction shall include testing requirements to ensure that both new and rehabilitated side sewer/laterals and connections, as constructed, meet specified leakage limitations. All new side sewer/laterals shall be tested by either a water test or a low pressure air test.
- The water test shall be an infiltration test if the side sewer/lateral is installed below the groundwater level. The water test shall be an exfiltration test if the side sewer/lateral is installed above the groundwater level. Testing shall be in conformance with WSDOT/APWA Standard Specifications. The downstream end of the private side sewer/lateral shall be plugged to isolate the private side sewer/lateral from the public side sewer/lateral stub and the building plumbing when water testing methods are employed.
- Low pressure air testing shall conform to the requirements of the WSDOT/APWA Standard Specifications. The downstream end of the private side sewer/lateral shall be plugged to isolate the private side sewer/lateral from the public side sewer/lateral stub and the building plumbing when low-pressure air testing methods are employed.
- Where a rehabilitated lateral/side sewer cannot be water tested or low pressure air tested, the pipeline shall be CCTV inspected for leakage at its connection point to the sewer main. The inspection for leakage shall be performed during the wet season when surrounding soils are fully saturated.
- On publicly funded rehabilitation projects, additional testing at the completion of the warranty period to establish the continued integrity of the side sewer/lateral shall be required. Since water testing or low-pressure air testing of side sewer/laterals after they have been put into service is problematic, visual inspection using CCTV shall be conducted as the most effective practical testing method available for confirming that warranty requirements have been met.

Potential Edmonds Impacts

- Possible additional cost and additional staffing requirements for acceptance and warranty testing verification.
- Possible additional construction cost to account for acceptance and warranty testing requirements.
- Potential additional cost to conduct CCTV Inspection and /or review inspection data at the end of the warranty period.

Potential Private Property/Ratepayer Impacts

- Increased permit costs for added testing requirements, as well as inspections, where standard requirements exceed current requirements.

TITLE: Manhole Leak Inspection

STANDARD NO. S-27

I/I CONTROL MEASURE ISSUE:
Several aspects of sewer manhole installation, if not properly designed and constructed, may result in infiltration entering the finished sewer system. Leakage inspection of the assembled manhole during the first wet season following construction is the best opportunity for verification that the manhole meets acceptable I/I criteria prior to being placed into service.
A final visual inspection for manhole leakage to confirm that as-built conditions have not degraded due to material failures, bedding or backfill settlement, or other causes needs to be performed at the end of the warranty period.

STANDARD

- Acceptance criteria following construction on new and rehabilitated manholes shall include a visual inspection to ensure that the manholes and connections to the manholes, as constructed, are watertight. Groundwater level shall be allowed to return to its normal elevation before performing the inspection. It is recommended that the visual inspection for manhole leakage be performed during the wet season when surrounding soils are fully saturated.

POTENTIAL EDMONDS IMPACTS

- Possible additional cost and additional staffing requirements for visual inspections.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potentially higher ratepayer costs for increased inspection requirements.

TITLE: Product Specific Inspection

STANDARD NO. S-28

I/I CONTROL MEASURE ISSUE:
Products used in sewer system construction for both new and rehabilitation improvements can fail and lead to I/I due to improper installation and/or the use of non-specified products being installed. Without inspection, there are no assurances the product installed is the one specified and installed properly.

Standard

- Product inspection is the visual verification of product test results and/or confirmation that an approved product is the one being installed, and that the sequence of construction or application is appropriate. Verify the approved product is being installed in accordance with approved specifications. This includes pipe, fittings, bedding, and rehabilitation products. It is important to distinguish the difference between inspection and testing. Those products covered under the testing standard shall have those tests performed to verify compliance.
- Pipe shall be inspected at the point of installation to verify that it has factory markings identifying the type and class of pipe. Unlabeled products will not be approved for installation.
- Pipe fittings shall be inspected at the point of installation to confirm they meet the specifications.
- Pipe bedding material shall be inspected at the time of installation to be appropriate for the type of pipe (flexible or rigid).
- For rehabilitation products, the manufacturer's recommended installation procedure shall be reviewed prior to installation. An installation list with references shall be provided documenting recent projects where the product has been installed. Contact references and document the installation and operational experiences with the product. Conduct any additional investigations determined necessary for approval of the product and installation. If through this review the product appears acceptable, the installation requirements shall be documented from the review process along with any testing requirements of the installation.

Potential Edmonds Impacts

- Added cost for increased inspection.
- Additional qualification investigation for proposed rehabilitation products.

Potential Private Property/Ratepayer Impacts

- Potentially higher ratepayer costs where product specific inspection is currently not being performed.

TITLE: Product Specific Inspection (Side Sewers)

STANDARD NO. S-29

I/I CONTROL MEASURE ISSUE:
Side sewer system products in both new and rehabilitation improvements can fail and lead to I/I due to improper installation and/or non-specified products being installed. Without inspection, there are no assurances the product installed is the one specified and was installed properly.

Standard

- Product inspection is the visual verification of product test results and/or confirmation that an approved product is the one being installed, and the sequence of construction or application is appropriate. All products being installed shall be inspected to verify the approved product is being installed in accordance with approved specifications. This includes pipe, fittings, bedding, and rehabilitation products. It is important to distinguish the difference between inspection and testing. Those products covered under the testing standard shall have those tests performed to verify compliance.
- Pipe shall be inspected at the point of installation to verify that it has factory markings identifying the type and class of pipe. Unlabeled products will not be approved for installation.
- Pipe fittings shall be inspected at the point of installation to confirm they meet the specifications.
- Pipe bedding material shall be inspected at the time of installation to confirm the material is appropriate for the type of pipe (flexible or rigid).
- For rehabilitation products, the manufacturer's recommended installation procedure shall be reviewed prior to installation. An installation list with references shall be provided documenting recent projects where the product has been installed recently. The Edmonds shall contact references and document the installation and operational experiences with the product, and conduct any additional investigations determined necessary for approval of the product and installation. If through this review the product appears acceptable, the installation requirements shall be documented from the review process along with any testing requirements of the installation.

Potential Edmonds Impacts

- Added cost for increased inspection.
- Additional qualification investigation for proposed rehabilitation products.

Potential Private Property/Ratepayer Impacts

- Potential for increased inspection costs.
- Possible extension of construction schedule to accommodate inspection requirements.

TITLE: CCTV Inspection

STANDARD NO. S-30

I/I CONTROL MEASURE ISSUE:
Television inspection of newly installed and rehabilitated sewers provides documentation of lateral connections, confirms pipe joints are properly pushed home, and identifies infiltration and internal defects.

