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Seattle Public Utilities

Henderson CSO Reduction Project
Flow Monitoring Report
January 2008 through May 2009

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ACRONYMS

CSO	Combined sewer overflow
DWF	Dry weather flow
EPA	Environmental Protection Agency
fps	Feet per second
ft	Feet
GIS	Geographic Information System
in	Inches
MG	Million gallons
mgd	Million gallons per day
MH	Maintenance hole
MP	Monitoring point
NAVD88	North American Vertical Datum of 1988
NPDES	National Pollution Discharge Elimination System
QA / QC	Quality assurance / quality control
QAPP	Quality Assurance Project Plan
RG	Rain gage
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedure
SPU	Seattle Public Utilities
WWW	Wet weather flow

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1.0 Executive Summary

This Flow Monitoring Report describes the results of flow monitoring within the Henderson Area. Flow monitoring was conducted as part of the Henderson CSO Reduction project. The goal of the Henderson CSO Reduction project is to design and construct CSO reduction facilities and reduce CSOs from NPDES basins 44, 45, 46, 47, 48, 49 and 171 down to one overflow per site per year on average.

In support of this goal, the flow monitoring program for the Henderson Area assisted in the characterization of the combined sewer system and existing facilities. The objective of the flow monitoring program was to characterize the performance of the combined sewer system and existing facilities before, during, and after storm events regardless of their overflow status.

The Henderson Area occupies approximately 1,830 acres in southeast Seattle adjacent to Lake Washington, with Seward Park at the basins' north end. The basins are bisected east-west by Henderson Street and north-south by Rainier Avenue South. The basins are divided into two areas; Henderson North is the area north of Henderson Street and Henderson South is the area south of Henderson Street. The basins consist of CSO basins 44, 45, 46, 47, 48, 49 and 171.

To achieve the flow monitoring program objectives, 24 temporary monitors were installed and maintained from January 2008 through May 2009 throughout the basin. Additional data came from the following sources:

- 11 Seattle Public Utilities (SPU)-maintained permanent flow monitors installed at each of the CSO basin overflow structure – Some CSO basins contain more than one CSO structure.
- Flow monitoring data from three King County flow monitors located in the area at maintenance holes (MHs) 080-334, 080-368 and 080-358
- Supervisory control and data acquisition (SCADA) data from SPU Pump Station 9 and Pump Station 10
- SCADA data from King County's Henderson Pump Station and Henderson Trunk / MLK Tunnel facility
- Precipitation data from SPU's Rain Gages 10, 18 and 30
- Precipitation data from King County's Rain Gage SKY1

Flow from the Henderson Area is conveyed to the King County Metro system through the King County Henderson Pump Station and Henderson Trunk / MLK Tunnel facility.

During the 17 months of monitoring, there were 48 rainfall events that included:

- Two 2-year storms
- Four 1-year storms
- 20 storms between 2 months and 1 year

Of these, ten storms have been recommended as model calibration storms, and five are available for model validation.

The rainfall that fell during the monitoring period is representative of the historical period and data quality from the flow monitors, and SCADA data is sufficient to support hydraulic modeling. The combination of availability of usable rainfall events with usable flow monitoring data greatly increases the accuracy of the calibrated model.

In addition, the following findings are noted from the data or through field investigations resulting from the project.

- Fifty-two separate combined sewer overflows occurred during the flow monitoring period. Most of these occurred at Outfall 44, specifically at CSO structure 44B.
- Lake flow entering the system at 45A between mid-April 2009 and mid-May 2009 may impact flow measurements for basin characterization and model calibration at downstream monitors 081-059 and 081-085.
- HydroBrake stage-discharge curves were developed for four of the five HydroBrakes. The only HydroBrake where a stage discharge curve was not developed was the HydroBrake in NPDES basin 171 at MH 081-231. A new temporary monitor downstream of the HydroBrake was installed at MH 081-229 on June 24, 2009. The Manufacturer's Curve will be used in the hydraulic model at this location until sufficient data have been collected so that a stage-discharge curve can be developed.
- The HydroBrake in Basin 44 (067-272) exhibited inconsistent performance during the monitoring period. The HydroBrake performance varied from more restrictive to less restrictive. This behavior makes it difficult to mimic the performance of this HydroBrake in the hydraulic model.
- In general, available storage is used efficiently, completely filling before overflows are allowed to occur. Frequent overflows at CSO structures 47B and 171 indicate that the storage facility (CSO Facility #5) for those basins is undersized.

2.0 Introduction

2.1 Background & Purpose

The City of Seattle (City) has a National Pollutant Discharge Elimination System (NPDES) permit for its Combined Sewer Overflow (CSO) outfalls. In accordance with the NDPES permit and state law, the City is required to implement capital projects in its uncontrolled CSO basins to reduce CSOs to an average of one untreated discharge per CSO site per year. The Henderson Area was designated for a CSO reduction project in the 2001 and 2005 CSO Plan Amendments.

This Flow Monitoring Report describes the results of flow monitoring within the Henderson Area. Flow monitoring was conducted as part of the Henderson CSO Reduction project. The goal of the Henderson CSO Reduction project is to design and construct CSO reduction facilities that reduce CSOs from NPDES basins 44, 45, 46, 47, 48, 49 and 171 down to one overflow per site per year on average.

In support of this goal, the flow monitoring program for the Henderson Area assisted in the characterization of the combined sewer system and existing facilities. This Flow Monitoring Report supports the requirements for Monitoring and Planning in support of the Facilities Plan that SPU will provide to the Washington State Department of Ecology (Ecology).

A planning-level hydrologic/hydraulic model for the Henderson Area was created in InfoWorks software and updated in 2006. This existing model needs to be expanded and refined for the more rigorous demands of preliminary engineering and design. In preparation for updating the model, SPU and HDR evaluated the available monitoring data from the 2005/2006 and 2006/2007 wet seasons to meet the project objectives. These existing flow monitoring data were deemed insufficient and SPU expanded the existing program and selected flow monitoring locations that met the immediate needs of the project. The project data needed to include the following components:

- Volume and frequency of overflows at each of the basin's outfall location
- Depth and velocity to develop stage discharge curves at the CSO control facilities (HydroBrakes) and to assess performance of storage facilities
- Measured flow at strategic points to support allocating flow upstream within the outfall basins for both dry weather and wet weather conditions
- Storm flow data at strategic points to enable the evaluation of treatment options that could include storm water flows as well as CSO flows

ADS Environmental Services (ADS) conducted the flow monitoring services for the Henderson Area. Monitoring started in January 2008 and continued through May 2009. The flow monitoring period was divided into two phases of data collection: Phase I occurred from January 15, 2008 through June 10, 2008 and Phase II occurred from June 11, 2008 through May 31, 2009. At the end of Phase I, rainfall data were evaluated to determine if rainfall events of sufficient depth and duration occurred to develop an understanding of the performance of the existing system. The team determined that the

Phase I rainfall events did not provide enough data for understanding system performance and flow monitoring was continued through Phase II. Flow monitoring will continue at some sites beyond May 31, 2009 in order to collect data for NPDES permit compliance and future model verification needs.

Monitoring consisted of simultaneous measurements of velocity and depth at strategic points within the system and precipitation over the Henderson Area. "Temporary" flow monitors complemented the "permanent" or depth monitors currently installed on the basins' outfalls. Existing tipping bucket gages near the basin were used to measure precipitation.

The flow monitoring plan guiding the objectives, approach, and quality assurance / quality control (QA/QC) procedures for the project is summarized in the *Quality Assurance Project Plan (QAPP): Henderson Basin Flow Monitoring Study* (HDR Engineering, August 2008). Throughout the flow monitoring period, HDR evaluated the data with respect to the ability to meet basin modeling data needs. This evaluation resulted in a series of written data review summaries and flow monitoring workshops. A description of the data reviews and reporting that occurred in each phase is discussed in Section 3.6.

The objective of the flow monitoring program was to characterize the performance of the combined sewer system and existing facilities before, during, and after storm events.

2.2 Study Boundaries

The Henderson Area is located adjacent to Lake Washington in southeast Seattle, with Seward Park at the basins' north end. The area is bisected east-west by South Henderson Street and north-south by Rainier Avenue South. The basins are divided into two areas; Henderson North is the area north of South Henderson Street and Henderson South is the area south of South Henderson Street.

The entire Henderson Area is primarily a partially separated sanitary sewer system, which conveys wastewater and runoff from directly connected rooftops and area drains to the combined sewer system. The combined sewer system is conveyed to the King County mainline that extends along South Henderson Street to the Henderson Pump Station and the West Point Wastewater Treatment Plant. CSO outfalls discharge directly to Lake Washington through seven outfall locations. Separated stormwater is discharged to Lake Washington via a 96-inch-diameter storm pipe near the CSO outfall in Basin 46 at Prichard Island Beach and an 84-inch-diameter storm pipe in South Henderson Street in Basin 47N. Street runoff is primarily collected in a separate storm system. The Henderson Area is shown in **Figure 2-1**.

The Henderson Area contains five CSO control facilities, seven outfalls to Lake Washington, and four associated pump stations. Other significant facilities include five vortex valves (HydroBrakes). These facilities are listed in **Table 2-1**.

Table 2-1: Henderson Area CSO Facilities

Facility	Location	Description
CSO Structure		
Facility No. 8	Basin 44 – Adjacent to Lake Washington Blvd. S. south of S. Juneau Street	Overflow weirs, HydroBrake & approximately 50,000 gallon off-line storage facility.
Facility No. 29	Basin 45 – 57th Avenue S. south of Holly Street	Overflow structure & HydroBrake.
Facility No. 7	Basins 47C, 47D, 47E along S. Henderson Street 47C at Rainier Avenue S. 47D at 46th Avenue S. 47E at Renton Avenue S.	47C – Approximately 890,000 gallon in-line storage, weir diversion, slide gate to King County Henderson Trunk 47D – Weir diversion to King County Henderson Trunk 47E – Weir diversion King County Henderson Trunk
Facility No. 5	Basin 47 – Rainier Avenue S. between 52nd Avenue S. & 56th Avenue S.	Approximately 70,000 gallon off-line storage structure with HydroBrake & two overflow outfalls.
Facility No. 4	Basin 49 – Rainier Avenue S. between Cooper Street & Perry Street	Approximately 310,000 gallon off-line storage facility & HydroBrake.
Outfalls		
Outfall No. 44	To Lake Washington from MH 067-275	24-inch-diameter outfall
Outfall No. 45	To Lake Washington from MHs 074-152 & 074-153	15-inch-diameter outfall
Outfall No. 46	To Lake Washington from MH 081-062	12-inch-diameter outfall
Outfall No. 47	To Lake Washington at S. Henderson Street from MHs 081-330, 080-298, 080-480 & 081-224	84-inch-diameter outfall
Outfall No. 48	To Lake Washington from MH 306-250	24-inch-diameter outfall (no overflows recorded at this location)
Outfall No. 49	To Lake Washington from MH 306-435	21-inch-diameter outfall
Outfall No. 171	To Lake Washington from MH 081-231	36-inch-diameter outfall
Pump Stations		
Pump Station 10	Basin 45 – South of Holly Street	Lifts flows from Basins 44 & approximately half of Basin 45.
Pump Station 9	MH 081-056 downstream of Basin 46 in Basin 47A	Lifts flows from Basins 44, 45 & 46.
Pump Station 80	Basin 48 – East side of Rainier Avenue S. at Perry Street	Lifts flows from about 25 homes in Basin 48.
Henderson Pump Station	Basin 47 – S. Henderson Street at Seward Park Avenue S.	King County facility – Conveys flow from the Henderson Area to the West Point Wastewater Treatment Plant.
Special Structures		
HydroBrake	Basin 44 – Lake Washington Blvd. S. in Seward Park	MH 067-272
HydroBrake	Basin 45 – 57th Avenue S. & S. Holly Street	MH 074-159
HydroBrake	Basin 47A – Seward Park Avenue S & S. Henderson Street	MH 081-239
HydroBrake	Basin 47B/171 – Rainier Avenue S. & Seward Park Avenue S.	MH 081-231
HydroBrake	Basin 49 – Rainier Avenue S. & S. Perry Street	MH 306-428

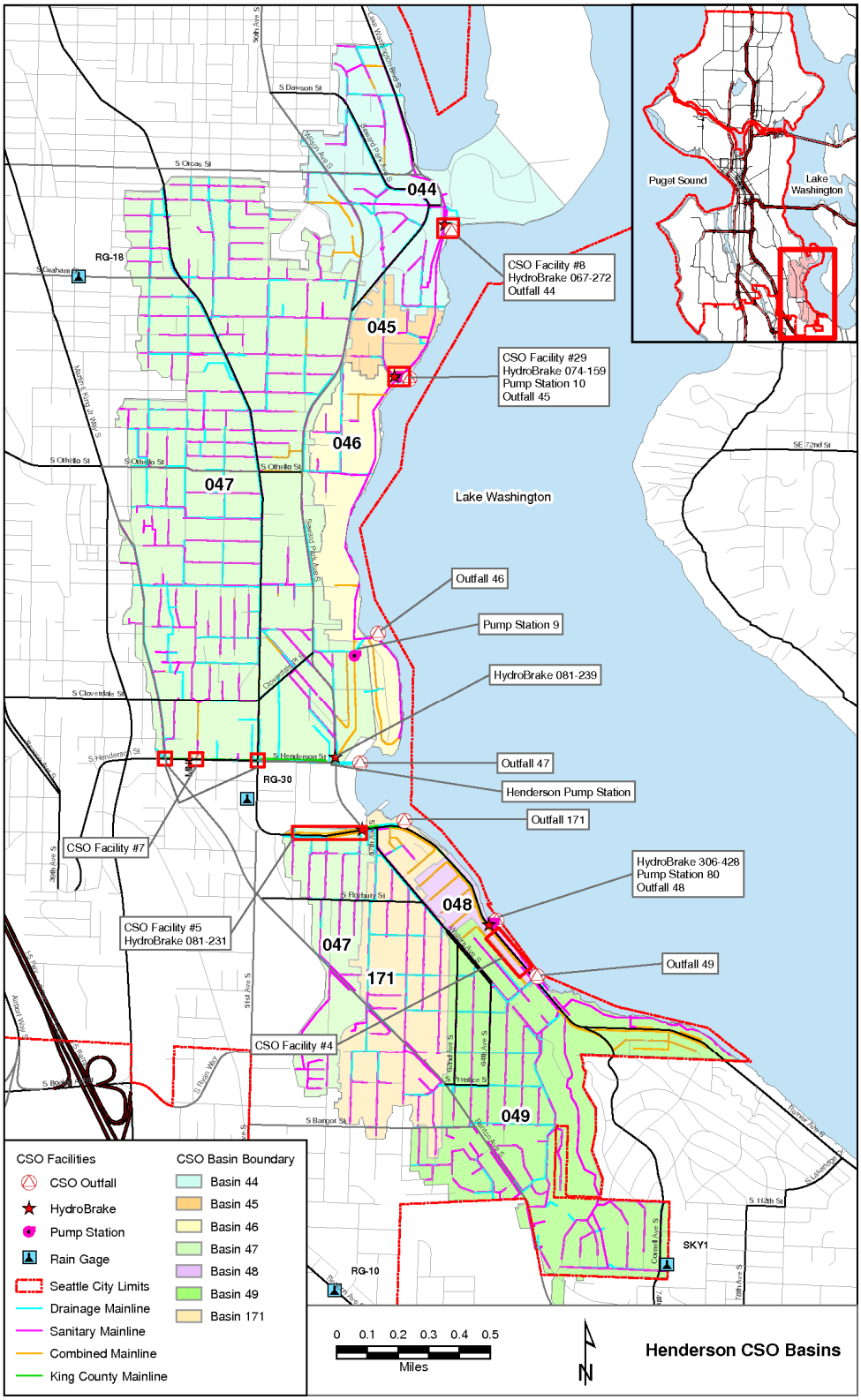

Figure 2-1: Henderson Area Overview

3.0 Monitoring Network

3.1 Rainfall Monitoring Equipment

Both SPU and King County operate a network of rain gages that were used to provide rainfall data for this flow monitoring project. The rain gages record the totalized precipitation depth in 0.01-inch increments and 1-minute intervals. The rainfall gages utilized for the Henderson Area are described below:

- SPU Rain Gage 10 (RG10), located at Rainier Avenue Elementary (11650 Beacon Avenue S.)
- SPU Rain Gage 18 (RG18), located at Aki Kurose Middle School (3928 S. Graham Street)
- SPU Rain Gage 30 (RG30), located at Rainier Beach Public Library (9125 Rainier Avenue S.)
- King County Rain Gage SKY1, located at Lakeridge Elementary School (7400 S. 115th Street)

RG18 covers the northern portion of the Henderson Area and was active throughout the monitoring period. RG10 and RG30 cover the southern portion of Henderson Area. RG10 was taken out of service at the end of June 2008. The new rain gage, RG30, was not installed until January of 2009. In the interim, data from King County rain gage SKY1, also located in the southern portion of the Henderson Area, were used to provide rainfall information between July 2008 and January 2009. None of these rain gages are heated and consequently may deliver inconsistent results during freezing temperatures and snow events.

A Thiessen analysis of the SPU rain gages was performed. The development of Thiessen polygons is a technique for approximating the distribution area around rain gages to distribute average rain depths over an area. The location of the rain gages and Thiessen analysis for the SPU gages are shown in **Figure 3-1** for RG10 and in **Figure 3-2** for RG30.

Rain gage specifications and data quality assurance procedures are discussed in Section 7.3 and Section 9 of the Henderson QAPP, and in SPU Standard Operating Procedures (SOPs) METR Q1100_R0D7, METR Q1200_R0D3 and METR Q1300_R0D2. The SPU SOPs are included in Appendix F of the Henderson QAPP.

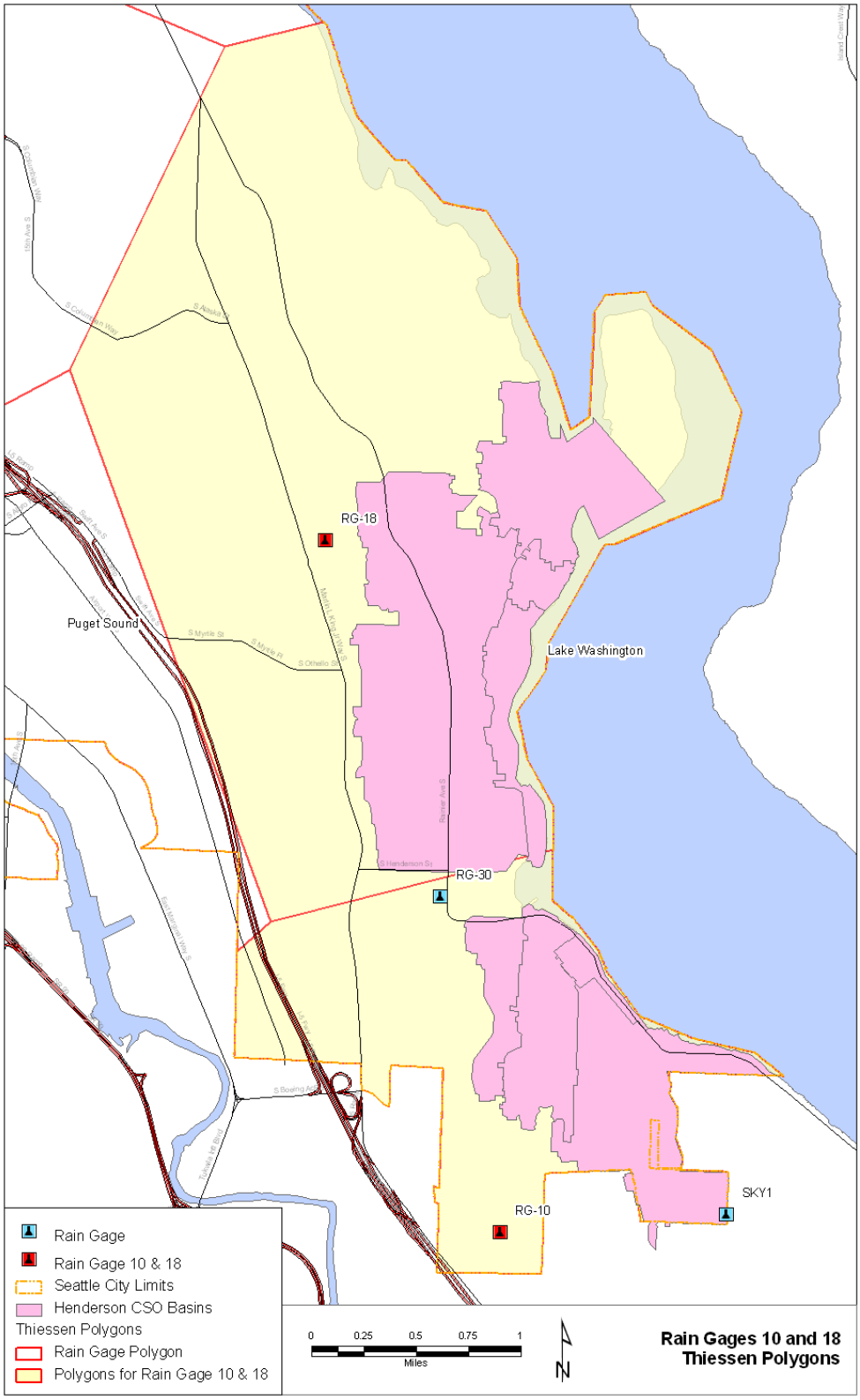

Figure 3-1: Rain Gages and Thiessen Analysis – RG18 and RG10

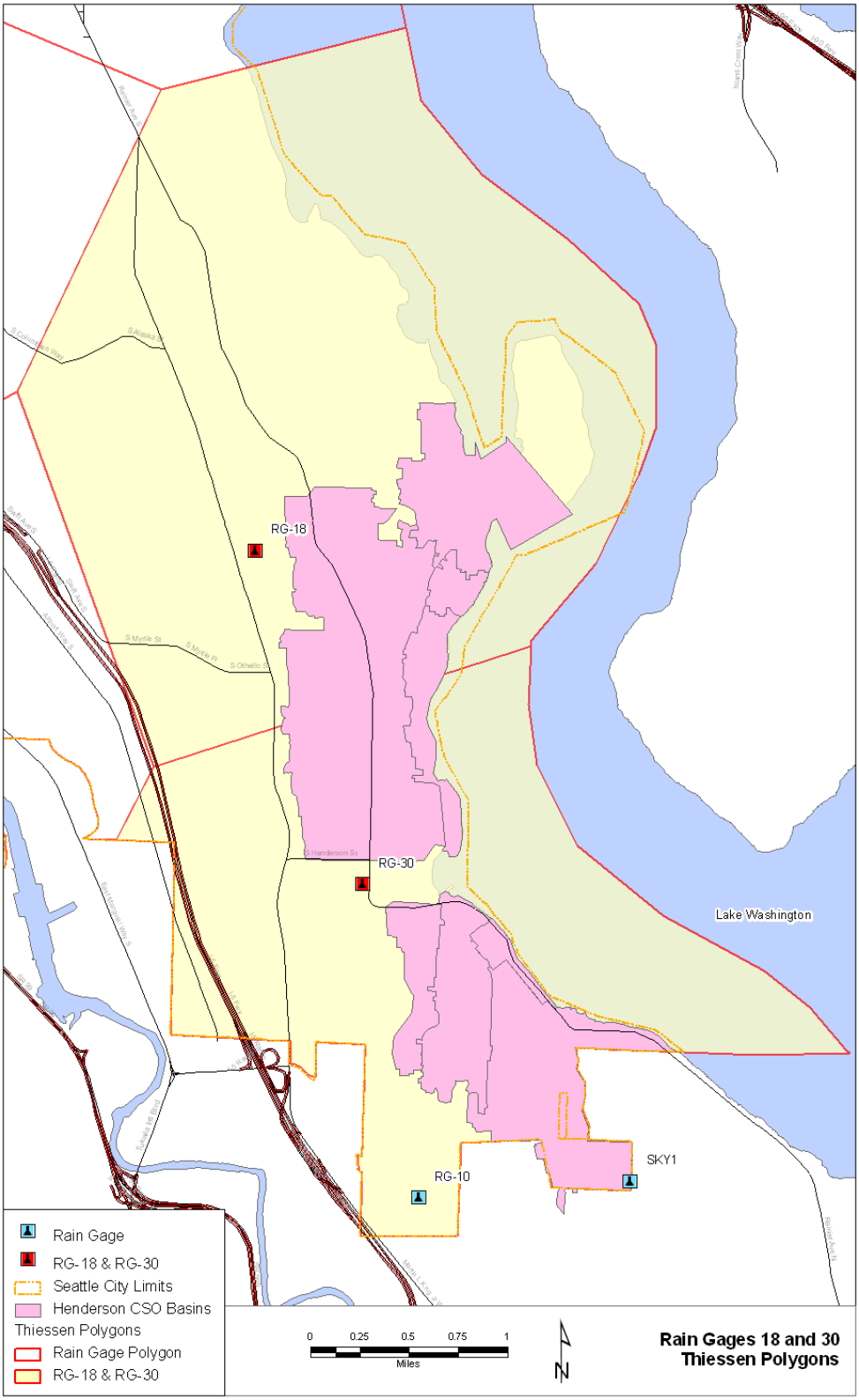

Figure 3-2: Rain Gages and Thiessen Analysis – RG18 and RG30

3.2 Flow Monitoring Equipment

Monitoring consisted of simultaneous measurement of velocity and depth at strategic locations and precipitation over the Henderson Area. Permanent flow monitors were installed in the fall of 2007 at each basin's outfall diversion structure to record and quantify CSO overflow events, as required by the City's NPDES permit. These monitors will remain in place beyond the duration of the monitoring period described in this report. Temporary flow monitors complemented the permanent flow monitors that are installed at the basins' CSO outfalls.

The majority of the temporary flow monitors were installed in January 2007. Additional locations were identified for monitor installation during the monitoring period to better understand system response. The temporary monitors were installed to characterize the hydrologic response of basin sub-catchments (smaller areas within the Henderson Area), or to develop stage-discharge curves for each of the HydroBrakes located in the Henderson Area.

The typical configuration of the monitoring equipment within the Henderson Area includes one set of sensors – including a velocity, pressure, and ultrasonic sensor – in a pipe upstream of a MH recording instantaneous data at 5-minute intervals. Deviations from the typical configuration occurred to better capture unique hydraulics and include an additional set of sensors or sensors installed on the downstream side of a MH. Appendix A contains the specifications used for the flow monitors in this study.

3.3 Flow Monitors

Each of the monitoring locations (both temporary and permanent) was selected to meet a primary purpose, and often one or more secondary purposes. The three purposes for the flow monitors are listed below:

1. Measuring overflows
2. Measuring HydroBrake performance
3. Measuring basin hydrologic response (basin characterization)

The primary purpose of the permanent monitors is to measure combined sewer overflows through six of the seven NPDES regulated outfalls. (One NPDES outfall, Outfall 48, is a monitored pump station overflow location.) Several permanent monitors also served secondary purposes of measuring HydroBrake performance and/or basin hydrologic response.

Some monitors were used to develop stage-discharge curves for the HydroBrakes located throughout the basins. Monitors were needed both upstream and downstream of the HydroBrake to determine differential head across the structure. Flow through the HydroBrake was typically measured at the downstream monitor. Because the monitors used for HydroBrake stage-discharge curve development also measured flow, they also served to assist in characterizing basin hydrologic response.

Monitors whose purpose was to characterize the hydrologic response of sub-catchments were used to divide the total area into smaller areas (monitoring subbasins), allowing for

more refined model calibration and validation. The goal of these monitors was to determine flow through a specific point; specifically, to capture the hydrologic response of the subbasins as cleanly as possible, without being influenced by hydraulic control structures.

Two of the temporary monitors, D081-131 and D081-069, were used to measure flow from the stormwater basin adjacent to the outfall of CSO Basins 46 and 47, respectively. The purpose of these monitors was to gather general information about the hydrologic and hydraulic response of the stormwater basins.

Figure 3-3 and **Figure 3-4** are maps showing the monitoring locations used in this study. **Table 3-1** summarizes the location and purpose of each monitor evaluated during the flow monitoring period from January 2008 – May 2009. The table also includes the tributary area of each monitoring basin, reporting both *gross* and *net* areas. Gross area includes all upstream monitoring basins, and net subtracts out the upstream monitoring basin and represents only that basin's contribution. For terminal flow monitoring basins, those basins that are most upstream, the gross and net values are equal.

Additional details regarding the monitoring locations can be found on the ADS site installation sheets in Appendix B. Information on how flow monitoring basins were used to develop model basin flows are described further in the *Henderson Combined Sewer Overflow Reduction Plan Project: Henderson Modeling Plan* (CH2M HILL, December 2008).

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Table 3-1: Henderson Flow Monitoring Locations

Basin	Monitor MH	Type*	Status**	Pipe Size (in)	Location	Purpose	Sensor Set †	Gross Basin Area (acres)	Net Basin Area (acres)	Net Basin Length of Pipe (ft)
44	067-274	P	N/A	30	NPDES #44 Outfall. CSO Structure 44A. In 30-inch-diameter pipe downstream of weir diversion to storage.	Characterize basin flow and measure CSO events. Meter measures depth in storage & estimates flow over weir to outfall.	MP1 (FS)	N/A‡	N/A‡	N/A
44	067-261	P	N/A	15	NPDES #44 Outfall CSO Structure 44B. In 15-inch-diameter pipe upstream of weir diversion & downstream of HydroBrake.	Characterize basin flow and measure CSO events. Meter measures depth & estimates flow over weir to outfall. Depth & flow will be used to develop stage-discharge curve for HydroBrake located upstream.	MP1 (FS)	N/A‡	N/A‡	N/A
44	067-191	T	#	24	N. of Seward Park on Lake Washington Blvd. S. In 24-inch-diameter pipe.	Characterize basins flow. Meter measures depth & velocity in pipe.	MP1 (FS)	49	49	7,730
44	067-271	T	To remain after 5/31/2009	30	Seward Park Rd. east of Lake Washington Blvd. S. In 30-inch-diameter pipe upstream of HydroBrake.	Meter measures depth and velocity in pipe. Depth will be used to develop stage-discharge curve for HydroBrake located in next downstream MH.	MP1 (FS)	161	112	20,250
44	067-275	T	#	30 (MP1) 15 (MP2)	NPDES #44 Outfall. Downstream of diversions 44A and 44B. Sensor MP1 in 30-inch-diameter pipe from north & Sensor MP2 in 15-inch-diameter pipe from west	Characterize flow in overflow structure. Meters measures depth and velocity in both monitored pipes.	MP1 (FS) MP2 (FS)	N/A‡	N/A‡	N/A
45	074-153	P	N/A	15 (MP1) 15 (MP2)	NPDES #45 Outfall. 57th Avenue S. CSO Structure 45A Sensor MP1 in 15-inch-diameter pipe upstream of MH & sensor MP2 in the 15-inch-diameter elevated overflow to outfall.	Characterize basin flow and measure CSO events. Meters measures depth & velocity in both monitored pipes.	MP1 (FS) MP2 (FS)	182	21	4,960
45	074-167	P	N/A	8	NPDES #45 Outfall. CSO Structure 45B In 8-inch-diameter pipe to storm pipeline.	Characterize basin flow and measure CSO events. Meter measures depth & velocity in pipe.	MP1 (FS)	N/A‡	N/A‡	N/A
45	074-152	T	# (MP1) MP2 installed after 5/31/2009	8 (MP1) 8 (MP2)	Martha Washington Park Sensor MP1 in 8-inch-diameter downstream of HydroBrake. Sensor MP2 in 8-inch-diameter overflow pipe.	Meter measures depth & velocity to be used to develop stage-discharge curve for HydroBrake. Sensor MP2 will assist in measurement of CSO events.	MP1 (FS) MP2 (U)	N/A‡	N/A‡	N/A
45	074-159	T	#	15	Martha Washington Park 57th Avenue S In 15-inch-diameter pipe upstream of HydroBrake.	Characterize basin flow. Meter measures depth & velocity. Depth will be used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	28	28	2,910
46	081-062	P	N/A	21 (MP1) 12 (MP2)	NPDES #46 Outfall. Island Dr. S. CSO Structure 46. Sensor MP1 in 21-inch-diameter pipe from east Sensor MP2 in 12-inch-diameter overflow pipe.	Characterize basin flow (Prichard Island). Meter measures depth & velocity in both locations.	MP1 (FS) MP2 (FS)	20	20	3,120
46	081-059	T	To remain after 5/31/2009	21	East of Seward Park Avenue S. between S. Kenyon Street & S. Budd Ct. In 21-inch-diameter pipe upstream of Pump Station #9.	Characterize basin flow. Meter measures depth & velocity in pipe.	MP1 (FS)	288	78	9,650
46	D081-131	TS	#	108	In 108-inch-diameter storm pipe. Cloverdale Pl. S. & Wabash Avenue S. (standing water at this location due to lake level).	Characterize storm flow. Meter measures depth & velocity in pipe.	MP1 (FS)	1,056	1,056	123,060
47	081-224	P	N/A	24	NPDES #47 Outfall. CSO Structure 47B. In 24-inch-diameter pipe downstream of weir diversion to storage & upstream of weir diversion to outfall.	Characterize basin flow and measure CSO events. Meter measures depth in storage & used to estimate flow over weir to outfall.	MP1 (FS)	N/A‡	N/A‡	N/A

Basin	Monitor MH	Type*	Status**	Pipe Size (in)	Location	Purpose	Sensor Set †	Gross Basin Area (acres)	Net Basin Area (acres)	Net Basin Length of Pipe (ft)
47	081-330	P	N/A	78	NPDES #47 Outfall. CSO Structure 47C. In 78-inch-diameter pipe upstream of weir diversion to outfall.	Measure CSO events. Meter measures depth & velocity. Used to estimate flow over weir to outfall.	MP1 (FS)	N/A‡	N/A‡	N/A
47	080-298	P	N/A	12	NPDES #47 Outfall. 46th Avenue S. & S. Henderson Street CSO Structure 47D. In 12-inch-diameter pipe upstream of weir diversion to outfall.	Characterize basin flow and measure CSO events. Meter measures depth & velocity. Used to estimate flow over weir to outfall.	MP1 (FS)	52	52	7,040
47	080-480	P	N/A	10	NPDES #47. Renton Avenue S. & S. Henderson Street CSO Structure 47E. In 10-inch-diameter pipe upstream of weir diversion to outfall.	Characterize basin flow and measure CSO events. Meter measures depth & velocity. Used to estimate flow over weir to outfall.	MP1 (FS)	40	40	5,830
47	073-268	T	#	30	Basin 47C South of S. Holly Street on Rainier Avenue In 30-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	210	210	32,670
47	073-276	T	#	42	Basin 47C S. Fontanelle Street & Rainier Avenue S. In 42-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	393	183	30,870
47	080-329	T	#	78	Basin 47C North of S. Henderson Street on Rainier Avenue S. In 78-inch-diameter pipe (in-line storage).	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	583	190	26,790
47	081-049	T	#	15	Basin 47A In 15-inch-diameter North of S. Henderson Street on Seward Park Avenue S. Downstream of HydroBrake.	Meter measures depth & velocity to be used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	N/A‡	N/A‡	N/A
47	081-239	T	#	60	Basin 47A North of S. Henderson Street on Seward Park Avenue S. In 60-inch-diameter pipe just upstream of HydroBrake.	Meter measures depth & velocity. Depth will be used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	35	35	11,520
47	081-085	T	To remain after 5/31/2009	30	Basin 47A Seward Park Avenue S. & S. Henderson Street In 30-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	343	28	3,780
47	081-139	T	#	30	Basin 47B Rainier Avenue S. & 53rd Avenue S. In 30-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	81	81	14,280
47	081-120	T	#	18	Basin 47B Rainier Avenue S. & 51st Avenue S. In 18-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity prior to entering King County system.	MP1 (FS)	117	36	6,680
47	D081-069 (081-086)	TS	#	84	Basin 47A In 84-inch-diameter storm pipe. S. Henderson Street & Seward Avenue S. (standing water at this location due to lake level).	Characterize storm flow. Meter measures depth & velocity.	MP1 (FS)	312	312	43,040
171	081-231	P	N/A	12	NPDES #171 Outfall. CSO Structure 171. In 12-inch-diameter pipe downstream of weir diversion to storage & upstream of HydroBrake & weir diversion to outfall.	Characterize basin flow and measure CSO events. Meter measures depth in storage. Depth & velocity used to estimate flow over weir to outfall. Used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	N/A‡	N/A‡	N/A
171	081-229	T	Installed after 5/31/2009	12	Seward Park Avenue South just south of South Fisher Place. In 12-inch-diameter pipe.	Used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	N/A‡	N/A‡	N/A

Basin	Monitor MH	Type*	Status**	Pipe Size (in)	Location	Purpose	Sensor Set †	Gross Basin Area (acres)	Net Basin Area (acres)	Net Basin Length of Pipe (ft)
171	306-192	T	#	8	S. Gazelle Street & 59th Avenue S. In 8-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	63	63	9,870
171	081-237	T	To remain after 5/31/2009	30	Rainier Avenue S. west of 57th Avenue S. In 30-inch-diameter pipe upstream of weir diversion to storage.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	179	116	18,130
49	306-437	P	N/A	72	NPDES #49 Outfall. CSO Structure 49. In 72-inch-diameter storage pipe.	Measure CSO events. Meter measures depth in storage. Depth & velocity used to estimate flow over weir to outfall.	MP1 (FS)	N/A‡	N/A‡	N/A
49	306-284	T	#	18	In roadway in front of 9926 Waters Ave S, in northwest-heading side of road. In 18-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	66	66	10,790
49	306-343	T	#	27	Rainier Avenue S. between S. Cooper Street & S. Thayer Street In 27-inch-diameter pipe.	Characterize basin flow. Meter measures depth & velocity.	MP1 (FS)	274	274	44,280
49	306-245	T	#	15	Rainier Avenue S. just south of S. Pilgrim Street In 15-inch-diameter pipe.	Captures flow from northern portion of CSO Basin 49. Meter measures depth & velocity.	MP1 (FS)	18	18	3,840
49	306-246	T	To remain after 5/31/2009	12	In 12-inch-diameter King County pipeline downstream of HydroBrake in 306-428 & upstream of force main connection from Pump Station #80.	Meter measures depth & velocity. Used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	N/A‡	N/A‡	N/A
49	306-275	T	#	15	Rainier Avenue S. just south of S. Pilgrim Street In 15-inch-diameter pipe.	Captures dry weather flow for CSO Basin 49. Meter measures depth & velocity.	MP1 (FS)	376	36	9,020
49	306-428	T	To remain after 5/31/2009	18	Rainier Avenue S. near Pump Station 80 (CSO Basin 48). In 18-inch-diameter pipe upstream of HydroBrake.	Measures depth in storage. Depth used to develop stage-discharge curve for HydroBrake.	MP1 (FS)	394	N/A‡	N/A

* P = Permanent Monitoring Location; T = Temporary Monitoring Location; TS = Temporary Storm Drainage Monitoring Location
** # = Removed after June 1, 2009
† MP = Monitoring Point; FS = Full Set (ultrasonic level, pressure level, velocity); U = Ultrasonic Level Sensor; P = Pressure Level Sensor; V = Velocity Sensor
‡ Due to other monitors one pipe length away or because this site only measures overflows, the net basin area was not calculated for this site.

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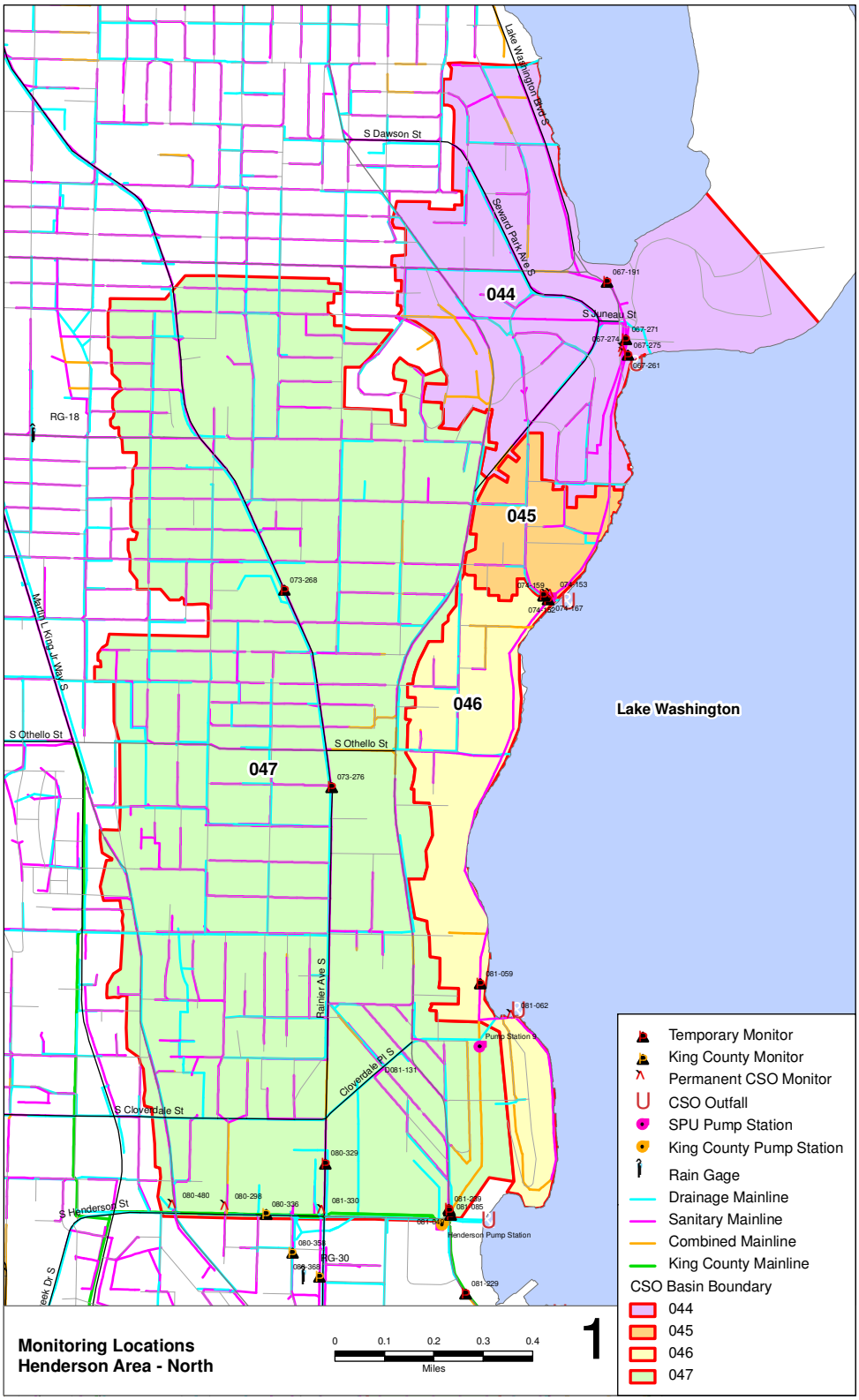

Figure 3-3: Flow Monitoring Locations – Henderson North

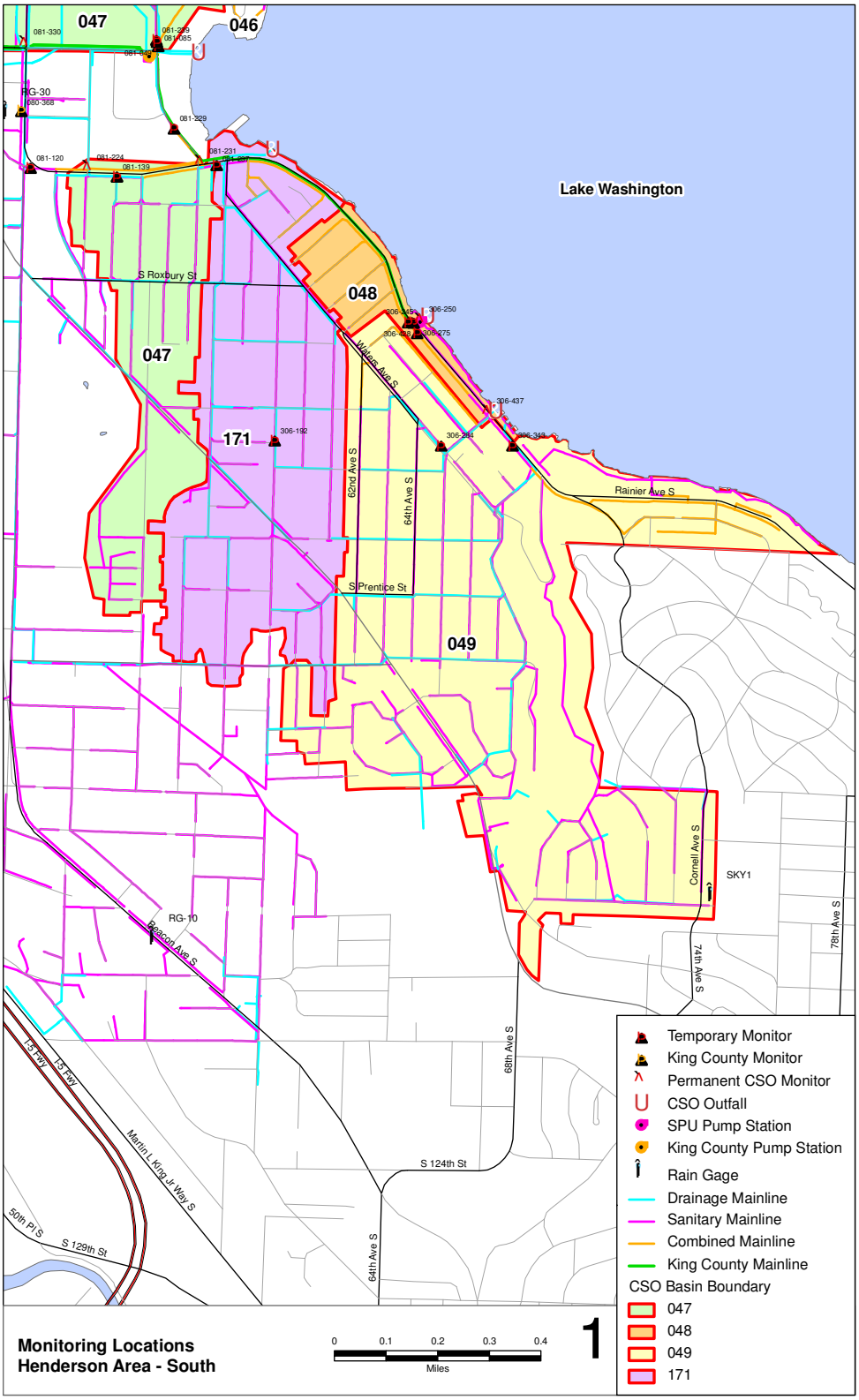

Figure 3-4: Flow Monitoring Locations – Henderson South

3.3.1 Permanent Flow Monitors

The permanent flow monitors in the Henderson Area are part of the NPDES permit program. Data from these permanent monitors are made available via an automatic data collection and reporting system (IntelliServe) operated and maintained by ADS. Data from these monitors are available in real-time or near real-time to facilitate CSO overflow alarming and monitoring required by the City's NPDES permit.

Table 3-2 shows details about each permanent monitoring location. Alarm settings are notification depths at each CSO structure. At the High Alarm setting, City staff is notified. The High High Alarm is the depth at which CSO events begin. Detailed schematics of the monitoring configuration at each permanent site can be found in Appendix B.

Most overflow volumes are calculated using a weir equation. At locations where sensors are installed in an overflow pipe, overflow is calculated using the Continuity Equation.

Table 3-2: Permanant Monitoring Site Details (from ADS)

Site	Location	Installation Date	High High Alarm (in)	High Alarm (in)	Pipe Height (in)	Pipe Width (in)	Sensors*	Overflow Calculation Type
44A	067-274	7/27/07	78.12	39.06	30.00	30.00	U, P & V	Weir
44B	067-261	7/30/09	28.25	20.30	15.00	14.50	U, P & V	Weir
45A	074-153 MP1	8/2/07	35.38	21.23	14.00	14.88	U, P & V	Round Weir
45A-2	074-153 MP2	4/14/09	N/A	N/A	14.75	14.88	U, P & V	
45B	074-167	7/24/07	N/A	2.50	8.00	8.00	U, P & V	MP1 Qfinal (Qcont)
46	081-062 MP1	7/24/07	29.40	14.70	20.88	20.75	U, P & V	MP2 Qfinal (Qcont)
46-2	081-062 MP2	7/24/07	N/A	N/A	12.00	11.88	U, P & V	N/A
47B	081-224	8/6/07	26.38	13.19	23.88	23.88	U, P & V	MP1 Qfinal (Weir)
47C	081-330	8/27/07	48.13	24.07	78.25	78.00	U, P & V	MP1 Qfinal (Weir)
47D	081-298	8/6/07	14.00	9.80	12.00	11.75	U, P & V	MP1 Qfinal (Weir)
47E	081-480	8/6/07	12.13	8.49	9.75	9.75	U, P & V	Weir
49	306-437	8/6/07	70.00	35.00	72.00	71.63	U, P & V	Weir
171	081-231	8/27/07	82.38	41.19	24.00	24.00	U, P & V	Weir

* U = Ultrasonic; P = Pressure; V = Velocity

3.3.2 Temporary Flow Monitors

The temporary flow monitors were used for basin characterization and/or the development of HydroBrake stage-discharge curves. All but six were removed soon after the conclusion of the monitoring program. One new temporary flow monitor was

installed (at MH 081-229) after May 2009 to gather additional data so that a HydroBrake stage-discharge curve for the HydroBrake at MH 081-231 could be developed.

3.4 King County Flow Monitor Locations & Specifications

In addition to the temporary and permanent monitors used in this project, data from King County flow monitoring locations were reviewed as needed during the monitoring period. King County identified three monitors within the Henderson Area all in or near CSO Basin 47:

- South Henderson Street just east of 50th Avenue, South (MH 080-334)
- 9125 Rainier Avenue, South, in the driveway of the library (MH 080-368)
- 9101 50th Avenue, South, behind the library (MH 080-358)

The monitor at MH 080-358 is downstream of SPU temporary monitor 081-120.

King County flow monitors recorded data at 15-minute time steps. Data for these meters were obtained from King County for the time period from October 2007 through February 2009.

3.5 Other Related Data

In addition to the flow monitoring and rain gage data, information from the following sources was used to help characterize flows within the Henderson Area:

- Basin 46 – Pump Station 9 SCADA data (November 2007 through January 2009 – 5-minute-interval data through September 2008; after that time-step varies)
- Basin 45 – Pump Station 10 SCADA data (November 2007 through January 2009 – 5-minute-interval data through September 2008; after that time-step varies)
- Basin 48 – Pump Station 80 SCADA and overflow data (November 2007 through January 2009 – 5-minute-interval data through September 2008; after that time-step varies)
- Henderson Pump Station (King County facility) SCADA data (5-minute-interval data from October 2007 through February 2008; 15-minute-interval data from January 2008 through January 2009)
- Henderson Tunnel / MLK Structure (King County facility) SCADA data (15-minute-interval data from January 2008 through January 2009)
- Field observations made during inspection, installation and/or maintenance at each flow monitoring site by SPU or ADS field crews

These data were analyzed and used in calibrating and validating the hydraulic model. In addition, the information at the Henderson Pump Station and the Henderson Tunnel / MLK Structure was used to set the downstream boundary conditions in the hydraulic model.

3.6 Data Collection and Reporting Procedures

The objective of the flow monitoring program was to adequately and accurately characterize the performance of the combined sewer system and existing facilities before, during and after storm events that both cause and do not cause overflows. This range includes approximately two storm events that are mild enough to not cause overflows and two medium storm events that may cause overflow (not all outfalls experience an overflow). Ideally it also is beneficial for system characterization to capture two heavier storm events that cause overflow in all outfall locations. A summary of storms experienced during the monitoring period is presented in Sections 4.1 and 4.2. A summary of overflow events is presented in Section 5.1.

Monitors used in this study were installed by ADS. The raw data were automatically downloaded through daily wireless transfer or periodic manual data collection, and accessed by project team members through the web-based IntelliServe interface the next day. Continuous review by SPU and ADS personnel (each reviewing the data two days per week) of the IntelliServe data was designed to ensure the availability of data, and enable field crews to respond quickly to problems as they arose.

During Phase I (January 2008 through mid-June 2008), HDR reviewed the raw data available on ADS's FlowView Portal (a web-based data viewer) every two weeks to verify that the data met project objectives. Documentation was prepared and presented to SPU at monthly meetings. At the conclusion of Phase I, missing data were reconstituted, where possible, and any additional adjustments were made by ADS analysts. Then, finalized data were uploaded to IntelliServe for data distribution to HDR and SPU.

During Phase II (mid-June 2008 through May 2009), raw data continued to be regularly reviewed by ADS and SPU personnel. Because most issues with the data had been reconciled, the bi-weekly review of raw data by HDR was no longer necessary. Finalized data, available monthly on IntelliServe, were reviewed by HDR to ensure ability to meet modeling needs, and presented in regularly-scheduled workshops.

Data collection, quality assurance and reporting procedures for this study are presented in greater detail in Sections 6 through 14 of the Henderson QAPP.

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4 Monitoring Results

4.1 Rainfall Monitoring Data – RG18

For the monitoring period, a total of 48.22 inches of rain fell at RG18. A maximum of 1.58 inches fell in a single day (November 6, 2008). The maximum 12-month rolling average was 36.7 inches, which is slightly less than the 37.1-inch average for Seattle. Rain gage 18 was available for the entire monitoring period. **Figure 4-1** shows the cumulative precipitation throughout the monitoring period, as well as daily total precipitation.

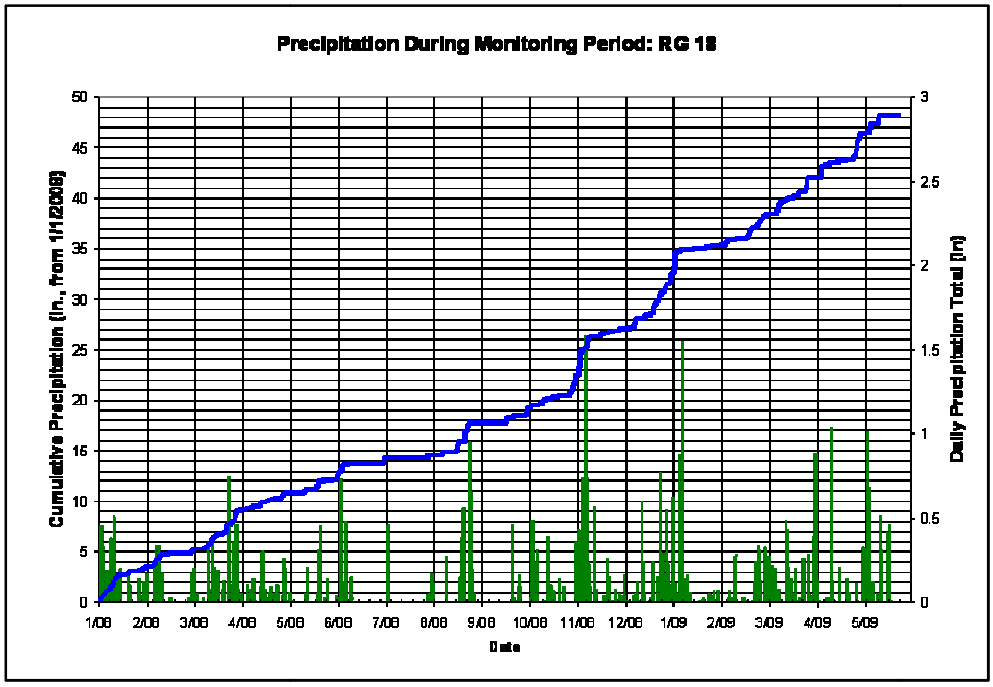

Figure 4-1: Rain Gage 18 - Cumulative and Daily Precipitation

For purposes of storm selection and classification, an inter-event time of 6 hours and a minimum storm depth of 0.30 inches were selected. **Table 4-1** lists all storms that satisfy these criteria. The storm definition criteria were selected to facilitate rainfall analysis. They were chosen to limit the number of official storms to those that were likely to have a moderate hydrologic effect and to reduce the overall length of these storms so that the storm duration was representative of the actual hydrologic response.

Table 4-1: Rain Gage 18 - Summary of Storms

Date	Storm Precipitation (in)	Storm Duration (hours)	Max Freq.-Duration (hours)*	Max Freq.-depth (in)	Max Freq. (month)
1/2/08 2:40	0.36	5.3	5.3	0.36	<2
1/2/08 14:05	0.42	29.8	29.8	0.42	<2
1/8/08 0:55	0.31	8.0	8.0	0.31	<2
1/9/08 21:05	0.47	12.7	12.7	0.47	<2
1/10/08 16:50	0.33	12.8	12.8	0.33	<2
2/6/08 14:00	0.35	11.7	11.7	0.35	<2
2/8/08 13:55	0.35	11.3	11.3	0.35	<2
3/13/08 6:30	0.59	33.8	33.8	0.59	<2
3/23/08 4:55	0.75	10.3	12.0	0.75	2
3/25/08 14:25	0.31	15.8	15.8	0.31	<2
3/29/08 15:50	0.50	11.2	168.0	2.22	3
4/14/08 14:20	0.30	8.0	8.0	0.30	<2
5/19/08 23:30	0.36	10.3	10.3	0.36	<2
5/21/08 18:20	0.44	1.7	1.0	0.31	6
6/2/08 22:50	0.62	13.7	13.7	0.62	2
6/6/08 5:00	0.48	14.0	1.0	0.33	9
7/3/08 5:35	0.46	5.9	5.9	0.46	<2
8/19/08 20:45	0.66	10.7	24.0	0.94	2
8/24/08 12:50	0.95	10.8	6.0	0.64	4
8/25/08 12:20	0.65	8.4	0.5	0.38	24
9/20/08 6:40	0.47	18.1	18.1	0.47	<2
10/3/08 6:20	0.72	31.0	0.1	0.06	2
10/6/08 8:10	0.31	15.0	15.0	0.31	<2
10/13/08 18:50	0.40	6.6	0.2	0.22	24
10/31/08 3:30	0.36	11.7	11.7	0.36	<2
11/2/08 5:40	0.65	28.3	1.0	0.19	2
11/3/08 18:35	0.86	14.2	6.0	0.60	4
11/6/08 1:35	2.26	32.4	24.0	2.01	24
11/11/08 0:00	1.02	45.6	168.0	3.66	12
12/12/08 9:05	0.83	23.2	23.2	0.83	<2
12/24/08 12:15	1.03	28.1	6.0	0.68	6
12/28/08 14:45	0.31	8.7	168.0	2.03	2
12/31/08 21:55	0.76	30.5	168.0	1.90	2
1/4/09 16:40	0.91	15.8	6.0	0.82	9
1/6/09 15:25	2.05	35.9	168.0	3.75	12

Date	Storm Precipitation (in)	Storm Duration (hours)	Max Freq.-Duration (hours)*	Max Freq.-depth (in)	Max Freq. (month)
2/24/09 22:40	0.38	18.0	18.0	0.38	<2
3/1/09 14:25	0.33	17.3	17.3	0.33	<2
3/14/09 6:05	0.49	14.8	14.8	0.49	<2
3/15/09 5:50	0.77	52.1	52.1	0.77	<2
4/1/09 7:25	0.41	18.3	18.3	0.41	<2
4/2/09 8:55	0.99	21.4	6.0	0.71	6
4/12/09 3:00	1.04	15.2	0.2	0.16	12
5/2/09 11:35	0.33	9.8	9.8	0.33	<2
5/4/09 15:55	1.32	24.3	24.0	1.31	6
5/5/09 22:55	0.69	23.7	96.0	2.08	6
5/13/09 14:20	0.82	23.1	23.1	0.82	<2
5/18/09 20:00	0.43	8.5	8.5	0.43	<2
5/19/09 19:45	0.45	4.8	1.0	0.35	12

* This is the duration of the maximum return interval period. Where none of the return intervals exceeded <2 months, this is the duration of the storm. Storm durations analyzed include 5 minute, 10 minute, 30 minute, 1 hour, 6 hour, 24 hour, 48 hour, 96 hour and 168 hour. The maximum frequency occurring for any of the analyzed storm durations is reported in the "Max Freq." column. The corresponding duration and depth are similarly reported. Cases where Max Frequency Duration exceeds the Storm Duration account for precipitation that occurred prior to the listed storm. The full analysis for each of these durations is included in Appendix C.

Storm frequency was determined using an extrapolation of the storm statistics developed in Table 5 and Table E-17 of *Analysis of Precipitation-Frequency and Storm Characteristics for the City of Seattle* (MGS Engineering Consultants, December 2003). Storm frequencies less than 6 months were extrapolated using regional storm patterns scaled to less frequent storms, developed by CH2M HILL.

Table 4-1 lists the maximum storm recurrence interval for a variety of duration intervals for each of the storms listed. The largest of these storms (greater than 2-month recurrence interval) is plotted on top of depth-duration-frequency curves for RG18 in **Figure 4-2** through **Figure 4-4**. The figures are broken down into the different phases of monitoring. Phase I covered the time period from January 2008 through mid-June 2008 while Phase II covered mid-June 2008 through May 2009. A list of storms with frequency reported at multiple durations can be found in Appendix C.

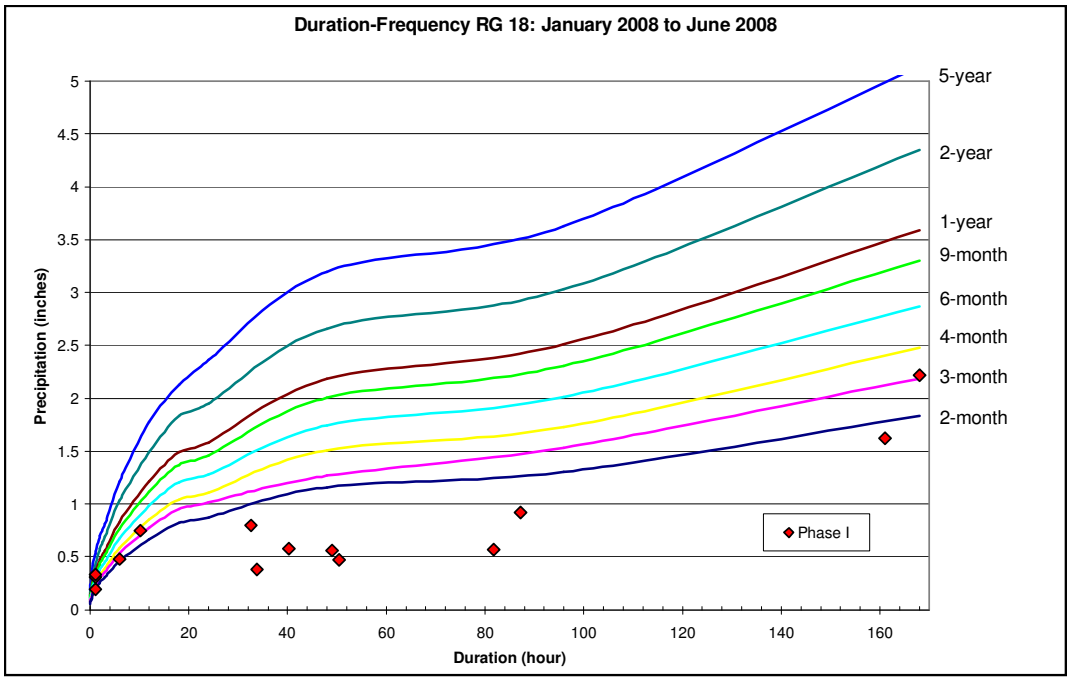

Figure 4-2: RG18 Duration Frequency – Phase I (January 2008 to June 2008)

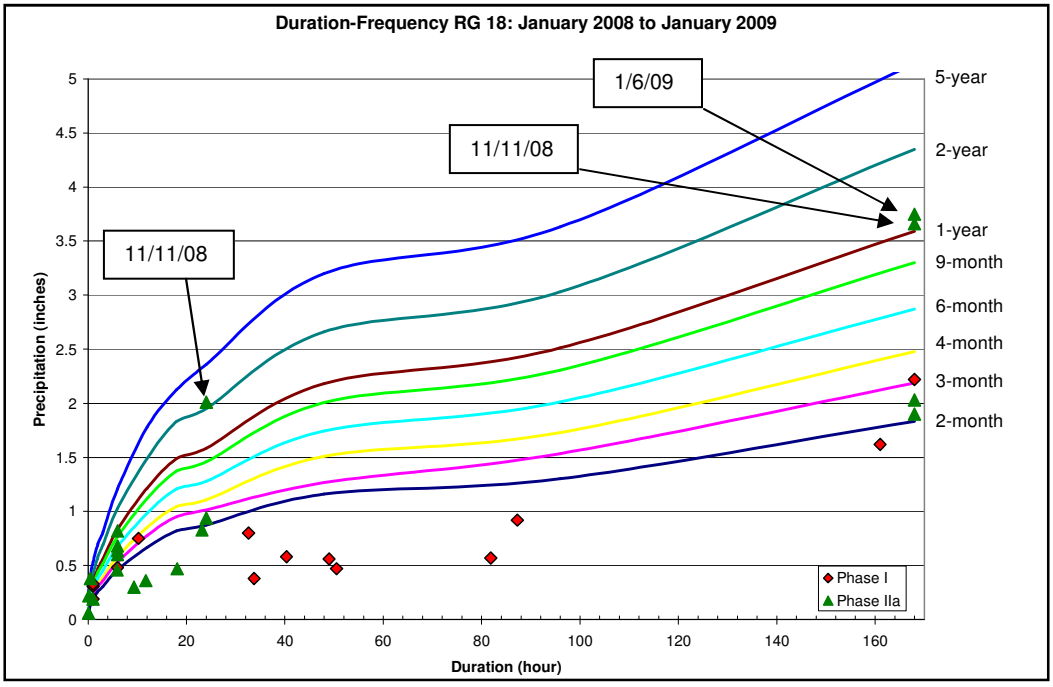

Figure 4-3: RG18 Duration Frequency – Phases I & IIa (January 2008 to January 2009)

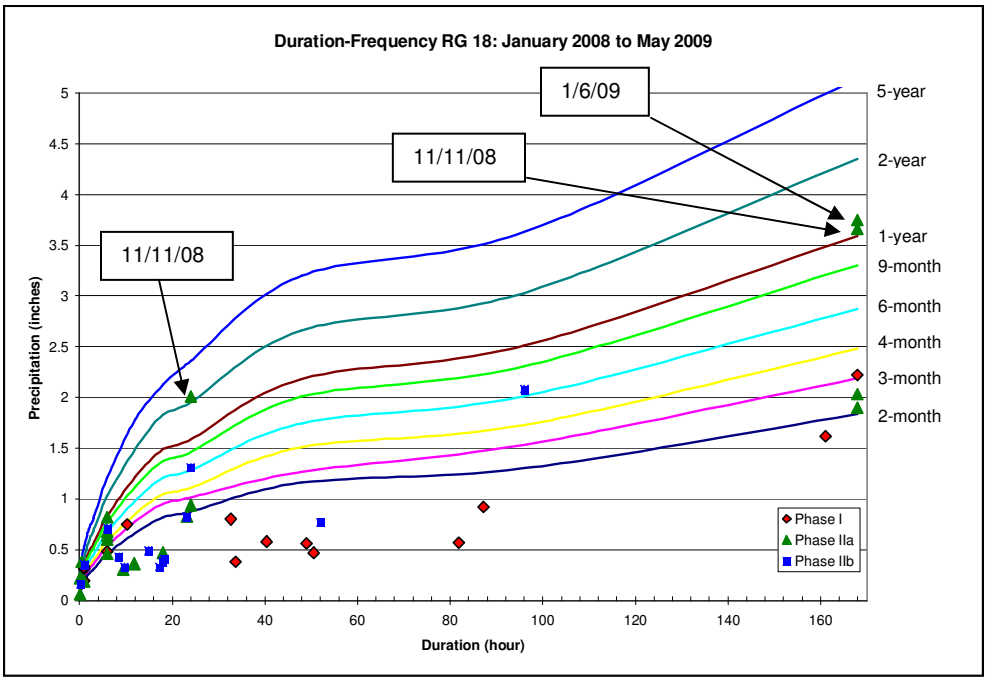

Figure 4-4: RG18 Duration Frequency – Phases I, IIa & IIb (January 2008 to May 2009)

Figure 4-2 shows storms that occurred between January 2008 and mid-June 2008, Phase I of the monitoring period. The lack of large return-interval storms during this period resulted in the need to extend the monitoring period (Phase II) in an effort to collect larger rainfall events. Phase II of the monitoring period extended from June 2008 through May 2009.

Figure 4-3 includes storms that occurred during the first part of Phase II (Phase IIa). Phase IIa covered mid-June 2008 through January 2009. Several larger storm events occurred during this period. These storms were available for model calibration.

Figure 4-4 shows all the storms that make up the monitoring period. Storms that occurred in the second half of Phase II (Phase IIb – February 2009 through May 2009) are available for model validation.

4.2 Rainfall Monitoring Data – Rain Gages 10, 30 & SKY1

As described in Section 3.0, three rain gages were used to characterize rainfall over the southern area of the Henderson Area. RG10 covered dates from January 2009 through June 2008. King County's SKY1 rain gage covered the time period from July 2008 to January 2009. New SPU rain gage, RG30, was used from January 2009 through the end of the monitoring period, May 2009.

For the monitoring period, a total of 53.44 inches of rain fell at these gages. A maximum of 2.65 inches fell in a single day (January 5, 2009). **Figure 4-5** shows the cumulative precipitation throughout the monitoring period, as well as daily total precipitation.

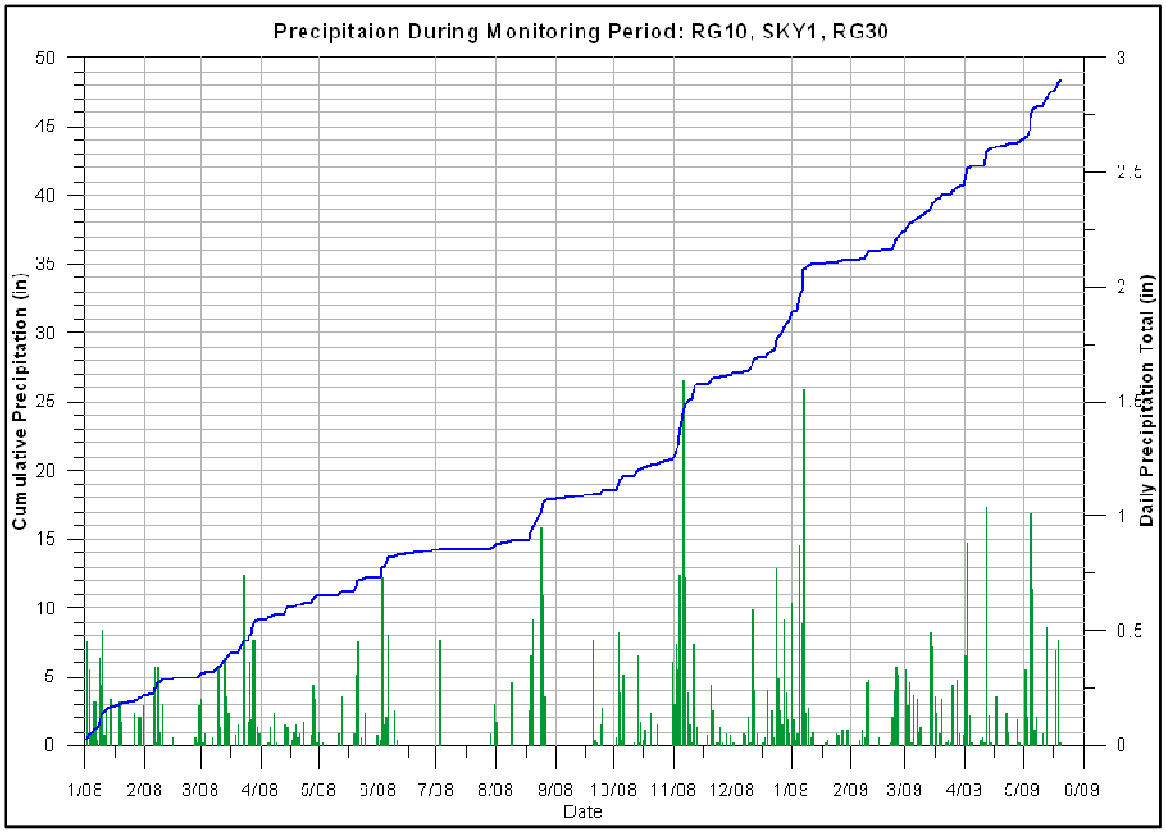

Figure 4-5: RG10, SKY1, RG30 – Cumulative and Daily Precipitation

As with RG18, rainfall for this rain gage grouping was broken down into specific storms. Individual storms were defined by an inter-event time of 6 hours and a minimum storm depth of 0.30 inches. **Table 4-2** lists all storms that satisfy that criteria.

Storm frequency for the events listed in **Table 4-2** could not be determined for this series of rain gages because there was insufficient historical statistical data available.

Table 4-2: Rain Gages 10, 30 SKY1 - Summary of Storms

Date	Storm Precipitation (in)	Storm Duration (hour)
1/2/2008 4:45	0.41	5.6
1/8/2008 1:05	0.44	8.3
1/9/2008 21:10	0.50	11.6
1/10/2008 16:45	0.47	12.8
2/6/2008 15:40	0.34	10.3
2/8/2008 14:00	0.36	9.3
2/9/2008 23:00	0.30	9.3
3/13/2008 6:30	0.79	33.8

Date	Storm Precipitation (in)	Storm Duration (hour)
3/23/2008 5:15	0.77	11.4
3/25/2008 14:35	0.34	15.8
3/28/2008 8:50	0.52	17.8
3/29/2008 14:05	0.68	20.8
3/31/2008 17:55	0.57	1.3
4/28/2008 4:10	0.33	7.3
5/19/2008 23:10	0.46	10.9
6/2/2008 22:35	0.62	13.8
6/6/2008 4:55	0.66	13.2
7/2/2008 19:35	0.43	15.9
8/19/2008 20:25	1.61	30.6
8/24/2008 14:15	1.32	10.0
8/25/2008 17:15	0.70	2.5
9/20/2008 6:25	0.59	23.2
10/3/2008 6:05	0.57	31.7
10/6/2008 2:15	0.30	23.7
10/31/2008 0:55	0.33	13.6
11/3/2008 19:35	0.70	13.4
11/6/2008 1:45	2.47	32.9
11/11/2008 1:05	1.04	41.7
12/12/2008 17:15	0.94	23.3
12/24/2008 20:45	0.93	27.6
12/26/2008 18:00	0.35	27.3
12/28/2008 6:15	0.34	10.8
12/29/2008 0:00	0.38	19.3
1/1/2009 5:45	1.12	32.3
1/4/2009 16:55	0.79	15.5
1/5/2009 23:55	2.65	51.7
2/24/2009 22:05	0.40	18.8
3/1/2009 14:20	0.33	17.5
3/14/2009 4:55	0.66	15.9
3/15/2009 5:05	1.02	52.7
3/28/2009 8:30	0.35	20.6

Date	Storm Precipitation (in)	Storm Duration (hour)
4/1/2009 7:30	0.50	18.3
4/2/2009 8:40	1.25	23.3
4/12/2009 3:25	0.98	15.2
5/4/2009 16:00	2.26	55.2
5/13/2009 14:30	1.01	19.1
5/18/2009 19:55	0.44	4.9
5/19/2009 19:50	0.42	1.6

4.3 Flow Monitoring Data

The following section gives an overview of the results for each monitoring site for the duration of the monitoring period (January 2008 through May 2009). A schematic of the monitor locations is shown in **Figure 4-5**. Each site includes a description of the site location, set-up, reoccurring problems encountered, if any, and data suitability for modeling purposes. The descriptions were compiled based on results from biweekly data reviews, monitoring workshops, and data screenings. Additional details, including site reports and hydrographs and scattergraphs can be found in Appendices B and D, respectively. ADS's service history and confirmations for all Henderson monitoring locations are included in Appendix E.

Summary details for the temporary monitors including overall monitor uptime (the percentage of time the monitor was actively recording data over the entire monitoring period), silt depths and range of measurements during the monitoring period are shown in **Table 4-3**. Specific detail regarding each site can be found on the ADS Site Installation Sheets in Appendix B. Detail on each monitor's uptime is included in Appendix F.

Table 4-3: Monitor Data Summary – Temporary Monitor Locations

Basin	Monitor	Overall Uptime	Silt / Sediment Depth (in)	Min/Mean/Max Recorded Depth (in)	Min/Mean/Max Recorded Velocity (fps)*	Min/Mean/Max Recorded Flow (mgd)*
44	067-191	95%		0.43 / 2.14 / 48.42	0 / 0.97 / 2.08	0 / 0.09 / 4.49
	067-271	100%		0.66 / 3.37 / 69.39	0 / 2.68 / 4.69	0 / 0.25 / 8.36
	067-275 MP1	89%		0 / 1.50 / 16.62	-2.12 / 0.04 / 10.13	-0.01 / 0.00 / 16.25
	067-275 MP2	94%		0 / 0.05 / 3.09	-4.73 / 0.01 / 4.79	-0.18 / 0.00 / 0.53
45	074-152	98%		1.00 / 2.23 / 28.37	0.00 / 1.14 / 4.61	0.00 / 0.06 / 1.04
	074-159	87%	0.25	1.00 / 4.07 / 42.03	0.00 / 0.69 / 3.41	0.00 / 0.09 / 1.27
46	081-059	99%		1.51 / 4.98 / 56.78	0.00 / 1.47 / 2.85	0.00 / 0.44 / 3.43

Basin	Monitor	Overall Uptime	Silt / Sediment Depth (in)	Min/Mean/Max Recorded Depth (in)	Min/Mean/Max Recorded Velocity (fps)*	Min/Mean/Max Recorded Flow (mgd)*
	D081-131	98%		0.58 / 2.91 / 46.07	0.00 / 1.70 / 9.08	0.00 / 0.99 / 148.45
47N	073-268	96%		0.00 / 2.81 / 28.75	0.00 / 3.39 / 7.51	0.00 / 0.54 / 9.96
	073-276	99%		1.15 / 3.06 / 13.94	2.39 / 4.96 / 7.85	0.19 / 1.00 / 11.81
	080-329	99%		3.45 / 6.24 / 48.10	0.69 / 1.43 / 3.64	0.28 / 1.30 / 26.39
	081-049	93%		0.86 / 1.26 / 12.42	0.00 / 2.07 / 4.34	0.00 / 0.07 / 0.54
	081-085	97%		2.62 / 5.48 / 32.10	0.00 / 1.91 / 3.73	0.00 / 0.84 / 4.74
	D081-069	99%	2.63	48.30 / 63.14 / 76.10	0.00 / 0.03 / 8.41	0.00 / 0.52 / 166.77
	081-239	98%	2.75	2.25 / 4.39 / 71.12	0.00 / 0.70 / 1.66	0.00 / 0.14 / 2.43
47S	081-120	99%		2.13 / 5.45 / 17.18	0.92 / 1.76 / 2.75	0.18 / 0.53 / 2.45
	081-139	98%		0.32 / 3.52 / 19.95	0.85 / 1.92 / 2.97	0.01 / 0.41 / 3.46
49	306-245	98%	0.13 / 0.25 †	1.36 / 3.82 / 187.41	0.00 / 0.61 / 1.79	0.00 / 0.05 / 1.21
	306-246	100%		4.13 / 6.76 / 49.00	0.65 / 1.74 / 9.82	0.10 / 0.53 / 4.92
	306-275	100%		4.97 / 8.68 / 94.05	0.00 / 1.04 / 3.27	0.00 / 0.44 / 2.40
	306-284	99%		0.11 / 0.75 / 12.54	0.00 / 2.57 / 7.67	0.00 / 0.06 / 3.15
	306-343	100%	4.88 / 3.00 ‡	5.97 / 7.68 / 38.64	-0.59 / 1.09 / 2.44	-0.63 / 0.40 / 5.93
	306-428	99%	2.5	3.89 / 10.68 / 106.20	0.00 / 0.87 / 5.44	0.00 / 0.43 / 5.81
171	081-237	100%		0.23 / 1.44 / 26.65	2.17 / 3.48 / 6.56	0.01 / 0.22 / 5.58
	306-192	100%		0.35 / 1.09 / 19.36	0.00 / 4.39 / 9.08	0.00 / 0.09 / 1.95

* Negative values indicate reverse flow across the sensor.

† Silt depth changed from 0.13” to 0.25” on 6/11/2008

‡ Silt depth changed from 4.88” to 3.00” on 12/16/2008

Some of the permanent flow monitors also are used to measure flows during both dry and wet weather upstream of the diversion weir. Although the primary purpose for these monitors is to obtain CSO volumes and flows, the data collected also were used to supplement the basin characterization data collected by the temporary monitors.

Because of complex hydraulic conditions inherent at the monitoring sites, it was common that many of these sites did not have high quality flow data for both dry and wet weather. Depth in excess of 1 inch and a velocity between 2 and about 4 feet per second (fps) are typically needed to yield high quality flow data. In addition to the

complex hydraulics of a site, one or more of the following conditions were present at many of the monitoring locations limiting their use in model calibration:

- A nearby downstream constriction, such as a HydroBrake, resulting in backwatering and velocity dropouts
- Pipe material or shape that cause uneven flow (standing waves)
- Non-uniform weir elevations
- Frequent debris or sediments that accumulate on the monitoring sensor

An evaluation of the flow monitoring data at each site were made based on the repeatability of data patterns, capability of the monitor to measure accurately due to local site conditions, presence and frequency of data gathering issues, overall monitor uptime, and review of the data by the modeling team. This data evaluation made a distinction between dry weather flow and wet weather flow, as well as between depth and velocity readings.

Table 4-4 shows an estimation of data quality for each monitoring location. Quality ratings of "Good", "Fair" and "Poor" were assigned to both the depth and velocity data collected at each site, as well as the overall quality of dry weather flow (DWF) and wet weather flow (WWF). If a sensor was located on the dry-side of a weir, it was not possible to perform sensor confirmations and therefore its confidence rating was considered "Fair". Further discussion of each site is included below.

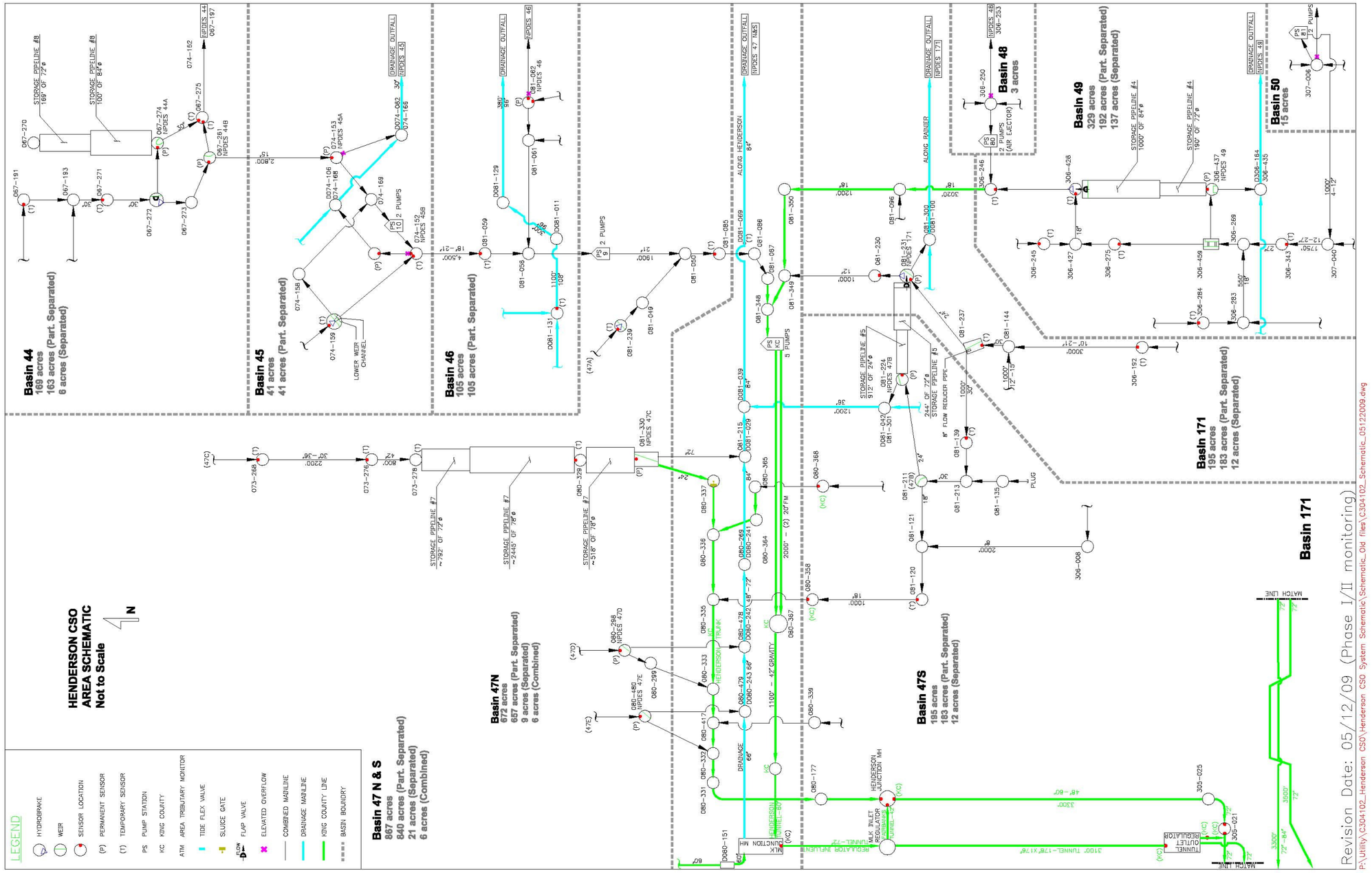

Figure 4-6: Monitor Schematic

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Table 4-4: Monitor Data Quality

Basin	Location	Install Date	End Date	Depth Quality	Velocity Quality	DWF Quality	WWF Quality	Notes
44	067-274 (NPDES 44A)	7/27/07	Ongoing	Good	Fair	N/A	Fair	Downstream of high-flow weir; At higher depths a velocity gradient may have been introduced which was not measurable by the sensor.
	067-261 (NPDES 44B)	7/30/07	Ongoing	Good	Good	Good	Good	
	067-191	1/3/08	6/3/09	Good	Good	Good	Good	
	067-271	1/11/08	Ongoing	Good	Poor	Good	Poor	Velocity readings high during wet weather
	067-275 MP1	3/25/08	6/18/09	Good	Fair	N/A	Fair	30-inch pipe; downstream of CSO weir
	067-275 MP2	3/25/08	6/18/09	Good	Fair	N/A	Fair	15-inch pipe; downstream of CSO weir
45	074-153 MP1 (NPDES 45A)	8/2/07	Ongoing	Good	Good	Good	Good	
	074-153 MP2 (NPDES 45A)	4/14/09	Ongoing	Good	Fair	N/A	Fair	In elevated overflow pipe
	074-167	7/24/07	Ongoing	Good	Fair	N/A	Fair	In elevated overflow pipe
	074-152	1/3/08	6/23/09	Good	Good	Good	Good	
	074-159	1/9/08	6/3/09	Good	Poor	Poor	Poor	Turbulence in MH caused poor velocity readings
46	081-062 MP1 (NPDES 46)	7/24/07	Ongoing	Good	Fair	Fair	Good	Low flows difficult to measure during dry weather due to flat slope in pipeline
	081-062 MP2 (NPDES 46)	7/24/07	Ongoing	Good	Fair	N/A	Fair	In elevated overflow pipe
	081-059	1/9/08	Ongoing	Good	Good	Good	Good	
	D081-131	3/6/08	6/3/09	Good	Good	N/A	Good	Stormwater
47N	081-330 (NPDES 47C)	8/28/08	Ongoing	Good	Good	Good	Good	
	080-298 (NPDES 47D)	8/6/07	Ongoing	Good	Good	Good	Good	

Basin	Location	Install Date	End Date	Depth Quality	Velocity Quality	DWF Quality	WWF Quality	Notes
	080-480 (NPDES 47E)	8/6/07	Ongoing	Good	Good	Good	Good	
	073-268	1/8/08	6/3/09	Good	Good	Good	Good	
	073-276	1/11/08	6/3/09	Good	Good	Good	Good	
	080-329	1/15/08	6/3/09	Good	Good	Good	Good	
	081-049	12/12/08	6/4/09	Good	Good	Good	Good	
	081-085	1/10/08	Ongoing	Good	Good	Good	Good	
	D081-069	3/6/08	6/3/09	Good	Good	Good	Good	Site always in backwater from Lake Washington
	081-239	1/11/08	6/4/09	Good	Good	Good	Good	
47S	081-224 (NPDES 47B)	8/6/07	Ongoing	Good	Fair	N/A	Fair	Downstream of high flow weir
	081-120	1/10/08	6/3/09	Good	Good	Good	Good	
	081-139	1/10/08	6/3/09	Good	Good	Good	Good	
49	306-437 (NPDES 49)	8/6/07	Ongoing	Good	Fair	N/A	Fair	Downstream of high flow weir
	306-245	1/8/08	6/4/09	Good	Fair	Fair	Fair	Low flows difficult to measure during dry weather
	306-246	1/9/08	Ongoing	Good	Poor	Good	Poor	Velocity readings high during wet weather
	306-275	1/9/08	6/4/09	Good	Good	Good	Good	
	306-284	1/11/08	5/29/09	Good	Good	Good	Good	
	306-343	1/11/08	6/4/09	Good	Good	Good	Good	
	306-428	4/16/08	Ongoing	Good	Good	Good	Good	
171	081-231 (NPDES 171)	8/28/07	Ongoing	Good	Fair	N/A	Fair	Downstream of high flow weir
	081-237	1/10/08	Ongoing	Good	Good	Good	Good	
	306-192	1/9/08	6/4/09	Good	Good	Good	Good	

4.3.1 CSO Basin 44 Monitors

Three temporary and two permanent monitors were located in Basin 44 during the monitoring period. The temporary monitors were used to help characterize basin flows and, along with one of the permanent monitors, used to help develop a HydroBrake stage-discharge curve. All elevations are given in NAVD88.

Monitor 067-191

Monitor 067-191 was installed on January 3, 2008 and removed on June 3, 2009. It was located northern portion of Basin 44 north of Seward Park in Lake Washington Boulevard South. Flows from this basin flowed toward the Basin 44 CSO Facility # 8 and was used to characterize basin flows. Site specifics are as follows:

- Sensor location pipe size: 24 inches
- Sensor location pipe invert elevation: 25.1 (from GIS)
- Typical flow regime: Subcritical flow

Data from this site were generally repeatable during wet weather events. This site periodically experienced backwater from downstream conditions. No significant recurring issues were encountered during the monitoring period. The data were usable for basin characterization and model development.

Monitor 067-271

Monitor 067-271 was installed on January 11, 2008 and remains in place. It is located in Basin 44 upstream of CSO Facility #8 on Lake Washington Boulevard South. This monitor was used, along with monitor 067-274, to develop the HydroBrake stage-discharge curve for the HydroBrake located in MH 067-272. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 22.98 (from GIS)
- Typical flow regime: Supercritical but transitions to subcritical when backwater conditions occur due to HydroBrake downstream

Data from this site were usable during dry weather. This site periodically experienced backwater from the downstream HydroBrake. During wet weather, velocity readings tended to be high, causing a flow imbalance when compared to flows reaching MH 067-274. **Figure 4-7** shows the difference between flow volumes for the monitors during rain events in April 2009. If the monitors were reading properly, volume differences should be at or near zero. (Small variations are expected due to travel time between the monitors.) As the figure shows, a positive imbalance occurs during wet weather indicating that measured flows are higher at the monitor at 067-271.

Thus, for this monitor during wet weather only depth was reliable. Velocity and flow are usable only during dry periods.

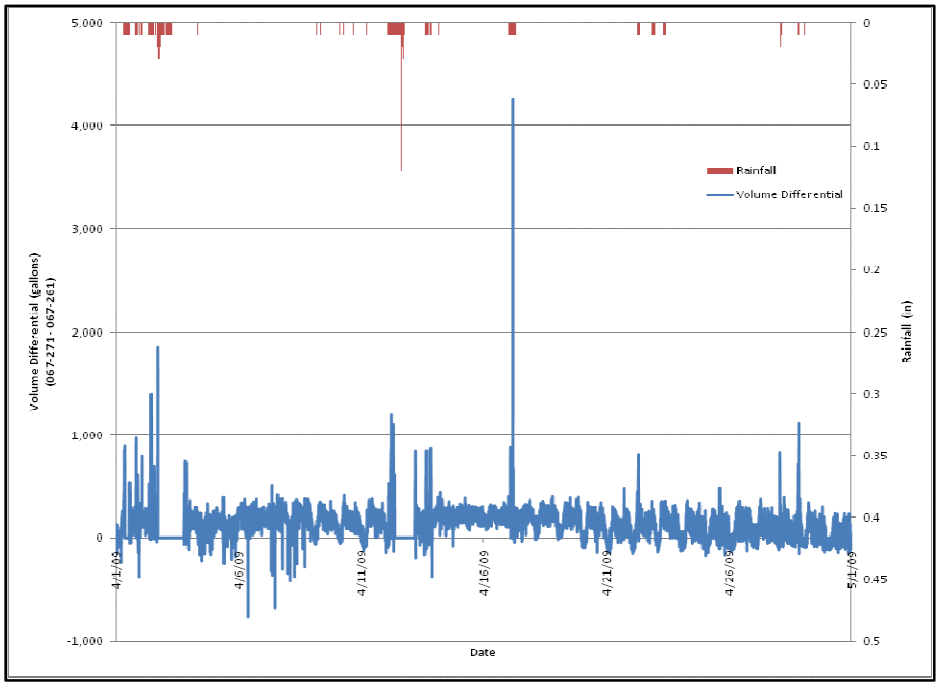

Figure 4-7: Volume Imbalance Between Monitors 067-271 and 067-274

Monitor 067-275

Monitor 067-275 was installed on March 25, 2008 and removed on June 16, 2009. This monitor included two sets of sensors. These sensors are located downstream of the CSO structures at 44A and 44B in the outfall pipe for Basin 44. There is one set of sensors in the 30-inch pipeline from 44A and one set of sensors in the 15-inch pipe from 44B. Site specifics are as follows:

- Sensor MP1 location pipe size: 30 inches
- Sensor MP1 location pipe invert elevation: 18.2 (from GIS)
- Sensor MP2 location pipe size: 15 inches
- Sensor MP2 location pipe invert elevation: 19.8 (from GIS)

Data from this monitor set were used primarily to verify the occurrences and volumes of overflows.

Monitor 067-274 (NPDES 44A)

Monitor 067-274 is a permanent monitoring location. The monitor was installed on July 27, 2007 and is located in the Basin 44A CSO structure in Seward Park. The monitor's sensors are located downstream of the high flow weir into CSO Storage Facility #8. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 21.43 (from survey performed February 2009)

- High flow weir elevation (in MH 067-272): 26.95 (from survey performed February 2009)
- CSO weir elevation: 27.89 (from survey performed February 2009)

This monitor is used to record the occurrence and volume of CSO events. The depth also is used to estimate storage utilization in the storage facility. At higher depths, a velocity gradient may have been introduced which was not measurable by the sensor.

Monitor 067-261 (NPDES 44B)

Monitor 067-261 is a permanent monitoring location. The monitor was installed on July 30, 2007 and is located in the Basin 44B CSO structure in Seward Park. The monitor's sensors are located in the mainline which enables data to be used to help characterize basin flow in addition to being used for CSO reporting. Site specific are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 21.15 (from survey performed February 2009)
- CSO weir elevation: 23.49 (from survey performed February 2009)
- Typical flow regime: Subcritical flow

This monitor is downstream of a HydroBrake and flow and depth information was used along with data from monitor 067-271 to develop the HydroBrake stage-discharge curve. See Section 5.2.1 for information on the development of the HydroBrake stage-discharge curve.

Data from this site were generally repeatable during wet weather events. This site periodically experienced backwater from downstream conditions. No significant recurring issues were encountered during the monitoring period. The collected data were usable for basin characterization and model development.

4.3.2 CSO Basin 45 Monitors

Two temporary and two permanent monitors were located in Basin 45 during the monitoring period. The temporary monitors were used to help characterize basin flows and used to help develop a HydroBrake stage-discharge curve.

Monitor 074-152

Monitor 074-152 was installed on January 3, 2008. A second sensor was installed in the overflow pipe on June 11, 2009. The mainline sensor was removed on June 23, 2009. The second sensor will remain in place and be used in the future to assist with CSO reporting. The monitor is located in Martha Washington Park in 57th Avenue South. This location is downstream of the HydroBrake located in MH 074-159 and was used to characterize basin flow and help develop a HydroBrake stage-discharge curve. Site specifics are as follows:

- Sensor MP1 location pipe size: 8 inches

- Sensor MP1 location pipe invert elevation: 23.39 (from survey performed March 2009)
- Sensor MP2 location pipe size: 8 inches
- Sensor MP2 location pipe invert elevation: 25.27 (from survey performed March 2009)
- Typical flow regime (at MP1): Subcritical flow

Data from this monitor, along with the data from monitor 074-159, were used to help develop a HydroBrake stage-discharge curve (see Section 5.2.2). Since silt/sediment problems made it difficult to obtain accurate flow readings at monitor 074-159, this monitor was used to characterize flows from Basin 45.

Data from this site were repeatable and generally usable. Evidence of a downstream overflow was seen at this monitor (**Figure 4-8**) but after several field investigations, the location of the overflow was not determined. No visible sign of a surface overflow was found. It is possible that the overflow signature is being caused by the root intrusion problems seen in the Lake Line downstream of this location (see Section 5.6.1). The line was cleaned in late January 2009. Data from late January through March of 2008 show no signs of the overflow signature. However, rainfall events were smaller during this time period and may not have been strong enough to trigger the overflow event. With increased rainfall activity in April through June 2009, the overflow signature returns.

The signature also may be caused by flows backing up into a side sewer connection, but that has not been confirmed by the City.

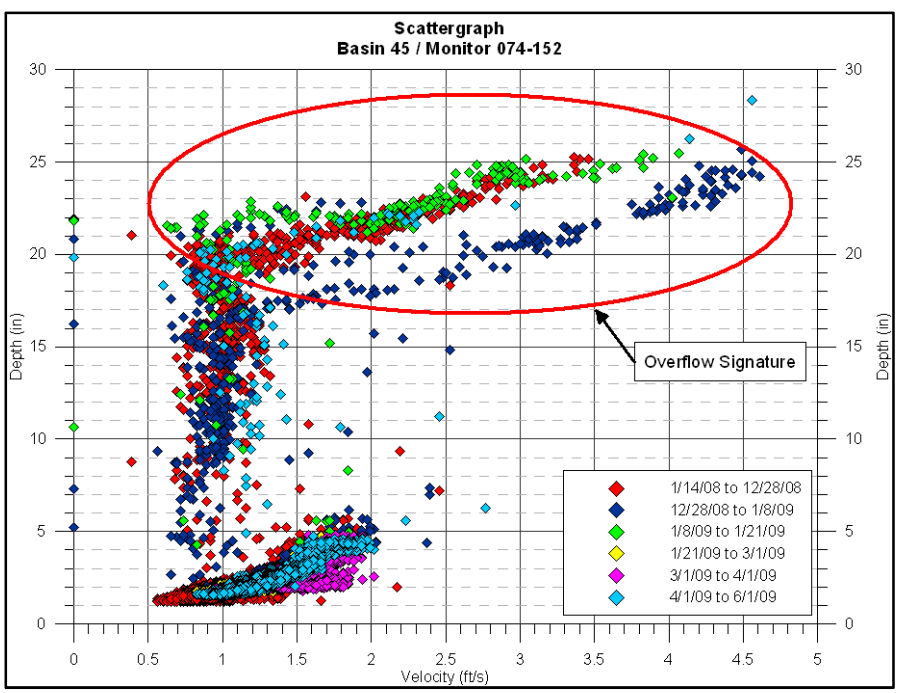

Figure 4-8: Overflow Signature in Monitor 074-152 data

Monitor 074-159

Monitor 074-159 was installed on January 9, 2008 and was removed on June 3, 2009. It was located in Martha Washington Park in 57th Avenue South. Flows from a portion of Basin 45 were captured by this monitor. It was used to help develop a HydroBrake stage-discharge curve. Site specifics are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 24.2 (from GIS)
- High flow weir elevation: 27.3 (from as-built drawings)
- Typical flow regime: Subcritical flow

This monitor is in the same MH as a HydroBrake and was used, along with monitor 074-152, to develop the HydroBrake stage-discharge curve. See Section 5.2.2 for information on the development of the HydroBrake stage-discharge curve.

Data from this site were repeatable. Velocity was difficult to measure due to silt/sediment buildup, approximately 0.25 inches, at the HydroBrake which caused unstable flow patterns. Thus, velocity and flow readings at this site are not recommended to be used for hydraulic modeling purposes.

Monitor 074-153 (NPDES 45A)

Monitor 074-153 is a permanent monitoring location. This monitor was installed on August 2, 2007 and is located in Martha Washington Park in 57th Avenue South. This monitor is used to indicate CSO events and help estimate CSO volume. CSO events occur when depths are sufficient to reach the elevated overflow pipe.

At the beginning of the monitoring period, the elevated overflow pipe had an upturned elbow. This elbow prevented water from Lake Washington from entering the system. In November 2008, this elbow was removed due to maintenance activity. The site was reconfigured in May 2009. Site specifics are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 16.43 (from as-built drawings)
- Elevated pipe invert elevation (no elbow): 18.3 (from survey performed summer 2008)
- Overflow weir elevation: TBD (survey currently being conducted by SPU)

Data from this site were repeatable and usable for basin characterization. In late April 2009, the Army Corps of Engineers raised the level of Lake Washington causing water from the Lake to enter the system at this location. Data recorded at this monitor and monitors downstream during the middle of April through the middle of May should be used with caution due to the additional input of flow from Lake Washington.

Monitor 074-167 (NPDES 45B)

Monitor 074-167 is a permanent monitoring location. This monitor was installed on July 24, 2007 and is located in Martha Washington Park in 57th Avenue South. This sensor is located in an overflow pipe to Outfall 45. The overflow pipe originates at MH 074-152. CSOs at 44B are directly measured by this monitor. Site specifics are as follows:

- Sensor location pipe size: 8 inches
- Sensor location pipe invert elevation: 24.7 (from GIS)
- Overflow pipe invert elevation at MH 074-152: 25.27 (from survey performed March 2009)

Monitoring data showed that this site experienced a constant depth of about 2 inches. Occasional flows were recorded at this location when depths at 074-152 were not high enough to reach the overflow pipe invert elevation. These measured flows may have been a result of flow entering the system through the MH cover at this location. Work is being done to relocate this sensor to a better hydraulic location one pipe segment downstream to MH 074-106. This new site will record CSO volume, while the sensor in the overflow pipe at MH 074-152 will be used to indicate CSO occurrence.

For hydraulic model development data from this site were only used to evaluate system behavior. The data were not relied upon for quantifiable performance. Additional information on how data from this site were used in the development of the hydraulic model can be found in the Henderson Modeling Report (CH2M HILL, Publication Pending).

4.3.3 CSO Basin 46 Monitors

One temporary monitor, one permanent monitor, and one storm system monitor was located in Basin 46 during the monitoring period. The temporary and permanent monitors were used to help characterize basin flow. The storm monitor was used to characterize stormwater flow from the Basin.

Monitor 081-059

Monitor 081-059 was installed on January 9, 2008 and remains in place. It is located east of Seward Park Avenue South between South Kenyon Street and South Budd Court, upstream of Pump Station 9. Data from this monitor were used to characterize flows from the northern portion of Basin 46. Site specifics are as follows:

- Sensor location pipe size: 21 inches
- Sensor location pipe invert elevation: 16.5 (from GIS)
- Typical flow regime: Subcritical flow

Data from this monitor were repeatable and no significant recurring issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-062 (NPDES 46)

Monitor 081-062 is a permanent monitoring location. This monitor was installed on July 24, 2007 and is located on Island Drive South on Prichard Island. There are two sensors at this location. One sensor is located in the main sewer line and the other is located in the elevated overflow pipe to the outfall. This location also serves as the Pump Station #9 overflow relief point. Site specifics are as follows:

- Sensor MP1 location pipe size: 21 inches
- Sensor MP1 location pipe invert elevation: 16.24 (from survey performed April 2009)
- Sensor MP2 location pipe size: 12 inches
- Sensor MP2 location pipe invert elevation: 18.96 (from survey performed April 2009)
- Typical flow regime (mainline): Subcritical flow

Velocity at sensor MP1 was difficult to measure during dry weather due to flat slopes and low volumes. For this reason, velocity and flow were not as reliable as depth. With the increased volume associated with wet weather, data quality improved. Data collected at this site were usable for basin characterization and model development during wet weather. Data should be used with caution during dry periods.

Sensor MP2 records CSO occurrences and volumes. During the monitoring period, there were instances when this sensor recorded a CSO event but depths recorded at Sensor MP1 did not reach the overflow pipe elevation. This location is immediately adjacent to Lake Washington and lake level was checked relative to sensor location. It did not appear that lake level reached the sensor during the monitoring period. It is possible that surface runoff or other forms of inflow/infiltration may be affecting this sensor. Further fieldwork is being done to identify the potential cause of these "false" measurements.

Monitor D081-131

Monitor D081-131 was installed in a stormwater line on March 5, 2008 and was removed on June 3, 2009. The monitor was located at Cloverdale Place South and Wabash Avenue South. The monitor was intended to characterize stormwater flow in the basin. Site specifics are as follows:

- Sensor location pipe size: 108 inches
- Sensor location pipe invert elevation: 36.7 (from GIS)

This location was impacted to some extent by levels in Lake Washington. Data collected were repeatable and, despite a constant level due to the lake, response to storms was observed with increases in depth and velocity.

4.3.4 CSO Basin 47 Monitors

Basin 47 consists of two parts; a northern section, 47N, and a southern section, 47S. The northern portion encompasses the area to the north of South Henderson Street. The southern portion encompasses the area to the south of Rainier Avenue South. Eight temporary monitors, four permanent monitors and one storm system monitor were located in Basin 47 during the monitoring period. The temporary monitors were used to characterize basin flow and help to develop a HydroBrake stage-discharge curve. Three of the permanent monitors in this basin also were used to characterize basin flow in addition to registering and quantifying CSO events.

Monitor 073-268

Monitor 073-268 was installed on January 8, 2008 and was removed on June 3, 2009. It was located on Rainier Avenue South, south of South Holly Street. Data from this monitor were used to characterize basin flow for the upper reaches of Basin 47N. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 83.3 (from GIS)
- Typical flow regime: Supercritical flow

Data from this monitor were repeatable and no significant recurring issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 073-276

Monitor 073-276 was installed on January 11, 2008 and was removed on June 3, 2009. It was located on Rainier Avenue South and South Fontanelle Street. Data from this monitor were used to characterize basin flow for the mid-area of Basin 47N. Site specifics are as follows:

- Sensor location pipe size: 43 inch
- Sensor location pipe invert elevation: 45.9 (from GIS)
- Typical flow regime: Supercritical flow

Data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 080-329

Monitor 080-329 was installed on January 15, 2008 and was removed on June 3, 2009. It was located on Rainier Avenue South north of South Henderson Street in the upstream section of a large in-line storage pipeline. Data from this monitor were used to characterize basin flow for the southern area of Basin 47N. Site specifics are as follows:

- Sensor location pipe size: 78 inches

- Sensor location pipe invert elevation: 28.2 (from GIS)
- Typical flow regime: Subcritical flow

Data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-049

Monitor 081-049 was installed on December 12, 2008 and removed on June 4, 2009. It was located in Seward Park Avenue South north of South Henderson Street in Basin 47N just downstream of the HydroBrake at MH 081-239. Site specifics are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 19.1 (from GIS)

Flow and depth data from this monitor were used, along with data from monitor 081-239, to develop a HydroBrake stage-discharge curve for the HydroBrake located at MH 081-239 (see Section 5.2.3). Data were repeatable with no significant issues reported.

Monitor 081-085

Monitor 081-085 was installed on January 10, 2008 and remains in service. It is located in Seward Park Avenue South just north of South Henderson Street. It reports total flow from Basins 44, 45, 46 and parts of Basin 47N. This flow enters King County's Henderson Pump Station. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 17.7 (from GIS)
- Typical flow regime: Subcritical flow

Data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-120

Monitor 081-120 was installed on January 10, 2008 and removed on June 3, 2009. It was located at Rainier Avenue South and 51st Street South. This monitor reported flow from a portion of Basin 47S and Basin 171. Flows from this location are directed to the King County system toward the Henderson Tunnel facility. Site specifics are as follows:

- Sensor location pipe size: 18 inches
- Sensor location pipe invert elevation: 29.2 (from GIS)
- Typical flow regime: Subcritical flow

There is a King County monitor just downstream of this location at MH 080-358 (on 50th Avenue South behind the Rainier Beach Library). Data between monitor 081-120 and the

King County monitor generally agreed. Data from the King County monitor are representative of flows from this portion of the Henderson Area.

Data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-139

Monitor 081-139 was installed on January 10, 2008 and removed on June 3, 2009. It was located on Rainier Avenue South and 53rd Avenue South. This monitor recorded dry weather flow from Basins 171 and portions of Basin 47S. It was used to characterize basin flow from these areas. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 31.2 (from GIS)
- Typical flow regime: Transitions from supercritical to subcritical as backwater effects occur

Backwater effects occur periodically due to the downstream high flow weir located a MH 081-211. Generally data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-239

Monitor 081-239 was installed on January 11, 2008 and was removed on June 4, 2009. It was located in Seward Park Avenue South north of South Henderson Street in Basin 47N. This monitor was at the downstream end of in-line storage and was at the location of a HydroBrake. Site specifics are as follows:

- Sensor location pipe size: 60 inches
- Sensor location pipe invert elevation: 19.6 (from GIS)
- Typical flow regime: Subcritical flow

Depth data from this monitor, along with data from monitor 081-049, were used to develop the HydroBrake stage-discharge curve for the HydroBrake located in this same MH (see Section 5.2.3). The data also were used to characterize basin flow from a portion of Basin 47N.

Silt buildup at this location was common. Despite this, data from this monitor were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-224 (NPDES 47B)

Monitor 081-224 is a permanent monitoring location. This monitor was installed on August 6, 2007 and is located at the intersection of Rainier Avenue South and 52nd Avenue South in 47S at the west end of the storage pipe of CSO Facility #5. This monitor

is downstream of a high flow weir located at MH 081-211 and only receives wet weather flows. Site specifics are as follows:

- Sensor location pipe size: 24 inches
- Sensor location pipe invert elevation: 30.12 (from survey performed Spring 2008)
- High flow weir elevation (MH 081-211): 31.85 (from survey performed April 2009)
- CSO weir elevation: 32.08 (from survey performed Spring 2008)

In addition to indicating CSO events and volumes, data from this monitor were used in conjunction with data from monitor 081-231 to evaluate storage utilization for CSO Facility #5. Data were repeatable and of sufficient quality for storage characterization and model development.

Monitor 081-330 (NPDES 47C)

Monitor 081-330 is a permanent monitoring location. This monitor was installed on August 28, 2008 and is located in Basin 47N at South Henderson Street and Rainier Avenue South. This monitor captures most of the flow from the northern portion of Basin 47 and is at the downstream end of an inline storage pipe facility. Site specifics are as follows:

- Sensor location pipe size: 76 inches
- Sensor location pipe invert elevation: 27.77 (from survey performed March 2009)
- CSO weir elevation: 31.65 (from survey performed March 2009)

This monitor is used primarily to record the instance and volume of CSO events. The CSO weir at this location is approximately 30 feet long. This extreme length makes it difficult to measure CSO volumes accurately. Only one overflow occurred at this location during the monitoring period.

Since the monitor was located on the wet side of the weir, it also was used for basin characterization. Data collected were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 080-298 (NPDES 47D)

Monitor 080-298 is a permanent monitor location. This monitor was installed on August 6, 2007 and is located at South Henderson Street and 46th Avenue South in Basin 47N. This monitor records flow from a small portion of the western side of Basin 47N. Site specifics are as follows:

- Sensor location pipe size: 12 inches
- Sensor location pipe invert elevation: 39.26 (from survey performed March 2009)
- CSO weir elevation: 40.46 (NAVD88; from survey performed March 2009)

This monitor is used primarily to record the occurrence and volume of CSO events. Like the monitor at 47C, overflows also can be used for basin characterization. The data collected were repeatable and no significant issues were encountered during the monitoring period.

Monitor 080-480 (NPDES 47E)

Monitor 080-480 is a permanent monitoring location. This monitor was installed on August 6, 2007 and is located at South Henderson Street and Renton Avenue South in Basin 47N. This monitor records flow from a small area on the west side of Basin 47N. Site specifics are as follows:

- Sensor location pipe size: 10 inches
- Sensor location pipe invert elevation: 42.48 (from survey performed March 2009)
- CSO weir elevation: 43.49 (from survey performed March 2009)

This monitor is used primarily to record instance and volume of CSO events. Like monitors 47C and 47D, it also was used for basin characterization. The data collected were deemed repeatable and no overflows or significant issues were encountered during the monitoring period.

Monitor D081-069

Monitor D081-069 was installed in a stormwater line on March 6, 2008 and was removed on June 3, 2009. The monitor was located at South Henderson Street and Seward Avenue South. The monitor was intended to characterize stormwater flow in the basin. Site specifics are as follows:

- Sensor location pipe size: 84 inches
- Sensor location pipe invert elevation: 13.2 (from GIS)

This location was severely impacted by levels in Lake Washington and had measurable silt of over 2.5 inches. The majority of the pipe, approximately 65 inches, is filled with water from the lake. Data collected were repeatable and, despite the constant level due to the lake, response to large storms was observed. Smaller storms did not register a significant enough change in depth or velocity to be reliably recorded by the monitoring sensors. Data were usable to characterize storm basin response to large storms.

4.3.5 CSO Basin 49 Monitors

There are six temporary monitors and one permanent monitor located in Basin 49. The temporary monitors were used to characterize basin flow and to help develop a HydroBrake stage-discharge curve. The permanent monitor was used to register and quantify CSO events and evaluate the use of CSO Facility #4.

Monitor 306-245

Monitor 306-245 was installed on January 8, 2008 and was removed on June 4, 2009. It is located on Rainier Avenue South just south of South Pilgrim Street. The monitor captures flow from a small area in the northern portion of Basin 49. Site specifics are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 30.7 (from GIS)
- Typical flow regime: Subcritical flow

Velocity was difficult to measure accurately due to low flow volumes during dry weather. This location also was impacted by the larger flows from the south (from MH 306-275) and the weir and HydroBrake located in CSO Facility #4. These downstream system constraints caused backwater conditions to frequently occur, especially during wet weather. Depths as high as 15 feet and silt with depths varying from 0.13 inches to 0.25 inches were recorded at this location.

Dry weather data should be used with caution at this location due to the low velocities experienced. There were issues with high depth measurements early in the monitoring period, but this was corrected by ADS and all depth measurements should now be correct. Despite these issues, monitoring data at this site were deemed to be sufficient for model development.

Monitor 306-246

Monitor 306-246 was installed on January 9, 2008 and remains in place. It is located in Rainier Avenue South north of CSO Facility #4 and downstream of the HydroBrake at MH 306-428. Flow measured by this monitor continues to the King County Henderson Pump Station. Site specifics are as follows:

- Sensor location pipe size: 12 inch
- Sensor location pipe invert elevation: 28.1 (from GIS)
- Typical flow regime: Subcritical flow

Data from this monitor were used, in conjunction with data from monitor 306-428, to help develop a HydroBrake stage-discharge curve for the HydroBrake in MH 306-428. (Section 5.2.5) describes this process.

Initial evaluation of collected data indicated that the data looked usable. However, issues were identified when comparing flow data to that collected at monitor 306-428. Similar to findings at monitor 067-271, velocity readings tended to be high during wet weather causing a flow imbalance when compared to flows at 306-428. A volume balance performed at these two locations was performed for data collected during November 2009. **Figure 4-9** shows results of that analysis. The figure shows that a negative imbalance occurs during wet weather. If the monitors were reading properly, volume differences should be at or near zero. (Small variations are expected due to travel time between monitors.) The negative imbalance indicates that measured flows are higher at monitor 306-246.

Thus, for basin characterization and model development, only depth was reliable during wet weather. All measurements (depth, velocity and flow) are usable during dry periods.

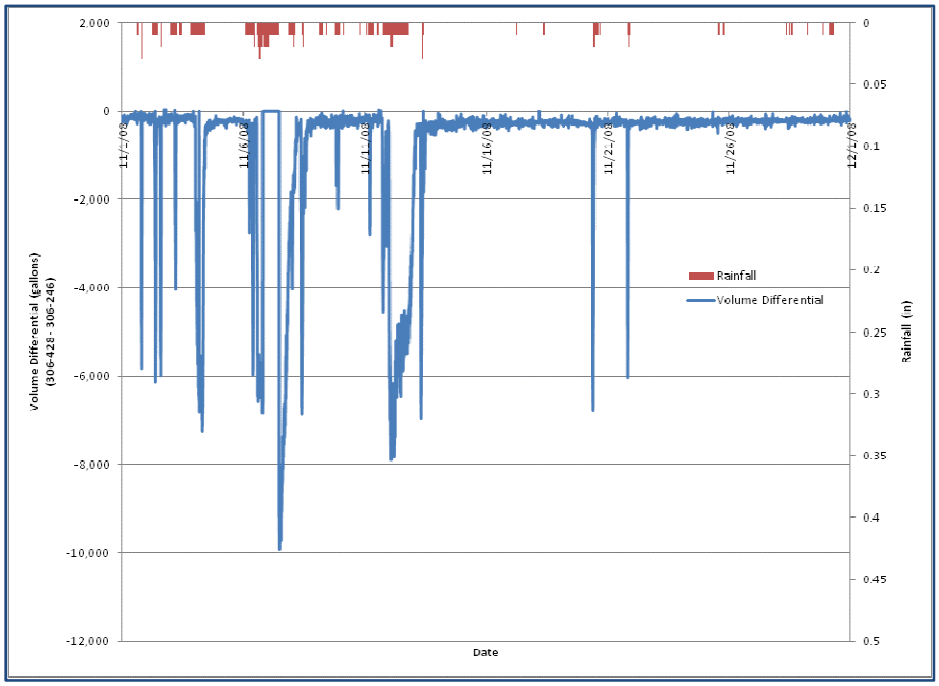

Figure 4-9: Volume Imbalance Between Monitors 306-428 and 306-246

Monitor 306-275

Monitor 306-275 was installed on January 9, 2008 and was removed on June 4, 2009. It was located on Rainier Avenue South just south of South Pilgrim Street. This monitor captured all dry weather flows from Basin 49 with the exception of that measured by monitor 306-245. Site specifics are as follows:

- Sensor location pipe size: 15 inches
- Sensor location pipe invert elevation: 28.7 (from GIS)
- Typical flow regime: Subcritical flow

This location experienced backwater during wet weather due to system backups caused by the HydroBrake and weir in CSO Facility #4. Data collected at this location were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 306-284

Monitor 306-284 was installed on January 11, 2008 and removed on May 29, 2009. It was located in the roadway in front of 9926 Waters Avenue South in the northwest-heading side of the road. This monitor collected flow from the western portion of Basin 49. Site specifics are as follows:

- Sensor location pipe size: 18 inches
- Sensor location pipe invert elevation: 158.5 (from GIS)
- Typical flow regime: Supercritical flow

Data collected at this location were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 306-343

Monitor 306-343 was installed on January 11, 2008 and removed on June 4, 2009. It was located on Rainier Avenue South between South Cooper Street and South Thayer Street. It collected flow from the eastern portion of Basin 49. Site specifics are as follows:

- Sensor location pipe size: 27 inches
- Sensor location pipe invert elevation: 35.3 (from GIS)
- Typical flow regime: Subcritical flow

This site experienced significant silt buildup; between 3 and 5 inches of silt was observed. In addition, backwater effects were observed during wet weather events due to the system constraints at the downstream end of CSO Facility #4. In spite of these difficulties, data collected were repeatable and deemed usable for basin characterization and model development.

Monitor 306-428

Monitor 306-428 was installed on April 16, 2008 and remains in place. It is located in Rainier Avenue South at the downstream end of CSO Facility #4, upstream of the HydroBrake located in the same MH. Flow entering this location is controlled by the downstream HydroBrake. As flows back up, flows overtop a weir into the storage at CSO Facility #4. Flow is released into this MH from the storage facility through a duckbill valve. Site specifics are as follows:

- Sensor location pipe size: 18 inches
- Sensor location pipe invert elevation: 28.32 (from survey performed April 2009)
- Storage baffle weir elevation: 34.69 (from survey performed April 2009)
- Typical flow regime: Subcritical flow

Data from this site, along with data from monitor 306-246, were used to help develop a HydroBrake stage-discharge curve for the HydroBrake at this location (see Section 5.2.5). Silt buildup of 2.5 inches was recorded. Data were repeatable and no significant issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 306-437 (NPDES 49)

Monitor 306-437 is a permanent monitoring location. This monitor was installed on August 6, 2007 and is located at Rainier Avenue South and South Cooper Street at the south end of CSO Facility #4. This monitor is downstream of a high flow weir located at MH 306-459 and only receives wet weather flows. Site specifics are as follows:

- Sensor location pipe size: 72 inches

- Sensor location pipe invert elevation: 30.91 (from survey performed December 2008)
- High flow weir elevation (MH306-459): 36.85 (from survey performed April 2009)
- CSO weir elevation: 36.64 (from survey performed December 2008)

In addition to being used to indicate CSO occurrence and volume, data from this monitor were used to evaluate storage utilization in CSO Facility #4. Mainly depth was evaluated during the monitoring period. Generally data were found to be repeatable and usable for storage characterization and model development.

4.3.6 CSO Basin 171 Monitors

During the monitoring period there were two temporary monitors and one permanent monitor located in Basin 171. The temporary monitors were used to characterize basin flows. An additional temporary monitor was installed after the end of the monitoring period (i.e., after May 31, 2009). This temporary monitor, along with the permanent monitor, will be used to help develop a HydroBrake stage-discharge curve. The permanent monitor registers and quantifies CSO events and helps to evaluate storage usage at CSO Facility #7.

Monitor 081-229

Monitor 081-229 was installed on June 24, 2009. It is located in Seward Park Avenue South just south of South Fisher Place. It is located downstream of the HydroBrake located at 081-231. There is a small stormwater connection just upstream of this location. Site specifics are as follows:

- Sensor location pipe size: 12 inches
- Sensor location pipe invert elevation: 23.0 (from GIS)

This monitor was installed after the monitoring period. Future data collected along with the monitor at 081-231 will be used to develop a HydroBrake stage-discharge curve for the HydroBrake in 081-231. Data from this monitor will assist in the calculation of flows entering the King County Henderson Pump Station from CSO Basin 171.

Monitor 081-237

Monitor 081-237 was installed on January 10, 2008. It is located along Rainier Avenue South west of 57th Avenue South. This monitor captures flow from the northern portion of Basin 171. The monitor is located in the same MH as a high flow weir. Flows over this weir enter the eastern end of storage at CSO Facility #5. Site specifics are as follows:

- Sensor location pipe size: 30 inches
- Sensor location pipe invert elevation: 33.27 (from survey performed April 2009)
- High flow weir elevation: 33.83 (from survey performed April 2009)
- Typical flow regime: Supercritical flow

Data from this monitor were repeatable and no significant recurring issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 306-192

Monitor 306-192 was installed on January 9, 2008 and was removed on June 4, 2009. It was located at South Gazelle Street and 59th Avenue South. This monitor captured flow from the southern portion of Basin 171. Site specifics are as follows:

- Sensor location pipe size: 8 inches
- Sensor location pipe invert elevation: 206.7 (from GIS)
- Typical flow regime: Supercritical flow

Data from this monitor were repeatable and no significant recurring issues were encountered during the monitoring period. The data were deemed usable for basin characterization and model development.

Monitor 081-231 (NPDES 171)

Monitor 081-231 is a permanent monitoring location. This monitor was installed on August 28, 2007 and is located in Rainier Avenue South at the eastern end of CSO Facility #5. Flow entering this location continues on through a HydroBrake to King County Henderson Pump Station. As the HydroBrake causes flow to back up, flow overtops the baffle weir into storage at CSO Facility #5. When storage is filled, flow overtops the CSO weir to outfall 171. Site specifics are as follows:

- Sensor location pipe size: 24 inches
- Sensor location pipe invert elevation: 25.34 (from survey performed spring 2008)
- Baffle weir elevation: 27.86 (from survey performed spring 2008)
- CSO weir elevation: 32.11 (from survey performed spring 2008)

Data from this monitor will be used, in conjunction with data from monitor 081-229, to develop a HydroBrake stage-discharge curve for the HydroBrake at this location. Depth data were used to evaluate storage performance for CSO Facility #5.

No significant recurring issues were encountered during the monitoring period at this location. This site only receives flow when flows overtop the high flow weir at MH 081-237. Thus flow confirmations at this location are difficult to achieve. The data were deemed usable at this site but care should be taken due to the difficulty to achieve flow confirmations.

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5 System Operation during Monitoring Period

5.1 Combined Sewer Overflows

Fifty-two separate CSOs occurred during the flow monitoring period. Most of these occurred at Outfall 44, specifically at CSO structure 44B. A list of the CSO events that occurred during the monitoring period is shown in Table 5-1. Information included in this table was obtained from ADS's monthly CSO reports.

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Table 5-1: Henderson CSO Summary – January 2008 through May 2009

CSO Event		Outfall 44			Outfall 45			Outfall 46	Outfall 47 – North				Outfall 47 – South	Outfall 171	Outfall 49
		44A	44B	TOTAL	45A	45B	TOTAL	46	47C	47D	47E	TOTAL	47B	171	49
2008															
1/9/08	Start Time:		23:50												
	Duration (hr:min):		22:10												
	Volume (gallons):		50,237	**50,237**											
1/10/08	Start Time:					20:20									
	Duration (hr:min):					0:05									
	Volume (gallons):					233	**233**								
1/14/08	Start Time:		15:50												
	Duration (hr:min):		1:20												
	Volume (gallons):		8,112	**8,112**											
1/19/08	Start Time:		17:45												
	Duration (hr:min):		0:40												
	Volume (gallons):		2,452	**2,452**											
3/1/08	Start Time:		17:35												
	Duration (hr:min):		0:25												
	Volume (gallons):		1,413	**1,413**											
3/13/08	Start Time:							14:55							
	Duration (hr:min):							0:15							
	Volume (gallons):							375							
3/23/08	Start Time:		13:30		14:10	13:25		7:40						14:30	
	Duration (hr:min):		2:25		0:15	1:40		11:10						0:15	
	Volume (gallons):		46,717	**46,717**	2,103	14,115	**16,218**	238,740						32,346	
3/26/08	Start Time:							7:20							
	Duration (hr:min):							15:15							
	Volume (gallons):							497							
3/28/08	Start Time:		23:15					13:55							
	Duration (hr:min):		23:45					49:35							
	Volume (gallons):		20,730	**20,730**				273,111							
3/29/08	Start Time:					19:45									
	Duration (hr:min):					1:30									
	Volume (gallons):					4,031	**4,031**								

CSO Event		Outfall 44			Outfall 45			Outfall 46	Outfall 47 – North				Outfall 47 – South	Outfall 171	Outfall 49
		44A	44B	TOTAL	45A	45B	TOTAL	46	47C	47D	47E	TOTAL	47B	171	49
4/28/08	Start Time:							9:00							
	Duration (hr:min):							0:35							
	Volume (gallons):							14,410							
5/13/08	Start Time:							13:25							
	Duration (hr:min):							1:15							
	Volume (gallons):							18,438							
5/20/08	Start Time:							2:15							
	Duration (hr:min):							0:55							
	Volume (gallons):							8,000							
5/21/08	Start Time:		19:30												
	Duration (hr:min):		0:55												
	Volume (gallons):		9,393	**9,393**											
5/25/08	Start Time:							4:40							
	Duration (hr:min):							0:20							
	Volume (gallons):							4,947							
6/3/08	Start Time:		7:30												
	Duration (hr:min):		14:35												
	Volume (gallons):		2,908	**2,908**											
6/6/08	Start Time:		16:30												
	Duration (hr:min):		1:25												
	Volume (gallons):		24,998	**24,998**											
8/24/08	Start Time:	18:25	17:30											18:30	
	Duration (hr:min):	0:50	6:15											23:50	
	Volume (gallons):	77,570	20,452	**98,022**										77,914	
8/25/08	Start Time:												17:25		
	Duration (hr:min)												0:30		
	Volume (gallons):												2,539		
11/6/08	Start Time:	16:50	20:30			19:05							21:00	16:10	21:05
	Duration (hr:min)	16:00	10:15			9:45							0:15	16:45	11:10
	Volume (gallons):	253,721	111,793	**365,514**		281,806	**281,806**						588	2,757,124	9,138
12/27/08	Start Time:	13:20	13:05										12:00	12:05	
	Duration (hr:min)	28:55	30:05										17:30	17:40	
	Volume (gallons):	4,223	41,034	**45,257**									87,935	1,376,967	

CSO Event		Outfall 44			Outfall 45			Outfall 46	Outfall 47 – North				Outfall 47 – South	Outfall 171	Outfall 49
		44A	44B	TOTAL	45A	45B	TOTAL	46	47C	47D	47E	TOTAL	47B	171	49
12/28/08	Start Time:					15:55									
	Duration (hr:min)					19:15									
	Volume (gallons):					72,639	**72,639**								
2009															
1/6/09	Start Time:												23:10	23:10	
	Duration (hr:min)												32:05	32:20	
	Volume (gallons):												814,716	1,289,069	
1/7/09	Start Time:	17:00	17:35		16:45	16:30		22:00	19:25						
	Duration (hr:min)	15:20	13:50		13:35	15:10		1:50	6:45						
	Volume (gallons):	1,136,309	70,390	**1,206,699**	730,154	223,597	**953,751**	2,288	3,307,035			**3,307,035**			
4/2/09	Start Time:	18:25	19:00		18:45								18:30	18:30	
	Duration (hr:min)	12:50	11:55		0:15								4:20	4:25	
	Volume (gallons):	642,898	601	**643,499**	626		**626**						72,117	306,637	
4/12/09	Start Time:	16:20			16:15	16:15									
	Duration (hr:min)	4:05			0:30	0:20									
	Volume (gallons):	379,568		**379,568**	8,792	3,892	**12,684**								
4/28/09	Start Time:					2:40									
	Duration (hr:min)					18:05									
	Volume (gallons):					2,865	**2,865**								
5/5/09	Start Time:	5:15						6:50							
	Duration (hr:min)	3:20						0:25							
	Volume (gallons):	295,355		**295,355**				191							
5/6/09	Start Time:	15:35													
	Duration (hr:min)	2:35													
	Volume (gallons):	218,417		**218,417**											
5/19/09	Start Time:	21:10											20:50	20:55	
	Duration (hr:min)	0:45											0:20	0:25	
	Volume (gallons):	41,063		**41,063**									9,331	44,415	

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5.2 HydroBrake Performance

HydroBrakes use vortex action to regulate flow and are designed to allow nearly constant flow for a given differential head. HydroBrakes are designed to:

- Reduce the flow downstream of the HydroBrake during large flow events
- Maximize in-line and off-line storage efficiency upstream of the HydroBrake.

However, HydroBrakes do not always operate as designed. Part of the goal for the monitoring study is to characterize the actual operation of each HydroBrake within the Henderson Area so that it may be accurately represented in the hydraulic model.

HydroBrake characterization requires two sets of flow depths to determine the differential head across the HydroBrake. The monitors used to measure differential head are listed in **Table 5-2**.

Table 5-2: HydroBrake Monitors

NPDES Basin	CSO Facility #	HydroBrake MH	Supporting Upstream Monitoring Location	Supporting Downstream Monitoring Location
44	8	067-272	067-271	067-274
45	29	074-159	074-159	074-152
47	In-System	081-239	081-239	081-049
49	4	306-428	306-428	306-246
171	5	081-231	081-231	081-229

The HydroBrake stage-discharge curves were developed by comparing the differential head across the HydroBrake and the flow, typically from the monitor located downstream, through the HydroBrake. The flow from the downstream monitor was used because the HydroBrakes are designed to cause very low velocity or near-stagnant water just upstream, which often results in velocity dropouts and low quality flow data. The stage-discharge curve developed for each HydroBrake was compared to the manufacturer's curve. A final recommendation on the appropriate stage-discharge curves to be used in the hydraulic model was forwarded to the model development team. The Henderson Modeling Report (CH2M HILL, Publication Pending) details how the recommended stage-discharge curves are used in the hydraulic model.

5.2.1 HydroBrake 067-272 Performance

HydroBrake 067-272 is located in CSO Basin 44 on Lake Washington Blvd. S. near Seward Park at the diversion structure to storage, CSO Facility #8 (**Figure 5-1**). The HydroBrake is intended to regulate flow into the downstream portions of the system. As the HydroBrake capacity is exceeded, wastewater is backed up until it reaches the weir elevation at MH 067-272. The flow over the weir then proceeds into off-line storage at CSO Facility #8.

The monitors used to generate the HydroBrake stage-discharge curve at this location included the temporary monitor located in MH 067-271 and the permanent monitor located in MH 067-261. Differential head across the HydroBrake was calculated using depth measurements at both of these monitoring locations. Because of the difference in invert elevations between these two monitors, shown in **Figure 5-2**, it was not possible to develop the stage-discharge curve for low depths. A depth differential of about 1.8 feet was necessary for development of the stage-discharge curve. Flow at the downstream monitor in MH 067-261 was used to develop the HydroBrake stage-discharge curve.

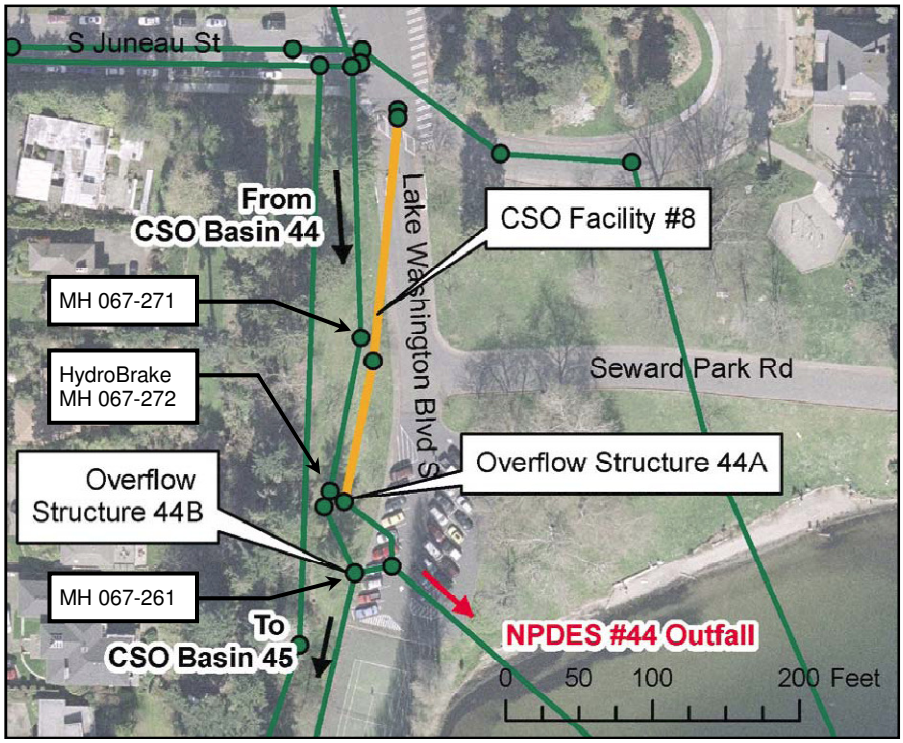

Figure 5-1: HydroBrake 067-272

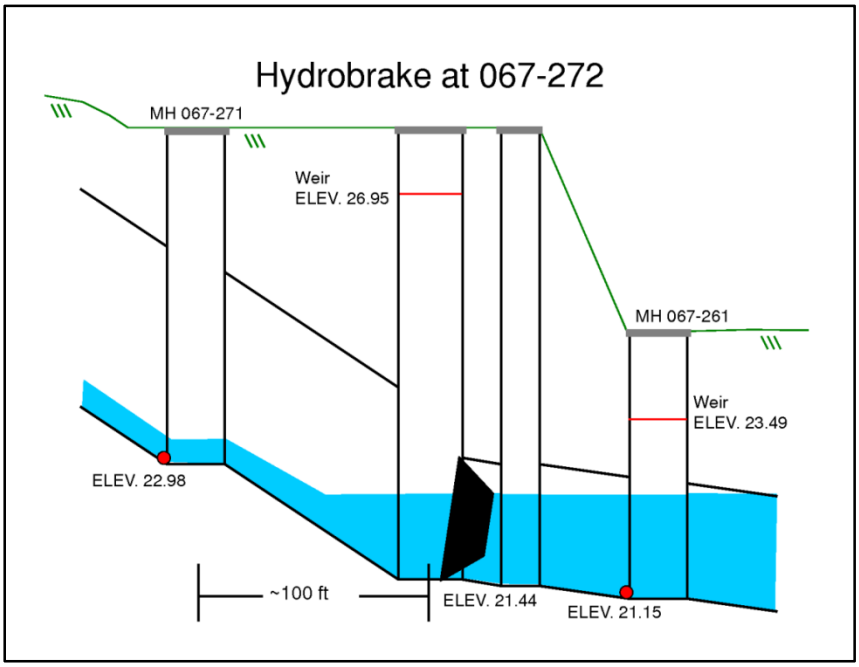

Figure 5-2: HydroBrake 067-272 Profile

The HydroBrake stage-discharge curve used for this HydroBrake appears in **Figure 5-3**. The data collected show that the operation of this HydroBrake is inconsistent. The data show that performance varies from restrictive to less-restrictive over time. At this time, the reason for the change in HydroBrake performance is unknown. Based on discussions with the City and the model development team, the decision was made to use the Manufacturer's curve in the hydraulic model.

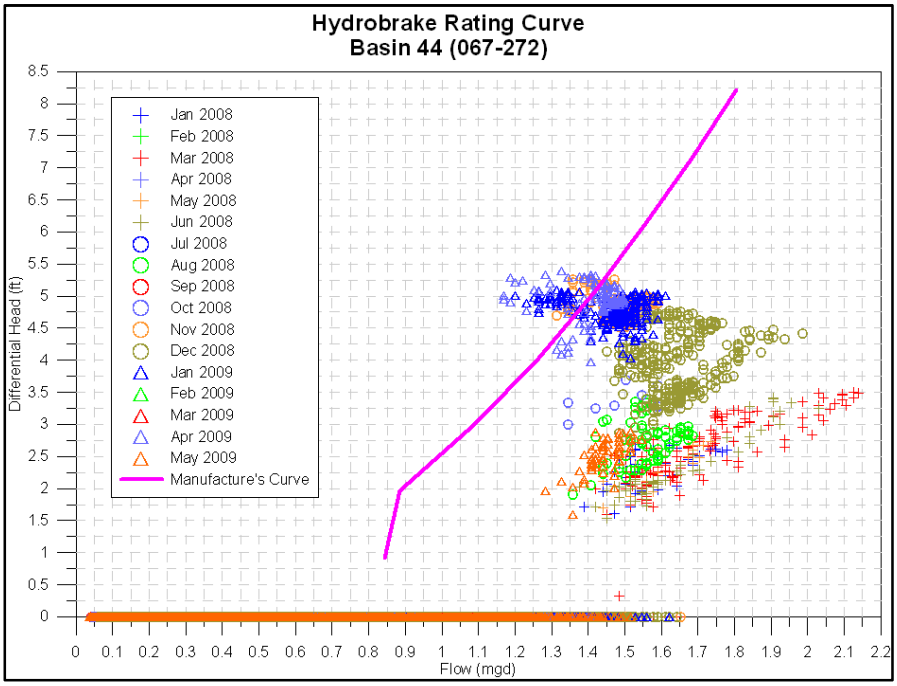

Figure 5-3: HydroBrake 067-272 Stage-discharge Curve

5.2.2 HydroBrake 074-159 Performance

HydroBrake 074-159 is located in CSO Basin 45 at 57th Avenue South and South Holly Street near Martha Washington Park in CSO Facility #29 (**Figure 5-4**). The HydroBrake is intended to regulate flow into the downstream portions of the system. As the HydroBrake capacity is exceeded, wastewater is backed up in the upstream mainline sewers until it reaches the high-flow weir elevation at MH 074-159. The flow over the weir is discharged to the upstream side of Pump Station 10.

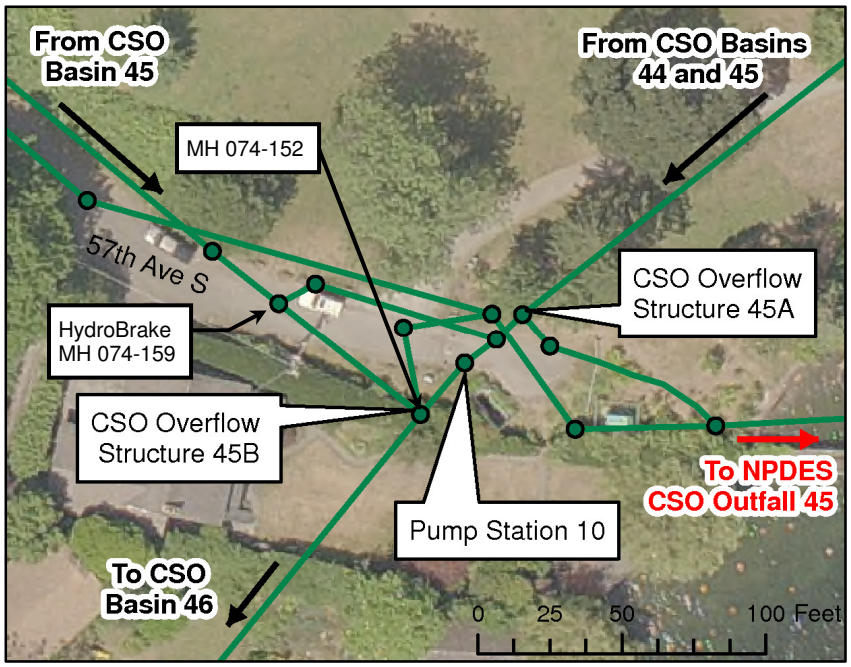

Figure 5-4: HydroBrake 074-159

The monitors used to generate the HydroBrake stage-discharge curve at this location included the temporary monitor located in MH 074-159 and the temporary monitor located in MH 074-152. Differential head across the HydroBrake was calculated using depth measurements at both of these monitoring locations. Flow at the downstream monitor in MH 074-152 was used to develop the HydroBrake stage-discharge curve. The stage-discharge curve is shown in **Figure 5-5**.

The stage-discharge curve shows consistent performance over the monitoring period. A curve slightly less restrictive than the Manufacturer's curve was recommended for inclusion in the hydraulic model.

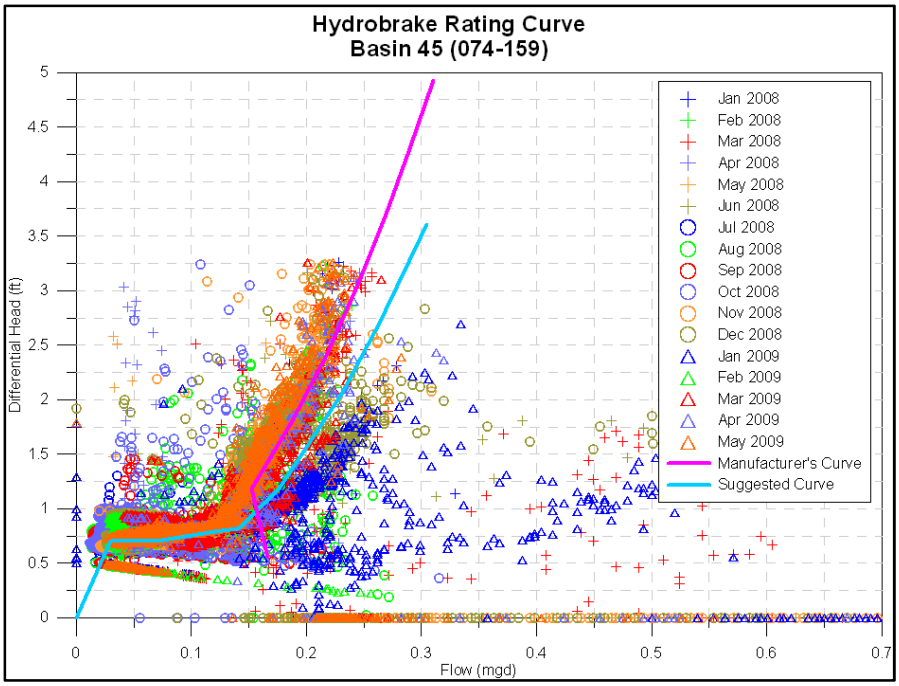

Figure 5-5: HydroBrake 074-159 Stage-discharge Curve

5.2.3 HydroBrake 081-239 Performance

HydroBrake 081-239 is located in CSO Basin 47 at Seward Park Avenue South and South Henderson Street (**Figure 5-6**). The HydroBrake is intended to regulate flow into the King County's Henderson Pump Station. As the HydroBrake capacity is exceeded, wastewater is backed up into an in-line storage facility located in Seward Park Avenue South. When the storage facility fills, wastewater overtops a high-flow weir located in the HydroBrake MH and continues downstream to King County's Henderson Pump Station.

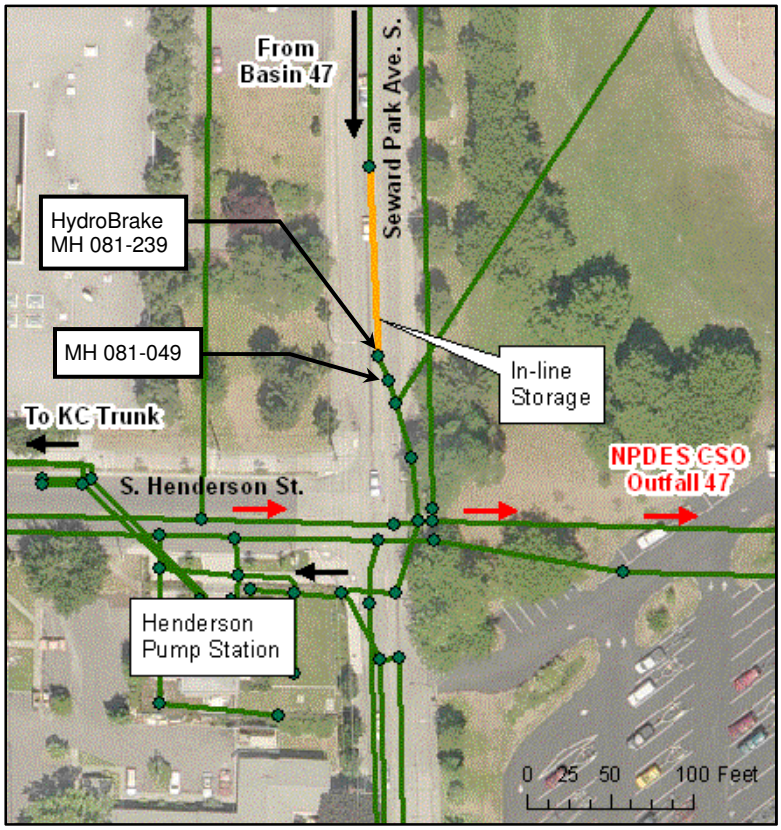

Figure 5-6: HydroBrake 081-239

The monitors used to generate the HydroBrake stage-discharge curve at this location included the temporary monitor located in MH 081-239 and the temporary monitor located in MH 081-049. Differential head across the HydroBrake was calculated using depth measurements at both these monitoring locations. Flow at the downstream monitor in MH 081-049 was used to develop the HydroBrake stage-discharge curve.

The stage-discharge curve is shown in **Figure 5-7**. The stage-discharge curve shows consistent performance over the monitoring period. Based on the data collected, a curve more restrictive than the Manufacturer's curve was recommended for inclusion in the hydraulic model.

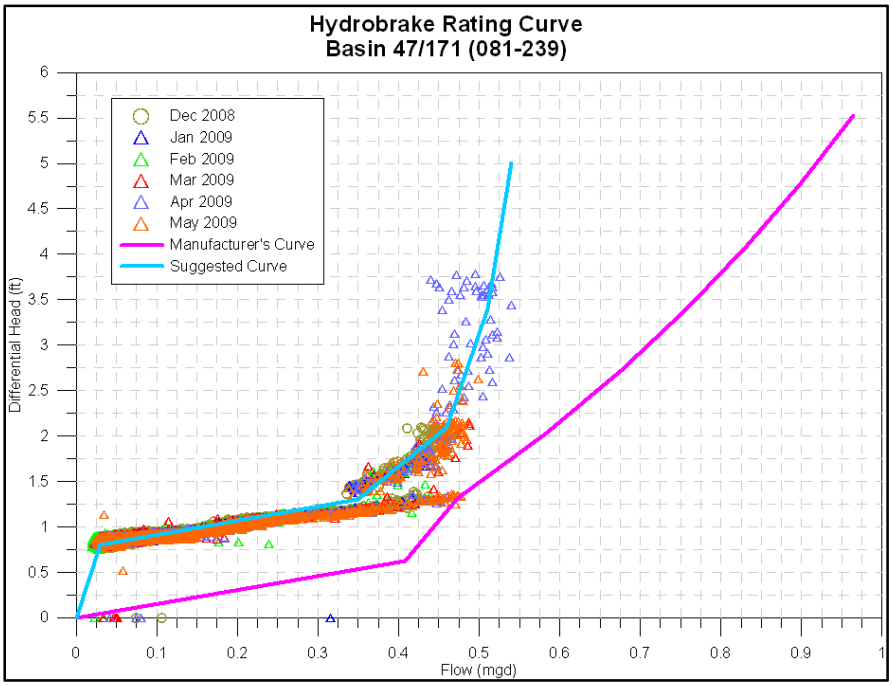

Figure 5-7: HydroBrake 081-239 Stage-discharge Curve

5.2.4 HydroBrake 081-231 Performance

HydroBrake 081-231 is located in the northern portion of CSO Basin 171 at Rainier Avenue South and Seward Park Avenue South. This location only receives flows when the high flow weir at MH 081-237 has been overtopped. The HydroBrake is intended to regulate flow into the King County Henderson Pump Station. As the HydroBrake capacity is exceeded, wastewater is backed up and overtops a weir into storage at CSO Facility #5 which is located in Rainier Avenue South.

A HydroBrake stage-discharge curve has not been developed for this location at this time. Initially the Manufacture's stage-discharge curve will be used in the hydraulic model. A new temporary monitor located in MH 081-229 has been installed to help generate enough data to evaluate HydroBrake performance. The monitors that will be used to generate the HydroBrake stage-discharge curve at this location will include the monitor located in MH 081-231 and the new temporary monitor. Differential head across the HydroBrake will be calculated using depth measurements at both these monitoring locations. Flow at the downstream monitor in MH 081-229 will be used to develop the HydroBrake stage-discharge curve. The Manufacture's stage-discharge curve will be modified, as necessary, as data are collected and the HydroBrake performance can be evaluated.

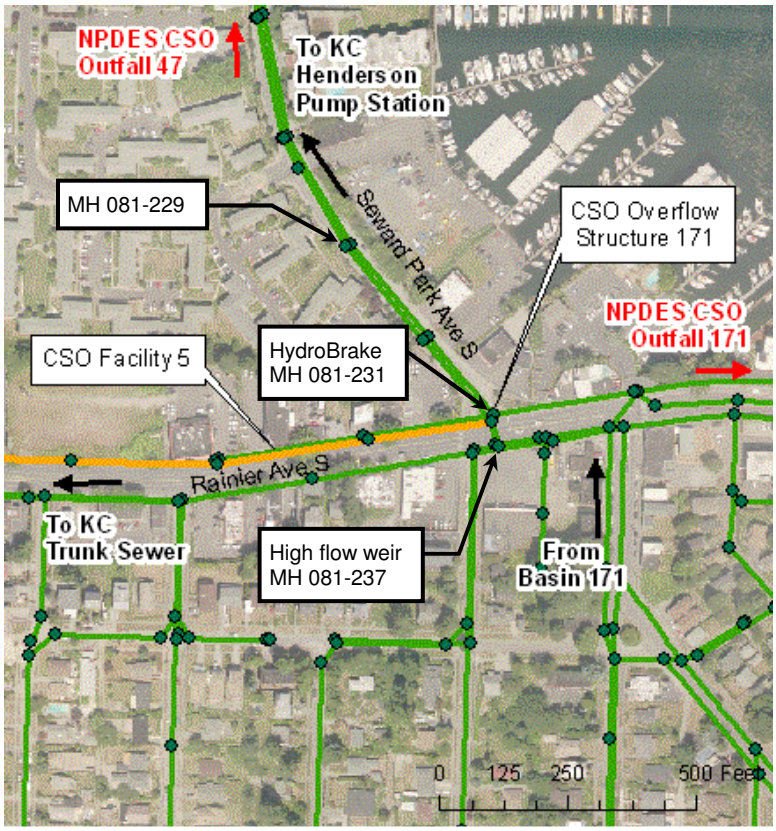

Figure 5-8: HydroBrake 081-231

5.2.5 HydroBrake 306-428 Performance

HydroBrake 306-428 is located in CSO Basin 49 on Rainier Avenue South near South Perry Street at the downstream end of storage for CSO Facility #4 (**Figure 5-9**). The HydroBrake is intended to regulate the flow to the King County trunk and Henderson Pump Station. As the HydroBrake capacity is exceeded, wastewater is backed up until it reaches the weir elevation at MH 306-428. The flow over the weir is stored in off-line storage at CSO Facility #4.

The monitors used to generate the HydroBrake stage-discharge curve at this location included the temporary monitor located in MH 306-428 and the temporary monitor located in MH 306-246. Differential head across the HydroBrake was calculated using depth measurements at both of these monitoring locations.

As discussed in Section 4.3.5, issues were observed with the velocity measurements during wet weather at the monitor located in MH 306-246. Thus flows at this monitoring location were not used to develop the HydroBrake stage-discharge curve. Instead, flow at the upstream monitor in MH 306-428 was used in the determination of the HydroBrake curve. Using this flow information and the differential head across the HydroBrake, it was decided that the Manufacturer's curve should be used in the hydraulic model. The HydroBrake stage-discharge curve is shown in **Figure 5-10**.

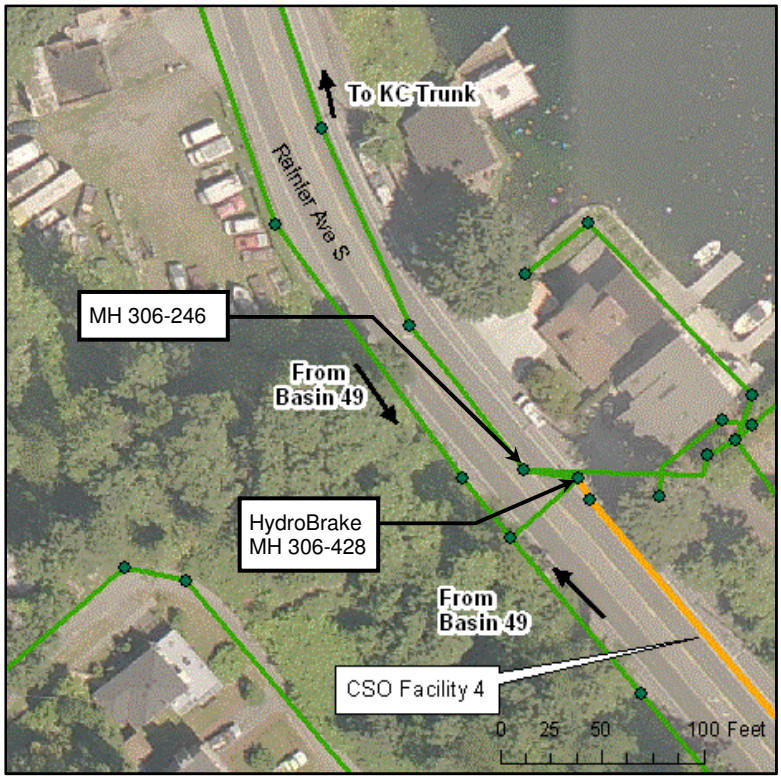

Figure 5-9: HydroBrake 306-428

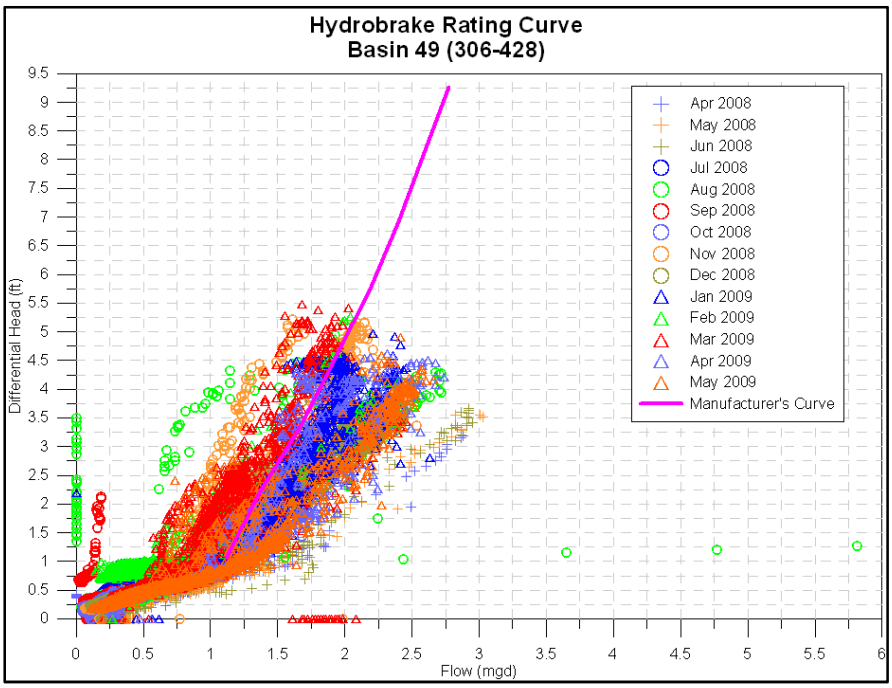

Figure 5-10: HydroBrake 306-428 Stage-discharge Curve

5.3 Storage Performance

This section describes the analysis of the storage facility's performance in the Henderson Area. Each of these facilities had a monitor installed on the downstream end to provide depth measurements with which to estimate the depth to which the storage fills. This depth measurement enabled the calculation of stored volume. The calculated stored volume was compared to the total volume available to determine the percentage volume utilized. This is referred to as "Storage Utilization". Storage utilization charts are included for select storm events in Appendix G.

5.3.1 CSO Facility #8

CSO Facility #8 is located in Basin 44 upstream of CSO structure 44A and consists of approximately 100 feet of 84-inch-diameter pipe and approximately 170 feet of 72-inch-diameter pipe. Total storage volume is approximately 50,000 gallons. This storage facility fills when the capacity of the HydroBrake located at MH 067-272 is exceeded and flows overtop the high flow weir. When this storage facility is fully utilized, the CSO 44A weir at MH 067-274 is overtopped and a CSO event is registered. When capacity in the mainline becomes available, then stored water is released through a flap gate back into the system.

Monitoring data collected indicated that during the early portion of the monitoring period, prior to about August 2008, this facility did not appear to be operating as expected. It appeared that the HydroBrake at MH 067-272 was allowing too much flow downstream causing overflows to occur at the downstream overflow point, CSO structure 44B, before storage was fully utilized. This resulted in nine overflows in the first half of 2008 at 44B while there were no overflows recorded at 44A.

Data subsequent to August 2008 showed that the facility seems to be operating as intended with storage filling as expected. Storage at 44A is fully utilized before overflows are allowed at the downstream structure at 44B.

5.3.2 CSO Facility #7

CSO Facility #7 is located in Basin 47N upstream of CSO structure 47C and consists of over 3,600 feet of 78-inch-diameter pipe. This facility provides about 890,000 gallons of inline storage upstream of CSO structure 47C. Throughout the entire monitoring period, this structure has only recorded one overflow. This indicates that this storage facility is well utilized and helping to meet the CSO criteria of one untreated discharge per CSO site per year.

5.3.3 CSO Facility #5

CSO Facility #5 is located between Basins 47S and 171, between CSO structures 47B and 171 in the southern portion of the Henderson Area. This facility consists of approximately 915 feet of 24-inch-diameter pipe and approximately 240 feet of 72-inch-diameter pipe. Total storage volume is approximately 70,000 gallons.

This storage facility can fill from both Basins 47S and 171. Flow from Basin 47S enters the system by overtopping a high flow weir located at MH 081-211. Flow from Basin 171 enters the system when the capacity of the HydroBrake at MH 081-231 is exceeded and

depths are high enough to overtop the baffle wall in that MH. Storage drains through a duckbilled valve at MH 081-231 and flow continues through the HydroBrake to King County's system. CSO weirs at CSO structures 47B and 171 are at approximately the same elevation. CSOs should occur simultaneously from both ends of facility when the storage is fully utilized.

Monitoring data show that this facility fills quickly and is used frequently. Overflows occur at both ends with overflows occasionally occurring first at CSO structure 171.

5.3.4 CSO Facility #4

CSO Facility #4 is located in Basin 49 in Rainier Avenue South and includes CSO structure 49. It consists of approximately 990 feet of 84-inch-diameter pipe and approximately 200 feet of 72-inch-diameter pipe. The total volume of this facility is approximately 310,000 gallons.

This storage facility can fill from both ends via a high flow weir at MH 306-459 to the south and over a baffle weir at MH 306-428 on the north end. Outflow from storage occurs through a duckbilled valve located at MH 306-428. Outflow is regulated by a HydroBrake also located in MH 306-428. Overflow from the facility discharge to an outfall at the south end of the facility at CSO structure 49. Monitoring data indicate that this storage facility is used efficiently, filling and draining as designed. During the monitoring period only one overflow has been reported.

5.4 Pump Station Operation

5.4.1 Pump Station #10

Pump Station #10 is located on the southwest corner of Martha Washington Park along 57th Avenue South; the pump station is located adjacent to NPDES #45 within NPDES Basin 45. Flow is conveyed south along the Lake Line from Seward Park (NPDES [Basin 44]) to Martha Washington Park. Flow then is pumped down to NPDES Basin 46 by Pump Station #10. If the pump station reaches capacity, flow will back up into the Lake Line until the weir in Overflow Structure 45A is reached. Overflow Structure 45A serves as both a CSO Outfall and emergency pump station overflow in the event of a pump station failure.

Table 5-3: Pump Station #10 – Parameters and Sources

Parameter	Value	Source
Wet well chamber floor elevation	11.2 feet[1]	As-builts[2]
Wet well chamber roof elevation	23.7 feet[1]	As-builts[2]
Wet well plan cross-section area	96.5 SF	Draw down test[3]
Invert elevation of incoming pipe	16.6 feet[1]	As-builts[2]
Exiting force main invert (equal to pump centerline)	11.7 feet[1]	As-builts[2]

Parameter	Value	Source
Start and Stop elevations	Start: 15.3 feet[1] Stop: 12.3 feet[1]	SPU SCADA data [4]
Lift station type	Single screw pump	Modeling decision[5]
Pump capacities	2.2 mgd[6]	

[1] NAVD88

[2] "Seward Park Trunk Sewer" sheets 20 and 22 (10/11/1933): Vault # 777-15

[3] Lift Station #10 Draw Down Test (8/22/2008), head is equivalent to the average water depth during the draw down test.

[4] Start and stop levels determined from SPU SCADA data wet well levels, converted to NAVD88 elevations by adding the elevation of the chamber floor (11.20 feet).

[5] Modeling this pump station as a single screw pump with a QH curve decreased run times on the Henderson model by avoiding constant start/stop cycling of the pump station.

[6] Represents maximum capacity of pump station based on SCADA data.

5.4.2 Pump Station #9

Pump Station #9 is located on the south end of Be'er Sheva Park. The Lake Line pump station is located adjacent to NPDES #46 within NPDES Basin 47. Flow is conveyed south along the Lake Line from Martha Washington Park (NPDES Basin 45); additional flows from NPDES Basin 46 enter the Lake Line prior to the pump station. If the pump station reaches capacity, flow will back up into the Lake Line until the weir in Overflow Structure 46 (located on Pritchard Island) is reached. Overflow Structure 46 serves as both a CSO Outfall and emergency pump station overflow in the event of a pump station failure. During the monitoring period, a number of CSOs occurred because the pumps were not able to handle peak flow rates and due to pump station failures.

Table 5-4: Pump Station #9 – Parameters and Sources

Parameter	Value	Source
Wet well chamber floor elevation	9.7 feet[1]	As-builts[2]
Wet well chamber roof elevation	22.2 feet[1]	As-builts[2]
Wet well plan cross-section area	168.1 SF	Draw down test[3]
Invert elevation of incoming pipe	14.8 feet[1]	As-builts[2]
Exiting force main invert (equal to pump centerline)	13.4 feet[1]	As-builts[2]
Start and stop elevations	Start: 12.7 feet[1] Stop: 11.2 feet[1]	SPU SCADA data[3, 4]
Lift station type	Single screw pump	Modeling decision[5]

Parameter	Value	Source
Pump capacities	3.0 mgd[6]	

[1] NAVD88

[2] "Seward Park Trunk Sewer" Sheets 27 – 28 (10/11/1933): Vault # 777-15

[3] Lift Station #9 Draw Down Test (8/22/2008), head is equivalent to the average water depth during the draw down test.

[4] Start and stop levels determined from SPU SCADA data wet well levels, converted to NAVD88 elevations by adding the elevation of the chamber floor (11.20 feet).

[5] Modeling this pump station as a single screw pump with a QH curve decreased run times on the Henderson model by avoiding constant start/stop cycling of the pump station.

[6] Represents maximum capacity of pump station based on SCADA data.

5.4.3 Pump Station #80

Pump Station #80 is located along Rainer Avenue South within NPDES Basin #49. The pump station is very small with a capacity of 0.2 MGD. The pump station is intended to handle flows from NPDES Basin #48, which contains approximately 10 homes along Rainer Avenue South. During the monitoring period, Pump Station #80 did not experience any failures or CSOs as a result of wet weather.

Table 5-5: Pump Station #80 - Parameters and Sources

Parameter	Value	Source
Wet well chamber floor elevation	7.4 feet[1]	As-builts[2,3]
Wet well chamber roof elevation	10.4 feet[1]	As-builts[2,3]
Wet well plan cross-section area	7.1 SF	As-builts[23]
Invert elevation of incoming pipe	12.6 feet[1]	As-builts[2,3]
Exiting force main invert (equal to pump centerline)	20.7 feet[1]	As-builts[2,3]
Pump start and stop elevations	Start: 9.4 feet[4] Stop: 7.7 feet[4]	Developed for model[4]
Lift station type	Screw pump	Modeling decision[5]
Pump capacities	0.2 mgd[6]	

[1] NAVD88

[2] "Taylor Mill Sanitary Sewer System" as-built, Approved Nov. 7 1968, Sheet 18, Vault No. 777-117.

[3] City of Seattle Pump Station Data Sheets

[4] Start assumed at 1-ft below roof elevation, stop assumed at 4" above floor.

[5] Modeling this pump station as a single screw pump with a QH curve decreased run times on the Henderson model by avoiding constant start/stop cycling of the pump station.

[6] Point based on pump station start elevation and capacity.

5.4.4 Henderson Pump Station (King County)

The Henderson Pump Station is located at the intersection of South Henderson Street and Seward Park Avenue South. The pump station is operated by King County and receives flows from Basins 44, 45, 46, 48 and 49, as well as a portion of 47 and 171. In the event flows enter CSO Facility #5, flows from Basin 47 and 171 are conveyed to the Henderson Pump Station.

Table 5-6: King County Henderson Pump Station - Parameters and Sources

Parameter	Value[1]	Source
Wet well chamber floor elevation	9.27 feet	As-builts[2]
Wet well chamber roof elevation	27.35 feet	As-builts[2]
Wet well plan cross-section area	196.5 Sq FT (Valid only to EL 15.35	As-builts[2]
Invert elevation of incoming pipe	15.85 feet	As-builts[2]
Exiting force main invert (equal to pump centerline)	22.27 feet	As-builts[2]
Pump station start and stop elevations	Start: 16.0 feet Stop: 14.4 feet	SCADA[3]
Overflow Elevation	19.32 feet	As-builts[2]
Lift station type	Screw pump	Modeling decision[4]
Pump capacities	16.6 mgd[5] 21.9 mgd[6]	As-builts

[1] NAVD88 Elevations

[2] Henderson/MLK CSO Project – Henderson Pumping Station Conformed Documents July 2001

[3] King County SCADA data made available from 1/1/2008 to 2/1/2009. Wet well A elevation (tag ID: HEND.LB774271A). Sensor is assumed to be located 0.5 feet above wet well chamber floor elevation.

[4] Modeling this pump station as a single screw pump with a QH curve decreased run times on the Henderson model by avoiding constant start/stop cycling of the pump station.

[5] Firm capacity with 4 pumps running.

[6] Peak capacity with 5 pumps running.

5.5 Flow Balancing

Flow balancing is a method of checking flow monitoring data quality and was performed on data from the Henderson Area during the beginning of the project. Assuming that mass, and thus volume, are conserved, the sum of flows at upstream meters should be less than or equal to the flow at downstream meters. With good flow data, periods of imbalance should be short and infrequent. Flow imbalances may be an indication of a meter being installed in an incorrect location, unaccounted for losses

between upstream and downstream meters, monitor bias and other inconsistencies with the monitoring data. Flow imbalances serve as red flags to direct more extensive reviews.

Some flow imbalances have been identified and discussed in Section 4.3 for Basins 44, 45 and 49 (see monitors 067-271 in Section 4.3.1, 074-159 in Section 4.3.2 and 306-246 in Section 4.3.5).

Figure 5-11 shows the flow imbalance between monitor 067-271 and 067-261. These monitors are in series and placed very close together, with 067-271 upstream of 067-261. No major flow contributions to the system are made between these monitors and it is expected that flow at both monitors should be about the same. This is not the case. During larger wet weather events it is possible for some flow recorded at 067-271 to be diverted at the CSO structure 44A which may account for some of discrepancy. However, the higher flow values recorded at 067-271 are seen throughout the data.

After reviewing the monitoring data, the team concluded that the velocity recorded by monitor 067-271 was too high to be reasonable; thereby, the flowrate calculated was also too high to be reasonable. This monitor should be used for depth only during the modeling phase.

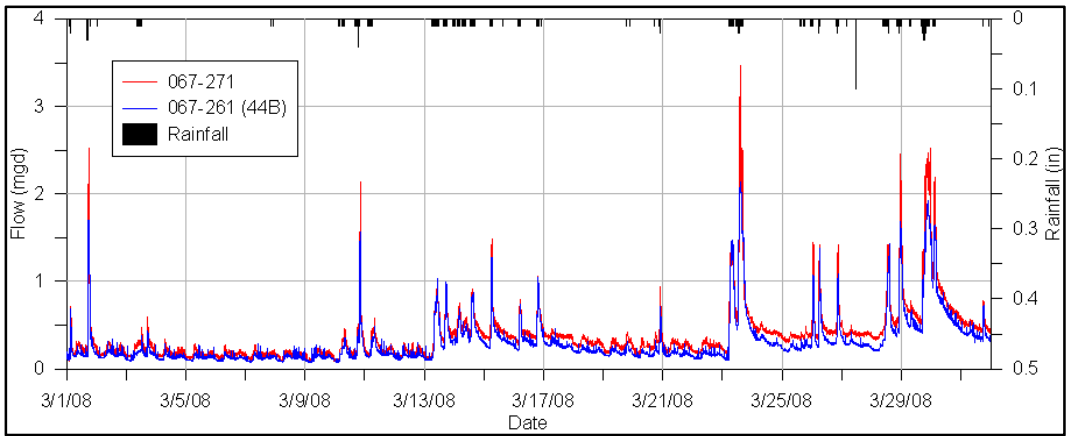

Figure 5-11: Flow Blance – Monitors 067-271 and 067-261

In Basin 45 the flow recorded at monitors 074-159 and 074-152 also showed an imbalance. Both monitors are in series, with monitor 074-159 upstream of monitor 074-152. These monitors are located very close together with no flow contributions between them. It is expected that flow recorded at these monitors be about the same. Figure 5-12 shows that data recorded at monitor 074-159 is consistently higher in both dry-weather and wet-weather flows than that recorded at monitor 074-152. This discrepancy was attributed to the turbulence and silting observed at MH 074-159 which affected the velocity measurements taken at that location.

After reviewing the monitoring data, the team concluded that the velocity recorded by monitor 074-159 was too high; thereby, the flowrate calculated was also too high. This monitor should be used for depth only during the modeling phase.

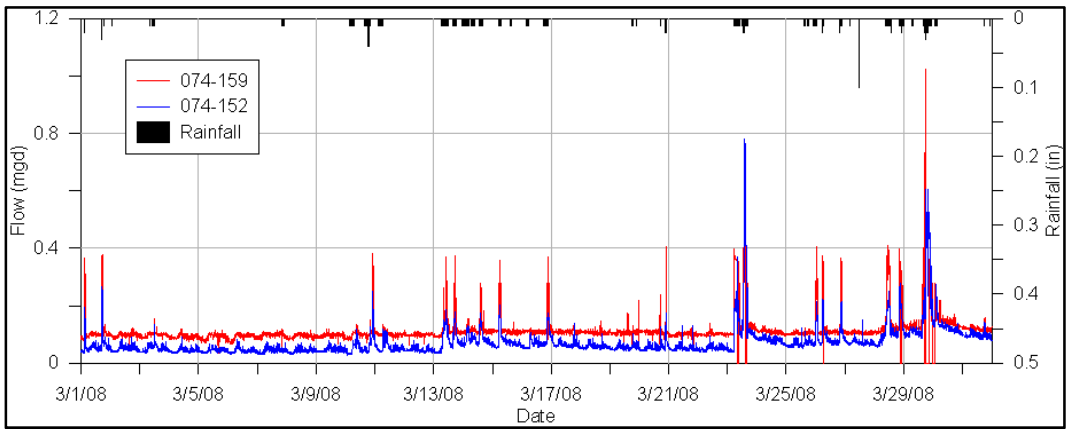

Figure 5-12: Flow Balance – Monitors 074-159 and 074-152

Figure 5-13 shows the flow balance between monitors 306-428 and 306-246 in Basin 49. As with the monitors in Basins 44 and 45 these two monitors are close together with no significant flow contributions between them. Flows should be about the same for these two monitors. As can be seen in the figure higher flows are recorded at 306-246, the downstream monitor, during wet weather events.

After reviewing the monitoring data, the team concluded that the depth recorded by monitor 306-428 was too high during wet-weather events; thereby, the flowrate calculated was also too high wet-weather events. This monitor should be used for depth and flow only for dry-weather analysis and should not be weighted during GLUE calibration of wet-weather events.

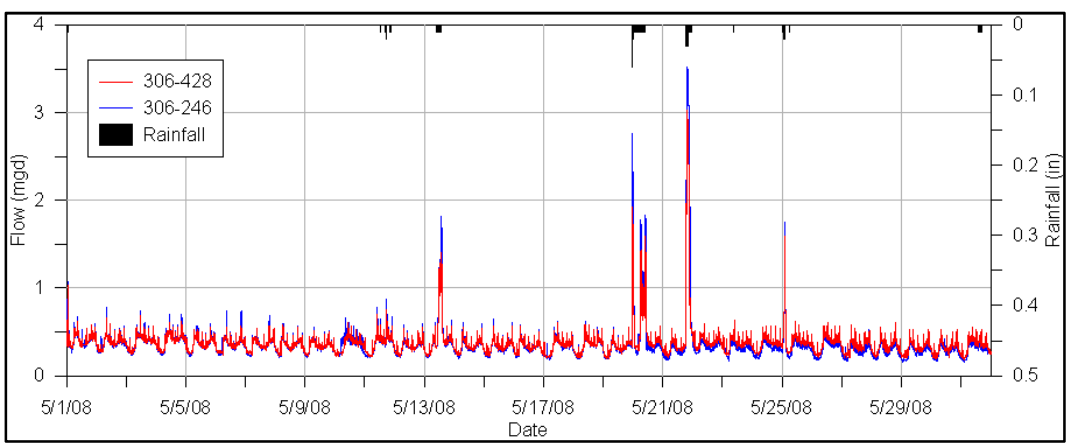

Figure 5-13: Flow Balance - Monitors 306-428 and 306-246

5.6 Notable Events and Observations

5.6.1 Lake Line Condition

The pipeline along Lake Washington, the Lake Line, between Basins 45 and 46 is known to have condition issues. Video inspection of this line was performed in the winter of 2008 and several root intrusion problems were noted. The most significant was observed between MH 074-114 and MH 074-115 (**Figure 5-14**), upstream of Pump Station #9 in Basin 46.

Figure 5-14: Root intrusion between MH 074-114 and MH 074-115

These root intrusion problems may be contributing to the appearance of the overflow signature in the data from monitor 074-152. The Lake Line between Basins 45 and 46 was jet cleaned on or about January 21, 2009. Data after this cleaning event do show the disappearance of the overflow signature but it cannot be solely attributed to the cleaning. Rainfall events in February through March of 2009 may not have been large enough to trigger the overflow event. Larger rain events in April and May of 2009 show the return of overflow signature in the data at monitor 074-152.

5.6.2 Lake Washington Inflow

The Army Corps of Engineers (Corps) controls the level in Lake Washington seasonally. Typically lake levels are at their lowest in the winter and the highest in the early summer. The lake level has impacted three of the temporary monitors in the Henderson Area. The two monitors in the storm lines, D081-131 and D081-069, always have standing water in them from the lake.

The invert for the overflow pipe at monitor 074-153 is set below the highest level the lake is known to reach. Initially, an upturned elbow was installed to prevent lake water from entering the system (**Figure 5-15**). Survey activity in the summer of 2008 noted that the grout-seal around the elbow was loose or absent. In November 2008, this elbow was removed because it was at risk of dislodging from the MH wall and falling into the conveyance system. At the time, lake levels were below the overflow pipe invert.

Figure 5-15: MH 074-153 prior to Elbow Removal

In mid-April 2009 the Corps began raising the level in Lake Washington. Lake water was observed entering the system at 074-153 on April 30, 2009 (**Figure 5-16**). The monitoring data at the downstream monitors – 081-059 and 081-085 – indicate that flow started entering the system on about April 27, 2009 (**Figure 5-17**).

Figure 5-16: Lake Entering System at MH 074-153 (April 20, 2009)

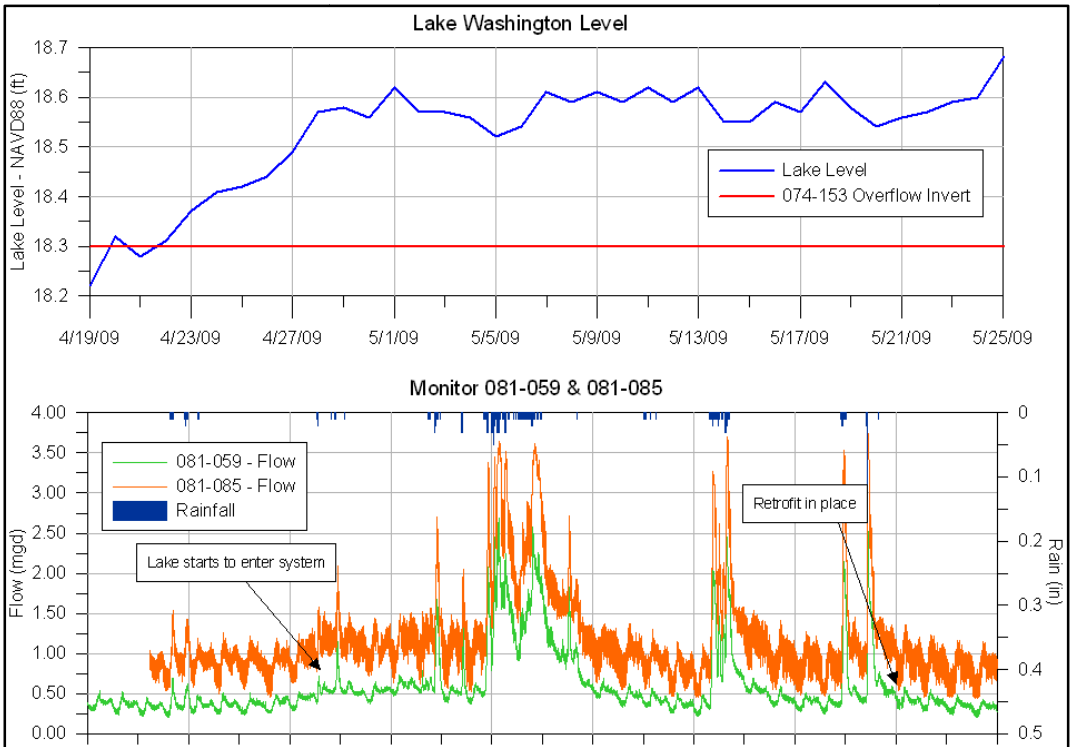

Figure 5-17: Increase in Flow Due to Lake Inflow at Monitor 081-059 and 081-085

A retrofit of the overflow pipe – a new weir that prevented lake water from entering the system – was completed on May 21, 2009 (Figure 5-18). After this date, lake flow was no longer entering the system.

Figure 5-18: New Overflow Weir at Overflow Structure 45A

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6 Data Suitability for Hydraulic Modeling Efforts

The key objective of the Henderson flow monitoring project was to support the calibration and validation of the Henderson hydraulic model. Calibration is the process of adjusting model parameters and comparing the simulated model results with data measured or observed in the field. For the Henderson model, depth and calculated flow (from depth and velocity measurements) were the parameters targeted during model calibration. Validation is the simulation of flows and depths during rainfall events not used for calibration; it provides information on the repeatability of the model to accurately simulate the system under varying conditions.

The flow monitoring data collected from January 2008 through January 2009 (Phase I and Phase IIa) was used for model calibration. Data from February 2009 through May 2009 (Phase IIb) will be used for model validation. Below is a description of the dry and wet weather calibration and validations and recommendations on the suitability of the data to support hydraulic modeling. Additional information on the use of the monitoring data in the development of the hydraulic model can be found in the Henderson Modeling Plan (CH2M HILL, December 2008) and Henderson Model Report (CH2M HILL, Publication Pending).

6.1 Identification of Dry and Wet Weather Periods

6.1.1 Dry Weather Period

To calibrate the Henderson model, the model is first calibrated to dry weather. Simulation results are compared to monitor data for the system during dry periods – those periods without the influence of rainfall. Dry weather is simulated in the Henderson model by applying a diurnal pattern to a per capita flow value multiplied by the population within each catchment. The accuracy of the dry weather calibration is gauged primarily on the comparison of the following variables:

- Volume or average flow rate
- Daily diurnal pattern at each monitoring site

Effects of seasonal fluctuations in the data, due to groundwater infiltration, were also noted.

To select a representative period of dry weather flow, the monitoring data were reviewed first for consistency and availability of quality data. The largest impact to the quality of dry weather data were during periods of particularly low flow. The water level would fall below the velocity sensor and a "velocity dropout" would occur. Data during these instances could generally be reconstituted from site verification data during finalization of the data and generally had little effect on the quality of dry weather flow data.

6.1.2 Wet Weather Rainfall

As summarized in the precipitation tables, **Table 4-1** and **Table 4-2**, there were 48 rainfall events at both sets of gages that occurred from January 2008 through May 2009

that had a cumulative depth greater than 0.3 inches using an inter-event time of 6 hours. This depth and inter-event time were initial criteria to define distinct storms. Each rain event is available to support model calibration and validation.

6.2 Monitoring Stations Recommended for Model Calibration

The monitoring locations that will be used for model development and calibration were selected based on one or more of the following purposes:

- Flow loading
- Develop HydroBrake performance curve
- CSO volume and flow rate

At each of these locations the depth and/or flow measured at the site will be used during model calibration. **Table 6-1** lists the monitors to be used along with the primary parameter to be used for calibration. This list may be modified during the automated model calibration process.

Table 6-1: Monitors to Support Model Calibration

Basin	Monitor	Monitor Type	Purpose	Calibration Parameter
44	067-191	Temporary	Basin characterization	Flow, Depth
	067-271	Temporary	HydroBrake characterization	Depth
	067-275	Temporary	CSO measurement	Flow
	067-275 MP2	Temporary	CSO measurement	Flow
	067-274	Permanent	CSO measurement	Flow, Depth
	067-261	Permanent	CSO measurement, basin characterization	Flow, Depth
45	074-152	Temporary	CSO measurement, basin characterization	Depth
	074-159	Temporary	HydroBrake characterization	Flow, Depth
	074-153	Permanent	CSO measurement, basin characterization	Flow, Depth
	074-167	Permanent	CSO measurement	Flow, Depth
46	081-059	Temporary	Basin characterization	Flow, Depth
	081-062	Permanent	Basin characterization	Flow, Depth
	081-062 MP2	Permanent	CSO measurement	Flow, Depth
47	073-268	Temporary	Basin characterization	Flow, Depth
	073-276	Temporary	Basin characterization	Flow, Depth
	080-329	Temporary	Basin characterization	Flow, Depth

Basin	Monitor	Monitor Type	Purpose	Calibration Parameter
	081-239	Temporary	HydroBrake characterization	Flow, Depth
	081-049	Temporary	HydroBrake characterization	Flow, Depth
	081-085	Temporary	Basin characterization	Flow, Depth
	081-120	Temporary	Basin characterization	Flow, Depth
	081-139	Temporary	Basin characterization	Flow, Depth
	081-224	Permanent	CSO measurement, hyddrologic response	Flow, Depth
	081-330	Permanent	CSO measurement, basin characterization	Flow, Depth
	080-298	Permanent	CSO measurement, basin characterization	Flow, Depth
	080-480	Permanent	CSO measurement, basin characterization	Flow, Depth
49	306-245	Temporary	Basin characterization	Flow, Depth
	306-246	Temporary	HydroBrake characterization, basin characterization	Depth
	306-275	Temporary	Basin characterization	Flow, Depth
	306-428	Temporary	HydroBrake characterization	Flow, Depth
	306-284	Temporary	Basin characterization	Flow, Depth
	306-343	Temporary	Basin characterization	Flow, Depth
	306-437	Permanent	CSO measurement, hydrologic response	Flow, Depth
171	081-237	Temporary	Basin characterization	Flow, Depth
	306-192	Temporary	Basin characterization	Flow, Depth
	081-231	Permanent	CSO measurement, hydrologic response	Flow, Depth
Other	NPDES 45A Overflow	Permanent	CSO measurement	Flow
	NPDES 47B Overflow	Permanent	CSO measurement	Flow
	NPDES 47C Overflow	Permanent	CSO measurement	Flow
	NPDES 49 Overflow	Permanent	CSO measurement	Flow
	NPDES 171 Overflow	Permanent	CSO measurement	Flow
	080-334	King County	Establish model boundary conditions	Flow

Basin	Monitor	Monitor Type	Purpose	Calibration Parameter
	080-358	King County	Establish model boundary conditions	Flow
	080-368	King County	Establish model boundary conditions	Flow
	Henderson Lift Station Discharge	SCADA	Establish model boundary conditions	Flow

6.3 Storms Recommended for Model Calibration

Of the 48 rainfall events monitored during the monitoring period with greater than 0.3 inches with an inter-event time of 6 hours, twelve of the storms were identified as potential calibration storms due to their cumulative depth and high return frequency. The storms are listed in **Table 6-2**.

Table 6-2: Calibration Storms

Storm ID	Start Date	End Date	Duration (hours)	RG 18 Precipitation (in)	RG18 Max. Freq. (months)	RG10/SKY1/RG30 Precipitation (in)
Storm 1	3/28/2008 18:20	3/30/2008 8:22	38.0	0.73	3	0.82
Storm 2	5/21/2008 18:00	5/22/2008 3:00	9.0	0.44	6	0.28
Storm 3	6/6/2008 10:10	6/7/2008 0:00	13.8	0.44	9	0.59
Storm 4	8/24/2008 12:25	8/25/2008 8:35	20.2	0.95	4	1.32
Storm 5	8/25/2008 16:00	8/26/2008 0:00	8.0	0.65	24	0.70
Storm 6	10/13/2008 17:35	10/14/2008 0:35	7.0	0.39	24	0.24
Storm 7	11/5/2008 23:15	11/8/2008 4:20	53.1	2.38	24	2.58
Storm 8	1/6/2009 13:50	1/9/2009 0:00	58.2	2.12	12	2.41
Storm 9	4/2/2009 0:00	4/3/2009 10:50	34.8	0.99	6	1.27
Storm 10	4/12/2009 0:00	4/12/2009 23:55	23.9	1.04	12	0.98
Storm 11	5/2/2009 12:00	5/7/2009 0:00	108.0	2.45	12	2.61
Storm 12	5/18/2009 19:00	5/20/2009 12:00	41.0	0.88	6	0.87

Data quality for both flow/velocity and depth was evaluated for each calibration storm. This was done to help justify monitor and storm weightings assigned during the calibration process. Quality was quantified by establishing the following ratings:

0	Data quality high
1	Missing monitoring data or data dropouts
2	15-minute time step. However data may be usable
3	Monitor over-predicted data
4	Questionable monitoring data
5	Monitor located in an overflow pipe so no flow or depth was present under typical conditions

Table 6-3 and **Table 6-4** show the ratings at each monitor for each calibration storm for depth and flow/velocity, respectively. Additional information on the calibration process can be found in the hydraulic modeling report (CH2M HILL, Publication Pending). Hydrographs and scattergraphs for each calibration storm are included in Appendix H.

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Table 6-3: Calibration Storm Depth Rating

Basin	Monitor	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	Storm 6	Storm 7	Storm 8	Storm 9	Storm 10	Storm 11	Storm 12
44	067-274 (44A)	5	5	5	5	5	5	5	5	5	5	5	5
	067-261 (44B)	0	0	0	0	0	0	0	0	0	0	0	0
	067-191	0	0	0	0	0	2	0	0	0	0	0	0
	067-271	0	0	0	0	0	0	0	0	0	0	0	0
	067-275	5	5	5	5	5	5	5	5	5	5	5	5
	067-275 MP2	5	5	5	5	5	5	5	5	5	5	5	5
45	074-153 (45A)	0	0	0	0	0	0	0	0	0	0	0	0
	NPDES 45A Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	074-167 (45B)	5	5	5	5	5	5	5	5	5	5	5	5
	074-152	0	0	0	0	0	0	0	0	0	0	0	0
	074-159	0	0	0	0	0	0	0	0	0	0	4	4
46	081-062	0	0	0	0	0	0	0	0	0	0	0	0
	081-062 MP2	5	5	5	5	5	5	5	5	5	5	5	5
	081-059	2	0	0	0	0	0	0	0	0	0	0	0
47	081-224 (47B)	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 47B Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	081-330 (47C)	0	0	0	0	0	0	0	0	0	0	0	0
	NPDES 47C Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	080-298 (47D)	0	0	0	0	0	0	0	0	0	0	0	0
	080-480 (47E)	0	0	0	0	0	0	0	0	0	0	0	0
	073-268	0	0	0	0	0	0	0	0	0	0	0	0
	073-276	0	0	0	0	0	0	0	0	0	0	0	0
	080-329	0	0	0	0	0	0	0	0	0	0	0	0
	081-239	0	0	0	0	0	0	0	0	0	0	0	0
	081-049	1	1	1	1	1	1	1	1	0	0	0	0

Basin	Monitor	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	Storm 6	Storm 7	Storm 8	Storm 9	Storm 10	Storm 11	Storm 12
	081-085	0	0	0	0	0	0	0	0	0	1	4	4
	081-120	0	0	0	0	0	0	0	0	0	0	0	0
	081-139	0	0	0	0	0	0	0	0	0	0	0	0
49	306-437	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 49 Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	306-245	0	1	0	1	1	4	4	0	0	0	0	0
	306-246	0	0	0	0	0	0	0	0	0	0	0	0
	306-275	0	0	0	0	0	0	0	0	0	0	0	0
	306-284	2	0	0	0	0	0	0	0	0	0	0	0
	306-343	0	0	0	0	0	0	0	0	0	0	0	1
	306-428	1	0	0	0	1	0	0	0	0	0	0	0
171	081-231	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 171 Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	081-237	0	0	0	0	0	0	0	0	0	0	0	0
	306-192	0	0	0	0	0	0	0	0	0	0	0	0
King County	080-334	2	2	1	2	2	2	2	2	1	1	1	1
	080-358	2	2	2	2	2	2	2	2	1	1	1	1
	080-368	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson Lift Station Discharge	5	5	5	5	5	5	5	5	5	5	5	5

Table 6-4: Calibration Storm Velocity/Flow Rating

Basin	Monitor	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	Storm 6	Storm 7	Storm 8	Storm 9	Storm 10	Storm 11	Storm 12
44	067-274 (44A)	5	5	5	5	5	5	5	5	5	5	5	5
	067-261 (44B)	0	0	0	0	0	0	0	0	0	0	0	0
	067-191	0	0	1	0	0	2	4	1	0	0	0	0
	067-271	3	3	3	3	3	3	3	3	3	3	3	3
	067-275	5	5	5	5	5	5	5	5	5	5	5	5
	067-275 MP2	5	5	5	5	5	5	5	5	5	5	5	5
45	074-153 (45A)	0	0	0	0	0	0	0	0	0	0	0	0
	NPDES 45A Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	074-167 (45B)	5	5	5	5	5	5	5	5	5	5	5	5
	074-152	0	0	0	0	0	0	0	0	0	0	0	0
	074-159	4	1	4	4	4	4	4	4	1	4	1	4
46	081-062	1	1	1	1	1	0	0	1	1	1	1	0
	081-062 MP2	5	5	5	5	5	5	5	5	5	5	5	5
	081-059	2	0	0	0	0	0	0	0	0	0	4	4
47	081-224 (47B)	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 47B Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	081-330 (47C)	0	4	0	0	0	0	4	0	0	0	0	0
	NPDES 47C Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	080-298 (47D)	0	0	0	0	0	0	0	0	0	0	0	0
	080-480 (47E)	0	0	0	0	0	0	0	0	0	0	0	0
	073-268	0	0	0	0	0	0	0	0	0	0	0	0
	073-276	0	0	0	0	0	0	0	0	0	0	0	0
	080-329	0	0	0	0	0	0	0	0	0	0	0	0
	081-239	1	1	0	1	1	0	1	1	1	1	1	1
	081-049	1	1	1	1	1	1	1	1	0	0	0	0
	081-085	0	0	0	0	0	0	0	0	0	1	4	4

Basin	Monitor	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	Storm 6	Storm 7	Storm 8	Storm 9	Storm 10	Storm 11	Storm 12
	081-120	0	0	0	0	0	0	0	0	0	0	0	0
	081-139	0	0	0	0	0	0	0	0	0	0	0	0
49	306-437	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 49 Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	306-245	0	1	0	1	1	1	1	1	1	1	1	1
	306-246	3	3	3	3	3	3	3	3	3	3	3	3
	306-275	0	0	0	0	0	0	1	1	1	0	0	0
	306-284	2	0	0	0	0	0	0	0	0	0	0	0
	306-343	0	0	0	0	0	0	0	0	0	0	0	1
	306-428	1	0	0	0	1	0	0	0	0	0	0	0
171	081-231	5	5	5	5	5	5	5	5	5	5	5	5
	NPDES 171 Overflow	5	5	5	5	5	5	5	5	5	5	5	5
	081-237	0	0	0	0	0	0	0	0	0	0	0	0
	306-192	0	0	0	1	1	0	0	0	0	0	0	0
King County	080-334	2	2	1	2	2	2	4	4	1	1	1	1
	080-358	2	2	2	2	2	2	2	2	1	1	1	1
	080-368	3	3	3	3	3	3	3	3	3	3	3	3
	Henderson Lift Station Discharge	5	5	5	5	5	5	5	5	5	5	5	5

7 Conclusions and Recommendations

Flow monitoring was conducted as part of the Henderson CSO Reduction Project, primarily to characterize the performance of the combined sewer system and existing facilities to support Henderson Area modeling and to verify NPDES basin performance. A total of 24 temporary monitors were installed and maintained from January 2008 through May 2009 to supplement the 11 permanent monitors installed at the CSO outfalls. The following conclusions and recommendations are based on the 17 months of monitoring:

- Flow monitoring data were collected during 48 rainfall events greater than 0.3 inches cumulative depth (inter-event time of 6 hours). These events include:
  - Two 2-year storms
  - Four 1-year storms
  - Twenty storms between 2-month and 1-year
- Data were collected during ten model calibration storms. These events include:
  - Two 2-year storms
  - One 1-year storm
  - Two 6-month storms
  - One 4-month storm
  - Two 3-month storm
  - Two storms less than 2 month
- Rainfall during the monitoring period is representative of the historical record based on storm recurrence interval evaluation.
- Fifty-two separate combined sewer overflows occurred during the flow monitoring period. Most of these occurred at Outfall 44, specifically at CSO structure 44B. These overflows are summarized in **Table 5-1,** which is derived from the information provided in the SPU monthly CSO Reports to Ecology
- Lake flow entering the system at 45A between mid-April 2009 and mid-May 2009 may impact flow measurements for basin characterization and model calibration at downstream monitors 081-059 and 081-085.
- Data collected from monitors 067-271 (Basin 44) and 306-248 (Basin 49) proved to be adequate for HydroBrake stage-discharge curve development but not for basin characterization.
- Data quality is sufficient to support the hydraulic model through development, calibration, and validation.
- HydroBrake stage-discharge curves were developed for four of the five HydroBrakes. The only HydroBrake where a stage discharge curve was not developed was the HydroBrake in NPDES Basin 171 at MH 081-231. A new temporary monitor downstream of the HydroBrake was installed at MH 081-229 on June 24, 2009. The Manufacturer's Curve will be used in the hydraulic model at

this location until sufficient data have been collected so that a stage-discharge curve can be developed.

- The HydroBrake in Basin 44 (067-272) exhibited inconsistent performance during the monitoring period. The HydroBrake performance varied from more restrictive to less restrictive. This behavior makes it difficult to mimic the performance of this HydroBrake in the hydraulic model.
- In general, available storage is used efficiently, completely filling before overflows are allowed to occur. Frequent overflows at CSO structures 47B and 171 indicate that storage facility at CSO Facility #5 is undersized.

Lessons learned during the Henderson Flow Monitoring Project include the following:

- The on-going QA/QC review by multiple parties was essential to achieve useable, quality data.
- It was critical to understand monitor purpose to guide site selection and ongoing data review. For the Henderson monitoring program, this purpose has been listed in **Table 3-1**. It was also important to document which flow components were targeted at each site (e.g., was the depth over the weir, flow through the outfall, and/or flow into the CSO diversion structure, including the dry weather flow, the targeted flow monitoring values to measure?)
- Monitoring sites should be surveyed early in the project to provide accurate elevations for monitor sensor locations relative to significant structures (i.e., weirs, bench, pinch valves, etc.) so that monitoring data from multiple locations can be compared.
- Site installation sheets and photos are needed early in the project detailing sensor location relative to weirs, bench, pinch valves, etc. This information helps the data screener understand the complexities of each structure and can help to explain unusual patterns observed in the data.

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Appendix A
Monitor Equipment Specifications

HARDWARE

FLOWSHARK™

The new FlowShark™ from ADS is an open channel flow monitor for use in sanitary, CSO and storm sewers. It is designed for the ultimate performance and versatility, including single pipe or dual pipe measurement, small and large pipe application and industry -leading data collection, analysis, management, and reporting access options.

ADS FlowShark Features:

- Supports two complete sensor arrays for a total of six sensors, measuring two monitoring points - ideal for CSO monitoring.
- Wireless or standard telemetry for field versatility.
- Two 4-20 mA inputs for industry standard water quality primary sensing instruments.
- Two 4-20 mA outputs for SCADA integration variables such as flow rate, depth, and velocity.
- A remarkable 18 month battery life for low cost of maintenance.
- Monitor-Level Intelligence (MLI™) improves sensor accuracy and allows FlowShark to operate in a wider range of hydraulic conditions.
- Superior noise reduction design for maximizing accoustic signal reception from depth and velocity sensors.
- Seven communication and reporting modes for accessing flow information including standard collection and reporting software, Web-based alarming, and FlowView Portal.
- Intrinsically Safe (IS) Certification, meeting U.S. and international standards for Class 1, Div 1, ATEX Zone 1. *
- Marine-grade aluminum canister ensuring maximum protection and reliability in harsh sewer environments.

Applications

The FlowShark is designed for a multitude of project applications, including:

- Billing
- Trending
- Capacity Analysis
- CSOs
- SCADA networks
- Annexation and planning studies
- SSO monitoring
- CMOM/Operations and Maintenance programs
- Storm sewer/water quality characterization
- I/I studies

About ADS ...

A leading technology and service provider, ADS® Environmental Services has established the industry standard for open channel flow monitoring and has the only ETV verified flow monitoring technology for wastewater collection systems. These battery-powered monitors are specially designed to operate with reliability, durability, and accuracy in sewer environments.

INNOVATION • FLEXIBILITY • AFFORDABILITY

ADS ENVIRONMENTAL SERVICES®

Available Sensors

The following ADS sensors work interchangeably with the FlowShark and all ADS flow monitors. Together they provide a complete flow monitoring system with the highest accuracy and reliability. Detailed specifications for each sensor are also available from ADS.

Quad-redundant Ultrasonic Level Sensor

This non-intrusive, zero-drift sensing method results in a stable, accurate & reliable flow depth calculation. Four independent ultrasonic transceivers allow up to twelve sensor pair configurations for independent crosscheck, which provides built-in confidence and reliability. Advanced software filtering helps compensate for adverse monitoring conditions such as waves, foam, debris, etc.

Function: Measures elapsed time for an ultrasonic signal to travel to the flow surface and back and records the distance to the flow surface. The sensor is composed of 4 independent piezoelectric crystals. Resident software evaluates sensor readings and discards aberrant data.

Range: Up to 12.5 ft (3.8 m) in typical installations.

Pressure Depth Sensor

This sensor is used to measure surcharge levels, or to provide a redundant depth reading when used in conjunction with the ultrasonic level sensor.

Function: Measures depth of flow by recording the difference in atmospheric and water pressure.

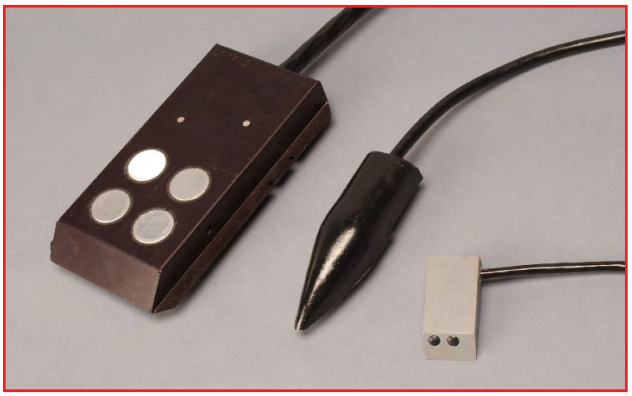
Range: 0.0-5.0 psi: up to 11.5 ft (3.5 m); 0.0-15.0 psi: up to 34.5 ft (10.5 m); 0.0-30.5 psi: up to 69.0 ft (21.0 m)

Peak Velocity Sensor

Readings from this sensor are used to calculate average flow velocity. Its miniature size and streamlined design minimize fouling and prevent flow disruption.

Function: An ultrasonic signal is transmitted out into the flow. The reflected signal is digitally analyzed for Doppler shift to measure the peak flow velocity.

Range: -15.0 to +15.0 ft/sec (-4.5 to +4.5 m/sec)



From left, Quadredundant ultrasonic level, pressure depth and peak velocity sensors.

Monitor Interfaces

Water Quality Sampler Interface
- Flow proportional or time-based

Rain Fall Measurement
- Tipping bucket

Analog Input
- PH, salinity, conductivity, other flow device

Analog Output
- Flow, ultrasonic level, pressure level, velocity

Product Specifications

Housing
0.13 in. (0.30 cm) thick seamless marine-grade aluminum with stainless steel hardware.

Dimensions
Cylinder is 20.0 in. long x 6.38 in. diameter (50.80 cm x 16.21 cm).

Weight
35 lbs.

Connectors
U.S. Military spec. MIL-C-26482 series 1, for environmental sealing, with gold plated contacts.

Electronics
Ultra-low power CMOS microprocessor-based architecture.

Power
Battery pack can power unit for more than 18 months at the standard 15-minute sample rate or can be powered with a DC power source (11-15vdc).

Measurement Intervals
A crystal oscillator timer activates depth intervals and velocity measurements at preset intervals such as 1.0, 2.0, 2.5, 5.0, 7.5, and 15 minutes. Time is synchronized to a central station computer.

Available Memory
2 Megabytes of available data storage, furnishing up to 12 months of data storage capacity with full sensor configuration at 15-minute sample rate.

Intrinsic Safety Certification *
U.S.: Class 1, Division 1, Groups C & D.
International: ATEX Zone 1.

Operating Temperature
32 degrees to 140 degrees F (0 degrees to 60 degrees C).

Warranty
One-Year Limited Warranty.

* Certification Pending

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Document DSFLSK0705V1

HARDWARE

Quadredundant Ultrasonic Level Sensor

The ADS® Quadredundant Ultrasonic Sensor is a non-intrusive, accurate measurement device for use in open channel flow monitoring applications. It operates by measuring the elapsed time for an ultrasonic signal to travel to the flow surface and back, and calculates the distance to the flow surface. This information, in conjunction with data pertaining to pipe geometry, is used to compute depth of flow. The sensor is mounted at the top of the pipe. The patented Quadredundant Ultrasonic Sensor is manufactured under an ISO9001 Quality Management System.

Sensor Features

- ***Quadredundancy*** - Four independent ultrasonic transceivers allow for independent cross-check, which provides superior confidence and reliability
- ***Minimal Dead Zone*** - Less than 1" (2.54 cm) - allows for up-the-pipe mounting
- ***Zero Drift*** - Solid state, non-mechanical
- ***Local Temperature Compensation*** - Through redundant temperature sensors mounted in the sensor housing
- ***Non-Intrusive Installation*** - Top of pipe mounting minimizes fouling, flow distortion, and head loss - also suitable for mounting in chambers, vaults, or other structures
- ***Optional Intrinsically Safe Configuration*** - Suitable for installation in hazardous areas when used with ADS Model 1600™, ADS Model 3600™ and IS FlowShark monitors

Applications

Depth data provided by the ADS Quadredundant Ultrasonic Level Sensor is used to calculate flows in a variety of applications, including:

- ***Infiltration/inflow programs***
- ***Inter-agency billing***
- ***CSO and SSO monitoring***
- ***Storm sewer monitoring***
- ***Sewer capacity studies/trending***
- ***Rehabilitation effectiveness monitoring***
- ***Flume calibration studies***
- ***Sewer master plan studies***

Approvals

- Intrinsically Safe, Class 1, Div. 1, Group C & D (US)
- Intrinsically Safe, ATEX Zone 0, EEx ia IIB T4 (International)

ETV

The ADS Quadredundant Ultrasonic/ Pressure Technology was tested and verified by the EPA's Environmental Technology Verification Program.

Product Specifications

For ADS FlowShark:

Range
Up to 12.5 ft. (3.81 m)

Housing
Marine-grade aluminum / epoxy
7.13 x 4.2 x .86 in.
(18.11 x 10.67 x 2.19 cm)

Resolution
0.01 in. (0.0254 cm)

Accuracy
0.125 in. (0.32 cm)

Drift
0.0 in.

Sensor Cable
- 0.50" (1.27 cm) OD polyurethane jacket
- 35 ft. (10.67 m) standard cable length
- Extension cables available to 300 ft. (91.4 m)

* Product specifications may vary for other ADS flow monitors.

The Quadredundant Ultrasonic Level Sensor utilizes four independent transceivers and up to 144 measurements to generate accurate and reliable flow depth quantity calculations.

About ADS

A leading technology and service provider, ADS Environmental Services® has established the industry standard for open channel flow monitoring and has the only ETV verified flow monitoring technology for wastewater collection systems. These battery-powered monitors are specially designed to operate with reliability, durability, and accuracy in sewer environments.

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HARDWARE

Pressure Depth Sensor

The ADS® Differential Pressure Sensor measures depth in open channel flow monitoring applications under free flow and surcharged conditions. It measures the depth of flow by recording the difference in atmospheric and water height pressure. When installed with the standard ADS sensor suite, the pressure sensor is used to back up the ultrasonic depth sensor. In addition, the pressure sensor can be installed in the pipe or in the manhole to record the depth of surcharge. The patented Pressure Depth Sensor is manufactured under an ISO9001 Quality Management System.

Sensor Features

- ***Remote Diagnostics*** - Sensor can be activated, deactivated, and calibrated from a remote location
- ***Streamlined Housing*** - Minimizes flow distortion commonly caused by intrusive sensors
- ***Non Fouling PVC/Stainless Steel Material*** - Enables sensor to operate in the harsh sewer environment with minimal fouling compared to other materials
- ***Automatic Temperature Compensated -*** Allows accurate depth measurement across a wide range of fluid temperatures
- ***Multi-Condition Performance*** - Measures depth under free-flow and surcharged conditions
- ***Optional Intrinsically Safe Configuration*** - Suitable for installation in hazardous areas when used with ADS Model 1600™, ADS Model 3600™ and IS FlowShark monitors.

Applications

Depth data measured by the ADS Pressure Sensor is used to calculate flows for the following applications:

- ***Infiltration/inflow programs***
- ***Inter-agency billing networks***
- ***CSO and SSO monitoring***
- ***Storm sewer monitoring***
- ***Sewer capacity studies/trending***
- ***Rehabilitation effectiveness monitoring***
- ***Flume calibration studies***
- ***Sewer master plan studies***

Approvals

- Intrinsically Safe, Class 1, Div. 1, Group C & D (US)
- Intrinsically Safe, ATEX Zone 0, EEx ia IIB T4 (International)

Product Specifications

Range
0 - 5 psi: (11.5'/3.5m)
0 - 15 psi: (34.5'/10.5m)
0 - 30 psi: (69'/21m) PSIG ranges available
Operational Temperature 0° to 50° C

Housing
Solid machined PVC/stainless steel,
5.25 x 1.4 x 1.15 in.
(13.34 x 3.56 x 2.92 cm)

Resolution
0.025% of Full Scale

Accuracy
0.25% of Full Scale for 0 to 5, 15 and 30 PSI sensors

Sensor Cable
- 0.292" (.72 cm) OD polyurethane jacket
- 40 ft. (12.19 m) standard cable length
- Extension cables available to 300 ft. (91.4 m)

The ADS Pressure Sensor measures depth of flow under free-flow and surcharged conditions.

About ADS

A leading technology and service provider, ADS® Environmental Services has established the industry standard for open channel flow monitoring and has the only ETV verified flow monitoring technology for wastewater collection systems. These battery-powered monitors are specially designed to operate with reliability, durability, and accuracy in sewer environments.

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HARDWARE

Peak Velocity Sensor

The ADS® Peak Velocity Sensor measures velocities over the full depth of flow profile in open channel flow monitoring applications. It operates by transmitting an ultrasonic signal throughout the flow cross-section. The returning reflected signal is processed using a digital signal processor to report peak velocity, from which average velocity is calculated. The sensor is installed at the invert of the pipe, or if silt is present, under the flow surface above the silt level. The patented Peak Velocity Sensor is manufactured under an ISO9001 Quality Management System.

Sensor Features

- ***Miniature Size*** - Allows measurements in flows as shallow as 1" (2.5 cm) in depth
- ***No Drift*** - No moving parts
- ***Non Fouling*** - Streamlined design minimizes need for periodic cleaning
- ***Operating Range*** of -5.0 to +15.0 feet per second
- ***Remote Diagnostics*** - Allows analysis of sensor operation from a remote location
- ***Can Be Mounted On Pipe Wall*** - Allows velocity measurement in silt conditions
- ***Optional Intrinsically Safe Configuration*** - Suitable for installation in hazardous areas when used with ADS Model 1600™, ADS Model 3600™ and IS FlowShark monitors.

Applications

For use with Continuity Equation (Q=AV) applications in wastewater systems, even where non-free flow conditions exist. Accurate, reliable velocity data is critical for:

- ***Infiltration/inflow programs***
- ***Inter-agency billing***
- ***CSO and SSO monitoring***
- ***Storm sewer monitoring***
- ***Sewer capacity studies/trending***
- ***Rehabilitation effectiveness monitoring***
- ***Flume calibration studies***
- ***Sewer master plan studies***

Product Specifications

Range
-5.0 to +15.0 ft/sec
(-1.5 to +6.1 m/sec)

Housing
Solid machined PVC / epoxy
2.35 x 1.13 x .49 in.
(5.97 x 2.87 x 1.25 cm)

Resolution
0.04 ft/sec (.01 m/sec)

Accuracy
-5.0 to +5.0 ft/sec (-1.5 to +1.5 m/sec) 0.8% full scale
5.0 to 10.0 ft/sec 1.5 to 3.0 m/sec) 1.2% full scale
10.0 to 15.0 ft/sec (3.0 to 4.5 m/sec) 2.8% full scale

Size
1.5 x 1.125 x 0.5 in.
(3.8 x 2.85 x 1.27 cm)

Sensor Cable
- 0.25" (.64 cm) OD polyurethane jacket
- 40 ft. (12.19 m) standard cable length
- Extension cables available to 300 ft. (91.4 m)

Approvals

- Intrinsically Safe, Class 1, Div. 1, Group C & D (US)
- Intrinsically Safe, ATEX Zone 0, EEx ia IIB T4 (International)

ETV

The ADS Peak Velocity Sensor accuracy specification was tested and verified by the EPA's Environmental Technology Verification Program.

Through the use of digital spectrum analysis, the ADS Peak Velocity Sensor measures accurate and repeatable velocities over the full flow profile.

About ADS

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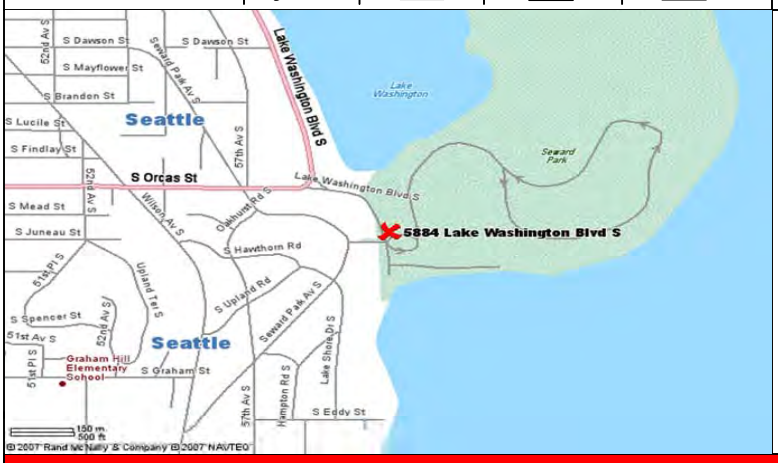
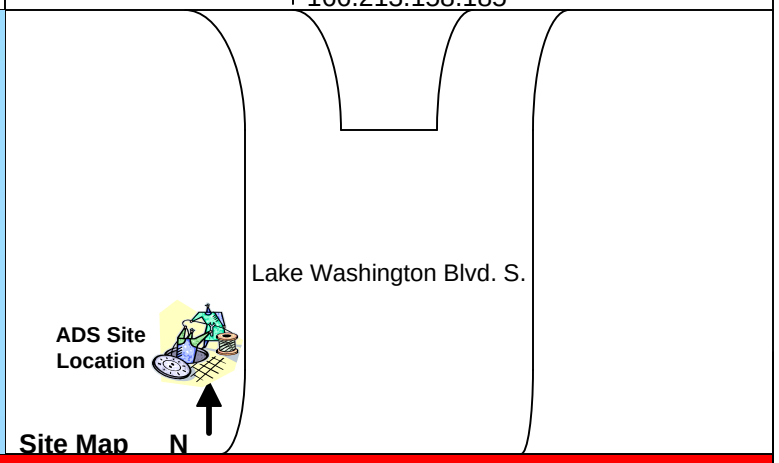
Appendix B
ADS Site Installation Sheets & Site Schematics

ADS Site Report

Quality Form

Project Name:	**Henderson**	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN44_067191	**Monitor Series:**	5000 AG	**Monitor S/N:**	20094
Address/Location:	5884 Lake Washington Blvd. S.			**Manhole #**	067191
				Thomas Bros Map Page:	
				Pipe Height:	24.75 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 24.75 "
					IP Address: 166.213.158.185





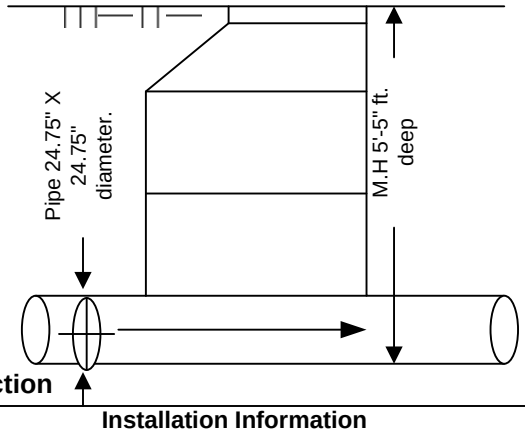
Investigation Information:

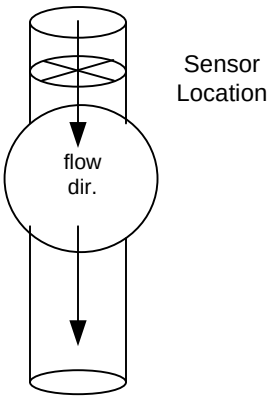
Date/Time of Investigation:	1-2-08 0840
Site Hydraulics:	Smooth Steady Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	4.25 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	1.10 fps
Silt:	0.25 Inches

Manhole Information:

Manhole Depth:	11'-9"			
Manhole Material / Condition	Brick / Fair			
Pipe Material / Condition:	Clay / Fair			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:				
Access Pole #:				
Distance From Manhole:	Feet			
Road Cut Length:	Feet			
Trench Length:	Feet			

Other Information:





Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN44_067191

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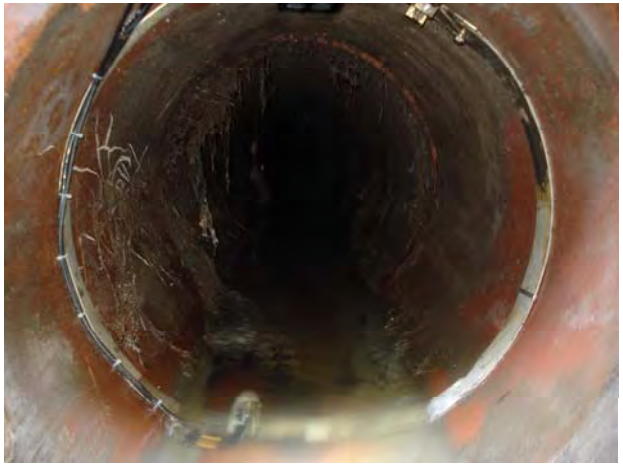
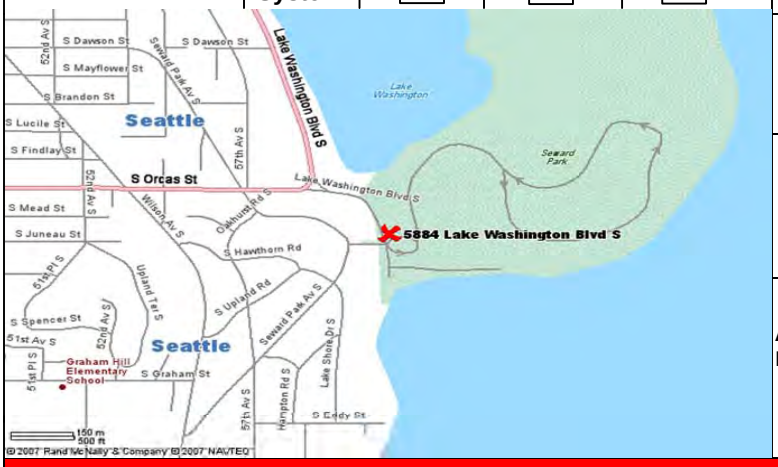
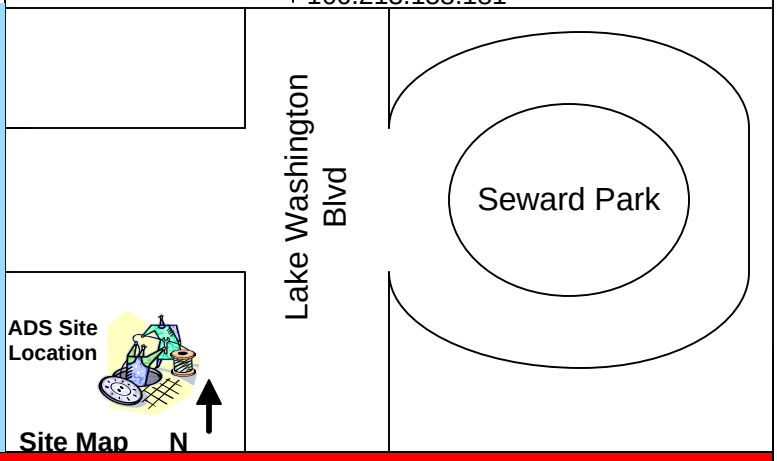


ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN44_067271	**Monitor Series:**	5000 AG	**Monitor S/N:**	20085
Address/Location:	Seward Park			**Manhole #**	067271
				Thomas Bros Map Page:	595-H7
				Pipe Height:	30.00 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	29.88 "
				IP Address:	166.213.158.181





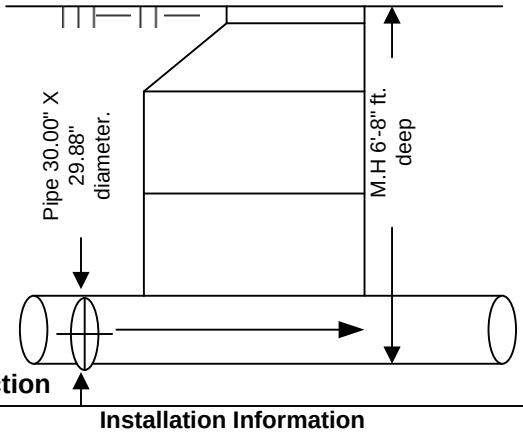
Investigation Information:

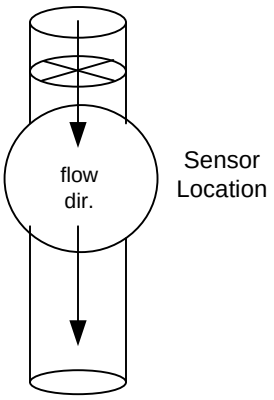
Date/Time of Investigation:	12-27-07 1219	**Site Hydraulics:**	Smooth Steady Flow
Upstream Input: (L/S, P/S)		**Upstream Manhole:**	DNI
Downstream Manhole:	DNI	**Depth of Flow:**	2.63 +/- 0.38"
Range (Air DOF):	+/-	**Peak Velocity:**	3.41 fps
Silt:	0.00 Inches		

Manhole Information:

Manhole Depth:	6'-8"				
Manhole Material / Condition	Concrete / Fair				
Pipe Material / Condition:	Concrete / Fair				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:					
Access Pole #:					
Distance From Manhole:	Feet				
Road Cut Length:	Feet				
Trench Length:	Feet				

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN44_067271

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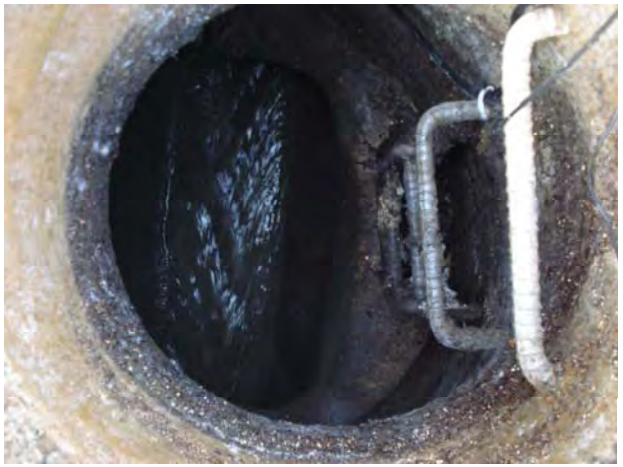
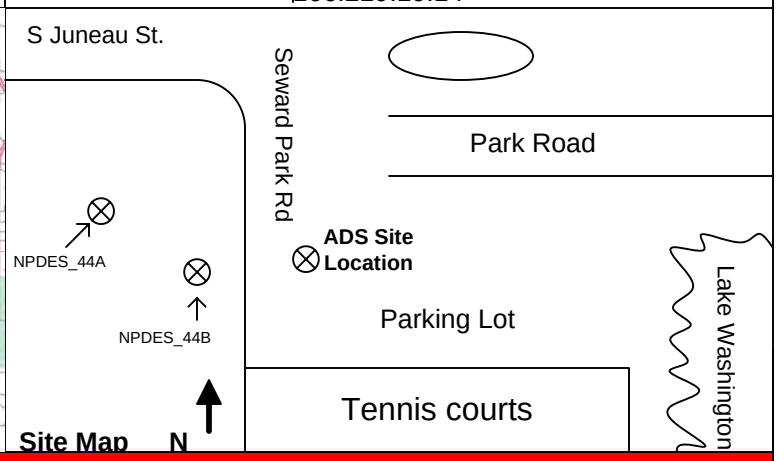


ADS Site Report — Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA
FM Initials:	SW		
Site Name:	HEN44_067275	**Monitor Series:**	5000 BG
Monitor S/N:	18037		
Address/Location:	Seward Park Rd and S. Juneau St; located in W parking lot at Seward Park by tennis courts	**Manhole #**	067-275
Thomas Bros Map Page:	595 H7		
Pipe Height:	MP1 30.00" MP2 15.00"		
Pipe Width:	MP1 30.00" MP2 15.00"		
IP Address:	166.219.19.14		

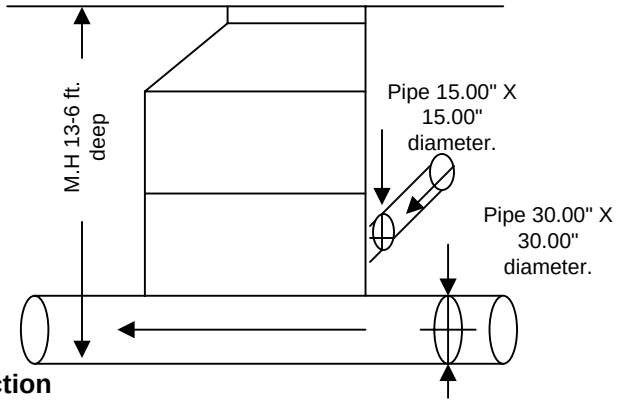
Access:	**Type of System:**	Sanitary	Storm	Combined
Drive				X



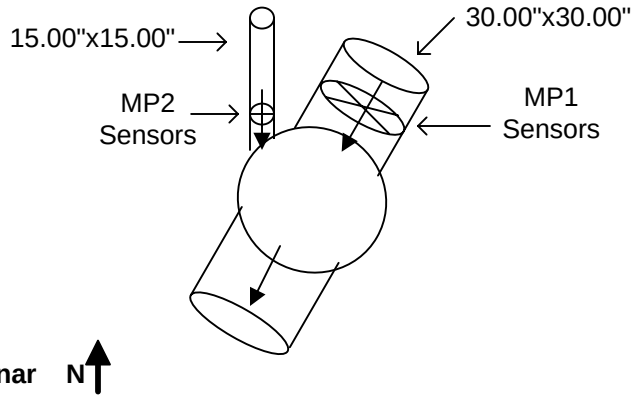
Investigation Information:

Date/Time of Investigation:	3/25/08 13:00	**Manhole Depth:**	8' 3"
Site Hydraulics:	Both MP's are dry pipes	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Good (Both Pipes)
Upstream Manhole:	DNI	**Mini System Character:**	Residential X; Commercial; Industrial; Trunk
Downstream Manhole:		**Telephone Information:**	
Depth of Flow:	0 +/- Both MP's	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	0 fps Both MP's	**Road Cut Length:**	Feet
Silt:	0 Inches Both MP's	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

Installation Information	
Installation Type:	Standard on Both MP's
Sensors Devices:	Ultra / Pressure / Velocity (Both MP's)
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk				
Lift / Pump Station				
WWTP				
Other				

Additional Site Information / Comments:

Both Monitoring points are dry pipes, they are both one manhole downstream of dry side of weir walls. These are tail end of overflow pipes.

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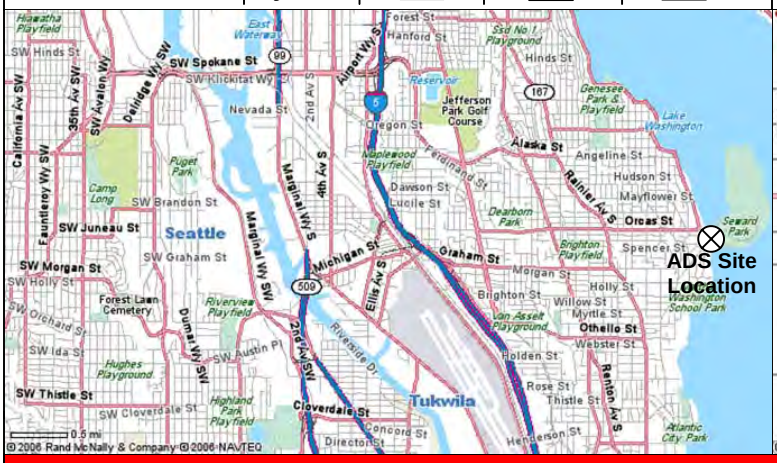
ADS Site Report

Quality Form

Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SW	
Site Name: NPDES 44A/SEA_067274	**Monitor Series:** 5000 AG	**Monitor S/N:**	15011
Address/Location: Lake Washington BLVD S. s/o S. Juneau St. (n/o the tennis courts and parking lot)		**Manhole #**	067-274
		Thomas Bros Map Page:	595 H7
		Pipe Height:	30.00 "
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	30.00 "
		IP Address:	166.219.19.33



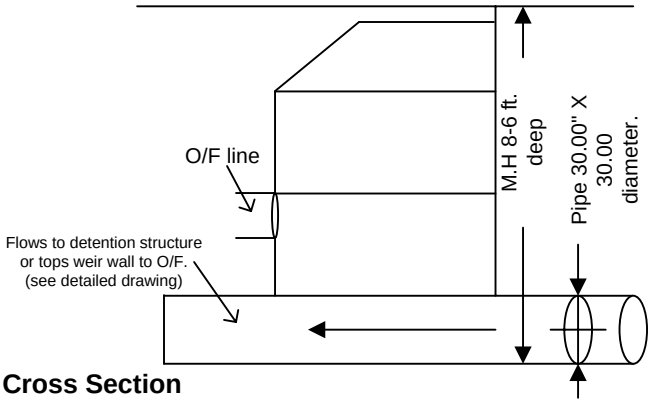
Investigation Information:

Date/Time of Investigation:	8/30/2007 11:30
Site Hydraulics:	Normally stagnant, but I believe a forced main line gets discharge into line u/s and comes into site slow and smooth flow and also with reverse flow leaving the inlet pipe due to this manhole being a detention structure and O/F line.
Upstream Input: (L/S, P/S)	L/S
Upstream Manhole:	Has hydrobrake
Downstream Manhole:	O/F line to the lake
Depth of Flow:	2.00" +/- 0.25"
Range (Air DOF):	28.00" +/- 0.25"
Peak Velocity:	Stagnant
Silt:	0.00 Inches

Manhole Information:

Manhole Depth:	8' - 6"				
Manhole Material / Condition	Concrete / Good				
Pipe Material / Condition:	Concrete / Good				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:	Doesn't apply				
Access Pole #:	Doesn't apply				
Distance From Manhole:	Doesn't apply	Feet			
Road Cut Length:	Doesn't apply	Feet			
Trench Length:	Doesn't apply	Feet			

Other Information:



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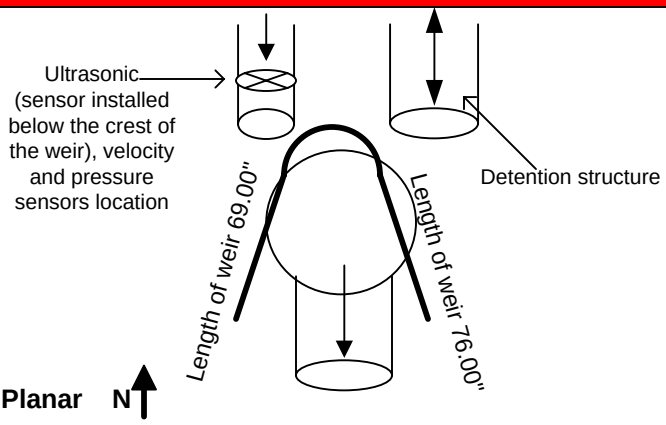

Planar

Installation Information	
Installation Type:	Regular
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	RG_18

Backup	Yes	No	?	Distance
Trunk	[ ]	[X]	[ ]	
Lift / Pump Station	[X]	[ ]	[ ]	L/S 20 feet
WWTP	[ ]	[X]	[ ]	
Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Weir Measurements: Height: Left 64.75", Center 65.75", Right 64.75" (reference point from sensor location). Length: Left side 69.00", Right side 76.00", Total length 145.00".
Point of overflow 64.75" (what monitor reads when high high threshold is met).
Pressure (5 PSI, accuracy +/- 0.25% for range of 0.25 – 11.5 ft.)

Rev. 2 12/10/08

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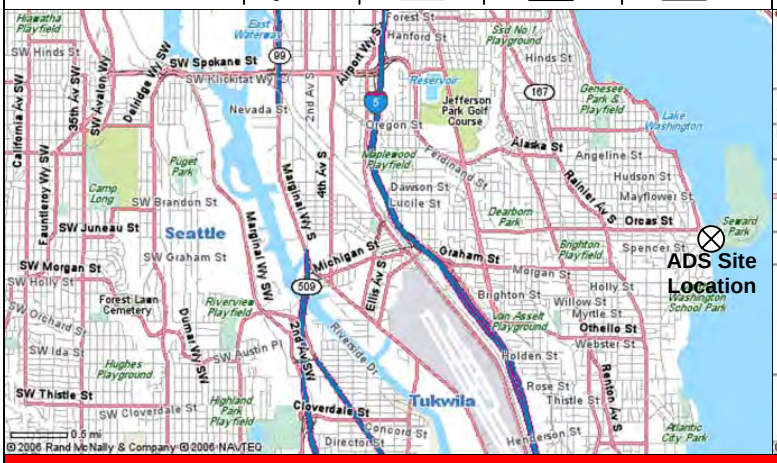
ADS Site Report — Quality Form

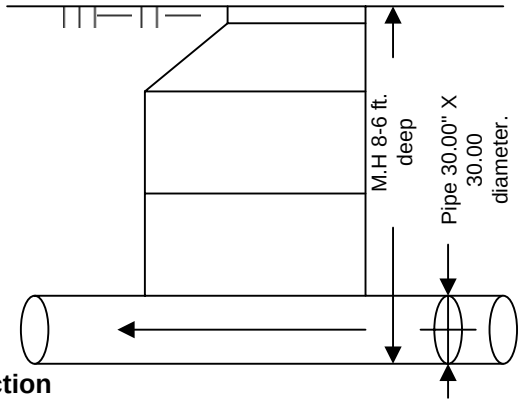
Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SS	
Site Name: NPDES 44A/SEA_067274	**Monitor Series:** 5000 AG	**Monitor S/N:**	15074
Address/Location: Lake Washington BLVD S. s/o S. Juneau St. (n/o the tennis courts and parking lot)		**Manhole #**	067-274
		Thomas Bros Map Page:	595 H7
		Pipe Height:	30.00 "
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	30.00 "
		IP Address:	166.219.19.27



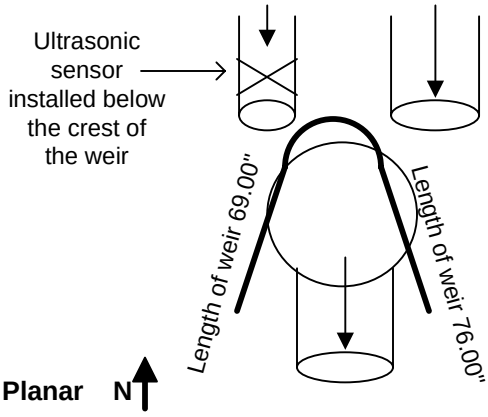
Investigation Information:

Date/Time of Investigation:	12/19/2006 08:52	**Manhole Depth:**	8' - 6"
Site Hydraulics:	Further info. pending	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Good
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	Further info. pending +/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	Further info. pending fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

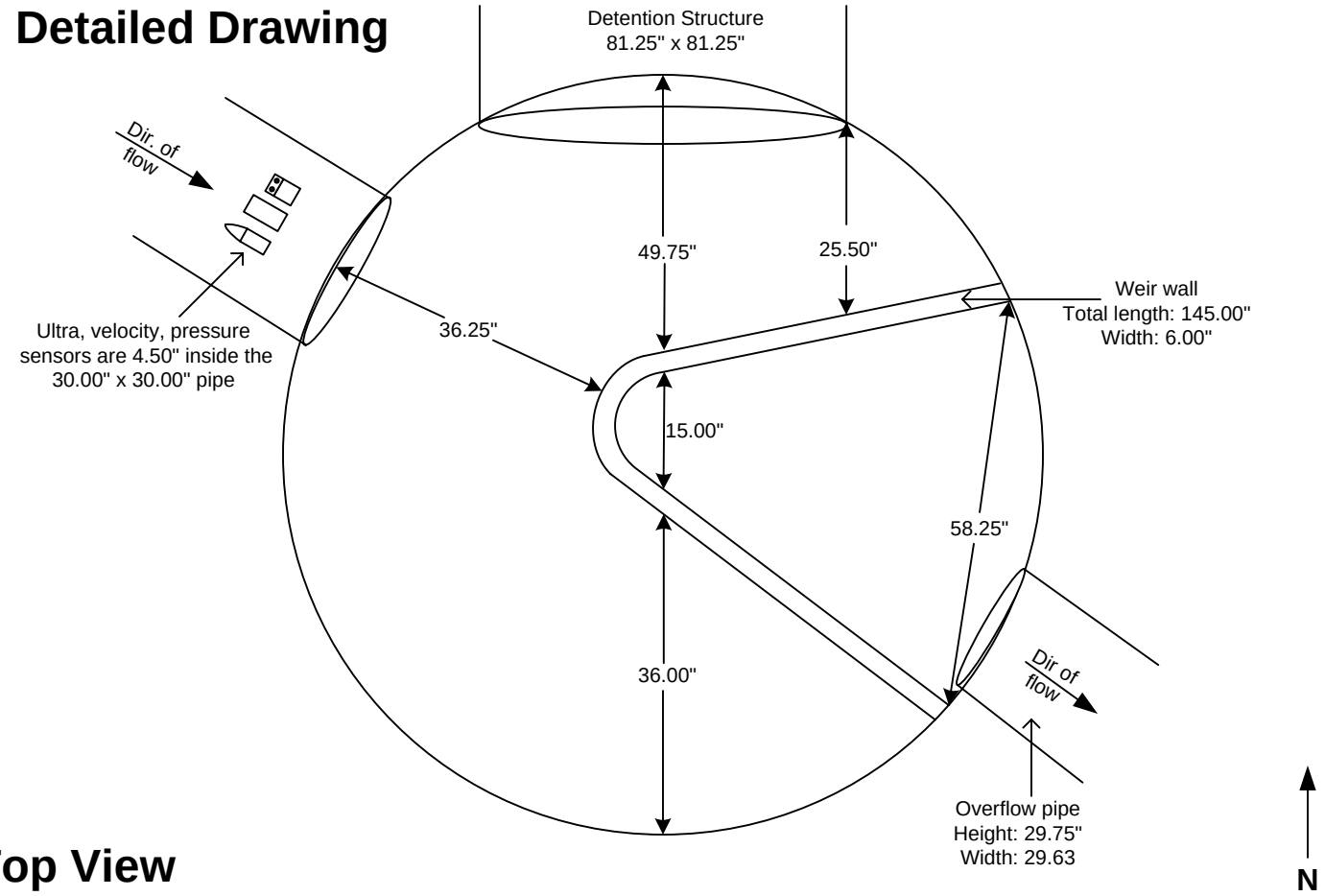
Installation Information	
Installation Type:	Regular
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

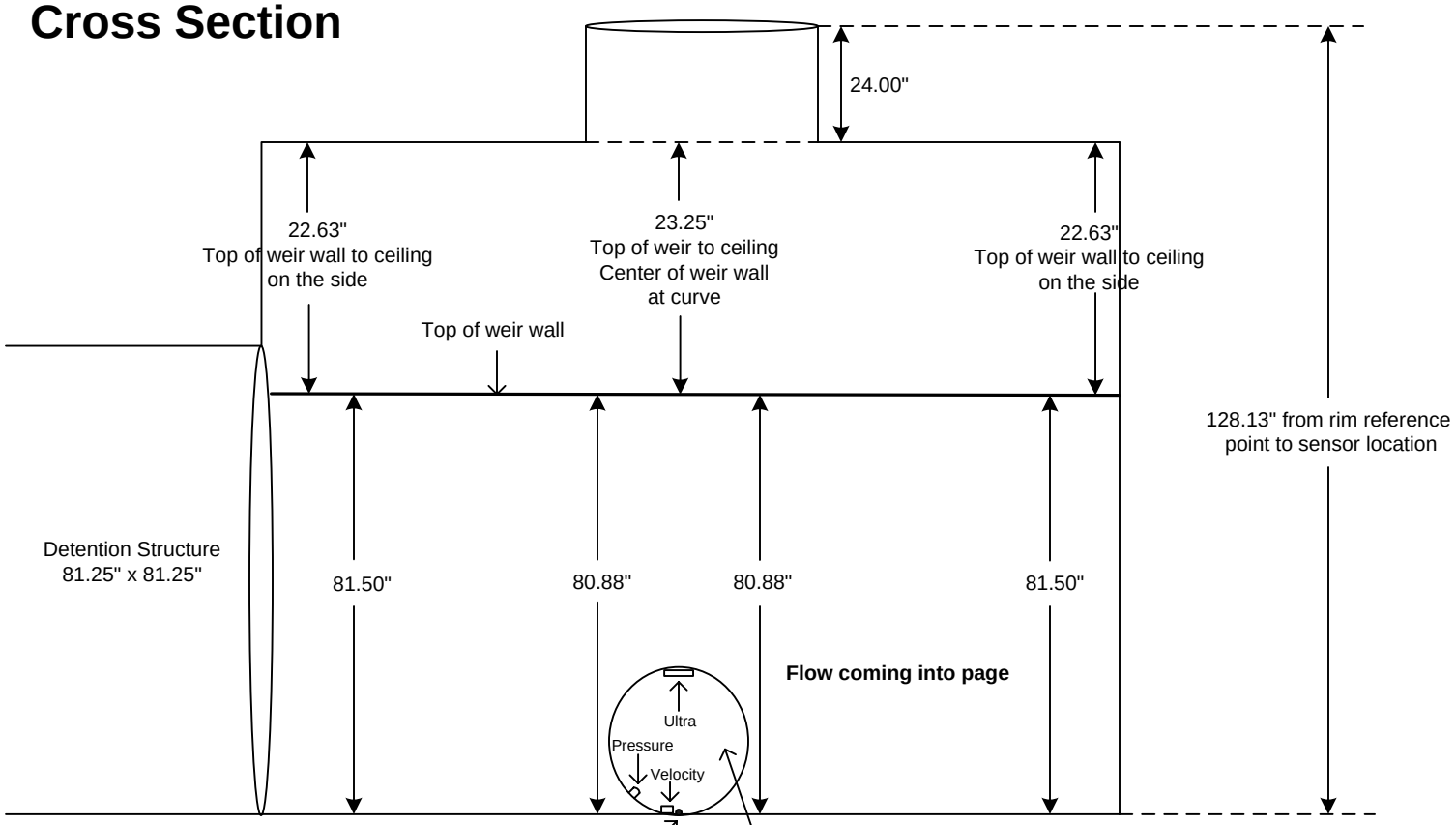
Weir Measurements: Length: Left side 69.00", Right side 76.00". Height: Left 62.50", Center 63.50", Right 62.50". Reverse install. 0-15 psi pressure. Overflow quantification method: Broad Crested Weir Equation.

NPDES_44A MH067-274
Detailed Drawing



Top View

Cross Section

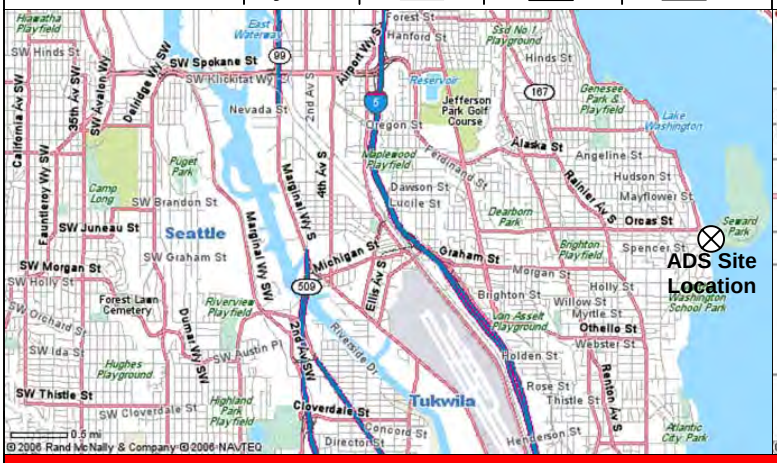


Overflow point is 80.88"
Overflow quantity is quantified with the equation: If(Dfinal - O/F<0),0,2.62 x (weir length)* (((Dfinal - O/F)/12)^3/2)))

Not to scale
Rev. 2 12/10/08

ADS Site Report — Quality Form

Project Name:	Seattle - CSO	**City / State:**	Seattle, WA
FM Initials:	SW		
Site Name:	NPDES 44B/SEA_067261	**Monitor Series:**	5000 AG
Monitor S/N:	19009		
Address/Location:	Lake Washington BLVD S. s/o S. Juneau St. (n/o the tennis courts and parking lot)	**Manhole #**	067-261
		Thomas Bros Map Page:	595 H7
		Pipe Height:	15.00 "
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	14.50 "
		IP Address:	166.219.18.253



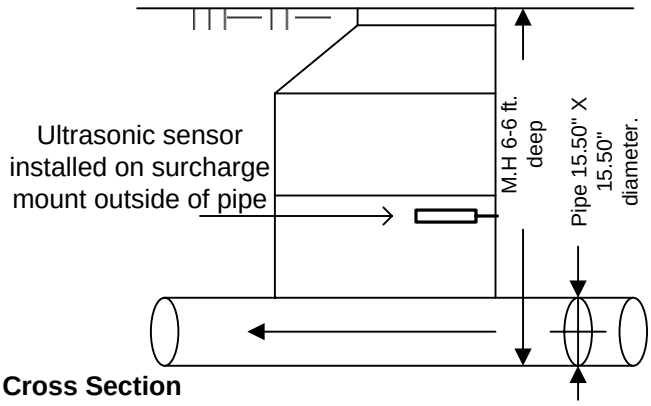
Investigation Information:

Date/Time of Investigation:	12/19/2006 10:00	**Site Hydraulics:**	Smooth flow
Upstream Input: (L/S, P/S)	No	**Upstream Manhole:**	DNI
Downstream Manhole:	DNI	**Depth of Flow:**	6.50"+/- 0.25"
Range (Air DOF):	8.50" +/- 0.25"	**Peak Velocity:**	0.73 fps
Silt:	0.00 Inches		

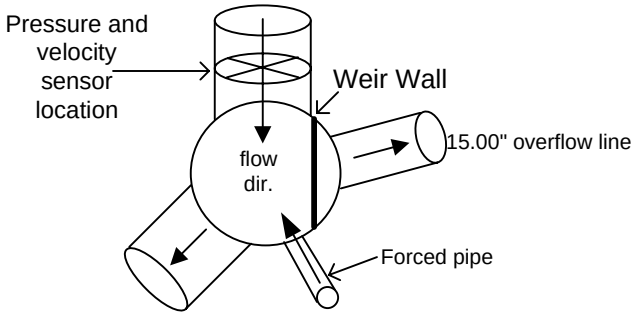
Manhole Information:

Manhole Depth:	6' - 6"	**Manhole Material / Condition**	Concrete / Good	**Pipe Material / Condition:**	Concrete / Good
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:	Doesn't apply	**Access Pole #:**	Doesn't apply		
Distance From Manhole:	Doesn't apply Feet	**Road Cut Length:**	Doesn't apply Feet	**Trench Length:**	Doesn't apply Feet

Other Information:



Cross Section



Planar N

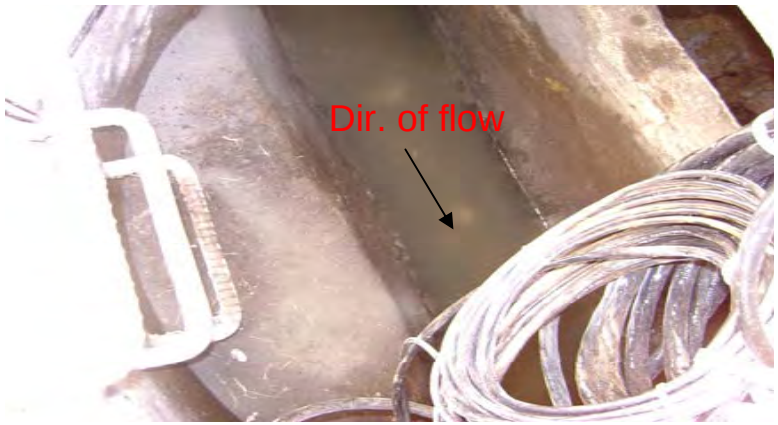
Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Velocity and pressure in pipe, ultra on surcharge mount	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[X]	Forced main flows into MH
Surcharge Height:	0.00" Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_18	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Weir wall dimensions: Length: 75.00", Width: 4.00"
Point of overflow 28.50"

Rev. 1 11/13/08

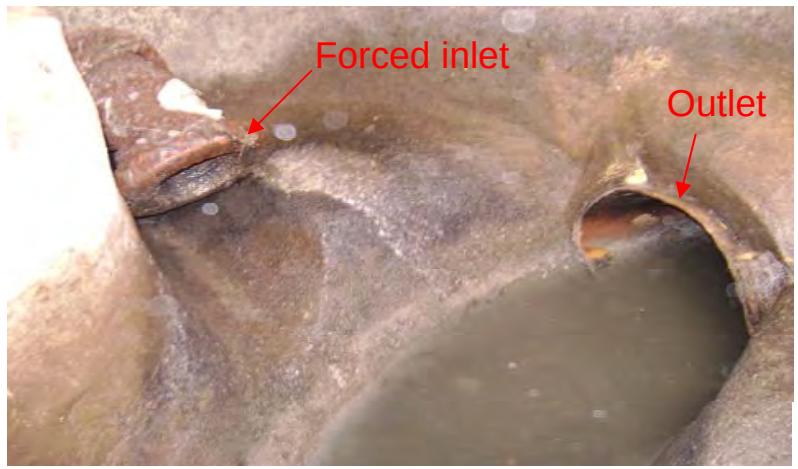
NPDES_44B
MH 067-261
Installation



View down manhole looking north

View of inlet w/ velocity and pressure

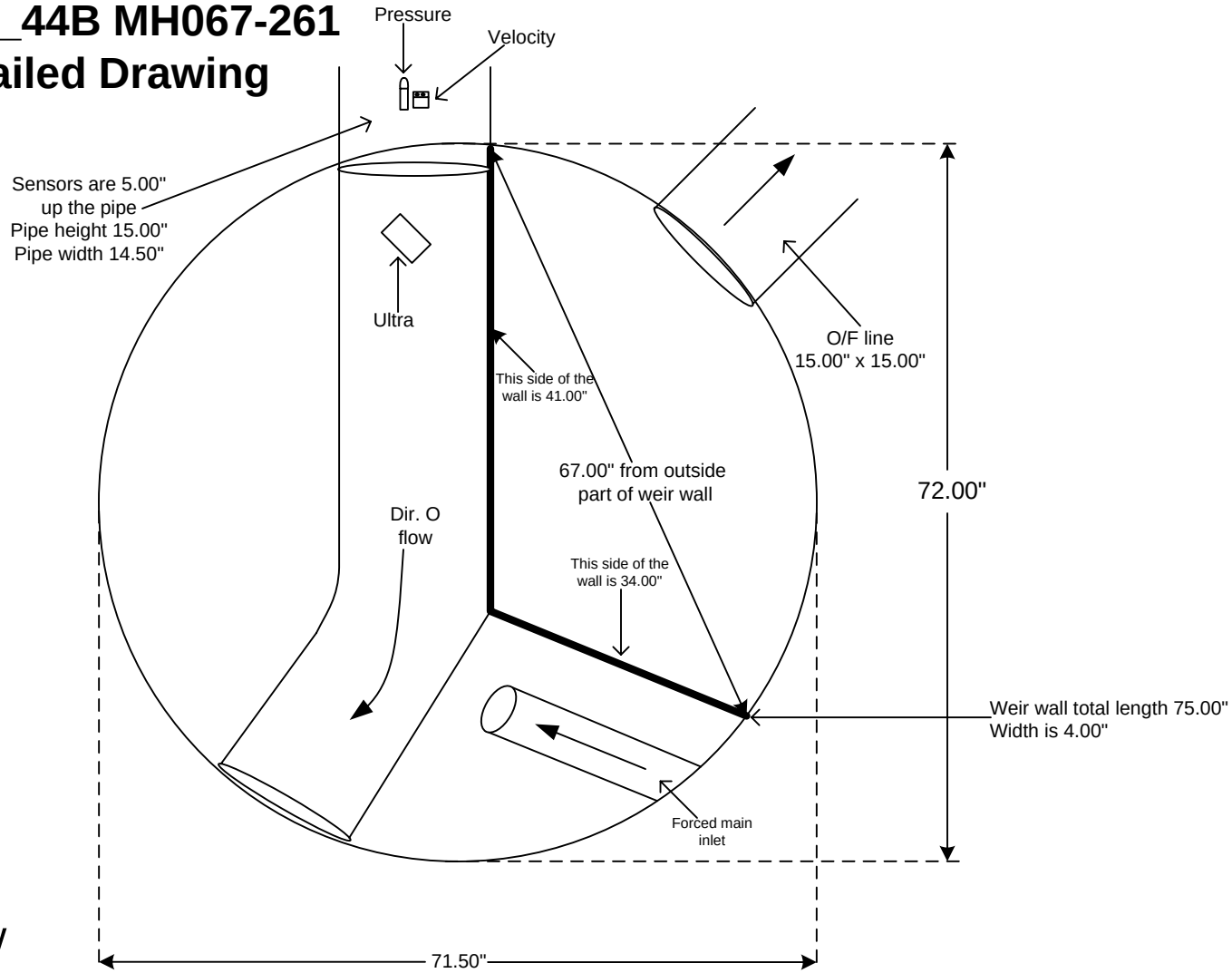
View of inlet w/ sensors related to weir and O/F line



View of outlet and a forced sideline inlet

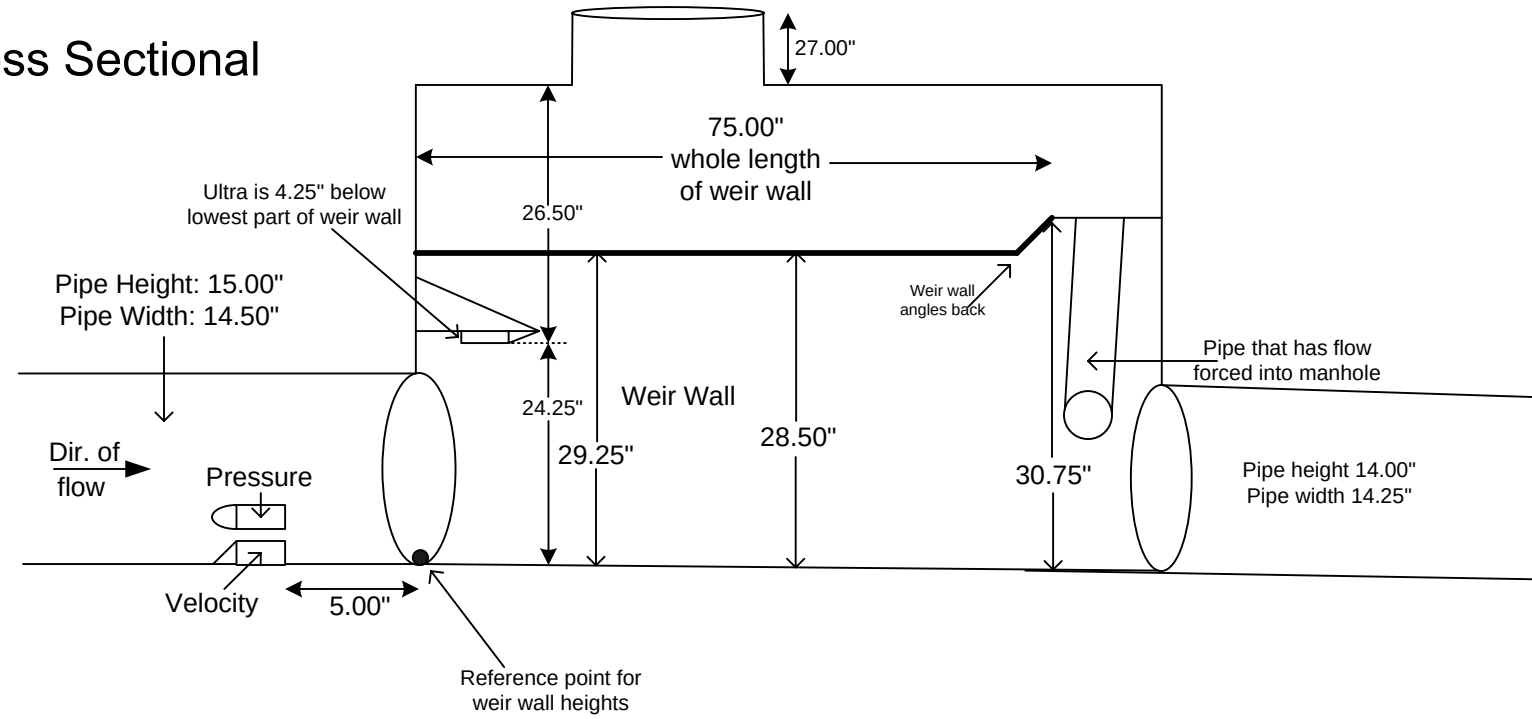
Rev.2 3/13/09

NPDES_44B MH067-261
Detailed Drawing



Top View

Cross Sectional



Overflow point is 28.50"
Overflow quantity is quantified with the equation: If(Dfinal - O/F<0),0,2.62 x (weir length)* (((Dfinal - O/F)/12)^3/2)))

Not to scale
Rev. 1 10/15/08

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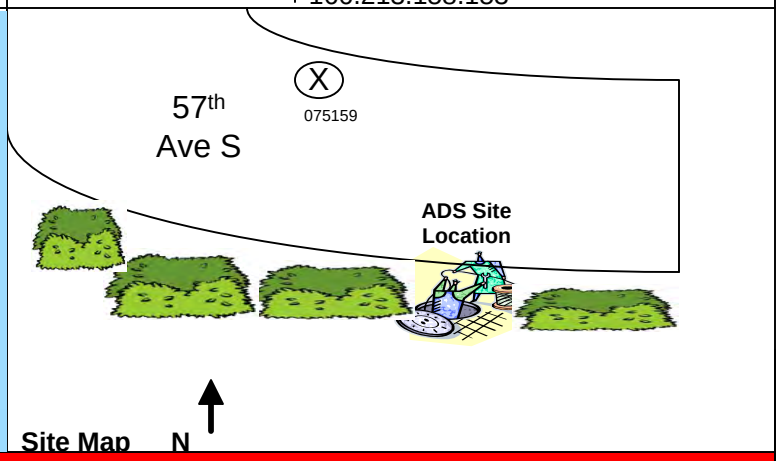
ADS Site Report

Quality Form

Project Name: Henderson	**City / State:** Seattle, WA	**FM Initials:** SK	
Site Name: HEN45_074152	**Monitor Series:** 5000 AG	**Monitor S/N:**	20003
Address/Location: 6747 57th Ave S.		**Manhole #**	074152
		Thomas Bros Map Page:	
		Pipe Height:	8.00 "
Access: Drive/Walk	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	8.00 "
		IP Address:	166.213.158.153



Site Map

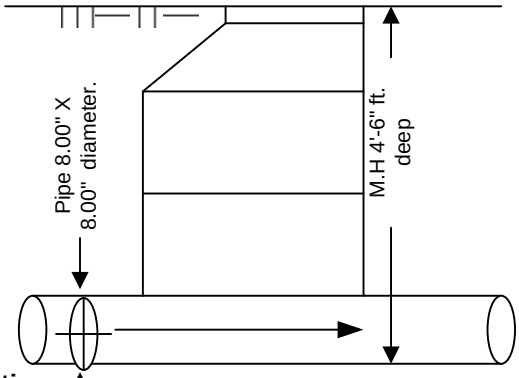
Investigation Information:

Date/Time of Investigation:	1-2-08 0915
Site Hydraulics:	Choppy Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	2.50 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	2.03 fps
Silt:	0.00 Inches

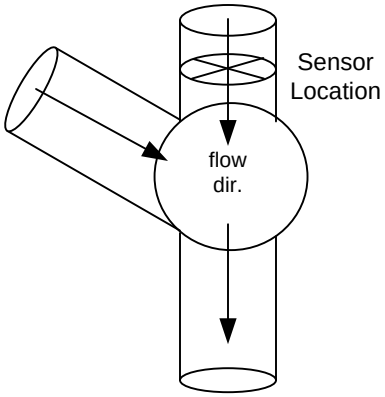
Manhole Information:

Manhole Depth:	4'-6"				
Manhole Material / Condition	Brick / Fair				
Pipe Material / Condition:	Concrete / Fair				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:					
Access Pole #:					
Distance From Manhole:	Feet				
Road Cut Length:	Feet				
Trench Length:	Feet				

Other Information:



Cross Section



Planar N

Installation Information	
Installation Type:	Special
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN45_074152

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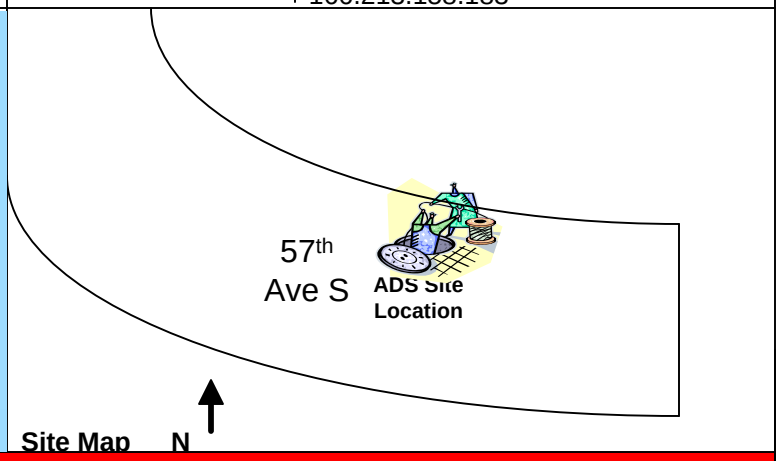
ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN45_074159	**Monitor Series:**	5000 AG	**Monitor S/N:**	20063
Address/Location:	5563 57th Ave S			**Manhole #**	074159
				Thomas Bros Map Page:	
				Pipe Height:	14.88 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 14.88 "
					IP Address: 166.213.158.183

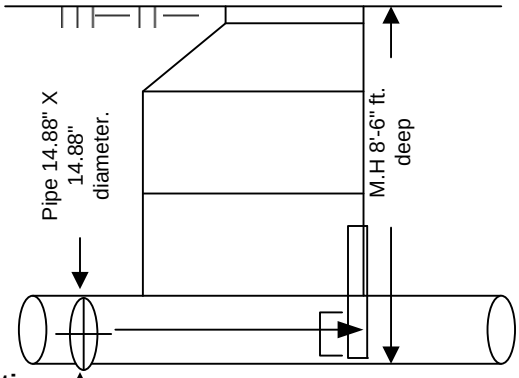


Site Map

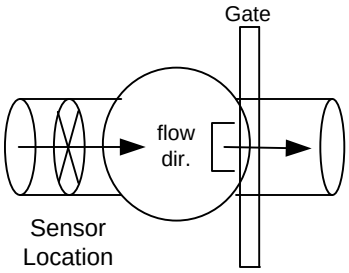
Investigation Information:

Date/Time of Investigation:	1-2-08 0945	**Manhole Depth:**	8'-6"
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	5.13 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	0.57 fps	**Road Cut Length:**	Feet
Silt:	2.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar N

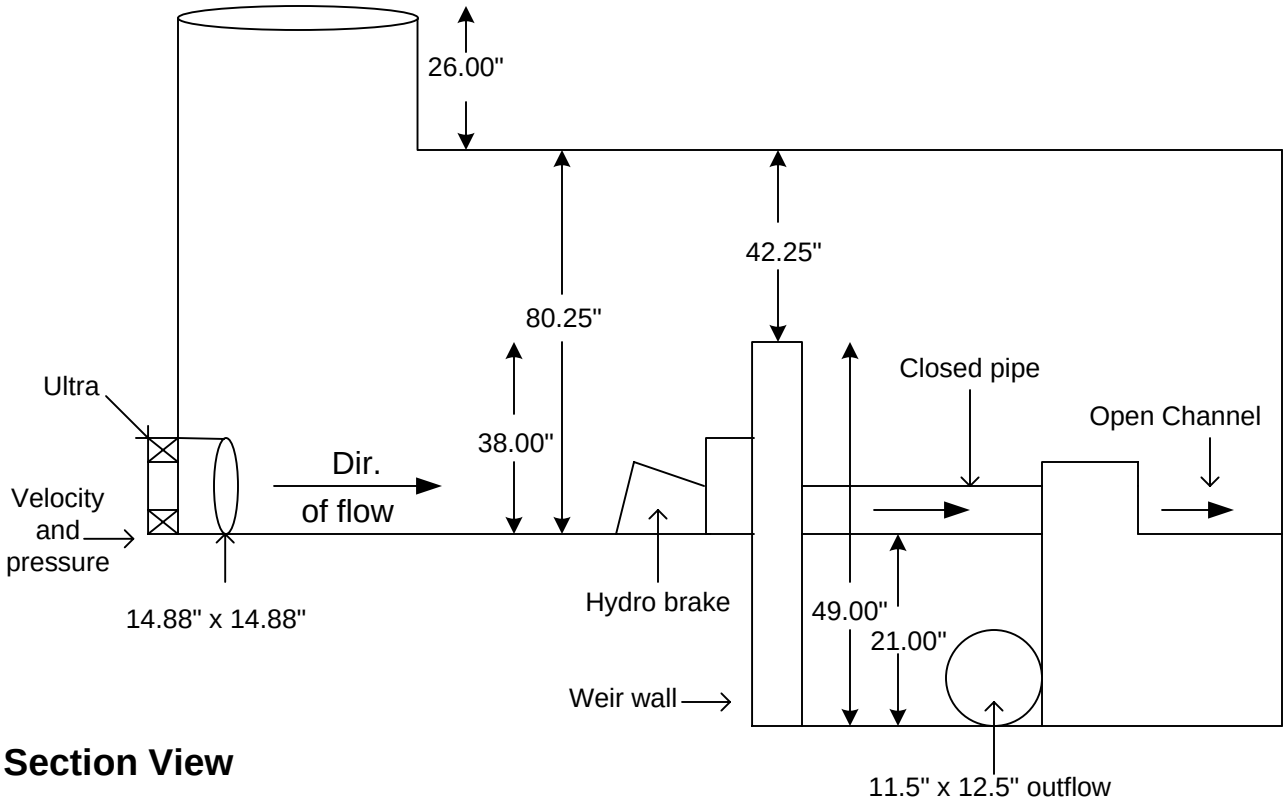
Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

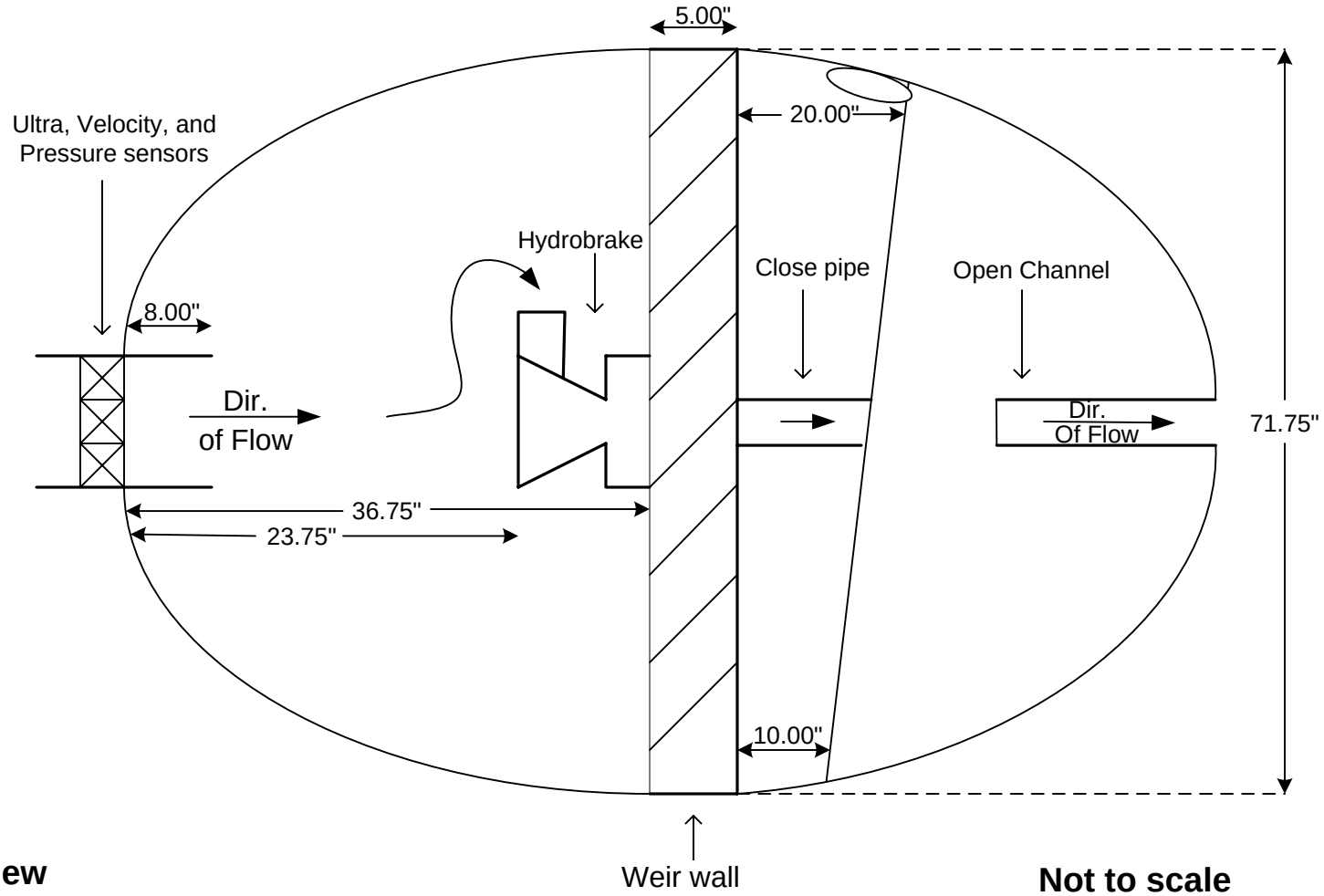
HEN45_074159

ADS ENVIRONMENTAL SERVICES®

HEN45_074159



Section View



Top View

Not to scale

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ADS Site Report — Quality Form

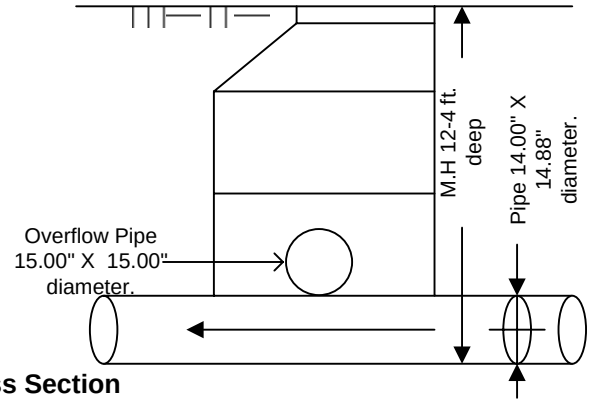
Project Name:	Seattle - CSO	**City / State:**	Seattle, WA
FM Initials:	SW		
Site Name:	NPDES 45A/SEA_074153	**Monitor Series:**	5000 AG
Monitor S/N:	26101		
Address/Location:	S. Holly St. @ Martha Washington Park (location is between path and dead-end section of Holly)	**Manhole #**	074-153
		Thomas Bros Map Page:	625 G1
		Pipe Height:	14.00 "
Access:	Drive	**Pipe Width:**	14.88 "
IP Address:	166.219.18.17		

Type of System:	Sanitary	Storm	Combined
			X

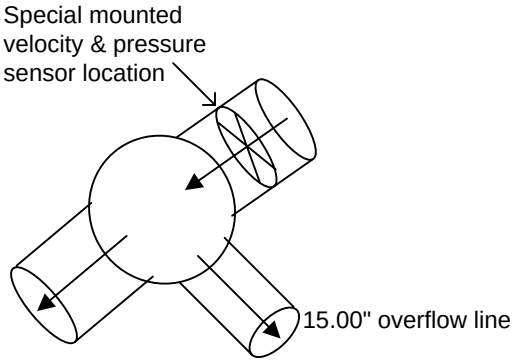
Investigation Information:

Date/Time of Install:	8/2/2007 11:06	**Manhole Depth:**	12' - 4"
Site Hydraulics:	Smooth flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)	No	**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential: X; Commercial: ; Industrial: ; Trunk:
Downstream Manhole:	DNI	**Telephone Information:**	Doesn't apply
Depth of Flow:	6.00"+/- 0.25"	**Access Pole #:**	Doesn't apply
Range (Air DOF):	+/-	**Distance From Manhole:**	Doesn't apply Feet
Peak Velocity:	3.00 fps	**Road Cut Length:**	Doesn't apply Feet
Silt:	0.00 Inches	**Trench Length:**	Doesn't apply Feet

Other Information:



Cross Section



Planar N

Installation Information	
Installation Type:	Special install
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	RG_18

Backup	Yes	No	?	Distance
Trunk		X		
Lift / Pump Station			X	37 feet D/S
WWTP		X		
Other		X		

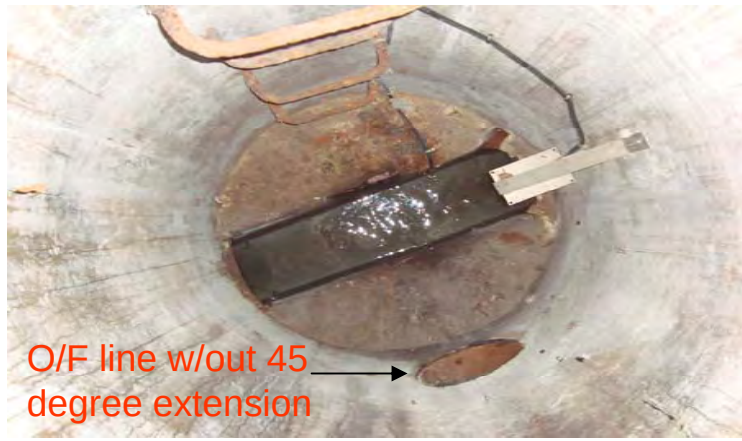
Additional Site Information / Comments:

Point of overflow is 24.25"
There is no weir wall at this site, overflow goes directly into a 15.00" x 15.00" pipe

Rev. 1 11/13/08

NPDES_45A
MH 074-153

Site looking north

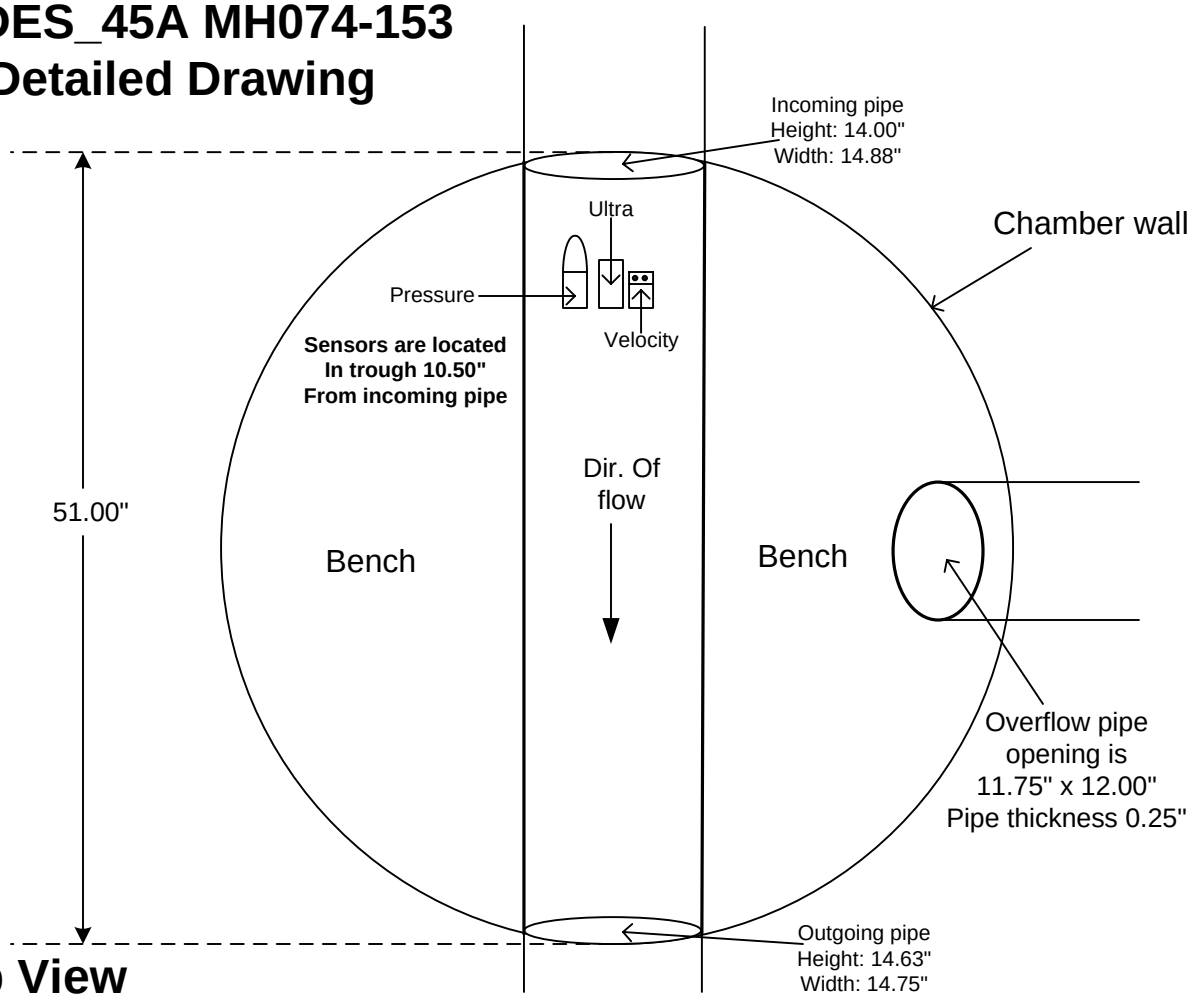


Looking down MH

Sensor location

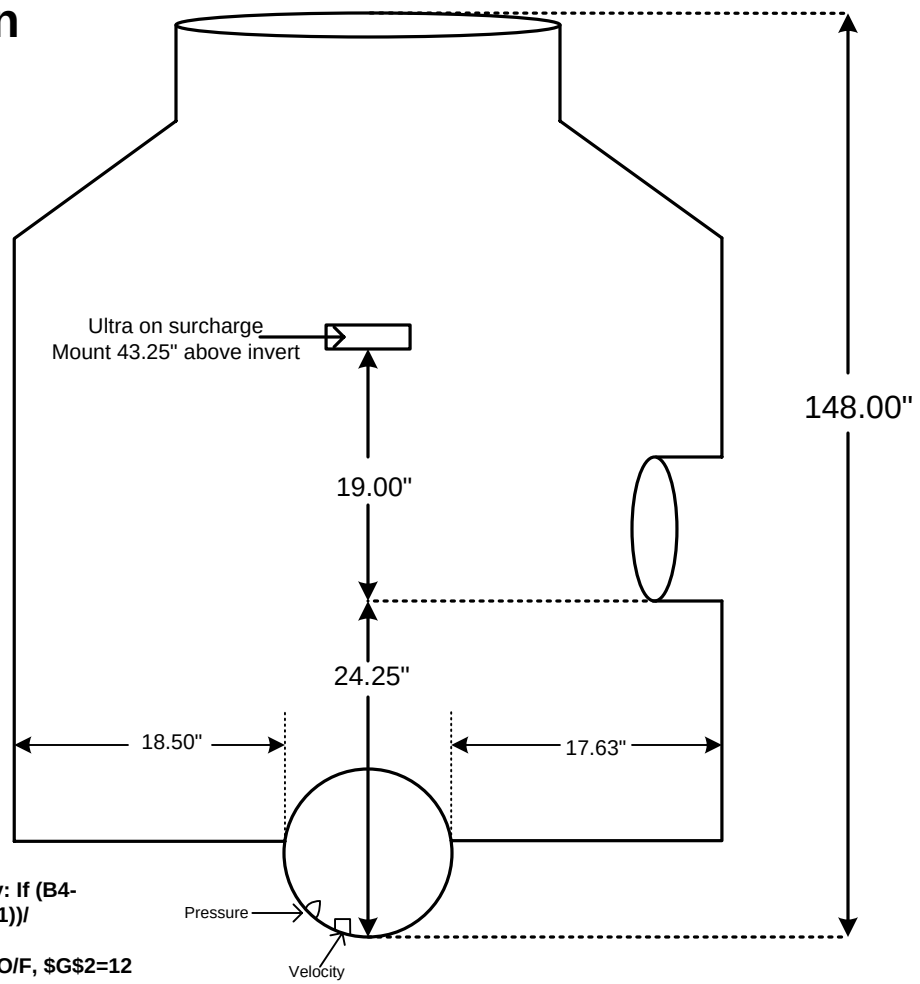
Head on view of O/F line

NPDES_45A MH074-153
Detailed Drawing



Top View

Cross Section



Overflow point is 24.25"
Overflow quantity is calculated by: If (B4-$G$1<0,0,8.69*(1-((($G$2-(B4-$G$1))/$G$2)))^1.88*($G$2/12)^2.48)
Where B4= Dfinal, $G$1=Point of O/F, $G$2=12

Not to scale
Rev. 2 11/13/08

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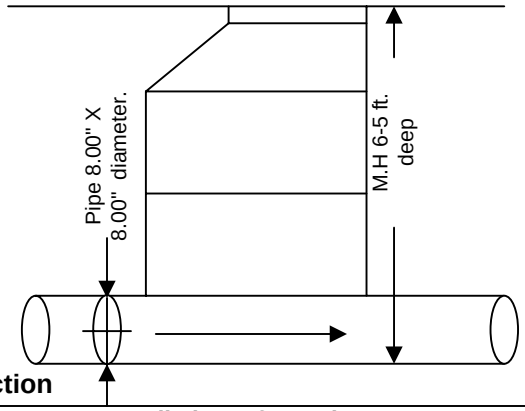
ADS Site Report — Quality Form

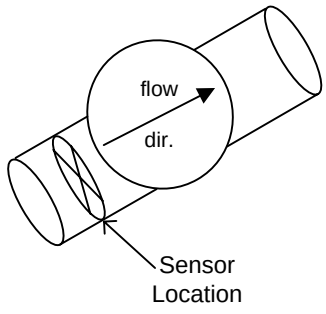
Project Name:	Seattle - CSO	**City / State:**	Seattle, WA
FM Initials:	SW		
Site Name:	NPDES 45B/SEA_074167	**Monitor Series:**	5000 AG
Monitor S/N:	26139		
Address/Location:	S. Holly St. @ Martha Washington Park (located in Holly near the dead-end)	**Manhole #**	074-167
Thomas Bros Map Page:	625 G1		
Pipe Height:	8.00"		
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	8.00"
IP Address:	166.219.18.211		

Investigation Information:

Date/Time of Investigation:	12/19/2006 10:50	**Manhole Depth:**	6' - 5"
Site Hydraulics:	No flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)	O/F line w/possibilty of P/S influence	**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	Doesn't apply
Depth of Flow:	0.00" +/- 0.25"	**Access Pole #:**	Doesn't apply
Range (Air DOF):	8.00" +/- 0.25"	**Distance From Manhole:**	Doesn't apply Feet
Peak Velocity:	0.00" fps	**Road Cut Length:**	Doesn't apply Feet
Silt:	0.00 Inches	**Trench Length:**	Doesn't apply Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard install	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[X]	U/S 30 feet
Surcharge Height:	0.00" Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_18	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

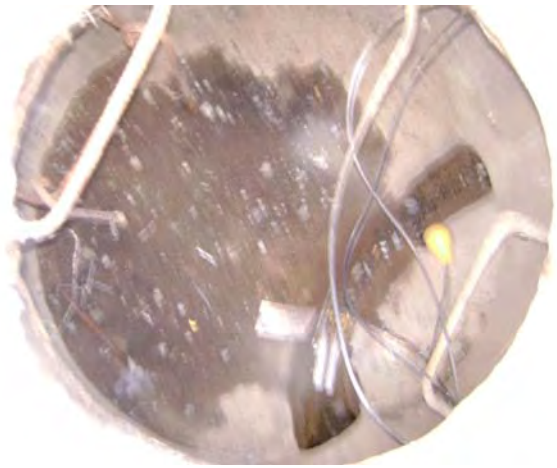
No weir wall
Quantification method: Q final.

Rev. 2 11/13/08

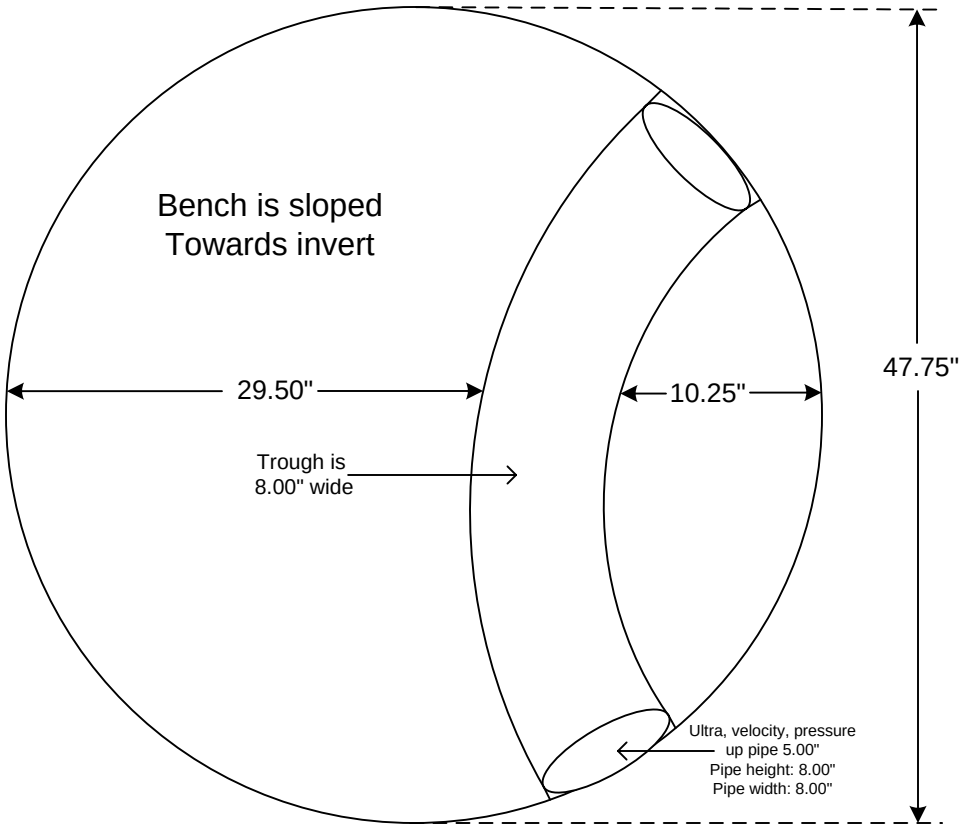
NPDES_45B

074-167

ADS ENVIRONMENTAL SERVICES®

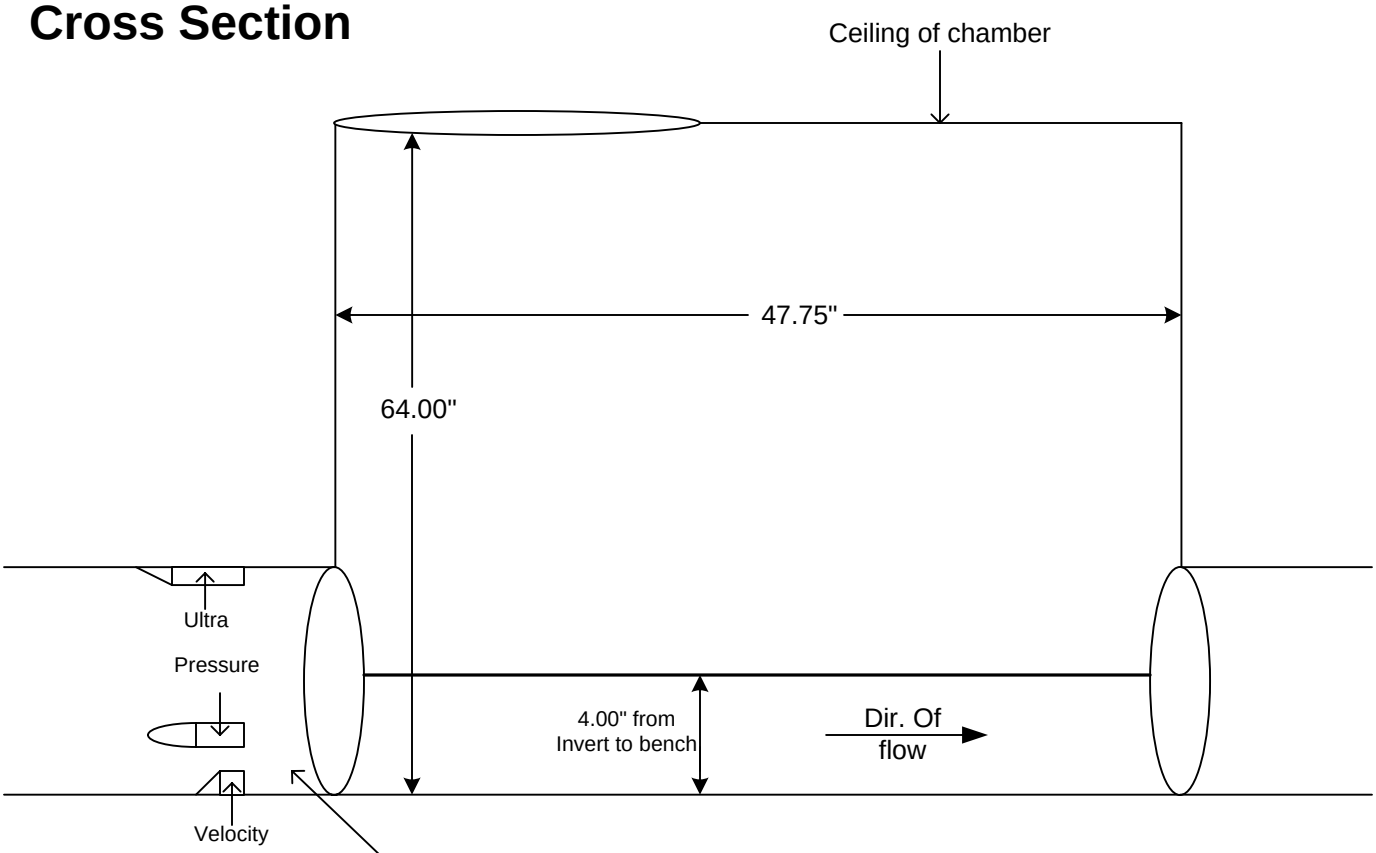


NPDES_45B MH074-167
Detailed Drawing



Top View

Cross Section



No weir wall, this is an overflow line, quantity is calculated by Q-final

Not to scale
Rev.2 3/13/09

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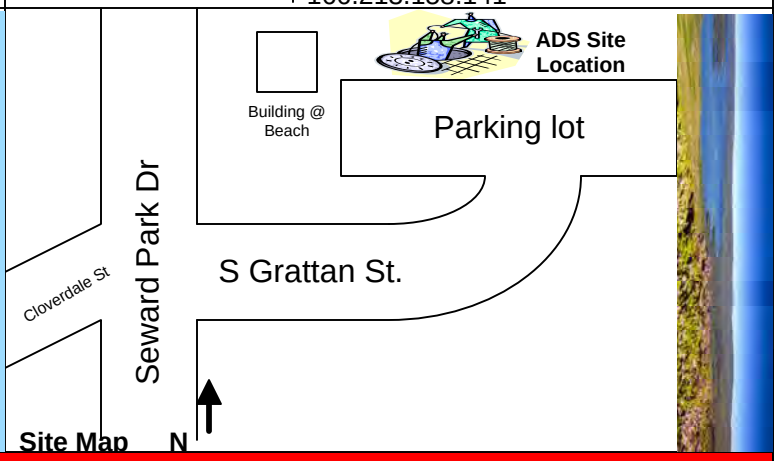
ADS Site Report

Quality Form

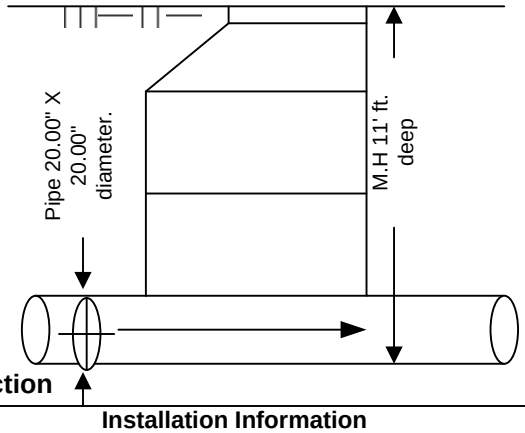
Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN46_081059	**Monitor Series:**	5000 AG	**Monitor S/N:**	16013
Address/Location:	Pritchard Beach			**Manhole #**	081059
				Thomas Bros Map Page:	
				Pipe Height:	20.00 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 20.00 "
					IP Address: 166.213.158.141

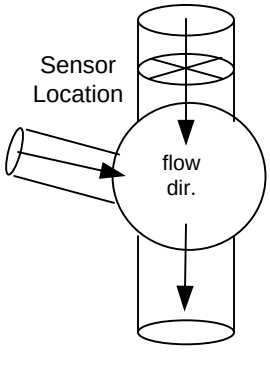


Investigation Information:

Date/Time of Investigation:	12-27-08 1309	**Manhole Depth:**	11'
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	7.00 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	1.95 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

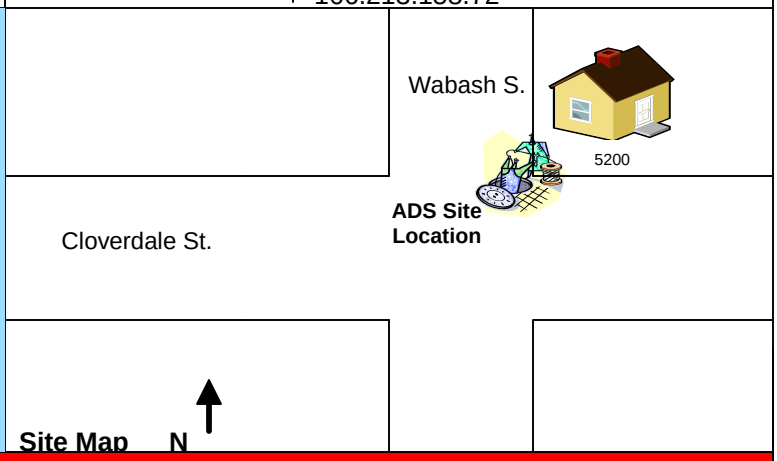
HEN46_081059

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN46_081131	**Monitor Series:**	5000 AG	**Monitor S/N:**	20043
Address/Location:	5200 Cloverdale Pl S.			**Manhole #**	081131
				Thomas Bros Map Page:	
				Pipe Height:	108.00"
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [X]	Combined [ ]	**Pipe Width:** 108.00"
					IP Address: 166.213.158.72

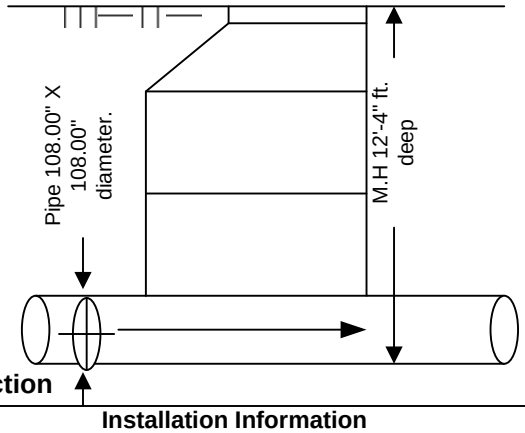


Site Map

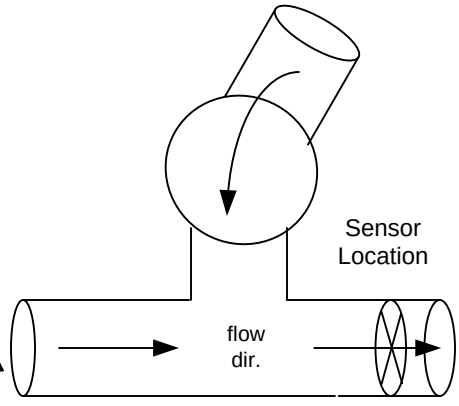
Investigation Information:

Date/Time of Investigation:	3-5-08	**Manhole Depth:**	12'-4"
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	2.00 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	1.64 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Special	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

100% Clear Flow

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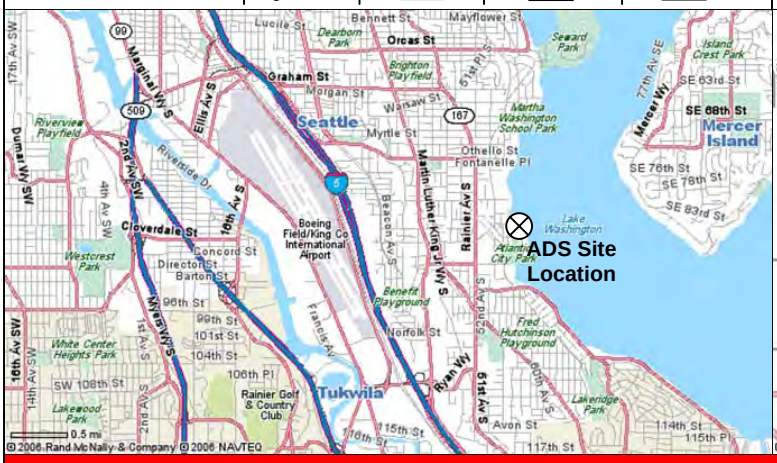
ADS Site Report

Quality Form

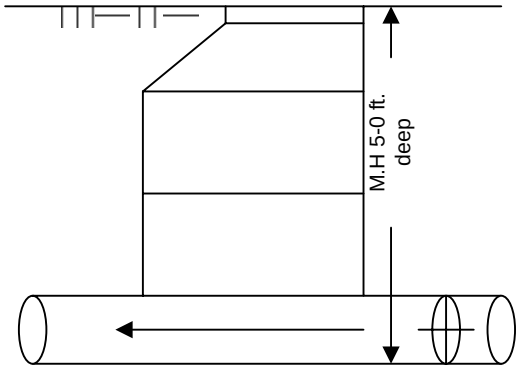
Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SS	
Site Name: NPDES 46/SEA_025289	**Monitor Series:** 5000 BG	**Monitor S/N:**	19009
Address/Location: 8314 Island Dr S. (North of 8314 in grass/woods)		**Manhole #**	025-289
		Thomas Bros Map Page:	625 G 2/3
		Pipe Height:	MP1 21.00" MP2 12.00"
Access: Drive / Walk	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	MP1 20.38 MP 11.88
		IP Address:	166.219.19.12



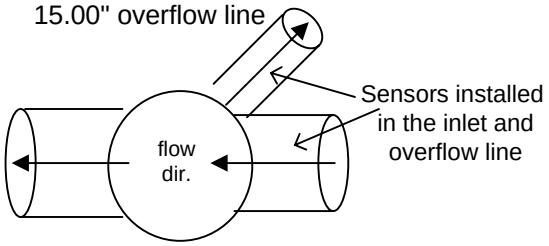
Investigation Information:

Date/Time of Investigation:	12/19/2006 11:32	**Manhole Depth:**	5' - 0"
Site Hydraulics:	Further info. pending	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Clay / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	4.50"+/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	0.38 fps	**Road Cut Length:**	Feet
Silt:	2.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Regular	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	5' - 0"	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

Overflow pipe elevated 32.00" above manhole invert.

NPDES_46

MH 081-062

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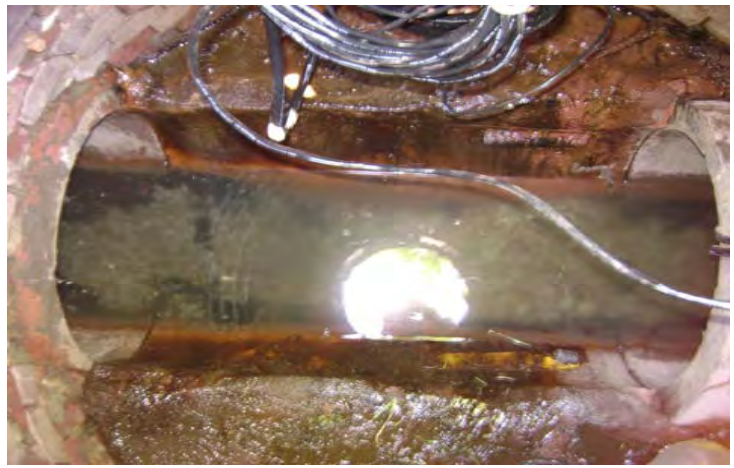
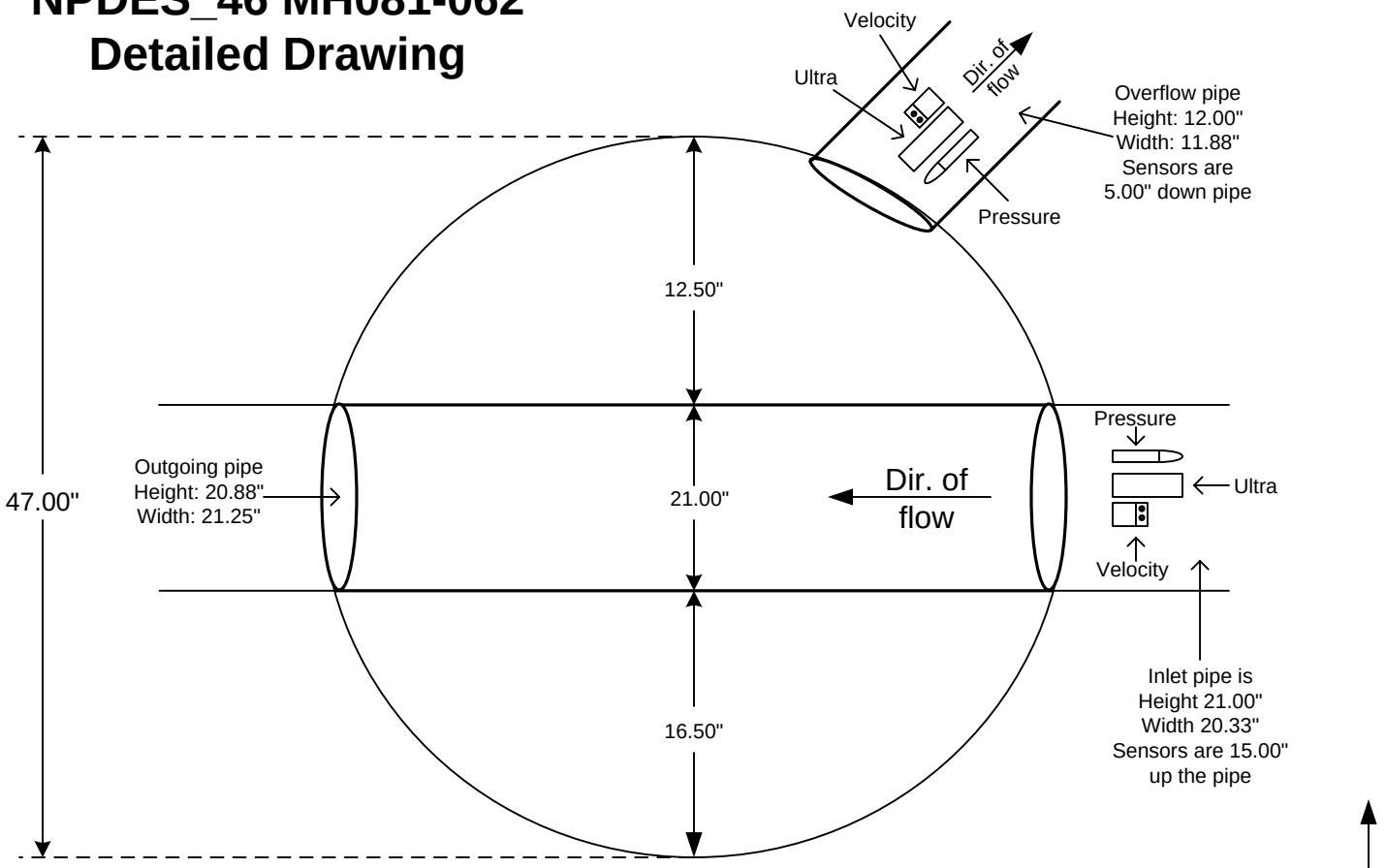
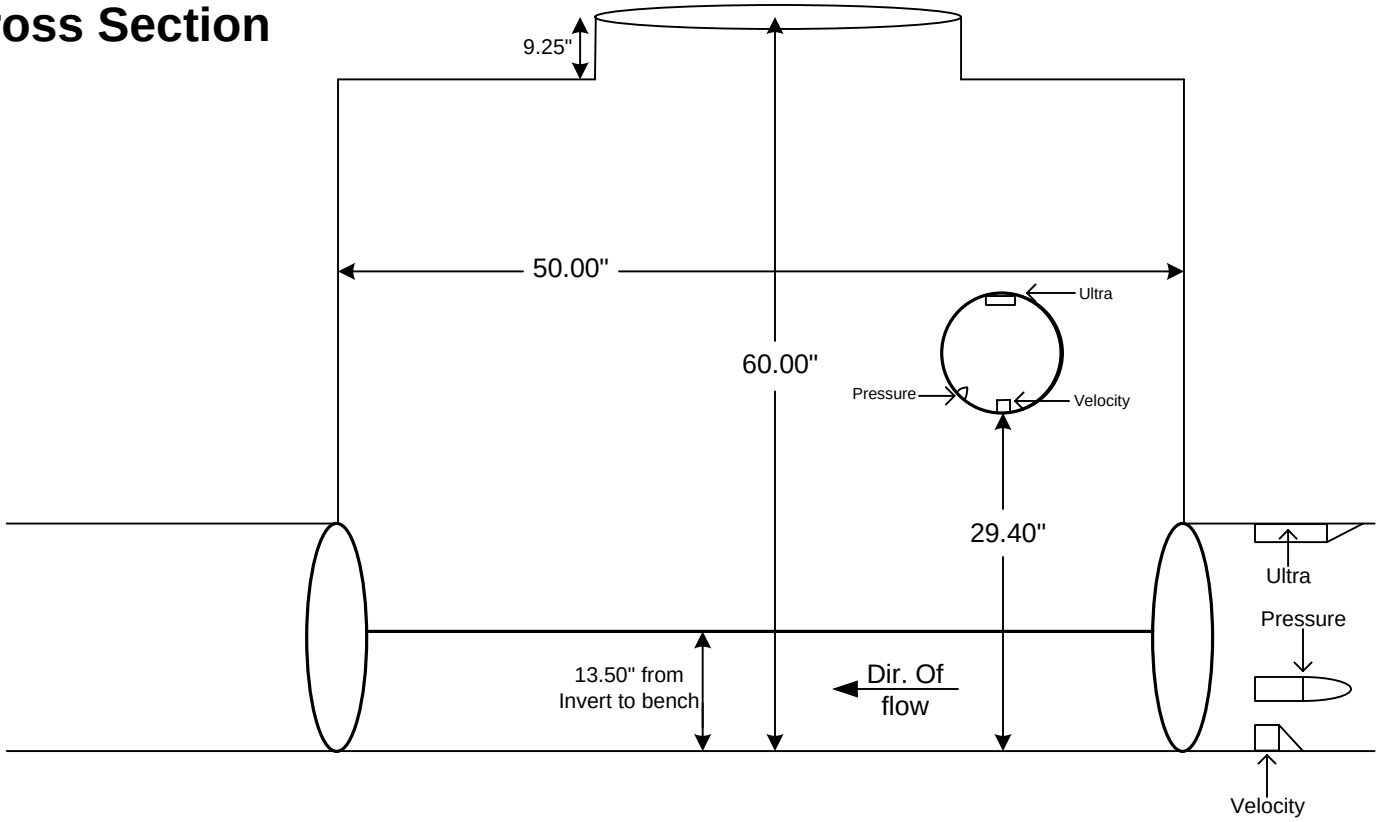


NPDES_46 MH081-062
Detailed Drawing



Top View

Cross Section



Point of overflow 29.40"
Overflow quantified by Q-final
in monitoring point 2

Not to scale
Rev. 1 10/30/08

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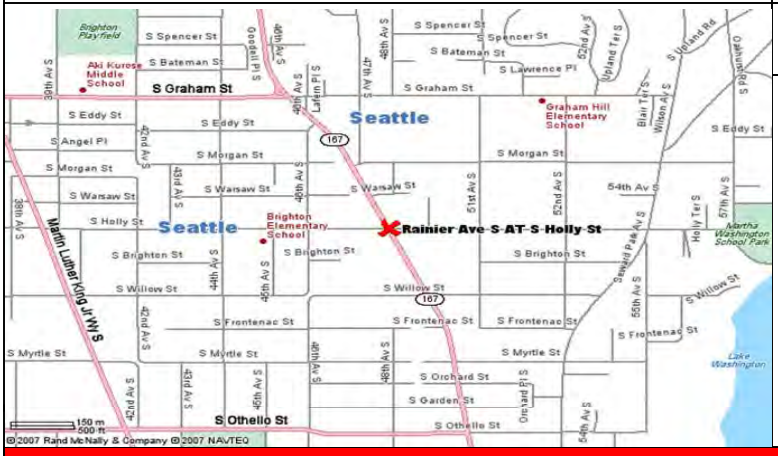
ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_073268	**Monitor Series:**	5000 AG	**Monitor S/N:**	20043
Address/Location:	6800 Rainier Ave S./ Just South of Holly			**Manhole #**	073268
				Thomas Bros Map Page:	625-G5
				Pipe Height:	30.13 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 30.00 "
					IP Address: 166.213.158.72

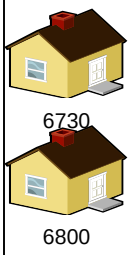


Holly St.

Site Map N

ADS Site Location

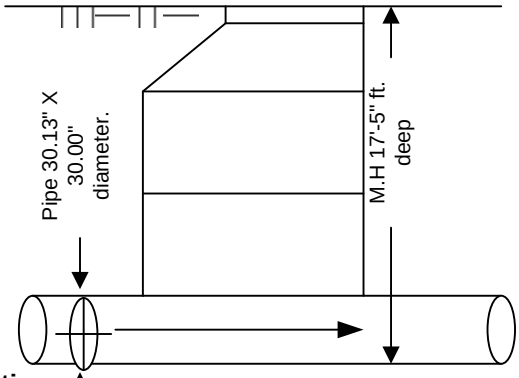
Rainier Ave S,



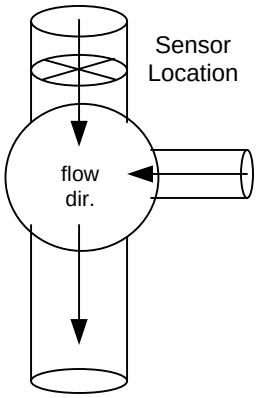
Investigation Information:

Date/Time of Investigation:	1-8-08 0000	**Manhole Depth:**	17'-5"
Site Hydraulics:	Small Wave	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Clay / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	2.25 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	3.80 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar N

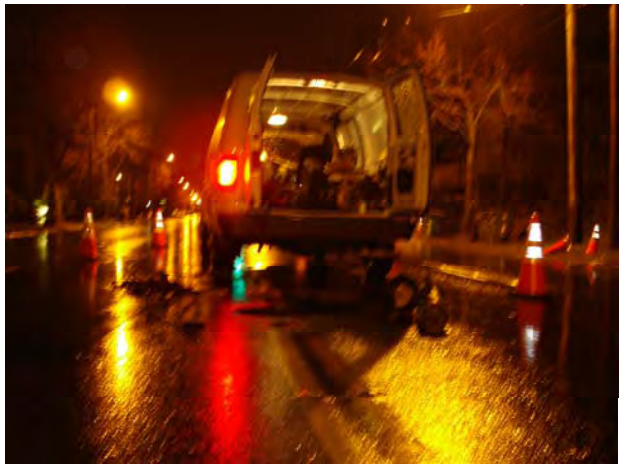
Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

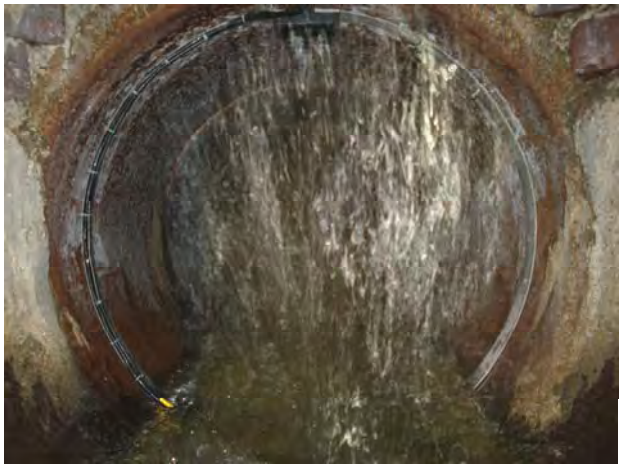
Additional Site Information / Comments:

Night Site

HEN47_073268

ADS ENVIRONMENTAL SERVICES®

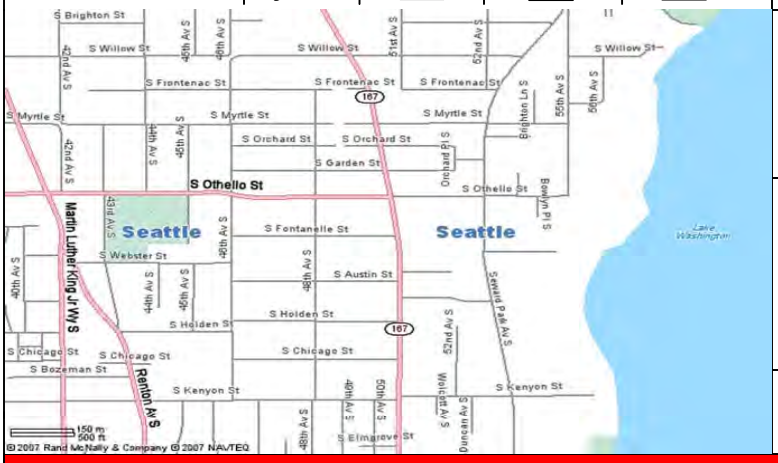


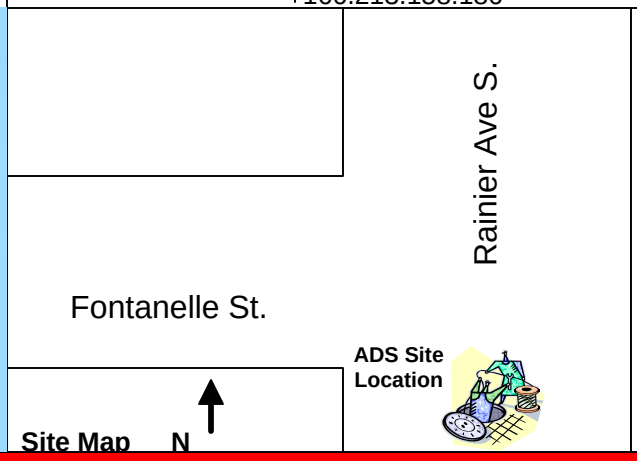


ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_073276	**Monitor Series:**	5000 AG	**Monitor S/N:**	20042
Address/Location:	Fontanelle St. & Rainier Ave S.			**Manhole #**	073276
				Thomas Bros Map Page:	
				Pipe Height:	38.25 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 38.00 "
					IP Address: 166.213.158.186

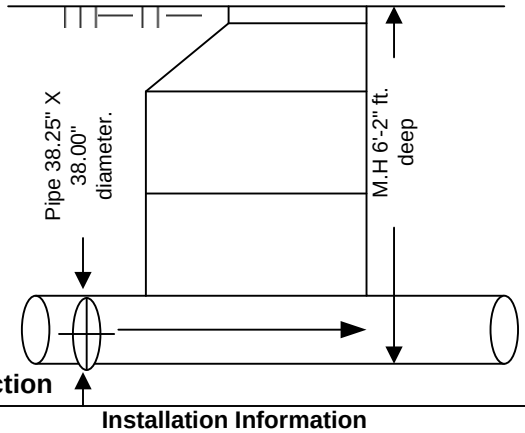


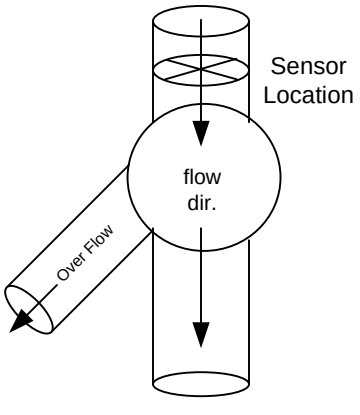


Investigation Information:

Date/Time of Investigation:	1-11-08 0358	**Manhole Depth:**	19'-6"
Site Hydraulics:	Fast Choppy Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	+/-	**Access Pole #:**	
Range (Air DOF):	31.38 +/- 0.38"	**Distance From Manhole:**	Feet
Peak Velocity:	7.35 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



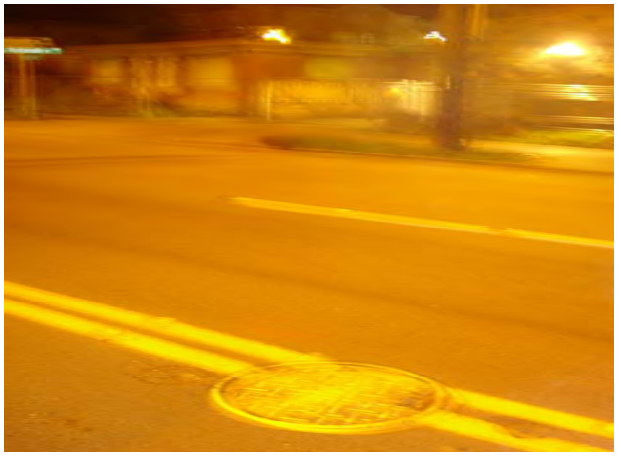


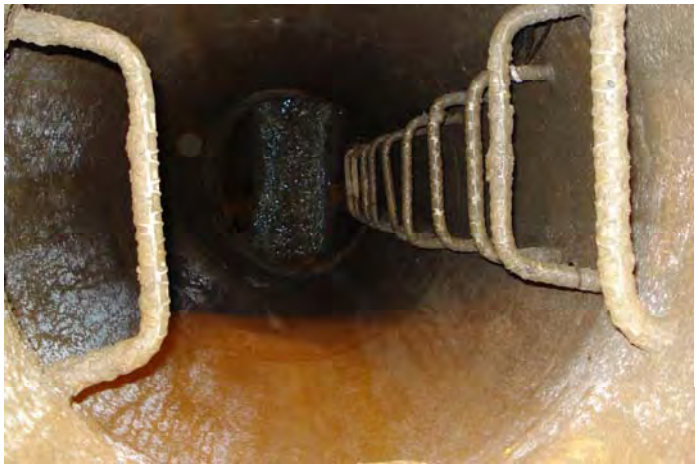
Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Special	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN47_073276

ADS ENVIRONMENTAL SERVICES®

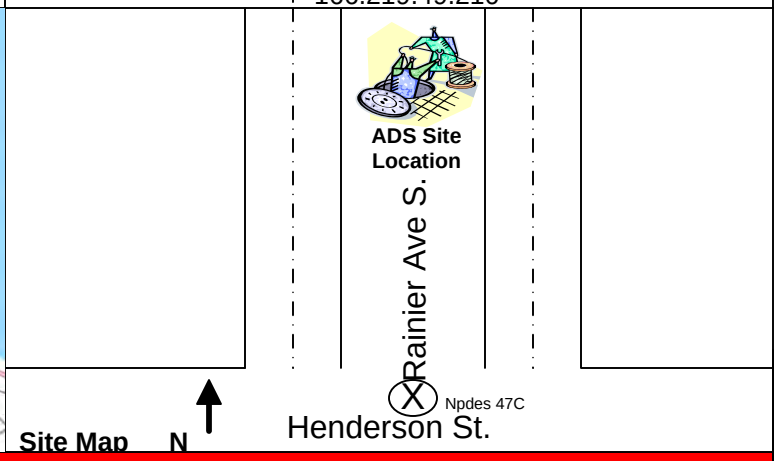




ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_080329	**Monitor Series:**	5000 AG	**Monitor S/N:**	20008
Address/Location:	Rainier Ave S. & Henderson St.			**Manhole #**	080329
				Thomas Bros Map Page:	
				Pipe Height:	77.25 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	79.25 "
				IP Address:	166.219.49.210



Site Map

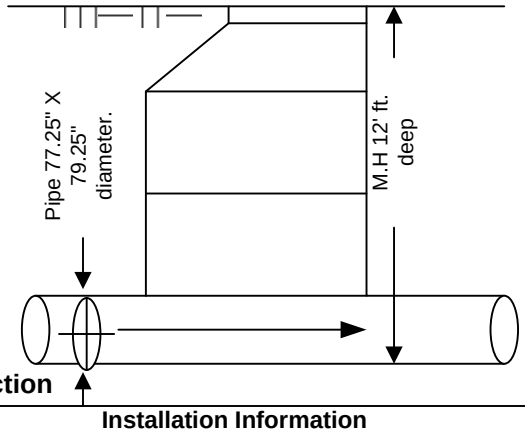
Investigation Information:

Date/Time of Investigation:	1-15-08
Site Hydraulics:	Slow Smooth Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	6.88 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	1.86 fps
Silt:	0.25 Inches

Manhole Information:

Manhole Depth:	12'				
Manhole Material / Condition	Precast / Fair				
Pipe Material / Condition:	Concrete / Fair				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:					
Access Pole #:					
Distance From Manhole:	Feet				
Road Cut Length:	Feet				
Trench Length:	Feet				

Other Information:



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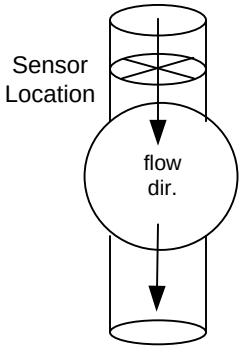


Planar

Installation Information	
Installation Type:	Special
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN47_080329

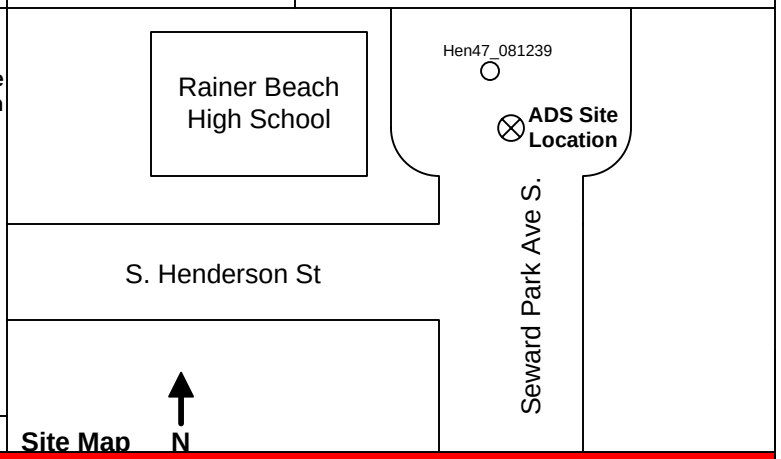
ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SW
Site Name:	HEN47_081049	**Monitor Series:**	FS 5000 AG	**Monitor S/N:**	20034
Address/Location:	Just north of the intersection S. Henderson St. and Seward Park Ave S. on Seward Park S.			**Manhole #**	081-049
				Thomas Bros Map Page:	625 G3
				Pipe Height:	15.25"
Access:	Drive	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	15.00"
				IP Address:	166.219.49.130

Access Map

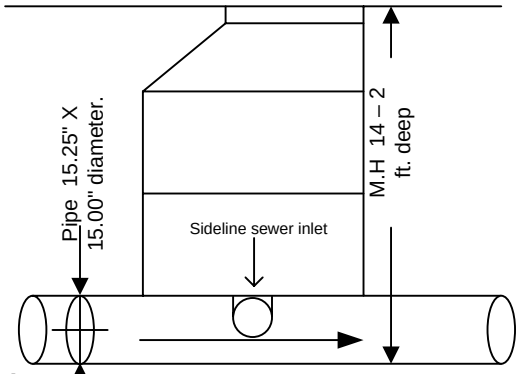


Site Map

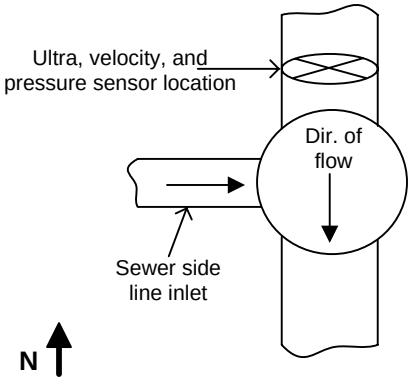
Investigation Information:

Date/Time of Investigation:	12/12/2008 09:03	**Manhole Depth:**	10' - 2"
Site Hydraulics:	Smooth and steady flow	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	No Influence	**Pipe Material / Condition:**	Concrete / Good
Upstream Manhole:	Has hydrobrake about 10 feet away	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	Has two combined sewer inlets	**Telephone Information:**	Doesn't apply
Depth of Flow:	1.13" +/- 0.25"	**Access Pole #:**	Doesn't apply
Range (Air DOF):	14.00" +/- 0.25"	**Distance From Manhole:**	Doesn't apply Feet
Peak Velocity:	2.36 fps	**Road Cut Length:**	Doesn't apply Feet
Silt:	0 Inches	**Trench Length:**	Doesn't apply Feet

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Regular	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0.00"	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_16,18	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Pressure (5 PSI, accuracy +/- 0.25% for range of 0.25 – 11.5 ft.)

Rev.1 12/27/08

HEN47_081049 Installation

View of site looking north

View down manhole looking north

View of inlet and sensor placement

Need to obtain view of outlet

1/27/09

ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_081085	**Monitor Series:**	5000 AG	**Monitor S/N:**	20056
Address/Location:	Corner of Seward Ave. & Henderson St.			**Manhole #**	081085
				Thomas Bros Map Page:	625-G5
				Pipe Height:	29.88 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	29.88 "
				IP Address:	166.213.158.149

Site Map N

Rainier Beach High School

Henderson St.

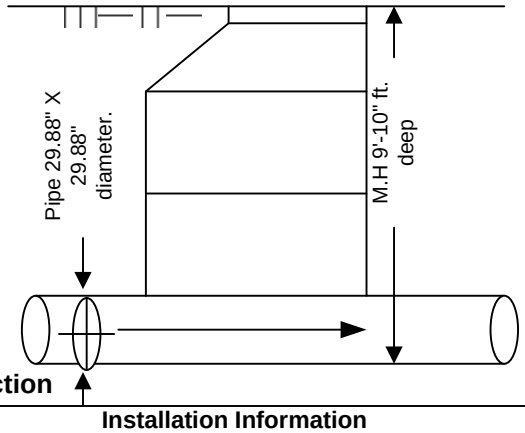
Seward Ave S.

ADS Site Location

Investigation Information:

Date/Time of Investigation:	12-27-07 1340	**Manhole Depth:**	9'-10"
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	8.13 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	2.65 fps	**Road Cut Length:**	Feet
Silt:	0.25 Inches	**Trench Length:**	Feet

Other Information:



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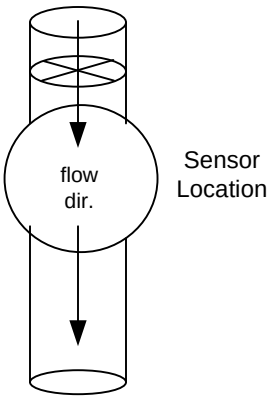


Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

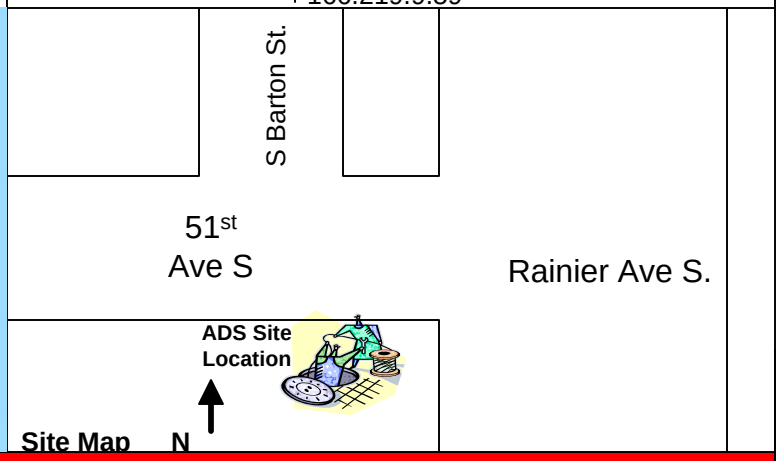
HEN47_081085

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

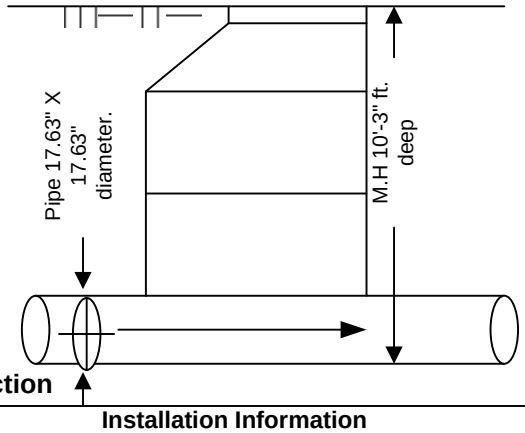
Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_081120	**Monitor Series:**	5000 AG	**Monitor S/N:**	21019
Address/Location:	Corner of Rainier Ave & 51st Ave			**Manhole #**	081120
				Thomas Bros Map Page:	
				Pipe Height:	17.63 "
Access: Drive/Walk	**Type of System:**	Sanitary [X]	Storm [ ]	Combined [X]	**Pipe Width:** 17.63 "
					IP Address: 166.219.9.59

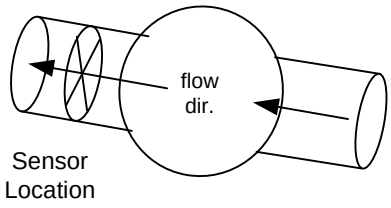


Investigation Information:

Date/Time of Investigation:	1-10-08 1204	**Manhole Depth:**	13'-3"
Site Hydraulics:	Choppy Steady flow	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	7.25 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	2.76 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Reverse	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

Strong petroleum smell

HEN47_081120

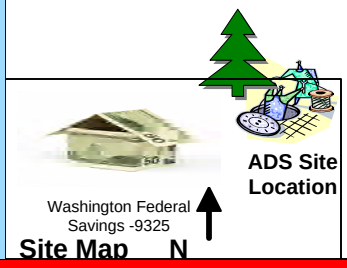
ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

Project Name:	**Henderson**	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_081139	**Monitor Series:**	5000 AG	**Monitor S/N:**	21019
Address/Location:	Corner of Rainier Ave S & 53rd Ave S.			**Manhole #**	081139
				Thomas Bros Map Page:	625-G5
				Pipe Height:	29.88 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 29.88 "
					IP Address: 166.213.158.111

Rainier Ave S,



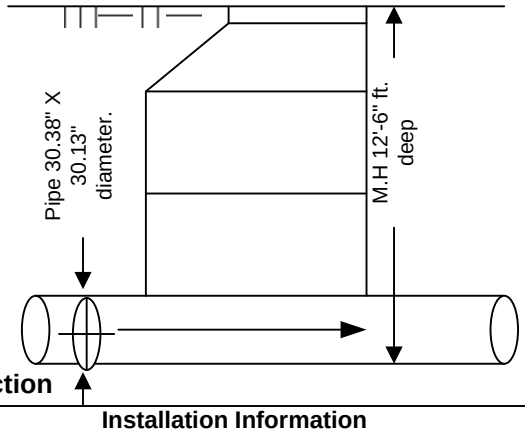
53rd Ave S

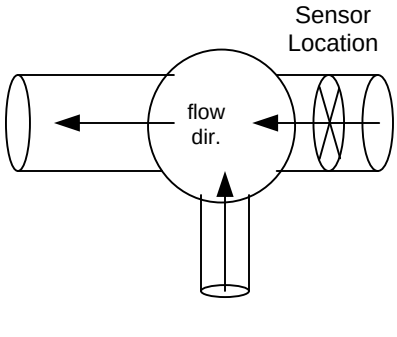
Investigation Information:

Date/Time of Investigation:	12-27-07 1340	**Manhole Depth:**	12'-6"
Site Hydraulics:	Choppy Steady Flow	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Clay / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	5.25 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	2.71 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Manhole Information:

Other Information:





Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

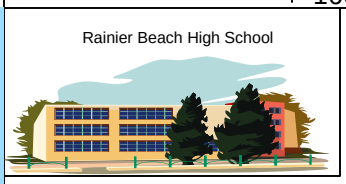
HEN47_081139

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_081239	**Monitor Series:**	5000 AG	**Monitor S/N:**	20031
Address/Location:	Corner of Seward Ave. & Henderson St.			**Manhole #**	081239
				Thomas Bros Map Page:	625-G5
				Pipe Height:	59.75 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	60.00 "
				IP Address:	166.219.49.196



ADS Site Location

Seward Ave S.

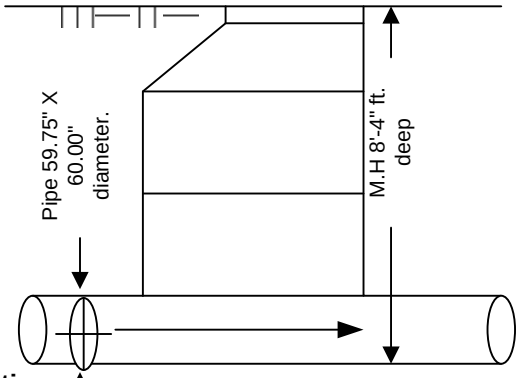
Henderson St.

