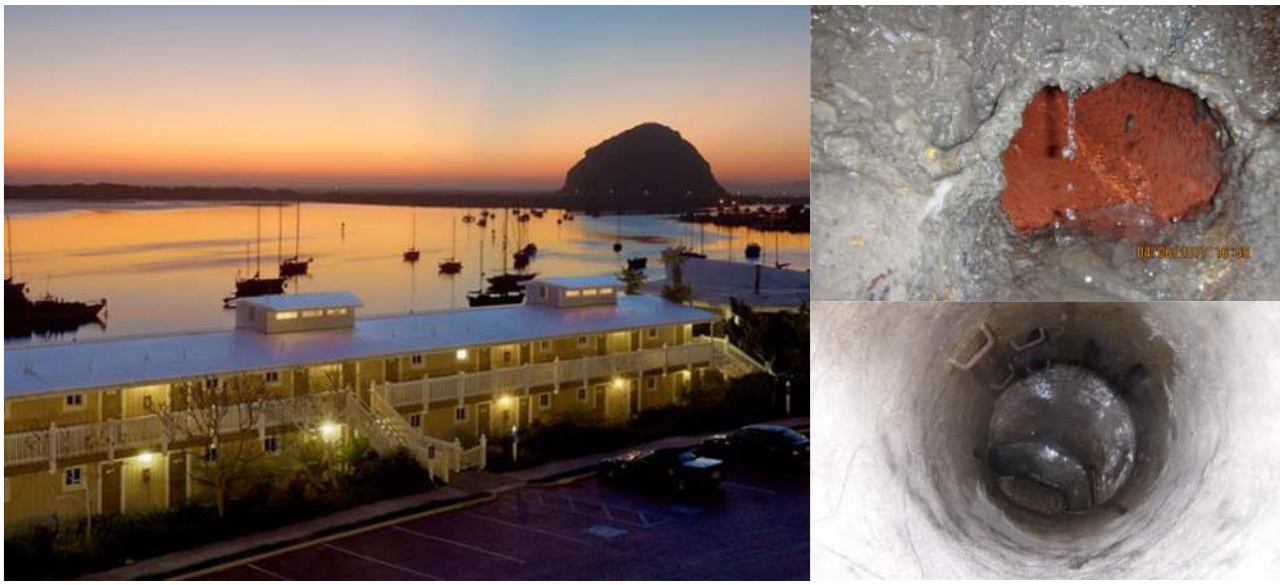
City of Morro Bay

2017 Sewer Flow Monitoring and Inflow/Infiltration Study



Prepared for:

City Of Morro Bay
595 Harbor St.
Morro Bay, CA 93442

Date:

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V&A Project No. 17-0050

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Abbreviations and Acronyms

Abbreviations/Acronyms	Definition
ADWF	Average Dry Weather Flow
AVG	Average
CCTV	Closed-Circuit Television
CDEC	California Data Exchange Center
CIP	Capital Improvement Plan
CO	Carbon Monoxide
CWOP	Citizen Weather Observing Program
DIA.	Diameter
d/D	Depth/Diameter Ratio
FT.	Feet
FM	Flow Monitor
GPD	Gallons per Day
GPM	Gallons per Minute
GWI	Groundwater Infiltration
H2S	Hydrogen Sulfide
IN.	Inch
I/I	Inflow and Infiltration
IDM	Inch-Diameter Mile
IDW	Inverse Distance Weighting
LEL	Lower Explosive Limit
MAX.	Maximum
MGD	Million Gallons per Day
MIN.	Minimum
NOAA	National Oceanic and Atmospheric Administration
N/A	Not applicable
PF	Peaking Factor
PS	Pump Station
Q	Flow Rate
RDI/I	Rainfall-Dependent Infiltration and Inflow
RG	Rain Gauge
SSO	Sanitary Sewer Overflow
V&A	V&A Consulting Engineers, Inc.
WEF	Water Environment Federation
WRCC	Western Regional Climate Center

Terms and Definitions

Term	Definition
Average dry weather flow (ADWF)	Average flow rate or pattern from days without noticeable inflow or infiltration response. ADWF usage patterns for weekdays and weekends differ and must be computed separately. ADWF is expressed as a numeric average and may include the influence of normal groundwater infiltration (not related to a rain event).
Basin	Sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. Also refers to the ground surface area near and enclosed by pipelines. A basin may refer to the entire collection system upstream from a flow meter or exclude separately monitored basins upstream.
Depth/diameter (*d/D*) ratio	Depth of water in a pipe as a fraction of the pipe's diameter. A measure of fullness of the pipe used in capacity analysis.
Design storm	A theoretical storm event of a given duration and intensity that aligns with historical frequency records of rainfall events. For example, a 10-year, 24-hour design storm is a storm event wherein the volume of rain that falls in a 24-hour period would historically occur once every 10 years. Design storm events are used to predict I/I response and are useful for modeling how a collection system will react to a given set of storm event scenarios.
Infiltration and inflow	Infiltration and inflow (I/I) rates are calculated by subtracting the ADWF flow curve from the instantaneous flow measurements taken during and after a storm event. Flow in excess of the baseline consists of inflow, rainfall-responsive infiltration, and rainfall-dependent infiltration. **Total I/I** is the total sum in gallons of additional flow attributable to a storm event.
Infiltration, *groundwater*	Groundwater infiltration (**GWI**) is groundwater that enters the collection system through pipe defects. GWI depends on the depth of the groundwater table above the pipelines as well as the percentage of the system that is submerged. The variation of groundwater levels and subsequent groundwater infiltration rates is seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
Infiltration, *rainfall-dependent*	Rainfall-dependent infiltration (**RDI**) is similar to groundwater infiltration but occurs as a result of storm water. The storm water percolates into the soil, submerges more of the pipe system, and enters through pipe defects. RDI is the slowest component of storm-related infiltration and inflow, beginning gradually and often lasting 24 hours or longer. The response time depends on the soil permeability and saturation levels.
Inflow	**Inflow** is defined as water discharged into the sewer system, including private sewer laterals, from **direct** connections such as downspouts, yard and area drains, holes in manhole covers, cross-connections from storm drains, or catch basins. Inflow creates a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows. Overflows are often attributable to high inflow rates.
Peaking factor (PF)	PF is the ratio of peak measured flow to average dry weather flow. This ratio expresses the degree of fluctuation in flow rate over the monitoring period and is used in capacity analysis.
Surcharge	When the flow level is higher than the crown of the pipe, then the pipeline is said to be in a **surcharged** condition. The pipeline is surcharged when the *d/D* ratio is greater than 1.0.
Synthetic hydrograph	A set of algorithms has been developed to approximate the actual I/I hydrograph. The synthetic hydrograph is developed strictly using rainfall data and response parameters representing response time, recession coefficient and soil saturation.

Executive Summary

Scope and Purpose

V&A Consulting Engineers (V&A) has completed sanitary sewer flow monitoring within the City of Morro Bay, CA (City). Flow monitoring was performed over several periods from April 7, 2017 to July 13, 2017 at 15 open-channel flow monitoring sites. V&A was also provided data from four City-owned flow meters and the City's influent flume in order to provide more information about wet weather flows. The dates of the data provided was from November 7, 2016 through July 18, 2017 for the flume and January 3, 2017 through February 27, 2017 for the City-owned meters. There were four general purposes of this overall project.

1. Establish the baseline sanitary flows at the flow monitoring sites during two distinct periods with different flow regimes
    a. Non-holiday periods: from April 7, 2017 to July 11, 2017, excluding the Memorial Day weekend (May 27 – 29, 2017) and the week of the Fourth of July holiday (July 1 - 9, 2017).
    b. Holiday periods: during the two peak periods, May 27 – 29, 2017 and July 1 - 9, 2017, that see a heavy tourist presence and its influence on the sanitary flows.
2. Establish the peak flow condition during the rainfall events
3. Quantify inflow/infiltration (I/I) at the applicable flow monitoring sites.
4. Assess and calibrate the City's influent flume. The results of this work will be presented in a separate technical memorandum.

Rainfall Monitoring

There were a series of rainfall events that occurred from January 2017 through February 2017, of which five rainfall events were defined. Rainfall Event 1 from January 7, 2017 through January 12, 2017 was one of the largest rainfall events. This event was classified as a 12-year, 6-Hour rainfall event at one of the rain gauges used for analysis. This rainfall event, as well as several others, was of sufficient strength to elicit an I/I response from the installed City-owned flow monitoring sites that was suitable for I/I analysis.

There was not sufficient rainfall during the V&A flow monitoring period to elicit an analyzable I/I response. All I/I analysis within this study was based on data from the four City-owned flow meters and the City's influent flume.

Site Flow Monitoring and Capacity Results

Peak measured flows and the corresponding flow levels (depths) are important to understand the capacity limitations of a collection system. The peak flows and flow levels reported are from the peak measurements as taken across the entirety of the flow monitoring period. Peak flows and levels may not correspond to a rainfall event.

The following capacity analyses terms are defined as follows:

- **d/D Ratio:** The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study.
- **Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the ADWF. Peaking factors are influenced by many factors including size and topography of tributary area and the amount and characteristics of I/I entering the collection system. Flow attenuation and flow restrictions will also affect the peaking factor.

Table ES-1 summarizes the flow monitoring and capacity results for the flow monitoring sites. V&A flow monitoring sites are named "Site #" and the City's flow monitoring sites are named "MB #" in the report. Figure ES-1 and Figure ES-2 show the peak flow schematic for the V&A and City meters. Results of note have been shaded in RED. Capacity analysis data is presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ.

Table ES-1. Capacity Analysis Summary

Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Diameter (in)	Peak Level (in)	*d/D* Ratio	Level Surcharged above Crown (ft)	
Site 1	0.18	0.48	2.6	11.75	5.6	0.48	--	April 7 – July 11, 2017
Site 2	0.03	0.08	3.1	8	2.5	0.32	--	
Site 3	0.29	0.89	3.0	15	7.4	0.49	--	
Site 4	0.22	0.58	2.6	17.5	8.4	0.48	--	
Site 5	0.09	0.28	3.1	8	2.5	0.32	--	
Site 6	0.11	0.35	3.1	13	4.1	0.32	--	
Site 7	0.04	0.16	4.1	9.75	3.5	0.36	--	
Site 8	0.07	0.21	3.1	13	7.3	0.56	--	
Site 9	0.02	0.10	4.8	12	3.8	0.32	--	
Site 10	0.07	0.32	4.7	8	4.6	0.57	--	
Site 11	0.06	0.25	3.9	8	3.6	0.46	--	
Site 12	0.13	0.38	3.0	14.375	7.7	0.54	--	
Site 13	0.09	0.31	3.3	15.5	7.0	0.45	--	
Site 14	0.09	0.32	3.5	10	2.5	0.25	--	
Site 15	0.05	0.21	4.6	10	3.5	0.35	--	
MB 1	0.17	0.93	5.6	12	14.0	1.17	0.17	Jan 3 – Feb 27, 2017
MB 2	0.03	0.17	5.9	6	2.5	0.41	--	
MB 3	0.30	2.54	8.6	15	23.6	1.57	0.70	
MB 4	0.22	1.02	4.6	18	6.1	0.34	--	
Morro Bay Flume	0.92	10.08	11.0	27	N/A	N/A	N/A	Nov 7, 2016 – Jul 17, 2017

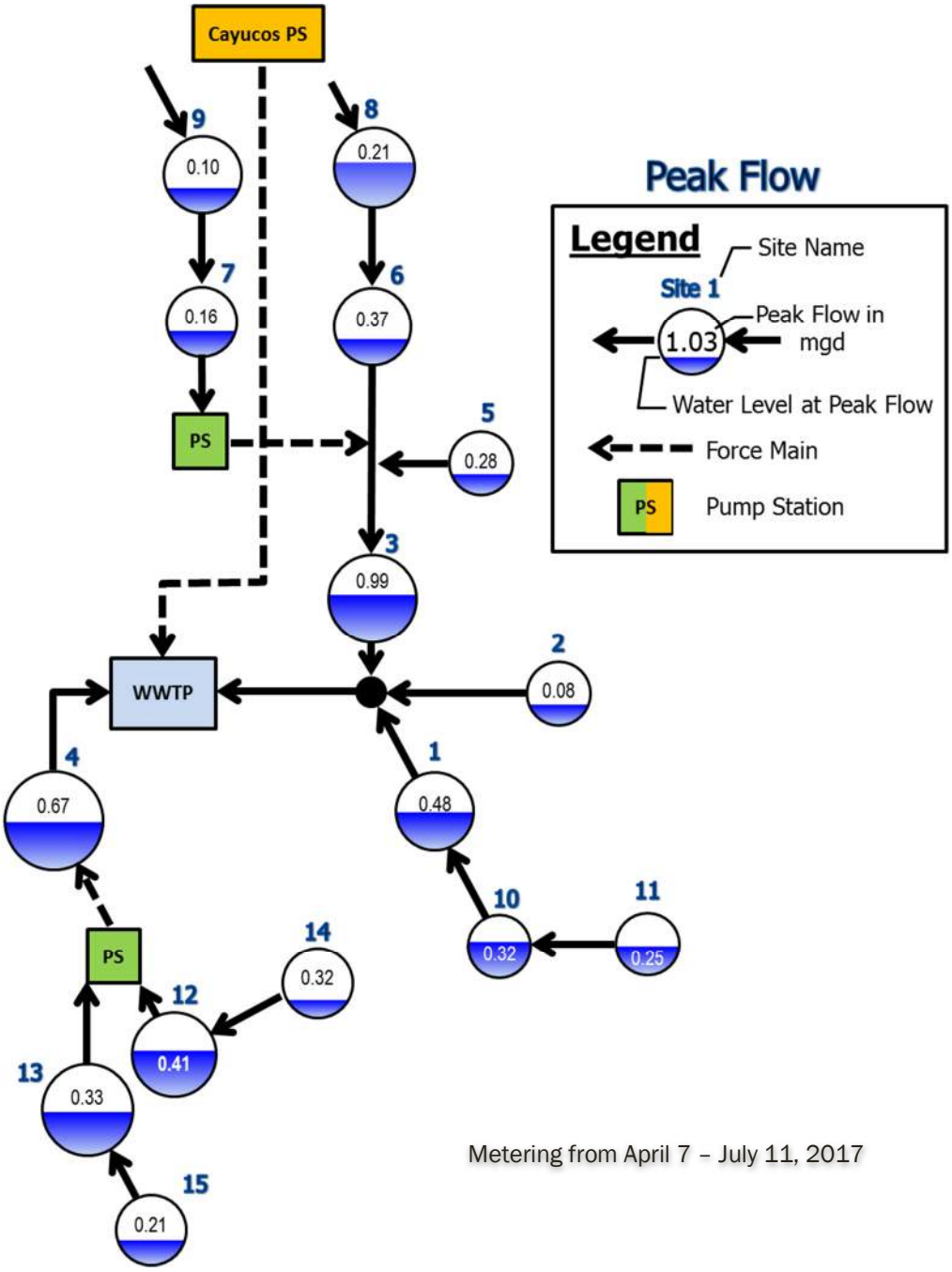


Figure ES-1. Peak Flow Schematic – V&A Sites

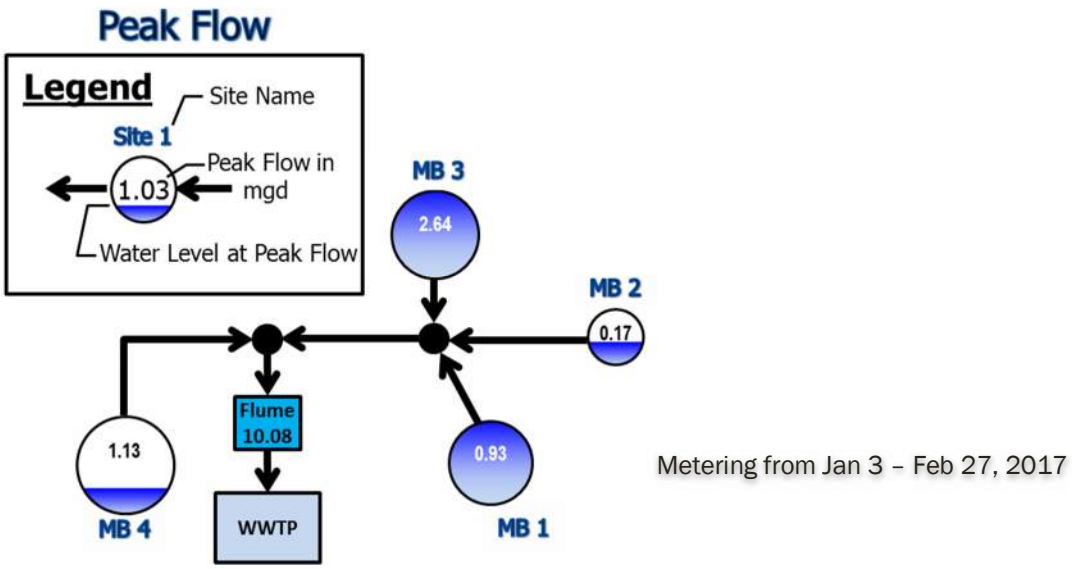


Figure ES-2. Peak Flow Schematic – Morro Bay Sites

The following capacity analysis results are noted:

- **Peaking Factor:** Only three sites, sites MB 1, MB 2 and MB 3, as well as the Morro Bay Influent Flume had peaking factors that exceeded 5. It should be noted that the City-owned sites were installed during the bulk of the rainfall season, while the V&A sites were installed afterwards.
- **d/D Ratio:** Only two of the nineteen flow monitoring sites, MB 1 and MB 3, had d/D ratios that were above the common threshold value of 0.75 d/D. These two sites reached a surcharge condition during the study, also during peak rainfall events.
- **Flume**: The Morro Bay 27-inch Palmer Bowlus Flume had a peak measured flow of 10.08 mgd. The manufacturer American Sigma's drawing states a 10.24 mgd maximum flow and 1.76 maximum head. As a result, the peak measured flow is at 98% capacity.

Infiltration and Inflow Analysis

The I/I results of this study are based on the data of the four City-owned flow meters that were installed during the bulk of the rainfall season. I/I analysis on the flume was not performed as there is no substantive basin that could be isolated. The flume's reaction to the rainfall events is included in Appendix A. Table ES-2 summarizes the I/I results for all basins in the study.

Results of note have been shaded in RED. Please refer to the *I/I Methods* section for more information on inflow and infiltration analysis methods.

Table ES-2. I/I Analysis Summary

Metering Basin	ADWF (mgd)	Peak I/I per ADWF [A]	RDI per ADWF [B]	Total I/I per ADWF (per in-Rain) [C]	Suggestion of GWI?
MB 1	0.17	4.07	75%	2.87	
MB 2	0.03	4.87	79%	2.90	
MB 3	0.30	7.27	87%	4.09	Yes
MB 4	0.22	3.12	10%	0.36	

[A] Event 1, [B] Event 4, [C] Events 1-5 (January 3 – February 27, 2017)

The following inflow/infiltration analysis results are noted:

- **Inflow:** Basin 3 had the highest normalized inflow contribution. Basins 1 and 2 also had elevated levels of inflow.
- **RDI:** Basin 3 had the highest normalized rain-dependent infiltration contribution. Basins 1 and 2 also had elevated levels of RDI.
- **GWI:** Of the Morro Bay owned meters, only MB 3 showed evidence of GWI contribution.

Recommendations

V&A advises that future I/I reduction plans consider the following recommendations:

1. **Determine I/I Reduction Program:** The City should examine its I/I reduction needs to determine their needs and goals for a future I/I reduction program.
   a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the higher inflow/ADWF ratios.
   b. If infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the higher RDI/ADWF ratios.
2. **I/I Investigation Methods:** Potential I/I investigation methods include the following:
   a. Smoke testing
   b. Mini-basin flow monitoring
   c. Night-time reconnaissance work to (1) investigate and determine direct point sources of inflow, and (2) determine the areas and/or pipe reaches responsible for high levels of infiltration contribution.
   d. CCTV inspection
3. **I/I Reduction Cost Effective Analysis:** The City should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow/infiltration and systematically rehabilitating or replacing the faulty pipelines; or (2) continued treatment of the additional rainfall dependent I/I flow.

1 Introduction

1.1 Scope and Purpose

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    b. Holiday period: during the two peak periods, May 27 – 29, 2017 and July 1 - 9, 2017, that see a heavy tourist presence and its influence on the sanitary flows.
2. Establish the peak flow condition during the rainfall events
3. Quantify inflow/infiltration (I/I) at the applicable flow monitoring sites.
4. A fourth goal of this project was to assess and calibrate the City's influent flume. The results of this work will be presented in a separate technical memorandum.

The flow monitoring sites are listed in Table 1-1 and shown in Figure 1-1. V&A flow monitoring sites are named "Site #" and the City's flow monitoring sites are named "MB #" in the report.

Flow monitoring basins are localized areas of a sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. The basin refers to the ground surface area near and enclosed by the pipelines. A basin may refer to the entire collection system upstream from a flow meter or may exclude separately monitored basins upstream. To isolate a particular drainage basin, an addition or subtraction of flows may be required[1]. For this study, there were no basins that required a subtraction in flows.

Figure 1-2 shows the basins used for the I/I analysis and Table 1-2 shows which V&A flow sites are contained within these basins.

[1] There is error inherent in flow monitoring. Adding and subtracting flows increases error on an additive basis. For example, if Site A has an error of ±10% and Site B has an error of ±10%, then the resulting flow when subtracting Site A from Site B would have an error of up to ±20%.

Table 1-1. List of Flow Monitoring Locations

Monitoring Site	Measured Pipe Diameter (in)	Location
Site 1	11.75	Intersection of Main Street and Errol Street, meter on south 11.75" inlet
Site 2	8	Atascadero Road ~85 feet east of Sunset Avenue, meter on west 8" outlet
Site 3	15	Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet
Site 4	17.5	Embarcadero, ~685 feet north of Coleman Drive, meter on south 17.5" inlet
Site 5	8	371 Avalon Street, meter on east 8" inlet
Site 6	13	Main Street, ~290 feet south of Elena Street, meter on north 13" inlet
Site 7	9.75	Coral Avenue, ~630 feet north of Emerald Circle, meter on north 9.75" inlet
Site 8	13	Main Street, ~400 feet south of Island Street, meter on north 13" inlet
Site 9	12	125 Java Street (near intersection of Sandalwood Avenue), meter on west 12" inlet
Site 10	8	Main Street, just north of intersection with Radcliff Avenue, meter on south 8" inlet
Site 11	8	785 Quintana Road, meter on east 8" inlet
Site 12	14.375	Parking lot of 1154 Embarcadero, meter on south 14.375" inlet
Site 13	15.5	Sidewalk of 910 Embarcadero, meter on south 15.5" inlet
Site 14	10	Intersection of Main Street and Marina Street, meter on east 10" inlet
Site 15	10	301 Embarcadero, ~90 feet north of Morro Bay Launching Facility, meter on south 10" inlet
MB 1	12	Main Street, ~220’ south of intersection with Errol Street, meter on south 11.75" inlet
MB 2	6	Atascadero Road ~85 feet east of Sunset Avenue, meter on east 6" inlet
MB 3	15	Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet
MB 4	18	Embarcadero, ~290’ south of entrance to Arroyo Dunes Mobile Home Park, meter on south 18” inlet
Flume	27	Located at Morro Bay Wastewater Treatment Plant

Table 1-2. List of Basins Used in I/I Analysis

I/I Basin	V&A Sites
Basin MB 1	Sites 1, 10, 11
Basin MB 2	Site 2
Basin MB 3	Sites 3, 5, 6, 7, 8, 9
Basin MB 4	Sites 4, 12, 13, 14, 15

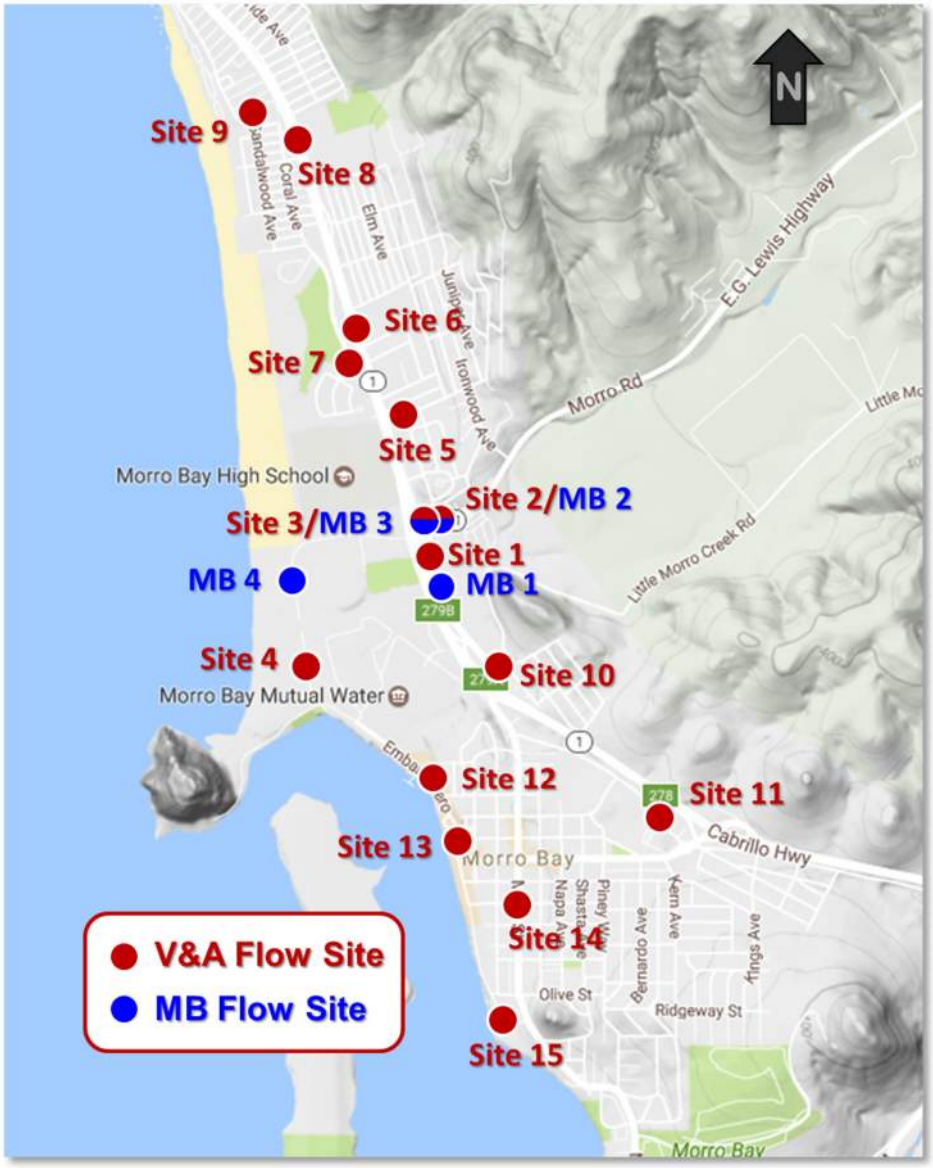


Figure 1-1. Map of Flow Monitoring Sites

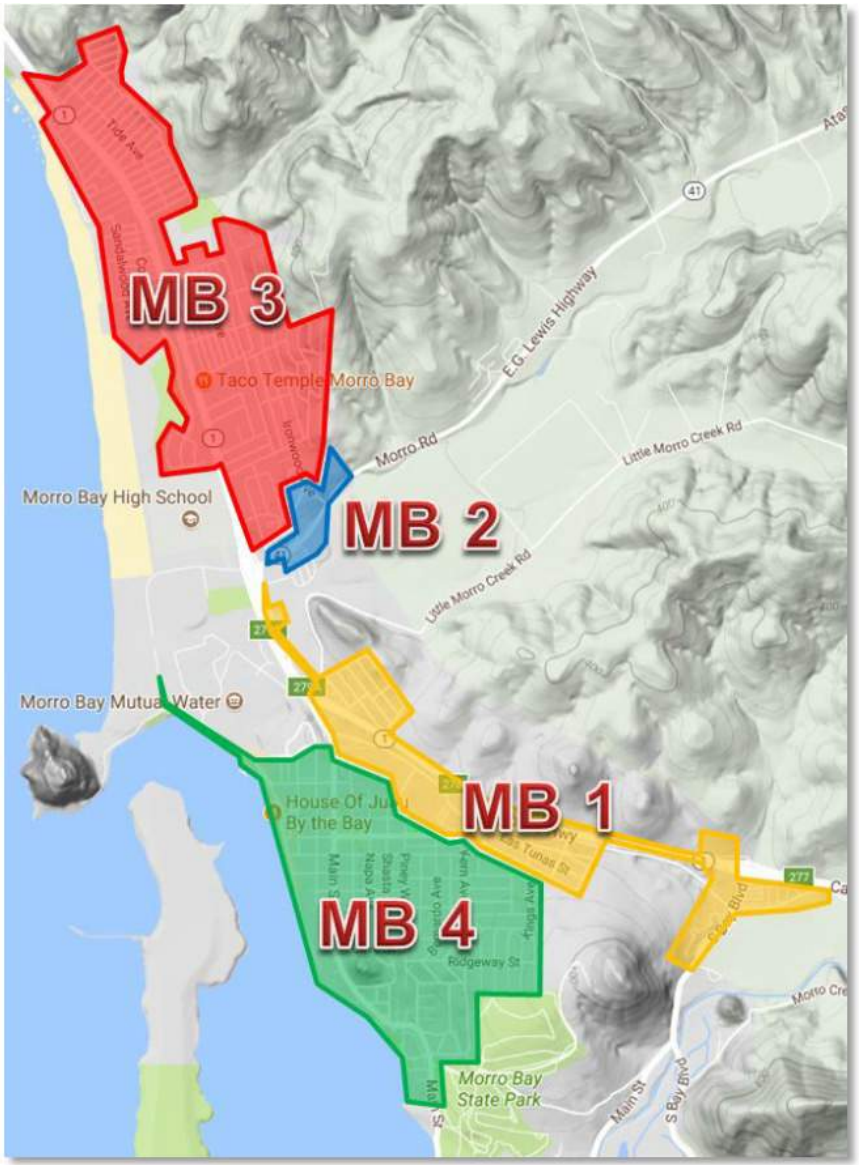


Figure 1-2. Map of Morro Bay Flow Monitoring Basins

2 Methods and Procedures

2.1 Confined Space Entry

A confined space (Photo 2-1) is defined as any space that is large enough and so configured that a person can bodily enter and perform assigned work, has limited or restricted means for entry or exit and is not designed for continuous employee occupancy. In general, the atmosphere must be constantly monitored for sufficient levels of oxygen (19.5% to 23.5%), and the presence of hydrogen sulfide (H_2S) gas, carbon monoxide (CO) gas, and lower explosive limit (LEL) levels. A typical confined space entry crew has members with OSHA-defined responsibilities of Entrant, Attendant and Supervisor. The Entrant is the individual performing the work. He or she is equipped with the necessary personal protective equipment needed to perform the job safely, including a personal four-gas monitor (Photo 2-2). If it is not possible to maintain line-of-sight with the Entrant, then more Entrants are required until line-of-sight can be maintained. The Attendant is responsible for maintaining contact with the Entrants to monitor the atmosphere using another four-gas monitor and maintaining records of all Entrants, if there is more than one. The Supervisor is responsible for developing the safe work plan for the job at hand prior to entering.



Photo 2-1. Confined Space Entry



Photo 2-2. Typical Personal Four-Gas Monitor

2.2 Flow Meter Installation

Isco 2150 flow meters were installed by V&A in the sewer lines listed in Table 1-1. Isco 2150 meters use submerged sensors with a pressure transducer to collect depth readings and an ultrasonic Doppler sensor to determine the average fluid velocity. The ultrasonic sensor emits high-frequency sound waves, which are reflected by air bubbles and suspended particles in the flow. The sensor receives the reflected signal and determines the Doppler frequency shift, which indicates the estimated average flow velocity. The sensor is typically mounted at a manhole inlet to take advantage of smoother upstream flow conditions. The sensor may be offset to one side to lessen the chances of fouling and sedimentation where these problems are expected to occur. Manual level and velocity measurements were taken during installation of the flow meters and again when they were removed and were compared to simultaneous level and velocity readings from the flow meters to ensure proper calibration and accuracy. The pipe diameter was also verified in order to accurately calculate the flow cross-section. The continuous depth and velocity readings were recorded by the flow meters on 5-minute intervals. Figure 2-1 shows a typical installation for a flow meter with a submerged sensor.

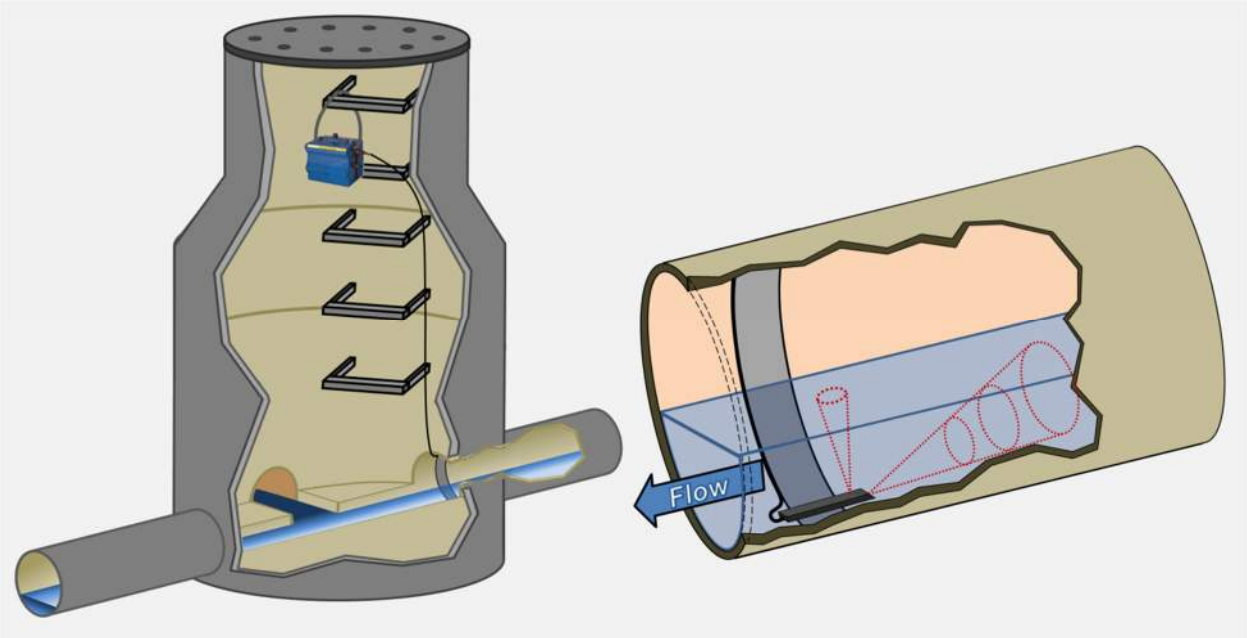


Figure 2-1. Typical Installation for Flow Meter with Submerged Sensor

2.3 Flow Calculation

Data retrieved from the flow meter was placed into a spreadsheet program for analysis. Data analysis includes data comparison to field calibration measurements, as well as necessary geometric adjustments as required for sediment (sediment reduces the pipe's wetted cross-sectional area available to carry flow). Area-velocity flow metering uses the continuity equation,

$$Q = v \cdot A = v \cdot (A_T - A_S)$$

where Q: volume flow rate
v: average velocity as determined by the ultrasonic sensor
A: cross-sectional area available to carry flow
A_T: total cross-sectional area with both wastewater and sediment
A_S: cross-sectional area of sediment.

For circular pipe,

$$A_T = \left[\frac{D^2}{4}\cos^{-1}\left(1-\frac{2d_W}{D}\right)\right] - \left[\left(\frac{D}{2}-d_W\right)\left(\frac{D}{2}\right)\sin\left(\cos^{-1}\left(1-\frac{2d_W}{D}\right)\right)\right]$$

$$A_S = \left[\frac{D^2}{4}\cos^{-1}\left(1-\frac{2d_S}{D}\right)\right] - \left[\left(\frac{D}{2}-d_S\right)\left(\frac{D}{2}\right)\sin\left(\cos^{-1}\left(1-\frac{2d_S}{D}\right)\right)\right]$$

where d_W: distance between wastewater level and pipe invert
d_S: depth of sediment
D: pipe diameter

2.4 Average Dry Weather Flow Determination

For this study, four distinct average dry weather flow curves were established for each site location:

- Mondays – Thursdays
- Fridays
- Saturdays
- Sundays

Flows for many sites differ on Friday evenings compared to Mondays through Thursdays. Starting around 7 pm, the flows are often decreased (compared to Monday through Thursday). Similarly, flow patterns for Saturday and Sunday were also separated due to their unique evening flow pattern. This type of differentiation can be important when determining I/I response, especially if a rain event occurs on a Friday, Saturday or Sunday evening.

Figure 2-2 illustrates a sample of varying flow patterns within a typical week dry week.

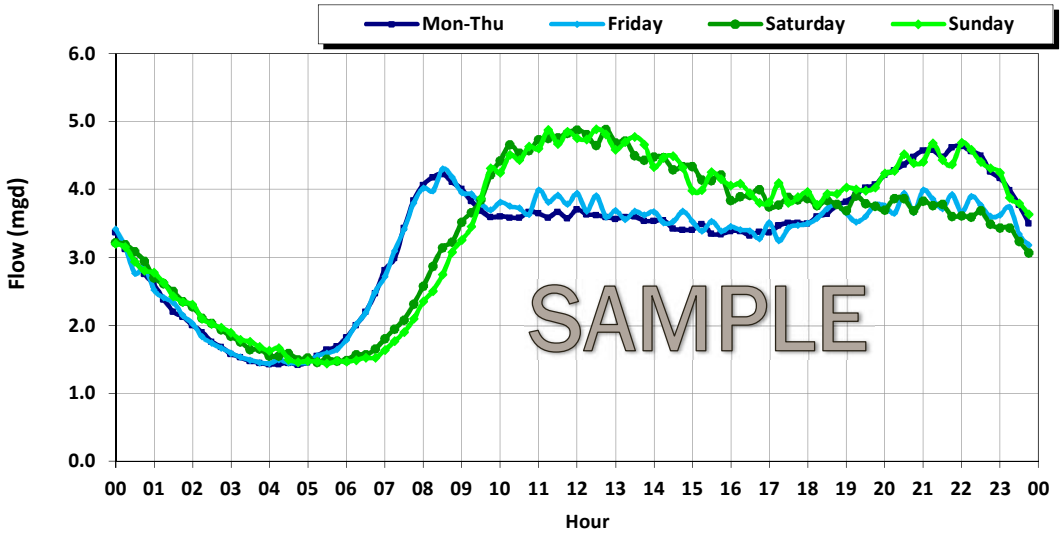


Figure 2-2. Sample ADWF Diurnal Flow Patterns

ADWF curves are taken from "Dry Days", when RDI had the least impact on the baseline flow. For this study, the ADWF curves were also taken from days that did not have major holidays and the resultant tourist traffic. The overall average dry weather flow (ADWF) was calculated per the following equation:

$$ADWF = \left(ADWF_{Mon-Thu} \times \frac{4}{7} \right) + \left(ADWF_{Fri} \times \frac{1}{7} \right) + \left(ADWF_{Sat} \times \frac{1}{7} \right) + \left(ADWF_{Sun} \times \frac{1}{7} \right),$$

2.5 Flow Attenuation

Flow attenuation in a sewer collection system is the natural process of the reduction of the peak flow rate through redistribution of the same volume of flow over a longer period of time. This occurs as a result of friction (resistance), internal storage and diffusion along the sewer pipes. Fluids are constantly working towards equilibrium. For example, a volume of fluid poured into a static vessel with no outside turbulence will eventually stabilize to a static state, with a smooth fluid surface without peaks and valleys. Attenuation within a sanitary sewer collection system is based upon this concept. A flow profile with a strong peak will tend to stabilize towards equilibrium, as shown in Figure 2-3.

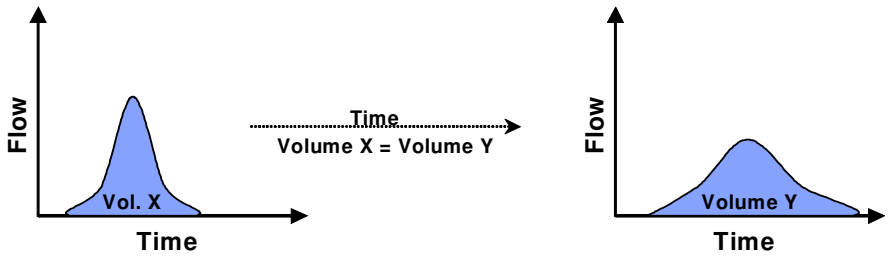


Figure 2-3. Attenuation Illustration

Within a sanitary sewer collection system, each individual basin will have a specific flow profile. As the flows from the basins combine within the trunk sewer lines, the peaks from each basin will (a) not necessarily coincide at the same time, and (b) due to the length and time of travel through the trunk sewers, peak flows will attenuate prior to reaching the treatment facility. The sum of the peak flows of the individual basins within a collection system will usually be greater than the peak flows observed at the treatment facility.

2.6 Inflow / Infiltration Analysis: Definitions and Identification

Inflow and infiltration (I/I) consists of storm water and groundwater that enter the sewer system through pipe defects and improper storm drainage connections and is defined as follows:

2.6.1 Definition and Typical Sources

- **Inflow:** Storm water inflow is defined as water discharged into the sewer system, including private sewer laterals, from direct connections such as downspouts, yard and area drains, holes in manhole covers, cross-connections from storm drains, or catch basins.
- **Infiltration:** Infiltration is defined as water entering the sanitary sewer system through defects in pipes, pipe joints, and manhole walls, which may include cracks, offset joints, root intrusion points, and broken pipes.

Figure 2-4 illustrates the possible sources and components of I/I.

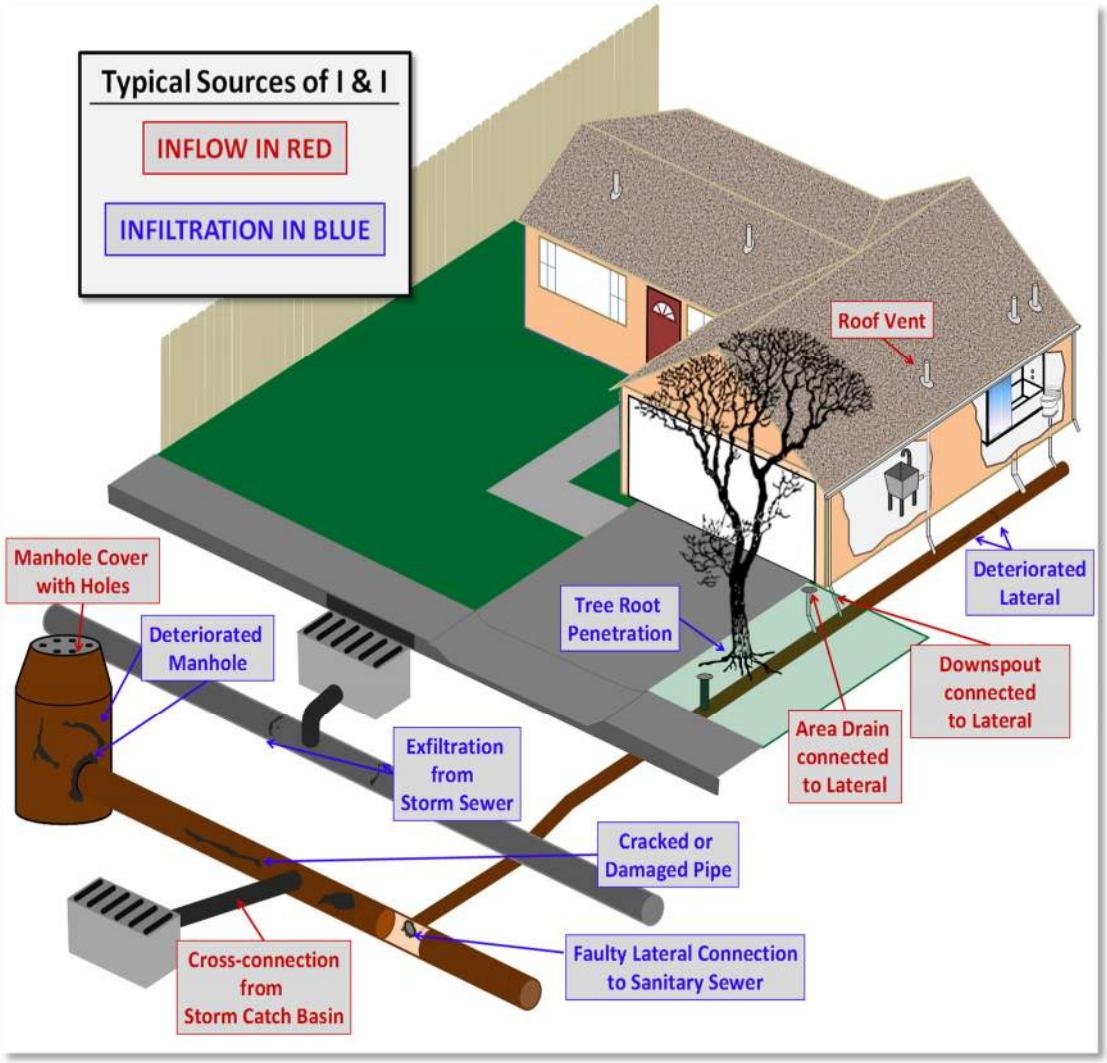


Figure 2-4. Typical Sources of Infiltration and Inflow

2.6.2 Infiltration Components

Infiltration can be further subdivided into components as follows:

- **Groundwater Infiltration:** Groundwater infiltration (GWI) depends on the depth of the groundwater table above the pipelines as well as the percentage of the system submerged. The variation of groundwater levels and subsequent groundwater infiltration rates is seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
- **Rainfall-Dependent Infiltration:** Rainfall-Dependent Infiltration (RDI) occurs as a result of storm water and enters the sewer system through pipe defects, as with groundwater infiltration. The storm water first percolates directly into the soil and then migrates to an infiltration point. Typically, the time of concentration for rainfall-related infiltration may be 24 hours or longer, but this depends on the soil permeability and saturation levels.
- **Rainfall-Responsive Infiltration** is storm water which enters the collection system indirectly through pipe defects, but normally in sewers constructed close to the ground surface such as private laterals. Rainfall-responsive infiltration is independent of the groundwater table and reaches defective sewers via the pipe trench in which the sewer is constructed, particularly if the pipe is placed in impermeable soil and bedded and backfilled with a granular material. In this case, the pipe trench serves as a conduit similar to a French drain, conveying storm drainage to defective joints and other openings in the system. This type of infiltration can have a quick response and graphically can look very similar to inflow.

2.6.3 Impact and Cost of Source Detection and Removal

- **Inflow:**
  - Impact: This component of I/I creates a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows. Because the response and magnitude of inflow is tied closely to the intensity of the storm event, the short-term peak instantaneous flows may result in surcharging and overflows within a collection system. Severe inflow may result in sewage dilution, resulting in upsetting the biological treatment (secondary treatment) at the treatment facility.
  - Cost of Source Identification and Removal: Inflow locations are usually less difficult to find and less expensive to correct. These sources include direct and indirect cross-connections with storm drainage systems, roof downspouts, and various types of surface drains. Generally, the costs to identify and remove sources of inflow are low compared to potential benefits to public health and safety or the costs of building new facilities to convey and treat the resulting peak flows.
- **Infiltration:**
  - Impact: Infiltration typically creates long-term annual volumetric problems. The major impact is the cost of pumping and treating the additional volume of water, and of paying for treatment (for municipalities that are billed strictly on flow volume).
  - Cost of Source Detection and Removal: Infiltration sources are usually harder to find and more expensive to correct than inflow sources. Infiltration sources include defects in deteriorated sewer pipes or manholes that may be widespread throughout a sanitary sewer system.

2.6.4 Graphical Identification of I/I

Inflow is usually recognized graphically by large-magnitude, short-duration spikes immediately following a rain event. Infiltration is often recognized graphically by a gradual increase in flow after a wet-weather event. The increased flow typically sustains for a period after rainfall has stopped and then gradually drops off as soils become less saturated and as groundwater levels recede to normal levels. Real time flows were plotted against ADWF to analyze the I/I response to rainfall events. Figure 2-5 illustrates a sample of how this analysis is conducted and some of the measurements that are used to distinguish infiltration and inflow. Similar graphs were generated for the individual flow monitoring sites and can be found in *Appendix A*.

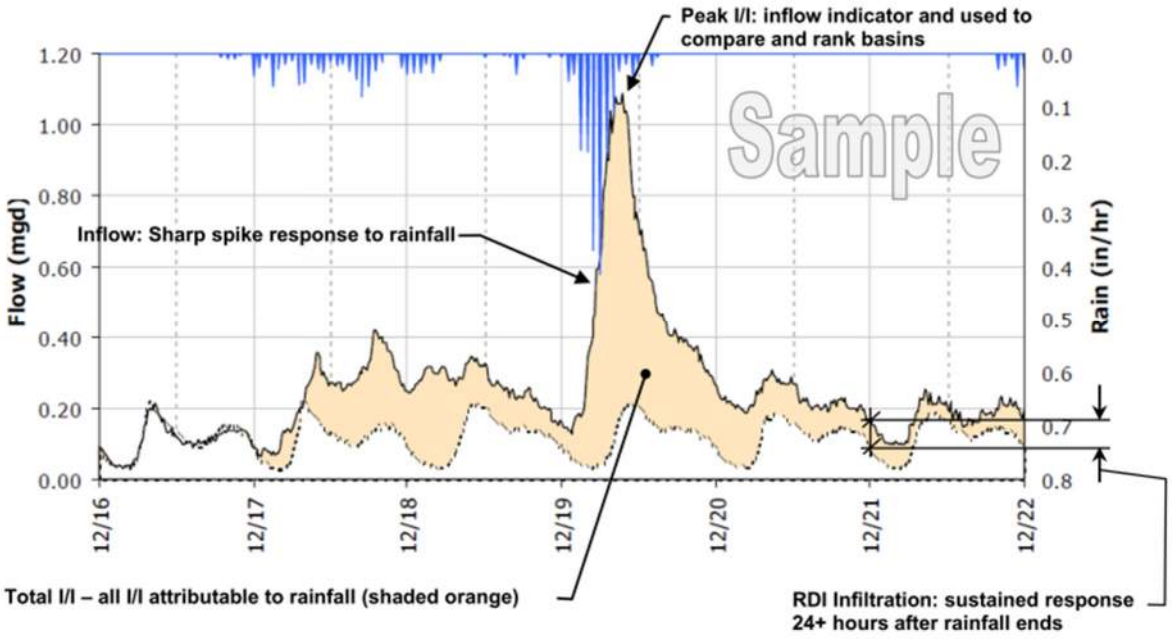


Figure 2-5. Sample Infiltration and Inflow Isolation Graph

2.6.5 Analysis Metrics

After differentiating I/I flows from ADWF flows, various calculations can be made to determine which I/I component (inflow or infiltration) is more prevalent at a particular site and to compare the relative magnitudes of the I/I components between drainage basins and between storm events:

- **Inflow – Peak I/I Flow Rate:** Inflow is characterized by sharp, direct spikes occurring during a rainfall event. Peak I/I rates are used for inflow analysis[2].
- **Groundwater Infiltration:** GWI analysis is conducted by looking at minimum dry weather flow to average dry weather flow ratios and comparing them to established standards to quantify the rate of excess groundwater infiltration.
- **Rainfall-Dependent Infiltration:** RDI Analysis is conducted by looking at the infiltration rates at set periods after the conclusion of a storm event. Depending on the particular collection system

[2] I/I flow rate is the real time flow less the estimated average dry weather flow rate. It is an estimate of flows attributable to rainfall. By using peak measured flow rates (inclusive of ADWF), the I/I flow rate would be skewed higher or lower depending on whether the storm event I/I response occurs during low-flow or high-flow hours.

and the time required for flows to return to ADWF levels, different periods may be examined to determine the basins with the greatest or most sustained rainfall-dependent infiltration rates.

- **Total Infiltration:** The total inflow and infiltration is measured in gallons per site and per storm event. Because it is based on total I/I volume, it is an indicator of combined inflow and infiltration and is used to identify the overall volumetric influence of I/I within the monitoring basin.

2.6.6 Normalization Methods

There are three ways to *normalize* the I/I analysis metrics for an "apples-to-apples" comparison amongst the different drainage basins:

- **per-ADWF:** The metric is divided by the established average dry weather flow rate and typically expressed as a ratio. *Peaking Factors* are examples of using ADWF to normalize data from different sites.
- **per-IDM:** The metric is divided by length of pipe (IDM [inch-diameter mile]) contained within the upstream basin. Final units typically are gallons per day (gpd) per IDM.
- **per-ACRE:** The metric is divided by the acreage of the upstream basin. Final units typically are gallons per day (gpd) per ACRE.

The infiltration and inflow indicators were normalized by the per-ADWF and the per-ACRE method in this report. In the event of a tie, the per-ADWF method is used to break the tie.

3 Rainfall Results

3.1 Flow Study Rainfall Data

V&A captured rainfall data from 5 publicly available rain gauges maintained by weather enthusiasts[3]. While V&A has no direct control over these gauges, V&A performs QAQC on the data before using it for analysis. V&A used rainfall data from January 1, 2017 through July 2017 to encompass the period when the V&A and City-owned meters were installed. There was a series of rainfall events that occurred from January 2017 through February 2017. Five rainfall events were defined. Table 3-1 and Figure 3-1 show the duration and precipitation of each rainfall event.

Table 3-1. Rainfall Events Used for I/I Analysis

Rainfall Event	Duration	Morro6	Morro28	Losos17	Losos19	Baywo16	Average of 5 RGs
1	1/3/2017 - 1/6/2017	2.44	3.12	2.86	2.60	2.48	2.70
2	1/7/2017 - 1/17/2017	3.42	3.29	2.50	2.33	2.04	2.72
3	1/18/2017 – 1/25/2017	2.75	3.90	3.90	2.18	2.92	3.13
4	2/5/2017 – 2/12/2017	2.23	2.60	2.48	2.44	2.33	2.42
5	2/16/2017 – 2/22/2017	2.54	3.19	3.58	3.77	3.14	3.24
Total over Monitoring Period		***15.53***	***19.22***	***17.99***	***16.22***	***15.76***	***16.95***

[3] National Oceanic and Atmospheric Administration (NOAA) Citizen Weather Observer Program (CWOP) members send data from their private weather stations to the NOAA MADIS server; the data undergoes quality checking and then is distributed.

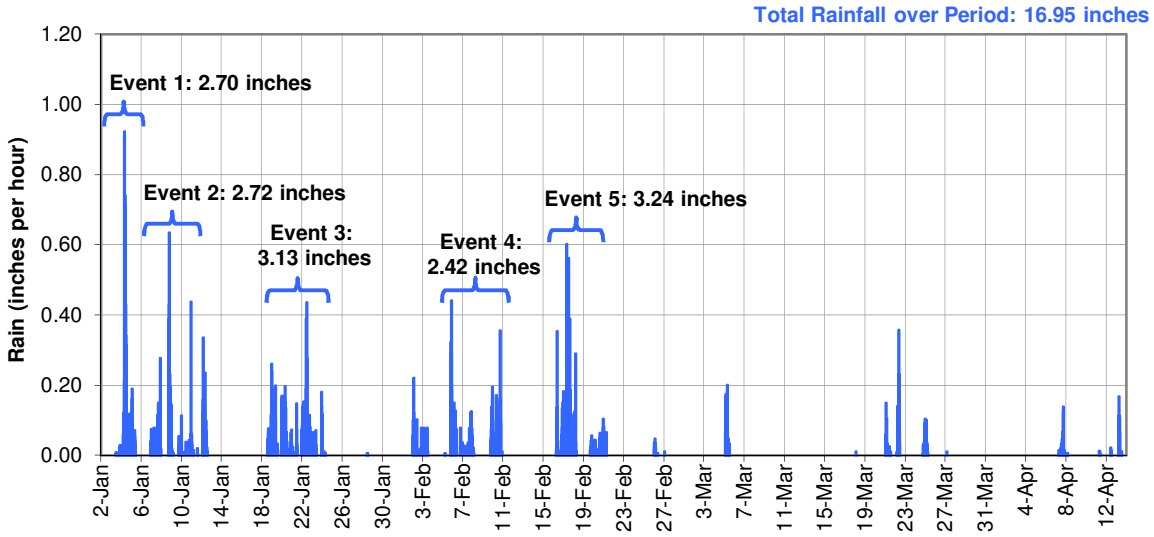


Figure 3-1. Rainfall Activity over Monitoring Period – Average of 5 Rain Gauges

Figure 3-2 shows the rain accumulation plot of the period rainfall, as well as the historical average rainfall[4] in Morro Bay during this project duration. Rainfall totals for the City were approximately 40% higher than historical normal levels during this time period.

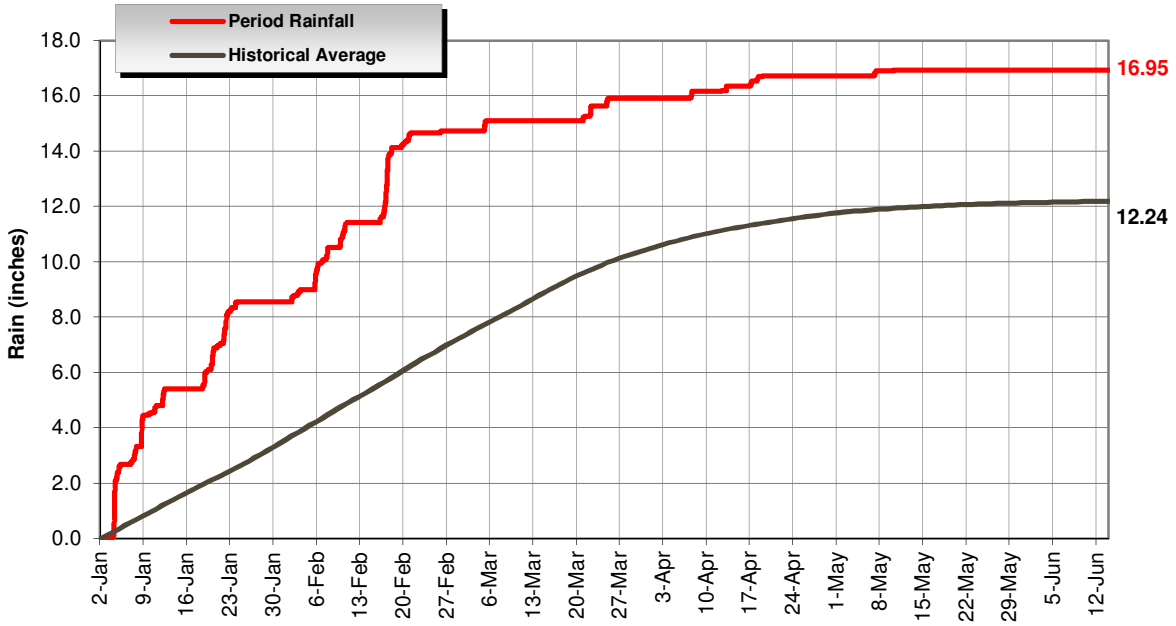


Figure 3-2. Rainfall Accumulation Plot – Average of 5 Rain Gauges

4 Historical data taken from the WRCC (Station 045866 in Morro Bay): http://www.wrcc.dri.edu/summary/climsmnca.html

3.2 Rainfall: Storm Event Classification

It is important to classify the relative size of a major storm event that occurs over the course of a flow monitoring period in order to compare the observed flow response to that occurring during a design storm event (sanitary sewers are often designed to withstand I/I contribution to sanitary flows for specific-sized "design" storm events). Rainfall events are classified by intensity and duration. For example, the National Oceanic and Atmospheric Administration (NOAA) Rainfall Frequency Atlas shown in Figure 3-3[5] classifies a 10-year, 24-hour storm event at the Morro6 rain gauge as 3.65 inches. This means that in any given year, at this specific location, there is a 10% chance that 3.65 inches of rain will fall in any 24-hour period.

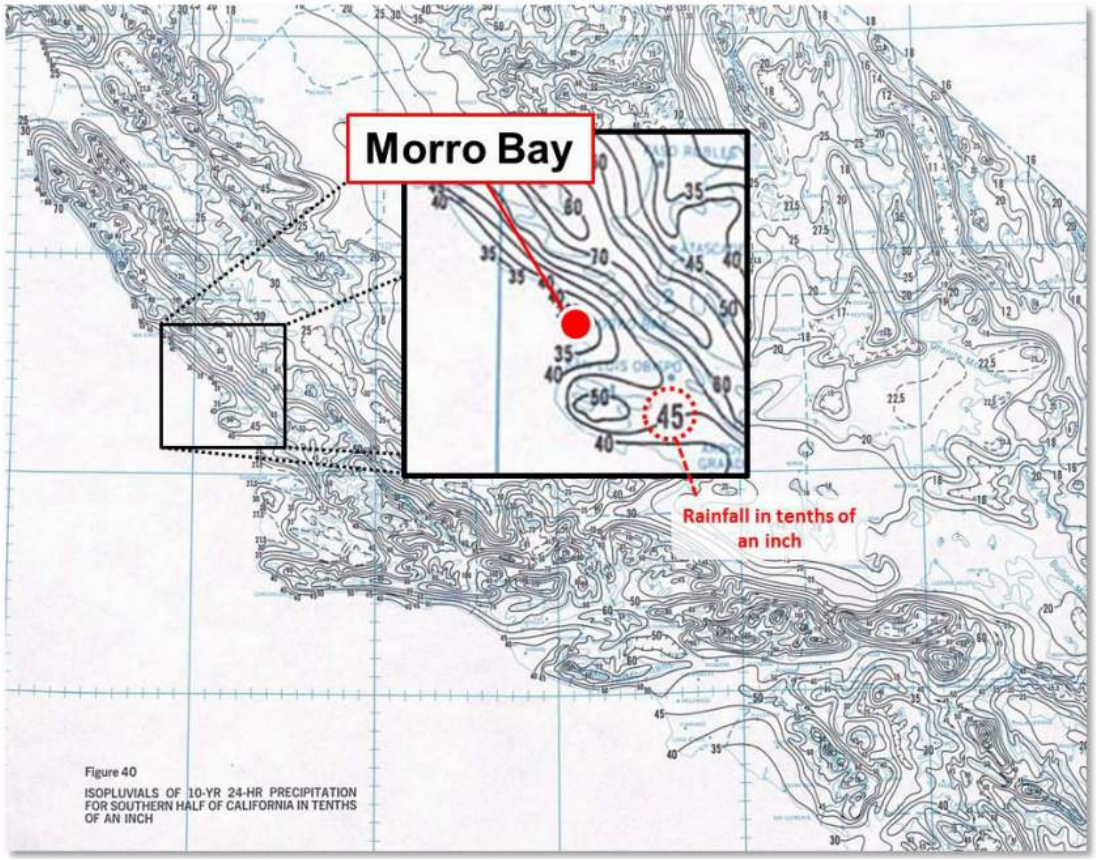


Figure 3-3. NOAA California Map of Isopluvials of 10-year, 24-hour Precipitation

From the NOAA frequency maps, for a specific latitude and longitude, the rainfall densities for period durations ranging from 15 minutes to 60 days are known for rain events ranging from 1-year to 100-year intensities. These are plotted to develop a rain event frequency map specific to each rainfall monitoring site. Superimposing the peak measured densities for the rainfall events on the rain event frequency plot determines the classification of the rainfall event, shown in Figure 3-4 through Figure 3-5 and summarized in Table 3-2.

[5] NOAA Western U.S. Precipitation Frequency Maps Atlas 14, Volume 6, Version 2, 2011: http://www.wrcc.dri.edu/pcpnfreq.html

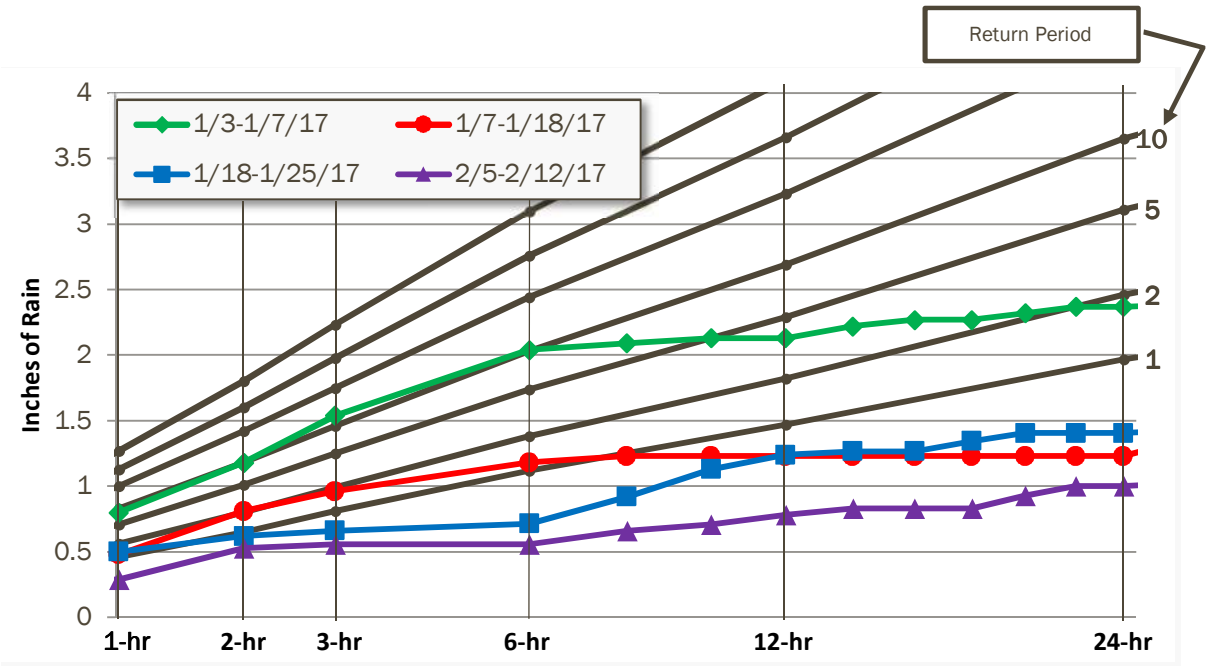


Figure 3-4. Rainfall Event Classification – 24-Hour Period (MORRO6)

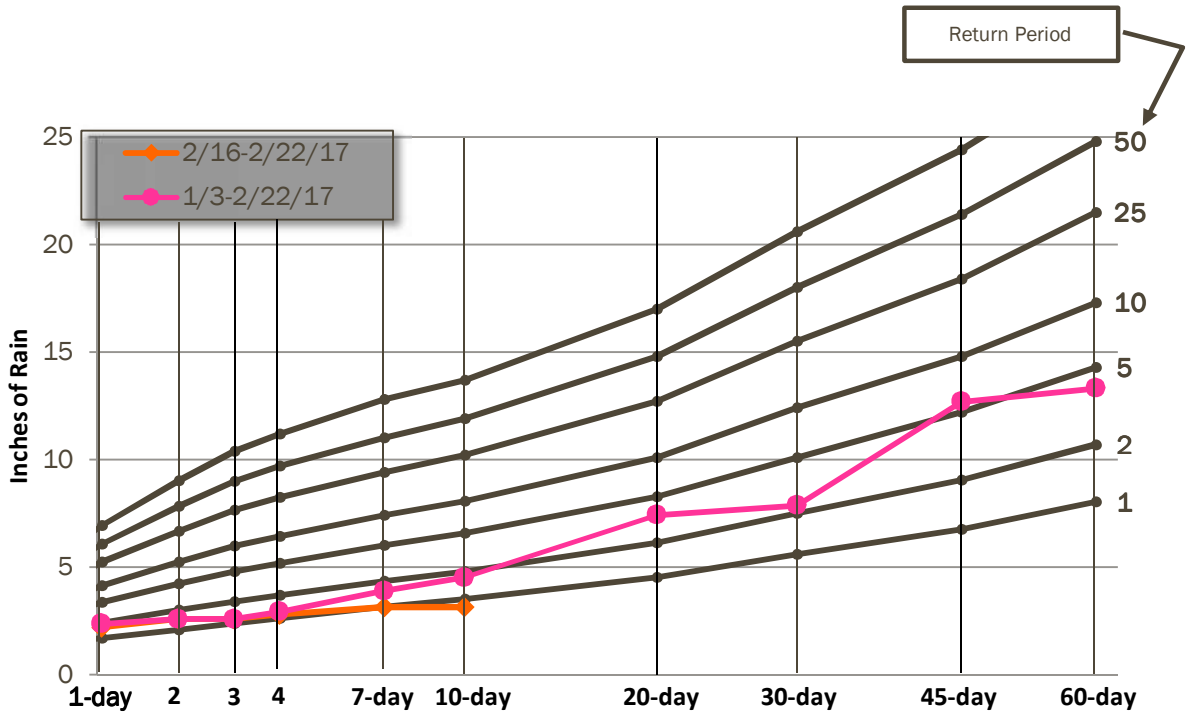


Figure 3-5. Rainfall Event Classification – 60-Day Period (BAYWO16)

Table 3-2. Rainfall Event Classification

Rainfall Event	Morro6	Morro28	Losos17	Losos19	Baywo16
1: Jan 3 - 6	10-Year, 6-Hour	**12-Year, 6-Hour**	10-Year, 3-Hour	10-Year, 3-Hour	5-Year, 3-Hour
2: Jan 7 - 17	1-Year, 6-Hour	**2-Year, 6-Hour**	1-Year, 6-Hour	1-Year, 3-Hour	<1-Year, 24-Hour
3: Jan 18 - 25	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour
4: Feb 5 – 12	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour	<1-Year, 24-Hour
5: Feb 16 - 22	1-Year, 24-Hour	2-Year, 24-Hour	**3-Year, 24-Hour**	**3-Year, 24-Hour**	1-Year, 24-Hour
Season: Jan 3 – Feb 22	5-Year, 60-Day	**10-Year, 60-Day**	**13-Year, 45-Day**	5-Year, 60-Day	5-Year, 45-Day

4 Flow Monitoring Results

4.1 Average Flow Analysis

ADWF curves were established during the two periods: January 13 through January 16 and January 24 through February 1 when RDI had the least impact on the baseline flow. Table 4-1 summarizes the dry weather flow data measured for this study. ADWF curves for each site can be found in *Appendix A.*

Figure 4-1 shows a flow schematic highlighting the average daily flows and levels of the V&A sites. Figure 4-2 shows the same for the City-owned meters.

Table 4-1. Dry Weather Flow

Monitoring Site	Monday-Thursday ADWF (mgd)	Friday ADWF (mgd)	Saturday ADWF (mgd)	Sunday ADWF (mgd)	Overall ADWF (mgd)
Site 1	0.180	0.185	0.185	0.184	0.182
Site 2	0.026	0.029	0.030	0.029	0.027
Site 3	0.281	0.303	0.316	0.321	0.295
Site 4	0.211	0.225	0.256	0.239	0.224
Site 5	0.085	0.093	0.099	0.107	0.091
Site 6	0.110	0.109	0.120	0.118	0.112
Site 7	0.039	0.041	0.041	0.045	0.040
Site 8	0.067	0.068	0.075	0.075	0.069
Site 9	0.019	0.020	0.021	0.023	0.020
Site 10	0.069	0.070	0.068	0.072	0.070
Site 11	0.062	0.063	0.068	0.071	0.064
Site 12	0.121	0.133	0.147	0.136	0.129
Site 13	0.089	0.089	0.105	0.102	0.093
Site 14	0.088	0.086	0.098	0.107	0.092
Site 15	0.042	0.046	0.052	0.052	0.046
MB 1	0.168	0.159	0.160	0.172	0.167
MB 2	0.027	0.031	0.029	0.034	0.029
MB 3	0.287	0.282	0.310	0.333	0.296
MB 4	0.205	0.226	0.258	0.253	0.223
Flume	0.887	0.910	0.982	0.998	0.920

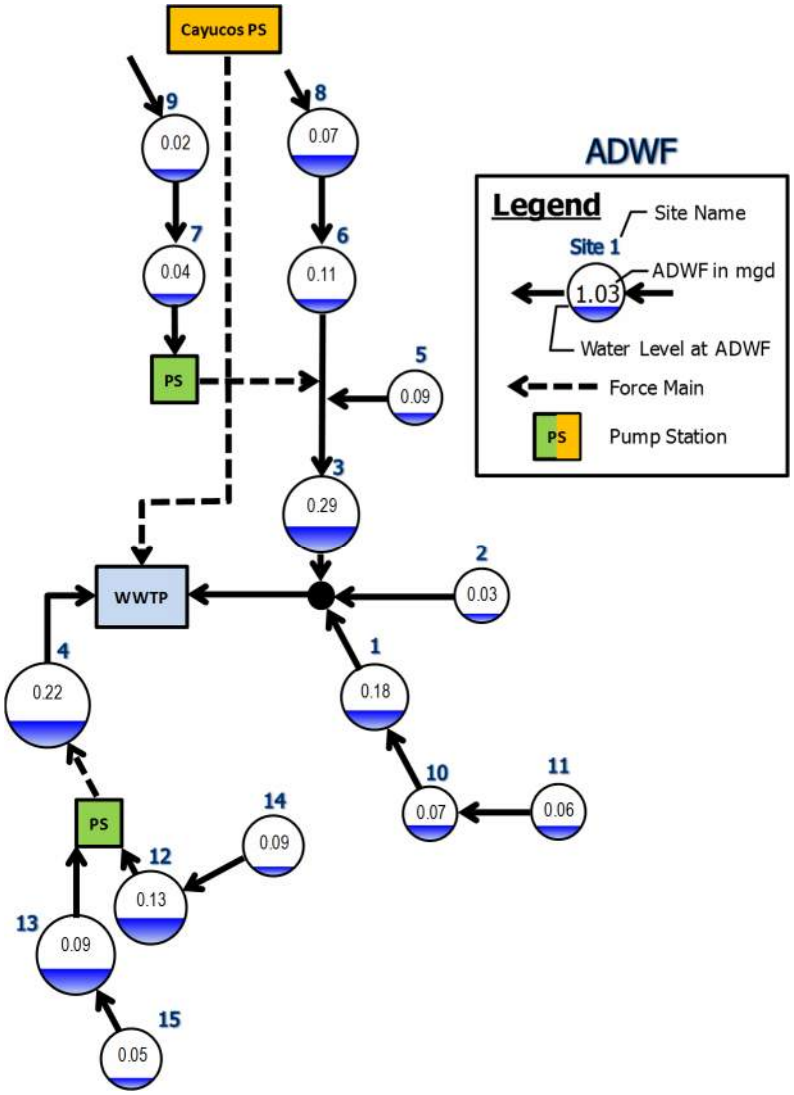


Figure 4-1. Dry Weather Flow Schematic – V&A Sites

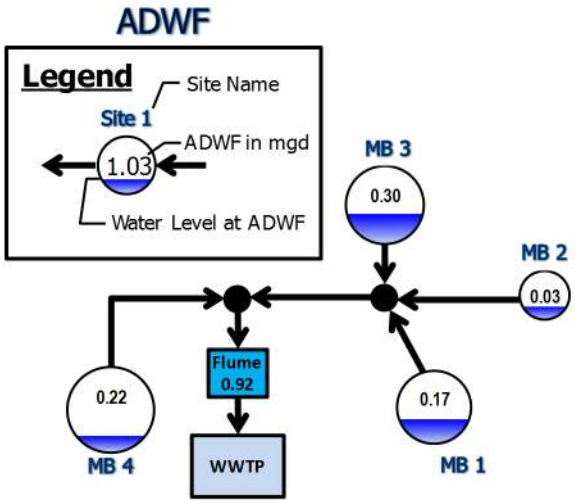


Figure 4-2. Dry Weather Flow Schematic – Morro Bay Sites

4.2 Tourist Flow

As a part of the flow study, V&A was asked to keep flow meters installed during the Memorial Day and July 4th holiday in order to provide the City with data about increases in flow due to the tourist population. Figure 4-3 and Figure 4-4 show the flows for Site 14 during the Memorial Day and July 4th holidays. Table 4-2 summarizes the percentage increase in flows and Figure 4-5 and Figure 4-6 show temperature maps of the V&A basins and the percentage increase in flow.

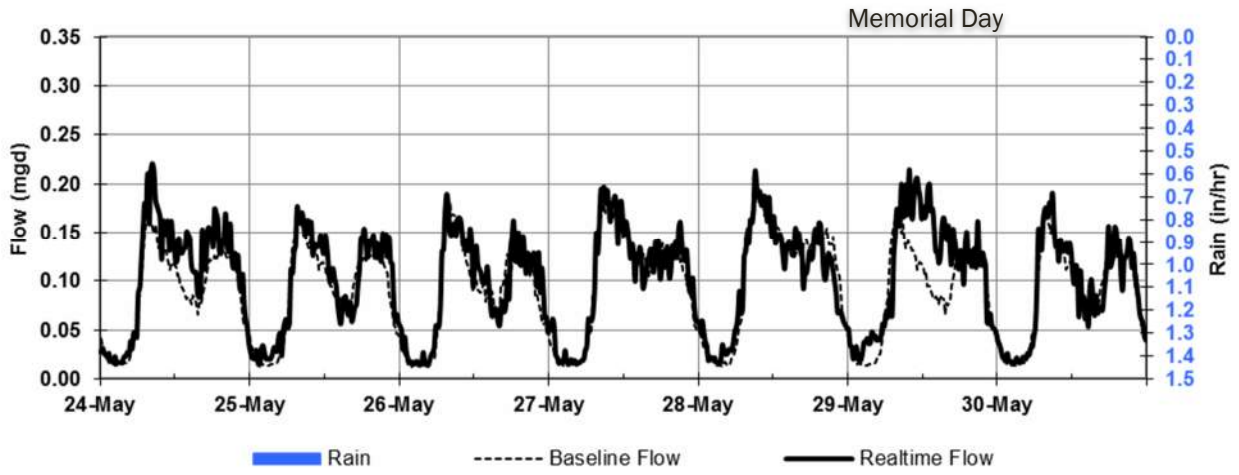


Figure 4-3. Site 14 Flows – Memorial Day Holiday

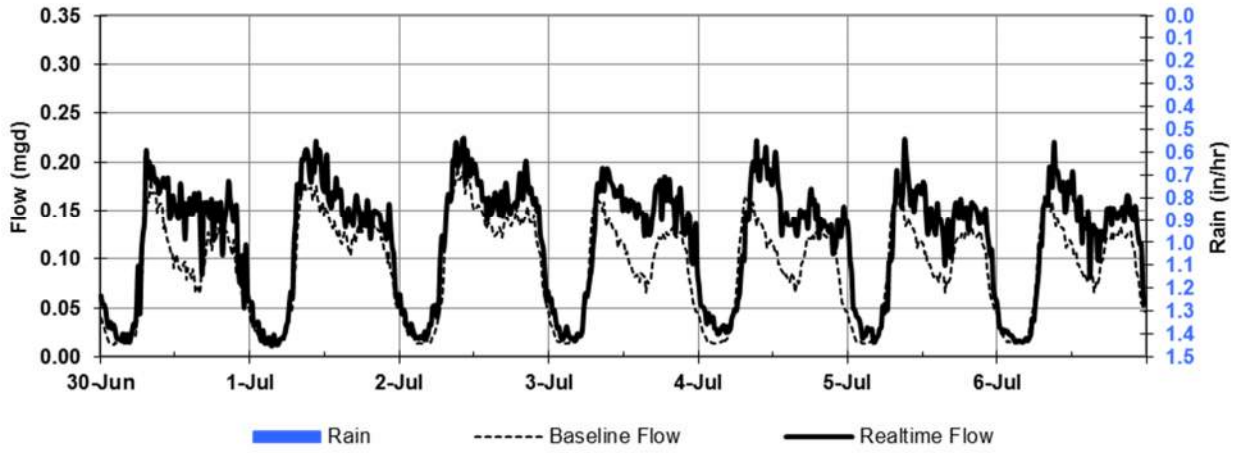


Figure 4-4. Site 14 Flows – July 4th Holiday

Table 4-2. Summary of Holiday Flows

Monitoring Basin*	Memorial Day Holiday Weekend Difference (%)	July 4th Holiday Weekend Difference (%)
Basin 1	n/a	9%
Basin 2	7%	19%
Basin 3	n/a	-18%
Basin 5	23%	12%
Basin 6	n/a	34%
Basin 7	10%	-10%
Basin 8	14%	35%
Basin 9	20%	70%
Basin 10	-83%	50%
Basin 11	16%	6%
Basin 12	25%	32%
Basin 13	15%	0%
Basin 14	10%	29%
Basin 15	2%	48%
Flume	7%	28%

* Basin 4 not ranked because basin boundary could not be determined, n/a – data not available

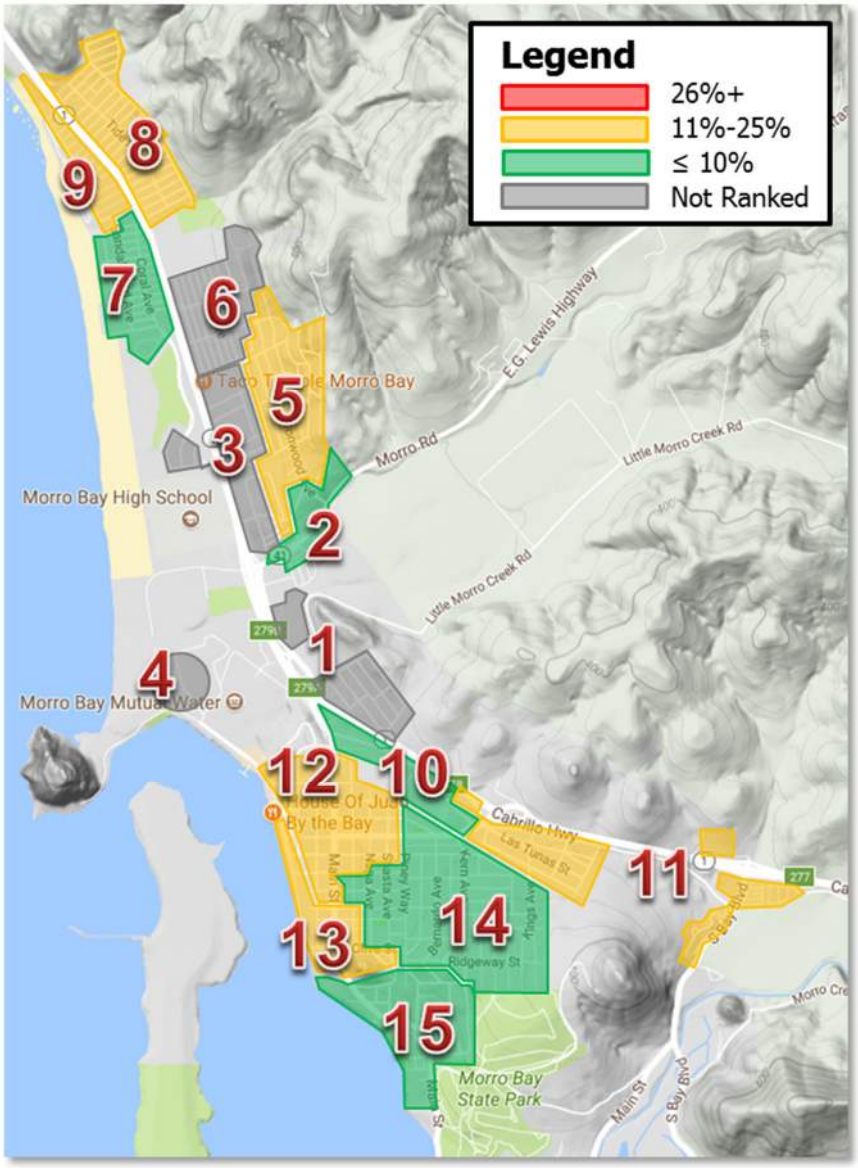


Figure 4-5. Memorial Day Holiday Flows temperature map

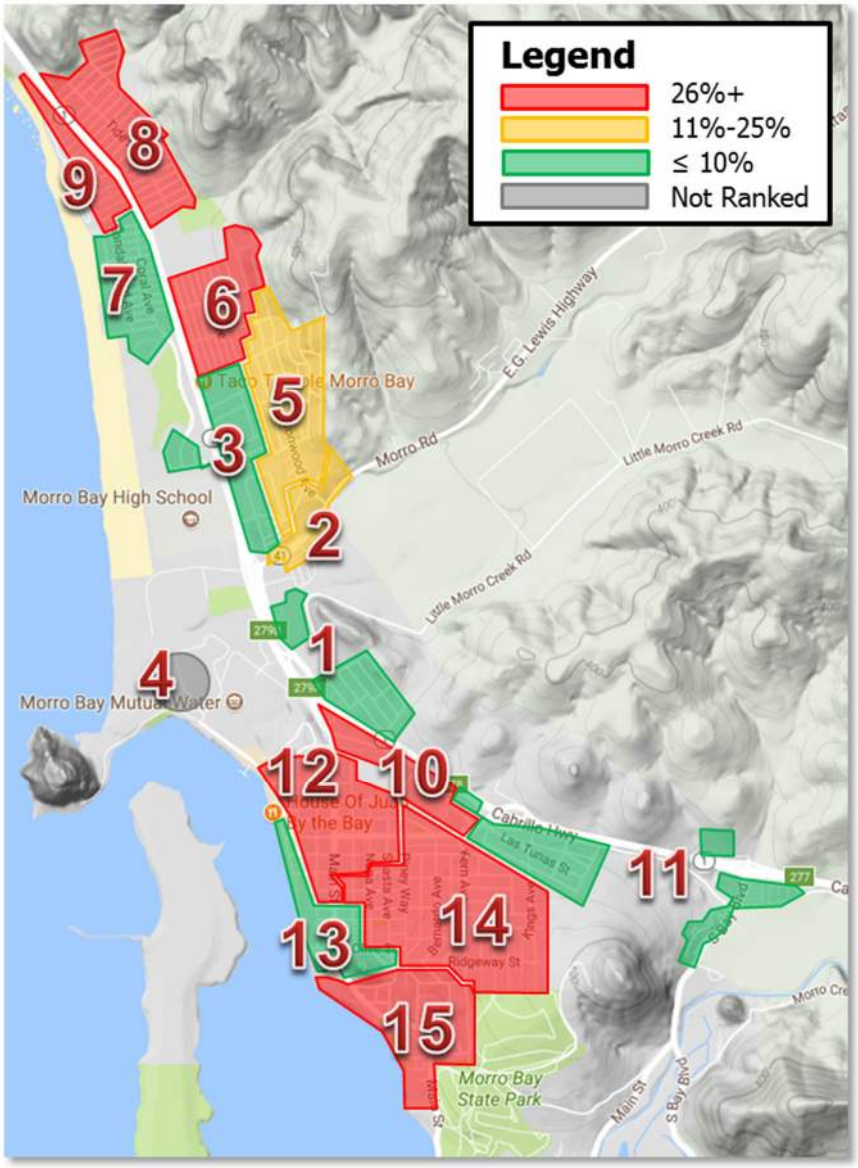


Figure 4-6. July 4th Holiday Flows temperature map

4.3 Capacity Analysis: Peaking Factor and d/D Ratio

Peak measured flows and the corresponding flow levels (depths) are important to understand the capacity limitations of a collection system. The peak flows and flow levels reported are from the peak measurements as taken across the entirety of the flow monitoring period. Peak flows and levels may not correspond to a rainfall event. There were several instances of backflow conditions (detailed below) due to capacity constraints and the inability of the local collection system to handle peak wet weather flows.

The following capacity analysis terms are defined as follows:

- **Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors including size and topography of tributary area and the amount and characteristics of I/I entering the collection system. Flow attenuation and flow restrictions will also affect the peaking factor. Ideally wet weather peaking factors would be approaching 3 for new systems.
- **d/D Ratio:** The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). Standards for d/D ratio vary from agency to agency, but typically range between $d/D \leq 0.5$ and $d/D \leq 0.75$. The d/D ratio for each site was computed based on the maximum depth of flow for the flow monitoring study.

Table 4-3 summarizes the peak recorded flows, levels, *d/D* ratios, and peaking factors per site during the flow monitoring period. Results of note have been shaded in RED. Capacity analysis data is presented on a site-by-site basis and represents the hydraulic conditions only at the point site locations. Hydraulic conditions in other areas of the collection system will differ.

Table 4-3. Capacity Analysis Summary

Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Diameter (in)	Peak Level (in)	*d/D* Ratio	Level Surcharged above Crown (ft)
Site 1	0.18	0.48	2.6	11.75	5.6	0.48	--
Site 2	0.03	0.08	3.1	8	2.5	0.32	--
Site 3	0.29	0.89	3.0	15	7.4	0.49	--
Site 4	0.22	0.58	2.6	17.5	8.4	0.48	--
Site 5	0.09	0.28	3.1	8	2.5	0.32	--
Site 6	0.11	0.35	3.1	13	4.1	0.32	--
Site 7	0.04	0.16	4.1	9.75	3.5	0.36	--
Site 8	0.07	0.21	3.1	13	7.3	0.56	--
Site 9	0.02	0.10	4.8	12	3.8	0.32	--
Site 10	0.07	0.32	4.7	8	4.6	0.57	--
Site 11	0.06	0.25	3.9	8	3.6	0.46	--
Site 12	0.13	0.38	3.0	14.375	7.7	0.54	--
Site 13	0.09	0.31	3.3	15.5	7.0	0.45	--
Site 14	0.09	0.32	3.5	10	2.5	0.25	--
Site 15	0.05	0.21	4.6	10	3.5	0.35	--

Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Diameter (in)	Peak Level (in)	*d/D* Ratio	Level Surcharged above Crown (ft)
MB 1	0.17	0.93	5.6	12	14.0	1.17	0.17
MB 2	0.03	0.17	5.9	6	2.5	0.41	--
MB 3	0.30	2.54	8.6	15	23.6	1.57	0.70
MB 4	0.22	1.02	4.6	18	6.1	0.34	--
Morro Bay Flume	0.92	10.08	11.0	27	N/A	N/A	N/A

The following capacity analysis results are noted:

- **Peaking Factor:** Only three sites, sites MB 1, MB 2 and MB 3, as well as the Morro Bay Influent Flume had peaking factors that exceeded 5. It should be noted that the City-owned sites were installed during the bulk of the rainfall season, while the V&A sites were installed afterwards.
- **d/D Ratio:** Only two of the nineteen flow monitoring sites, MB 1 and MB 3, had d/D ratios that were above the common threshold value of 0.75 d/D. These two sites reached a surcharge condition during the study.
- **Flume**: The Morro Bay 27-inch Palmer Bowlus Flume had a peak measured flow of 10.08 mgd. The manufacturer American Sigma's drawing states a 10.24 mgd maximum flow and 1.76 maximum head. As a result, the peak measured flow is at 98% capacity.

Figure 4-7 and Figure 4-8 show bar graphs summarizing the site-by-site d/D ratios, surcharge levels and peaking factors, respectively. Figure 4-9 shows a flow schematic showing the peak flow levels for the V&A flow meters. Figure 4-10 shows the same for the City-owned meters.

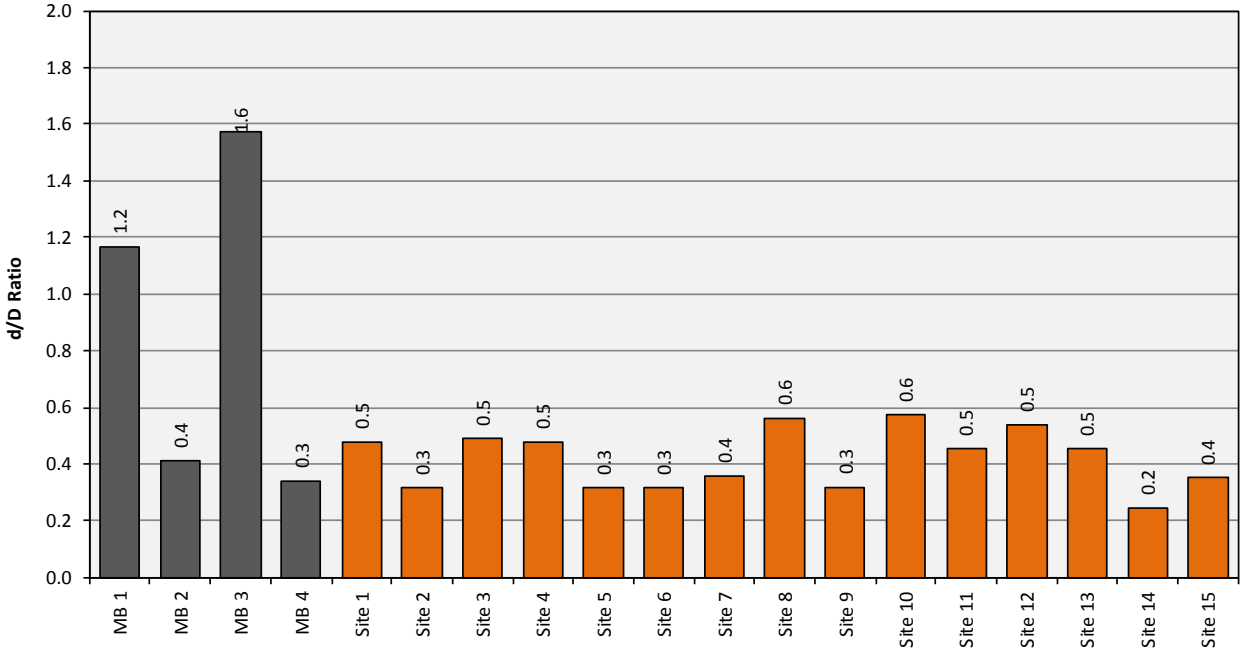


Figure 4-7. Capacity Summary: d/D Ratios

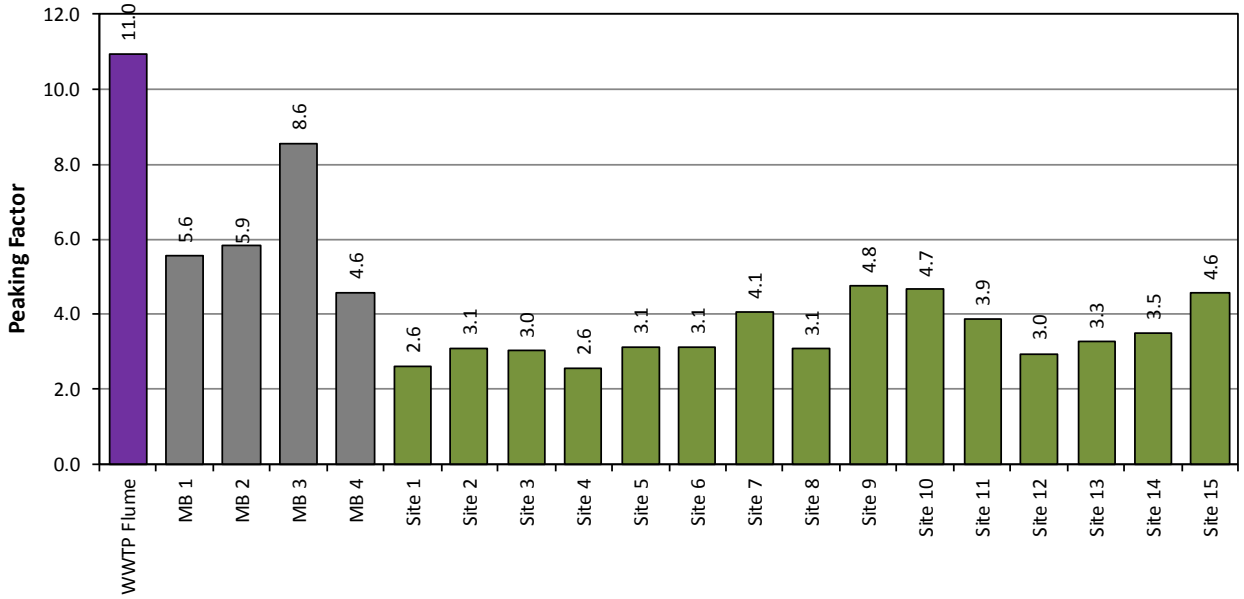


Figure 4-8. Capacity Summary: Peaking Factors

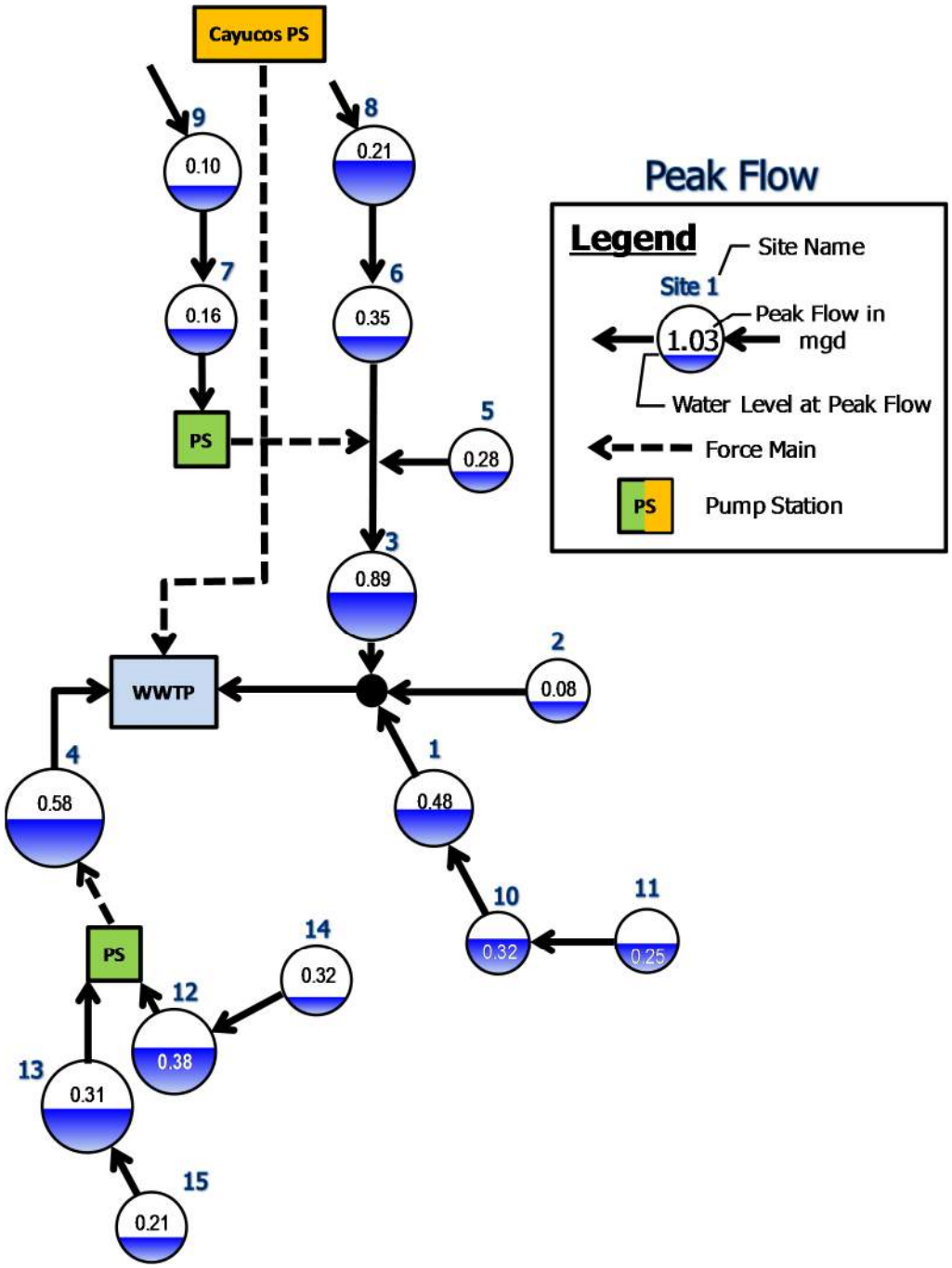


Figure 4-9. Peak Flow Schematic – V&A Sites

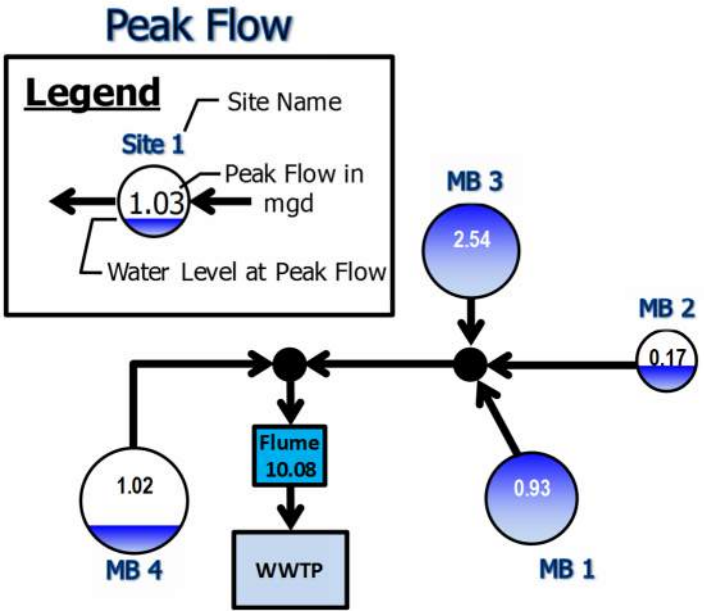


Figure 4-10. Peak Flow Schematic – Morro Bay Sites

5 Inflow and Infiltration Results

5.1 Preface

The following is noted for the I/I analyses of this study:

- The inflow analysis used Event 1 for the analysis (see Figure 5-1 for reference)
- The RDI rate was measured as the average I/I response after Event 4 from February 23, 2017 12:00 am to February 24, 2017 12:00am (see Figure 5-2 for reference).
- I/I analysis on the flume was not performed as there is no substantive basin that could be isolated. The flume's reaction to the rainfall events is included in Appendix A.