STANDARD

- A complete internal television inspection shall be performed on newly installed and rehabilitated sewers. An audio-visual digital recording of the inspection, compatible with the City of Edmonds's existing audio-visual format, shall be retained by the City. The television inspection shall be conducted following trench backfill and compaction, cleaning and testing. Groundwater level shall be allowed to return to its normal elevation before performing the inspection.

POTENTIAL EDMONDS IMPACTS

- Additional camera equipment and inspection time would be required, unless contracted with an outside vendor.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Television inspection of the lateral ensures there are no internal defects, potentially reducing future private property owner maintenance requirements due to improper installation.
- Potentially higher ratepayer costs for increased CCTV inspection requirements.

TITLE: CCTV Inspection (Side Sewers)

STANDARD NO. S-31

I/I CONTROL MEASURE ISSUE:
Television inspection of newly installed and rehabilitated side sewers provides documentation of connections, confirms pipe joints are properly pushed home, and identifies infiltration defects and inflow sources.

STANDARD

- A televised inspection of the connection of new and rehabilitated lateral/side sewers to the sewer main shall be performed where the lateral/side sewer cannot be pressure tested. An audio-visual digital recording of the inspection, compatible with the City of Edmonds's existing audio-visual format, shall be retained by the City. If camera access through a lateral test wye cannot be provided, the video camera equipment shall have a separate side-casting camera that allows inspection of the lateral. The television inspection shall be conducted following trench backfill and compaction, cleaning and testing. If dewatering was required for side sewer installation, the groundwater level shall be allowed to return to its normal elevation before performing the inspection.

POTENTIAL EDMONDS IMPACTS

- Additional inspection time to CCTV the lateral/side sewer and connection would be required, unless contracted with an outside vendor.
- Equipment costs for new CCTV camera equipment capable of inspecting lateral/side sewers may be required, unless contracted with an outside vendor.
- An increase in lateral/side sewers costs will result if the City is currently not requiring the contractor to perform CCTV inspections.

POTENTIAL PROPERTY OWNER/RATEPAYER IMPACTS

- CCTV inspection requirements will increase the total cost of lateral/side sewer installations.

WARRANTY

TITLE: Certification, Warranty and Qualifications

STANDARD NO. S-32

I/I CONTROL MEASURE ISSUE:
Some new construction and/or rehabilitation products or application systems may not have a proven track record of performance, yet offer attractive benefits or low costs which merit their use. A product specific certification can be used to protect the City of Edmonds's investment.

Every construction or rehabilitation project requires a period within which defects in construction or materials should be allowed to become evident before the contractor, supplier or manufacturer ceases to have responsibility for the project. A stipulated warranty length can be used to protect the City's investment. Conventional construction products and methods should be warranted for a period of at least one year. Unconventional or newer products and methods could be warranted for a longer period, from 2 to 5 years, as determined by the City's Engineer.

A formal procedure for qualifying a manufacturer or contractor can be used to protect the City's investment. Qualifications information to be supplied during bidding may include a summary of the firm's history, itemization of a number of recent, similar projects with descriptions, amounts, names and experience of specific firm representatives, and names/phone numbers of owner references.

It is vital that the certification, warranty and qualification requirements and procedures be fully described in the contract documents to be enforceable with the contractors and suppliers.

STANDARD

- When a new construction and/or rehabilitation product or application system does not have a documented record of comparable prior successful installations, the supplier of the product or system shall be required to provide certification that the product or system will perform as specified.
- The certification shall provide for the complete replacement of the product or system by the contractor if the product or system is found to be defective when installed or applied by a certified agent of the manufacturer.
- Each new construction and/or rehabilitation project shall include a warranty period of at least one year. Longer periods may be stipulated as determined by the City of Edmonds based on the nature of the work.
- Testing requirements at the end of the warranty period shall be consistent with those used to determine initial project acceptance.
- The City of Edmonds may determine that specific qualifications for the manufacturer or contractor be included in the evaluation of bids received.

POTENTIAL EDMONDS IMPACTS

- Staff or consultant Engineer will need to spend time to research and develop a certification period as well as a means for determining compliance.
- Verification of certification requirements during the submittal process will be required.
- Inspection during construction to monitor installation/application will increase staffing requirements.
- Follow-up time by staff to monitor product or system performance may delay project completion and may increase staff requirements.
- Potential for additional project cost by manufacturer or contractor.
- Staff or consultant Engineer needs to determine appropriate qualification procedures.
- Staff or consultant Engineer needs to determine appropriate length of warranty period.

❖ Legal and engineering effort to establish acceptable pre-qualification requirements will be greater. ❖ Additional engineering and legal costs during design and bid periods are likely to occur.
POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS ❖ Potentially higher ratepayer costs for certifications and longer warranty periods.

TITLE: Bonding and Warranty Inspection

STANDARD NO. S-33

I/I CONTROL MEASURE ISSUE:
One critical element of a warranty is verification of the improvement prior to the end of the warranty period so that construction deficiencies can be accomplished and paid for via the performance bond. Thus the system can be repaired and I/I eliminated.

STANDARD

- A warranty period shall be established on publicly funded projects for each side sewer project, or for each project containing a side sewer construction component. This warranty period shall be a minimum of one year in length.
- All side sewer pipes shall be CCTV inspected after 80% of the warranty period has expired but before the end of the warranty period. Defective portions of the system shall be repaired to meet all applicable I/I standards.
- A written record shall be made of acceptance of the improvement with the date and results of the inspections and testing. This shall be submitted to the City of Edmonds prior to release of the performance bond.

POTENTIAL EDMONDS IMPACTS

- Additional CCTV inspection and enforcement of the warranty.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potential of added costs for inspections and verifications.
- Possible schedule delay to allow for verifications.

PUBLIC EDUCATION

I/I CONTROL POLICY ISSUE: **Community Education and Involvement –**

The I/I Control Program will result in the expenditure of public funds. There will be an array of inquiries, complaints, questions and suggestions from the general public, ratepayers, tenants and property owners. The manner in which these are tracked and resolved will have a major impact upon the public perception of the I/I Control Program. For acceptance as a necessary public program, members of the public will need to understand the purposes of the program, and its benefits to the community and to individual property owners and rate payers.

POLICY 1

The City of Edmonds shall create and promote educational programs to introduce the general public to I/I as an issue, to explain the potential benefits from I/I mitigation efforts, and to inform the public of their responsibilities related to the I/I problem. Educational/informational materials shall be designed to present issues in a format suitable for use by the general public. Materials prepared for King County's Regional I/I Control Program may also be utilized.