Site Map N

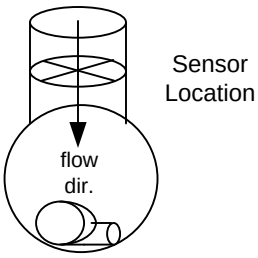
Investigation Information:

Date/Time of Investigation:	1-11-08 0730	**Manhole Depth:**	8'-4"
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Precast / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	6.13 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	.87 fps	**Road Cut Length:**	Feet
Silt:	3.50 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar N

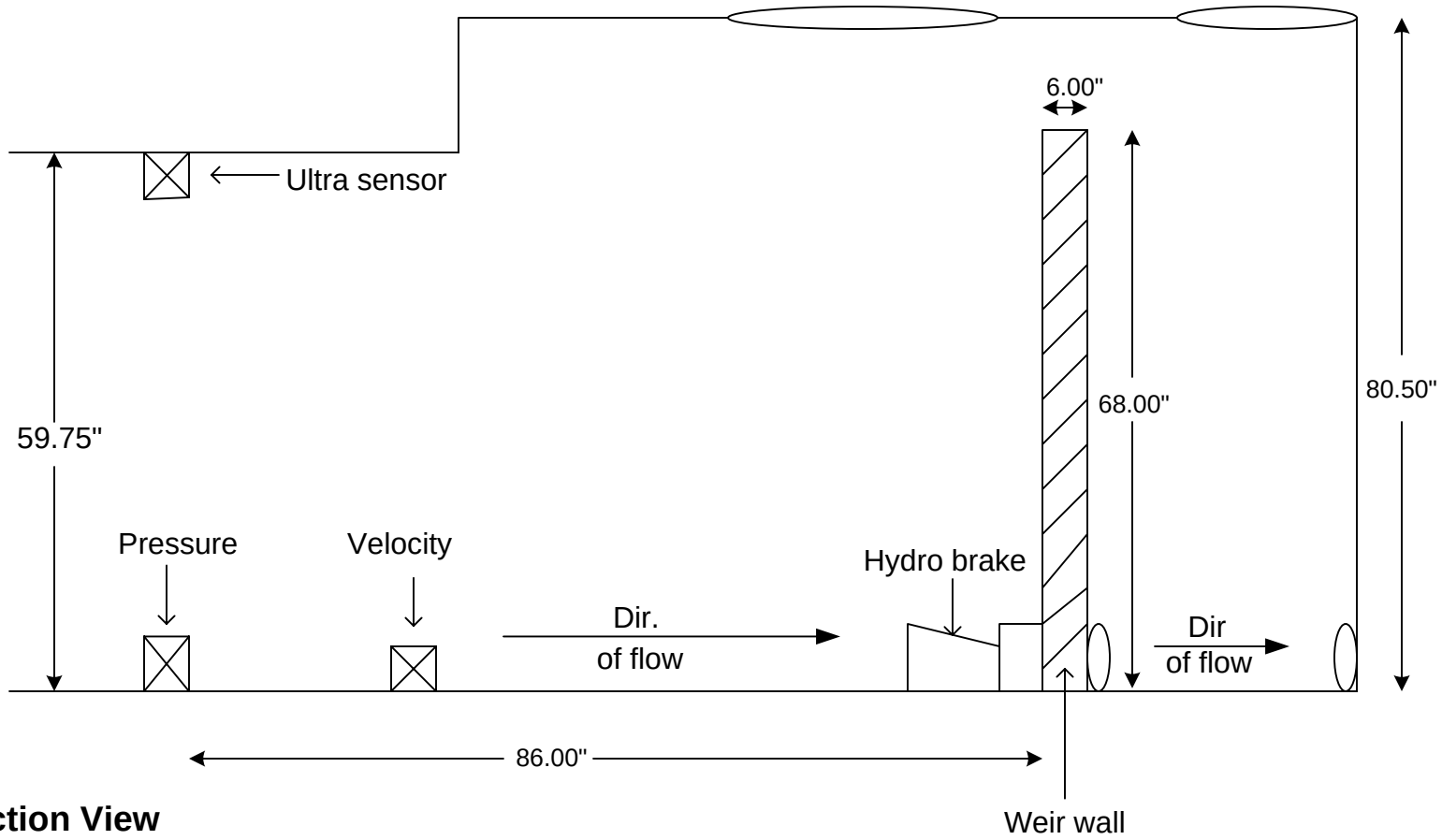
Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Special	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

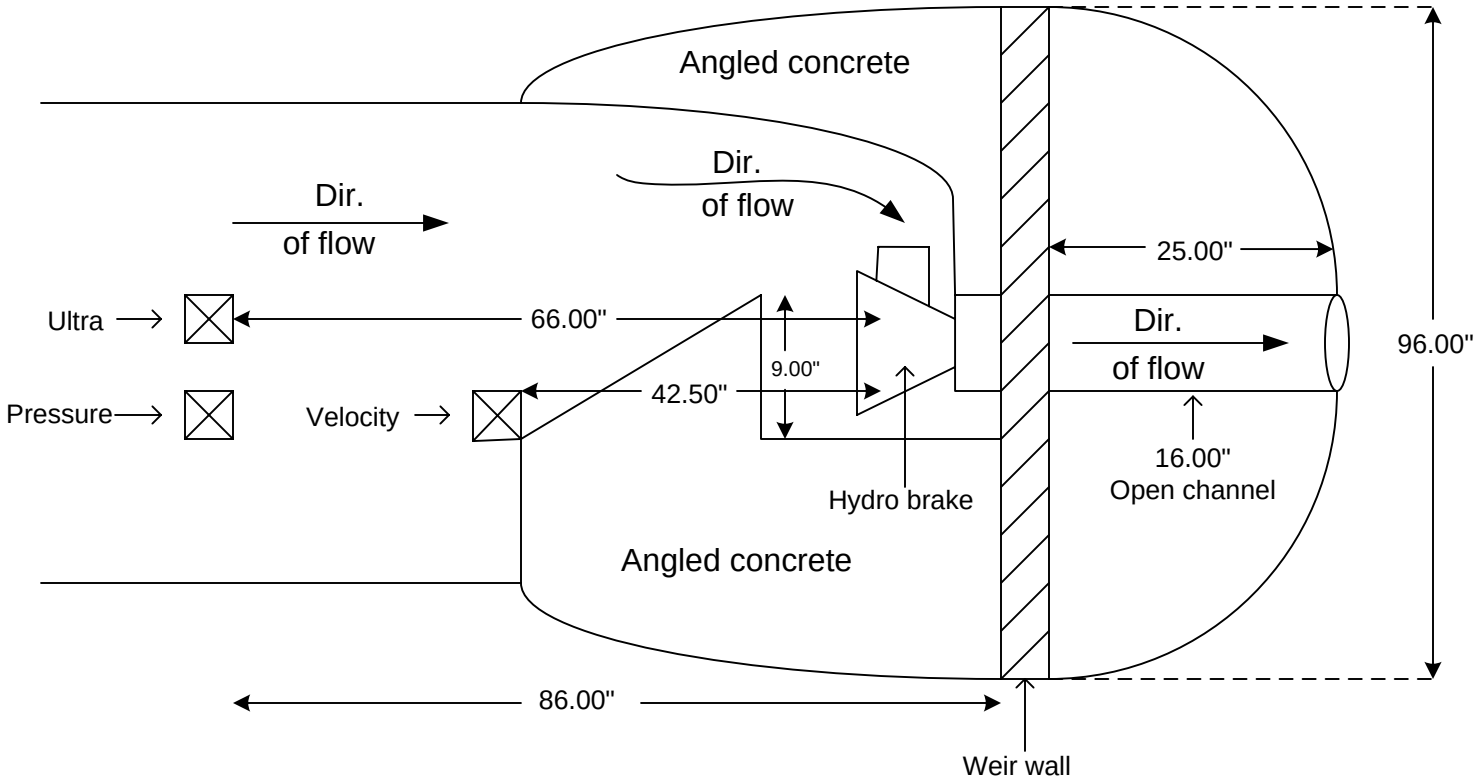
HEN47_081239

ADS ENVIRONMENTAL SERVICES®

HEN47_081239



Section View



Top View

Not to scale

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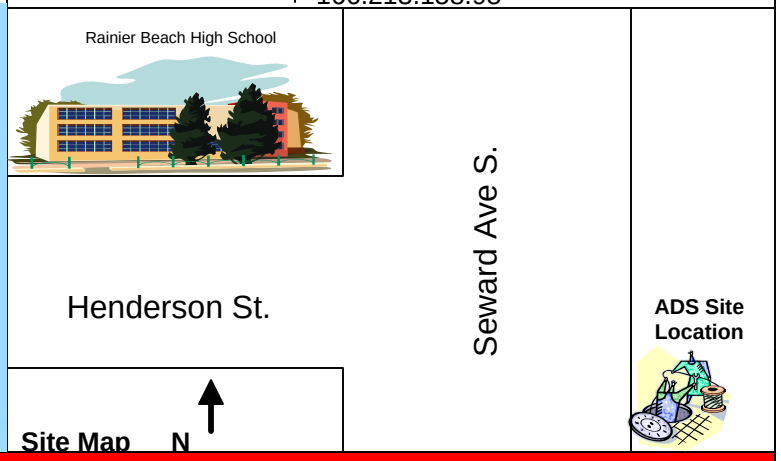
ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN47_081086	**Monitor Series:**	5000 AG	**Monitor S/N:**	20855
Address/Location:	Corner of Seward Ave. & Henderson St.			**Manhole #**	081086
				Thomas Bros Map Page:	625-G5
				Pipe Height:	75.88 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	76.00 "
				IP Address:	166.213.158.95



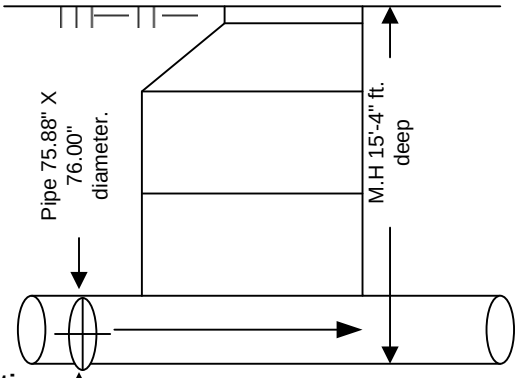
Investigation Information:

Date/Time of Investigation:	3-6-08 1320
Site Hydraulics:	Stagnate Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	60.13 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	0.00 fps
Silt:	2.63 Inches

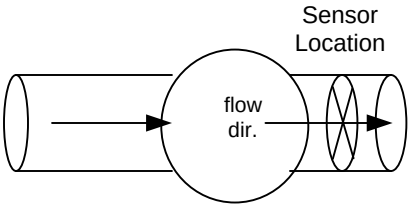
Manhole Information:

Manhole Depth:	15'-4"				
Manhole Material / Condition	Concrete / Fair				
Pipe Material / Condition:	Concrete / Fair				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:					
Access Pole #:					
Distance From Manhole:	Feet				
Road Cut Length:	Feet				
Trench Length:	Feet				

Other Information:



Cross Section



Planar N

Installation Information	
Installation Type:	Special (Shay's)
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN 47_081086

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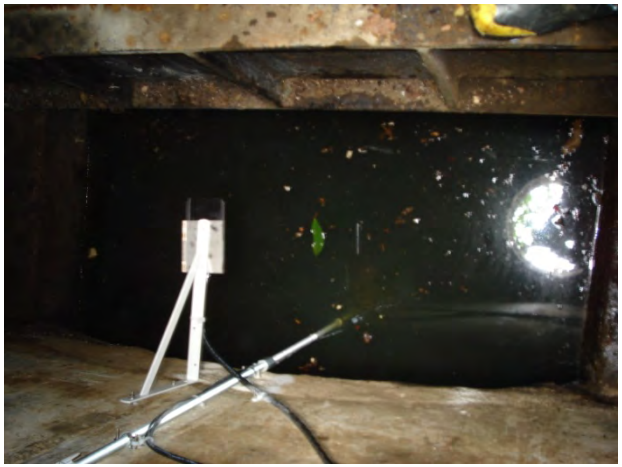
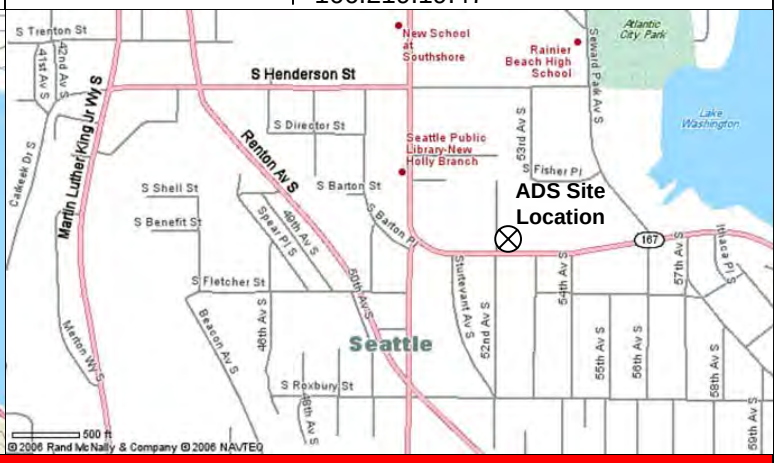


ADS Site Report

Quality Form

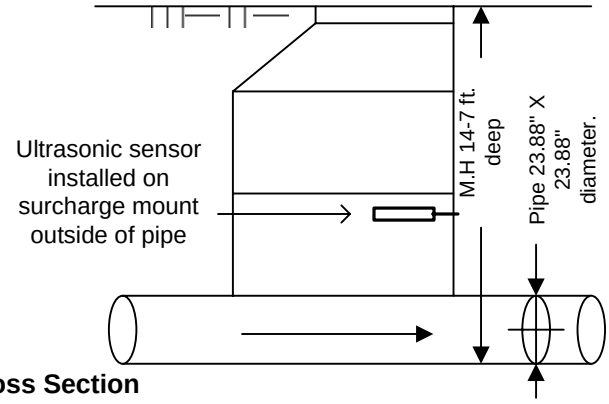
Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SW	
Site Name: NPDES 47B/SEA_081224	**Monitor Series:** 5000 AL	**Monitor S/N:**	15081
Address/Location: 9305 Rainier Av. S. @ 52nd Av. S. (Northeast corner of intersection on sidewalk)		**Manhole #**	081-224
		Thomas Bros Map Page:	625 G4
		Pipe Height:	23.88"
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	23.88"
		IP Address:	166.219.19.47



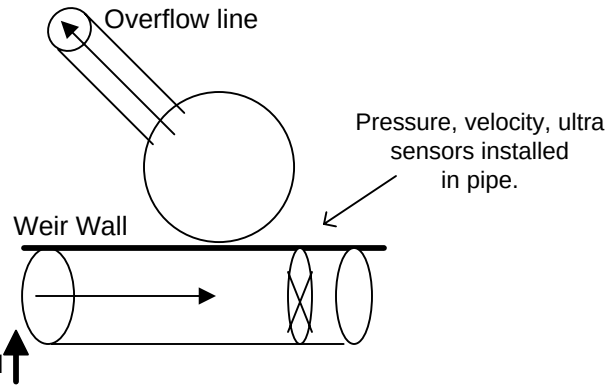
Investigation Information:

Date/Time of Investigation:	1219/2006 13:45	**Manhole Depth:**	14' - 7"
Site Hydraulics:	Stagnate flow	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	1.50"+/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	N/A fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Reverse	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

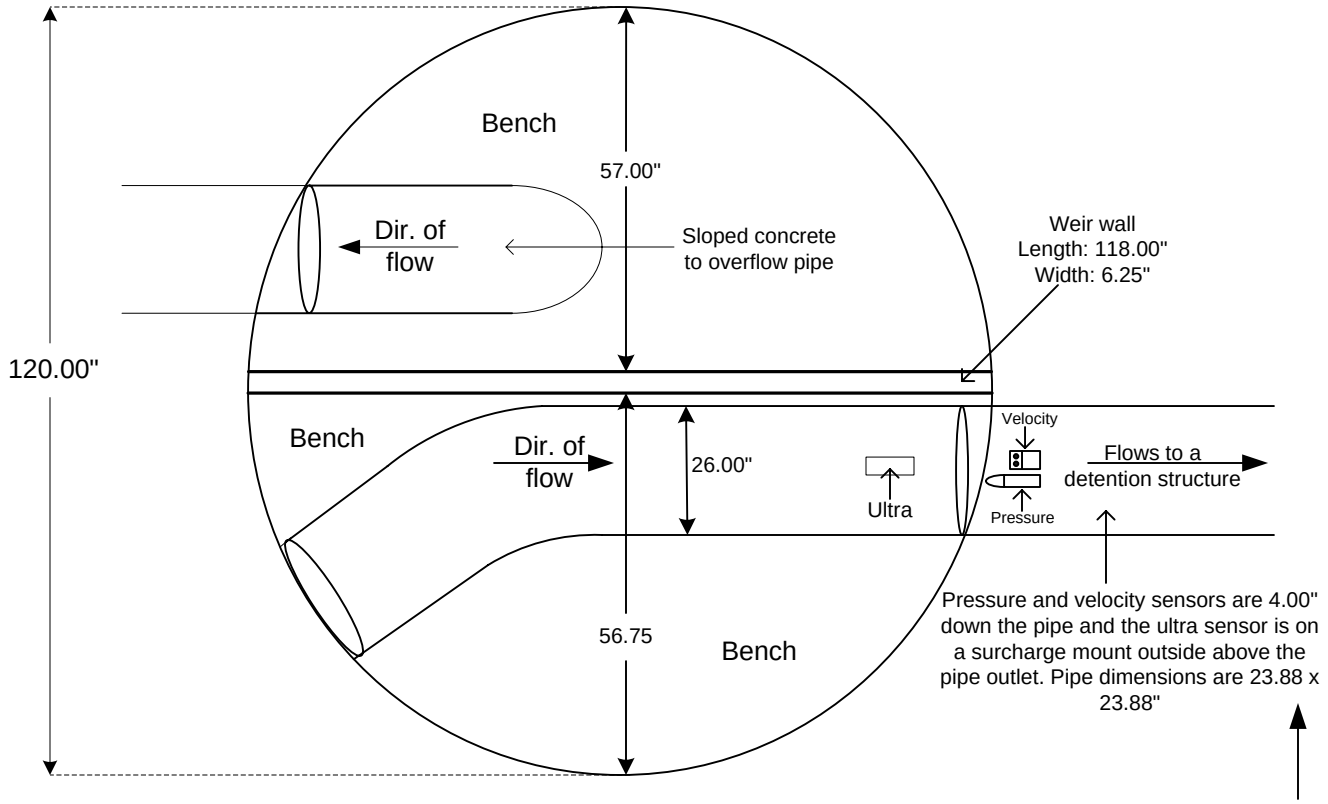
Weir Measurements: Length 118.00", Width 6.25", Height: Left 26.75", Center 27.75", Right 27.25".
Overflow quantification method: Broad Crested Weir Equation.

Rev #1 5/19/08

NPDES 47B
081224

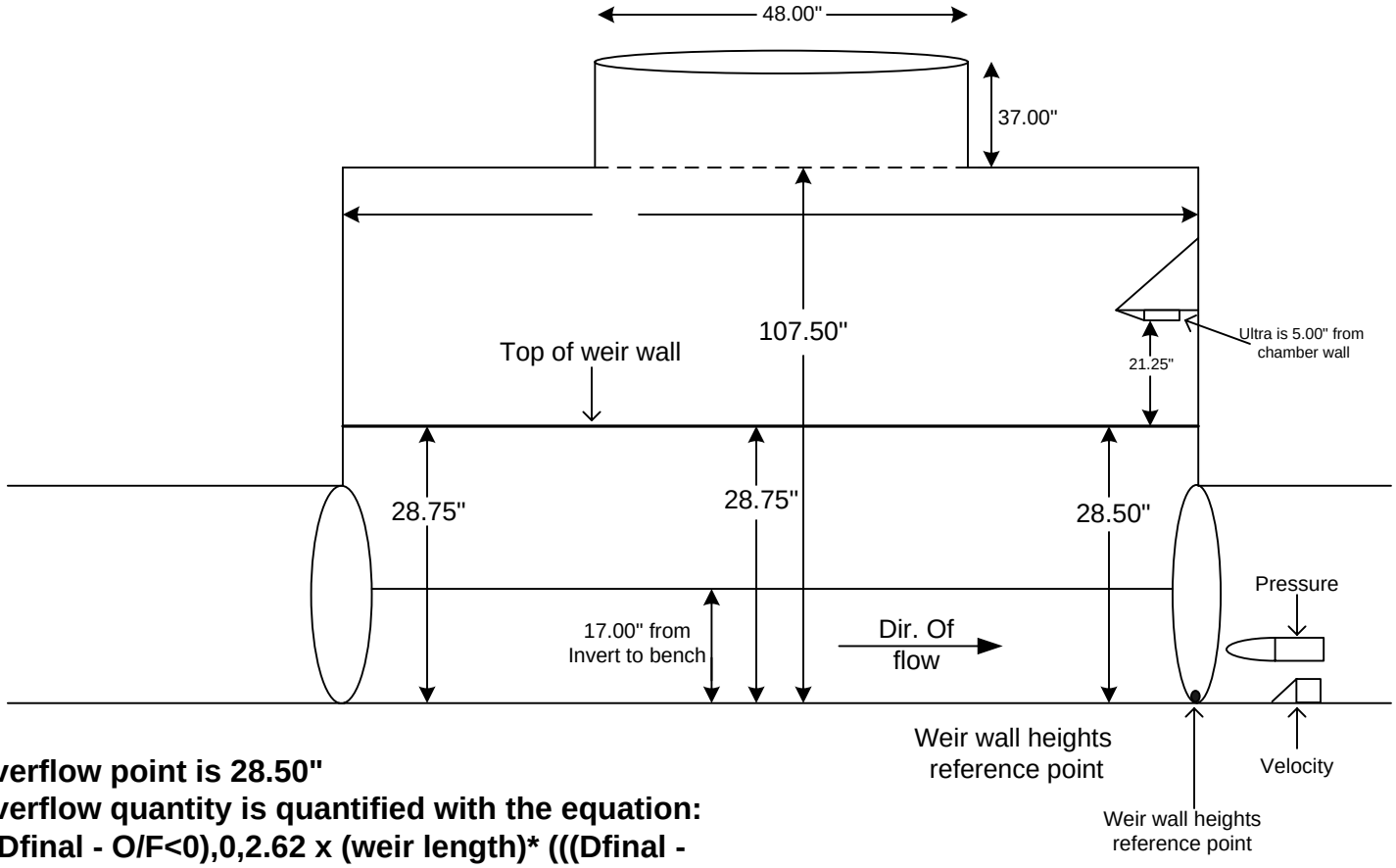
ADS ENVIRONMENTAL SERVICES®

NPDES_47B MH081-224
Detailed Drawing



Top View

Cross Section



Overflow point is 28.50"
Overflow quantity is quantified with the equation:
If(Dfinal - O/F<0),0,2.62 x (weir length)* (((Dfinal - O/F)/12)^3/2)))

Not to scale
Rev. 1 10/27/08

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ADS Site Report

Quality Form

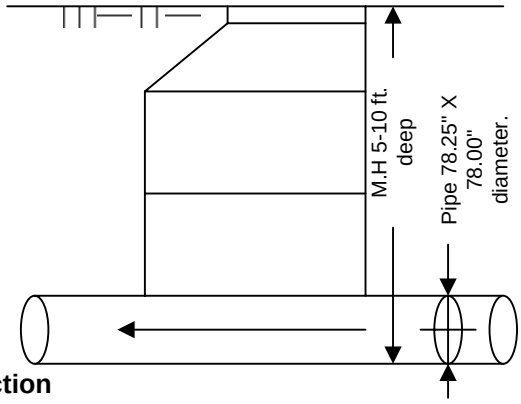
Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SS	
Site Name: NPDES 47C/SEA_081330	**Monitor Series:** 5000 AG	**Monitor S/N:**	15084
Address/Location: 9305 Rainier Av. S. @ 52nd Av. S. (Northeast corner of intersection on sidewalk)		**Manhole #**	081-330
		Thomas Bros Map Page:	625 F4
		Pipe Height:	78.25"
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	78.00"
		IP Address:	166.219.19.4

Investigation Information:

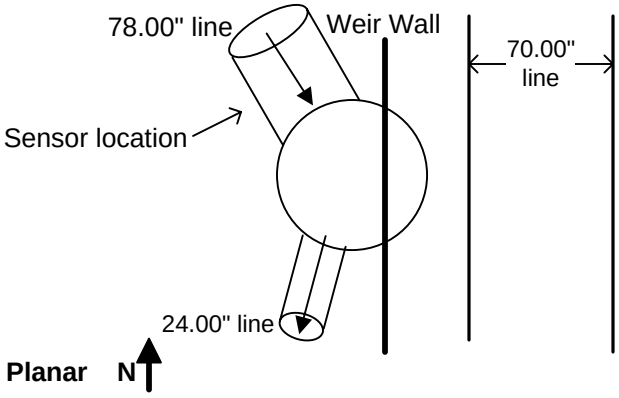
Date/Time of Investigation:	1219/2006 09:32	**Manhole Depth:**	5' - 10"
Site Hydraulics:	Smooth flow	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	10.00+/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	3.20 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Manhole Information:

Other Information:



Cross Section



Planar

Installation Information	
Installation Type:	Regular
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

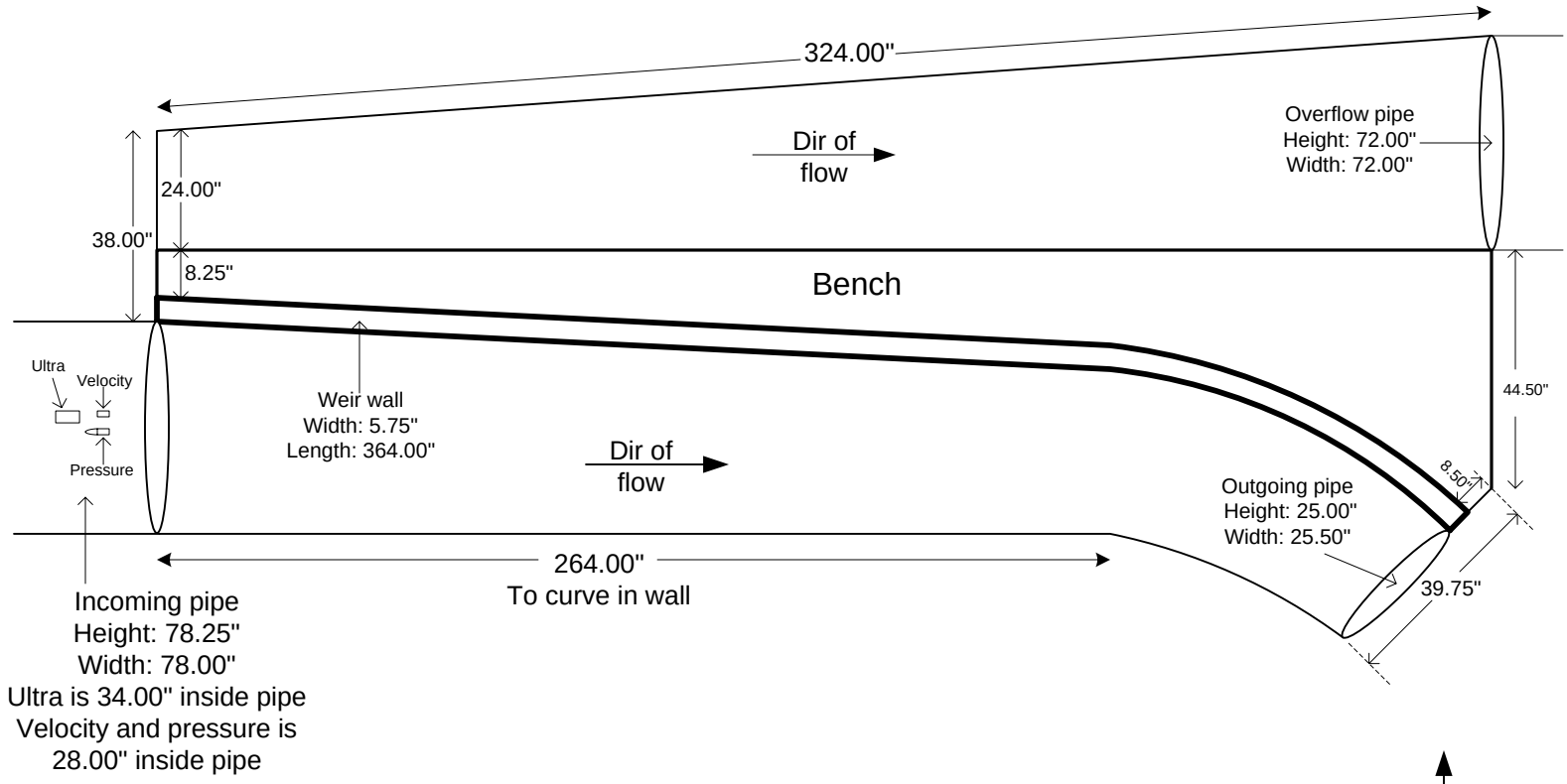
Additional Site Information / Comments:

Weir Measurements: Length 364.00", Width 5.75". Height: Left 48.00", Center 48.50", Right 49.00". Face of ultra to crest of weir 26.63".

NPDES 47C
081330

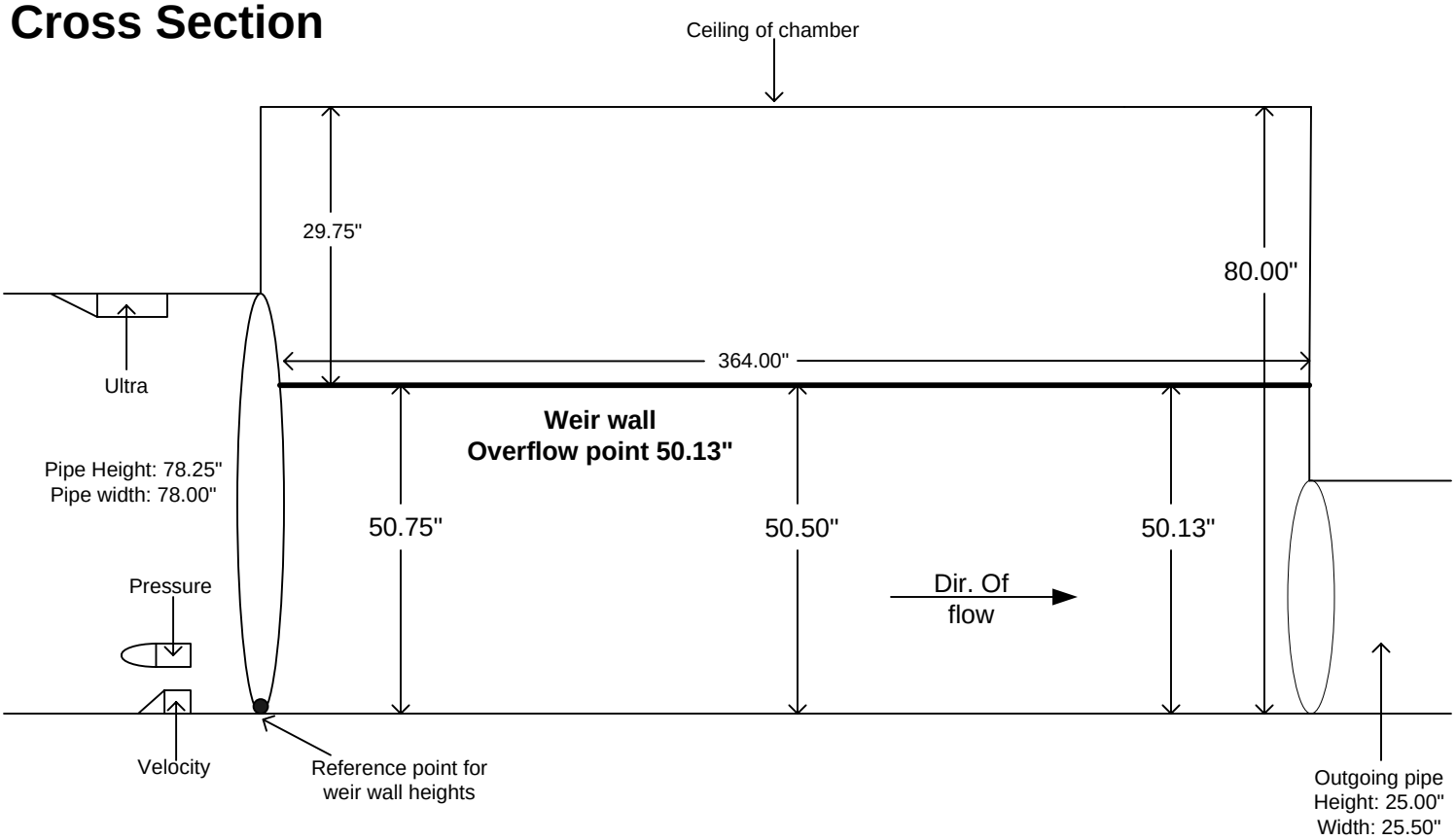
ADS ENVIRONMENTAL SERVICES®

NPDES_47C MH 081-330
Detailed drawing



Top View

Cross Section



Overflow point 50.13"
The overflow is quantified by MP1 Q-final

Not to scale
Rev.1 10/27/08

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ADS Site Report

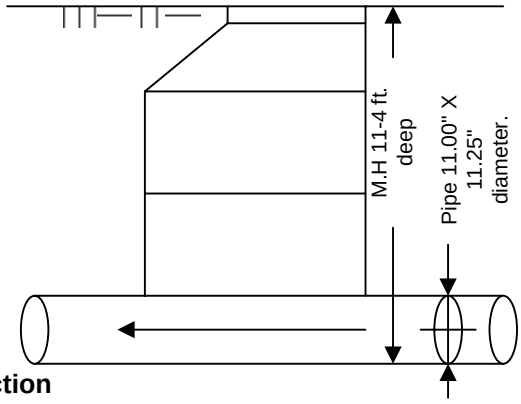
Quality Form

Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SS	
Site Name: NPDES 47D/SEA_080298	**Monitor Series:** 5000 AL	**Monitor S/N:**	15082
Address/Location: 4550 46th Av. S. @ S. Henderson St. (located NW corner of intersection)		**Manhole #**	080-298
		Thomas Bros Map Page:	625 F3
		Pipe Height:	12.00"
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	11.75"
		IP Address:	166.219.19.42

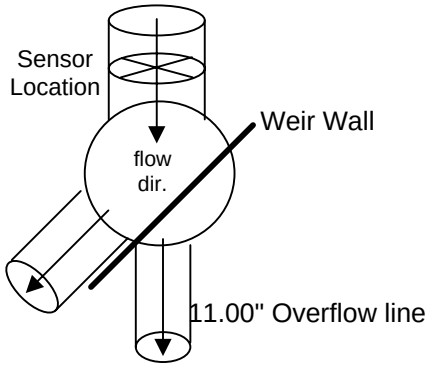
Investigation Information:

Date/Time of Investigation:	1219/2006 12:31	**Manhole Depth:**	11' - 4"
Site Hydraulics:	Fast smooth flow	**Manhole Material / Condition**	Brick / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Clay / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	2.25"+/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	3.30 fps	**Road Cut Length:**	Feet
Silt:	N/A Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Regular	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

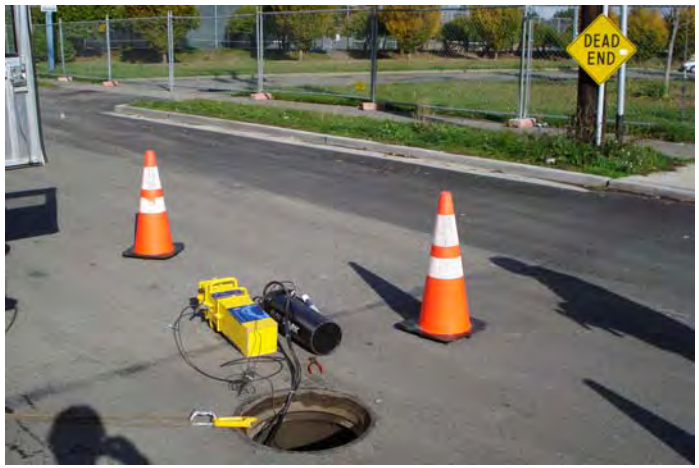
Additional Site Information / Comments:

Weir Measurements: Length 49.50", Width 6.00". Height: Left 14.63, Center 14.75", Right 20.00"

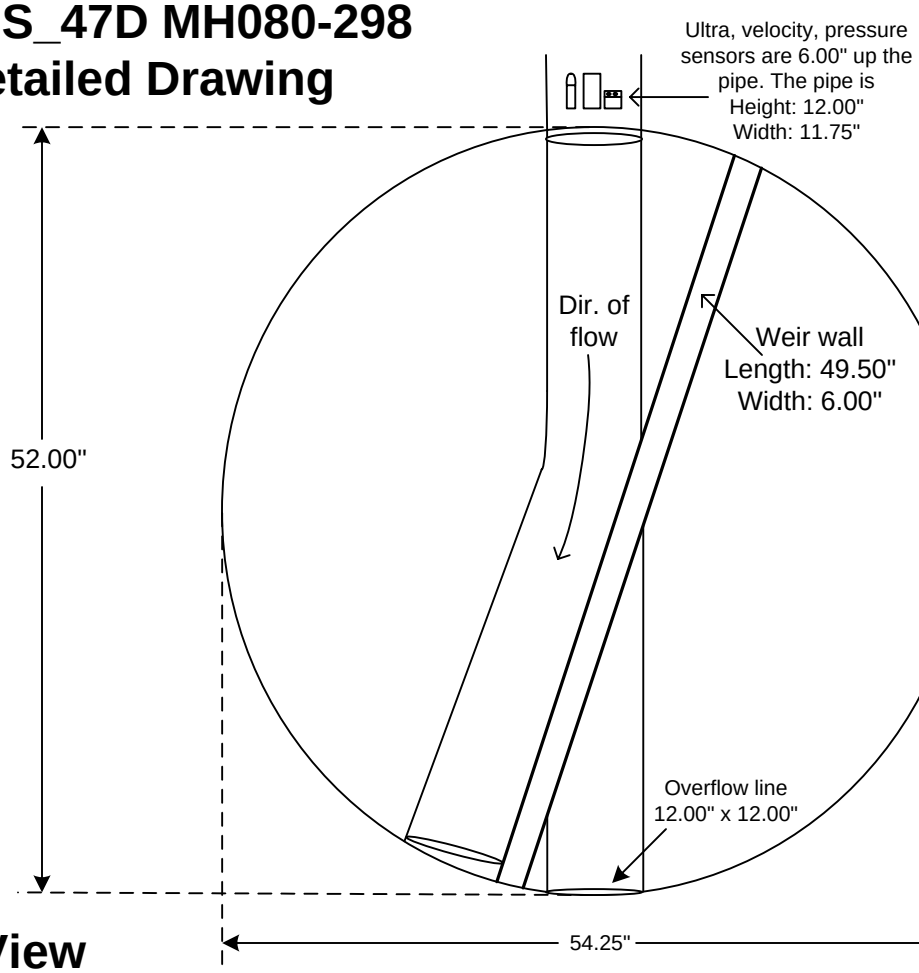
NPDES 47D

080298

ADS ENVIRONMENTAL SERVICES®



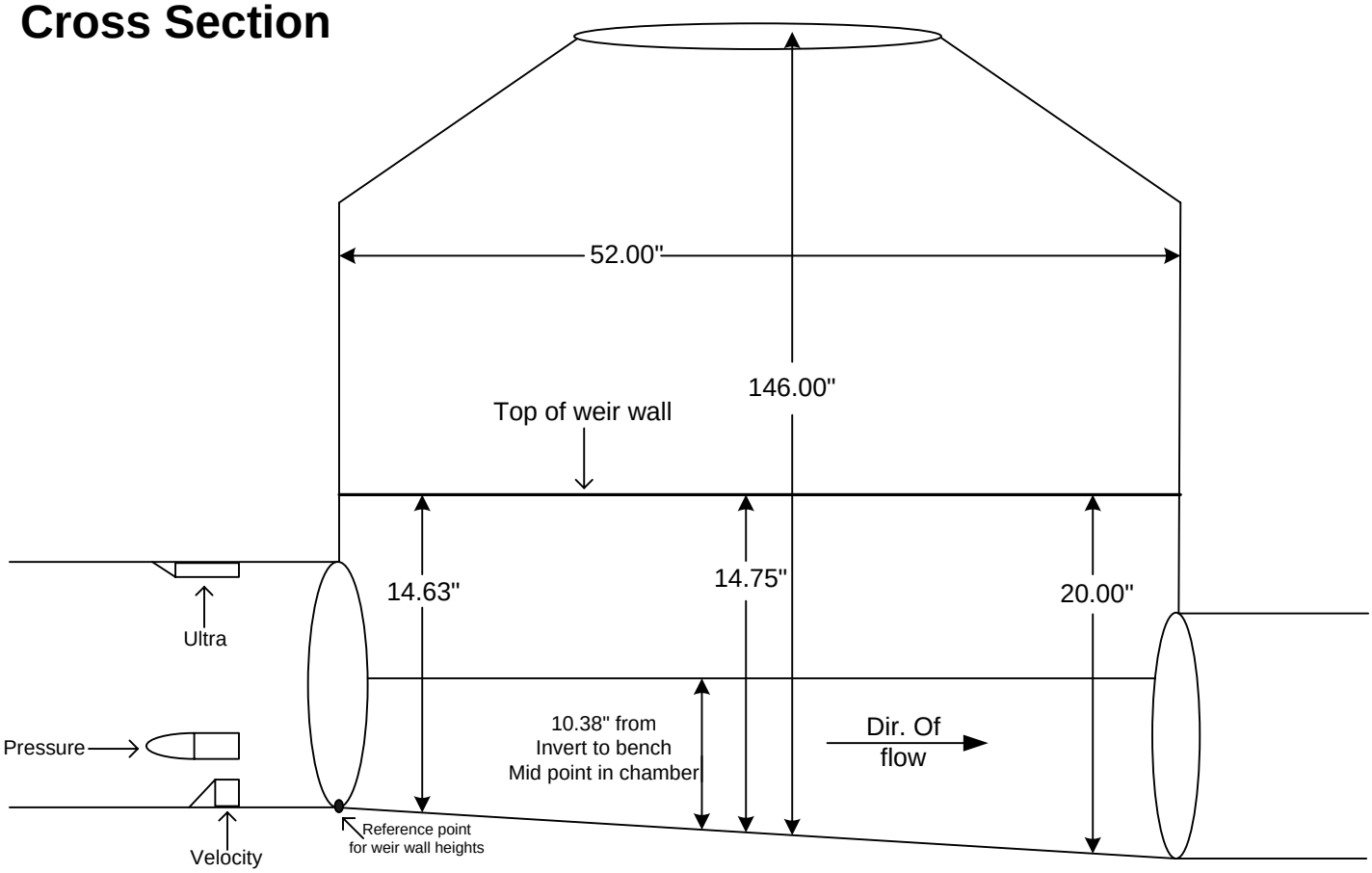
NPDES_47D MH080-298
Detailed Drawing



Top View

N

Cross Section



Overflow point is 14.63"
Overflow is quantified by Q-final from monitoring point

Not to scale
Rev. 1 10/30/08

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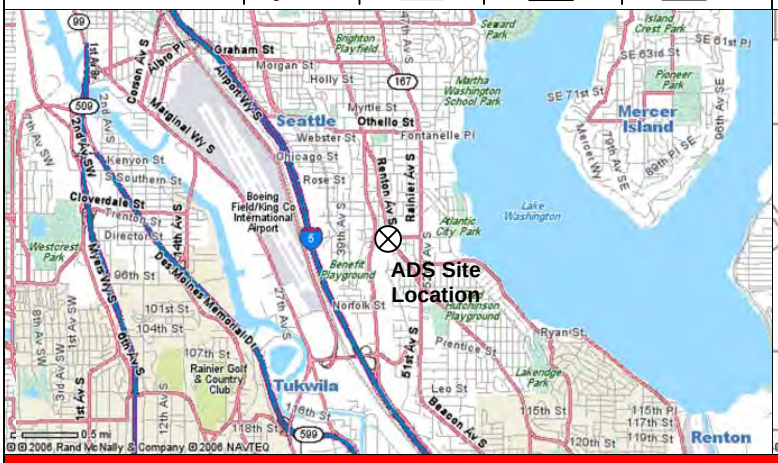
ADS Site Report — Quality Form

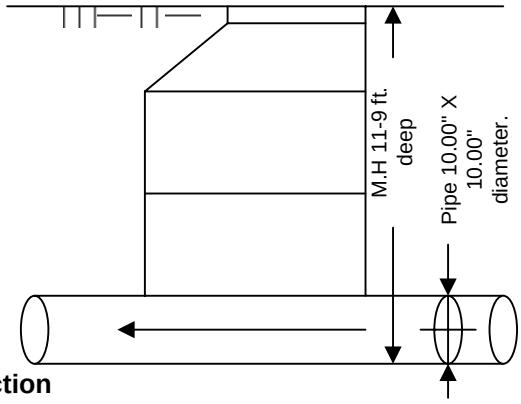
Project Name:	Seattle - CSO	**City / State:**	Seattle, WA	**FM Initials:**	SS
Site Name:	NPDES 47E/SEA_080480	**Monitor Series:**	5000 AL	**Monitor S/N:**	15078
Address/Location:	8824 Renton Av. S. @ S. Henderson St. (located in middle of Renton slightly north of Henderson)			**Manhole #**	080-480
				Thomas Bros Map Page:	625 F3
				Pipe Height:	10.00 "
Access: Drive	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 10.00 "
					IP Address: 166.219.19.43



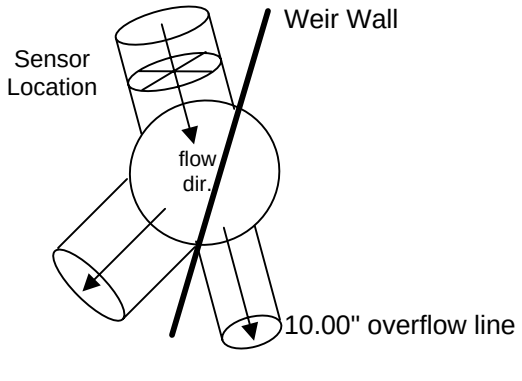
Investigation Information:

Date/Time of Investigation:	12/19/2006 12:08	**Manhole Depth:**	11' - 9"
Site Hydraulics:	Further info. pending	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Clay / Good
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	4.00" +/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	5.13 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar

Installation Information	
Installation Type:	Regular
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

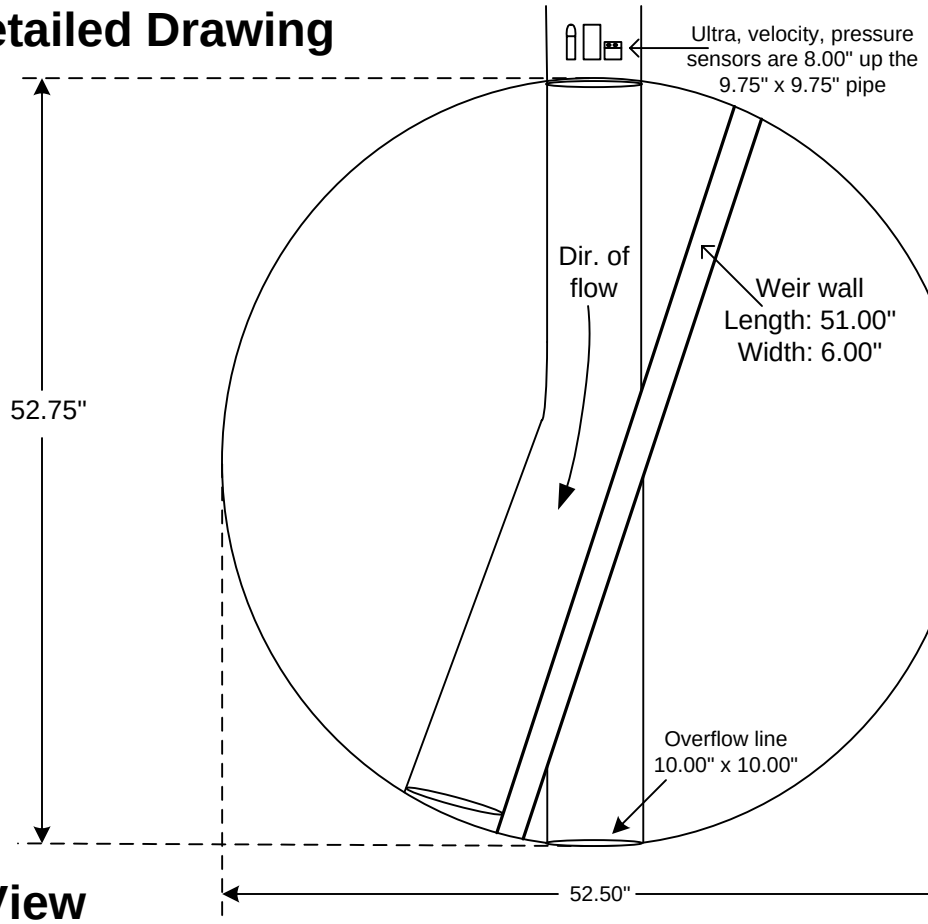
Additional Site Information / Comments:

Weir Measurements: Length 51.00", Width 6.00". Height: Left 12.88", Center 14.25", Right 22.00".
0-5 psi

NPDES 47E
080480

ADS ENVIRONMENTAL SERVICES®

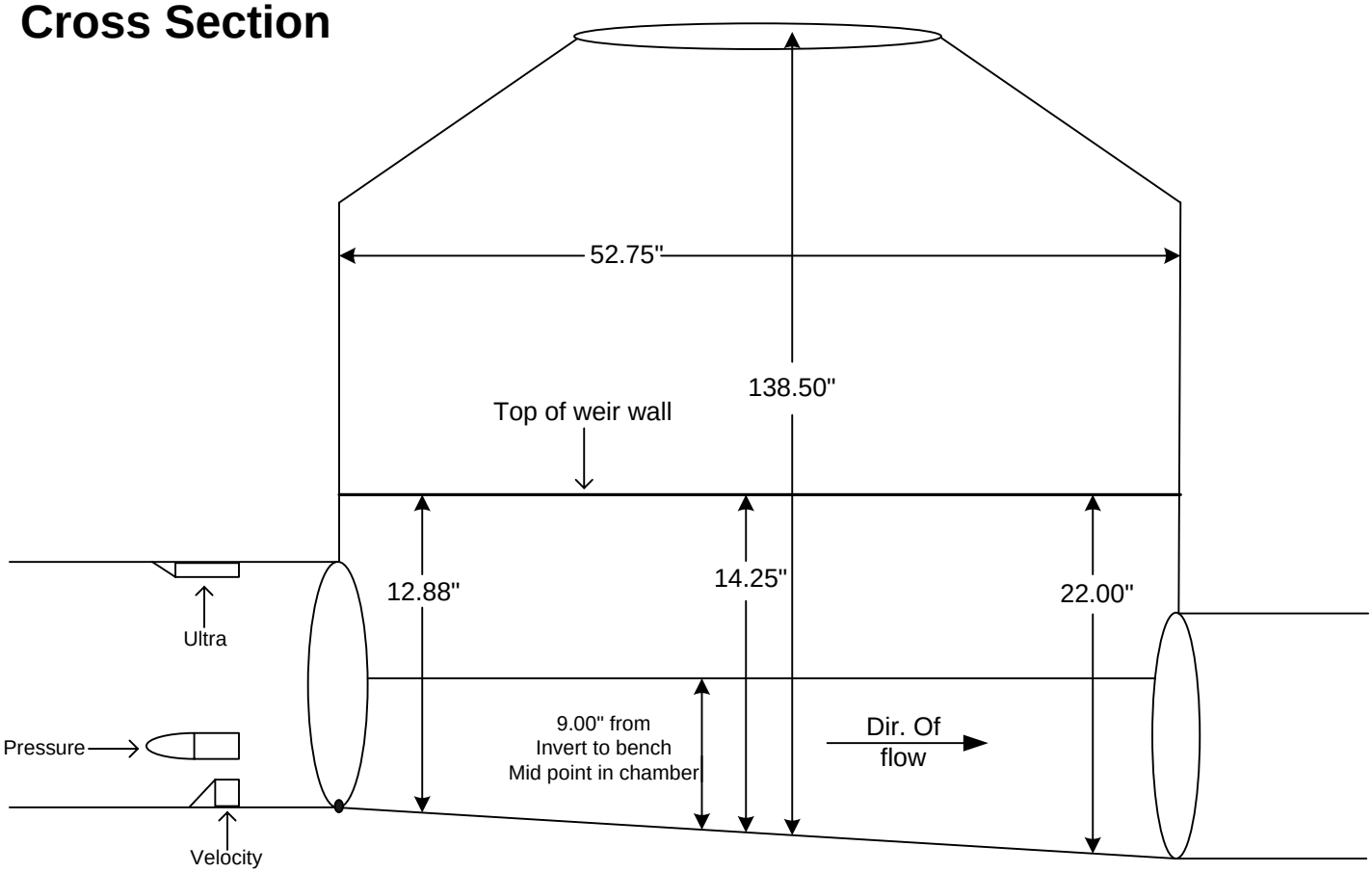
NPDES_47E MH080-480
Detailed Drawing



Top View

N

Cross Section



Overflow point is 12.88"
Overflow is quantified by Q-final from monitoring point

Not to scale
Rev. 1 10/30/08

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ADS Site Report

Quality Form

Project Name:	**Henderson**	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN49_306245	**Monitor Series:**	5000 AG	**Monitor S/N:**	20024
Address/Location:	9720 Rainier Ave S.			**Manhole #**	306245
				Thomas Bros Map Page:	
				Pipe Height:	14.63 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 14.63 "
					IP Address: 166.213.158.99

ADS Site Location

Rainier Ave S.

9720

9722

Site Map N

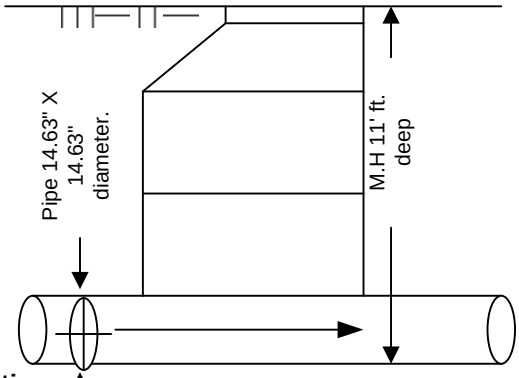
Investigation Information:

Date/Time of Investigation:	1-2-08 1215
Site Hydraulics:	Smooth Steady Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	2.75 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	.53 fps
Silt:	.75 Inches

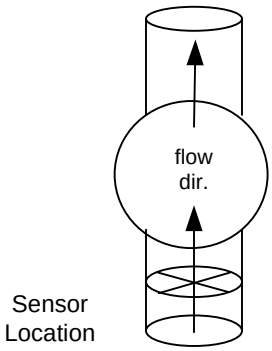
Manhole Information:

Manhole Depth:	11'			
Manhole Material / Condition	Brick / Fair			
Pipe Material / Condition:	Concrete / Fair			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:				
Access Pole #:				
Distance From Manhole:	Feet			
Road Cut Length:	Feet			
Trench Length:	Feet			

Other Information:



Cross Section



Sensor Location

Planar N

Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN49_306245

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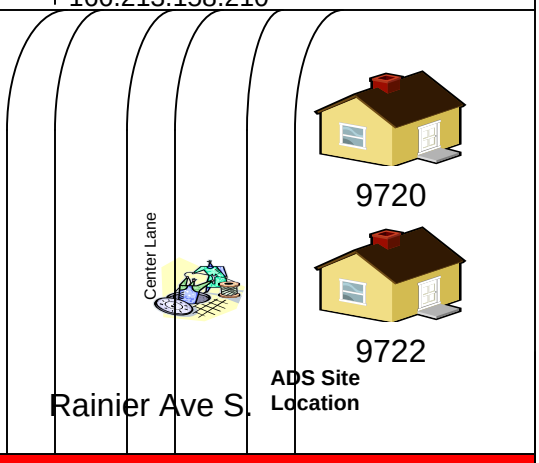
ADS Site Report

Quality Form

Project Name: Henderson	**City / State:** Seattle, WA	**FM Initials:** SK	
Site Name: HEN49_306246	**Monitor Series:** 5000 AG	**Monitor S/N:**	20072
Address/Location: 9722 Rainier Ave S.		**Manhole #**	306246
		Thomas Bros Map Page:	
		Pipe Height:	10.50 "
Access: Drive/Walk	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	10.50 "
		IP Address:	166.213.158.210

Site Map N

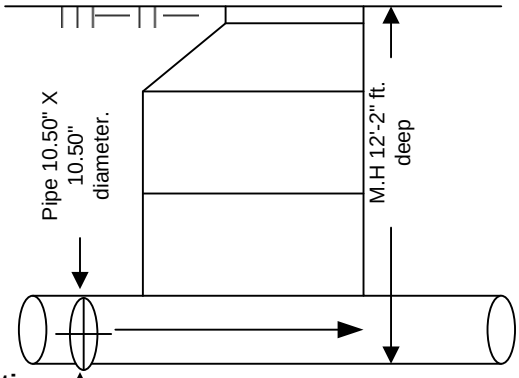


Investigation Information:

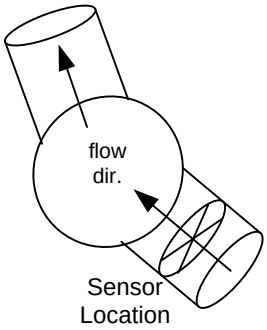
Date/Time of Investigation:	12-27-07 1510	**Manhole Depth:**	12'-2"
Site Hydraulics:	Smooth Steady Flow	**Manhole Material / Condition**	Concrete / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	10.00 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	3.75 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Manhole Information:

Other Information:



Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN49_306246

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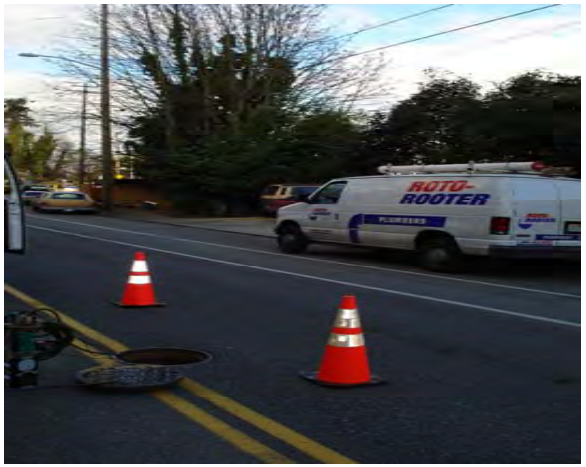
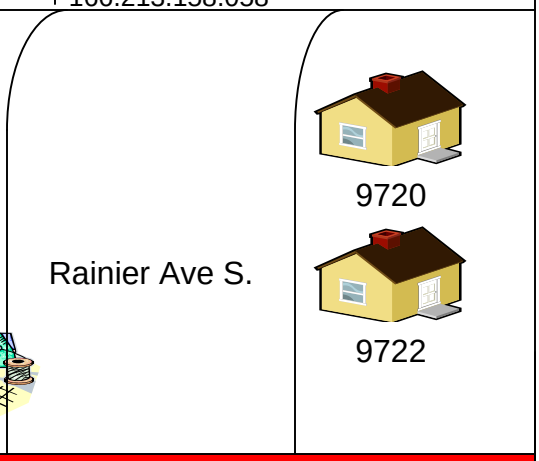


ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN49_306275	**Monitor Series:**	5000 AG	**Monitor S/N:**	20022
Address/Location:	9722 Rainier Ave S.			**Manhole #**	306275
				Thomas Bros Map Page:	
				Pipe Height:	14.63 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 14.25 "
					IP Address: 166.213.158.058



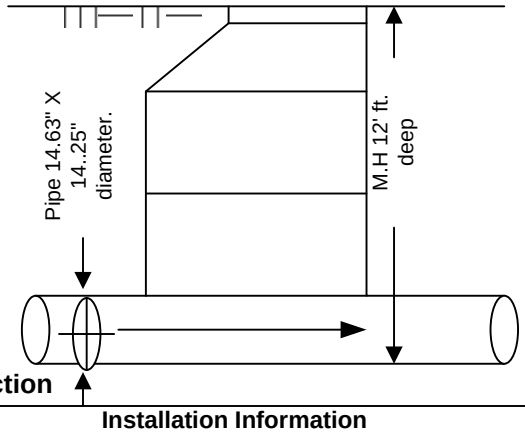
Investigation Information:

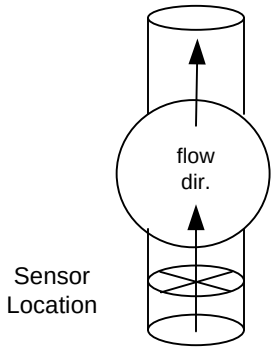
Date/Time of Investigation:	1-2-08 1240
Site Hydraulics:	Smooth Steady Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	9.00 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	1.83 fps
Silt:	0.25 Inches

Manhole Information:

Manhole Depth:	12'			
Manhole Material / Condition	Brick / Fair			
Pipe Material / Condition:	Concrete / Fair			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:				
Access Pole #:				
Distance From Manhole:	Feet			
Road Cut Length:	Feet			
Trench Length:	Feet			

Other Information:





Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

Ultra is on a surcharge mount

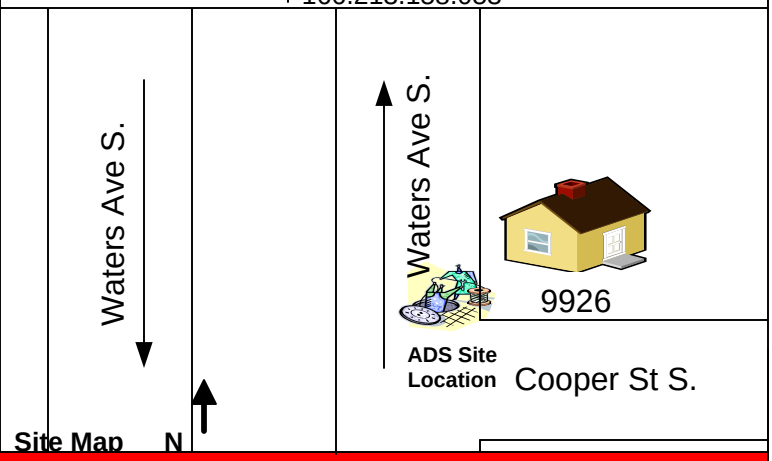
HEN49_306275

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

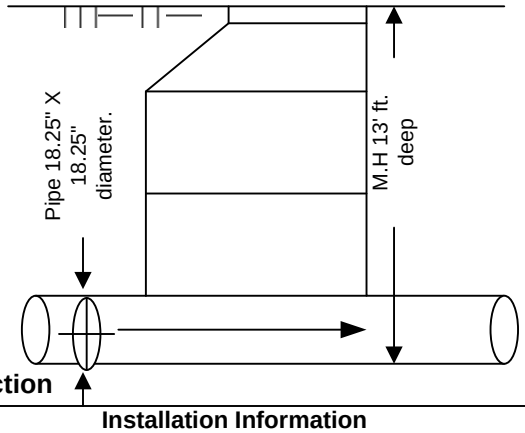
Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN49_306284	**Monitor Series:**	5000 AG	**Monitor S/N:**	20089
Address/Location:	9926 Waters Ave S. & Cooper St. S.			**Manhole #**	306284
				Thomas Bros Map Page:	625-H5
				Pipe Height:	18.25 "
Access:	Drive/Walk	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	18.25 "
				IP Address:	166.213.158.053

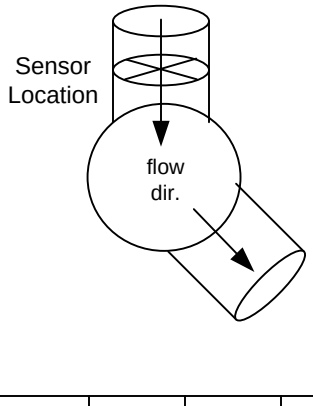


Investigation Information:

Date/Time of Investigation:	12-27-07 1415	**Manhole Depth:**	13'
Site Hydraulics:	Fast Smooth Flow	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	1.63 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	3.57 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

Ultra is on a surcharge mount

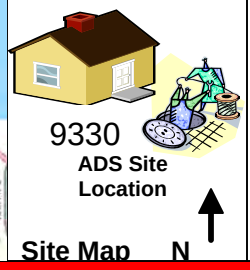
HEN49_306284

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN49_306343	**Monitor Series:**	5000 AG	**Monitor S/N:**	20045
Address/Location:	9330 Rainier Ave S.			**Manhole #**	306343
				Thomas Bros Map Page:	
				Pipe Height:	26.50 "
Access: Drive/Walk	**Type of System:**	Sanitary [ ]	Storm [ ]	Combined [X]	**Pipe Width:** 27.75 "
					IP Address: 166.213.158.110



Site Map

Rainier Ave S.

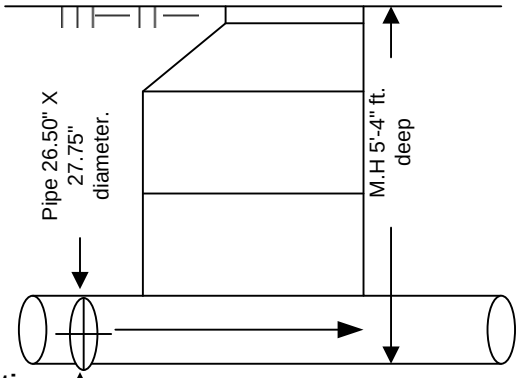
Investigation Information:

Date/Time of Investigation:	1-10-08
Site Hydraulics:	Slow Smooth Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	10.00 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	1.58 fps
Silt:	4.50 Inches

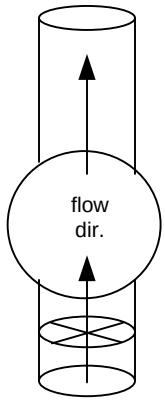
Manhole Information:

Manhole Depth:	5'-4"			
Manhole Material / Condition	Brick / Fair			
Pipe Material / Condition:	Clay / Fair			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:				
Access Pole #:				
Distance From Manhole:	Feet			
Road Cut Length:	Feet			
Trench Length:	Feet			

Other Information:



Cross Section



Planar

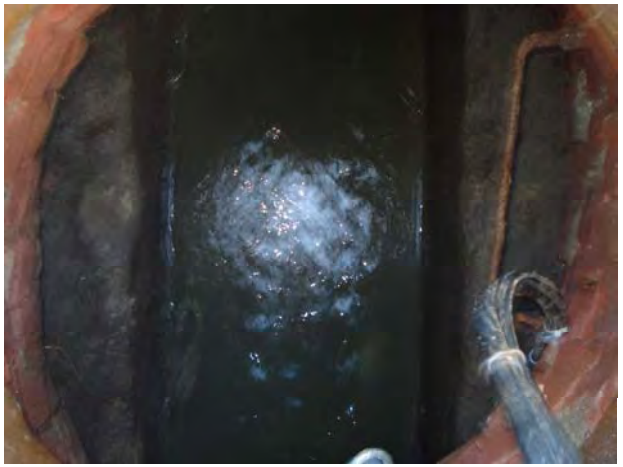
Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN49_306343

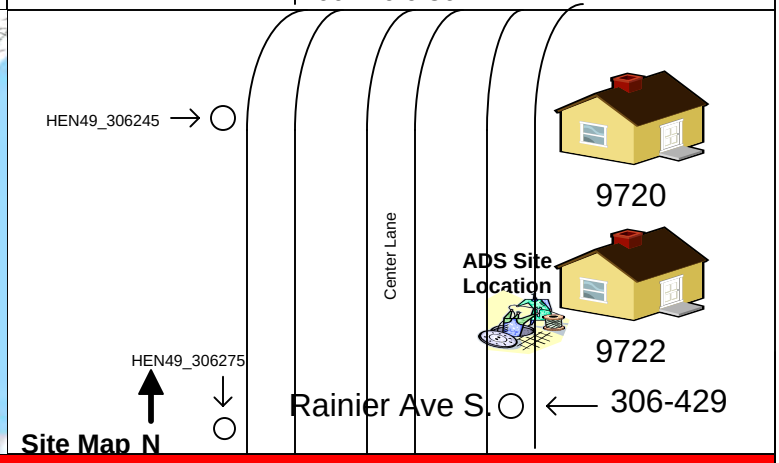
ADS ENVIRONMENTAL SERVICES®



ADS Site Report

Quality Form

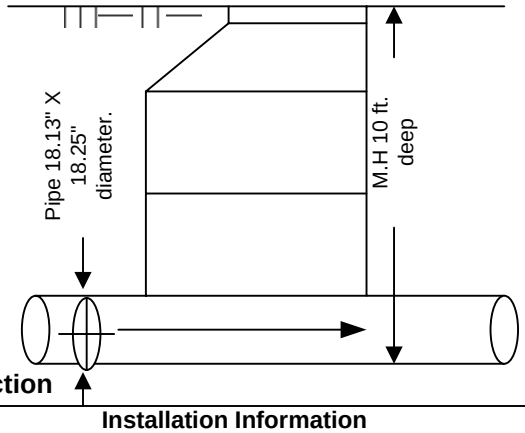
Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SW
Site Name:	HEN49_306428	**Monitor Series:**	5000 AG	**Monitor S/N:**	20970
Address/Location:	9722 Rainier Ave S.			**Manhole #**	306-428
				Thomas Bros Map Page:	625 H4
				Pipe Height:	18.13 "
Access:	Drive	**Type of System:**	Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	18.25 "
				IP Address:	166.219.9.36

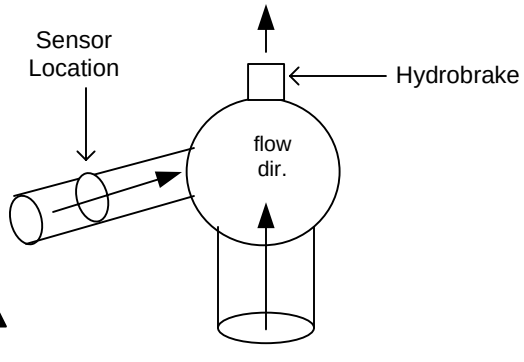


Investigation Information:

Date/Time of Investigation:	4/16/08 08:50	**Manhole Depth:**	10'
Site Hydraulics:	Smooth consistent	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Good
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	9.88 +/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	1.16 fps	**Road Cut Length:**	Feet
Silt:	2.75 Inches	**Trench Length:**	Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	52.50" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

Rev. #1 4/21/08

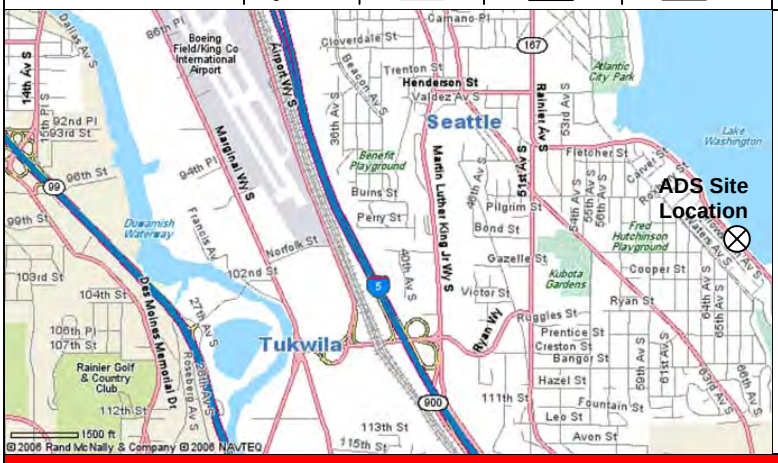
HEN49_306428

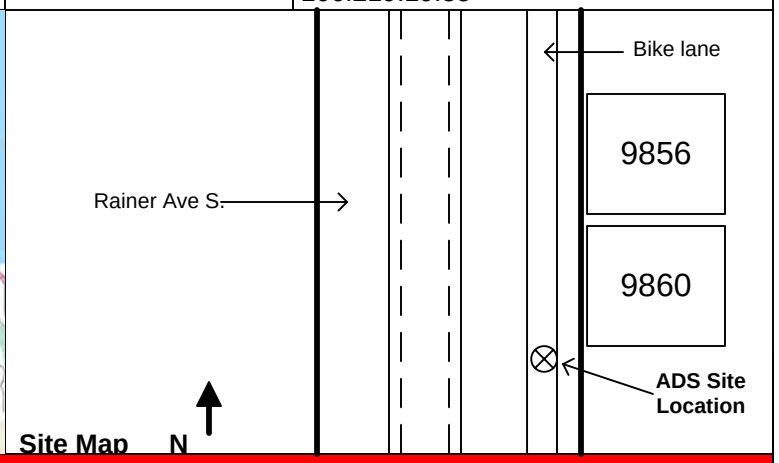
Proper MH

ADS ENVIRONMENTAL SERVICES®

ADS Site Report — Quality Form

Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SW	
Site Name: NPDES 49/SEA_306437	**Monitor Series:** 5000 BG	**Monitor S/N:**	19027
Address/Location: 9860 Rainier Av. S. (in bike lane)		**Manhole #**	306-437
		Thomas Bros Map Page:	625 H4/5
		Pipe Height:	72.00"
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	71.63"
		IP Address:	166.219.19.55

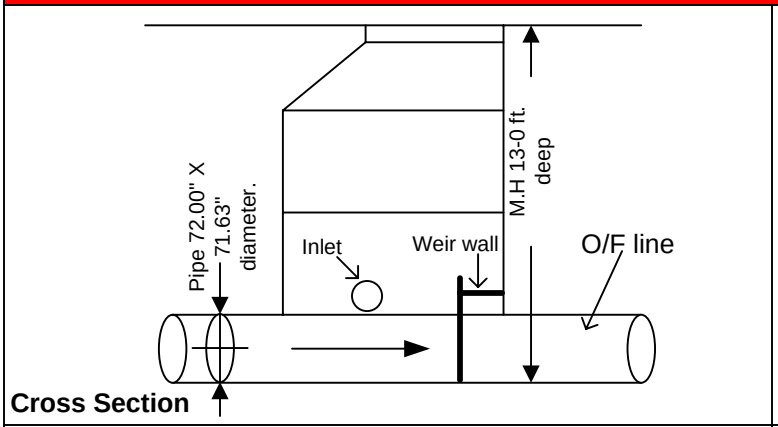


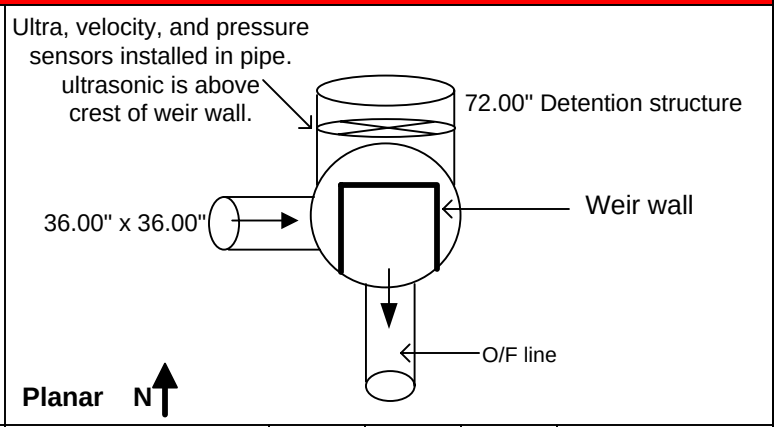


Investigation Information:

Date/Time of Investigation:	12/19/2006 14:30	**Manhole Depth:**	13' - 0"
Site Hydraulics:	No flow	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	No influence	**Pipe Material / Condition:**	Concrete / Good
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	Doesn't apply
Depth of Flow:	0.00" +/- 0.25"	**Access Pole #:**	Doesn't apply
Range (Air DOF):	72.00"+/- 0.25"	**Distance From Manhole:**	Doesn't apply Feet
Peak Velocity:	0.00 fps	**Road Cut Length:**	Doesn't apply Feet
Silt:	0.00 Inches	**Trench Length:**	Doesn't apply Feet

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Regular	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_10,16,18	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

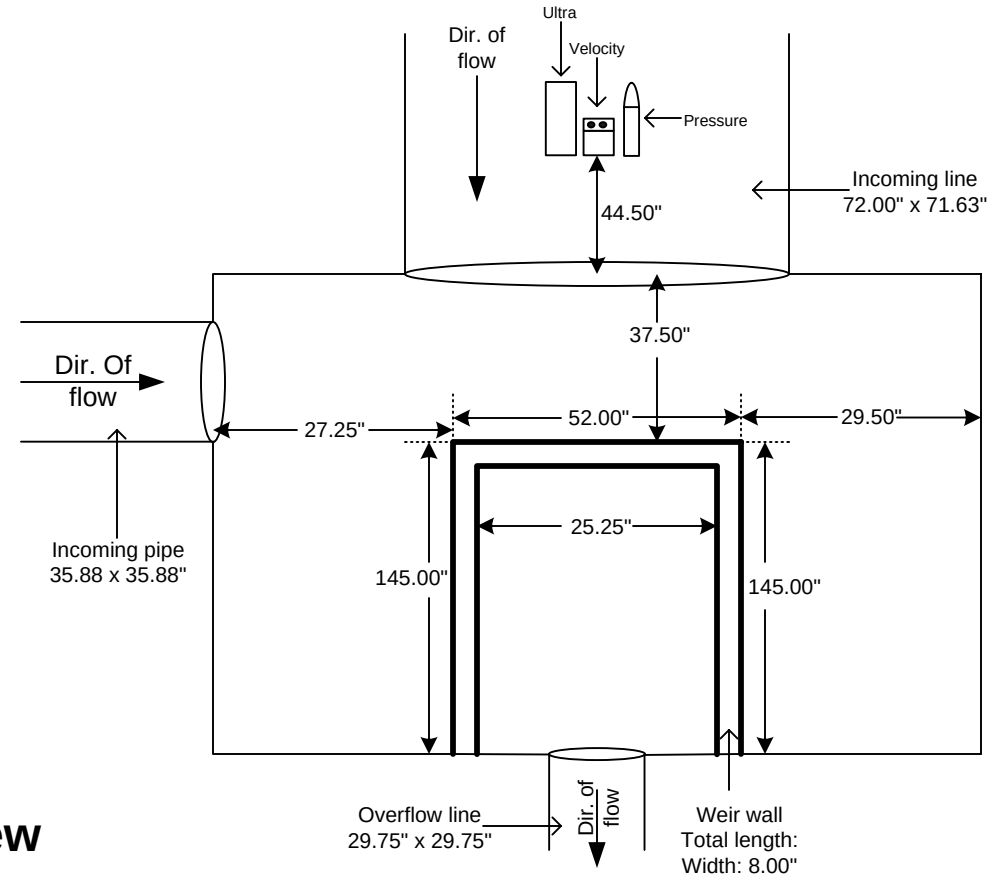
Weir Measurements: Length (total of all 3 sides) 342.00", Width 8.00". Height: Left 70.00", Center 76.63", Right 70.00" (reference from point of sensors).
Point of O/F 70.00" (what monitor reads when High High threshold is met)
Pressure (15 PSI, accuracy +/- 0.25% for range of 0.25 – 34.5 ft.)

Rev. 1 12/5/08

NPDES 49
306437

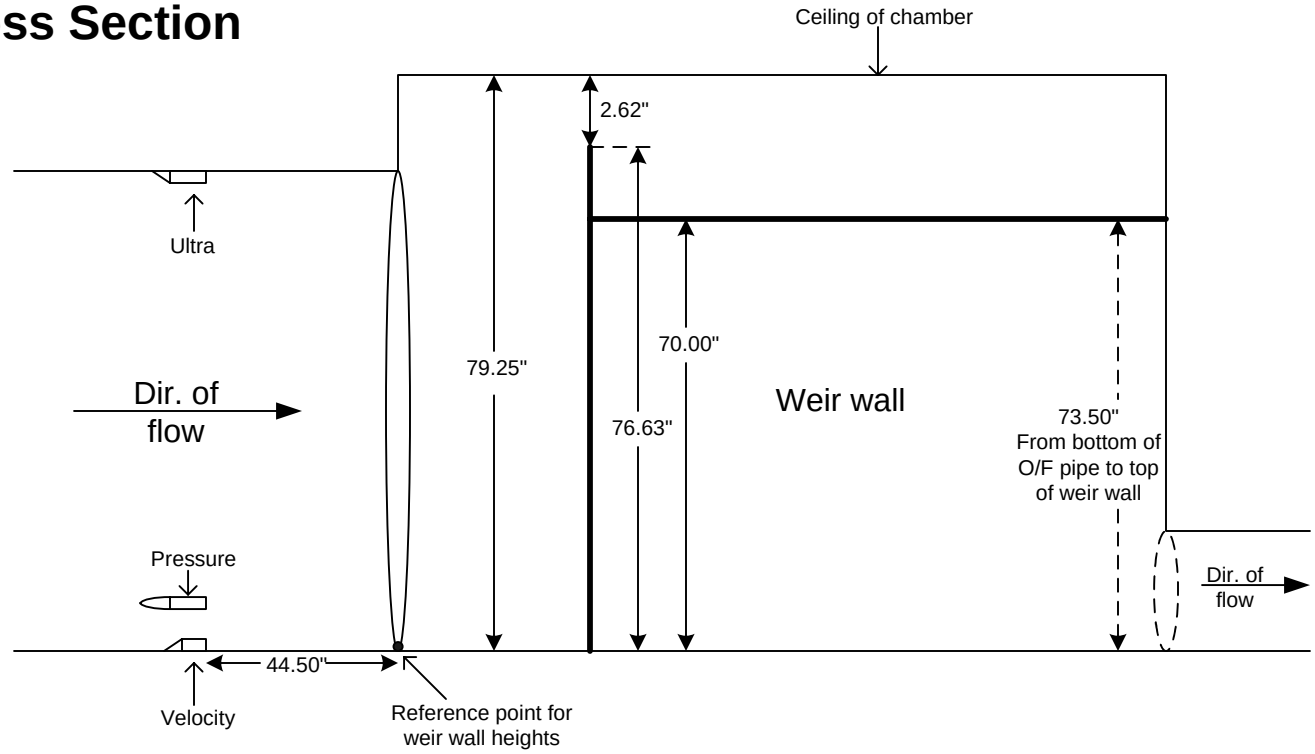
ADS ENVIRONMENTAL SERVICES®

NPDES_49 MH306-437
Detailed Drawing



Top View

Cross Section



Overflow point is 70.00"
Overflow quantity is quantified with the equation: If(Dfinal - O/F<0),0,2.62 x (weir length)* (((Dfinal - O/F)/12)^3/2)))

Not to scale
Rev. 1 10/31/08

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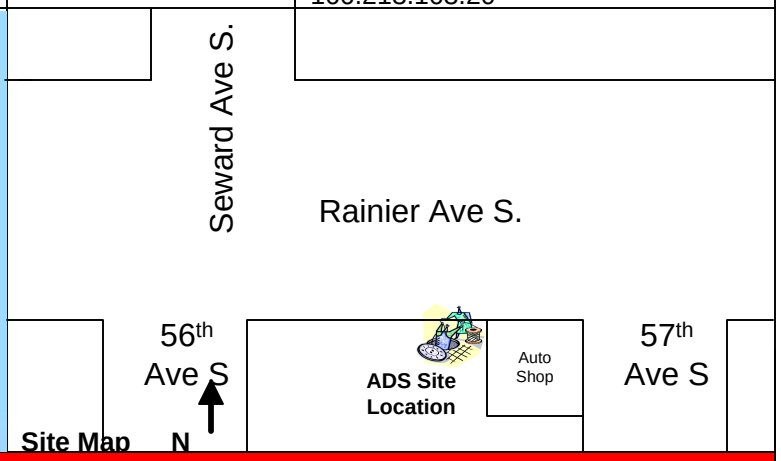
ADS Site Report

Quality Form

Project Name: Henderson	**City / State:** Seattle, WA	**FM Initials:** SK	
Site Name: HEN171_081237	**Monitor Series:** 5000 AG	**Monitor S/N:**	16052
Address/Location: Rainier Ave. Between 56th & 57th Ave. On south side		**Manhole #**	081237
		Thomas Bros Map Page:	625-G4
		Pipe Height:	30.50 "
Access: Drive/Walk	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	30.50 "
		IP Address:	166.213.163.20



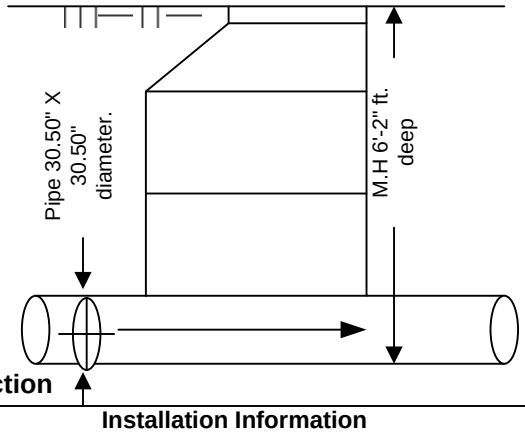
Investigation Information:

Date/Time of Investigation:	12-27-07 1400
Site Hydraulics:	Fast Smooth Flow
Upstream Input: (L/S, P/S)	
Upstream Manhole:	DNI
Downstream Manhole:	DNI
Depth of Flow:	2.50 +/- 0.38"
Range (Air DOF):	+/-
Peak Velocity:	4.0 fps
Silt:	0.00 Inches

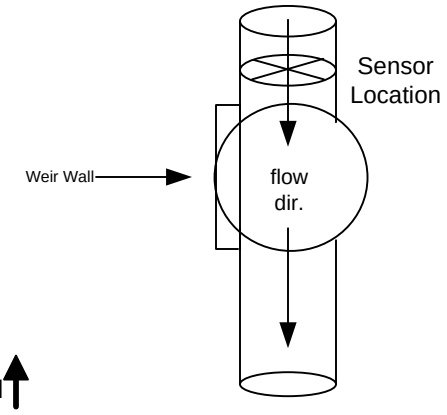
Manhole Information:

Manhole Depth:	6'-2"				
Manhole Material / Condition	Concrete / Fair				
Pipe Material / Condition:	Concrete / Fair				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]	
Telephone Information:					
Access Pole #:					
Distance From Manhole:	Feet				
Road Cut Length:	Feet				
Trench Length:	Feet				

Other Information:



Cross Section



Planar N

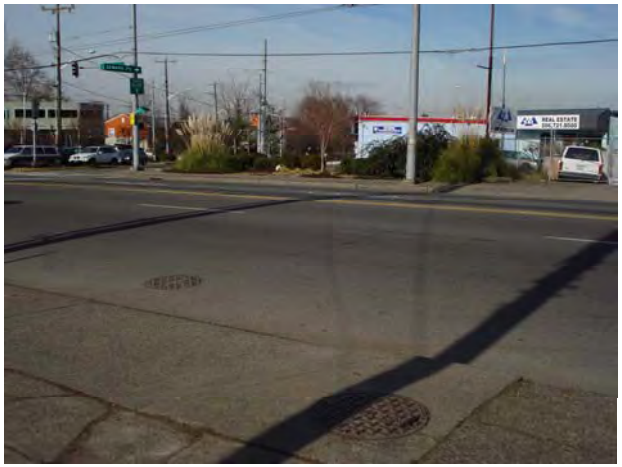
Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

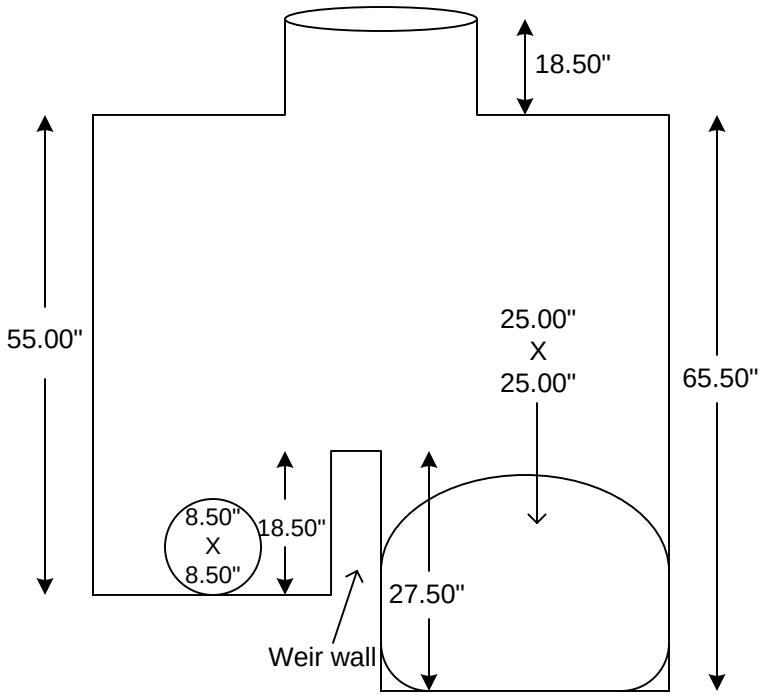
Additional Site Information / Comments:

HEN171_081237

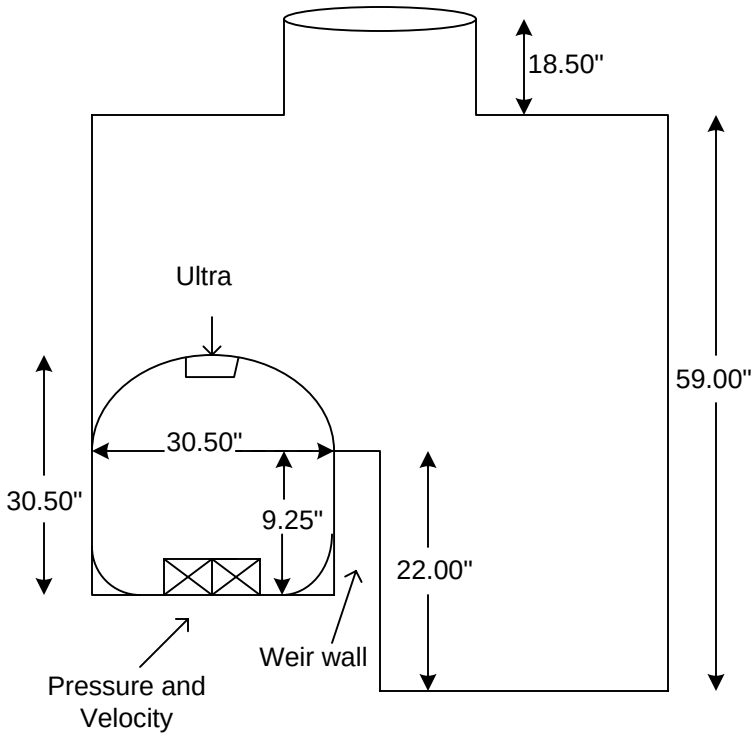
ADS ENVIRONMENTAL SERVICES®



HEN171_081237

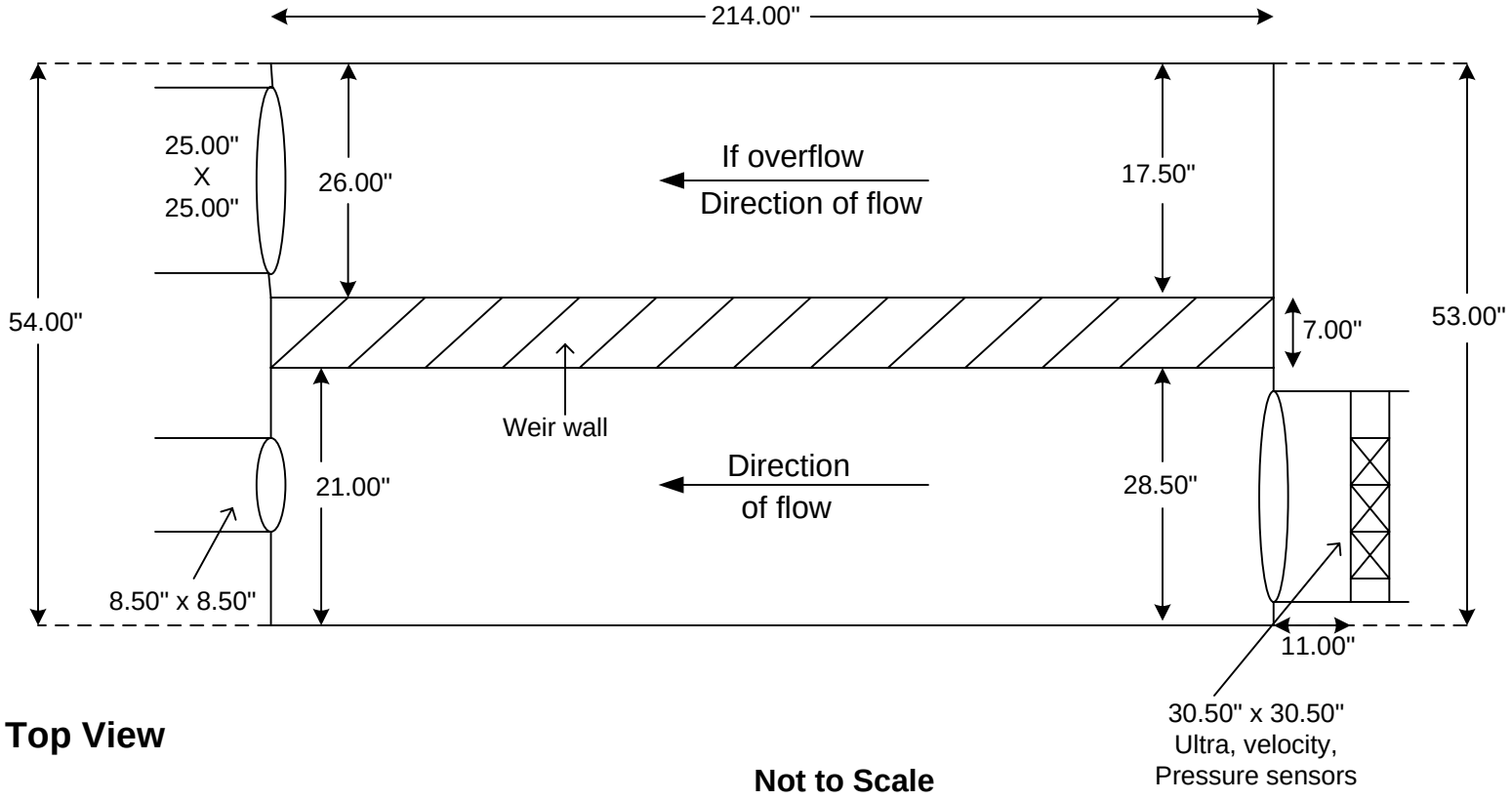


Flow going into page



Flow coming out of page

Section View



Top View

Not to Scale

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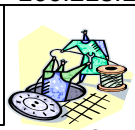
ADS Site Report

Quality Form

Project Name:	Henderson	**City / State:**	Seattle, WA	**FM Initials:**	SK
Site Name:	HEN171_306192	**Monitor Series:**	5000 AG	**Monitor S/N:**	20077
Address/Location:	9830 59th Ave S			**Manhole #**	306192
				Thomas Bros Map Page:	
				Pipe Height:	8.75 "
Access:	Drive/Walk	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	8.50 "
				IP Address:	166.213.158.145



ADS Site Location

S Gazelle St.

59th Ave S

9830

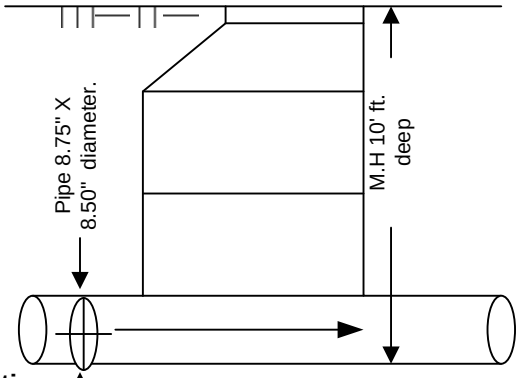
S Copper ST.

Site Map N

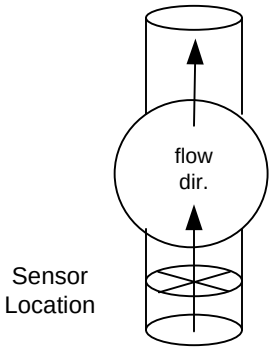
Investigation Information:

Date/Time of Investigation:	1-2-08 1020	**Manhole Depth:**	10'
Site Hydraulics:	Fast Steady Flow	**Manhole Material / Condition**	Brick / Fair
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Brick / Fair
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	1.50 +/- 0.38"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	4.83 fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Other Information:



Cross Section



Planar N

Installation Information	
Installation Type:	Standard
Sensors Devices:	Ultra / Pressure / Velocity
Surcharge Height:	0.00" Feet
Rain Guage Zone:	

Backup	Yes	No	?	Distance
Trunk	[ ]	[ ]	[ ]	
Lift / Pump Station	[ ]	[ ]	[ ]	
WWTP	[ ]	[ ]	[ ]	
Other	[ ]	[ ]	[ ]	

Additional Site Information / Comments:

HEN171_306192

ADS ENVIRONMENTAL SERVICES®

ADS Site Report

Quality Form

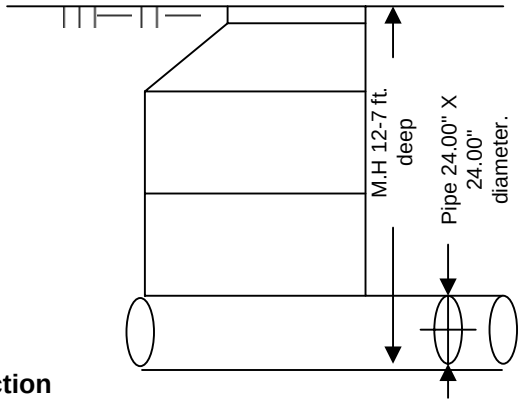
Project Name: Seattle - CSO	**City / State:** Seattle, WA	**FM Initials:** SS	
Site Name: NPDES 171/SEA_081231	**Monitor Series:** 5000 AG-M	**Monitor S/N:**	26168
Address/Location: Rainier Av. S. & Seward Park Av. S.		**Manhole #**	081-231
		Thomas Bros Map Page:	625 G4
		Pipe Height:	24.00 "
Access: Drive	**Type of System:** Sanitary [ ] Storm [ ] Combined [X]	**Pipe Width:**	24.00 "
		IP Address:	166.219.18.244

Investigation Information:

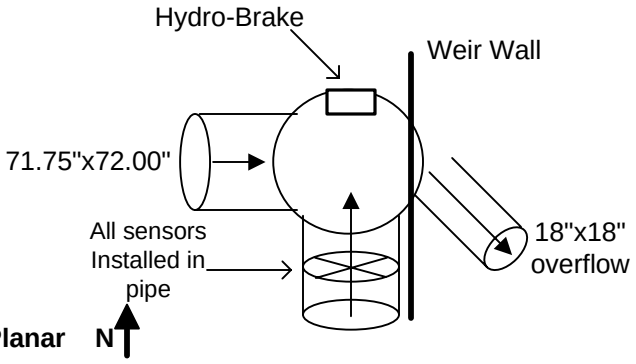
Date/Time of Investigation:	1/12/2007 03:36	**Manhole Depth:**	12' - 7"
Site Hydraulics:	Info. pending	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)		**Pipe Material / Condition:**	Concrete / Good
Upstream Manhole:	DNI	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	DNI	**Telephone Information:**	
Depth of Flow:	0.25"+/- 0.25"	**Access Pole #:**	
Range (Air DOF):	+/-	**Distance From Manhole:**	Feet
Peak Velocity:	Info. pending fps	**Road Cut Length:**	Feet
Silt:	0.00 Inches	**Trench Length:**	Feet

Manhole Information:

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Regular	Trunk	[ ]	[ ]	[ ]	
Sensors Devices:	Ultra / Pressure / Velocity	Lift / Pump Station	[ ]	[ ]	[ ]	
Surcharge Height:	0.00" Feet	WWTP	[ ]	[ ]	[ ]	
Rain Guage Zone:		Other	[ ]	[ ]	[ ]	

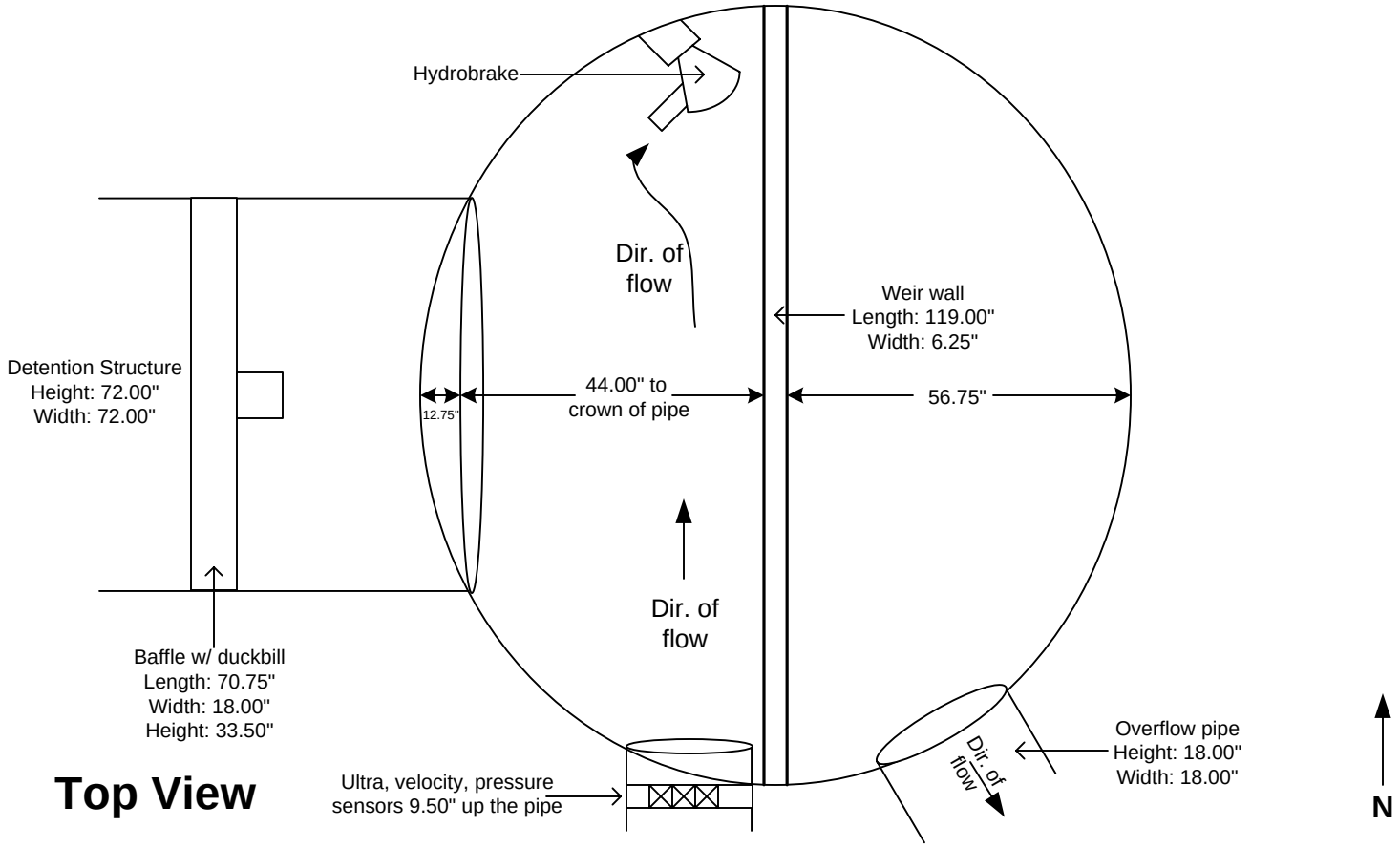
Additional Site Information / Comments:

Weir Measurements: Length 119.00", Width 6.25". Height: Left 89.00", Center 85,25", Right 81.00". Overflow quantification method: Broad Crested Weir Equation. **Night install**

NPDES 171
081231

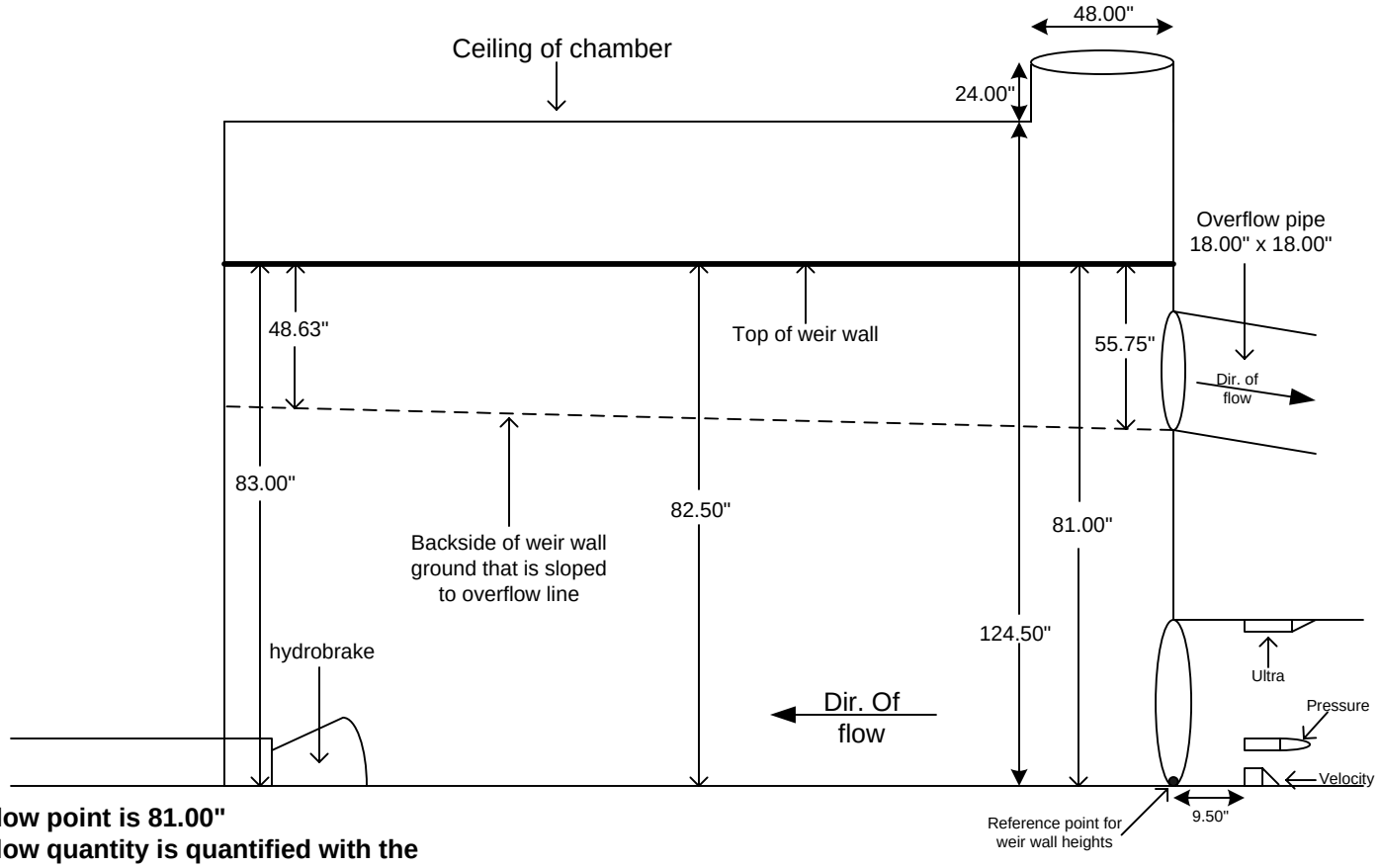
ADS ENVIRONMENTAL SERVICES®

NPDES_171 MH081231
Detailed Drawing



Top View

Cross Section



Overflow point is 81.00"
Overflow quantity is quantified with the equation: If(Dfinal - O/F<0),0,2.62 x (weir length)* (((Dfinal - O/F)/12)^3/2)))

Not to scale
Rev. 1 10/28/08

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Appendix C
Rainfall Event Detail

Rain Gage 18: Storms from 1/1/2008 to 5/31/2009 based on project storm definition (6 hour interevent period, 0.3" minimum storm depth)

Storm Definition = 6 hours between measured precip., 0.3" minimum depth. Precipitation not meeting these requirements is not reported.

Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	Depth and Frequency for Multiple Durations																			
					5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
12/16/07 18:00	12/17/07 5:00	11.00	0.9	0.39	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.15	< 2 Month	0.20	< 2 Month	0.39	< 2 Month	0.39	< 2 Month	0.45	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
12/18/07 2:25	12/18/07 18:30	16.08	0.9	0.47	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.28	< 2 Month	0.42	< 2 Month	0.47	< 2 Month	0.83	< 2 Month	0.88	< 2 Month	0.00	< 2 Month
12/19/07 1:05	12/19/07 9:45	8.67	0.3	0.31	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.25	< 2 Month	0.31	< 2 Month	0.63	< 2 Month	0.78	< 2 Month	1.17	< 2 Month	0.00	< 2 Month
12/22/07 4:45	12/22/07 12:15	7.50	1.6	0.35	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.32	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.36	< 2 Month	0.73	< 2 Month	1.94	2-month
12/23/07 7:10	12/23/07 18:05	10.92	0.8	0.37	0.02	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.30	< 2 Month	0.37	< 2 Month	0.37	< 2 Month	0.72	< 2 Month	0.72	< 2 Month	2.26	3-month
12/27/07 8:55	12/28/07 2:00	17.08	1.1	0.32	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.23	< 2 Month	0.29	< 2 Month	0.32	< 2 Month	0.33	< 2 Month	0.48	< 2 Month	1.20	< 2 Month
1/2/08 2:40	1/2/08 8:00	5.33	2.9	0.36	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.83	< 2 Month
1/2/08 14:05	1/3/08 19:50	29.75	0.3	0.42	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.14	< 2 Month	0.37	< 2 Month	0.53	< 2 Month	0.78	< 2 Month	0.78	< 2 Month	1.10	< 2 Month
1/8/08 0:55	1/8/08 8:55	8.00	1.0	0.31	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.25	< 2 Month	0.31	< 2 Month	0.31	< 2 Month	0.42	< 2 Month	0.65	< 2 Month	1.55	< 2 Month
1/9/08 21:05	1/10/08 9:45	12.67	1.1	0.47	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.38	< 2 Month	0.46	< 2 Month	0.47	< 2 Month	0.70	< 2 Month	0.85	< 2 Month	1.49	< 2 Month
1/10/08 16:50	1/11/08 5:40	12.83	0.3	0.33	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.26	< 2 Month	0.31	< 2 Month	0.72	< 2 Month	0.80	< 2 Month	1.15	< 2 Month	1.63	< 2 Month
2/6/08 14:00	2/7/08 1:40	11.67	0.9	0.35	0.03	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.23	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.55	< 2 Month	0.56	< 2 Month	0.73	< 2 Month
2/8/08 13:55	2/9/08 1:15	11.33	1.5	0.35	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.26	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.39	< 2 Month	0.70	< 2 Month	0.91	< 2 Month
3/13/08 6:30	3/14/08 16:15	33.75	2.0	0.59	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.25	< 2 Month	0.36	< 2 Month	0.47	< 2 Month	0.59	< 2 Month	0.65	< 2 Month	1.04	< 2 Month
3/23/08 4:55	3/23/08 15:10	10.25	2.3	0.75	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.19	2-month	0.46	< 2 Month	0.75	2-month	0.75	< 2 Month	0.75	< 2 Month	0.88	< 2 Month	1.09	< 2 Month
3/25/08 14:25	3/26/08 6:15	15.83	2.0	0.31	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.20	< 2 Month	0.27	< 2 Month	0.31	< 2 Month	0.31	< 2 Month	0.94	< 2 Month	1.27	< 2 Month
3/29/08 15:50	3/30/08 3:00	11.17	0.4	0.50	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.14	< 2 Month	0.41	< 2 Month	0.50	< 2 Month	0.63	< 2 Month	1.00	< 2 Month	1.01	< 2 Month	2.22	3-month
4/14/08 14:20	4/14/08 22:20	8.00	0.8	0.30	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.29	< 2 Month	0.30	< 2 Month	0.32	< 2 Month	0.39	< 2 Month	0.39	< 2 Month	0.54	< 2 Month
5/19/08 23:30	5/20/08 9:45	10.25	6.4	0.36	0.03	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.25	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.56	< 2 Month
5/21/08 18:20	5/21/08 20:00	1.67	0.5	0.44	0.06	2-month	0.12	4-month	0.22	6-month	0.31	6-month	0.44	< 2 Month	0.44	< 2 Month	0.45	< 2 Month	0.81	< 2 Month	0.81	< 2 Month	0.81	< 2 Month
6/2/08 22:50	6/3/08 12:30	13.67	2.3	0.62	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.15	< 2 Month	0.48	2-month	0.59	< 2 Month	0.62	< 2 Month	0.62	< 2 Month	0.66	< 2 Month	0.66	< 2 Month
6/6/08 5:00	6/6/08 19:00	14.00	0.5	0.48	0.05	< 2 Month	0.09	2-month	0.21	6-month	0.33	9-month	0.41	< 2 Month	0.47	< 2 Month	0.48	< 2 Month	0.60	< 2 Month	0.88	< 2 Month	1.48	< 2 Month
7/3/08 5:35	7/3/08 11:30	5.92	22.8	0.46	0.04	< 2 Month	0.07	< 2 Month	0.15	2-month	0.16	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month
8/19/08 20:45	8/20/08 7:30	10.75	1.2	0.66	0.02	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.16	< 2 Month	0.52	2-month	0.66	< 2 Month	0.66	< 2 Month	0.81	< 2 Month	0.81	< 2 Month	0.81	< 2 Month
8/24/08 12:50	8/24/08 23:35	10.75	3.8	0.95	0.04	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.22	3-month	0.64	4-month	0.95	4-month	0.95	2-month	0.95	< 2 Month	0.95	< 2 Month	2.04	2-month
8/25/08 12:20	8/25/08 20:45	8.42	0.5	0.65	0.10	9-month	0.16	1-year	0.38	2-year	0.53	2-year	0.64	4-month	0.65	< 2 Month	1.00	2-month	1.60	4-month	1.60	3-month	2.54	4-month
9/20/08 6:40	9/21/08 0:45	18.08	24.2	0.47	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.31	< 2 Month	0.45	< 2 Month	0.47	< 2 Month	0.47	< 2 Month	0.47	< 2 Month	0.47	< 2 Month
10/3/08 6:20	10/4/08 13:20	31.00	0.5	0.72	0.06	2-month	0.08	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.30	< 2 Month	0.47	< 2 Month	0.63	< 2 Month	0.73	< 2 Month	0.75	< 2 Month	0.75	< 2 Month
10/6/08 8:10	10/6/08 23:10	15.00	0.4	0.31	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.26	< 2 Month	0.30	< 2 Month	0.31	< 2 Month	0.33	< 2 Month	0.77	< 2 Month	1.08	< 2 Month
10/13/08 18:50	10/14/08 1:25	6.58	2.4	0.40	0.12	1-year	0.22	2-year	0.28	1-year	0.30	6-month	0.39	< 2 Month	0.40	< 2 Month	0.40	< 2 Month	0.40	< 2 Month	0.41	< 2 Month	0.42	< 2 Month
10/31/08 3:30	10/31/08 15:15	11.75	7.8	0.36	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.12	< 2 Month	0.31	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month
11/2/08 5:40	11/3/08 9:55	28.25	0.3	0.65	0.03	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.19	2-month	0.33	< 2 Month	0.39	< 2 Month	0.58	< 2 Month	0.83	< 2 Month	1.14	< 2 Month	1.19	< 2 Month
11/3/08 18:35	11/4/08 8:45	14.17	0.4	0.86	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.60	4-month	0.82	3-month	0.88	2-month	1.32	3-month	1.69	3-month	2.05	2-month
11/6/08 1:35	11/7/08 10:00	32.42	1.7	2.26	0.03	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.24	4-month	0.80	9-month	1.43	1-year	2.01	2-year	2.26	1-year	2.43	9-month	4.22	1-year
11/11/08 0:00	11/12/08 21:35	45.58	1.1	1.02	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.15	< 2 Month	0.41	< 2 Month	0.66	< 2 Month	0.81	< 2 Month	1.02	< 2 Month	1.06	< 2 Month	3.66	1-year
12/12/08 9:05	12/13/08 8:15	23.17	1.9	0.83	0.04	< 2 Month	0.06	< 2 Month	0.11	< 2 Month	0.14	< 2 Month	0.34	< 2 Month	0.54	< 2 Month	0.83	< 2 Month	0.83	< 2 Month	0.84	< 2 Month	1.05	< 2 Month
12/24/08 12:15	12/25/08 16:20	28.08	0.8	1.03	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.21	2-month	0.68	6-month	0.77	2-month	0.89	2-month	1.03	< 2 Month	1.06	< 2 Month	1.45	< 2 Month
12/28/08 14:45	12/28/08 23:25	8.67	0.3	0.31	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.18	< 2 Month	0.28	< 2 Month	0.31	< 2 Month	0.56	< 2 Month	0.64	< 2 Month	0.82	< 2 Month	2.03	2-month
12/31/08 21:55	1/2/09 4:25	30.50	0.8	0.76	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.38	< 2 Month	0.51	< 2 Month	0.62	< 2 Month	0.76	< 2 Month	0.89	< 2 Month	1.90	2-month
1/4/09 16:40	1/5/09 8:25	15.75	1.4	0.91	0.03	< 2 Month	0.06	< 2 Month	0.18	4-month	0.33	9-month	0.82	9-month	0.88	4-month	0.91	2-month	0.92	< 2 Month	0.93	< 2 Month	2.03	2-month
1/6/09 15:25	1/8/09 3:20	35.92	0.4	2.05	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.20	2-month	1.02	1-year	1.44	1-year	1.56	9-month	2.09	9-month	2.96	1-year	3.75	1-year
2/24/09 22:40	2/25/09 16:40	18.00	0.4	0.38	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.38	< 2 Month	0.85	< 2 Month	0.96	< 2 Month	1.02	< 2 Month
2/24/09 22:40	2/25/09 16:40	18.00	0.4	0.38	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.38	< 2 Month	0.85	< 2 Month	0.96	< 2 Month	0.00	< 2 Month
3/1/09 14:25	3/2/09 7:40	17.25	0.3	0.33	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.24	< 2 Month	0.41	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	1.44	< 2 Month
3/14/09 6:05	3/14/09 20:55	14.83	4.3	0.49	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.32	< 2 Month	0.37	< 2 Month	0.49	< 2 Month	0.49	< 2 Month	0.49	< 2 Month	0.63	< 2 Month
3/15/09 5:50	3/17/09 9:55	52.08	0.4	0.77	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.34	< 2 Month	0.38	< 2 Month	0.53	< 2 Month	1.01	< 2 Month	1.22	< 2 Month	1.26	< 2 Month
4/1/09 7:25	4/2/09 1:45	18.33	0.7	0.41	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.28	< 2 Month	0.33	< 2 Month	0.41	< 2 Month	0.45	< 2 Month	0.45	< 2 Month	0.78	< 2 Month
4/2/09 8:55	4/3/09 6:20	21.42	0.3	0.99	0.03	< 2 Month	0.06	< 2 Month	0.15	2-month	0.29	6-month	0.71	6-month	0.79	3-month	0.99	2-month	1.40	3-month	1.44	2-month	1.77	< 2 Month
4/12/09 3:00	4/12/09 18:15	15.25	0.9	1.04	0.12	1-year	0.16	1-year	0.25	9-month	0.33	9-month	0.62	4-month	0.88	4-month	1.04	3-month	1.05	< 2 Month	1.08	< 2 Month	1.10	< 2 Month
5/2/09 11:35	5/2/09 21:20	9.75	3.4	0.33	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.29	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.45	< 2 Month
5/4/09 15:55	5/5/09 16:15	24.33	0.8	1.32	0.05	< 2 Month	0.09	2-month	0.21	6-month	0.28	6-month	0.68	6-month	0.95	4-month	1.31	6-month	1.44	3-month	1.73	4-month	1.83	< 2 Month
5/5/09 22:55	5/6/09 22:35	23.67	0.3	0.69	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.34	< 2 Month	0.52	< 2 Month	1.03	3-month	1.95	6-month	2.08	6-month	2.46	3-month
5/13/09 14:20	5/14/09 13:25	23.08	2.1	0.82	0.02	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.15	< 2 Month	0.41	< 2 Month	0.56	< 2 Month	0.82	< 2 Month	0.82	< 2 Month	0.83	< 2 Month	1.06	< 2 Month
5/18/09 20:00	5/19/09 4:30	8.50	4.3	0.43	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.16	< 2 Month	0.42	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	1.25	< 2 Month
5/19/09 19:45	5/20/09 0:30	4.75	0.6	0.45	0.08	4-month	0.14	6-month	0.25	9-month	0.35	1-year	0.45	< 2 Month	0.45	< 2 Month	0.72	< 2 Month	0.88	< 2 Month	0.88	< 2 Month	1.70	< 2 Month

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Rain Gage 18: Storms from 1/1/2008 to 5/31/2009
All depths reported.

Storm Definition = 6 hours between measured precip. All depths reported.

Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	Depth and Frequency for Multiple Durations																			
					5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
12/14/07 23:05	12/15/07 20:40	21.58		0.24	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.18	< 2 Month	0.20	< 2 Month	0.24	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
12/16/07 18:00	12/17/07 5:00	11.00	0.9	0.39	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.15	< 2 Month	0.20	< 2 Month	0.39	< 2 Month	0.39	< 2 Month	0.45	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
12/18/07 2:25	12/18/07 18:30	16.08	0.9	0.47	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.28	< 2 Month	0.42	< 2 Month	0.47	< 2 Month	0.83	< 2 Month	0.88	< 2 Month	0.00	< 2 Month
12/19/07 1:05	12/19/07 9:45	8.67	0.3	0.31	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.25	< 2 Month	0.31	< 2 Month	0.63	< 2 Month	0.78	< 2 Month	1.17	< 2 Month	0.00	< 2 Month
12/19/07 16:25	12/19/07 20:40	4.25	0.278	0.28	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.13	< 2 Month	0.28	< 2 Month	0.39	< 2 Month	0.59	< 2 Month	1.06	< 2 Month	1.34	2-month	0.00	< 2 Month
12/20/07 3:15	12/20/07 5:00	1.75	0.274	0.09	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.34	< 2 Month	0.60	< 2 Month	1.10	< 2 Month	1.19	< 2 Month	0.00	< 2 Month
12/20/07 15:05	12/20/07 15:05	0.00	0.420	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.10	< 2 Month	0.38	< 2 Month	0.75	< 2 Month	1.16	< 2 Month	0.00	< 2 Month
12/22/07 4:45	12/22/07 12:15	7.50	1.6	0.35	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.32	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.36	< 2 Month	0.73	< 2 Month	1.94	2-month
12/23/07 7:10	12/23/07 18:05	10.92	0.8	0.37	0.02	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.30	< 2 Month	0.37	< 2 Month	0.37	< 2 Month	0.72	< 2 Month	0.72	< 2 Month	2.26	3-month
12/25/07 12:35	12/25/07 16:50	4.25	1.771	0.15	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.17	< 2 Month	0.52	< 2 Month	1.62	< 2 Month
12/26/07 7:15	12/26/07 7:15	0.00	0.601	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.16	< 2 Month	0.16	< 2 Month	0.52	< 2 Month	1.39	< 2 Month
12/27/07 8:55	12/28/07 2:00	17.08	1.1	0.32	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.23	< 2 Month	0.29	< 2 Month	0.32	< 2 Month	0.33	< 2 Month	0.48	< 2 Month	1.20	< 2 Month
12/28/07 12:30	12/28/07 15:50	3.33	0.438	0.04	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.28	< 2 Month	0.36	< 2 Month	0.49	< 2 Month	1.24	< 2 Month
12/29/07 13:05	12/29/07 16:20	3.25	0.885	0.10	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.32	< 2 Month	0.46	< 2 Month	0.99	< 2 Month
12/30/07 4:40	12/30/07 4:40	0.00	0.514	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.47	< 2 Month	1.00	< 2 Month
1/2/08 2:40	1/2/08 8:00	5.33	2.9	0.36	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.83	< 2 Month
1/2/08 14:05	1/3/08 19:50	29.75	0.3	0.42	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.14	< 2 Month	0.37	< 2 Month	0.53	< 2 Month	0.78	< 2 Month	0.78	< 2 Month	1.10	< 2 Month
1/4/08 4:55	1/4/08 11:35	6.67	0.378	0.06	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.12	< 2 Month	0.24	< 2 Month	0.58	< 2 Month	0.84	< 2 Month	0.99	< 2 Month
1/5/08 1:30	1/5/08 13:15	11.75	0.580	0.19	0.02	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.15	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.38	< 2 Month	0.85	< 2 Month	1.13	< 2 Month
1/6/08 5:00	1/6/08 13:20	8.33	0.656	0.16	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.16	< 2 Month	0.25	< 2 Month	0.35	< 2 Month	0.54	< 2 Month	1.19	< 2 Month
1/6/08 22:25	1/7/08 1:55	3.50	0.378	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.21	< 2 Month	0.39	< 2 Month	0.46	< 2 Month	1.24	< 2 Month
1/8/08 0:55	1/8/08 8:55	8.00	1.0	0.31	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.25	< 2 Month	0.31	< 2 Month	0.31	< 2 Month	0.42	< 2 Month	0.65	< 2 Month	1.55	< 2 Month
1/8/08 16:10	1/8/08 19:40	3.50	0.302	0.07	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.17	< 2 Month	0.38	< 2 Month	0.43	< 2 Month	0.59	< 2 Month	1.62	< 2 Month
1/9/08 21:05	1/10/08 9:45	12.67	1.1	0.47	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.38	< 2 Month	0.46	< 2 Month	0.47	< 2 Month	0.70	< 2 Month	0.85	< 2 Month	1.49	< 2 Month
1/10/08 16:50	1/11/08 5:40	12.83	0.3	0.33	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.26	< 2 Month	0.31	< 2 Month	0.72	< 2 Month	0.80	< 2 Month	1.15	< 2 Month	1.63	< 2 Month
1/12/08 6:05	1/12/08 8:20	2.25	1.017	0.15	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.50	< 2 Month	0.95	< 2 Month	1.67	< 2 Month
1/12/08 14:25	1/12/08 14:25	0.00	0.253	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.16	< 2 Month	0.16	< 2 Month	0.49	< 2 Month	0.96	< 2 Month	1.55	< 2 Month
1/14/08 12:15	1/14/08 16:15	4.00	1.910	0.20	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.36	< 2 Month	1.54	< 2 Month
1/19/08 16:05	1/19/08 18:00	1.92	4.993	0.19	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.14	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.39	< 2 Month
1/20/08 1:45	1/20/08 8:00	6.25	0.323	0.10	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.22	< 2 Month	0.29	< 2 Month	0.29	< 2 Month	0.29	< 2 Month	0.49	< 2 Month
1/26/08 13:25	1/26/08 23:05	9.67	6.226	0.14	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.39	< 2 Month
1/28/08 11:30	1/28/08 11:30	0.00	1.517	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month
1/28/08 21:50	1/29/08 7:40	9.83	0.431	0.15	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.16	< 2 Month	0.16	< 2 Month	0.30	< 2 Month	0.30	< 2 Month
1/30/08 13:40	1/30/08 22:05	8.42	1.250	0.12	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.26	< 2 Month	0.28	< 2 Month	0.42	< 2 Month
1/31/08 9:40	1/31/08 20:45	11.08	0.483	0.17	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.16	< 2 Month	0.17	< 2 Month	0.21	< 2 Month	0.29	< 2 Month	0.44	< 2 Month	0.59	< 2 Month
2/5/08 0:40	2/5/08 15:35	14.92	4.163	0.21	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.12	< 2 Month	0.20	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.50	< 2 Month
2/6/08 14:00	2/7/08 1:40	11.67	0.9	0.35	0.03	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.23	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.55	< 2 Month	0.56	< 2 Month	0.73	< 2 Month
2/8/08 13:55	2/9/08 1:15	11.33	1.5	0.35	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.26	< 2 Month	0.35	< 2 Month	0.35	< 2 Month	0.39	< 2 Month	0.70	< 2 Month	0.91	< 2 Month
2/9/08 22:25	2/10/08 6:15	7.83	0.882	0.23	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.20	< 2 Month	0.23	< 2 Month	0.23	< 2 Month	0.58	< 2 Month	0.58	< 2 Month	1.14	< 2 Month
2/15/08 14:50	2/15/08 18:15	3.42	5.358	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.56	< 2 Month
2/27/08 8:40	2/27/08 9:20	0.67	11.601	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month
2/28/08 13:45	2/28/08 13:45	0.00	1.184	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month
2/29/08 15:25	2/29/08 17:55	2.50	1.069	0.17	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.17	< 2 Month	0.17	< 2 Month	0.17	< 2 Month	0.18	< 2 Month	0.21	< 2 Month	0.21	< 2 Month
3/1/08 2:35	3/1/08 3:05	0.50	0.361	0.07	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.24	< 2 Month	0.24	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.28	< 2 Month
3/1/08 16:35	3/1/08 18:55	2.33	0.563	0.13	0.03	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.12	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.21	< 2 Month	0.37	< 2 Month	0.38	< 2 Month	0.41	< 2 Month
3/2/08 1:10	3/2/08 1:10	0.00	0.260	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.14	< 2 Month	0.21	< 2 Month	0.38	< 2 Month	0.39	< 2 Month	0.42	< 2 Month
3/3/08 8:15	3/3/08 12:00	3.75	1.295	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.19	< 2 Month	0.43	< 2 Month	0.47	< 2 Month
3/7/08 20:20	3/7/08 22:20	2.00	4.347	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.29	< 2 Month
3/10/08 3:10	3/10/08 7:30	4.33	2.201	0.09	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.12	< 2 Month	0.17	< 2 Month
3/10/08 16:05	3/10/08 20:05	4.00	0.358	0.25	0.04	< 2 Month	0.07	< 2 Month	0.14	< 2 Month	0.19	2-month	0.25	< 2 Month	0.25	< 2 Month	0.34	< 2 Month	0.34	< 2 Month	0.36	< 2 Month	0.37	< 2 Month
3/11/08 2:40	3/11/08 6:35	3.92	0.274	0.08	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.28	< 2 Month	0.35	< 2 Month	0.42	< 2 Month	0.42	< 2 Month	0.45	< 2 Month
3/13/08 6:30	3/14/08 16:15	33.75	2.0	0.59	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.25	< 2 Month	0.36	< 2 Month	0.47	< 2 Month	0.59	< 2 Month	0.65	< 2 Month	1.04	< 2 Month

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Rain Gage 18: Storms from 1/1/2008 to 5/31/2009
All depths reported.

Storm Definition = 6 hours between measured precip. All depths reported.					Depth and Frequency for Multiple Durations																			
Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
3/15/08 5:05	3/15/08 6:40	1.58	0.535	0.13	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.25	< 2 Month	0.71	< 2 Month	0.72	< 2 Month	1.14	< 2 Month
3/15/08 15:10	3/15/08 15:10	0.00	0.354	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.14	< 2 Month	0.15	< 2 Month	0.48	< 2 Month	0.73	< 2 Month	1.15	< 2 Month
3/16/08 3:35	3/16/08 5:30	1.92	0.517	0.06	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.18	< 2 Month	0.32	< 2 Month	0.79	< 2 Month	1.21	< 2 Month
3/16/08 18:15	3/16/08 21:45	3.50	0.531	0.13	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.19	< 2 Month	0.33	< 2 Month	0.56	< 2 Month	1.34	< 2 Month
3/19/08 18:20	3/19/08 21:15	2.92	2.858	0.08	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.08	< 2 Month	0.08	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	1.00	< 2 Month
3/20/08 17:00	3/20/08 21:55	4.92	0.823	0.13	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.77	< 2 Month
3/23/08 4:55	3/23/08 15:10	10.25	2.3	0.75	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.19	2-month	0.46	< 2 Month	0.75	2-month	0.75	< 2 Month	0.75	< 2 Month	0.88	< 2 Month	1.09	< 2 Month
3/25/08 14:25	3/26/08 6:15	15.83	2.0	0.31	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.20	< 2 Month	0.27	< 2 Month	0.31	< 2 Month	0.31	< 2 Month	0.94	< 2 Month	1.27	< 2 Month
3/26/08 19:30	3/26/08 21:20	1.83	0.552	0.15	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.40	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	1.34	< 2 Month
3/27/08 4:20	3/27/08 4:20	0.00	0.292	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.16	< 2 Month	0.28	< 2 Month	0.47	< 2 Month	0.47	< 2 Month	1.35	< 2 Month
3/28/08 8:50	3/28/08 14:10	5.33	1.188	0.27	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.27	< 2 Month	0.27	< 2 Month	0.27	< 2 Month	0.43	< 2 Month	0.74	< 2 Month	1.49	< 2 Month
3/28/08 20:25	3/29/08 0:30	4.08	0.260	0.21	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.21	< 2 Month	0.40	< 2 Month	0.48	< 2 Month	0.49	< 2 Month	0.84	< 2 Month	1.70	< 2 Month
3/29/08 7:00	3/29/08 7:20	0.33	0.271	0.02	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.23	< 2 Month	0.50	< 2 Month	0.50	< 2 Month	0.66	< 2 Month	1.72	< 2 Month
3/29/08 15:50	3/30/08 3:00	11.17	0.4	0.50	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.14	< 2 Month	0.41	< 2 Month	0.50	< 2 Month	0.63	< 2 Month	1.00	< 2 Month	1.01	< 2 Month	2.22	3-month
3/31/08 17:40	3/31/08 22:10	4.50	1.611	0.05	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.45	< 2 Month	0.77	< 2 Month	1.52	< 2 Month
4/4/08 8:35	4/4/08 12:05	3.50	3.434	0.05	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	1.07	< 2 Month
4/4/08 20:05	4/4/08 22:10	2.08	0.333	0.04	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.86	< 2 Month
4/5/08 21:05	4/6/08 4:00	6.92	0.955	0.09	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.24	< 2 Month
4/8/08 7:45	4/8/08 9:50	2.08	2.156	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.12	< 2 Month	0.22	< 2 Month
4/8/08 17:10	4/8/08 19:10	2.00	0.306	0.11	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.11	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.23	< 2 Month	0.33	< 2 Month
4/9/08 20:15	4/9/08 20:15	0.00	1.045	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.34	< 2 Month
4/13/08 18:25	4/13/08 20:15	1.83	3.924	0.09	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.24	< 2 Month
4/14/08 14:20	4/14/08 22:20	8.00	0.8	0.30	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.29	< 2 Month	0.30	< 2 Month	0.32	< 2 Month	0.39	< 2 Month	0.39	< 2 Month	0.54	< 2 Month
4/15/08 8:05	4/15/08 8:50	0.75	0.406	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.33	< 2 Month	0.42	< 2 Month	0.42	< 2 Month	0.55	< 2 Month
4/15/08 16:55	4/15/08 20:55	4.00	0.337	0.05	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.19	< 2 Month	0.44	< 2 Month	0.47	< 2 Month	0.55	< 2 Month
4/17/08 18:25	4/17/08 18:45	0.33	1.896	0.02	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.16	< 2 Month	0.49	< 2 Month
4/18/08 15:50	4/18/08 20:05	4.25	0.878	0.06	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.08	< 2 Month	0.11	< 2 Month	0.55	< 2 Month
4/19/08 10:35	4/19/08 16:20	5.75	0.604	0.09	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.17	< 2 Month	0.17	< 2 Month	0.64	< 2 Month
4/20/08 5:00	4/20/08 6:10	1.17	0.528	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.12	< 2 Month	0.18	< 2 Month	0.20	< 2 Month	0.67	< 2 Month
4/21/08 0:50	4/21/08 0:55	0.08	0.778	0.02	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.14	< 2 Month	0.20	< 2 Month	0.60	< 2 Month
4/21/08 18:50	4/21/08 19:10	0.33	0.747	0.03	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.19	< 2 Month	0.36	< 2 Month
4/23/08 2:30	4/23/08 4:30	2.00	1.306	0.10	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.08	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.13	< 2 Month	0.18	< 2 Month	0.35	< 2 Month
4/27/08 17:15	4/27/08 20:15	3.00	4.531	0.04	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.19	< 2 Month
4/28/08 3:15	4/28/08 9:00	5.75	0.292	0.25	0.03	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.10	< 2 Month	0.25	< 2 Month	0.25	< 2 Month	0.29	< 2 Month	0.29	< 2 Month	0.29	< 2 Month	0.42	< 2 Month
4/28/08 21:40	4/28/08 21:40	0.00	0.528	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.26	< 2 Month	0.30	< 2 Month	0.30	< 2 Month	0.40	< 2 Month
4/29/08 4:00	4/29/08 4:00	0.00	0.264	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.25	< 2 Month	0.31	< 2 Month	0.31	< 2 Month	0.41	< 2 Month
4/29/08 22:10	4/29/08 23:30	1.33	0.757	0.19	0.03	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.16	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.20	< 2 Month	0.46	< 2 Month	0.50	< 2 Month	0.60	< 2 Month
4/30/08 23:30	5/1/08 3:05	3.58	1.000	0.07	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.27	< 2 Month	0.53	< 2 Month	0.57	< 2 Month
5/3/08 13:40	5/3/08 13:40	0.00	2.441	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.08	< 2 Month	0.58	< 2 Month
5/11/08 11:50	5/11/08 12:30	0.67	7.924	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month
5/11/08 19:55	5/11/08 20:00	0.08	0.309	0.02	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month
5/13/08 9:35	5/13/08 13:55	4.33	1.566	0.21	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.23	< 2 Month	0.26	< 2 Month	0.26	< 2 Month
5/19/08 23:30	5/20/08 9:45	10.25	6.4	0.36	0.03	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.25	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.56	< 2 Month
5/21/08 5:15	5/21/08 5:15	0.00	0.813	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.25	< 2 Month	0.37	< 2 Month	0.37	< 2 Month	0.37	< 2 Month
5/21/08 18:20	5/21/08 20:00	1.67	0.5	0.44	0.06	2-month	0.12	4-month	0.22	6-month	0.31	6-month	0.44	< 2 Month	0.44	< 2 Month	0.45	< 2 Month	0.81	< 2 Month	0.81	< 2 Month	0.81	< 2 Month
5/23/08 8:40	5/23/08 8:45	0.08	1.528	0.02	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.46	< 2 Month	0.54	< 2 Month	0.83	< 2 Month
5/23/08 19:50	5/23/08 19:50	0.00	0.462	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.48	< 2 Month	0.84	< 2 Month
5/25/08 0:15	5/25/08 5:35	5.33	1.184	0.14	0.03	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.17	< 2 Month	0.17	< 2 Month	0.98	< 2 Month
5/31/08 14:15	5/31/08 16:45	2.50	6.361	0.04	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month
6/2/08 22:50	6/3/08 12:30	13.67	2.3	0.62	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.15	< 2 Month	0.48	2-month	0.59	< 2 Month	0.62	< 2 Month	0.62	< 2 Month	0.66	< 2 Month	0.66	< 2 Month
6/3/08 20:00	6/4/08 9:50	13.83	0.313	0.22	0.03	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.10	< 2 Month	0.15	< 2 Month	0.24	< 2 Month	0.76	< 2 Month	0.84	< 2 Month	0.84	< 2 Month	0.88	< 2 Month
6/5/08 10:00	6/5/08 17:05	7.08	1.007	0.12	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.38	< 2 Month	0.96	< 2 Month	1.00	< 2 Month
6/6/08 5:00	6/6/08 19:00	14.00	0.5	0.48	0.05	< 2 Month	0.09	2-month	0.21	6-month	0.33	9-month	0.41	< 2 Month	0.47	< 2 Month	0.48	< 2 Month	0.60	< 2 Month	0.88	< 2 Month	1.48	< 2 Month
6/9/08 7:25	6/9/08 16:20	8.92	2.517	0.15	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.52	< 2 Month	1.59	< 2 Month
6/10/08 8:25	6/10/08 9:40	1.25	0.670	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.15	< 2 Month	0.17	< 2 Month	0.17	< 2 Month	1.16	< 2 Month
7/3/08 5:35	7/3/08 11:30	5.92	22.8	0.46	0.04	< 2 Month	0.07	< 2 Month	0.15	2-month	0.16	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month	0.46	< 2 Month

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Rain Gage 18: Storms from 1/1/2008 to 5/31/2009
All depths reported.

Storm Definition = 6 hours between measured precip. All depths reported.					Depth and Frequency for Multiple Durations																			
Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
7/29/08 14:50	7/29/08 21:05	6.25	26.139	0.05	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.00	< 2 Month
7/31/08 17:45	8/1/08 6:05	12.33	1.861	0.28	0.03	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.17	< 2 Month	0.27	< 2 Month	0.28	< 2 Month	0.28	< 2 Month	0.33	< 2 Month	0.33	< 2 Month
8/9/08 5:10	8/9/08 7:35	2.42	7.962	0.09	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month
8/9/08 16:10	8/9/08 18:30	2.33	0.358	0.18	0.06	2-month	0.08	< 2 Month	0.13	< 2 Month	0.15	< 2 Month	0.18	< 2 Month	0.21	< 2 Month	0.27	< 2 Month	0.27	< 2 Month	0.27	< 2 Month	0.27	< 2 Month
8/18/08 9:35	8/18/08 16:30	6.92	8.628	0.15	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.12	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month
8/19/08 20:45	8/20/08 7:30	10.75	1.2	0.66	0.02	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.16	< 2 Month	0.52	2-month	0.66	< 2 Month	0.66	< 2 Month	0.81	< 2 Month	0.81	< 2 Month	0.81	< 2 Month
8/20/08 13:55	8/20/08 18:05	4.17	0.267	0.28	0.03	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.11	< 2 Month	0.28	< 2 Month	0.35	< 2 Month	0.94	2-month	0.94	< 2 Month	1.09	< 2 Month	1.09	< 2 Month
8/24/08 12:50	8/24/08 23:35	10.75	3.8	0.95	0.04	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.22	3-month	0.64	4-month	0.95	4-month	0.95	2-month	0.95	< 2 Month	0.95	< 2 Month	2.04	2-month
8/25/08 12:20	8/25/08 20:45	8.42	0.5	0.65	0.10	9-month	0.16	1-year	0.38	2-year	0.53	2-year	0.64	4-month	0.65	< 2 Month	1.00	2-month	1.60	4-month	1.60	3-month	2.54	4-month
8/26/08 20:55	8/27/08 2:05	5.17	1.007	0.25	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.13	< 2 Month	0.25	< 2 Month	0.25	< 2 Month	0.25	< 2 Month	0.95	< 2 Month	1.85	4-month	2.54	4-month
9/20/08 6:40	9/21/08 0:45	18.08	24.2	0.47	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.31	< 2 Month	0.45	< 2 Month	0.47	< 2 Month	0.47	< 2 Month	0.47	< 2 Month	0.47	< 2 Month
9/21/08 21:05	9/21/08 21:05	0.00	0.847	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.48	< 2 Month	0.48	< 2 Month	0.48	< 2 Month
9/22/08 6:30	9/22/08 6:30	0.00	0.392	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.49	< 2 Month	0.49	< 2 Month	0.49	< 2 Month
9/24/08 13:05	9/24/08 17:25	4.33	2.274	0.09	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.58	< 2 Month
9/25/08 0:30	9/25/08 1:45	1.25	0.295	0.16	0.03	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.15	< 2 Month	0.16	< 2 Month	0.24	< 2 Month	0.25	< 2 Month	0.25	< 2 Month	0.26	< 2 Month	0.74	< 2 Month
10/2/08 10:35	10/2/08 10:50	0.25	7.368	0.02	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month
10/2/08 18:45	10/2/08 18:45	0.00	0.330	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month
10/3/08 6:20	10/4/08 13:20	31.00	0.5	0.72	0.06	2-month	0.08	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.30	< 2 Month	0.47	< 2 Month	0.63	< 2 Month	0.73	< 2 Month	0.75	< 2 Month	0.75	< 2 Month
10/5/08 12:00	10/5/08 12:00	0.00	0.944	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.11	< 2 Month	0.69	< 2 Month	0.74	< 2 Month	0.76	< 2 Month
10/5/08 21:45	10/5/08 21:45	0.00	0.406	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.34	< 2 Month	0.74	< 2 Month	0.77	< 2 Month
10/6/08 8:10	10/6/08 23:10	15.00	0.4	0.31	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.26	< 2 Month	0.30	< 2 Month	0.31	< 2 Month	0.33	< 2 Month	0.77	< 2 Month	1.08	< 2 Month
10/11/08 9:10	10/11/08 9:10	0.00	4.417	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.49	< 2 Month
10/13/08 18:50	10/14/08 1:25	6.58	2.4	0.40	0.12	1-year	0.22	2-year	0.28	1-year	0.30	6-month	0.39	< 2 Month	0.40	< 2 Month	0.40	< 2 Month	0.40	< 2 Month	0.41	< 2 Month	0.42	< 2 Month
10/15/08 19:30	10/16/08 4:35	9.08	1.753	0.12	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.13	< 2 Month	0.52	< 2 Month	0.53	< 2 Month
10/17/08 21:10	10/17/08 22:55	1.75	1.691	0.07	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.19	< 2 Month	0.60	< 2 Month
10/20/08 7:50	10/20/08 16:20	8.50	2.372	0.14	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.21	< 2 Month	0.73	< 2 Month
10/23/08 4:15	10/23/08 8:05	3.83	2.497	0.09	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.22	< 2 Month	0.30	< 2 Month
10/31/08 3:30	10/31/08 15:15	11.75	7.8	0.36	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.12	< 2 Month	0.31	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month	0.36	< 2 Month
11/1/08 13:45	11/1/08 23:05	9.33	0.938	0.18	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.13	< 2 Month	0.17	< 2 Month	0.18	< 2 Month	0.18	< 2 Month	0.54	< 2 Month	0.54	< 2 Month	0.54	< 2 Month
11/2/08 5:40	11/3/08 9:55	28.25	0.3	0.65	0.03	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.19	2-month	0.33	< 2 Month	0.39	< 2 Month	0.58	< 2 Month	0.83	< 2 Month	1.14	< 2 Month	1.19	< 2 Month
11/3/08 18:35	11/4/08 8:45	14.17	0.4	0.86	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.60	4-month	0.82	3-month	0.88	2-month	1.32	3-month	1.69	3-month	2.05	2-month
11/6/08 1:35	11/7/08 10:00	32.42	1.7	2.26	0.03	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.24	4-month	0.80	9-month	1.43	1-year	2.01	2-year	2.26	1-year	2.43	9-month	4.22	1-year
11/7/08 19:55	11/8/08 11:50	15.92	0.413	0.29	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.12	< 2 Month	0.17	< 2 Month	0.25	< 2 Month	1.30	6-month	2.36	1-year	2.55	1-year	4.24	1-year
11/9/08 2:15	11/9/08 8:25	6.17	0.601	0.04	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.20	< 2 Month	0.77	< 2 Month	2.54	1-year	4.09	1-year
11/9/08 19:05	11/9/08 21:55	2.83	0.444	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.35	< 2 Month	1.69	3-month	3.74	1-year
11/11/08 0:00	11/12/08 21:35	45.58	1.1	1.02	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.15	< 2 Month	0.41	< 2 Month	0.66	< 2 Month	0.81	< 2 Month	1.02	< 2 Month	1.06	< 2 Month	3.66	1-year
11/13/08 6:40	11/13/08 7:55	1.25	0.378	0.08	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.09	< 2 Month	0.22	< 2 Month	0.95	< 2 Month	1.10	< 2 Month	3.54	9-month
11/18/08 5:45	11/18/08 7:20	1.58	4.910	0.04	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.99	< 2 Month
11/20/08 8:35	11/20/08 15:10	6.58	2.052	0.26	0.02	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.13	< 2 Month	0.24	< 2 Month	0.26	< 2 Month	0.26	< 2 Month	0.26	< 2 Month	0.30	< 2 Month	0.30	< 2 Month
11/21/08 19:00	11/21/08 20:25	1.42	1.160	0.15	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.11	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.41	< 2 Month	0.41	< 2 Month	0.45	< 2 Month
11/23/08 9:10	11/23/08 9:10	0.00	1.531	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.16	< 2 Month	0.36	< 2 Month	0.46	< 2 Month
11/24/08 9:00	11/24/08 9:00	0.00	0.993	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.17	< 2 Month	0.47	< 2 Month
11/25/08 12:05	11/25/08 18:10	6.08	1.128	0.08	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.08	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.51	< 2 Month
11/26/08 8:05	11/26/08 8:05	0.00	0.580	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.11	< 2 Month	0.52	< 2 Month
11/28/08 9:35	11/28/08 13:20	3.75	2.063	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.13	< 2 Month	0.31	< 2 Month
11/30/08 2:35	11/30/08 6:00	3.42	1.552	0.04	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.20	< 2 Month
12/1/08 15:40	12/1/08 21:35	5.92	1.403	0.16	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.16	< 2 Month	0.16	< 2 Month	0.16	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.34	< 2 Month
12/2/08 16:40	12/2/08 16:40	0.00	0.795	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.14	< 2 Month	0.17	< 2 Month	0.21	< 2 Month	0.30	< 2 Month
12/7/08 5:35	12/7/08 5:35	0.00	4.538	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.19	< 2 Month
12/7/08 14:40	12/7/08 14:40	0.00	0.378	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.19	< 2 Month
12/7/08 23:35	12/8/08 3:50	4.25	0.372	0.07	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.26	< 2 Month
12/9/08 9:35	12/9/08 15:15	5.67	1.240	0.12	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.19	< 2 Month	0.21	< 2 Month	0.22	< 2 Month
12/10/08 12:00	12/10/08 12:00	0.00	0.865	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.06	< 2 Month	0.13	< 2 Month	0.21	< 2 Month	0.22	< 2 Month
12/12/08 9:05	12/13/08 8:15	23.17	1.9	0.83	0.04	< 2 Month	0.06	< 2 Month	0.11	< 2 Month	0.14	< 2 Month	0.34	< 2 Month	0.54	< 2 Month	0.83	< 2 Month	0.83	< 2 Month	0.84	< 2 Month	1.05	< 2 Month
12/14/08 12:35	12/14/08 14:15	1.67	1.181	0.05	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.58	< 2 Month	0.88	< 2 Month	1.09	< 2 Month
12/17/08 15:45	12/17/08 15:45	0.00	3.063	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.89	< 2 Month

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Rain Gage 18: Storms from 1/1/2008 to 5/31/2009
All depths reported.

Storm Definition = 6 hours between measured precip. All depths reported.					Depth and Frequency for Multiple Durations																			
Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
12/18/08 5:35	12/18/08 5:40	0.08	0.576	0.03	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.92	< 2 Month
12/19/08 11:55	12/19/08 14:50	2.92	1.260	0.24	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.12	< 2 Month	0.24	< 2 Month	0.24	< 2 Month	0.24	< 2 Month	0.28	< 2 Month	0.28	< 2 Month	0.82	< 2 Month
12/22/08 12:10	12/22/08 15:45	3.58	2.889	0.15	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.15	< 2 Month	0.22	< 2 Month	0.43	< 2 Month
12/23/08 11:15	12/23/08 16:05	4.83	0.813	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.16	< 2 Month	0.18	< 2 Month	0.18	< 2 Month	0.46	< 2 Month
12/24/08 12:15	12/25/08 16:20	28.08	0.8	1.03	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.21	2-month	0.68	6-month	0.77	2-month	0.89	2-month	1.03	< 2 Month	1.06	< 2 Month	1.45	< 2 Month
12/25/08 23:45	12/26/08 0:00	0.25	0.309	0.04	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.19	< 2 Month	0.30	< 2 Month	1.07	< 2 Month	1.10	< 2 Month	1.49	< 2 Month
12/26/08 12:25	12/26/08 15:45	3.33	0.517	0.14	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.20	< 2 Month	1.05	< 2 Month	1.22	< 2 Month	1.44	< 2 Month
12/27/08 2:05	12/27/08 7:15	5.17	0.431	0.05	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.19	< 2 Month	0.41	< 2 Month	1.26	< 2 Month	1.44	< 2 Month
12/27/08 22:35	12/28/08 6:40	8.08	0.639	0.28	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.24	< 2 Month	0.28	< 2 Month	0.29	< 2 Month	0.47	< 2 Month	0.69	< 2 Month	1.72	< 2 Month
12/28/08 14:45	12/28/08 23:25	8.67	0.3	0.31	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.18	< 2 Month	0.28	< 2 Month	0.31	< 2 Month	0.56	< 2 Month	0.64	< 2 Month	0.82	< 2 Month	2.03	2-month
12/29/08 7:25	12/29/08 11:05	3.67	0.333	0.23	0.03	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.13	< 2 Month	0.23	< 2 Month	0.25	< 2 Month	0.54	< 2 Month	0.82	< 2 Month	1.01	< 2 Month	2.26	3-month
12/30/08 20:15	12/31/08 2:00	5.75	1.382	0.13	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.36	< 2 Month	0.89	< 2 Month	2.21	3-month
12/31/08 21:55	1/2/09 4:25	30.50	0.8	0.76	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.13	< 2 Month	0.38	< 2 Month	0.51	< 2 Month	0.62	< 2 Month	0.76	< 2 Month	0.89	< 2 Month	1.90	2-month
1/3/09 7:50	1/3/09 8:00	0.17	1.142	0.02	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.29	< 2 Month	0.78	< 2 Month	1.73	< 2 Month
1/4/09 16:40	1/5/09 8:25	15.75	1.4	0.91	0.03	< 2 Month	0.06	< 2 Month	0.18	4-month	0.33	9-month	0.82	9-month	0.88	4-month	0.91	2-month	0.92	< 2 Month	0.93	< 2 Month	2.03	2-month
1/5/09 15:10	1/5/09 15:10	0.00	0.281	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.56	< 2 Month	0.92	2-month	0.92	< 2 Month	0.94	< 2 Month	1.83	< 2 Month
1/6/09 0:05	1/6/09 6:45	6.67	0.372	0.10	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.88	2-month	1.02	< 2 Month	1.04	< 2 Month	1.93	2-month
1/6/09 15:25	1/8/09 3:20	35.92	0.4	2.05	0.03	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.20	2-month	1.02	1-year	1.44	1-year	1.56	9-month	2.09	9-month	2.96	1-year	3.75	1-year
1/8/09 16:05	1/8/09 16:50	0.75	0.531	0.07	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	1.35	6-month	2.07	9-month	2.22	6-month	3.33	9-month
1/10/09 7:50	1/10/09 8:25	0.58	1.625	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.09	< 2 Month	1.60	3-month	3.16	6-month
1/10/09 16:55	1/11/09 5:55	13.00	0.354	0.17	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.16	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	1.31	2-month	3.33	9-month
1/12/09 0:30	1/12/09 1:25	0.92	0.774	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	3.28	6-month
1/12/09 12:35	1/12/09 20:05	7.50	0.465	0.04	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.22	< 2 Month	0.25	< 2 Month	2.47	3-month
1/18/09 9:10	1/18/09 9:10	0.00	5.545	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.07	< 2 Month
1/19/09 5:15	1/19/09 5:15	0.00	0.837	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.06	< 2 Month
1/20/09 0:05	1/20/09 0:05	0.00	0.785	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month
1/20/09 8:10	1/20/09 8:10	0.00	0.337	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month
1/24/09 21:00	1/25/09 5:00	8.00	4.535	0.09	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.08	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.13	< 2 Month
1/27/09 10:50	1/27/09 17:15	6.42	2.243	0.07	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.16	< 2 Month	0.16	< 2 Month
1/30/09 20:55	1/30/09 22:05	1.17	3.153	0.07	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.23	< 2 Month
2/5/09 10:15	2/5/09 10:15	0.00	5.507	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.08	< 2 Month
2/5/09 22:45	2/5/09 22:45	0.00	0.521	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.09	< 2 Month
2/6/09 5:55	2/6/09 14:25	8.50	0.299	0.07	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.09	< 2 Month	0.09	< 2 Month	0.16	< 2 Month
2/8/09 19:40	2/9/09 9:25	13.75	2.219	0.27	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.22	< 2 Month	0.24	< 2 Month	0.27	< 2 Month	0.27	< 2 Month	0.31	< 2 Month	0.36	< 2 Month
2/9/09 20:10	2/9/09 22:50	2.67	0.448	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.14	< 2 Month	0.27	< 2 Month	0.30	< 2 Month	0.30	< 2 Month	0.39	< 2 Month
2/10/09 9:40	2/10/09 20:15	10.58	0.451	0.28	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.30	< 2 Month	0.57	< 2 Month	0.58	< 2 Month	0.67	< 2 Month
2/15/09 17:35	2/15/09 18:50	1.25	4.889	0.03	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.61	< 2 Month
2/16/09 5:50	2/16/09 5:50	0.00	0.458	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.50	< 2 Month
2/21/09 8:15	2/21/09 8:15	0.00	5.101	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.05	< 2 Month
2/22/09 5:20	2/22/09 9:25	4.08	0.878	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.10	< 2 Month
2/22/09 18:15	2/23/09 4:30	10.25	0.368	0.08	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.13	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.15	< 2 Month
2/23/09 14:35	2/23/09 16:20	1.75	0.420	0.22	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.17	< 2 Month	0.22	< 2 Month	0.23	< 2 Month	0.30	< 2 Month	0.35	< 2 Month	0.36	< 2 Month	0.36	< 2 Month
2/23/09 23:20	2/24/09 12:10	12.83	0.292	0.28	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.21	< 2 Month	0.26	< 2 Month	0.50	< 2 Month	0.58	< 2 Month	0.63	< 2 Month	0.64	< 2 Month
2/24/09 22:40	2/25/09 16:40	18.00	0.4	0.38	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.38	< 2 Month	0.85	< 2 Month	0.96	< 2 Month	1.02	< 2 Month
2/26/09 9:50	2/26/09 13:05	3.25	0.715	0.13	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.11	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.34	< 2 Month	0.59	< 2 Month	1.01	< 2 Month	1.15	< 2 Month
2/22/09 5:55	2/22/09 9:25	3.50	-4.299	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
2/22/09 18:15	2/23/09 4:30	10.25	0.368	0.08	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.13	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
2/23/09 14:35	2/23/09 16:20	1.75	0.420	0.22	0.02	< 2 Month	0.04	< 2 Month	0.11	< 2 Month	0.17	< 2 Month	0.22	< 2 Month	0.23	< 2 Month	0.30	< 2 Month	0.00	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
2/23/09 23:20	2/24/09 12:10	12.83	0.292	0.28	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.10	< 2 Month	0.21	< 2 Month	0.26	< 2 Month	0.50	< 2 Month	0.58	< 2 Month	0.00	< 2 Month	0.00	< 2 Month
2/24/09 22:40	2/25/09 16:40	18.00	0.4	0.38	0.02	< 2 Month	0.04	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.25	< 2 Month	0.28	< 2 Month	0.38	< 2 Month	0.85	< 2 Month	0.96	< 2 Month	0.00	< 2 Month
2/26/09 9:50	2/26/09 13:05	3.25	0.715	0.13	0.01	< 2 Month	0.02	< 2 Month	0.06	< 2 Month	0.11	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.34	< 2 Month	0.59	< 2 Month	1.01	< 2 Month	0.00	< 2 Month
3/1/09 1:15	3/1/09 8:00	6.75	2.507	0.10	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.09	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.10	< 2 Month	0.23	< 2 Month	1.21	< 2 Month
3/1/09 14:25	3/2/09 7:40	17.25	0.3	0.33	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.24	< 2 Month	0.41	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	1.44	< 2 Month
3/2/09 18:05	3/2/09 18:15	0.17	0.434	0.07	0.04	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.07	< 2 Month	0.08	< 2 Month	0.28	< 2 Month	0.50	< 2 Month	0.50	< 2 Month	1.29	< 2 Month
3/3/09 4:15	3/3/09 8:05	3.83	0.417	0.11	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.08	< 2 Month	0.11	< 2 Month	0.17	< 2 Month	0.18	< 2 Month	0.57	< 2 Month	0.61	< 2 Month	1.32	< 2 Month
3/3/09 18:00	3/3/09 19:10	1.17	0.413	0.16	0.03	< 2 Month	0.05	< 2 Month	0.12	< 2 Month	0.15	< 2 Month	0.16	< 2 Month	0.17	< 2 Month	0.27	< 2 Month	0.55	< 2 Month	0.77	< 2 Month	1.28	< 2 Month

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Rain Gage 18: Storms from 1/1/2008 to 5/31/2009
All depths reported.

Storm Definition = 6 hours between measured precip. All depths reported.					Depth and Frequency for Multiple Durations																			
Storm Date/Time Range		Storm Duration (hours)	Antecedent Dry Period (days)	Total Storm Depth (inches)	5 min		10 min		30 min		1 hr		6 hr		12 hr		24 hr		48 hr		96 hr		168 hr	
Begin	End				Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency	Max Depth	Frequency
3/4/09 4:15	3/4/09 4:15	0.00	0.378	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.17	< 2 Month	0.27	< 2 Month	0.40	< 2 Month	0.77	< 2 Month	1.19	< 2 Month
3/5/09 7:00	3/5/09 11:55	4.92	1.115	0.22	0.03	< 2 Month	0.05	< 2 Month	0.09	< 2 Month	0.11	< 2 Month	0.22	< 2 Month	0.22	< 2 Month	0.22	< 2 Month	0.39	< 2 Month	0.57	< 2 Month	1.07	< 2 Month
3/7/09 7:45	3/7/09 11:05	3.33	1.826	0.20	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.26	< 2 Month	0.42	< 2 Month	1.20	< 2 Month
3/8/09 7:20	3/8/09 12:05	4.75	0.844	0.03	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.21	< 2 Month	0.23	< 2 Month	0.39	< 2 Month	1.13	< 2 Month
3/8/09 19:45	3/9/09 13:20	17.58	0.319	0.10	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.08	< 2 Month	0.11	< 2 Month	0.30	< 2 Month	0.33	< 2 Month	1.02	< 2 Month
3/9/09 23:45	3/9/09 23:45	0.00	0.434	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.34	< 2 Month	0.84	< 2 Month
3/14/09 6:05	3/14/09 20:55	14.83	4.3	0.49	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.32	< 2 Month	0.37	< 2 Month	0.49	< 2 Month	0.49	< 2 Month	0.49	< 2 Month	0.63	< 2 Month
3/15/09 5:50	3/17/09 9:55	52.08	0.4	0.77	0.02	< 2 Month	0.03	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.34	< 2 Month	0.38	< 2 Month	0.53	< 2 Month	1.01	< 2 Month	1.22	< 2 Month	1.26	< 2 Month
3/17/09 16:15	3/17/09 16:15	0.00	0.264	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.09	< 2 Month	0.19	< 2 Month	0.41	< 2 Month	0.93	< 2 Month	1.27	< 2 Month
3/19/09 1:10	3/19/09 10:40	9.50	1.372	0.05	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.15	< 2 Month	0.33	< 2 Month	1.32	< 2 Month
3/20/09 2:25	3/20/09 15:15	12.83	0.656	0.20	0.07	3-month	0.09	2-month	0.11	< 2 Month	0.11	< 2 Month	0.16	< 2 Month	0.17	< 2 Month	0.20	< 2 Month	0.25	< 2 Month	0.26	< 2 Month	1.52	< 2 Month
3/22/09 9:05	3/22/09 9:05	0.00	1.743	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.17	< 2 Month	0.23	< 2 Month	0.84	< 2 Month
3/23/09 18:20	3/23/09 18:50	0.50	1.385	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.43	< 2 Month
3/24/09 1:25	3/24/09 1:25	0.00	0.274	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.43	< 2 Month
3/25/09 1:15	3/25/09 11:30	10.25	0.993	0.26	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.21	< 2 Month	0.26	< 2 Month	0.26	< 2 Month	0.29	< 2 Month	0.29	< 2 Month	0.55	< 2 Month
3/28/09 8:20	3/28/09 18:55	10.58	2.868	0.28	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.06	< 2 Month	0.16	< 2 Month	0.28	< 2 Month	0.28	< 2 Month	0.28	< 2 Month	0.28	< 2 Month	0.58	< 2 Month
3/29/09 4:05	3/29/09 4:50	0.75	0.382	0.05	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.10	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.63	< 2 Month
3/31/09 9:40	3/31/09 15:30	5.83	2.201	0.04	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.29	< 2 Month	0.63	< 2 Month
4/1/09 7:25	4/2/09 1:45	18.33	0.7	0.41	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.07	< 2 Month	0.28	< 2 Month	0.33	< 2 Month	0.41	< 2 Month	0.45	< 2 Month	0.45	< 2 Month	0.78	< 2 Month
4/2/09 8:55	4/3/09 6:20	21.42	0.3	0.99	0.03	< 2 Month	0.06	< 2 Month	0.15	2-month	0.29	6-month	0.71	6-month	0.79	3-month	0.99	2-month	1.40	3-month	1.44	2-month	1.77	< 2 Month
4/4/09 7:55	4/4/09 7:55	0.00	1.066	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	1.00	< 2 Month	1.38	2-month	1.78	< 2 Month
4/9/09 4:35	4/9/09 7:55	3.33	4.861	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	1.02	< 2 Month
4/10/09 3:40	4/10/09 7:15	3.58	0.823	0.02	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.14	< 2 Month
4/10/09 16:00	4/10/09 16:00	0.00	0.365	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.06	< 2 Month
4/11/09 6:15	4/11/09 6:15	0.00	0.594	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.07	< 2 Month
4/12/09 3:00	4/12/09 18:15	15.25	0.9	1.04	0.12	1-year	0.16	1-year	0.25	9-month	0.33	9-month	0.62	4-month	0.88	4-month	1.04	3-month	1.05	< 2 Month	1.08	< 2 Month	1.10	< 2 Month
4/13/09 15:35	4/13/09 20:10	4.58	0.889	0.13	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.13	< 2 Month	0.13	< 2 Month	0.46	< 2 Month	1.17	2-month	1.18	< 2 Month	1.23	< 2 Month
4/14/09 4:35	4/14/09 4:35	0.00	0.351	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.09	< 2 Month	0.14	< 2 Month	1.12	< 2 Month	1.19	< 2 Month	1.24	< 2 Month
4/17/09 0:35	4/17/09 7:50	7.25	2.833	0.21	0.01	< 2 Month	0.01	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.19	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	0.21	< 2 Month	1.41	< 2 Month
4/22/09 6:30	4/22/09 8:25	1.92	4.944	0.06	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.27	< 2 Month
4/22/09 20:50	4/22/09 23:30	2.67	0.517	0.08	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.08	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.14	< 2 Month	0.35	< 2 Month
4/23/09 8:35	4/23/09 9:15	0.67	0.378	0.06	0.01	< 2 Month	0.02	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.10	< 2 Month	0.14	< 2 Month	0.20	< 2 Month	0.20	< 2 Month	0.41	< 2 Month
4/28/09 2:20	4/28/09 3:15	0.92	4.712	0.06	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.06	< 2 Month	0.26	< 2 Month
4/28/09 19:50	4/28/09 20:25	0.58	0.691	0.05	0.01	< 2 Month	0.02	< 2 Month	0.04	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.11	< 2 Month	0.11	< 2 Month	0.11	< 2 Month	0.31	< 2 Month
4/29/09 2:55	4/29/09 2:55	0.00	0.271	0.01	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.06	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.32	< 2 Month
5/2/09 11:35	5/2/09 21:20	9.75	3.4	0.33	0.02	< 2 Month	0.04	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.29	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.33	< 2 Month	0.45	< 2 Month
5/3/09 19:25	5/3/09 19:40	0.25	0.920	0.12	0.04	< 2 Month	0.08	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.12	< 2 Month	0.18	< 2 Month	0.45	< 2 Month	0.45	< 2 Month	0.57	< 2 Month
5/4/09 15:55	5/5/09 16:15	24.33	0.8	1.32	0.05	< 2 Month	0.09	2-month	0.21	6-month	0.28	6-month	0.68	6-month	0.95	4-month	1.31	6-month	1.44	3-month	1.73	4-month	1.83	< 2 Month
5/5/09 22:55	5/6/09 22:35	23.67	0.3	0.69	0.02	< 2 Month	0.03	< 2 Month	0.07	< 2 Month	0.12	< 2 Month	0.34	< 2 Month	0.52	< 2 Month	1.03	3-month	1.95	6-month	2.08	6-month	2.46	3-month
5/7/09 17:40	5/8/09 4:45	11.08	0.795	0.19	0.02	< 2 Month	0.04	< 2 Month	0.07	< 2 Month	0.11	< 2 Month	0.17	< 2 Month	0.19	< 2 Month	0.19	< 2 Month	0.83	< 2 Month	1.99	4-month	2.65	4-month
5/11/09 1:20	5/11/09 12:05	10.75	2.858	0.05	0.01	< 2 Month	0.01	< 2 Month	0.01	< 2 Month	0.02	< 2 Month	0.03	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	0.05	< 2 Month	2.25	3-month
5/13/09 14:20	5/14/09 13:25	23.08	2.1	0.82	0.02	< 2 Month	0.04	< 2 Month	0.10	< 2 Month	0.15	< 2 Month	0.41	< 2 Month	0.56	< 2 Month	0.82	< 2 Month	0.82	< 2 Month	0.83	< 2 Month	1.06	< 2 Month
5/18/09 20:00	5/19/09 4:30	8.50	4.3	0.43	0.02	< 2 Month	0.03	< 2 Month	0.09	< 2 Month	0.16	< 2 Month	0.42	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	0.43	< 2 Month	1.25	< 2 Month
5/19/09 19:45	5/20/09 0:30	4.75	0.6	0.45	0.08	4-month	0.14	6-month	0.25	9-month	0.35	1-year	0.45	< 2 Month	0.45	< 2 Month	0.72	< 2 Month	0.88	< 2 Month	0.88	< 2 Month	1.70	< 2 Month

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Precipitation Depth-Duration-Frequency table used for storm evalutation

Duration / Frequency	168 hr.	96 hr.	48 hr.	24 hr.	12 hr.	6 hr.	3 hr.	2 hr.	1 hr.	30 min.	15 min.	10 min.	5 min.
2-month	1.83	1.30	1.16	0.87	0.67	0.46	0.31	0.26	0.19	0.14	0.10	0.09	0.058
3-month	2.19	1.54	1.27	1.01	0.78	0.53	0.36	0.30	0.22	0.16	0.11	0.10	0.067
4-month	2.48	1.73	1.51	1.11	0.85	0.58	0.39	0.33	0.24	0.18	0.12	0.11	0.076
6-month	2.87	2.01	1.74	1.28	0.98	0.67	0.45	0.38	0.28	0.21	0.15	0.12	0.084
9-month	3.30	2.31	2.01	1.46	1.12	0.77	0.52	0.44	0.31	0.24	0.17	0.14	0.098
1-year	3.59	2.51	2.18	1.58	1.22	0.83	0.56	0.47	0.34	0.26	0.18	0.15	0.107
2-year	4.35	3.03	2.66	1.95	1.49	1.03	0.69	0.58	0.42	0.32	0.22	0.18	0.133
5-year	5.14	3.63	3.20	2.36	1.78	1.21	0.81	0.70	0.53	0.41	0.29	0.25	0.187
10-year	5.68	4.07	6.30	2.66	1.99	1.34	0.93	0.78	0.61	0.47	0.35	0.30	0.223
25-year	6.45	4.71	4.19	3.11	2.30	1.54	1.08	0.92	0.72	0.56	0.42	0.36	0.273
50-year	6.99	5.20	4.65	3.44	2.53	1.69	1.20	1.04	0.80	0.64	0.47	0.41	0.312
100-year	7.52	5.70	5.12	3.79	2.76	1.84	1.35	1.14	0.89	0.71	0.53	0.45	0.350

Sources:

Pat Stevens - King County

Schaefer, M.G., "Analysis of Precipitation Frequency and Storm Characteristics for the City of Seattle, Table 5, 2003, MGS Consultants.

Ibid - Table E-17, Figure E-17, Precipitation Magnitude-Frequency Estimates for SPU Gage 18

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STORM SUMMARY

Rain Gages 10, 30 & SKY1

- RG10 used from January 2008 through June 2008
- SKY1 (King County gage) used from July 2008 through December 2008
- RG30 used from January 2009 through May 2009
- Storms defined by 6-hour inter-event time

Event	Rank	Start Date/Time	End Date/Time	Duration (hours)	Antecedant Dry Period (Days)	Total Storm Depth (in)	MaxDepth (in)
1	35	1/2/2008 4:45	1/2/2008 10:19	5.58		0.41	0.01
2	50	1/2/2008 17:15	1/3/2008 19:45	26.5	0.29	0.28	0.02
3	171	1/4/2008 7:45	1/4/2008 8:15	0.5	0.50	0.03	0.01
4	79	1/5/2008 3:00	1/5/2008 13:25	10.42	0.78	0.19	0.02
5	114	1/6/2008 5:20	1/6/2008 13:54	8.58	0.66	0.13	0.01
6	166	1/6/2008 23:00	1/7/2008 1:49	2.83	0.38	0.03	0.01
7	32	1/8/2008 1:05	1/8/2008 9:20	8.25	0.97	0.44	0.02
8	127	1/8/2008 16:30	1/8/2008 22:10	5.67	0.30	0.09	0.01
9	27	1/9/2008 21:10	1/10/2008 8:44	11.58	0.96	0.50	0.02
10	29	1/10/2008 16:45	1/11/2008 5:34	12.83	0.33	0.47	0.02
11	67	1/12/2008 5:50	1/12/2008 14:45	8.92	1.01	0.24	0.02
12	81	1/14/2008 12:10	1/14/2008 15:50	3.67	1.89	0.19	0.02
13	126	1/19/2008 17:40	1/19/2008 18:20	0.67	5.08	0.09	0.02
14	118	1/20/2008 2:30	1/20/2008 9:30	7	0.34	0.12	0.01
15	73	1/26/2008 13:15	1/27/2008 1:34	12.33	6.16	0.22	0.01
16	63	1/28/2008 11:10	1/29/2008 10:14	23.08	1.40	0.25	0.01
17	204	1/30/2008 3:40	1/30/2008 3:44	0.08	0.73	0.01	0.01
18	122	1/30/2008 10:50	1/30/2008 22:15	11.42	0.30	0.10	0.01
19	71	1/31/2008 5:10	1/31/2008 21:40	16.5	0.29	0.23	0.02
20	201	2/2/2008 5:15	2/2/2008 5:19	0.08	1.32	0.01	0.01
21	78	2/5/2008 0:30	2/5/2008 15:34	15.08	2.80	0.21	0.01
22	42	2/6/2008 15:40	2/7/2008 1:59	10.33	1.00	0.34	0.01
23	38	2/8/2008 14:00	2/8/2008 23:15	9.25	1.50	0.36	0.01
24	197	2/9/2008 7:55	2/9/2008 7:59	0.08	0.36	0.01	0.01
25	47	2/9/2008 23:00	2/10/2008 8:15	9.25	0.63	0.30	0.02
26	165	2/15/2008 15:00	2/15/2008 18:15	3.25	5.28	0.03	0.01
27	194	2/16/2008 5:10	2/16/2008 5:14	0.08	0.45	0.01	0.01
28	139	2/27/2008 7:50	2/27/2008 13:45	5.92	11.11	0.08	0.01
29	70	2/29/2008 15:20	2/29/2008 19:15	3.92	2.07	0.23	0.01
30	152	3/1/2008 2:45	3/1/2008 3:04	0.33	0.31	0.05	0.02
31	135	3/1/2008 16:15	3/1/2008 20:30	4.25	0.55	0.08	0.04
32	147	3/3/2008 8:35	3/3/2008 12:50	4.25	1.50	0.06	0.01
33	187	3/7/2008 22:00	3/7/2008 22:19	0.33	4.38	0.02	0.01
34	141	3/10/2008 2:50	3/10/2008 6:05	3.25	2.19	0.07	0.01
35	58	3/10/2008 15:55	3/10/2008 20:29	4.58	0.41	0.27	0.05
36	123	3/11/2008 3:20	3/11/2008 10:05	6.75	0.28	0.10	0.01
37	15	3/13/2008 6:30	3/14/2008 16:15	33.75	1.85	0.79	0.02
38	97	3/15/2008 5:10	3/15/2008 6:59	1.83	0.54	0.15	0.01
39	182	3/15/2008 15:45	3/15/2008 15:55	0.17	0.36	0.02	0.01

Event	Rank	Start Date/Time	End Date/Time	Duration (hours)	Antecedant Dry Period (Days)	Total Storm Depth (in)	MaxDepth (in)
40	153	3/16/2008 4:20	3/16/2008 5:24	1.08	0.52	0.05	0.01
41	104	3/16/2008 18:20	3/16/2008 21:45	3.42	0.54	0.14	0.01
42	154	3/19/2008 18:20	3/19/2008 21:24	3.08	2.86	0.05	0.01
43	111	3/20/2008 14:45	3/20/2008 22:00	7.25	0.72	0.13	0.02
44	16	3/23/2008 5:15	3/23/2008 16:40	11.42	2.30	0.77	0.03
45	41	3/25/2008 14:35	3/26/2008 6:20	15.75	1.91	0.34	0.02
46	107	3/26/2008 18:30	3/27/2008 3:34	9.08	0.51	0.14	0.01
47	26	3/28/2008 8:50	3/29/2008 2:39	17.83	1.22	0.52	0.01
48	19	3/29/2008 14:05	3/30/2008 10:50	20.75	0.48	0.68	0.03
49	24	3/31/2008 17:55	3/31/2008 19:14	1.33	1.30	0.57	0.22
50	143	4/4/2008 8:25	4/4/2008 11:40	3.25	3.55	0.07	0.01
51	198	4/4/2008 20:10	4/4/2008 20:14	0.08	0.35	0.01	0.01
52	99	4/5/2008 19:50	4/6/2008 18:00	22.17	0.98	0.15	0.01
53	175	4/7/2008 6:00	4/7/2008 6:25	0.42	0.50	0.02	0.01
54	167	4/8/2008 7:15	4/8/2008 8:55	1.67	1.03	0.03	0.01
55	89	4/8/2008 17:35	4/8/2008 21:09	3.58	0.36	0.17	0.02
56	196	4/10/2008 9:10	4/10/2008 9:14	0.08	1.50	0.01	0.01
57	132	4/13/2008 18:20	4/13/2008 20:05	1.75	3.38	0.09	0.01
58	54	4/14/2008 11:40	4/14/2008 20:50	9.17	0.65	0.28	0.02
59	150	4/15/2008 18:10	4/15/2008 20:50	2.67	0.89	0.06	0.01
60	189	4/17/2008 18:35	4/17/2008 18:39	0.08	1.91	0.01	0.01
61	168	4/18/2008 23:20	4/18/2008 23:54	0.58	1.19	0.03	0.01
62	117	4/19/2008 10:05	4/19/2008 17:20	7.25	0.42	0.12	0.01
63	82	4/20/2008 6:30	4/20/2008 12:19	5.83	0.55	0.18	0.02
64	190	4/21/2008 1:00	4/21/2008 1:04	0.08	0.53	0.01	0.01
65	156	4/21/2008 18:45	4/21/2008 20:40	1.92	0.74	0.04	0.01
66	92	4/22/2008 22:05	4/23/2008 4:30	6.42	1.06	0.16	0.03
67	174	4/27/2008 17:20	4/27/2008 19:45	2.42	4.53	0.03	0.01
68	46	4/28/2008 4:10	4/28/2008 11:29	7.33	0.35	0.33	0.06
69	181	4/28/2008 21:45	4/28/2008 23:00	1.25	0.43	0.02	0.01
70	109	4/29/2008 21:55	4/29/2008 22:55	1	0.95	0.13	0.02
71	83	4/30/2008 19:10	5/1/2008 0:50	5.67	0.84	0.18	0.03
72	136	5/11/2008 12:30	5/11/2008 20:45	8.25	10.49	0.08	0.02
73	53	5/13/2008 9:25	5/13/2008 13:50	4.42	1.53	0.28	0.01
74	30	5/19/2008 23:10	5/20/2008 10:05	10.92	6.39	0.46	0.06
75	56	5/21/2008 18:40	5/21/2008 22:44	4.08	1.36	0.28	0.03
76	169	5/23/2008 8:35	5/23/2008 8:54	0.33	1.41	0.03	0.01
77	98	5/25/2008 0:30	5/25/2008 6:19	5.83	1.65	0.15	0.02
78	161	5/31/2008 13:45	5/31/2008 16:25	2.67	6.31	0.04	0.01
79	191	6/1/2008 10:55	6/1/2008 10:59	0.08	0.77	0.01	0.01
80	22	6/2/2008 22:35	6/3/2008 12:24	13.83	1.48	0.62	0.02
81	115	6/3/2008 23:30	6/4/2008 8:15	8.75	0.46	0.13	0.01
82	96	6/5/2008 9:55	6/5/2008 19:50	9.92	1.07	0.16	0.02
83	20	6/6/2008 4:55	6/6/2008 18:05	13.17	0.38	0.66	0.03
84	55	6/9/2008 9:25	6/9/2008 16:14	6.83	2.64	0.28	0.03
85	178	6/9/2008 23:00	6/10/2008 1:04	2.08	0.28	0.02	0.01
86	193	6/10/2008 9:30	6/10/2008 9:34	0.08	0.35	0.01	0.01

Event	Rank	Start Date/Time	End Date/Time	Duration (hours)	Antecedant Dry Period (Days)	Total Storm Depth (in)	MaxDepth (in)
87	33	7/2/2008 19:35	7/3/2008 11:30	15.92	22.42	0.43	0.06
88	195	7/4/2008 14:30	7/4/2008 14:34	0.08	1.12	0.01	0.01
89	199	7/5/2008 18:35	7/5/2008 18:39	0.08	1.17	0.01	0.01
90	121	7/29/2008 12:30	7/30/2008 0:00	11.5	23.74	0.10	0.03
91	61	7/31/2008 18:05	8/1/2008 6:20	12.25	1.75	0.26	0.03
92	110	8/9/2008 5:00	8/9/2008 8:25	3.42	7.94	0.13	0.02
93	91	8/9/2008 15:35	8/9/2008 18:50	3.25	0.30	0.17	0.1
94	106	8/18/2008 10:10	8/18/2008 22:35	12.42	8.64	0.14	0.02
95	4	8/19/2008 20:25	8/21/2008 2:59	30.58	0.91	1.61	0.07
96	5	8/24/2008 14:15	8/25/2008 0:15	10	3.47	1.32	0.05
97	17	8/25/2008 17:15	8/25/2008 19:45	2.5	0.71	0.70	0.14
98	51	8/26/2008 20:10	8/27/2008 2:05	5.92	1.02	0.28	0.02
99	23	9/20/2008 6:25	9/21/2008 5:35	23.17	24.18	0.59	0.02
100	72	9/24/2008 13:05	9/25/2008 2:20	13.25	3.31	0.22	0.03
101	172	9/25/2008 18:25	9/26/2008 0:59	6.58	0.67	0.03	0.01
102	179	10/2/2008 10:40	10/2/2008 11:40	1	6.40	0.02	0.01
103	108	10/2/2008 18:40	10/2/2008 18:50	0.17	0.29	0.13	0.1
104	25	10/3/2008 6:05	10/4/2008 13:45	31.67	0.47	0.57	0.02
105	205	10/5/2008 18:50	10/5/2008 18:54	0.08	1.21	0.01	0.01
106	48	10/6/2008 2:15	10/7/2008 1:55	23.67	0.31	0.30	0.02
107	66	10/13/2008 19:10	10/13/2008 22:29	3.33	6.72	0.24	0.08
108	95	10/15/2008 19:30	10/16/2008 6:19	10.83	1.88	0.16	0.01
109	94	10/17/2008 20:00	10/17/2008 23:00	3	1.57	0.16	0.01
110	105	10/20/2008 8:05	10/20/2008 16:09	8.08	2.38	0.14	0.01
111	113	10/23/2008 4:40	10/23/2008 9:10	4.5	2.52	0.13	0.01
112	44	10/31/2008 0:55	10/31/2008 14:29	13.58	7.66	0.33	0.02
113	76	11/1/2008 13:50	11/1/2008 19:39	5.83	0.97	0.22	0.03
114	65	11/2/2008 5:25	11/2/2008 14:40	9.25	0.41	0.25	0.02
115	77	11/2/2008 23:25	11/3/2008 10:05	10.67	0.36	0.21	0.01
116	18	11/3/2008 19:35	11/4/2008 9:00	13.42	0.40	0.70	0.01
117	2	11/6/2008 1:45	11/7/2008 10:40	32.92	1.70	2.47	0.03
118	119	11/7/2008 20:20	11/8/2008 2:54	6.58	0.40	0.11	0.02
119	124	11/8/2008 9:40	11/8/2008 10:50	1.17	0.28	0.10	0.02
120	146	11/9/2008 2:35	11/9/2008 9:39	7.08	0.66	0.06	0.01
121	100	11/9/2008 18:15	11/10/2008 3:00	8.75	0.36	0.15	0.01
122	208	11/10/2008 18:40	11/10/2008 18:44	0.08	0.65	0.01	0.01
123	8	11/11/2008 1:05	11/12/2008 18:45	41.67	0.26	1.04	0.02
124	90	11/13/2008 8:10	11/13/2008 9:50	1.67	0.56	0.17	0.03
125	209	11/17/2008 5:45	11/17/2008 5:49	0.08	3.83	0.01	0.01
126	183	11/18/2008 8:00	11/18/2008 8:40	0.67	1.09	0.02	0.01
127	69	11/20/2008 9:40	11/20/2008 15:35	5.92	2.04	0.23	0.02
128	120	11/21/2008 20:15	11/21/2008 21:30	1.25	1.19	0.11	0.02
129	128	11/25/2008 12:50	11/25/2008 19:05	6.25	3.64	0.09	0.01
130	142	11/28/2008 8:15	11/28/2008 14:25	6.17	2.55	0.07	0.01
131	210	11/29/2008 5:25	11/29/2008 5:29	0.08	0.62	0.01	0.01
132	212	11/29/2008 19:55	11/29/2008 19:59	0.08	0.60	0.01	0.01
133	145	11/30/2008 3:10	11/30/2008 7:10	4	0.30	0.07	0.01

Event	Rank	Start Date/Time	End Date/Time	Duration (hours)	Antecedant Dry Period (Days)	Total Storm Depth (in)	MaxDepth (in)
134	80	12/1/2008 18:00	12/2/2008 5:49	11.83	1.45	0.19	0.02
135	162	12/2/2008 21:15	12/3/2008 1:04	3.83	0.64	0.04	0.01
136	101	12/7/2008 21:30	12/7/2008 23:04	1.58	4.85	0.14	0.09
137	160	12/8/2008 7:45	12/8/2008 11:34	3.83	0.36	0.04	0.01
138	144	12/9/2008 17:30	12/9/2008 23:34	6.08	1.25	0.07	0.01
139	170	12/10/2008 16:00	12/10/2008 21:19	5.33	0.68	0.03	0.01
140	12	12/12/2008 17:15	12/13/2008 16:34	23.33	1.83	0.94	0.05
141	213	12/18/2008 0:00	12/18/2008 0:04	0.08	4.31	0.01	0.01
142	215	12/18/2008 10:30	12/18/2008 10:34	0.08	0.43	0.01	0.01
143	116	12/19/2008 20:30	12/19/2008 21:34	1.08	1.41	0.12	0.05
144	85	12/22/2008 20:45	12/23/2008 1:04	4.33	2.97	0.17	0.05
145	176	12/23/2008 21:15	12/23/2008 23:34	2.33	0.84	0.02	0.01
146	13	12/24/2008 20:45	12/26/2008 0:19	27.58	0.88	0.93	0.05
147	40	12/26/2008 18:00	12/27/2008 21:19	27.33	0.74	0.35	0.02
148	43	12/28/2008 6:15	12/28/2008 17:04	10.83	0.37	0.34	0.02
149	37	12/29/2008 0:00	12/29/2008 19:19	19.33	0.29	0.38	0.05
150	103	12/31/2008 4:45	12/31/2008 10:19	5.58	1.39	0.14	0.01
151	7	1/1/2009 5:45	1/2/2009 14:00	32.25	0.81	1.12	0.2
152	14	1/4/2009 16:55	1/5/2009 8:25	15.5	2.12	0.79	0.03
153	1	1/5/2009 23:55	1/8/2009 3:35	51.67	0.65	2.65	0.03
154	177	1/8/2009 16:25	1/8/2009 16:50	0.42	0.53	0.02	0.01
155	216	1/10/2009 7:55	1/10/2009 7:59	0.08	1.63	0.01	0.01
156	74	1/10/2009 18:30	1/11/2009 11:34	17.08	0.44	0.22	0.02
157	217	1/12/2009 1:15	1/12/2009 1:19	0.08	0.57	0.01	0.01
158	137	1/12/2009 11:20	1/13/2009 3:00	15.67	0.42	0.08	0.01
159	218	1/24/2009 21:05	1/24/2009 21:09	0.08	11.75	0.01	0.01
160	138	1/27/2009 9:55	1/27/2009 17:20	7.42	2.53	0.08	0.01
161	184	1/30/2009 21:50	1/30/2009 22:20	0.5	3.19	0.02	0.01
162	140	2/5/2009 22:05	2/6/2009 13:00	14.92	5.99	0.07	0.01
163	202	2/8/2009 1:50	2/8/2009 1:54	0.08	1.53	0.01	0.01
164	192	2/8/2009 20:40	2/8/2009 20:44	0.08	0.78	0.01	0.01
165	102	2/9/2009 3:20	2/9/2009 8:24	5.08	0.27	0.14	0.01
166	68	2/10/2009 13:10	2/10/2009 20:10	7	1.20	0.24	0.01
167	188	2/11/2009 9:00	2/11/2009 9:04	0.08	0.53	0.01	0.01
168	163	2/15/2009 17:40	2/15/2009 21:55	4.25	4.36	0.04	0.01
169	155	2/22/2009 5:20	2/22/2009 8:54	3.58	6.31	0.05	0.01
170	149	2/22/2009 18:50	2/22/2009 23:05	4.25	0.41	0.06	0.01
171	60	2/23/2009 14:05	2/23/2009 17:24	3.33	0.63	0.26	0.03
172	49	2/24/2009 0:00	2/24/2009 12:30	12.5	0.27	0.29	0.02
173	36	2/24/2009 22:05	2/25/2009 16:50	18.75	0.40	0.40	0.03
174	84	2/26/2009 10:00	2/26/2009 11:04	1.08	0.72	0.17	0.02
175	131	3/1/2009 1:15	3/1/2009 7:55	6.67	2.59	0.09	0.01
176	45	3/1/2009 14:20	3/2/2009 7:50	17.5	0.27	0.33	0.01
177	134	3/2/2009 18:00	3/2/2009 18:15	0.25	0.42	0.08	0.05
178	112	3/3/2009 4:00	3/3/2009 7:55	3.92	0.41	0.13	0.01
179	57	3/3/2009 17:40	3/3/2009 19:14	1.58	0.41	0.28	0.04
180	206	3/4/2009 4:55	3/4/2009 4:59	0.08	0.40	0.01	0.01

Event	Rank	Start Date/Time	End Date/Time	Duration (hours)	Antecedant Dry Period (Days)	Total Storm Depth (in)	MaxDepth (in)
181	93	3/5/2009 7:15	3/5/2009 11:40	4.42	1.09	0.16	0.03
182	59	3/7/2009 8:00	3/7/2009 11:15	3.25	1.85	0.26	0.03
183	186	3/7/2009 21:05	3/7/2009 22:15	1.17	0.41	0.02	0.01
184	185	3/8/2009 8:30	3/8/2009 9:45	1.25	0.43	0.02	0.01
185	75	3/8/2009 19:10	3/9/2009 13:55	18.75	0.39	0.22	0.02
186	21	3/14/2009 4:55	3/14/2009 20:50	15.92	4.63	0.66	0.04
187	9	3/15/2009 5:05	3/17/2009 9:45	52.67	0.34	1.02	0.02
188	220	3/17/2009 16:15	3/17/2009 16:19	0.08	0.27	0.01	0.01
189	148	3/19/2009 2:50	3/19/2009 10:54	8.08	1.44	0.06	0.01
190	151	3/20/2009 2:35	3/20/2009 2:50	0.25	0.65	0.05	0.03
191	86	3/20/2009 10:00	3/20/2009 15:25	5.42	0.30	0.17	0.07
192	164	3/23/2009 17:05	3/23/2009 20:24	3.33	3.07	0.04	0.01
193	62	3/25/2009 2:10	3/25/2009 14:44	12.58	1.24	0.25	0.01
194	39	3/28/2009 8:30	3/29/2009 5:04	20.58	2.74	0.35	0.01
195	158	3/31/2009 9:45	3/31/2009 10:40	0.92	2.19	0.04	0.02
196	28	4/1/2009 7:30	4/2/2009 1:45	18.25	0.87	0.50	0.01
197	6	4/2/2009 8:40	4/3/2009 7:59	23.33	0.29	1.25	0.04
198	207	4/9/2009 4:35	4/9/2009 4:39	0.08	5.86	0.01	0.01
199	203	4/9/2009 22:30	4/9/2009 22:34	0.08	0.74	0.01	0.01
200	180	4/10/2009 7:00	4/10/2009 12:49	5.83	0.35	0.02	0.01
201	159	4/11/2009 6:00	4/11/2009 9:10	3.17	0.72	0.04	0.01
202	11	4/12/2009 3:25	4/12/2009 18:35	15.17	0.76	0.98	0.04
203	88	4/13/2009 15:35	4/13/2009 20:24	4.83	0.87	0.17	0.02
204	200	4/14/2009 4:35	4/14/2009 4:39	0.08	0.34	0.01	0.01
205	64	4/17/2009 0:35	4/17/2009 8:39	8.08	2.83	0.25	0.01
206	130	4/22/2009 6:10	4/22/2009 9:20	3.17	4.90	0.09	0.01
207	87	4/22/2009 20:20	4/22/2009 23:20	3	0.46	0.17	0.02
208	157	4/23/2009 8:40	4/23/2009 9:29	0.83	0.39	0.04	0.01
209	125	4/28/2009 1:35	4/28/2009 3:15	1.67	4.67	0.09	0.02
210	173	4/28/2009 15:35	4/28/2009 20:05	4.5	0.51	0.03	0.01
211	219	4/29/2009 3:45	4/29/2009 3:49	0.08	0.32	0.01	0.01
212	52	5/2/2009 11:40	5/2/2009 22:50	11.17	3.33	0.28	0.03
213	133	5/3/2009 19:25	5/3/2009 19:59	0.58	0.86	0.08	0.03
214	3	5/4/2009 16:00	5/6/2009 23:10	55.17	0.83	2.26	0.05
215	211	5/8/2009 8:55	5/8/2009 8:59	0.08	1.41	0.01	0.01
216	129	5/11/2009 0:45	5/11/2009 12:10	11.42	2.66	0.09	0.01
217	10	5/13/2009 14:30	5/14/2009 9:34	19.08	2.10	1.01	0.03
218	31	5/18/2009 19:55	5/19/2009 0:50	4.92	4.43	0.44	0.02
219	34	5/19/2009 19:50	5/19/2009 21:24	1.58	0.79	0.42	0.12
220	214	5/20/2009 7:35	5/20/2009 7:39	0.08	0.42	0.01	0.01

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Appendix D
Hydrographs & Scattergraphs

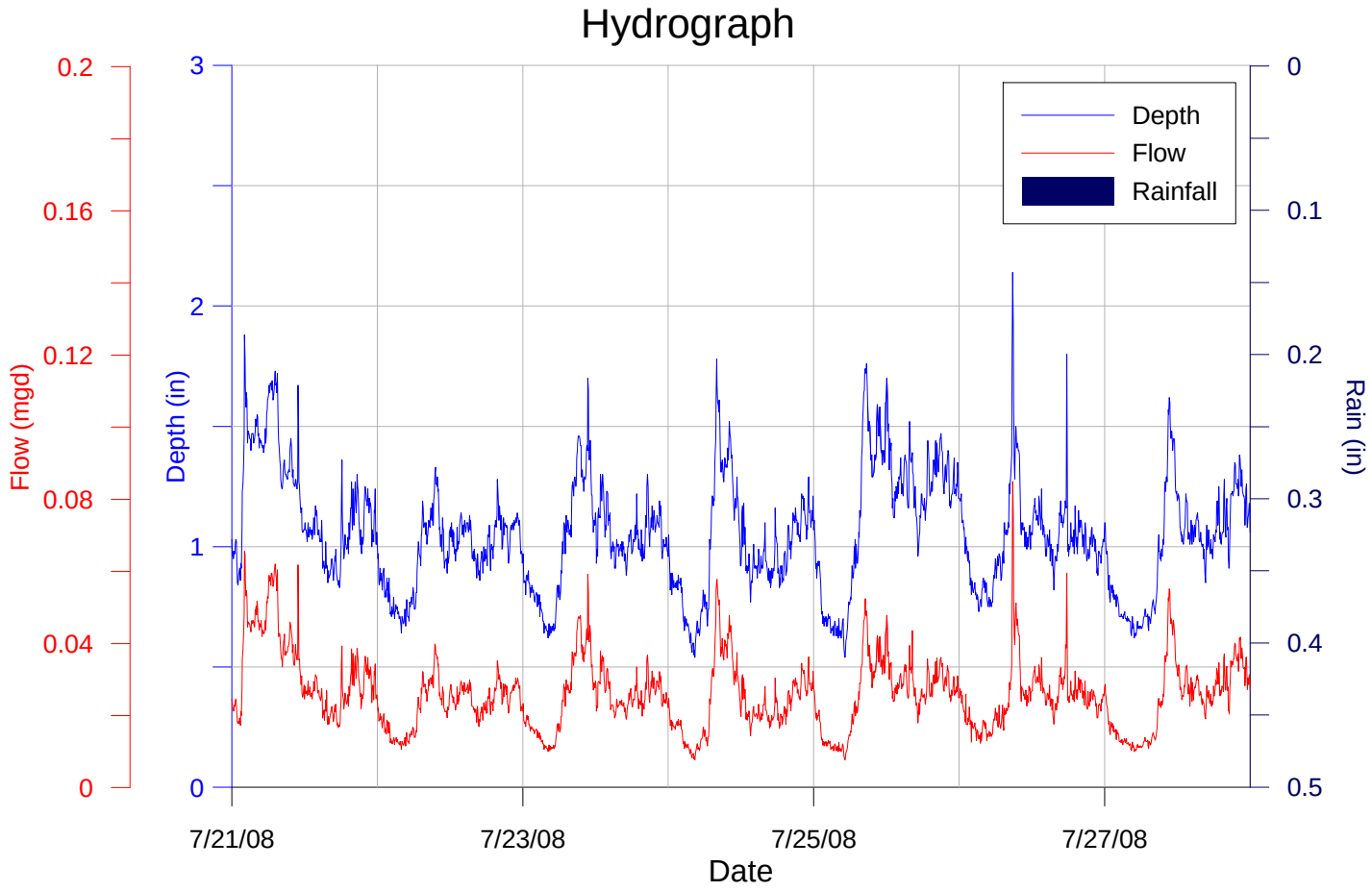
The following pages contain hydrographs and scattergraphs of data for the temporary and permanent monitors. The following time periods were selected to plot:

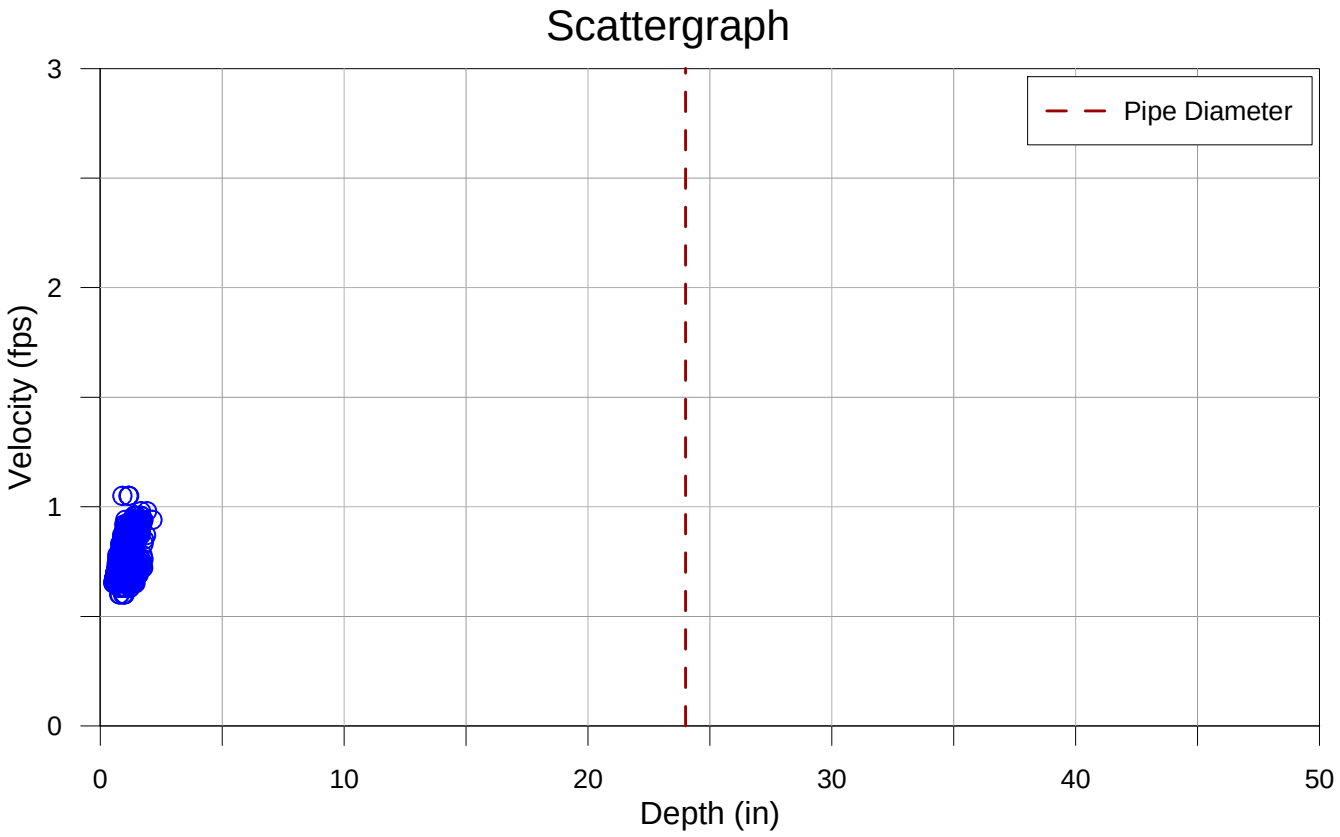
- July 21 – 28, 2008 (dry weather flow)
- August 23 – 28. 2008
- November 3 – 15, 2008
- January 4 – 11, 2009

Not all monitors had data for every time period. The matrix below indicates which hydrographs and scattergraphs are included in the following pages.

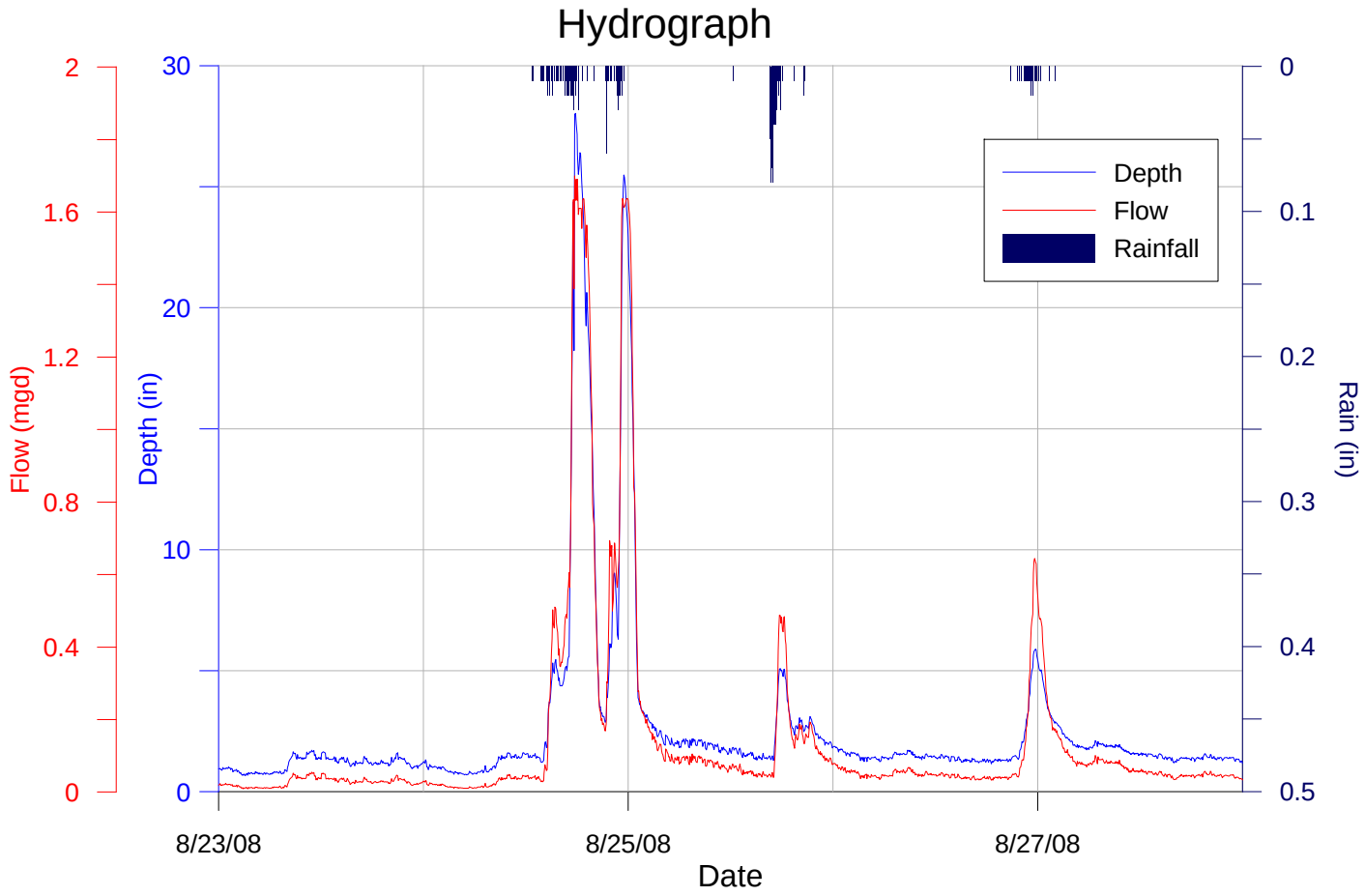
Basin	Monitor	July 2008	August 2008	November 2008	January 2009	Notes
44	067-191	X	X	X	X	
	067-271	X	X	X	X	
	067-275_1			X	X	Overflow in November & January
	067-275_2			X	X	Overflow in November & January
	067-274		X	X	X	Downstream of weir
	067-261	X	X	X	X	
45	074-152	X	X	X	X	
	074-159	X	X	X	X	
	074-153	X	X	X	X	
	074-167	X	X	X	X	July included to show constant depth
46	081-059	X	X	X	X	
	D081-131	X	X	X	X	
	081-062_1	X	X	X	X	
	081-062_2				X	Overflow in January 2009
47	073-268	X	X	X	X	
	073-276	X	X	X	X	
	080-329	X	X	X	X	
	081-049				X	Monitor installed in December 2008
	081-085	X	X	X	X	
	081-120	X	X	X	X	
	081-139	X	X	X	X	
	081-239	X	X	X	X	
	D081-069	X	X	X	X	
	081-224	X	X	X	X	July included to show constant depth
	081-330	X	X	X	X	
	080-298	X	X	X	X	
	080-480	X	X	X	X	
49	306-245	X	X	X	X	
	306-246	X	X	X	X	
	306-275	X	X	X	X	
	306-284	X	X	X	X	
	306-343	X	X	X	X	
	306-428	X	X	X	X	
	306-437		X	X	X	Primarily used for level
171	081-237	X	X	X	X	
	306-192	X	X	X	X	
	081-231		X	X	X	

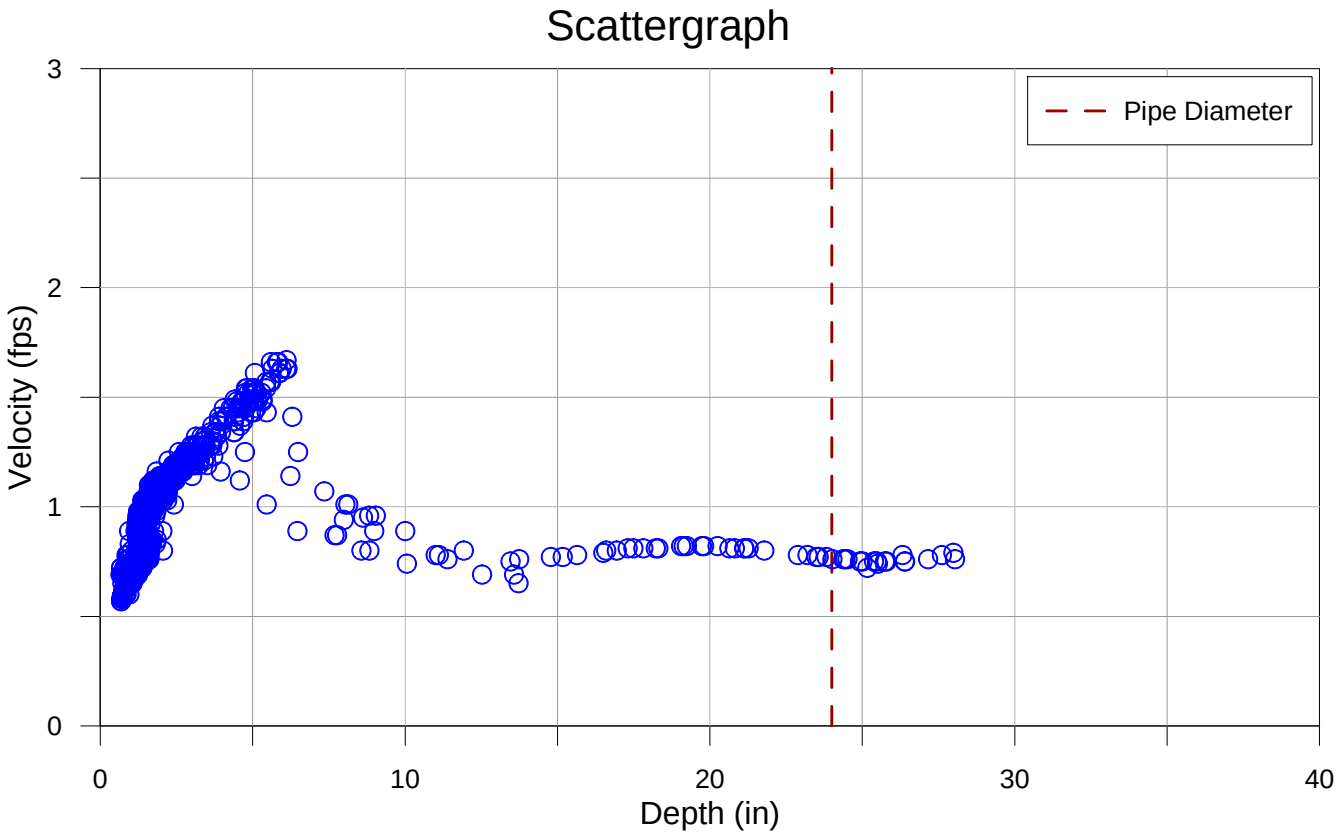
Monitor 067-191
July 21 - 28, 2008



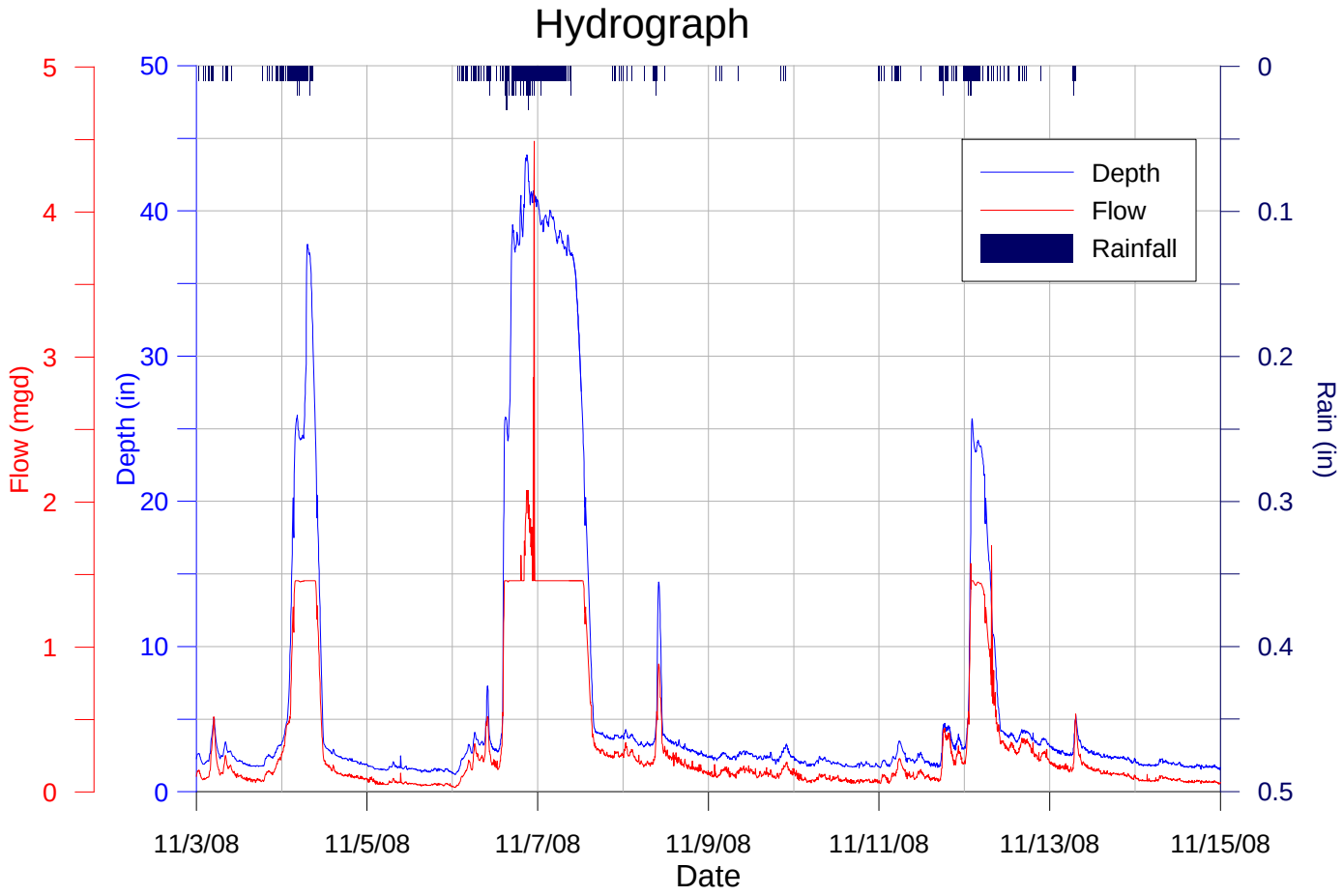


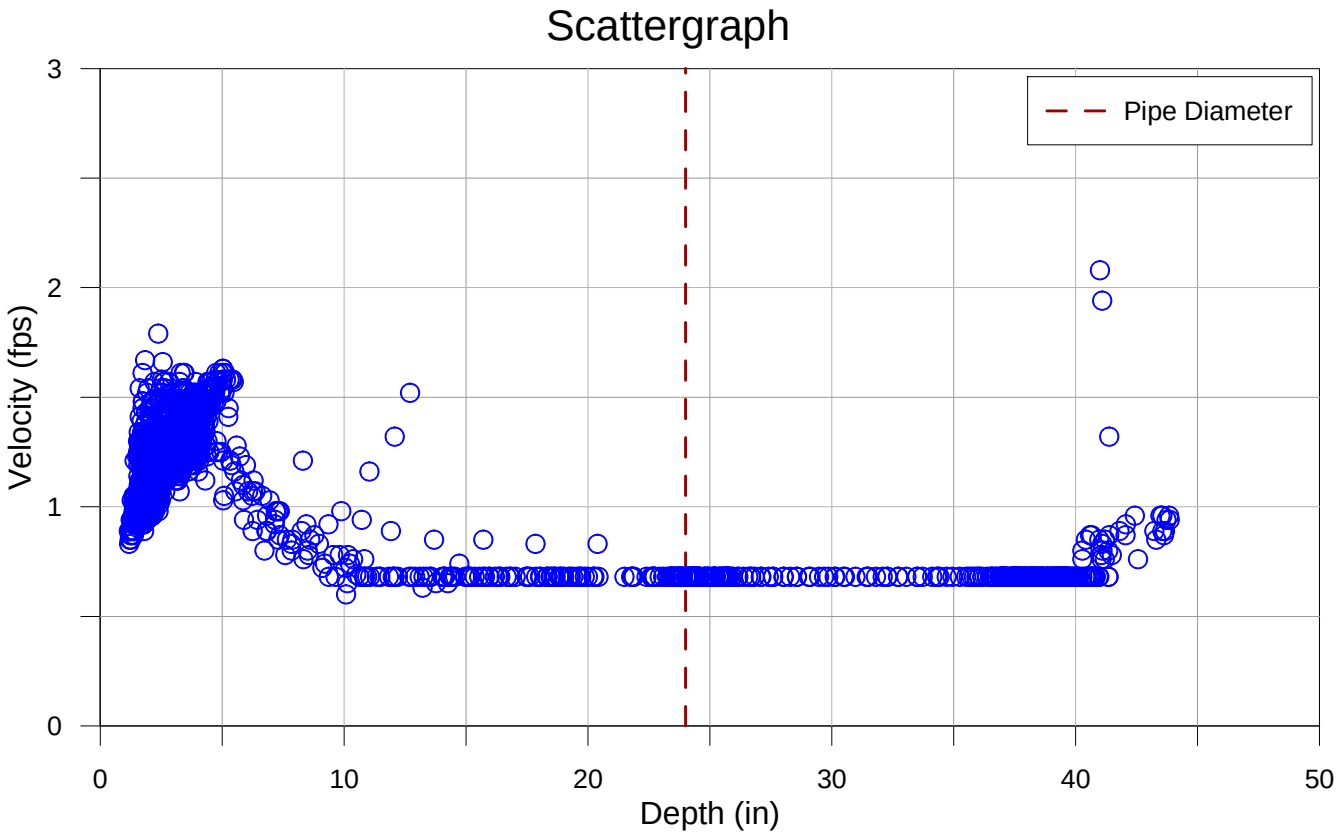
Monitor 067-191
August 23 - 28, 2008



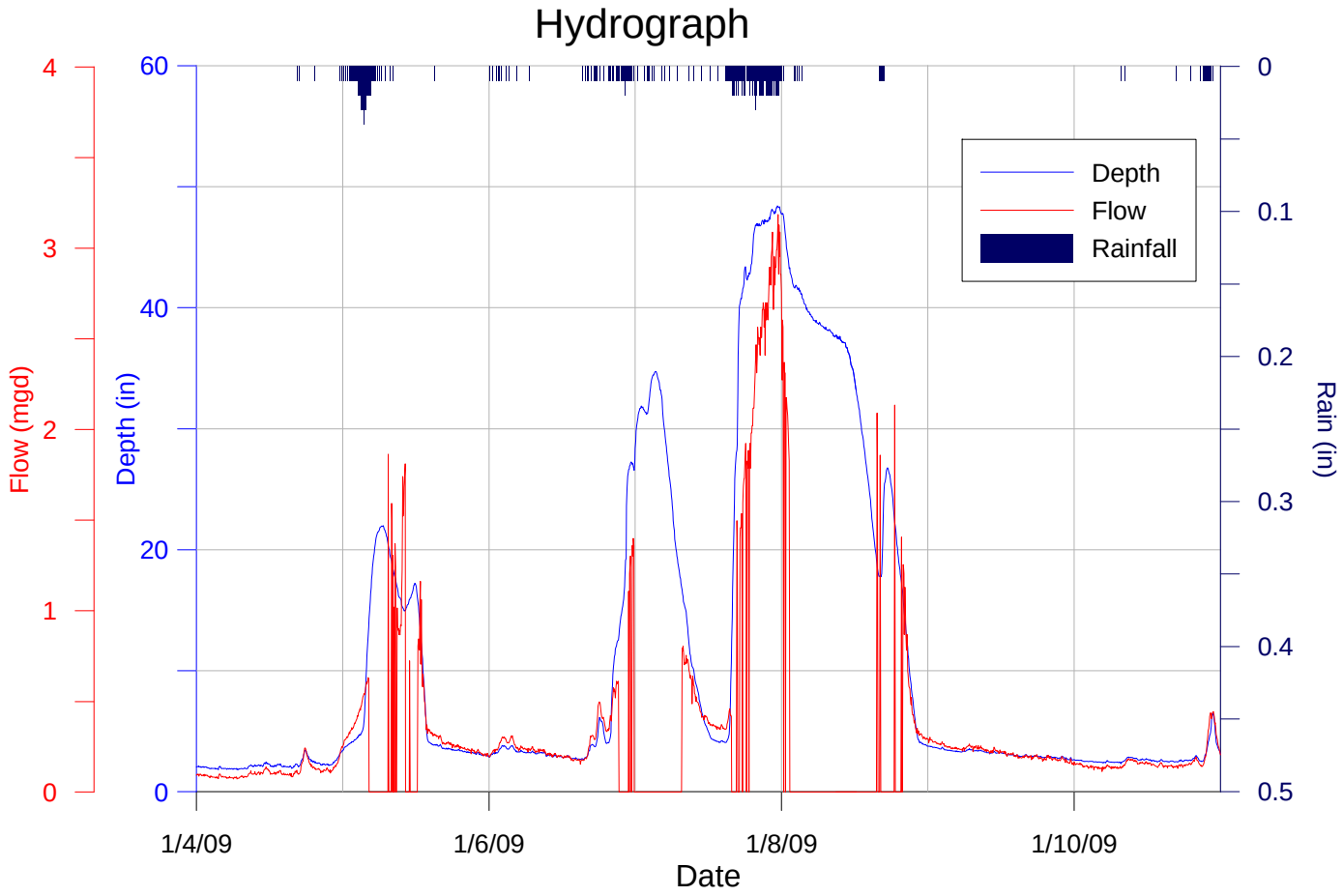


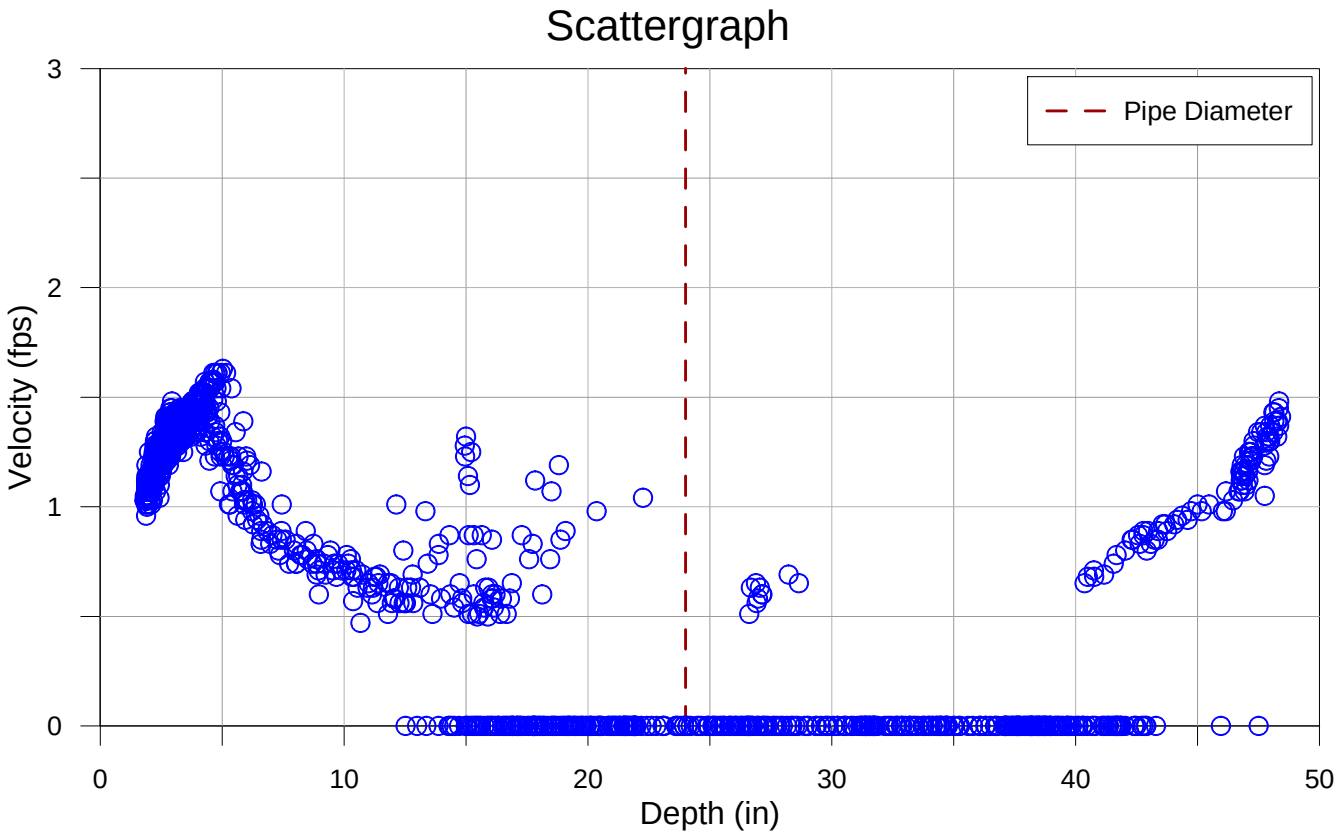
Monitor 067-191
November 3 - 15, 2008



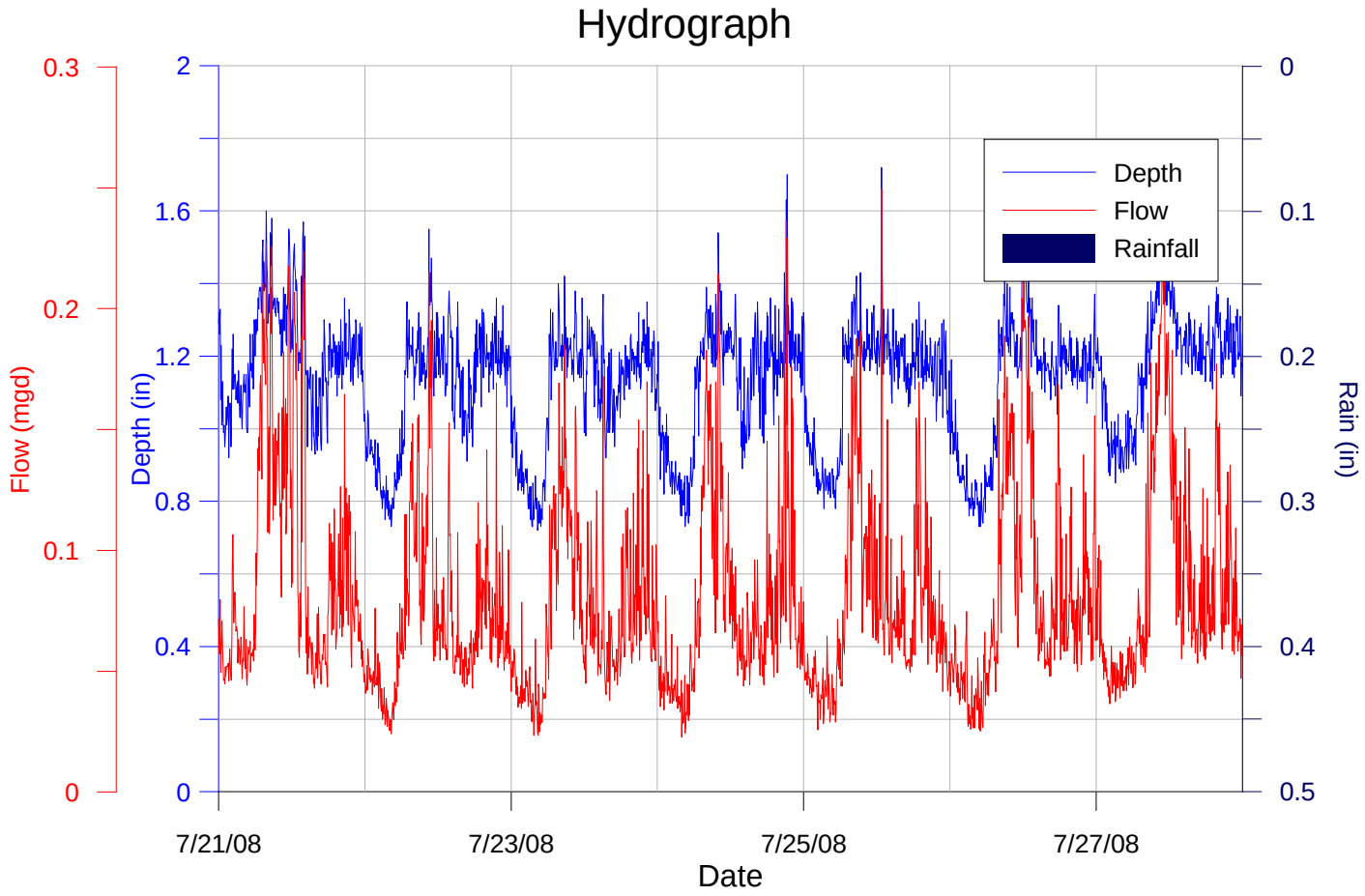


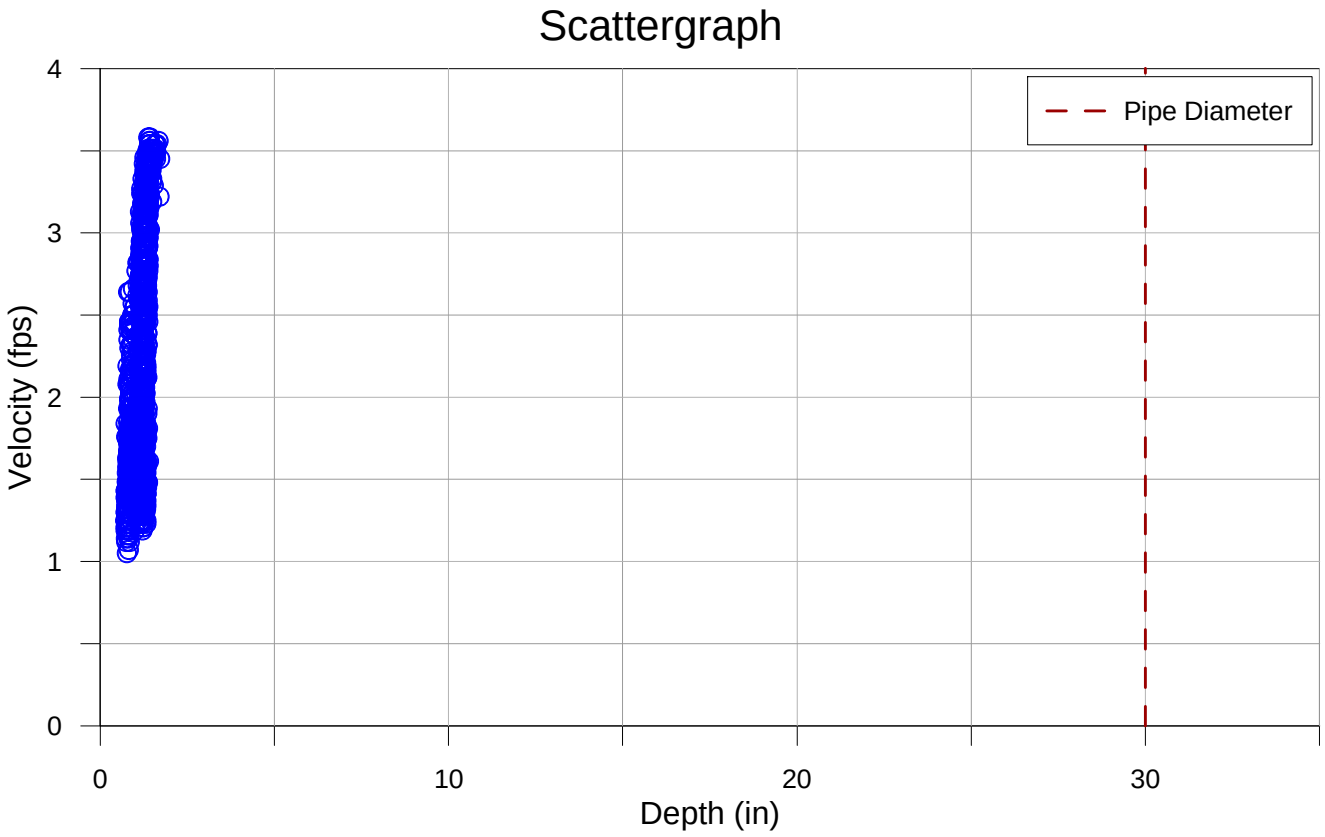
Monitor 067-191
January 4 - 11, 2009



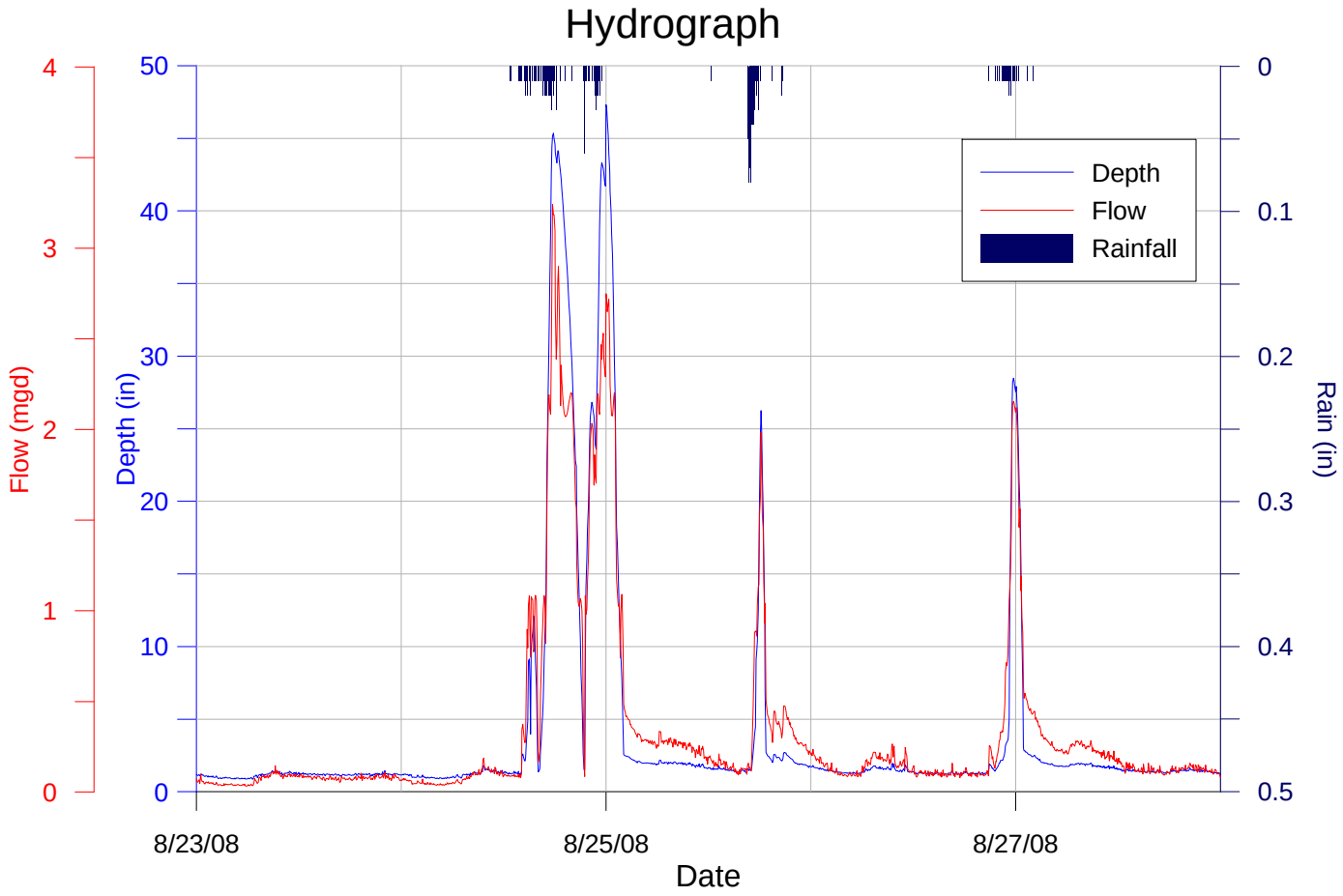


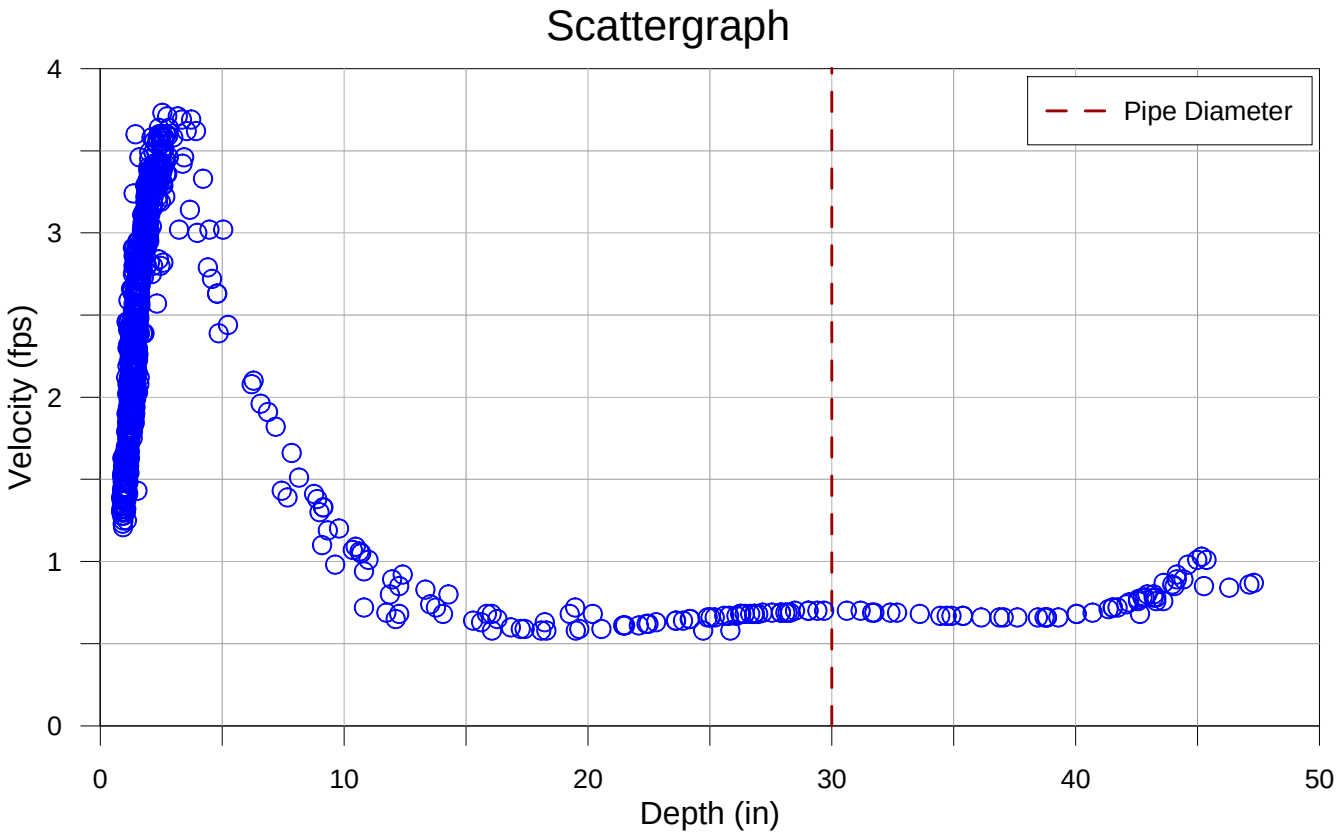
Monitor 067-271
July 21 - 28, 2008



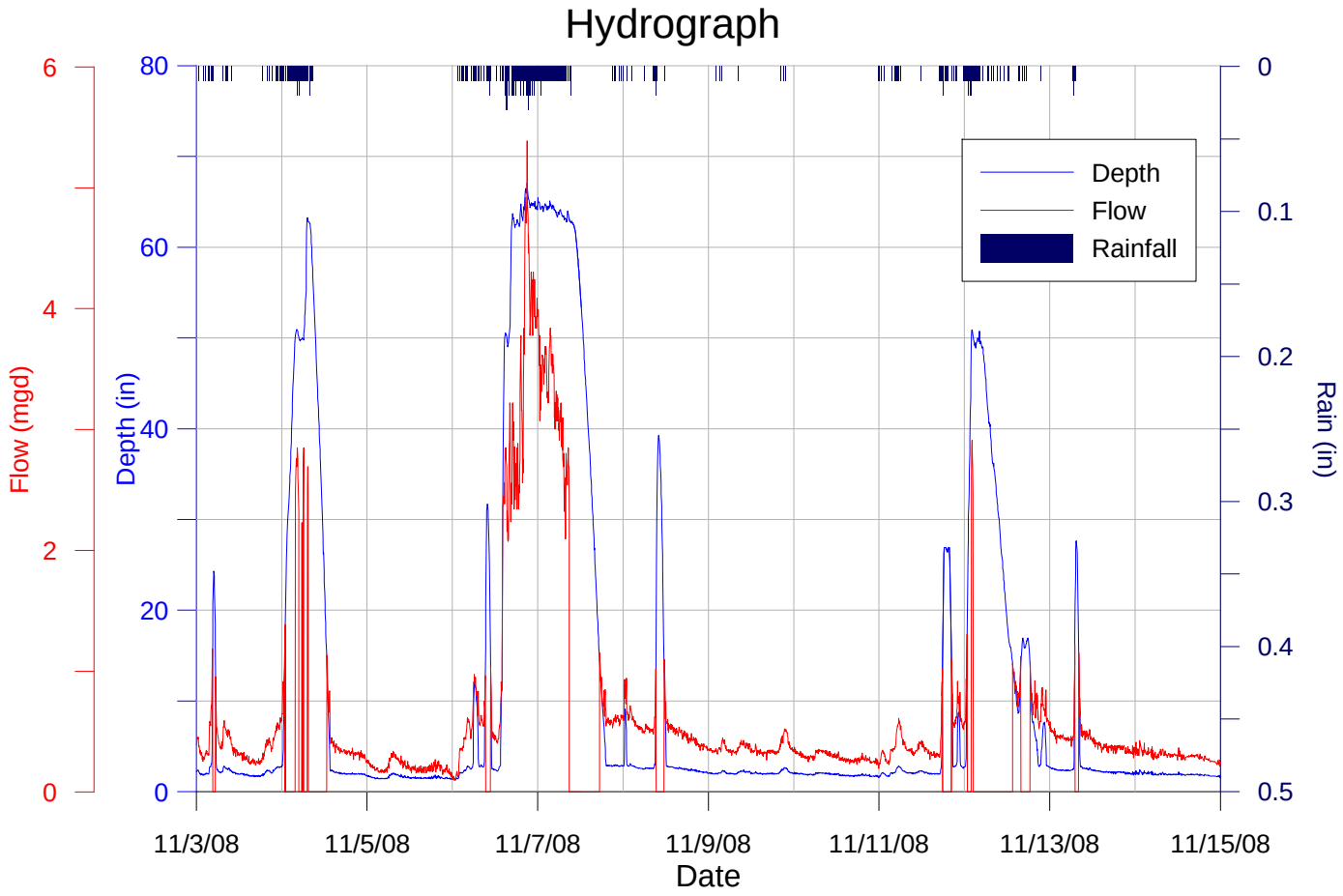


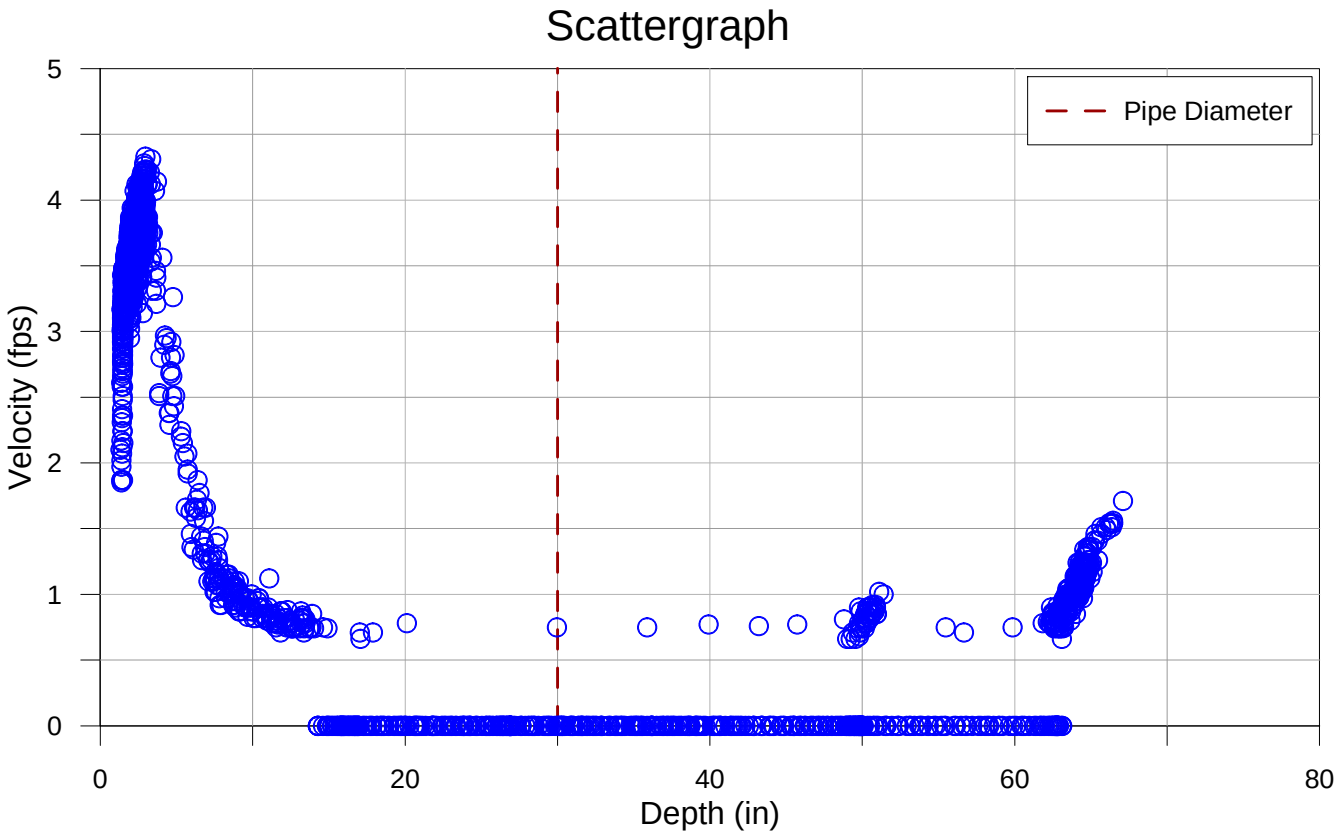
Monitor 067-271
August 23 - 28, 2008





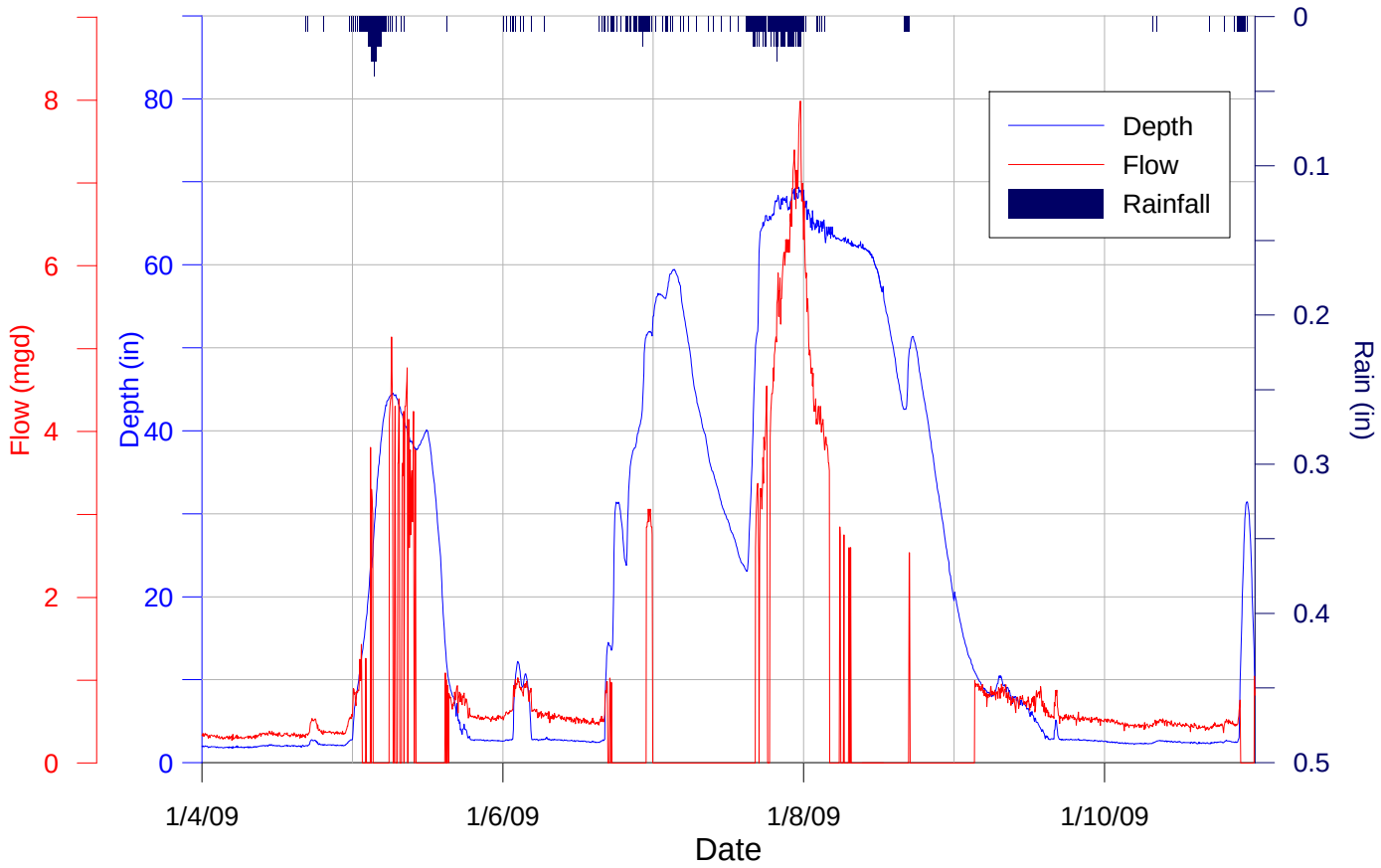
Monitor 067-271
November 3 - 15, 2008



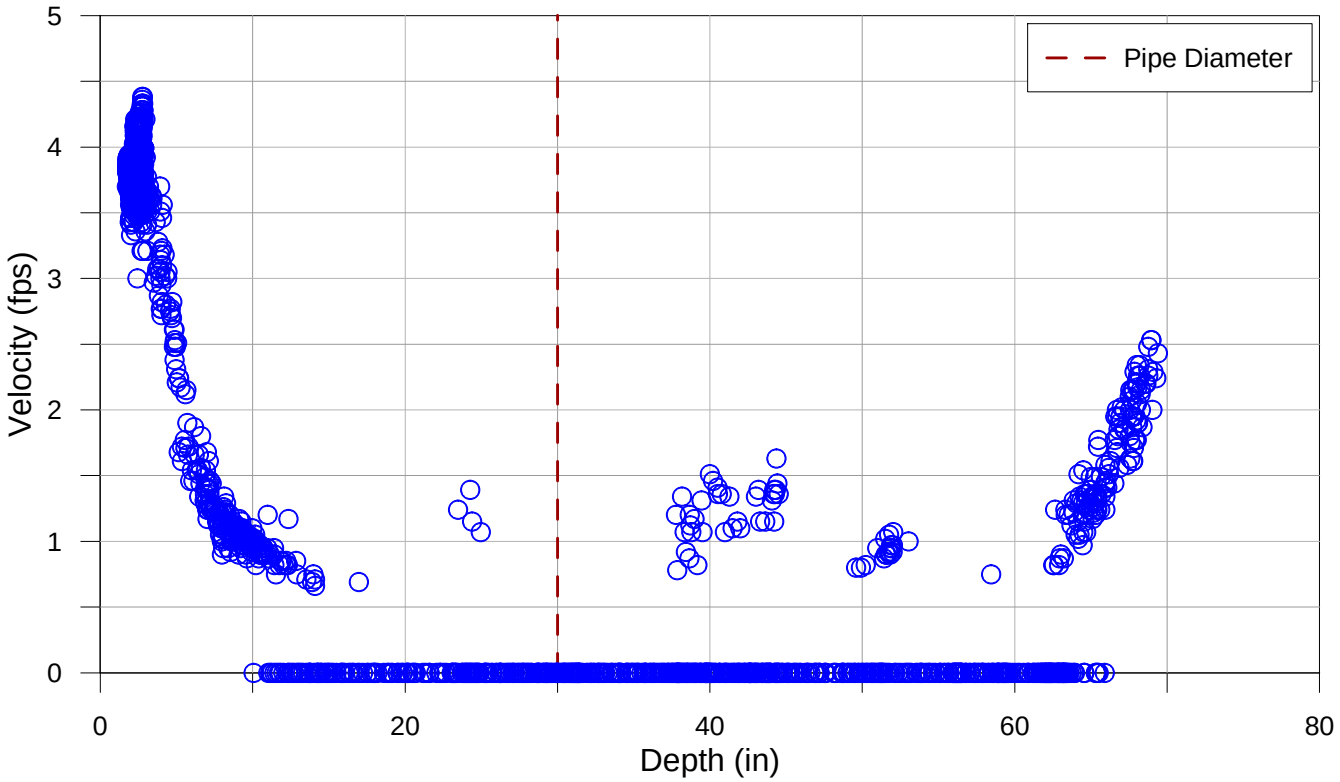


Monitor 067-271
January 4 - 11, 2009

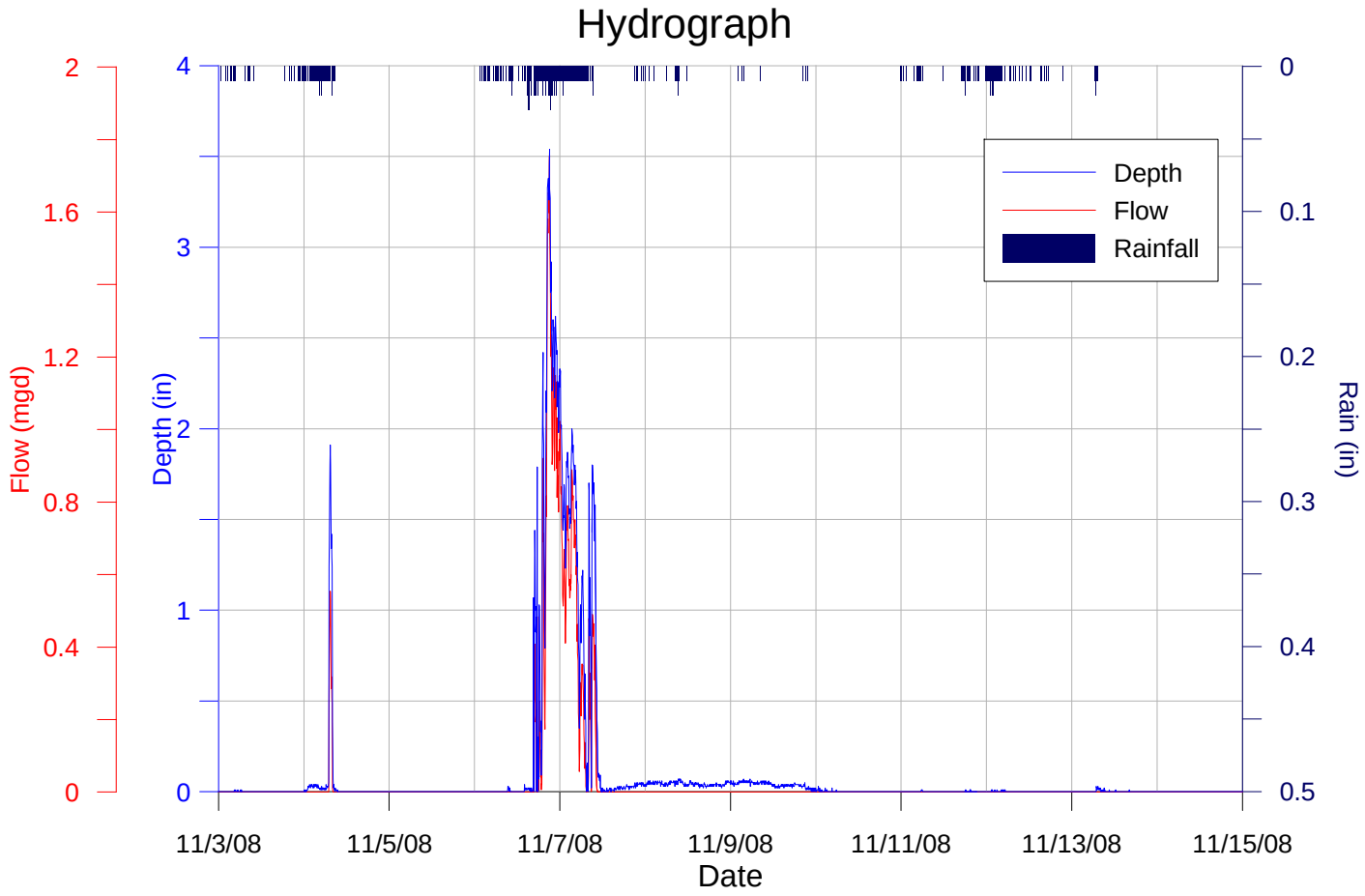
Hydrograph

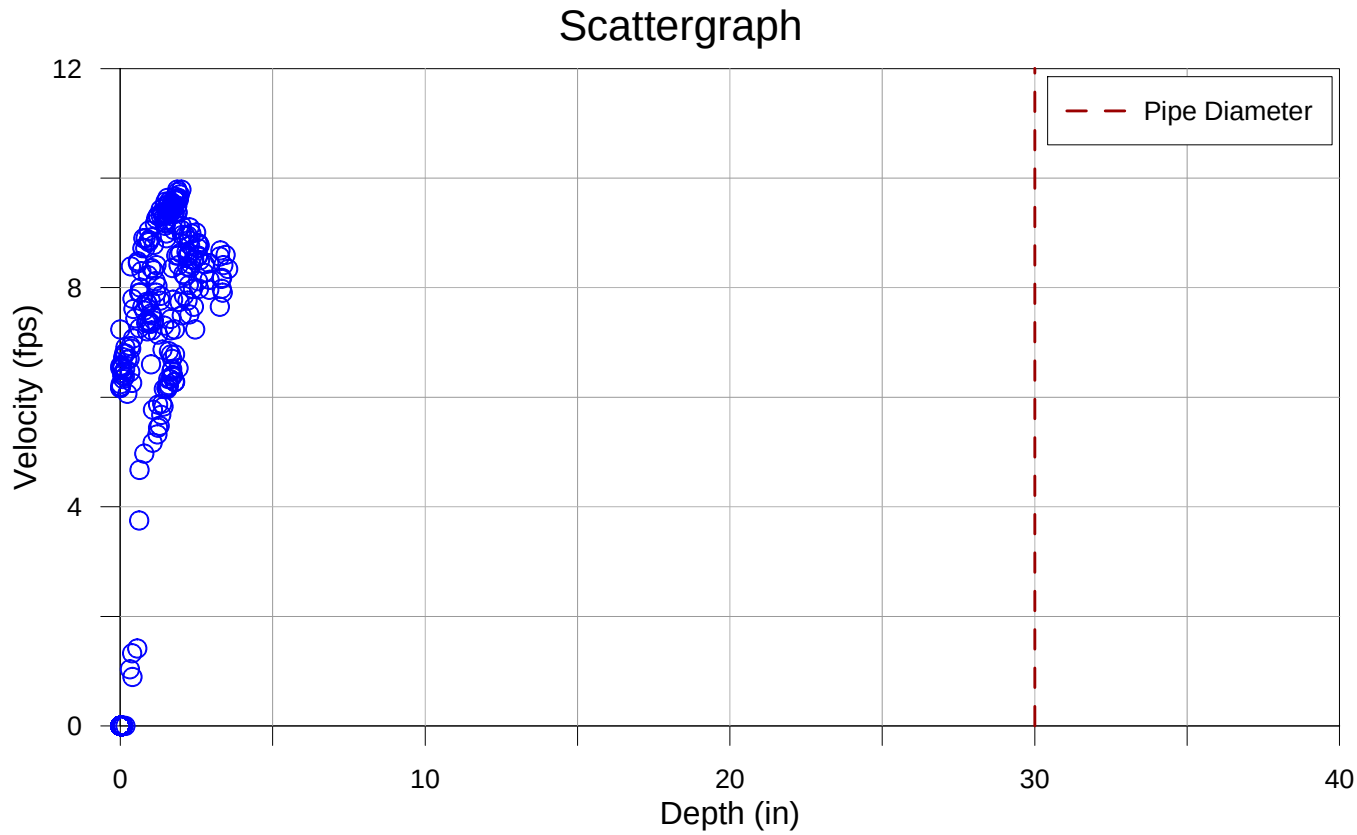


Scattergraph

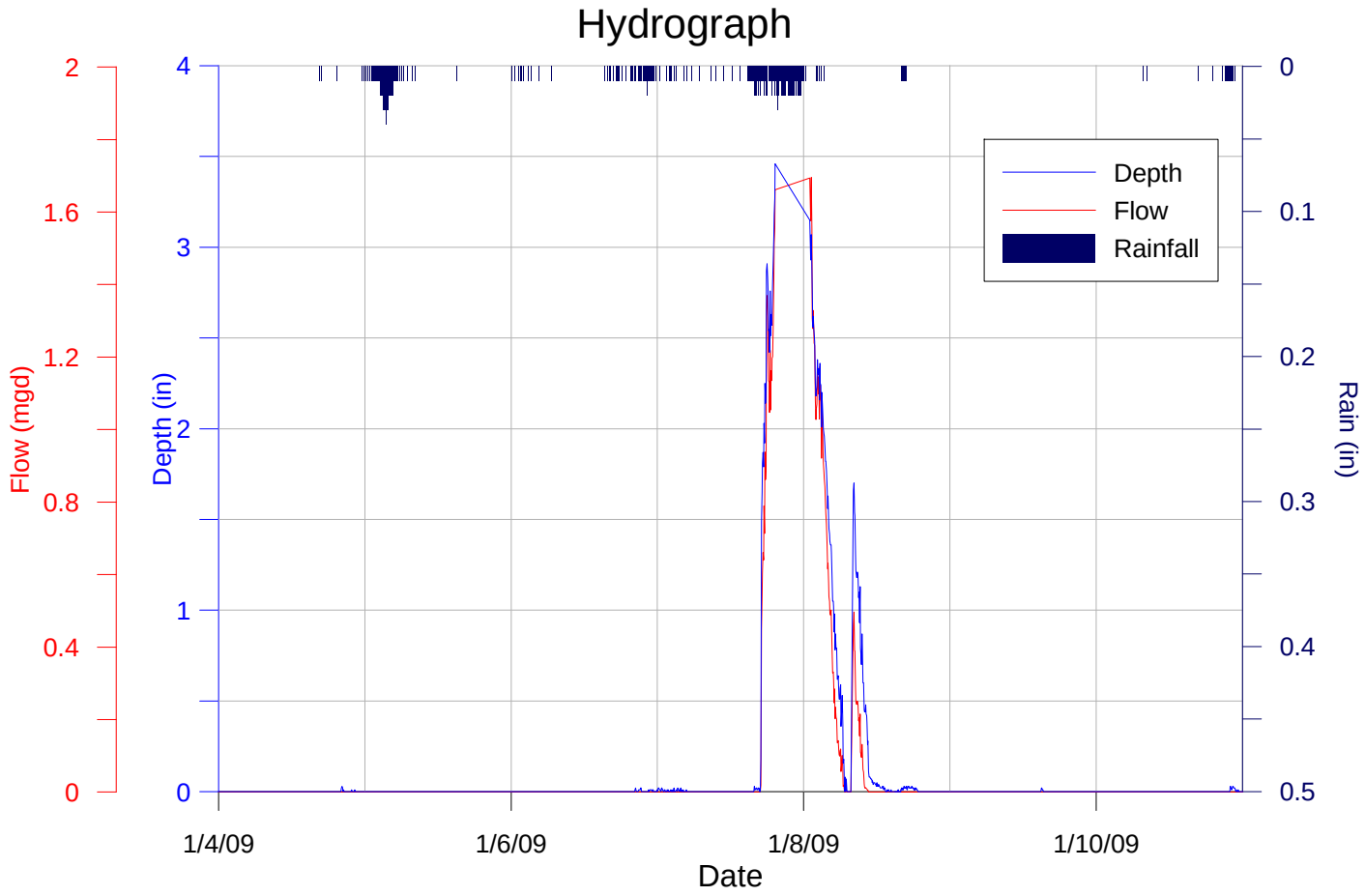


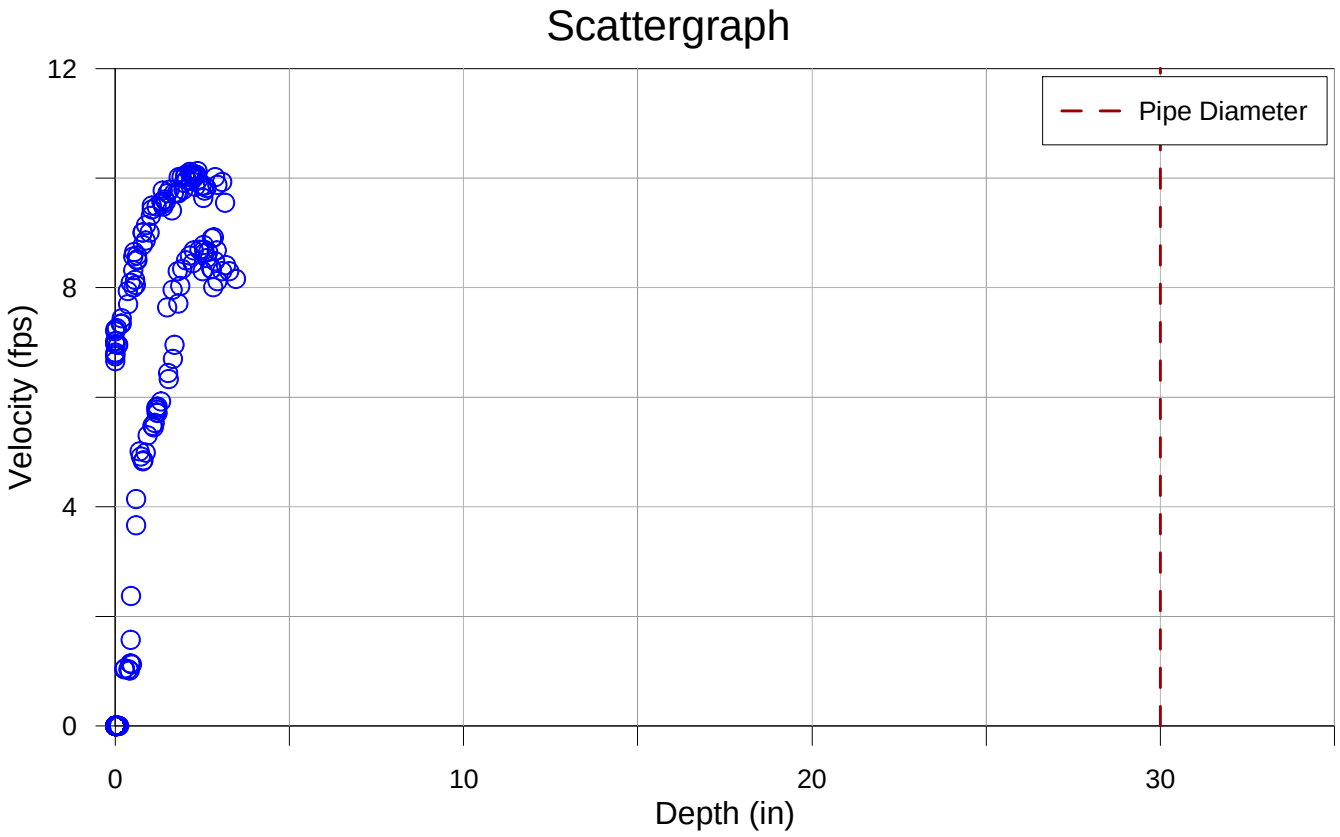
Monitor 067-275 Sensor MP1
November 3 - 15, 2008



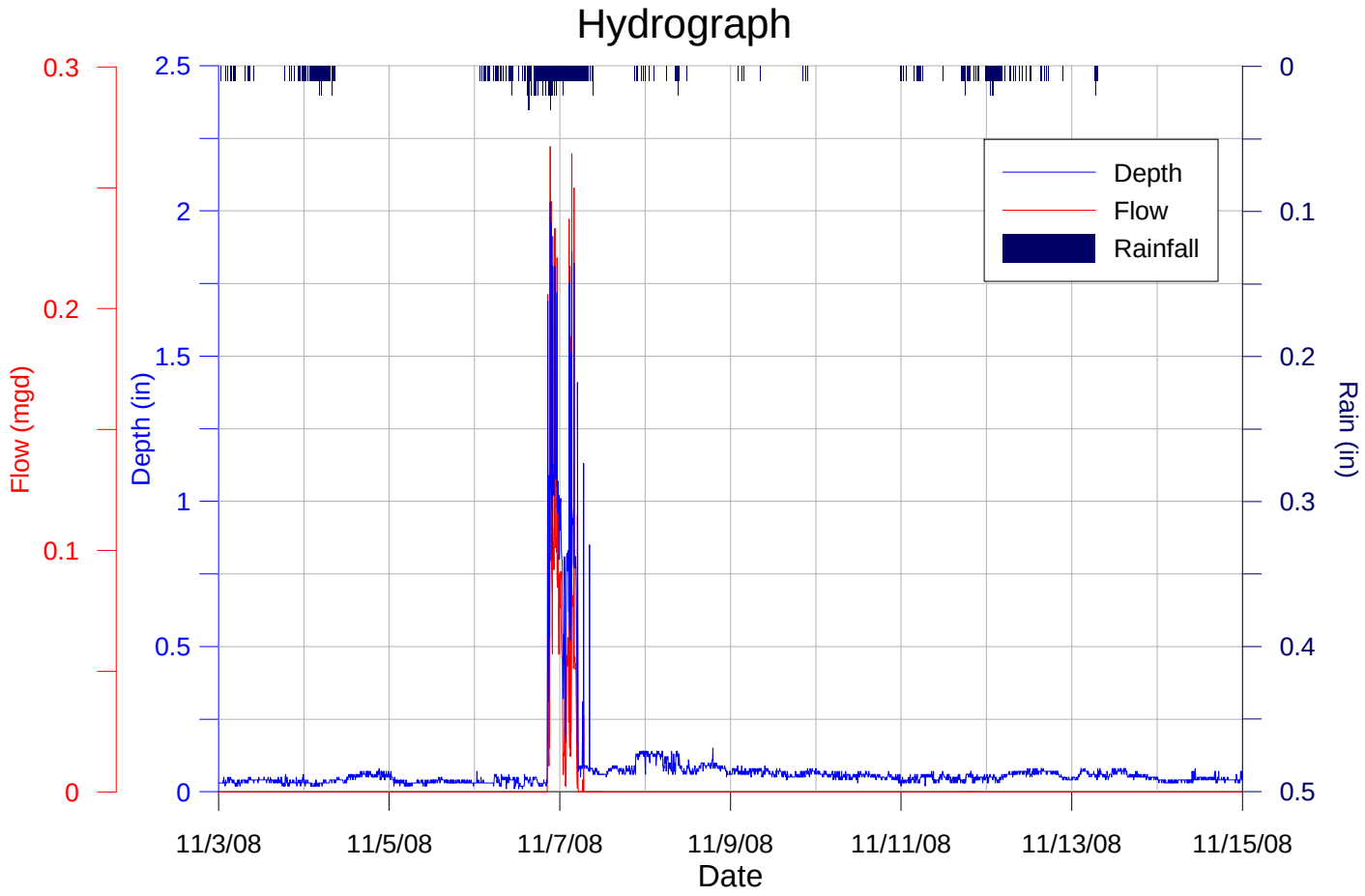


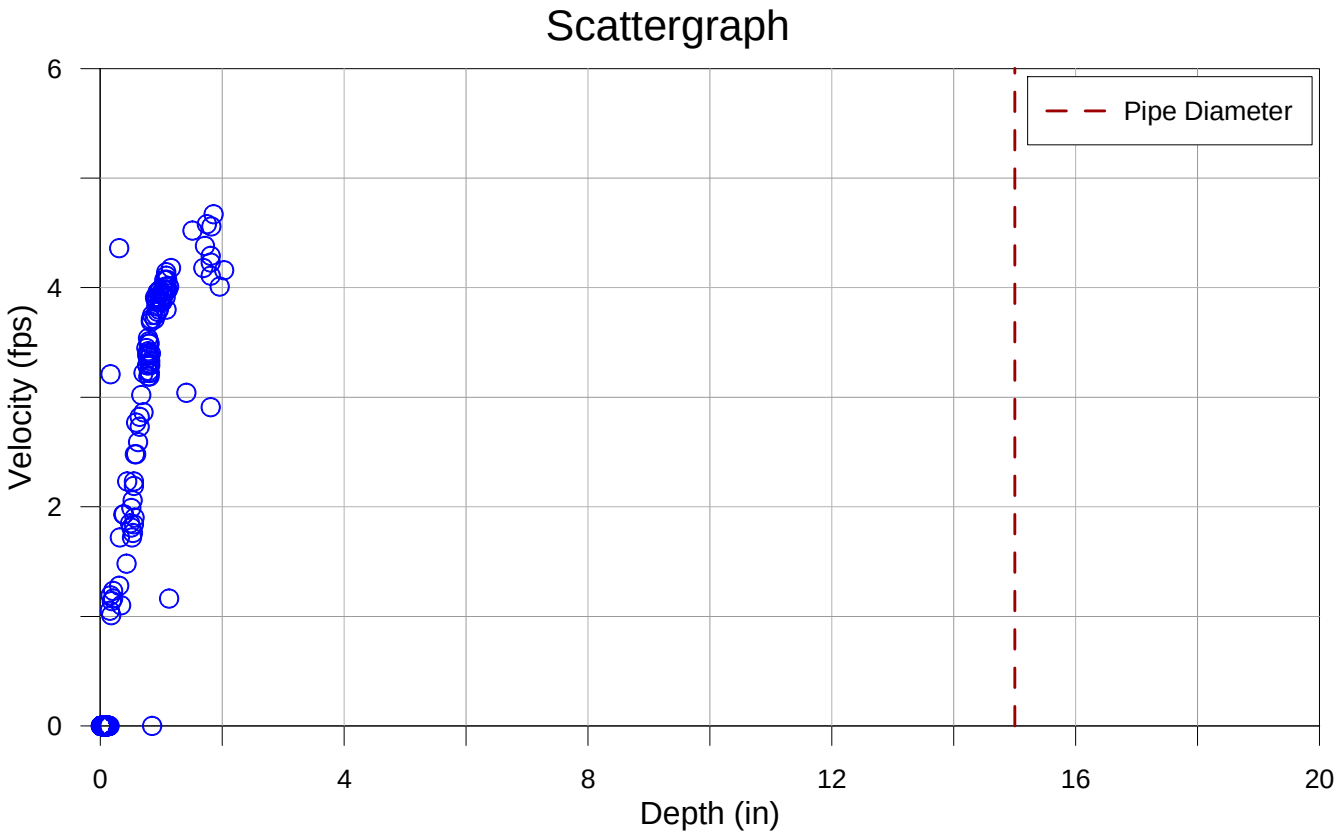
Monitor 067-275 Sensor MP1
January 4 - 11, 2009





Monitor 067-275 Sensor MP2
November 3 - 15, 2008





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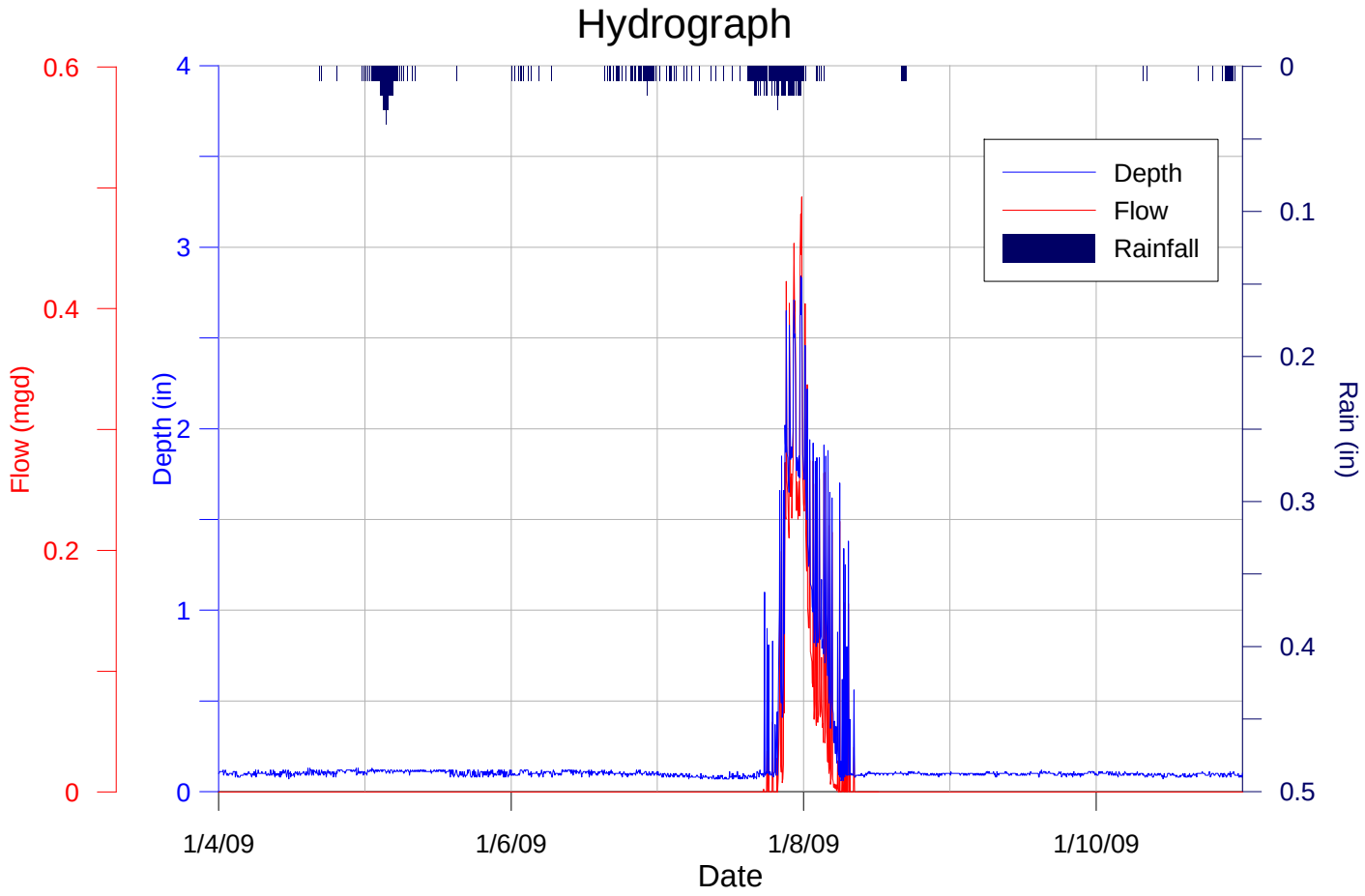
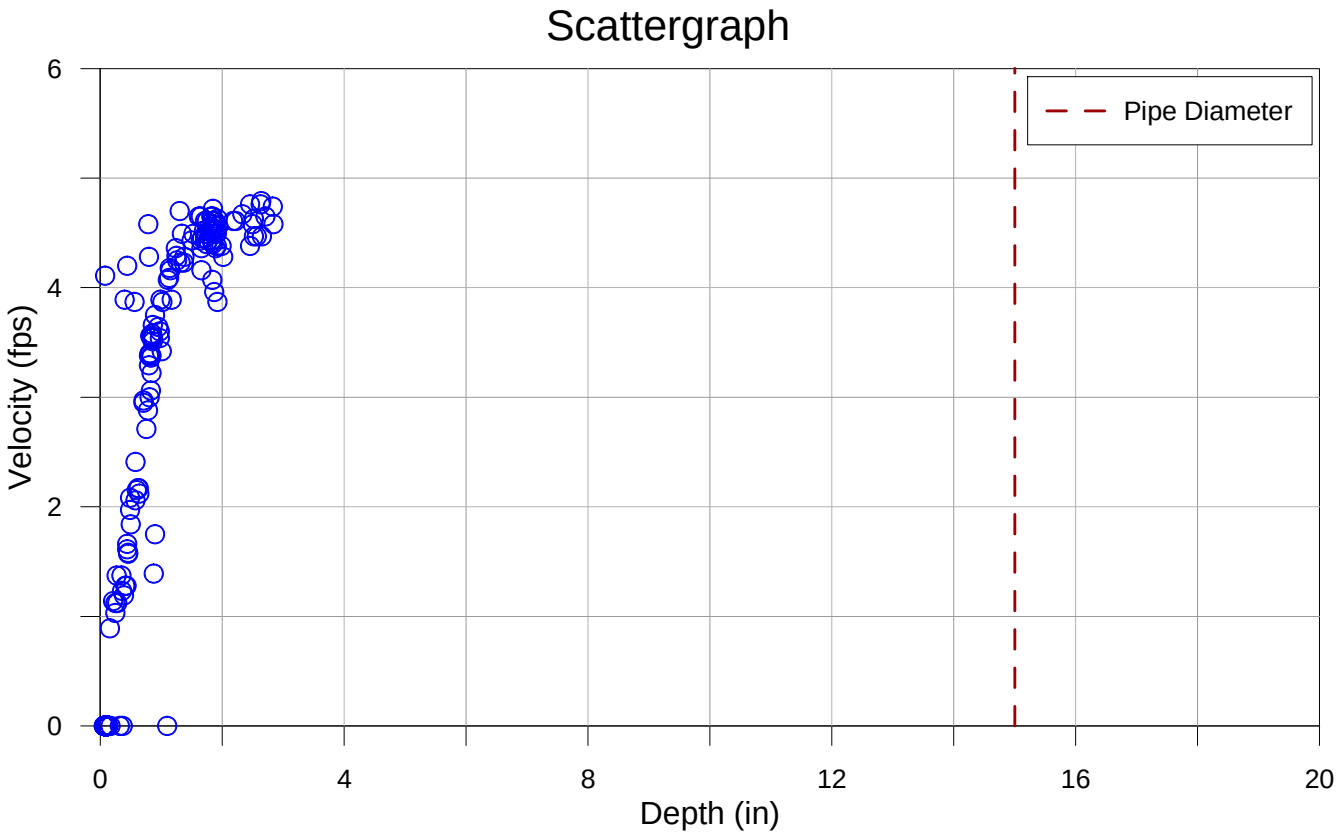
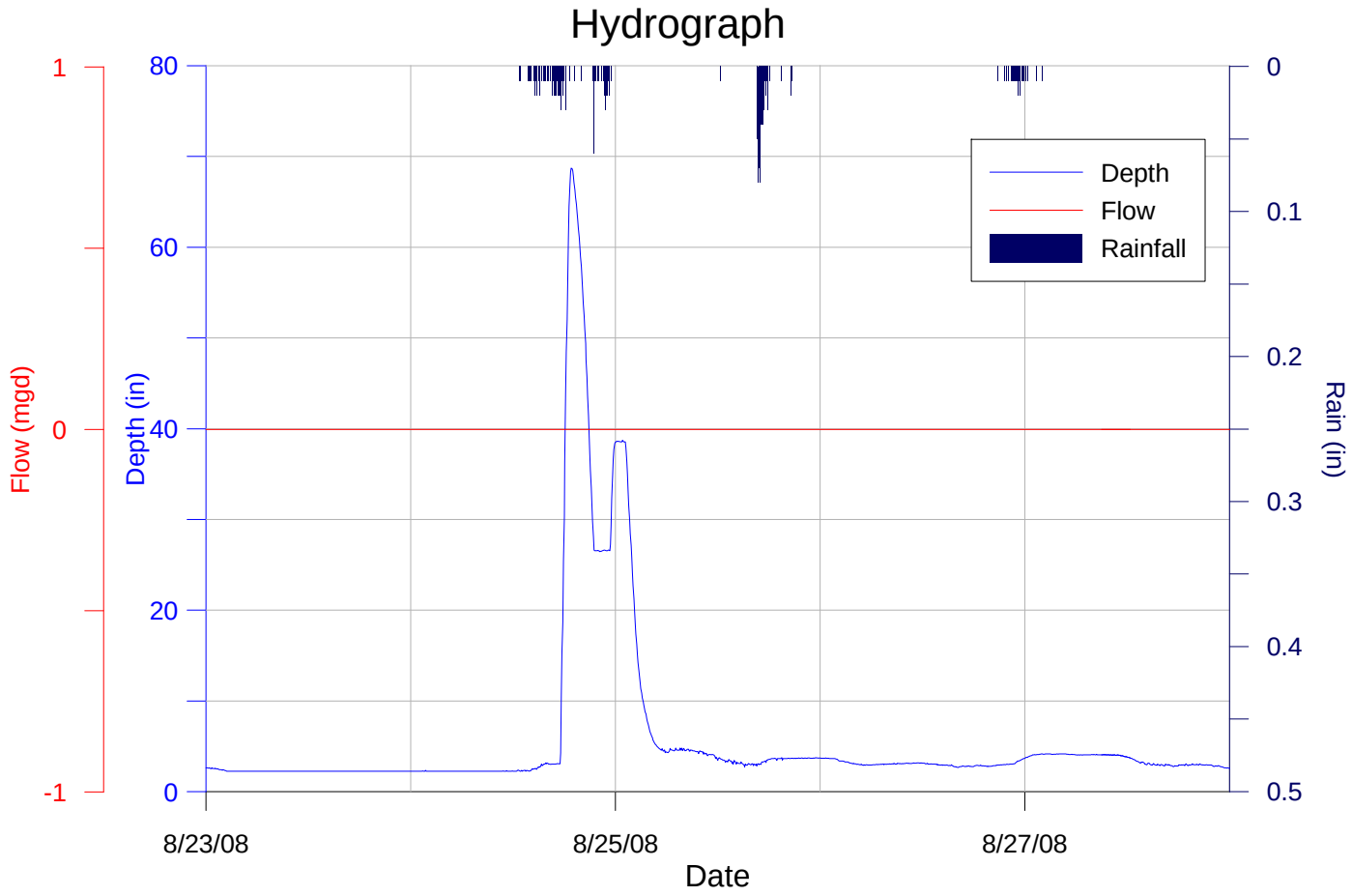
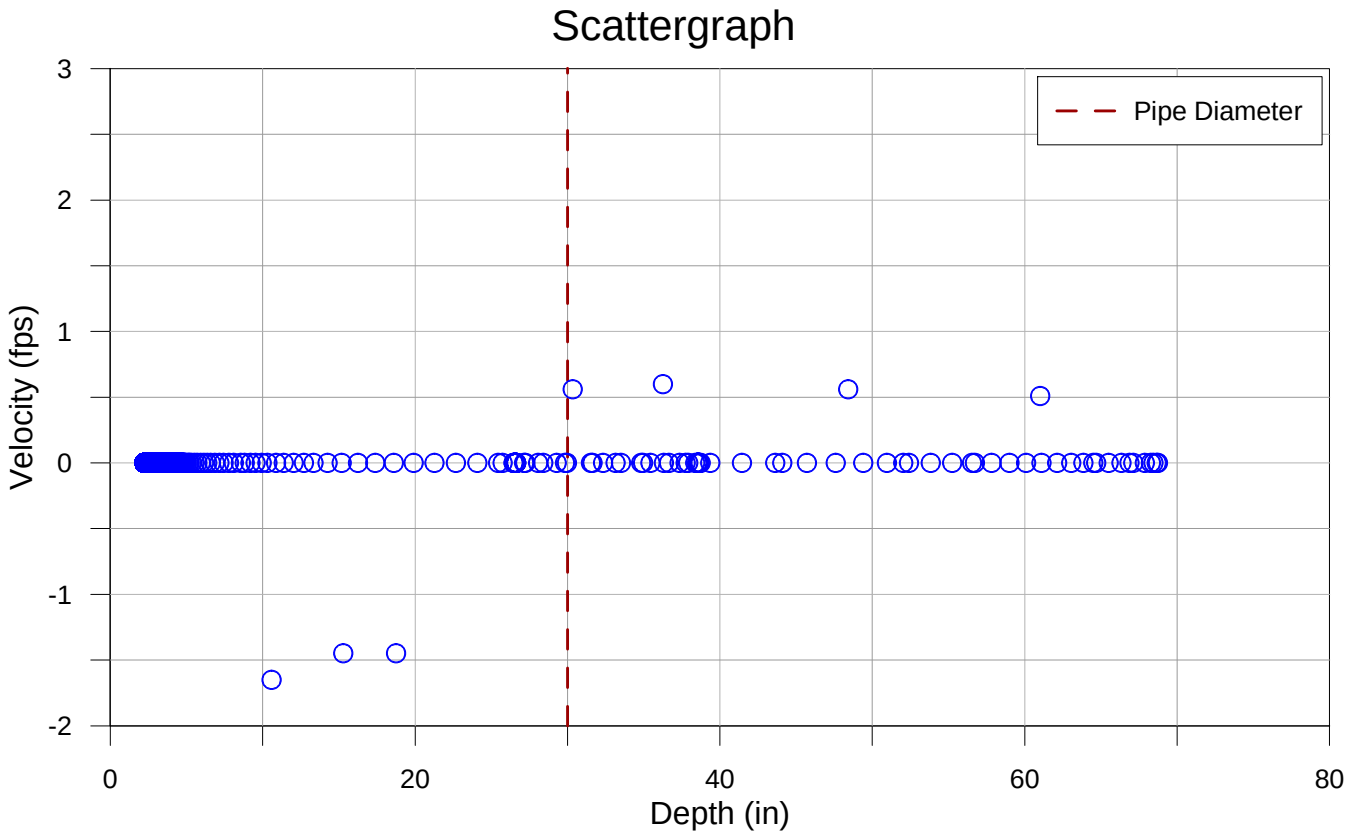
January 4 - 11, 2009



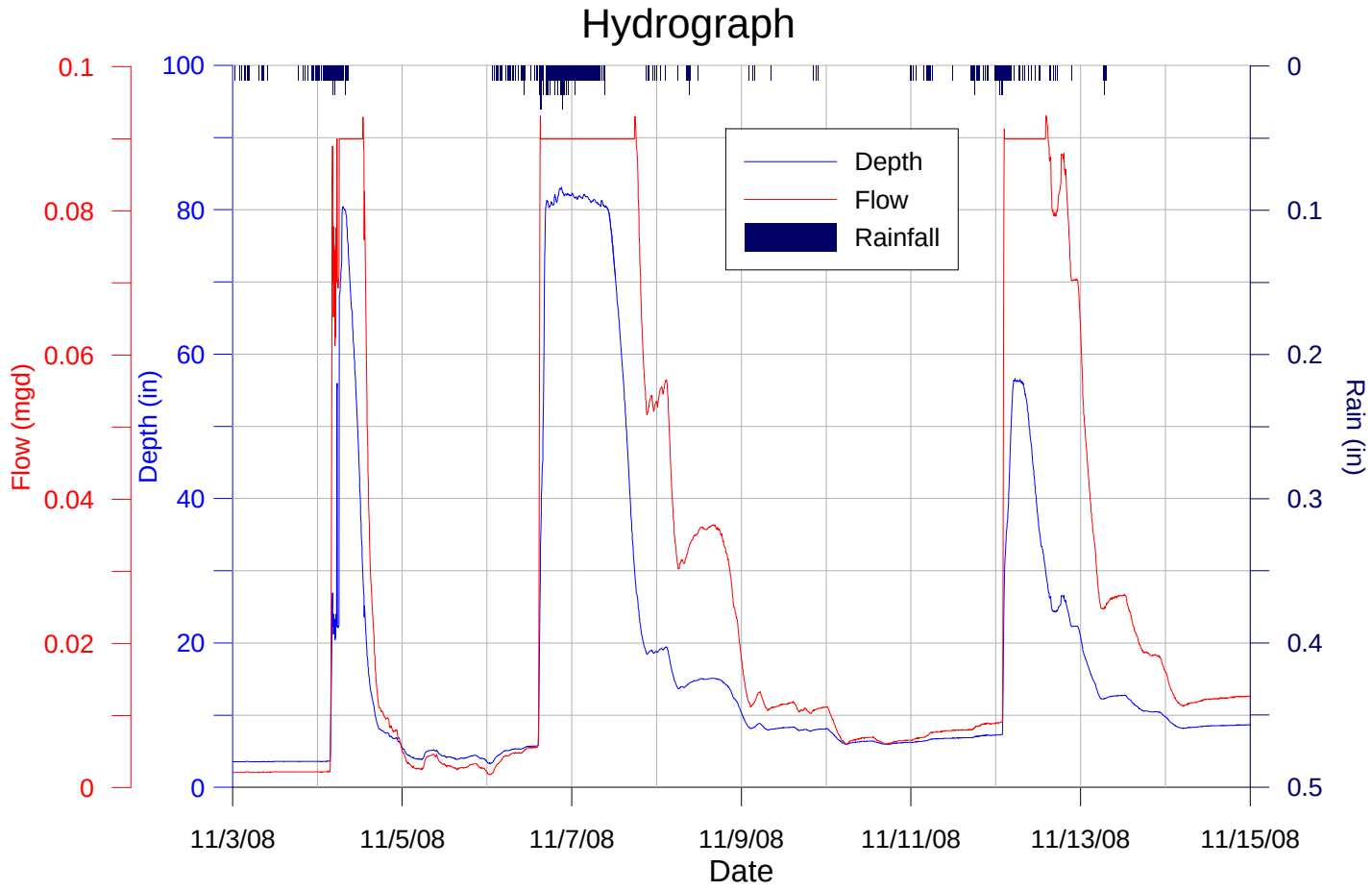


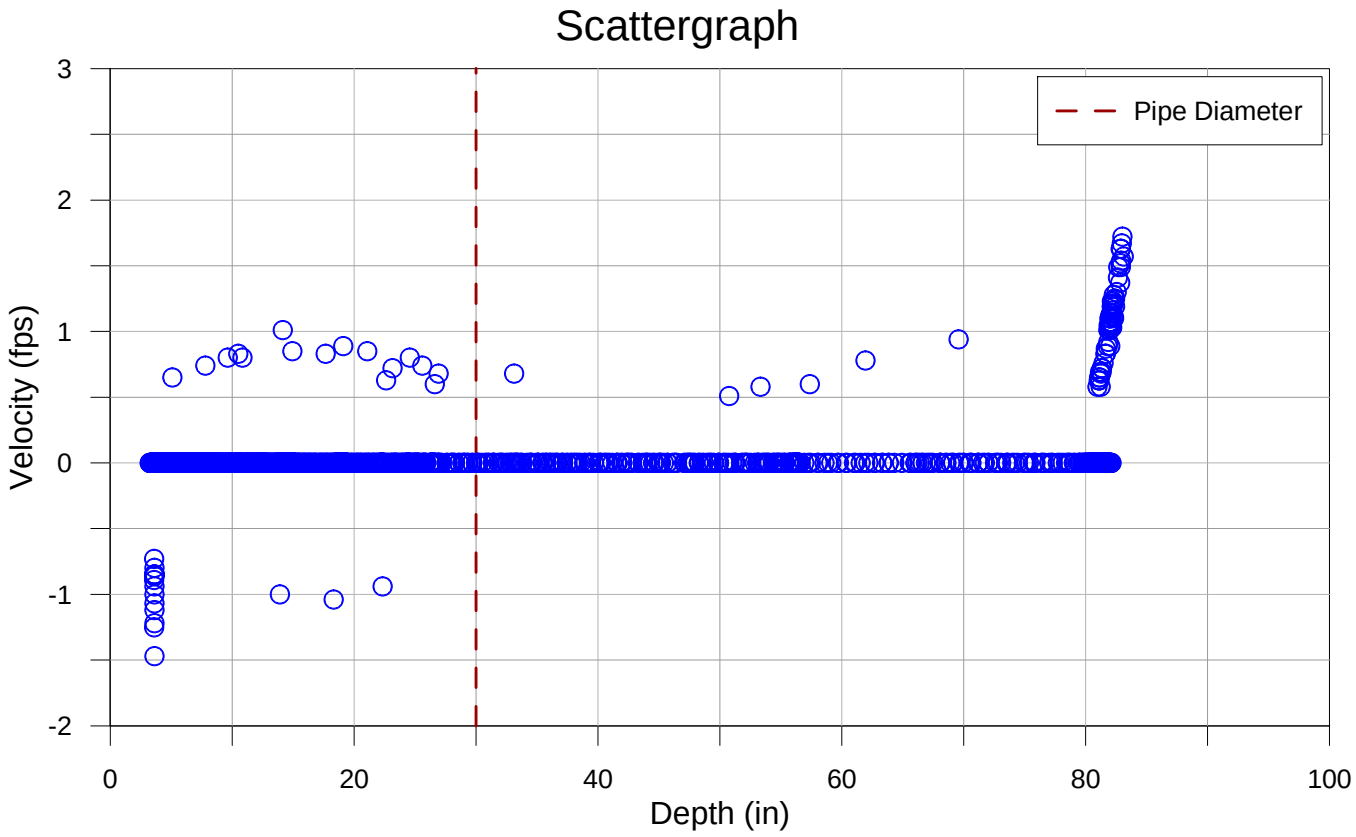
Monitor 067-274 (44A)
August 23 - 28, 2008



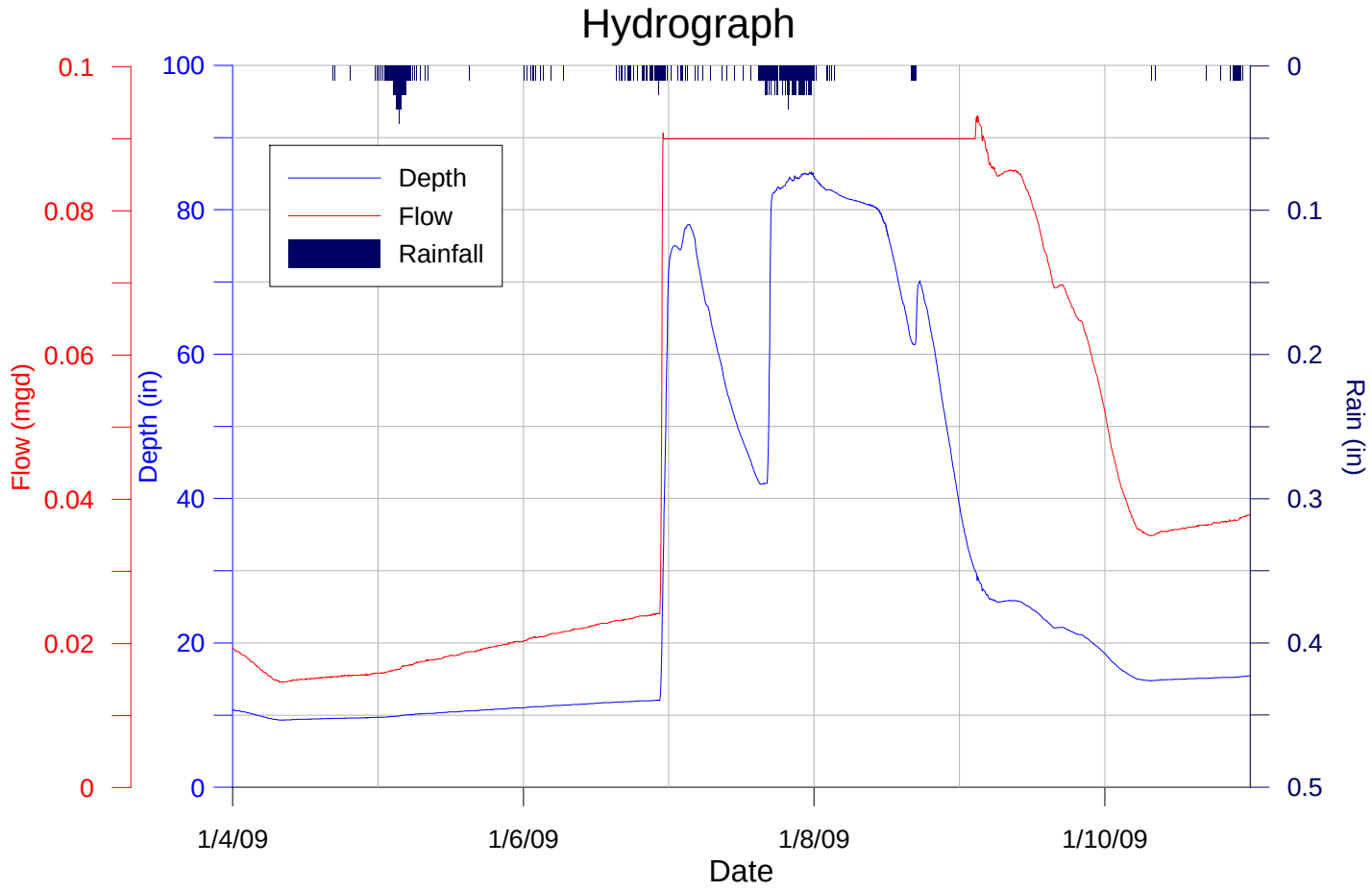


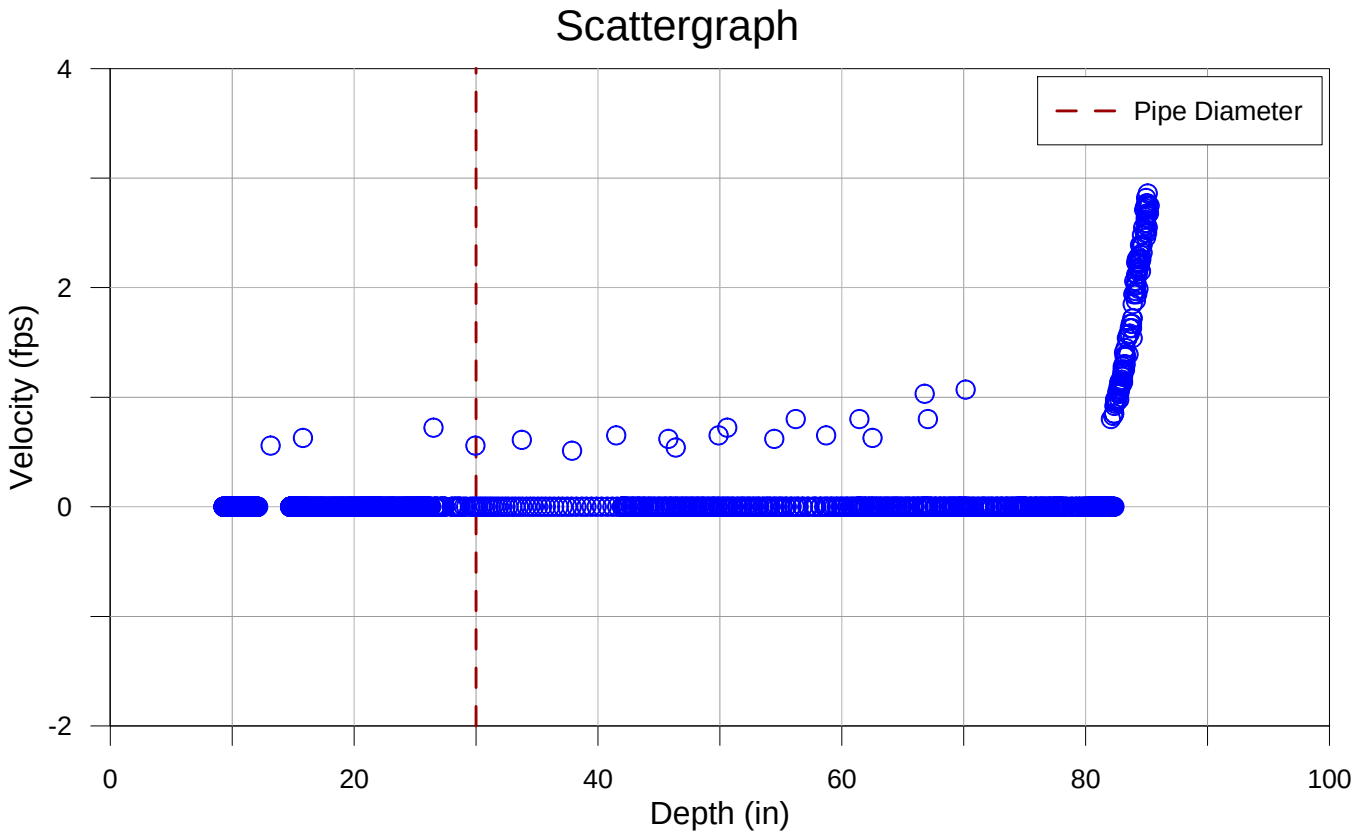
Monitor 067-274 (44A)
November 3 - 15, 2008





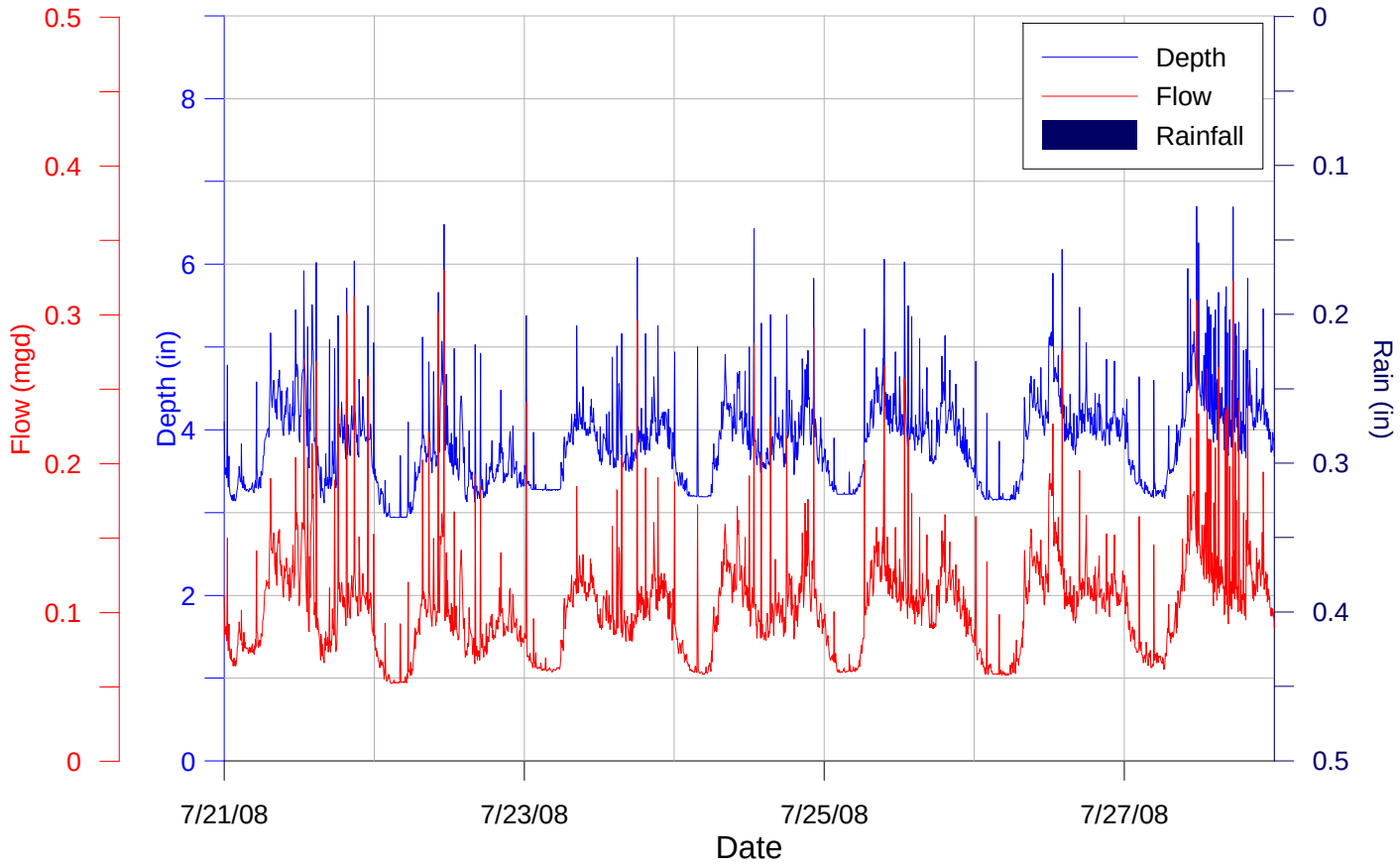
Monitor 067-274 (44A)
January 4 - 11, 2009



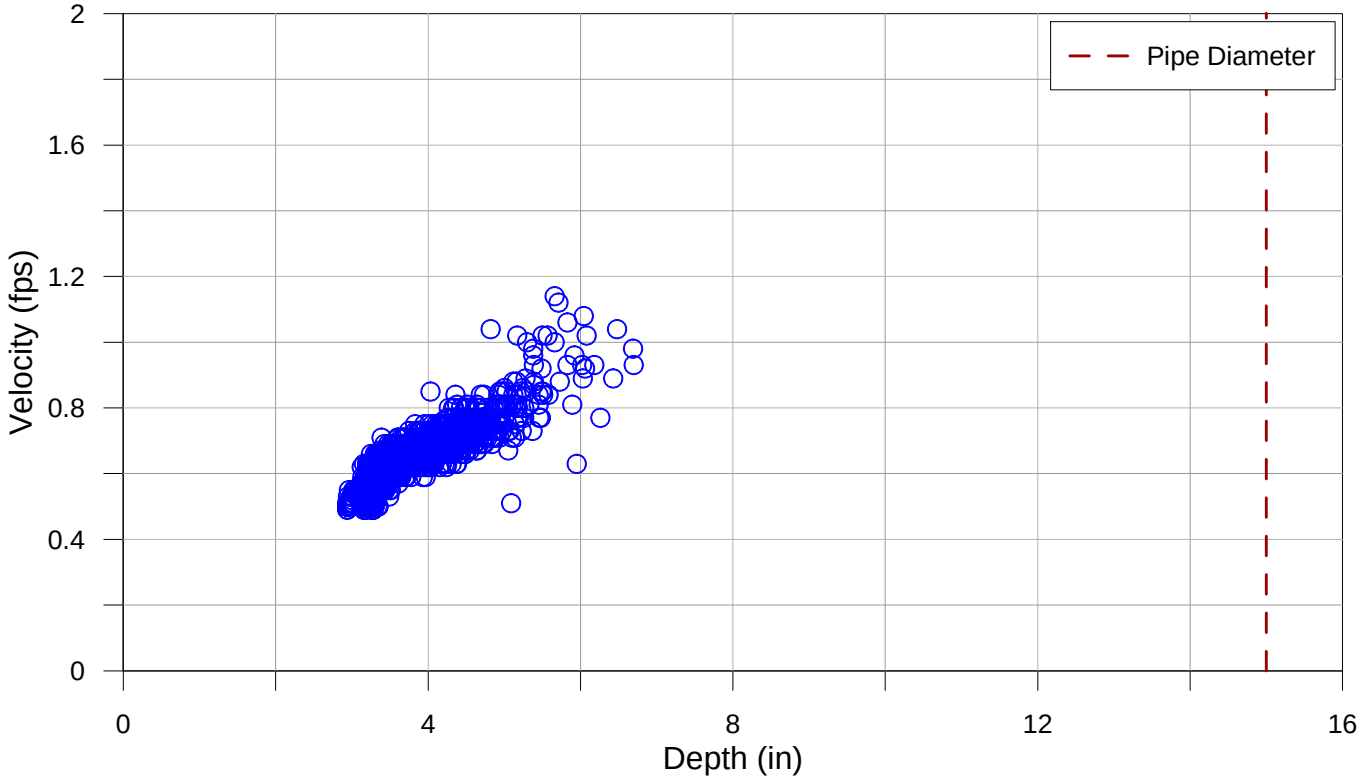


Monitor 067-261 (44B)
July 21 - 28, 2008

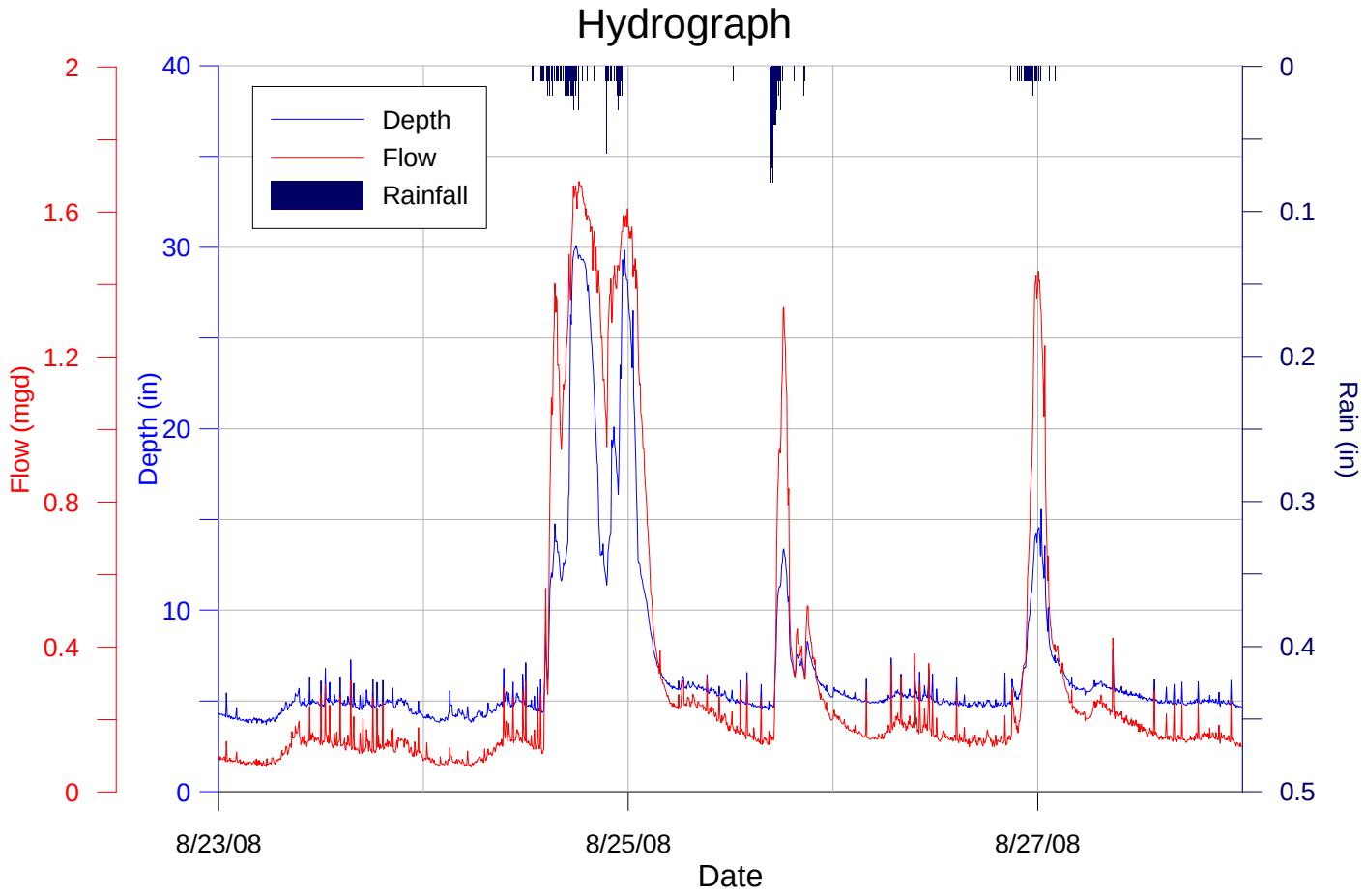
Hydrograph

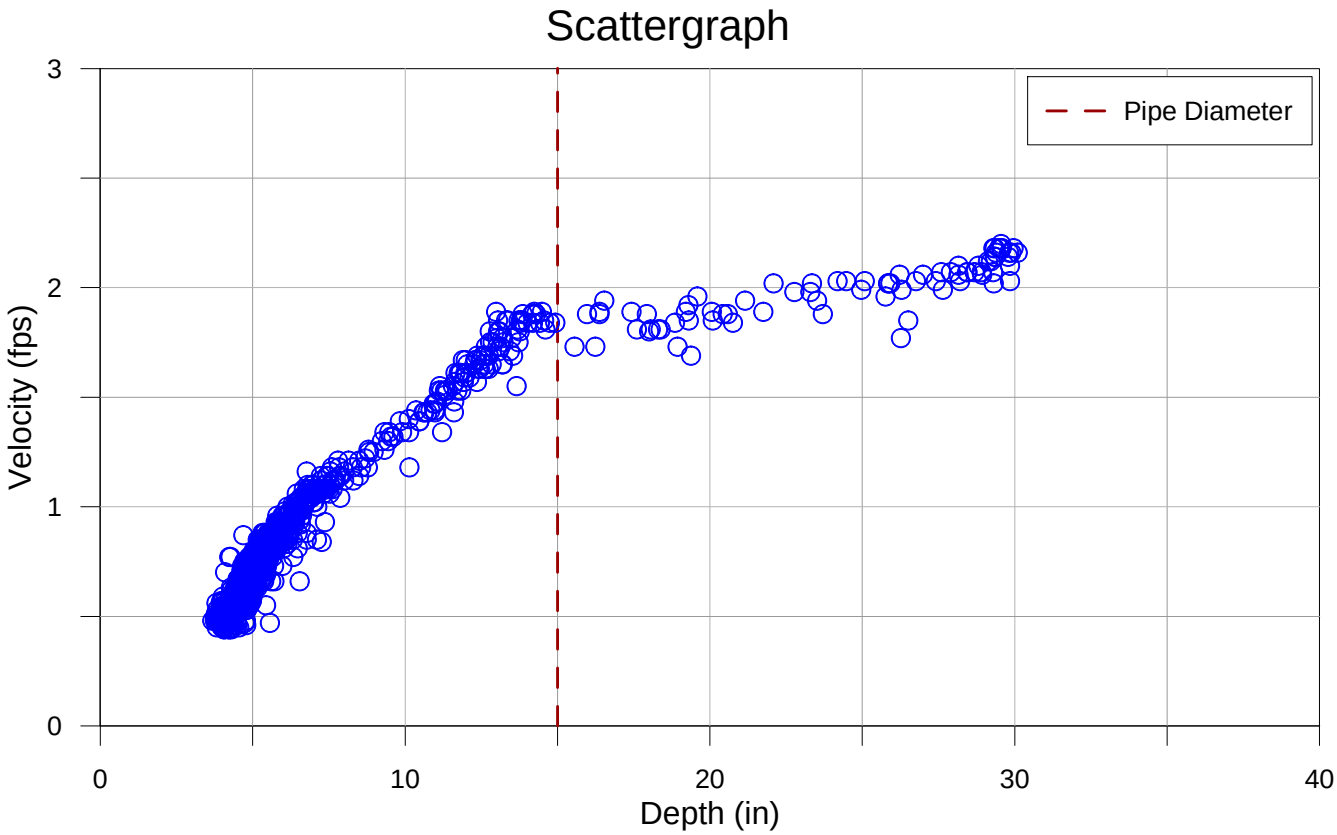


Scattergraph

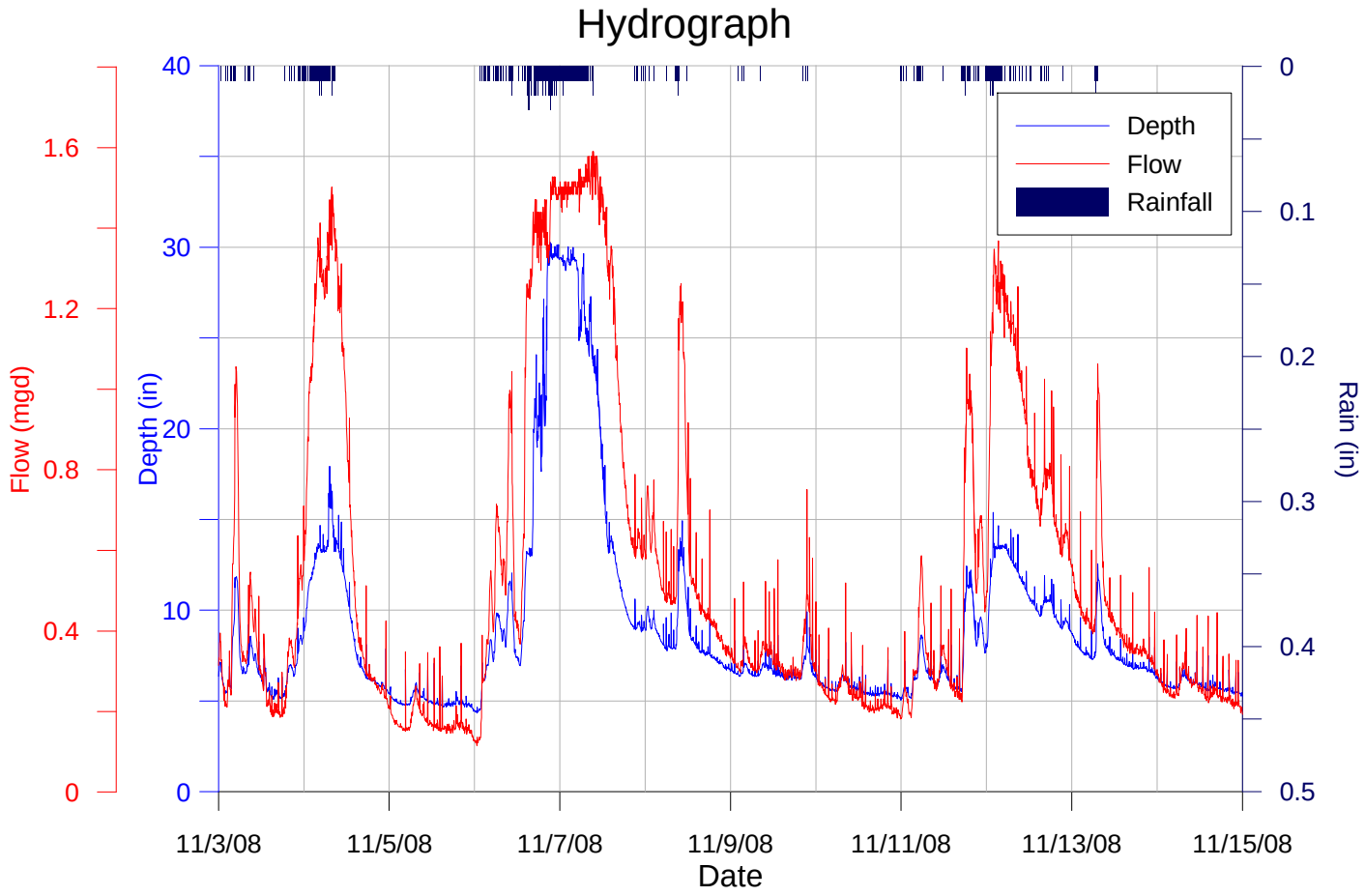


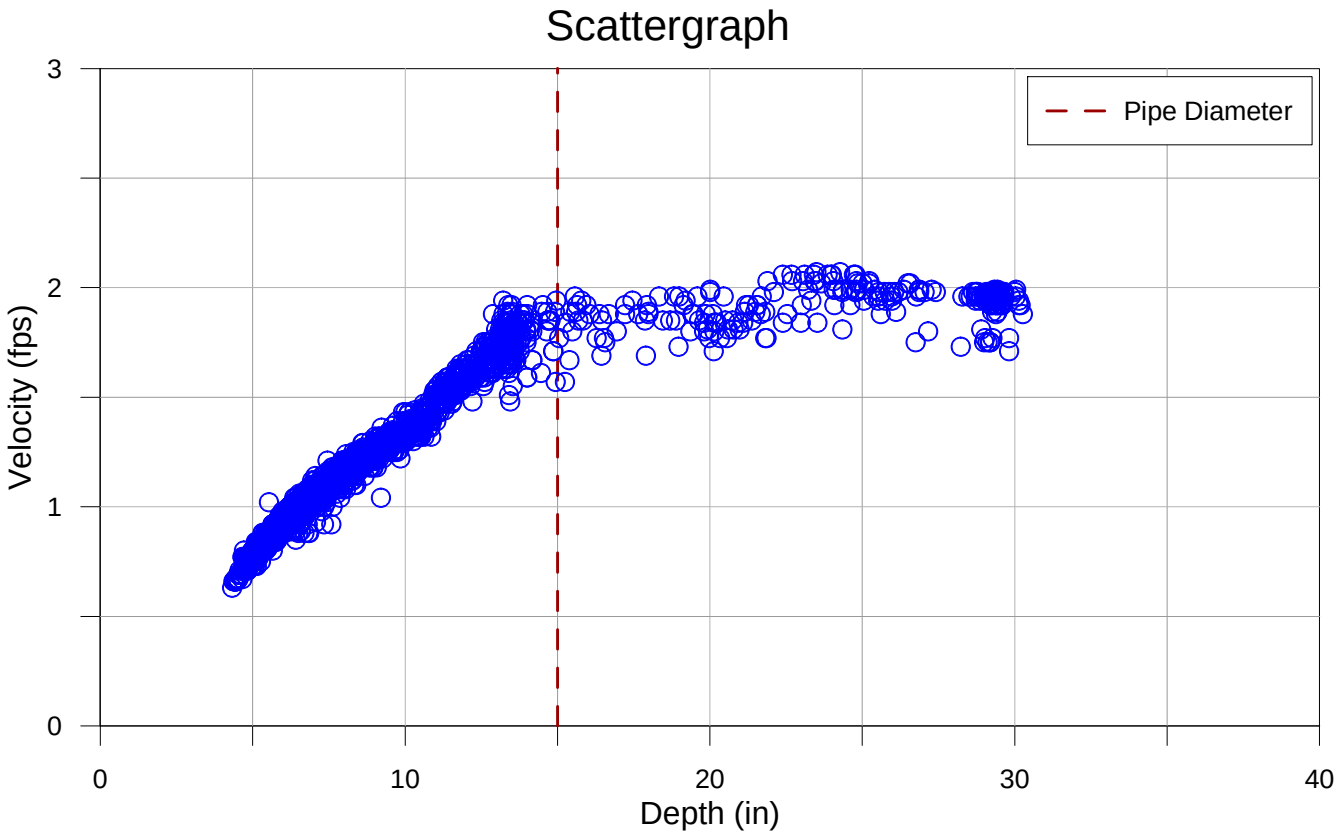
Monitor 067-261 (44B)
August 23 - 28, 2008



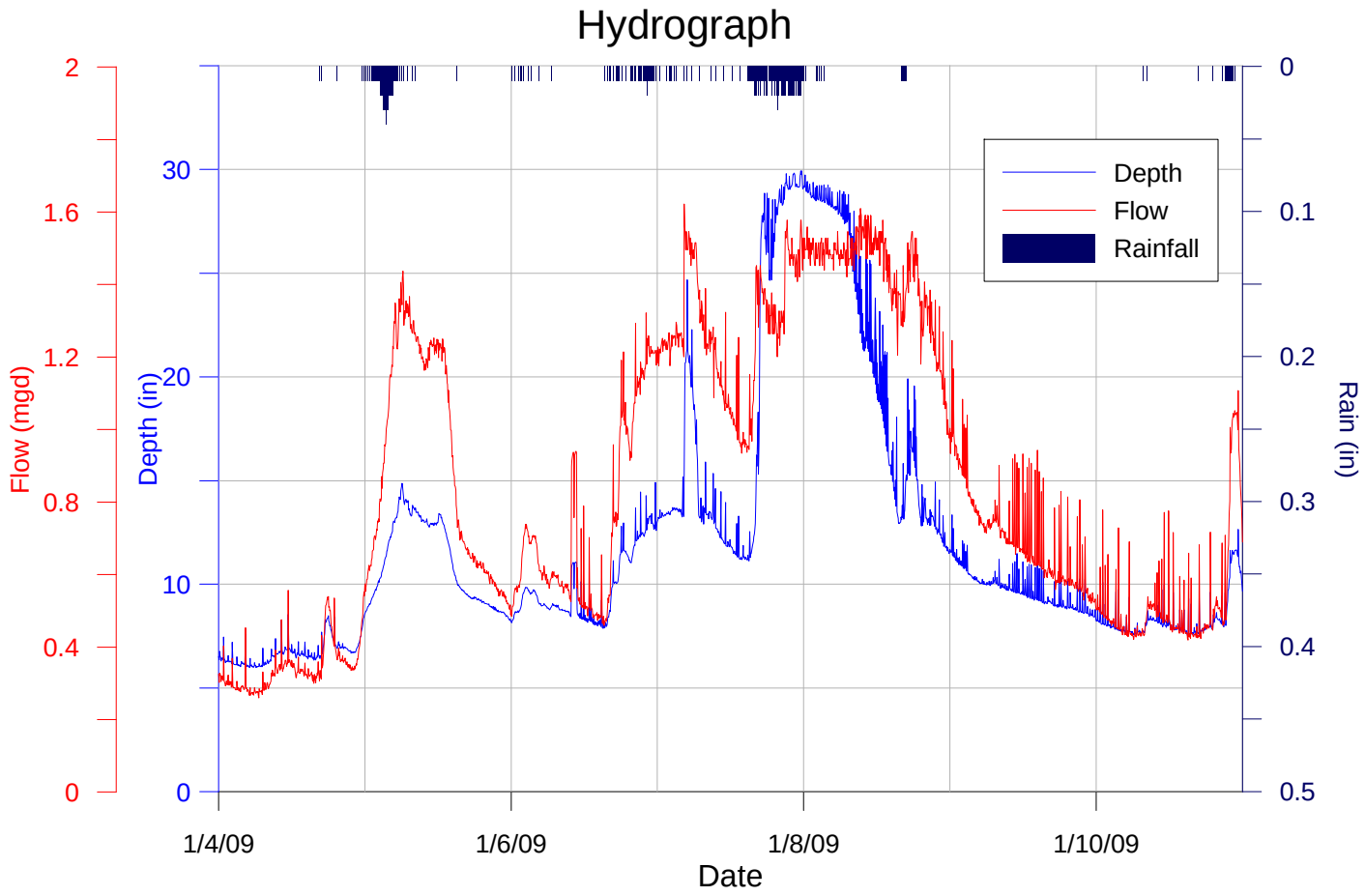


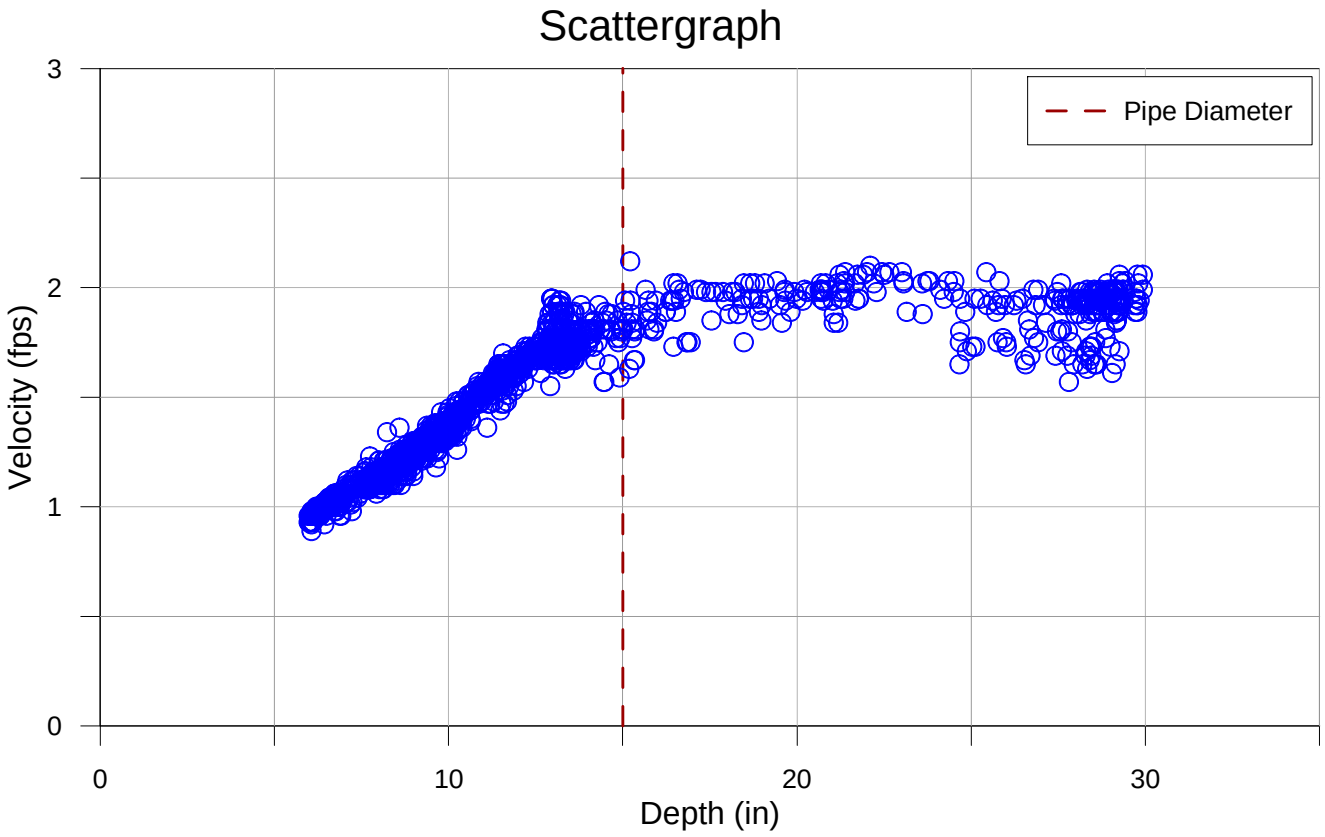
Monitor 067-261 (44B)
November 3 - 15, 2008



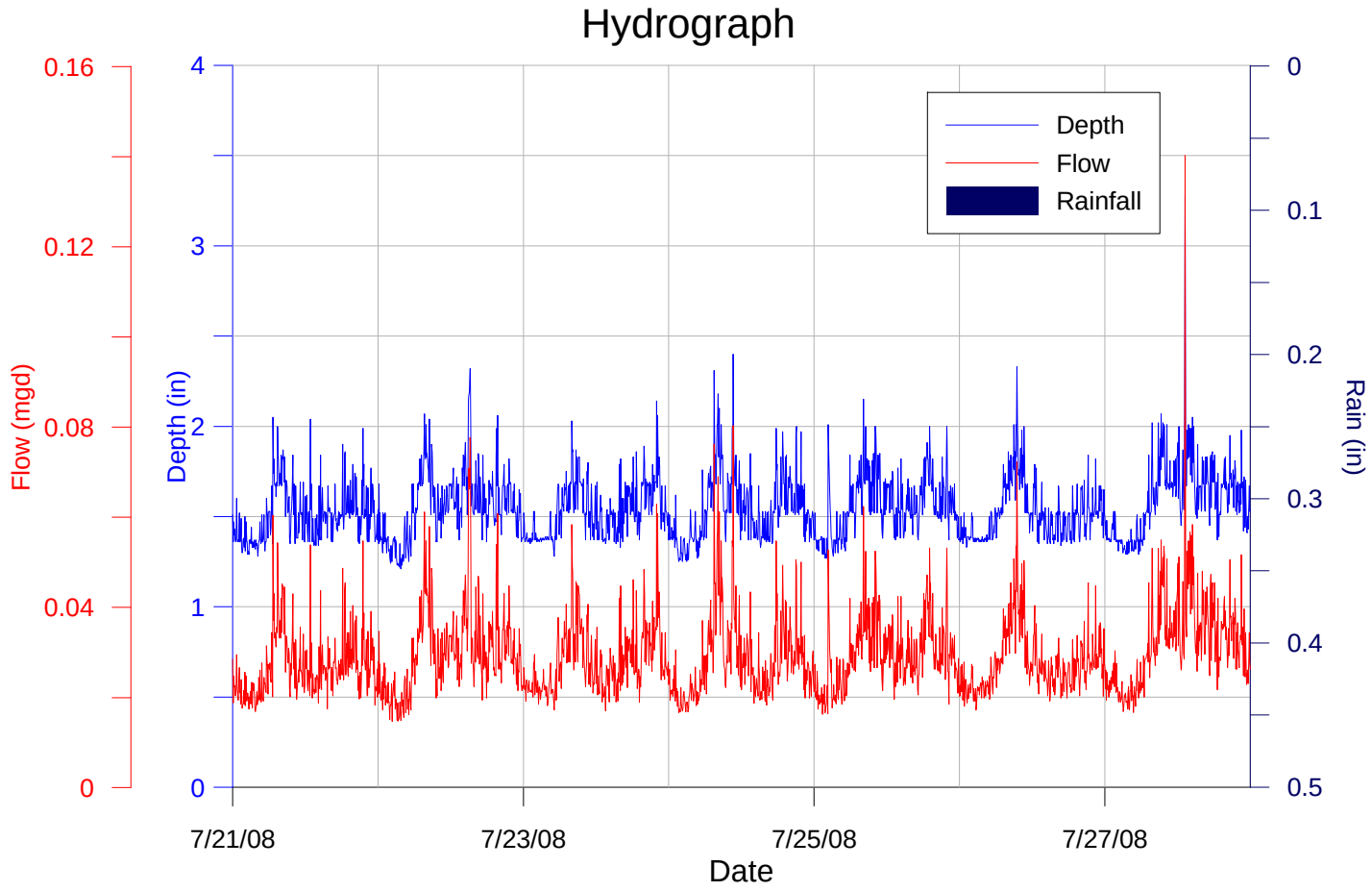


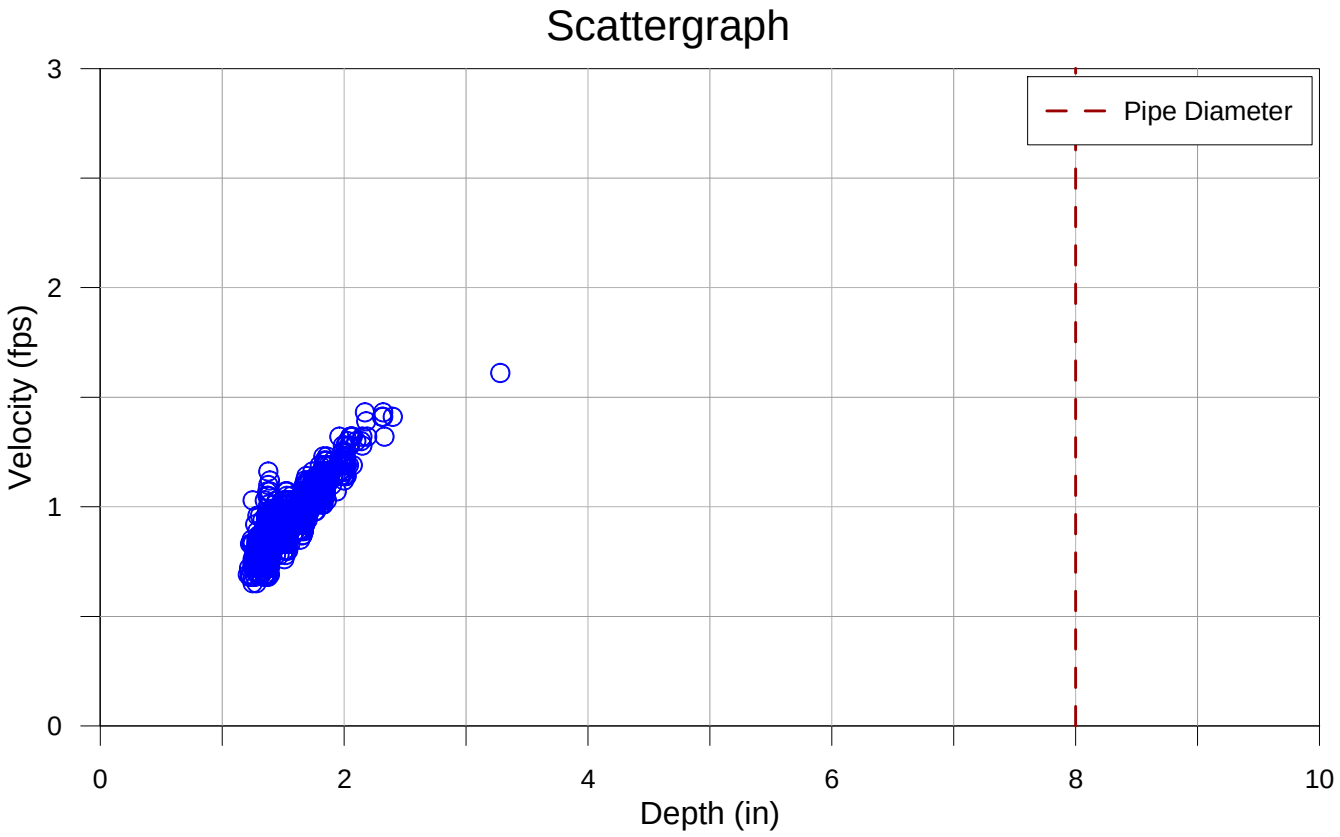
Monitor 067-261 (44B)
January 4 - 11, 2009