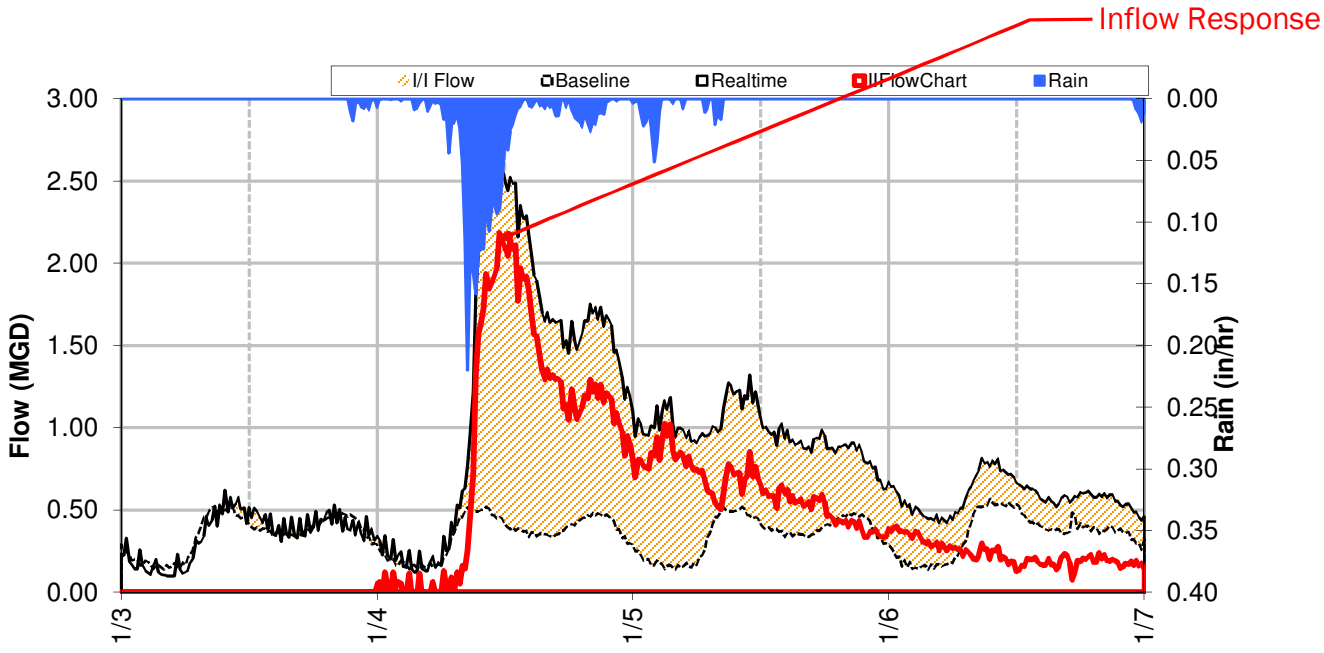


Figure 5-1. I/I Isolation Graph, Site MB 3, Event 1

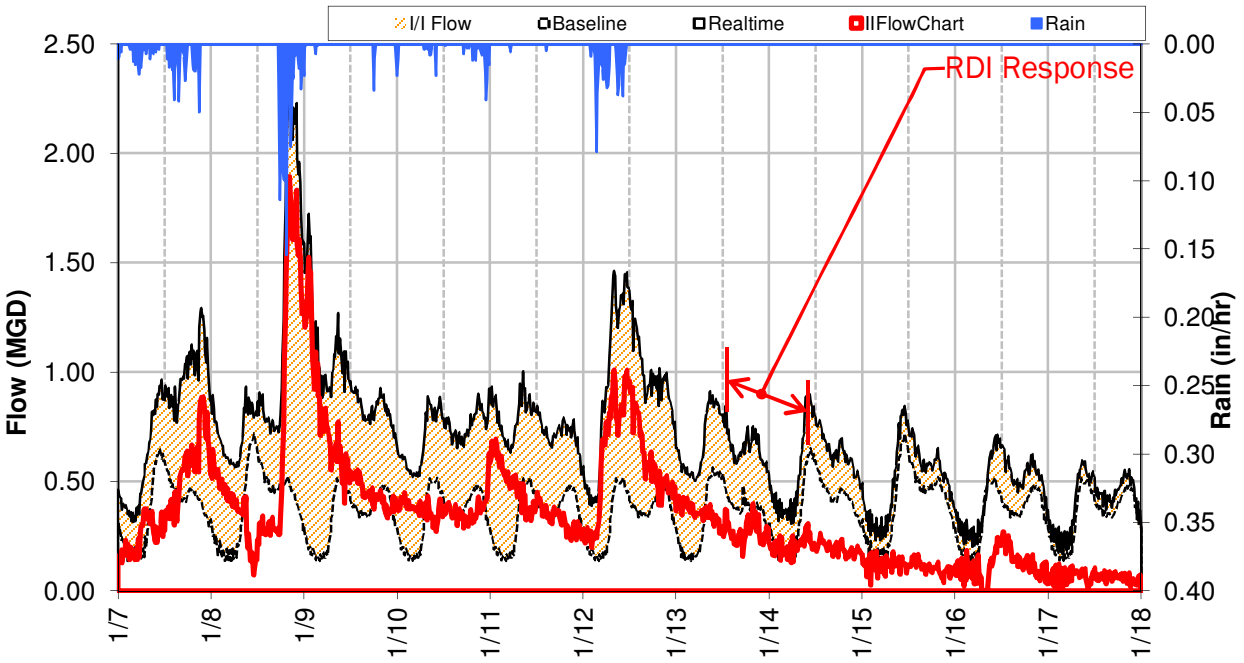


Figure 5-2. I/I Isolation Graph, Site MB 3, Event 2

5.2 January Flume Event

During rain event 1, which was used for inflow analysis, the City influent flume experienced a peak flow event. V&A compared the data from the flume to the data from the four upstream flow meters. As seen in Figure 5-3, the black line is the flume data, the purple line is the sum of sites MB 1, MB 2, MB 3 and MB 4. The data for the flume and the four City meters track each other very well throughout the study and for all of the rainfall events (see January 9 as a typical example) with the exception of the January 4 event. For this event, the flume data far exceeded the upstream measured data. This type of excessive spike was not measured for any of the other strong rainfall events.

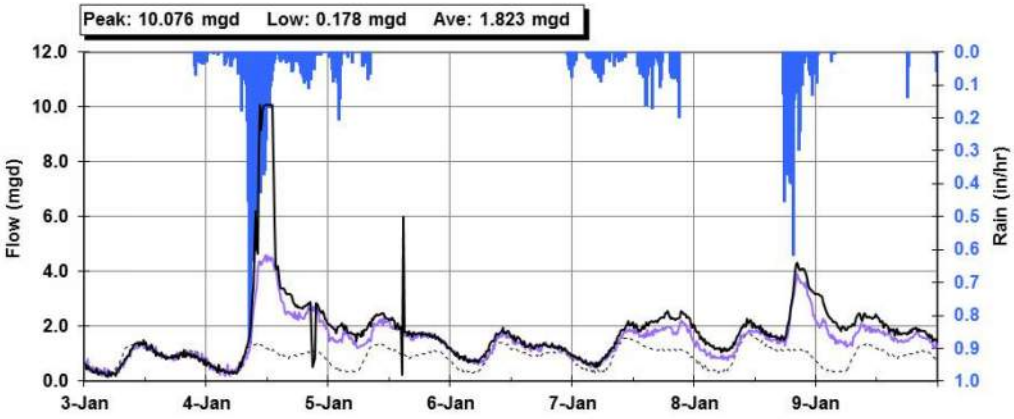


Figure 5-3. Flume and Upstream Meters Comparison – Event 1

Some possible causes of the spike are:

- Possible inflow source that only “activates” during extreme peak intensity rainfall events, located in the area not monitored between Sites 1,2,3,4 and the flume; Errol Street (upstream mobile home park) or Lila H Kaiser Park. These areas are highlighted ‘yellow’ in Figure 5-4. Little Morro Creek is also located in the area.
- Perhaps it was possible there was flow recirculated from the treatment plant back into the system and double-counted at the flume.



Figure 5-4. Area View of 4 City Meters and Flume

5.3 Inflow Results Summary

Inflow is storm water discharged into the sewer system through direct connections such as downspouts, area drains, cross-connections to catch basins, etc. These sources transport rain water directly into the sewer system and the corresponding flow rates are tied closely to the intensity of the storm. This component of I/I often causes a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows.

Table 5-1 and Figure 5-5 summarize the peak measured I/I flows and inflow analysis results. Peak I/I rates for all sites were measured during rain event 1 (January 3 to 6, 2017), as this was the most intensive short-term rainfall event. The top ranked basins with the highest normalized inflow have been shaded in RED.

The following inflow analysis results are noted:

- Basin MB 3 ranked highest for normalized inflow contribution. Basins MB 1 and MB 2 also had elevated levels of inflow.

Table 5-1. Inflow Analysis Summary

Monitoring Basin	ADWF (mgd)	Peak Inflow Rate (mgd)	Peak Inflow per ADWF	Peak Inflow per Acre (gpd/acre)	Inflow Ranking [A]
MB 1	0.17	0.68	4.07	2,750	3
MB 2	0.03	0.14	4.87	2,130	2
MB 3	0.30	2.15	7.27	3,226	1
MB 4	0.22	0.70	3.12	1,018	4

[A] Ranking of 1 represents most inflow after normalization.

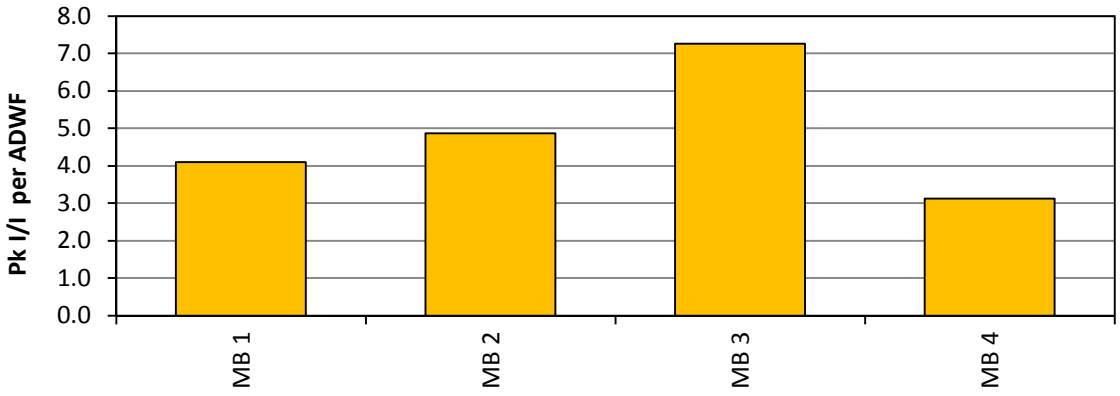


Figure 5-5. Bar Graph: Inflow Analysis Summary – Peak I/I to ADWF

5.4 Infiltration Results Summary

Rain dependent infiltration (RDI) is defined as water entering the sanitary sewer system through defects in pipes, pipe joints, and manhole walls, which may include cracks, offset joints, root intrusion points, and broken pipes. Increased flows into the sanitary sewer system are usually tied to groundwater levels and soil saturation levels. Infiltration sources transport rain water into the system *indirectly*; flow levels in the sanitary system increase gradually, are typically sustained for a period after rainfall has stopped, and then gradually drop off as soils become less saturated and as groundwater levels recede to normal. Infiltration typically creates long-term annual volumetric problems. The major impact is the cost of pumping and treating the additional volume of water, and of paying for treatment (for municipalities that are billed strictly on flow volume).

Table 5-2 summarizes the calculated RDI flow rates for Rain Event 2. Figure 5-6 shows a bar graph summary. The following infiltration analysis results are noted:

- Basin MB 3 had the highest rates of infiltration. Basins MB 1 and MB 2 also had elevated levels of infiltration.

Table 5-2. Infiltration Analysis Summary

Monitoring Basin	ADWF	RDI Rate (mgd)	RDI per ADWF	RDI per Acre (gpd / acre)	Rank[A]
MB 1	0.17	0.13	75%	509	3
MB 2	0.03	0.02	79%	345	2
MB 3	0.30	0.26	87%	386	1
MB 4	0.22	0.02	10%	33	4

[A] Ranking of 1 represents most inflow after normalization.

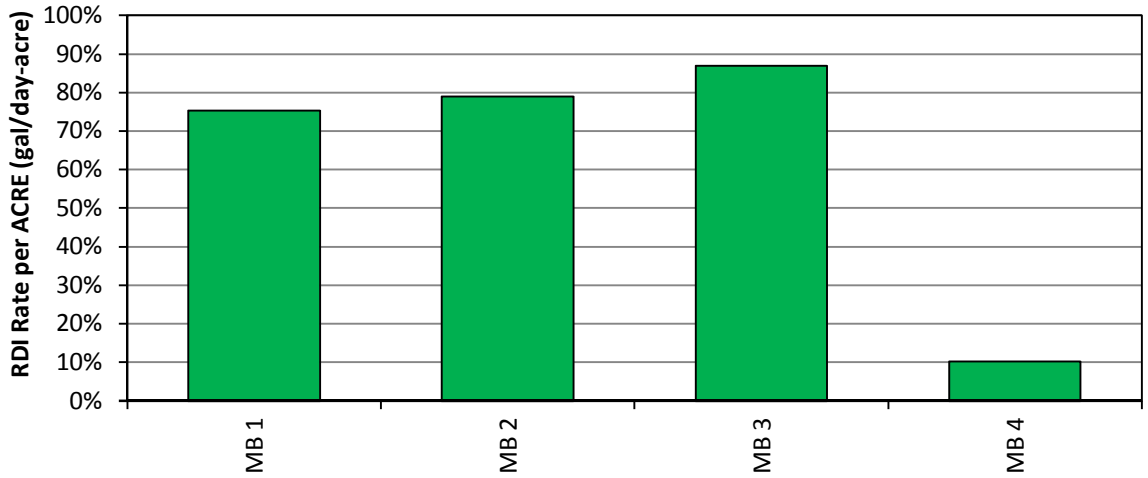


Figure 5-6. Bar Graph: Infiltration Analysis Summary – RDI Rate to ADWF

5.5 Groundwater Infiltration Results Summary

Dry weather (ADWF) flow can be expected to have a predictable diurnal flow pattern. While each site is unique, experience has shown that, given a reasonable volume of flow and typical loading conditions, the daily flows fall into a predictable range when compared to the daily average flow. If a site has a large percentage of groundwater infiltration occurring during the periods of dry weather flow measurement, the amplitudes of the peak and low flows will be dampened[6]. Figure 5-7 shows a sample of two flow monitoring sites, both with nearly the same average daily flow, but with considerably different peak and low flows. In this *sample* case, Site B1 may have a considerable volume of groundwater infiltration.

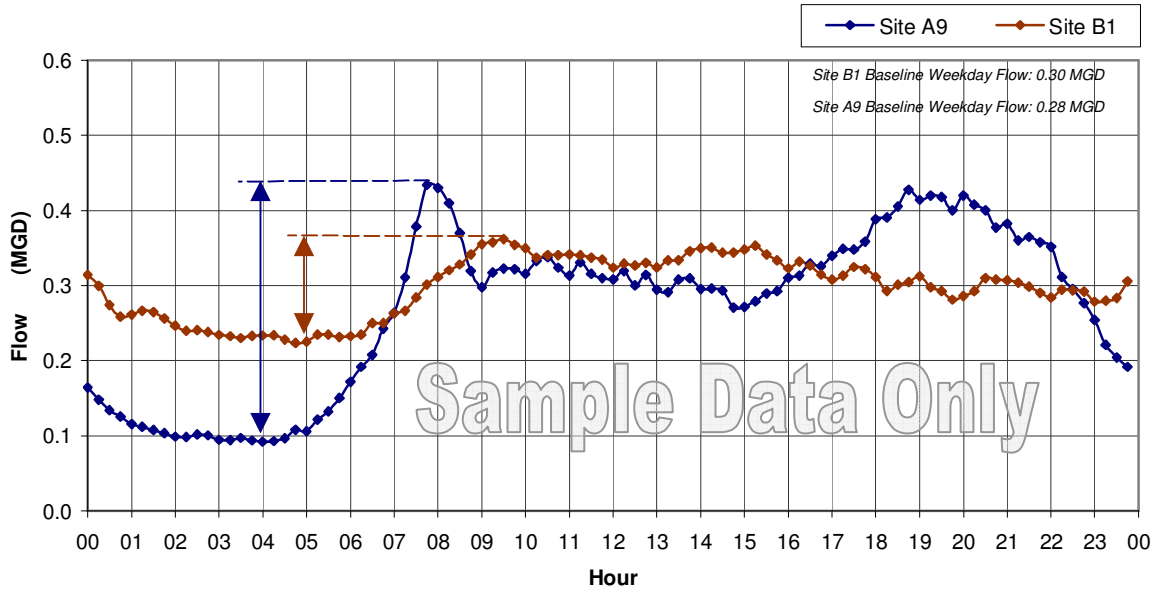


Figure 5-7. Sample Groundwater Infiltration Sample Graph

It can be useful to compare the low-to-ADWF flow ratios for the flow metering sites. A site with abnormal ratios, and with no other reasons to suspect abnormal flow patterns (such as proximity to a pump station, treatment facilities, etc.), has a possibility of higher levels of groundwater infiltration in comparison to the rest of the collection system.

Figure 5-8 plots the low-to-ADWF flow ratios against the ADWF flows for the sites monitored during this study. The dotted line shows "typical" low-to-ADWF ratios per the WEF[7], [8].

The following GWI results are noted:

- Only basins MB 3 may have some evidence of groundwater infiltration.

[6] In an extreme case, perhaps 0.2 mgd of ADWF flow and 2.0 mgd of groundwater infiltration, the peaks and lows would be barely recognizable; the ADWF flow would be nearly a straight line.

[7] WEF Manual of Practice No. 9, "Design and Construction of Sanitary and Rain Sewers."

[8] Due to attenuation, it should be expected that sites with larger flow volumes should not have quite the peak-to-average and low-to-average flow ratios as sites with lesser flow volumes. Therefore, the WEF typical trend line's slope is closer to 1.0 as the ADWF increases, as shown in the figure.

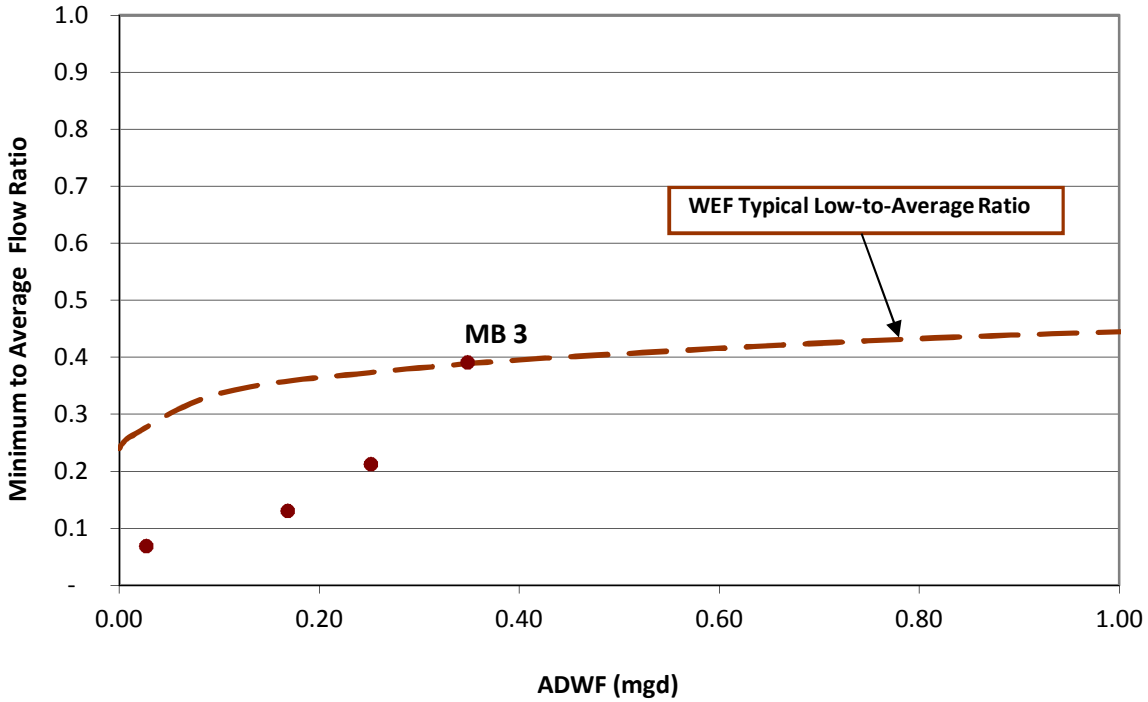


Figure 5-8. Minimum Flow Ratios vs. ADWF[9]

[9] Due to attenuation, it should be expected that sites with larger flow volumes should not have quite the peak-to-average and low-to-average flow ratios as sites with lesser flow volumes. This is why the WEF typical trend line's slope is closer to 1.0 as the ADWF increases, as shown in the figure.

5.6 Combined I/I Results Summary

Combined I/I analysis considers the totalized volume (in gallons) of both inflow and rainfall-dependent infiltration over the course of a storm event. Table 5-3 summarizes the combined I/I flow results for total I/I measured across the entirety of the flow monitoring period. Results of note have been shaded in RED. Figure 5-9 shows a bar graph summary of the combined I/I analysis.

The following combined I/I analysis results are noted:

- Basin MB 3 had the highest amounts of combined I/I. Basins MB 1 and MB 2 also had elevated levels of combined I/I.

Table 5-3. Combined I/I Analysis Summary

Monitoring Basin	ADWF	Combined I/I (gallons)	Combined I/I per ADWF (per inch-rain)	R Value	Combined I/I per Acre (per inch-rain)	Rank[A]
MB 1	0.17	7,331,000	2.87	7.14%	1,940	3
MB 2	0.03	1,286,000	2.90	4.67%	1,268	2
MB 3	0.30	18,545,000	4.09	6.68%	1,815	1
MB 4	0.22	1,219,000	0.36	0.43%	116	4

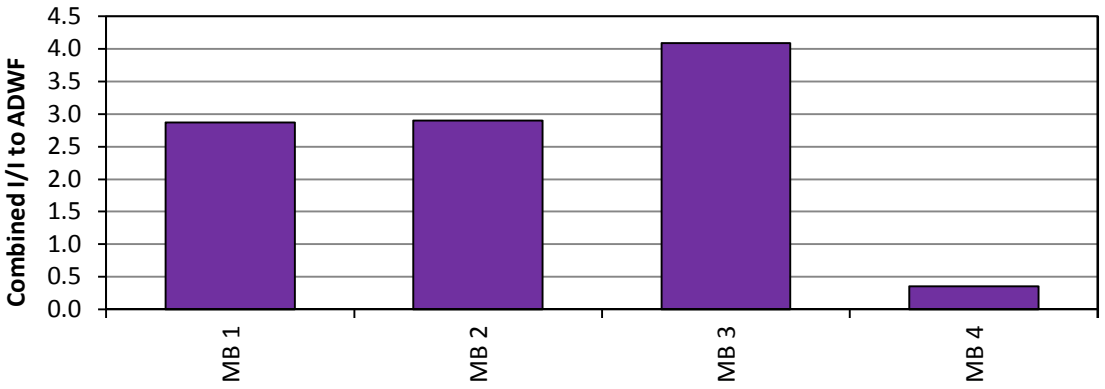


Figure 5-9. Bar Graph: Combined I/I Analysis Summary – Combined I/I Rate to ADWF

6 Recommendations

V&A advises that future I/I reduction plans consider the following recommendations:

1. **Determine I/I Reduction Program:** The City should examine its I/I reduction needs to determine their needs and goals for a future I/I reduction program.
    a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the higher inflow/ADWF ratios.
    b. If infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the higher RDI/ADWF ratios.
2. **I/I Investigation Methods:** Potential I/I investigation methods include the following:
    a. Smoke testing
    b. Mini-basin flow monitoring
    c. Night-time reconnaissance work to (1) investigate and determine direct point sources of inflow, and (2) determine the areas and/or pipe reaches responsible for high levels of infiltration contribution.
    d. CCTV inspection
3. **I/I Reduction Cost Effective Analysis:** The City should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow/infiltration and systematically rehabilitating or replacing the faulty pipelines; or (2) continued treatment of the additional rainfall dependent I/I flow.

Appendix A
Flow Monitoring Site Reports: Data, Graphs, Information

City of Morro Bay

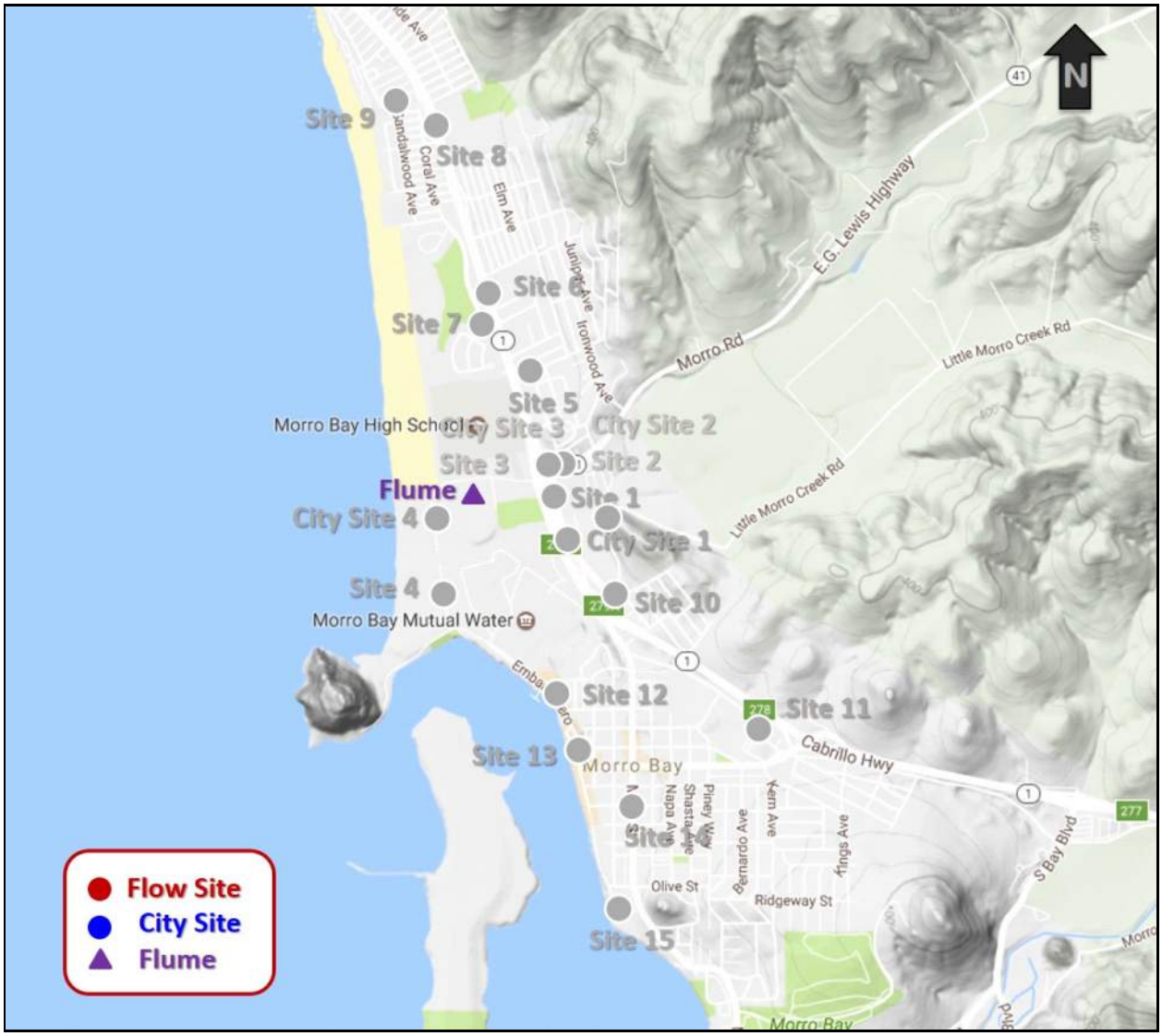
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - July 2017

Monitoring Site: WWTP Flume

Location: Wastewater Treatment Plant: 27" Palmer-Bowlus Flume

Data Summary Report



Vicinity Map: WWTP Flume

WWTP FLUME

Site Information

Location: Wastewater Treatment Plant: 27" Palmer-Bowlus Flume



Pipe Diameter: 27 inches

ADWF: 0.920 mgd

Peak Measured Flow: 10.076 mgd



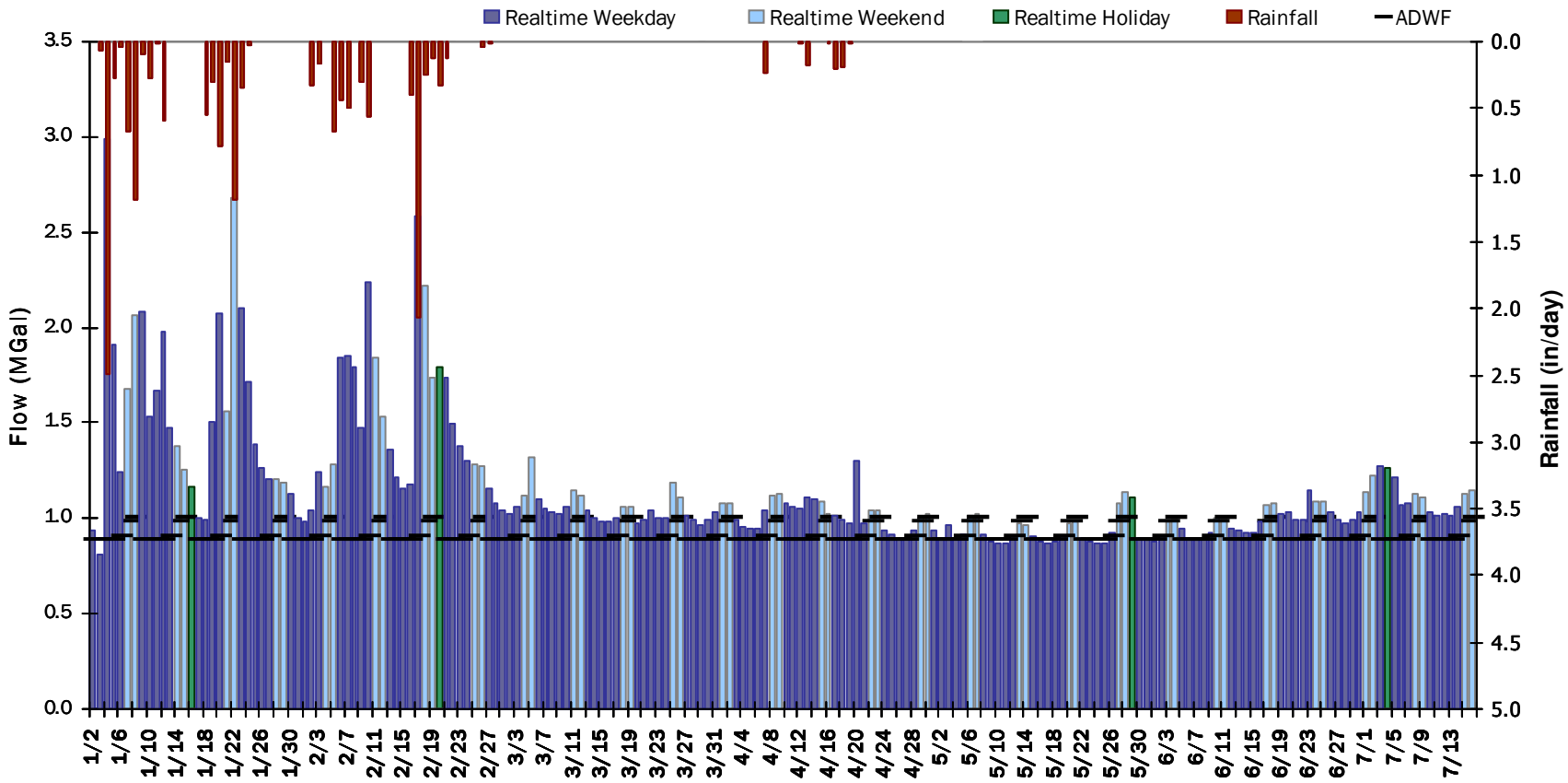






WWTP FLUME

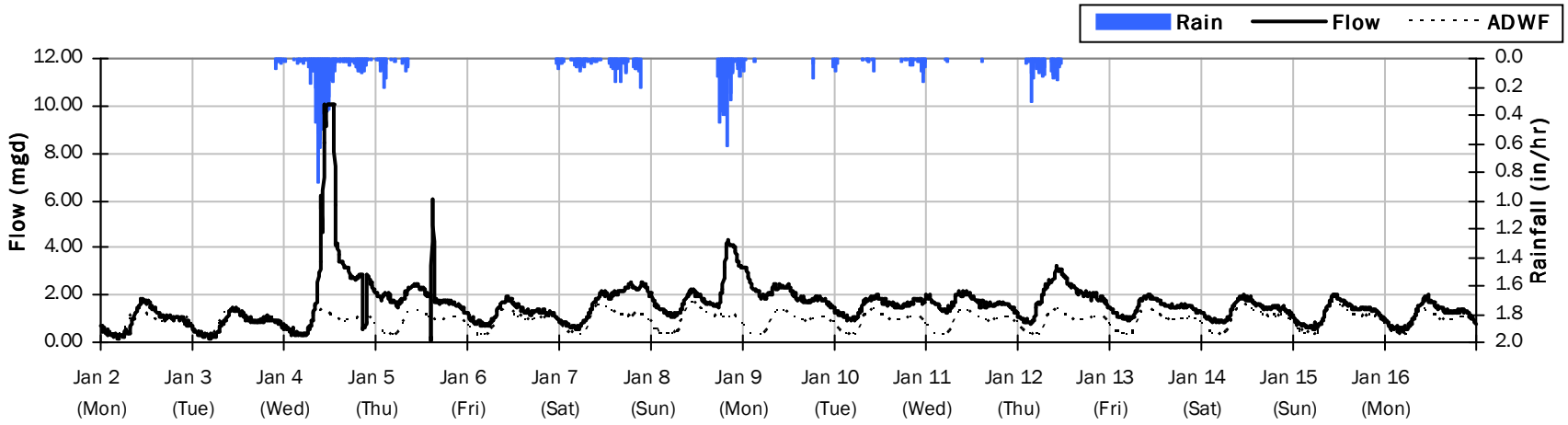
Period Flow Summary: Daily Flow Totals

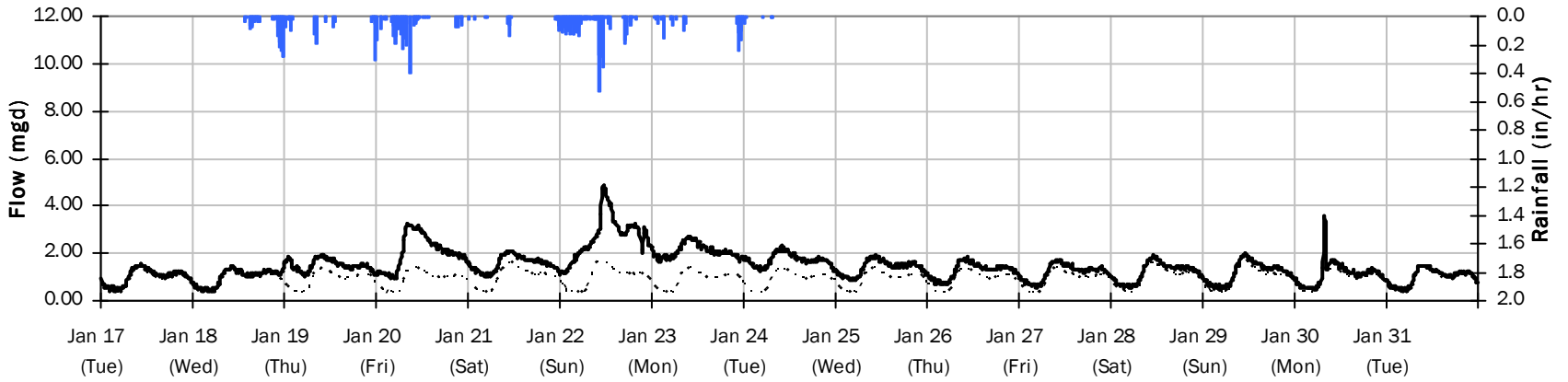


WWTP FLUME

Flow Summary: 1/2/2017 to 1/31/2017

Total Period Rainfall: 9.05 inches **Avg Flow: 1.538 mgd Peak Flow: 10.076 mgd Min Flow: 0.176 mgd**

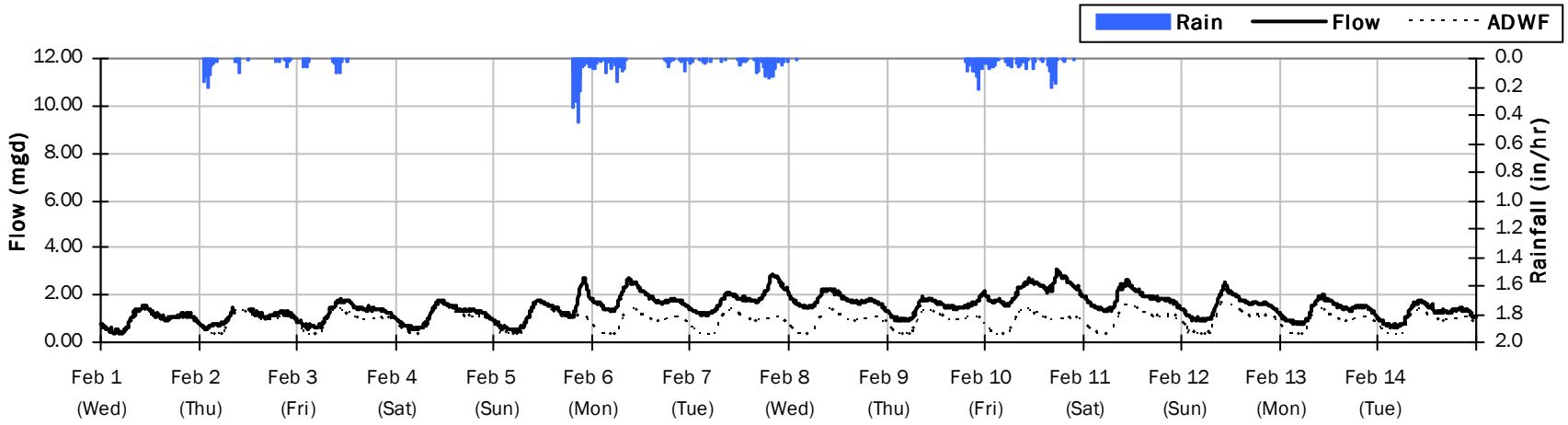


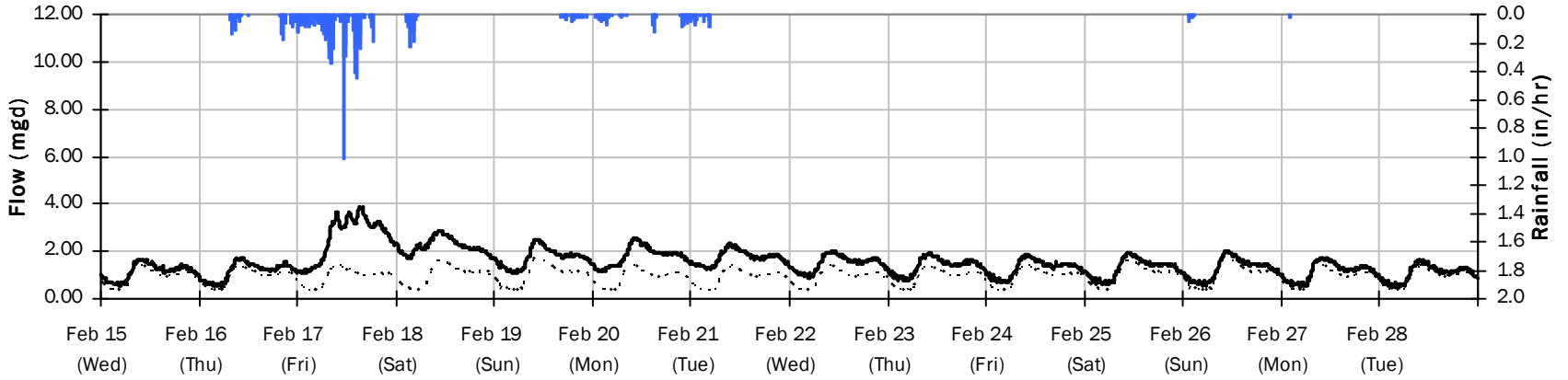


WWTP FLUME

Flow Summary: 2/1/2017 to 2/28/2017

Total Period Rainfall: 6.32 inches **Avg Flow: 1.510 mgd** **Peak Flow: 3.875 mgd** **Min Flow: 0.373 mgd**

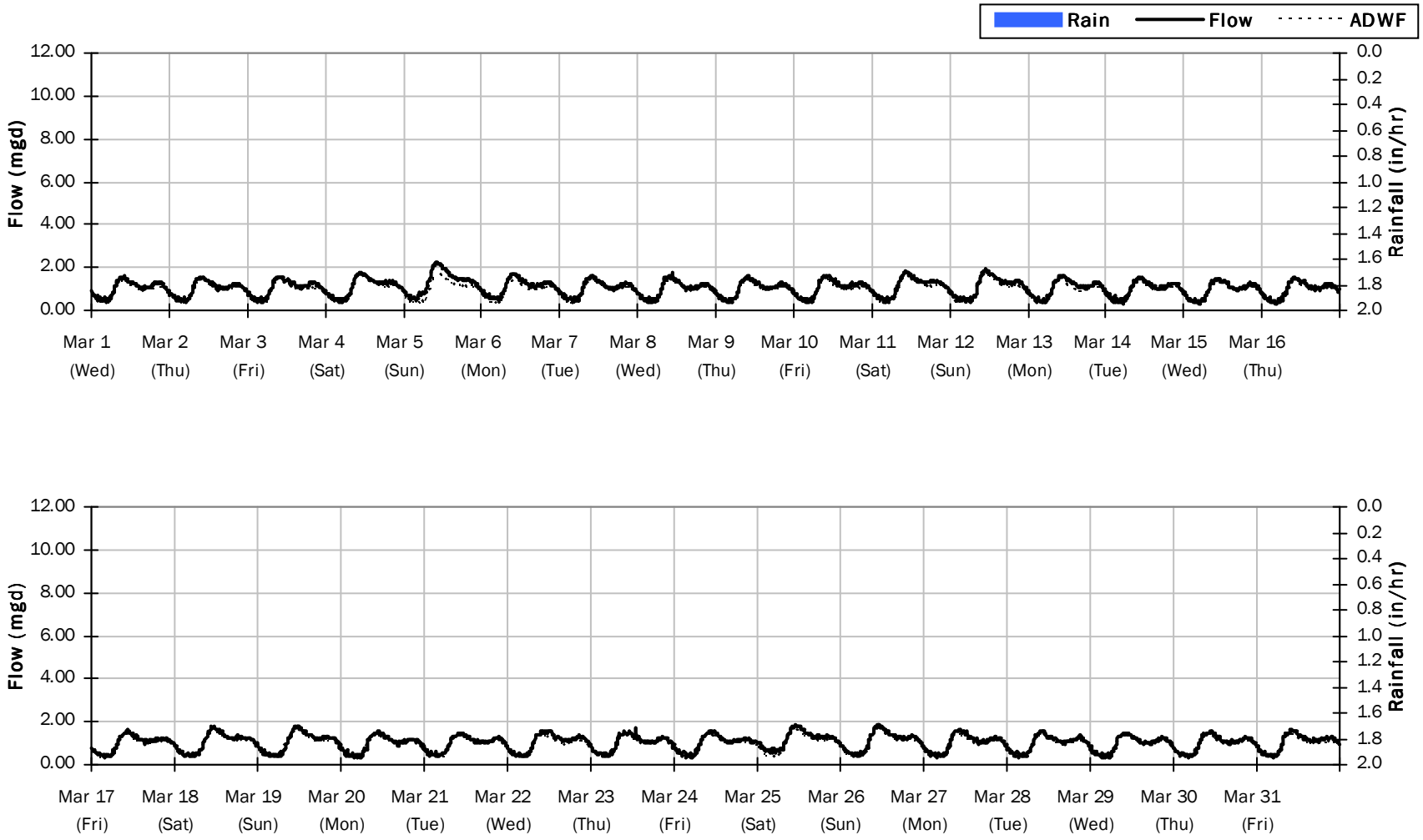




WWTP FLUME

Flow Summary: 3/1/2017 to 3/31/2017

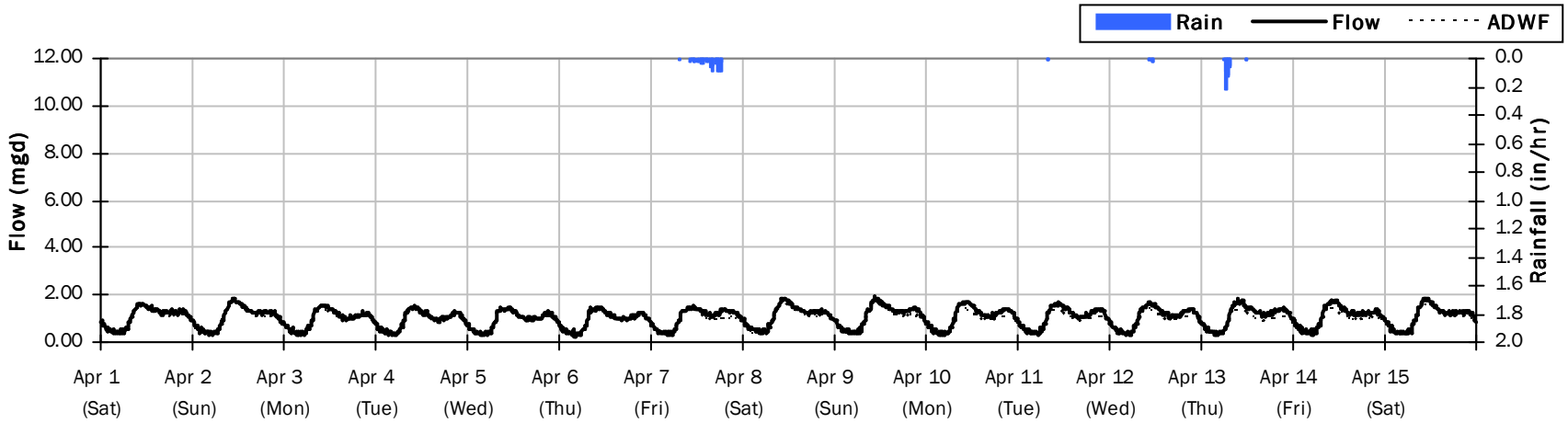
Total Period Rainfall: 0.00 inches **Avg Flow: 1.050 mgd Peak Flow: 2.262 mgd Min Flow: 0.312 mgd**

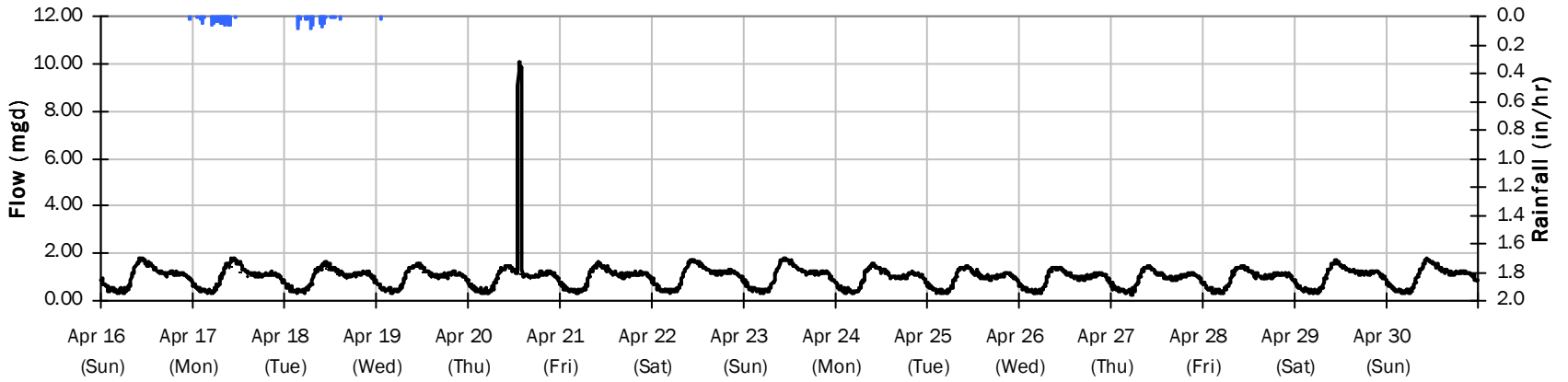


WWTP FLUME

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 1.024 mgd** **Peak Flow: 10.076 mgd** **Min Flow: 0.264 mgd**

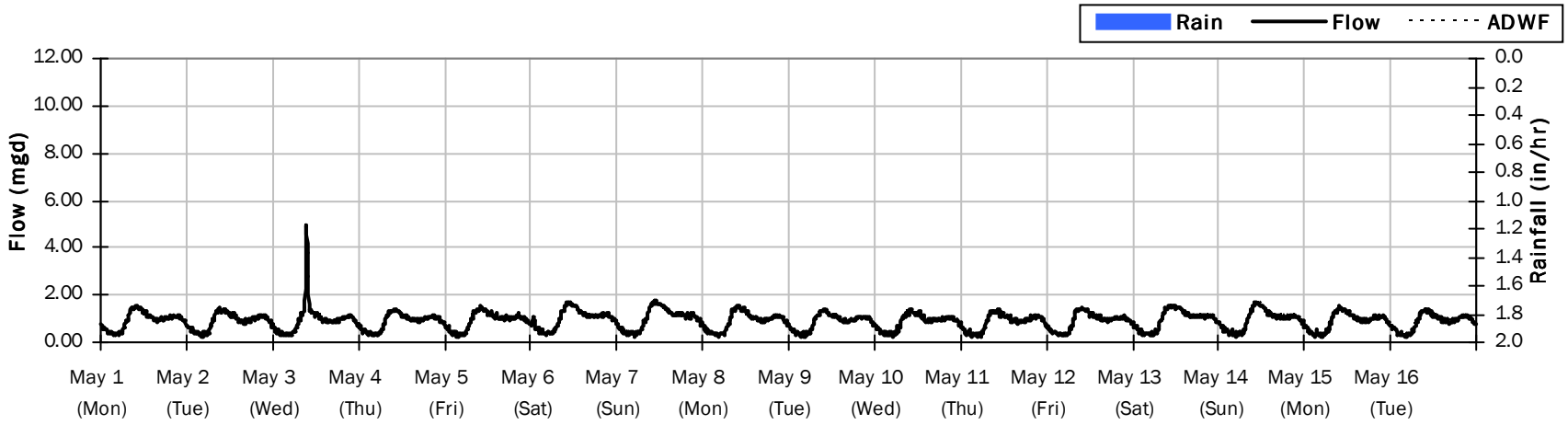


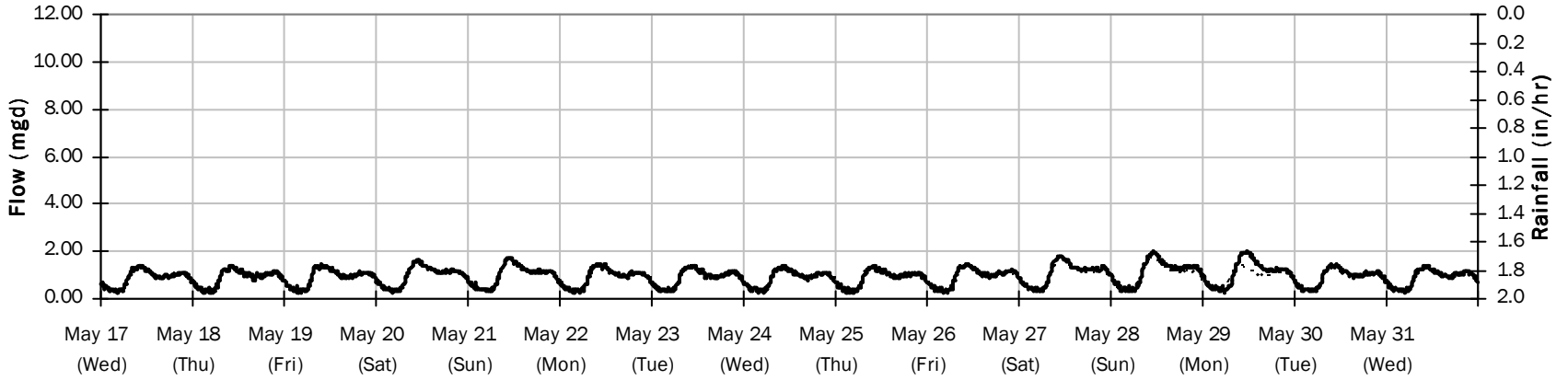


WWTP FLUME

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.933 mgd** **Peak Flow: 4.888 mgd** **Min Flow: 0.232 mgd**

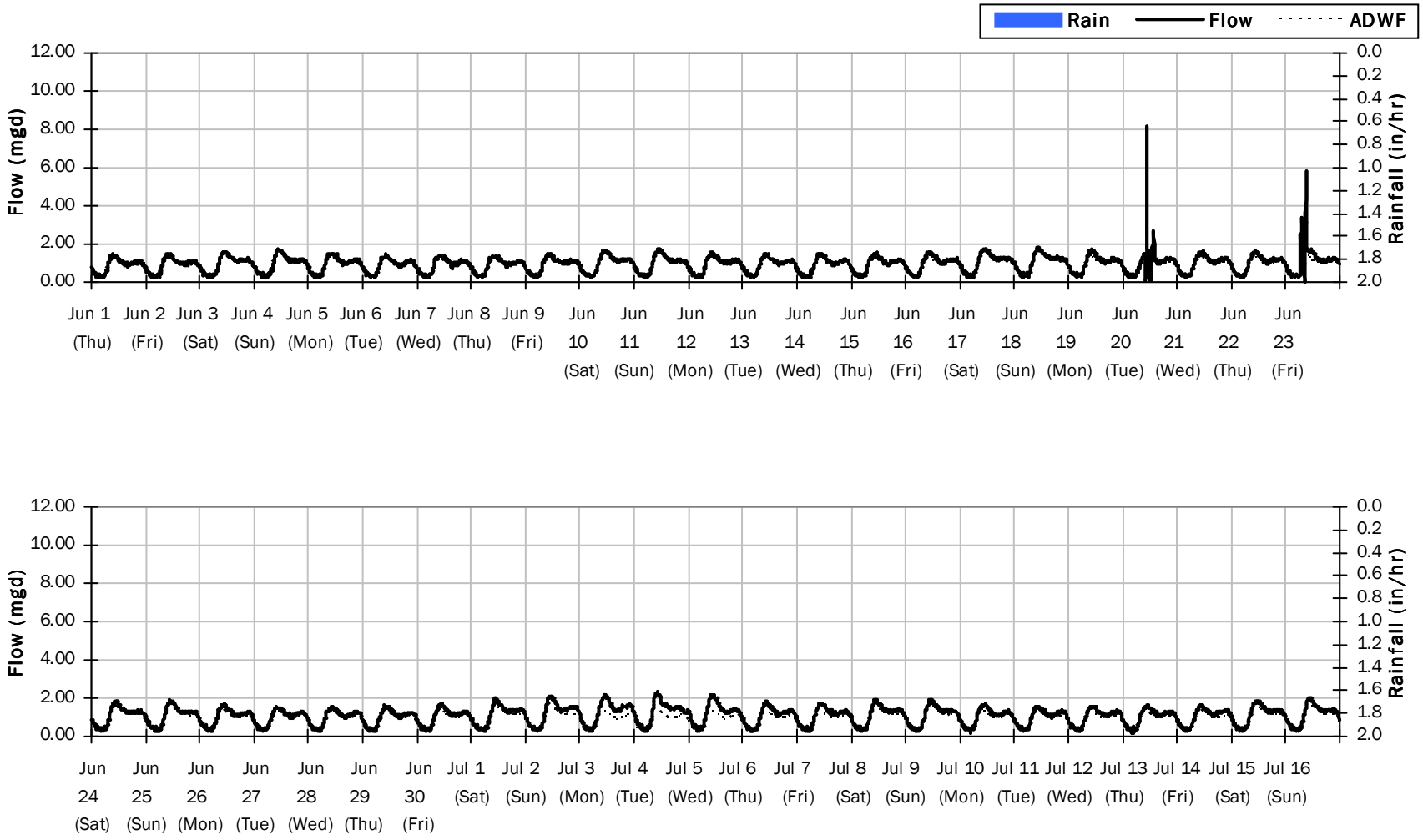




WWTP FLUME

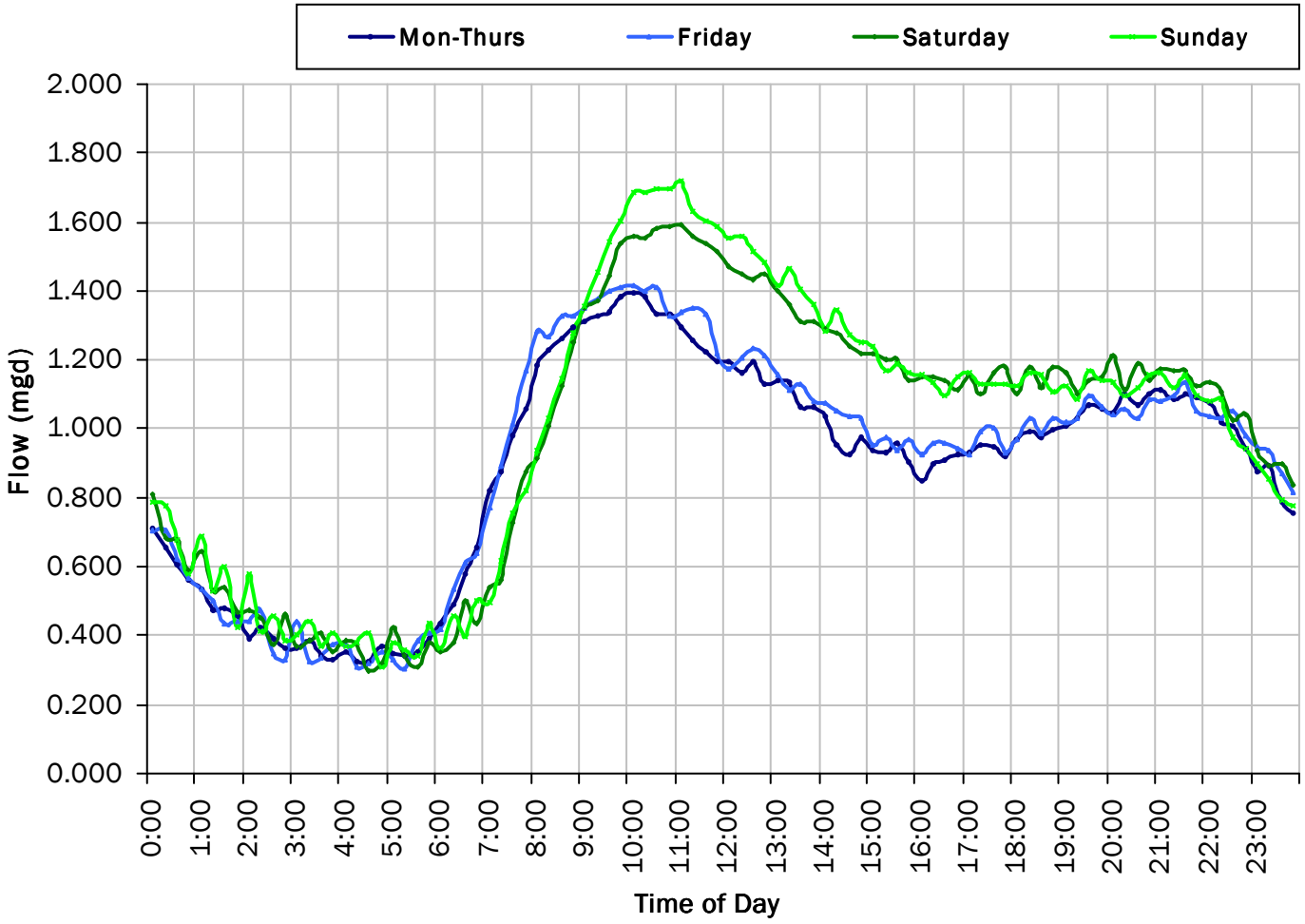
Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 1.033 mgd** **Peak Flow: 8.212 mgd** **Min Flow: 0.035 mgd**



WWTP FLUME

Average Dry Weather Flow Hydrographs

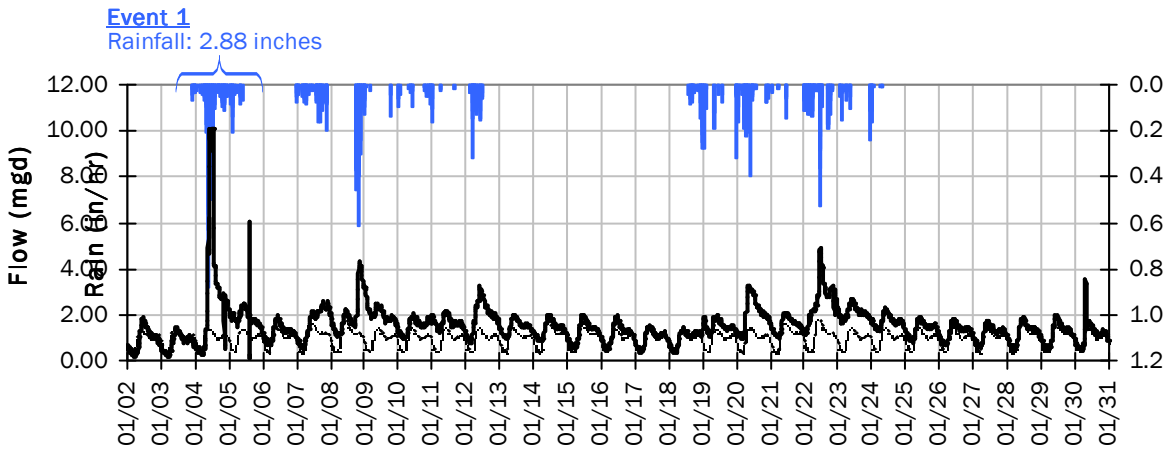


ADWF:

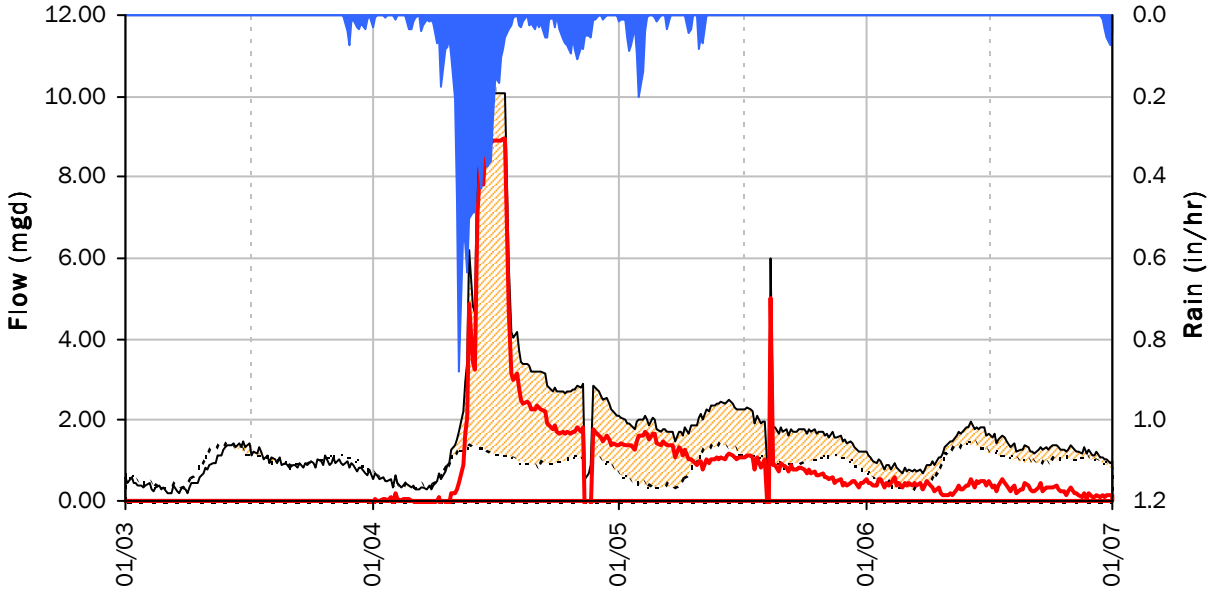
0.920 *mgd*

WWTP FLUME
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

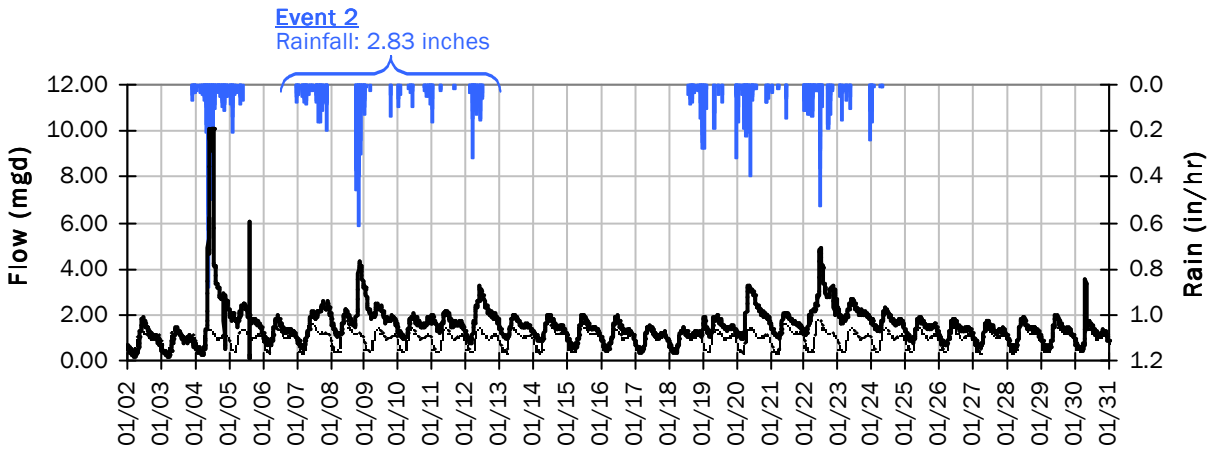


Storm Event I/I Analysis (Rain = 2.88 inches)

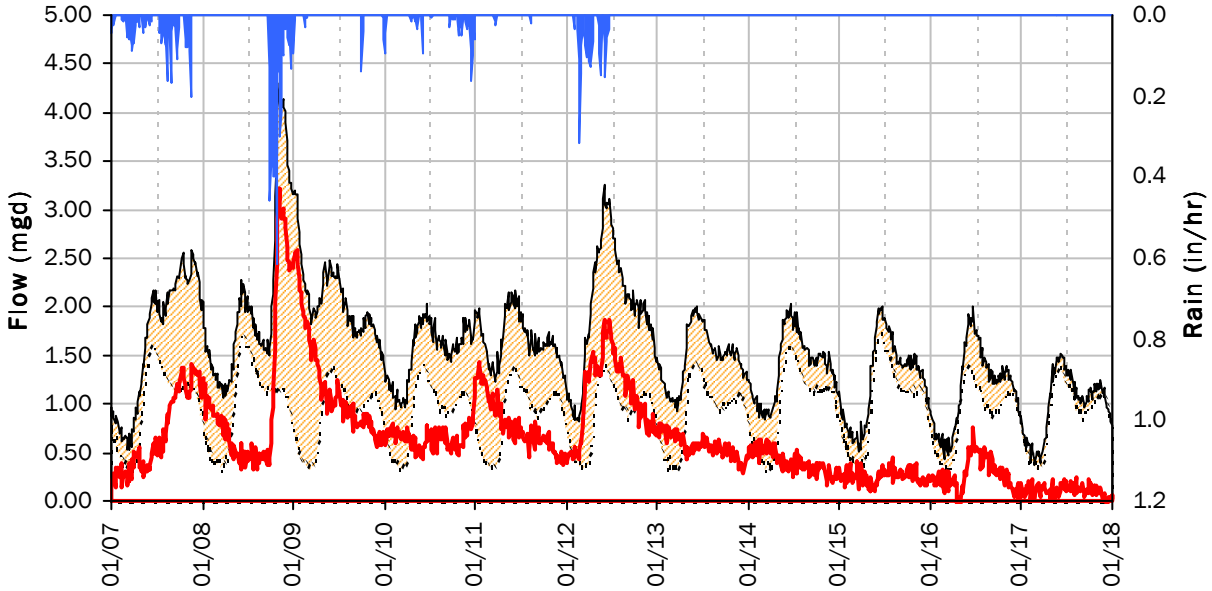
Capacity		Inflow / Infiltration	
Peak Flow:	10.08 *mgd*	**Peak I/I Rate:**	8.94 *mgd*
PF:	10.96	**Total I/I:**	3,447,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP FLUME
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

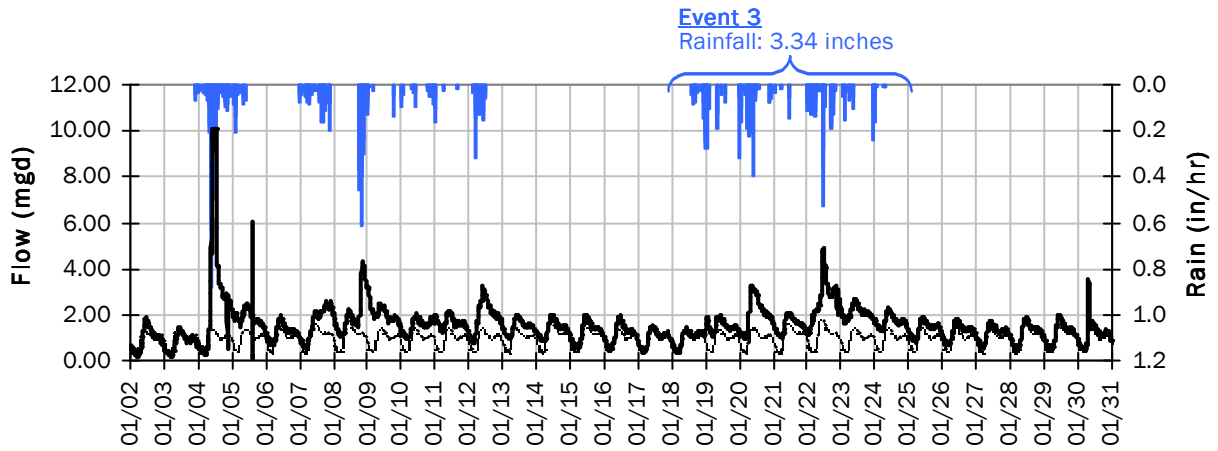


Storm Event I/I Analysis (Rain = 2.83 inches)

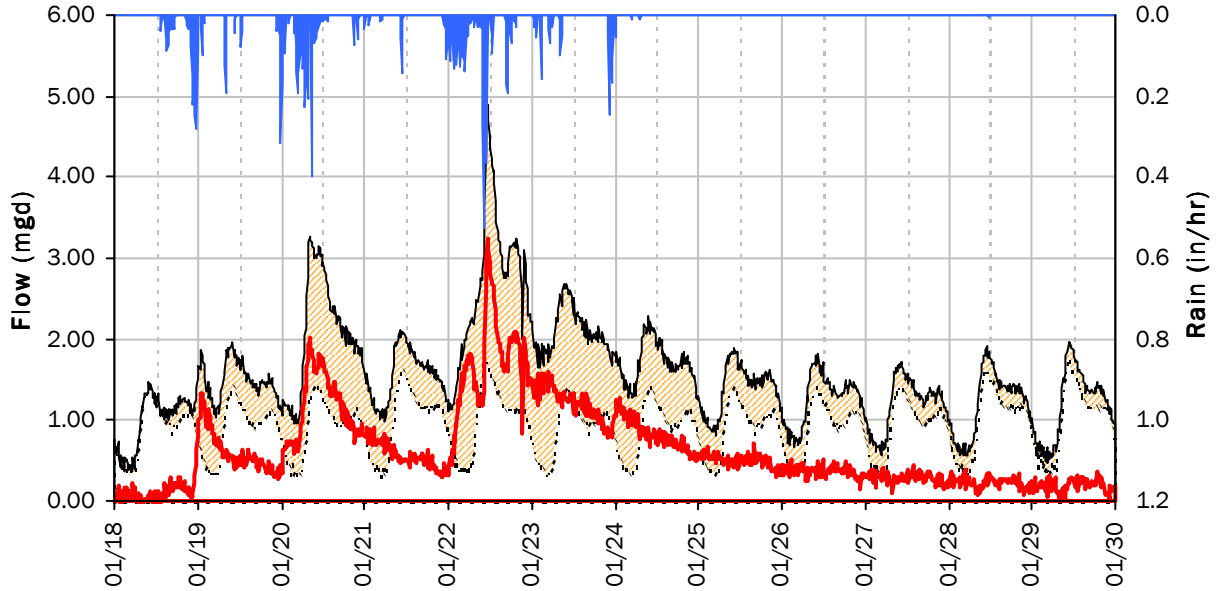
Capacity		Inflow / Infiltration	
Peak Flow:	4.31 *mgd*	**Peak I/I Rate:**	3.21 *mgd*
PF:	4.68	**Total I/I:**	7,080,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP FLUME
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

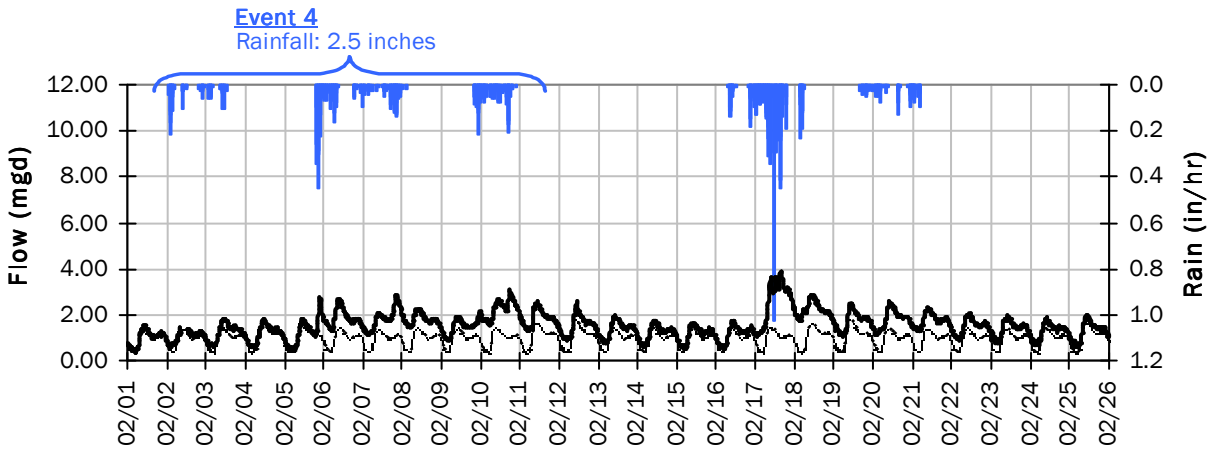


Storm Event I/I Analysis (Rain = 3.35 inches)

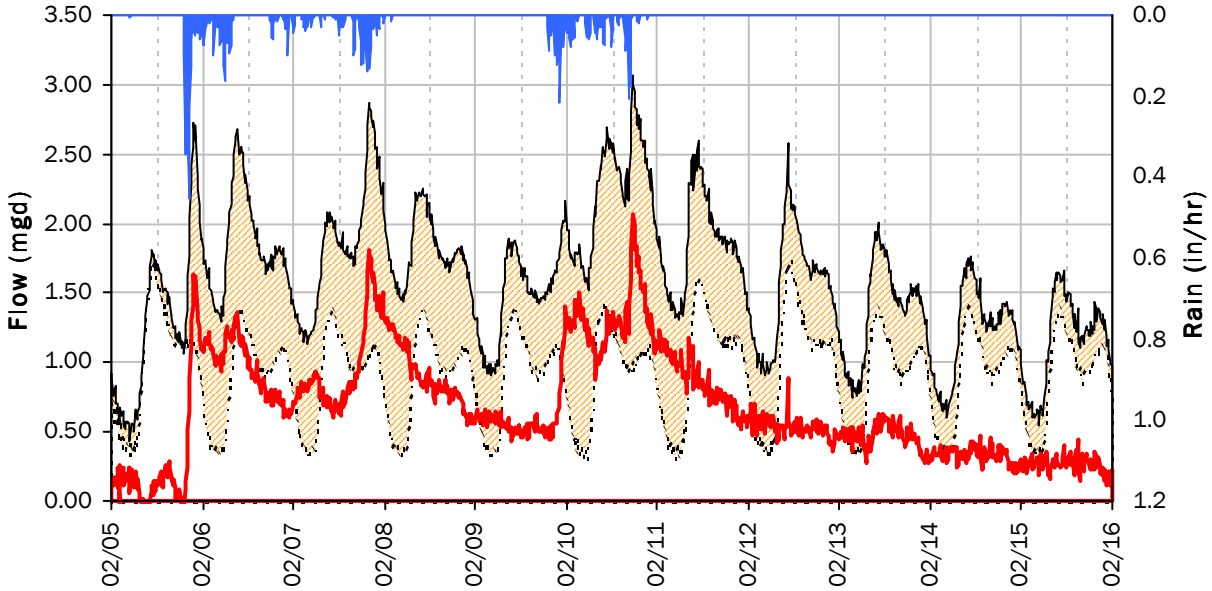
Capacity		Inflow / Infiltration	
Peak Flow:	4.89 *mgd*	**Peak I/I Rate:**	3.26 *mgd*
PF:	5.32	**Total I/I:**	7,778,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP FLUME
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph

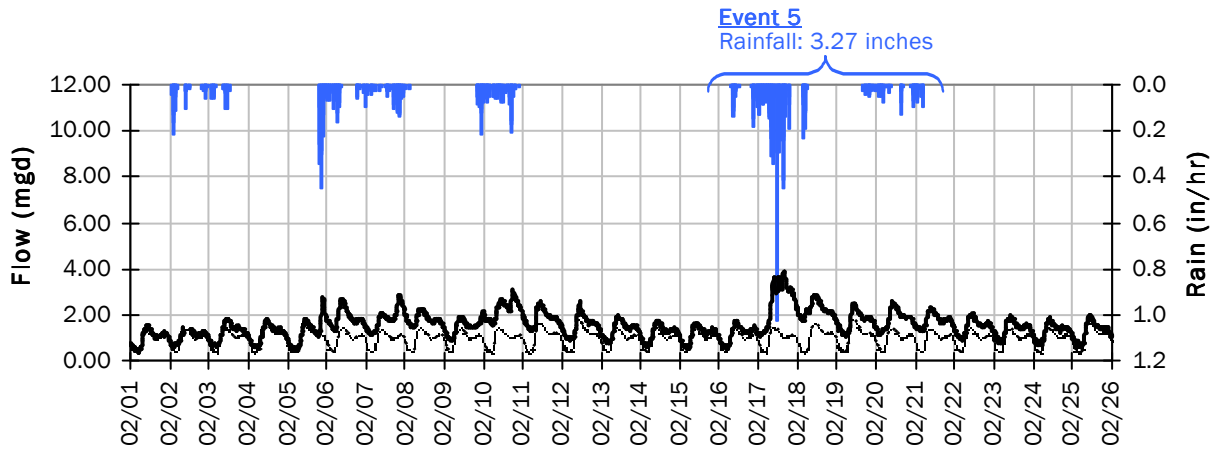


Storm Event I/I Analysis (Rain = 2.50 inches)

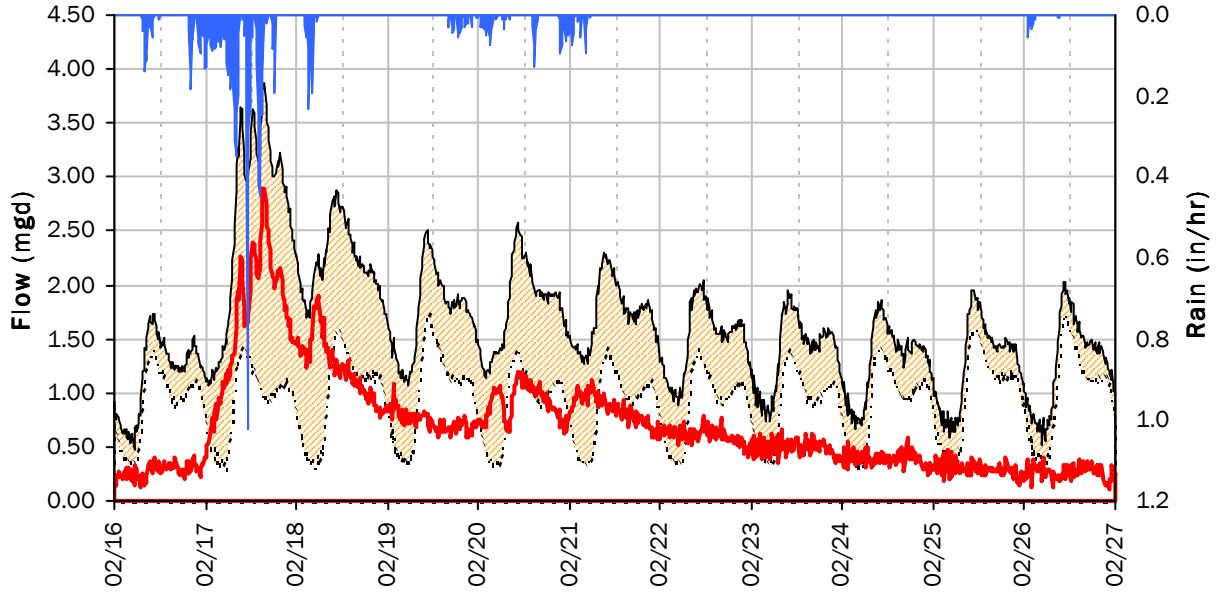
Capacity		Inflow / Infiltration	
Peak Flow:	3.07 *mgd*	**Peak I/I Rate:**	2.06 *mgd*
PF:	3.33	**Total I/I:**	7,472,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP FLUME
I/I Summary: Event 5

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 5 Detail Graph



Storm Event I/I Analysis (Rain = 3.28 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	3.87 *mgd*	**Peak I/I Rate:**	2.90 *mgd*
PF:	4.21	**Total I/I:**	7,763,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Morro Bay

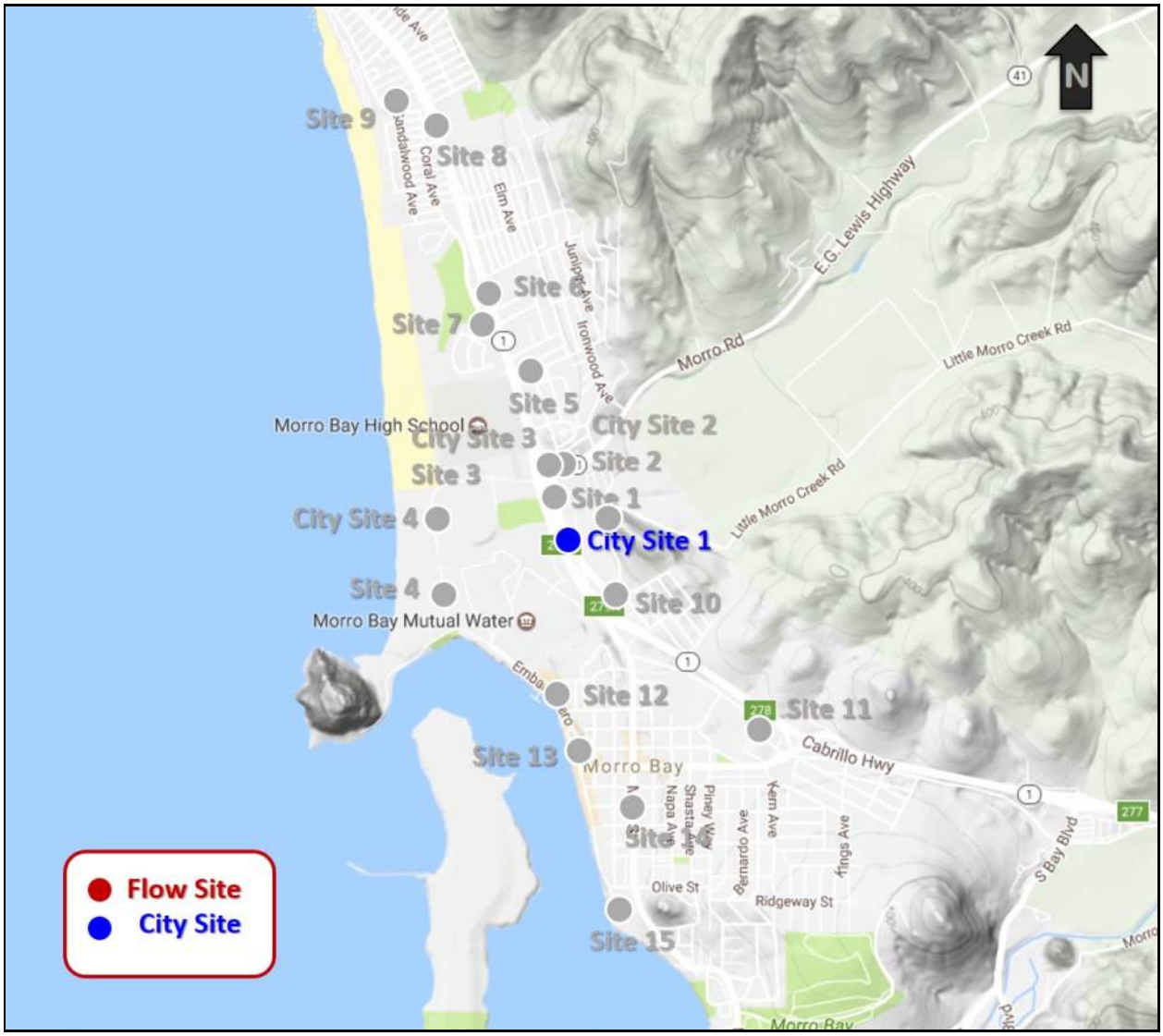
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - February 2017

Monitoring Site: MB 1

Location: City Meter at MH 13.36, Main Street ~225 feet south of Errol Street, meter on south 12" inlet

Data Summary Report



Vicinity Map: MB 1

MB 1

Site Information

Location: City Meter at MH 13.36, Main Street ~225 feet south of Errol Street, meter on south 12" inlet

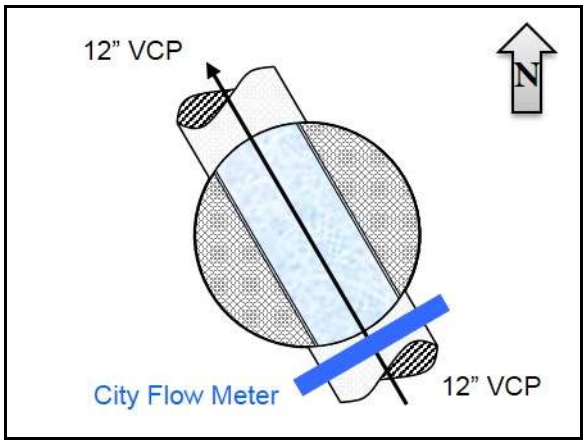


Pipe Diameter: 12 inches

ADWF: 0.167 mgd

Peak Measured Flow: 0.928 mgd







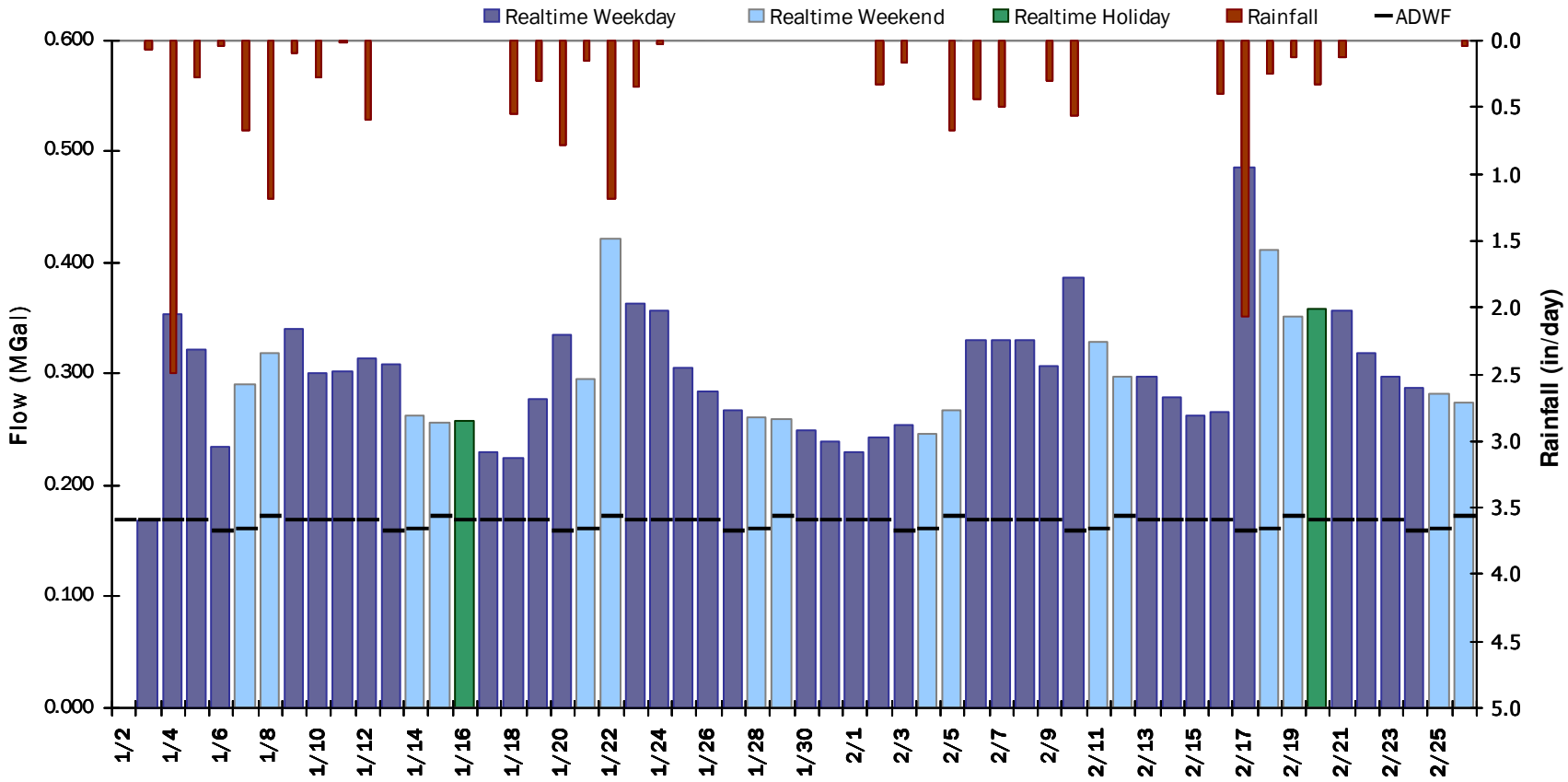
No Photo

MB 1

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.300 MGal **Peak Daily Flow: 0.487 MGal** **Min Daily Flow: 0.169 MGal**

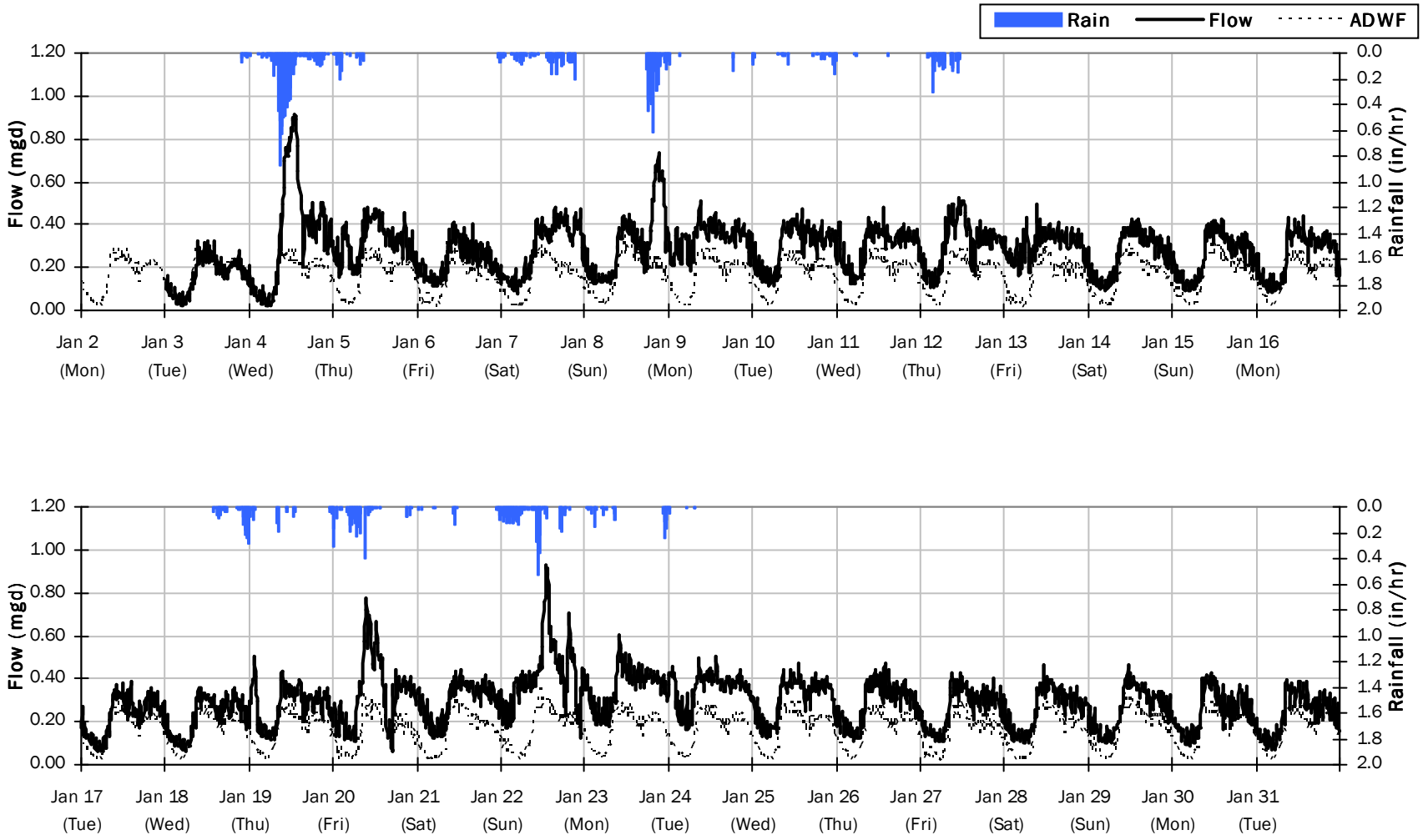
Total Period Rainfall: 15.37 inches



MB 1

Flow Summary: 1/2/2017 to 1/31/2017

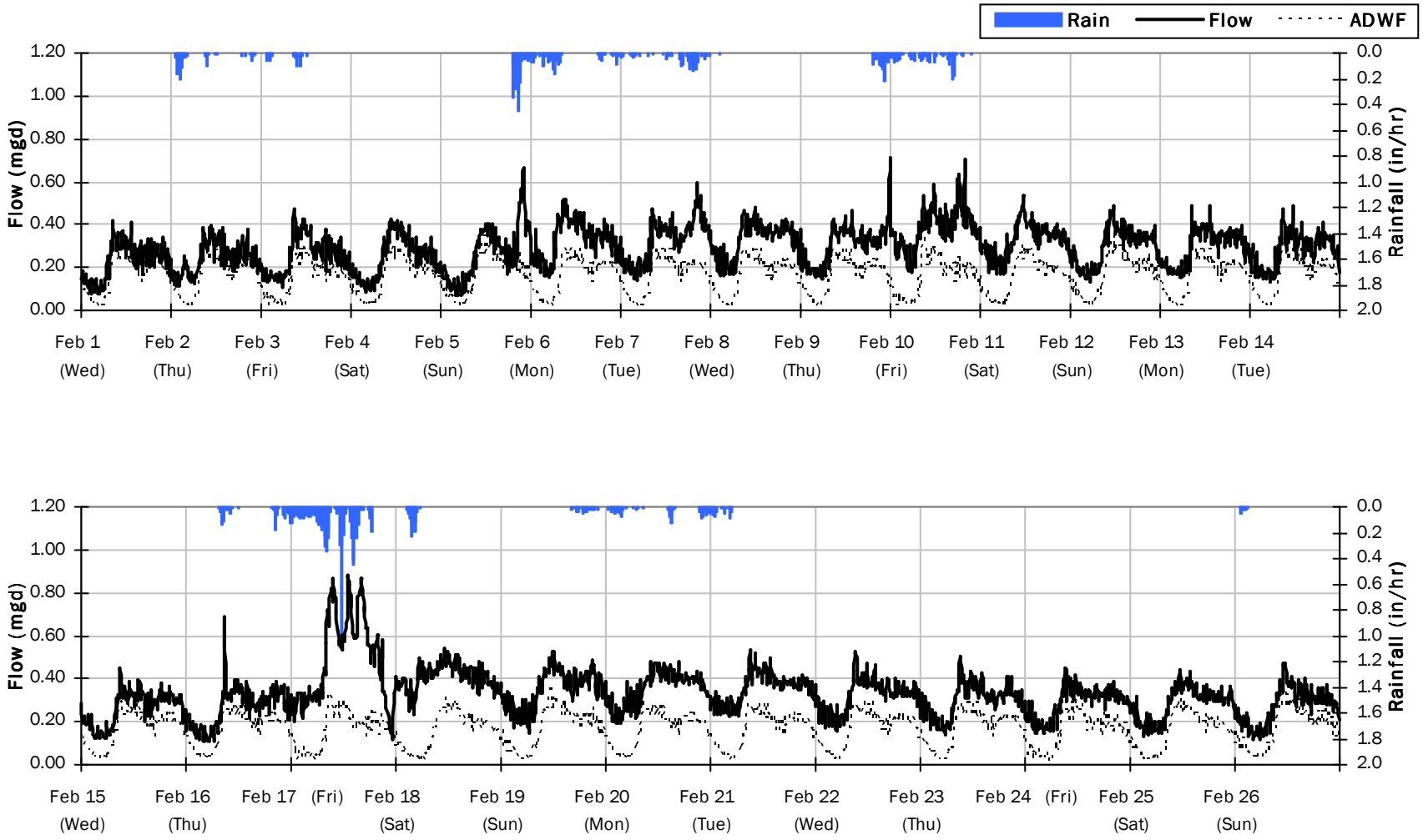
Total Period Rainfall: 9.05 inches **Avg Flow: 0.290 mgd** **Peak Flow: 0.928 mgd** **Min Flow: 0.024 mgd**