Explanation

- Public education is key to successfully addressing I/I from private property.
- The public's knowledge about storm and sanitary sewer systems and, in particular, I/I issues, is limited. Generating understanding of a program of this complexity is necessary in order to gain public support.
- An education program would explain the benefits of I/I reductions to:
  - the county-wide sewer system
  - the costs and benefits to the public, and
  - the benefits to private property owners.
- A central clearinghouse operated by King County is anticipated that would establish and publicize educational programs. Its operation is intended to help establish and maintain system-wide policies and standards.

Potential Edmonds Impacts

- The City could establish its own program or utilize the King County clearinghouse (once established).
- Using trained customer service representatives who use consistent approaches would buffer the City from dissatisfied individuals.
- It would allow for the wide distribution of contact information for I/I projects.

Potential Private Property/Ratepayer Impacts

- An awareness that changes in managing sewer and storm water are about to take place.
- Materials can be carefully tailored to areas with problems and geared to specific Edmonds needs.
- Ongoing Public Education – In order to maintain the rehabilitated sewer system, the property owner will need to be reminded of the importance of keeping major landscaping and buildings out of the utility maintenance easement area.
- Interested parties would not have to search for whom to contact regarding the work to be, or being, done on their property. It might reduce the frustration of dealing with a "bureaucracy". On the other hand, those who continue to be dissatisfied may turn to local political representatives or agency managers for more satisfactory relief.

I/I CONTROL POLICY ISSUE:	**Community Relations – Specific Project** **Community Education and Involvement**

I/I reduction projects will disrupt public and private property. There will be an array of inquiries, complaints, questions and suggestions from the general public, ratepayers, tenants and property owners. The manner in which these are tracked and resolved will have a major impact upon the perception of the I/I Control Program. For acceptance of specific I/I reduction projects, members of the public need to understand the purposes of the project, its benefits to the community and to individual property owners**.**

POLICY 2

For each specific I/I reduction project, the City of Edmonds shall be responsible for community education/involvement.

Explanation

- The City needs to be responsible for community relations, since it is most familiar with the specifics of the project and most aware of community concerns.

Potential Edmonds Impacts

- The City would implement the local design and implementation of project-related educational and community involvement material.
- Public education will have to be carefully tailored to areas with problems.

Potential Private Property/Ratepayer Impacts

- Individuals might feel that their elected local representatives would be more understanding and sympathetic to their concerns since materials are geared to their specific needs by the City.
- If an individual disagreed with a staff member's decision, a local problem resolution process may be more convenient and familiar.

FINANCING

I/I CONTROL POLICY ISSUE:	**Public Funding and Scope of Work**

The extent of public intervention and assistance in reducing or eliminating I/I from private properties will be shaped by a series of public policy choices. Some of the choices, like incorporating extensive surface and sub-surface restoration of private property, may require a series of adjunct policies. Other approaches may require only minor modification of local codes and regulations.

POLICY 3

Public funding shall be considered for all phases of I/I mitigation work on privately owned property. Funded work should include elements such as: permits, investigation, inspection and testing, any modifications to the side sewer connections and laterals, connections to public systems, restoration of disturbed areas (including landscaping, sidewalks, driveways, and rights-of-way) and post-rehabilitation testing and enforcement. Environmentally infeasible &/or prohibitively expensive modifications should be considered for variances/waivers.

Explanation

- Because maintenance and operation of the sanitary sewer system is for the public health and welfare, ensuring the elimination (or major reduction of) excessive I/I is usually considered a legitimate use of public funds.
- This alternative focuses on all types of private property, including residential commercial, and industry.

Potential Edmonds Impacts

- Given the expenditure required for public funding of an extensive program, the I/I Control Program would probably be initiated in selected mini basins (or smaller areas) with excessive I/I flow rates and with cost-effective solutions.

Potential Private Property/Ratepayer Impacts

- Property owners in a selected area would have to participate in this program.
- Utility rates would increase to pay for the I/I mitigation work; although substantial grant funding could reduce the burden on the local rate base.
- With full funding, issues such as constructing the program to accommodate economic hardship (of specific individuals as well as for customer classes such as those with fixed and low-income) would not be necessary.

I/I CONTROL POLICY ISSUE: **Rates, Incentives & Surcharges**

An effective I/I Reduction Program will be a significant additional expense to the City. Equitable means for generating the necessary funds should be considered.

POLICY 4

The City of Edmonds shall develop a funding mechanism for the I/I Reduction Program that includes a combination of adjustment to rates, addition of surcharges and/or incentives to property owners.

Explanation

- If I/I reduction is found to be necessary for a large part of the City, a dedicated rate increase could be adopted.
- For areas where I/I reduction is necessary but infeasible due to issues such as areas prone to flooding, unstable slopes, or lack of a storm water conveyance system, a surcharge to ratepayers in the area could be adopted, and the funds utilized in other areas of the sewer system.
- Incentivized programs could be developed where property owners could be reimbursed for installing City-approved I/I reduction measures.

Potential Edmonds Impacts

- Council action required to authorize the funding mechanisms; commensurate City staff time to develop recommendations.
- City staff time and costs to develop and manage any incentivized programs.

Potential Private Property/Ratepayer Impacts

- Ratepayers would see increased costs reflecting the additional expense to the City.

I/I CONTROL POLICY ISSUE: **Cost Sharing**

An effective I/I Reduction Program will be a significant additional expense to the City. Equitable means for generating the necessary funds should be considered.

POLICY 5

The City of Edmonds shall develop a funding mechanism for the I/I Reduction Program that includes a combination of City revenues coupled with funding from local (LID) and State sources, such as grants and loans.

Explanation

- City and property owners in an area slated for an I/I Reduction project could share costs by means of a Local Improvement District or similar structure.
- City and State could share costs of an I/I Reduction project or projects using existing State grant/loan programs such as Public Works Trust Fund, Centennial Clean Water Fund, etc.

Potential Edmonds Impacts

- City staff time and expense participating in LID.
- City staff time and expense (or consultant) in preparing appropriate grant/loan applications and administering resulting funds per State requirements.
- City staff time and expense in working with State agencies to modify grant/loan program rules allowing for I/I Reduction projects, as required.

Potential Private Property/Ratepayer Impacts

- Cost to property owners could be mitigated by appropriate cost-sharing for project implementation.