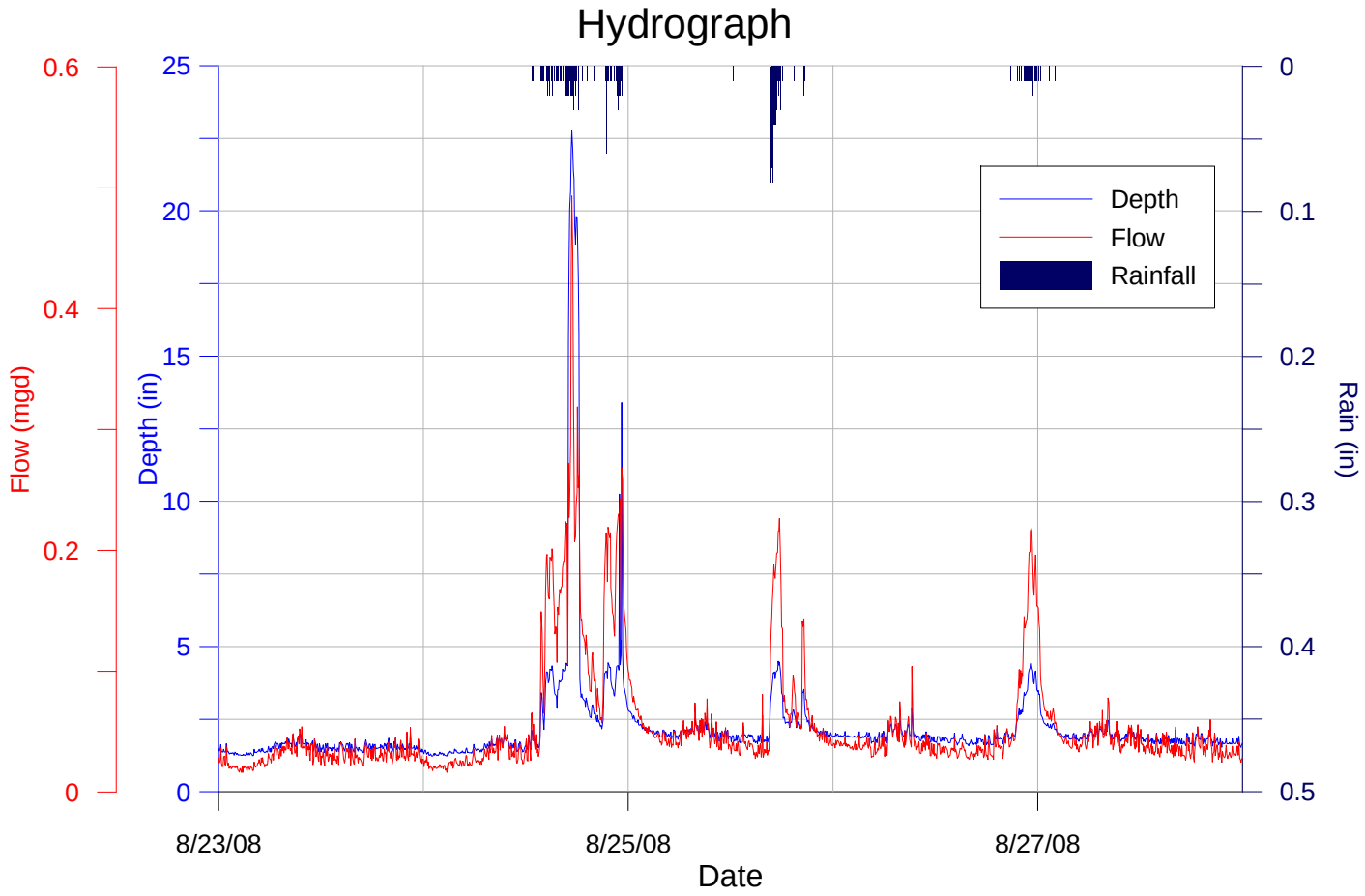


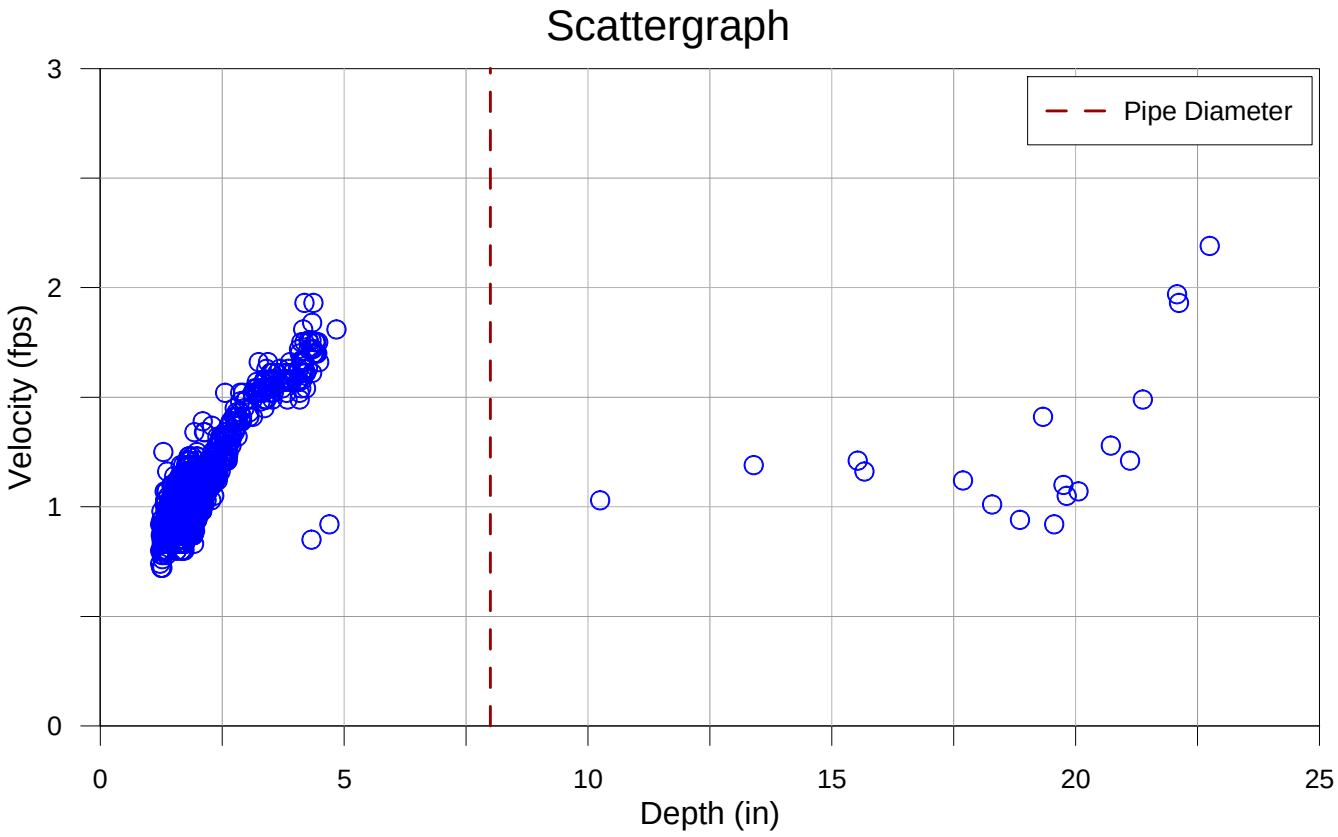
Monitor 074-152
July 21 - 28, 2008



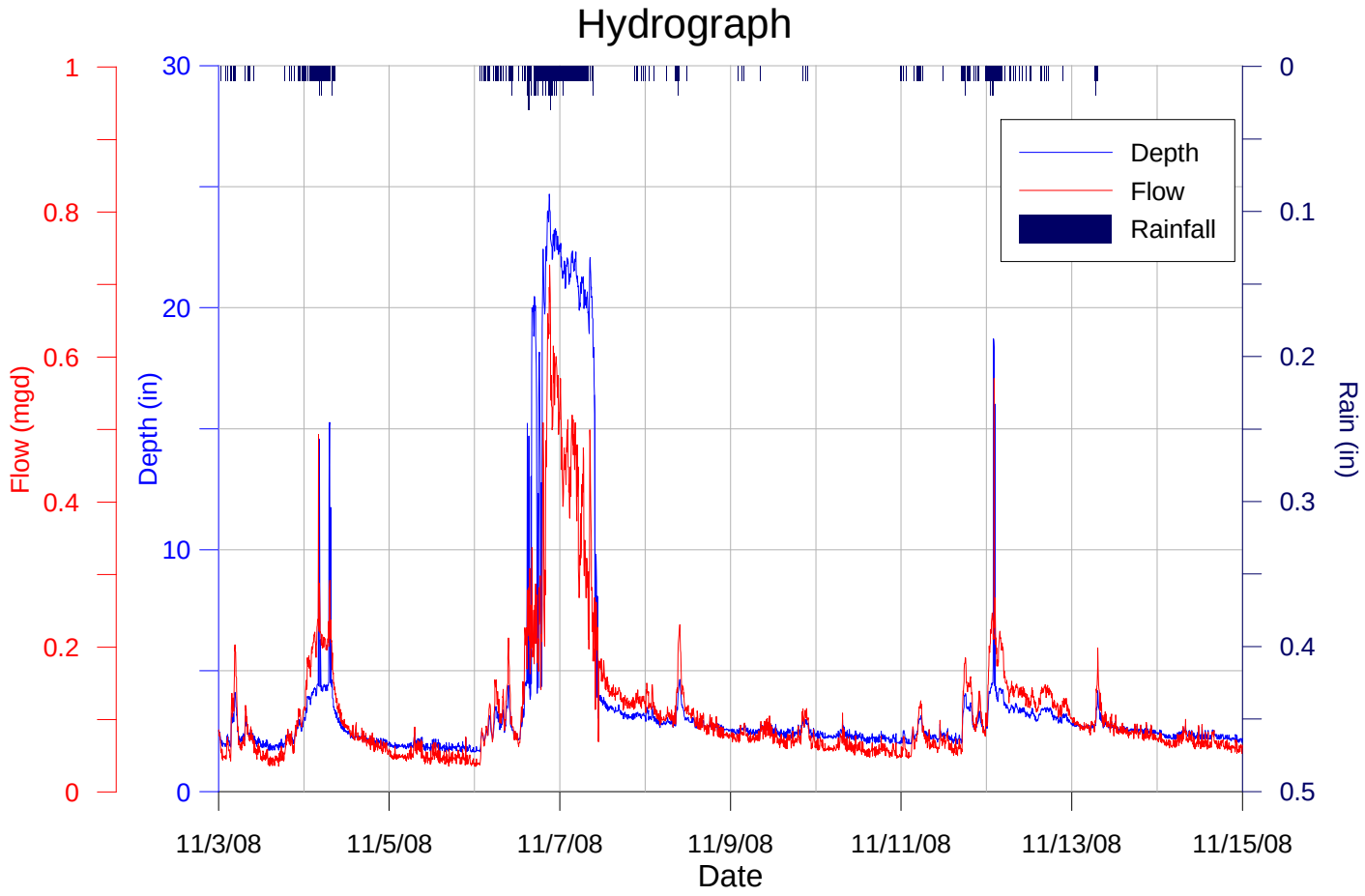


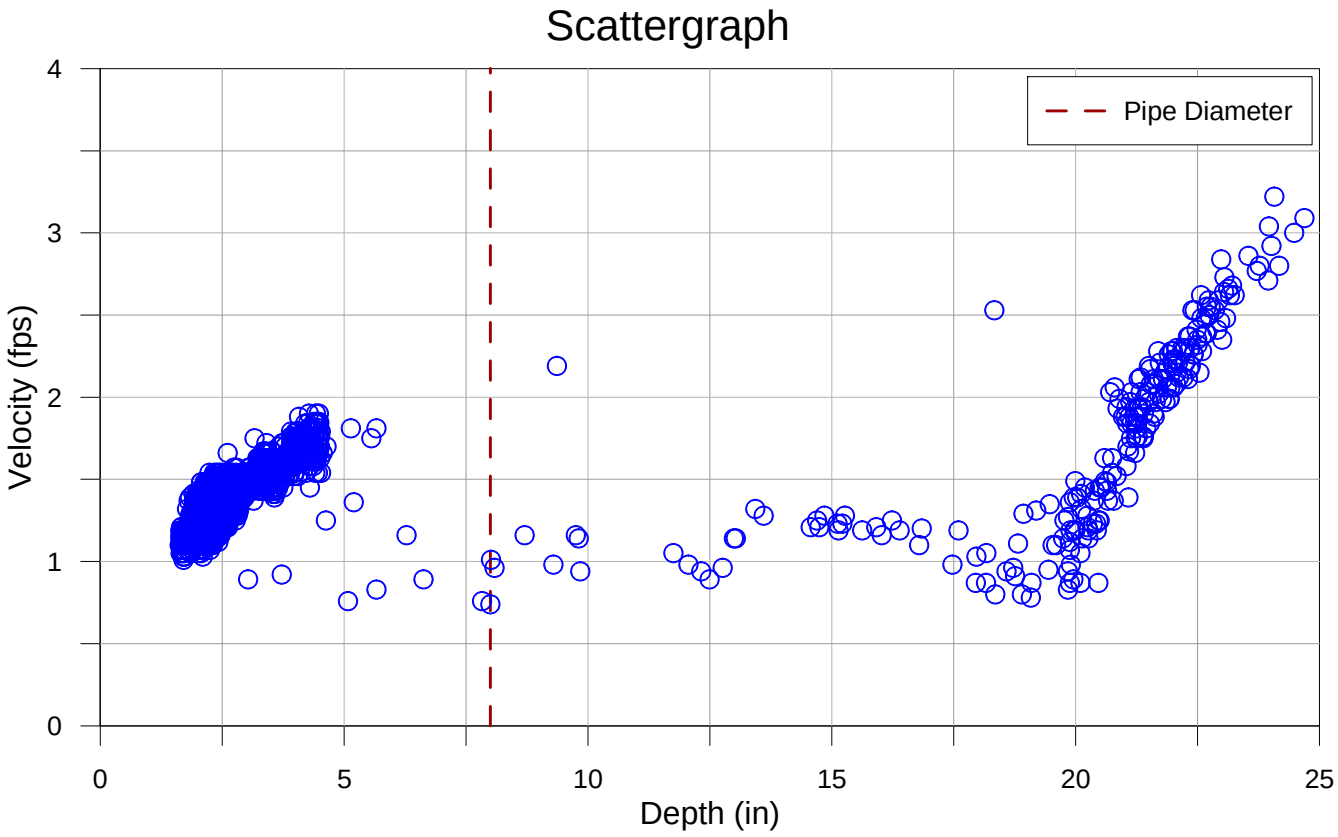
Monitor 074-152
August 23 - 28, 2008



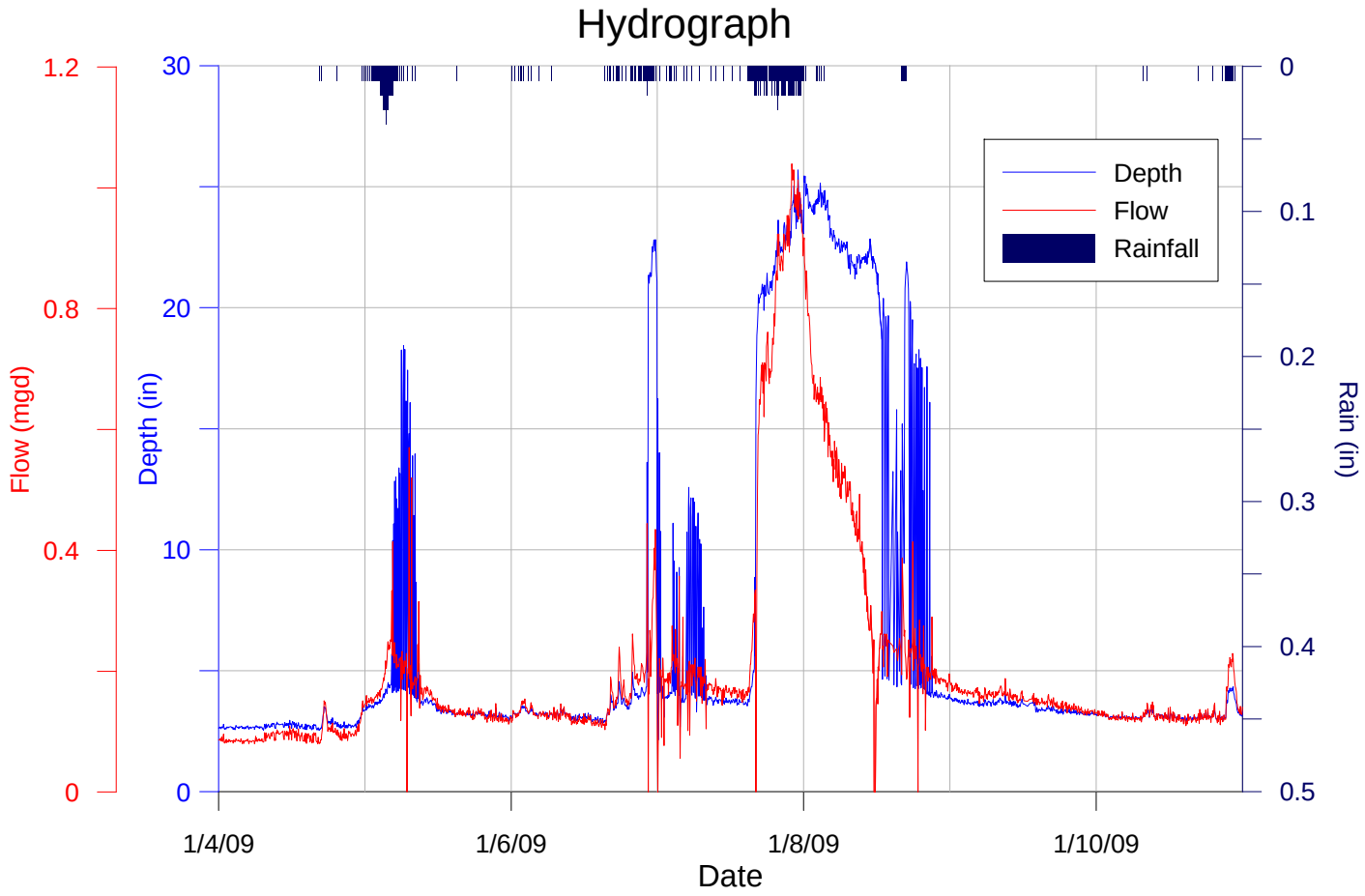


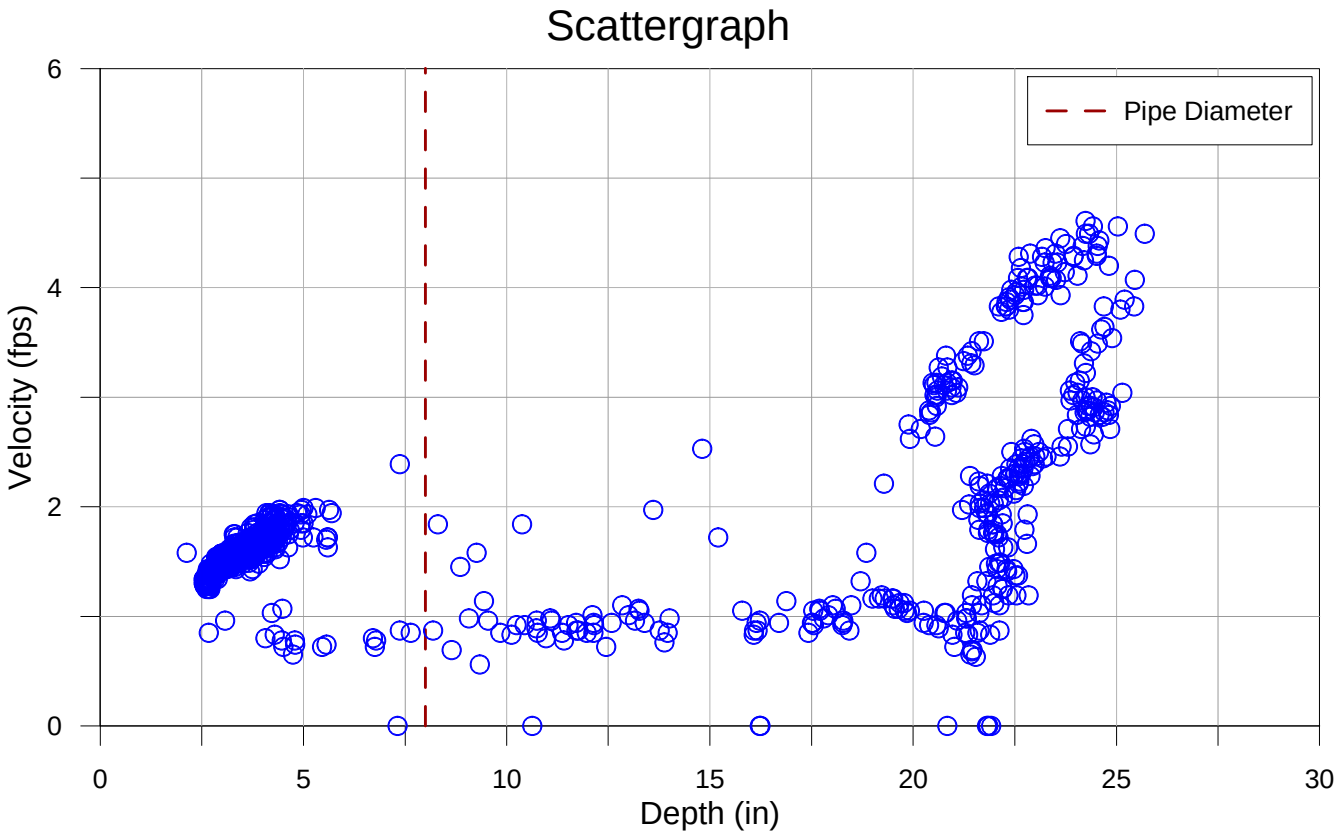
Monitor 074-152
November 3 - 15, 2008



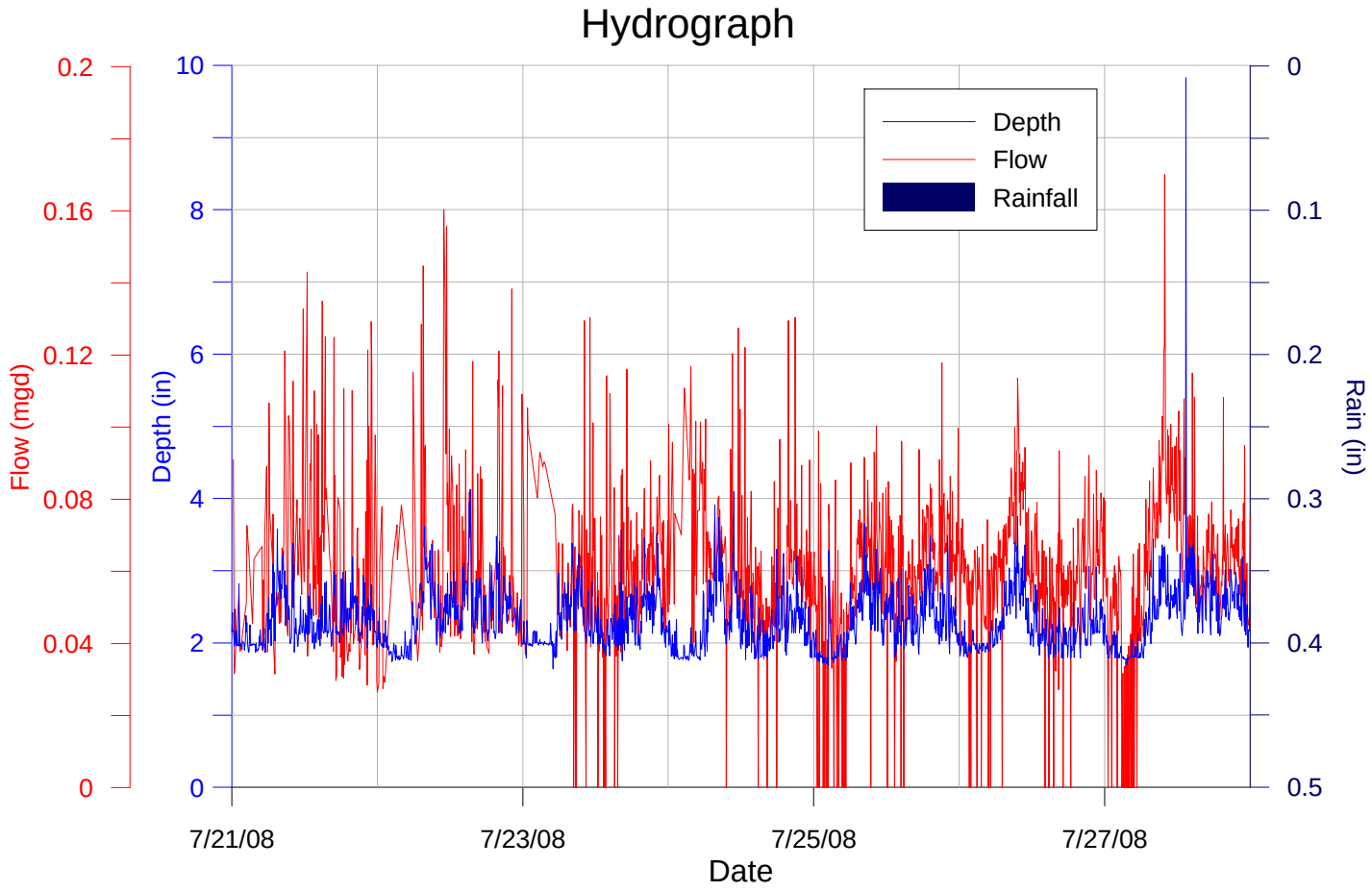


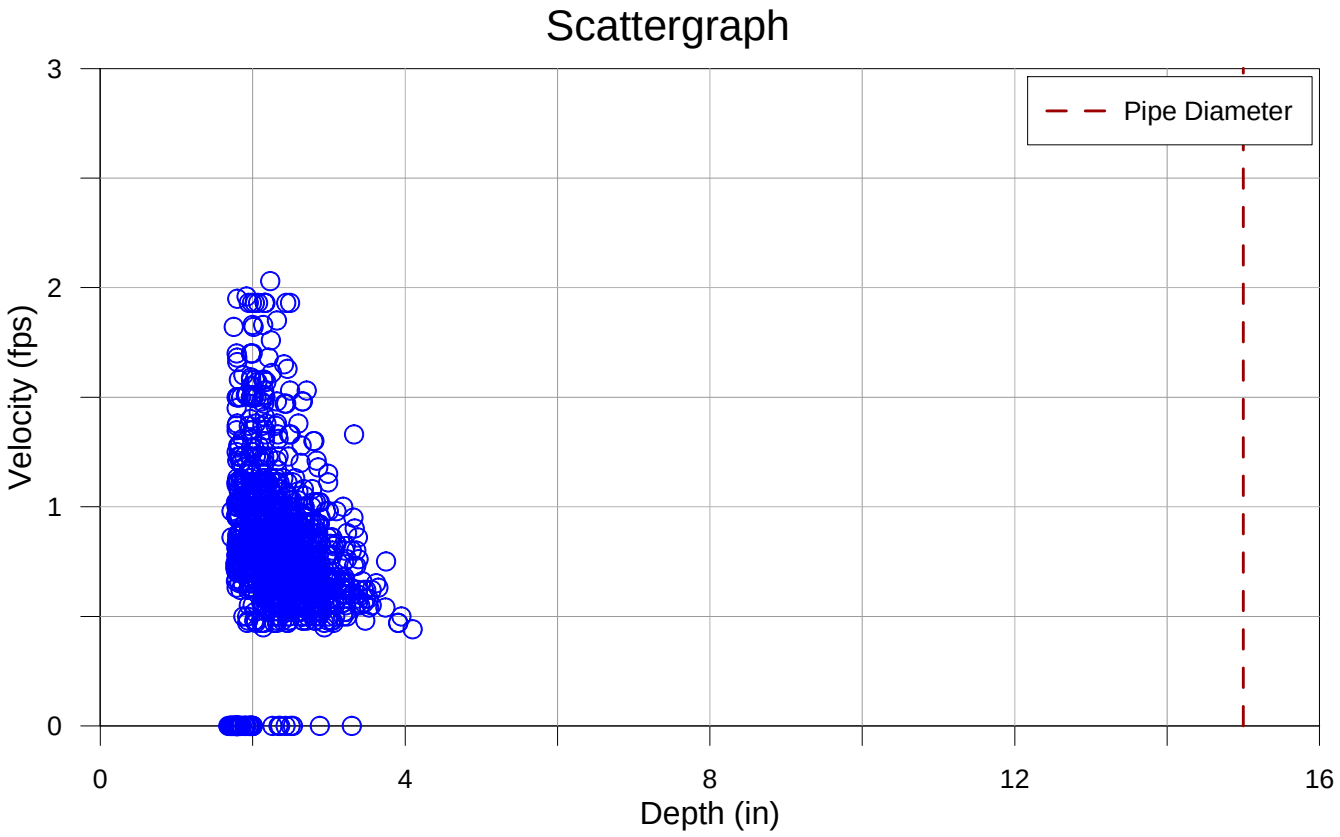
Monitor 074-152
January 4 - 11, 2009



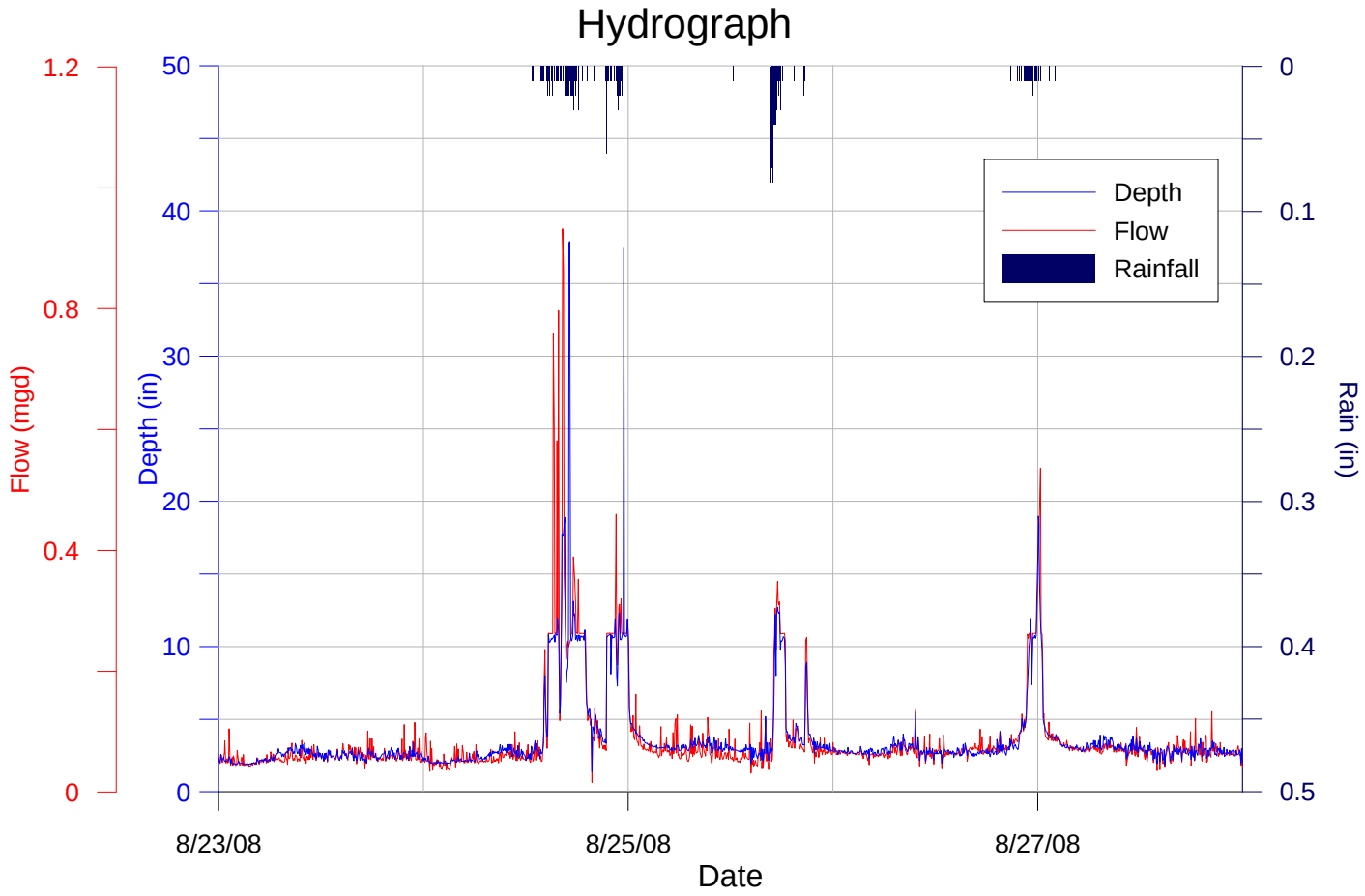


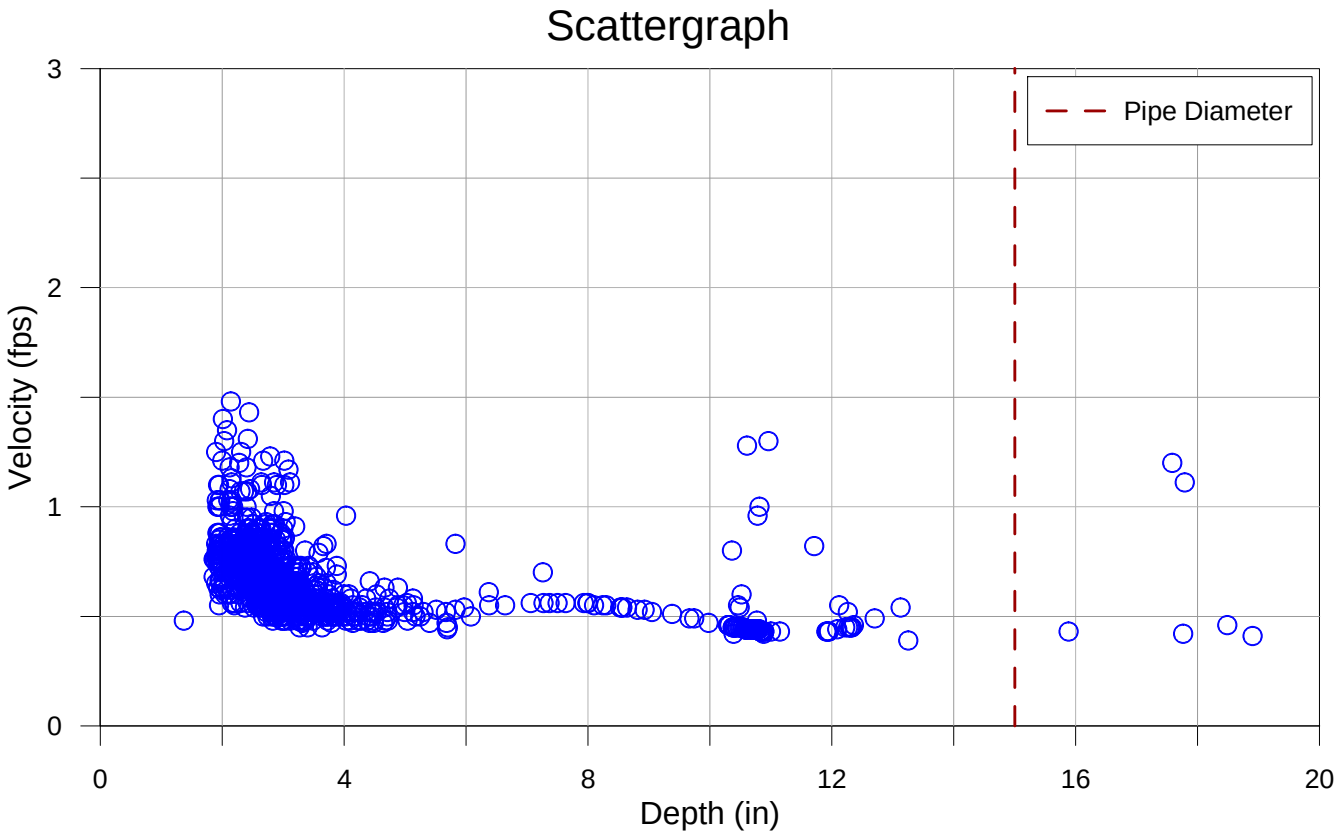
Monitor 074-159
July 21 - 28, 2008





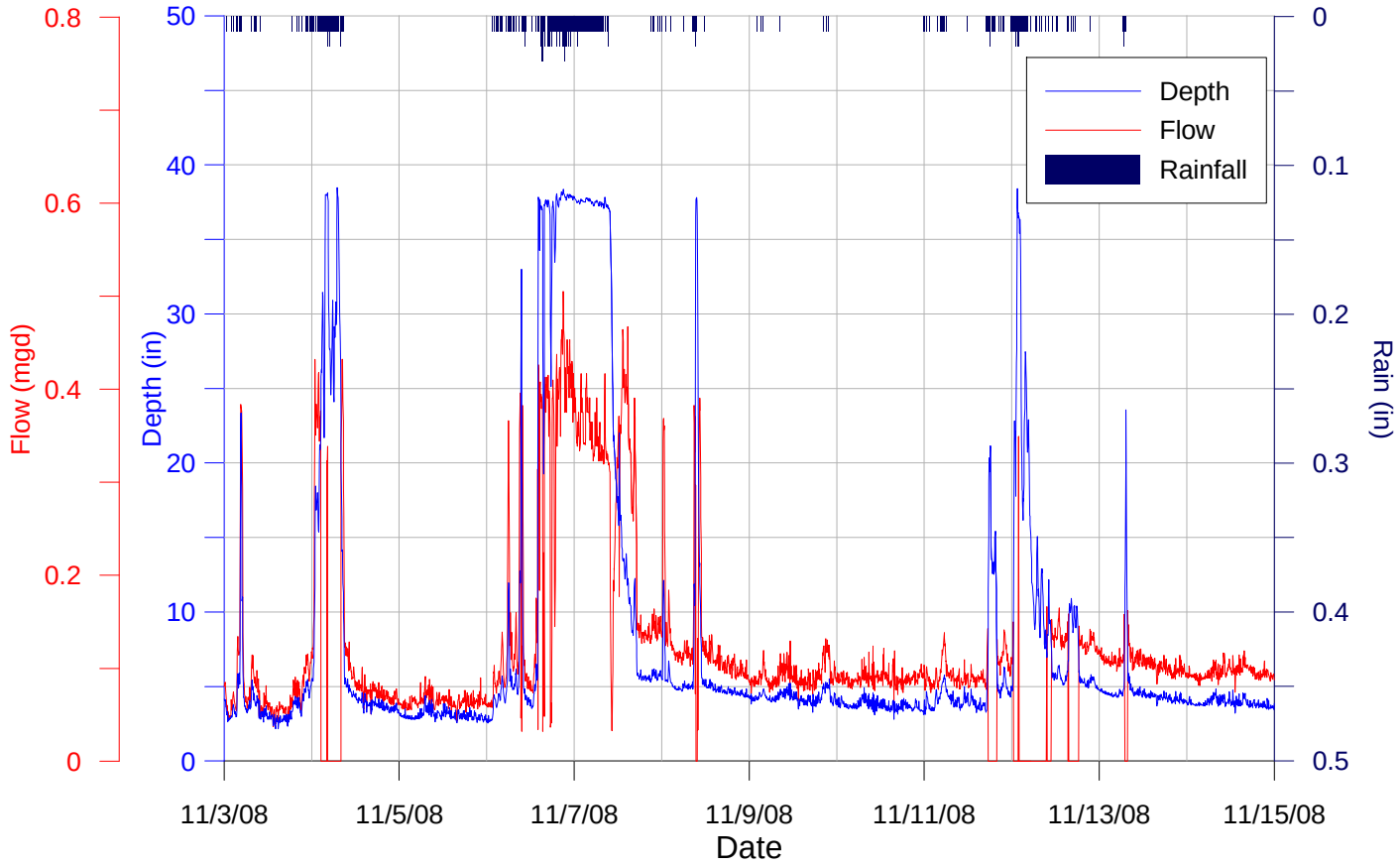
Monitor 074-159
August 23 - 28, 2008



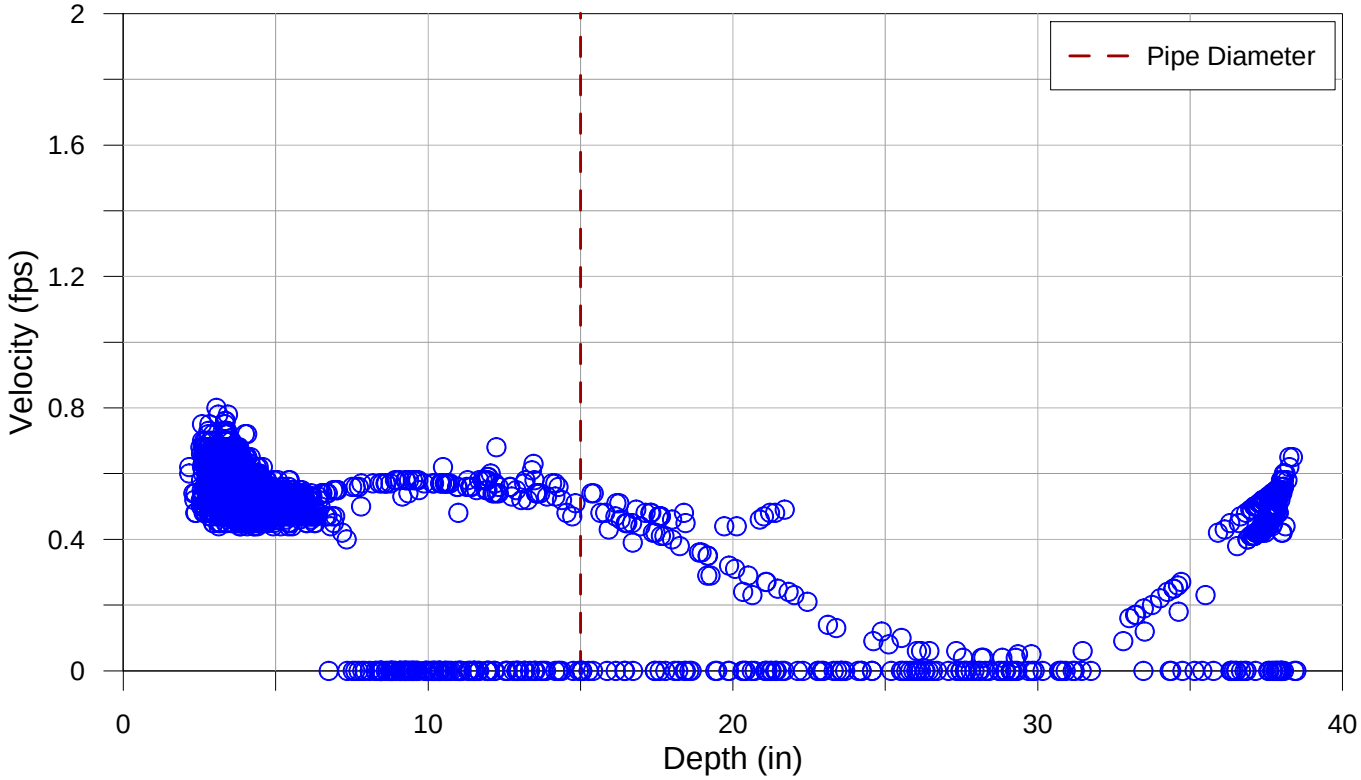


Monitor 074-159
November 3 - 15, 2008

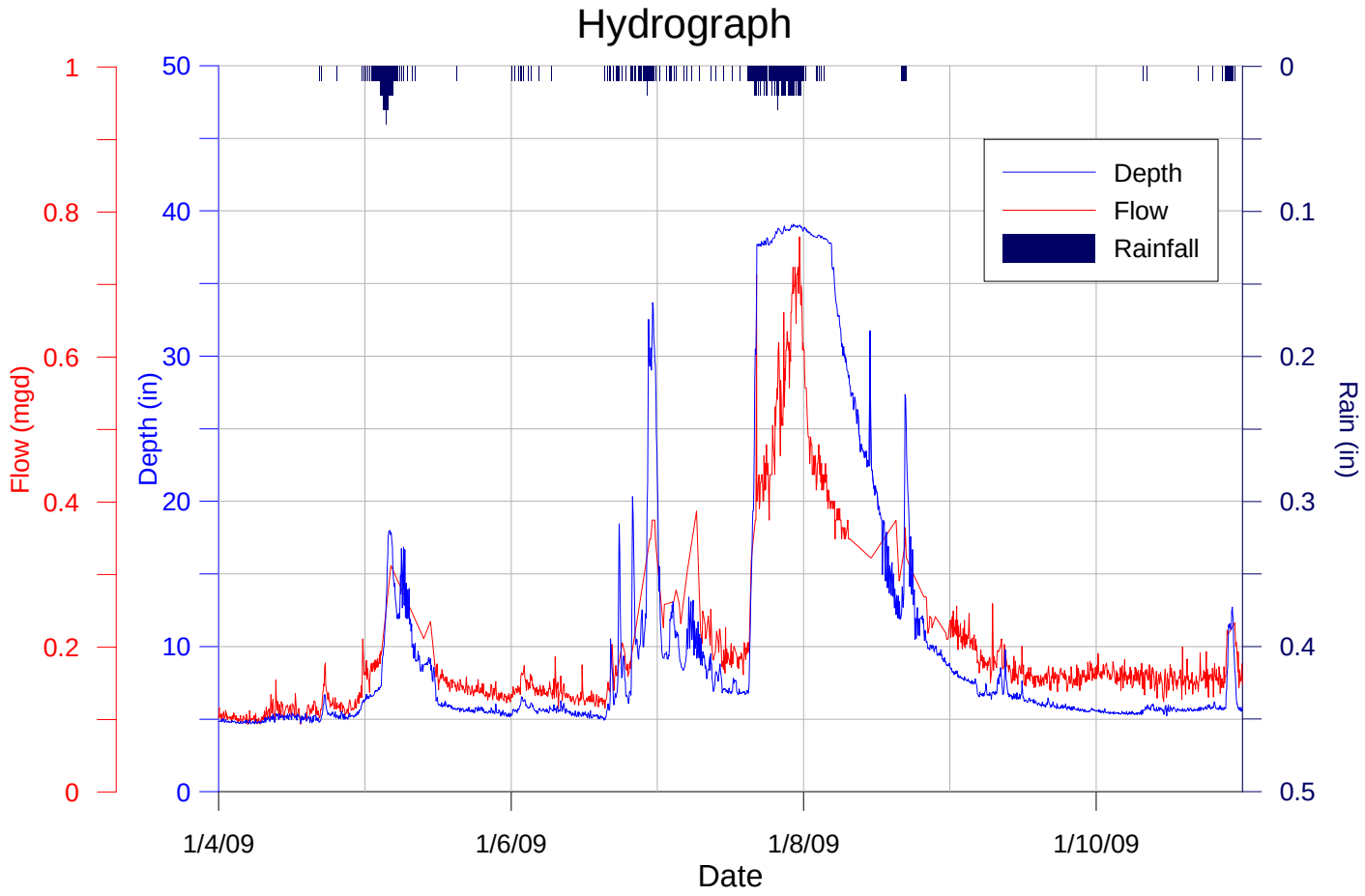
Hydrograph

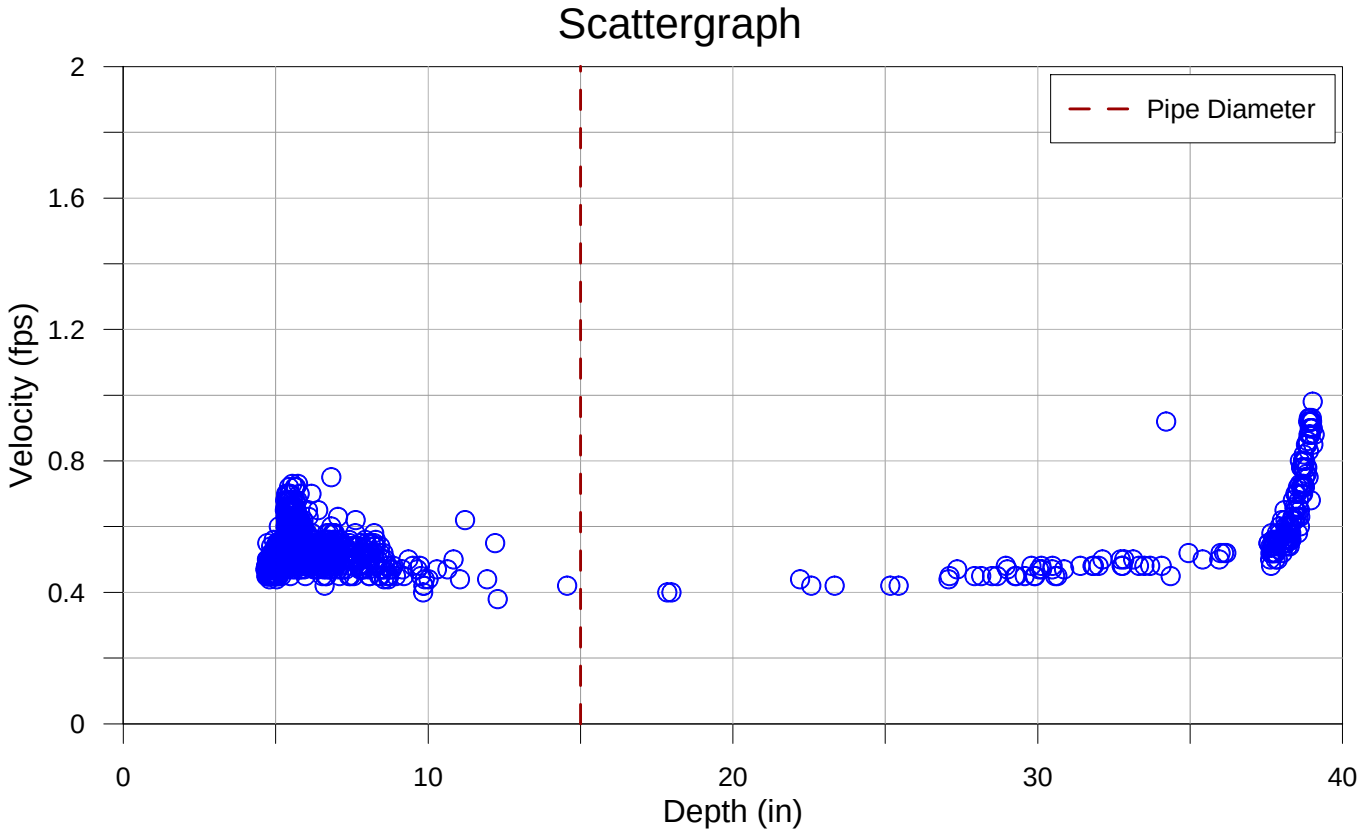


Scattergraph



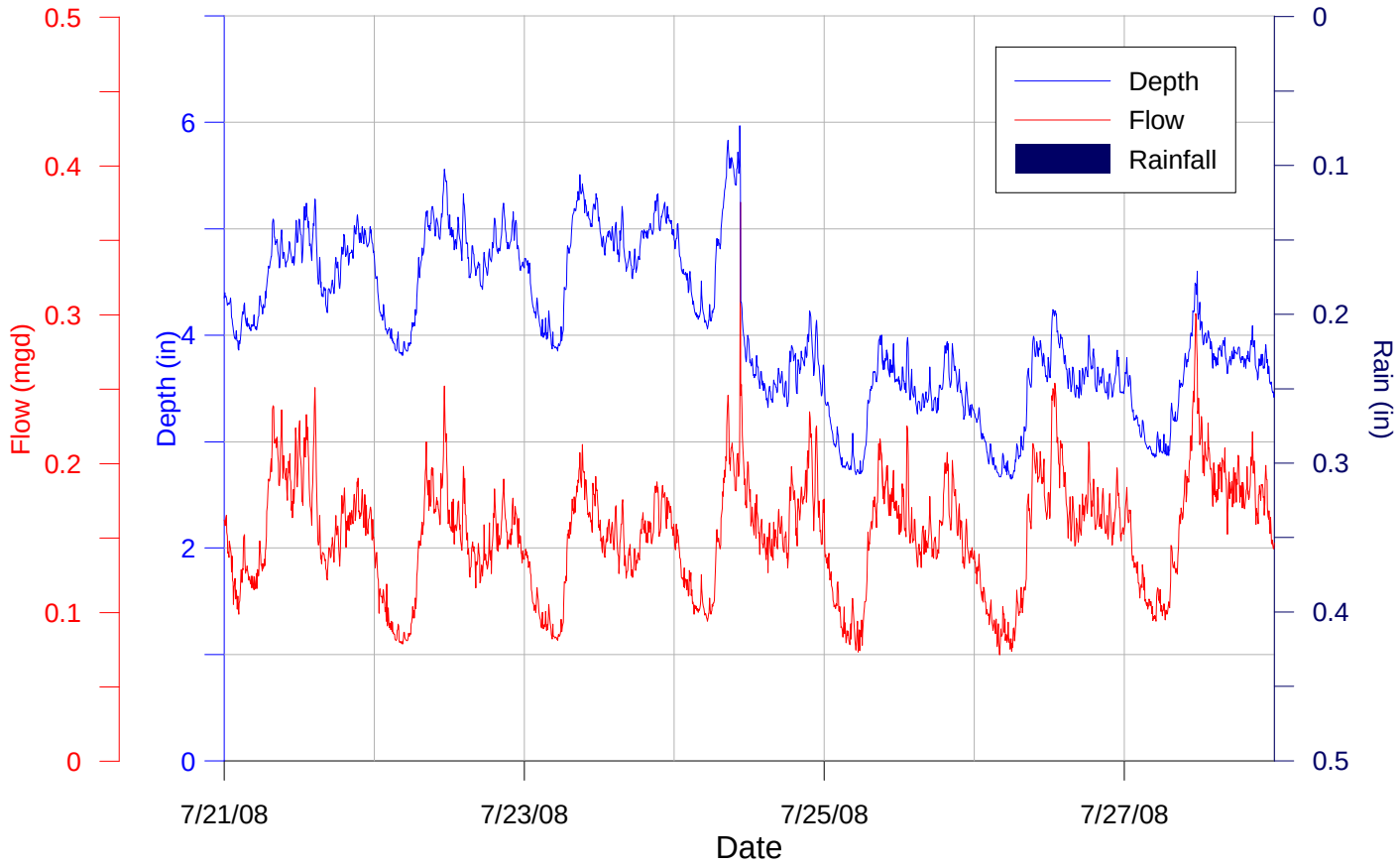
Monitor 074-159
January 4 - 11, 2009



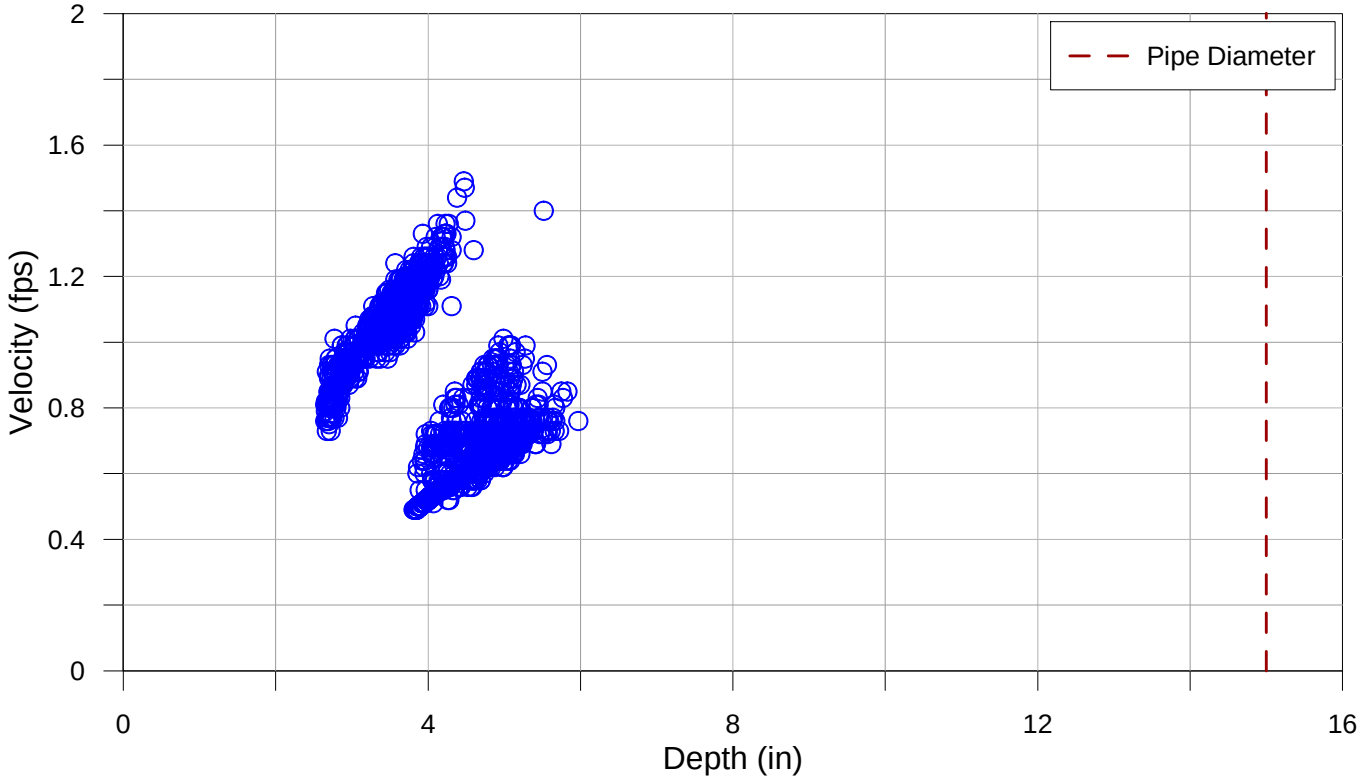


Monitor 074-153 (45A)
July 21 - 28, 2008

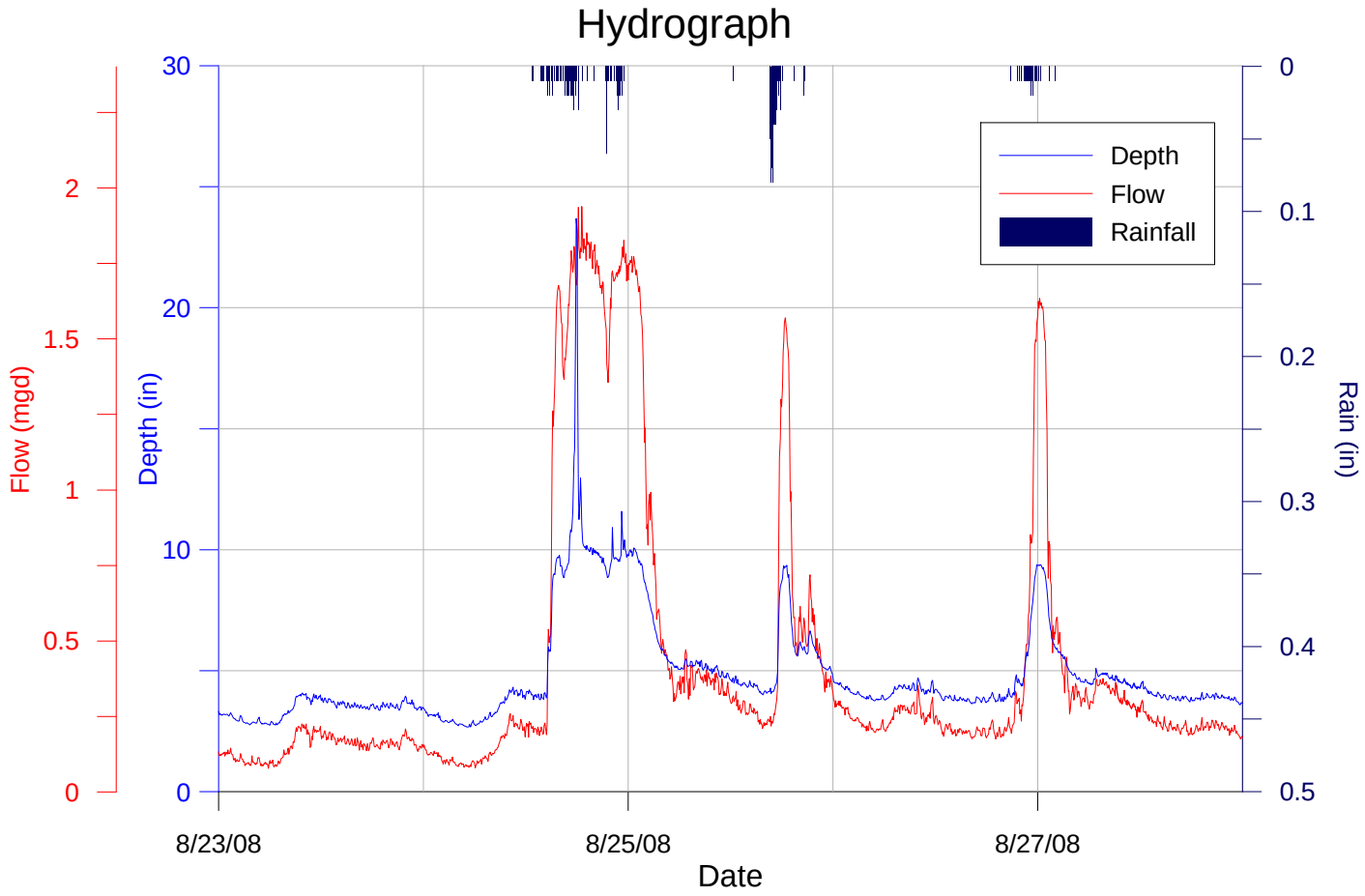
Hydrograph

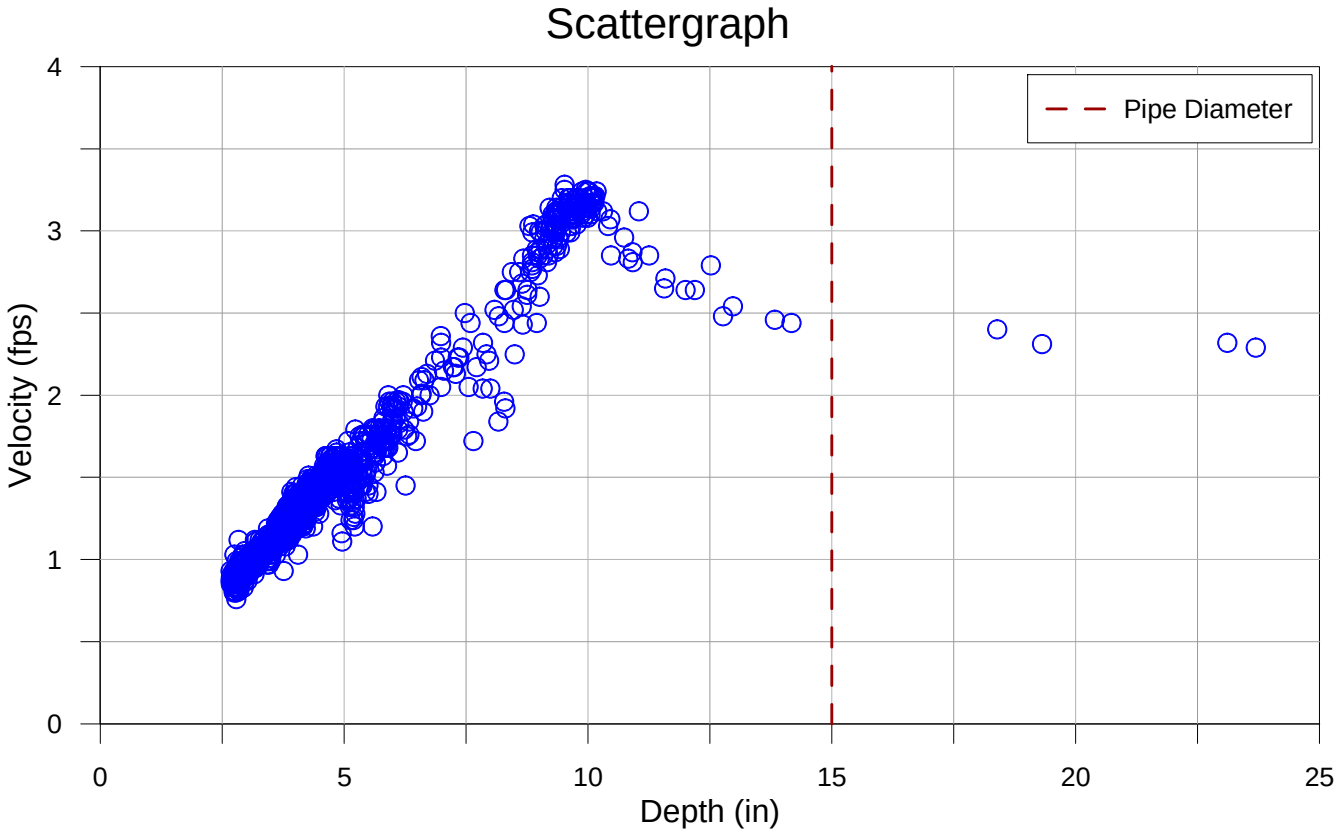


Scattergraph



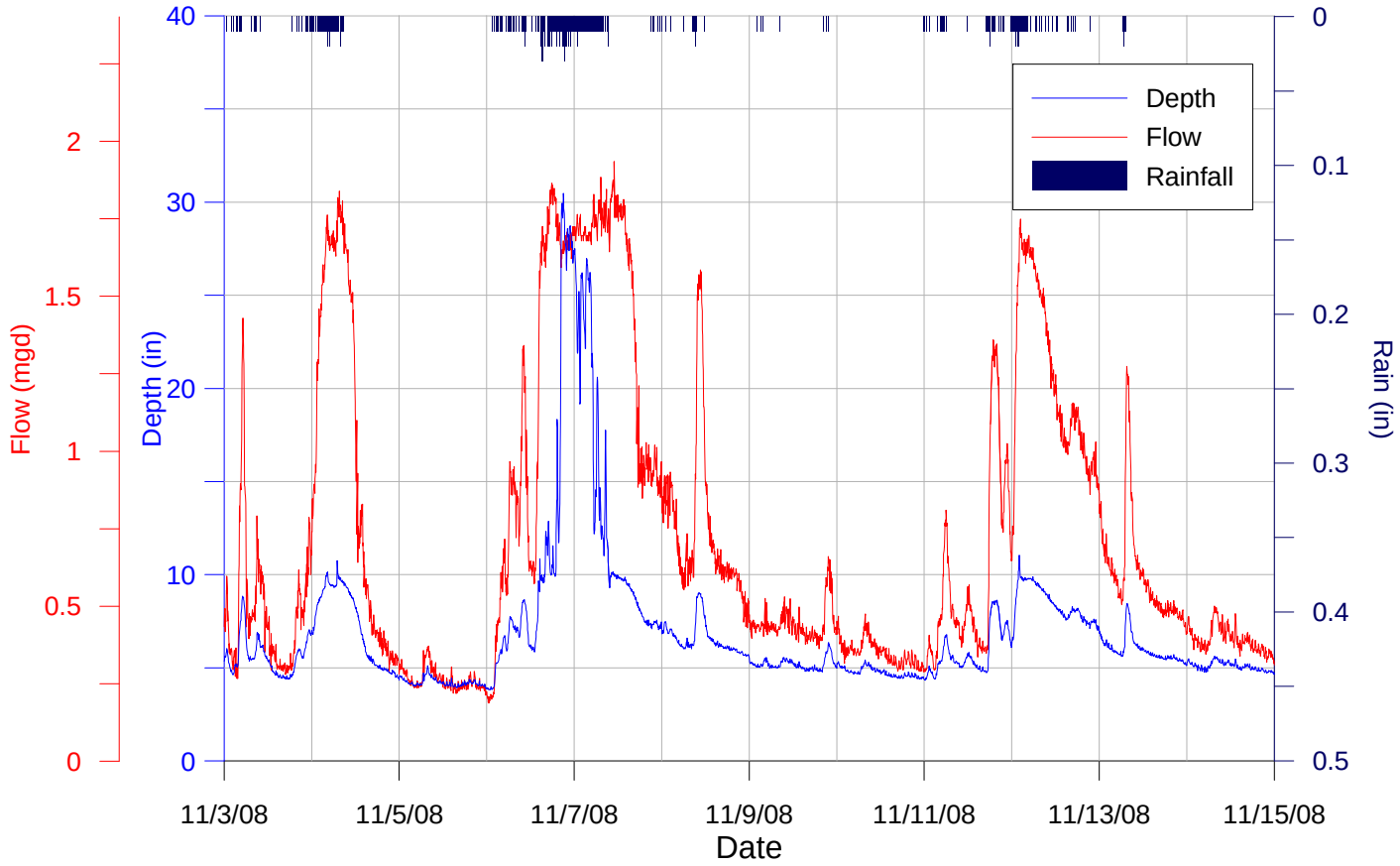
Monitor 074-153 (45A)
August 23 - 28, 2008



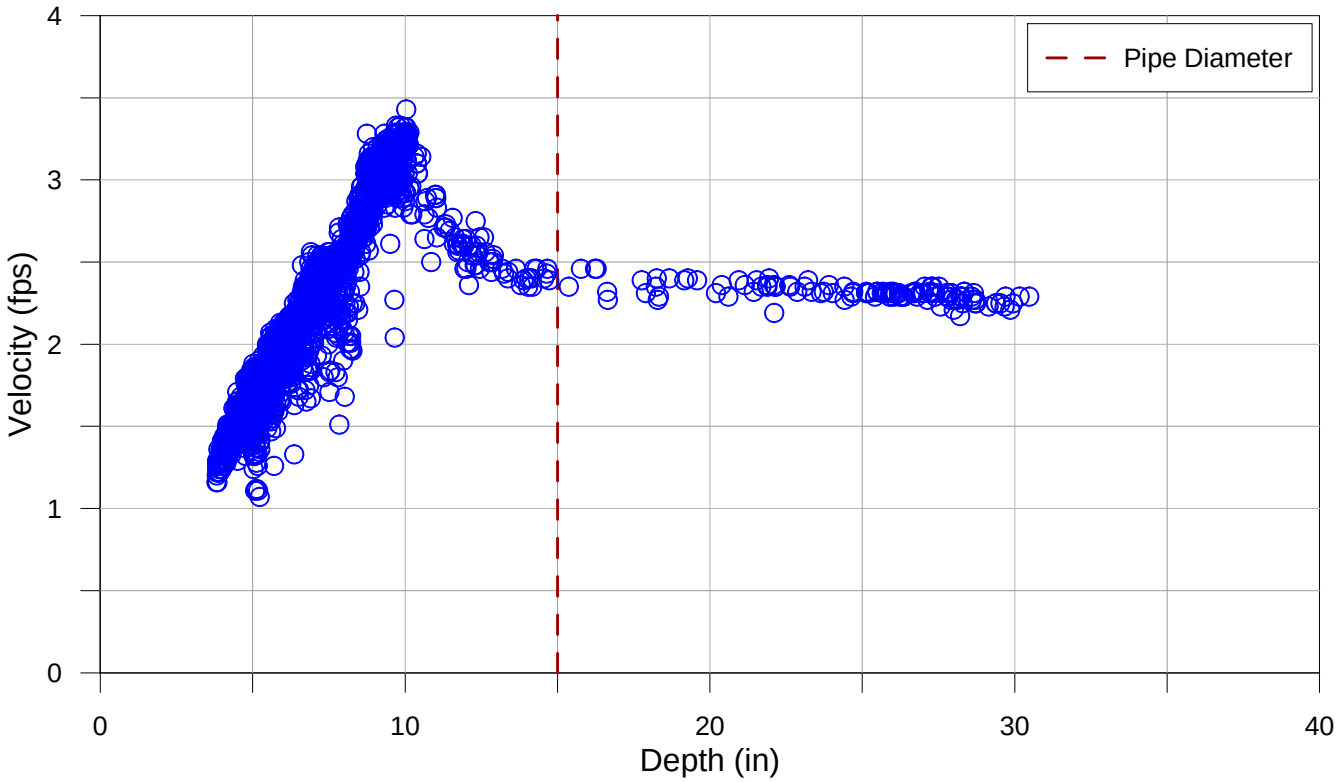


Monitor 074-153 (45A)
November 3 - 15, 2008

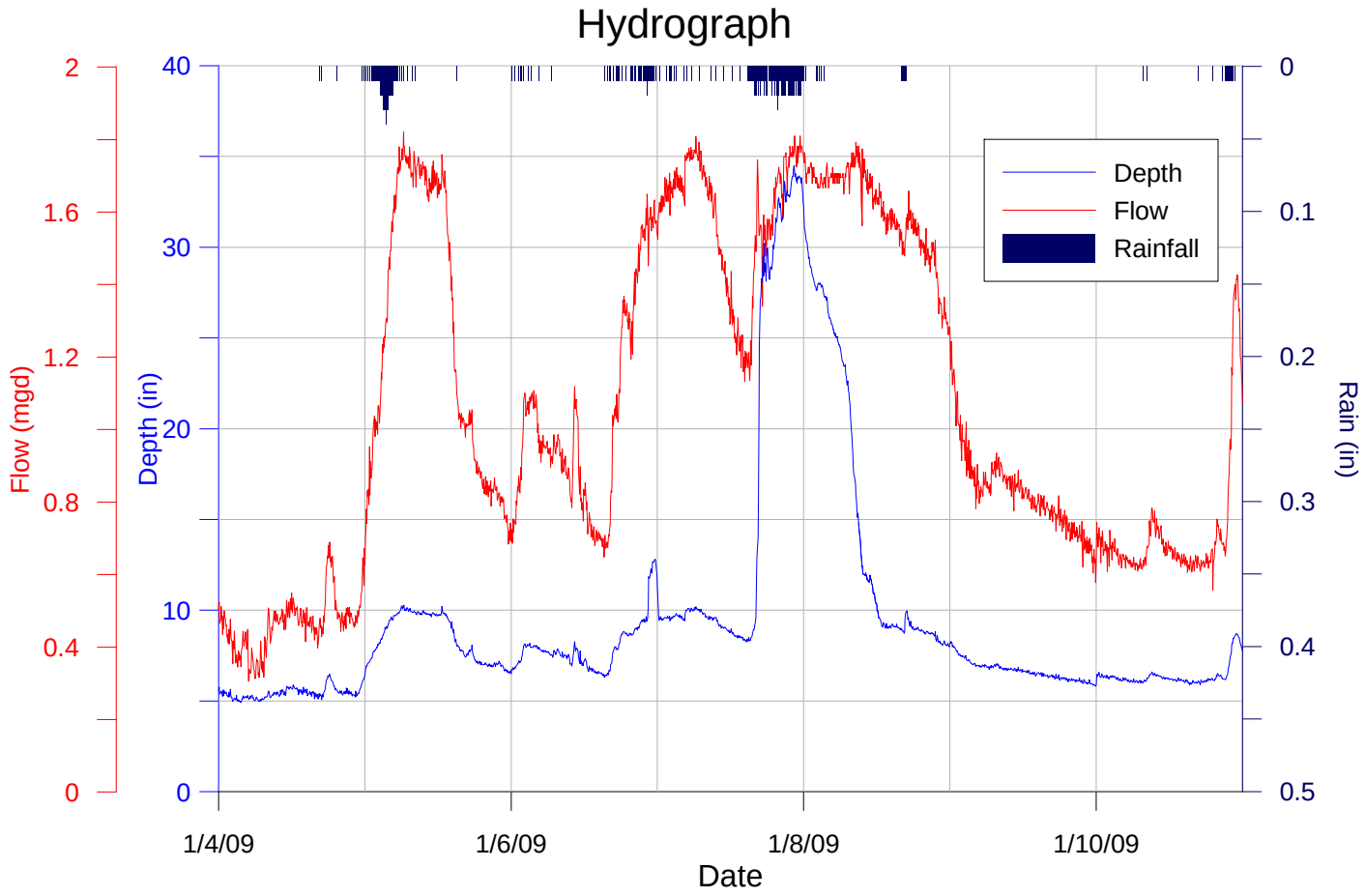
Hydrograph

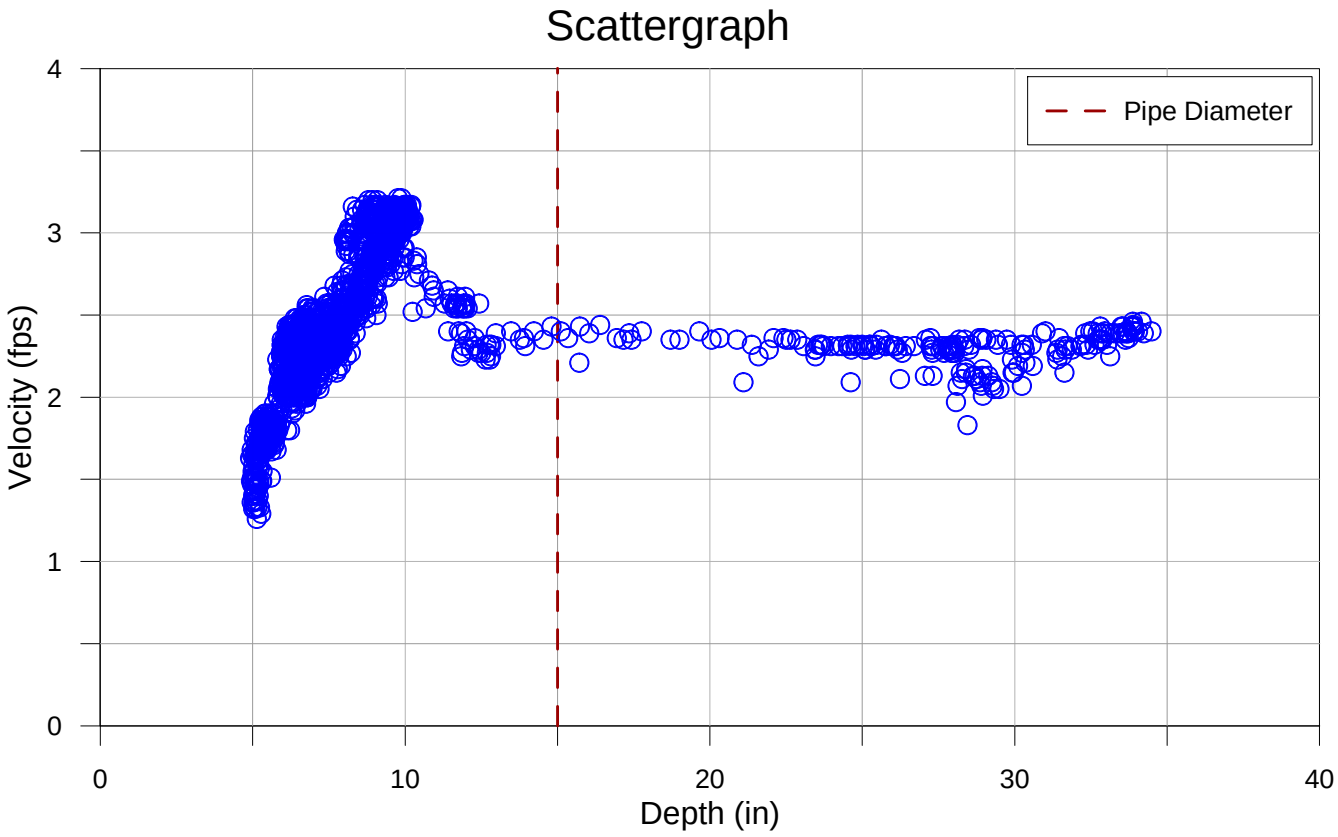


Scattergraph

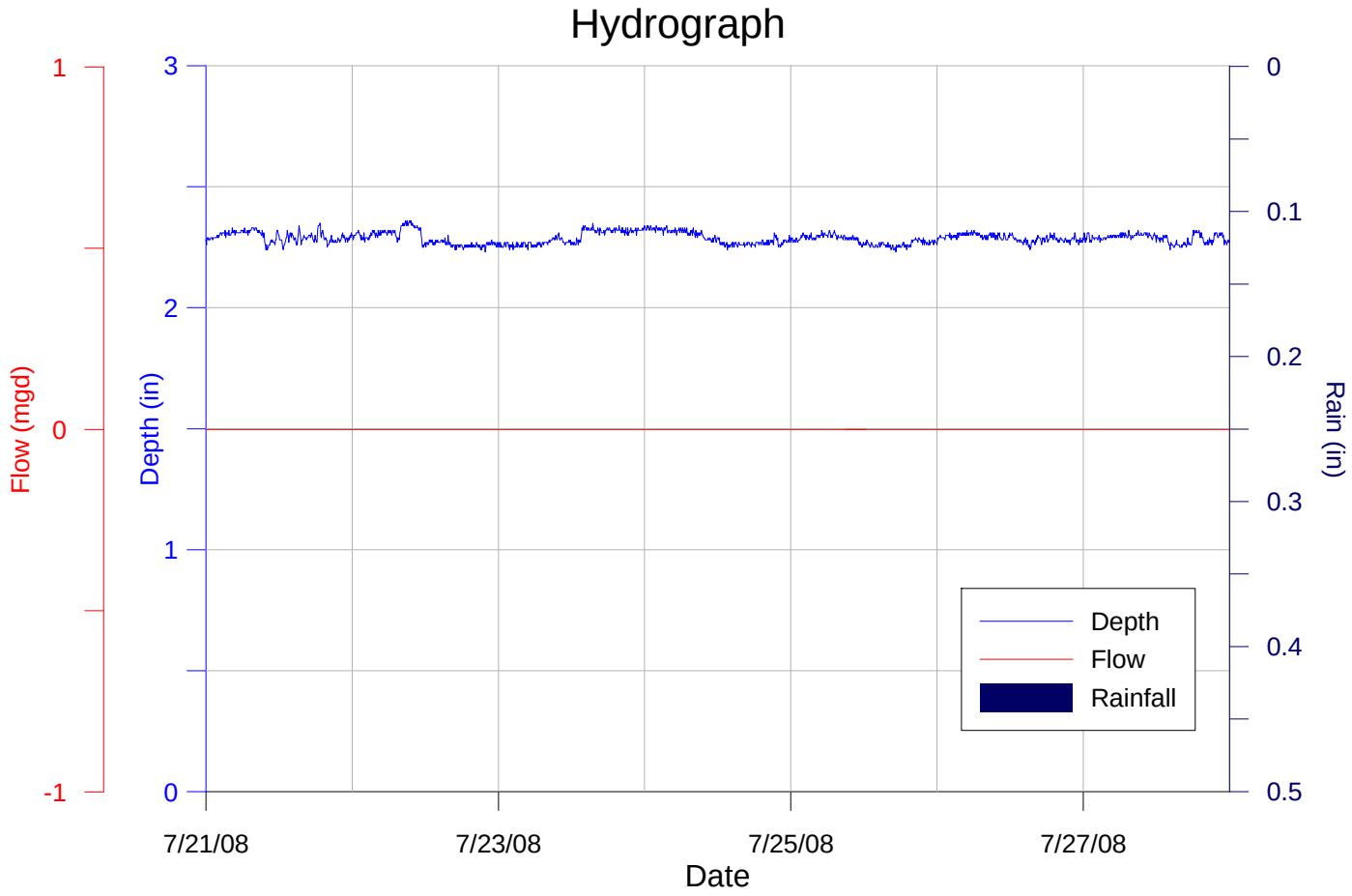


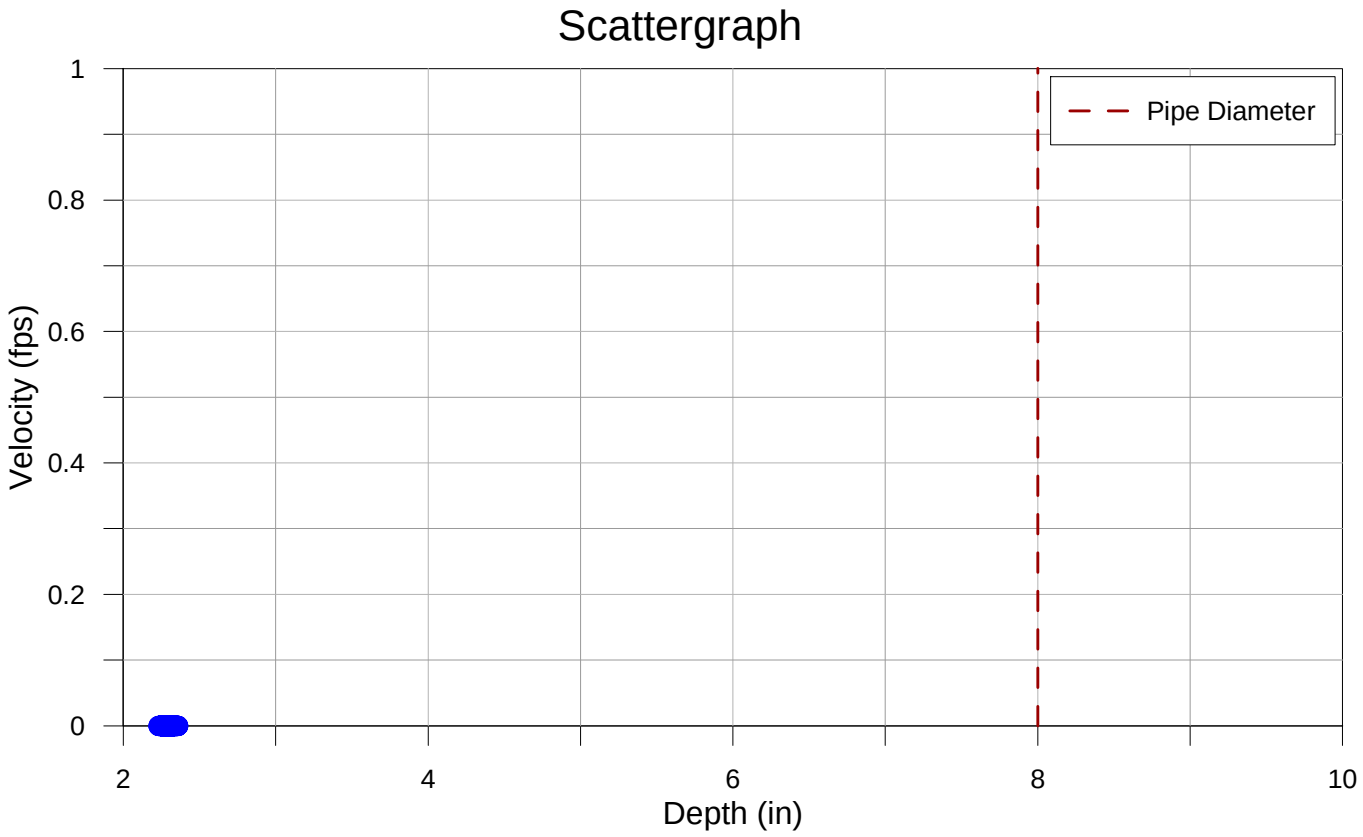
Monitor 074-153 (45A)
January 4 - 11, 2009



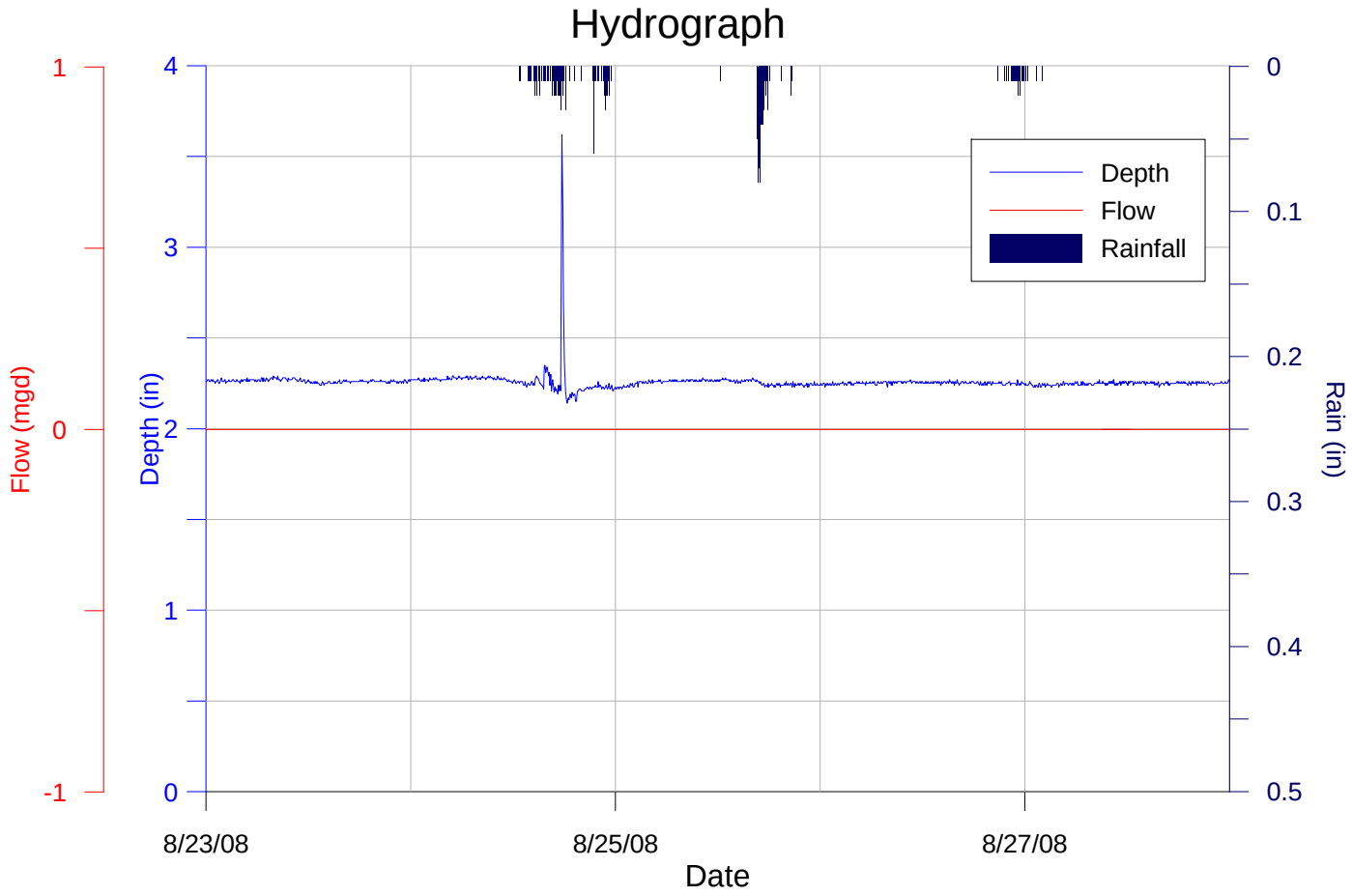


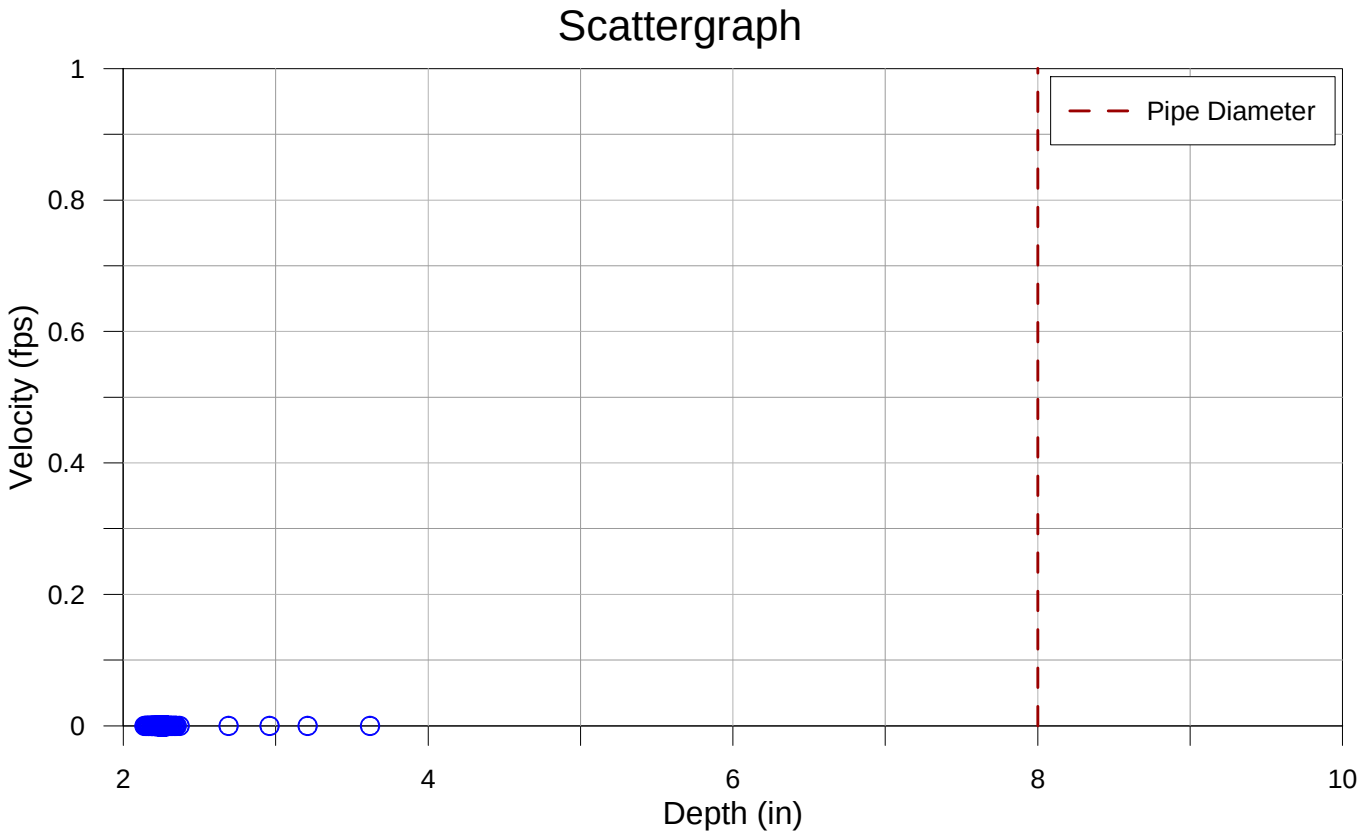
Monitor 074-167 (45B)
July 21 - 28, 2008





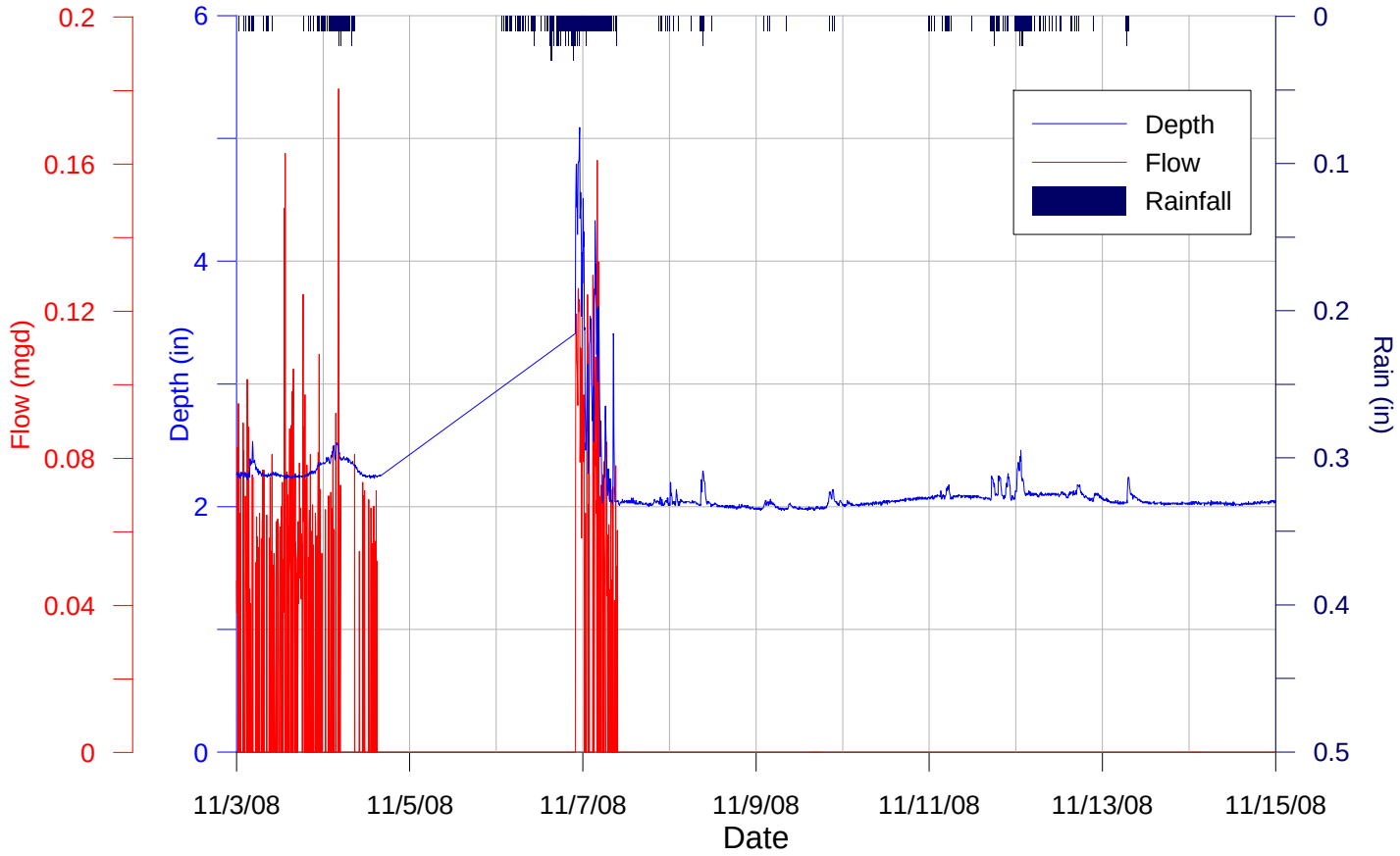
Monitor 074-167 (45B)
August 23 - 28, 2008



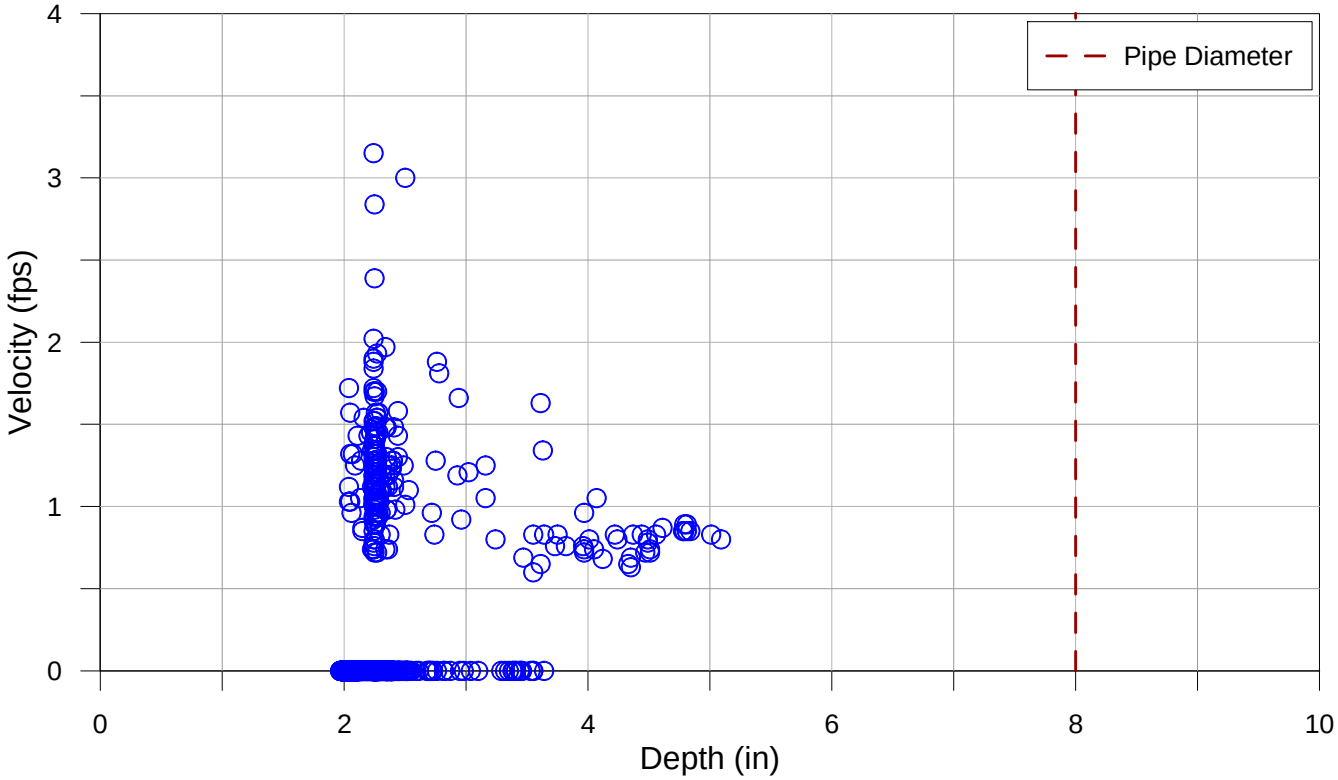


Monitor 074-167 (45B)
November 3 - 15, 2008

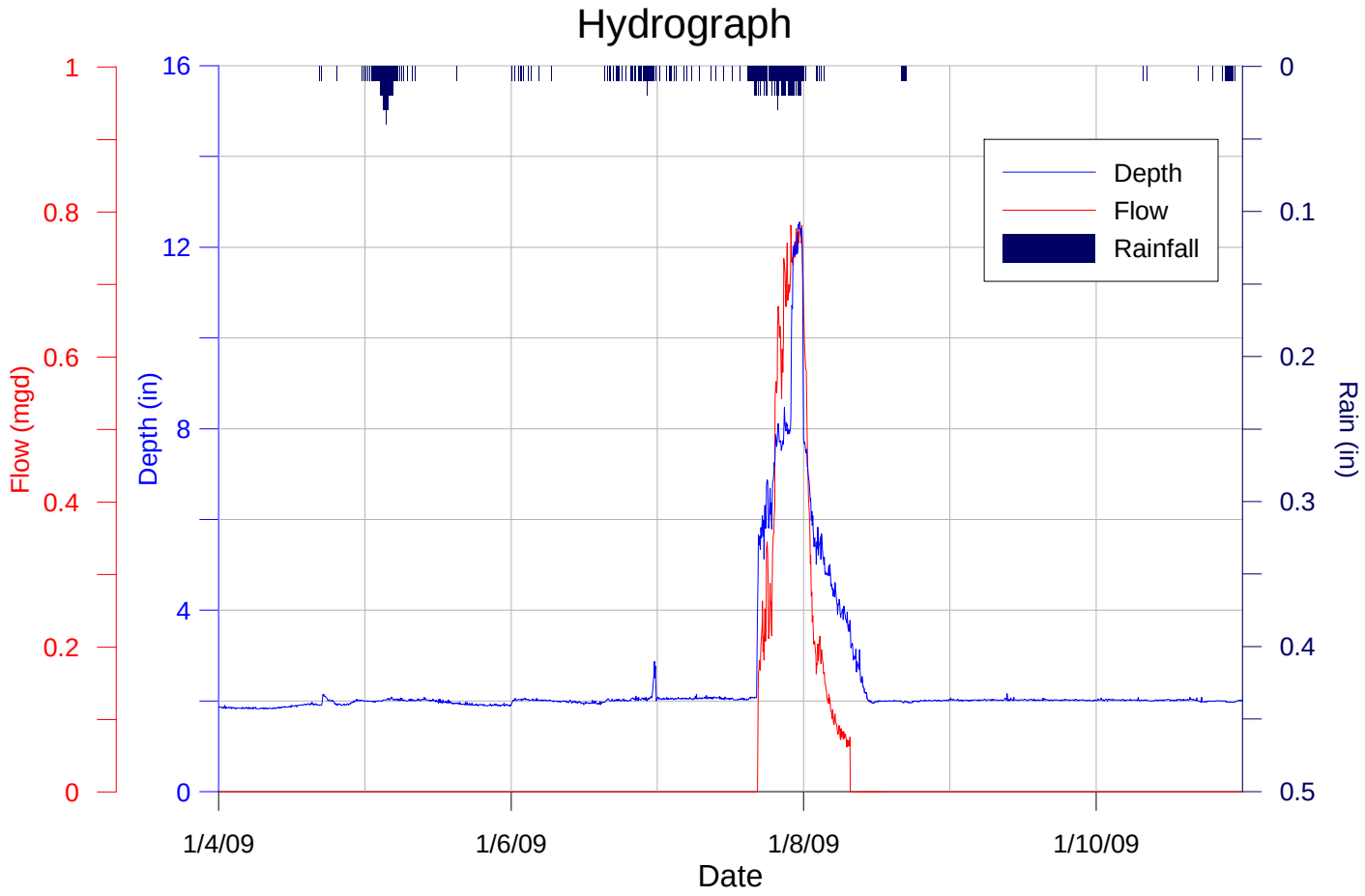
Hydrograph

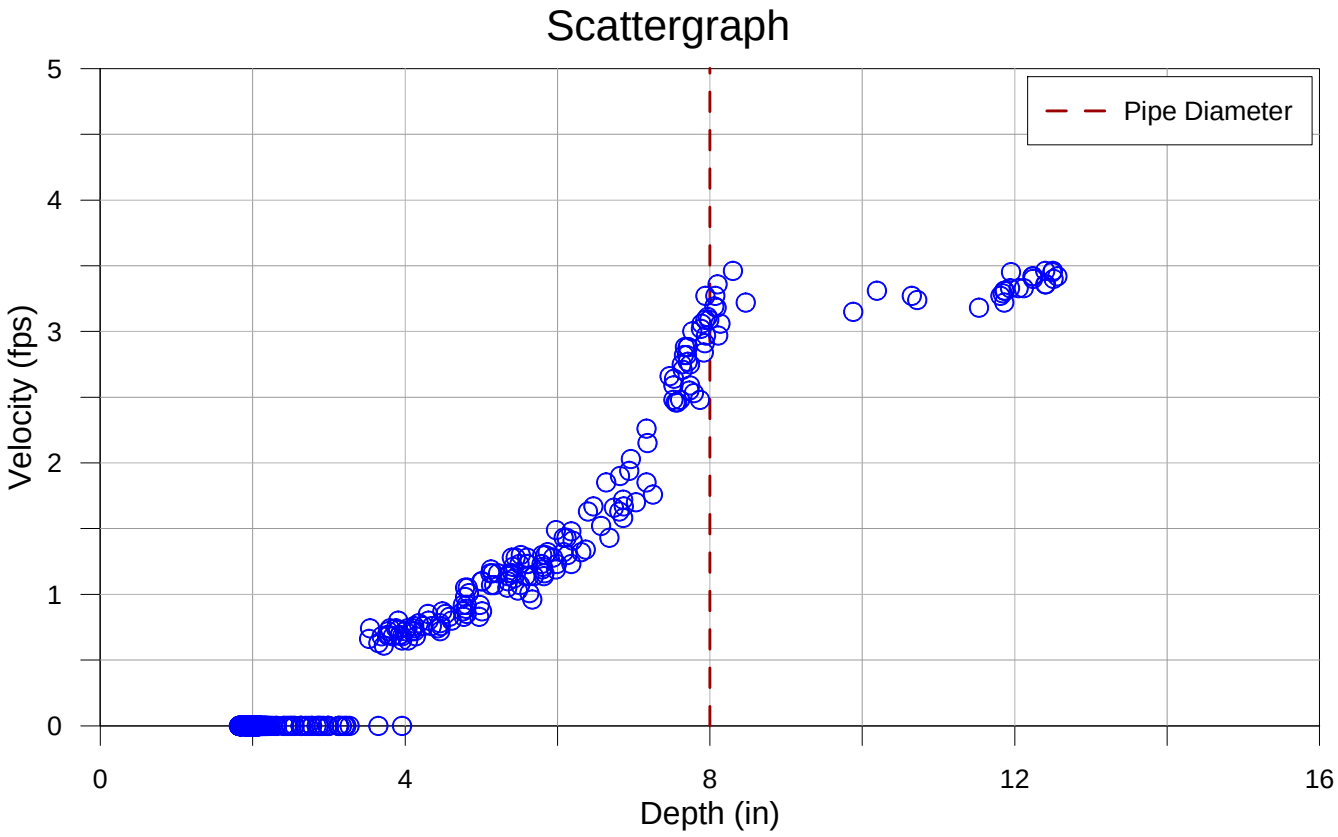


Scattergraph

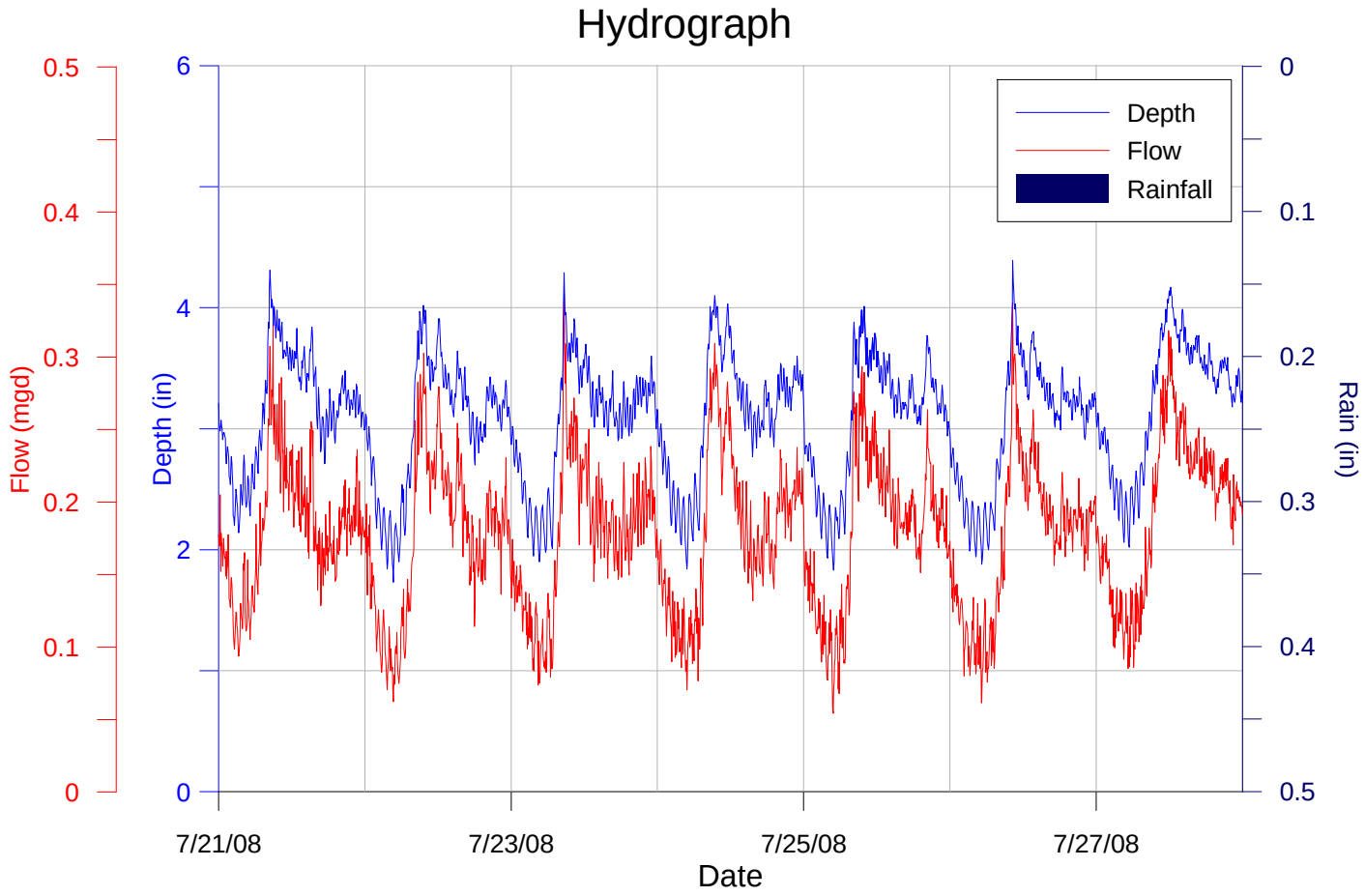


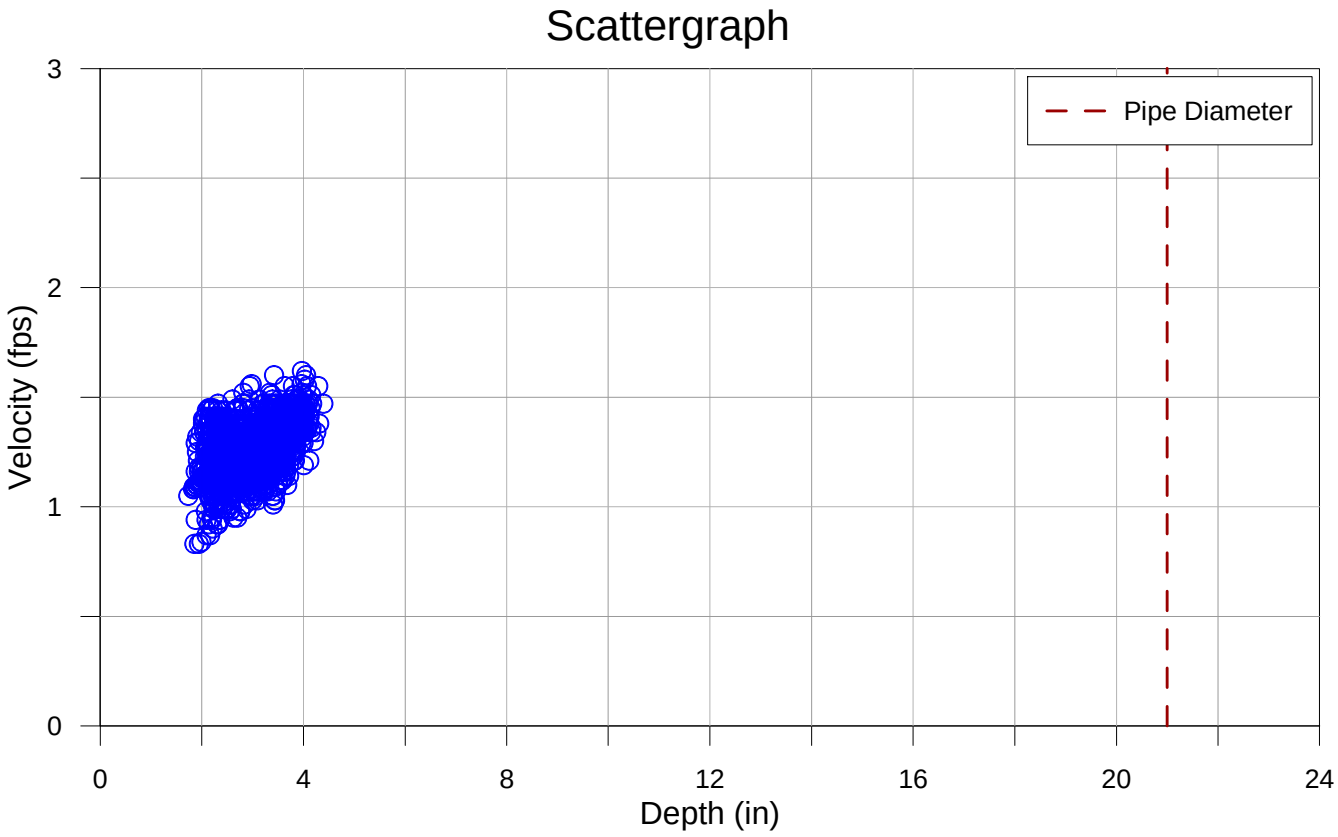
Monitor 074-167 (45B)
January 4 - 11, 2009





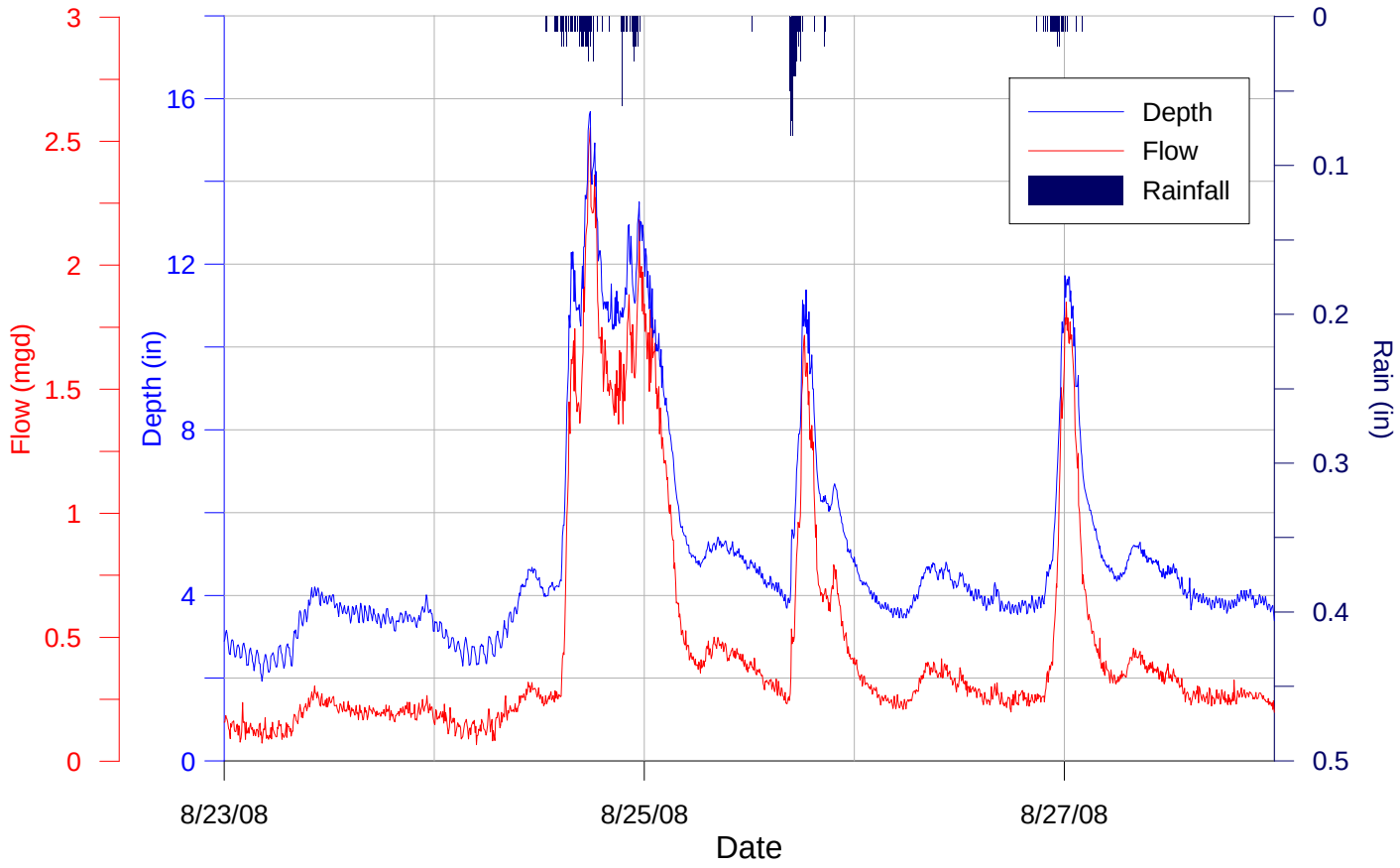
Monitor 081-059
July 21 - 28, 2008



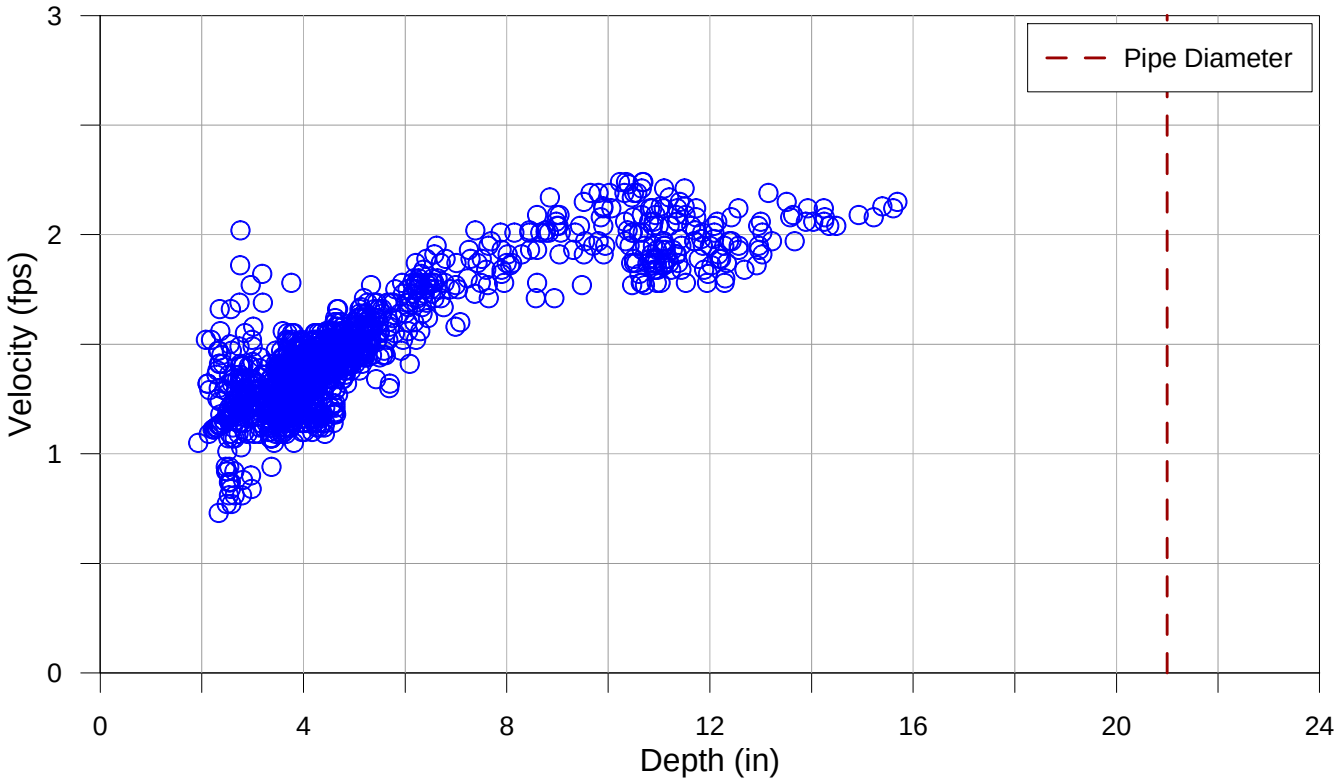


Monitor 081-059
August 23 - 28, 2008

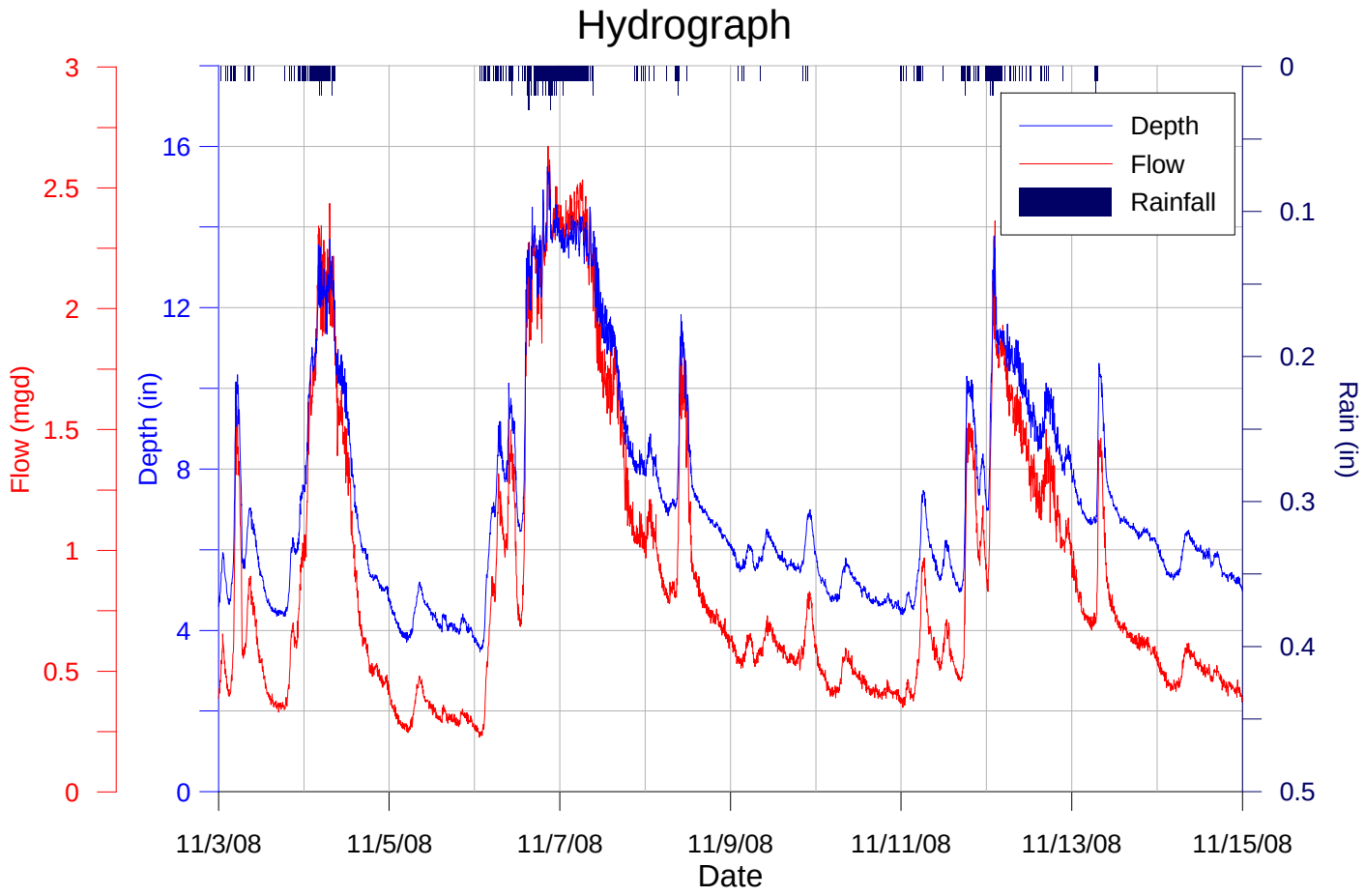
Hydrograph

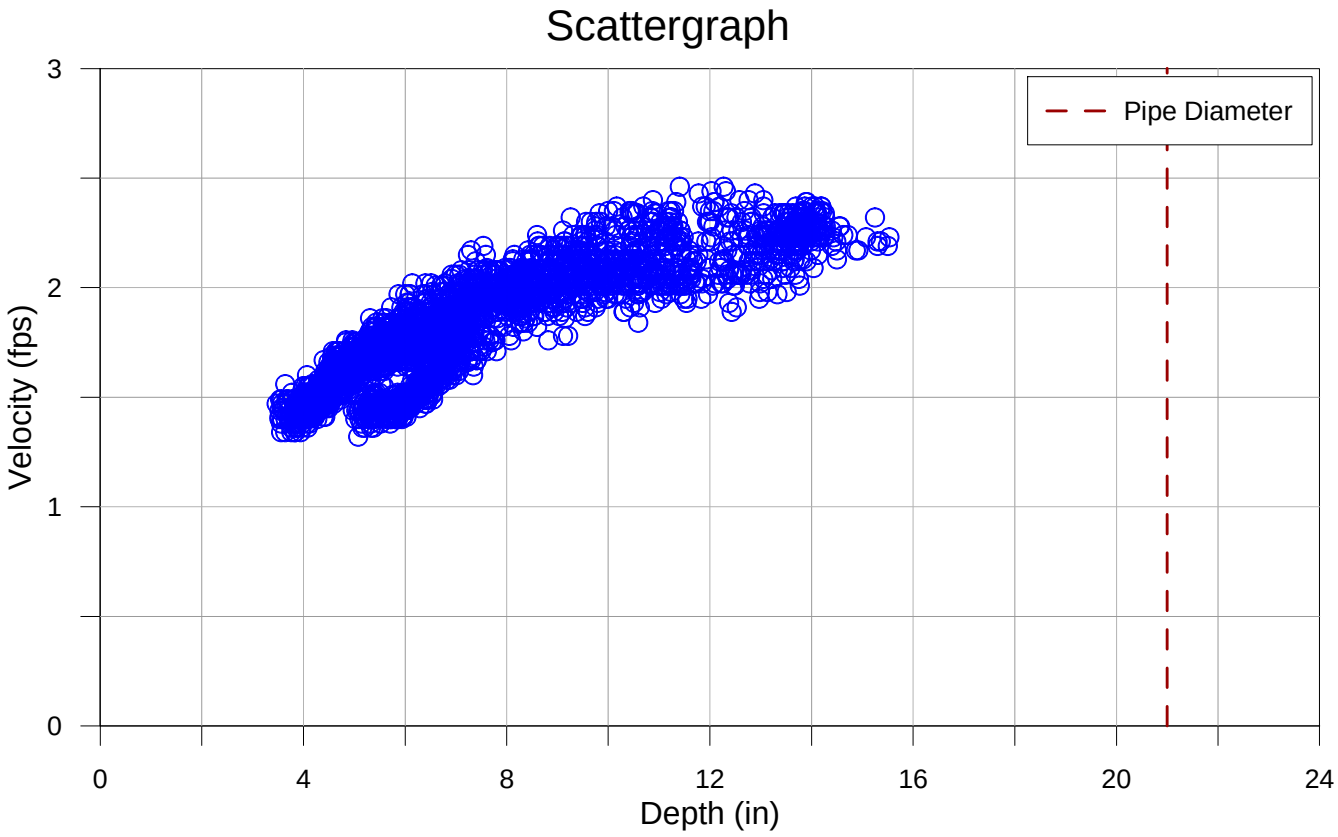


Scattergraph

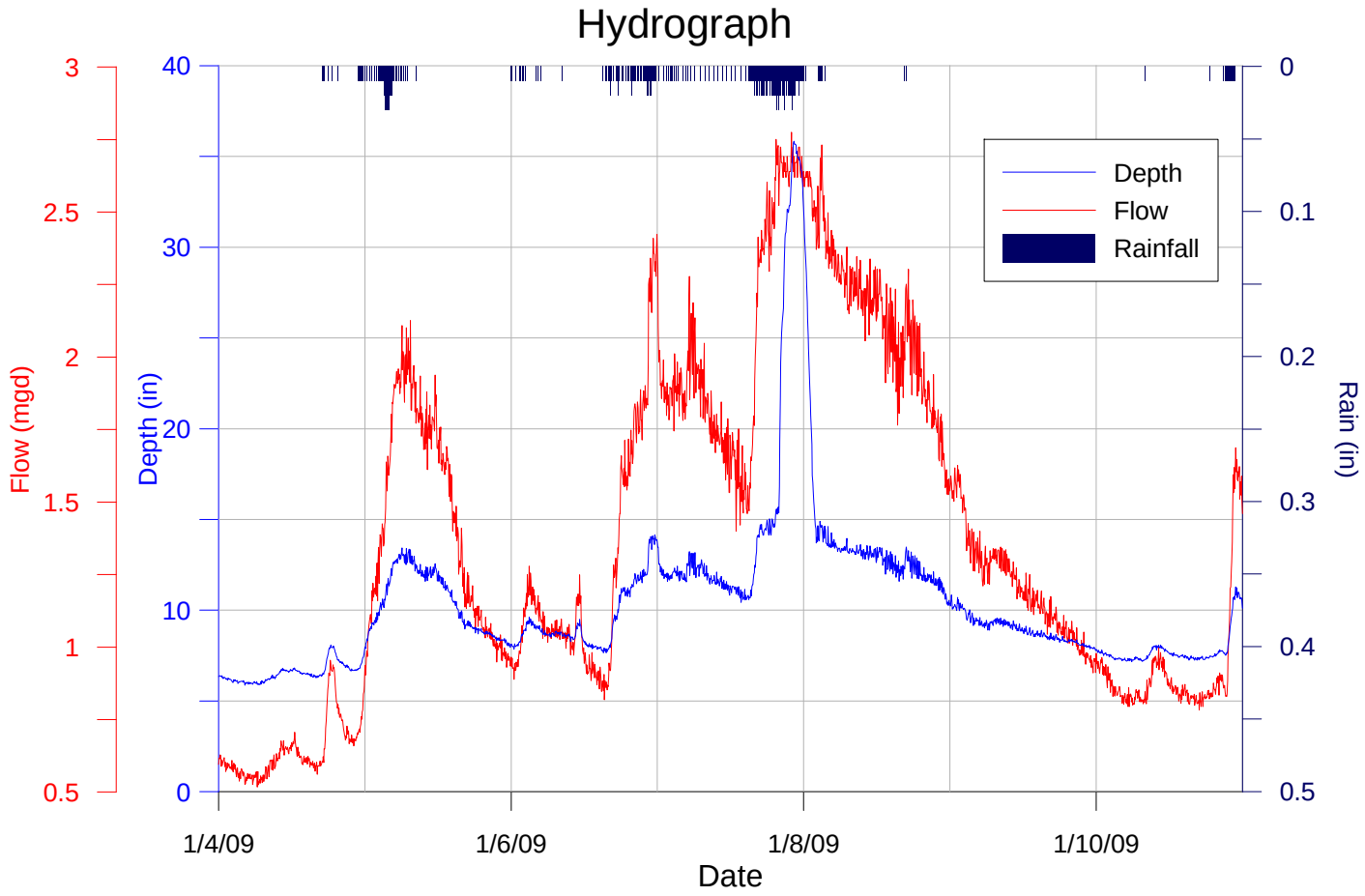


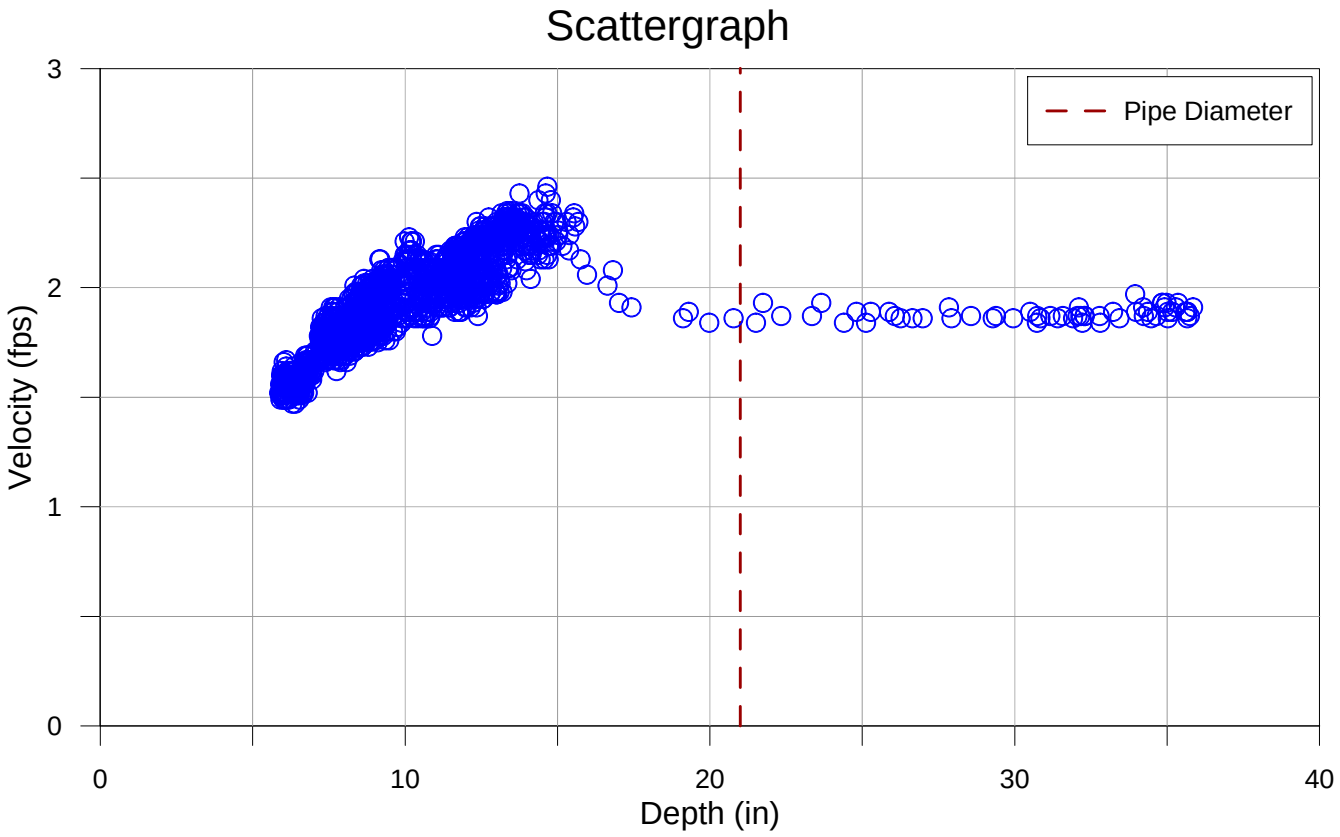
Monitor 081-059
November 3 - 15, 2008



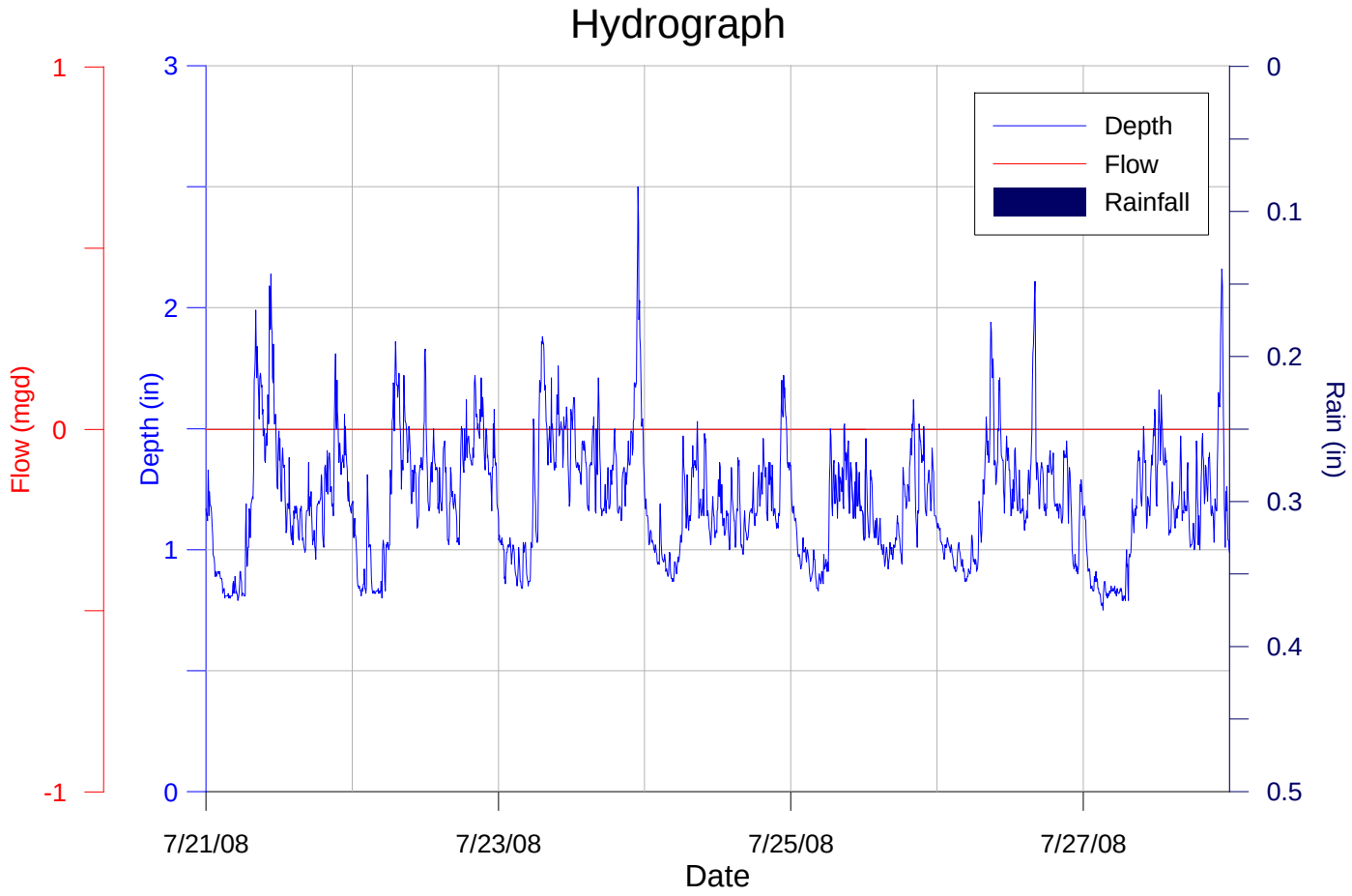


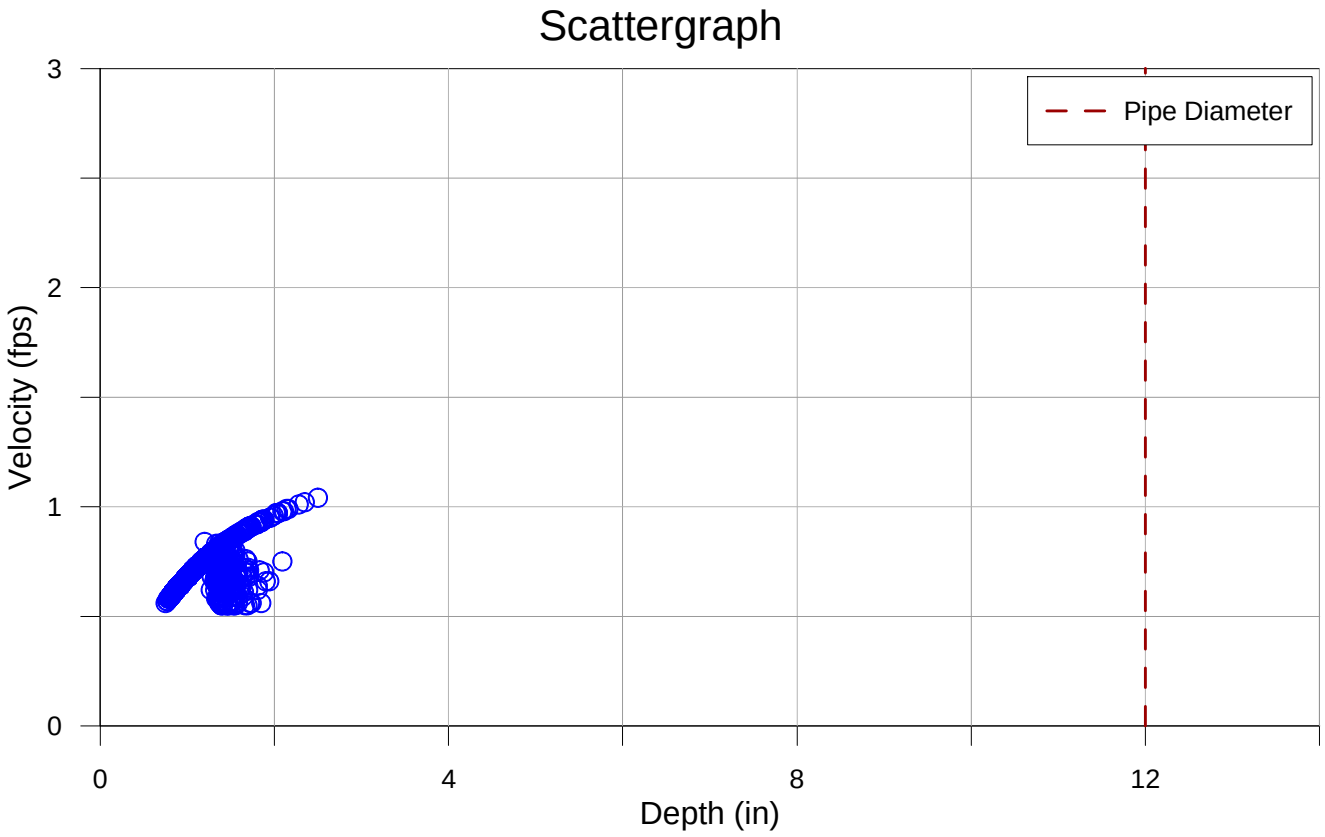
Monitor 081-059
January 4 - 11, 2009



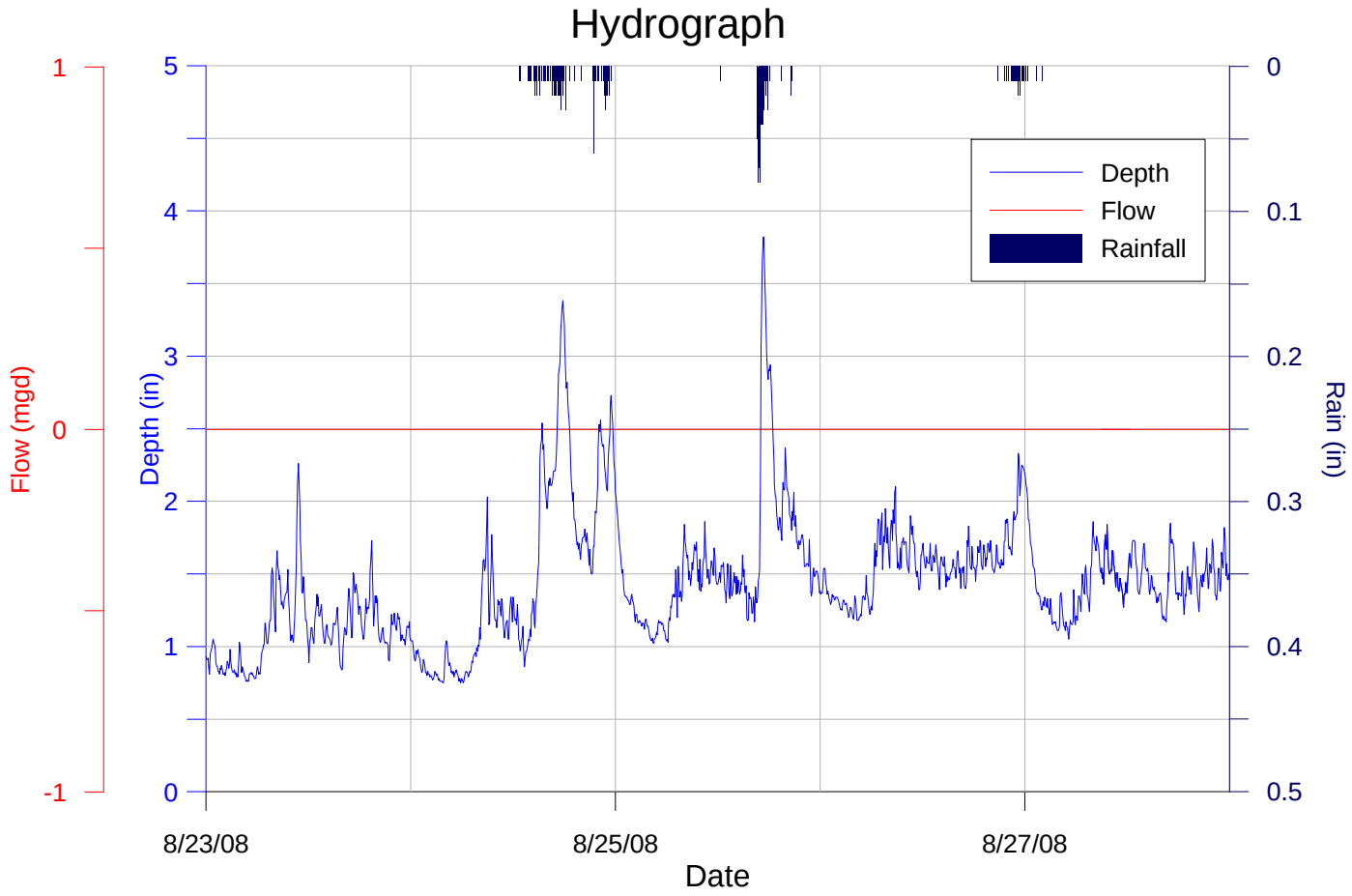


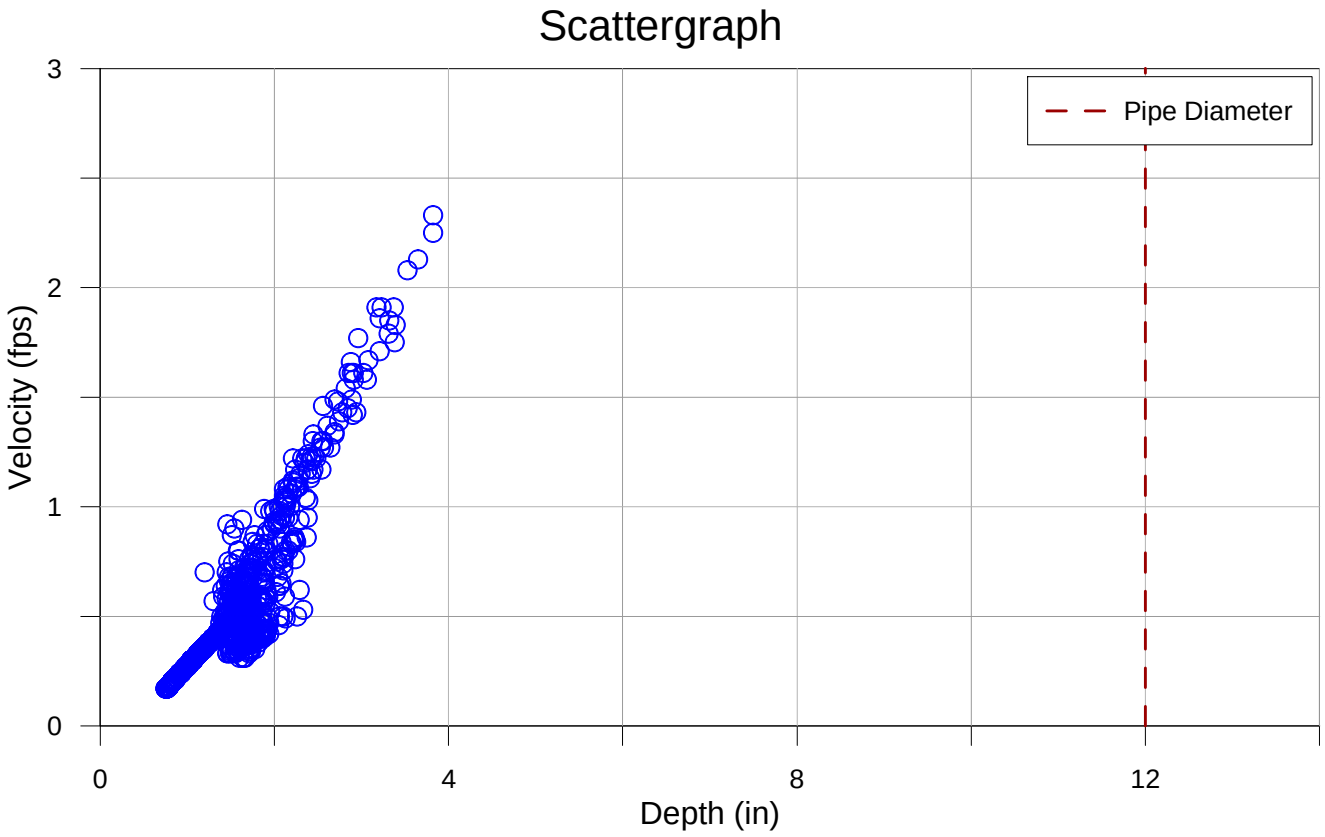
Monitor 081-062 (46) Sensor MP1
July 21 - 28, 2008



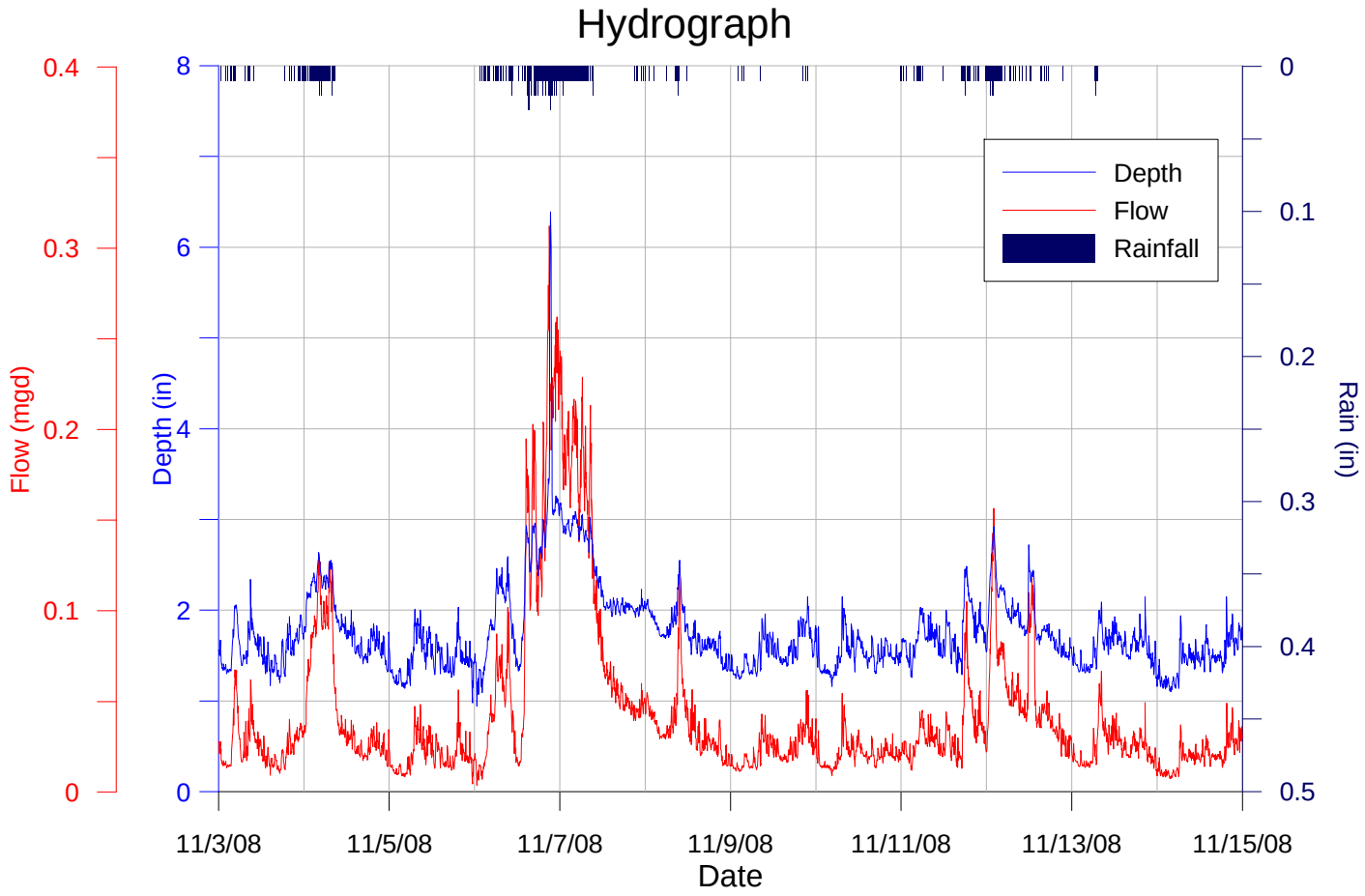


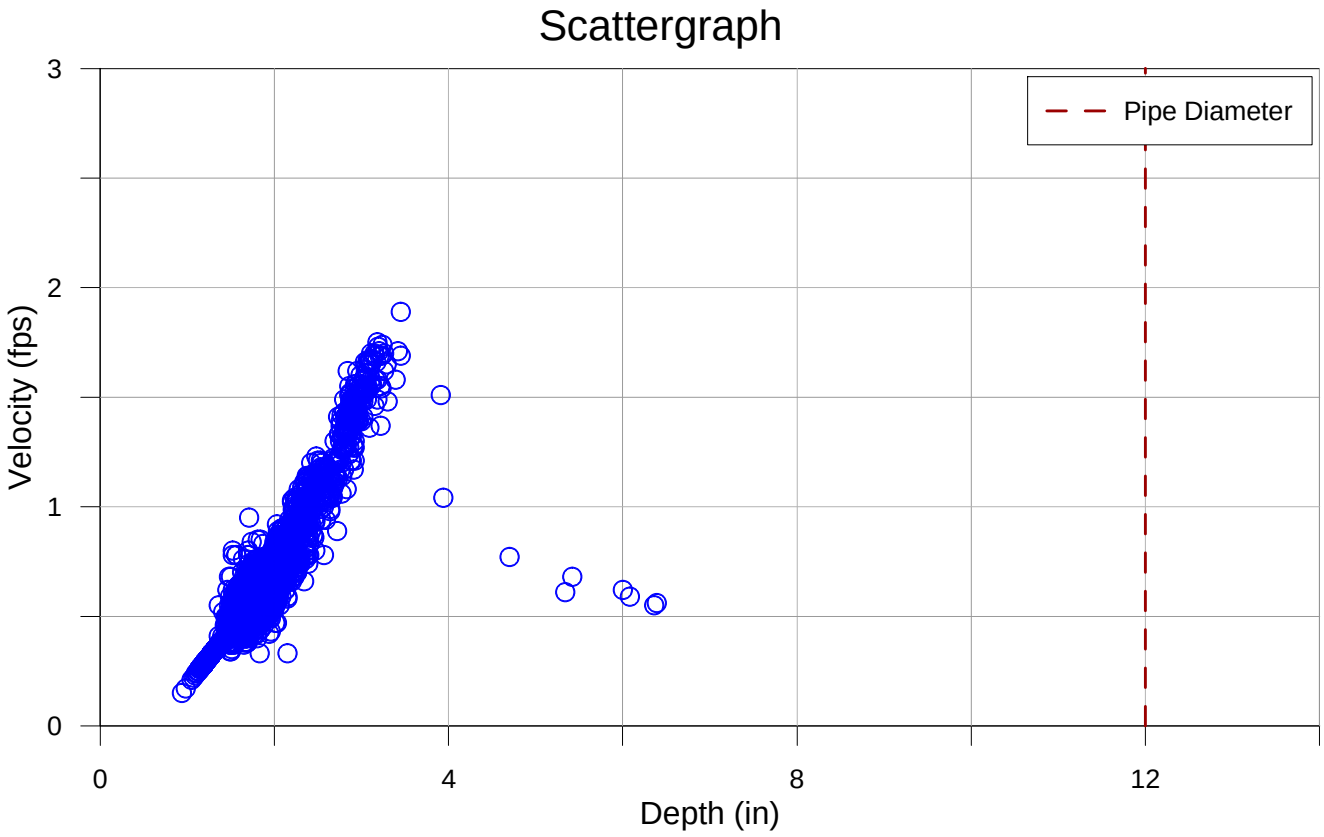
Monitor 081-062 (46) Sensor MP1
August 23 - 28, 2008



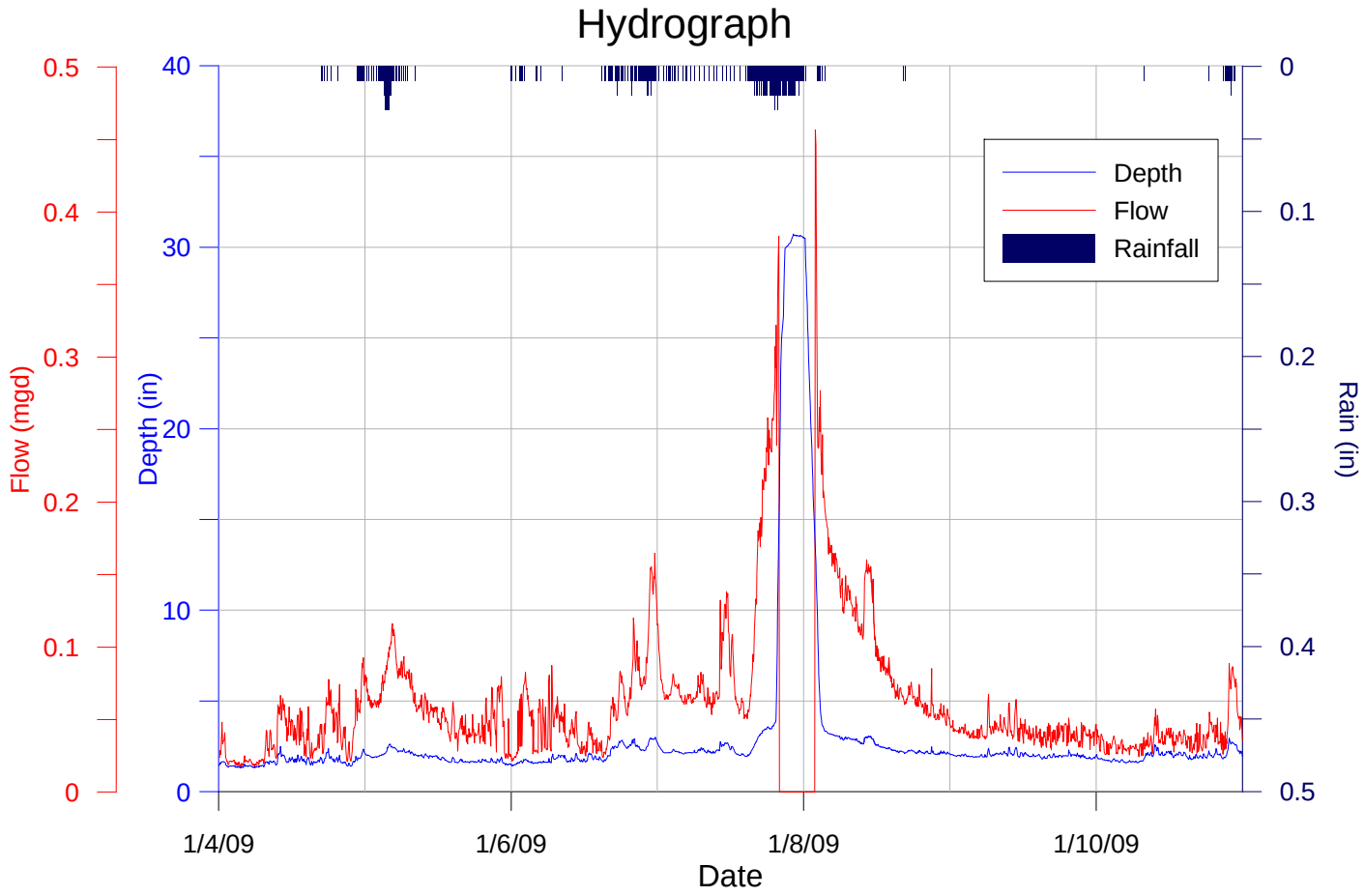


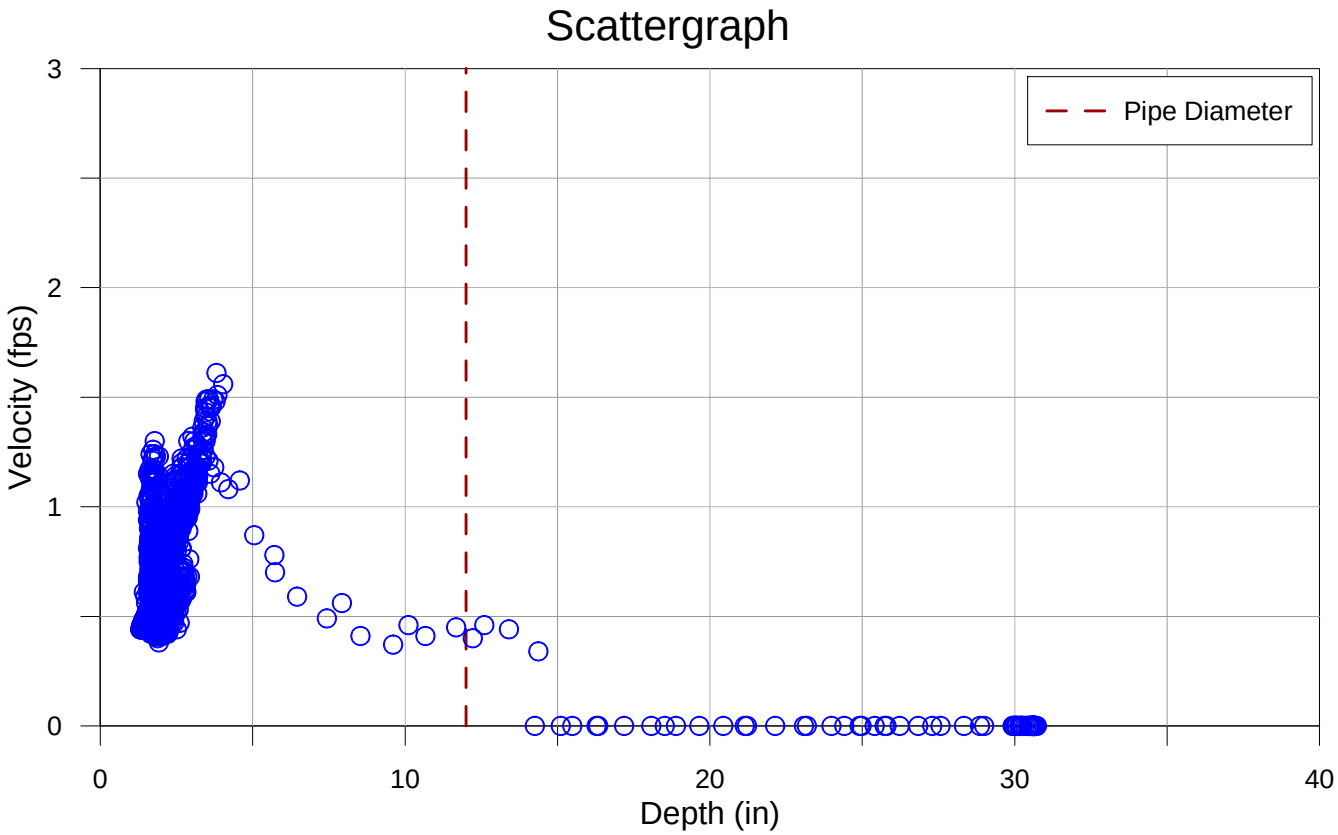
Monitor 081-062 (46) Sensor MP1
November 3 - 15, 2008



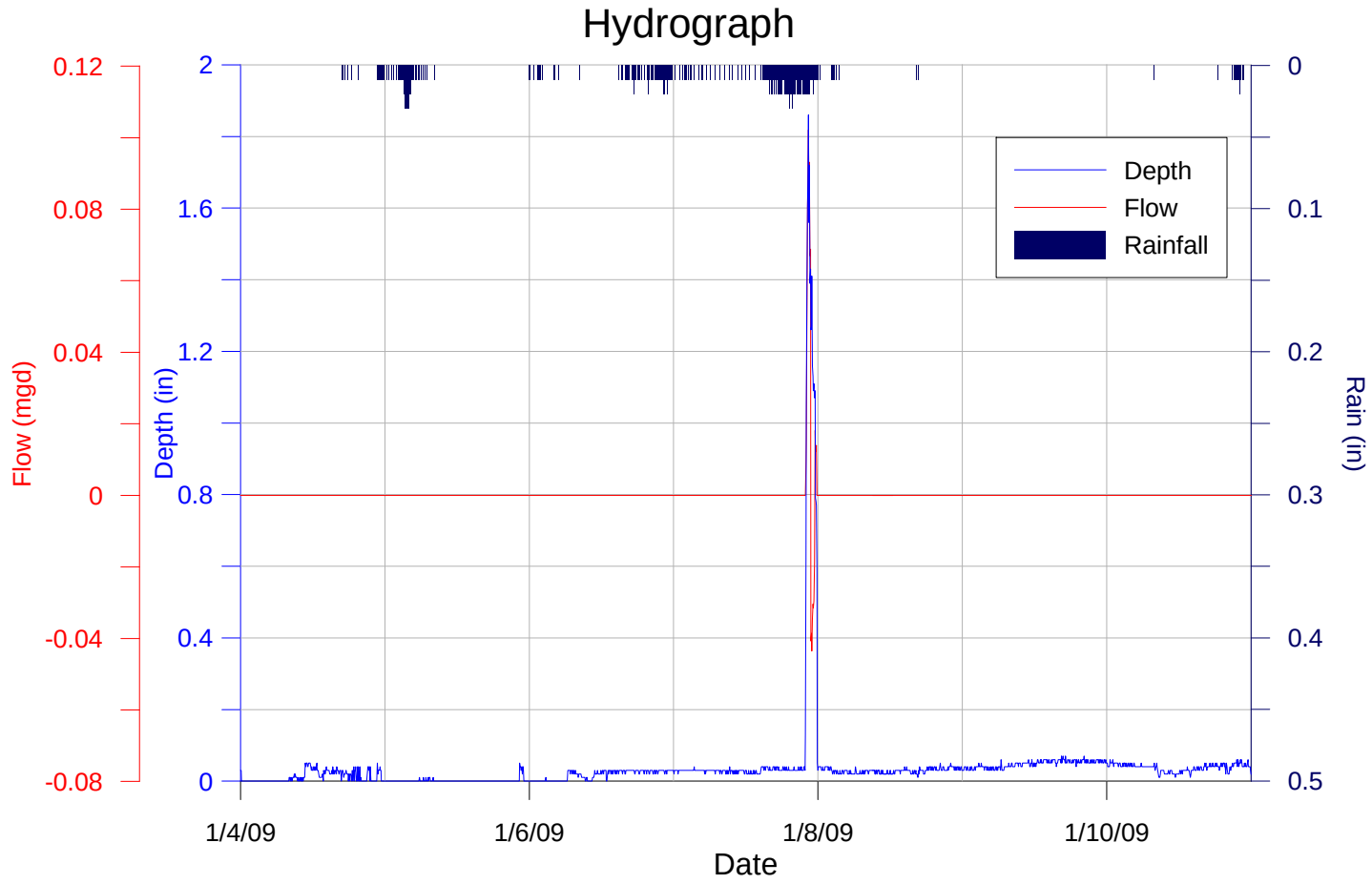


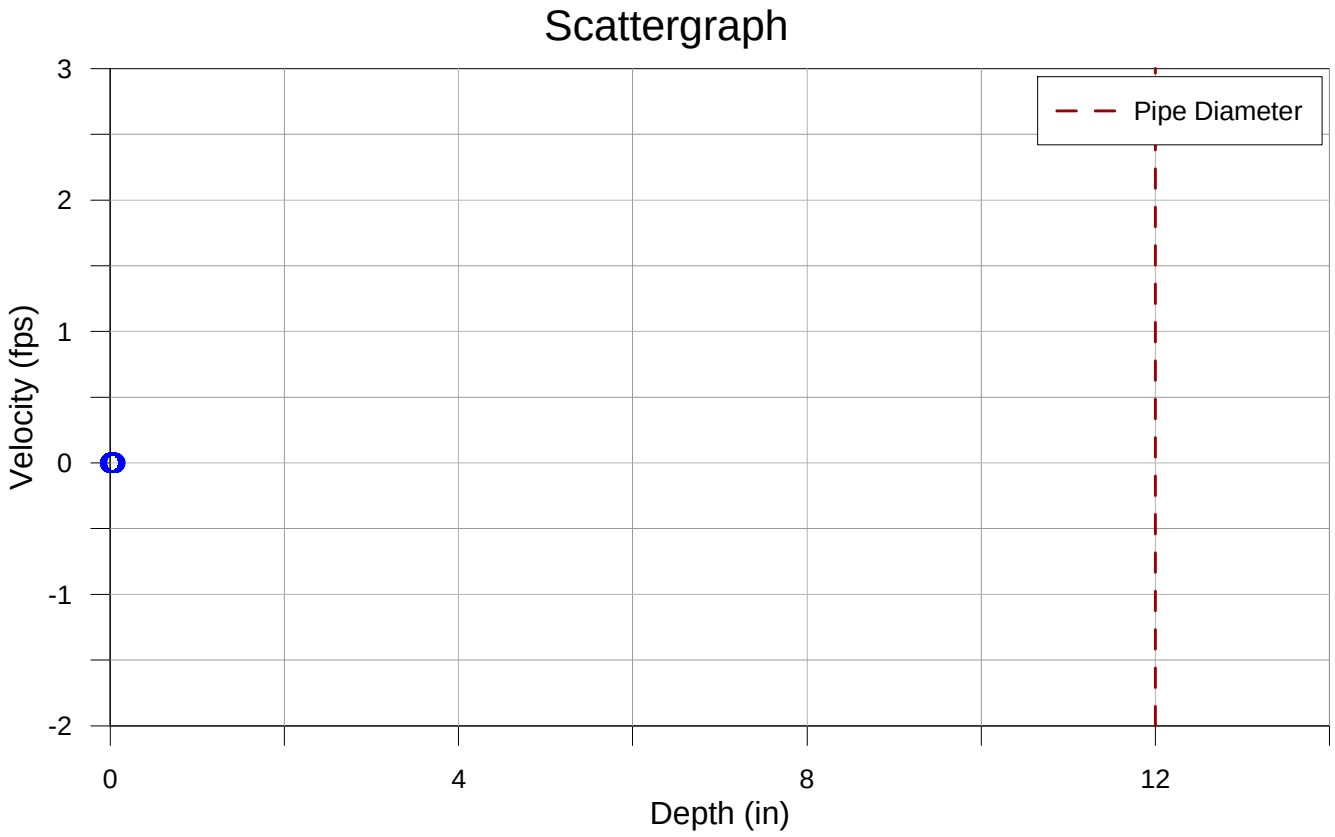
Monitor 081-062 (46) Sensor MP1
January 4 - 11, 2009





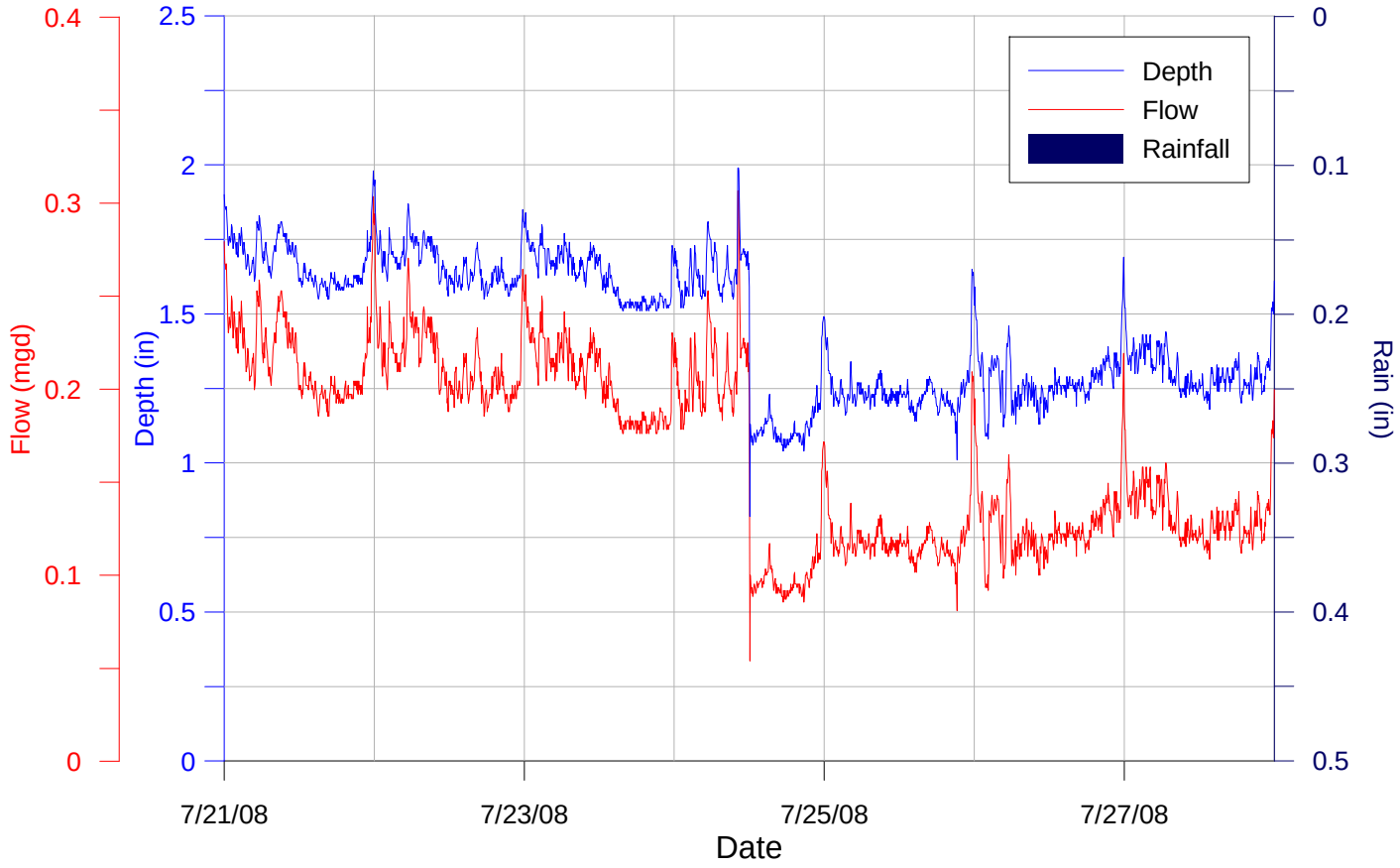
Monitor 081-062 (46) Sensor MP2
January 4 - 11, 2009