MB 1

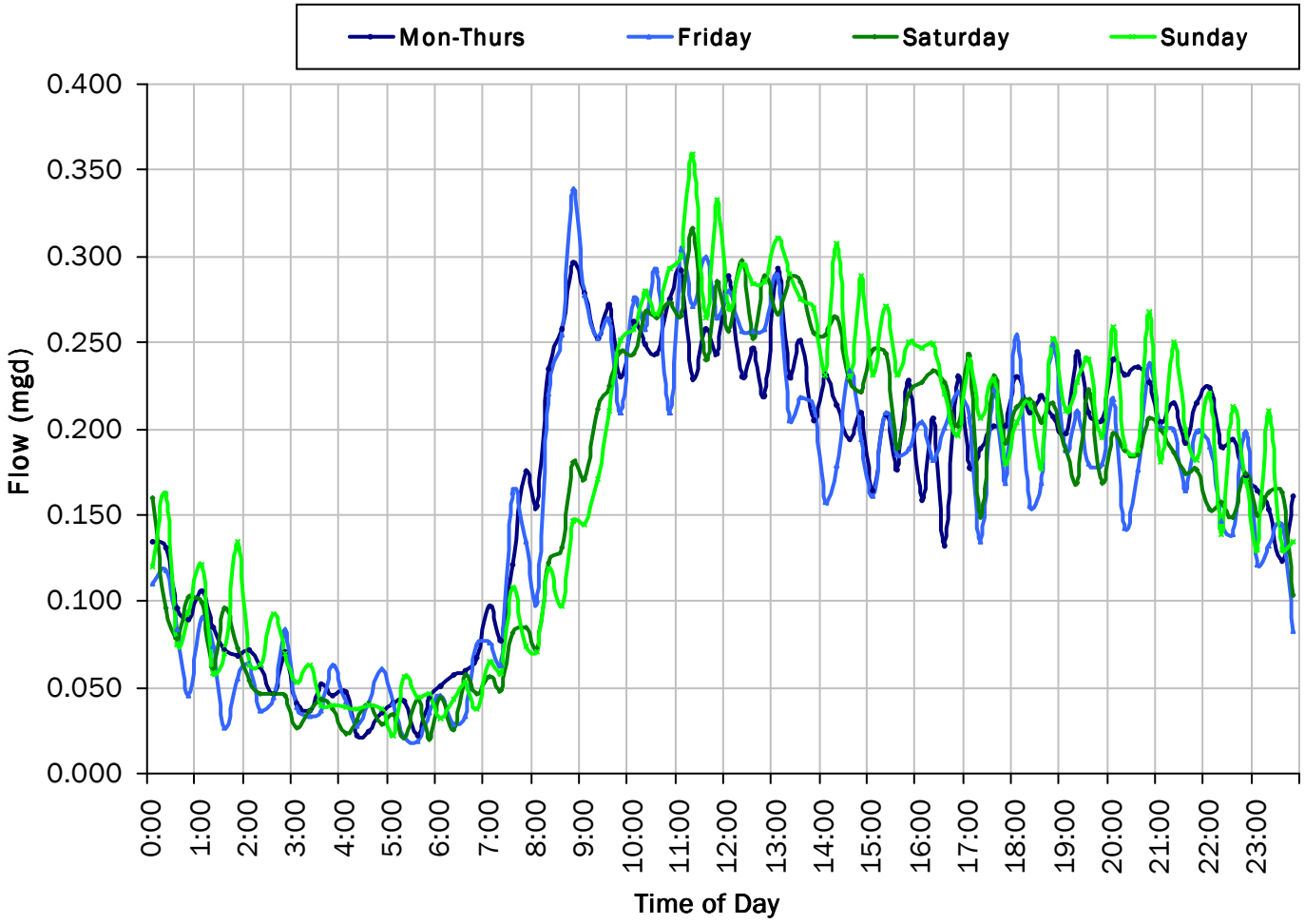
Flow Summary: 2/1/2017 to 2/28/2017

Total Period Rainfall: 6.31 inches **Avg Flow: 0.311 mgd** **Peak Flow: 0.872 mgd** **Min Flow: 0.070 mgd**



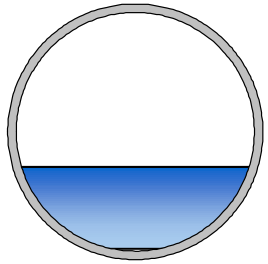
MB 1

Average Dry Weather Flow Hydrographs



ADWF:

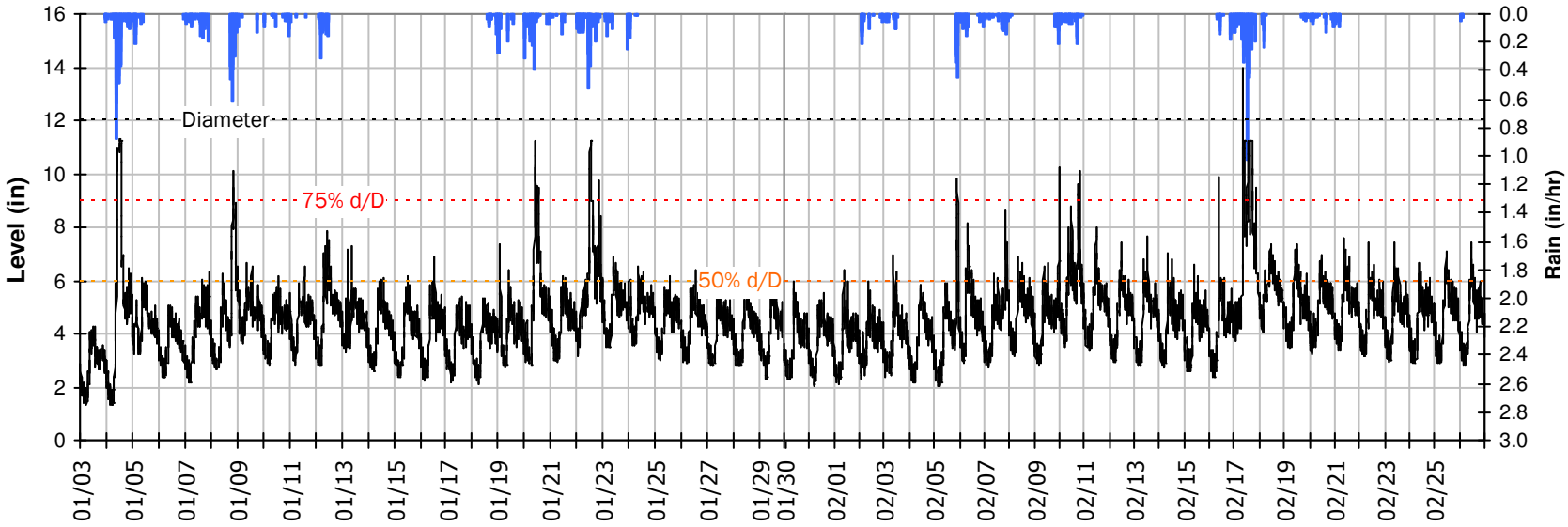
0.167 *mgd*

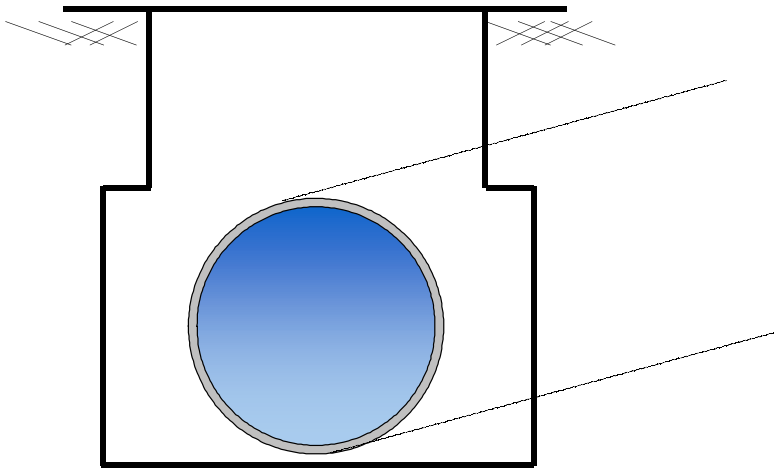


MB 1

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



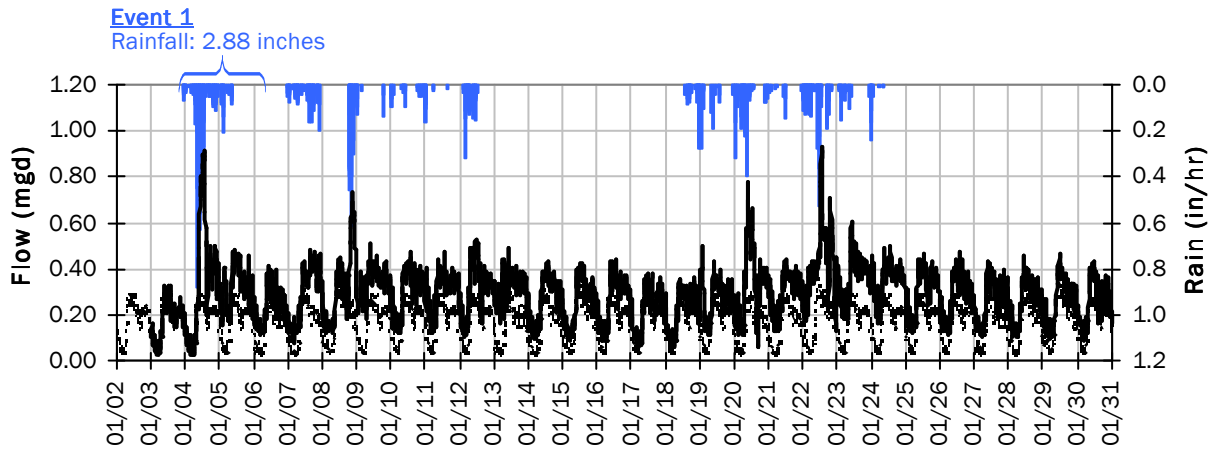


Pipe Diameter:	12	*inches*
Peak Measured Level:	14	*inches*
Peak d/D Ratio:	1.17	

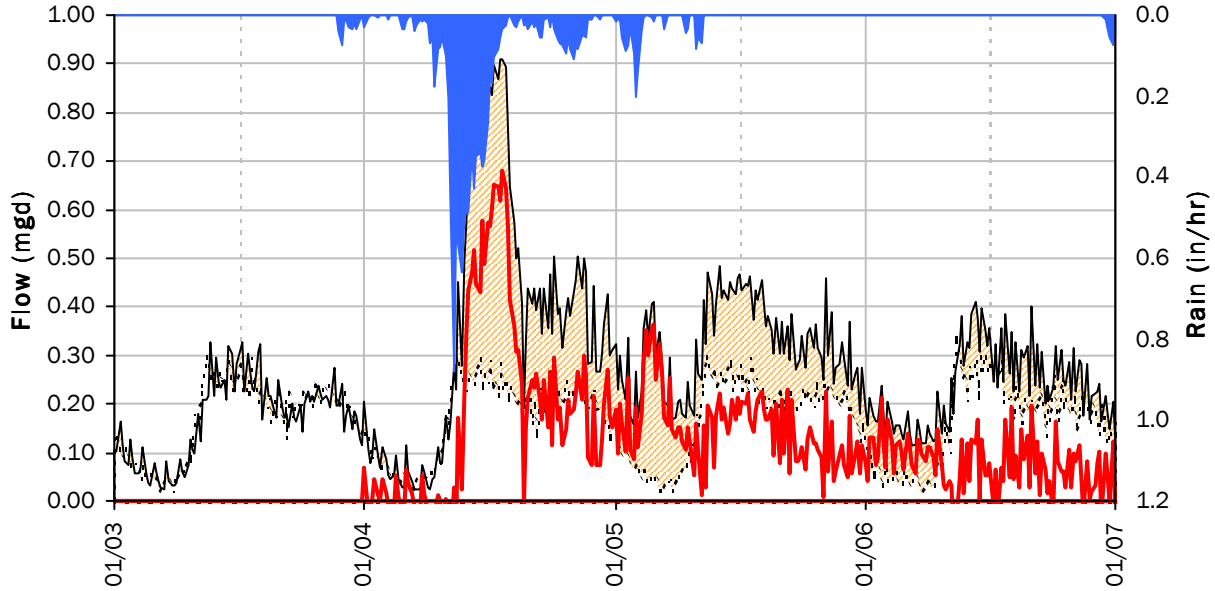
Surcharged 2.0 inches over crown

MB 1
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

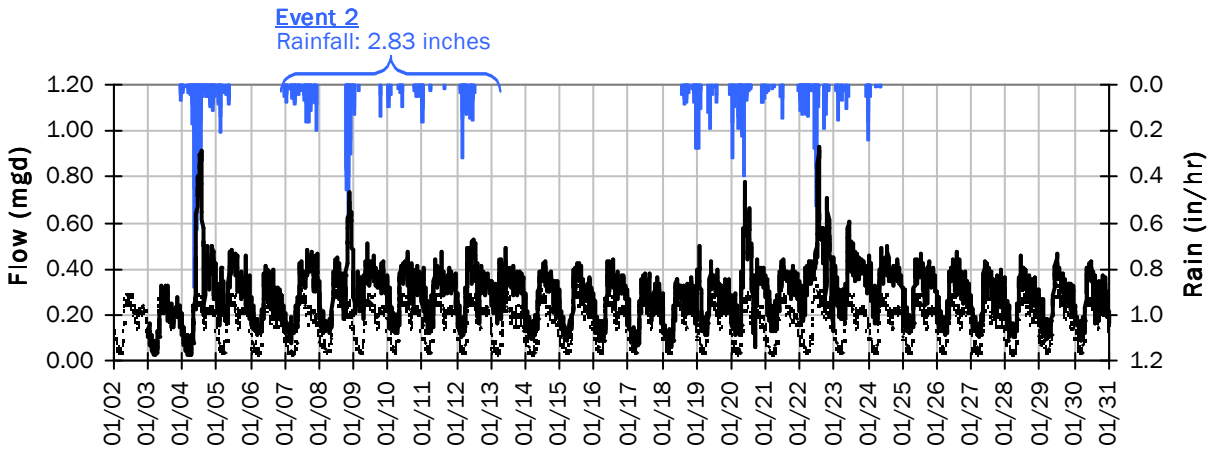


Storm Event I/I Analysis (Rain = 2.88 inches)

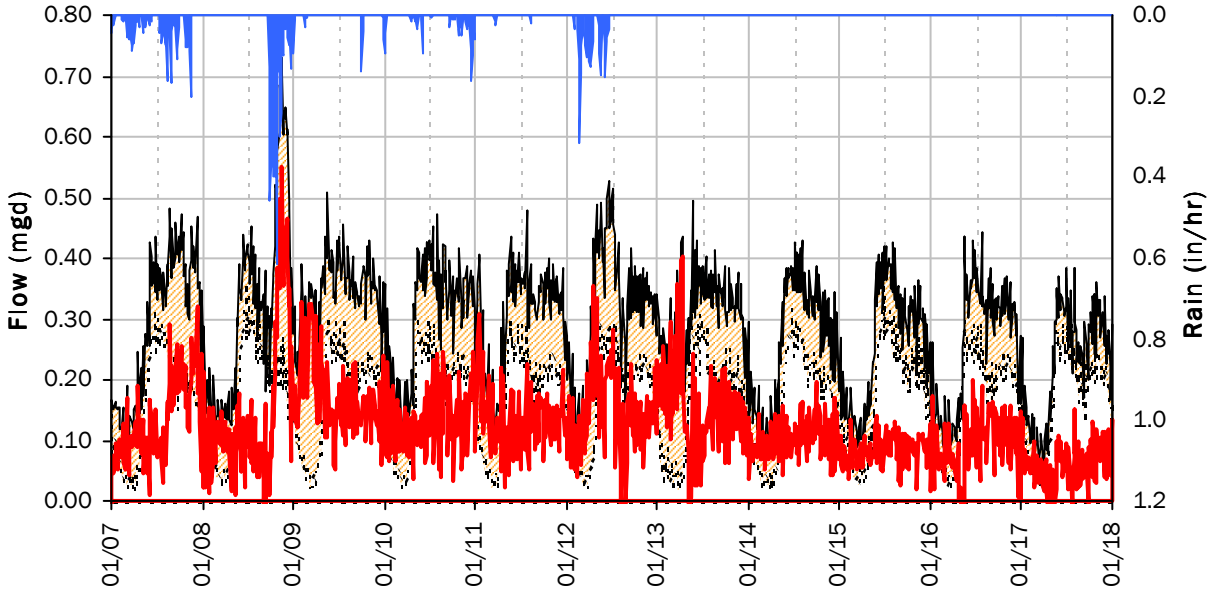
Capacity		Inflow / Infiltration	
Peak Flow:	0.91 *mgd*	**Peak I/I Rate:**	0.68 *mgd*
PF:	5.47	**Total I/I:**	414,000 *gallons*
Peak Level:	11.29 *in*		
d/D Ratio:	0.94		

MB 1
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

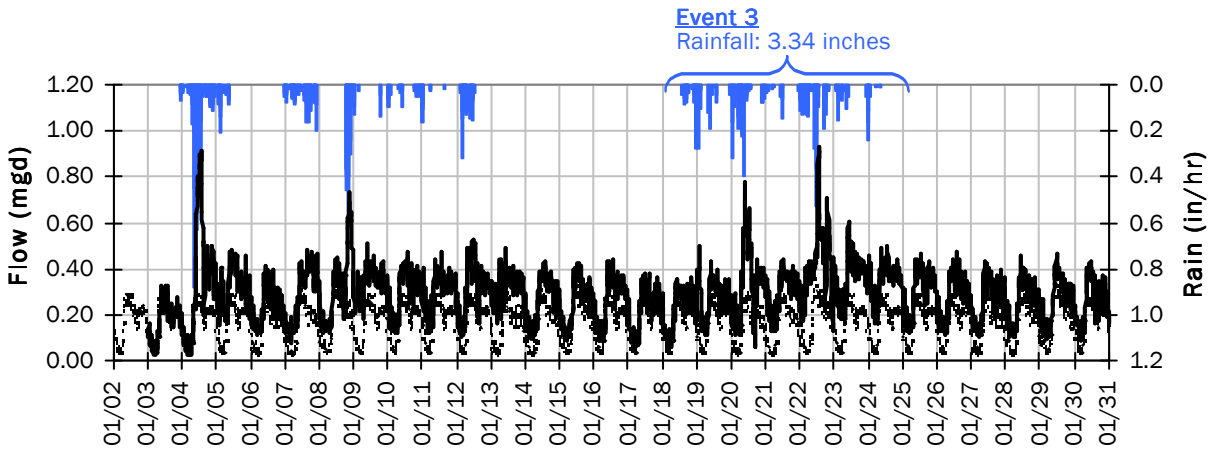


Storm Event I/I Analysis (Rain = 2.83 inches)

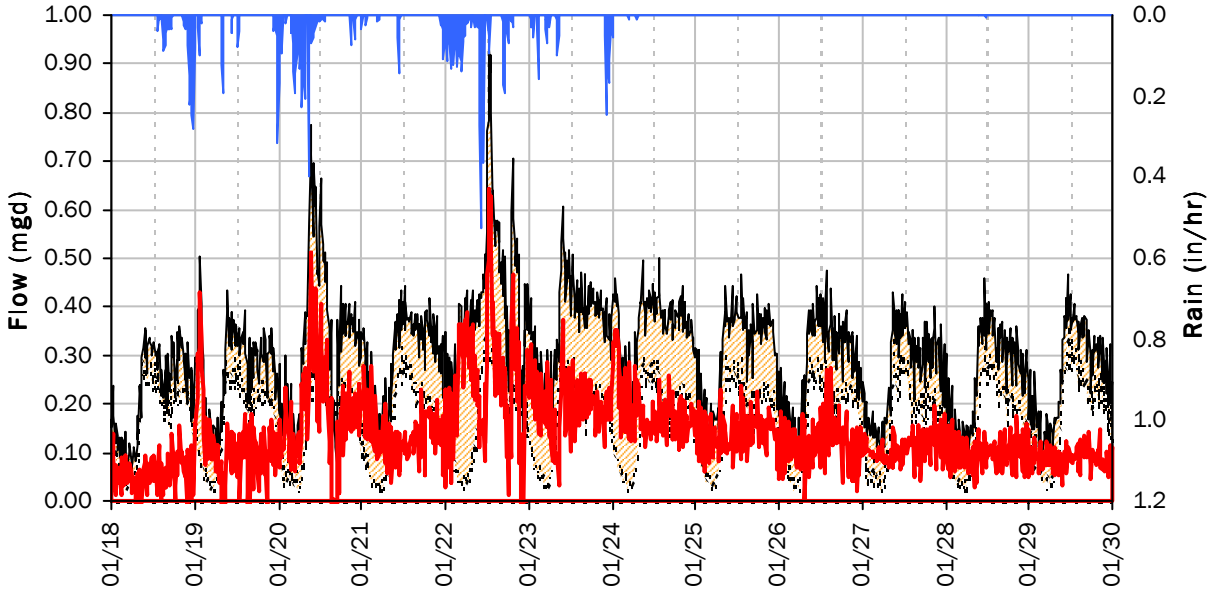
Capacity		Inflow / Infiltration	
Peak Flow:	0.73 *mgd*	**Peak I/I Rate:**	0.55 *mgd*
PF:	4.40	**Total I/I:**	1,345,000 *gallons*
Peak Level:	10.14 *in*		
d/D Ratio:	0.85		

MB 1
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

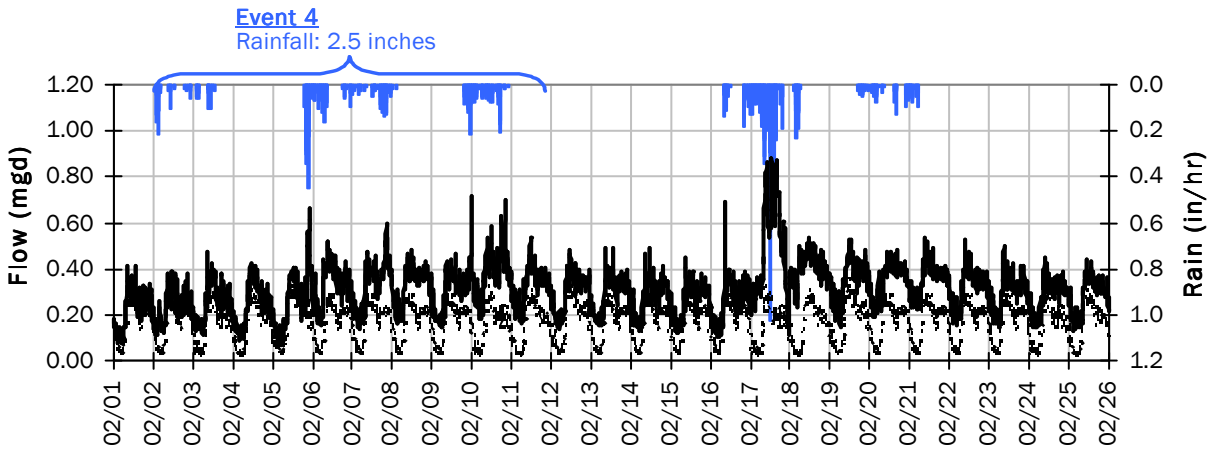


Storm Event I/I Analysis (Rain = 3.35 inches)

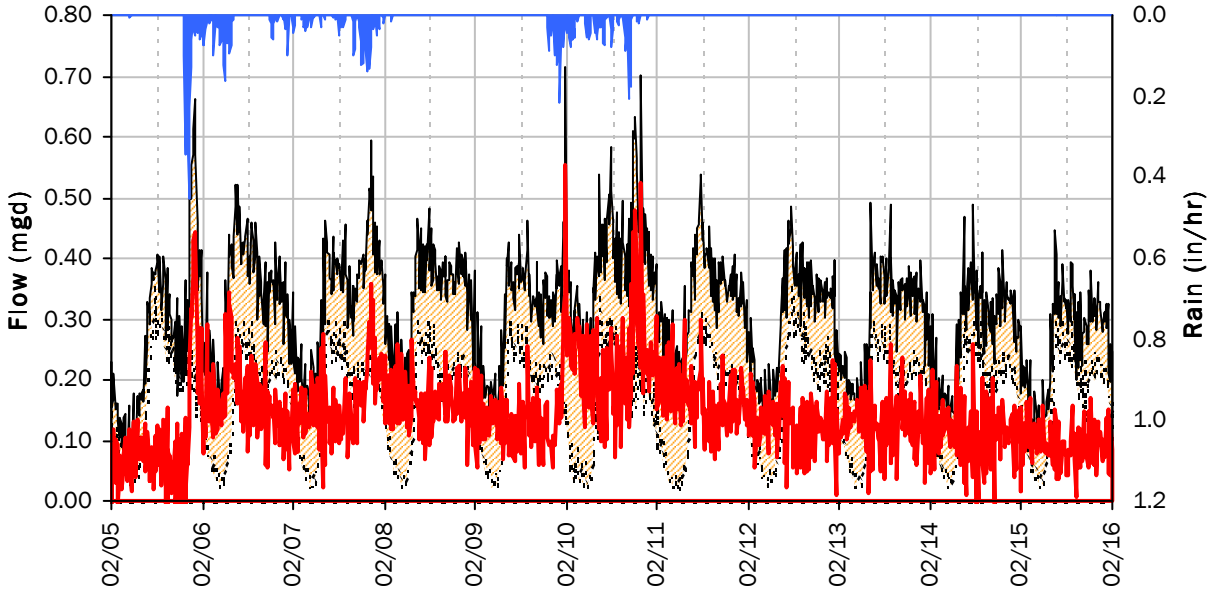
Capacity		Inflow / Infiltration	
Peak Flow:	0.93 *mgd*	**Peak I/I Rate:**	0.64 *mgd*
PF:	5.57	**Total I/I:**	1,662,000 *gallons*
Peak Level:	11.26 *in*		
d/D Ratio:	0.94		

MB 1
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph

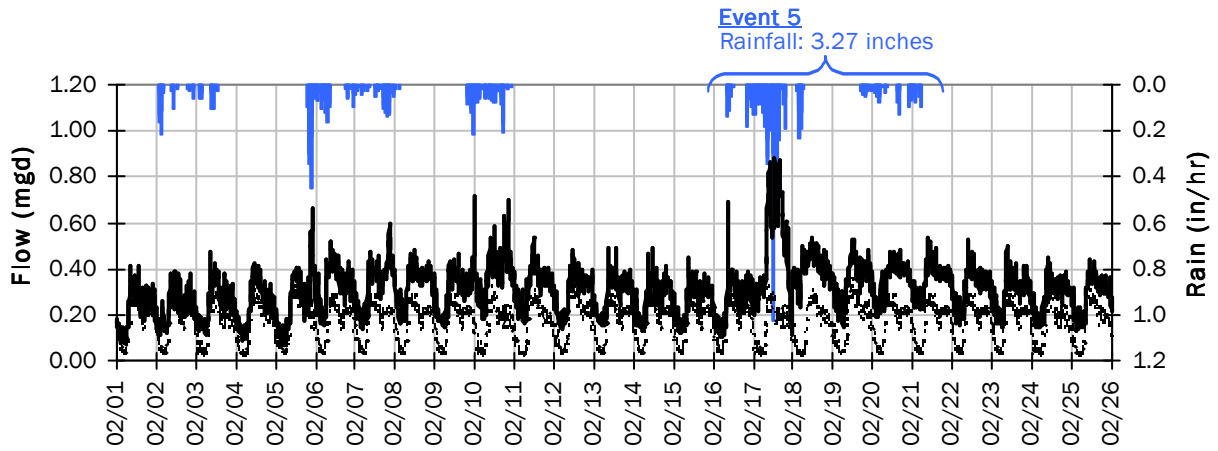


Storm Event I/I Analysis (Rain = 2.50 inches)

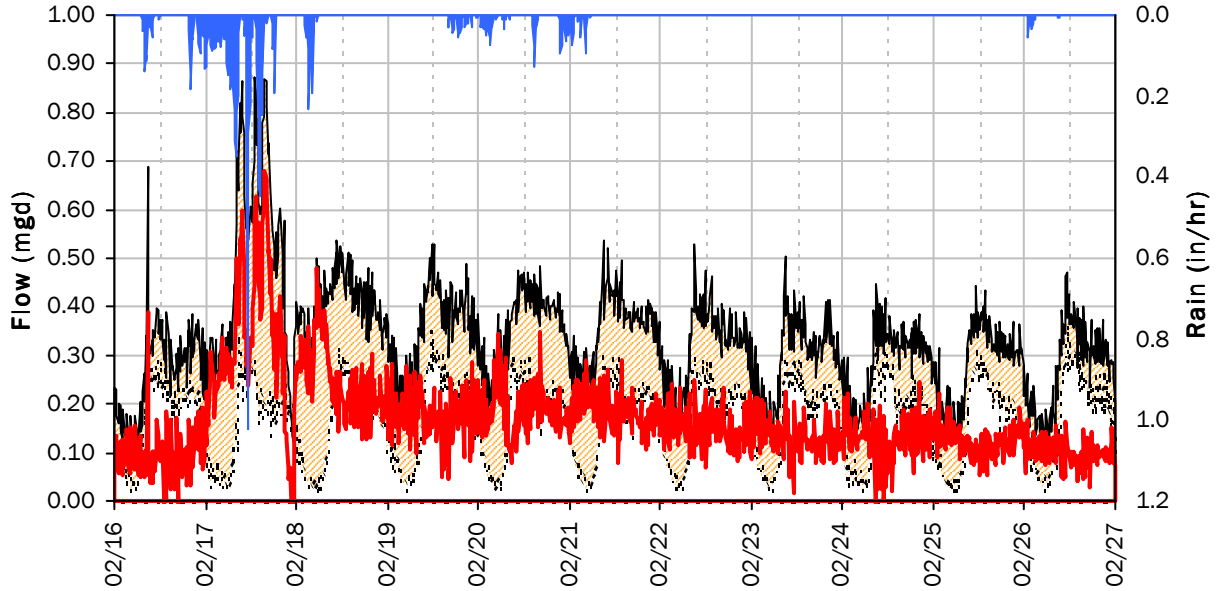
Capacity		Inflow / Infiltration	
Peak Flow:	0.71 *mgd*	**Peak I/I Rate:**	0.55 *mgd*
PF:	4.29	**Total I/I:**	1,577,000 *gallons*
Peak Level:	10.27 *in*		
d/D Ratio:	0.86		

MB 1
I/I Summary: Event 5

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 5 Detail Graph



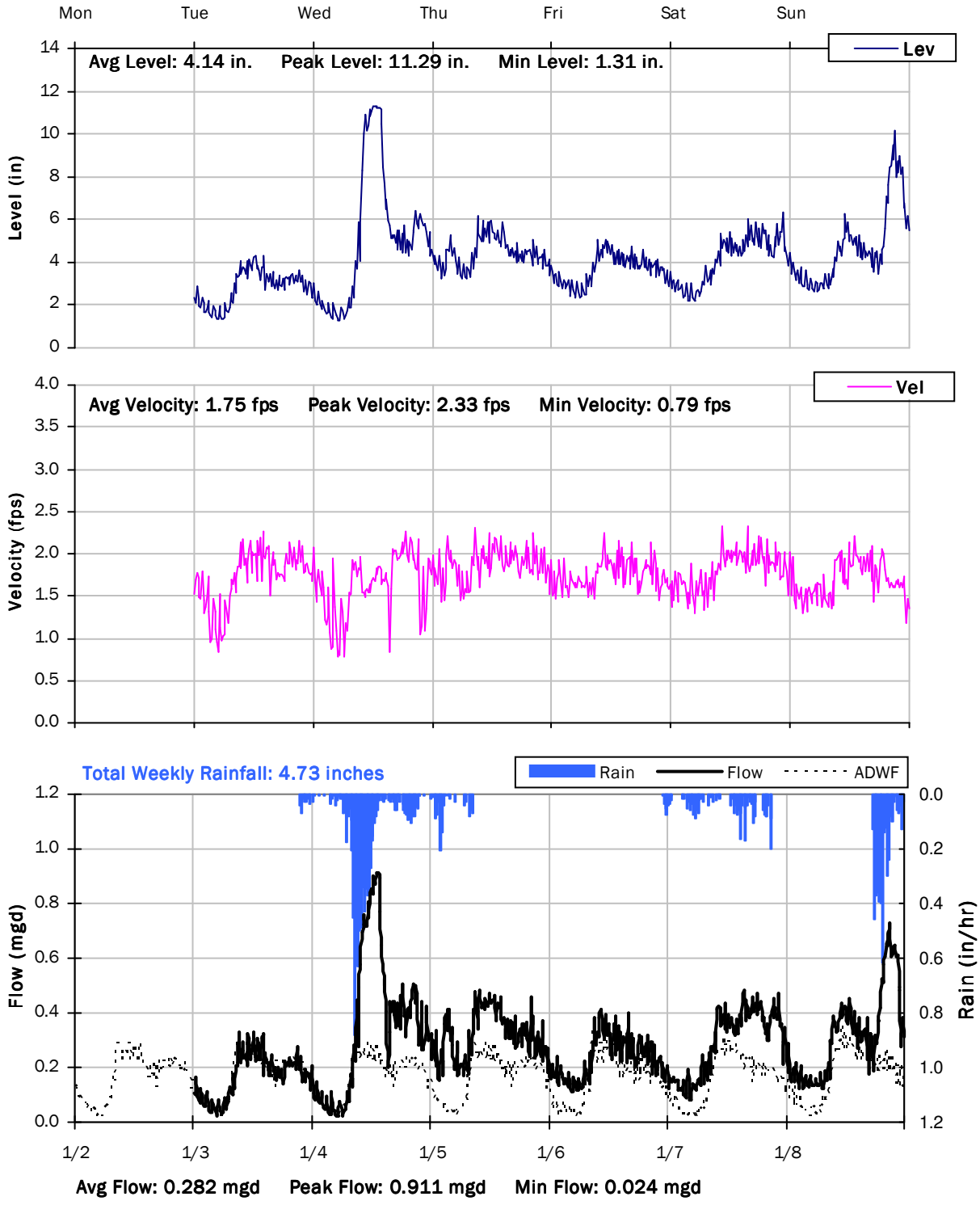
Storm Event I/I Analysis (Rain = 3.28 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.87 *mgd*	**Peak I/I Rate:**	0.68 *mgd*
PF:	5.23	**Total I/I:**	1,864,000 *gallons*
Peak Level:	14.00 *in*		
d/D Ratio:	1.17		

MB 1

Weekly Level, Velocity and Flow Hydrographs

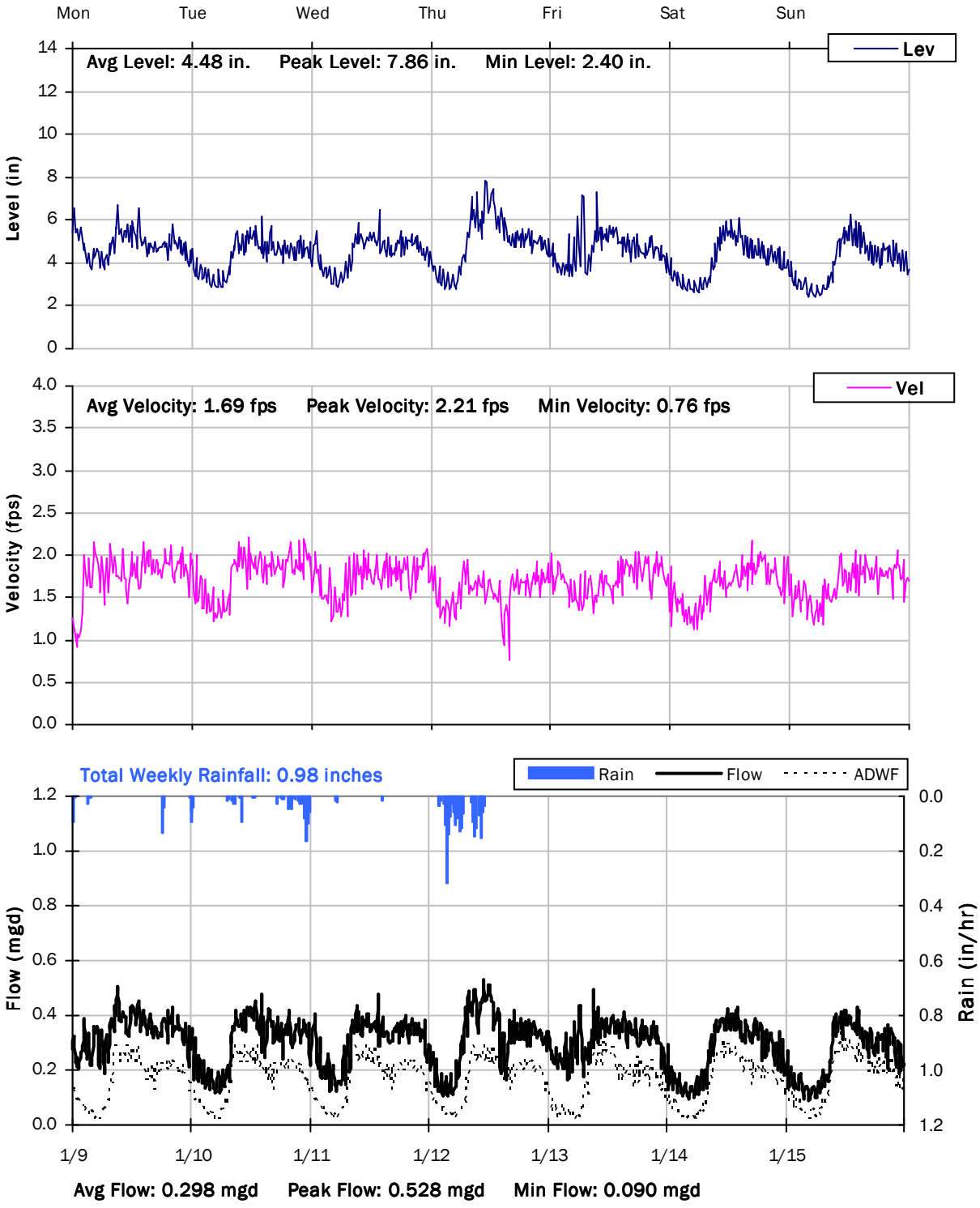
1/2/2017 to 1/9/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

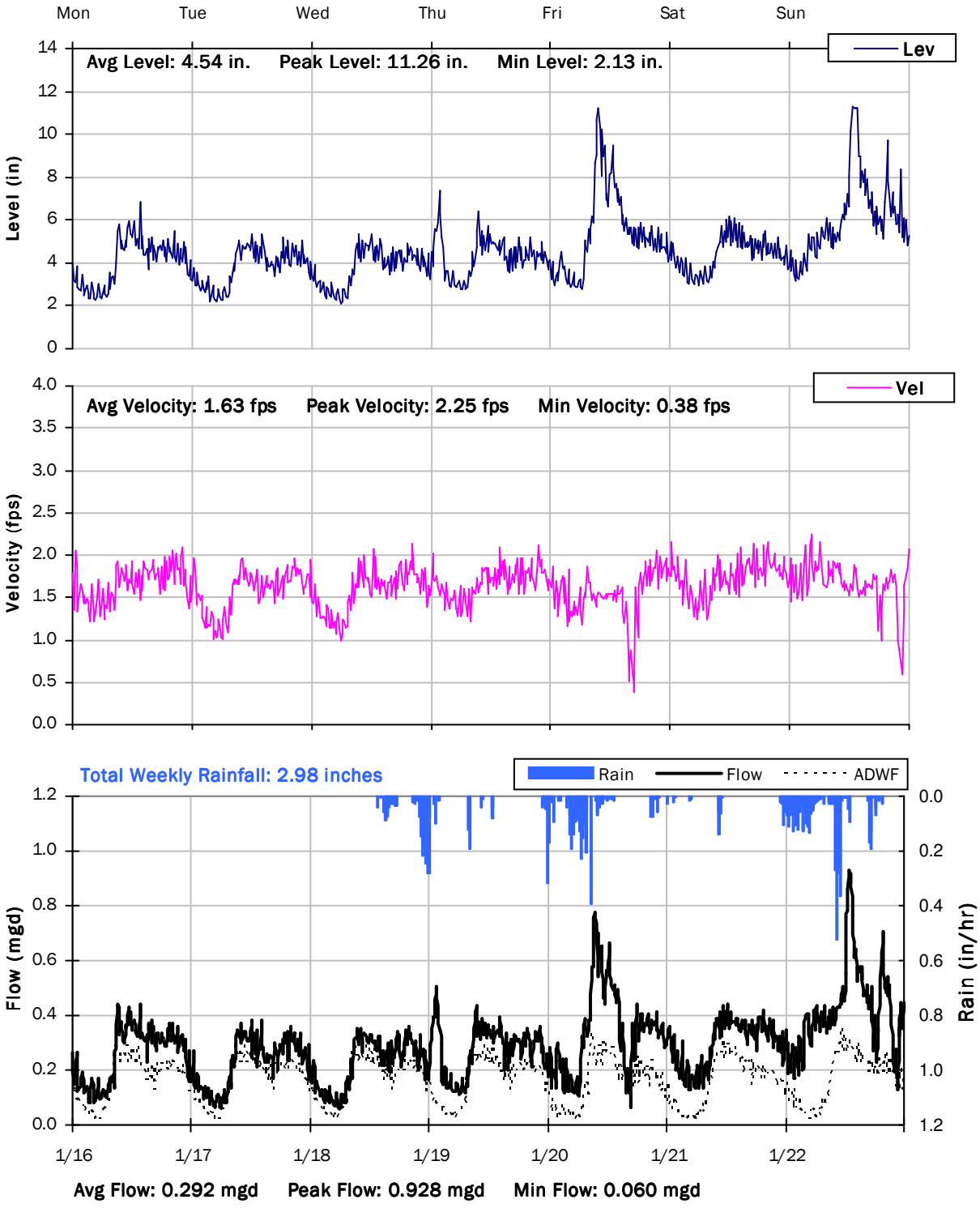
1/9/2017 to 1/16/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

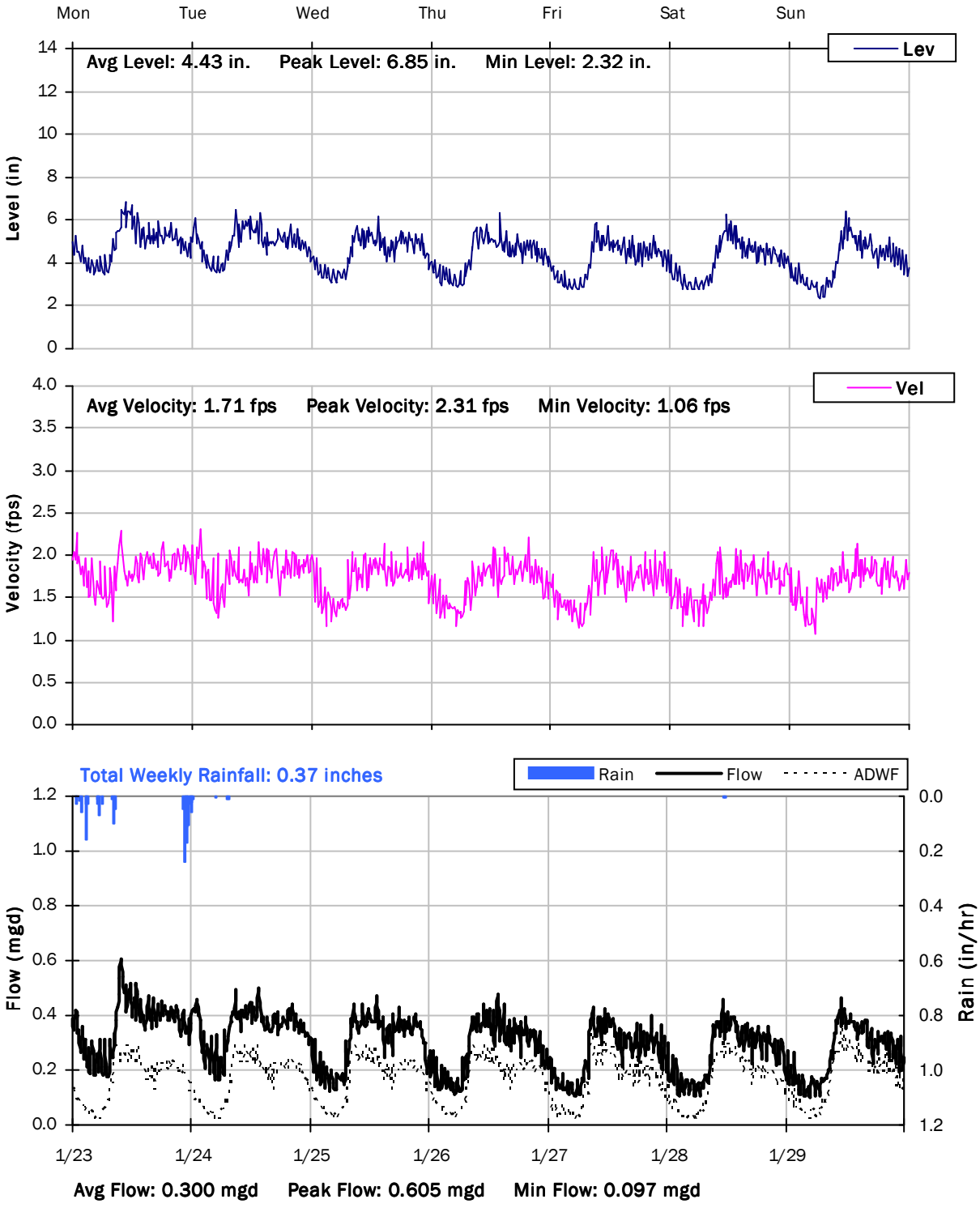
1/16/2017 to 1/23/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

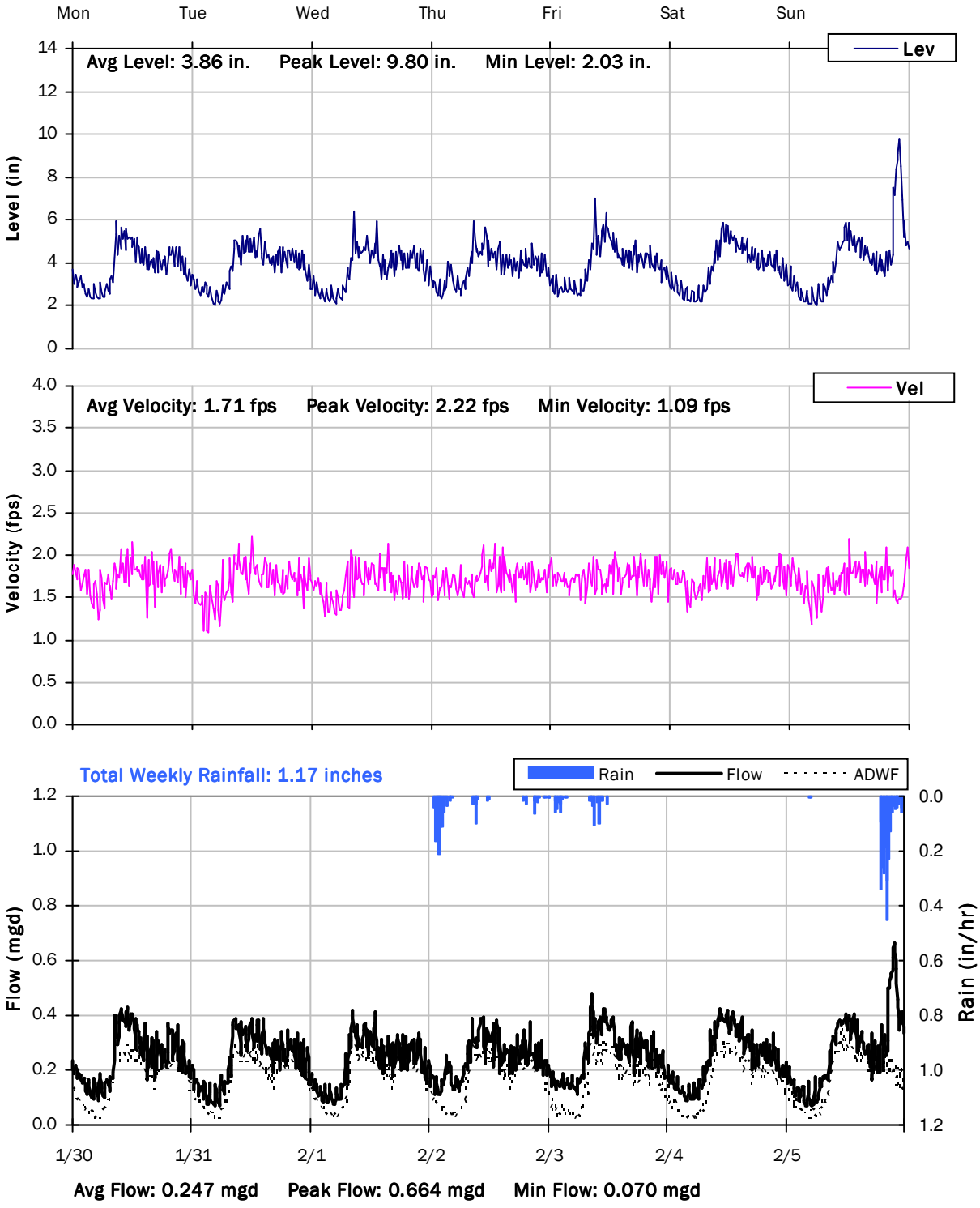
1/23/2017 to 1/30/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

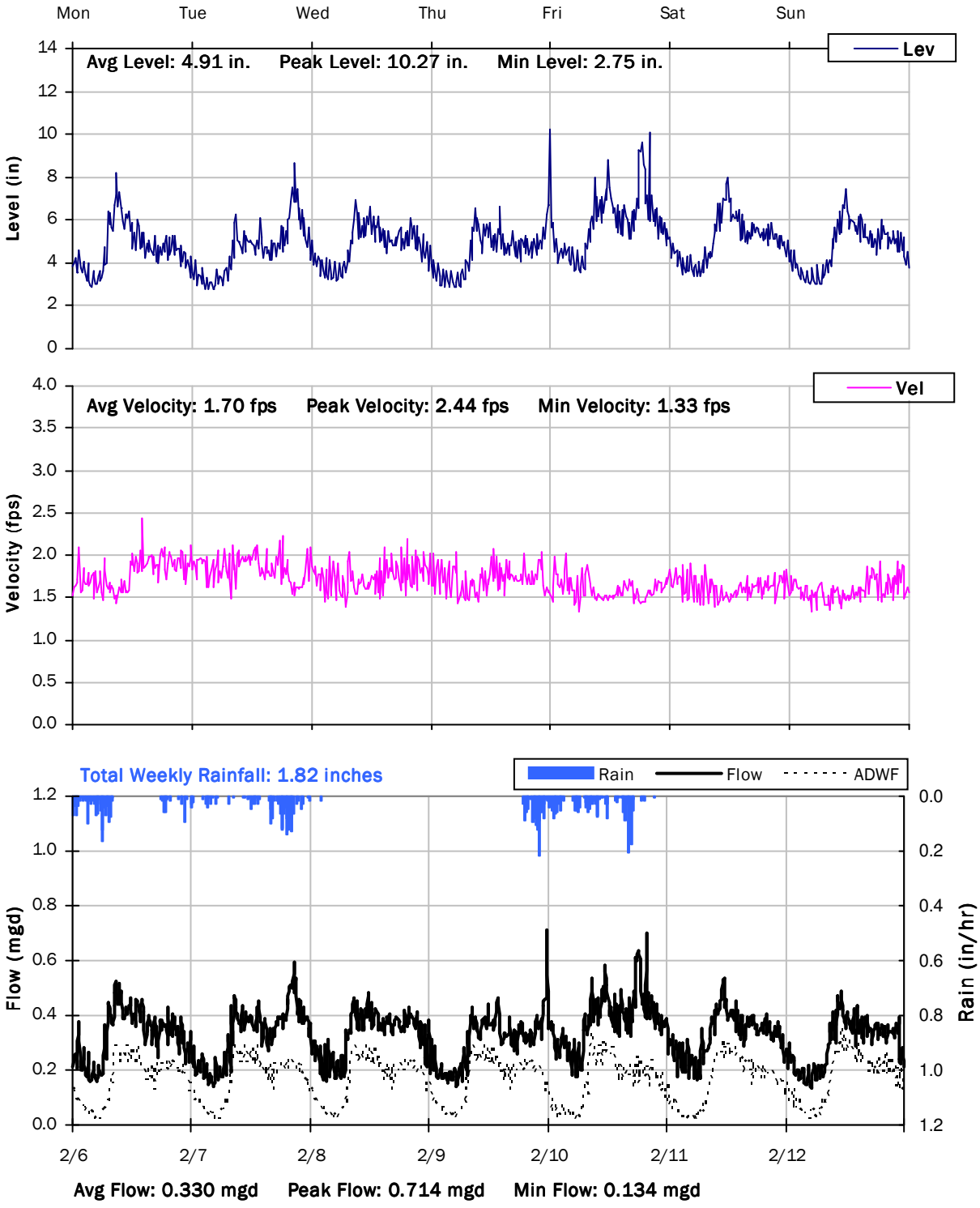
1/30/2017 to 2/6/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

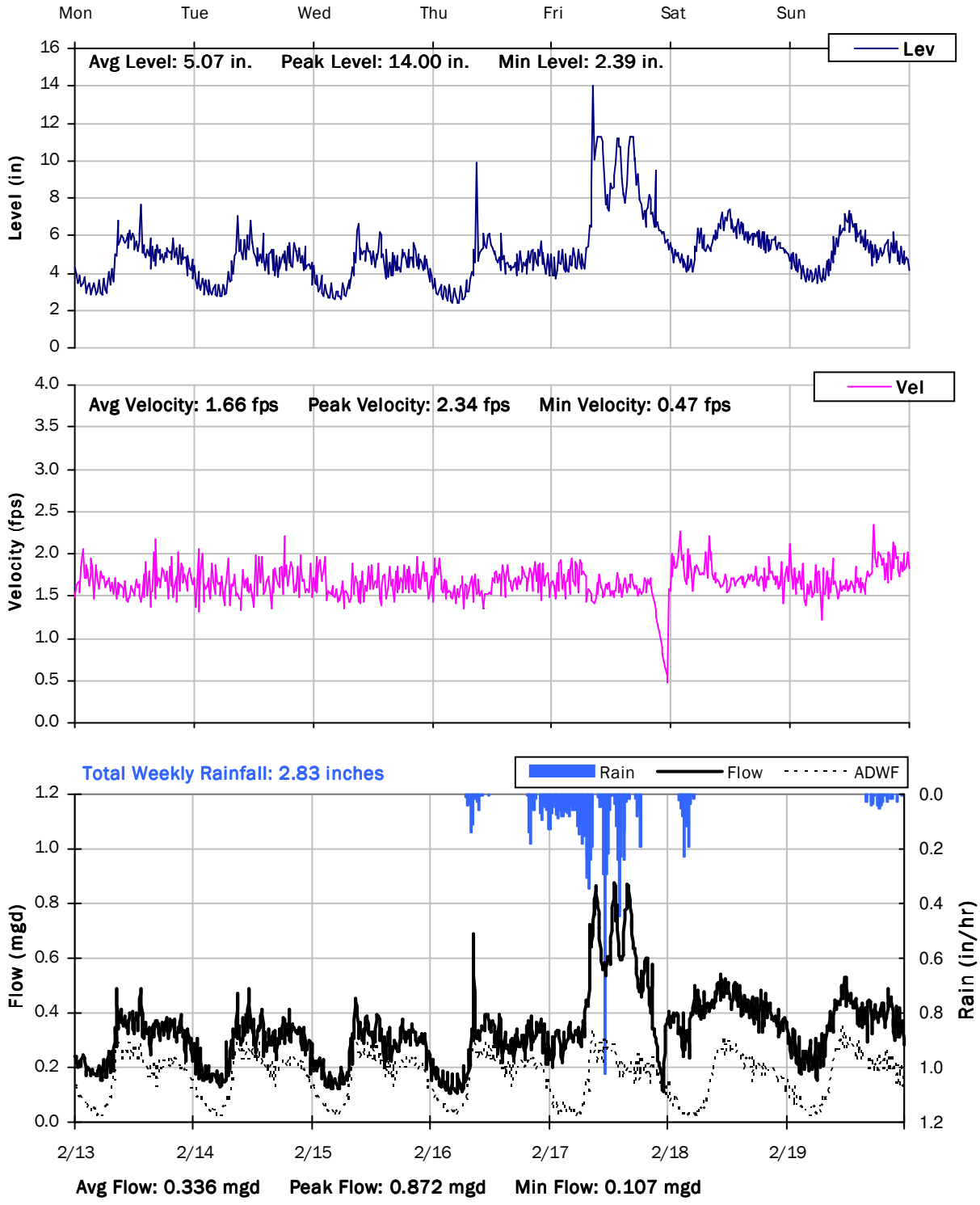
2/6/2017 to 2/13/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

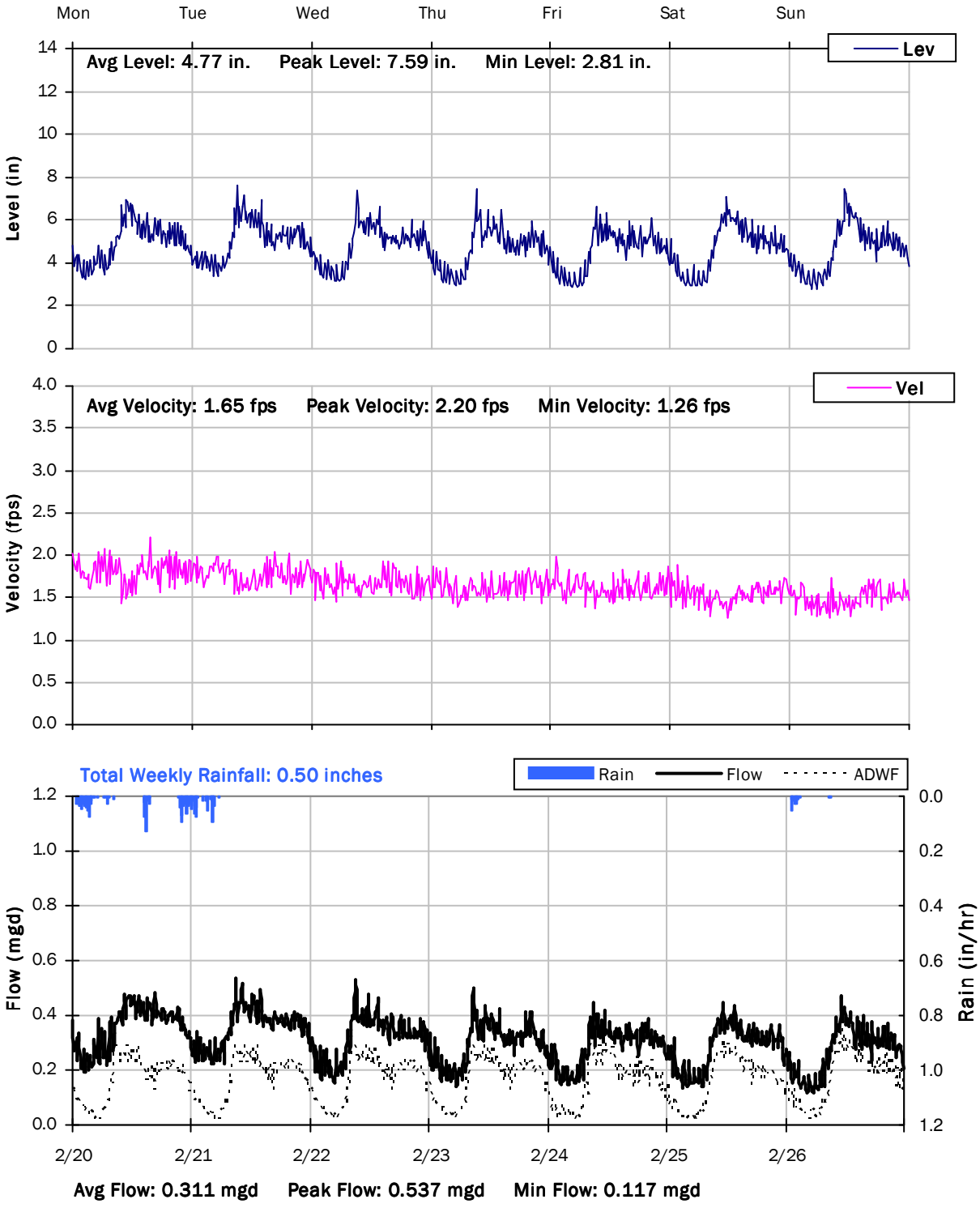
2/13/2017 to 2/20/2017



MB 1

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017



City of Morro Bay

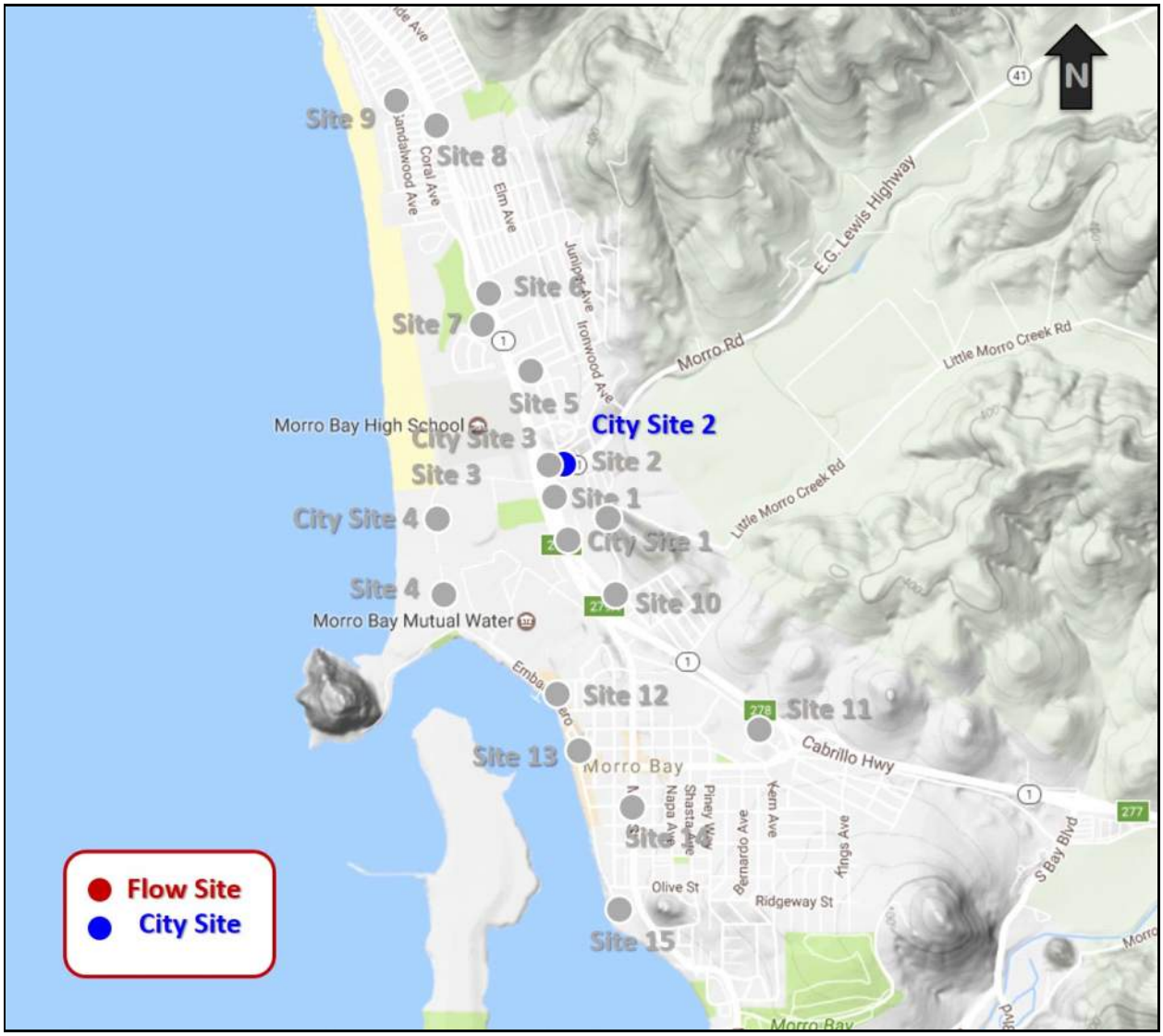
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - February 2017

Monitoring Site: MB 2

Location: City Meter at MH 5.19, Atascadero Road ~85 feet east of Sunset Avenue, meter on northeast 6" inlet

Data Summary Report



Vicinity Map: MB 2

MB 2

Site Information

Location: City Meter at MH 5.19, Atascadero Road ~85 feet east of Sunset Avenue, meter on northeast 6" inlet

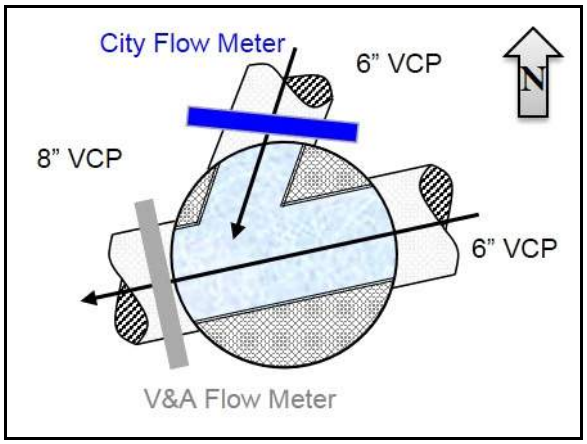


Pipe Diameter: 6 inches

ADWF: 0.029 mgd

Peak Measured Flow: 0.170 mgd







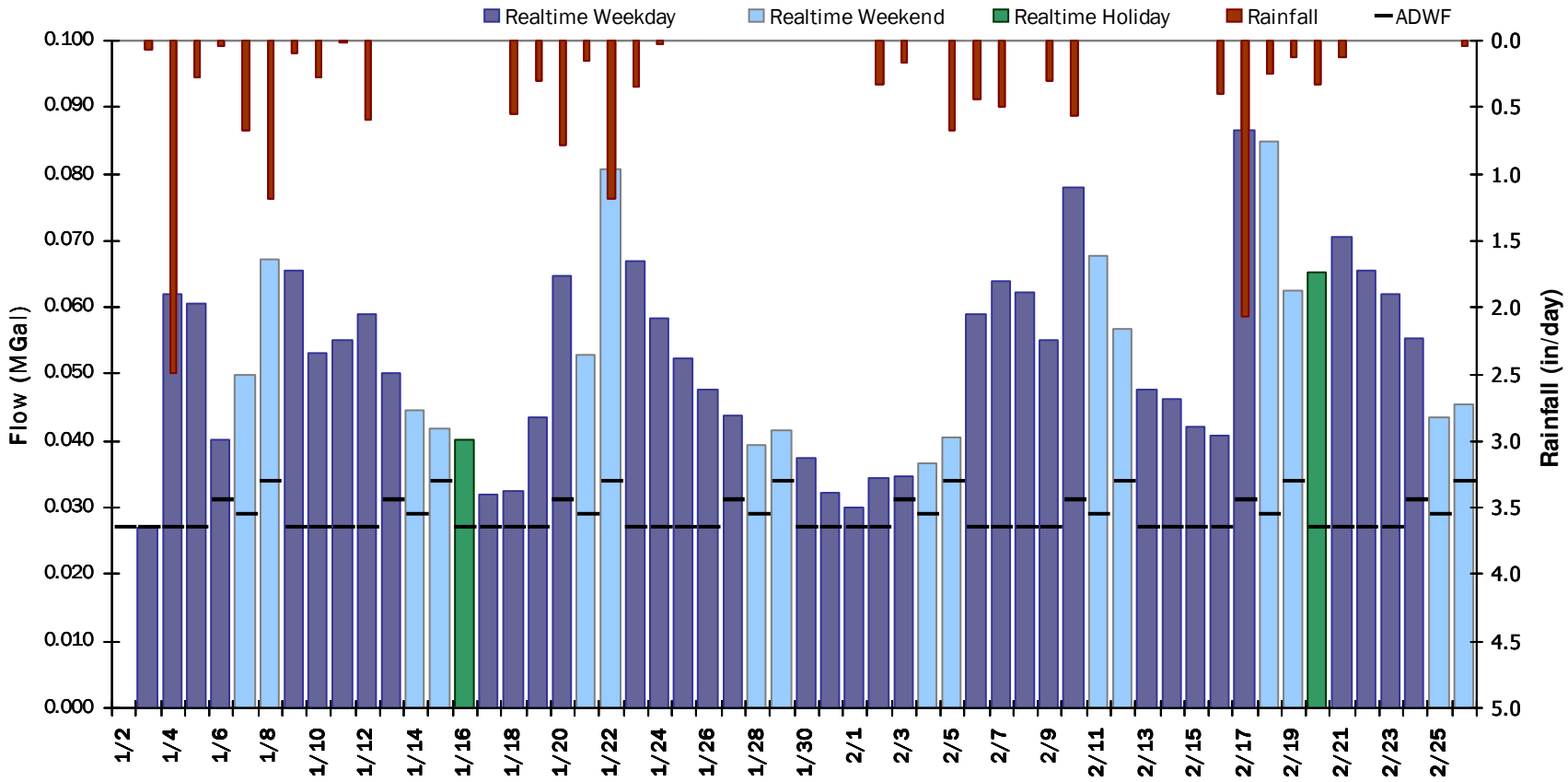


MB 2

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.052 MGal **Peak Daily Flow: 0.086 MGal** **Min Daily Flow: 0.027 MGal**

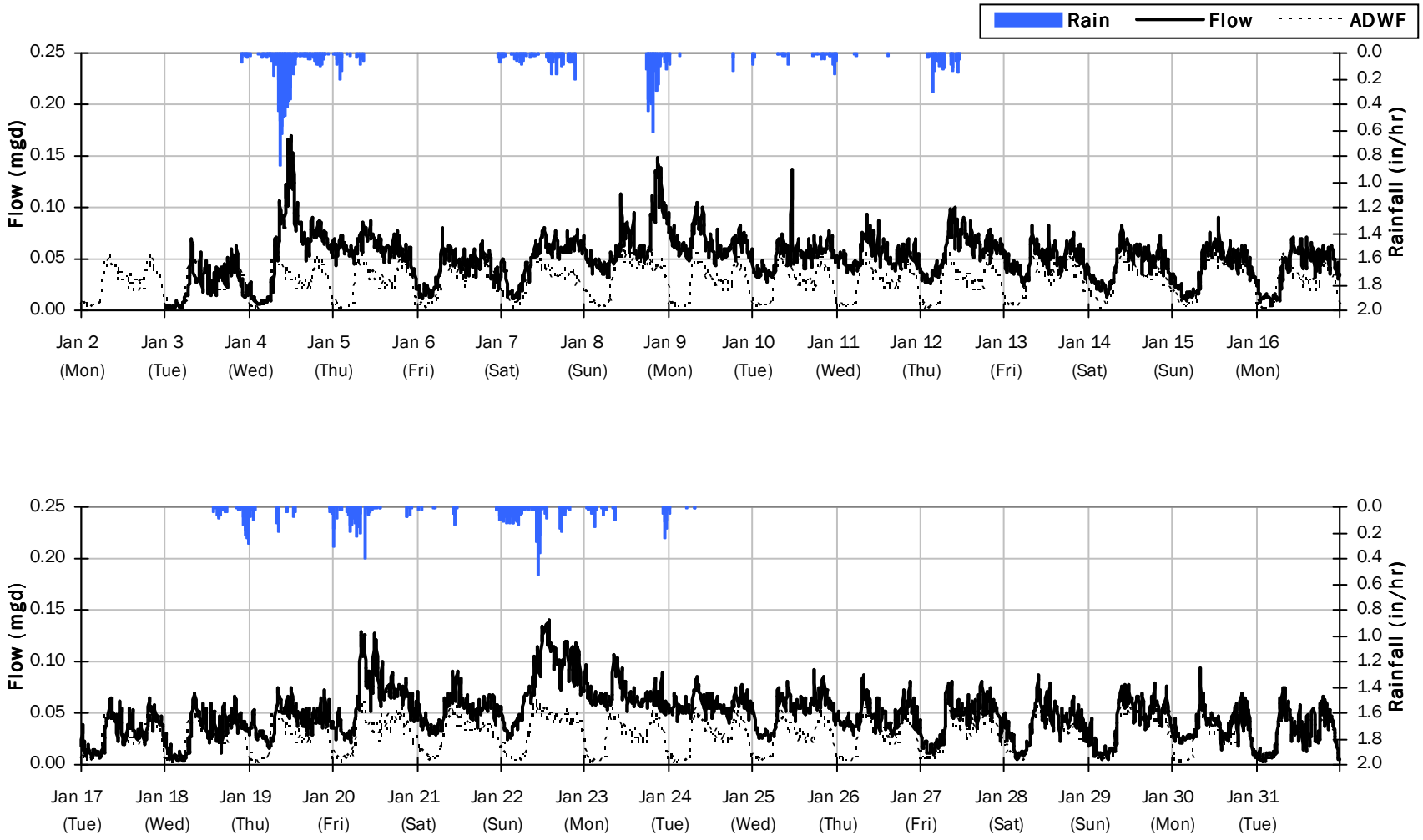
Total Period Rainfall: 15.37 inches



MB 2

Flow Summary: 1/2/2017 to 1/31/2017

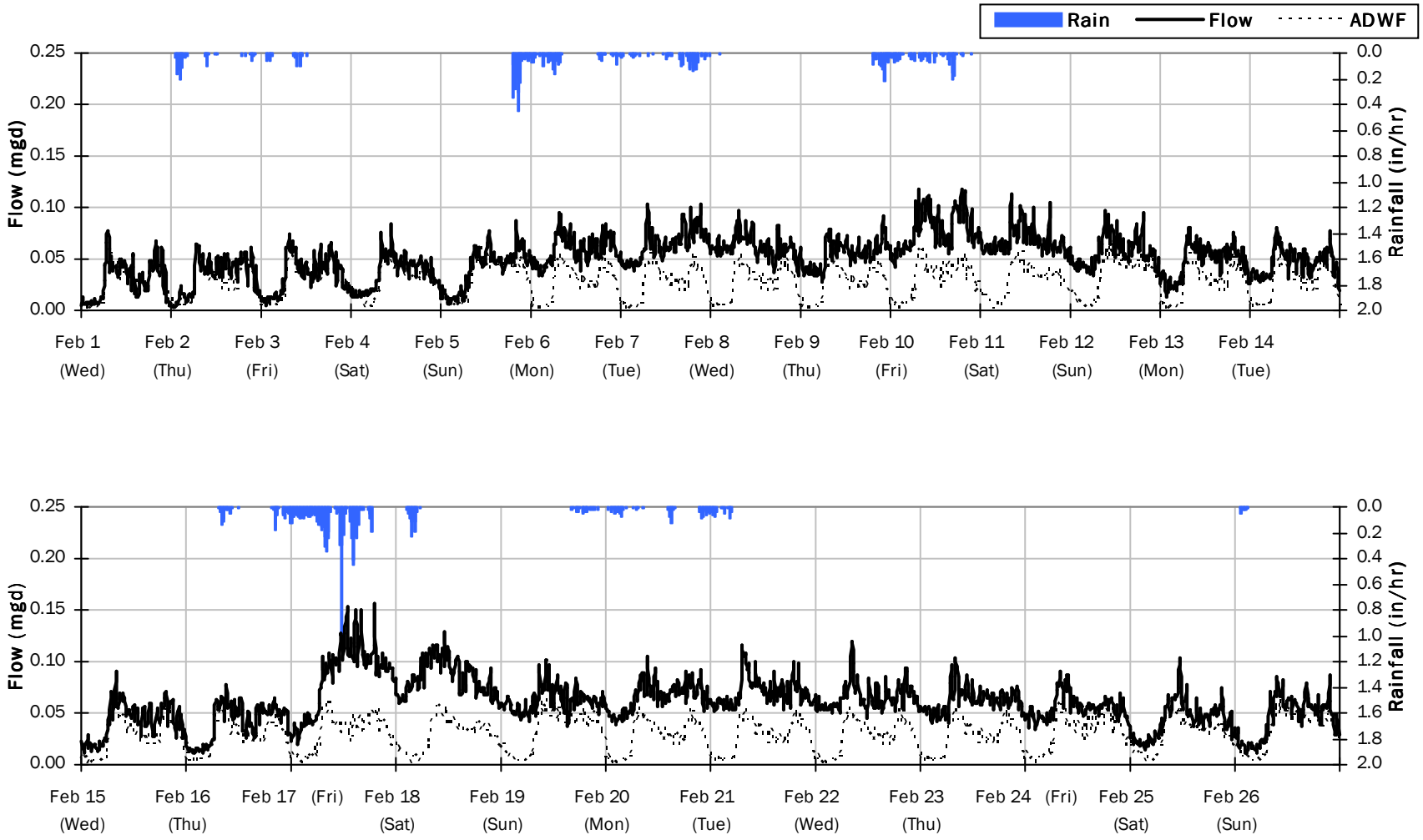
Total Period Rainfall: 9.05 inches **Avg Flow: 0.050 mgd Peak Flow: 0.170 mgd Min Flow: 0.002 mgd**



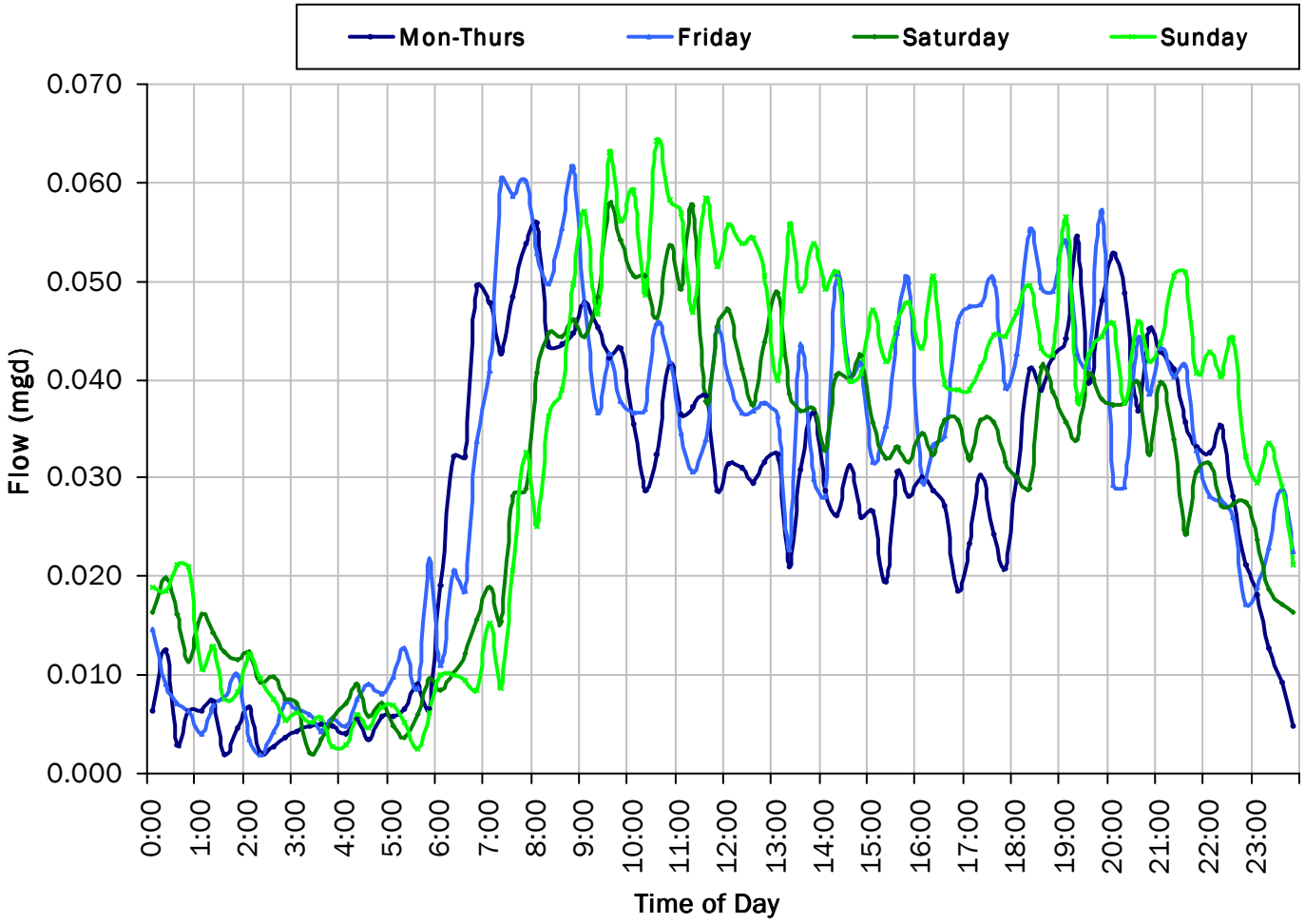
MB 2

Flow Summary: 2/1/2017 to 2/28/2017

Total Period Rainfall: 6.31 inches Avg Flow: 0.055 mgd Peak Flow: 0.157 mgd Min Flow: 0.003 mgd

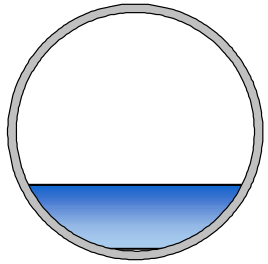


MB 2
Average Dry Weather Flow Hydrographs



ADWF:

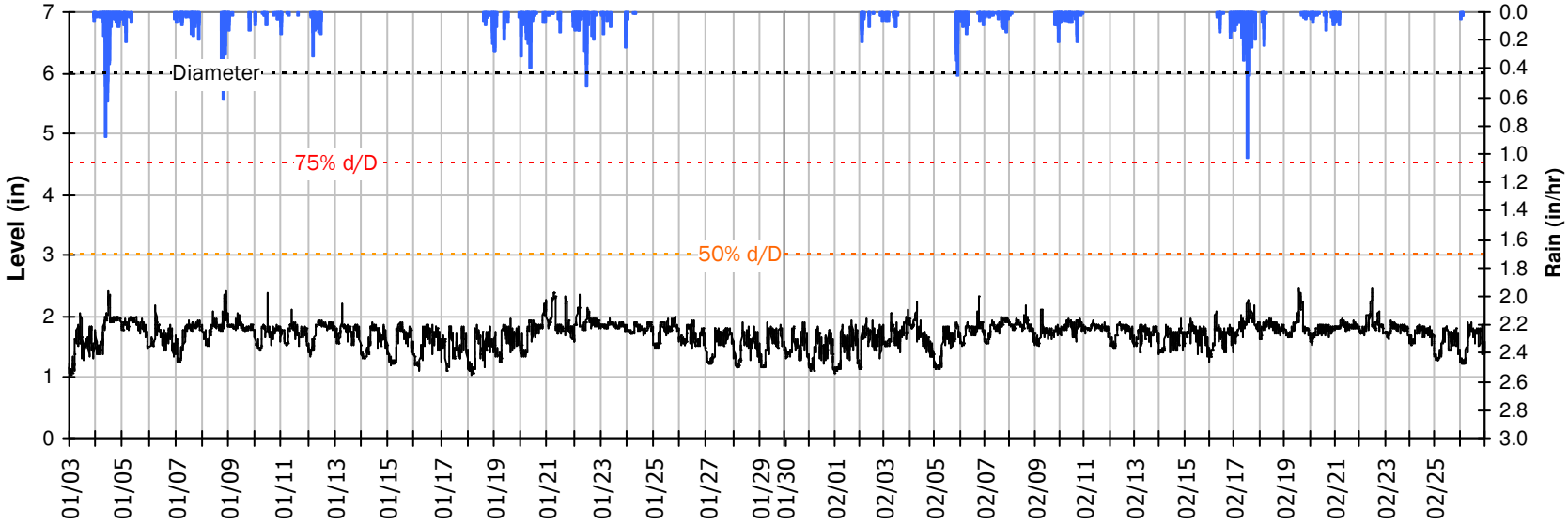
0.029 *mgd*

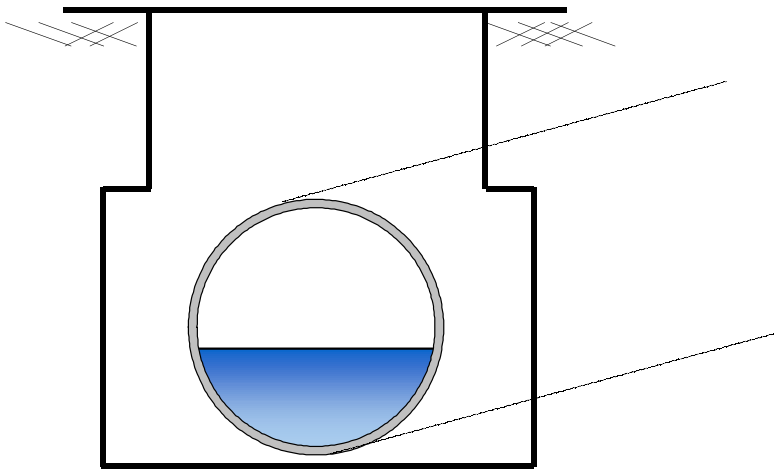


MB 2

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

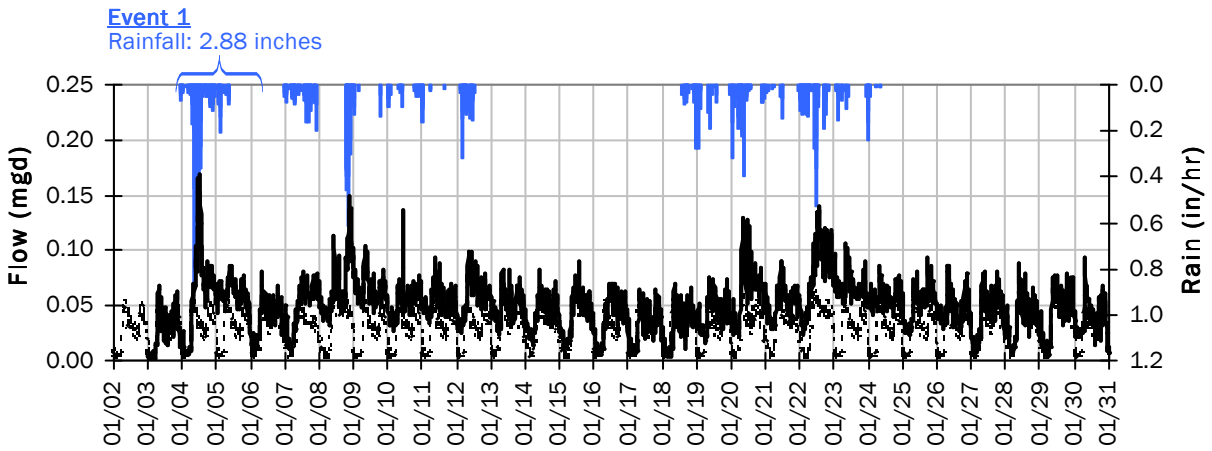




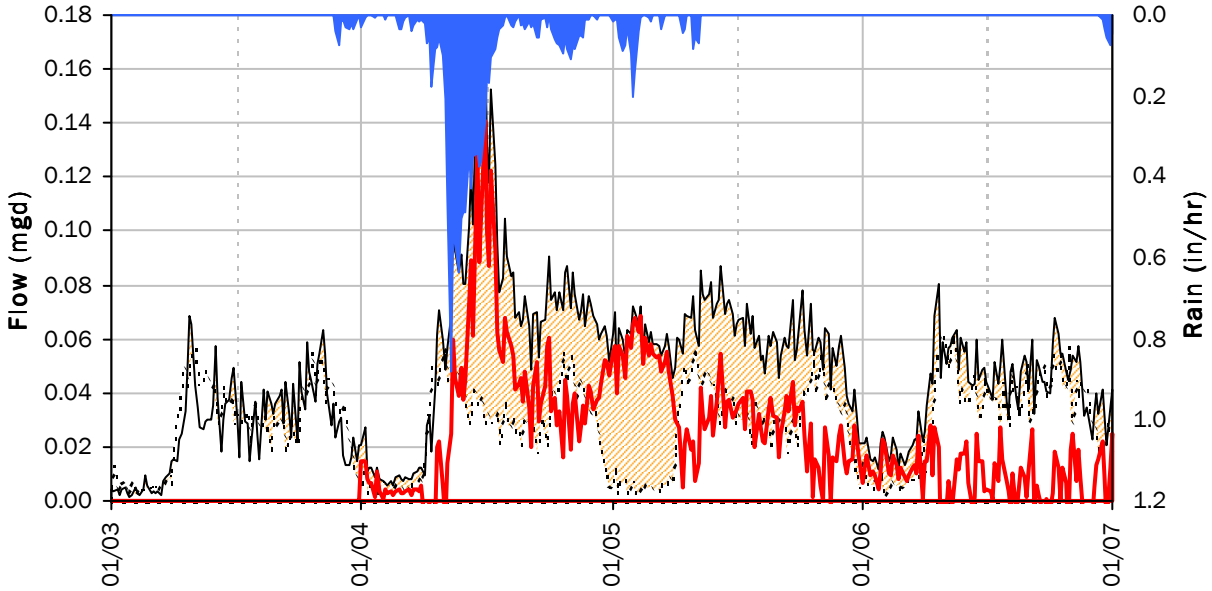
Pipe Diameter:	6	*inches*
Peak Measured Level:	2.47	*inches*
Peak d/D Ratio:	0.41	

MB 2
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

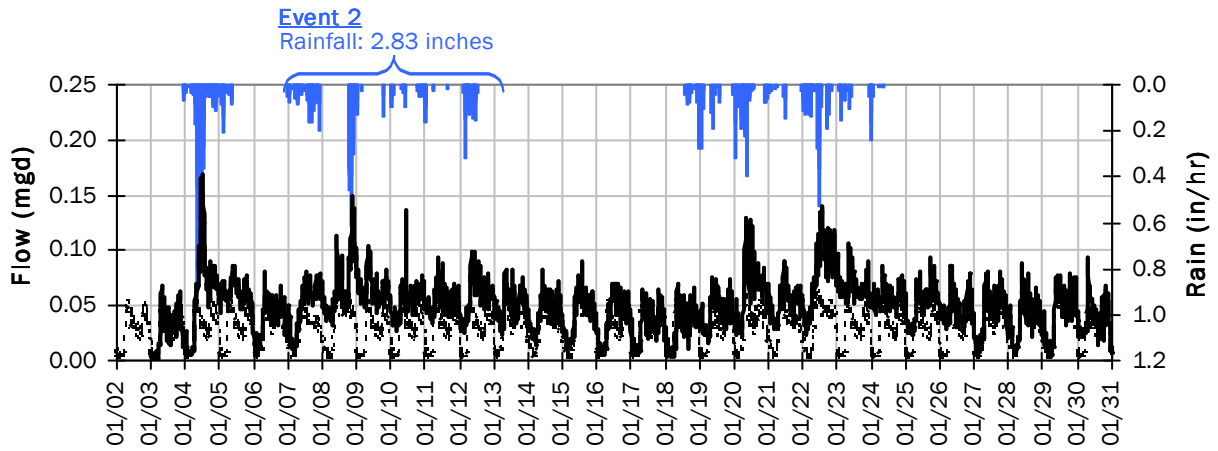


Storm Event I/I Analysis (Rain = 2.88 inches)

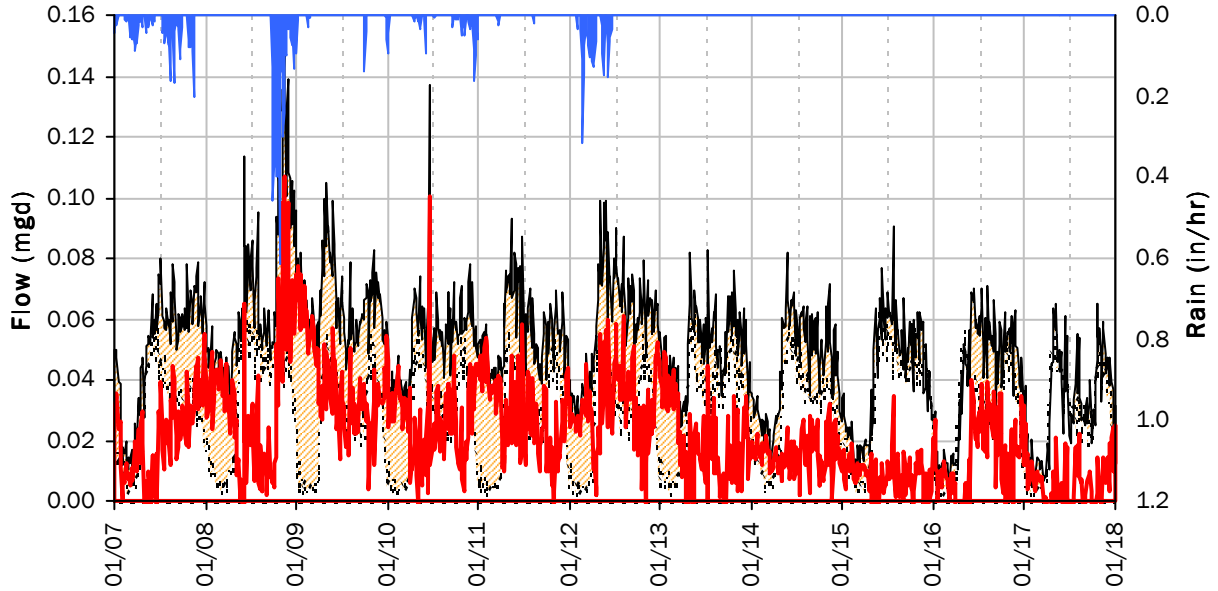
Capacity		Inflow / Infiltration	
Peak Flow:	0.17 *mgd*	**Peak I/I Rate:**	0.14 *mgd*
PF:	5.86	**Total I/I:**	78,000 *gallons*
Peak Level:	2.44 *in*		
d/D Ratio:	0.41		

MB 2
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

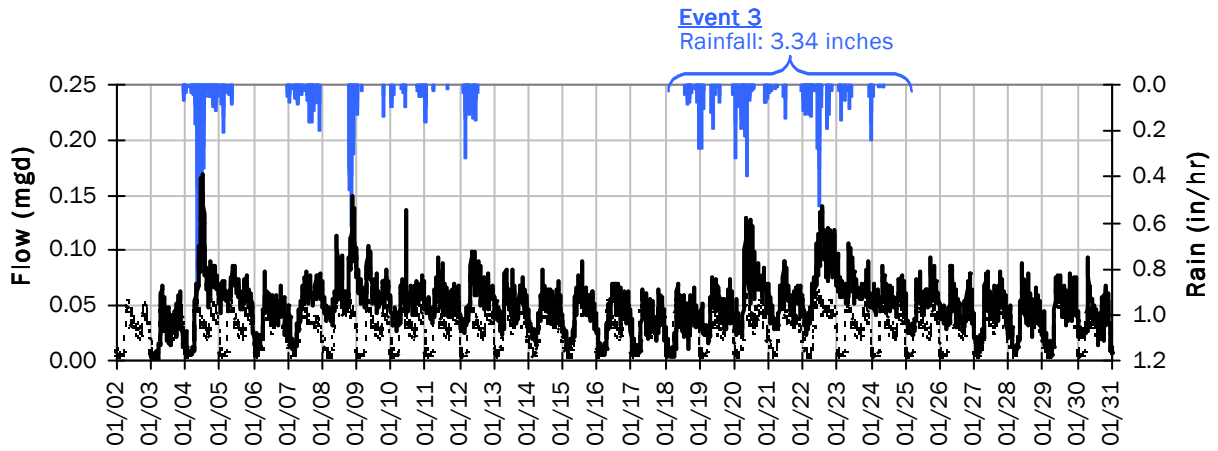


Storm Event I/I Analysis (Rain = 2.83 inches)