I/I DISCHARGE SITE CONDITIONS

I/I CONTROL POLICY ISSUE: **Stormwater Drainage Ordinance**

If storm water is diverted away from the existing sanitary sewer system, then alternatives may need to be found for the diverted storm water. Property owners and the City of Edmonds may need new options for surface and ground water drainage management.

POLICY 6

Where I/I work on private or public property results in the diversion of storm water drainage, and there exists a storm water system, then the I/I work shall involve meeting the provisions of the City's current "storm water drainage" ordinances. Jurisdictional approval must be obtained.

Explanation

- In areas with an existing public storm water management system, all drainage diverted from the sewer system could be discharged into the storm water system, provided that:
  - The jurisdiction controlling the public storm water system approves the connection; and
  - There are sound design options, capacity and gravity flow.

Potential Edmonds Impacts

- The capacity of the storm water system would have to be evaluated and a determination made regarding these new loads. Portions of the storm water systems may have to be upgraded. The costs for engineering analysis and design, construction and connections may be significant. Grants from the County's Surface Water Utility or the Public Works Trust Fund might help defray the cost of new and/or expanded storm water systems.
- This policy assumes that public funds for the removal of I/I would pay for the permits, engineering and other expenses associated with connecting storm water to a public system.

Potential Private Property/Ratepayer Impacts

- This will likely improve drainage and water intrusion problems for the affected homes and properties. The cost of the lines and connections to the storm water system will depend upon individual conditions.
- Potential increased storm water costs, including costs to connect to the storm sewer system.

I/I CONTROL POLICY ISSUE: **On-site Storm Drainage Management**

If storm water is diverted away from the existing sanitary sewer system, then alternatives may need to be found for the diverted storm water. Property owners and the City of Edmonds may need new options for surface and ground water drainage management.

POLICY 7

Where I/I work on private property results in the diversion of storm water and an adequate storm water system does not exist, then the private property owner bears responsibility for discharging the storm water drainage to an appropriate location.

Where I/I work on public property results in the diversion of storm water and an adequate storm water system does not exist, the City of Edmonds bears the responsibility for discharging the storm water drainage to an appropriate location.

EXPLANATION

- Connecting residential storm water systems to the public sewer system is illegal. Therefore, illicit connections should be removed.
- Properties with impermeable and semi-permeable surfaces have storm water drainage requirements. For example: most roofs and driveways, lawns and hard packed soils don't allow for storm water absorption, retention or evaporation. Alternative practices can be used to reduce or eliminate the need for off site storm water systems. For example:
  - Surface and ground water drainage can be collected and directed to location(s) on the property where the water can drain into the ground by means of an energy dissipation basin (French drain). The feasibility and effectiveness of such systems depend upon its design, lot size and topography, soil type and local area conditions. The complexity of energy dissipation basins will also depend upon local conditions and drainage requirements.
  - Poor maintenance can increase and exacerbate storm water problems. Tree limbs that overhang houses tend to increase the need for gutter and drain line cleaning/maintenance. Improper soil drainage at the perimeter of structures can increase basement and crawl space flooding.
  - Special landscaping practices can increase storm water absorption and retention.
  - Roofs with a planted sod layer can hold and evaporate storm water.
  - Driveways can be made out of porous pavers and other materials that allow for water absorption.
  - Rain barrels and cisterns can be used to recycle storm water for gardening and some domestic use.
  - Ponds can be used to hold and evaporate storm water.

POTENTIAL EDMONDS IMPACTS

- Design and construction review may be required. As a first measure, this could be a lower cost alternative for the City than side sewer repair. If properly designed, constructed and inspected, once in place, there would be little impact.
- Reduction of storm water flow into the sanitary and storm water system.

Potential Private Property/Ratepayer Impacts

- Appropriate management of storm water flow on private property could have direct benefits to the homeowners and the public sanitary and storm water systems, such as:
  - Proper use of on-site storm water management systems would likely result in dryer homes, basements and crawl spaces.
  - Dryer homes tend to have fewer problems with wood destroying organisms, mold and mildew. Dryer homes have longer lasting furnaces, roofing and interior surfaces.
  - Many of the defects that are likely to be found in such inspections have low cost and low impact solutions. Such on site systems usually don't require extensive digging or interference with decks or in-ground systems such as water lines or oil tanks.
  - When properly designed, they require a modest amount of maintenance.

I/I CONTROL POLICY ISSUE: **On-site Storm Drainage Management**

If storm water is diverted away from the existing sanitary sewer system, then alternatives may need to be found for the diverted storm water. Property owners and the City of Edmonds may need new options for surface and ground water drainage management.

POLICY 8

Where an I/I reduction project results in the diversion of storm water drainage (e.g., removal of illicit connections), and the modifications required to properly discharge the storm water are deemed to be infeasible &/or prohibitively expensive (for the property owner), consider giving the property owner a choice of disconnection of illicit connection or surcharge.

Explanation

- Connecting residential storm water systems to the public sewer system is illegal. Therefore, illicit connections should be removed. However, if re-routing the storm water drainage, to either a public storm water management system or another appropriate location is deemed infeasible &/or prohibitively expensive (for the property owner), the alternative of a surcharge may be offered.

Potential Edmonds Impacts

- If a property owner chooses to pay a surcharge, rather than to disconnect an illicit connection, utility rate revenue will increase.
- Additional administrative processes will be necessary.

Potential Private Property/Ratepayer Impacts

- A private property owner with an illicit connection may have the opportunity to reduce the cost of compliance.

PRELIMINARY ENGINEERING

I/I CONTROL POLICY ISSUE: **Contractor Qualifications**

A critical success factor for reducing I/I is to make sure contractors have experience using acceptable materials and skilled labor resources to perform construction and I/I rehabilitation of public sewer systems. One way to assure the qualifications of the contractors is through a review of their past performance and bonding and financial ability, and of the experience of their key supervisory staff. Contractor qualifications often become an issue during the selection process on public projects since the primary basis of award is "Low Bid".

POLICY 9

The City of Edmonds shall develop in the bid specifications specific minimum experience requirements for contractors to ensure that the contractor hired will have experience in the type of work they are to perform.

Explanation

- The ability to require contractors to meet certain minimum experience conditions can result in better I/I reduction projects.
- Prior experience with specialized sewer technologies is necessary to ensure correct handling and application of these technologies. Prior experience with construction such as tunnels, systems restoration/rehabilitation, and deep excavation is also necessary.

Potential Edmonds Impacts

- Assures higher quality work coupled with realistic bids and less chance for disputes.

Potential Private Property/Ratepayer Impacts

- Assurance of quality systems, lower potential for future repair/replacement.