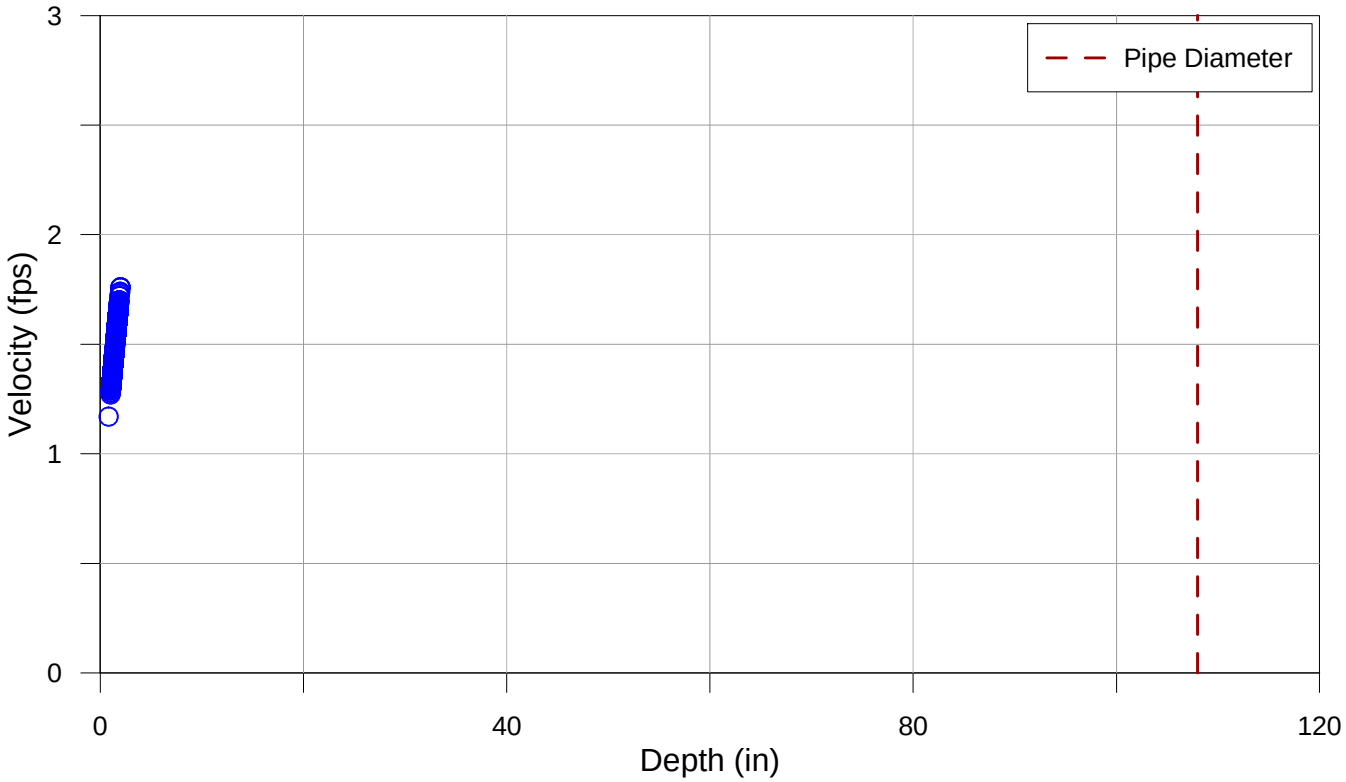


Monitor D081-131
July 21 - 28, 2008

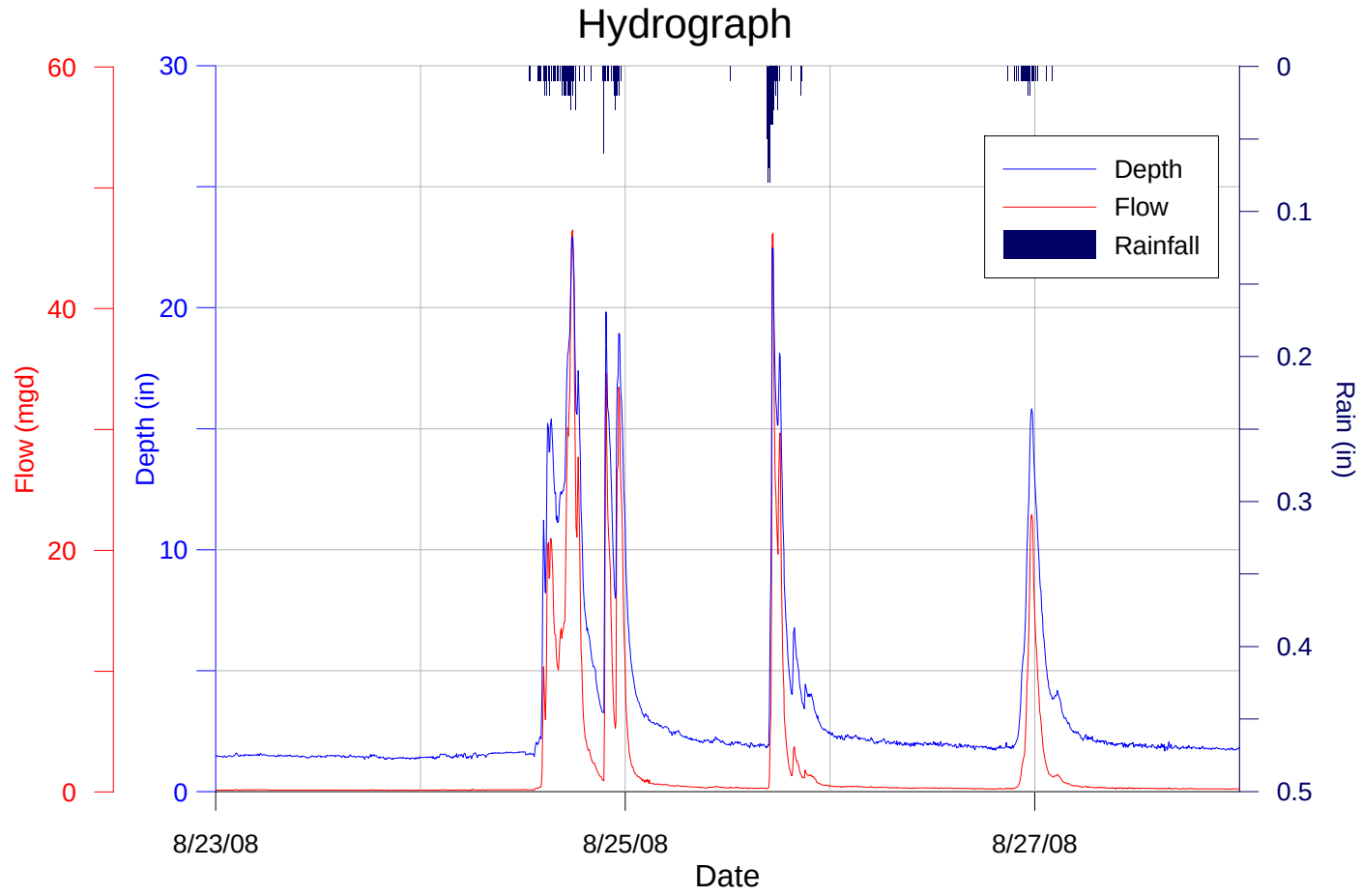
Hydrograph

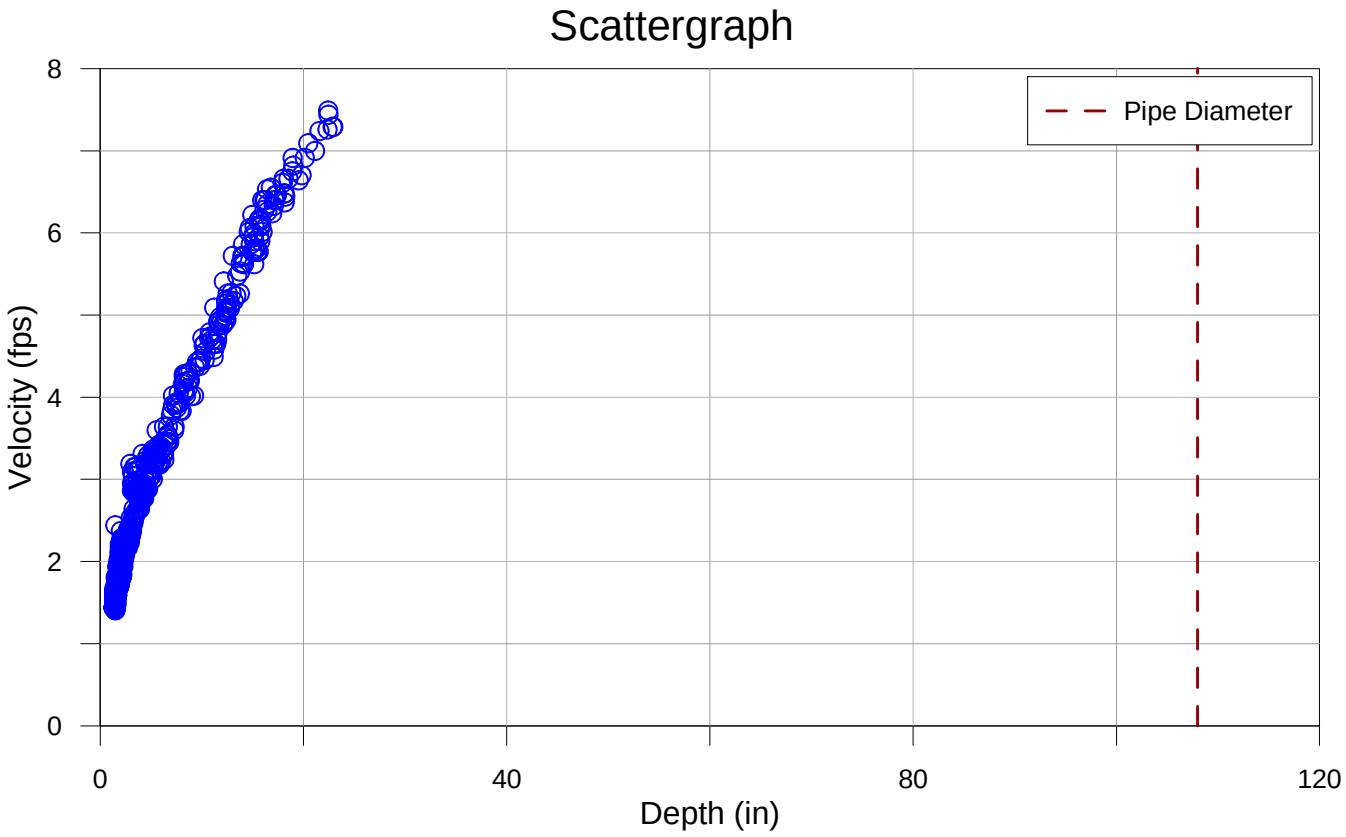


Scattergraph



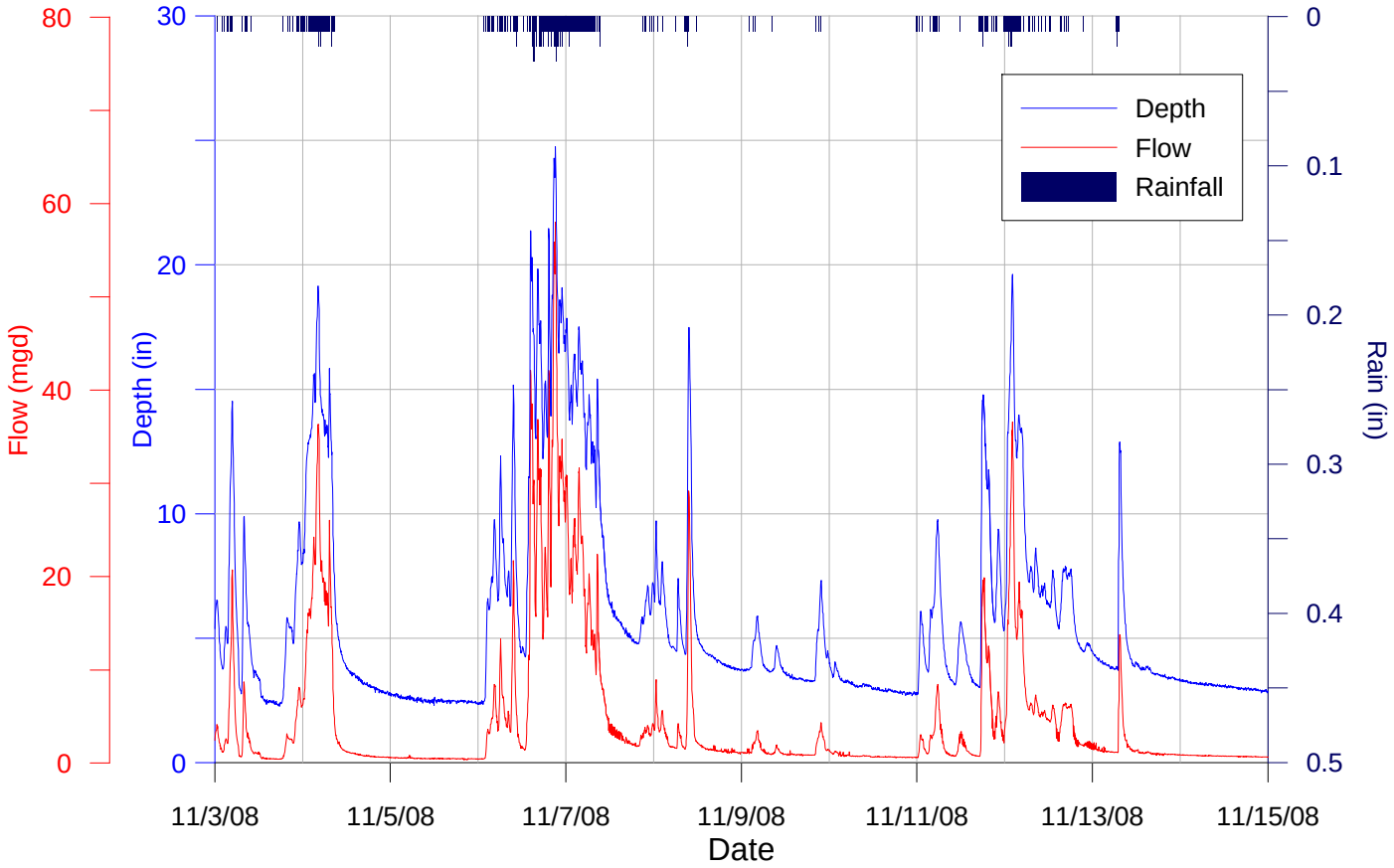
Monitor D081-131
August 23 - 28, 2008



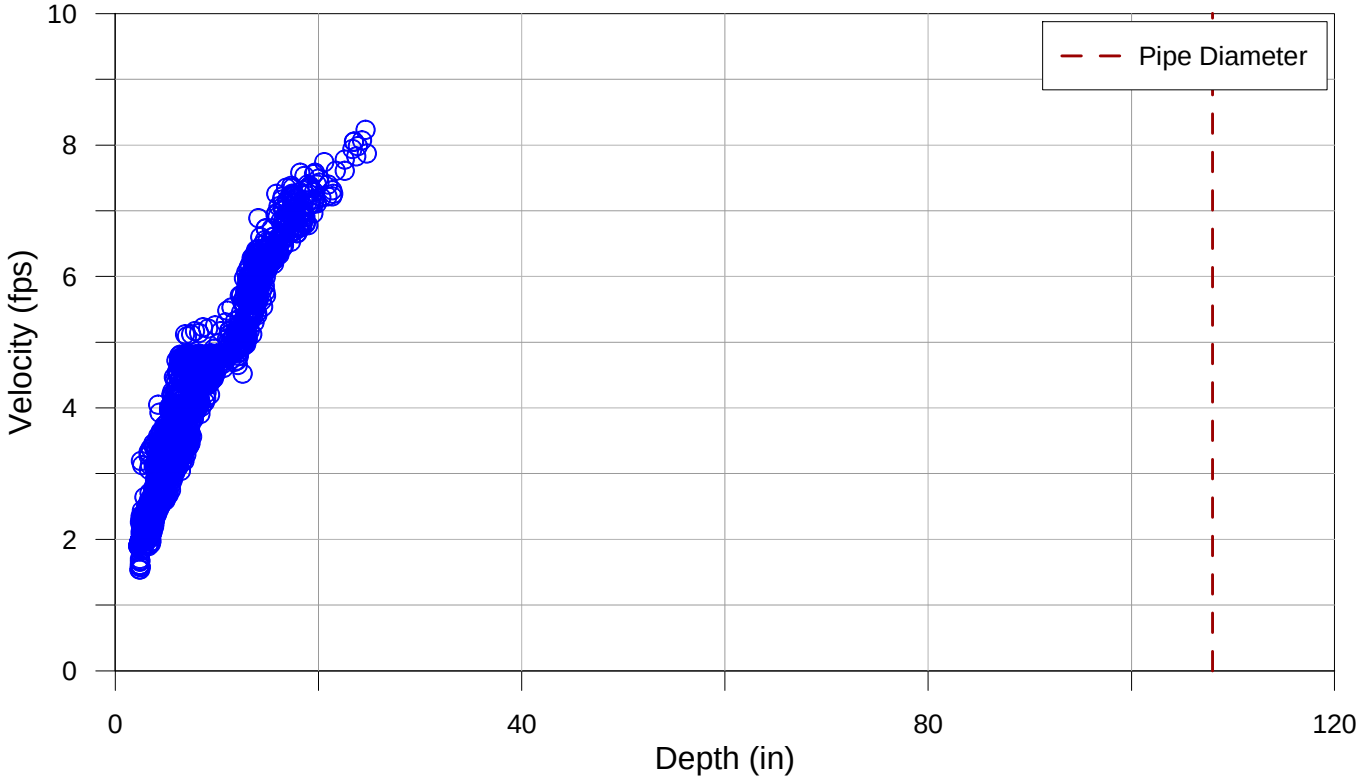


Monitor D081-131
November 3 - 15, 2008

Hydrograph

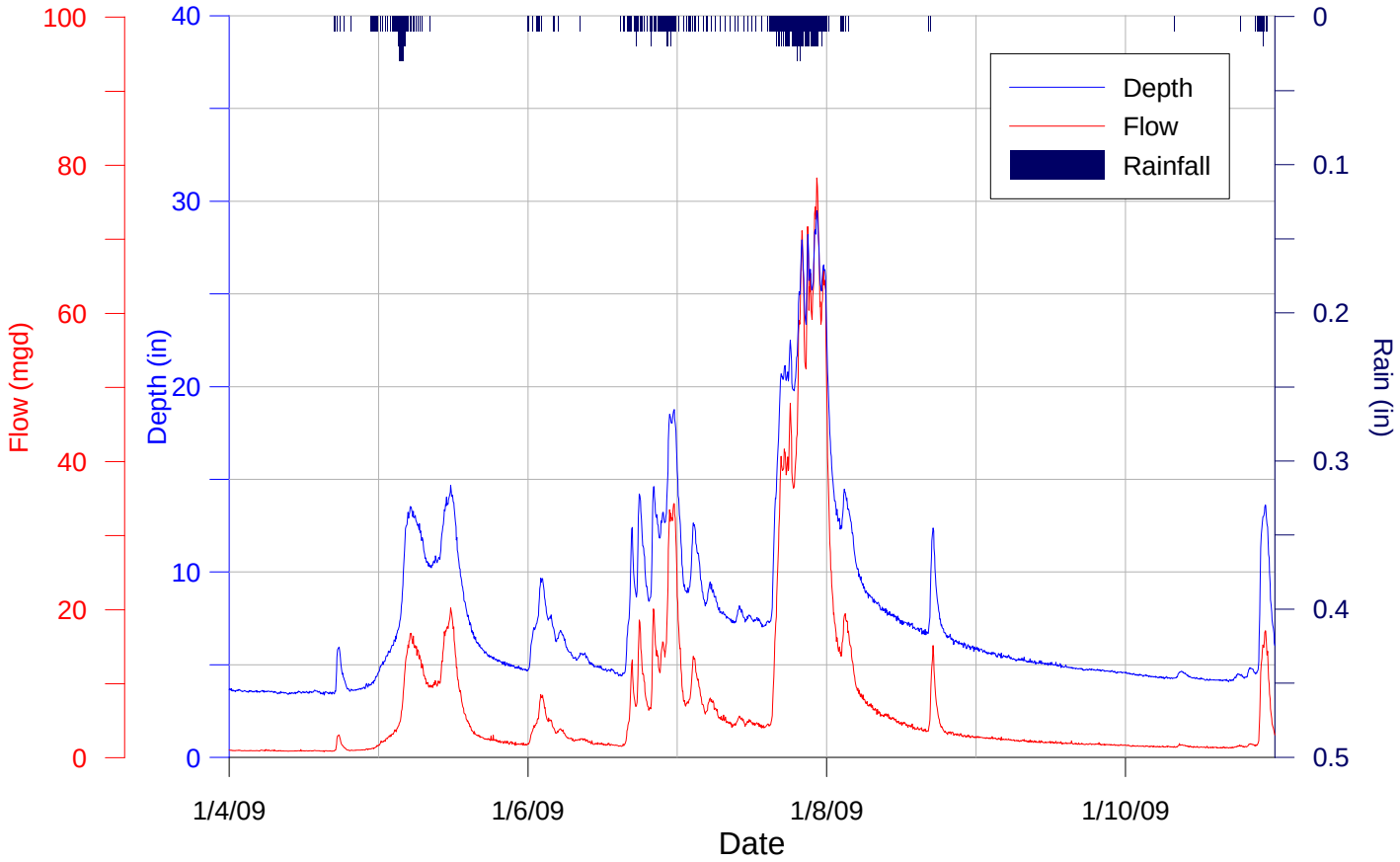


Scattergraph

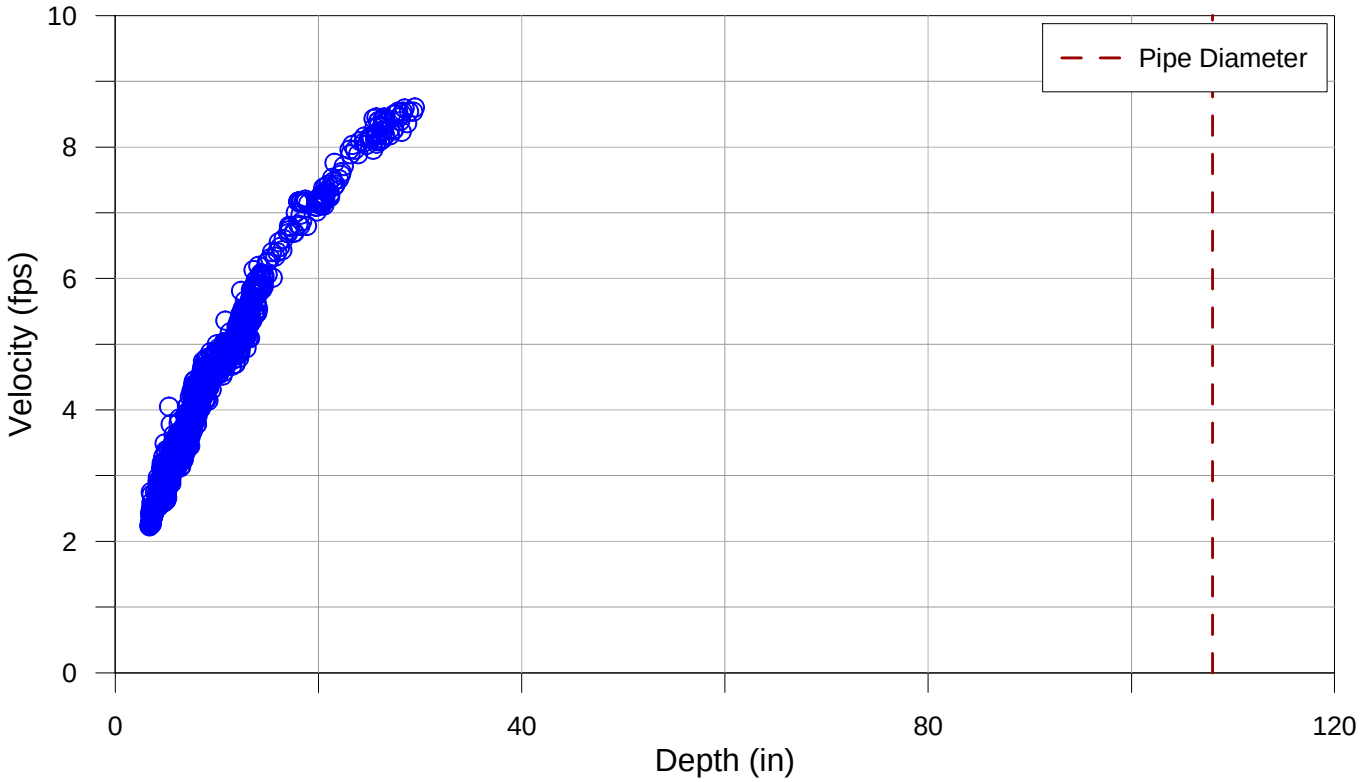


Monitor D081-131
January 4 - 11, 2009

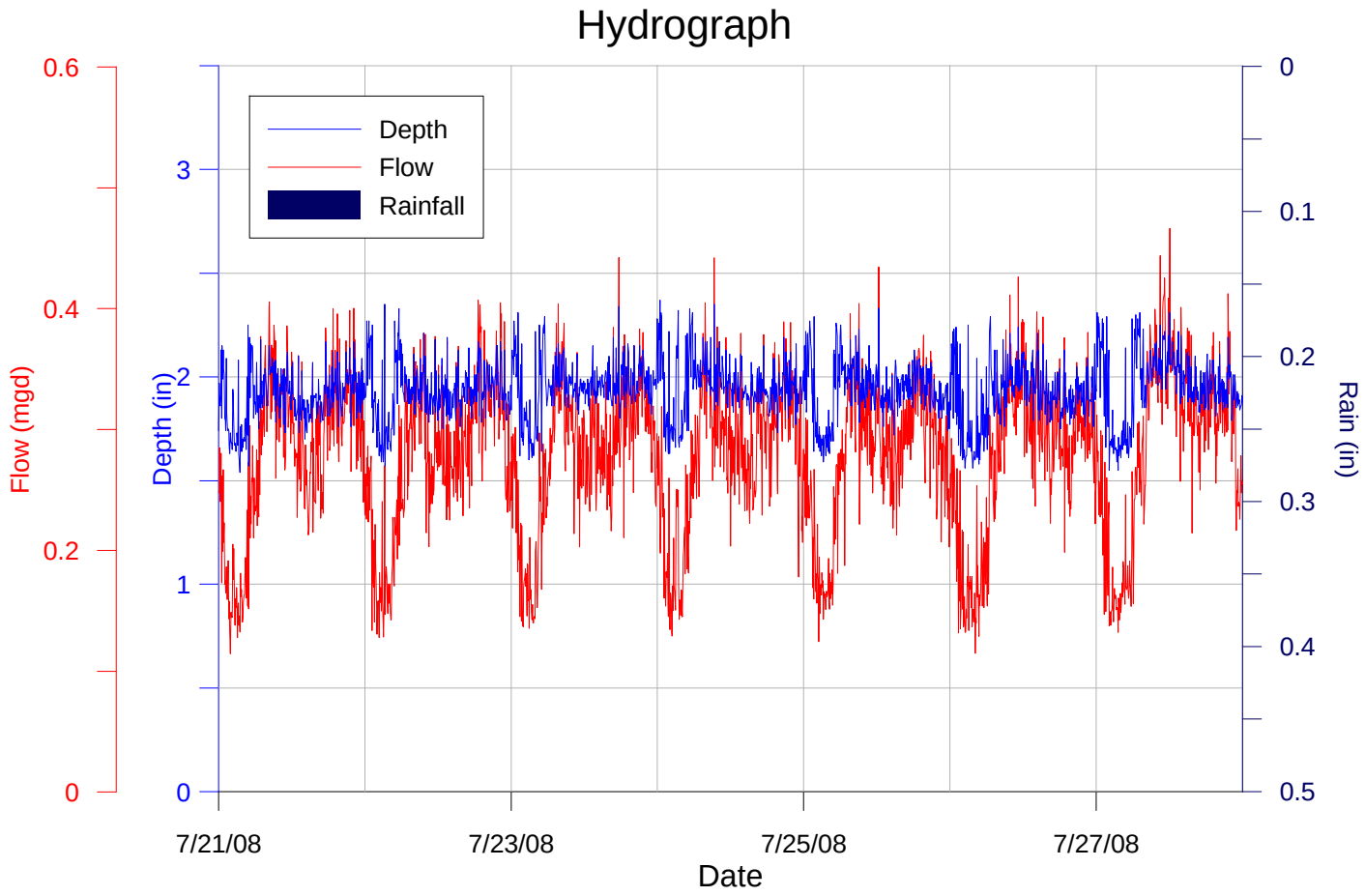
Hydrograph

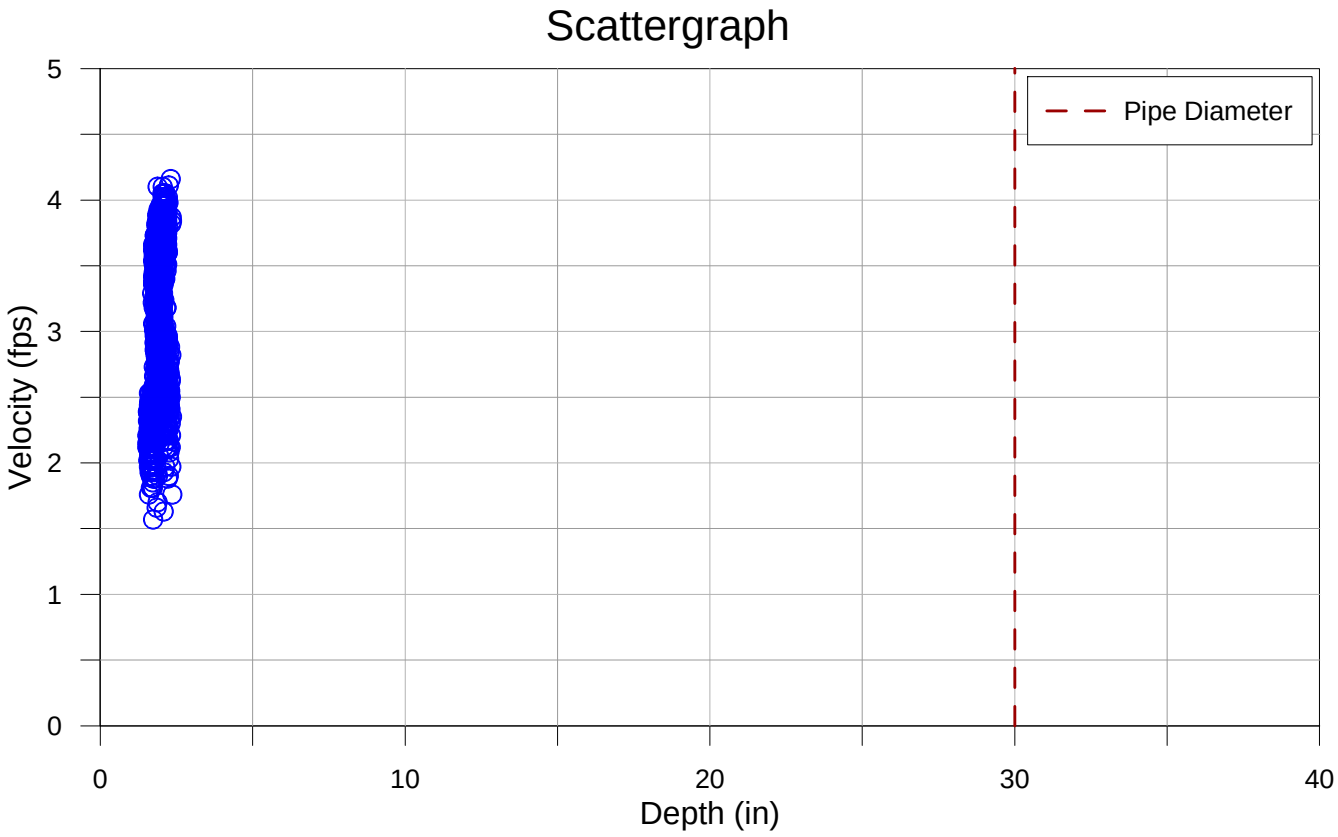


Scattergraph

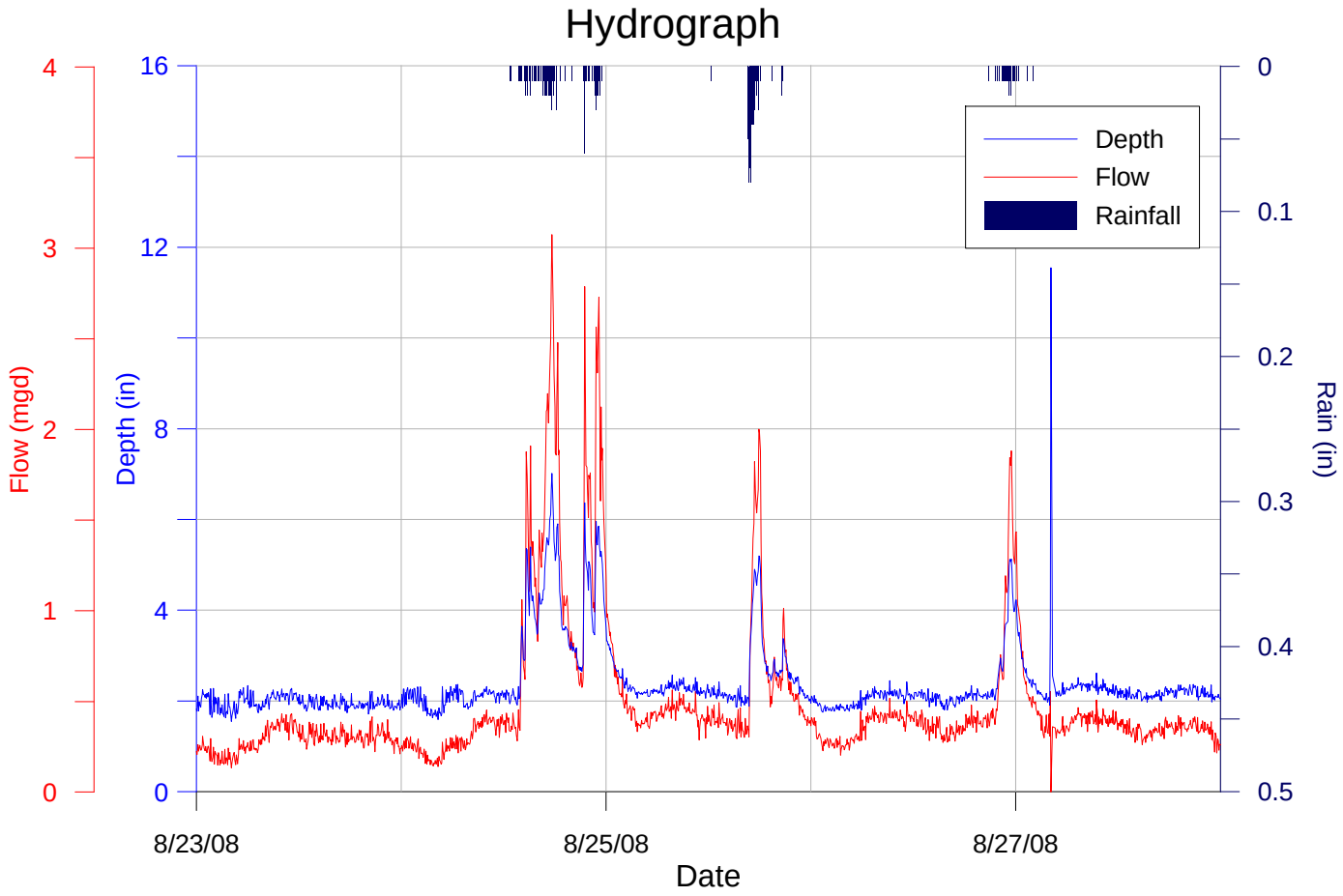


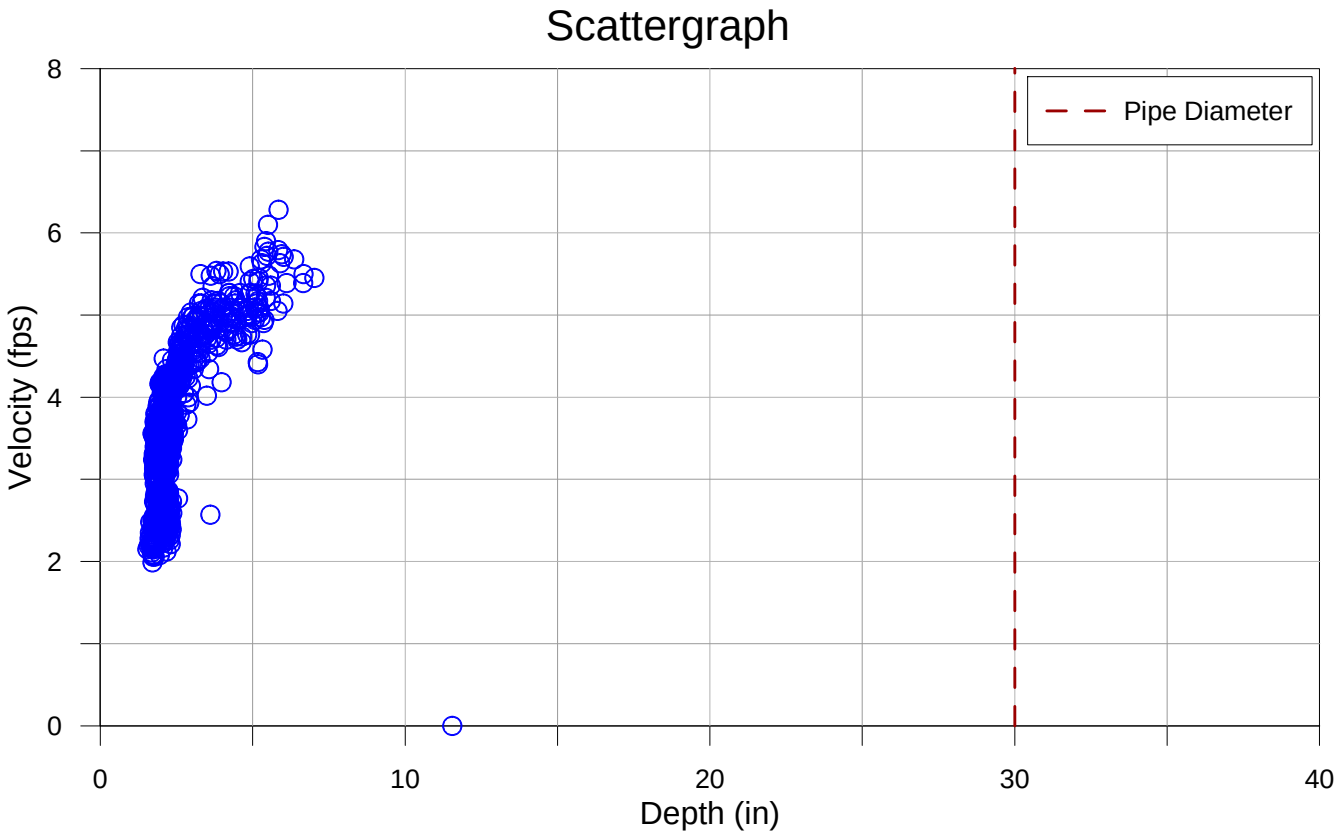
Monitor 073-268
July 21 - 28, 2008



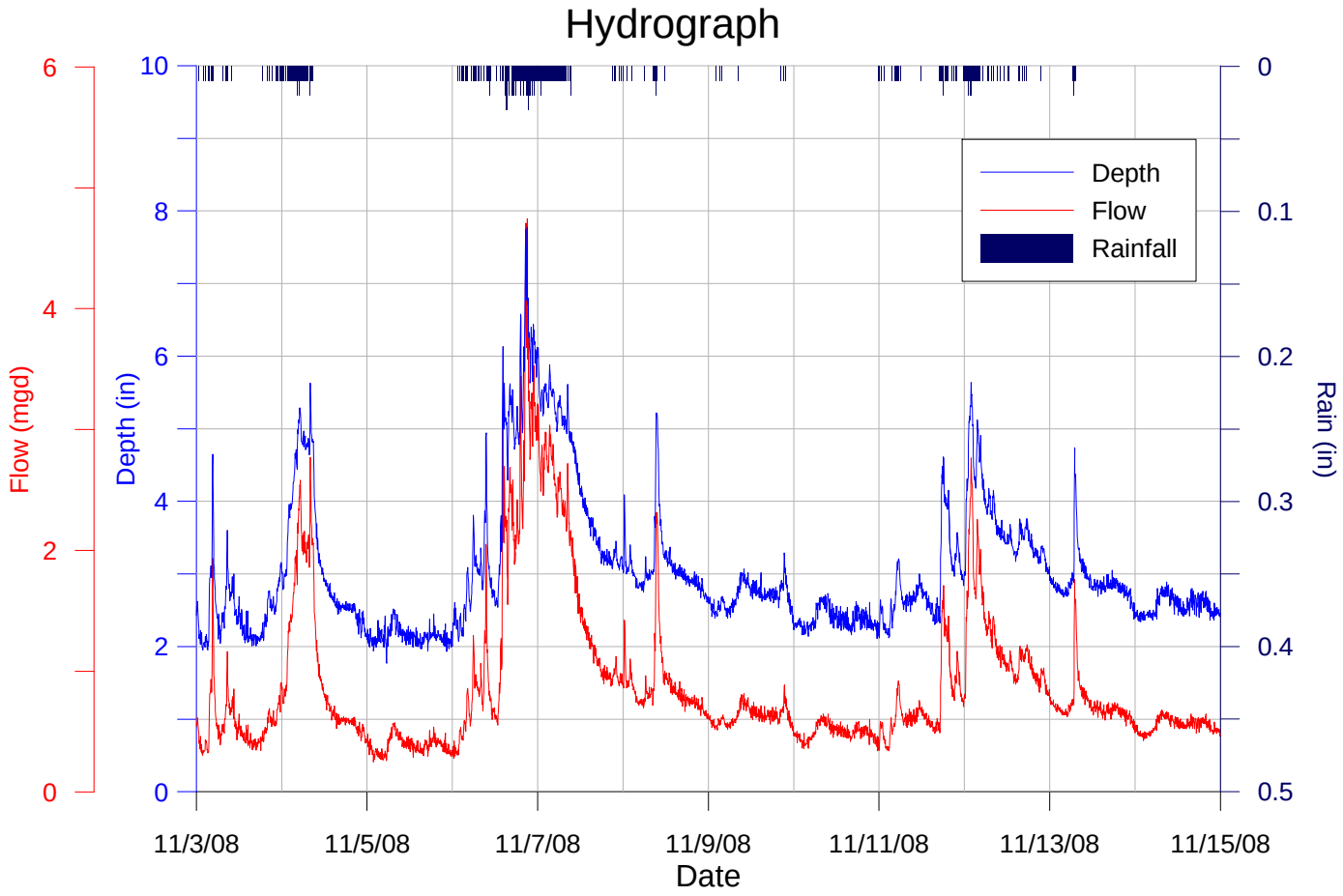


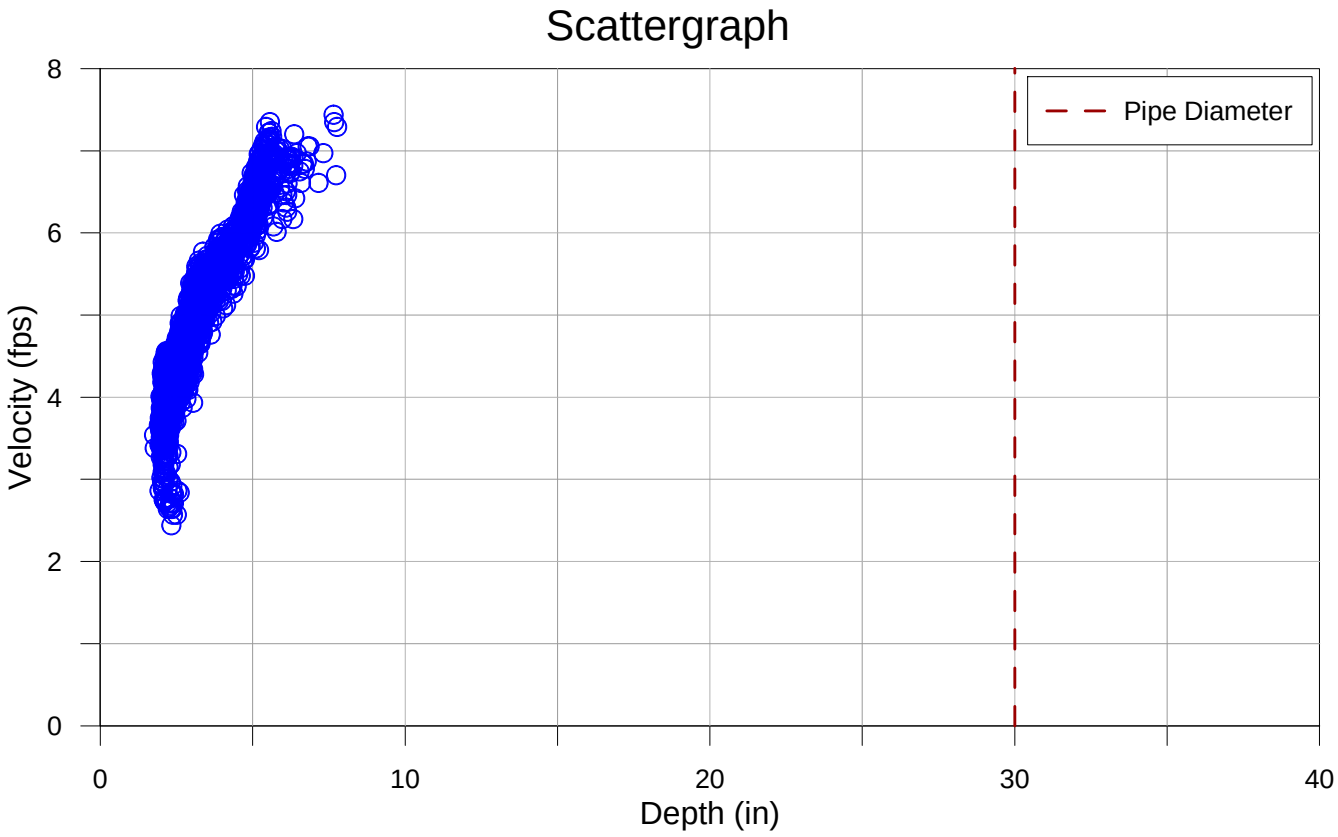
Monitor 073-268
August 23 - 28, 2008



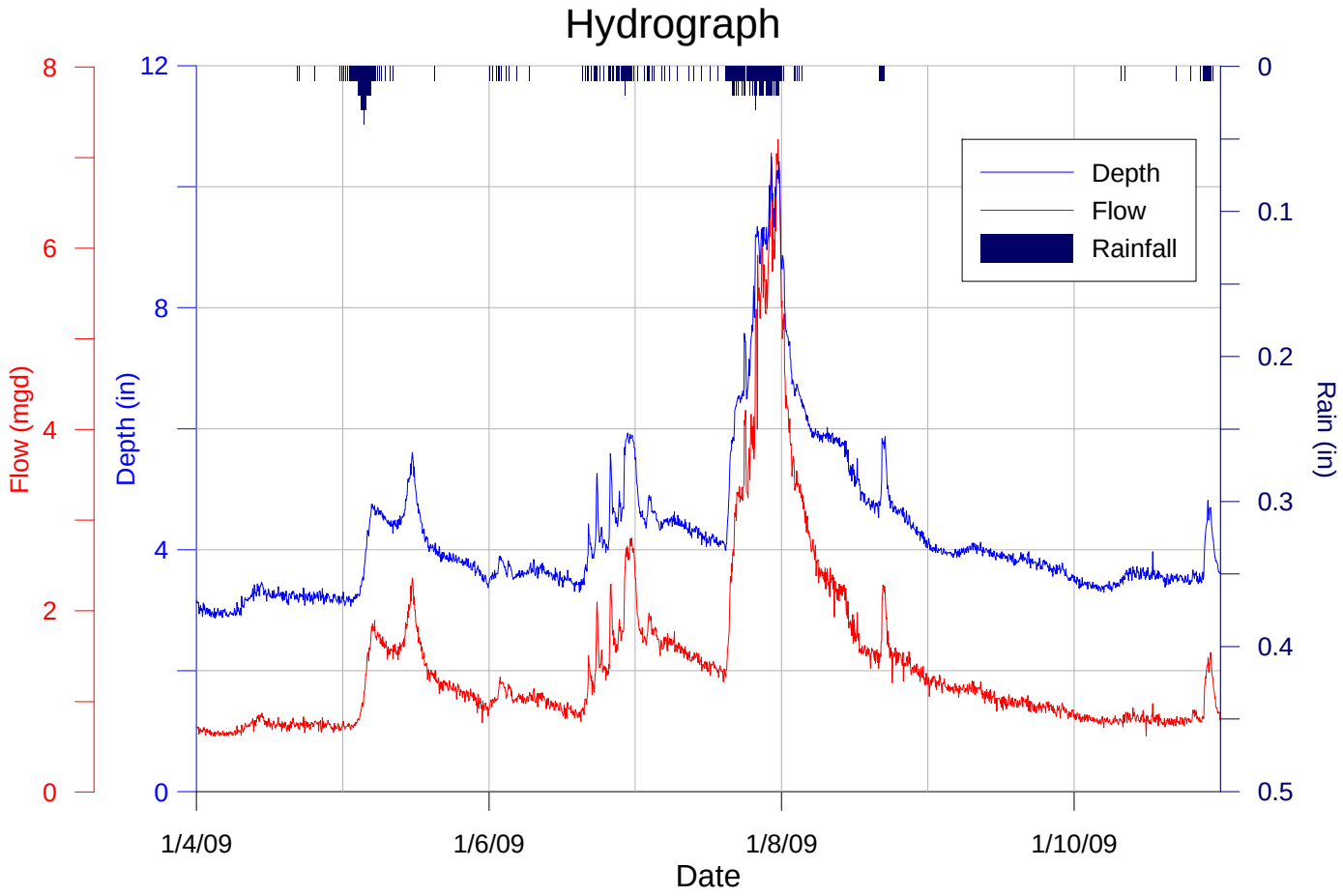


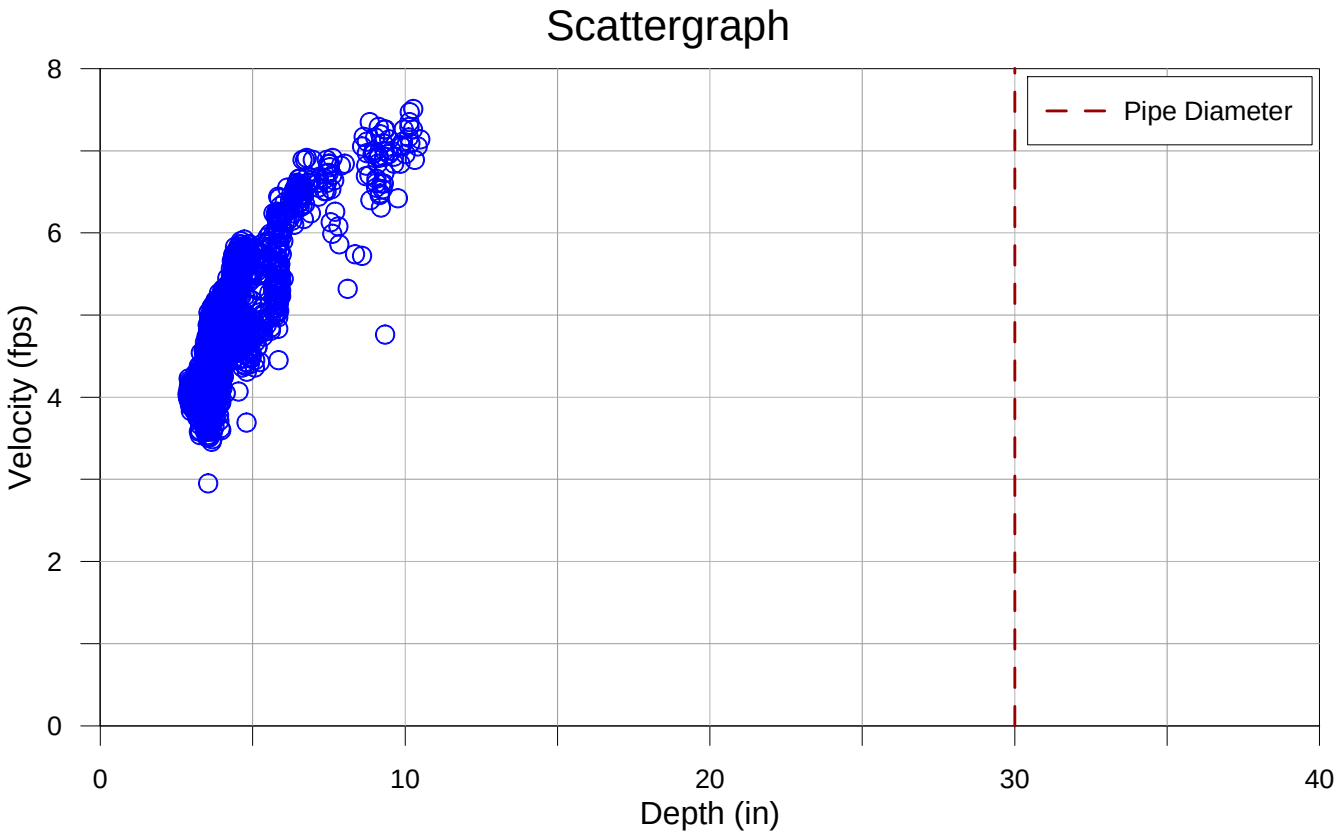
Monitor 073-268
November 3 - 15, 2008



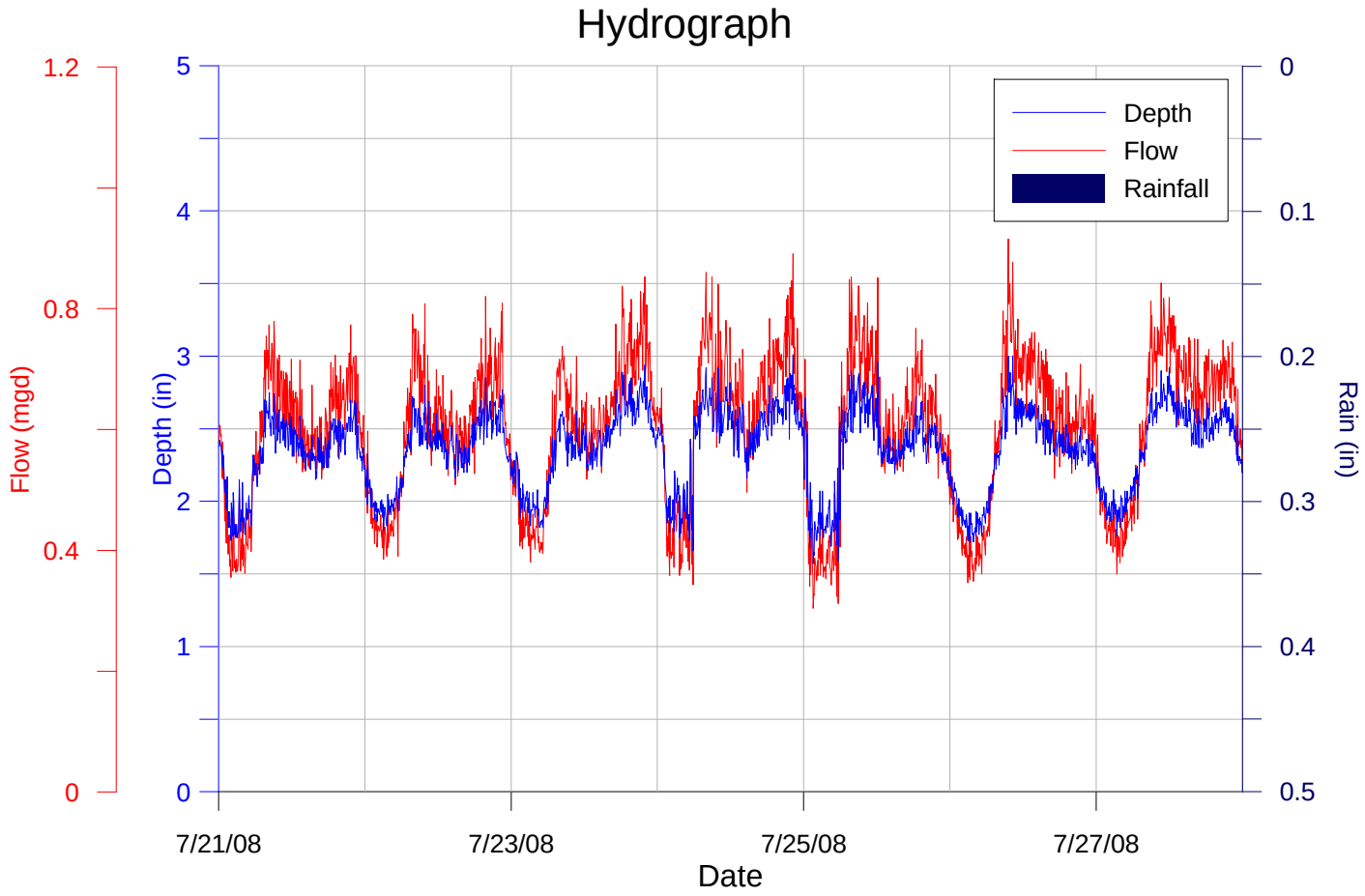


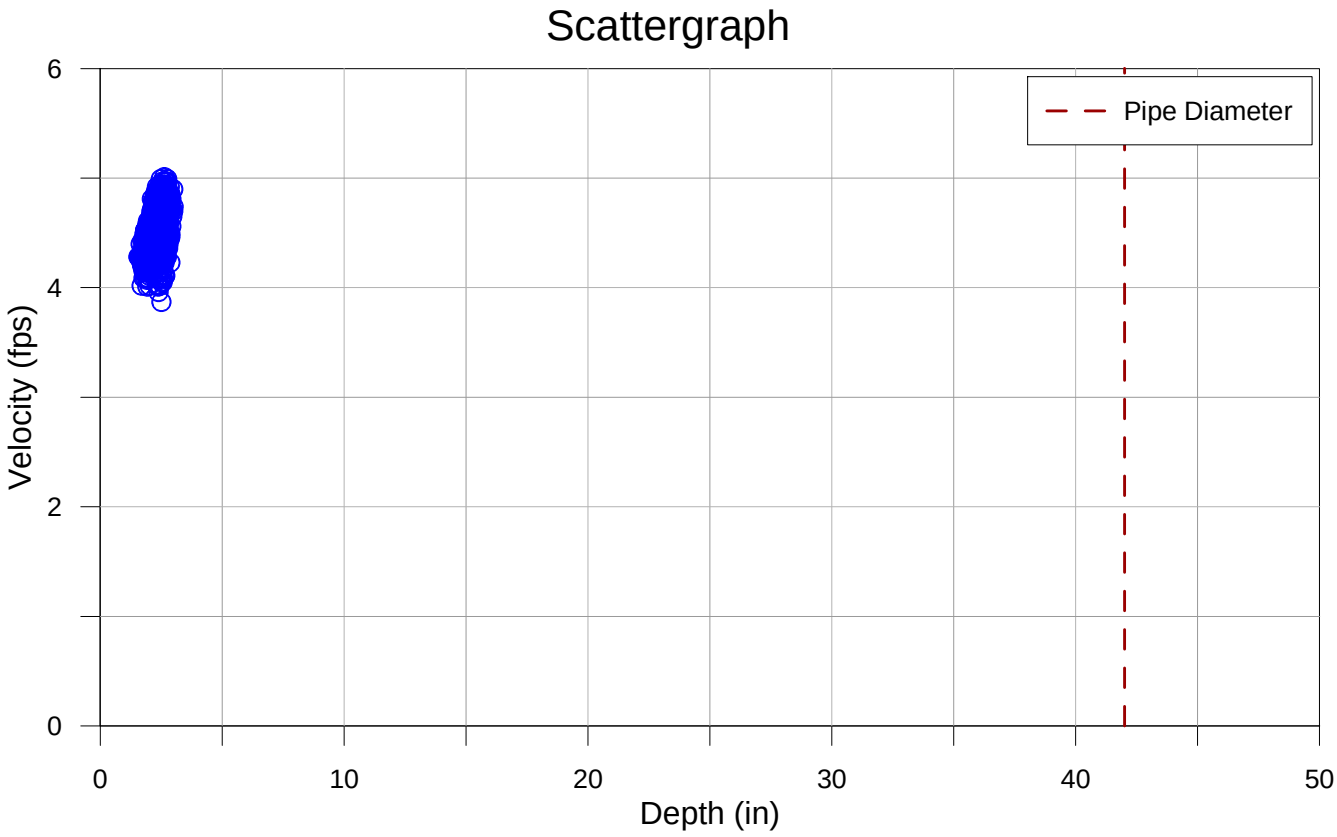
Monitor 073-268
January 4 - 11, 2009



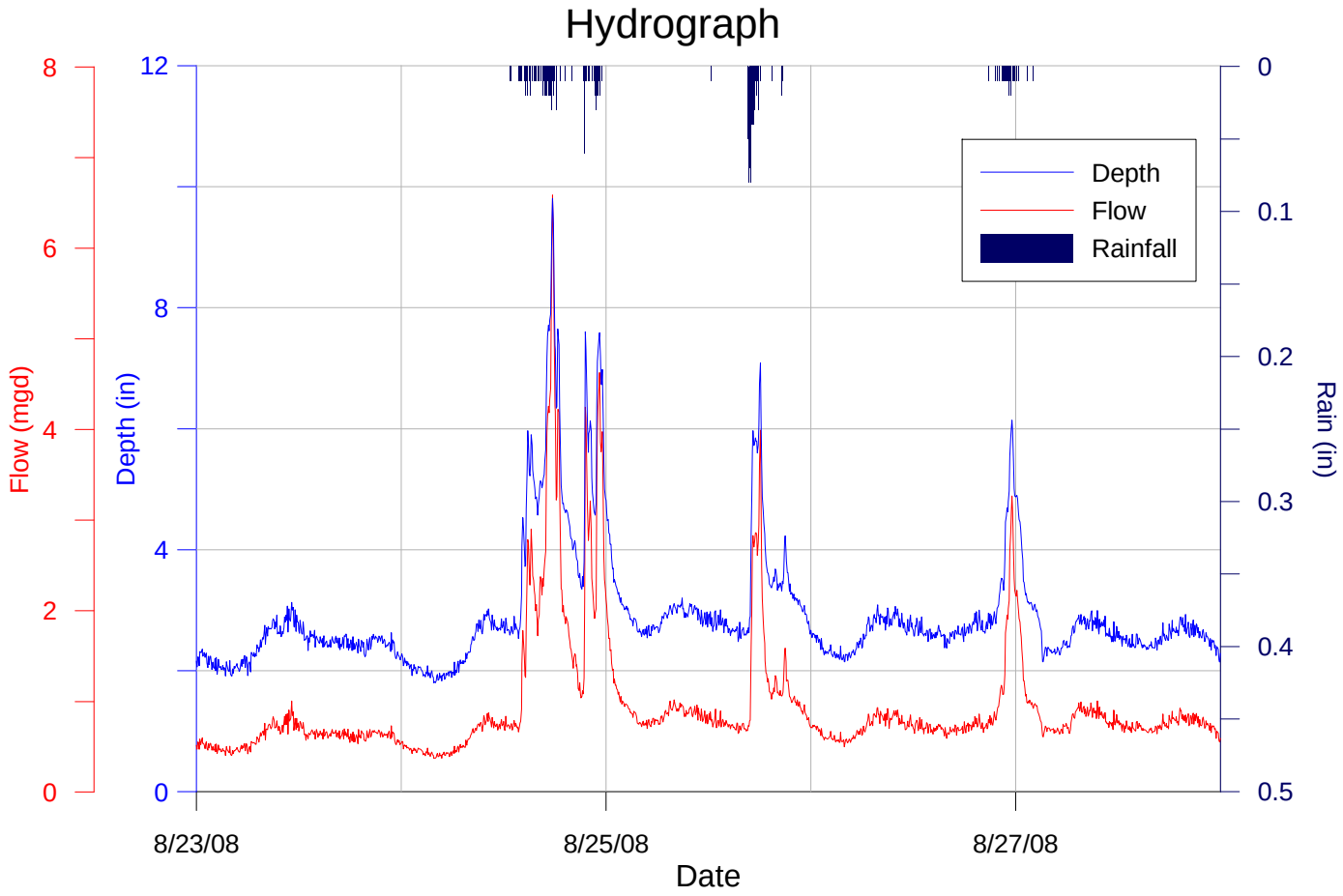


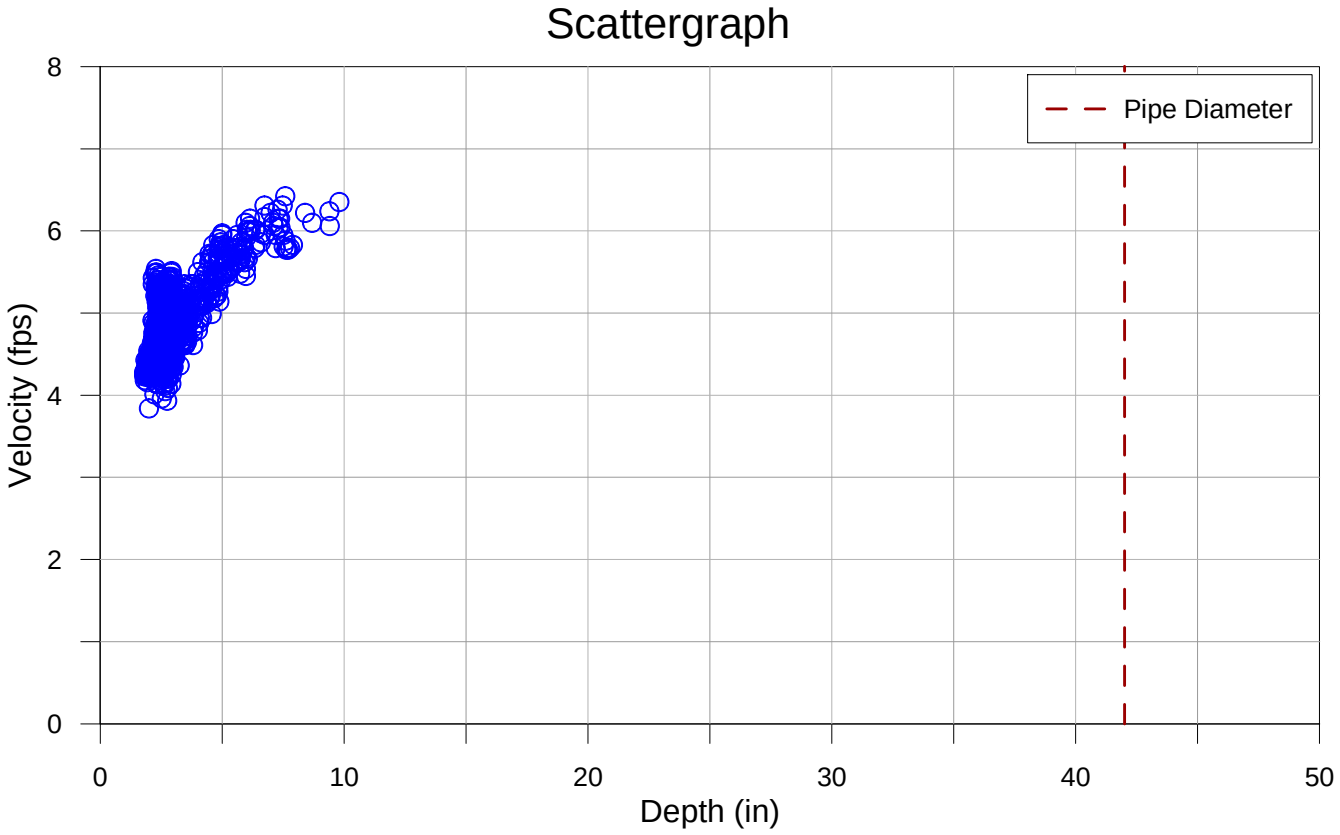
Monitor 073-276
July 21 - 28, 2008



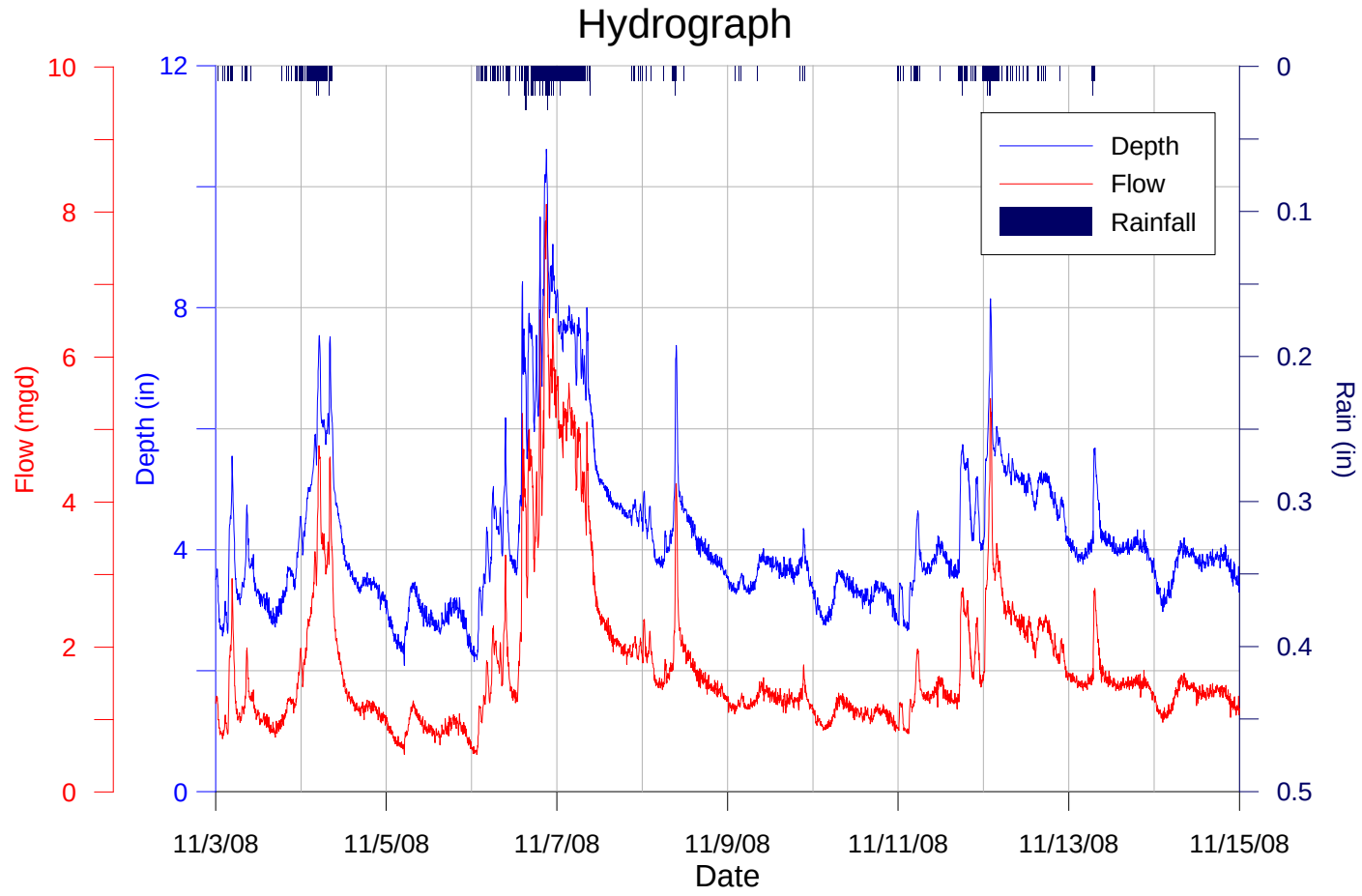


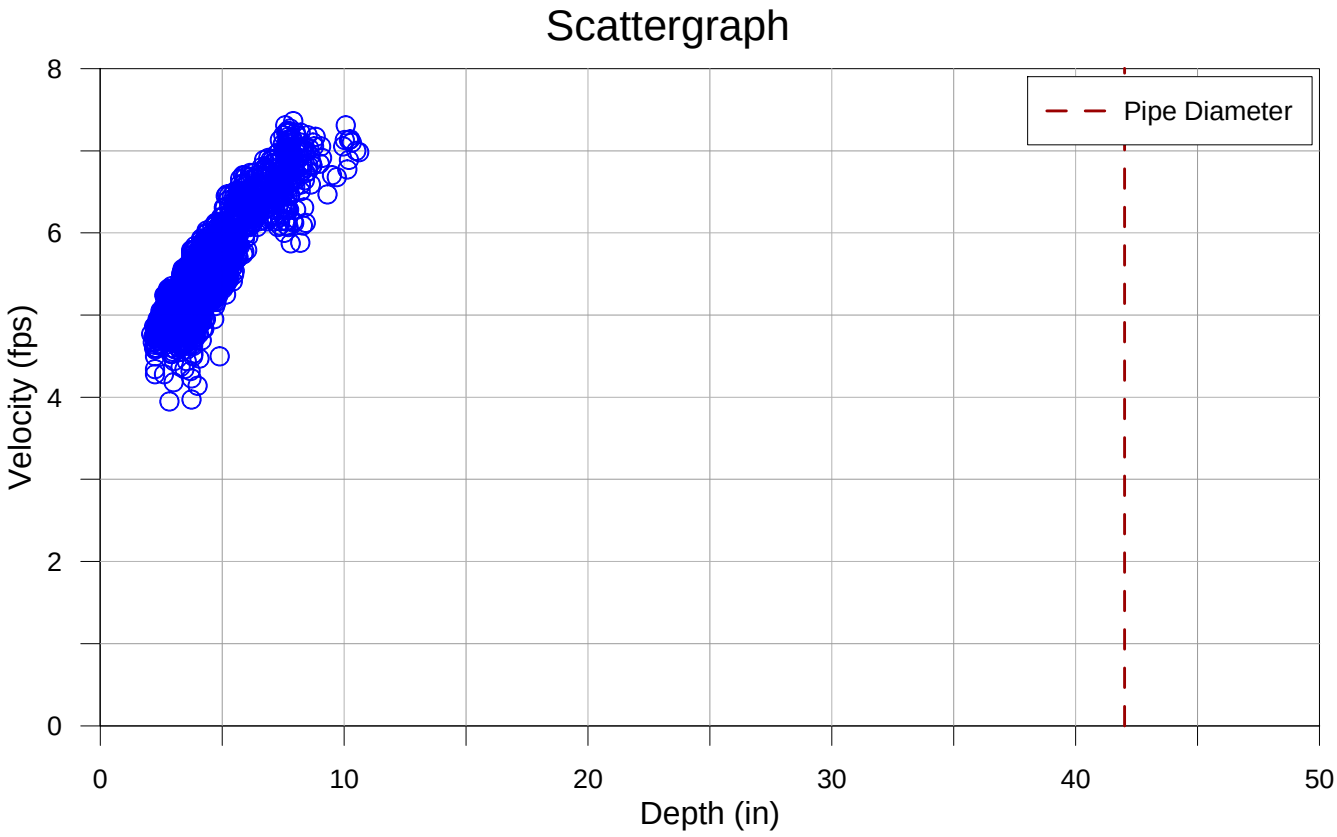
Monitor 073-276
August 23 - 28, 2008



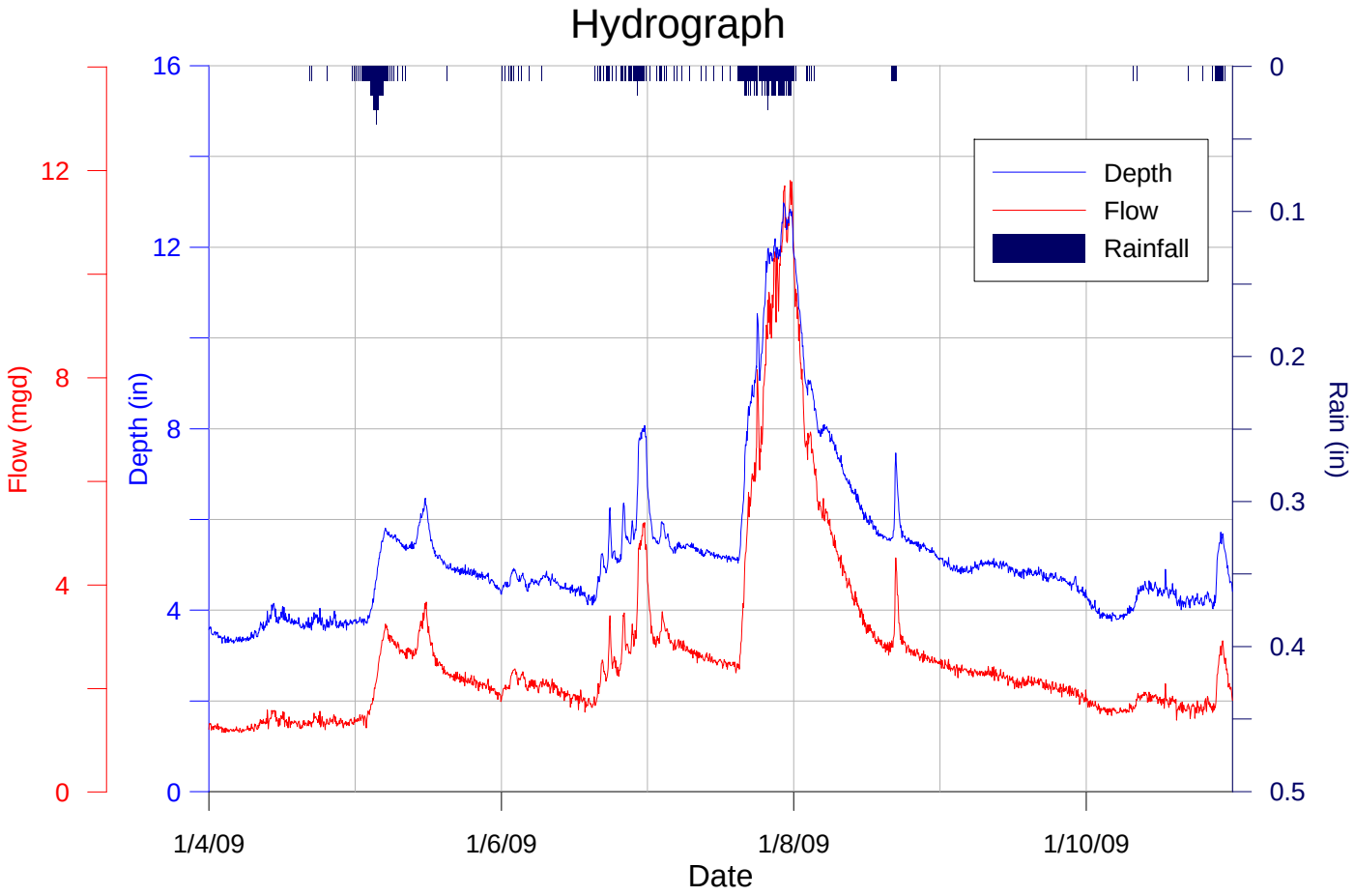


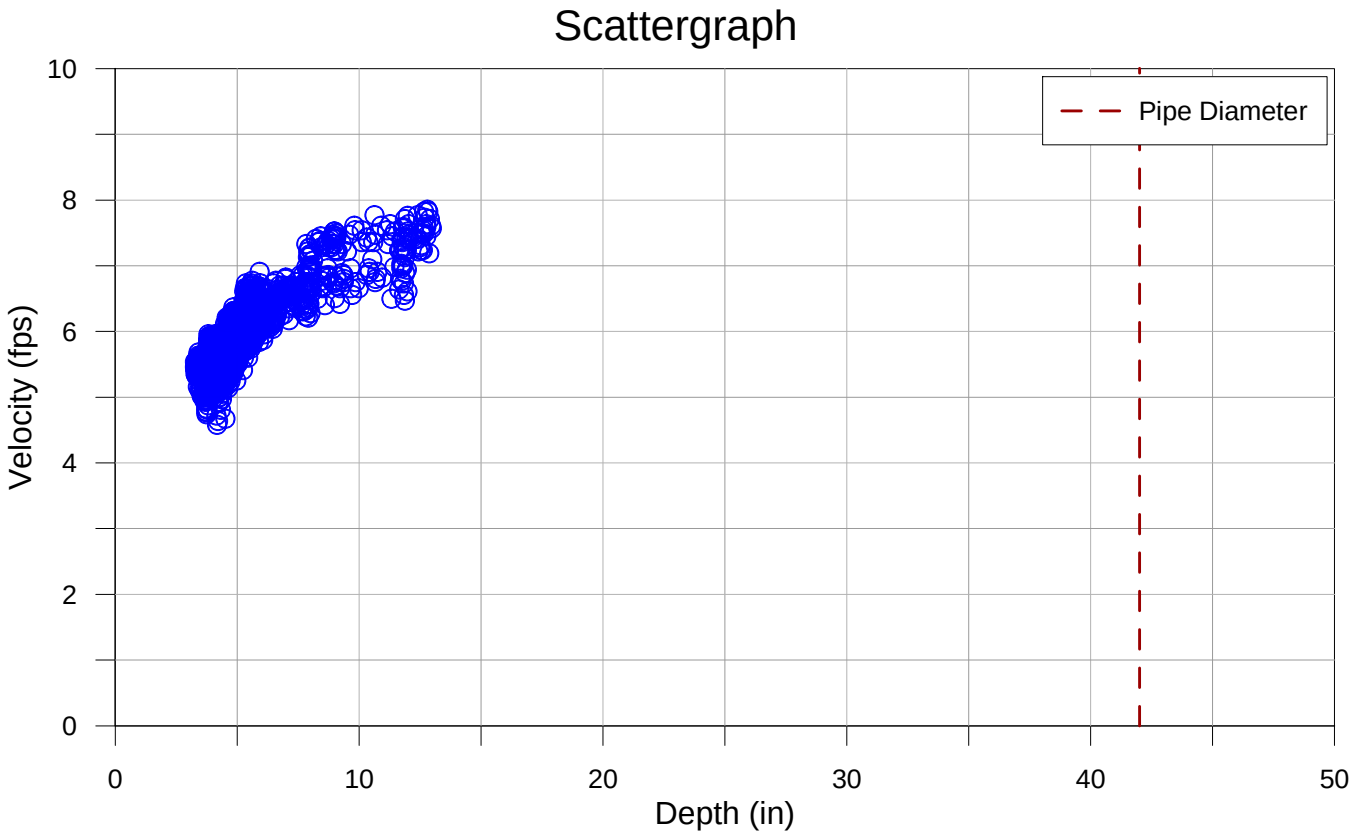
Monitor 073-276
November 3 - 15, 2008



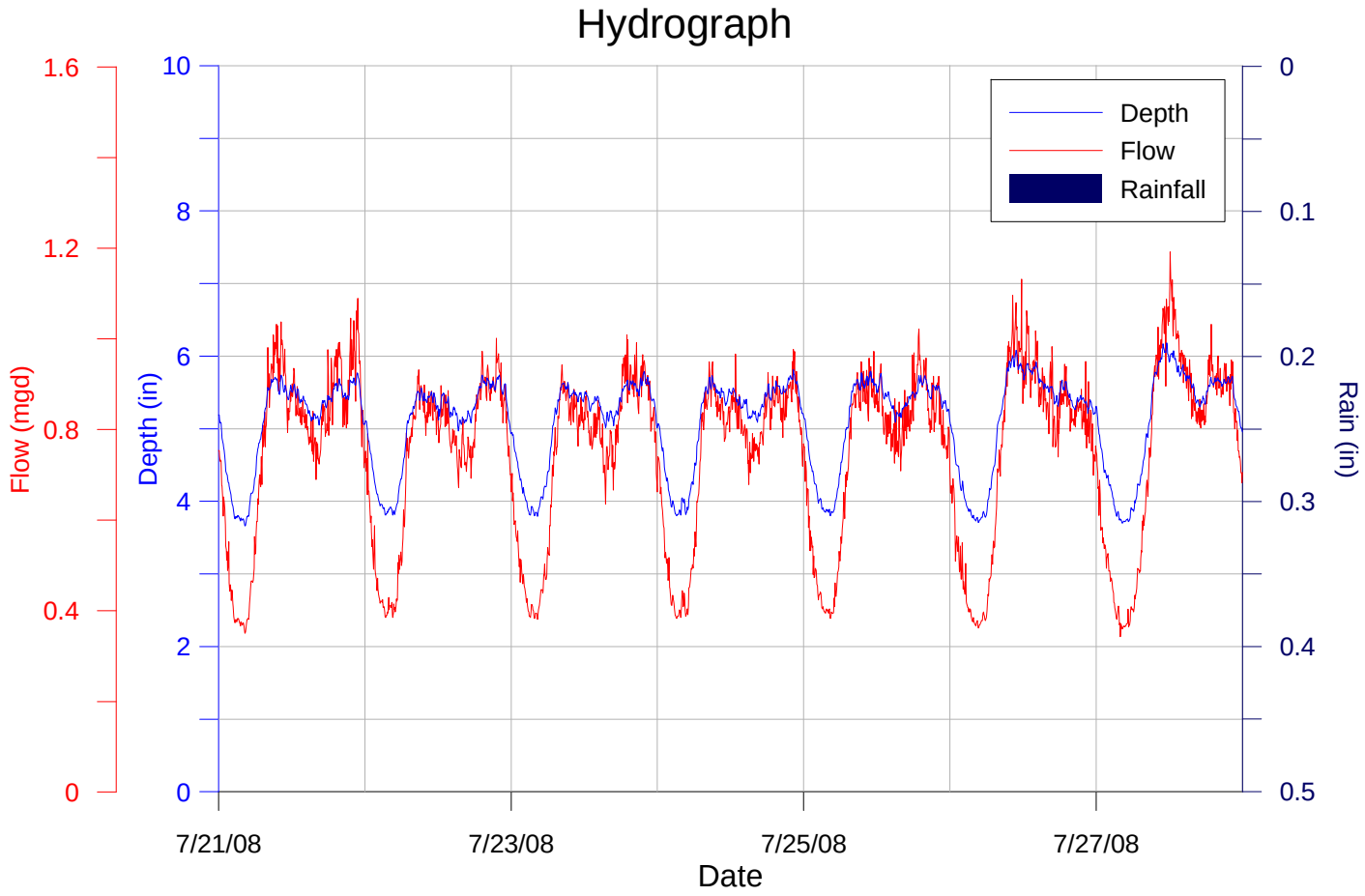


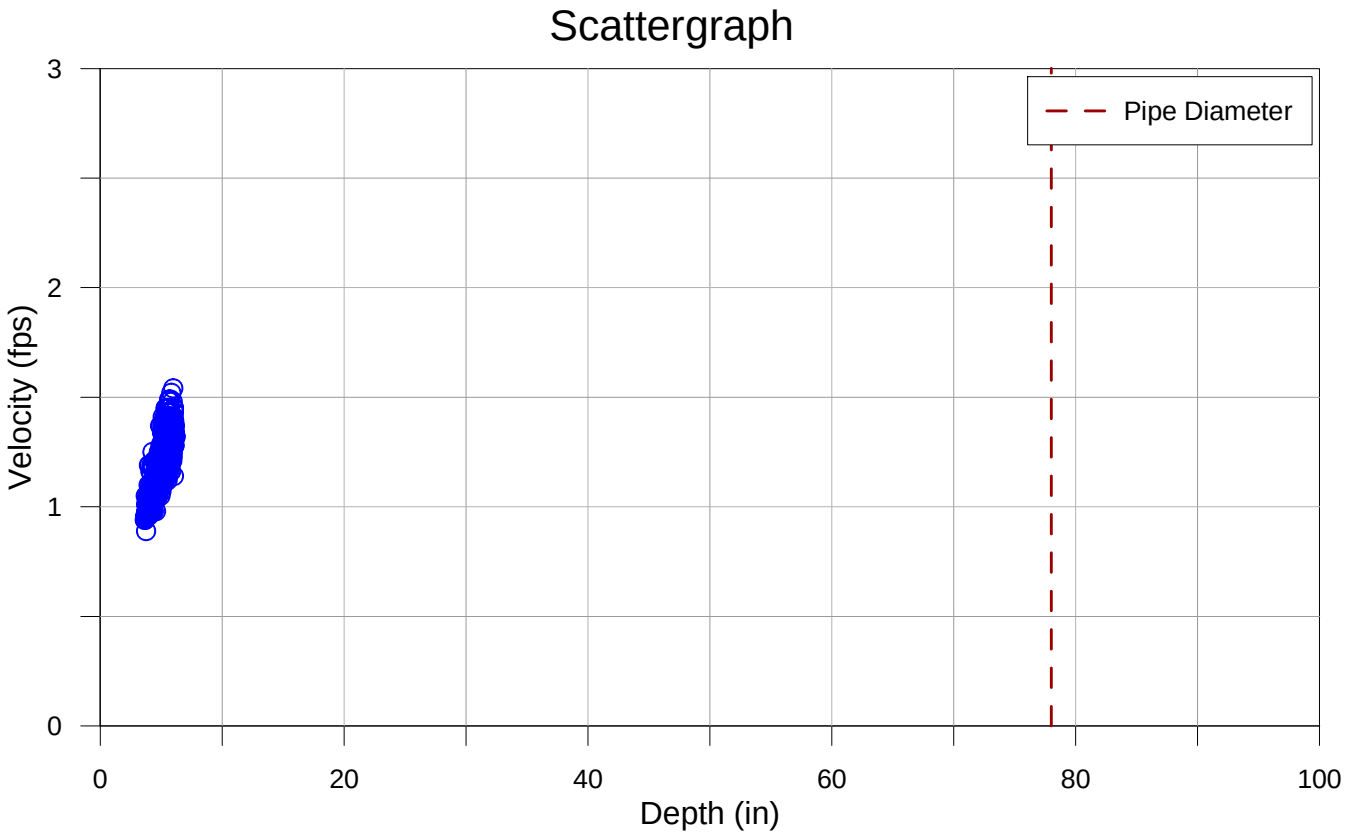
Monitor 073-276
January 4 - 11, 2009



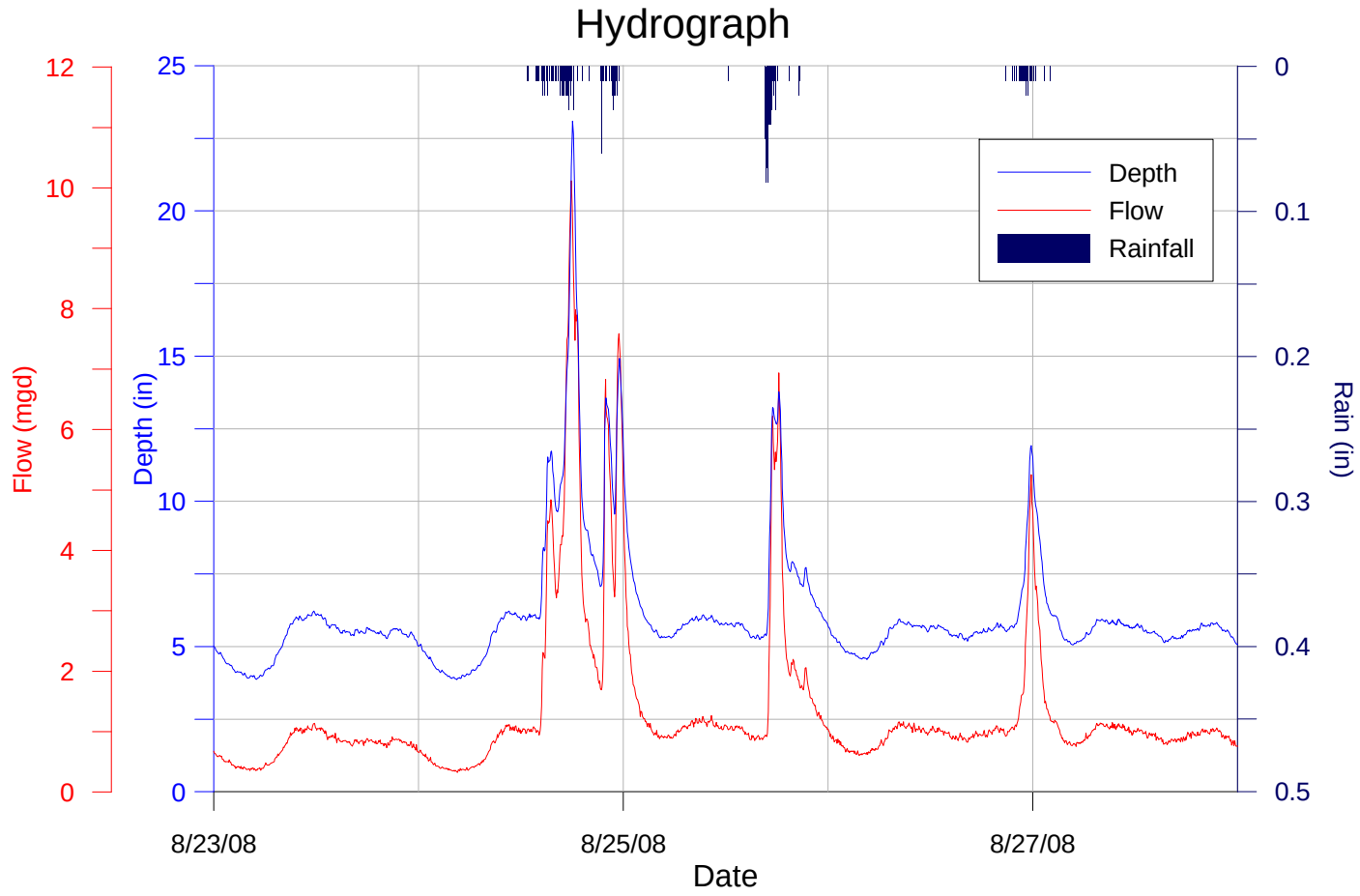


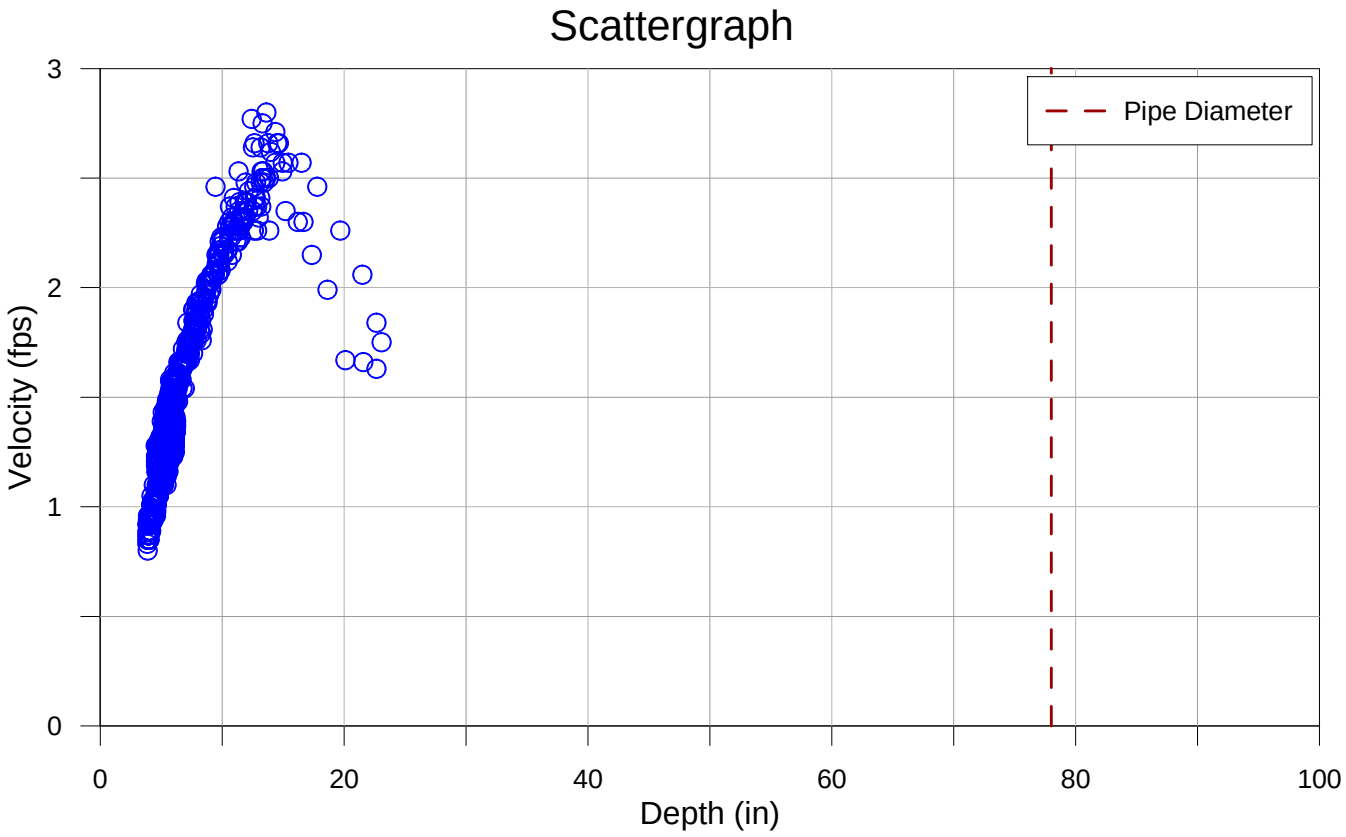
Monitor 080-329
July 21 - 28, 2008





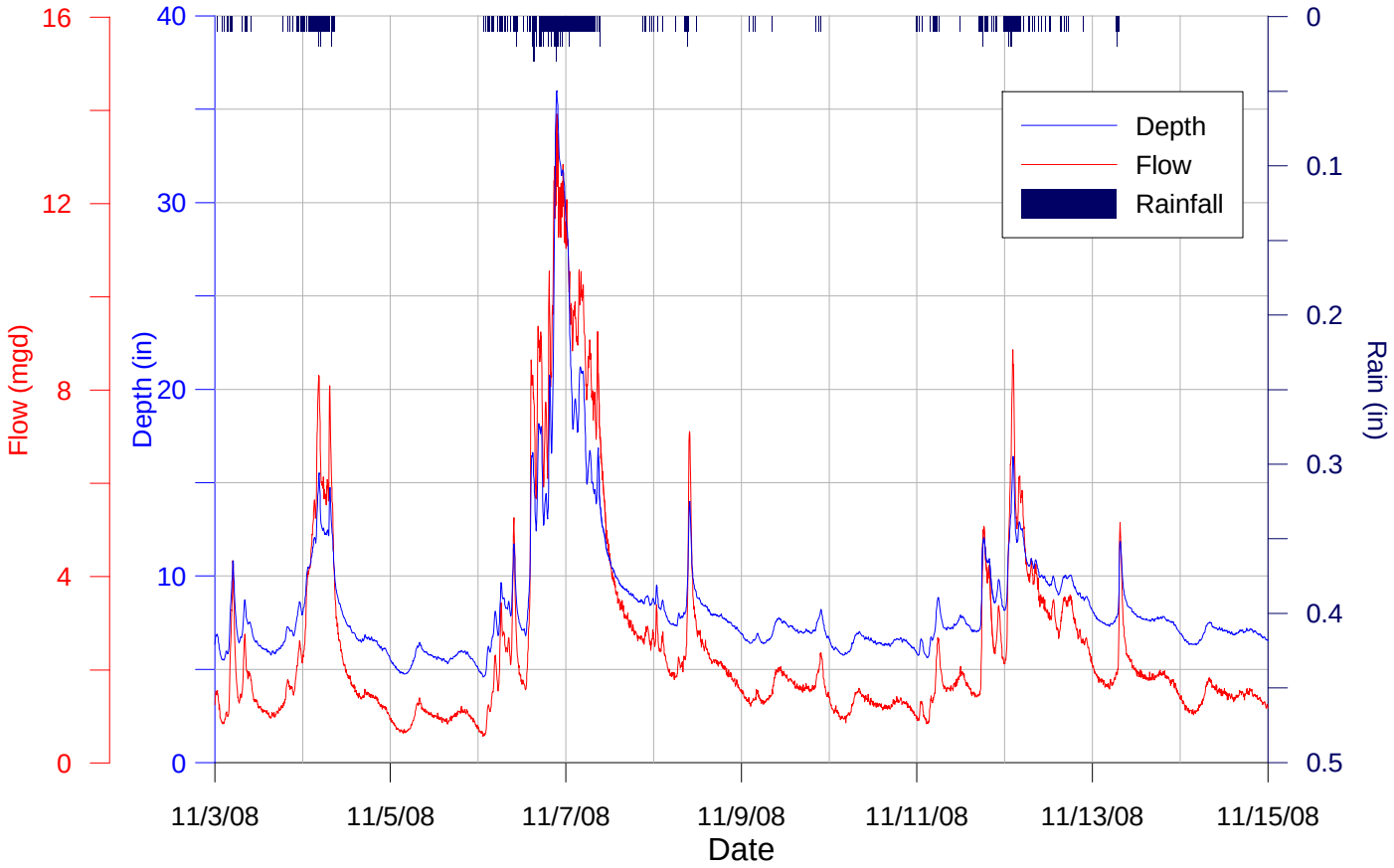
Monitor 080-329
August 23 - 28, 2008



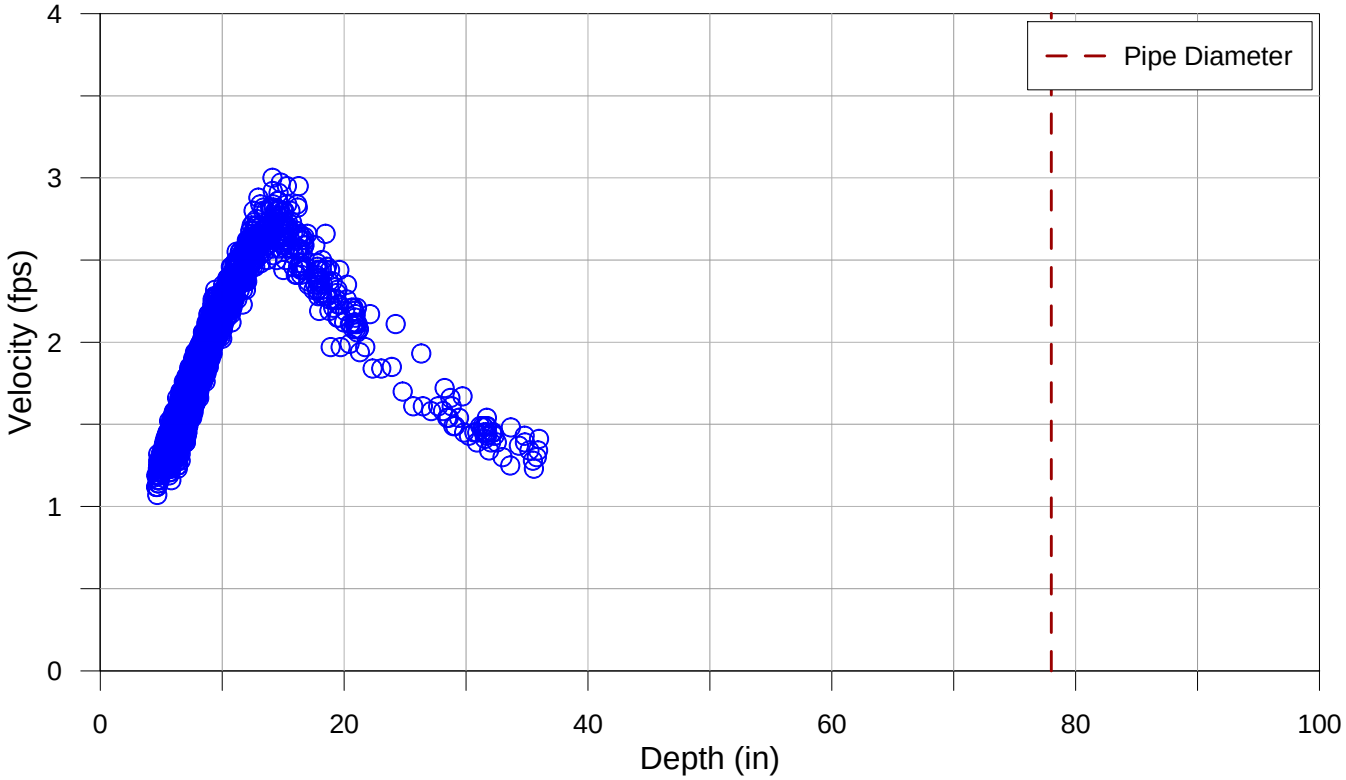


Monitor 080-329
November 3 - 15, 2008

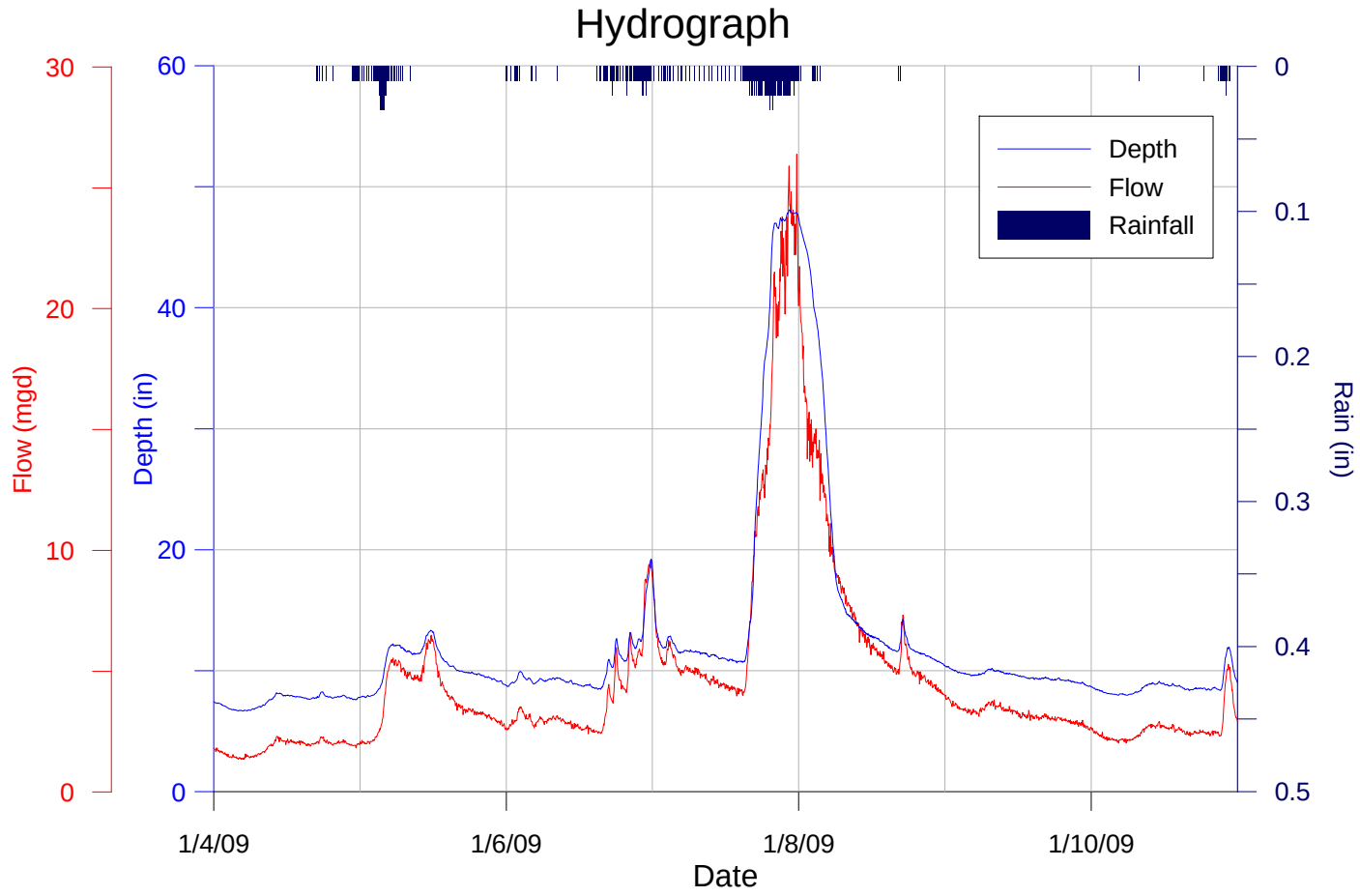
Hydrograph

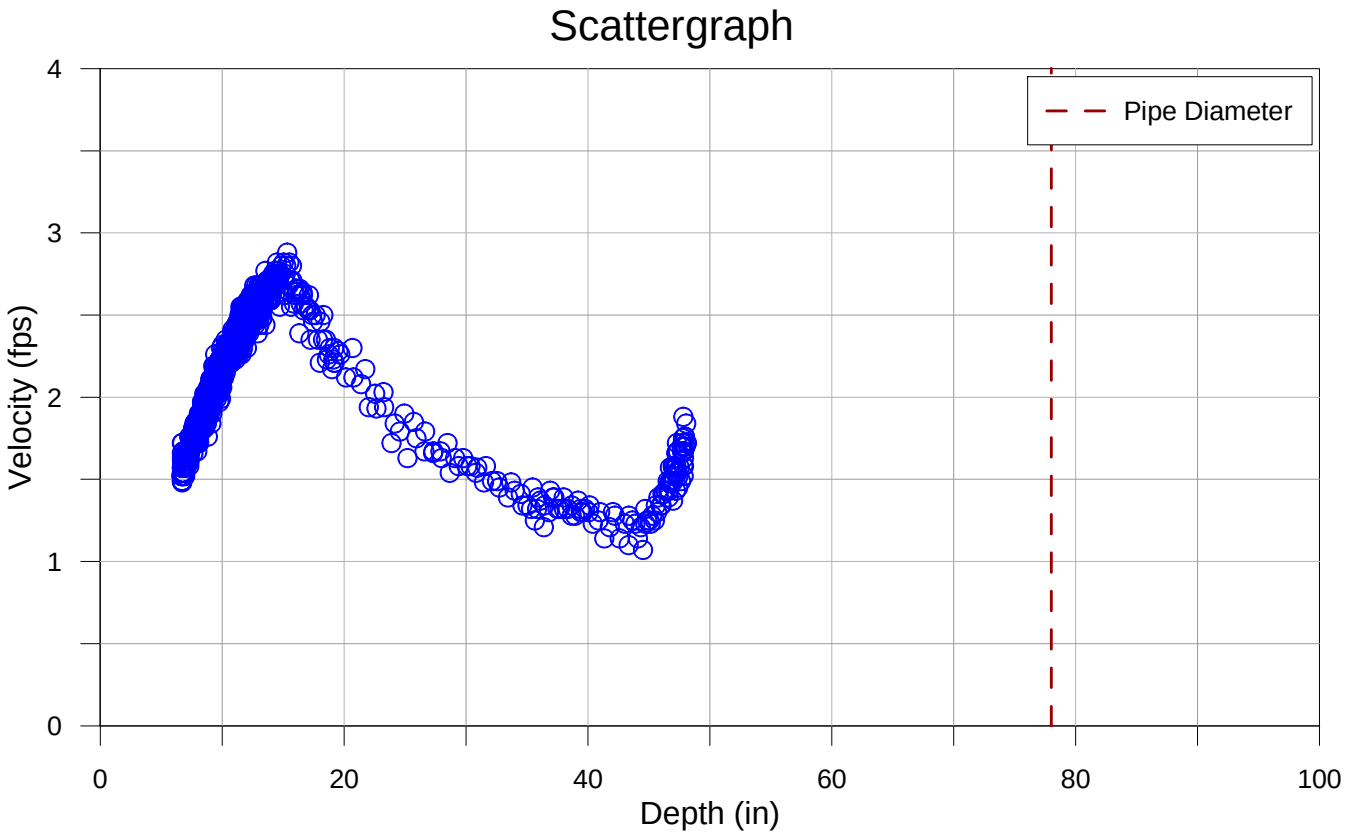


Scattergraph

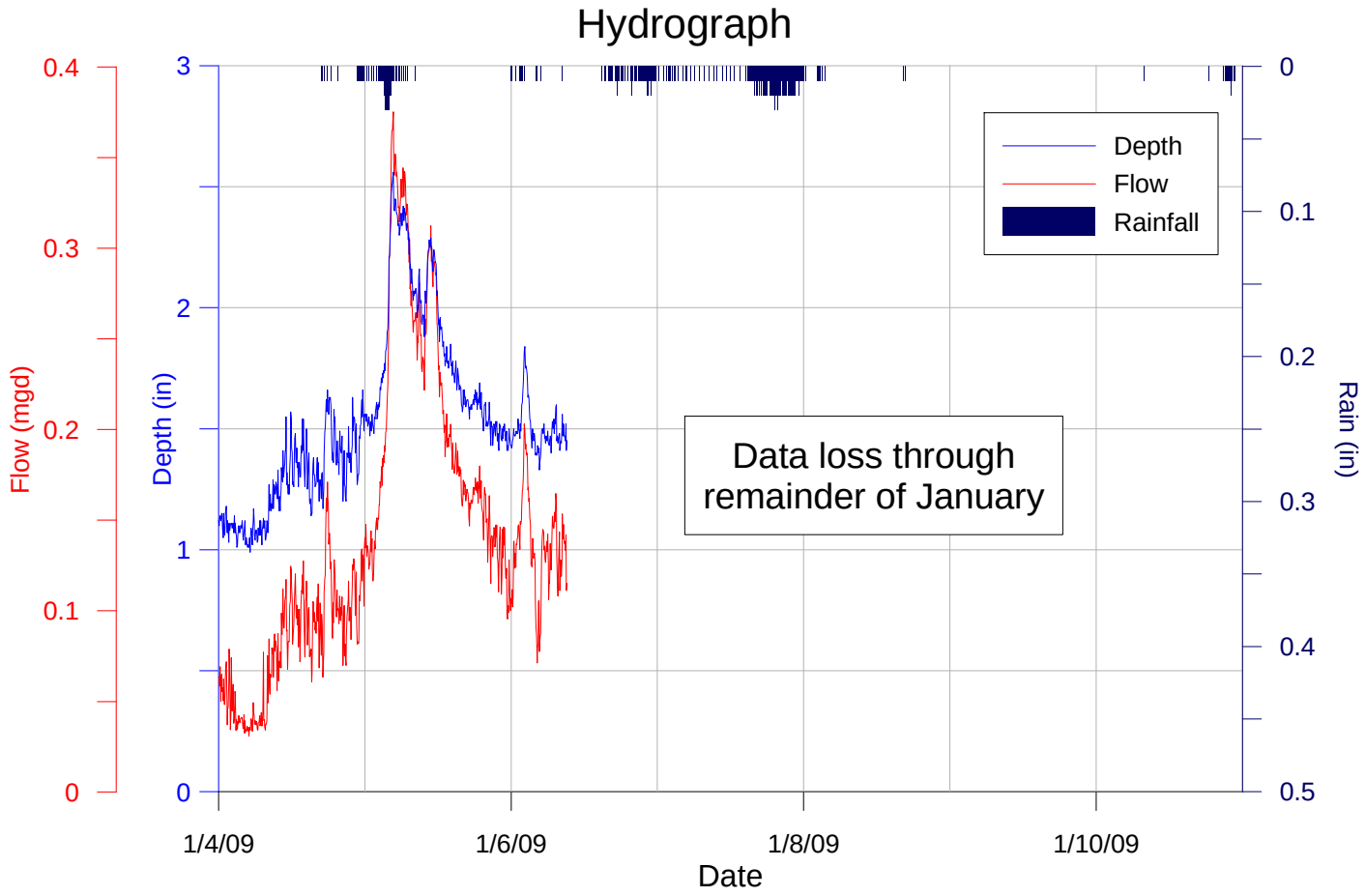


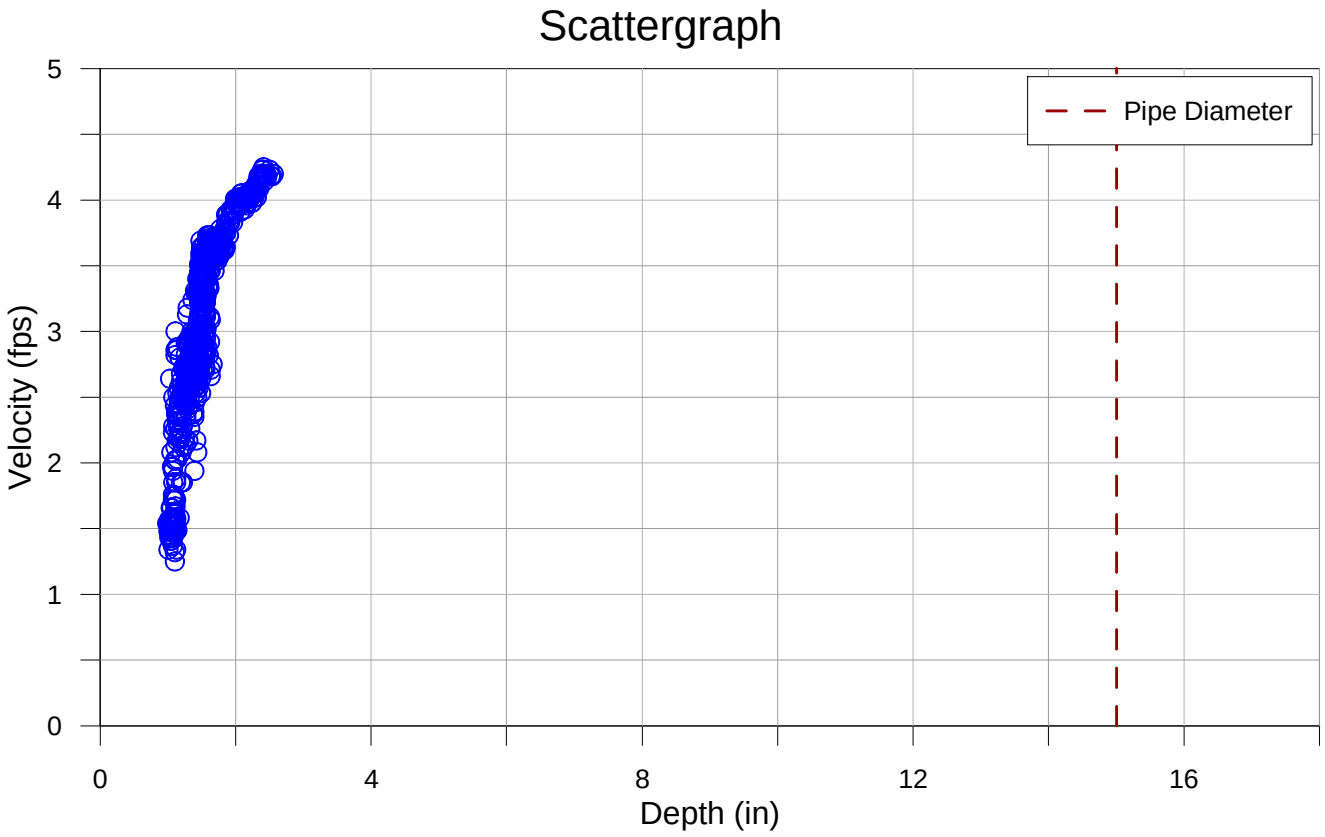
Monitor 080-329
January 4 - 11, 2009



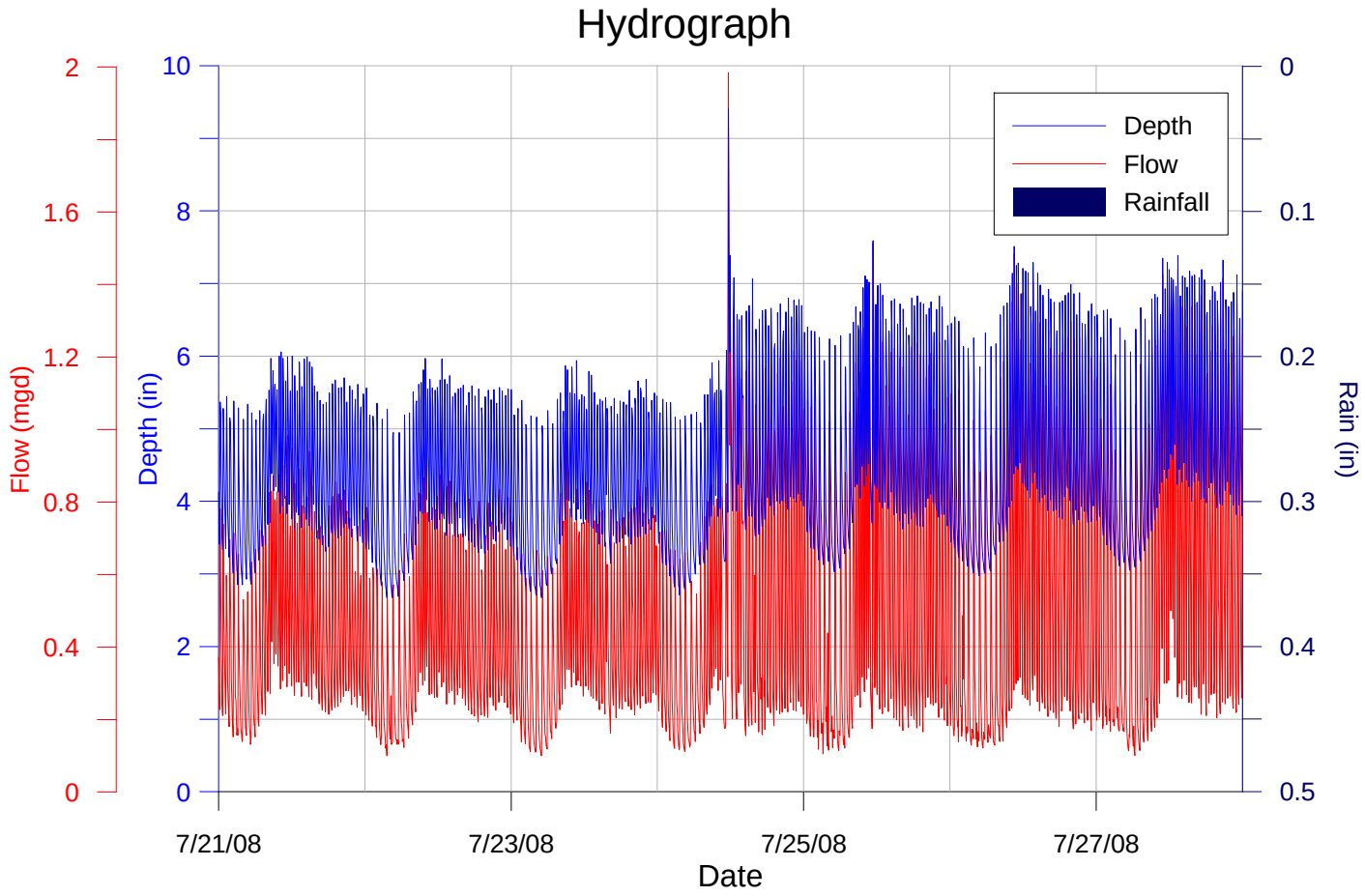


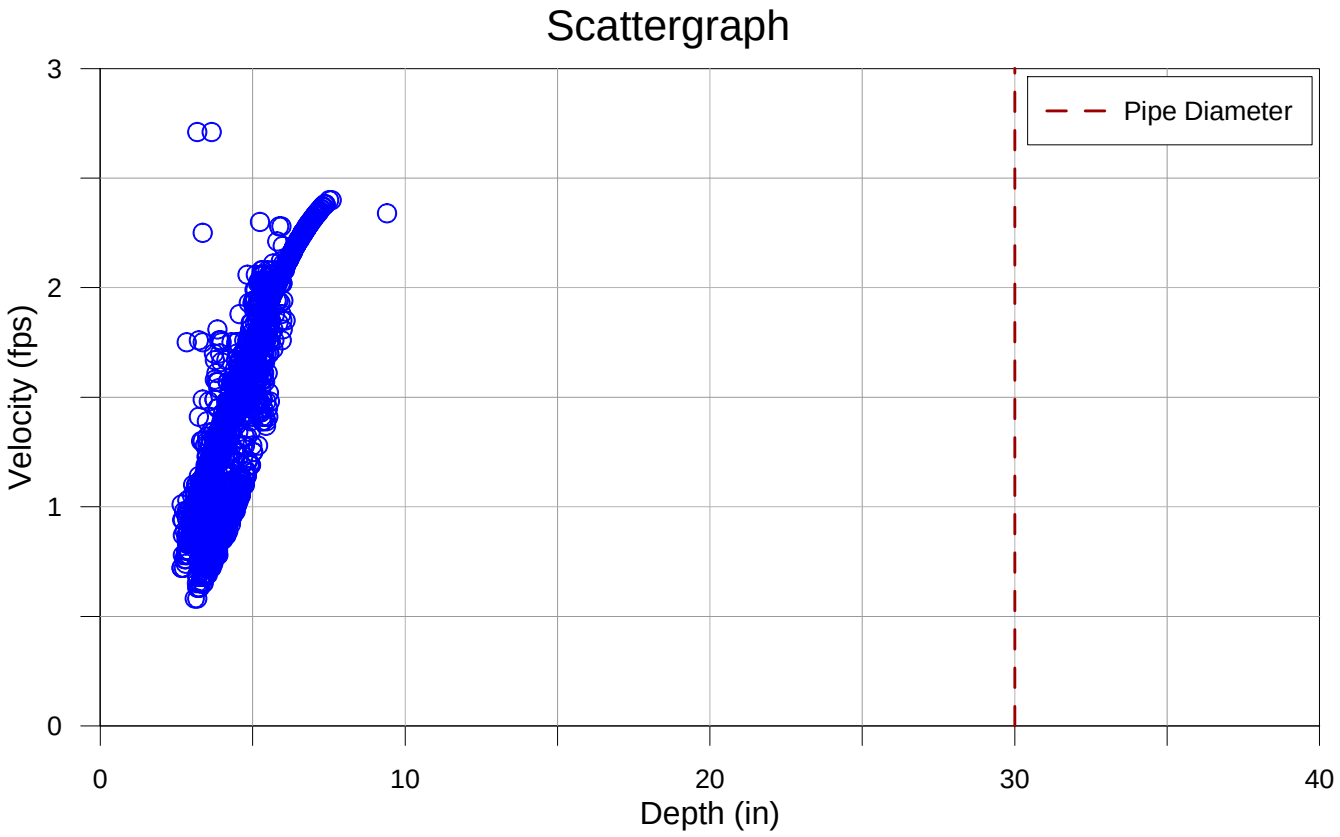
Monitor 081-049
January 4 - 11, 2009



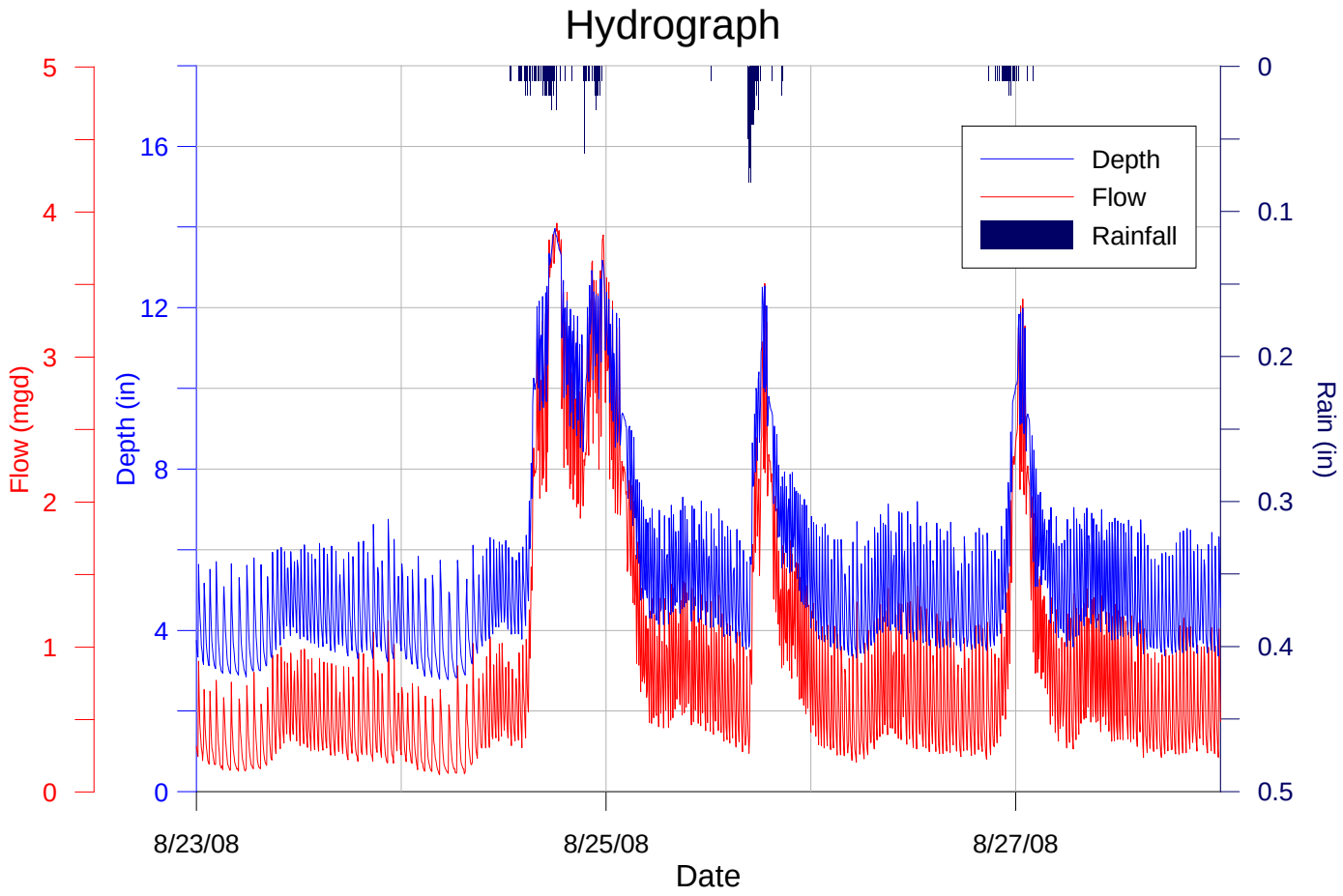


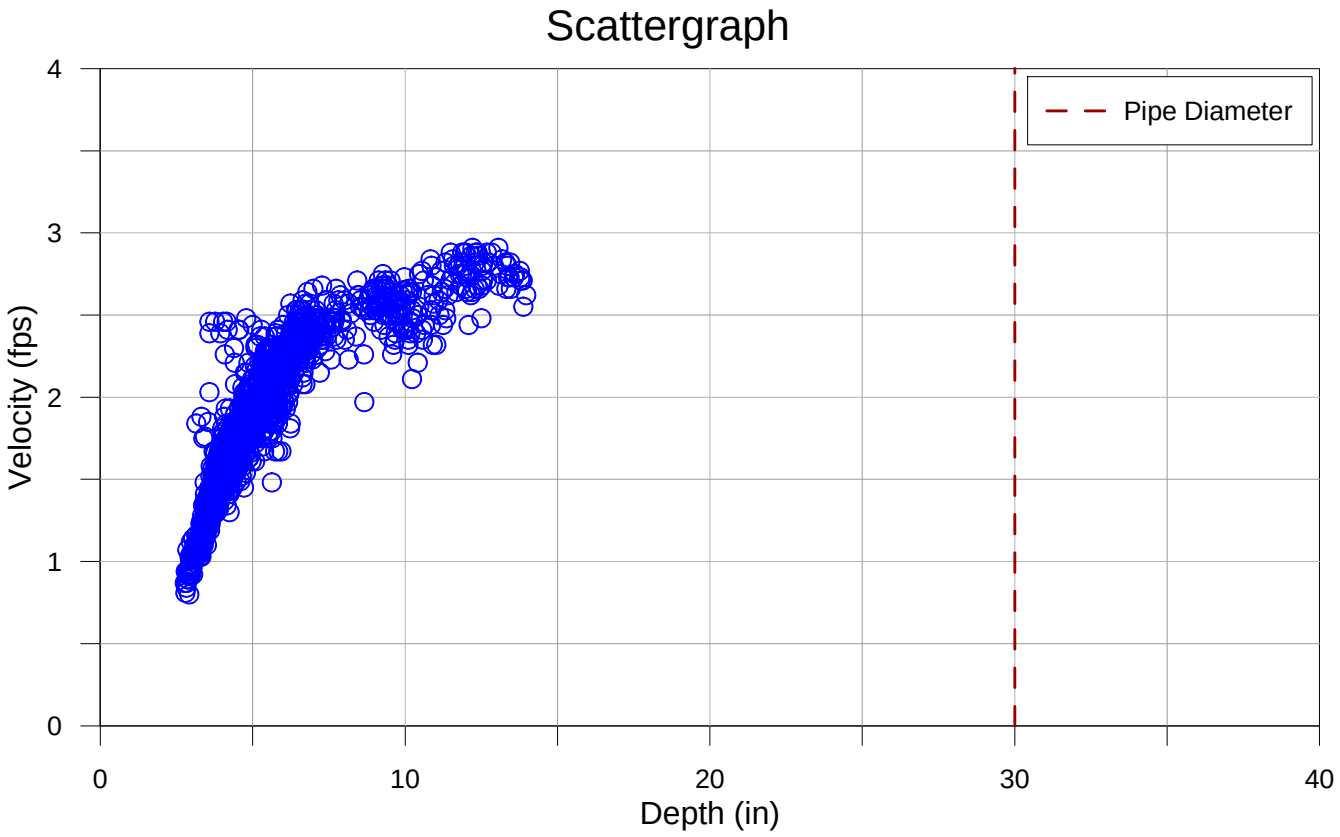
Monitor 081-085
July 21 - 28, 2008



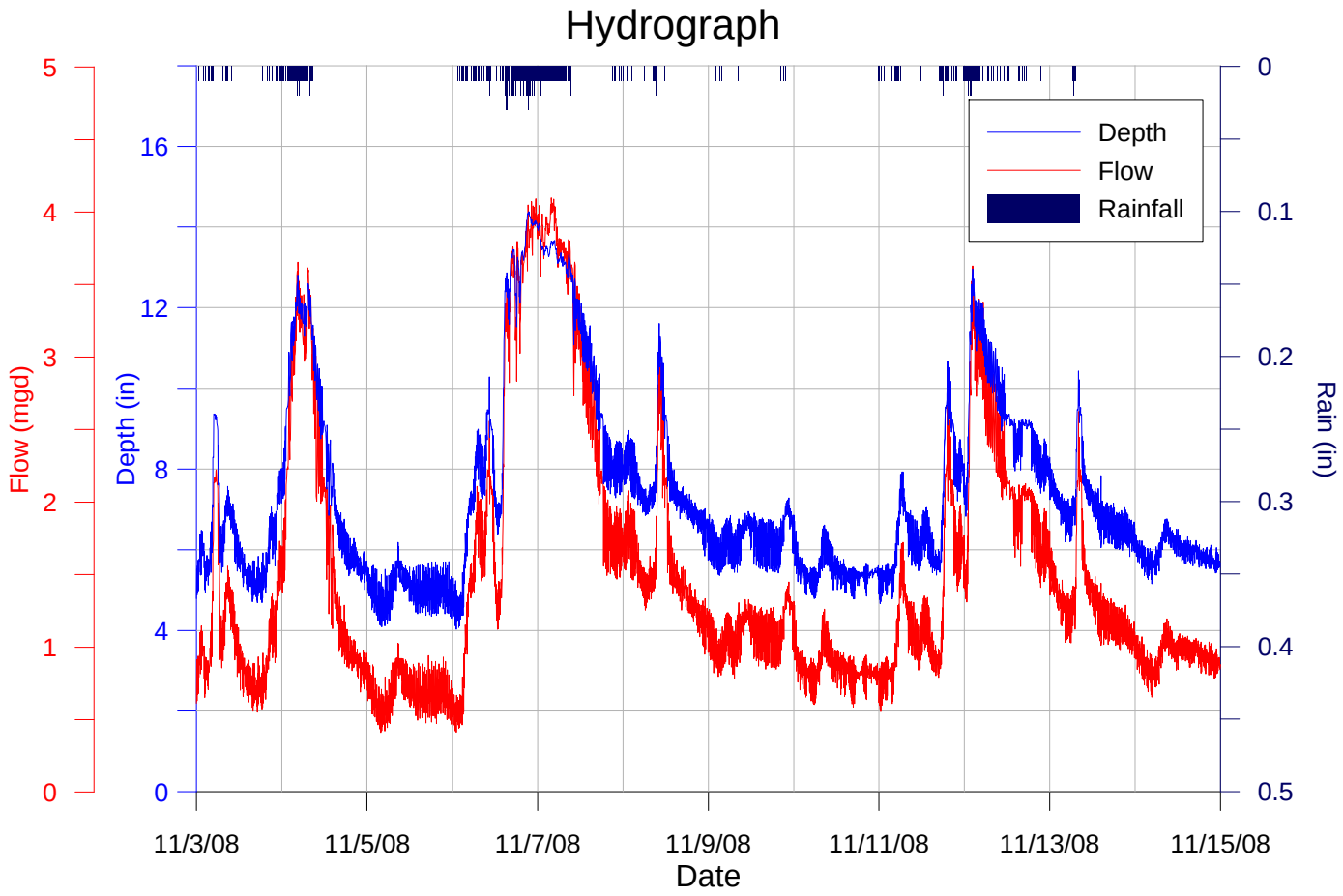


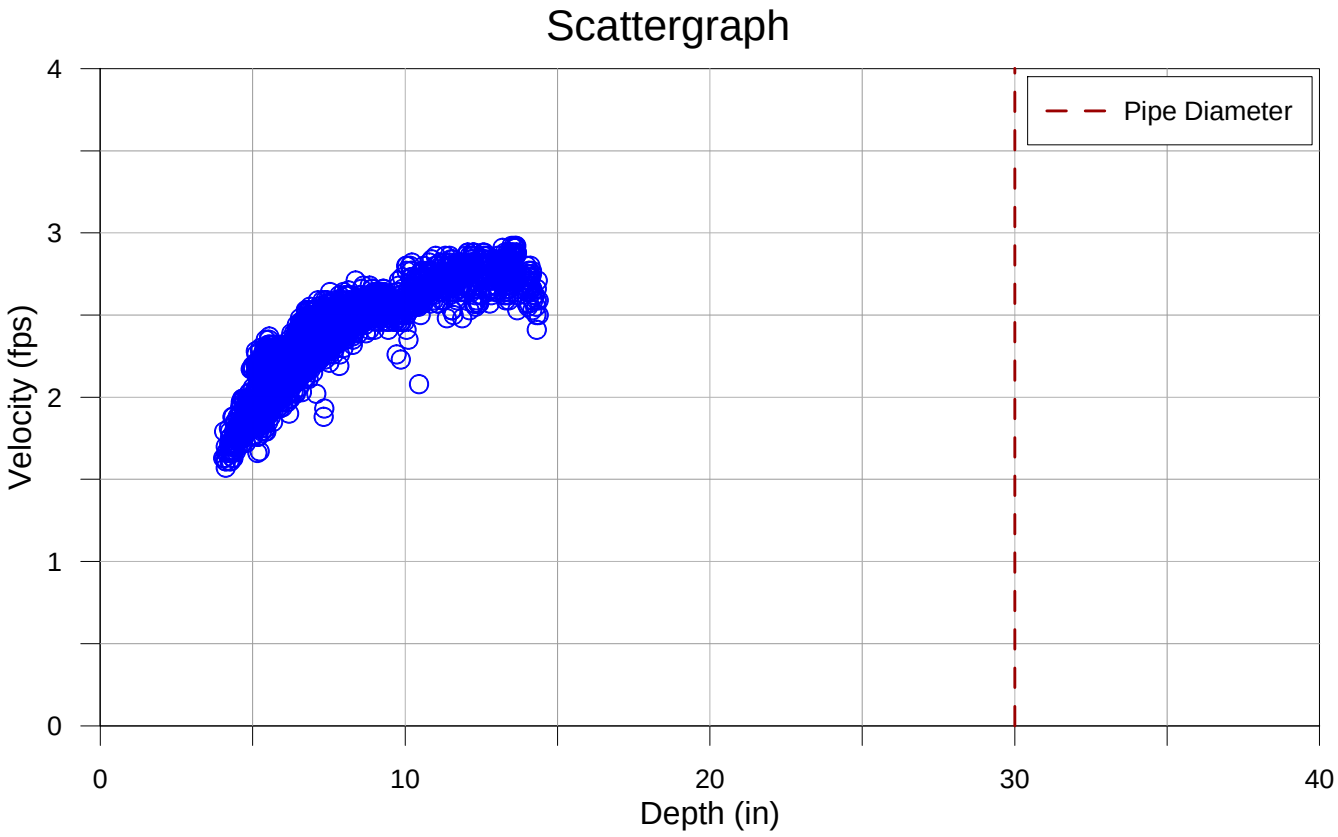
Monitor 081-085
August 23 - 28, 2008



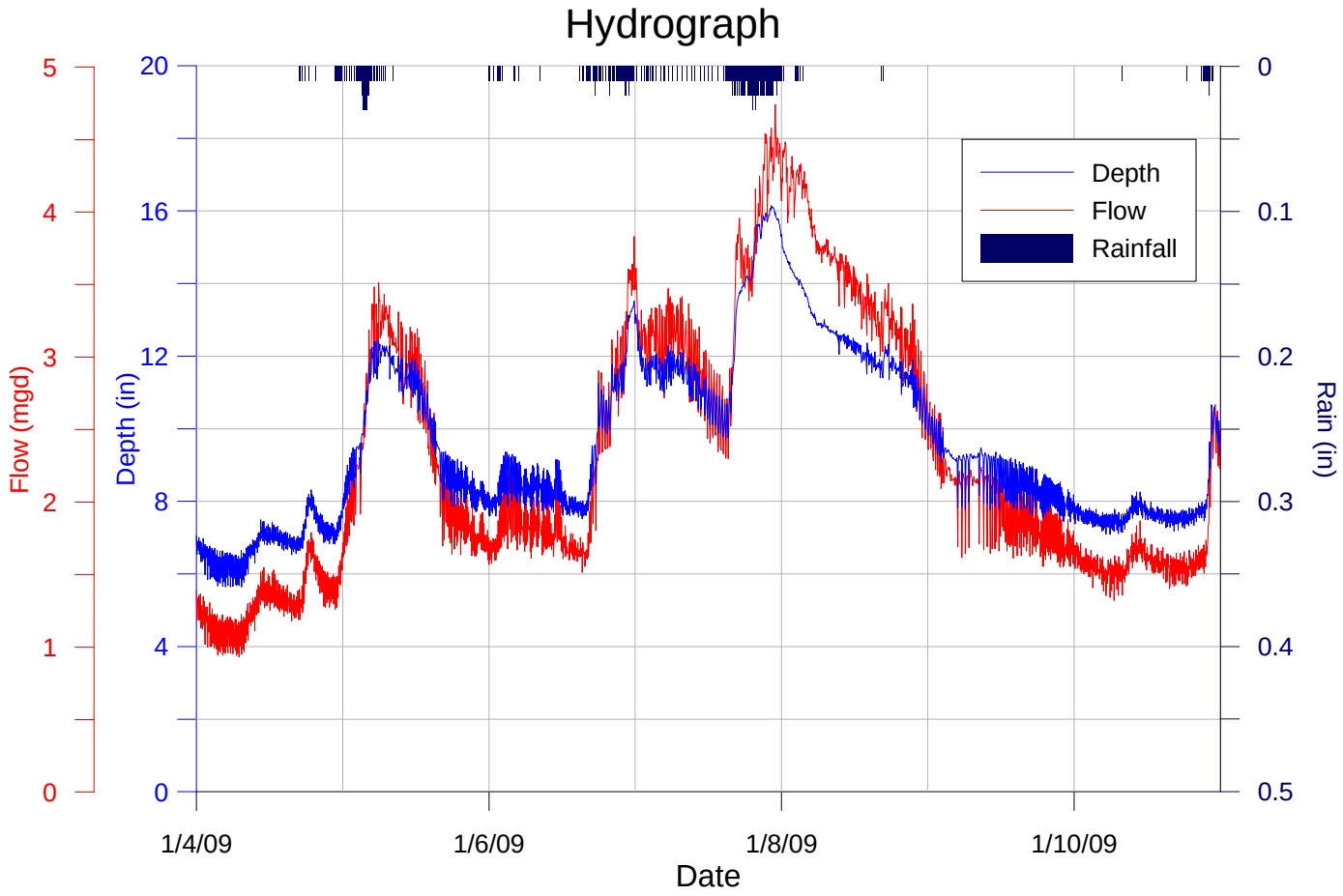


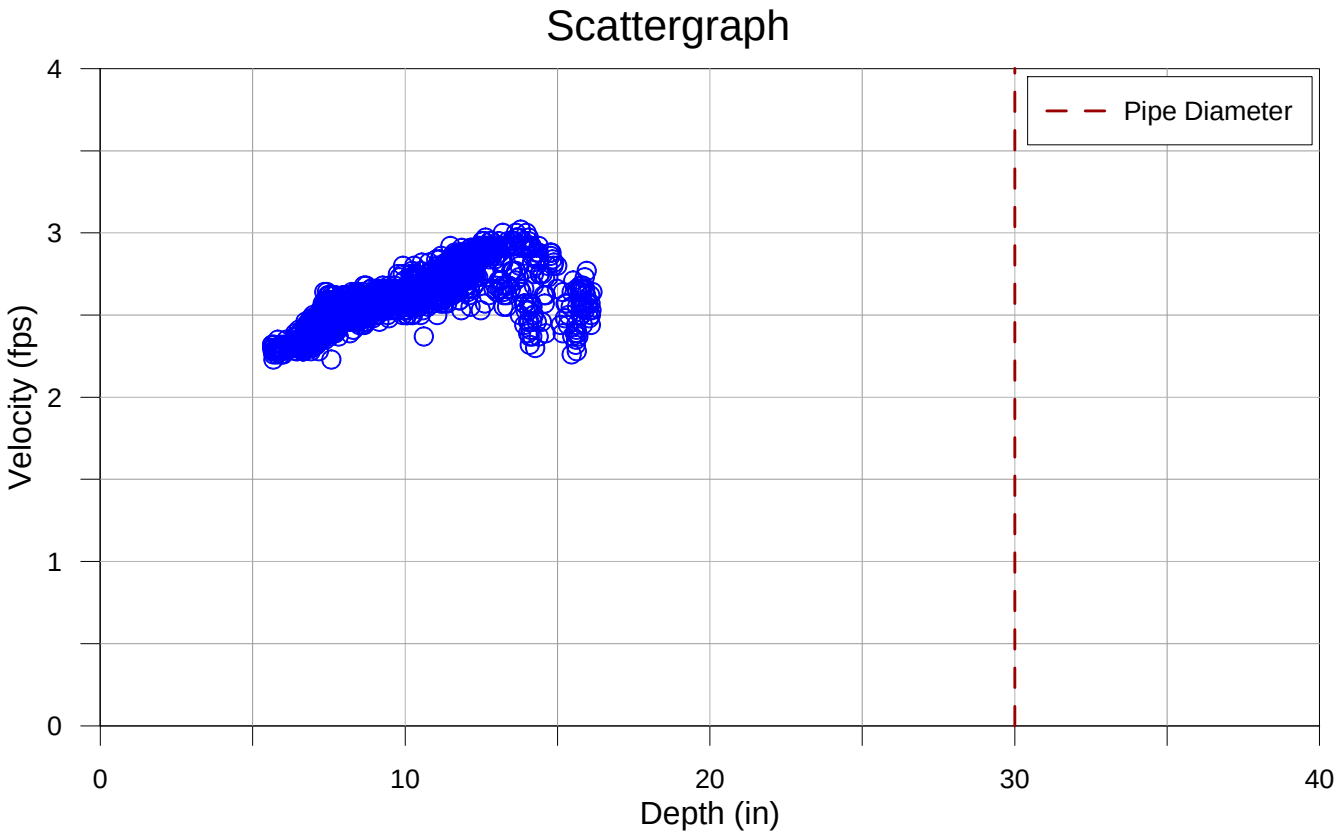
Monitor 081-085
November 3 - 15, 2008



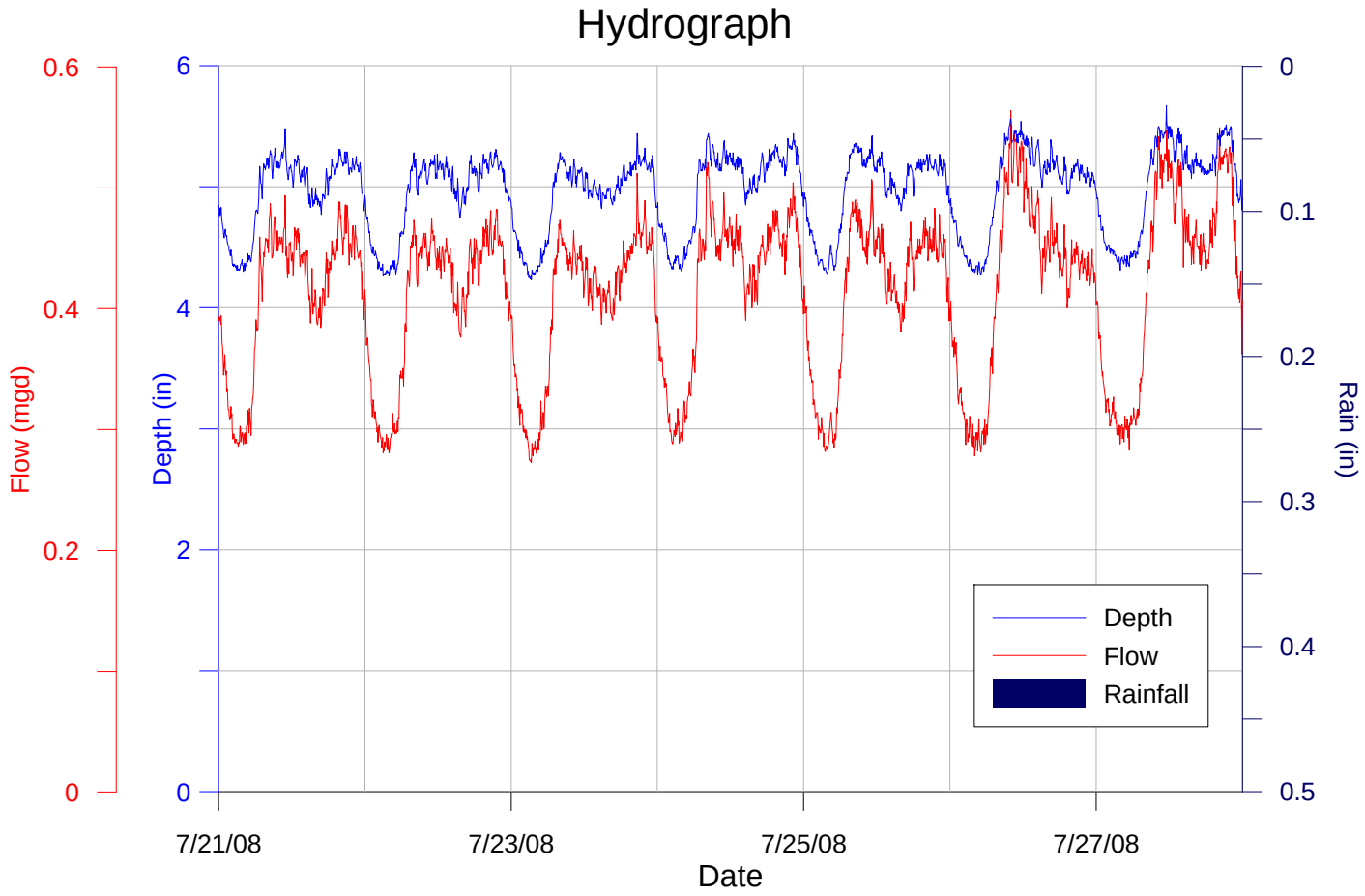


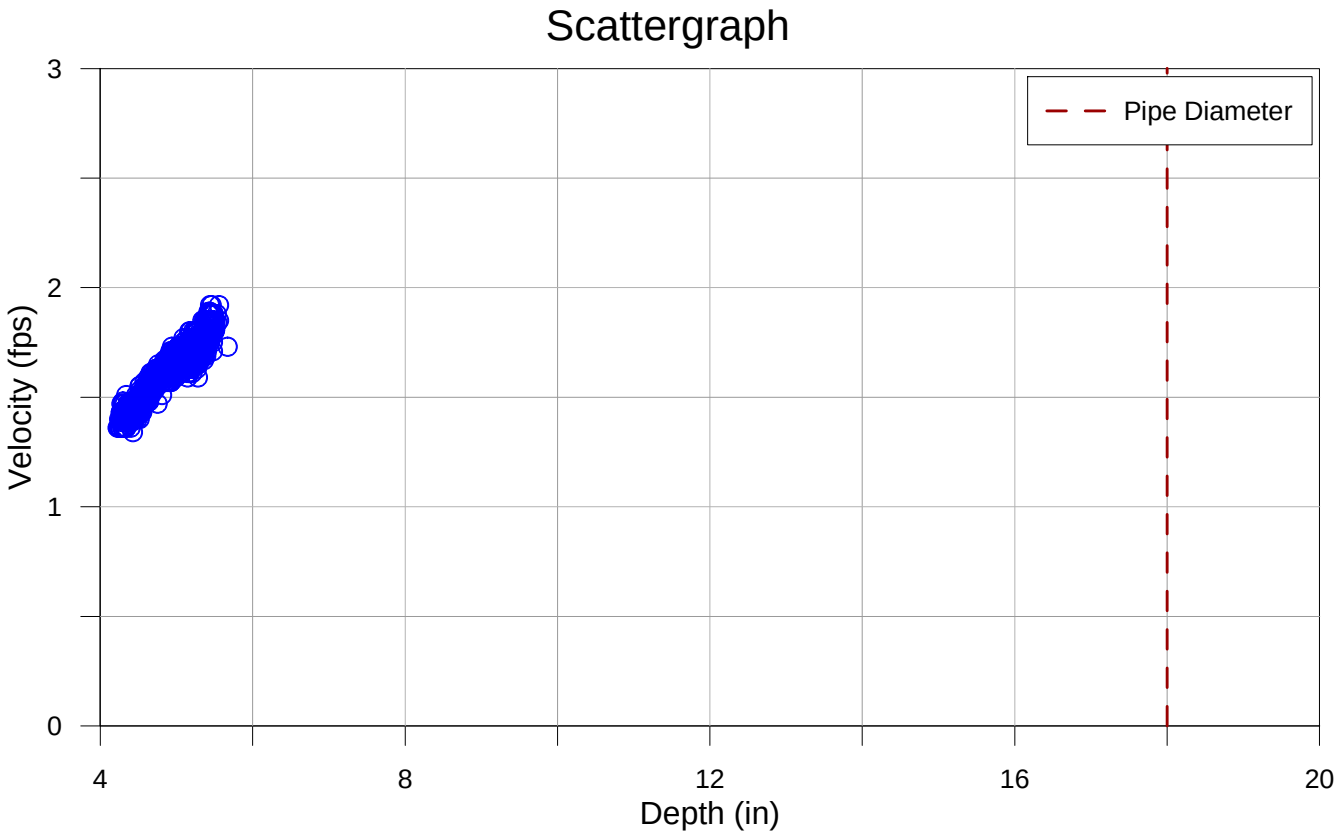
Monitor 081-085
January 4 - 11, 2009





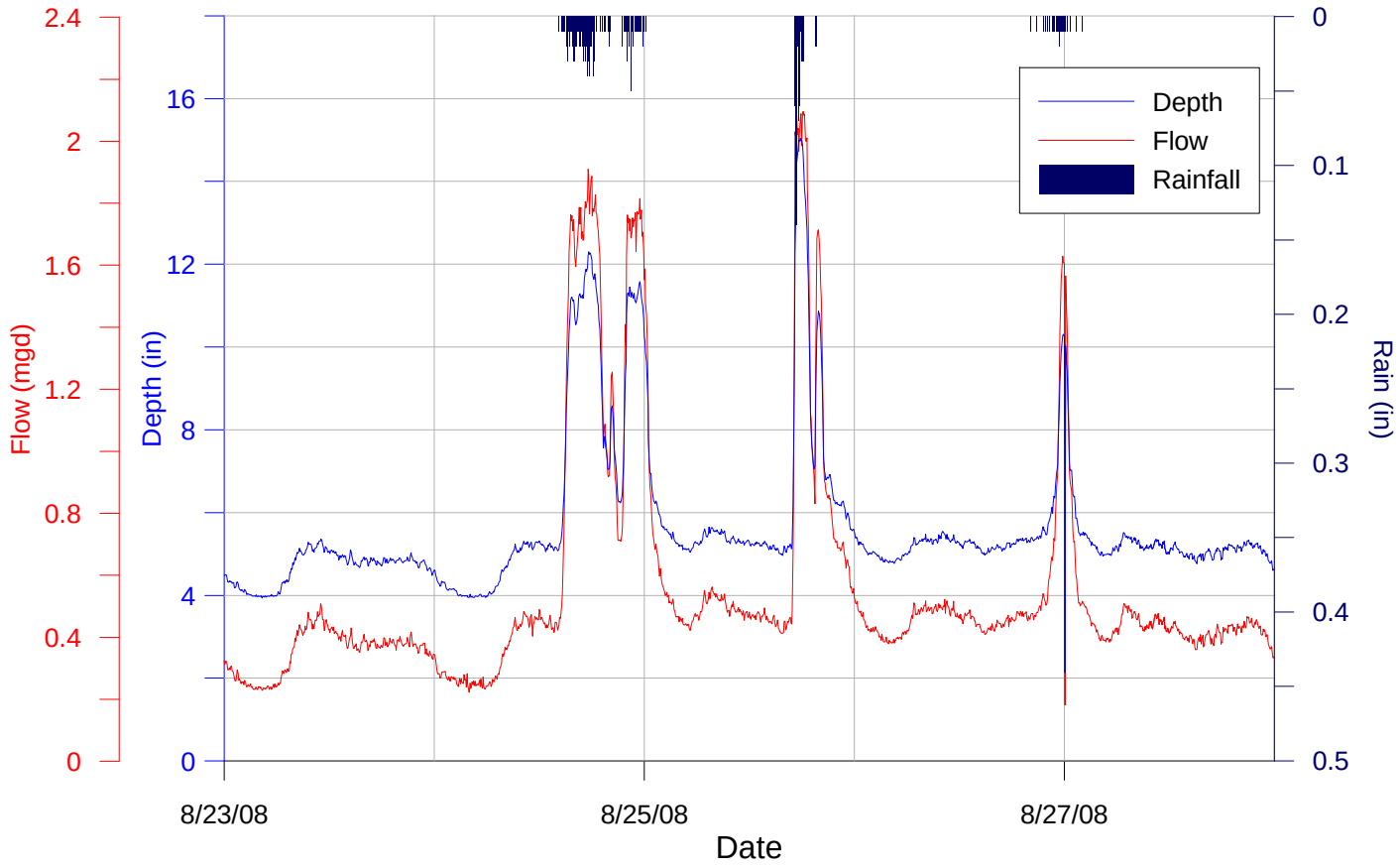
Monitor 081-120
July 21 - 28, 2008



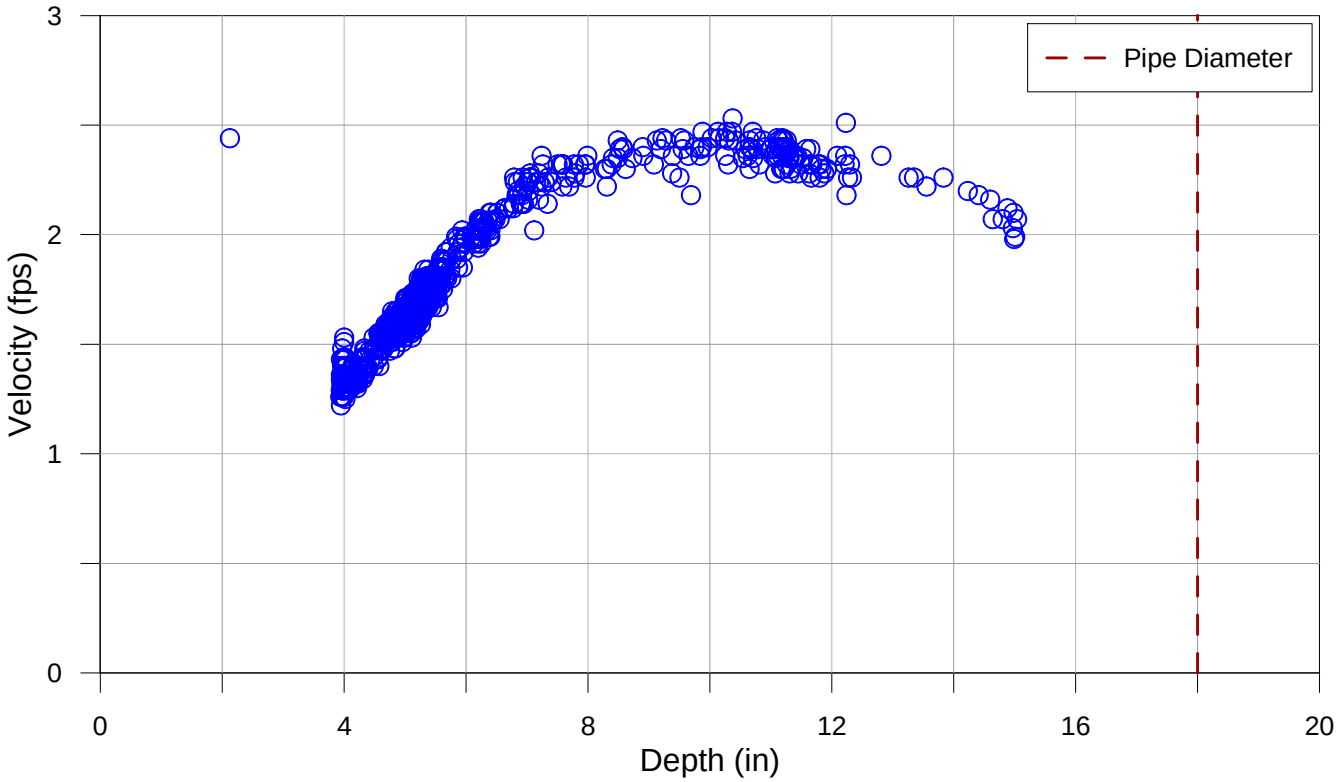


Monitor 081-120
August 23 - 28, 2008

Hydrograph

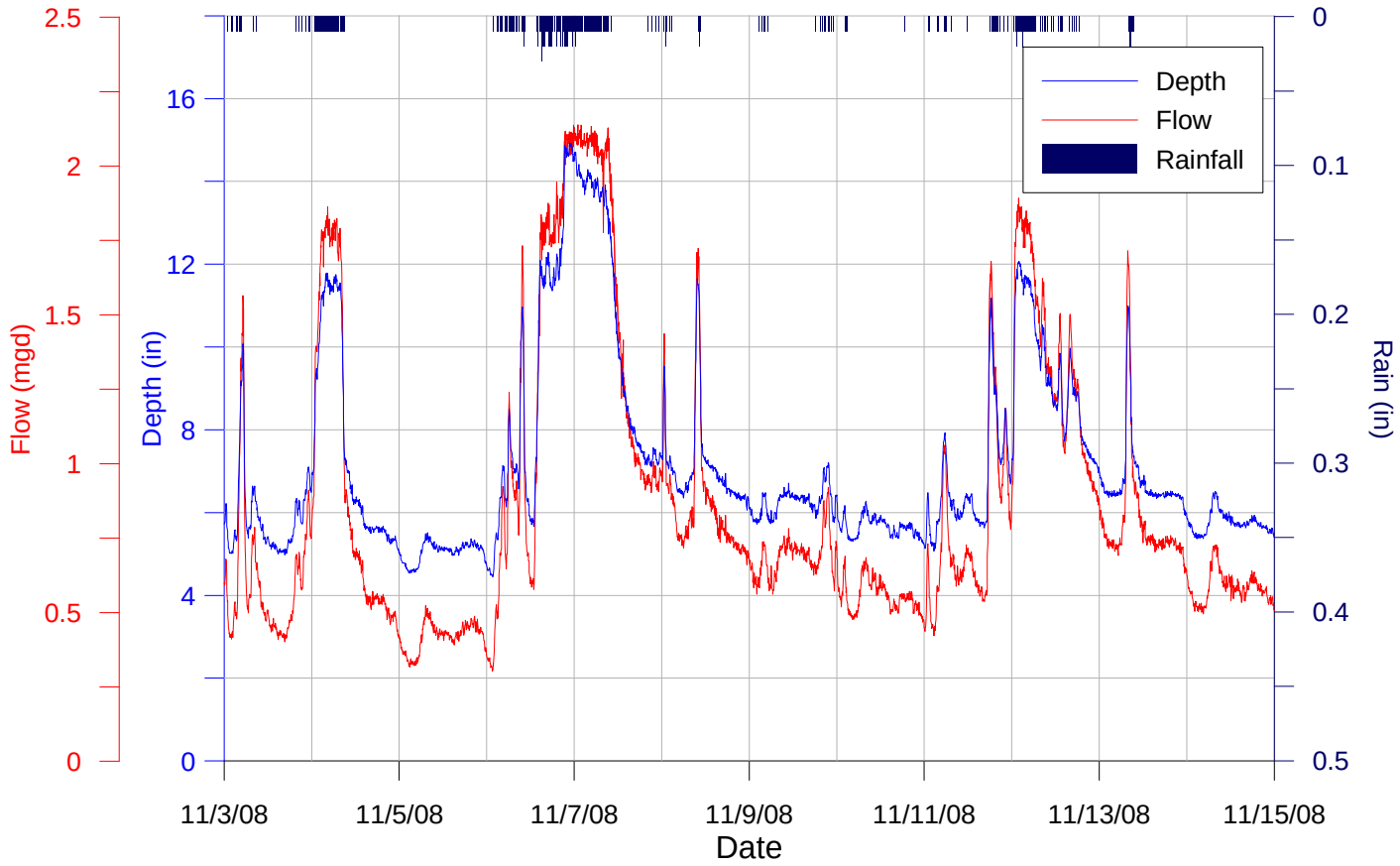


Scattergraph

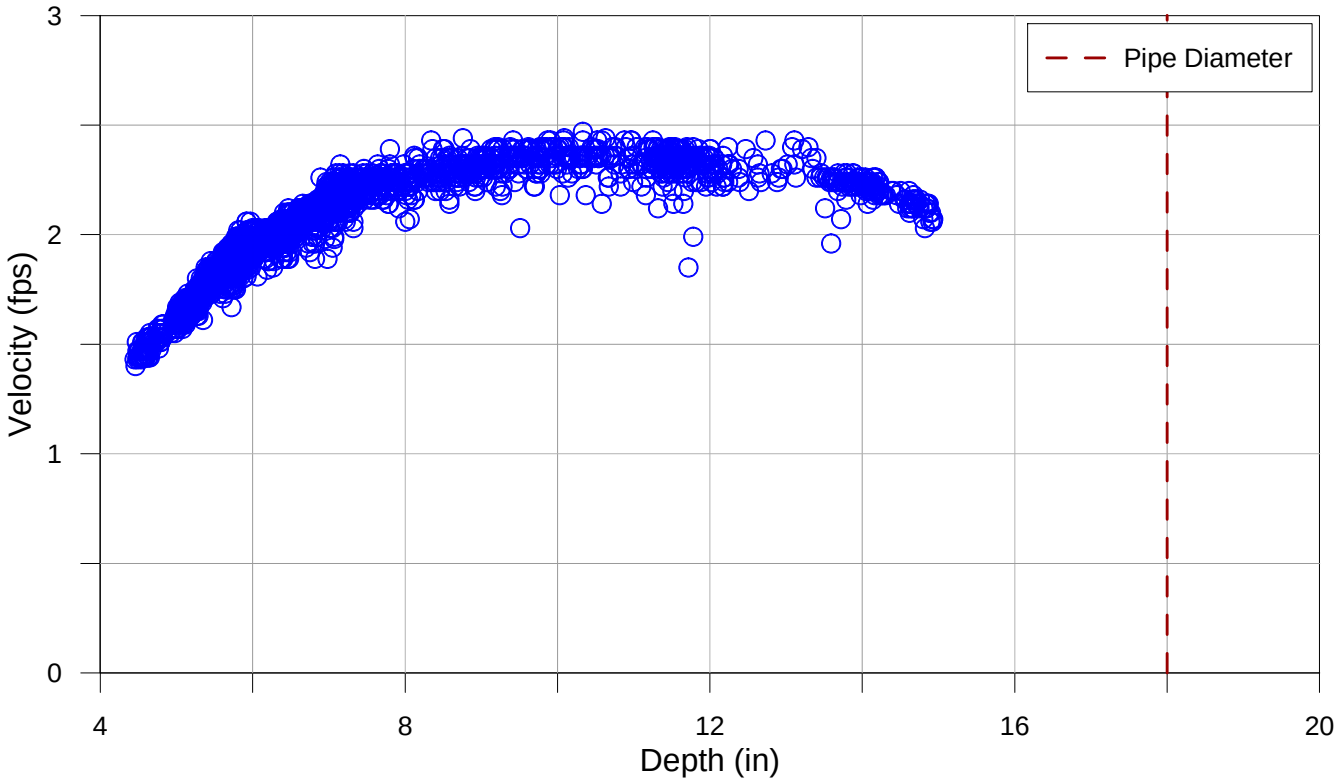


Monitor 081-120
November 3 - 15, 2008

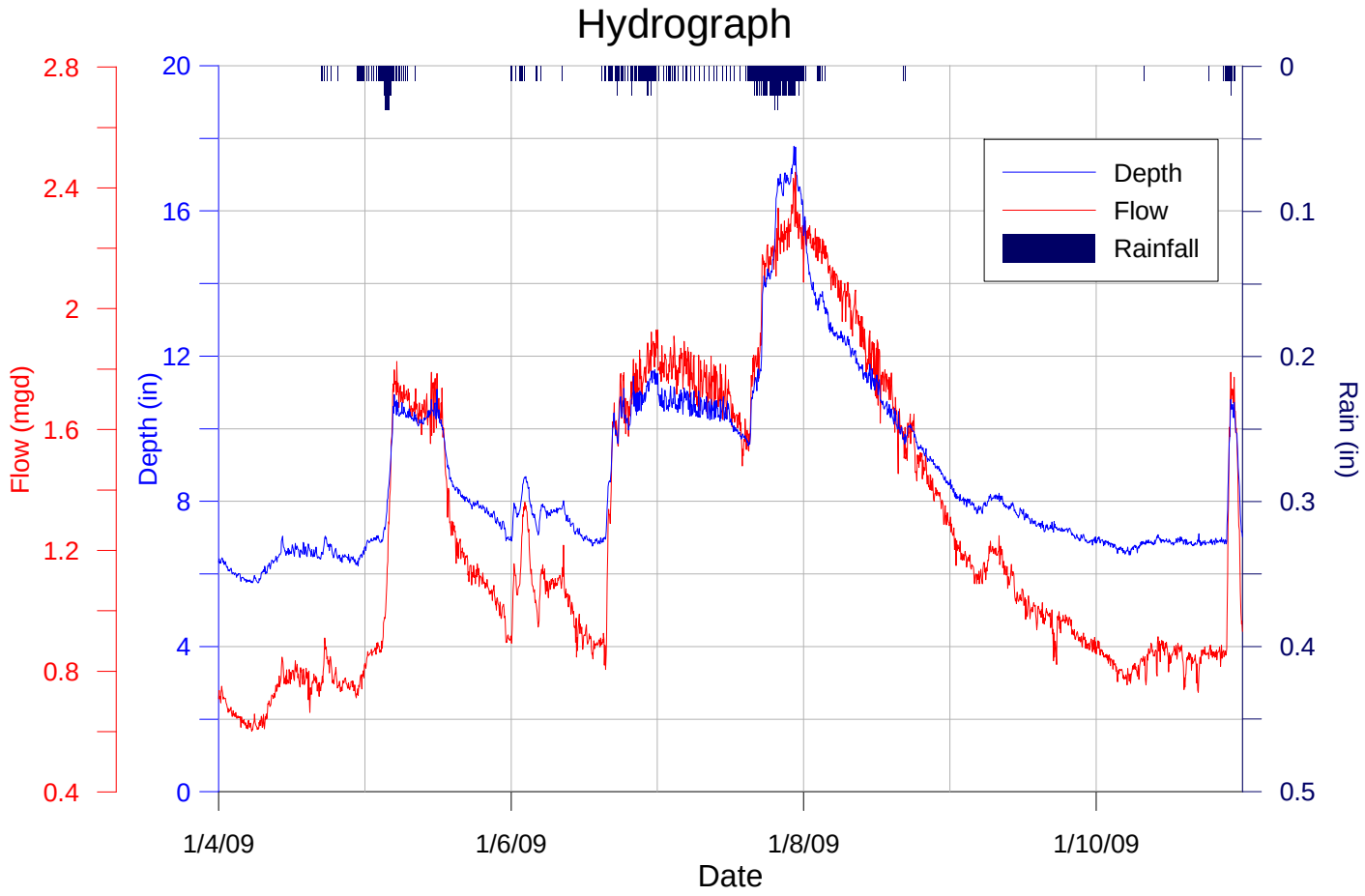
Hydrograph

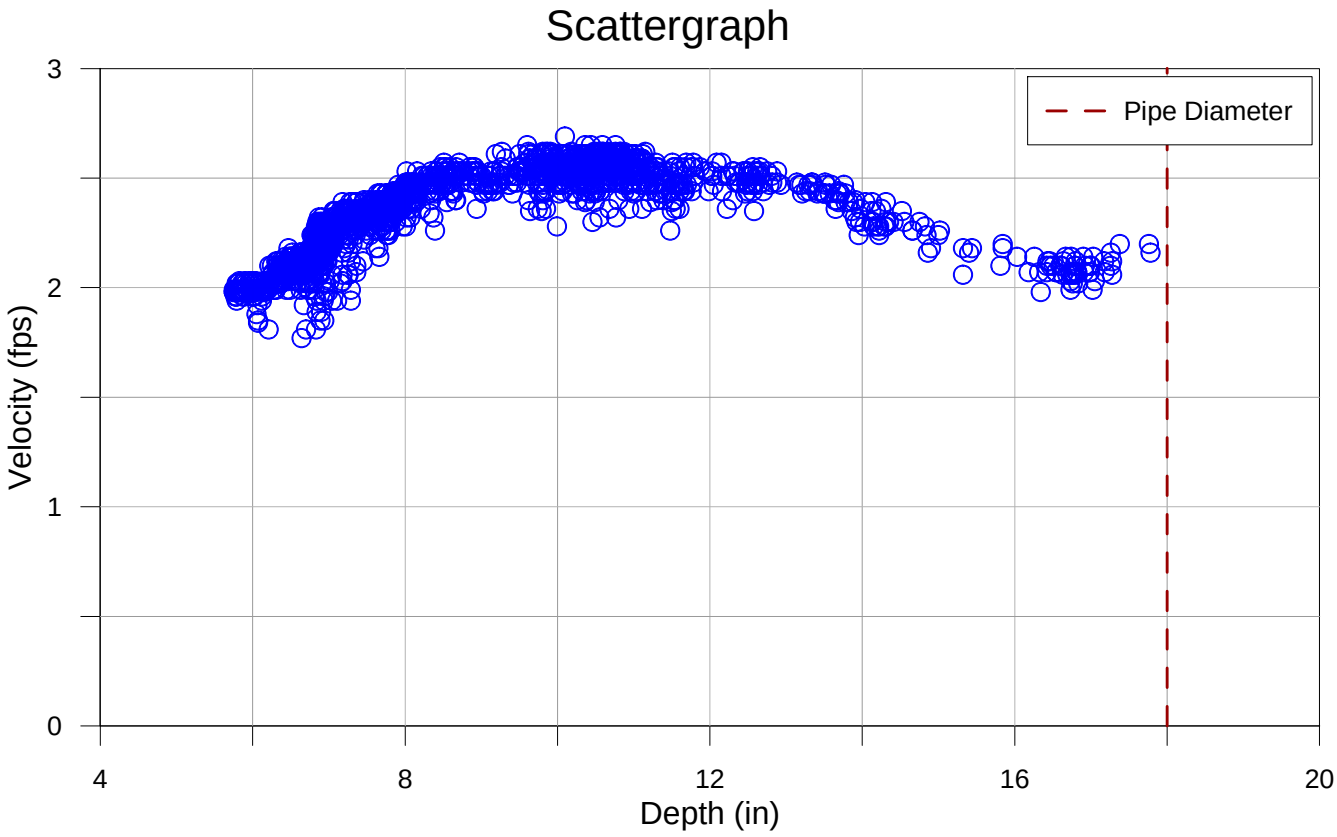


Scattergraph

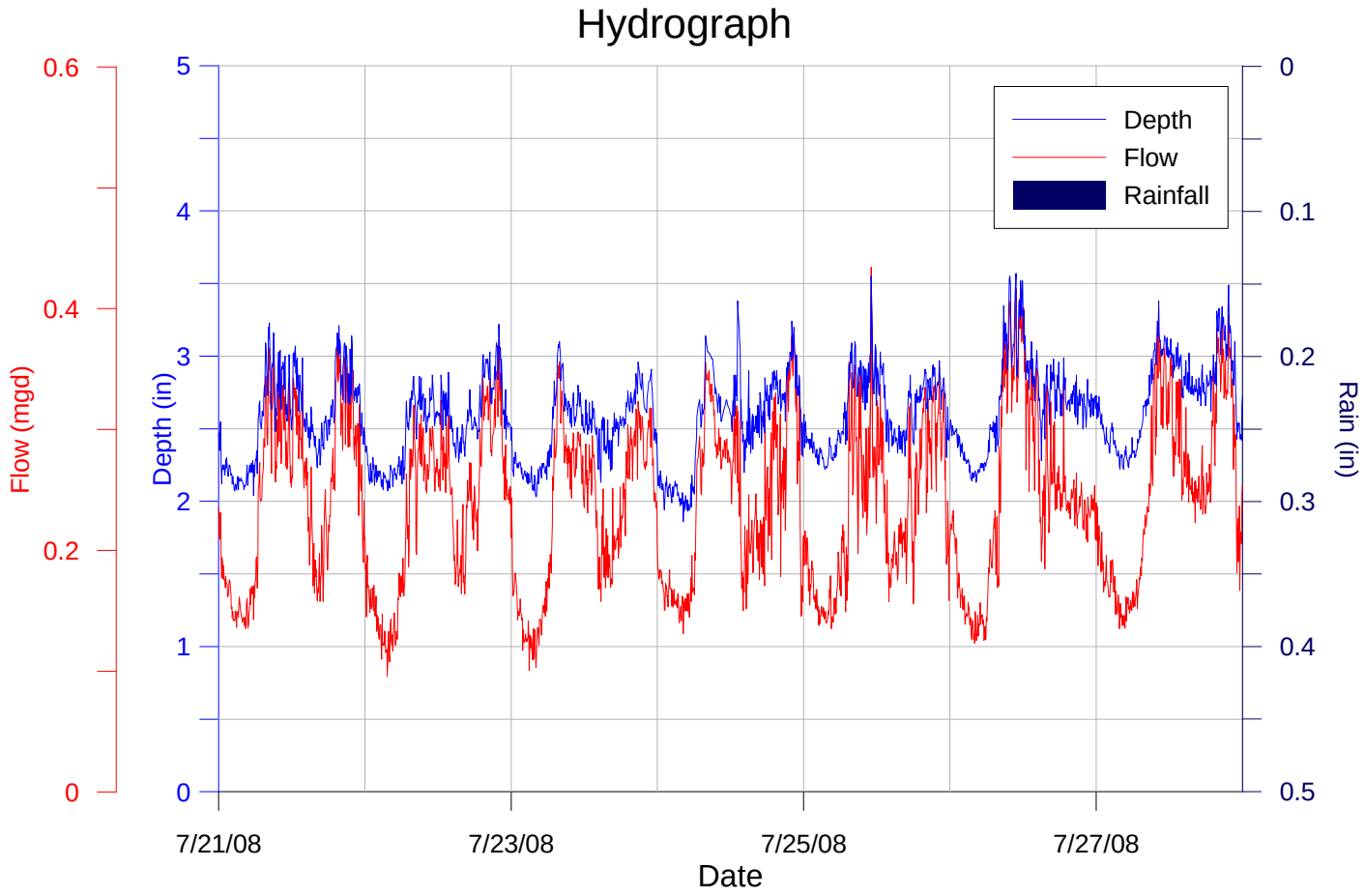


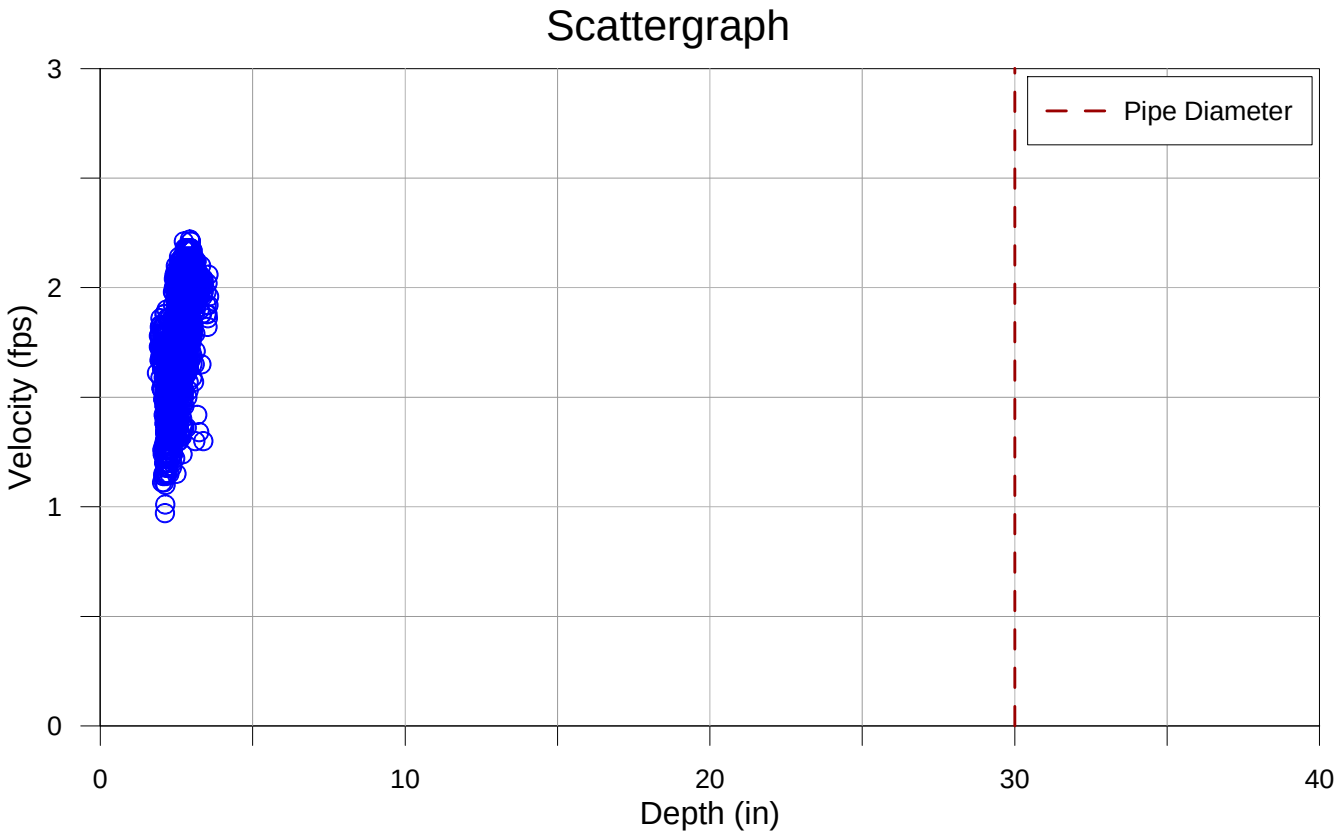
Monitor 081-120
January 4 - 11, 2008



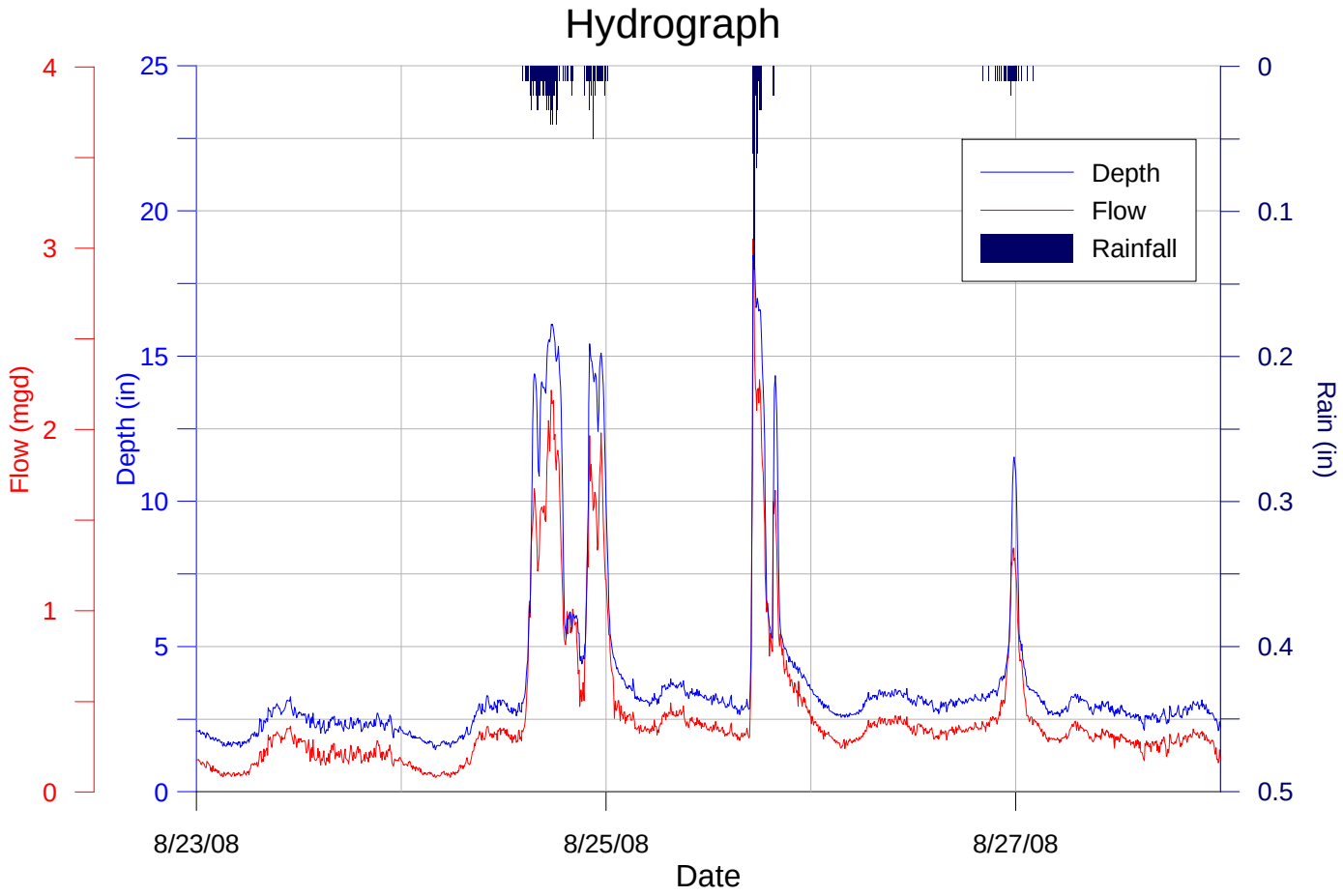


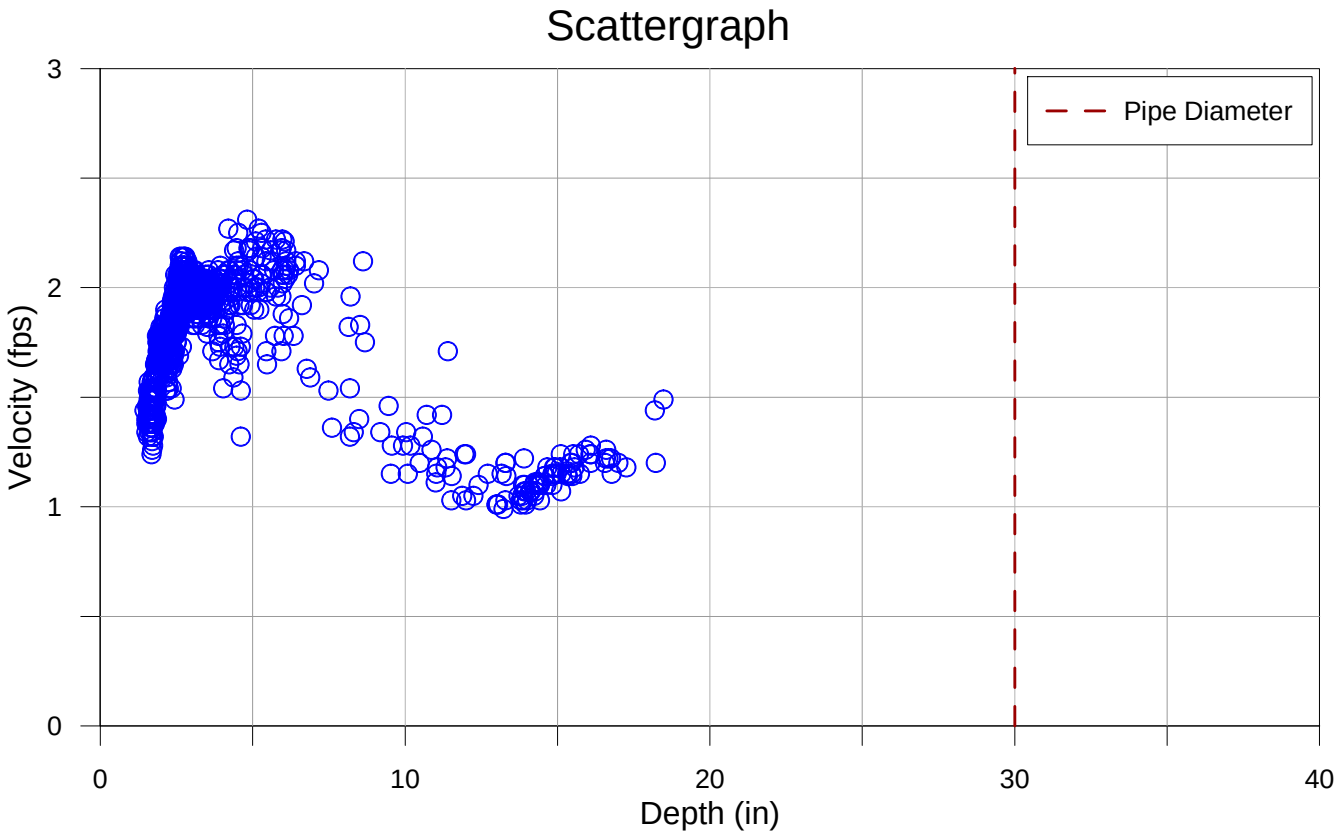
Monitor 081-139
July 21 - 28, 2008



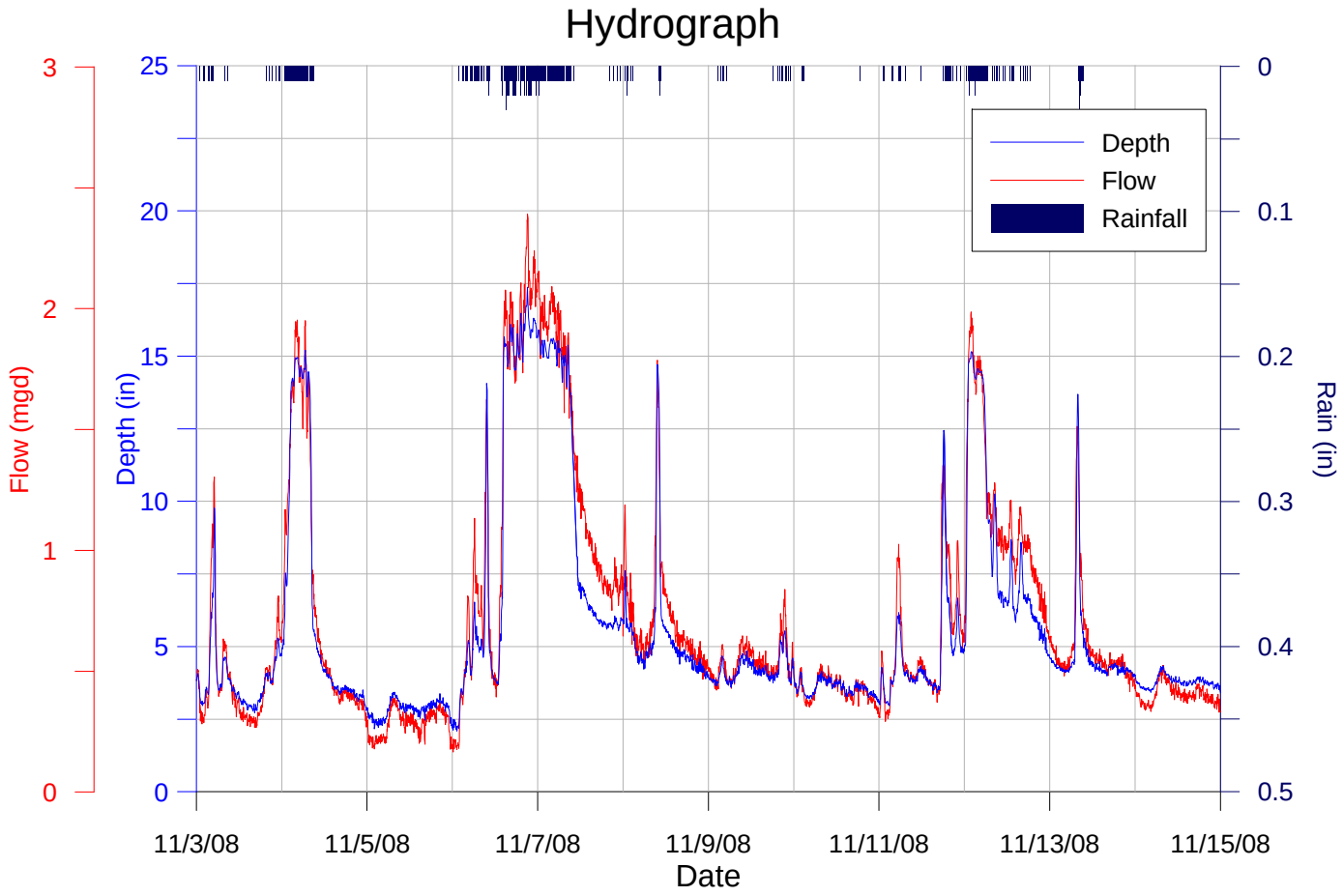


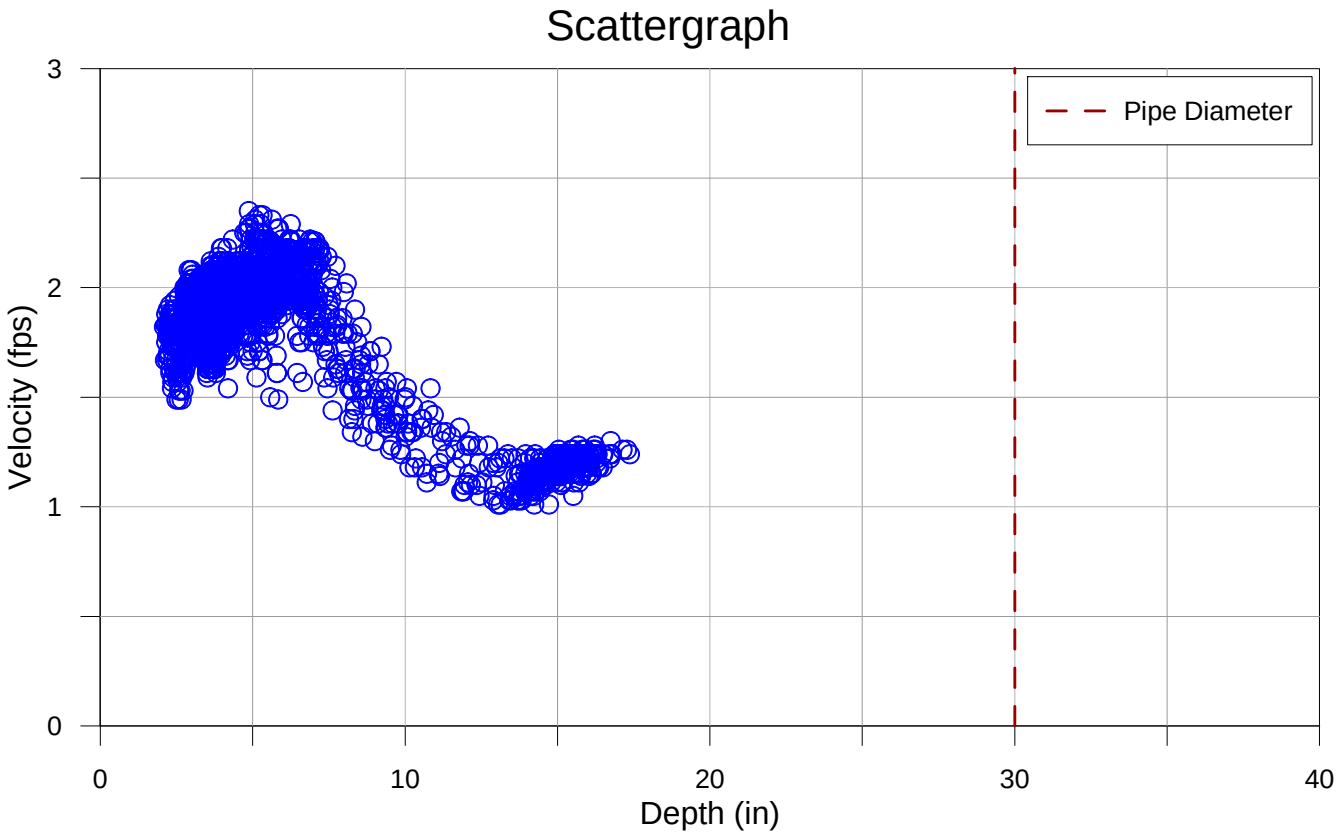
Monitor 081-139
August 23 - 28, 2008



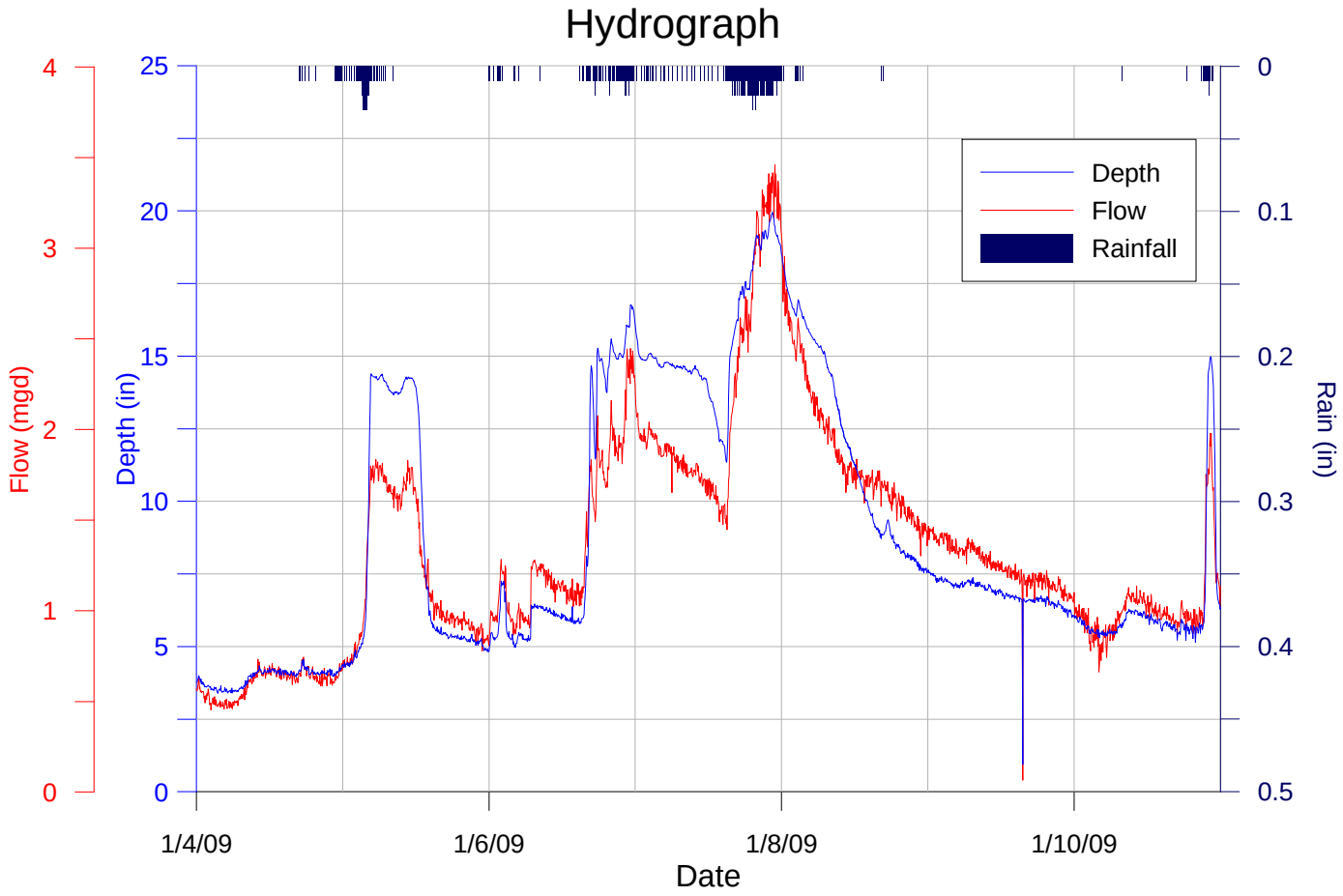


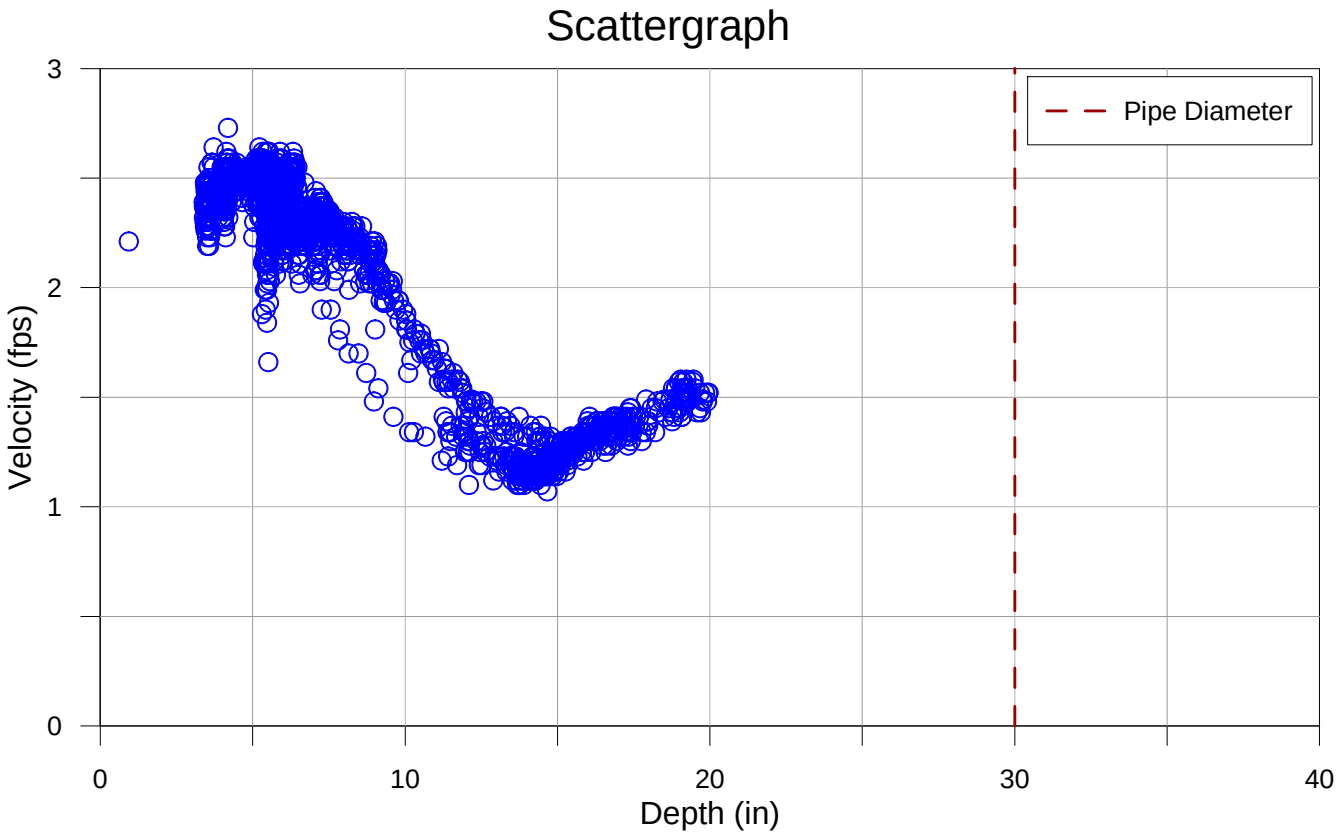
Monitor 081-139
November 3 - 15, 2008



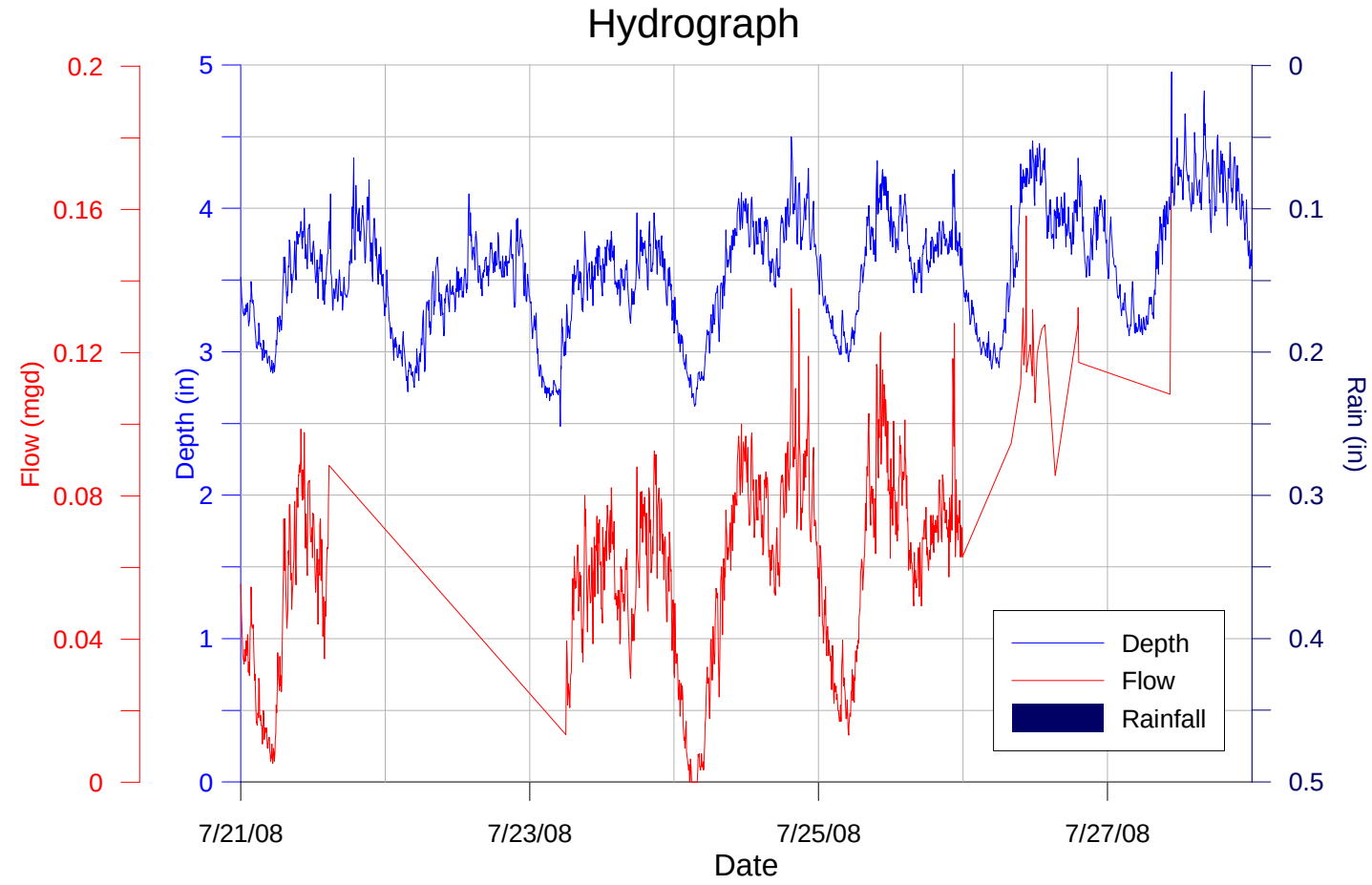


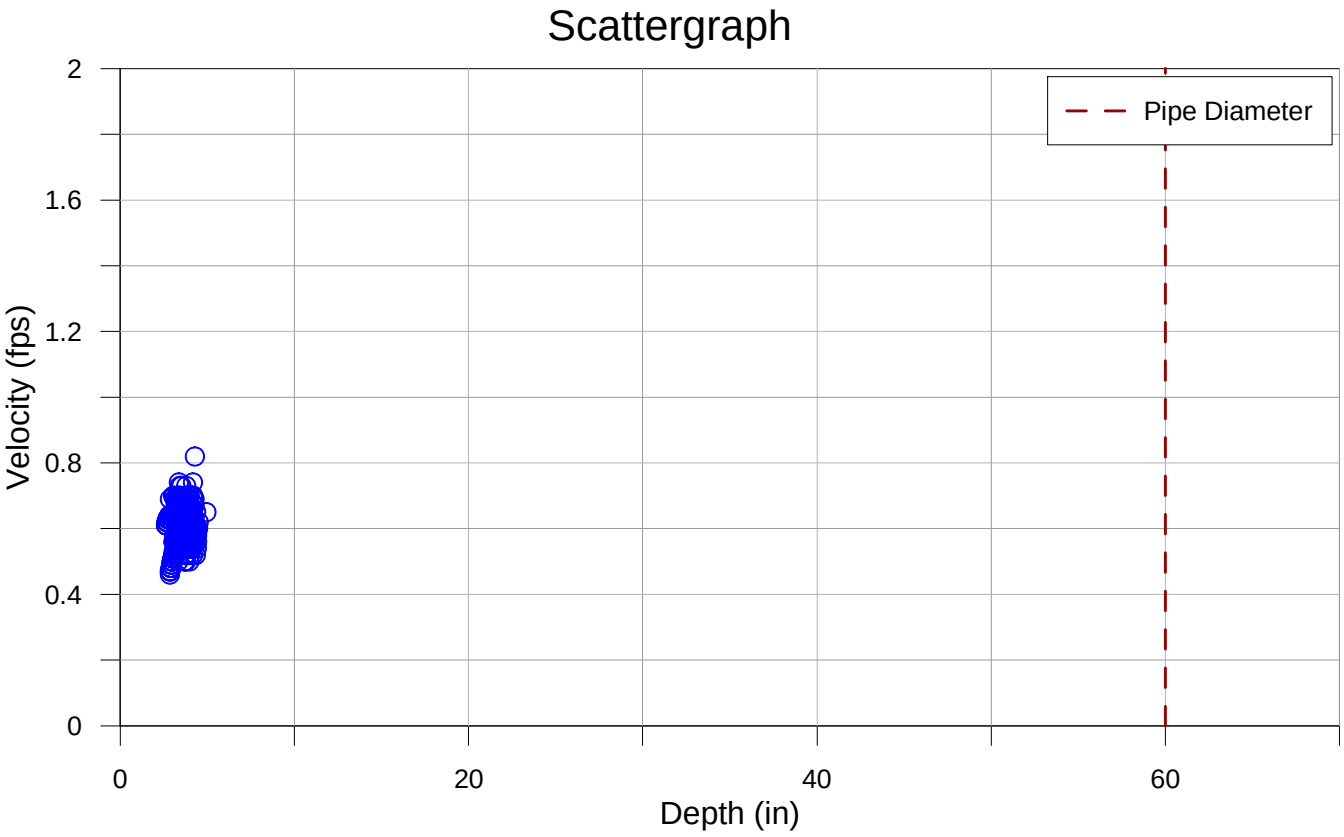
Monitor 081-139
January 4 - 11, 2009



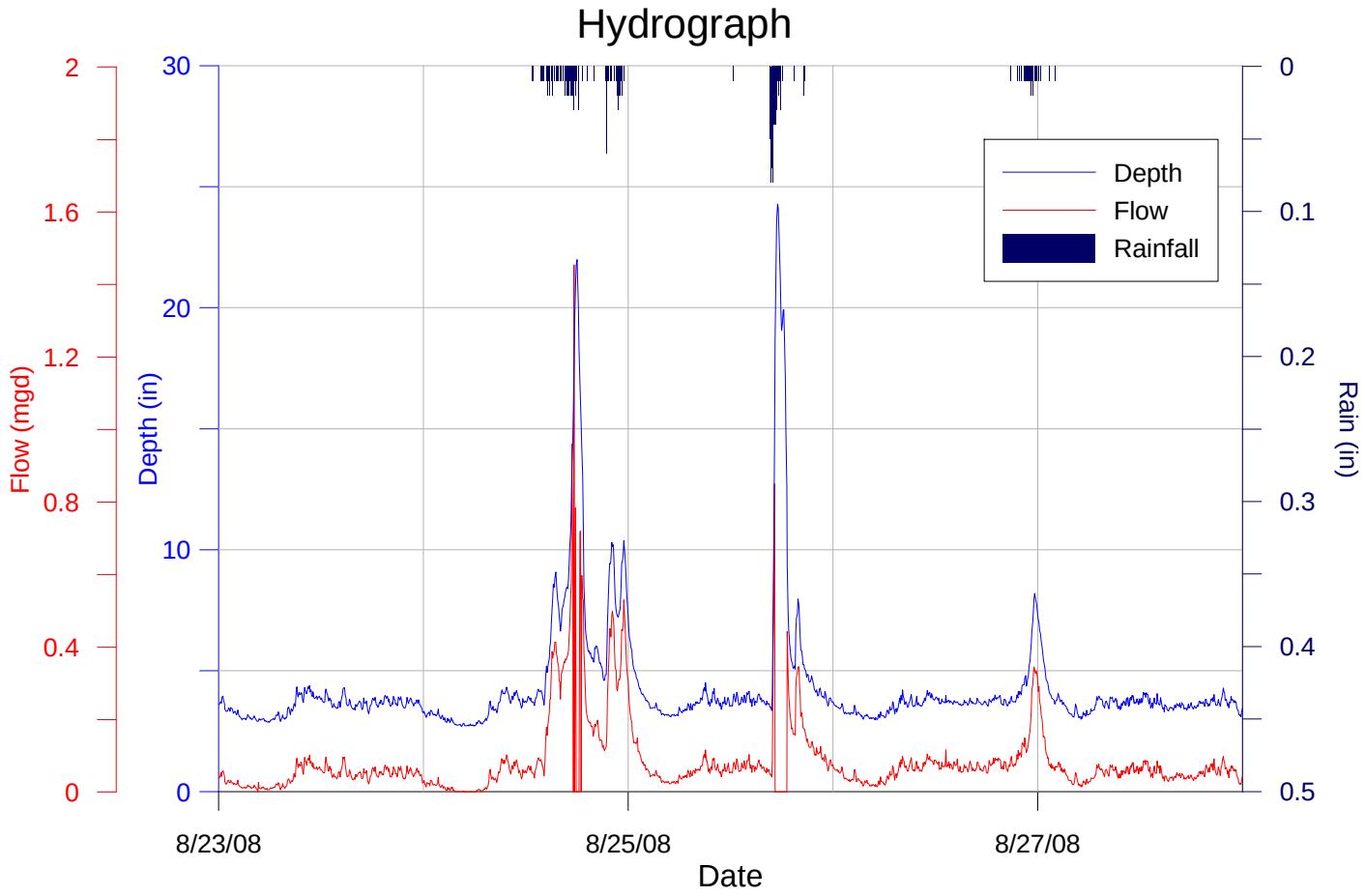


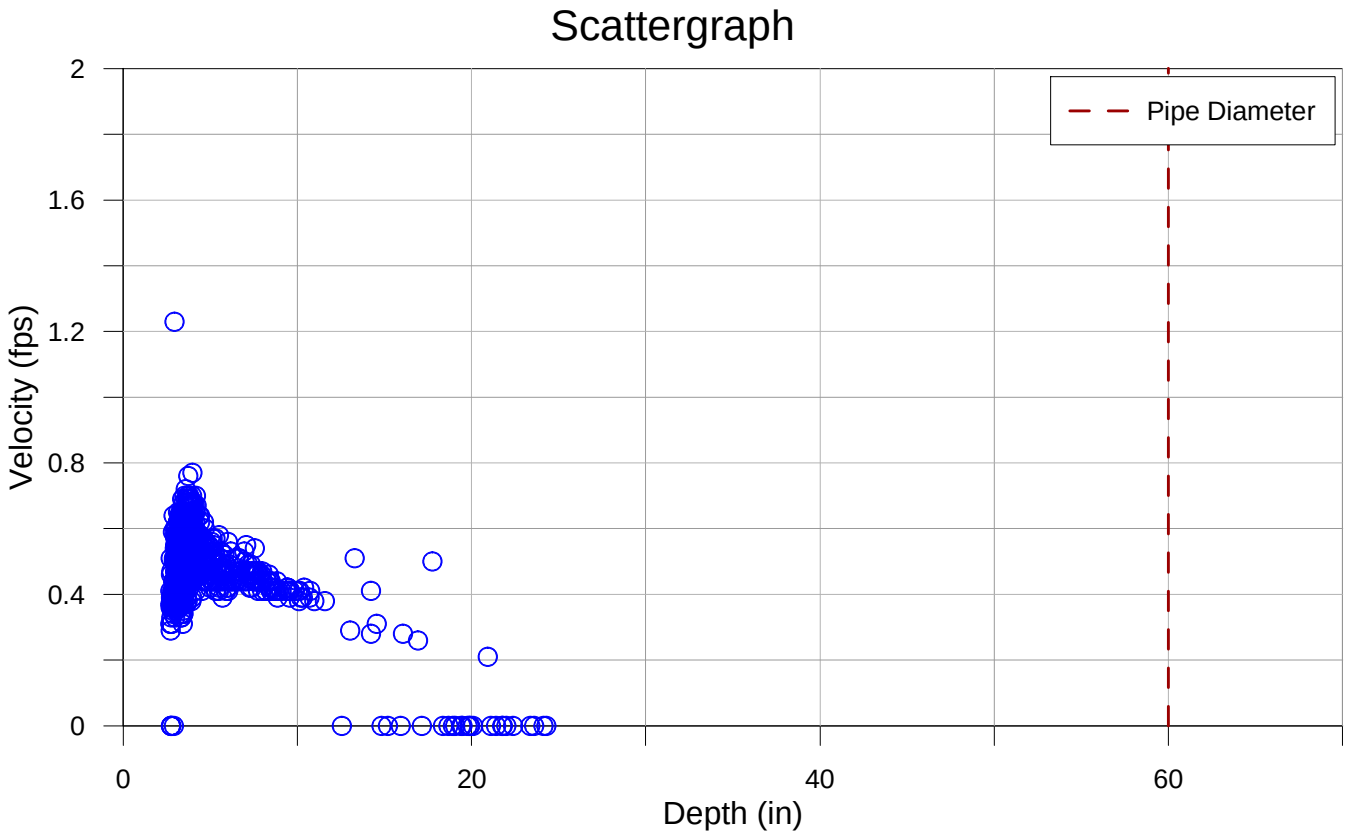
Monitor 081-239
July 21 - 28, 2008



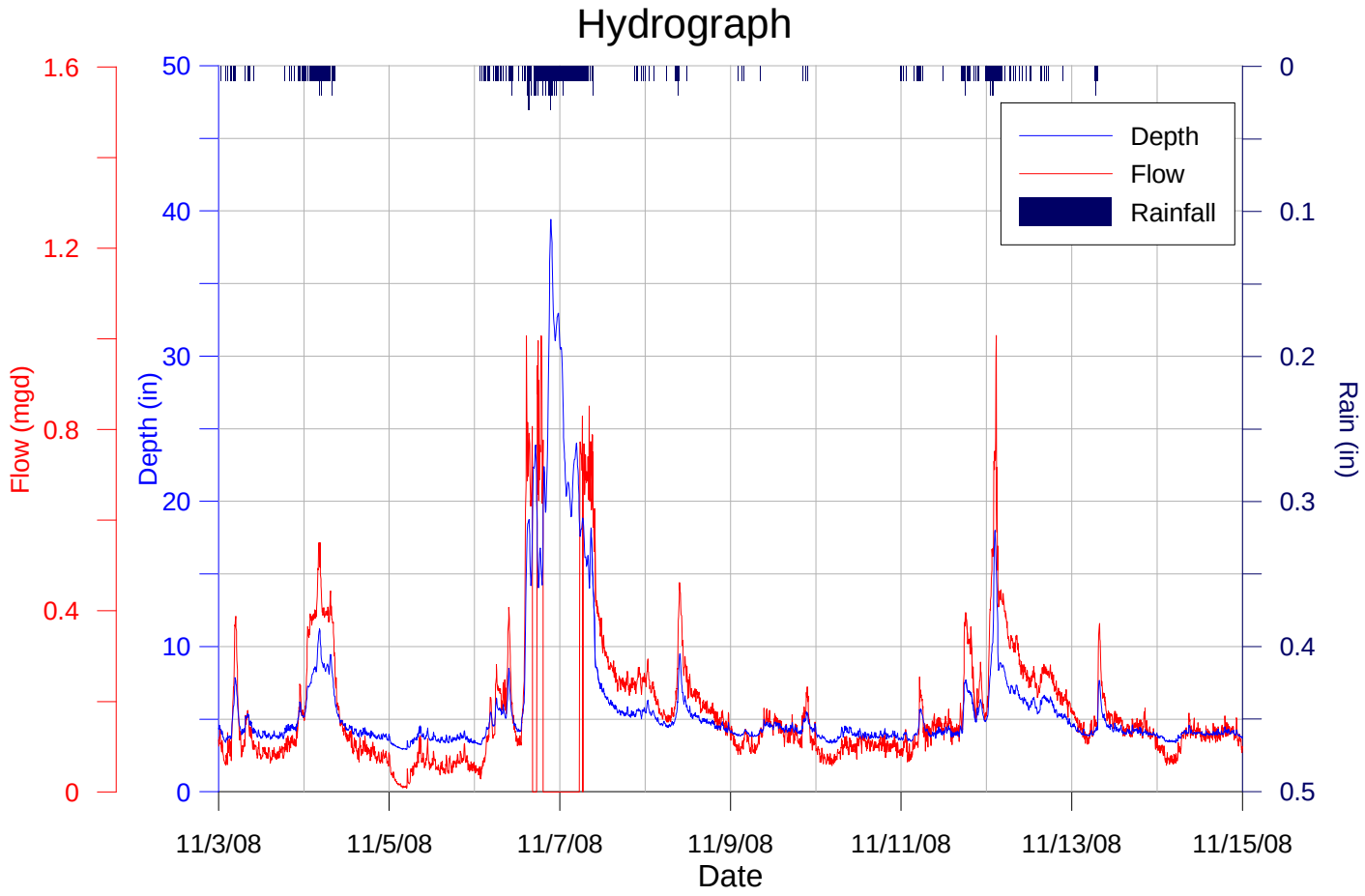


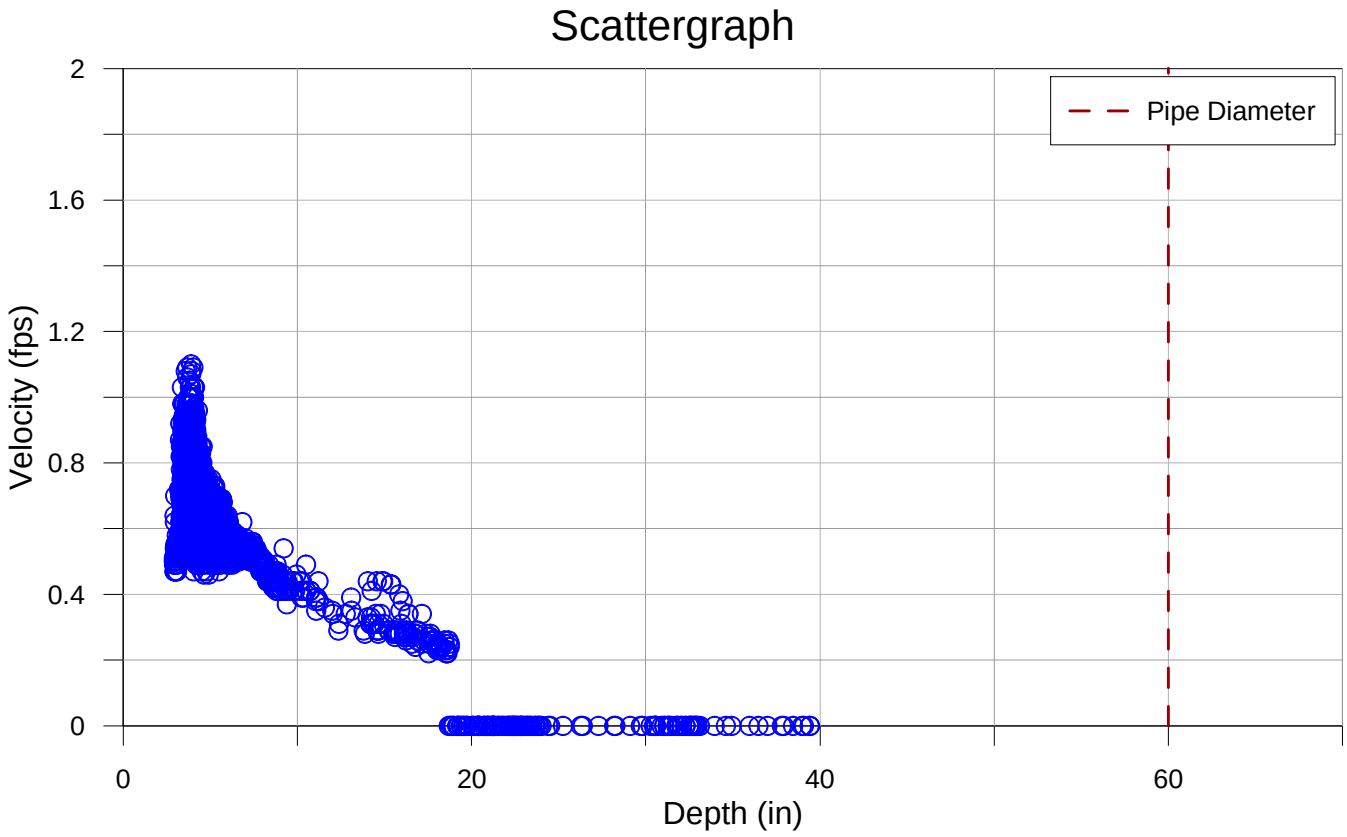
Monitor 081-239
August 23 - 28, 2008



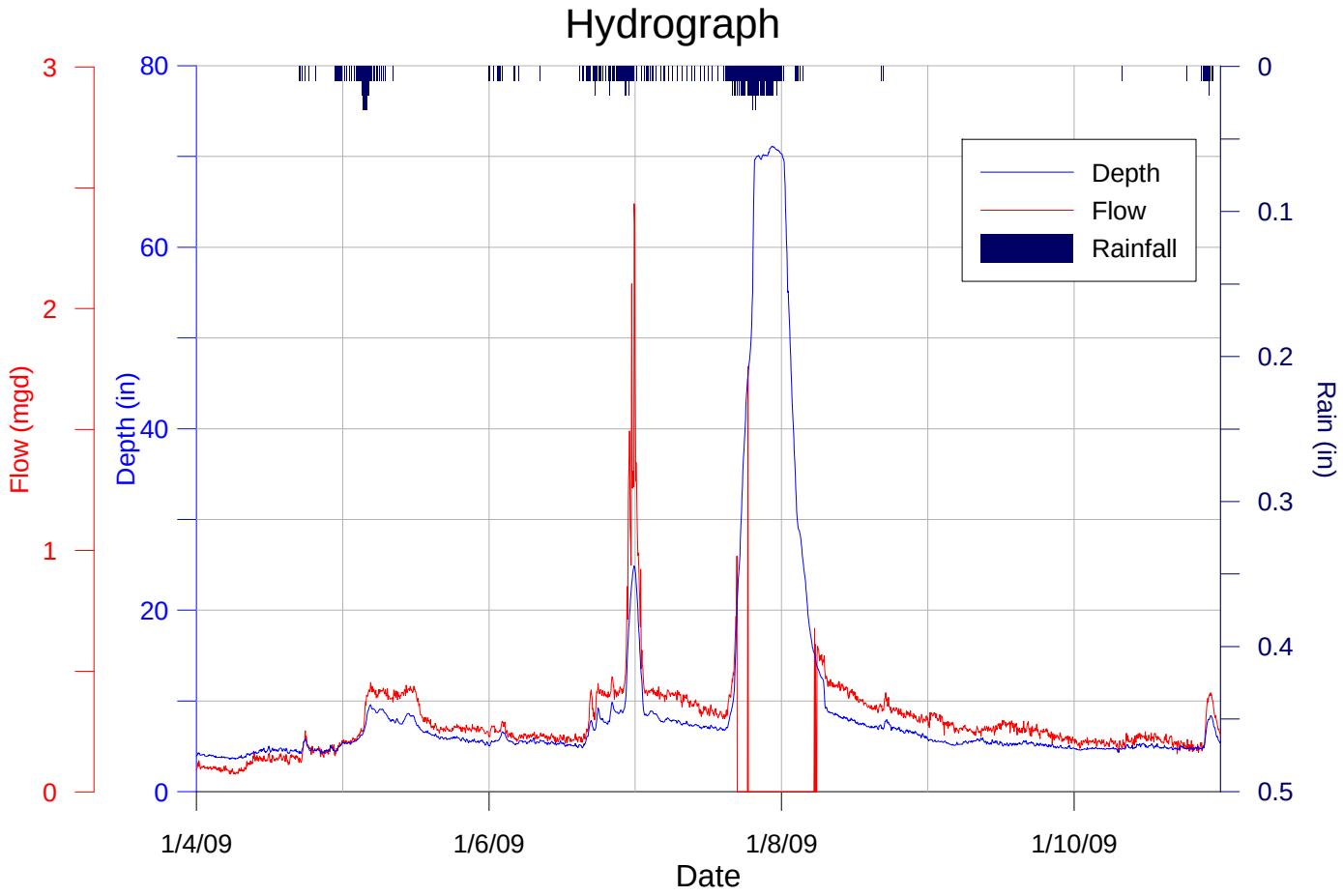


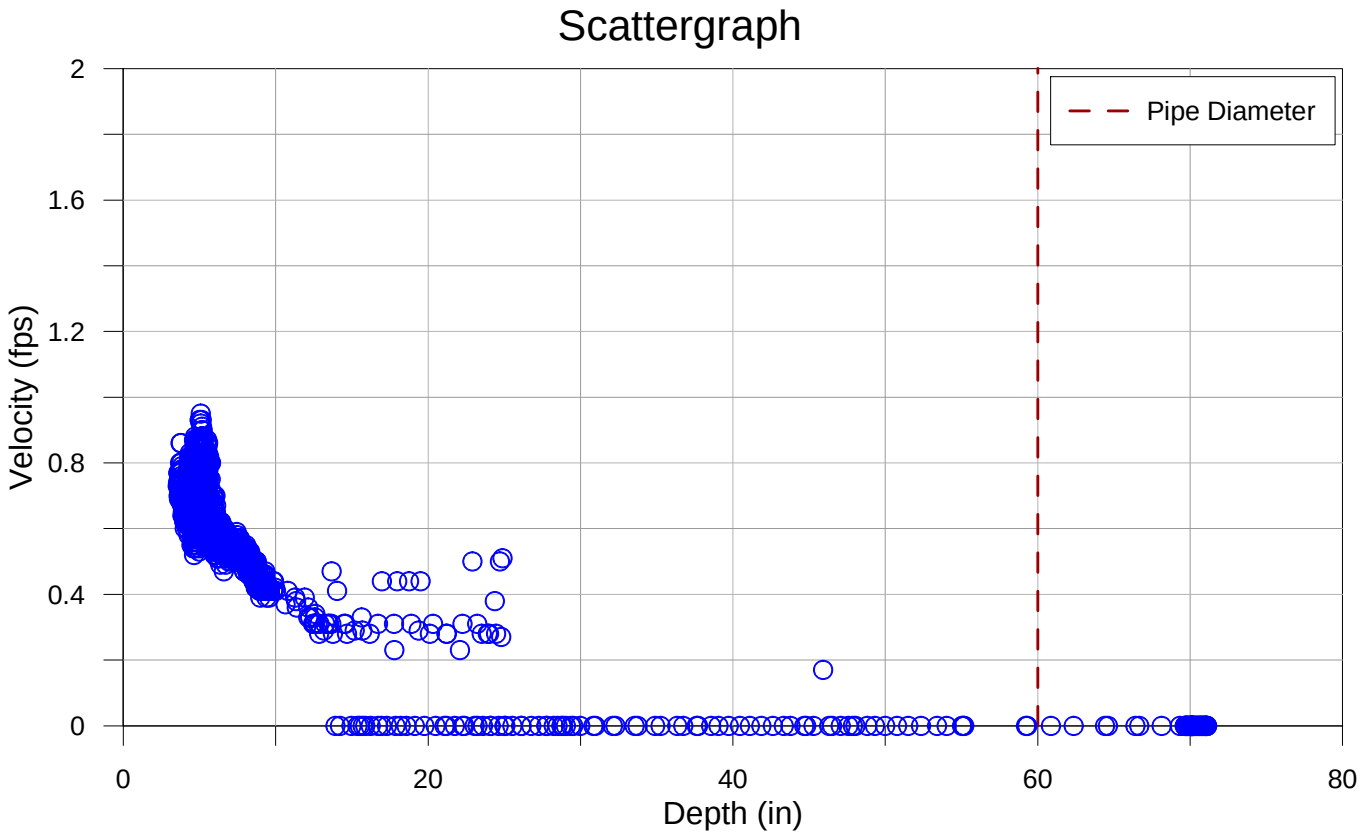
Monitor 081-239
November 3 - 15, 2008



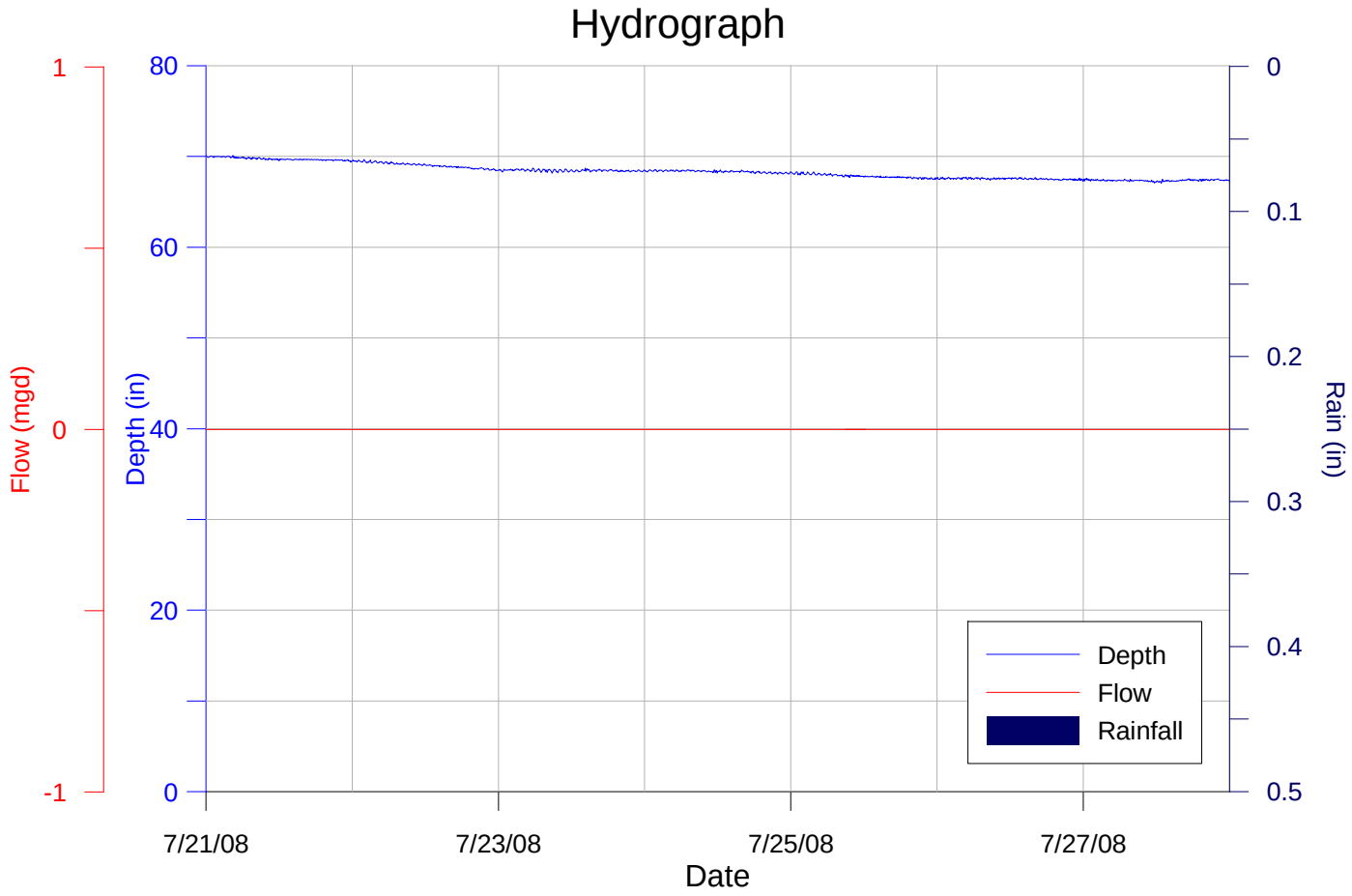


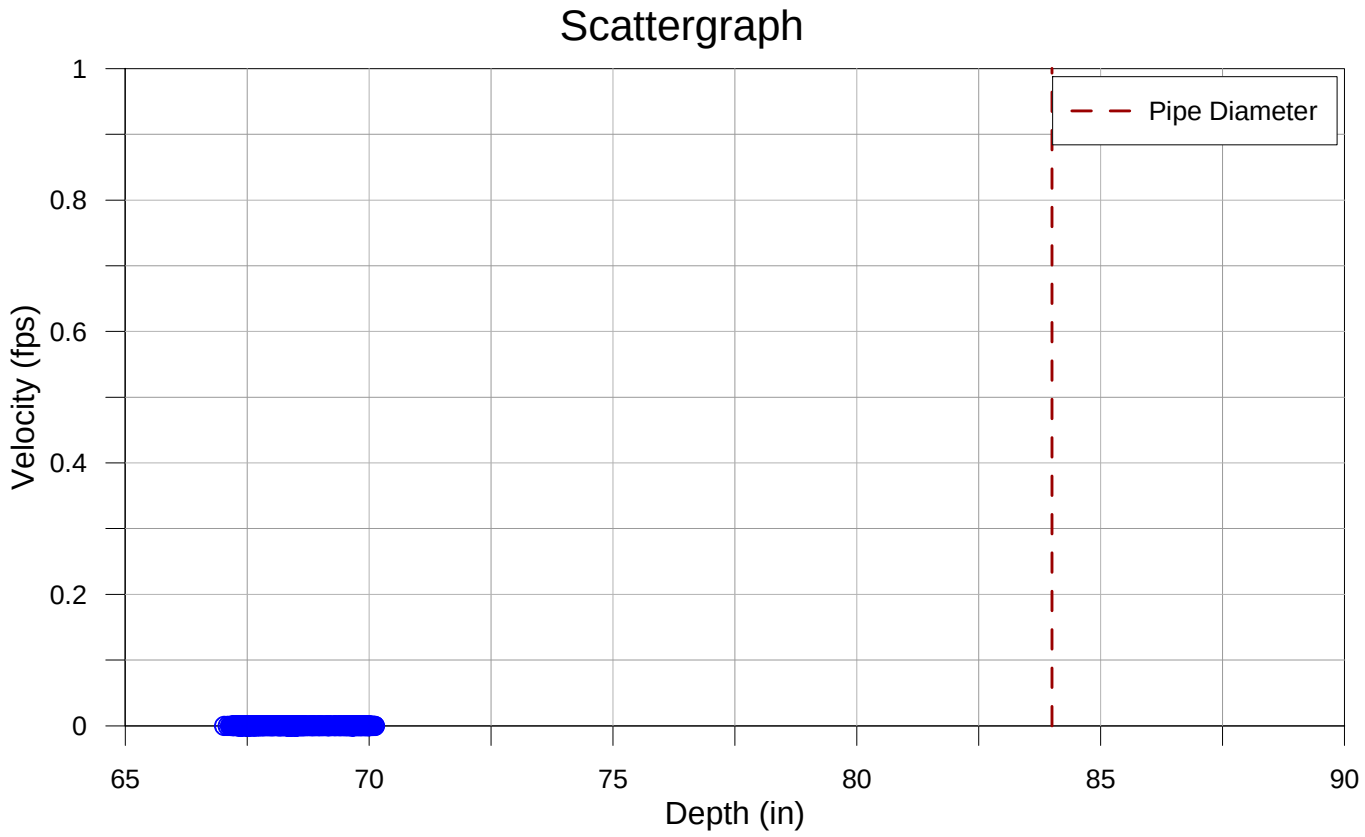
Monitor 081-239
January 4 - 11, 2009



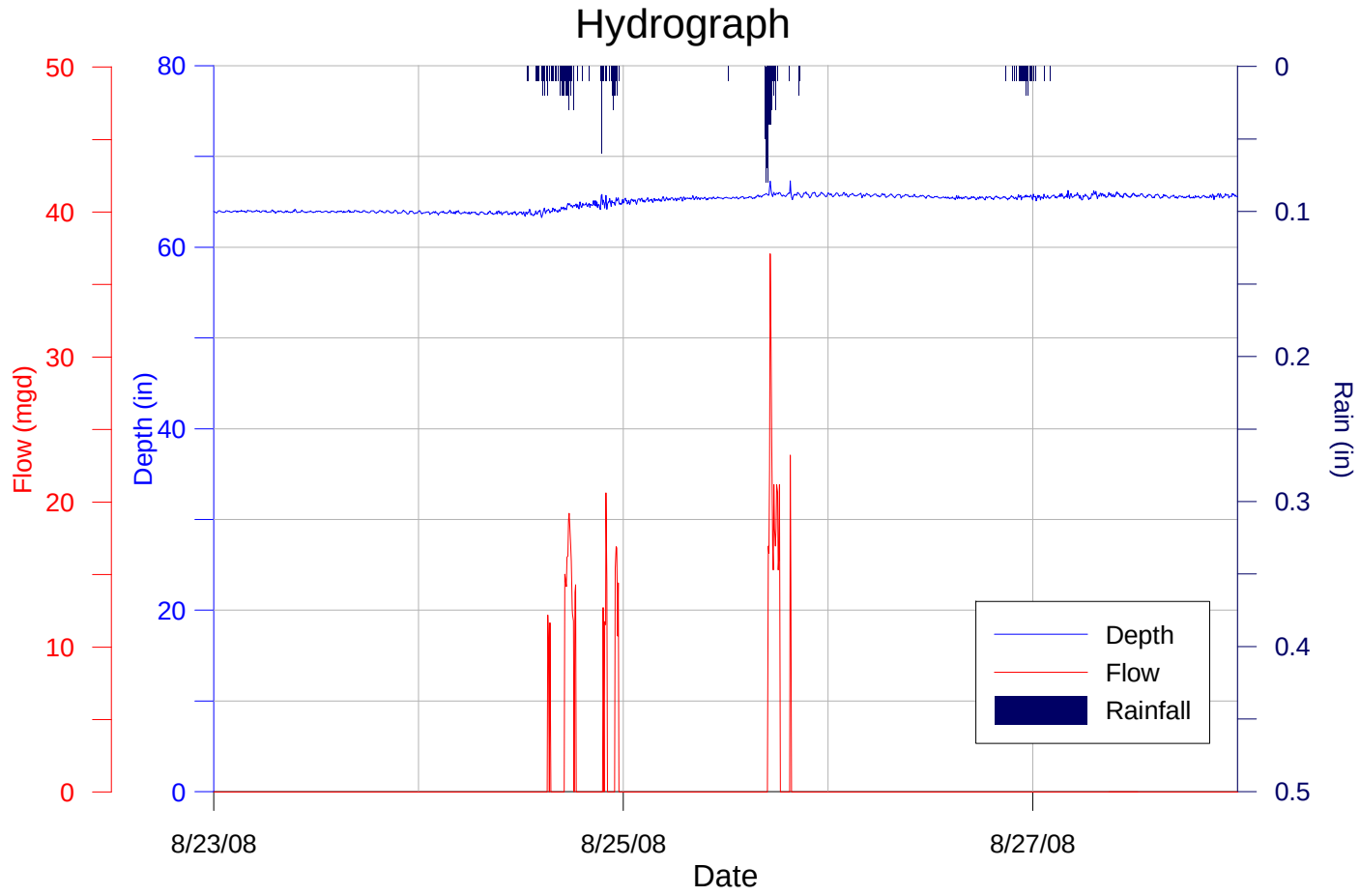


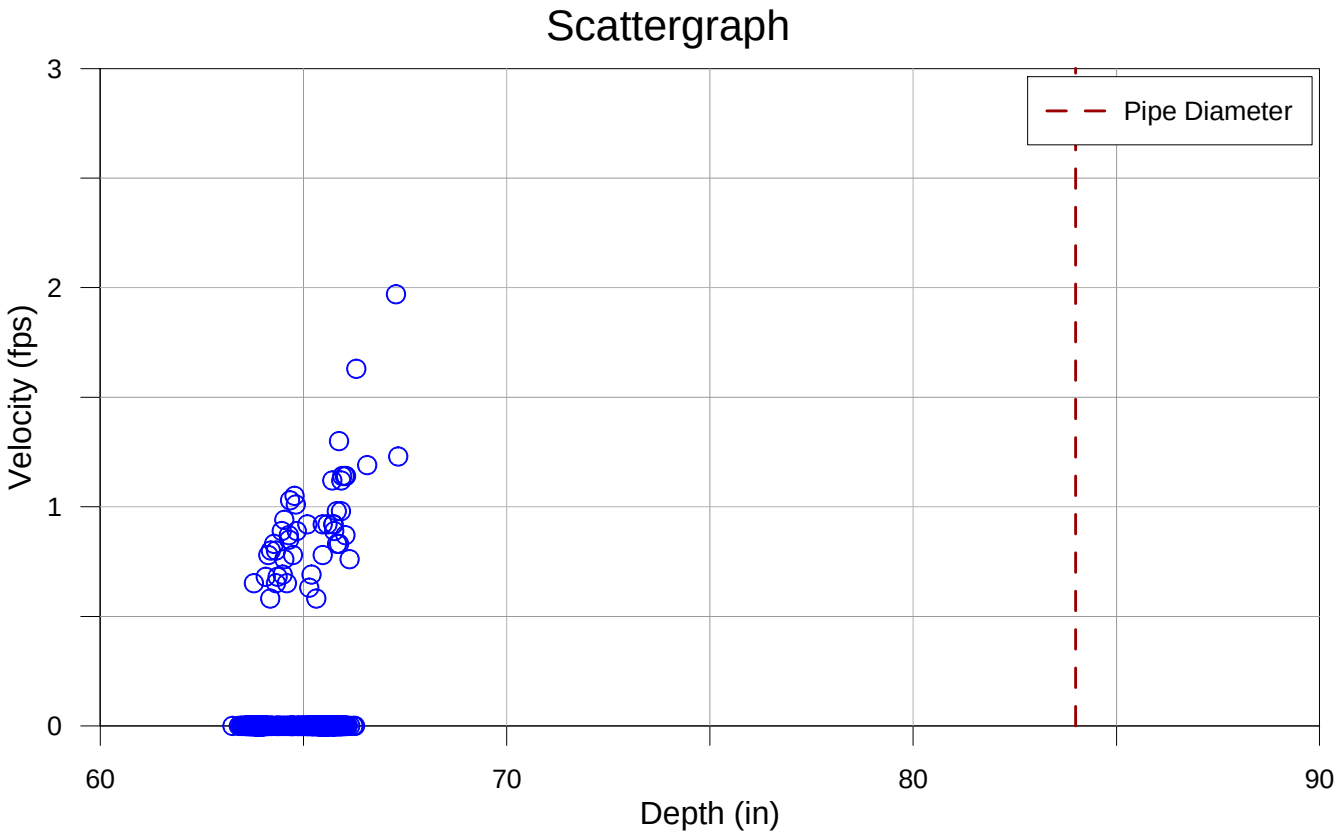
Monitor D081-069
July 21 - 28, 2008



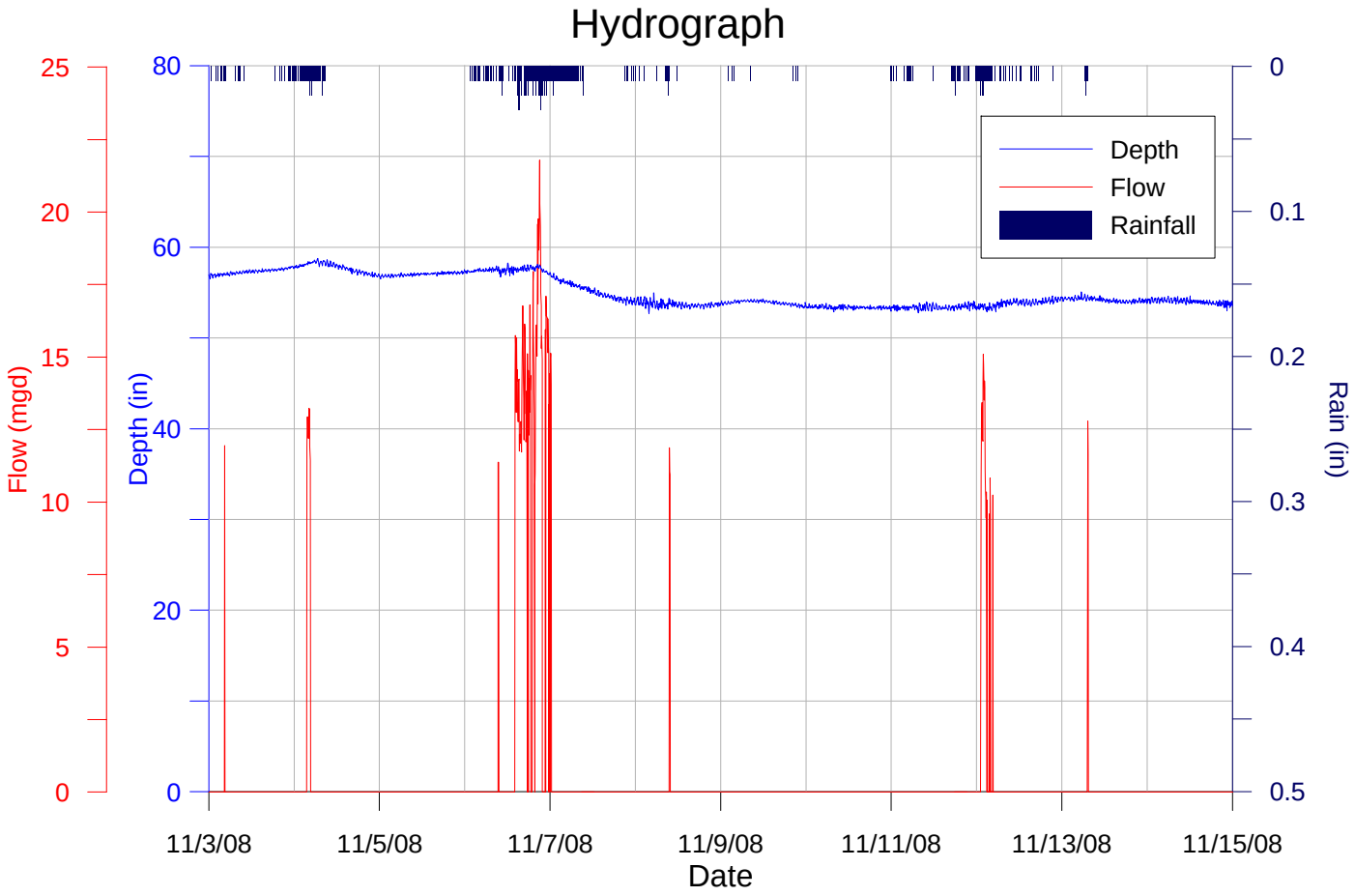


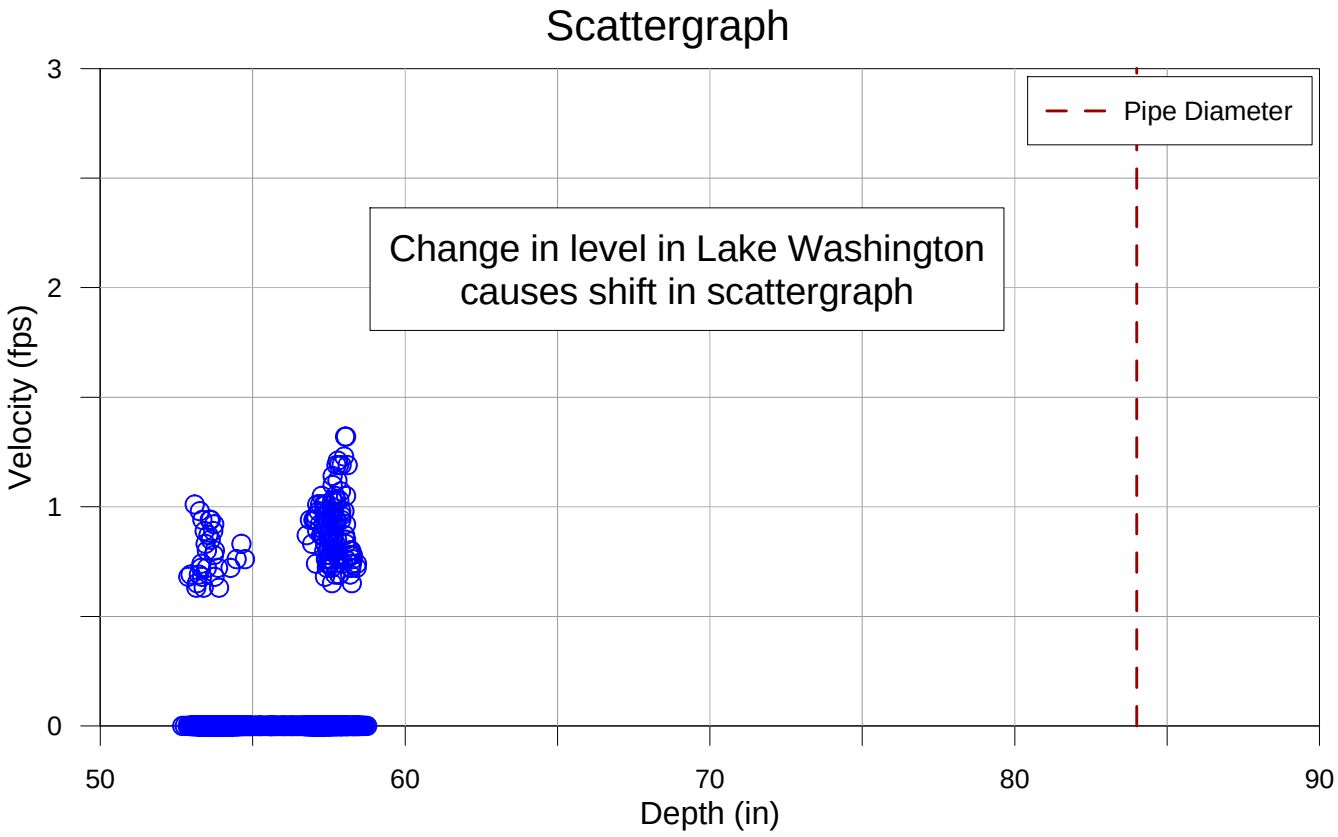
Monitor D081-069
August 23 - 28, 2008



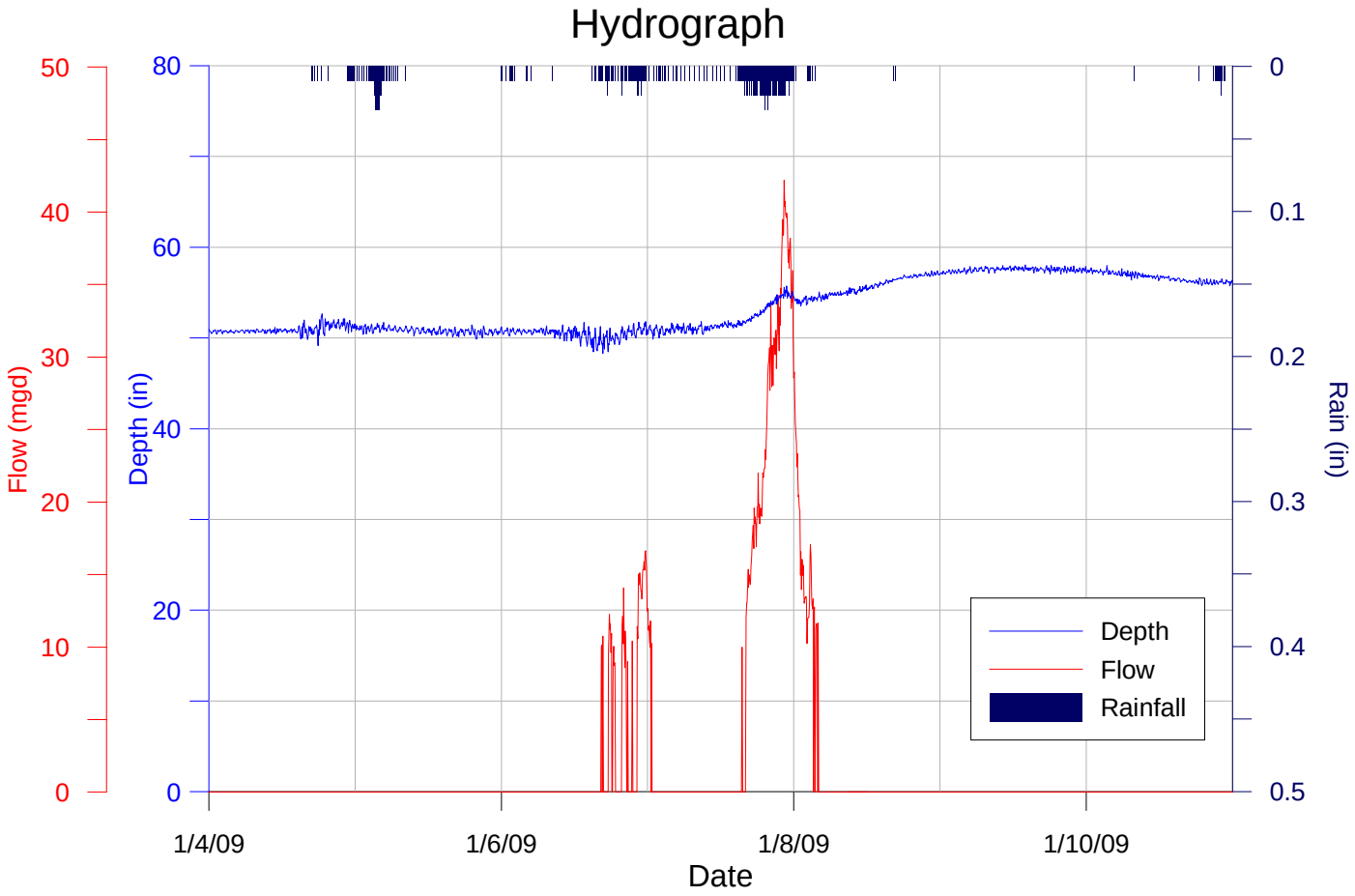


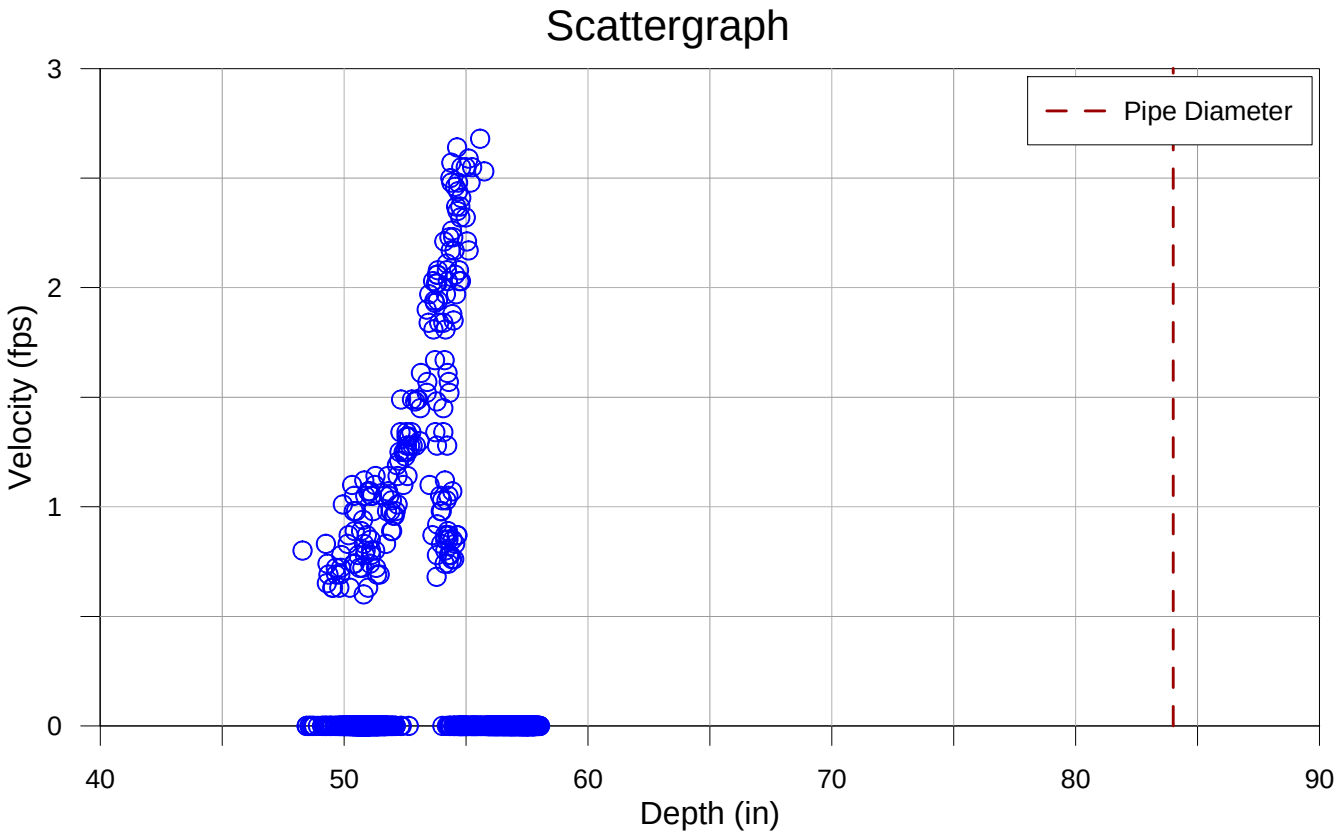
Monitor D081-069
November 3 - 15, 2008



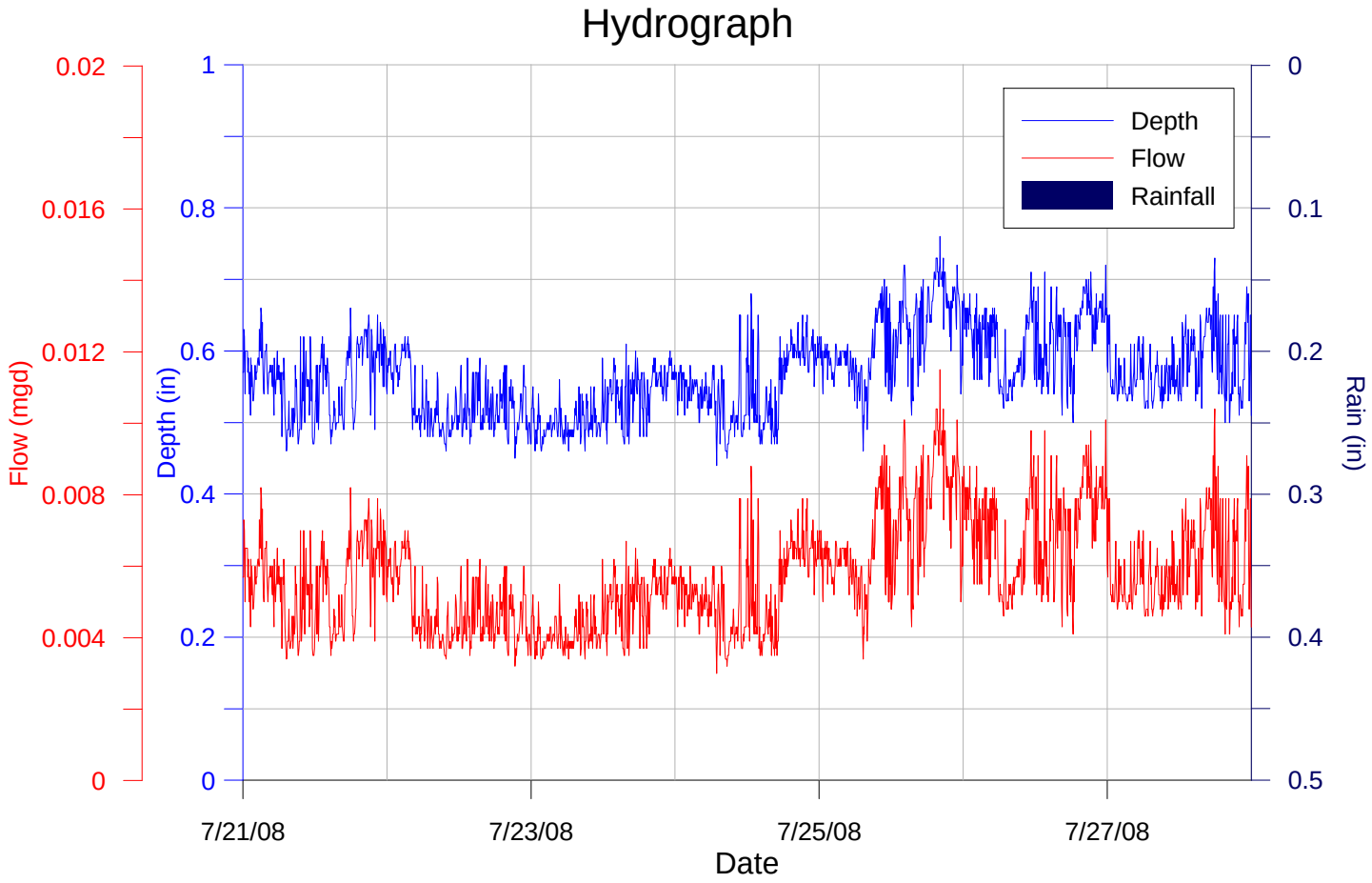


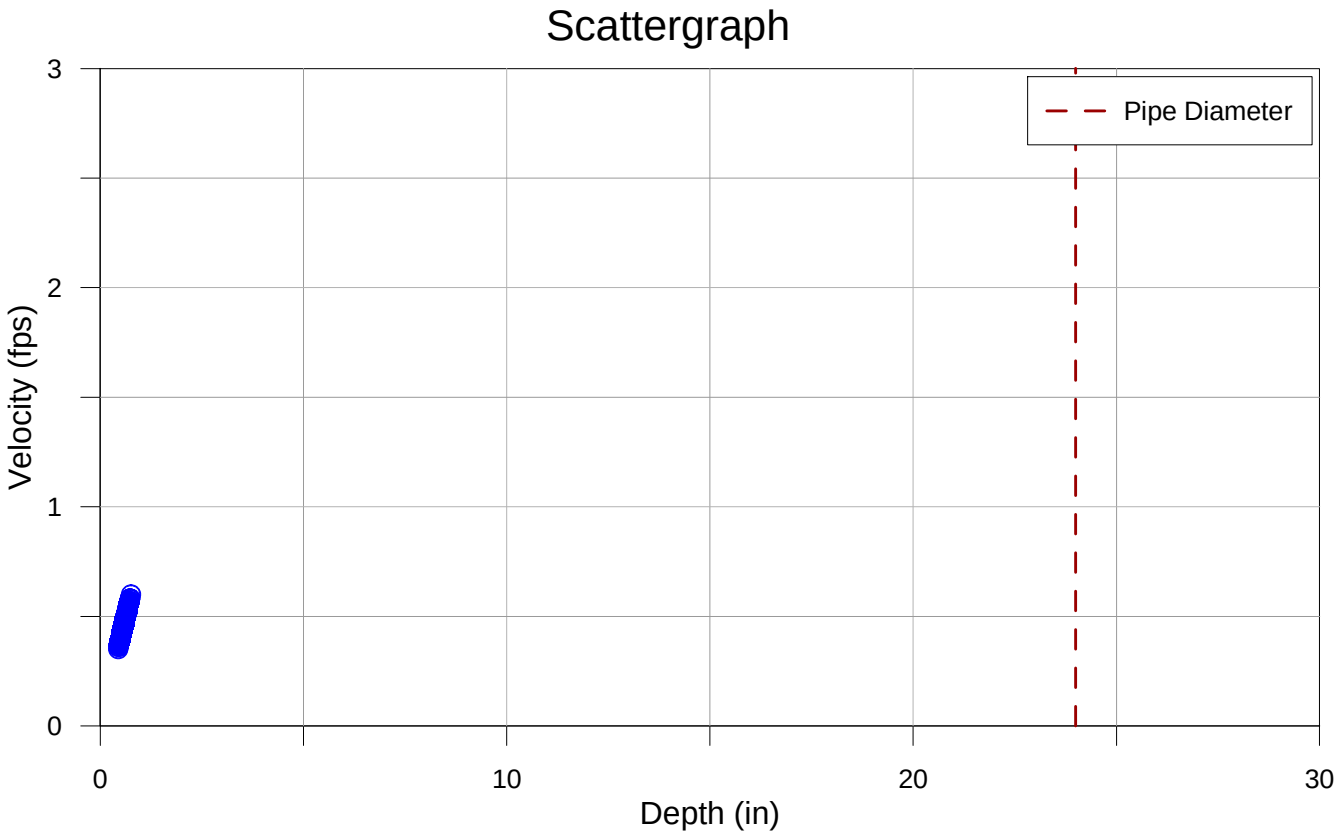
Monitor D081-069
January 4 - 11, 2009



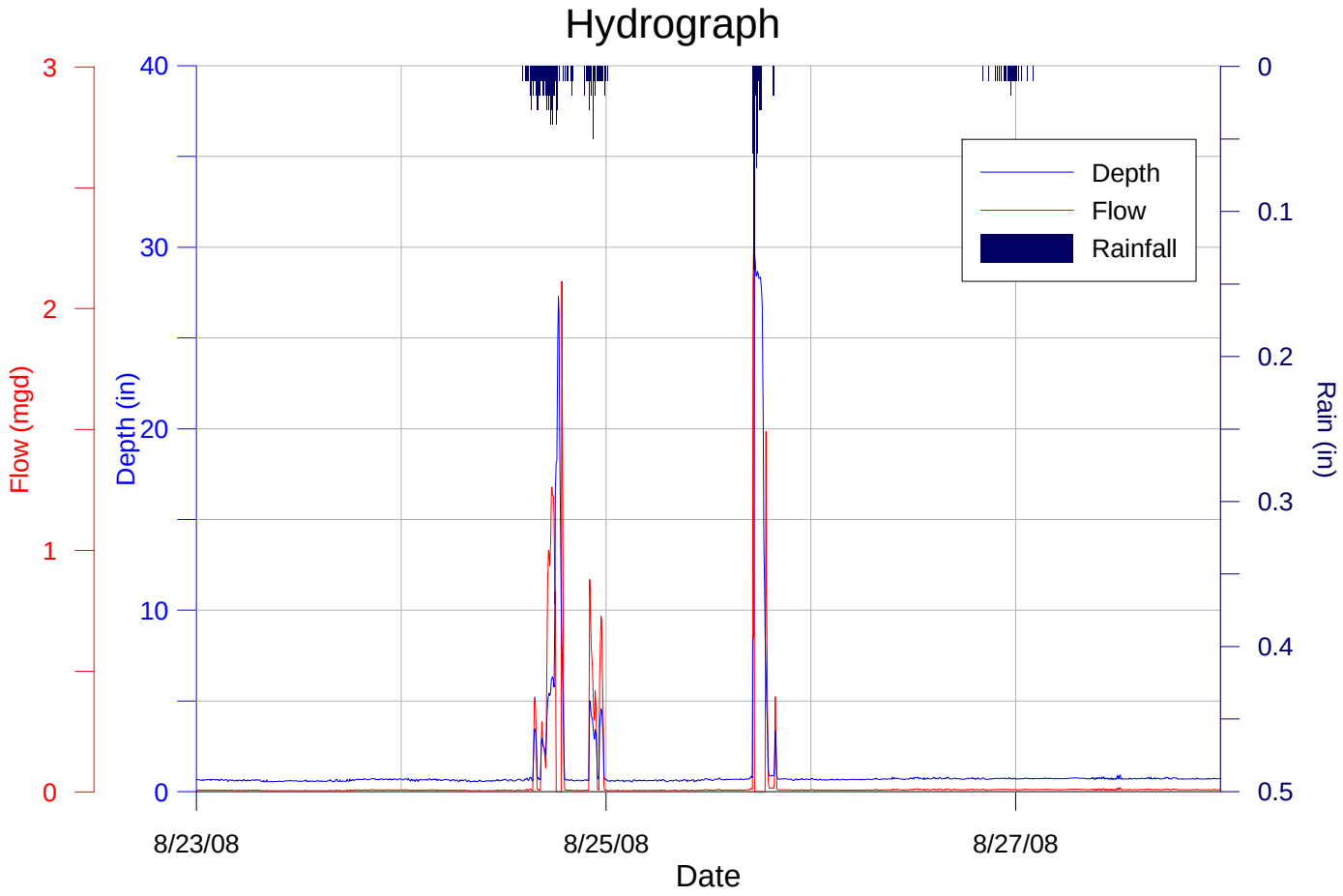


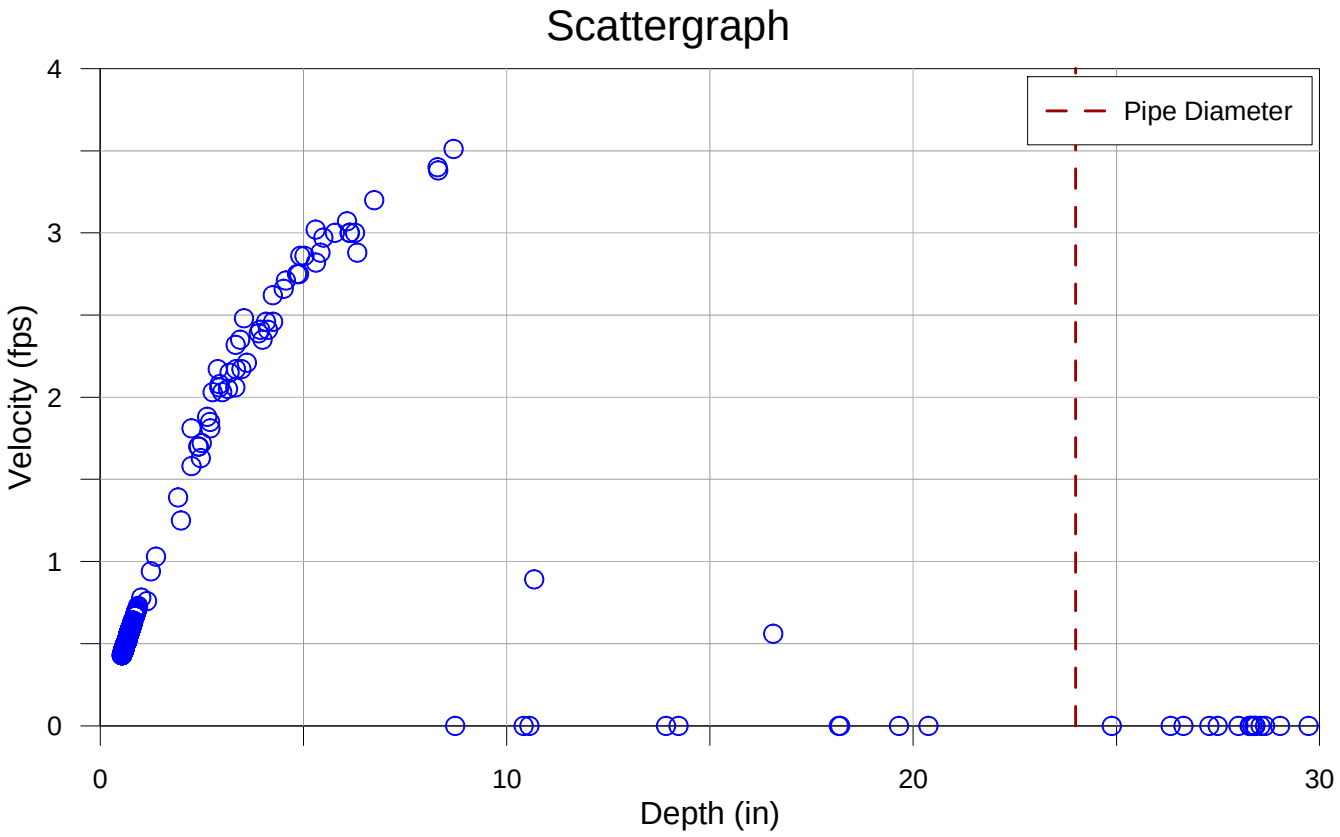
Monitor 081-224 (47B)
July 21 - 28, 2008



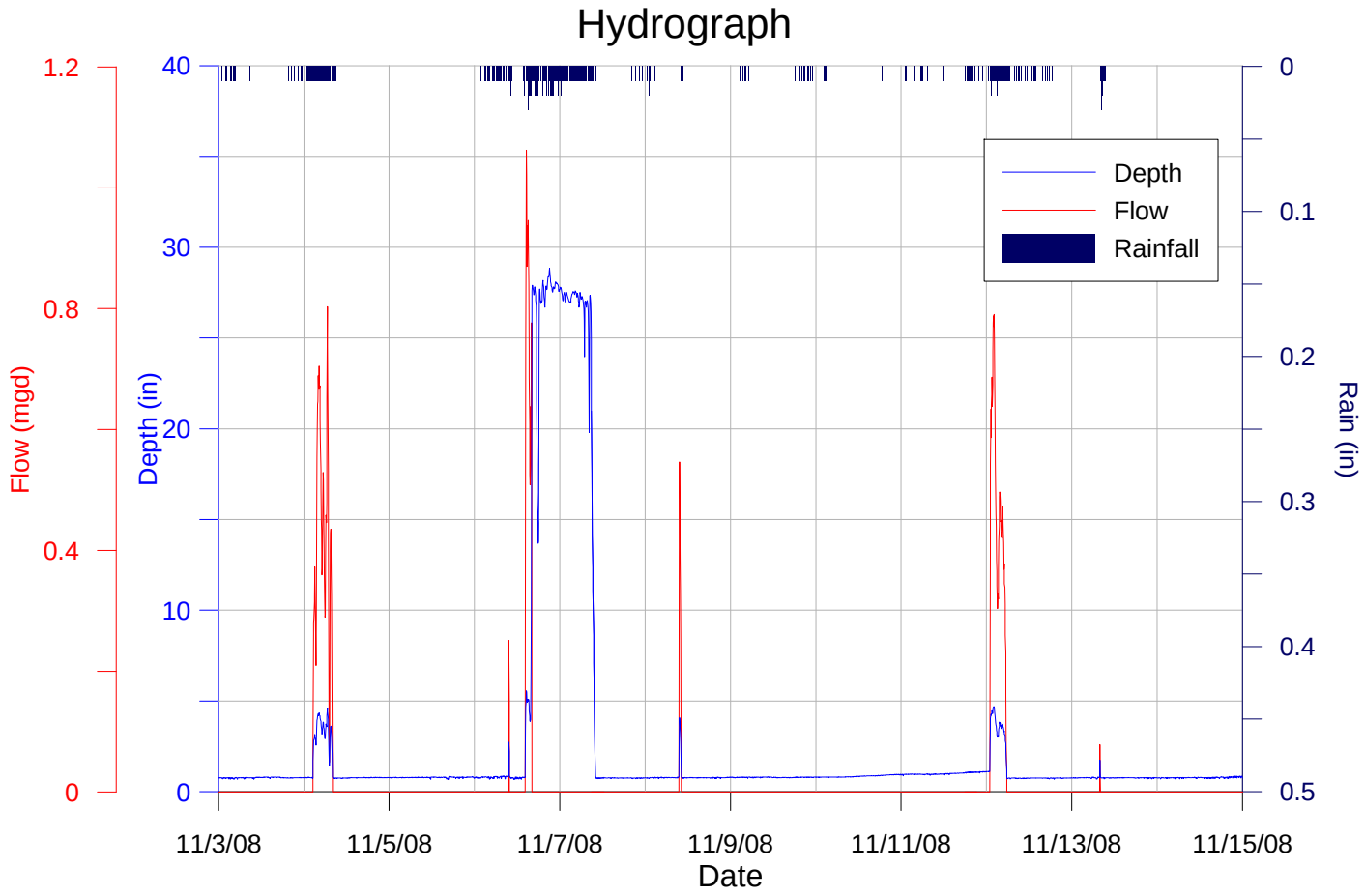


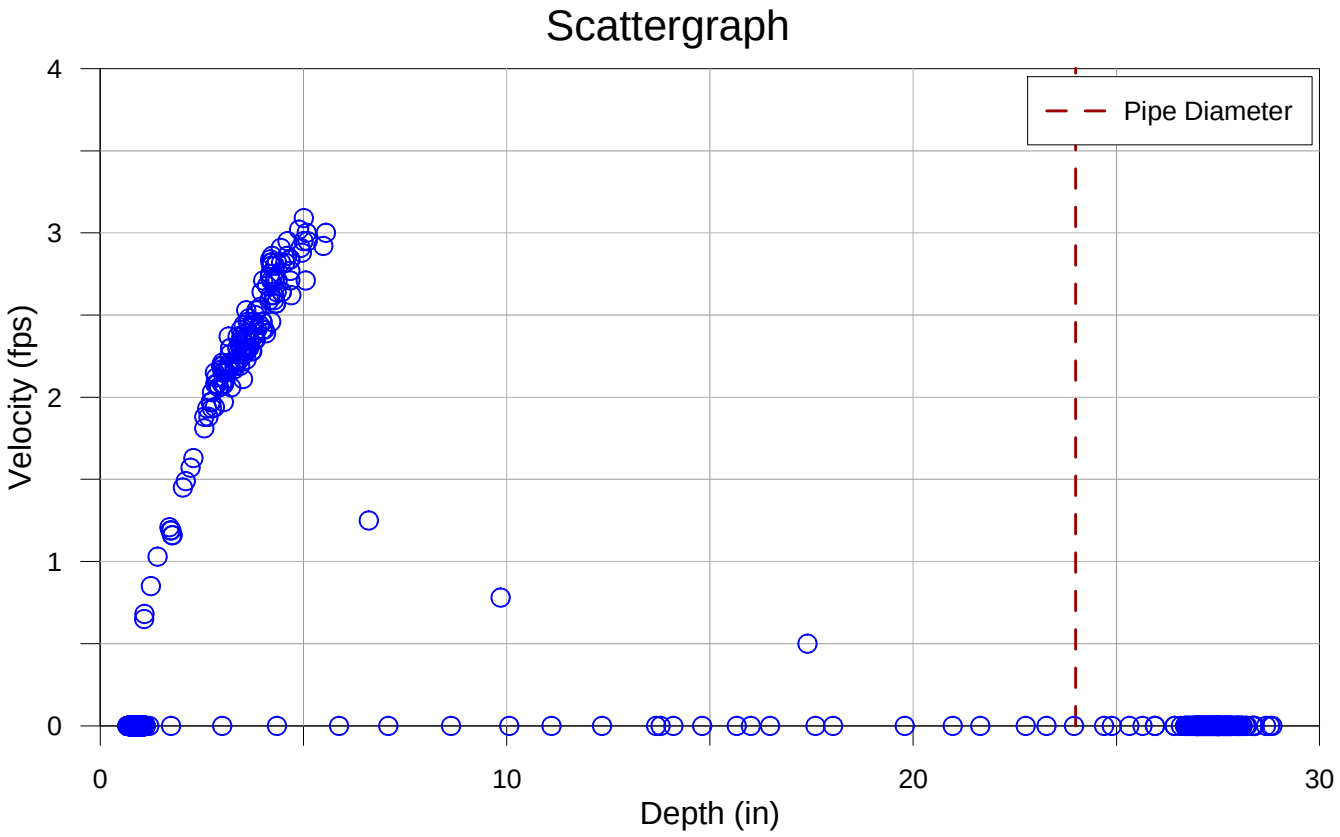
Monitor 081-224 (47B)
August 23 - 28, 2008



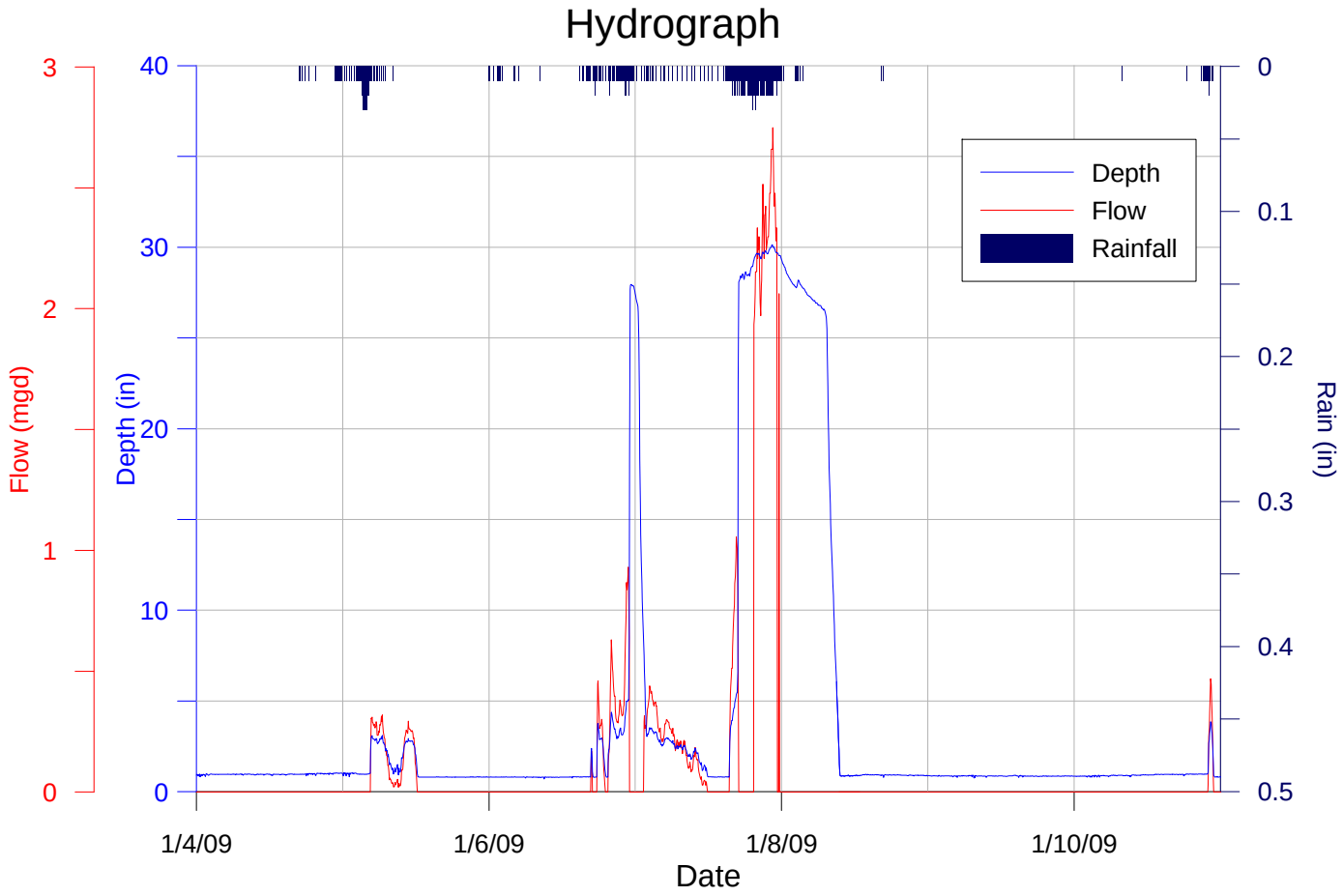


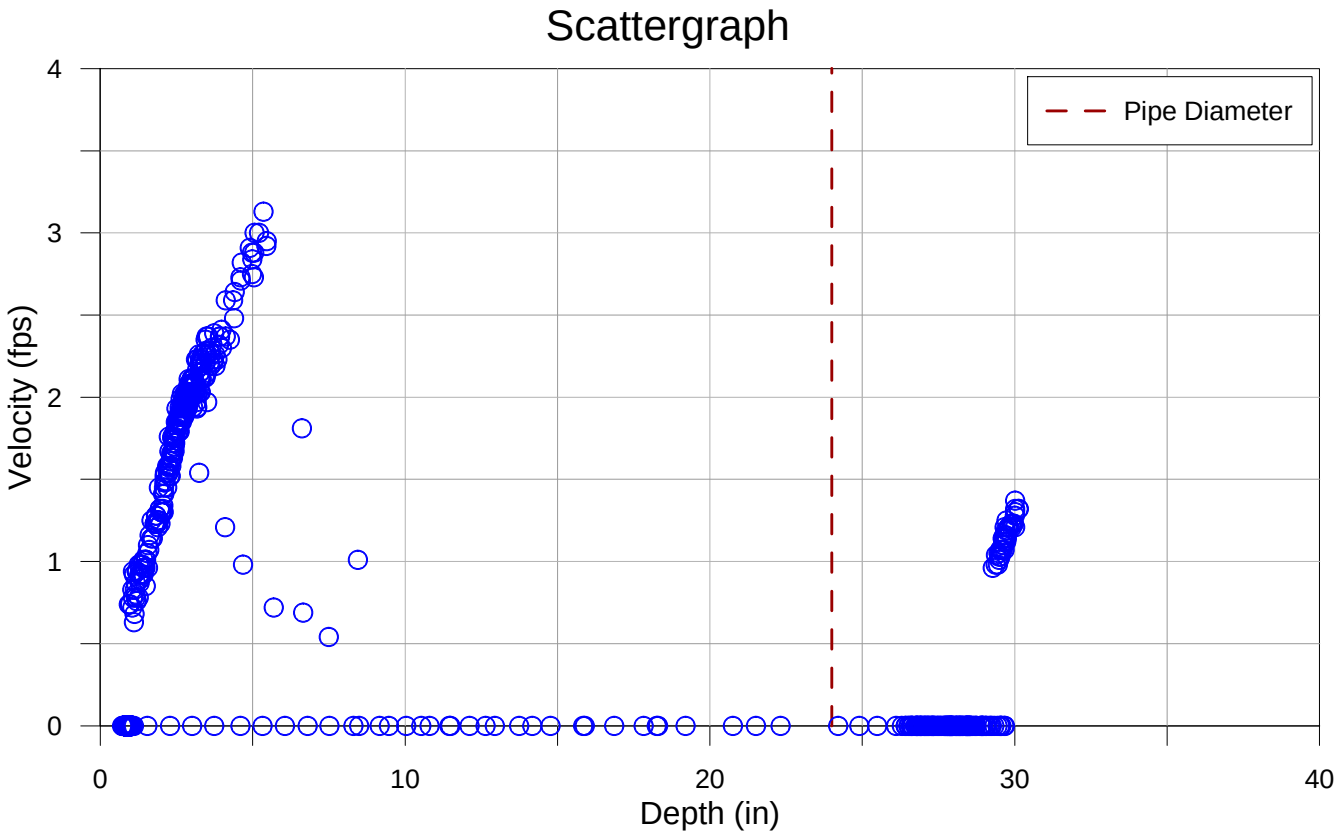
Monitor 081-224 (47B)
November 3 - 15, 2008



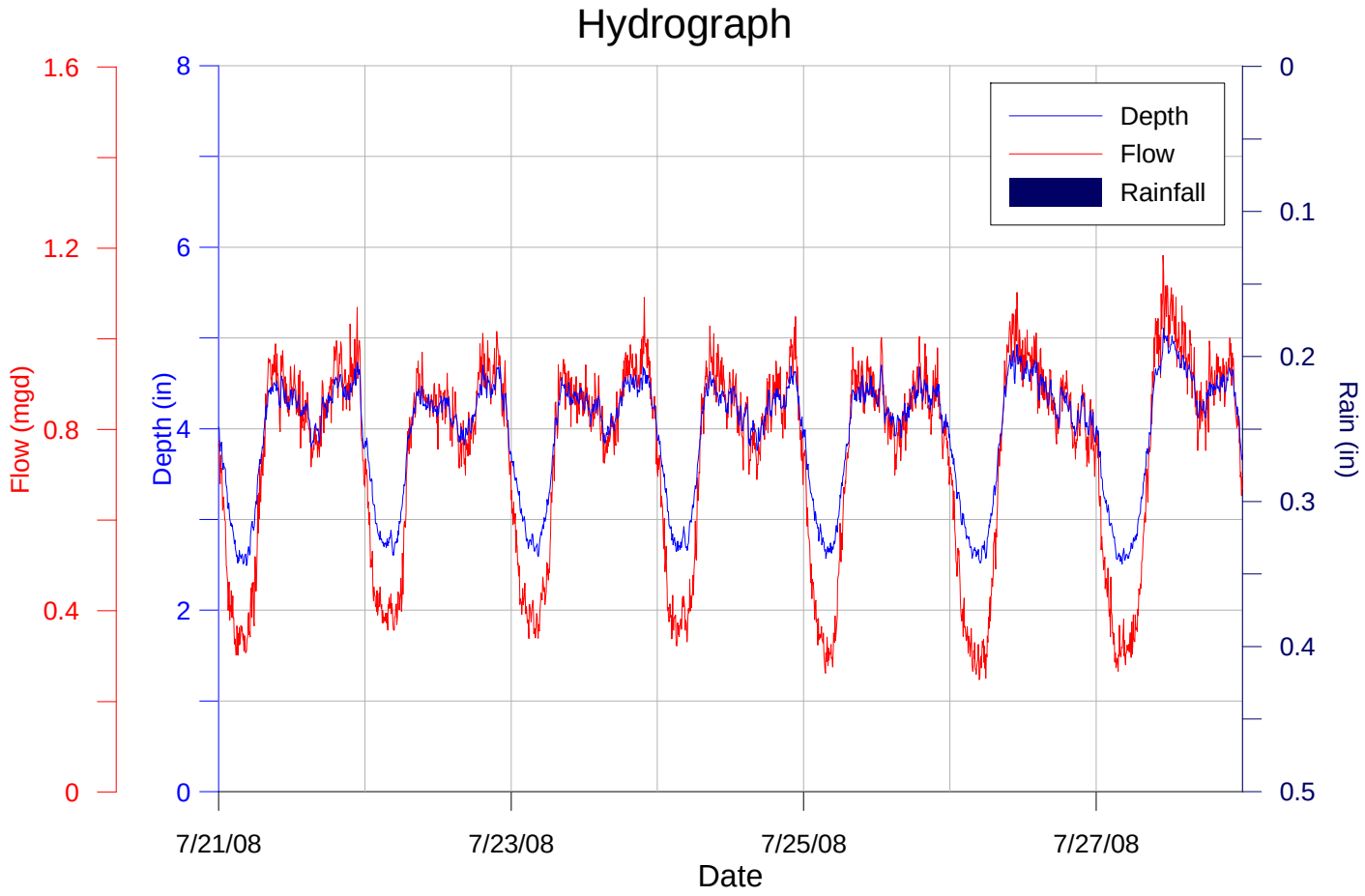


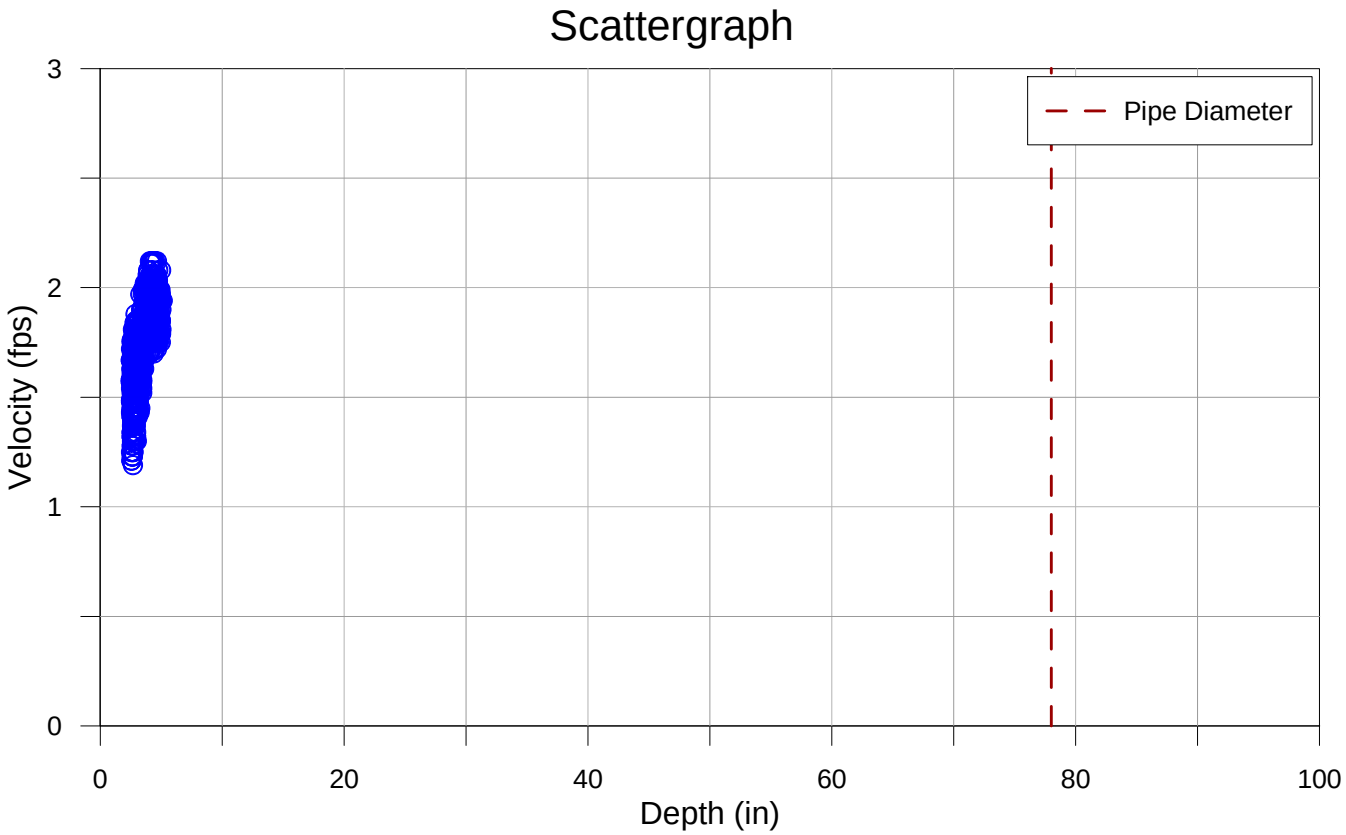
Monitor 081-224 (47B)
January 4 - 11, 2009



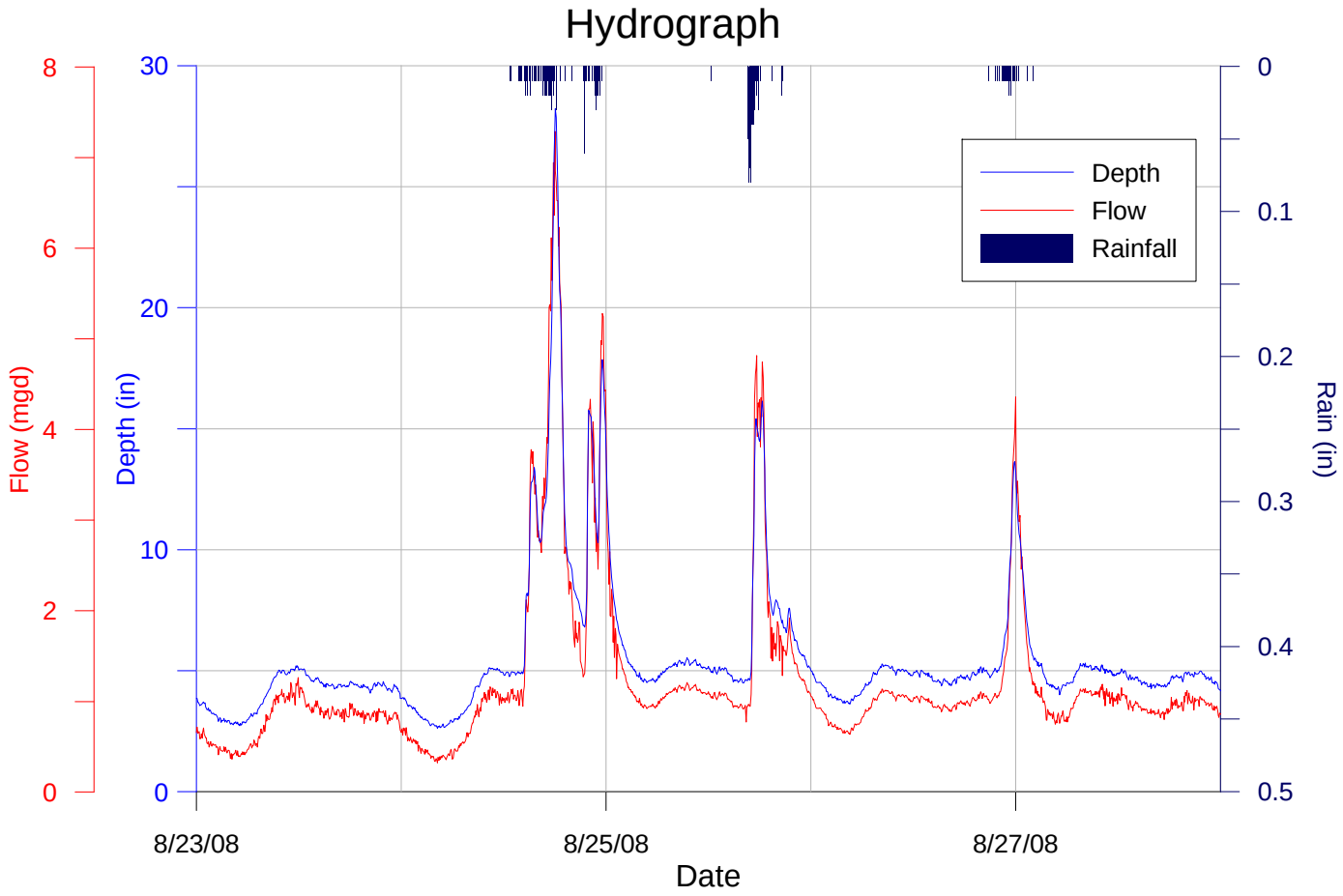


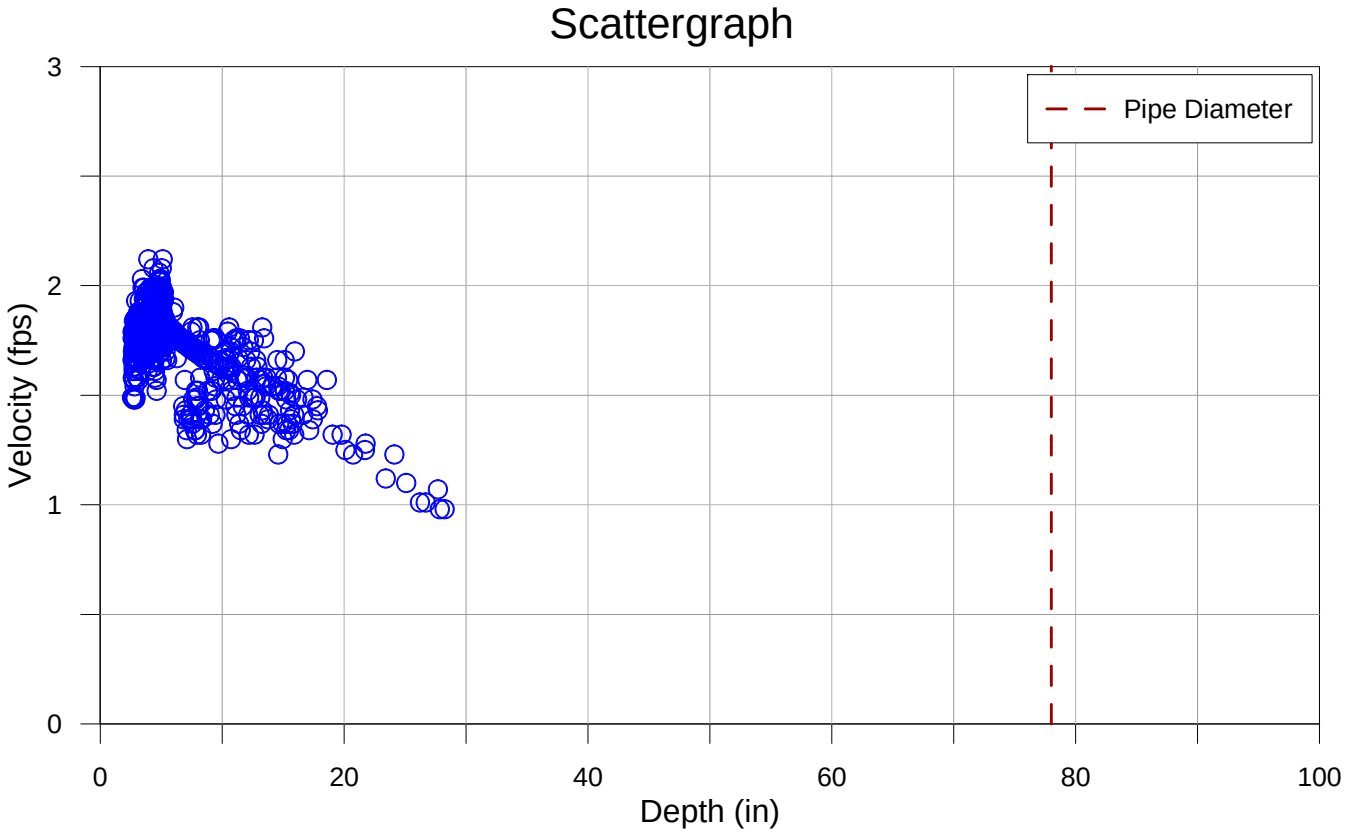
Monitor 081-330 (47C)
July 21 - 28, 2008



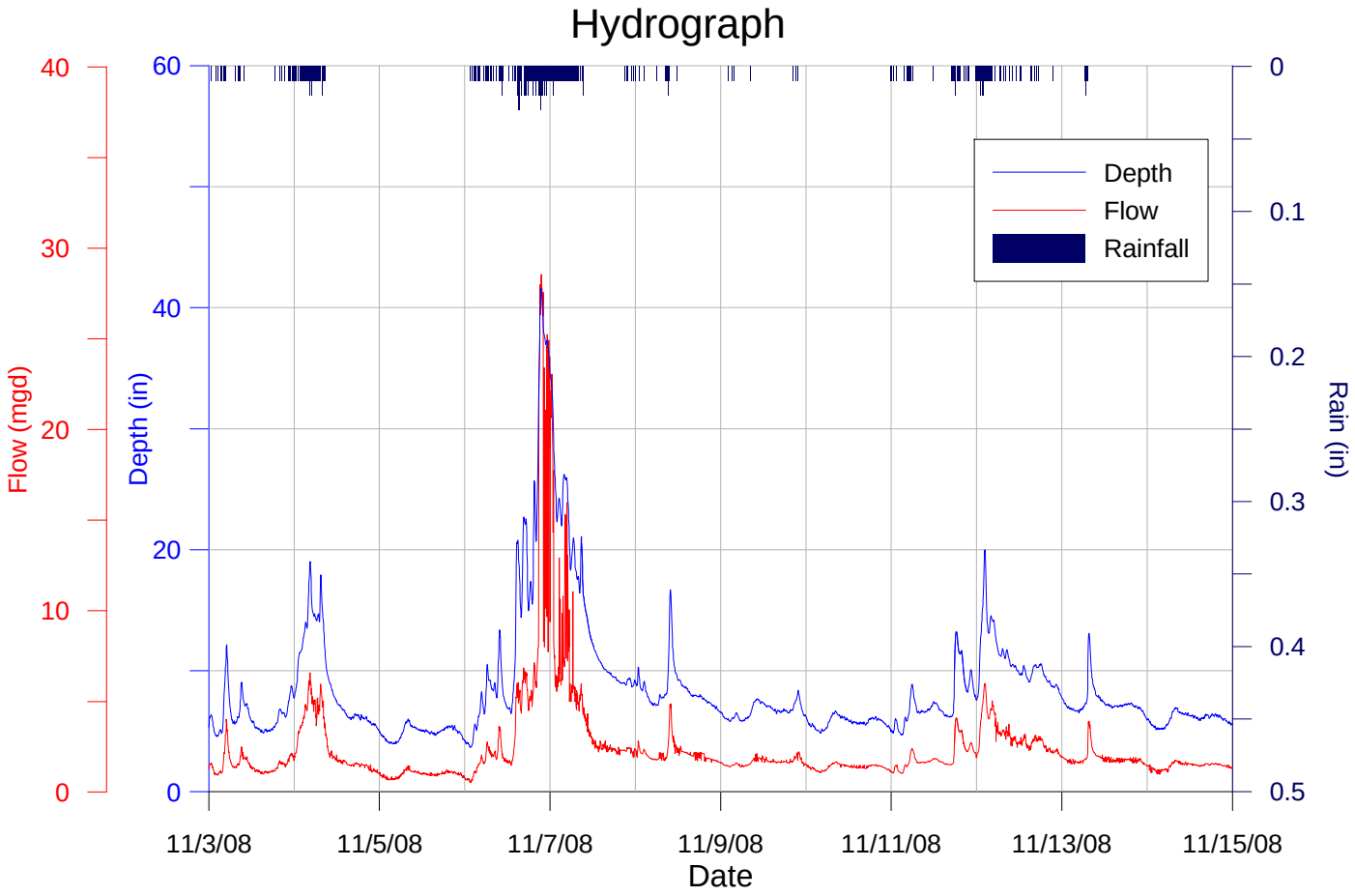


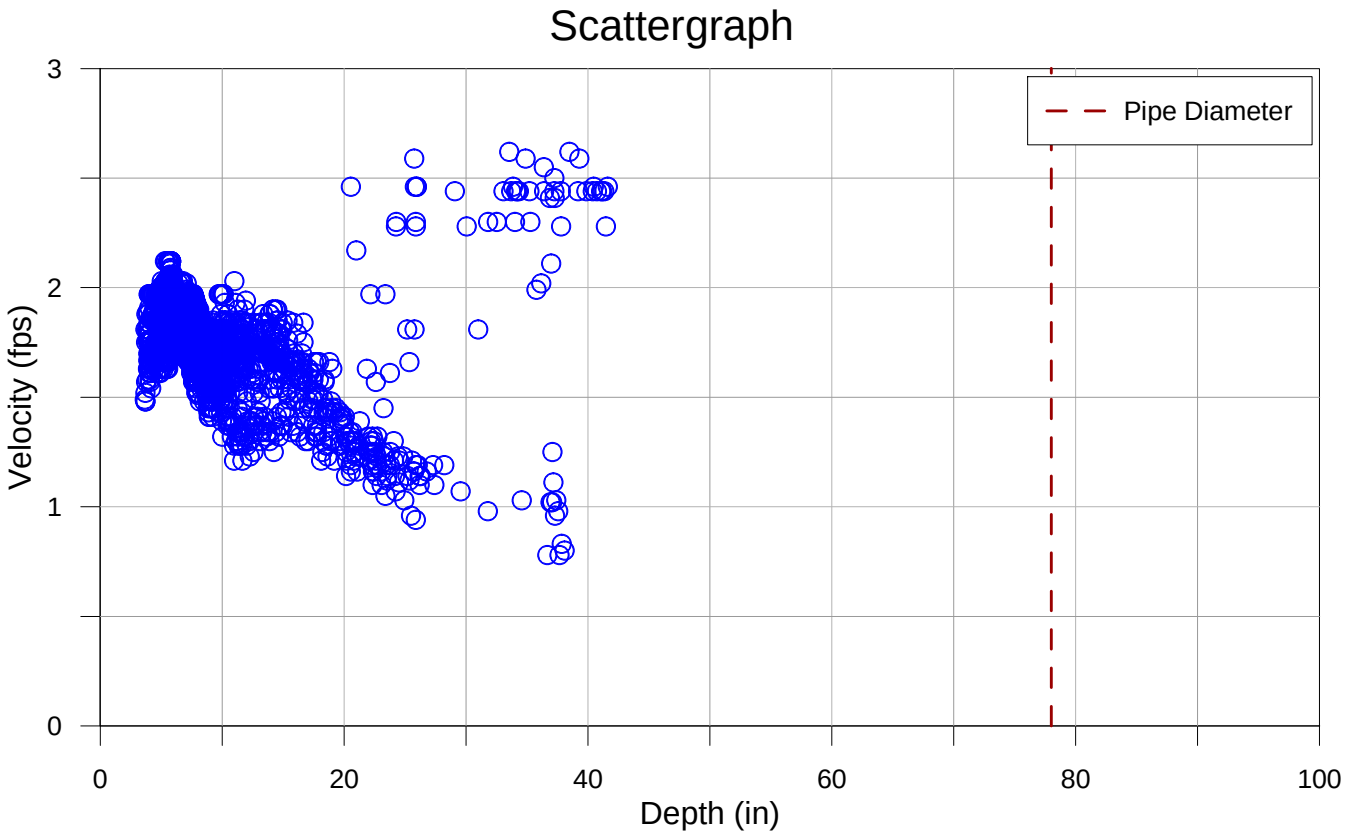
Monitor 081-330 (47C)
August 23 - 28, 2008



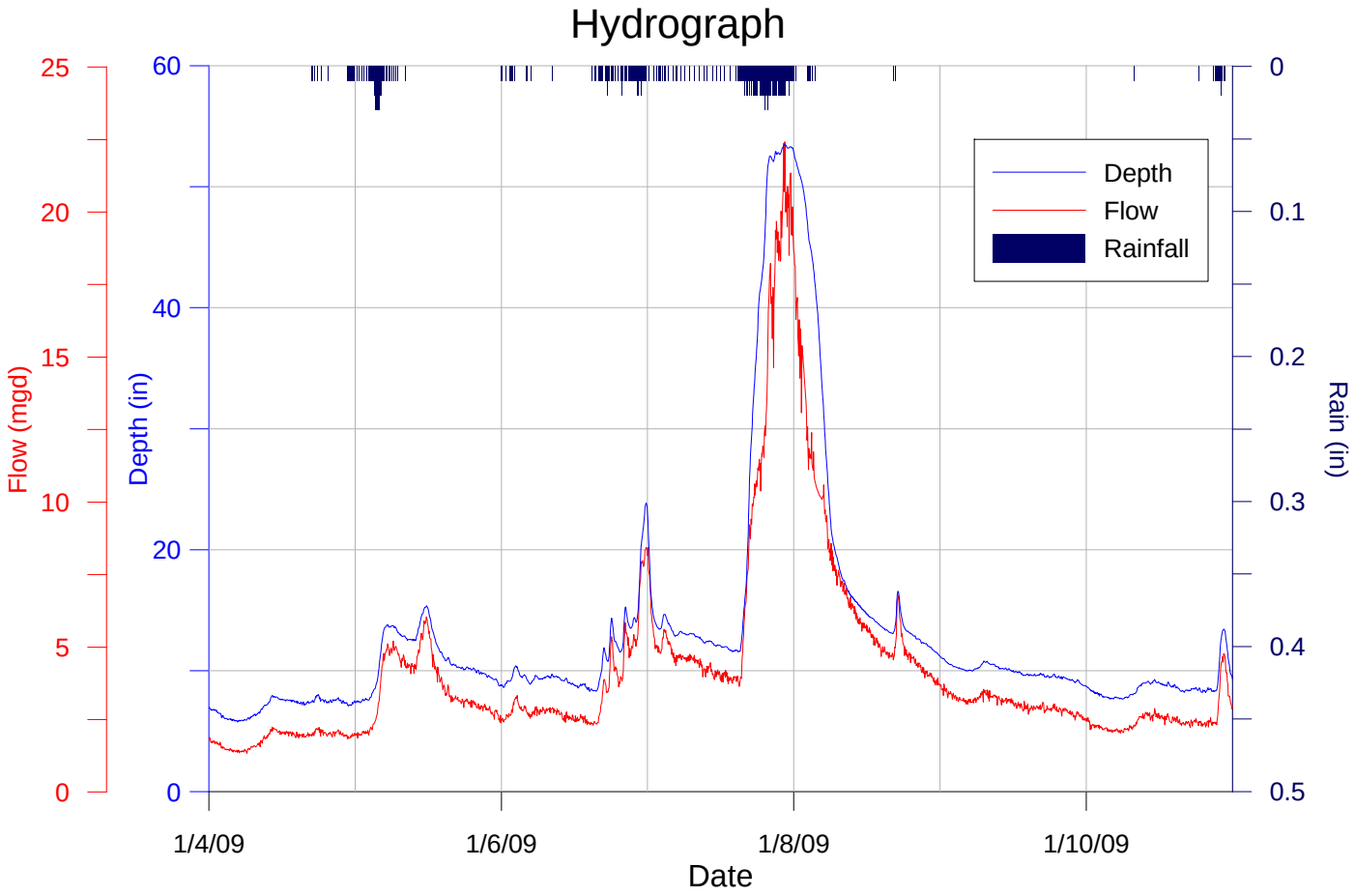


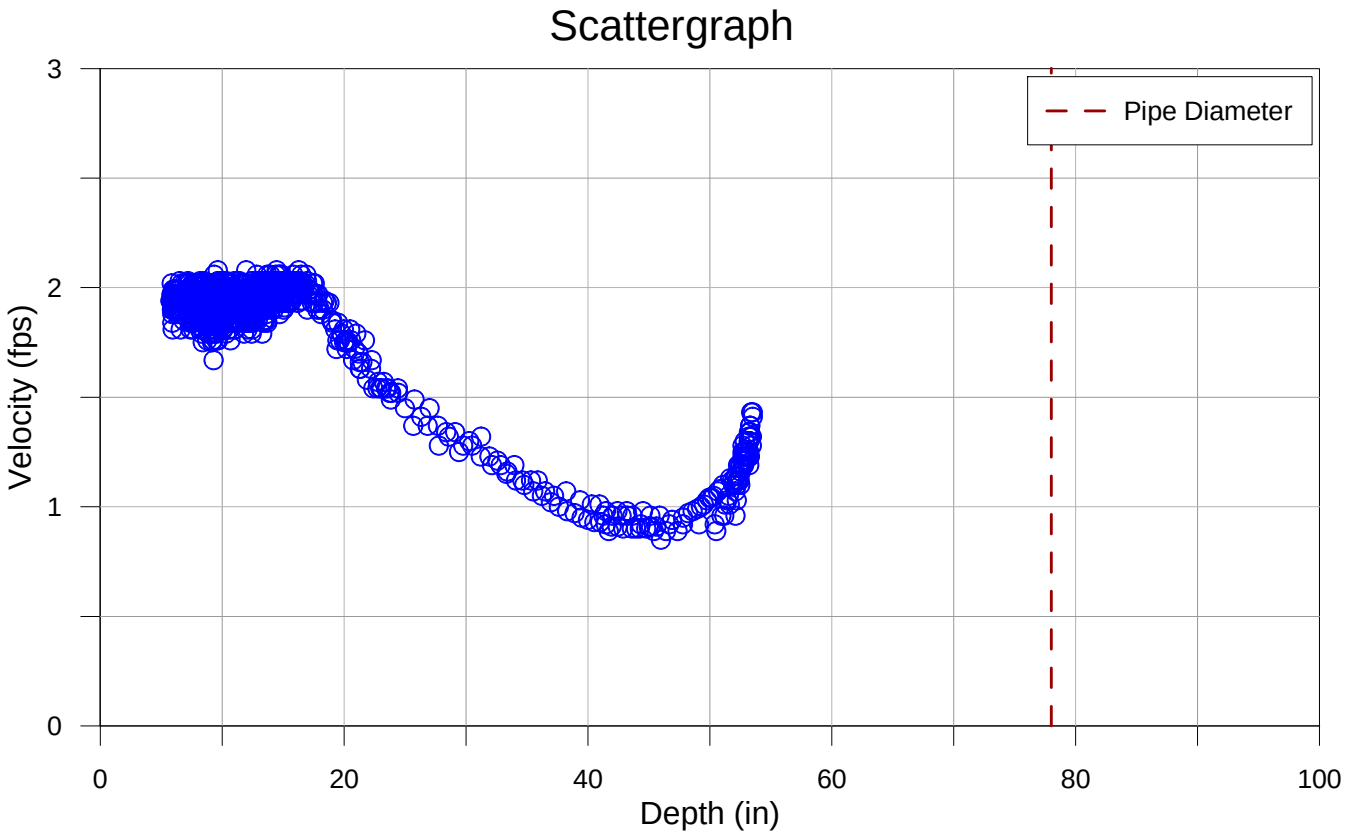
Monitor 081-330 (47C)
November 3 - 15, 2008



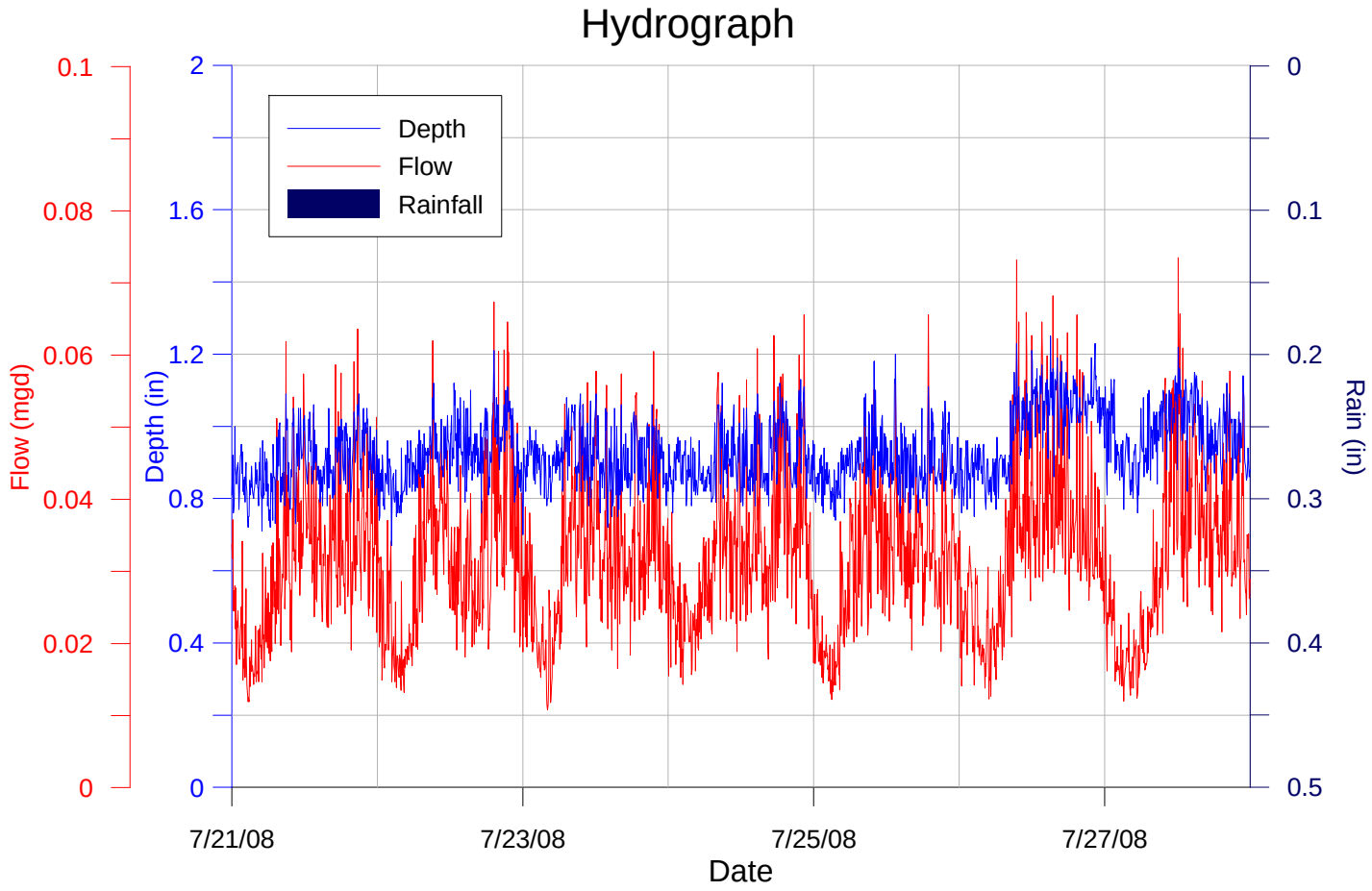


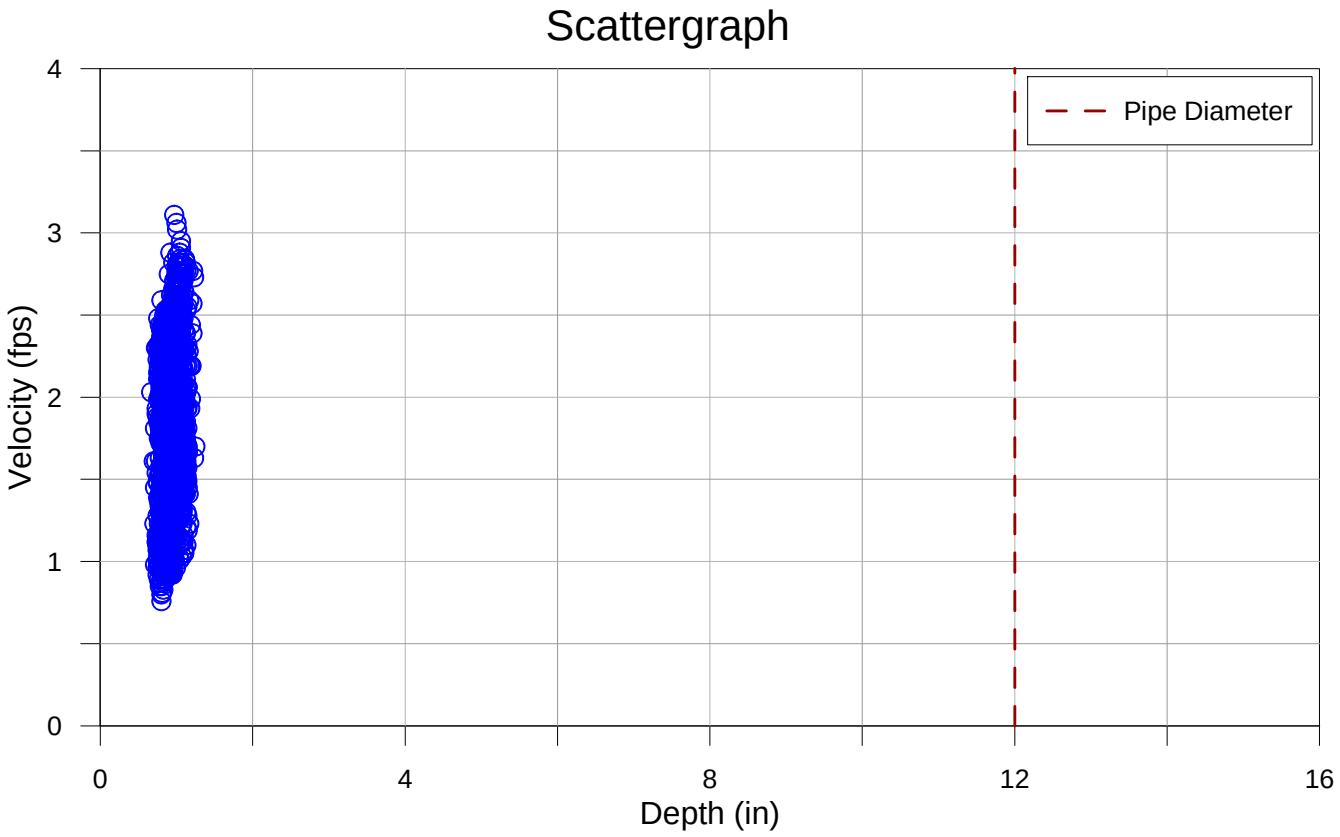
Monitor 081-330 (47C)
January 4 - 11, 2009



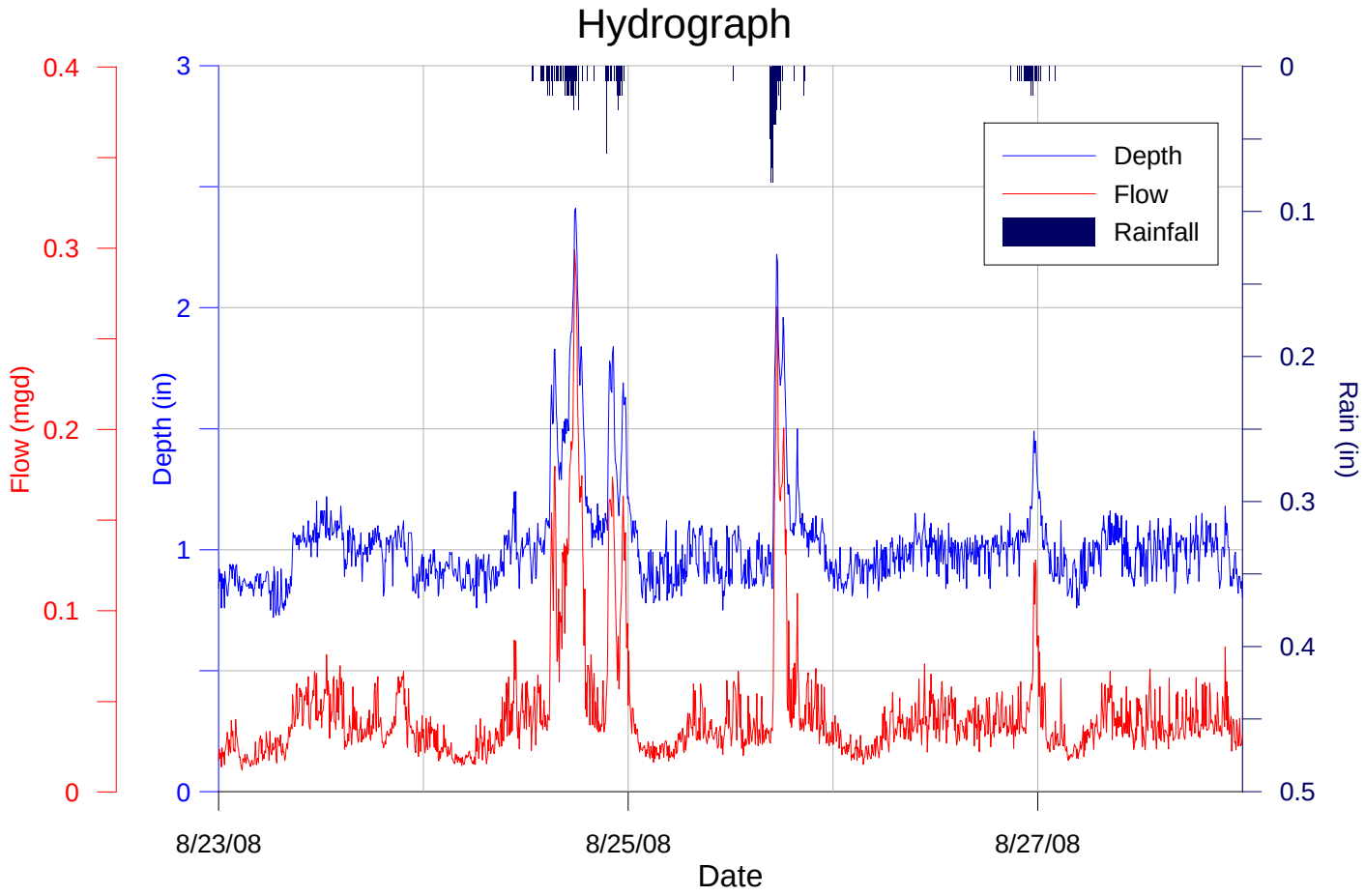


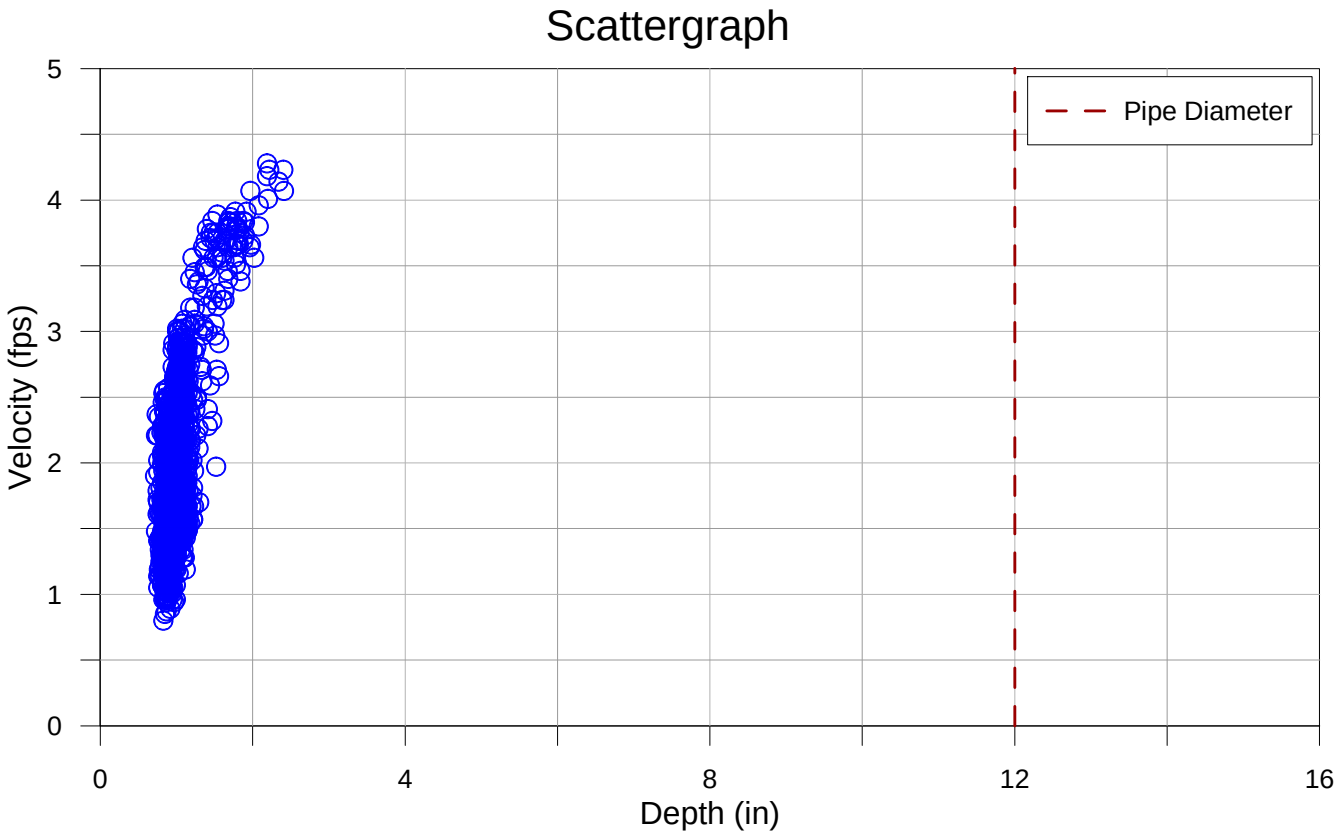
Monitor 080-298 (47D)
July 21 - 28, 2008



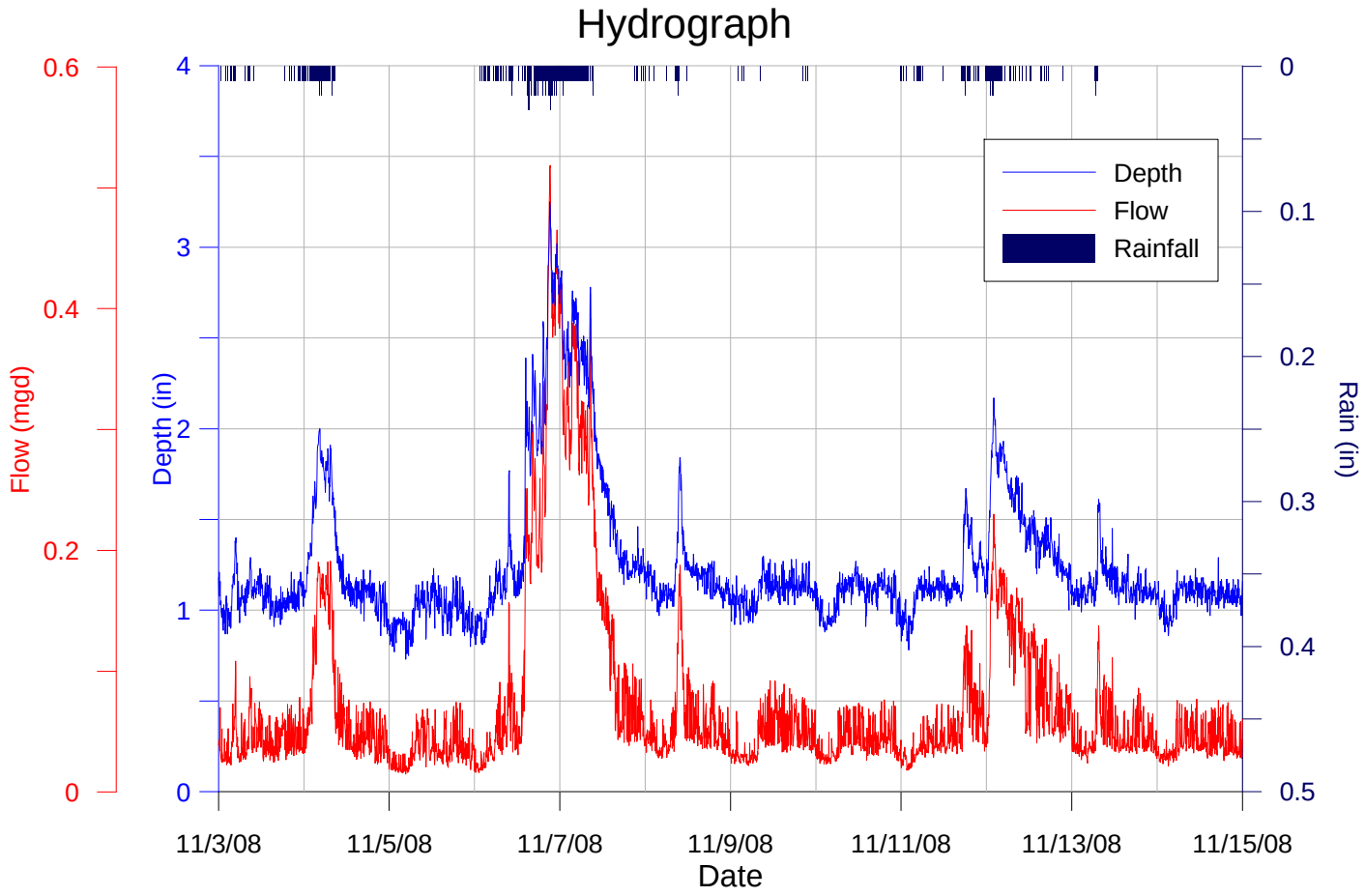


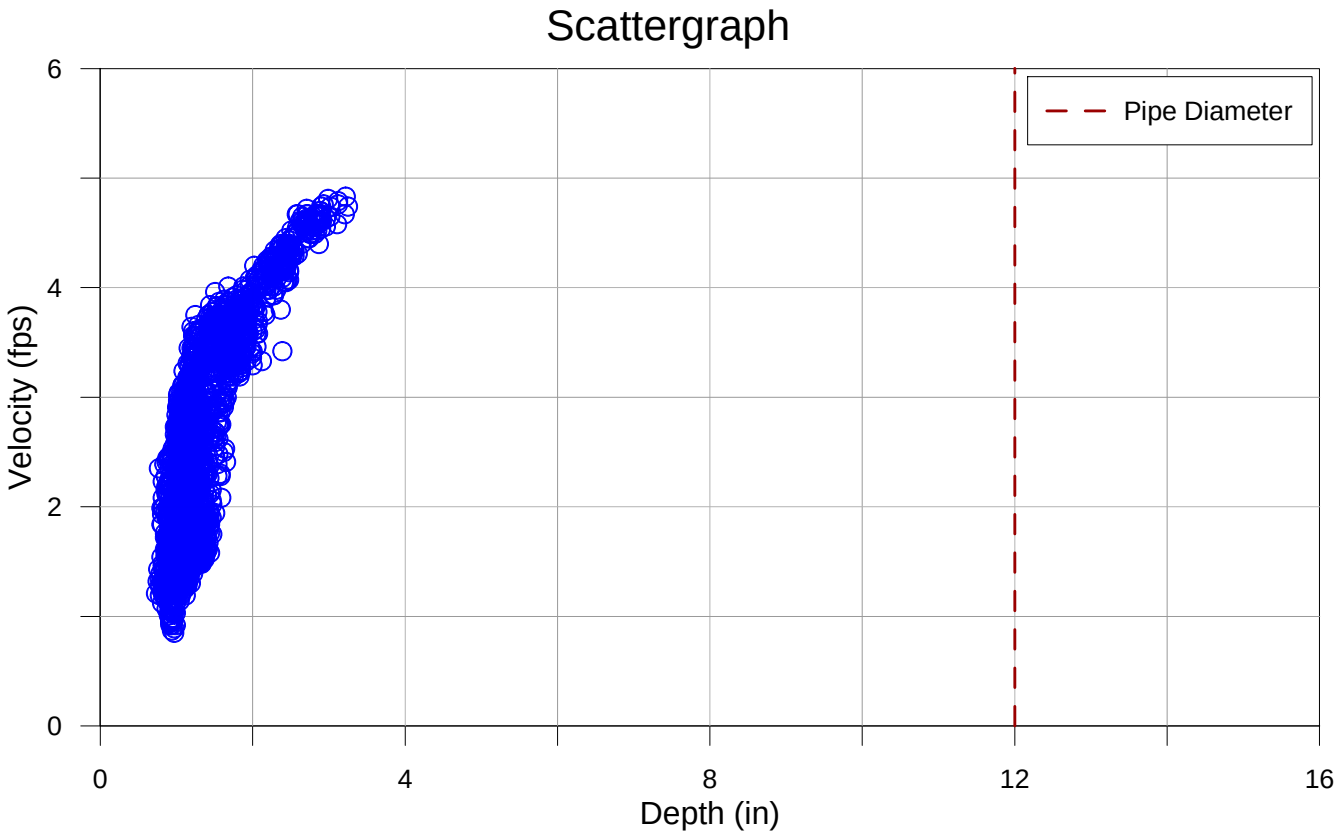
Monitor 080-298 (47D)
August 23 - 28, 2008



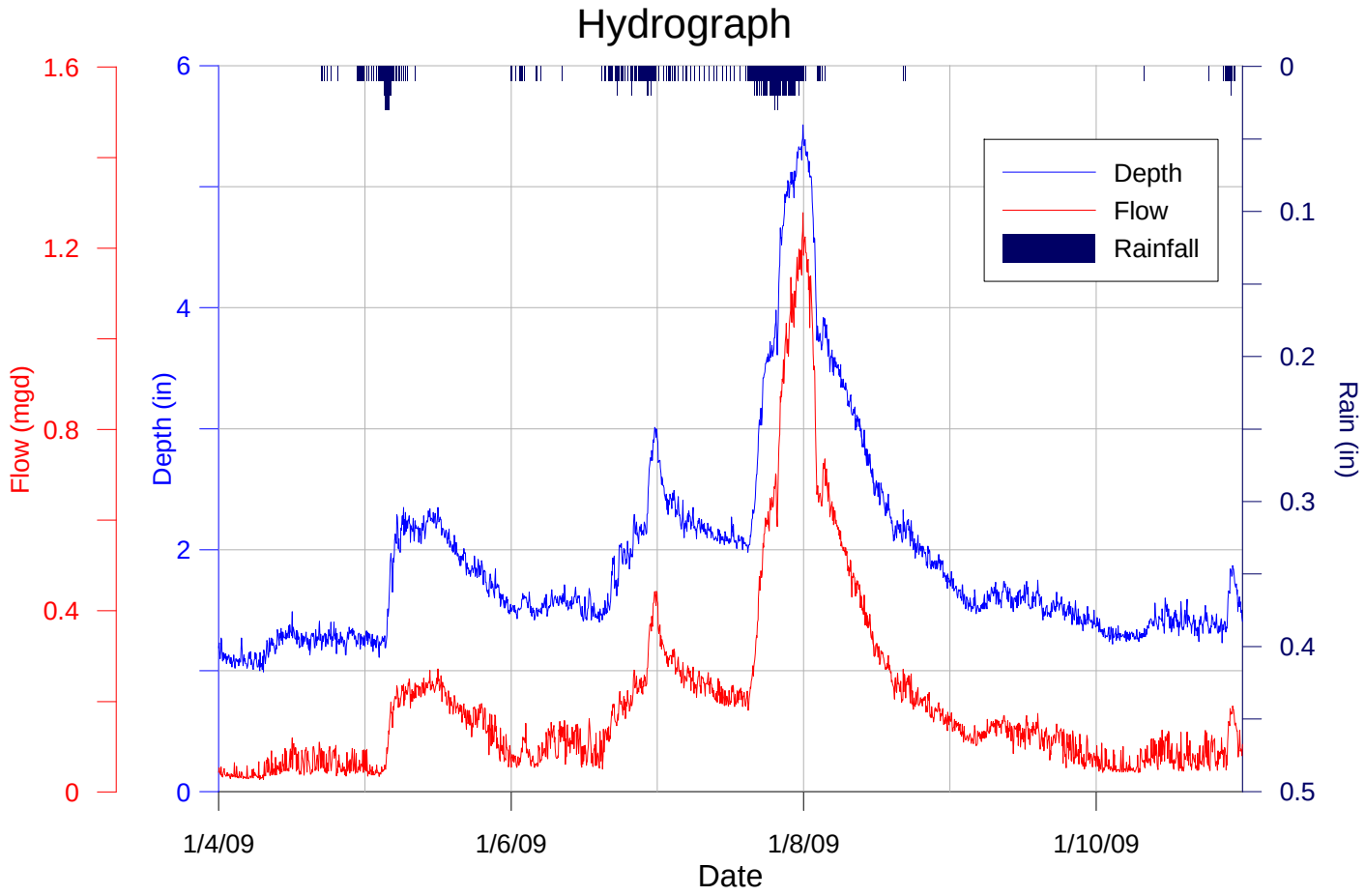


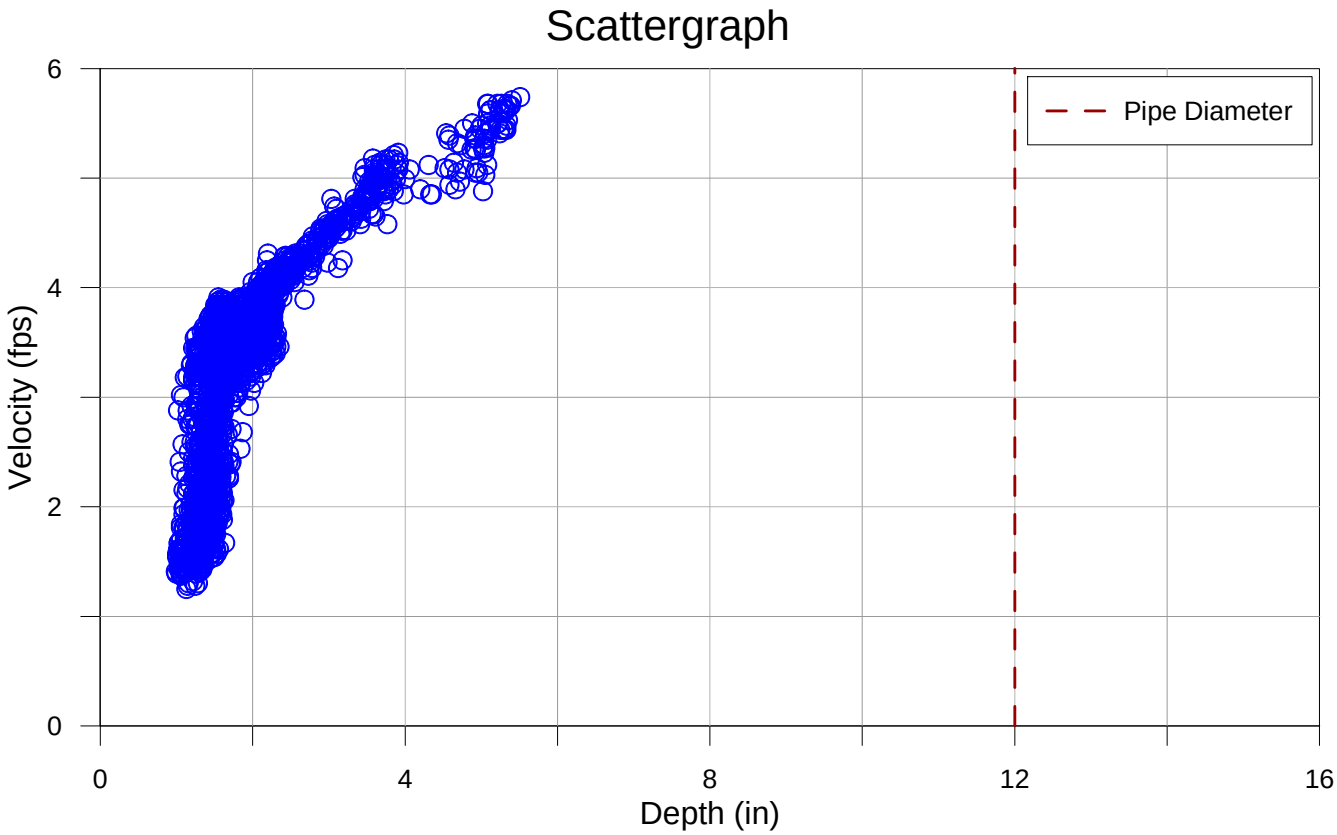
Monitor 080-298 (47D)
November 3 - 15, 2008



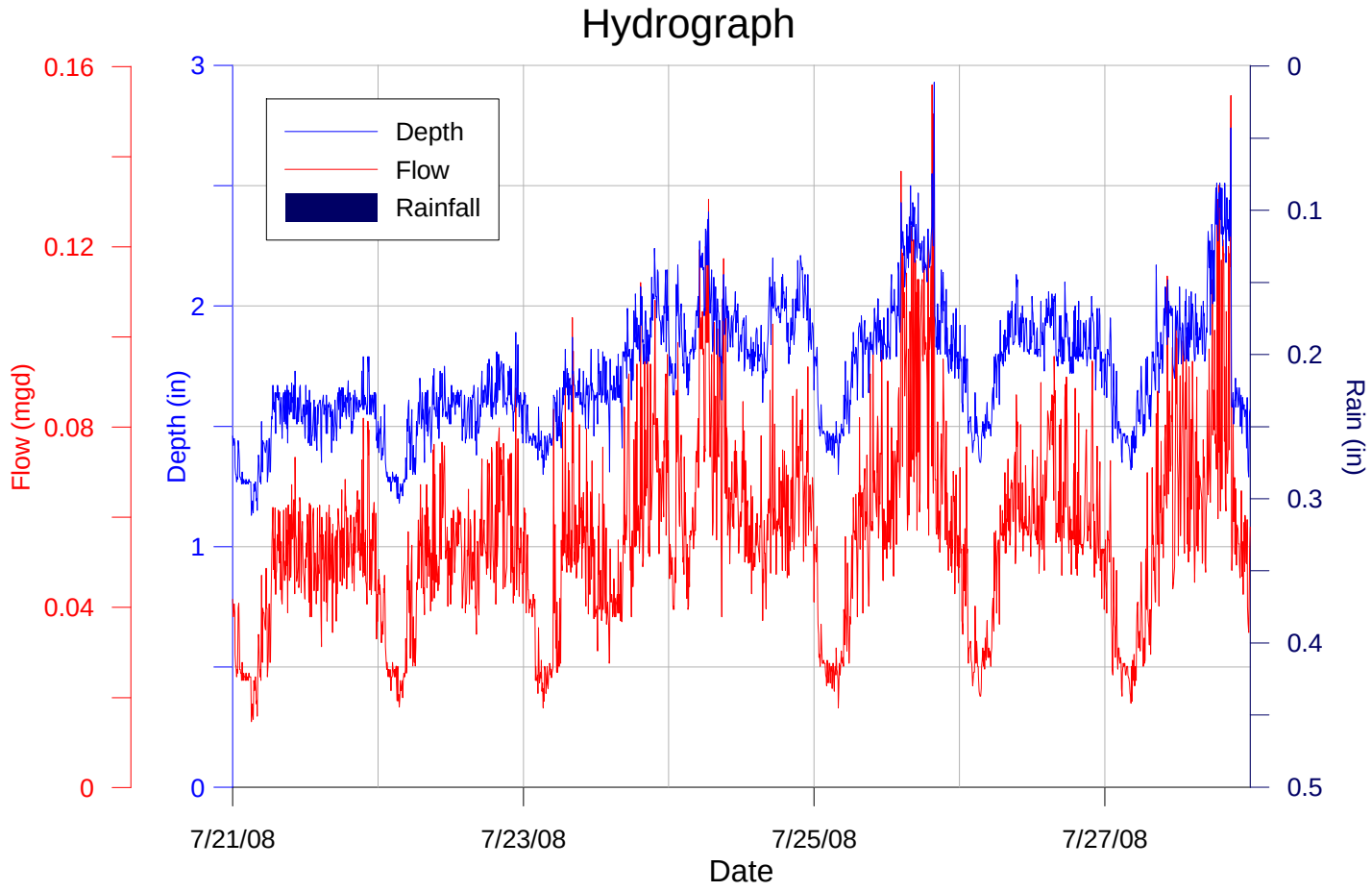


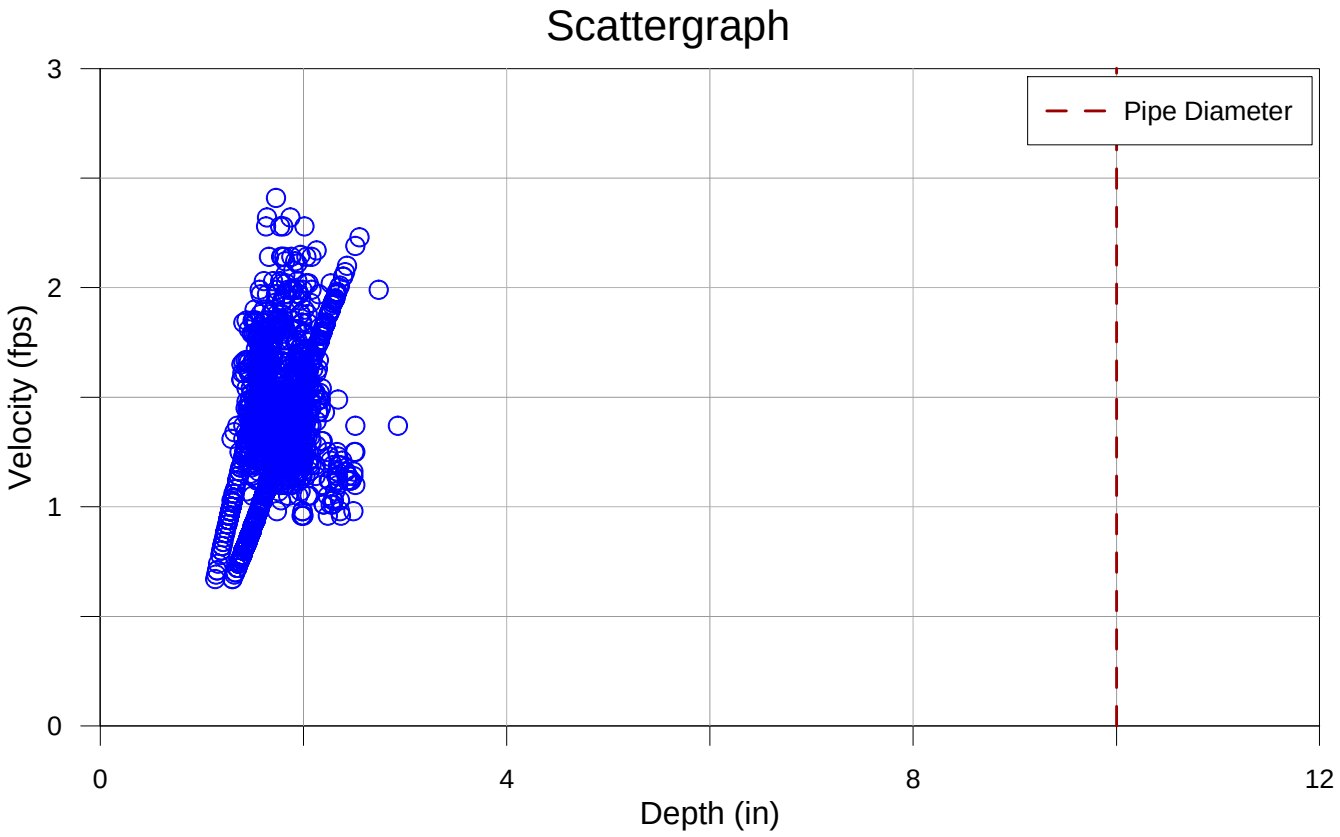
Monitor 080-298 (47D)
January 4 - 11, 2009



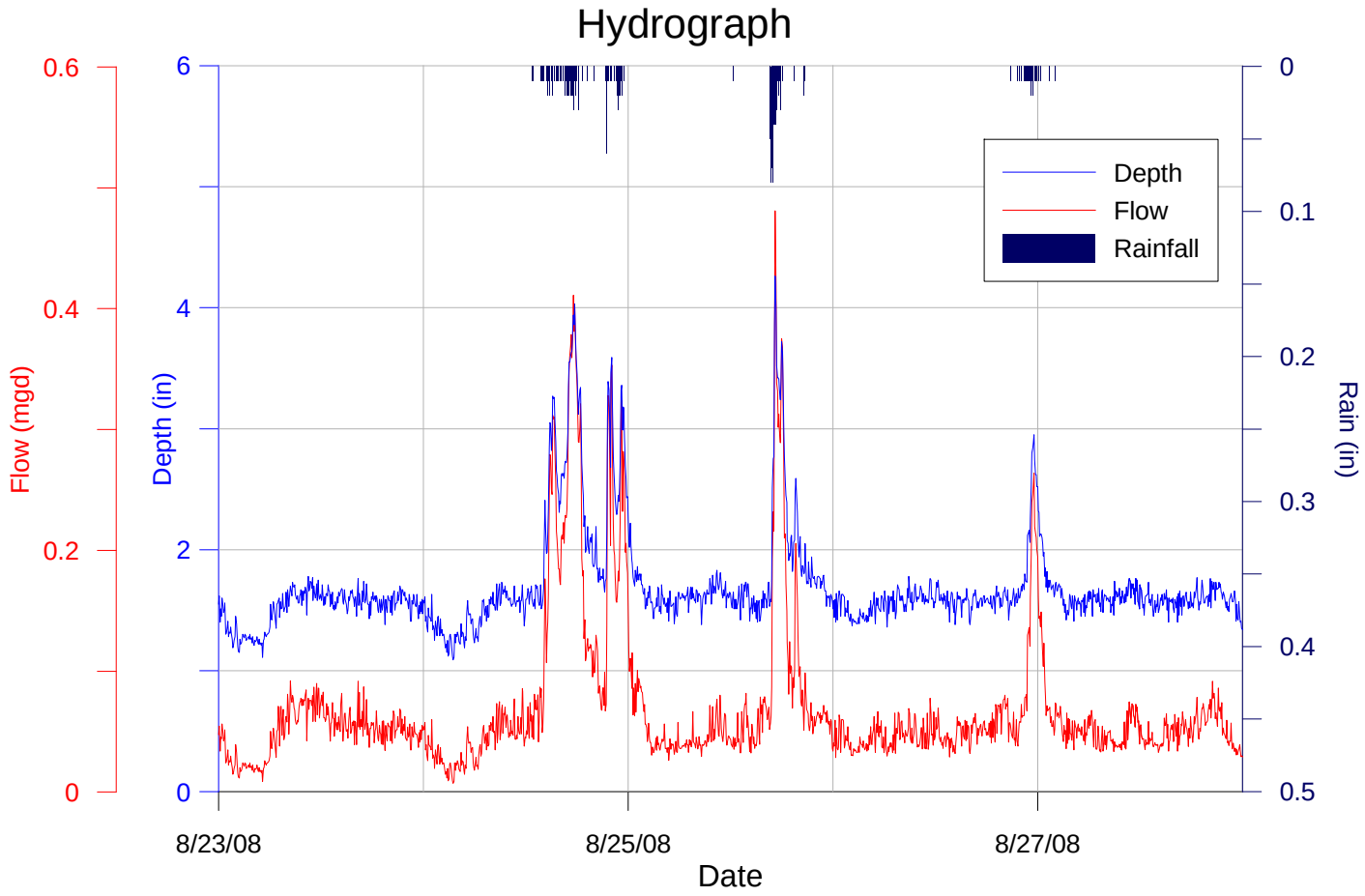


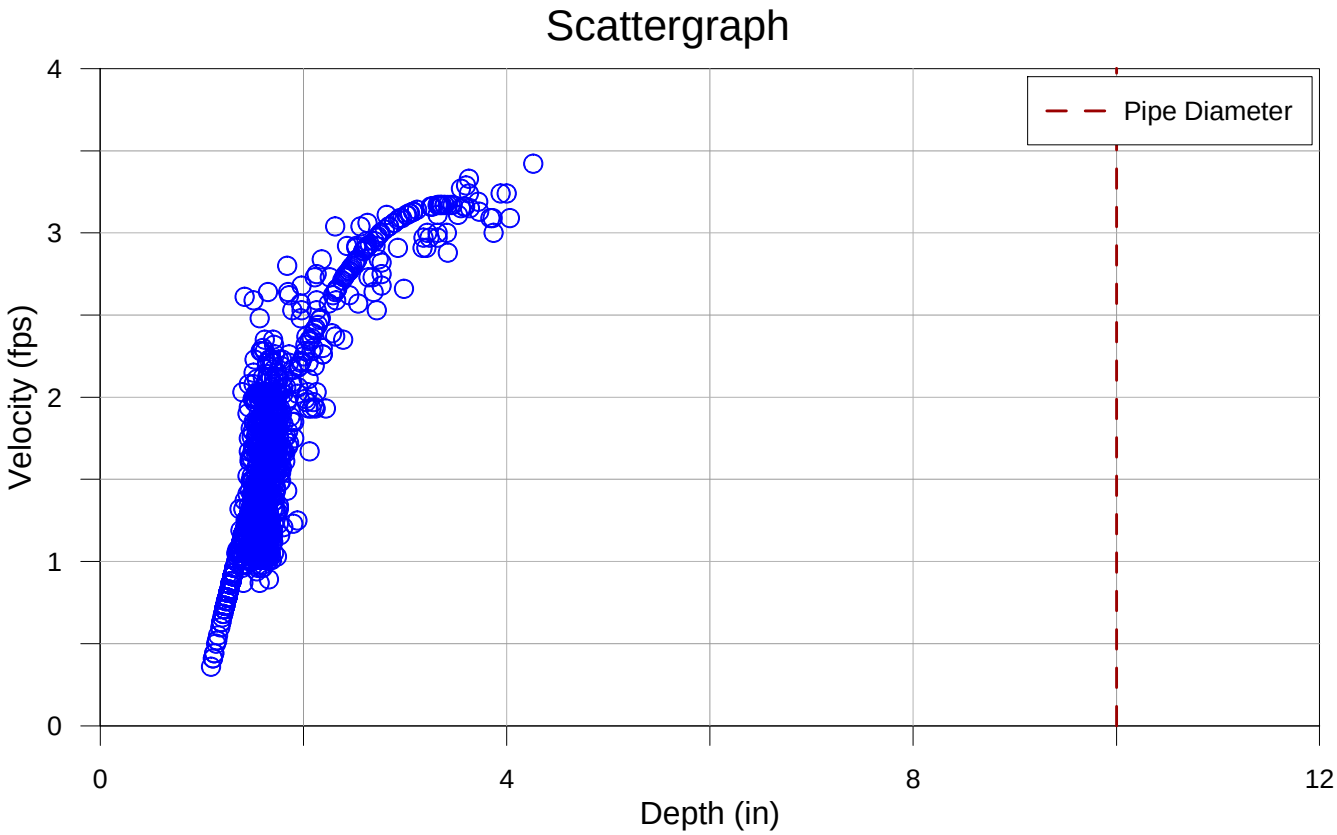
Monitor 080-480 (47E)
July 21 - 28, 2008



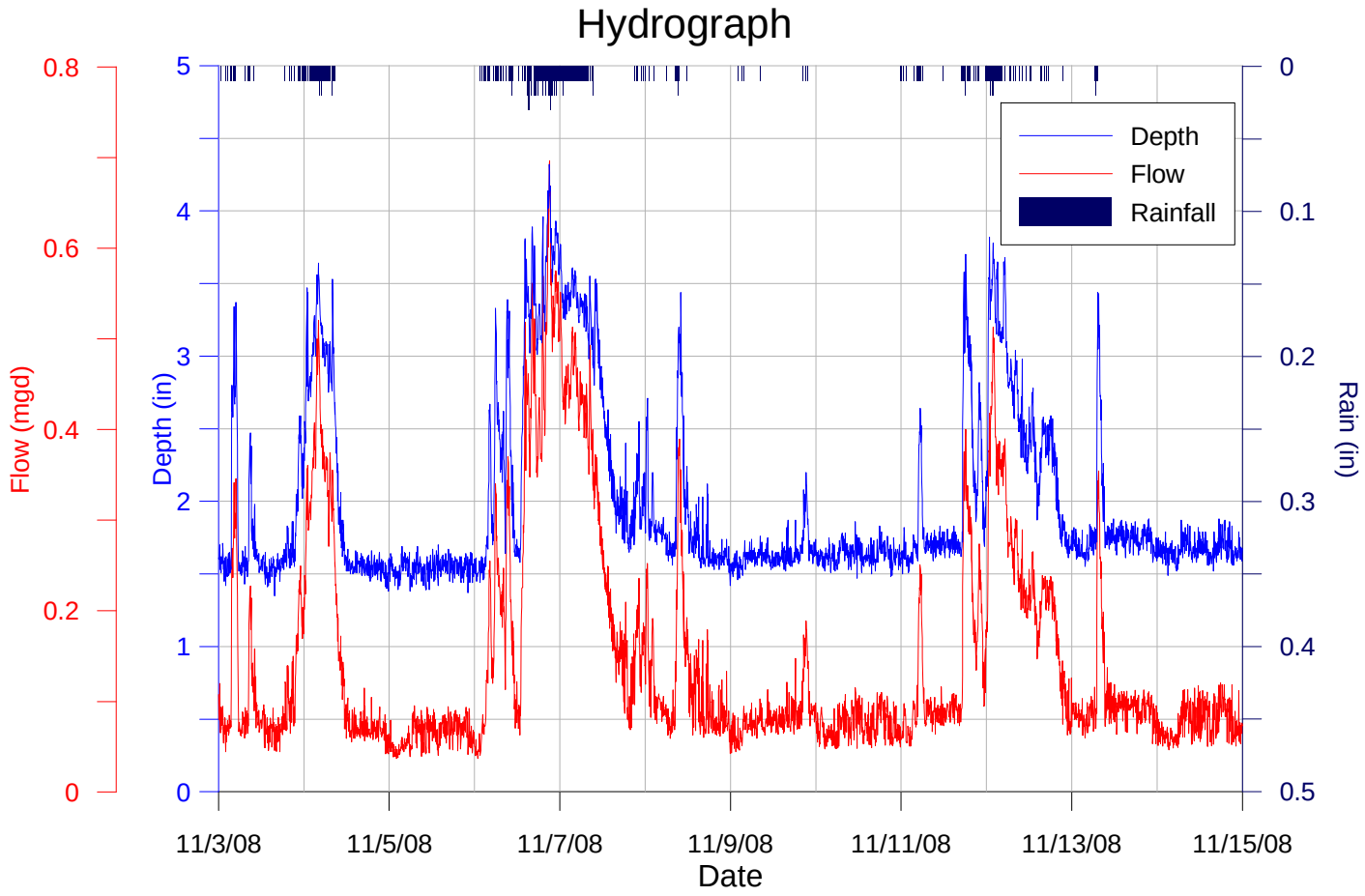


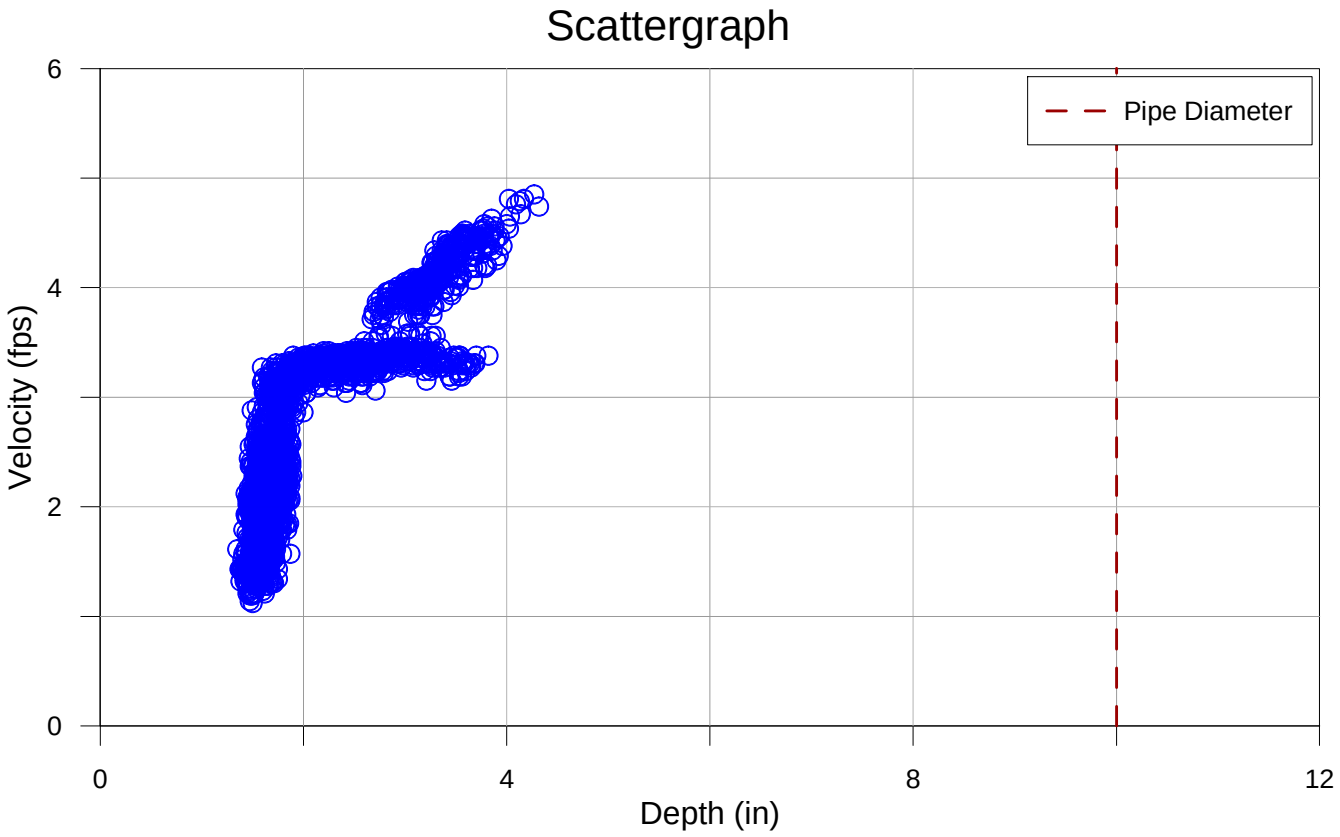
Monitor 080-480 (47E)
August 23 - 28, 2008



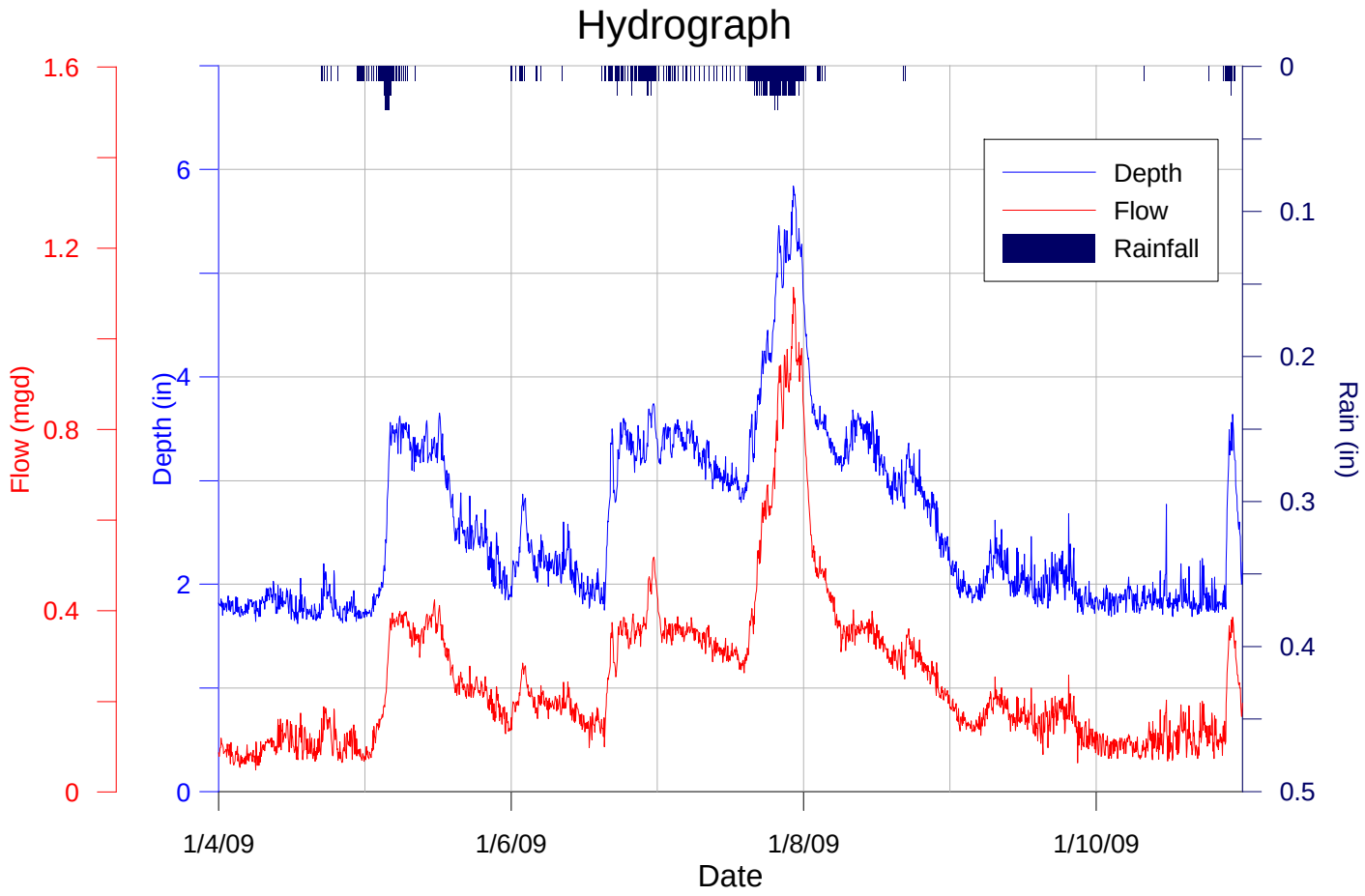


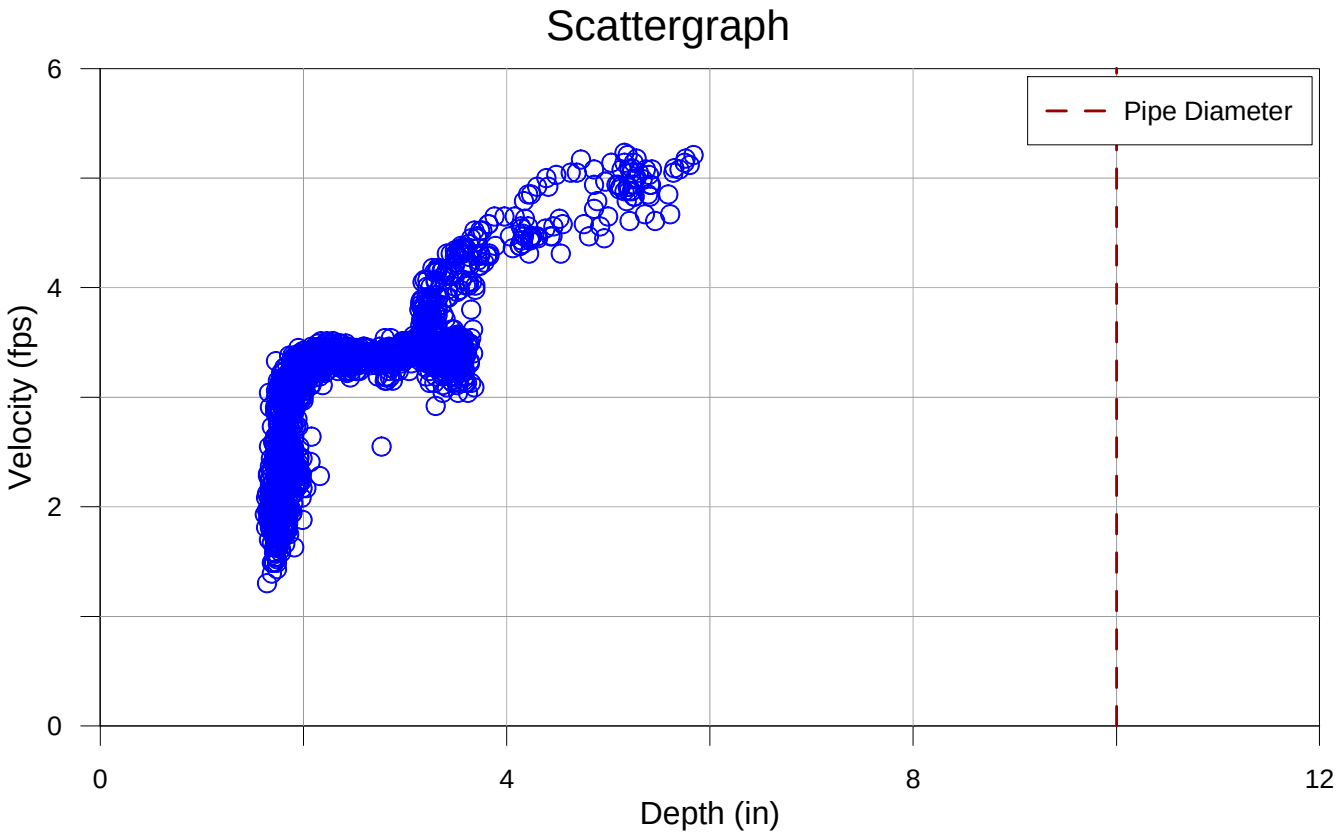
Monitor 080-480 (47E)
November 3 - 15, 2008



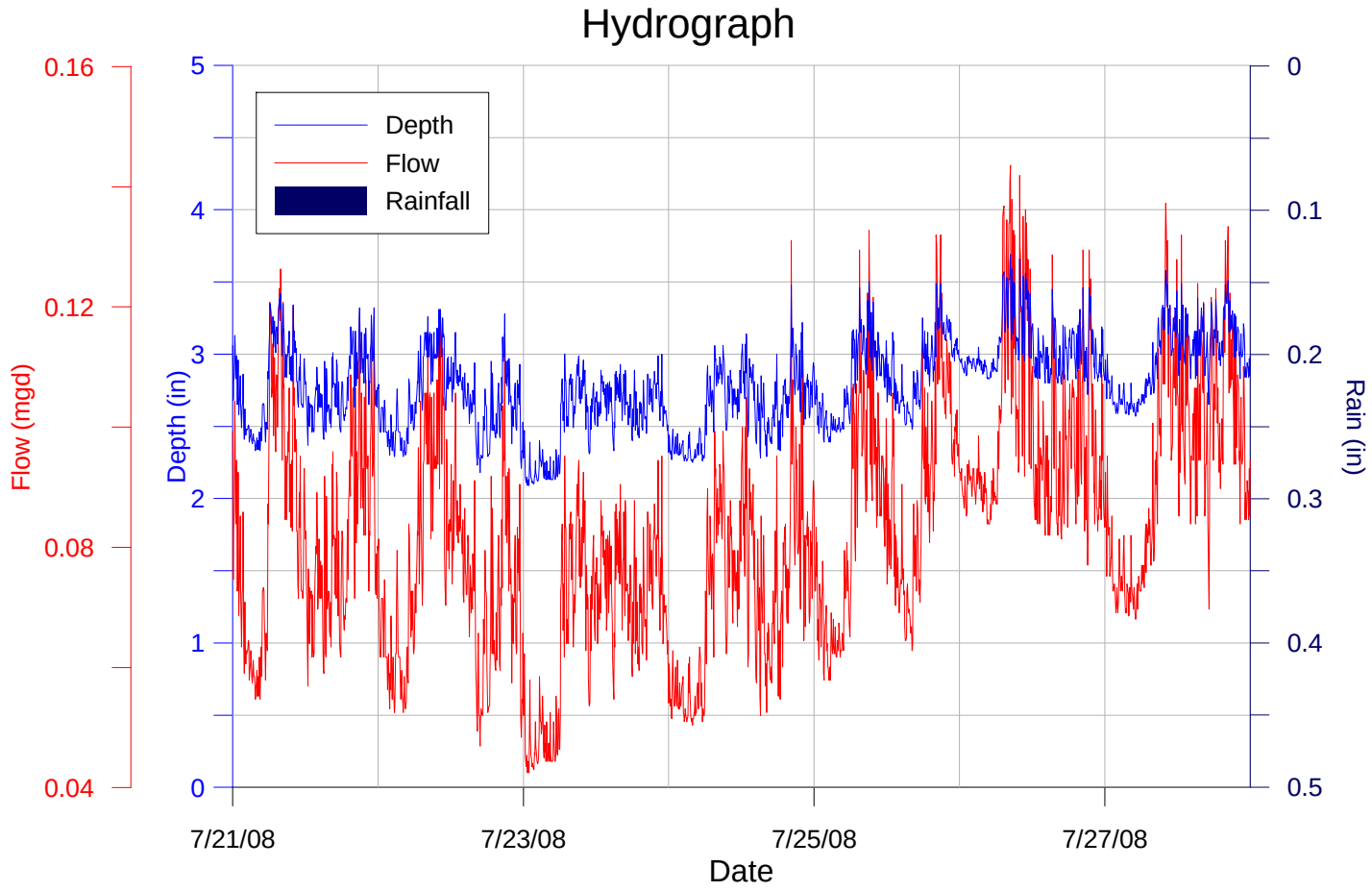


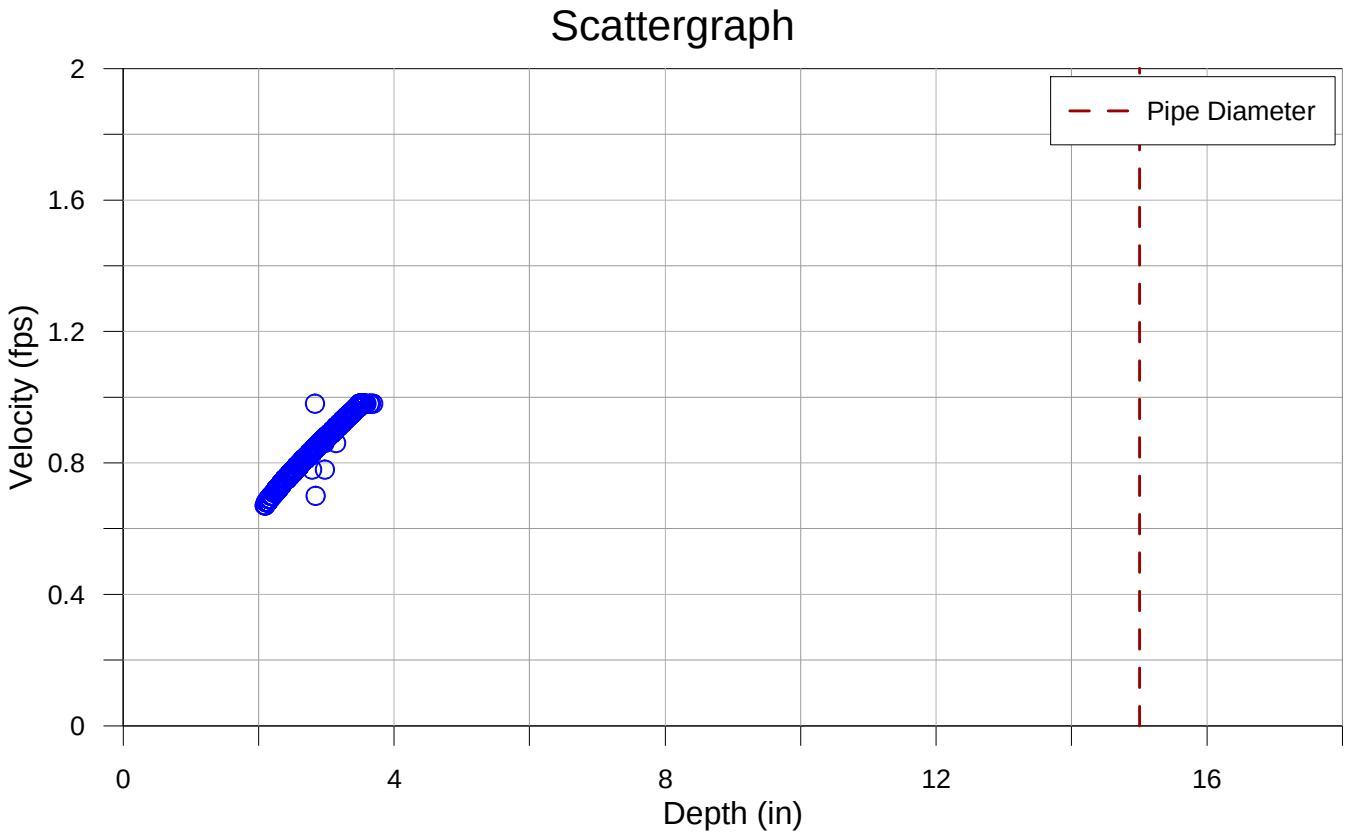
Monitor 080-480 (47E)
January 4 - 11, 2009