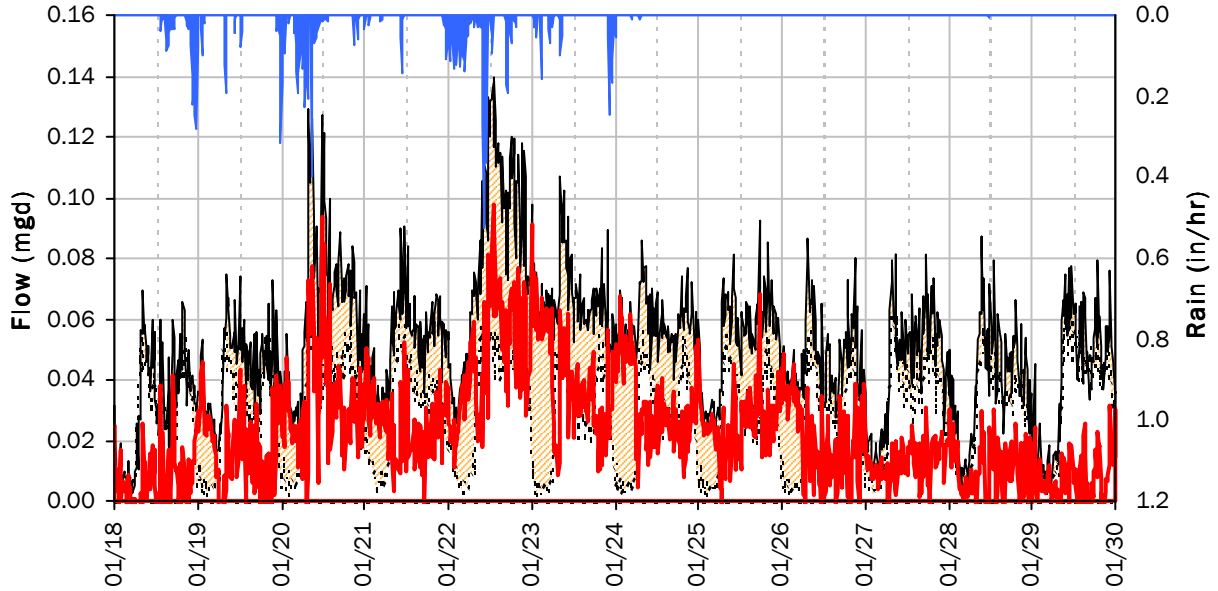
Capacity		Inflow / Infiltration	
Peak Flow:	0.15 *mgd*	**Peak I/I Rate:**	0.11 *mgd*
PF:	5.14	**Total I/I:**	239,000 *gallons*
Peak Level:	2.44 *in*		
d/D Ratio:	0.41		

MB 2
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

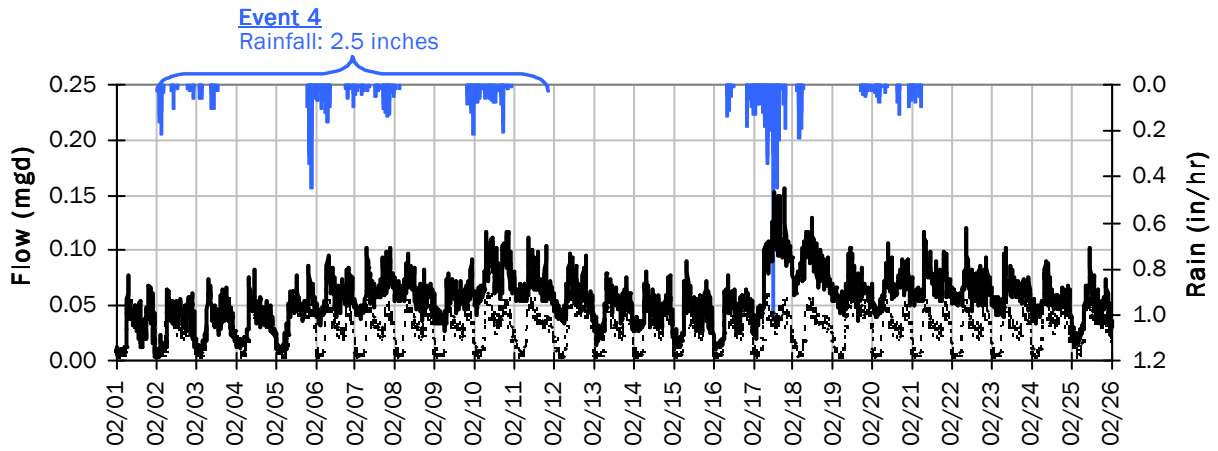


Storm Event I/I Analysis (Rain = 3.35 inches)

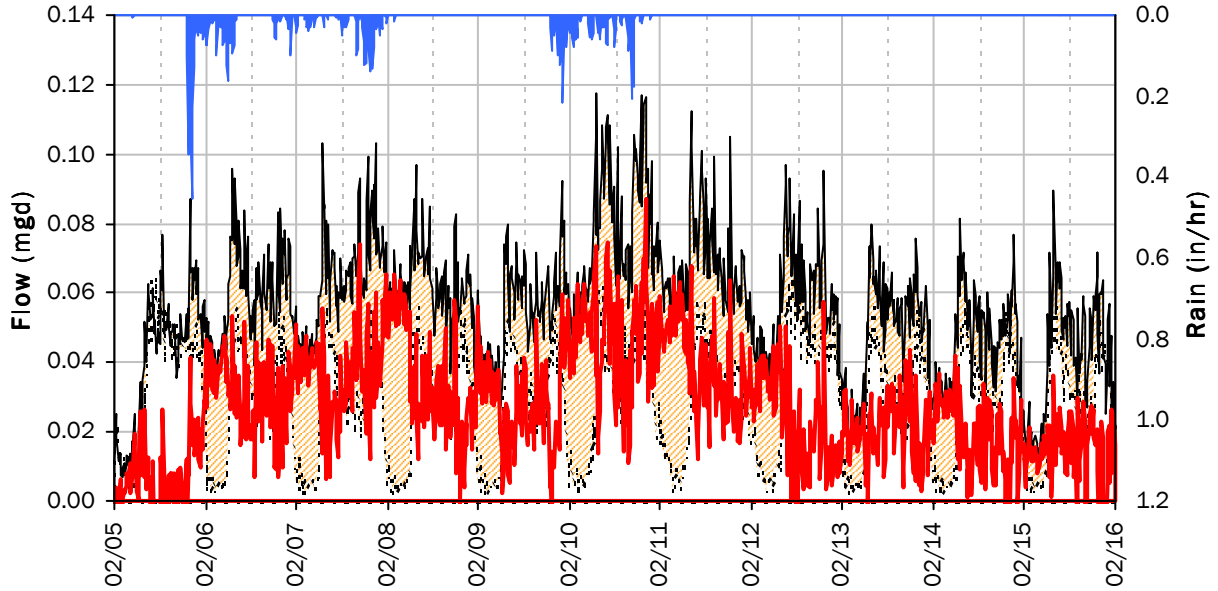
Capacity		Inflow / Infiltration	
Peak Flow:	0.14 *mgd*	**Peak I/I Rate:**	0.10 *mgd*
PF:	4.84	**Total I/I:**	274,000 *gallons*
Peak Level:	2.41 *in*		
d/D Ratio:	0.40		

MB 2
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph

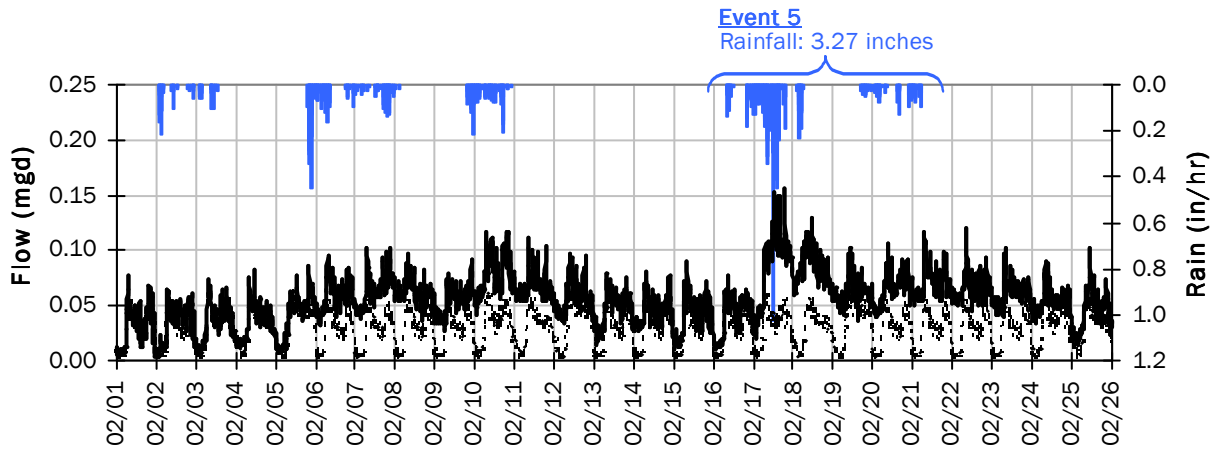


Storm Event I/I Analysis (Rain = 2.50 inches)

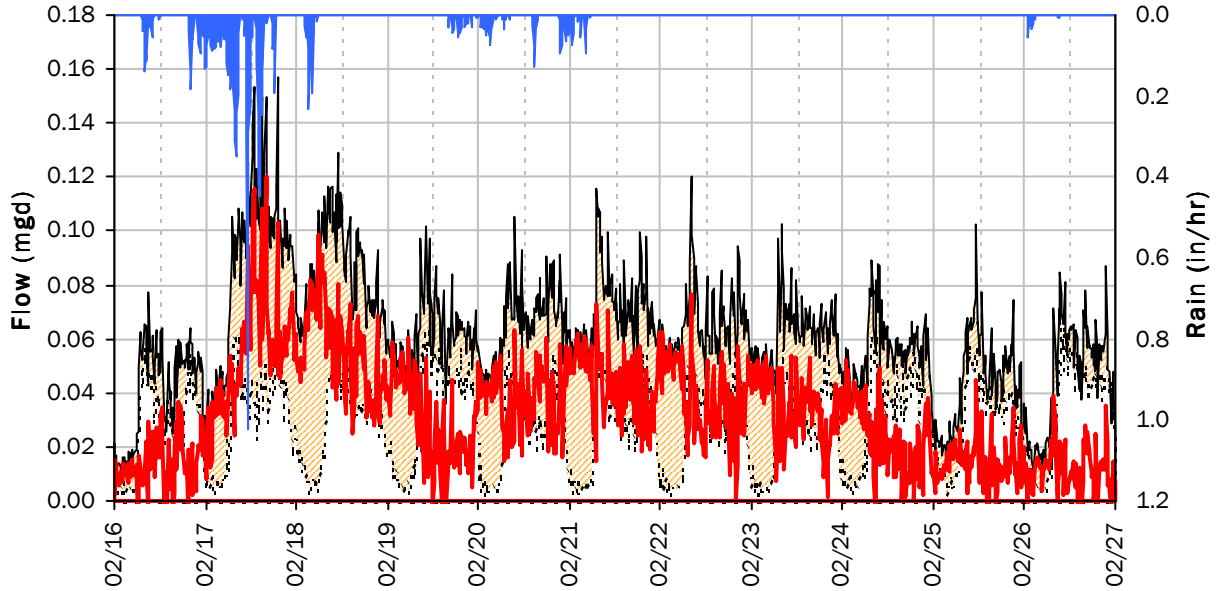
Capacity		Inflow / Infiltration	
Peak Flow:	0.12 *mgd*	**Peak I/I Rate:**	0.09 *mgd*
PF:	4.06	**Total I/I:**	302,000 *gallons*
Peak Level:	2.33 *in*		
d/D Ratio:	0.39		

MB 2
I/I Summary: Event 5

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 5 Detail Graph



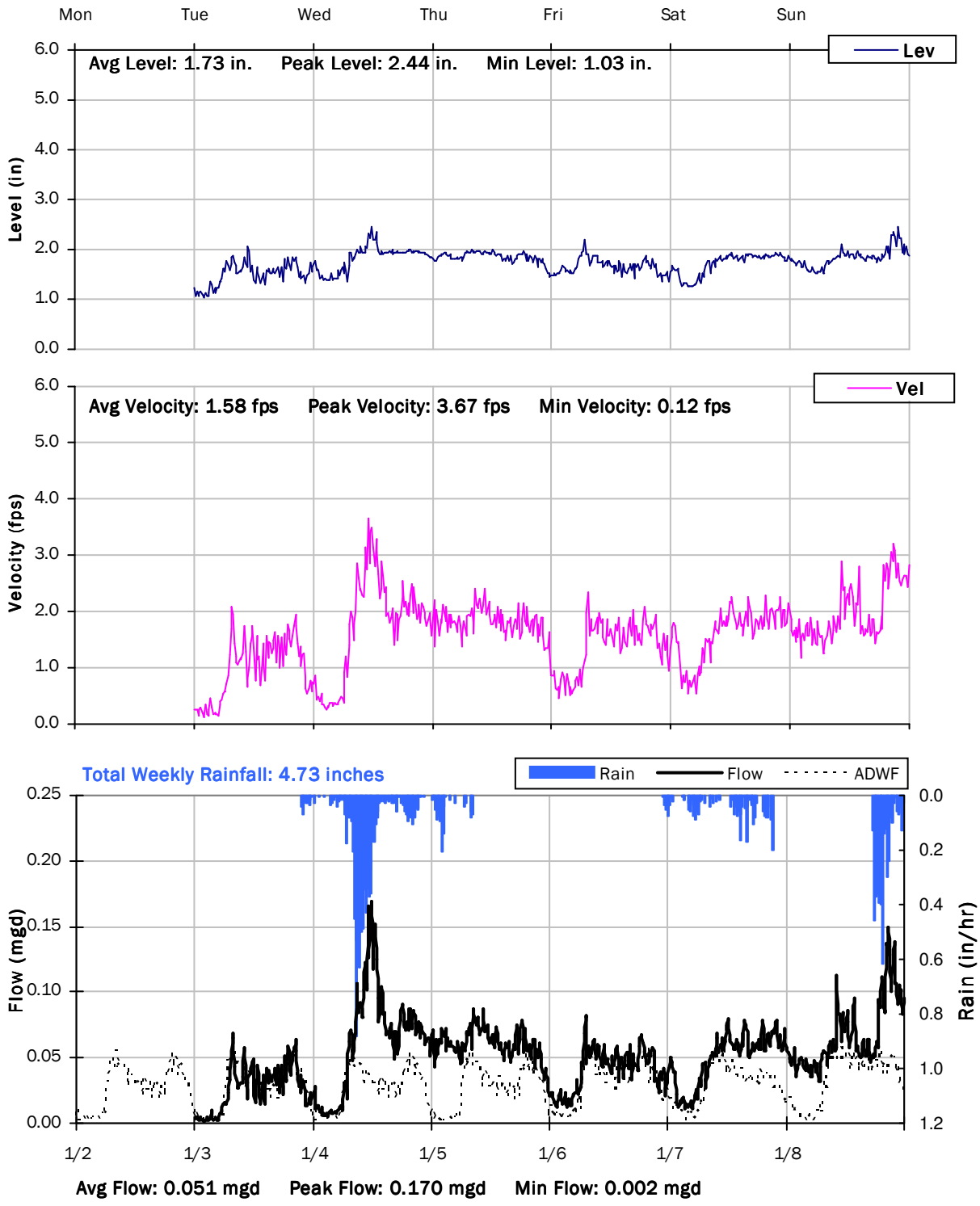
Storm Event I/I Analysis (Rain = 3.28 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.16 *mgd*	**Peak I/I Rate:**	0.12 *mgd*
PF:	5.42	**Total I/I:**	359,000 *gallons*
Peak Level:	2.47 *in*		
d/D Ratio:	0.41		

MB 2

Weekly Level, Velocity and Flow Hydrographs

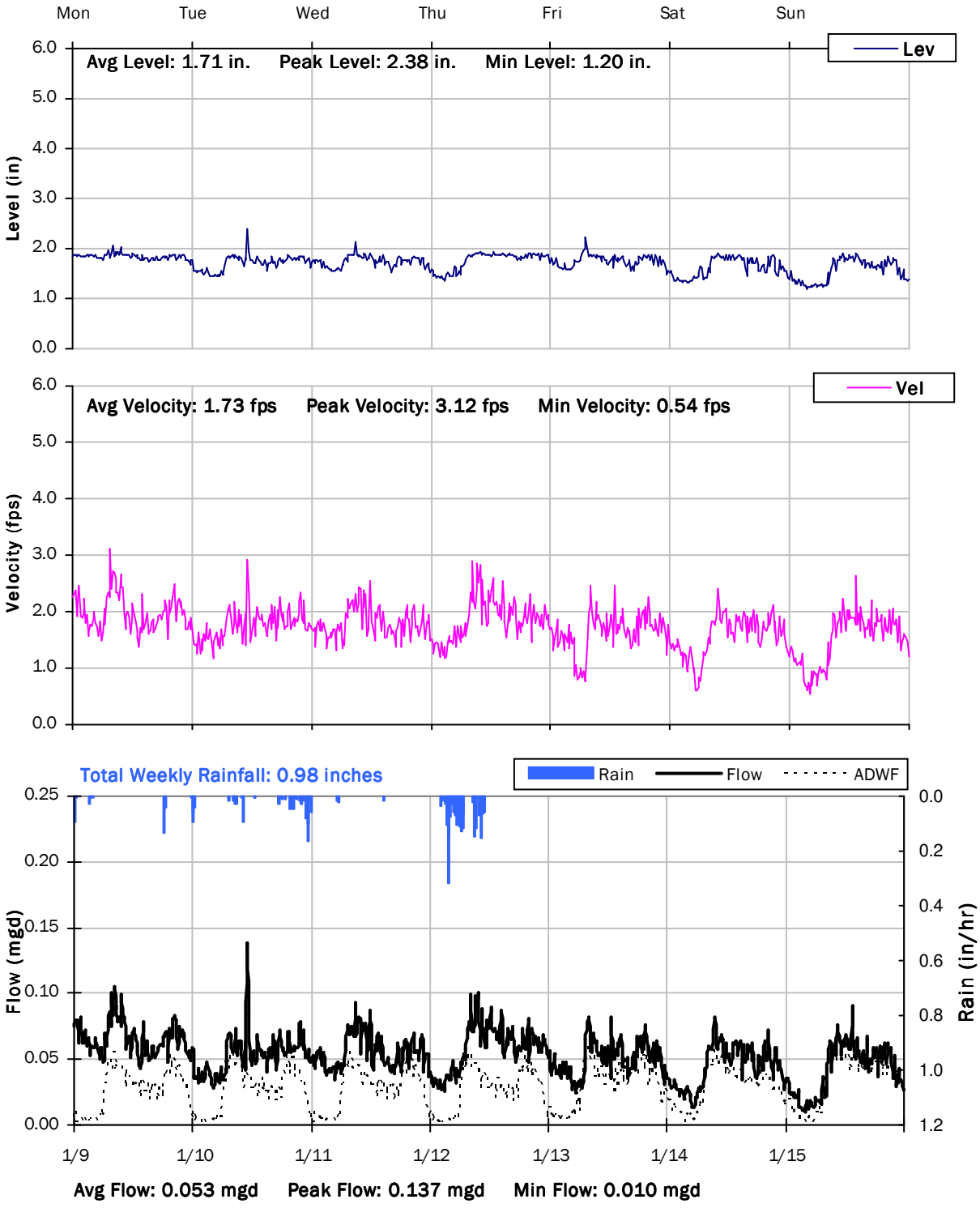
1/2/2017 to 1/9/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

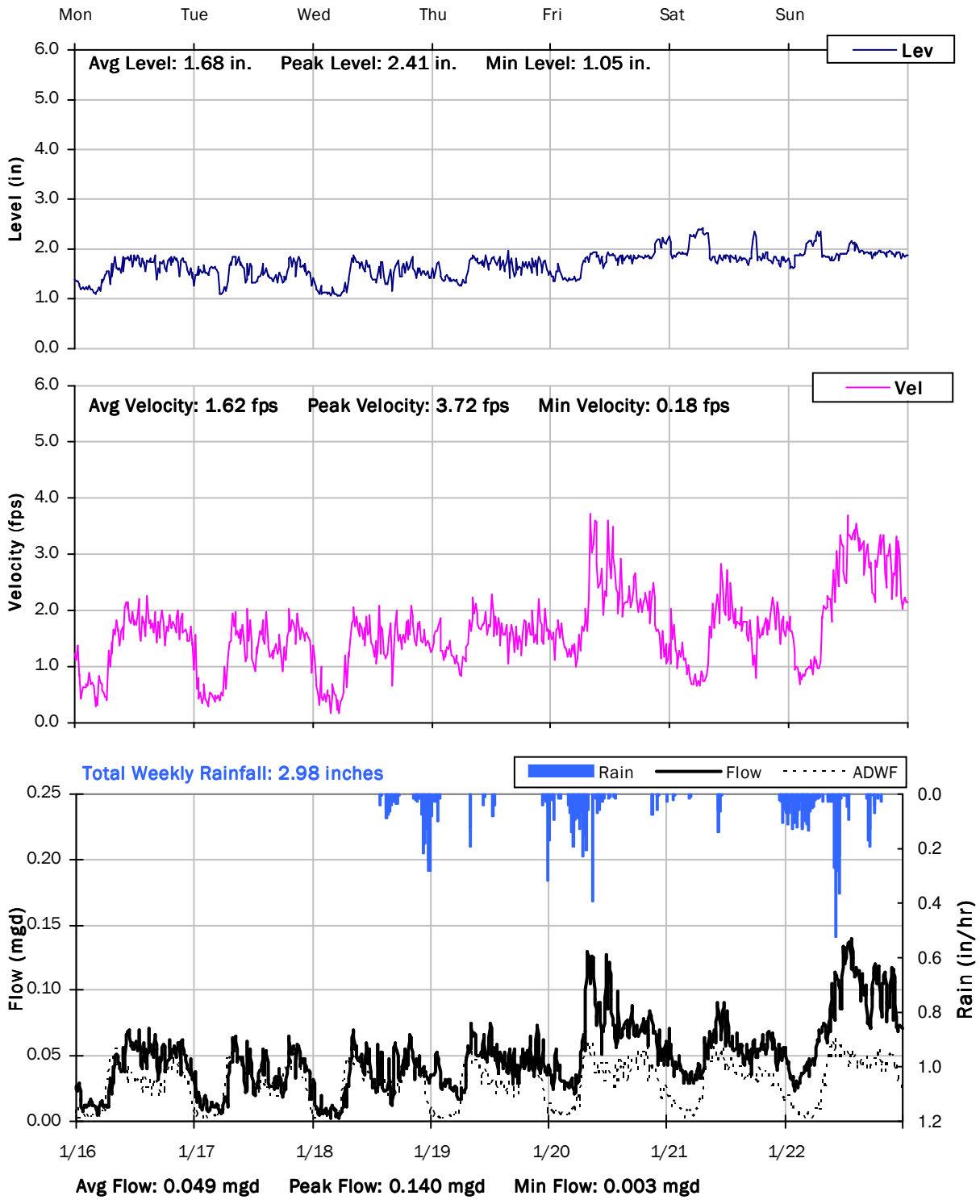
1/9/2017 to 1/16/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

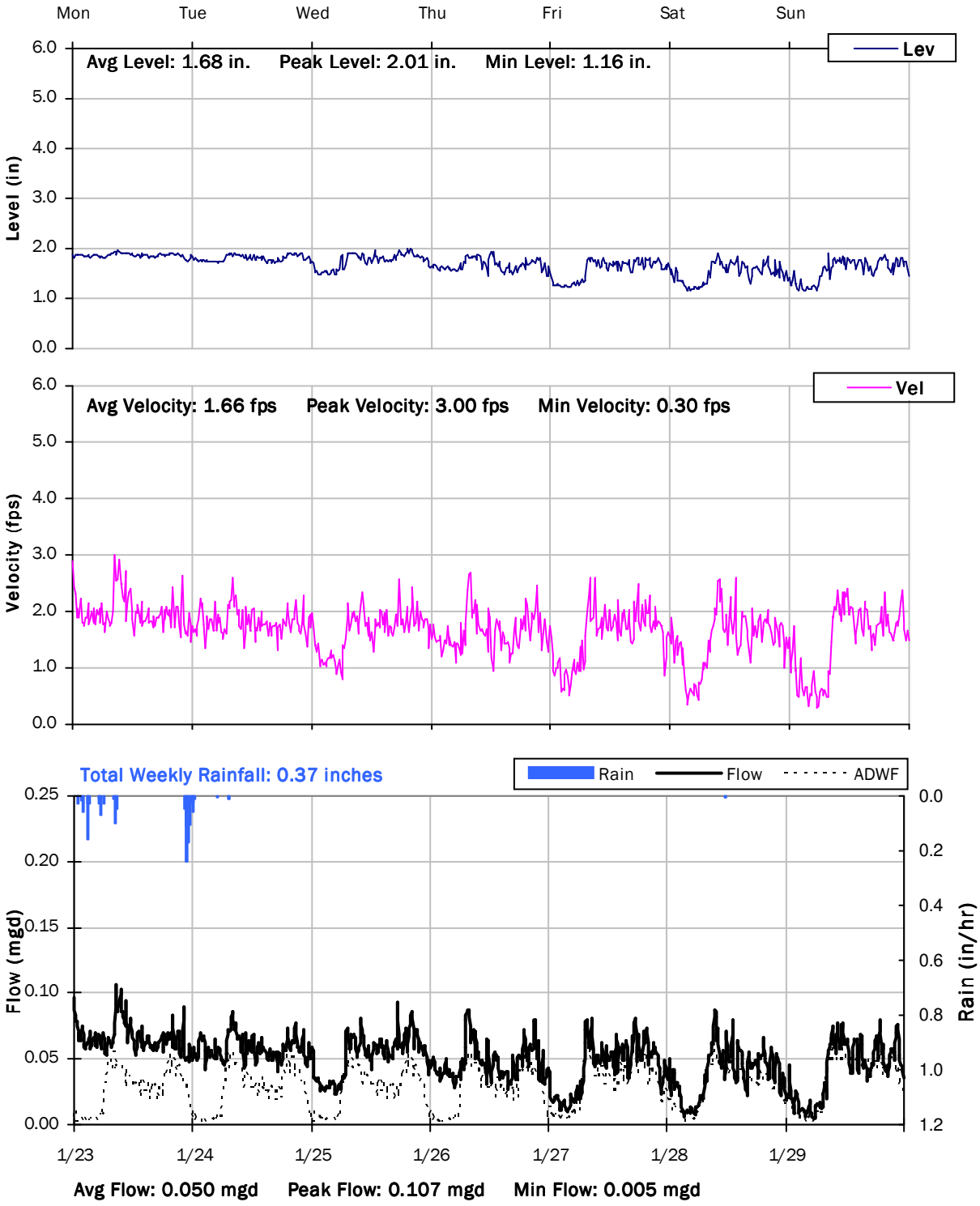
1/16/2017 to 1/23/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

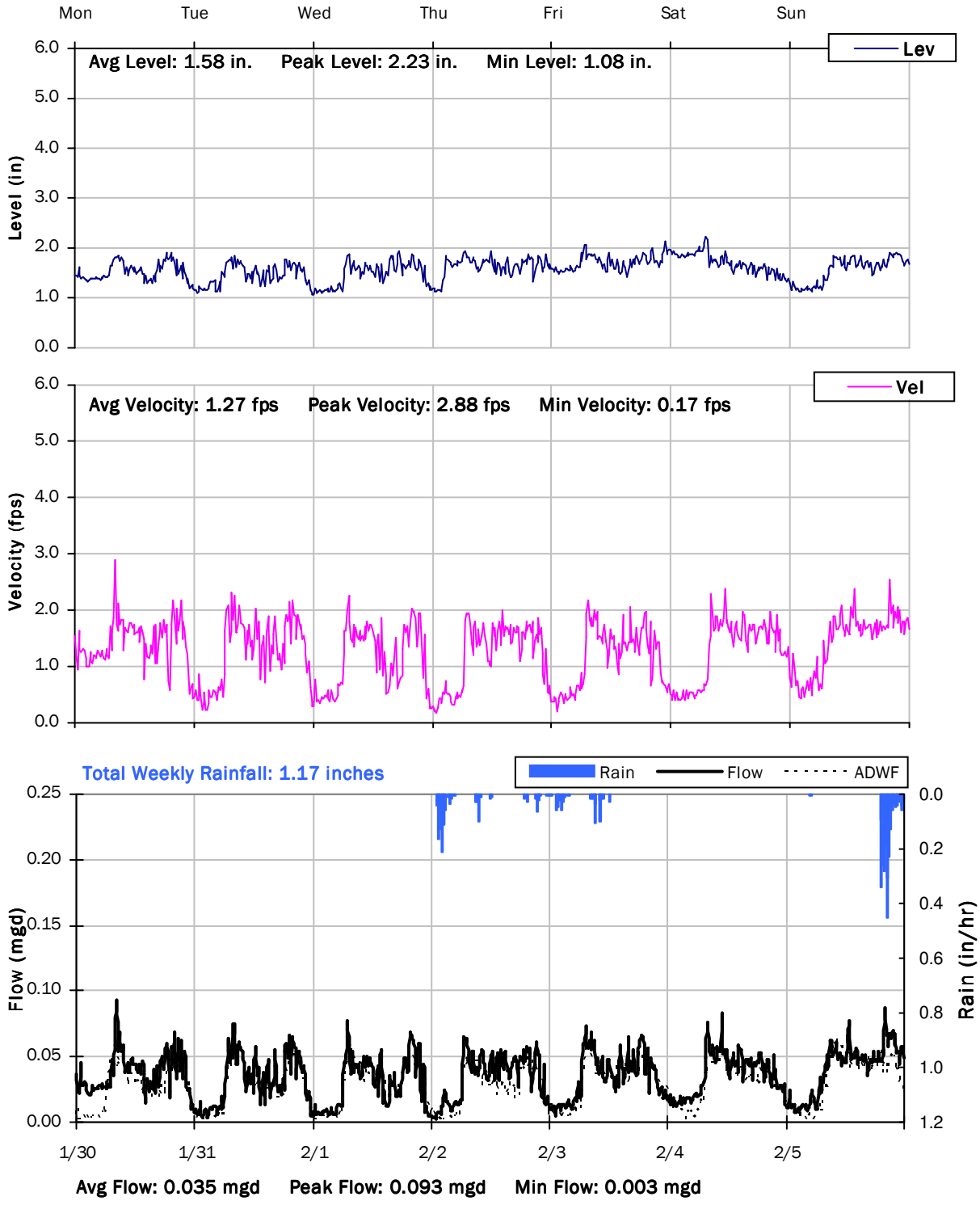
1/23/2017 to 1/30/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

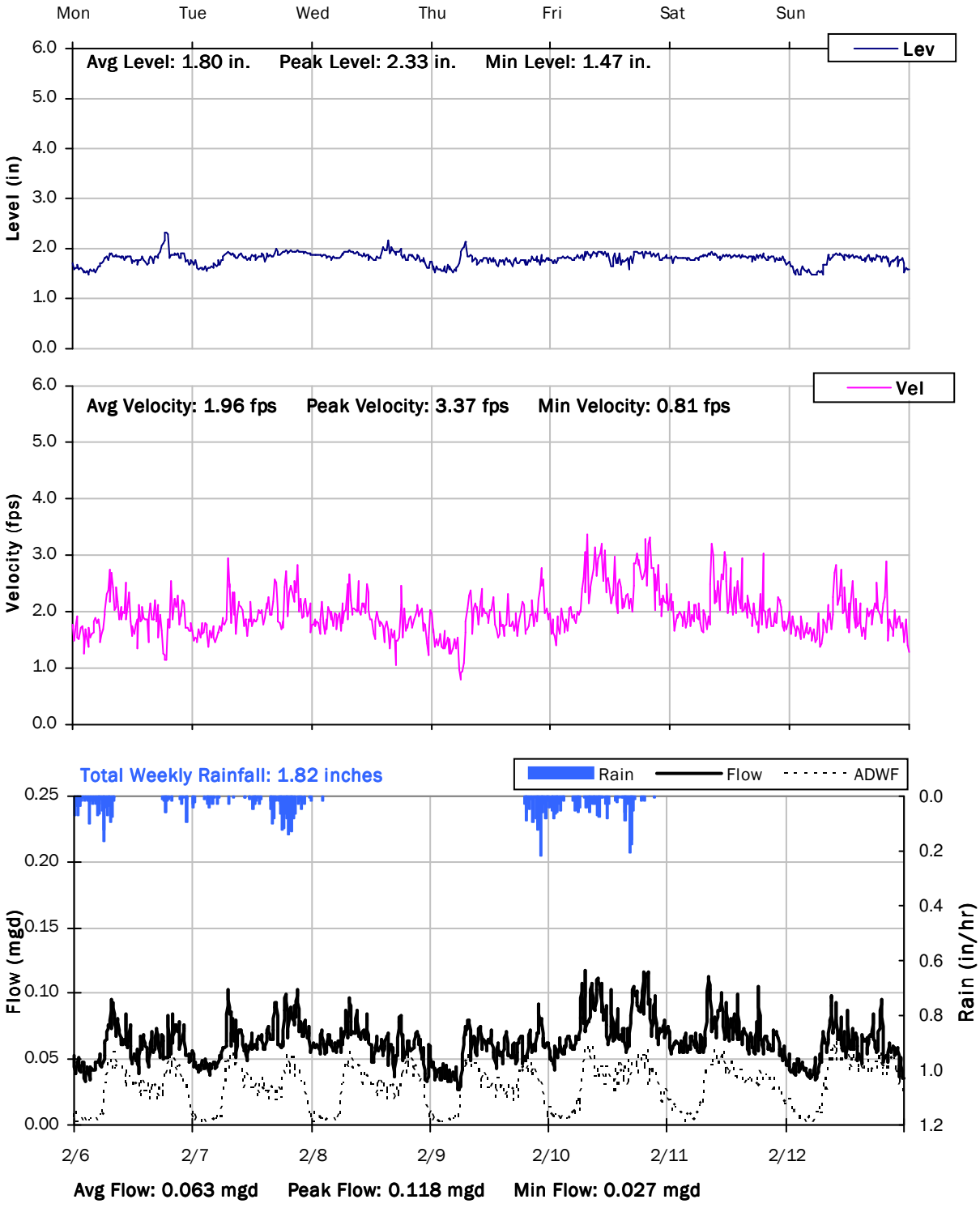
1/30/2017 to 2/6/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

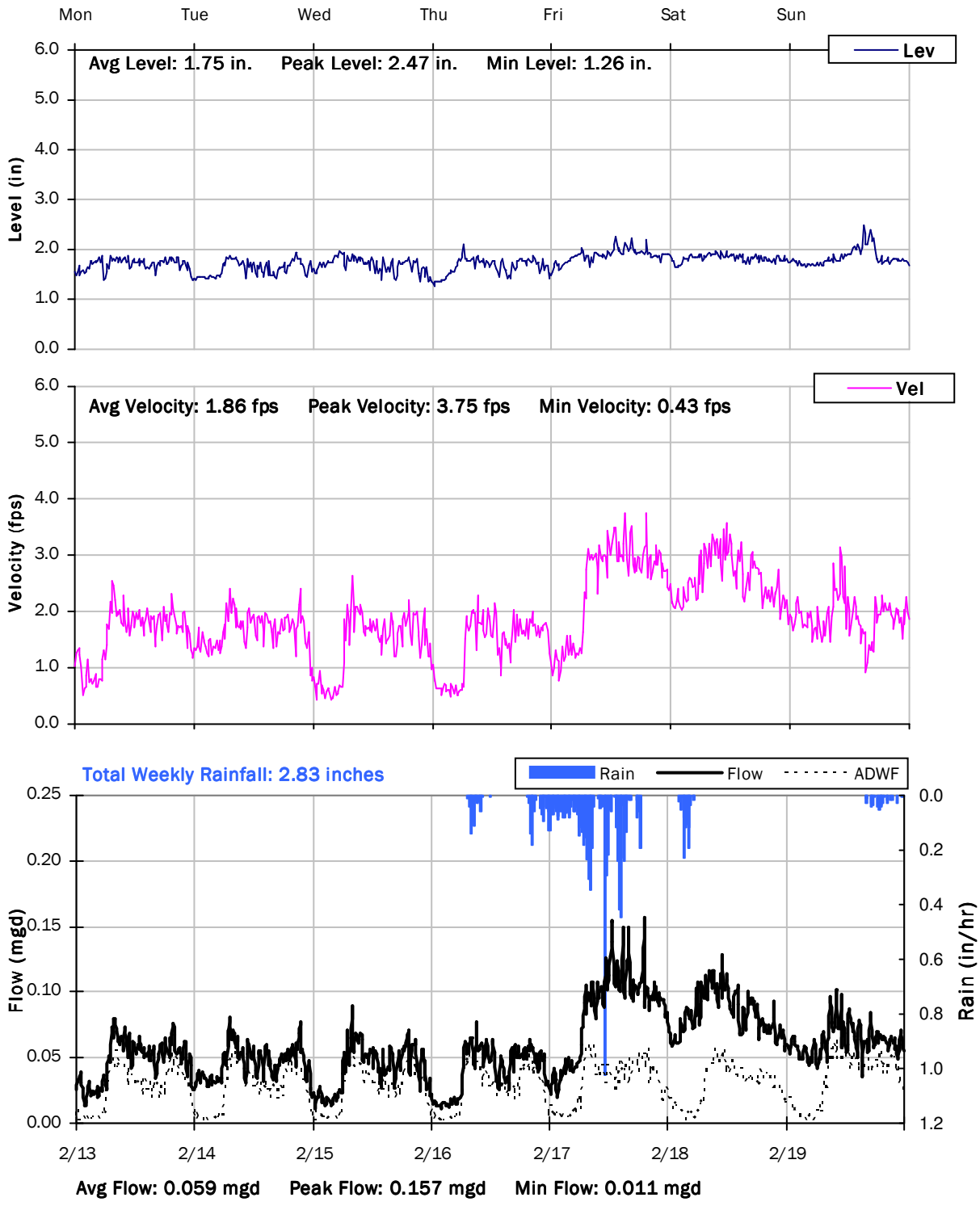
2/6/2017 to 2/13/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

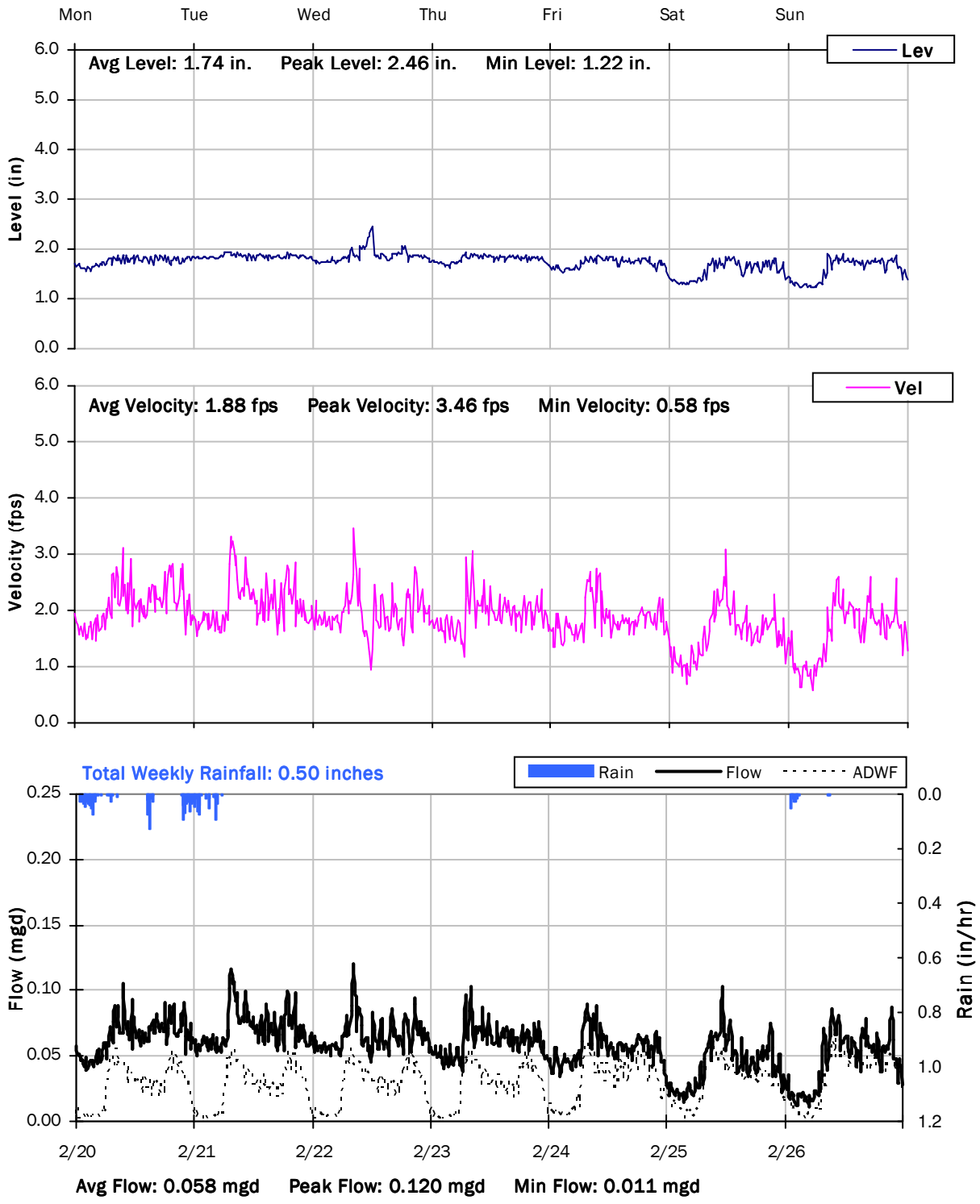
2/13/2017 to 2/20/2017



MB 2

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017



City of Morro Bay

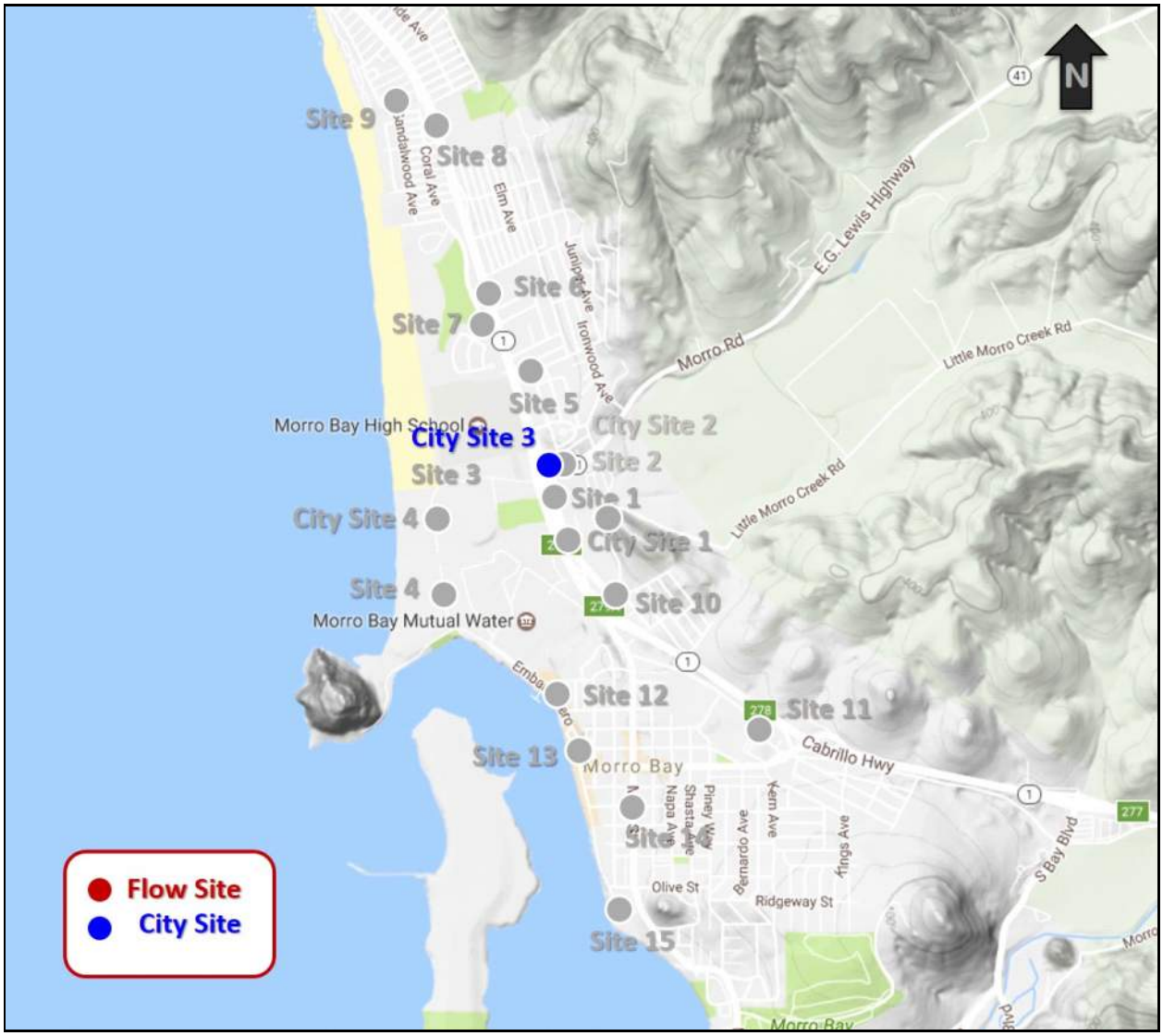
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - February 2017

Monitoring Site: MB 3

Location: City Meter at MH 5.25A, Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet

Data Summary Report



Vicinity Map: MB 3

MB 3

Site Information

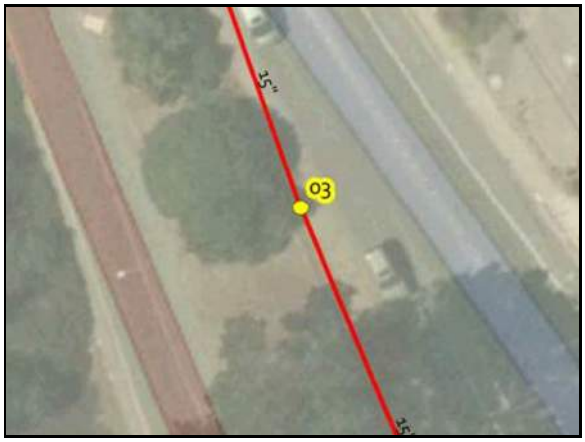
Location: City Meter at MH 5.25A, Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet

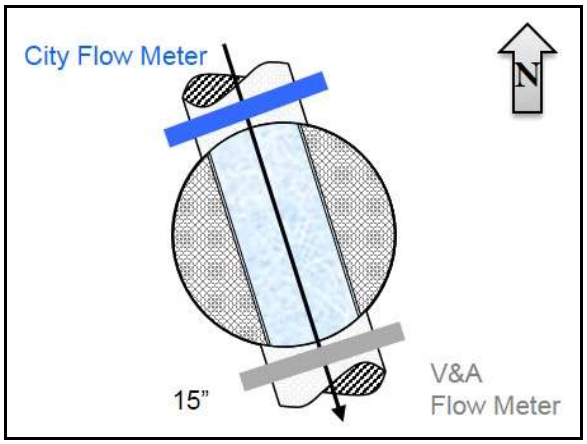


Pipe Diameter: 15 inches

ADWF: 0.296 mgd

Peak Measured Flow: 2.539 mgd







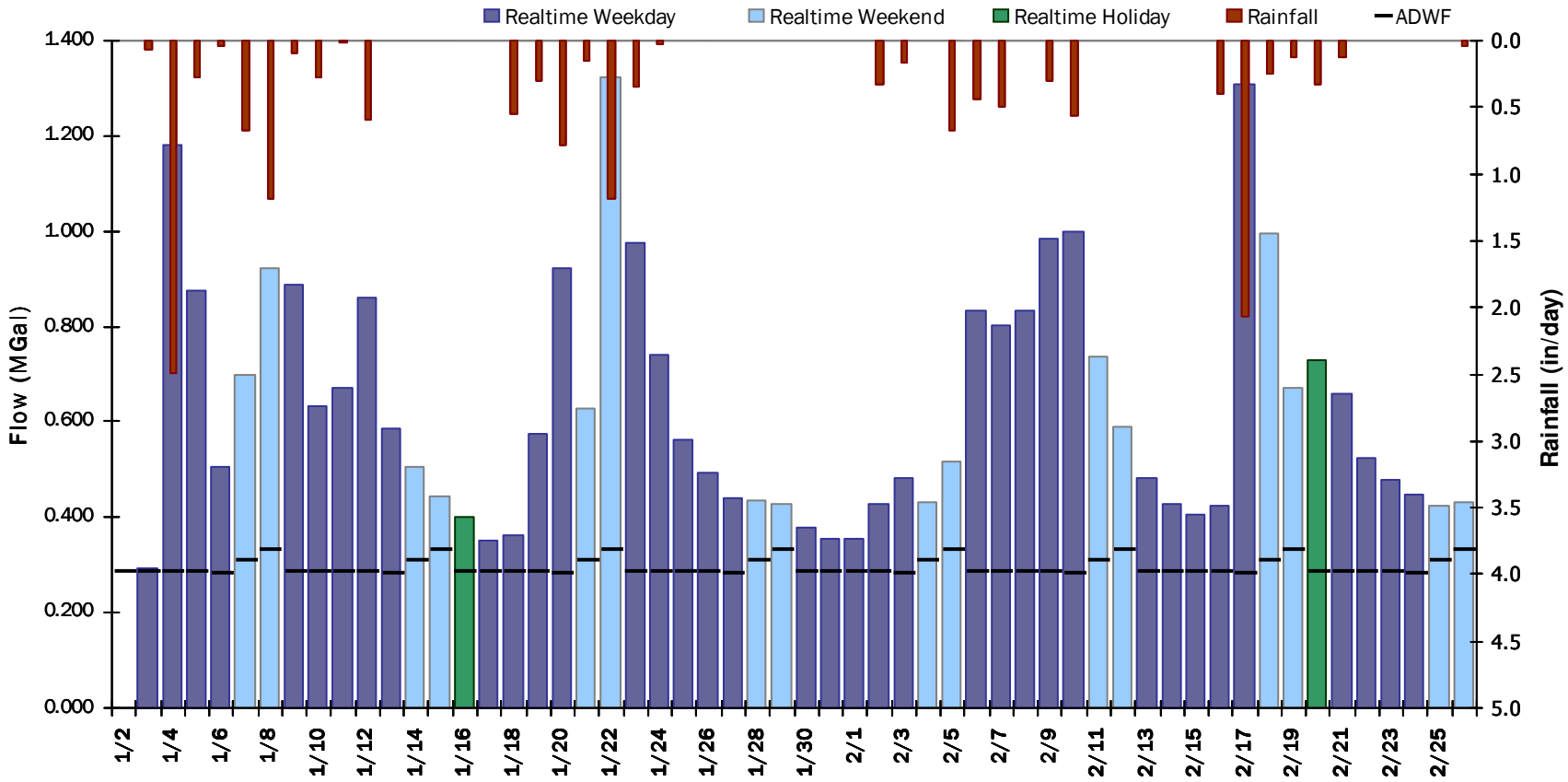


MB 3

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.633 MGal **Peak Daily Flow: 1.322 MGal** **Min Daily Flow: 0.292 MGal**

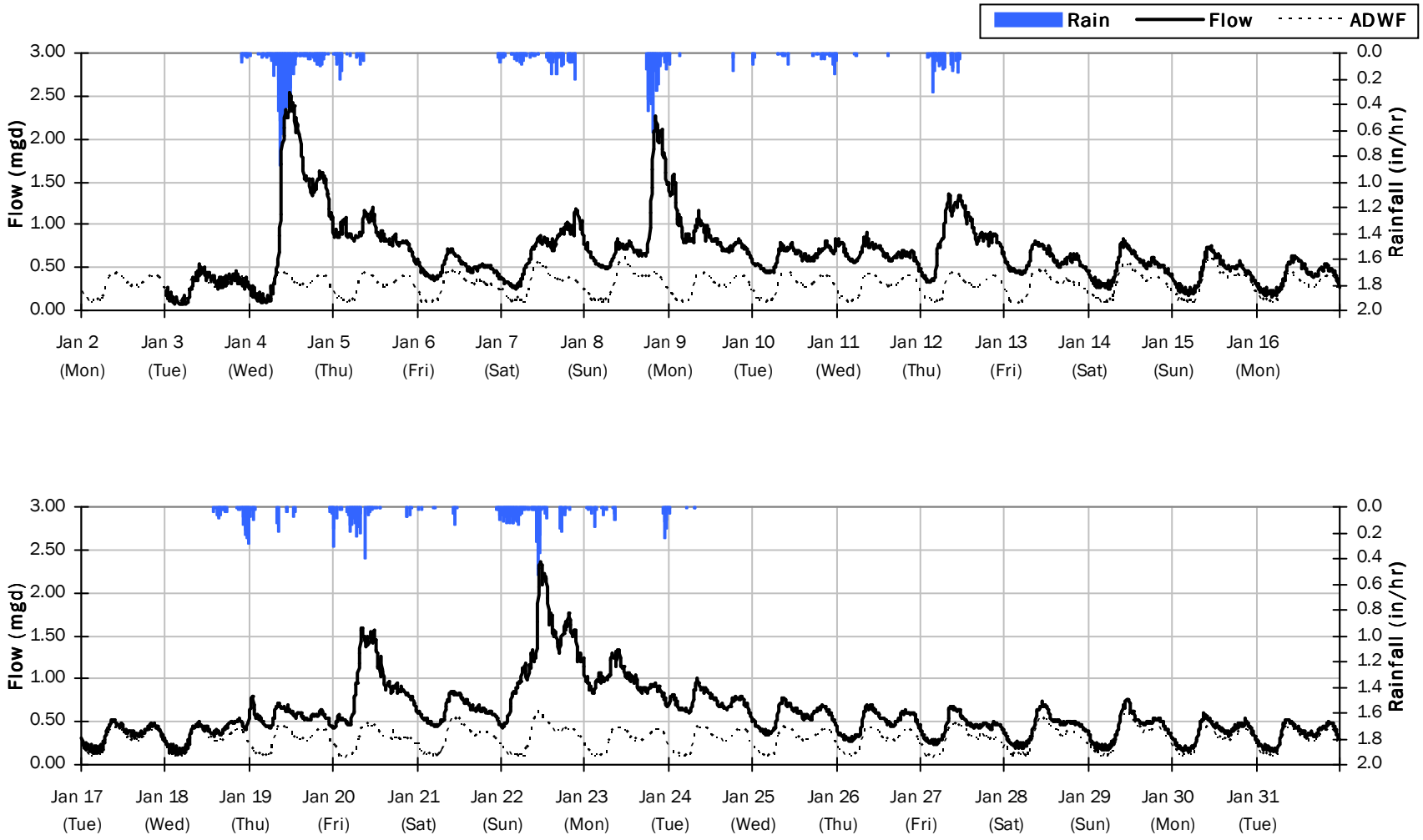
Total Period Rainfall: 15.37 inches



MB 3

Flow Summary: 1/2/2017 to 1/31/2017

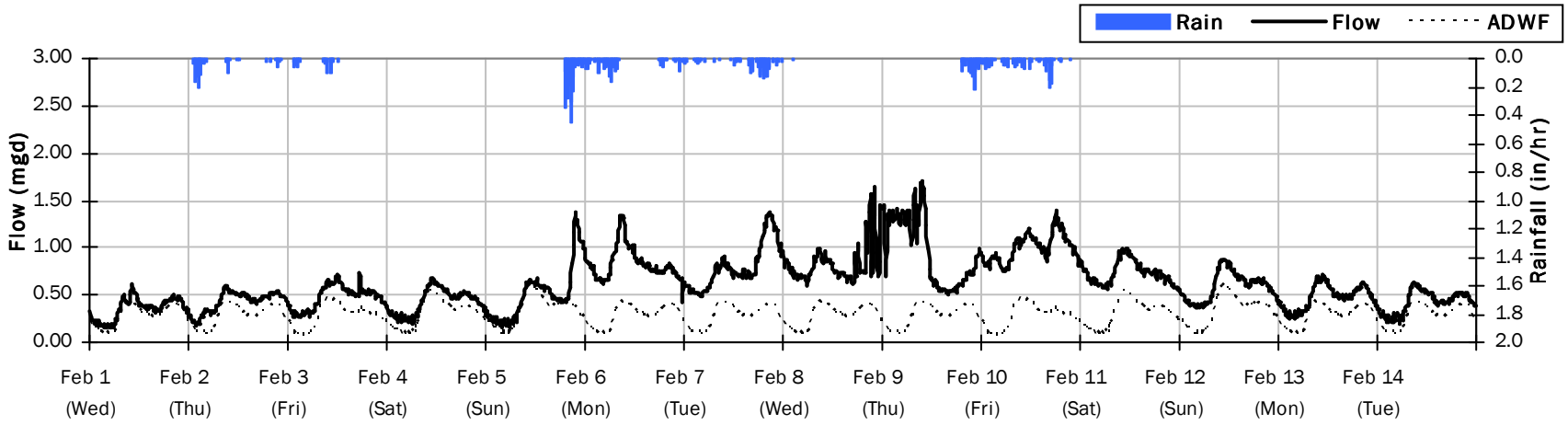
Total Period Rainfall: 9.05 inches **Avg Flow: 0.636 mgd** **Peak Flow: 2.539 mgd** **Min Flow: 0.071 mgd**

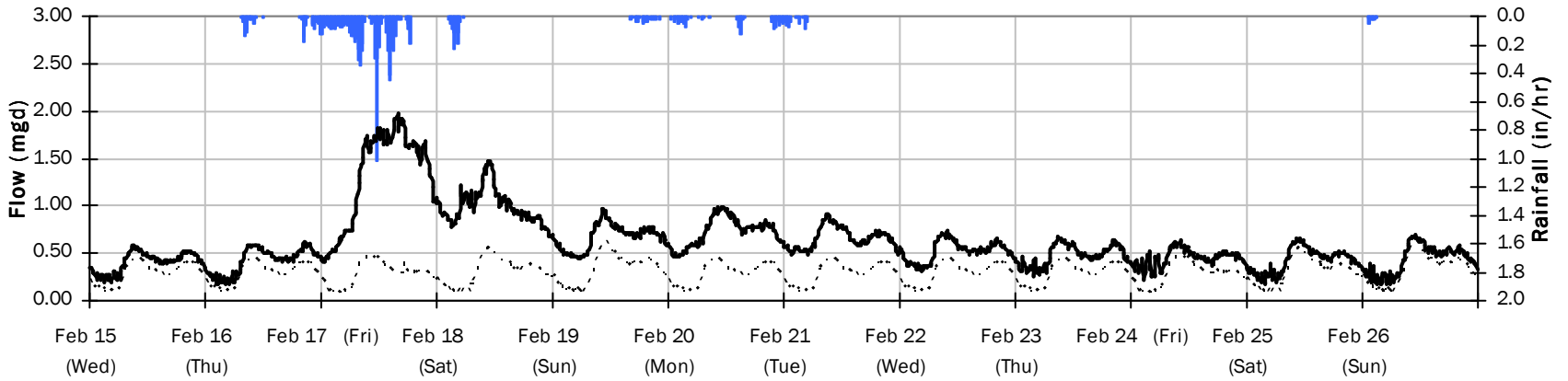


MB 3

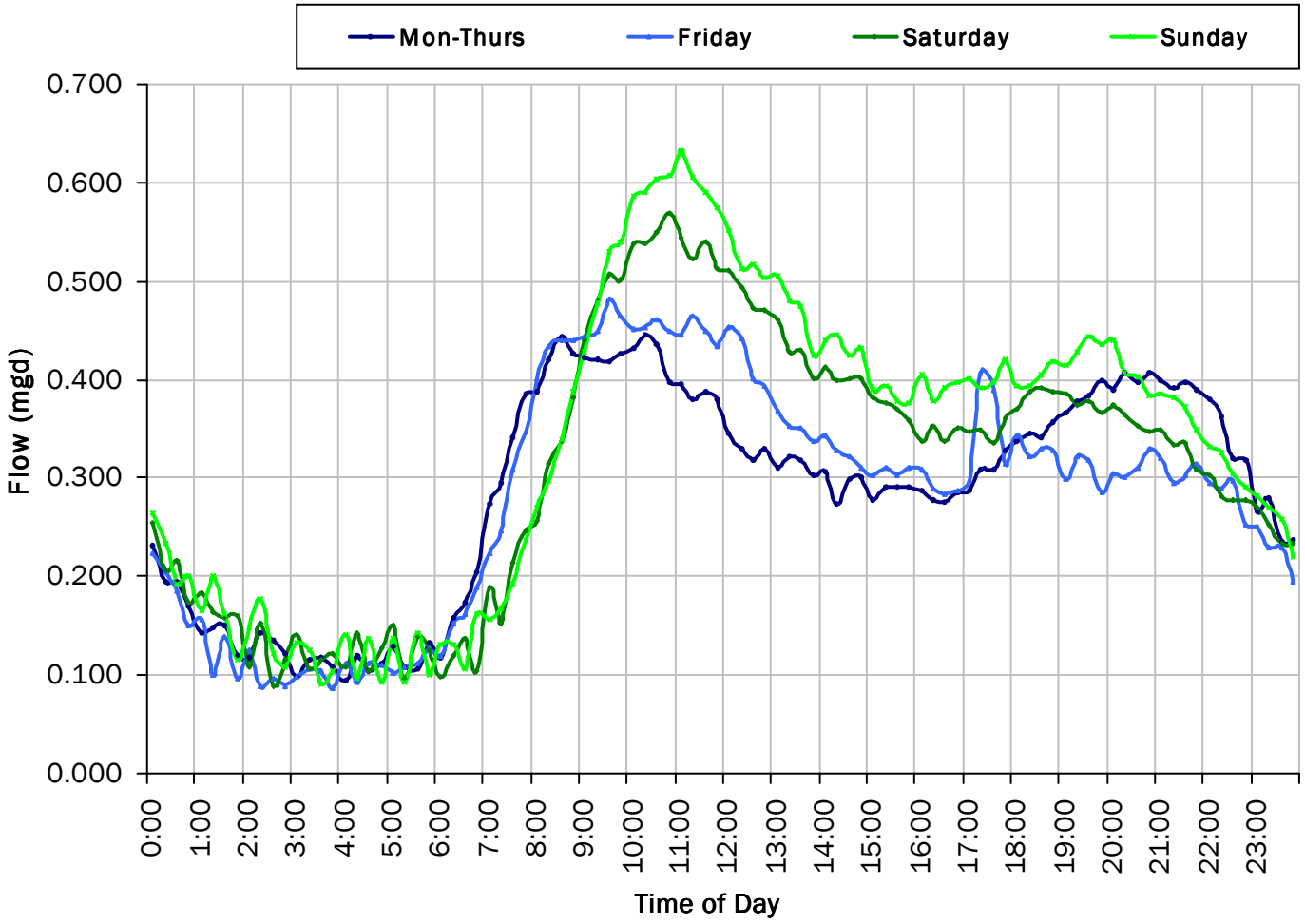
Flow Summary: 2/1/2017 to 2/28/2017

Total Period Rainfall: 6.31 inches **Avg Flow: 0.631 mgd Peak Flow: 1.967 mgd Min Flow: 0.148 mgd**



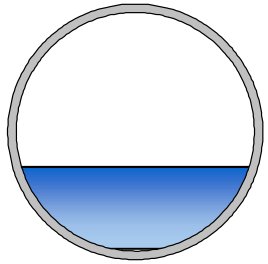


MB 3
Average Dry Weather Flow Hydrographs



ADWF:

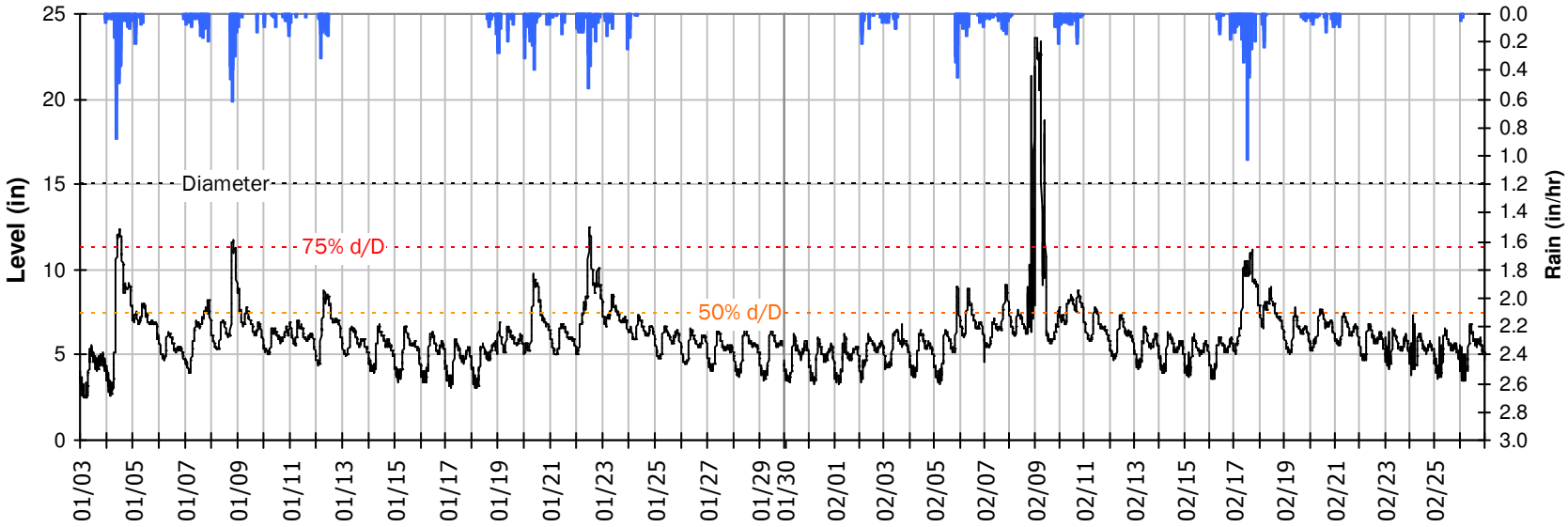
0.296 *mgd*

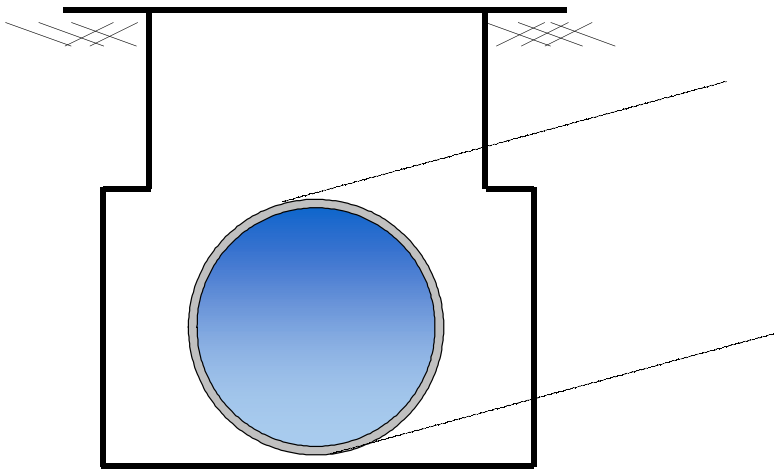


MB 3

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



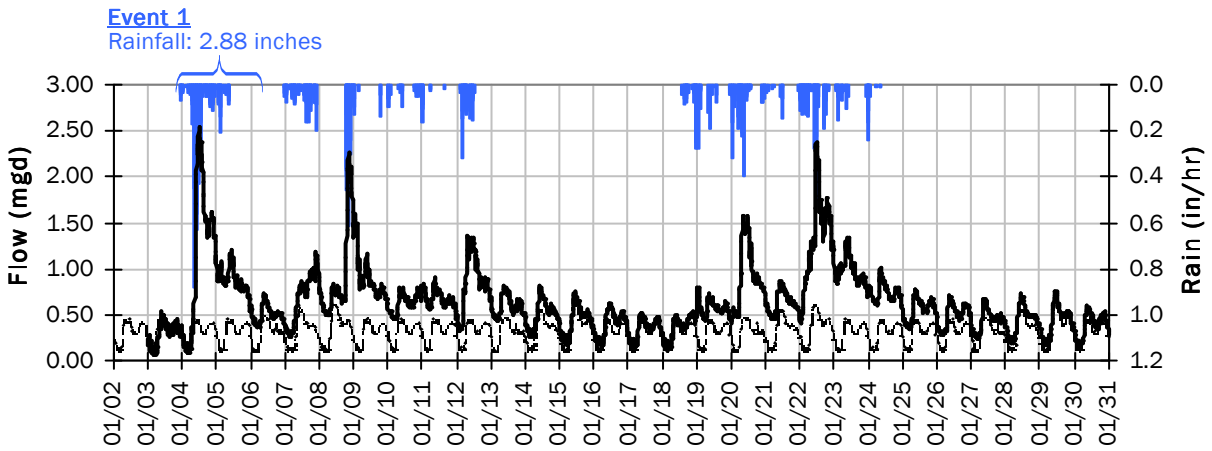


Pipe Diameter:	15	*inches*
Peak Measured Level:	23.6	*inches*
Peak d/D Ratio:	1.57	

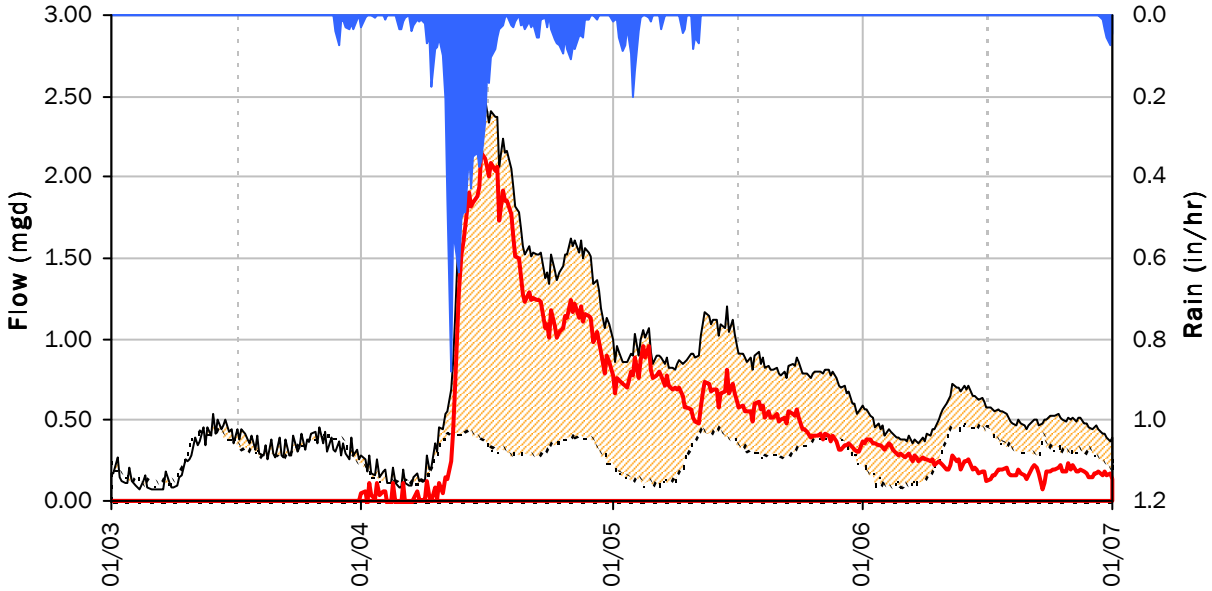
Surcharged 8.6 inches over crown

MB 3
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

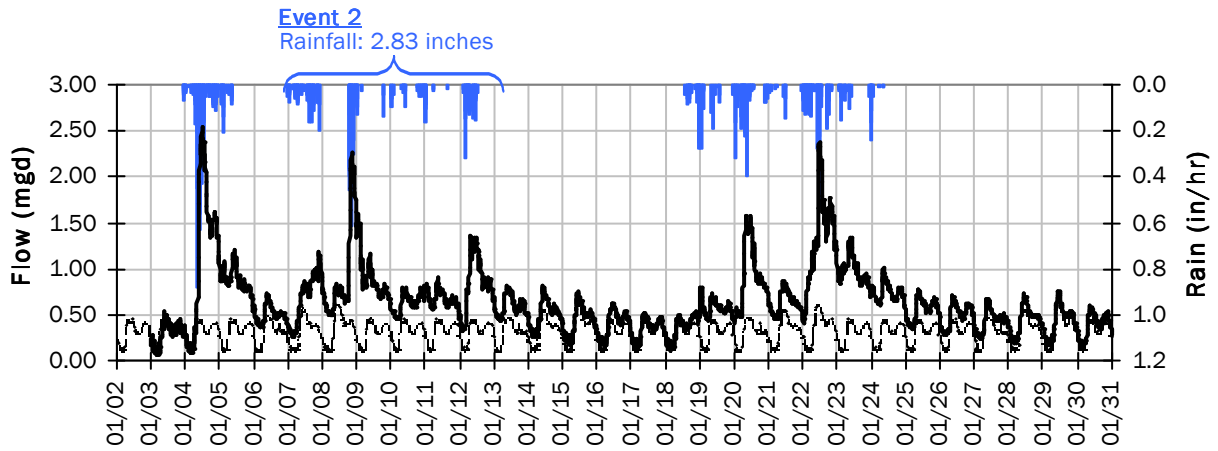


Storm Event I/I Analysis (Rain = 2.88 inches)

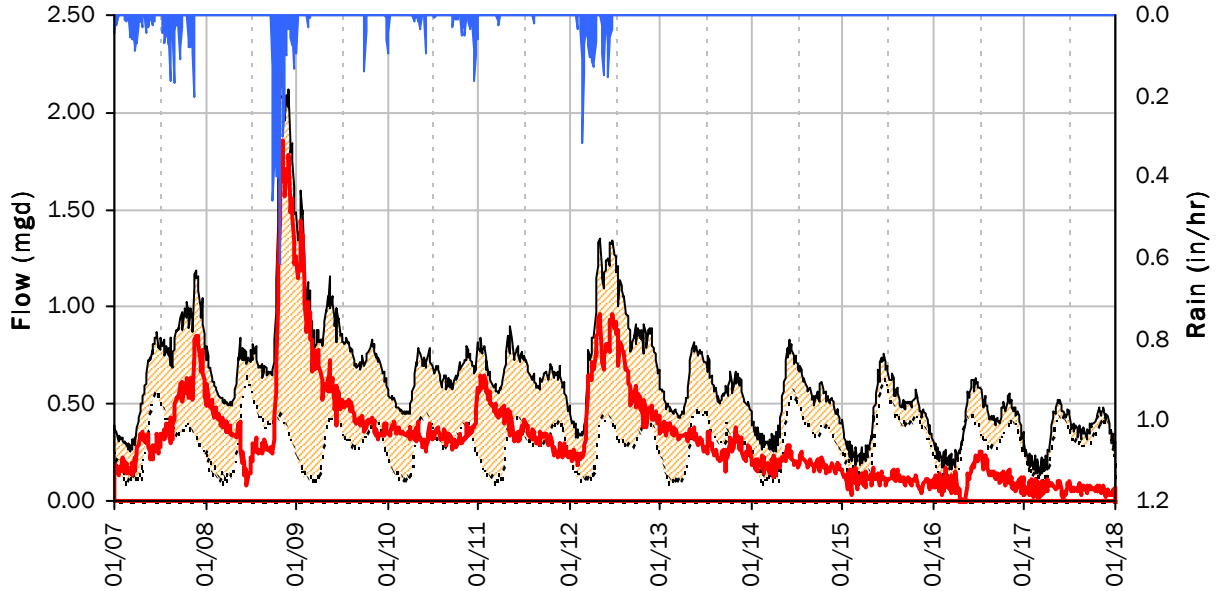
Capacity		Inflow / Infiltration	
Peak Flow:	2.54 *mgd*	**Peak I/I Rate:**	2.15 *mgd*
PF:	8.57	**Total I/I:**	1,709,000 *gallons*
Peak Level:	12.43 *in*		
d/D Ratio:	0.83		

MB 3
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

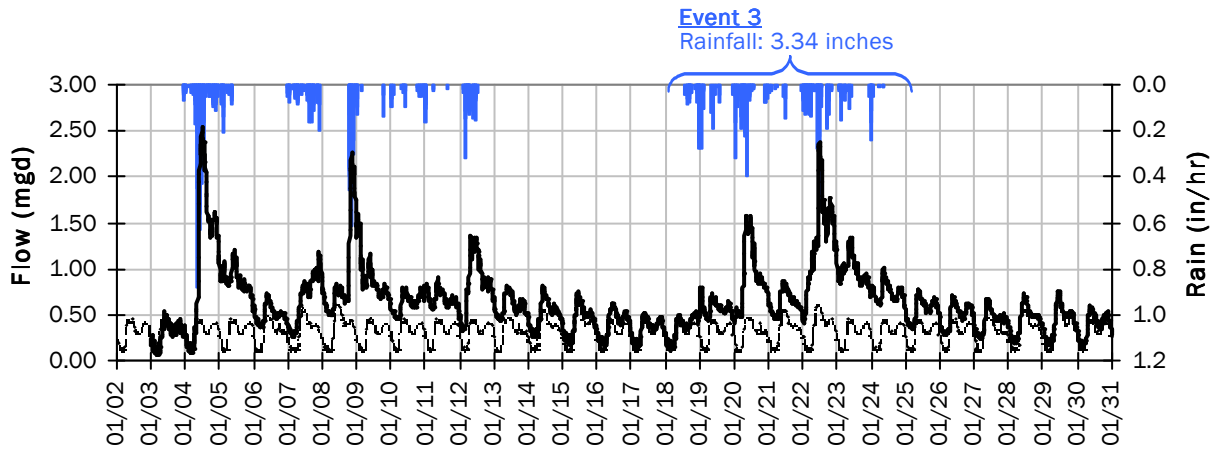


Storm Event I/I Analysis (Rain = 2.83 inches)

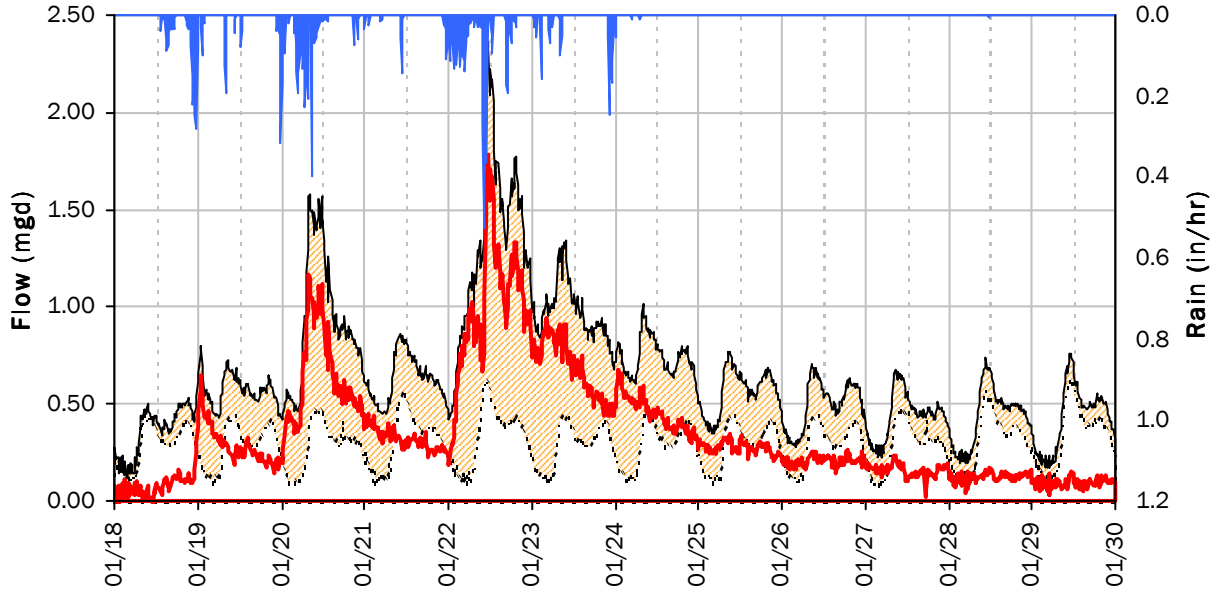
Capacity		Inflow / Infiltration	
Peak Flow:	2.26 *mgd*	**Peak I/I Rate:**	1.86 *mgd*
PF:	7.65	**Total I/I:**	3,668,000 *gallons*
Peak Level:	11.74 *in*		
d/D Ratio:	0.78		

MB 3
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

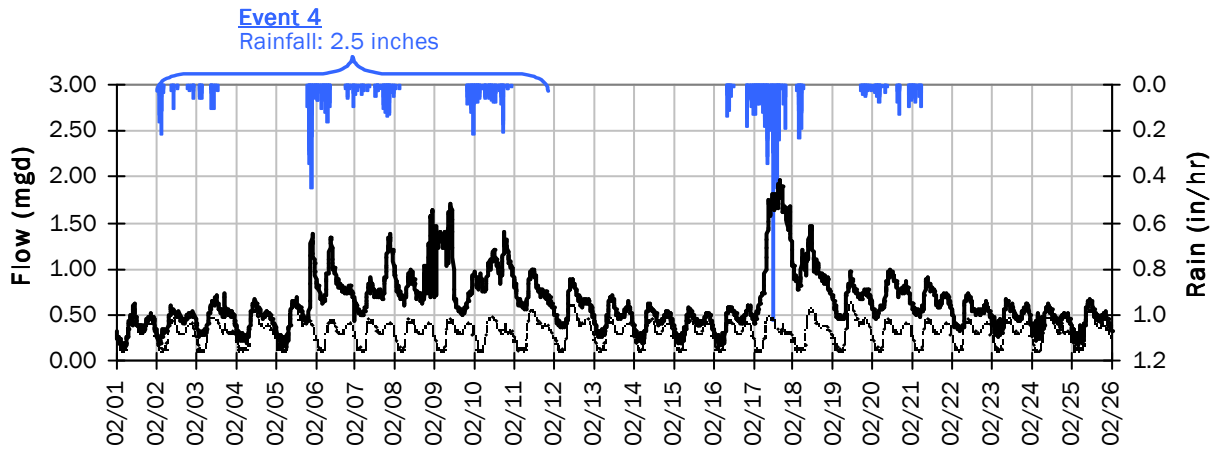


Storm Event I/I Analysis (Rain = 3.35 inches)

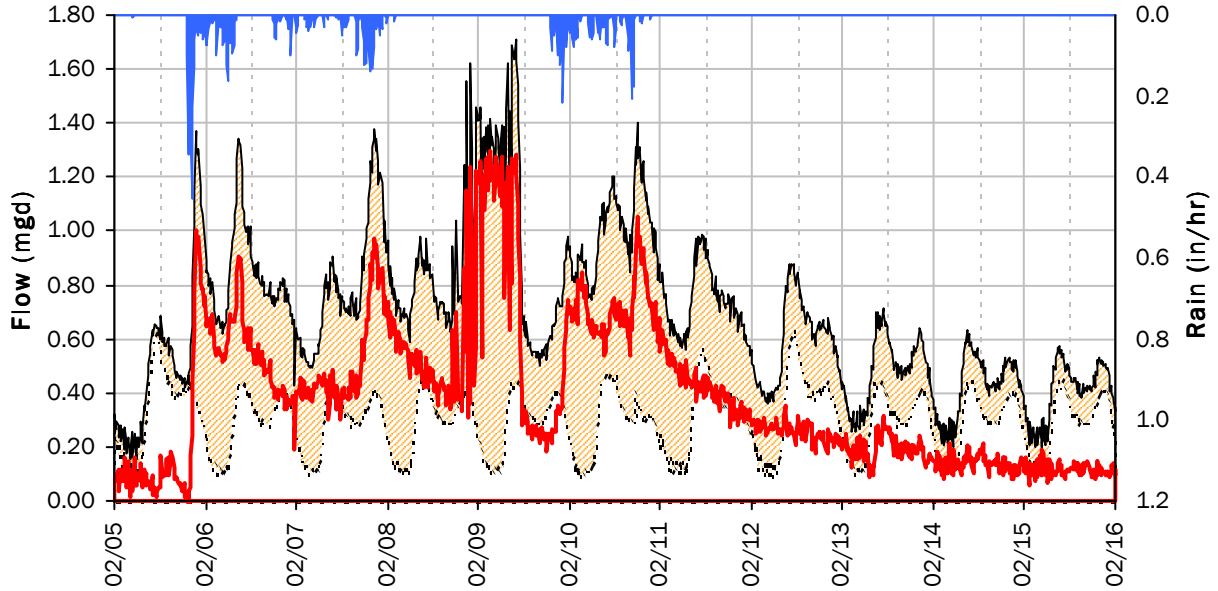
Capacity		Inflow / Infiltration	
Peak Flow:	2.37 *mgd*	**Peak I/I Rate:**	1.78 *mgd*
PF:	8.00	**Total I/I:**	4,318,000 *gallons*
Peak Level:	12.55 *in*		
d/D Ratio:	0.84		

MB 3
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph

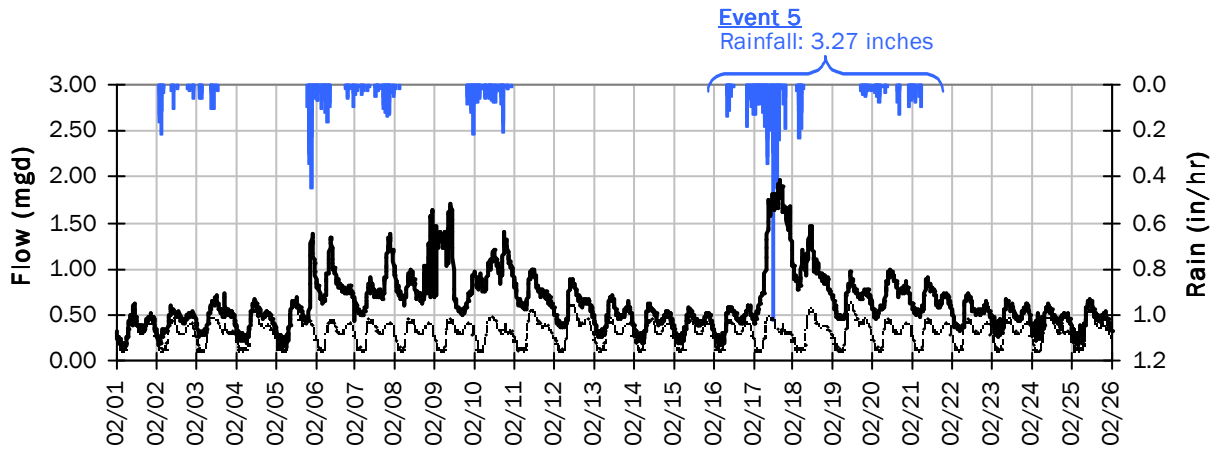


Storm Event I/I Analysis (Rain = 2.50 inches)

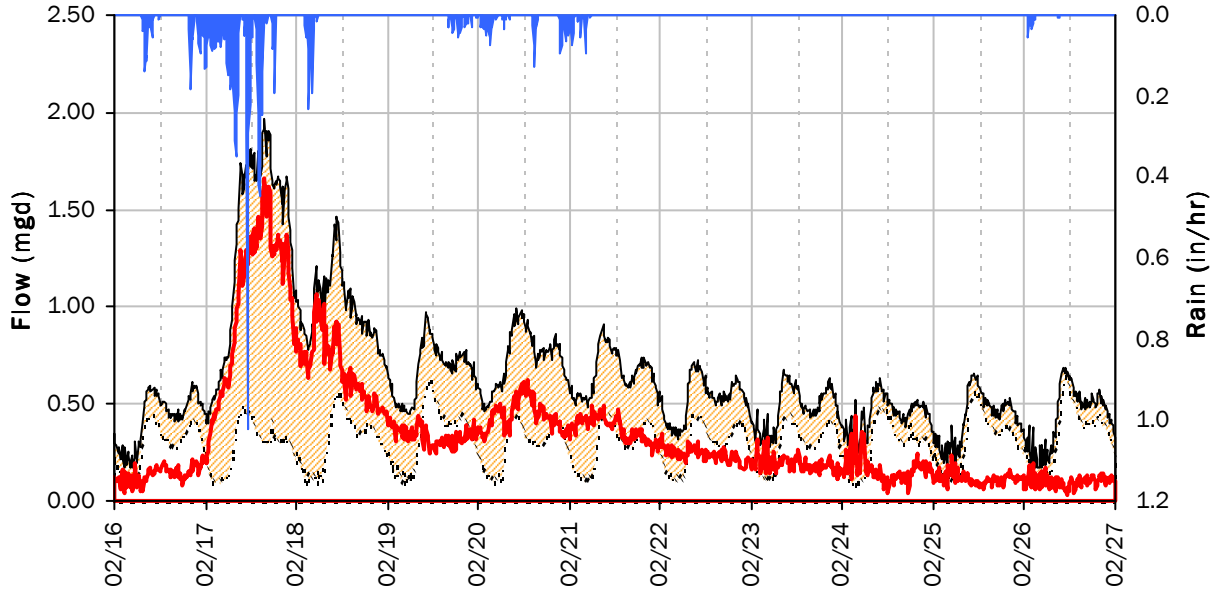
Capacity		Inflow / Infiltration	
Peak Flow:	1.71 *mgd*	**Peak I/I Rate:**	1.30 *mgd*
PF:	5.77	**Total I/I:**	4,344,000 *gallons*
Peak Level:	23.62 *in*		
d/D Ratio:	1.57		

MB 3
I/I Summary: Event 5

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 5 Detail Graph



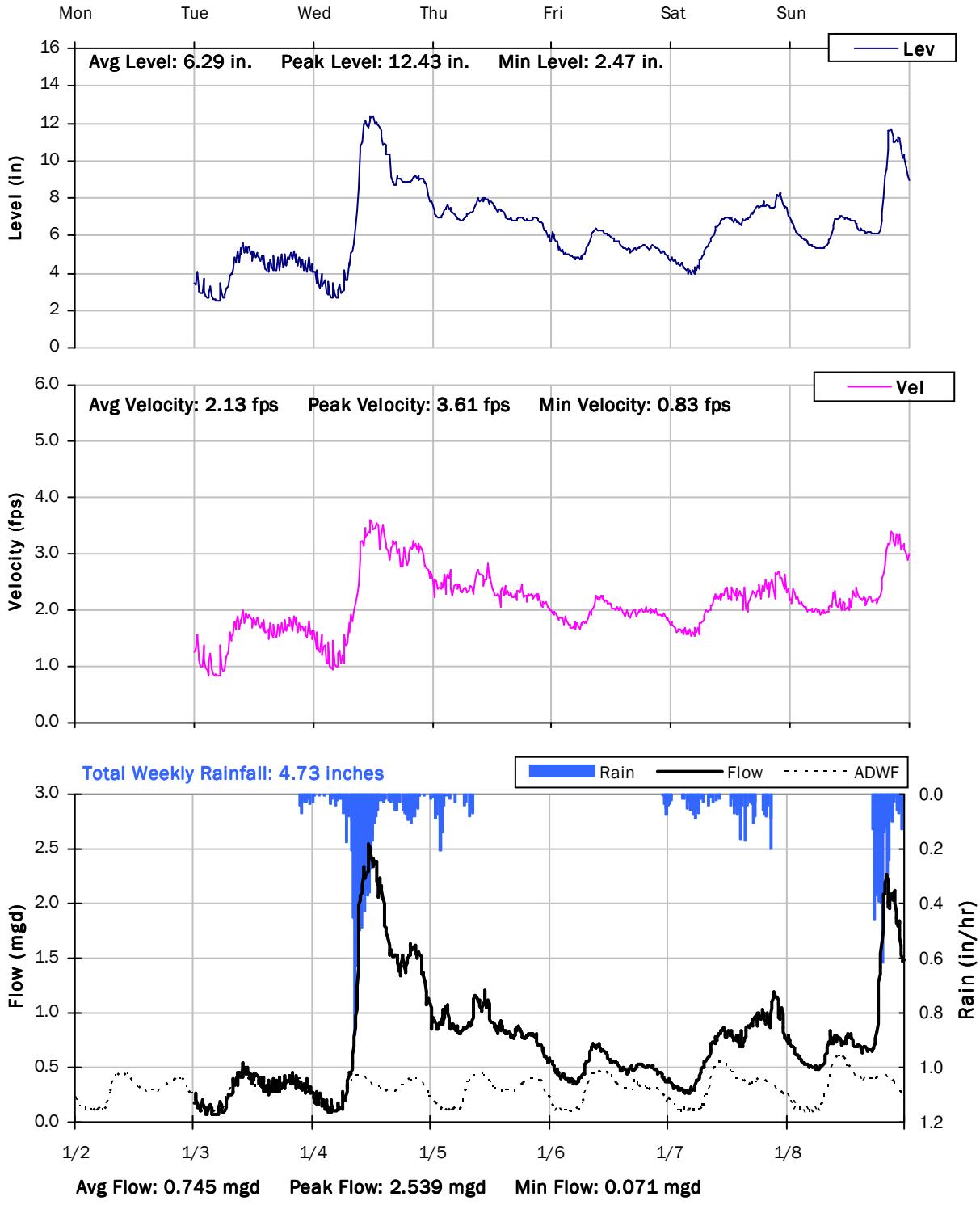
Storm Event I/I Analysis (Rain = 3.28 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.97 *mgd*	**Peak I/I Rate:**	1.66 *mgd*
PF:	6.64	**Total I/I:**	3,813,000 *gallons*
Peak Level:	11.14 *in*		
d/D Ratio:	0.74		

MB 3

Weekly Level, Velocity and Flow Hydrographs

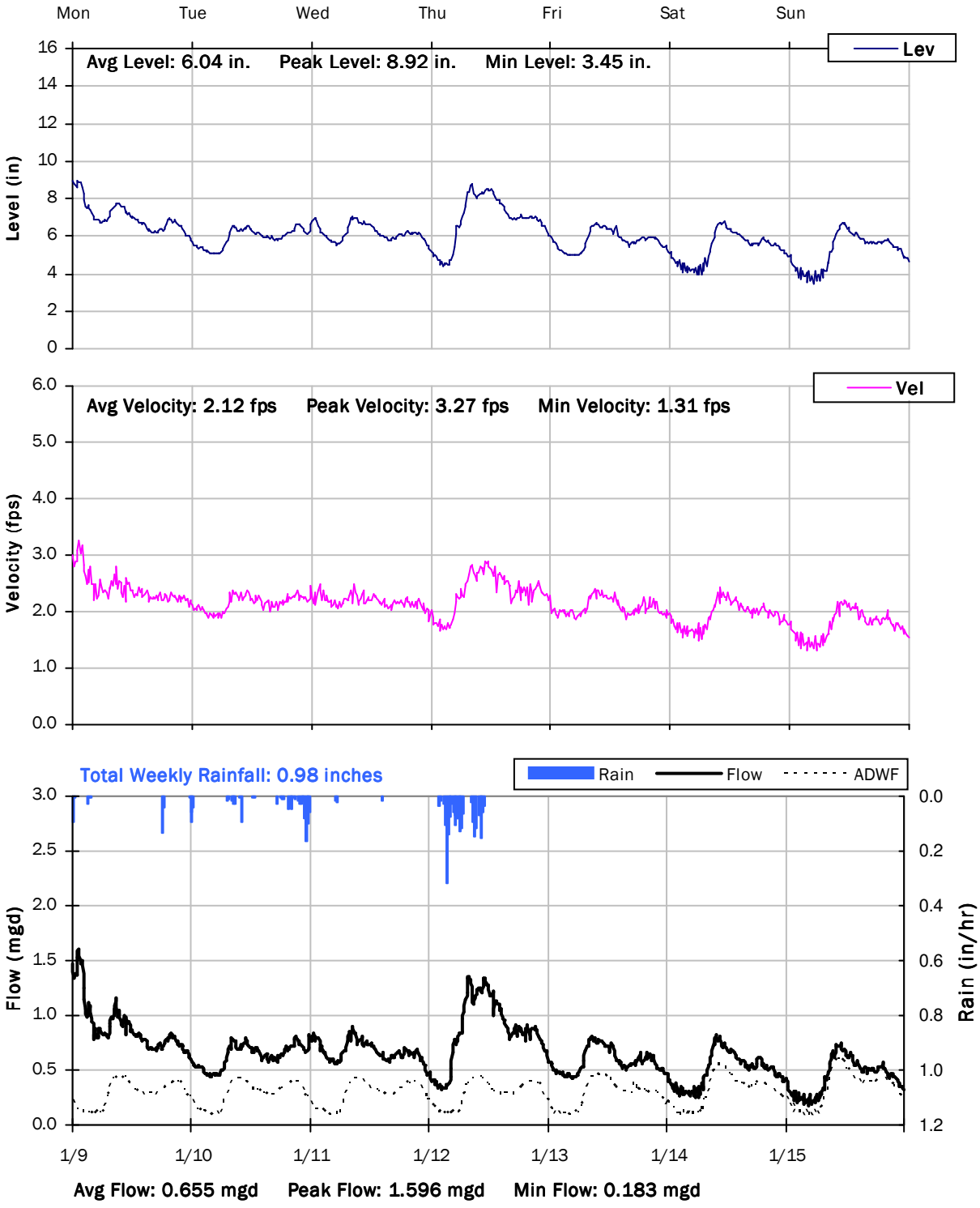
1/2/2017 to 1/9/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