I/I CONTROL POLICY ISSUE:	**I/I Reduction Projects – Permits**
Permits and conditions are usually required on I/I reduction projects. Responsibility for obtaining these permits can vary.	

Policy 10

The City of Edmonds shall obtain all permits feasible, including the SEPA, HPA, 404, or other State or Federally required permits. The contractor shall obtain permits as detailed in the specifications such as the building, road or utility, ROW use, &/or clearing and grading permits. The permits required to be obtained by the contractor shall be specifically listed in the bidding documents.

Explanation

- Several permits may be required for work on I/I reduction projects. Project environmental permits should be obtained by the City, while permits such as building, utility and ROW should be obtained by the contractor.

Potential Edmonds Impacts

- The City would be responsible for obtaining those permits not specifically related to construction as part of its administrative duties.
- Potentially higher program cost.

Potential Private Property/Ratepayer Impacts

- Permits and conditions associated with permits help assure that public concerns and issues are addressed and mitigated.

CONSTRUCTION AND INSPECTION

I/I CONTROL POLICY ISSUE: **Rehabilitation Planning and Oversight – Inspection and Testing**

Initial and follow-up inspection and investigation of the condition and installation of public sewer lines and private sewer and storm drainage connections is a key to ensuring that neither inflow nor infiltration is occurring. The type and extent of inspection and investigation could vary depending upon the focus, extent and the approach selected to remove I/I from privately owned property and public sewer lines.

POLICY 11

The City of Edmonds shall provide training opportunities on the I/I Control Program to its representatives. The training material will include a checklist of guidelines for best practices and the adopted I/I Control Standards, Procedures & Policies. The City's efforts should be coordinated with training provided by King County (as available) under its Regional I/I Control Program.

Explanation

- Because inspections are such an integral part of controlling I/I from private property, specially trained staff would ensure that the inspections occur with consistency and uniformity.
- The inspections could include a variety of tasks, such as: checking all connections, testing all lines, verifying the functionality of on-site and/or off-site storm drainage management, and ensuring restoration of sidewalks, driveways and rights of way.

Potential Edmonds Impacts

- Adequate staff time for training. Side sewer permits would be expanded to include the entire residential drainage system.
- Coordination between areas of responsibilities would be key, for example, building permits and sewer permits; inspectors and paving crews; sewer maintenance/storm water maintenance and inspectors; and inspectors and maintenance, engineering and CIP personnel.

Potential Private Property/Ratepayer Impacts

- The property owner's contractor would remain responsible for ensuring work performed on private residential property meets code and has been "signed off" by the City's "I/I Control Inspector".
- The cost of this expanded inspection and testing service could be included in the City's base rate or within a newly created I/I rate component.

I/I CONTROL POLICY ISSUE:	**Post-Rehabilitation Management – Restoration**

Many of the private property I/I mitigation options can interfere with private property conditions, especially buildings, site work and landscaping. Restoration of these disturbed areas could be expensive and complicated. A poorly understood or badly managed restoration policy and program could lead to significant public distrust, concerns, and problems. A policy is required that outlines the roles, responsibilities and any limits on such restoration work.

POLICY 12

If confirmed by legal counsel.

The City of Edmonds shall establish a standard for property restoration before initiating any I/I work (including landscaping, sidewalks, and driveways). Public property restoration is governed by City of Edmonds codes and ordinances.

Options can include:

1 – "Restoration as near as possible to pre-construction condition"
2 – "Basing value on restoration to as near as possible to pre-construction condition, consider up front property owner payment with signed waiver"

Explanation

- Some amount of restoration of private properties would be part of the I/I reduction program.
- Prior to the start of any I/I work, the property would be inspected and photographed, and relevant improvements and conditions would be thoroughly documented.
- The public funds used for this purpose would compensate for all of the agreed-to restoration work or up-front payment in recognition of the public benefits derived from the I/I program.
- Since certain plant/vegetation types are not easily restored, a "restoration to pre-construction condition" standard is not always possible.
- Disagreements would use the preferred method as chosen from the alternatives under Policy 2.

Potential Edmonds Impacts

- A more complex program that recognizes the impact of the I/I program upon private property.

Potential Private Property/Ratepayer Impacts

- Impacted Property Owners – Depending on the choice made, property impacts could be small to large, but property owner would receive rehabilitated side sewer.
- Ratepayers – Increases the cost of the I/I Control Program and therefore might result in higher rates.

WARRANTY

I/I CONTROL POLICY ISSUE:	**Contractor Bonding, Licensing and Warranty**

POLICY 13

The City of Edmonds shall be responsible for ensuring that, for publicly funded I/I reduction projects, the construction contract includes appropriate bonding, licensing, insurance, and warranty provisions to ensure satisfactory completion of the project and warranty of the project for a sufficient amount of time (recommended minimum 12 months).

EXPLANATION

- Contractors for public projects must be licensed, bonded and insured. For publicly funded projects, agencies generally establish standards for contractor bonding, end of project retainage, and warranties that ensure the completed facilities will continue to function as intended for a reasonable period of time.
- A schedule of required contractor warranties would be established at the beginning of a project. For example, pipe performance would have a longer warranty requirement than pumps.

POTENTIAL EDMONDS IMPACTS

- A "retainage" could be required to be held back after "substantial completion" of the work. The retainage would be released once all punch list items have been completed and final inspections performed.
- Bonding, retainage and warranties reduce the likelihood of poor work and future maintenance/repair requirements.
- All contractors could be required to maintain a performance bond equal to a pre-determined percentage of the project cost.
- Such standards increase contractor costs and prices.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Higher up front costs, but lower maintenance costs.
- Better quality control of the I/I work.
- Any allowed "do it yourself" work would most likely not be subject to bonding or warranty requirements.

PRIVATE PROPERTY / LEGAL

I/I CONTROL POLICY ISSUE: **Rehab Planning, Oversight, Inspection, Monitoring and Testing – Right of Entry**

With specific exceptions, individuals cannot enter or alter property owned by another individual without explicit permission (authority for utility representatives to access private premises for the purpose of inspecting and determining code compliance can be legislated for public health and welfare). Yet initial follow-up and inspection of the condition and installation of public sewer lines and private sewer and storm drainage connections is a key to ensuring that I/I is not occurring. New standards need to be developed to ensure that the system remains intact and maintained. The right of entry for purposes other than verification of code compliance usually requires either a written agreement between the public entity and the private property owner or a notice of potential legal action.