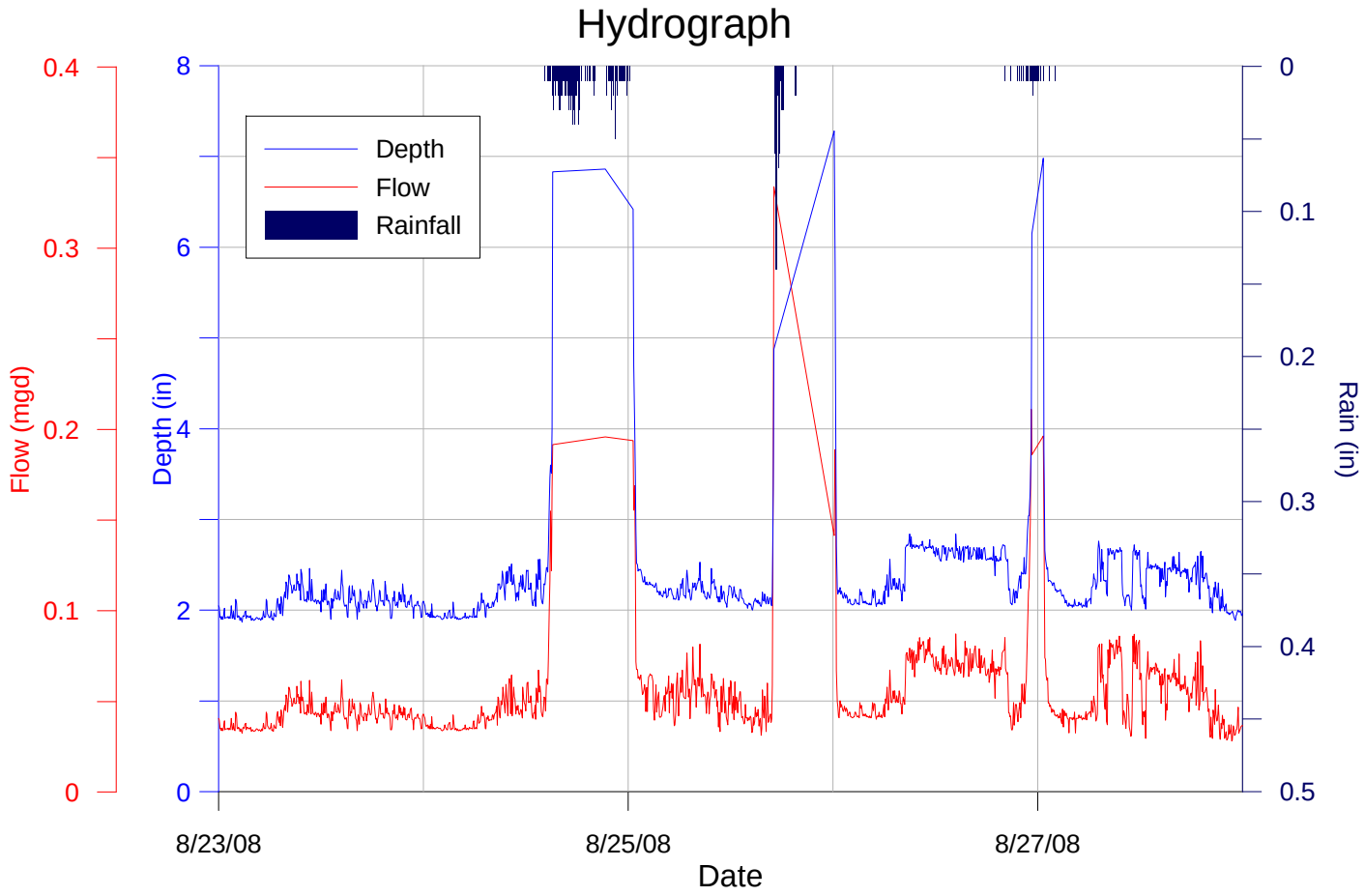


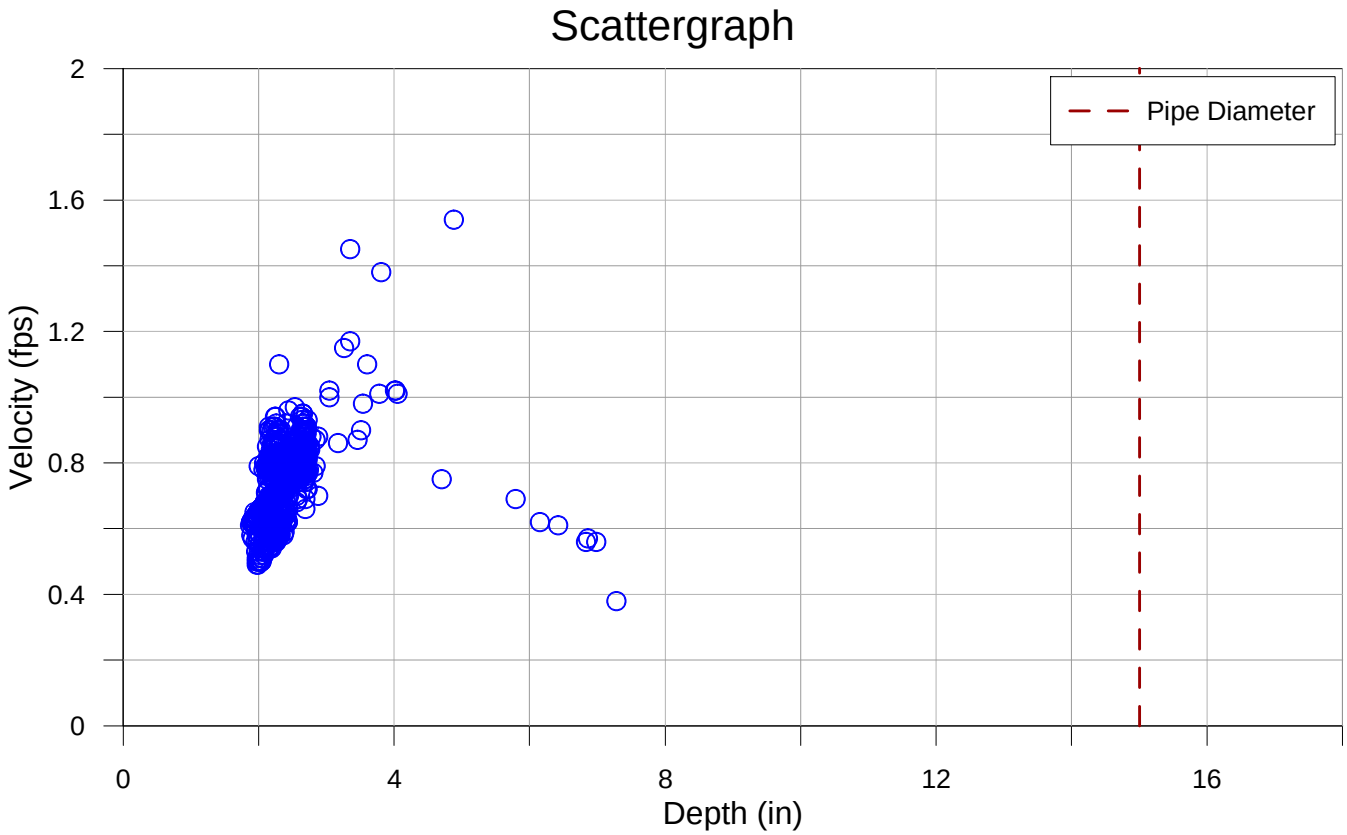
Monitor 306-245
July 21 - 28, 2008



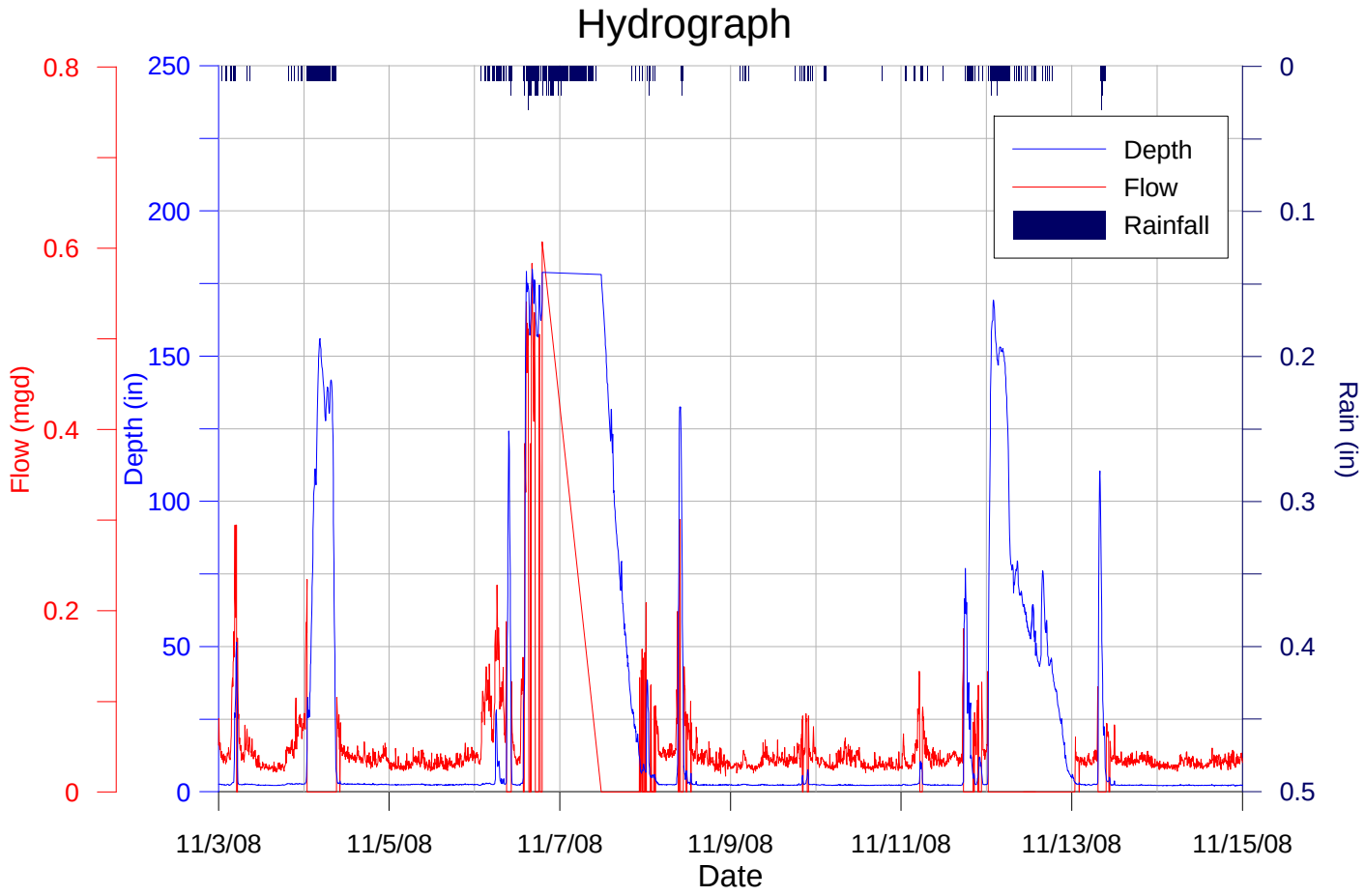


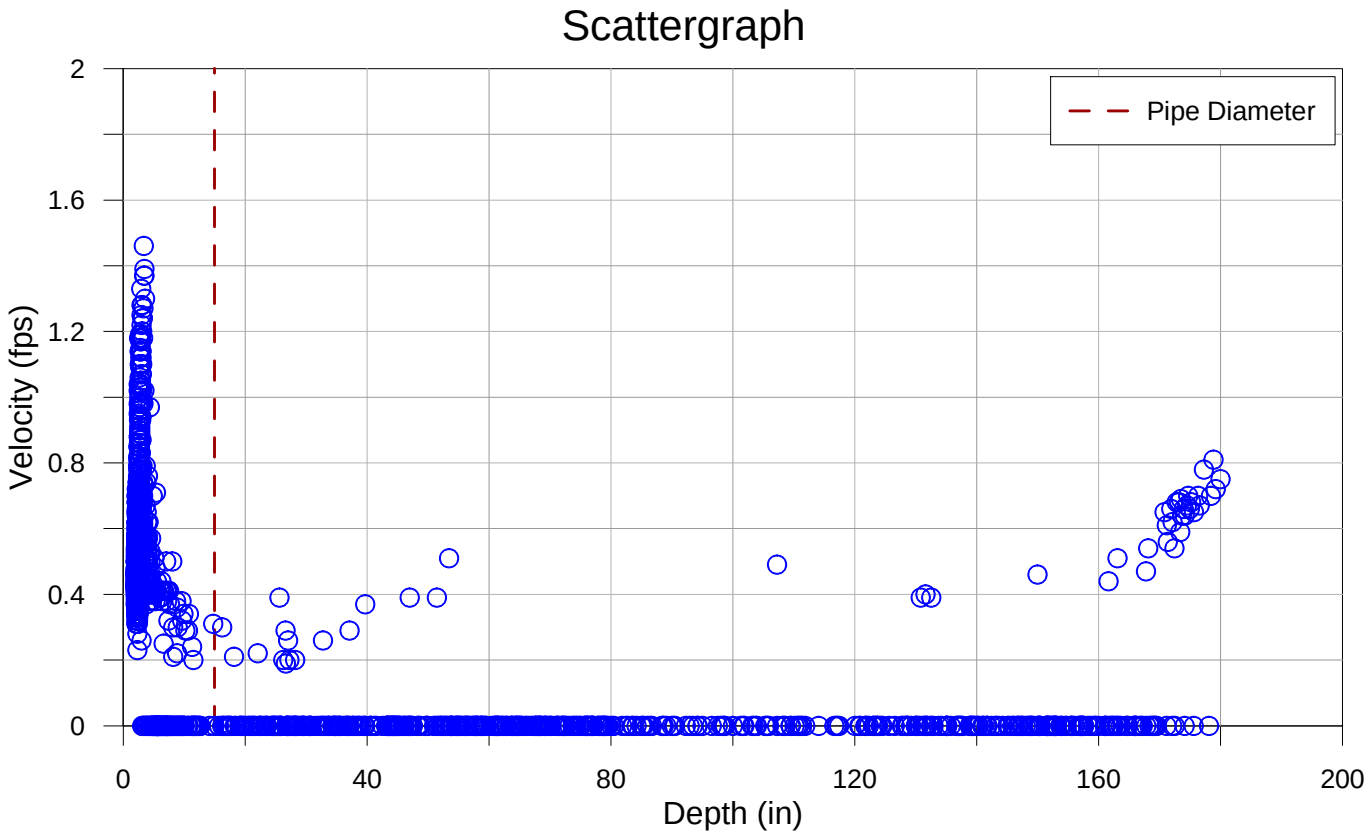
Monitor 306-245
August 23 - 28, 2008





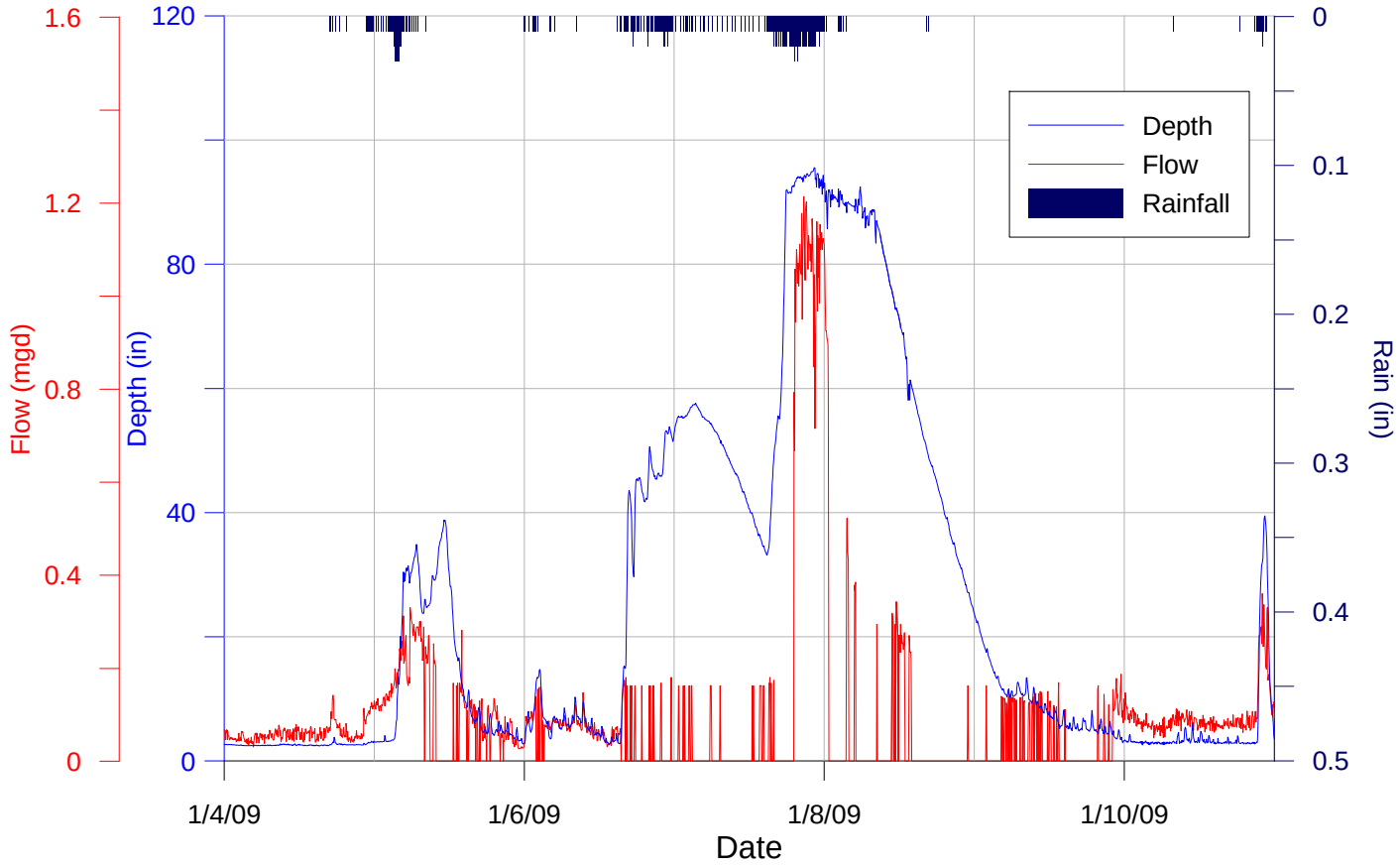
Monitor 306-245
November 3 - 15, 2008



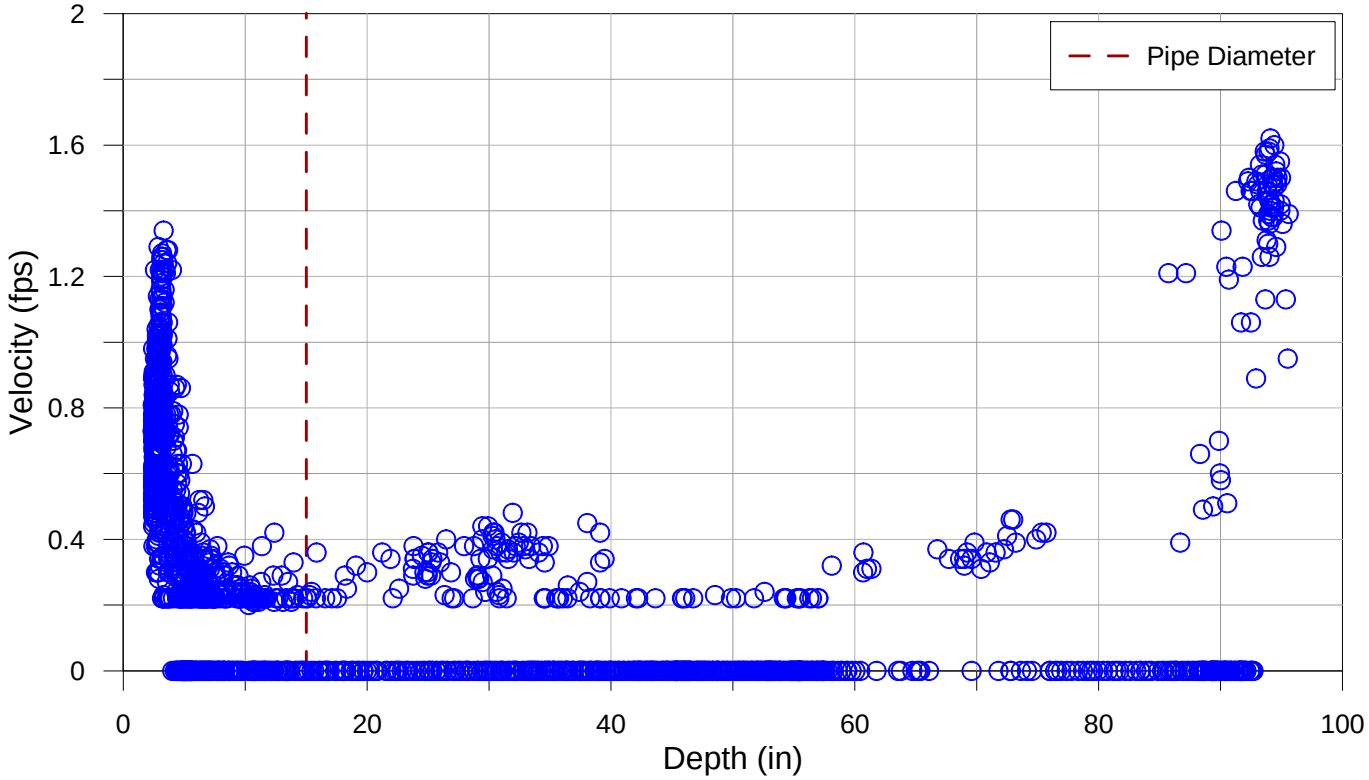


Monitor 306-245
January 4 - 11, 2009

Hydrograph

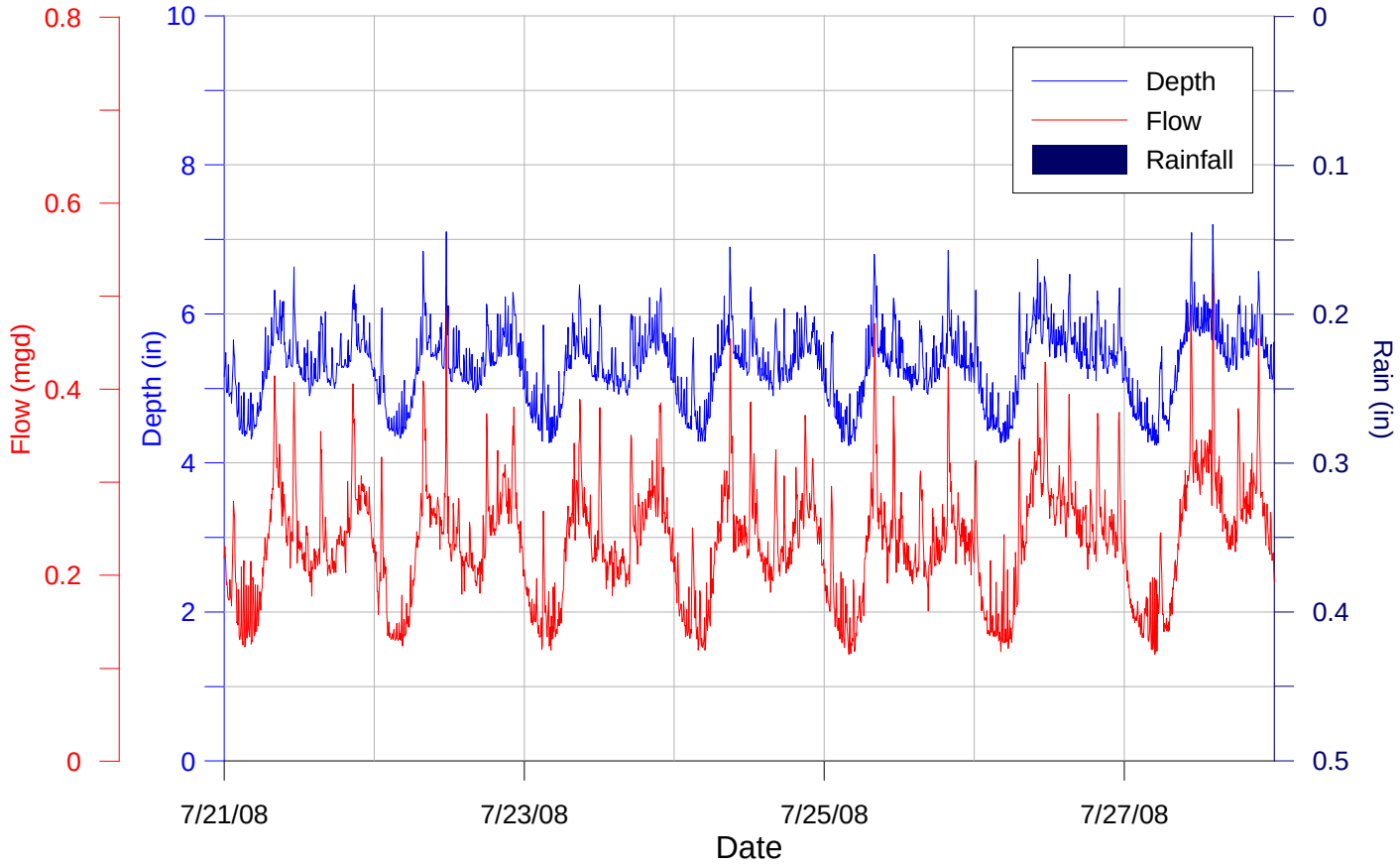


Scattergraph

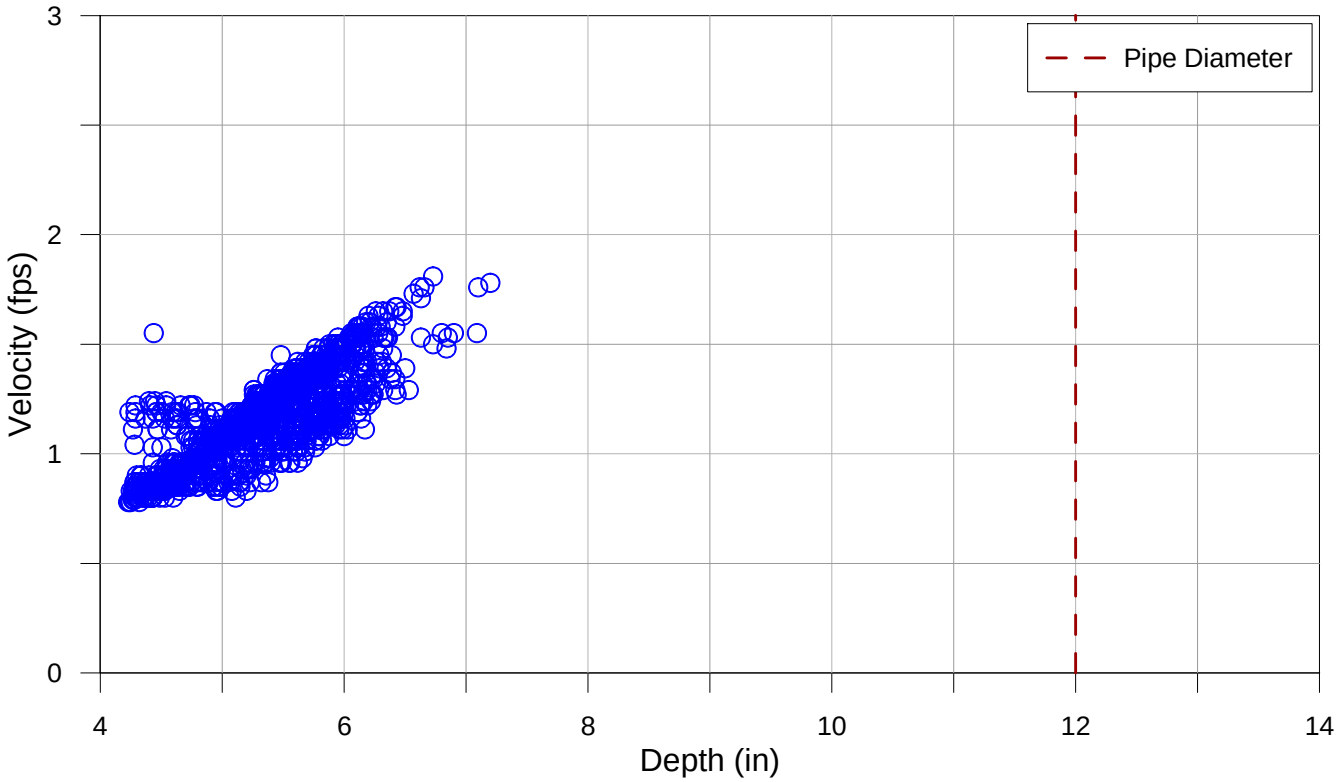


Monitor 306-246
July 21 - 28, 2008

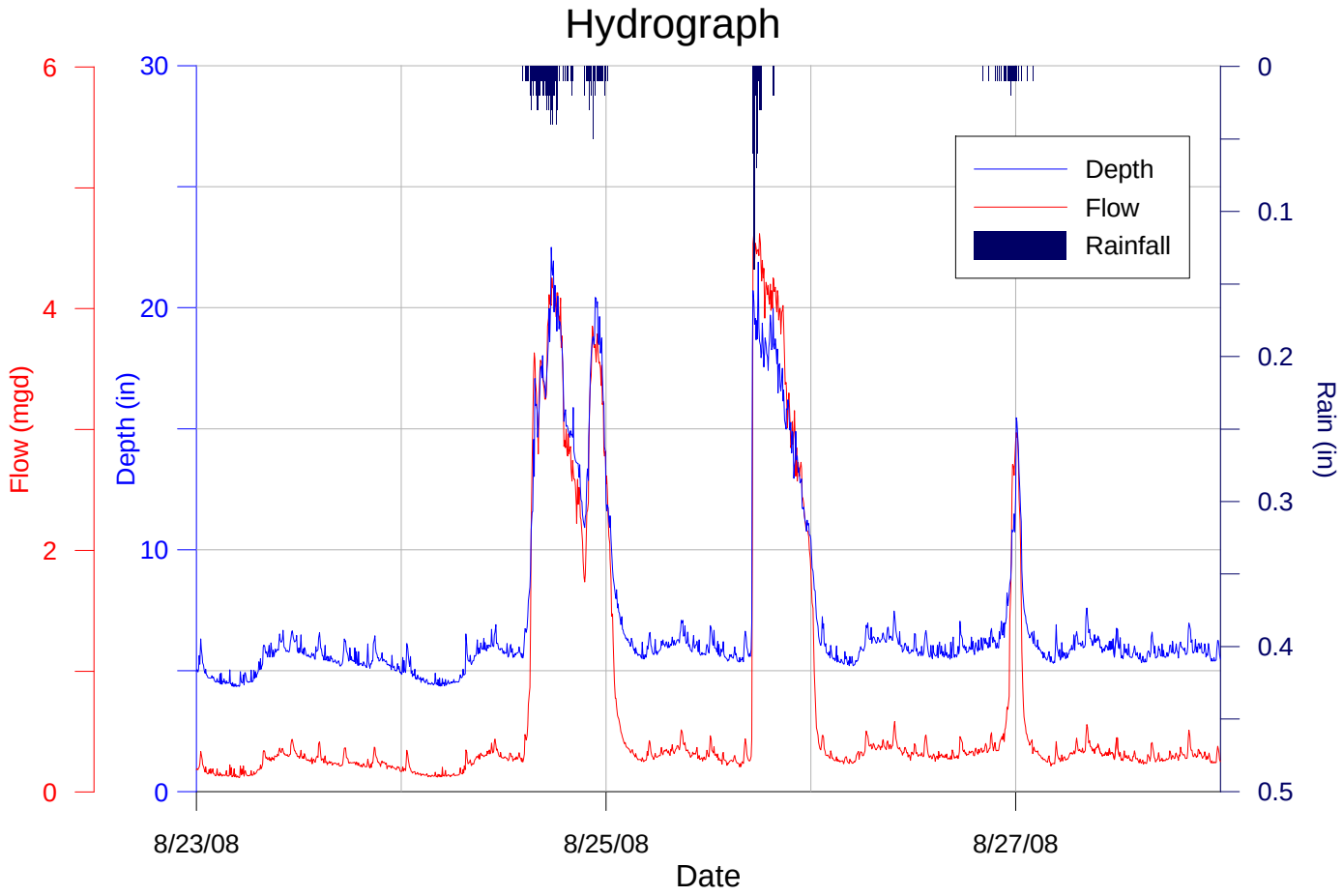
Hydrograph

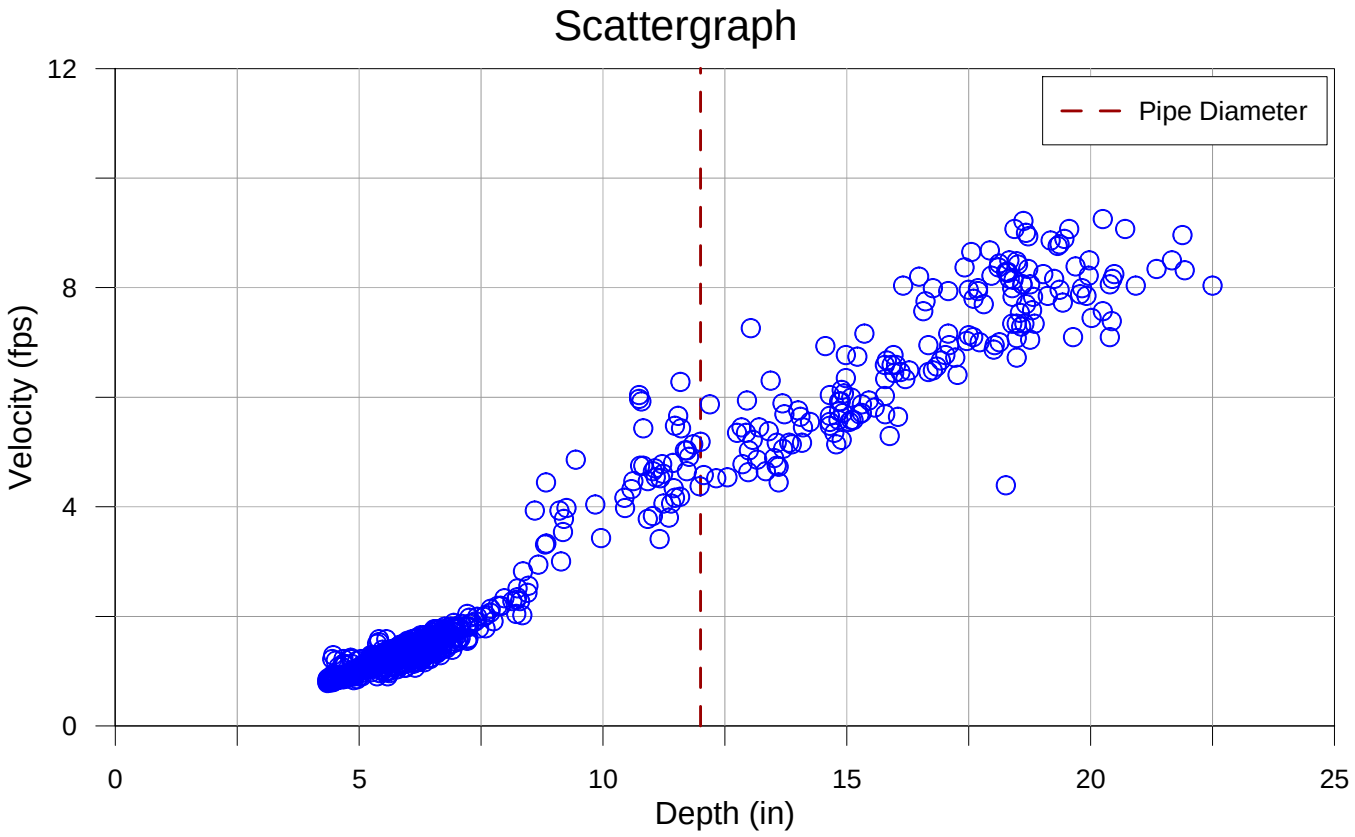


Scattergraph



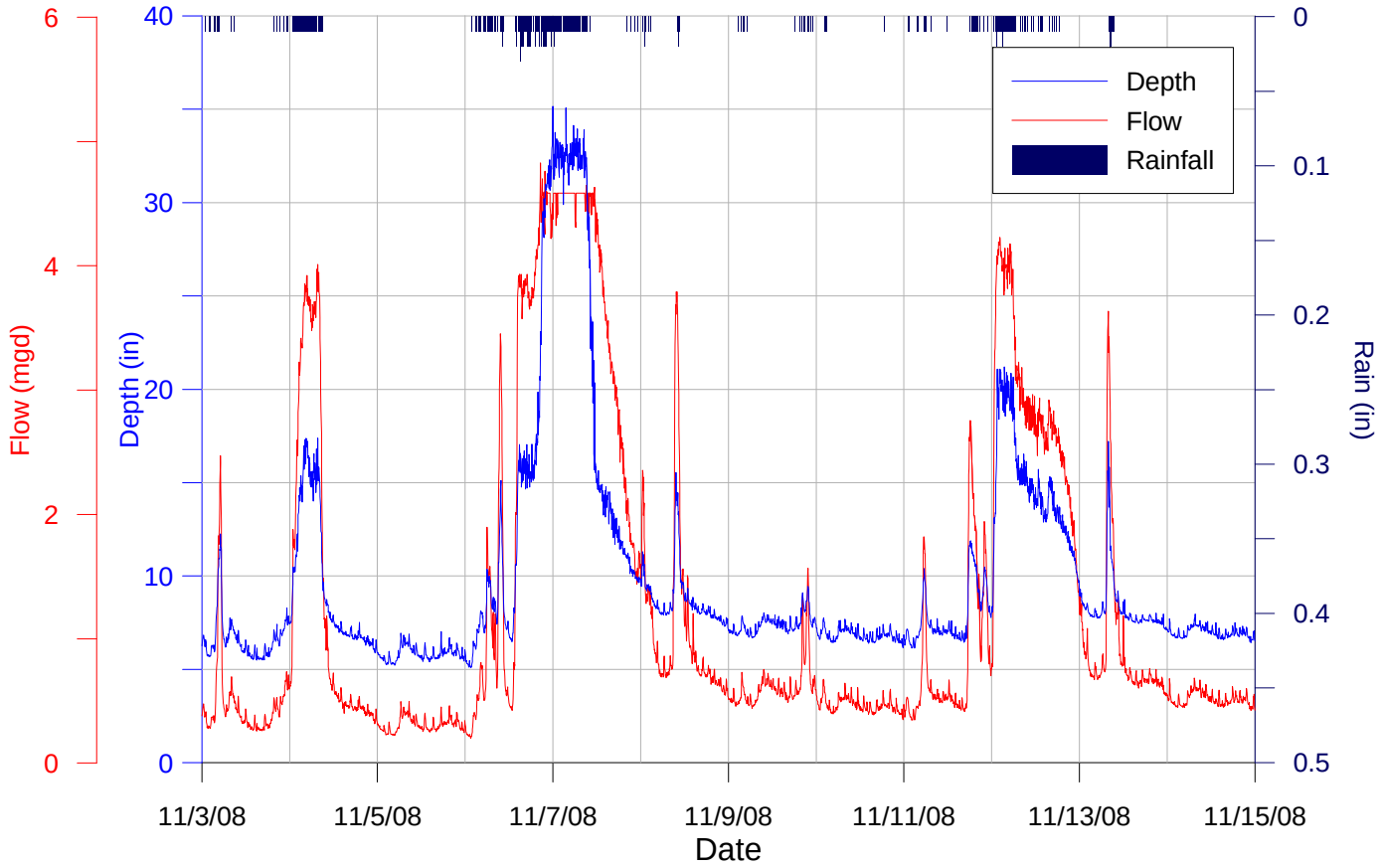
Monitor 306-246
August 23 - 28, 2008



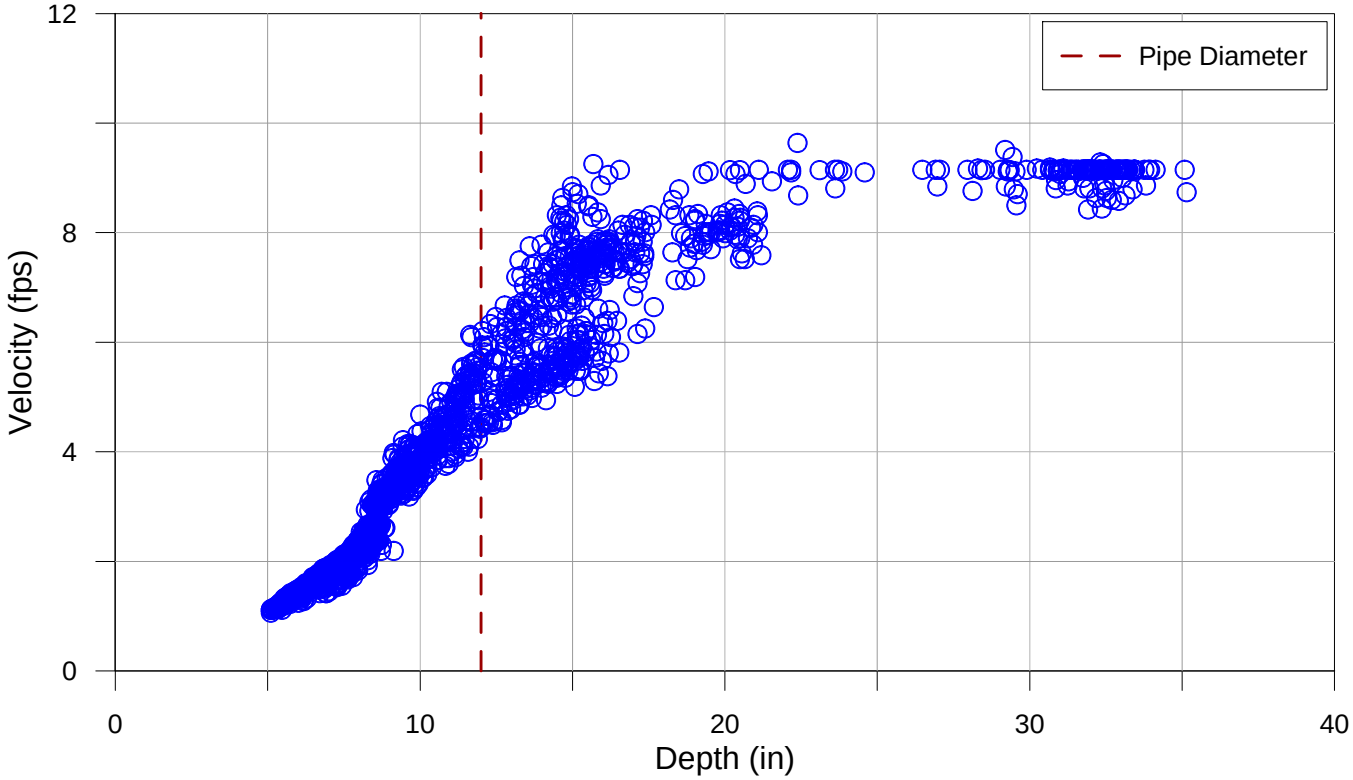


Monitor 306-246
November 3 - 15, 2008

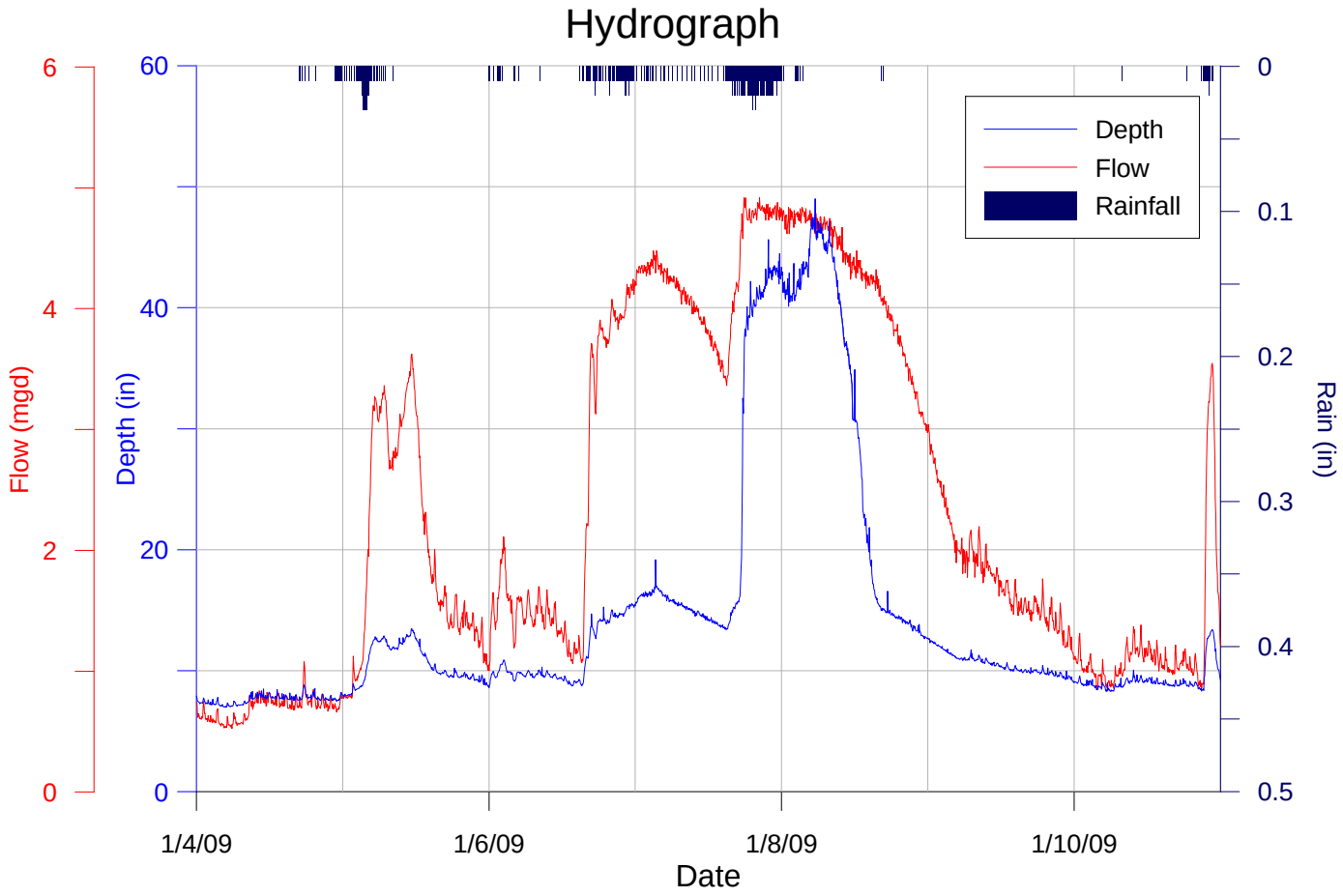
Hydrograph

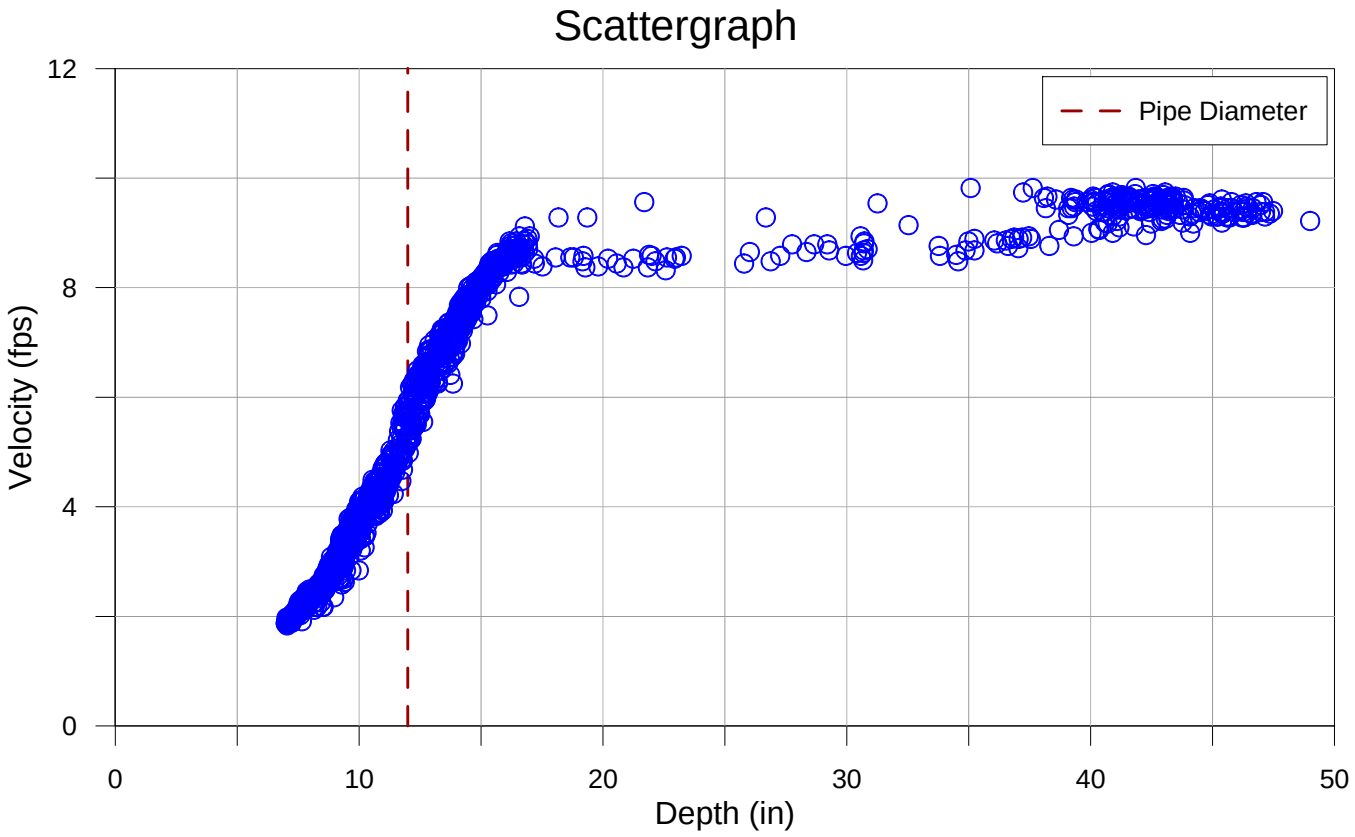


Scattergraph

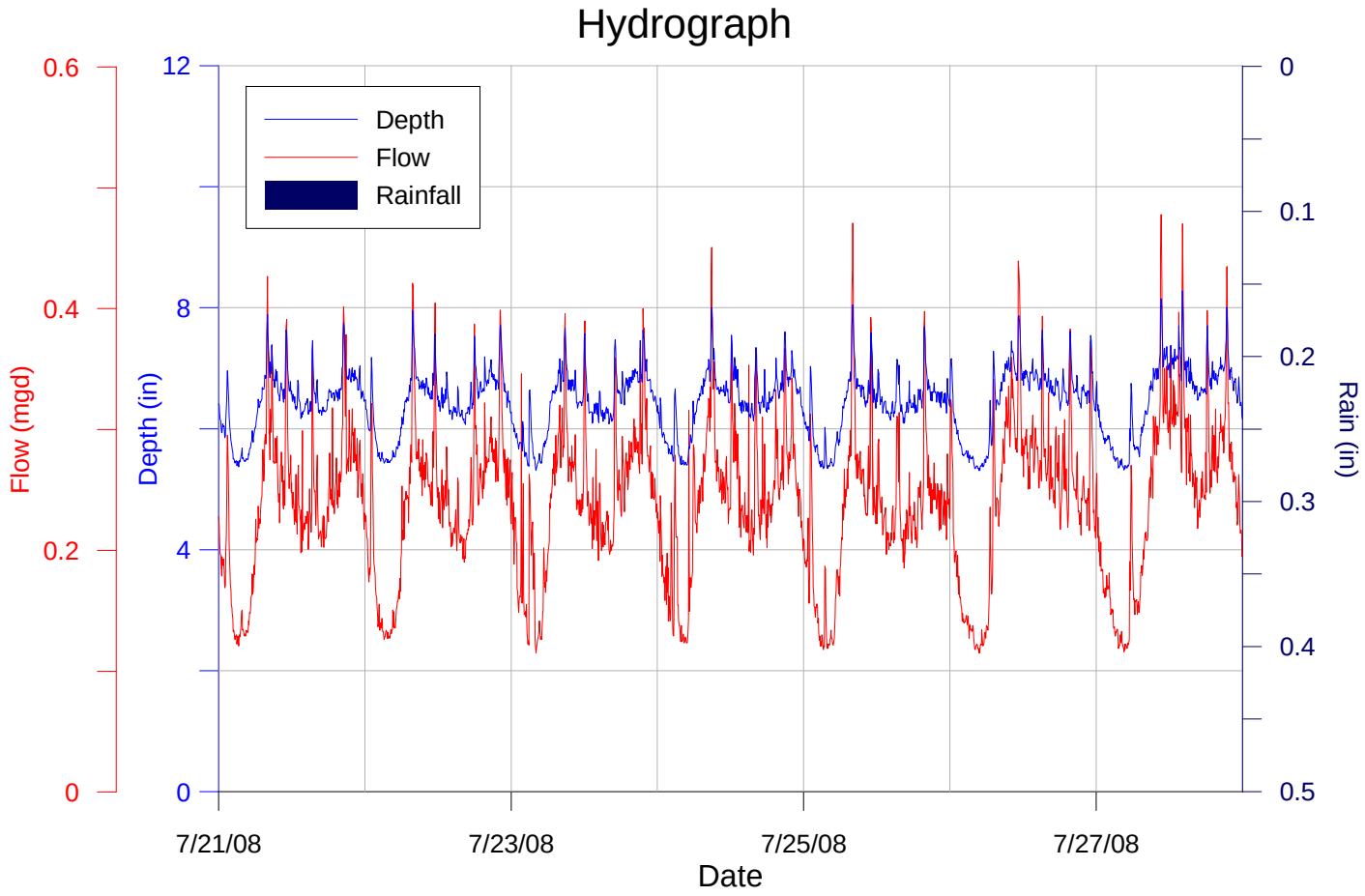


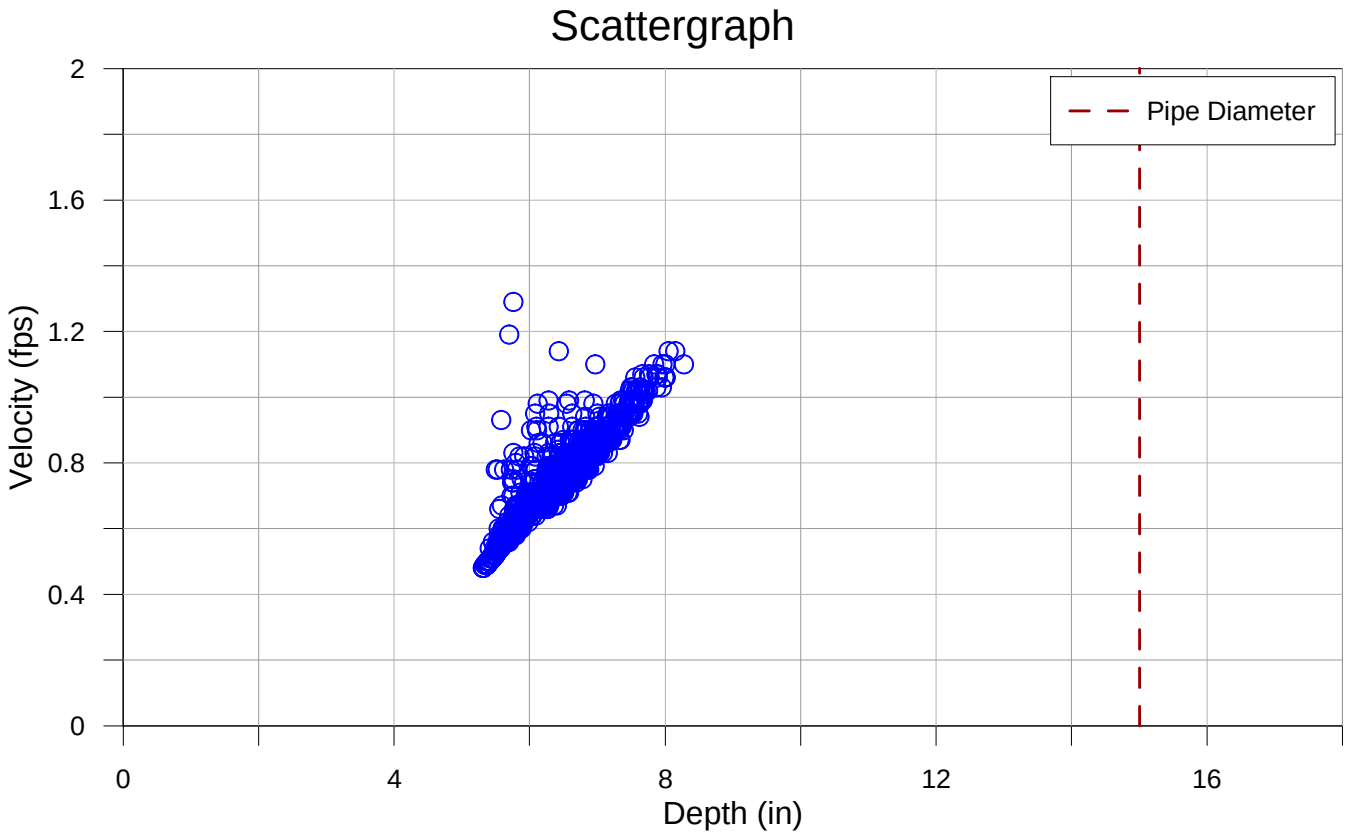
Monitor 306-246
January 4 - 11, 2009



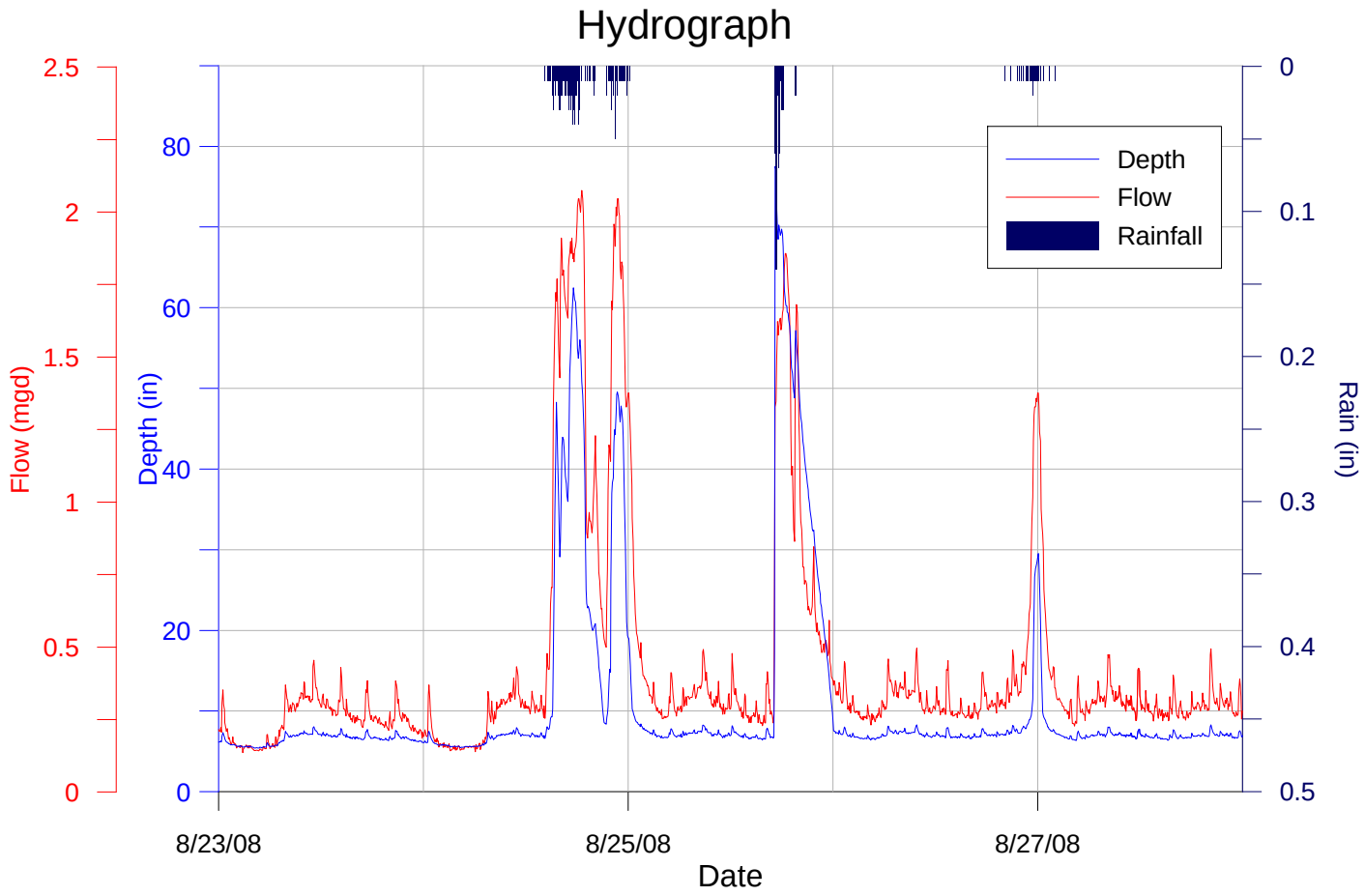


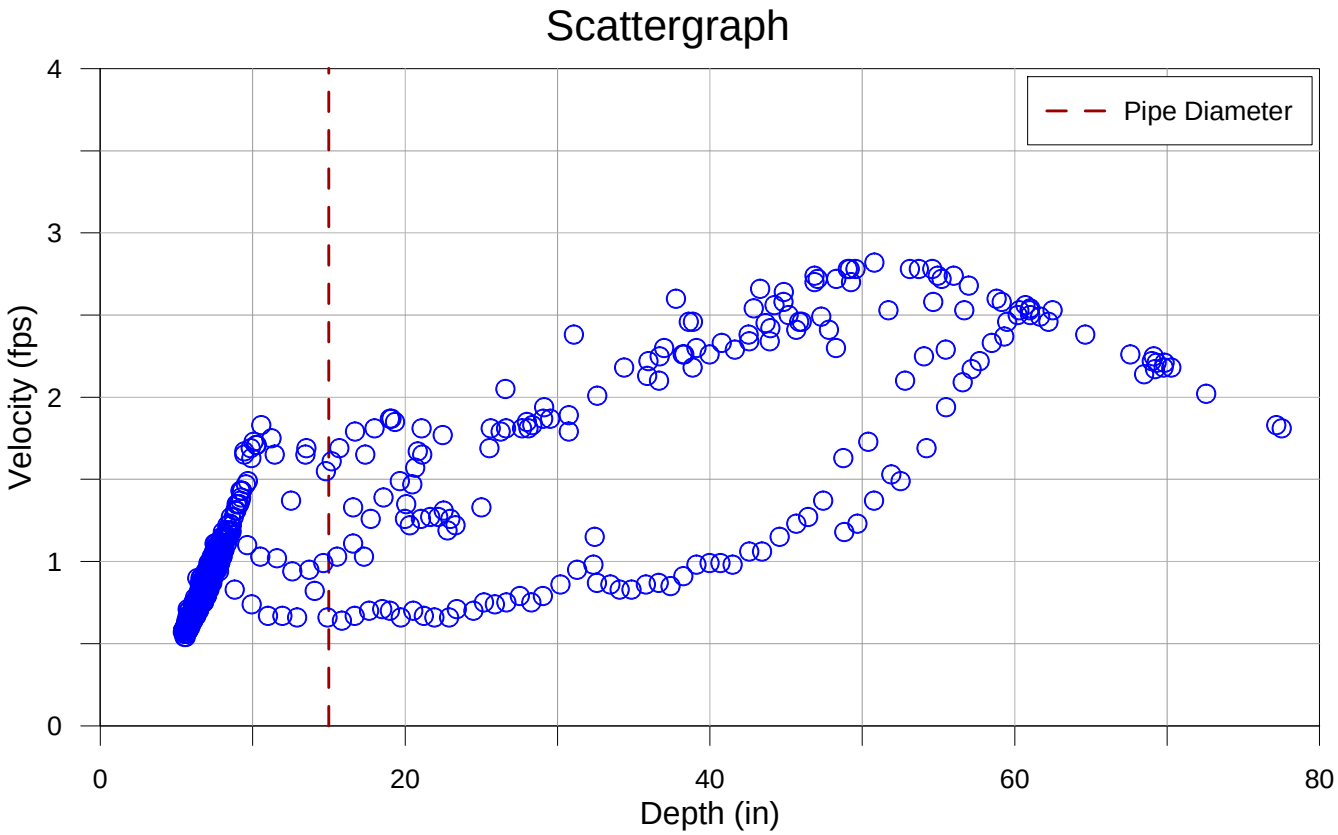
Monitor 306-275
July 21 - 28, 2008



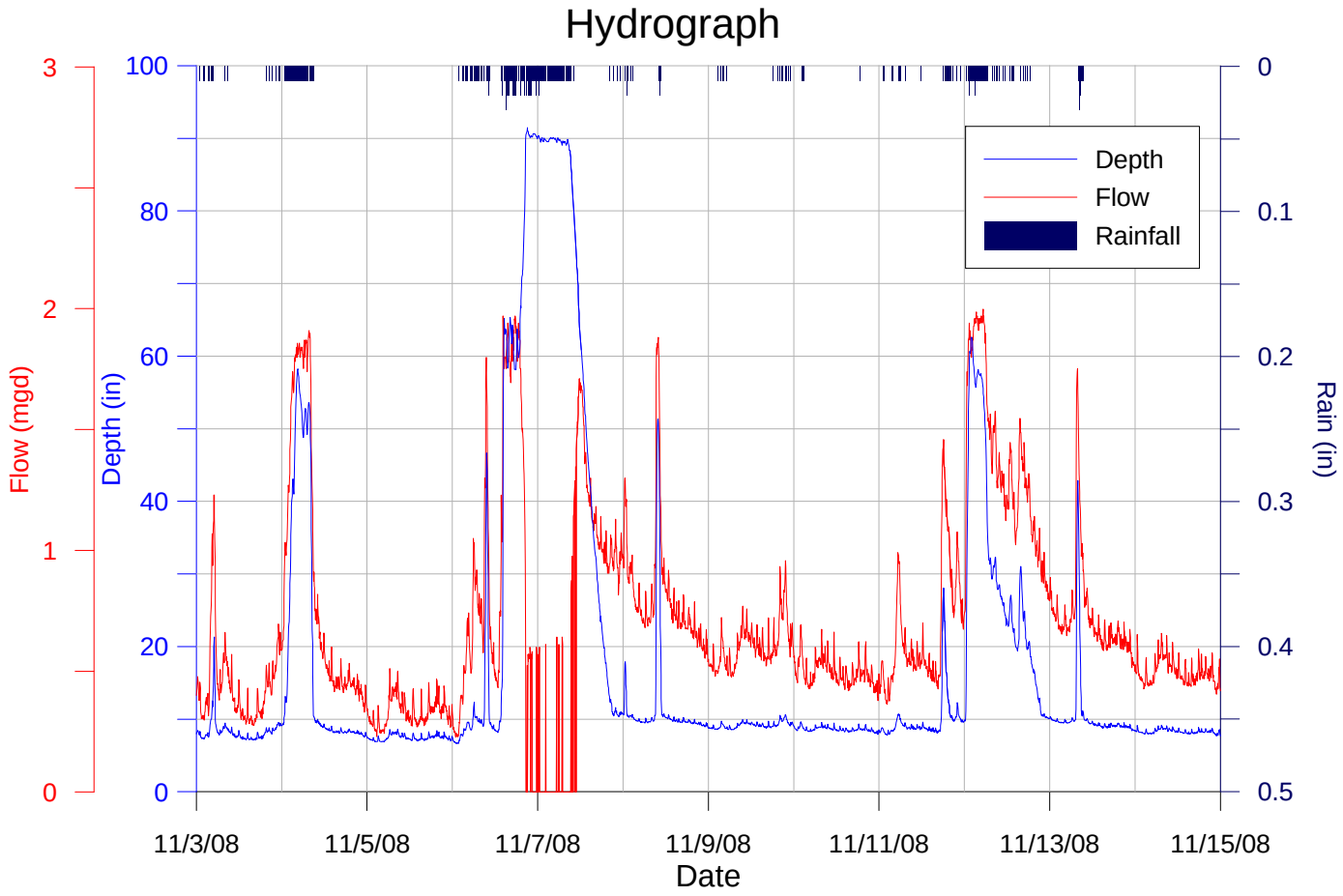


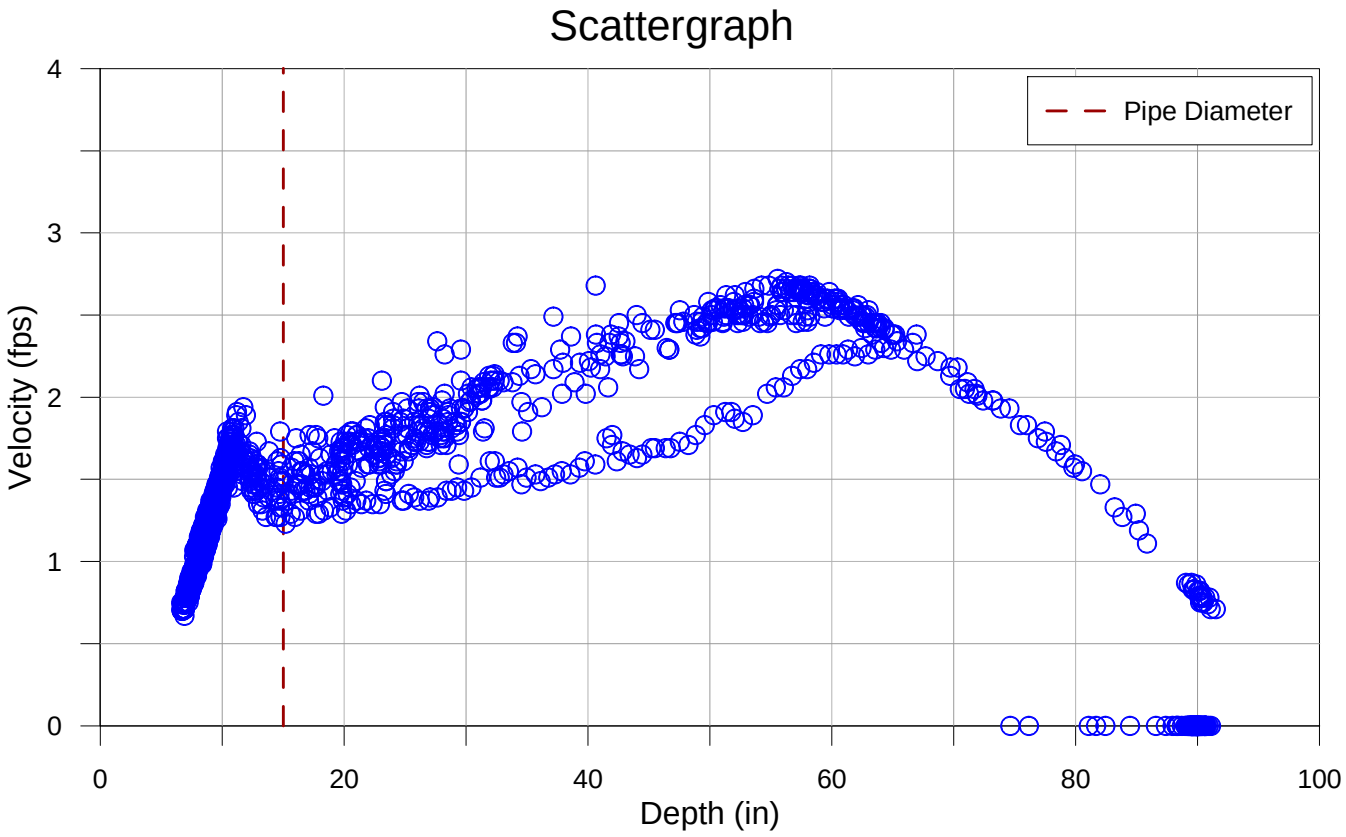
Monitor 306-275
August 23 - 28, 2008



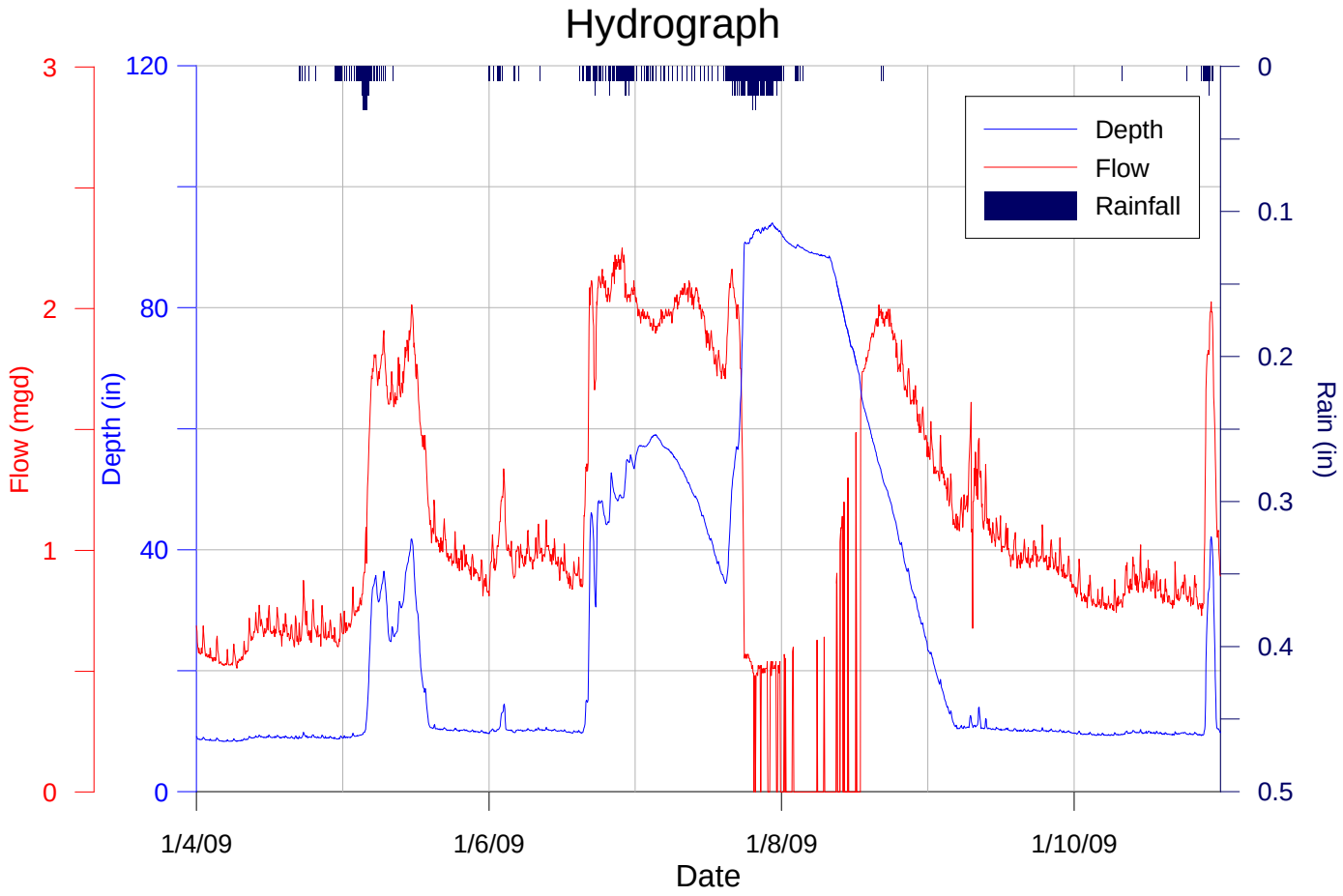


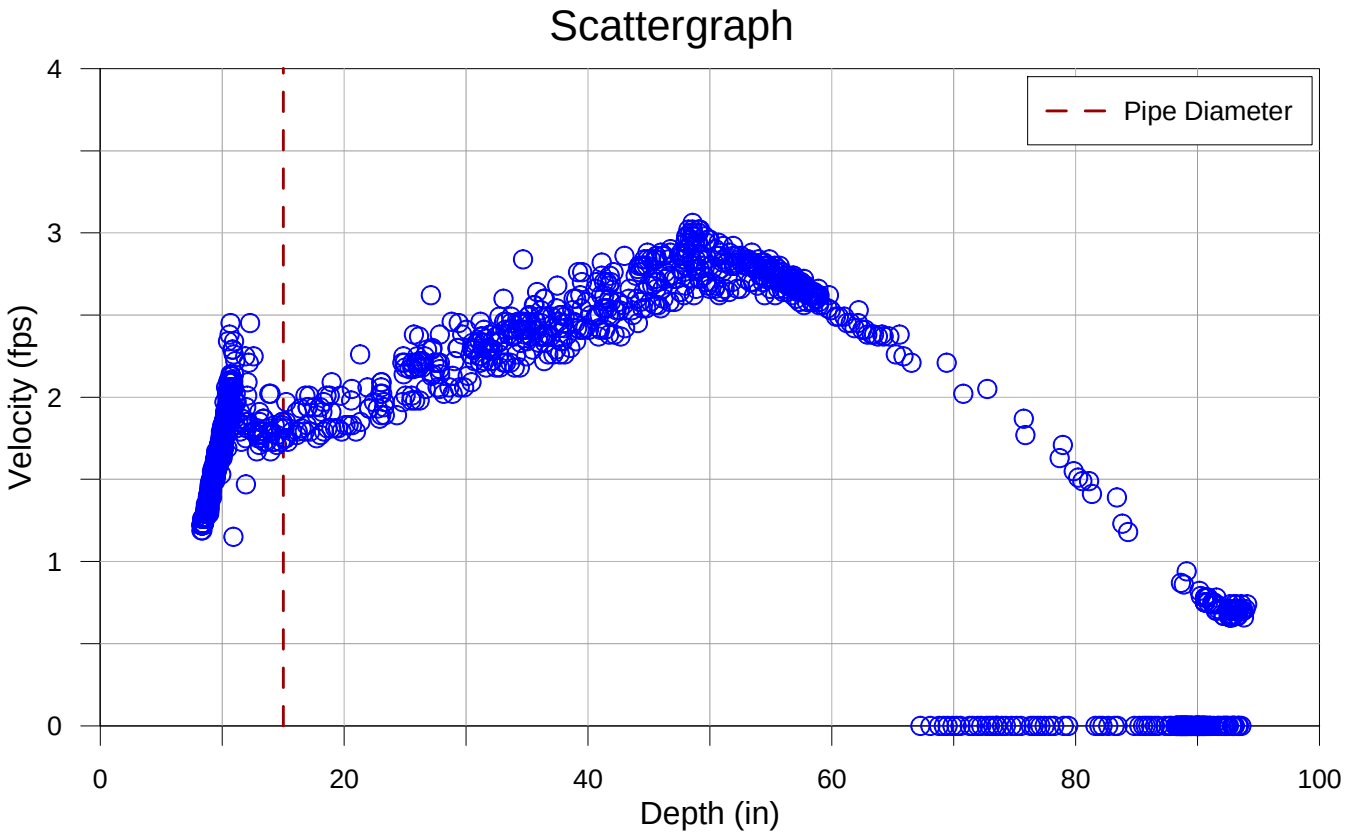
Monitor 306-275
November 3 - 15, 2008





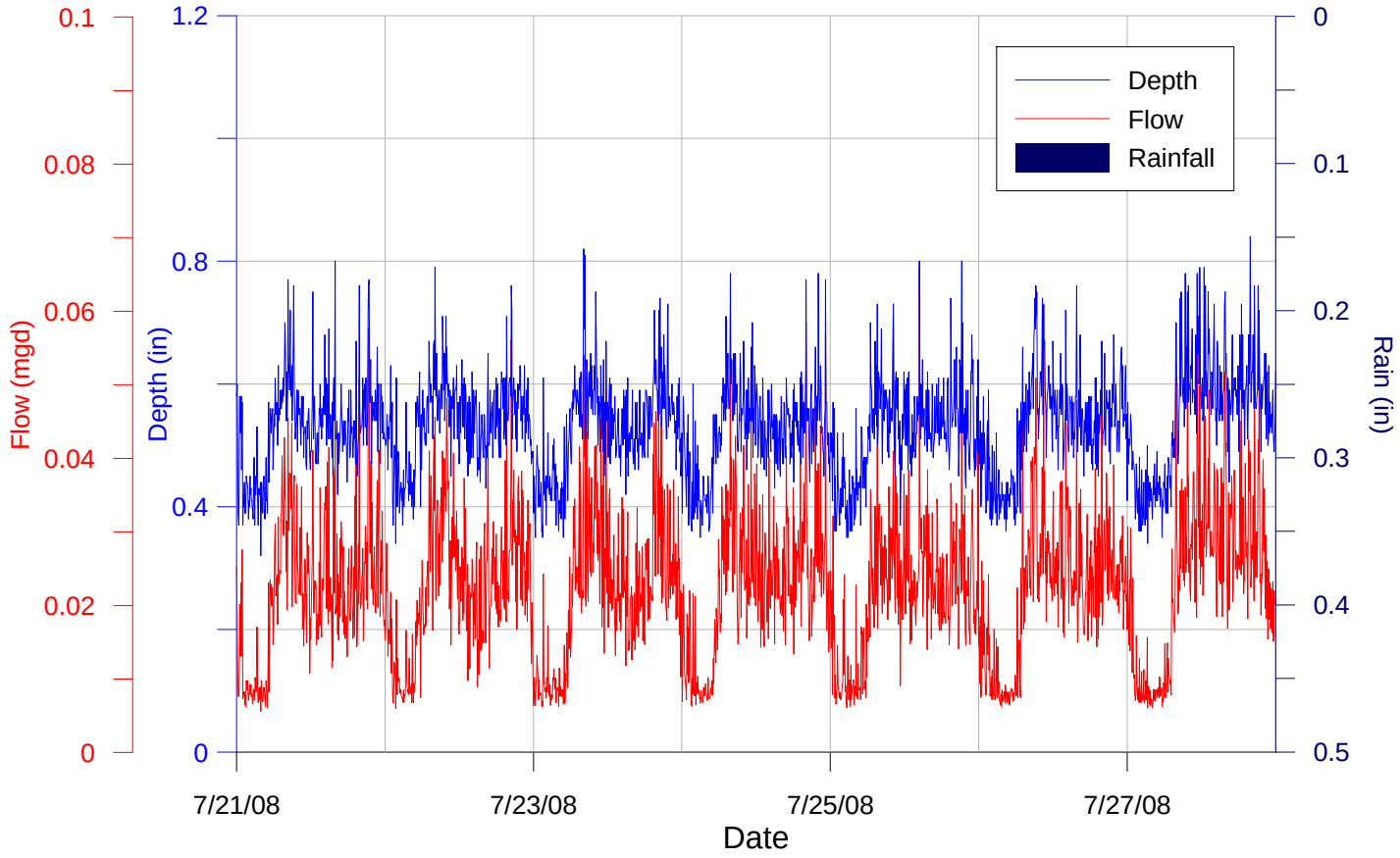
Monitor 306-275
January 4 - 11, 2009



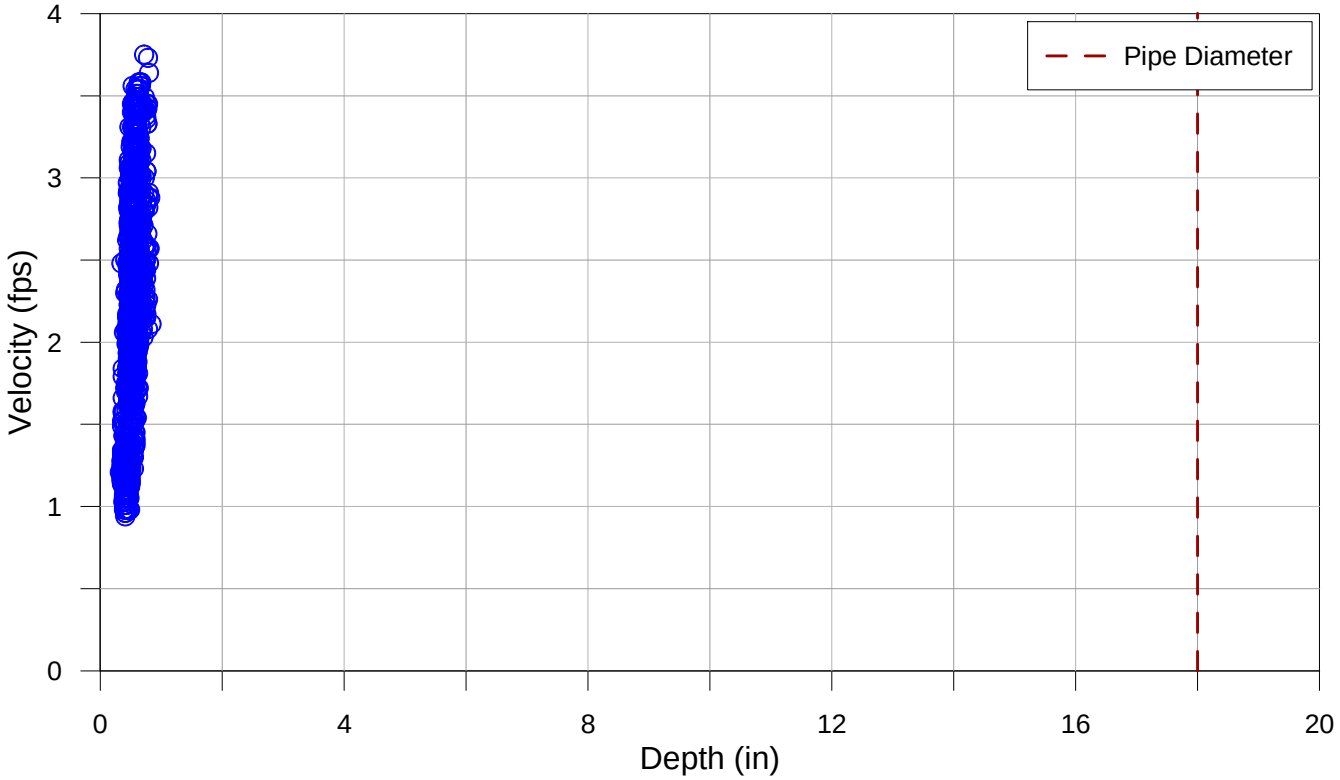


Monitor 306-284
July 21 - 28, 2008

Hydrograph

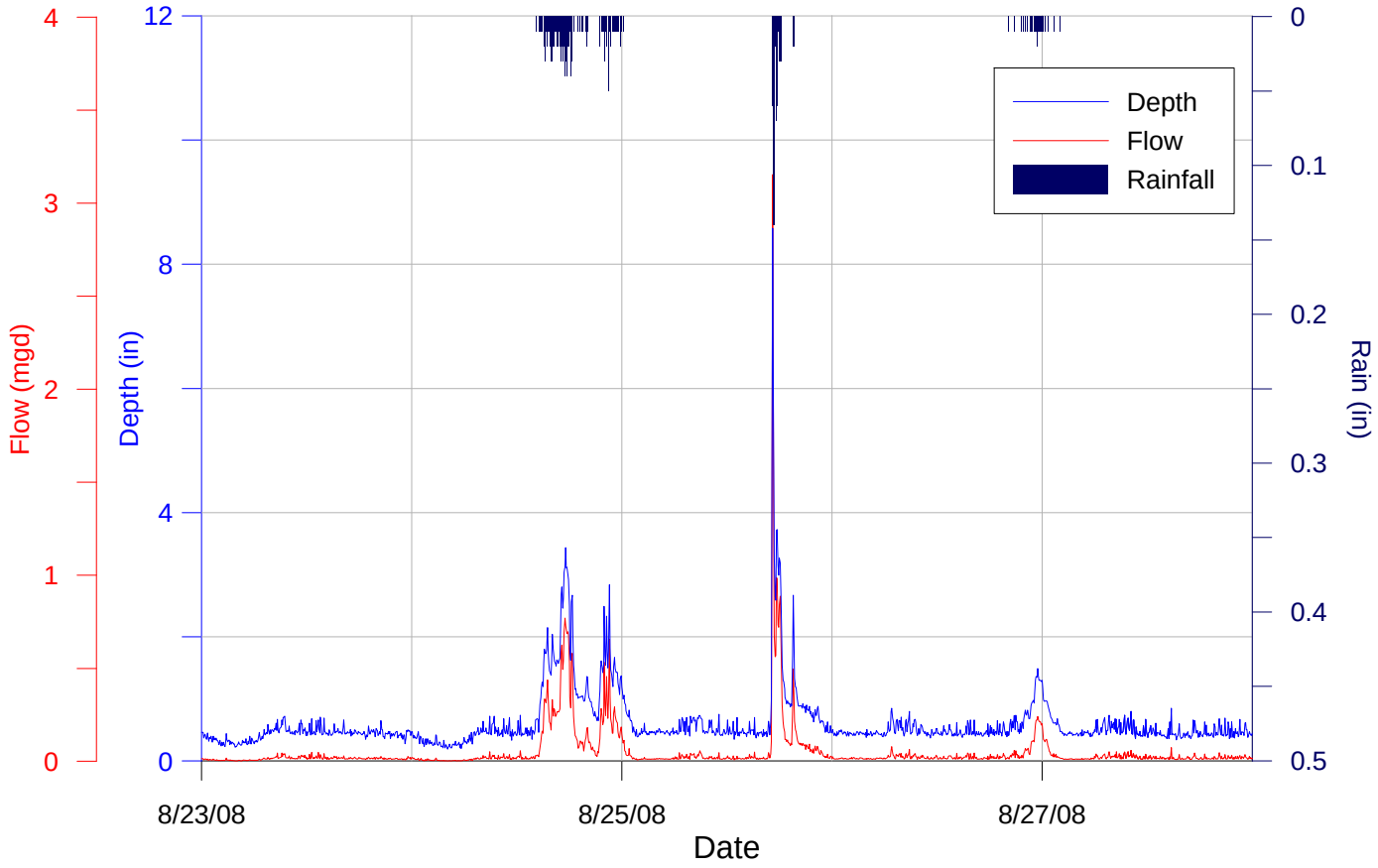


Scattergraph

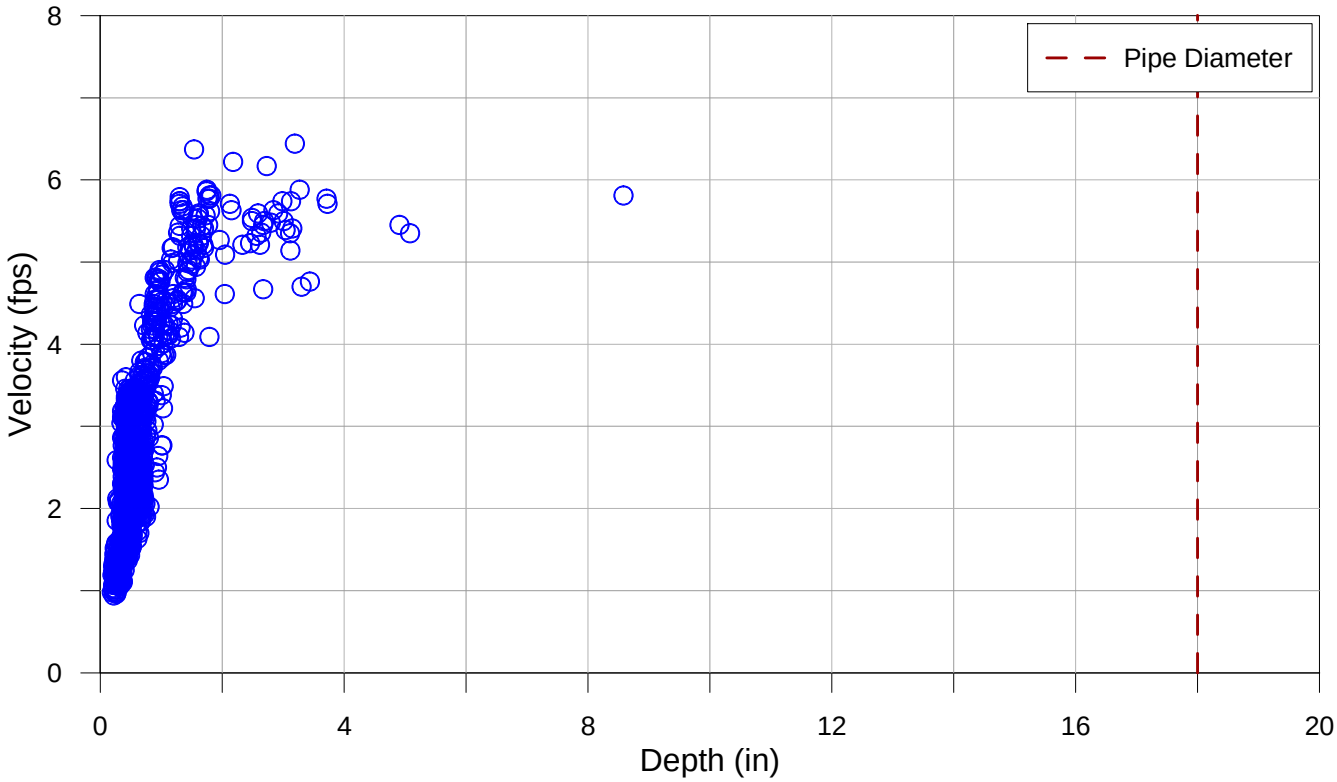


Monitor 306-284
August 23 - 28, 2008

Hydrograph

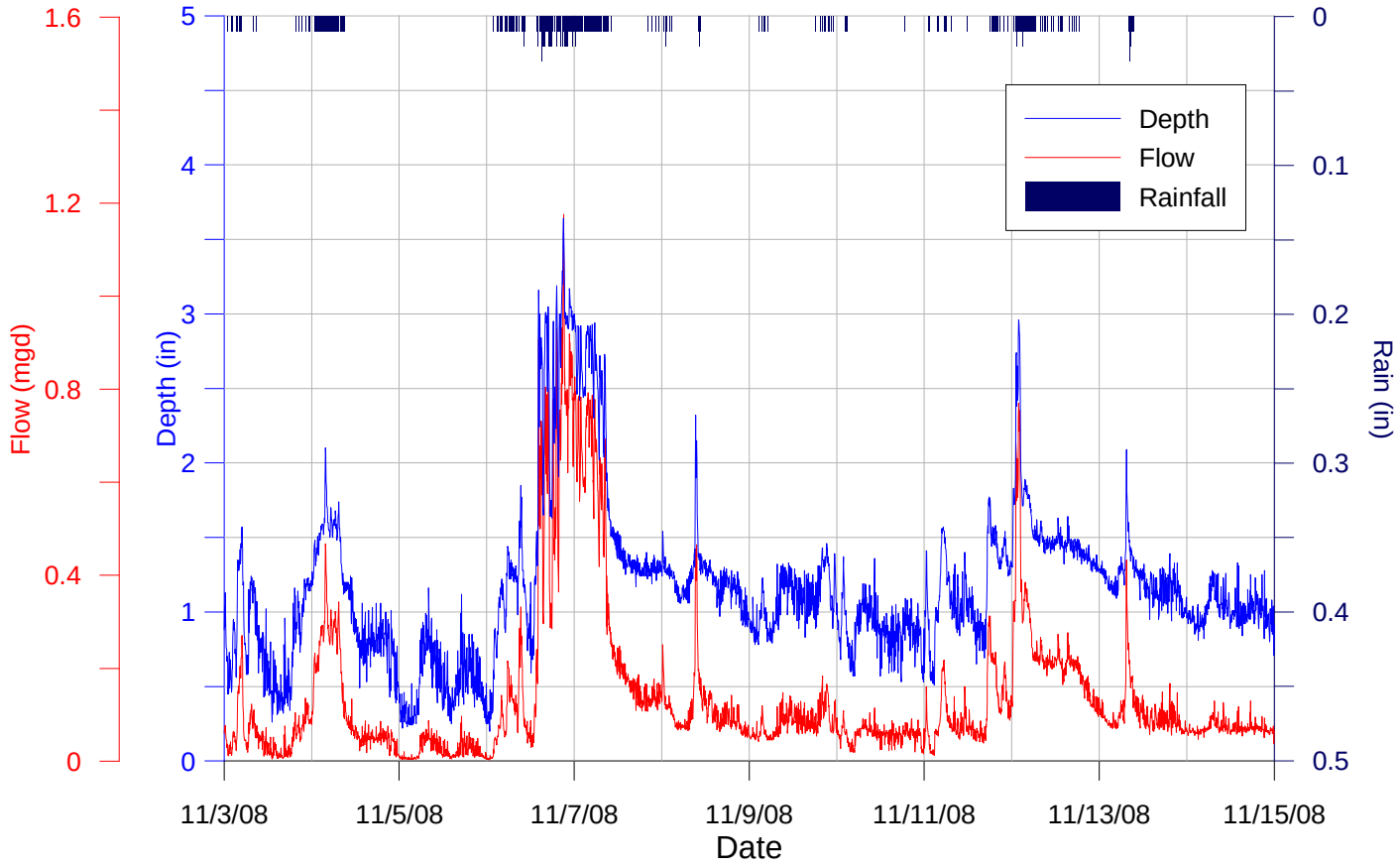


Scattergraph

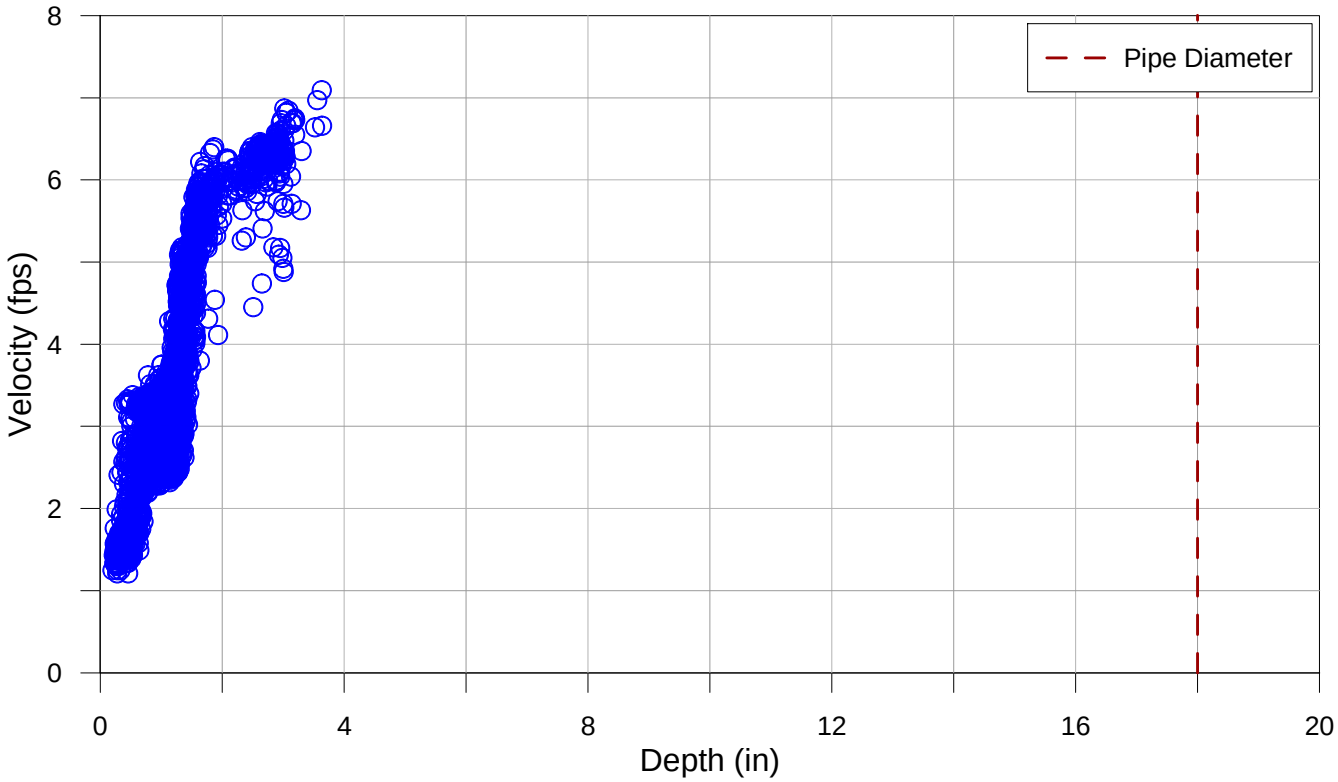


Monitor 306-284
November 3 - 15, 2008

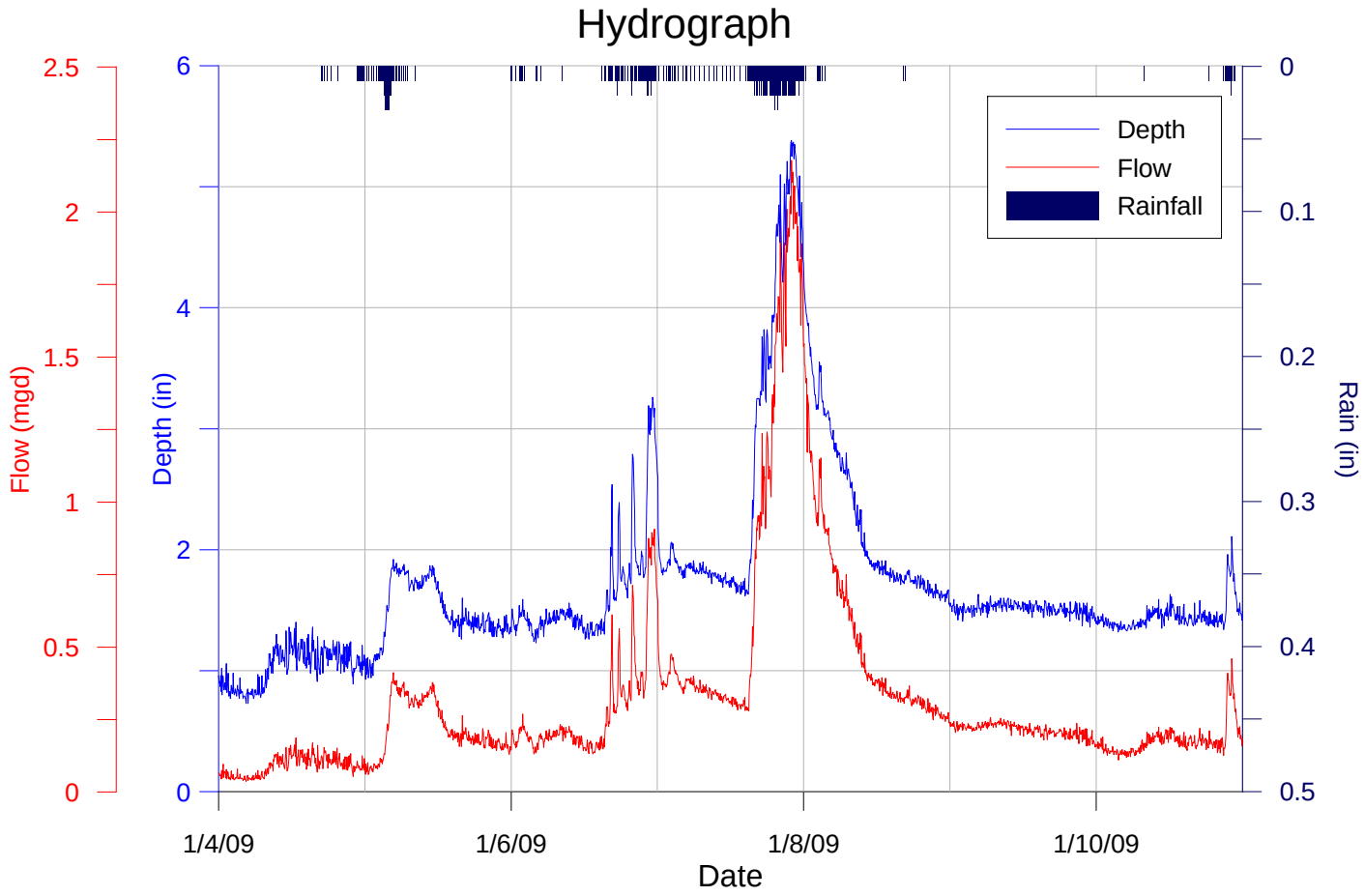
Hydrograph

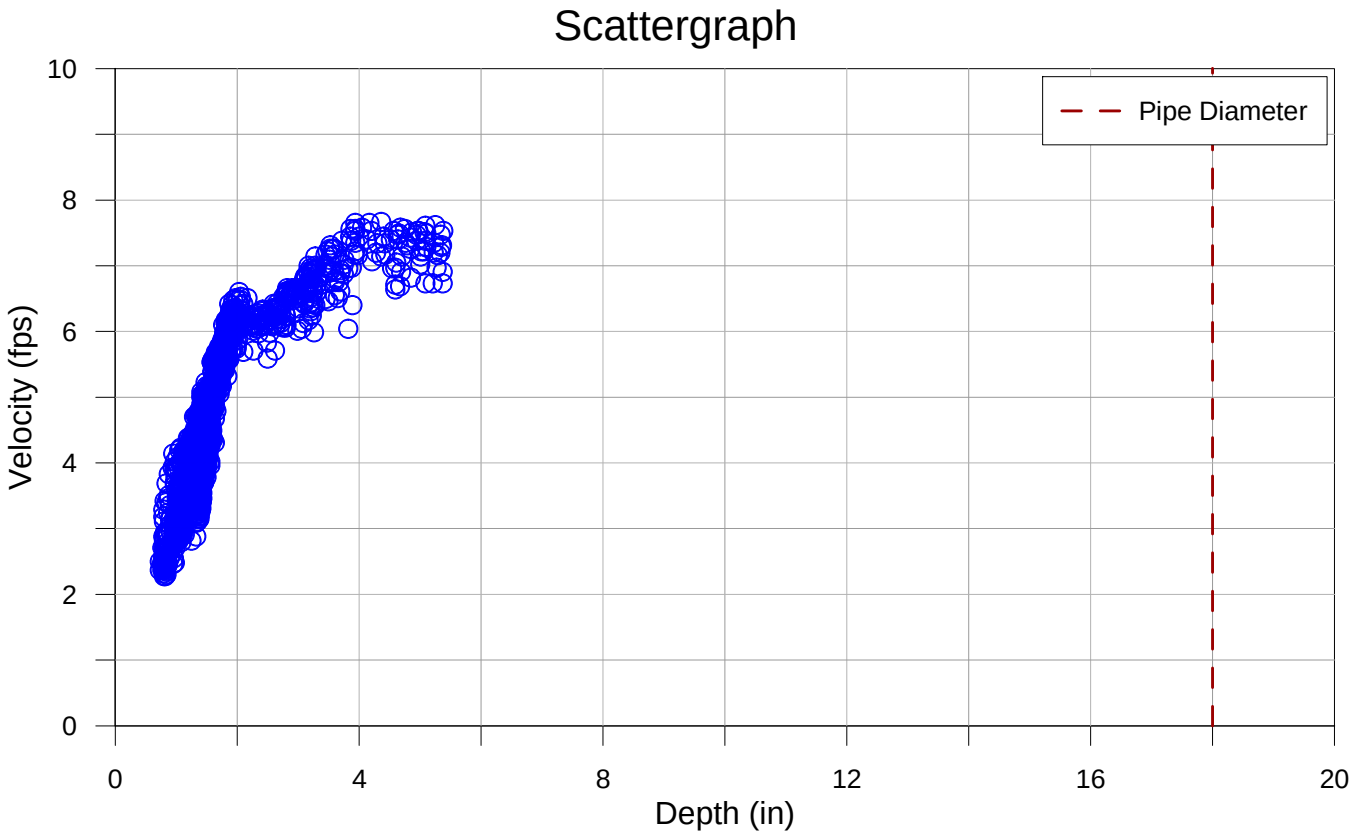


Scattergraph

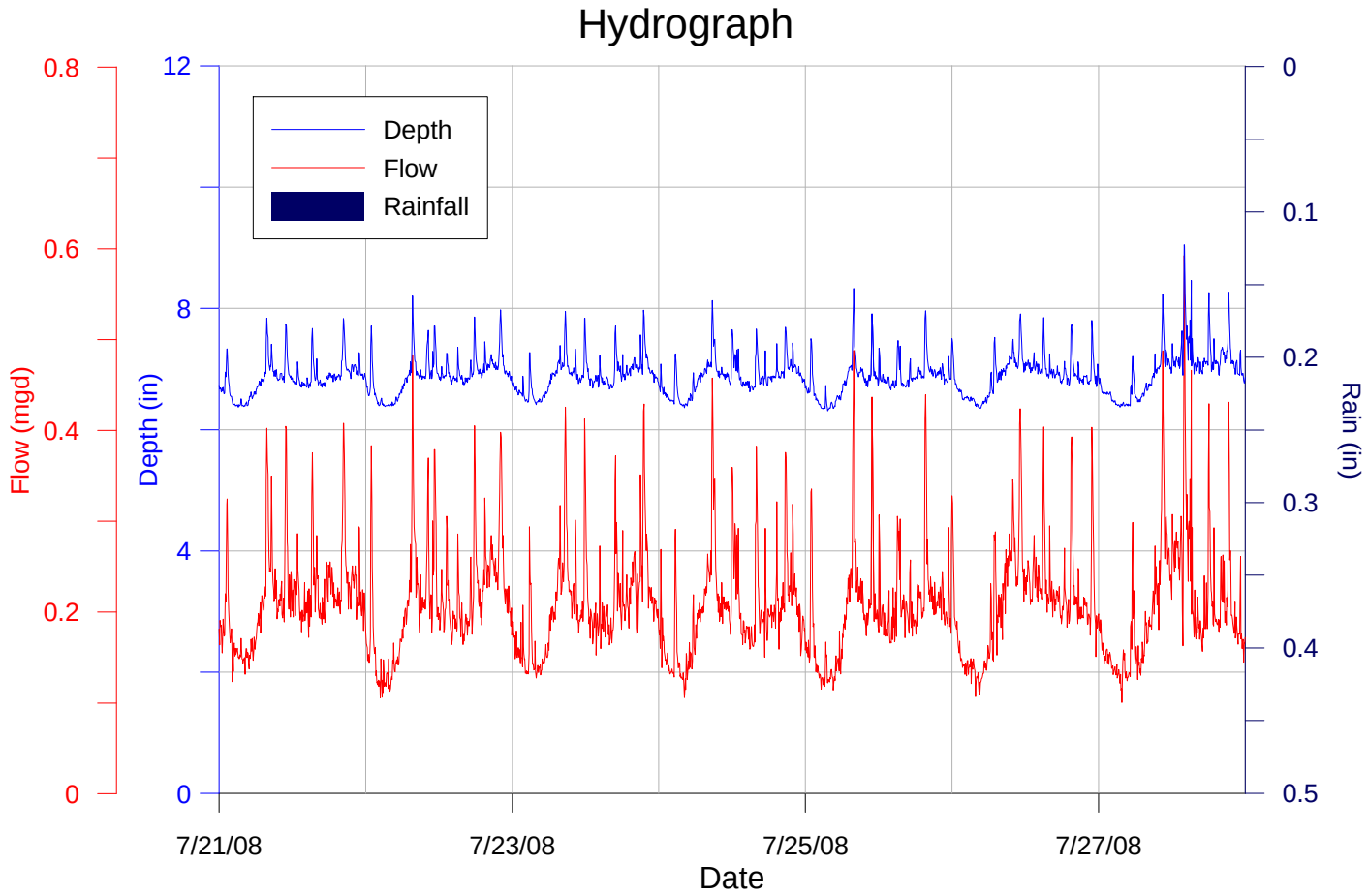


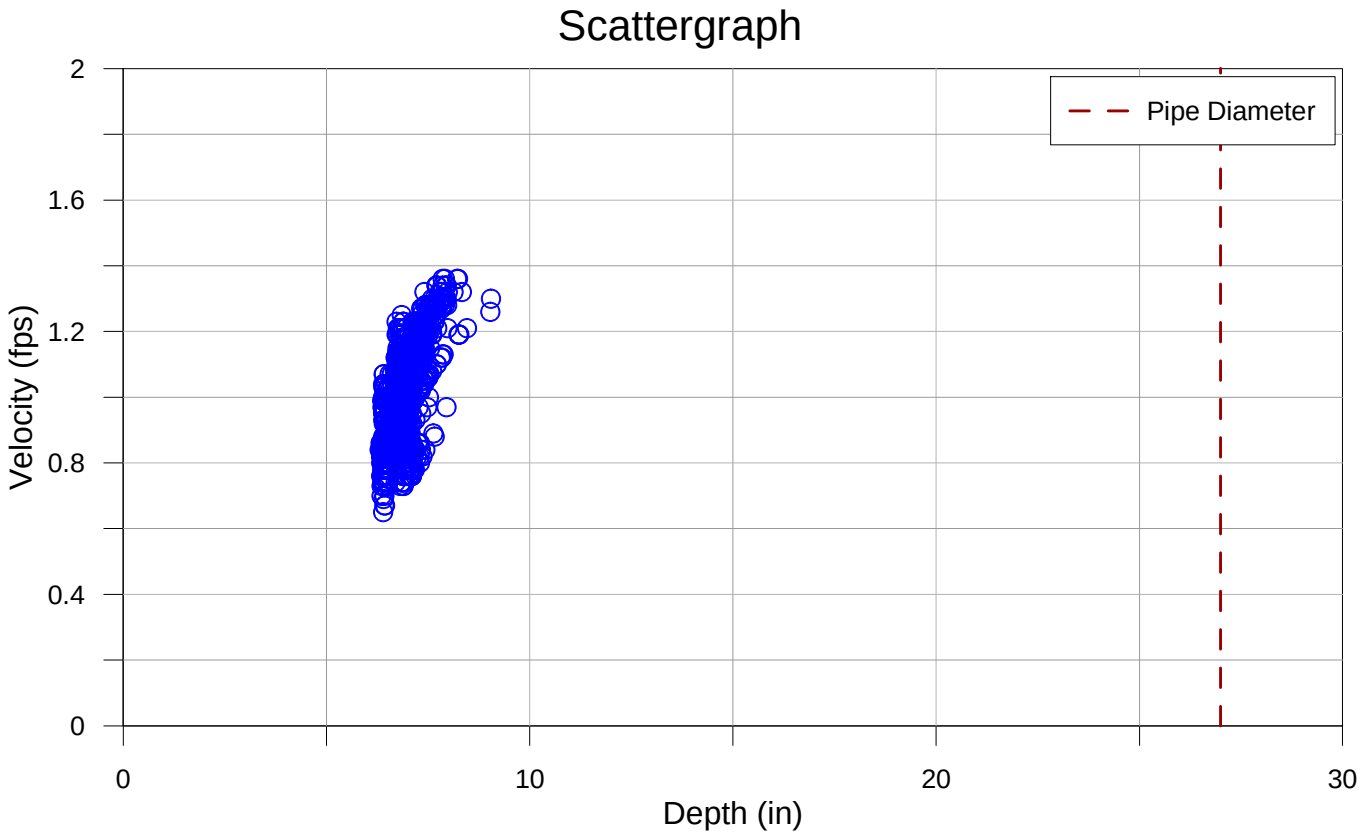
Monitor 306-284
January 4 - 11, 2009



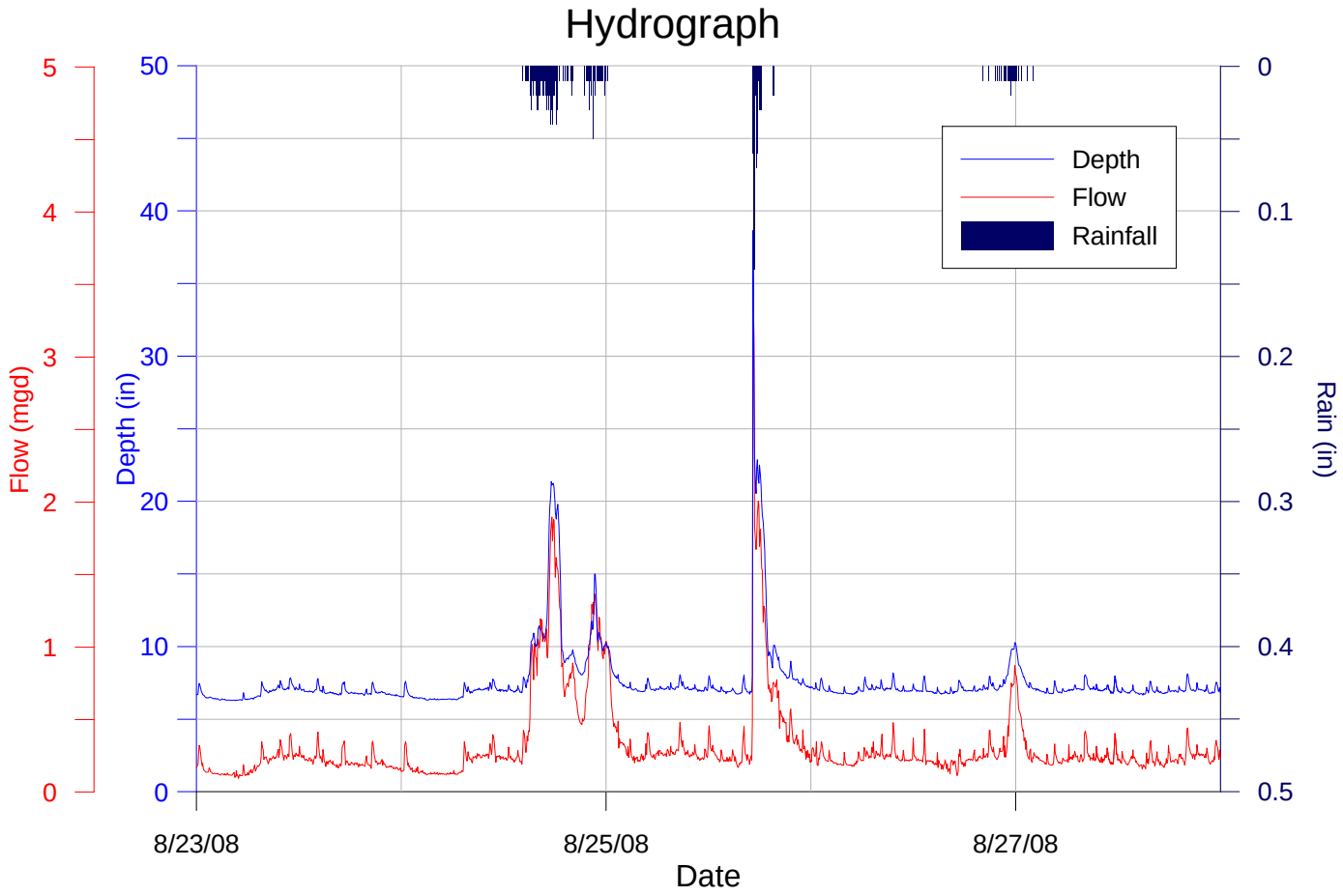


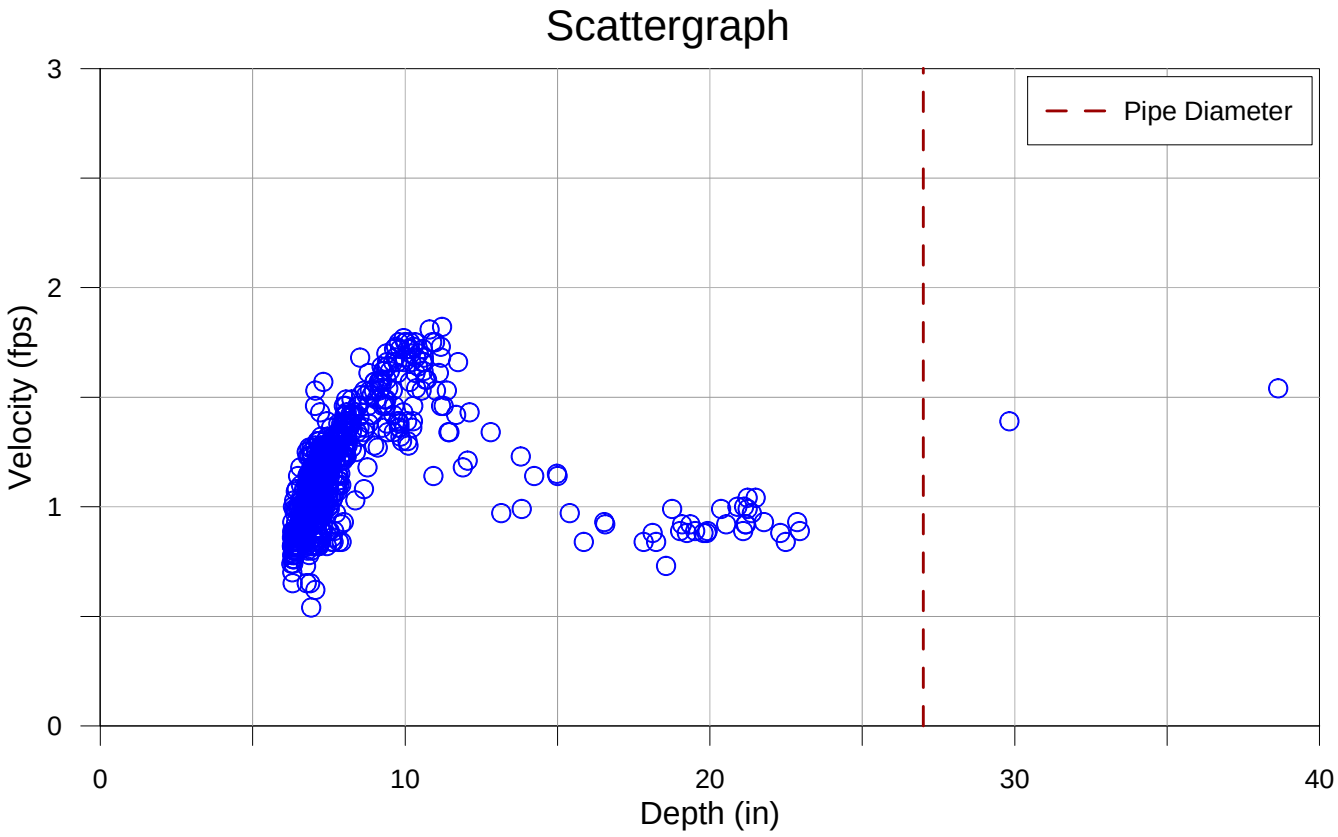
Monitor 306-343
July 21 - 28, 2008



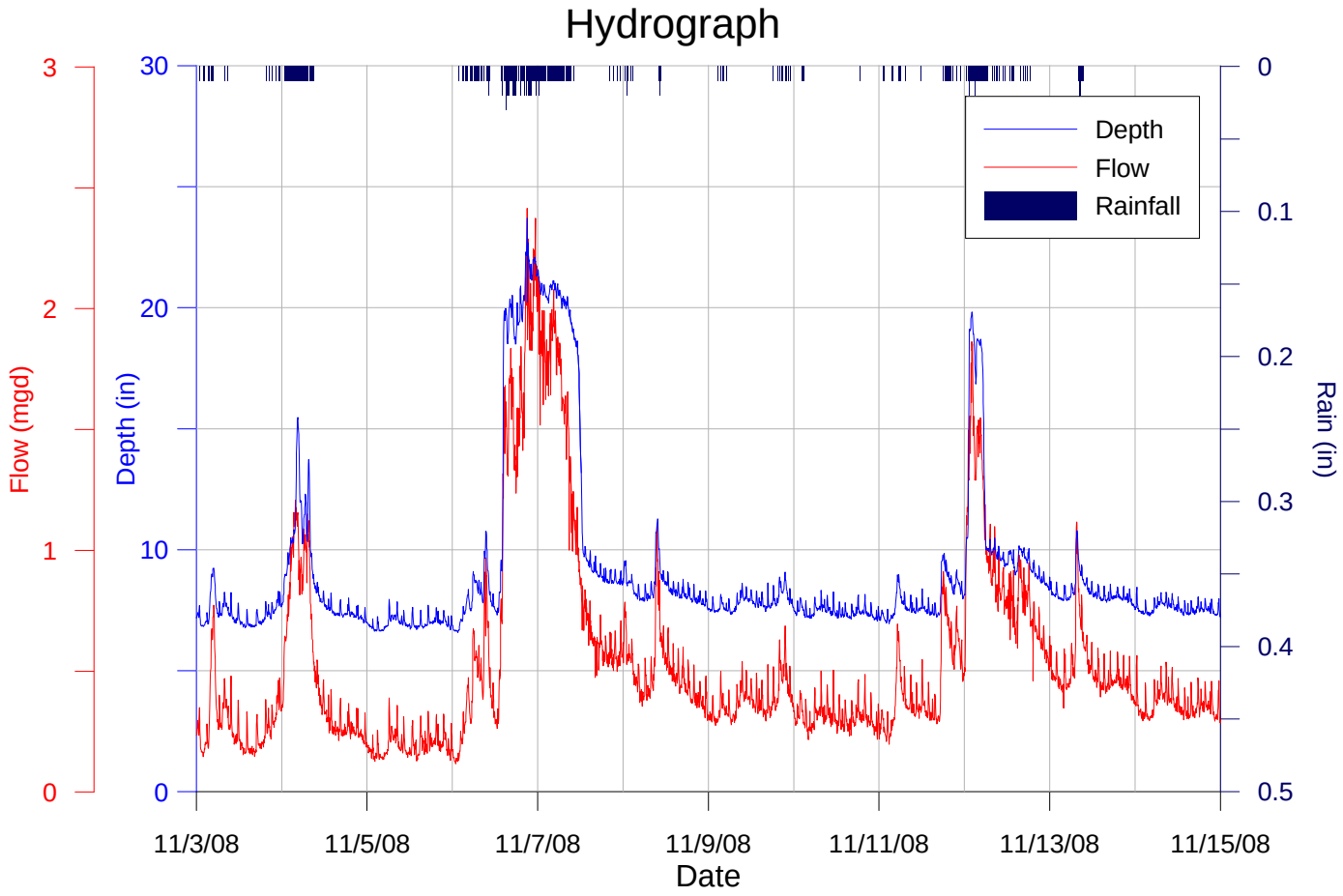


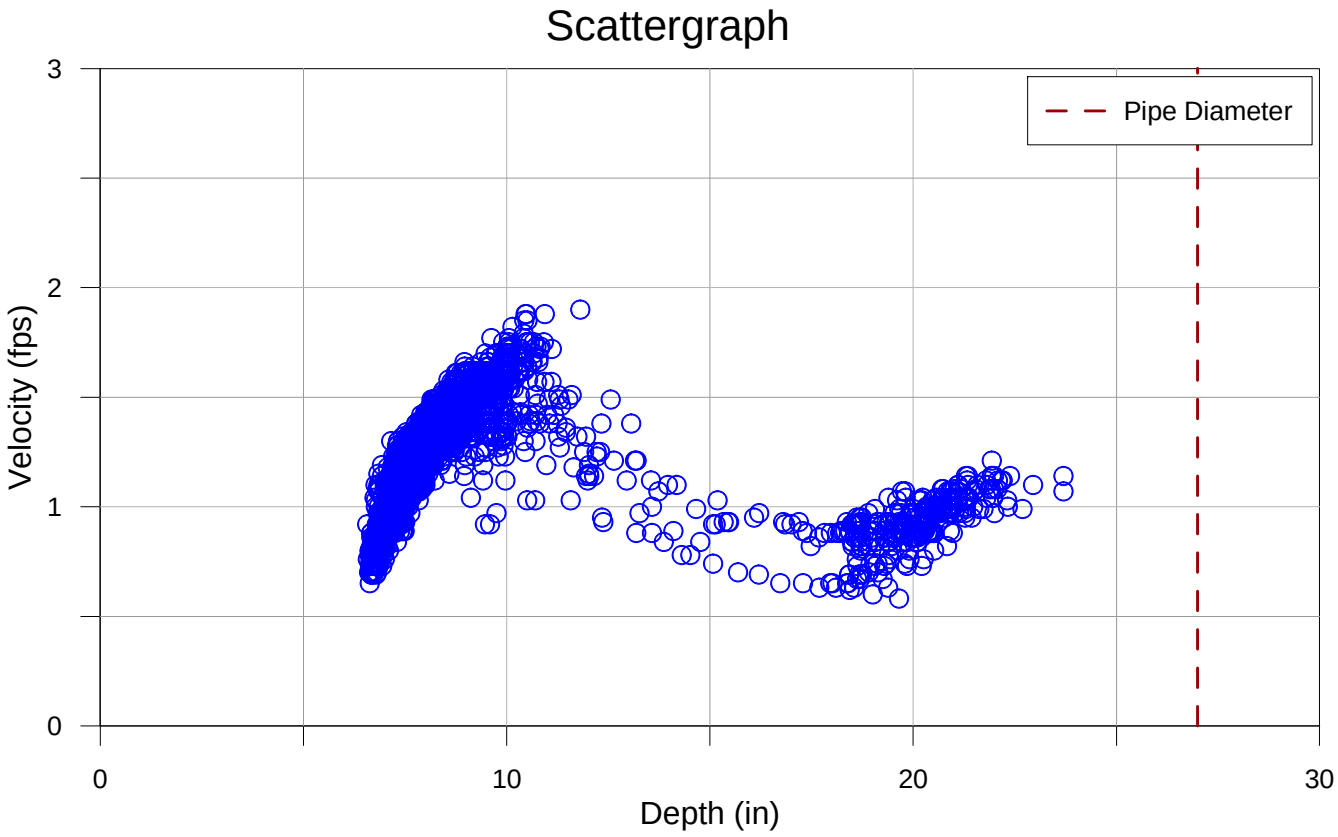
Monitor 306-343
August 23 - 28, 2008



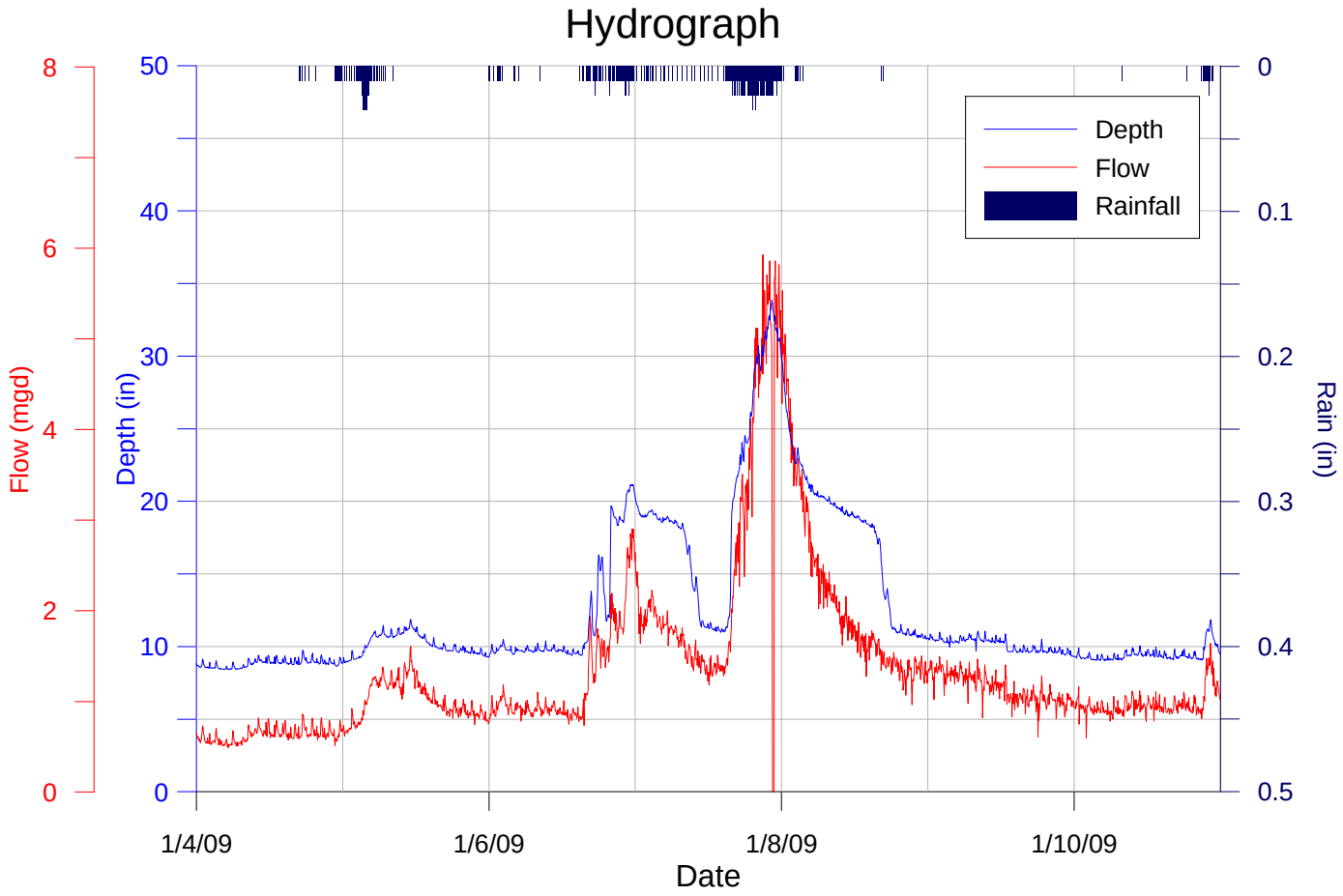


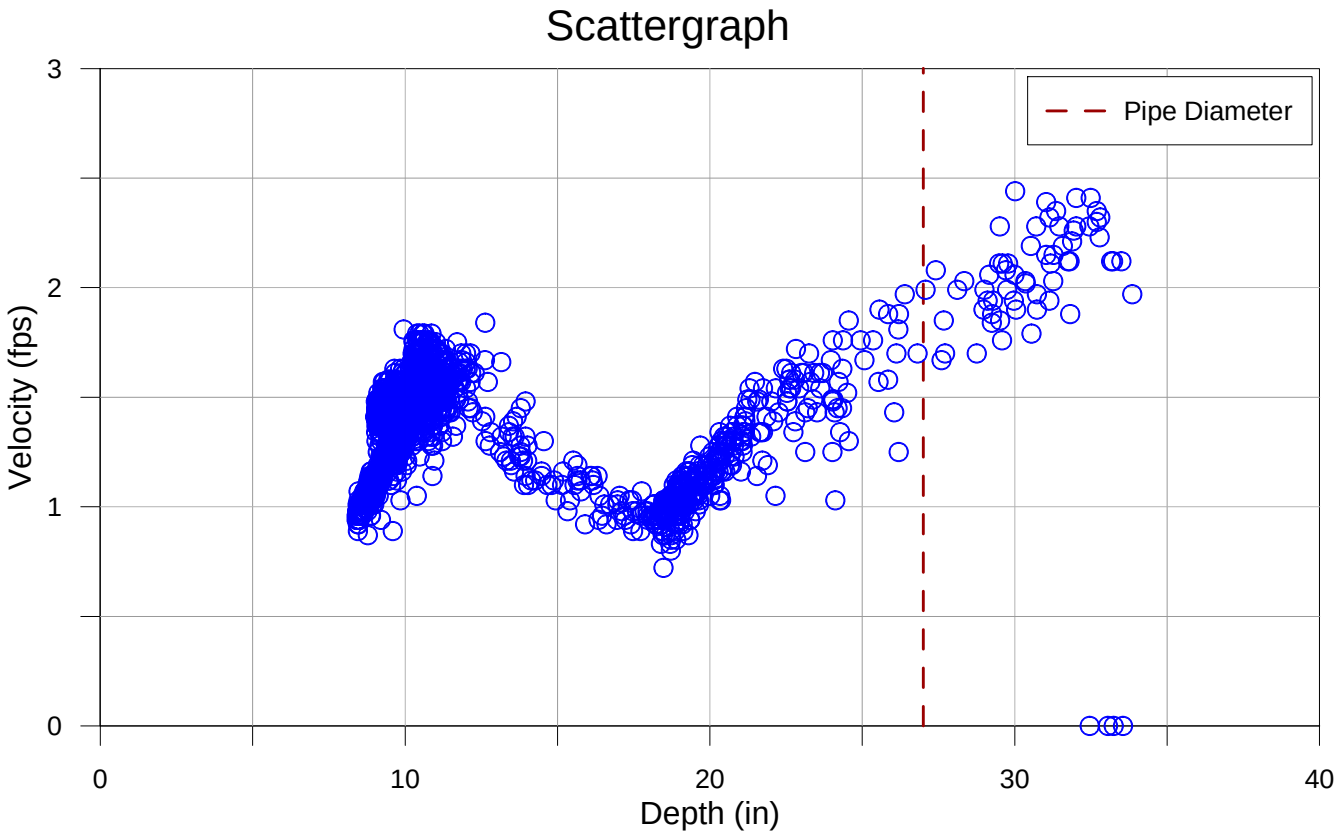
Monitor 306-343
November 3 - 15, 2008



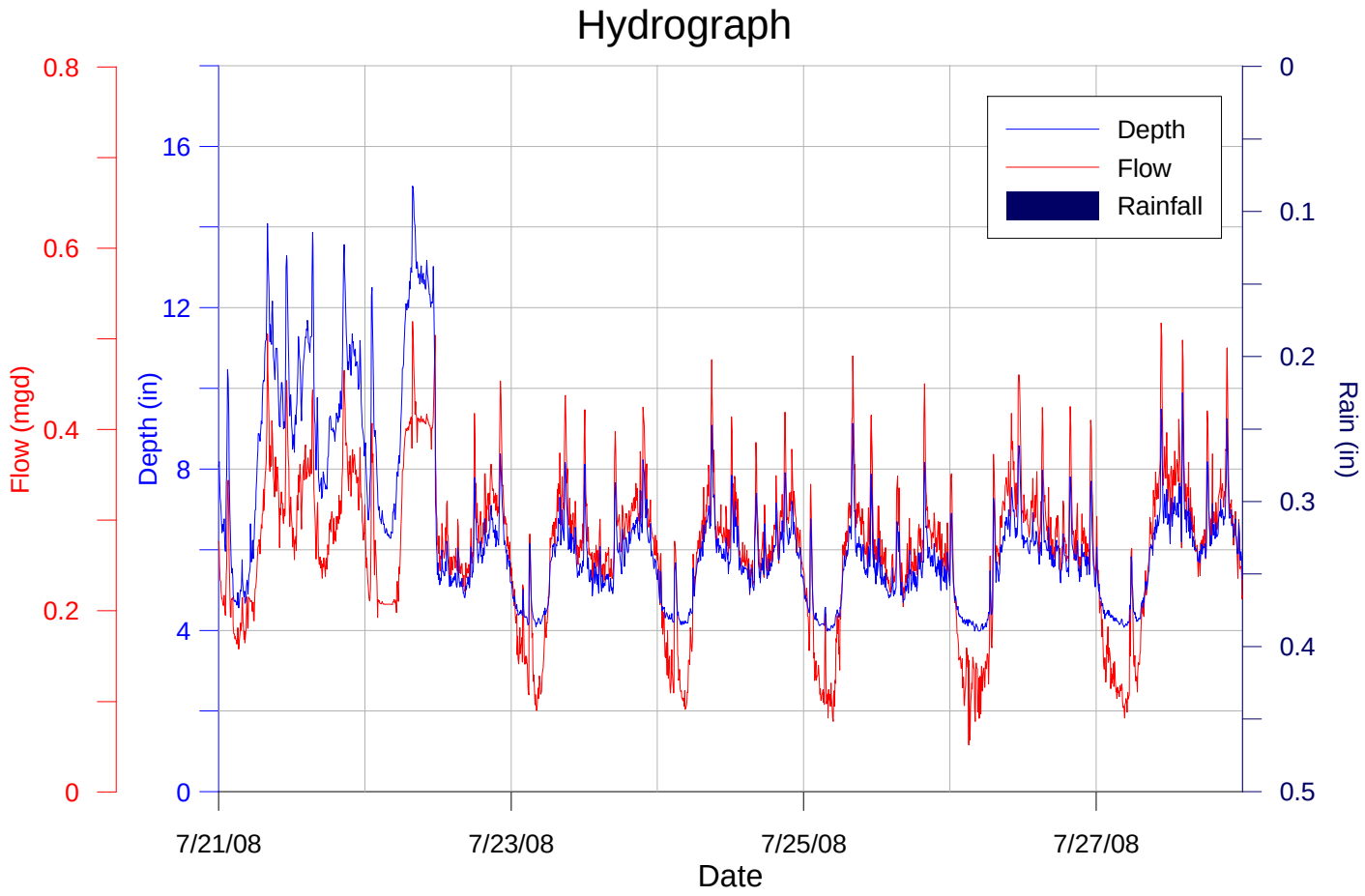


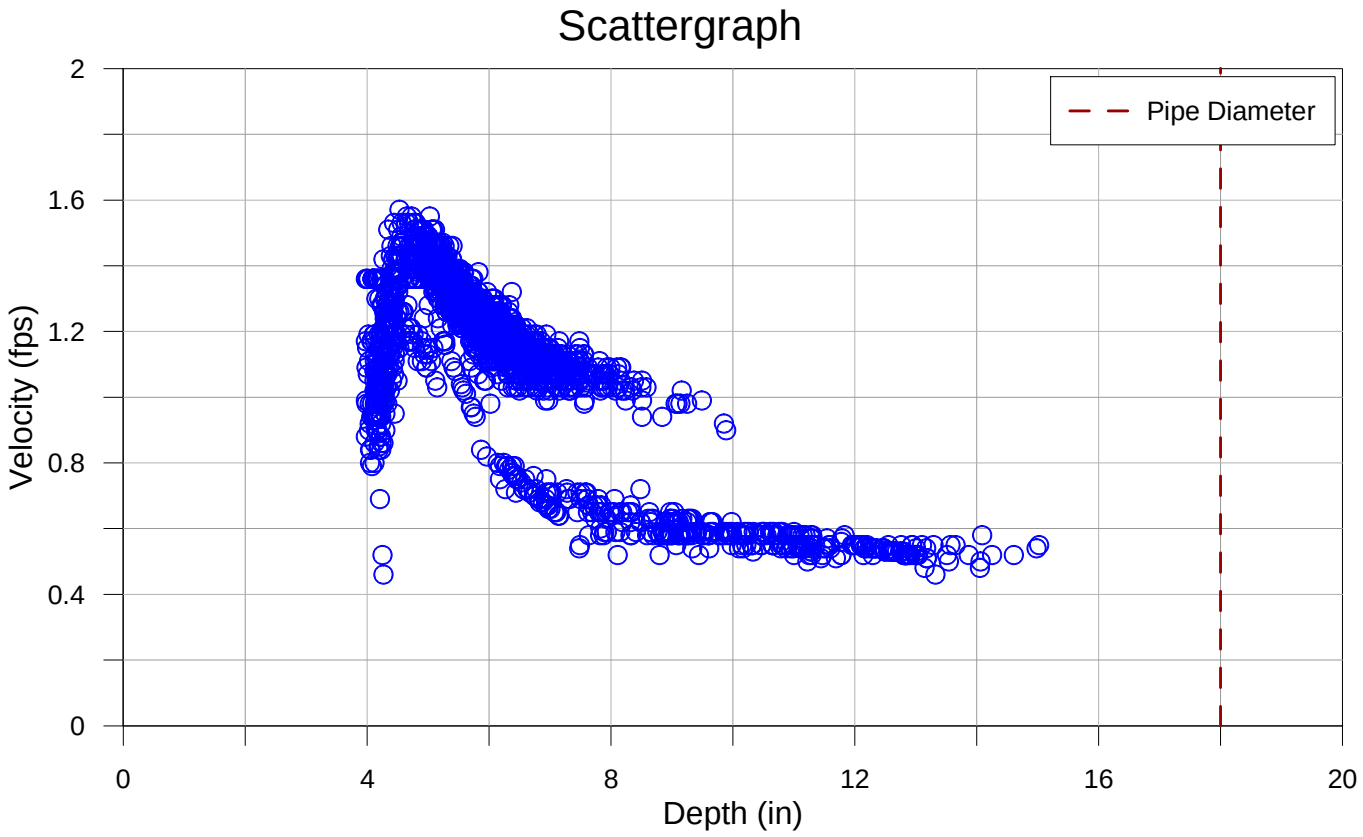
Monitor 306-343
January 4 - 11, 2009



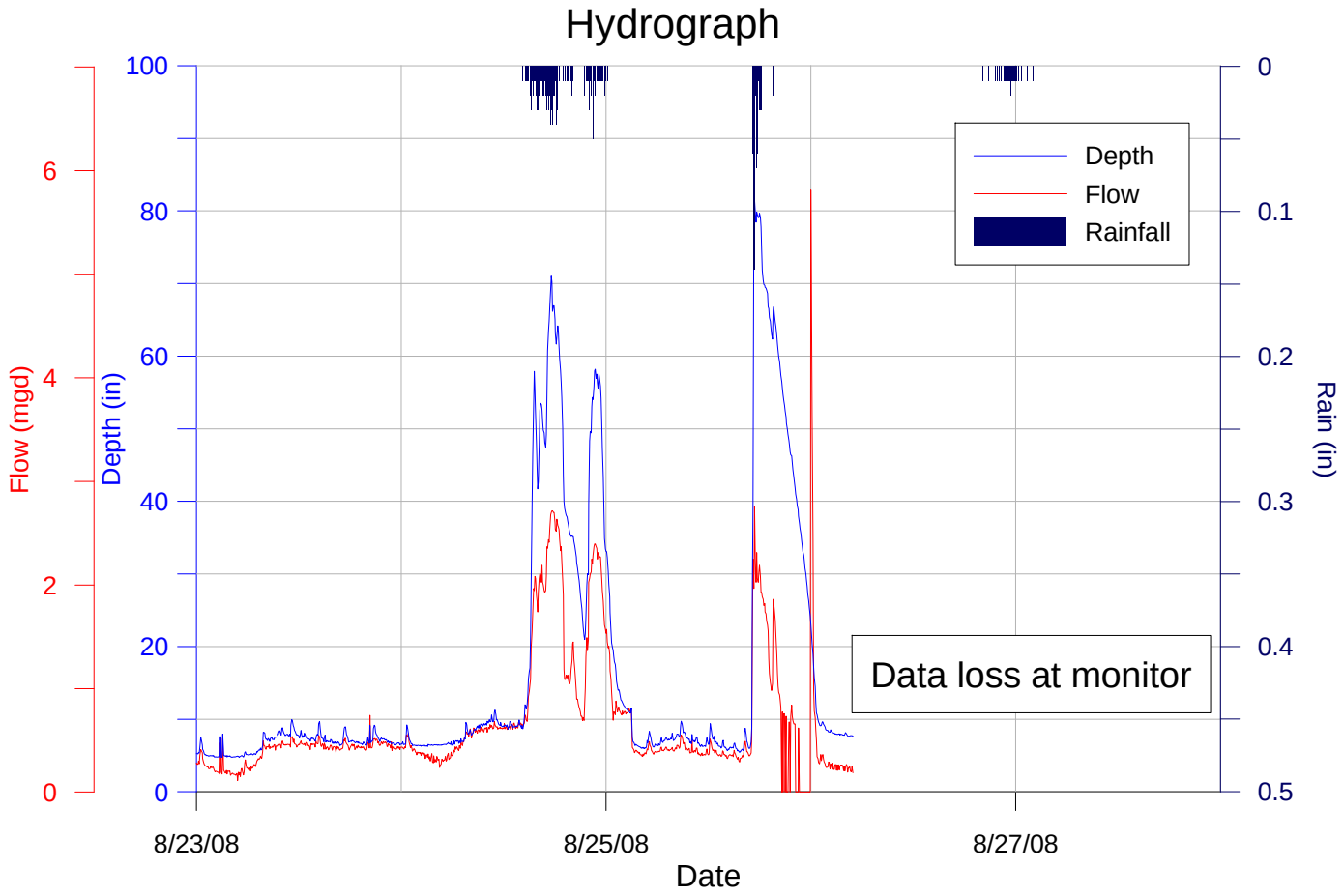


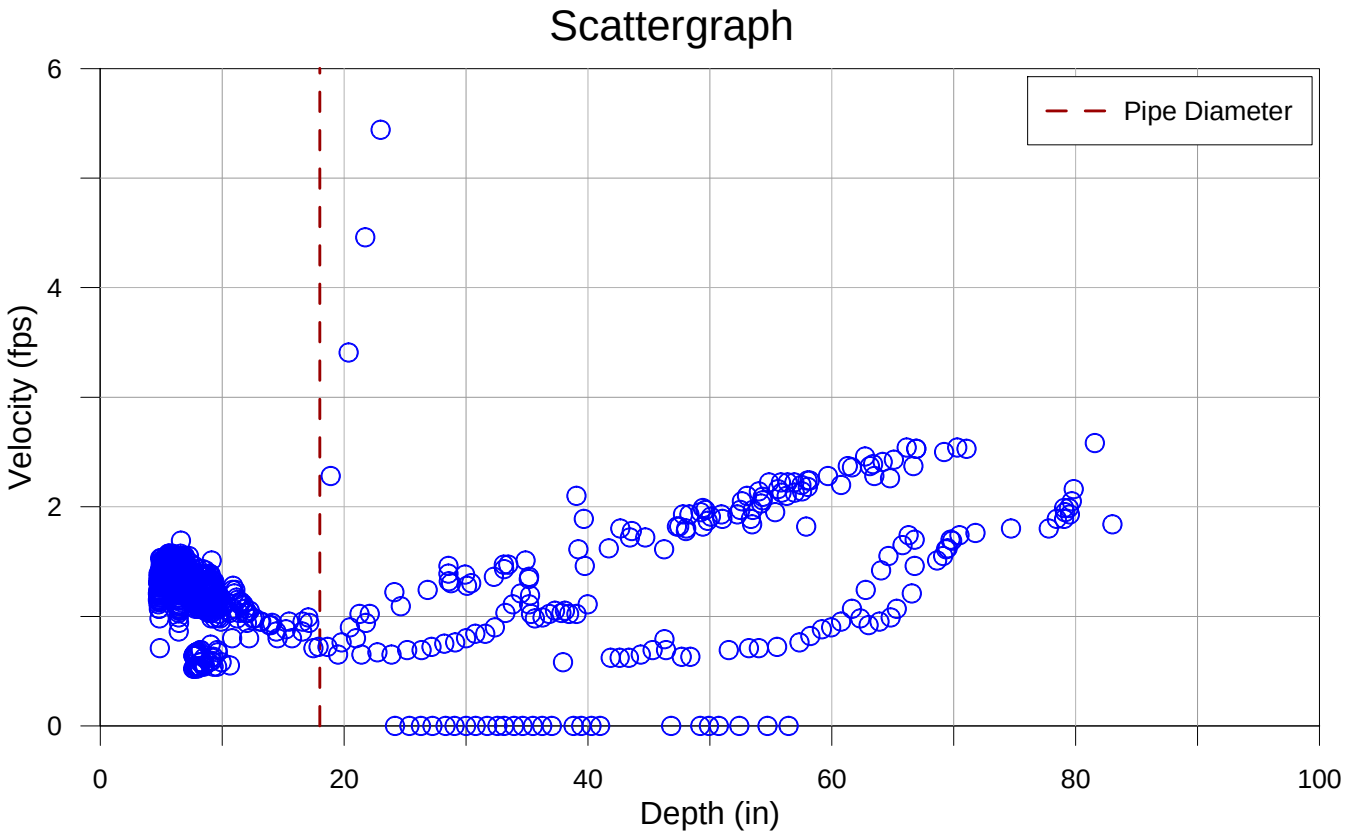
Monitor 306-428
July 21 - 28, 2008



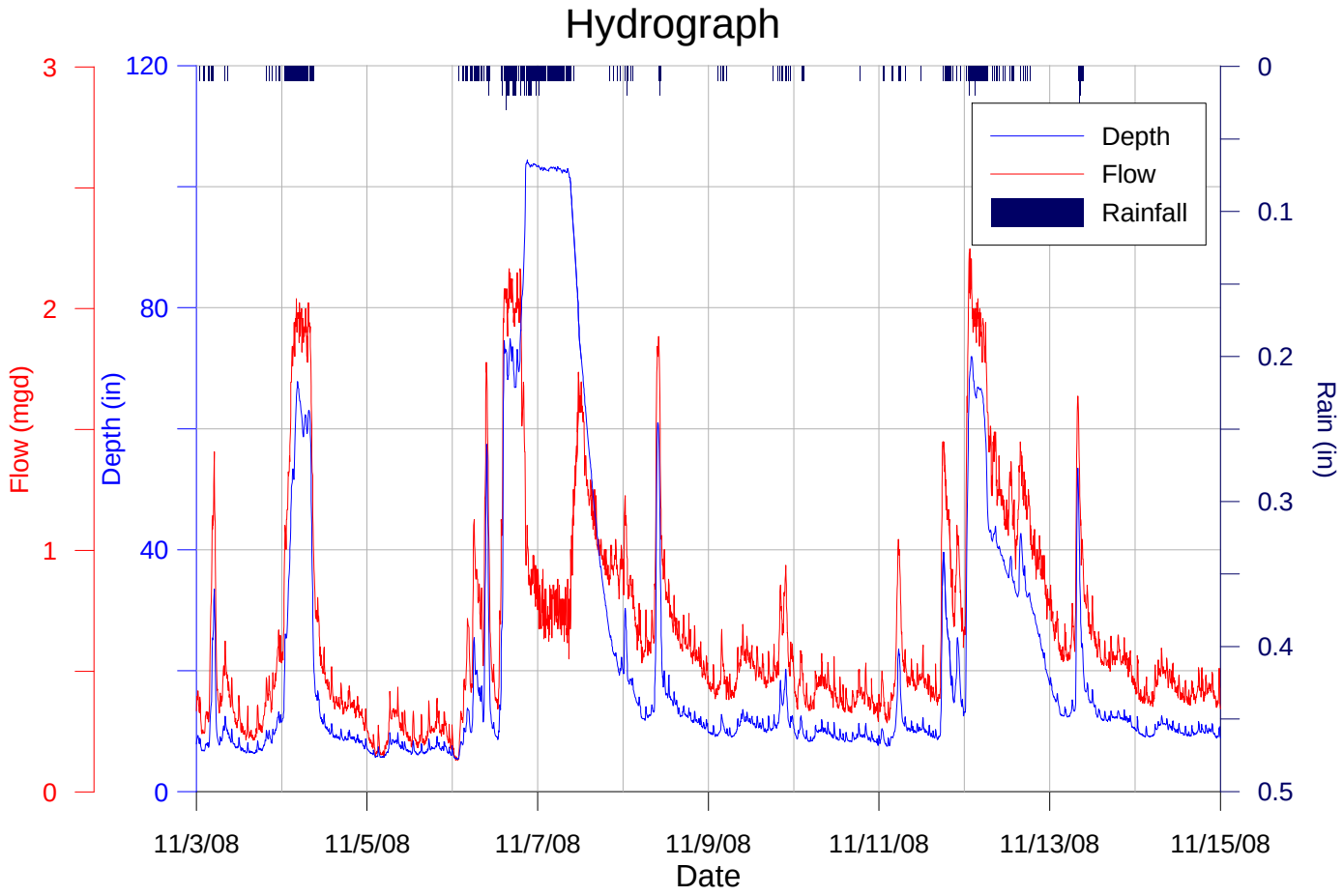


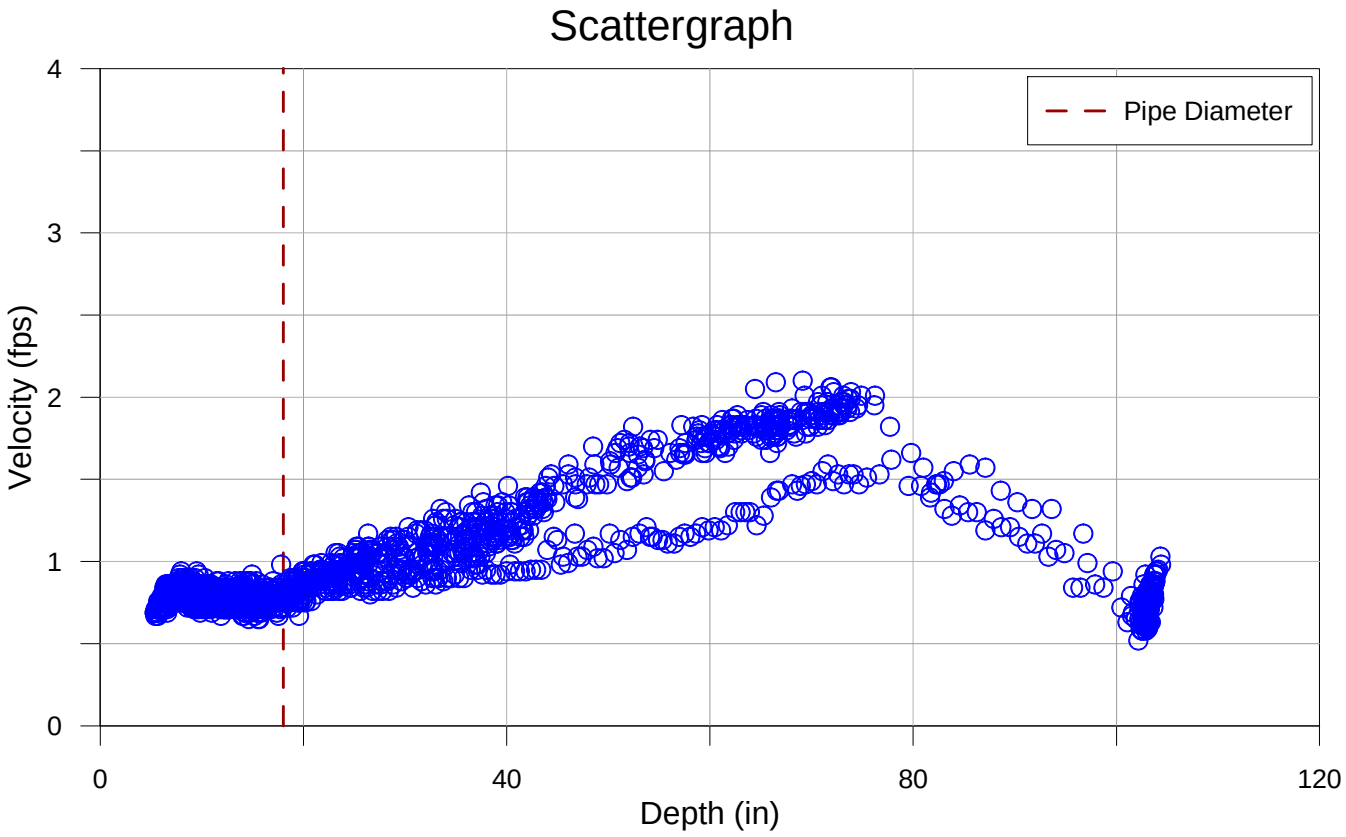
Monitor 306-248
August 23 - 28, 2008



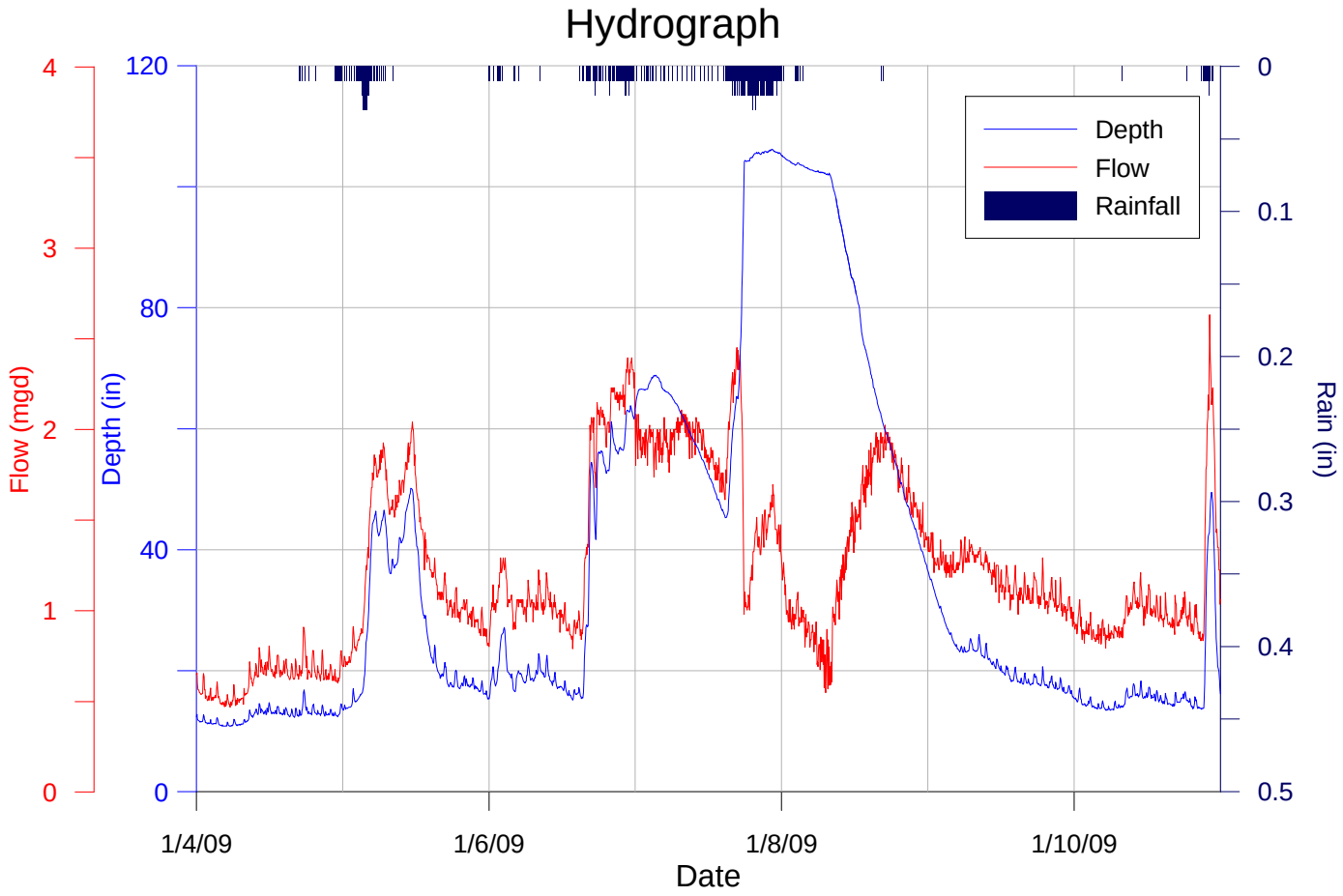


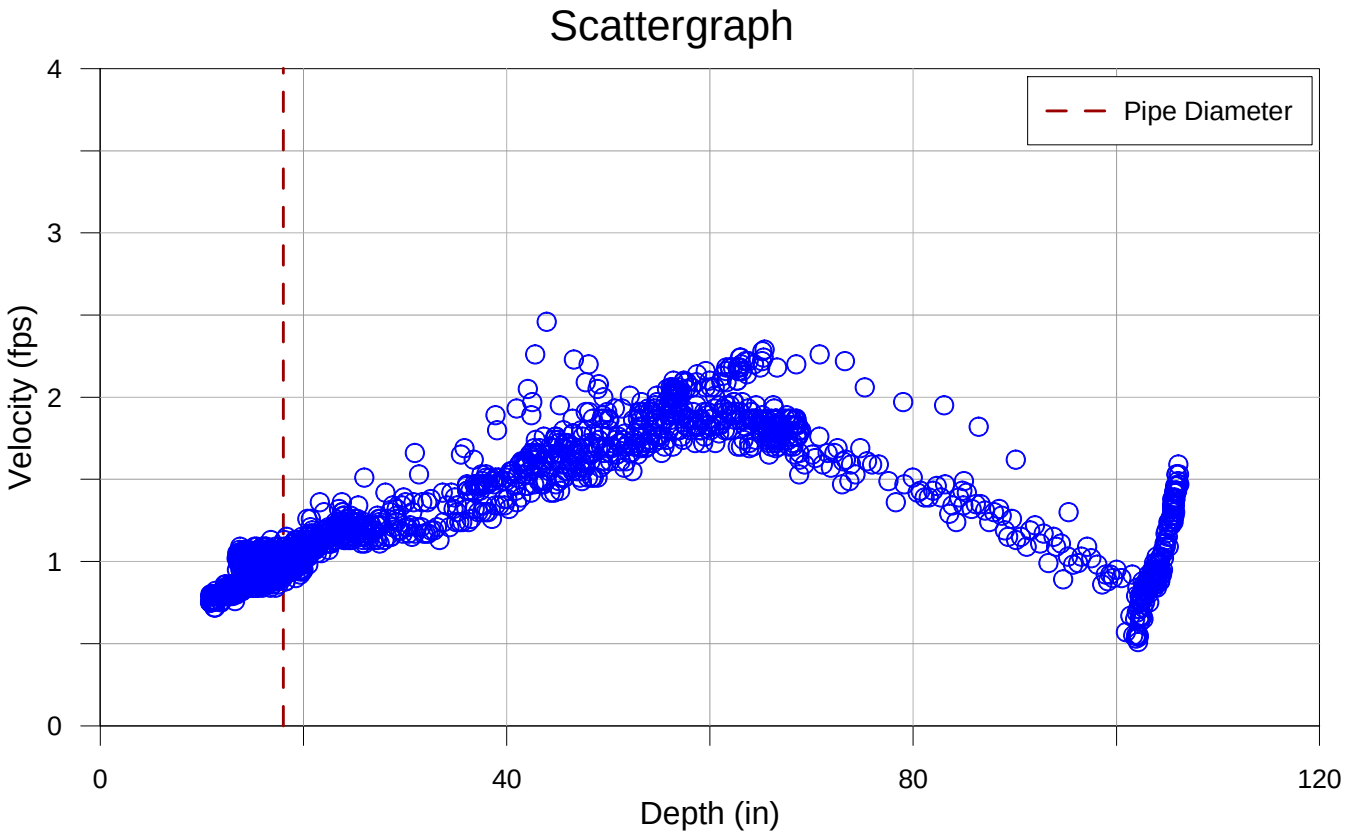
Monitor 306-428
November 3 - 15, 2008



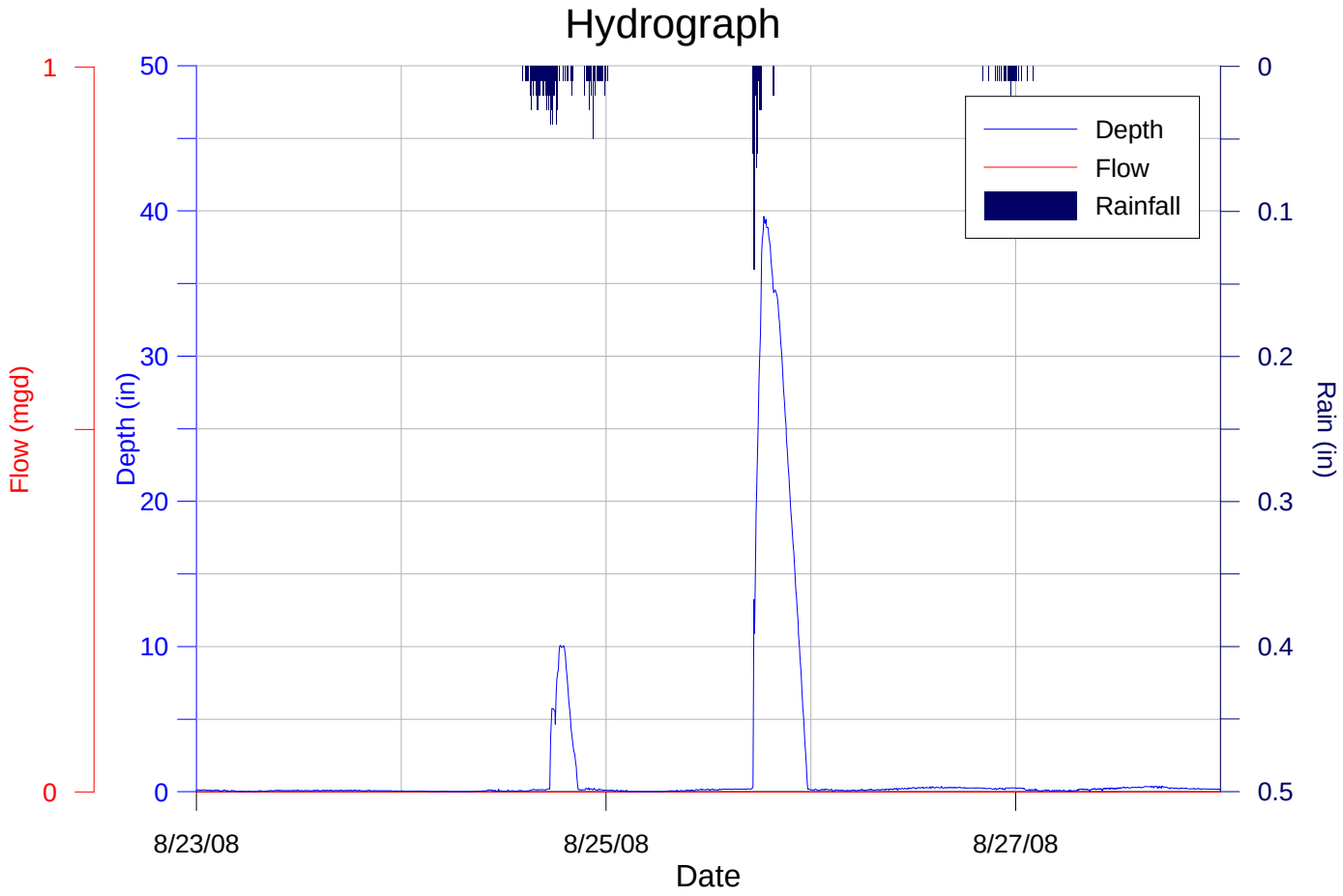


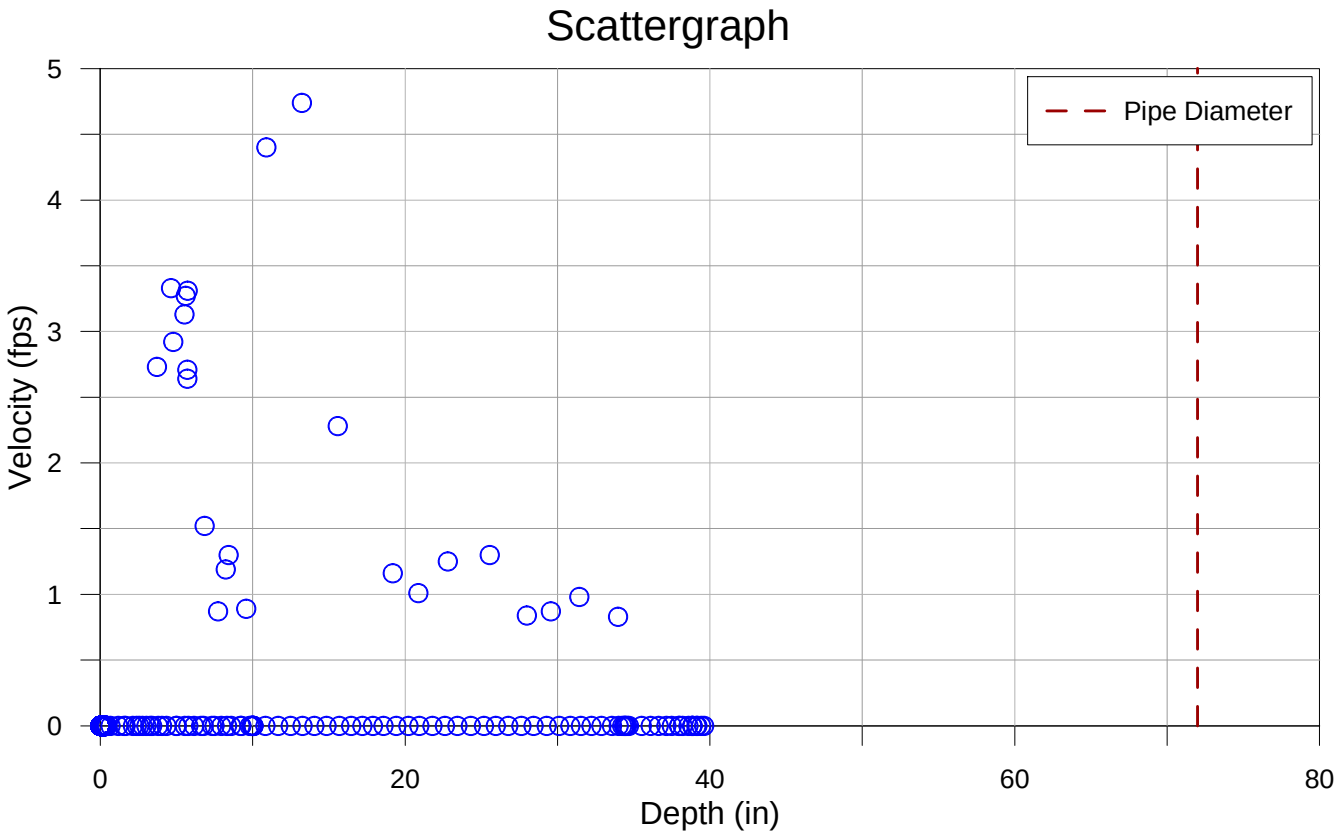
Monitor 306-428
January 4 - 11, 2009



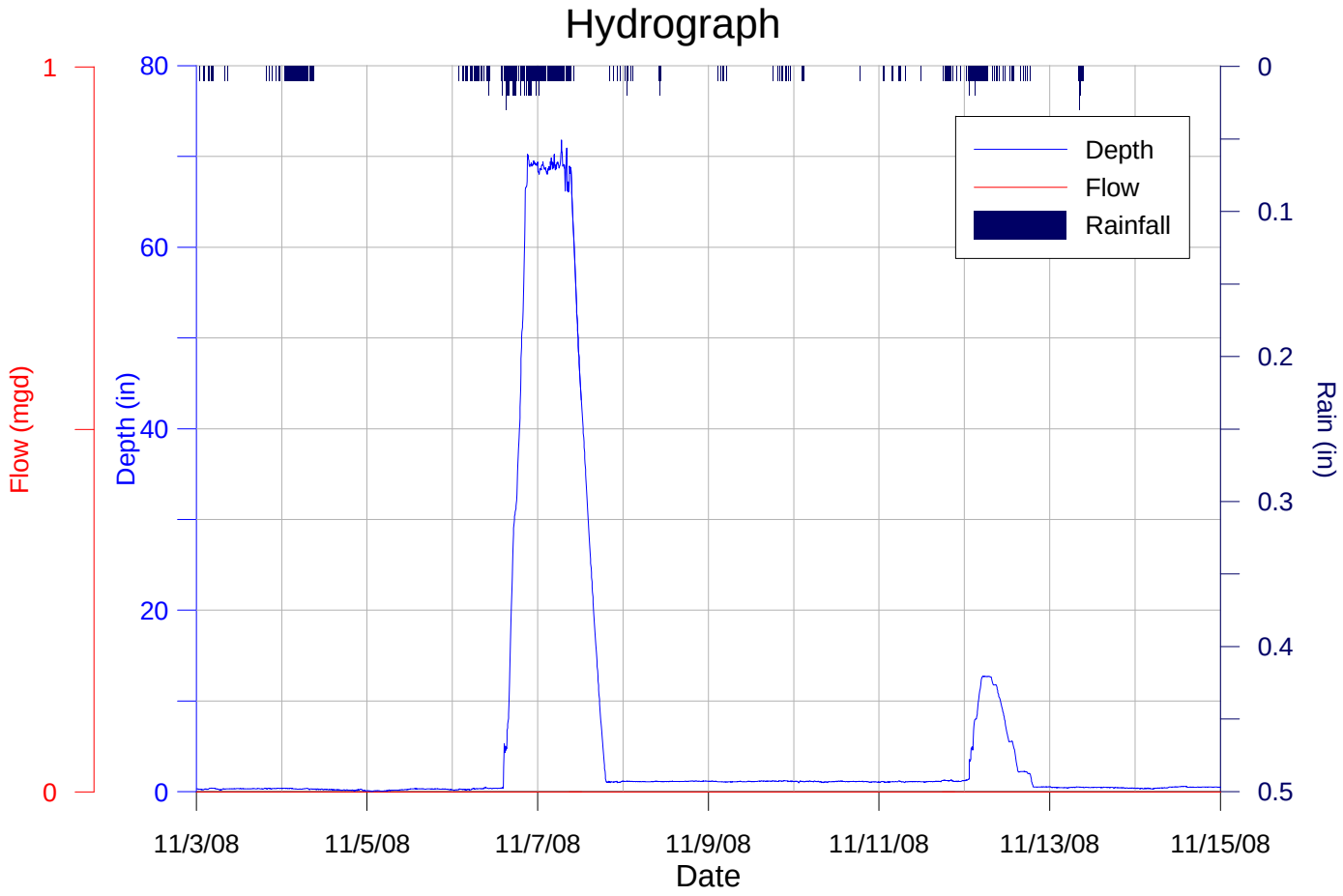


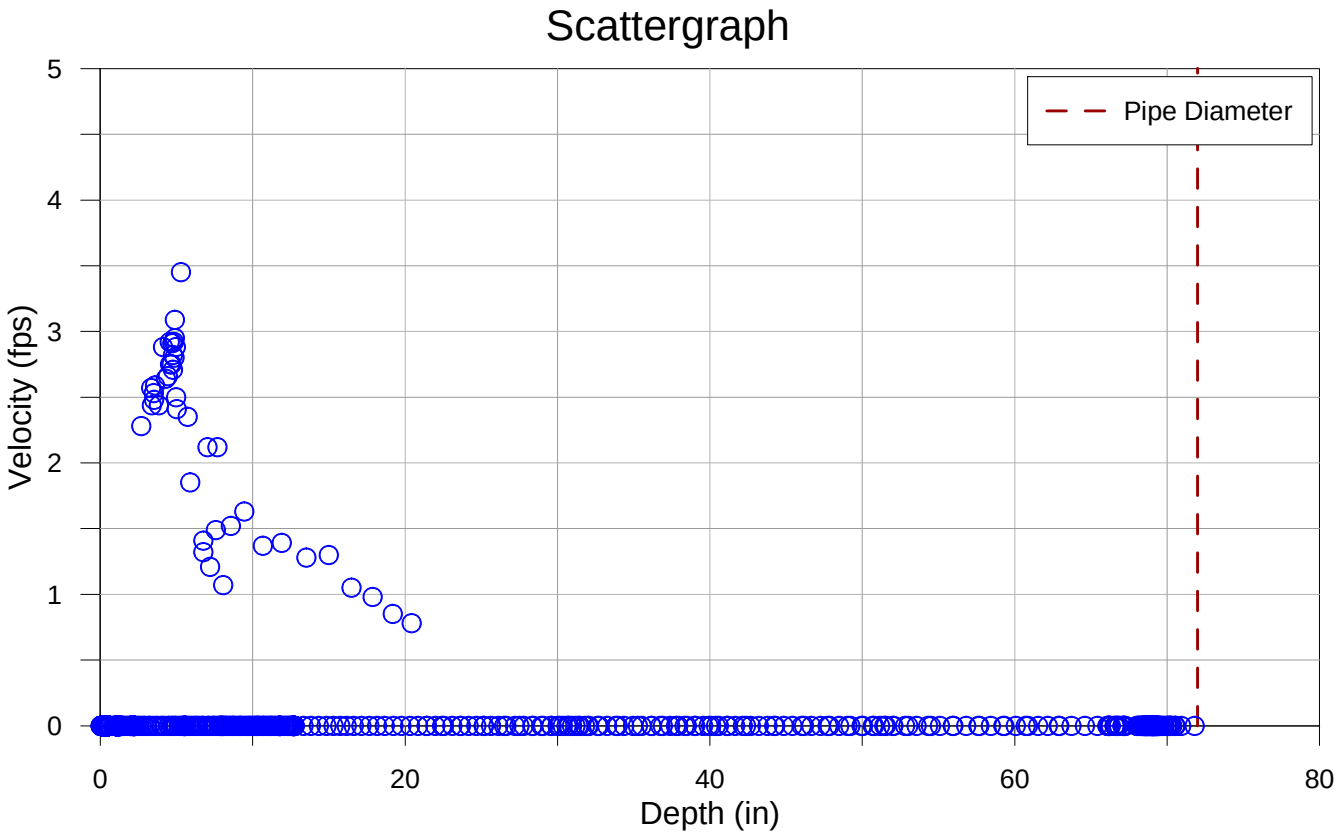
Monitor 306-437 (49)
August 23 - 28, 2008



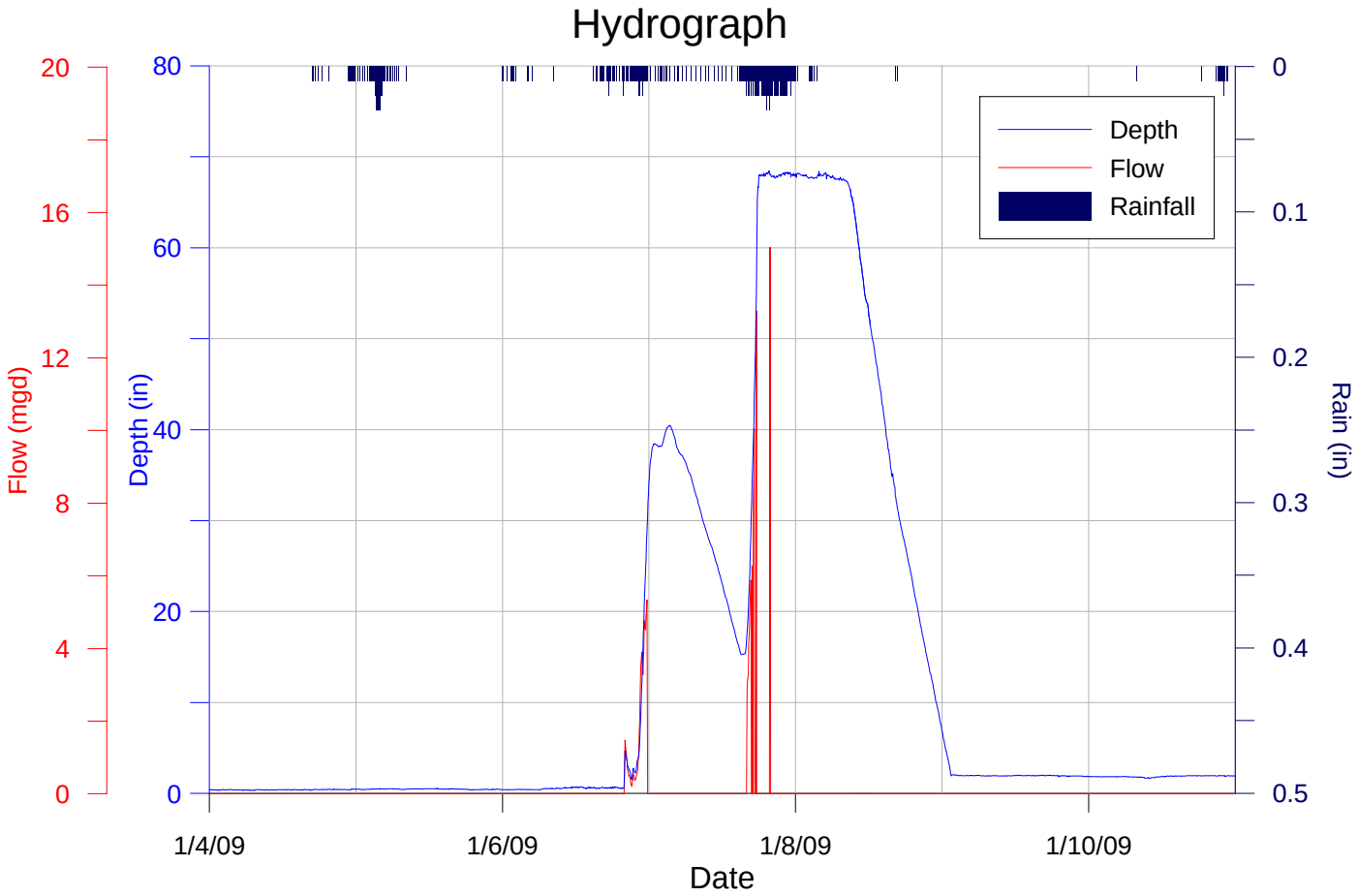


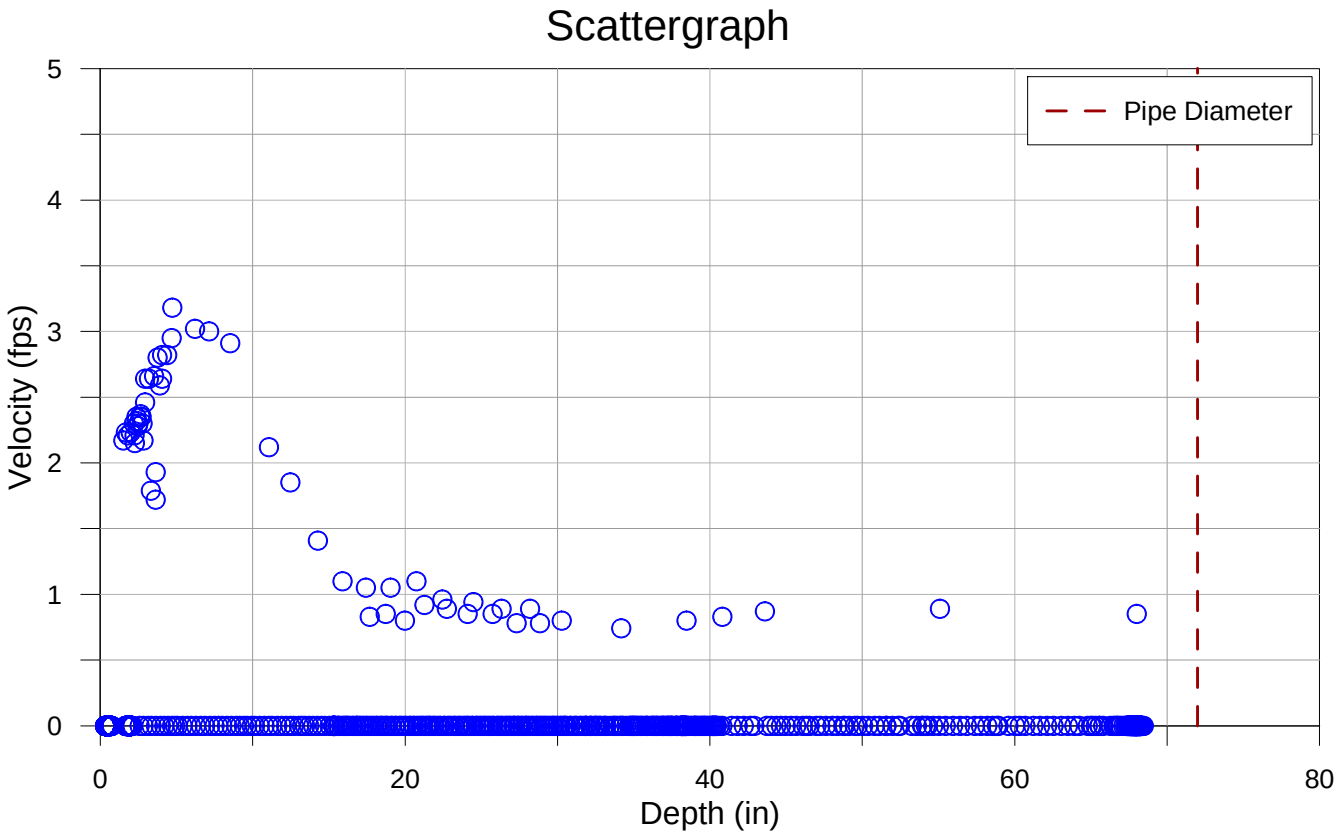
Monitor 306-437 (49)
November 3 - 15, 2008



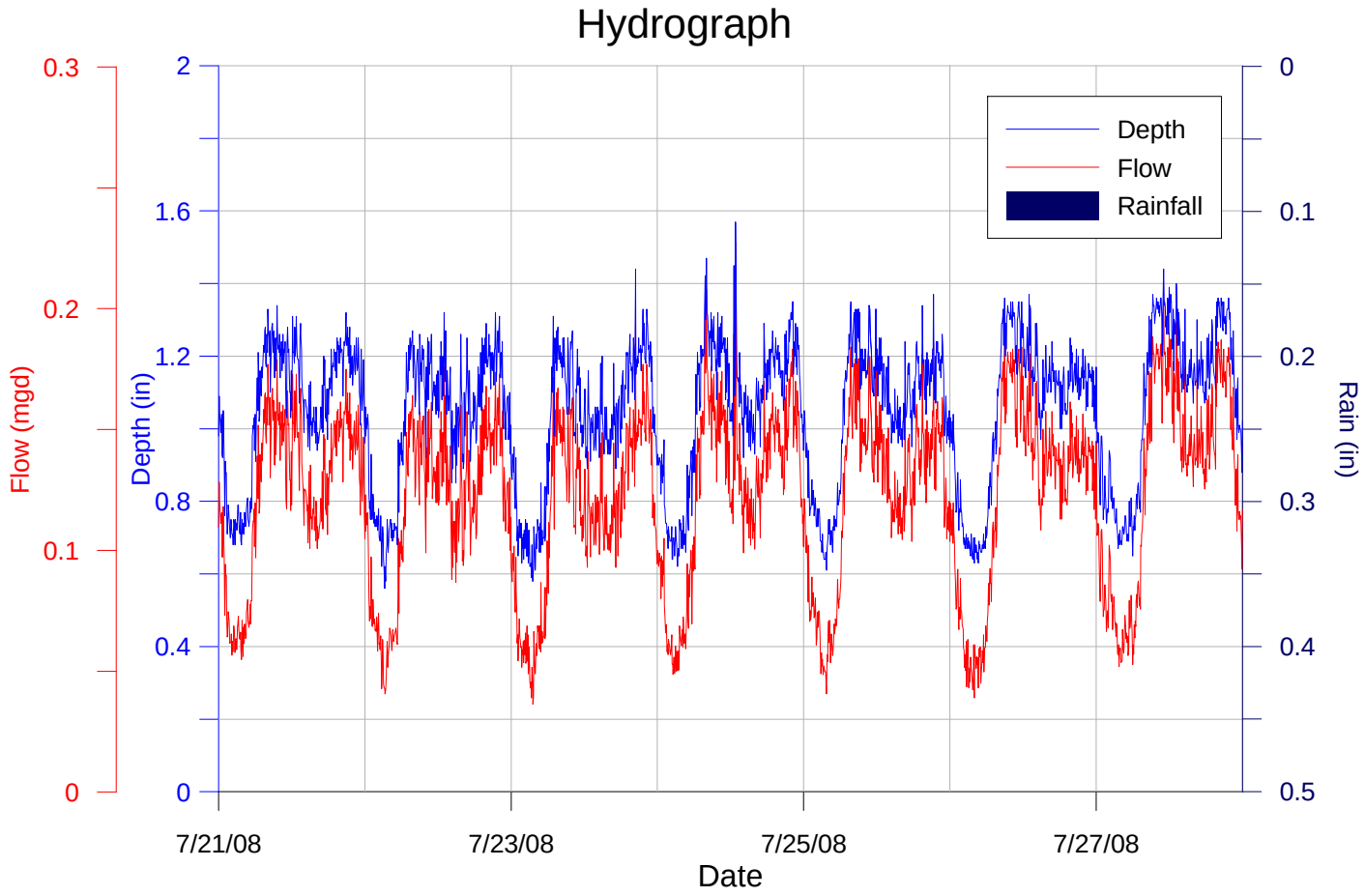


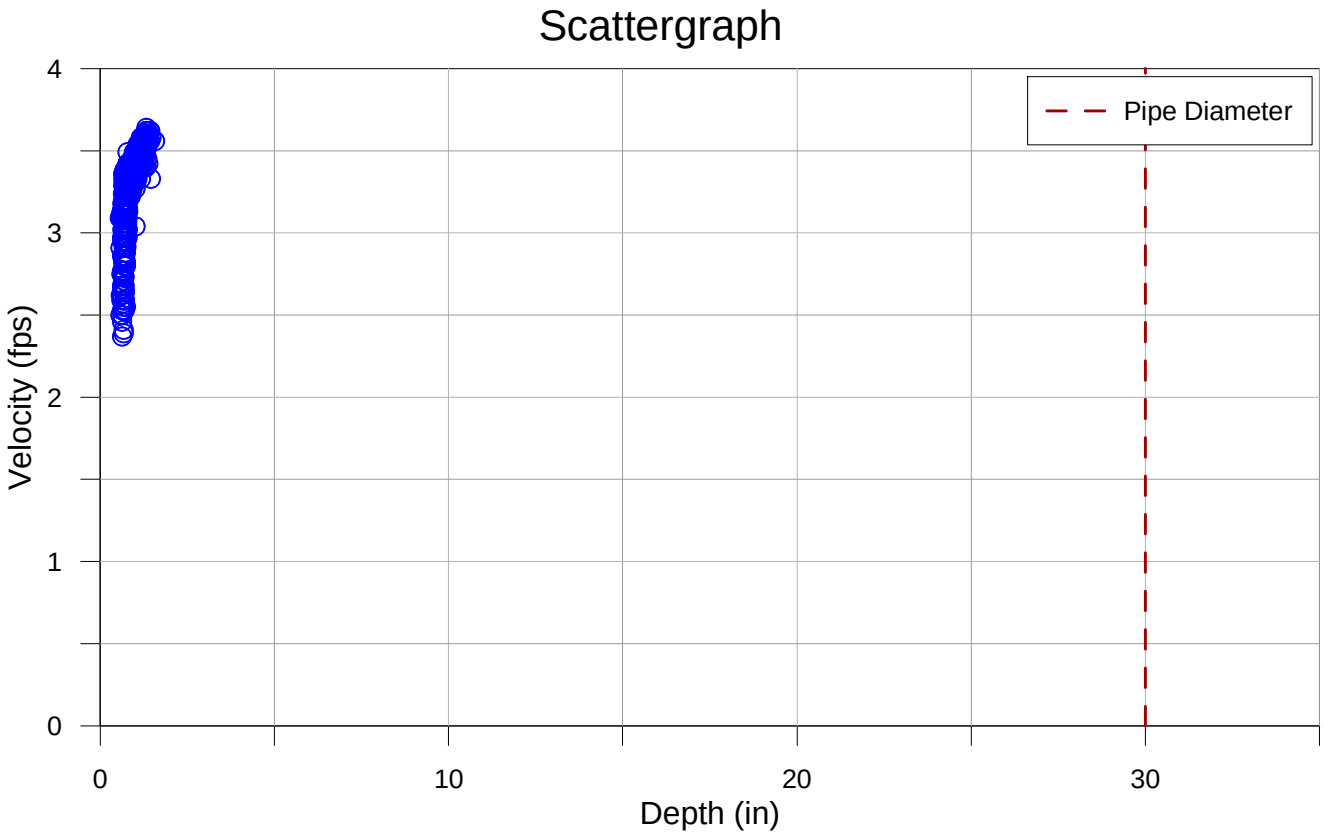
Monitor 306-437 (49)
January 4 - 11, 2009



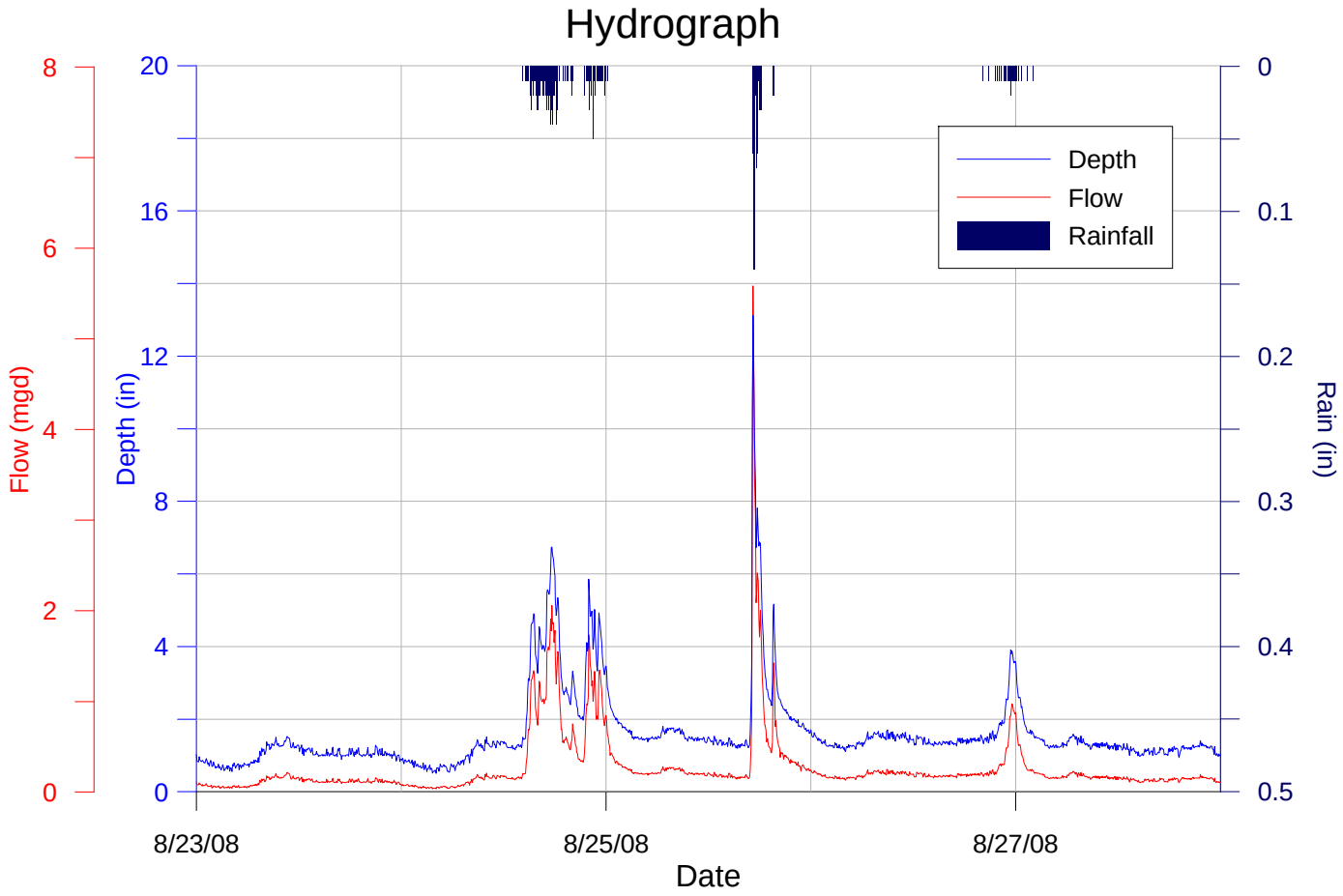


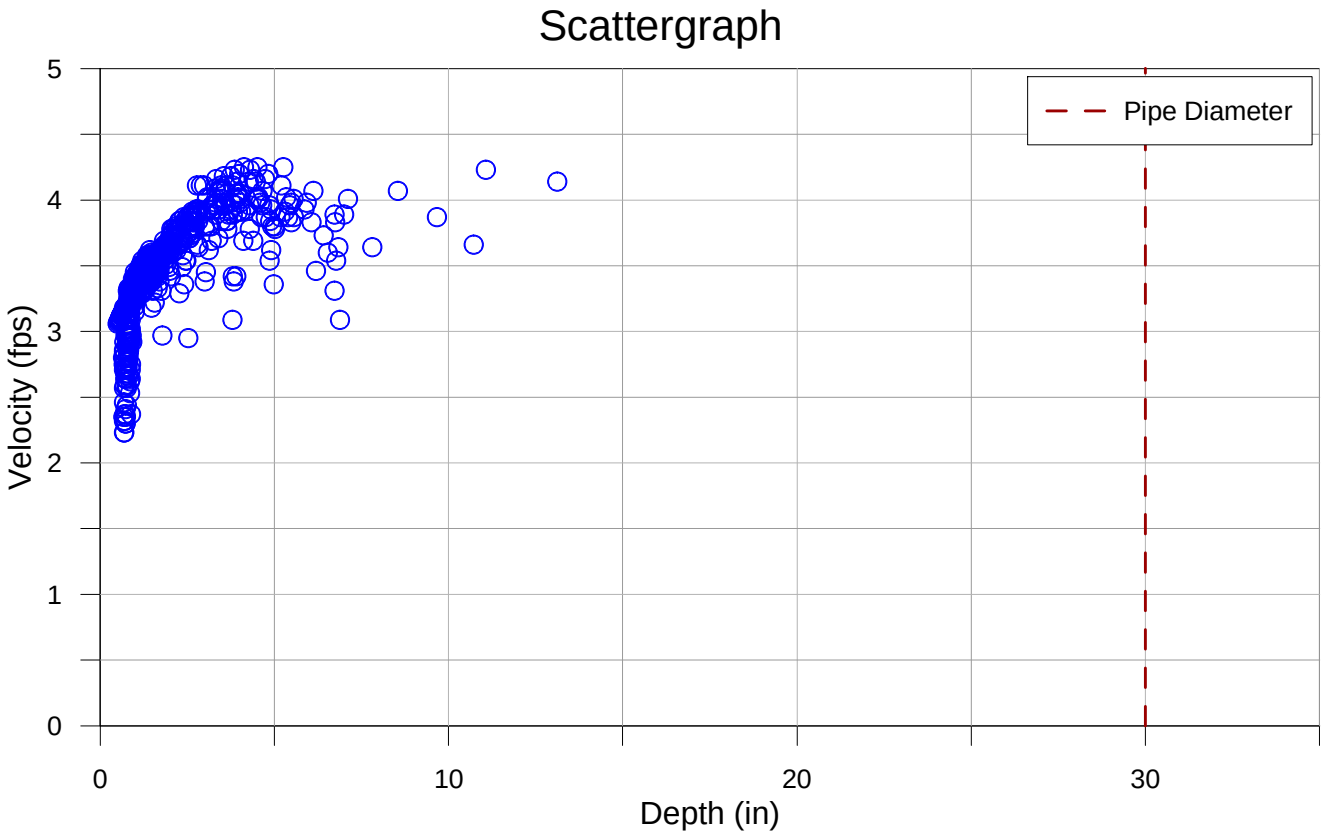
Monitor 081-237
July 21 - 28, 2008



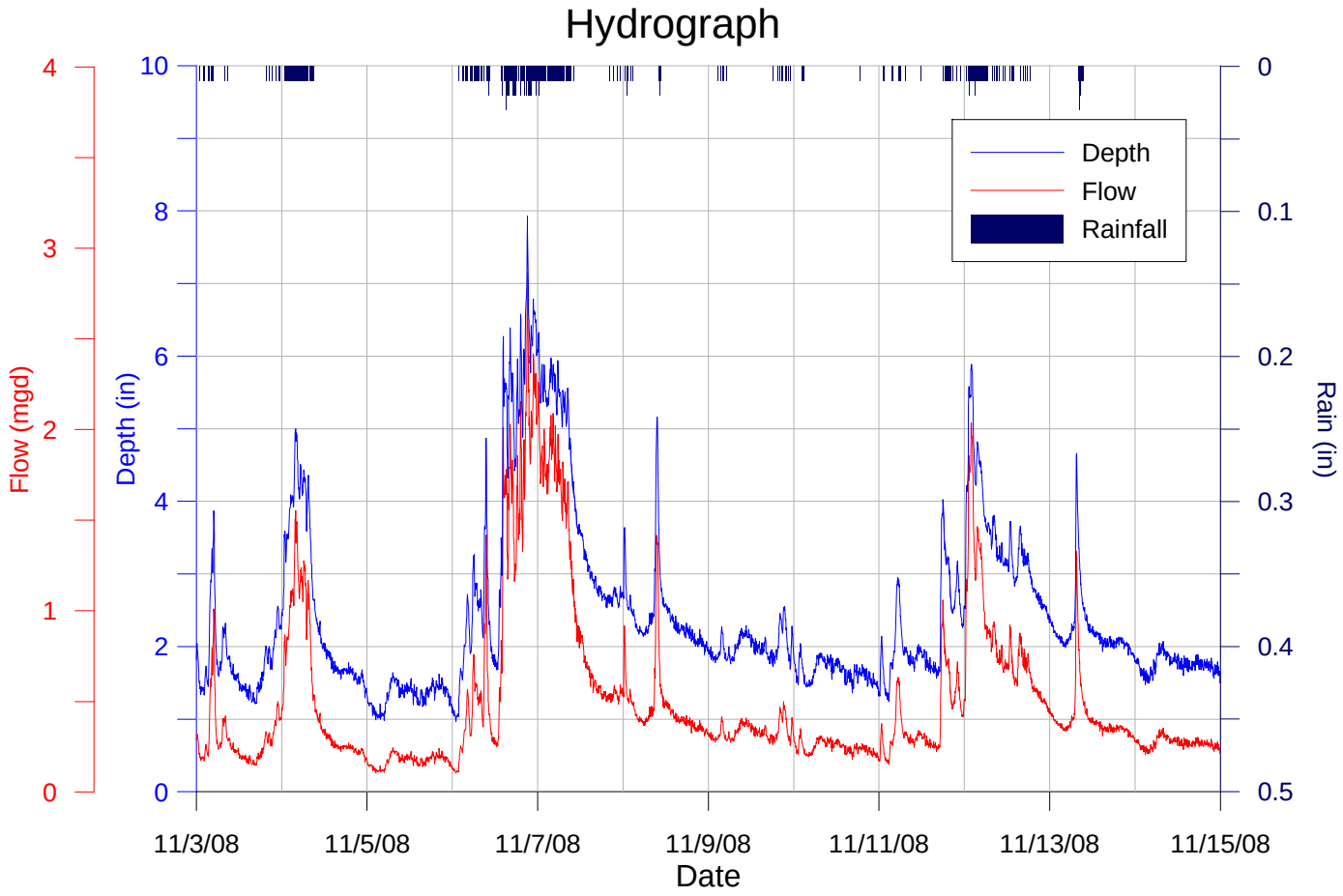


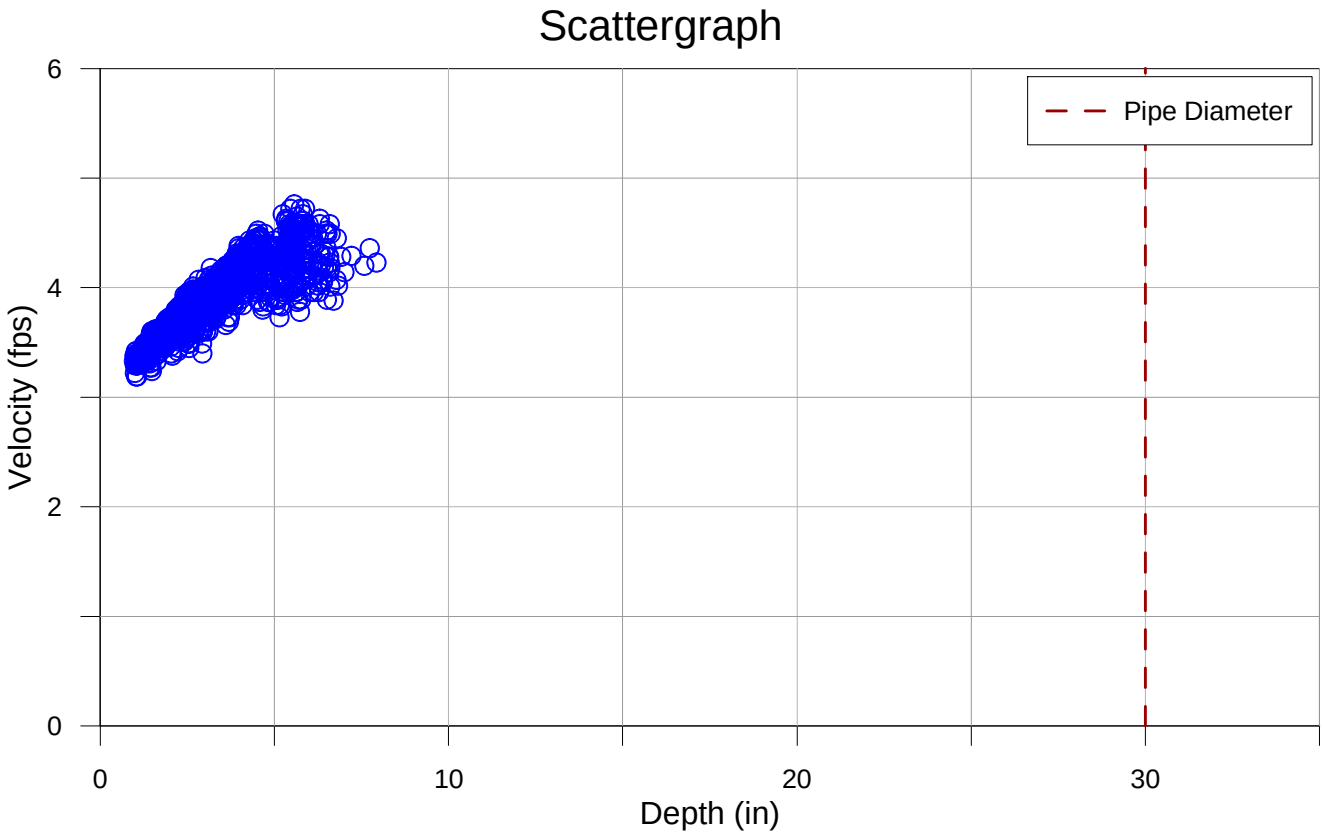
Monitor 081-237
August 23 - 28, 2008



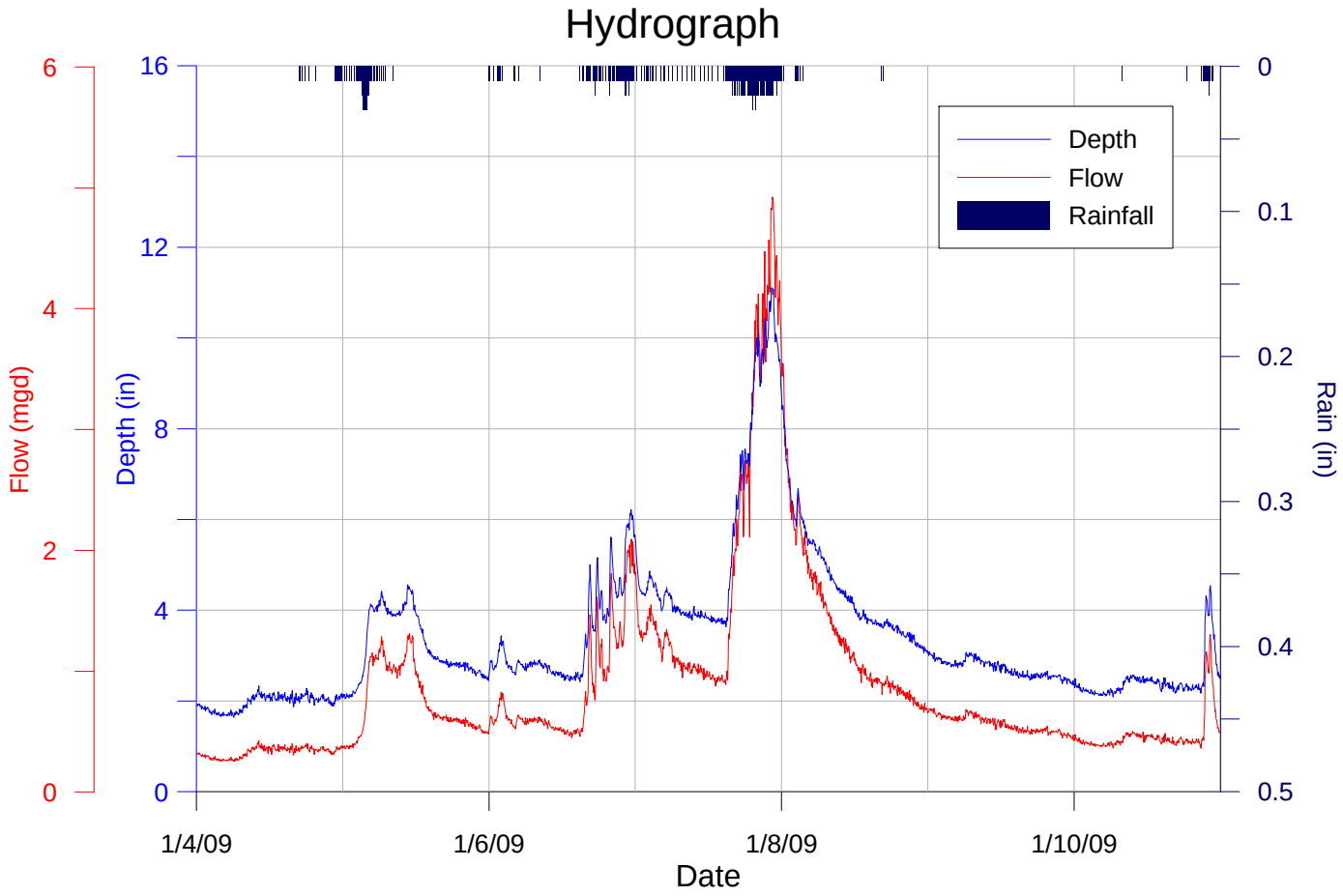


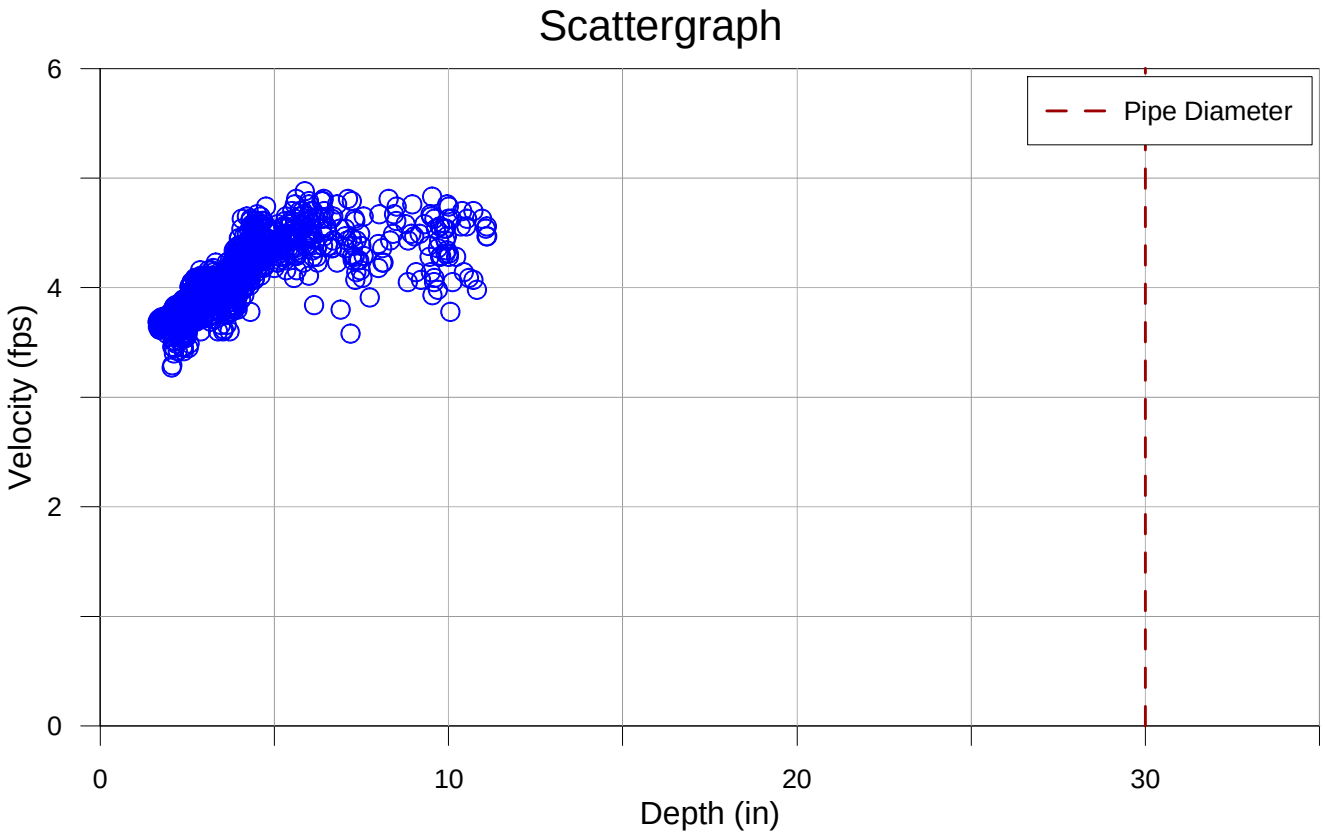
Monitor 081-237
November 3 - 15, 2008



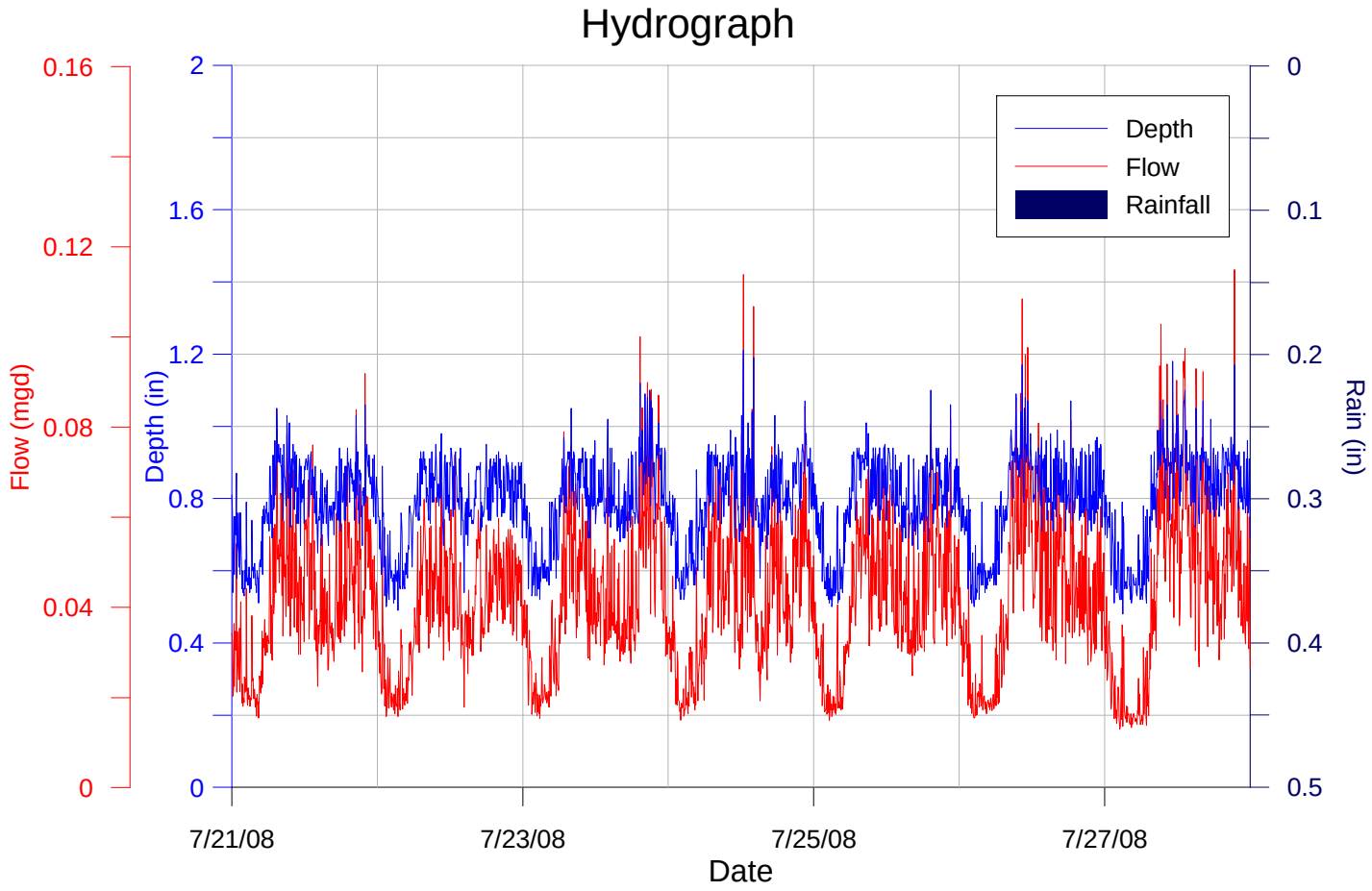


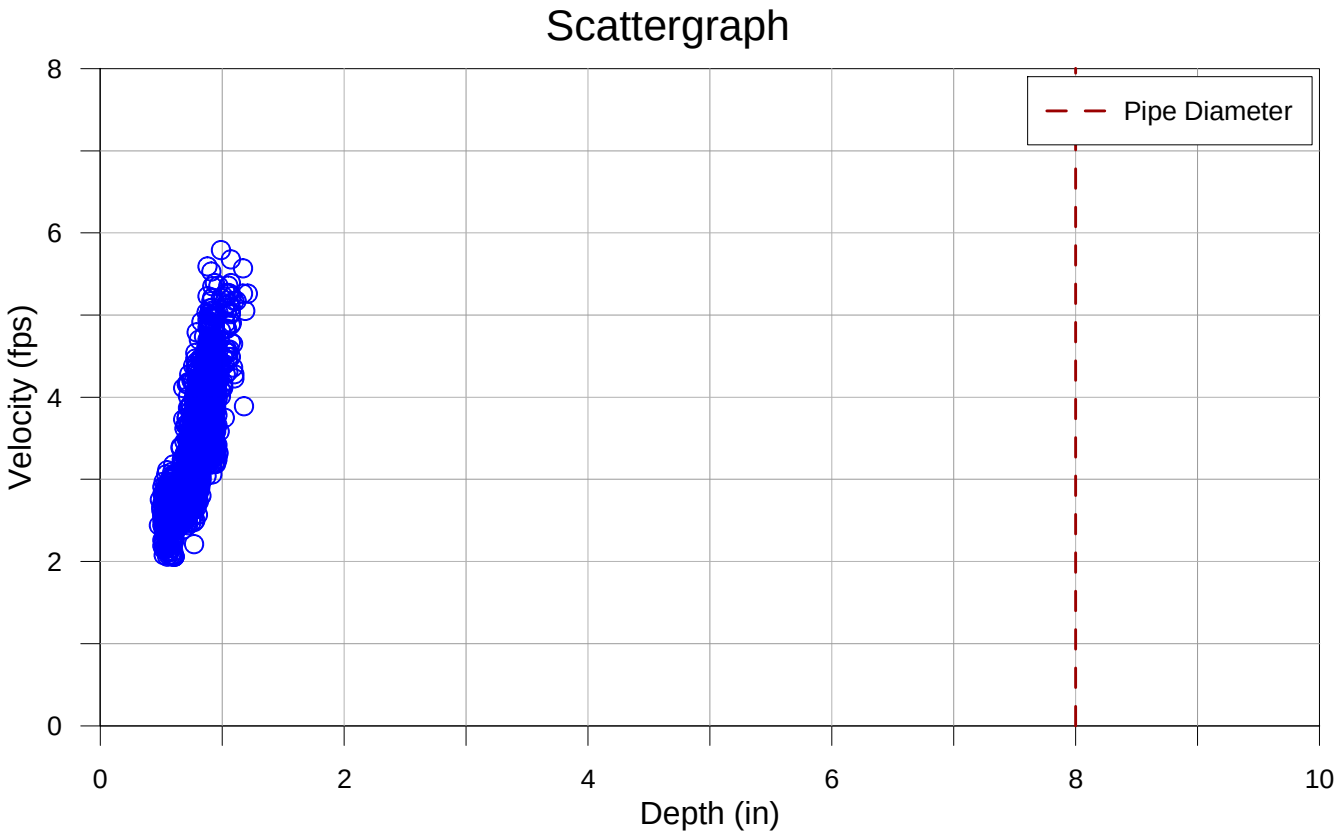
Monitor 081-237
January 4 - 11, 2009





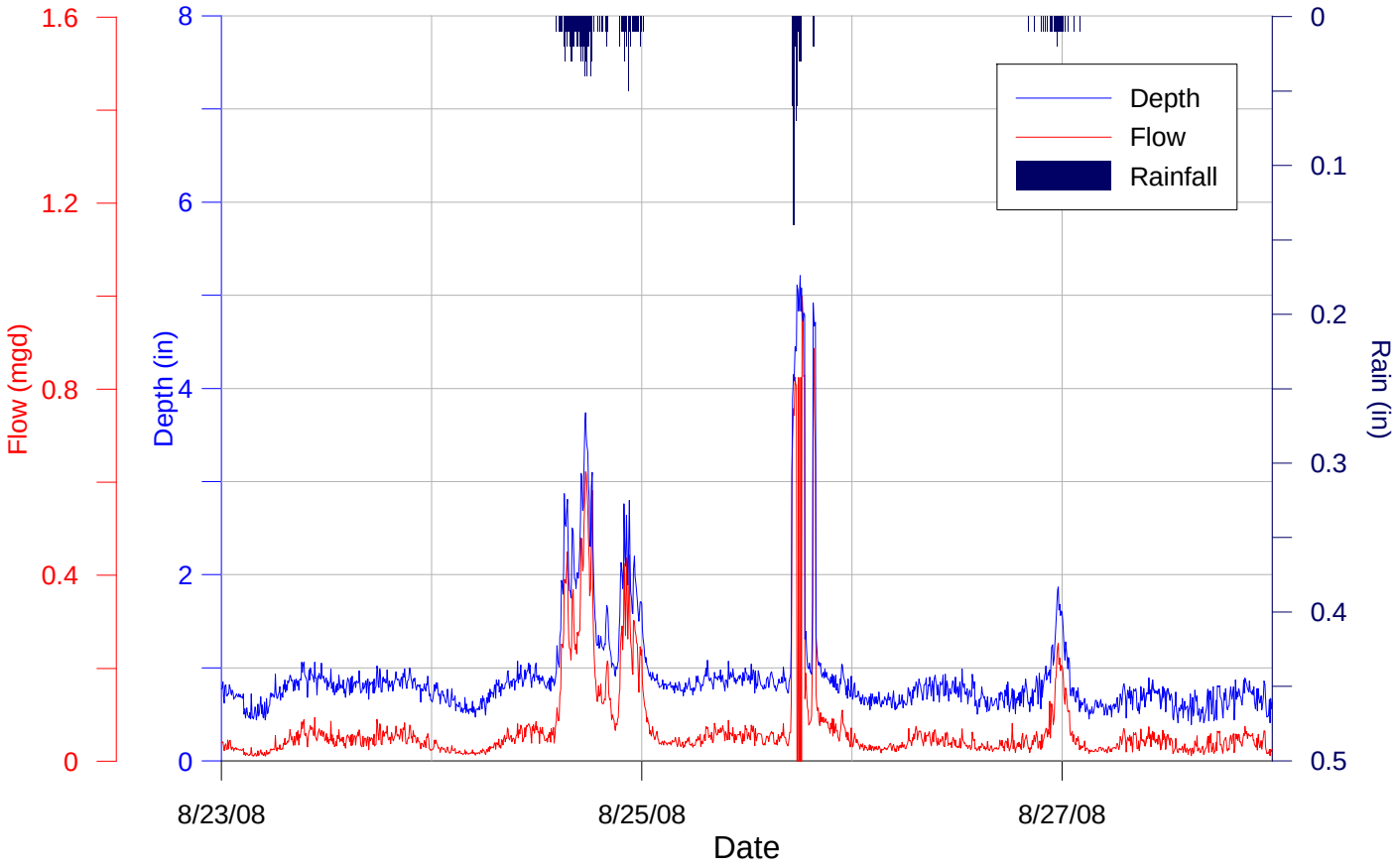
Monitor 306-192
July 21 - 28, 2008



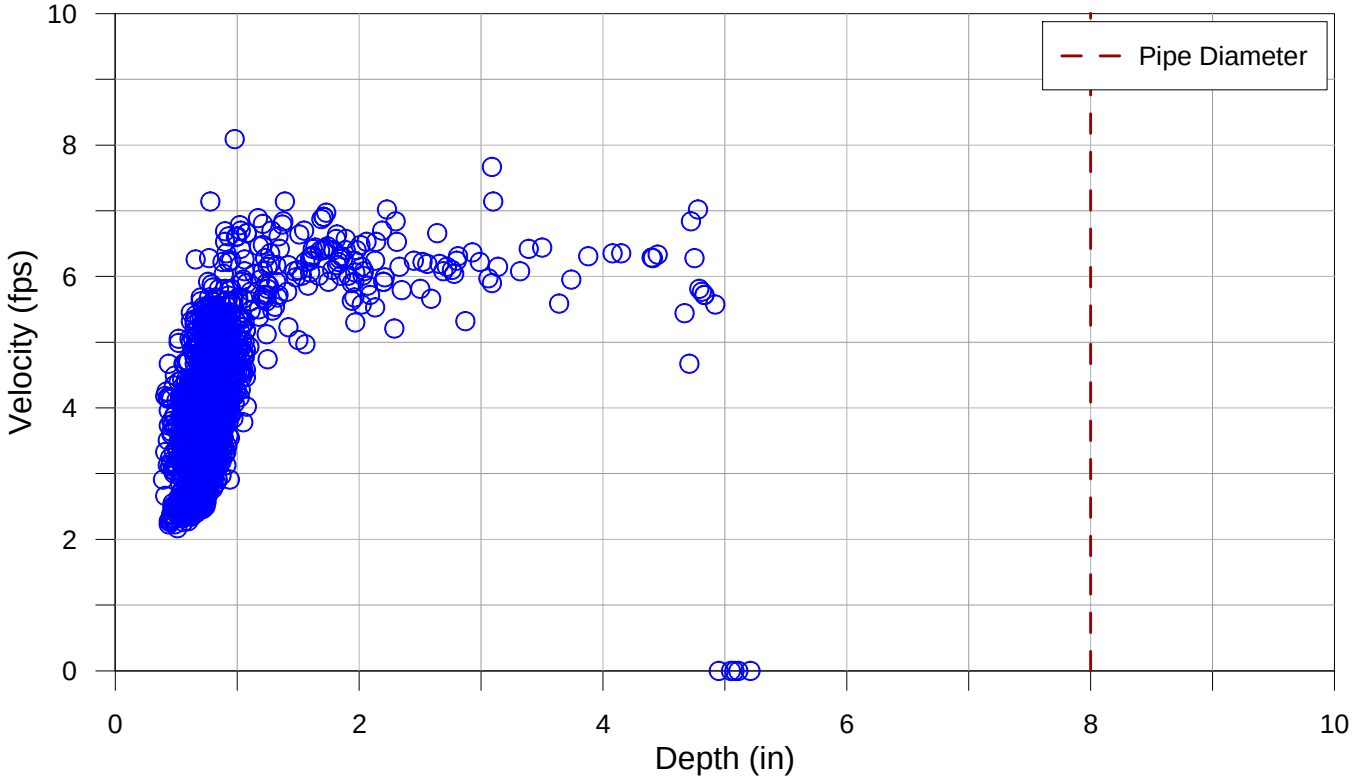


Monitor 306-192
August 23 - 28, 2008

Hydrograph

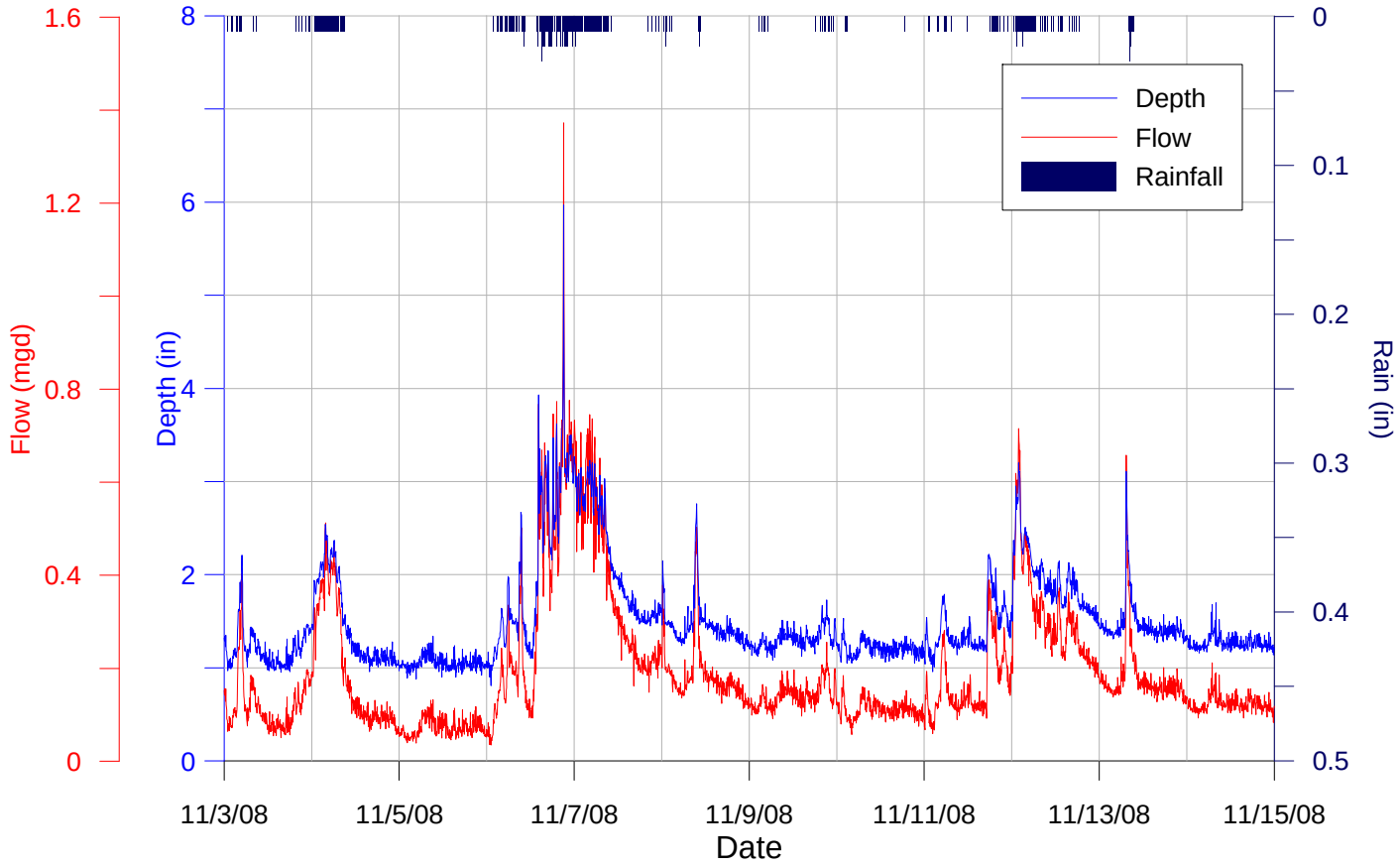


Scattergraph

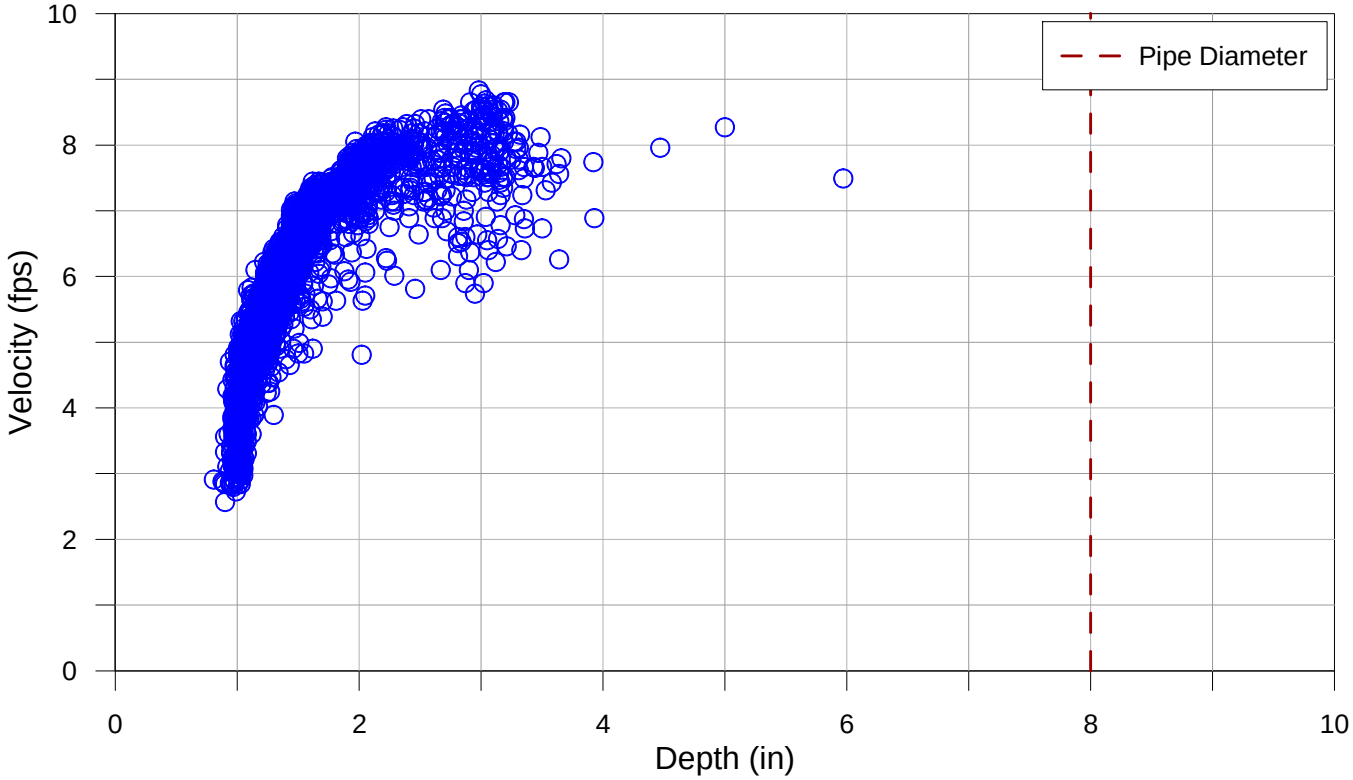


Monitor 306-192
November 3 - 15, 2008

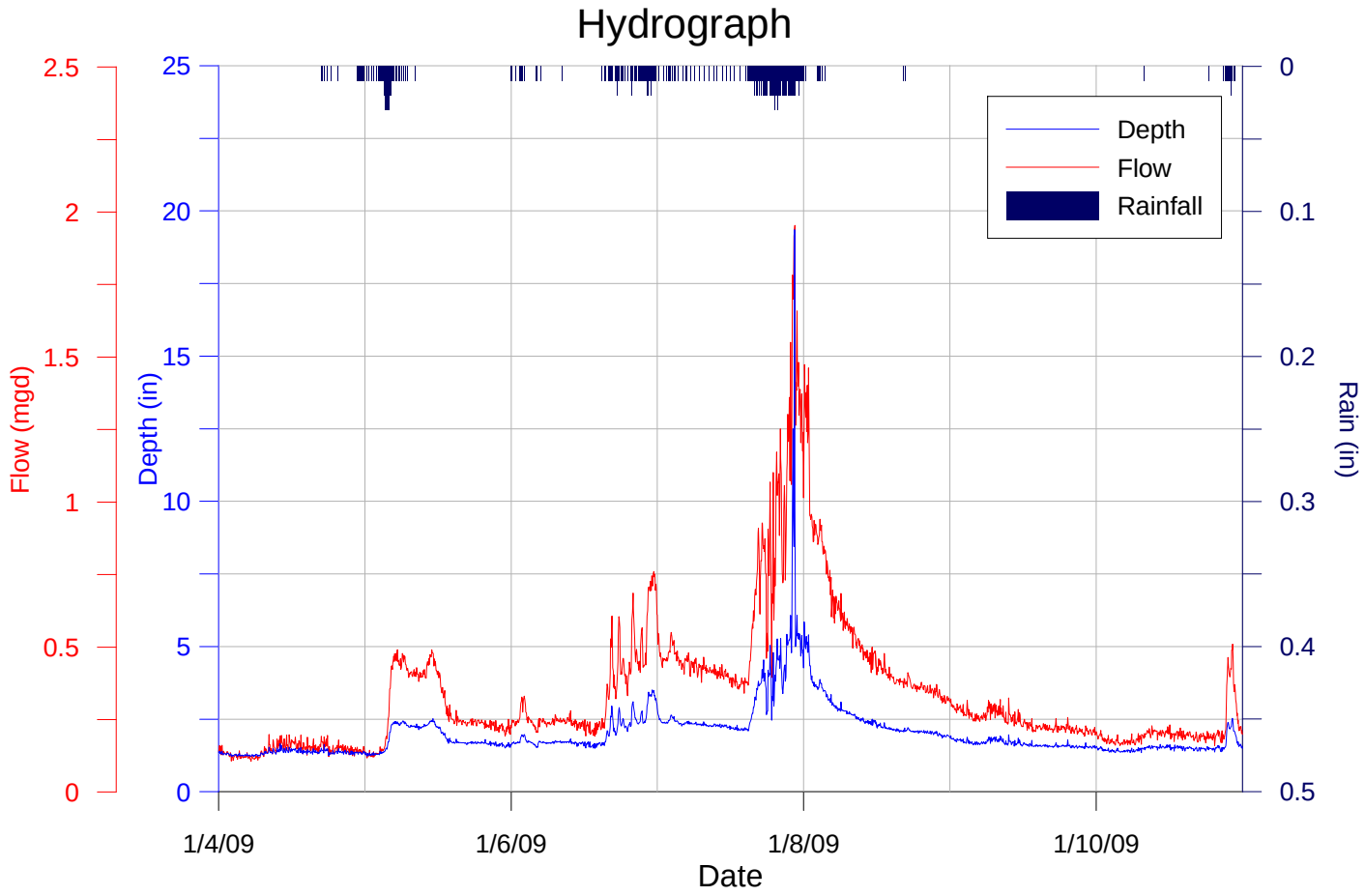
Hydrograph

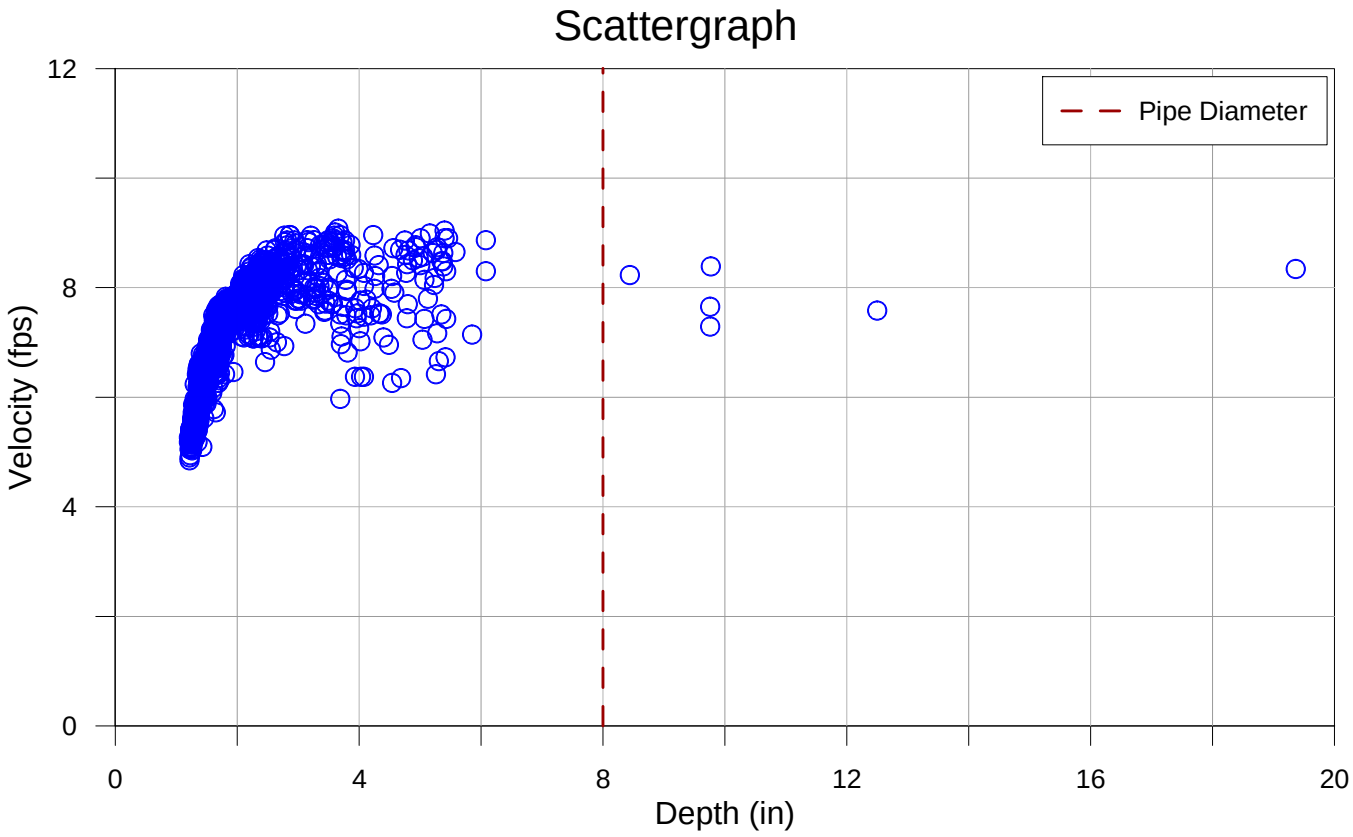


Scattergraph

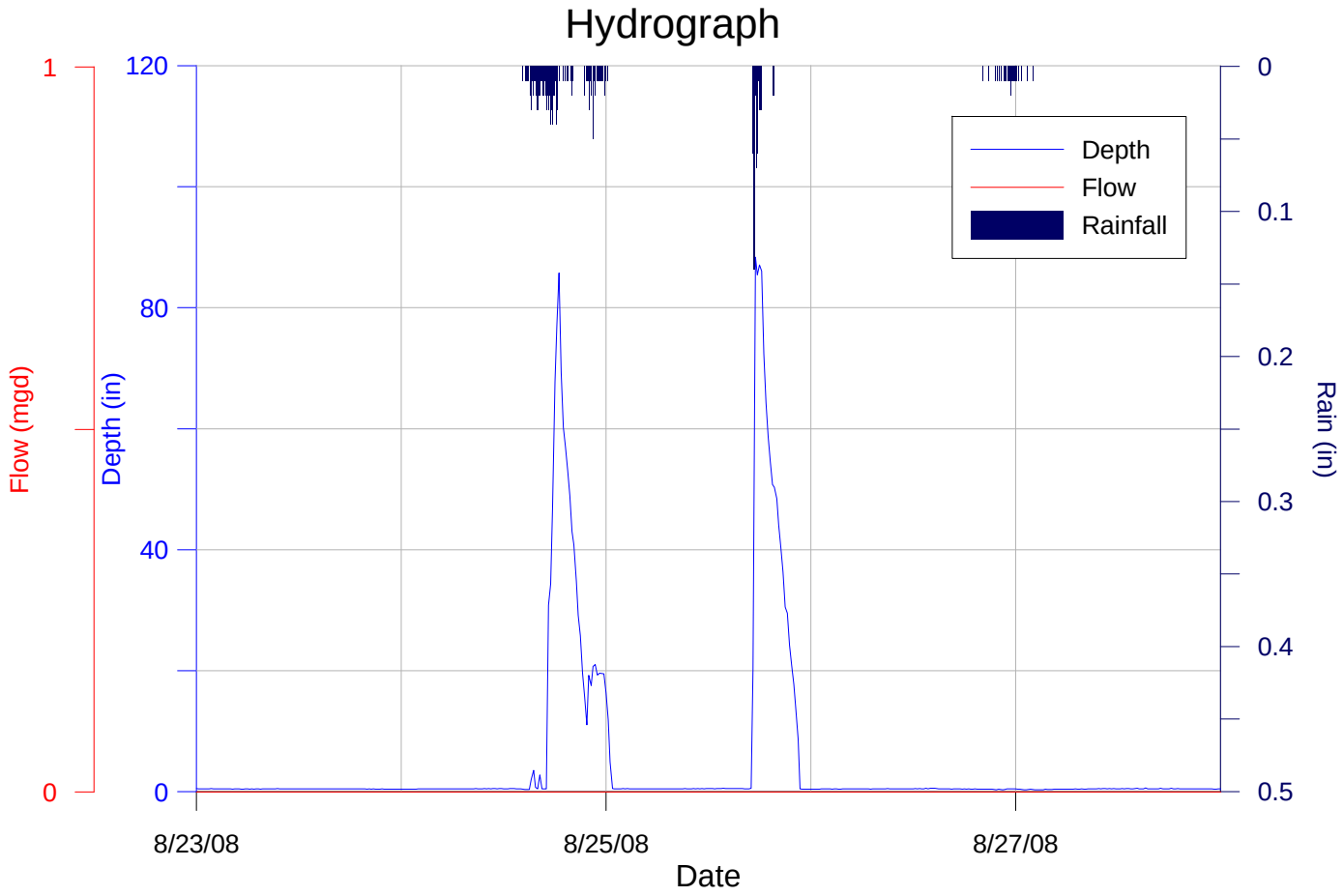


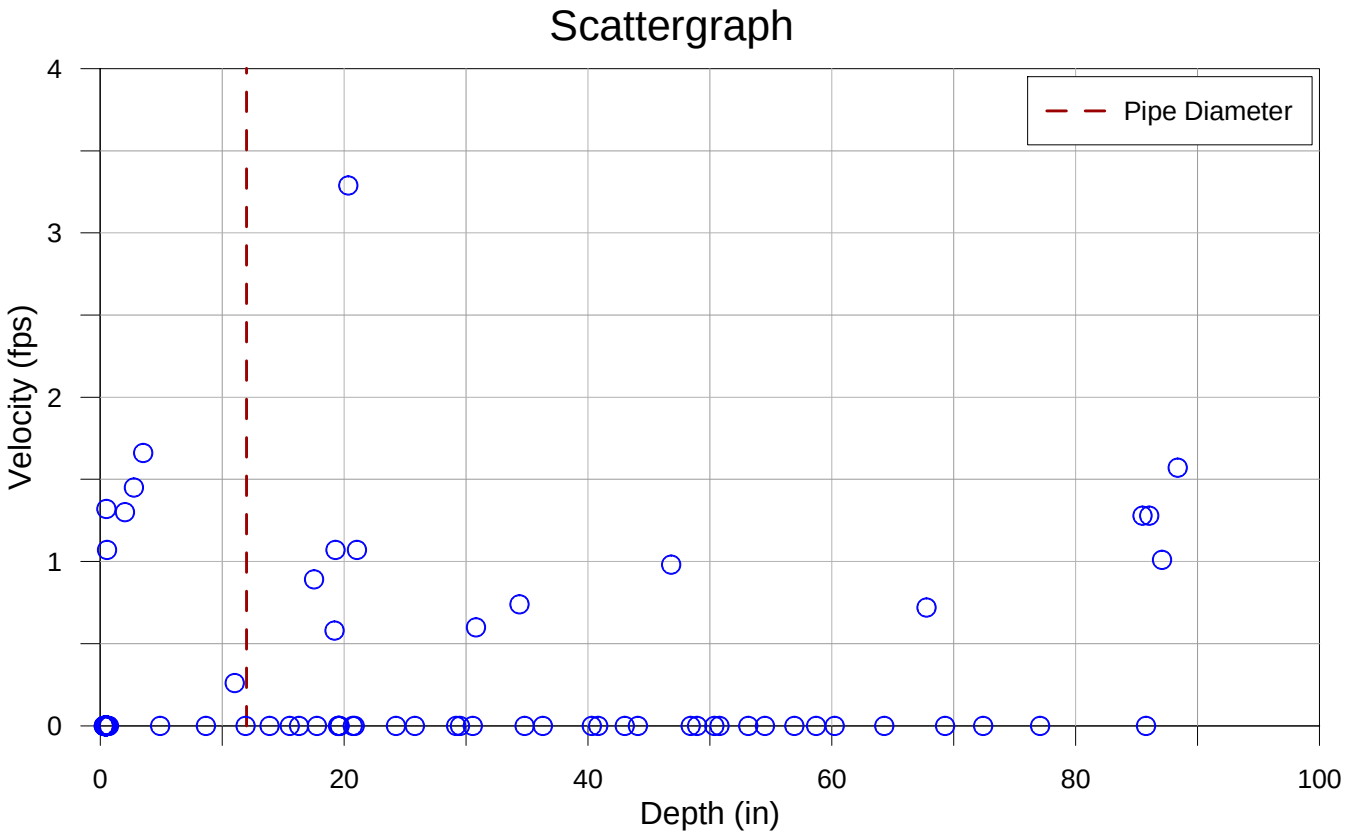
Monitor 306-192
January 4 - 11, 2009





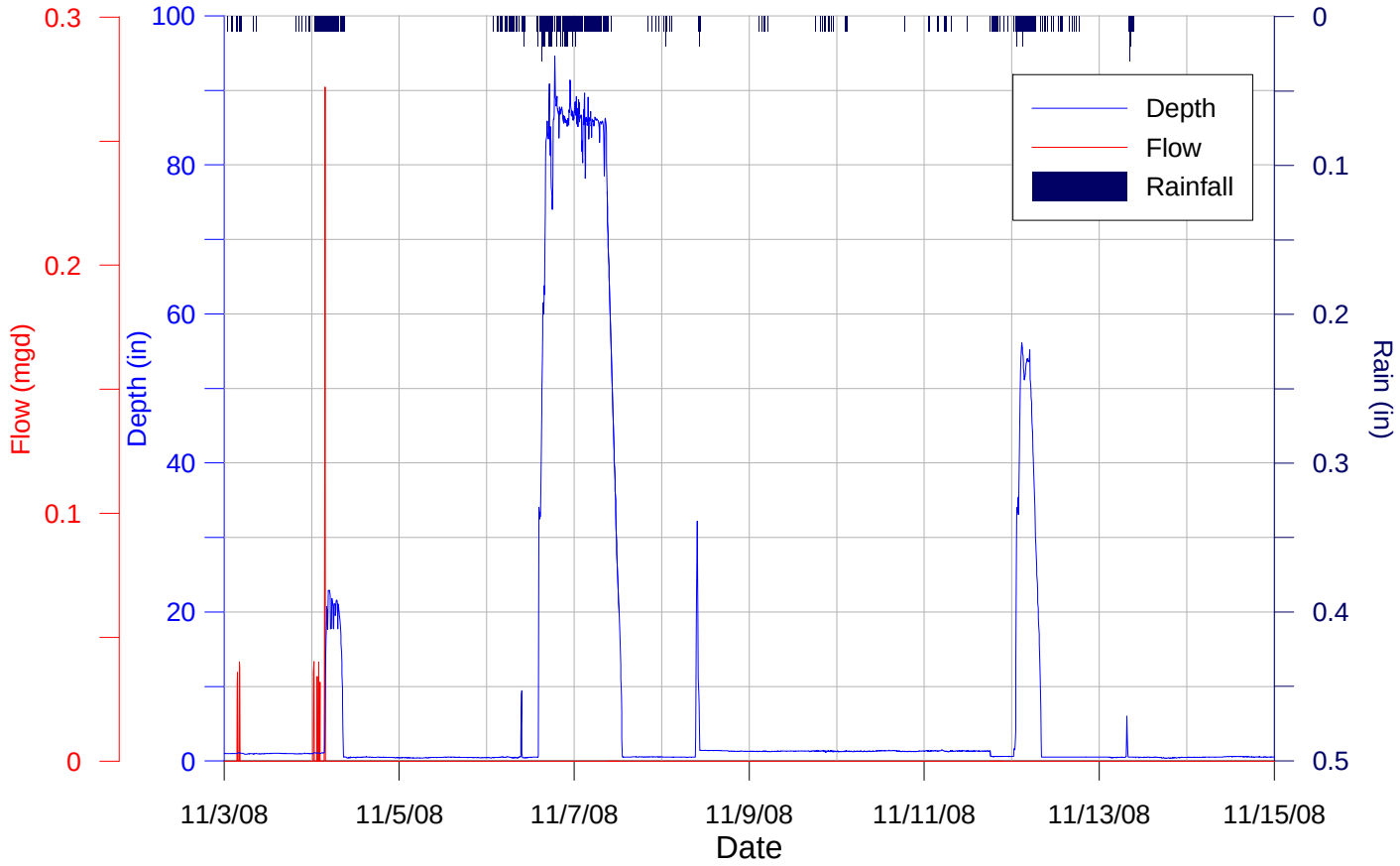
Monitor 081-231 (171)
Augsut 23 - 28, 2008



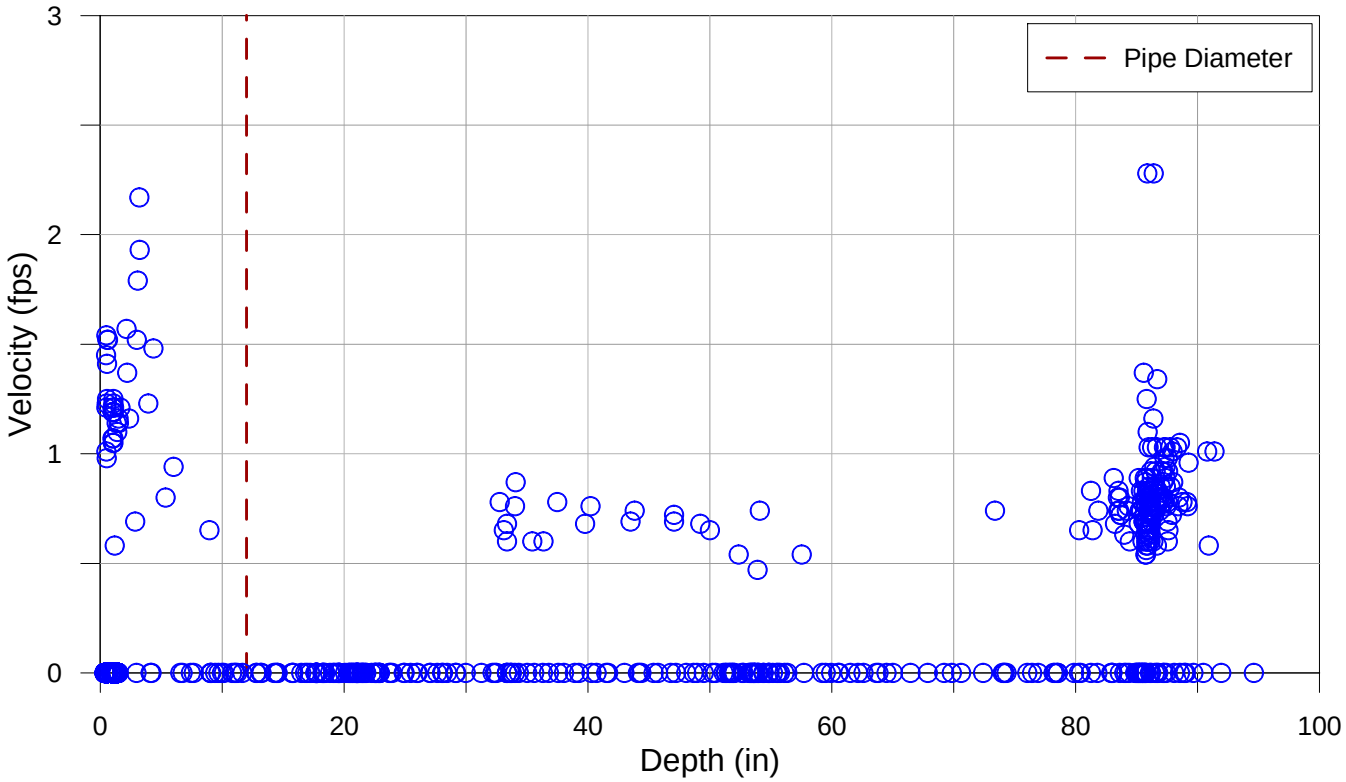


Monitor 081-231 (171)
November 3 - 15, 2008

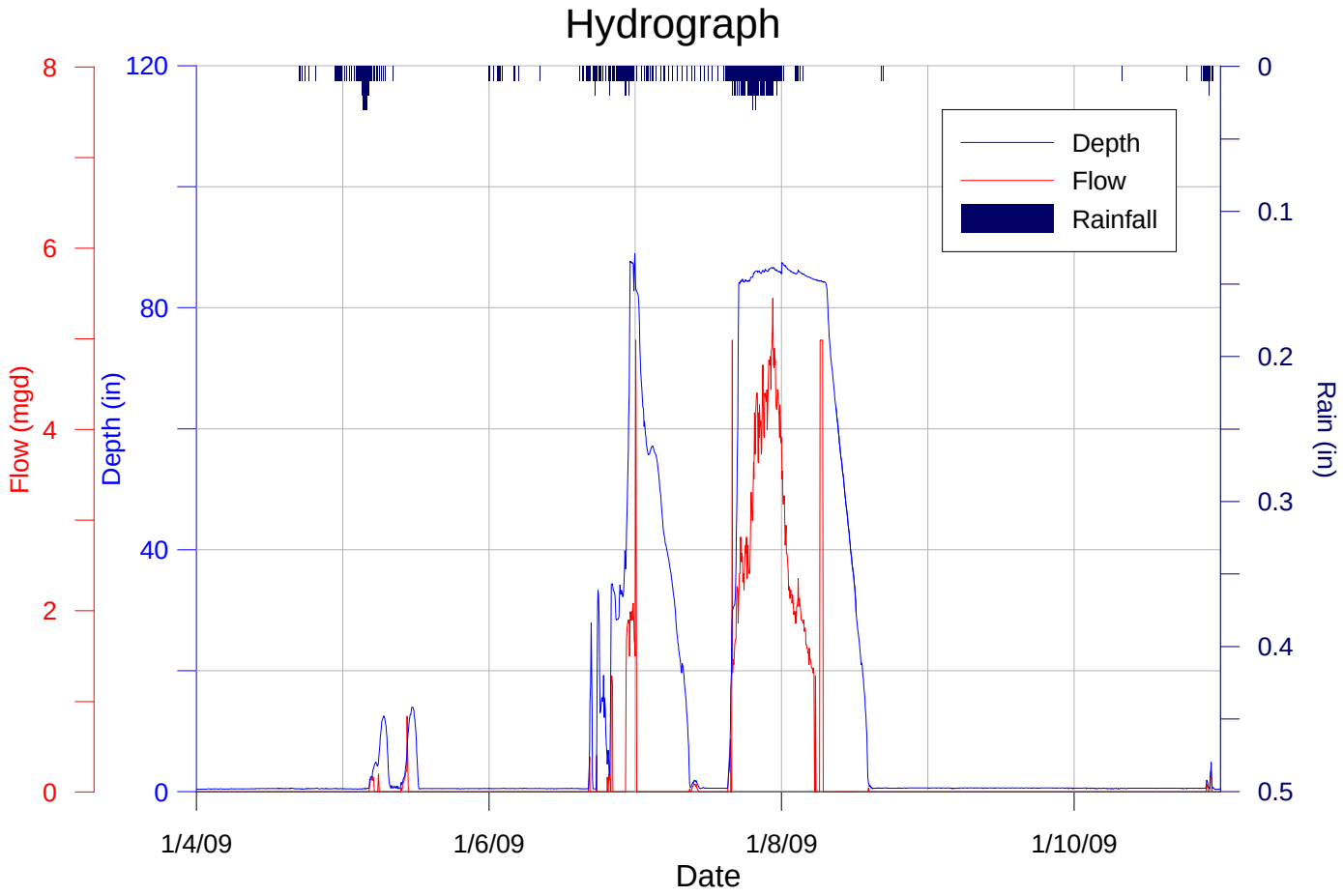
Hydrograph

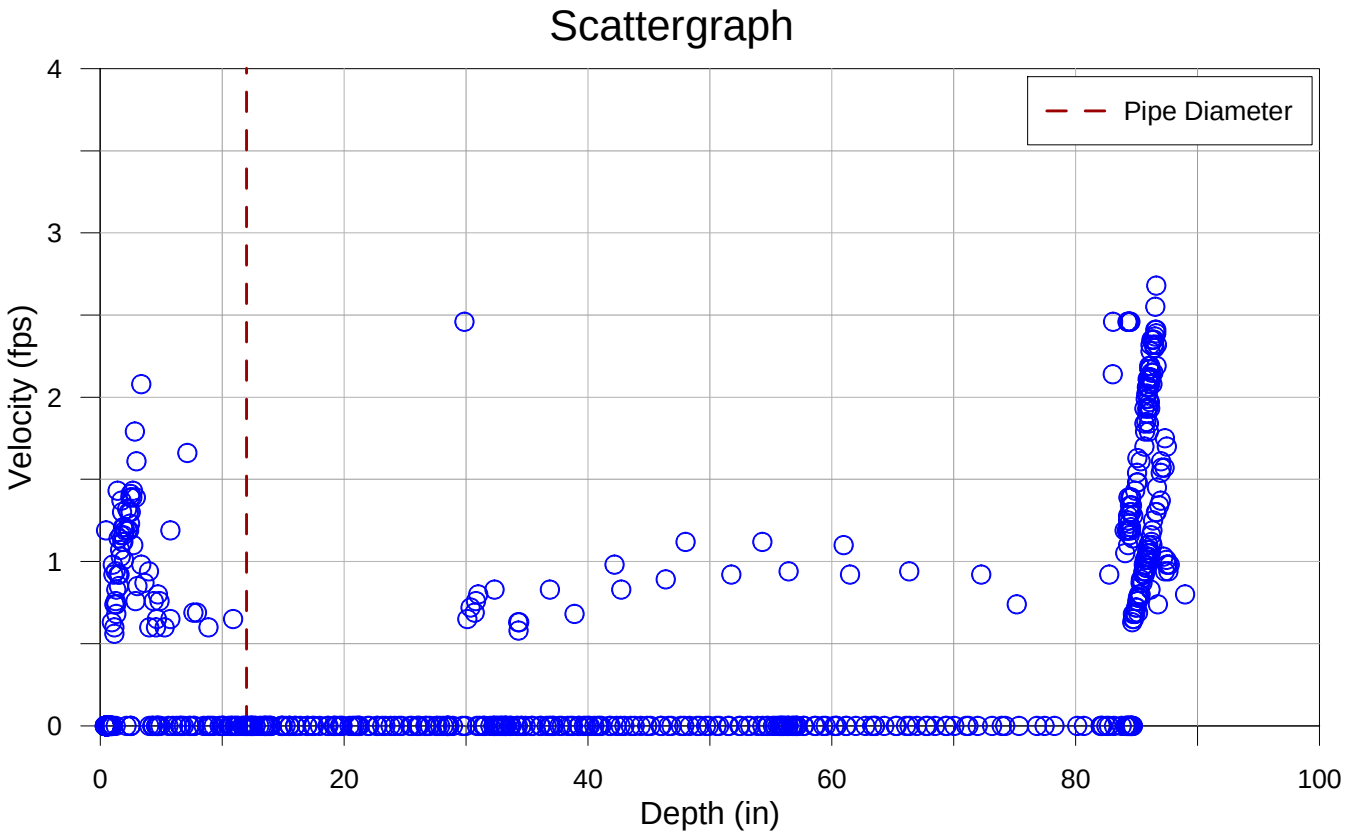


Scattergraph



Monitor 081-231 (171)
January 4 - 11, 2009





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Appendix E
ADS Confirmations & Service History

Service History Report

ABS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	6/3/2008	6/3/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002933	
	5/27/2008	5/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002809	
	5/22/2008	5/22/2008	Pressure drifting	No problem	1300002785	
	5/16/2008	5/16/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300002691	
	5/16/2008	5/16/2008	Velocity problem	Scrub/Clean Sensors	1300002691	
	5/8/2008	5/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002586	
	4/29/2008	4/30/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002409	
	4/11/2008	4/14/2008	Battery low - Monitor	Other	1300002178	
	4/3/2008	4/4/2008	Battery Low - Wireless	Other	1300002098	
	3/24/2008	4/1/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001932	
	3/19/2008	3/20/2008	Pressure problem	Other	1300001915	
	3/12/2008	3/12/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001803	
	3/6/2008	3/6/2008	Pressure problem	Replaced Pressure Sensor	1300001742	
	2/12/2008	2/14/2008	Pressure problem	Scrub/Clean Sensors	1300001517	
	1/22/2008	1/29/2008	Communication problem	Collected Data	1300001334	
HEN171_306192	6/10/2008	6/10/2008	Pressure problem	Troubleshoot - Pressure sensor problem	1300002992	
	5/27/2008	5/27/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002813	
	4/11/2008	4/14/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002179	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	4/8/2008	4/9/2008	Pressure drifting	Other	1300002134	
	3/27/2008	3/31/2008	Pressure drifting	Other	1300001996	
	3/6/2008	3/6/2008	Pressure problem	Replaced Pressure Sensor	1300001743	
	3/5/2008	3/5/2008	Pressure problem	Other	1300001733	
	2/12/2008	2/13/2008	Pressure problem	Other	1300001518	
	1/28/2008	1/29/2008	Communication problem	Collected Data	1300001419	
	1/17/2008	1/24/2008	Communication problem	Manual Collect	1300001298	
HEN44_067191	6/10/2008	6/10/2008	Communication problem	Collected Data	1300002993	
	6/5/2008	6/5/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002953	
	6/3/2008	6/3/2008	Communication problem	Collected Data	1300002926	
	5/27/2008	5/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002810	
	5/22/2008	5/22/2008	Communication problem	Collected Data	1300002778	
	5/2/2008	5/2/2008	Communication problem	Collected Data	1300002471	
	4/29/2008	4/29/2008	Communication problem	Collected Data	1300002399	
	4/8/2008	4/9/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002135	
	4/3/2008	4/4/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300002099	
	3/17/2008	3/18/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001855	
	3/12/2008	3/12/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001804	
	3/12/2008	3/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300001804	
	2/26/2008	2/26/2008	Velocity - spikes/drop out in mins	Scrub/Clean Sensors	1300001630	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067191	1/28/2008	1/29/2008	Communication problem	Collected Data	1300001420	
	1/17/2008	1/23/2008	Communication problem	Manual Collect	1300001299	
HEN44_067271	5/13/2008	5/13/2008	Communication problem	Collected Data	1300002647	
	5/8/2008	5/9/2008	Communication problem	Collected Data	1300002591	
	5/6/2008	5/6/2008	Communication problem	Collected Data	1300002533	
	5/2/2008	5/2/2008	Communication problem	Collected Data	1300002472	
	4/29/2008	4/29/2008	Communication problem	Collected Data	1300002400	
	4/24/2008	4/25/2008	Communication problem	Collected Data	1300002351	
	4/22/2008	4/22/2008	Communication problem	Collected Data	1300002314	
	4/18/2008	4/18/2008	Communication problem	Collected Data	1300002268	
	4/15/2008	4/15/2008	Communication problem	Collected Data	1300002214	
	3/31/2008	4/2/2008	Communication problem	Collected Data	1300002029	
	3/24/2008	3/26/2008	Communication problem	Collected Data	1300001936	
	3/19/2008	3/20/2008	Communication problem	Collected Data	1300001910	
	3/17/2008	3/18/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001856	
	3/12/2008	3/12/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001805	
	3/3/2008	3/5/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300001679	
	1/17/2008	1/23/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001287	
HEN44_067275	5/13/2008	5/13/2008	Communication problem	Collected Data	1300002648	
	5/8/2008	5/9/2008	Communication problem	Collected Data	1300002592	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067275	5/2/2008	5/2/2008	Communication problem	Collected Data	1300002473	
	4/29/2008	4/30/2008	Ultrasonic problem	Replaced Monitor	1300002405	
	4/24/2008	4/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002344	
	4/18/2008	4/18/2008	Communication problem	Replaced Battery - Monitor	1300002269	
	4/15/2008	4/15/2008	Communication problem	Manual Collect	1300002215	
	4/3/2008	4/4/2008	Ultrasonic problem	Scrub/Clean Sensors	1300002102	
HEN45_074152	5/20/2008	5/20/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002748	
	5/19/2008	5/19/2008	Confirmation(PVD)	Confirmation(Profile/Weir)	1300002716	
	4/11/2008	4/14/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002180	
	4/8/2008	4/9/2008	Communication problem	Collected Data	1300002132	
	3/19/2008	3/20/2008	Communication problem	Manual Collect	1300001911	
	1/17/2008	1/23/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001288	
HEN45_074159	6/5/2008	6/5/2008	Communication problem	No problem	1300002954	
	5/19/2008	5/19/2008	Confirmation(PVD)	Confirmation(Profile/Weir)	1300002717	
	5/16/2008	5/16/2008	Velocity problem	Scrub/Clean Sensors	1300002692	
	5/13/2008	5/13/2008	Velocity problem	Scrub/Clean Sensors	1300002652	
	4/18/2008	4/18/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002273	
	4/11/2008	4/14/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002181	
	3/31/2008	4/2/2008	Communication problem	Collected Data	1300002030	
	3/19/2008	3/20/2008	Communication problem	Manual Collect	1300001912	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN45_074159	3/5/2008	3/4/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001732	
	3/3/2008	3/4/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001676	
	2/26/2008	2/26/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300001631	
	2/11/2008	2/12/2008	Velocity problem	Scrub/Clean Sensors	1300001512	
	1/17/2008	1/23/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001289	
HEN46_081059	6/10/2008	6/10/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002994	
	6/3/2008	6/3/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002929	
	5/29/2008	5/29/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002857	
	5/29/2008	5/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002857	
	5/20/2008	5/20/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002751	
	5/8/2008	5/13/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002587	
	5/6/2008	5/6/2008	Battery low - Monitor	No problem	1300002536	
	4/15/2008	4/15/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002216	
	3/19/2008	3/20/2008	Communication problem	Collected Data	1300001913	
	3/3/2008	3/4/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001677	
	3/3/2008	3/3/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300001680	
	2/26/2008	2/26/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300001632	
	2/12/2008	2/13/2008	Pressure problem	Replaced Pressure Sensor	1300001519	
HEN46_081131	6/3/2008	6/3/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002930	
	3/31/2008	4/1/2008	Battery low - Monitor	Other	1300002035	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN46_081131	3/25/2008	3/27/2008	Confirmation(Profile)	Collected Data	1300001972	
HEN47_073268	6/10/2008	6/10/2008	Communication problem	Manual Collect	1300002998	
	6/3/2008	6/4/2008	Communication problem	Manual Collect	1300002927	
	5/22/2008	5/28/2008	Communication problem	Collected Data	1300002779	
	5/13/2008	5/14/2008	Communication problem	Manual Collect	1300002649	
	5/6/2008	5/8/2008	Communication problem	Manual Collect	1300002534	
	4/29/2008	4/30/2008	Communication problem	Manual Collect	1300002401	
	4/22/2008	4/28/2008	Communication problem	Manual Collect	1300002315	
	4/18/2008	4/28/2008	Communication problem	Manual Collect	1300002270	
	4/11/2008	4/15/2008	Communication problem	Manual Collect	1300002184	
	3/31/2008	4/2/2008	Communication problem	Collected Data	1300002031	
	3/24/2008	3/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001933	
	3/6/2008	3/7/2008	Pressure problem	Replaced Pressure Sensor	1300001744	
	2/26/2008	2/27/2008	Ultrasonic - Zero good pairs	Replaced Ultrasonic Sensor	1300001633	
	2/25/2008	2/26/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300001619	
	1/17/2008	1/25/2008	Communication problem	Manual Collect	1300001300	
HEN47_073276	6/10/2008	6/10/2008	Communication problem	Manual Collect	1300002999	
	6/3/2008	6/4/2008	Communication problem	Manual Collect	1300002928	
	5/22/2008	5/28/2008	Communication problem	Manual Collect	1300002780	
	5/13/2008	5/14/2008	Communication problem	Manual Collect	1300002650	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_073276	5/6/2008	5/8/2008	Communication problem	Manual Collect	1300002535	
	4/29/2008	4/30/2008	Communication problem	Manual Collect	1300002402	
	4/22/2008	4/28/2008	Communication problem	Manual Collect	1300002316	
	4/18/2008	4/28/2008	Communication problem	Manual Collect	1300002271	
	4/11/2008	4/15/2008	Communication problem	Manual Collect	1300002185	
	3/27/2008	4/1/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001992	
	3/24/2008	3/26/2008	Communication problem	Manual Collect	1300001937	
	3/12/2008	3/19/2008	Communication problem	Manual Collect	1300001809	
	3/3/2008	3/5/2008	Communication problem	Manual Collect	1300001682	
	2/25/2008	2/26/2008	Communication problem	Collected Data	1300001615	
	2/12/2008	2/13/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300001421	
	2/1/2008	2/13/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001461	
	1/28/2008	2/13/2008	Communication problem	Manual Collect	1300001422	
	1/17/2008	1/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001290	
HEN47_080329	6/10/2008	6/10/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002995	
	5/27/2008	5/27/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002814	
	5/13/2008	5/13/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002653	
	5/8/2008	5/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002588	
	4/15/2008	4/15/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002227	
	3/19/2008	3/20/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001914	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_080329	3/17/2008	3/17/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001890	
HEN47_081085	4/29/2008	4/30/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002406	
	3/17/2008	3/20/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300001860	
	1/22/2008	1/24/2008	Communication problem	Manual Collect	1300001331	
	1/17/2008	1/28/2008	Communication problem	Manual Collect	1300001301	
HEN47_081086	6/10/2008	6/10/2008	Communication problem	Collected Data	1300002997	
	6/5/2008	6/5/2008	Pressure drifting	Replaced Monitor	1300002958	
	6/3/2008	6/3/2008	Battery low - Monitor	Replaced Monitor	1300002931	
	5/8/2008	5/12/2008	Pressure drifting	Replaced Pressure Sensor	1300002594	
	5/2/2008	5/7/2008	Pressure drifting	Other	1300002474	
	4/29/2008	4/30/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002410	
	4/8/2008	4/9/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002136	
	3/25/2008	3/26/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300001973	
HEN47_081120	6/5/2008	6/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002955	
	4/11/2008	4/14/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002182	
	4/3/2008	4/4/2008	Pressure drifting	Scrub/Clean Sensors	1300002100	
	3/17/2008	3/18/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300001861	
	3/17/2008	3/18/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001857	
	2/25/2008	2/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001620	
	2/25/2008	2/26/2008	Battery low - Monitor	Replaced Analog board	1300001620	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081120	2/12/2008	2/13/2008	Pressure problem	Replaced Pressure Sensor	1300001520	
	1/17/2008	1/28/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001291	
HEN47_081139	6/3/2008	6/3/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002932	
	5/27/2008	5/27/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002816	
	5/16/2008	5/16/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002693	
	4/8/2008	4/9/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002137	
	3/24/2008	4/1/2008	Battery low - Monitor	Re-Install	1300001934	
	3/24/2008	4/1/2008	Battery low - Monitor	Other	1300001934	
	2/25/2008	2/25/2008	Communication problem	Collected Data	1300001616	
	2/12/2008	2/13/2008	Pressure problem	Replaced Pressure Sensor	1300001521	
	2/1/2008	2/5/2008	Ultrasonic - Erratic data	Replaced Ultrasonic Sensor	1300001462	
	1/28/2008	1/29/2008	Communication problem	Collected Data	1300001423	
	1/22/2008	1/24/2008	Communication problem	Manual Collect	1300001332	
	1/17/2008	2/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001297	
HEN47_081239	6/10/2008	6/11/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002996	
	6/5/2008	6/5/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002956	
	6/3/2008	6/3/2008	Ultrasonic - spikes	No problem	1300002934	
	5/27/2008	5/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002811	
	5/22/2008	5/22/2008	Velocity - spikes/drop out	No problem	1300002782	
	5/20/2008	5/20/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002749	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081239	5/16/2008	5/20/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002694	
	5/8/2008	5/13/2008	Velocity - spikes/drop out	No problem	1300002589	
	5/6/2008	5/7/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002538	
	4/15/2008	4/15/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002217	
	3/31/2008	4/1/2008	Velocity problem	Scrub/Clean Sensors	1300002033	
	3/24/2008	3/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001935	
	3/17/2008	3/26/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300001862	
	3/12/2008	3/26/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001807	
	2/27/2008	2/29/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001640	
	2/25/2008	2/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001621	
	2/12/2008	2/25/2008	Pressure problem	Scrub/Clean Sensors	1300001522	
	1/17/2008	1/23/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300001296	
HEN49_306245	6/5/2008	6/5/2008	Velocity problem	No problem	1300002957	
	5/29/2008	5/29/2008	Communication problem	Collected Data	1300002858	
	5/27/2008	5/27/2008	Communication problem	Manual Collect	1300002817	
	5/22/2008	5/22/2008	Communication problem	Collected Data	1300002781	
	5/20/2008	5/20/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002750	
	4/22/2008	4/22/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002318	
	4/15/2008	4/15/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002218	
	4/11/2008	4/14/2008	Battery low - Monitor	No problem	1300002183	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306245	4/3/2008	4/4/2008	Communication problem	Collected Data	1300002096	
	3/31/2008	4/1/2008	Communication problem	Collected Data	1300002032	
	3/24/2008	3/26/2008	Communication problem	Collected Data	1300001938	
	3/12/2008	3/12/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001808	
	3/7/2008	3/10/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001768	
	3/3/2008	3/5/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300001678	
	2/25/2008	2/27/2008	Velocity - Zeros	Scrub/Clean Sensors	1300001618	
	2/12/2008	2/14/2008	Pressure problem	Scrub/Clean Sensors	1300001524	
	1/17/2008	1/25/2008	Communication problem	Manual Collect	1300001302	
HEN49_306246	5/13/2008	5/16/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002654	
	5/6/2008	5/7/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002539	
	4/29/2008	4/29/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002404	
	4/24/2008	4/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002345	
	4/22/2008	4/22/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002319	
	4/8/2008	4/9/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002139	
	4/1/2008	4/2/2008	Pressure drifting	Other	1300002063	
	3/27/2008	3/31/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001993	
	3/17/2008	3/18/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001858	
	2/12/2008	2/13/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001525	
	1/17/2008	1/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001292	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306275	5/27/2008	5/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002812	
	5/8/2008	5/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002590	
	4/29/2008	4/30/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002407	
	4/8/2008	4/9/2008	Battery low - Monitor	Replaced Battery - Wireless	1300002138	
	3/27/2008	3/31/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001994	
	3/17/2008	3/18/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001859	
	3/6/2008	3/6/2008	Pressure problem	Replaced Pressure Sensor	1300001745	
	2/26/2008	2/26/2008	Pressure drifting	Scrub/Clean Sensors	1300001634	
	2/1/2008	2/5/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001463	
	1/17/2008	1/24/2008	Ultrasonic - Erratic data	Other	1300001293	
HEN49_306284	5/2/2008	5/2/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002475	
	4/29/2008	4/30/2008	Communication problem	Collected Data	1300002403	
	4/22/2008	4/22/2008	Communication problem	Collected Data	1300002317	
	4/18/2008	4/18/2008	Communication problem	Collected Data	1300002272	
	4/11/2008	4/14/2008	Communication problem	Collected Data	1300002186	
	4/8/2008	4/9/2008	Communication problem	Collected Data	1300002133	
	4/3/2008	4/4/2008	Communication problem	Collected Data	1300002097	
	3/31/2008	4/1/2008	Velocity problem	Scrub/Clean Sensors	1300002034	
	2/25/2008	2/26/2008	Communication problem	Collected Data	1300001617	
	1/22/2008	1/29/2008	Communication problem	Collected Data	1300001333	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306343	5/27/2008	5/27/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300002815	
	5/22/2008	5/22/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002783	
	5/16/2008	5/16/2008	Pressure problem	Replaced Pressure Sensor	1300002695	
	5/8/2008	5/9/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002593	
	5/6/2008	5/7/2008	Battery low - Monitor	No problem	1300002537	
	4/18/2008	4/18/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300002274	
	4/3/2008	4/4/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300002101	
	3/27/2008	3/31/2008	Communication problem	Collected Data	1300001995	
	3/24/2008	3/26/2008	Communication problem	Manual Collect	1300001939	
	3/12/2008	3/12/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001806	
	2/12/2008	2/14/2008	Pressure problem	Rework - Pressure	1300001523	
	2/1/2008	2/5/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001464	
	1/25/2008	1/25/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300001395	
	1/17/2008	1/23/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300001294	
HEN49_306428	4/29/2008	4/30/2008	Battery low - Monitor	Replaced Battery - Monitor	1300002408	
	3/7/2008	3/10/2008	Battery low - Monitor	Replaced Battery - Monitor	1300001769	
	2/25/2008	2/26/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300001622	
	1/22/2008	1/28/2008	Communication problem	Replaced Battery - Monitor	1300001335	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	8/13/2008	8/14/2008	Velocity - Zeros	Other	1300003709	
	8/11/2008	8/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003696	
	8/11/2008	8/11/2008	Velocity - spikes/drop out		1300003696	
	8/6/2008	8/7/2008	Velocity problem	Replaced Velocity Sensor	1300003622	
	7/28/2008	7/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003517	
	7/24/2008	7/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003499	
	7/14/2008	7/16/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300003385	
	7/1/2008	7/2/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003238	
	6/23/2008	6/25/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003168	
	6/23/2008	6/25/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003168	
	6/17/2008	6/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003094	
HEN171_306192	8/27/2008	8/28/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003898	
	8/27/2008	8/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003898	
	8/25/2008	8/25/2008	Communication problem	Collected Data	1300003822	
	8/20/2008	8/21/2008	Communication problem	Collected Data	1300003799	
	8/18/2008	8/19/2008	Pressure problem	Reset Monitor/Board	1300003727	
	7/28/2008	7/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003530	
	6/17/2008	6/17/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003091	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067191	8/20/2008	8/21/2008	Communication problem	Collected Data	1300003800	
	8/6/2008	8/10/2008	Can not connect	Collected Data	1300003629	
	8/4/2008	8/4/2008	Communication problem	Collected Data	1300003600	
	7/31/2008	7/31/2008	Communication problem	Collected Data	1300003577	
	7/28/2008	7/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003518	
	7/14/2008	7/14/2008	Communication problem	Collected Data	1300003381	
	7/10/2008	7/10/2008	Communication problem	Collected Data	1300003359	
	7/3/2008	7/7/2008	Communication problem	Collected Data	1300003261	
	7/1/2008	7/2/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003239	
	6/26/2008	6/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003185	
	6/23/2008	6/25/2008	Communication problem	Collected Data	1300003167	
	6/23/2008	6/25/2008	Pressure drifting	Replaced Pressure Sensor	1300003167	
	6/19/2008	6/19/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003123	
	6/19/2008	6/19/2008	Pressure drifting	Scrub/Clean Sensors	1300003123	
	6/17/2008	6/17/2008	Pressure drifting	Scrub/Clean Sensors	1300003101	
	6/12/2008	6/12/2008	Communication problem	Collected Data	1300003050	
HEN44_067271	8/25/2008	8/25/2008	Communication problem	Collected Data	1300003823	
	8/13/2008	8/14/2008	Communication problem	Collected Data	1300003711	
	7/3/2008	7/7/2008	Communication problem	Collected Data	1300003262	
	7/1/2008	7/2/2008	Communication problem	Collected Data	1300003232	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	6/26/2008	6/26/2008	Communication problem	Collected Data	1300003189	
HEN44_067275	8/20/2008	8/23/2008			1300003791	
	8/20/2008	8/21/2008	Flow change	Other	1300003792	
	7/28/2008	7/28/2008	Flow change	No problem	1300003526	
	7/22/2008	7/22/2008	Flow change	No problem	1300003471	
HEN45_074152	8/27/2008	8/28/2008	Communication problem	Collected Data	1300003896	
	6/26/2008	6/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003186	
	6/12/2008	6/12/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003054	
HEN45_074159	8/27/2008	8/28/2008	Pressure problem	No problem	1300003899	
	8/27/2008	8/28/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003899	
	8/20/2008	8/21/2008	Velocity problem	Scrub/Clean Sensors	1300003793	
	8/18/2008	8/19/2008	Flow change	Scrub/Clean Sensors	1300003731	
	8/11/2008	8/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003697	
	8/6/2008	8/7/2008	Velocity problem	Scrub/Clean Sensors	1300003623	
	7/31/2008	7/31/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003573	
	7/28/2008	7/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003519	
	7/24/2008	7/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003500	
	7/22/2008	7/22/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003466	
	7/17/2008	7/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003429	
	7/14/2008	7/14/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003376	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN45_074159	7/14/2008	7/14/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003376	
	7/10/2008	7/10/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003354	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Replaced Velocity Sensor	1300003265	
	7/1/2008	7/2/2008	Communication problem	Collected Data	1300003233	
	6/24/2008	6/25/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003170	
	6/19/2008	6/19/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300003119	
	6/12/2008	6/12/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003055	
HEN46_081059	8/4/2008	8/5/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003606	
	7/31/2008	7/31/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003574	
	7/22/2008	7/22/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003467	
	7/22/2008	7/22/2008	Velocity - spikes/drop out	Replaced Velocity Sensor	1300003467	
	7/17/2008	7/17/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003430	
	7/17/2008	7/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003430	
	7/14/2008	7/14/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003377	
	7/14/2008	7/14/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003377	
	7/10/2008	7/10/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003355	
	7/10/2008	7/10/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003355	
	7/7/2008	7/7/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003266	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Rotate Velocity Sensor	1300003266	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003266	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN46_081059	7/1/2008	7/2/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003240	
	6/24/2008	6/25/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003171	
	6/24/2008	6/25/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003171	
	6/19/2008	6/19/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300003120	
	6/19/2008	6/19/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300003120	
	6/17/2008	6/17/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003092	
HEN46_081131	8/25/2008	8/25/2008	Velocity - spikes/drop out	No problem	1300003827	
	8/13/2008	8/14/2008	Velocity - spikes/drop out	Confirmation(Profile/Weir)	1300003710	
	8/11/2008	8/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003698	
	8/6/2008	8/7/2008	Velocity problem	Replaced Velocity Sensor	1300003624	
	7/28/2008	7/28/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003527	
	7/24/2008	7/24/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003505	
HEN47_073268	8/25/2008	8/27/2008	Communication problem	Collected Data	1300003824	
	8/25/2008	8/27/2008	Pressure drifting	Replaced Pressure Sensor	1300003824	
	8/20/2008	8/25/2008	Pressure drifting	Scrub/Clean Sensors	1300003794	
	8/18/2008	8/20/2008	Manual Data collect	Manual Collect	1300003728	
	8/11/2008	8/13/2008	Communication problem	Manual Collect	1300003693	
	8/4/2008	8/6/2008	Communication problem	Manual Collect	1300003601	
	7/28/2008	7/29/2008	Manual Data collect	Manual Collect	1300003524	
	7/22/2008	7/23/2008	Manual Data collect	Manual Collect	1300003473	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_073268	7/14/2008	7/16/2008		Replaced Battery - Monitor	1300003382	
	7/14/2008	7/16/2008		Replaced Battery - Wireless	1300003382	
	7/14/2008	7/16/2008	Communication problem	Manual Collect	1300003382	
	7/7/2008	7/8/2008	Manual Data collect	Manual Collect	1300003281	
	7/1/2008	7/2/2008	Communication problem	Manual Collect	1300003234	
	6/23/2008	6/24/2008	Communication problem	Manual Collect	1300003165	
	6/17/2008	6/18/2008	Communication problem	Manual Collect	1300003097	
HEN47_073276	8/25/2008	8/27/2008	Communication problem	Collected Data	1300003825	
	8/25/2008	8/27/2008	Pressure drifting	Replaced Pressure Sensor	1300003825	
	8/20/2008	8/25/2008	Pressure drifting	Replaced Pressure Sensor	1300003795	
	8/18/2008	8/20/2008	Flow change	Confirmation(Profile/Weir)	1300003729	
	8/18/2008	8/20/2008	Manual Data collect	Manual Collect	1300003729	
	8/11/2008	8/13/2008	Communication problem	Manual Collect	1300003694	
	8/4/2008	8/6/2008	Communication problem	Manual Collect	1300003602	
	7/28/2008	7/29/2008	Manual Data collect	Manual Collect	1300003525	
	7/22/2008	7/23/2008	Manual Data collect	Manual Collect	1300003474	
	7/14/2008	7/16/2008	Communication problem		1300003383	
	7/14/2008	7/16/2008	Communication problem	Manual Collect	1300003383	
	7/7/2008	7/8/2008	Manual Data collect	Manual Collect	1300003283	
	7/1/2008	7/2/2008	Communication problem	Manual Collect	1300003235	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_073276	6/23/2008	6/24/2008	Communication problem	Manual Collect	1300003166	
	6/17/2008	6/18/2008	Communication problem	Manual Collect	1300003098	
HEN47_080329	8/25/2008	8/25/2008	Pressure problem	No problem	1300003831	
	8/6/2008	8/7/2008	Velocity problem	Replaced Velocity Sensor	1300003625	
	8/4/2008	8/5/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003607	
	7/31/2008	7/31/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003579	
	7/28/2008	7/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003520	
	7/22/2008	7/22/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003468	
	7/22/2008	7/22/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003468	
	7/17/2008	7/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003431	
	7/3/2008	7/3/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003267	
	6/17/2008	6/17/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003093	
HEN47_081085	8/11/2008	8/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003699	
	7/31/2008	7/31/2008	Communication problem	Collected Data	1300003578	
	7/28/2008	7/28/2008	Flow change	Confirmation(Profile/Weir)	1300003528	
	7/7/2008	7/8/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300003284	
	7/7/2008	7/8/2008	Velocity problem	Other	1300003284	
	6/26/2008	6/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003187	
HEN47_081086	8/4/2008	8/5/2008	Pressure drifting	Replaced Pressure Sensor	1300003605	
	7/28/2008	7/29/2008	Battery Low - Wireless		1300003531	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081086	7/10/2008	7/10/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003361	
	7/3/2008	7/7/2008	Communication problem	Collected Data	1300003263	
	6/12/2008	6/12/2008	Communication problem	Collected Data	1300003051	
HEN47_081120	8/25/2008	8/25/2008	Pressure problem	No problem	1300003829	
	7/31/2008	8/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003575	
	7/24/2008	7/24/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003503	
HEN47_081139	8/25/2008	8/25/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300003828	
	8/20/2008	8/23/2008		No problem	1300003797	
	8/18/2008	8/20/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300003730	
	8/11/2008	8/12/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300003700	
	8/11/2008	8/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003700	
	8/6/2008	8/7/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003626	
	8/6/2008	8/7/2008	Velocity problem	Scrub/Clean Sensors	1300003626	
	7/31/2008	8/4/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003576	
	7/28/2008	7/29/2008	Pressure problem	No problem	1300003529	
	7/24/2008	7/24/2008		Replaced Pressure Sensor	1300003504	
	7/24/2008	7/24/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003504	
	7/24/2008	7/24/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003504	
	7/17/2008	7/17/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003433	
	7/7/2008	7/8/2008	Pressure drifting	Scrub/Clean Sensors	1300003285	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081139	6/24/2008	6/25/2008	Pressure drifting	Scrub/Clean Sensors	1300003174	
HEN47_081239	8/4/2008	8/5/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003610	
	7/28/2008	7/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003521	
	7/17/2008	7/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003432	
	7/14/2008	7/14/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003378	
	7/10/2008	7/11/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003356	
	7/10/2008	7/11/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003356	
	7/10/2008	7/11/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003356	
	7/10/2008	7/11/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003356	
	7/3/2008	7/11/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003269	
	7/3/2008	7/11/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003269	
	6/24/2008	6/25/2008	Velocity - spikes/drop out	Other	1300003172	
	6/19/2008	6/20/2008	Velocity - Erratic data	Re-Install - Other	1300003121	
	6/17/2008	6/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003095	
	6/12/2008	6/12/2008	Velocity - spikes/drop out	Other	1300003052	
	6/10/2008	6/11/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300002996	
HEN49_306245	8/25/2008	8/25/2008	Velocity - spikes/drop out	No problem	1300003830	
	8/18/2008	8/20/2008	Flow change	Confirmation(Profile/Weir)	1300003732	
	8/6/2008	8/7/2008	Velocity problem	Scrub/Clean Sensors	1300003627	
	7/28/2008	7/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003522	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306245	7/24/2008	7/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003501	
	7/22/2008	7/22/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003469	
	7/22/2008	7/22/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003469	
	7/14/2008	7/15/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003379	
	7/10/2008	7/10/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003357	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003288	
	7/1/2008	7/2/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003241	
	6/24/2008	6/25/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003173	
	6/19/2008	6/19/2008	Velocity - Erratic data	Scrub/Clean Sensors	1300003122	
	6/17/2008	6/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003096	
	6/12/2008	6/12/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003053	
HEN49_306246	8/4/2008	8/7/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003608	
	7/14/2008	7/15/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003384	
	7/3/2008	7/3/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300003270	
HEN49_306275	8/11/2008	8/12/2008	Communication problem	Collected Data	1300003695	
	7/28/2008	7/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003523	
	7/10/2008	7/10/2008	Velocity - spikes/drop out	Replaced Velocity Sensor	1300003358	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003286	
	6/26/2008	6/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003188	
HEN49_306284	8/27/2008	8/28/2008	Communication problem	Collected Data	1300003897	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306284	8/25/2008	8/25/2008	Communication problem	Collected Data	1300003826	
	8/20/2008	8/21/2008	Pressure problem	Troubleshoot - Pressure sensor problem	1300003796	
	8/4/2008	8/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003609	
	7/17/2008	7/17/2008	Communication problem	Collected Data	1300003434	
	7/10/2008	7/10/2008	Communication problem	Collected Data	1300003360	
	7/3/2008	7/7/2008	Communication problem	Collected Data	1300003264	
	7/1/2008	7/2/2008	Communication problem	Collected Data	1300003236	
	6/26/2008	6/26/2008	Monitor problem	Replaced Monitor	1300003190	
HEN49_306343	8/27/2008	8/28/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003901	
	8/20/2008	8/21/2008	Pressure drifting	Scrub/Clean Sensors	1300003798	
	8/6/2008	8/7/2008	Velocity problem	Scrub/Clean Sensors	1300003628	
	7/31/2008	7/31/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003580	
	7/31/2008	7/31/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003580	
	7/22/2008	7/22/2008	Pressure problem	Replaced Pressure Sensor	1300003470	
	7/10/2008	7/10/2008	Battery Low - Wireless	No problem	1300003362	
	7/10/2008	7/10/2008	Pressure problem	Scrub/Clean Sensors	1300003362	
	7/7/2008	7/7/2008	Pressure drifting	Scrub/Clean Sensors	1300003287	
	7/7/2008	7/7/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003287	
	7/3/2008	7/3/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003268	
	7/1/2008	7/1/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300003242	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN49_306343	6/26/2008	6/26/2008	Pressure drifting	Adjusted Other	1300003191	
	6/24/2008	6/25/2008	Pressure drifting	Scrub/Clean Sensors	1300003175	
HEN49_306428	8/27/2008	8/28/2008	Battery low - Monitor	Replaced Monitor	1300003900	
	8/25/2008	8/25/2008	Ultrasonic - spikes	No problem	1300003832	
	8/18/2008	8/20/2008	Flow change	Confirmation(Profile/Weir)	1300003733	
	7/24/2008	7/24/2008	Pressure drifting	Scrub/Clean Sensors	1300003502	
	7/24/2008	7/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003502	
	7/22/2008	7/22/2008	Flow change	Other	1300003472	
	7/14/2008	7/15/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003380	
	7/1/2008	7/1/2008	Communication problem	Collected Data	1300003237	
	7/1/2008	7/1/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300003237	
	6/12/2008	6/12/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003056	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	9/24/2008	9/25/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004157	
HEN171_306192	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004173	
	9/1/2008	9/2/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300003920	
	9/1/2008	9/2/2008	Velocity - spikes/drop out	No problem	1300003920	
HEN44_067191	9/24/2008	9/24/2008	Communication problem	No problem	1300004160	
	9/10/2008	9/11/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004039	
HEN44_067271	9/3/2008	9/3/2008	Communication problem	No problem	1300003960	
HEN45_074159	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004174	
	9/28/2008	9/29/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004174	
	9/7/2008	9/8/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003987	
HEN46_081059	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004175	
	9/1/2008	9/2/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003921	
HEN46_081131	9/24/2008	9/26/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004158	
	9/1/2008	9/2/2008	Velocity - Zeros	Scrub/Clean Sensors	1300003922	
HEN47_073268	9/21/2008	9/24/2008	Communication problem	Manual Collect	1300004119	
	9/1/2008	9/4/2008	Communication problem	Collected Data	1300003918	
HEN47_073276	9/21/2008	9/24/2008	Communication problem	Manual Collect	1300004120	
	9/1/2008	9/4/2008	Communication problem	Manual Collect	1300003919	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_080329	9/28/2008	9/29/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004176	
HEN47_081085	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004177	
	9/28/2008	9/29/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004177	
	9/7/2008	9/8/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003988	
HEN47_081086	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004178	
	9/28/2008	9/29/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004178	
HEN47_081120	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Monitor	1300004179	
	9/17/2008	9/18/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004096	
	9/14/2008	9/17/2008	Flow change	No problem	1300004059	
	9/14/2008	9/17/2008	Velocity - spikes/drop out	No problem	1300004059	
	9/1/2008	9/2/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003923	
HEN47_081139	9/3/2008	9/4/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300003961	
HEN49_306245	9/3/2008	9/4/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300003962	
HEN49_306246	9/21/2008	9/23/2008	Ultrasonic - spikes	Replaced Battery - Monitor	1300004122	
	9/21/2008	9/23/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004122	
HEN49_306275	9/28/2008	9/29/2008	Battery low - Monitor	Replaced Battery - Wireless	1300004180	
	9/1/2008	9/2/2008	Battery low - Monitor	Replaced Battery - Monitor	1300003924	
HEN49_306284	9/21/2008	9/23/2008	Communication problem	Collected Data	1300004121	
HEN49_306343	9/28/2008	9/29/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004184	
HEN49_306428	9/28/2008	9/29/2008	Communication problem	Replaced Antenna	1300004183	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	10/5/2008	10/6/2008	Communication problem	Adjusted Other	1300004249	
HEN44_067191	10/30/2008	10/30/2008	Communication problem	Reset Monitor/Board	1300004477	
	10/5/2008	10/6/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004252	
HEN44_067271	10/23/2008	10/23/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004420	
	10/19/2008	10/23/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004382	
HEN45_074152	10/19/2008	10/27/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004383	
HEN45_074159	10/27/2008	10/27/2008	Confirmation(PVD)	No problem	1300004440	
	10/27/2008	10/27/2008	Flow change	No problem	1300004440	
	10/21/2008	10/21/2008	Other	No problem	1300004407	
	10/21/2008	10/21/2008	Velocity - Zeros	Scrub/Clean Sensors	1300004408	
HEN46_081059	10/27/2008	10/28/2008	Confirmation(PVD)	Confirmation(PVD)	1300004439	
	10/10/2008	10/10/2008	Monitor problem	Replaced Monitor	1300004306	
HEN46_081131	10/30/2008	10/30/2008	Communication problem	Manual Collect	1300004478	
	10/27/2008	10/27/2008	Communication problem	Manual Collect	1300004441	
	10/23/2008	10/23/2008	Communication problem	No problem	1300004418	
	10/12/2008	10/13/2008	Communication problem	Reset Monitor/Board	1300004316	
	10/8/2008	10/9/2008	Velocity - spikes/drop out	Replaced Monitor	1300004296	
	10/6/2008	10/6/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004261	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN47_073268	10/19/2008	10/22/2008	Communication problem	Manual Collect	1300004380	
	10/12/2008	10/15/2008	Communication problem	Manual Collect	1300004317	
	10/5/2008	10/8/2008	Communication problem	Manual Collect	1300004250	
	10/5/2008	10/8/2008	Communication problem	Replaced Velocity Sensor	1300004250	
HEN47_073276	10/19/2008	10/22/2008	Communication problem	Manual Collect	1300004381	
	10/12/2008	10/15/2008	Communication problem	Manual Collect	1300004318	
	10/5/2008	10/8/2008	Communication problem	Manual Collect	1300004251	
HEN47_081120	10/27/2008	10/28/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004438	
	10/5/2008	10/5/2008	Ultrasonic - spikes	No problem	1300004253	
HEN47_081139	10/8/2008	10/9/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004295	
HEN47_081239	10/30/2008	10/30/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004479	
	10/30/2008	10/30/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004479	
	10/15/2008	10/16/2008	Communication problem	Adjusted Other	1300004360	
HEN49_306245	10/23/2008	10/23/2008	Communication problem	No problem	1300004419	
	10/15/2008	10/16/2008	Communication problem	Replaced Battery - Wireless	1300004361	
	10/8/2008	10/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004292	
HEN49_306246	10/30/2008	10/30/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004480	
HEN49_306284	10/8/2008	10/9/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004293	
HEN49_306343	10/6/2008	10/6/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004262	
HEN49_306428	10/19/2008	10/21/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004384	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN49_306428	10/12/2008	10/12/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300004319	
	10/8/2008	10/8/2008	Battery Low - Wireless	No problem	1300004294	

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HEN171_081237	11/18/2008	11/18/2008	Battery Low - Wireless	No problem	1300004643	
	11/17/2008	11/18/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004626	
	11/5/2008	11/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004534	
HEN171_306192	11/26/2008	11/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004736	
HEN44_067191	11/26/2008	11/26/2008	Communication problem	Manual Collect	1300004744	
	11/10/2008	11/11/2008	Communication problem	Adjusted Other	1300004561	
	11/5/2008	11/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004535	
	11/5/2008	11/6/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004535	
HEN44_067271	11/18/2008	11/18/2008	Battery Low - Wireless	No problem	1300004644	
	11/17/2008	11/19/2008	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300004620	
	11/10/2008	11/11/2008	Communication problem	Adjusted Other	1300004562	
HEN44_067275	11/19/2008	11/21/2008	Battery Low - Wireless	No problem	1300004672	
	11/19/2008	11/21/2008	Communication problem	Manual Collect	1300004668	
HEN45_074152	11/19/2008	11/21/2008	Communication problem	Reset Monitor/Board	1300004669	
HEN45_074159	11/26/2008	11/26/2008	Battery low - Monitor	No problem	1300004737	
	11/12/2008	11/13/2008	Communication problem	Reset Monitor/Board	1300004602	
HEN46_081059	11/18/2008	11/18/2008	Battery Low - Wireless	No problem	1300004645	
	11/17/2008	11/18/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004622	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN46_081059	11/17/2008	11/17/2008	Other	No problem	1300004621	
HEN46_081131	11/26/2008	11/26/2008	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300004745	
	11/26/2008	11/26/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004745	
	11/17/2008	11/19/2008	Velocity - Zeros	Scrub/Clean Sensors	1300004625	
	11/12/2008	11/13/2008	Communication problem	Reset Monitor/Board	1300004603	
	11/5/2008	11/5/2008	Communication problem	No problem	1300004537	
HEN47_073268	11/10/2008	11/12/2008	Communication problem	Manual Collect	1300004563	
	11/2/2008	11/5/2008	Communication problem	Manual Collect	1300004503	
HEN47_073276	11/10/2008	11/12/2008	Communication problem	Manual Collect	1300004564	
	11/2/2008	11/5/2008	Communication problem	Manual Collect	1300004504	
HEN47_080329	11/26/2008	11/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004738	
HEN47_081085	11/26/2008	11/26/2008	Battery low - Monitor	No problem	1300004739	
HEN47_081086	11/26/2008	11/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004740	
HEN47_081120	11/26/2008	11/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004741	
	11/12/2008	11/13/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004604	
HEN49_306245	12/1/2008	11/26/2008	Pressure drifting	Replaced Pressure Sensor	1300004791	
	11/19/2008	11/19/2008	Battery low - Monitor	No problem	1300004671	
	11/17/2008	11/18/2008	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300004623	
	11/10/2008	11/11/2008	Communication problem	Adjusted Other	1300004565	
HEN49_306246	11/26/2008	11/26/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004742	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN49_306246	11/12/2008	11/13/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004605	
HEN49_306275	11/26/2008	11/26/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004743	
	11/12/2008	11/13/2008	Pressure drifting	Scrub/Clean Sensors	1300004606	
	11/12/2008	11/13/2008	Ultrasonic - spikes	Scrub/Clean Sensors	1300004606	
HEN49_306343	11/19/2008	11/18/2008	Communication problem	Reset Monitor/Board	1300004670	
	11/17/2008	11/18/2008	Communication problem	Manual Collect	1300004624	
	11/5/2008	11/6/2008	Communication problem	Reset Monitor/Board	1300004538	
	11/5/2008	11/6/2008	Communication problem	Replaced Battery - Monitor	1300004538	
HEN49_306428	11/5/2008	11/6/2008	Battery low - Monitor	Replaced Battery - Monitor	1300004536	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	12/30/2008	12/31/2008	Pressure drifting	No problem	1300005153	
	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005000	
	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005000	
	12/12/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004945	
HEN44_067191	12/30/2008	12/31/2008	Communication problem	Manual Collect	1300005154	
	12/23/2008	12/29/2008	Communication problem	Replaced Monitor	1300005094	
	12/18/2008	12/18/2008	Communication problem	No problem	1300005053	
	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005001	
	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004946	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004888	
	12/5/2008	12/5/2008	Communication problem	No problem	1300004839	
	12/1/2008	12/1/2008	Communication problem	No problem	1300004778	
HEN44_067271	12/23/2008	12/23/2008	Battery low - Monitor	Replaced Battery - Monitor	1300005095	
HEN44_067275	12/16/2008	12/16/2008	Communication problem	No problem	1300005002	
	12/12/2008	12/12/2008	Ultrasonic - spikes	Other	1300004947	
	12/9/2008	12/9/2008	Ultrasonic - spikes	No problem	1300004889	
HEN45_074152	12/30/2008	12/31/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005155	
	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005096	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN45_074152	12/16/2008	12/16/2008	Communication problem	No problem	1300005003	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004890	
HEN45_074159	12/23/2008	12/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005097	
	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005004	
	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004948	
	12/9/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004895	
	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004788	
HEN46_081059	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005098	
HEN46_081131	12/23/2008	12/23/2008	Pressure problem	No problem	1300005099	
	12/16/2008	12/16/2008	Velocity - spikes/drop out	No problem	1300005005	
	12/12/2008	12/12/2008	Velocity - Zeros	Scrub/Clean Sensors	1300004949	
	12/9/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004891	
HEN47_073268	12/16/2008	12/17/2008	Communication problem	Manual Collect	1300005011	
HEN47_073276	12/16/2008	12/17/2008	Communication problem	Manual Collect	1300005012	
HEN47_081085	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004789	
HEN47_081086	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005006	
	12/16/2008	12/16/2008	Velocity - spikes/drop out	No problem	1300005006	
	12/12/2008	12/12/2008	Communication problem	Reset Monitor/Board	1300004950	
HEN47_081120	12/18/2008	12/18/2008	Velocity - spikes/drop out	No problem	1300005054	
	12/16/2008	12/16/2008	Communication problem	Replaced Antenna	1300005007	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081120	12/16/2008	12/16/2008	Pressure drifting	No problem	1300005007	
	12/12/2008	12/12/2008	Communication problem	Hook-up - Other	1300004951	
HEN47_081139	12/16/2008	12/16/2008	Communication problem	No problem	1300005008	
	12/9/2008	12/9/2008	Communication problem	Replaced Battery - IS Monitor	1300004892	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004892	
	12/1/2008	12/1/2008	Communication problem	No problem	1300004779	
HEN47_081239	12/30/2008	12/31/2008	Communication problem	Reset Monitor/Board	1300005156	
	12/12/2008	12/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004952	
	12/5/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004837	
	12/1/2008	12/1/2008	Communication problem	No problem	1300004784	
	12/1/2008	12/1/2008	Velocity - spikes/drop out	No problem	1300004792	
HEN49_306245	12/30/2008	12/31/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005157	
	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005101	
	12/1/2008	11/26/2008	Pressure drifting	Replaced Pressure Sensor	1300004791	
HEN49_306275	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004790	
HEN49_306284	12/30/2008	12/31/2008	Pressure drifting	Replaced Pressure Sensor	1300005158	
	12/23/2008	12/29/2008	Communication problem	Manual Collect	1300005102	
	12/16/2008	12/16/2008	Communication problem	No problem	1300005009	
	12/12/2008	12/12/2008	Communication problem	Reset Monitor/Board	1300004953	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004893	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN49_306284	12/1/2008	12/1/2008	Communication problem	No problem	1300004785	
HEN49_306343	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005010	
	12/16/2008	12/16/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300005013	
	12/16/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005010	
	12/12/2008	12/12/2008	Velocity - Zeros	Replaced Velocity Sensor	1300004954	
	12/5/2008	12/5/2008	Velocity - spikes/drop out	No problem	1300004838	
	12/1/2008	12/1/2008	Velocity - spikes/drop out	No problem	1300004786	
HEN49_306428	12/12/2008	12/12/2008	Communication problem	Hook-up - Other	1300004955	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004894	
	12/5/2008	12/5/2008	Communication problem	No problem	1300004836	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	1/9/2009	1/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005300	
HEN171_306192	1/9/2009	1/9/2009	Communication problem	Manual Collect	1300005301	
HEN44_067191	1/9/2009	1/9/2009	Communication problem	Manual Collect	1300005302	
HEN44_067271	1/9/2009	1/9/2009	Pressure problem	Scrub/Clean Sensors	1300005303	
	1/9/2009	1/9/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300005303	
HEN44_067275	1/9/2009	1/9/2009	Communication problem	Manual Collect	1300005304	
HEN45_074152	1/9/2009	1/9/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300005305	
	1/9/2009	1/9/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005305	
HEN45_074159	1/9/2009	1/9/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300005306	
HEN47_081120	1/9/2009	1/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005307	
HEN49_306284	1/9/2009	1/13/2009	Pressure drifting	Replaced Pressure Sensor	1300005308	
HEN49_306343	1/9/2009	1/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005309	
HEN49_306428	1/9/2009	1/9/2008	Communication problem	No problem	1300005310	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	1/15/2009	1/16/2009	Communication problem	Manual Collect	1300005393	
	1/13/2009	1/13/2009	Communication problem	Manual Collect	1300005344	
HEN44_067191	1/15/2009	1/16/2009	Communication problem	Manual Collect	1300005394	
	1/13/2009	1/13/2009	Communication problem	Manual Collect	1300005345	
HEN47_081049	1/15/2009	1/20/2009	Communication problem	Manual Collect	1300005391	
	1/15/2009	1/20/2009	Confirmation(PVD)	Confirmation(PVD)	1300005391	
HEN47_081085	1/13/2009	1/13/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005346	
HEN49_306284	1/9/2009	1/13/2009	Pressure drifting	Replaced Pressure Sensor	1300005308	
HEN49_306428	1/13/2009	1/20/2009	Communication problem	Replaced Antenna	1300005347	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	1/22/2009	1/23/2009	Communication problem	Manual Collect	1300005451	
	1/20/2009	1/23/2009	Communication problem	Manual Collect	1300005411	
HEN44_067191	1/22/2009	1/23/2009	Communication problem	Manual Collect	1300005452	
	1/20/2009	1/23/2009	Communication problem	Manual Collect	1300005412	
HEN45_074159	1/22/2009	1/23/2009	Velocity - Zeros	Scrub/Clean Sensors	1300005453	
HEN47_080329	1/22/2009	1/23/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005455	
HEN47_081049	1/22/2009	1/23/2009	Communication problem	Manual Collect	1300005457	
	1/15/2009	1/20/2009	Communication problem	Manual Collect	1300005391	
	1/15/2009	1/20/2009	Confirmation(PVD)	Confirmation(PVD)	1300005391	
HEN47_081086	1/22/2009	1/23/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005454	
HEN49_306245	1/20/2009	1/20/2009	Communication problem	No problem	1300005413	
HEN49_306246	1/22/2009	1/22/2009	Battery low - Monitor	No problem	1300005456	
HEN49_306428	1/22/2009	1/23/2009	Communication problem	Manual Collect	1300005458	
	1/20/2009	1/23/2009	Communication problem	Manual Collect	1300005414	
	1/13/2009	1/20/2009	Communication problem	Replaced Antenna	1300005347	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	1/26/2009	1/27/2009	Communication problem	Manual Collect	1300005498	
HEN44_067191	1/29/2009	1/30/2009	Communication problem	Replaced Monitor	1300005552	
	1/26/2009	1/27/2009	Communication problem	Manual Collect	1300005497	
HEN45_074152	1/26/2009	1/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005493	
HEN45_074159	1/29/2009	1/29/2009	Communication problem	Collected Data	1300005557	
HEN46_081059	1/29/2009	1/30/2009	Velocity - Erratic data	Scrub/Clean Sensors	1300005553	
HEN47_081049	1/29/2009	1/30/2009	Communication problem	Replaced Monitor	1300005555	
	1/26/2009	1/27/2009	Communication problem	Manual Collect	1300005499	
HEN47_081120	1/26/2009	1/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005494	
HEN47_081239	1/29/2009	1/30/2009	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300005554	
	1/29/2009	1/30/2009	Velocity - Erratic data	Scrub/Clean Sensors	1300005554	
HEN49_306246	1/26/2009	1/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005495	
	1/26/2009	1/27/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005495	
HEN49_306284	1/26/2009	1/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005496	
HEN49_306428	1/29/2009	1/30/2009	Communication problem	Manual Collect	1300005556	
	1/26/2009	1/27/2009	Communication problem	Manual Collect	1300005500	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	2/4/2009	2/5/2009	Communication problem	Manual Collect	1300005667	
HEN171_306192	2/4/2009	2/8/2009	Velocity - spikes/drop out	No problem	1300005668	
HEN44_067271	2/4/2009	2/5/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005669	
	2/2/2009	2/3/2009	Communication problem	Manual Collect	1300005574	
HEN44_067275	2/4/2009	2/5/2009	Ultrasonic - Erratic data	No problem	1300005670	
HEN45_074159	2/2/2009	2/3/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005577	
HEN46_081131	2/4/2009	2/5/2009	Velocity - Erratic data	Scrub/Clean Sensors	1300005671	
HEN47_081085	2/2/2009	2/3/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005578	
HEN47_081120	2/2/2009	2/3/2009	Ultrasonic - spikes	Scrub/Clean Sensors	1300005579	
HEN47_081239	2/4/2009	2/5/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005672	
HEN49_306245	2/5/2009	2/5/2009	Velocity Meter Comparison	Confirmation(PVD)	1300005675	
HEN49_306275	2/3/2009	2/3/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005591	
HEN49_306343	2/4/2009	2/5/2009	Communication problem	Manual Collect	1300005673	
	2/2/2009	2/3/2009	Communication problem	Manual Collect	1300005575	
HEN49_306428	2/4/2009	2/5/2009	Communication problem	Manual Collect	1300005674	
	2/4/2009	2/5/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300005674	
	2/4/2009	2/5/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005674	
	2/2/2009	2/3/2009	Communication problem	Manual Collect	1300005576	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	2/4/2009	2/8/2009	Velocity - spikes/drop out	No problem	1300005668	
HEN44_067271	2/9/2009	2/10/2009	Communication problem	Collected Data	1300005699	
HEN45_074159	2/12/2009	2/12/2009	Confirmation(PVD)	Confirmation(Profile/Weir)	1300005745	
	2/12/2009	2/12/2009	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300005745	
	2/12/2009	2/12/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005745	
HEN47_081239	2/12/2009	2/12/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005746	
HEN49_306275	2/9/2009	2/10/2009	Communication problem	Manual Collect	1300005702	
HEN49_306343	2/12/2009	2/12/2009	Communication problem	Manual Collect	1300005747	
	2/9/2009	2/10/2009	Communication problem	Manual Collect	1300005700	
HEN49_306428	2/12/2009	2/12/2009	Communication problem	Manual Collect	1300005748	
	2/12/2009	2/12/2009	Ultrasonic - spikes	No problem	1300005748	
	2/9/2009	2/10/2009	Communication problem	Manual Collect	1300005701	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067275	2/16/2009	2/17/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300005785	
HEN45_074159	2/18/2009	2/19/2009	Ultrasonic problem	Confirmation(PVD)	1300005816	
	2/16/2009	2/17/2009	Velocity - Zeros	Scrub/Clean Sensors	1300005786	
HEN46_081131	2/18/2009	2/19/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005817	
HEN47_081139	2/18/2009	2/19/2009	Ultrasonic problem	Scrub/Clean Sensors	1300005818	
	2/18/2009	2/19/2009	Ultrasonic problem	Replaced Monitor	1300005818	
HEN47_081239	2/16/2009	2/17/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005787	
HEN49_306245	2/18/2009	2/19/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005819	
	2/16/2009	2/17/2009	Pressure drifting	Activated Monitor	1300005788	
HEN49_306428	2/16/2009	2/17/2009	Communication problem	Adjusted Other	1300005789	
	2/16/2009	2/17/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005789	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	2/23/2009	2/24/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005832	
HEN44_067275	2/23/2009	2/24/2009	Ultrasonic - spikes	Confirmation(PVD)	1300005833	
HEN45_074159	2/23/2009	2/24/2009	Ultrasonic - spikes	Scrub/Clean Sensors	1300005834	
	2/23/2009	2/24/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005834	
HEN46_081059	2/23/2009	2/24/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005835	
HEN49_306245	2/25/2009	2/24/2009	Battery low - Monitor	Rework - other	1300005851	
	2/23/2009	2/24/2009	Battery low - Monitor	No problem	1300005836	
HEN49_306275	2/23/2009	2/24/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005837	
HEN49_306428	2/23/2009	2/24/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005838	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN45_074159	3/3/2009	3/10/2009	Pressure drifting	Scrub/Clean Sensors	1300005923	
	3/3/2009	3/10/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005923	
HEN47_073276	3/4/2009	3/4/2009	Pressure drifting	No problem	1300005971	
HEN47_080329	3/3/2009	3/3/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300005924	
HEN47_081120	3/4/2009	3/4/2009	Ultrasonic - spikes	No problem	1300005970	
HEN47_081139	3/3/2009	3/3/2009	Communication problem	No problem	1300005925	
HEN49_306245	3/3/2009	3/3/2009	Battery low - Monitor	Replaced Battery - Monitor	1300005926	
	3/3/2009	3/3/2009	Battery low - Monitor	Replaced Antenna	1300005926	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	3/11/2009	3/11/2009	Pressure drifting	No problem	1300006064	
	3/9/2009	3/10/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006031	
	3/9/2009	3/10/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006031	
HEN171_306192	3/9/2009	3/10/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006032	
HEN45_074159	3/3/2009	3/10/2009	Pressure drifting	Scrub/Clean Sensors	1300005923	
	3/3/2009	3/10/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005923	
HEN46_081059	3/9/2009	3/10/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006033	
HEN46_081131	3/9/2009	3/10/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006034	
HEN47_073268	3/9/2009	3/11/2009	Communication problem	Manual Collect	1300006036	
HEN47_073276	3/9/2009	3/11/2009	Communication problem	Manual Collect	1300006037	
HEN47_080329	3/11/2009	3/12/2009	Pressure drifting	Replaced Monitor	1300006065	
HEN49_306343	3/9/2009	3/10/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006035	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	3/18/2009	3/19/2009	Communication problem	Manual Collect	1300006146	
HEN44_067191	3/18/2009	3/19/2009	Communication problem	Manual Collect	1300006147	
HEN45_074152	3/16/2009	3/17/2009	Pressure drifting	Replaced Pressure Sensor	1300006111	
HEN47_081139	3/11/2009	3/19/2009	Pressure drifting	No problem	1300006066	
HEN49_306245	3/18/2009	3/19/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006145	
HEN49_306246	3/16/2009	3/17/2009	Ultrasonic - spikes	Scrub/Clean Sensors	1300006112	
HEN49_306284	3/16/2009	3/17/2009	Pressure drifting	Activated Monitor	1300006113	
HEN49_306343	3/16/2009	3/17/2009	Ultrasonic - spikes	Scrub/Clean Sensors	1300006114	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	3/25/2009	3/27/2009	Communication problem	Manual Collect	1300006218	
HEN44_067271	3/25/2009	3/27/2009	Communication problem	Manual Collect	1300006219	
HEN47_080329	3/25/2009	3/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006223	
HEN47_081239	3/25/2009	3/27/2009	Velocity - Zeros	Scrub/Clean Sensors	1300006220	
HEN49_306245	3/25/2009	3/27/2009	Ultrasonic - spikes	Scrub/Clean Sensors	1300006221	
HEN49_306284	3/25/2009	3/27/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006222	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	4/1/2009	4/2/2009	Communication problem	Manual Collect	1300006312	
	3/30/2009	3/31/2009	Communication problem	Manual Collect	1300006261	
HEN45_074159	3/30/2009	3/31/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006262	
	3/30/2009	3/31/2009	Confirmation(PVD)	Confirmation(Profile/Weir)	1300006262	
	3/30/2009	3/31/2009	Velocity - Zeros	Scrub/Clean Sensors	1300006262	
HEN46_081131	3/30/2009	3/31/2009	Communication problem	Manual Collect	1300006263	
HEN47_080329	4/1/2009	4/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006314	
HEN47_081086	3/30/2009	3/31/2009	Ultrasonic problem	Replaced Monitor	1300006265	
HEN47_081120	3/30/2009	3/31/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006266	
HEN47_081239	3/30/2009	3/31/2009	Confirmation(PVD)	Replaced Velocity Sensor	1300006268	
HEN49_306245	3/30/2009	3/31/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006270	
HEN49_306246	3/30/2009	3/31/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006271	
HEN49_306343	4/1/2009	4/2/2009	Communication problem	Manual Collect	1300006313	
	3/30/2009	3/31/2009	Communication problem	Manual Collect	1300006274	
HEN49_306428	3/30/2009	3/31/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006272	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	4/8/2009	4/9/2009	Communication problem	Manual Collect	1300006390	
	4/6/2009	4/7/2009	Cables In Flow	Manual Collect	1300006338	
HEN44_067275	4/6/2009	4/9/2009	Pressure drifting	Confirmation(PVD)	1300006339	
HEN45_074152	4/6/2009	4/7/2009	Communication problem	Manual Collect	1300006340	
HEN45_074159	4/6/2009	4/7/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006341	
	4/6/2009	4/7/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006341	
HEN46_081131	4/6/2009	4/8/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006342	
HEN47_073268	4/6/2009	4/8/2009	Ultrasonic - spikes	Replaced Battery - Monitor	1300006343	
HEN47_080329	4/1/2009	4/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006314	
HEN47_081239	4/6/2009	4/7/2009	Velocity - Zeros	Scrub/Clean Sensors	1300006344	
HEN49_306275	4/6/2009	4/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006345	
HEN49_306343	4/8/2009	4/9/2009	Communication problem	Manual Collect	1300006391	

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Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN171_306192	4/16/2009	4/16/2009	Communication problem	Manual Collect	1300006483	
HEN47_080329	4/13/2009	4/16/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006437	
HEN47_081085	4/16/2009	4/16/2009	Communication problem	Manual Collect	1300006484	
HEN49_306343	4/13/2009	4/14/2009	Communication problem	Manual Collect	1300006436	
HEN49_306428	4/16/2009	4/16/2009	Communication problem	Manual Collect	1300006475	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	4/21/2009	4/21/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006530	
HEN171_306192	4/22/2009	4/24/2009	Communication problem	Manual Collect	1300006569	
	4/21/2009	4/21/2009	Communication problem	Manual Collect	1300006532	
HEN44_067275	4/21/2009	4/21/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006531	
	4/21/2009	4/21/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006531	
HEN45_074159	4/22/2009	4/24/2009	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300006570	
	4/22/2009	4/24/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006570	
HEN46_081131	4/22/2009	4/24/2009	Velocity - Zeros	Scrub/Clean Sensors	1300006571	
HEN47_081085	4/21/2009	4/21/2009	Communication problem	Manual Collect	1300006534	
HEN47_081086	4/22/2009	4/24/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006572	
HEN49_306428	4/22/2009	4/24/2009	Communication problem	Manual Collect	1300006573	
	4/21/2009	4/21/2009	Communication problem	Manual Collect	1300006535	

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Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	4/29/2009	4/30/2009	Communication problem	Manual Collect	1300006625	
	4/27/2009	4/28/2009	Communication problem	Manual Collect	1300006592	
	4/27/2009	4/28/2009	Pressure drifting	Activated Monitor	1300006592	
HEN44_067271	4/27/2009	4/28/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006593	
HEN46_081131	4/27/2009	4/28/2009	Communication problem	Manual Collect	1300006598	
	4/27/2009	4/28/2009	Velocity - spikes/drop out	Replaced Velocity Sensor	1300006598	
HEN47_081085	4/29/2009	4/30/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006627	
HEN47_081086	4/27/2009	4/29/2009	Velocity - spikes/drop out	Replaced Velocity Sensor	1300006594	
	4/27/2009	4/29/2009	Velocity - spikes/drop out	Replaced Pressure Sensor	1300006594	
HEN47_081120	4/27/2009	4/28/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006595	
HEN49_306246	4/27/2009	4/28/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006596	
HEN49_306343	4/29/2009	4/30/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006628	
HEN49_306428	4/29/2009	4/30/2009	Communication problem	Manual Collect	1300006626	
	4/27/2009	4/28/2009	Communication problem	Manual Collect	1300006597	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	5/6/2009	5/7/2009	Communication problem	Manual Collect	1300006683	
	5/4/2009	5/5/2009	Communication problem	Manual Collect	1300006653	
	5/4/2009	5/5/2009	Communication problem	Replaced Antenna	1300006653	
HEN44_067191	5/6/2009	5/7/2009	Communication problem	Manual Collect	1300006684	
HEN45_074159	5/6/2009	5/7/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006685	
HEN47_081139	5/4/2009	5/5/2009	Ultrasonic - spikes	No problem	1300006655	
HEN49_306245	5/6/2009	5/7/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006686	
HEN49_306284	5/4/2009	5/5/2009	Communication problem	Replaced Battery - Wireless	1300006656	
	5/4/2009	5/5/2009	Communication problem	Manual Collect	1300006656	
HEN49_306428	5/6/2009	5/7/2009	Communication problem	Replaced Battery - Monitor	1300006687	
	5/6/2009	5/7/2009	Communication problem	Manual Collect	1300006687	
	5/4/2009	5/5/2009	Communication problem	Manual Collect	1300006654	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	5/11/2009	5/13/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006711	
HEN171_306192	5/11/2009	5/13/2009	Communication problem	Manual Collect	1300006712	
HEN45_074159	5/13/2009	5/14/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006804	
HEN47_081239	5/13/2009	5/15/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006805	
	5/11/2009	5/13/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006713	
HEN49_306343	5/11/2009	5/13/2009	Communication problem	Replaced Battery - Monitor	1300006719	
	5/11/2009	5/13/2009	Communication problem	Manual Collect	1300006719	
	5/11/2009	5/13/2009	Communication problem	Replaced Antenna	1300006719	
HEN49_306428	5/11/2009	5/13/2009	Communication problem	Manual Collect	1300006714	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	5/21/2009	5/21/2009	Communication problem	Manual Collect	1300006840	
	5/19/2009	5/19/2009	Communication problem	Manual Collect	1300006820	
HEN45_074159	5/19/2009	5/19/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006821	
HEN46_081131	5/19/2009	5/19/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006822	
HEN49_306343	5/21/2009	5/21/2009	Ultrasonic - Erratic data	Scrub/Clean Sensors	1300006841	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	5/27/2009	5/27/2009	Communication problem	Manual Collect	1300006873	
	5/26/2009	5/26/2009	Communication problem	Manual Collect	1300006853	
HEN44_067271	5/27/2009	5/27/2009	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300006874	
HEN47_081049	5/26/2009	5/26/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006856	
HEN47_081139	5/27/2009	5/29/2009	Ultrasonic - Low number of good pairs	Scrub/Clean Sensors	1300006875	
	5/26/2009	5/26/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006854	
	5/26/2009	5/26/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006854	
HEN49_306245	5/27/2009	5/29/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006876	
HEN49_306275	5/26/2009	5/26/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006855	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN46_081059	6/3/2009	6/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006941	
	6/3/2009	6/9/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006941	
HEN49_306246	6/3/2009	6/4/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006942	
HEN49_306428	6/3/2009	6/4/2009	Confirmation(PVD)	Confirmation(PVD)	1300006943	
	6/3/2009	6/4/2009	Velocity - spikes/drop out	Scrub/Clean Sensors	1300006943	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_081237	6/11/2009	6/11/2009	Battery low - Monitor	Replaced Battery - Monitor	1300007011	
HEN44_067271	6/11/2009	6/11/2009	Communication problem	Manual Collect	1300007012	
HEN45_074152	6/8/2009	6/11/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006976	
HEN46_081059	6/3/2009	6/9/2009	Battery low - Monitor	Replaced Battery - Monitor	1300006941	
	6/3/2009	6/9/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300006941	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	6/16/2009	6/16/2009	Communication problem	Replaced Antenna	1300007039	
HEN46_081059	6/16/2009	6/16/2009	Confirmation(PVD)	Confirmation(PVD)	1300007041	
HEN47_081085	6/16/2009	6/16/2009	Battery low - Monitor	Replaced Battery - Monitor	1300007040	
HEN49_306428	6/17/2009	6/19/2009	Confirmation(PVD)	Confirmation(PVD)	1300007062	
	6/17/2009	6/19/2009	Velocity - spikes/drop out	No problem	1300007062	

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Service History Report

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067271	6/24/2009	6/25/2009	Confirmation(PVD)	Confirmation(PVD)	1300007144	
HEN45_074152	6/22/2009	6/25/2009	Battery Low - Wireless	Replaced Battery - Wireless	1300007118	
HEN49_306428	6/24/2009	6/25/2009	Confirmation(PVD)	Confirmation(PVD)	1300007143	
	6/24/2009	6/25/2009	Ultrasonic problem	No problem	1300007143	
	6/24/2009	6/25/2009	Velocity problem	No problem	1300007143	

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Service History Report

ABS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	12/1/2008	12/1/2008	Communication problem	No problem	1300004777	
HEN44_067191	12/5/2008	12/5/2008	Communication problem	No problem	1300004839	
	12/1/2008	12/1/2008	Communication problem	No problem	1300004778	
HEN45_074159	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004788	
HEN47_081085	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004789	
HEN47_081139	12/1/2008	12/1/2008	Communication problem	No problem	1300004779	
HEN47_081239	12/5/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004837	
	12/1/2008	12/1/2008	Communication problem	No problem	1300004784	
	12/1/2008	12/1/2008	Velocity - spikes/drop out	No problem	1300004792	
HEN49_306245	12/1/2008	11/26/2008	Pressure drifting	Replaced Pressure Sensor	1300004791	
HEN49_306275	12/1/2008	12/1/2008	Battery low - Monitor	No problem	1300004790	
HEN49_306284	12/1/2008	12/1/2008	Communication problem	No problem	1300004785	
HEN49_306343	12/5/2008	12/5/2008	Velocity - spikes/drop out	No problem	1300004838	
	12/1/2008	12/1/2008	Velocity - spikes/drop out	No problem	1300004786	
HEN49_306428	12/5/2008	12/5/2008	Communication problem	No problem	1300004836	

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Service History Report

ADS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	12/12/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004945	
HEN44_067191	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004946	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004888	
HEN44_067275	12/12/2008	12/12/2008	Ultrasonic - spikes	Other	1300004947	
	12/9/2008	12/9/2008	Ultrasonic - spikes	No problem	1300004889	
HEN45_074152	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004890	
HEN45_074159	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004948	
	12/9/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004895	
HEN46_081131	12/12/2008	12/12/2008	Velocity - Zeros	Scrub/Clean Sensors	1300004949	
	12/9/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004891	
HEN47_081086	12/12/2008	12/12/2008	Communication problem	Reset Monitor/Board	1300004950	
HEN47_081120	12/12/2008	12/12/2008	Communication problem	Hook-up - Other	1300004951	
HEN47_081139	12/9/2008	12/9/2008	Communication problem	Replaced Battery - IS Monitor	1300004892	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004892	
HEN47_081239	12/12/2008	12/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004952	
	12/5/2008	12/9/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004837	
HEN49_306284	12/12/2008	12/12/2008	Communication problem	Reset Monitor/Board	1300004953	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004893	

Customer *Henderson*

Site Name	*Reported*	*Site Visit*	*Problem*	*Resolution*	*WorkOrderID*	*RefNo:*
HEN49_306343	12/12/2008	12/12/2008	Velocity - Zeros	Replaced Velocity Sensor	1300004954	
HEN49_306428	12/12/2008	12/12/2008	Communication problem	Hook-up - Other	1300004955	
	12/9/2008	12/9/2008	Communication problem	Manual Collect	1300004894	

Service History Report

ABS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005000	
	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005000	
	12/12/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300004945	
HEN44_067191	12/18/2008	12/18/2008	Communication problem	No problem	1300005053	
	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005001	
	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004946	
HEN44_067275	12/16/2008	12/16/2008	Communication problem	No problem	1300005002	
HEN45_074152	12/16/2008	12/16/2008	Communication problem	No problem	1300005003	
HEN45_074159	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005004	
	12/12/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004948	
HEN46_081131	12/16/2008	12/16/2008	Velocity - spikes/drop out	No problem	1300005005	
HEN47_073268	12/16/2008	12/17/2008	Communication problem	Manual Collect	1300005011	
HEN47_073276	12/16/2008	12/17/2008	Communication problem	Manual Collect	1300005012	
HEN47_081086	12/16/2008	12/16/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005006	
	12/16/2008	12/16/2008	Velocity - spikes/drop out	No problem	1300005006	
HEN47_081120	12/18/2008	12/18/2008	Velocity - spikes/drop out	No problem	1300005054	
	12/16/2008	12/16/2008	Communication problem	Replaced Antenna	1300005007	
	12/16/2008	12/16/2008	Pressure drifting	No problem	1300005007	

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN47_081139	12/16/2008	12/16/2008	Communication problem	No problem	1300005008	
HEN47_081239	12/12/2008	12/17/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300004952	
HEN49_306284	12/16/2008	12/16/2008	Communication problem	No problem	1300005009	
HEN49_306343	12/16/2008	12/16/2008	Communication problem	Reset Monitor/Board	1300005010	
	12/16/2008	12/16/2008	Confirmation(Profile)	Confirmation(Profile/Weir)	1300005013	
	12/16/2008	12/16/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005010	

Service History Report

ADS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN44_067191	12/23/2008	12/29/2008	Communication problem	Replaced Monitor	1300005094	
HEN44_067271	12/23/2008	12/23/2008	Battery low - Monitor	Replaced Battery - Monitor	1300005095	
HEN45_074152	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005096	
HEN45_074159	12/23/2008	12/24/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005097	
HEN46_081059	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005098	
HEN46_081131	12/23/2008	12/23/2008	Pressure problem	No problem	1300005099	
HEN47_081239	12/23/2008	12/24/2008	Battery low - Monitor	Replaced Battery - Monitor	1300005100	
HEN49_306245	12/23/2008	12/23/2008	Battery low - Monitor	No problem	1300005101	
HEN49_306284	12/23/2008	12/29/2008	Communication problem	Manual Collect	1300005102	

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Service History Report

ABS ENVIRONMENTAL SERVICES

Customer *Henderson*

Site Name	Reported	Site Visit	Problem	Resolution	WorkOrderID	RefNo:
HEN171_306192	12/30/2008	12/31/2008	Pressure drifting	No problem	1300005153	
HEN44_067191	12/30/2008	12/31/2008	Communication problem	Manual Collect	1300005154	
	12/23/2008	12/29/2008	Communication problem	Replaced Monitor	1300005094	
HEN45_074152	12/30/2008	12/31/2008	Battery Low - Wireless	Replaced Battery - Wireless	1300005155	
HEN47_081239	12/30/2008	12/31/2008	Communication problem	Reset Monitor/Board	1300005156	
HEN49_306245	12/30/2008	12/31/2008	Velocity - spikes/drop out	Scrub/Clean Sensors	1300005157	
HEN49_306284	12/30/2008	12/31/2008	Pressure drifting	Replaced Pressure Sensor	1300005158	
	12/23/2008	12/29/2008	Communication problem	Manual Collect	1300005102	

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Appendix F
Monitor Uptime Detail

Monthly Monitor Uptime

Henderson Basin

Monitor	Date Installed	Overall Uptime	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09
HEN171_081237	1/10/08	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HEN171_306192	1/9/08	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HEN44_067191	1/3/08	95%	43%	100%	100%	100%	100%	100%	100%	100%	100%	83%	100%	100%	94%	100%	100%	100%	100%
HEN44_067271	1/11/08	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%
HEN44_067275_1	3/25/08	89%			16%	31%	100%	100%	100%	100%	100%	100%	100%	94%	100%	100%	100%	100%	100%
HEN44_067275_2	3/25/08	94%			98%	65%	100%	100%	100%	100%	100%	100%	100%	94%	100%	100%	100%	100%	58%
HEN45_074152	1/3/08	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	100%	100%	97%	98%	81%	100%
HEN45_074159	1/9/08	87%	99%	100%	100%	100%	100%	36%	59%	86%	100%	87%	99%	97%	90%	49%	86%	89%	100%
HEN46_081059	1/9/08	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	100%	100%	100%	100%	100%	100%	100%
HEN46_D081131		98%			84%	98%	100%	100%	100%	100%	98%	97%	100%	100%	100%	100%	100%	100%	100%
HEN47_073268	1/8/08	96%	95%	48%	100%	100%	100%	100%	100%	100%	100%	86%	100%	100%	100%	97%	100%	100%	100%
HEN47_073276	1/11/08	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%	100%
HEN47_080329	1/15/08	99%	84%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%
HEN47_081049	12/12/08	93%												100%	58%	100%	100%	100%	100%
HEN47_081085	1/10/08	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	51%	100%
HEN47_D081086	3/6/08	99%			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	85%	100%	100%
HEN47_081120	1/10/08	99%	100%	100%	100%	100%	100%	100%	100%	100%	89%	100%	100%	100%	100%	100%	100%	100%	100%
HEN47_081139	1/10/08	98%	96%	94%	100%	100%	99%	100%	100%	89%	100%	100%	100%	100%	100%	90%	100%	100%	100%
HEN47_081239	1/11/08	98%	100%	96%	100%	100%	100%	99%	76%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HEN49_306245	1/8/08	98%	100%	100%	100%	100%	91%	100%	100%	96%	100%	91%	100%	100%	100%	95%	98%	100%	100%
HEN49_306246	1/9/08	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	100%	100%	100%	100%	100%	99%	100%	100%
HEN49_306275	1/9/08	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HEN49_306284	1/11/08	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	84%	97%	100%	100%	100%	100%	94%

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Monthly Monitor Uptime

Henderson Basin

Monitor	Date Installed	Overall Uptime	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09
HEN49_306343	1/11/08	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%
HEN49_306428	4/16/08	99%				100%	99%	100%	100%	92%	98%	100%	100%	100%	100%	100%	100%	100%	100%
NPDES044A_MH067274	7/27/07	100%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NPDES044B_MH067261	7/27/07	99%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	90%	100%	100%	100%	100%	N/D
NPDES045A_MH074153_1	8/2/07	100%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NPDES045A_MH074153_2	4/14/09	84%																96%	71%
NPDES045B_MH074167	7/24/07	96%	N/D	N/D	N/D	N/D	N/D	91%	100%	95%	90%	100%	92%	100%	100%	100%	99%	93%	N/D
NPDES046_MH081062_1	7/24/07	96%	N/D	N/D	N/D	N/D	N/D	99%	97%	100%	100%	100%	100%	100%	100%	99%	99%	54%	100%
NPDES046_MH081062_2	7/24/07	99%	N/D	N/D	N/D	N/D	N/D	98%	100%	100%	100%	100%	97%	100%	100%	100%	100%	90%	100%
NPDES047B_MH081224	8/6/07	100%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	96%	N/D
NPDES047C_MH081330	8/28/07	100%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	N/D
NPDES47D_MH081298	8/6/07	99%	N/D	N/D	N/D	N/D	N/D	100%	96%	92%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NPDES47E_MH081480	8/6/07	99%	N/D	N/D	N/D	N/D	N/D	100%	99%	100%	100%	100%	100%	100%	100%	100%	93%	100%	100%
NPDES049_MH306437	8/6/07	98%	N/D	N/D	N/D	N/D	N/D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	100%
NPDES171_MH081231	8/28/07	97%	N/D	N/D	N/D	N/D	N/D	100%	100%	73%	97%	100%	100%	100%	100%	100%	99%	99%	N/D

N/D = No data available

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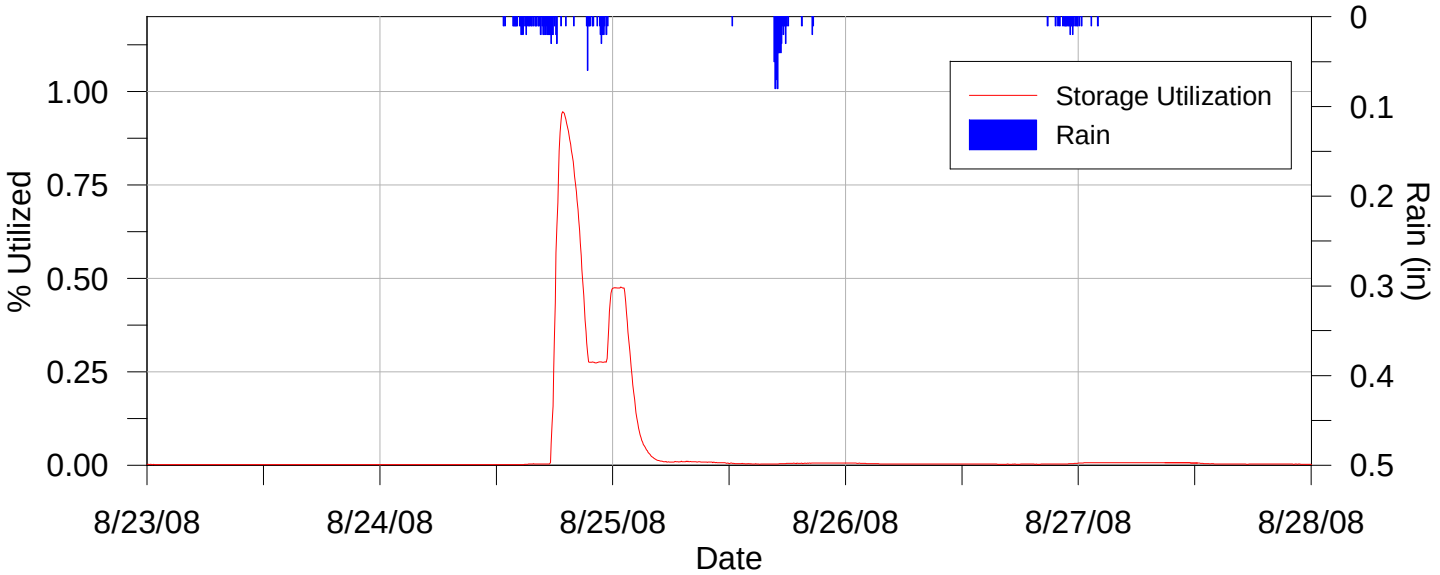
Appendix G
Storage Performance

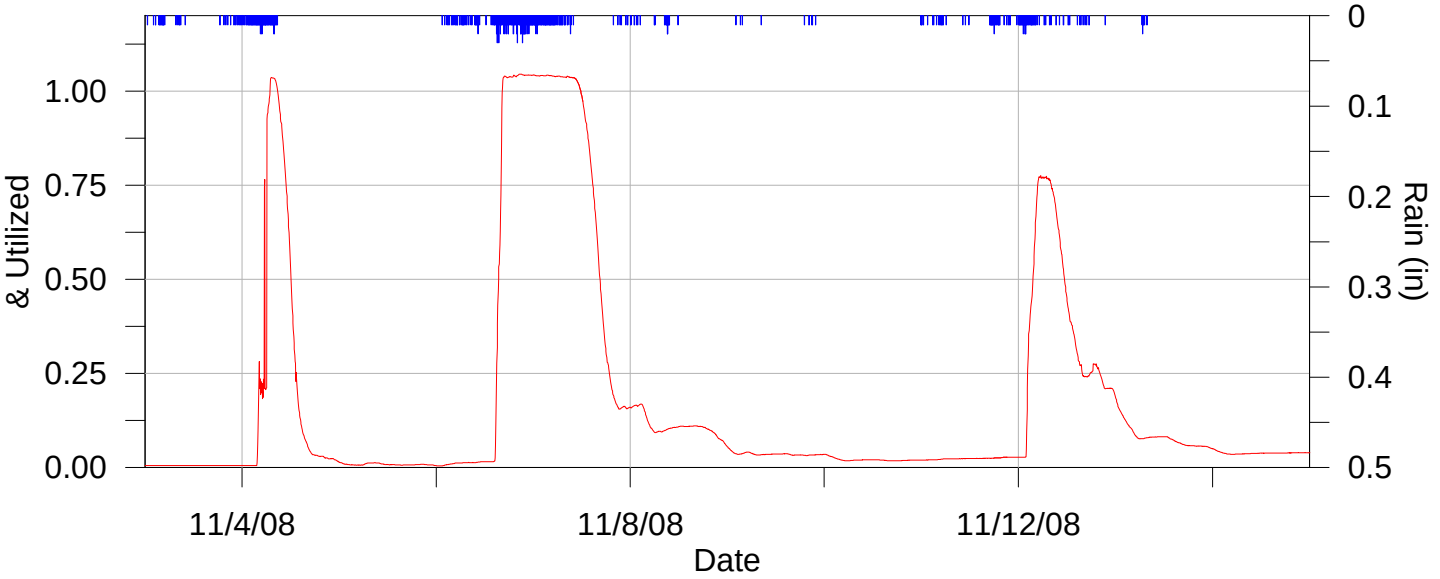
Storage performance was charted for three significant rainfall events:

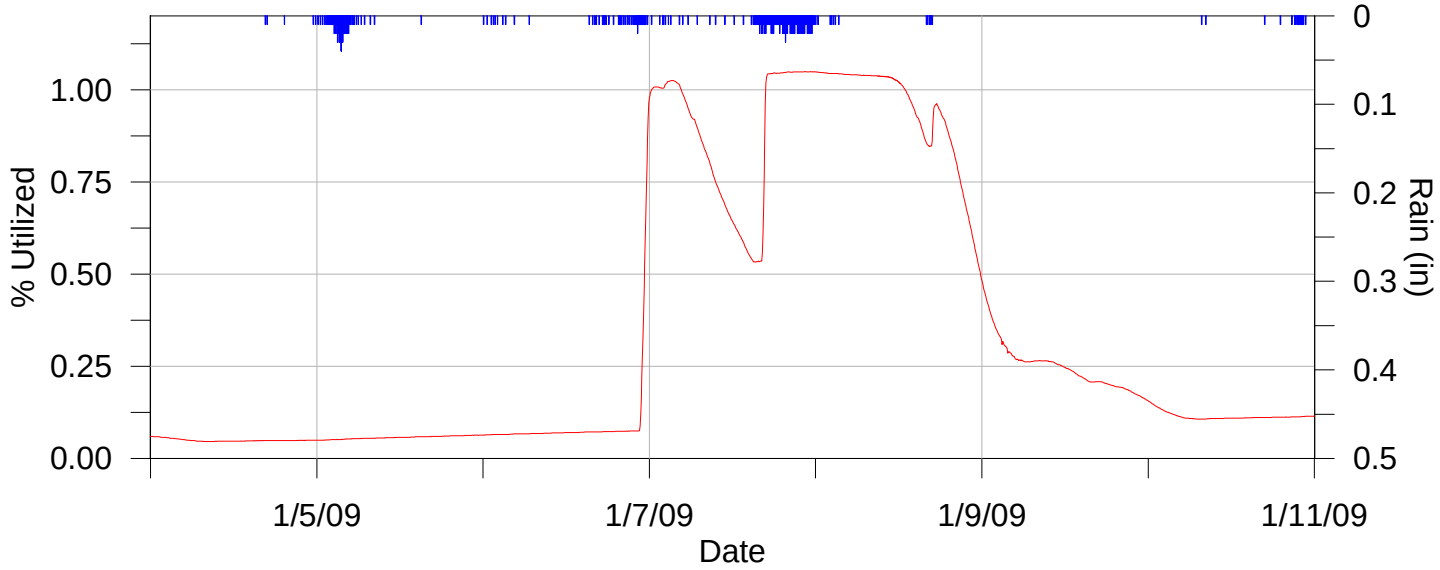
- August 23 – 28. 2008
- November 3 – 15, 2008 (largest rainfall event during monitoring period)
- January 4 – 11, 2009

These events provide a good representation of the larger events that were experienced during the monitoring period. Charts showing the storage utilization for each facility are included in the following pages.

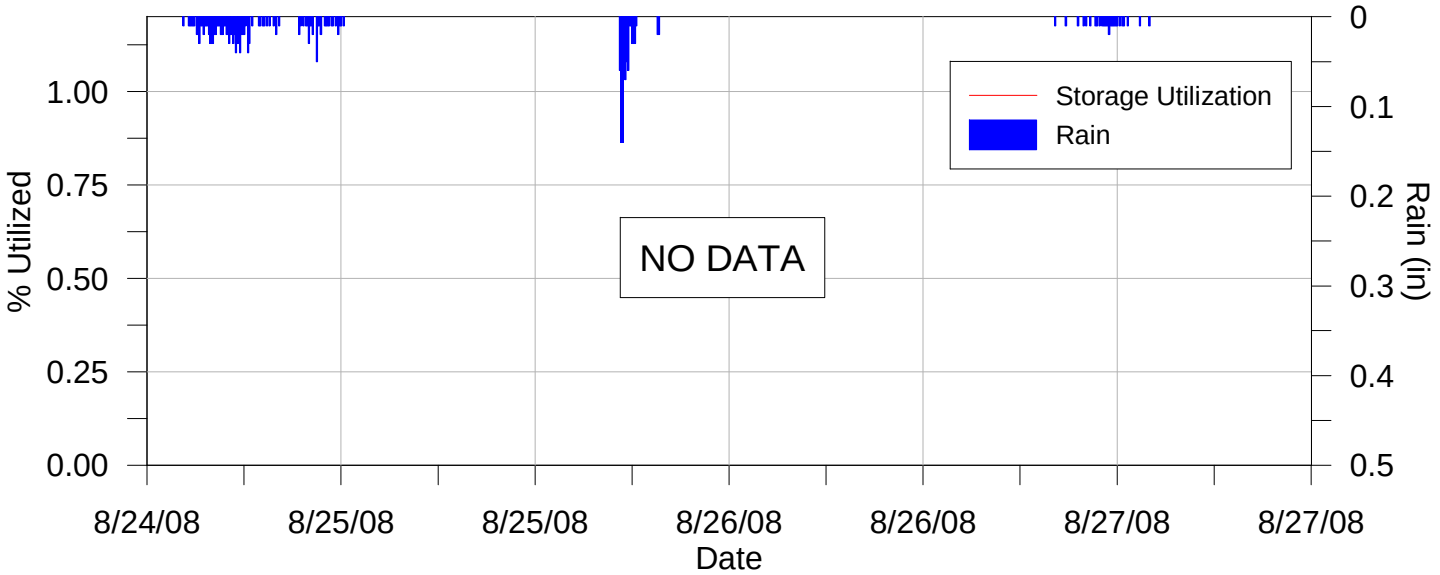
Storage Utilization
CSO Facility #8

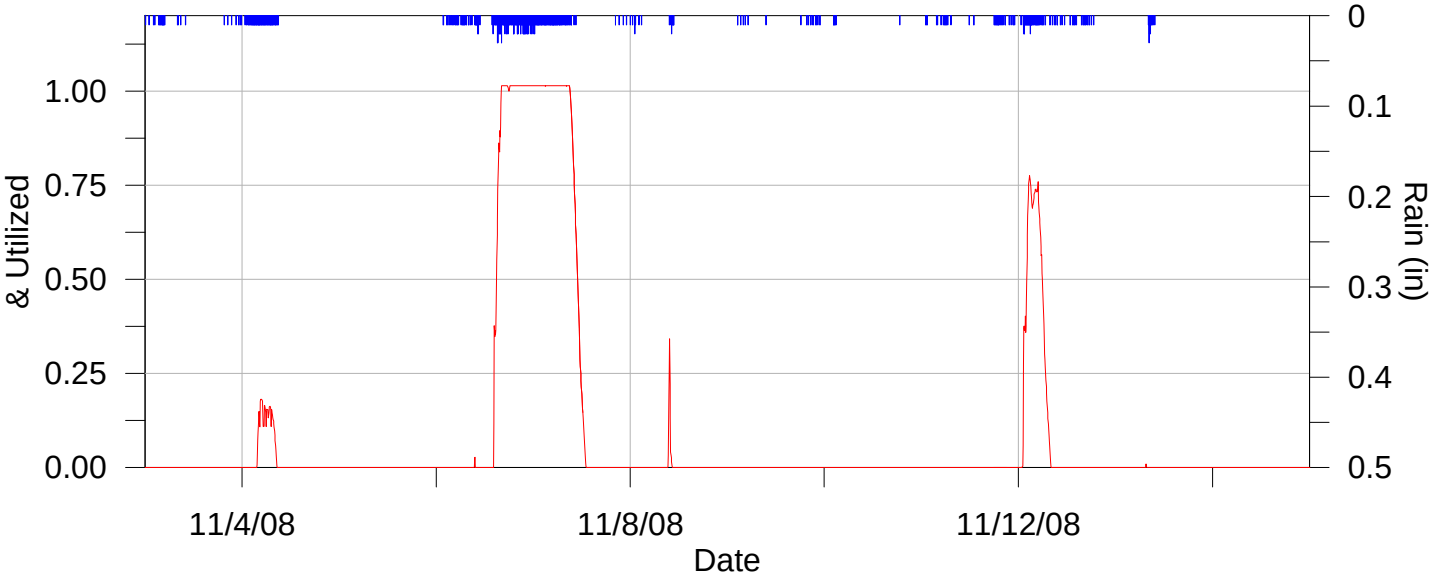


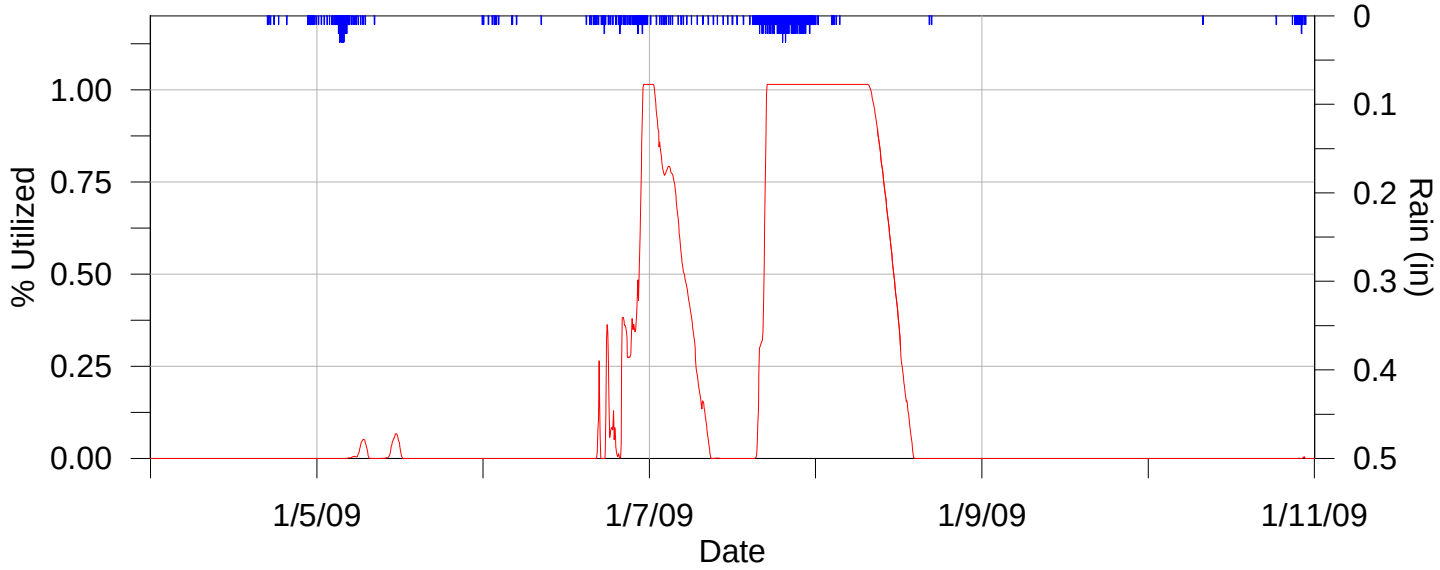




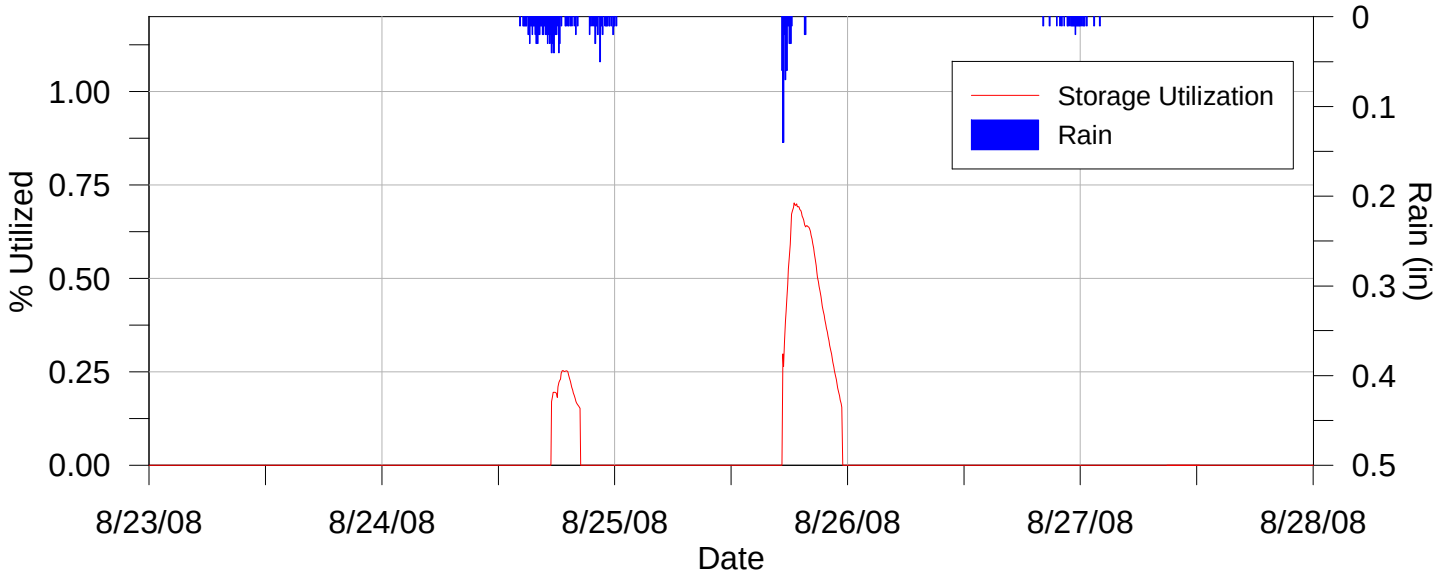
Storage Utilization
CSO Facility #5

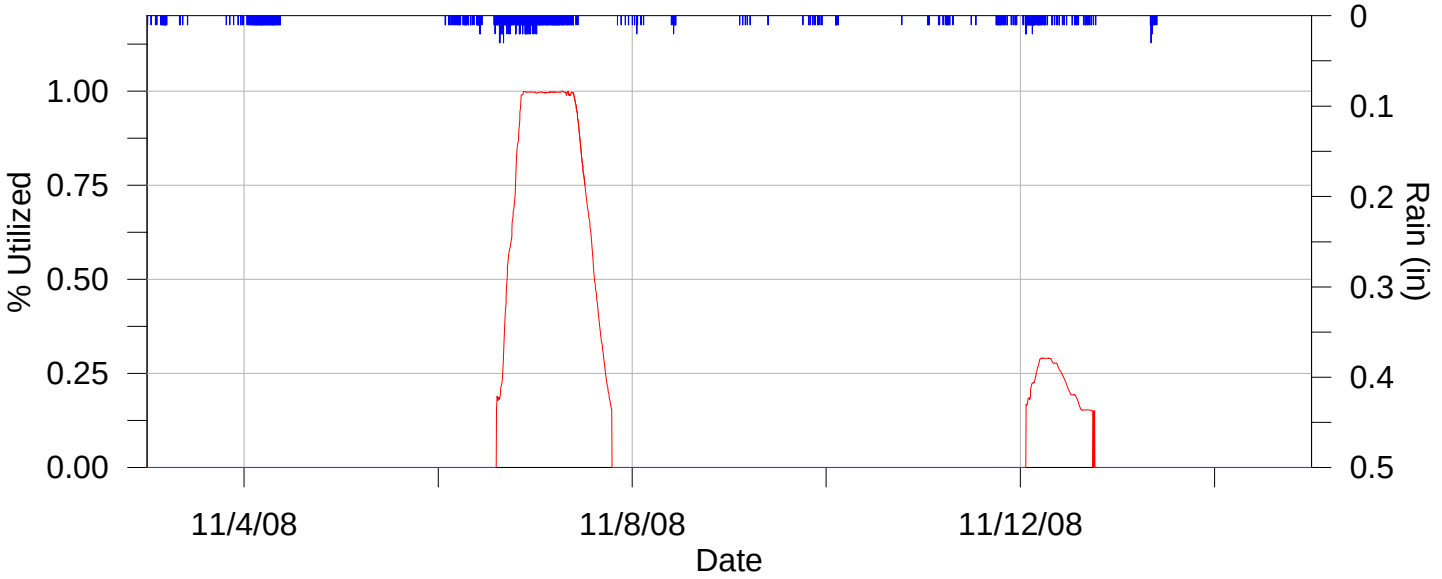


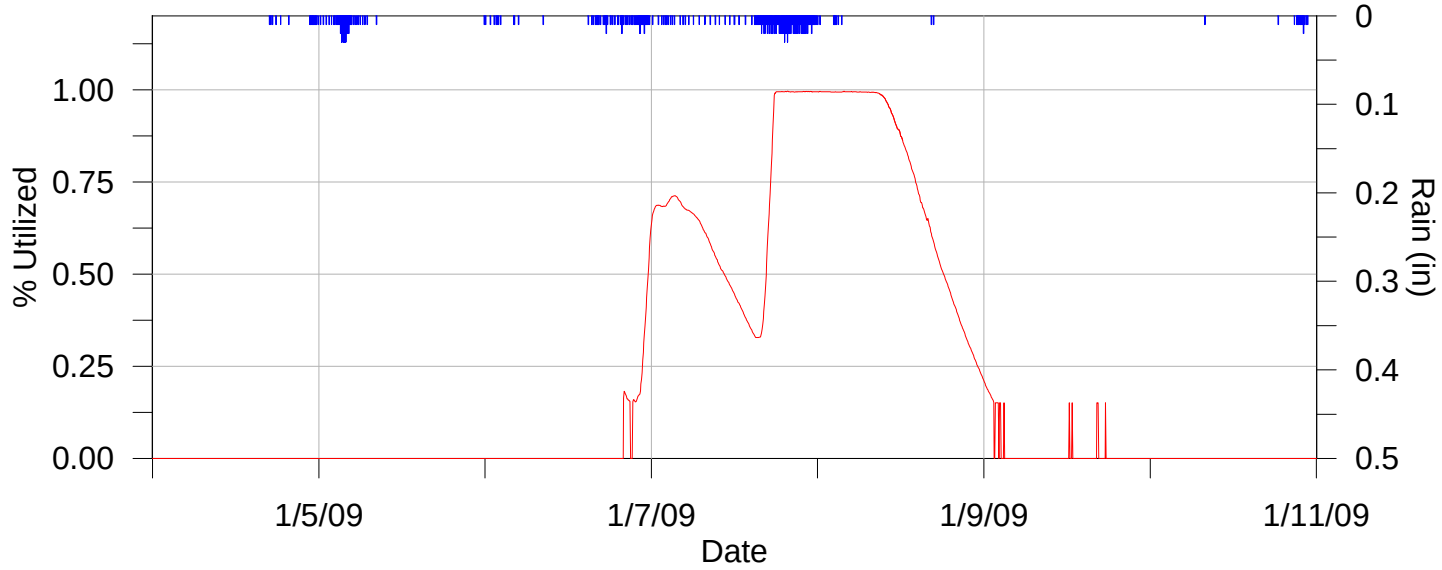




Storage Utilization
CSO Facility #4







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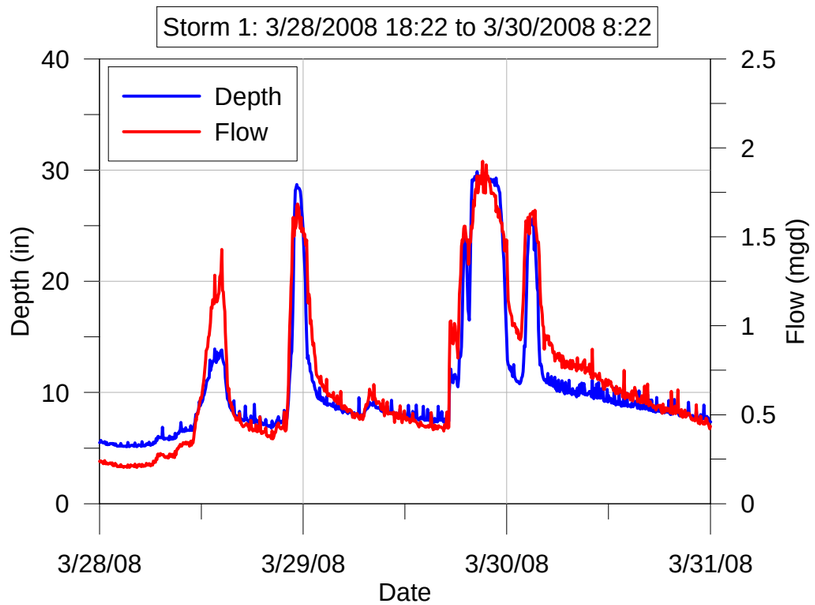
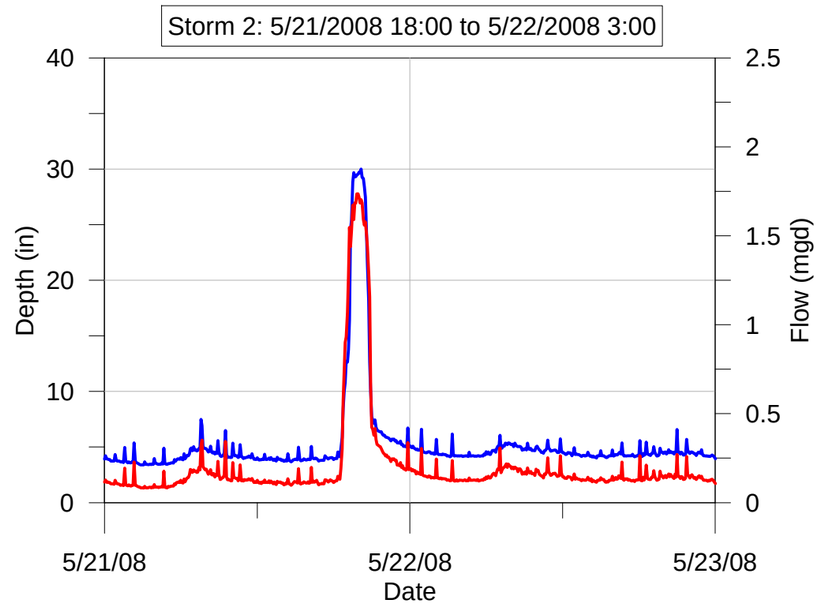
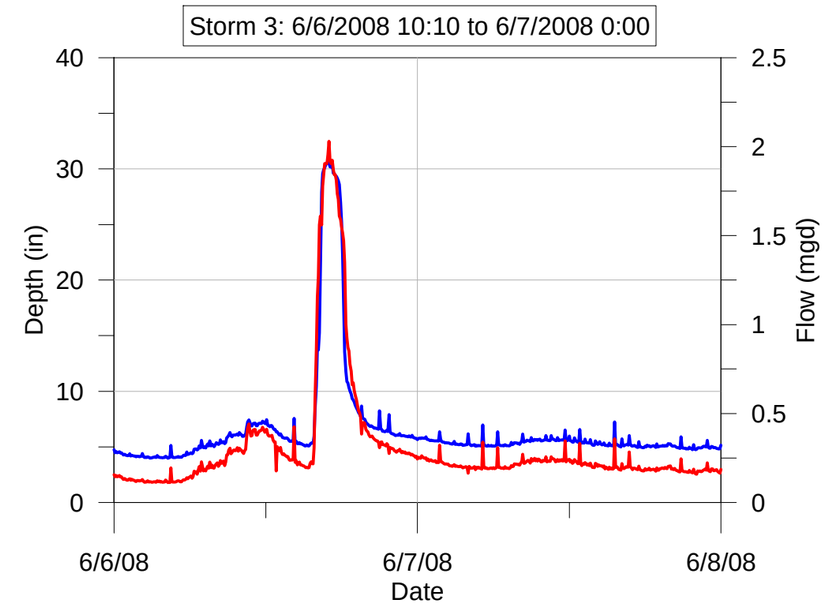
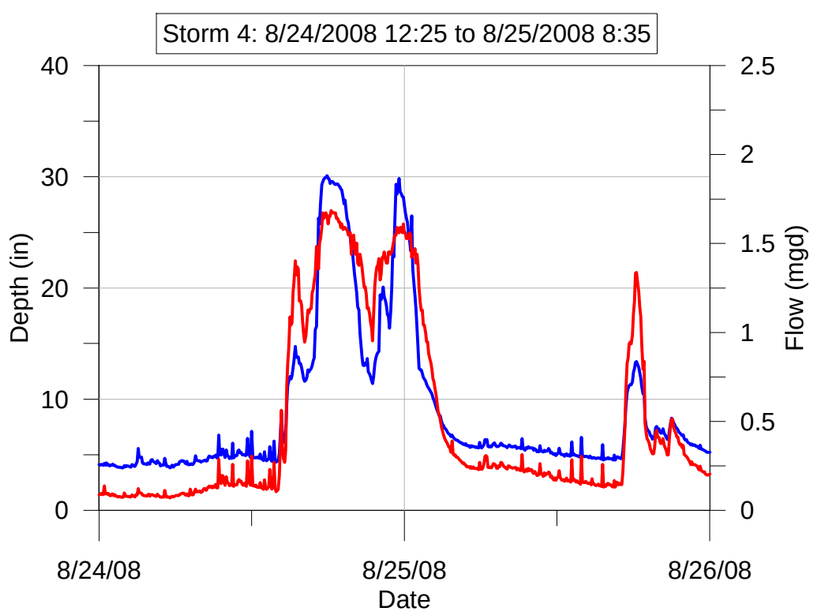
Appendix H
Calibration Storms:
Hydrographs & Scattergraphs

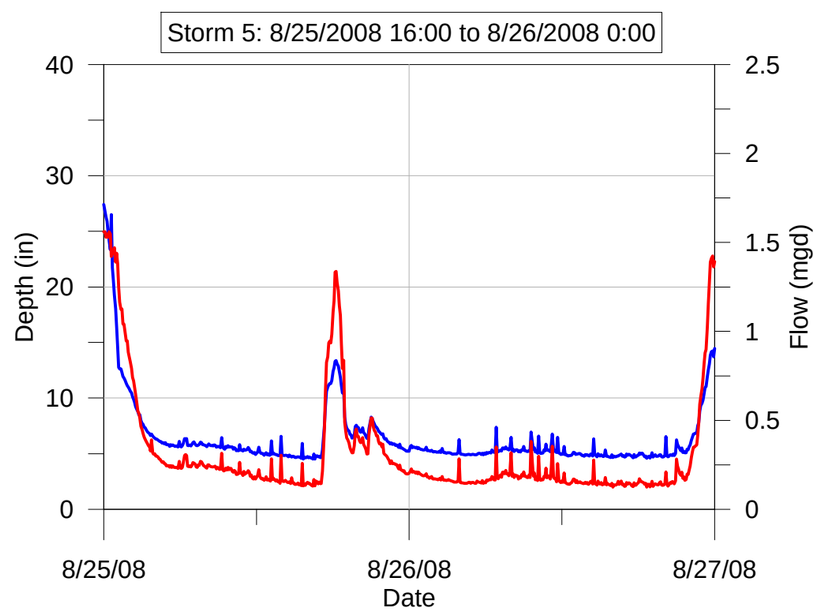
Calibration Storms
Monitor 067-261 (44B)

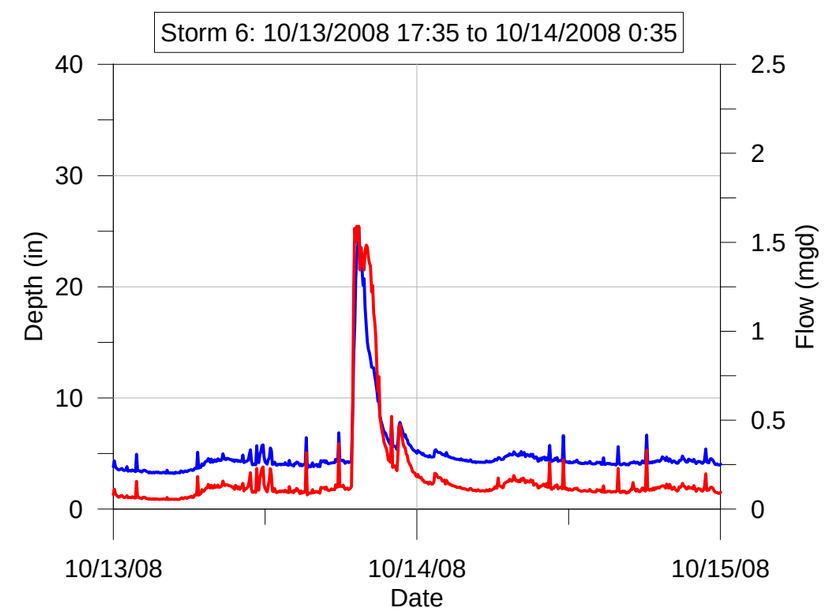




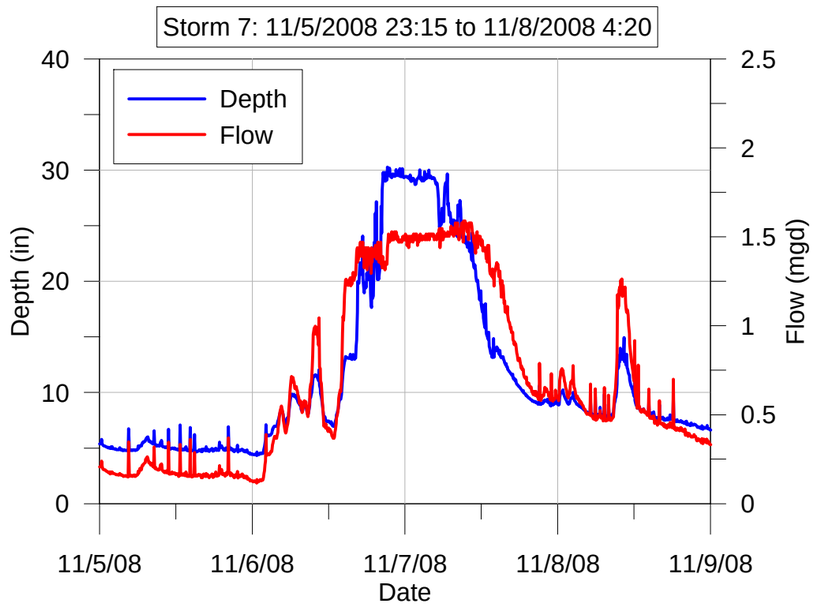


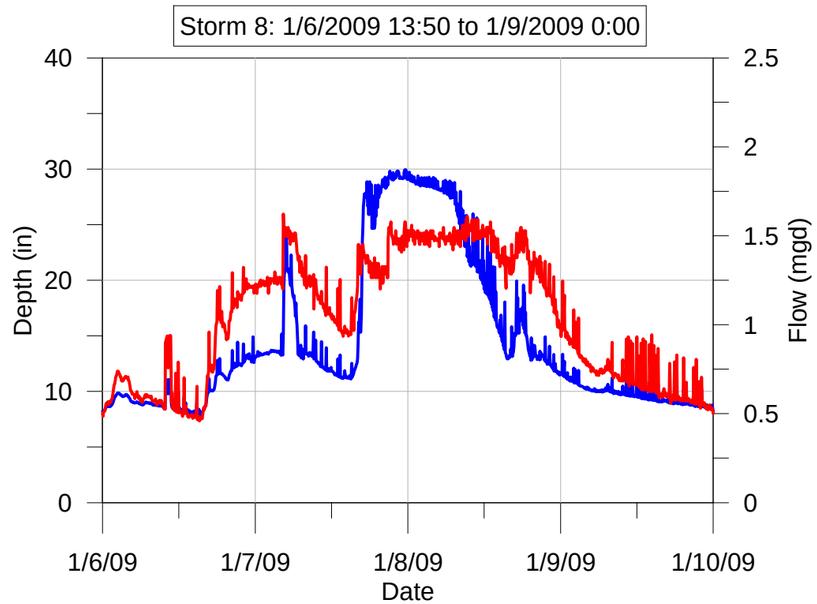


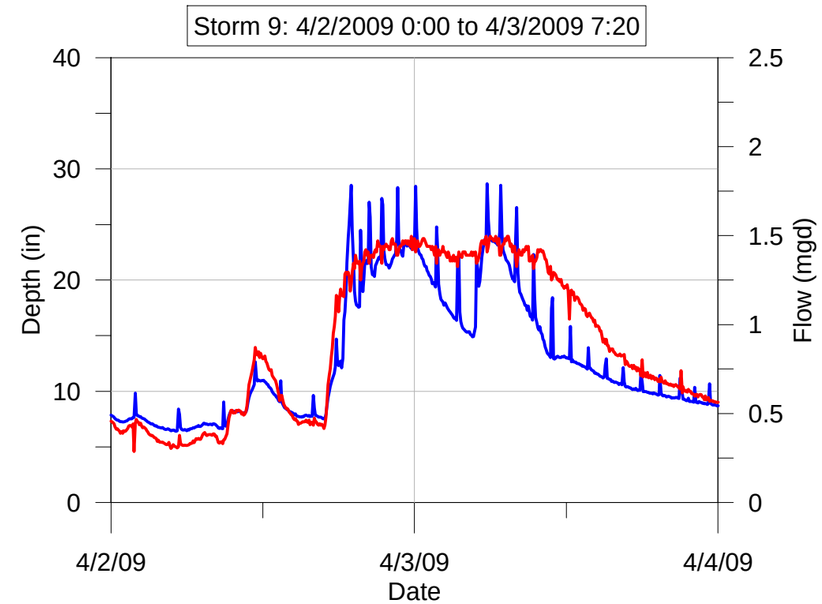


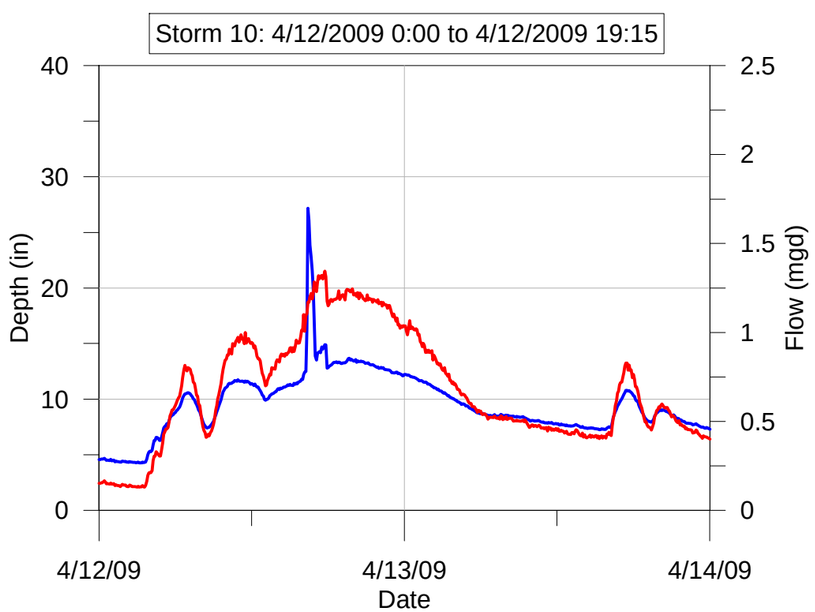


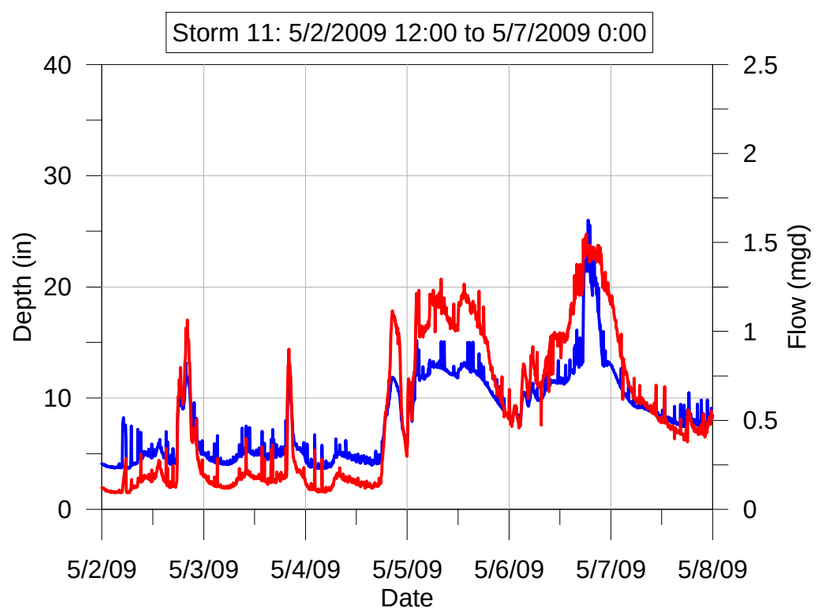
Calibration Storms
Monitor 067-261 (44B)

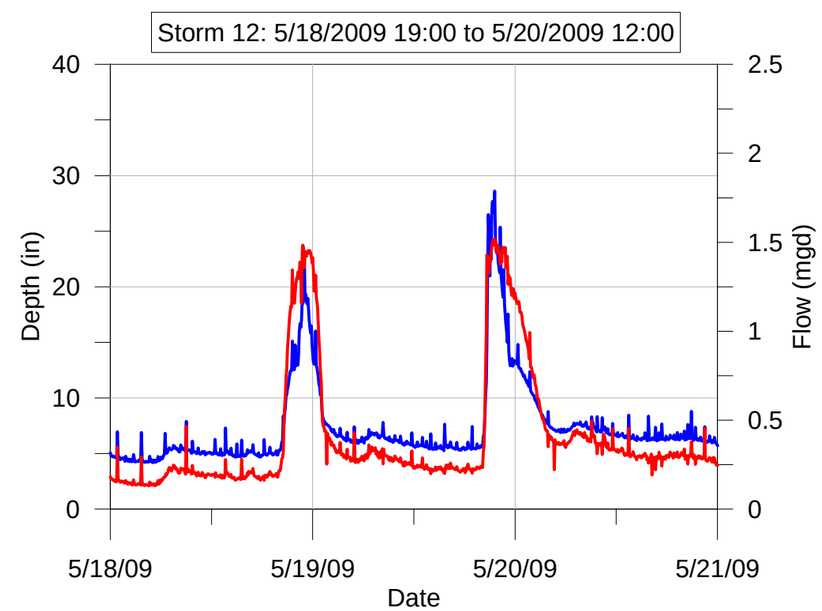




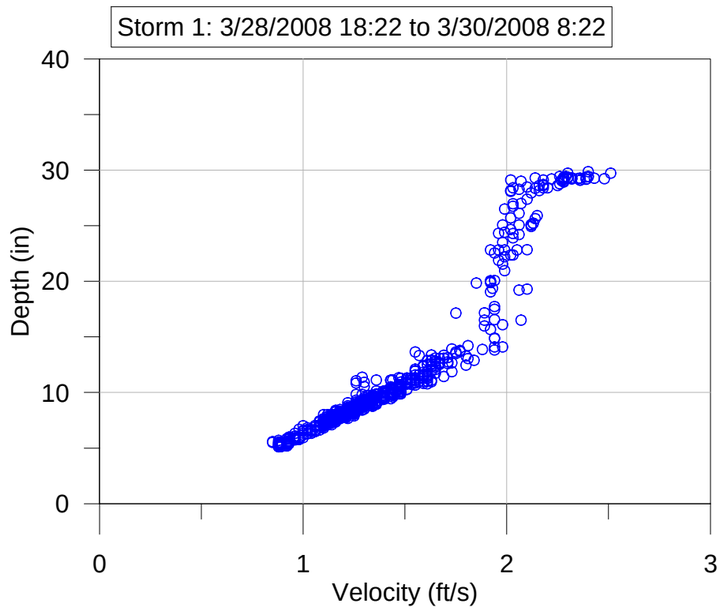


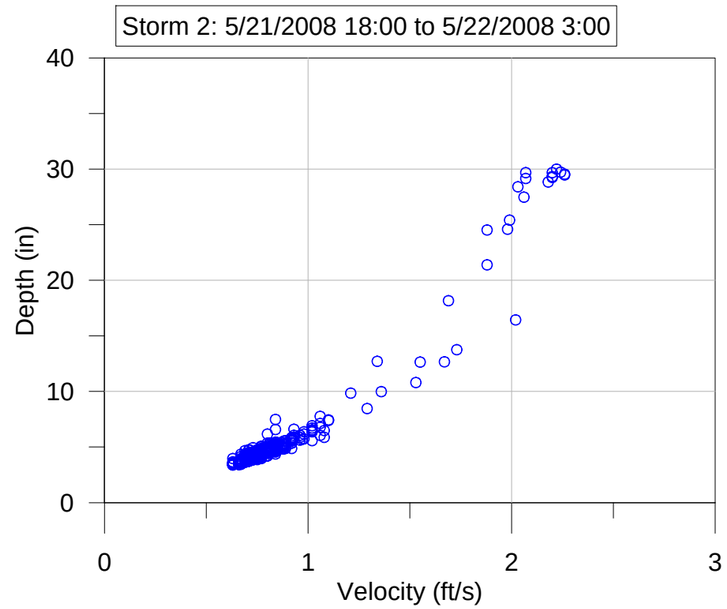


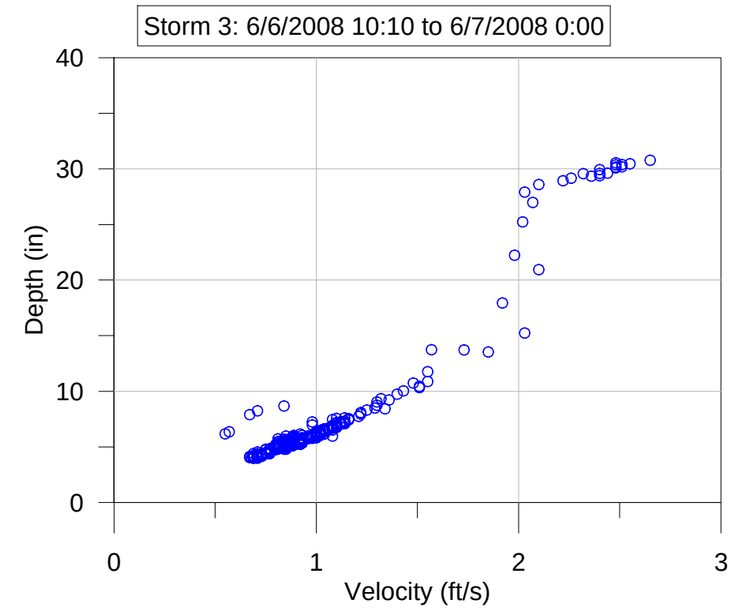


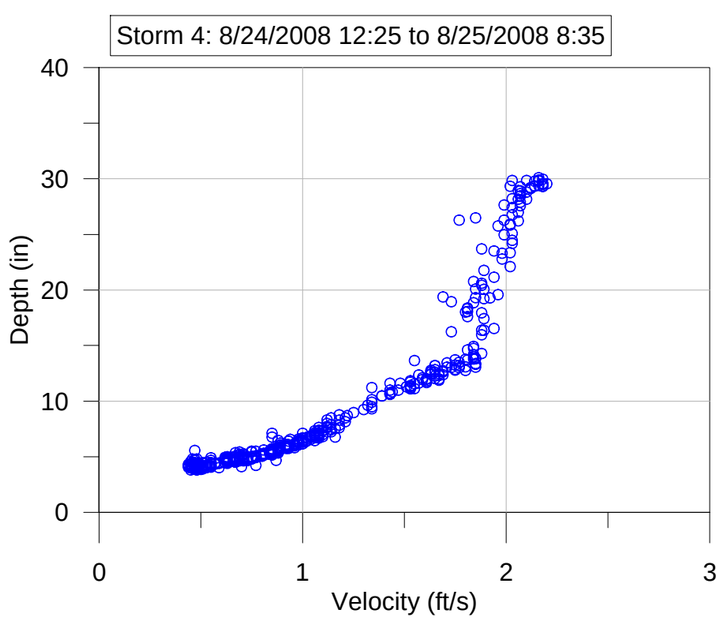


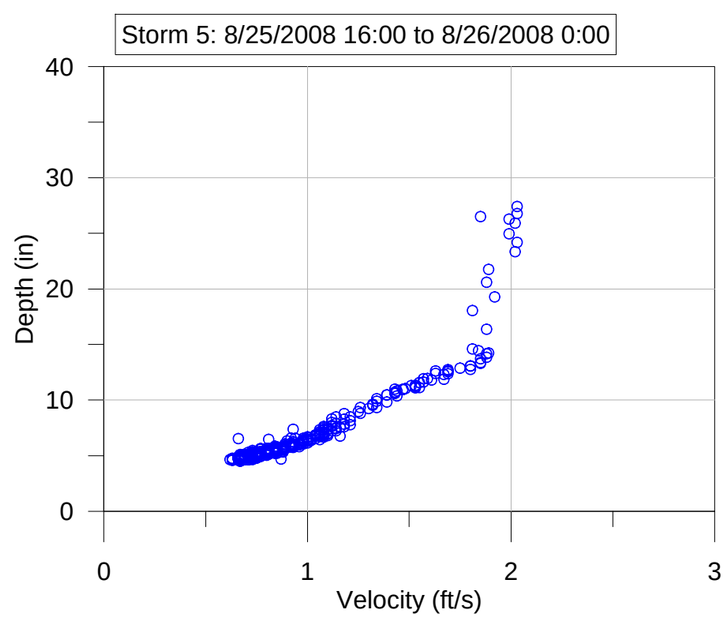
Calibration Storms - Scattergraphs
Monitor 067-261 (44B)

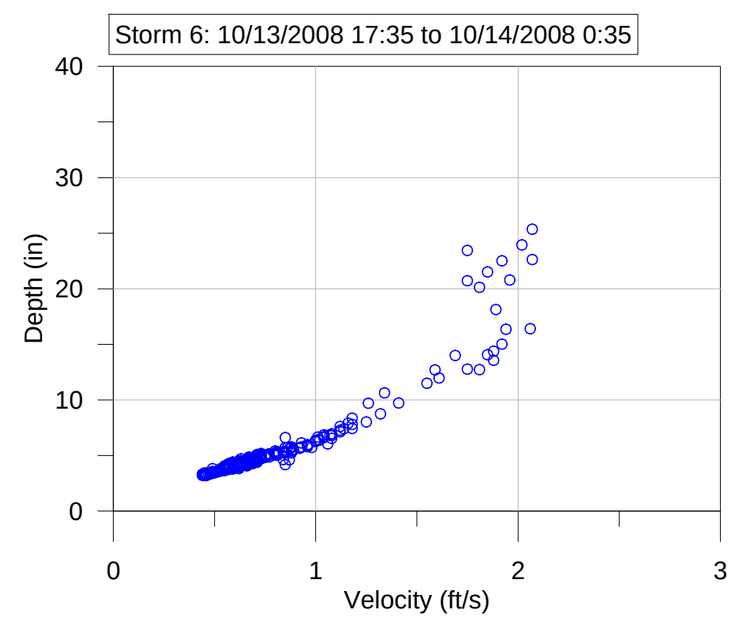




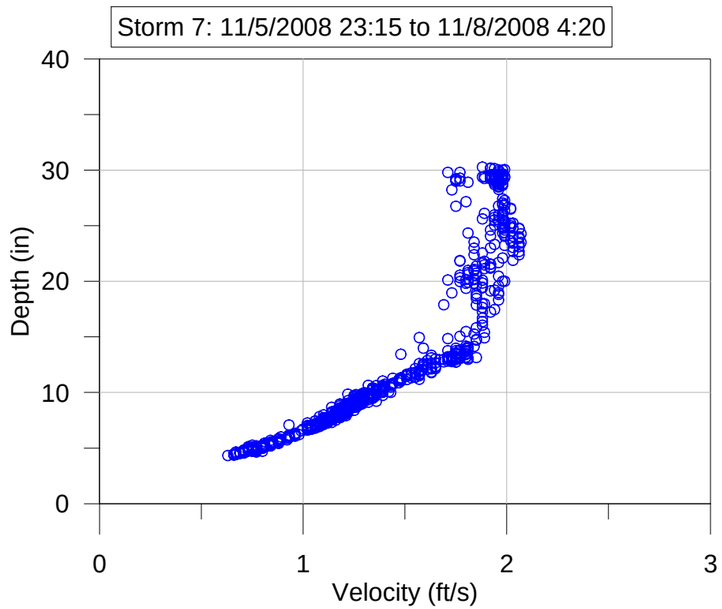


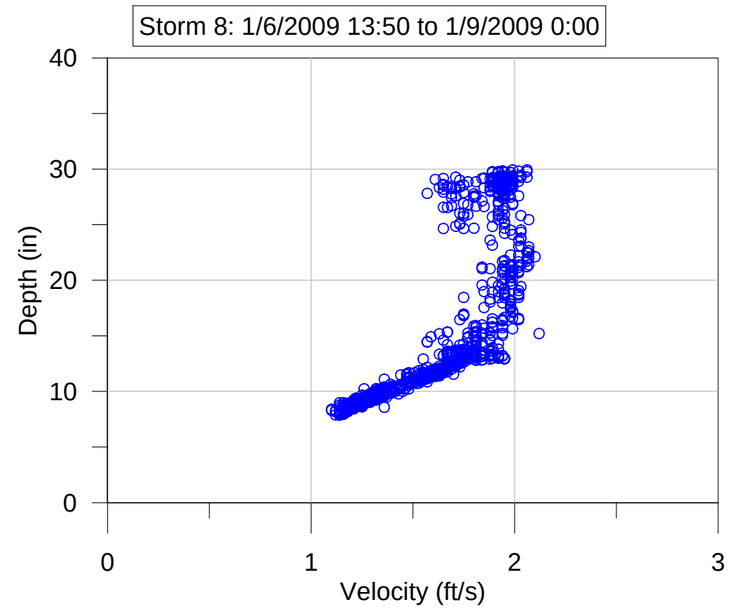


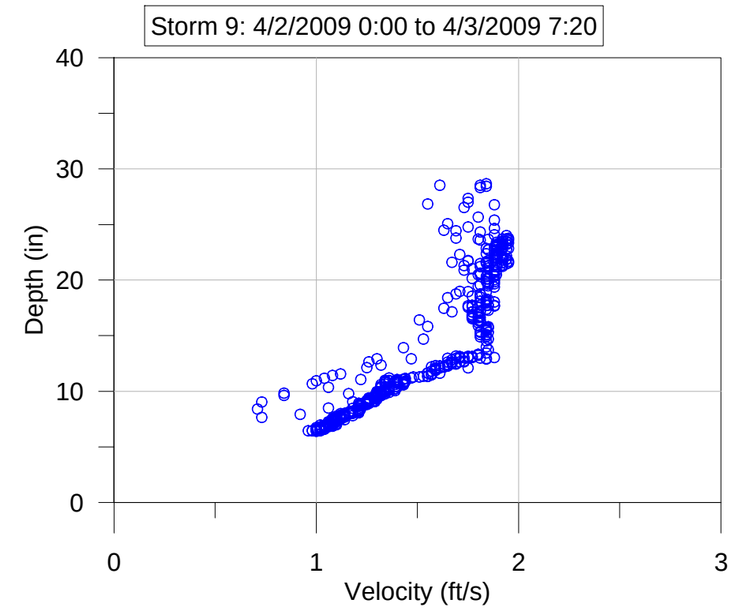


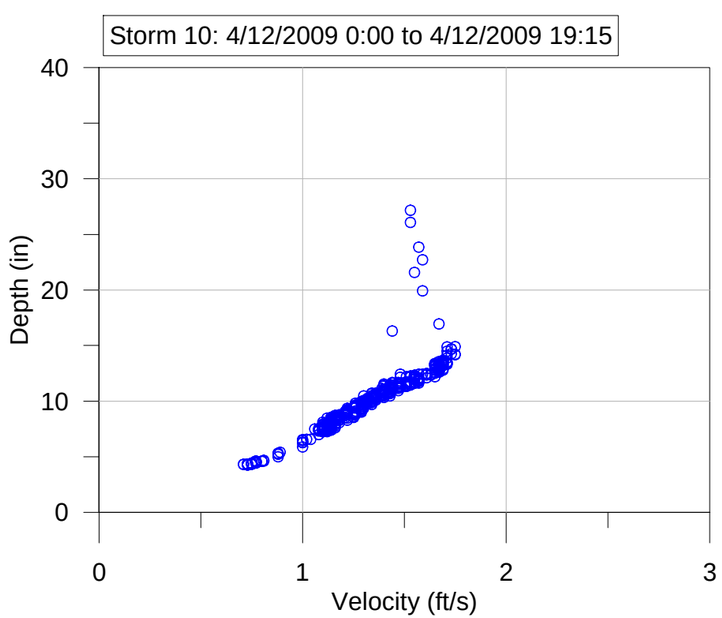


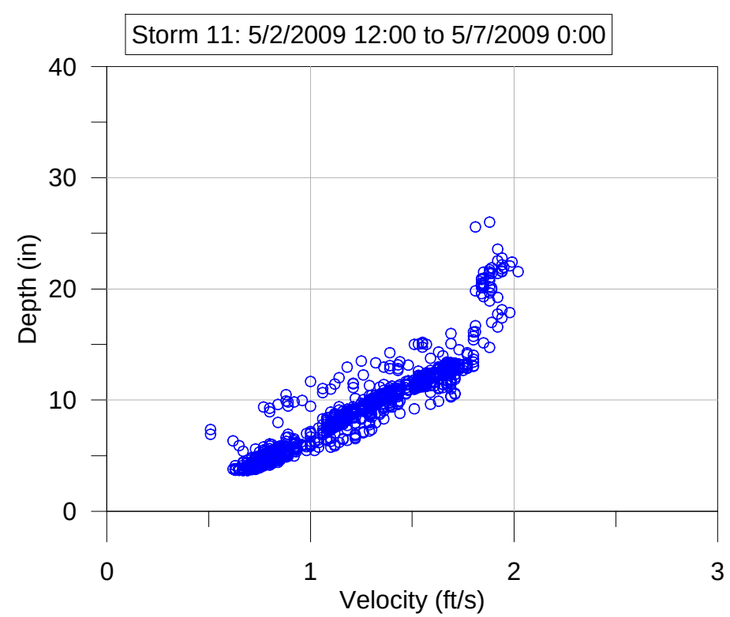
Calibration Storms - Scattergraphs
Monitor 067-261 (44B)

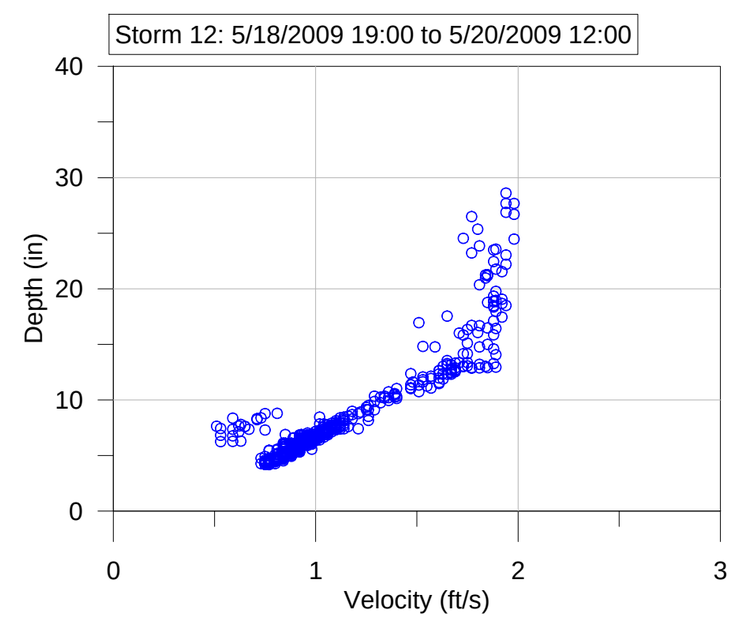




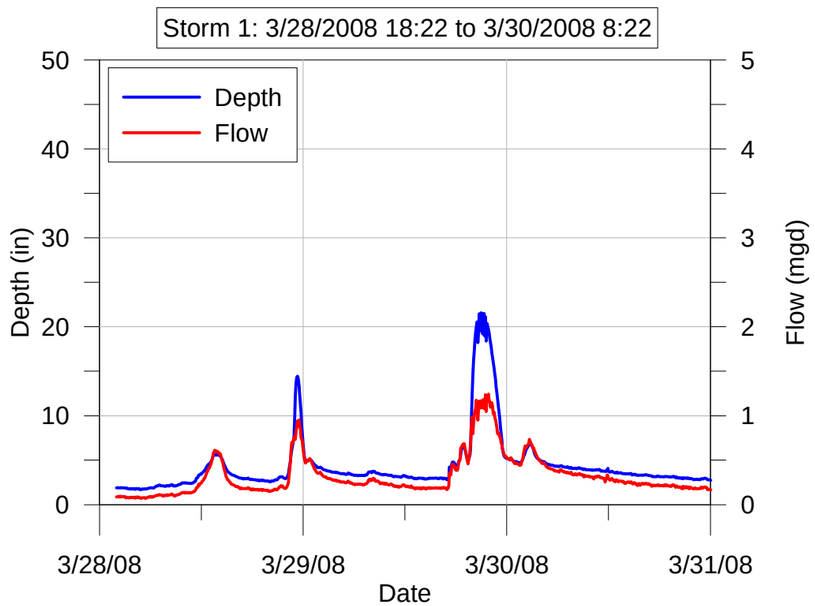


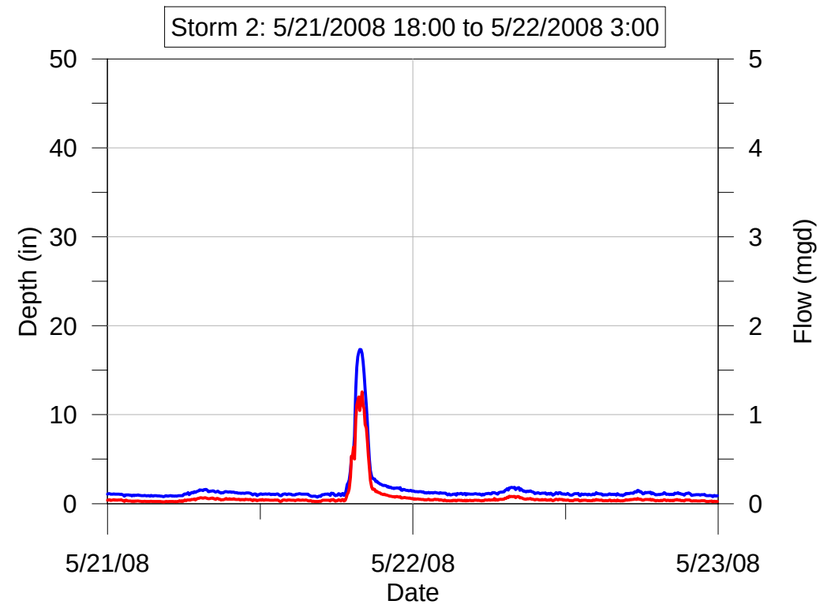


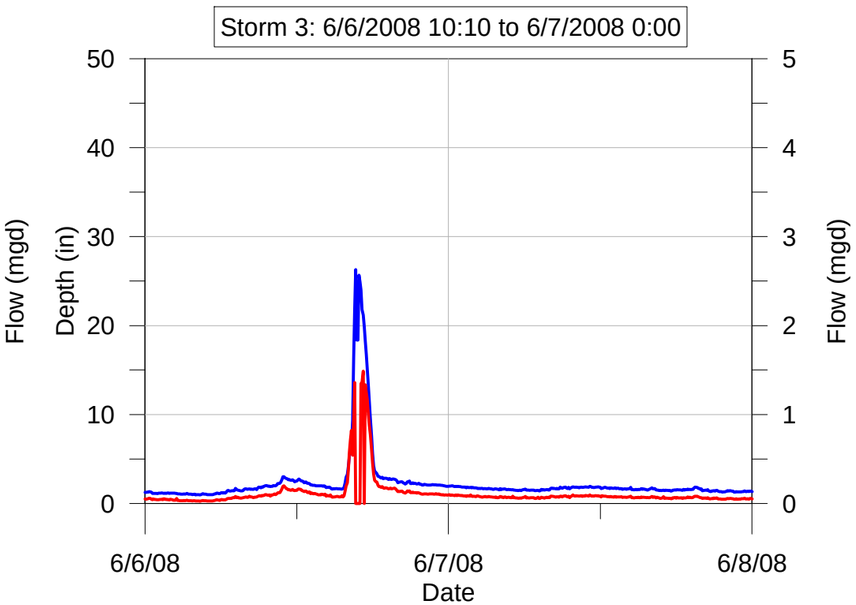


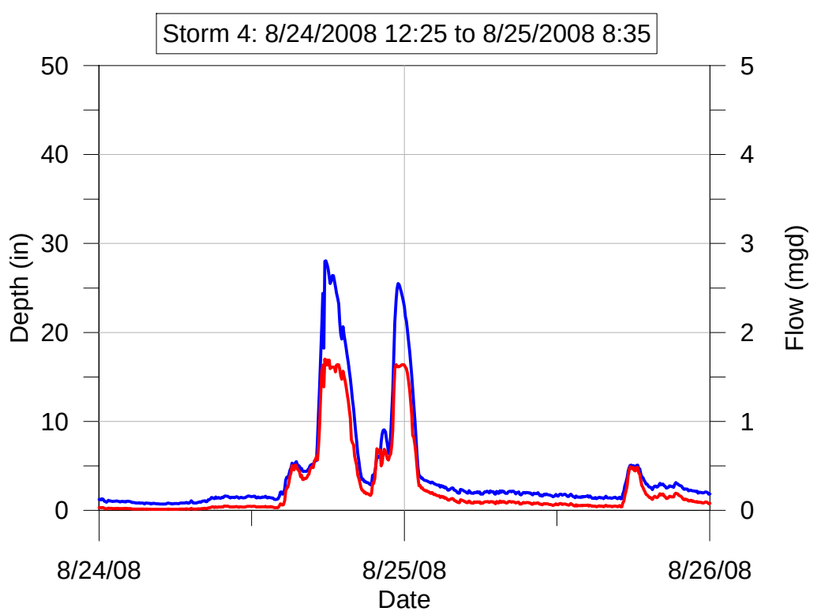


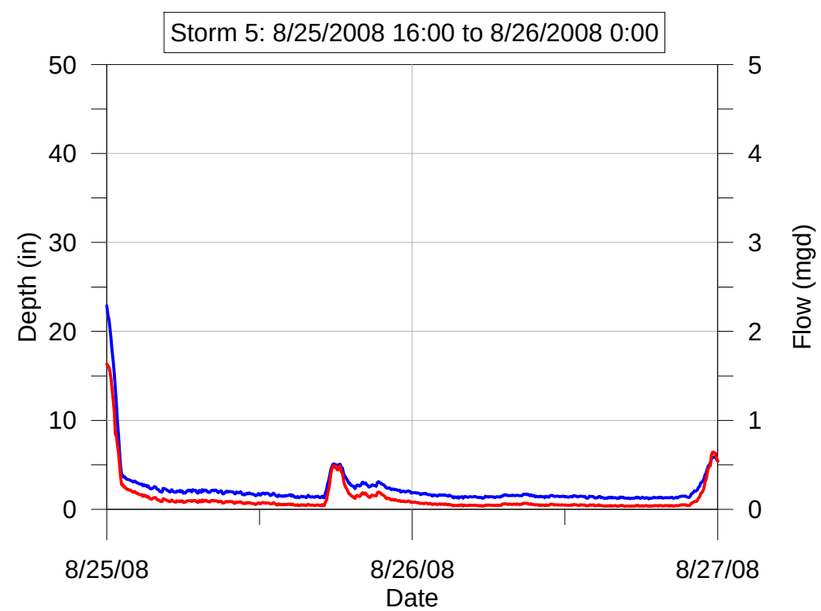
Calibration Storms - Hydrographs
Monitor 067-191

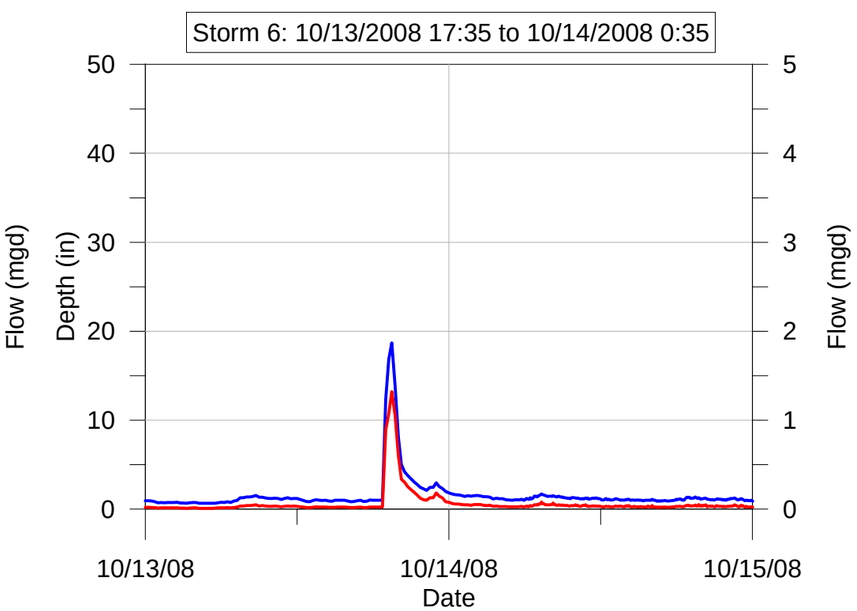




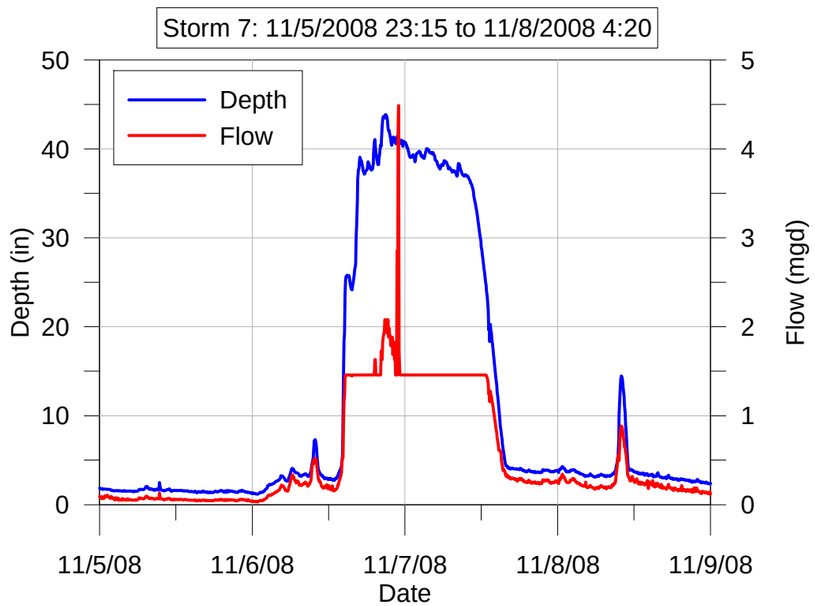


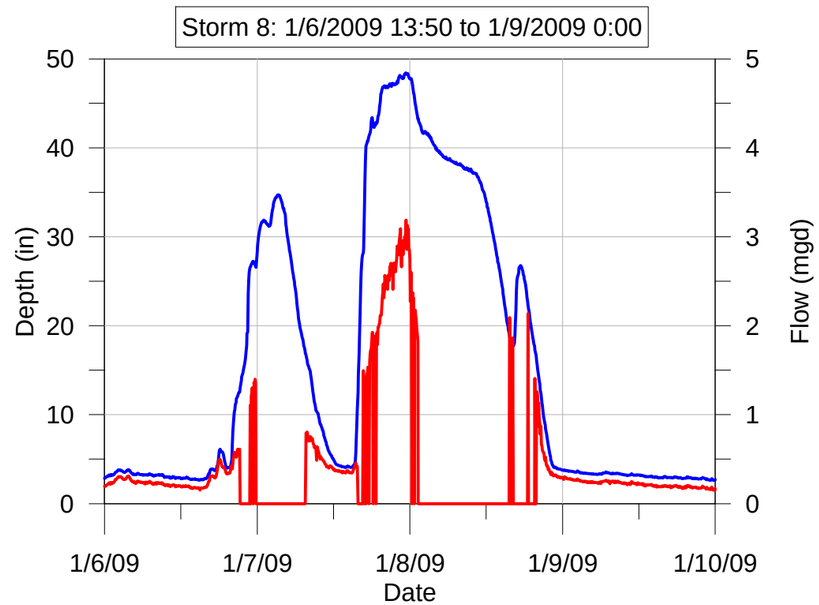


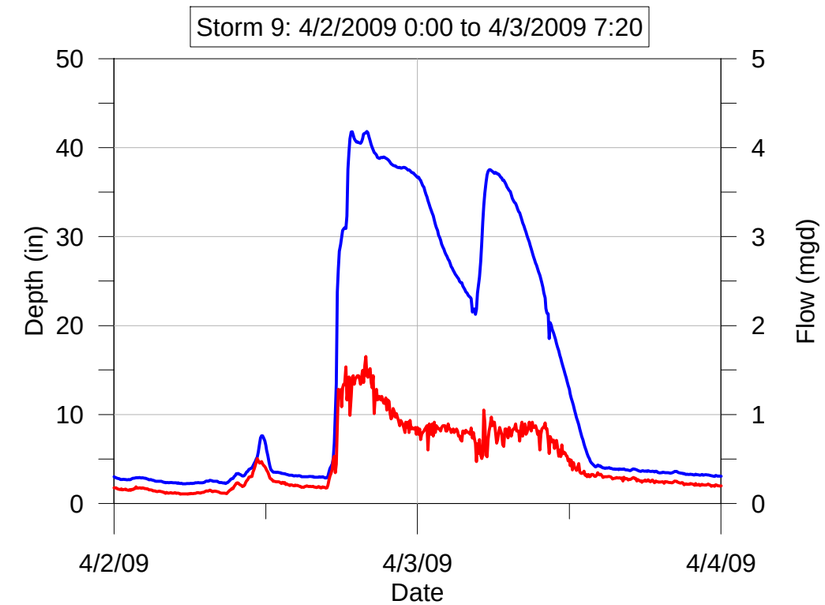


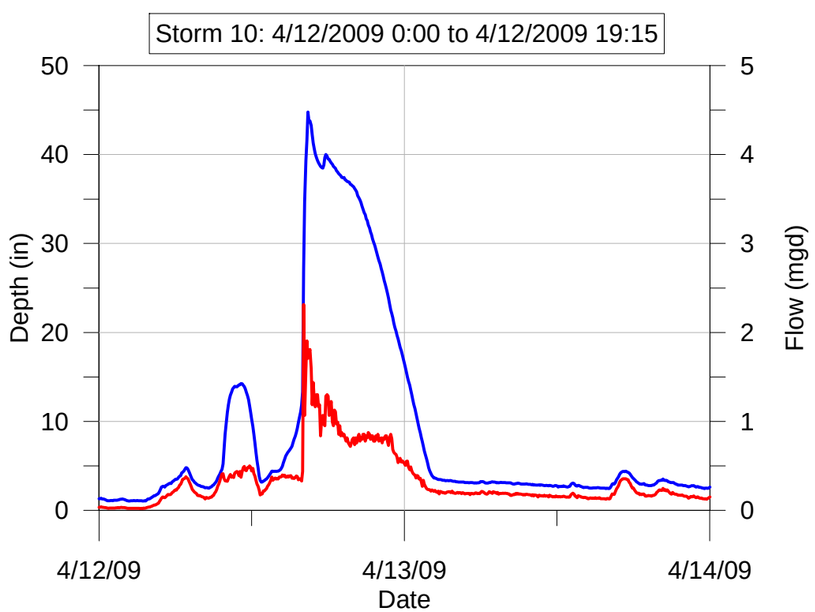


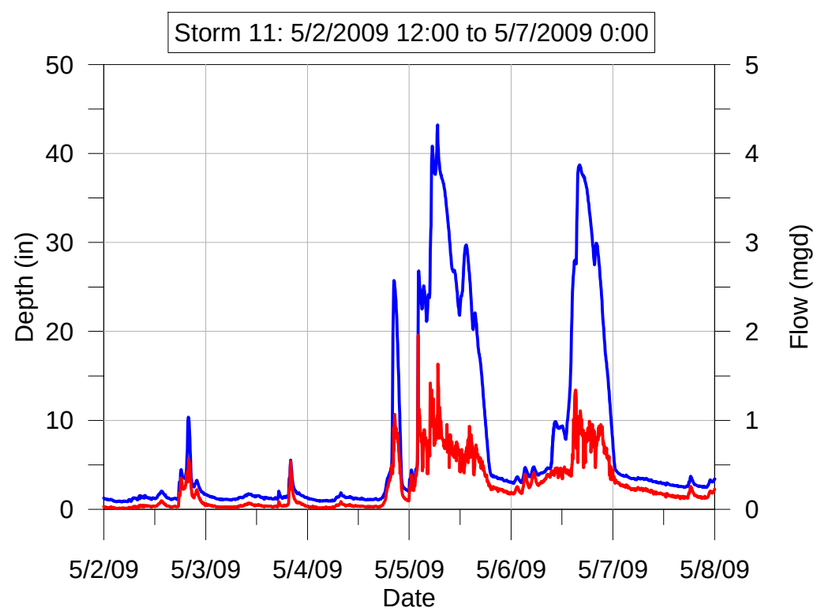
Calibration Storms - Hydrographs
Monitor 067-191

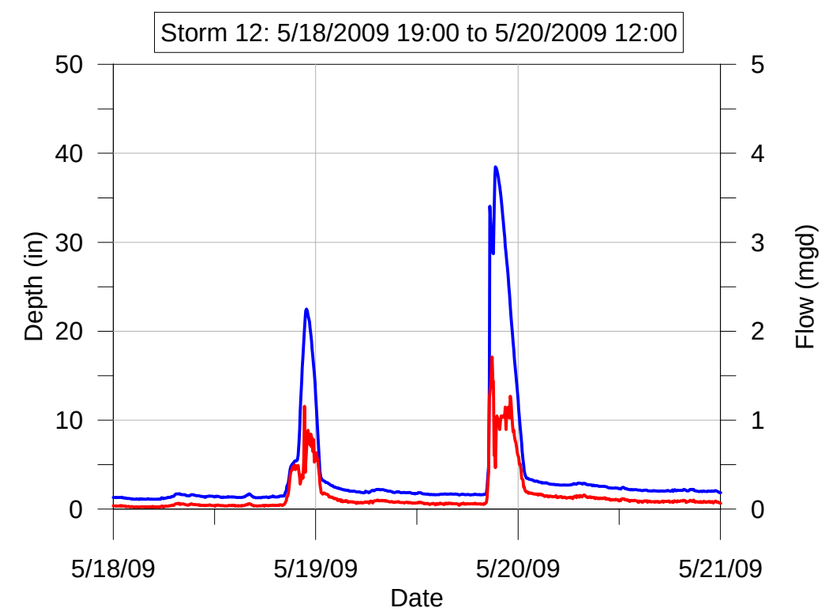




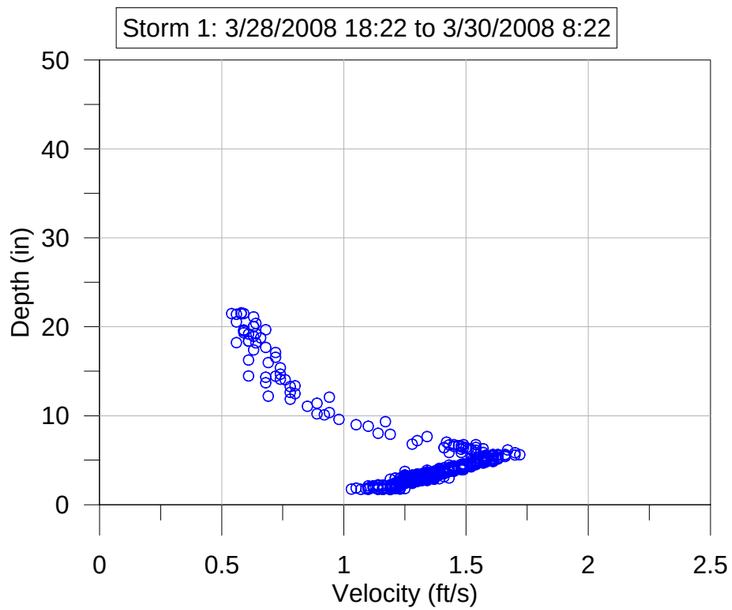


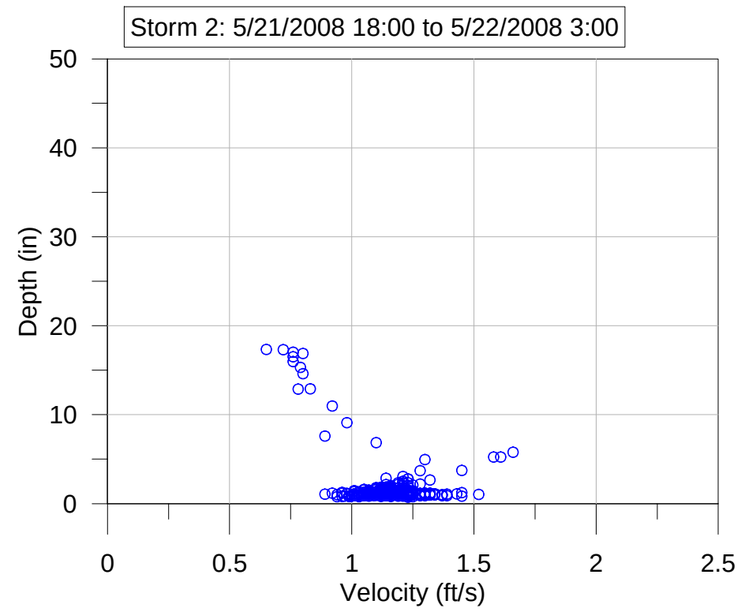


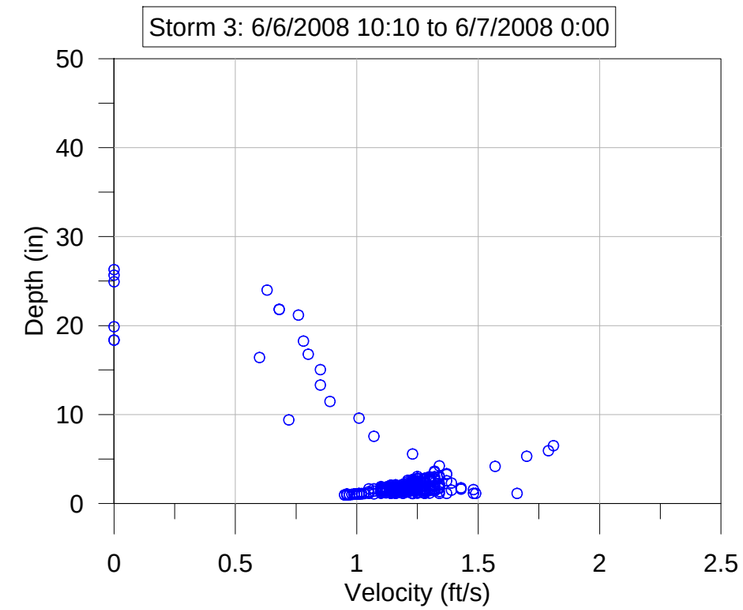


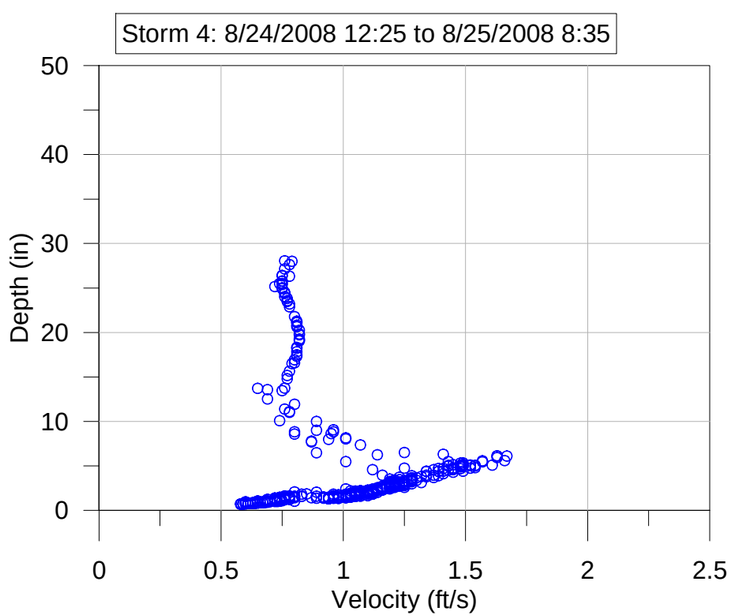


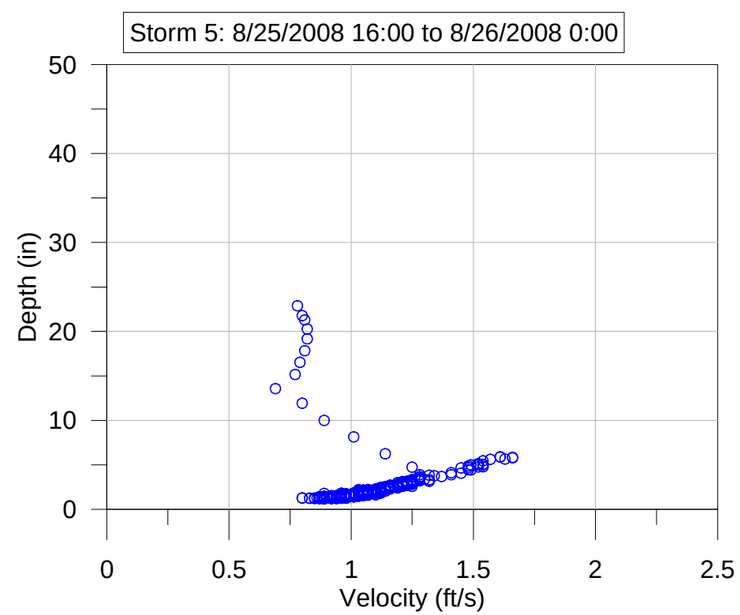
Calibration Storms - Scattergraphs
Monitor 067-191

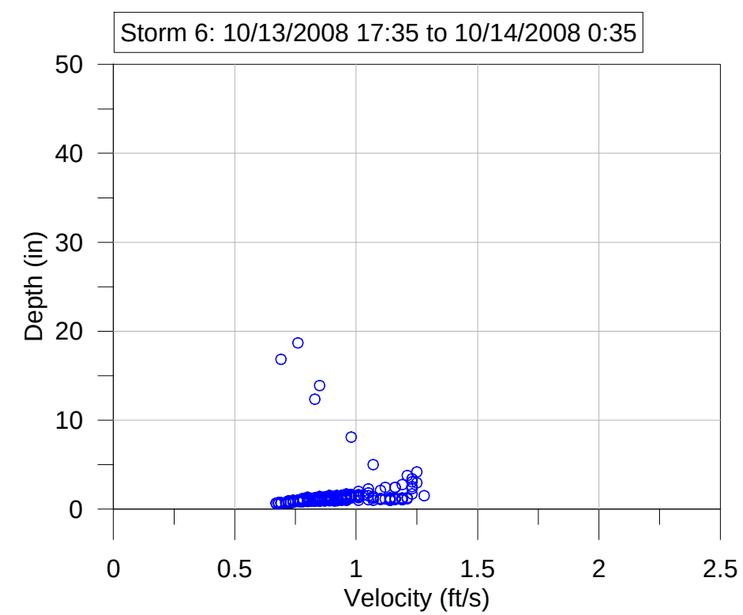




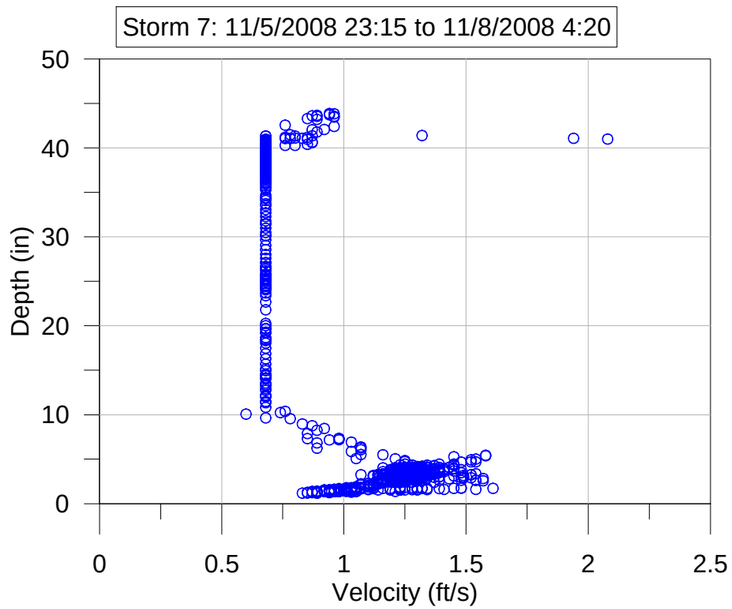


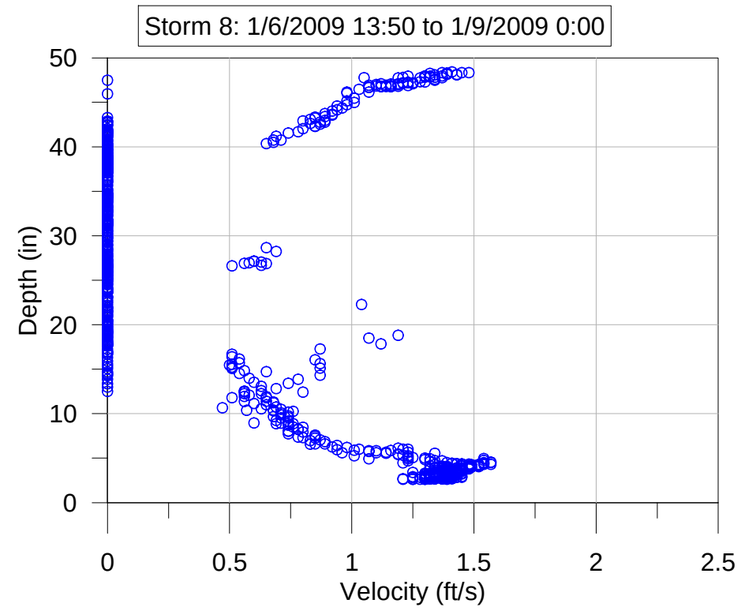


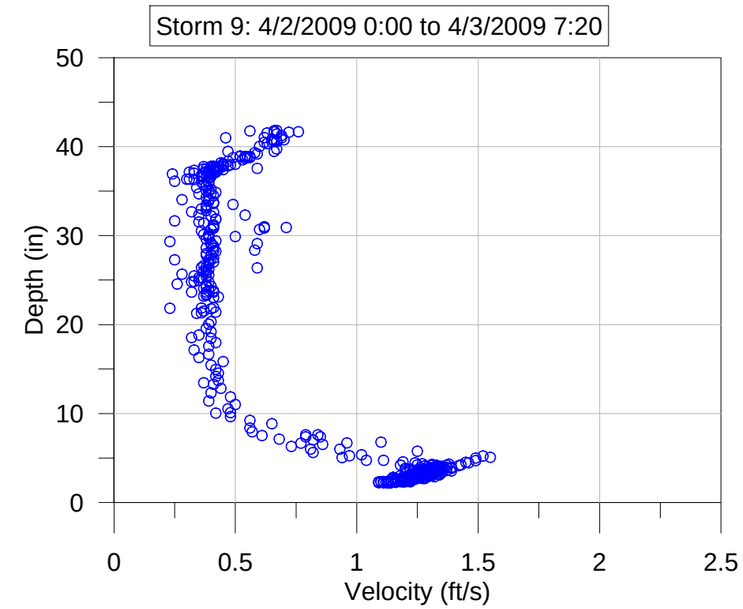


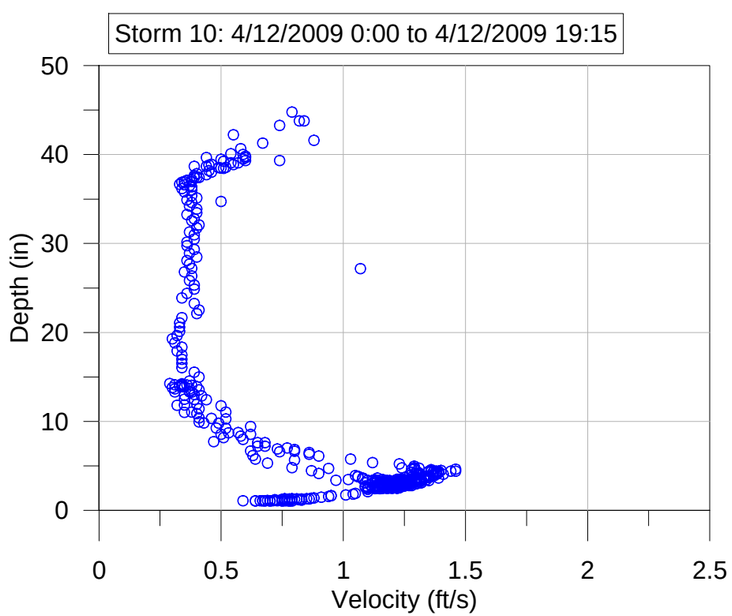


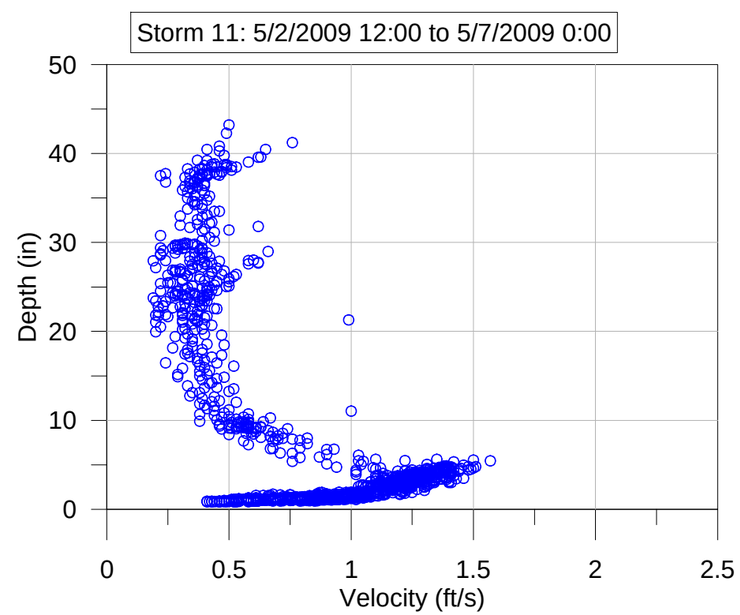
Calibration Storms - Scattergraphs
Monitor 067-191