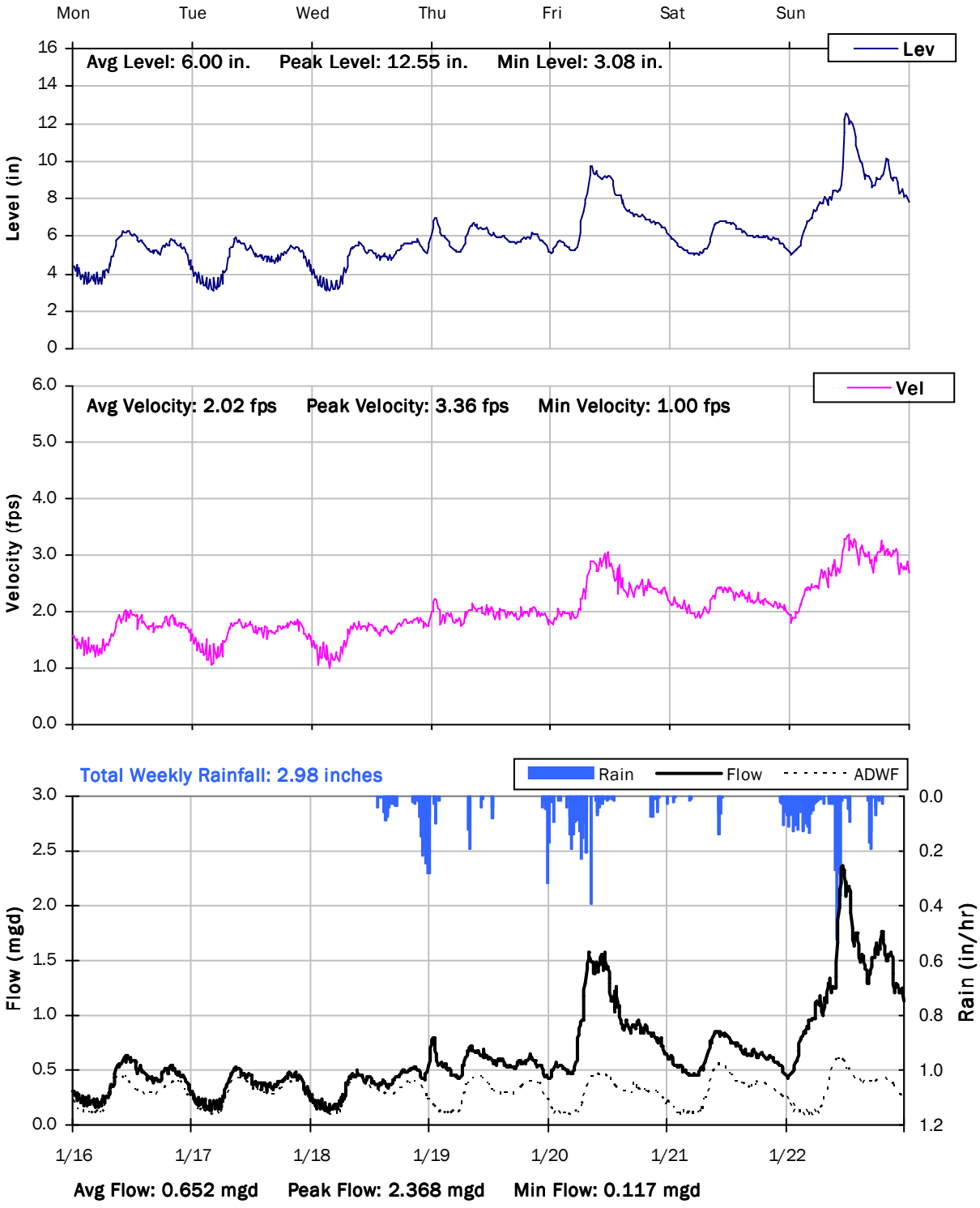
1/9/2017 to 1/16/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

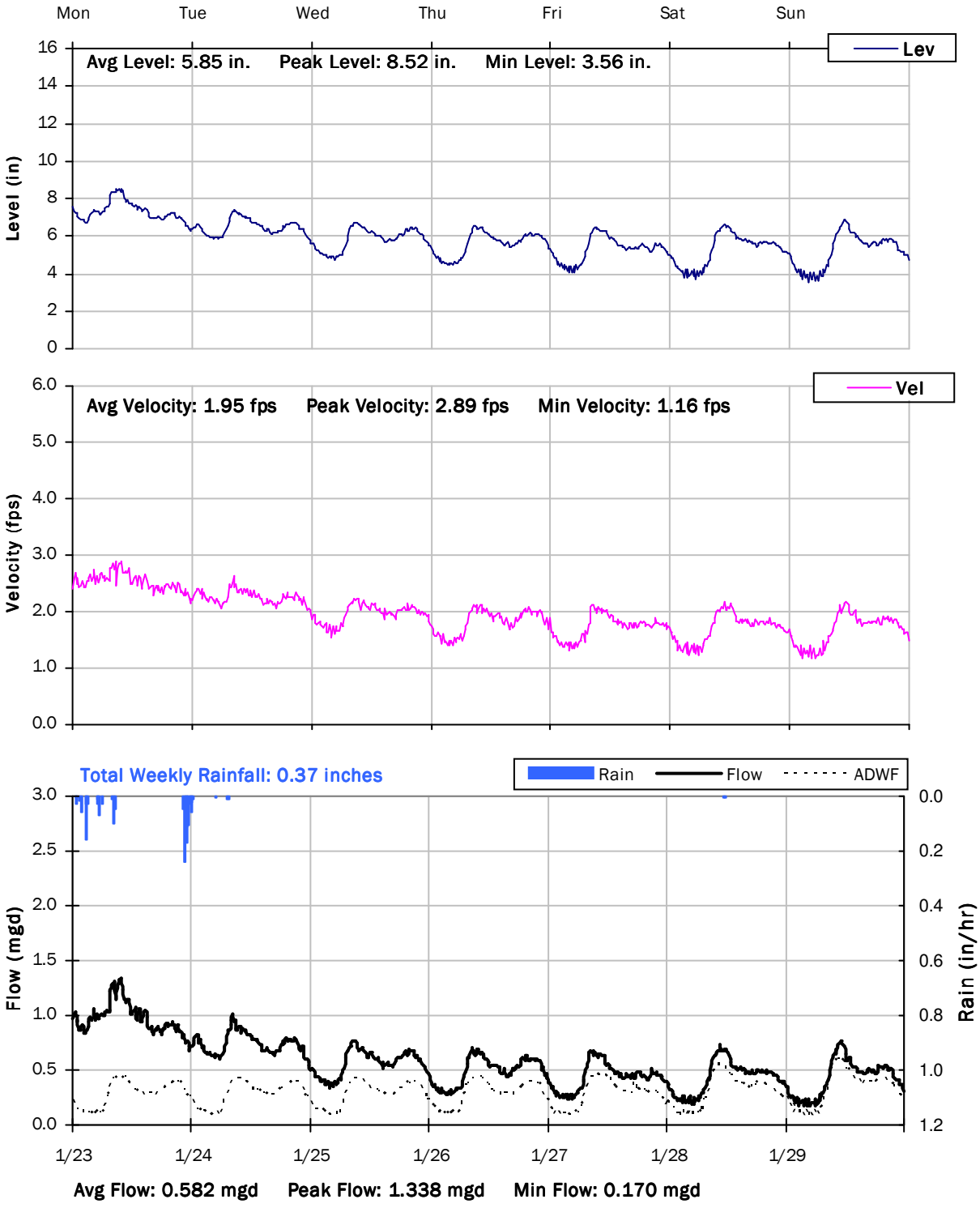
1/16/2017 to 1/23/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

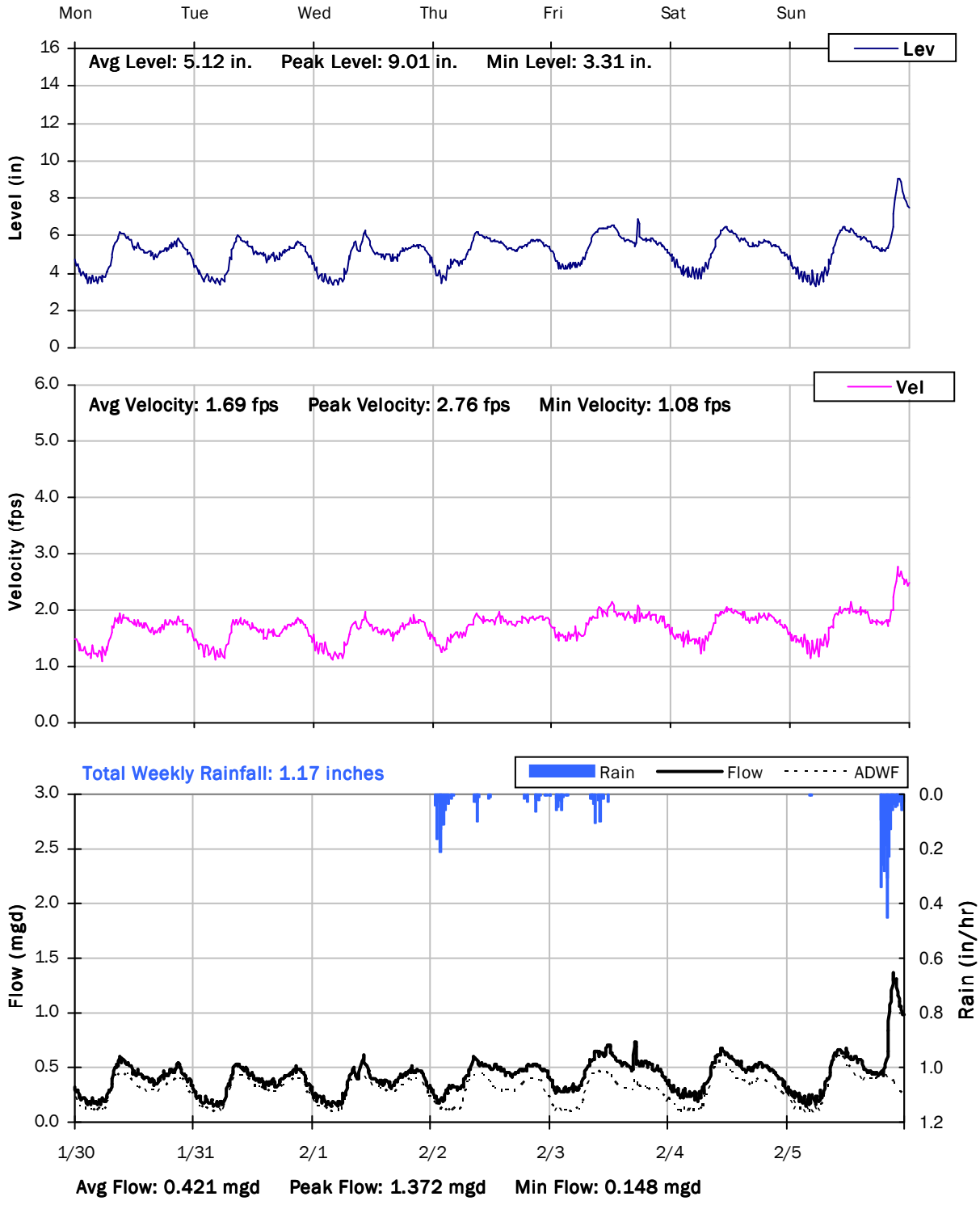
1/23/2017 to 1/30/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

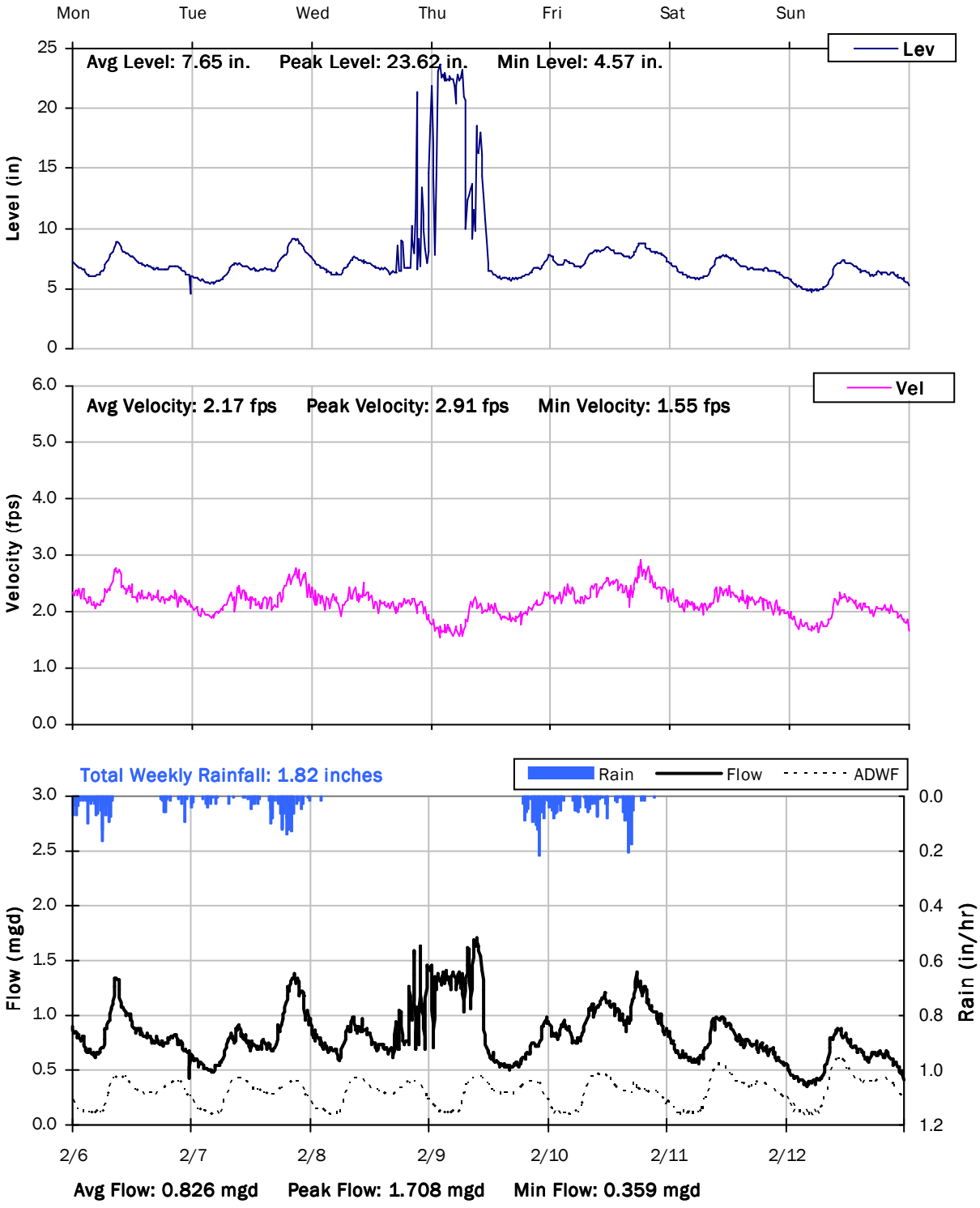
1/30/2017 to 2/6/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

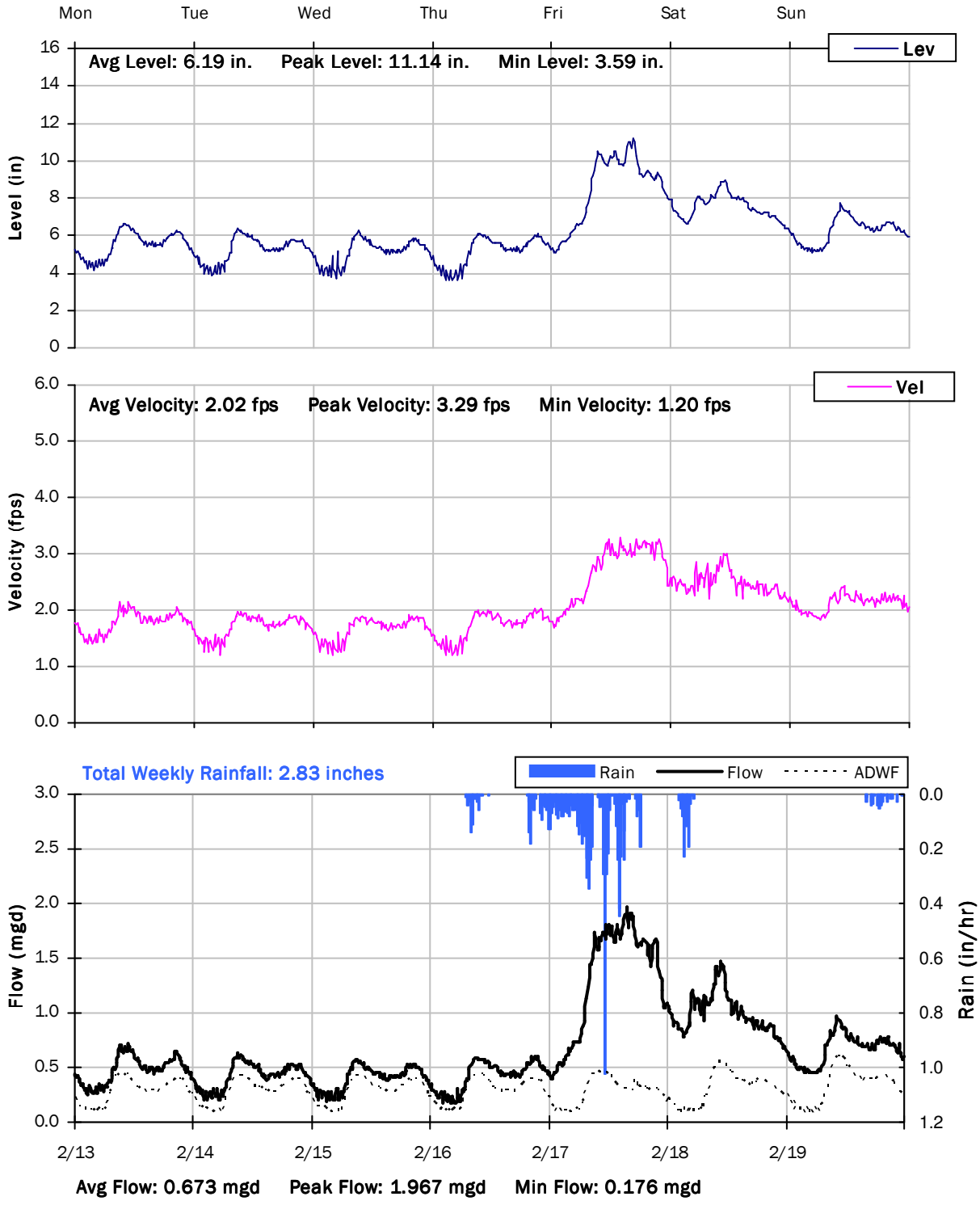
2/6/2017 to 2/13/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

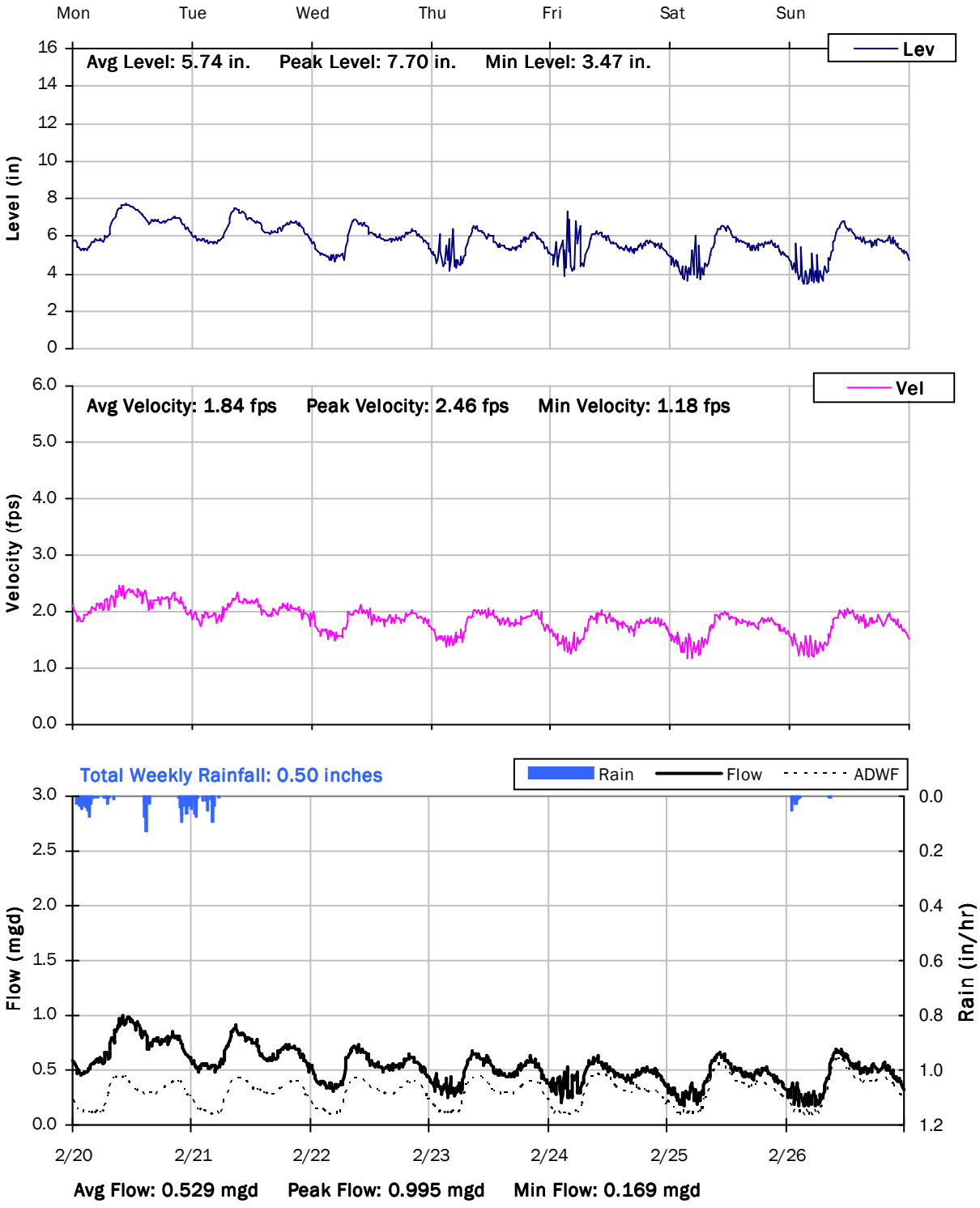
2/13/2017 to 2/20/2017



MB 3

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017



City of Morro Bay

Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - February 2017

Monitoring Site: MB 4

Location: City Meter at MH 14.5, Embarcadero ~300 feet south of entrance to Morro Dunes mobile home park, meter on south 18" inlet

Data Summary Report



Vicinity Map: MB 4

MB 4

Site Information

Location: City Meter at MH 14.5, Embarcadero ~300 feet south of entrance to Morro Dunes mobile home park, meter on south 18" inlet

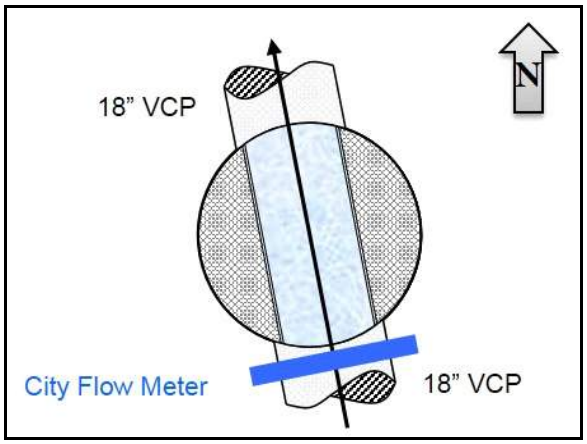


Pipe Diameter: 18 inches

ADWF: 0.223 mgd

Peak Measured Flow: 1.023 mgd







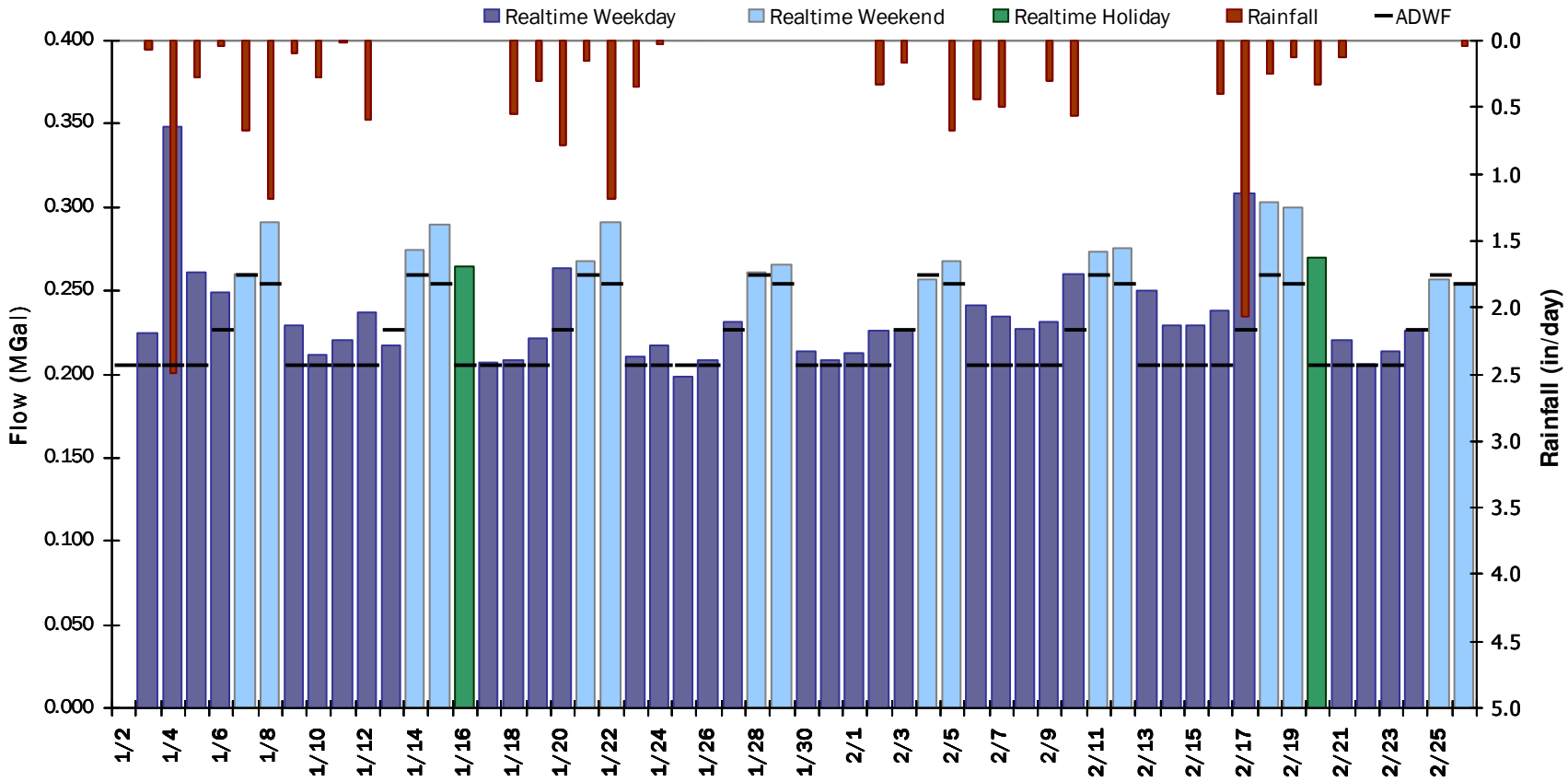
No Photo

MB 4

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.245 MGal **Peak Daily Flow: 0.348 MGal** **Min Daily Flow: 0.199 MGal**

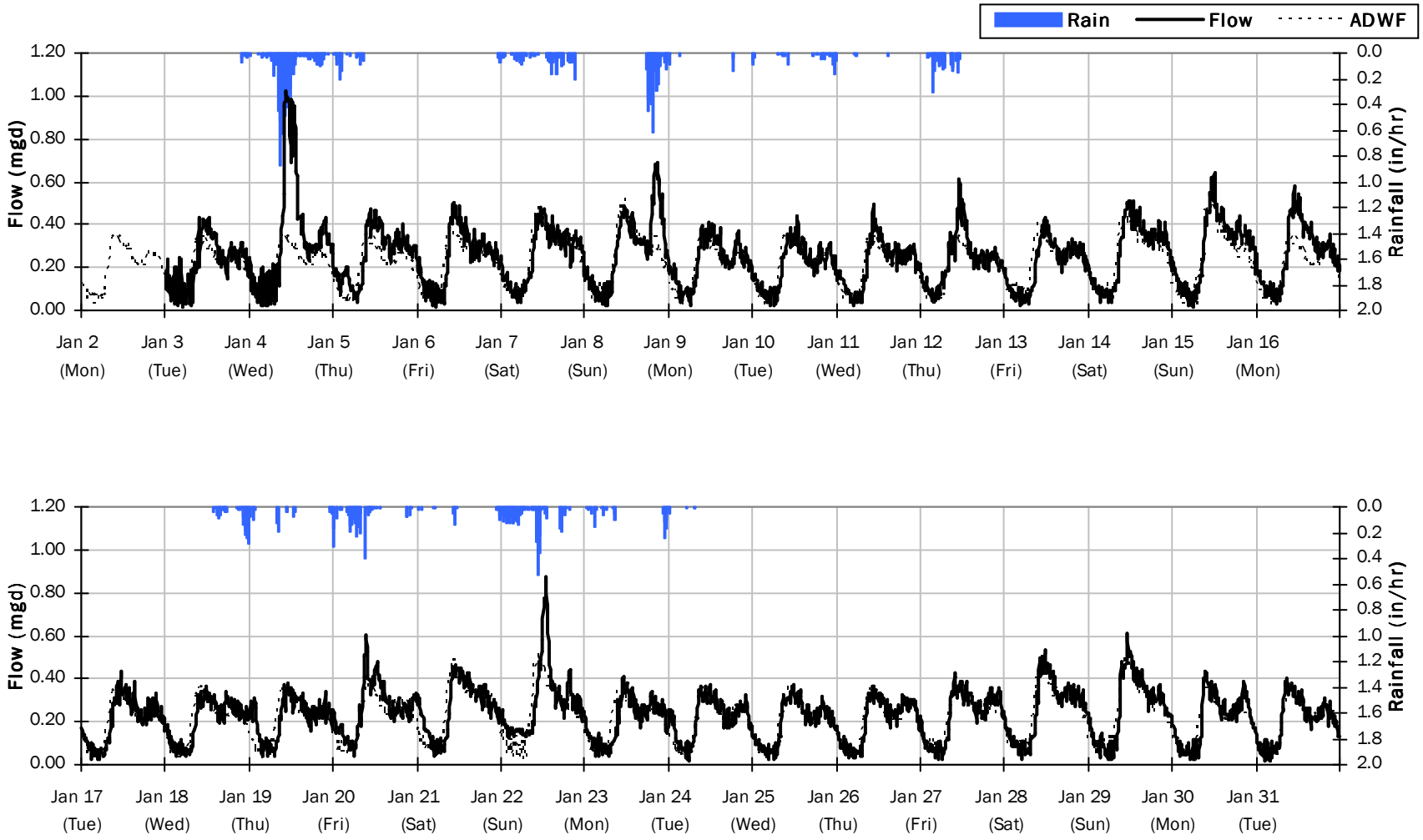
Total Period Rainfall: 15.37 inches



MB 4

Flow Summary: 1/2/2017 to 1/31/2017

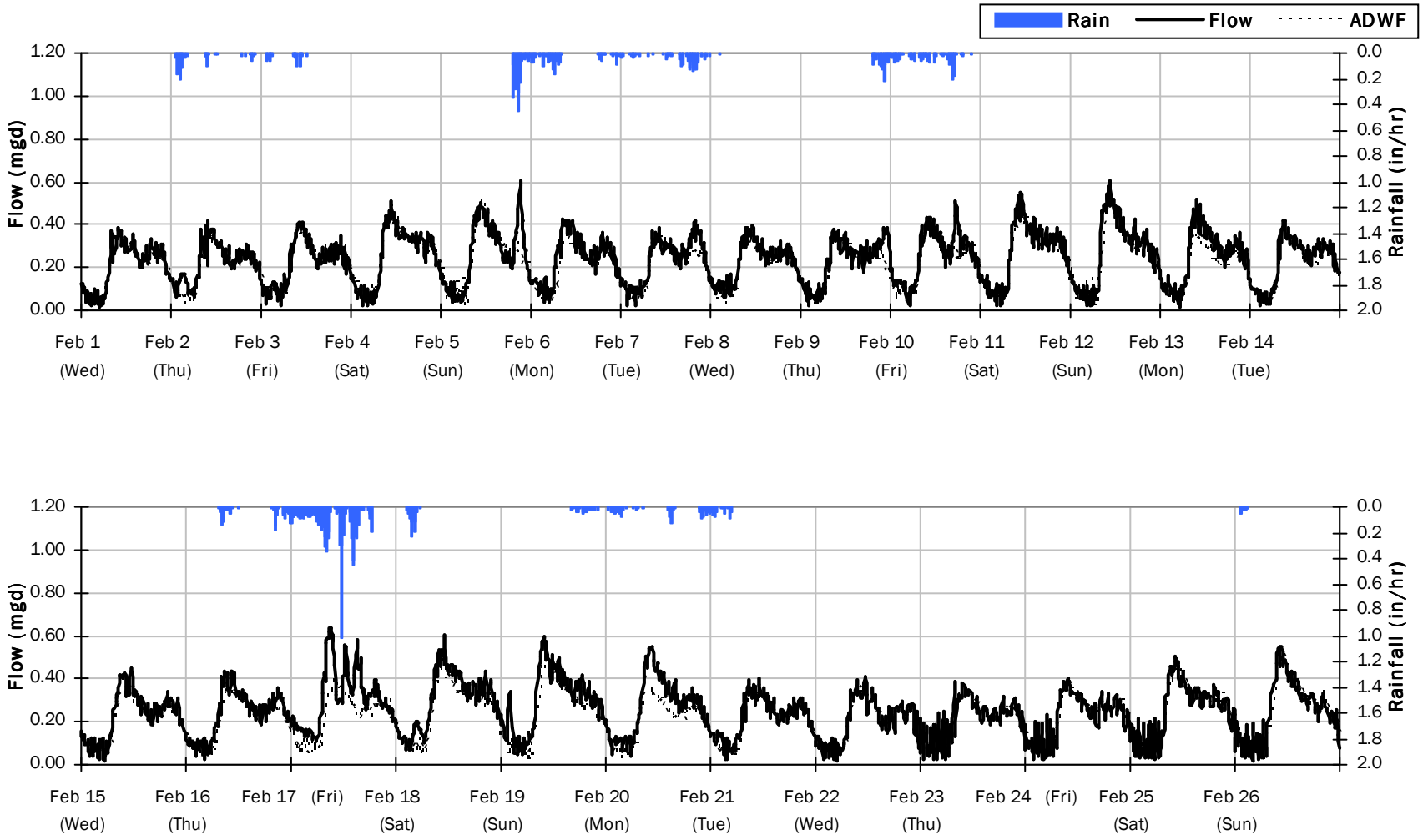
Total Period Rainfall: 9.05 inches **Avg Flow: 0.243 mgd** **Peak Flow: 1.023 mgd** **Min Flow: 0.012 mgd**



MB 4

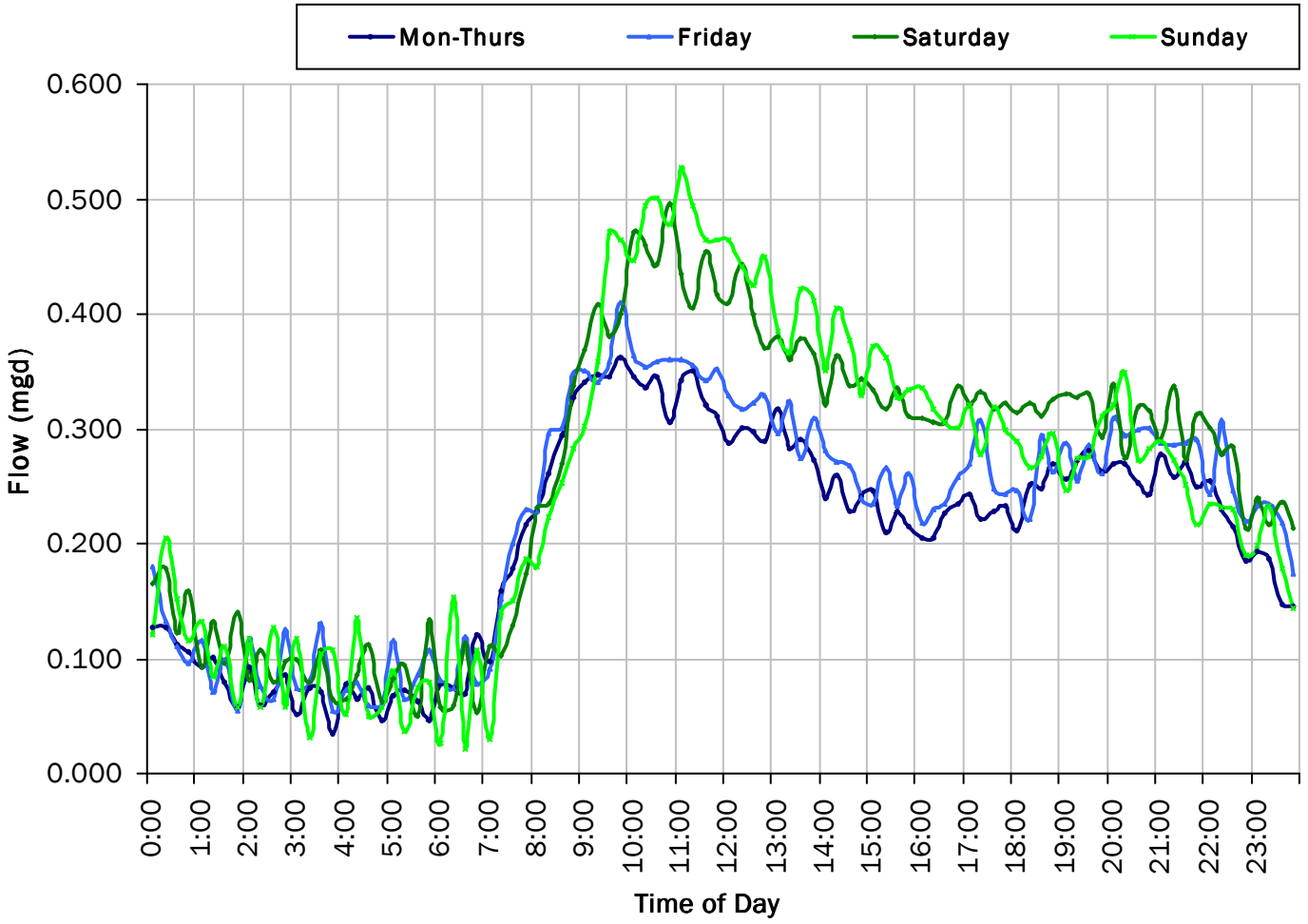
Flow Summary: 2/1/2017 to 2/28/2017

Total Period Rainfall: 6.31 inches **Avg Flow: 0.248 mgd** **Peak Flow: 0.634 mgd** **Min Flow: 0.013 mgd**



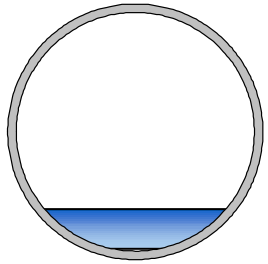
MB 4

Average Dry Weather Flow Hydrographs



ADWF:

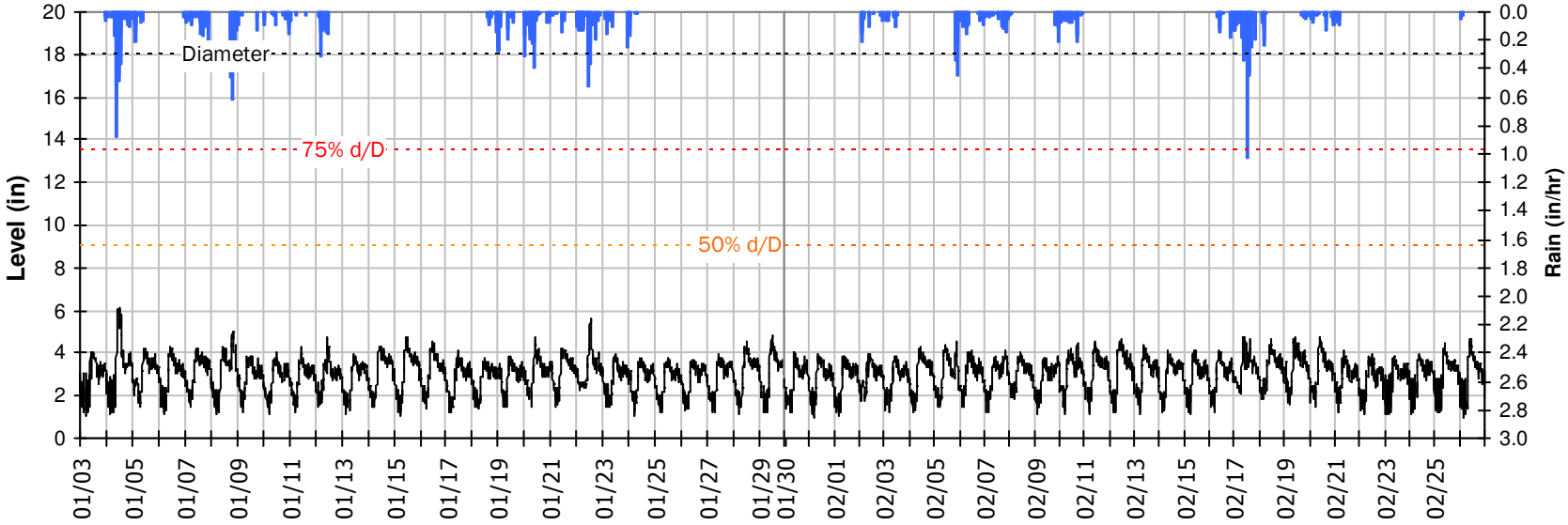
0.223 *mgd*

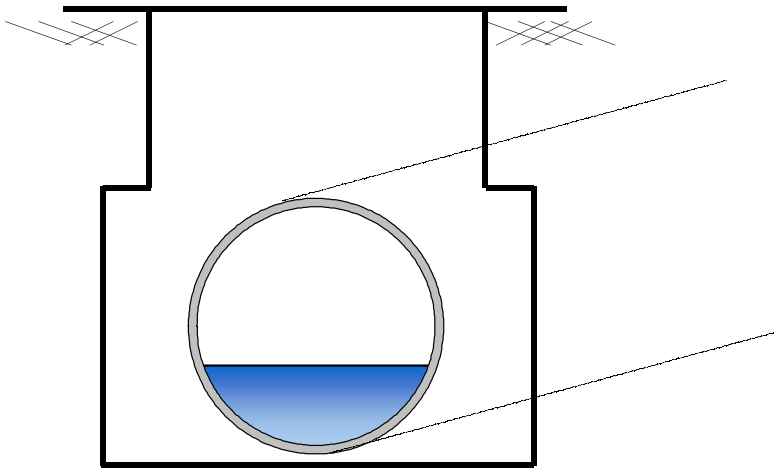


MB 4

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

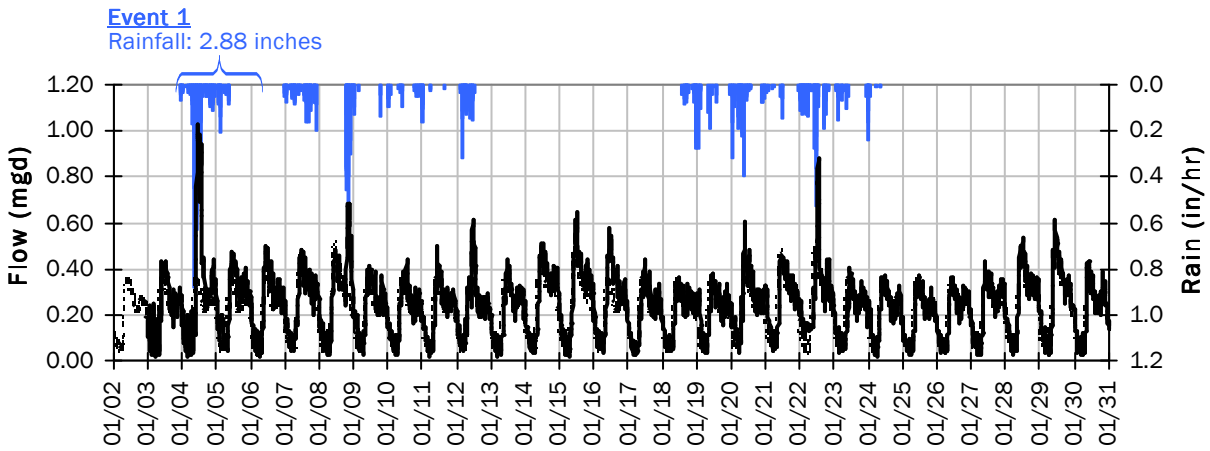




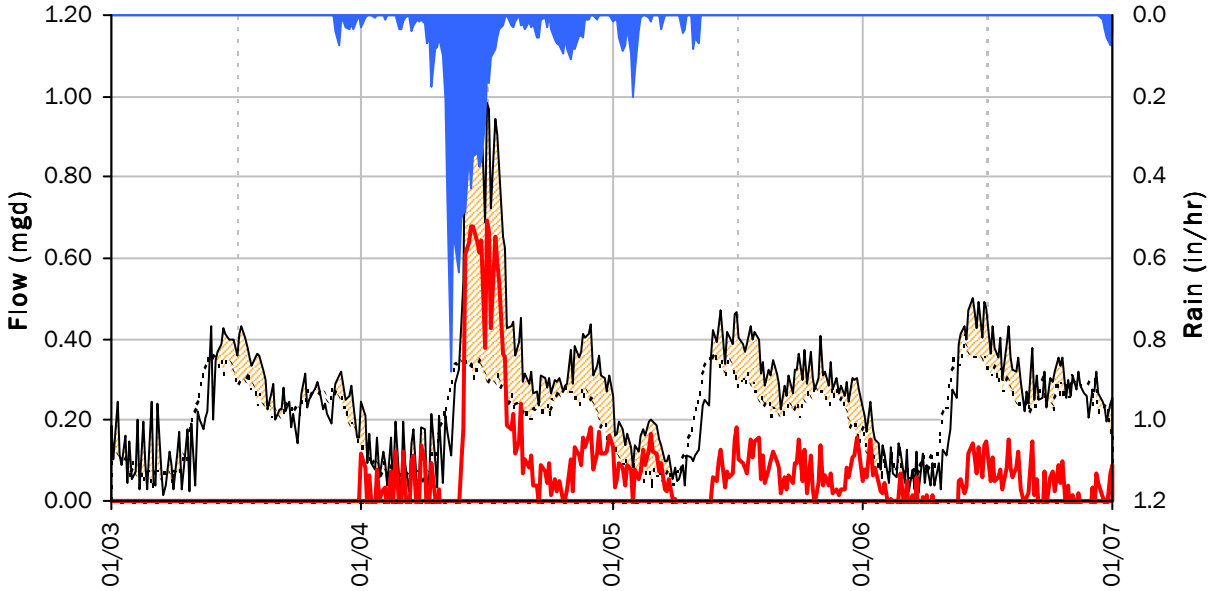
Pipe Diameter:	18	*inches*
Peak Measured Level:	6.1	*inches*
Peak d/D Ratio:	0.34	

MB 4
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

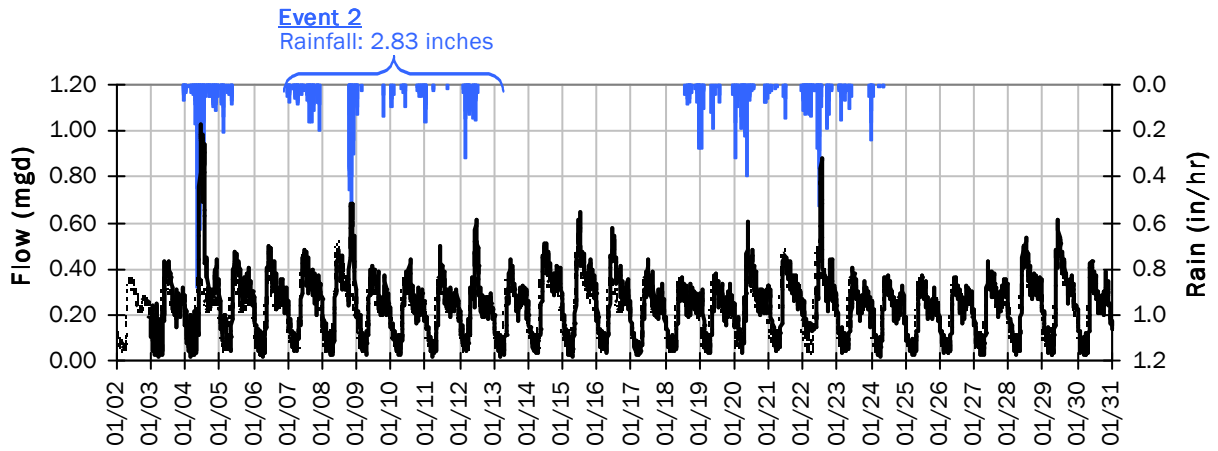


Storm Event I/I Analysis (Rain = 2.88 inches)

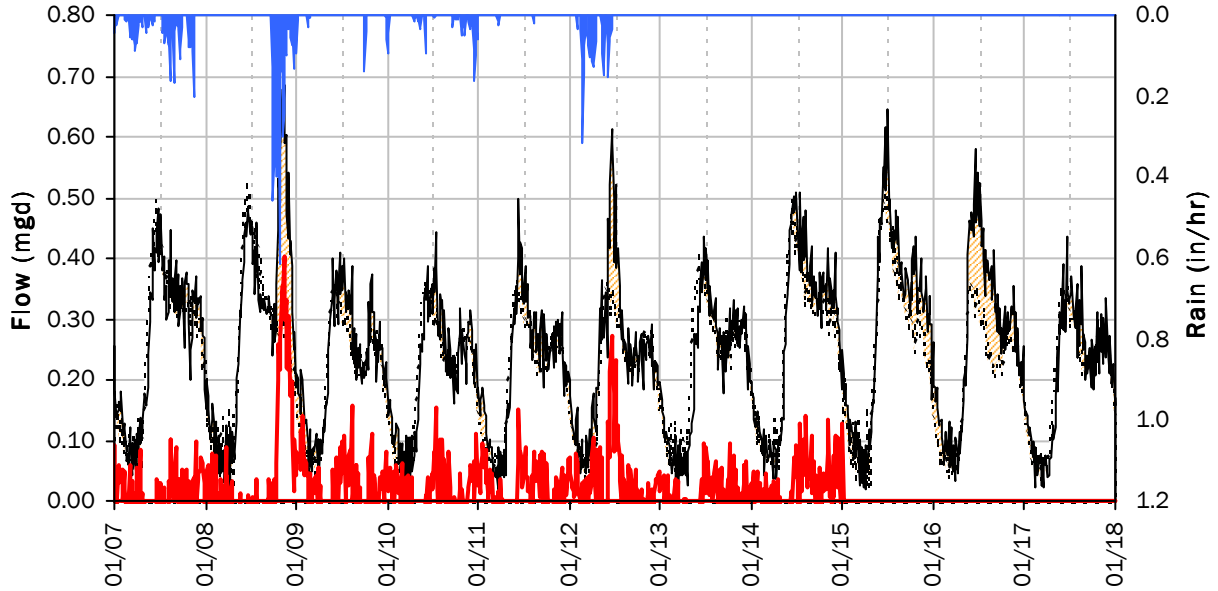
Capacity		Inflow / Infiltration	
Peak Flow:	1.02 *mgd*	**Peak I/I Rate:**	0.70 *mgd*
PF:	4.60	**Total I/I:**	223,000 *gallons*
Peak Level:	6.10 *in*		
d/D Ratio:	0.34		

MB 4
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

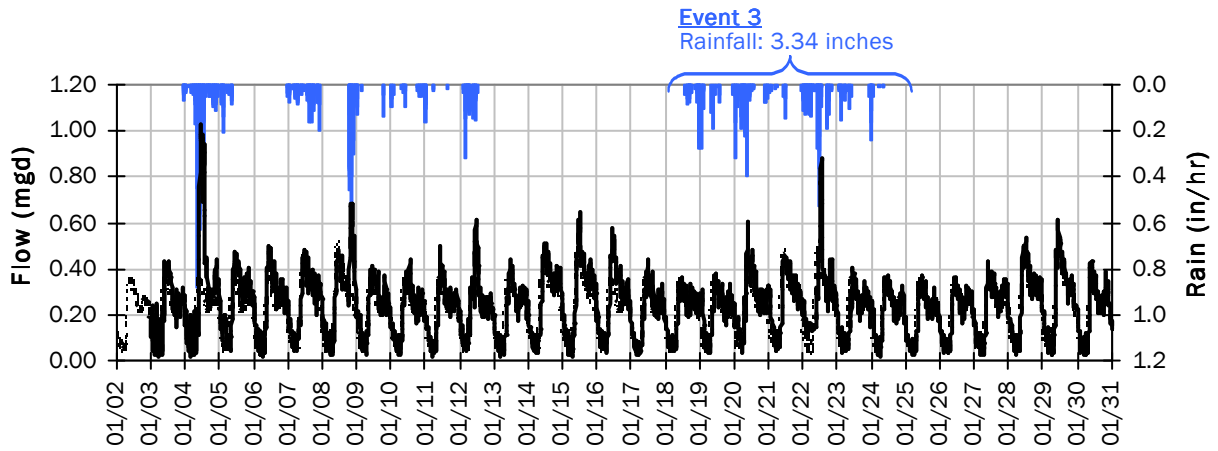


Storm Event I/I Analysis (Rain = 2.83 inches)

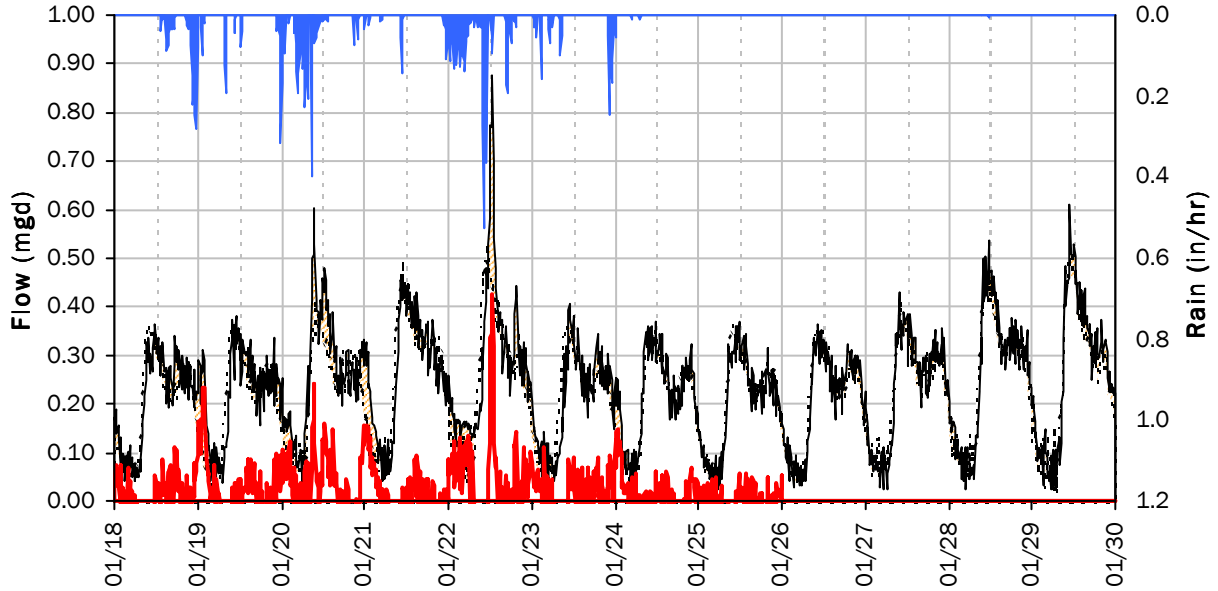
Capacity		Inflow / Infiltration	
Peak Flow:	0.69 *mgd*	**Peak I/I Rate:**	0.40 *mgd*
PF:	3.08	**Total I/I:**	124,000 *gallons*
Peak Level:	5.04 *in*		
d/D Ratio:	0.28		

MB 4
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

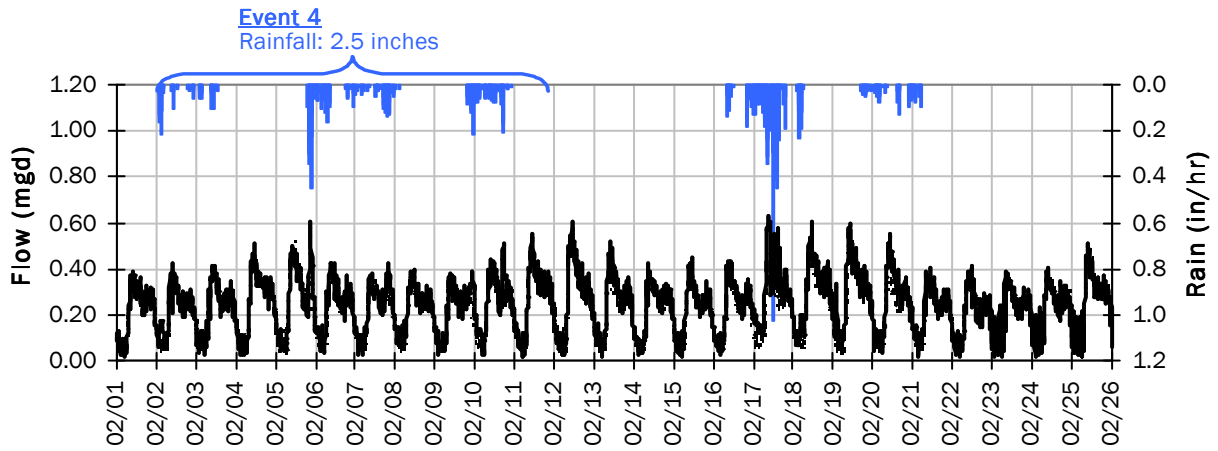


Storm Event I/I Analysis (Rain = 3.35 inches)

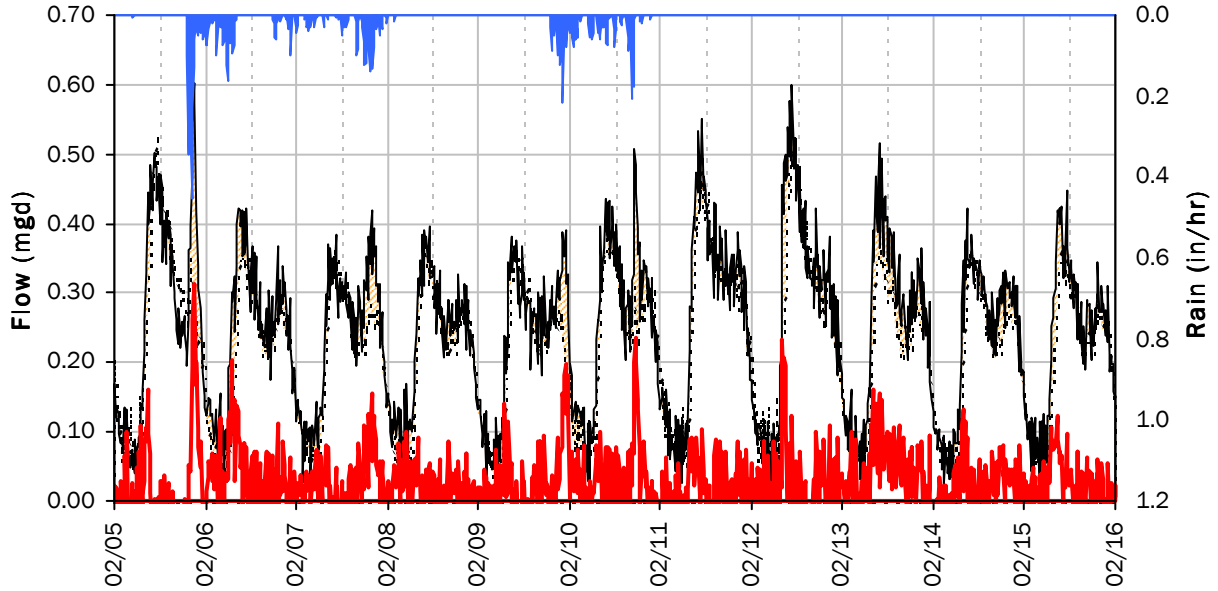
Capacity		Inflow / Infiltration	
Peak Flow:	0.88 *mgd*	**Peak I/I Rate:**	0.43 *mgd*
PF:	3.94	**Total I/I:**	116,000 *gallons*
Peak Level:	5.65 *in*		
d/D Ratio:	0.31		

MB 4
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph

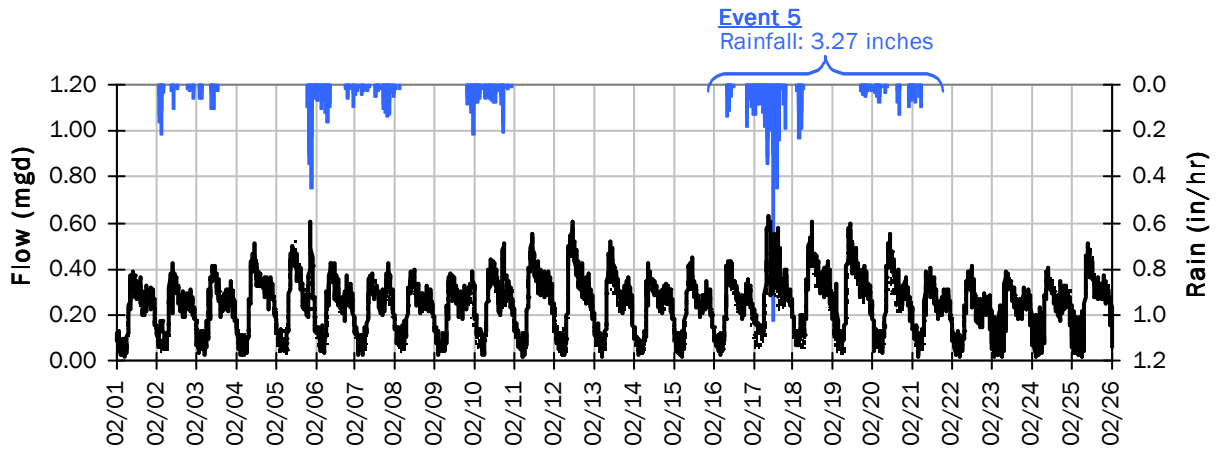


Storm Event I/I Analysis (Rain = 2.50 inches)

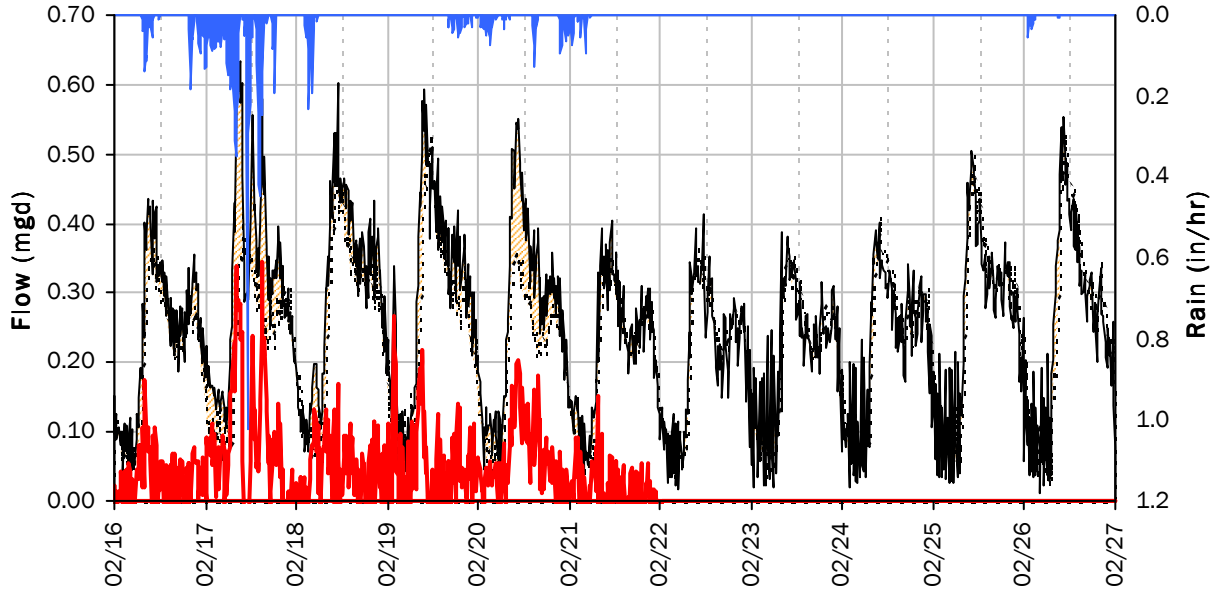
Capacity		Inflow / Infiltration	
Peak Flow:	0.60 *mgd*	**Peak I/I Rate:**	0.31 *mgd*
PF:	2.71	**Total I/I:**	293,000 *gallons*
Peak Level:	4.66 *in*		
d/D Ratio:	0.26		

MB 4
I/I Summary: Event 5

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 5 Detail Graph



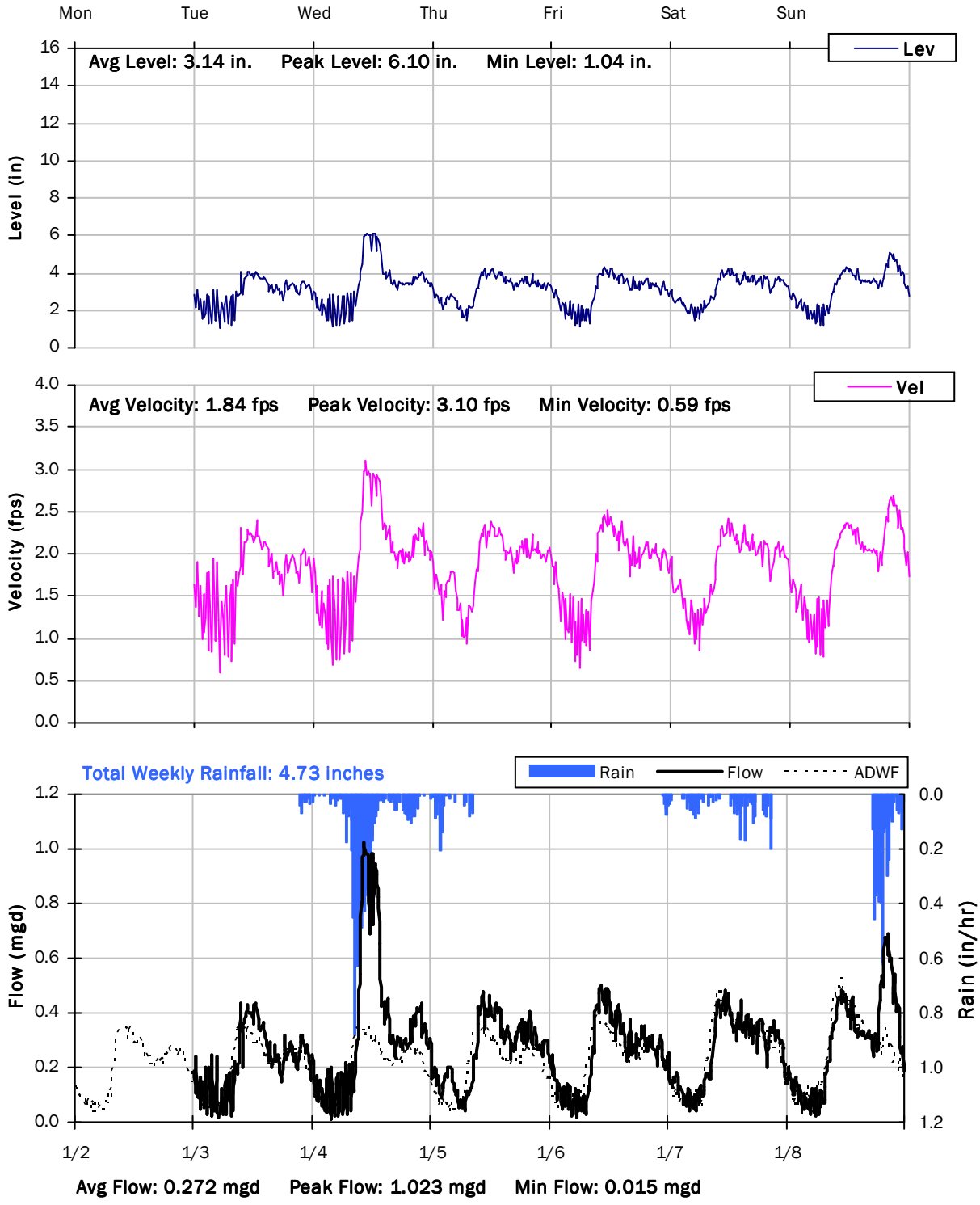
Storm Event I/I Analysis (Rain = 3.28 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.63 *mgd*	**Peak I/I Rate:**	0.34 *mgd*
PF:	2.85	**Total I/I:**	287,000 *gallons*
Peak Level:	4.77 *in*		
d/D Ratio:	0.27		

MB 4

Weekly Level, Velocity and Flow Hydrographs

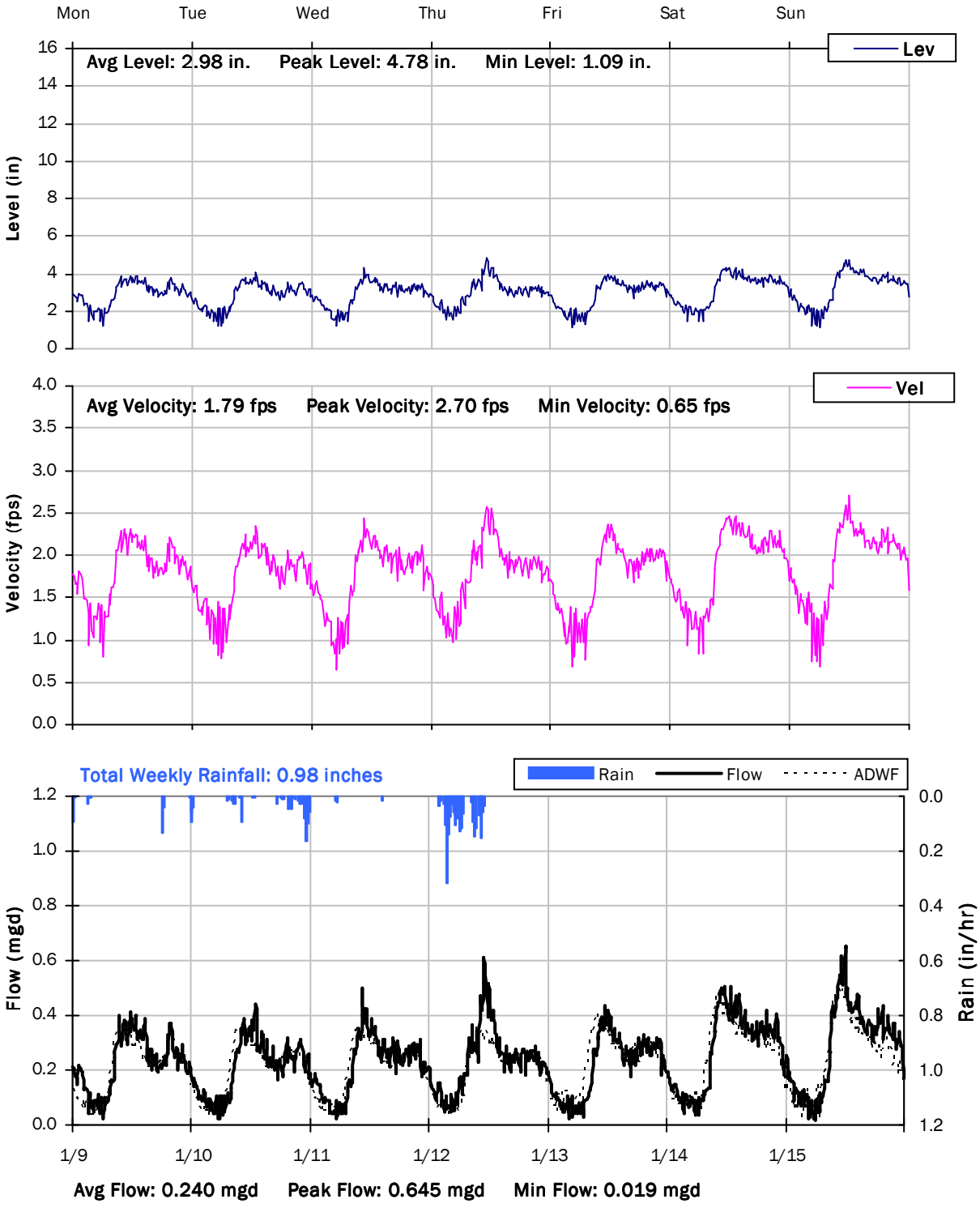
1/2/2017 to 1/9/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

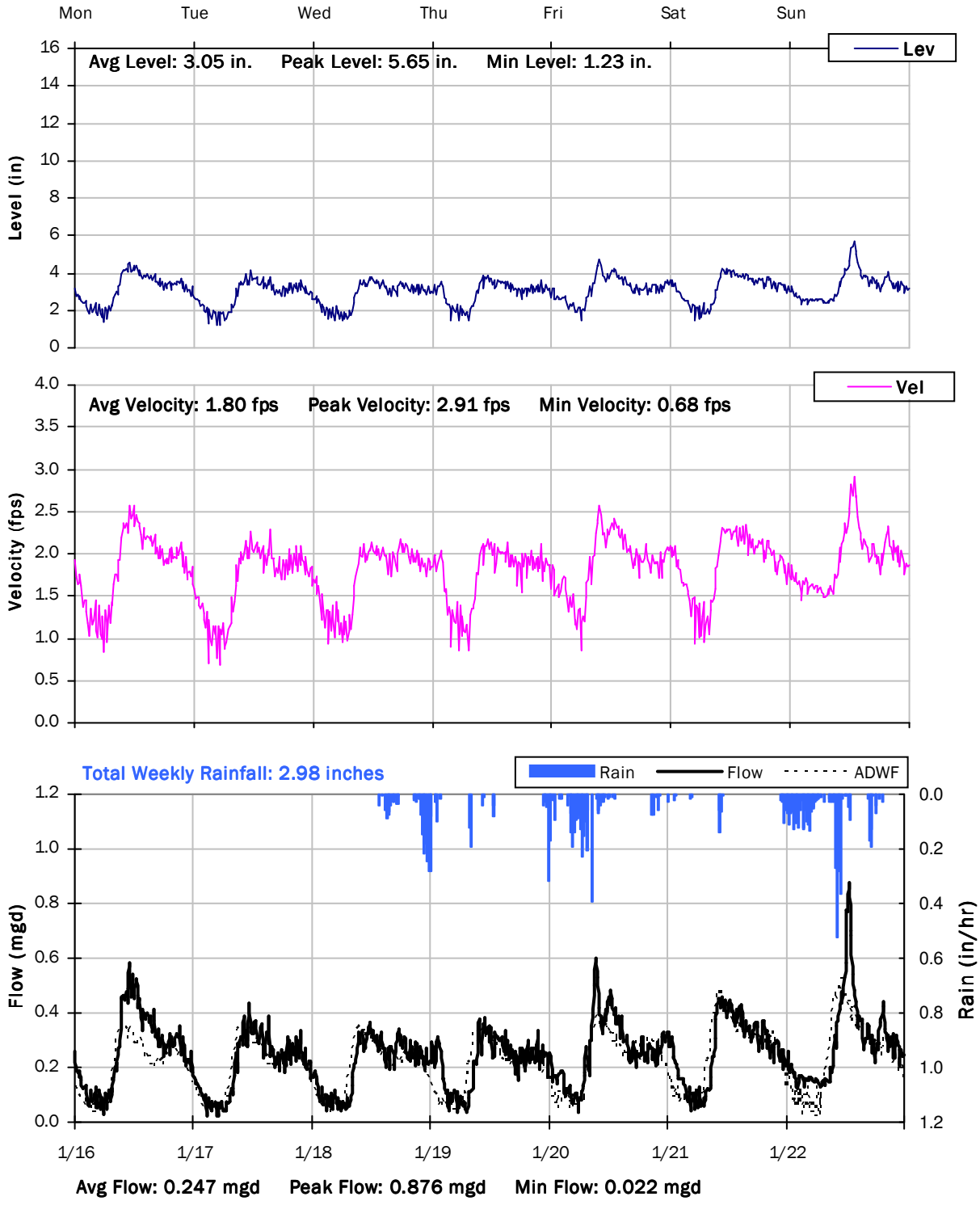
1/9/2017 to 1/16/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

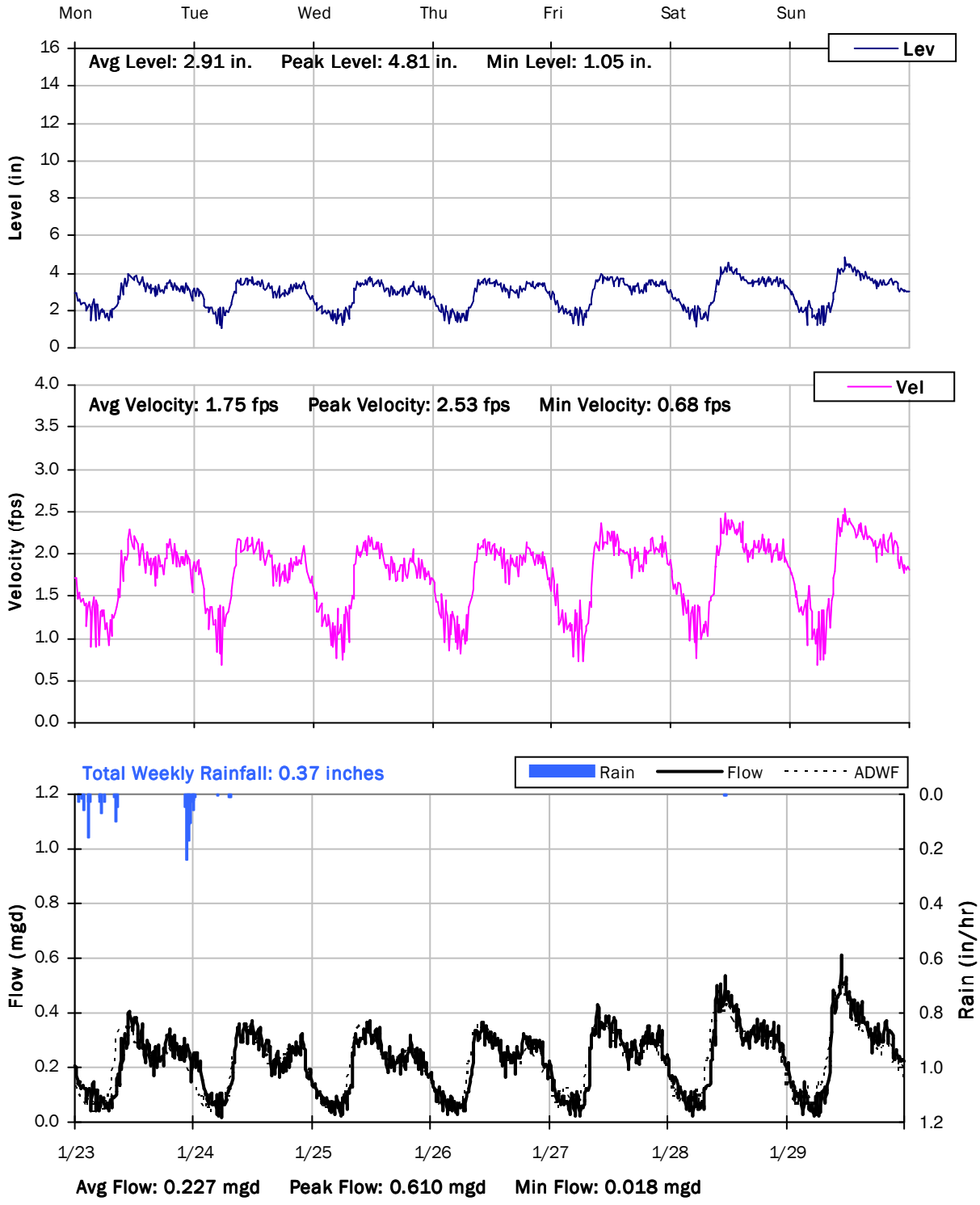
1/16/2017 to 1/23/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

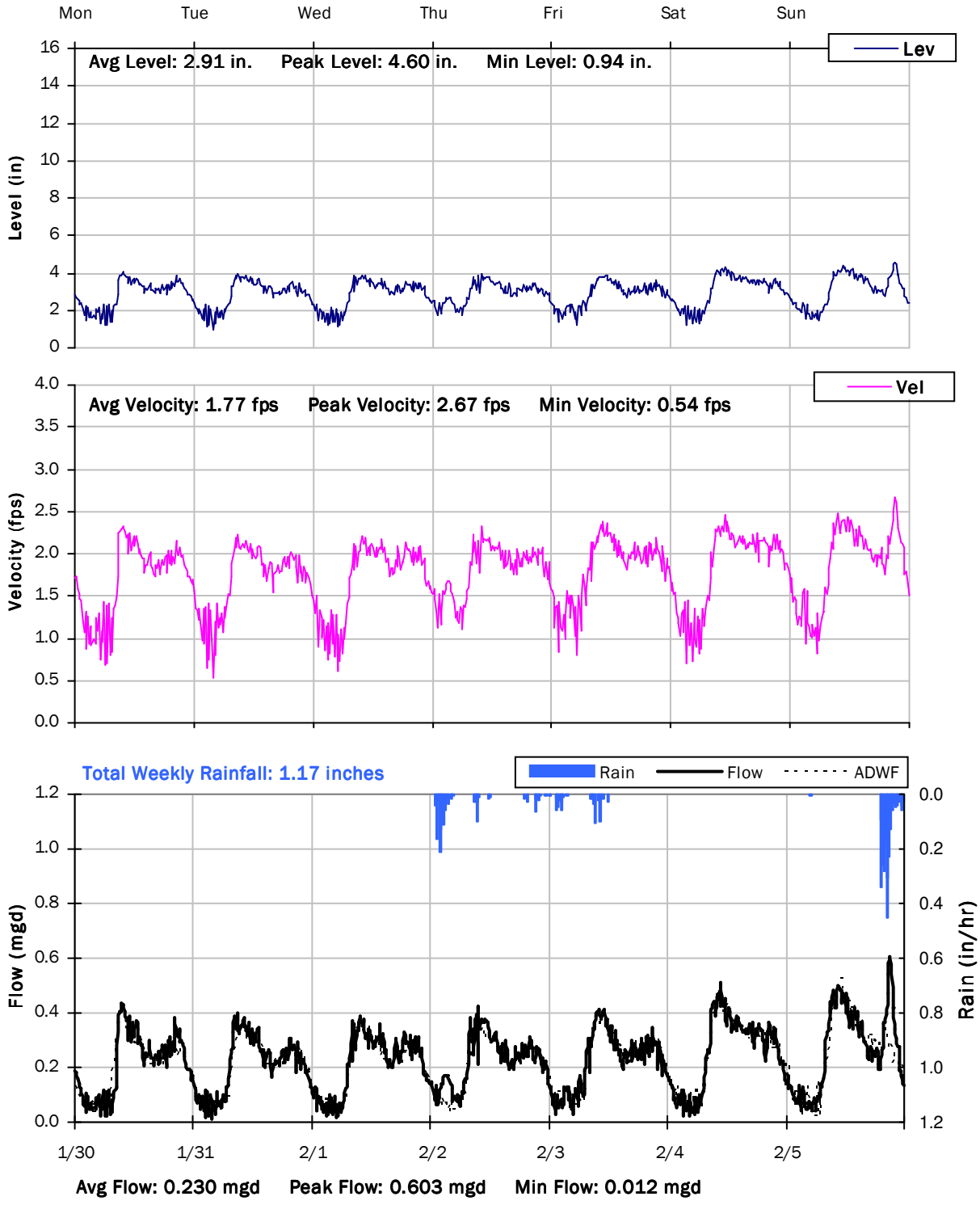
1/23/2017 to 1/30/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

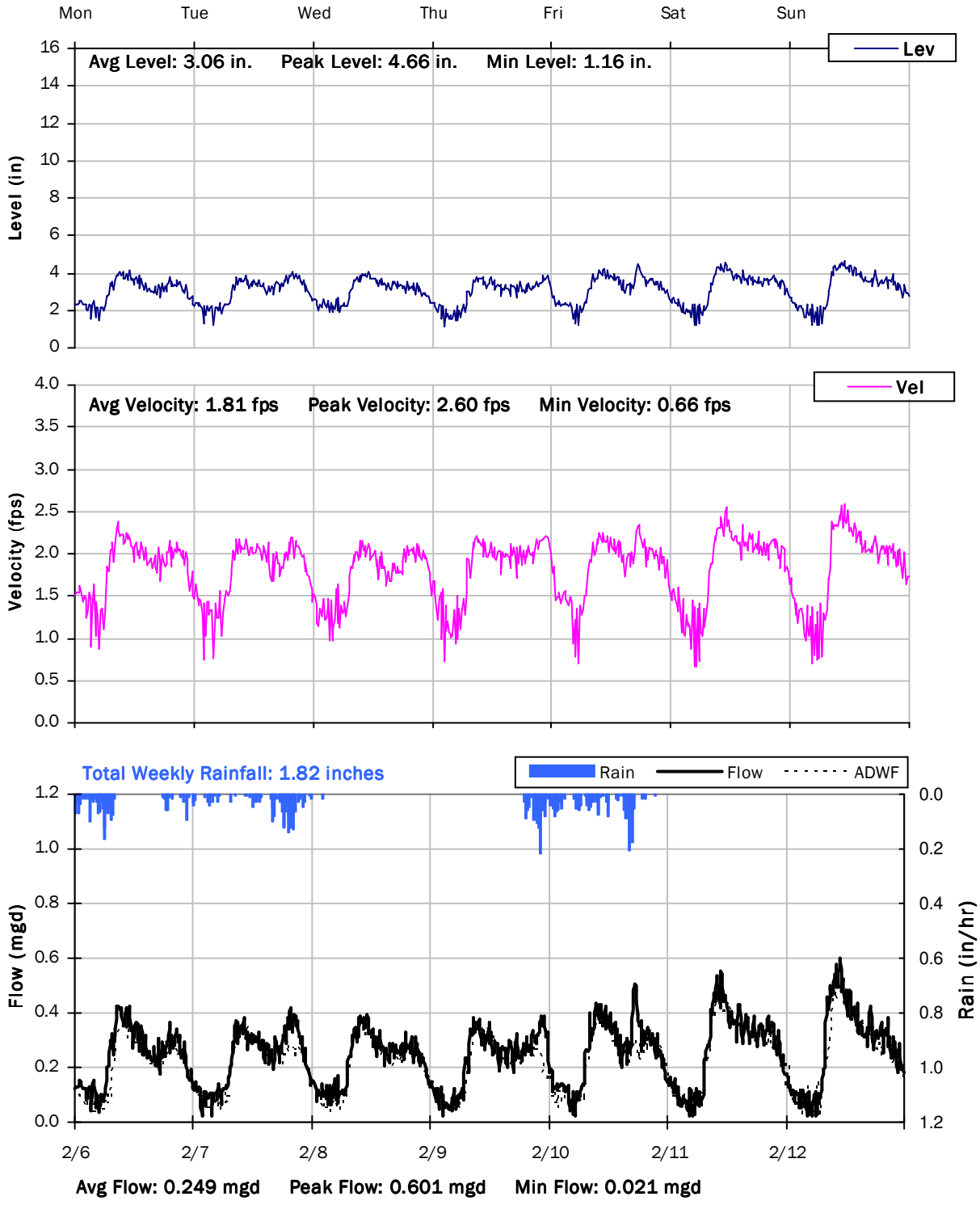
1/30/2017 to 2/6/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

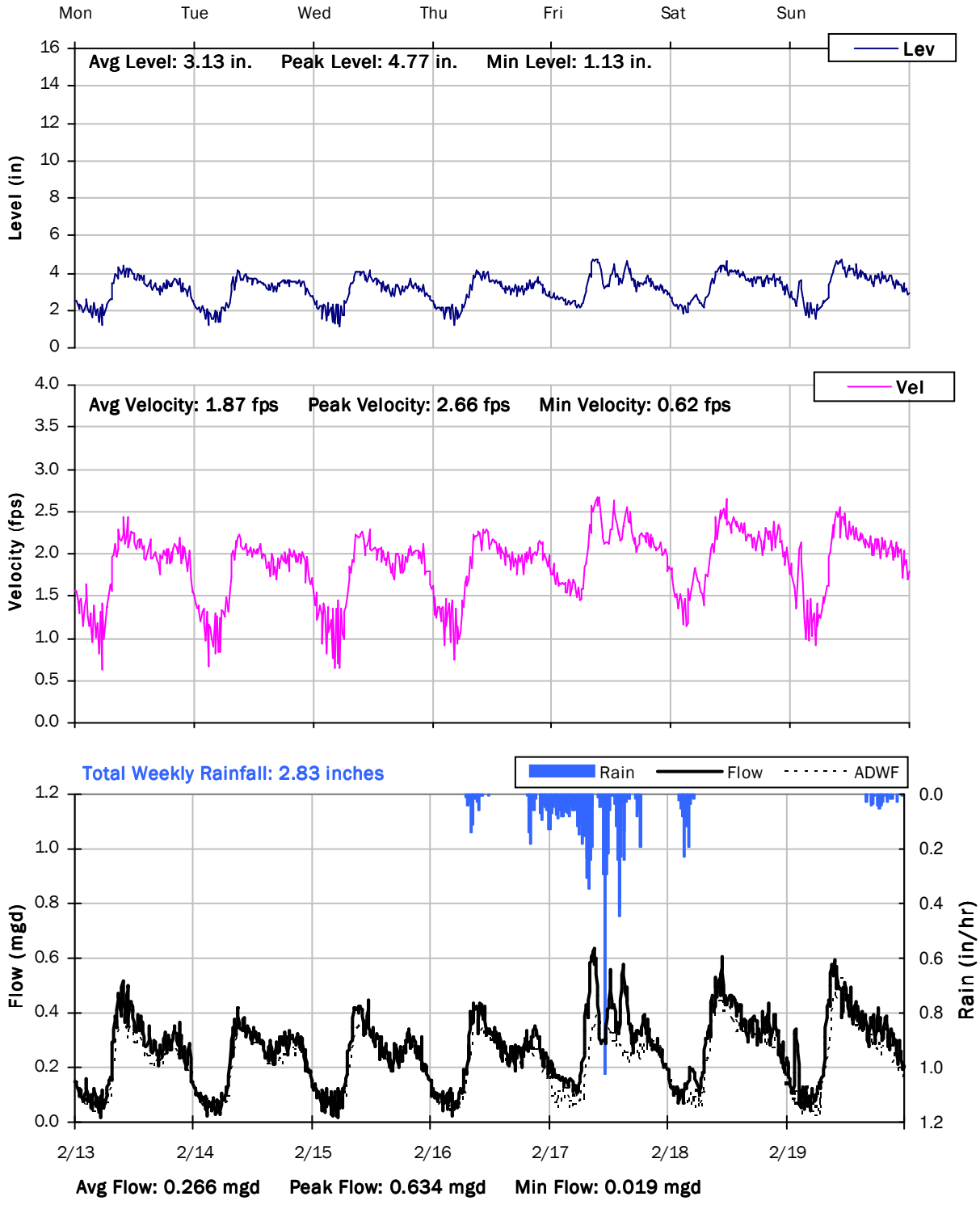
2/6/2017 to 2/13/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

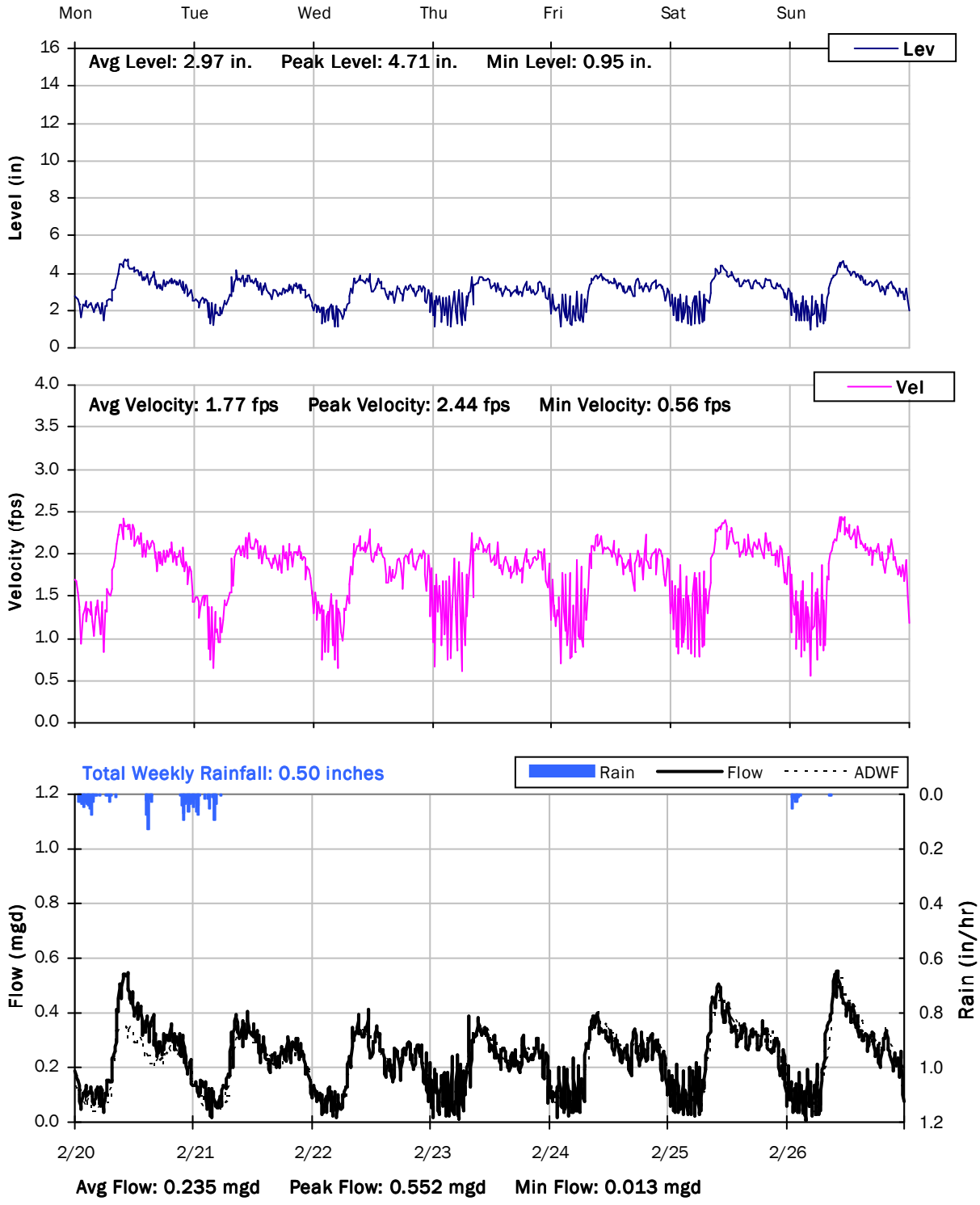
2/13/2017 to 2/20/2017



MB 4

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017



City of Morro Bay

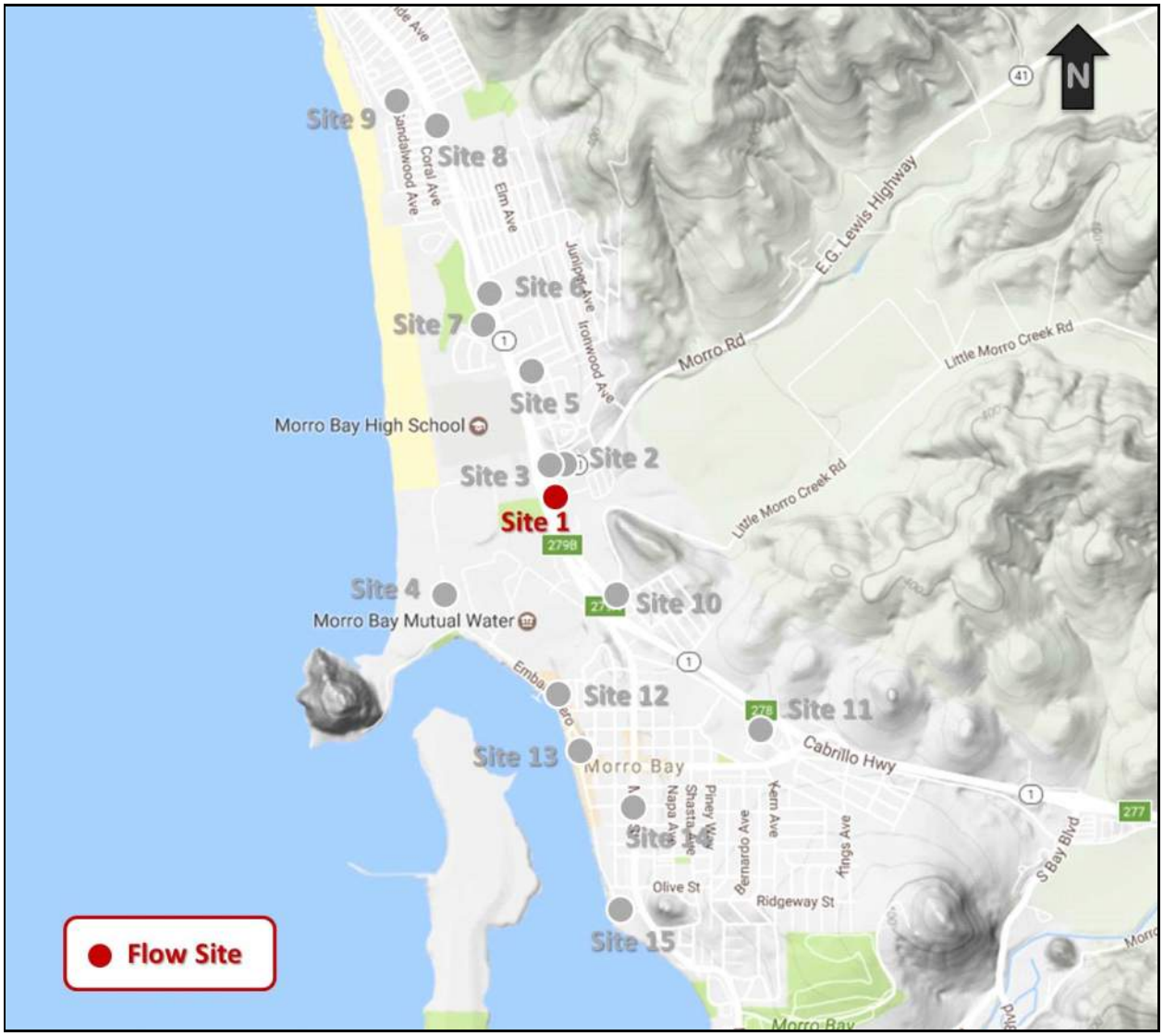
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 01