POLICY 14

The City of Edmonds shall pass the necessary ordinances/resolutions and develop the appropriate access agreements that allow its agents to gain access to private property, such as a right of entry or a construction and inspection easement. These agreements will allow certain actions related to I/I reduction and control, such as conducting a side sewer and/or lateral inspection; construction rehabilitation; or conducting code enforcement activities.

EXPLANATION

- The right of entry to verify code compliance is usually limited in several ways, the most basic of which is that entry must occur at reasonable times. This and other limiting provisions listed below may be adopted by the City's administration.
  - Entry only by individuals with "proper" identification;
  - Entry only with prior notice;
  - Entry only with written information regarding the nature of the inspection and with the findings of the investigation (notice of non-compliance with specific portions of the code; notice of remedies and/or potential penalties).
- The method(s) used for code compliance enforcement, inspection and testing or monitoring is not implicitly or explicitly included in this basic right of entry.
- Right of entry agreements, easements and legal notices will vary in complexity and scope of action though with legal advice some basic policy procedures can be drafted and used in routine actions. Unique agreements would be drafted for complex or unusual situations. General delimiters for access agreements include scope of public action, result of property damage or personal injury, and hold harmless and indemnification provisions. Administrative use of these legal instruments depends upon the authority granted by the Edmonds City Council.

POTENTIAL EDMONDS IMPACTS

- Allows the flexibility for the City to select and implement its preferred programmatic approach (e.g., all new side sewers could be located in an easement area that allows for future entry by the City to perform inspections and work without a separate right-of-entry agreement; side sewer permits could be expanded to include the entire residential drainage system).
- The City may undertake different actions according to its I/I reduction projects and applicable local regulations. Since most municipalities' codes allow only sewerage to enter the sanitary sewer system, using the basic right of entry to investigate code compliance could be the first

action to control improper inflow from private property. Once the initial I/I control remedies are in place, periodic investigation of code compliance may involve increased resources such as: inspectors, code compliance officers, engineers and/or attorneys. Record keeping would be crucial to track follow-up actions and inspection schedules.

- Utility storm water and sanitary sewer codes may have to be amended to include right-of-entry authority.
- The ease or difficulty of obtaining specific right-of-entry agreements or easements will depend on the property's I/I contribution to the system and the Policies and Standards of the I/I Control Program, e.g., the scope of work or the amount of restoration.
- Coordination between areas of responsibilities would be key, e.g., building permits and sewer permits; building and utility inspectors; maintenance, engineering and CIP personnel.

Potential Private Property/Ratepayer Impacts

- Many individuals may not realize that municipal representatives have the authority to enter their property to perform code compliance inspections. Municipal employees and legislators may have to cope with a range of reactions from accommodation to active resistance. These actions can be anticipated and a plan of action established.
- The types of private improvements (and landscaping) in the easement area should be restricted to simplify and standardize any future side sewer work and to prevent side sewer deterioration. There should be restrictions to the property owner making changes in side sewer location when remodeling occurs.
- For new construction the residential property owner's contractor would remain responsible for the work performed meeting code, and that it is "signed off" by the City's inspector.
- The cost of permits could increase to cover the increased intensity of service or the cost could be absorbed within the general residential rate base.

I/I CONTROL POLICY ISSUE: **Rehabilitation Planning and Oversight – Liability**

All phases of the I/I work on privately owned property could create liability issues. Some liability issues such as negligence, are a recognized concern. Side sewer and other excavation on private property may result in some special liability issues. The standards of work and documentation of conditions on private land are more varied than those found on public property and public right-of-ways. Potential liability matters may be limited in various ways.

POLICY 15

If public resources support any portion of the I/I reduction work on privately owned property, then the City of Edmonds shall establish a process to manage and limit its liability. The potential site and in-ground liability issues shall be a part of the I/I planning and design process, including an up-front agreement on when the jurisdiction's liability will begin and end.

Explanation

- When digging on private land, various types of unexpected conditions and systems are likely to be found, for example: underground oil tanks and contaminated soils, sprinkler systems and water lines, “invisible” dog fences, non-conforming in-use wells and septic systems, electrical and data cables, etc. Some of these conditions and systems are likely to be found in the areas of any side sewer work and pose a liability issue to the homeowner, contractor, governmental agency and/or the general public.
- Field reports suggest that about 25% of oil tanks leak. If contaminated soil is found during an excavation, then remediation is required and the issue of liability would have to be addressed.

Potential Edmonds Impacts

- Pre-digging protocols such as inspections to identify underground infrastructures and/or contaminated soil could reduce the potential liability disputes and costs.
- Resolution of disputes may become an issue that will need to be addressed by City staff and/or their attorneys.
- The City will *need to work closely with the homeowners, no matter what.*

Potential Private Property/Ratepayer Impacts

- Property owners may refuse permission to inspect or test for potential liability issues and might prefer not to know about such issues.
- Property owners may end up having to address the problem of soil contamination.
- Property owners will desire that the work minimize disruption to existing property improvements and landscaping.

I/I CONTROL POLICY ISSUE:	**Legislative Action Requirements**
In order to implement effective I/I reduction on private property, specific building codes enacted at the State level may need to be amended.	

POLICY 16

The City of Edmonds shall work to develop amended Statewide building codes to facilitate the implementation of effective I/I reduction measures.

Explanation

- Certain Statewide building codes, such as the State Plumbing Code, allow for items such as sump pumps and footing drains to be installed within the footprint of the building and do not specify where the resulting water is to be discharged. Code language may need to be amended to require discharge to a storm sewer (non-sanitary) system or location.

Potential Edmonds Impacts

- City staff time and expense working with the State Legislature and Trade Organizations.
- City expense could be reduced and message more effectively delivered through MWPAAC.

Potential Private Property/Ratepayer Impacts

- Additional cost to the property owner as reflected in developer/contractor costs.

]

I/I CONTROL POLICY ISSUE: **Side Sewer Ownership and Responsibility**

In Edmonds, side sewers are owned by the City from the sewer main to the property line, and by the property owner from the property line to the building connection. This can cause reduced effectiveness in a long-term I/I reduction program and could be modified by several options.

POLICY 17

The City of Edmonds shall assume ownership and/or responsibility for each side sewer from the sewer main to the point(s) of connection at the building.

EXPLANATION

- With the City having overall ownership and/or responsibility for the entire side sewer assembly from building to main, more effective construction inspection/oversight, as well as ongoing operation and maintenance, will increase the likelihood that long-term I/I reduction can be realized.
- Enabling legislation by the City Council and cost or other compensation for assuming ownership will be required.