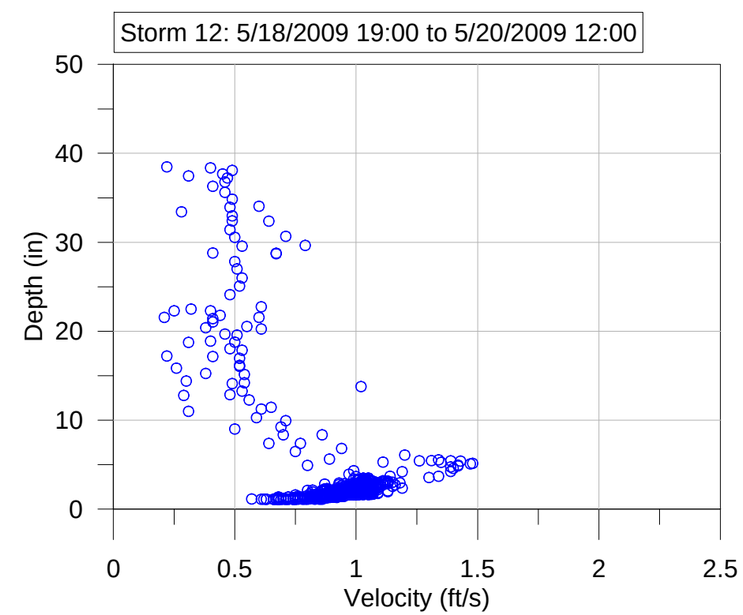




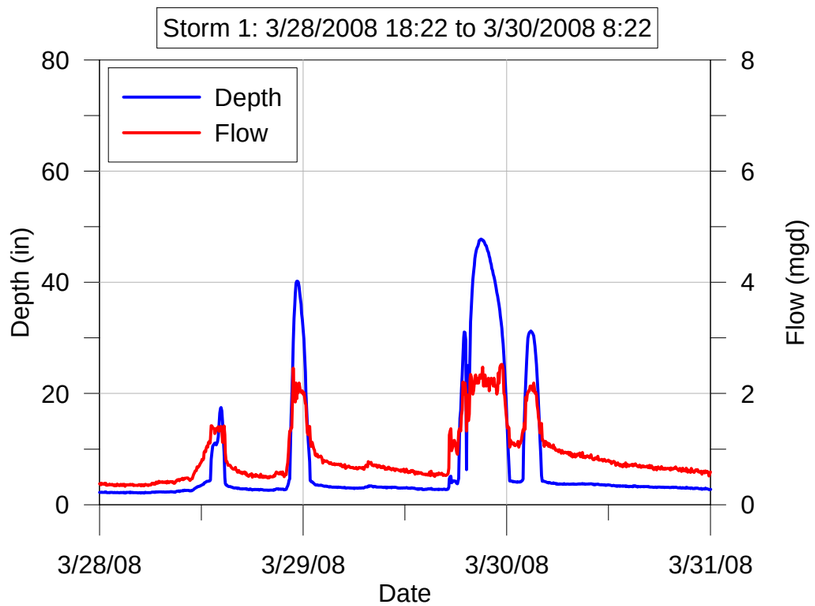


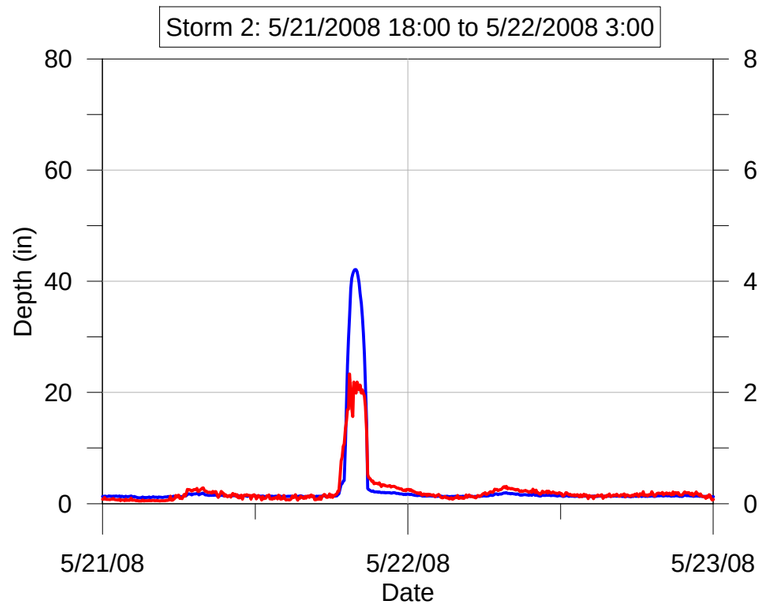


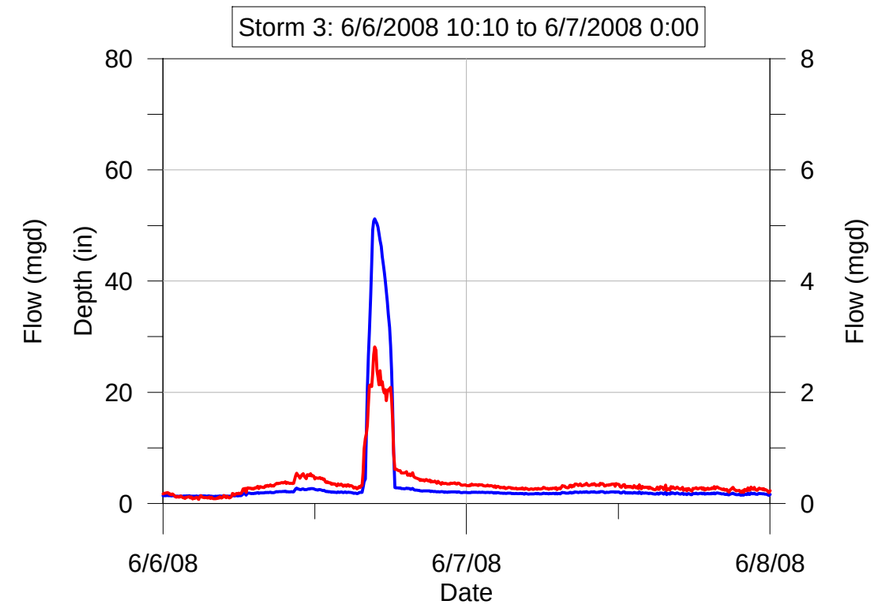


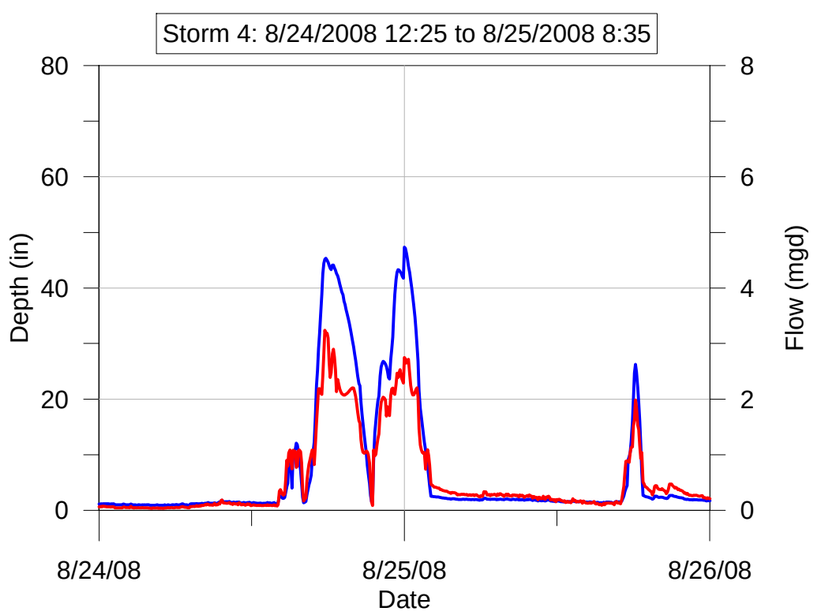


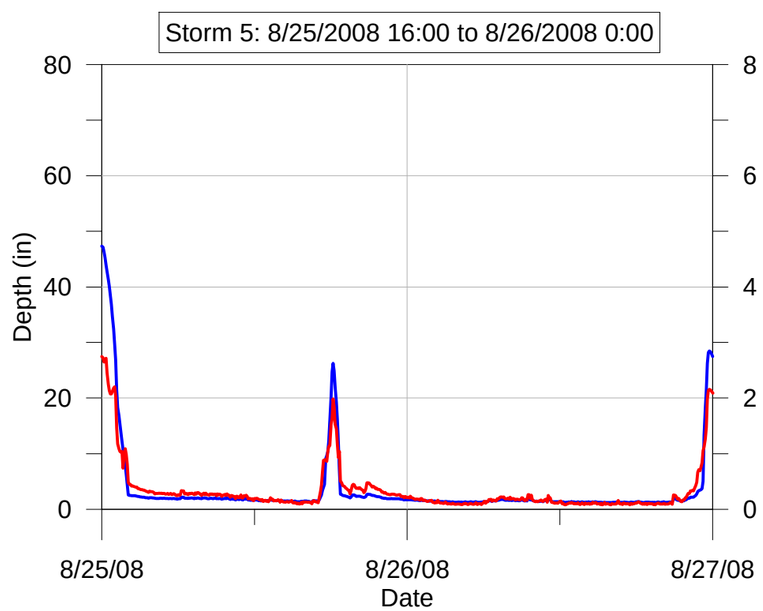
Calibration Storms
Monitor 067-271

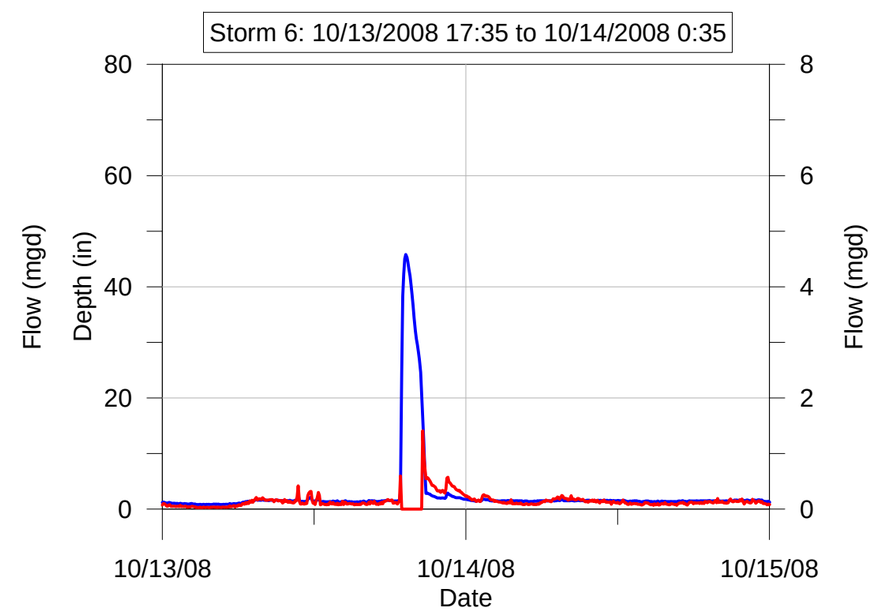




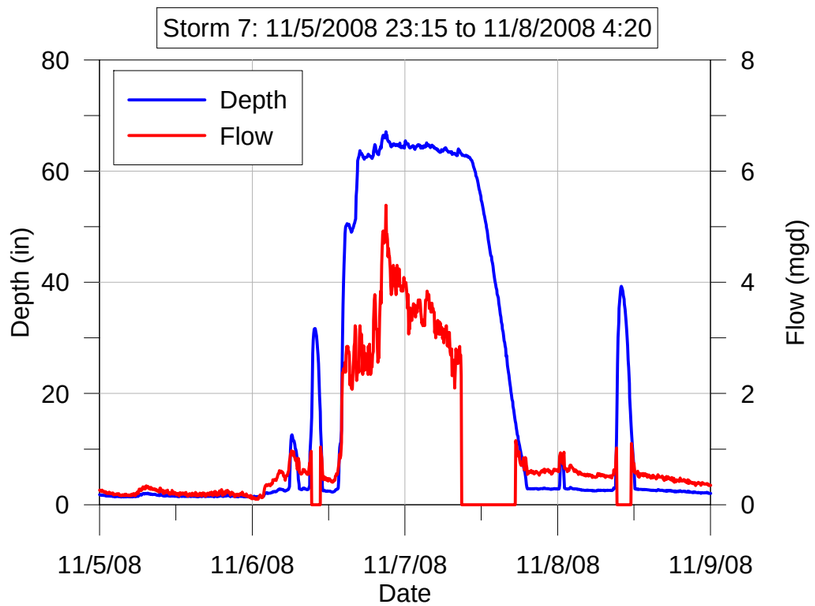


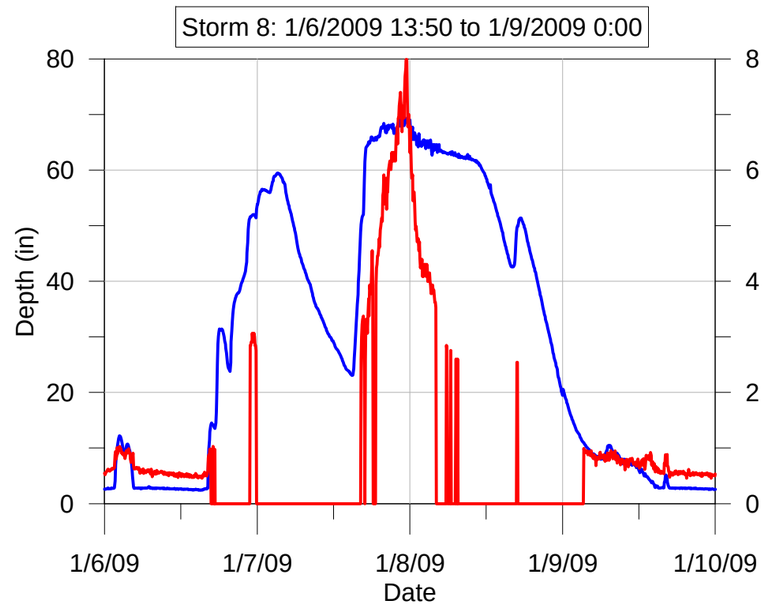


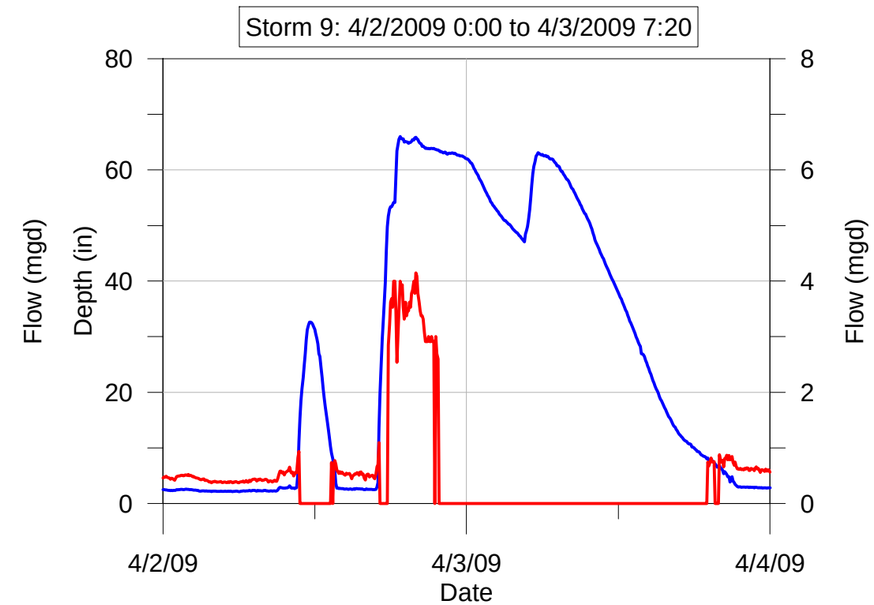


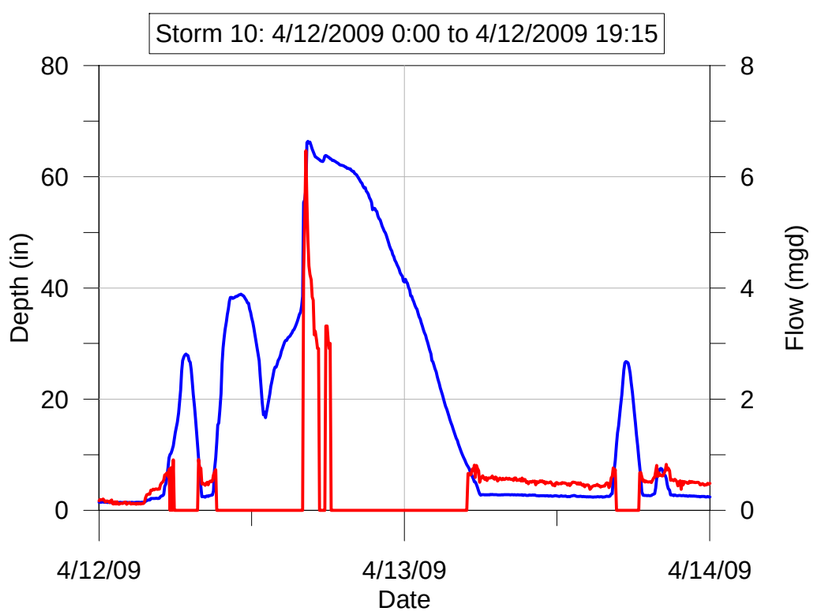


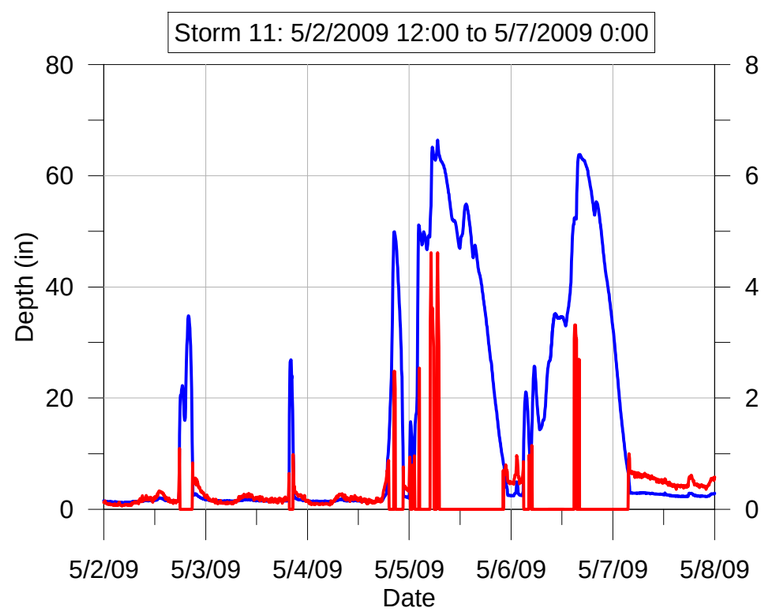
Calibration Storms
Monitor 067-271

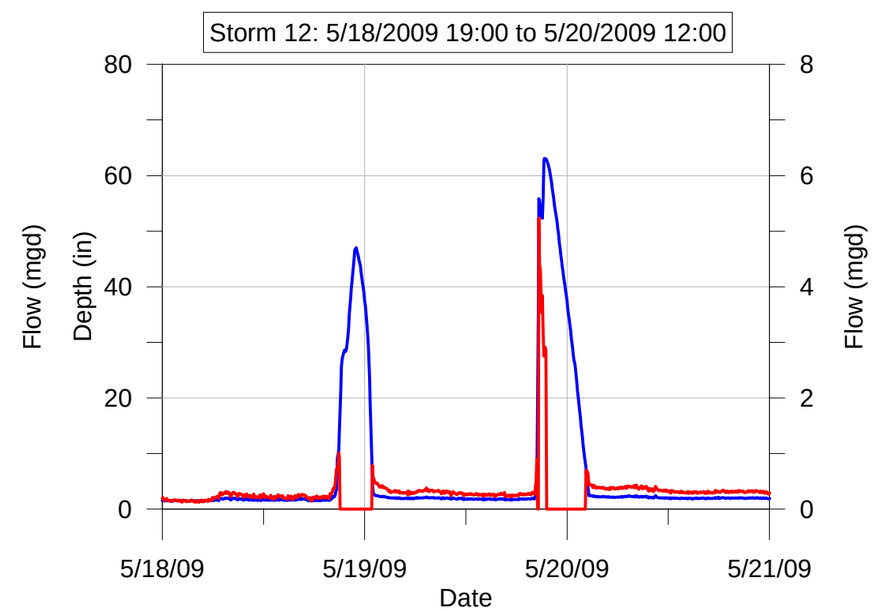




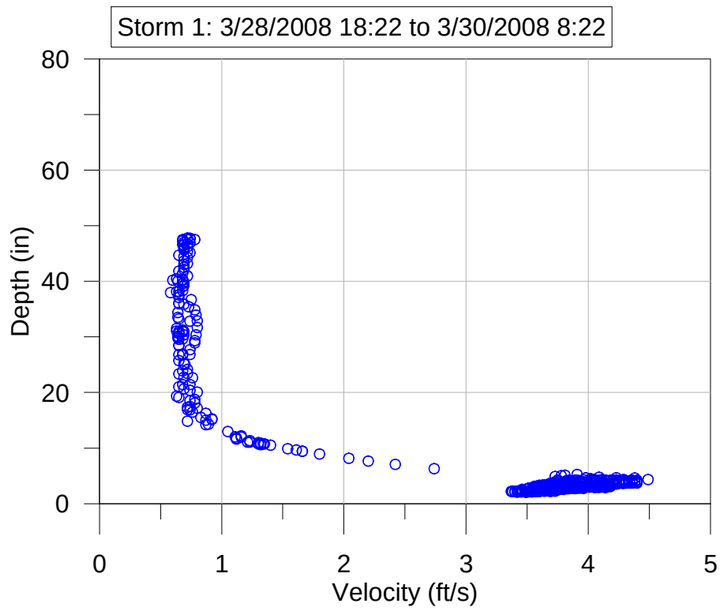


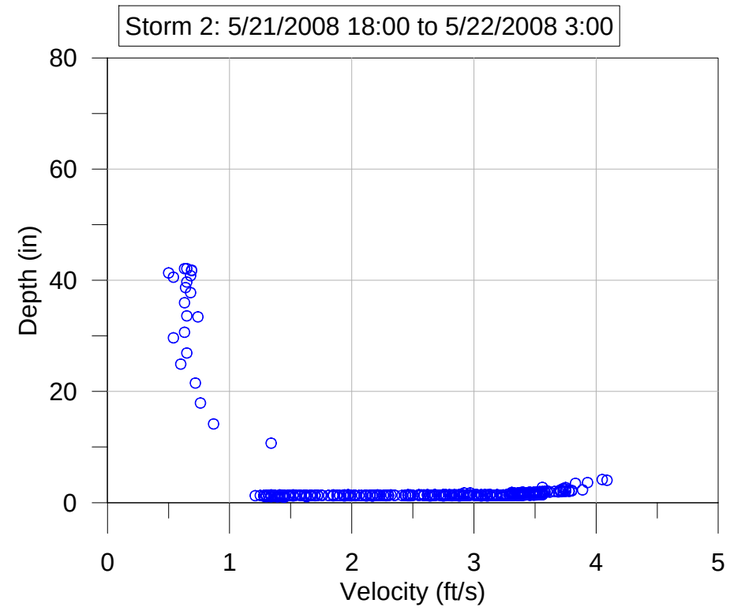


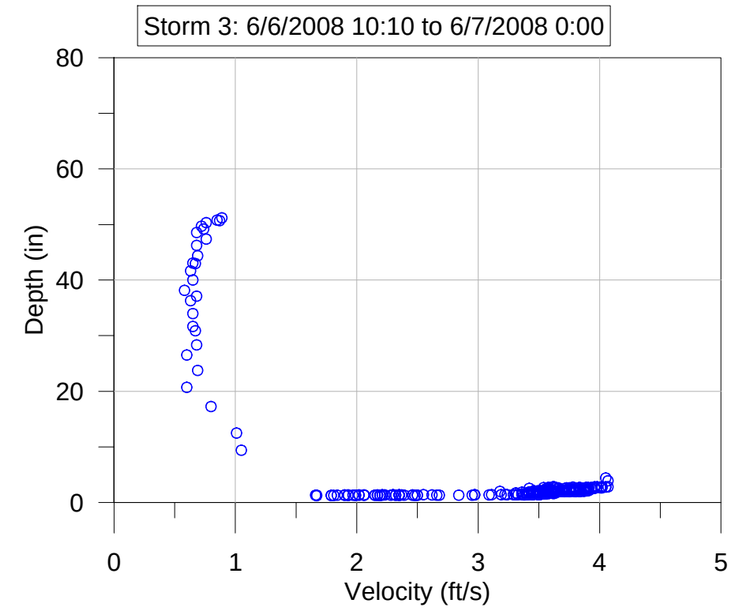


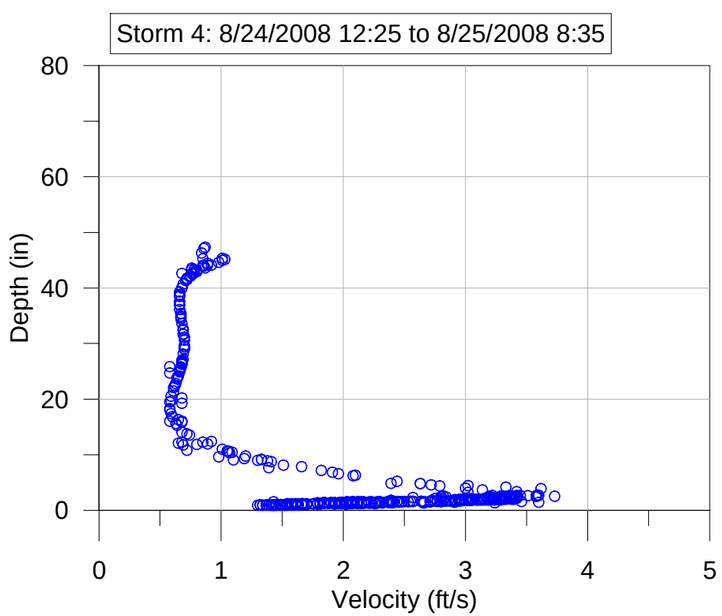


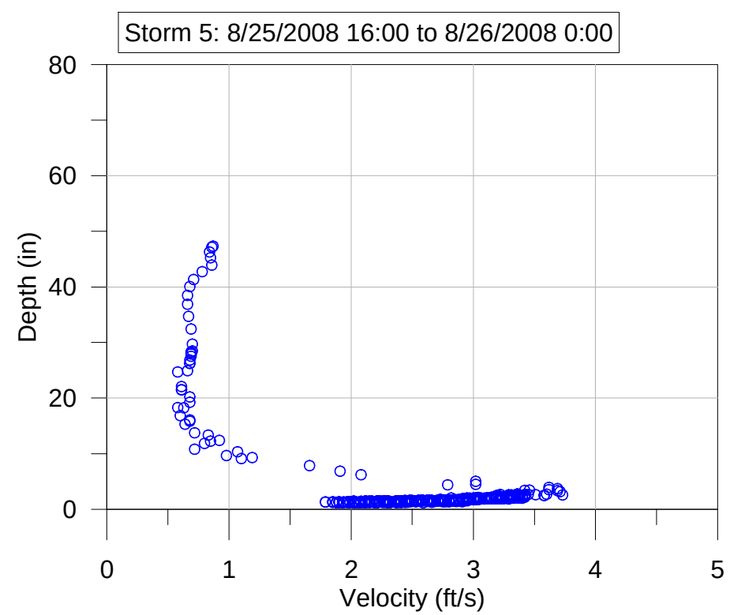
Calibration Storms - Scattergraphs
Monitor 067-271

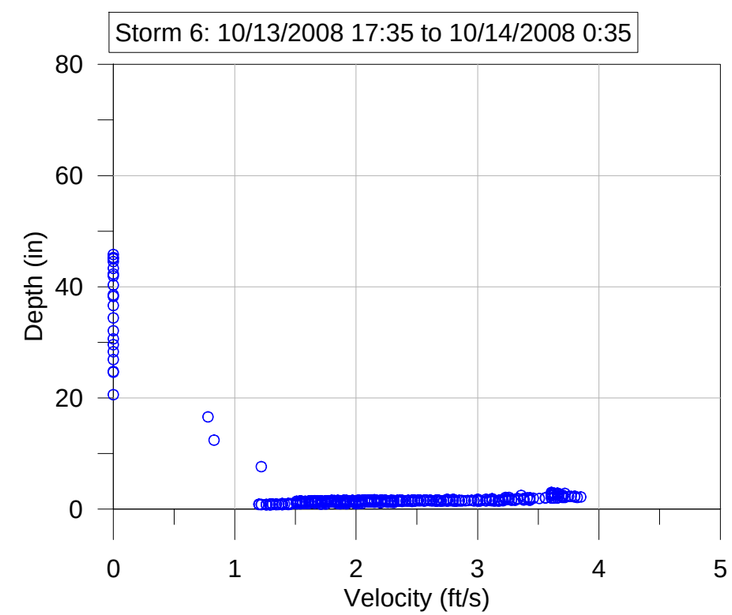




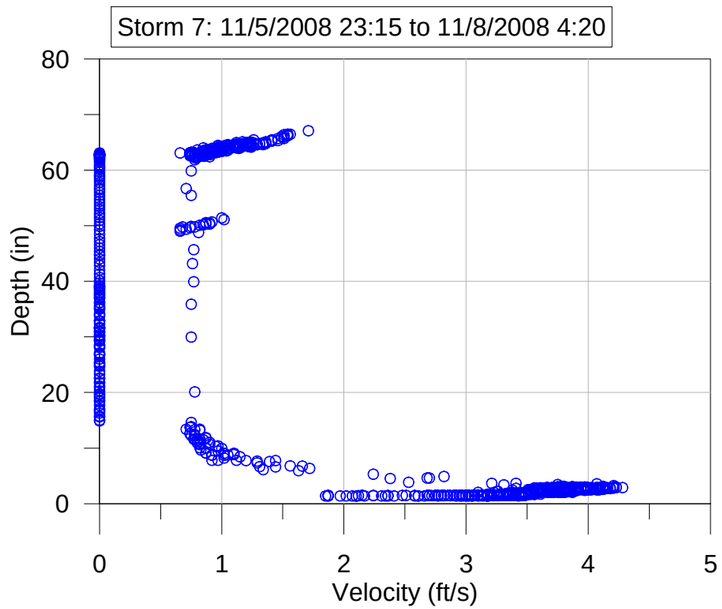


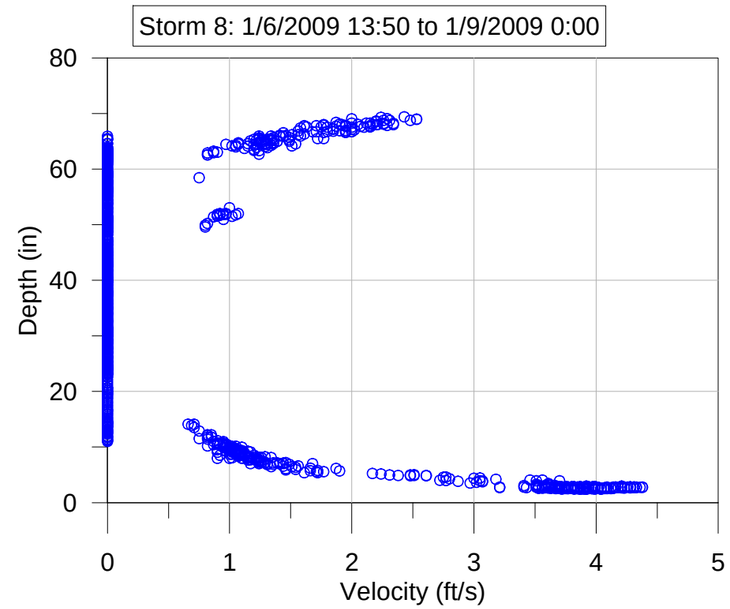


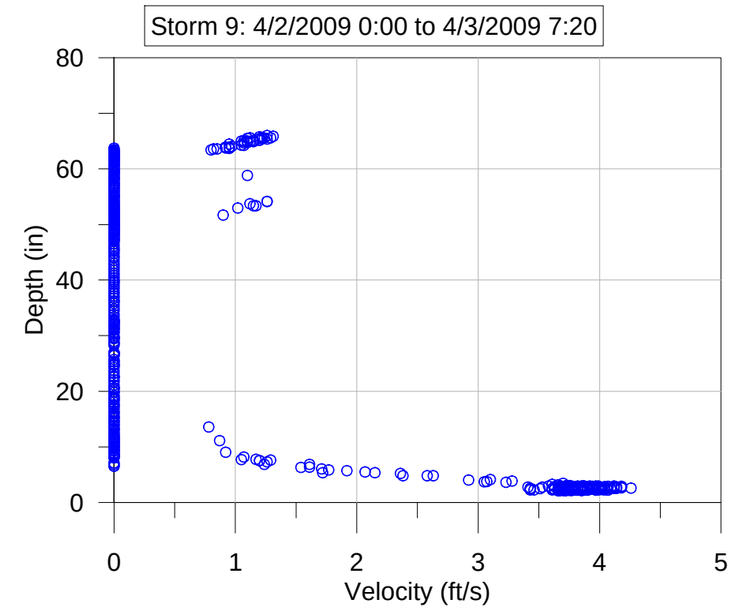


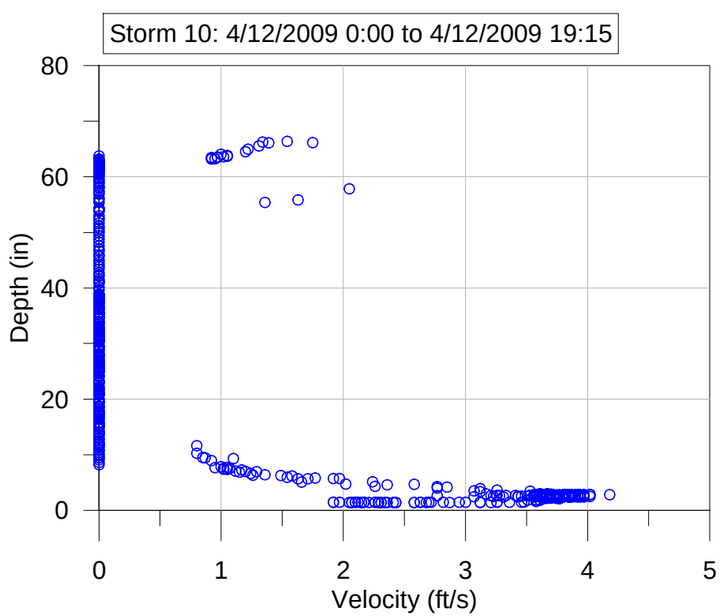


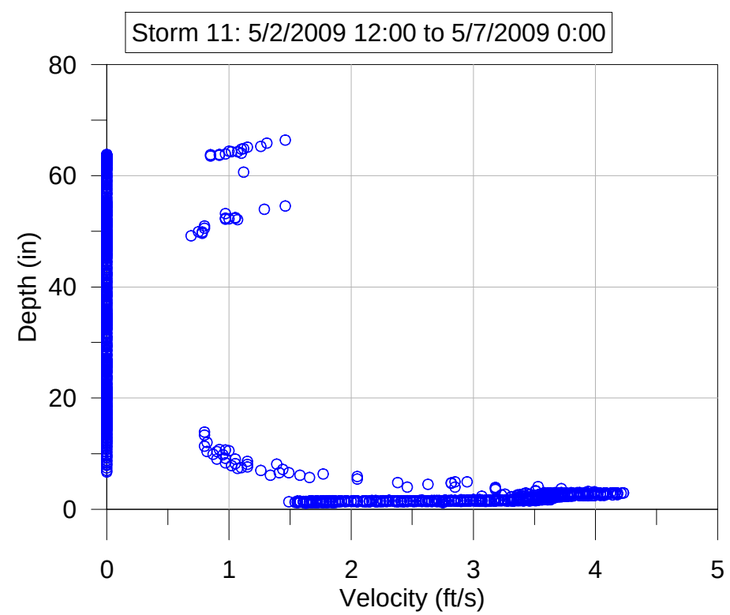
Calibration Storms - Scattergraphs
Monitor 067-271

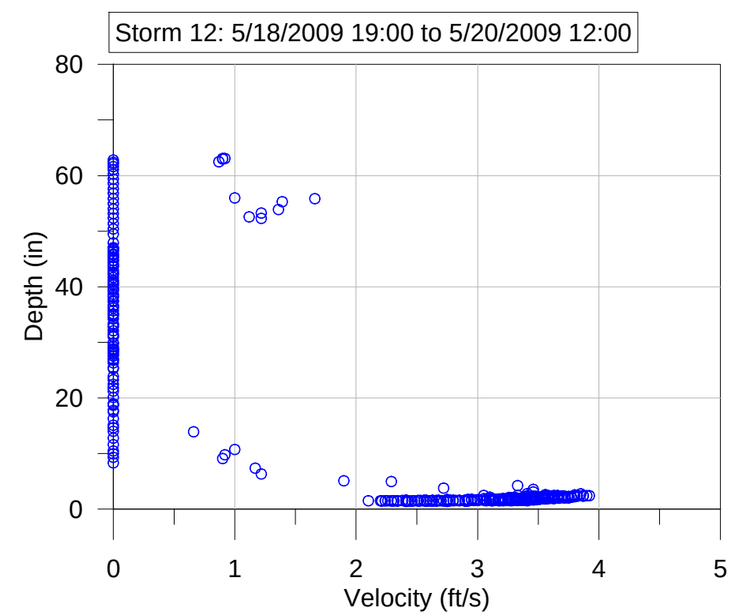




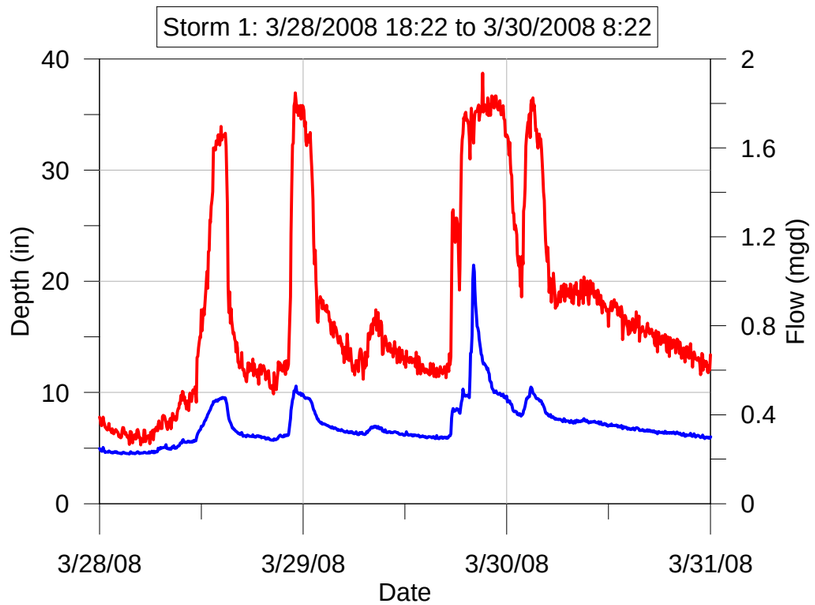


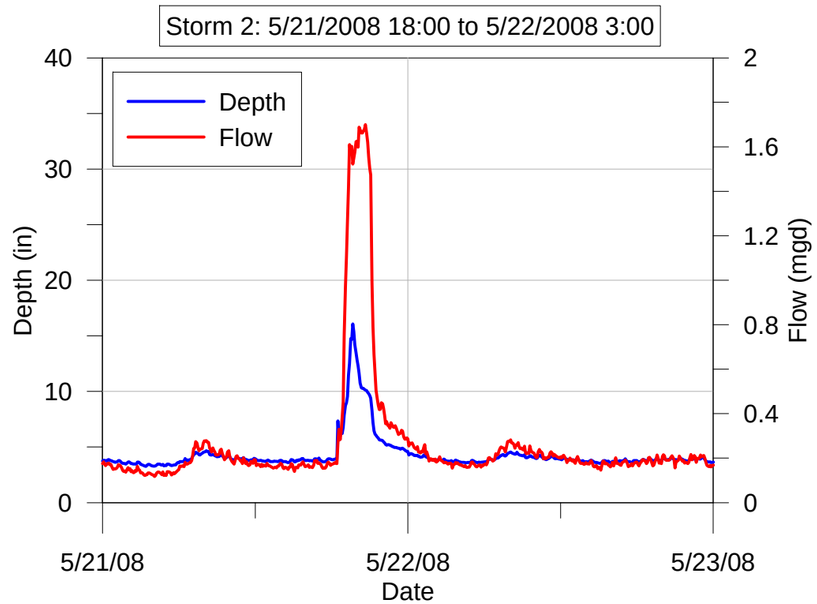


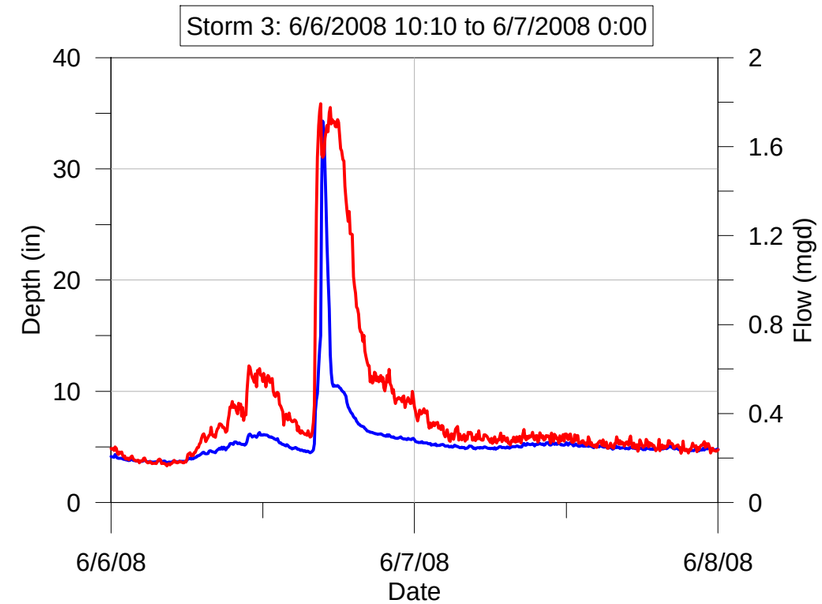


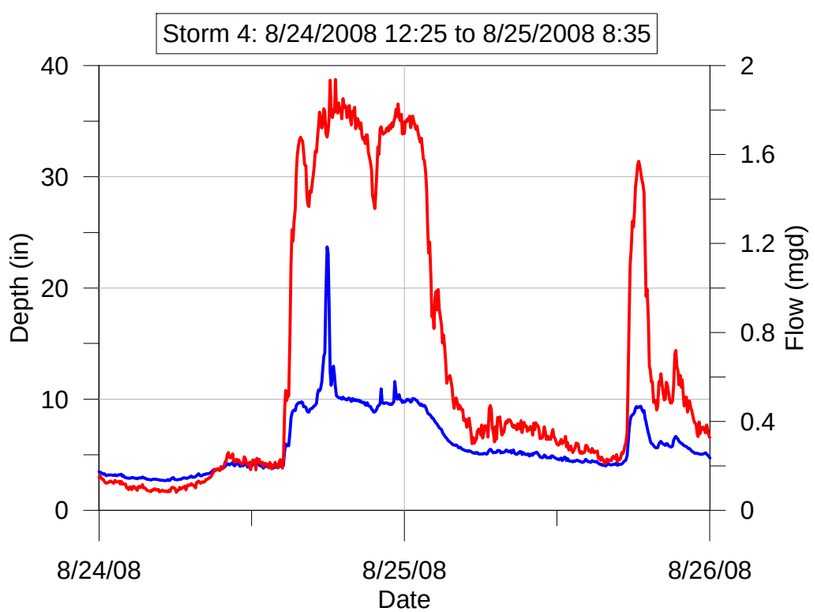


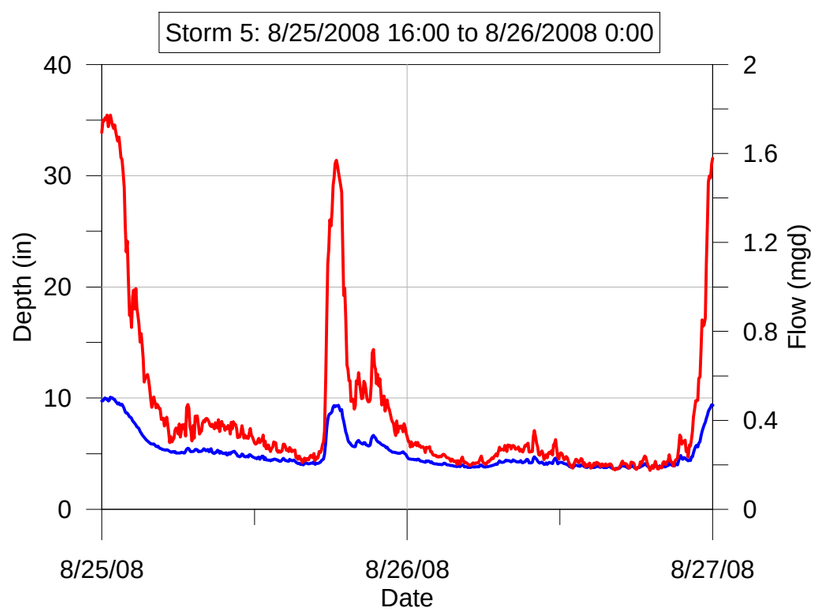
Calibration Storms
Monitor 074-153 (45A)

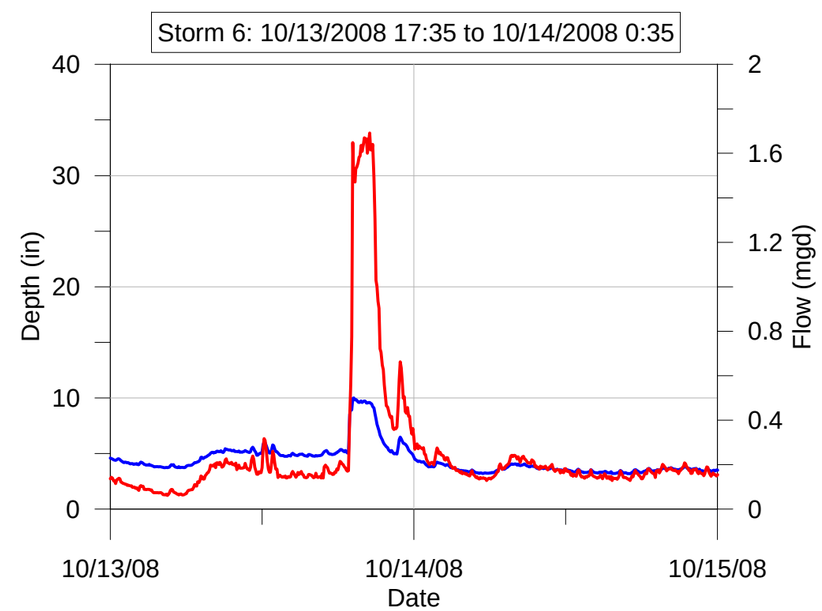




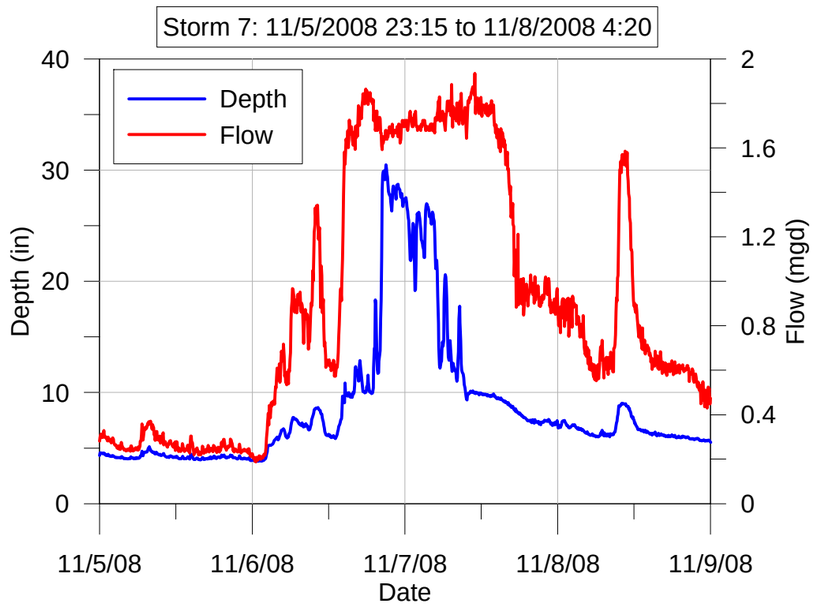


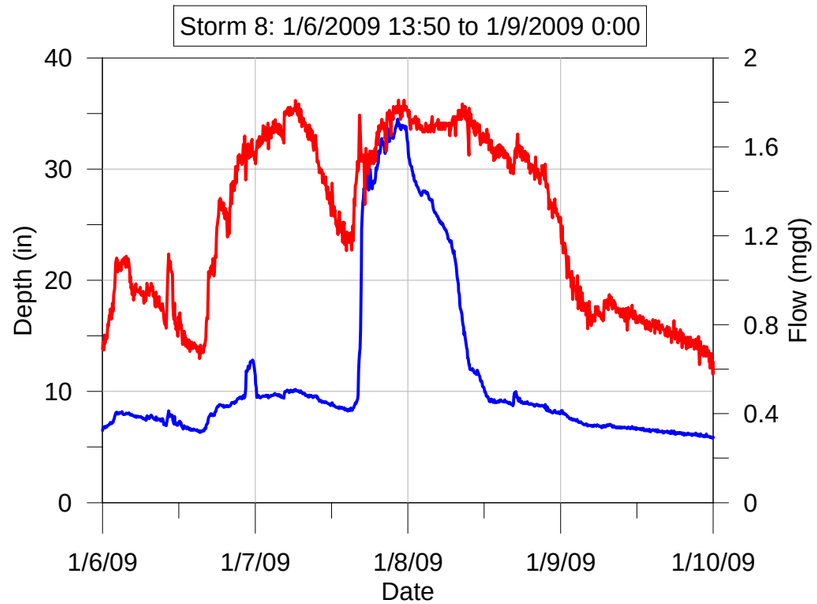


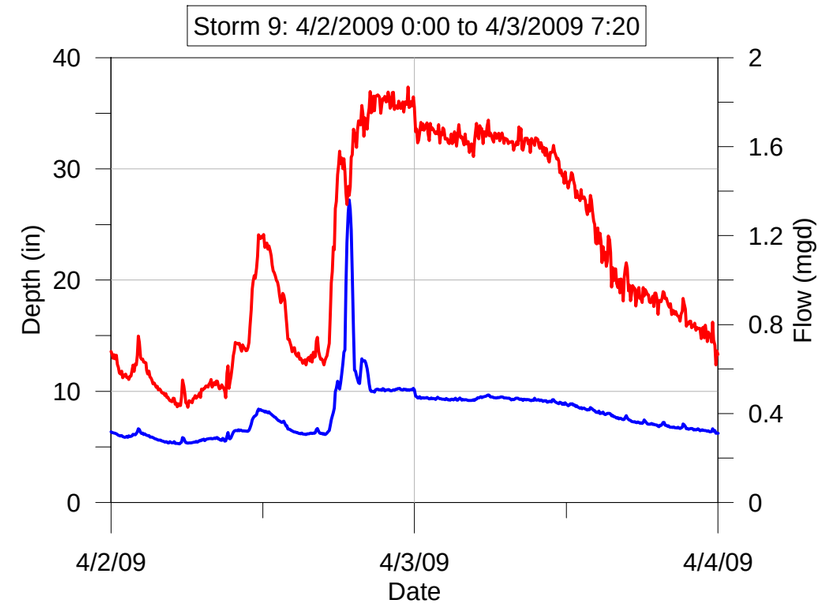


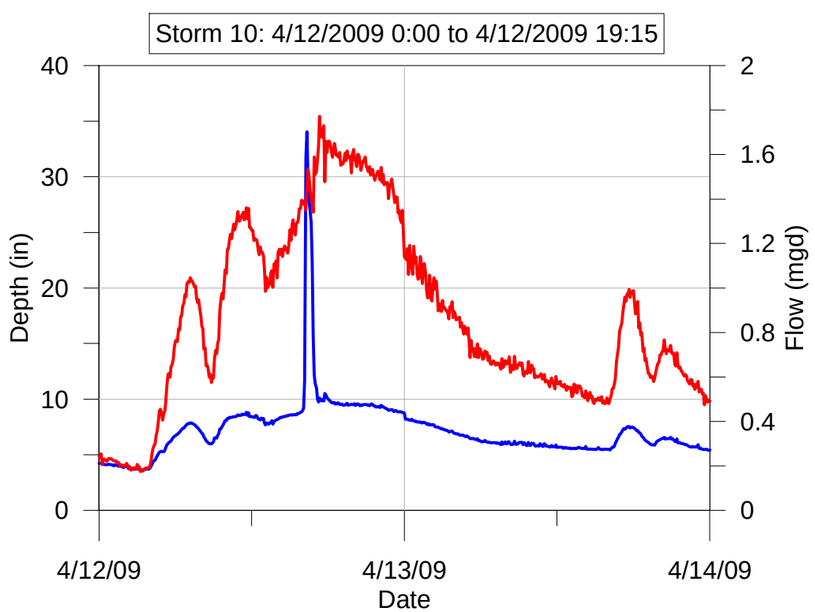


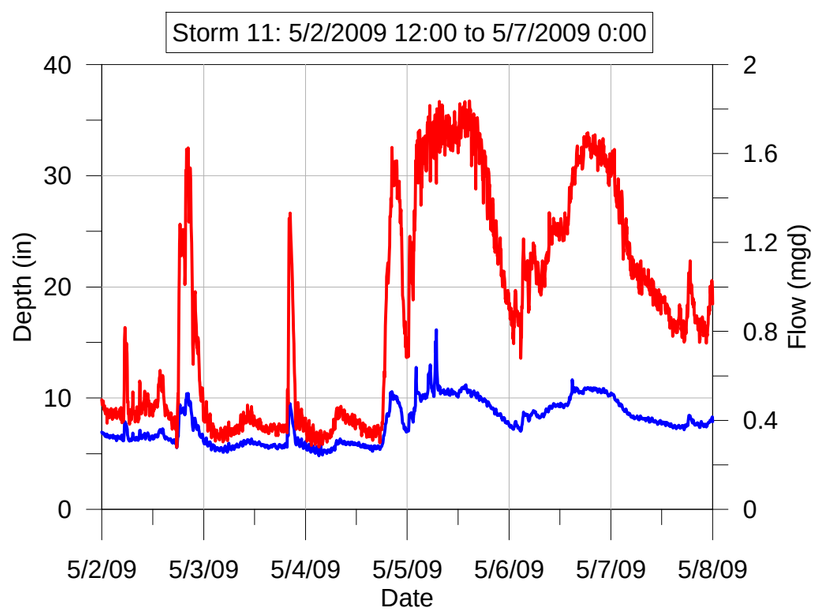
Calibration Storms
Monitor 074-153 (45A)

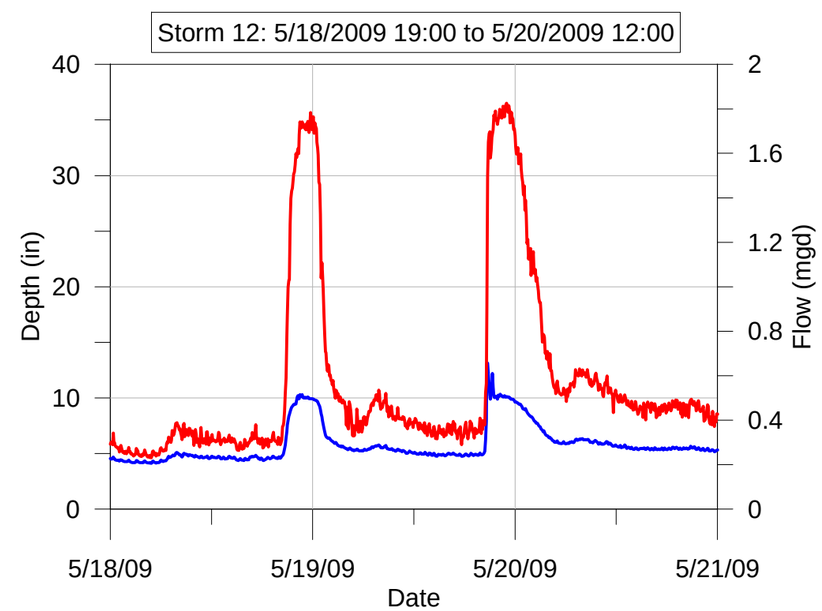




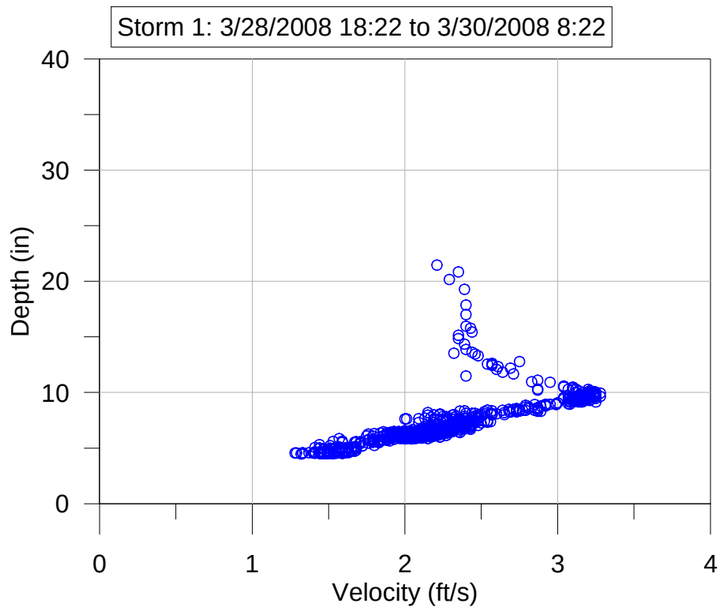


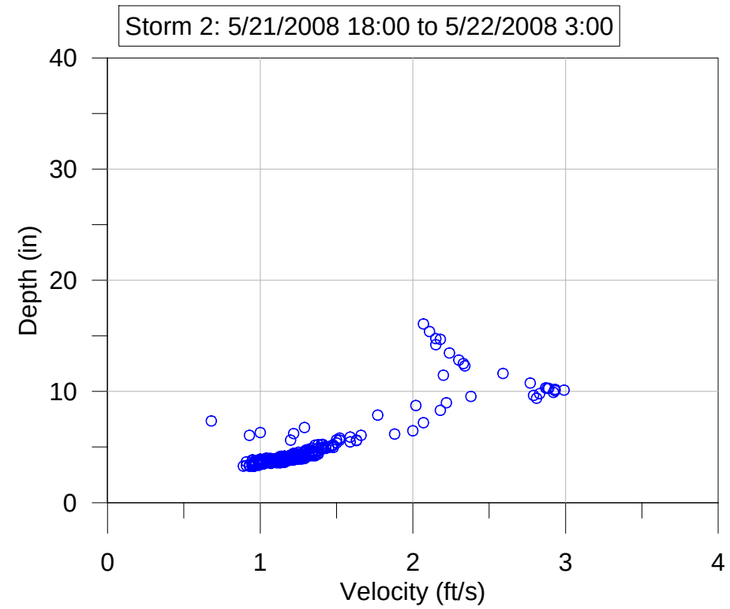


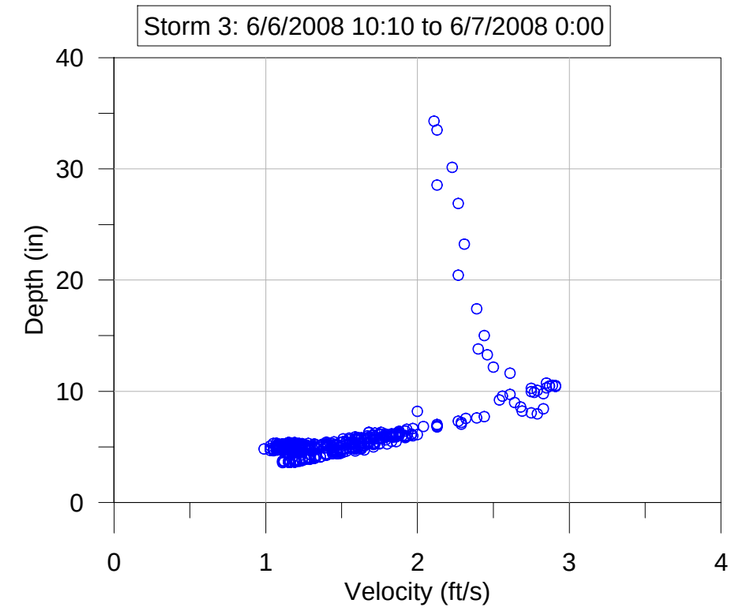


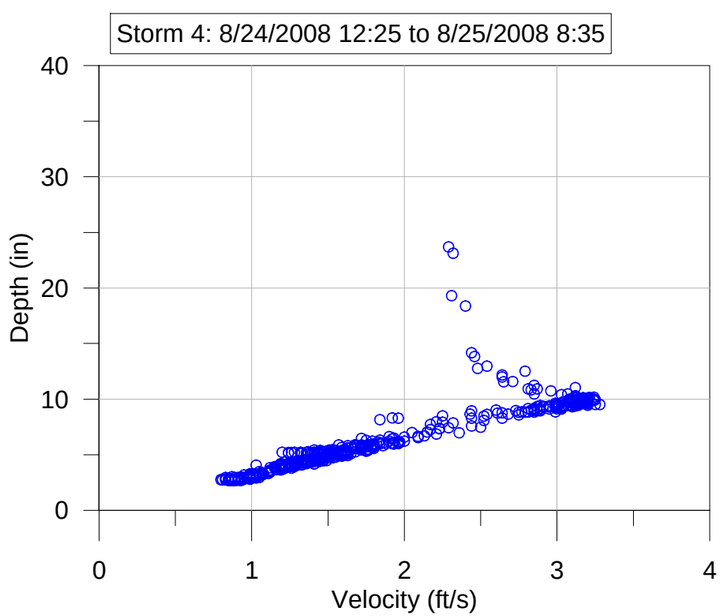


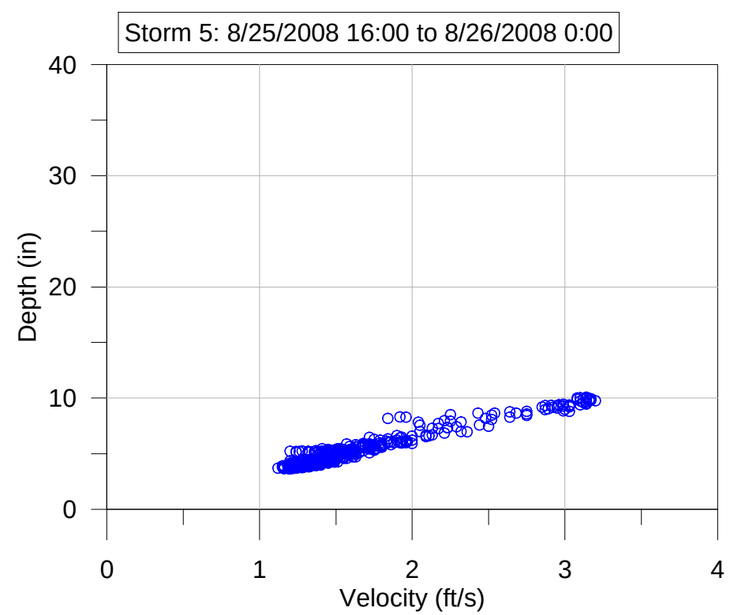
Calibration Storms - Scattergraphs
Monitor 074-153 (45A)

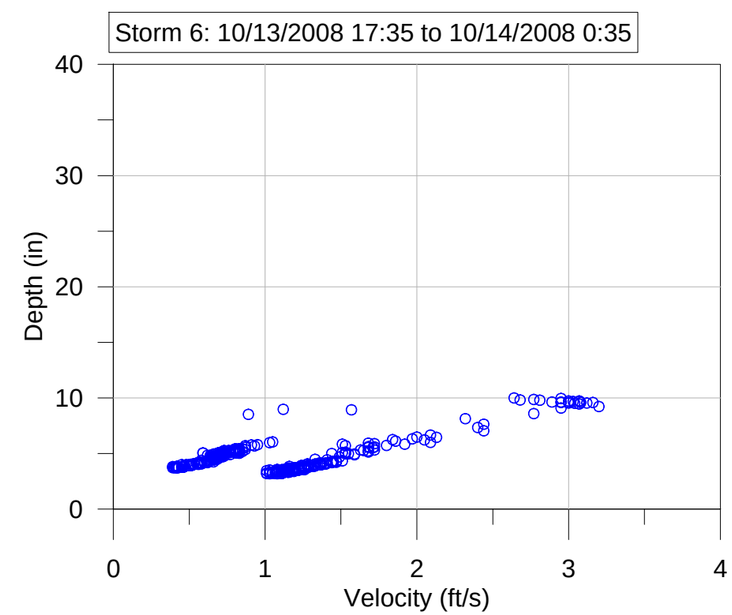




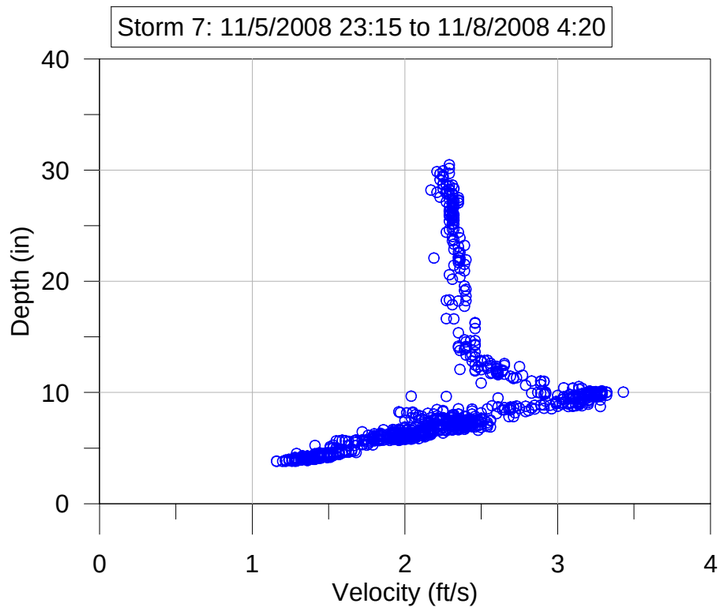


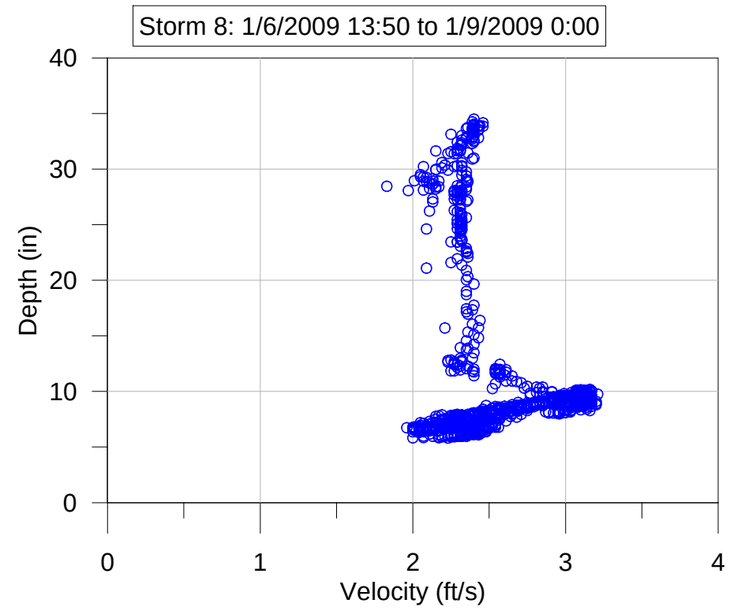


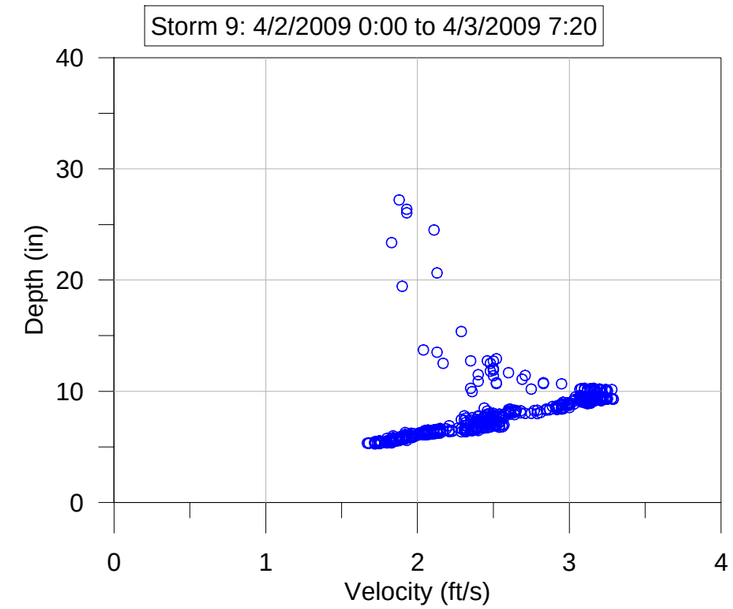


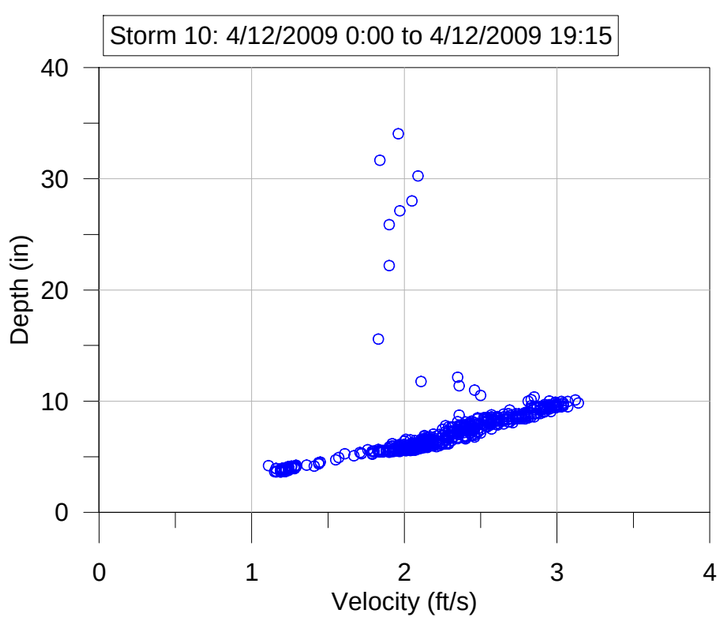


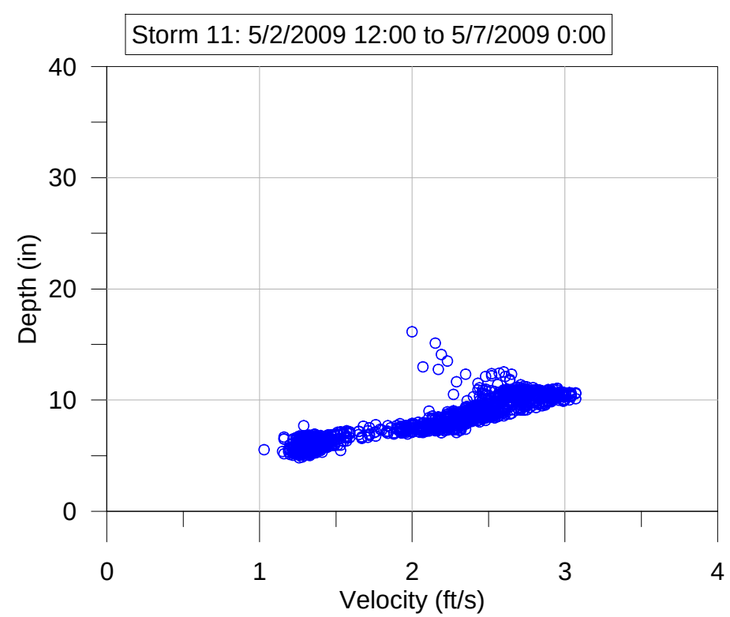
Calibration Storms - Scattergraphs
Monitor 074-153 (45A)

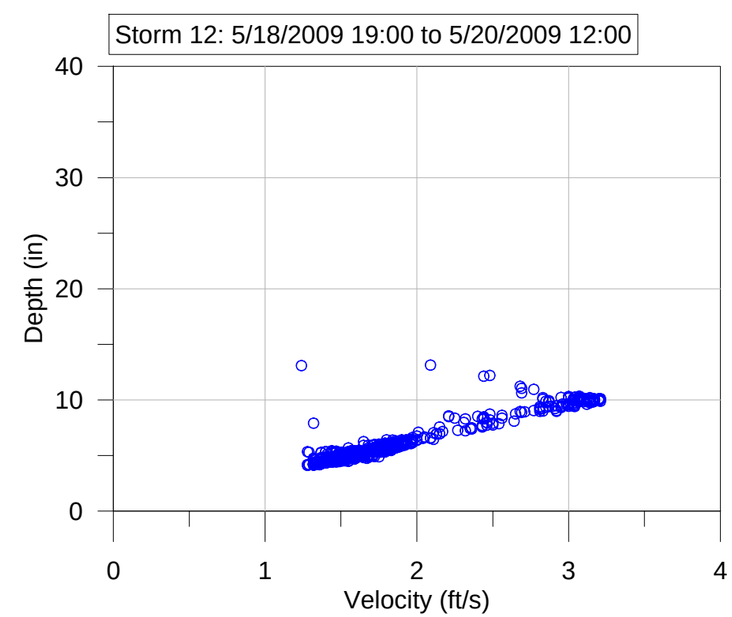




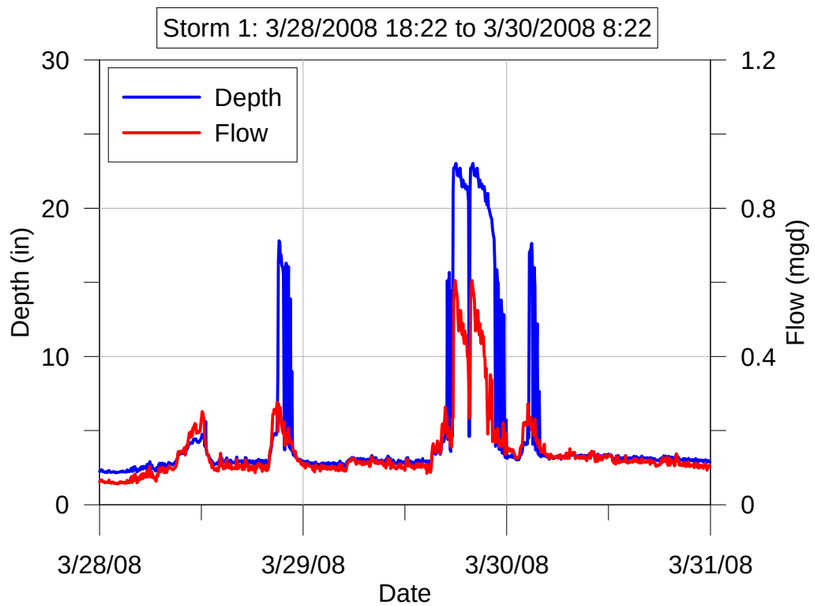


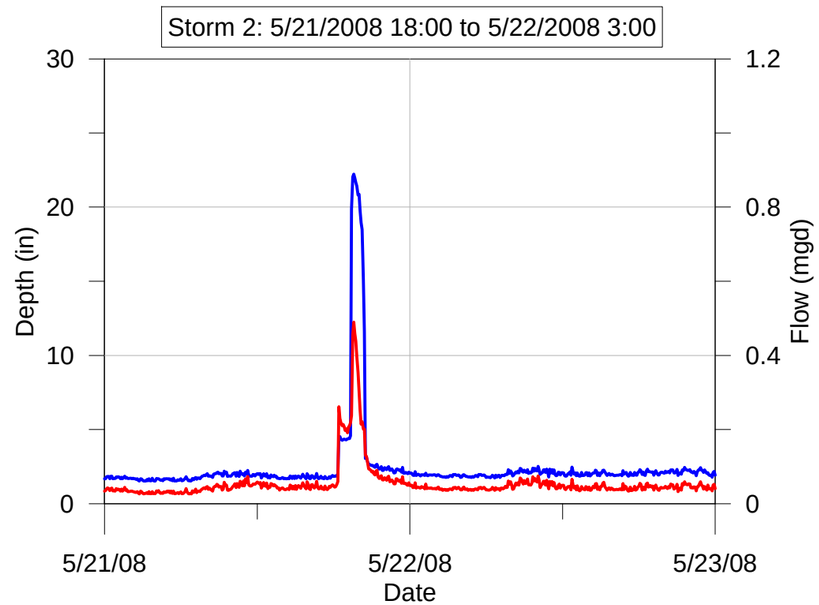


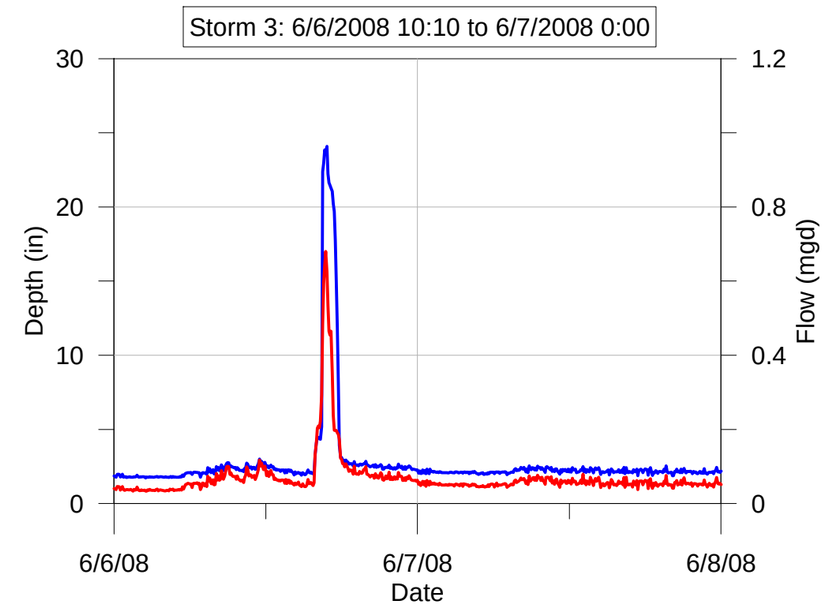


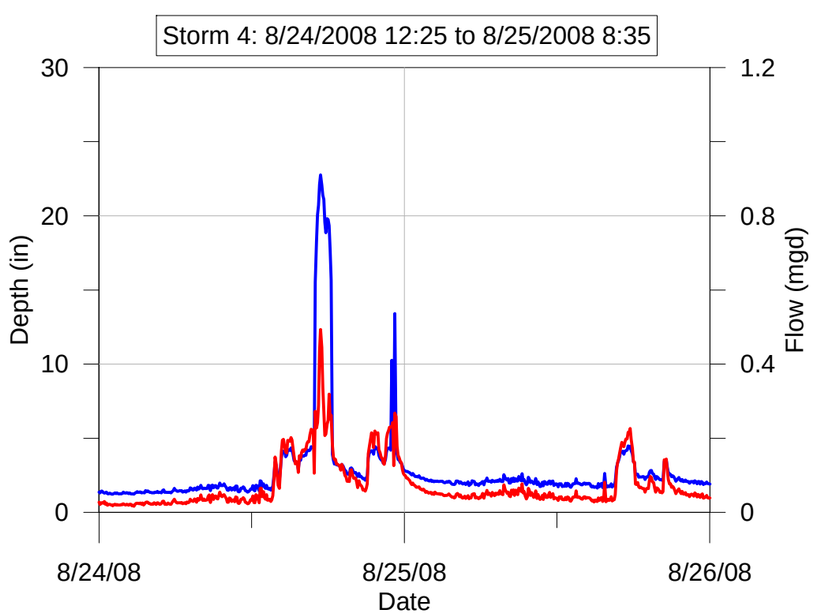


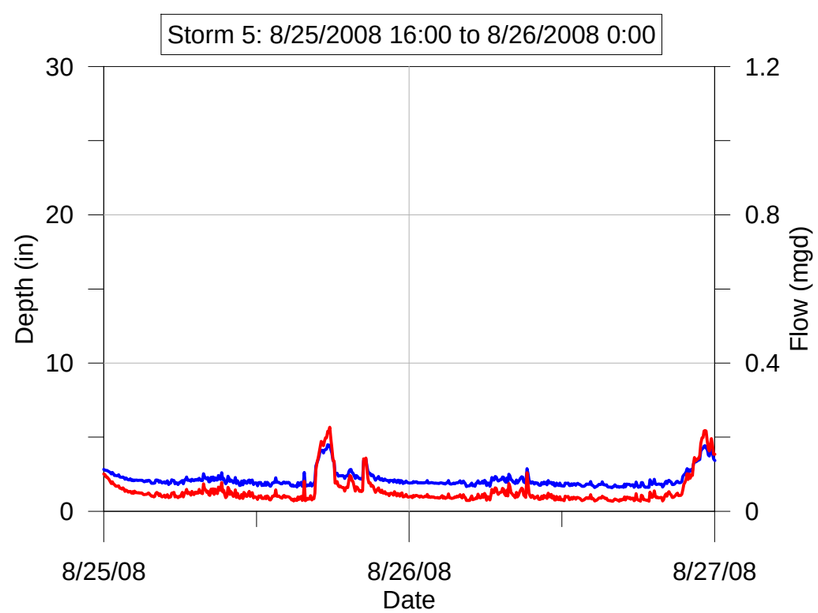
Calibration Storms
Monitor 074-152

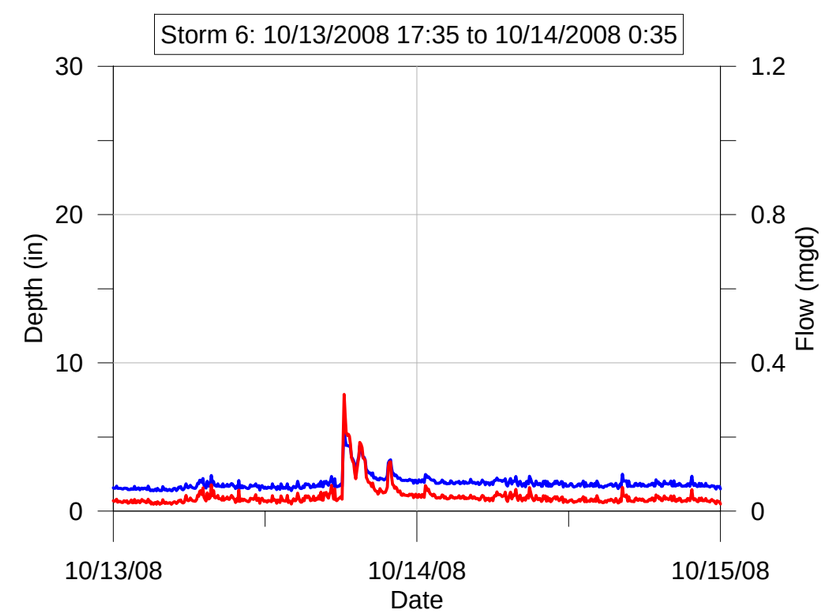




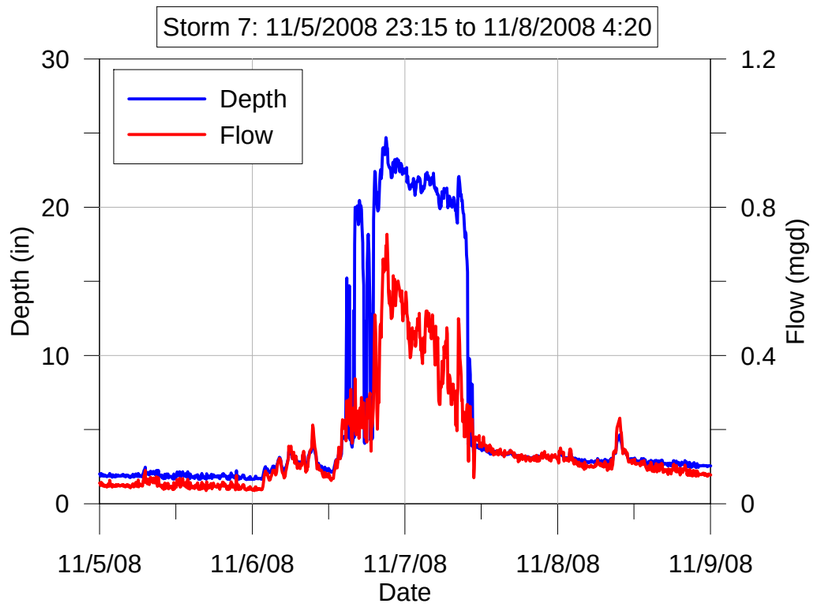


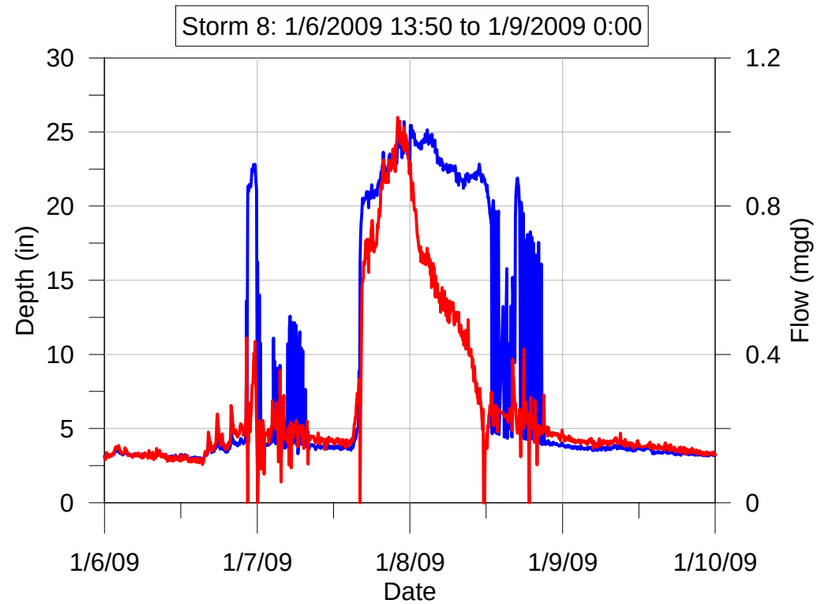


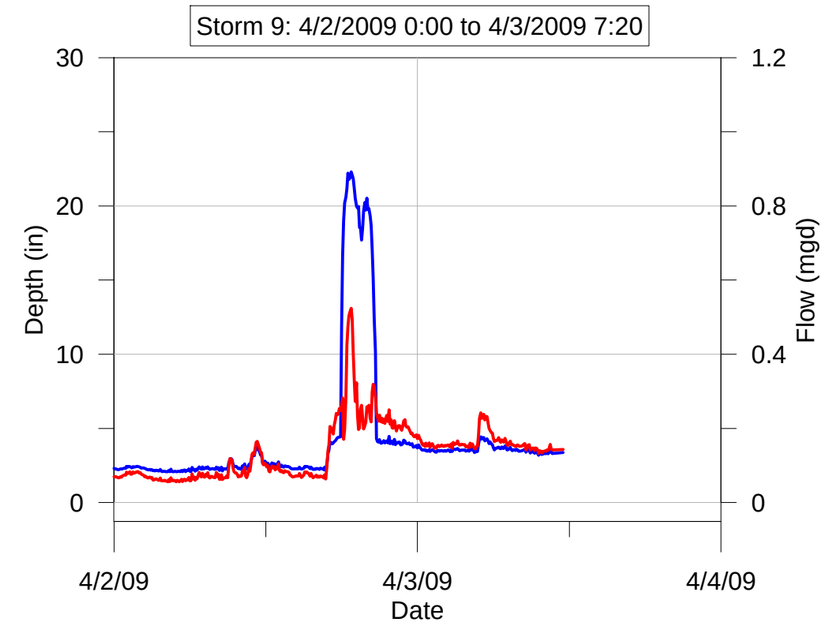


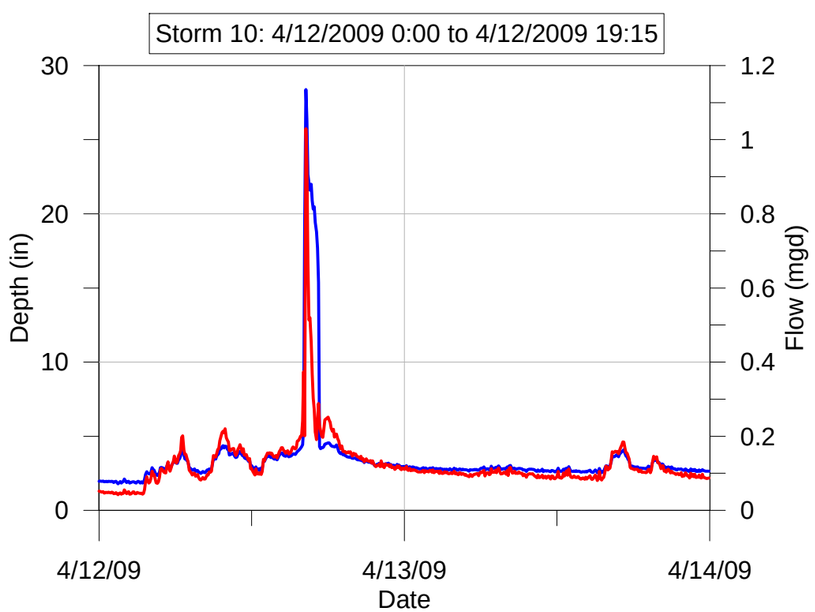


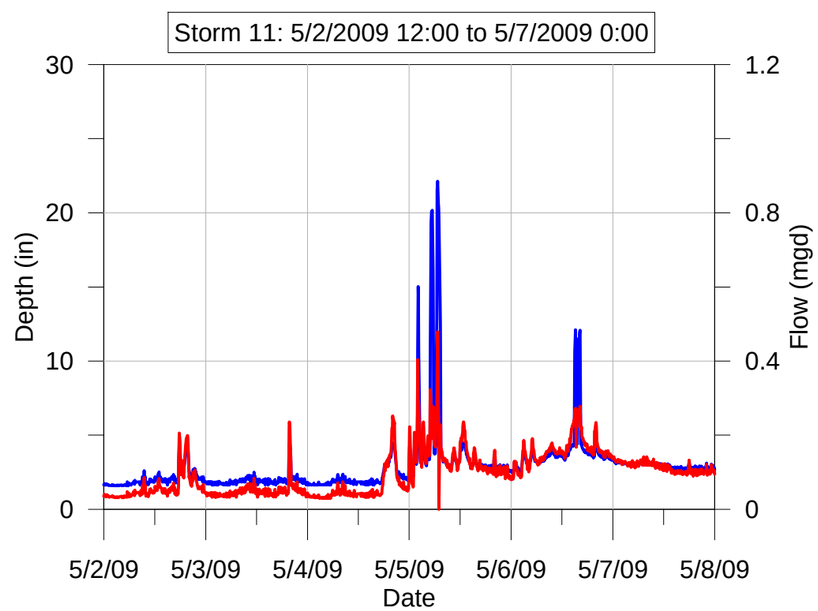
Calibration Storms
Monitor 074-152

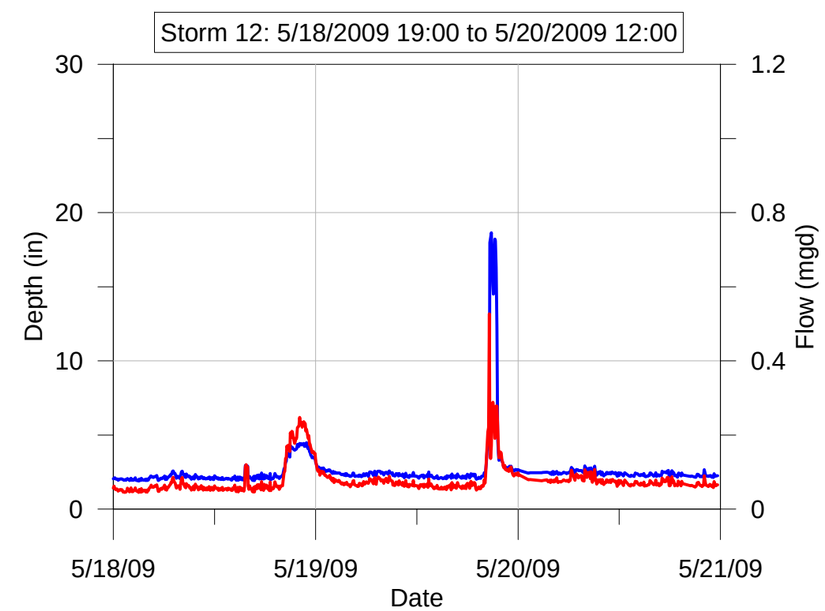




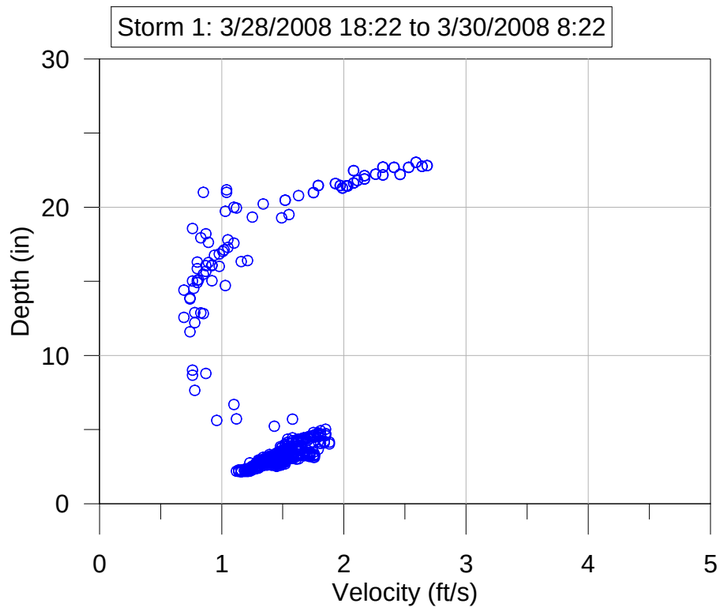


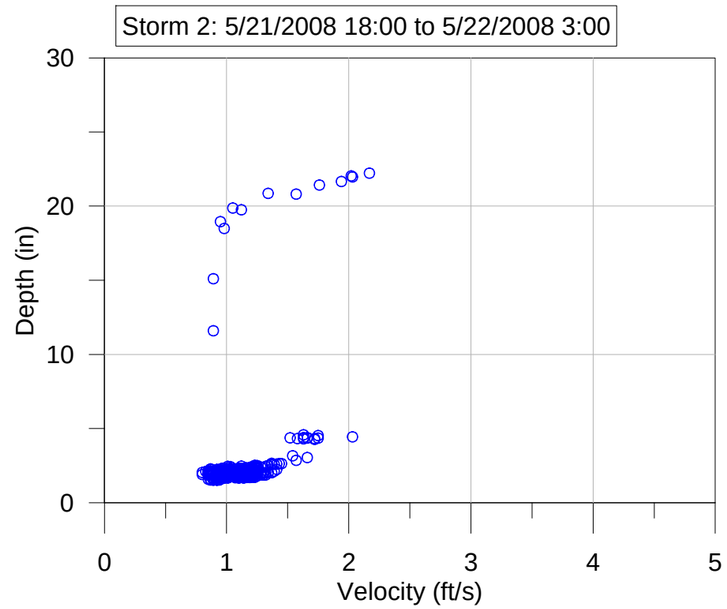


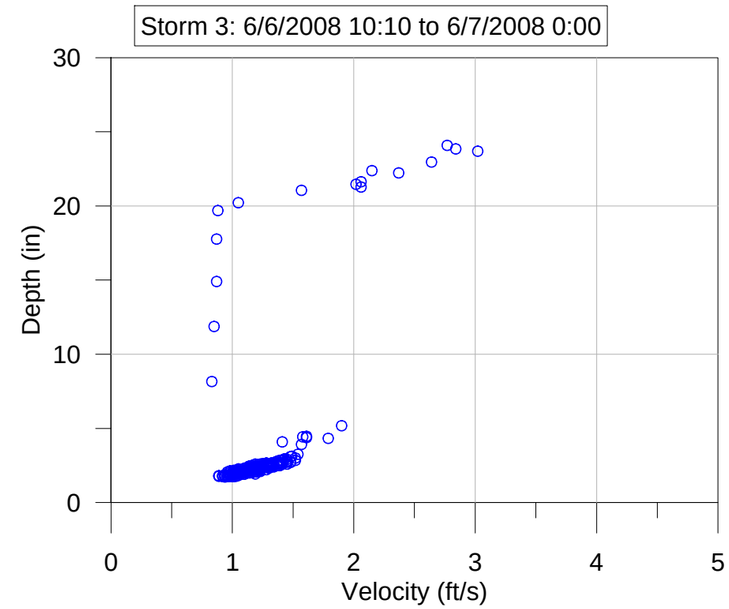


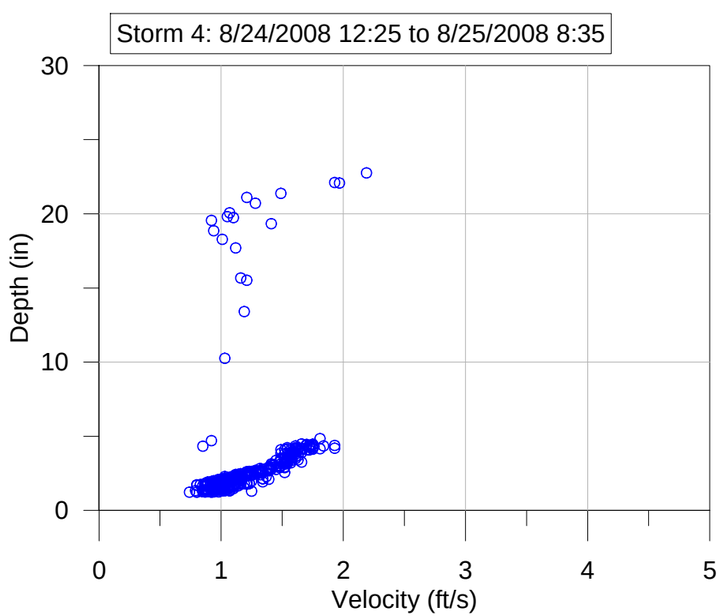


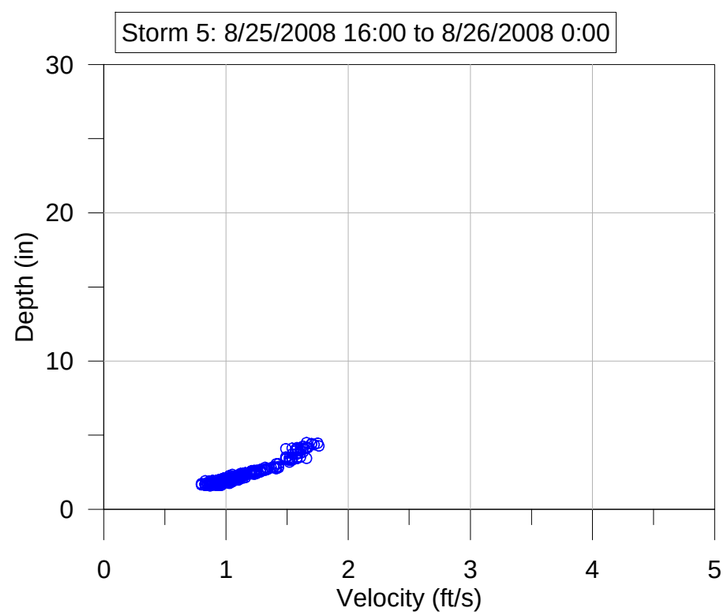
Calibration Storms - Scattergraphs
Monitor 074-152

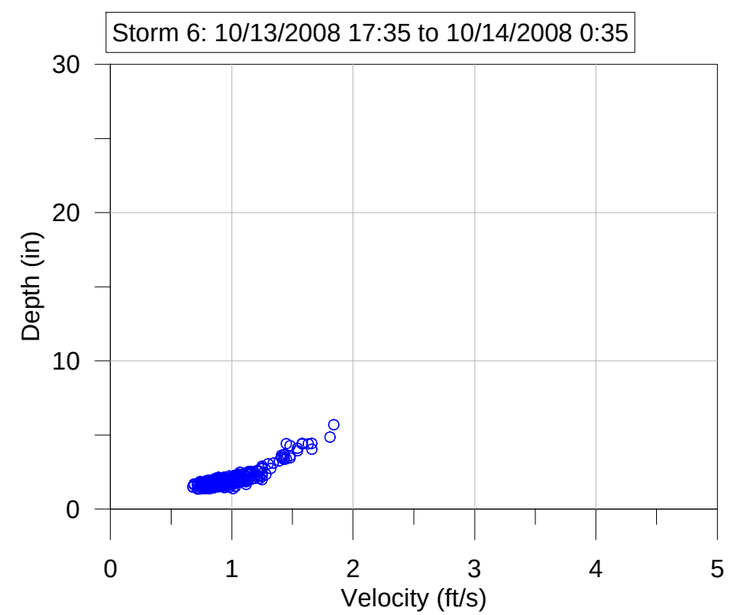




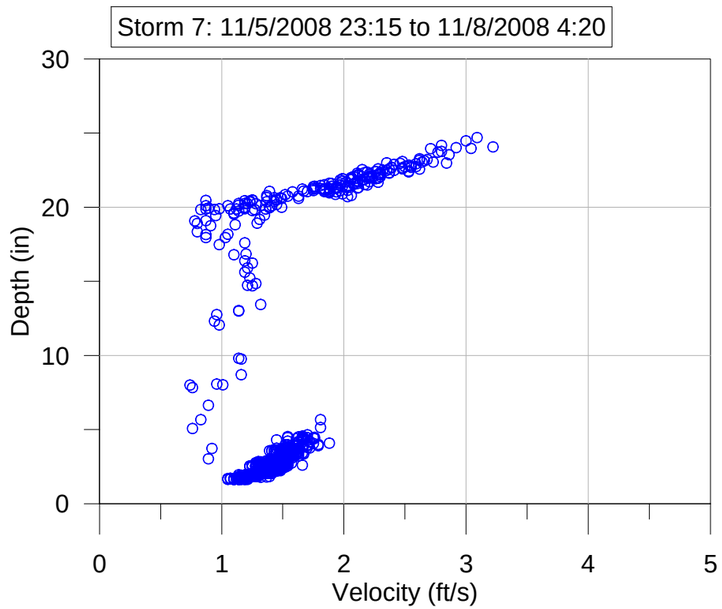


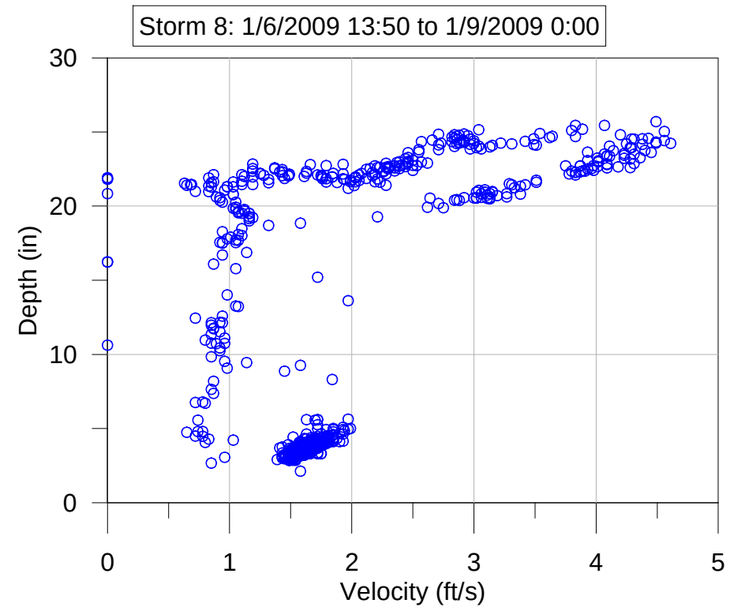


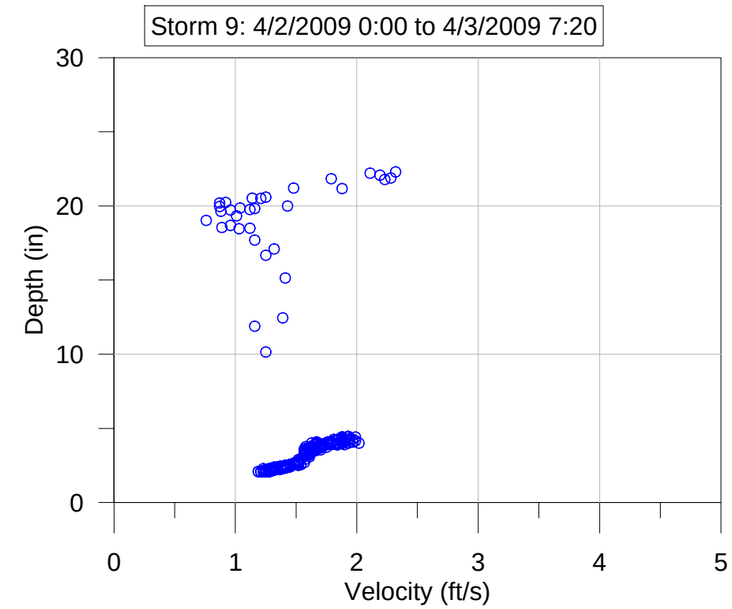


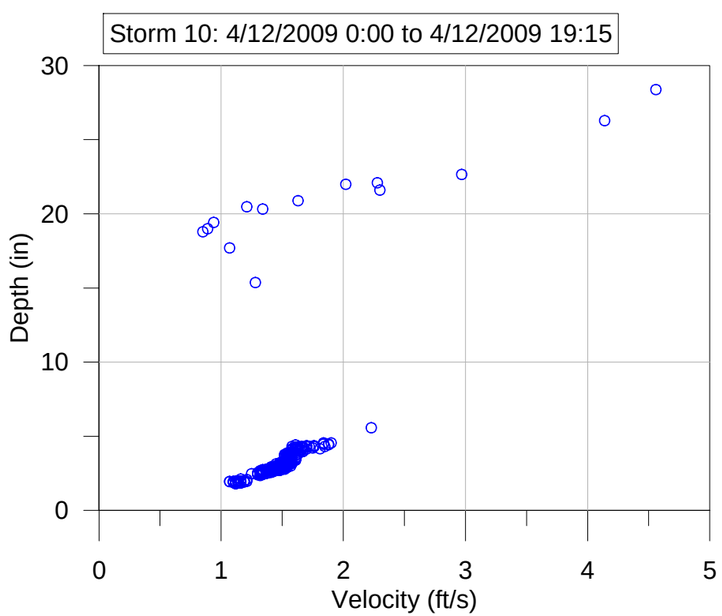


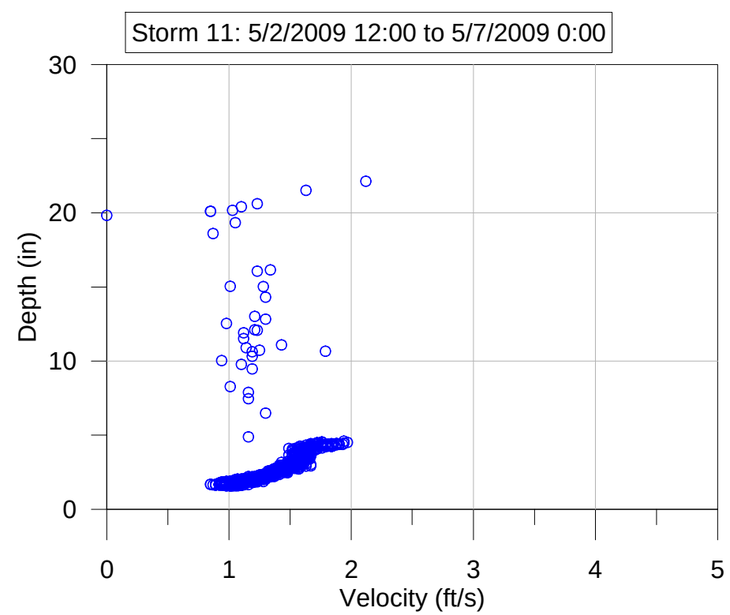
Calibration Storms - Scattergraphs
Monitor 074-152

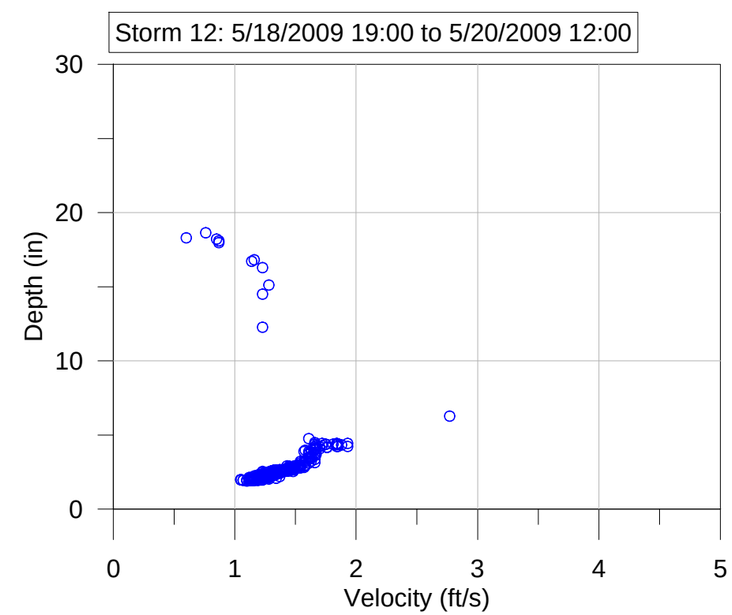




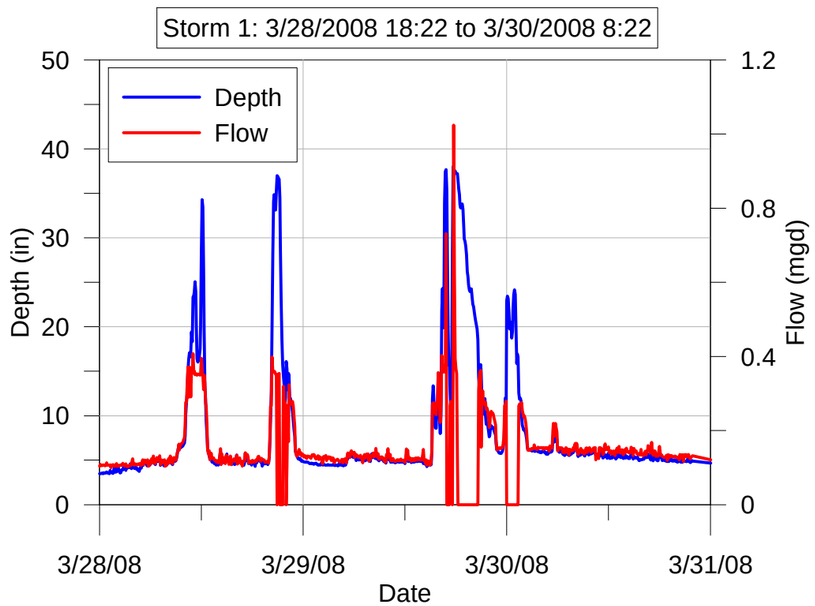


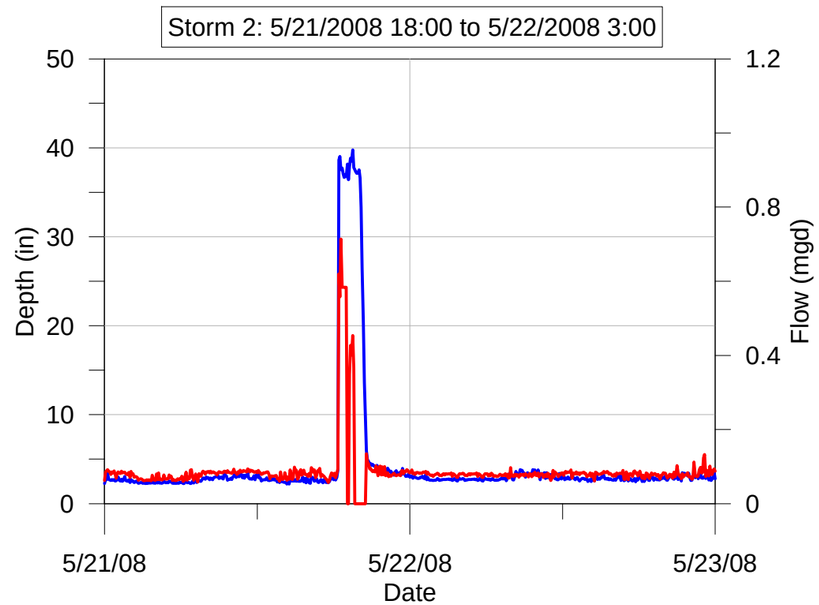


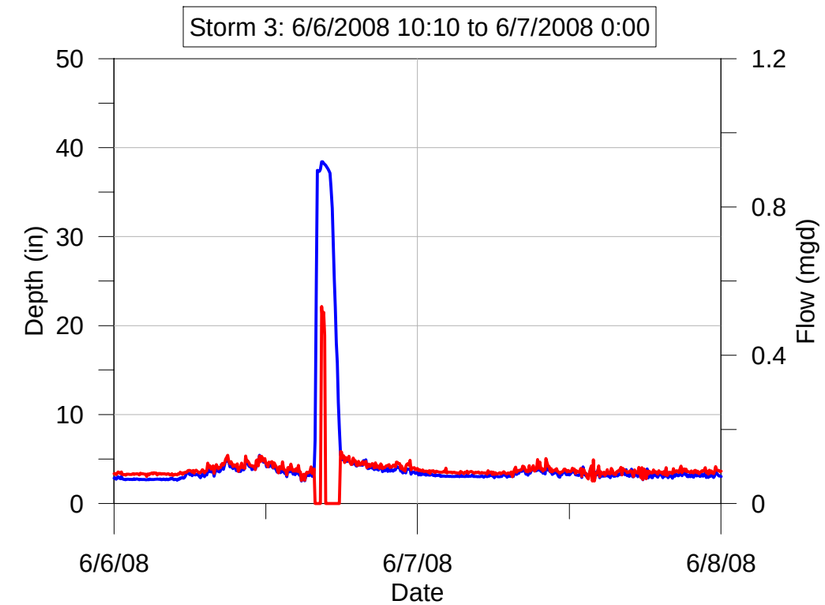


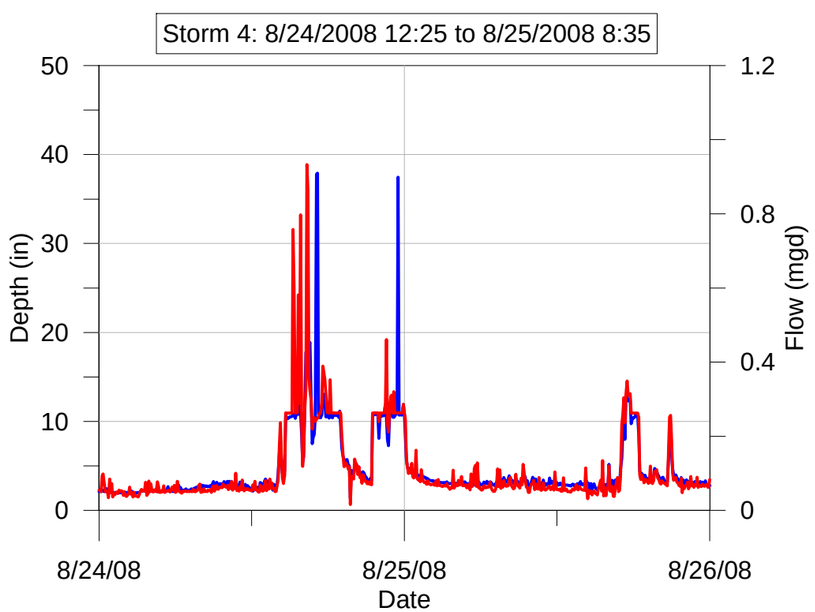


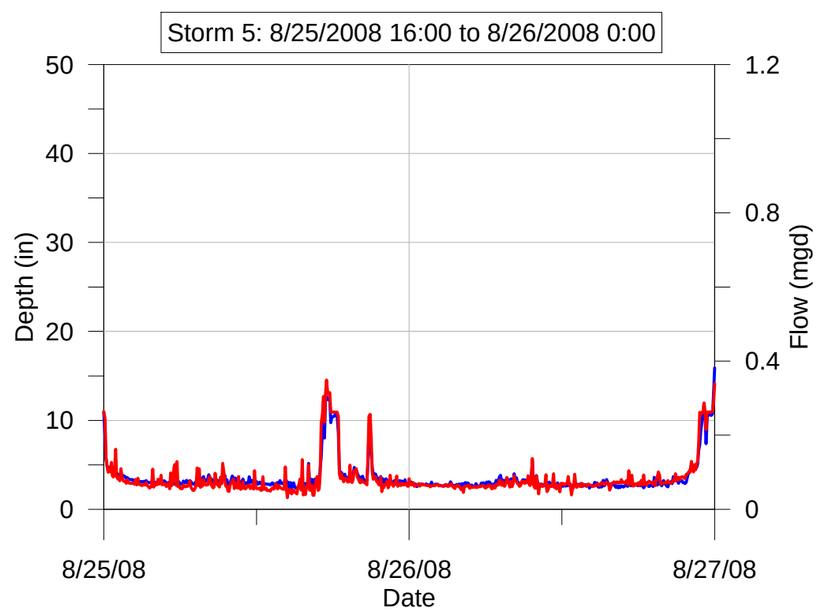
Calibration Storms
Monitor 074-159

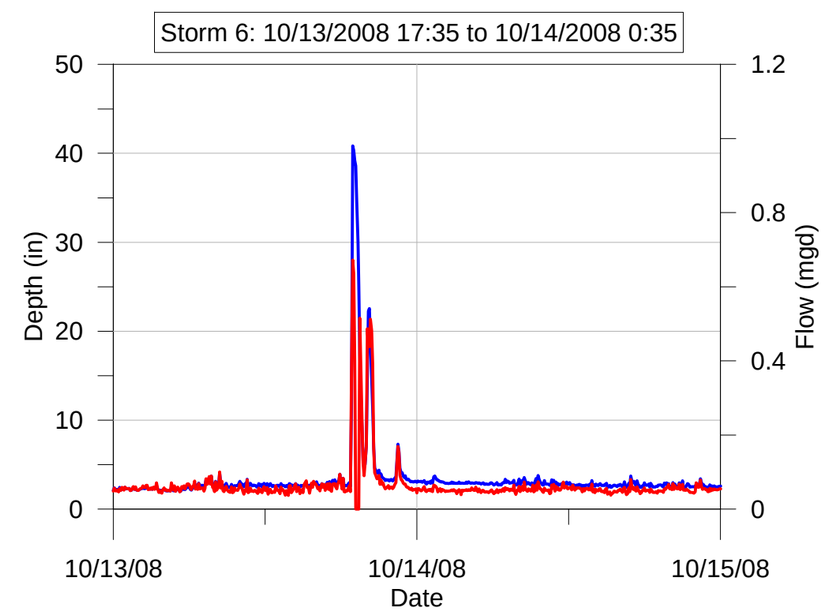




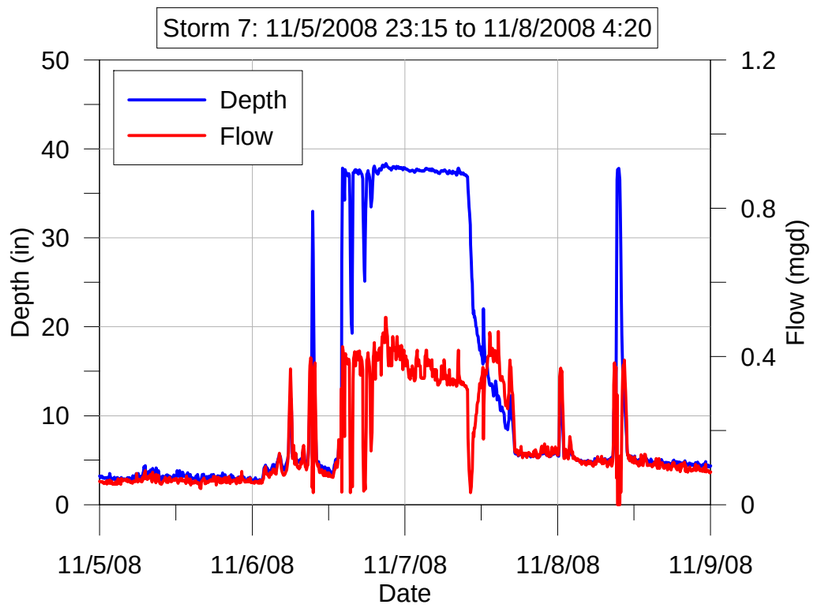


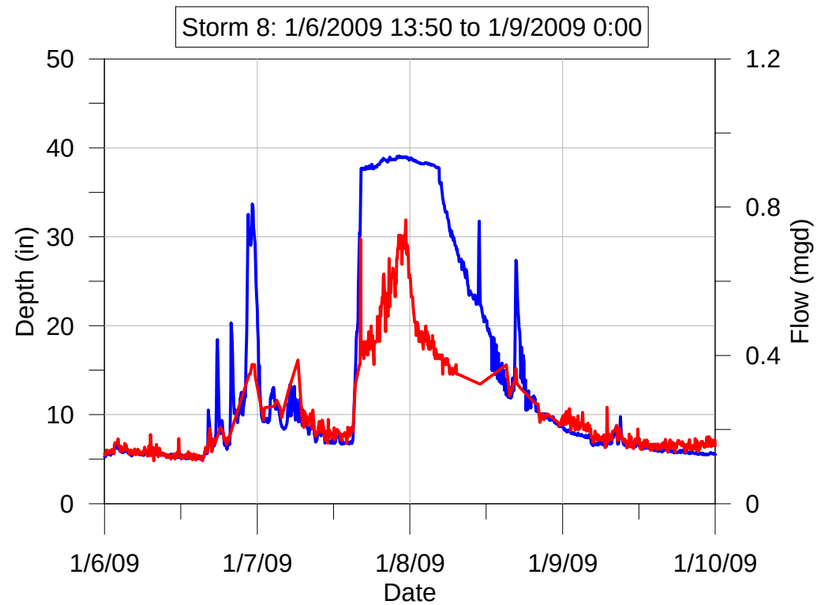


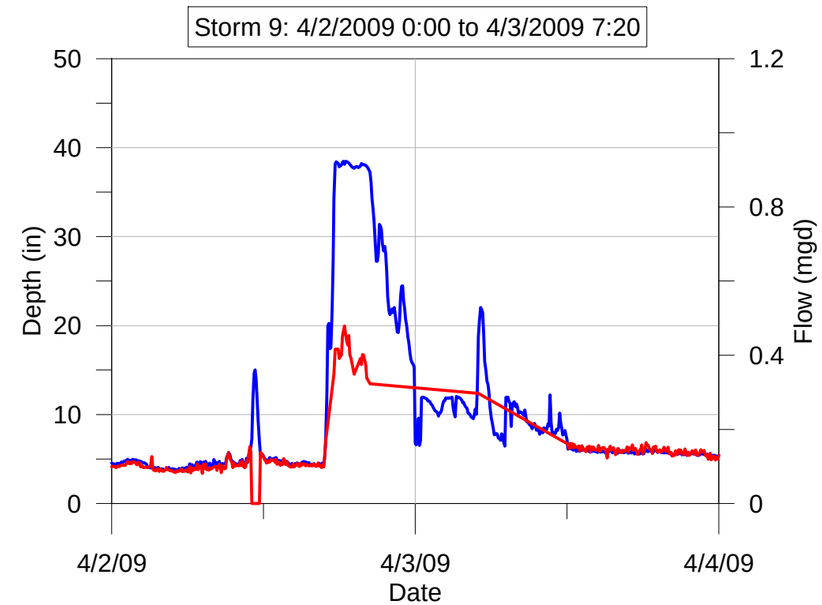


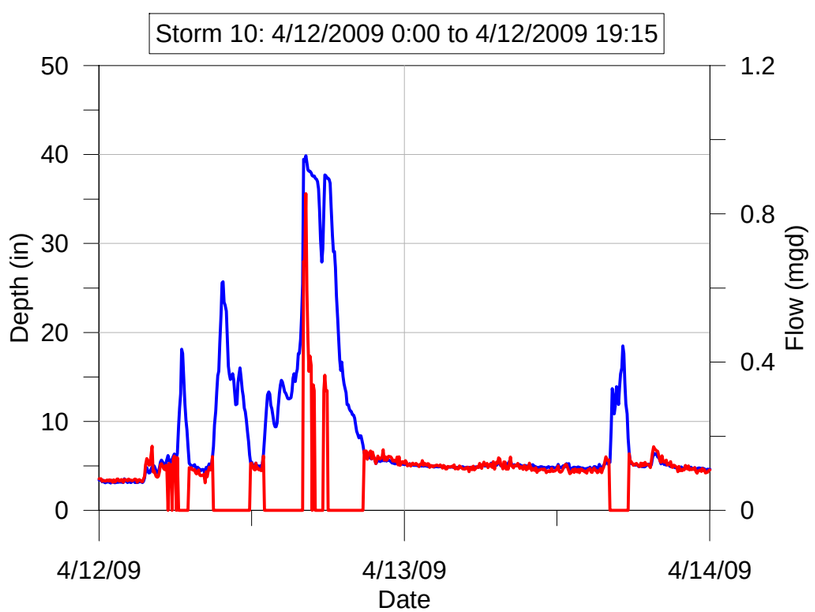


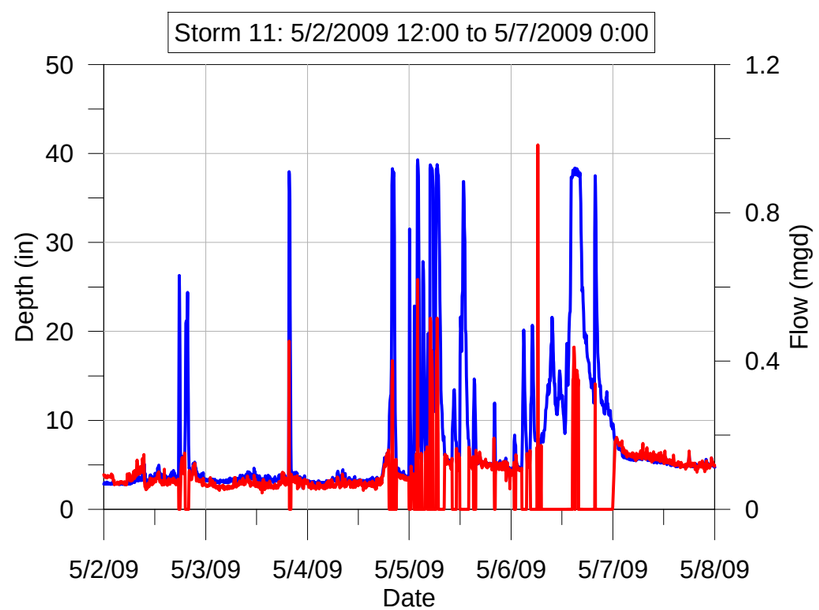
Calibration Storms
Monitor 074-159

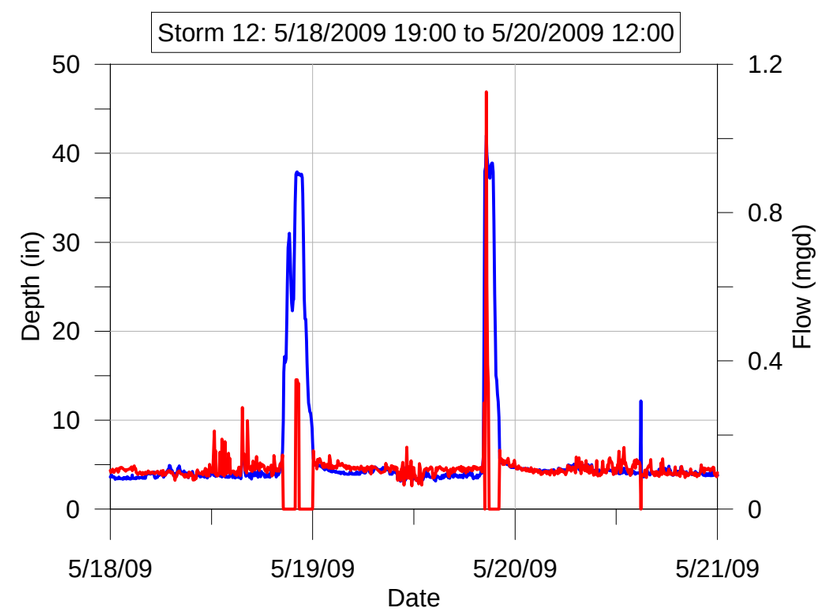




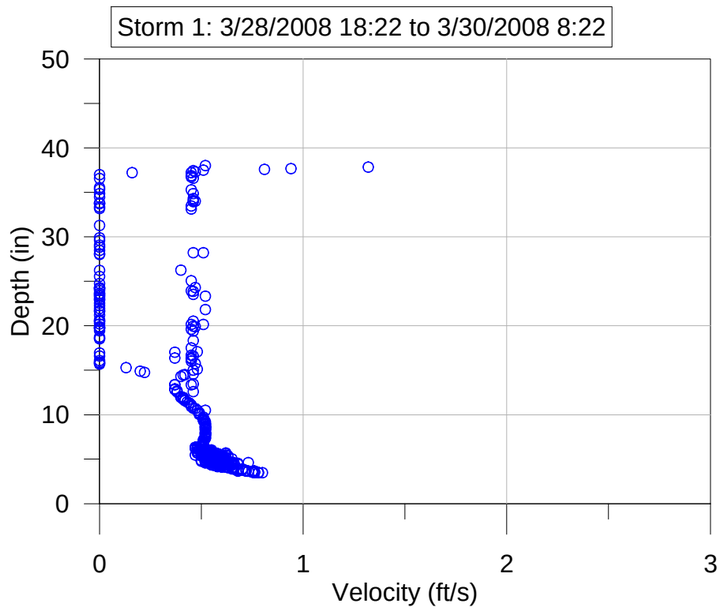


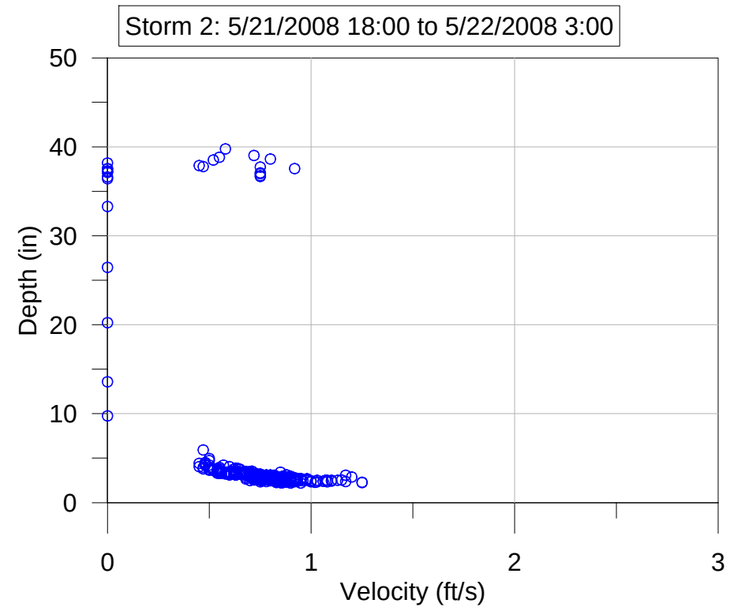


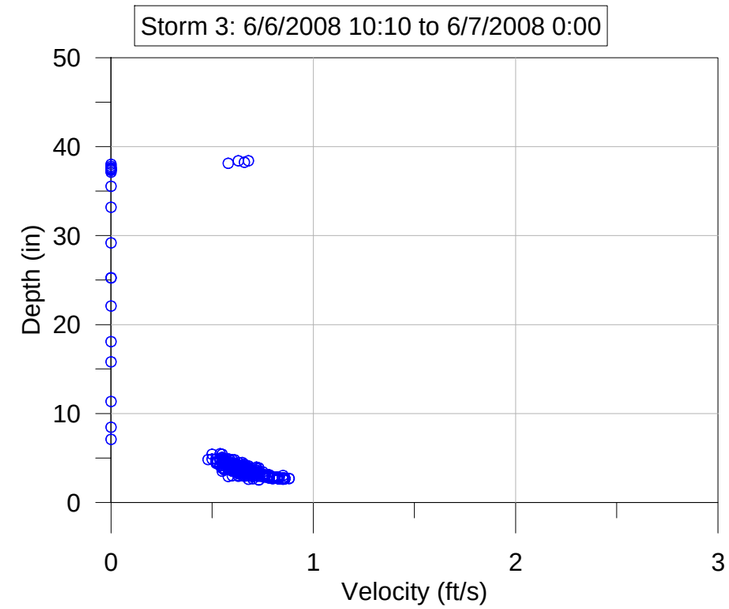


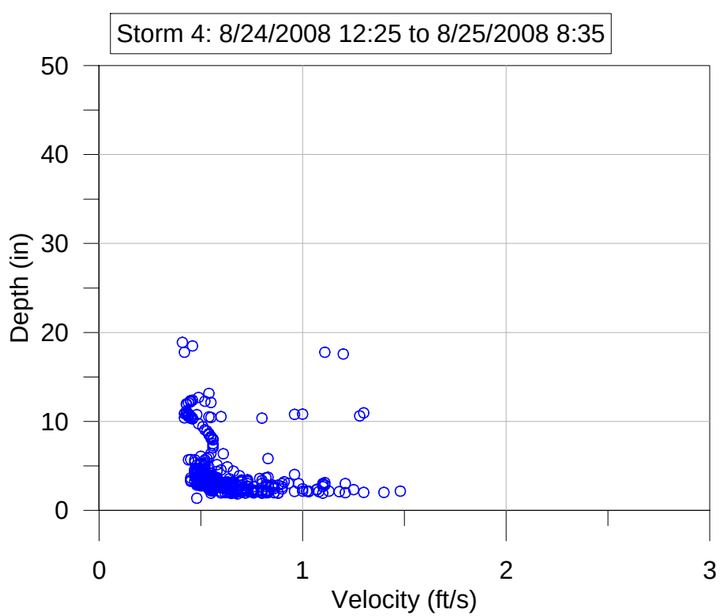


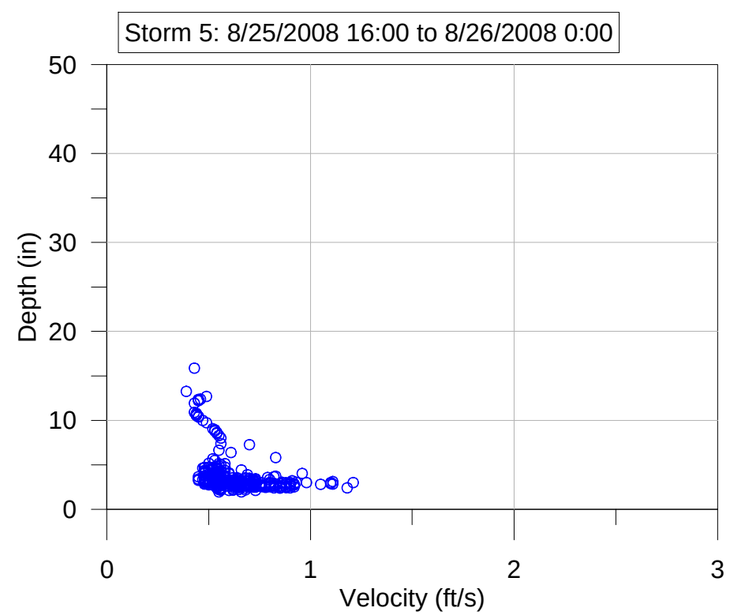
Calibration Storms - Scattergraphs
Monitor 074-159

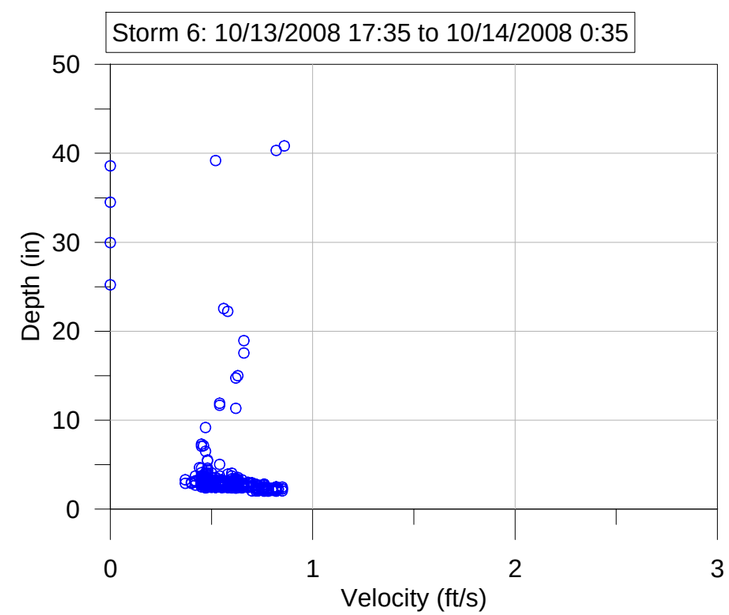




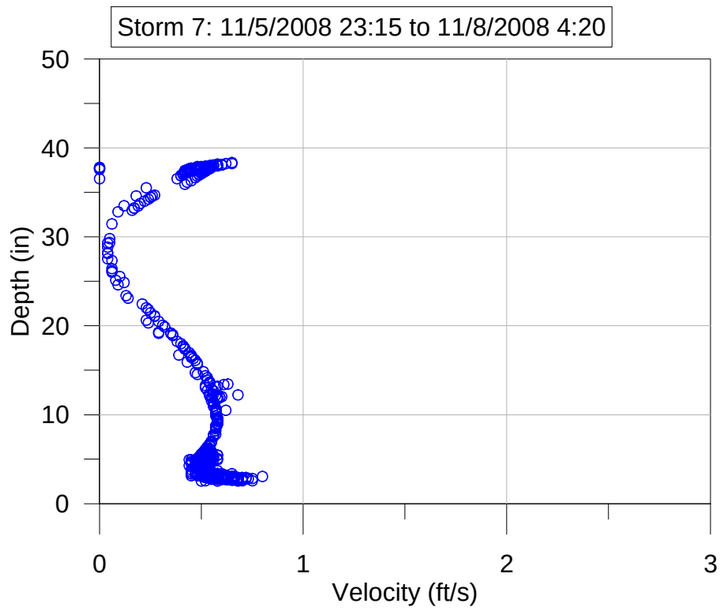


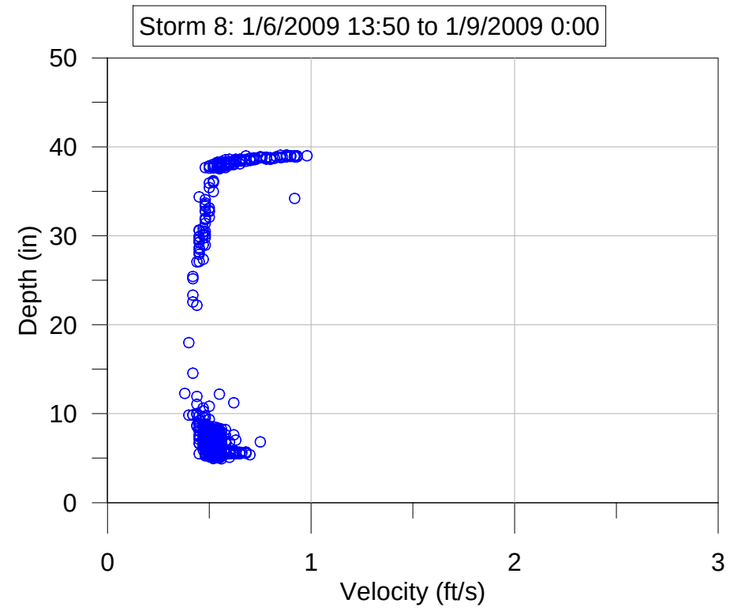


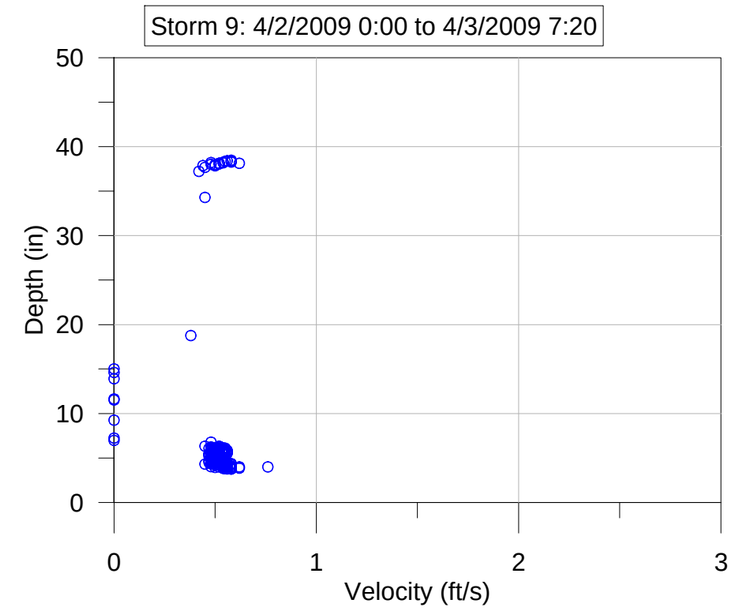


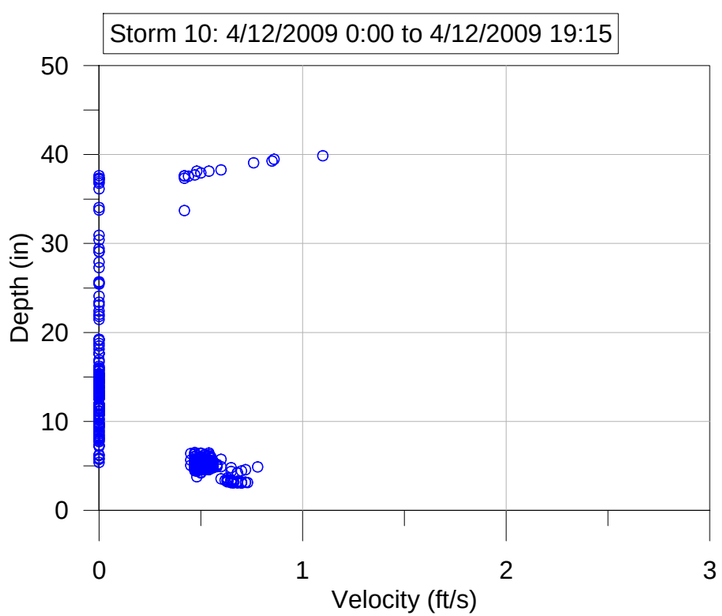


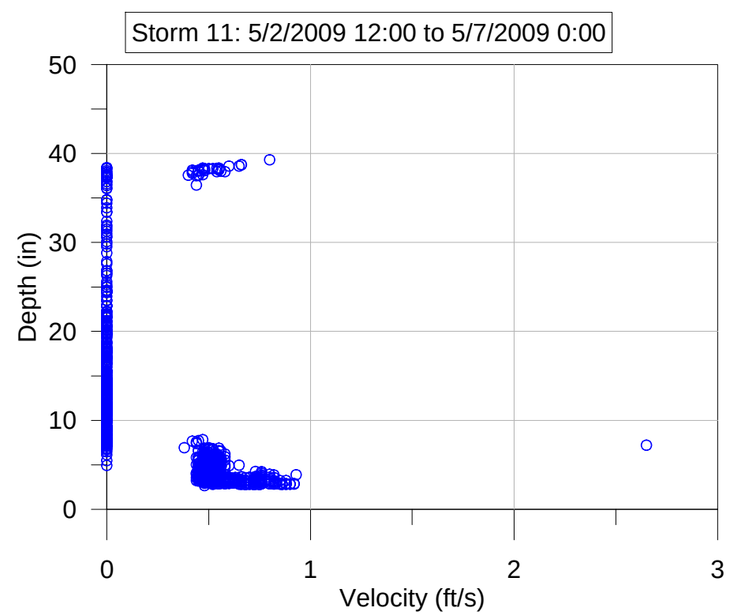
Calibration Storms - Scattergraphs
Monitor 074-159

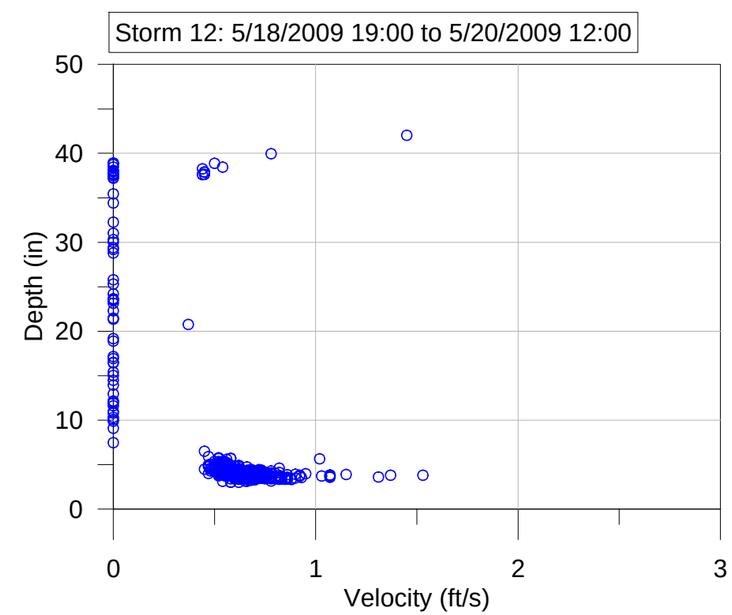




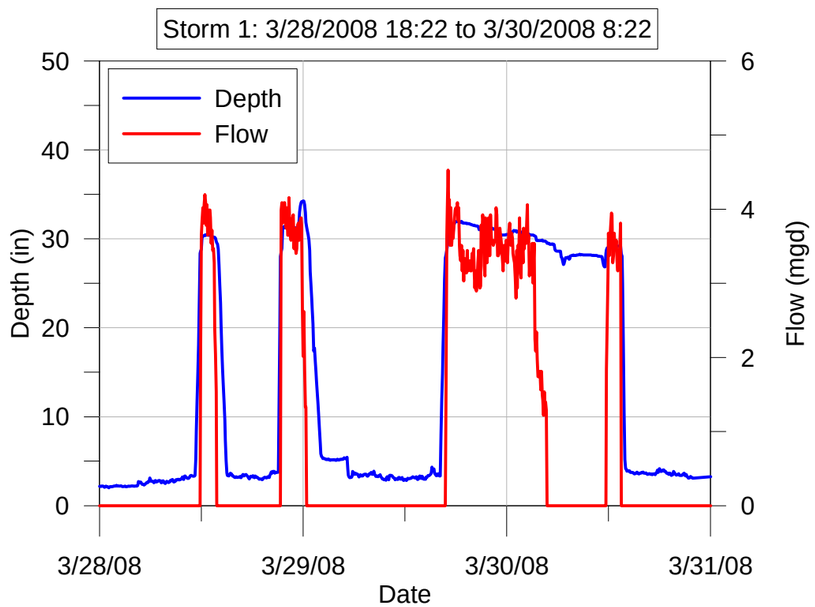


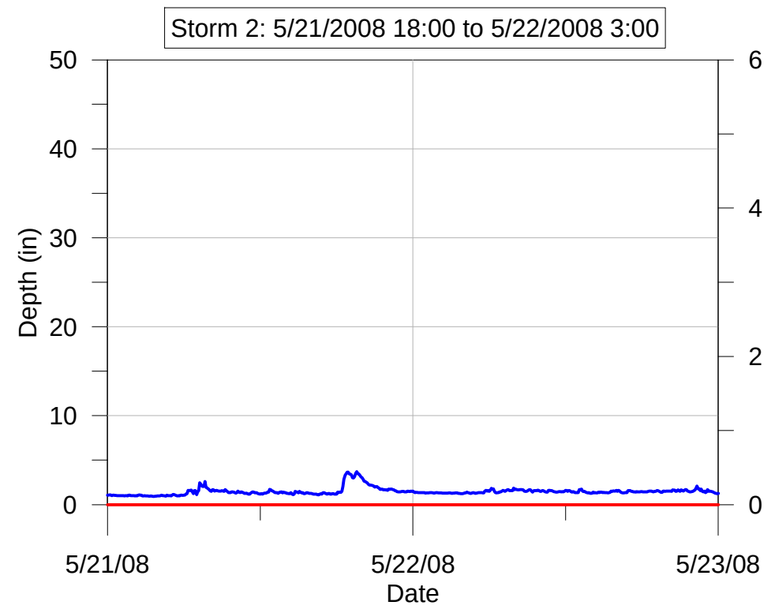


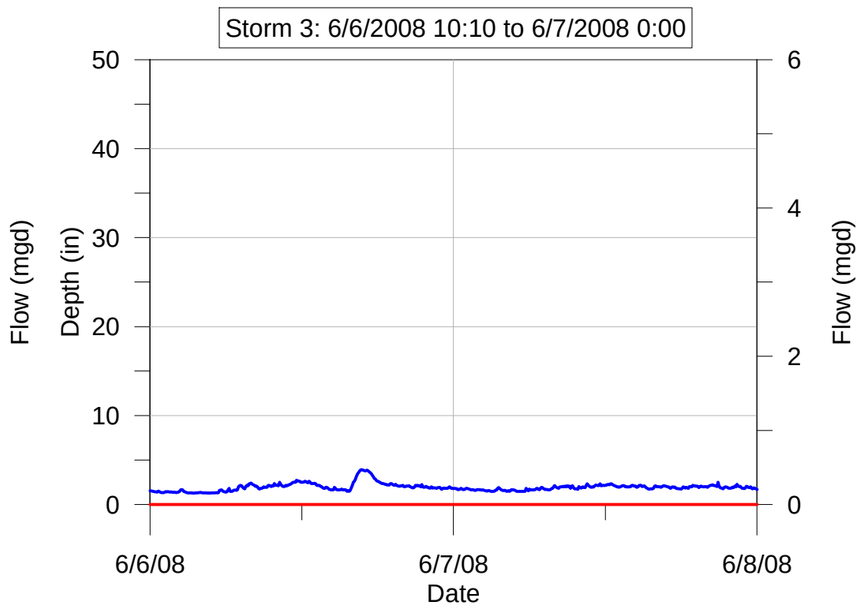


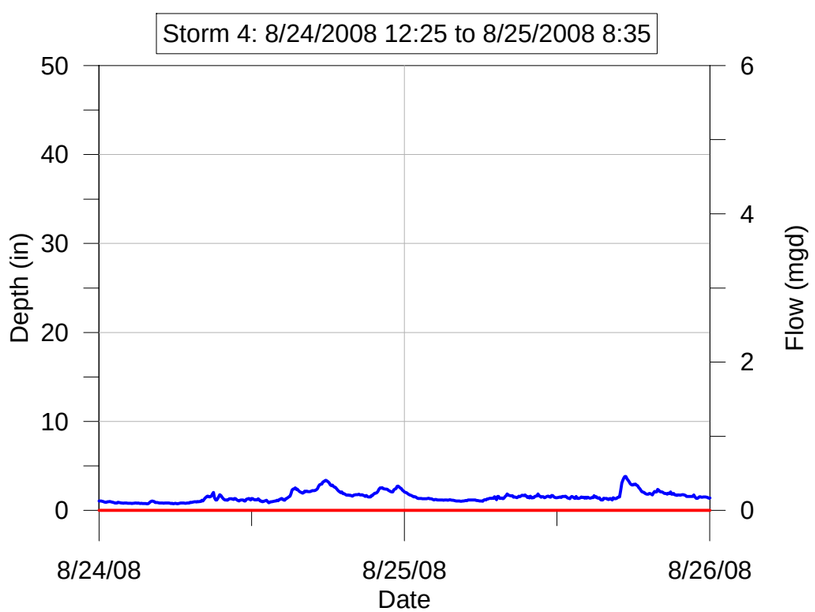


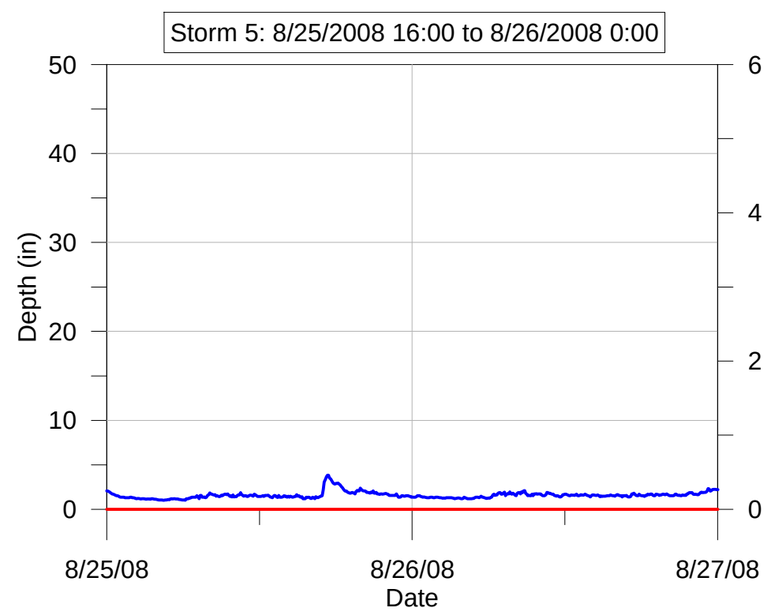
Calibration Storms
Monitor 081-062 (46)

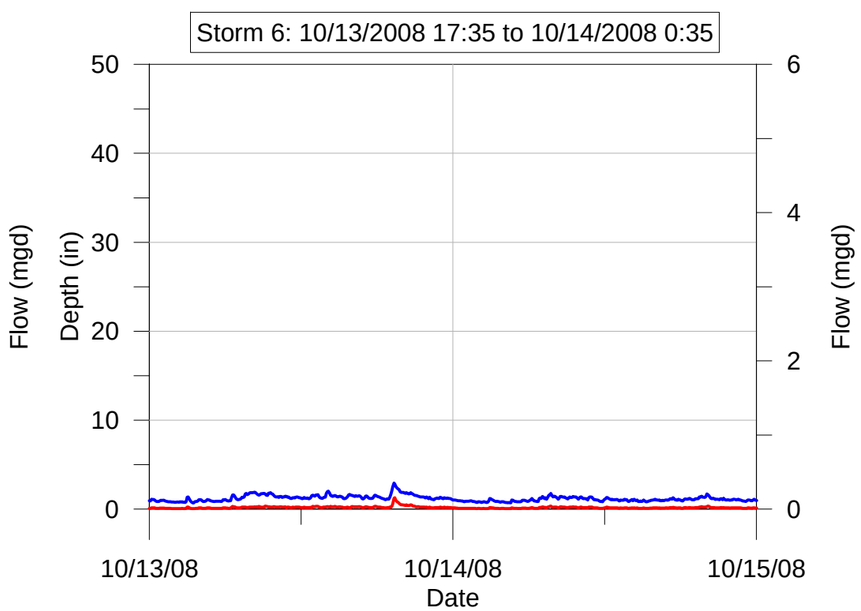




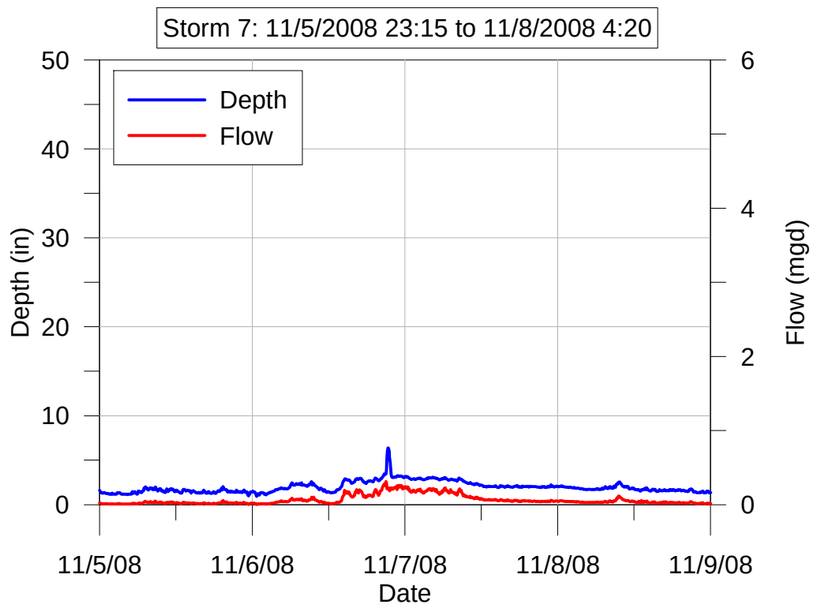


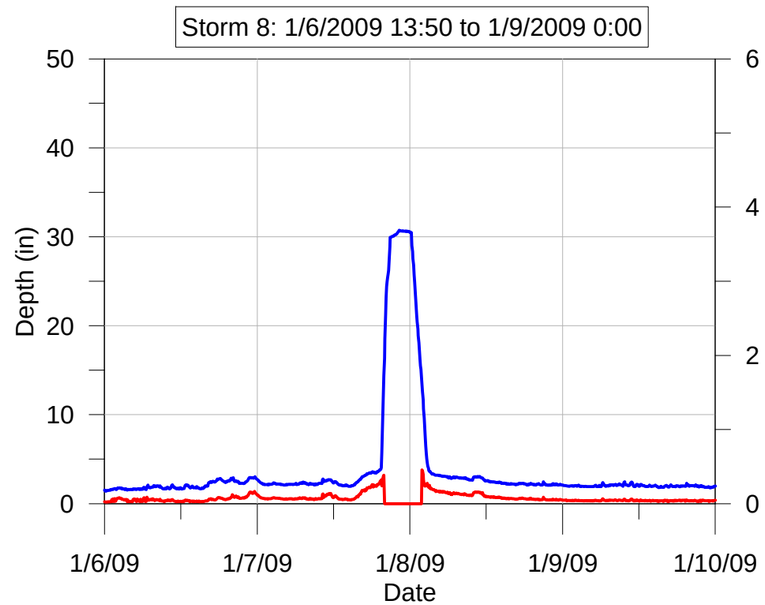


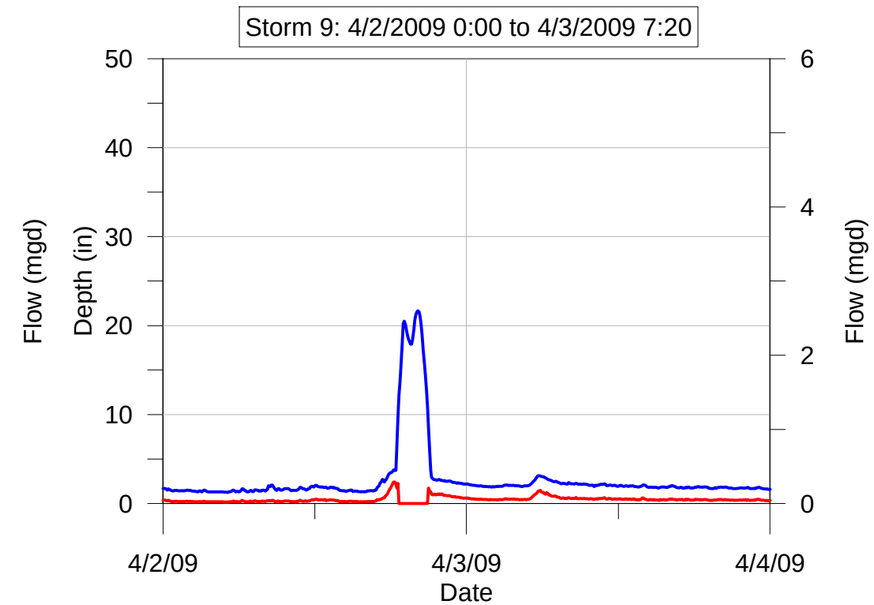


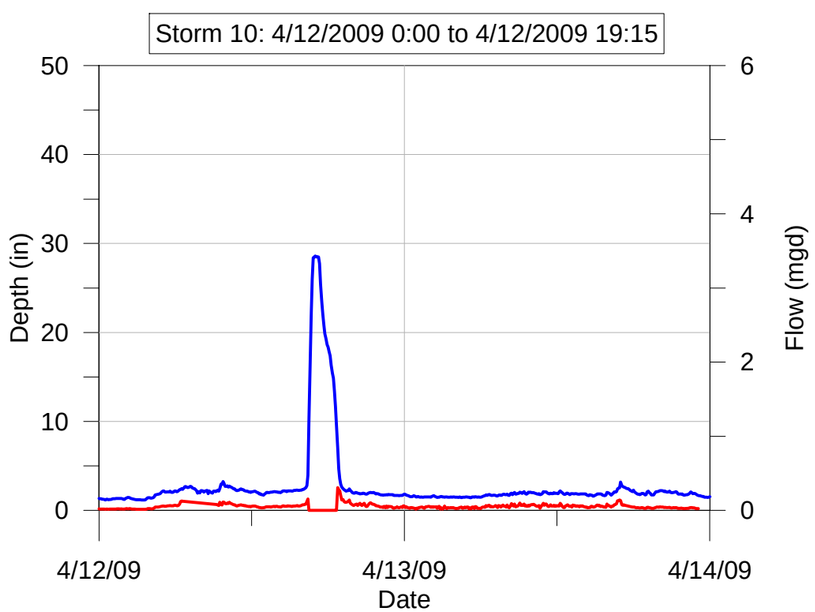


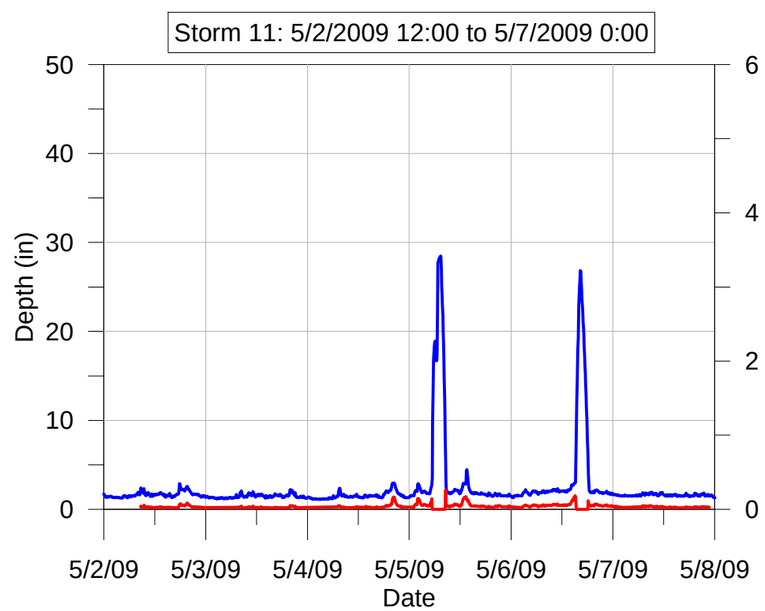
Calibration Storms
Monitor 081-062 (46)

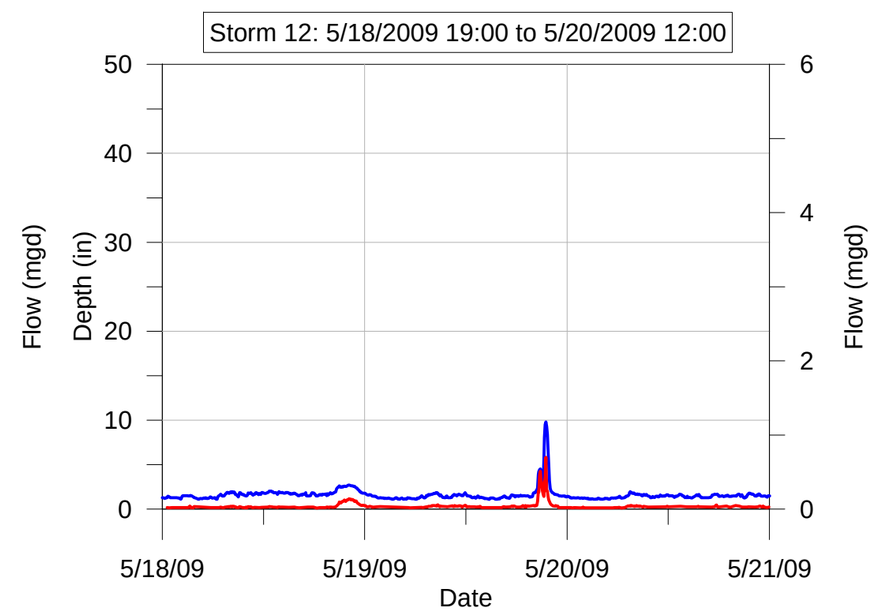




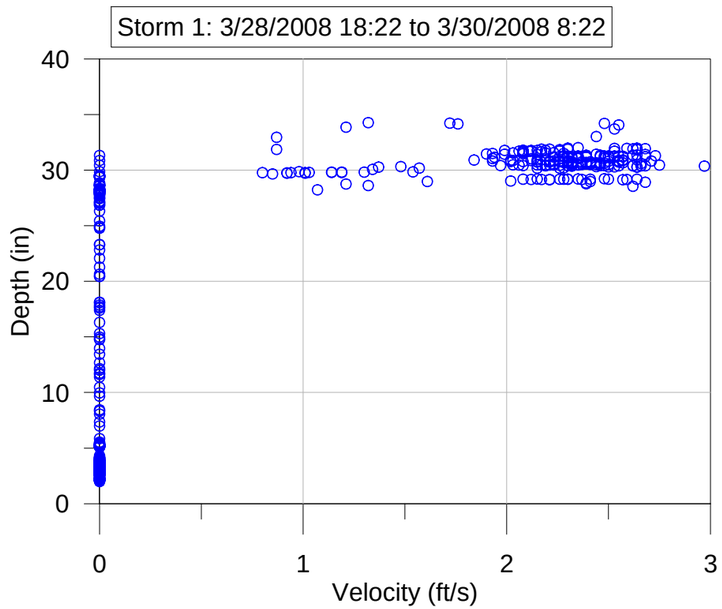


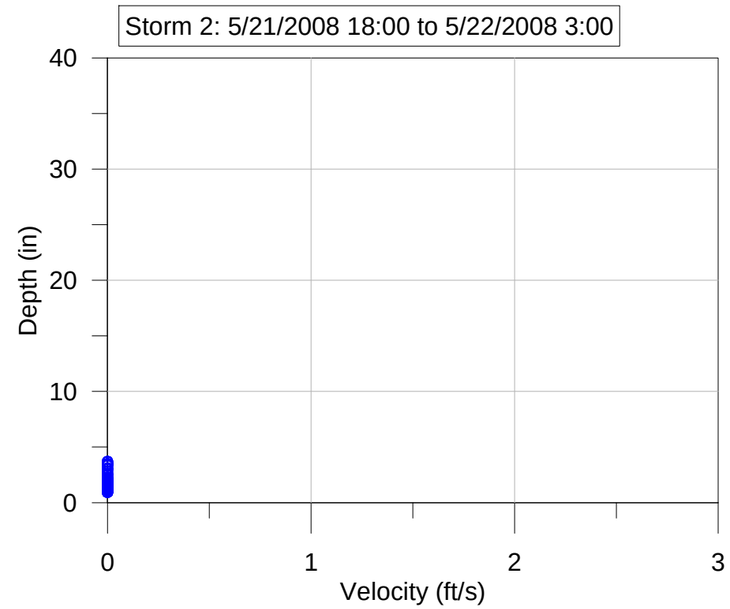


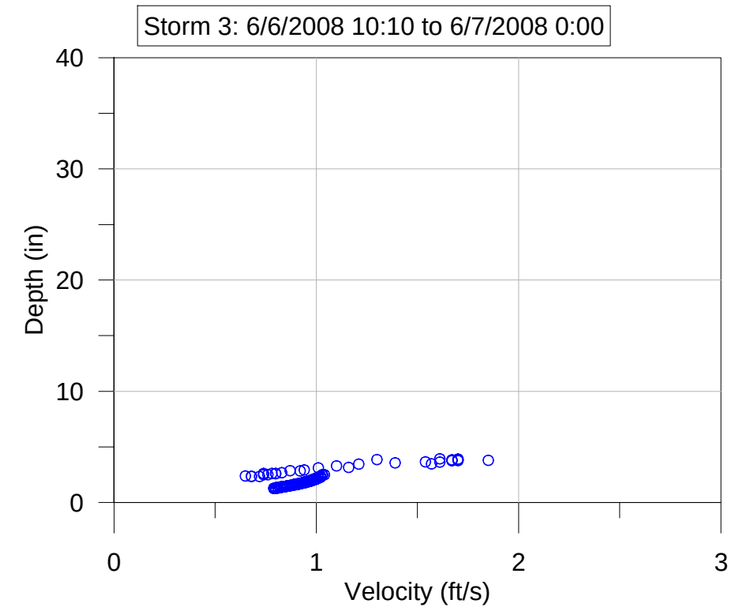


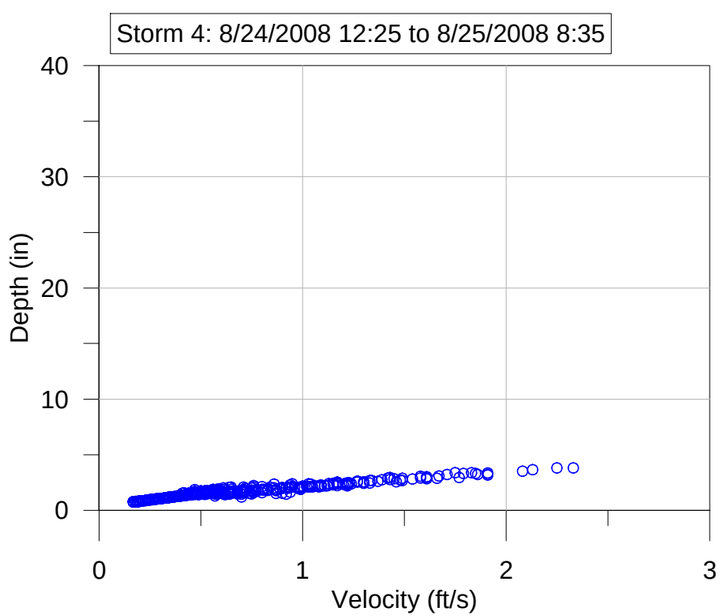


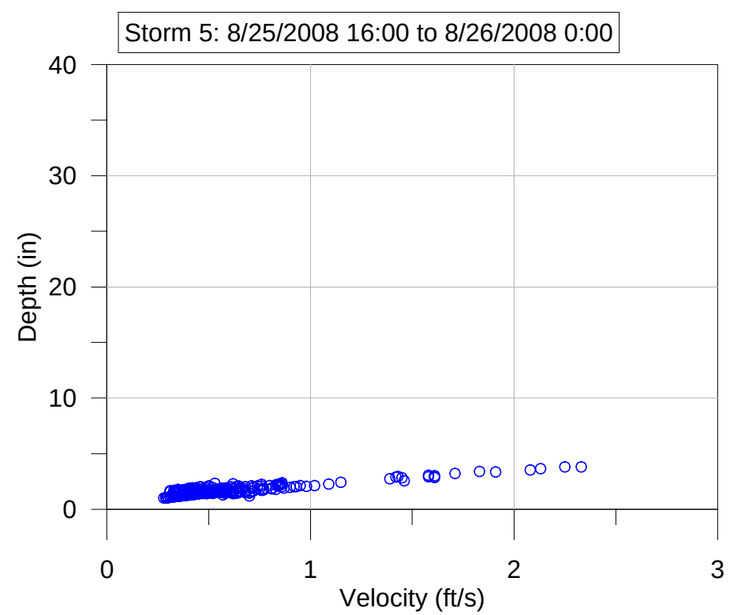
Calibration Storms - Scattergraphs
Monitor 081-062 (46)

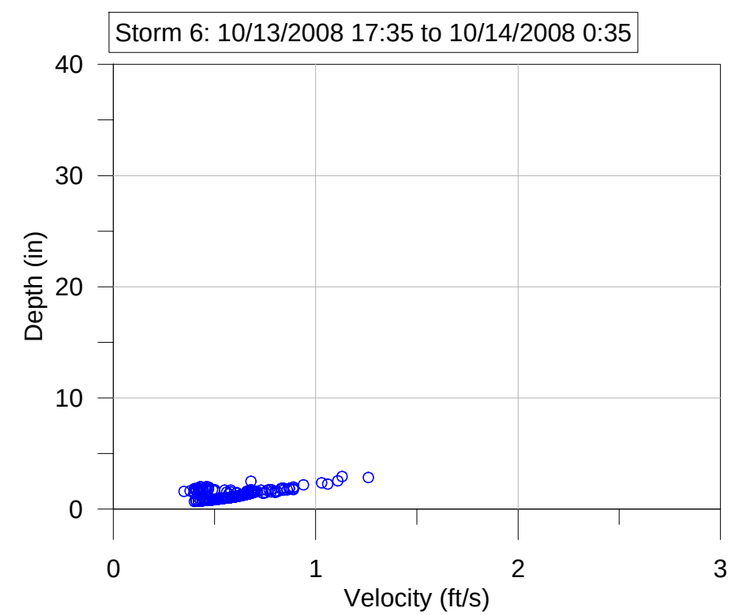




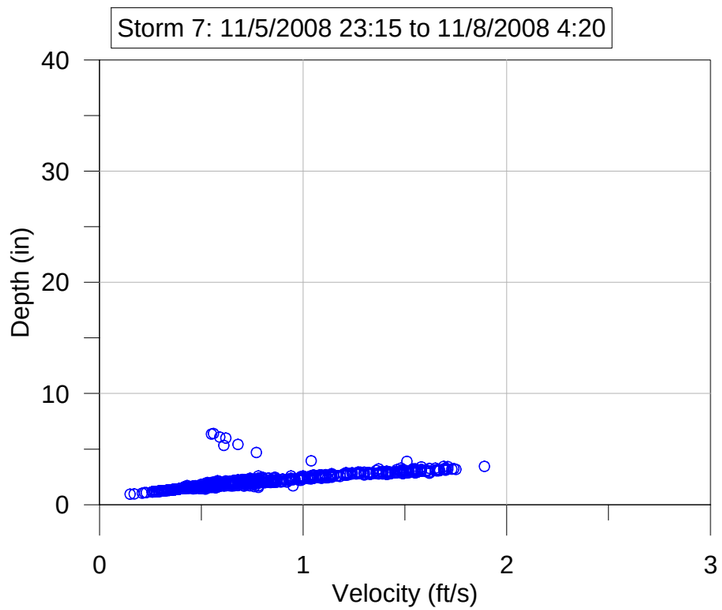


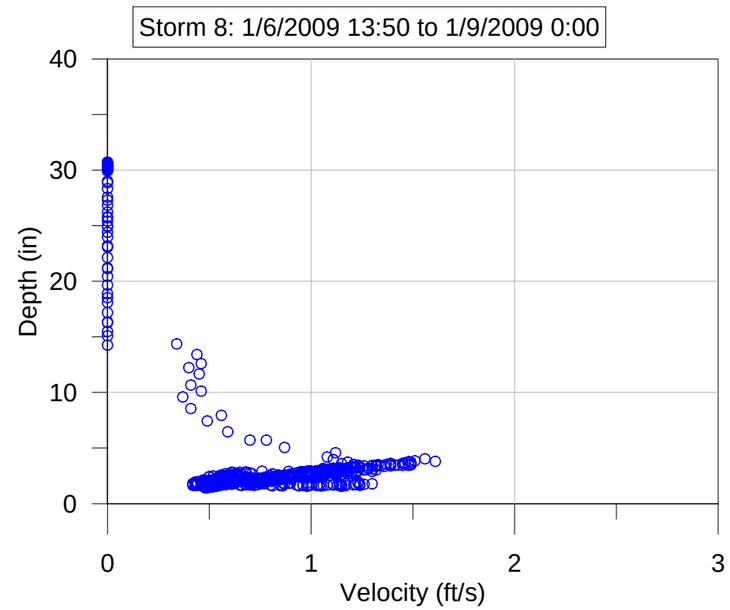


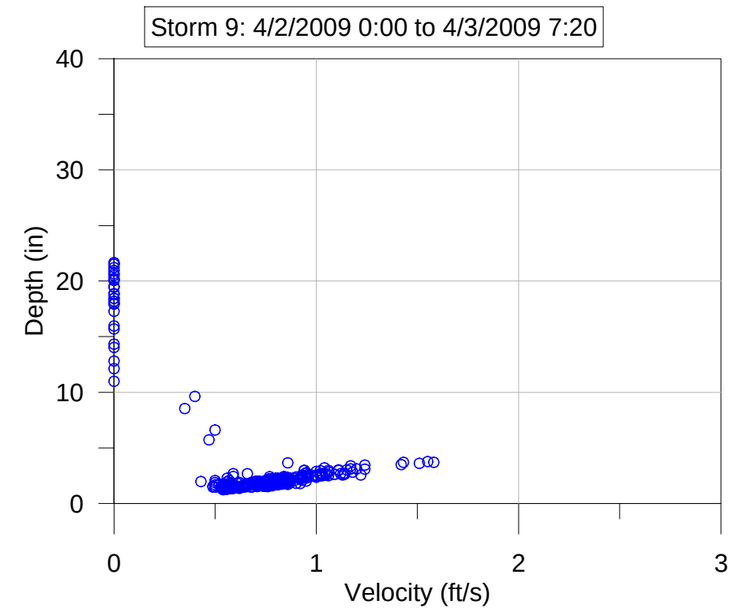


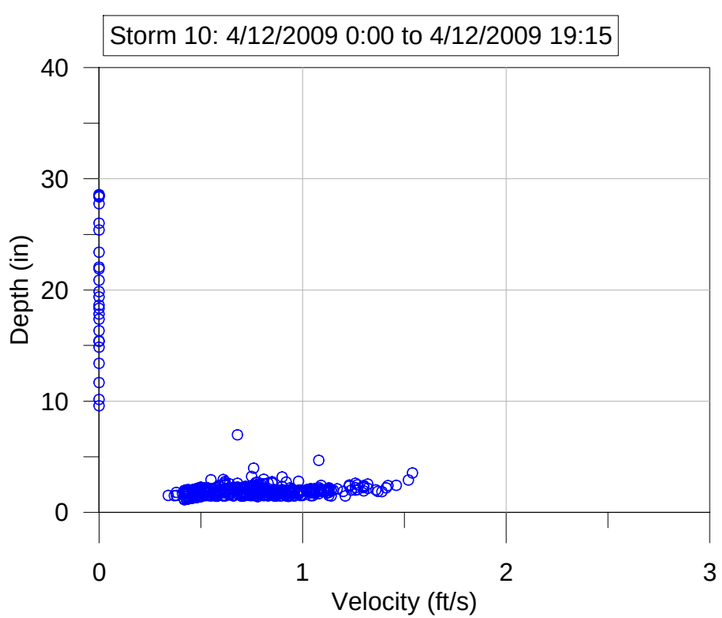


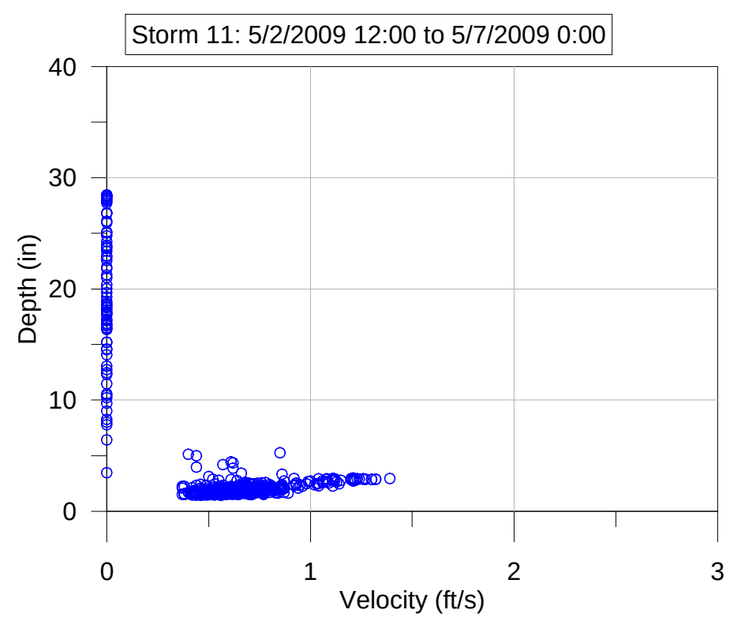
Calibration Storms - Scattergraphs
Monitor 081-062 (46)

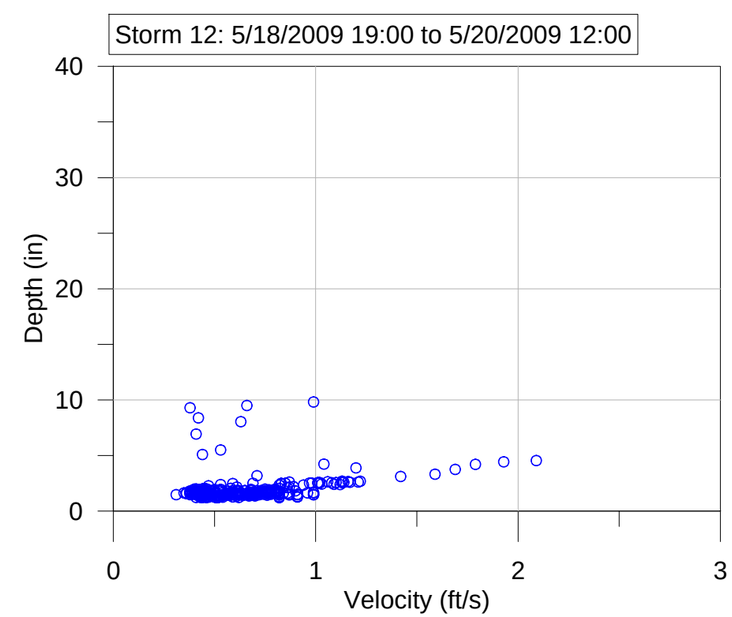




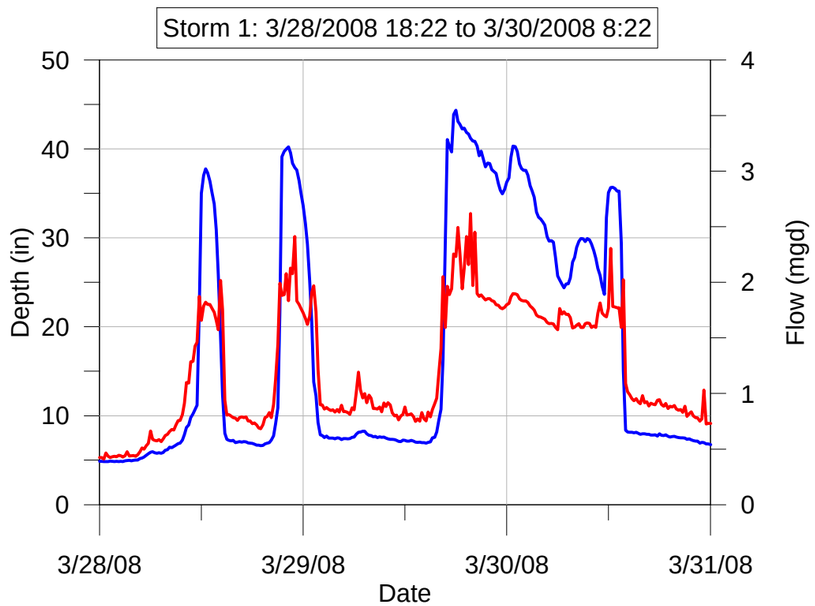


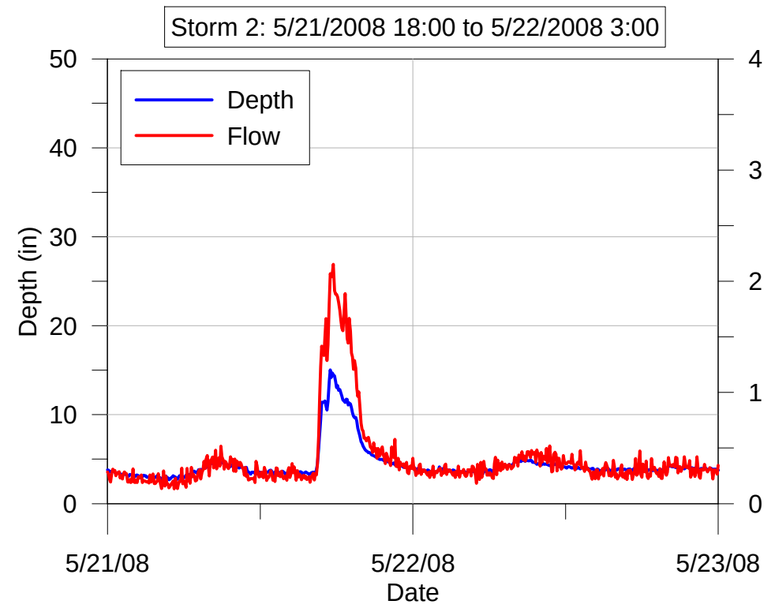


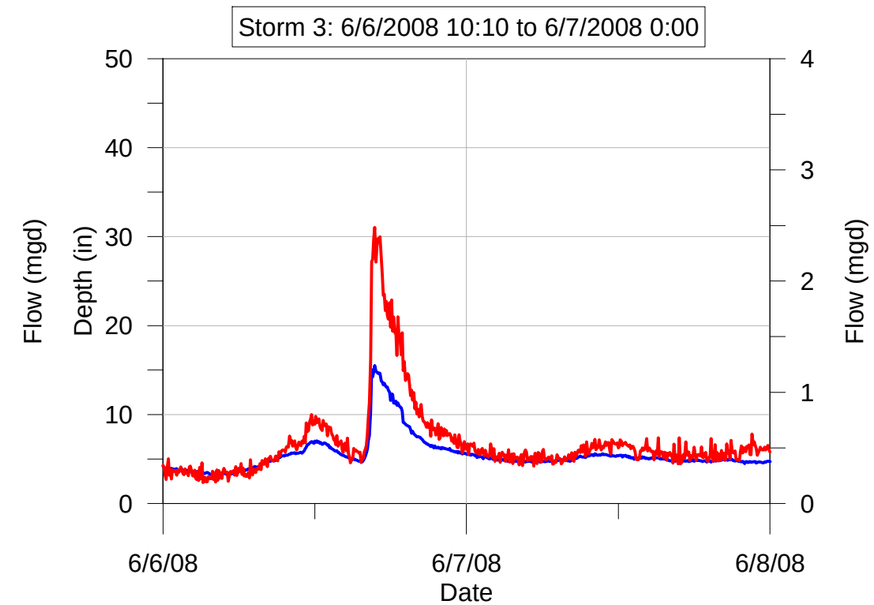


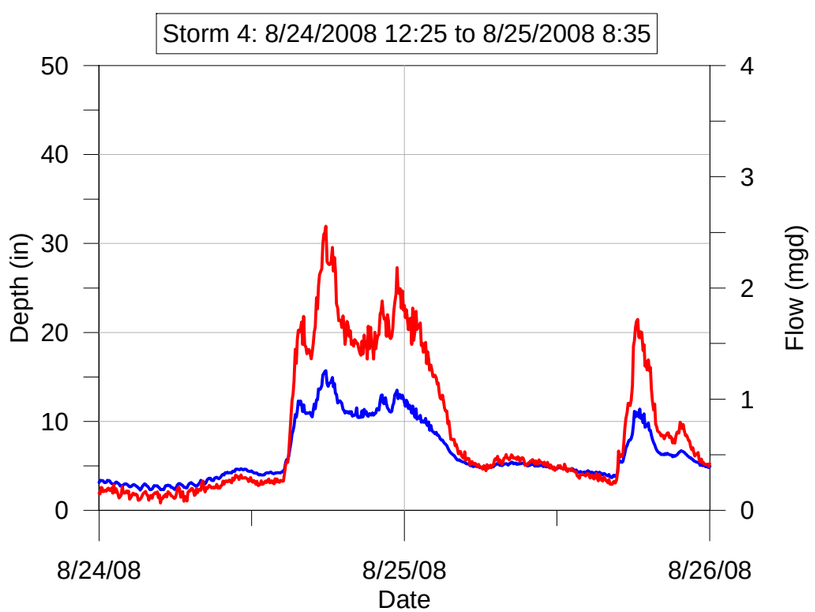


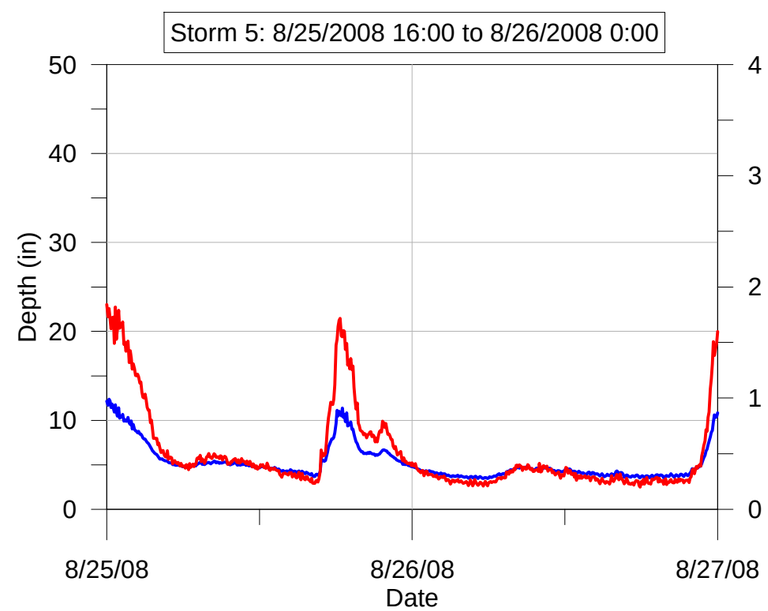
Calibration Storms
Monitor 081-059

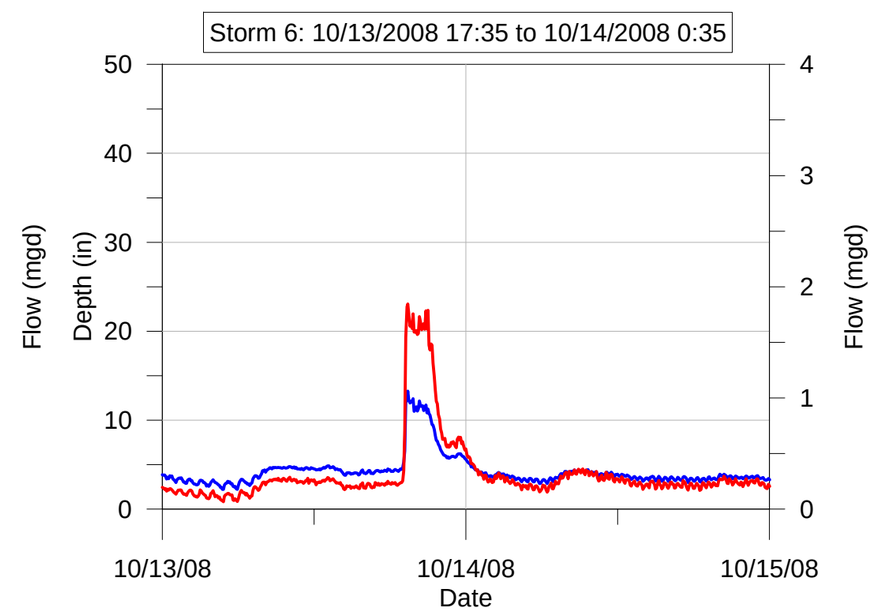




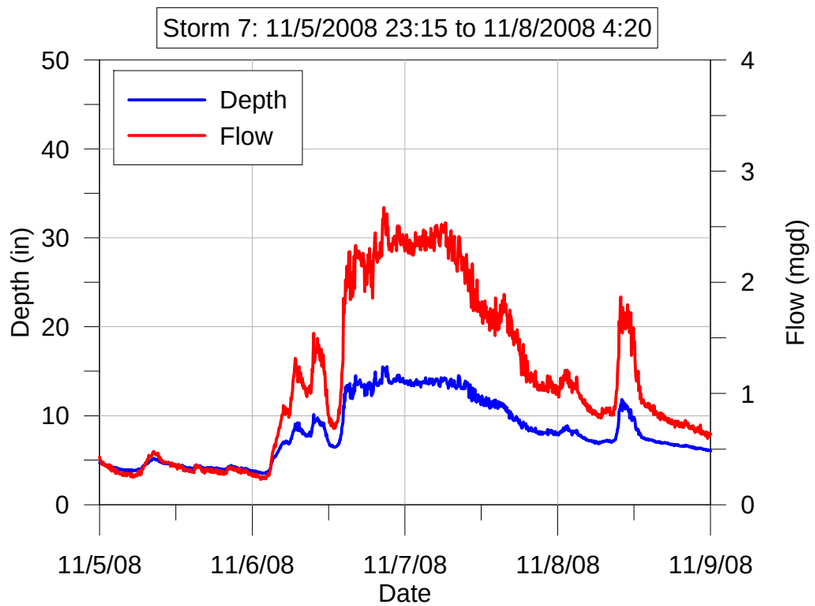


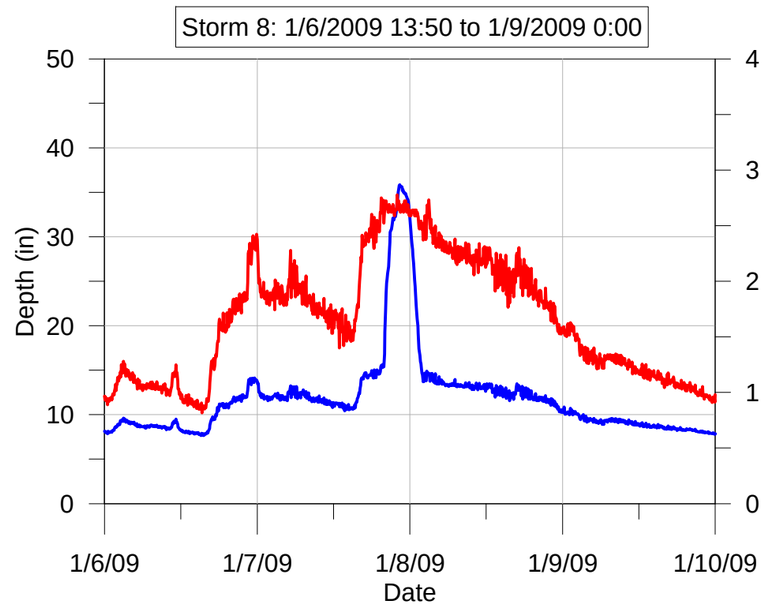


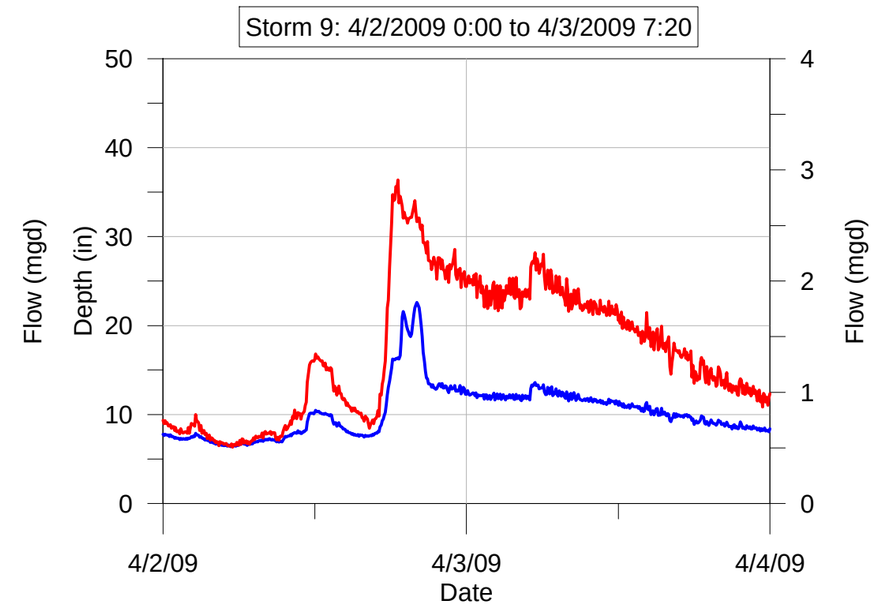


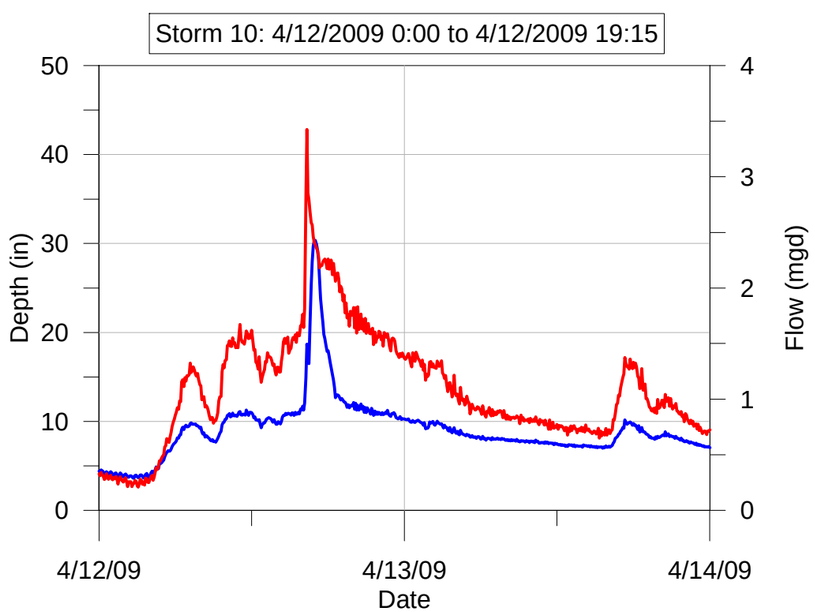


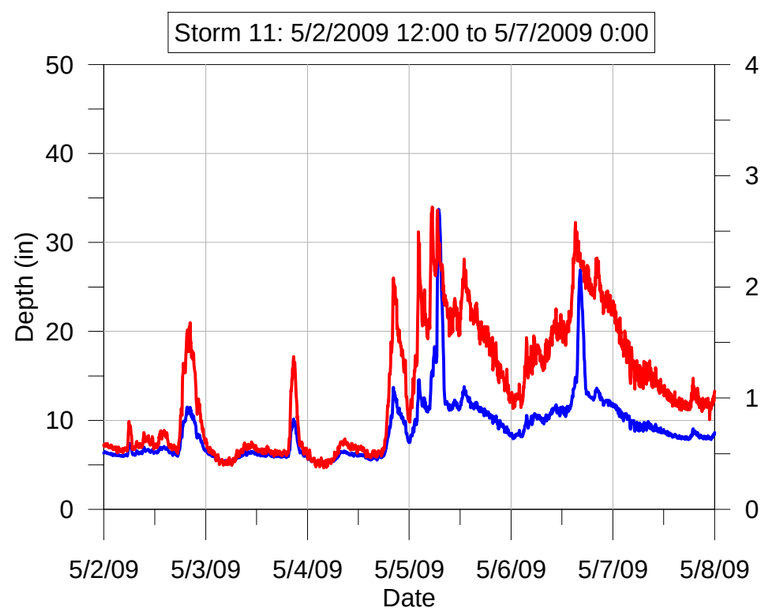
Calibration Storms
Monitor 081-059

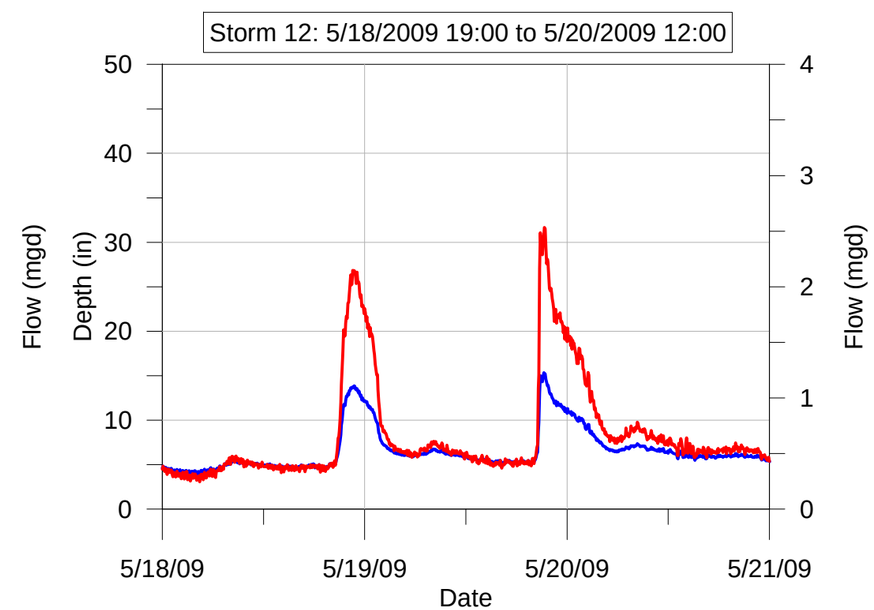




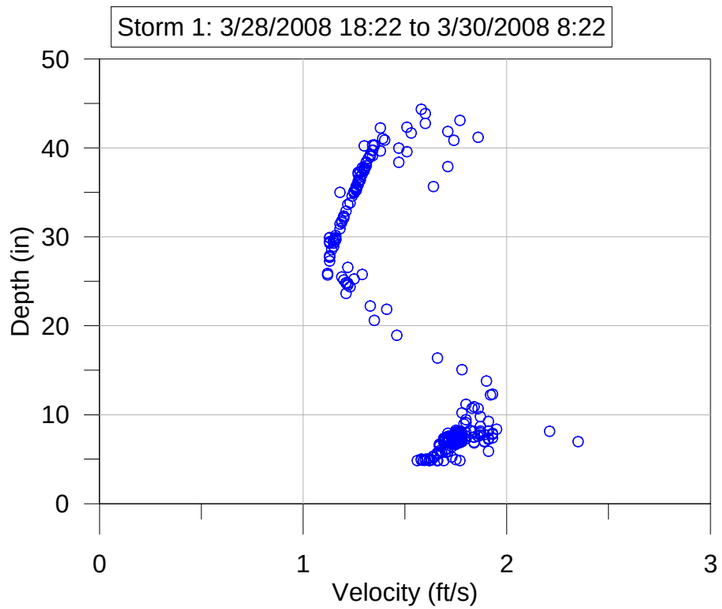


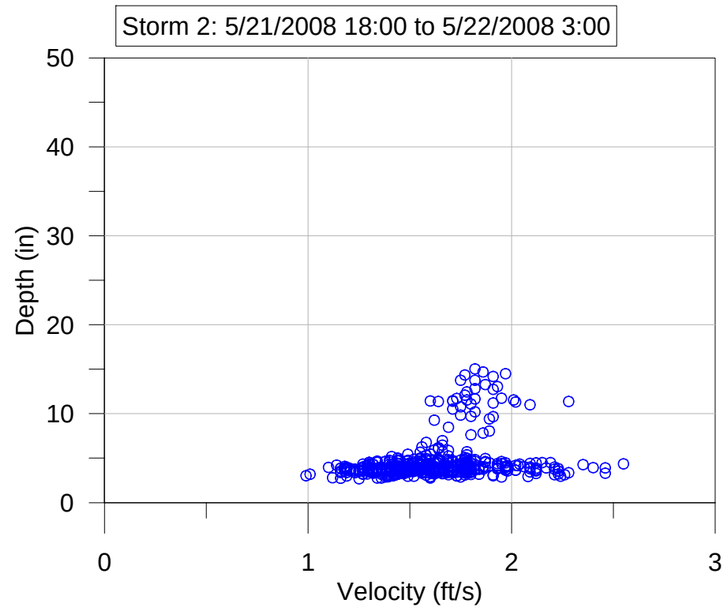


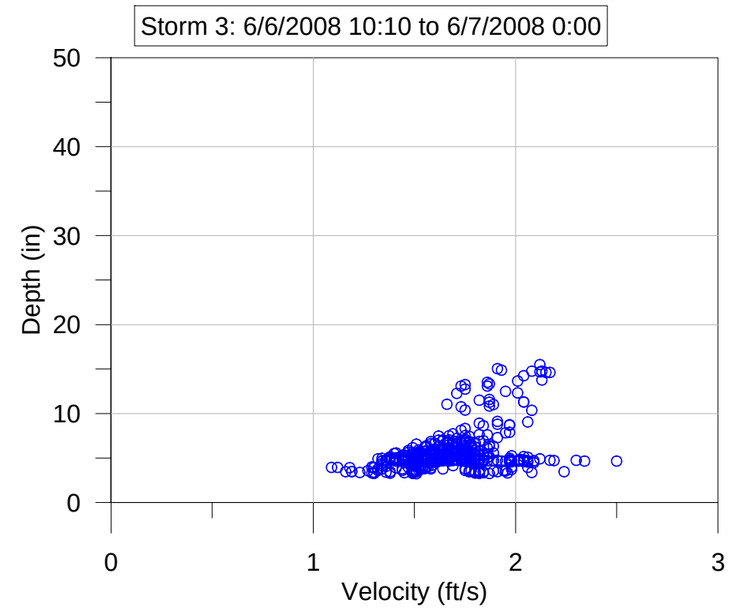


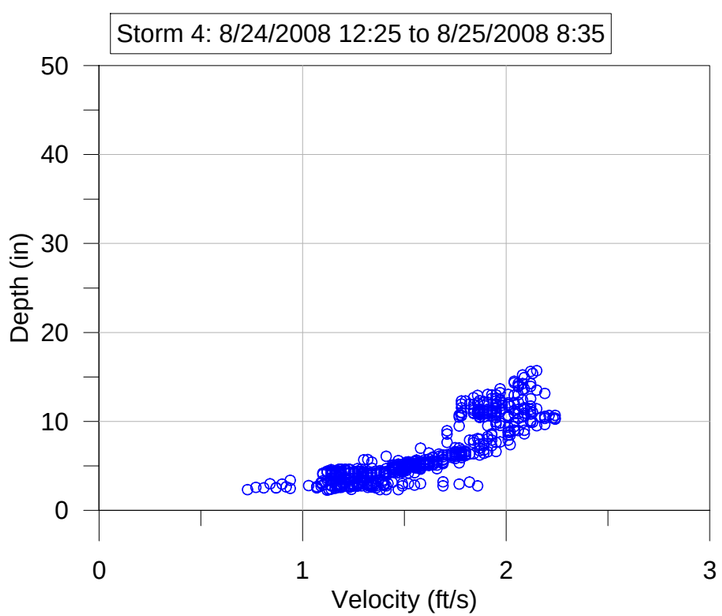


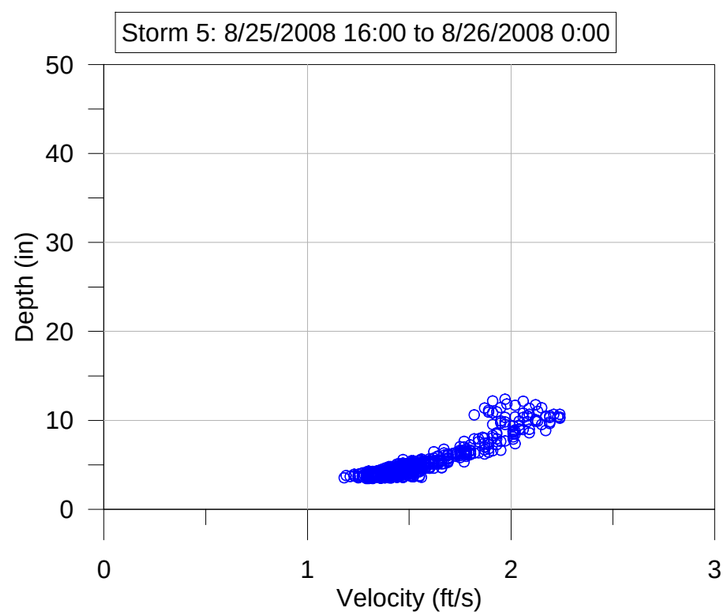
Calibration Storms - Scattergraphs
Monitor 081-059

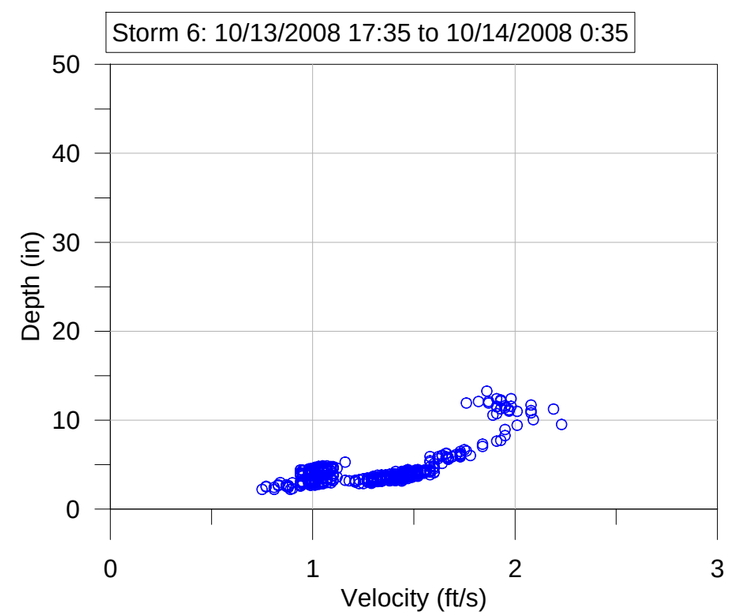




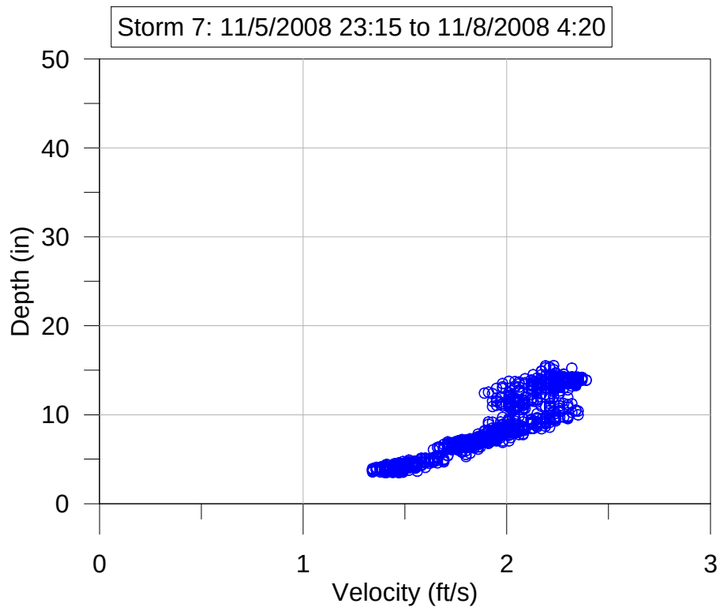


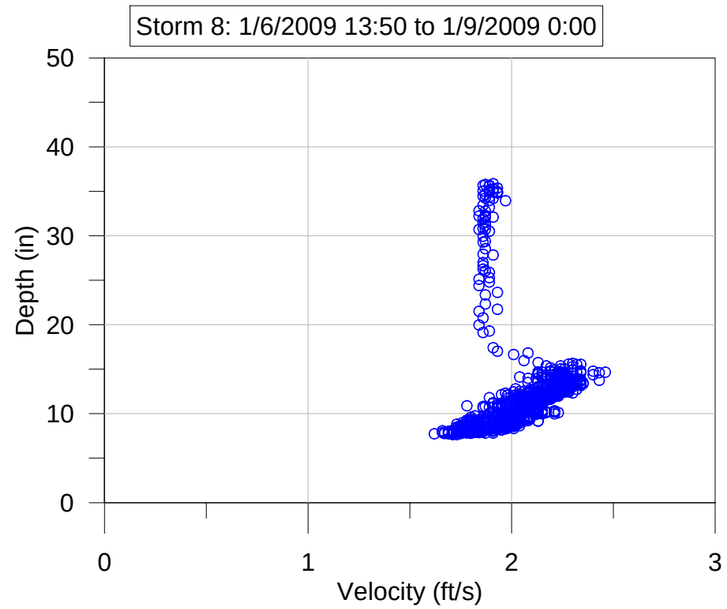


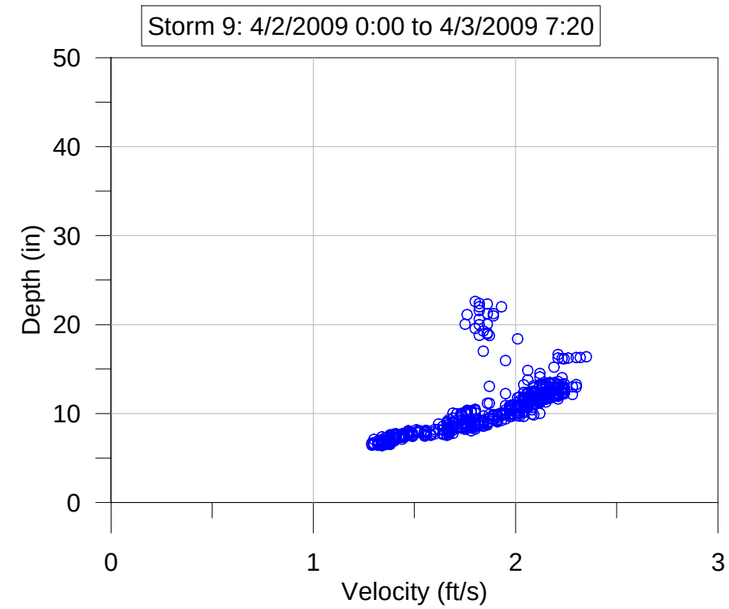


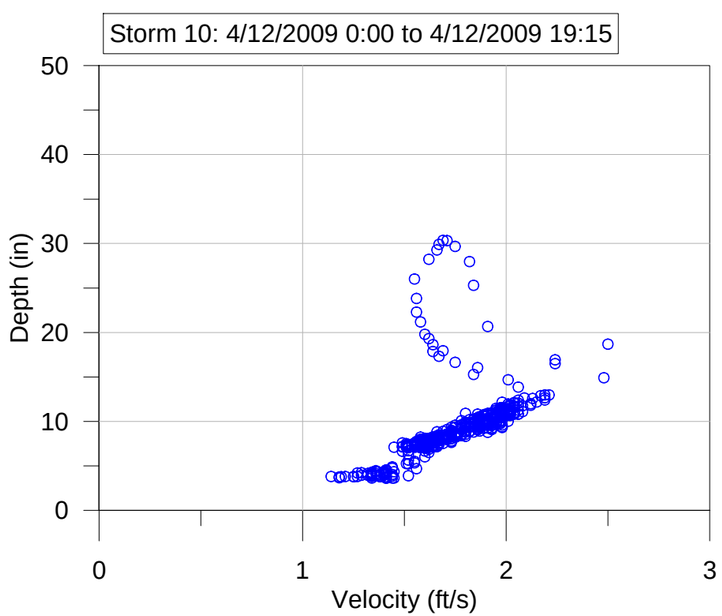


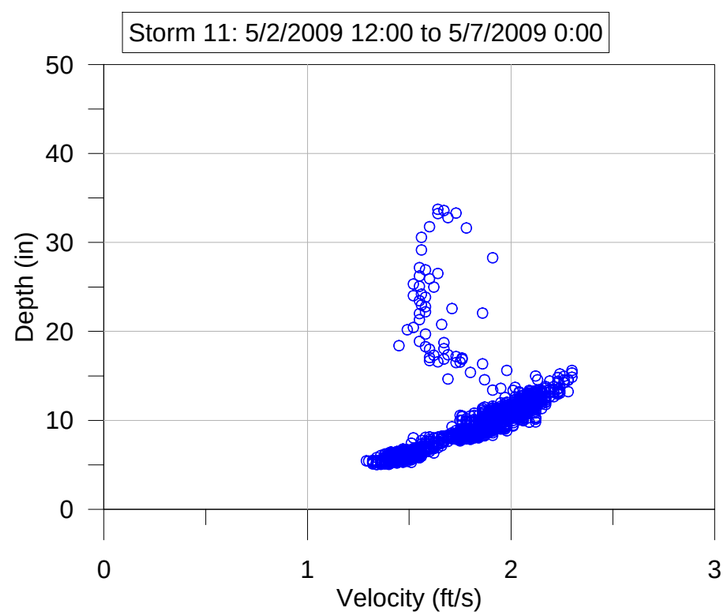
Calibration Storms - Scattergraphs
Monitor 081-059

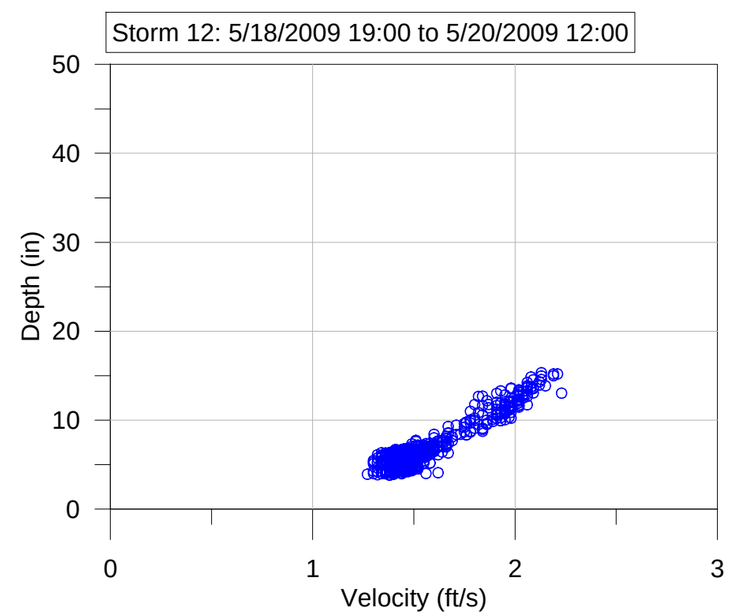




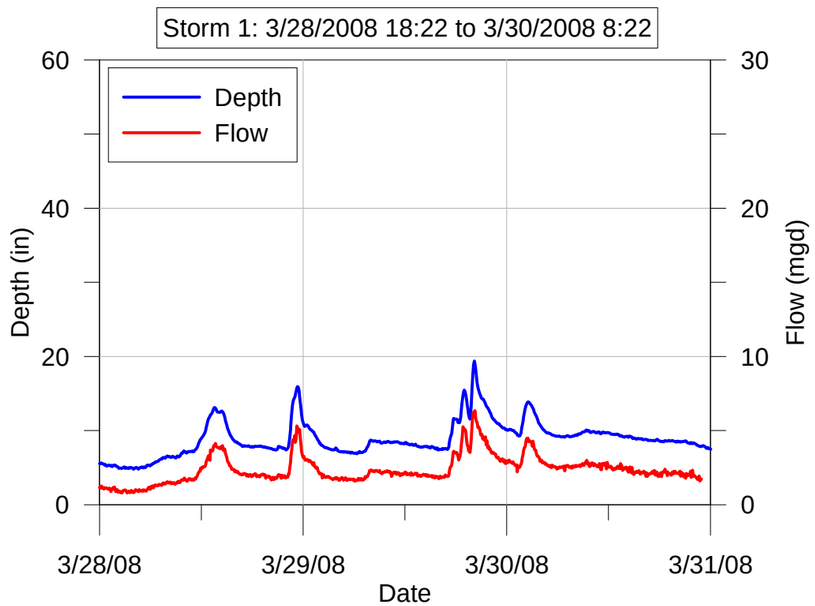


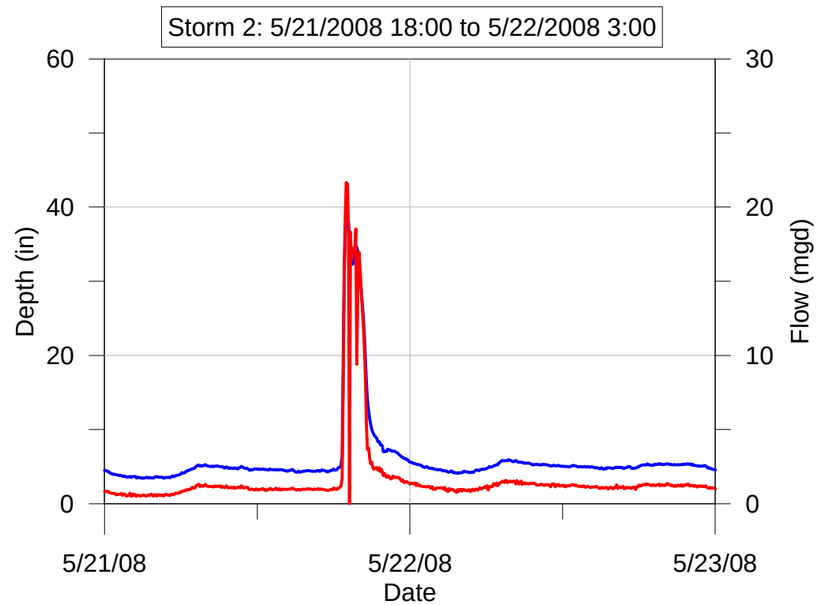


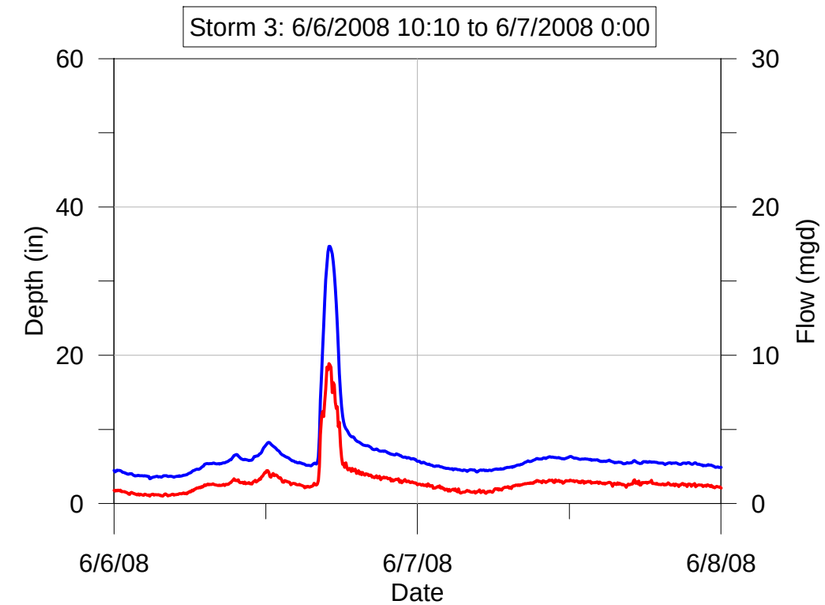


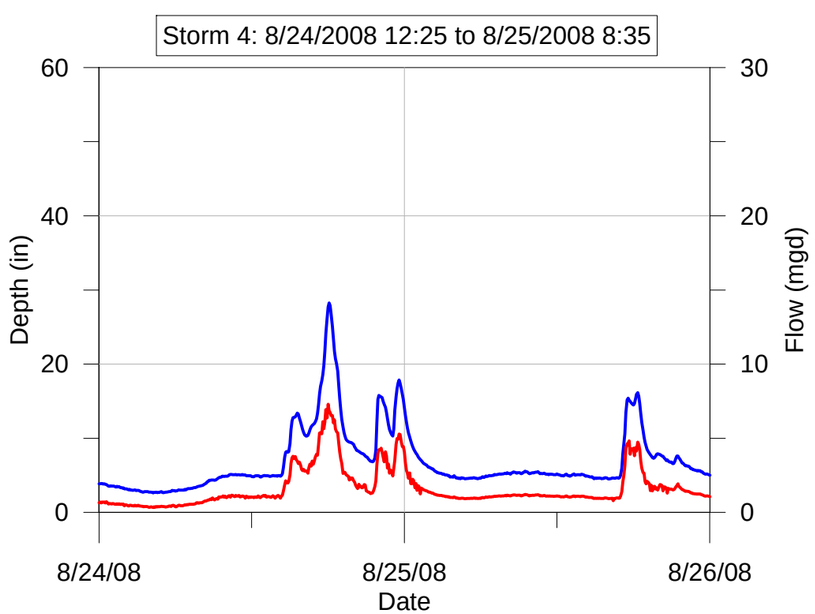


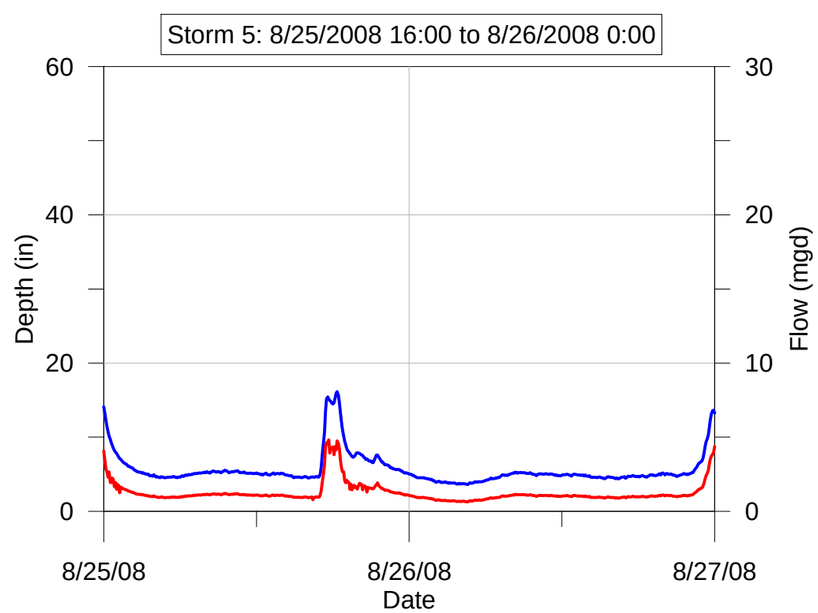
Calibration Storms
Monitor 081-330 (47C)

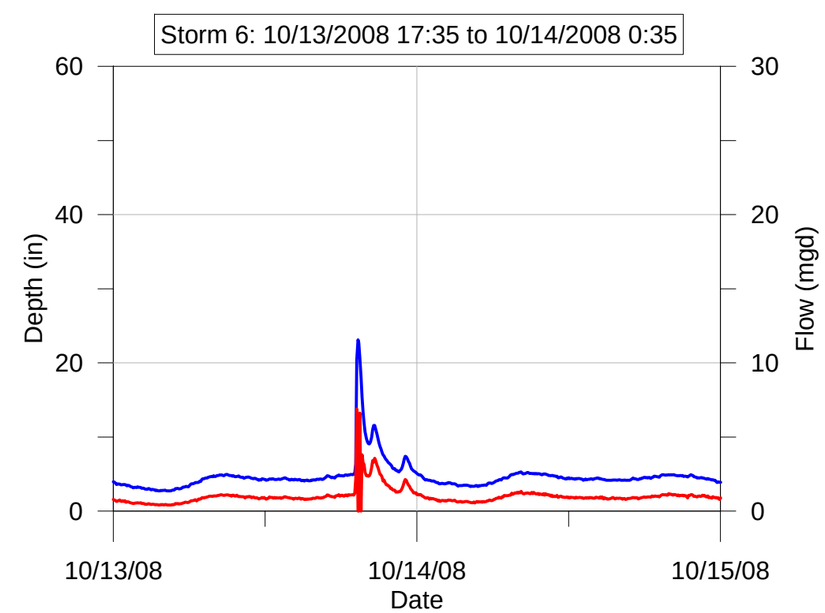




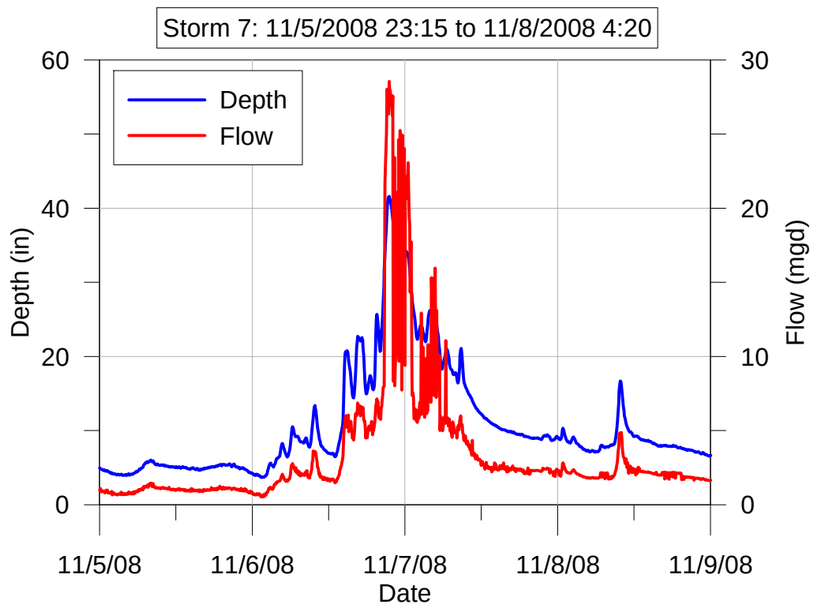


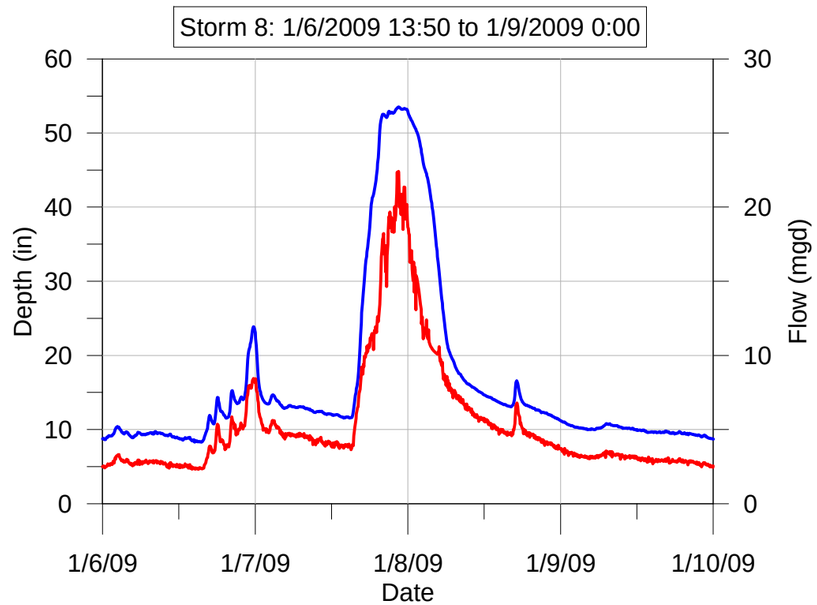


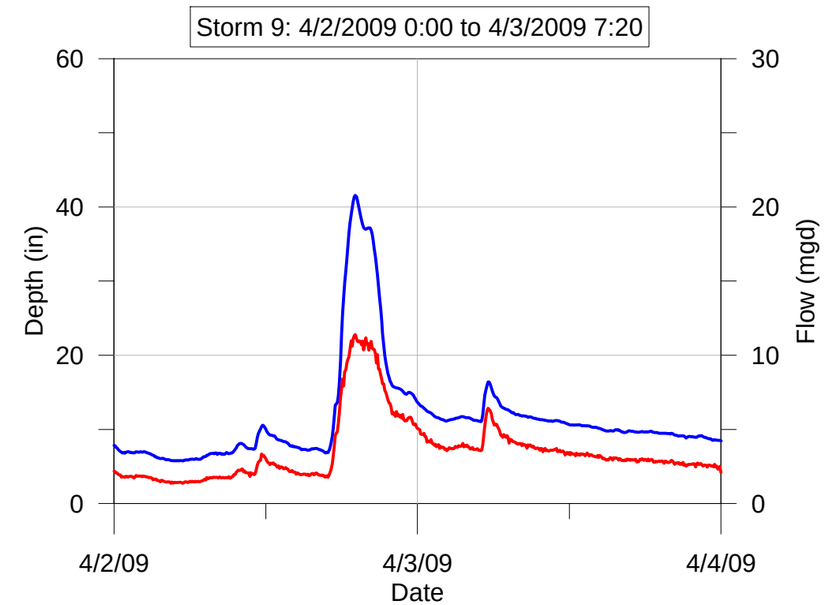


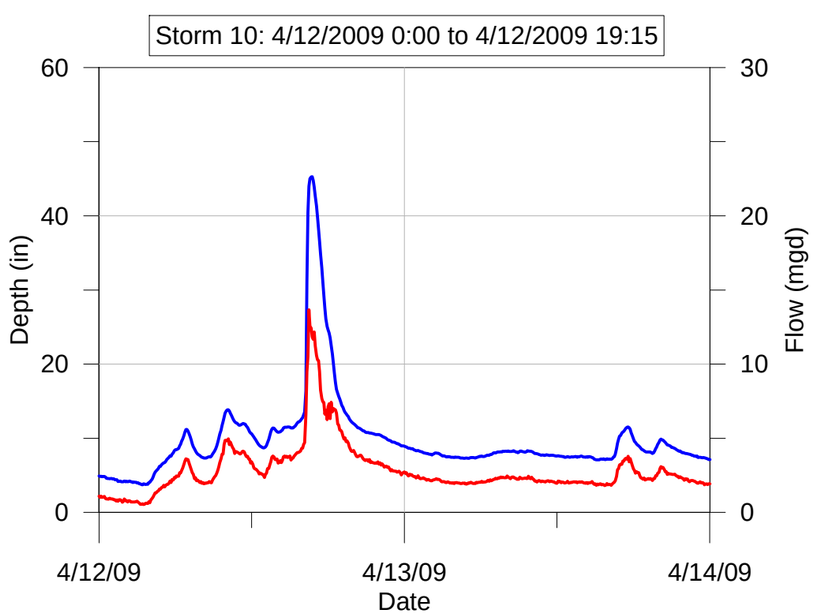


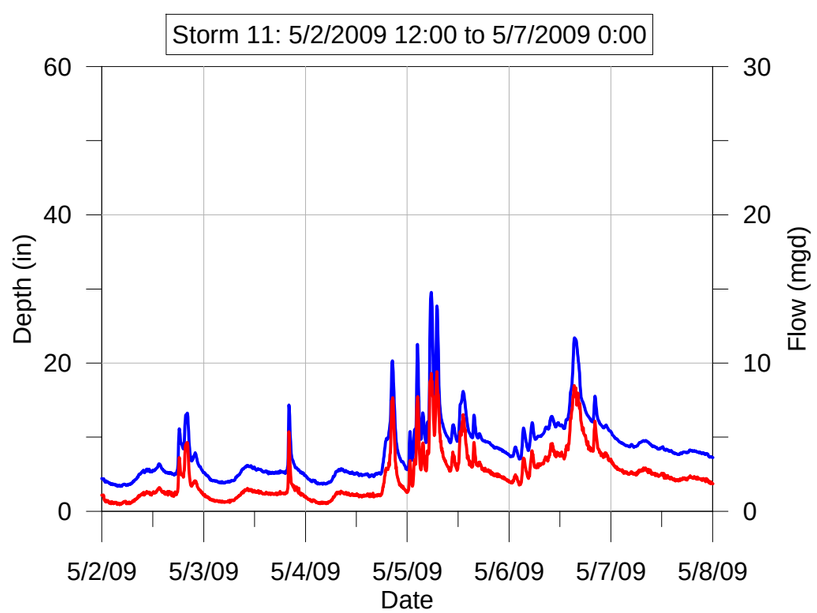
Calibration Storms
Monitor 081-330 (47C)

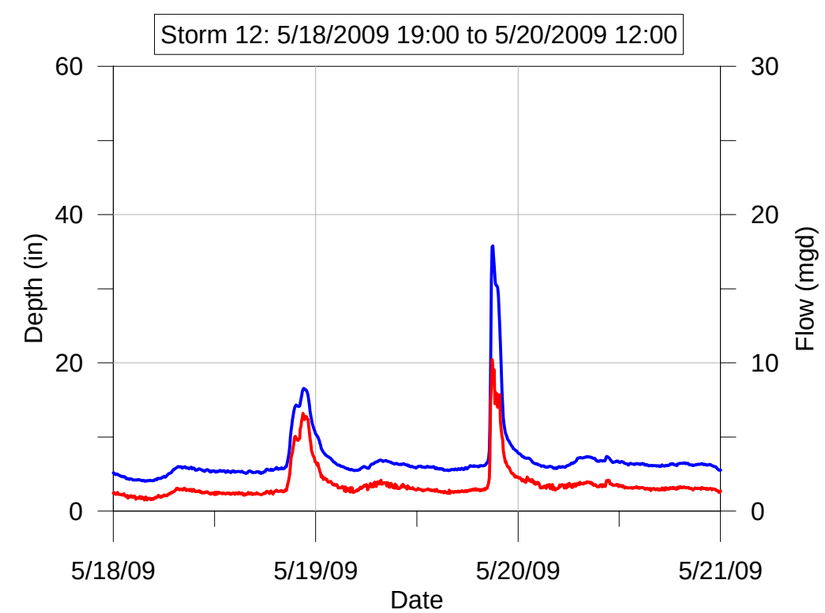




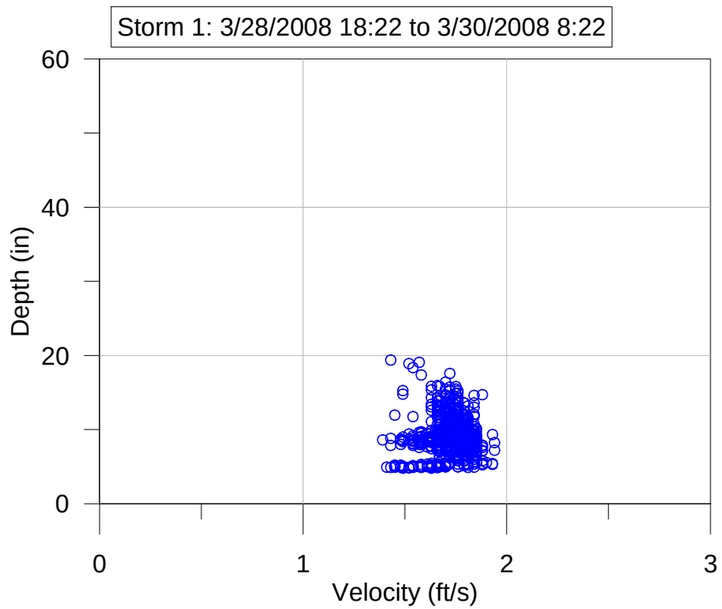


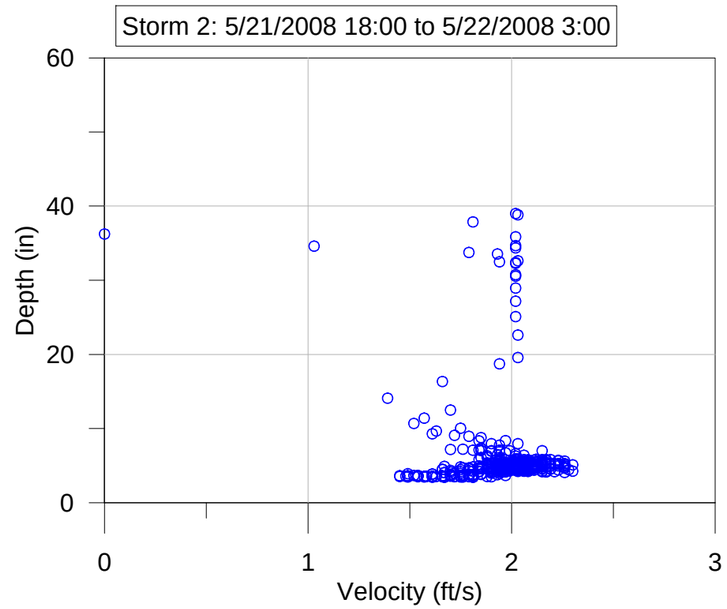


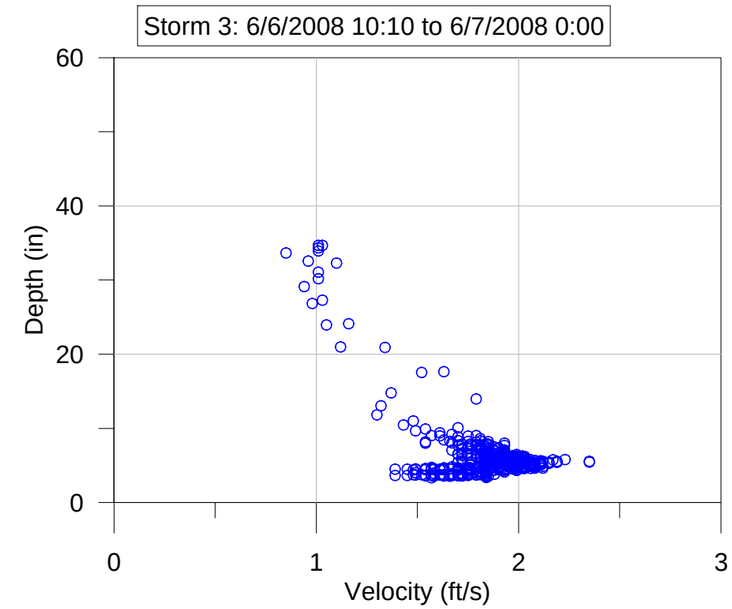


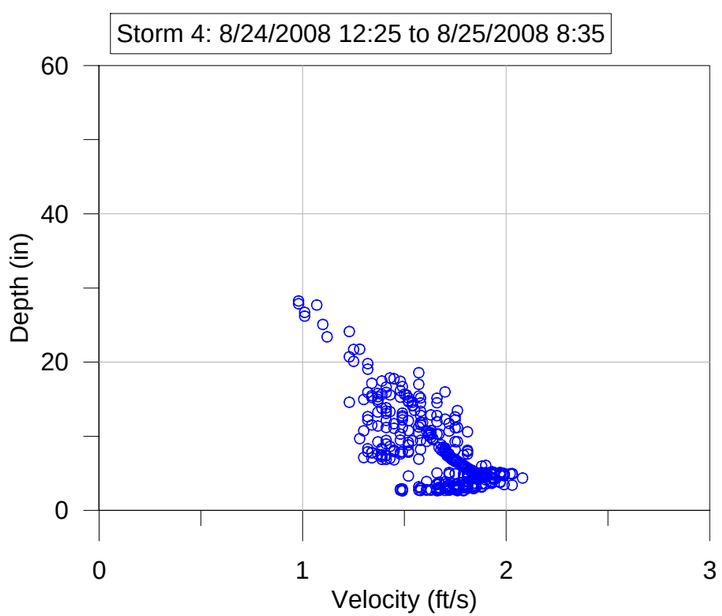


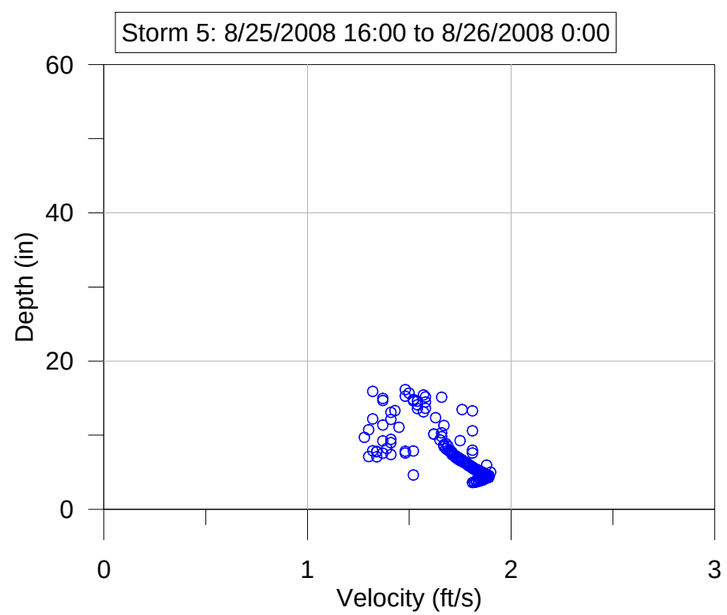
Calibration Storms - Scattergraphs
Monitor 081-330 (47C)

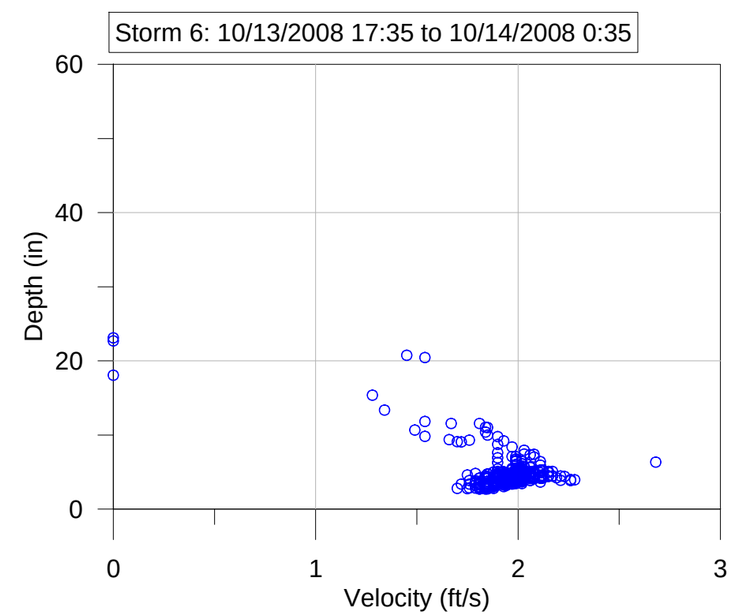




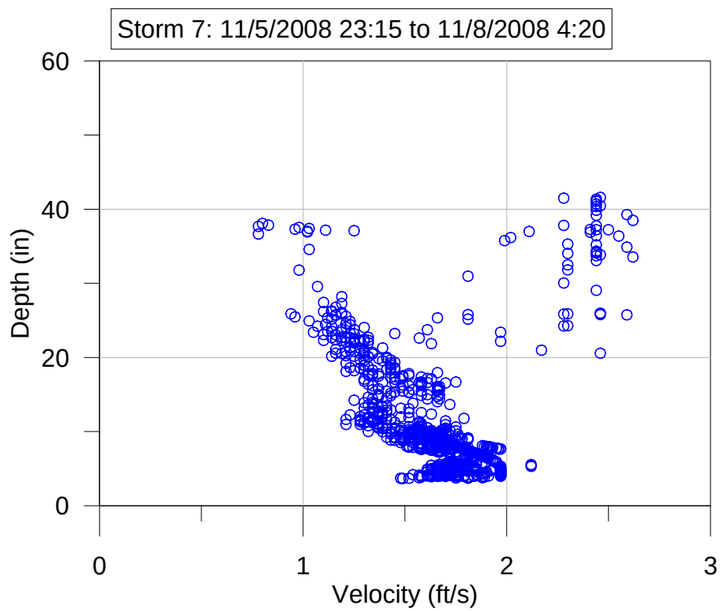


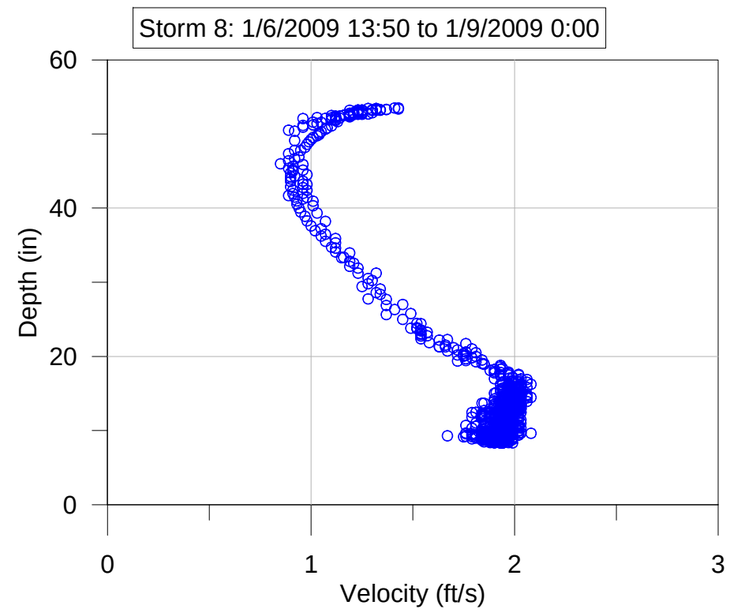


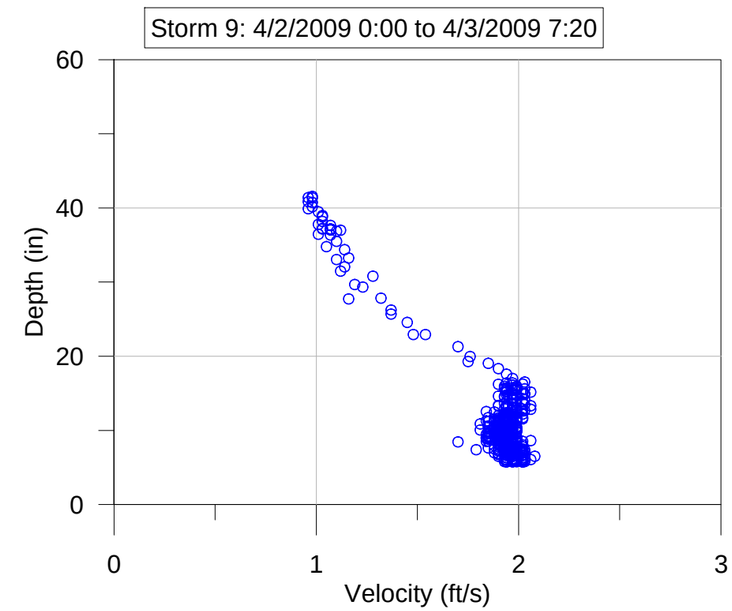


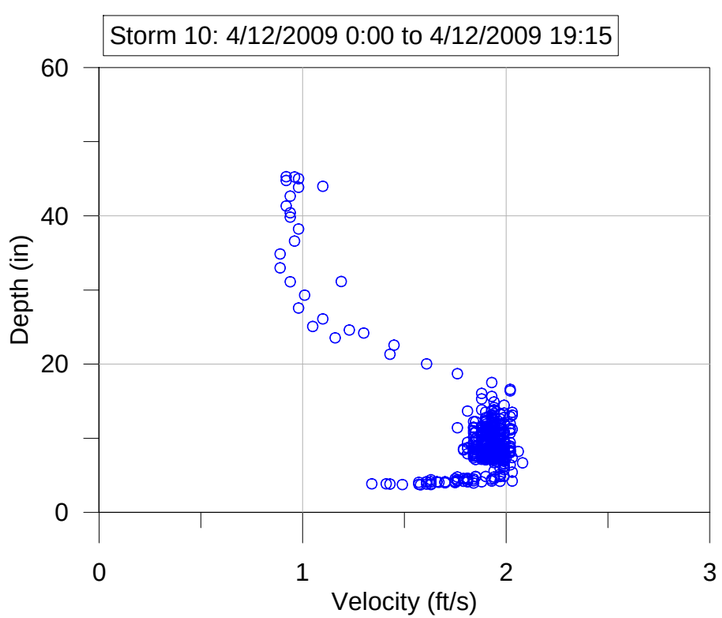


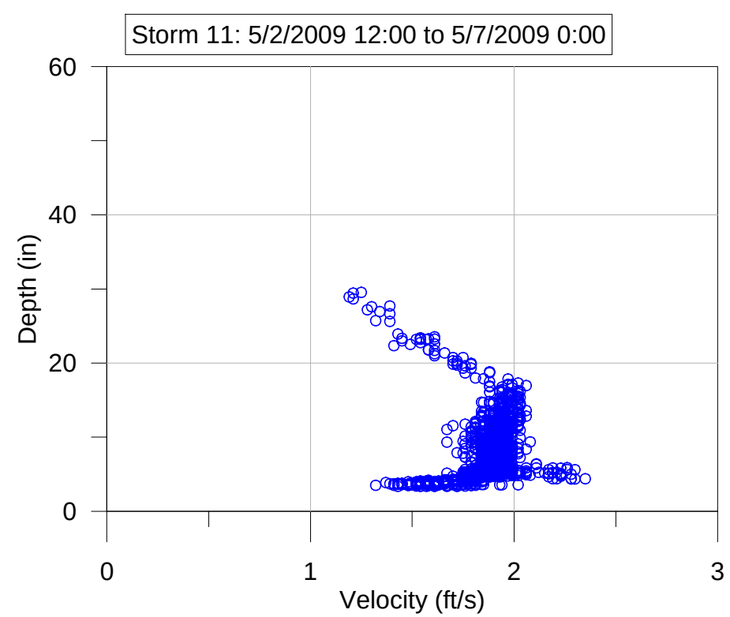
Calibration Storms - Scattergraphs
Monitor 081-330 (47C)

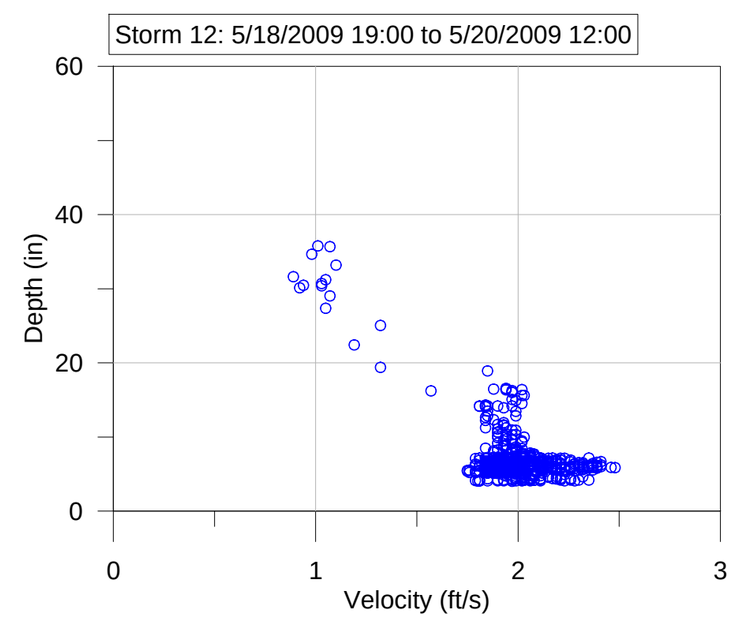




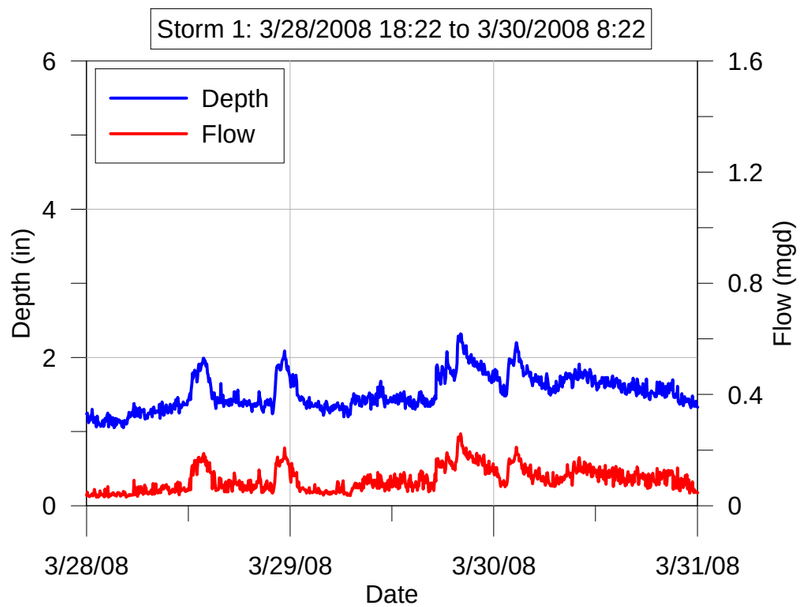


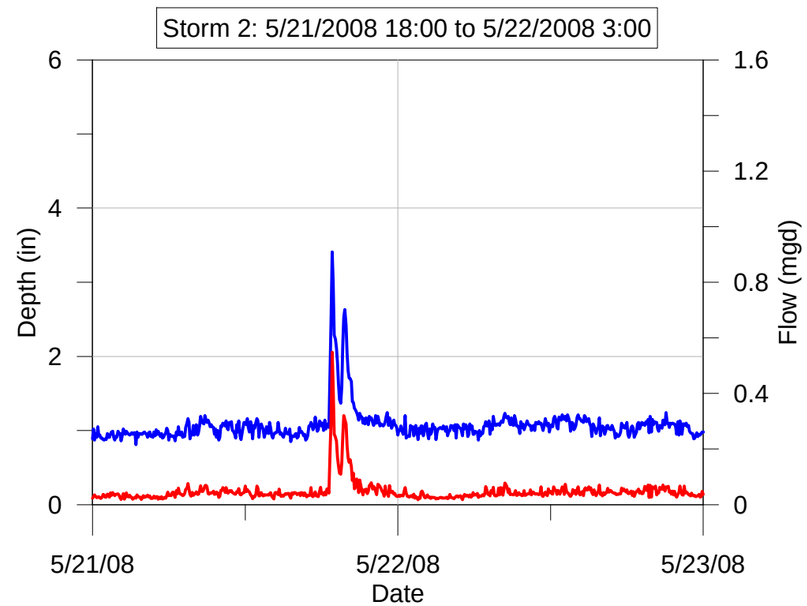


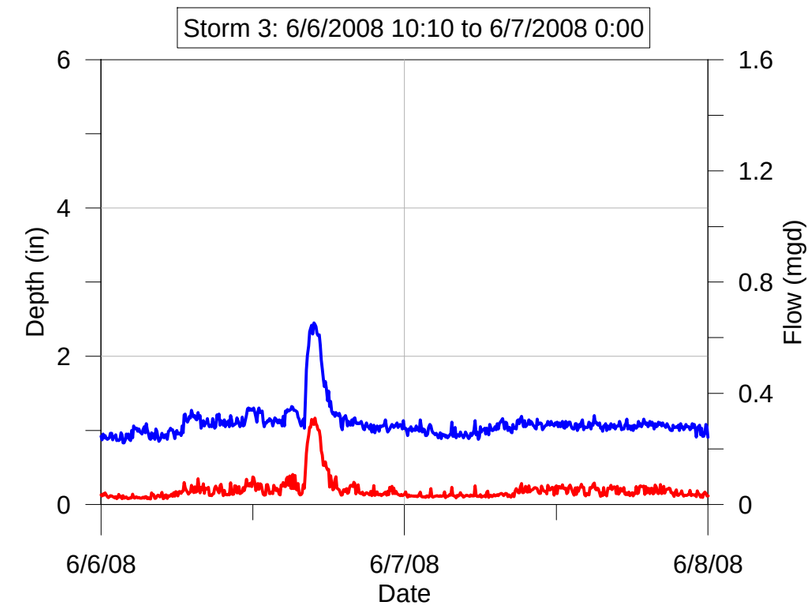


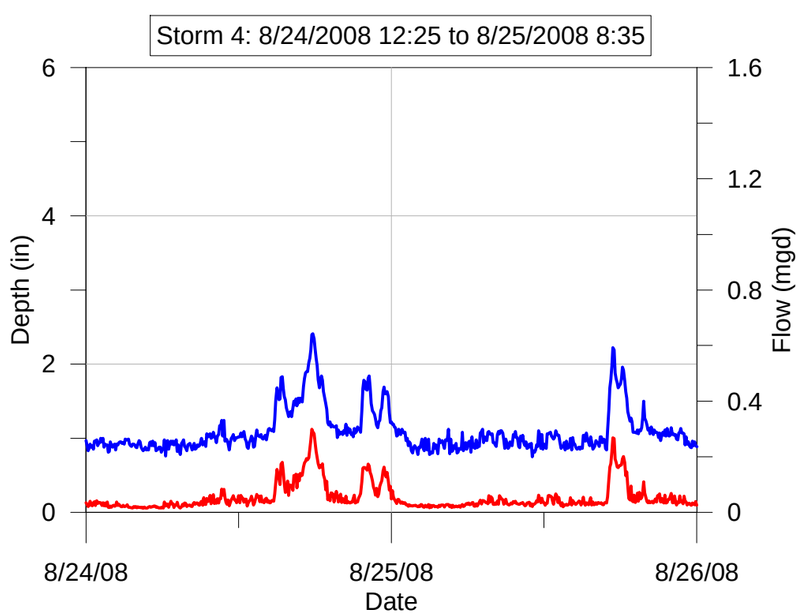


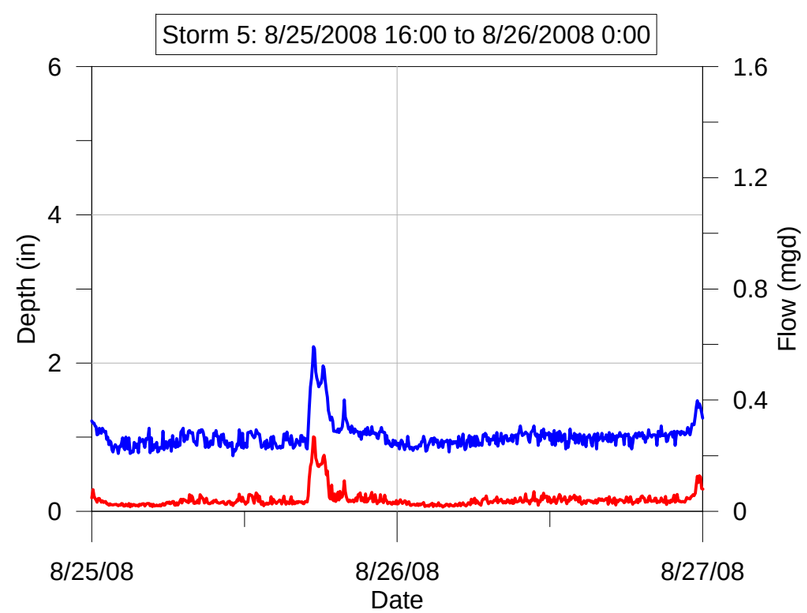
Calibration Storms - Hydrographs
Monitor 081-298 (47D)

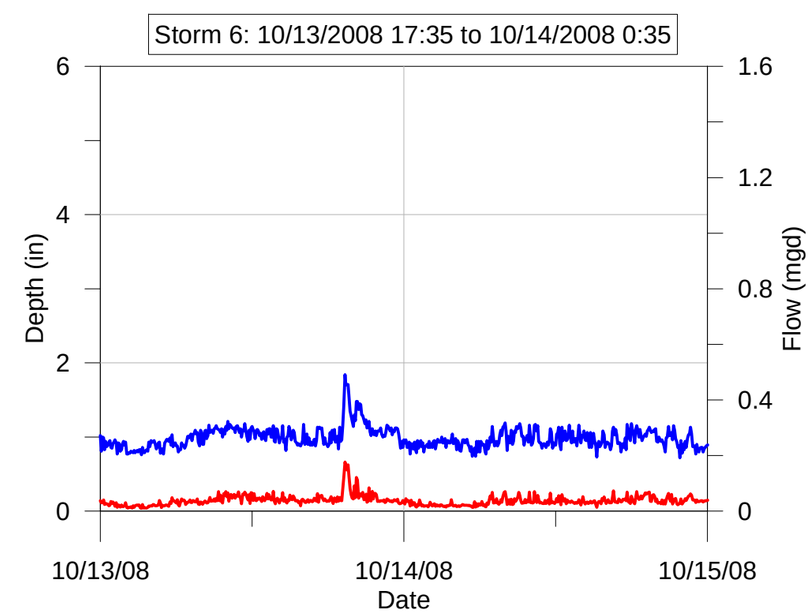




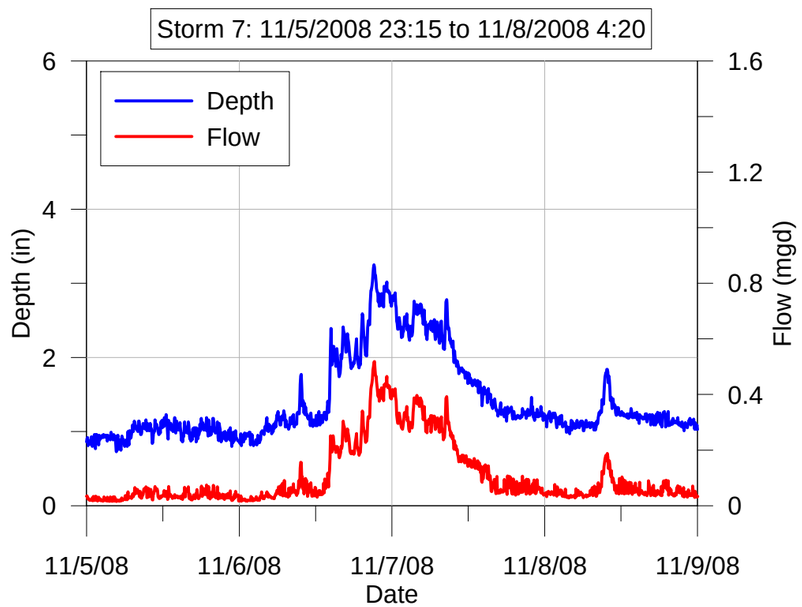


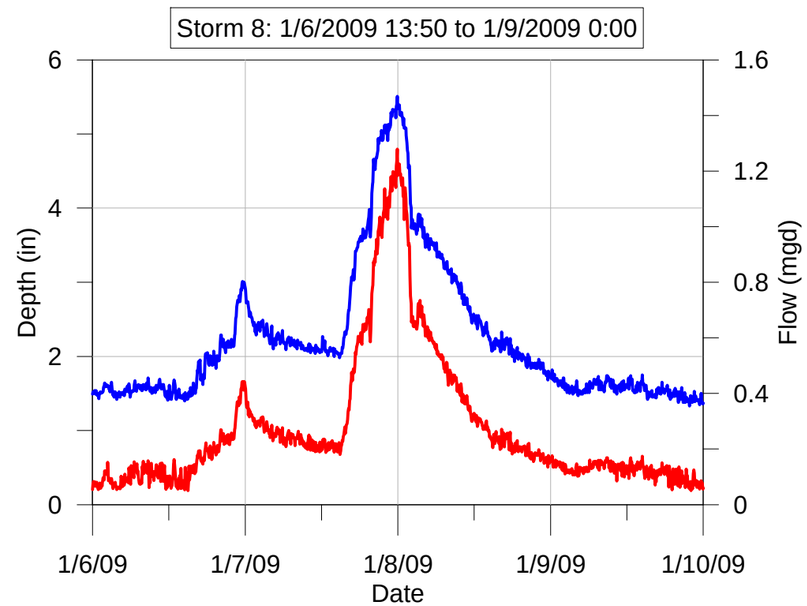


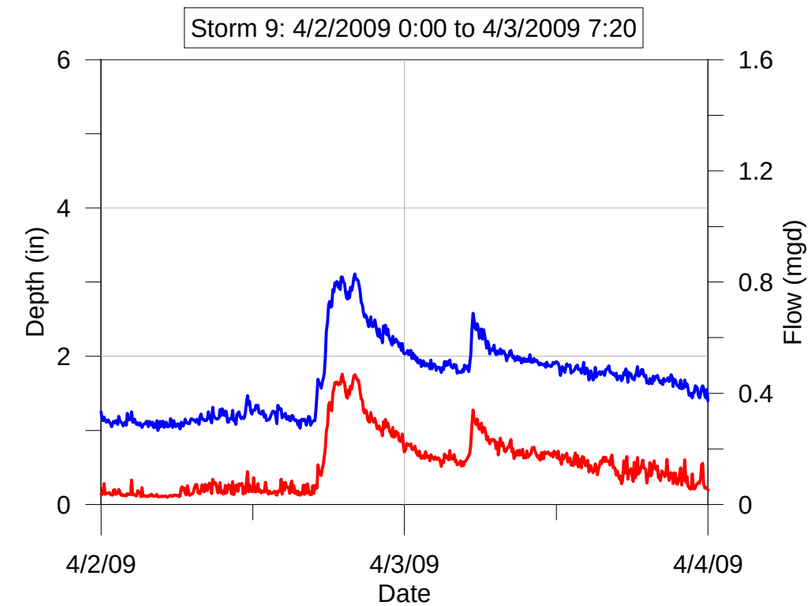


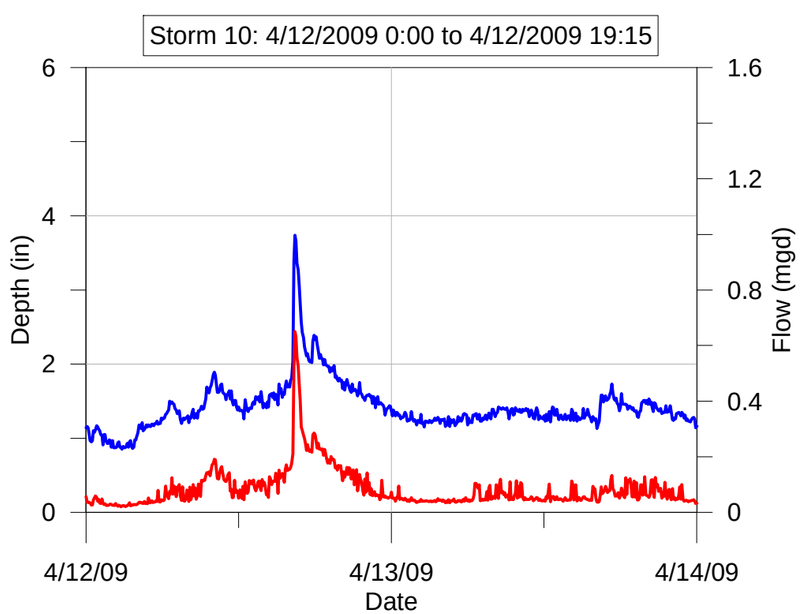


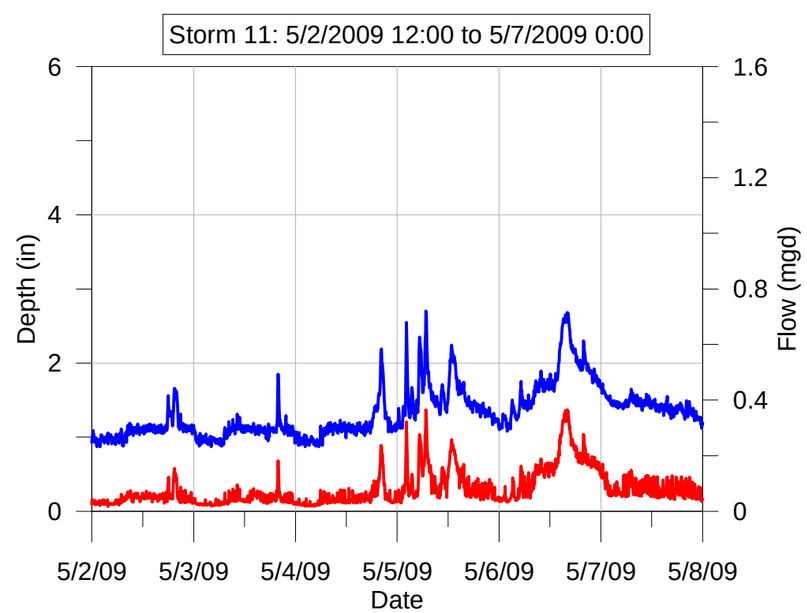
Calibration Storms - Hydrographs
Monitor 081-298 (47D)

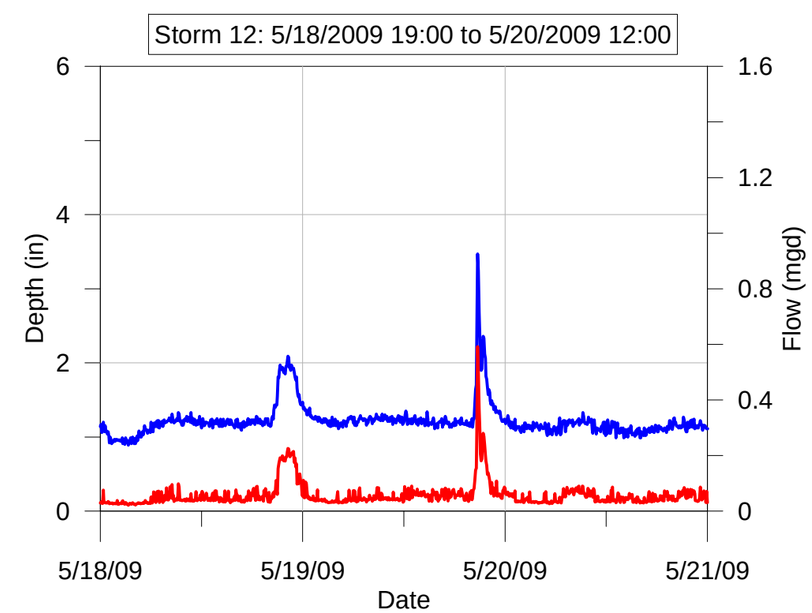




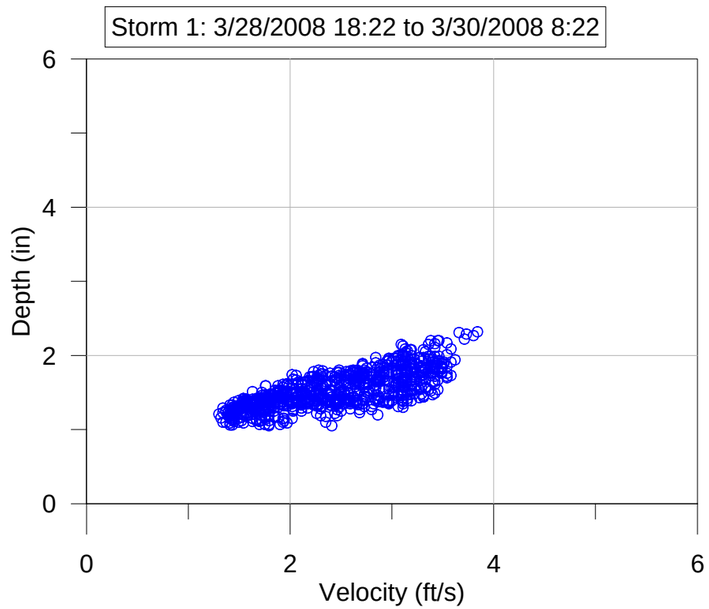


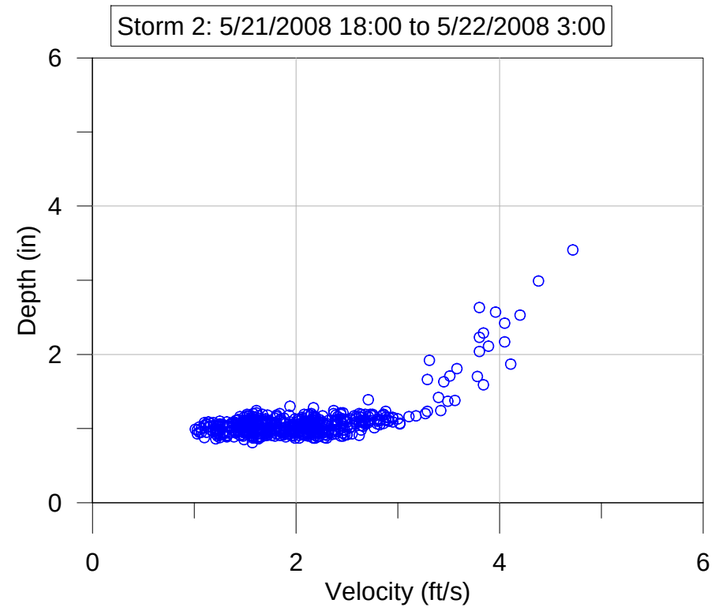


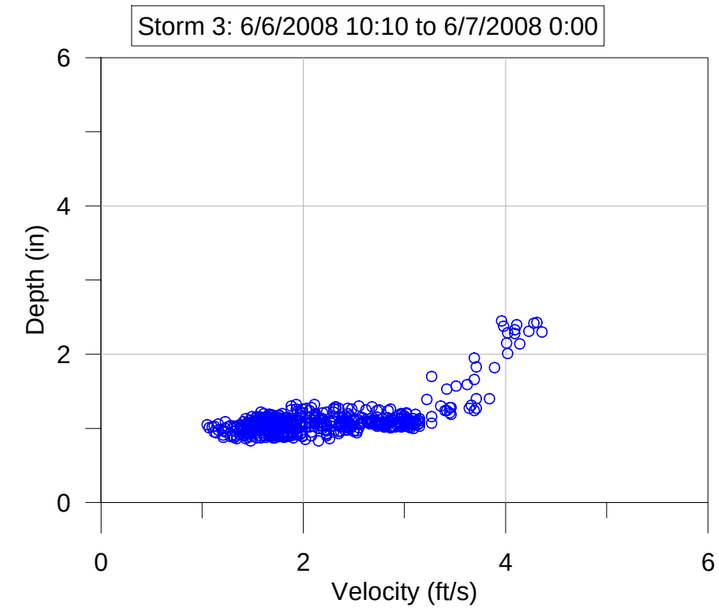


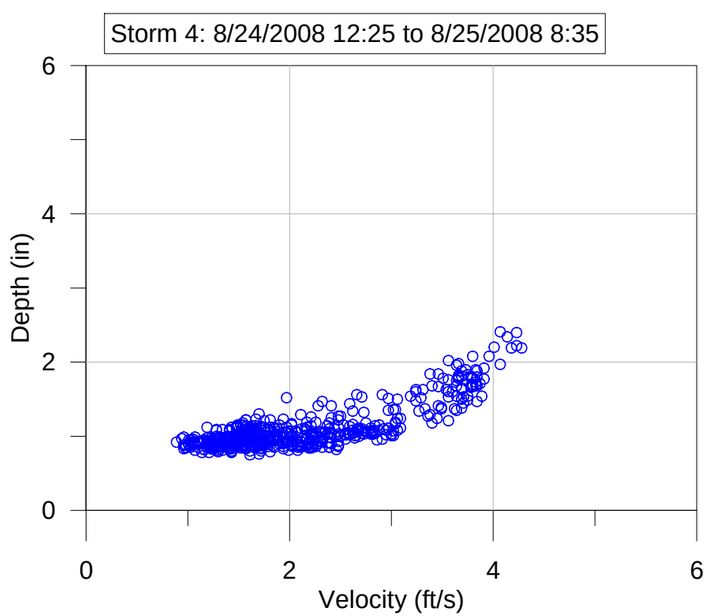


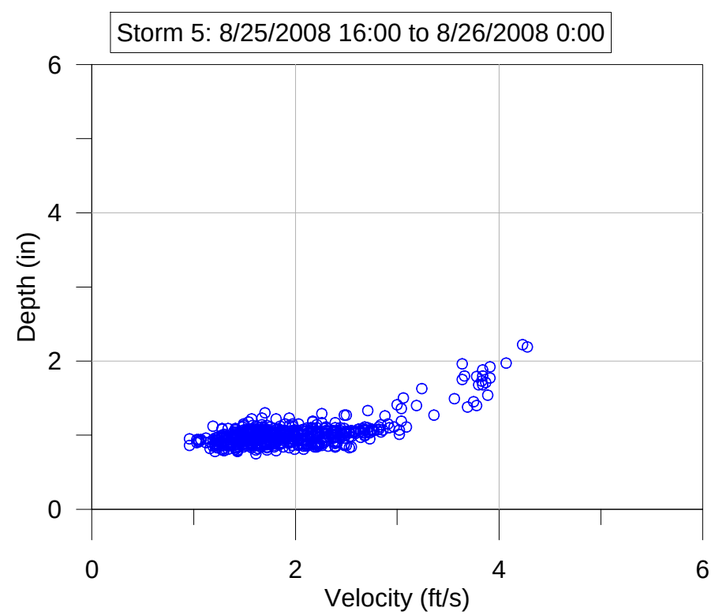
Calibration Storms - Scattergraphs
Monitor 080-298 (47D)

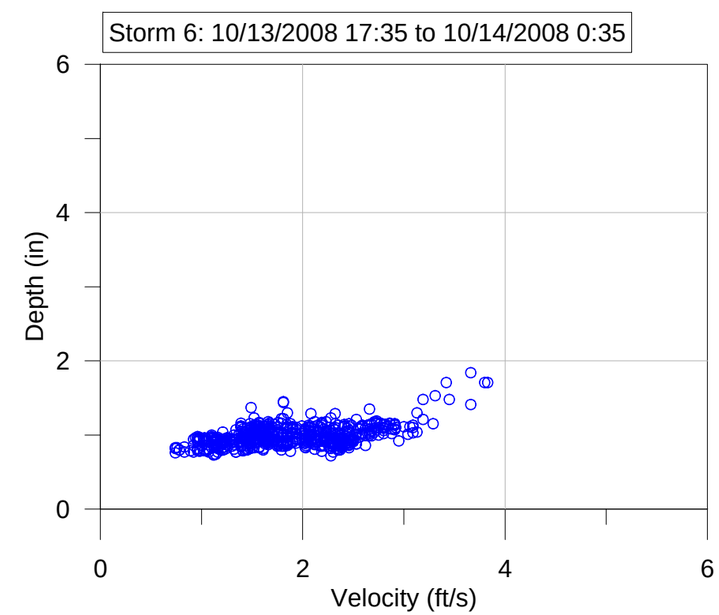




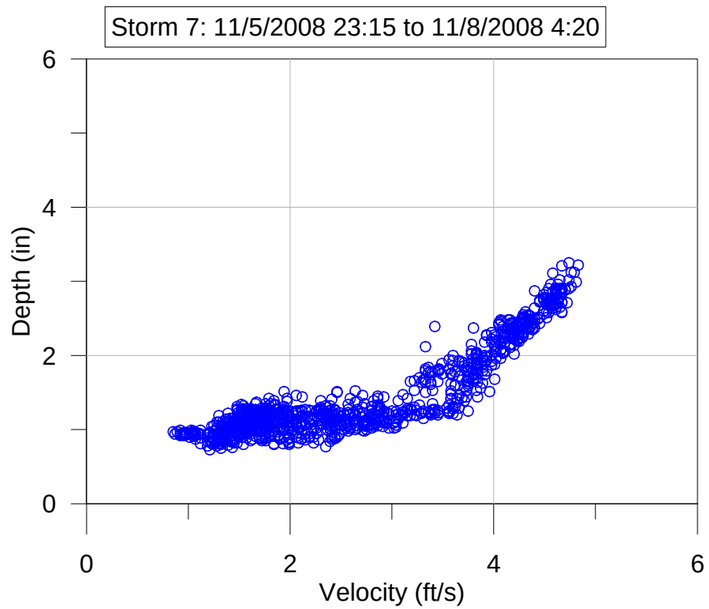


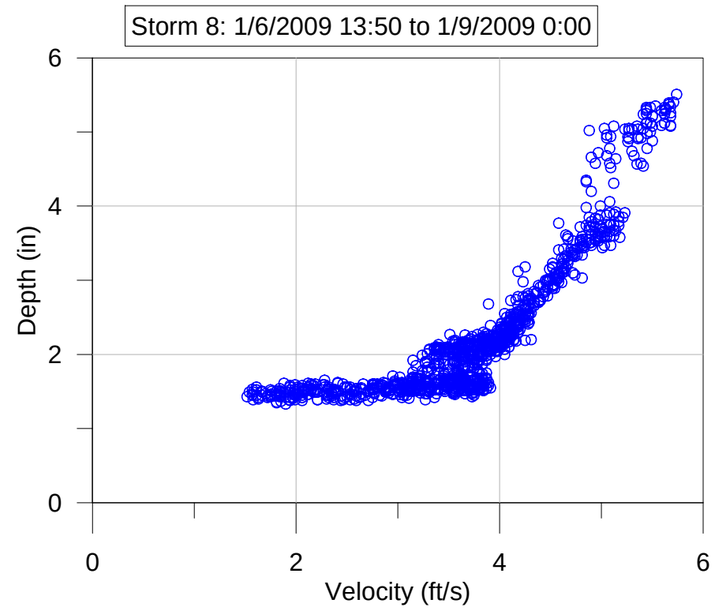


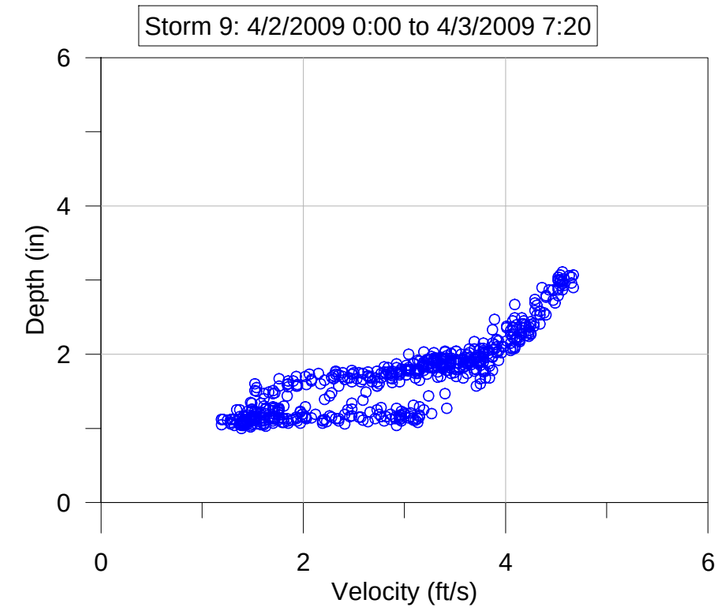


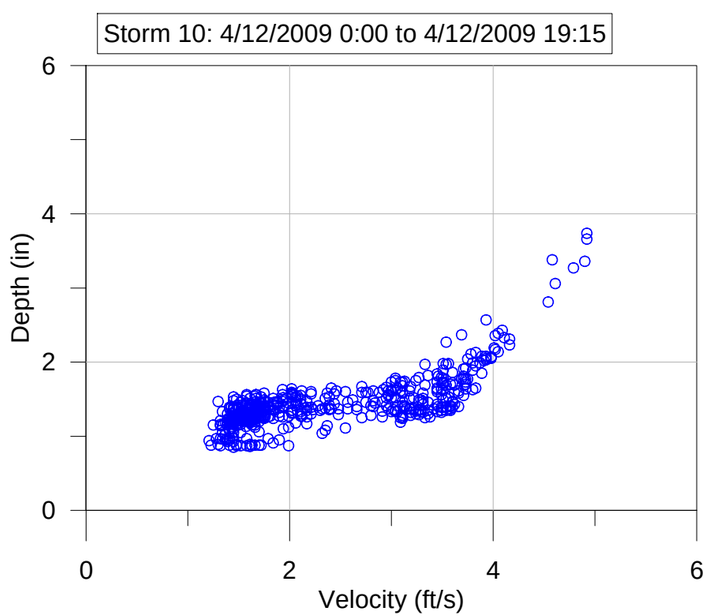


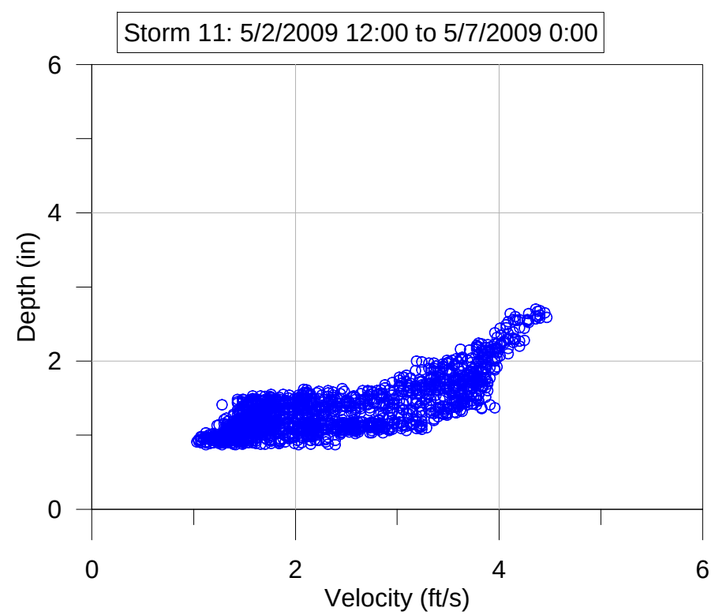
Calibration Storms - Scattergraphs
Monitor 080-298 (47D)

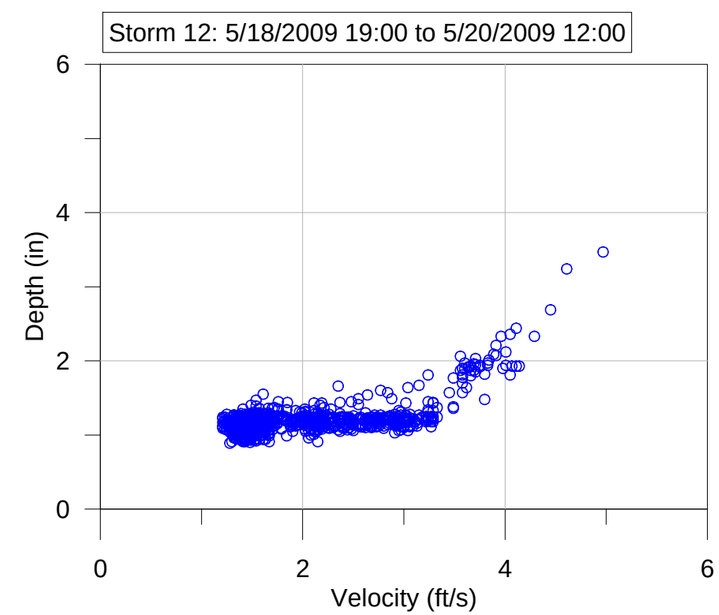




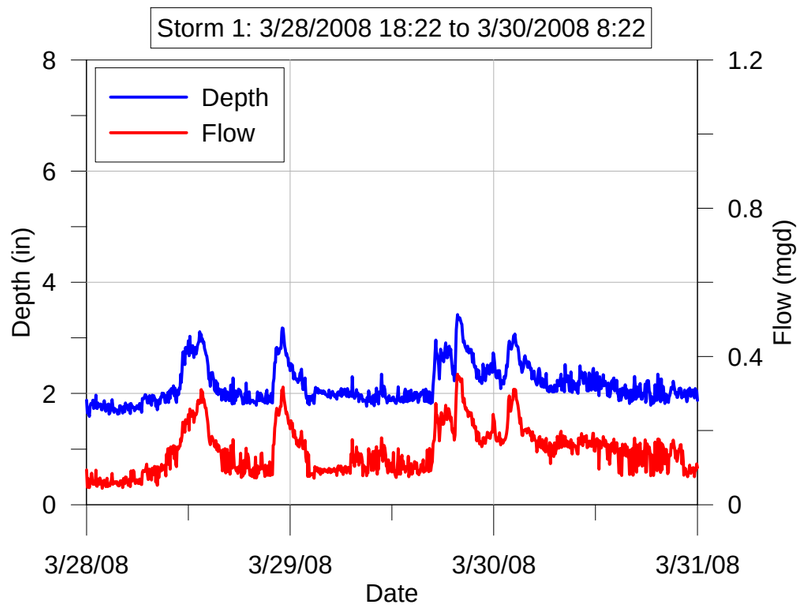


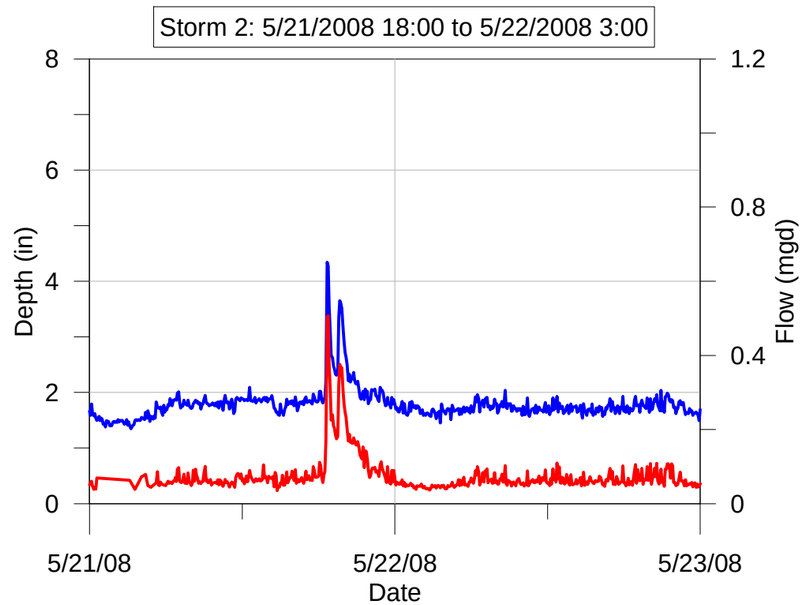


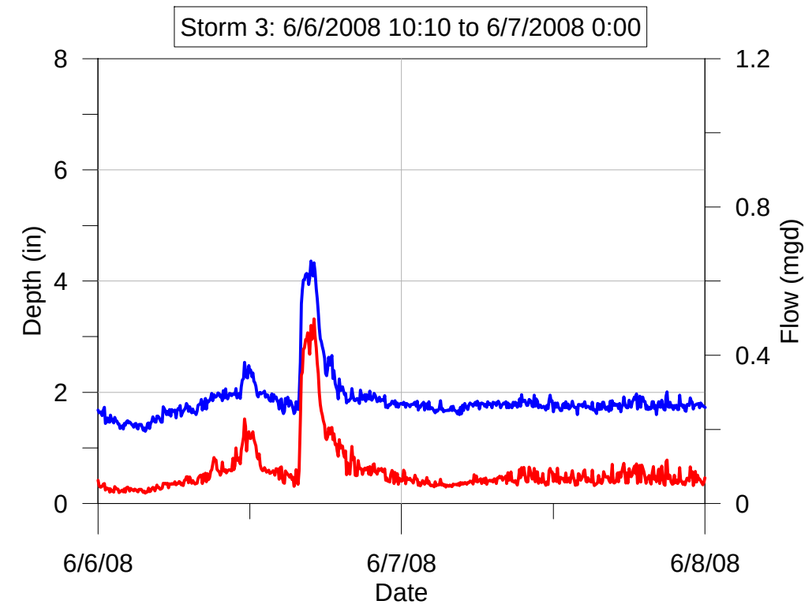


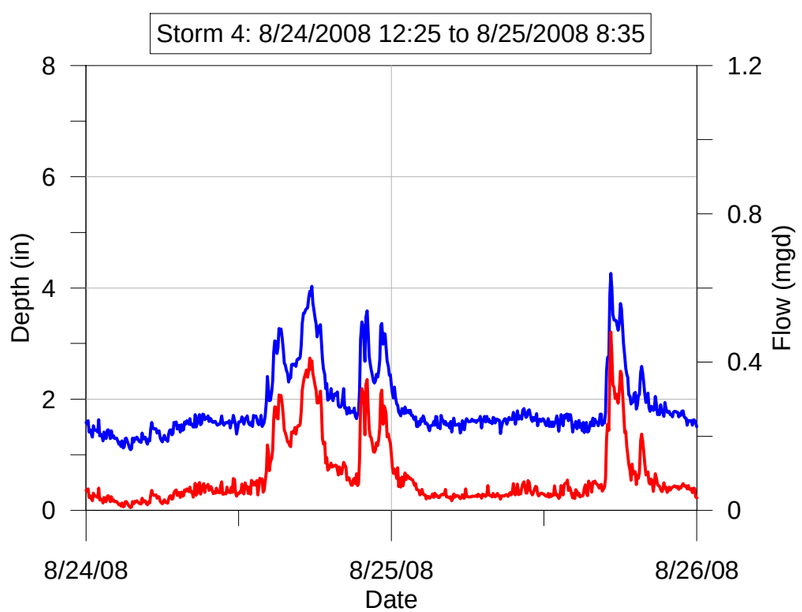


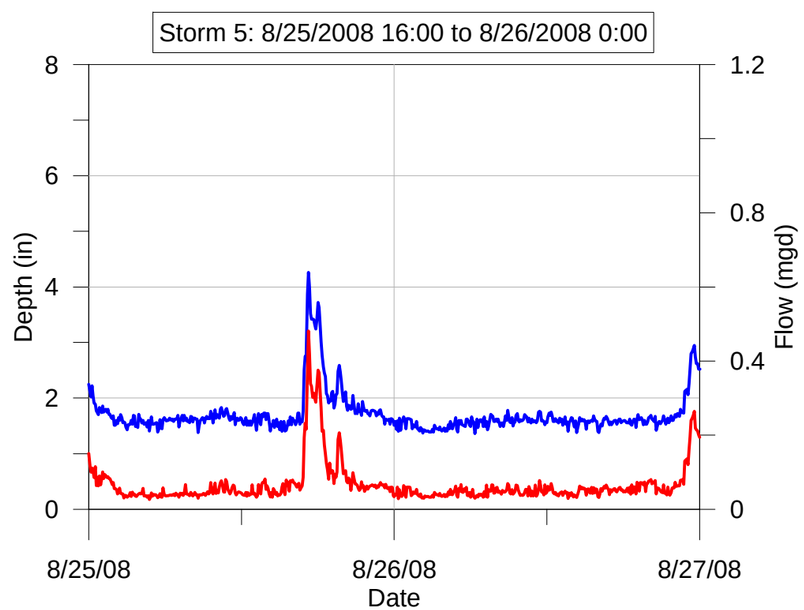
Calibration Storms - Hydrographs
Monitor 080-480 (47E)

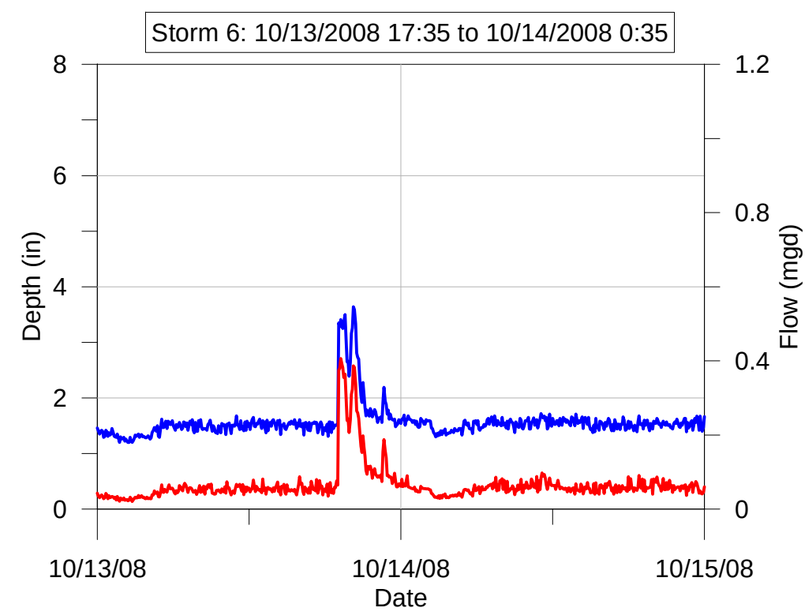




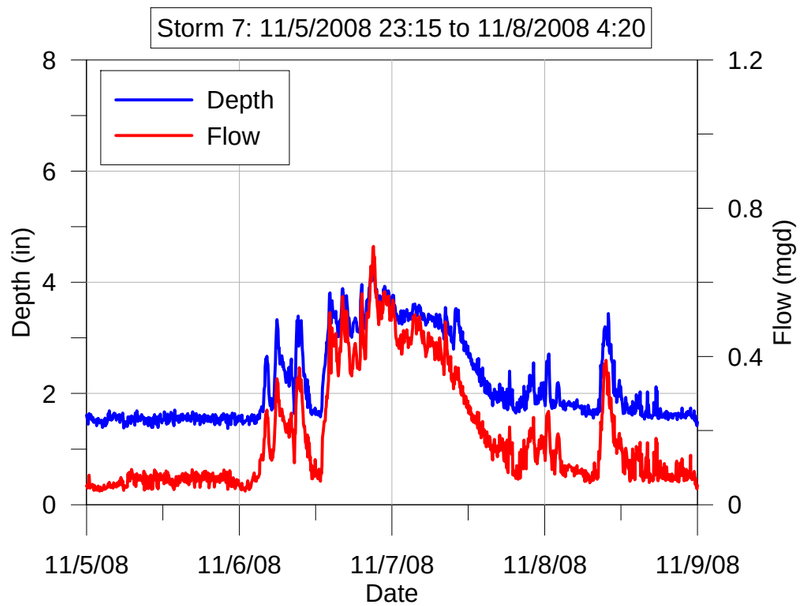


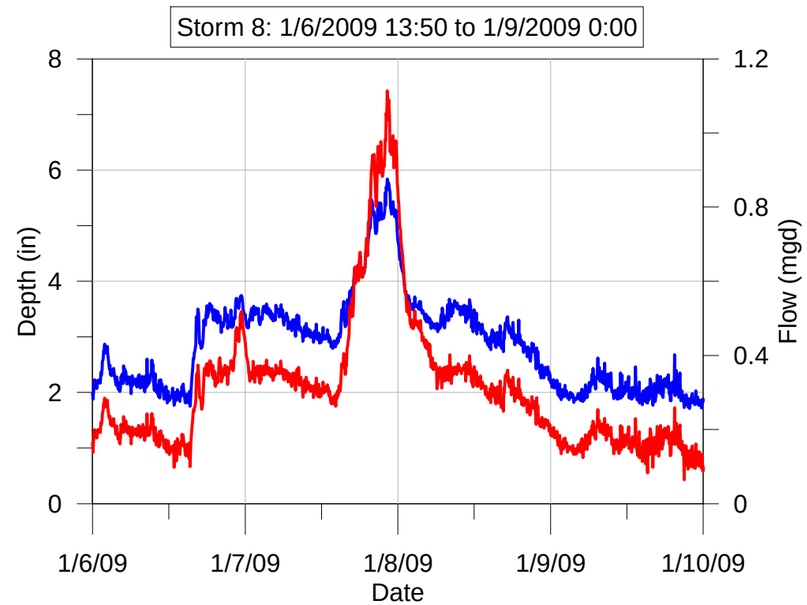


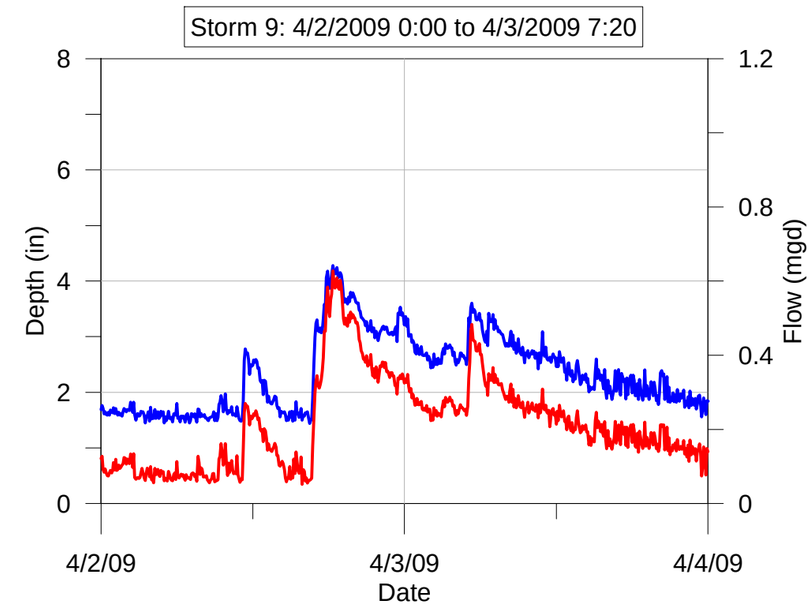


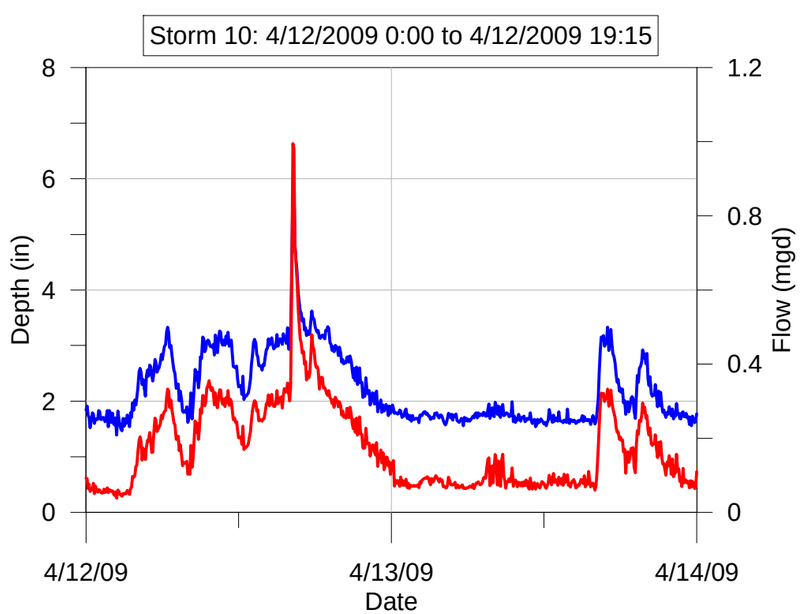


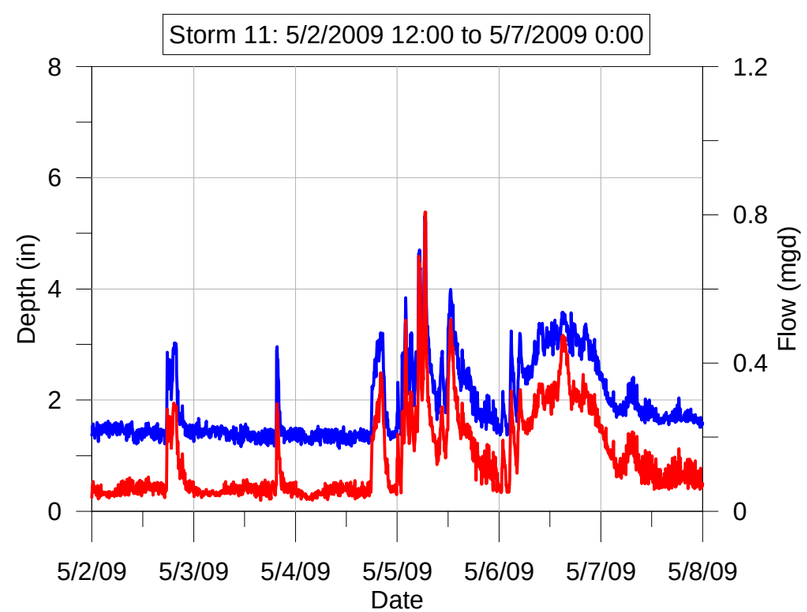
Calibration Storms - Hydrographs
Monitor 080-480 (47E)

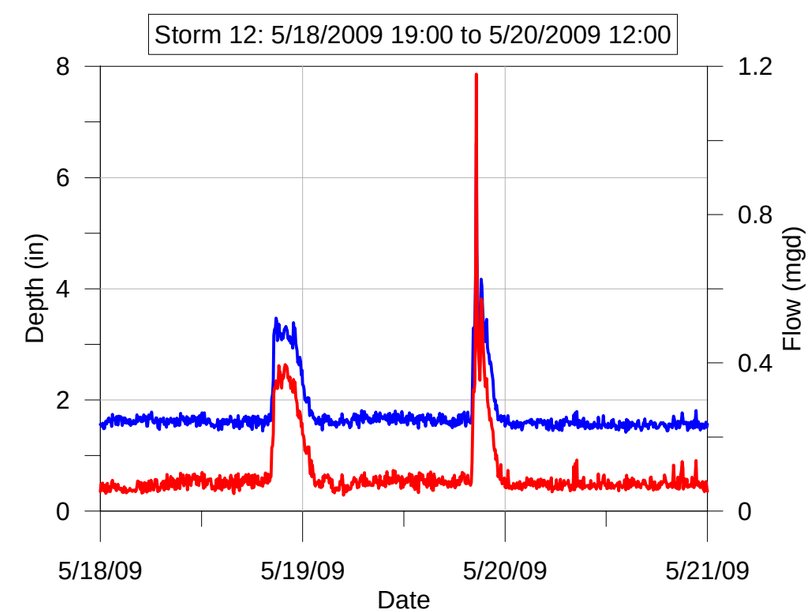




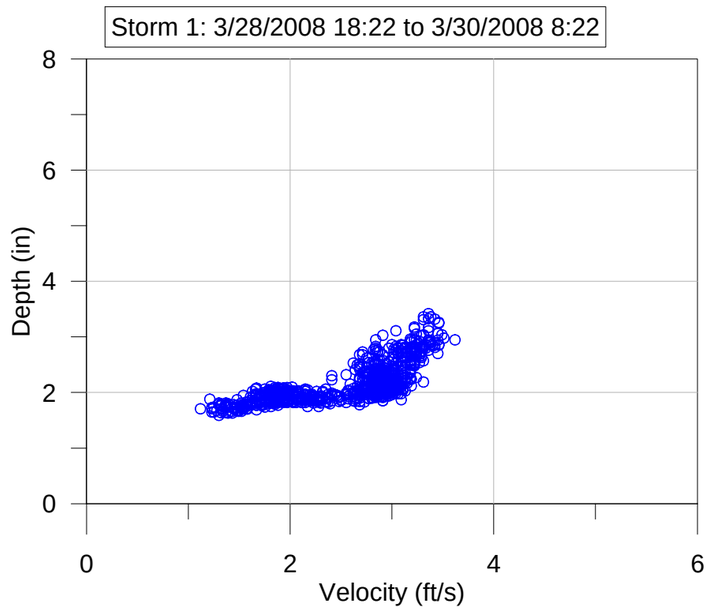


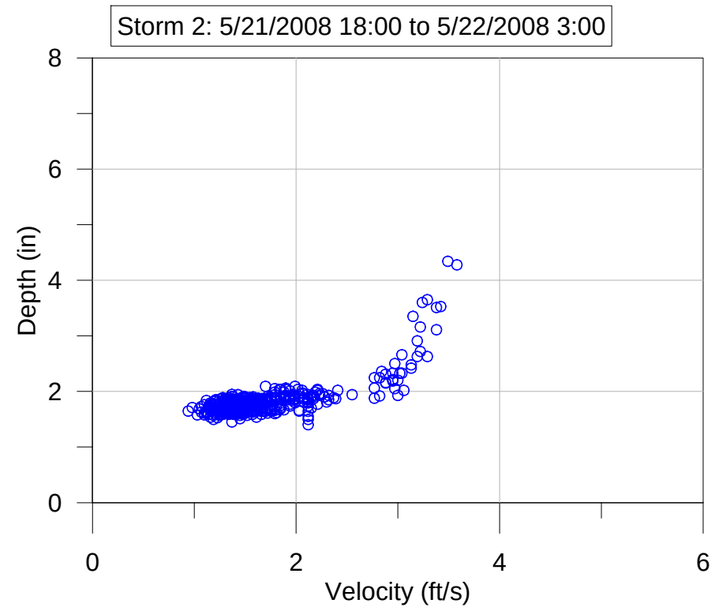


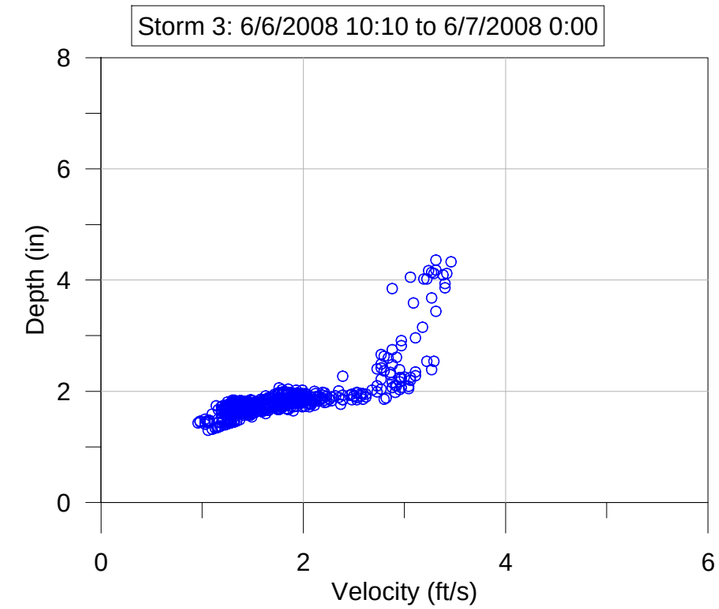


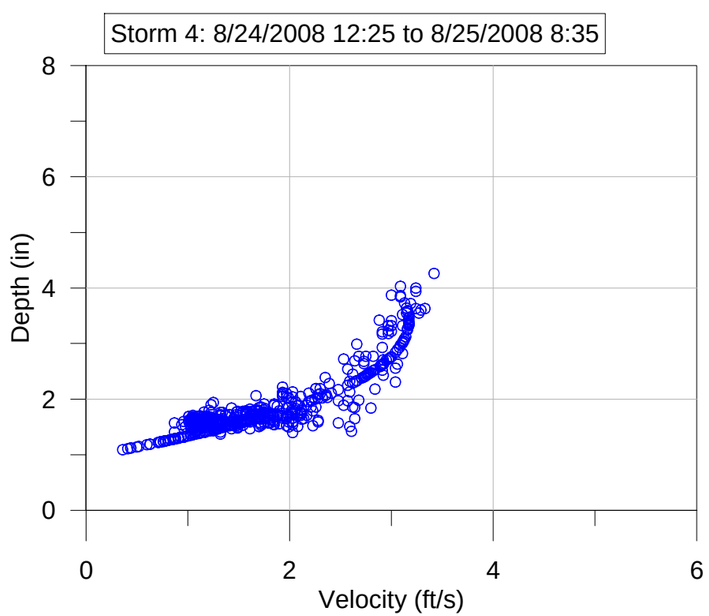


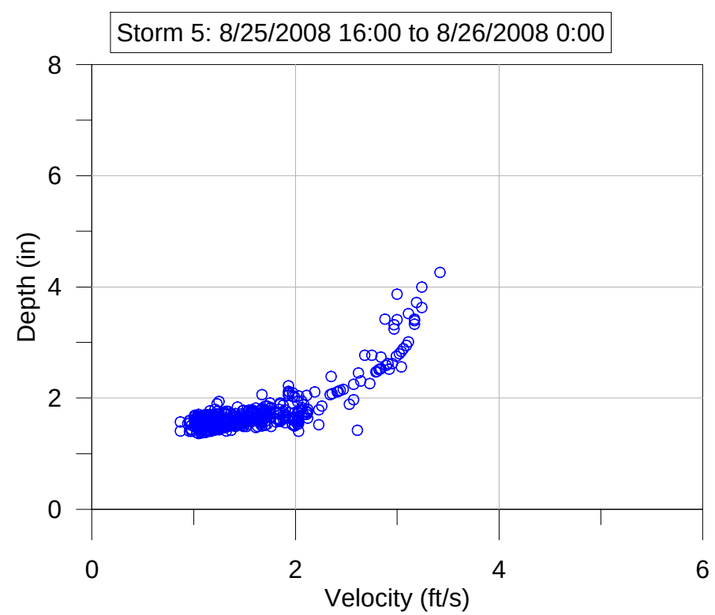
Calibration Storms - Scattergraphs
Monitor 080-480 (47E)

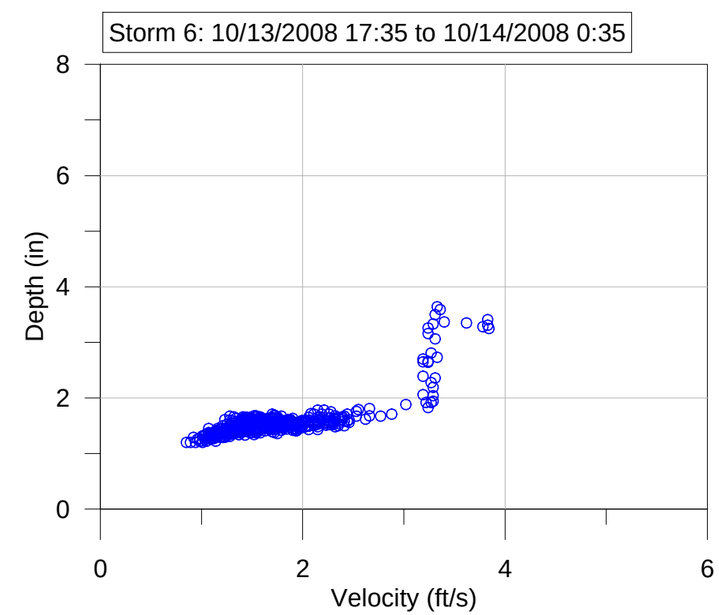




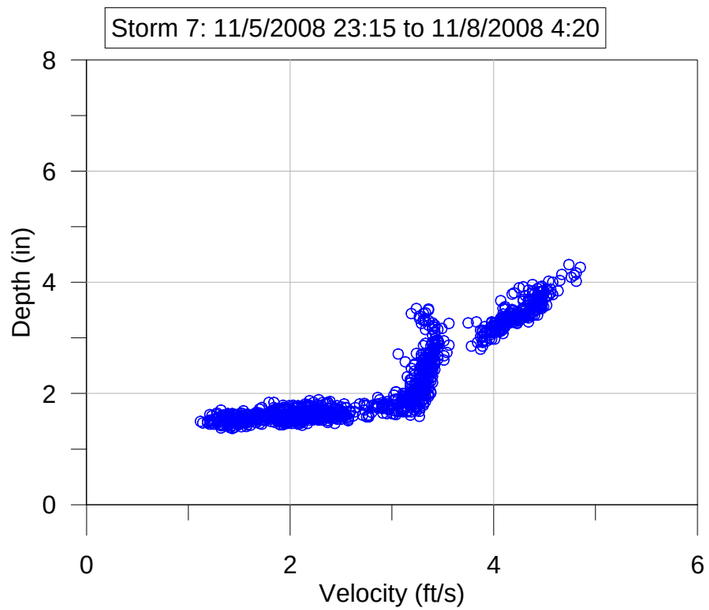


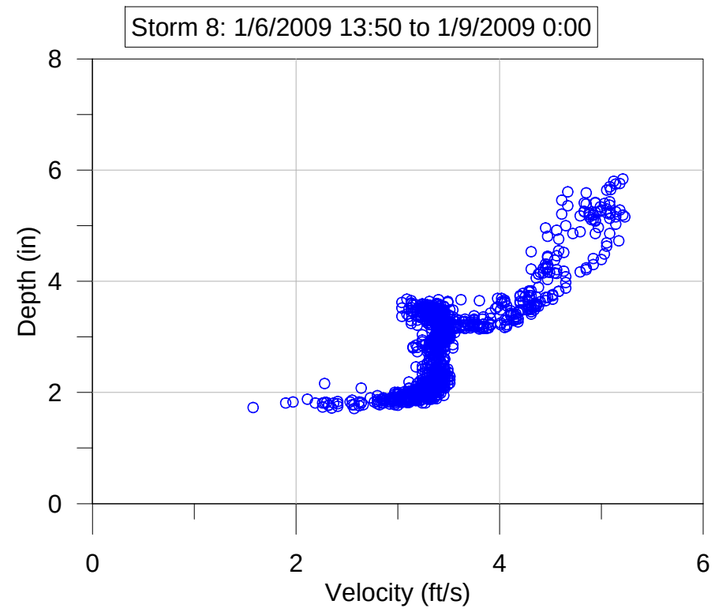


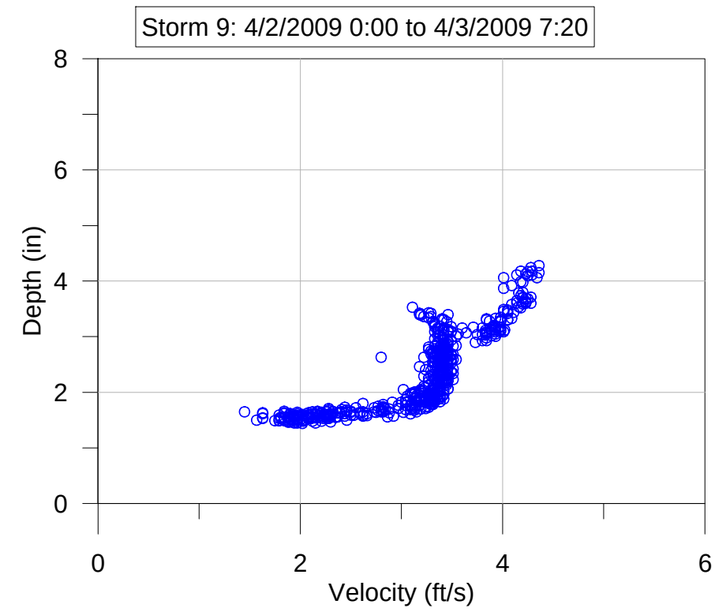


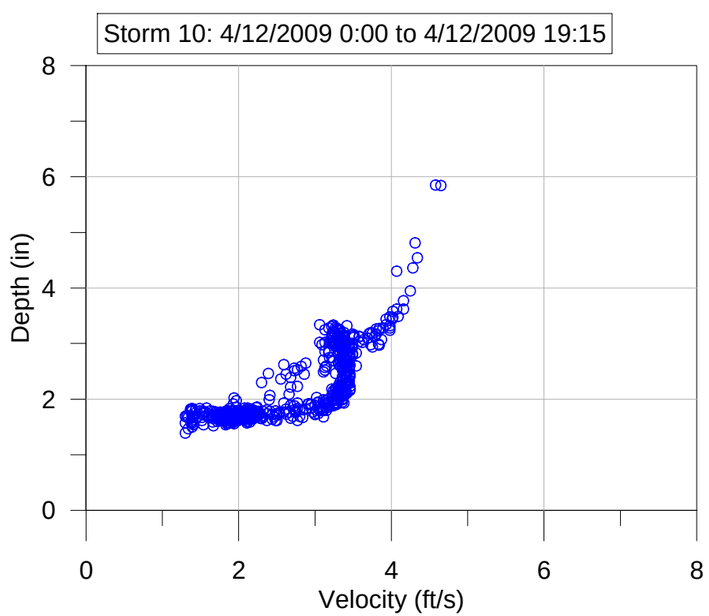


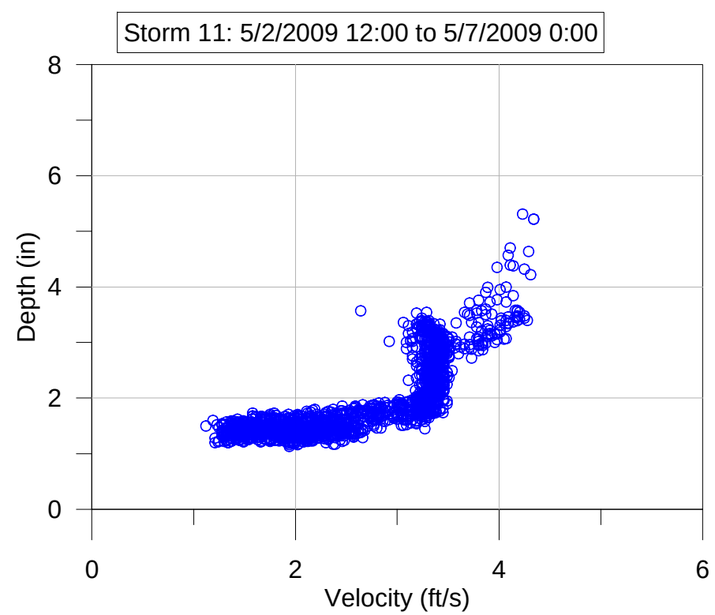
Calibration Storms - Scattergraphs
Monitor 080-480 (47E)

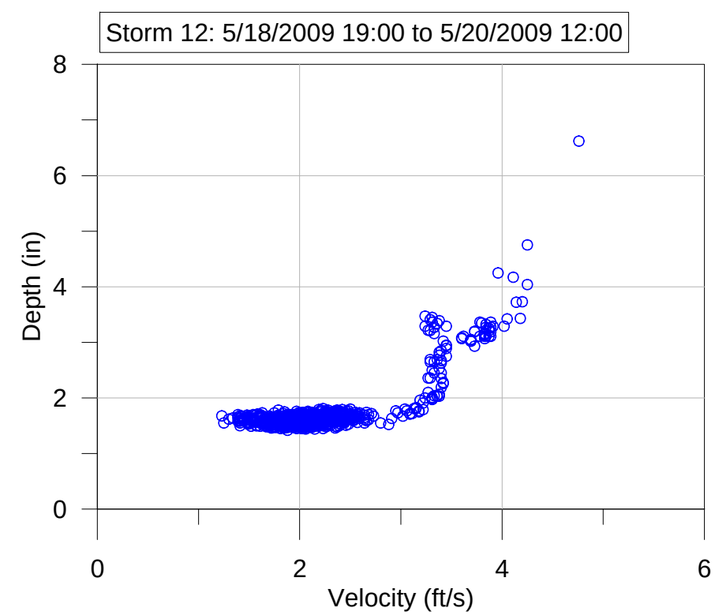




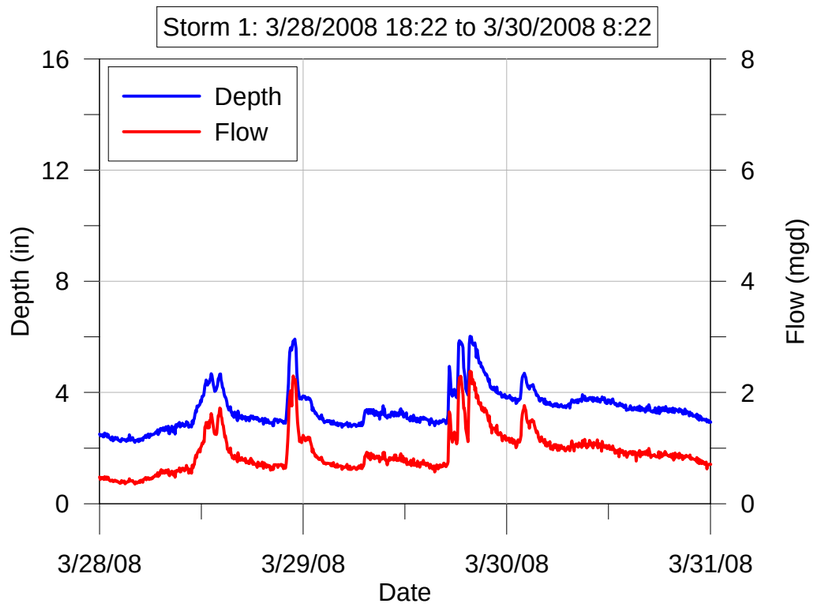


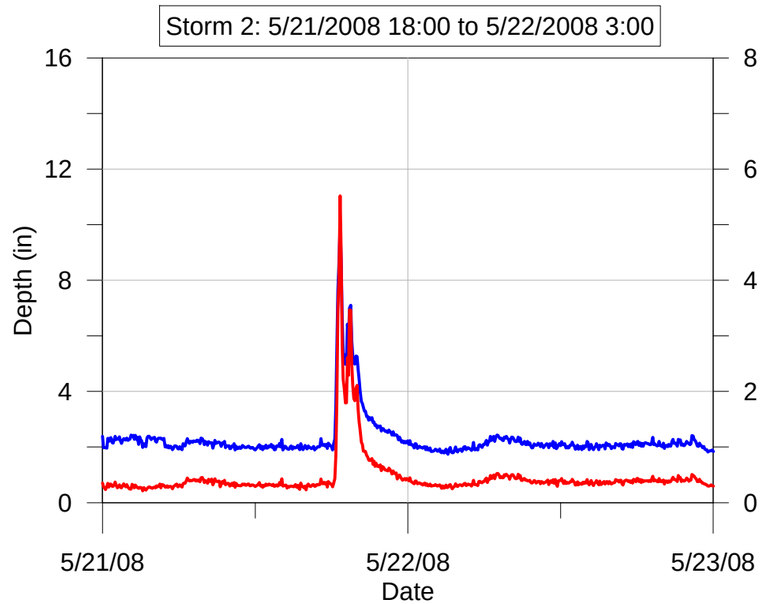


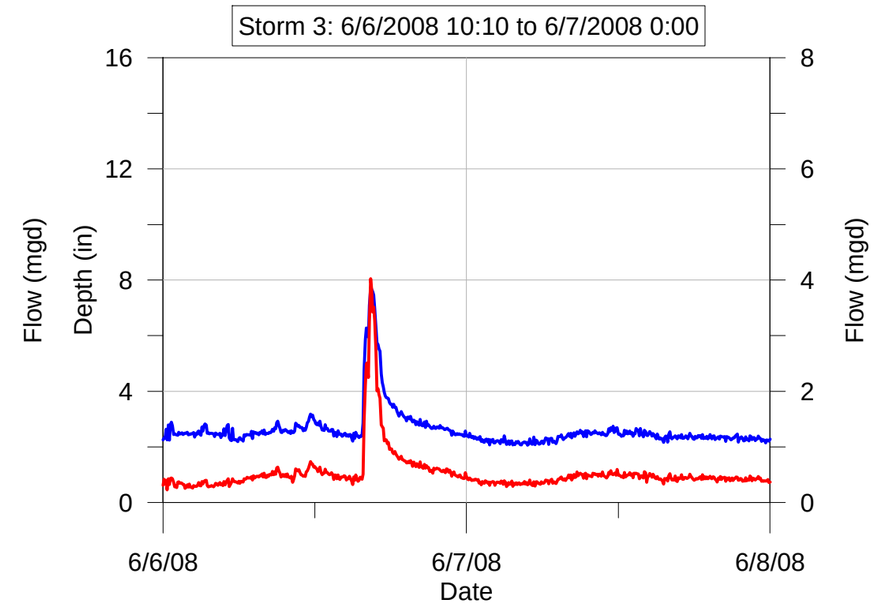


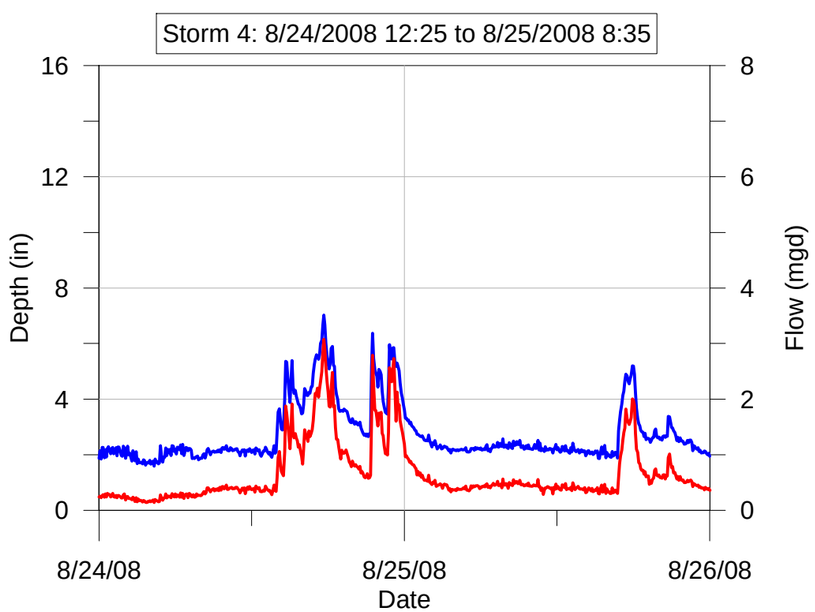


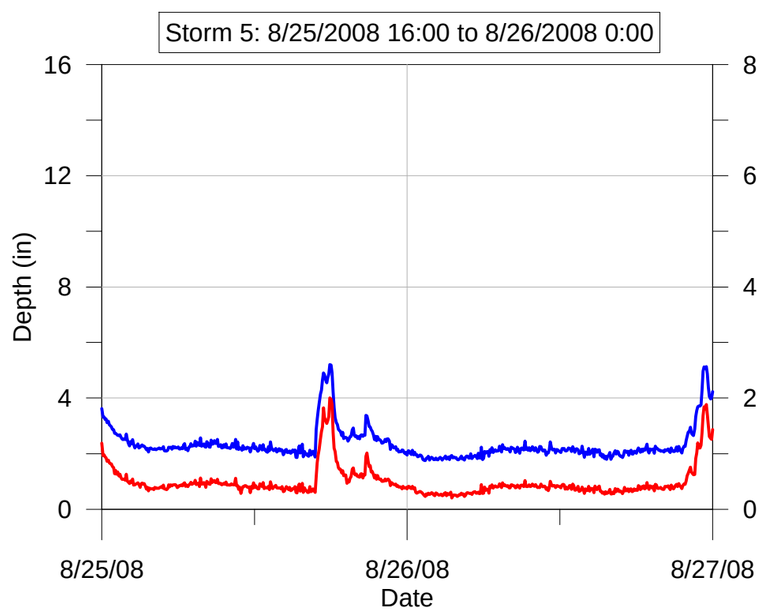
Calibration Storms
Monitor 072-268

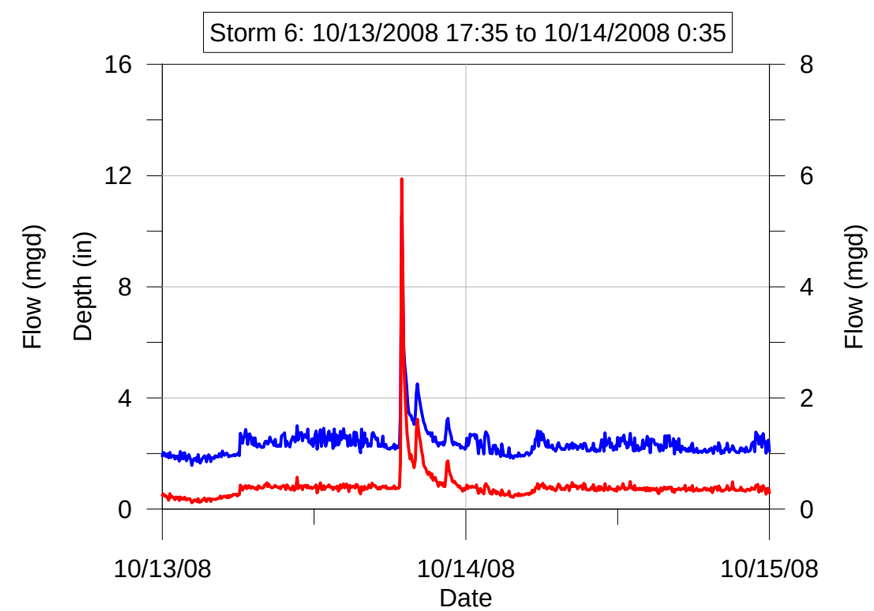




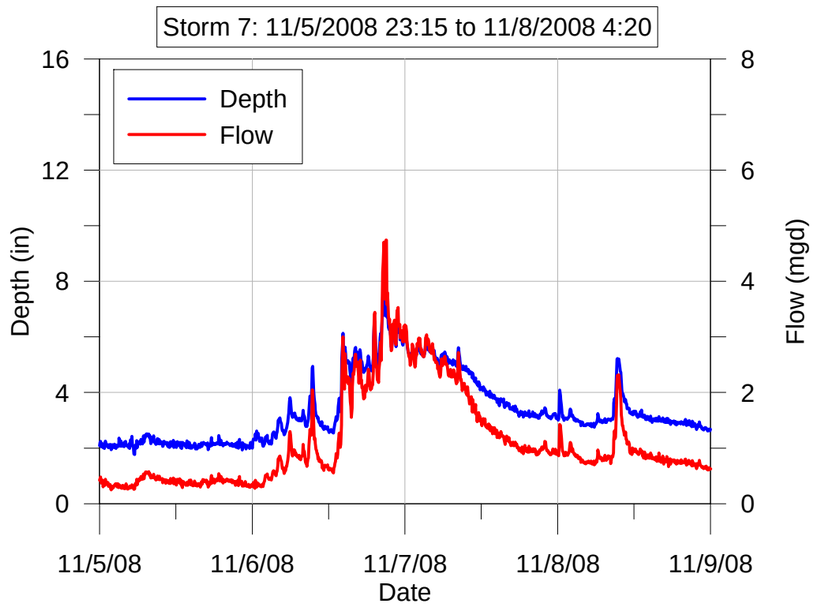


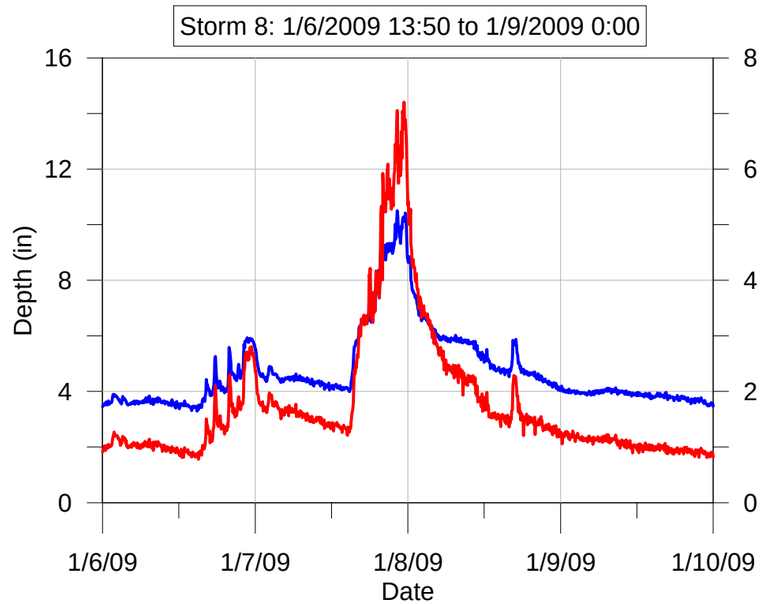


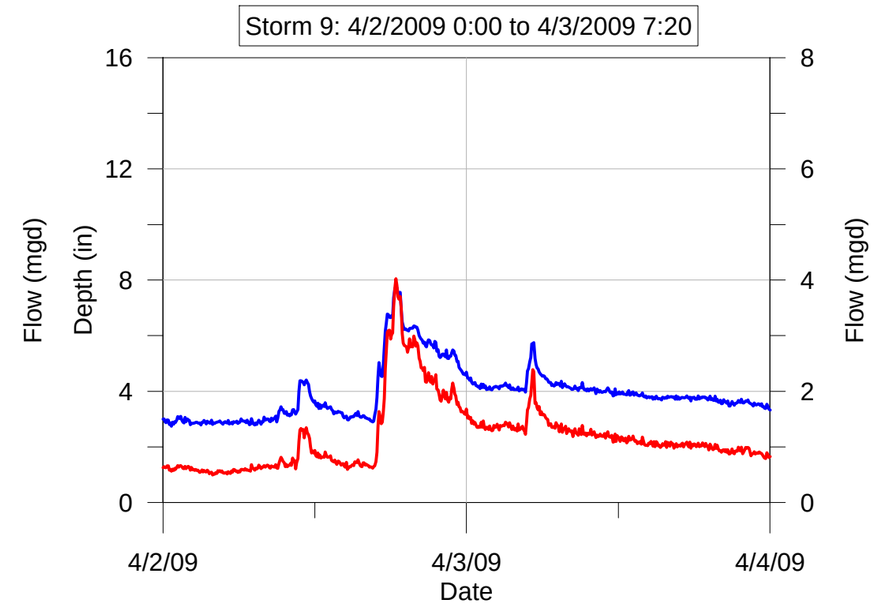


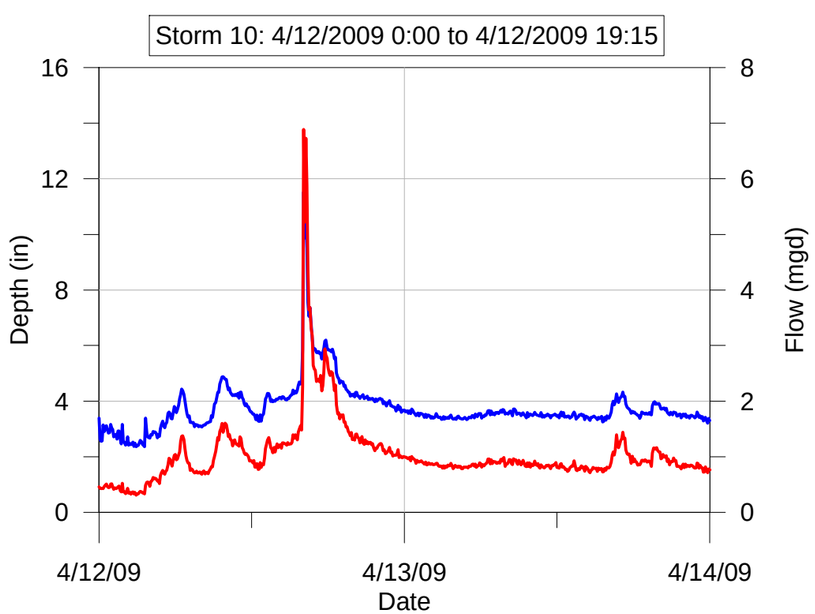


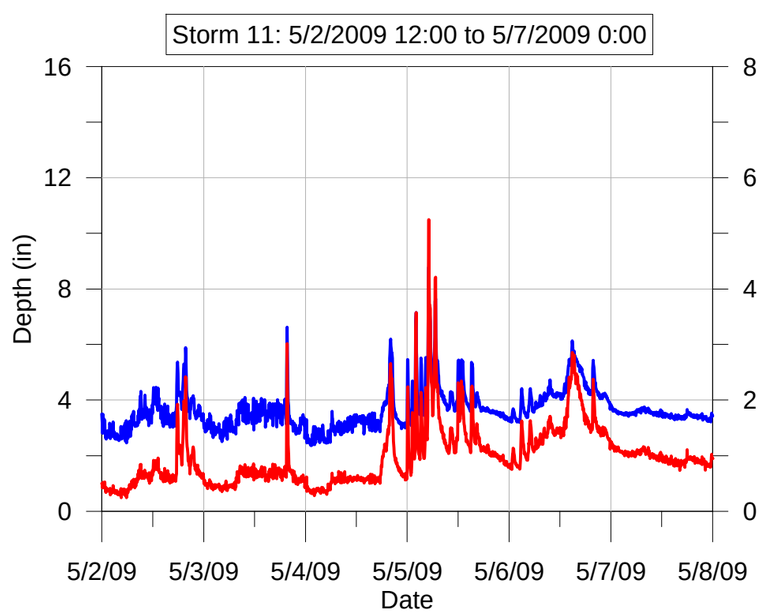
Calibration Storms
Monitor 073-268

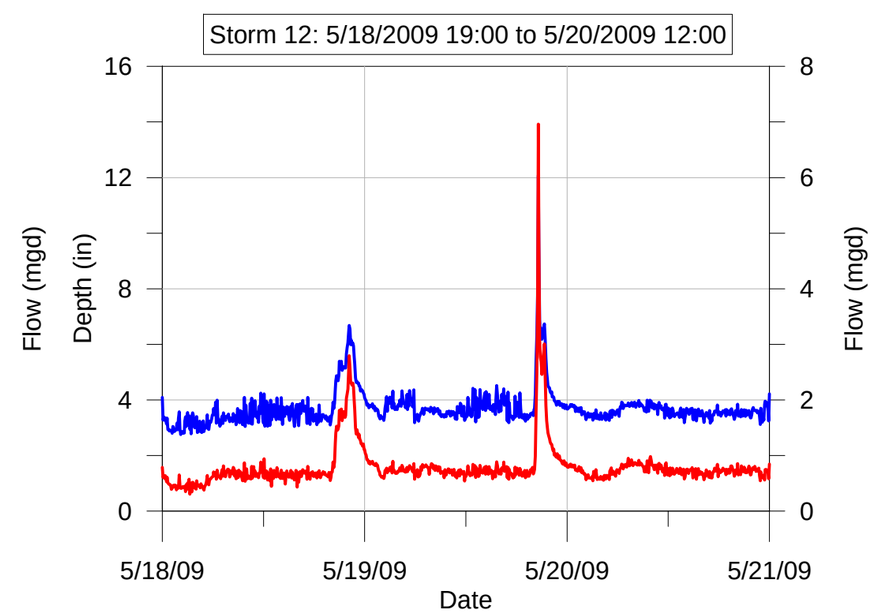




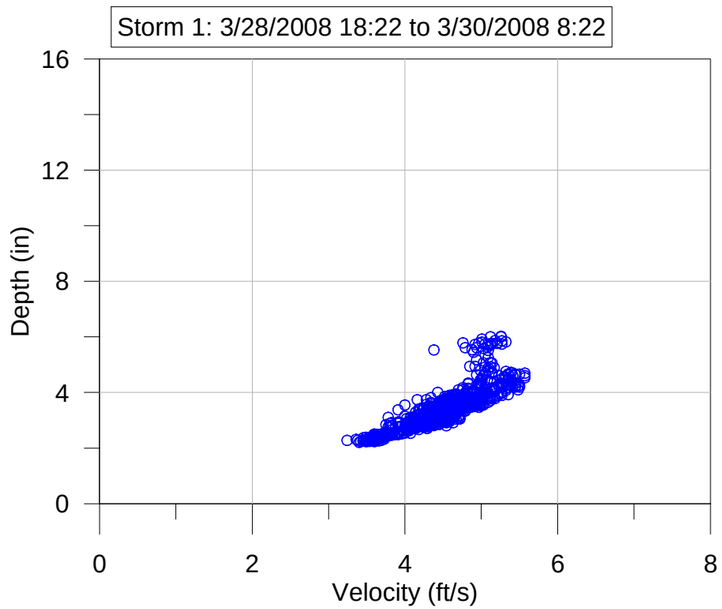


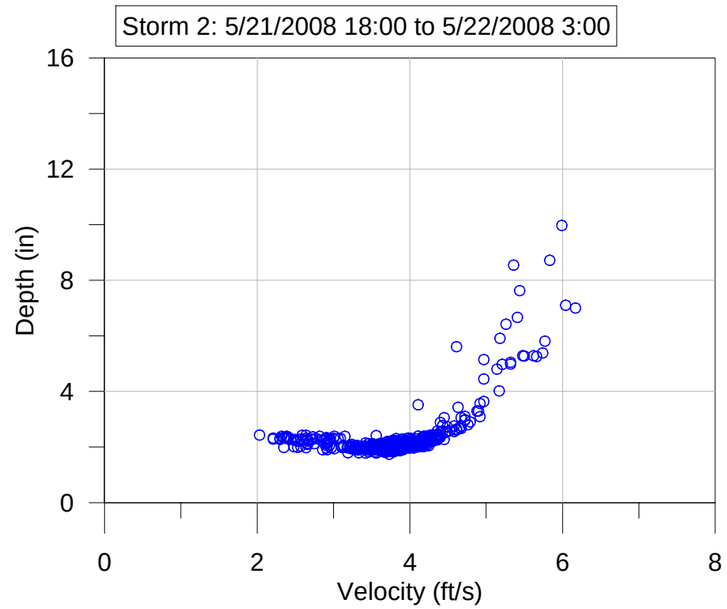


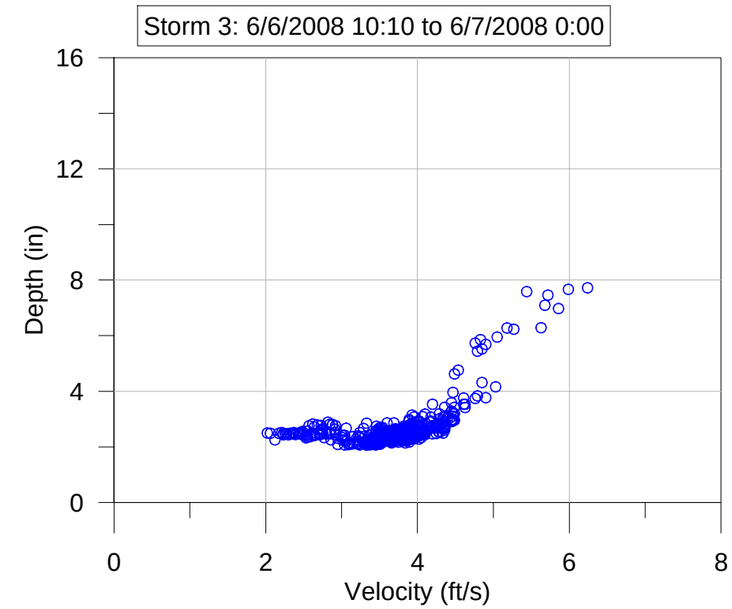


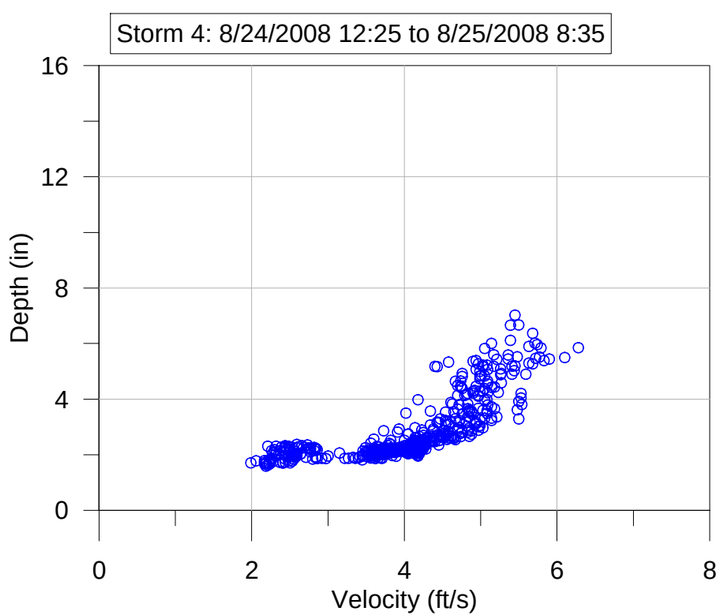


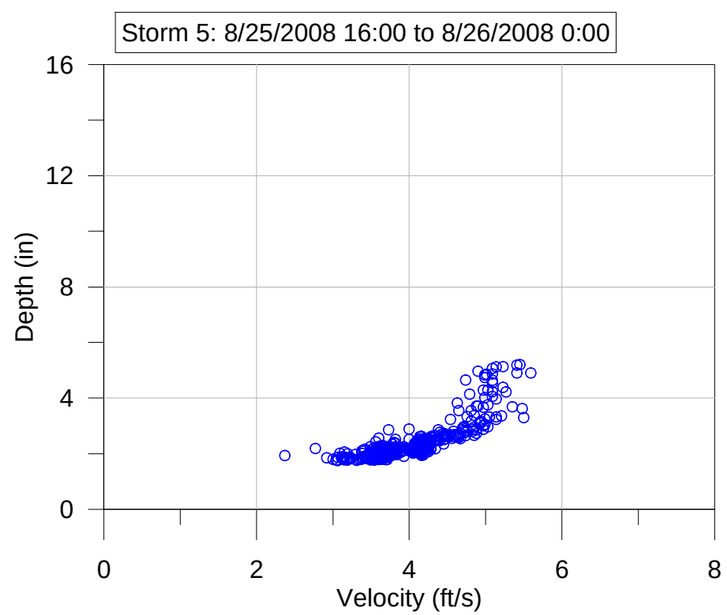
Calibration Storms - Scattergraphs
Monitor 073-268