Location: Intersection of Main Street and Errol Street, meter on south 11.75" inlet

Data Summary Report



Vicinity Map: Site 01

SITE 01

Site Information

Location: Intersection of Main Street and Errol Street, meter on south 11.75" inlet

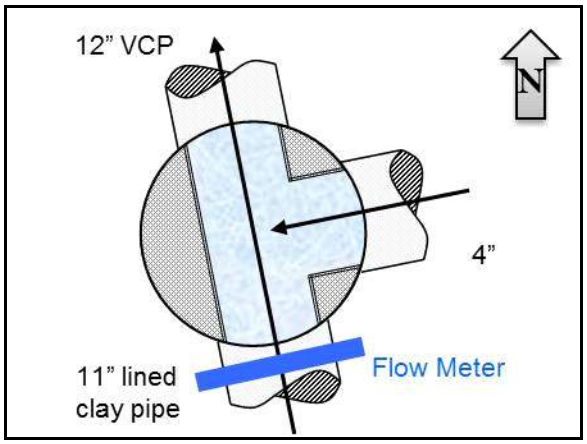


Pipe Diameter: 11.75 inches

ADWF: 0.182 mgd

Peak Measured Flow: 0.479 mgd









SITE 01

Additional Site Photos





SITE 01

Additional Site Photos

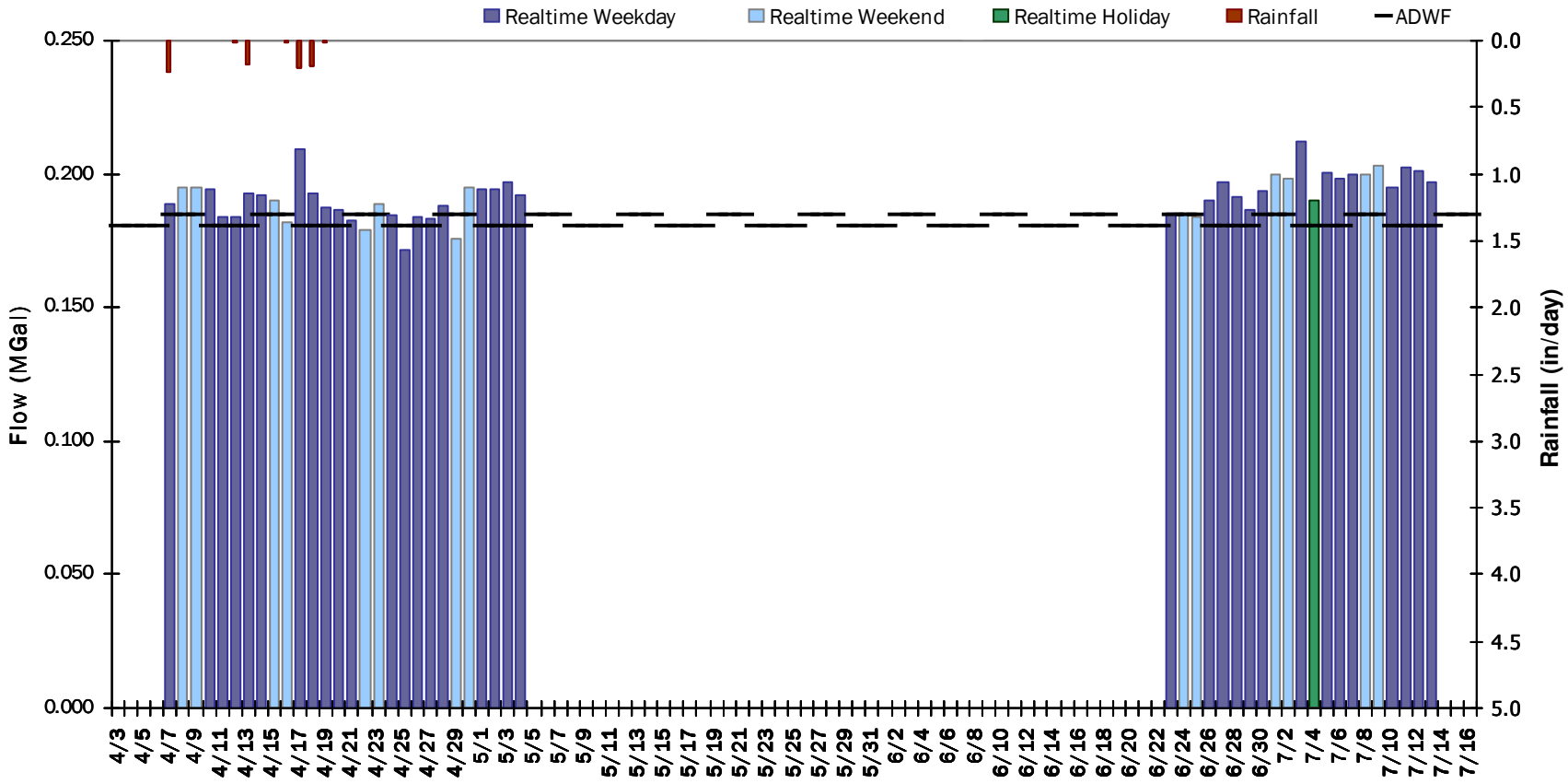


SITE 01

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.192 MGal Peak Daily Flow: 0.212 MGal Min Daily Flow: 0.172 MGal

Total Period Rainfall: 0.85 inches

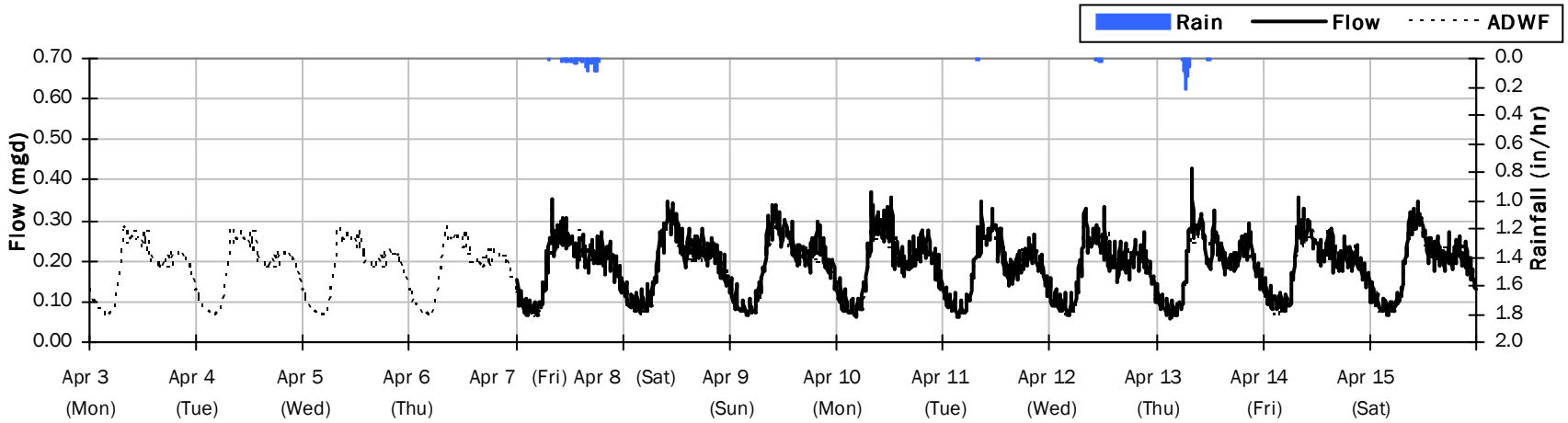


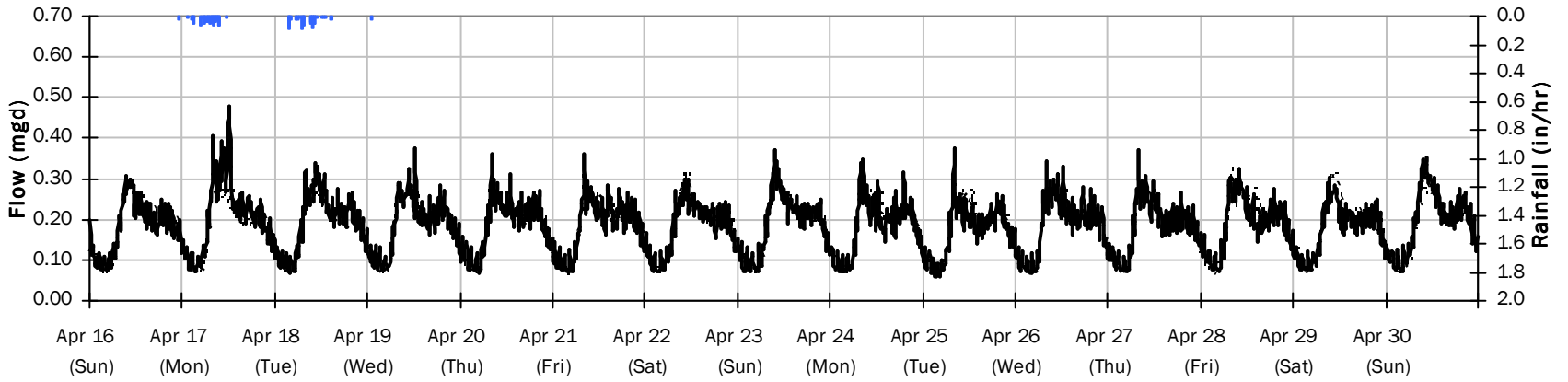
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 01

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.188 mgd** **Peak Flow: 0.479 mgd** **Min Flow: 0.059 mgd**

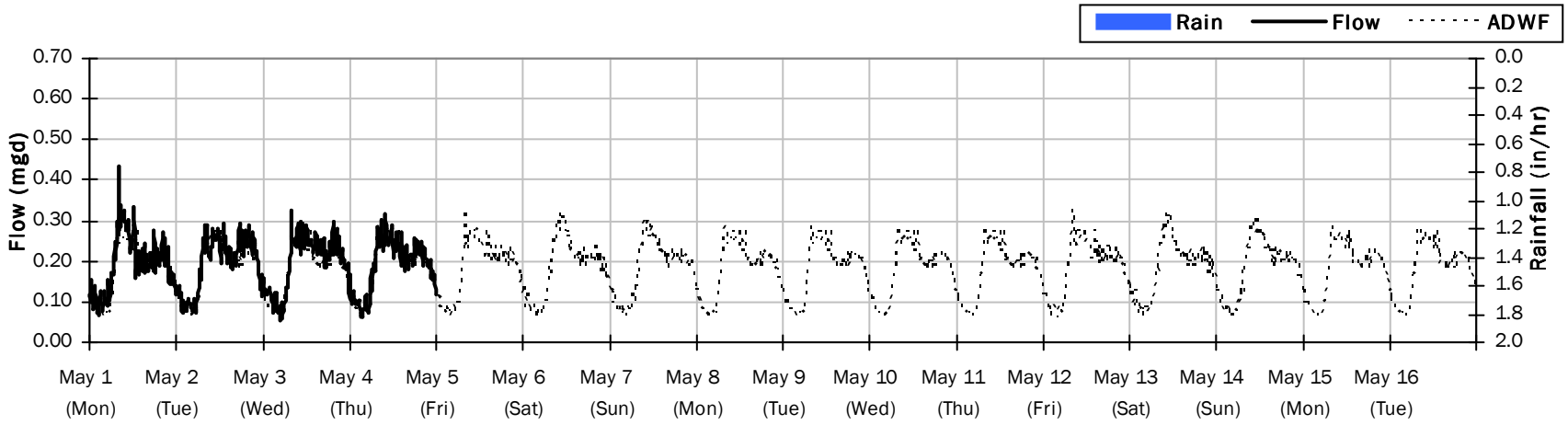


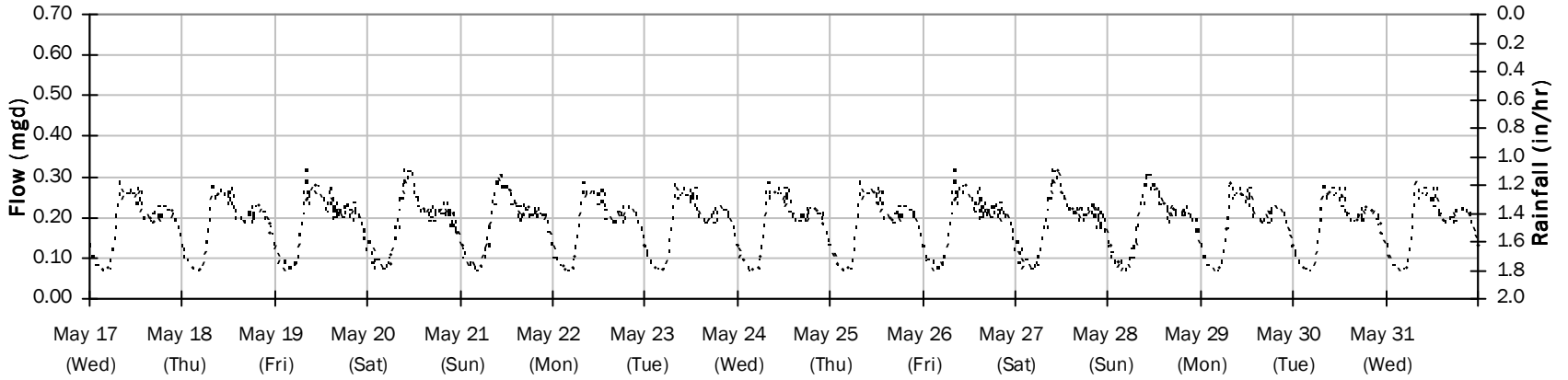


SITE 01

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.194 mgd Peak Flow: 0.433 mgd Min Flow: 0.056 mgd**



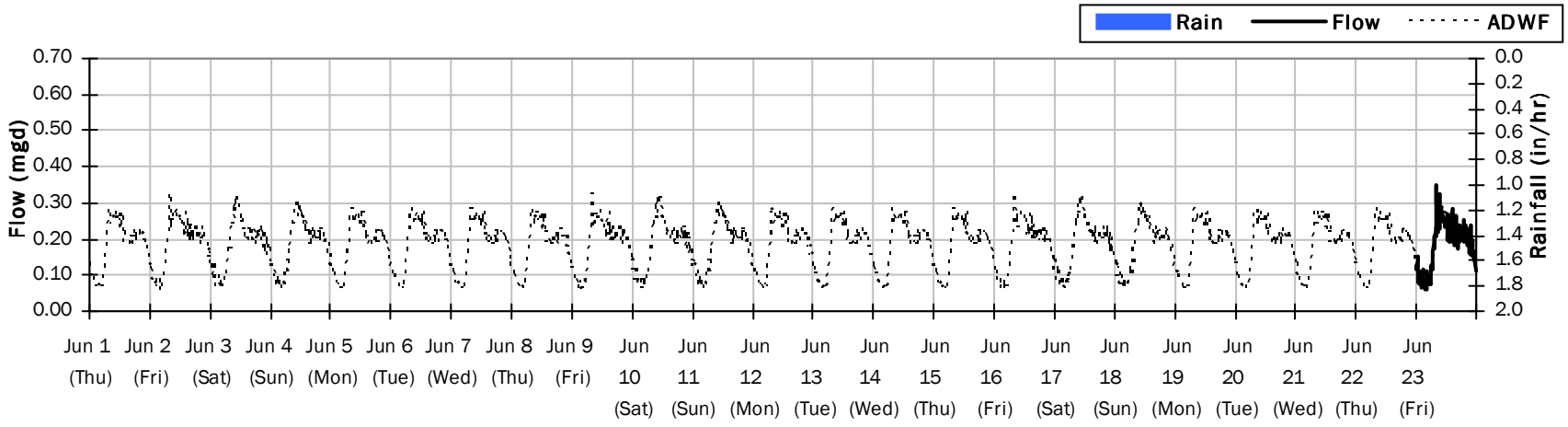


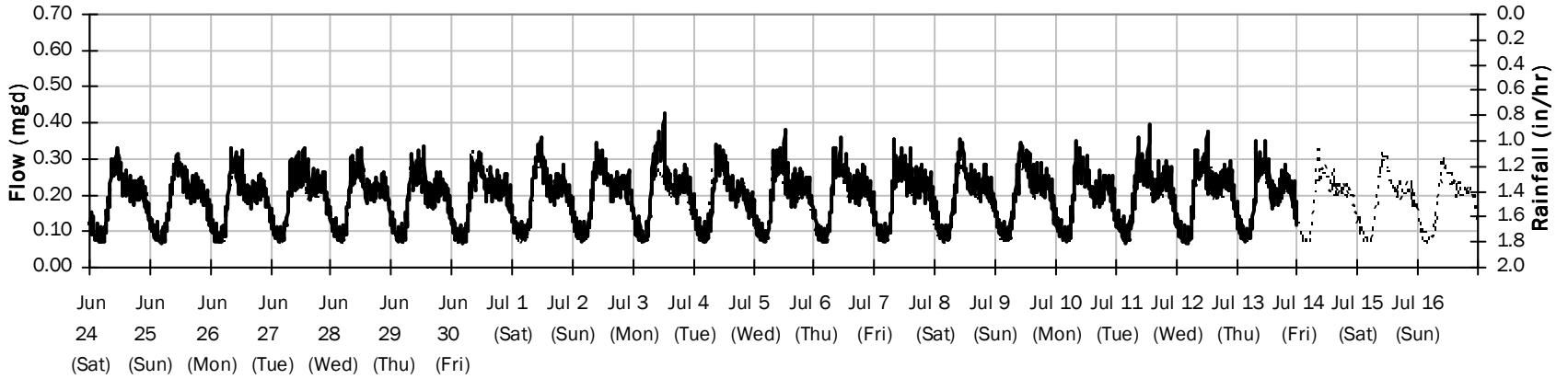
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 01

Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.196 mgd** **Peak Flow: 0.425 mgd** **Min Flow: 0.062 mgd**

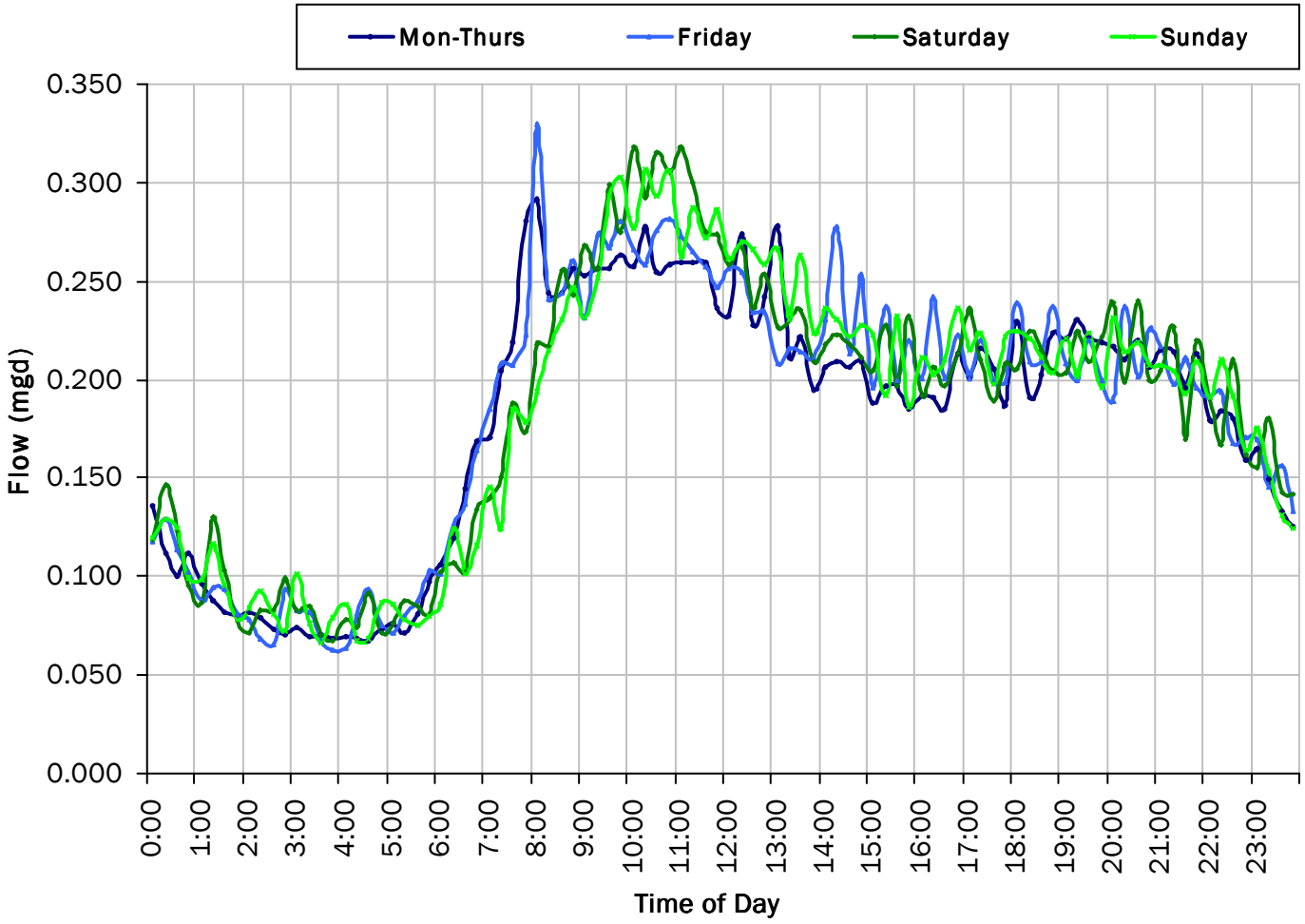




As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

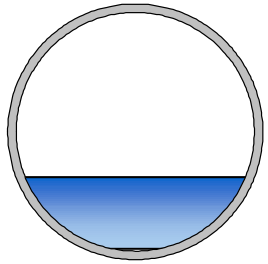
SITE 01

Average Dry Weather Flow Hydrographs



ADWF:

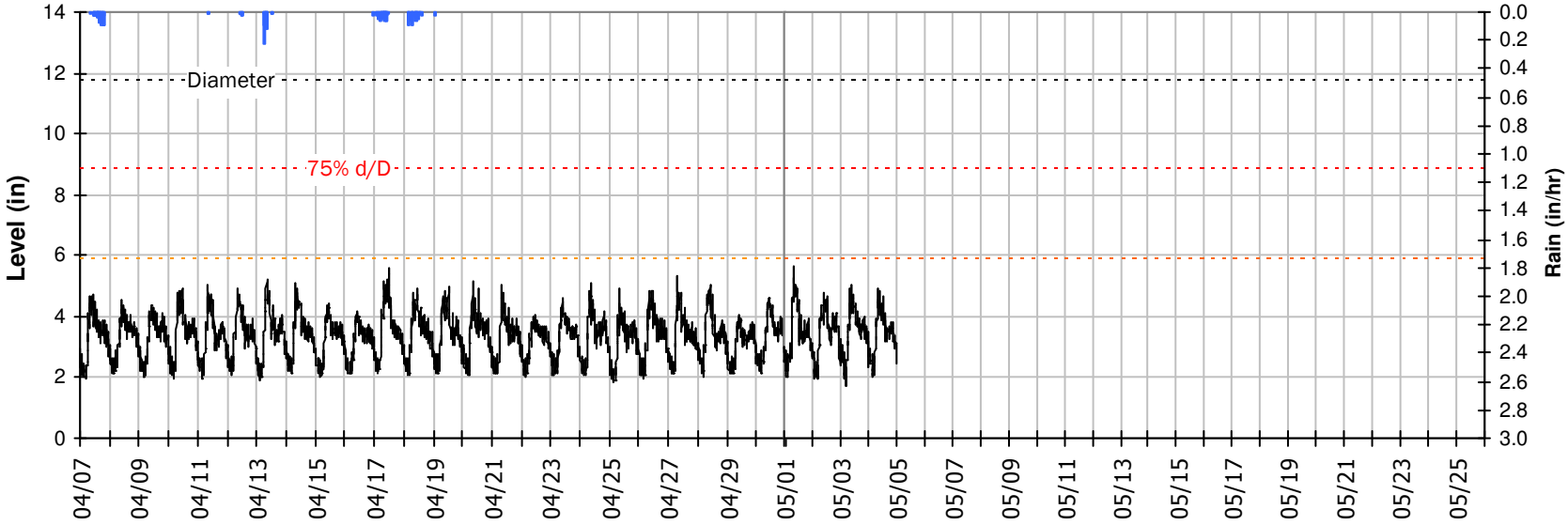
0.182 *mgd*

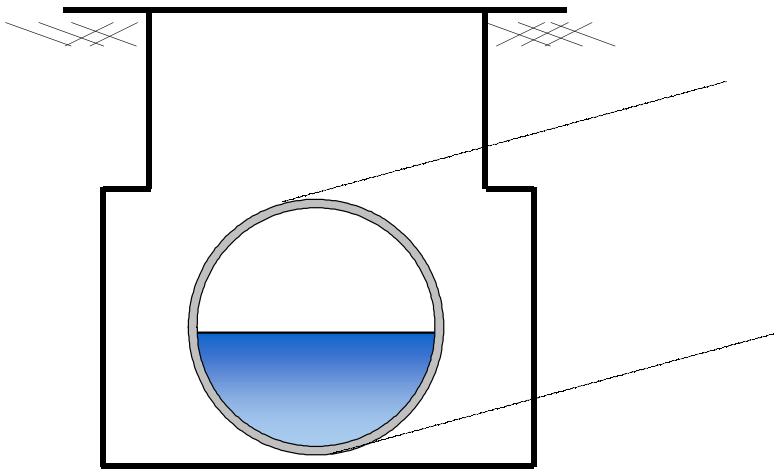


SITE 01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





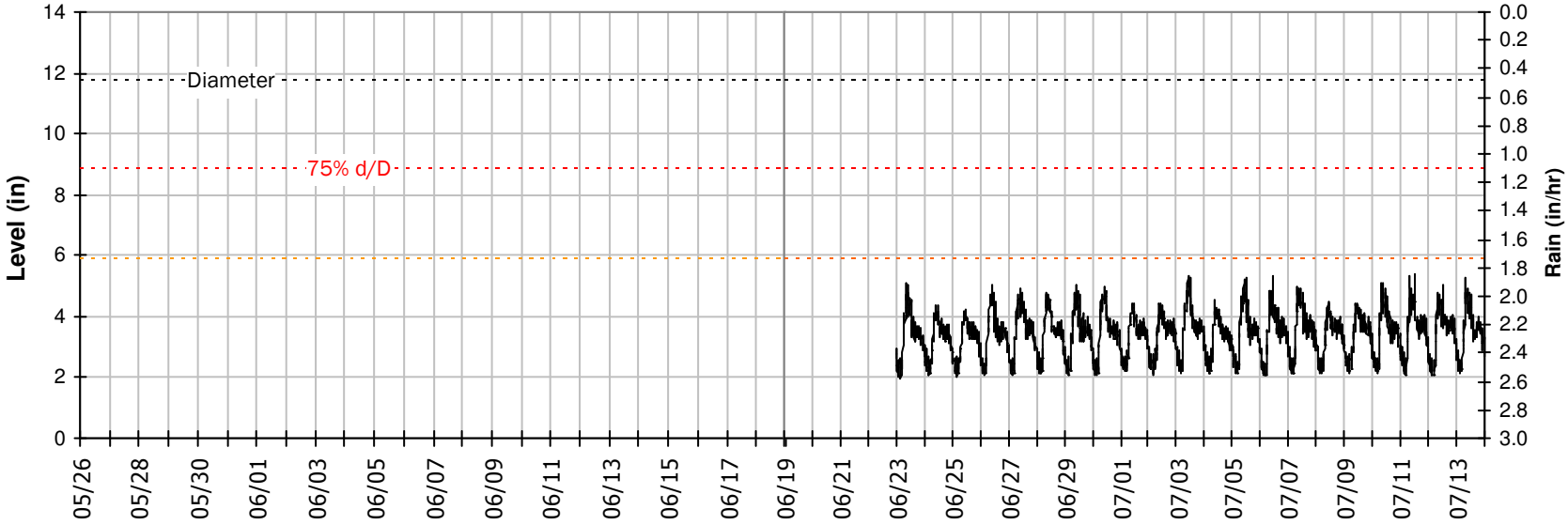
Pipe Diameter:	11.8	*inches*
Peak Measured Level:	5.63	*inches*
Peak d/D Ratio:	0.48	

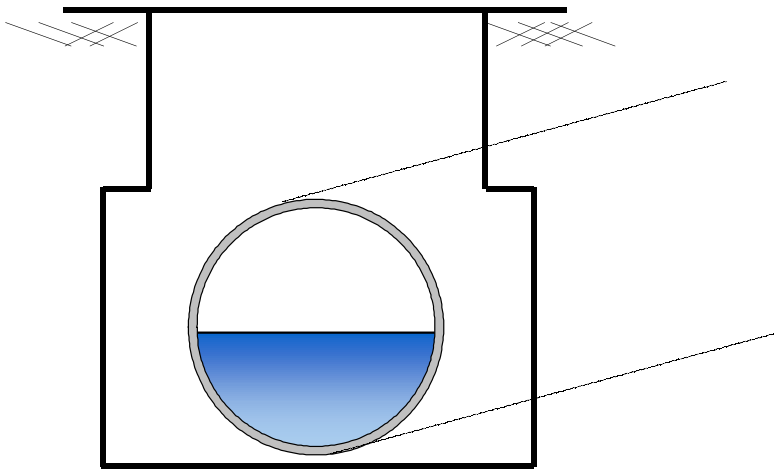
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





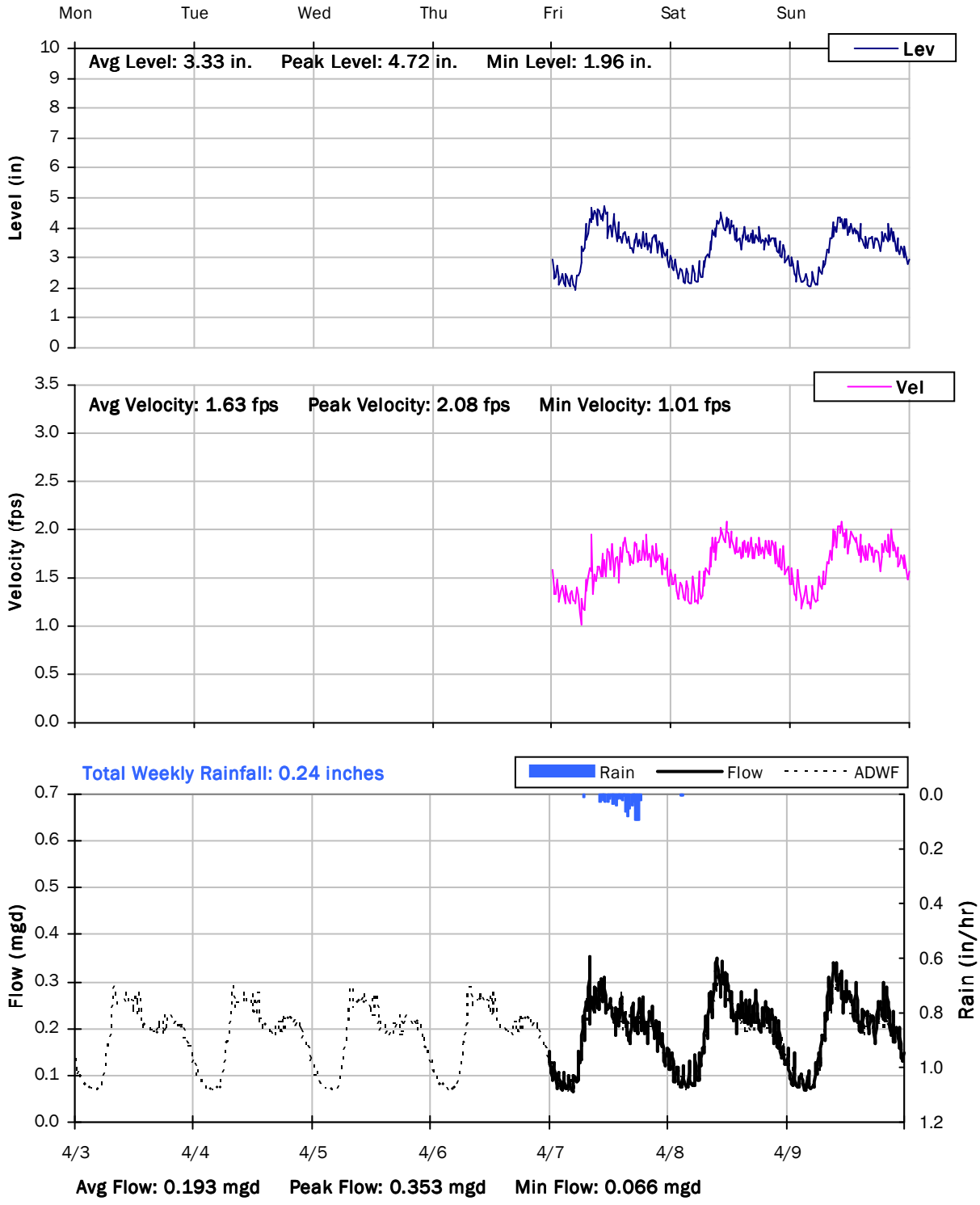
Pipe Diameter:	11.8	*inches*
Peak Measured Level:	5.63	*inches*
Peak d/D Ratio:	0.48	

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

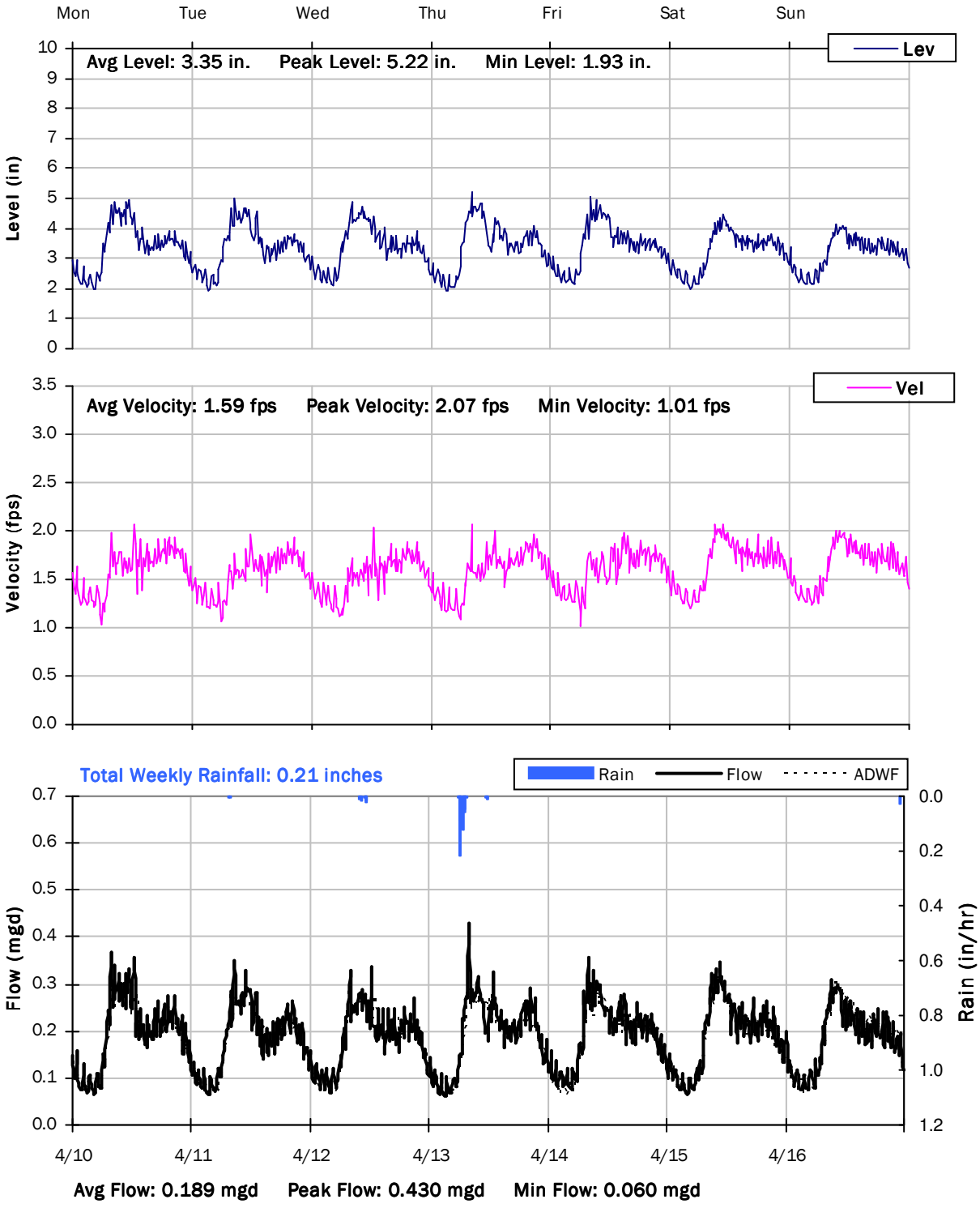
4/3/2017 to 4/10/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

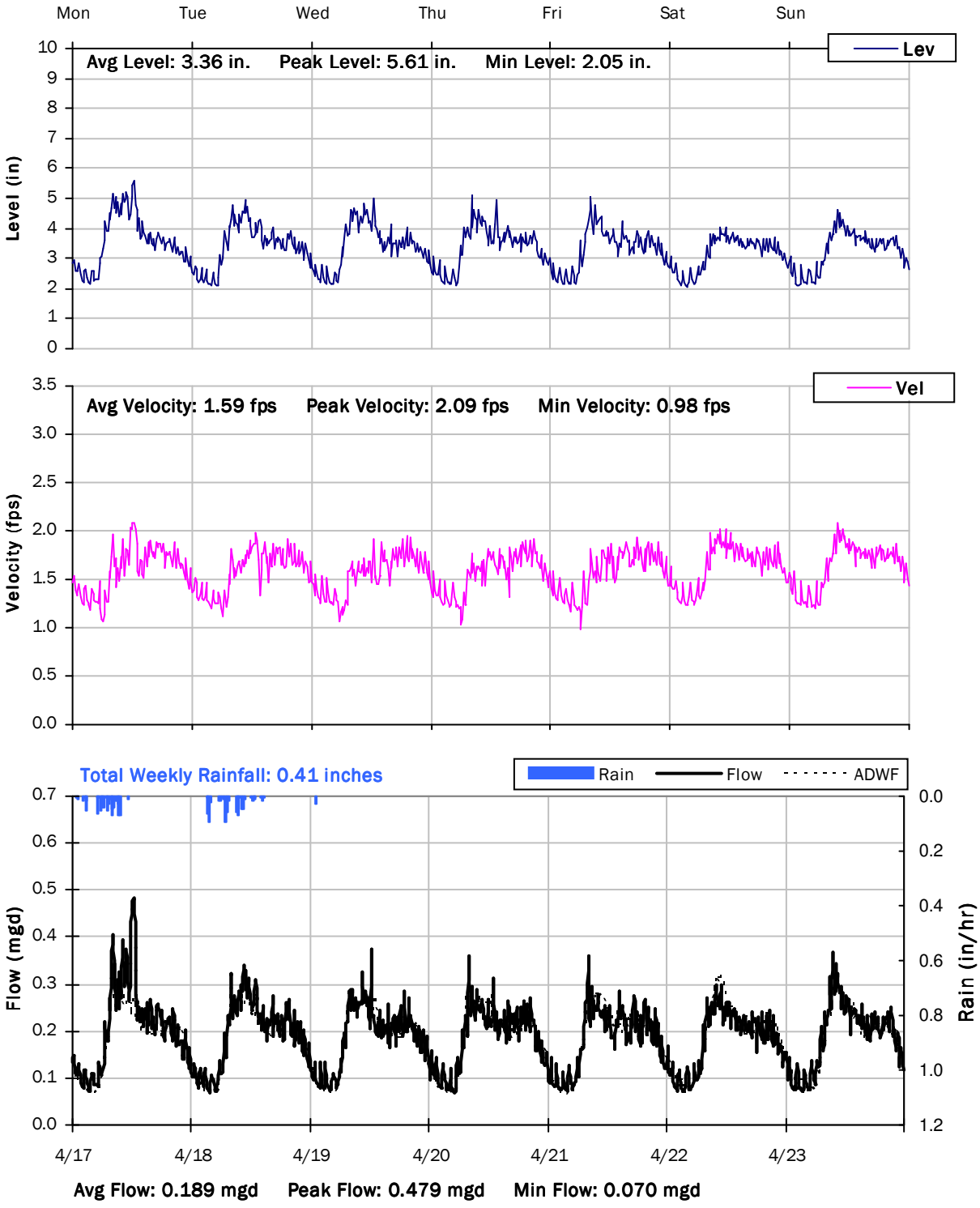
4/10/2017 to 4/17/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

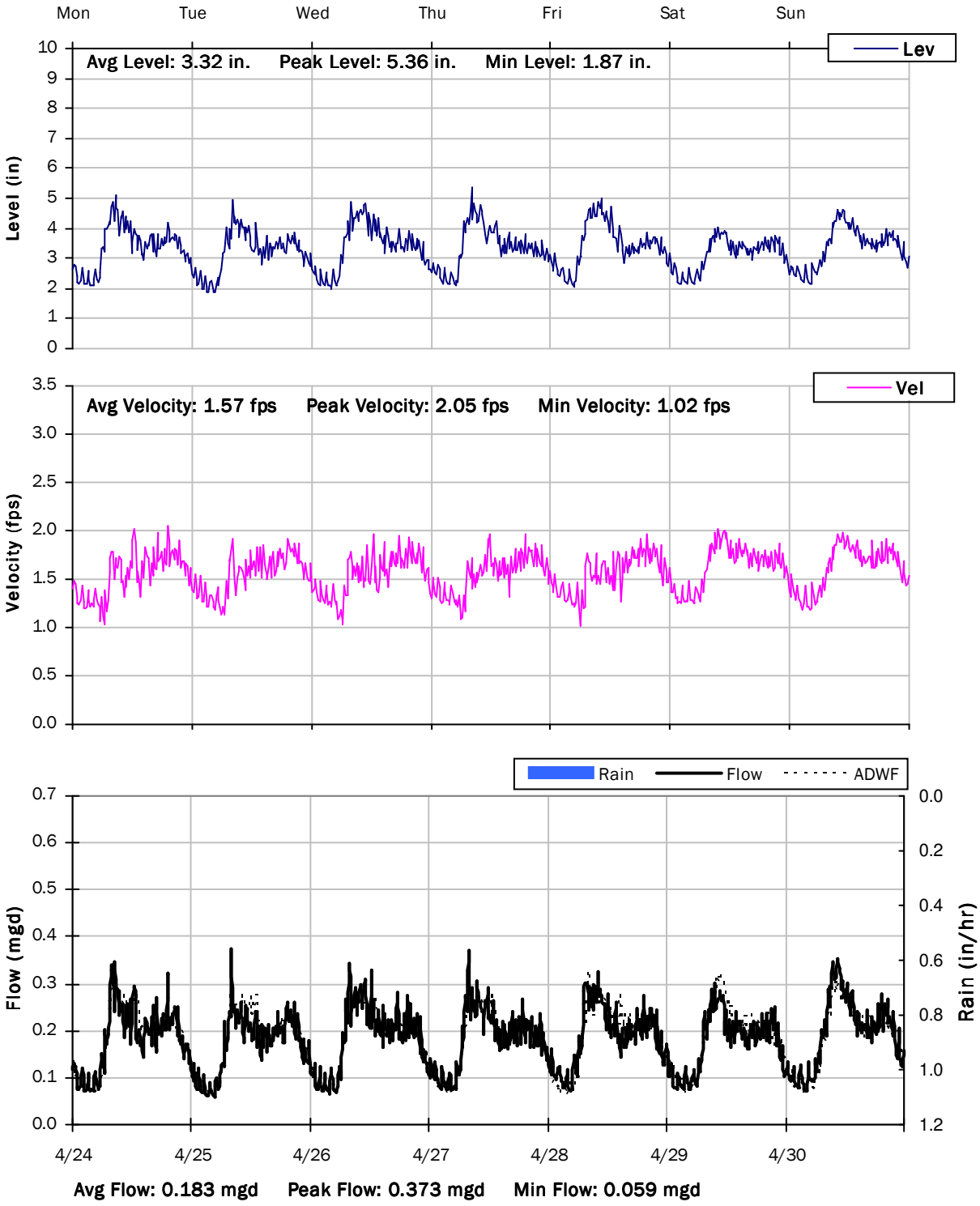
4/17/2017 to 4/24/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

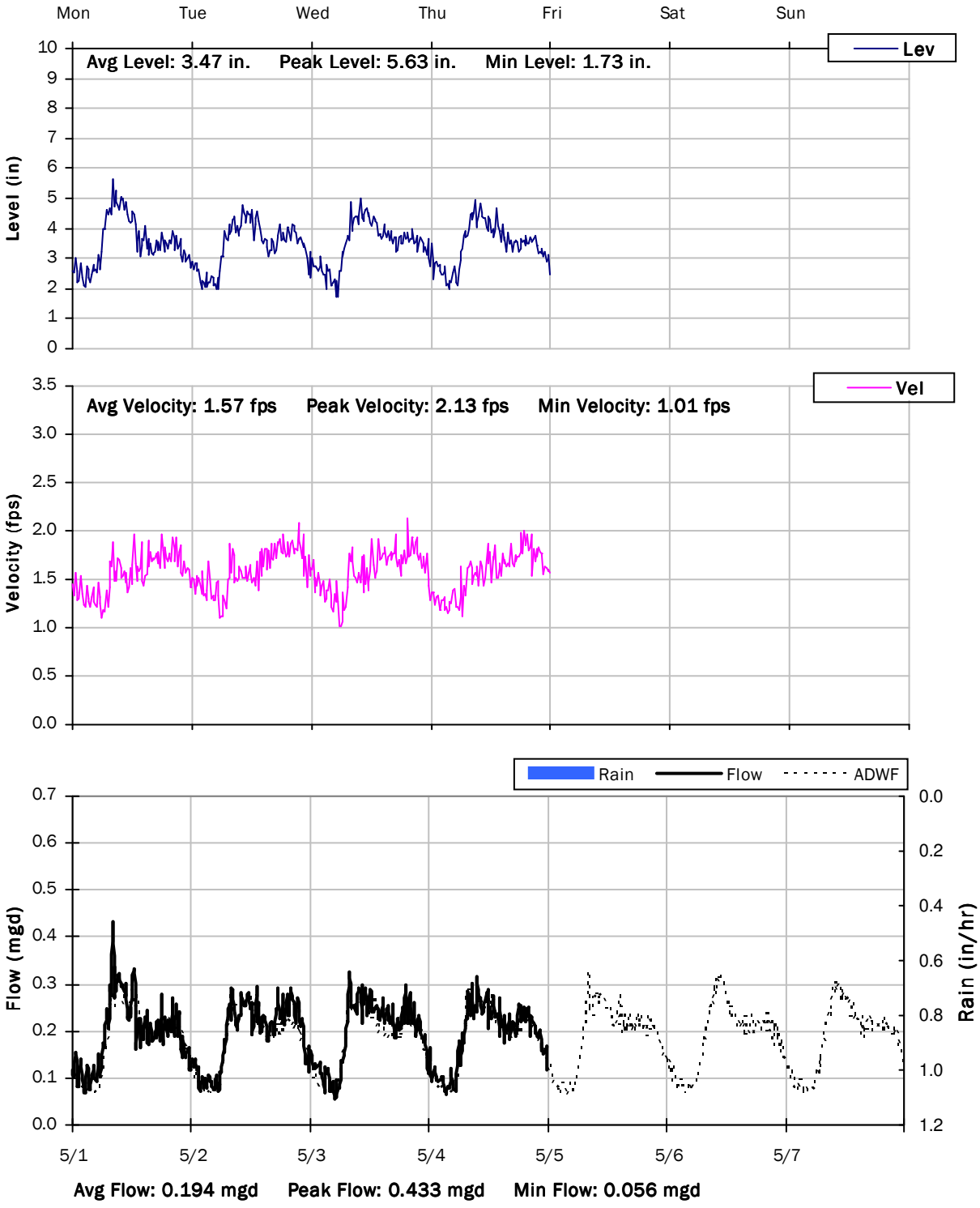
4/24/2017 to 5/1/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

5/1/2017 to 5/8/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

5/8/2017 to 5/15/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

5/15/2017 to 5/22/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

5/22/2017 to 5/29/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

5/29/2017 to 6/5/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

6/5/2017 to 6/12/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

6/12/2017 to 6/19/2017

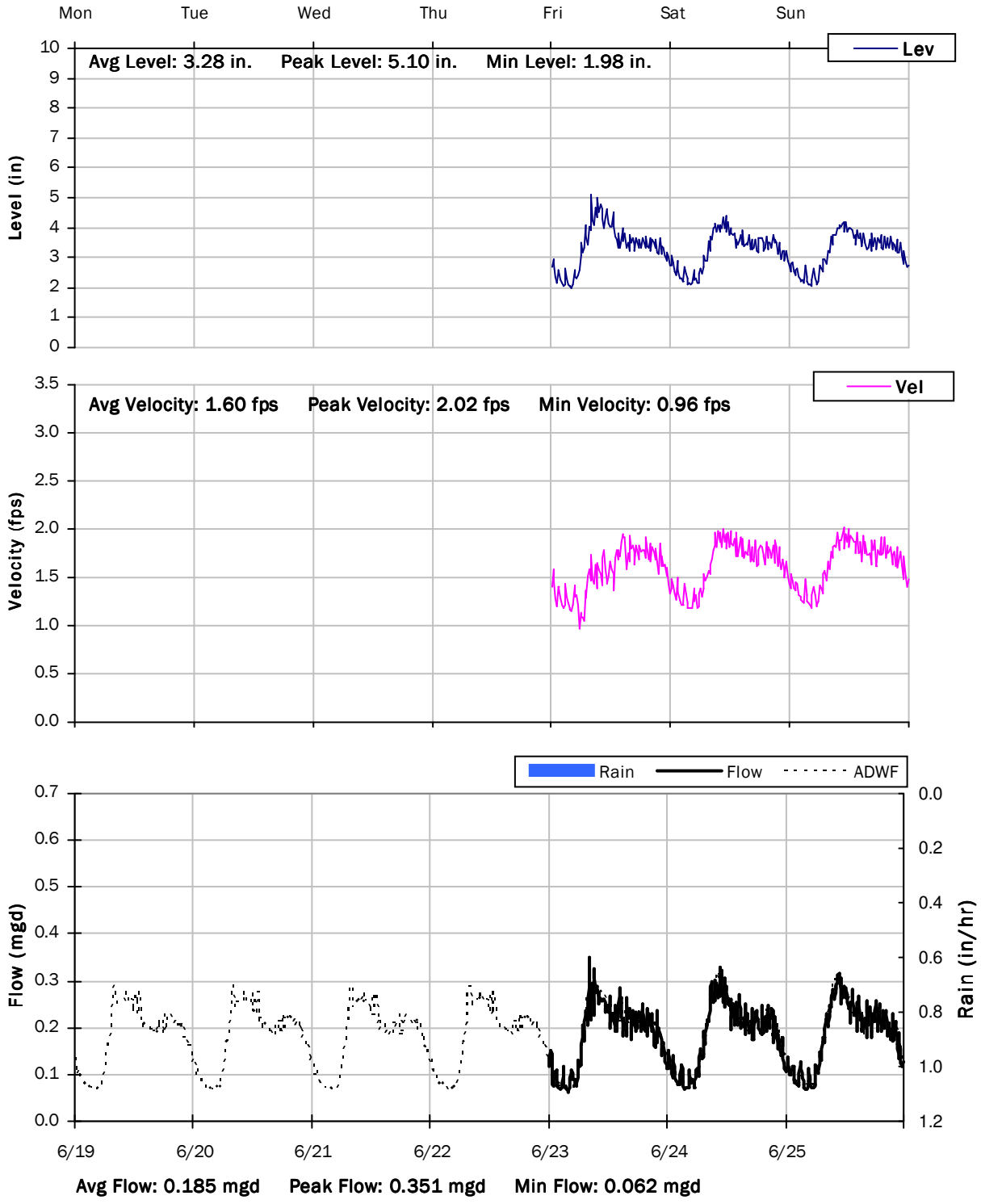
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 01

Weekly Level, Velocity and Flow Hydrographs

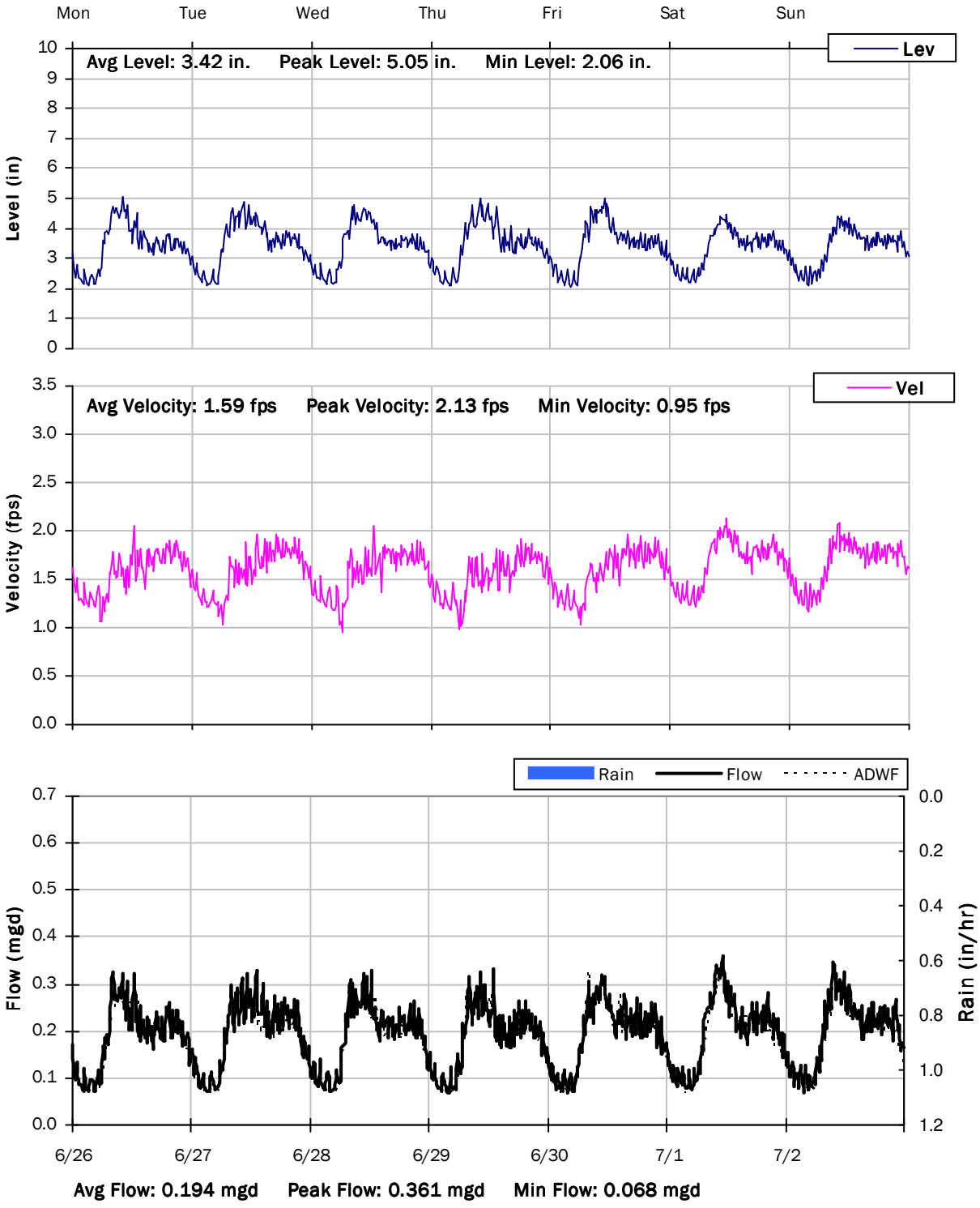
6/19/2017 to 6/26/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

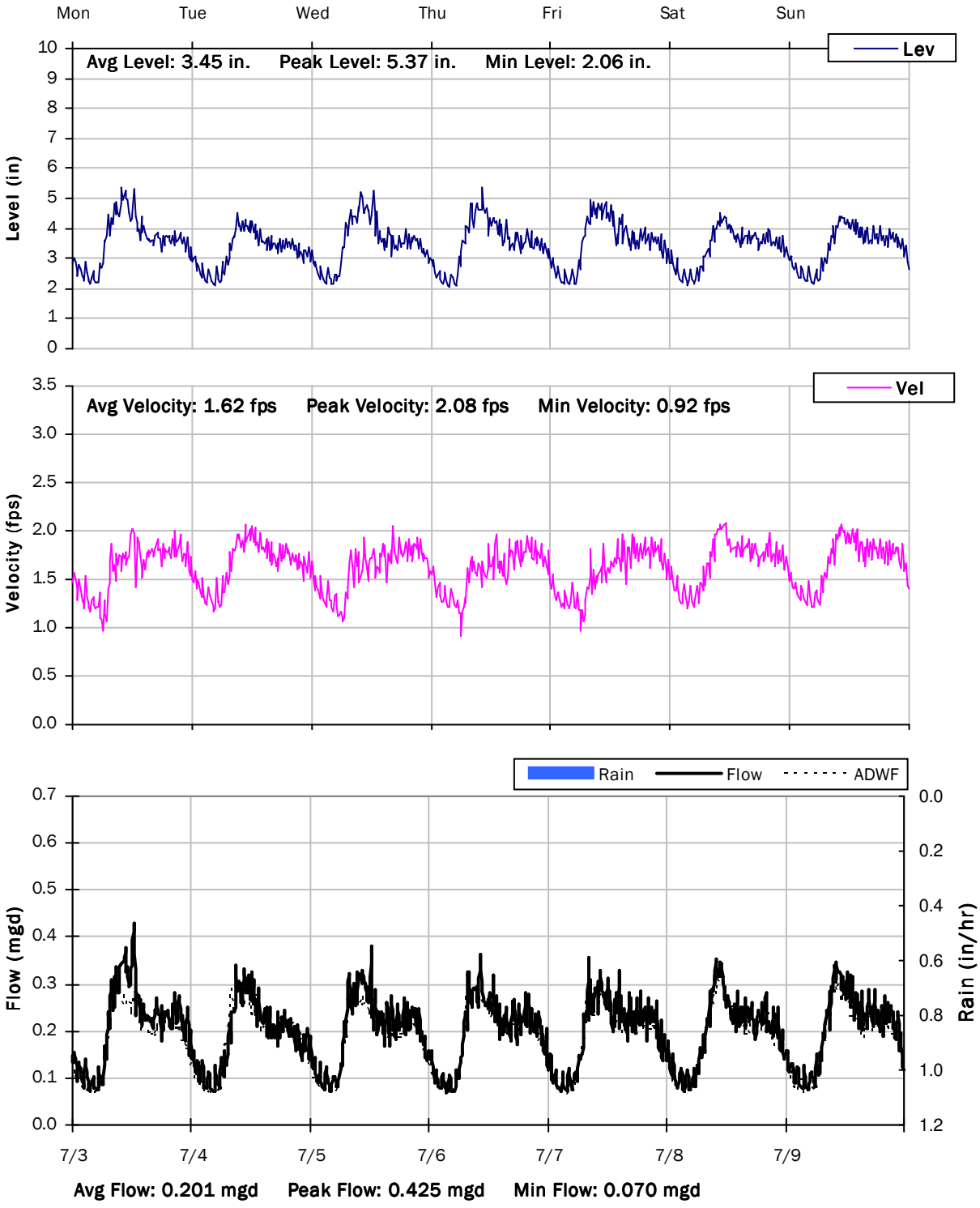
6/26/2017 to 7/3/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

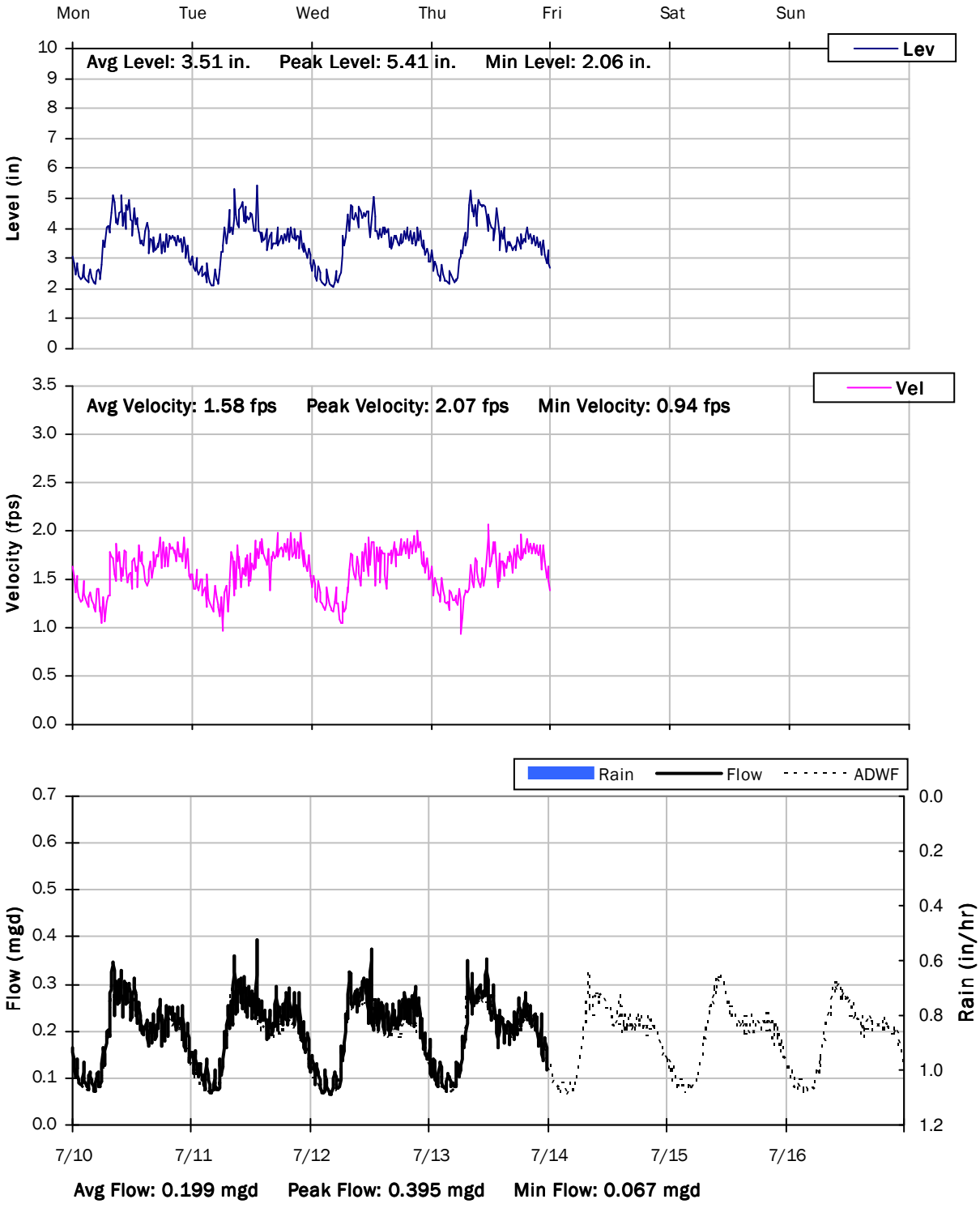
7/3/2017 to 7/10/2017



SITE 01

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

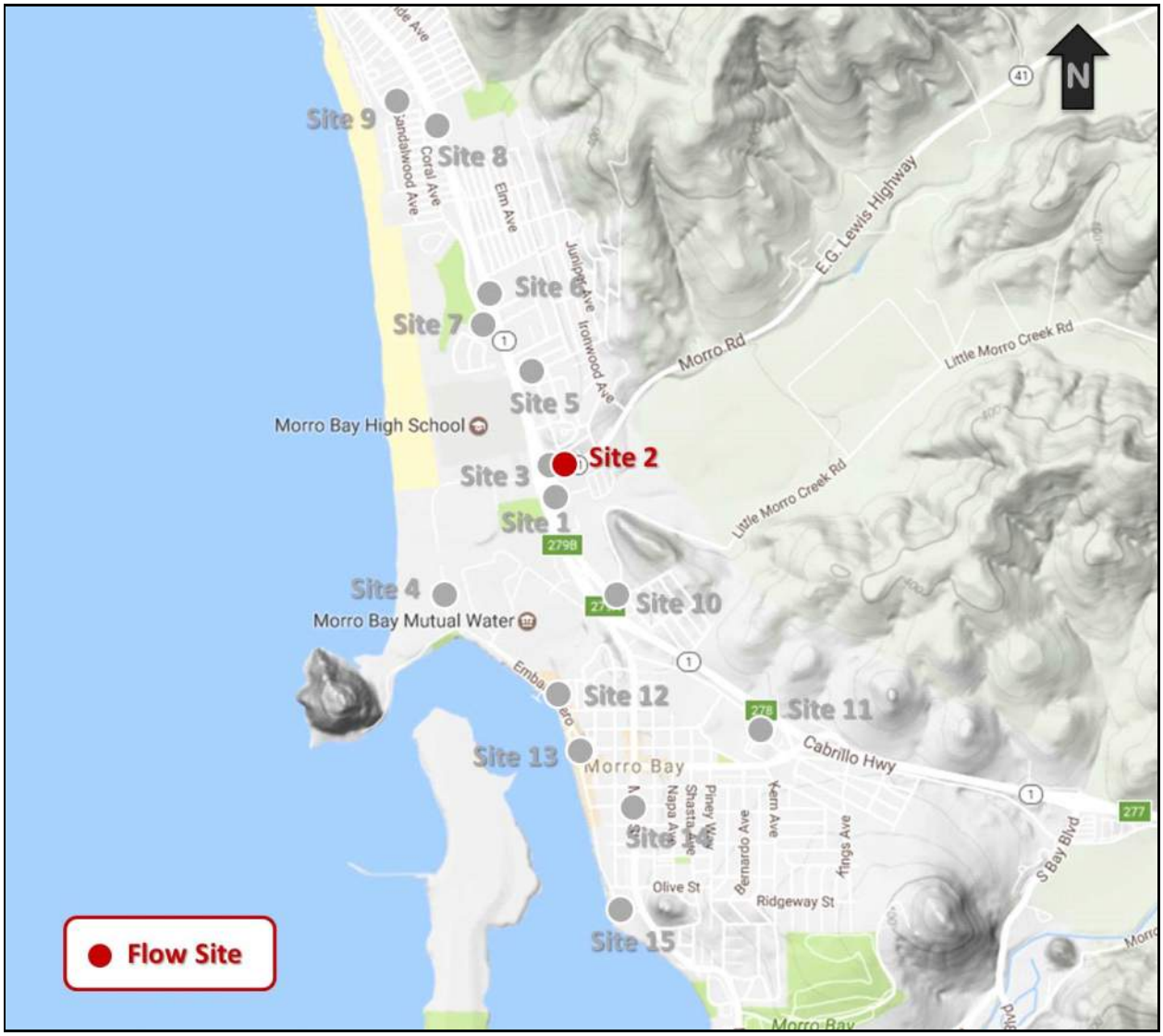
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 02

Location: Atascadero Road ~85 feet east of Sunset Avenue, meter on west 8" outlet

Data Summary Report



Vicinity Map: Site 02

SITE 02

Site Information

Location: Atascadero Road ~85 feet east of Sunset Avenue, meter on west 8" outlet

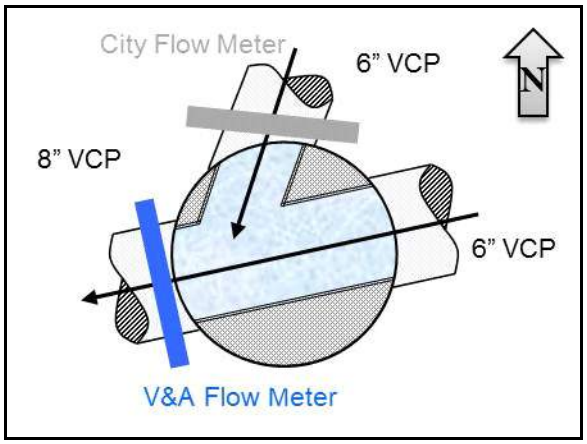


Pipe Diameter: 8 inches

ADWF: 0.027 mgd

Peak Measured Flow: 0.085 mgd









SITE 02

Additional Site Photos





SITE 02

Additional Site Photos

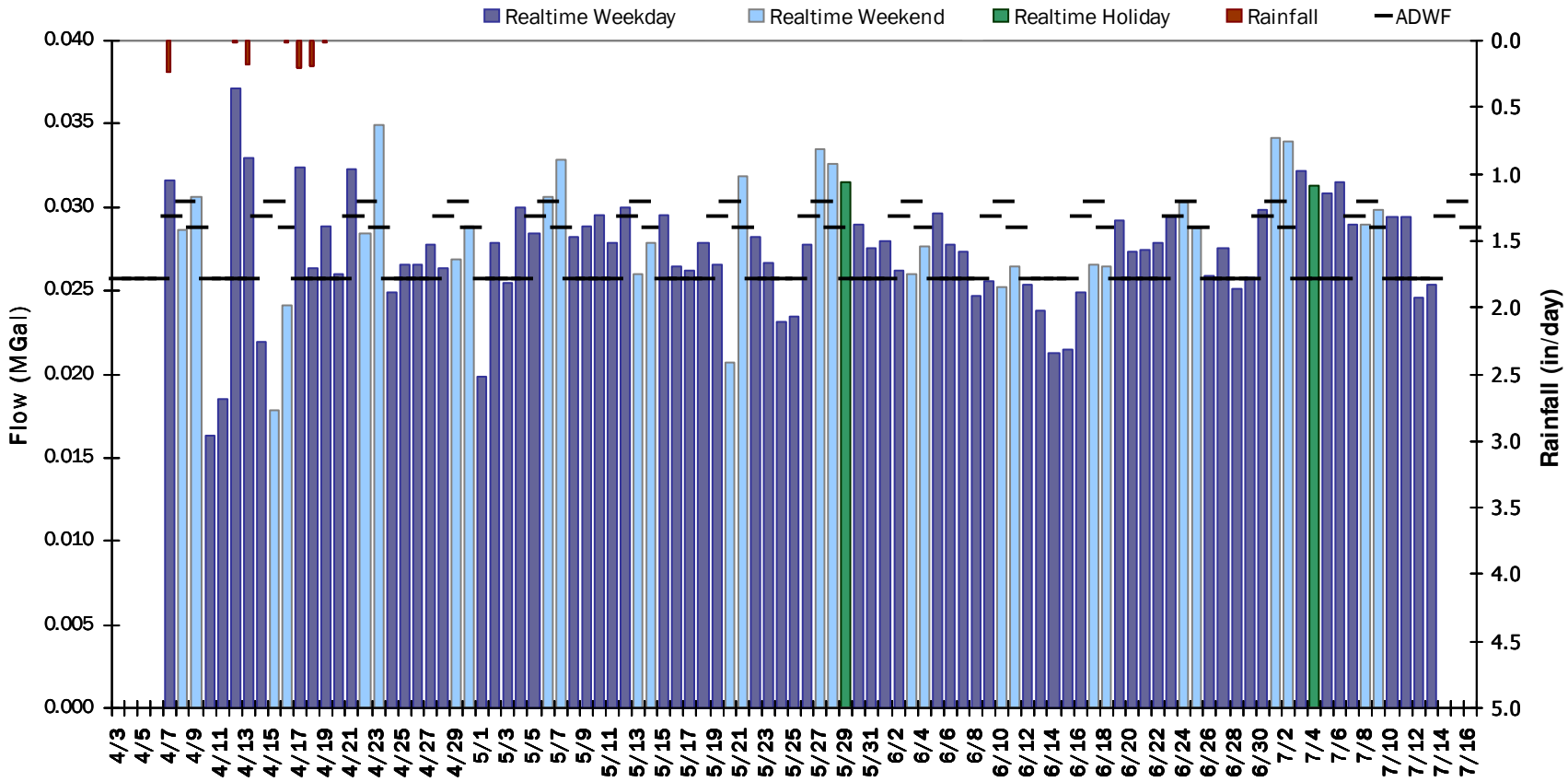


SITE 02

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.028 MGal Peak Daily Flow: 0.037 MGal Min Daily Flow: 0.016 MGal

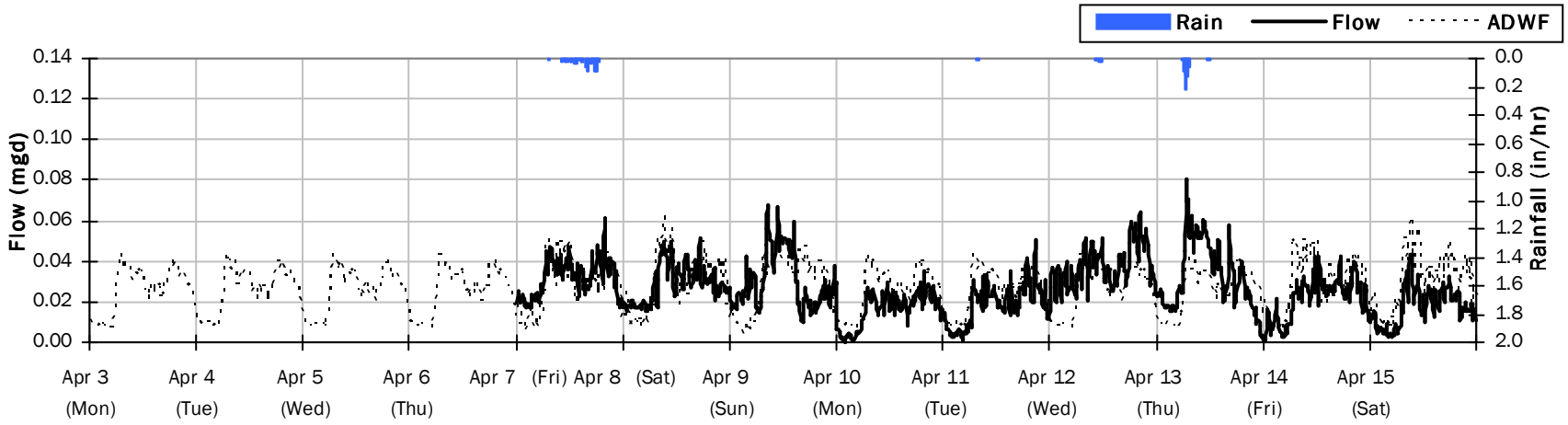
Total Period Rainfall: 0.85 inches

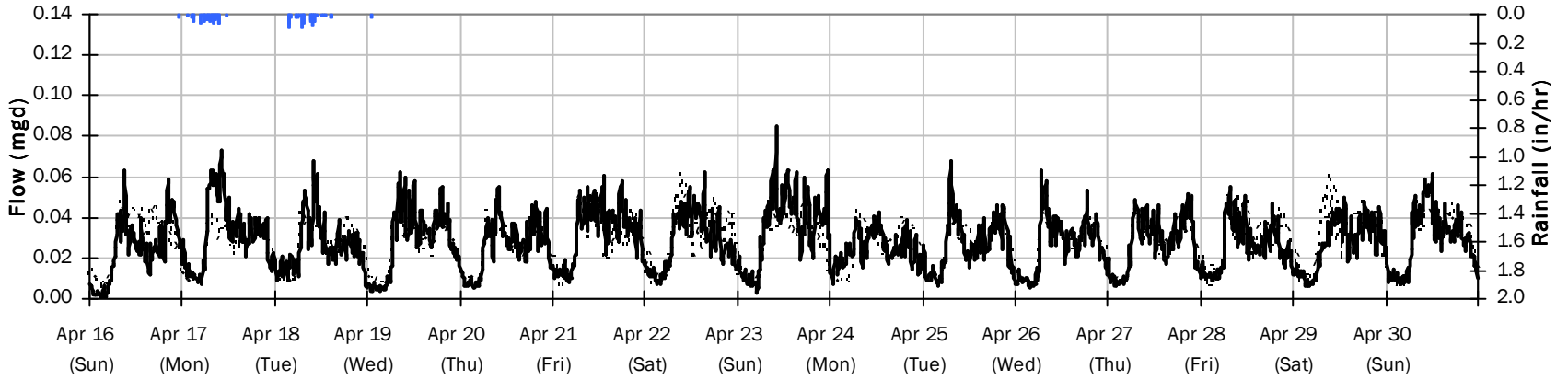


SITE 02

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.027 mgd** **Peak Flow: 0.085 mgd** **Min Flow: 0.000 mgd**

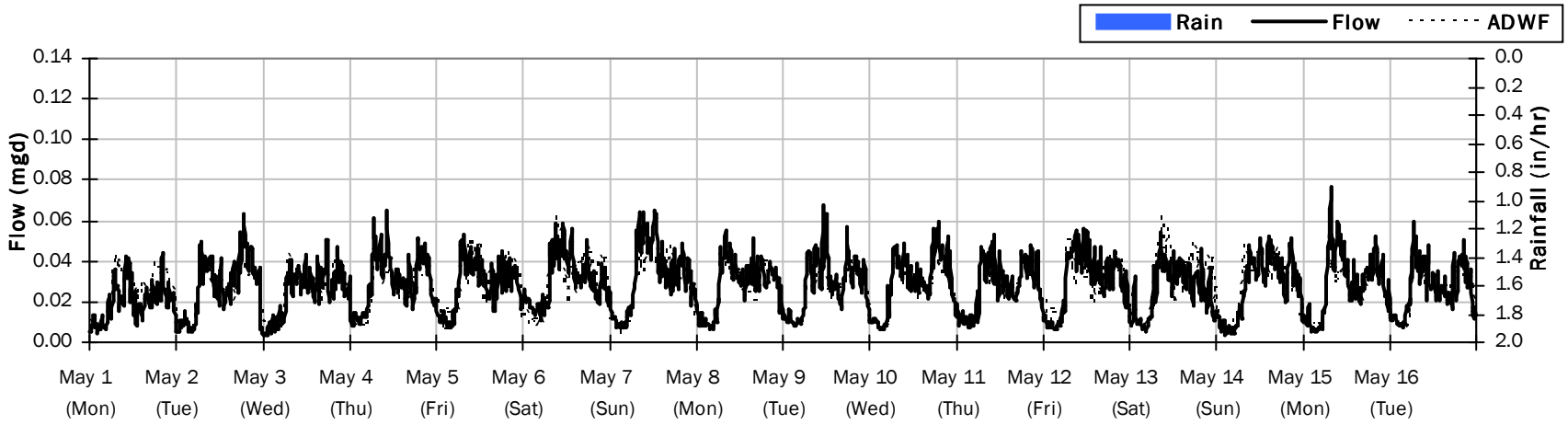


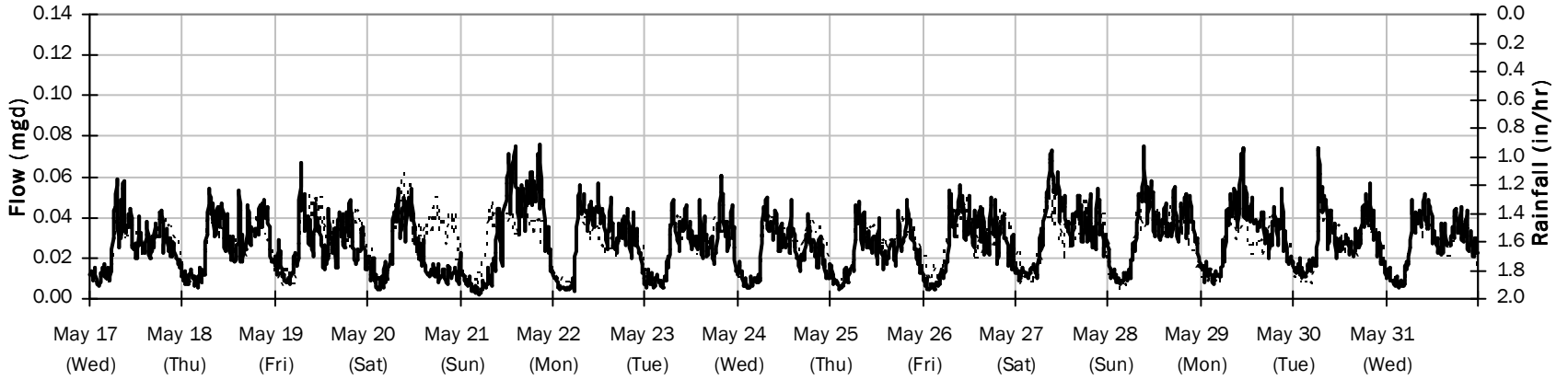


SITE 02

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.028 mgd** **Peak Flow: 0.077 mgd** **Min Flow: 0.002 mgd**

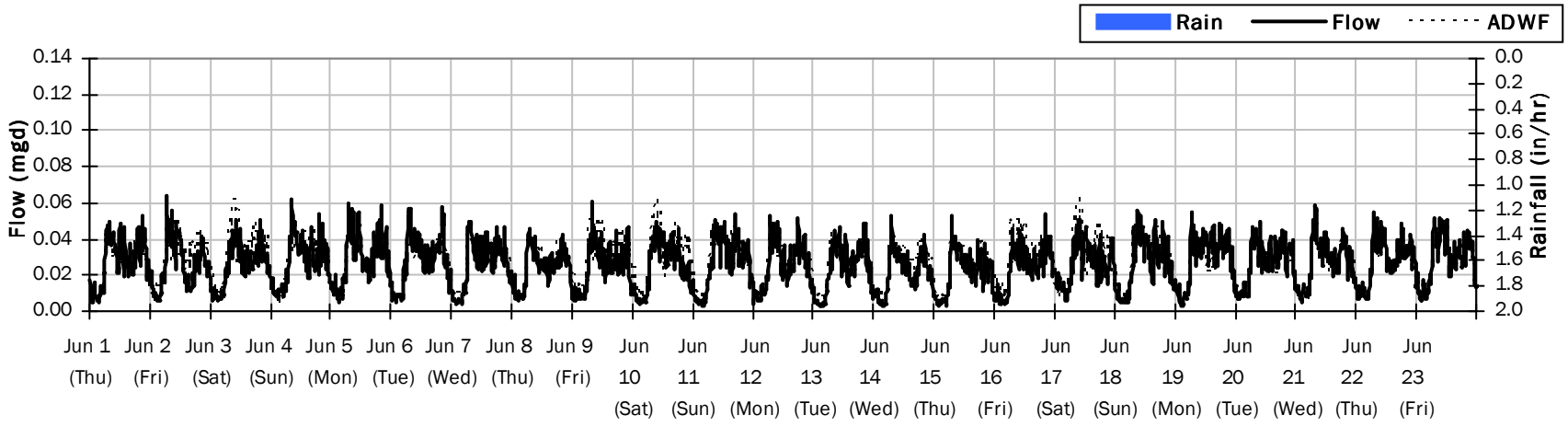


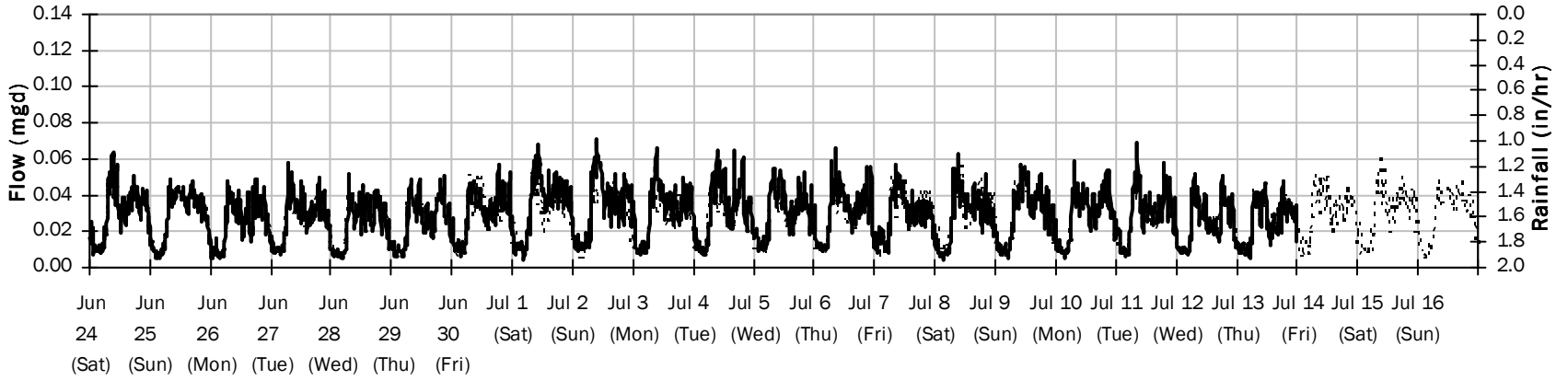


SITE 02

Flow Summary: 6/1/2017 to 7/16/2017

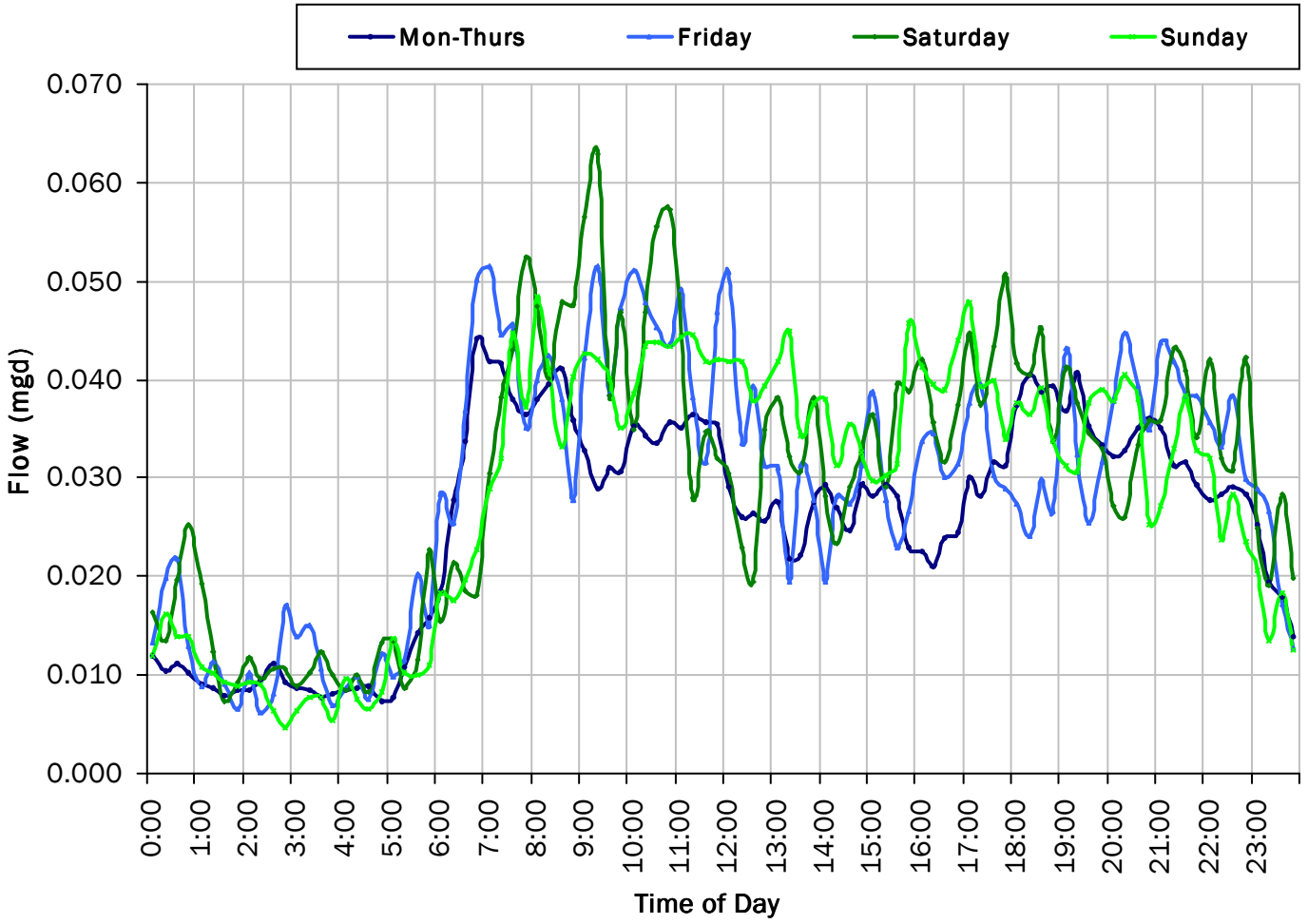
Total Period Rainfall: 0.00 inches **Avg Flow: 0.028 mgd** **Peak Flow: 0.072 mgd** **Min Flow: 0.003 mgd**





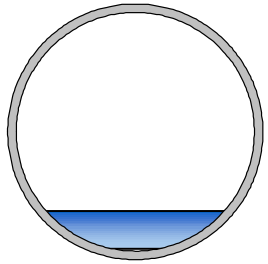
SITE 02

Average Dry Weather Flow Hydrographs



ADWF:

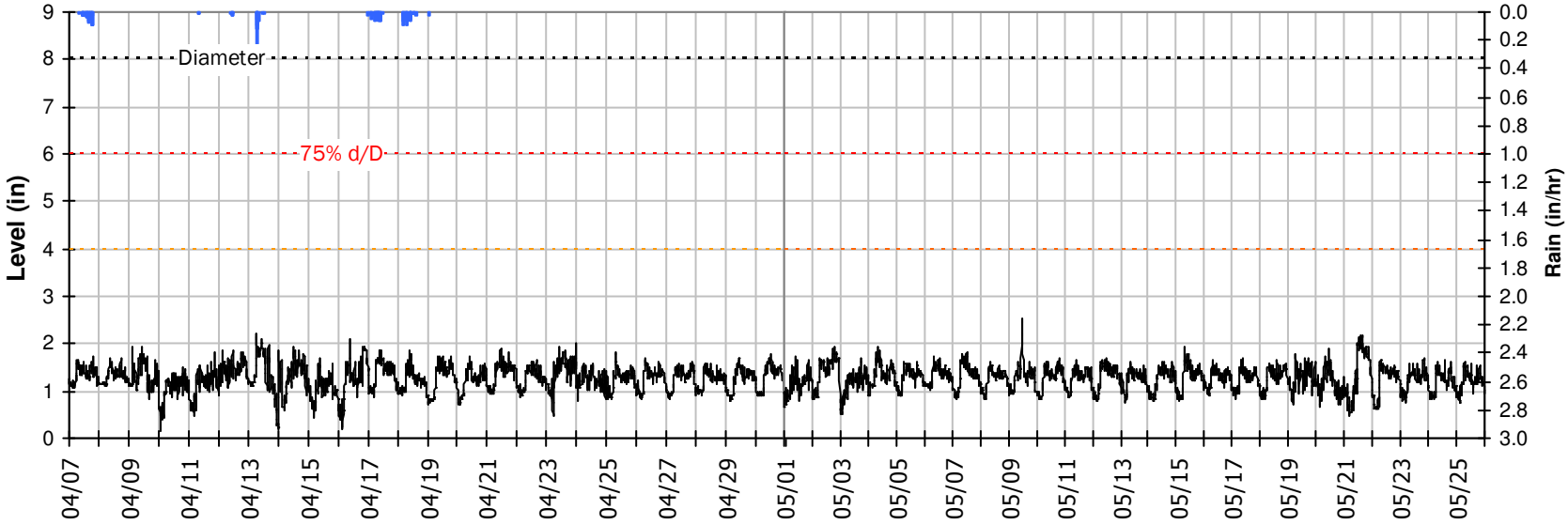
0.027 *mgd*

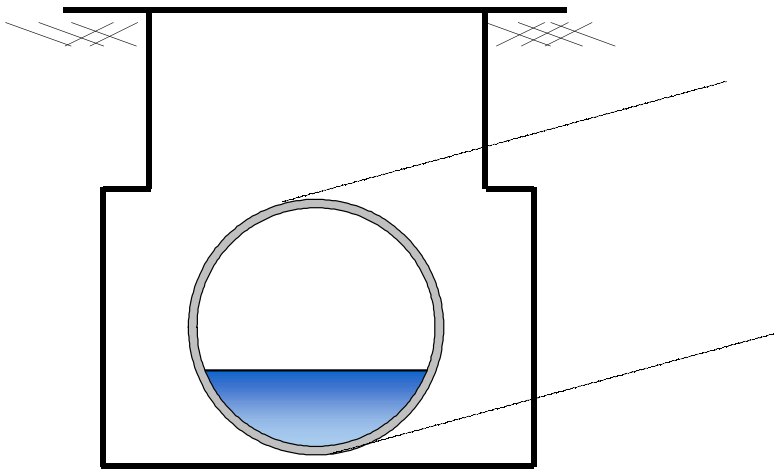


SITE 02

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



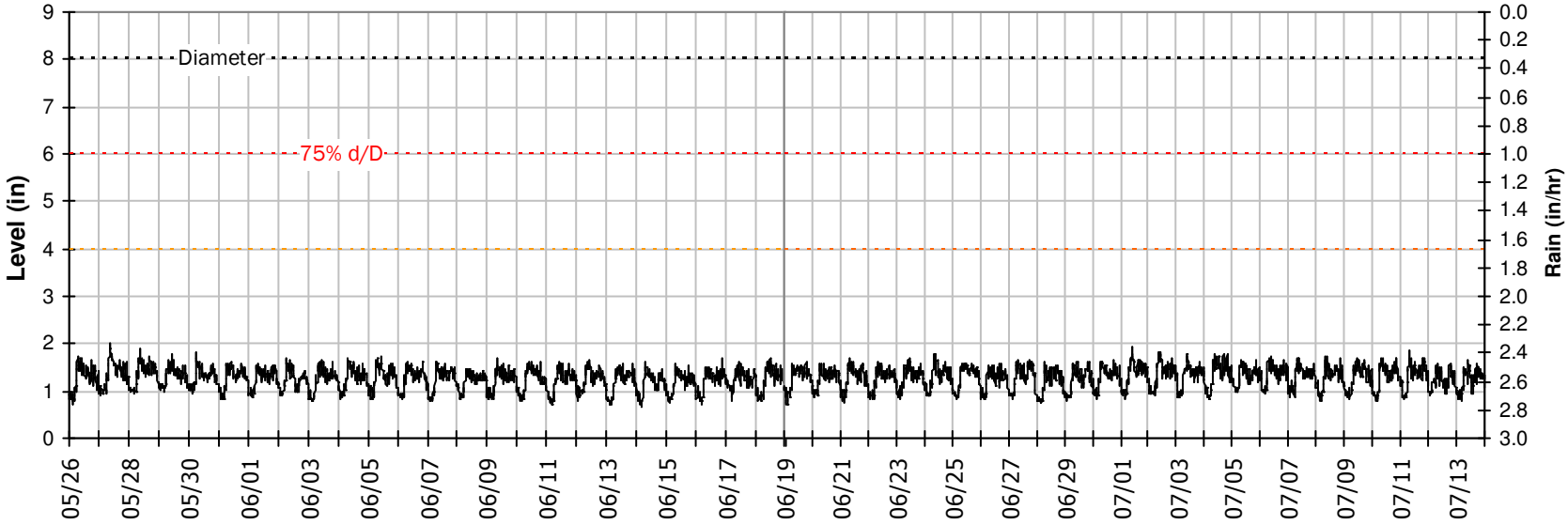


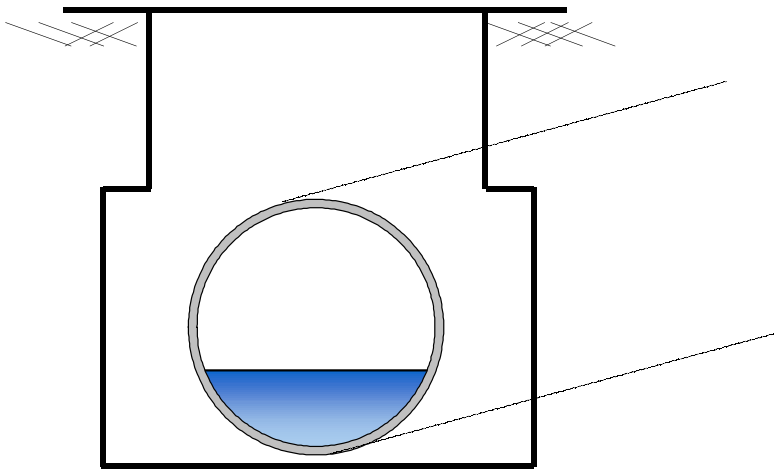
Pipe Diameter:	8	*inches*
Peak Measured Level:	2.53	*inches*
Peak d/D Ratio:	0.32	