POTENTIAL EDMONDS IMPACTS

- If ownership is assumed, additional compensation to property owners would be required.
- Increased City staff time and expense (or consultant) for side sewer installation inspection/oversight.
- Increased City staff time and expense to set up and maintain a long-term O&M program.
- More effective operation of the sewage conveyance system.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Increased access by City representatives on private property.
- Potential for increased costs due to increased O&M by City.
- Potential for reduced liability to property owner.

TITLE: Modeling and Engineering Analysis

GUIDELINE NO. G-1

I/I CONTROL MEASURE ISSUE:
Following the completion of the Edmonds sewer system modeling performed previously, the modeling basins should be reevaluated on a regular basis with updated flow and system network information to provide an ongoing tool for monitoring the integrity of the sewer system as it both ages and expands. Hydraulic models can also be used to evaluate system response to potential high-flow sources such as high-water-use industries, adjoining jurisdictions, or large developments.

GUIDELINE

- Sewer system modeling should be conducted on a regular basis to assess system loading and capacity for ongoing and future sewer planning efforts. A dynamic software modeling program should be used that can be used to calibrate measured flow data with rainfall measured during the corresponding storm. Flow data shall be obtained by the City of Edmonds, including measurement of wet-weather/storm conditions and concurrent rainfall data.
- Development of a reliable, well-calibrated model requires good as-built plans and maps, and long-term flow monitoring data. The City shall maintain an as-built record for new and modified piping.

POTENTIAL EDMONDS IMPACTS

- Competency of staff in computer modeling and interpretation, or outsourcing to a consultant on a periodic basis.
- Proactive planning and logistics for maintaining an as-built database.
- Purchase of license for a sewer software model, or cost to develop alternative model.
- Cost for training and operation of model by City staff.
- Expense for flow monitoring equipment and staff, whether purchased or leased/rented on a periodic basis.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Lateral and Side Sewer Rehabilitation Methods

GUIDELINE NO. G-2

I/I CONTROL MEASURE ISSUE:

Once the decision has been made to rehabilitate laterals or side sewers to control I/I, several alternatives may be used to replace or rehabilitate the pipe. These include trenchless rehabilitation techniques such as cure-in-place lining or pipe bursting, as well as conventional dig and replace. An evaluation should be made to determine suitability (technical and cost-effectiveness) of trenchless methods versus conventional dig and replacement of the sewer. The technical evaluation should assess specific issues such as the sewer location and length, alignment, condition of the pipe being replaced, assessment of the surface features that would be disturbed by construction, and the degree of root intrusion in the existing lines. The alternative pipe rehabilitation methods that should be considered include:

Pipe bursting is a trenchless pipeline rehabilitation method that can be used to replace side sewer pipes. Illicit connections are eliminated by removing the connection to the side sewer. It is possible to increase the size of the pipe; however, site specific constraints may limit the ability to increase the size. Using pipe bursting to replace a pipe may be restricted depending upon adjacent utilities, proximity to surface improvements, the type of existing pipe being replaced, and soil conditions. There are a number of variations on pipe bursting, such as pneumatic, hydraulic expansion, and static pull systems. All of these displace the old pipe into the adjacent ground and pull a new pipe in to replace the old pipe. There are also related processes such as pipe reaming, which is a variation of horizontal directional drilling, where pieces of the old pipe are removed rather than pushing them into the adjacent soil. The most common pipe material used is HDPE, but other types of pipe material such as cast iron, MDPE, and ABS can be used for the replacement pipe. Pipe bursting of side sewers will require excavation of at least two pits for insertion and pulling. Generally, pipe bursting is suitable for straight sections. If there are buried bends on the side sewer it may require additional pits to be excavated for installation of the replacement pipe.

Cure-in-place pipe (CIPP) liner is a trenchless pipeline rehabilitation method that can be used to repair existing side sewer pipes. CIPP liner involves inverting an epoxy-resin-impregnated flexible tube into an existing line using hydrostatic head. The resin is then cured using heat to produce a pipe inside the existing side sewer. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size.

Fold and form lining is a trenchless pipeline rehabilitation method that can be used to repair existing side sewer pipes. The fold-and-form process involves inserting a heated PVC or HDPE thermoplastic liner, folded or deformed into a U-shape, into an existing side sewer and re-rounding the liner using heat and pressure to produce a pipe inside the existing pipe. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size.

GUIDELINE

- Construction standards for pipe bursting, cure-in-place lining and folded and formed liners shall be as follows:
- Pipe Bursting:
  - Pipe bursting shall meet the requirements of the City's Inflow and Infiltration Control Program Guide Specifications.
- Cure-in-Place Lining:
  - Cure-in-place-lining shall meet the requirements of the City's Inflow and Infiltration Control Program Guide Specifications.
- Fold and Form:
  - Fold and form-lining shall meet the requirements of the City's Inflow and Infiltration Control Program Guide Specifications.

- Testing and Inspection:
  - The rehabilitated side sewer/lateral from the inspection wye/cleanout at the building foundation to the main side sewer/lateral pipeline shall be tested in accordance with the I/I Side Sewer/Lateral Leak Testing Standard S-20, and shall be television inspected in accordance with the I/I CCTV Inspection Standard S-25 after completion of the repairs and backfilling of the pipe trench.

POTENTIAL EDMONDS IMPACTS

- Added cost to perform inspection and testing.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Added cost for inspection and testing of private sewer lines.

TITLE: Pipe Protection-Depth of Cover

GUIDELINE NO. G-3

I/I CONTROL MEASURE ISSUE:
Shallow buried flexible pipe is susceptible to damage from heavy live loads and construction loads. Deeply buried flexible pipe is susceptible to damage from heavy soil loading. Pipe type, class, and the quality of the pipe bedding installation are especially important for flexible pipe buried less than 3 feet deep and greater than 15 feet deep beneath a general fill. Standard industry practice based on load testing, engineering analysis and field experience is to maintain a minimum cover over flexible pipe of 3 feet to avoid damage from heavy live loads and construction loads. Burial depths greater than 15 feet create soil loading conditions that exceed the capacity of flexible pipe unless extremely careful attention is paid to pipe bedding installation.

GUIDELINE

- Depth of cover over flexible pipe should be 3 feet minimum and 15 feet maximum. Where the depth of cover over a pipe is less than 3 feet or exceeds 15 feet, follow pipe manufacturer's recommendations for pipe material type and class, pipe installation procedures, bedding and backfill.
- Testing and inspection: Full time inspection of pipe bedding operation should be performed on flexible pipe installations over 15 feet.