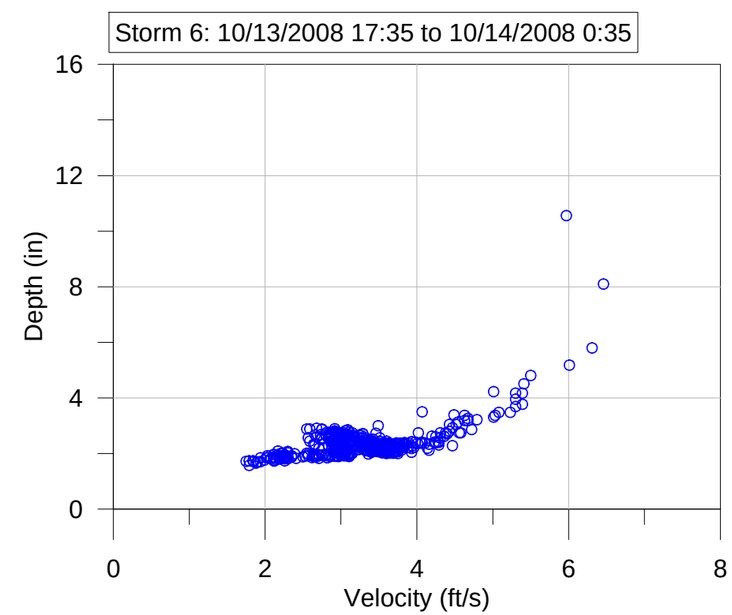




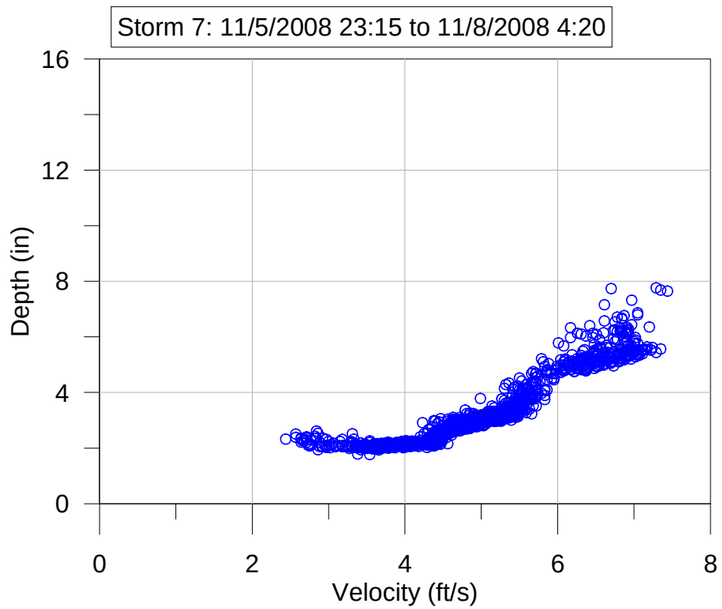


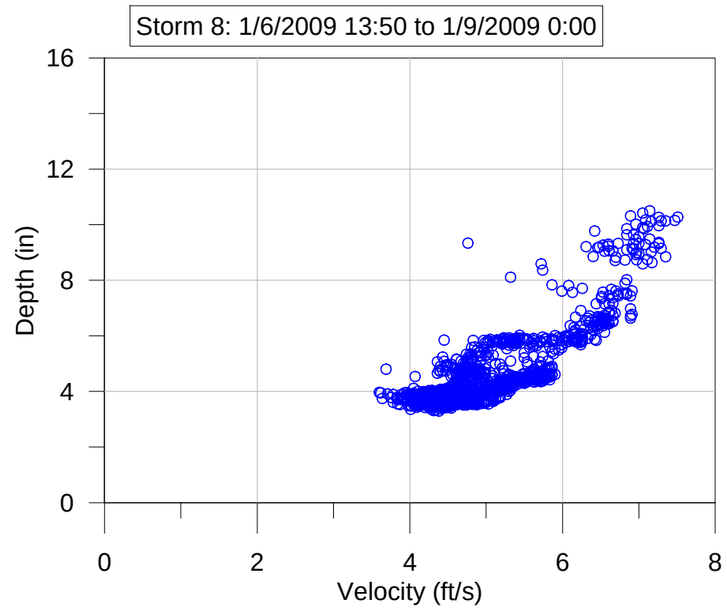


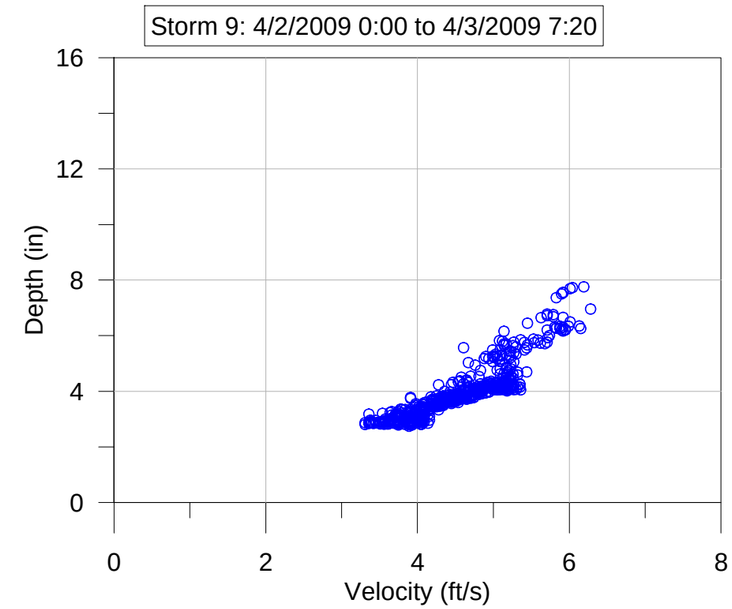


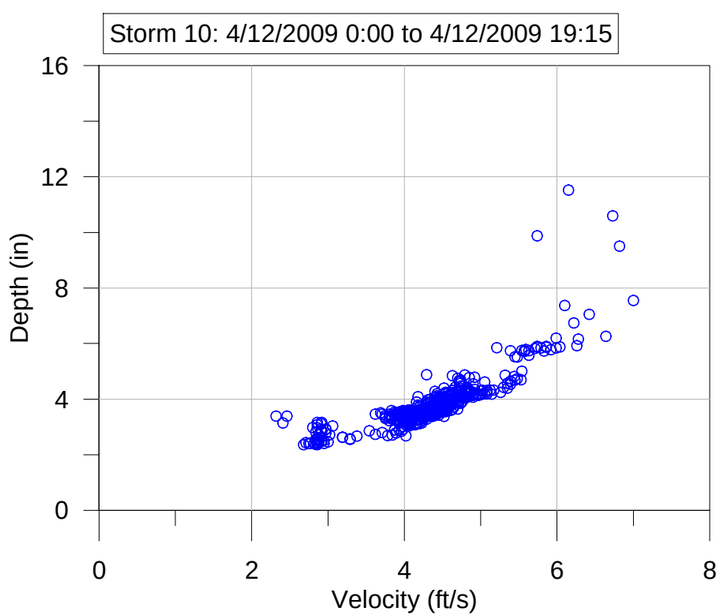


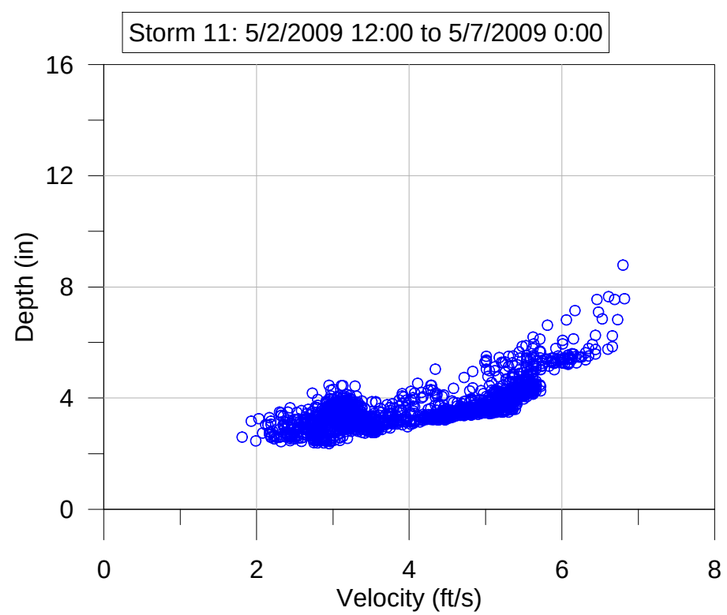
Calibration Storms - Scattergraphs
Monitor 073-268

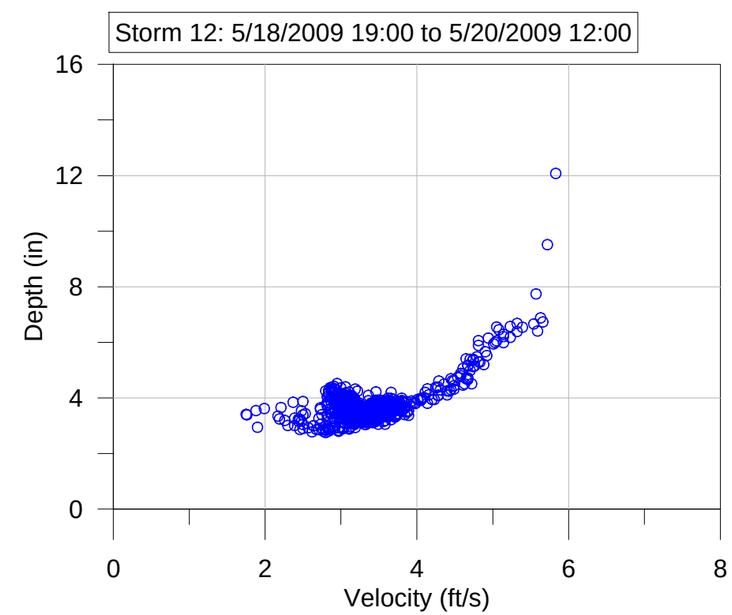




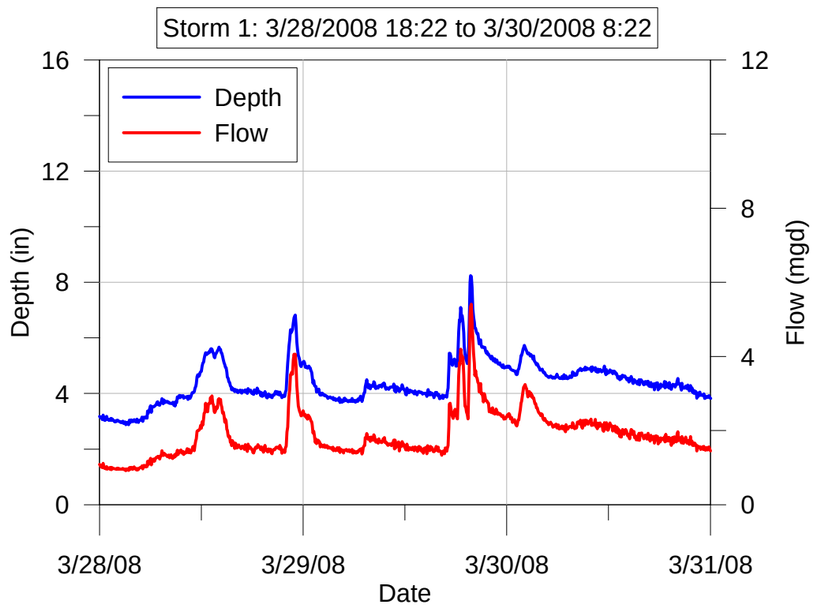


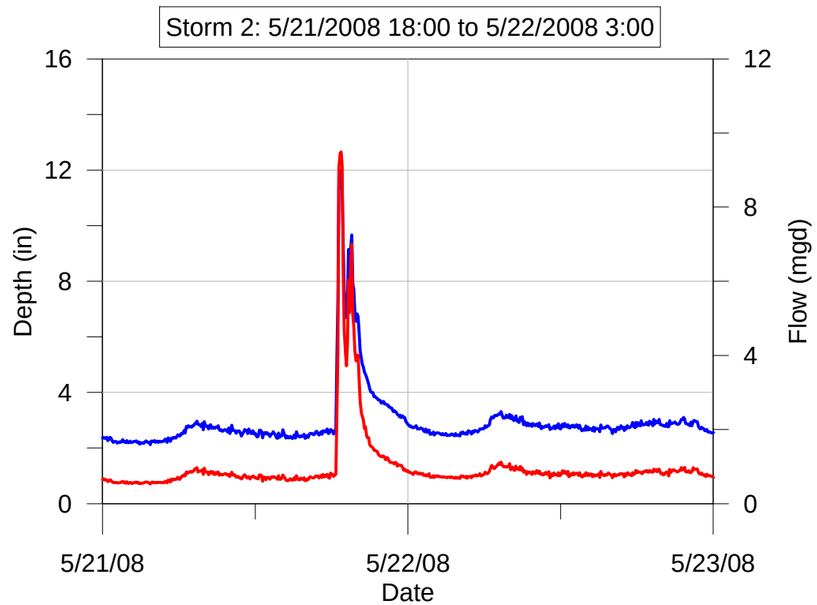


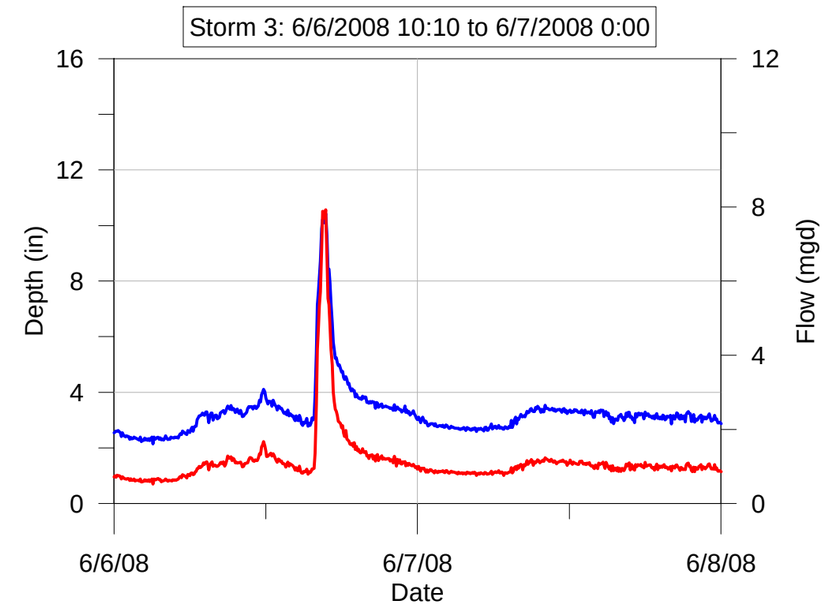


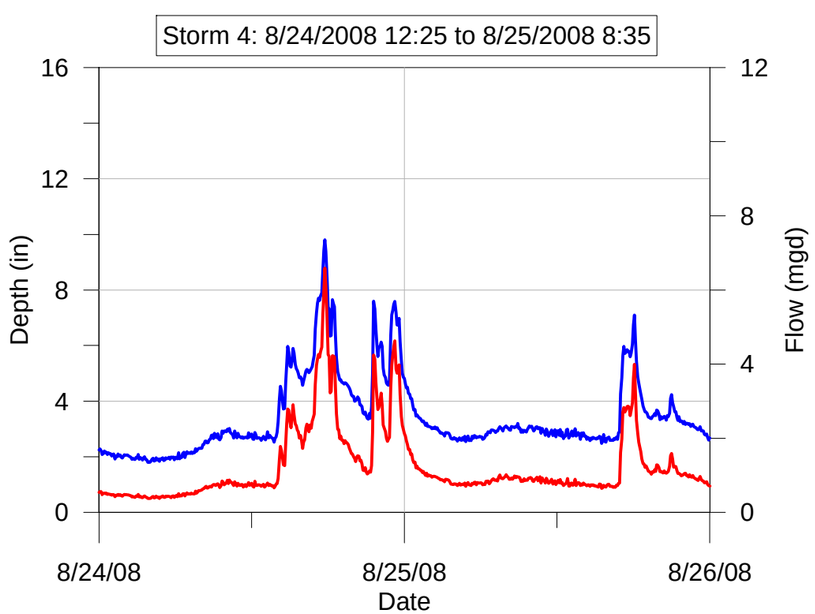


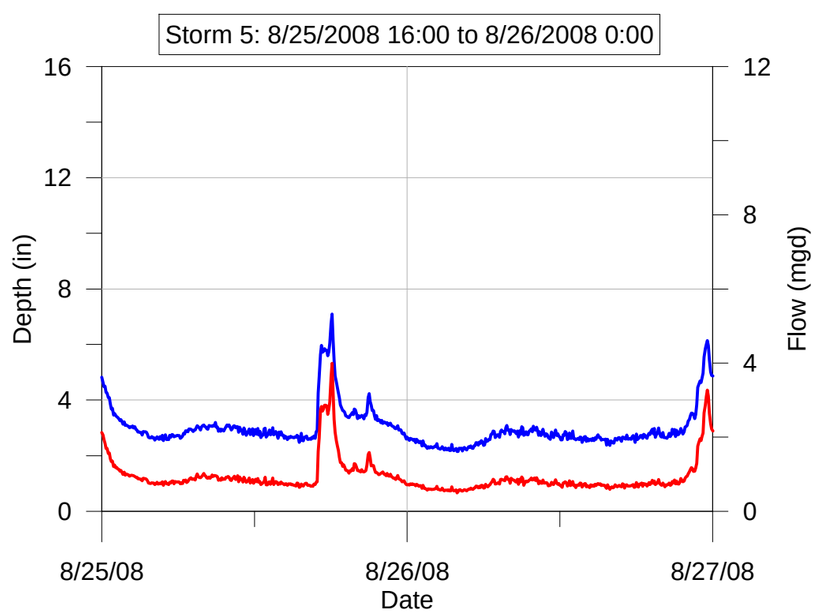
Calibration Storms
Monitor 072-276

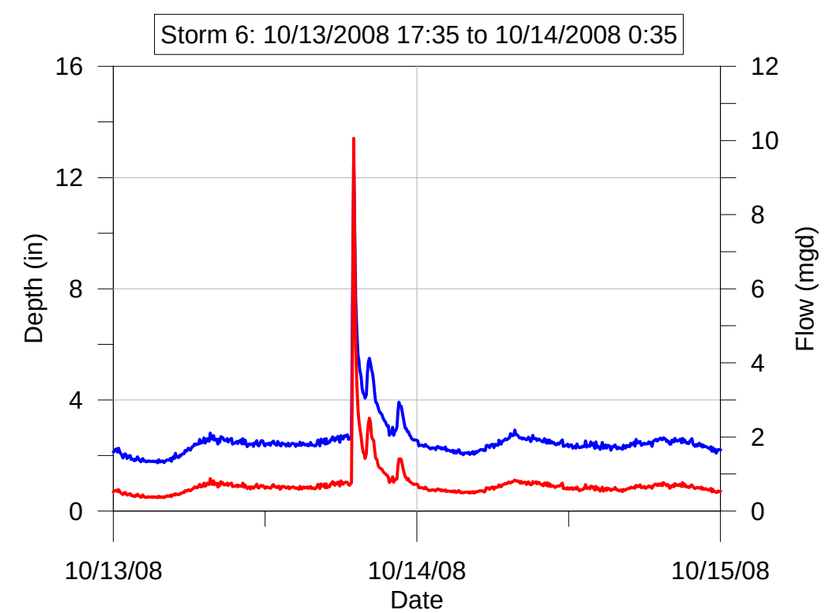




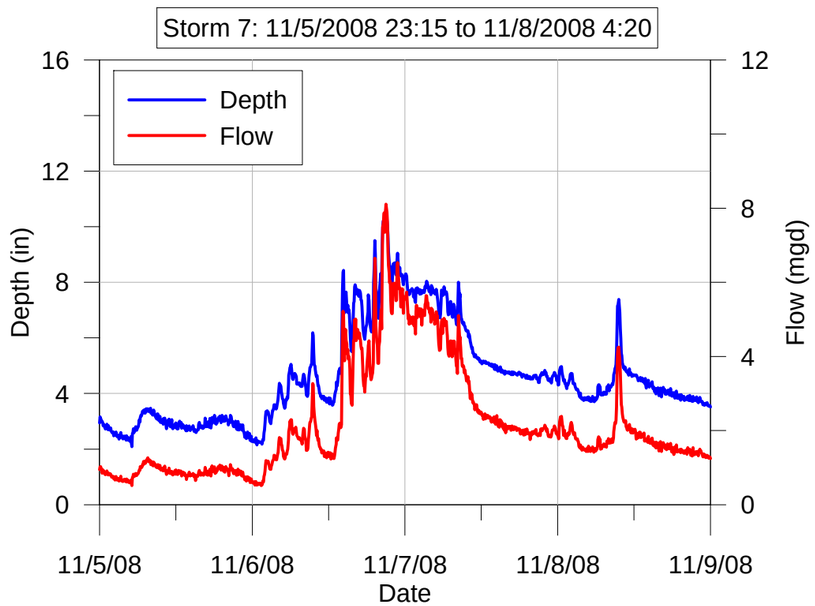


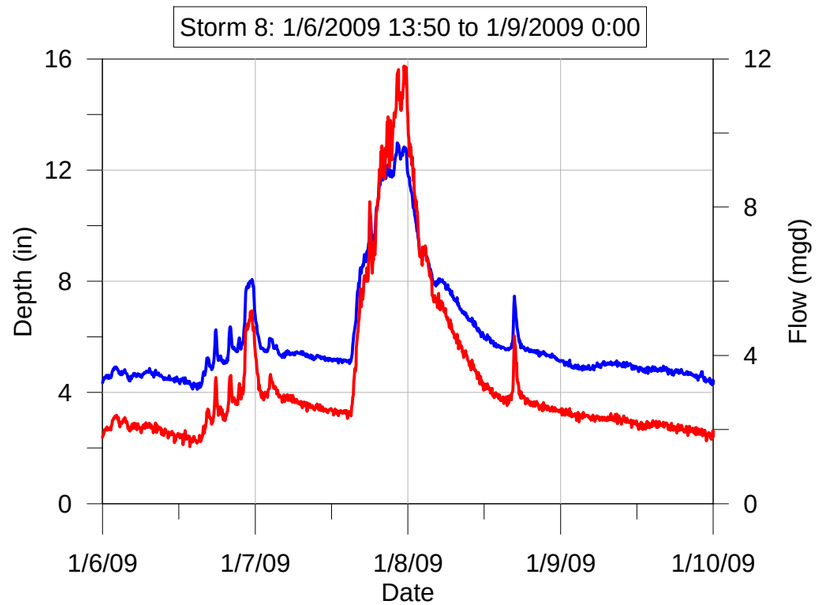


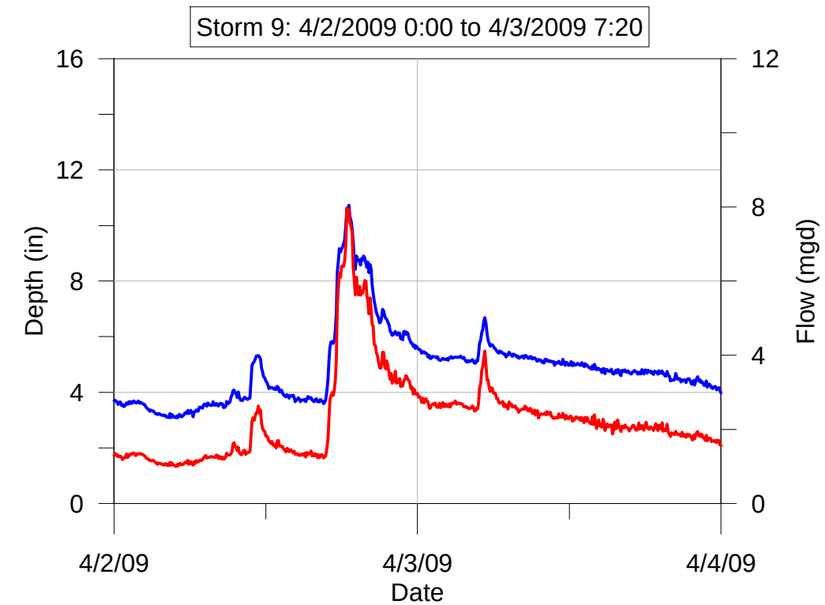


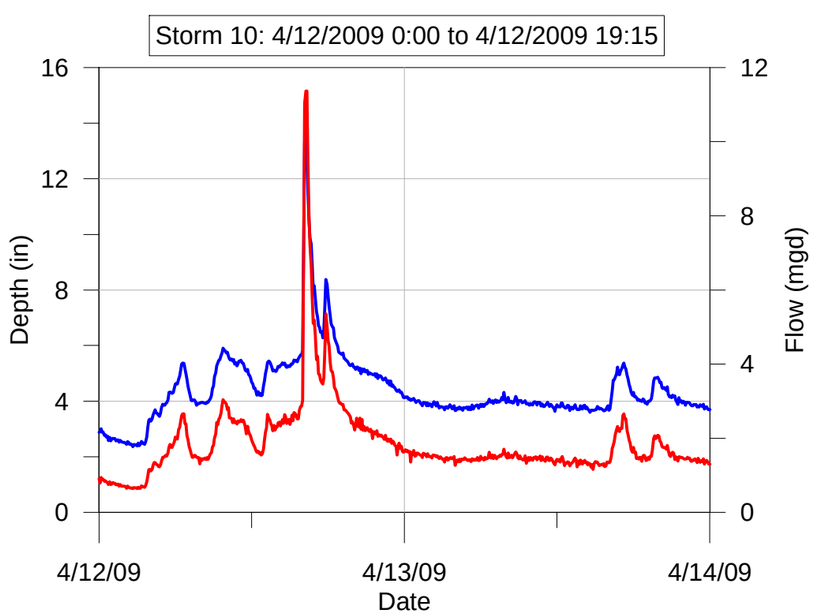


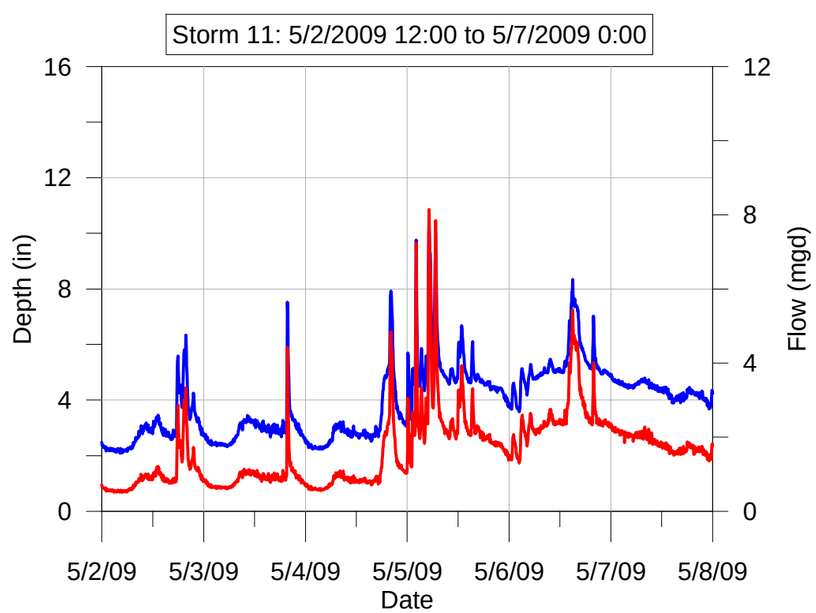
Calibration Storms
Monitor 073-276

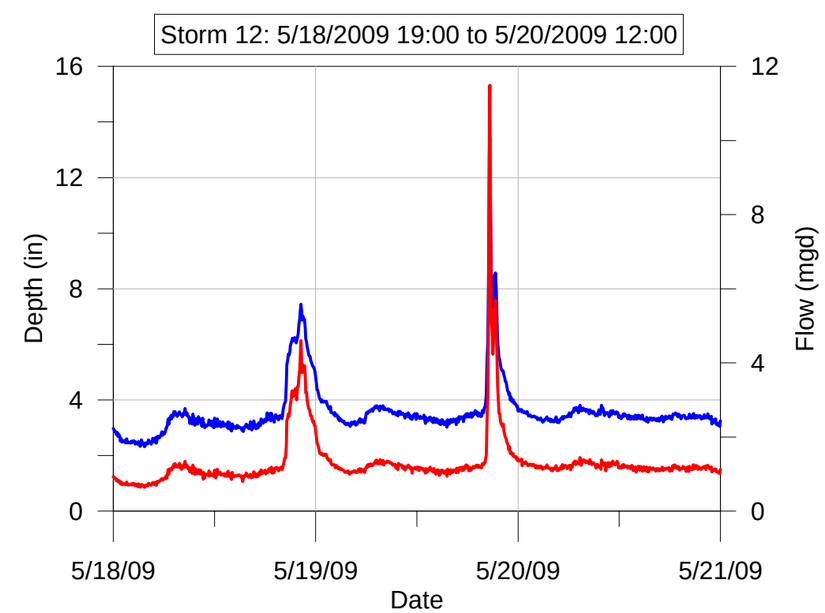




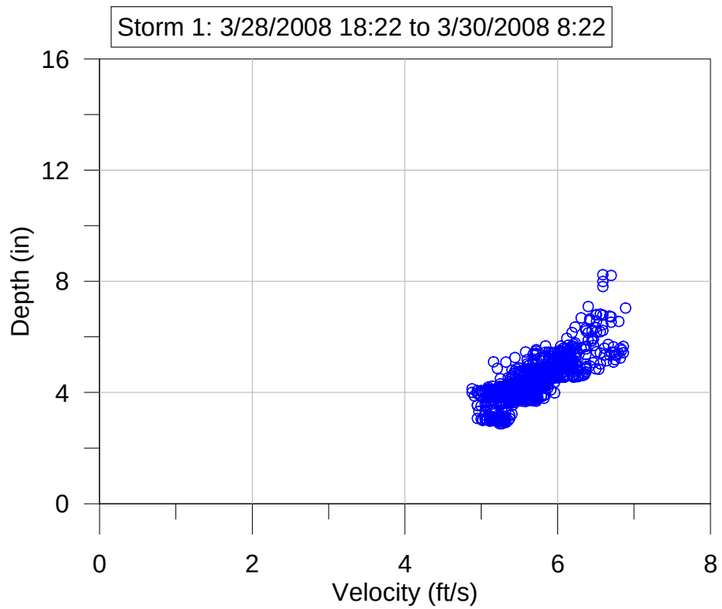


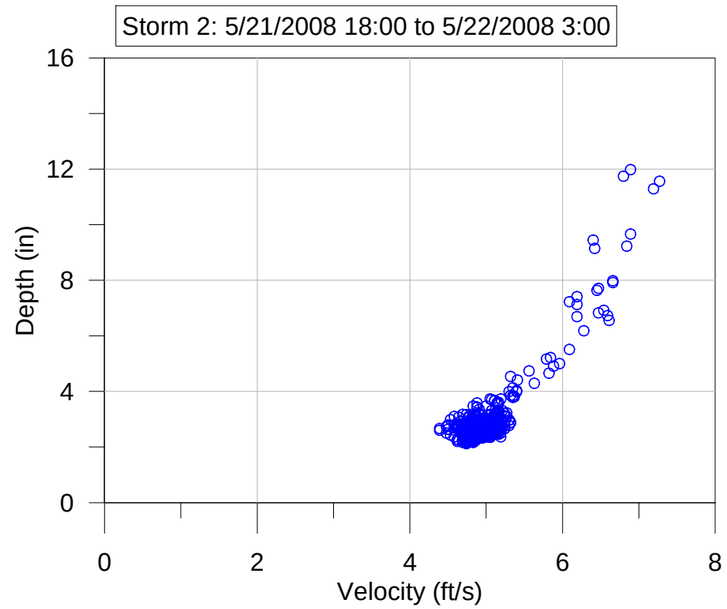


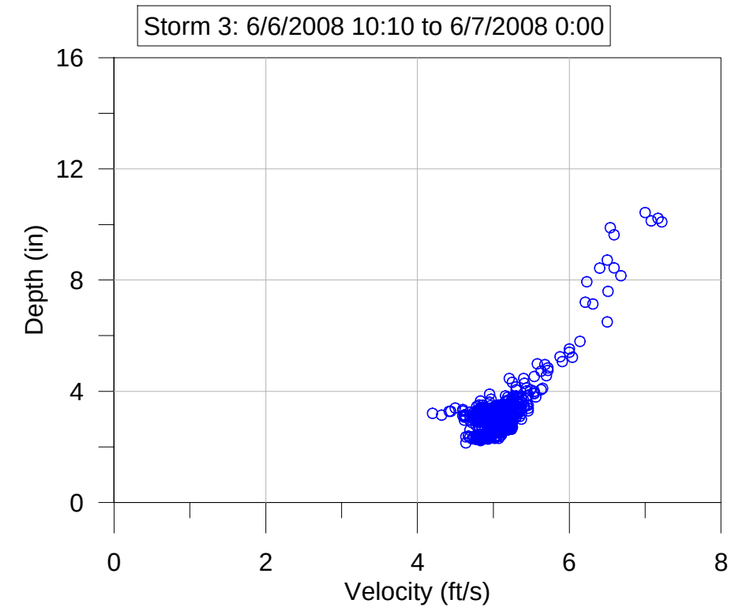


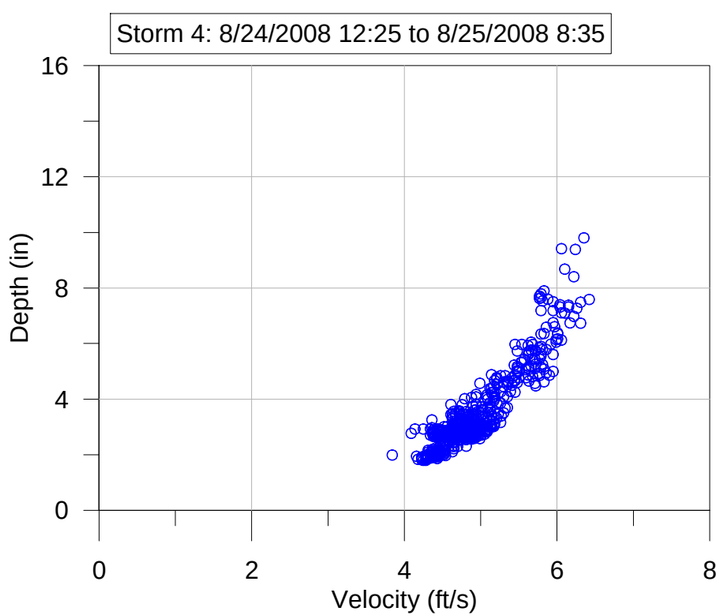


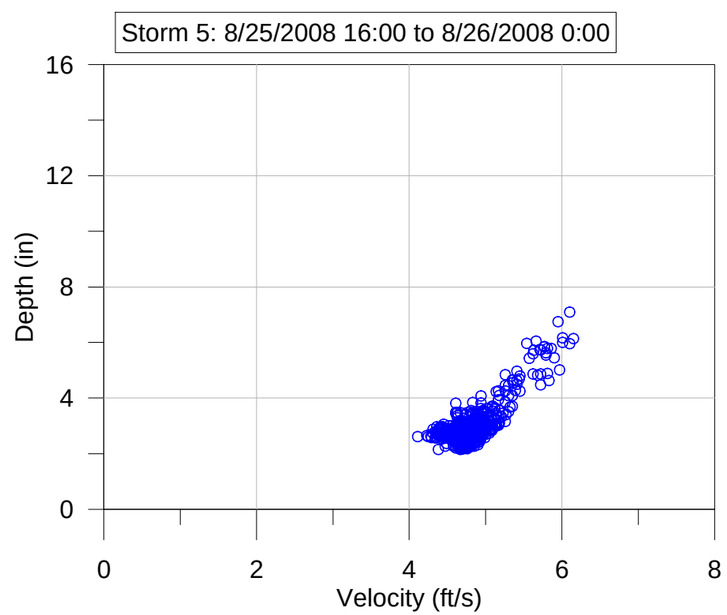
Calibration Storms - Scattergraphs
Monitor 073-276

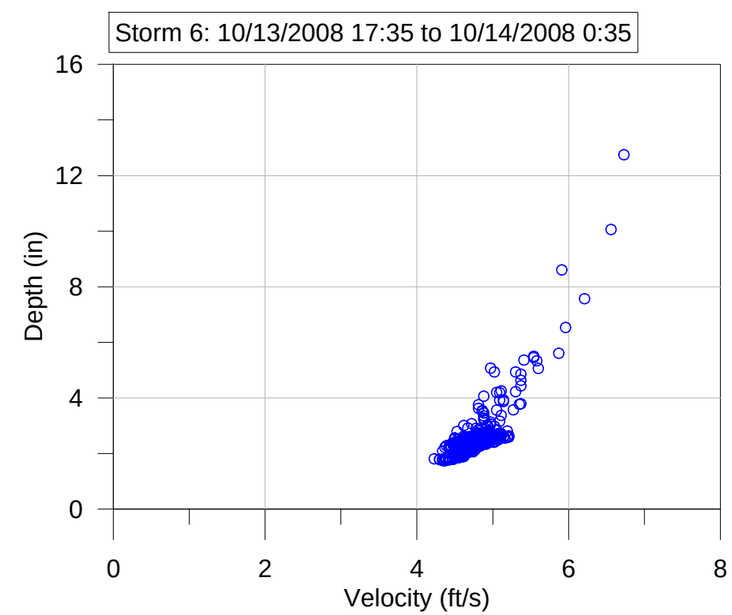




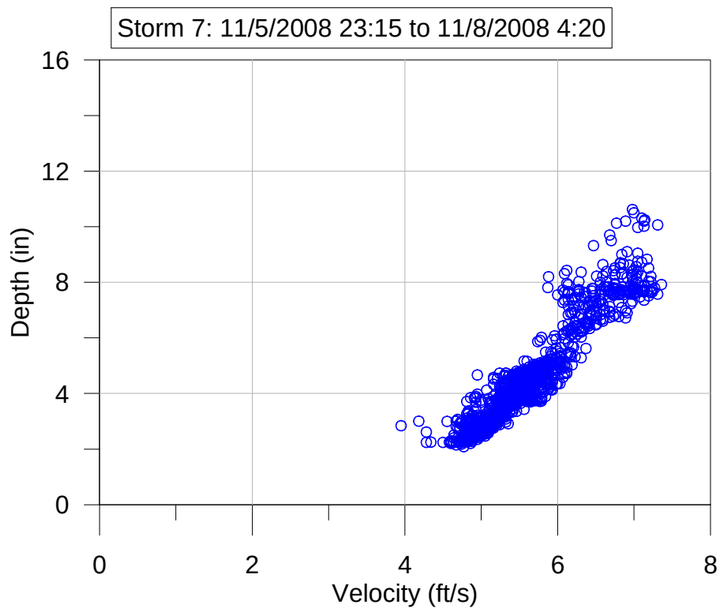


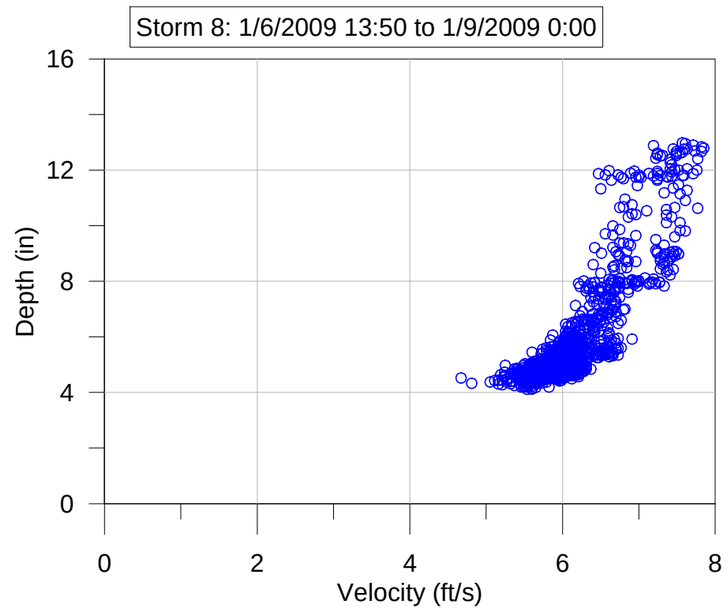


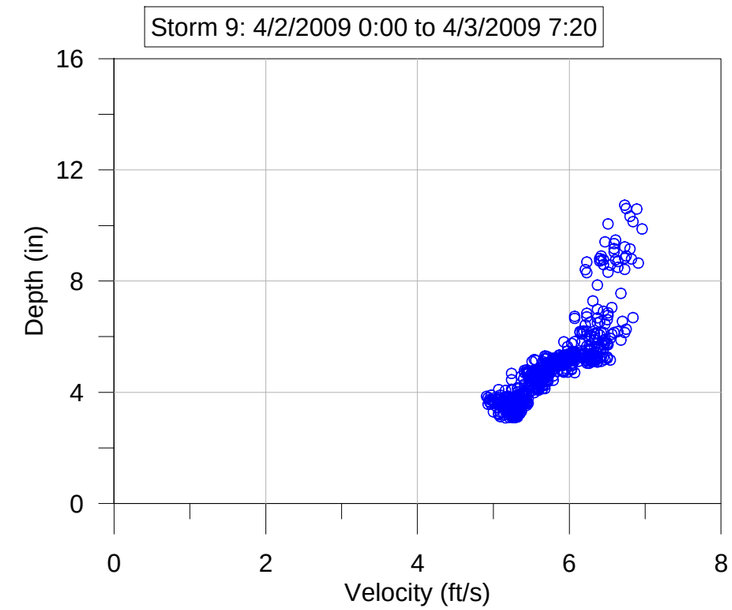


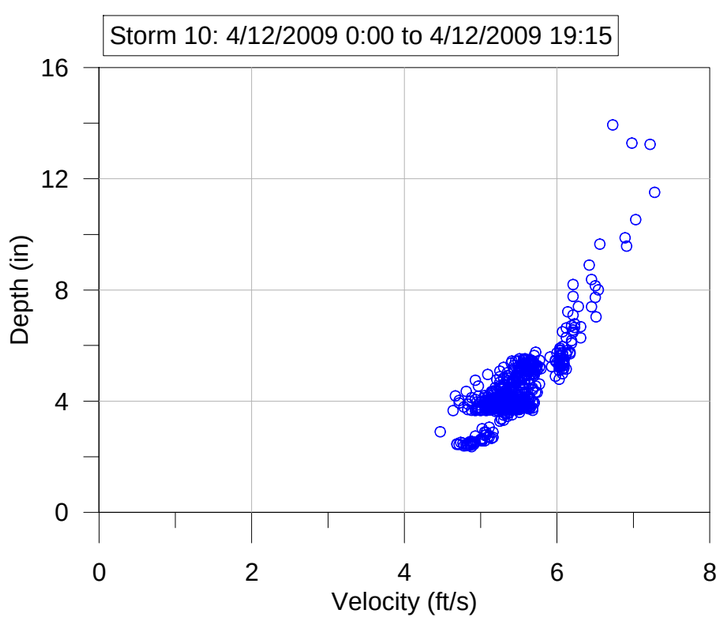


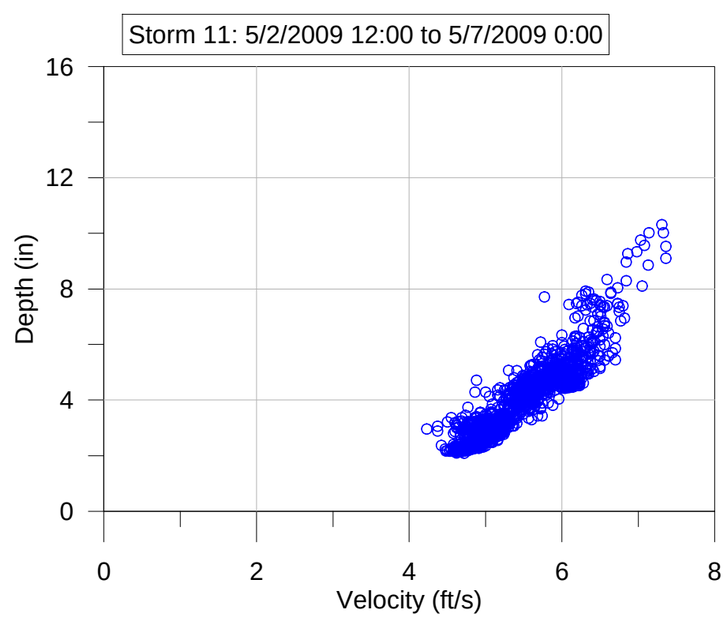
Calibration Storms - Scattergraphs
Monitor 073-276

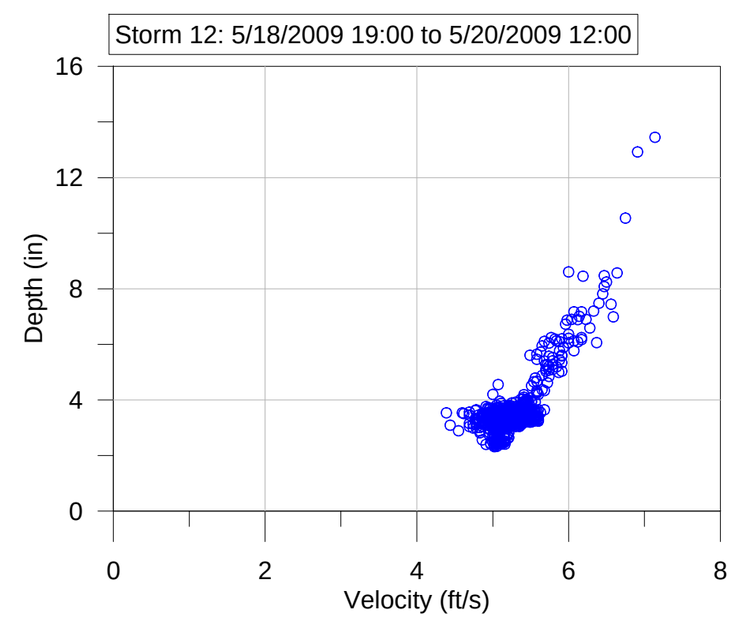




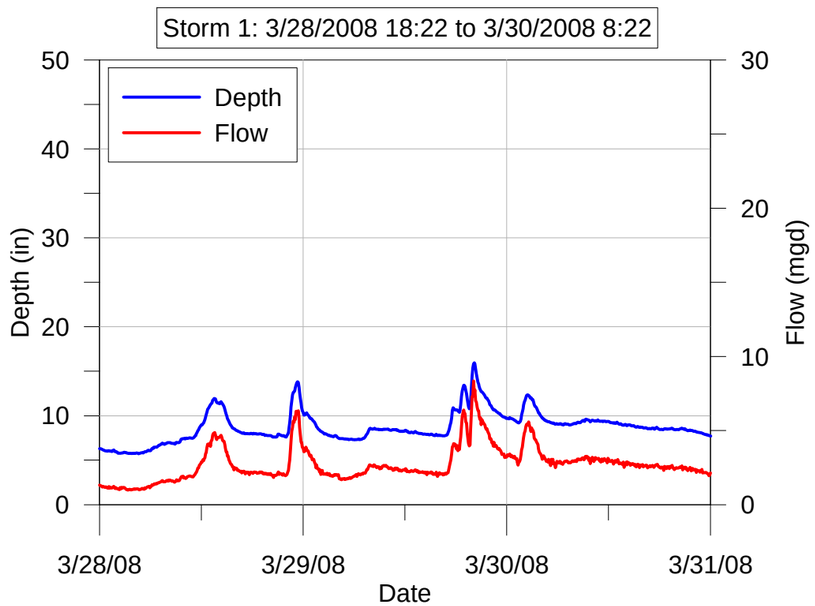


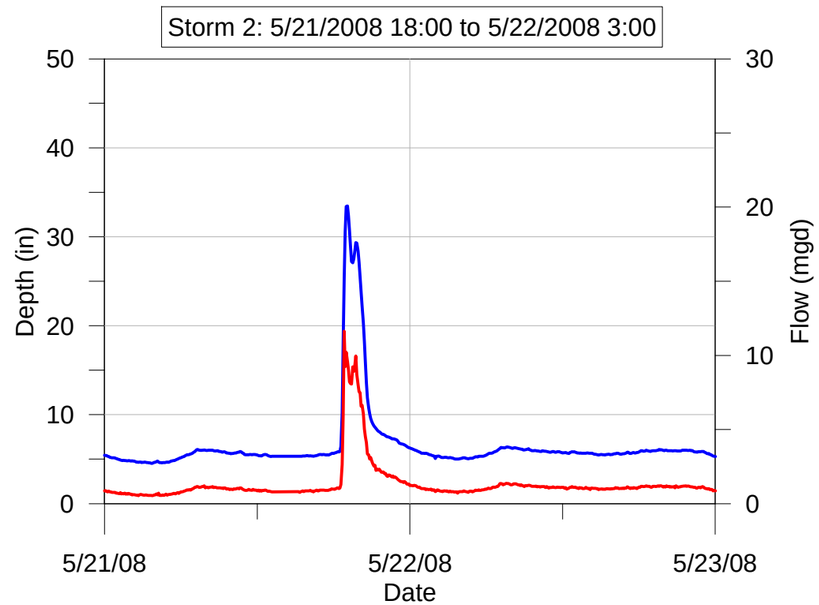


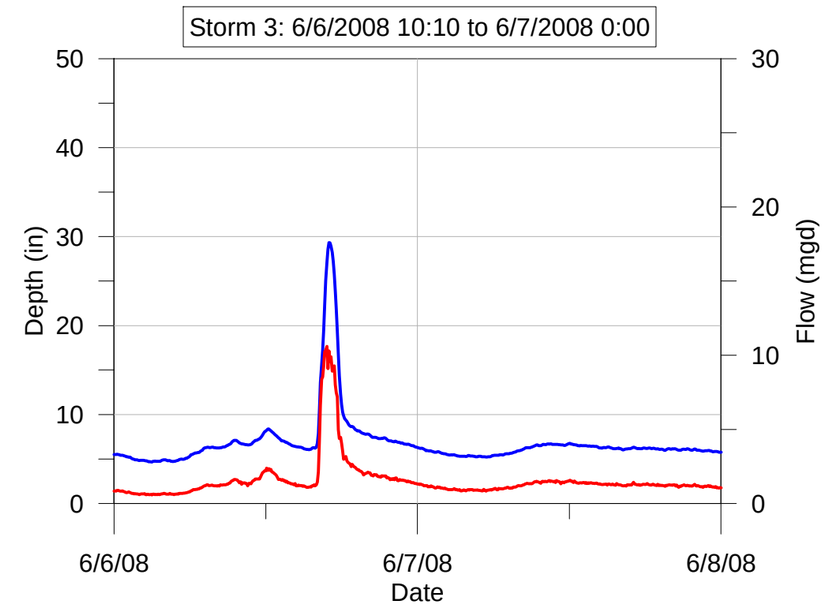


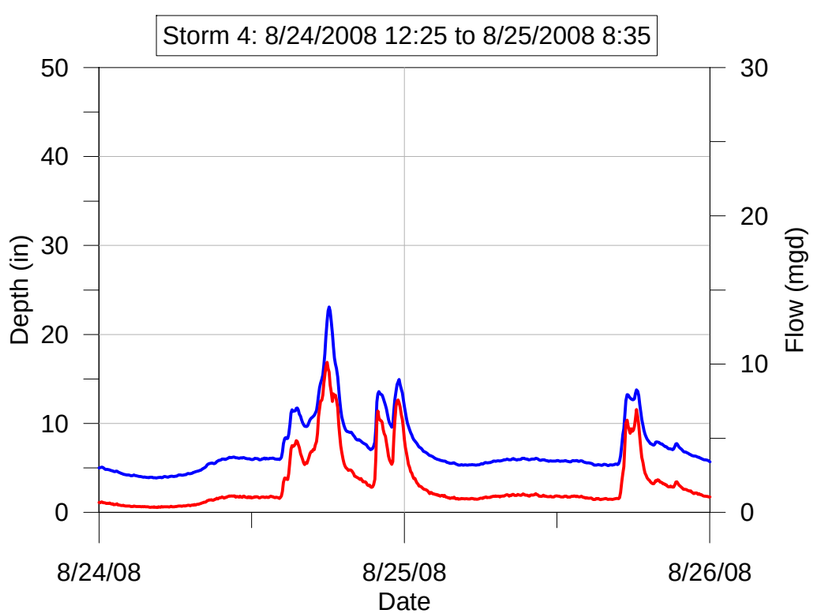


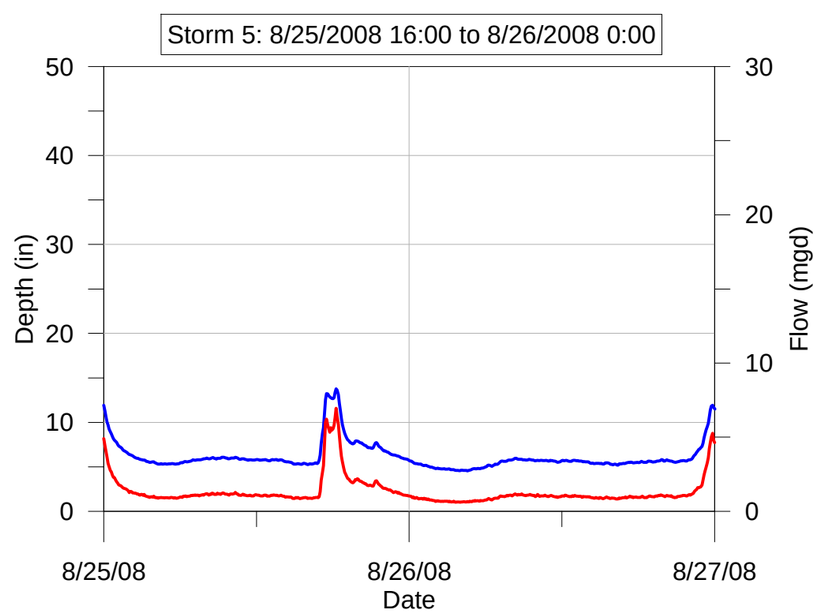
Calibration Storms
Monitor 080-329

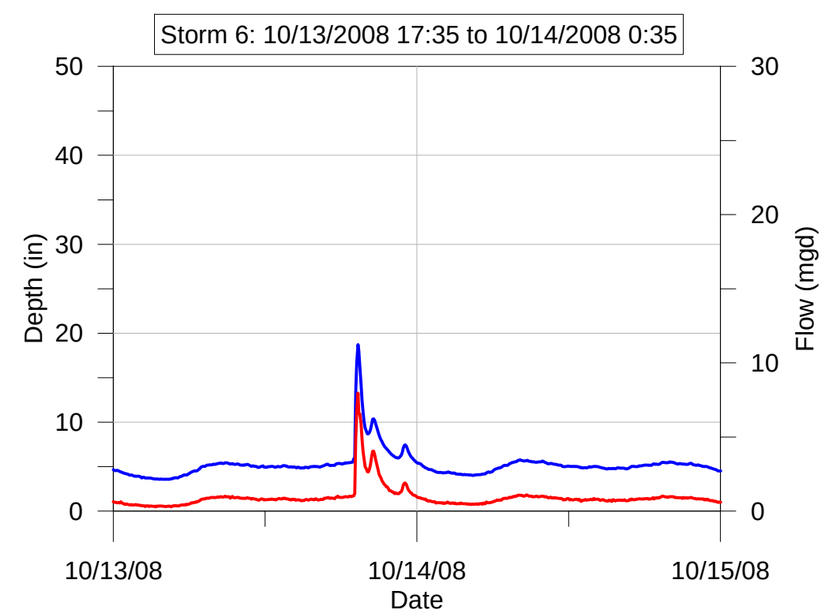




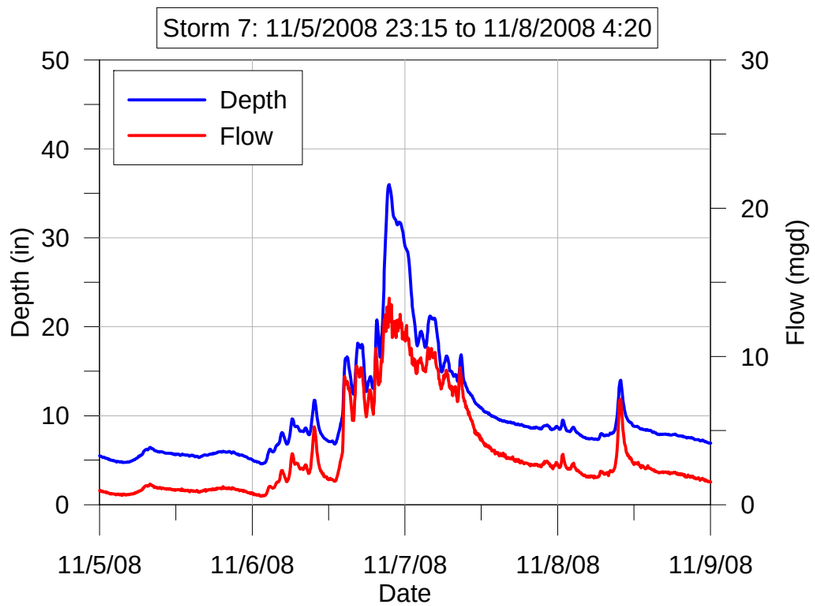


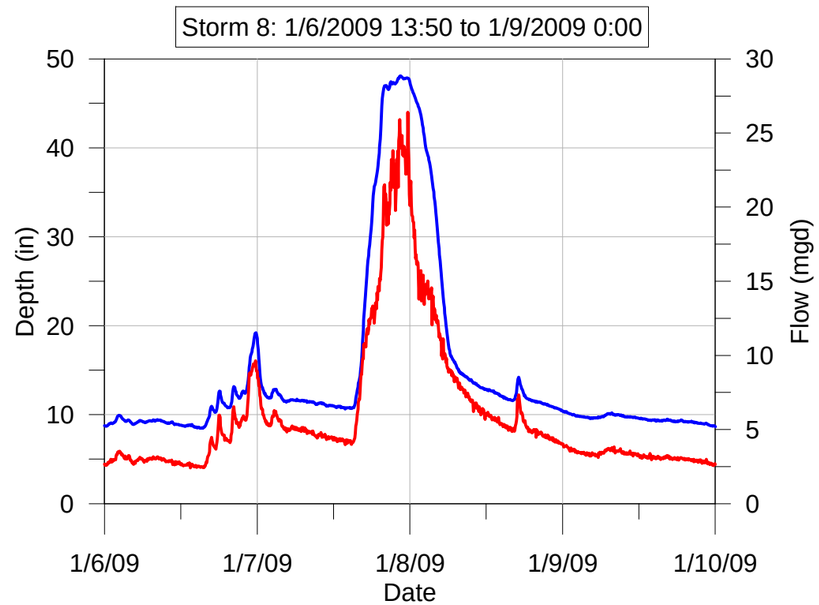


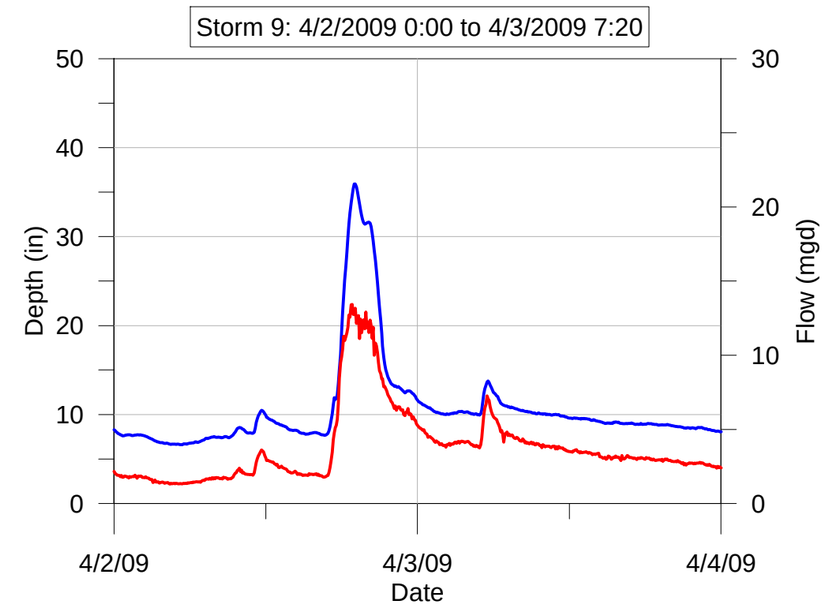


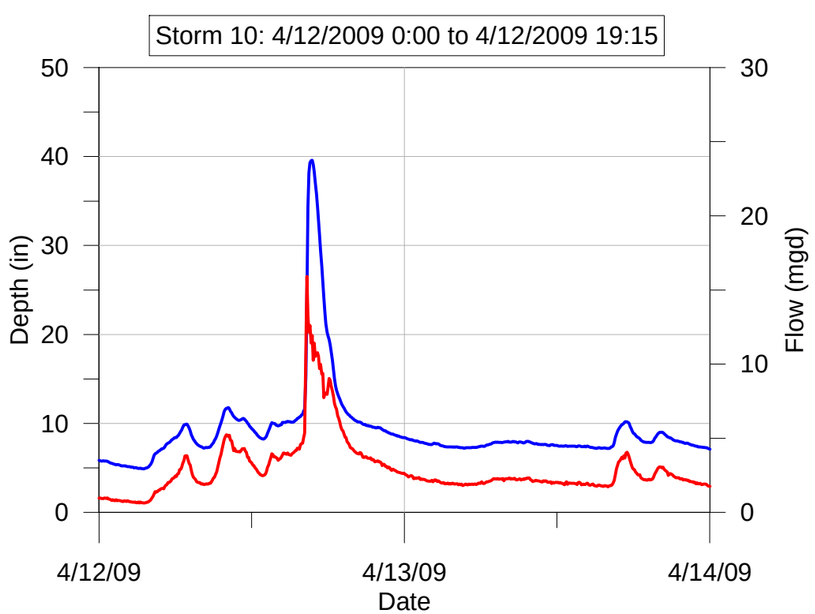


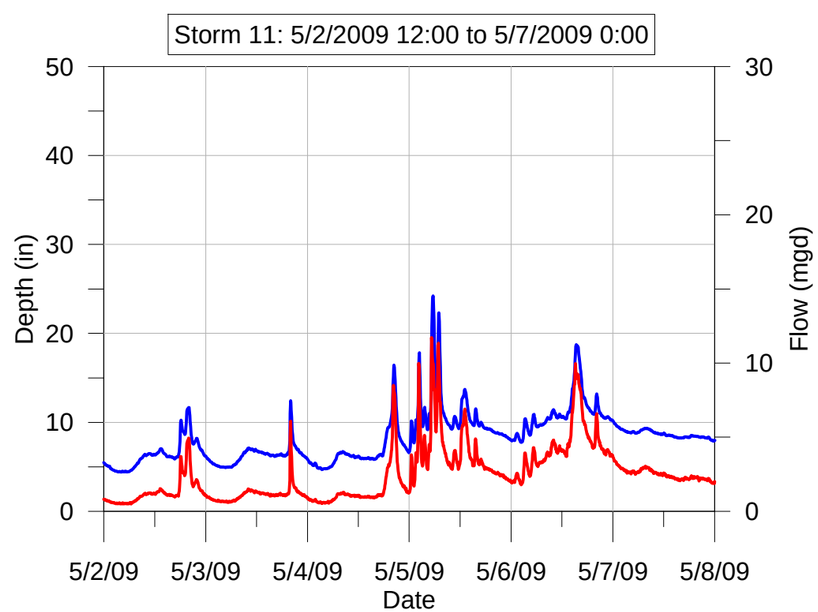
Calibration Storms
Monitor 080-329

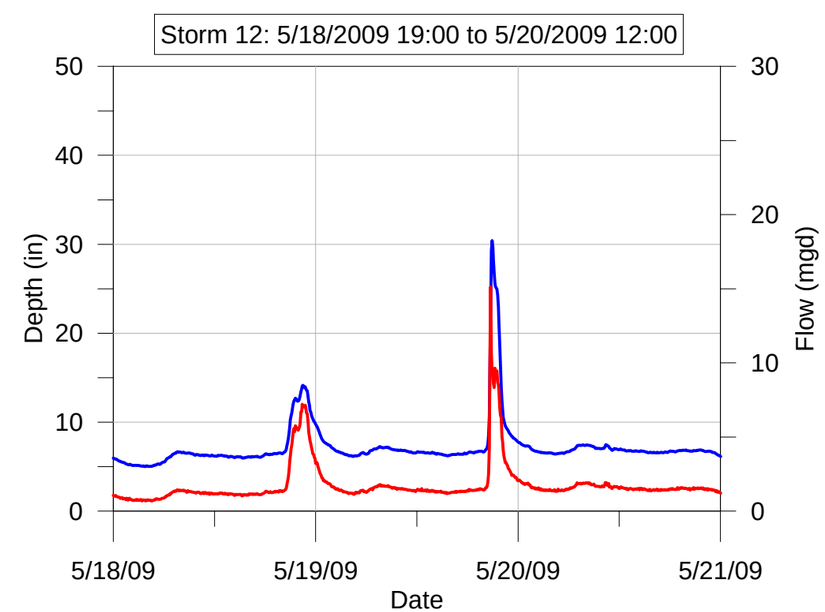




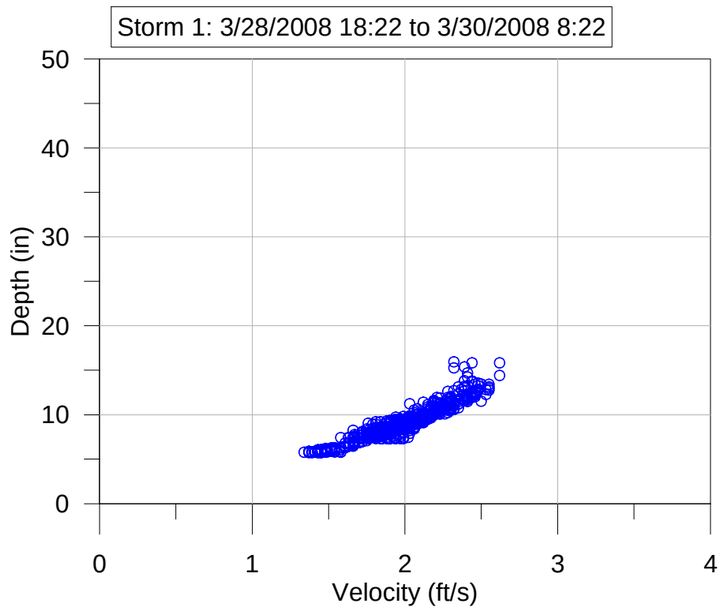


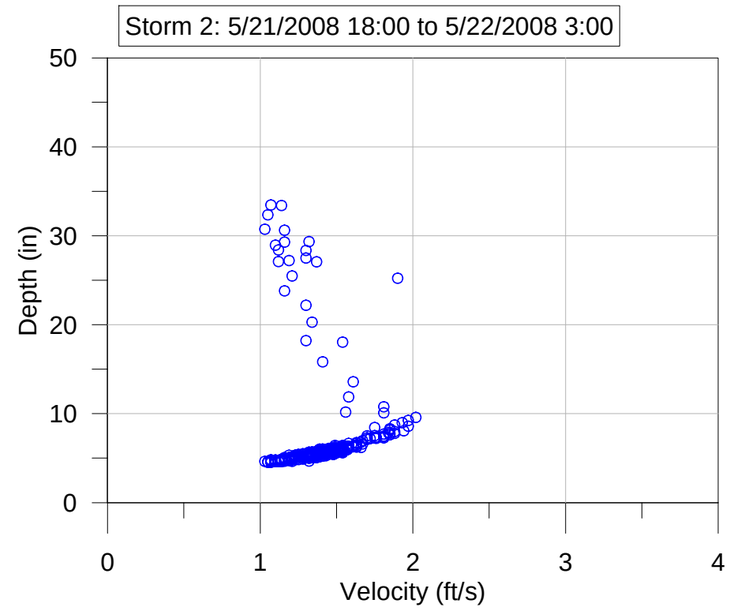


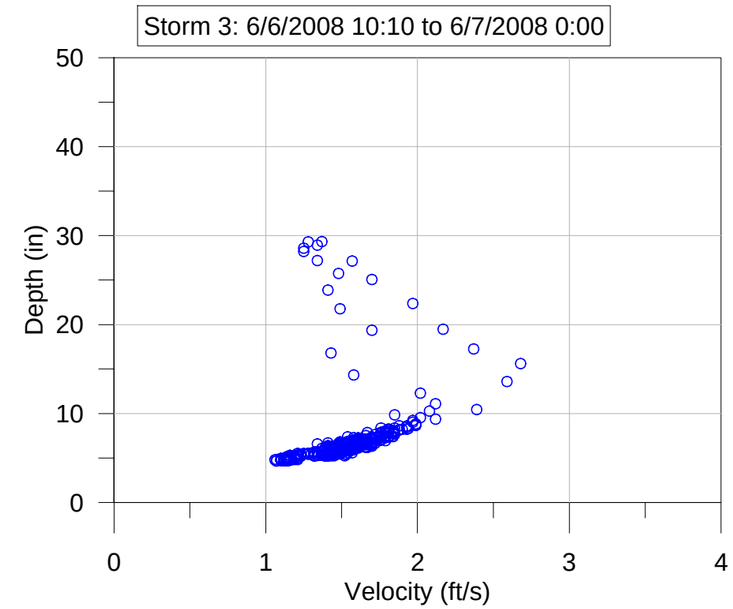


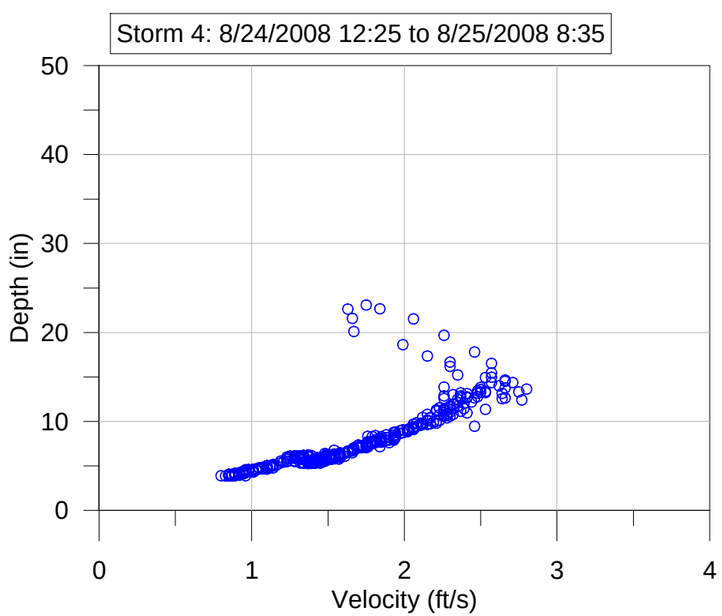


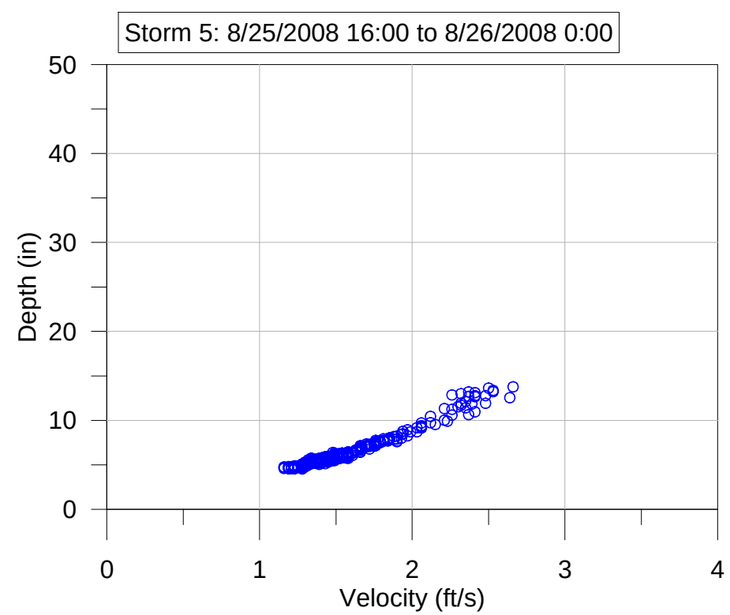
Calibration Storms - Scattergraphs
Monitor 080-329

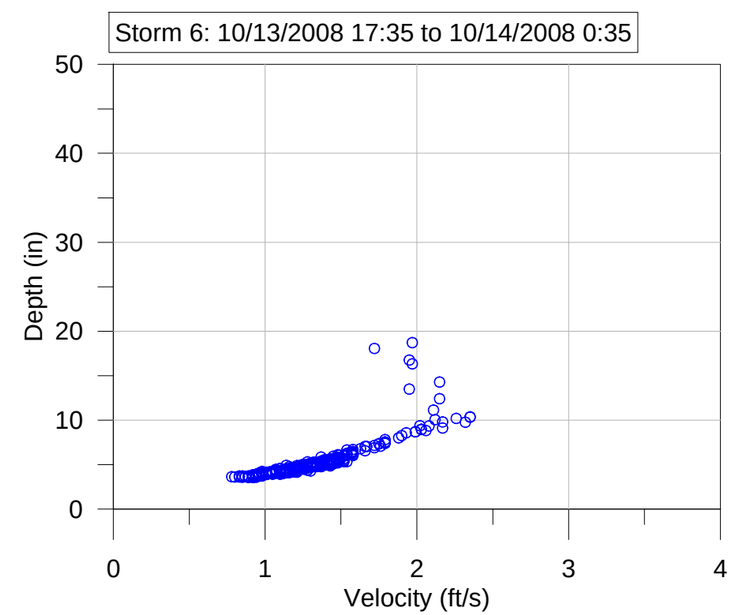




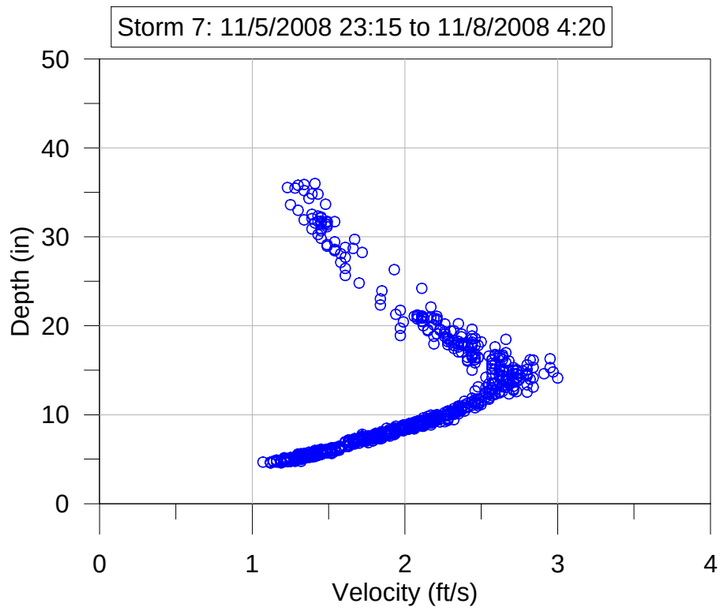


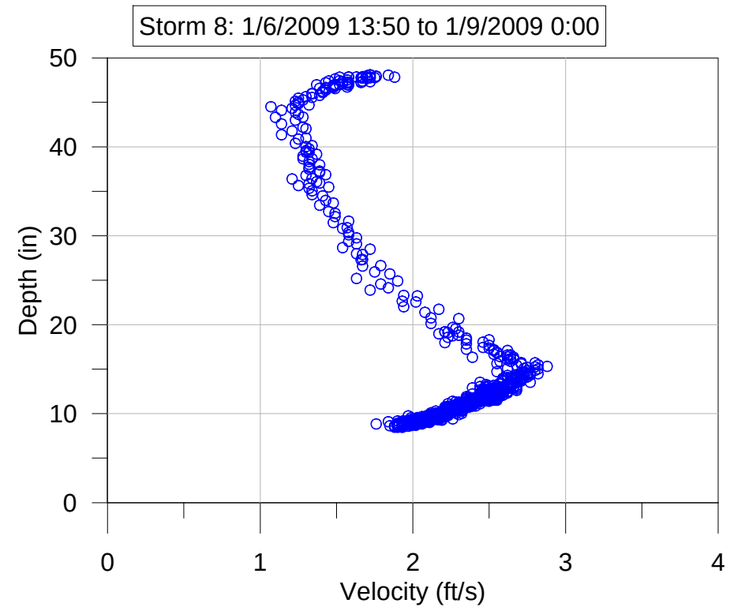


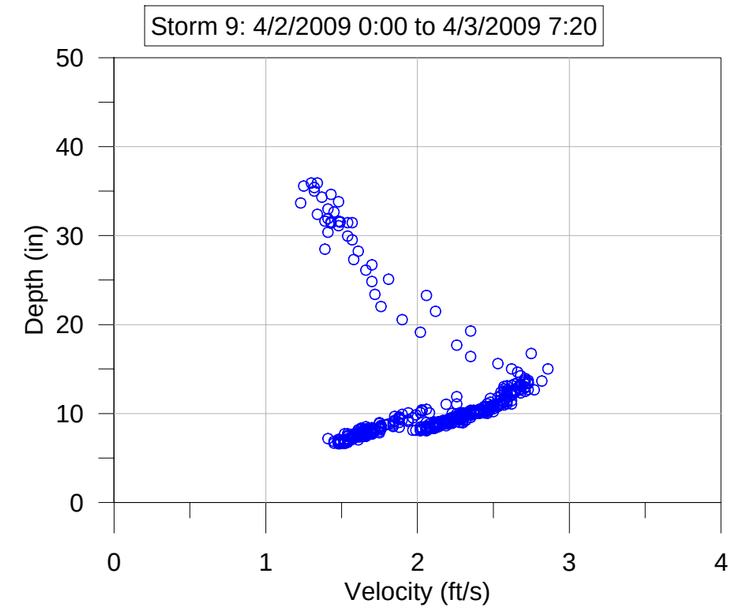


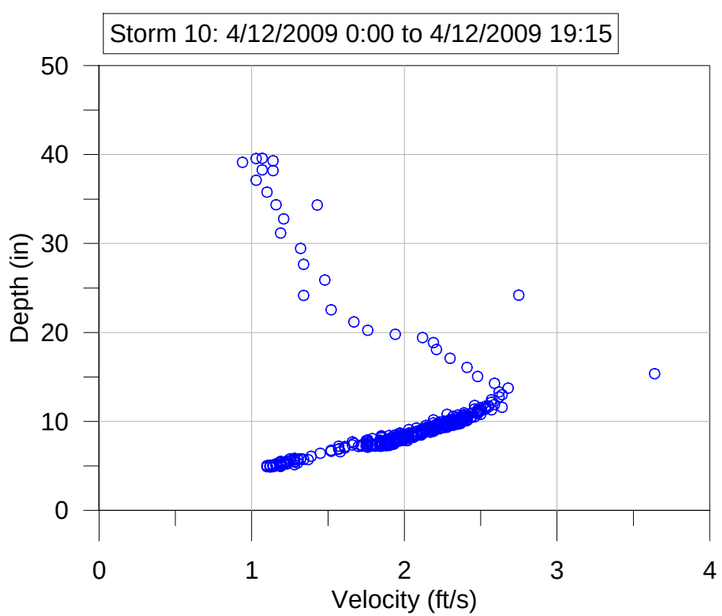


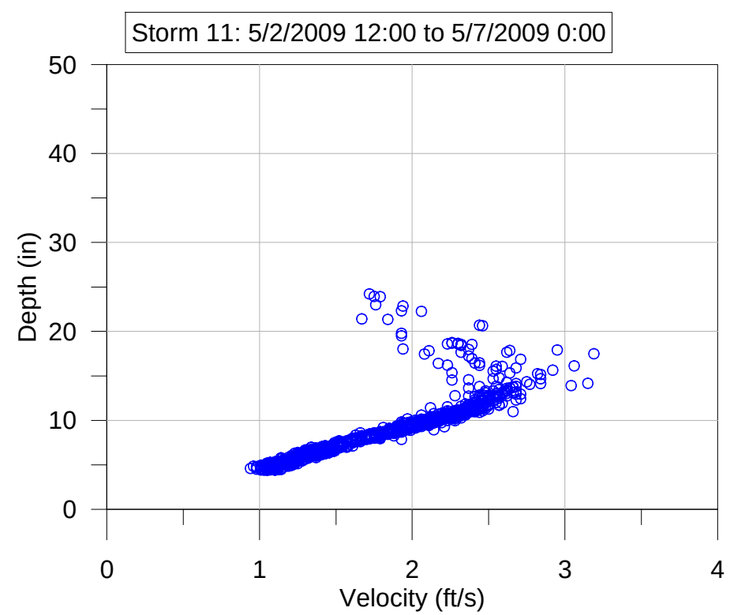
Calibration Storms - Scattergraphs
Monitor 080-329

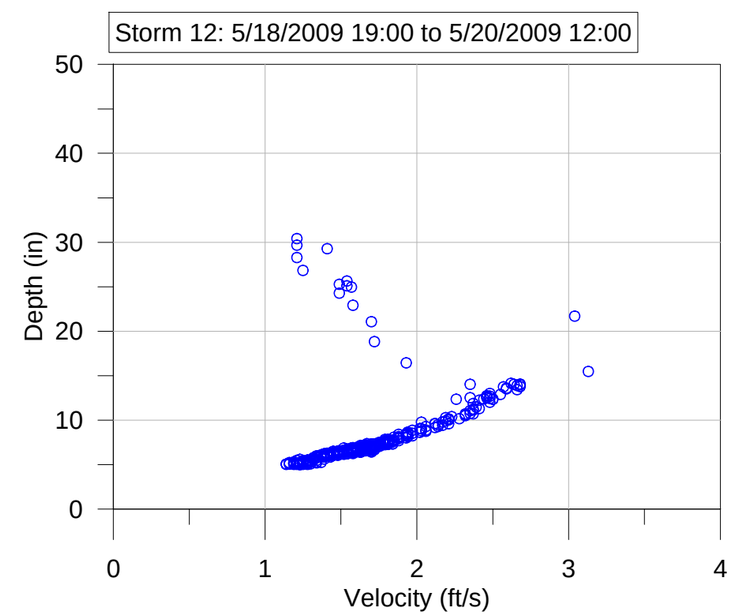




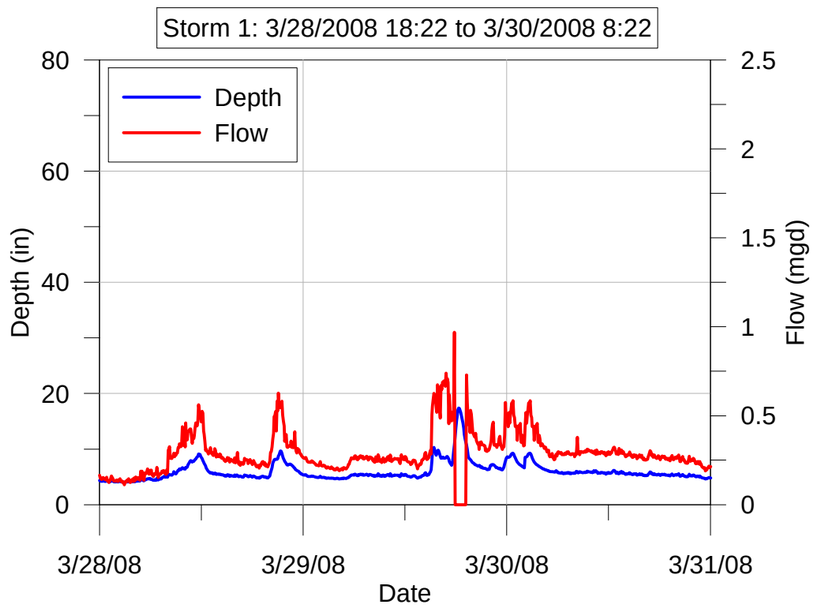


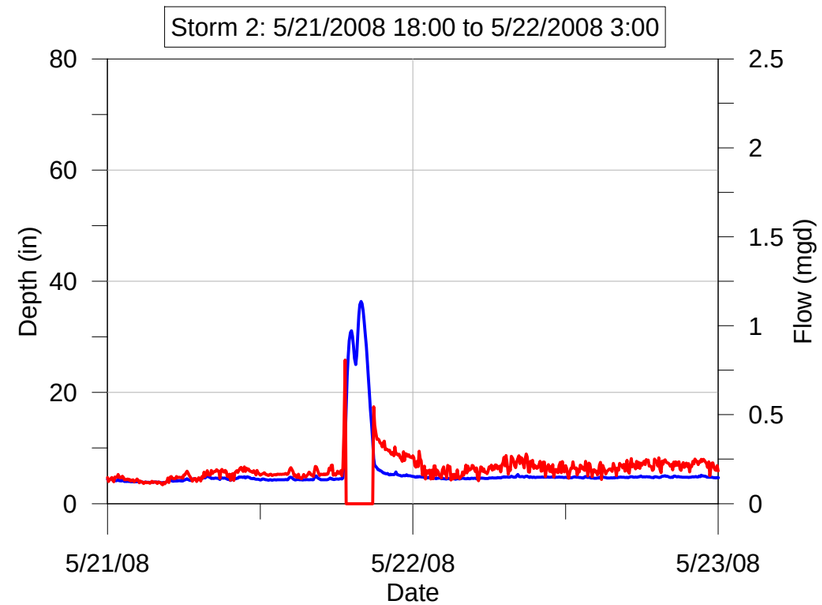


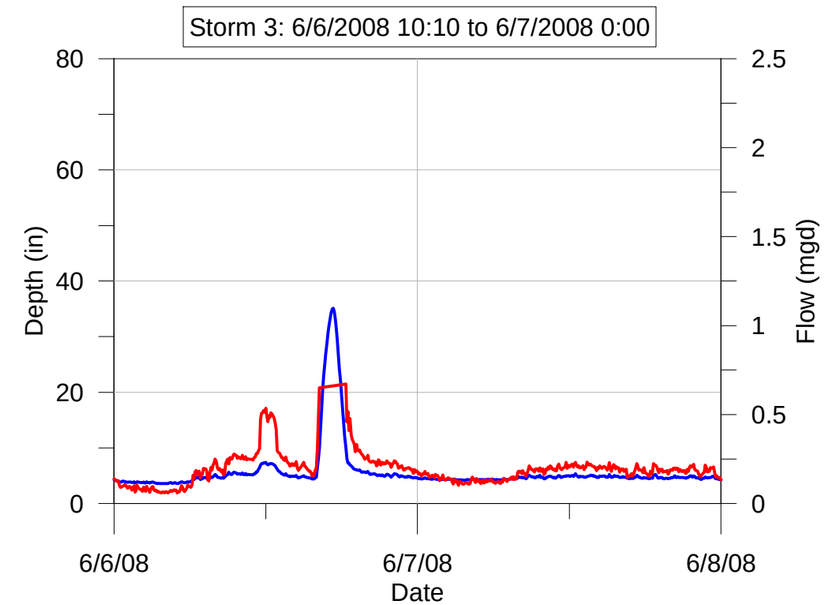


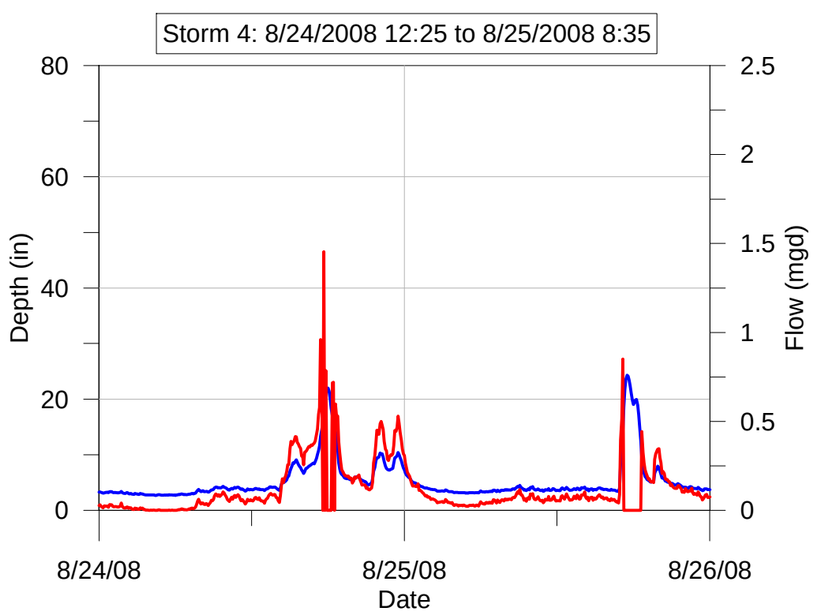


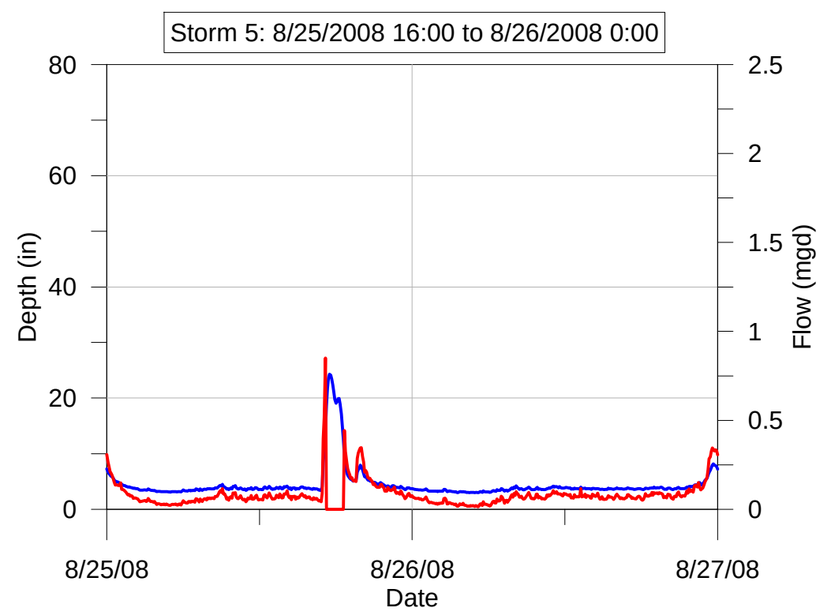
Calibration Storms
Monitor 081-239

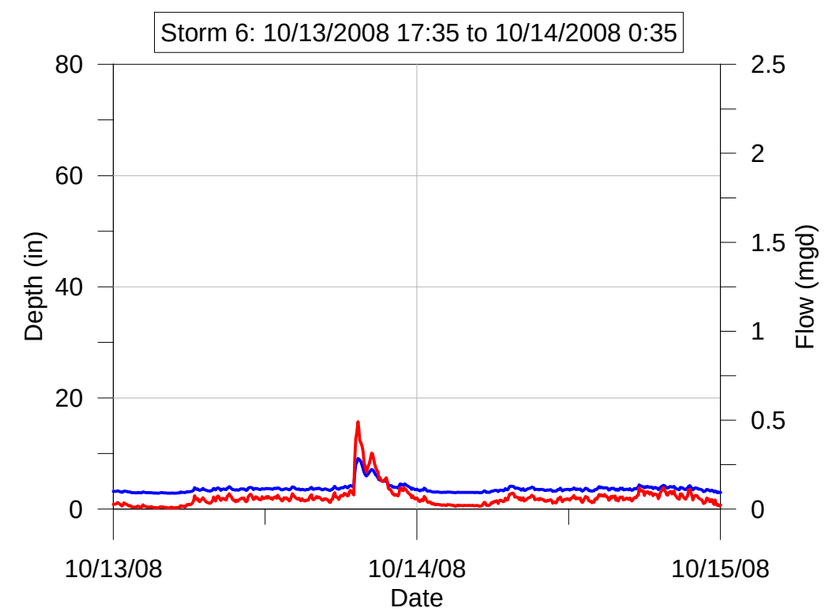




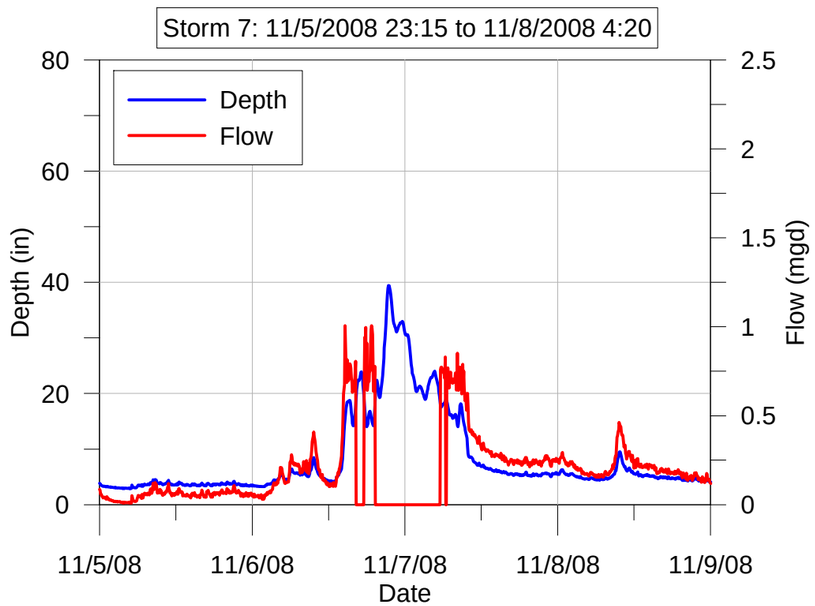


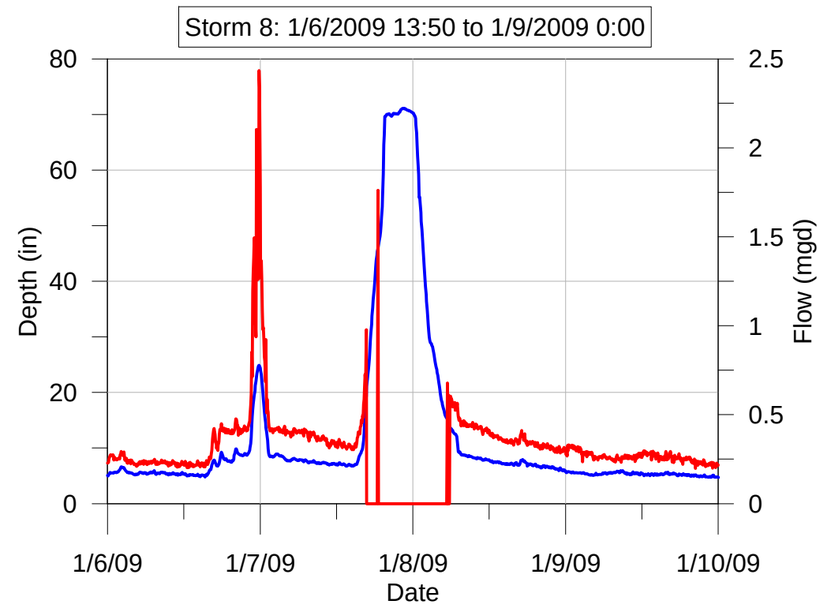


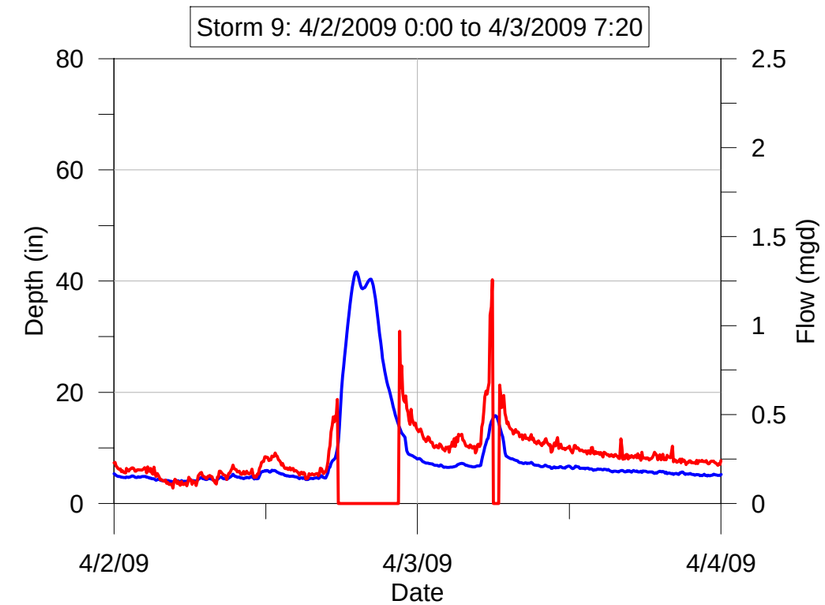


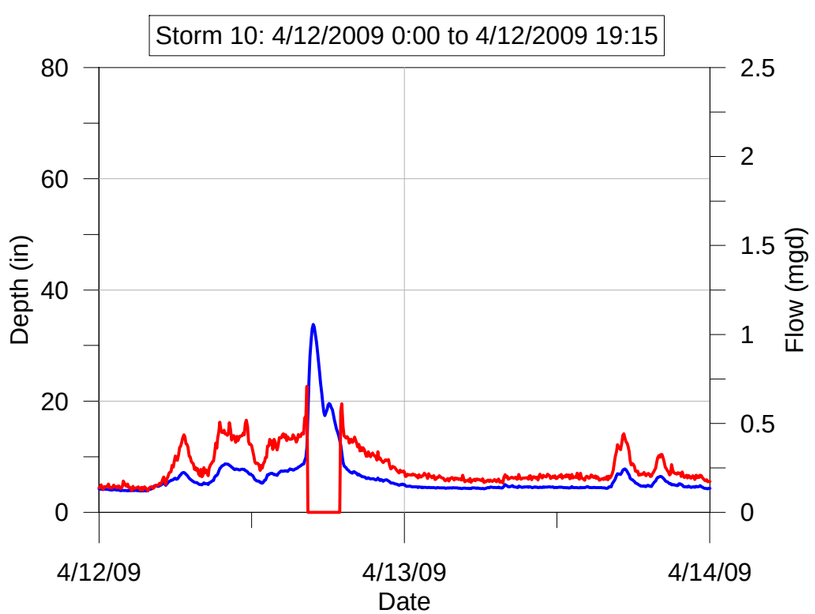


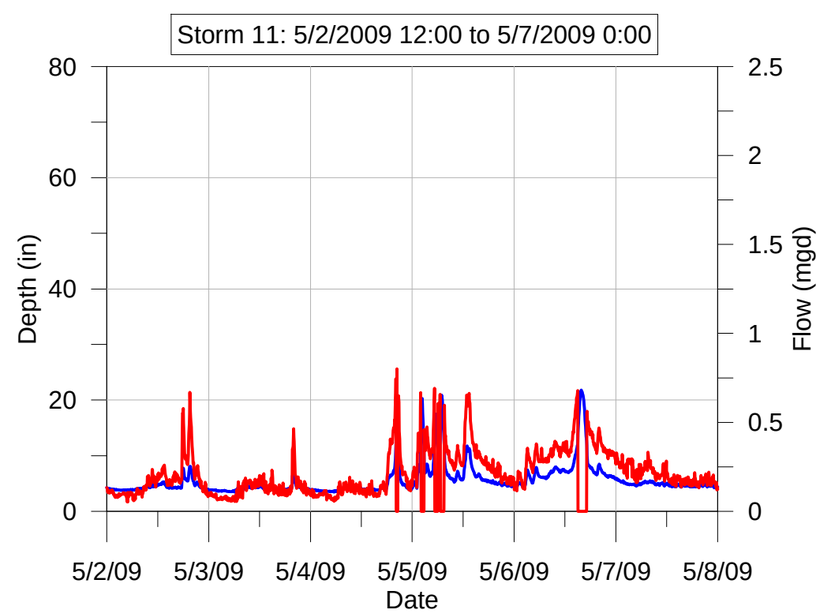
Calibration Storms
Monitor 081-239

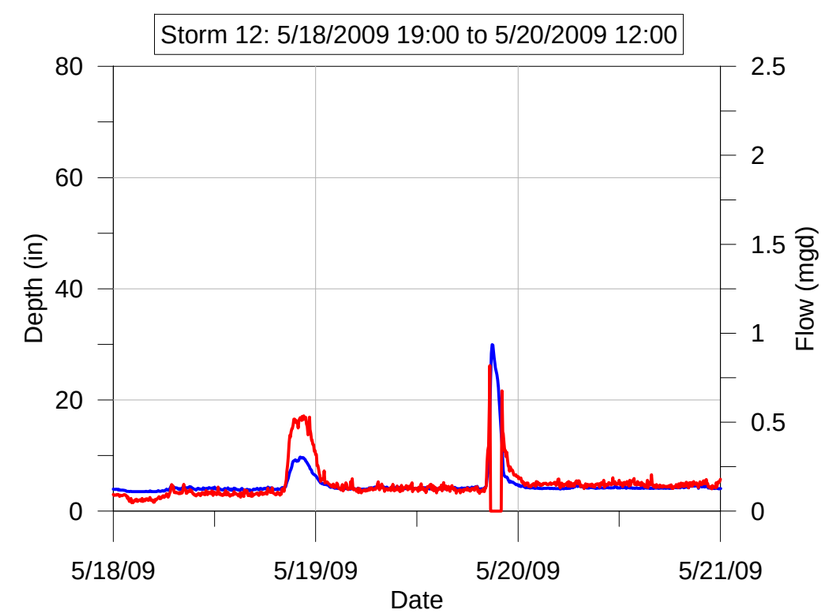




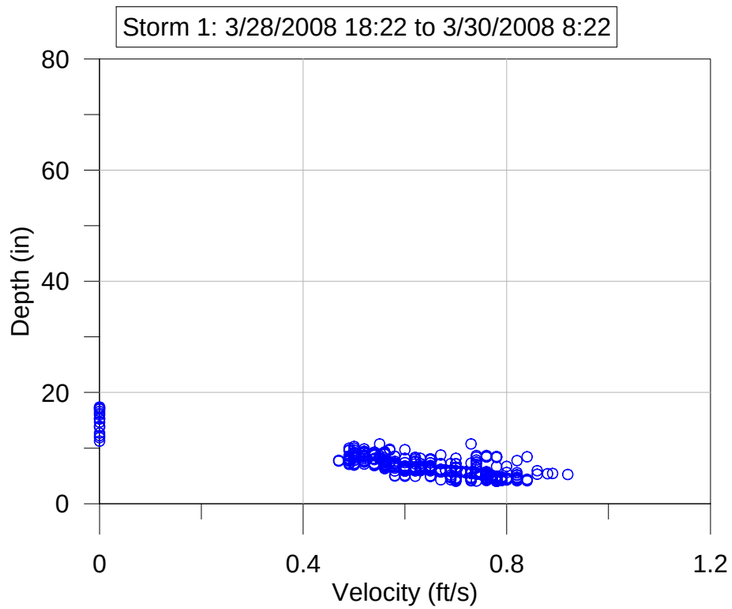


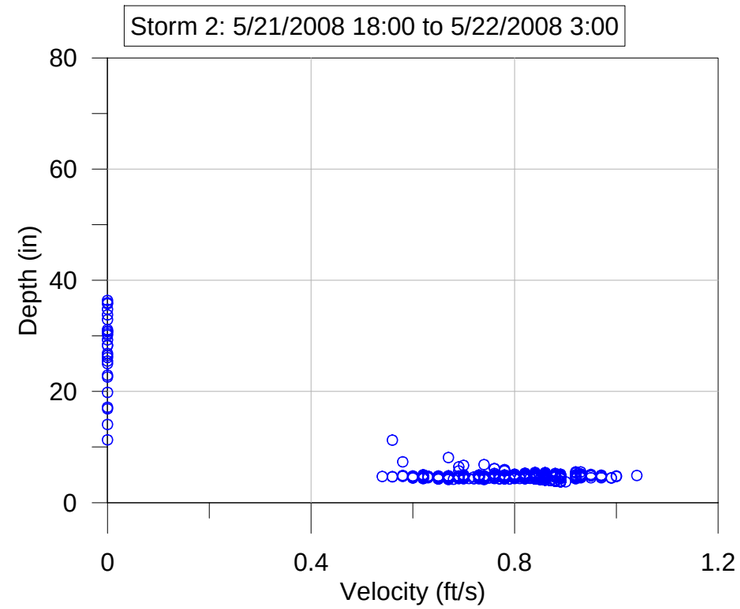


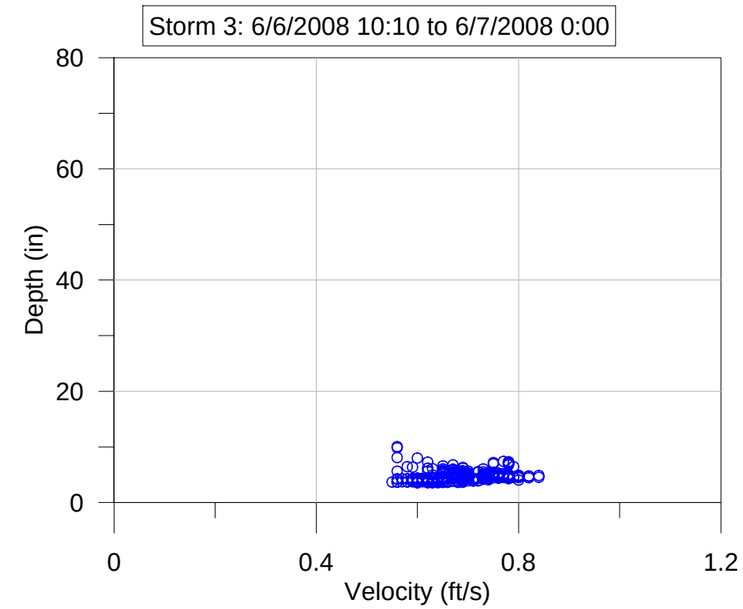


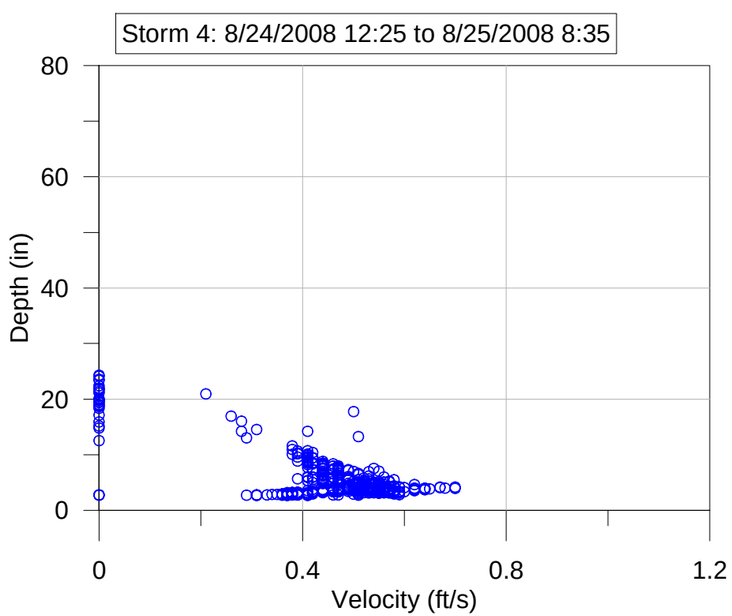


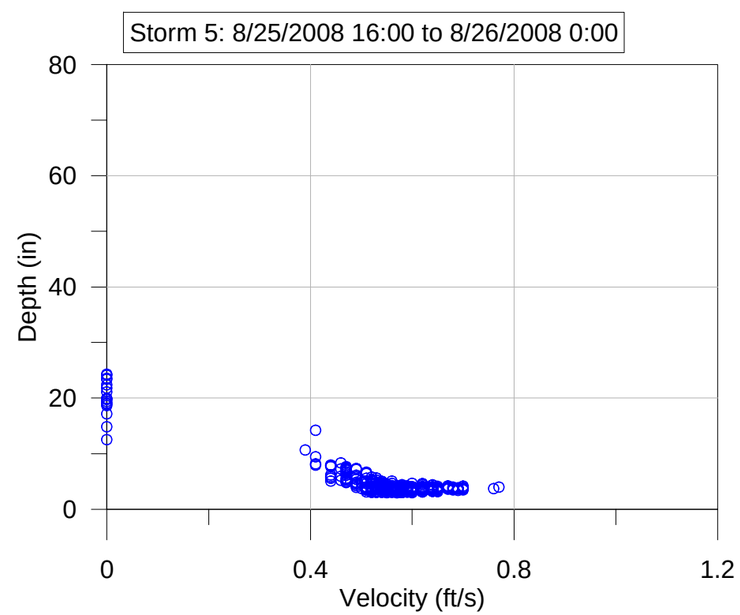
Calibration Storms - Scattergraphs
Monitor 081-239

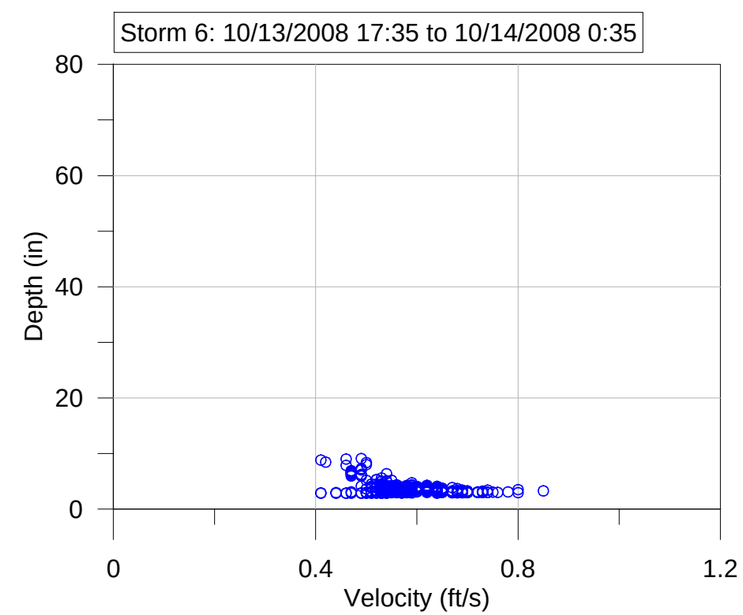




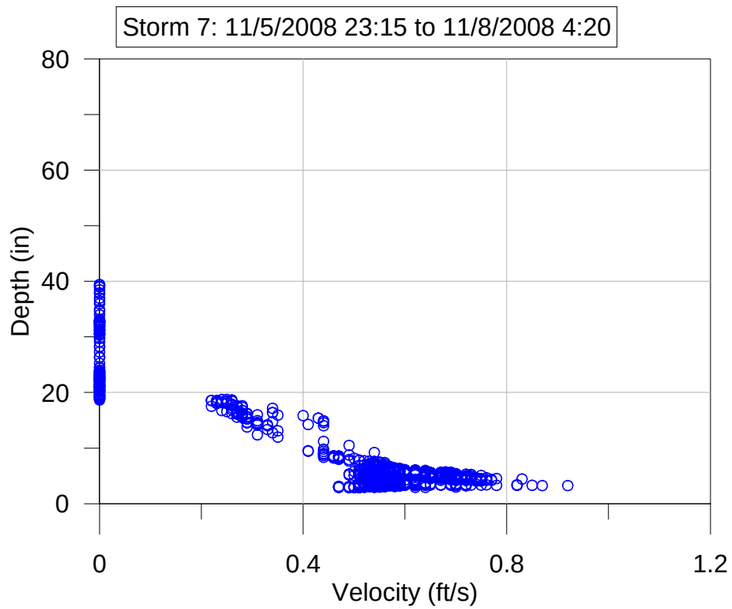


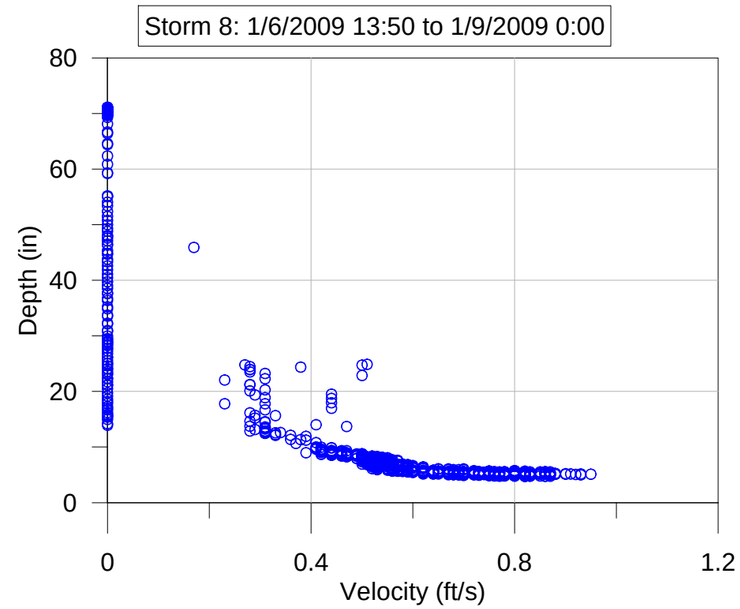


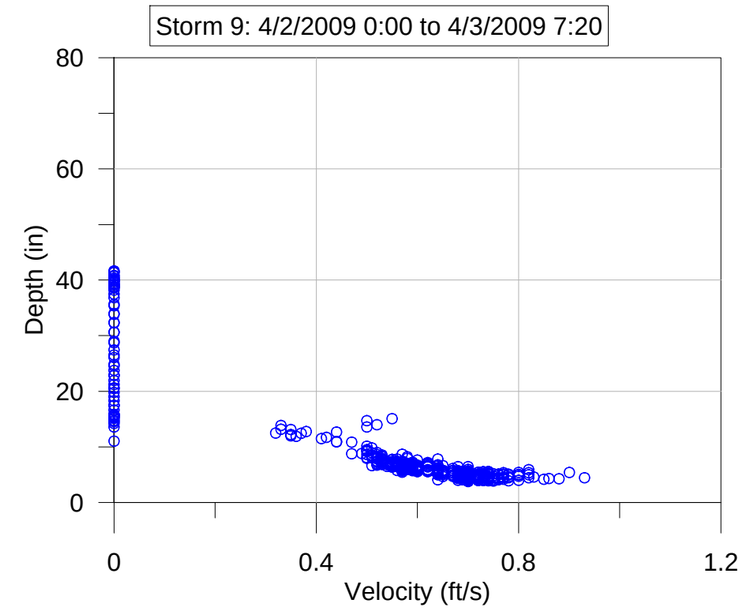


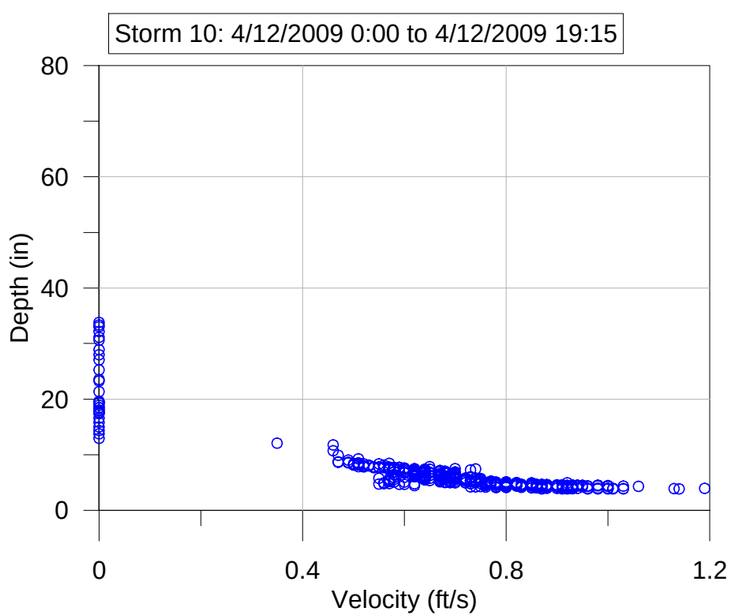


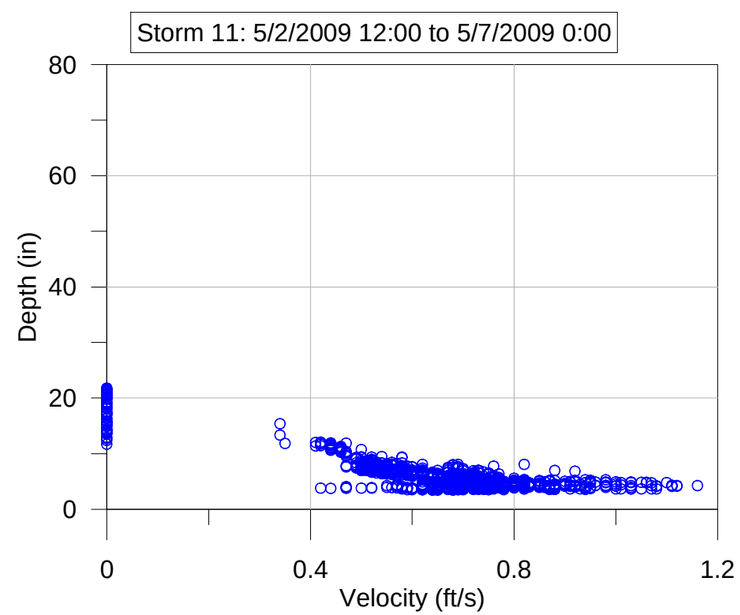
Calibration Storms - Scattergraphs
Monitor 081-239

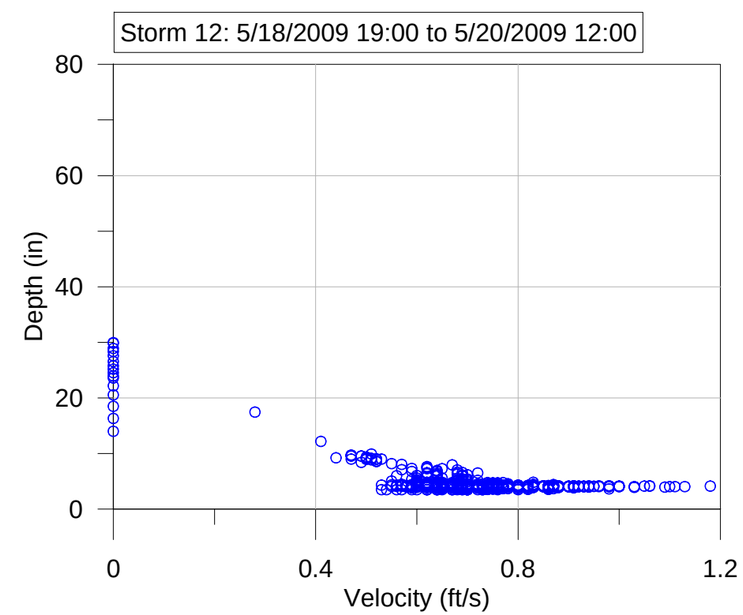




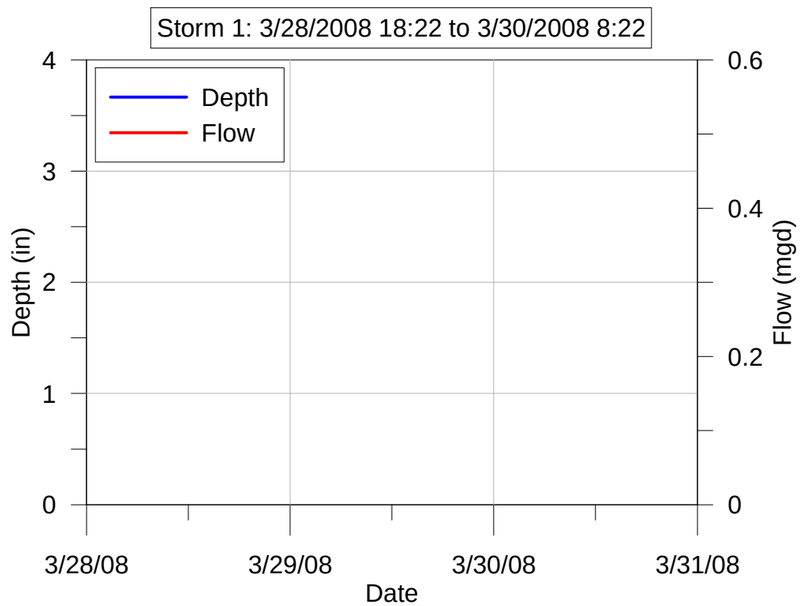


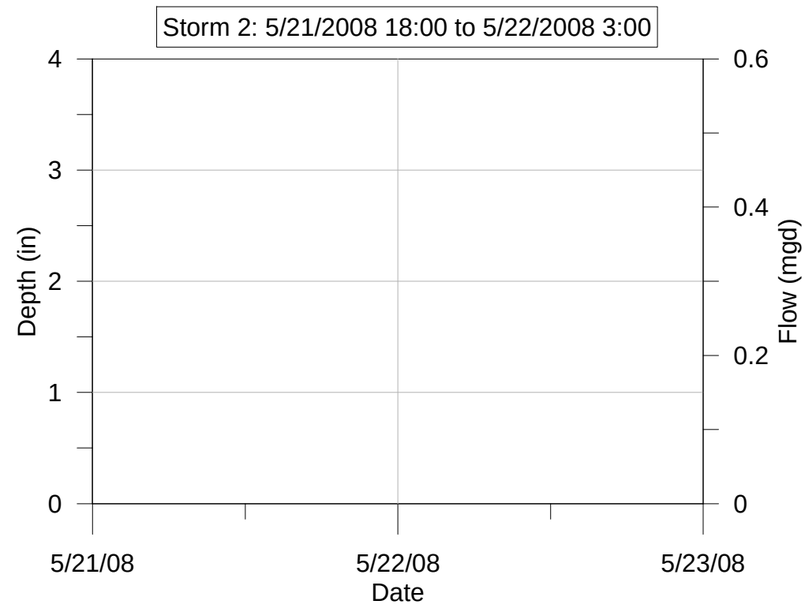


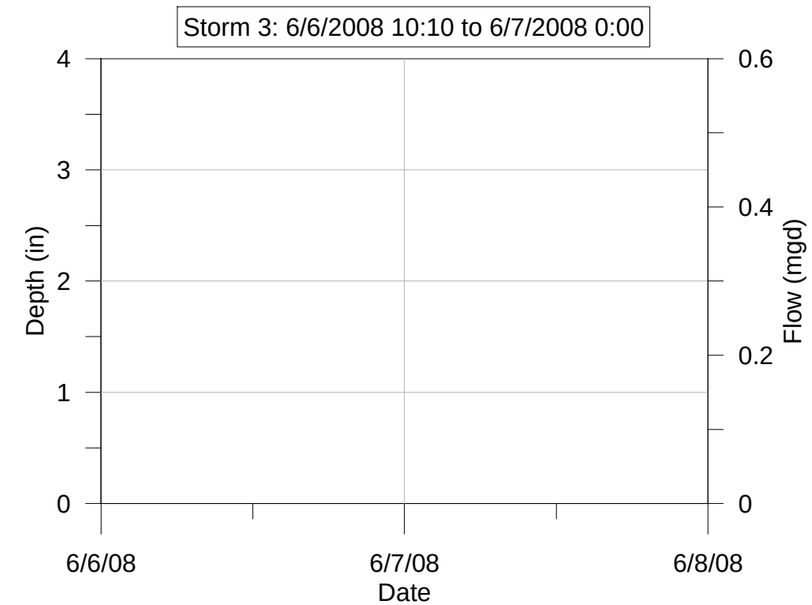


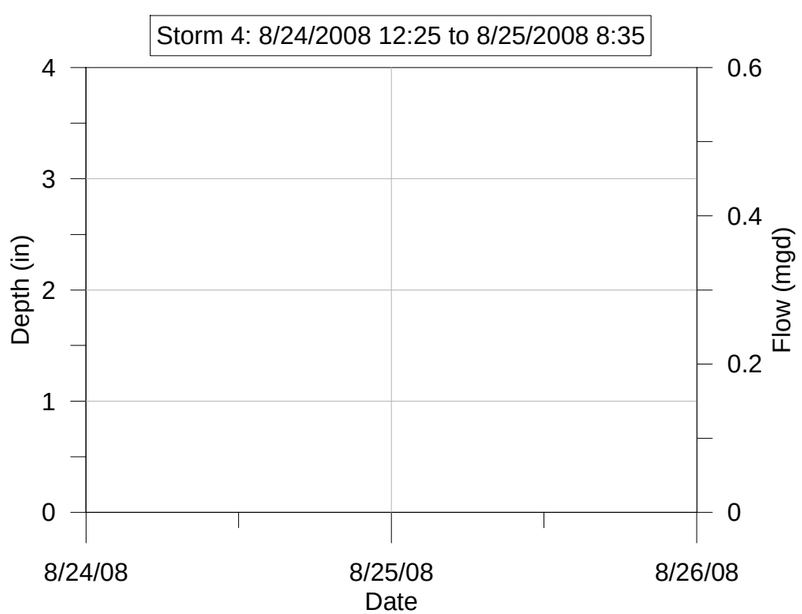


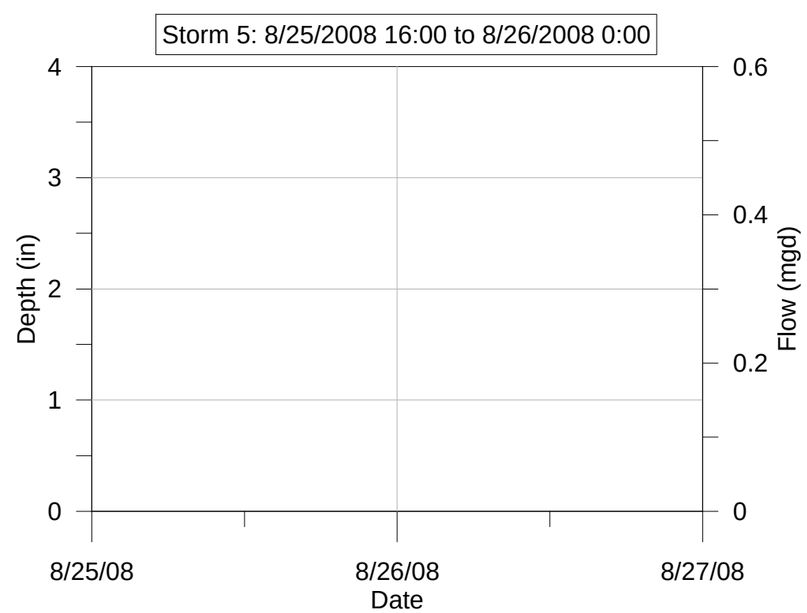
Calibration Storms
Monitor 081-049

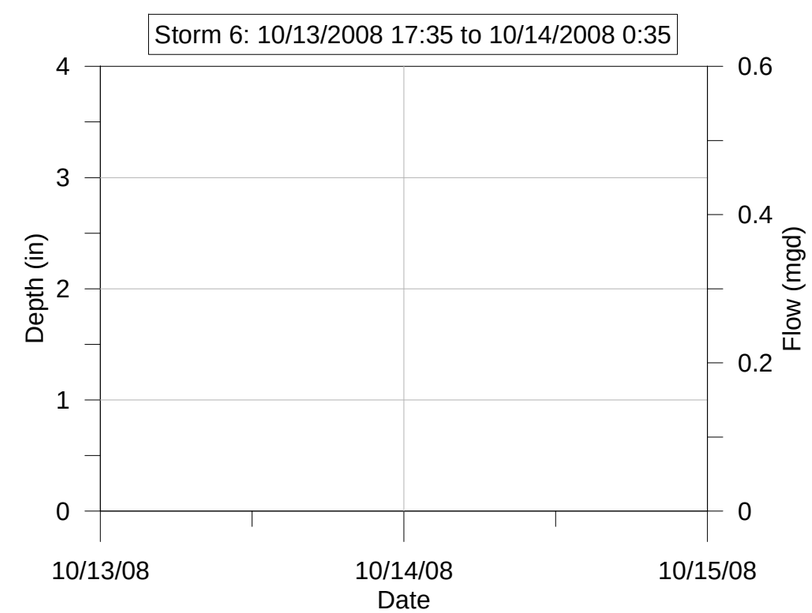




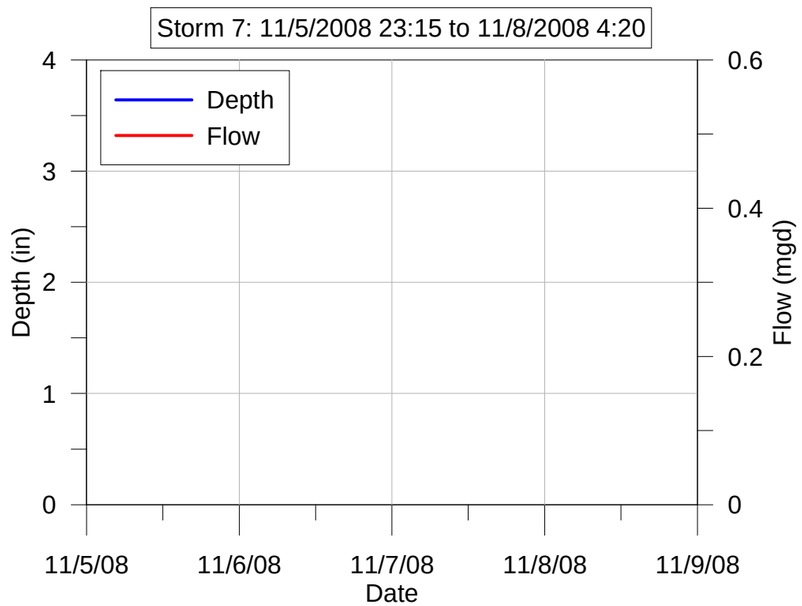


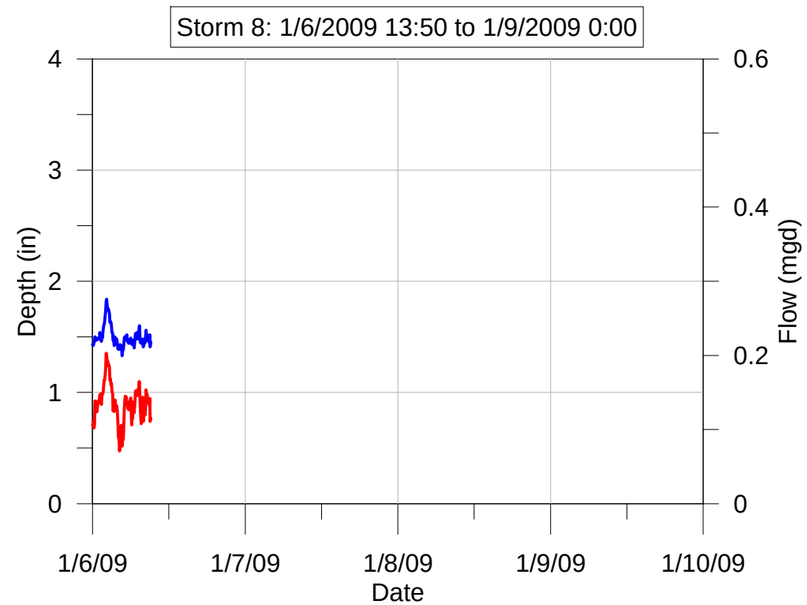


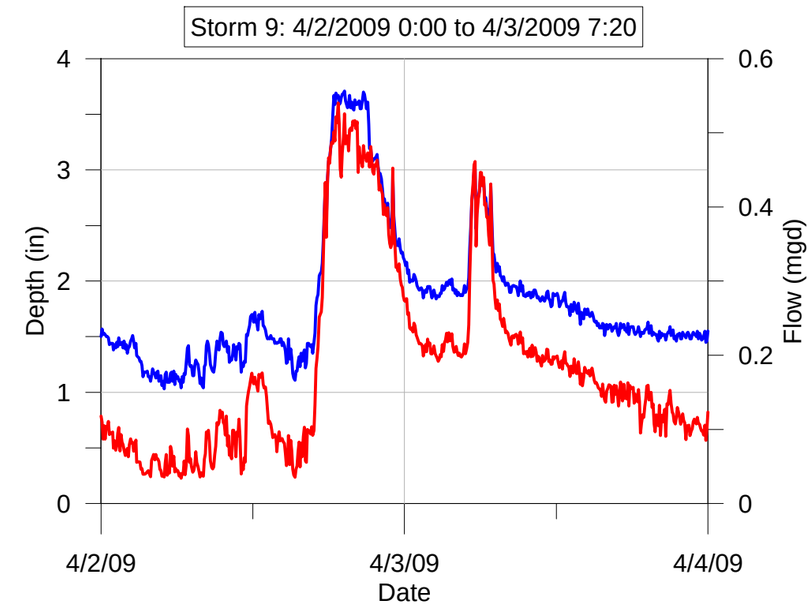


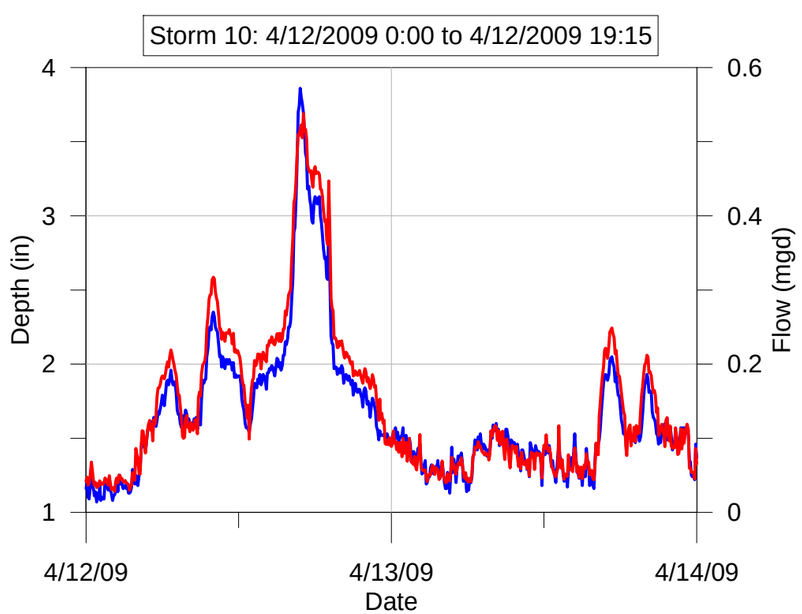


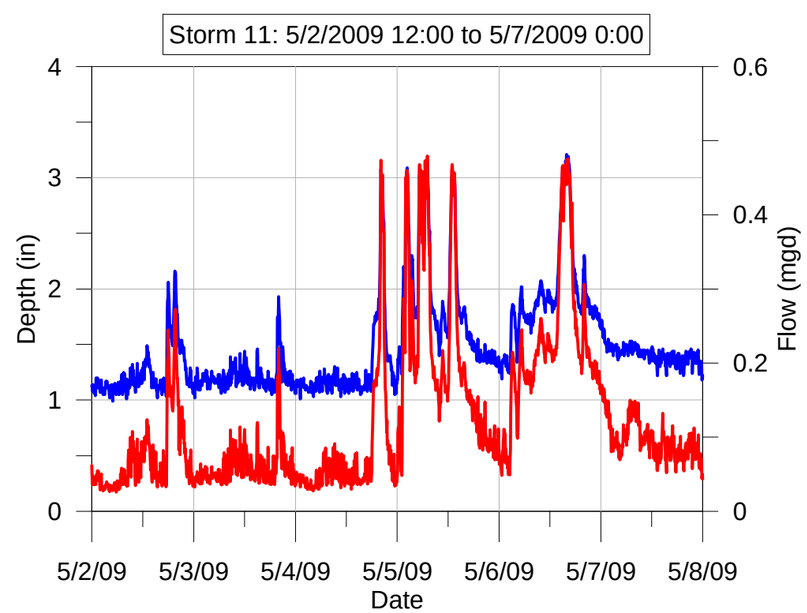
Calibration Storms
Monitor 081-049

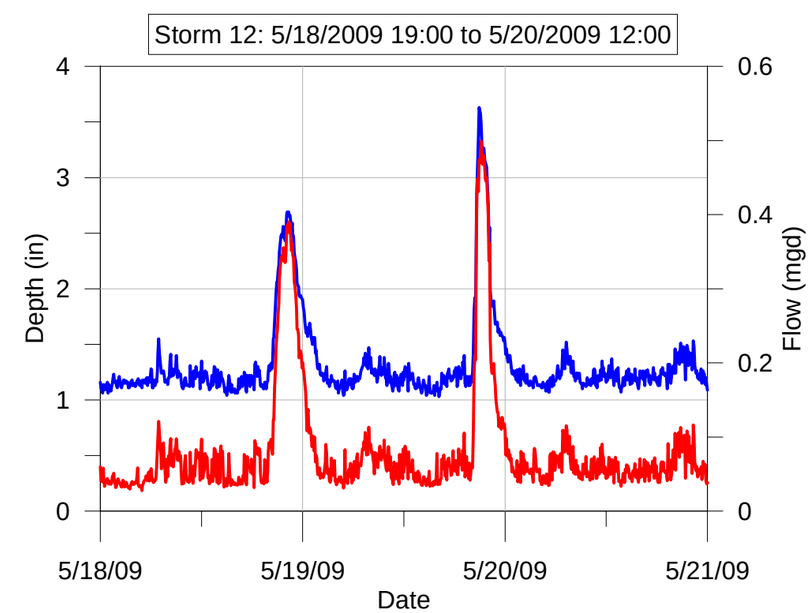




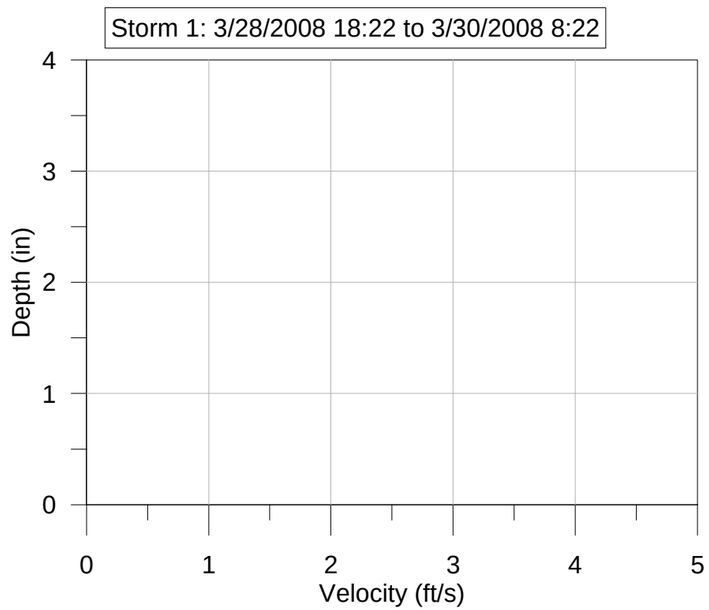


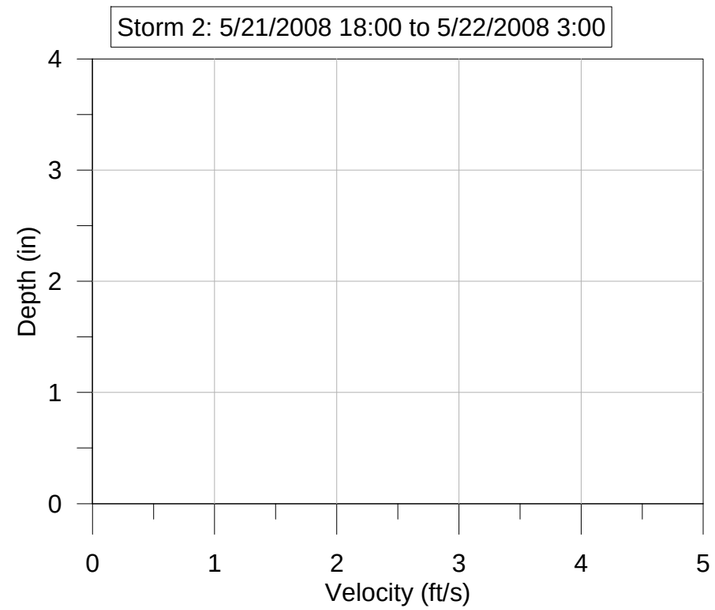


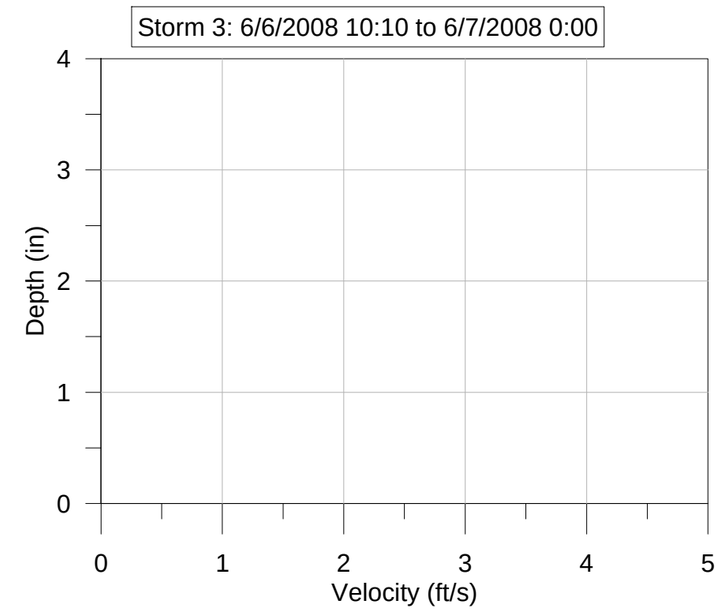


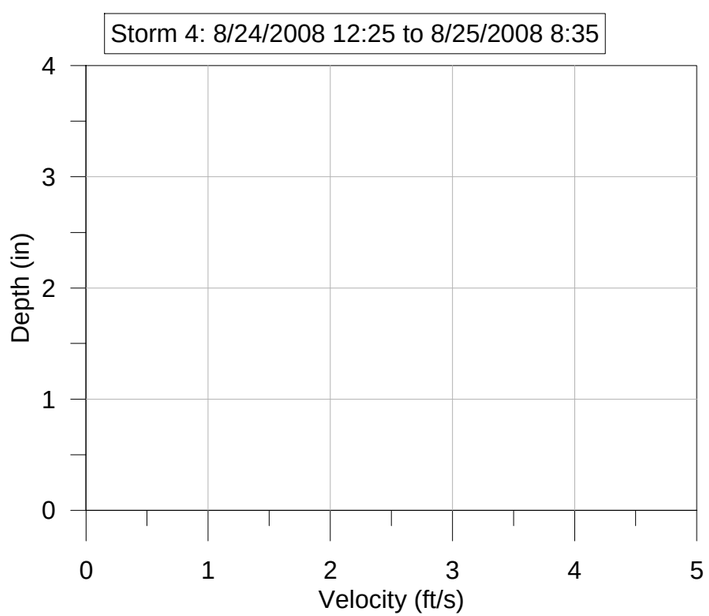


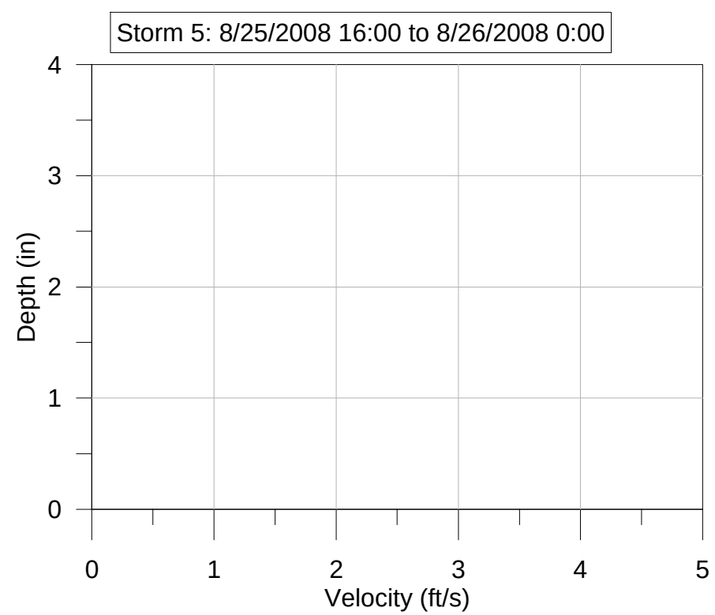
Calibration Storms - Scattergraphs
Monitor 081-049

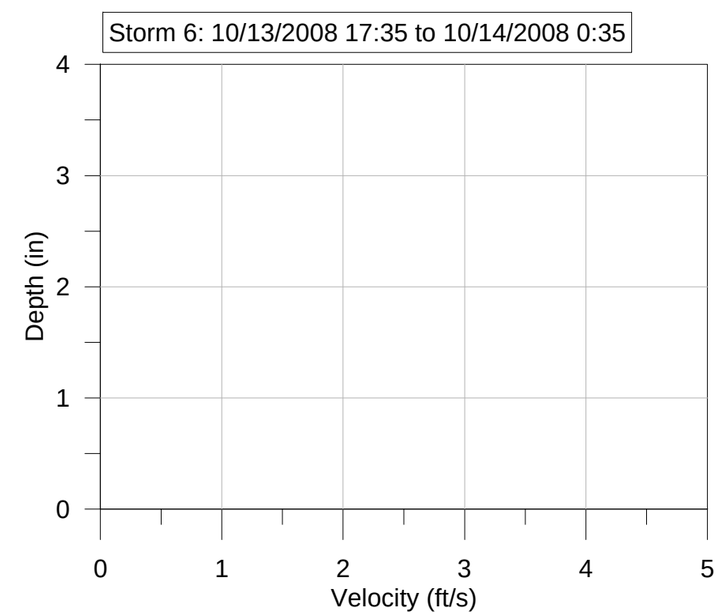




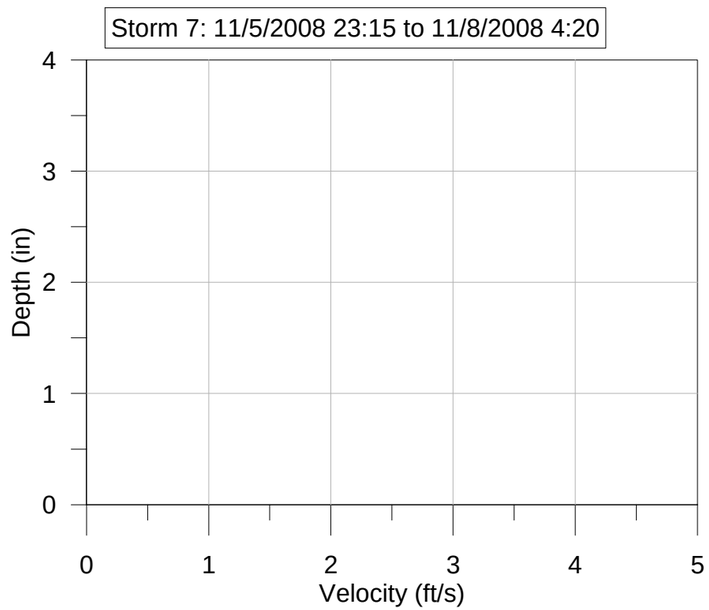


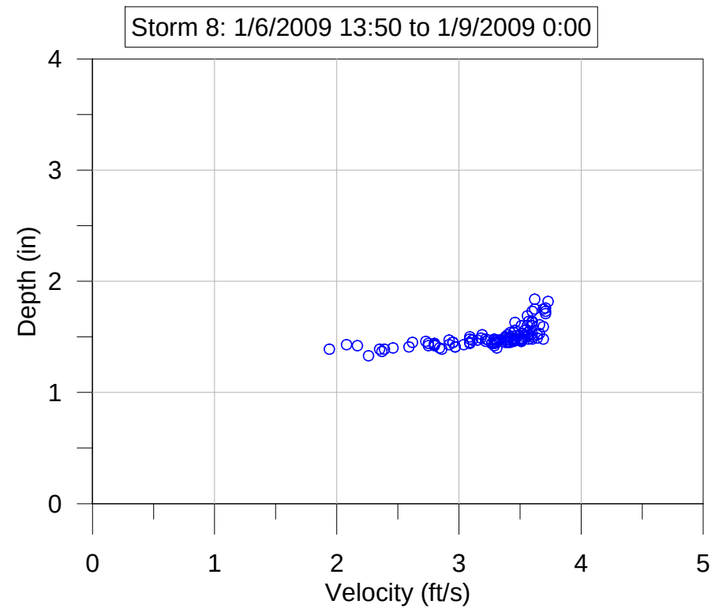


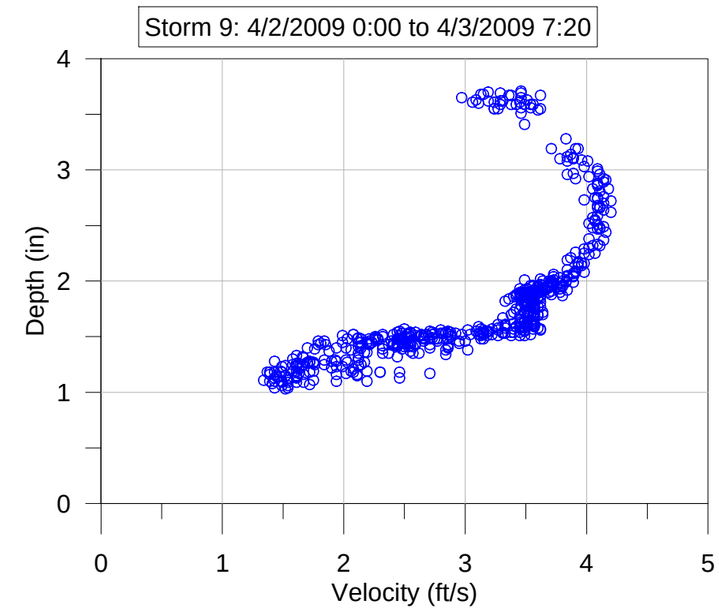


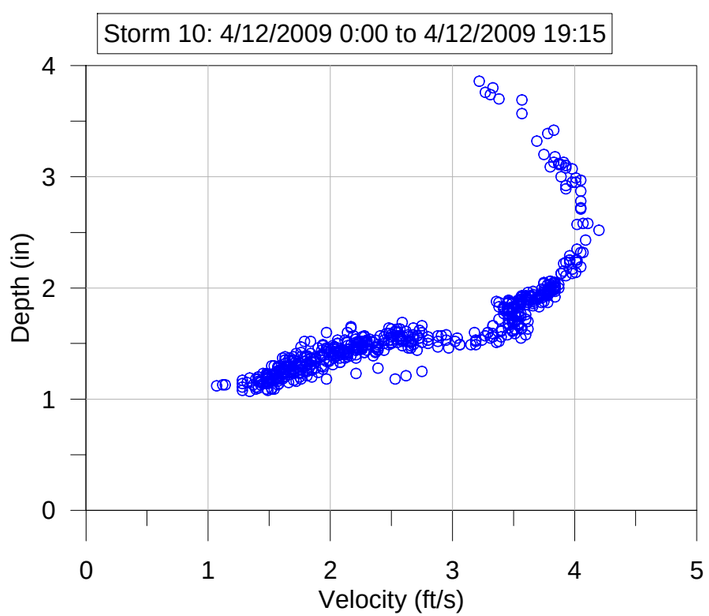


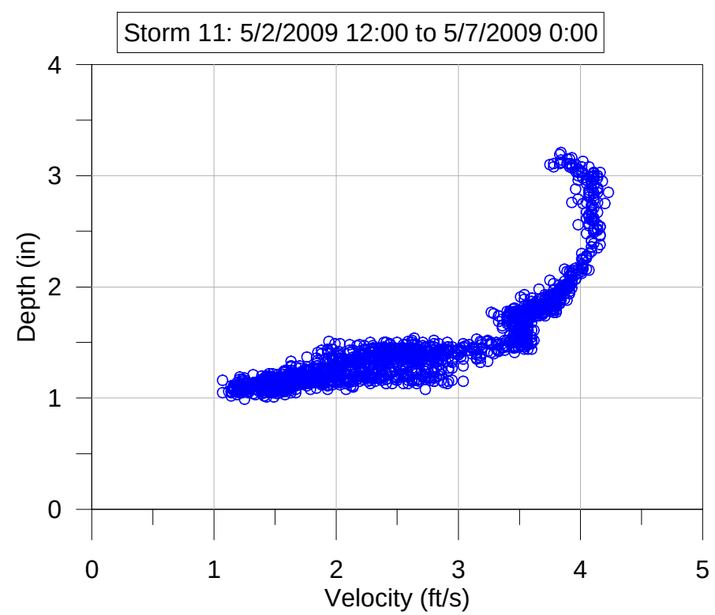
Calibration Storms - Scattergraphs
Monitor 081-049

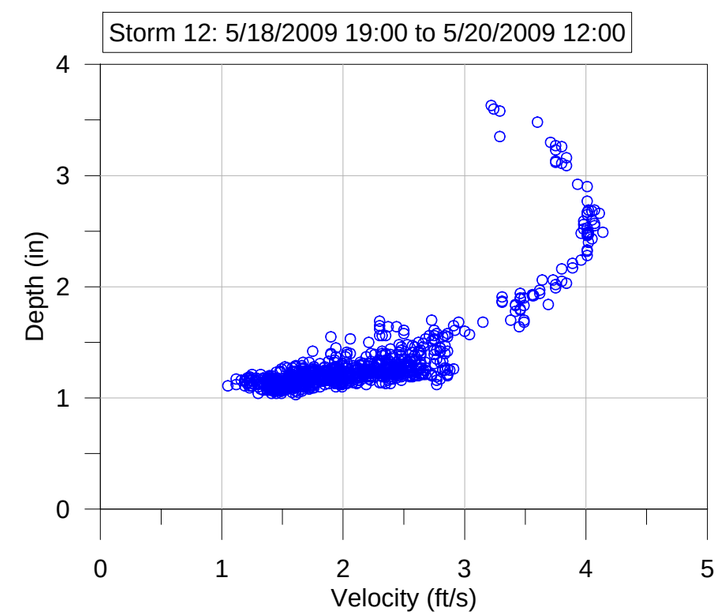




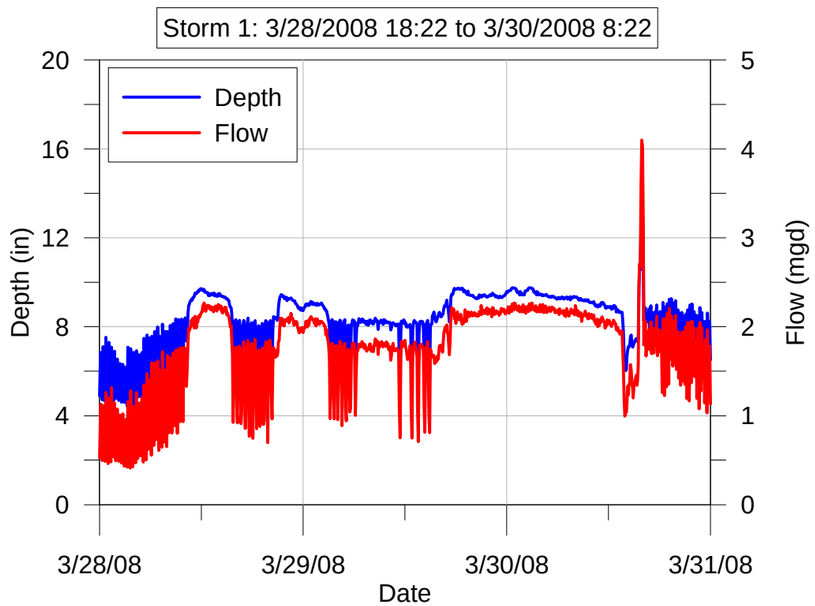


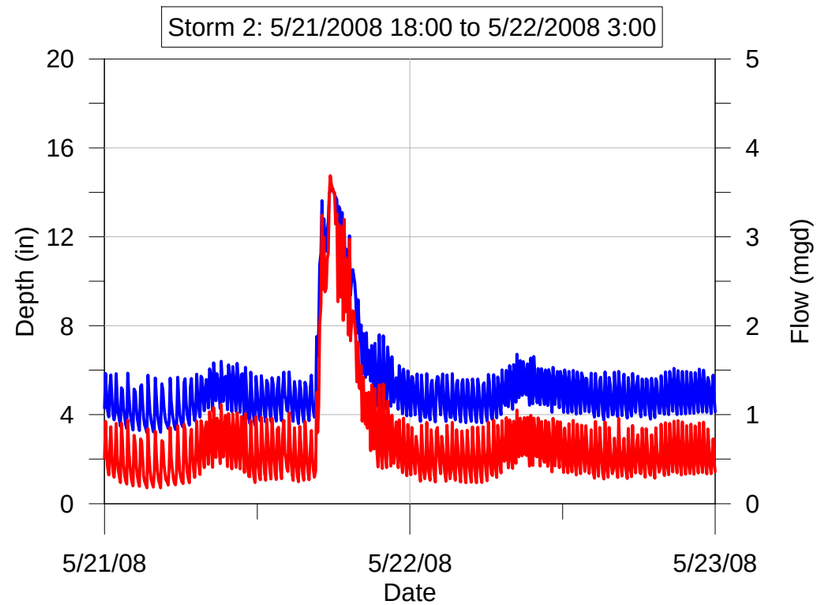


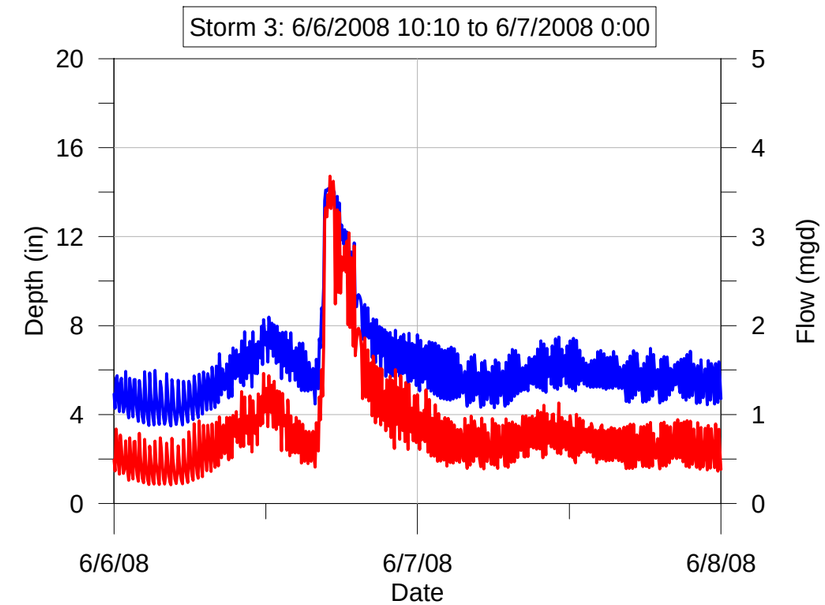


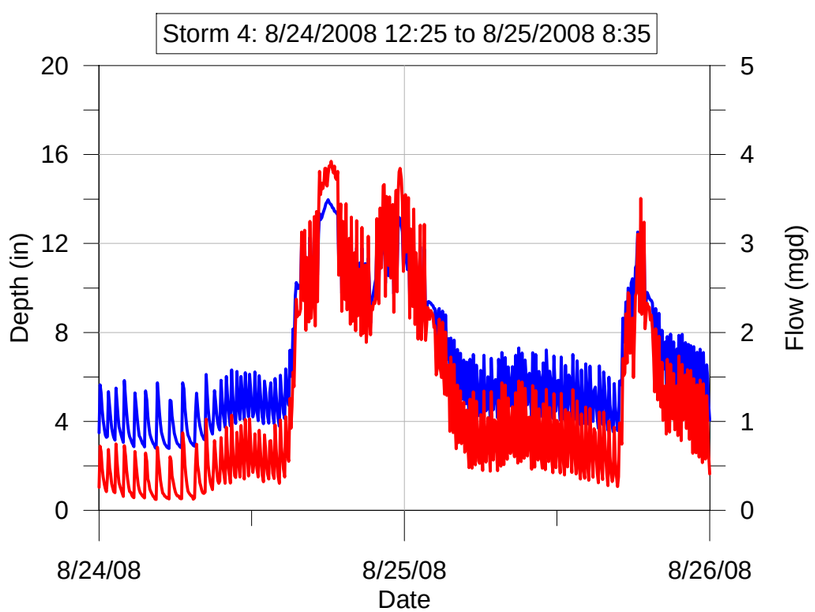


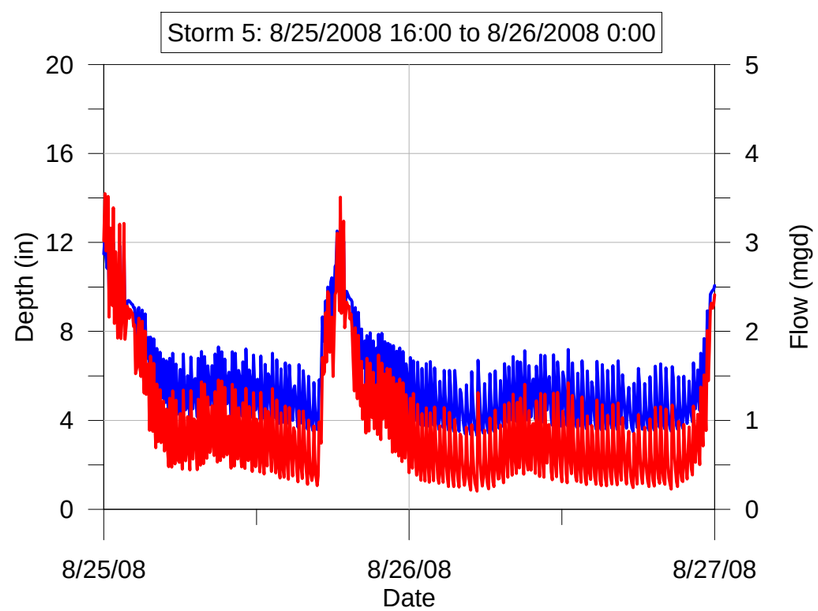
Calibration Storms
Monitor 081-085

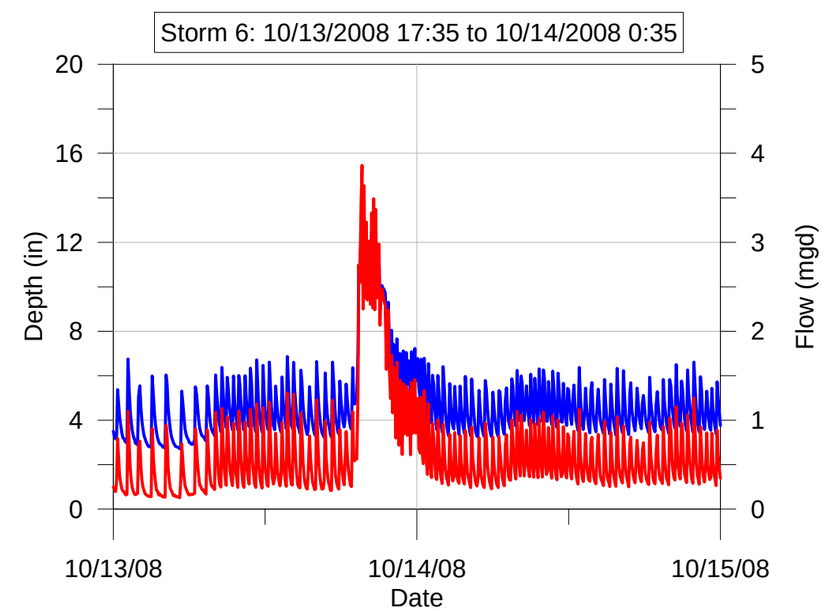




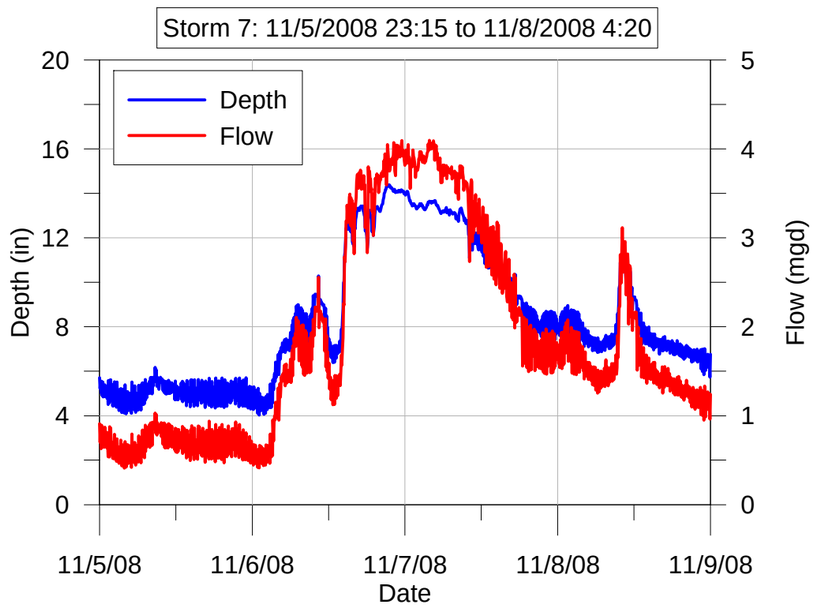


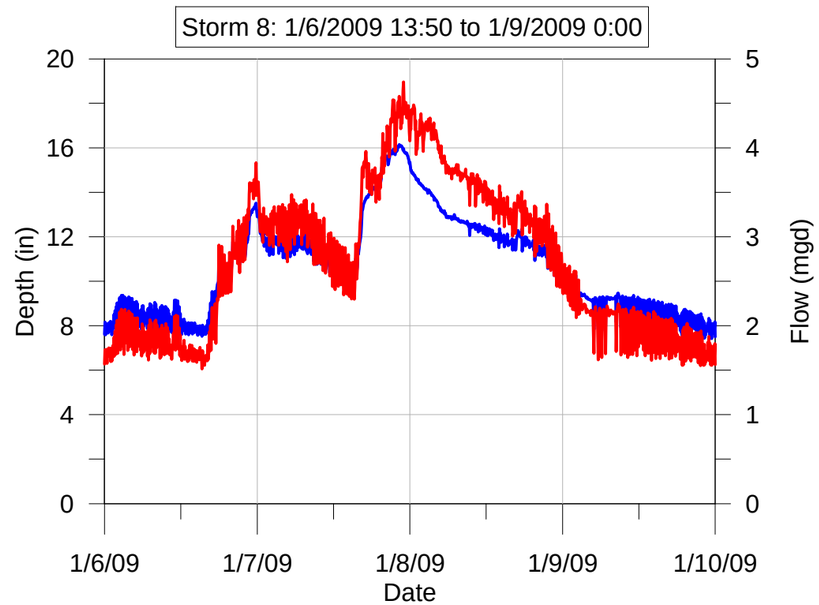


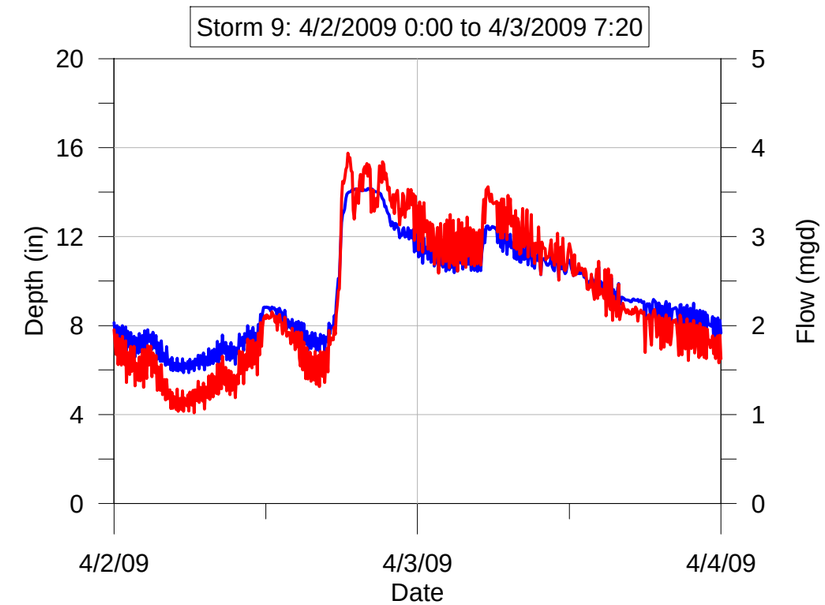


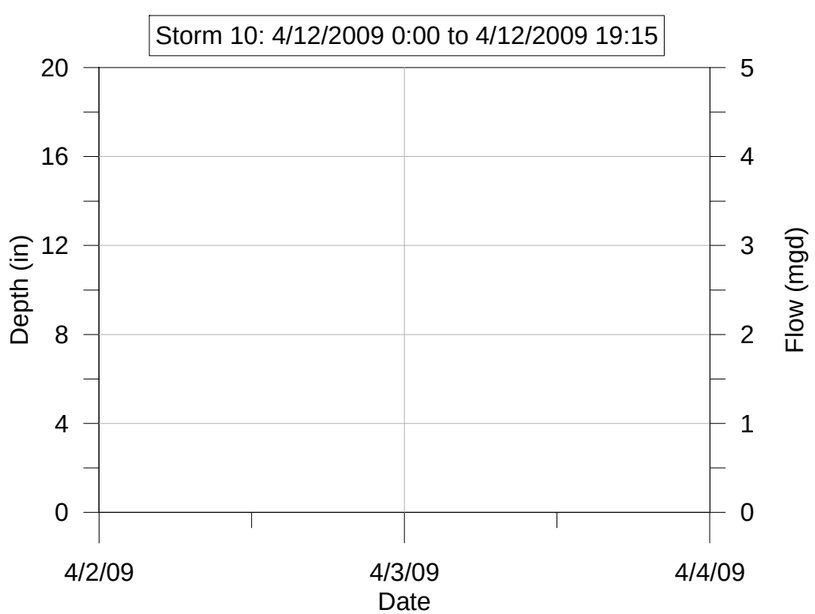


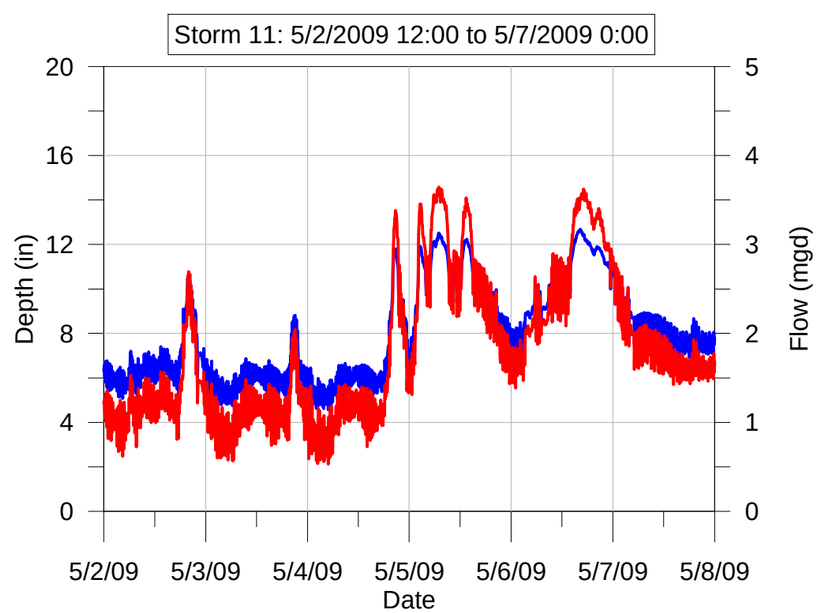
Calibration Storms
Monitor 081-085

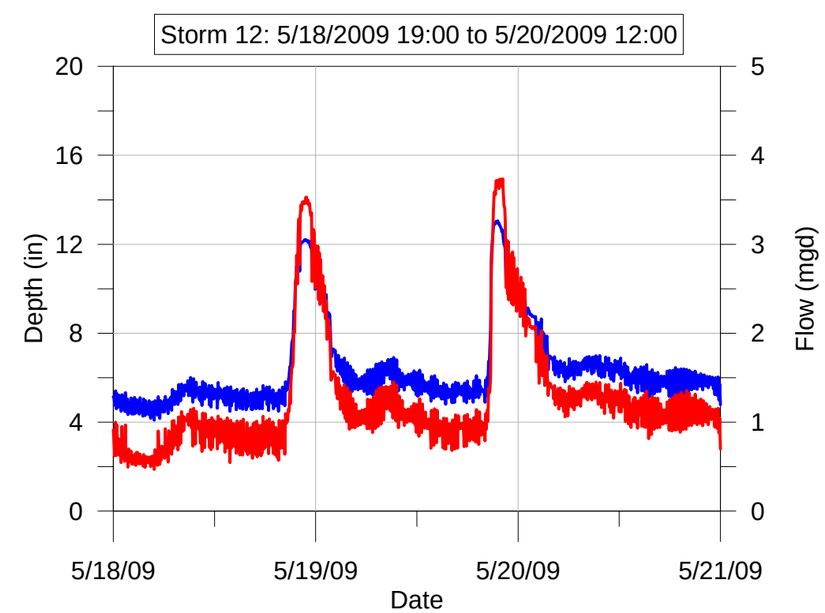




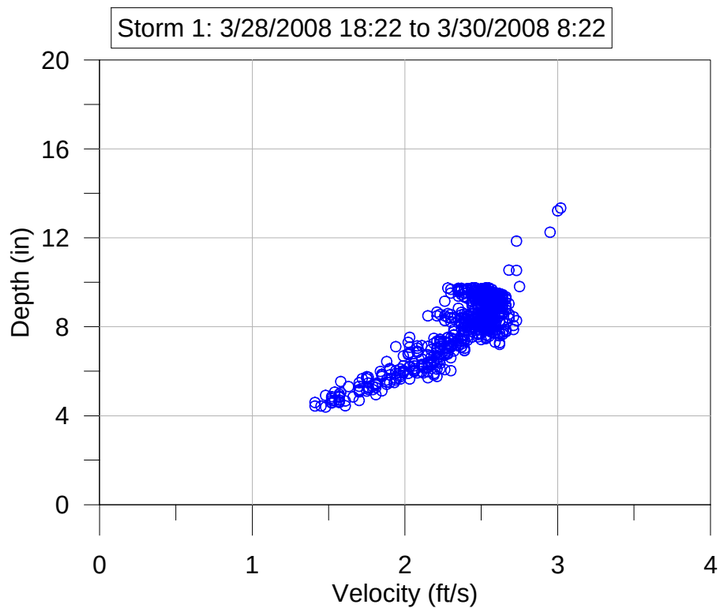


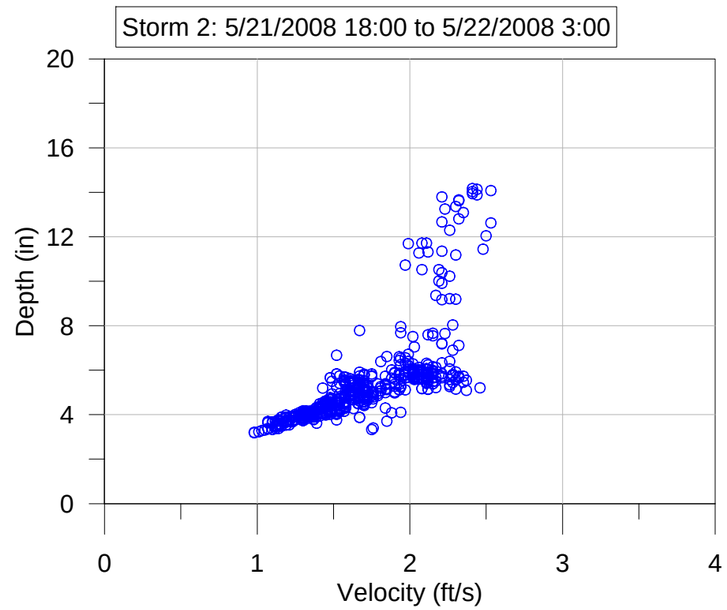


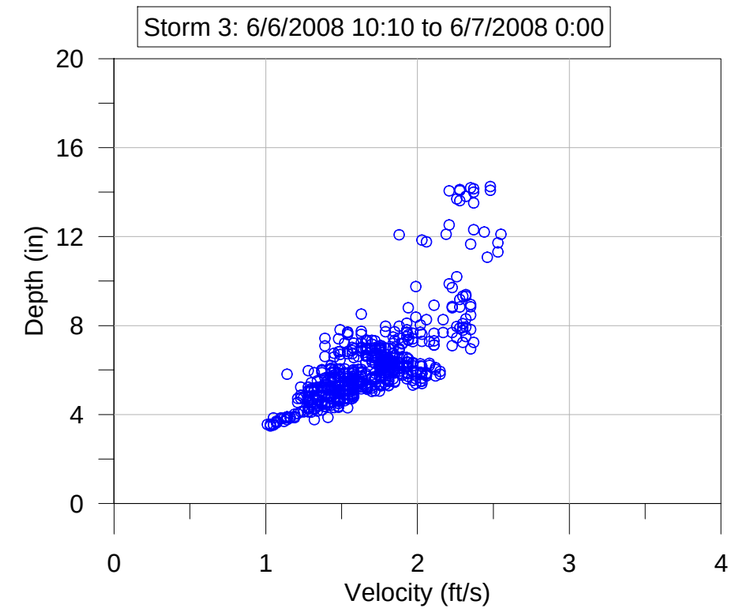


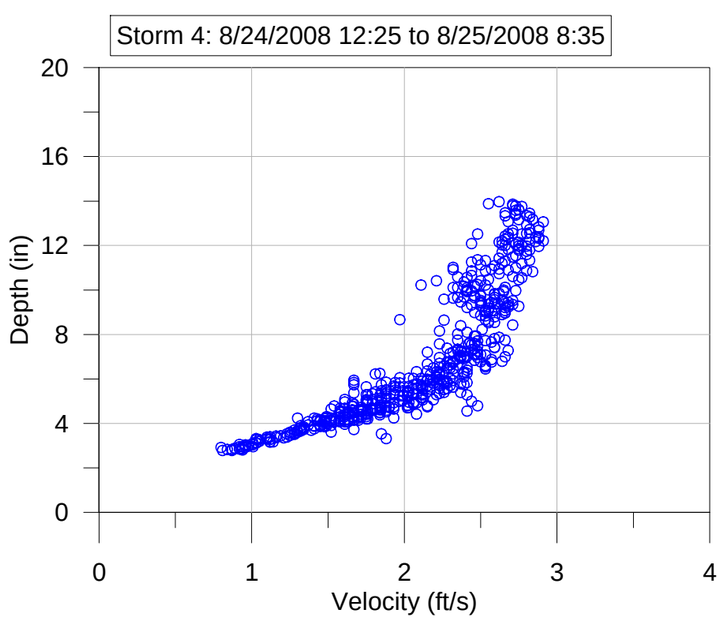


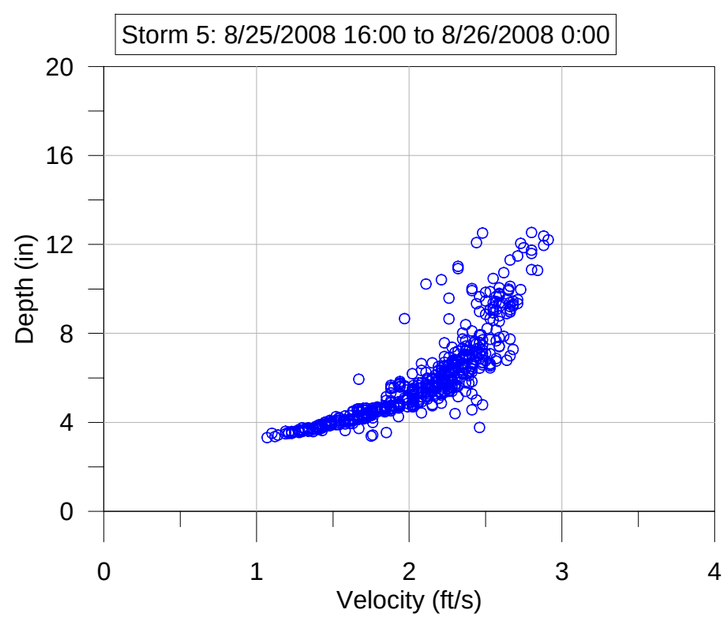
Calibration Storms - Scattergraphs
Monitor 081-085

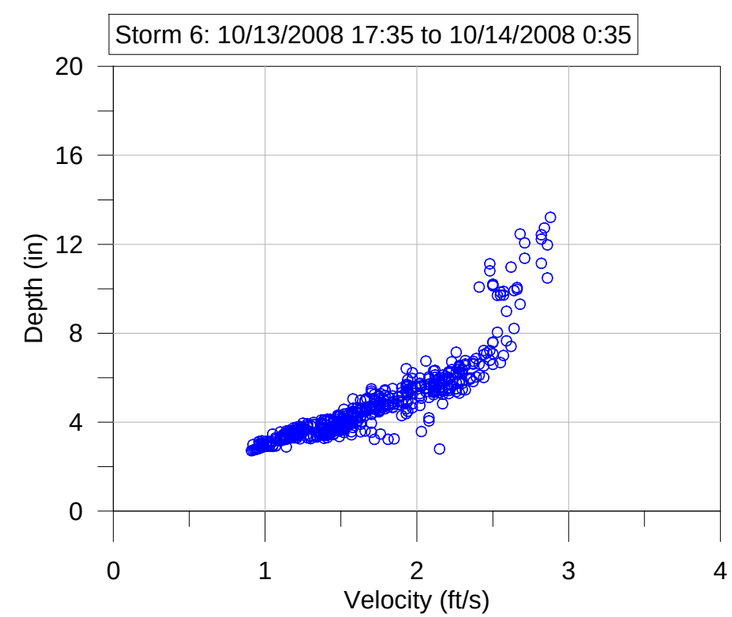




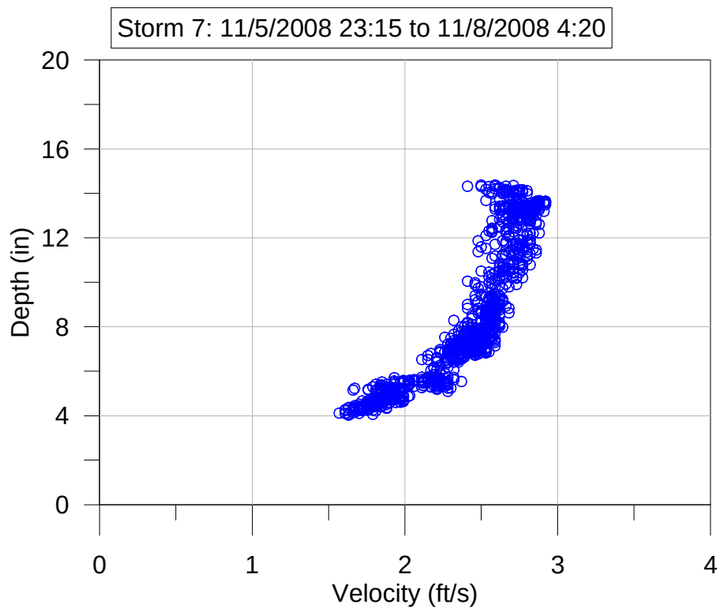


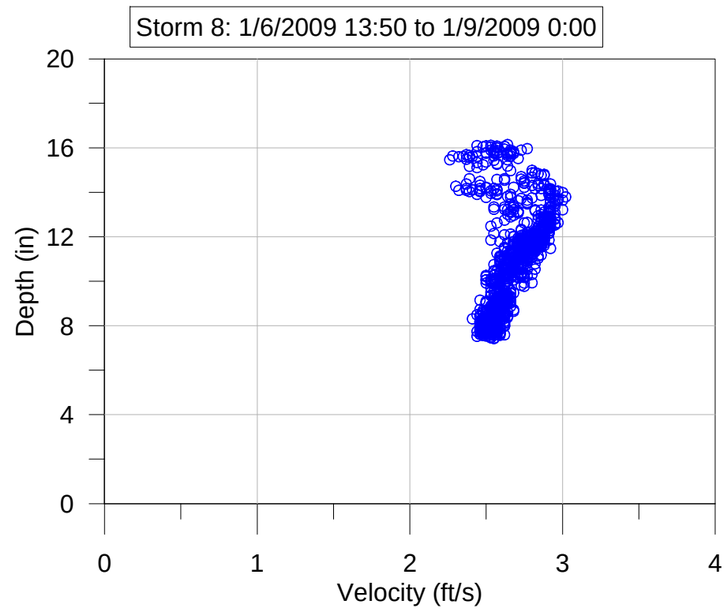


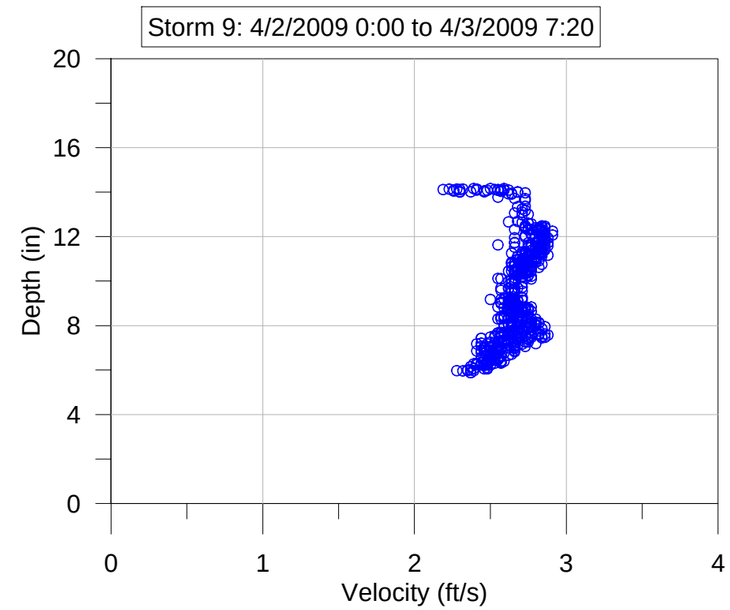


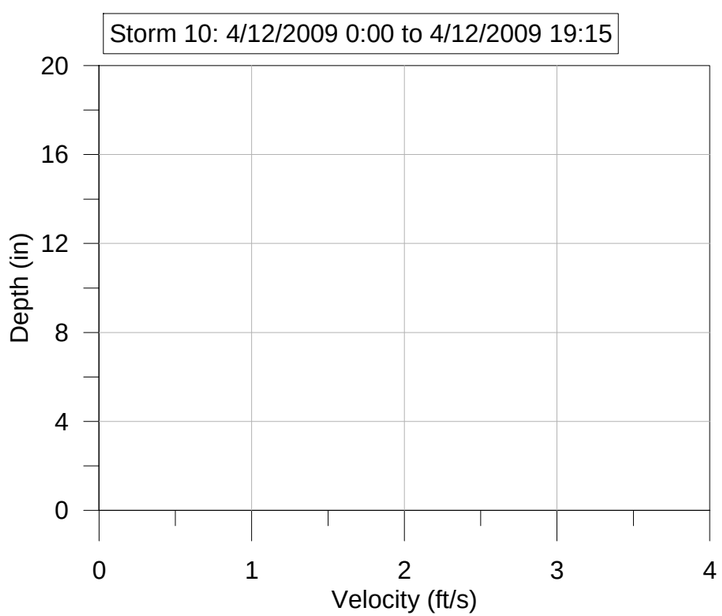


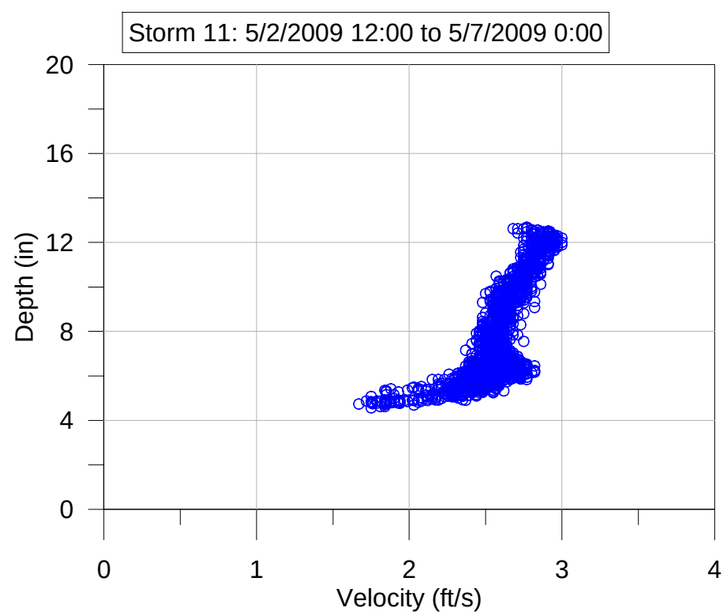
Calibration Storms - Scattergraphs
Monitor 081-085

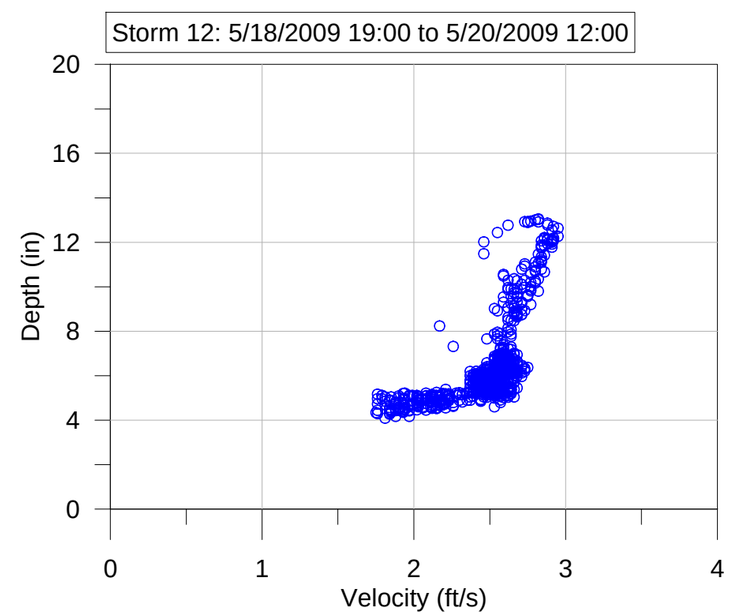




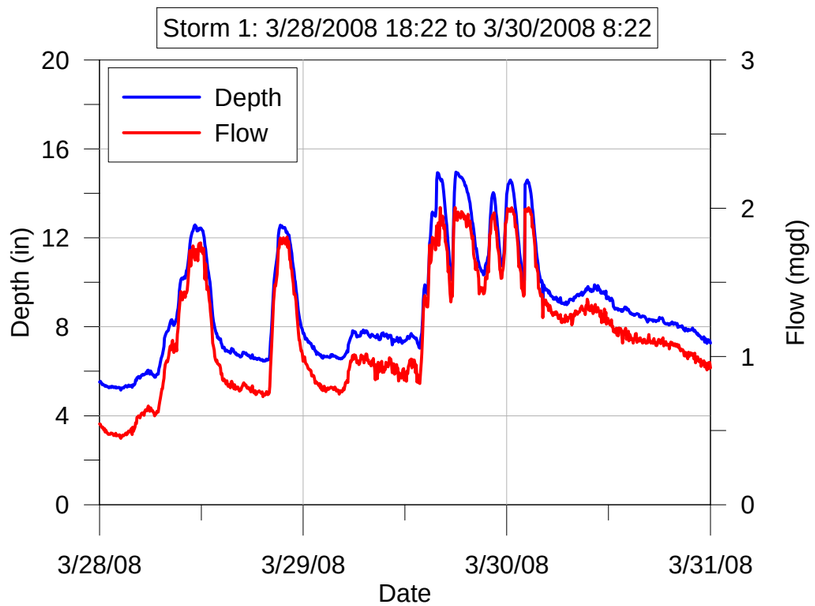


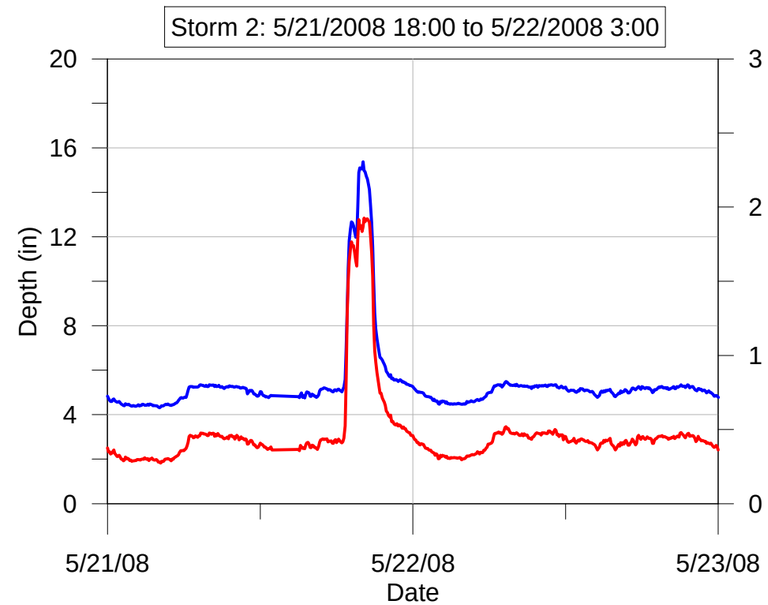


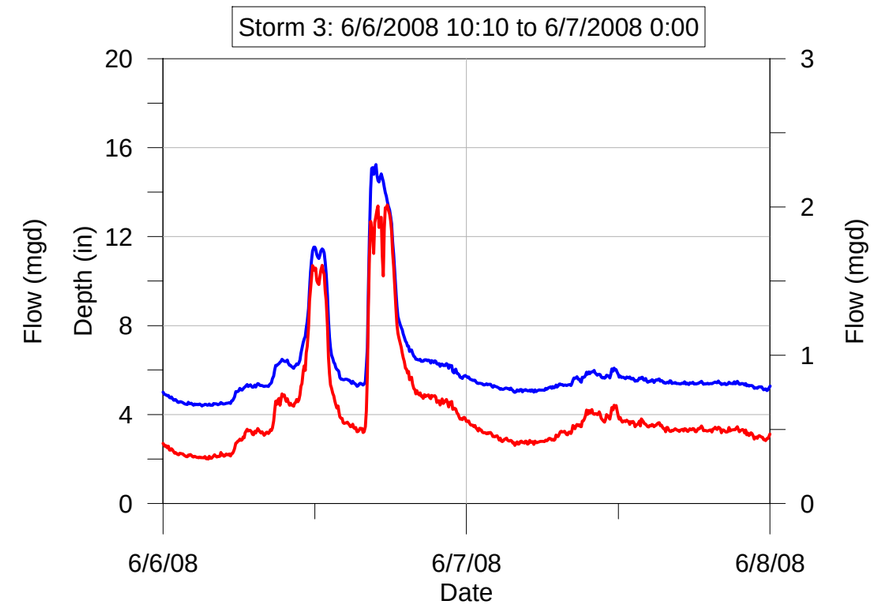


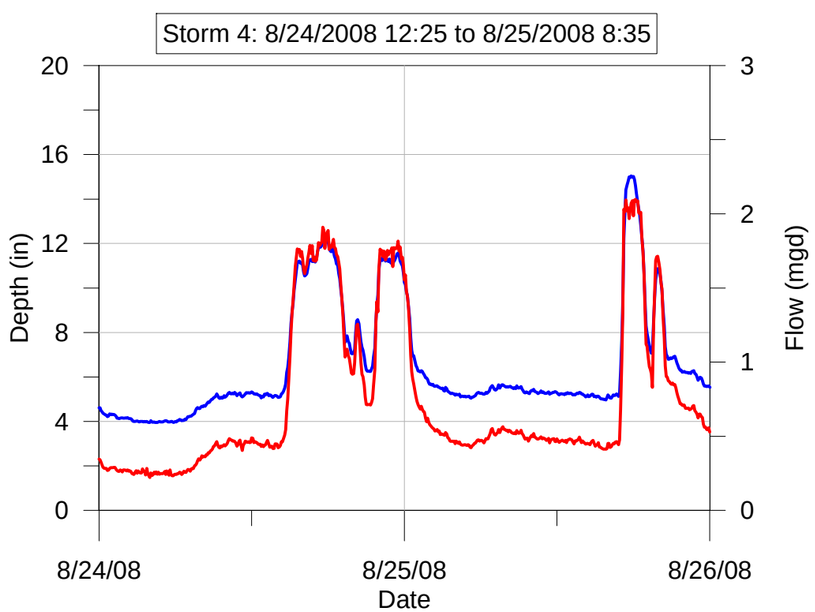


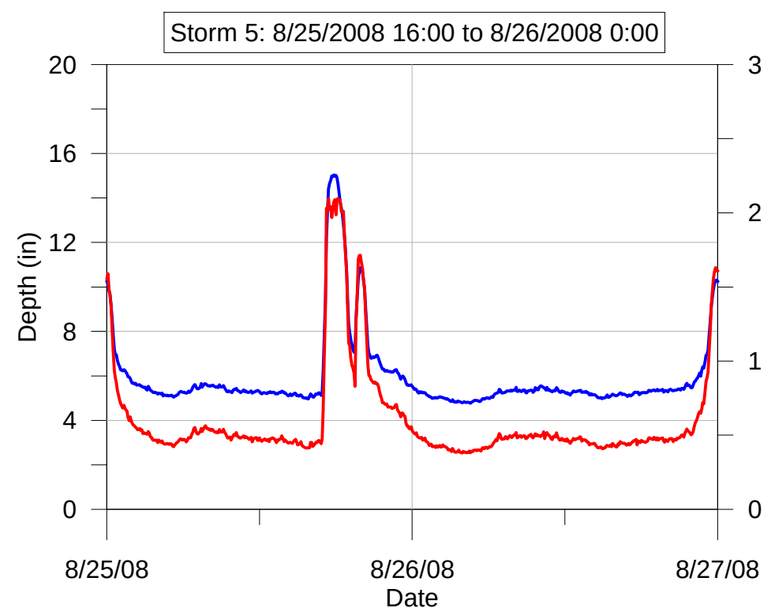
Calibration Storms
Monitor 081-120

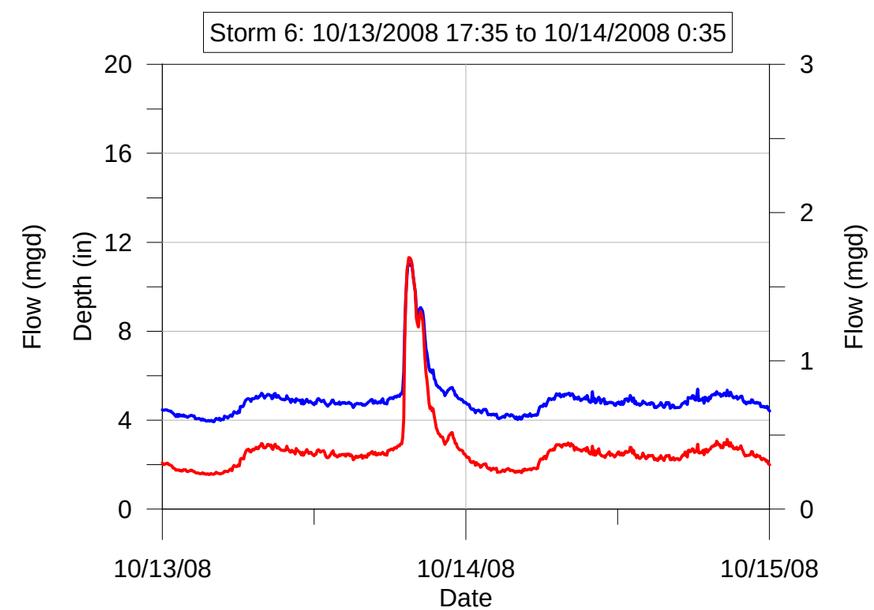




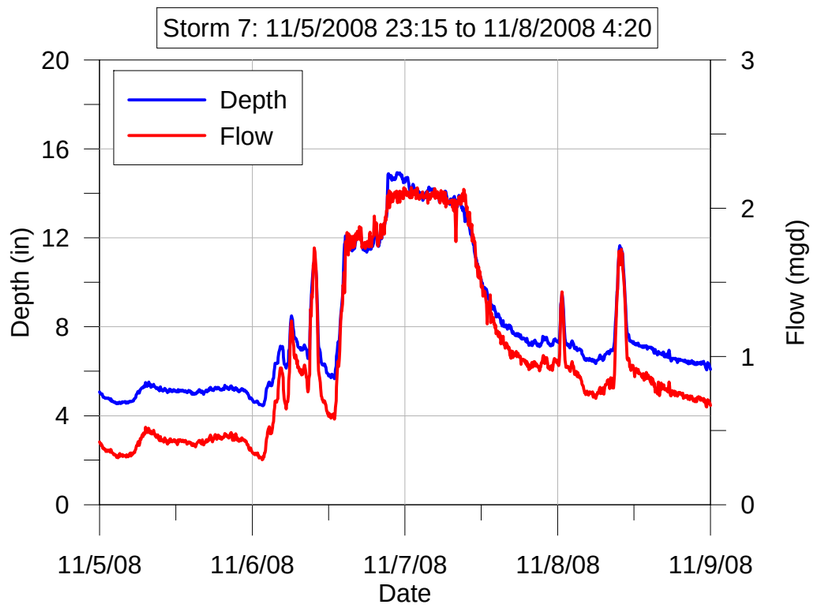


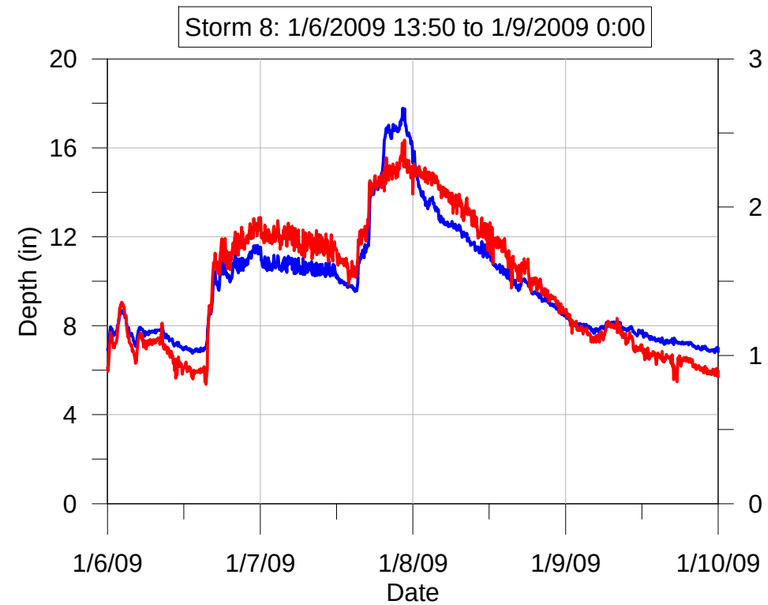


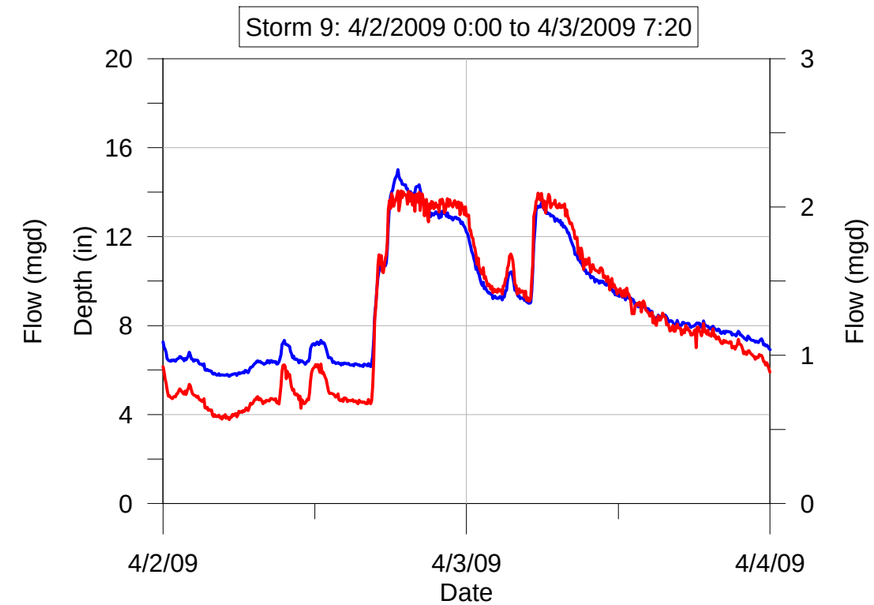


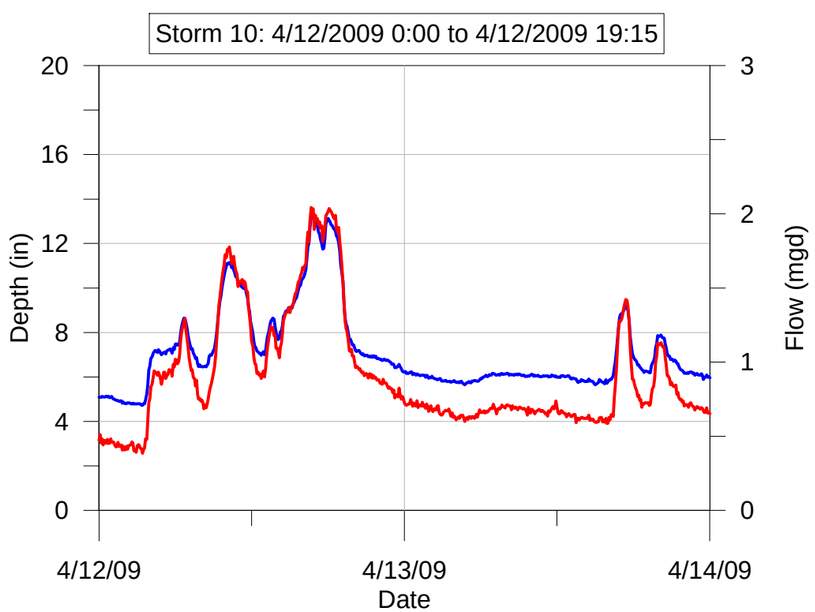


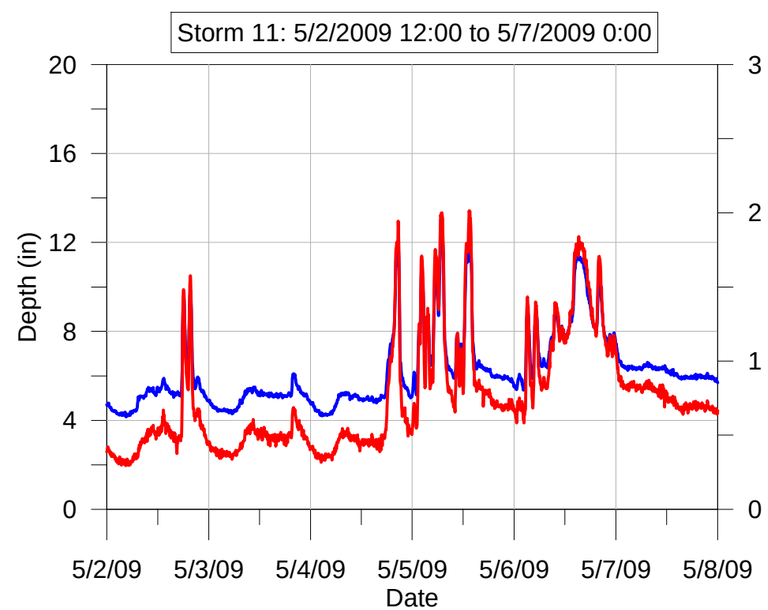
Calibration Storms
Monitor 081-120

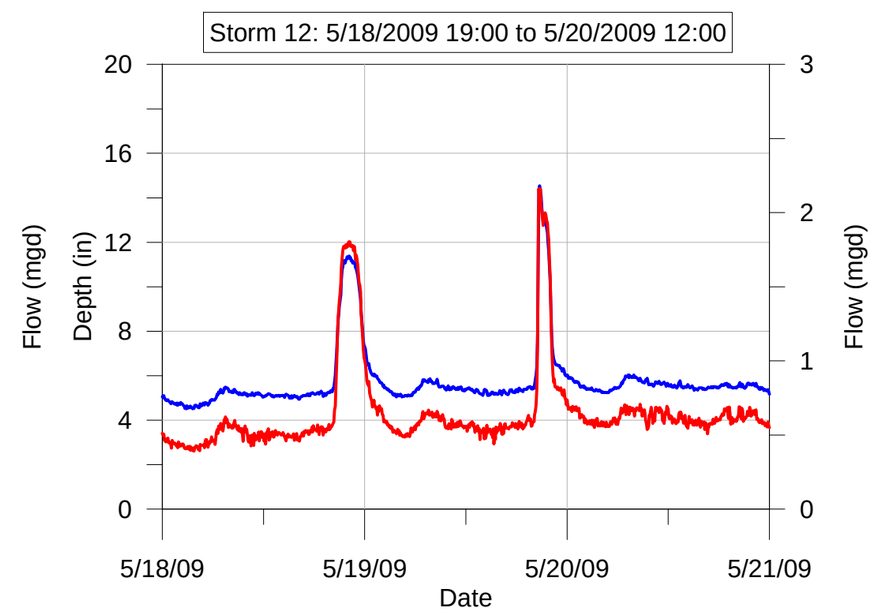




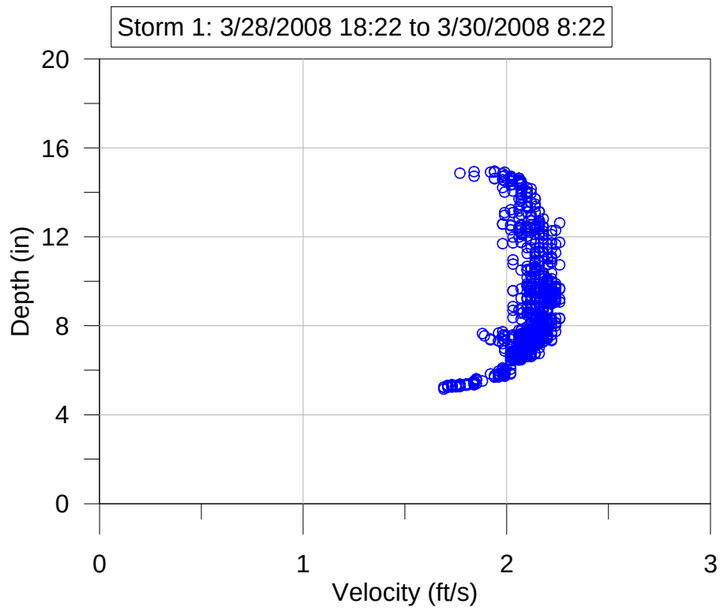


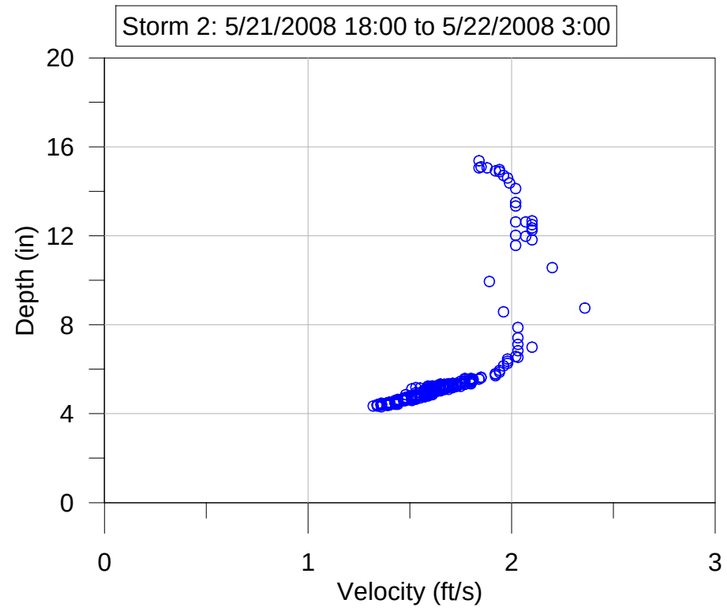


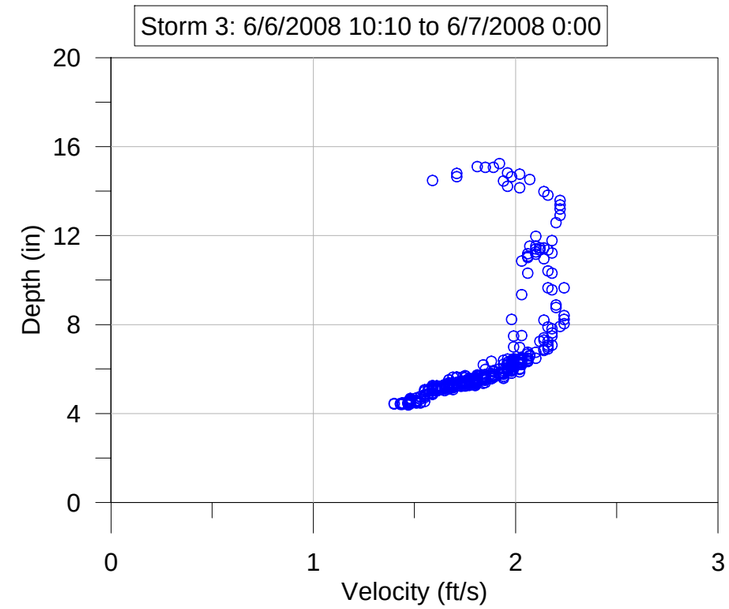


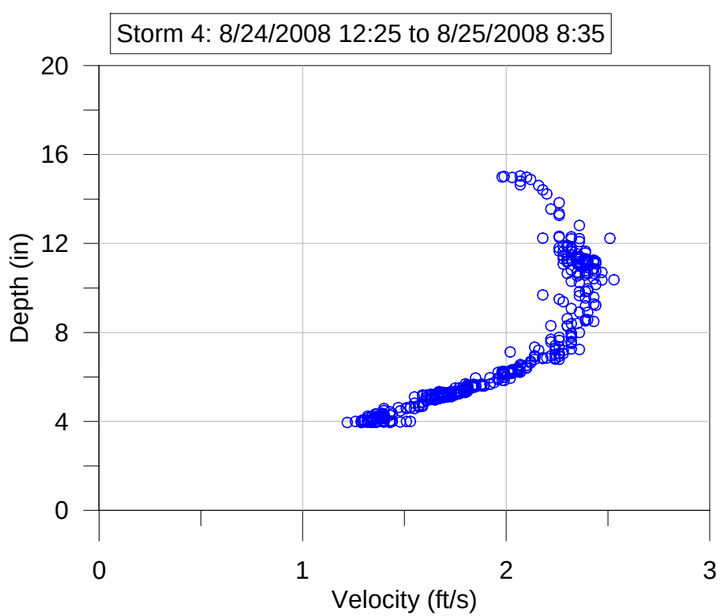


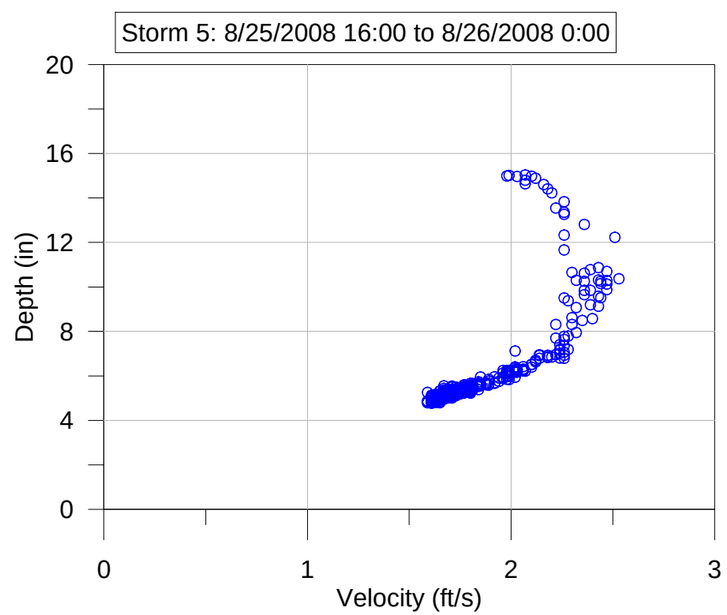
Calibration Storms - Scattergraphs
Monitor 081-120

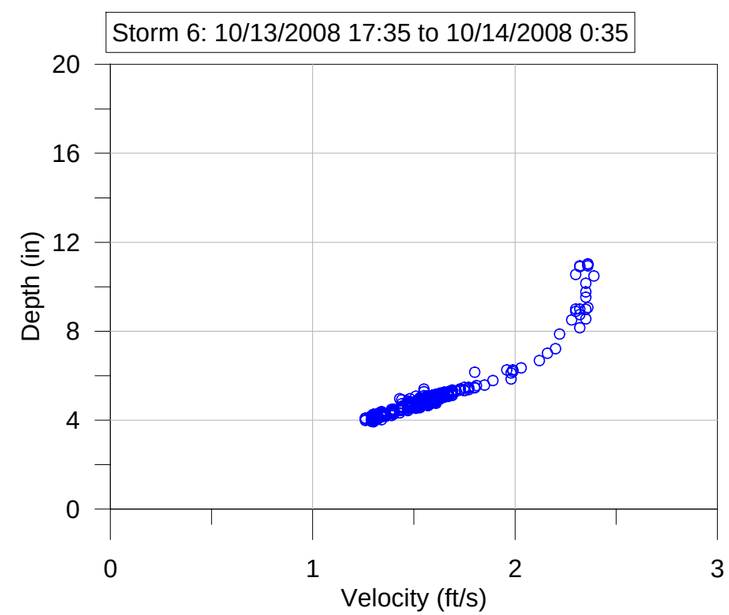




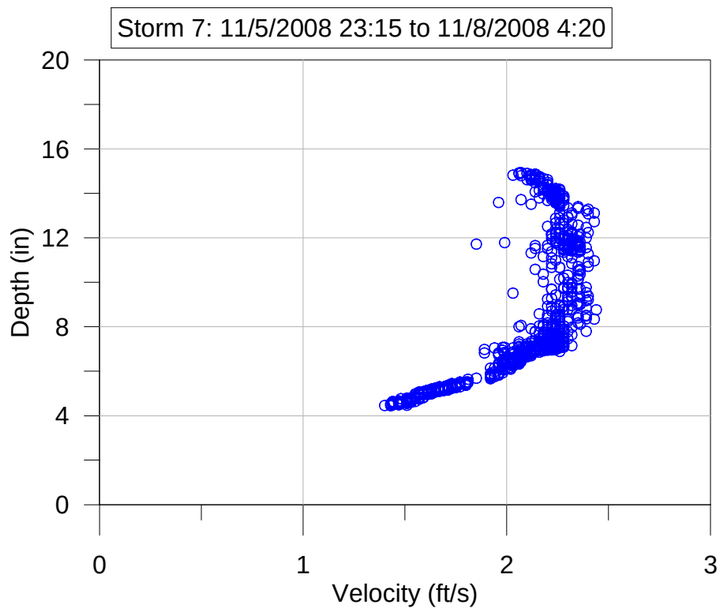


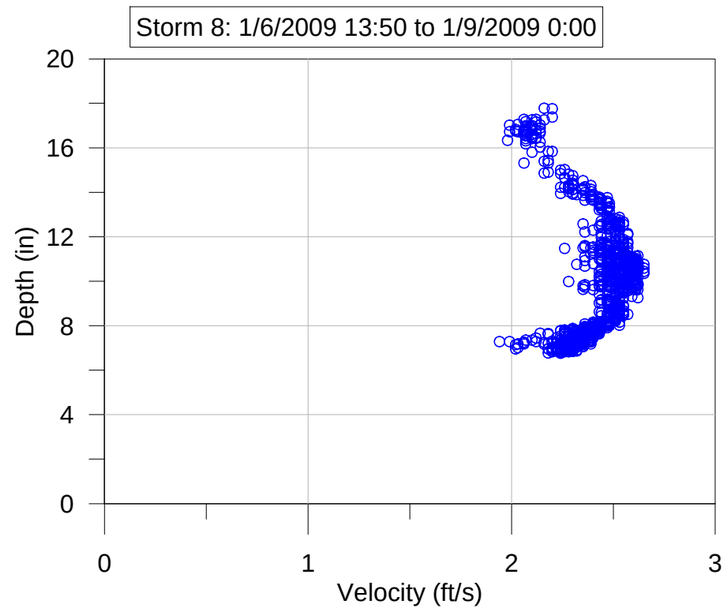


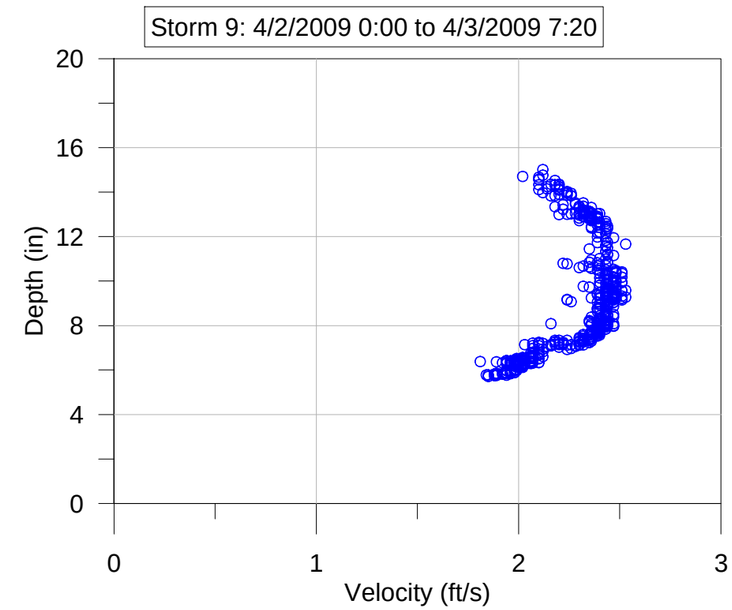


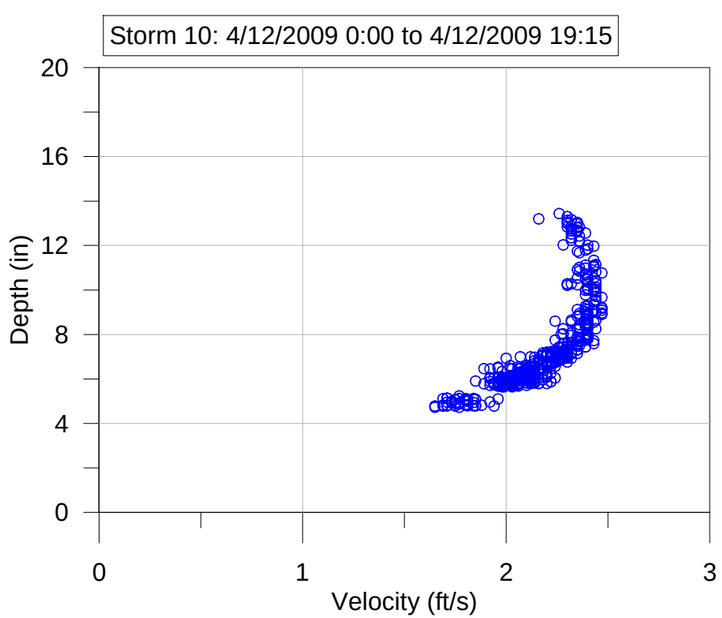


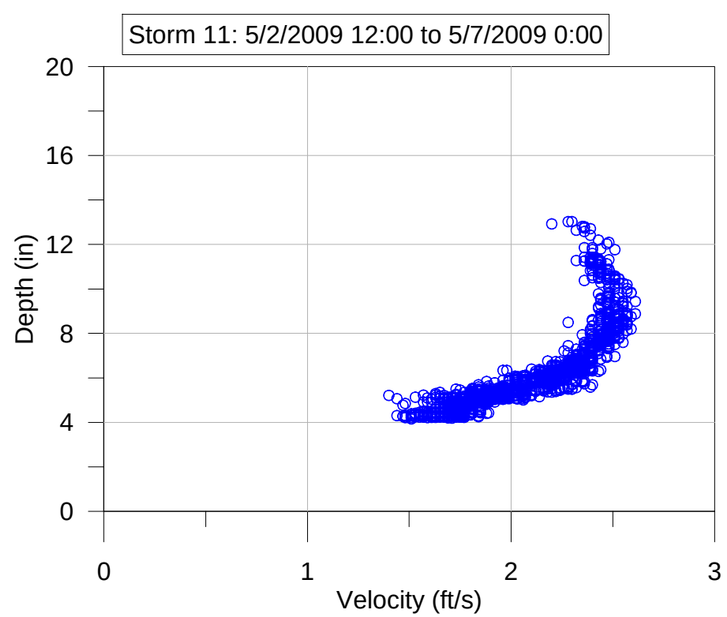
Calibration Storms - Scattergraphs
Monitor 081-120

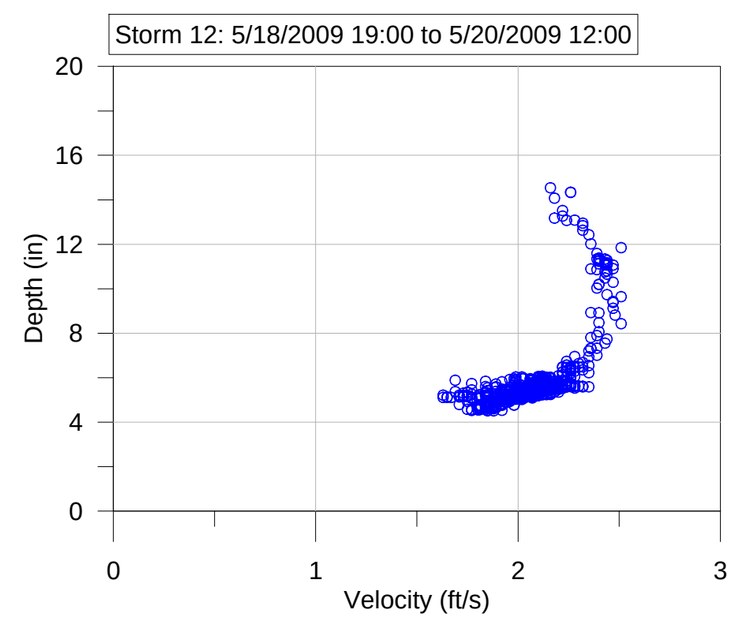




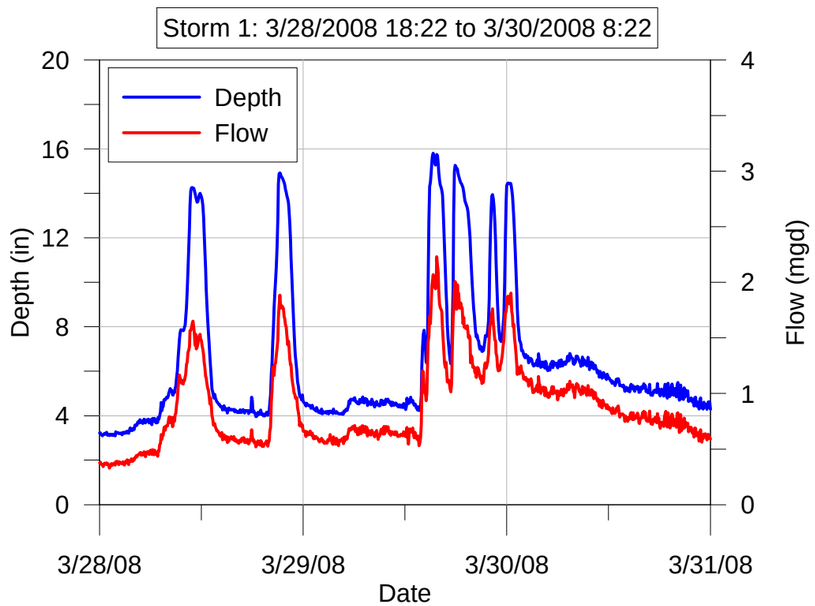


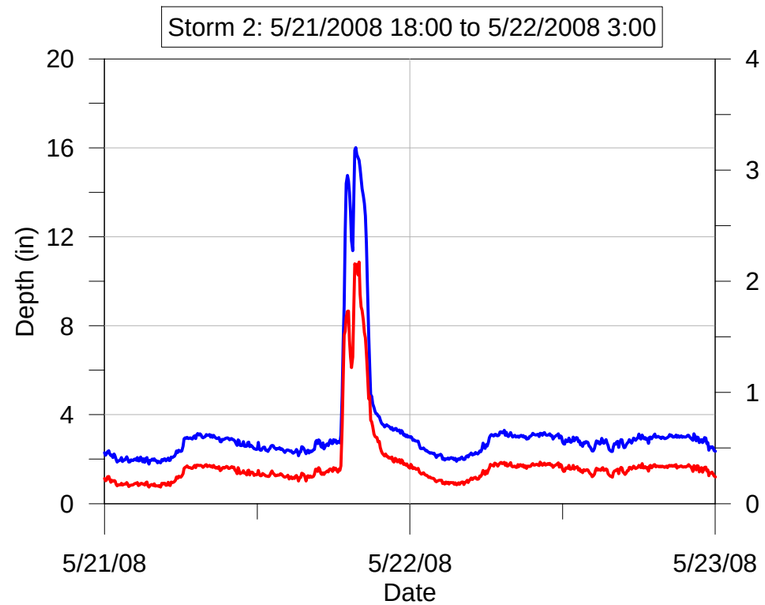


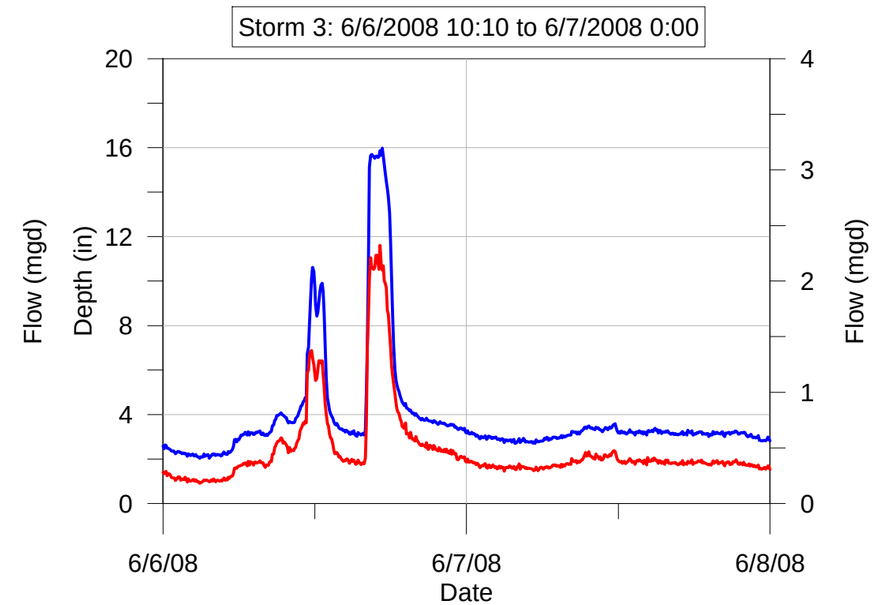


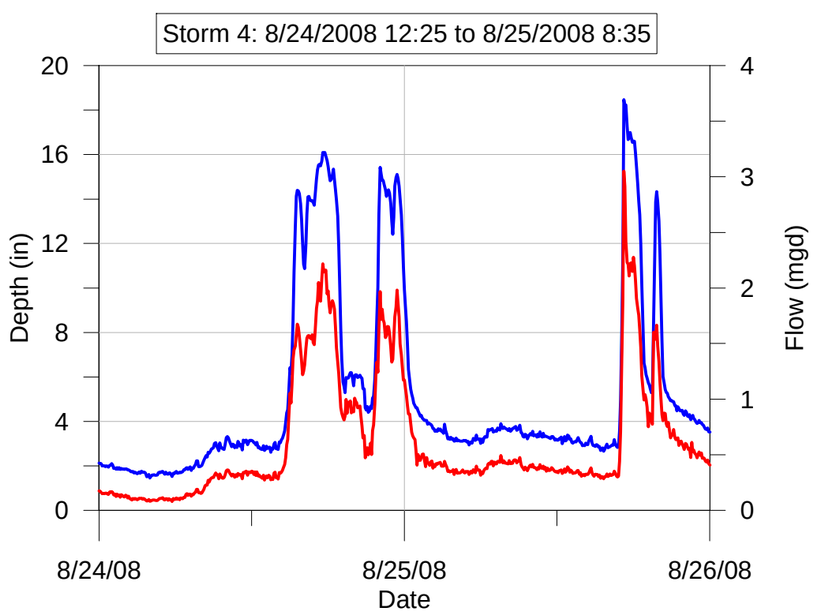


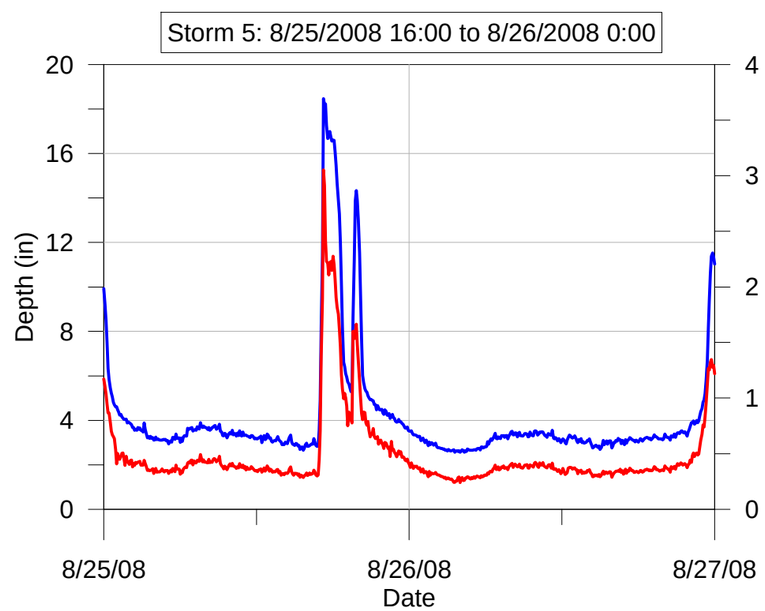
Calibration Storms
Monitor 081-139

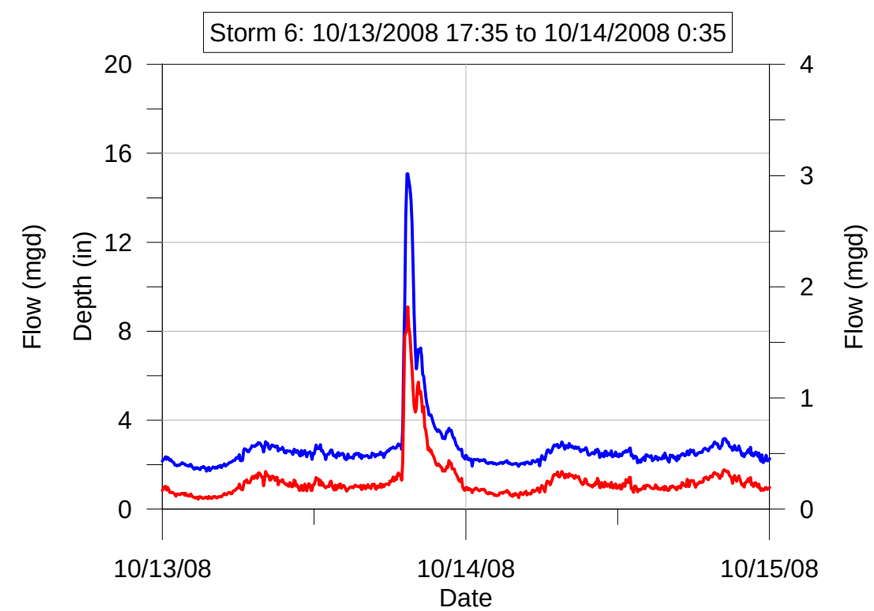




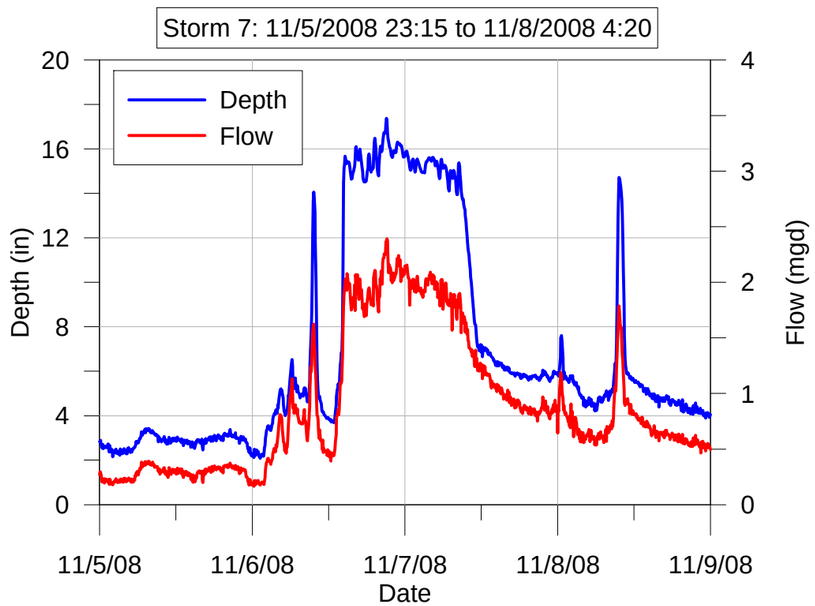


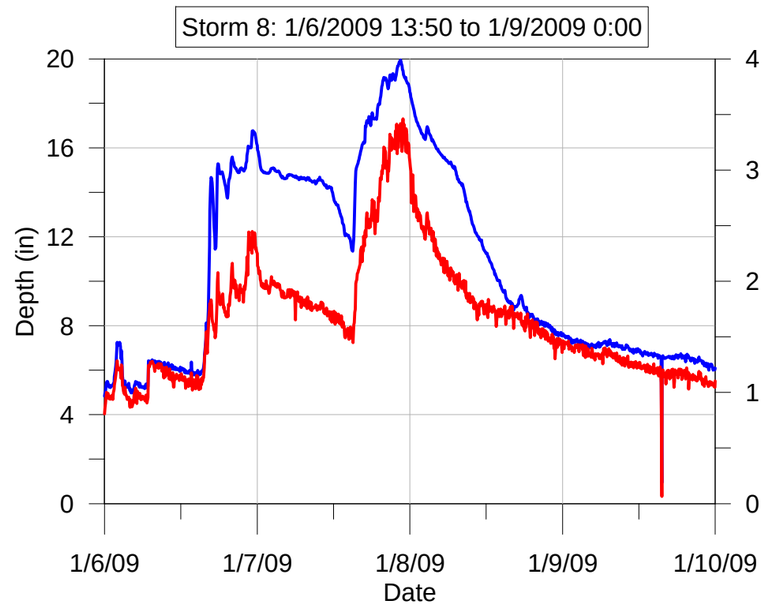


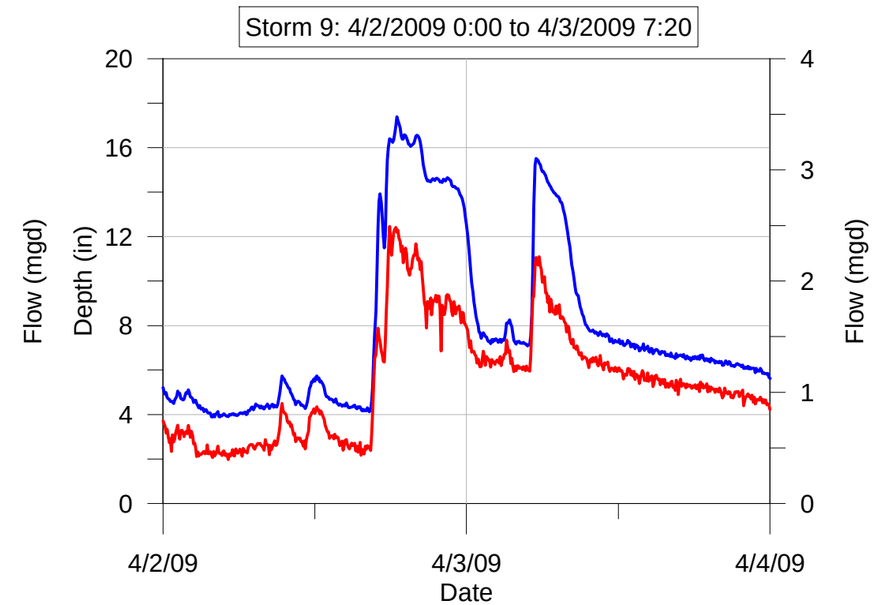


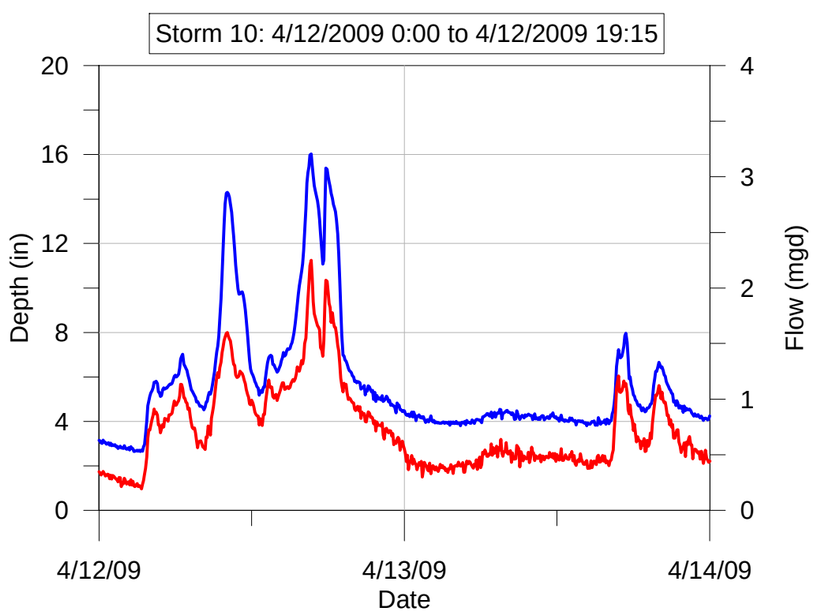


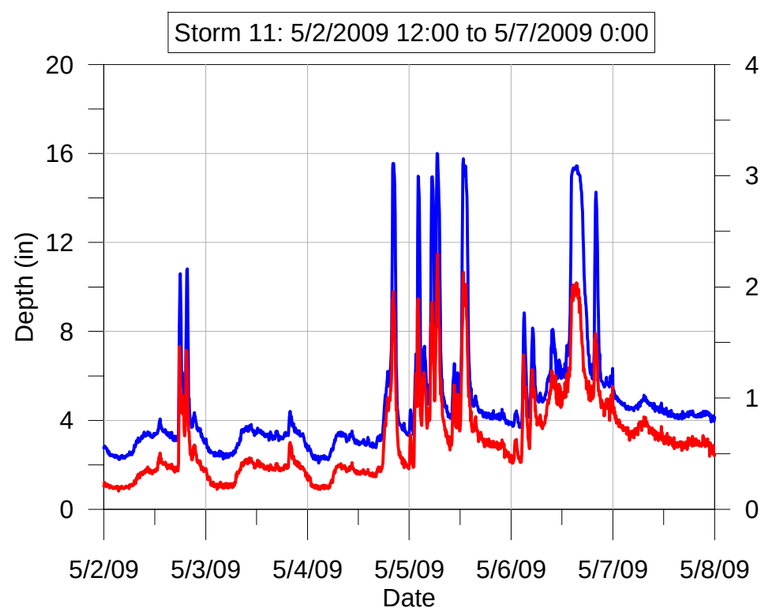
Calibration Storms
Monitor 081-139

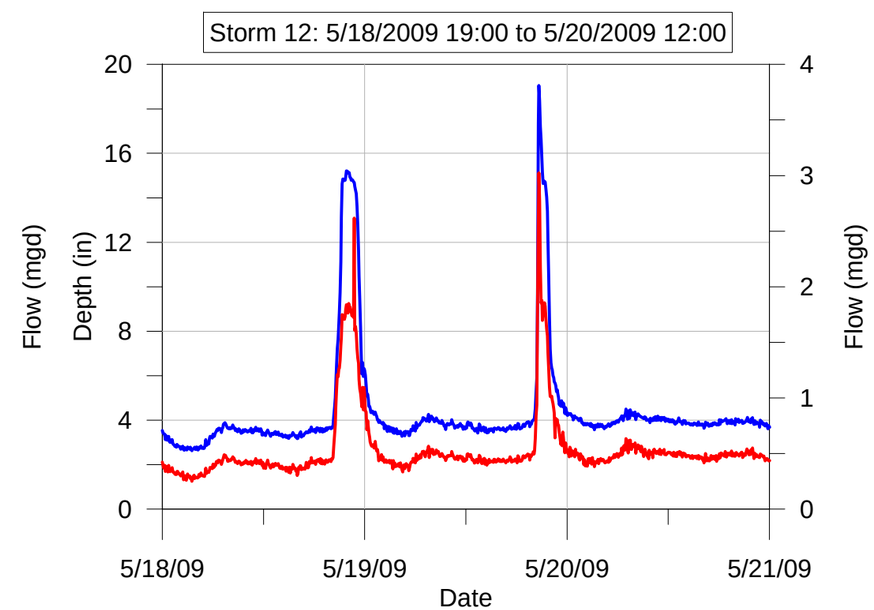




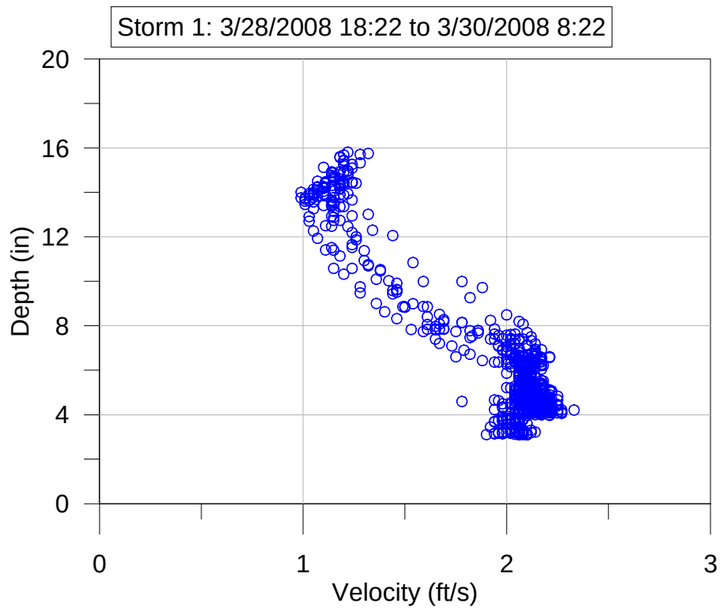


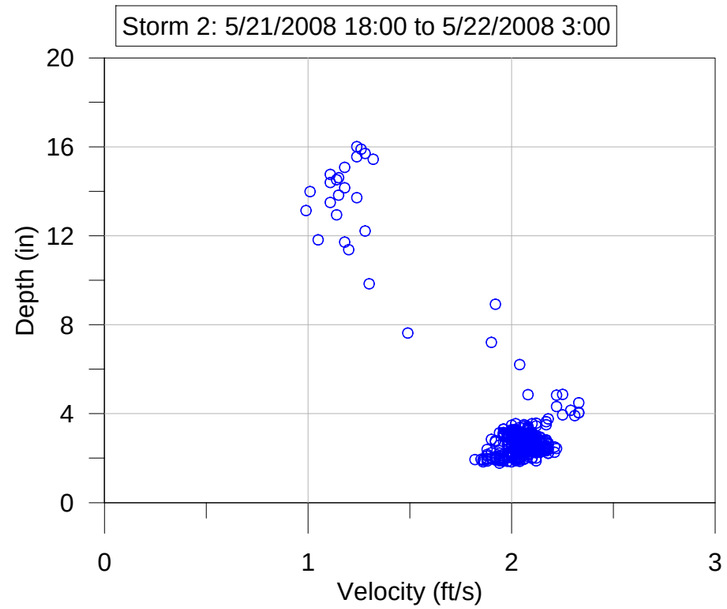


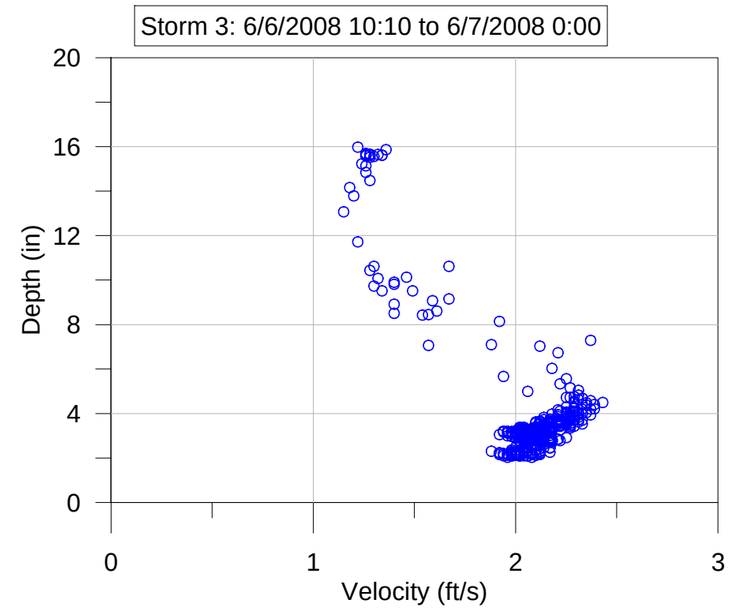


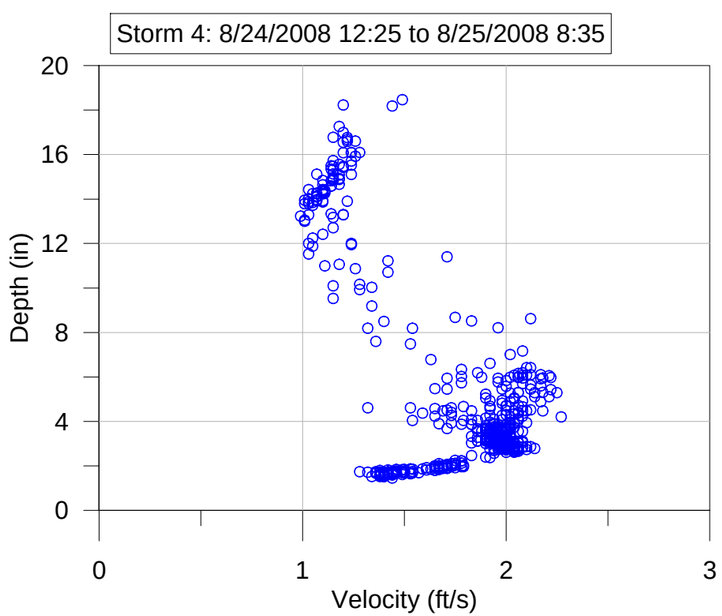


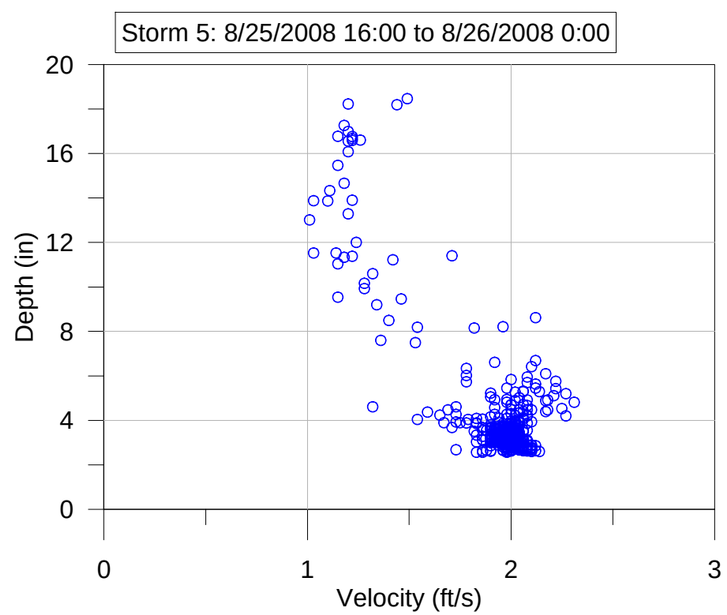
Calibration Storms - Scattergraphs
Monitor 081-139

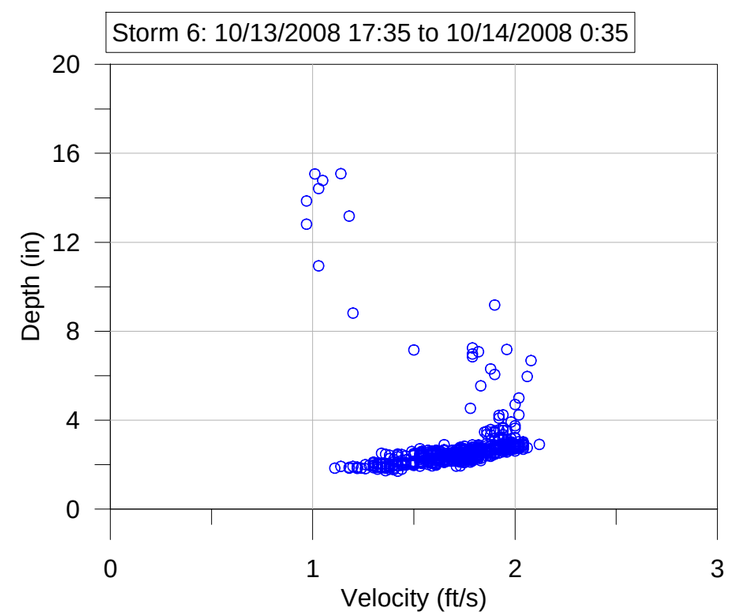




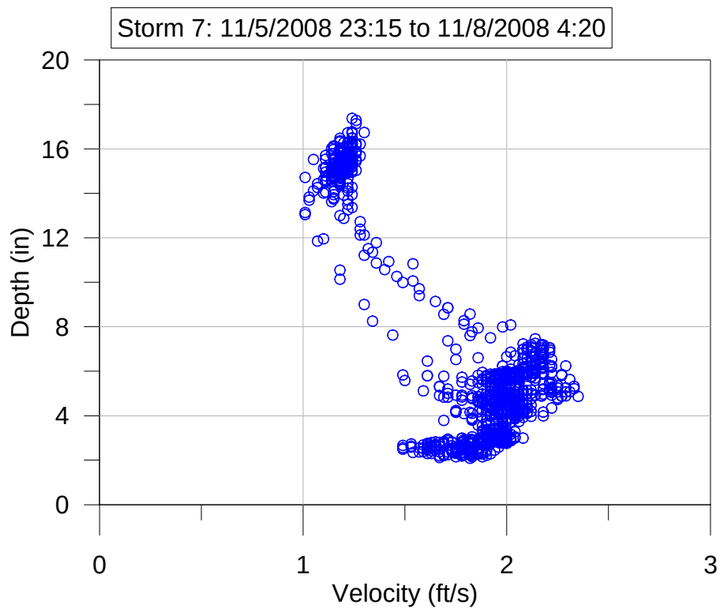


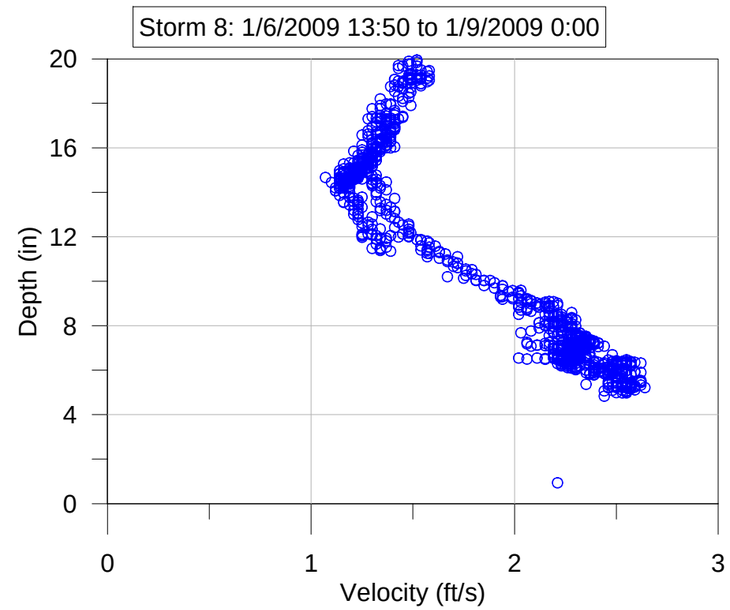


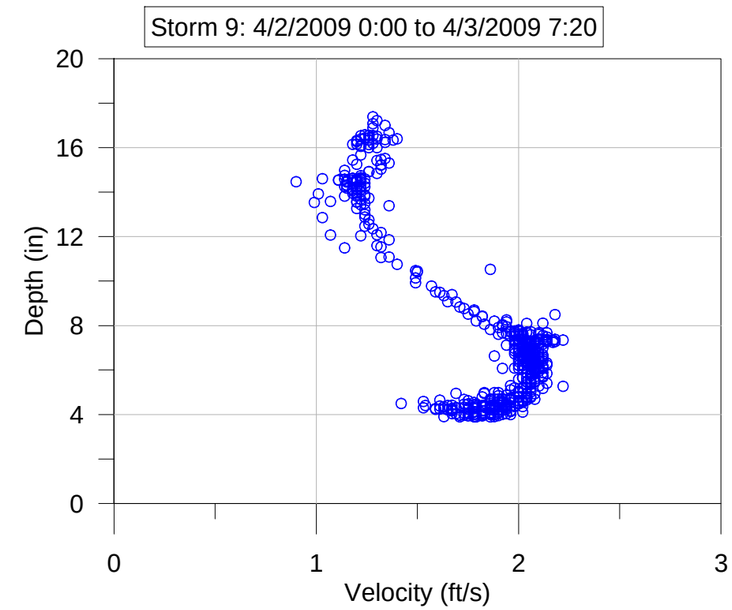


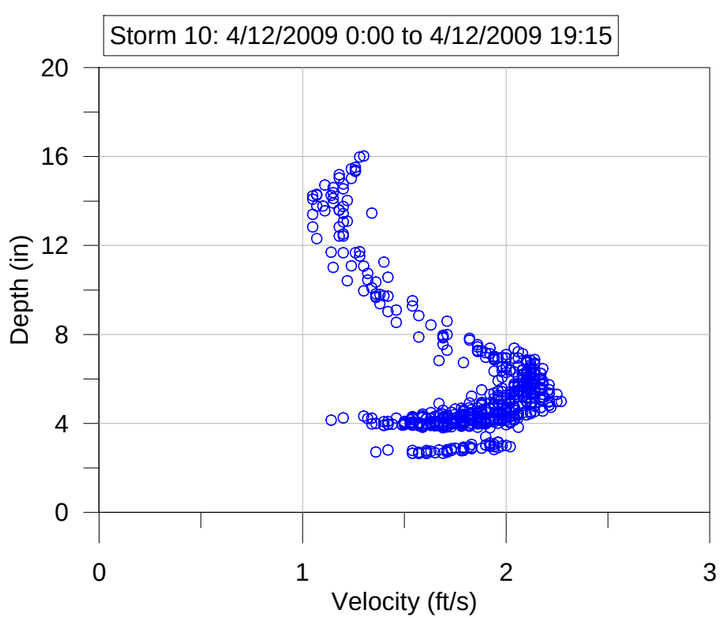


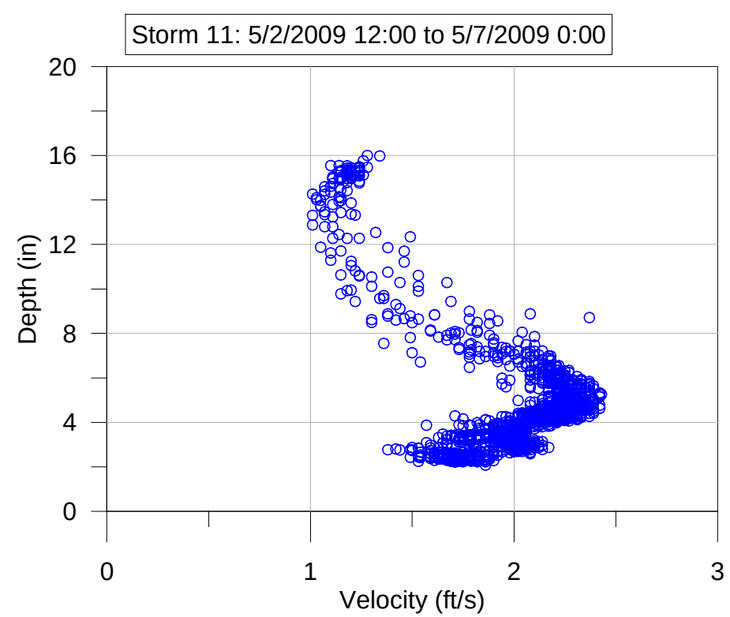
Calibration Storms - Scattergraphs
Monitor 081-139

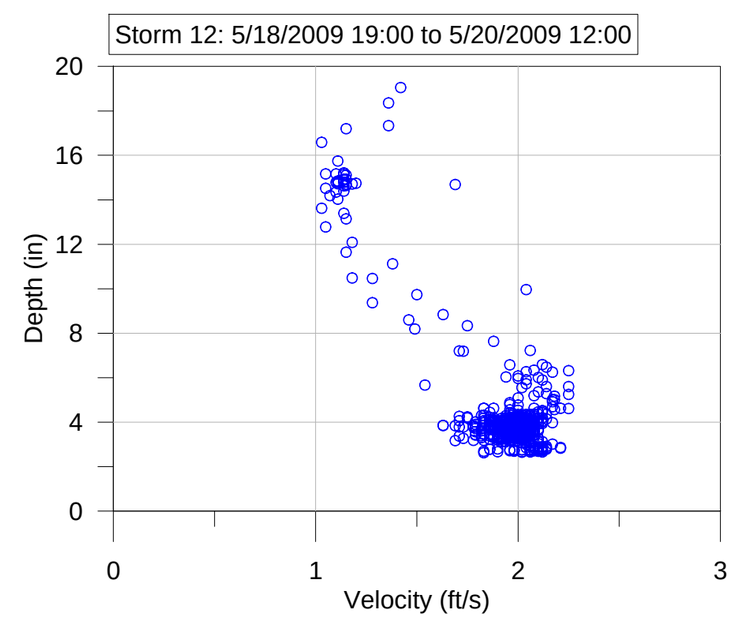




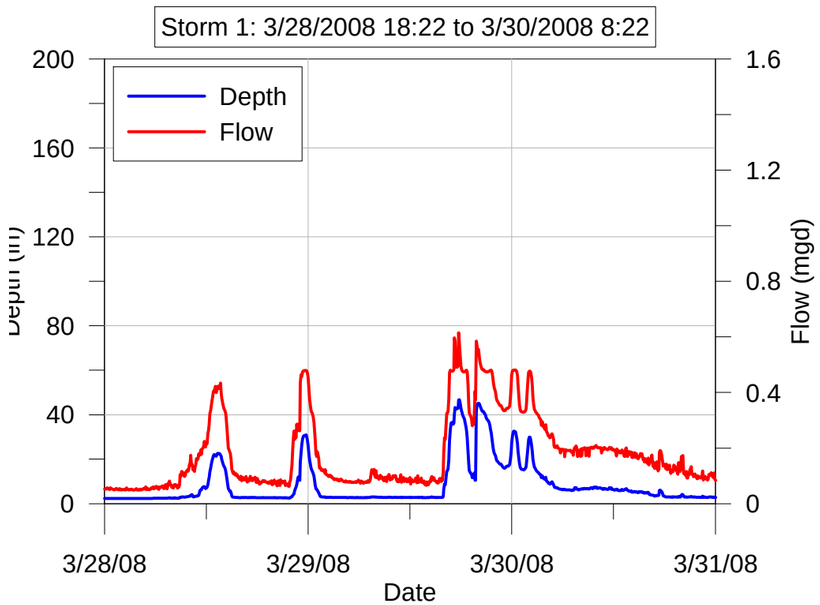


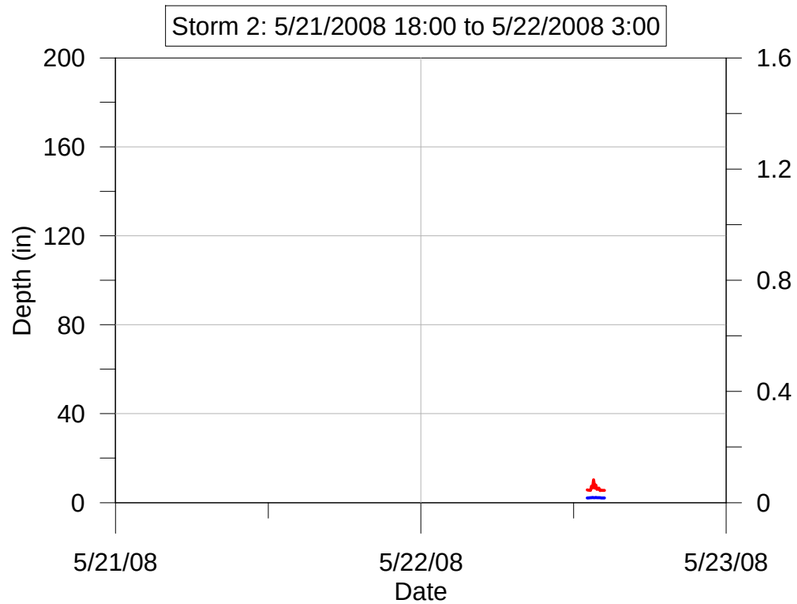


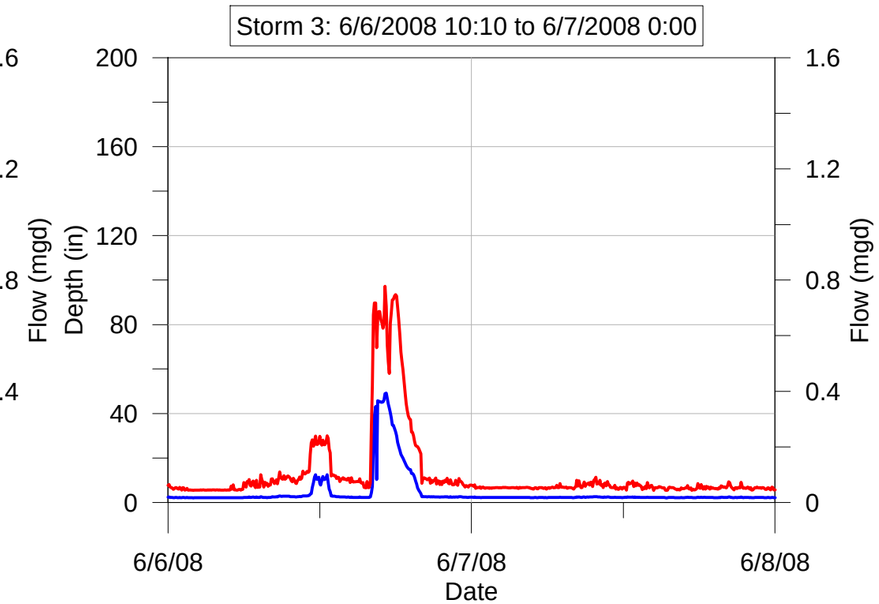


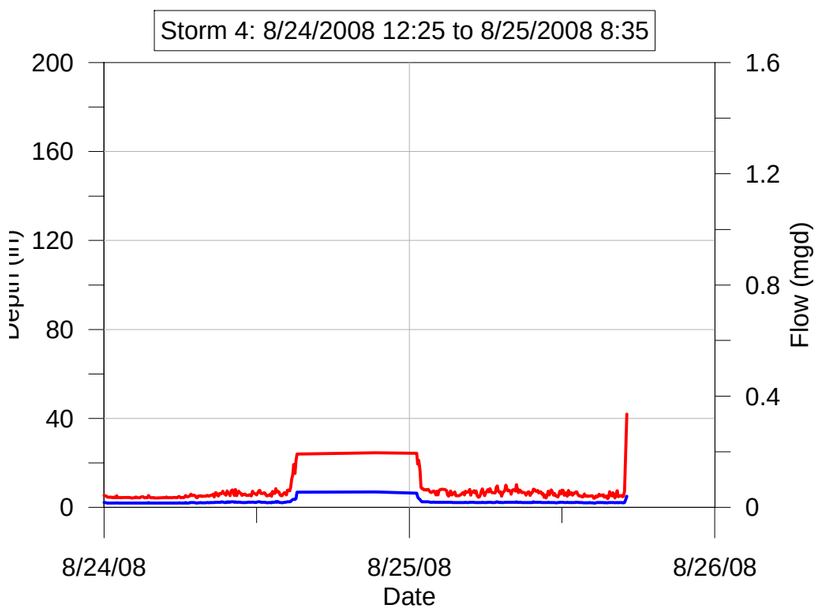


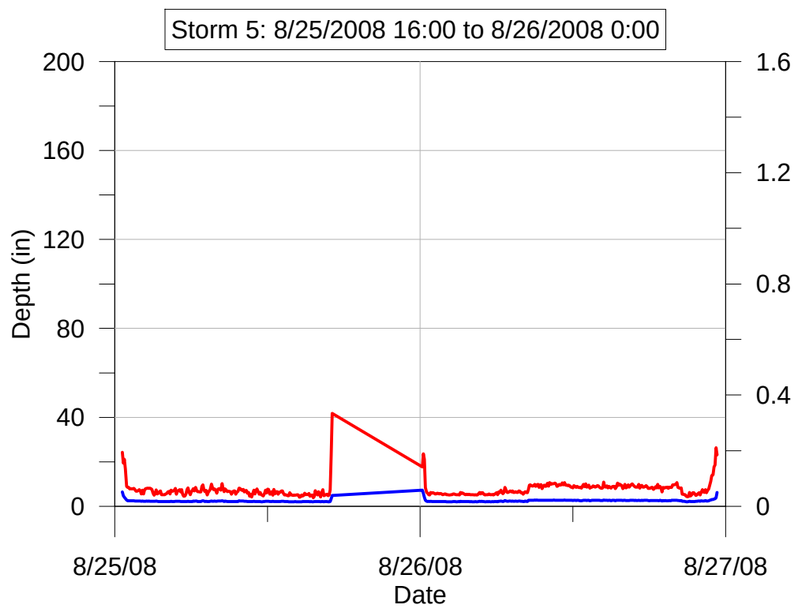
Calibration Storms
Monitor 306-245

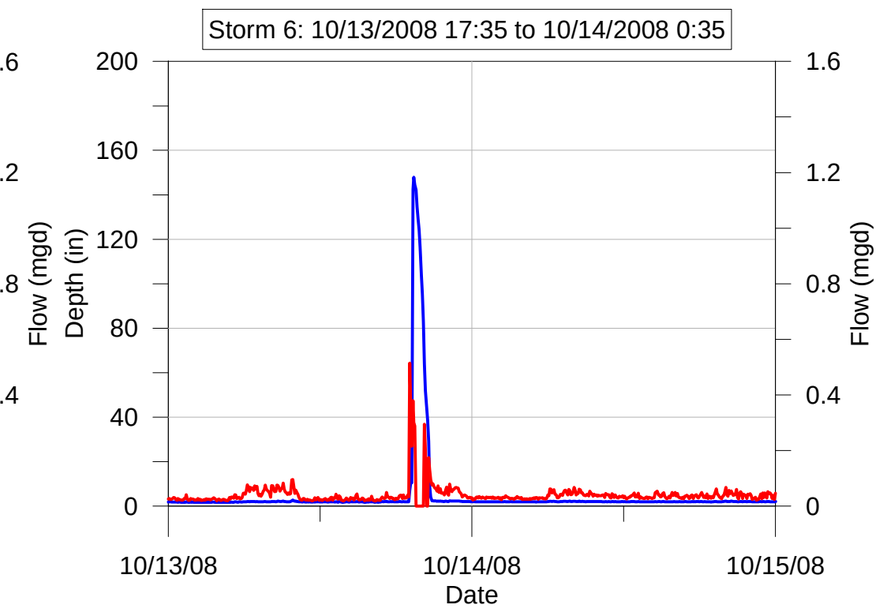




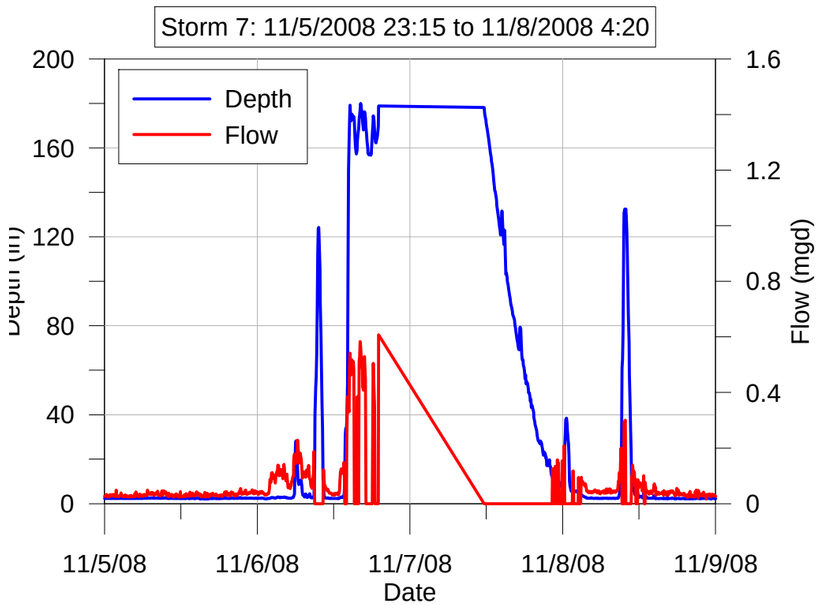


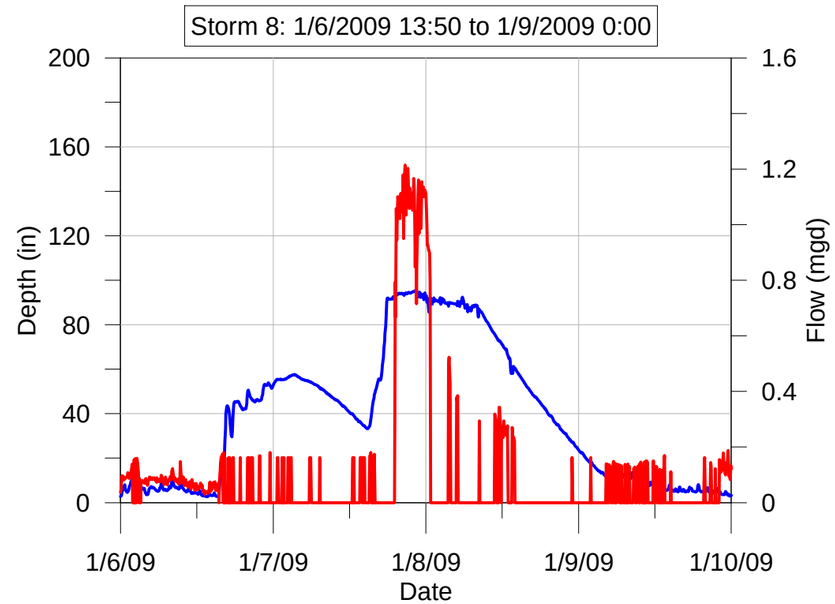


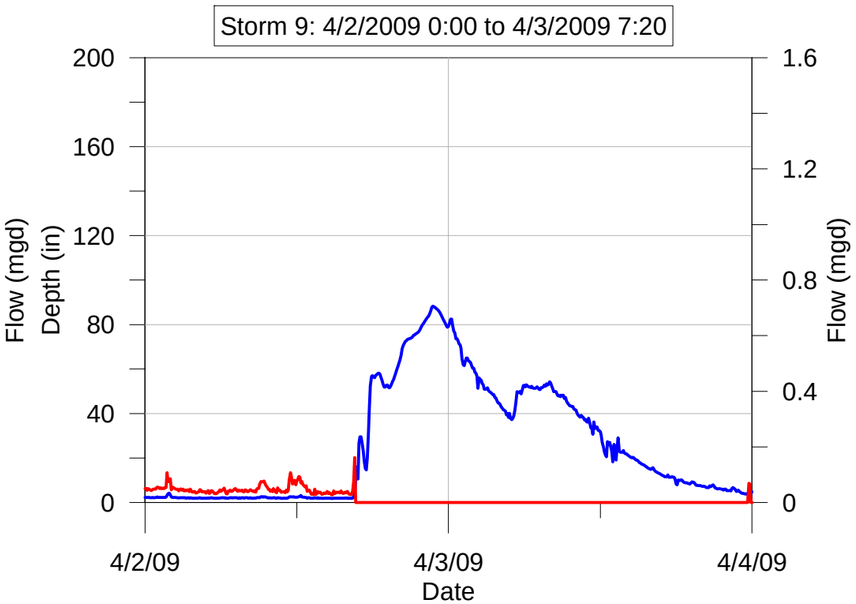


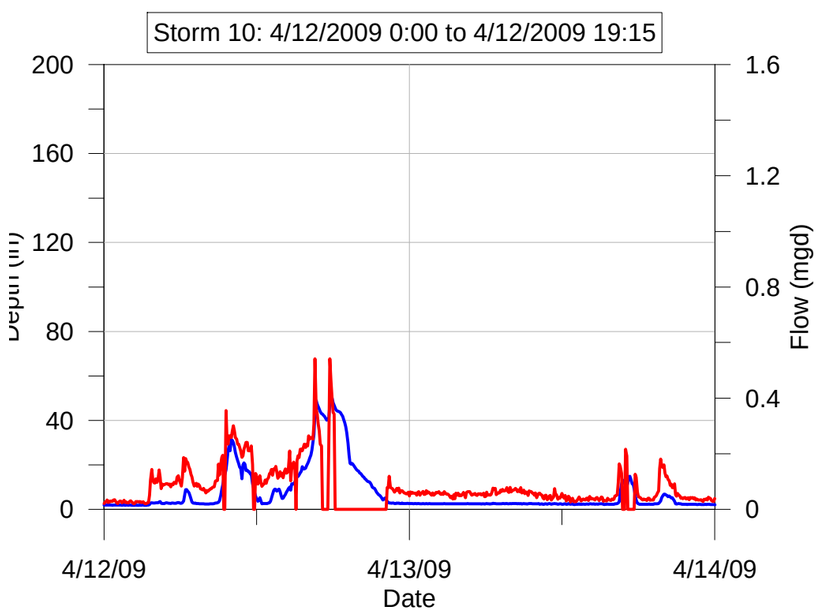


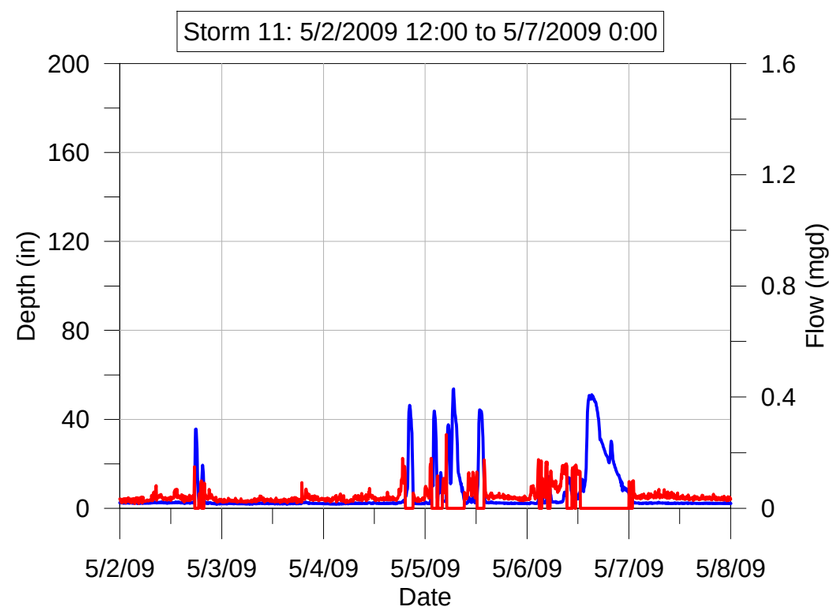
Calibration Storms
Monitor 306-245

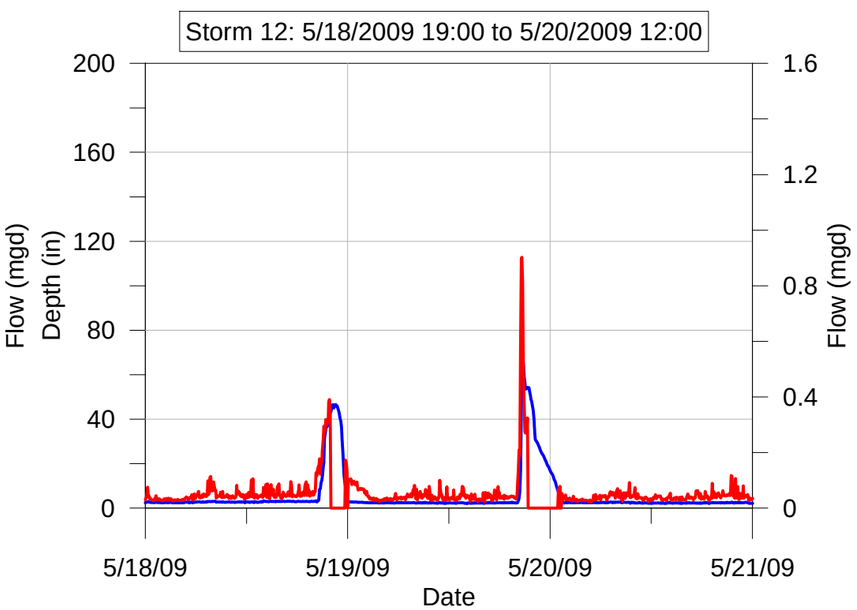




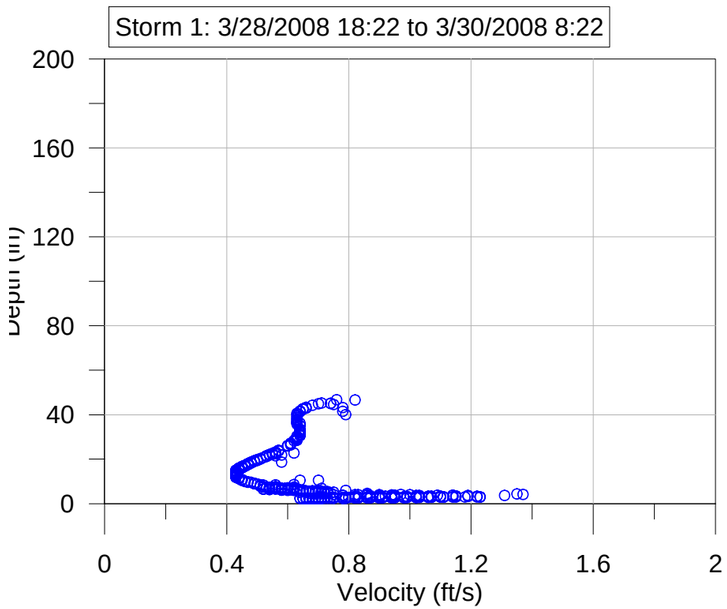


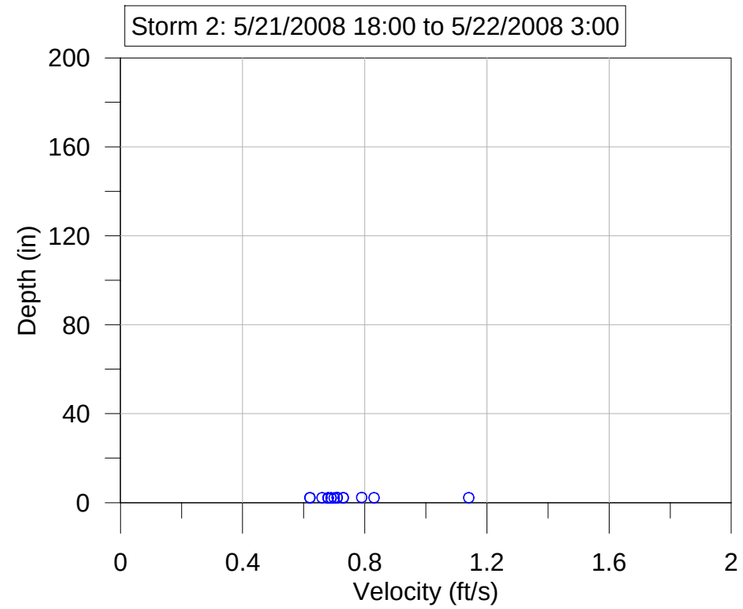


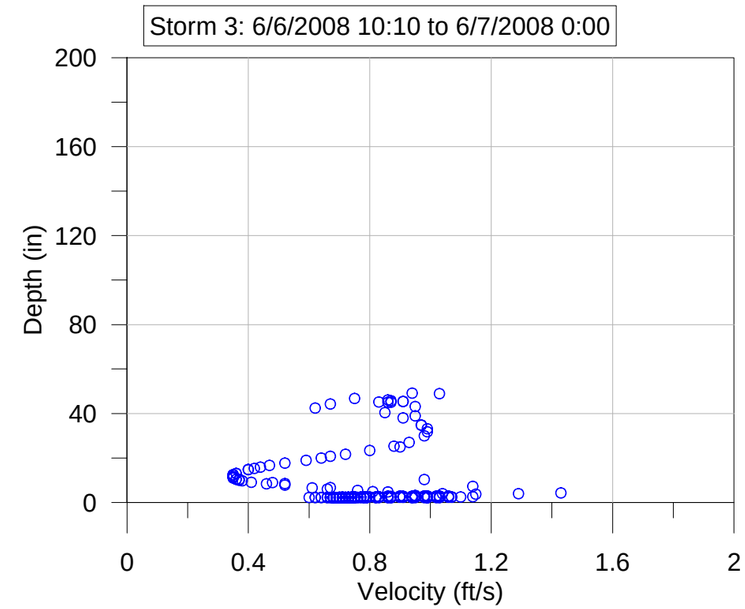


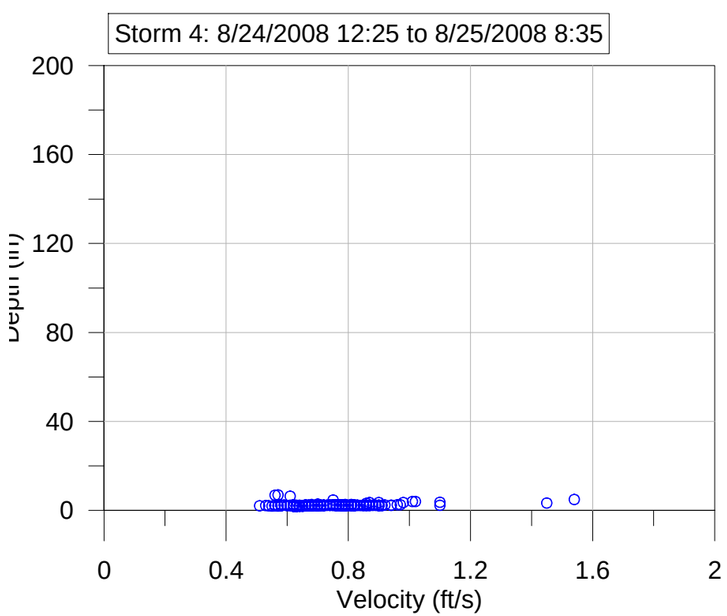


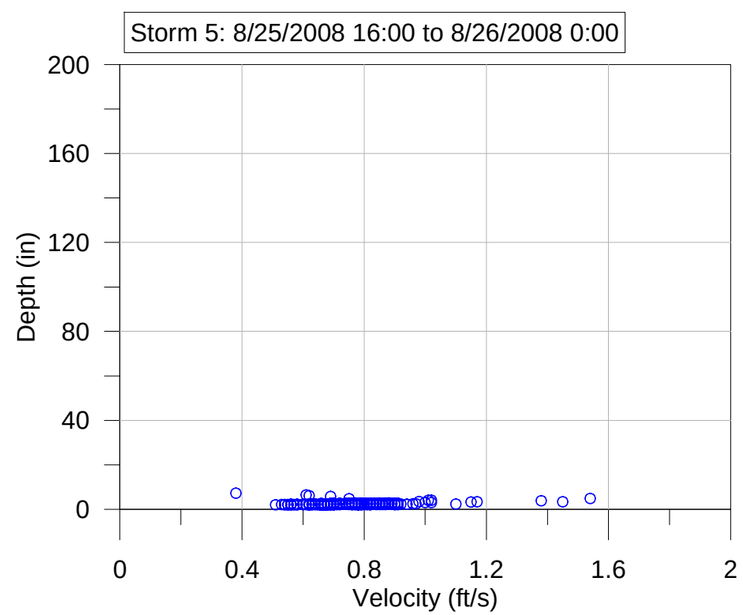
Calibration Storms - Scattergraphs
Monitor 306-245

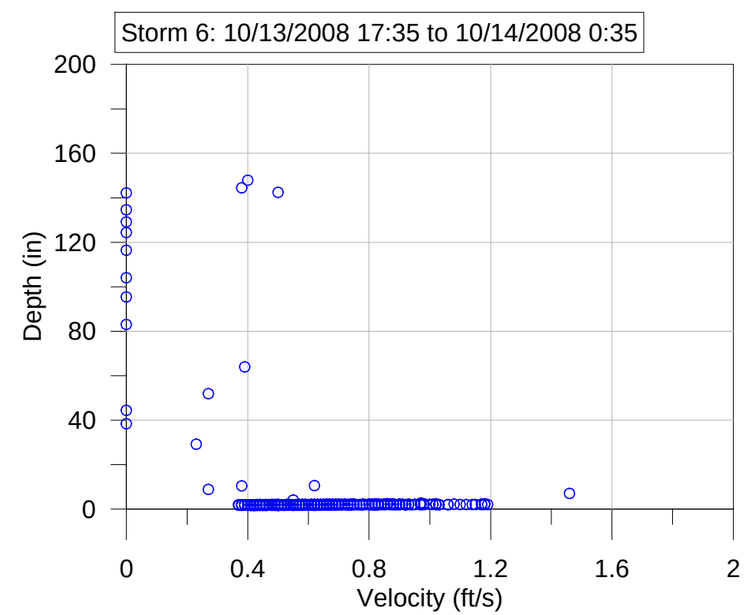




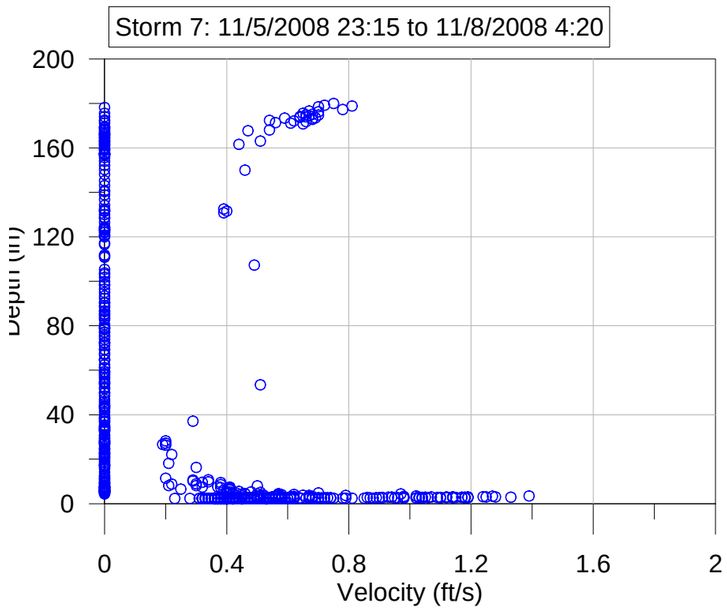


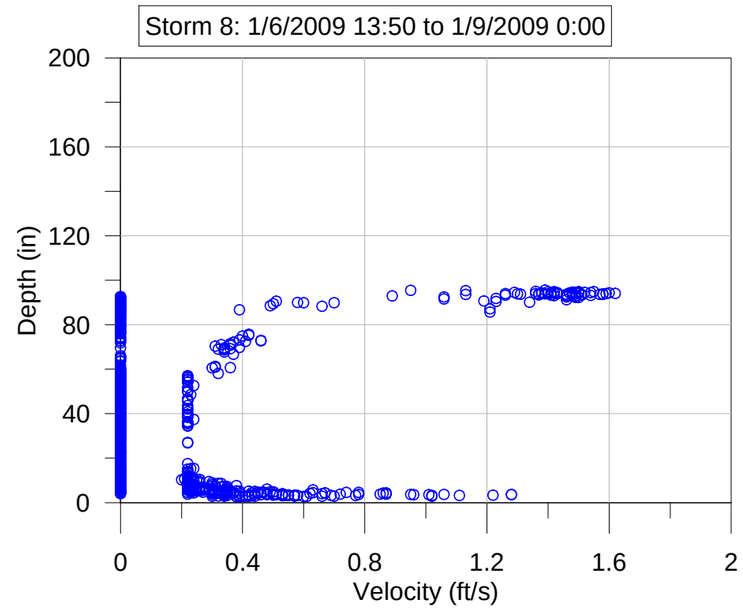


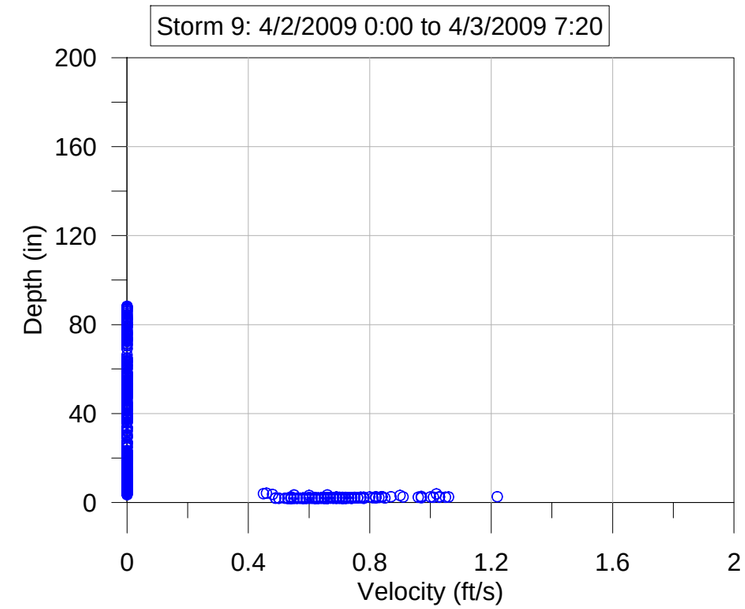


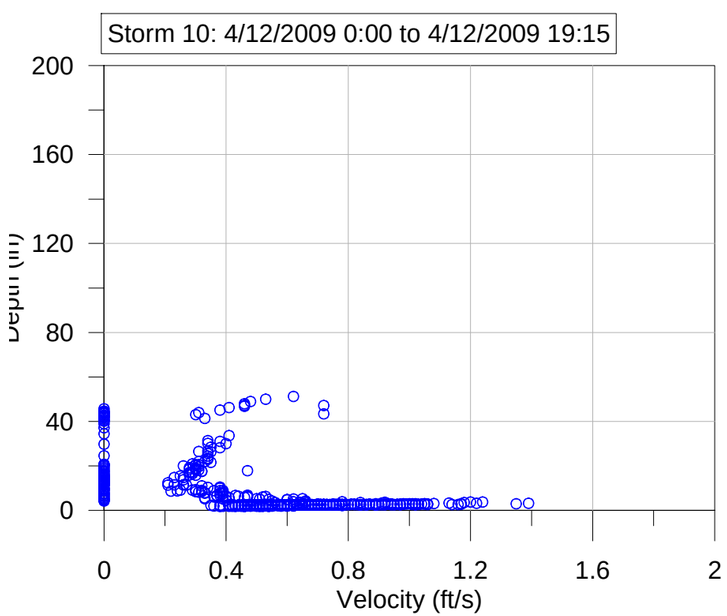


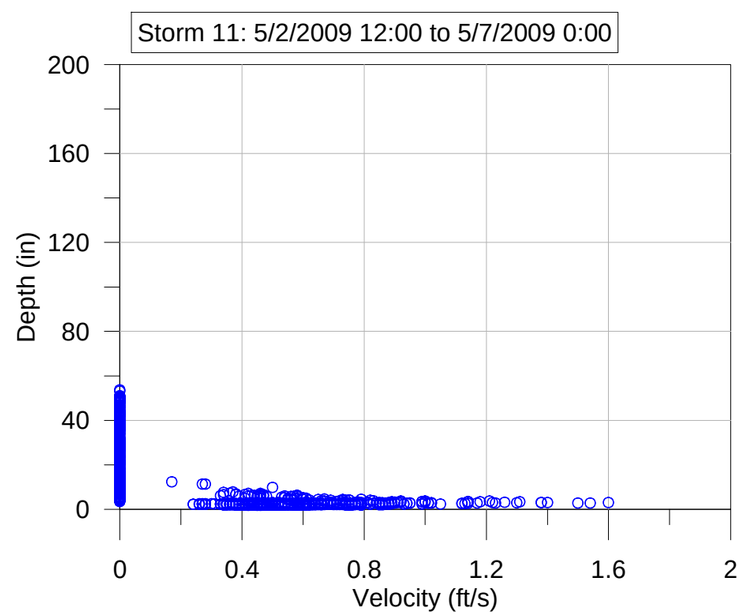
Calibration Storms - Scattergraphs
Monitor 306-245

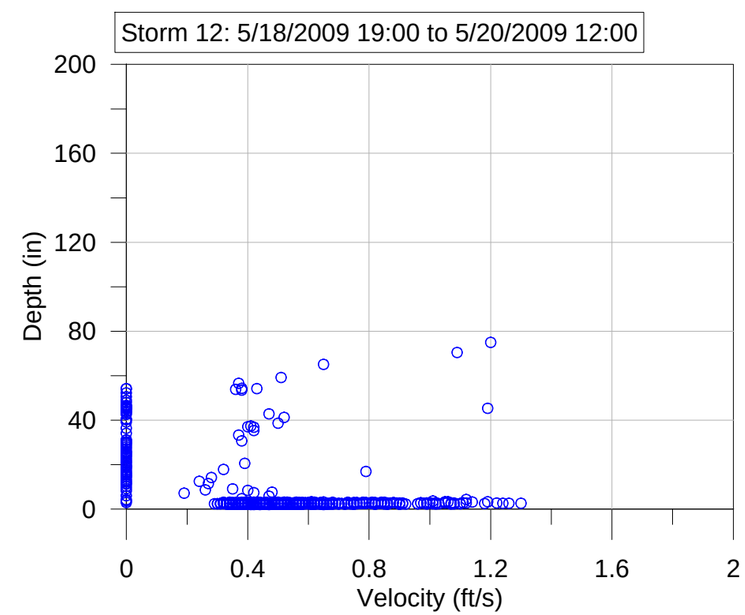




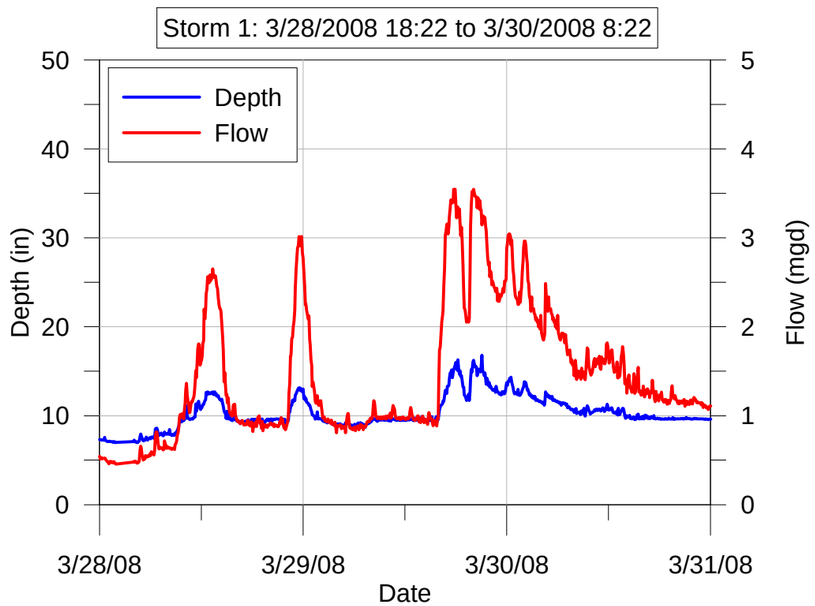


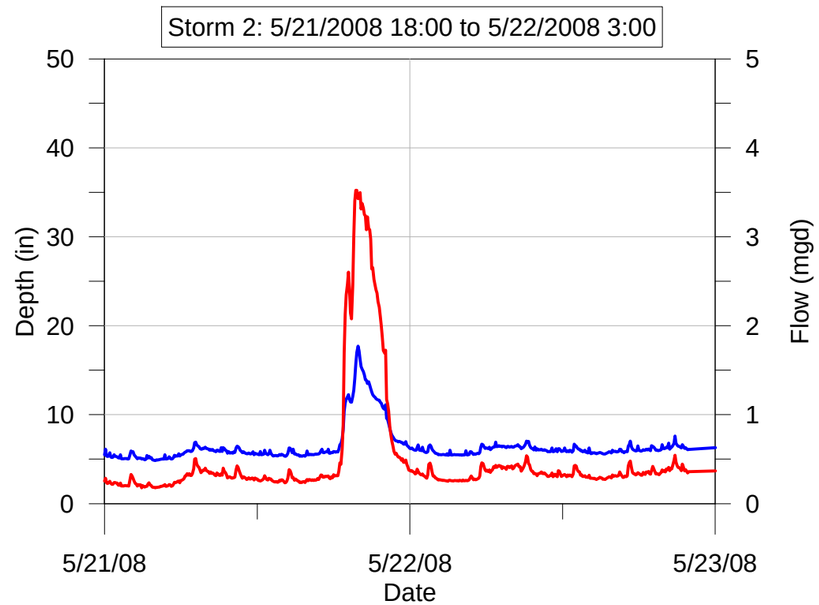


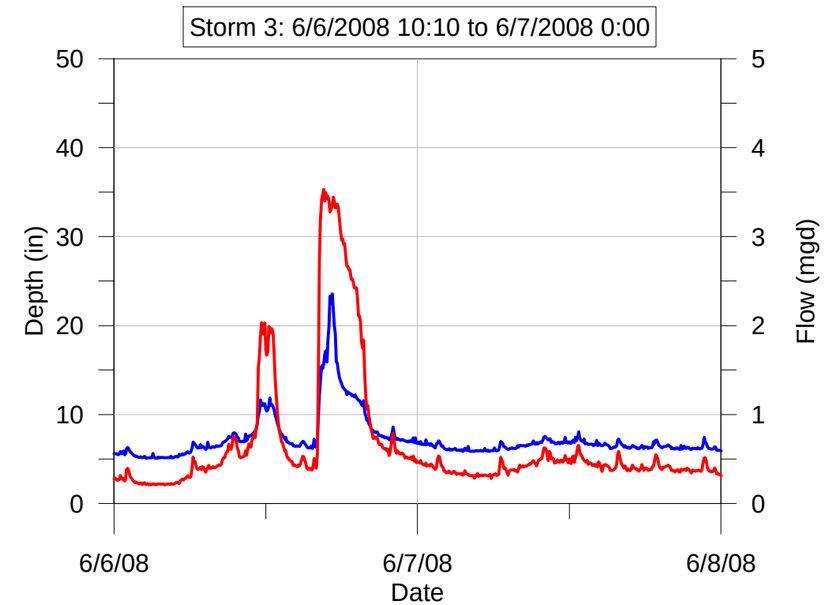


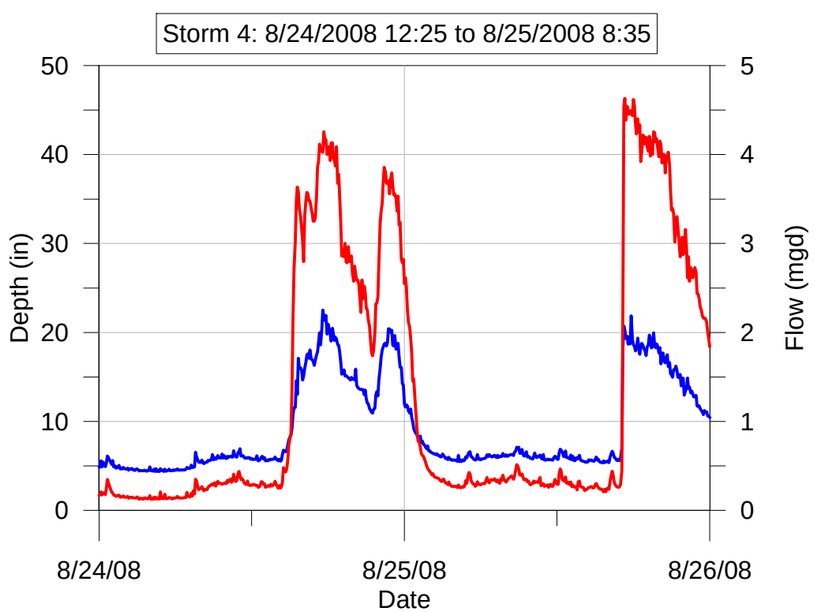


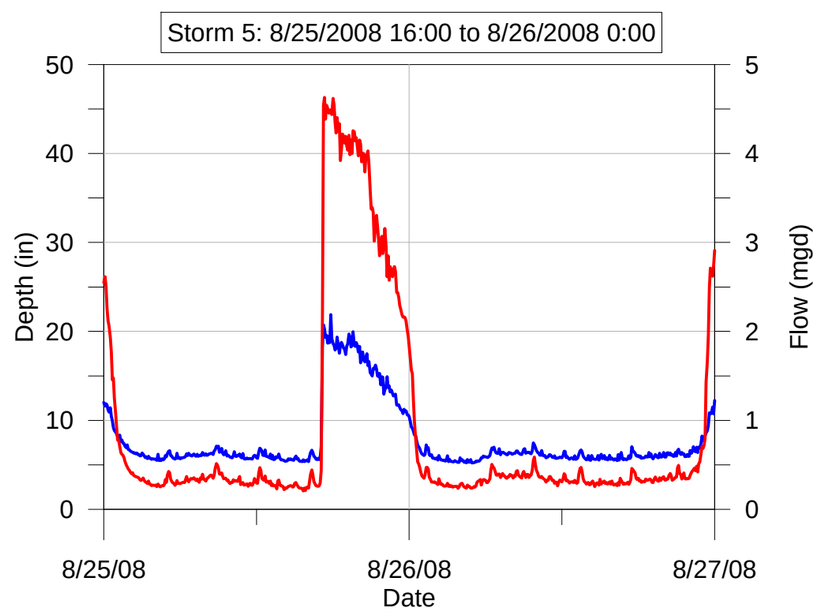
Calibration Storms
Monitor 306-246

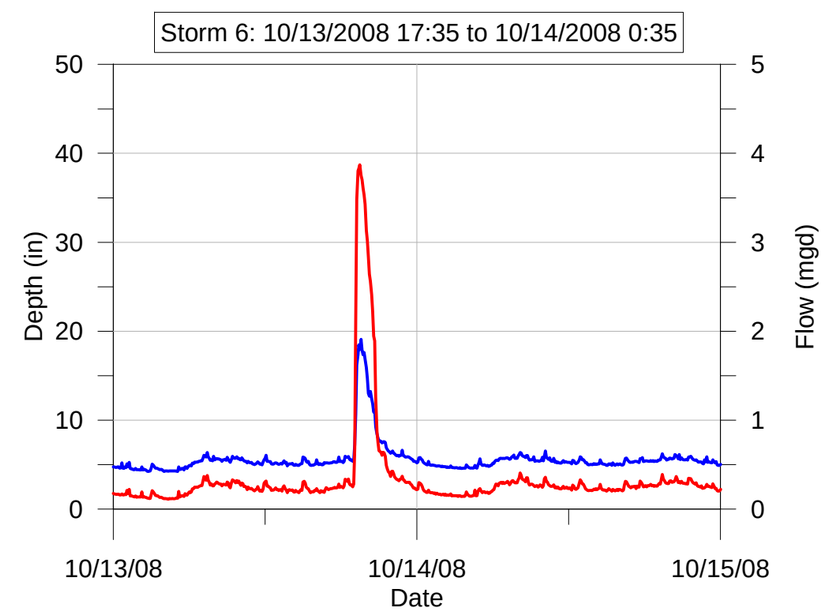




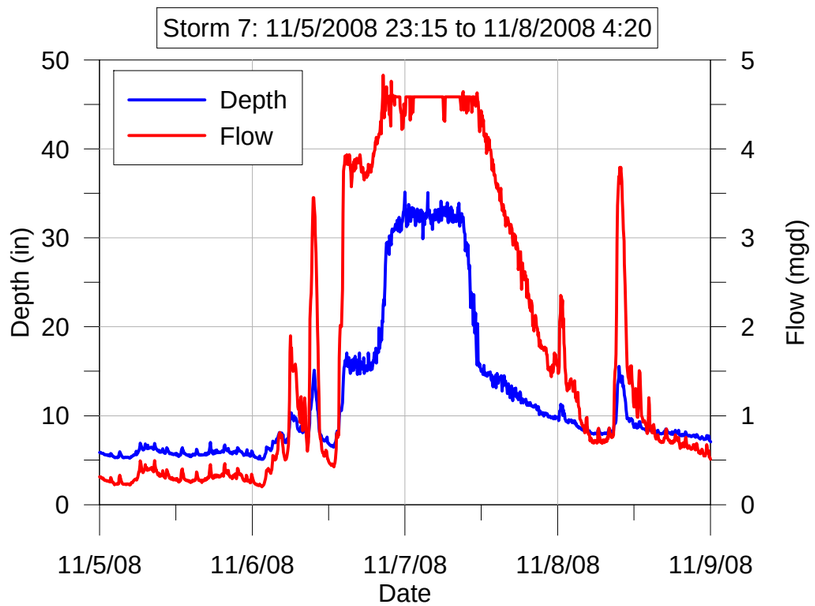


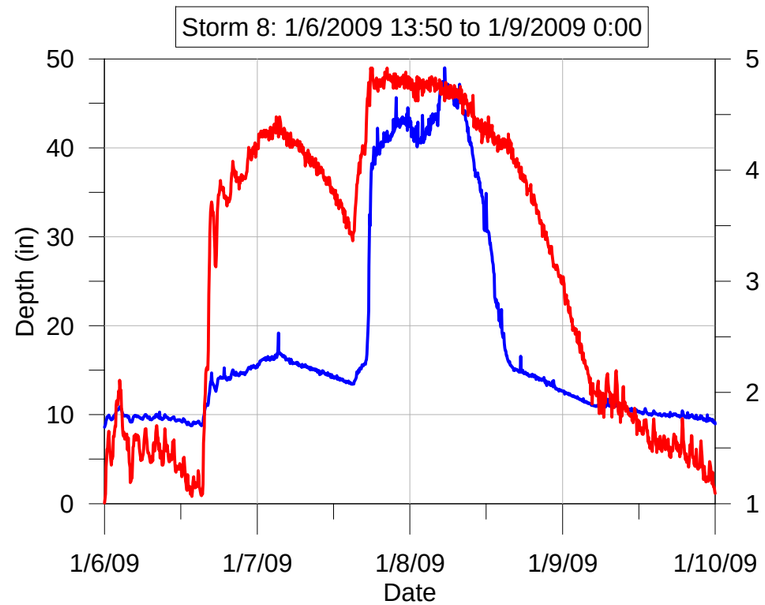


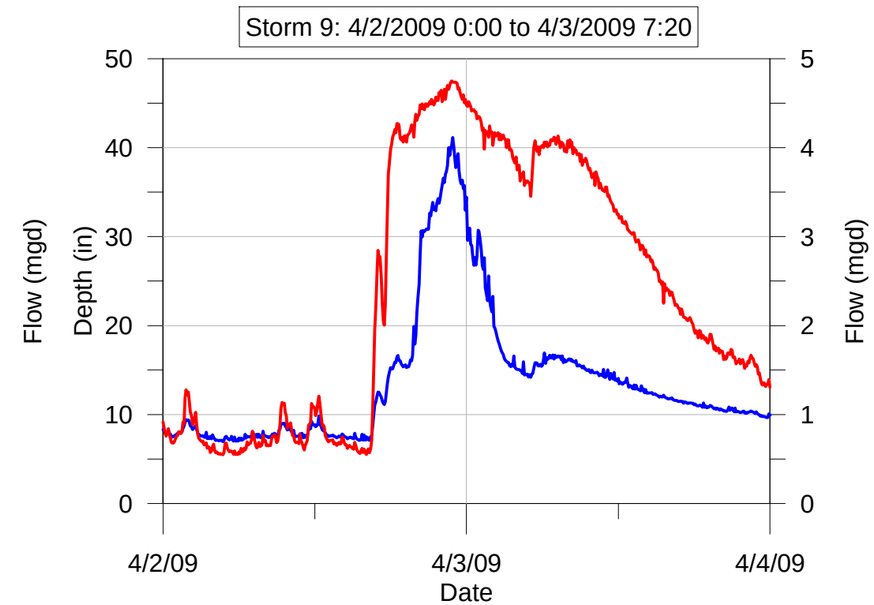


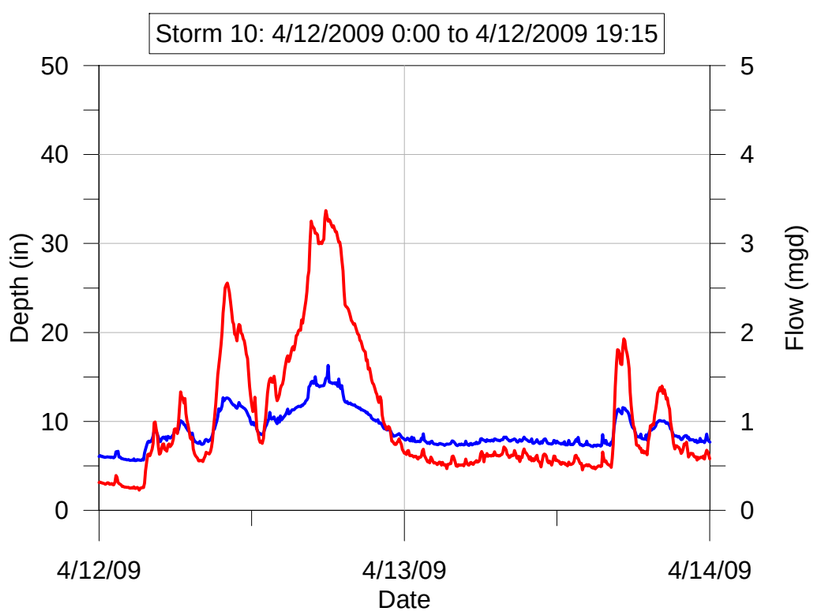


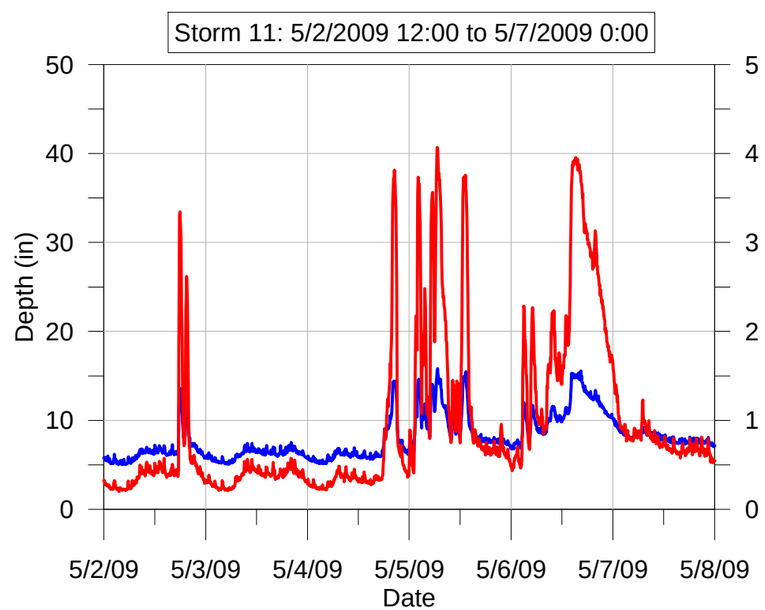
Calibration Storms
Monitor 306-246

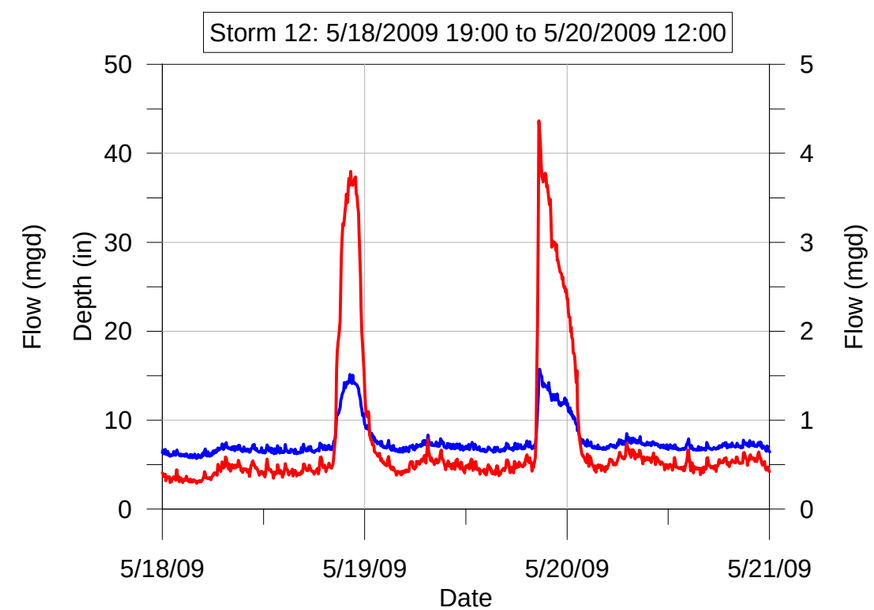




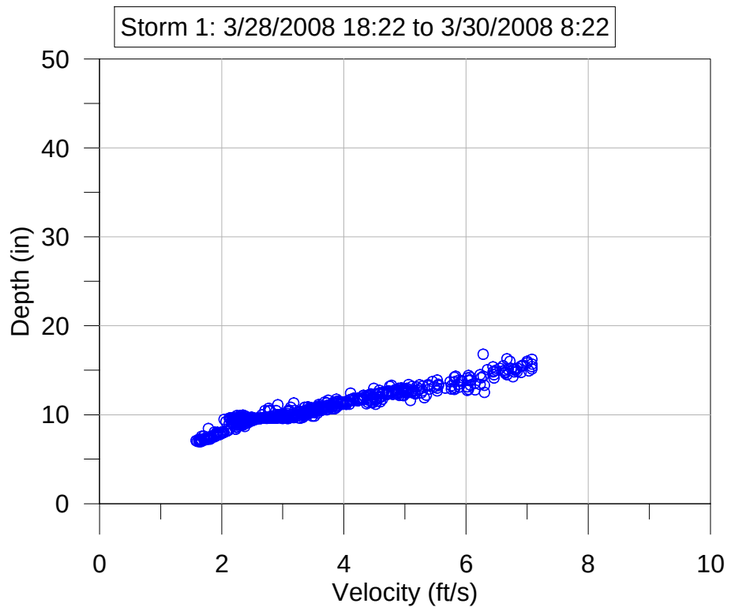


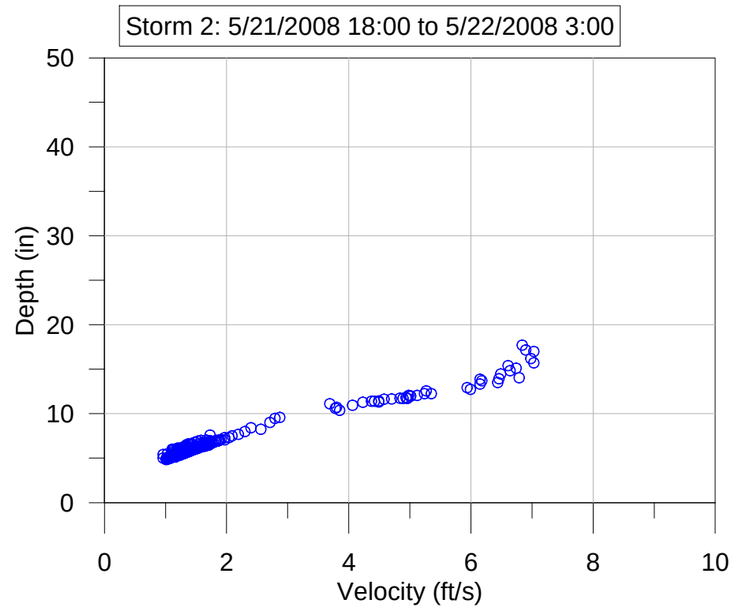


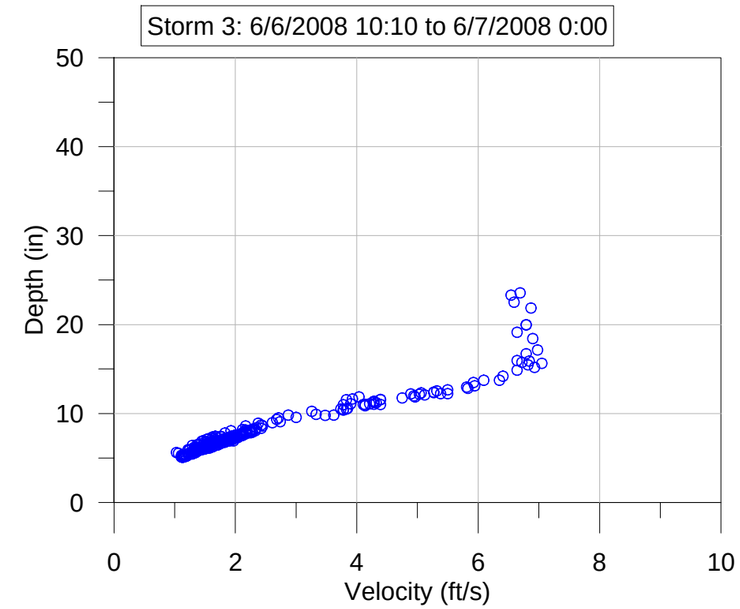


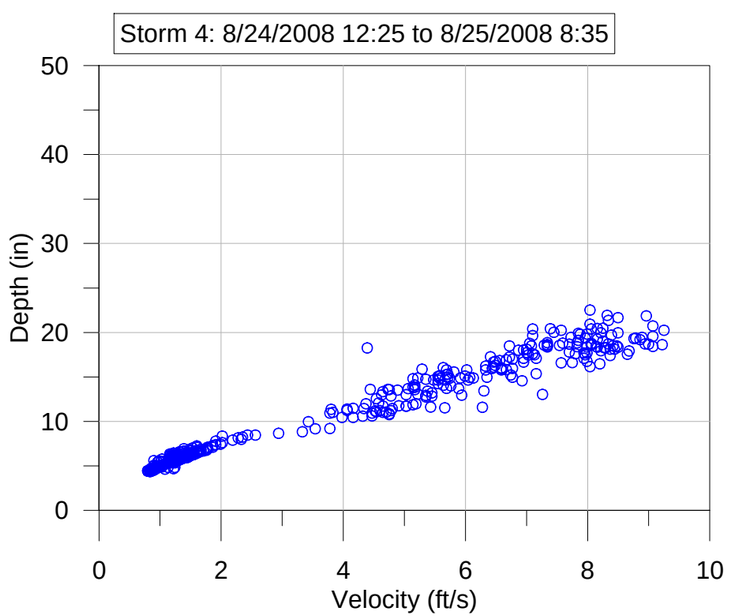


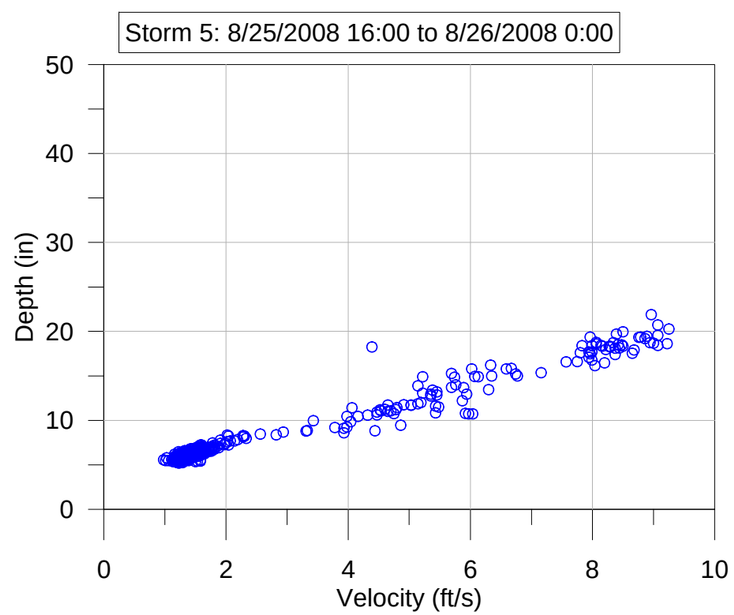
Calibration Storms - Scattergraphs
Monitor 306-246