SITE 02

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



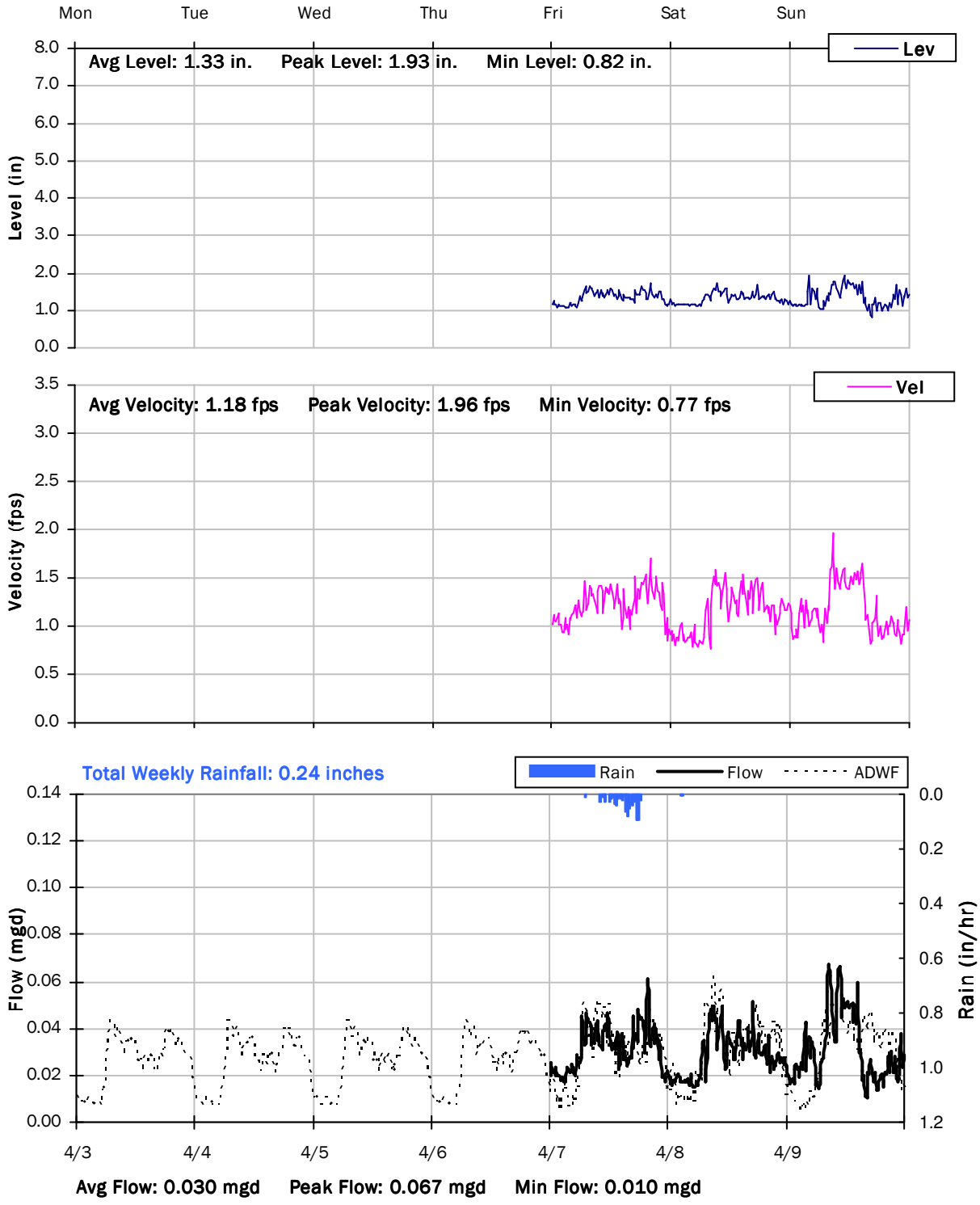


Pipe Diameter:	8	*inches*
Peak Measured Level:	2.53	*inches*
Peak d/D Ratio:	0.32	

SITE 02

Weekly Level, Velocity and Flow Hydrographs

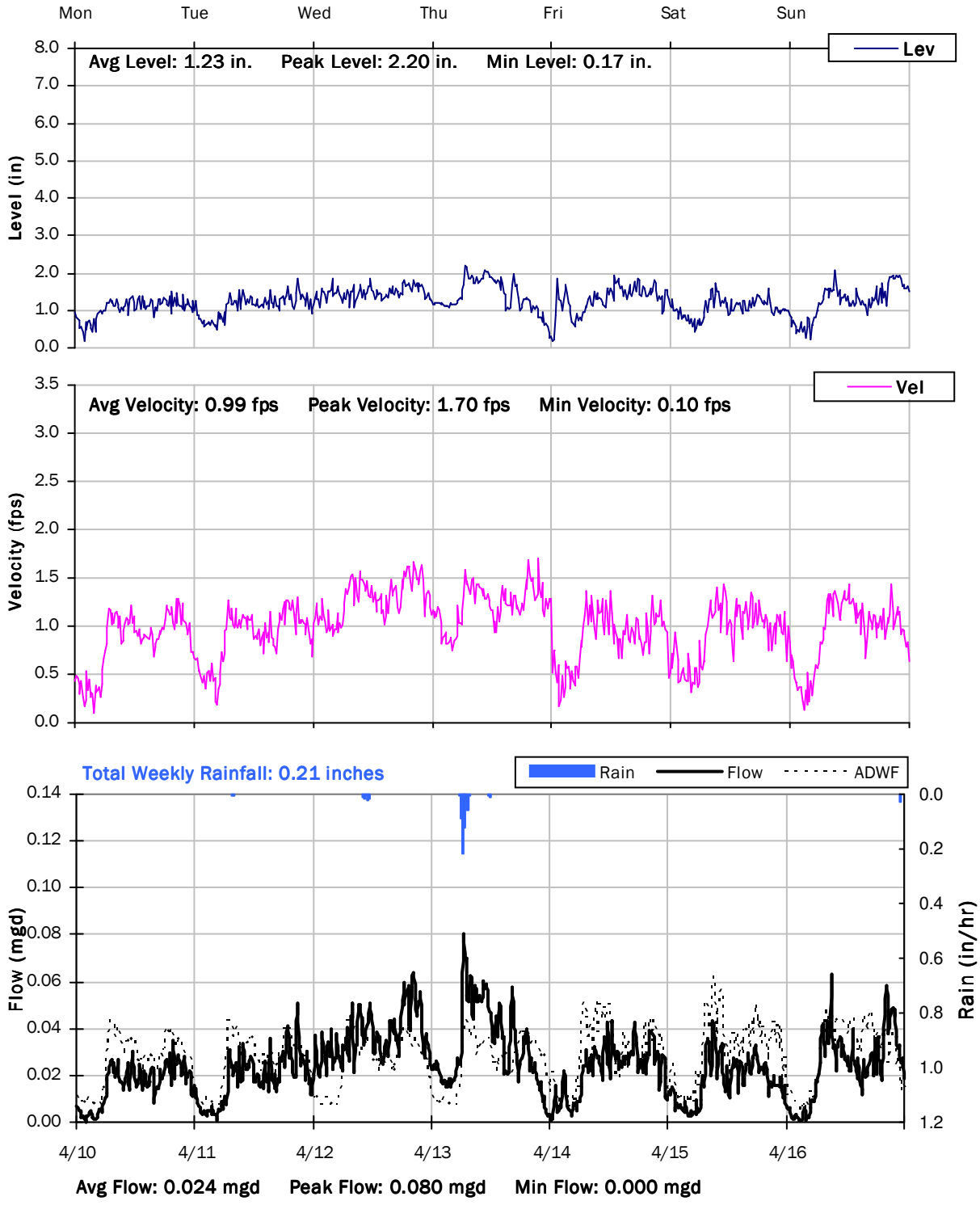
4/3/2017 to 4/10/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

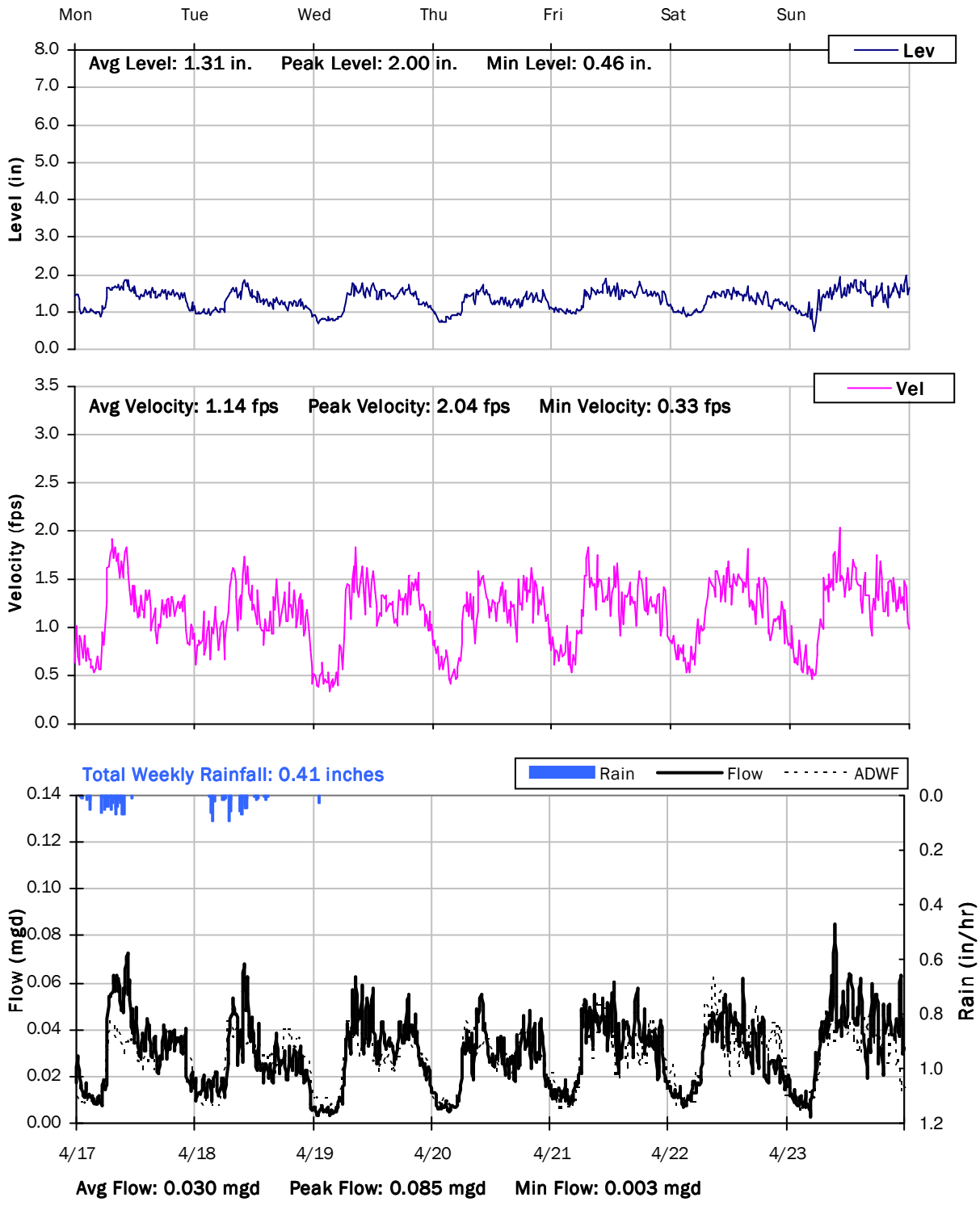
4/10/2017 to 4/17/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

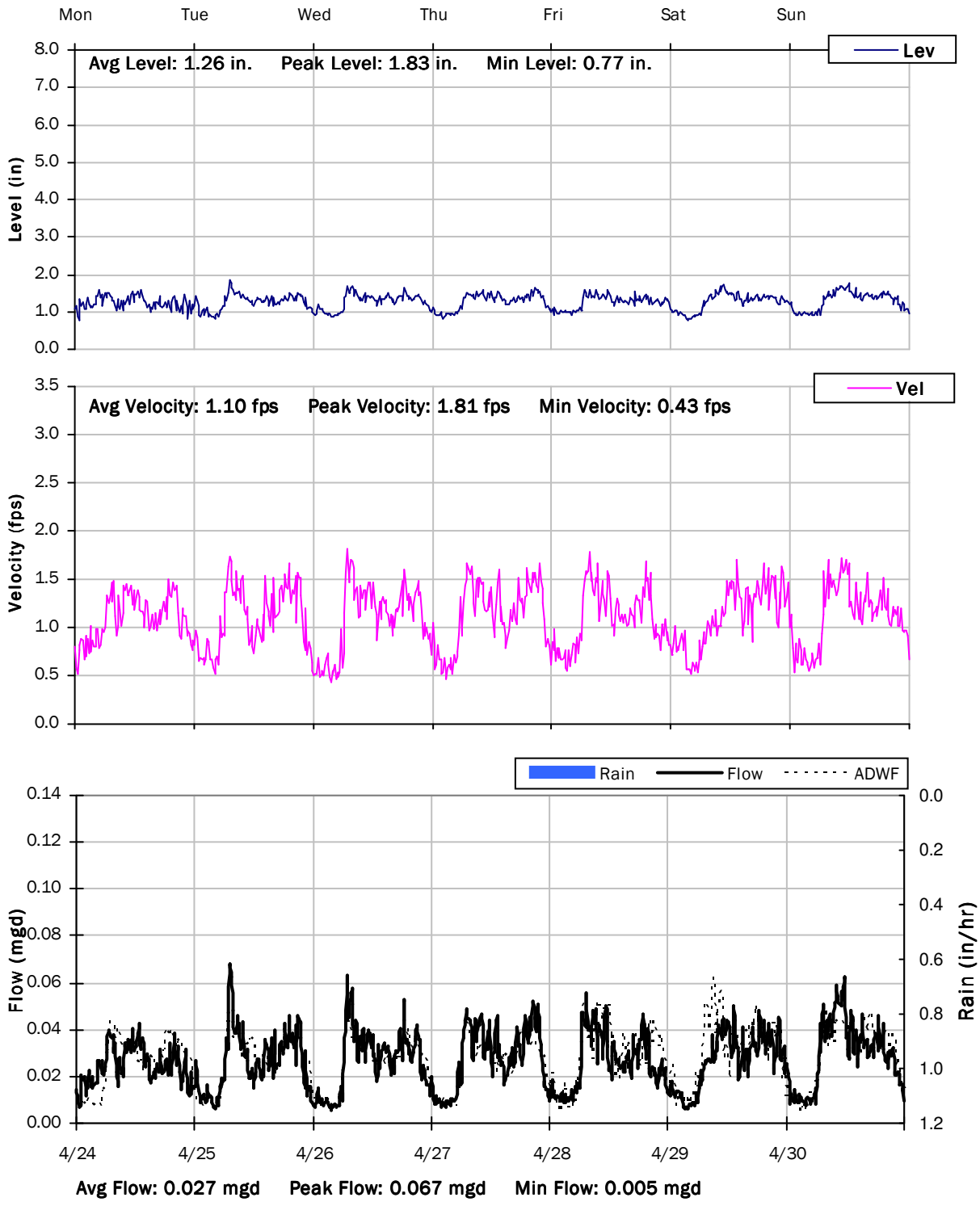
4/17/2017 to 4/24/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

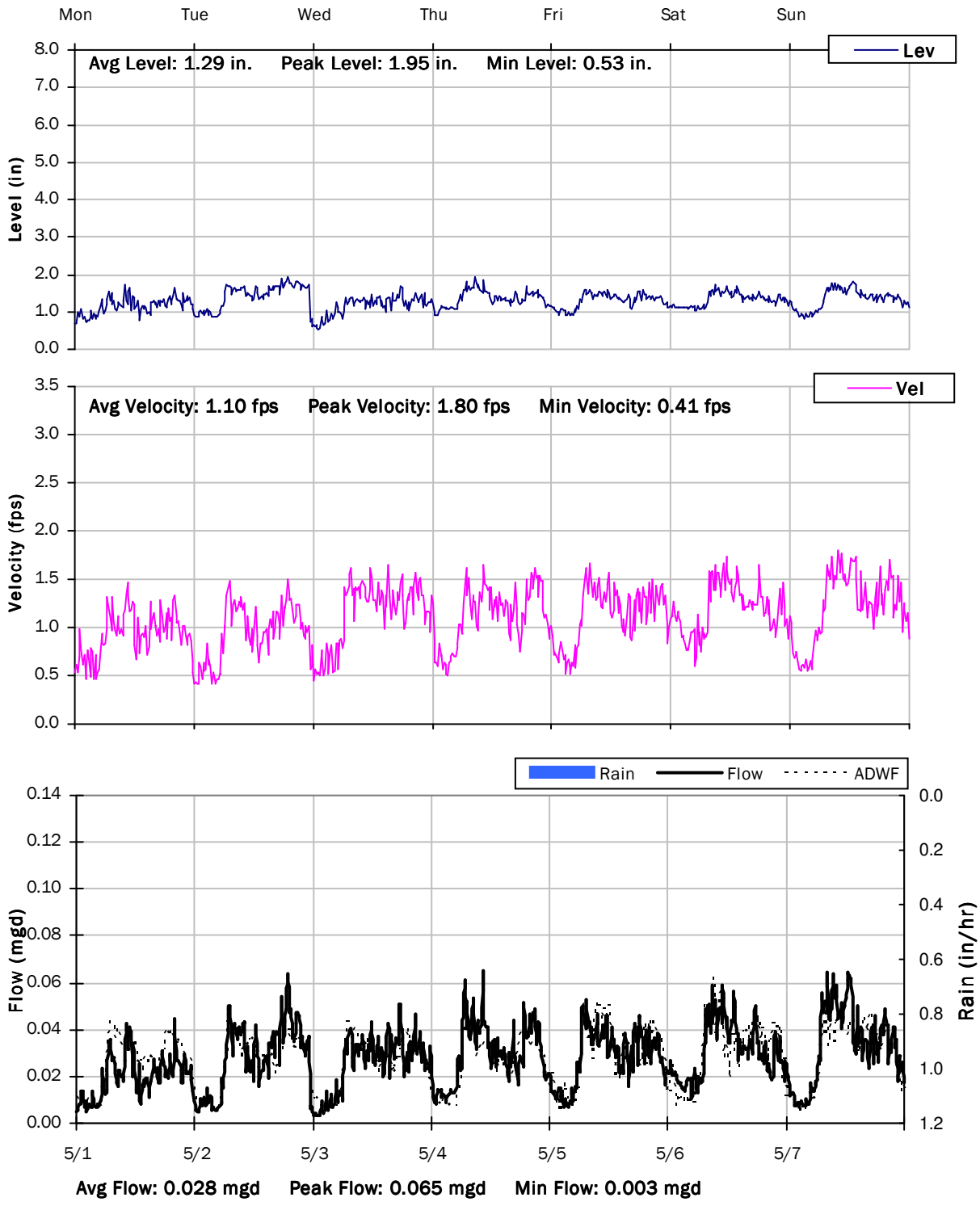
4/24/2017 to 5/1/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

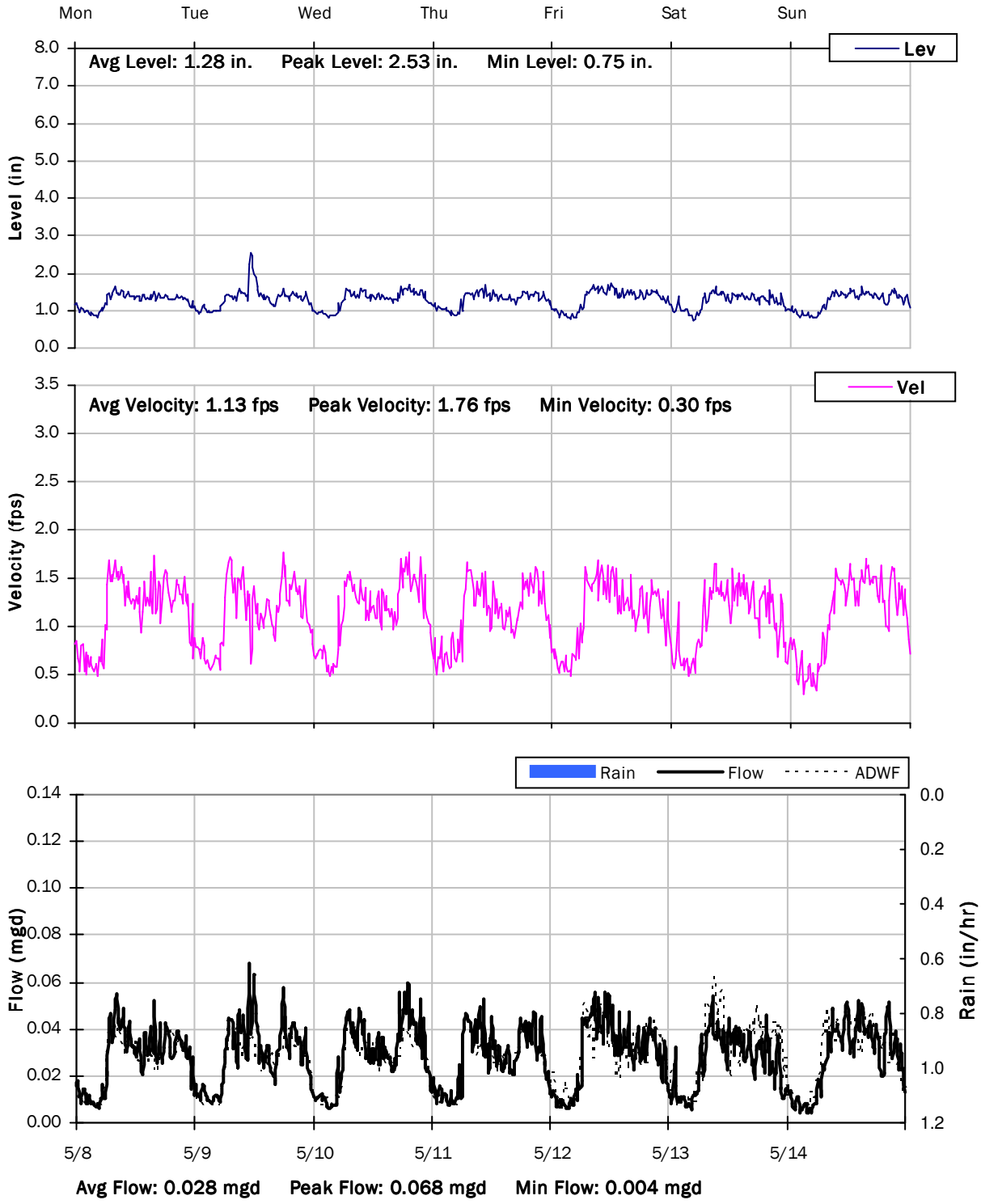
5/1/2017 to 5/8/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

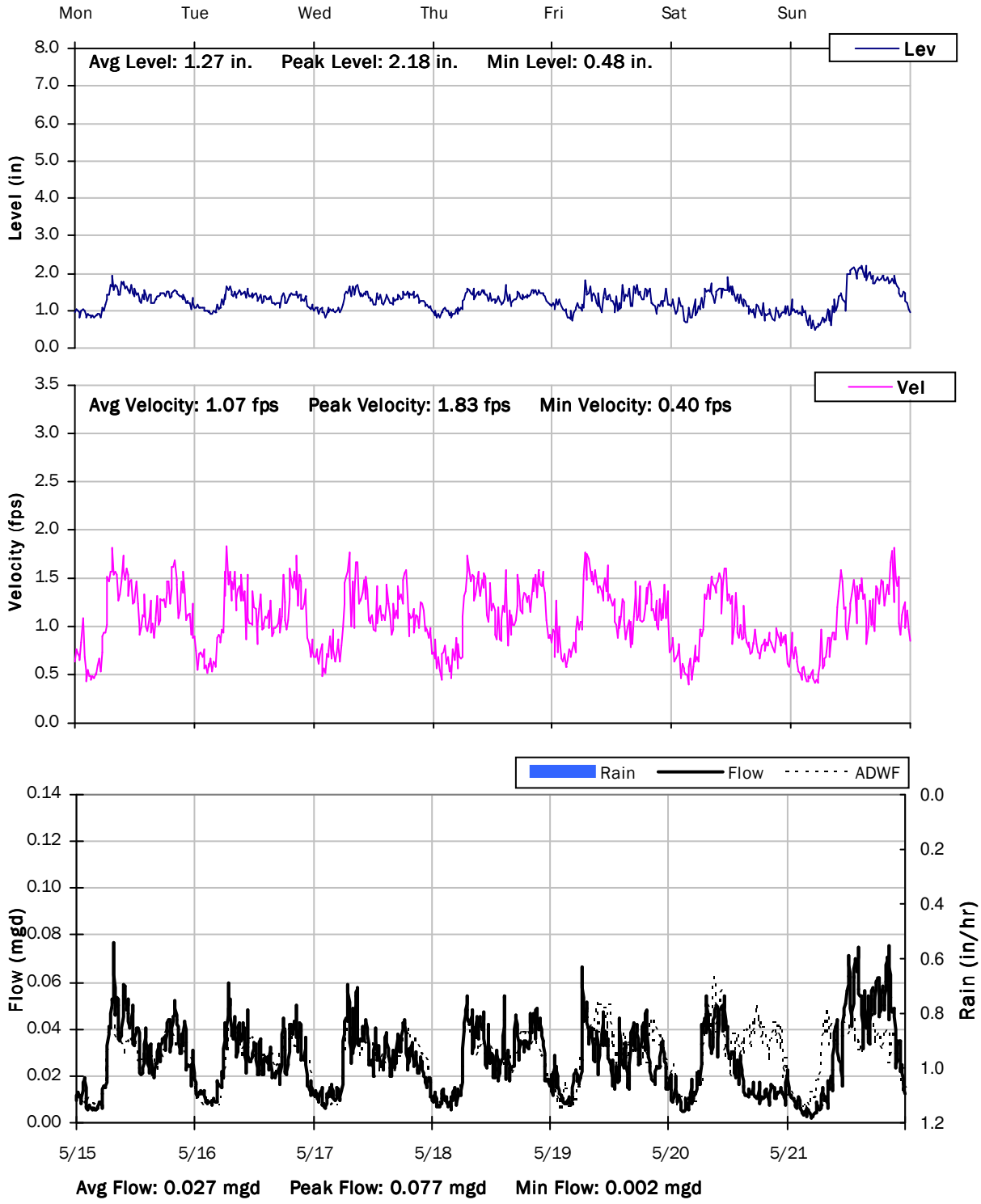
5/8/2017 to 5/15/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

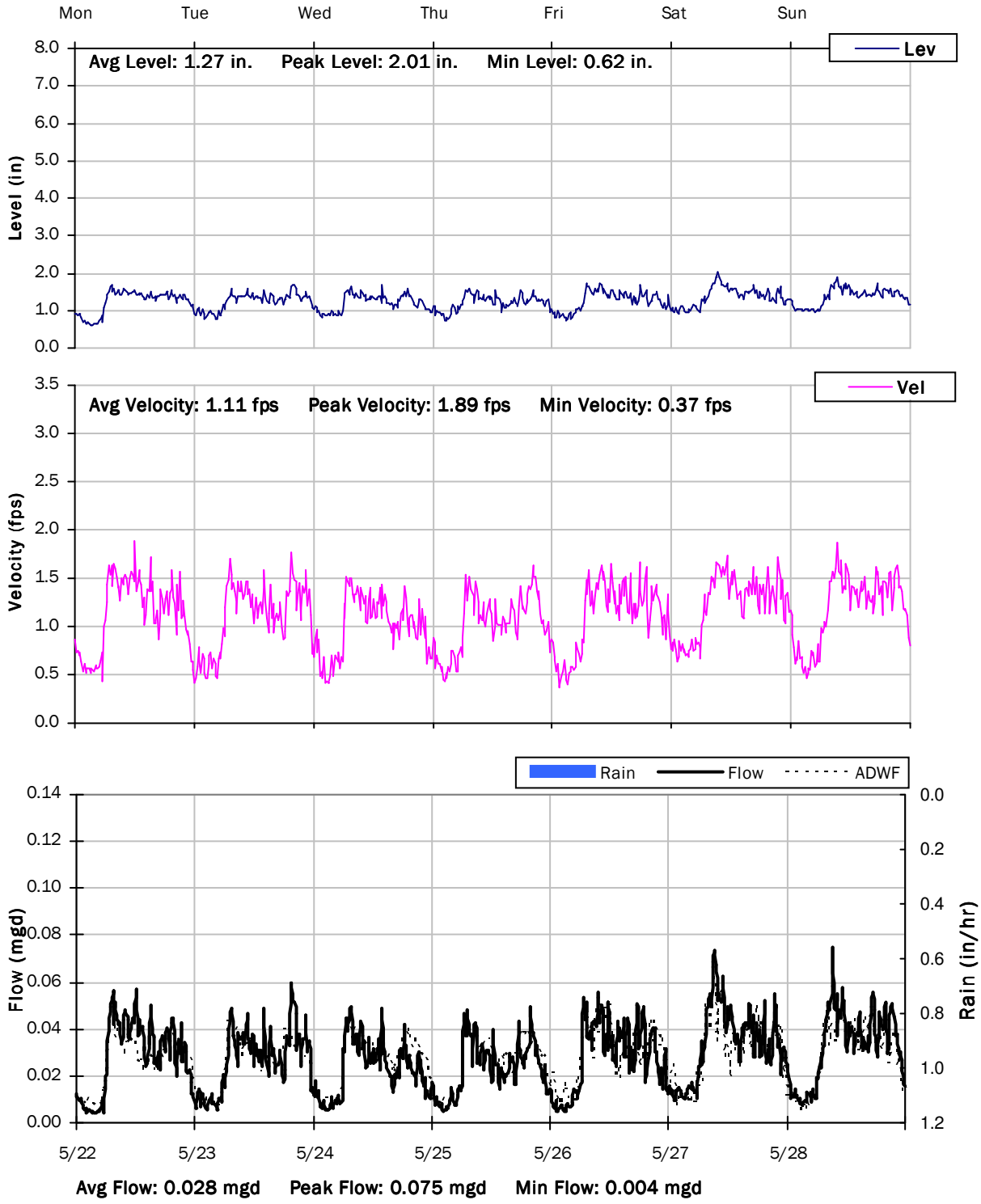
5/15/2017 to 5/22/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

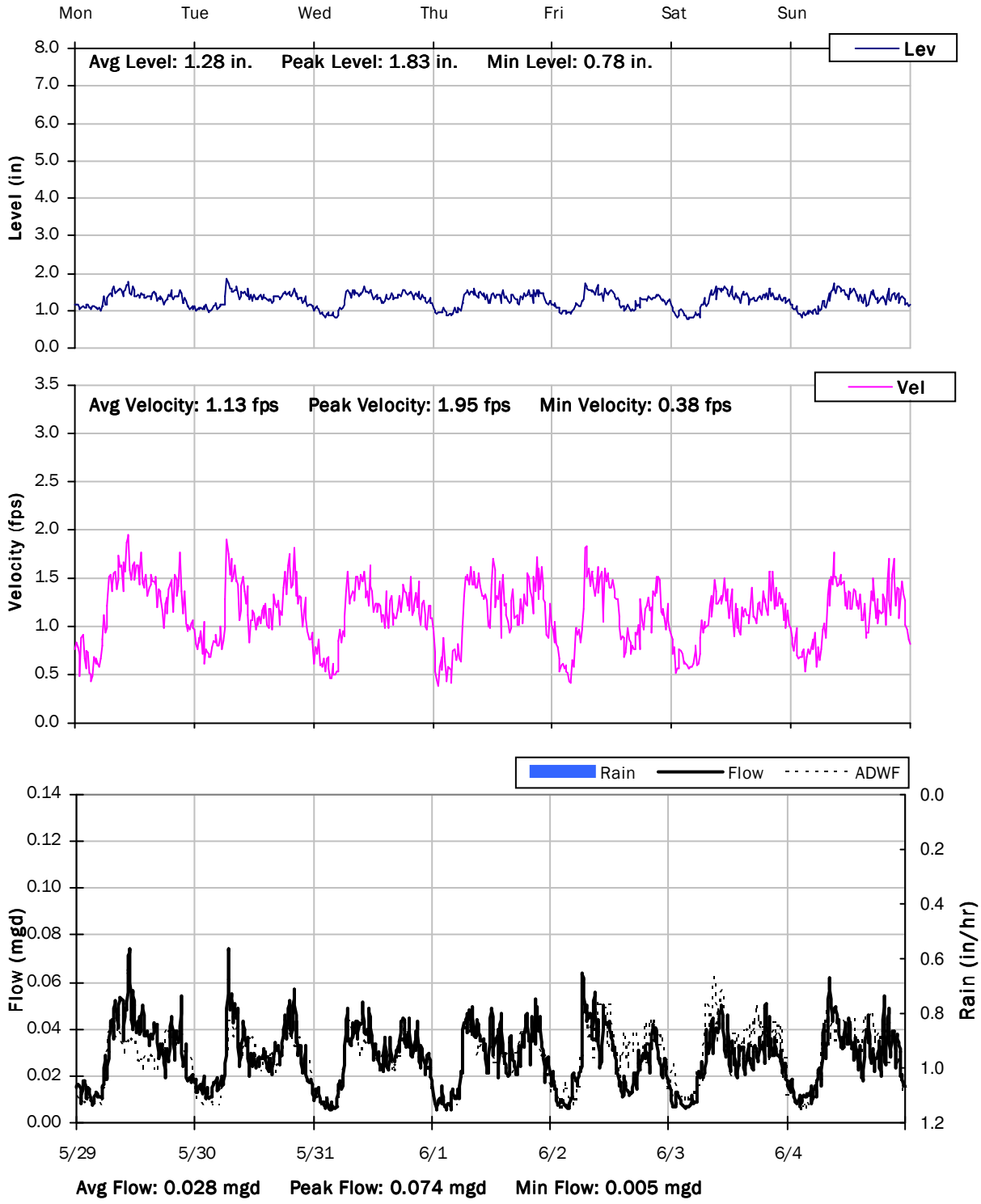
5/22/2017 to 5/29/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

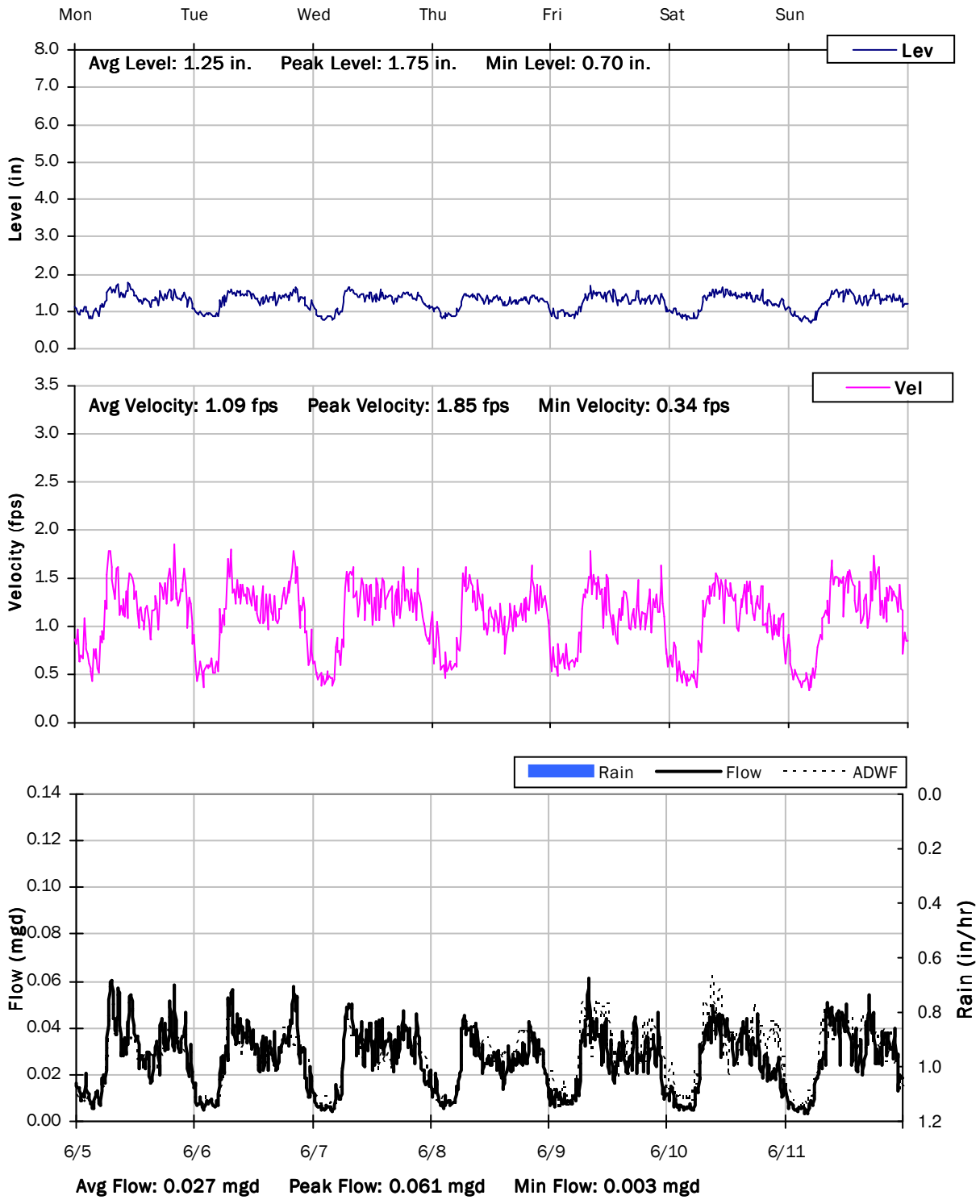
5/29/2017 to 6/5/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

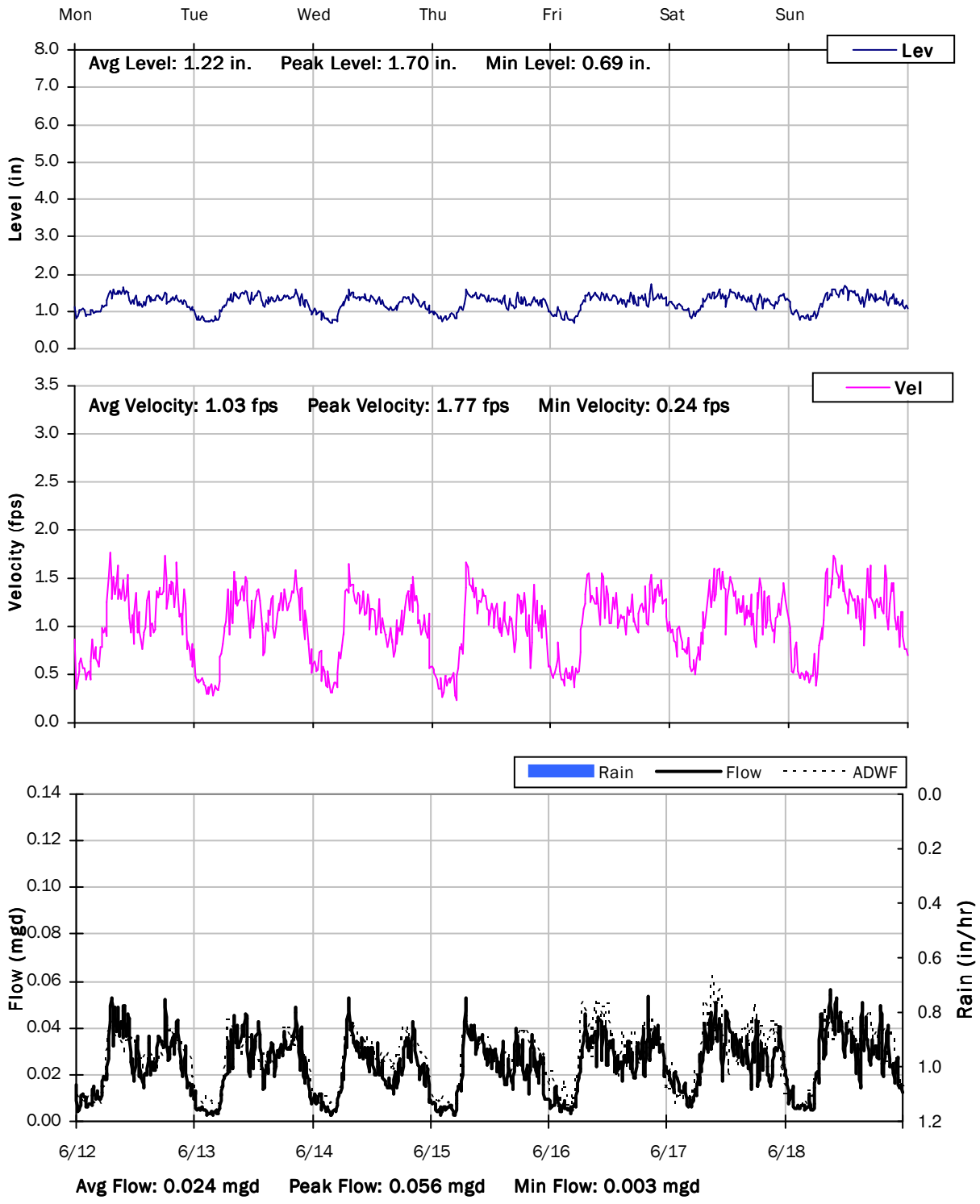
6/5/2017 to 6/12/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

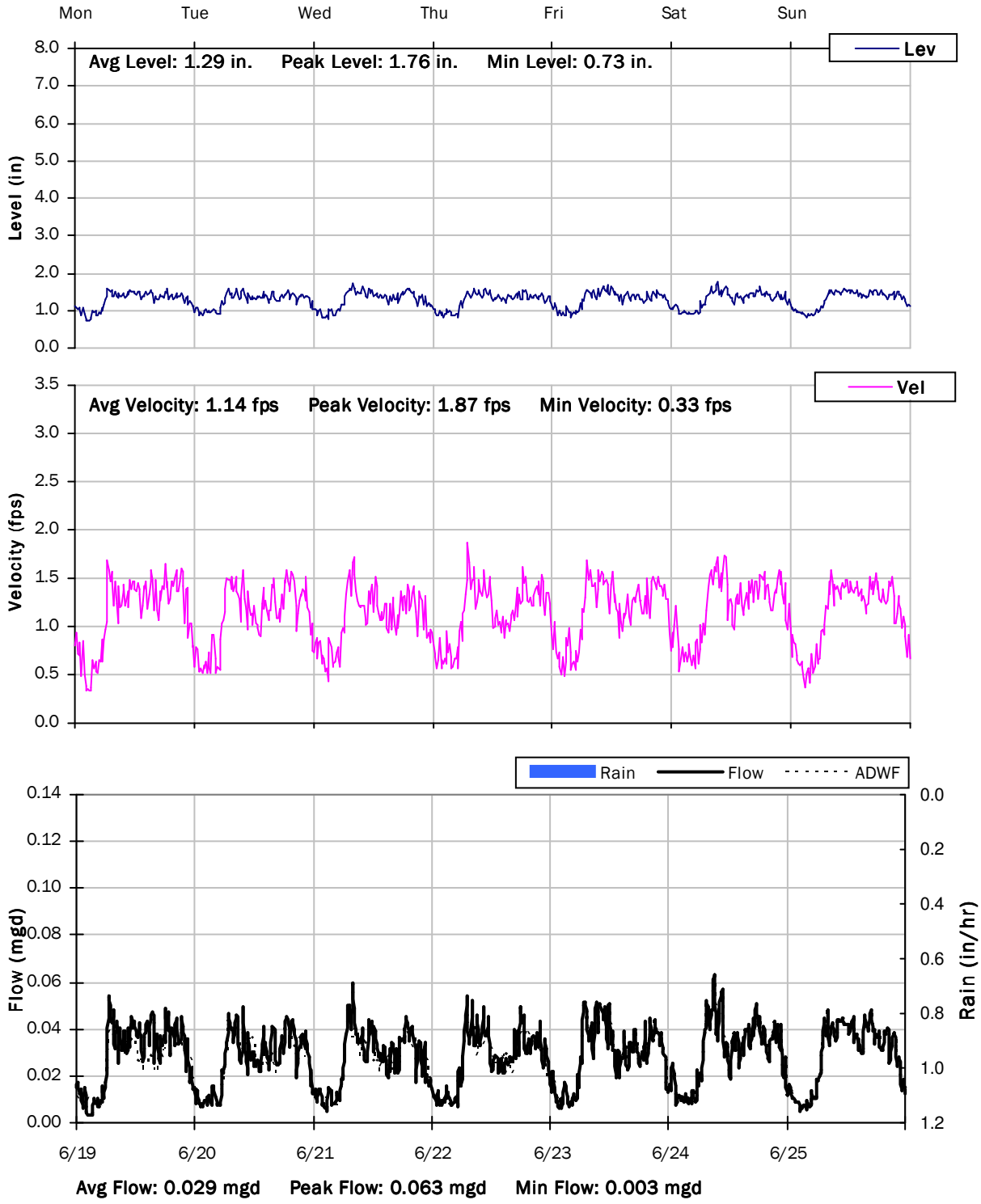
6/12/2017 to 6/19/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

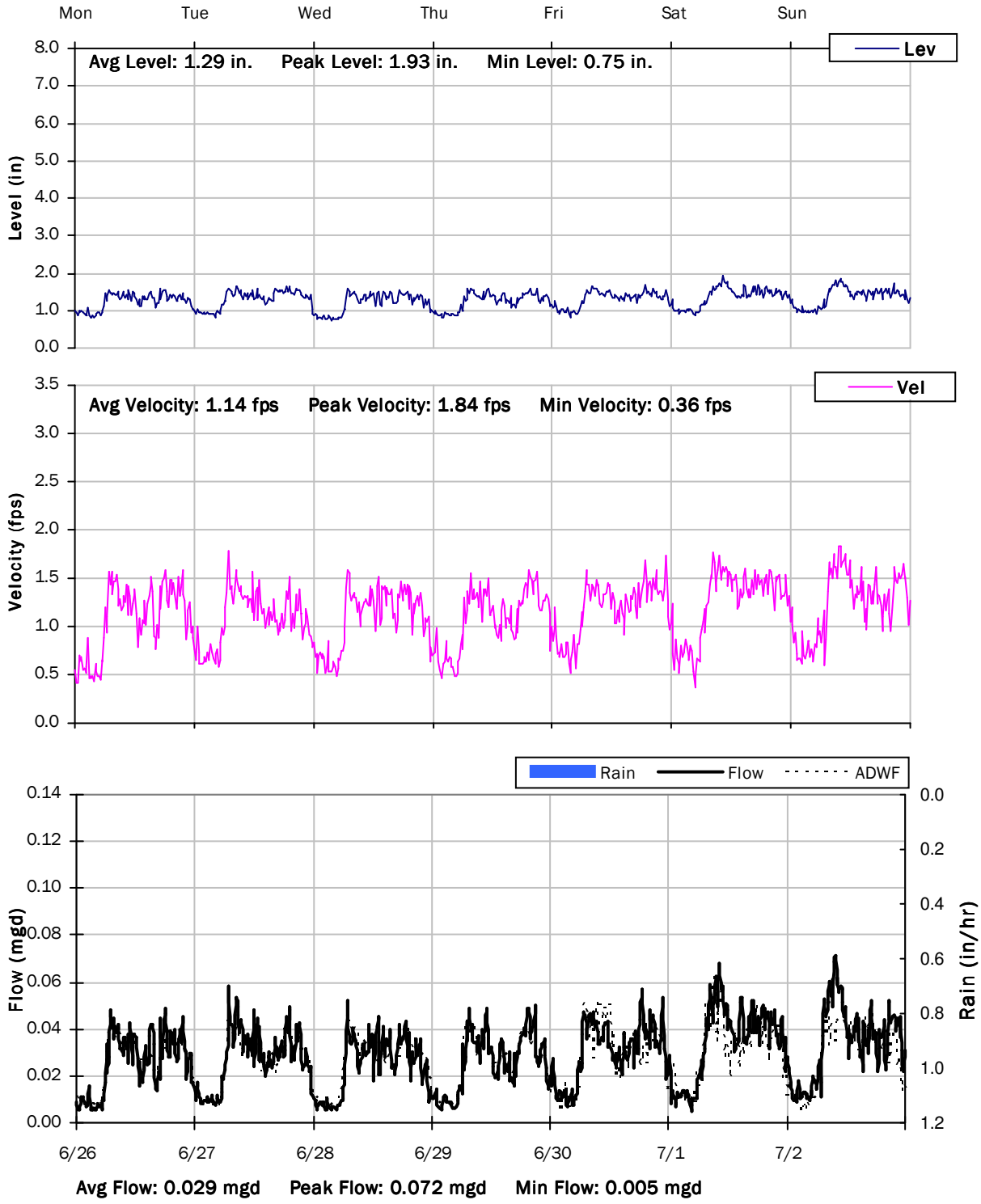
6/19/2017 to 6/26/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

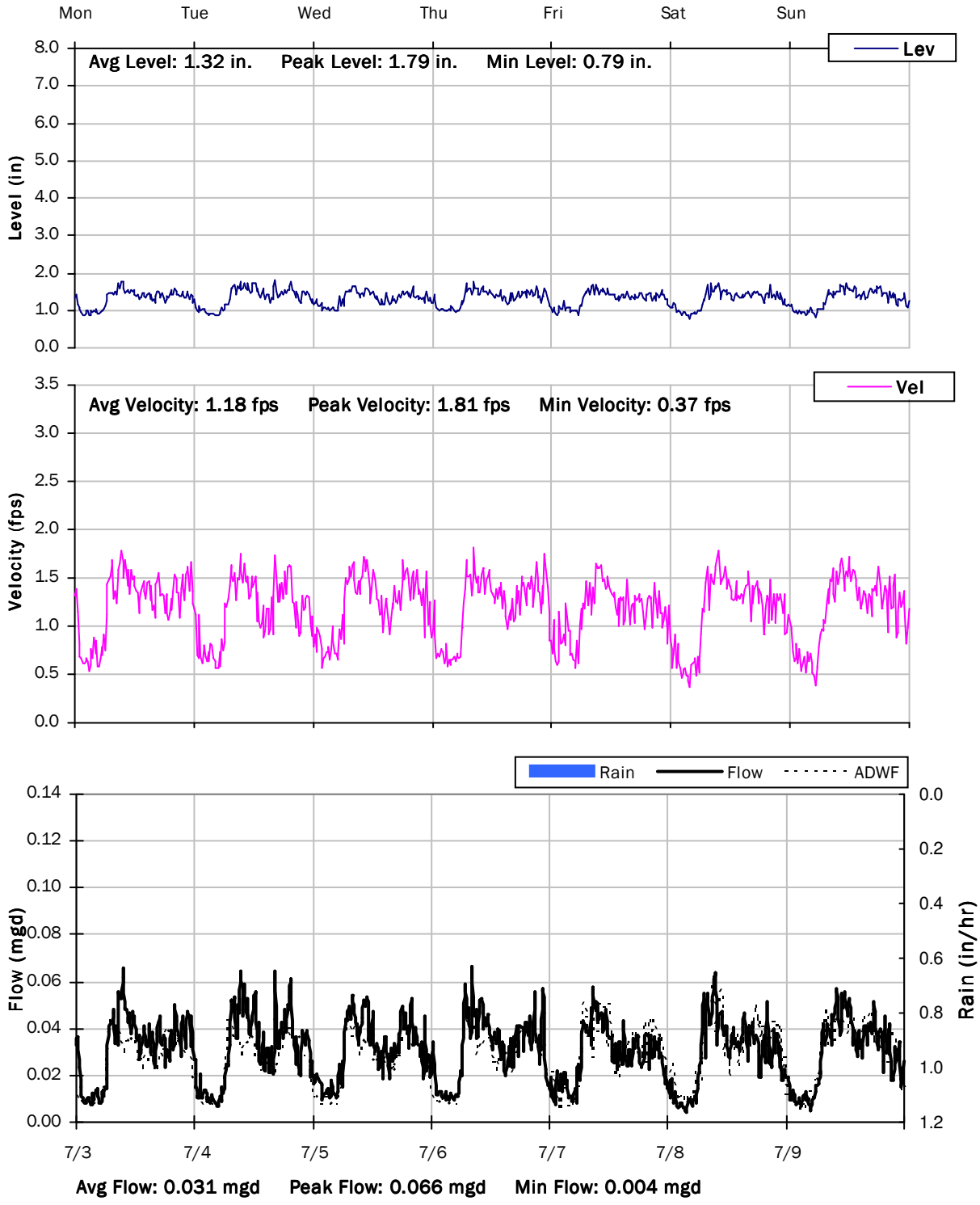
6/26/2017 to 7/3/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

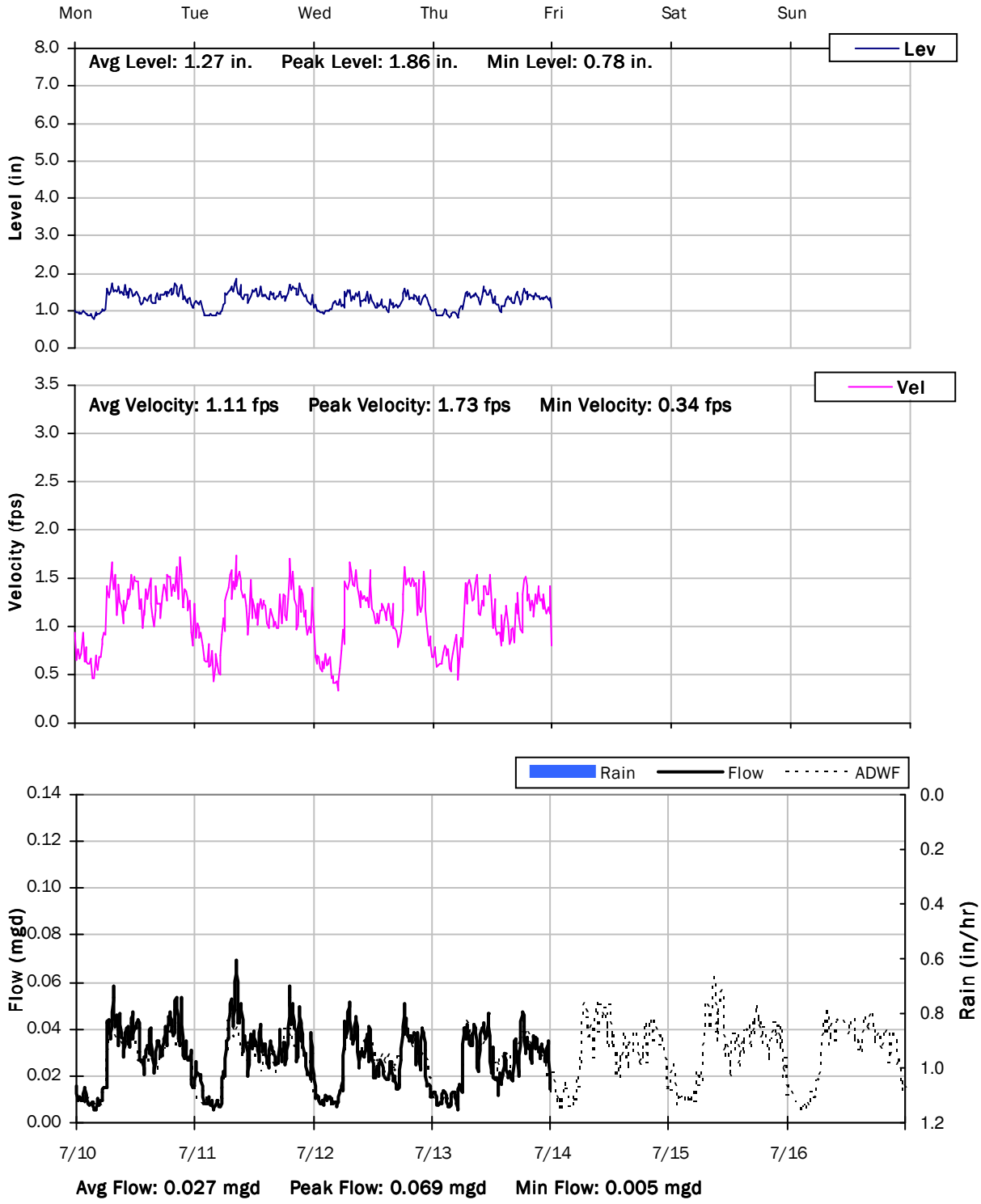
7/3/2017 to 7/10/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

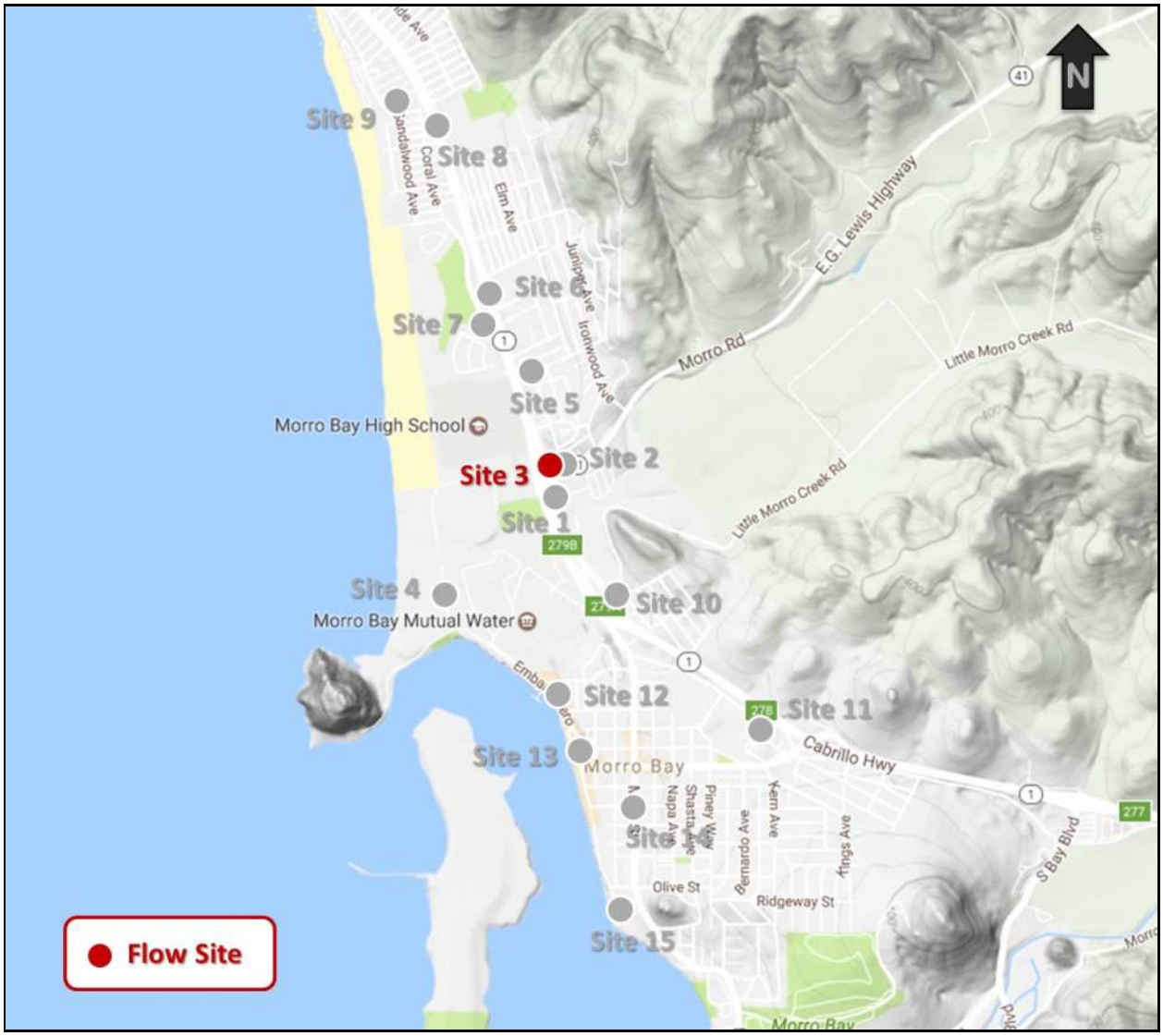
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 03

Location: Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet

Data Summary Report



Vicinity Map: Site 03

SITE 03

Site Information

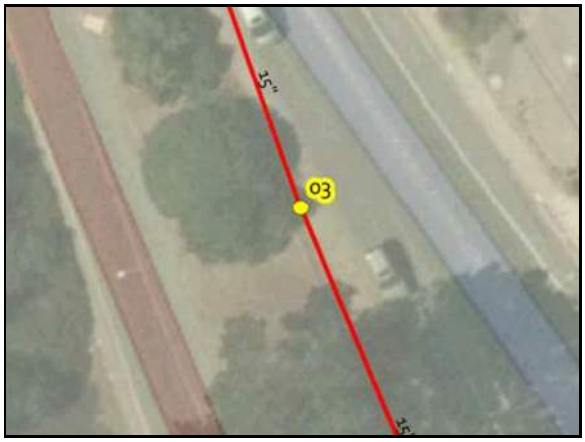
Location: Island between Main Street and HWY 1 on-ramp, ~135 feet north of Atascadero Road, meter on north 15" inlet

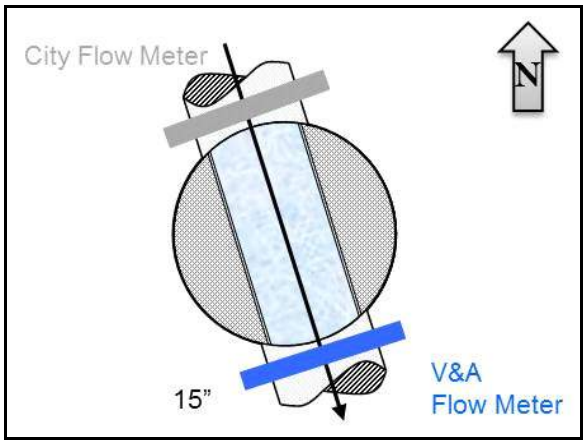


Pipe Diameter: 15 inches

ADWF: 0.295 mgd

Peak Measured Flow: 0.889 mgd









SITE 03

Additional Site Photos



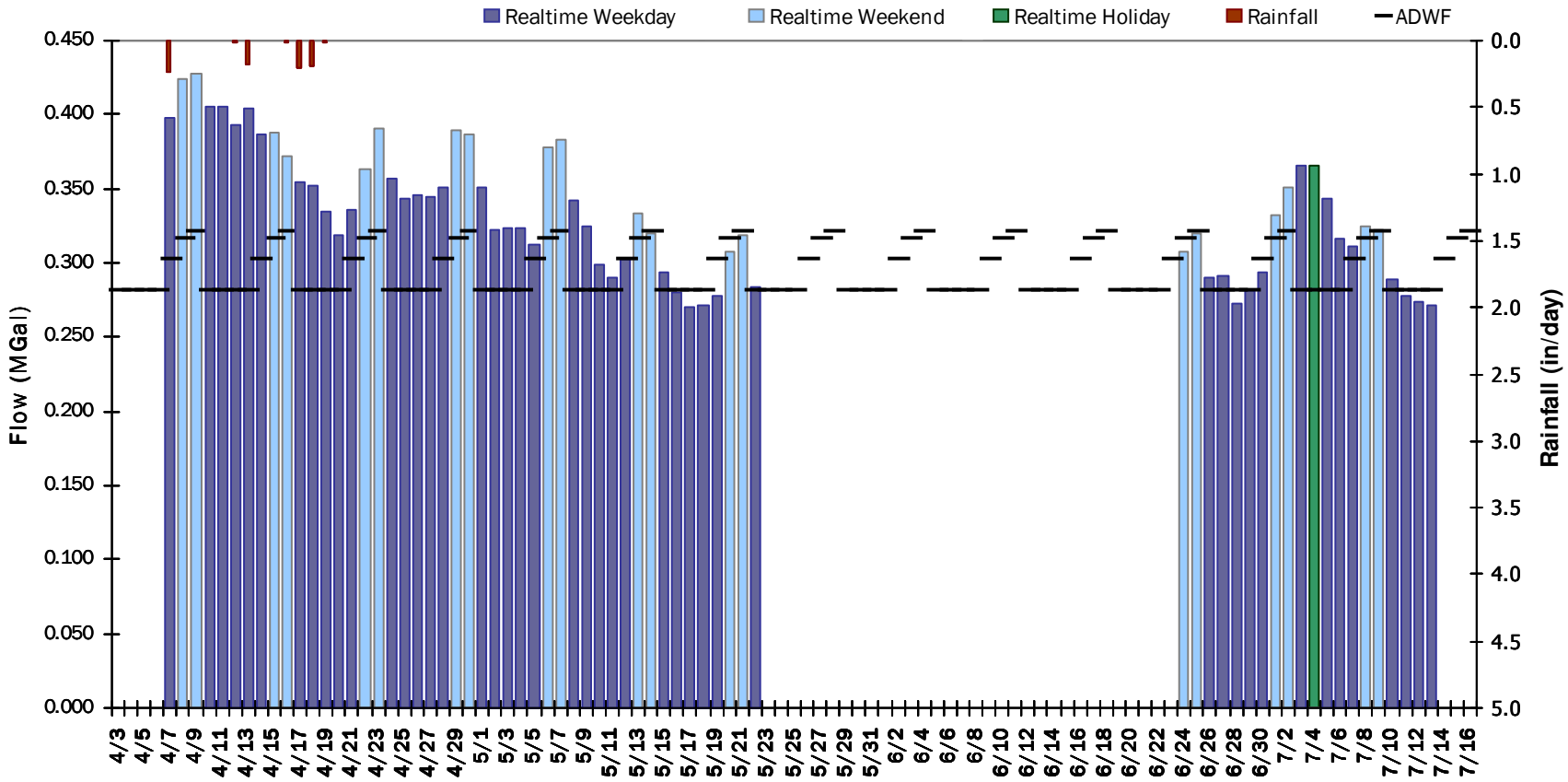


SITE 03

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.335 MGal Peak Daily Flow: 0.428 MGal Min Daily Flow: 0.270 MGal

Total Period Rainfall: 0.85 inches

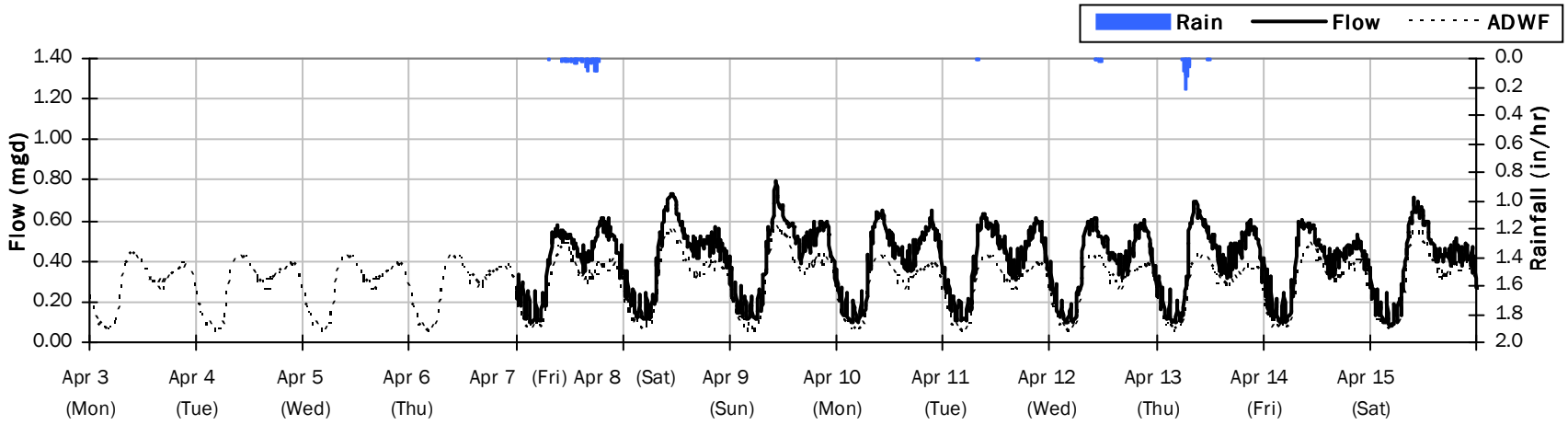


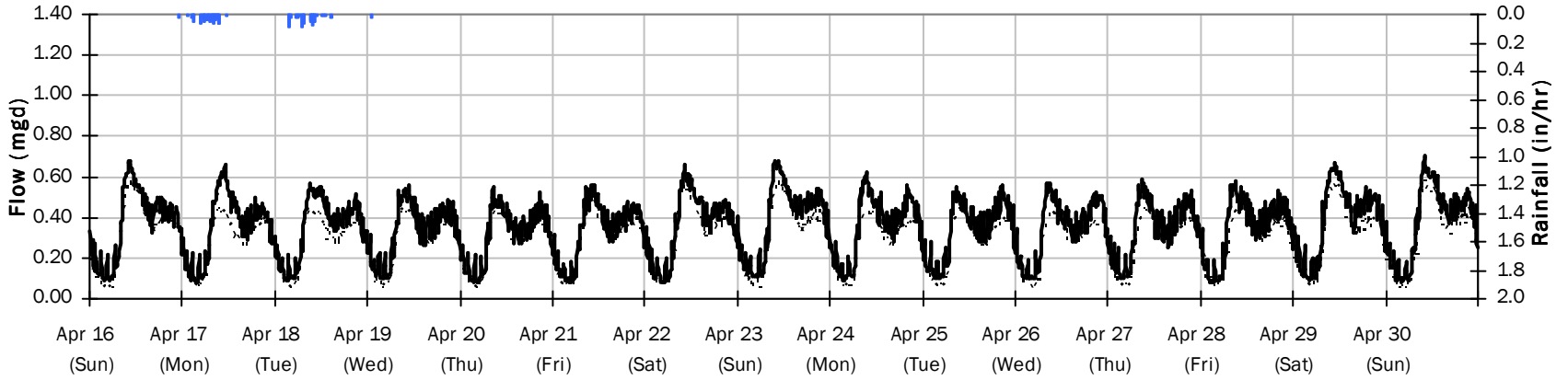
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 03

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.374 mgd** **Peak Flow: 0.794 mgd** **Min Flow: 0.078 mgd**

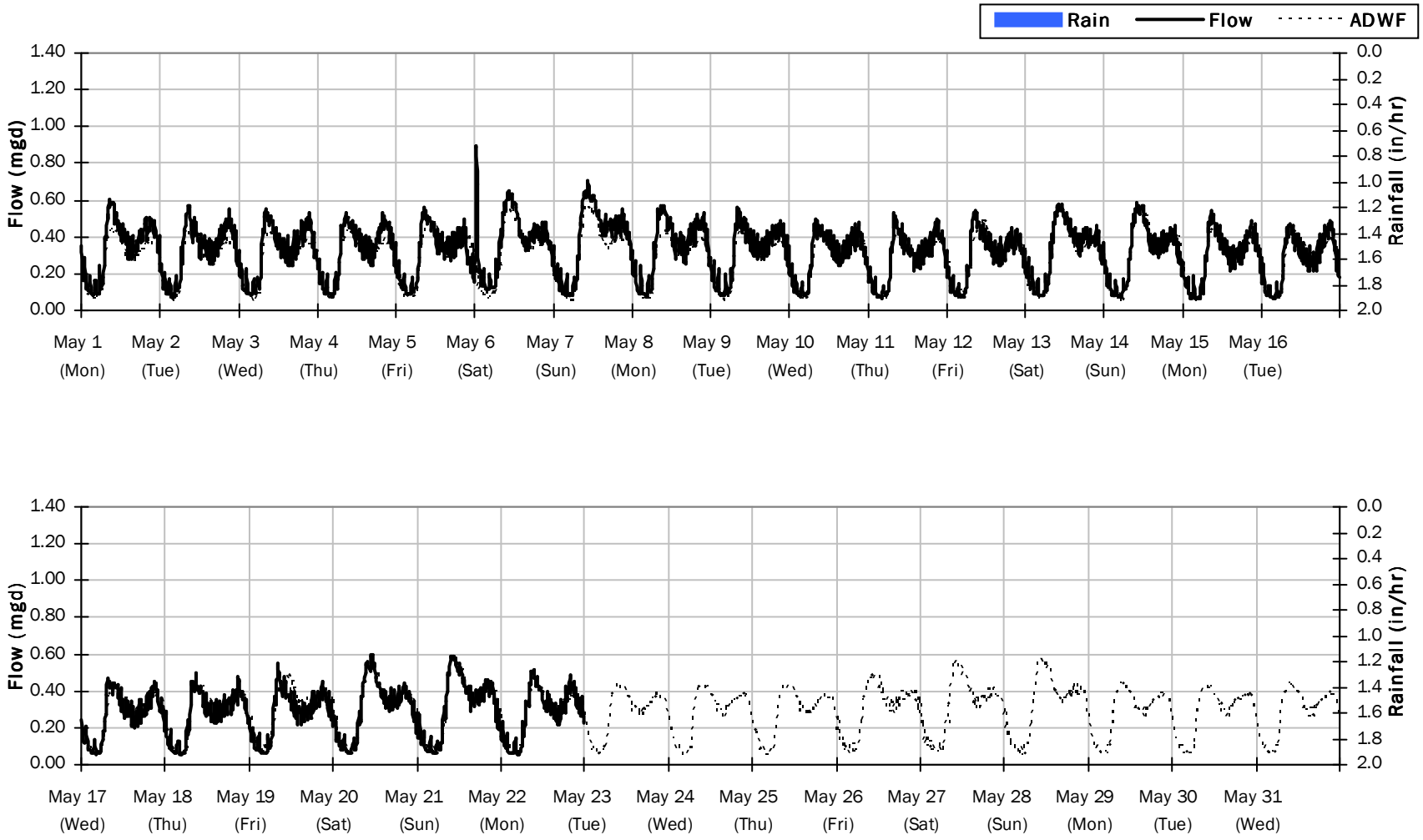




SITE 03

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.314 mgd Peak Flow: 0.889 mgd Min Flow: 0.055 mgd**

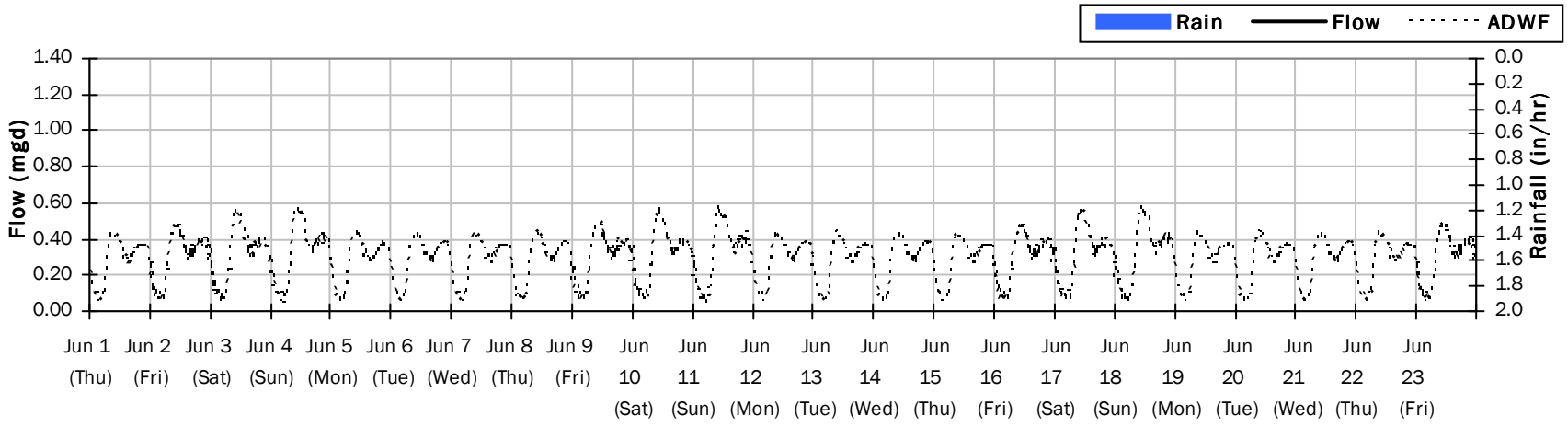


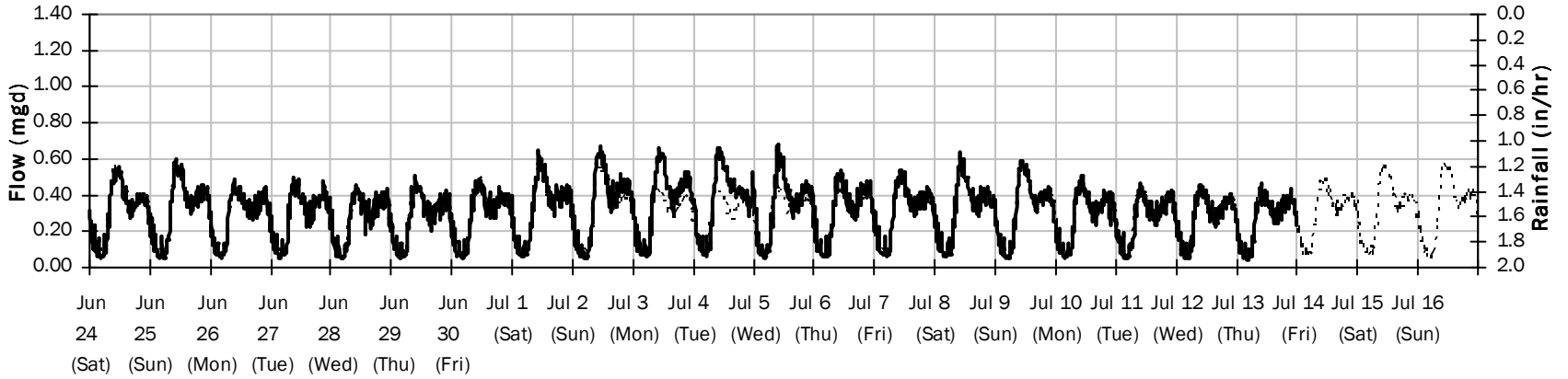
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SITE 03

Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.310 mgd Peak Flow: 0.684 mgd Min Flow: 0.041 mgd**

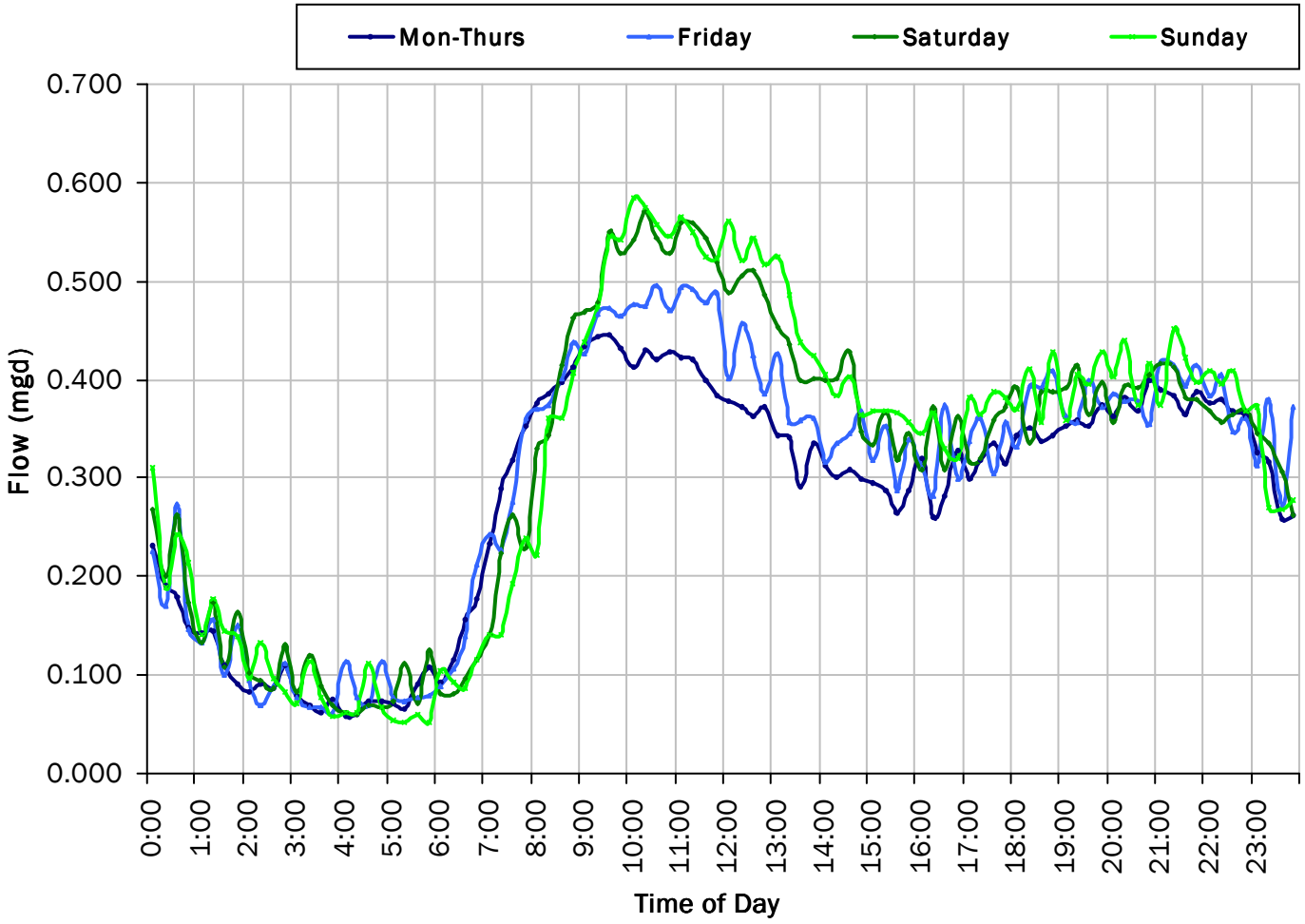




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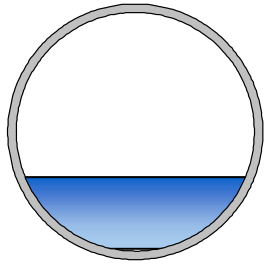
SITE 03

Average Dry Weather Flow Hydrographs



ADWF:

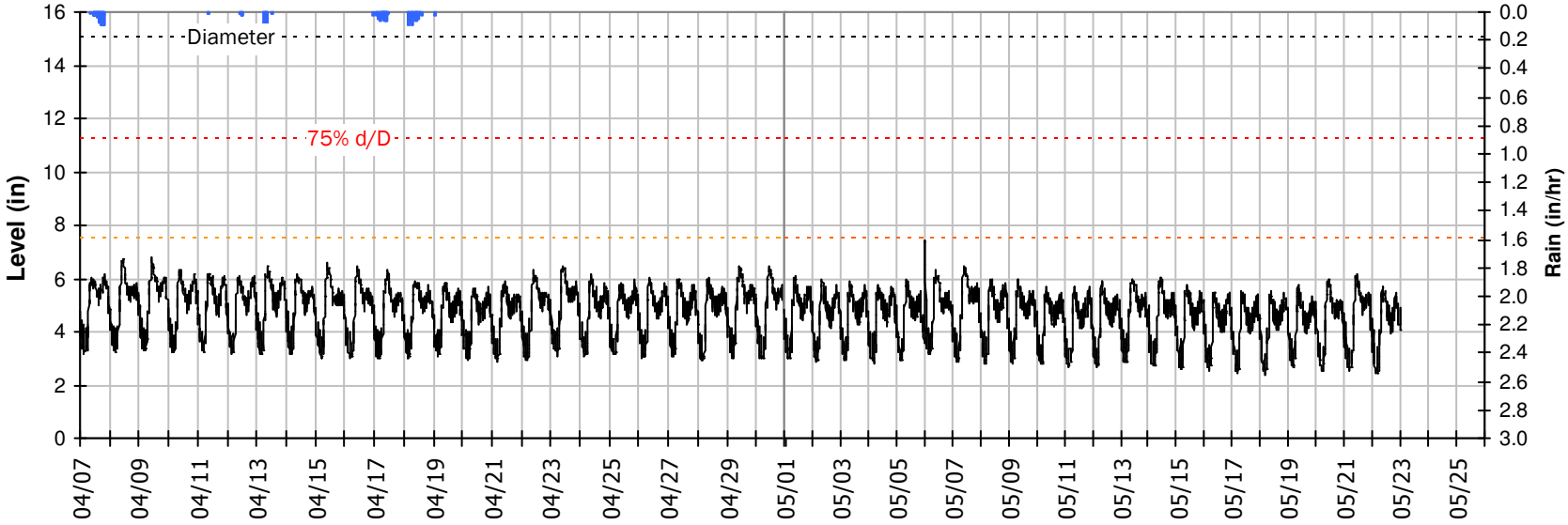
0.295 *mgd*

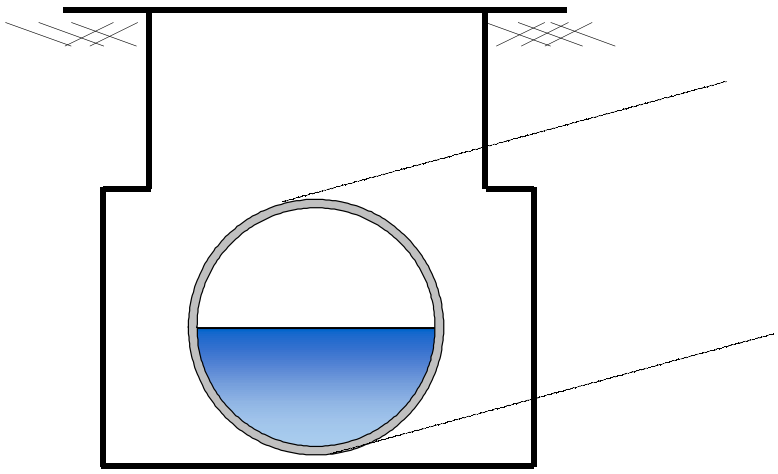


SITE 03

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





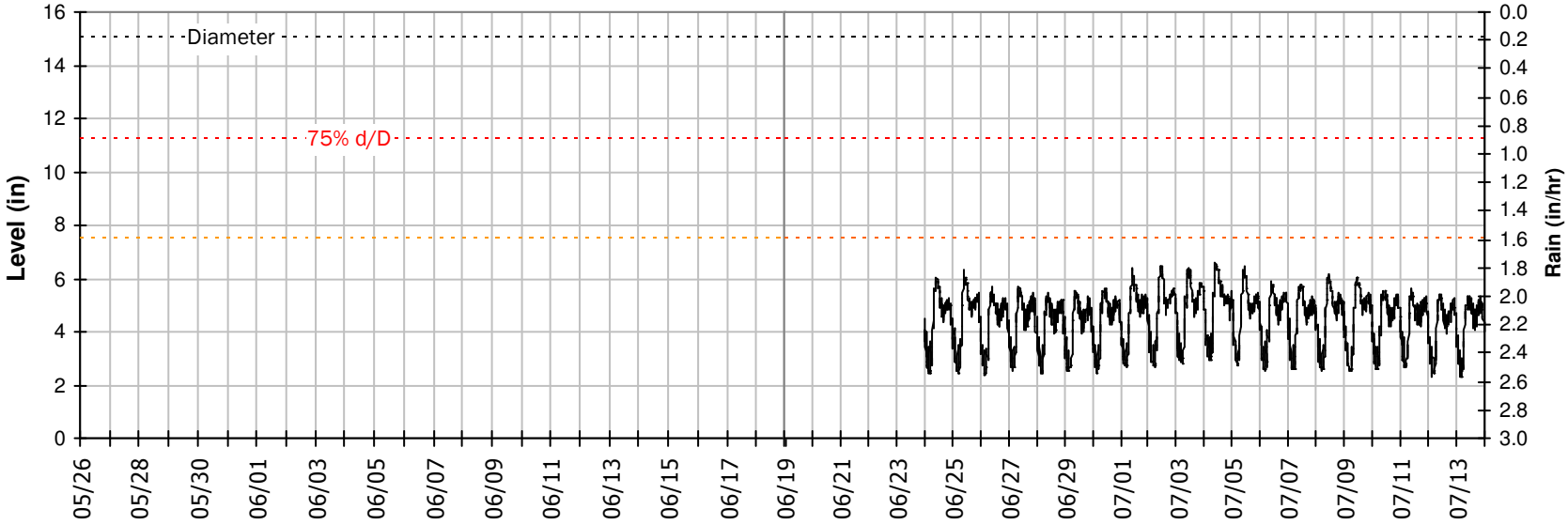
Pipe Diameter:	15	*inches*
Peak Measured Level:	7.36	*inches*
Peak d/D Ratio:	0.49	

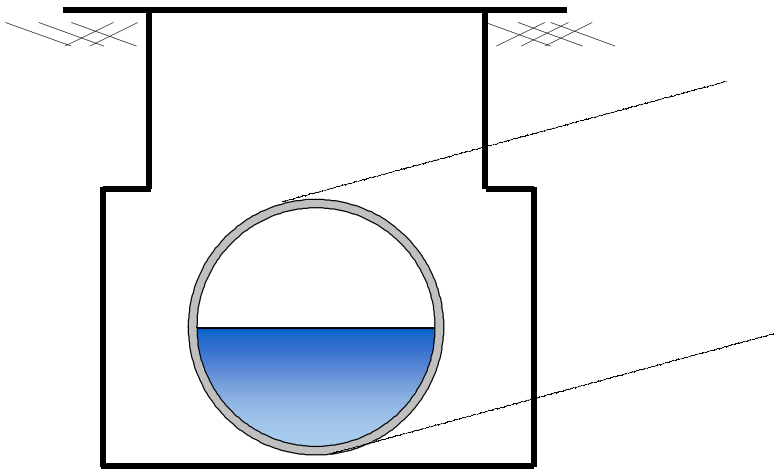
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SITE 03

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





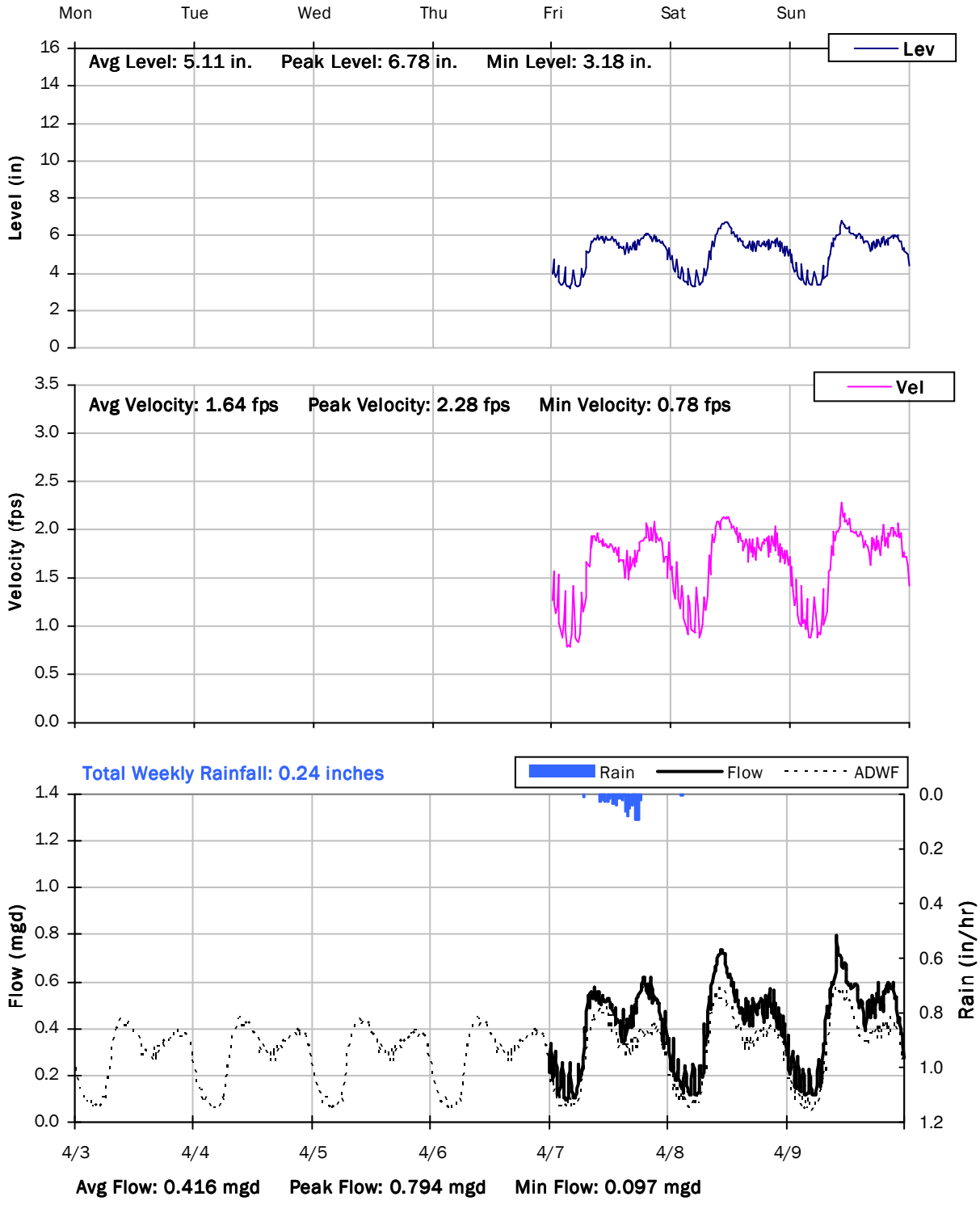
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SITE 03

Weekly Level, Velocity and Flow Hydrographs

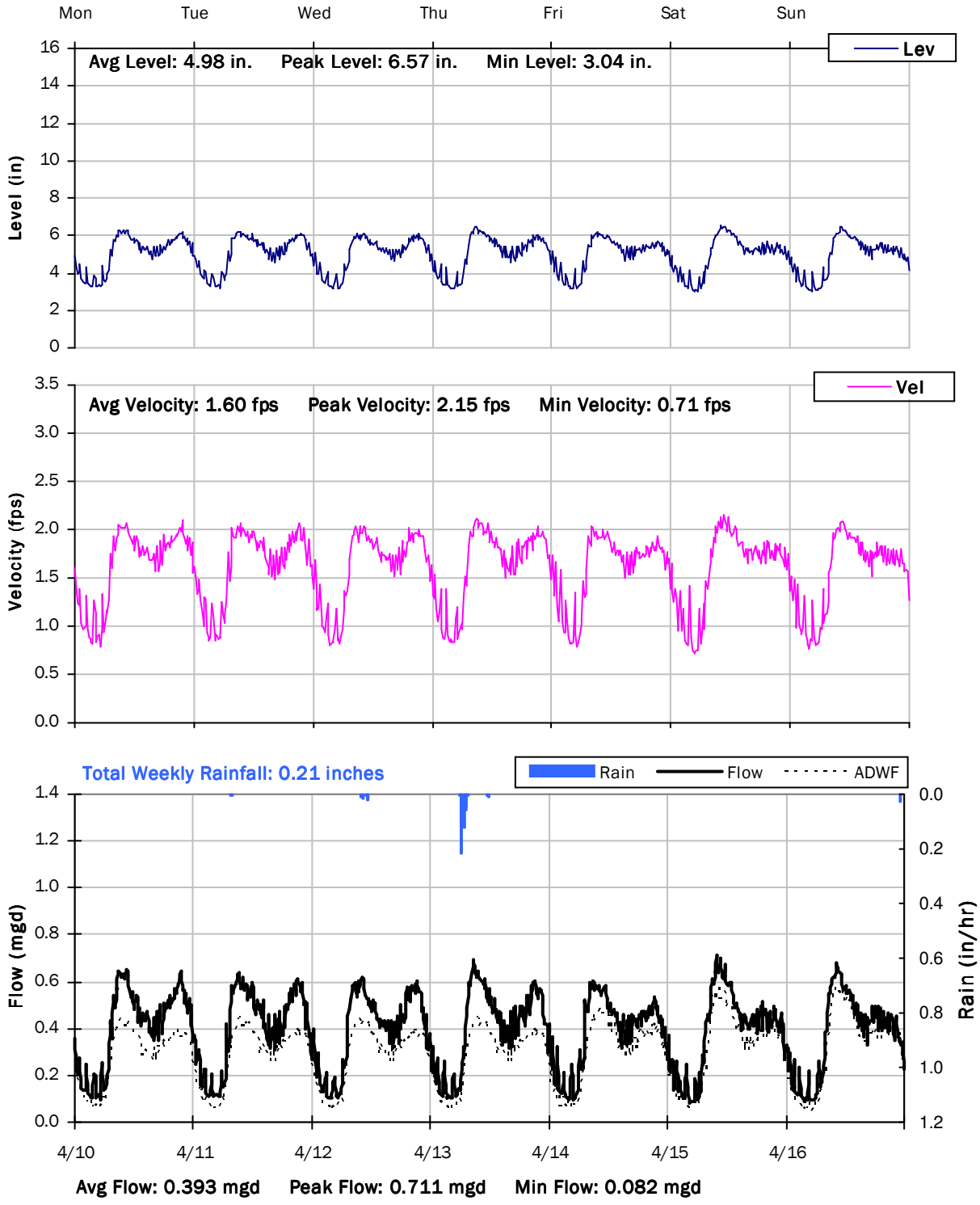
4/3/2017 to 4/10/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

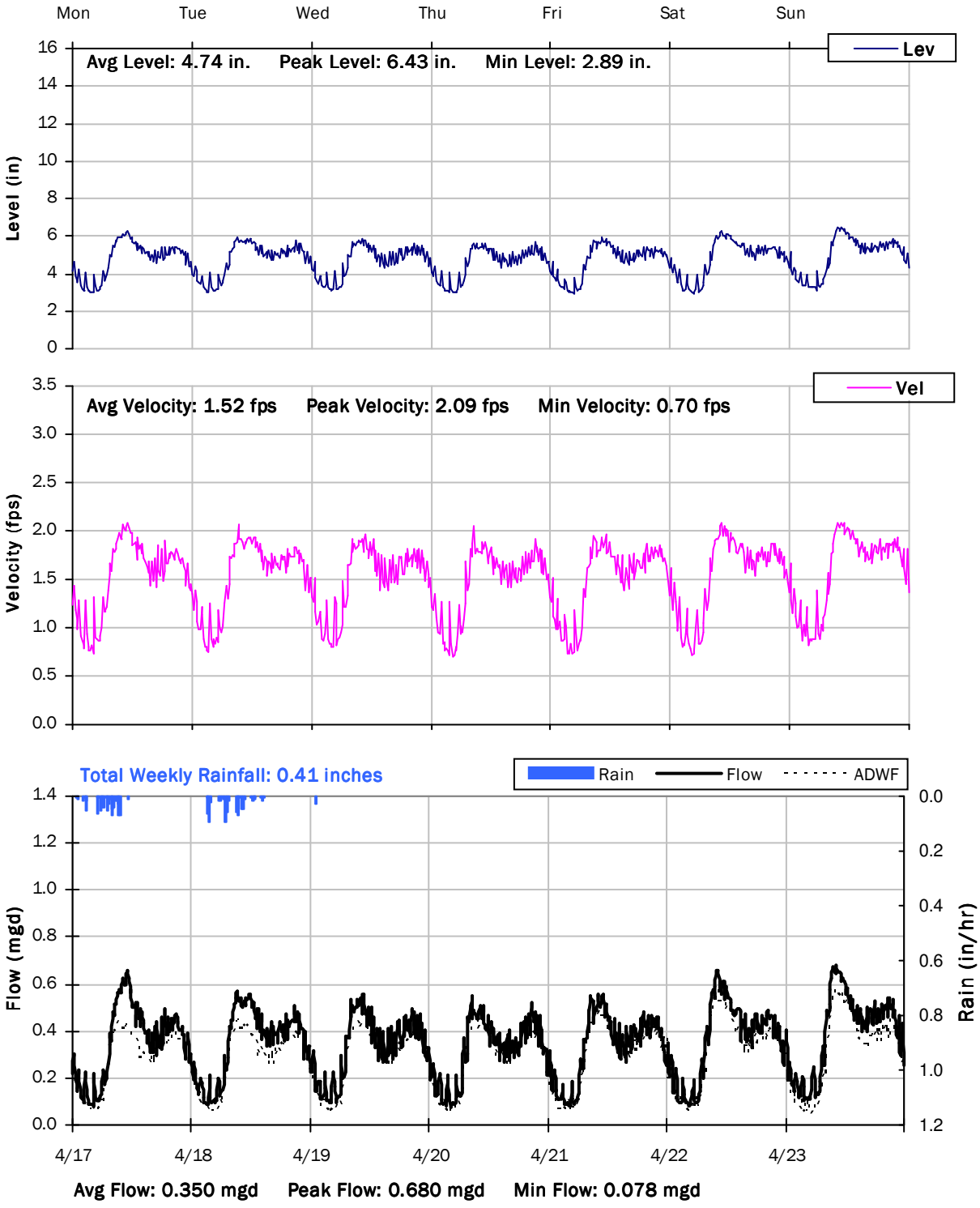
4/10/2017 to 4/17/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