POTENTIAL EDMONDS IMPACTS

- Inspection of bedding operations to ensure proper installation is especially critical for deeply buried flexible pipe.
- Inspection costs would go up if the City is currently not continuously inspecting bedding placement for deeply buried flexible pipe.
- Review of supporting calculations would be required when flexible pipe is used for installations over 15 feet.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Construction costs for deeply buried pipe may increase moderately, thus increasing costs to ratepayers.

TITLE: Manhole Rehabilitation

GUIDELINE NO. G-4

I/I CONTROL MEASURE ISSUE:
Manhole rehabilitation can be used to eliminate sources of both infiltration and inflow directly into the structure where the rehabilitation is determined to be more cost effective than replacement of the manhole. There are a variety of rehabilitation techniques, including manhole grouting, cementitious spray-on lining, epoxy linings, manhole inserts, and cure-in-place liners. Many of the methods provide benefits other than just I/I reduction such as protection from internal corrosion due to hydrogen sulfide. Manhole rehabilitation for I/I reduction may also include replacement of manhole rings or replacement of the ring and cover.

GUIDELINE

- When a manhole is rehabilitated for I/I reduction, consideration should be given to factors that contributed to the current condition and whether the selected rehabilitation technique will prevent the potential recurrence of I/I. Rehabilitation techniques include spray on coatings, cure-in-place linings, chemical grouting, or a rigid liner installed within the existing manhole. Coatings, linings and chemical grouting for manhole rehabilitation shall meet the requirements of the City's I/I Control Program Guide Specifications.

POTENTIAL EDMONDS IMPACTS

- Inspection requirements to confirm that the manhole preparation and rehabilitation is done correctly.
- Potential surface disruptions resulting from construction of the rehabilitation.
- Costs to test the completed manhole rehabilitation.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Potential inconveniences resulting from rehabilitation construction activities.

TITLE: Spot Repairs

GUIDELINE NO. G-5

I/I CONTROL MEASURE ISSUE:
Pipeline spot repairs are repairs to specific deficiencies in a pipeline, such as a specific leaking pipe joint. These repairs can be a cost-effective way to eliminate I/I in sections of a pipeline that are sound except for a few point locations. Only those specific deficiencies in the pipeline are repaired. In general, in pipeline sections that require three or more spot repairs, it is often more cost-effective to consider the entire manhole-to-manhole run of pipe for rehabilitation or replacement.

GUIDELINE

- Spot repairs can be accomplished by several different methods from trenchless systems like short CIPP liners, to injecting epoxy resins or chemical grout into leaking pipe joints, to dig and repair with structural grouting sleeves or short sections of pipe replacement. The repair method shall address whether the defect is structural or limited to an intact leaky joint. Spot repairs may be needed to properly prepare the line for some of the manhole-to-manhole rehabilitation/replacement options.
- For a dig and replace spot repair, the section of the sewer main shall be removed to the nearest joint and replaced with new pipe. The new section of pipe shall be installed with repair couplings meeting the City of Edmonds's approval but in any case shall provide a water tight repair.
- Trenchless spot repairs shall meet the I/I standard for the particular rehabilitation method used.
- If SSES reveals there are 3 or more defects that require repair on a manhole to manhole run of sewer main, it is recommended that the entire run of sewer be evaluated for rehabilitation or replacement.

POTENTIAL EDMONDS IMPACTS

- The costs associated with testing and inspecting the spot repair.
- Surface disruptions from construction activities may inconvenience the public.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- No impact.

TITLE: Spot Repairs (Side Sewers)

GUIDELINE NO. G-6

I/I CONTROL MEASURE ISSUE:
Private side sewer spot repairs are repairs to specific deficiencies in a side sewer pipe, such as a specific leaking pipe joint. These repairs can be a cost effective way to eliminate I/I in sections (generally cleanout-to-cleanout that show damage) of a side sewer that are sound except for a few point locations. Only those specific deficiencies in the side sewer are repaired. In sections with numerous spot problems or with other mitigating factors such as age, the entire side sewer is a candidate for complete rehabilitation or replacement.

GUIDELINE

- As a precursor to doing spot repairs, the City of Edmonds shall assess the age and material of the side sewer to determine if it should be completely replaced rather than allow spot repairs. If a side sewer is over 50 years old, it should be completely rehabilitated or replaced from the building to the public right-of-way.
- Spot repairs can be accomplished by several different methods from trenchless systems like CIPP liners, injecting epoxy resins, or chemical grout, to dig and repair with structural grouting sleeves or short sections of pipe replacement. The repair method shall address whether the defect is structural or limited to an intact leaky joint.
- For a dig and replace spot repair, the section of the side sewer shall be removed to the nearest joint and replaced with new pipe meeting the requirements of the I/I Pipe Materials Guideline G-6. The new section of pipe shall be installed with approved repair couplings.
- Trenchless spot repairs shall meet the I/I standard for the particular rehabilitation method used.
- Inspection wye/cleanouts shall be installed on the side sewer per Standard Detail SS-1as part of the spot repair.

POTENTIAL EDMONDS IMPACTS

- Cost of installing the inspection wye/cleanout if none exists.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Added cost will be incurred if no inspection wye/cleanout exists in the system.

TITLE: Manhole Lids/Inserts

GUIDELINE NO. G-7

I/I CONTROL MEASURE ISSUE:
Older style manhole covers may contain numerous pick holes that allow inflow into the collection system during storm events. Old and new manhole covers are both susceptible to inflow through or around the cover if water ponds over the cover. Eliminating this source of inflow will reduce excess flow from entering the system. Replacing the cover with a new cover will reduce or eliminate this source of inflow.

GUIDELINE

- Manhole covers that have been identified through an SSES as being susceptible to inflow may be replaced with a gasketed solid cover or just the ring or cover may be replaced if it is determined to be the source of the problem.
- In lieu of replacing the cover a manhole insert may be installed under the existing cover to eliminate or reduce the volume of inflow that enters the sewer. Manhole inserts are metal or plastic pans installed just under the manhole cover and are supported by the manhole ring. All materials used in the manufacture of manhole inserts shall be plastic or stainless steel in accordance with Standard Detail MH-3.

POTENTIAL EDMONDS IMPACTS

- Installation will be disruptive to traffic if the manhole is located in a street.
- Minor additional cost for using solid, gasketed covers.

POTENTIAL PRIVATE PROPERTY/RATEPAYER IMPACTS

- Possibly traffic inconveniences during the ring and cover replacement.