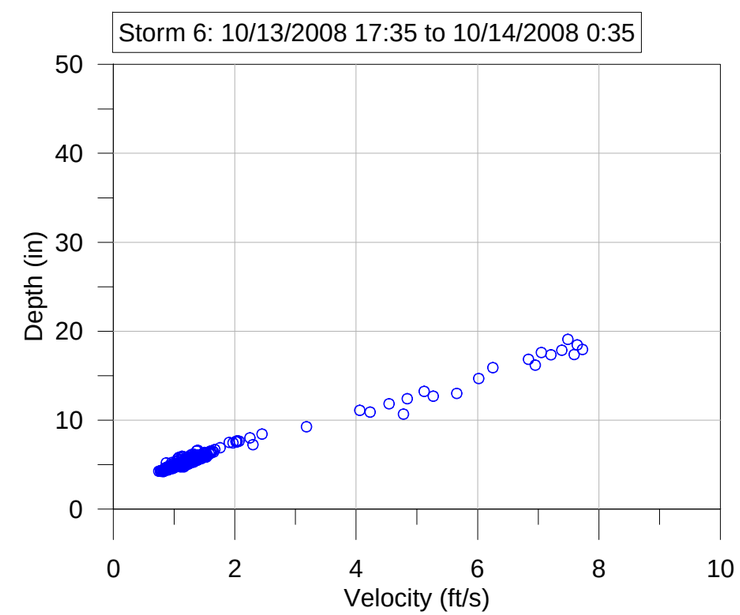




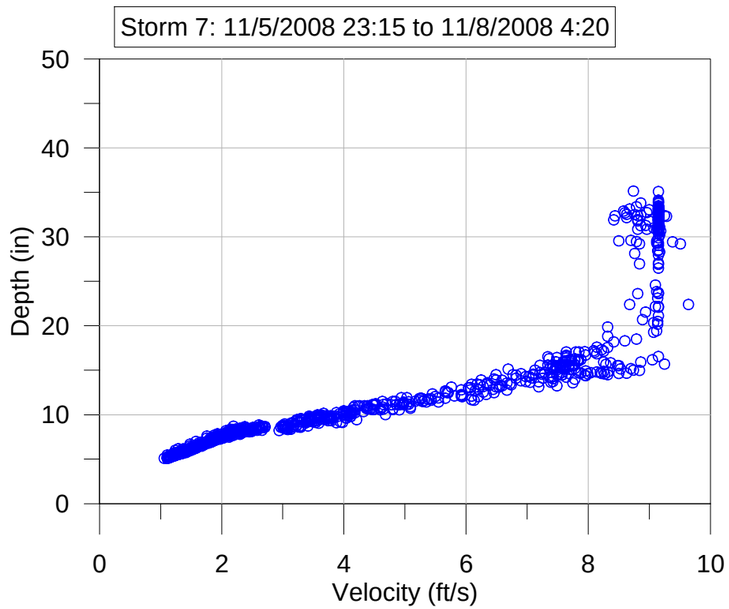


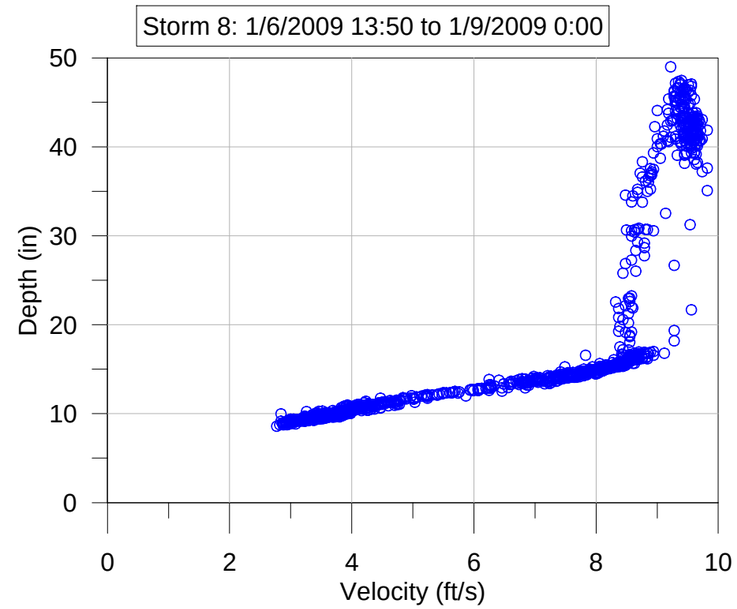


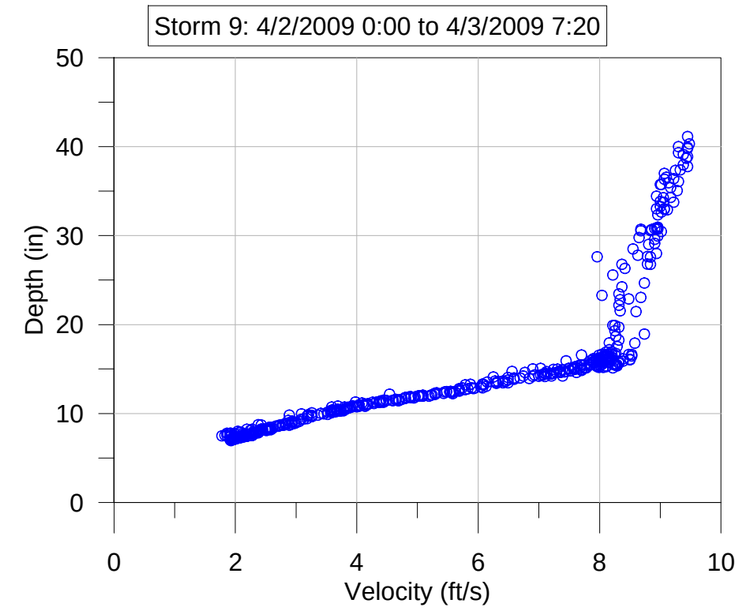


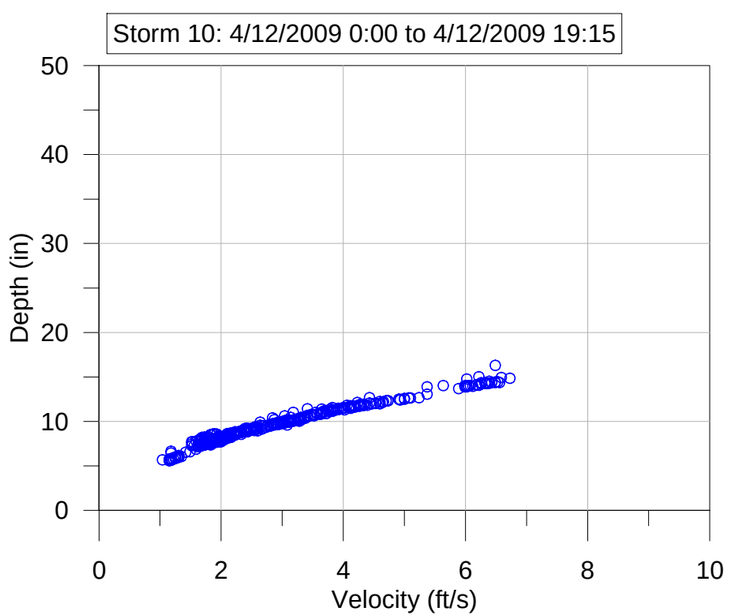


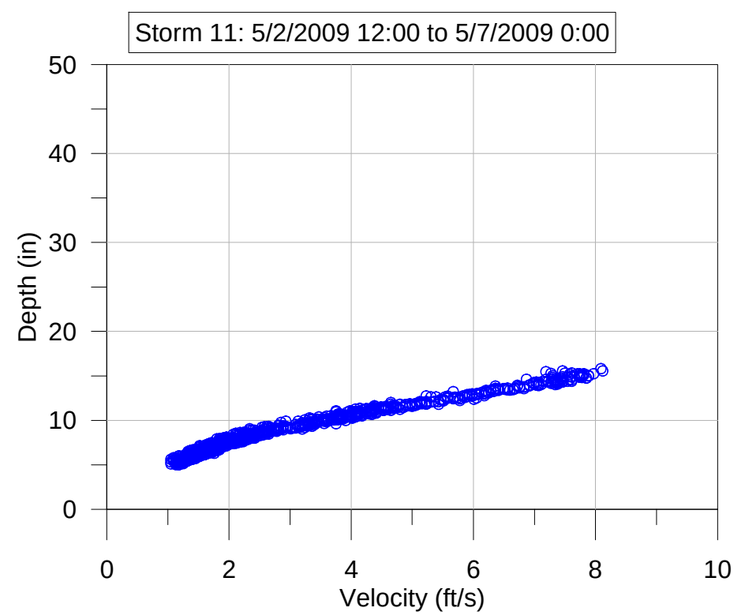
Calibration Storms - Scattergraphs
Monitor 306-246

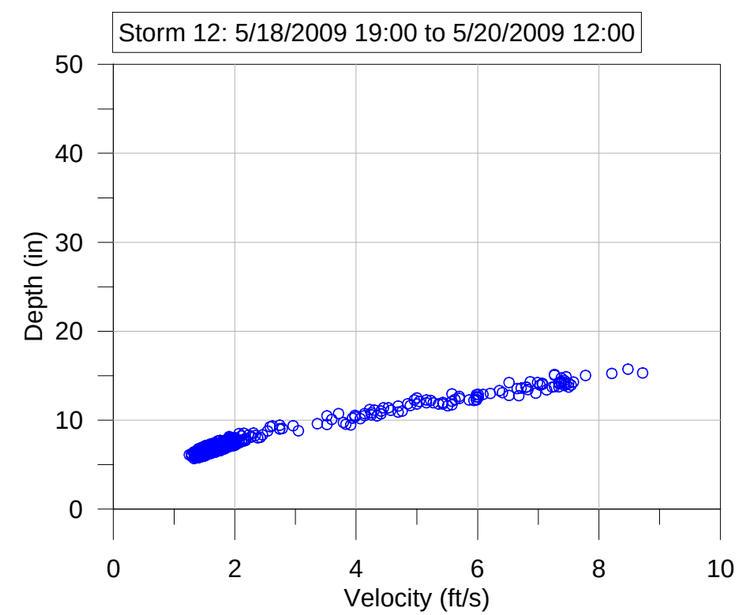




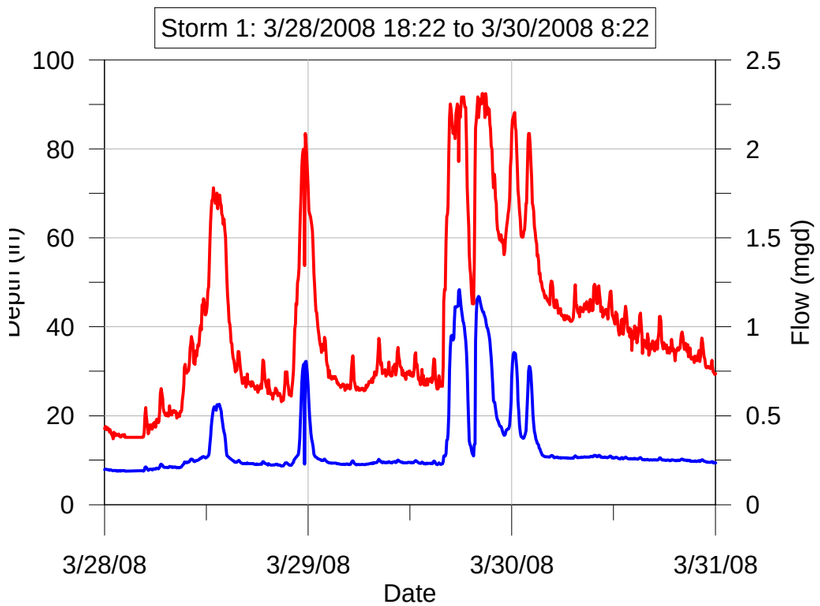


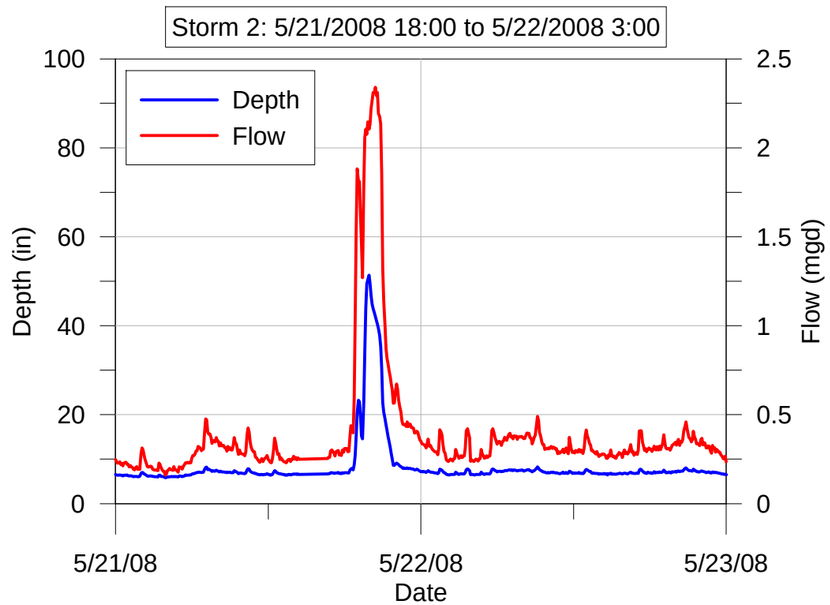


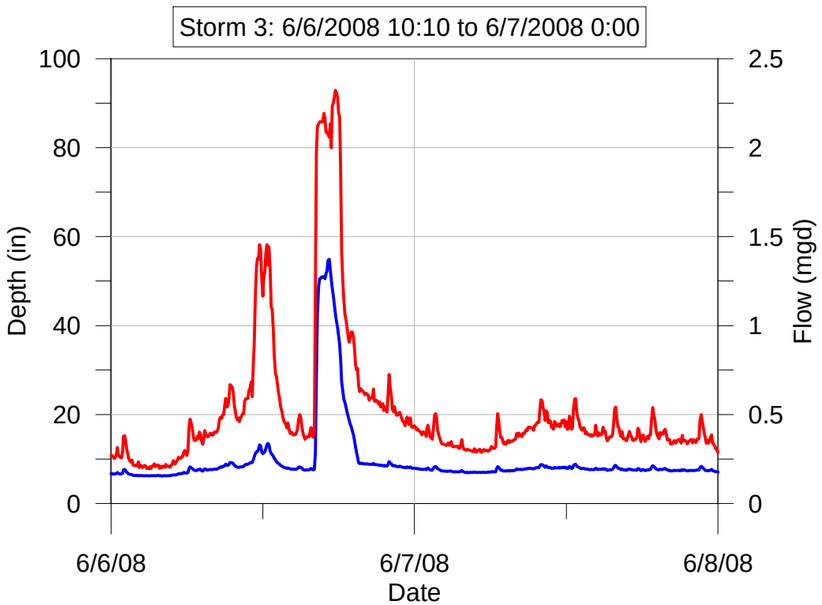


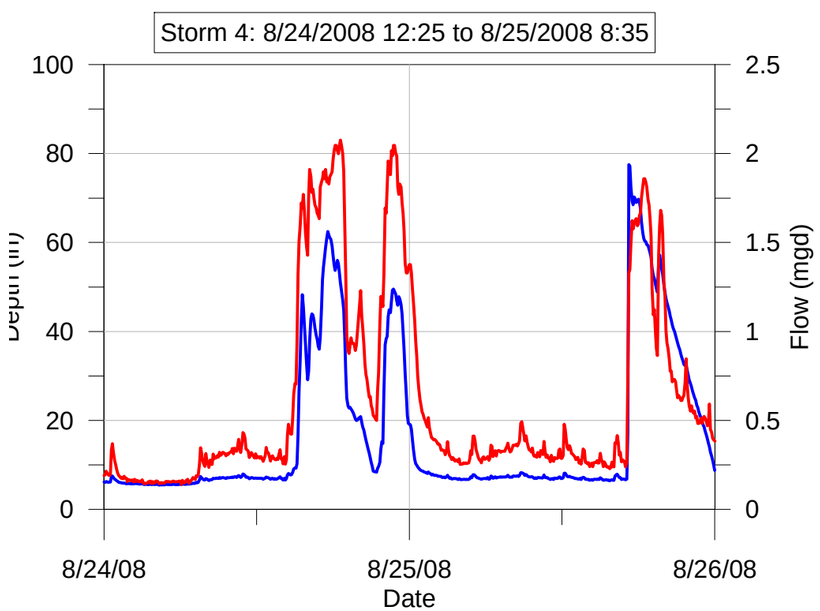


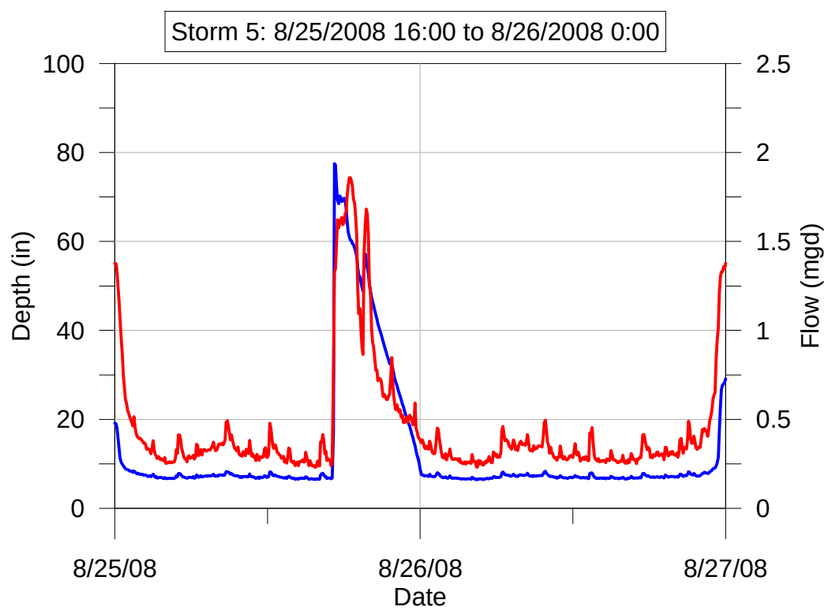
Calibration Storms
Monitor 306-275

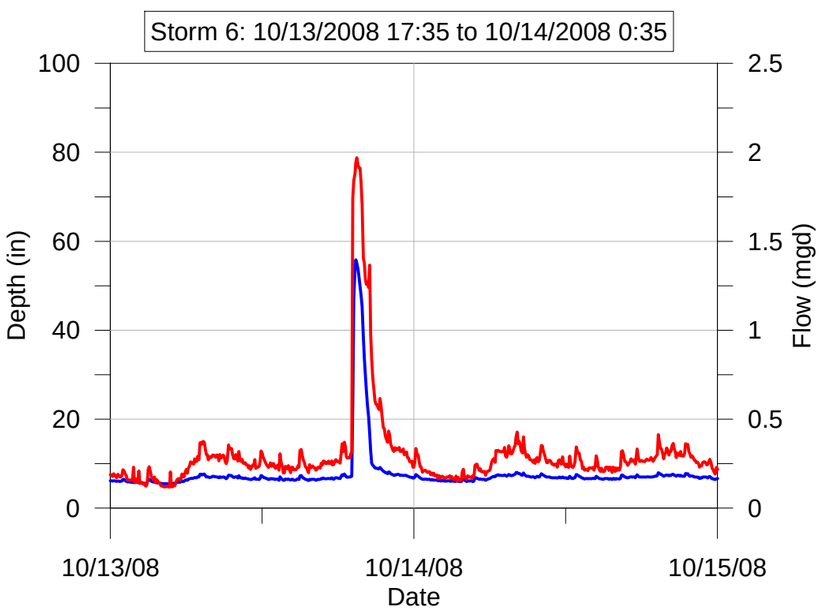




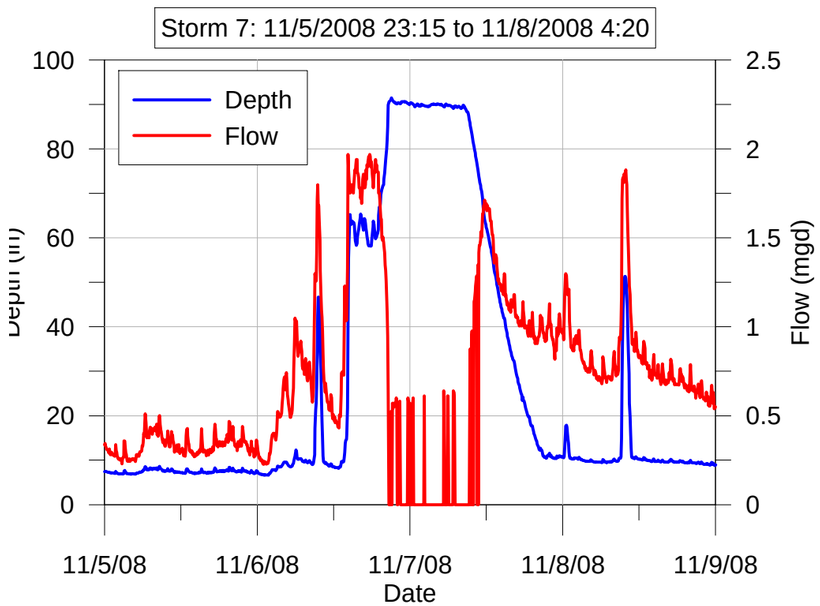


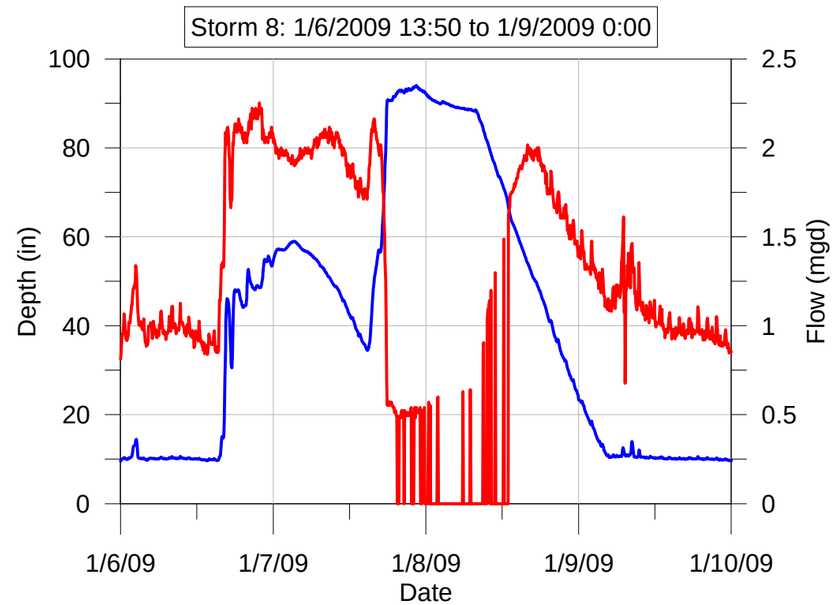


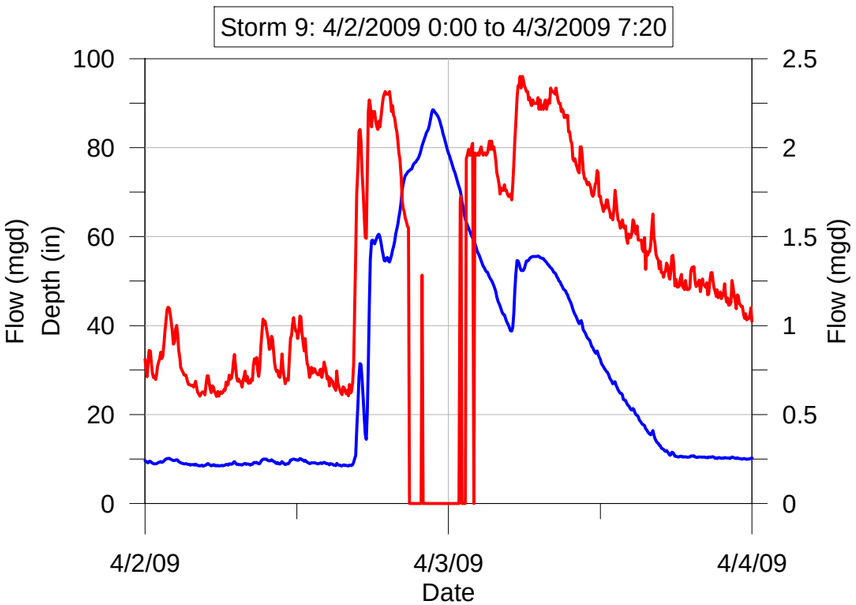


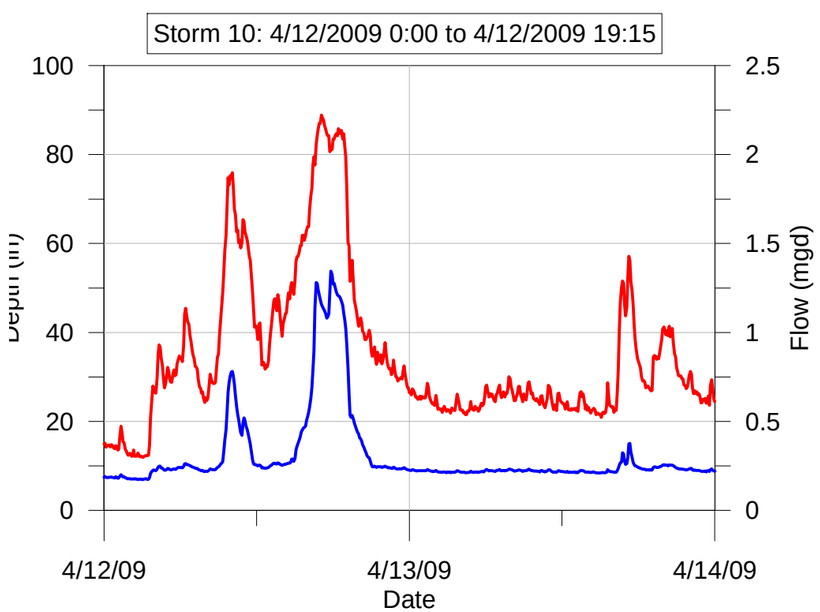


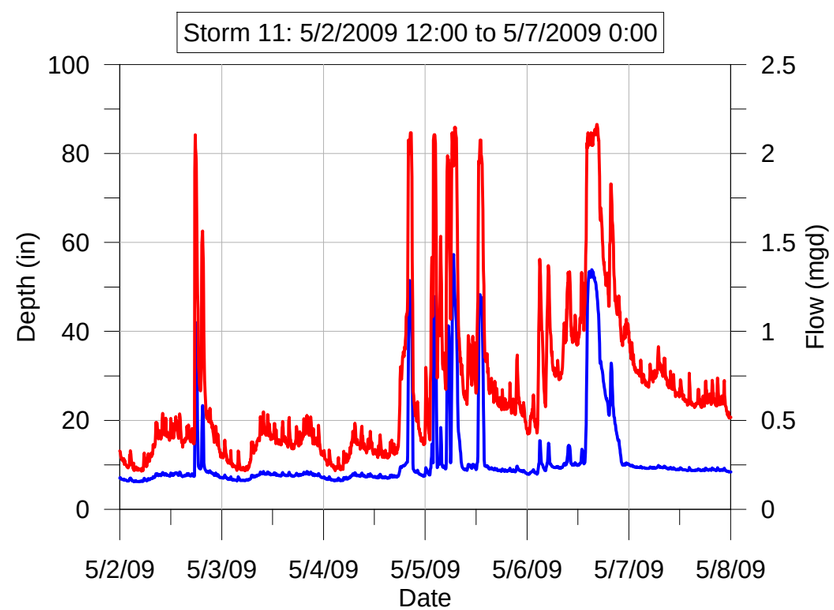
Calibration Storms
Monitor 306-275

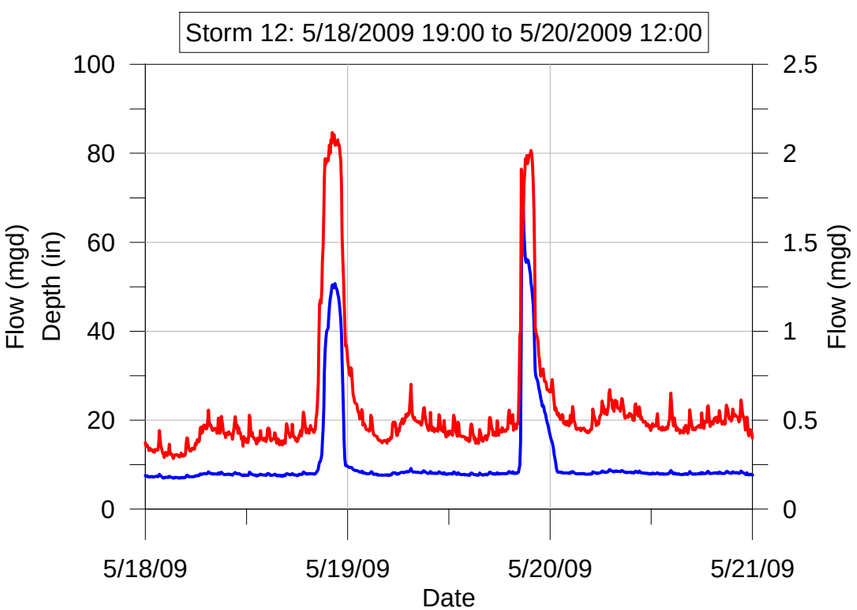




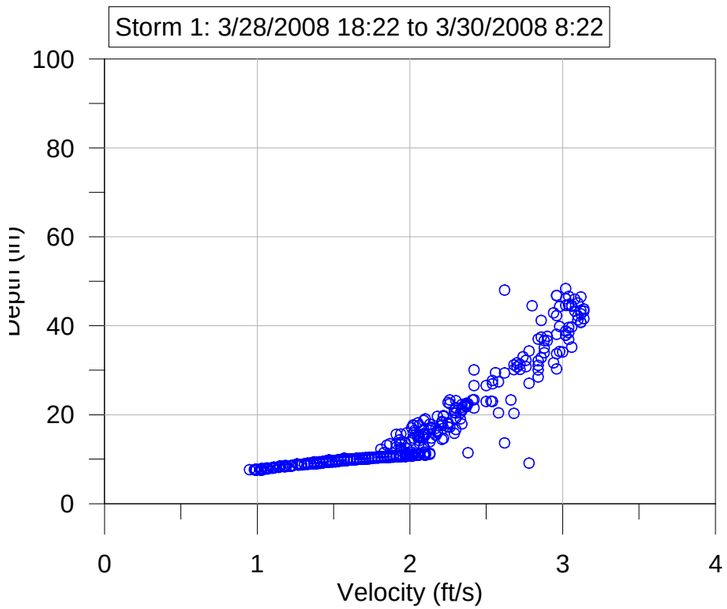


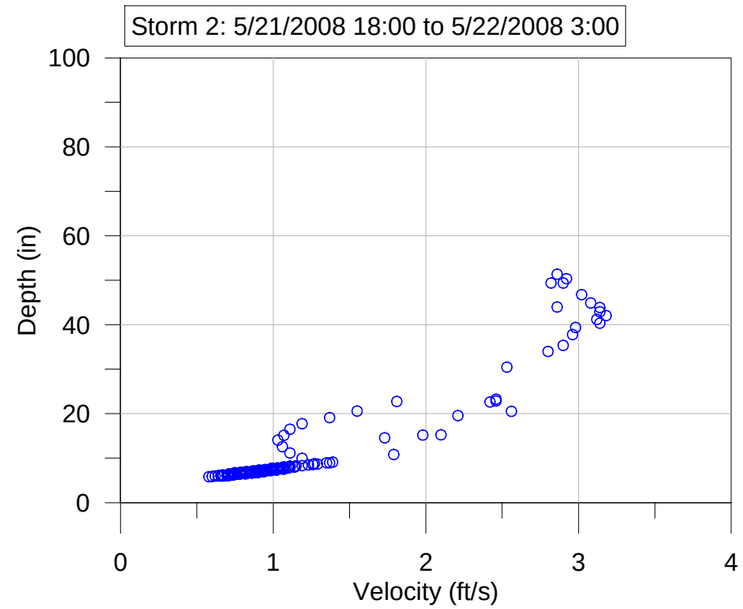


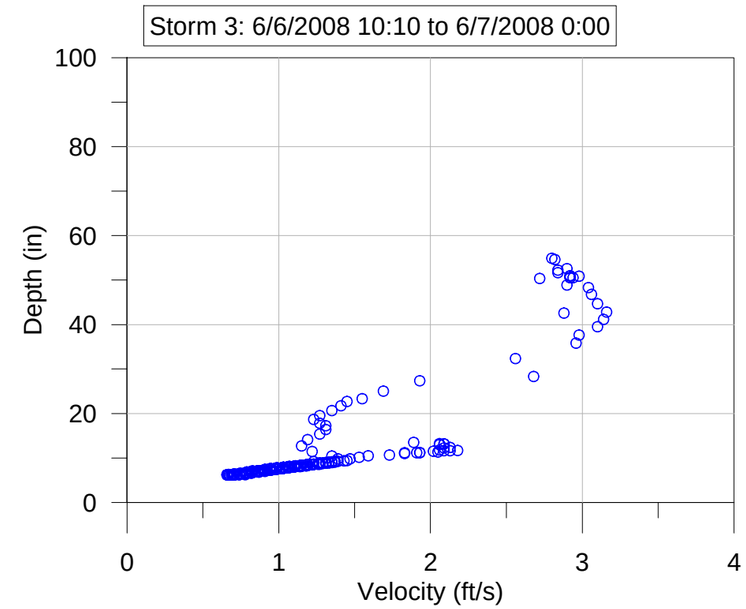


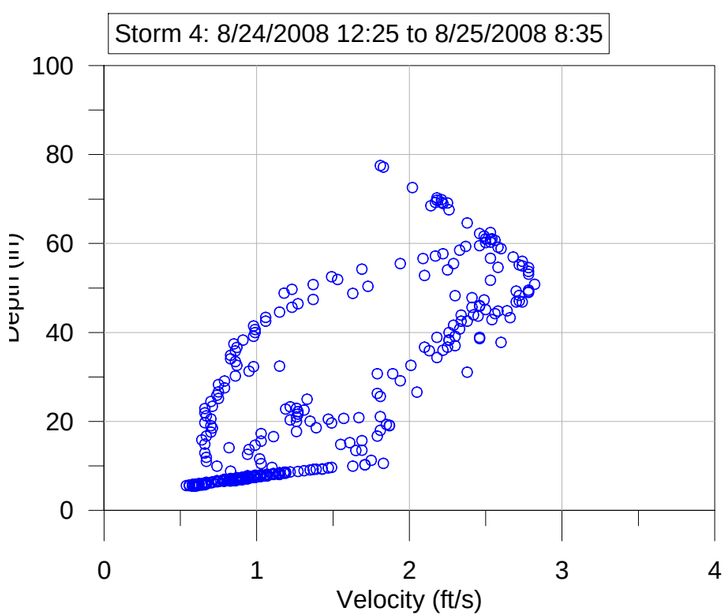


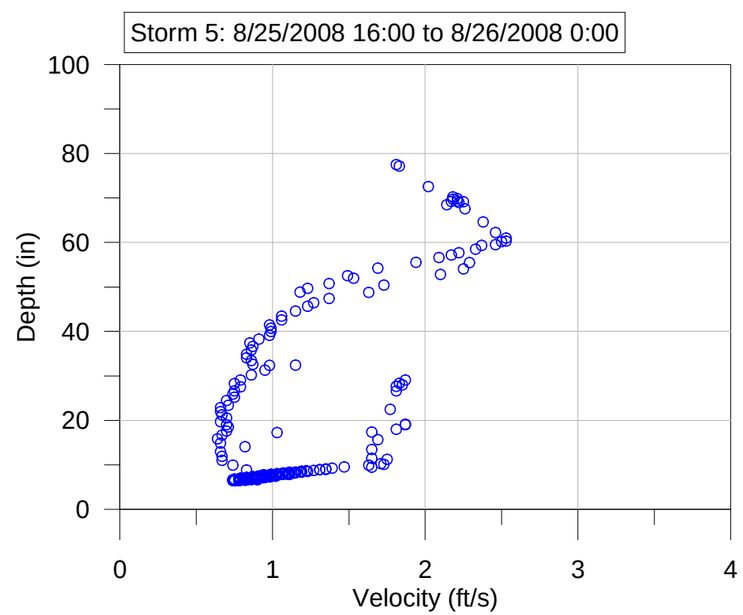
Calibration Storms - Scattergraphs
Monitor 306-275

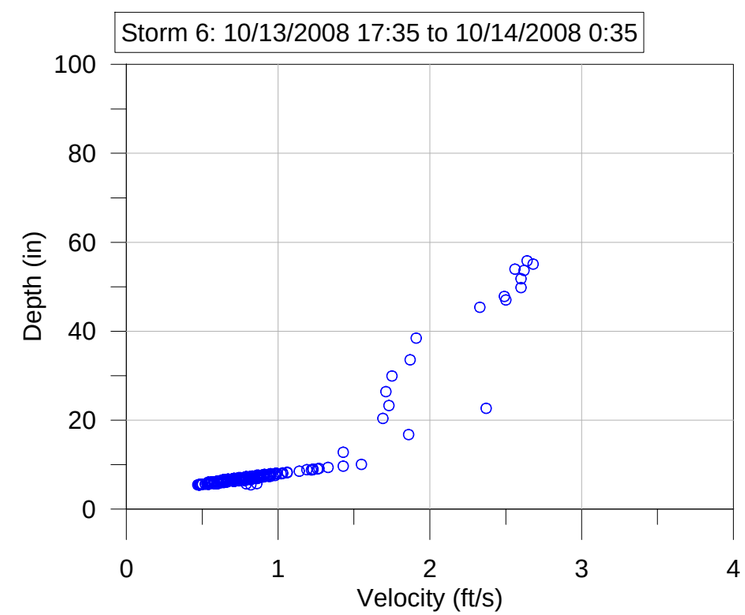




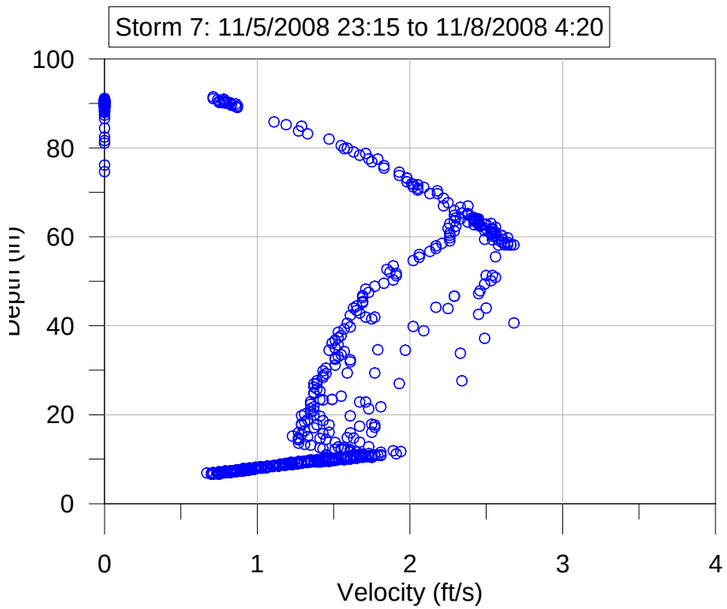


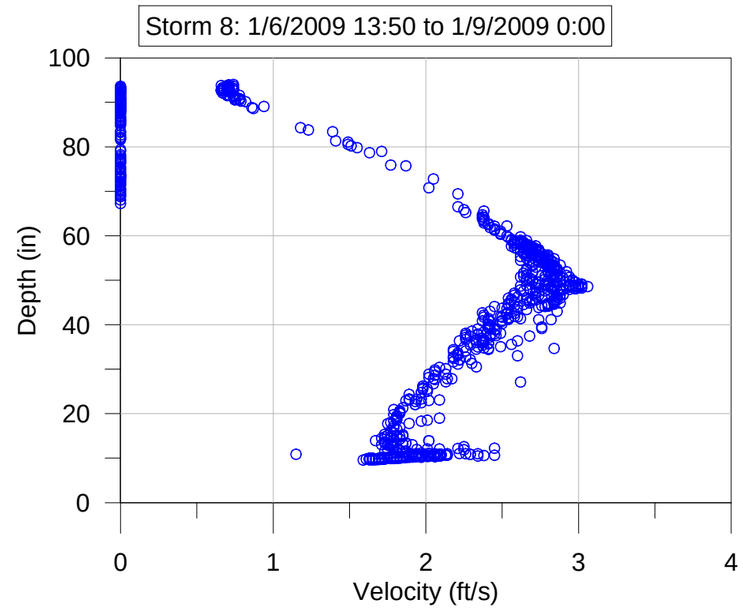


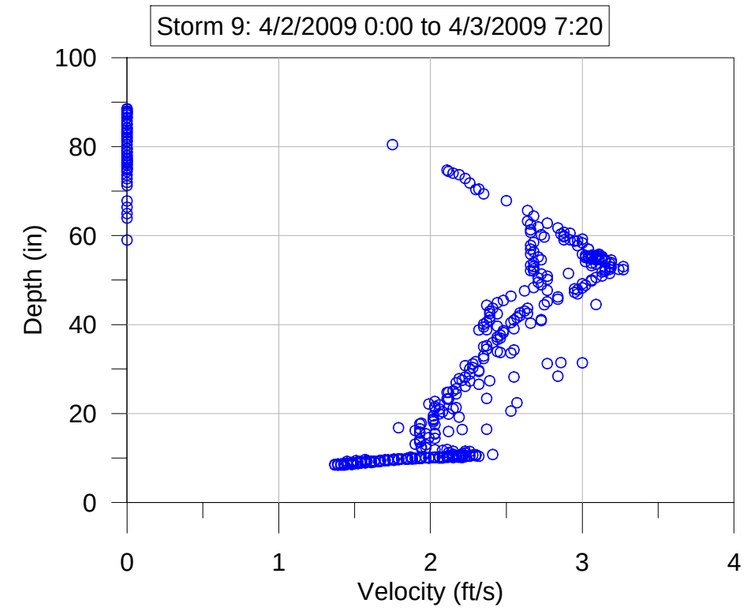


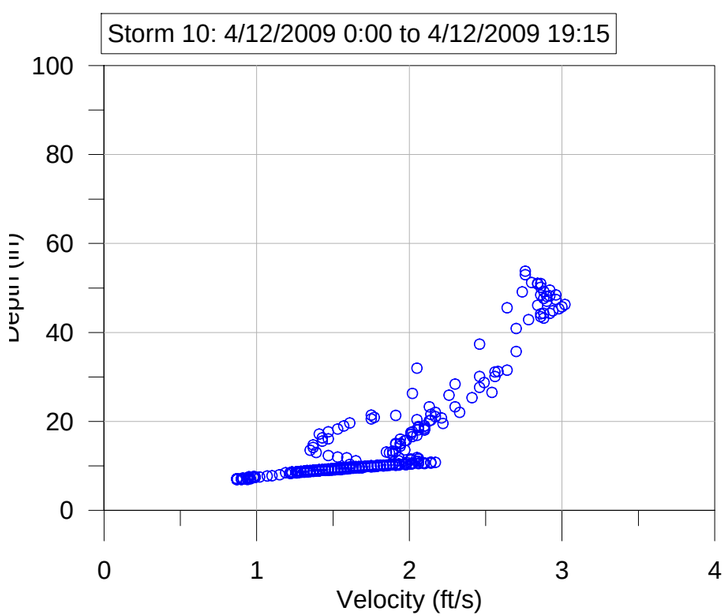


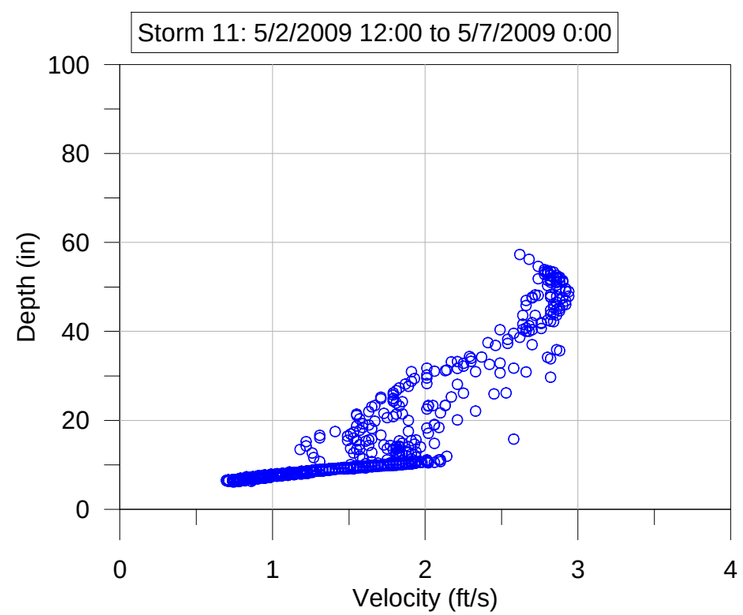
Calibration Storms - Scattergraphs
Monitor 306-275

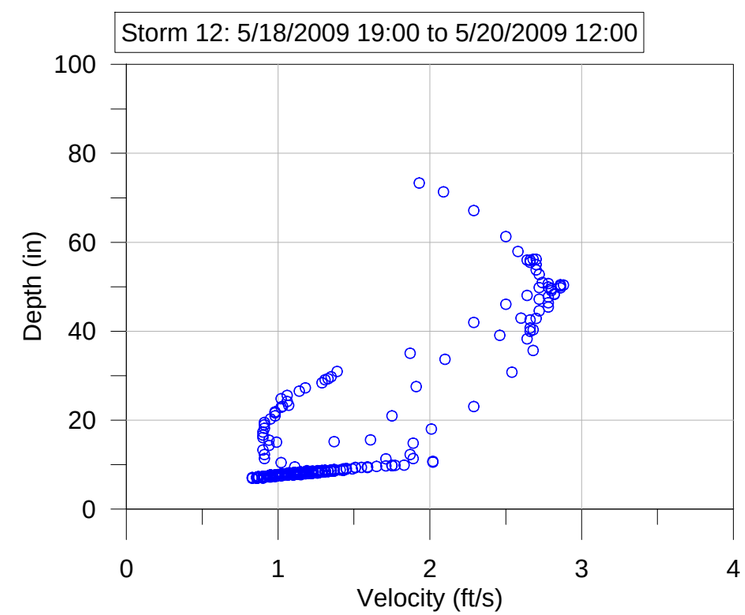




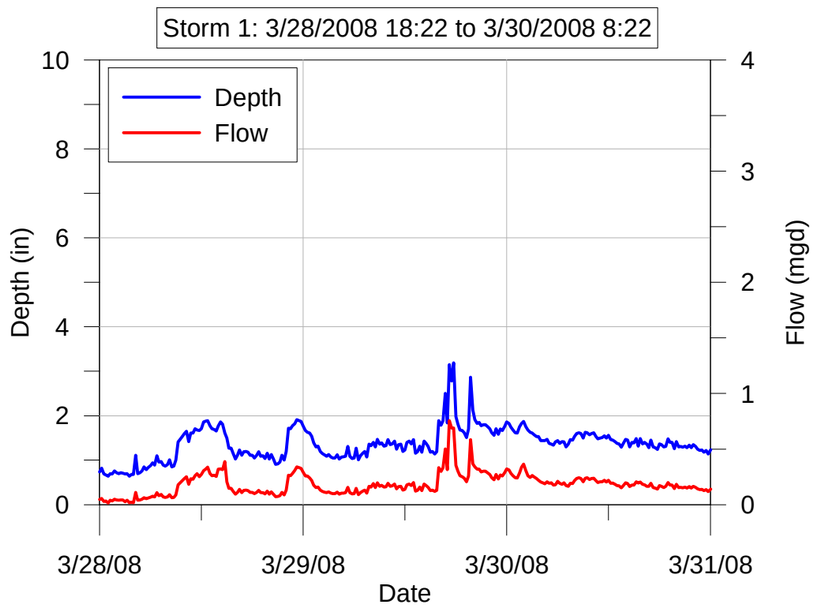


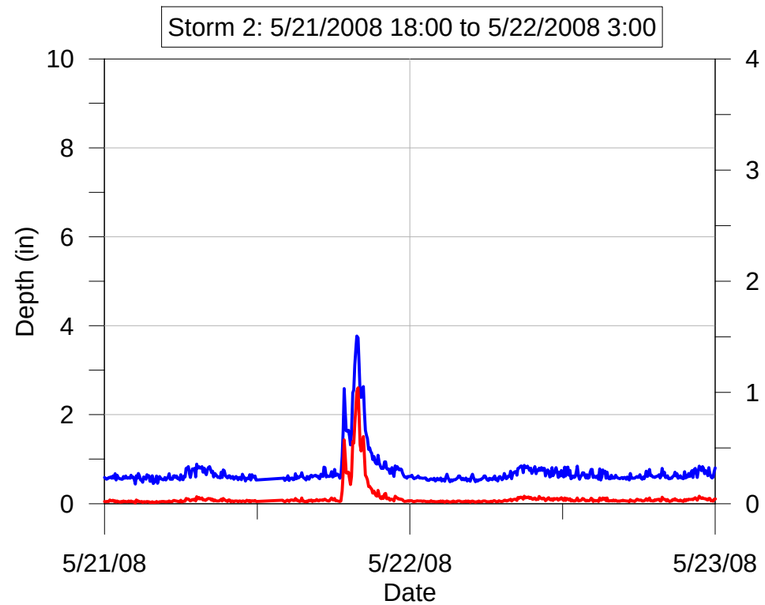


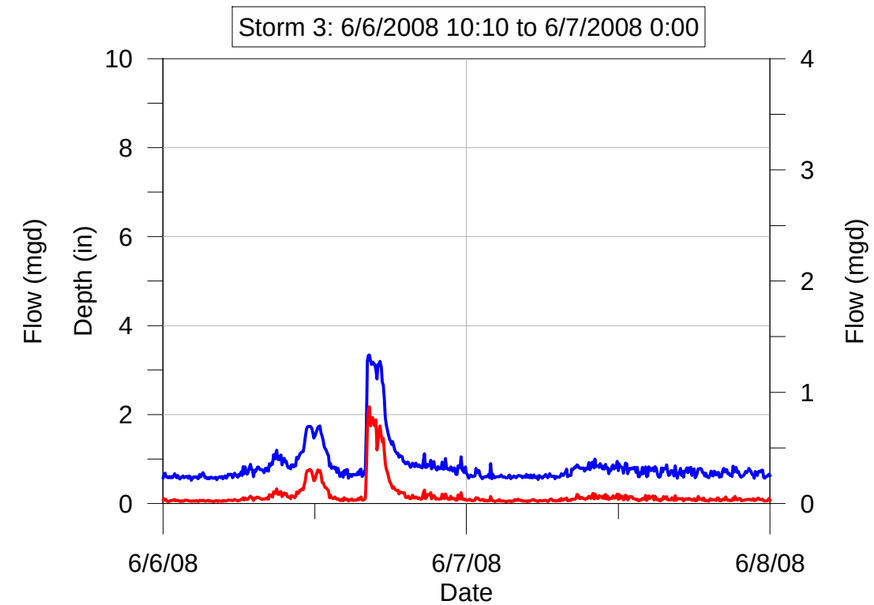


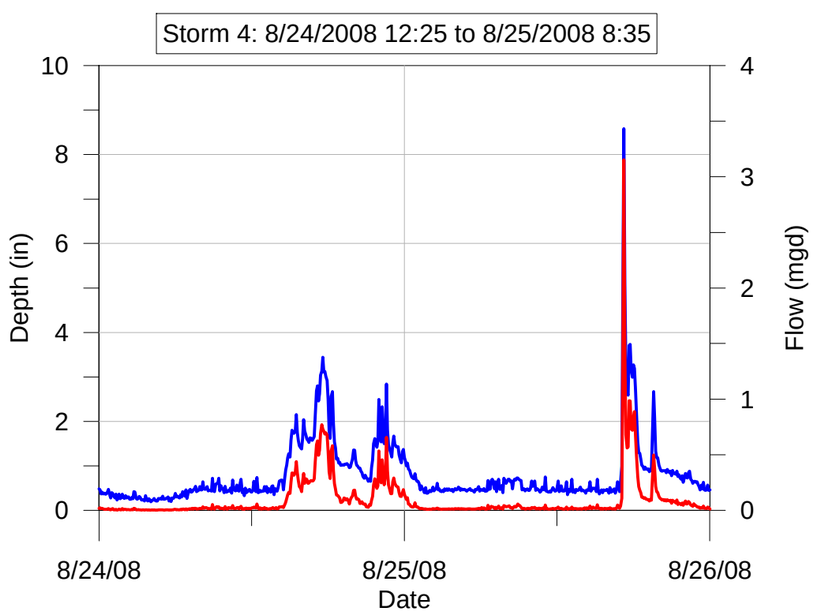


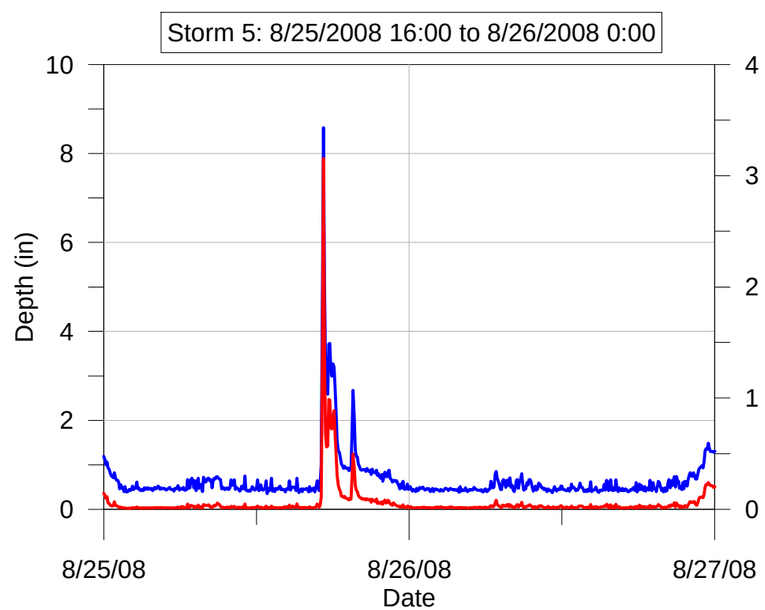
Calibration Storms
Monitor 306-284

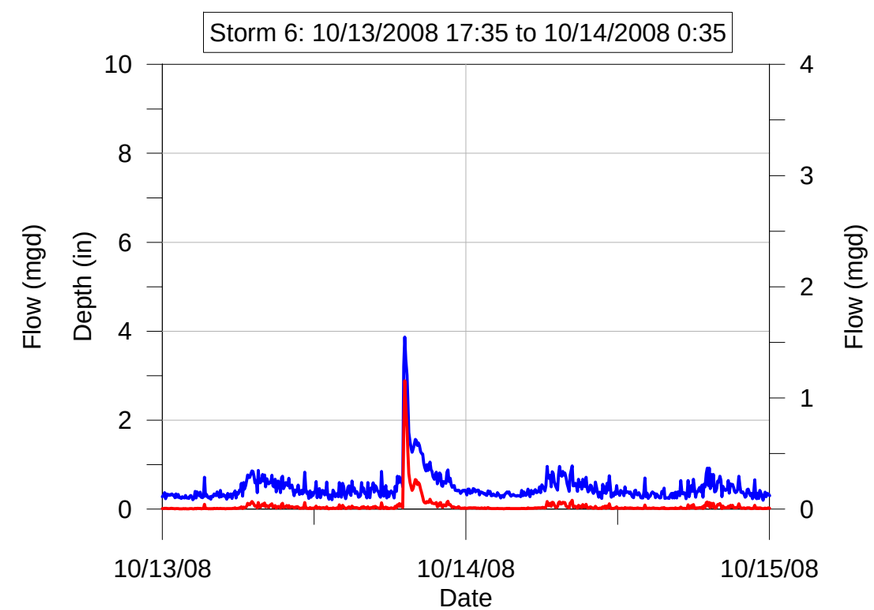




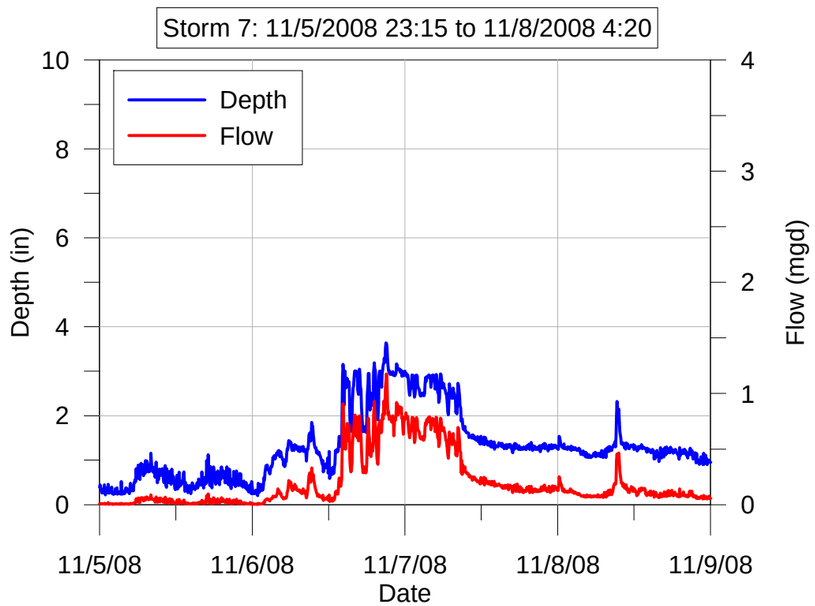


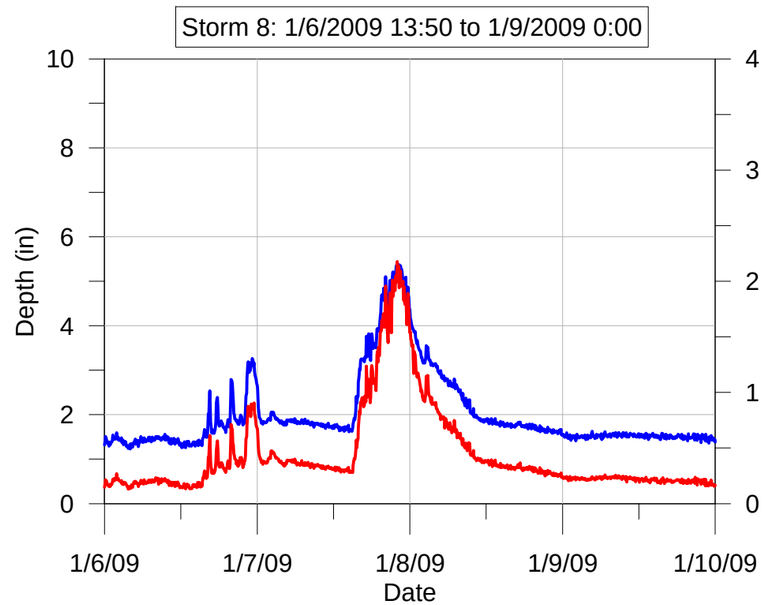


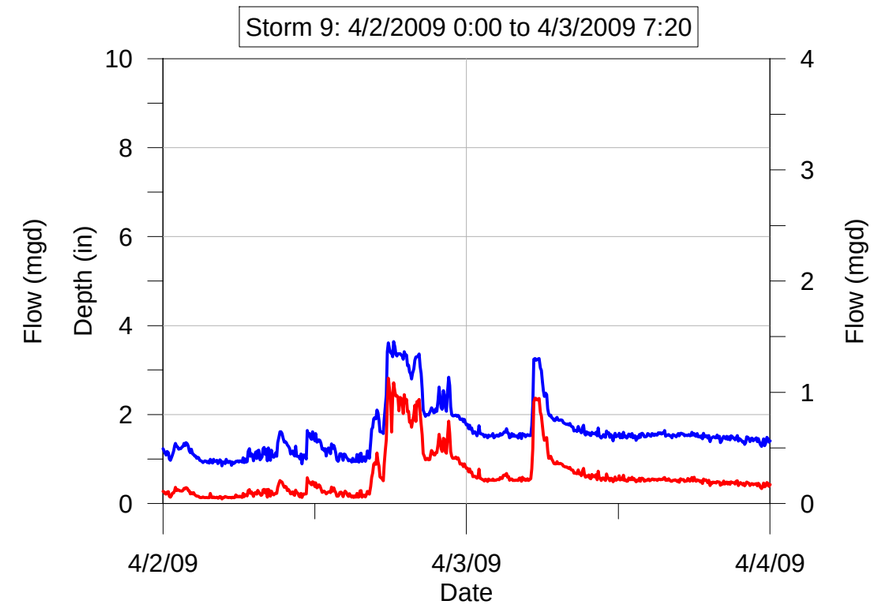


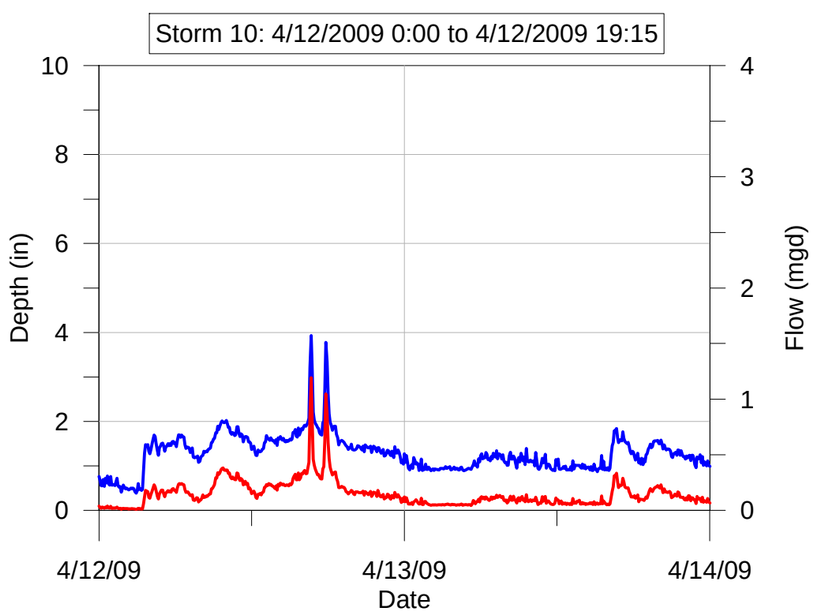


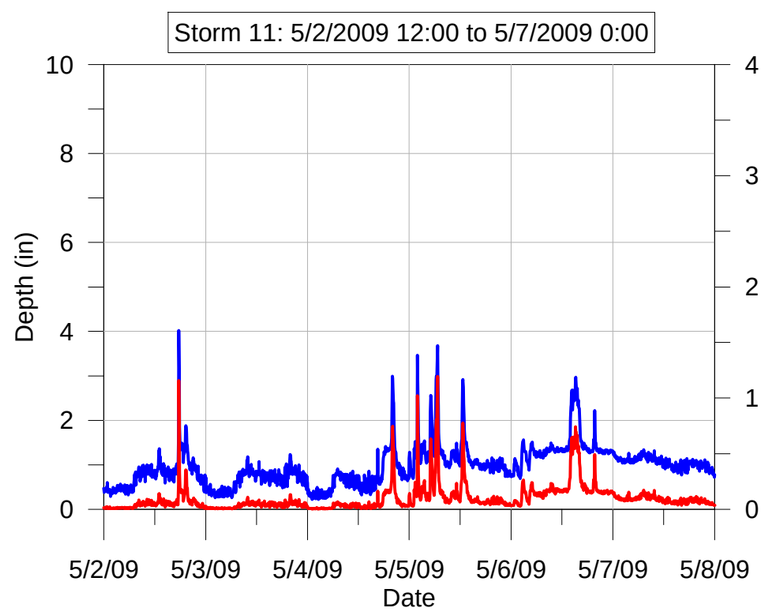
Calibration Storms
Monitor 306-284

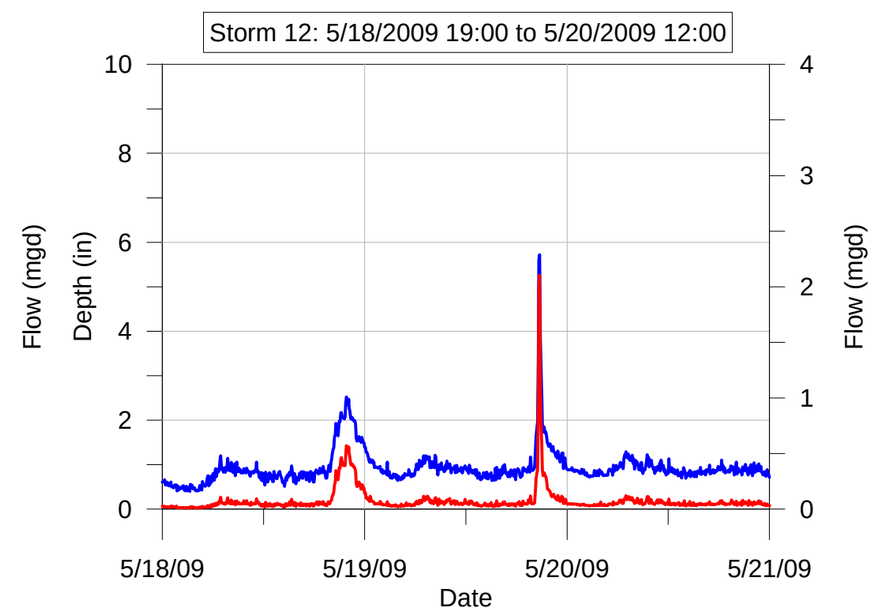




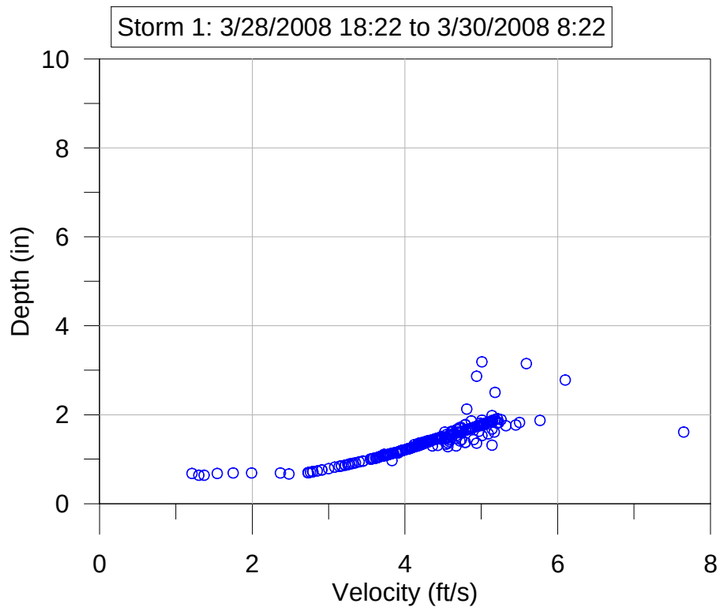


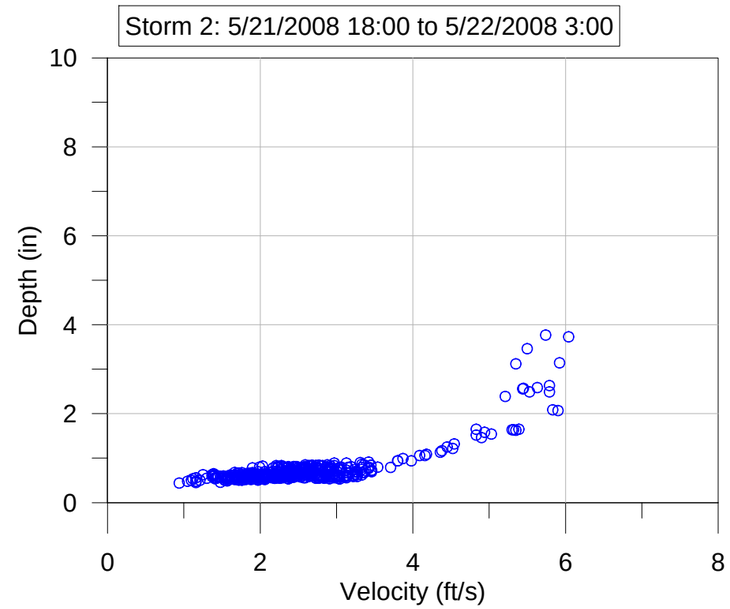


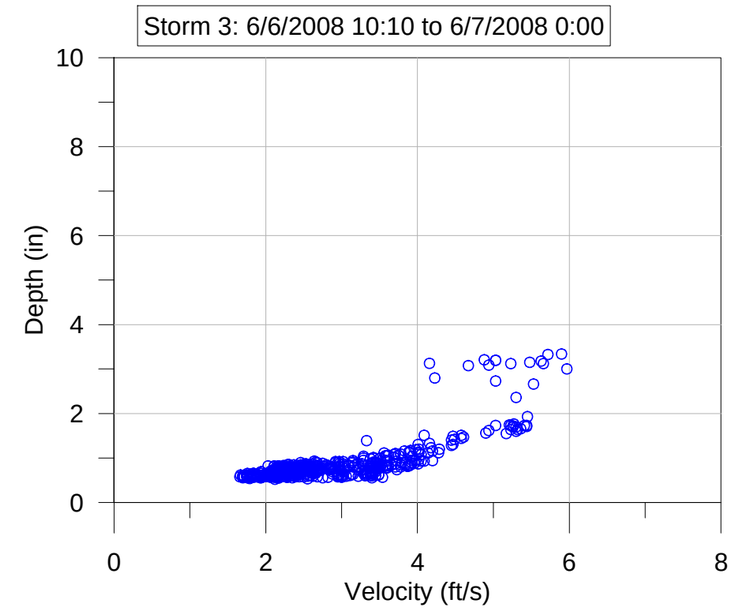


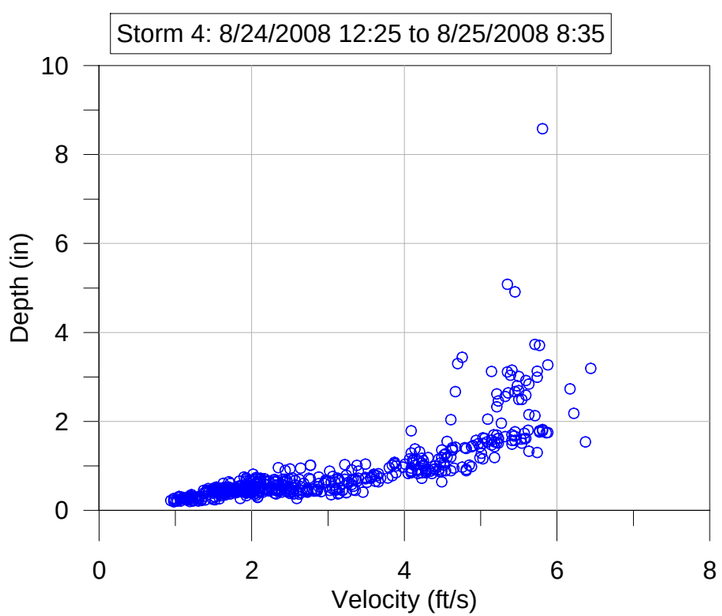


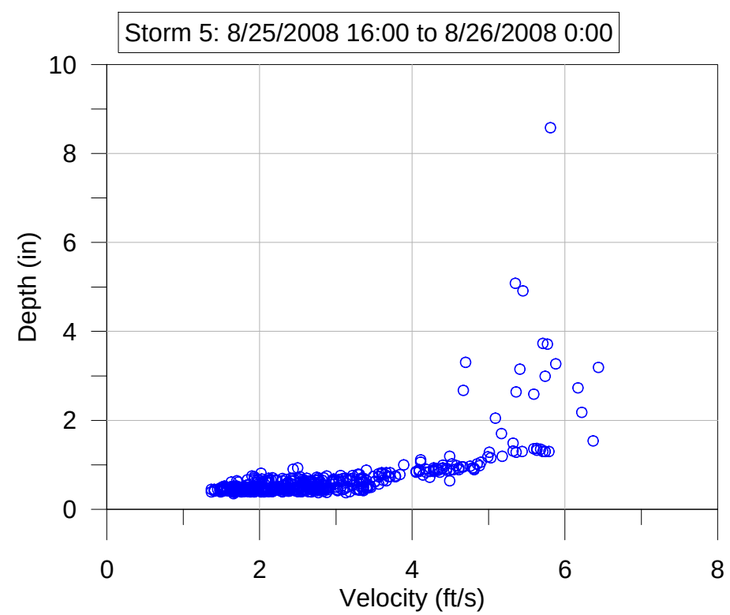
Calibration Storms - Scattergraphs
Monitor 306-284

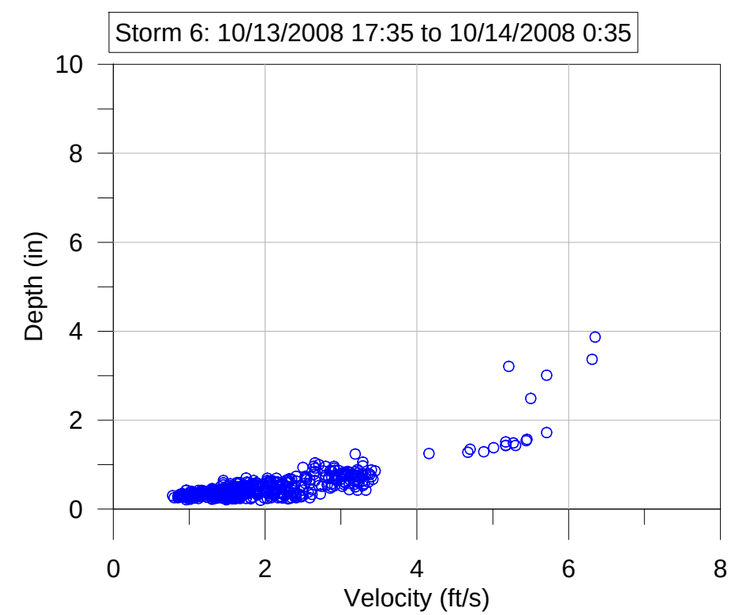




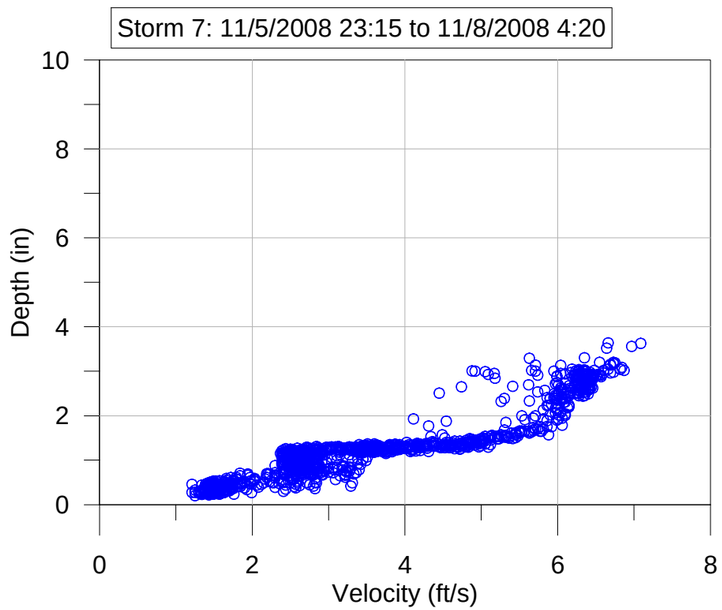


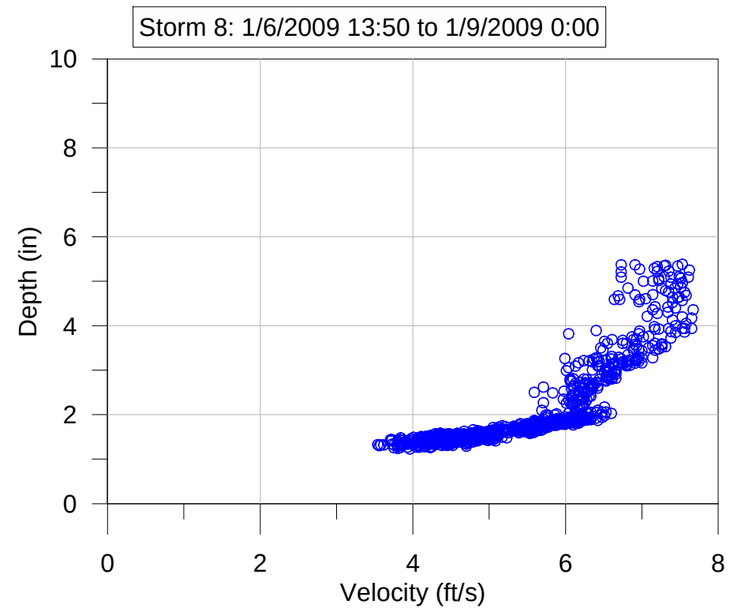


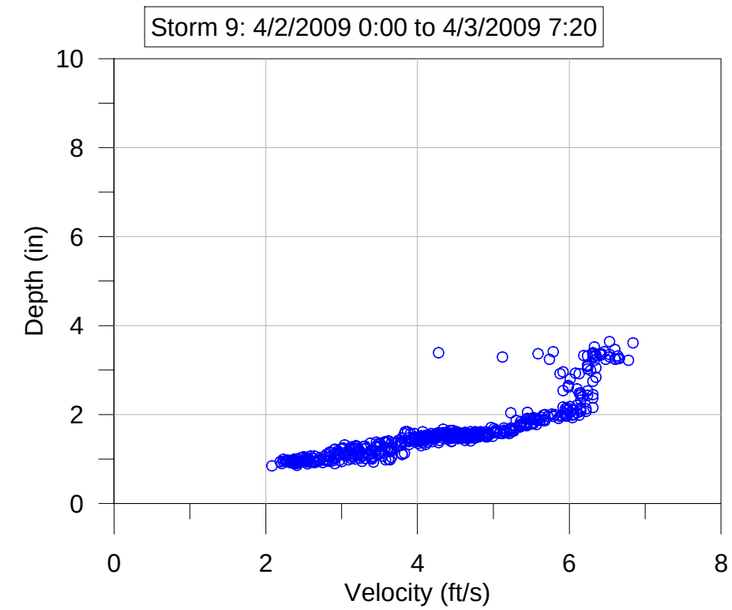


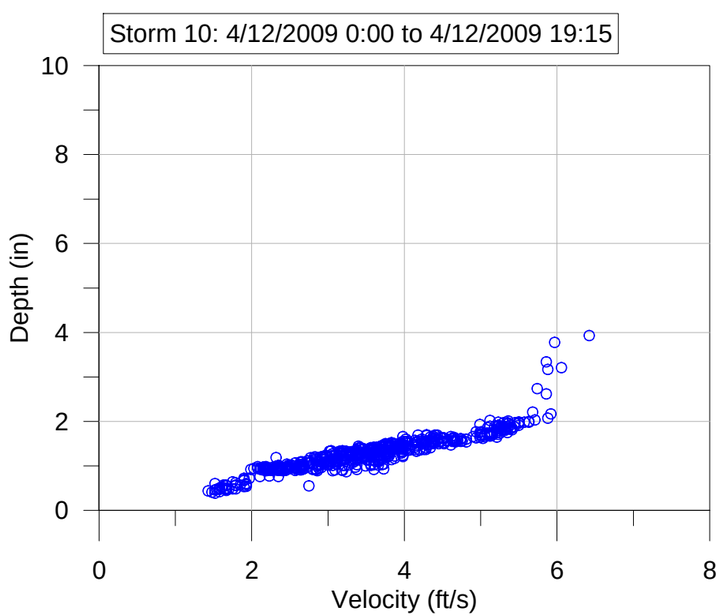


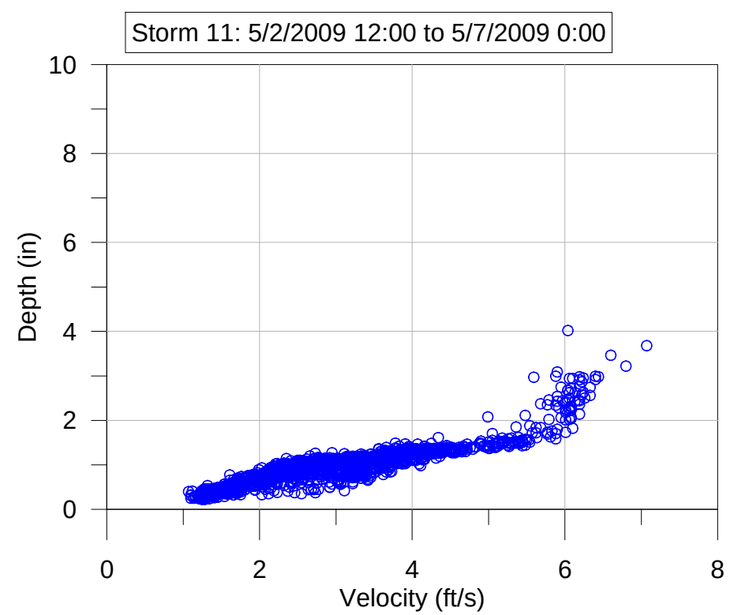
Calibration Storms - Scattergraphs
Monitor 306-284

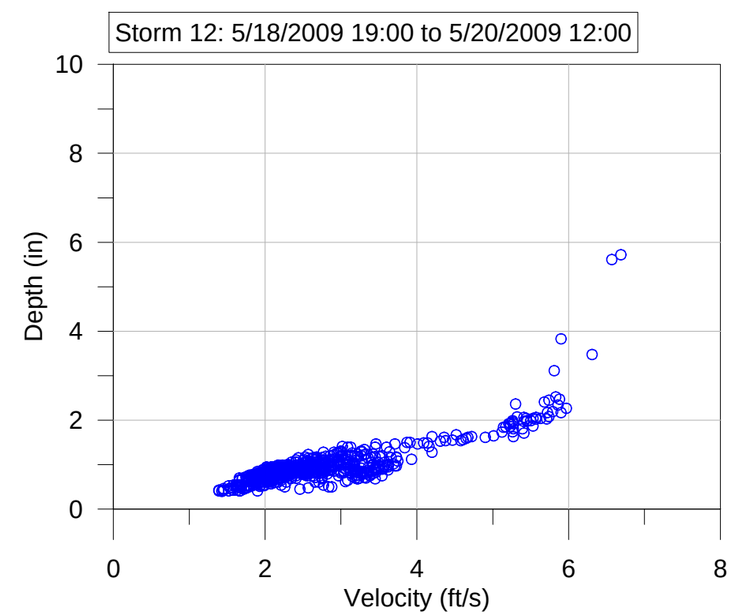




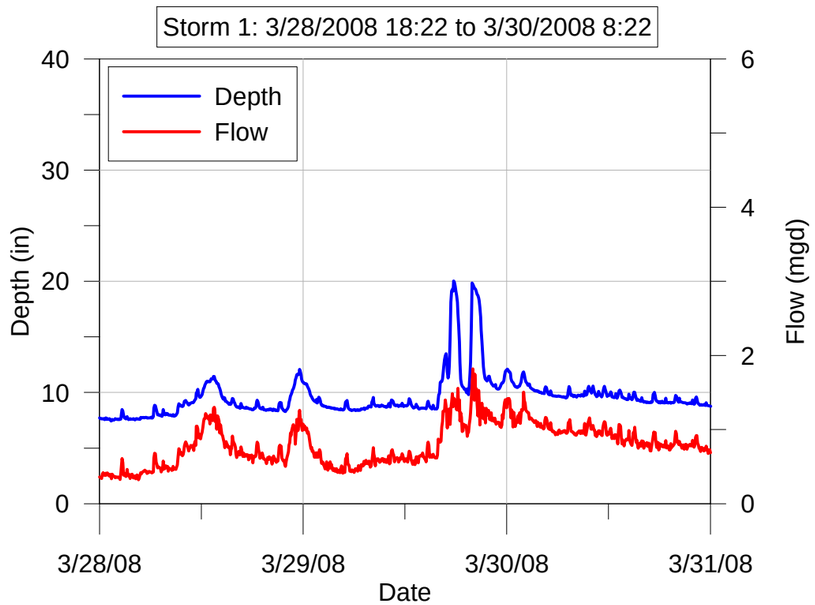


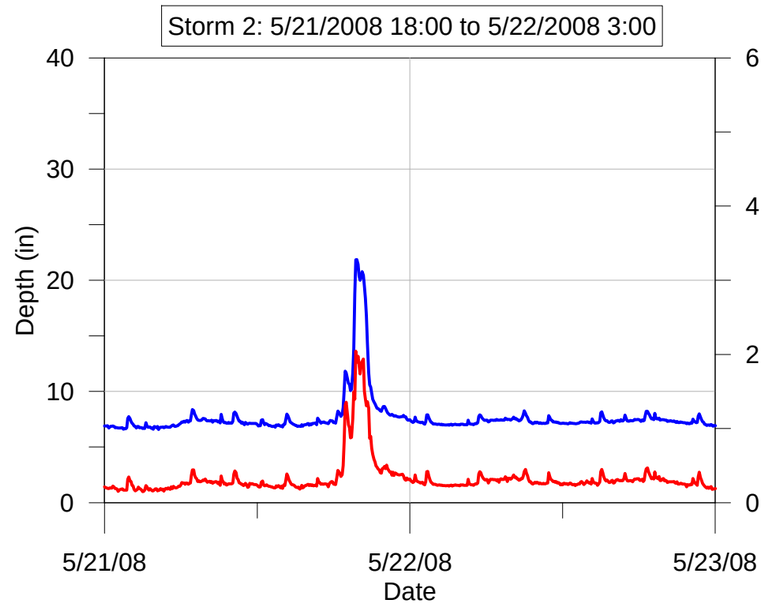


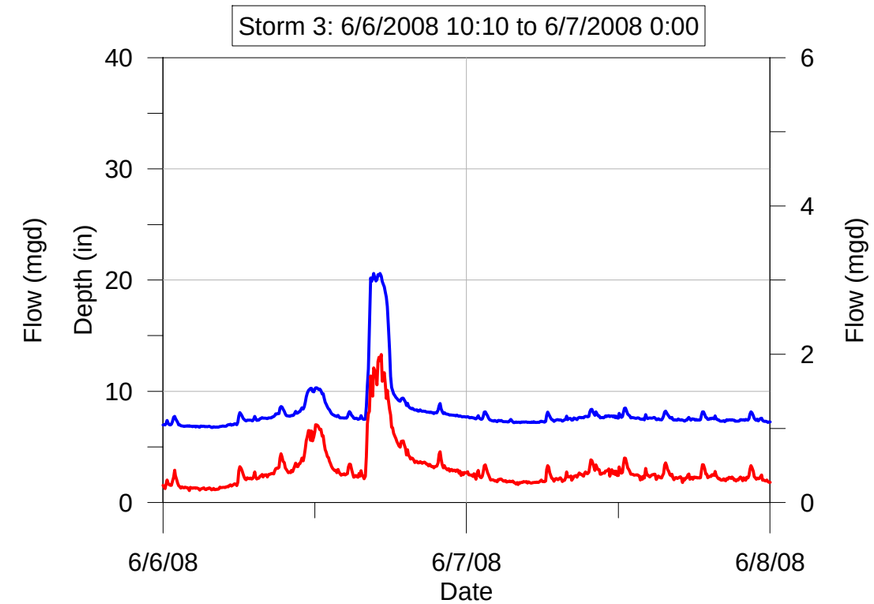


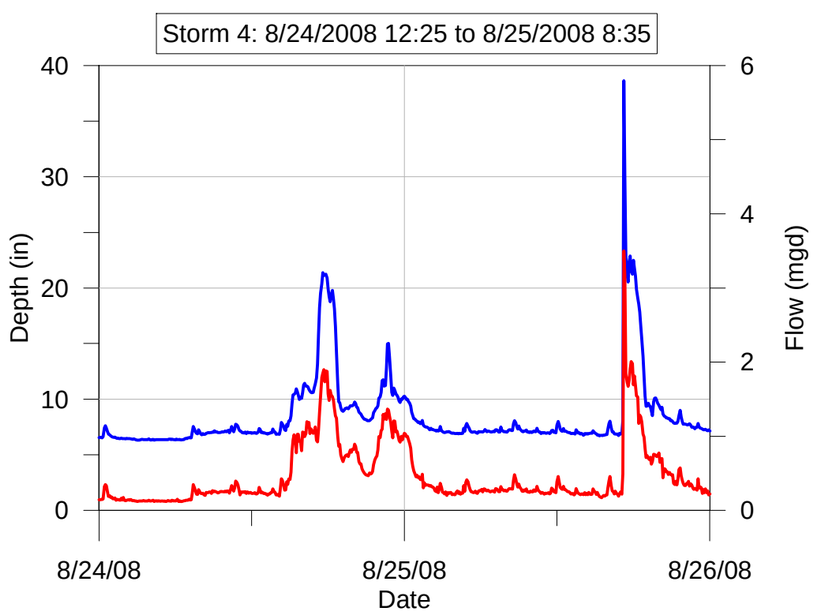


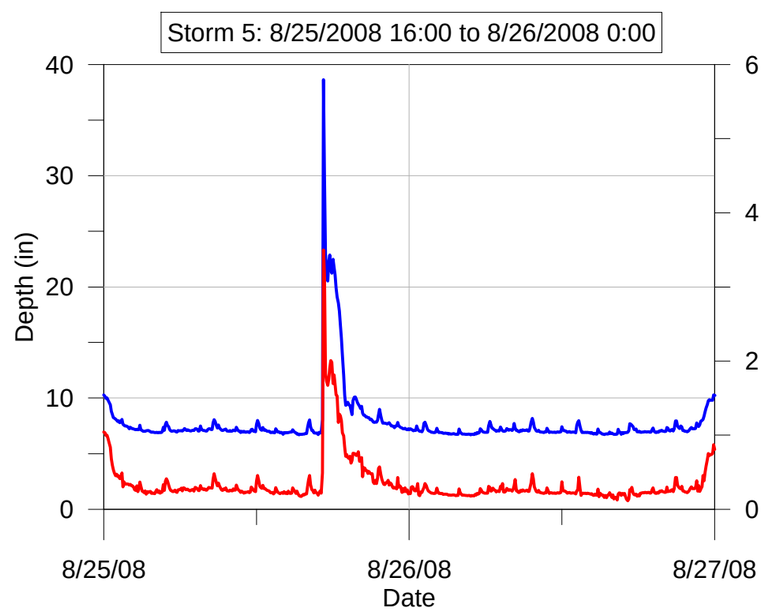
Calibration Storms
Monitor 306-343

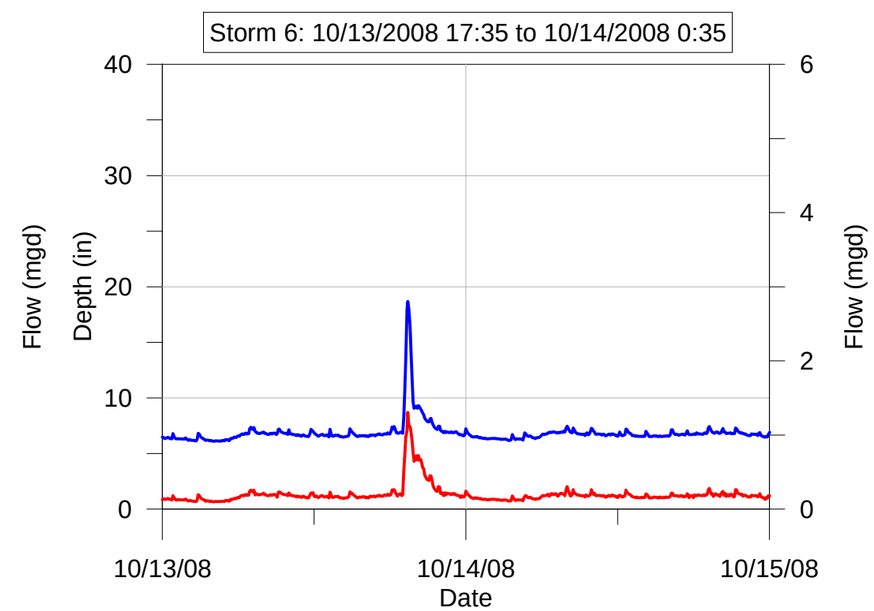




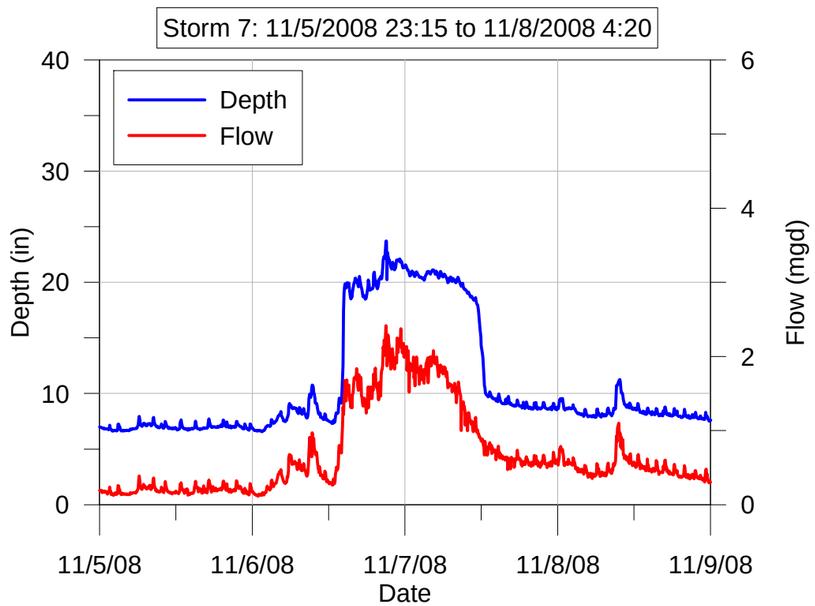


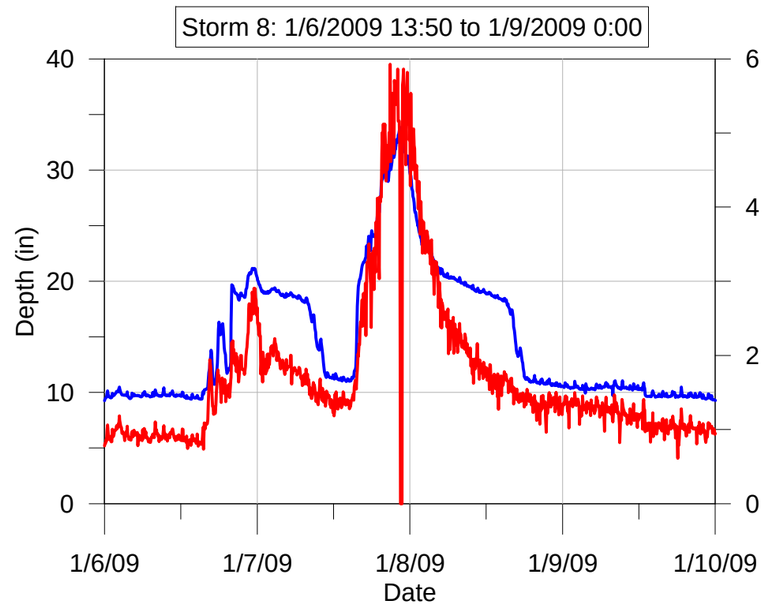


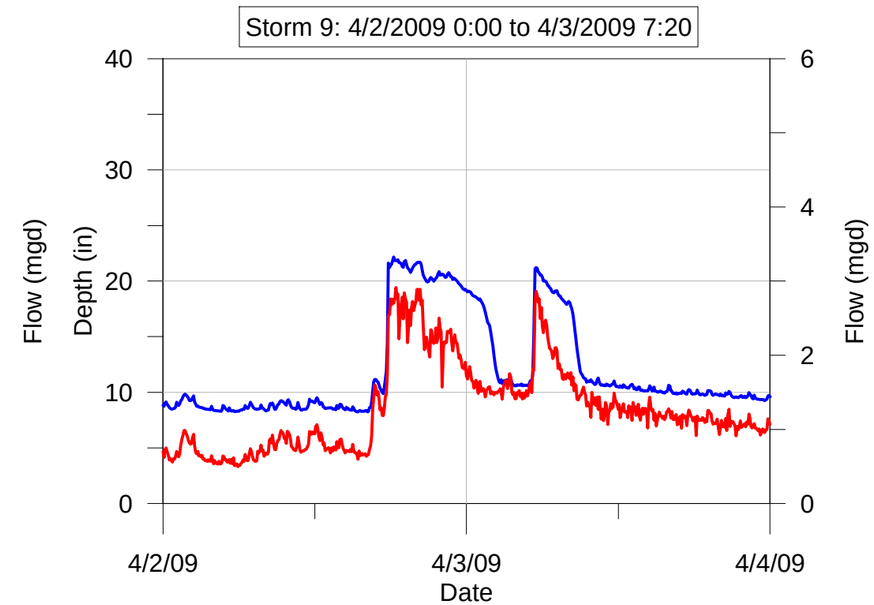


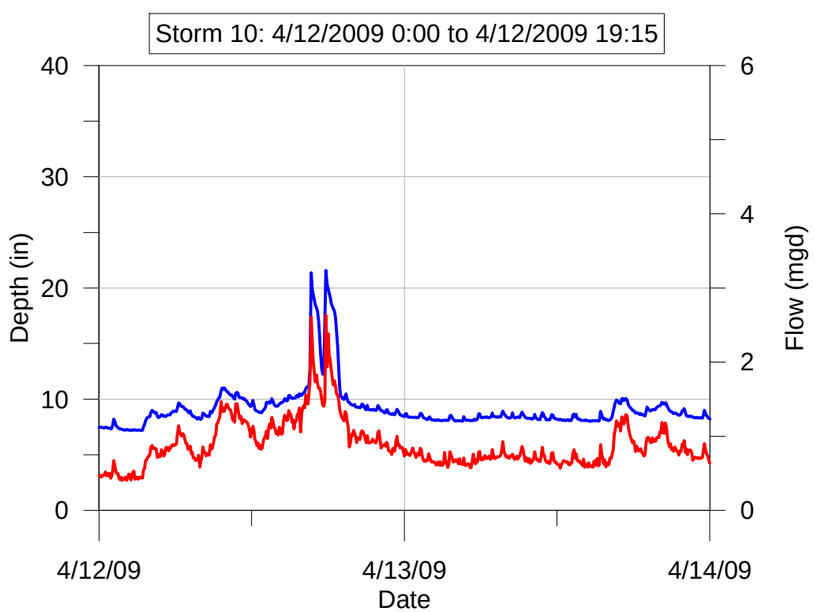


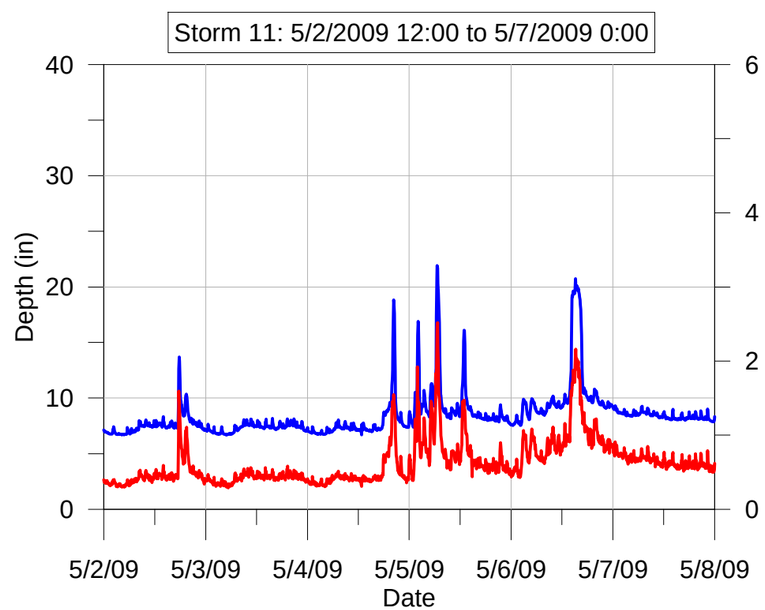
Calibration Storms
Monitor 306-343

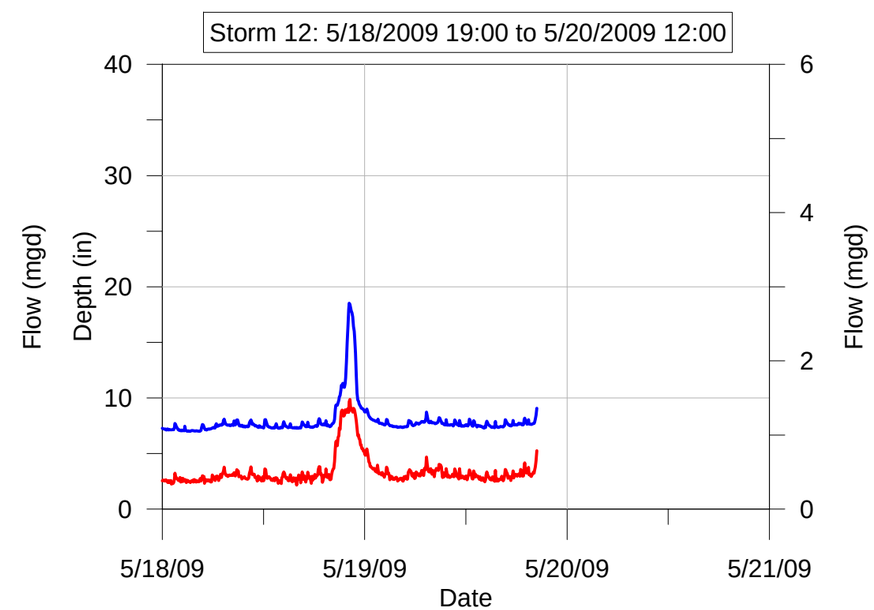




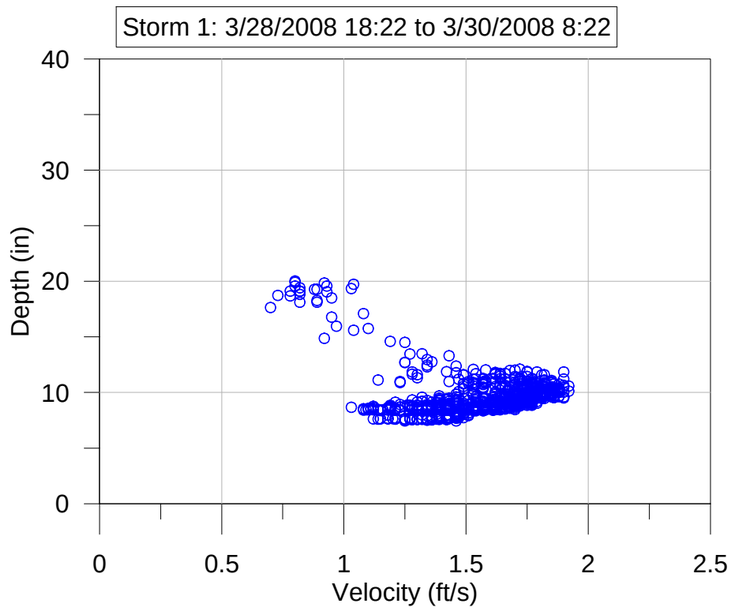


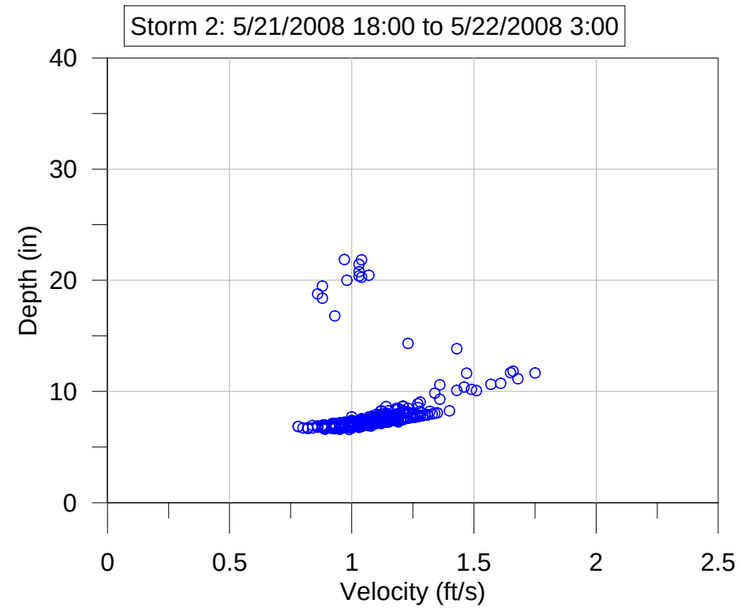


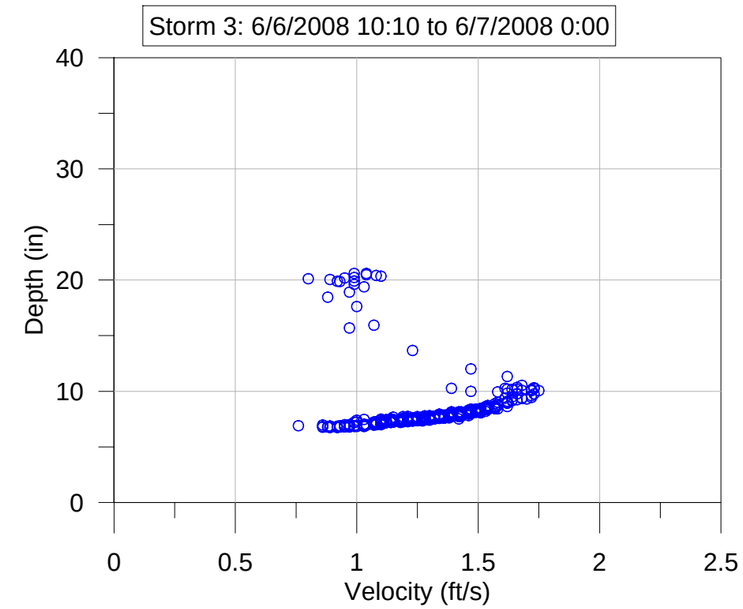


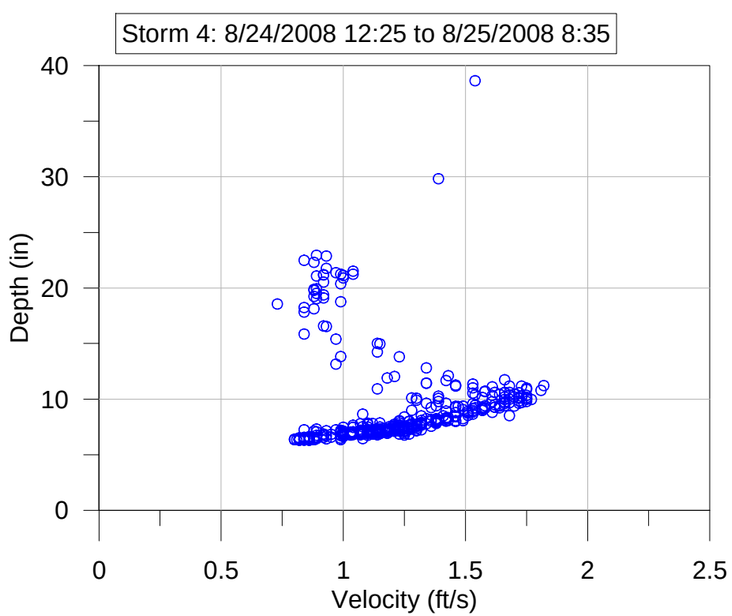


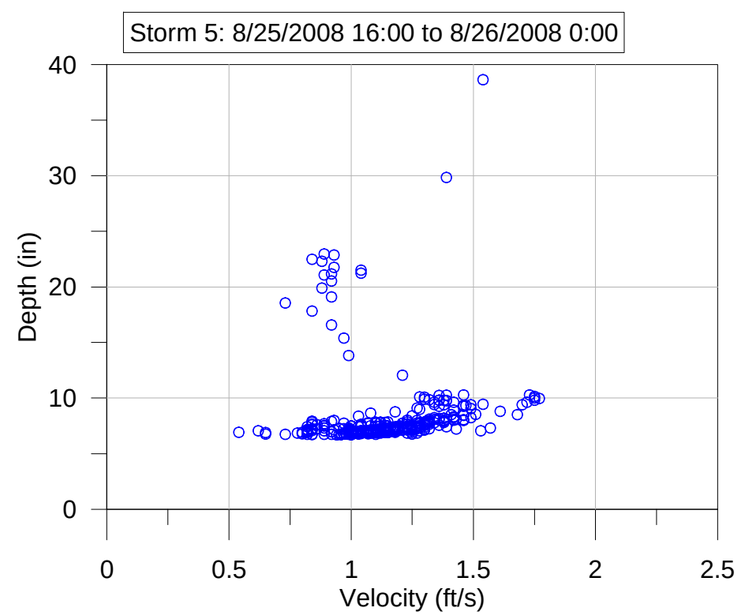
Calibration Storms - Scattergraphs
Monitor 306-343

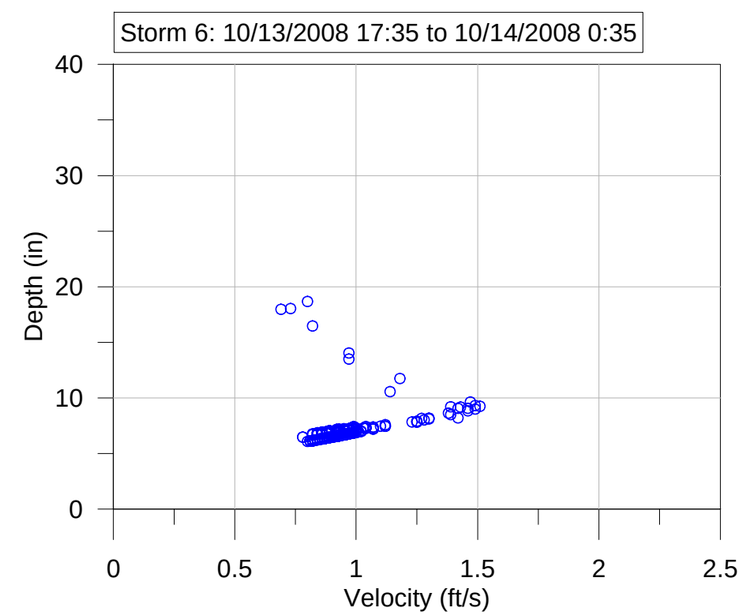




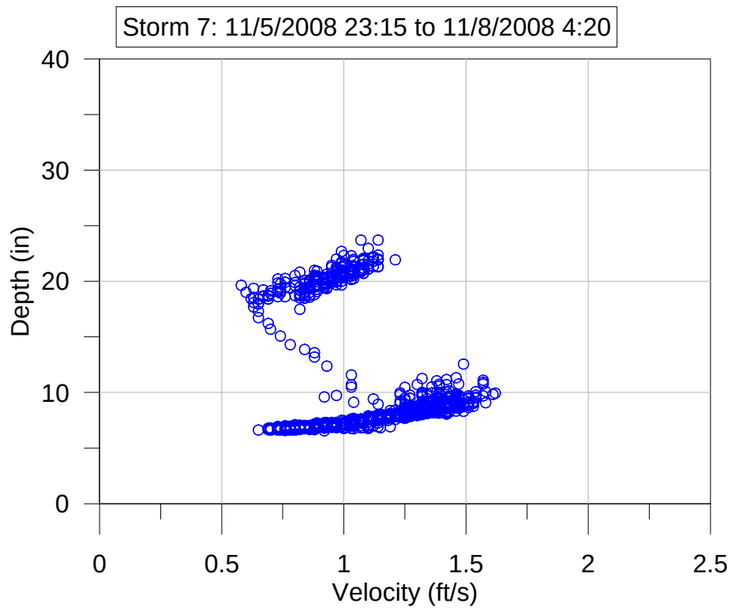


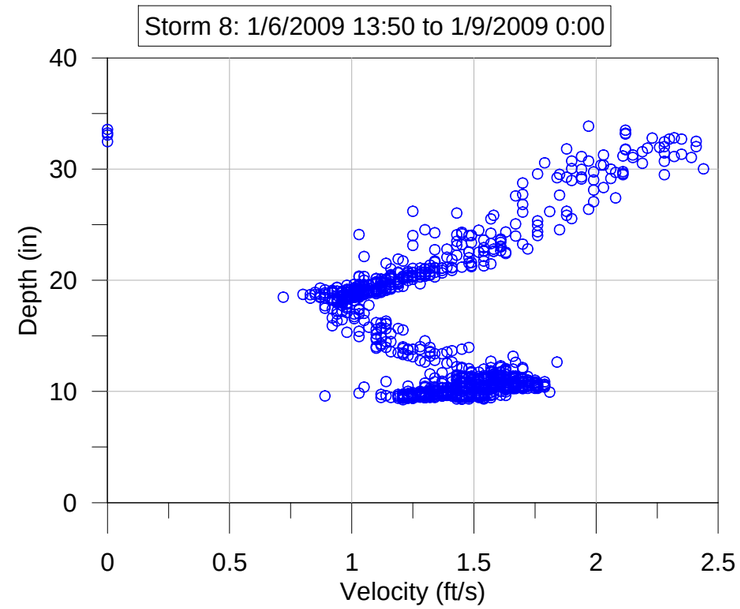


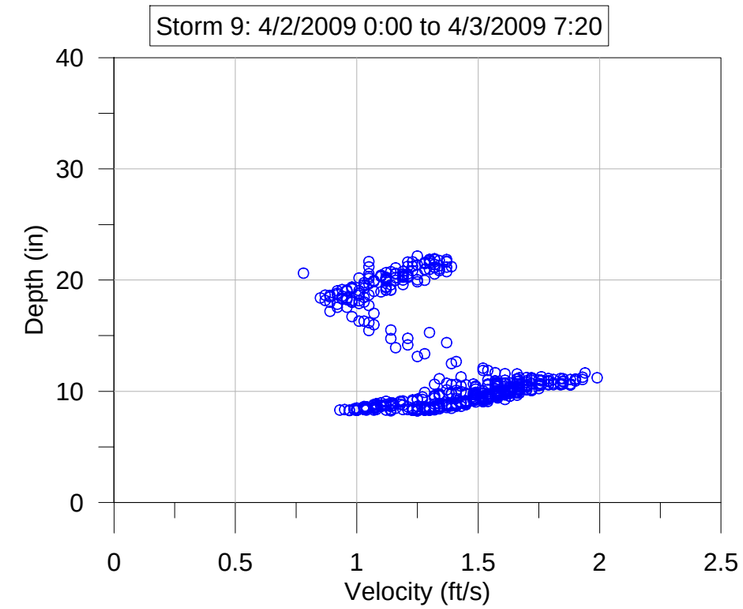


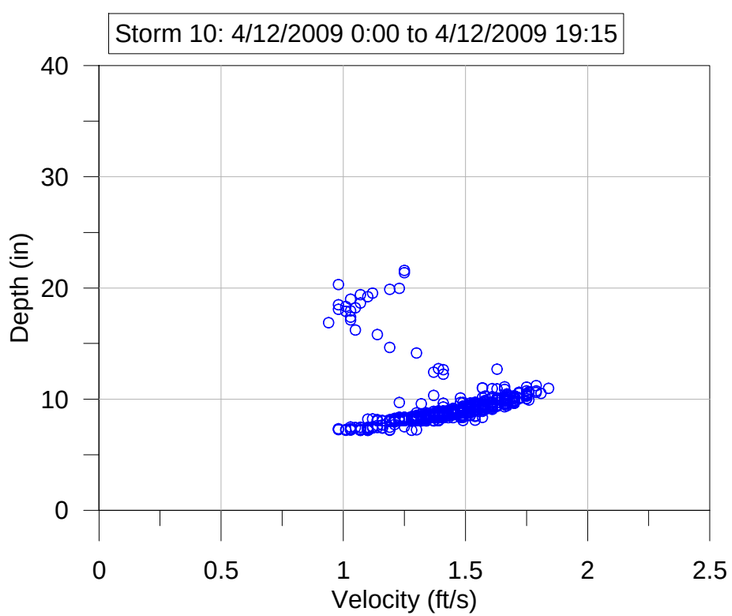


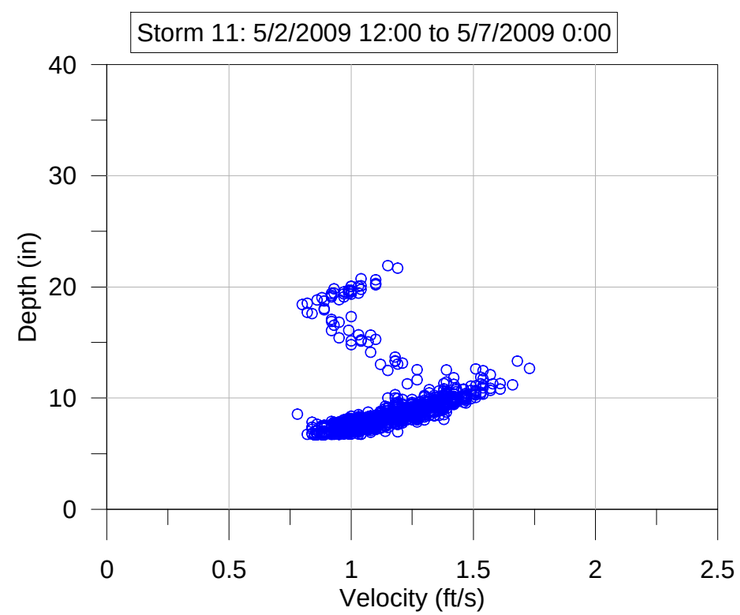
Calibration Storms - Scattergraphs
Monitor 306-343

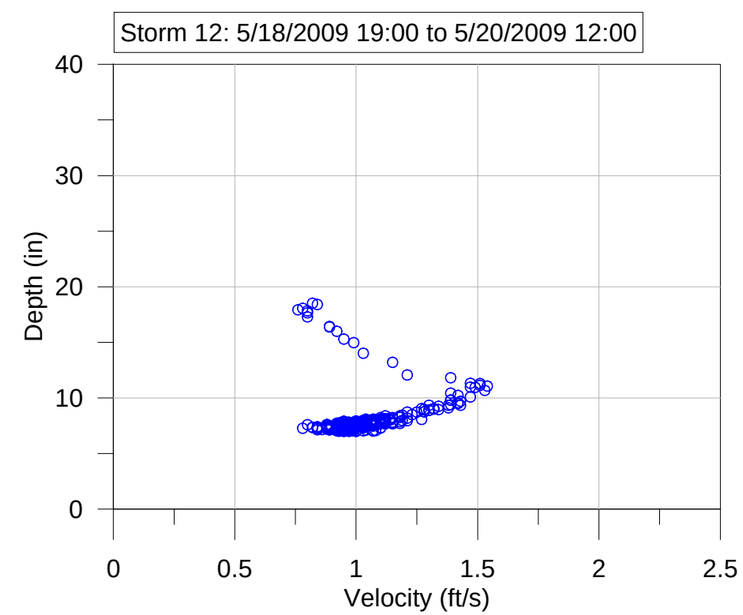




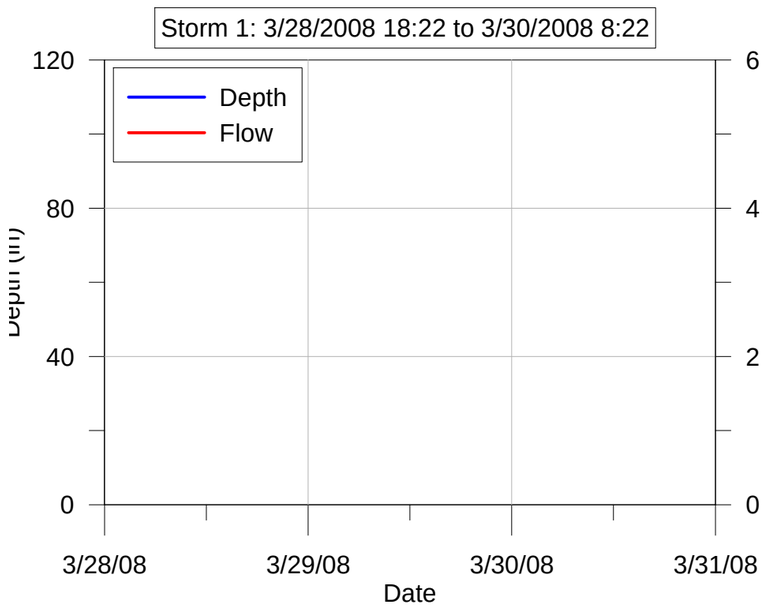


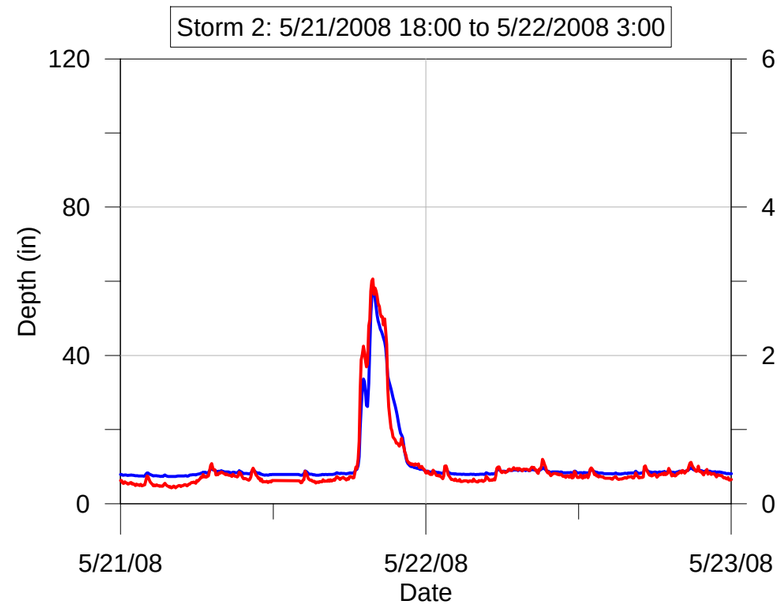


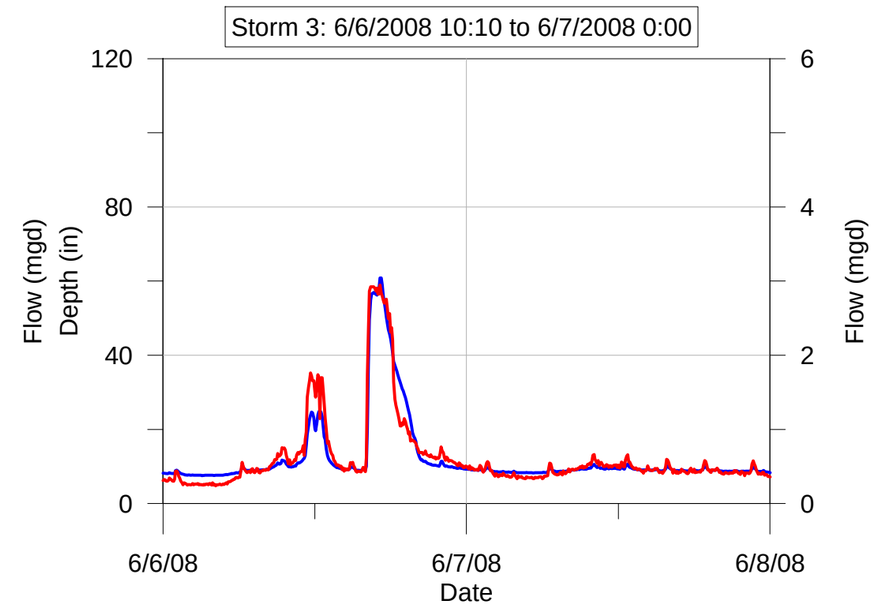


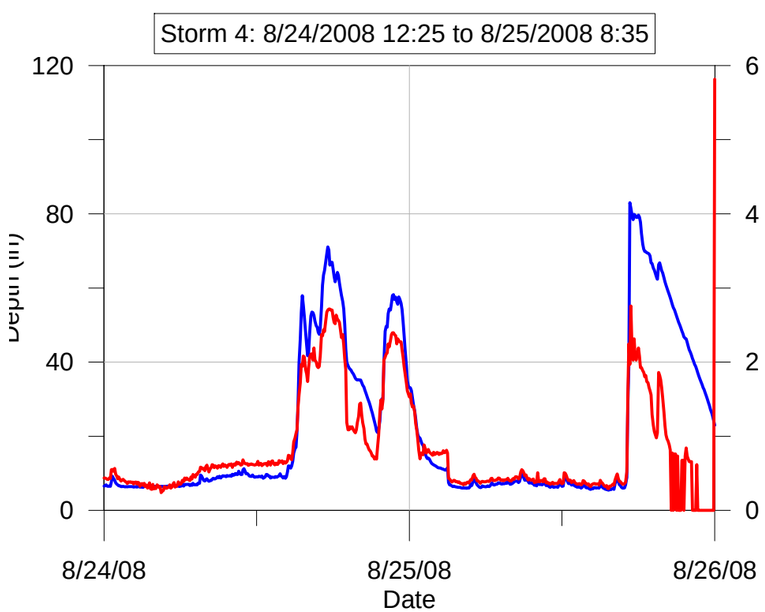


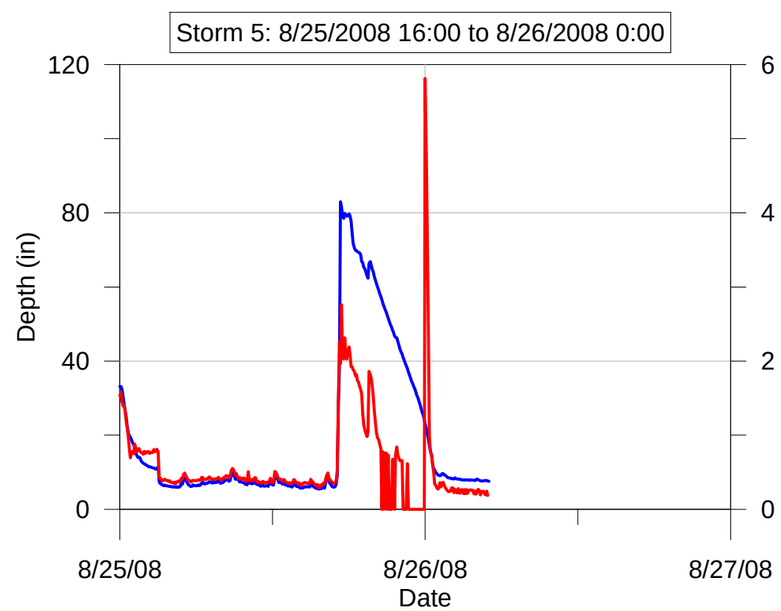
Calibration Storms
Monitor 306-428

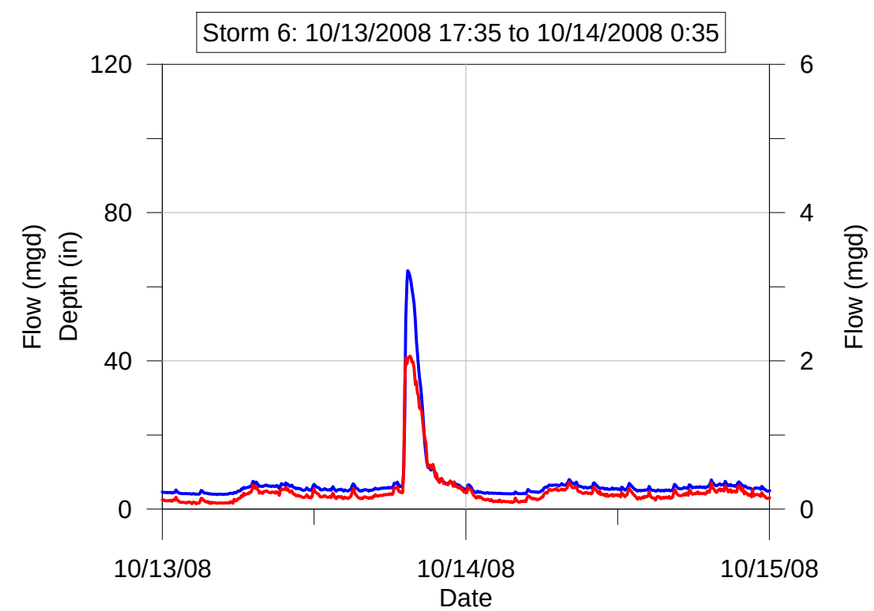




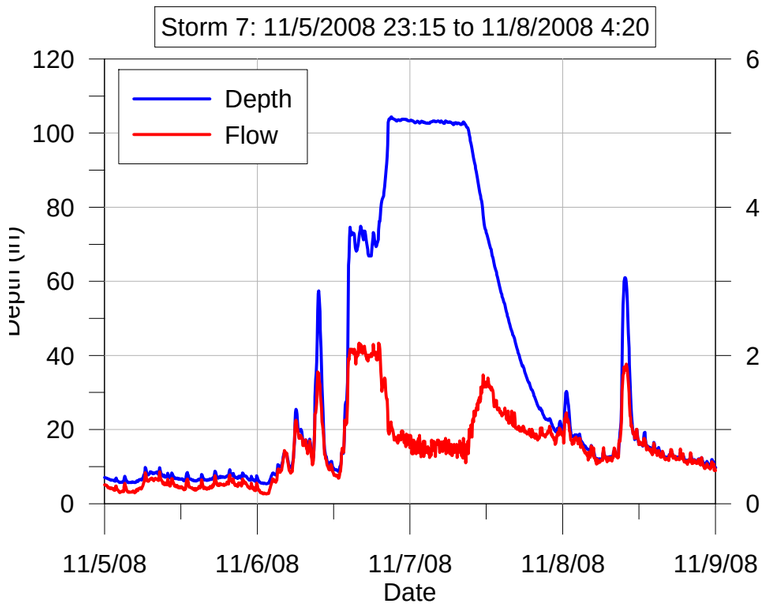


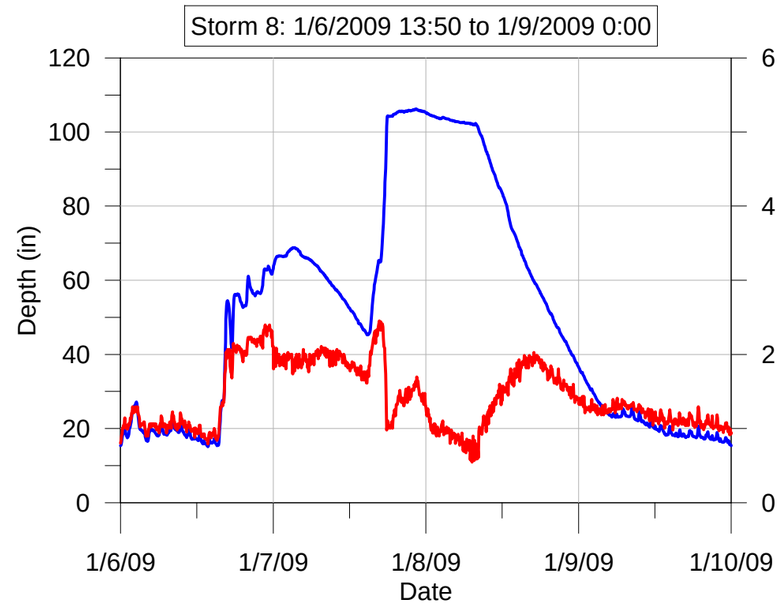


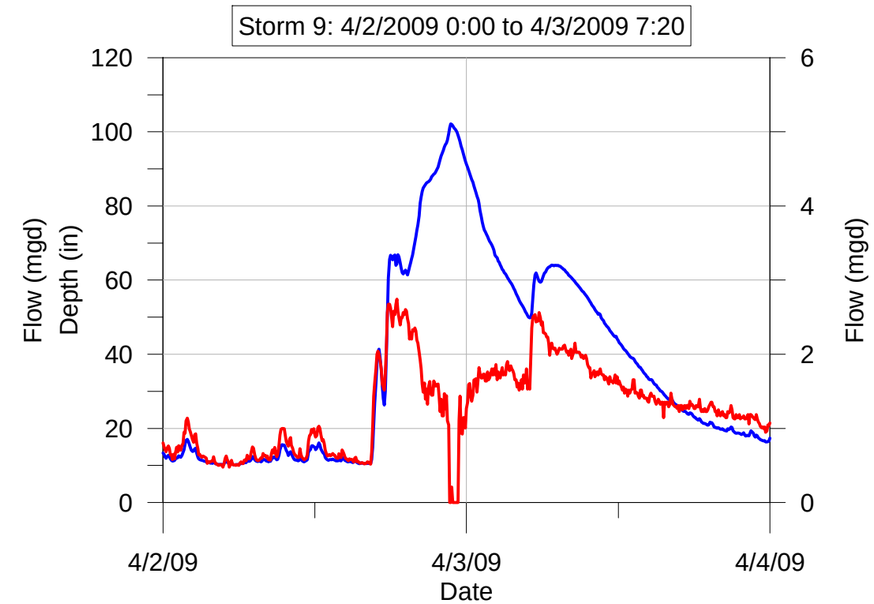


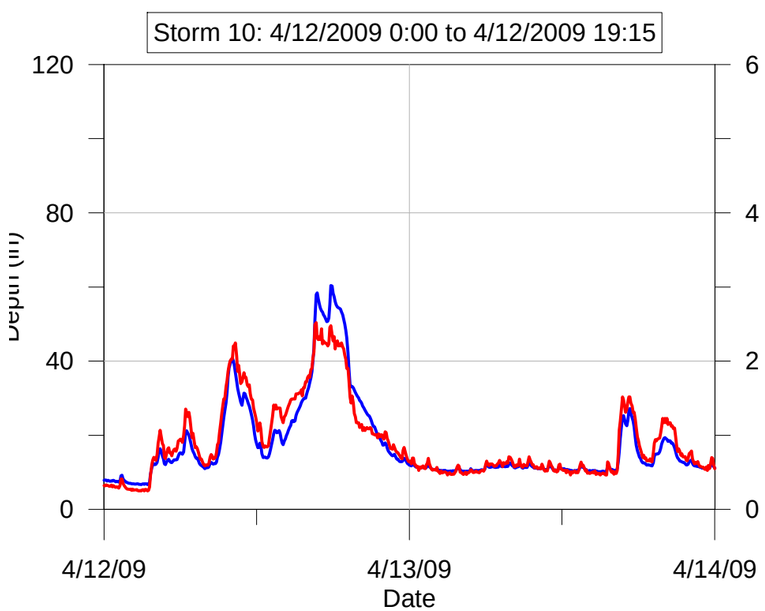


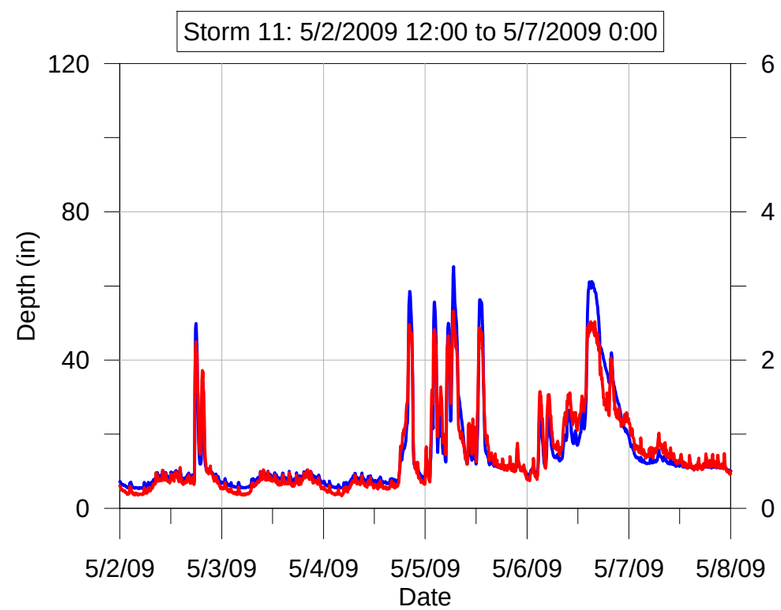
Calibration Storms
Monitor 306-428

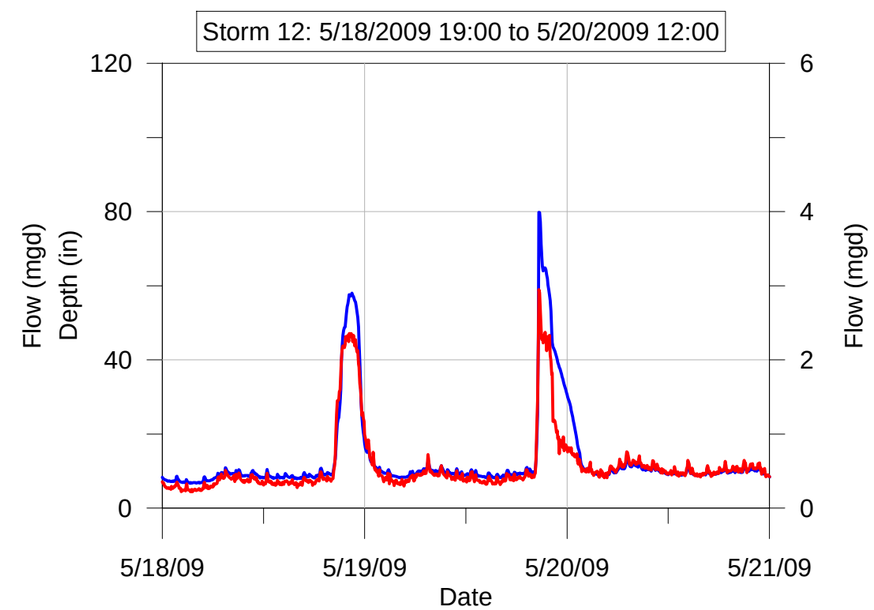




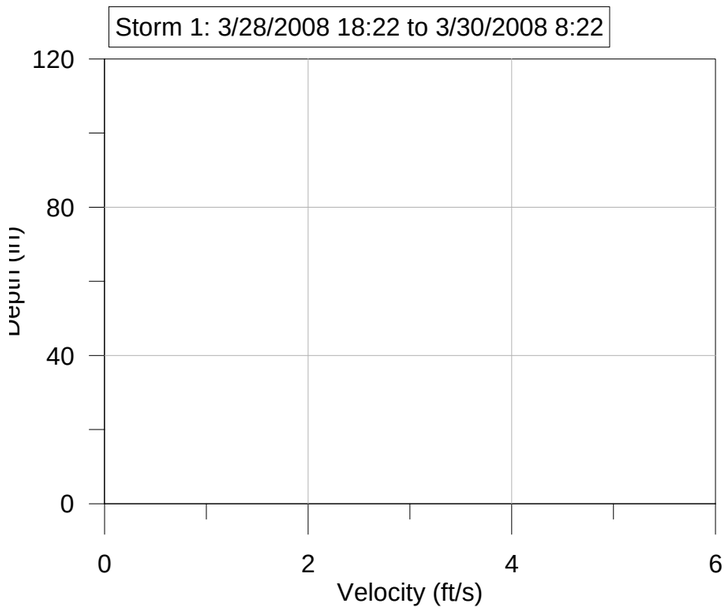


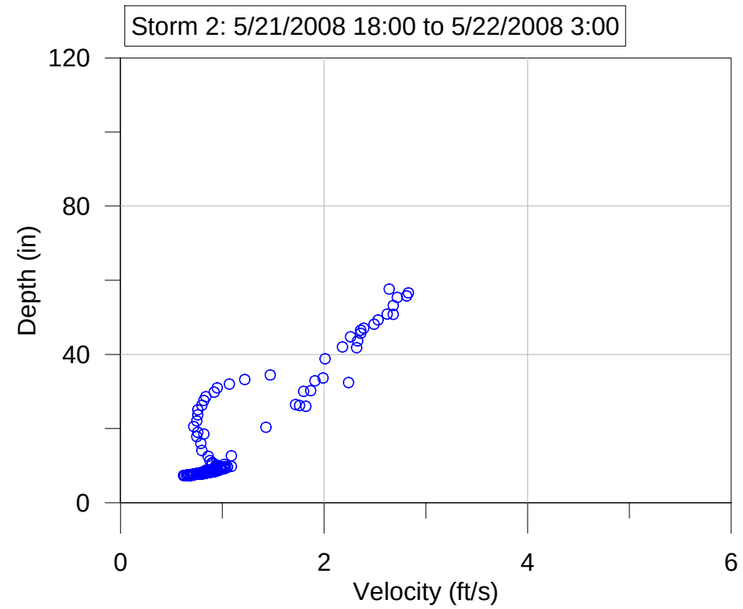


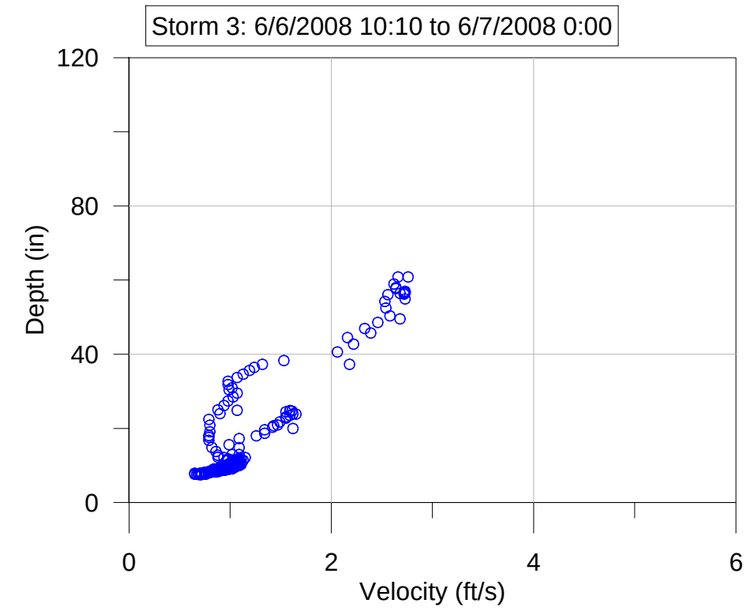


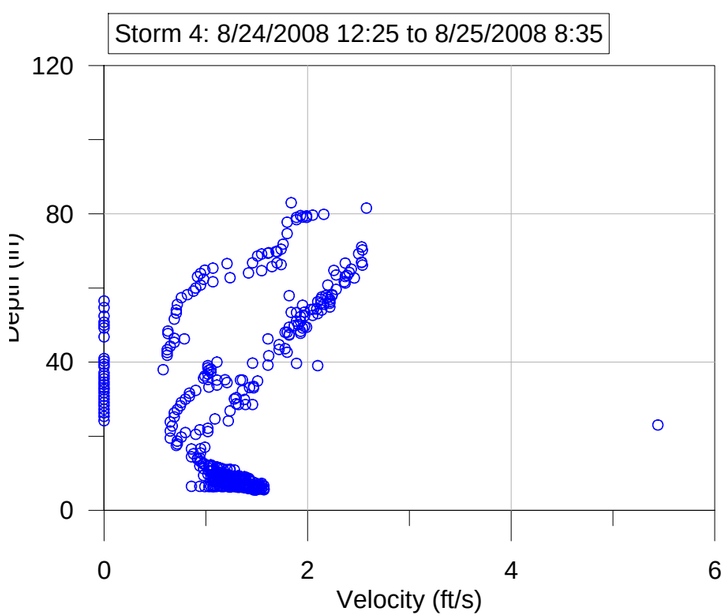


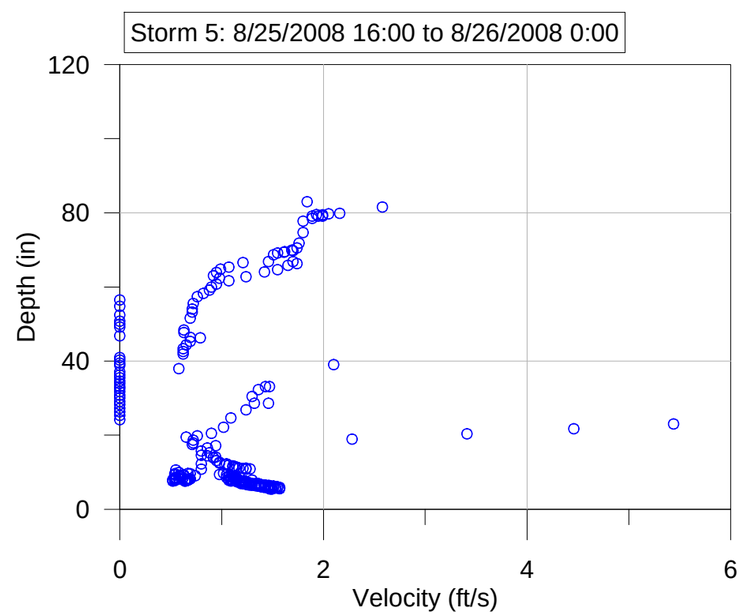
Calibration Storms - Scattergraphs
Monitor 306-428

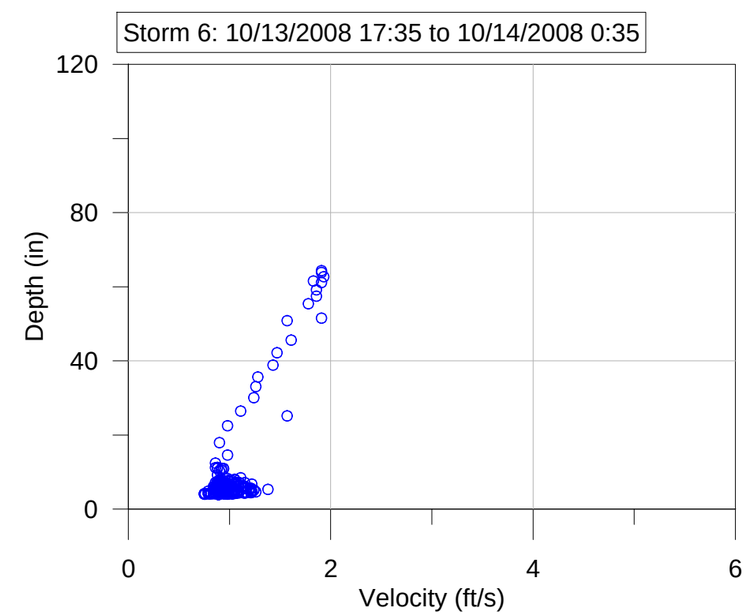




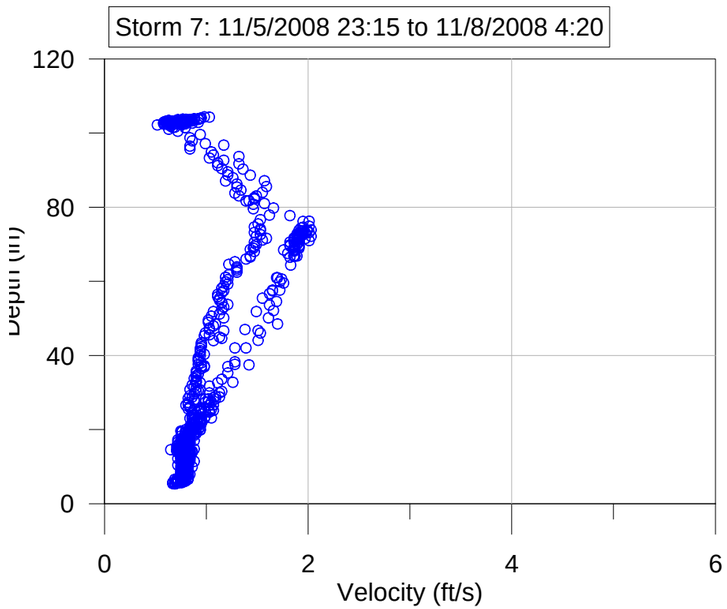


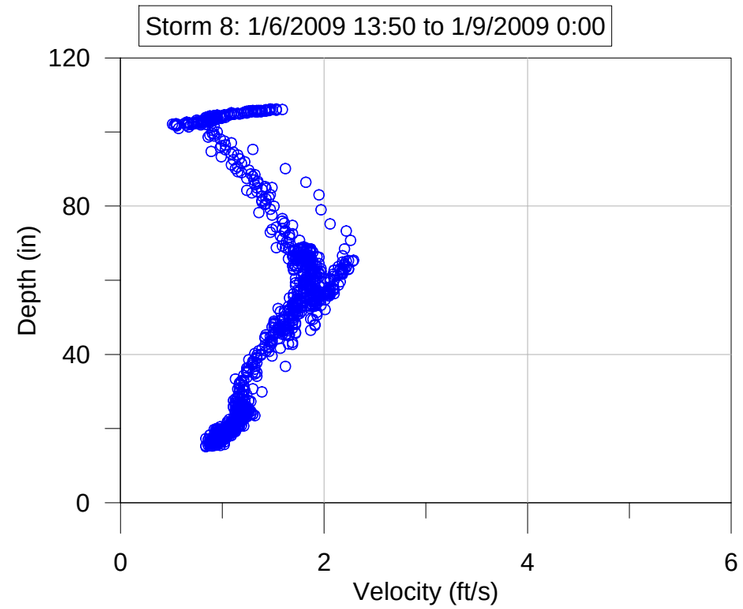


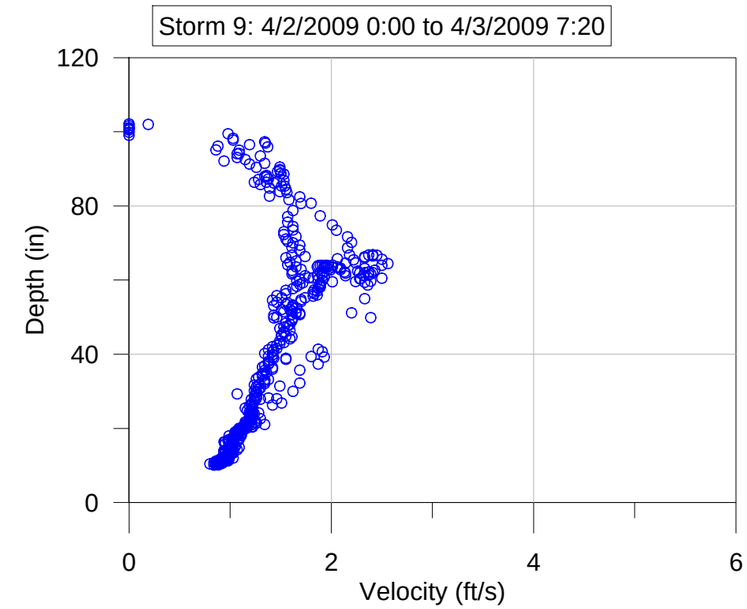


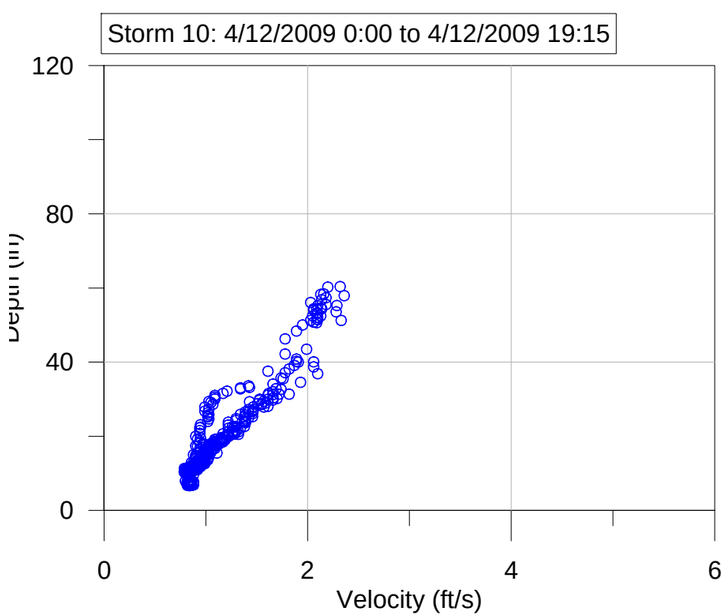


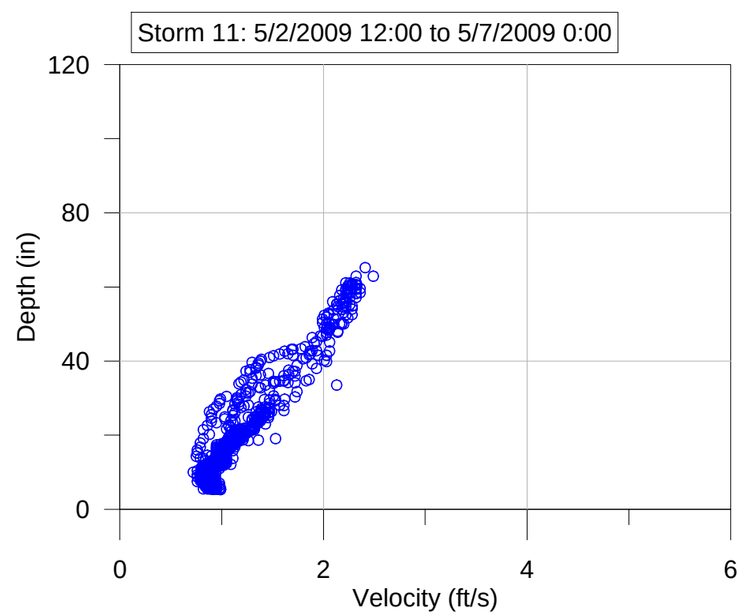
Calibration Storms - Scattergraphs
Monitor 306-428

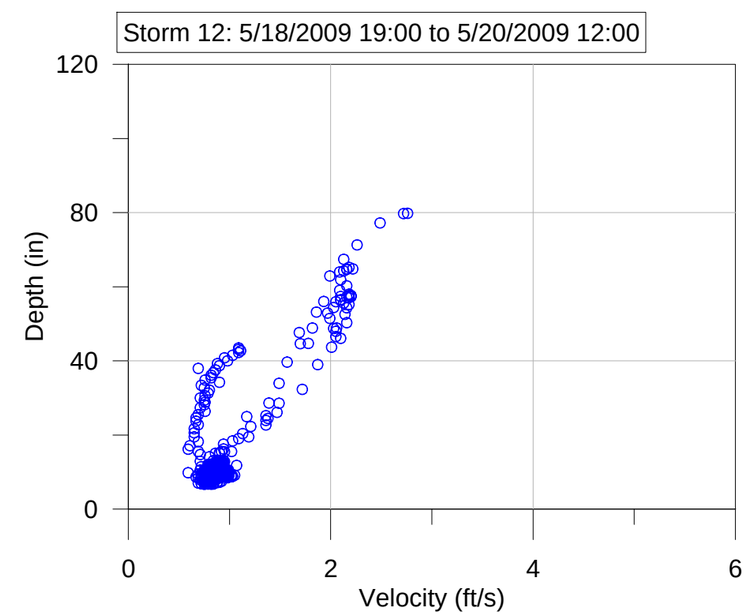




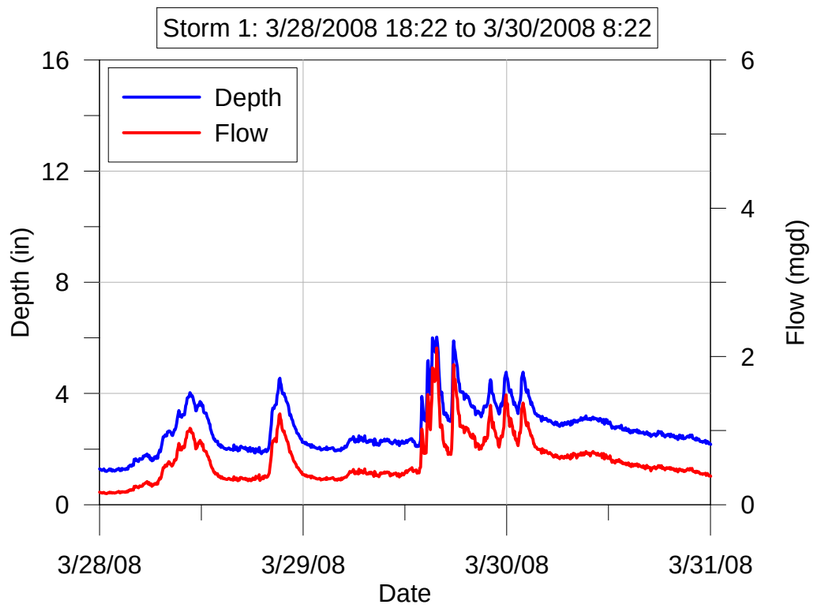


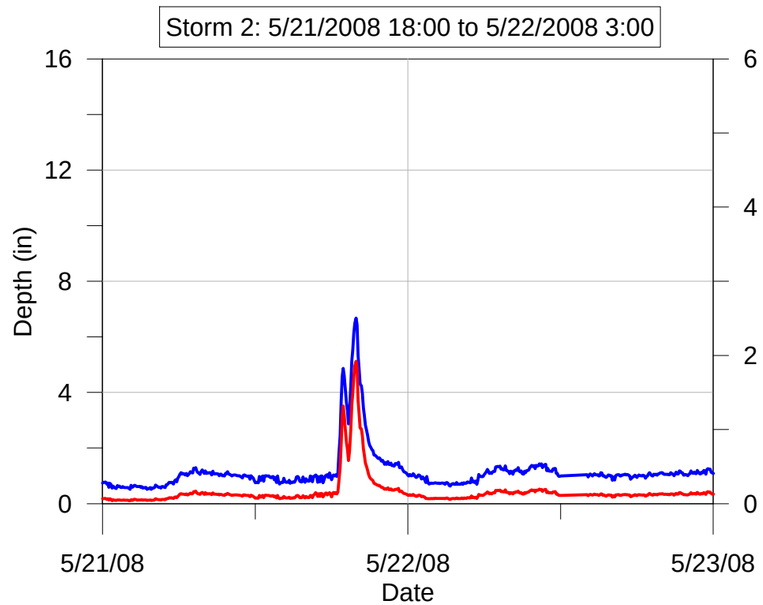


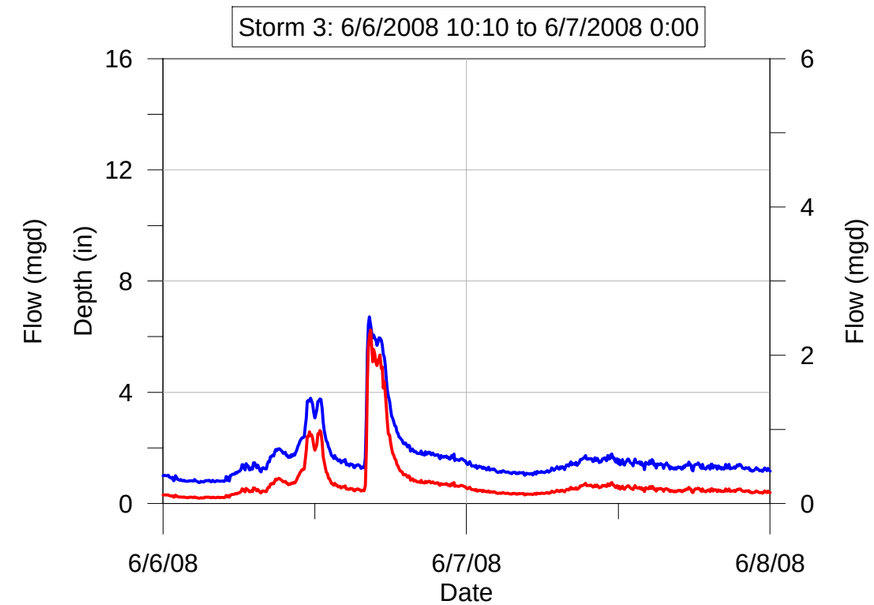


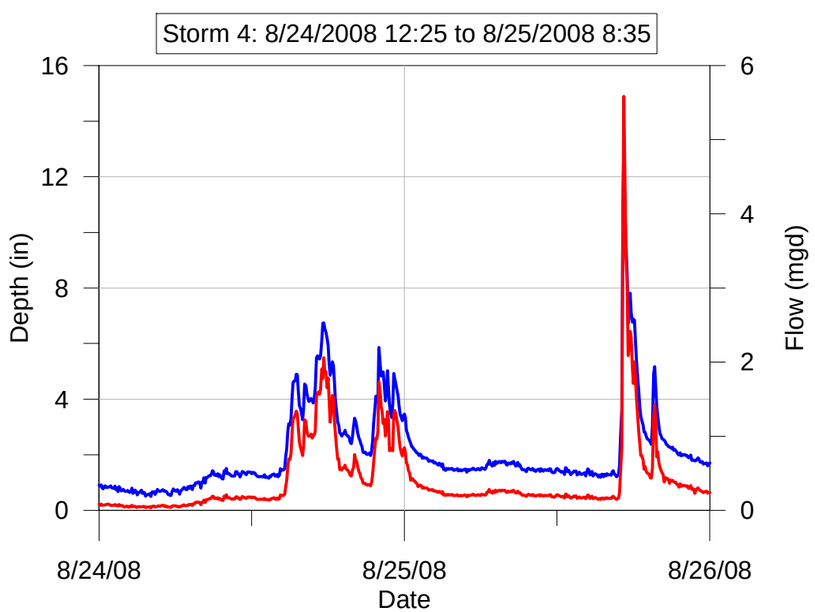


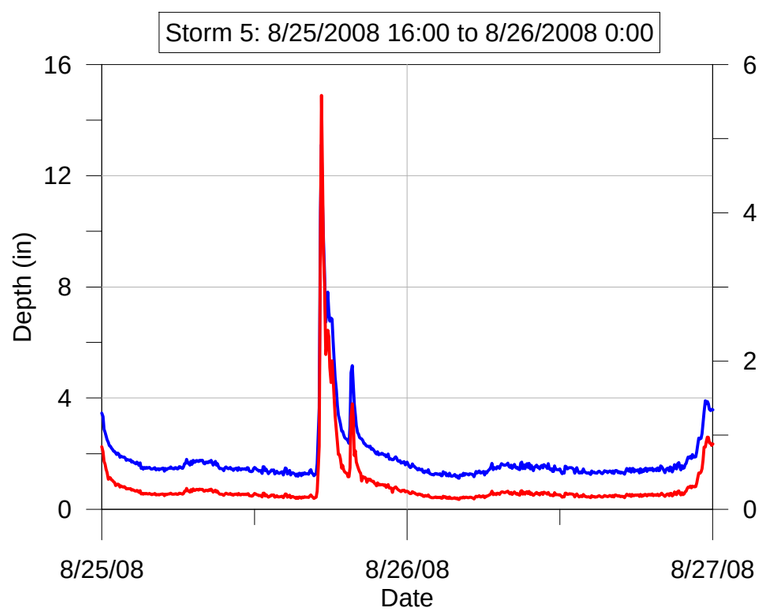
Calibration Storms
Monitor 081-237

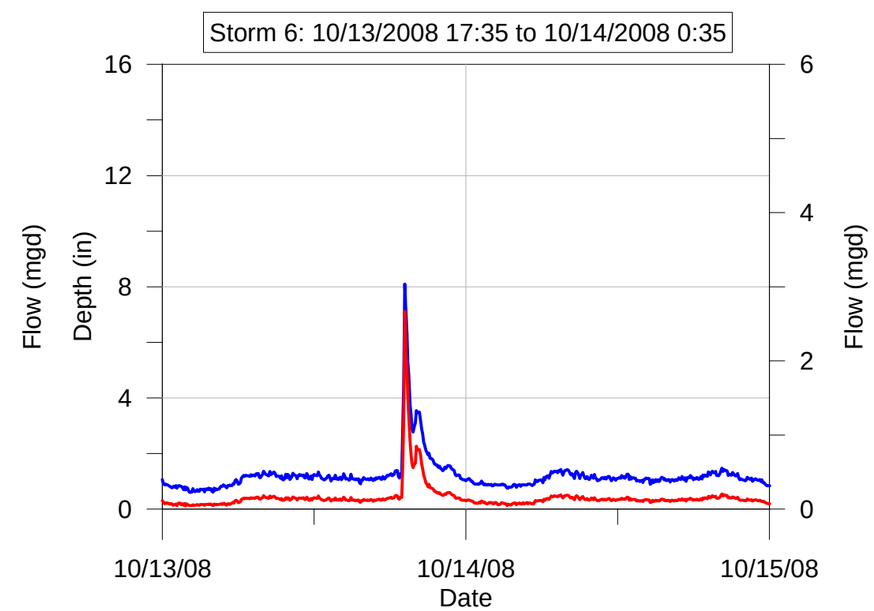




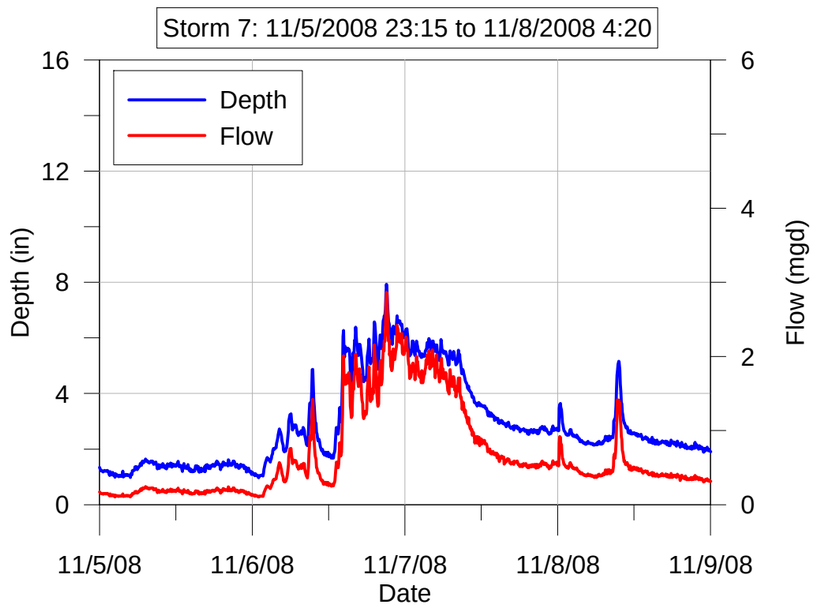


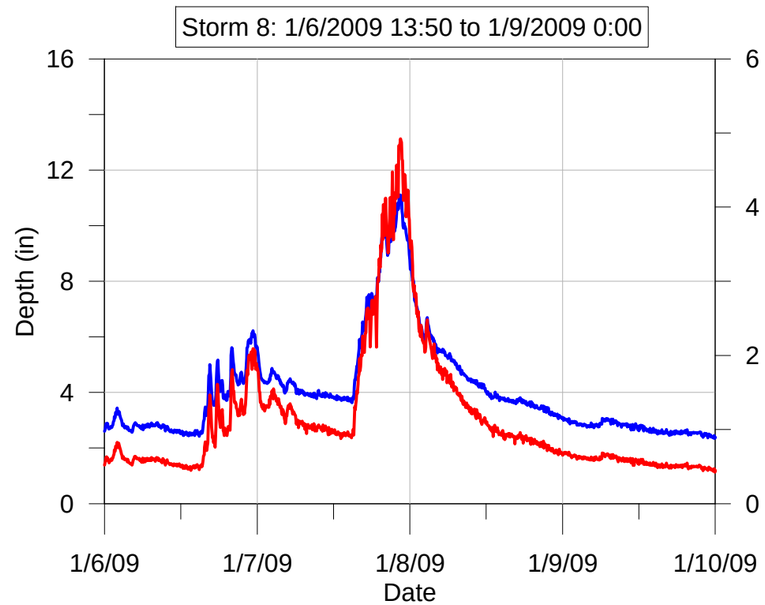


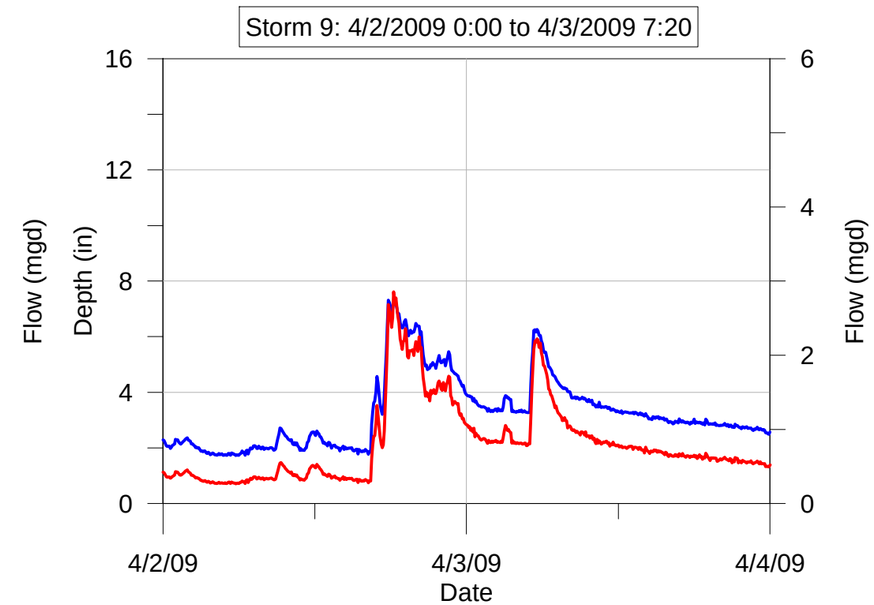


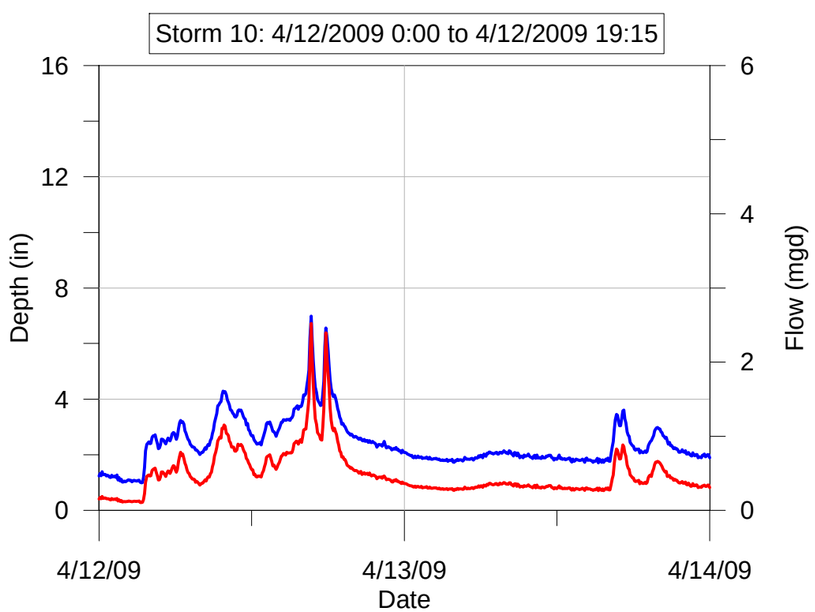


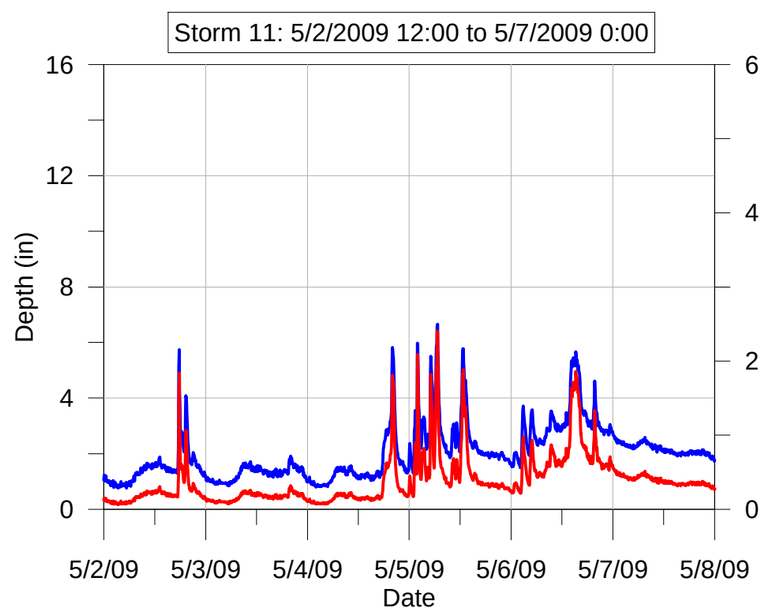
Calibration Storms
Monitor 081-237

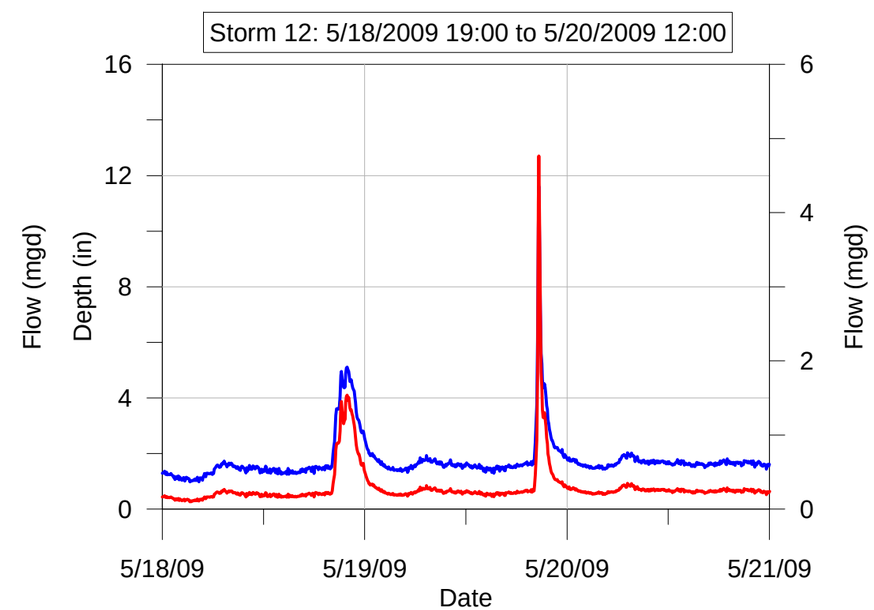




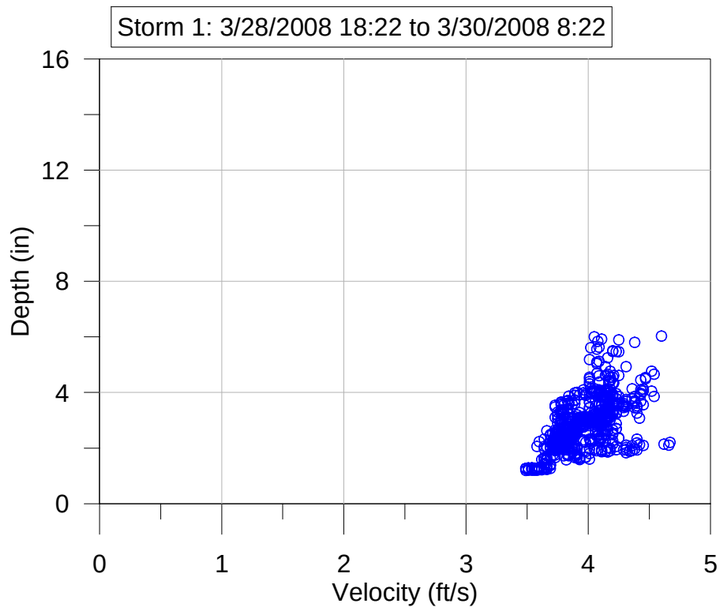


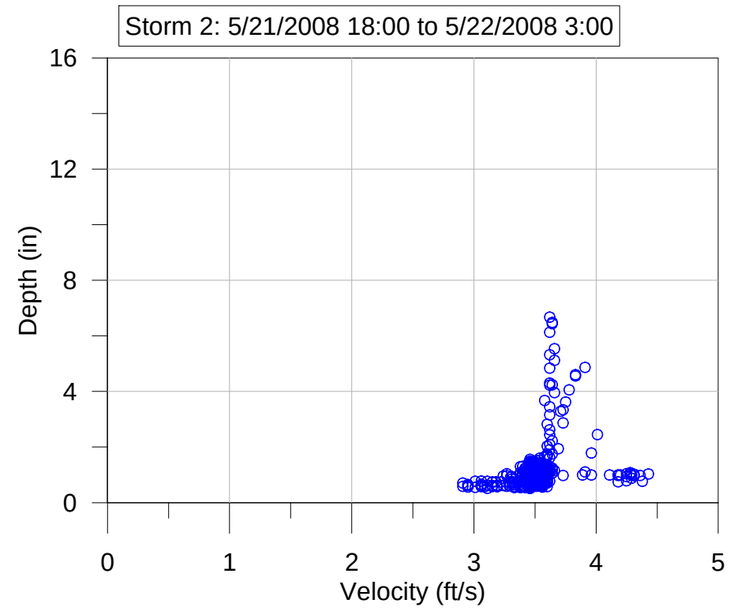


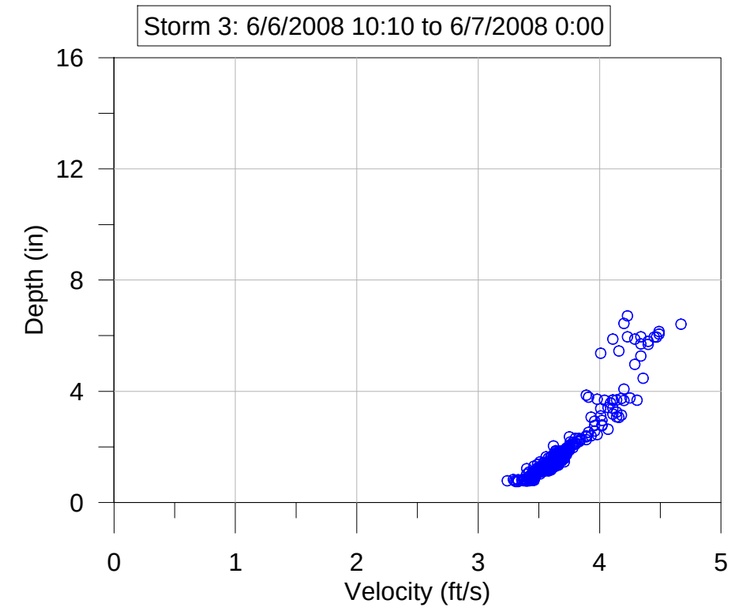


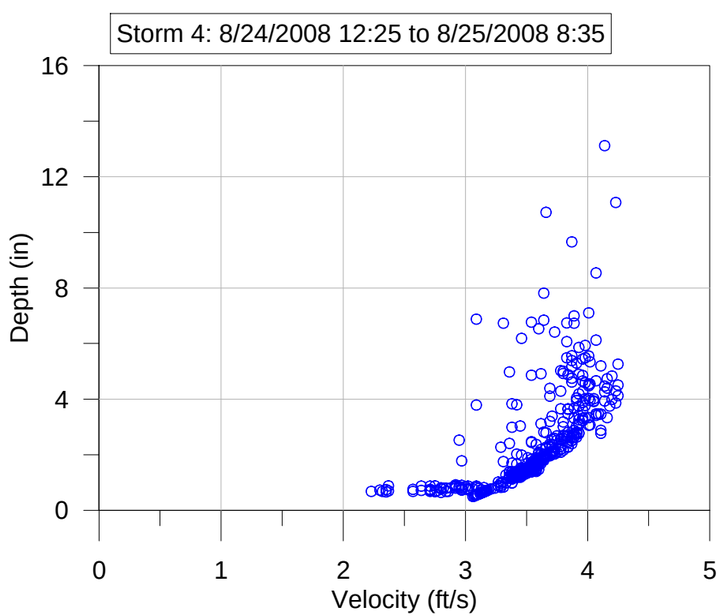


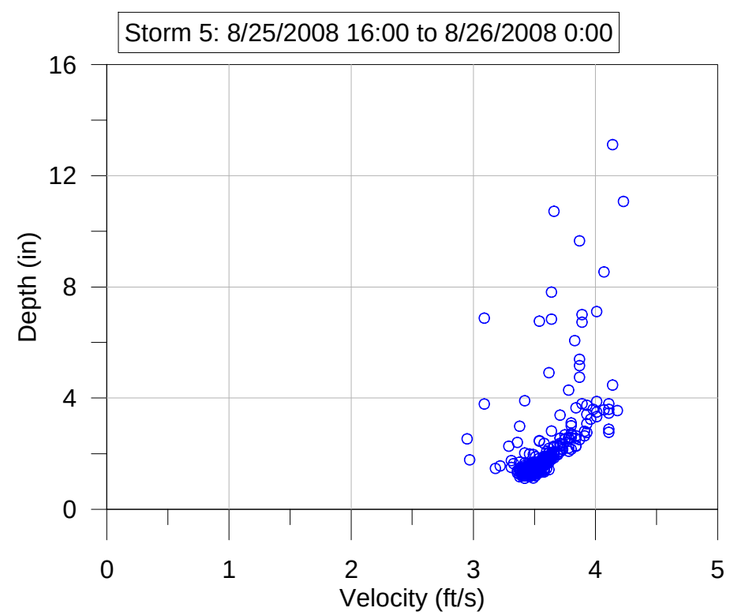
Calibration Storms - Scattergraphs
Monitor 081-237

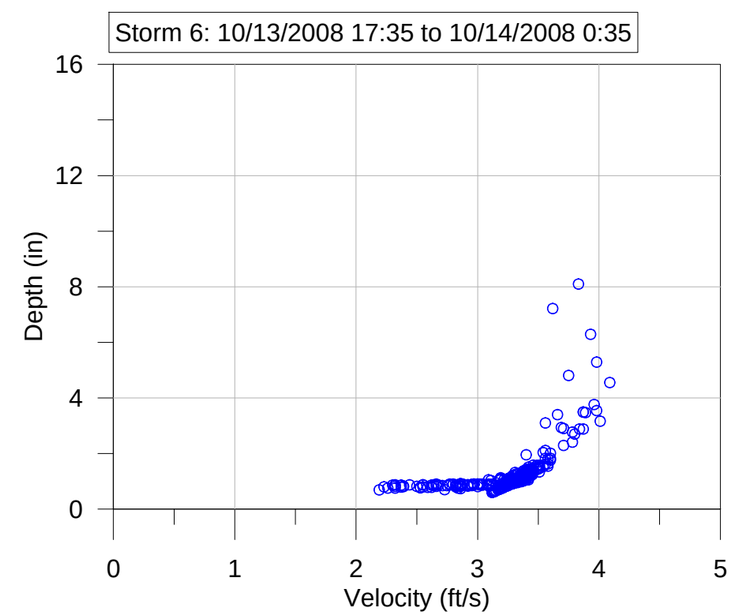




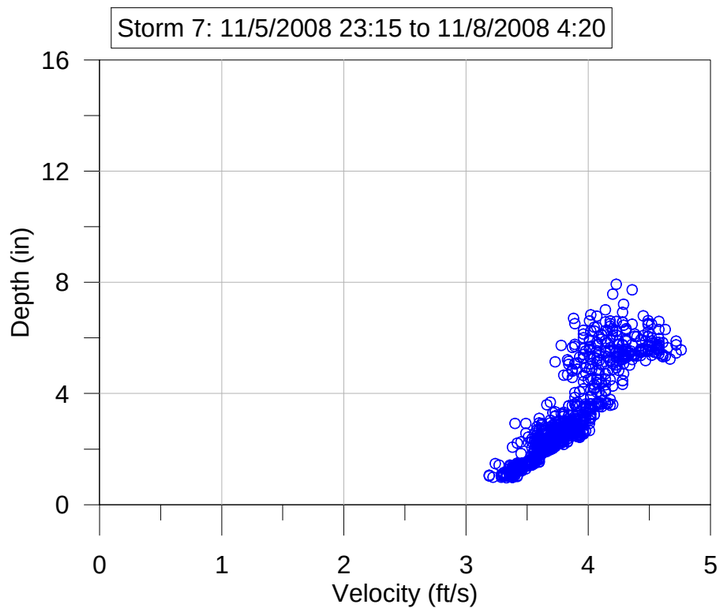


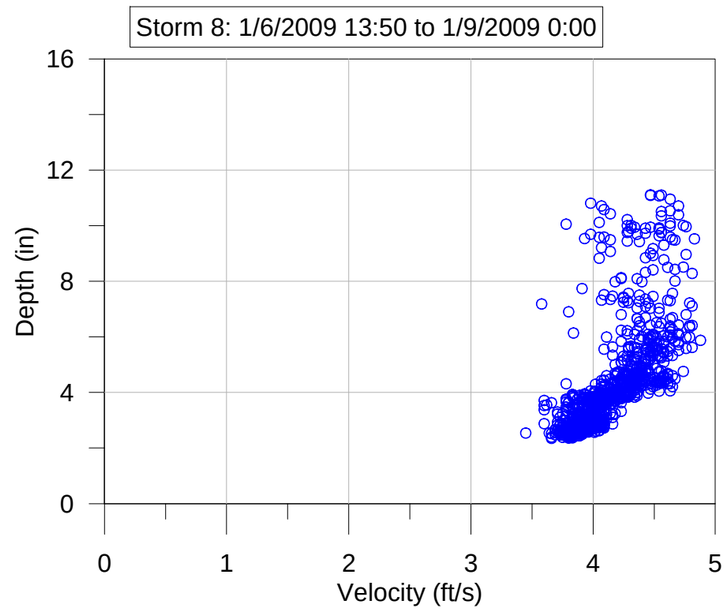


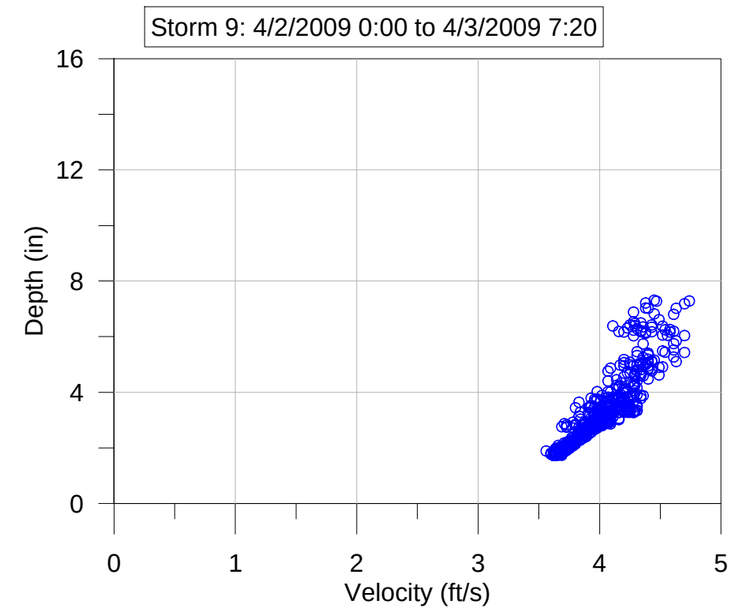


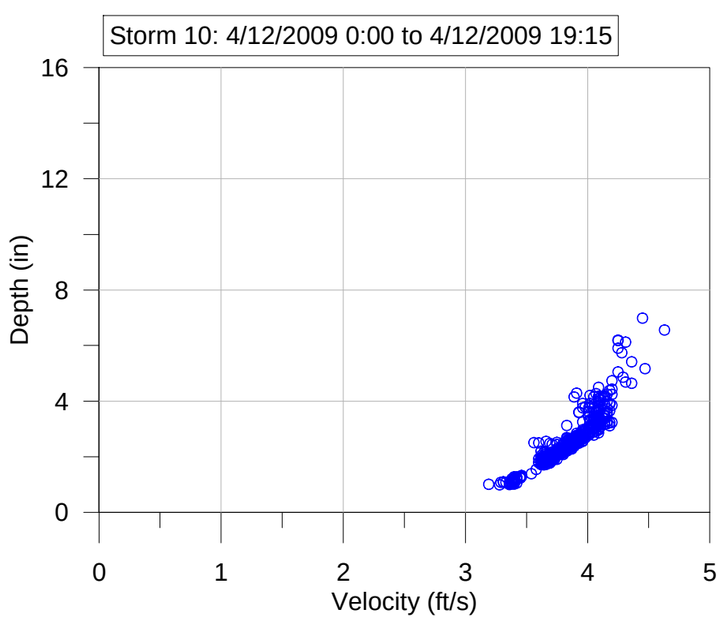


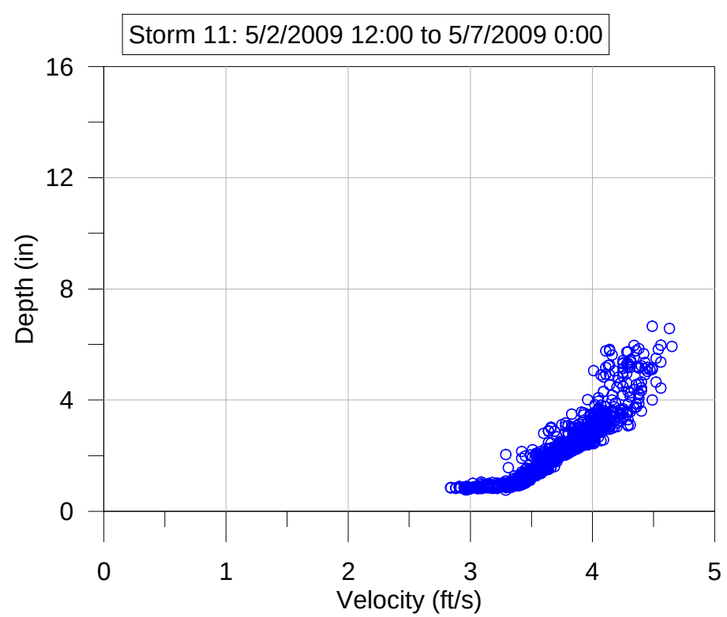
Calibration Storms - Scattergraphs
Monitor 081-237

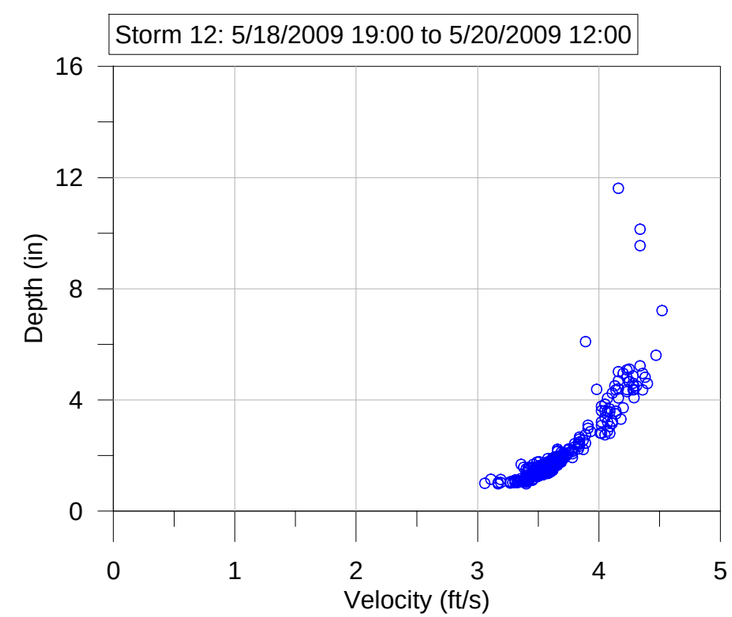




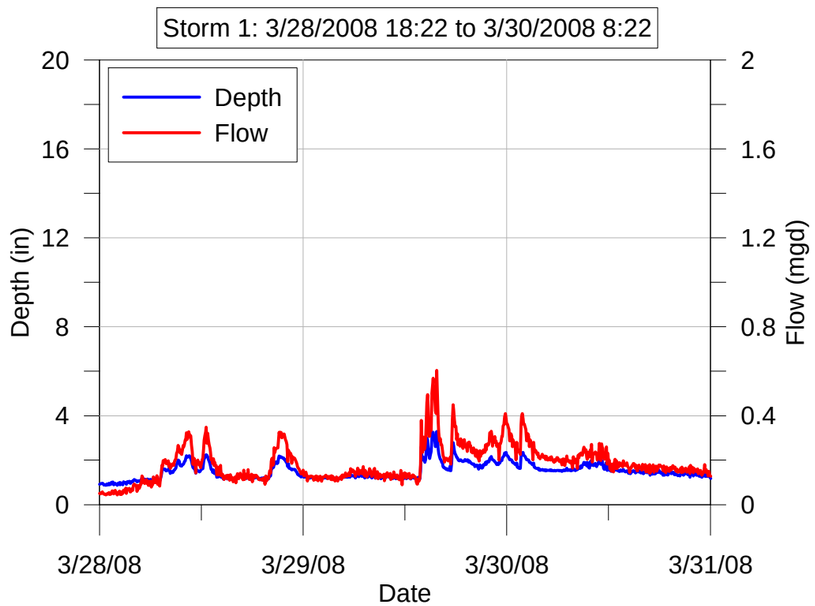


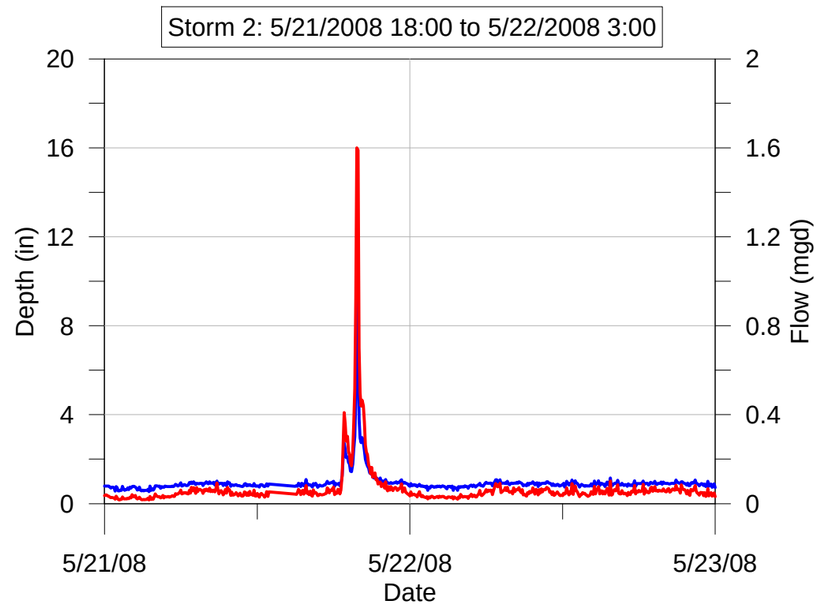


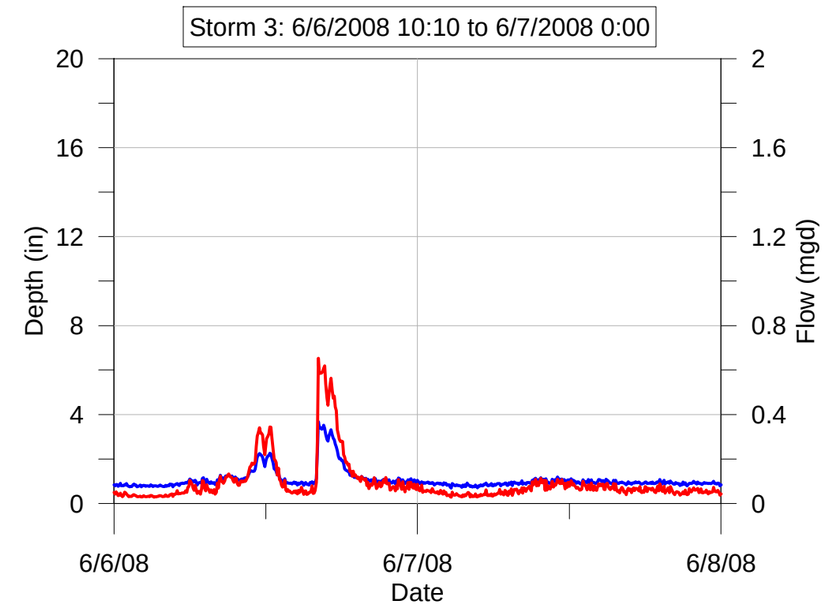


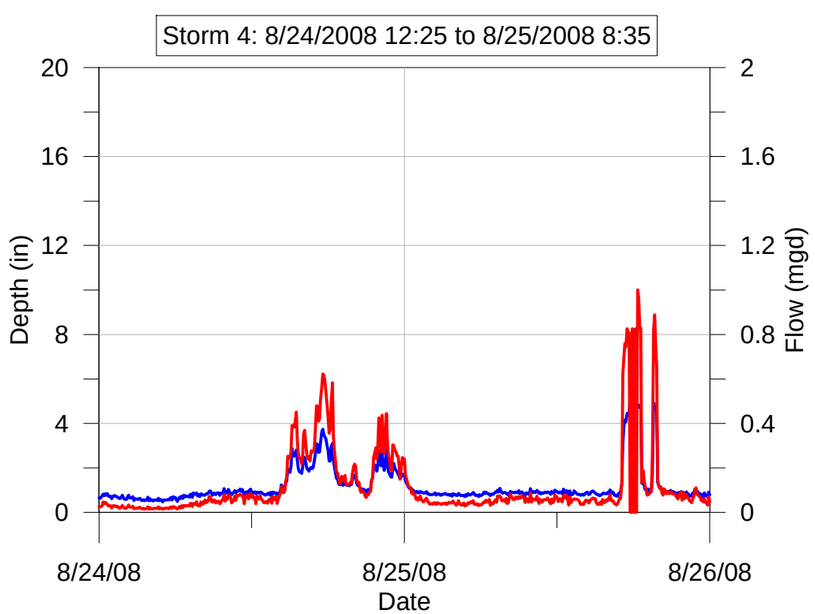


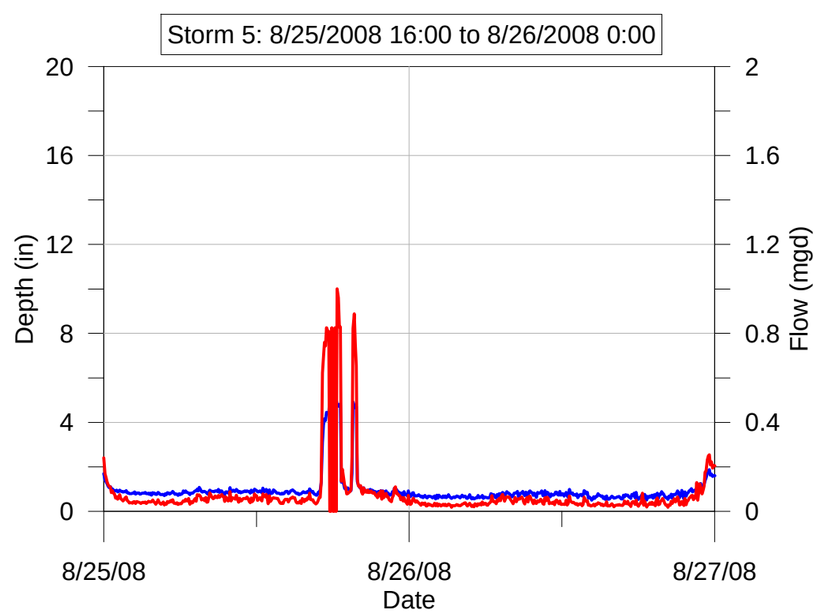
Calibration Storms
Monitor 306-192

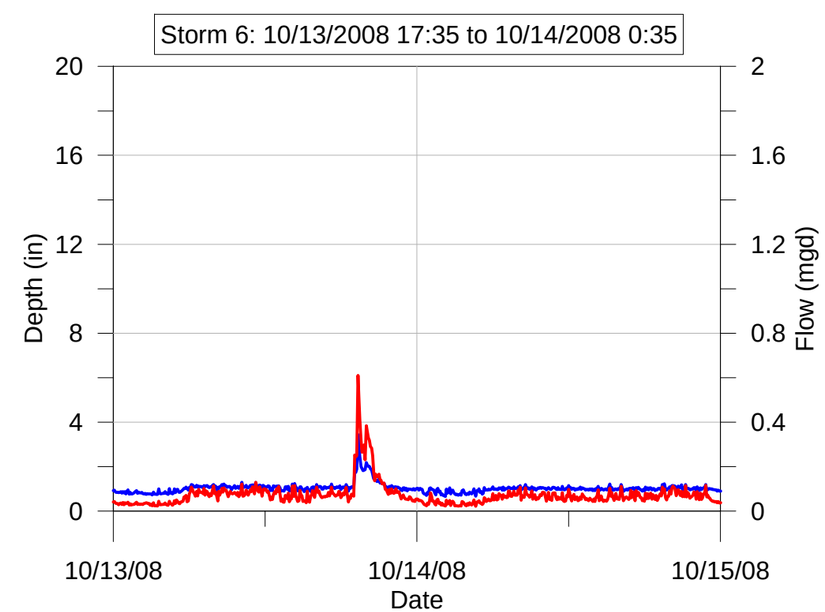




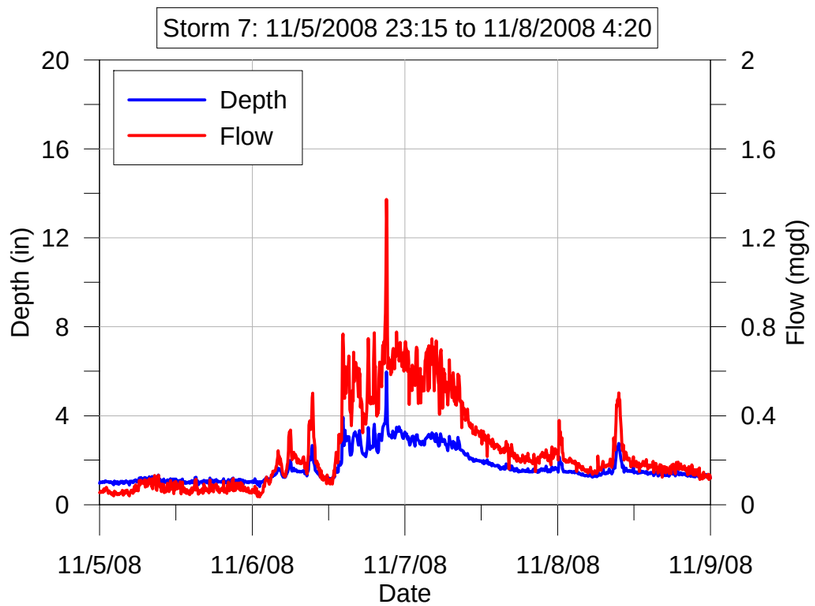


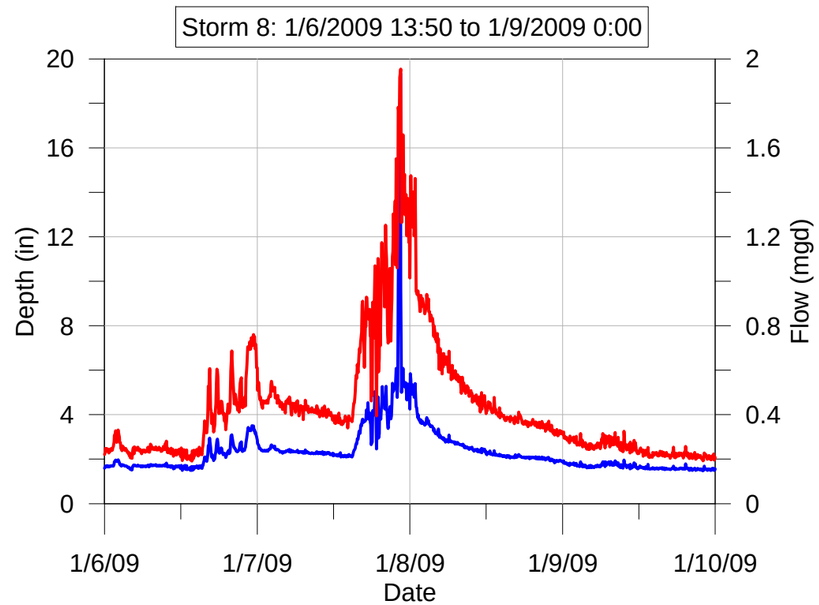


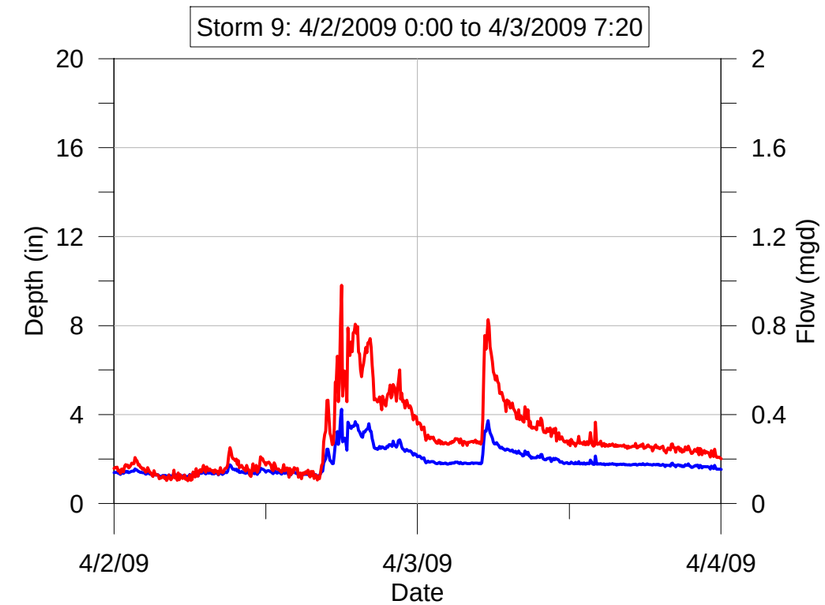


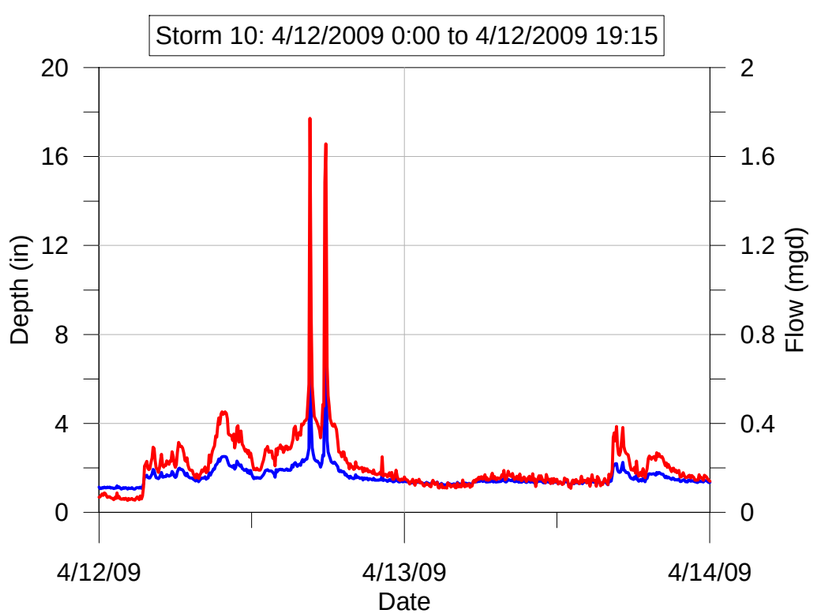


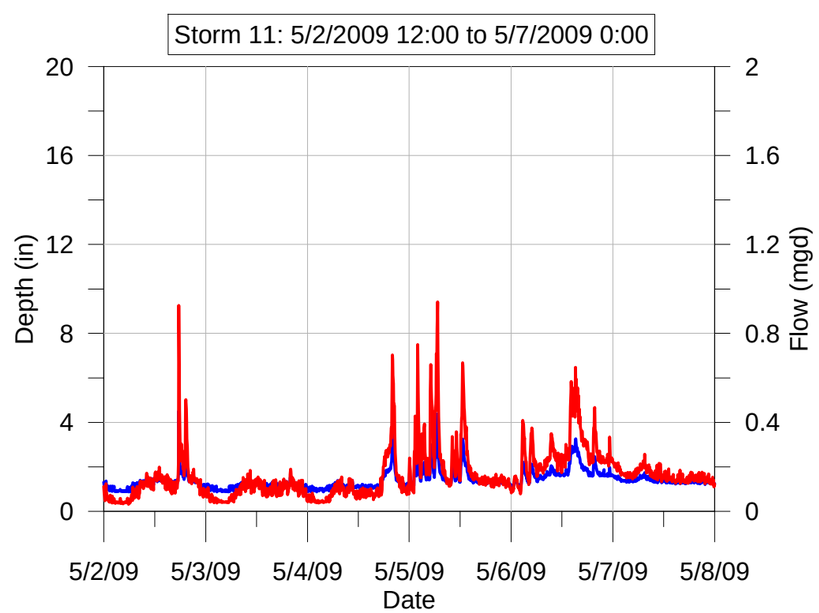
Calibration Storms
Monitor 306-192

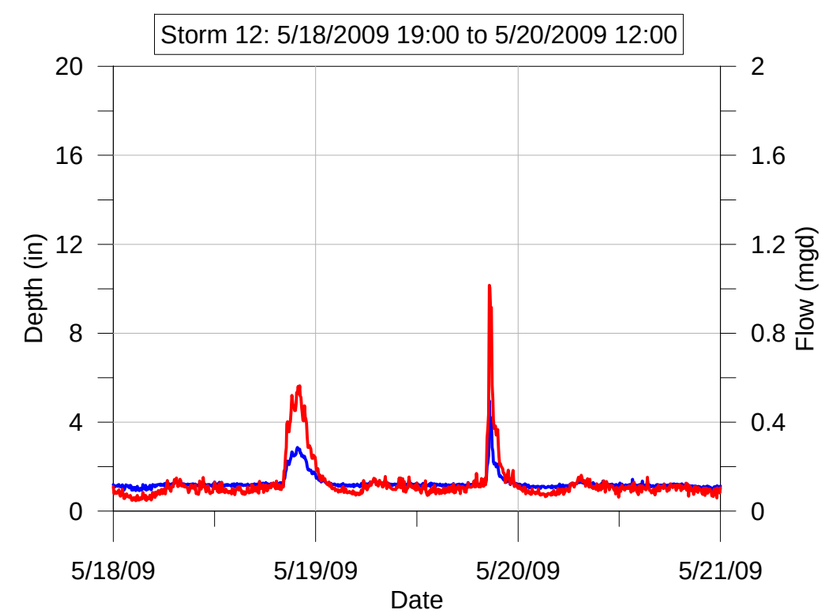




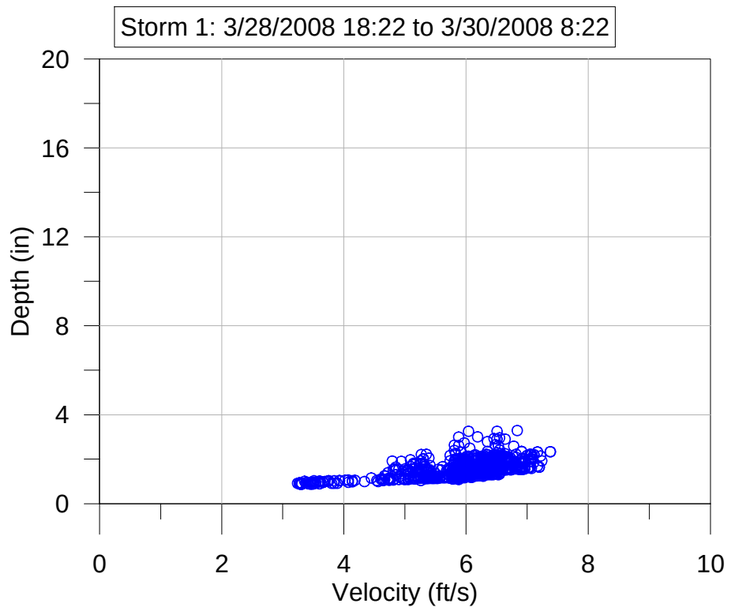


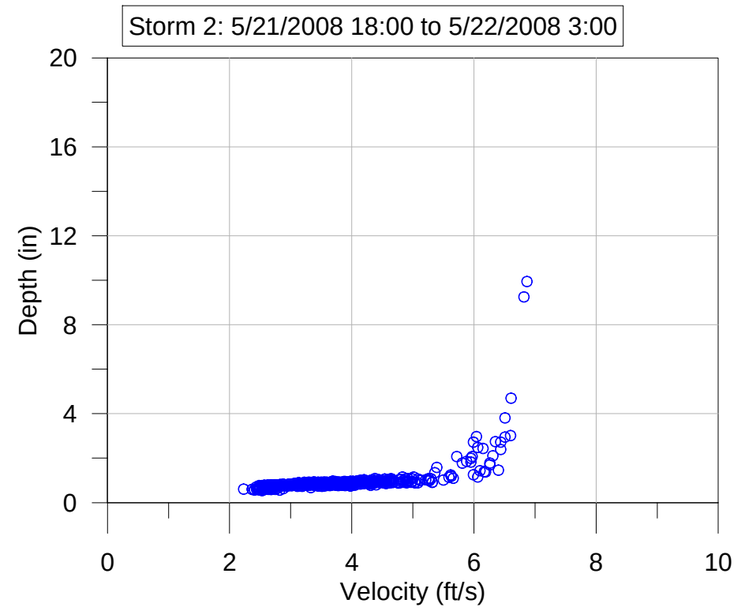


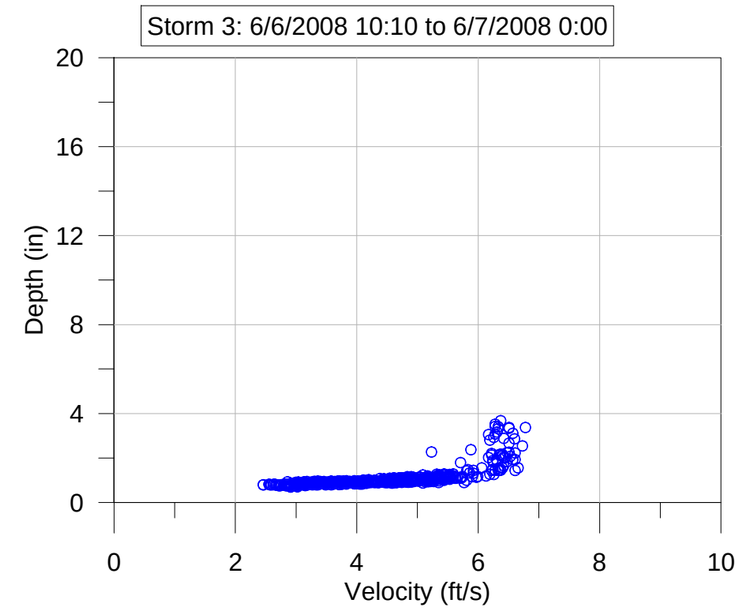


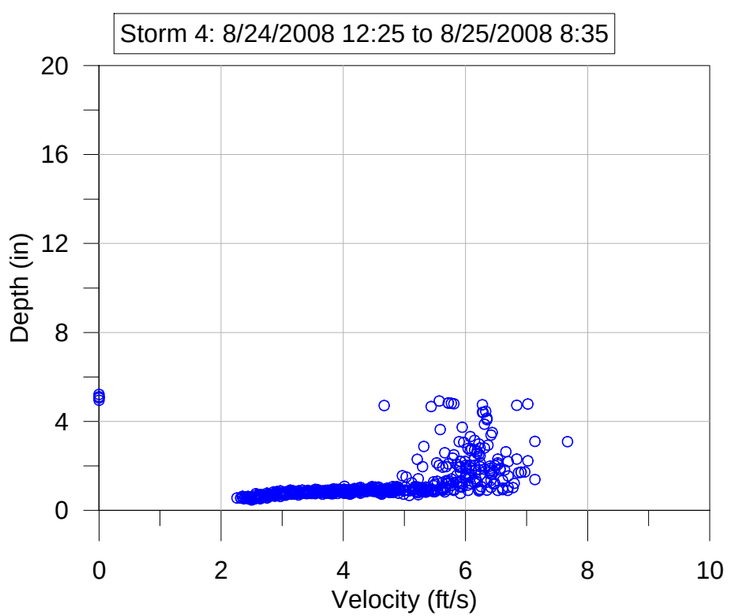


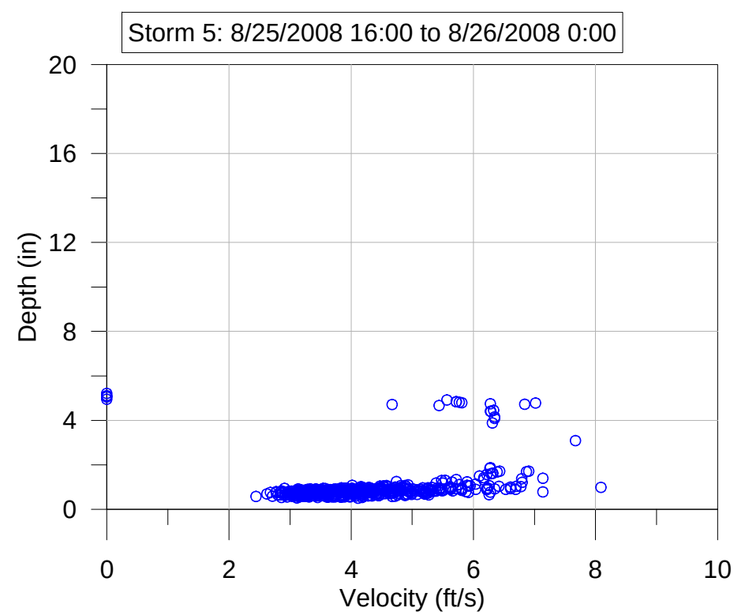
Calibration Storms - Scattergraphs
Monitor 306-192

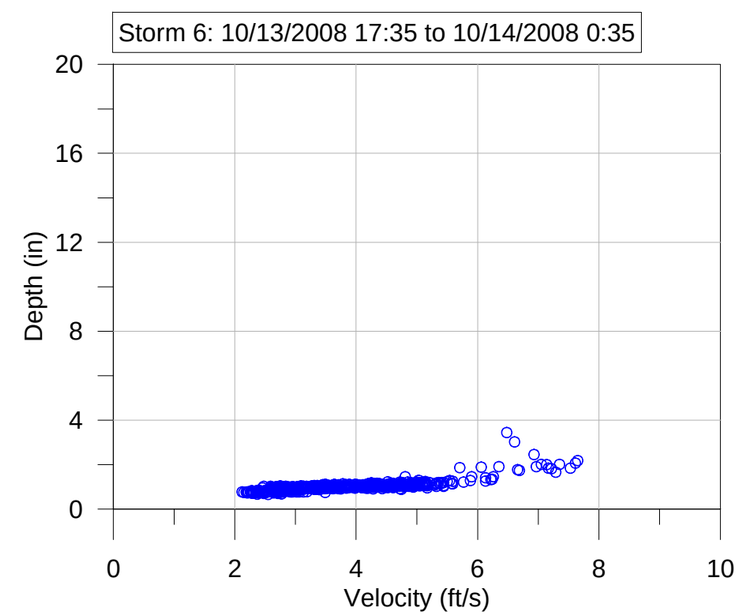




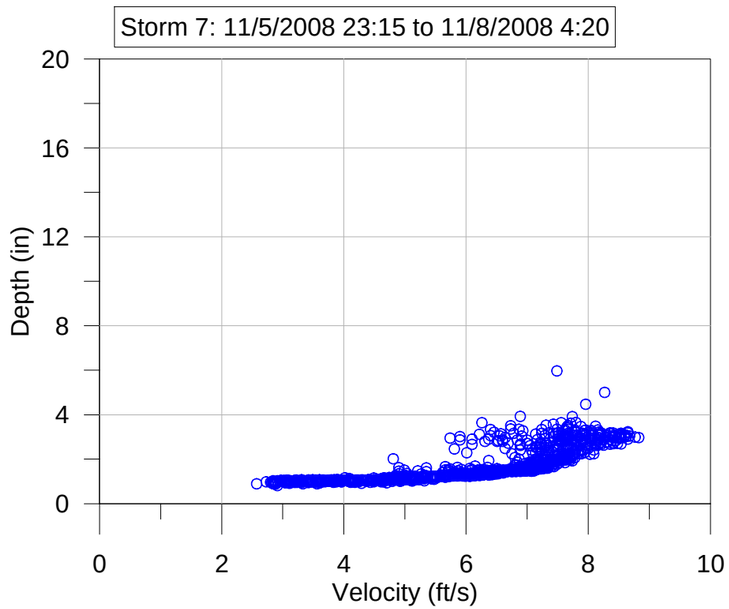


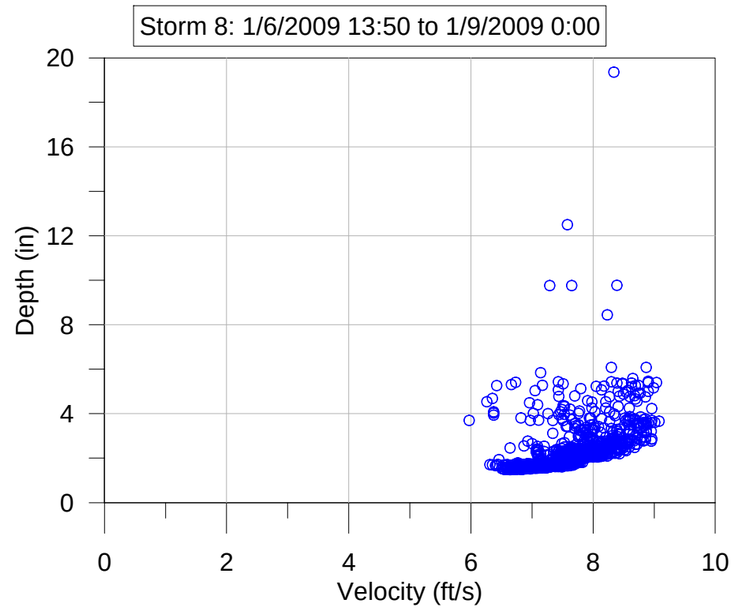


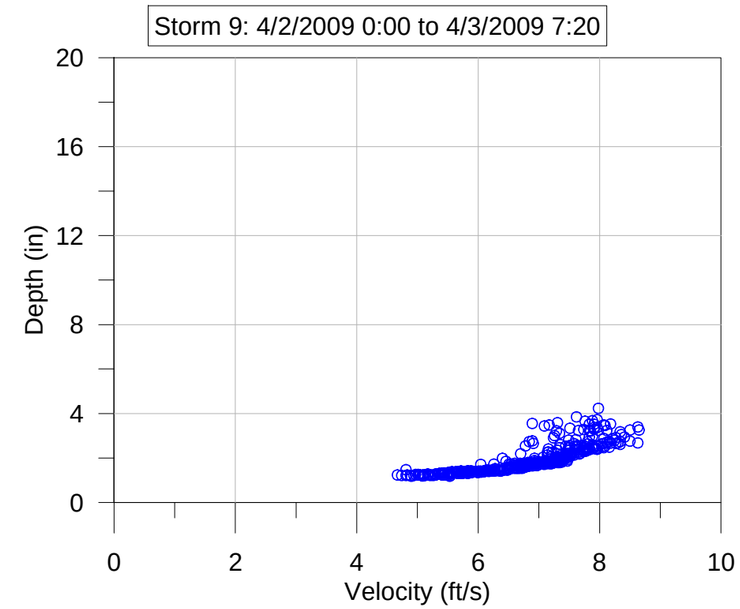


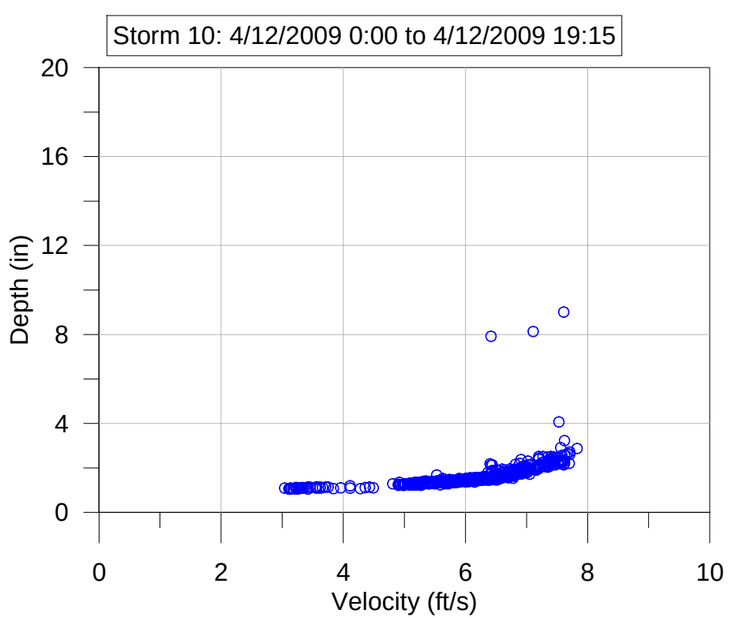


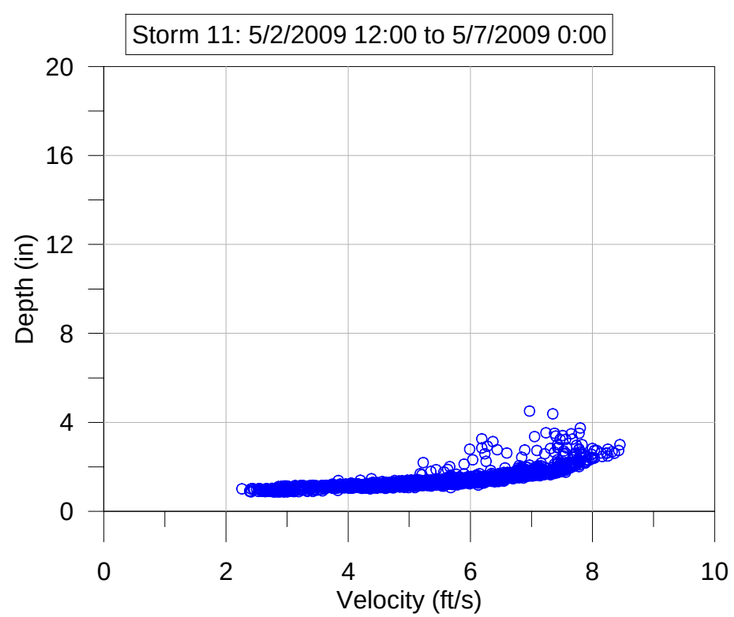
Calibration Storms - Scattergraphs
Monitor 306-192

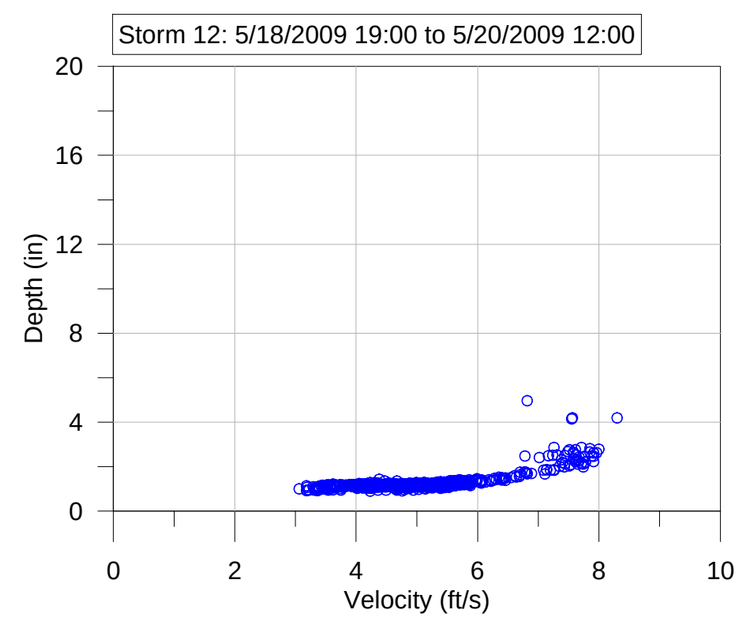




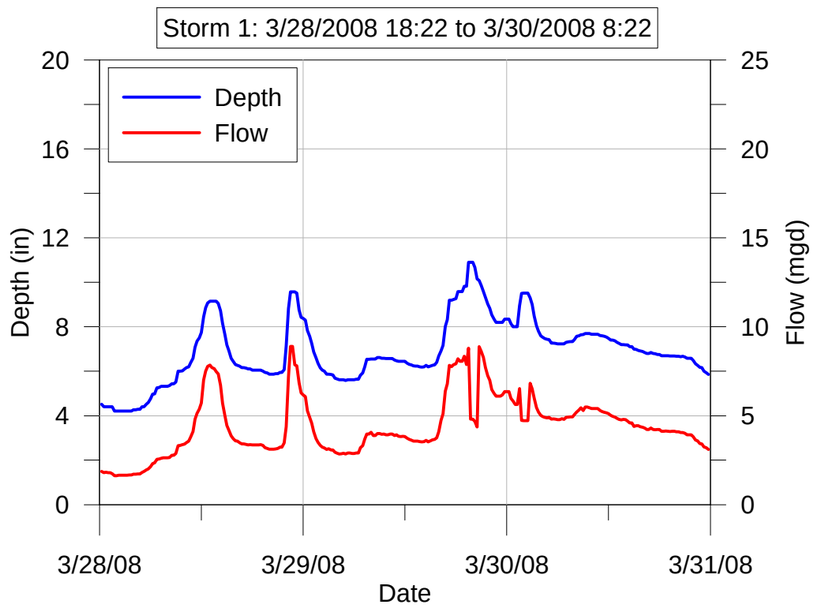


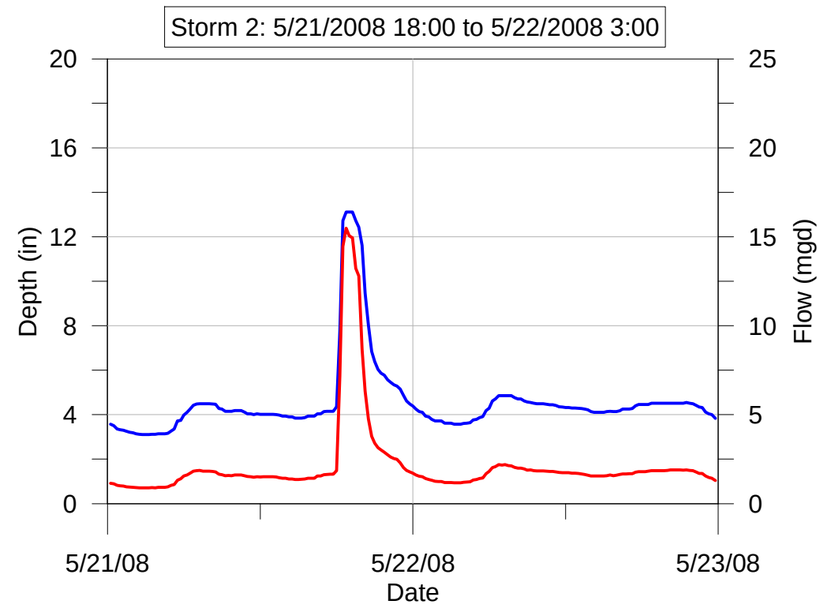


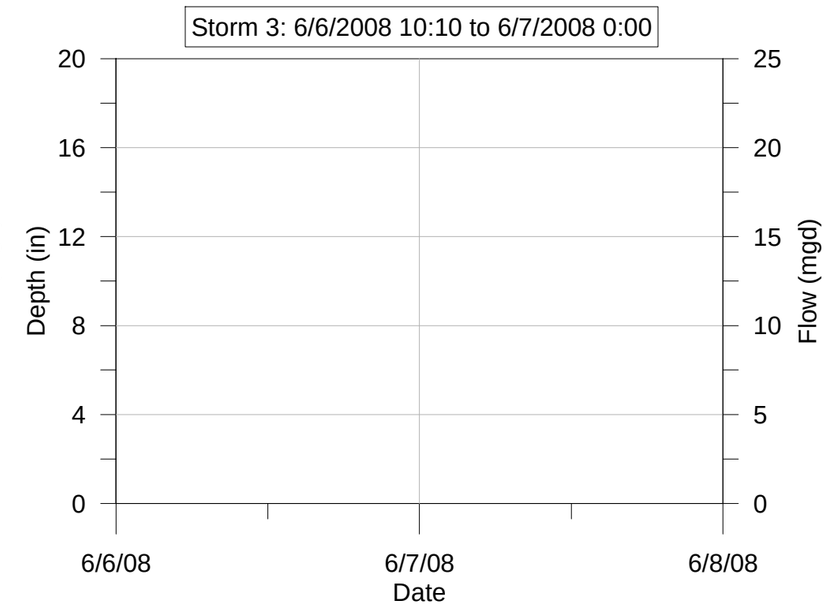


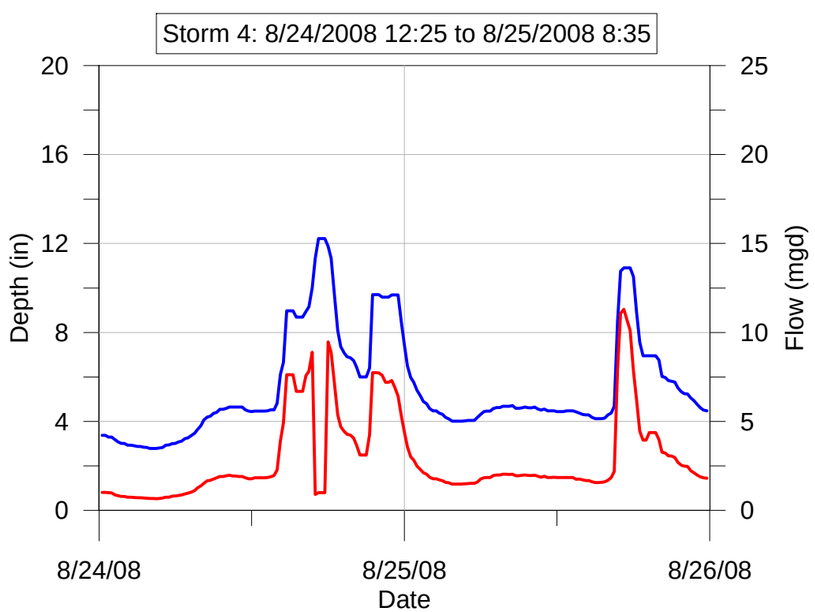


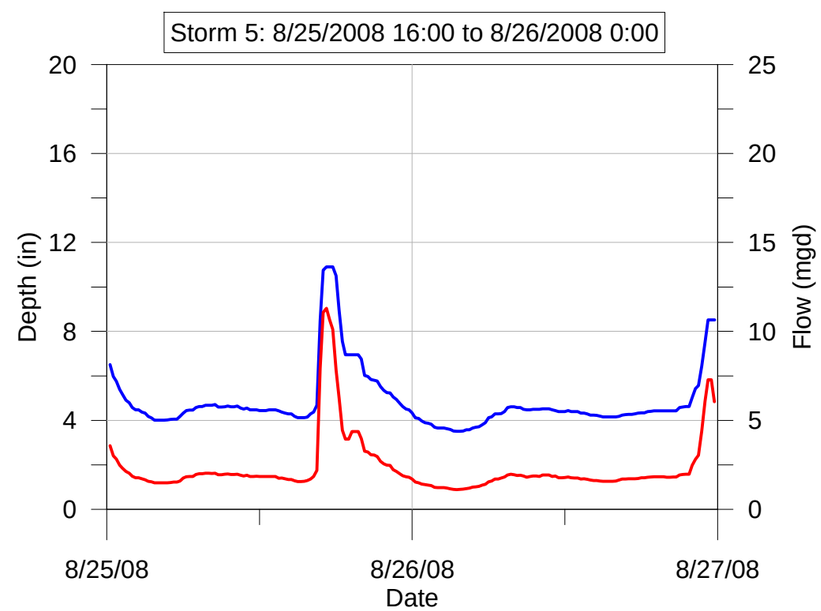
Calibration Storms
Monitor 080-334 (KC)

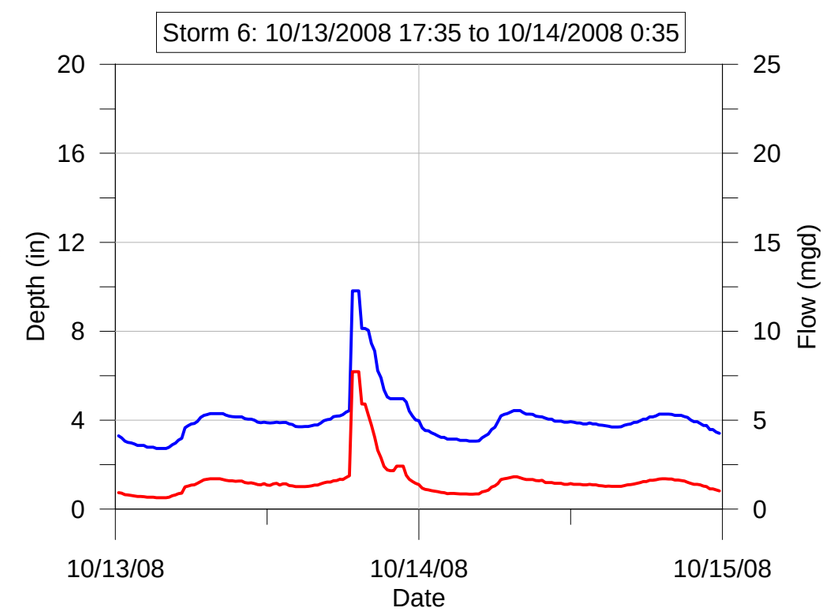




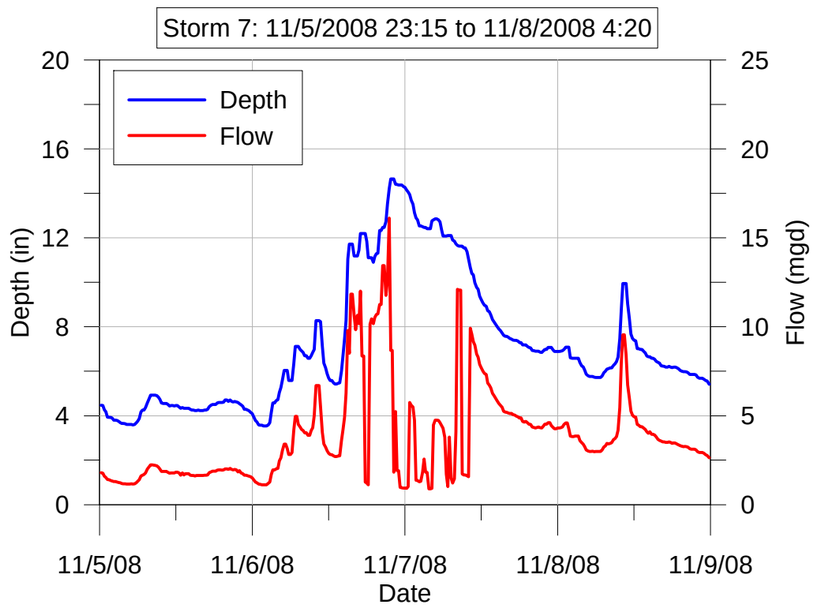


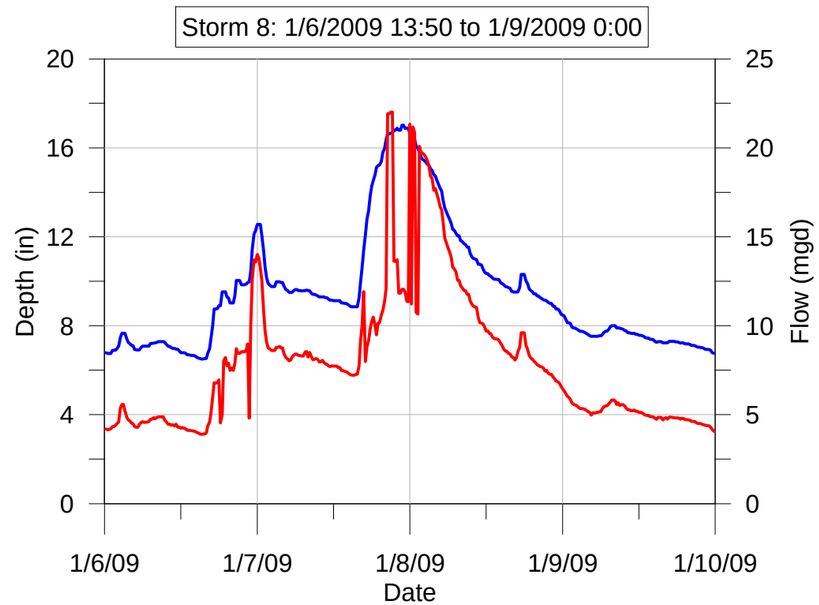


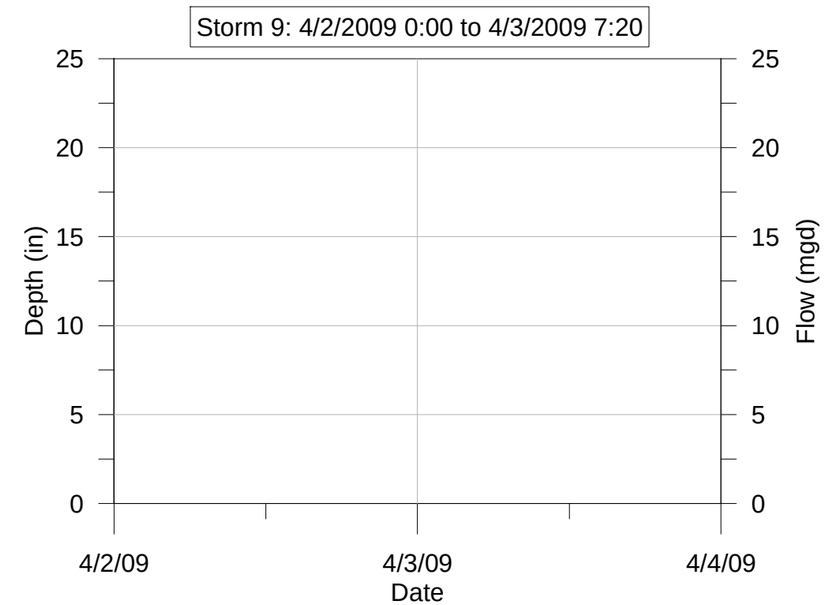


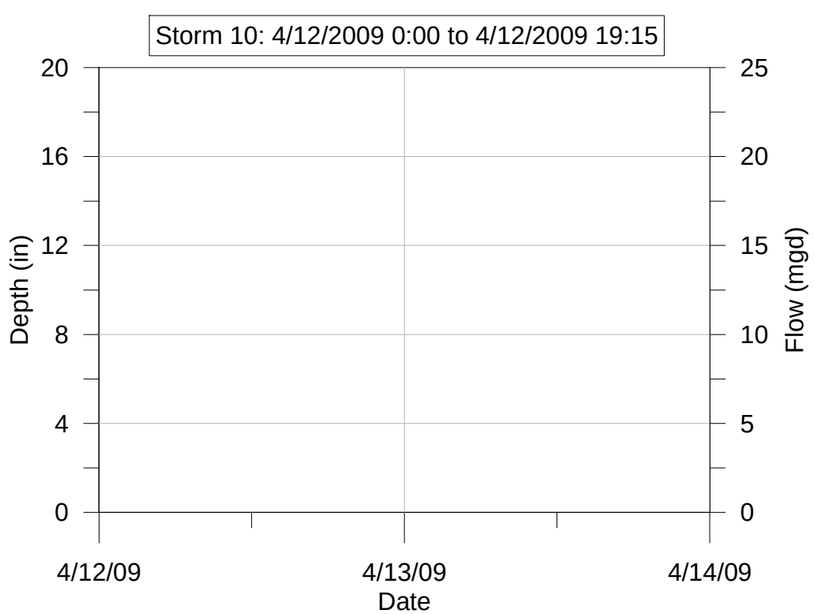


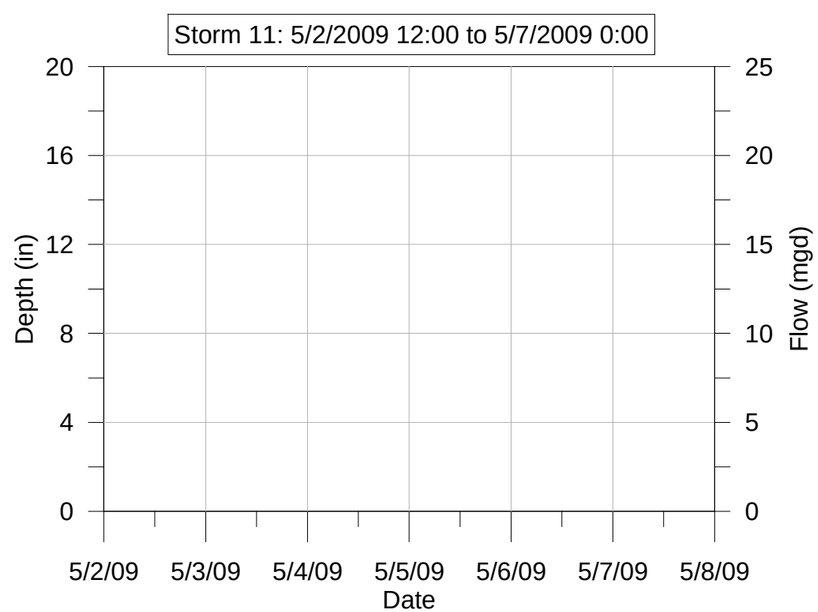
Calibration Storms
Monitor 080-334 (KC)

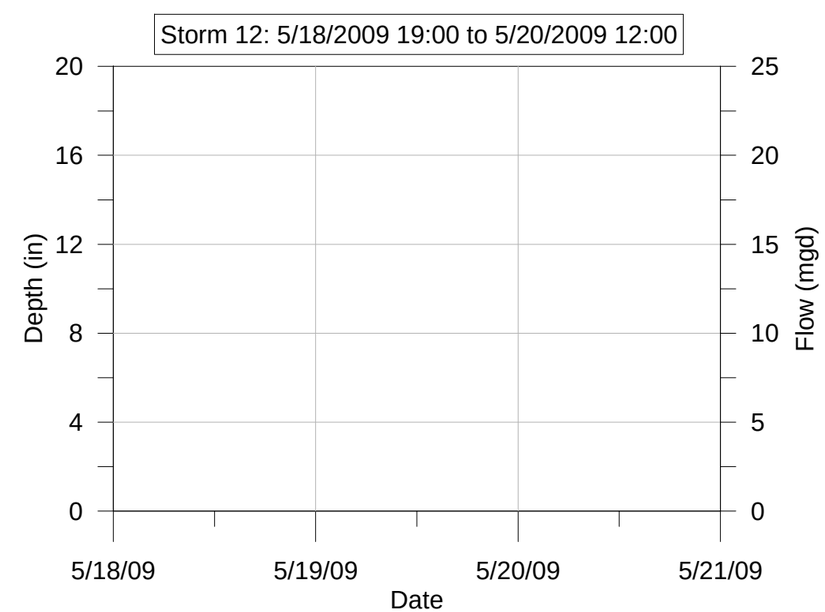




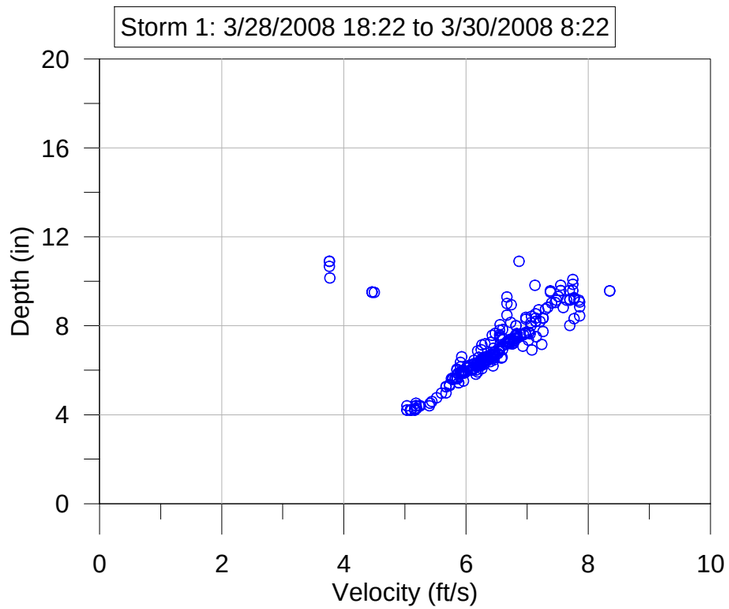


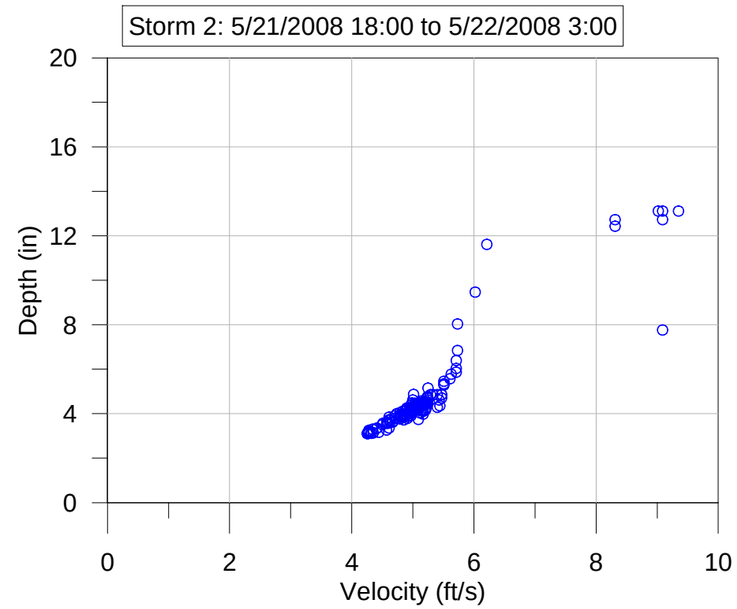


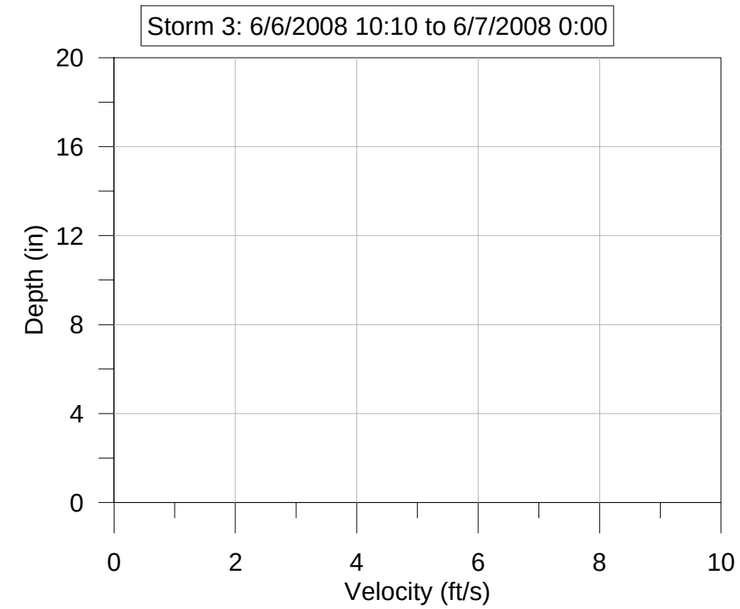


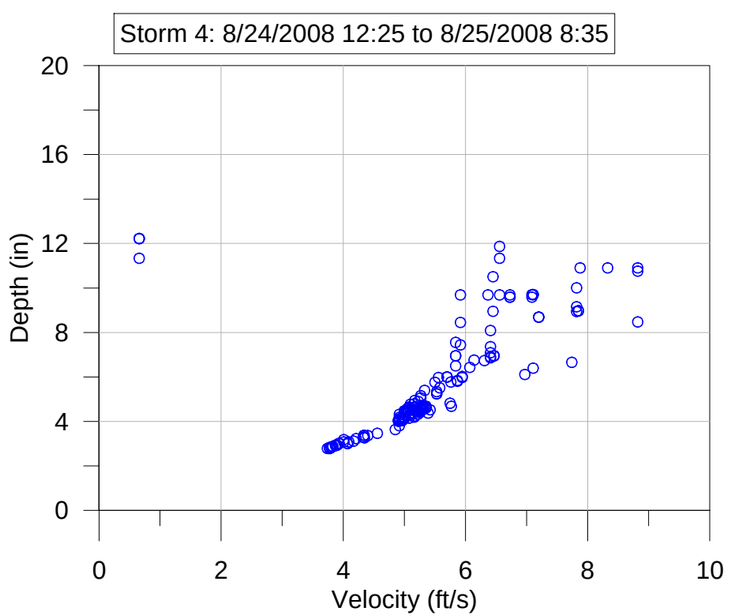


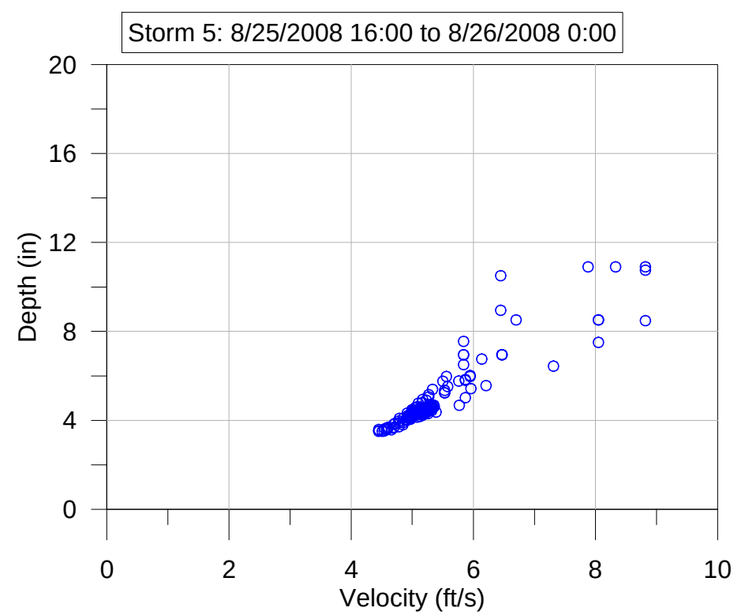
Calibration Storms - Scattergraphs
Monitor 080-334 (KC)

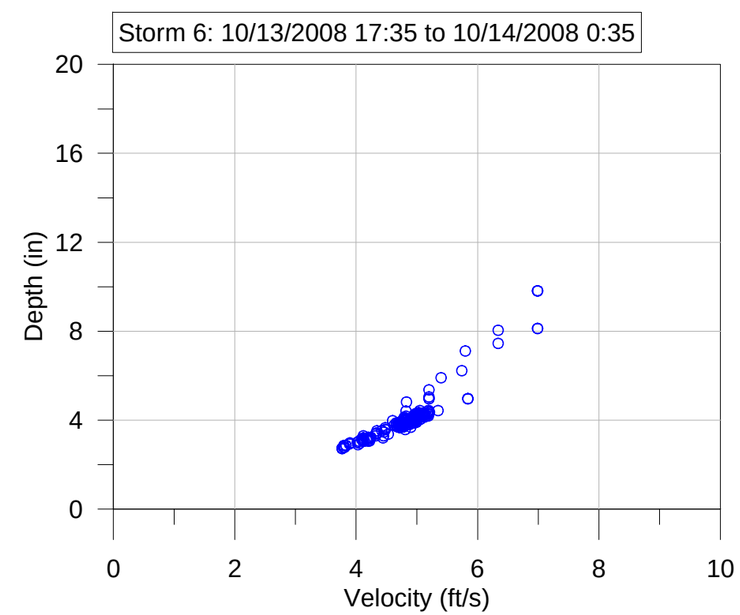




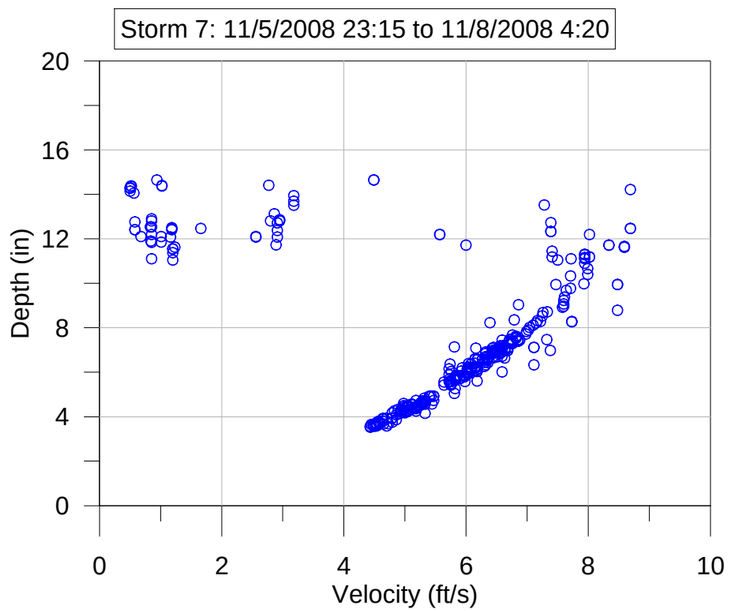


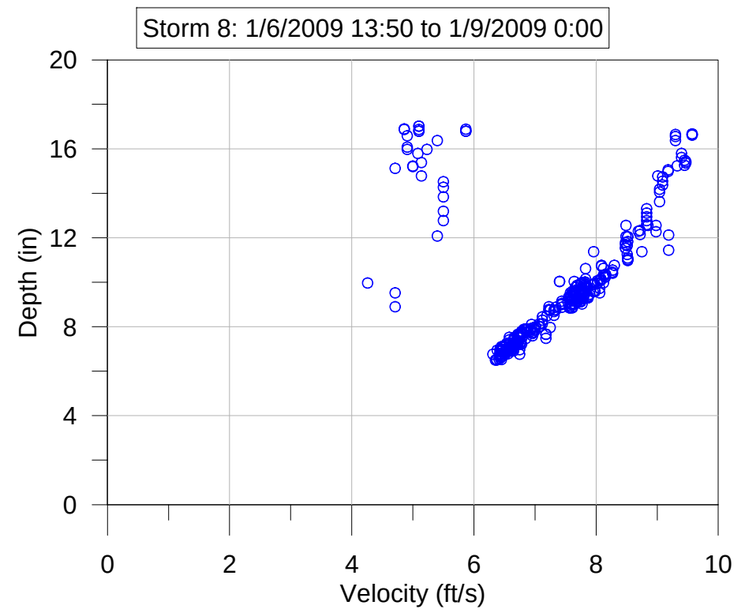


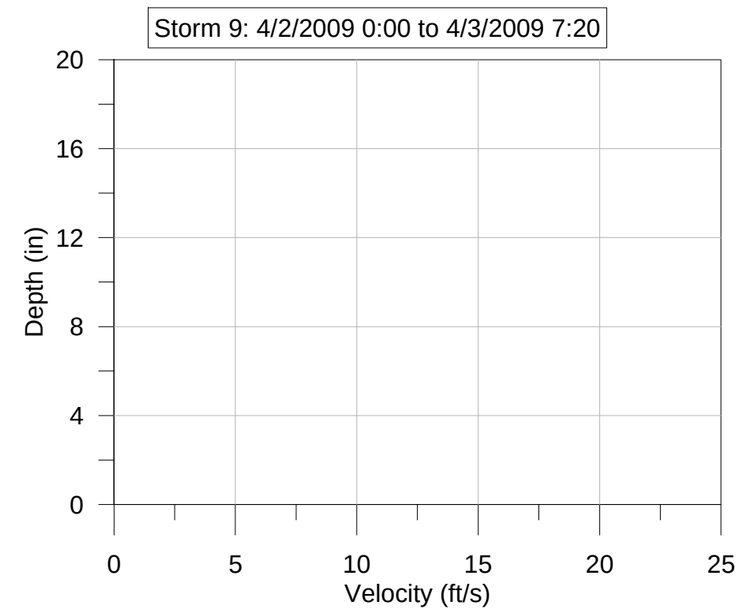


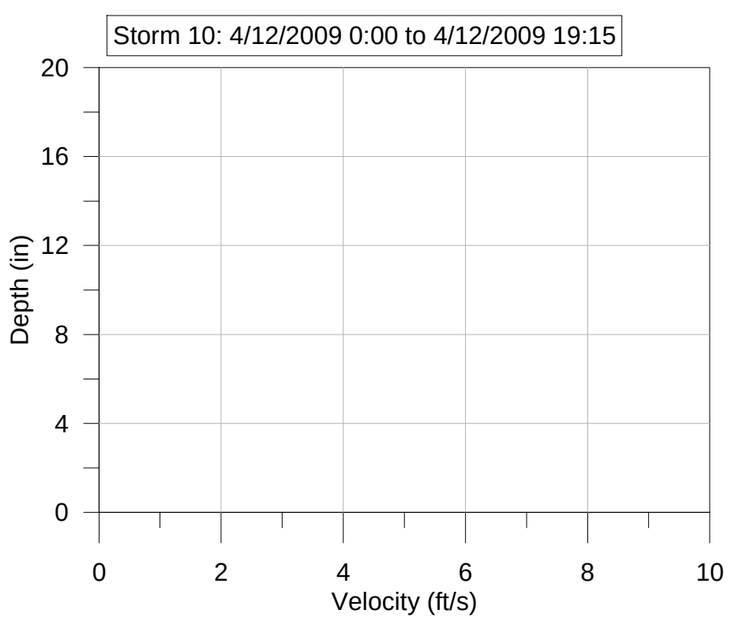


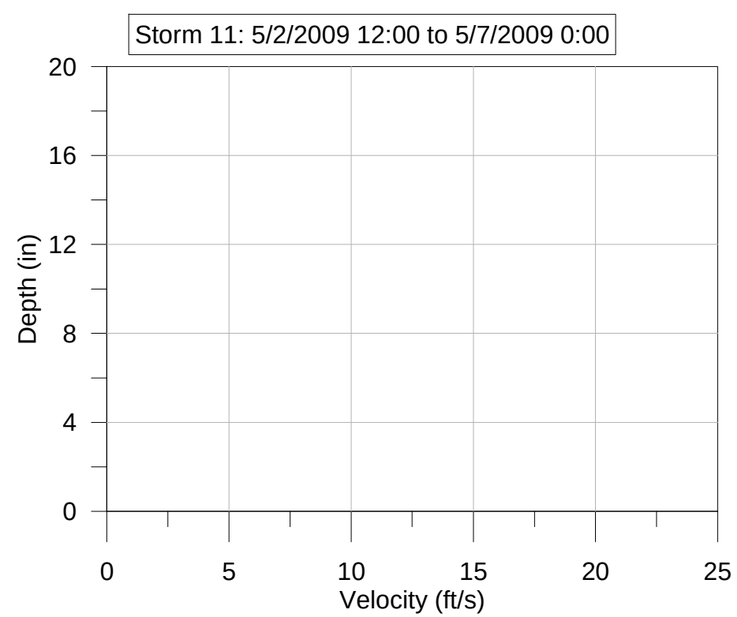
Calibration Storms - Scattergraphs
Monitor 080-334 (KC)

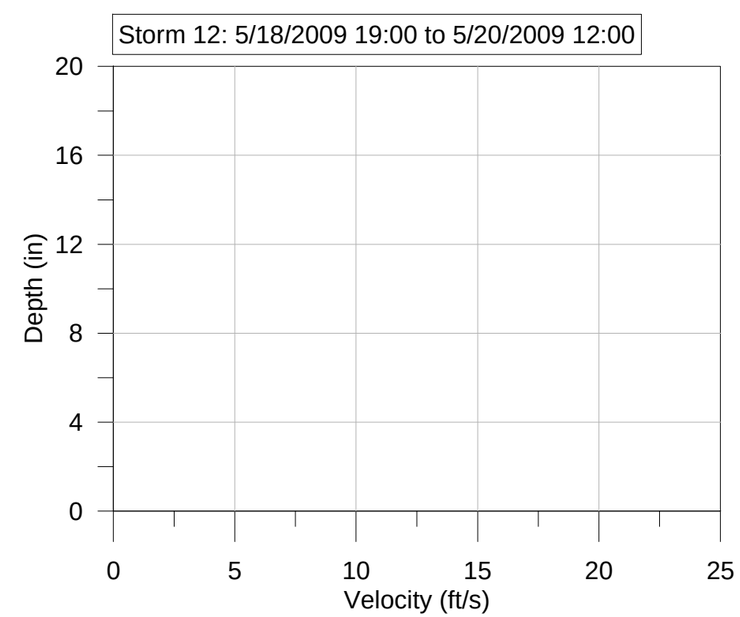




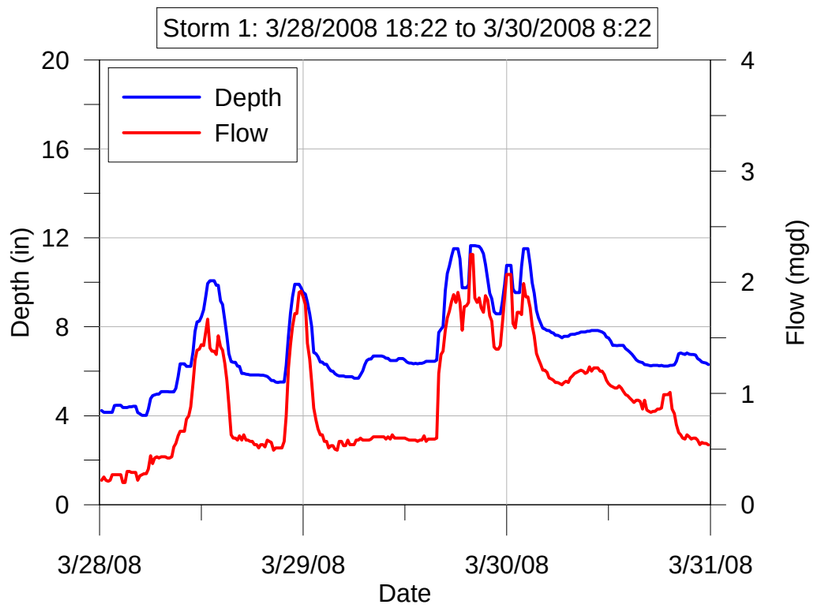


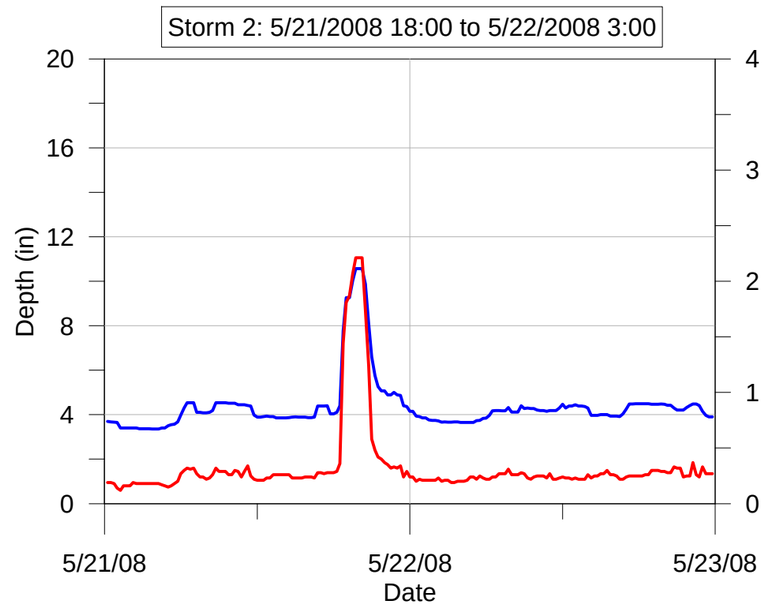


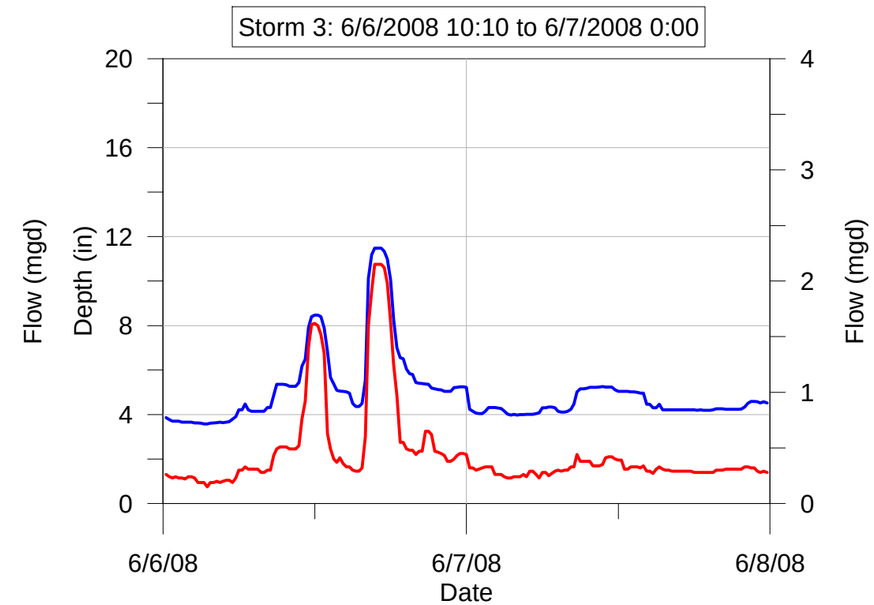


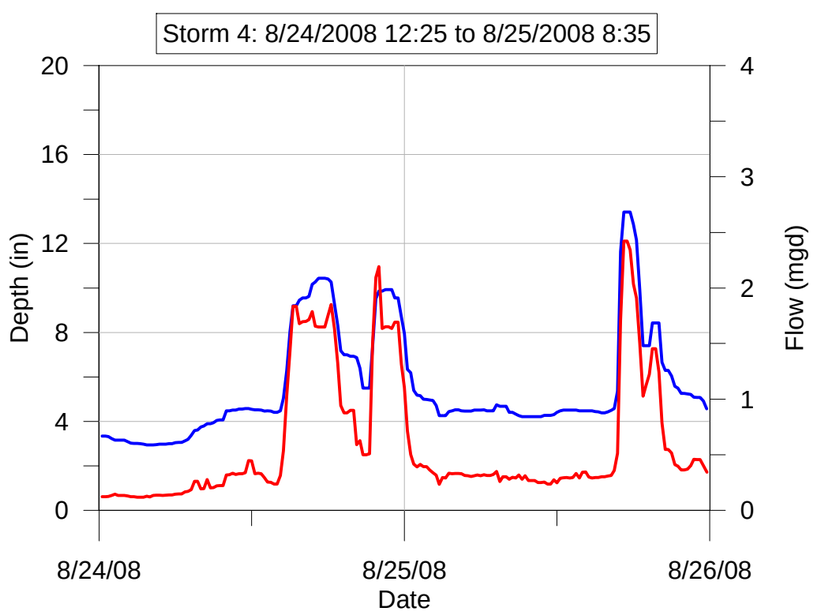


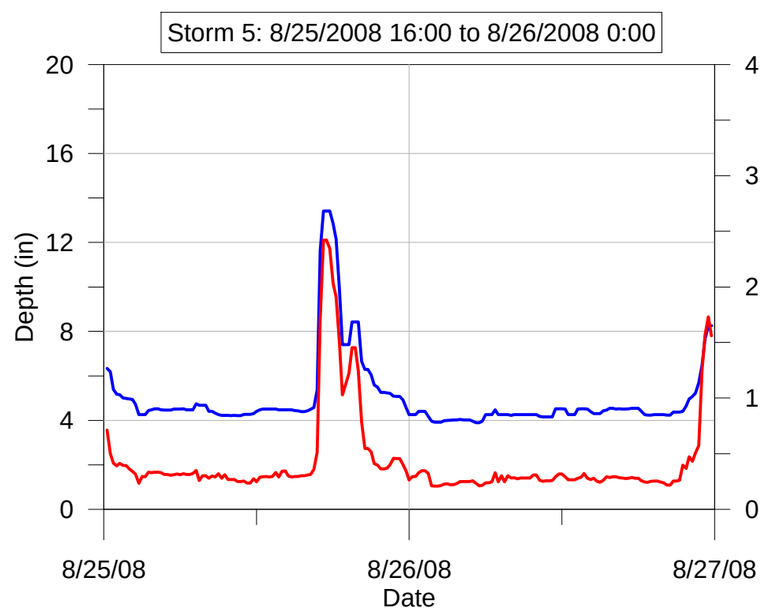
Calibration Storms
Monitor 080-358 (KC)

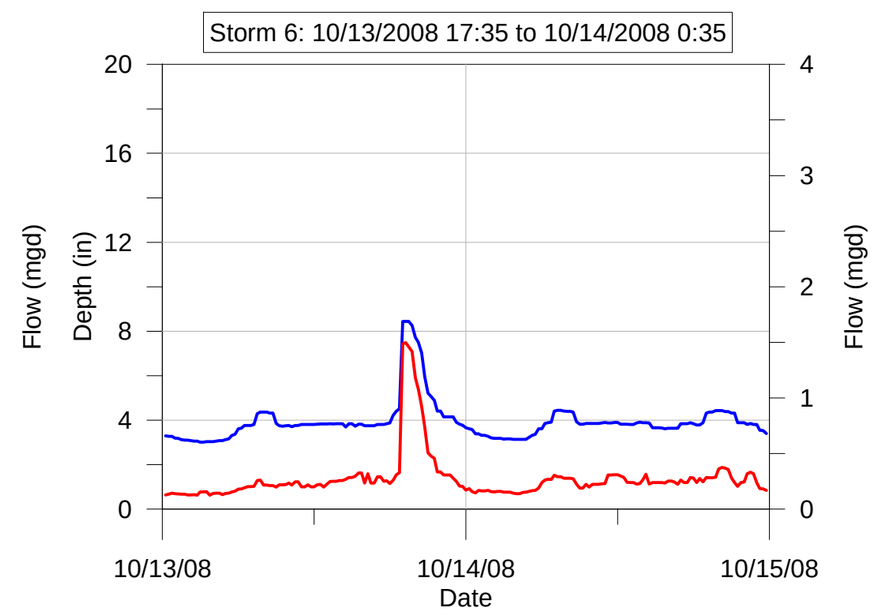




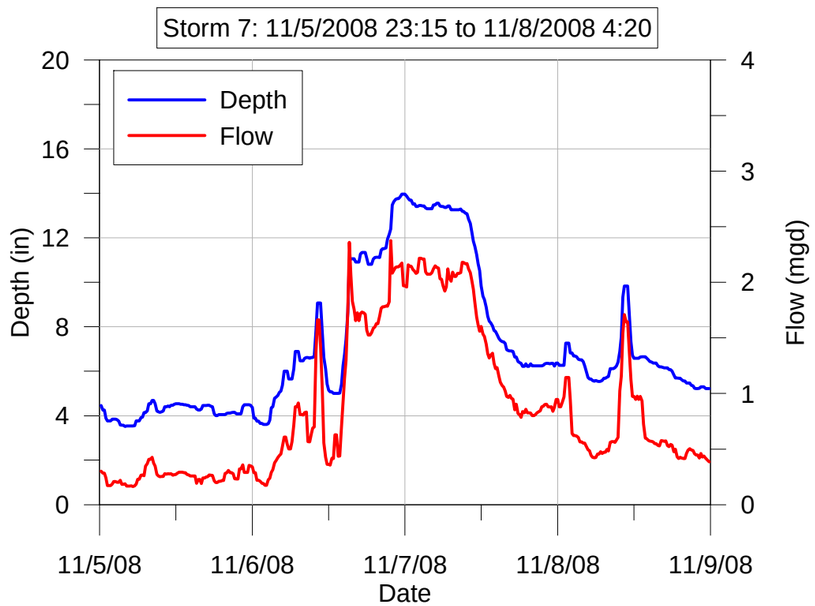


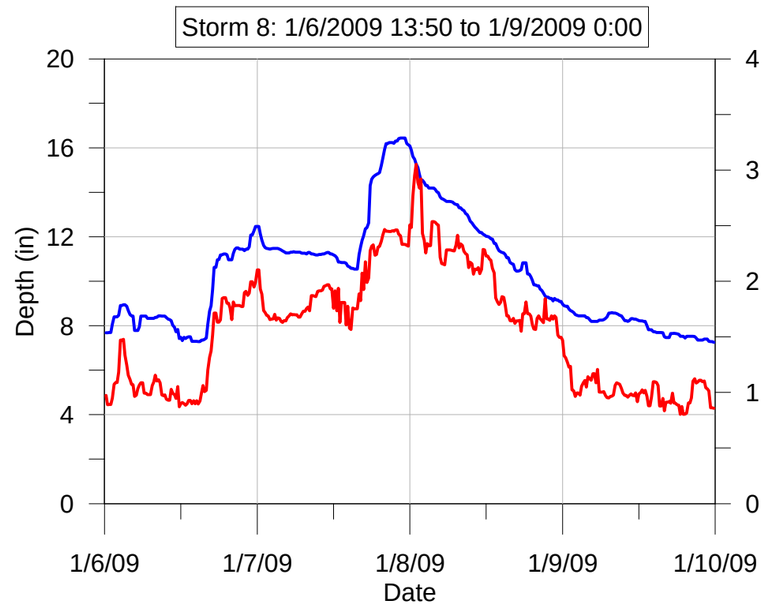


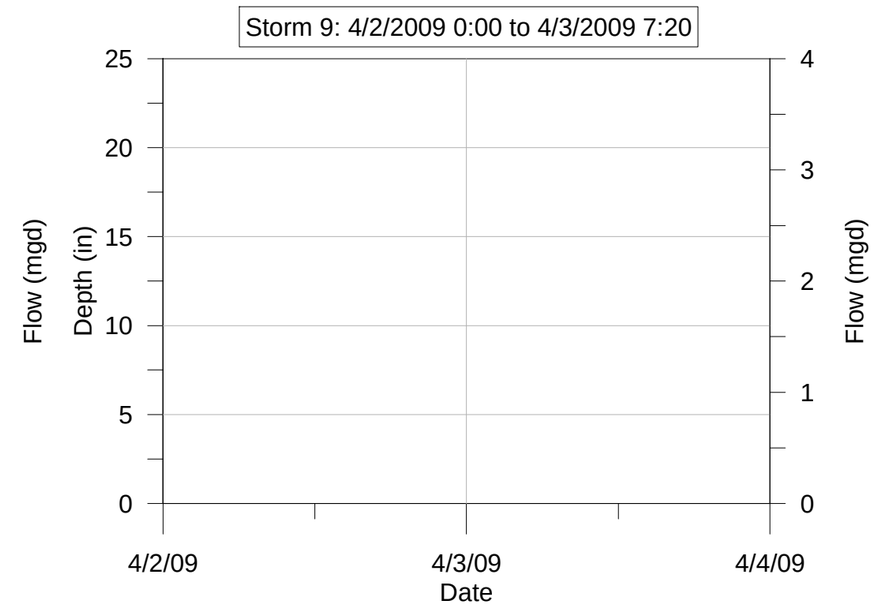


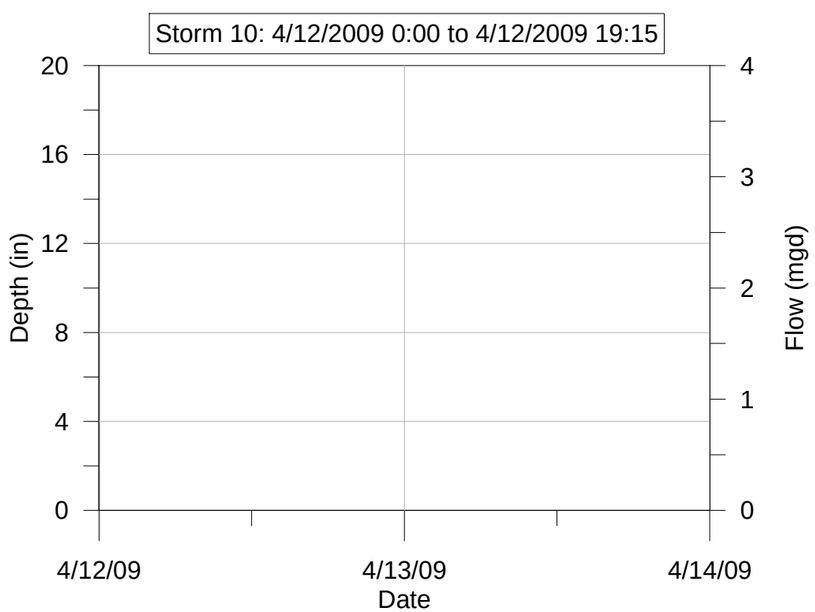


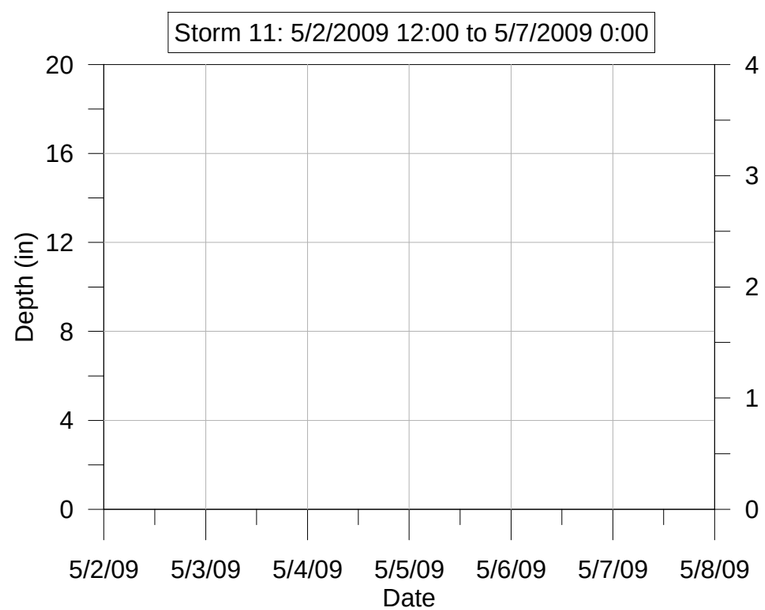
Calibration Storms
Monitor 080-358 (KC)

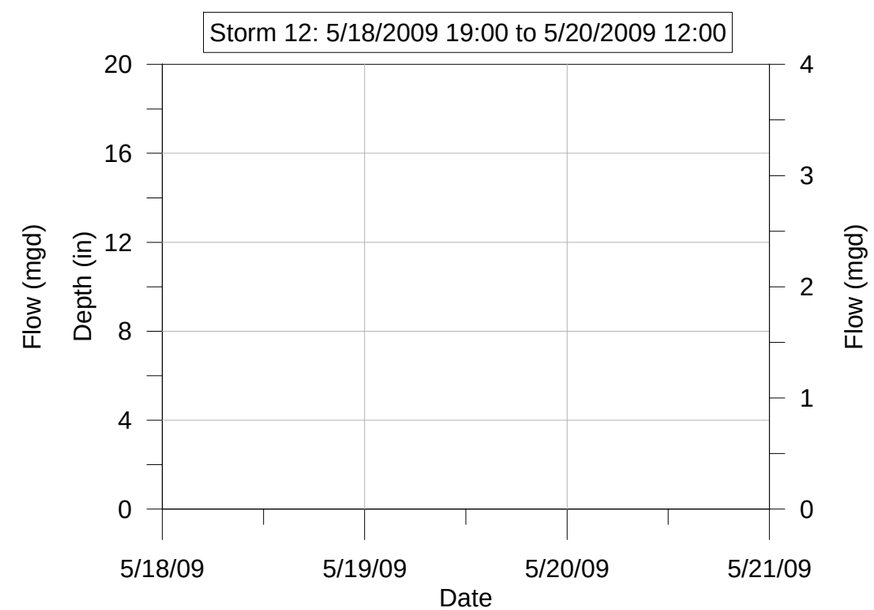




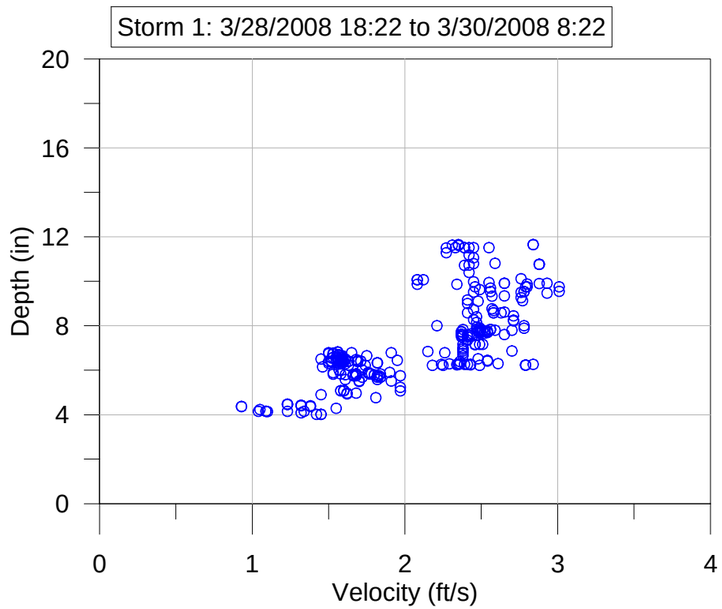


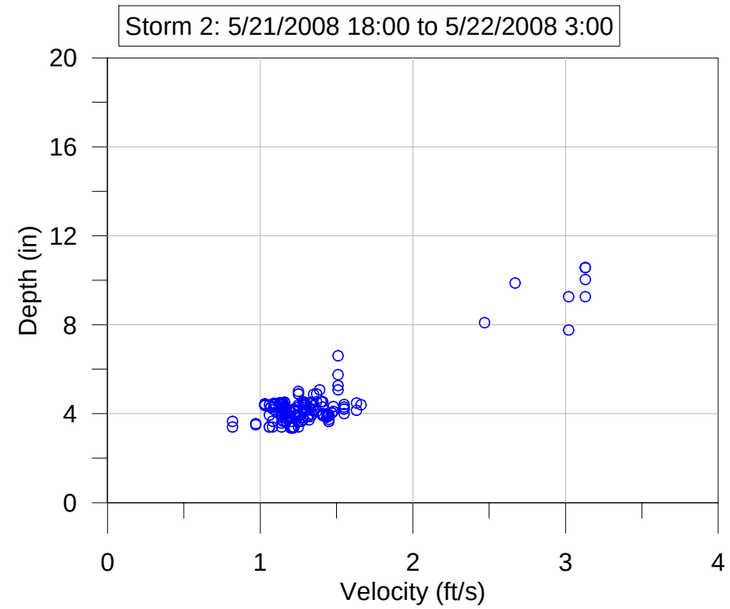


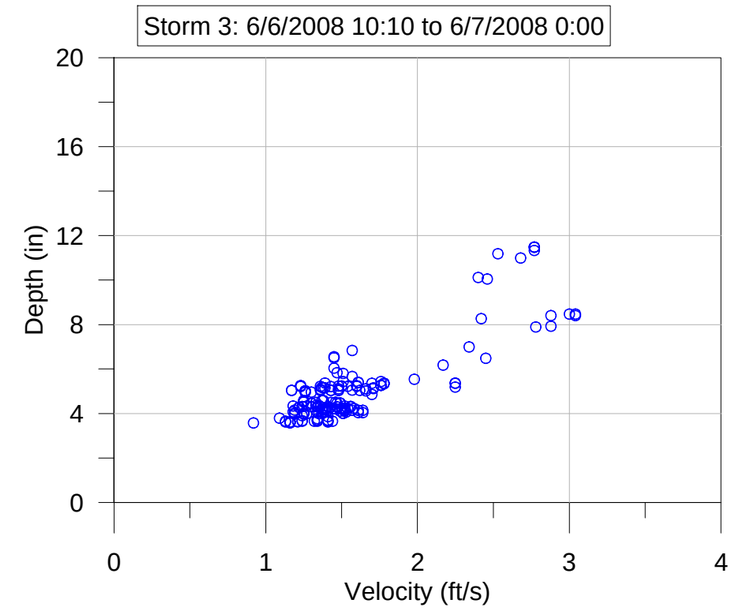


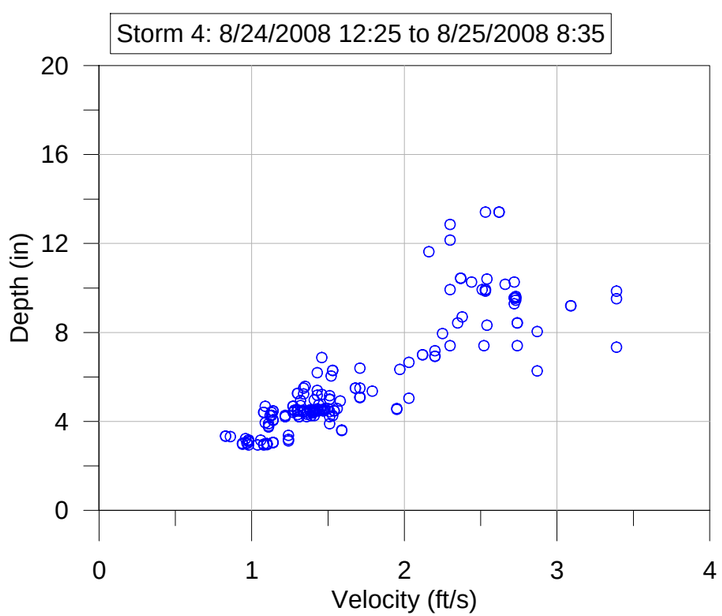


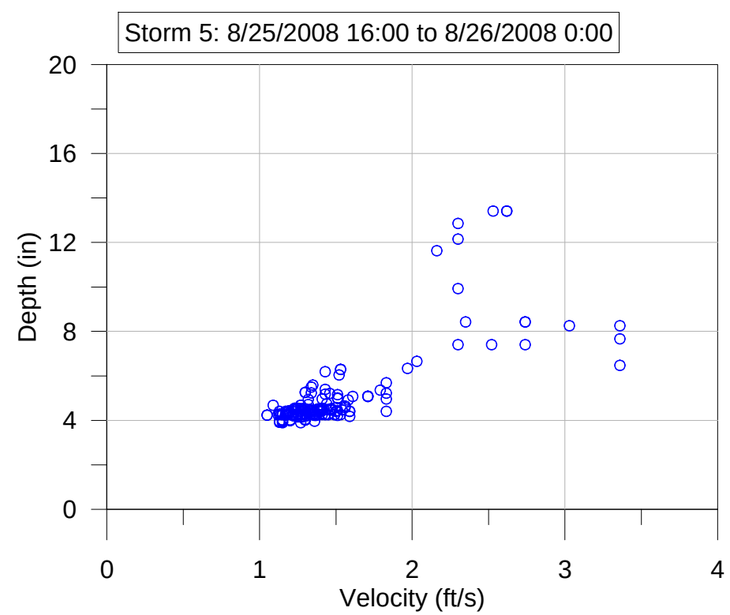
Calibration Storms - Scattergraphs
Monitor 080-358 (KC)

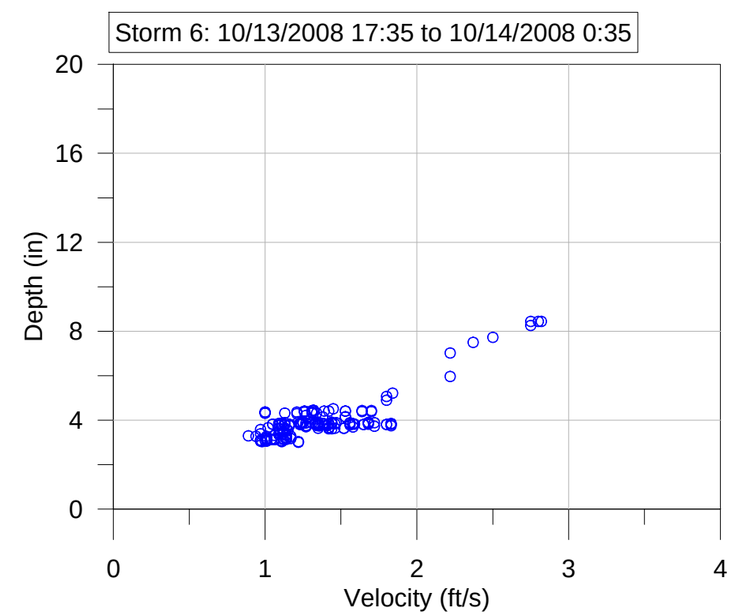




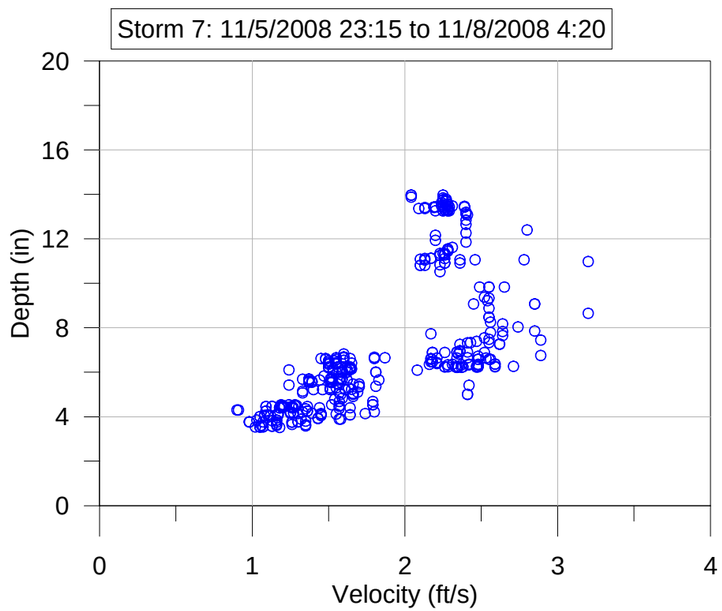


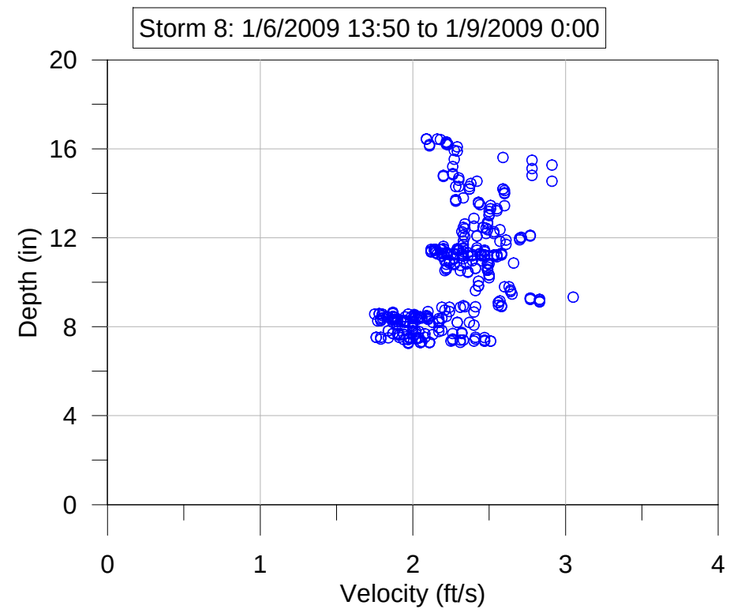


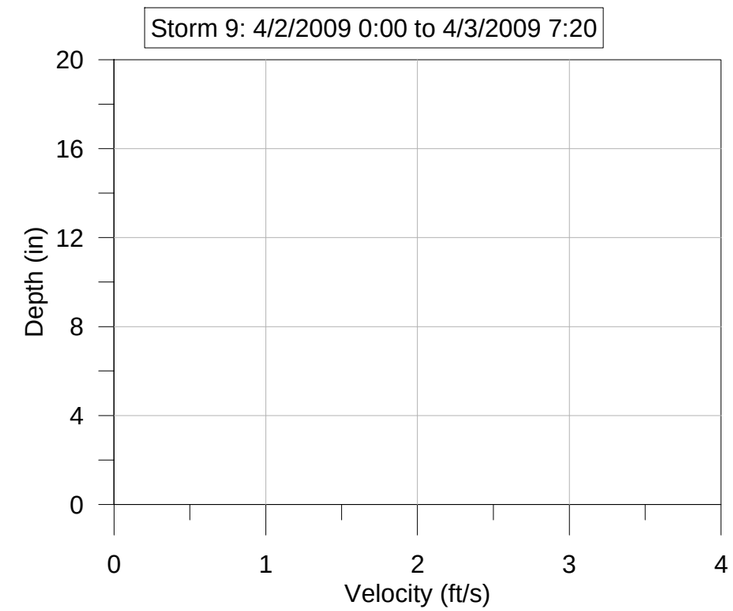


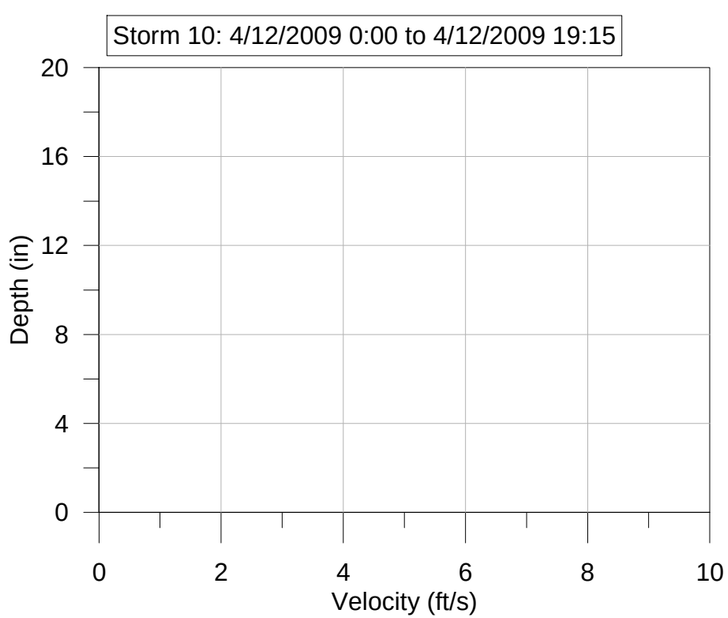


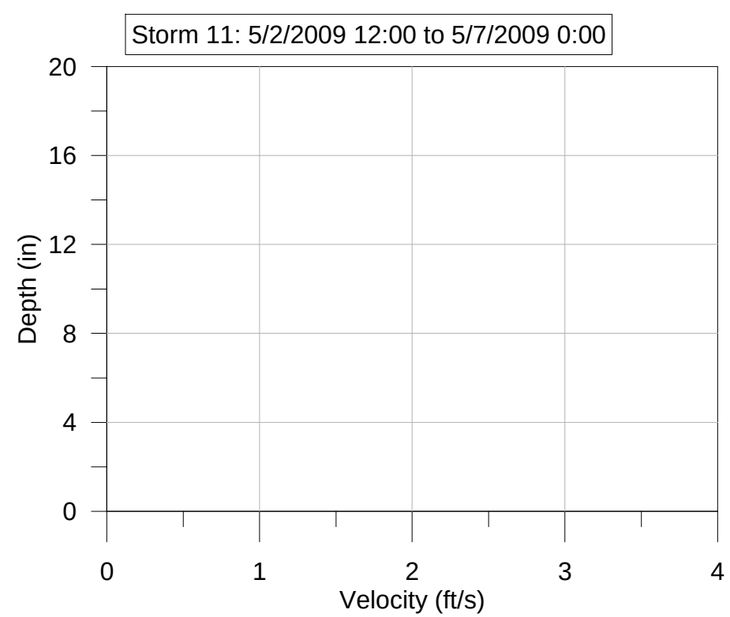
Calibration Storms - Scattergraphs
Monitor 080-358 (KC)

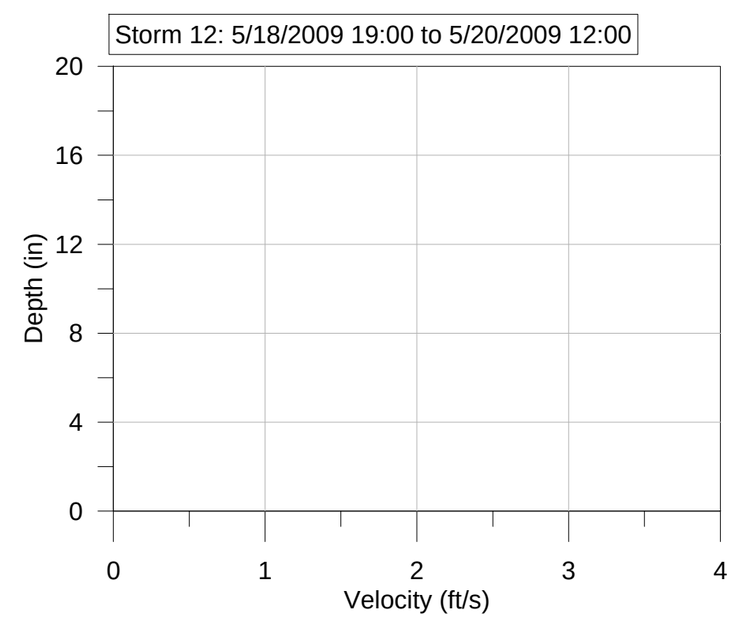




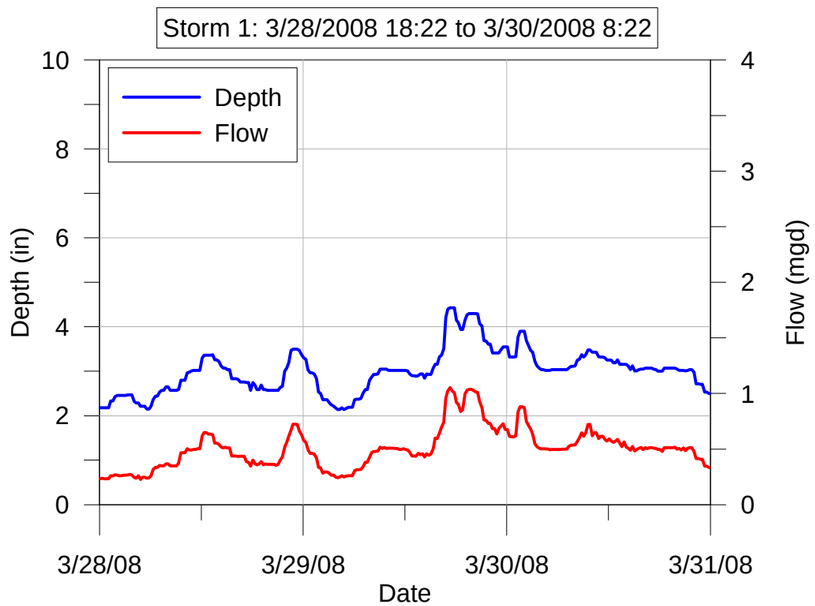


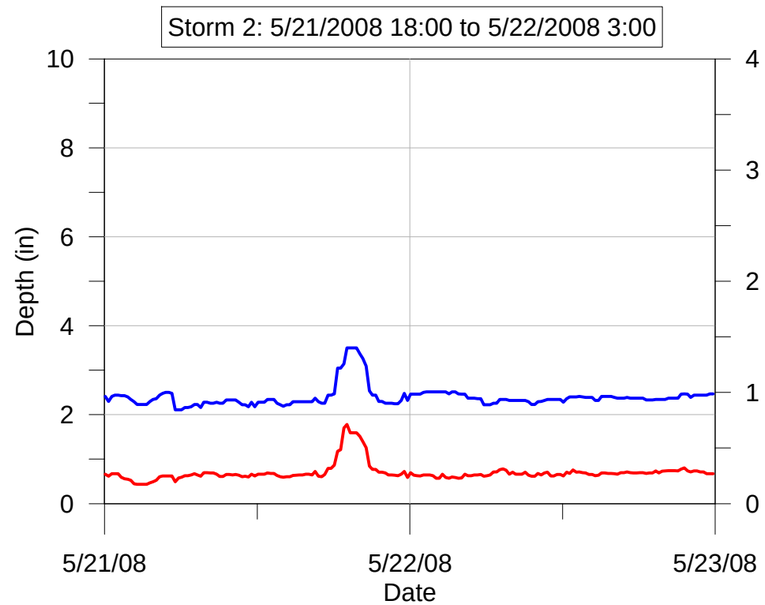


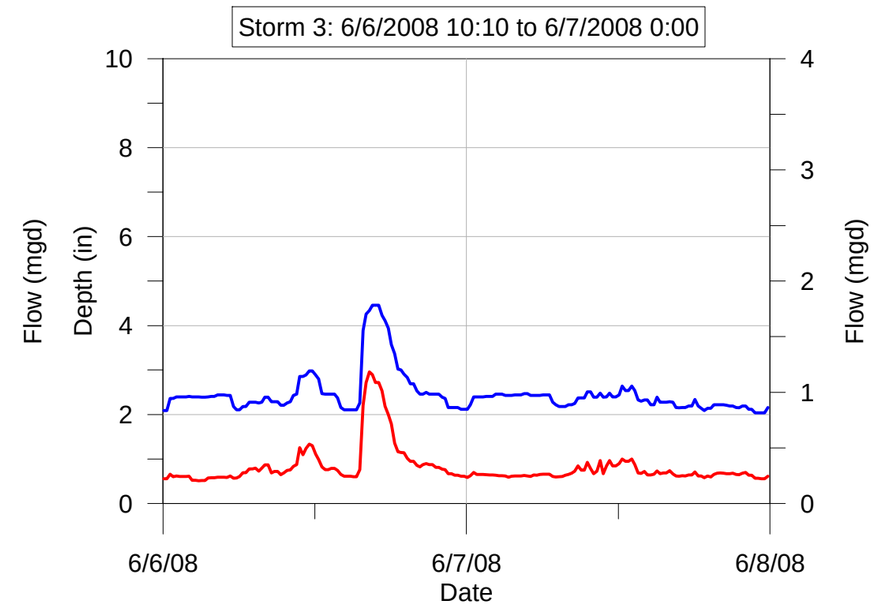


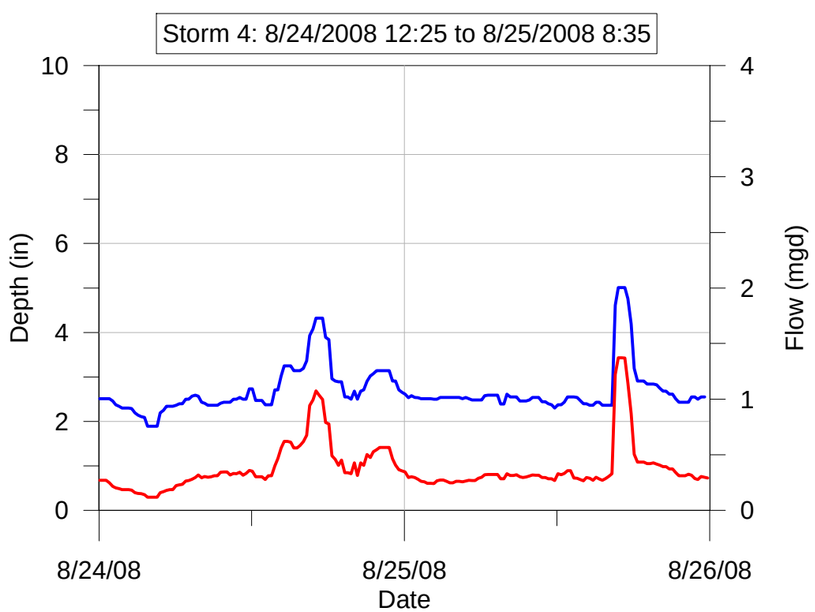


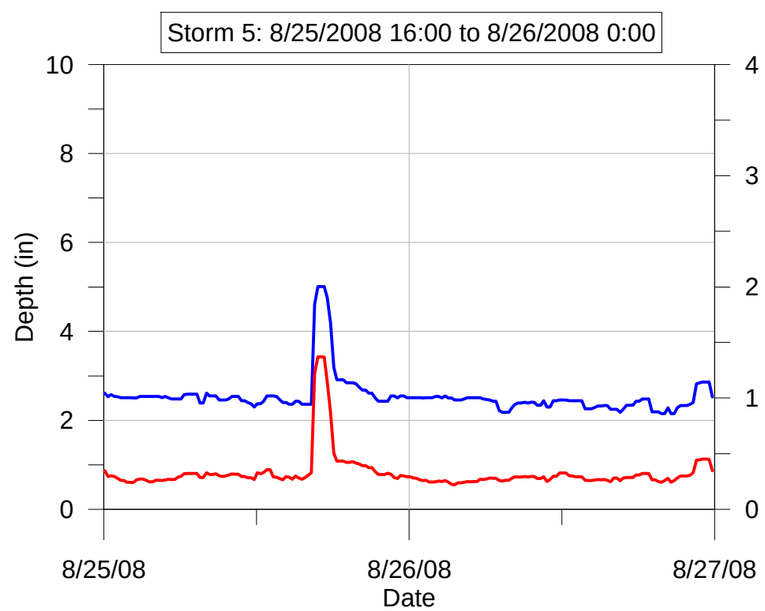
Calibration Storms
Monitor 080-368 (KC)

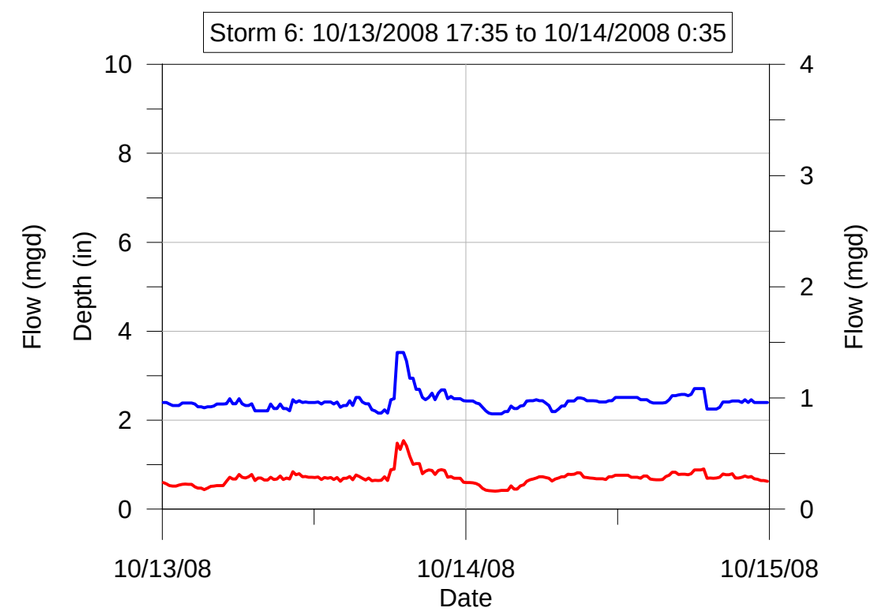




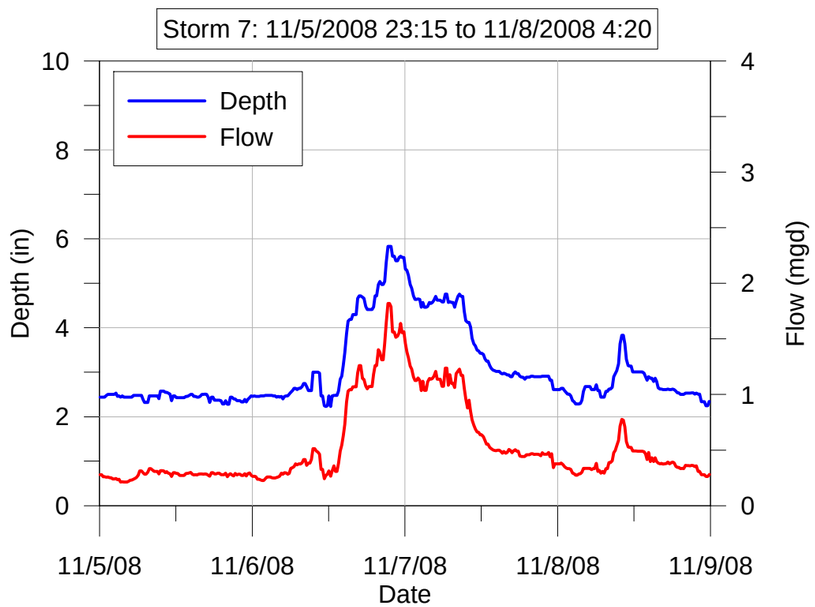


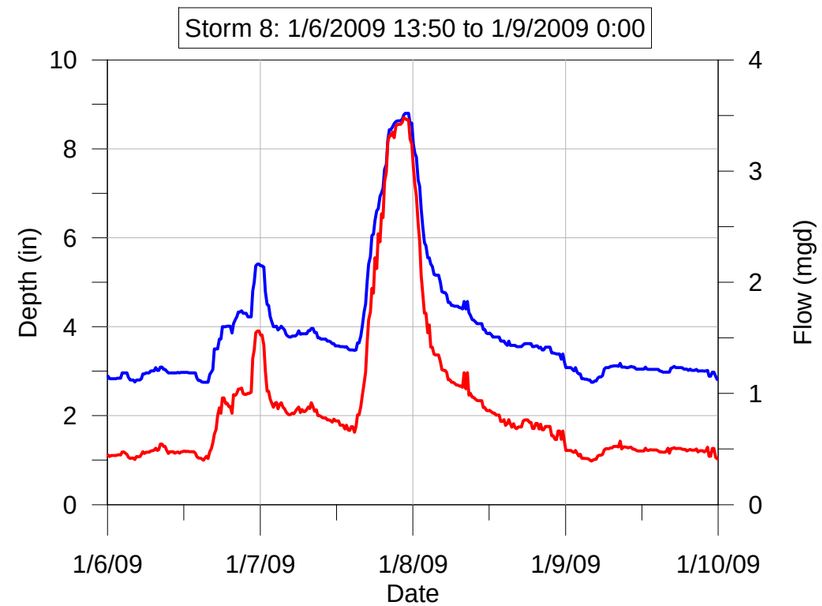


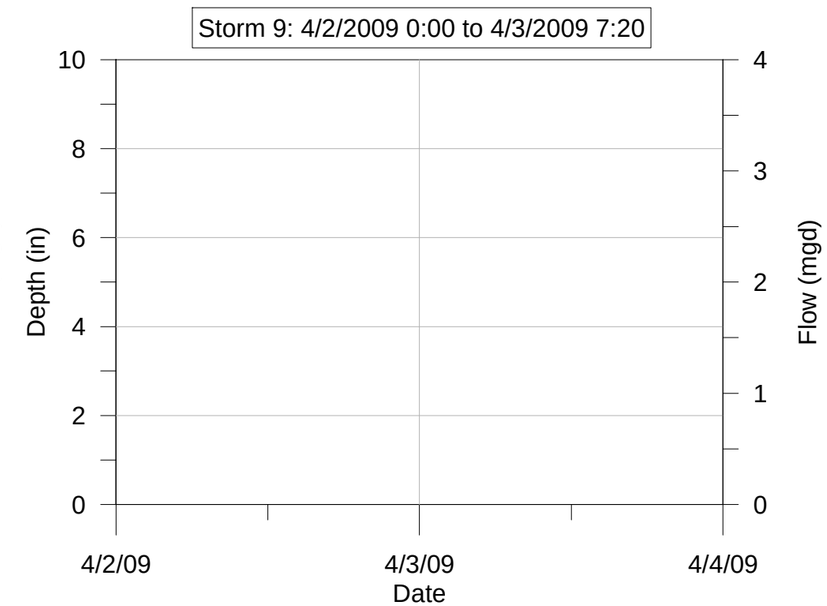


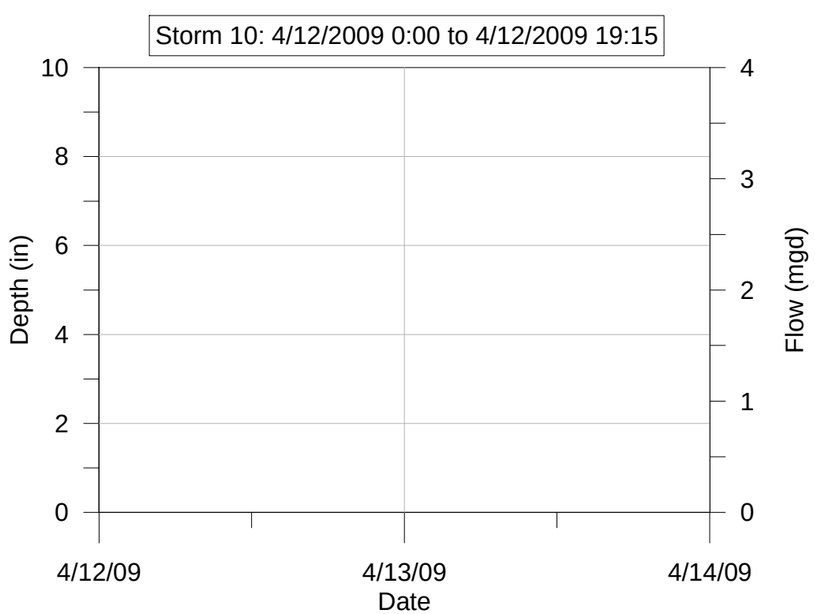


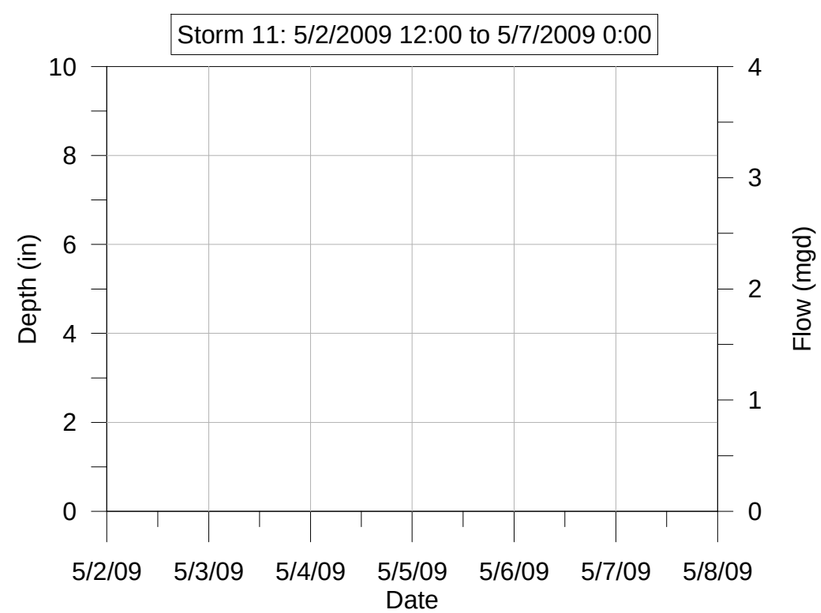
Calibration Storms
Monitor 080-368 (KC)

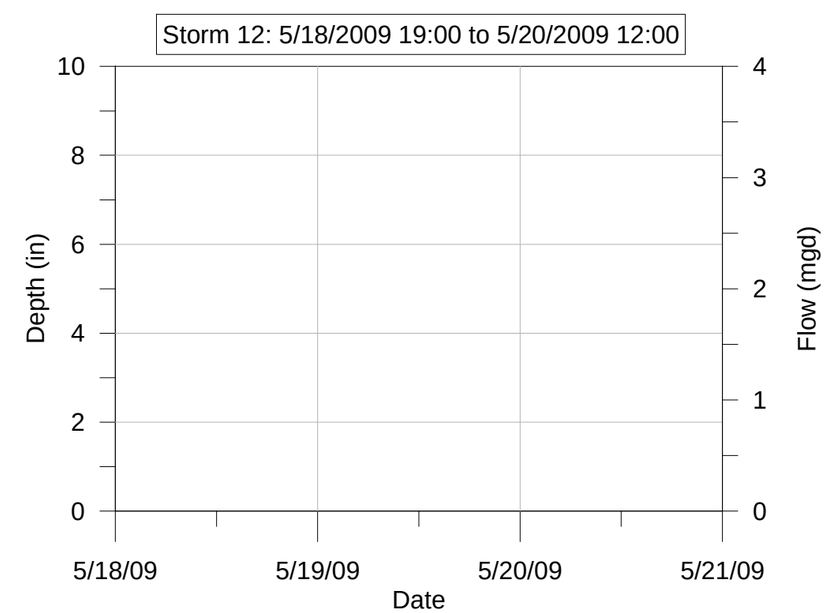




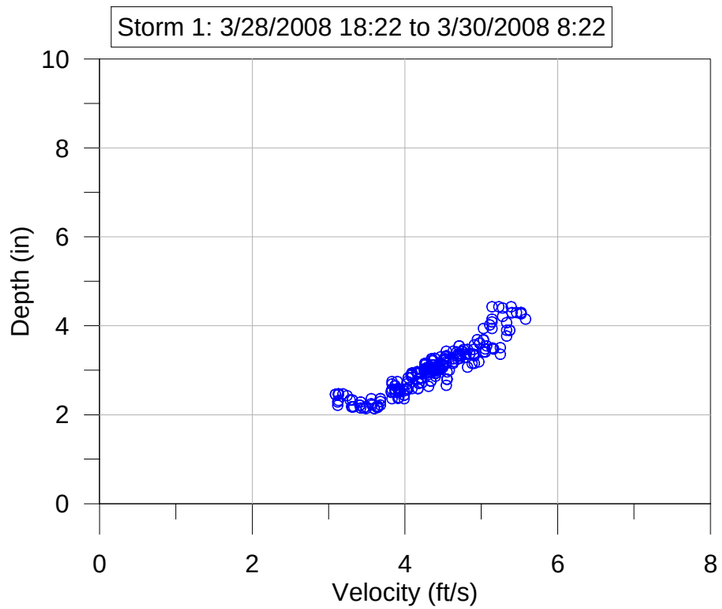


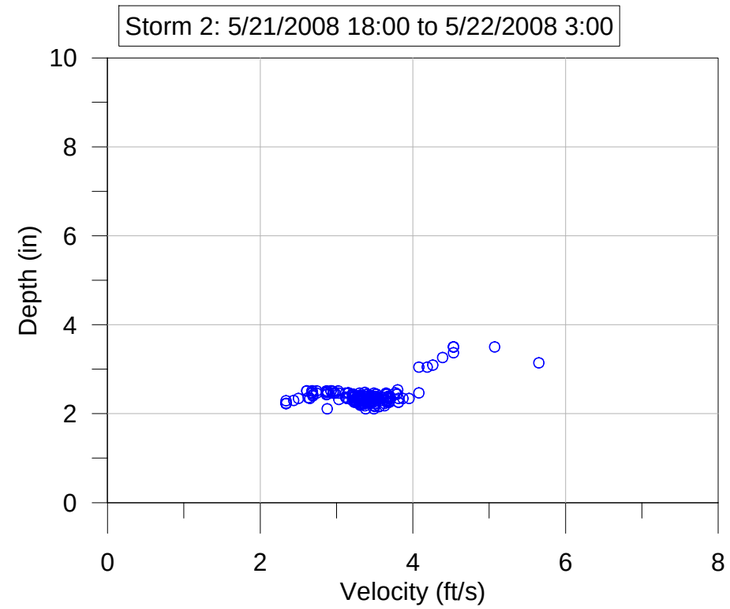


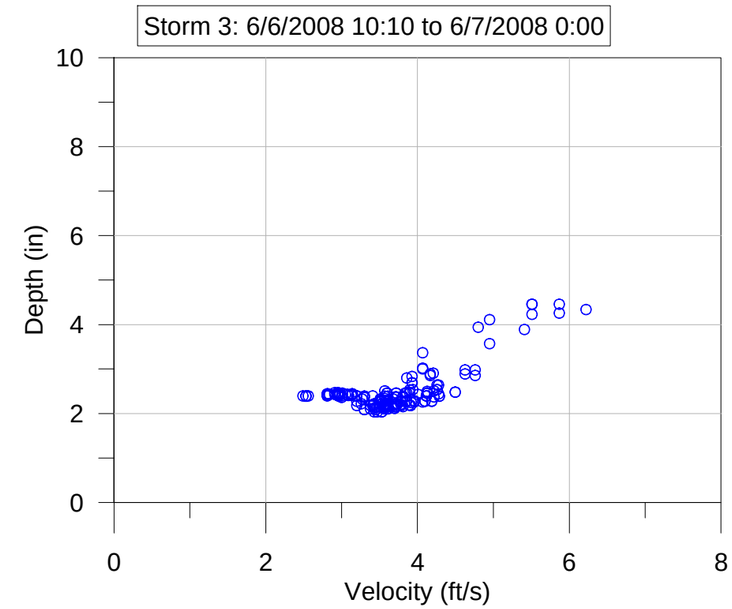


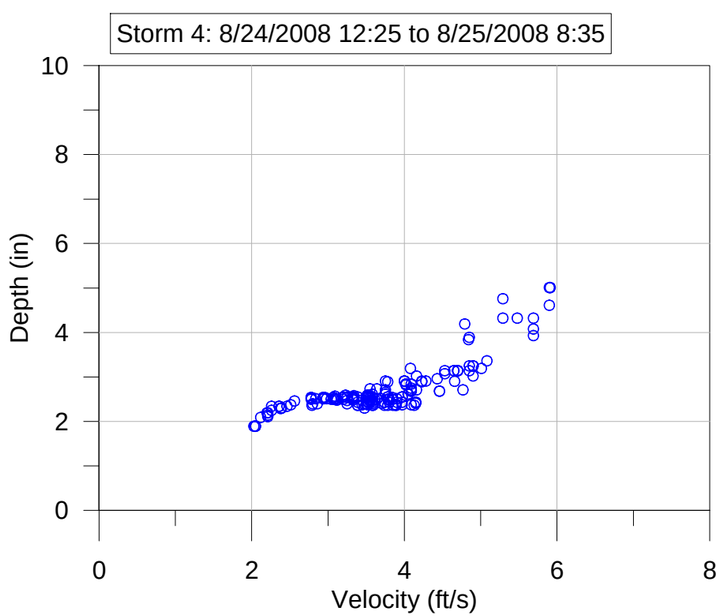


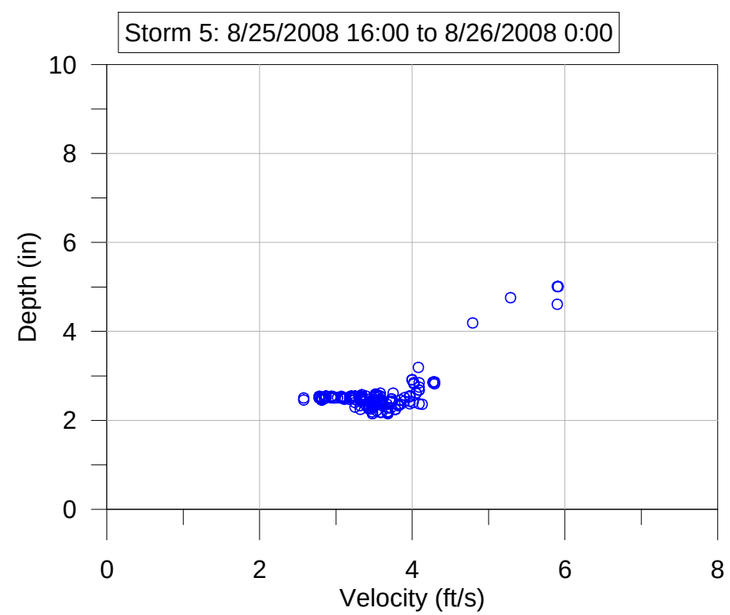
Calibration Storms - Scattergraphs
Monitor 080-368 (KC)

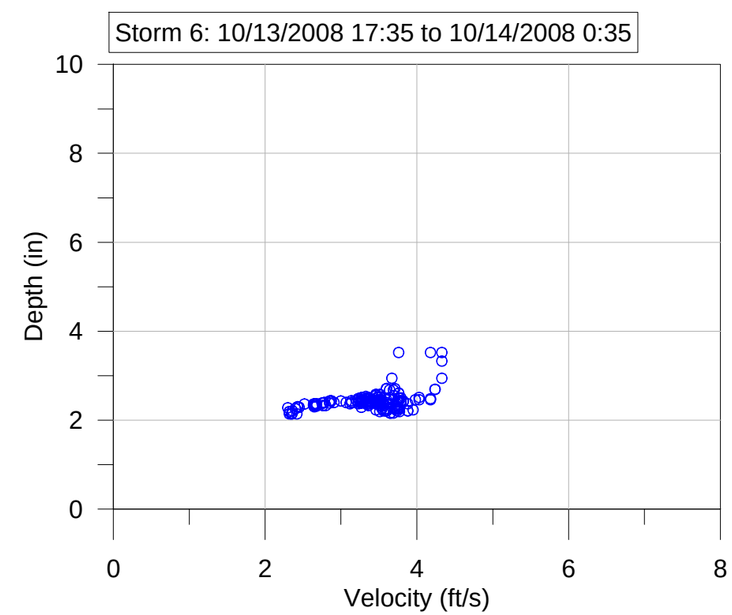




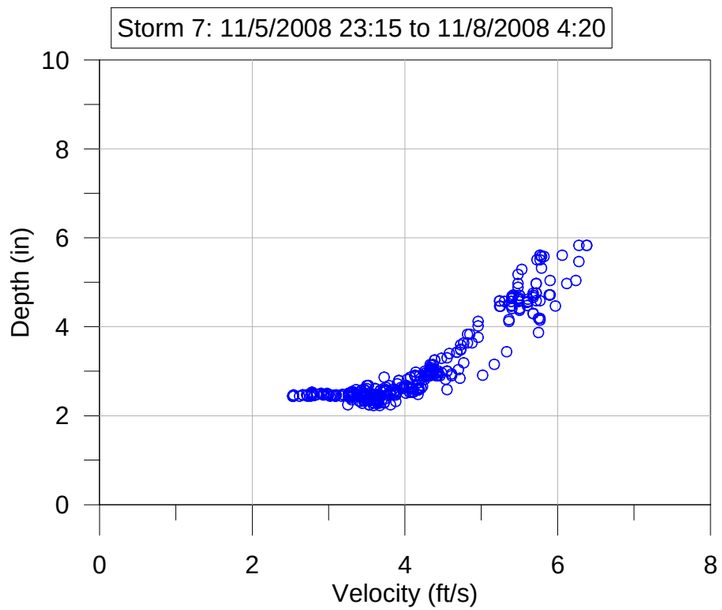


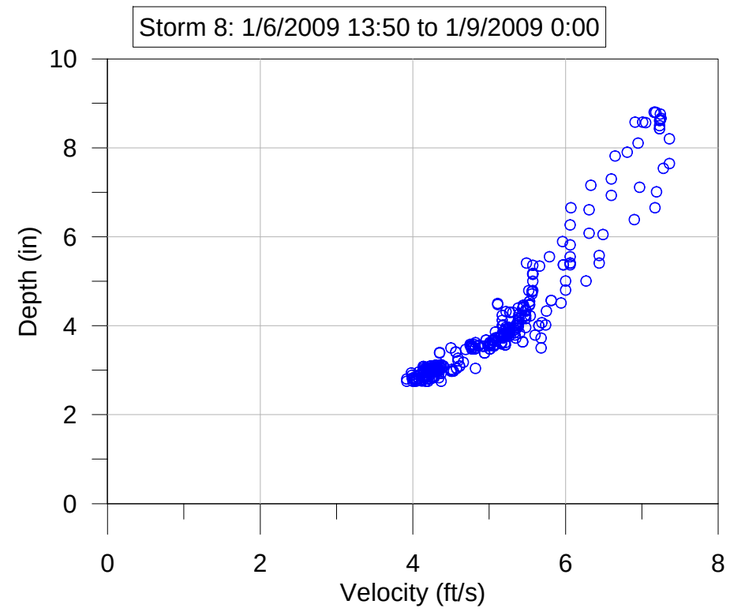


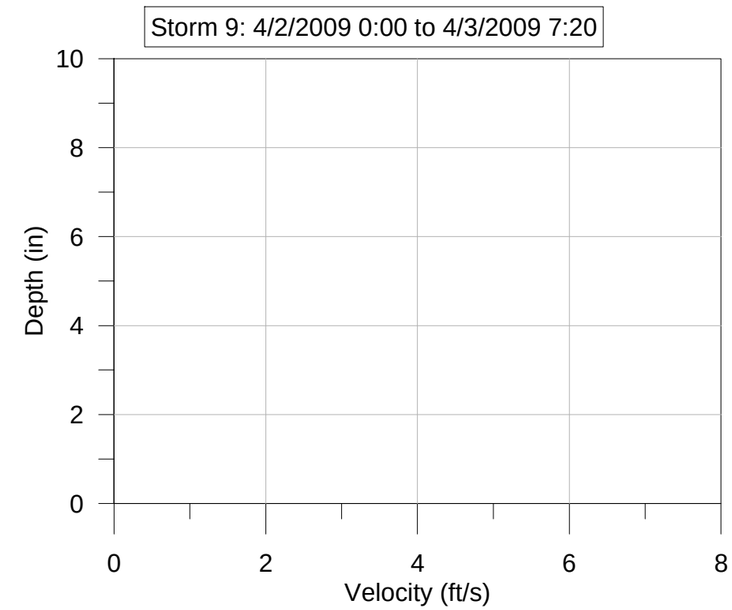


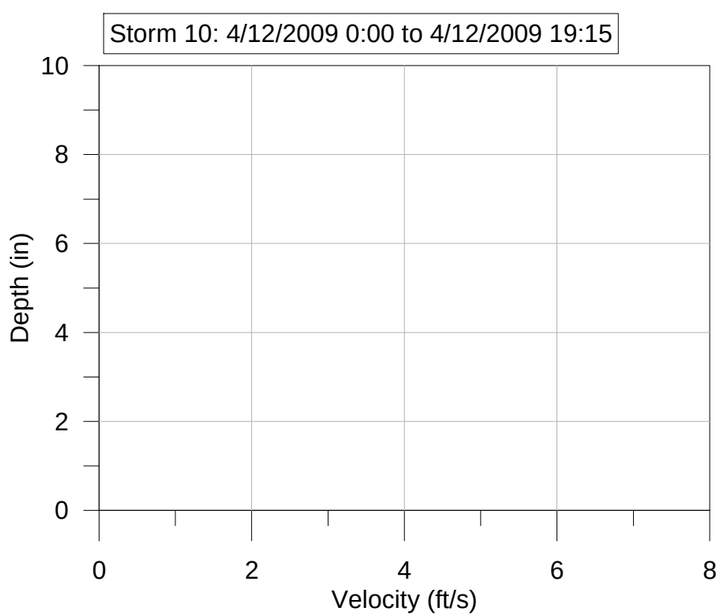


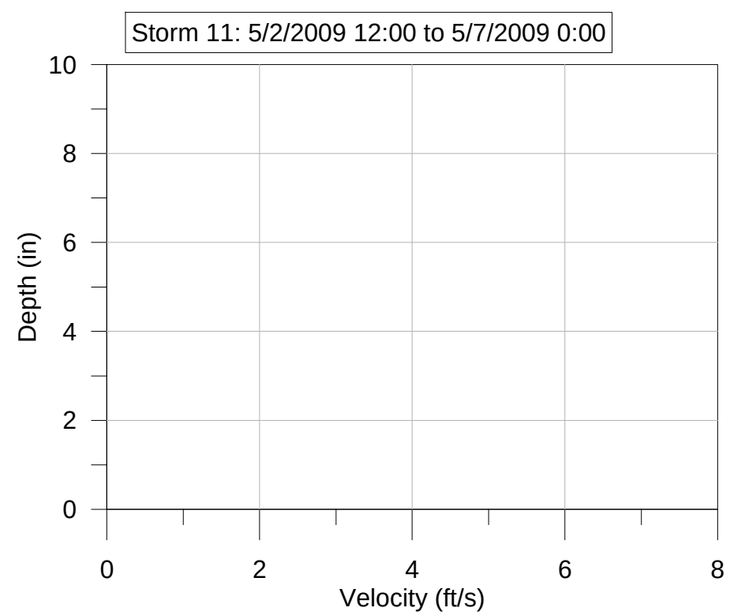
Calibration Storms - Scattergraphs
Monitor 080-368 (KC)

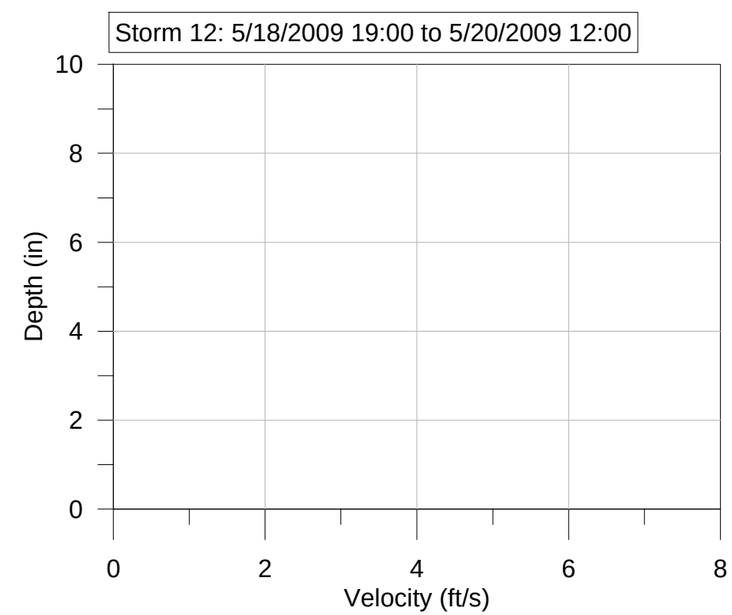












Appendix I
All Monitoring Data
(On CD)