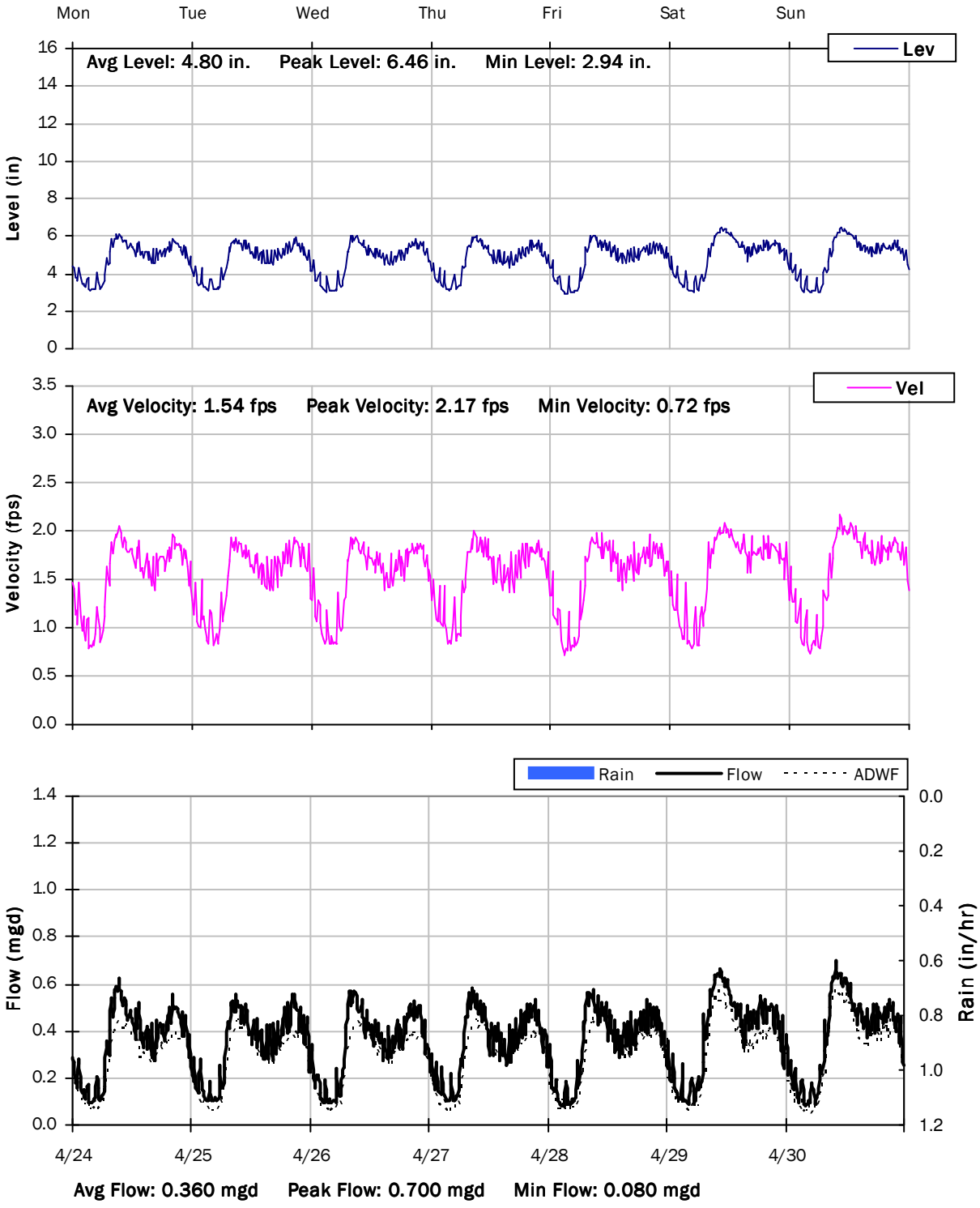
4/17/2017 to 4/24/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

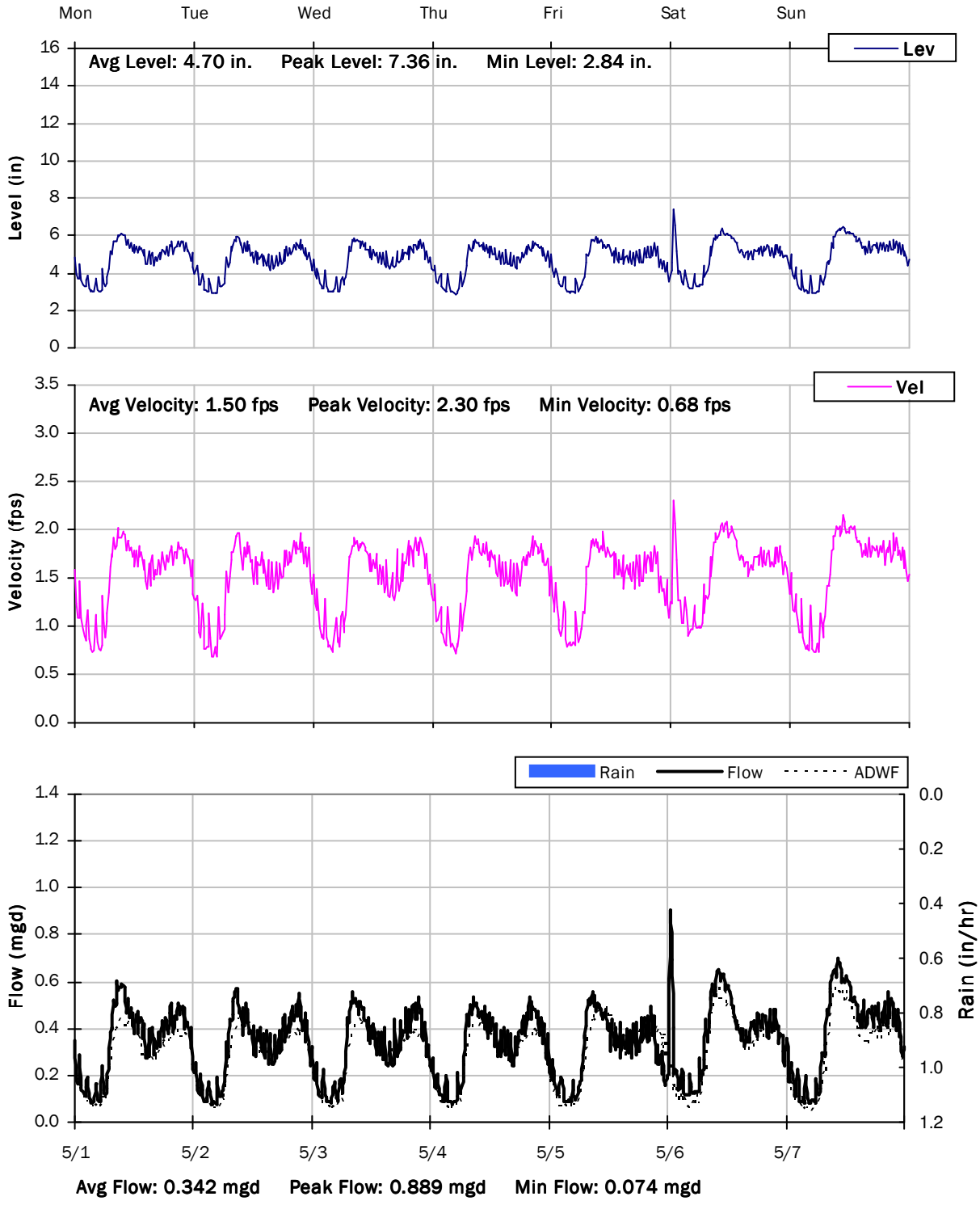
4/24/2017 to 5/1/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

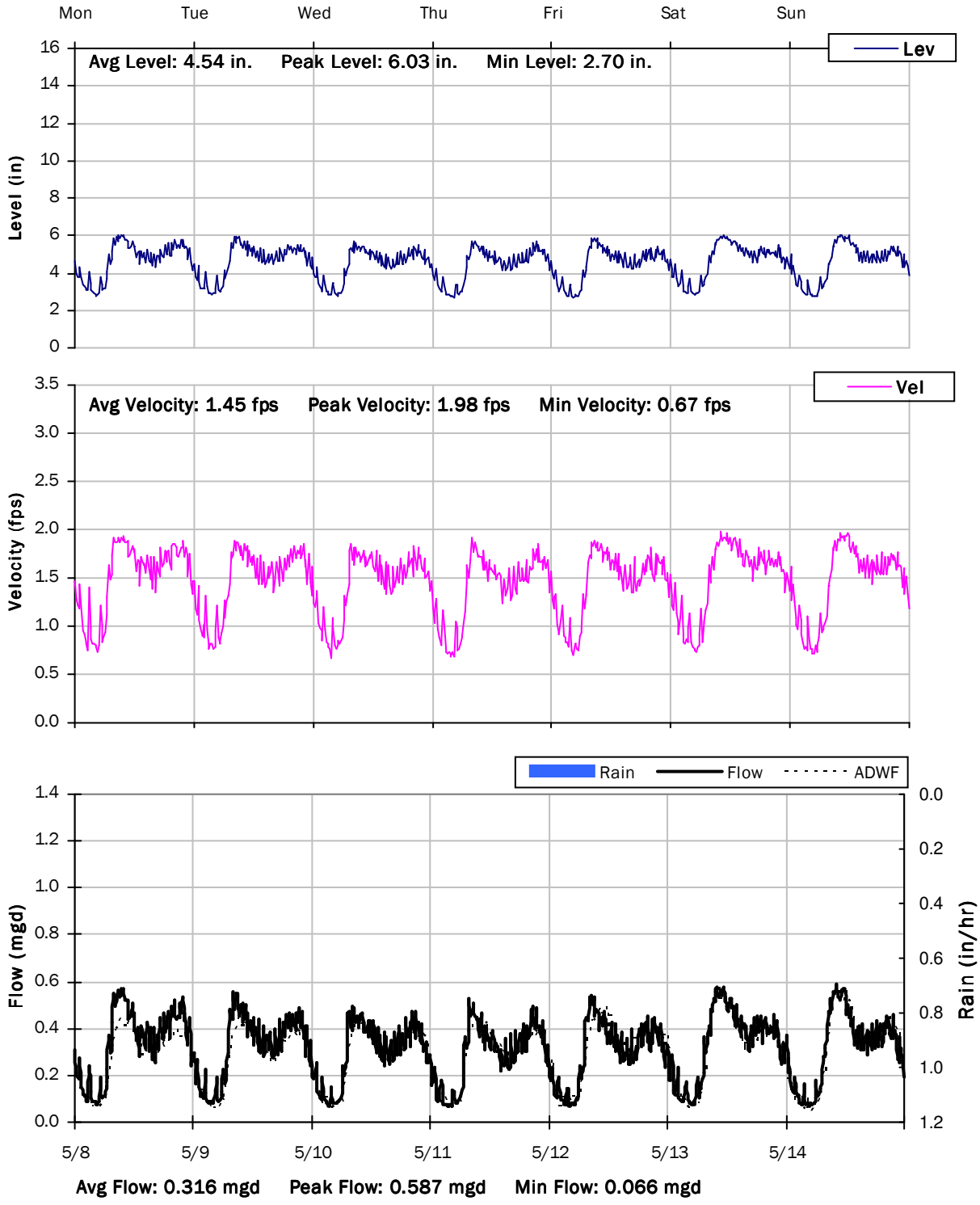
5/1/2017 to 5/8/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

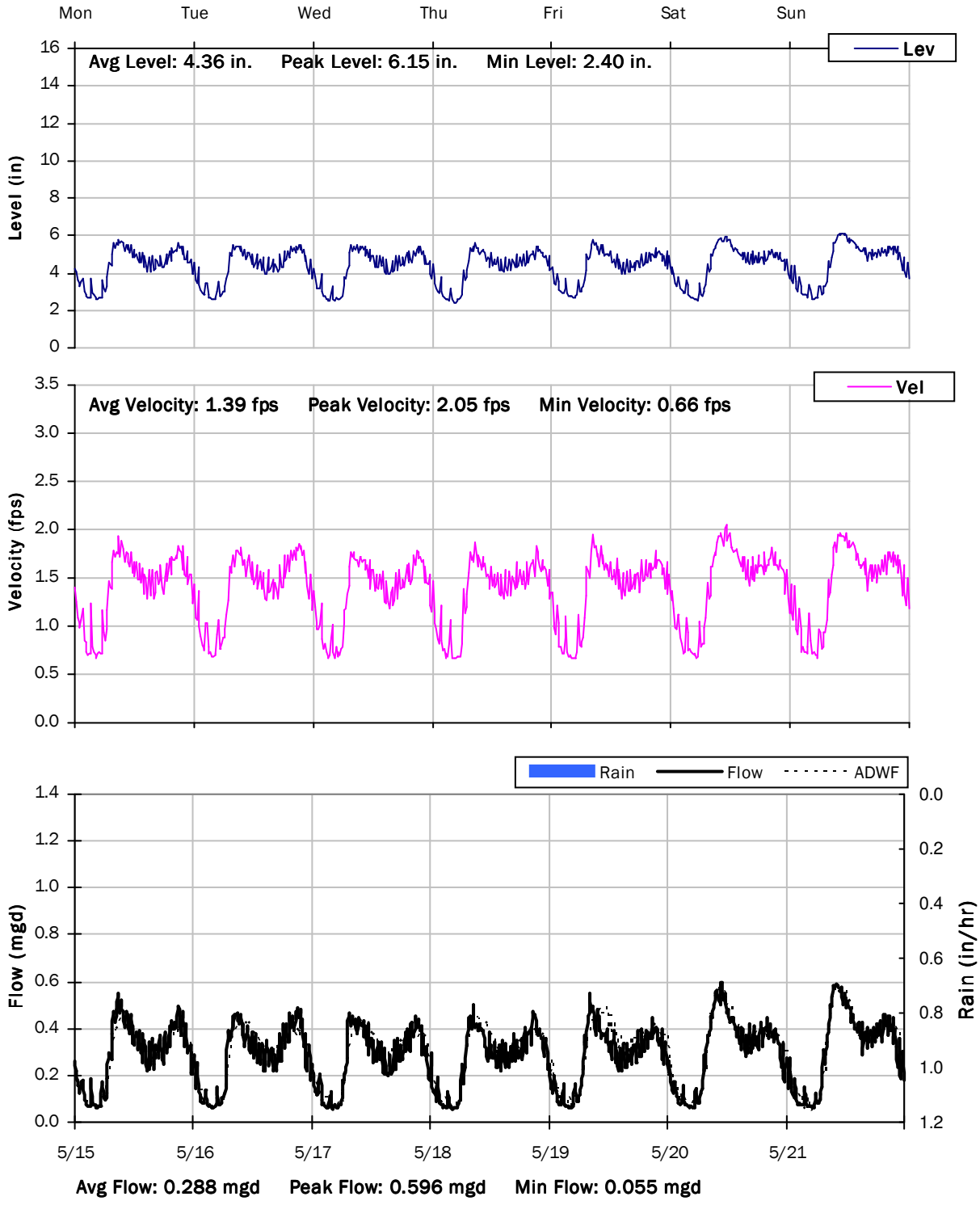
5/8/2017 to 5/15/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

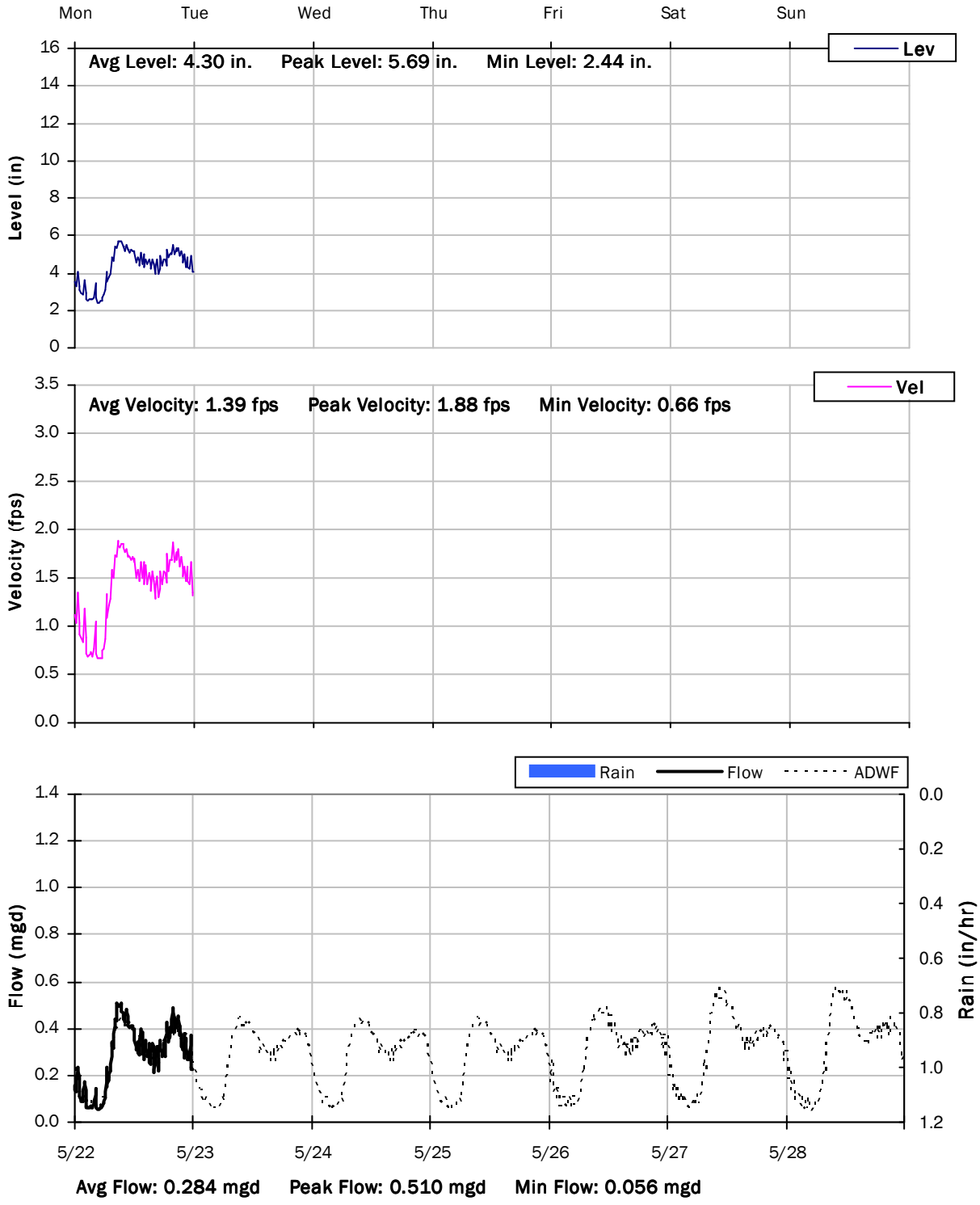
5/15/2017 to 5/22/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

5/22/2017 to 5/29/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

5/29/2017 to 6/5/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 03

Weekly Level, Velocity and Flow Hydrographs

6/5/2017 to 6/12/2017

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No reportable data this week.

SITE 03

Weekly Level, Velocity and Flow Hydrographs

6/12/2017 to 6/19/2017

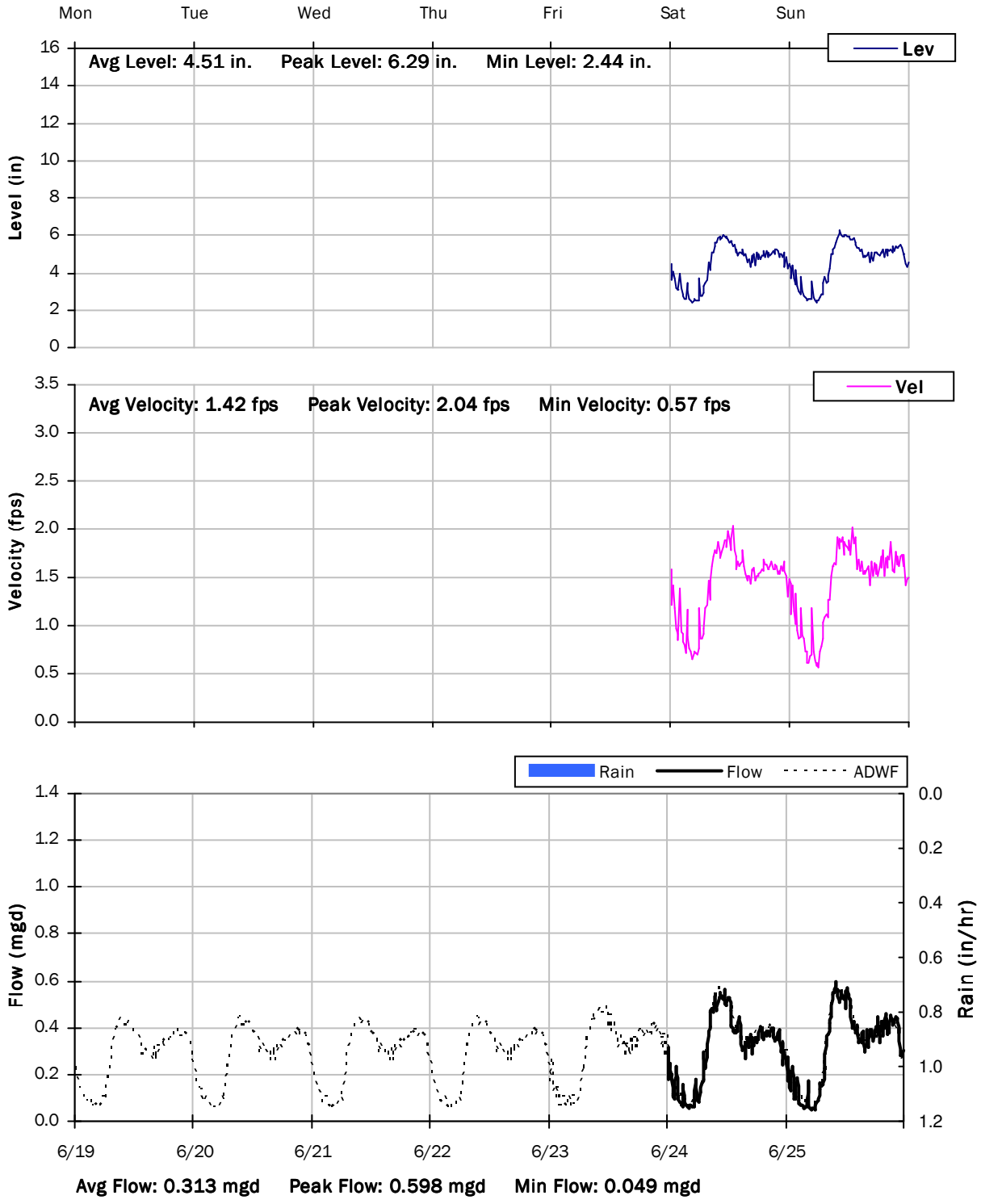
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No reportable data this week.

SITE 03

Weekly Level, Velocity and Flow Hydrographs

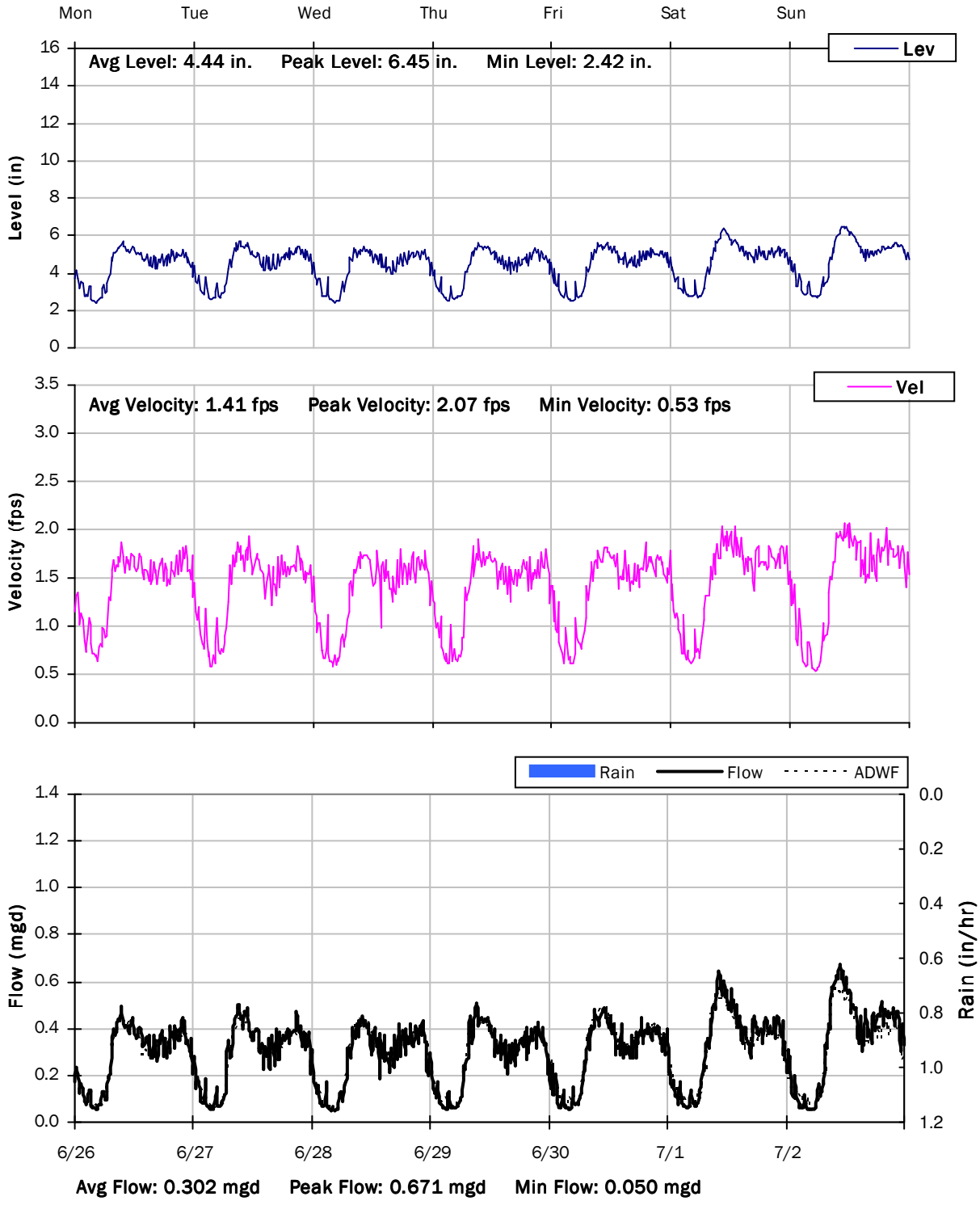
6/19/2017 to 6/26/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

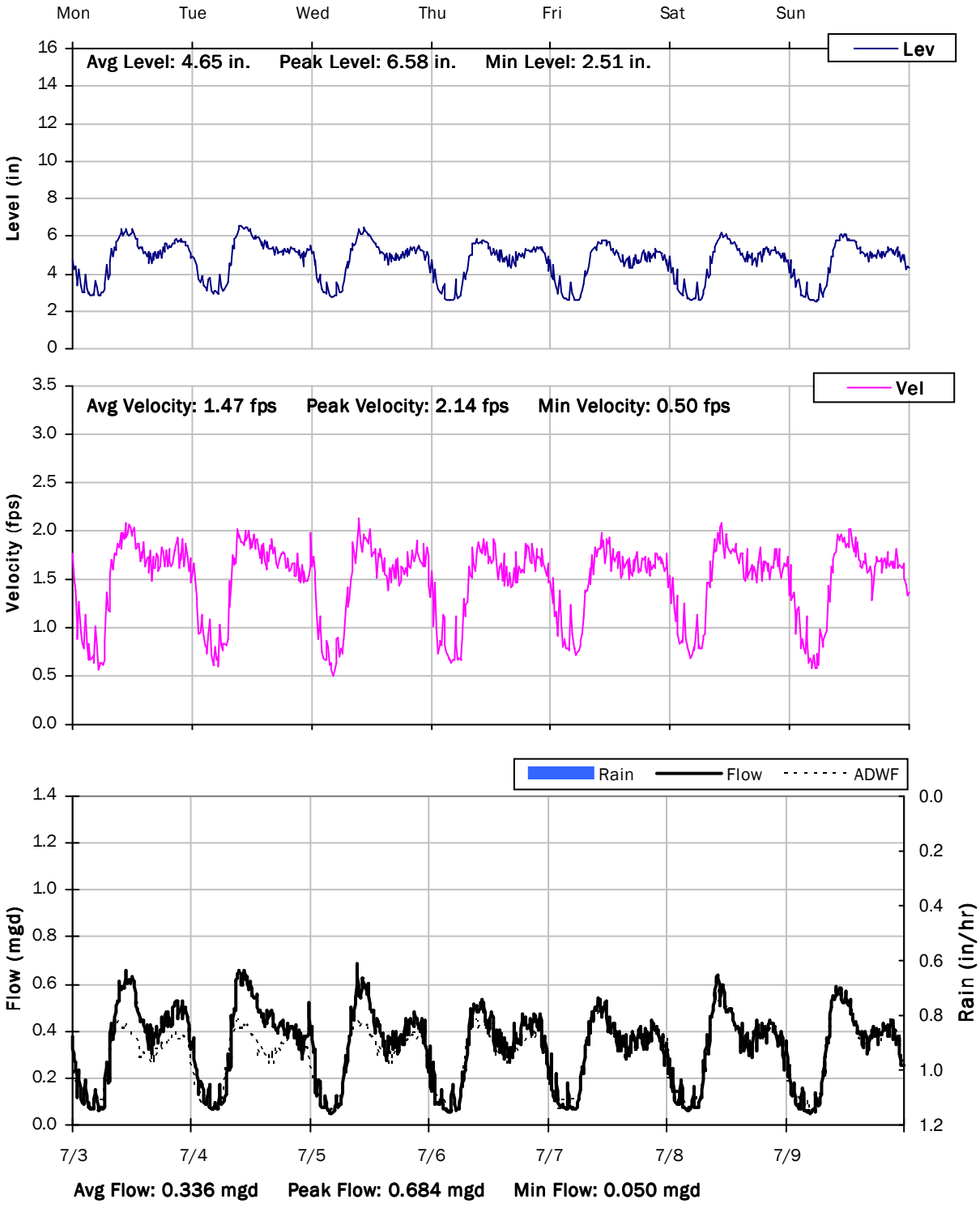
6/26/2017 to 7/3/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

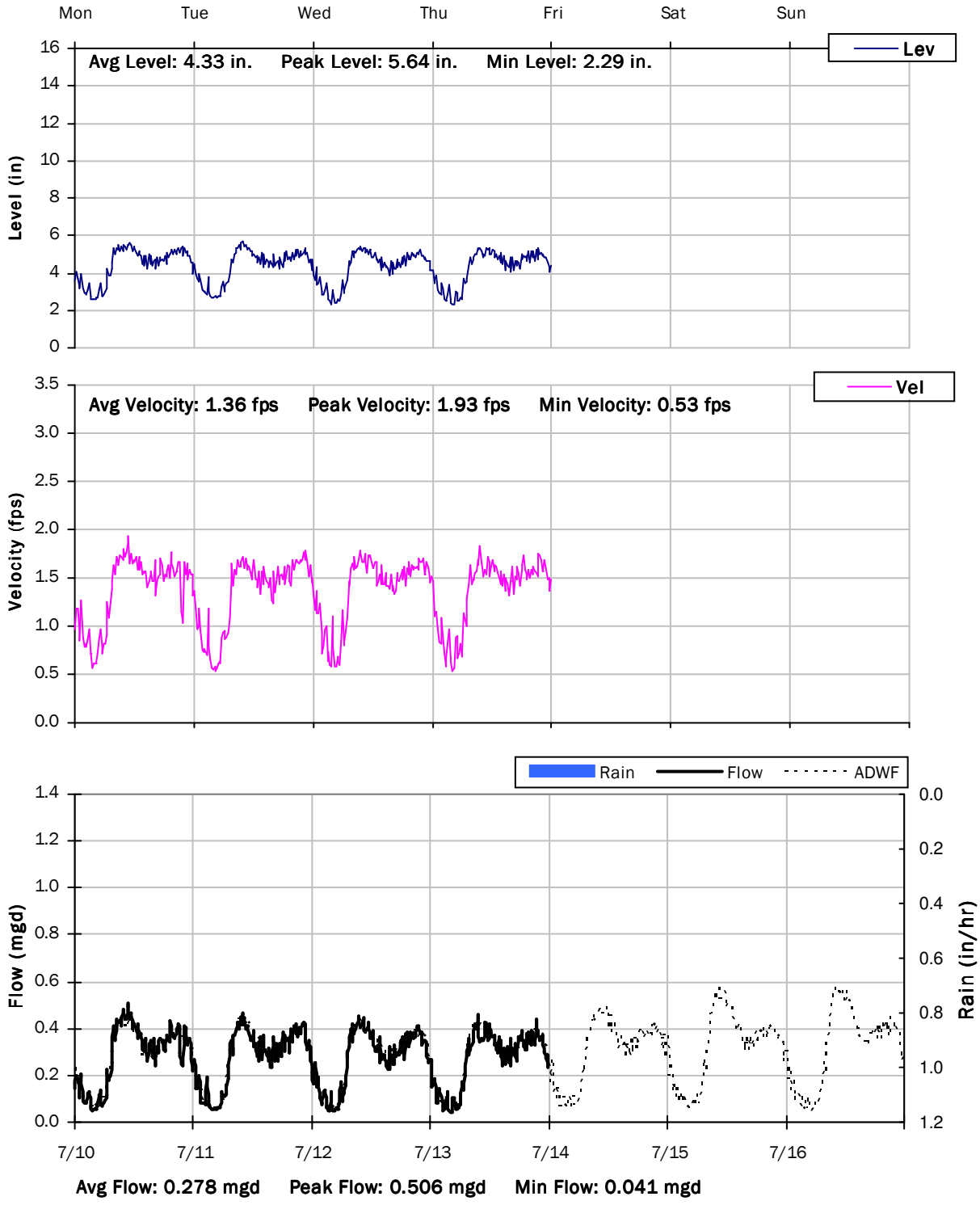
7/3/2017 to 7/10/2017



SITE 03

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

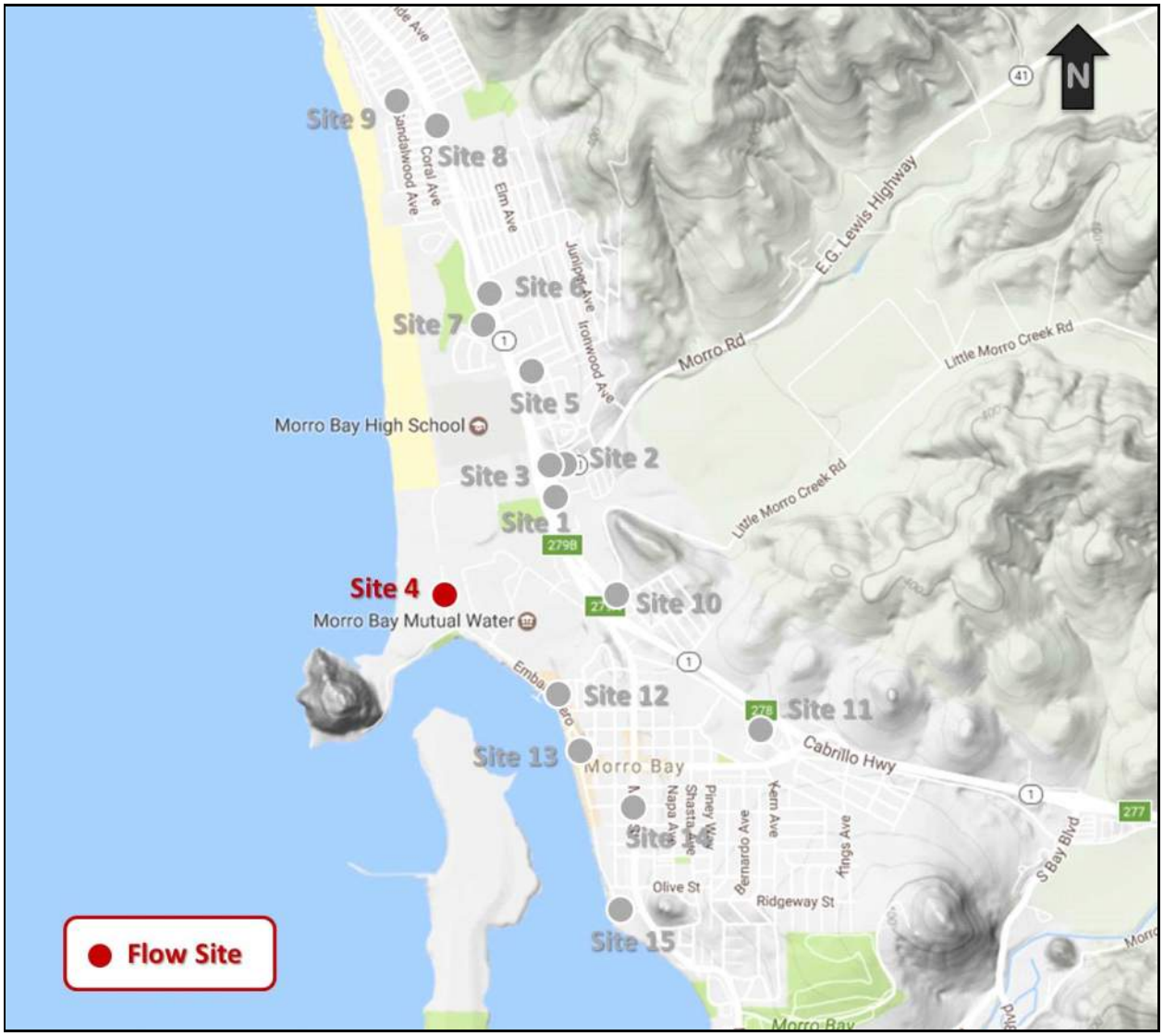
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 04

Location: Embarcadero, ~685 feet north of Coleman Drive, meter on south 17.5" inlet

Data Summary Report



Vicinity Map: Site 04

SITE 04

Site Information

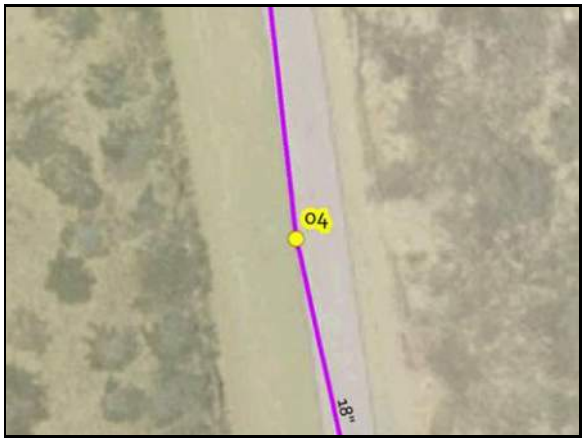
Location: Embarcadero, ~685 feet north of Coleman Drive, meter on south 17.5" inlet

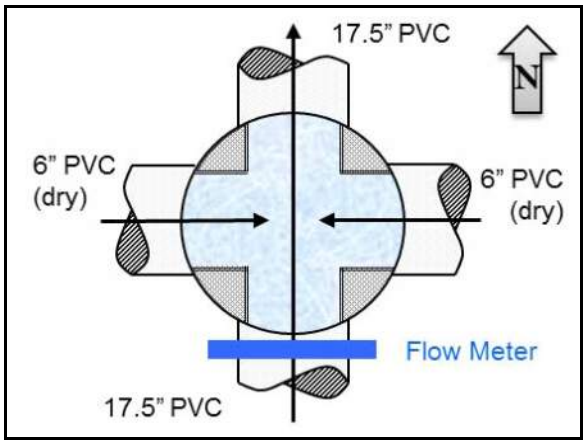


Pipe Diameter: 17.5 inches

ADWF: 0.224 mgd

Peak Measured Flow: 0.578 mgd









SITE 04

Additional Site Photos





SITE 04

Additional Site Photos



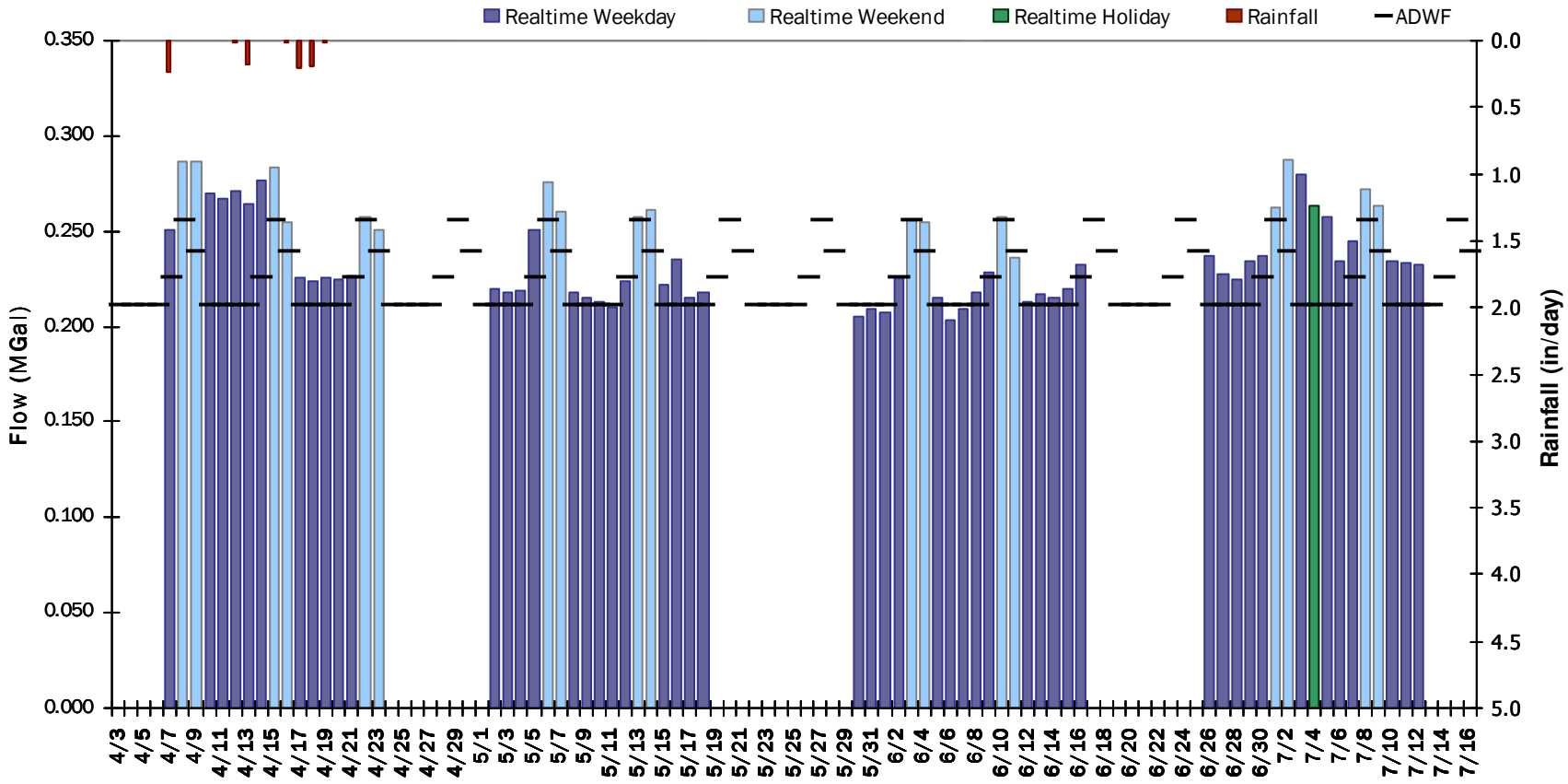


SITE 04

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.240 MGal Peak Daily Flow: 0.288 MGal Min Daily Flow: 0.204 MGal

Total Period Rainfall: 0.85 inches

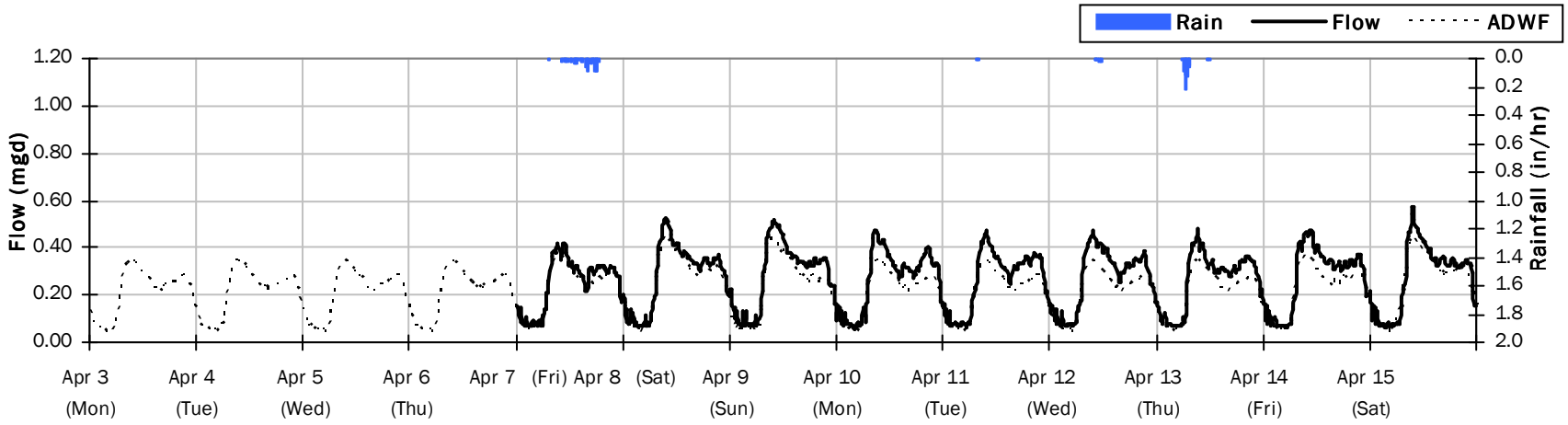


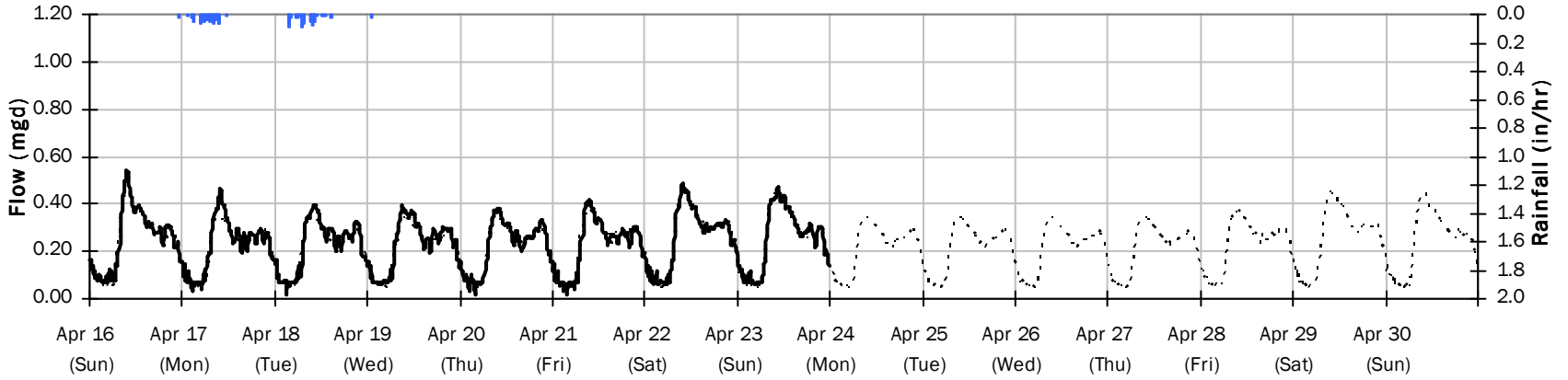
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SITE 04

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.256 mgd** **Peak Flow: 0.574 mgd** **Min Flow: 0.014 mgd**



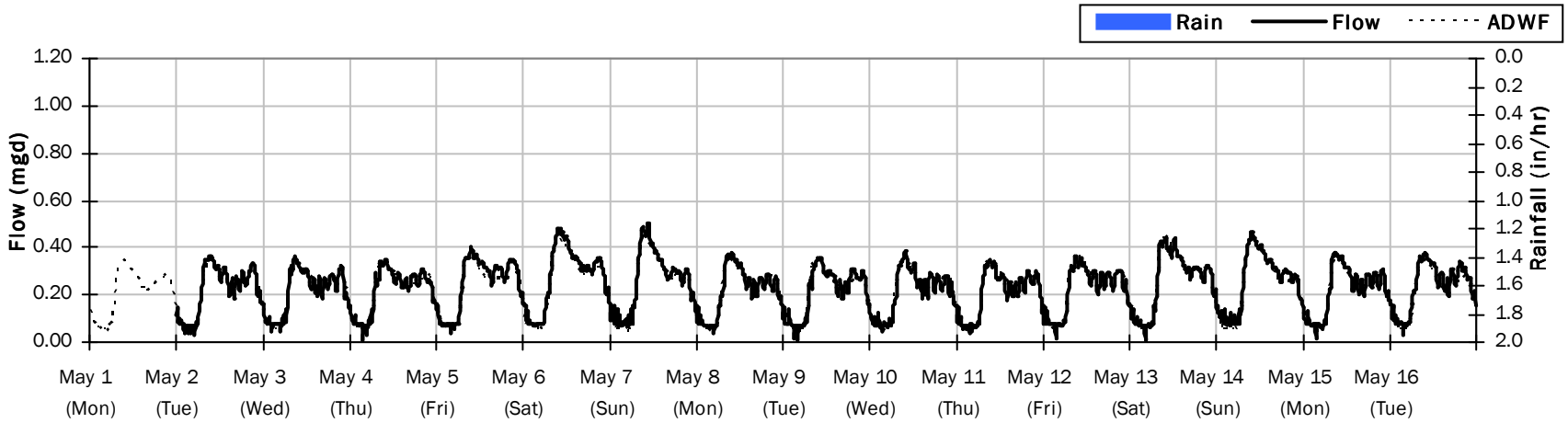


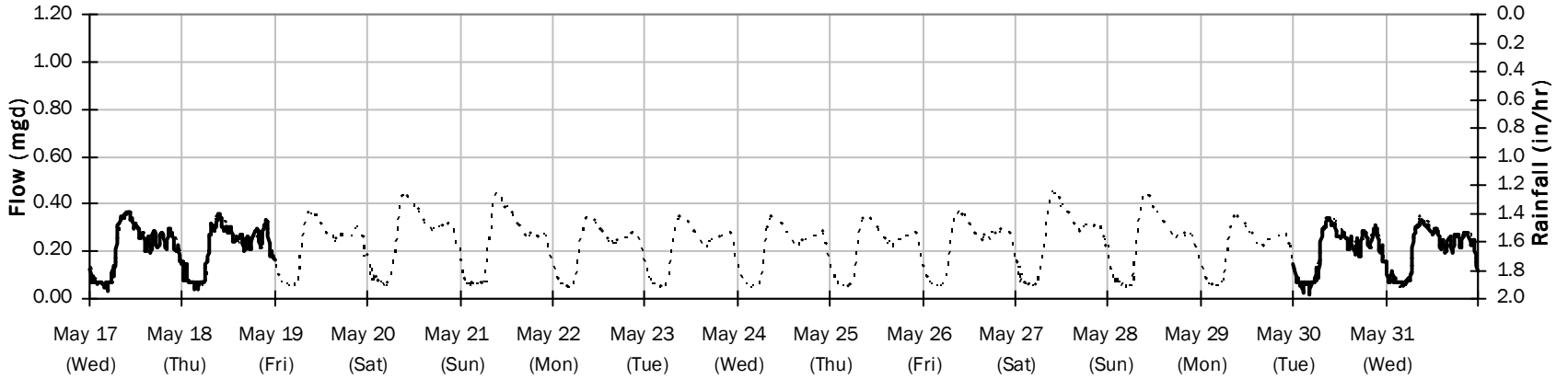
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SITE 04

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.229 mgd** **Peak Flow: 0.505 mgd** **Min Flow: 0.004 mgd**



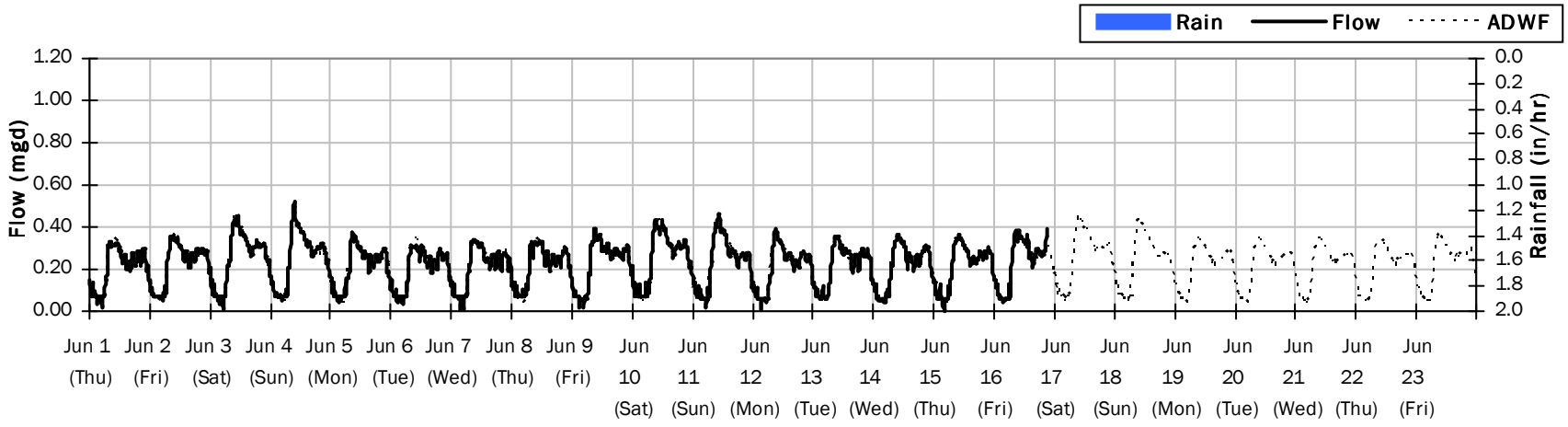


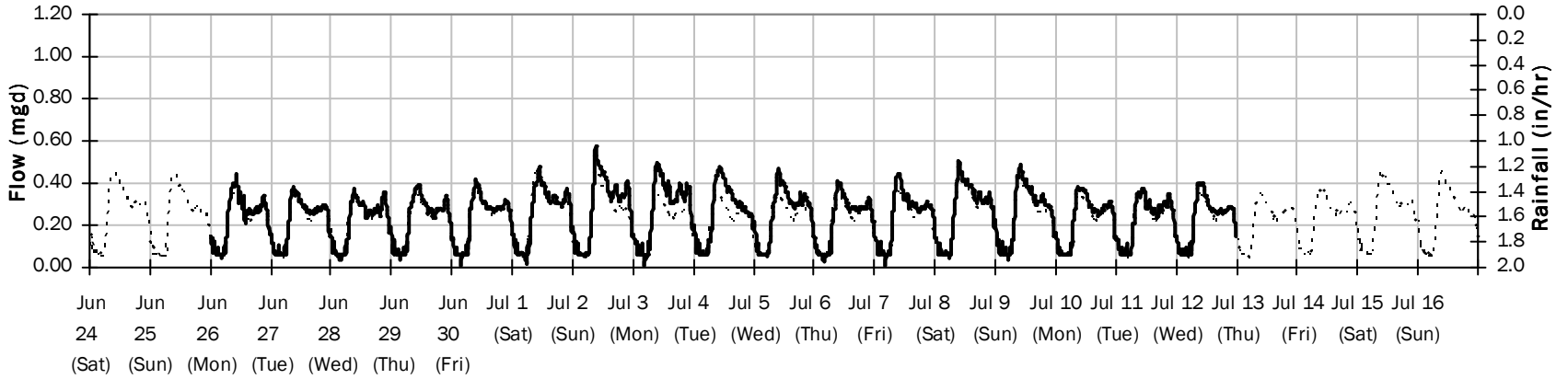
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SITE 04

Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.237 mgd Peak Flow: 0.578 mgd Min Flow: 0.004 mgd**

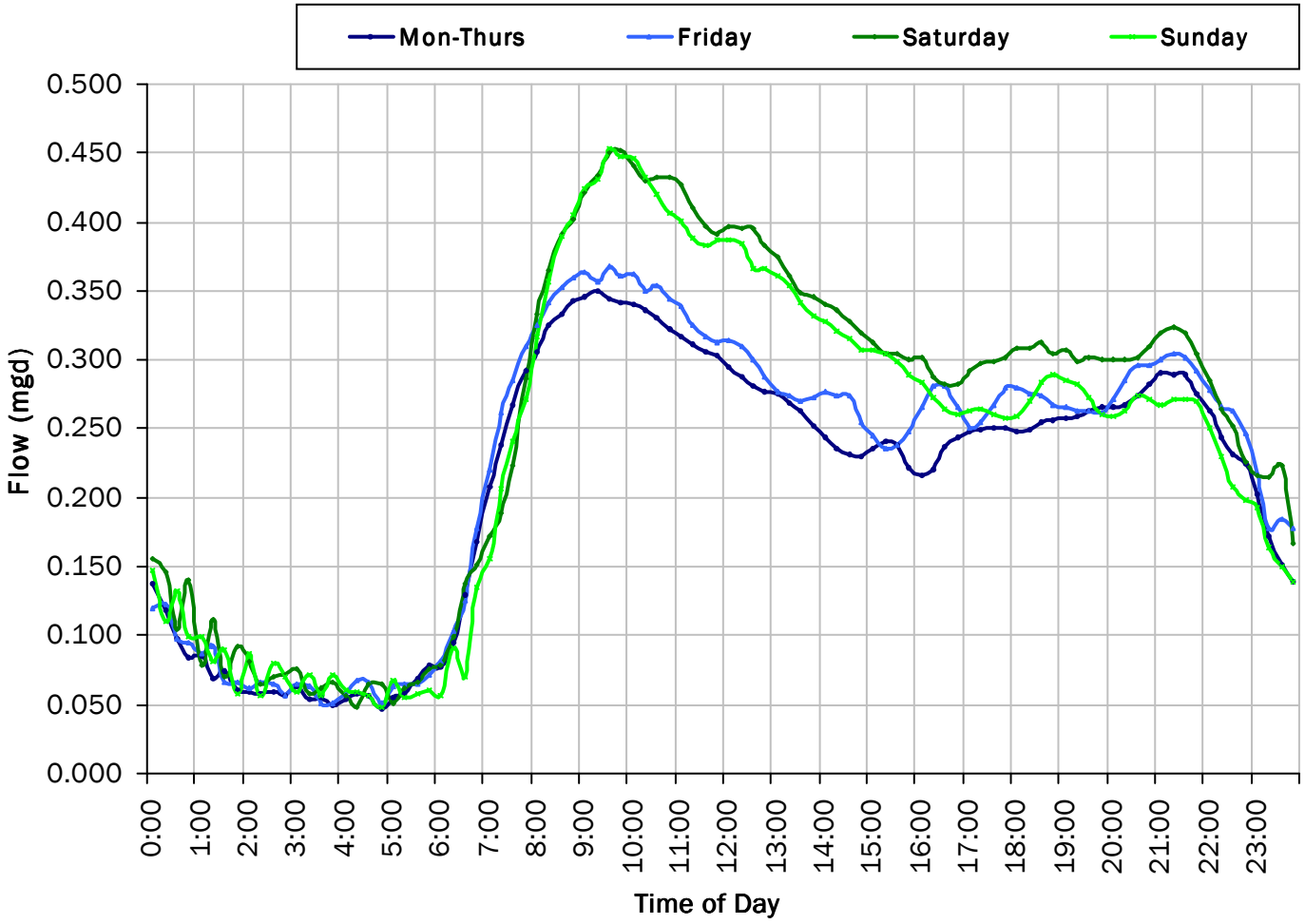




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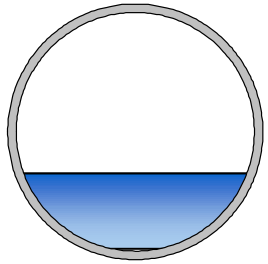
SITE 04

Average Dry Weather Flow Hydrographs



ADWF:

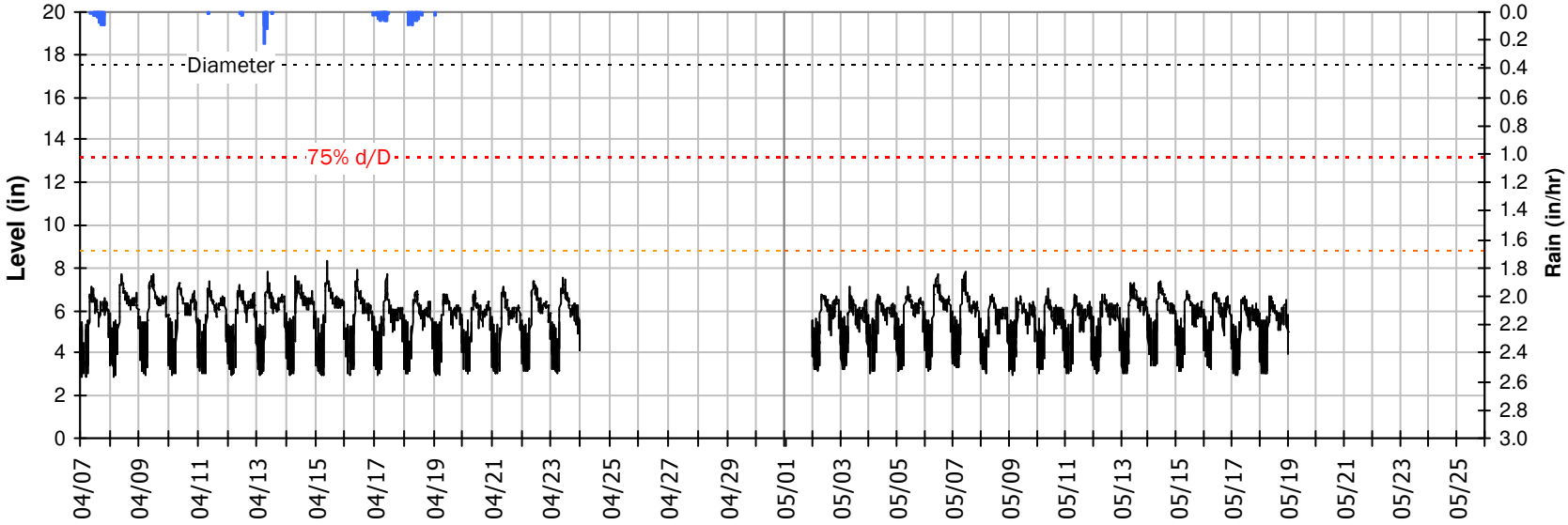
0.224 *mgd*

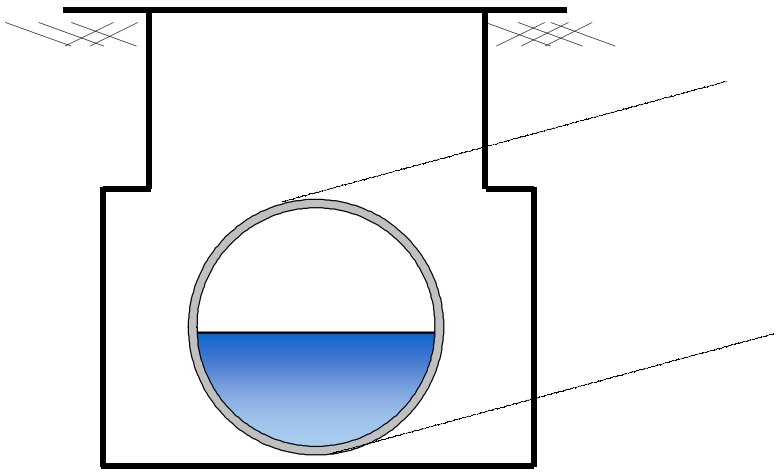


SITE 04

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





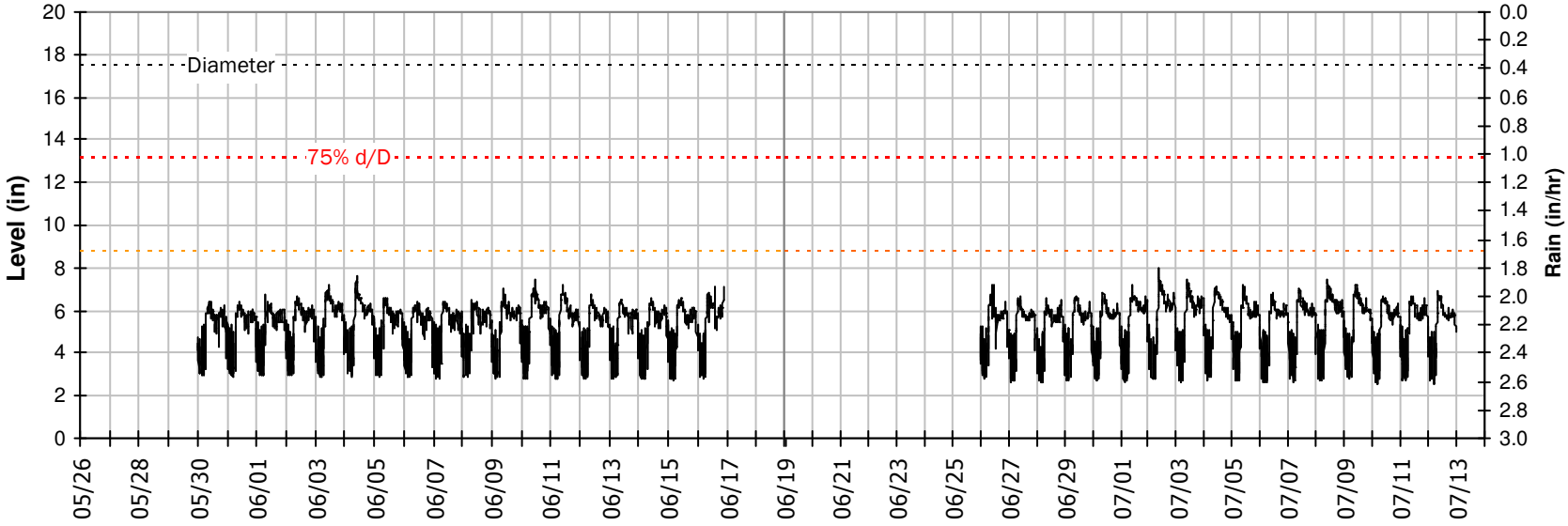
Pipe Diameter:	17.5	*inches*
Peak Measured Level:	8.36	*inches*
Peak d/D Ratio:	0.48	

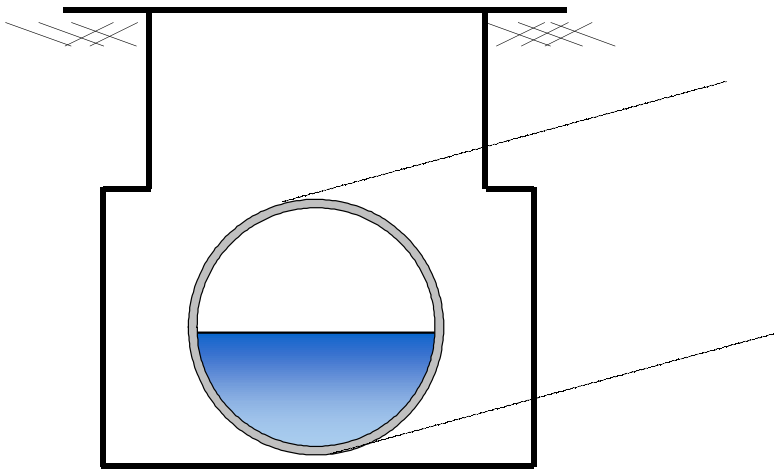
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SITE 04

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





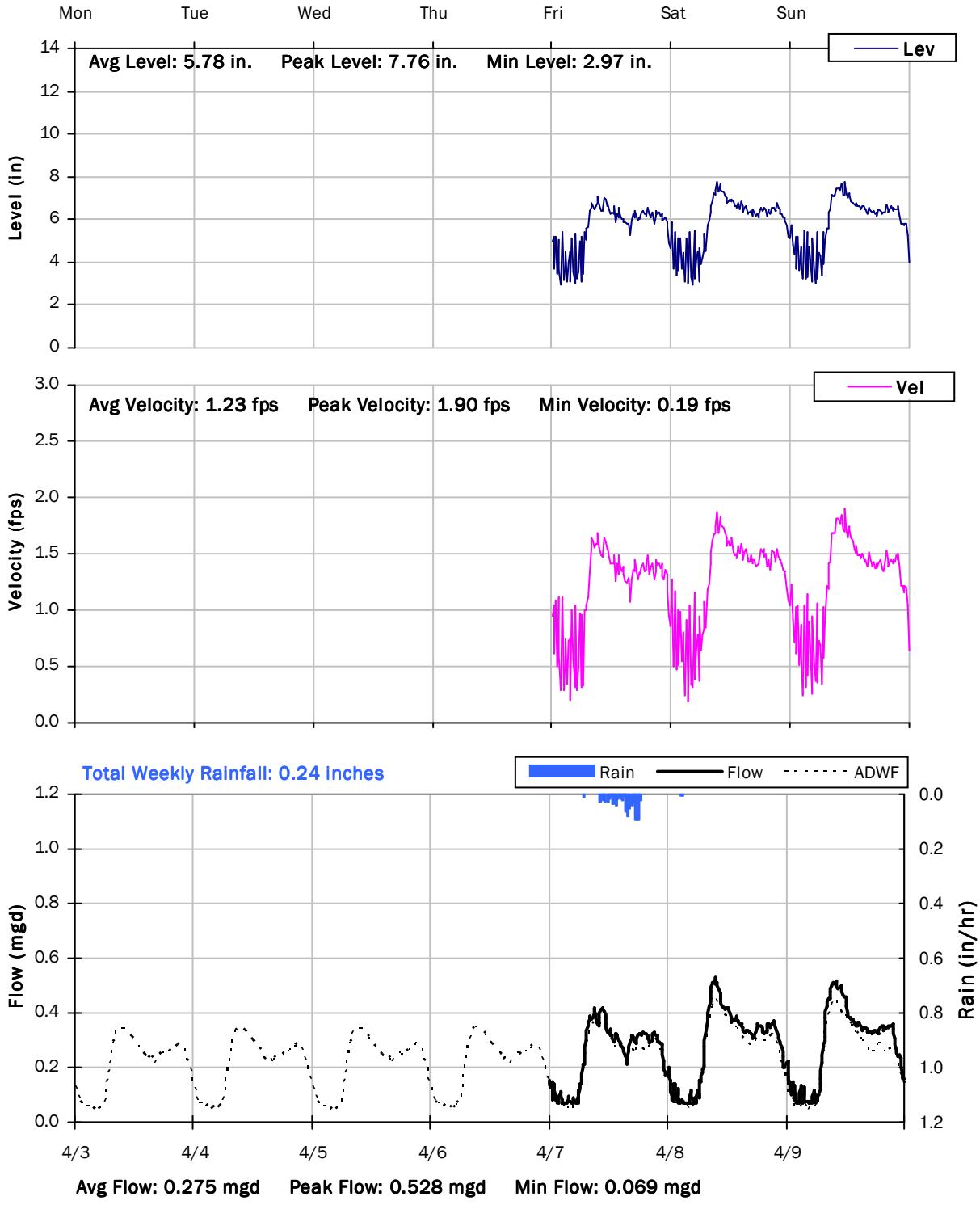
Pipe Diameter:	17.5	*inches*
Peak Measured Level:	8.36	*inches*
Peak d/D Ratio:	0.48	

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SITE 04

Weekly Level, Velocity and Flow Hydrographs

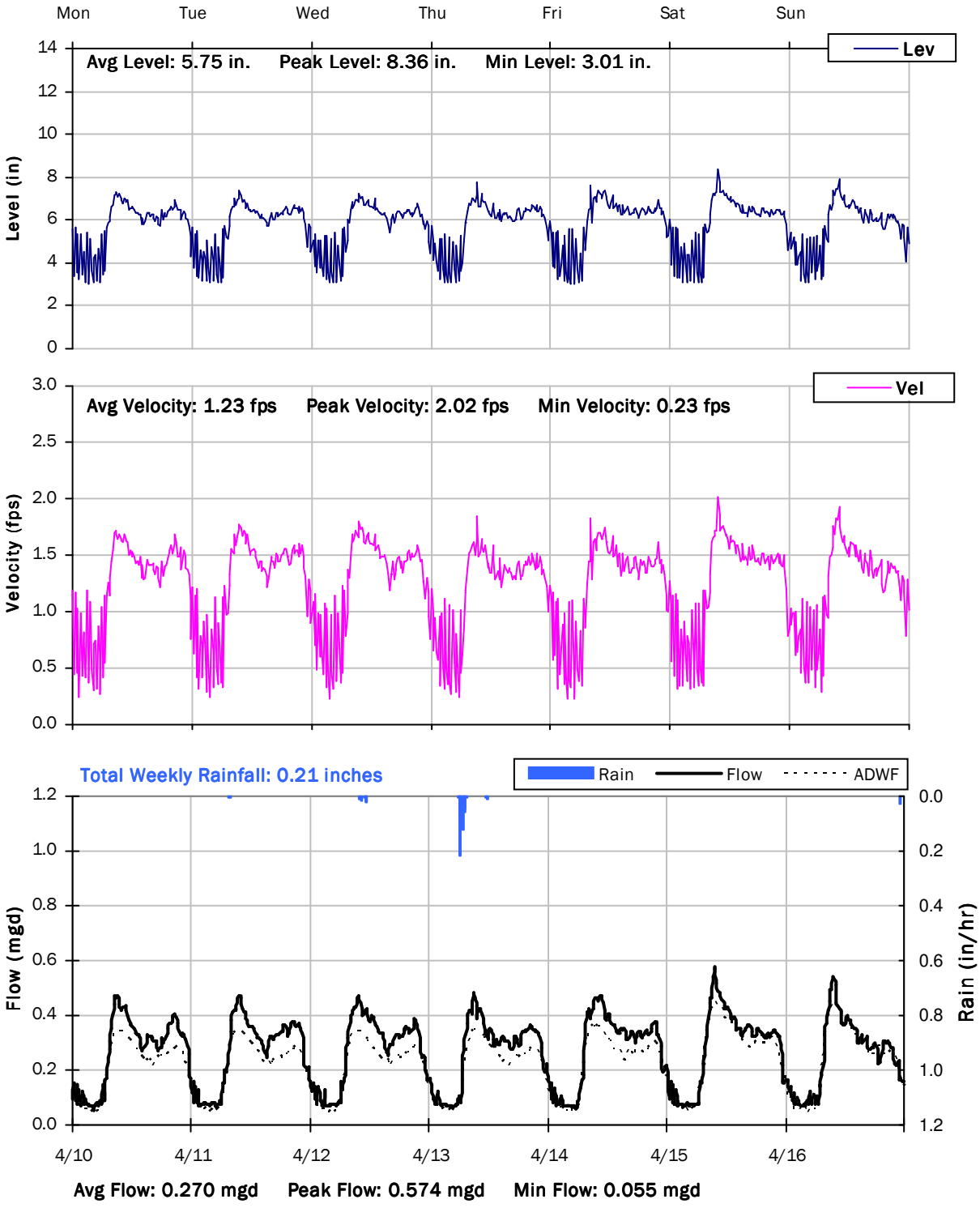
4/3/2017 to 4/10/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

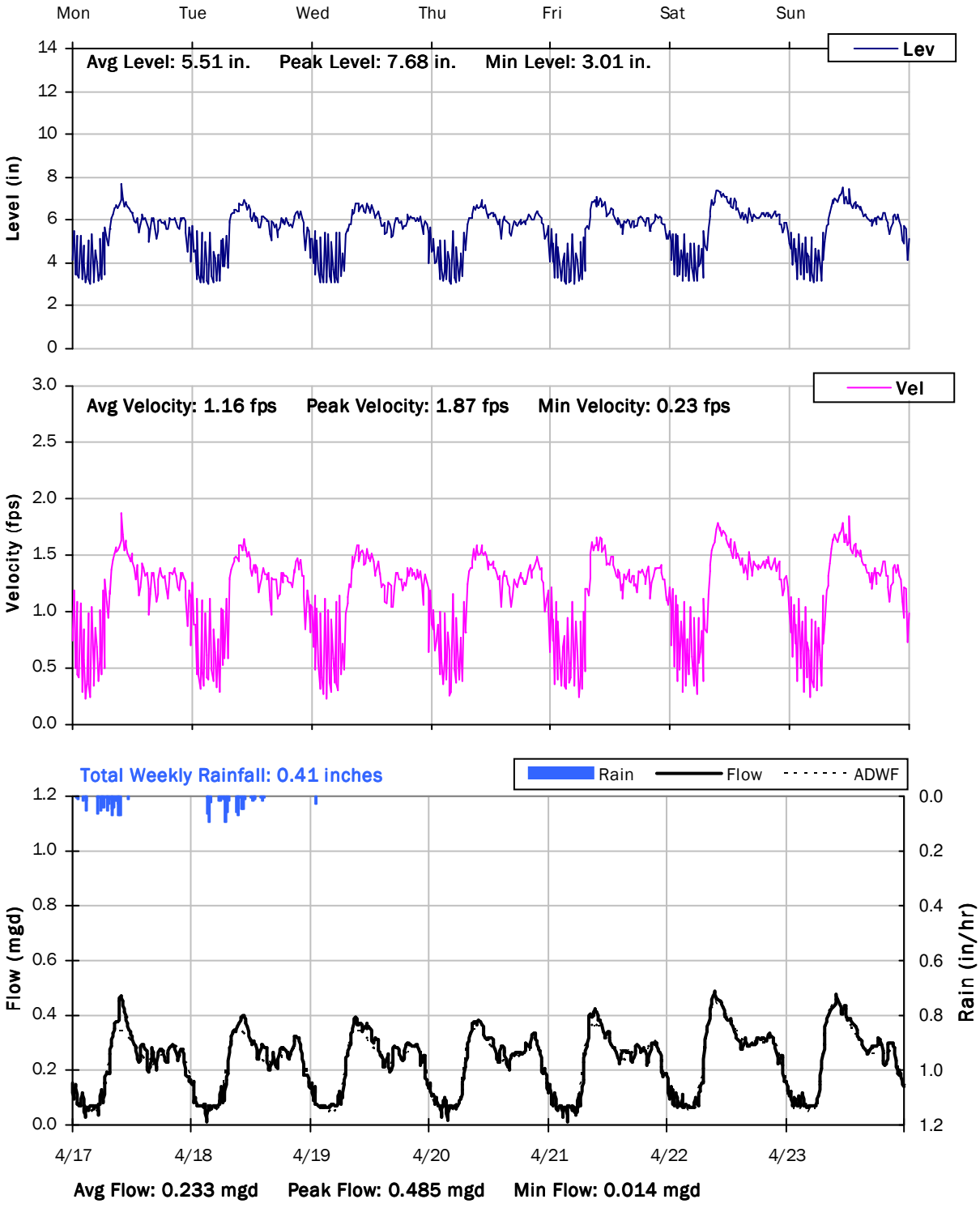
4/10/2017 to 4/17/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

4/17/2017 to 4/24/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

4/24/2017 to 5/1/2017

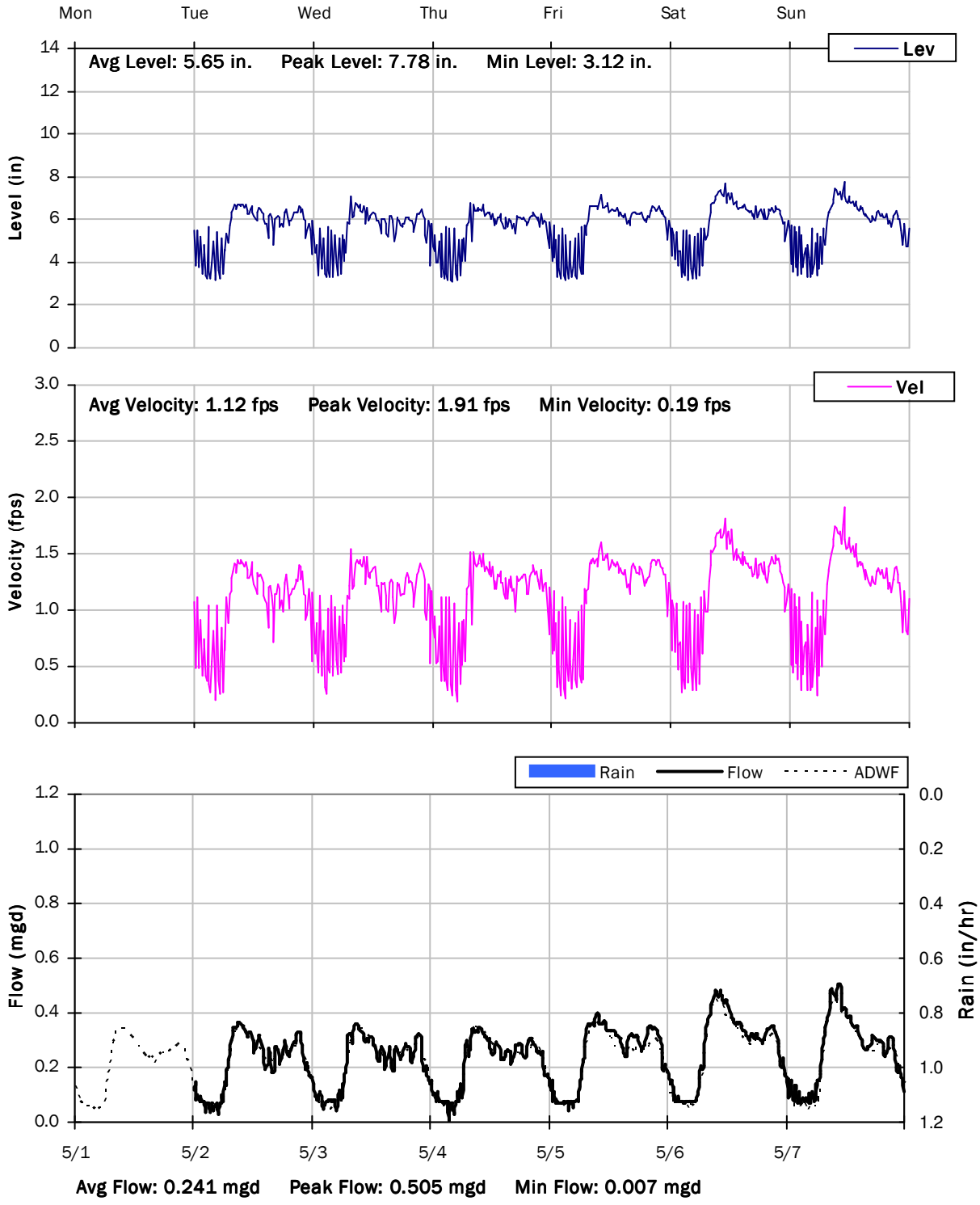
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 04

Weekly Level, Velocity and Flow Hydrographs

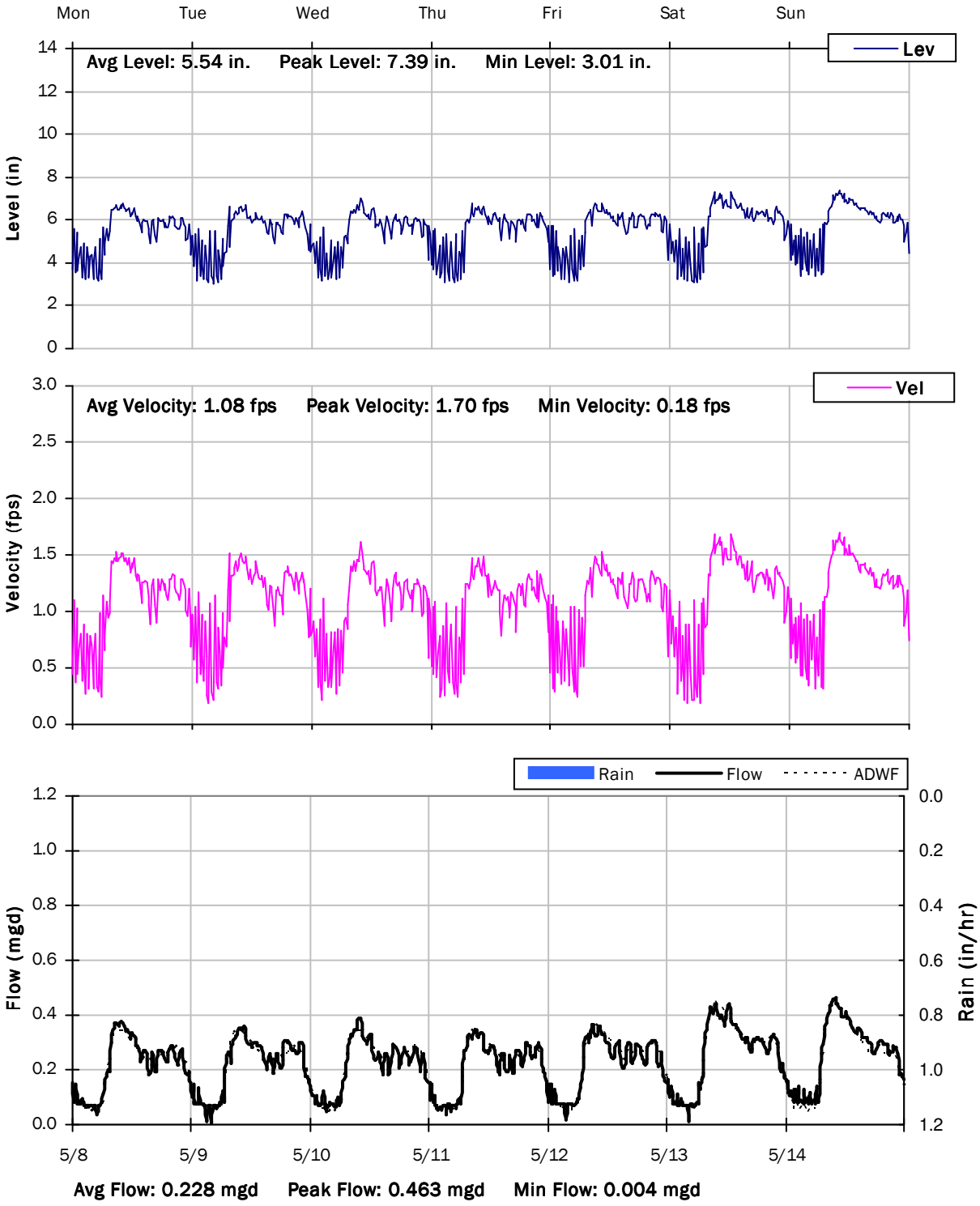
5/1/2017 to 5/8/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

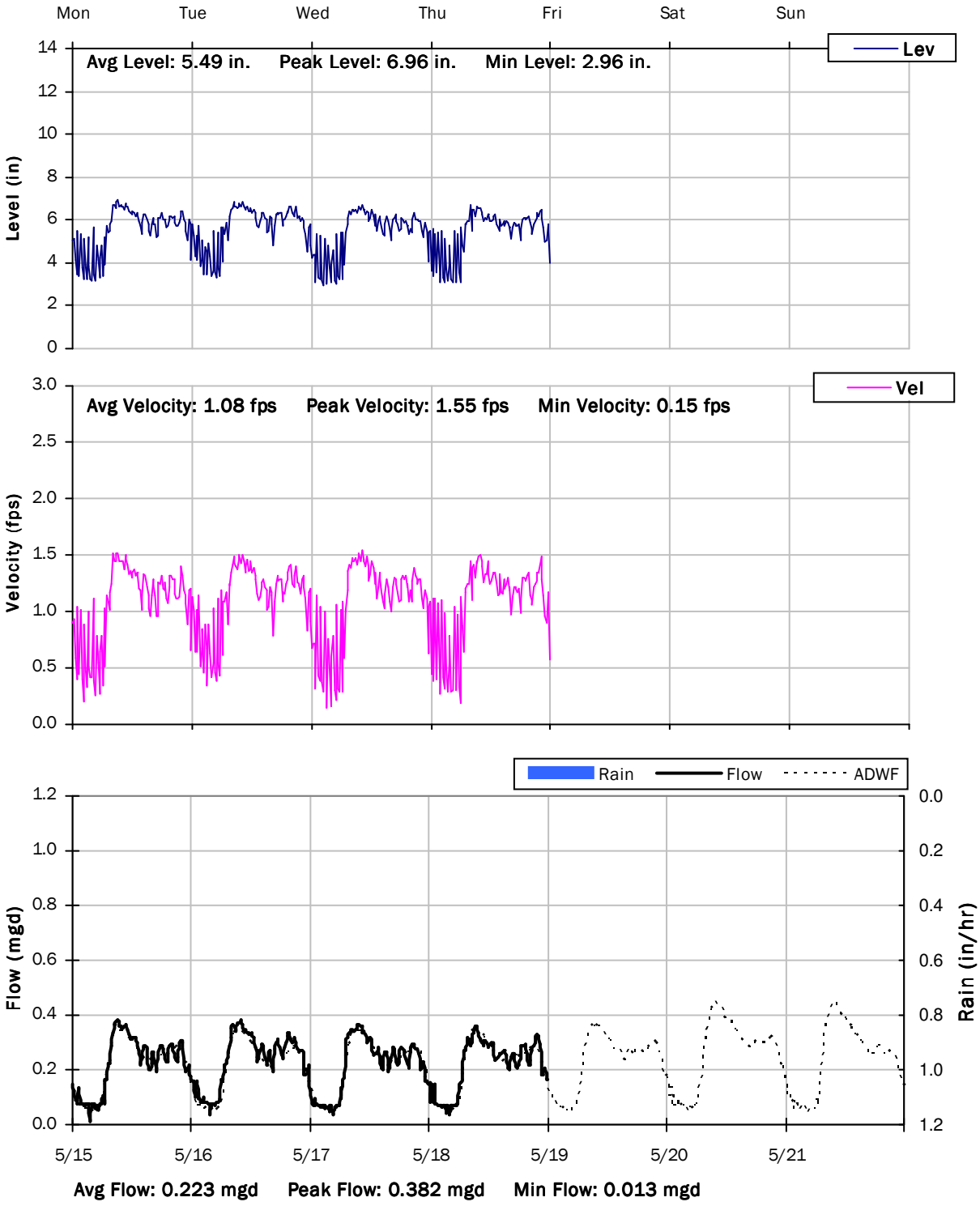
5/8/2017 to 5/15/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

5/15/2017 to 5/22/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

5/22/2017 to 5/29/2017

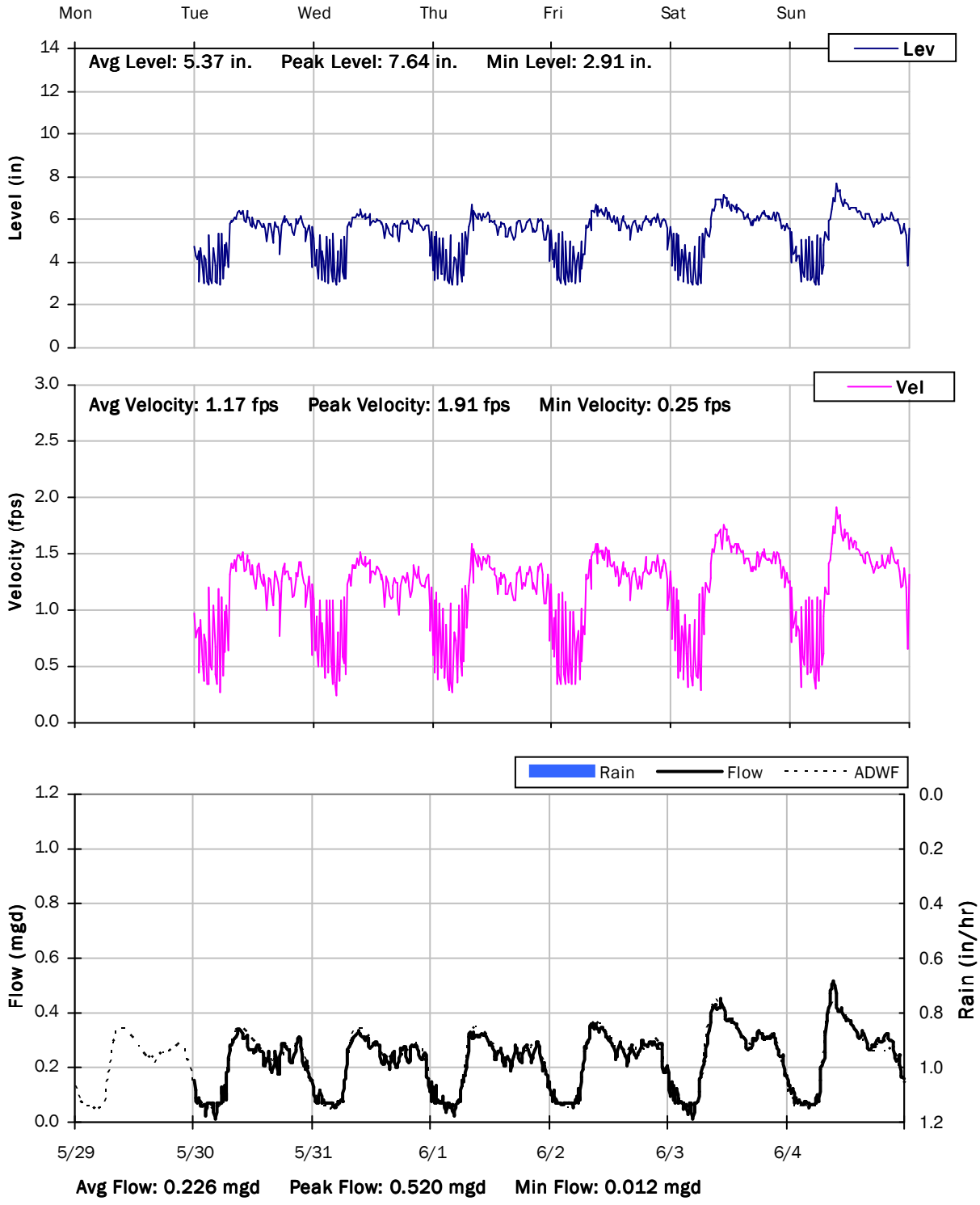
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No reportable data this week.

SITE 04

Weekly Level, Velocity and Flow Hydrographs

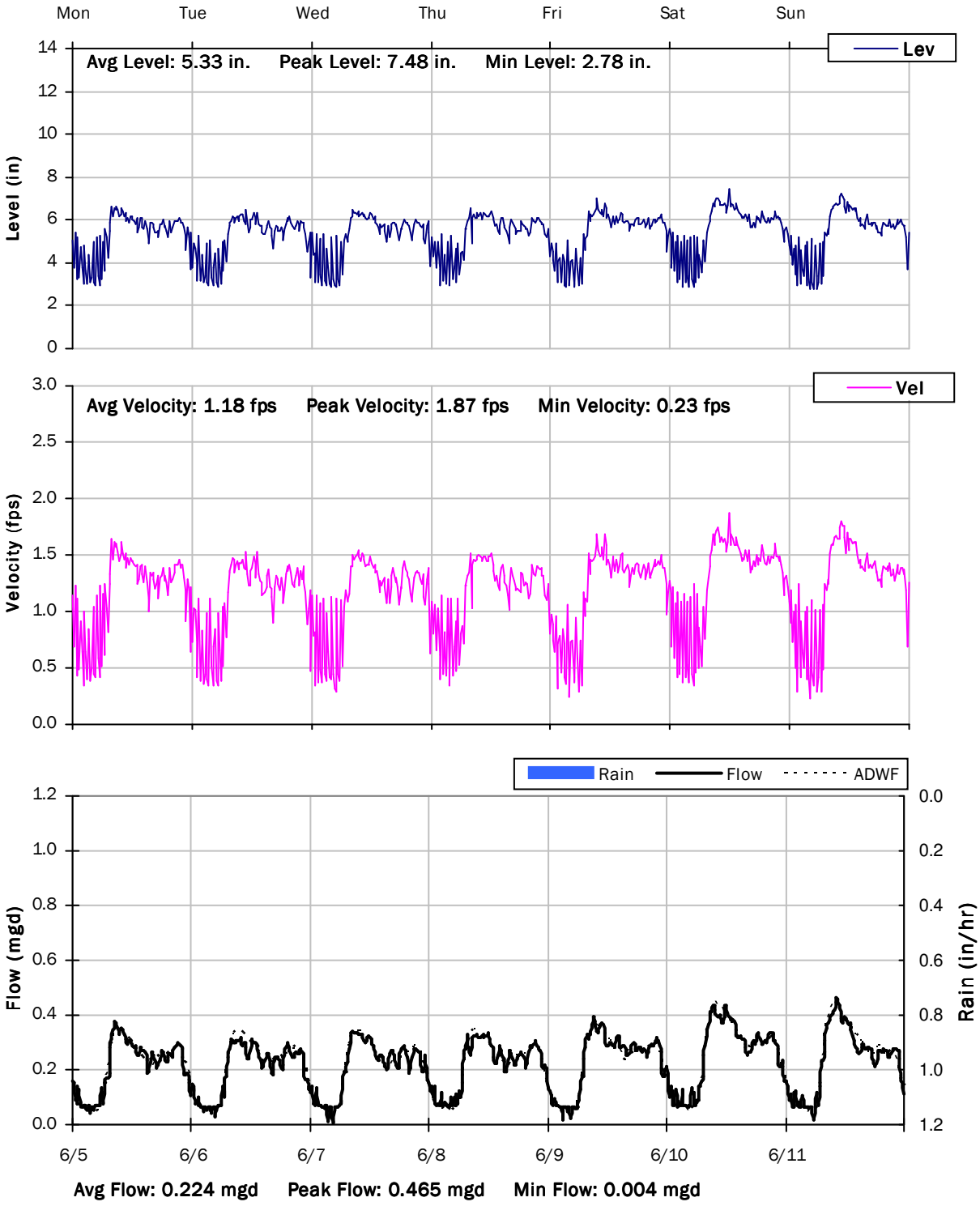
5/29/2017 to 6/5/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

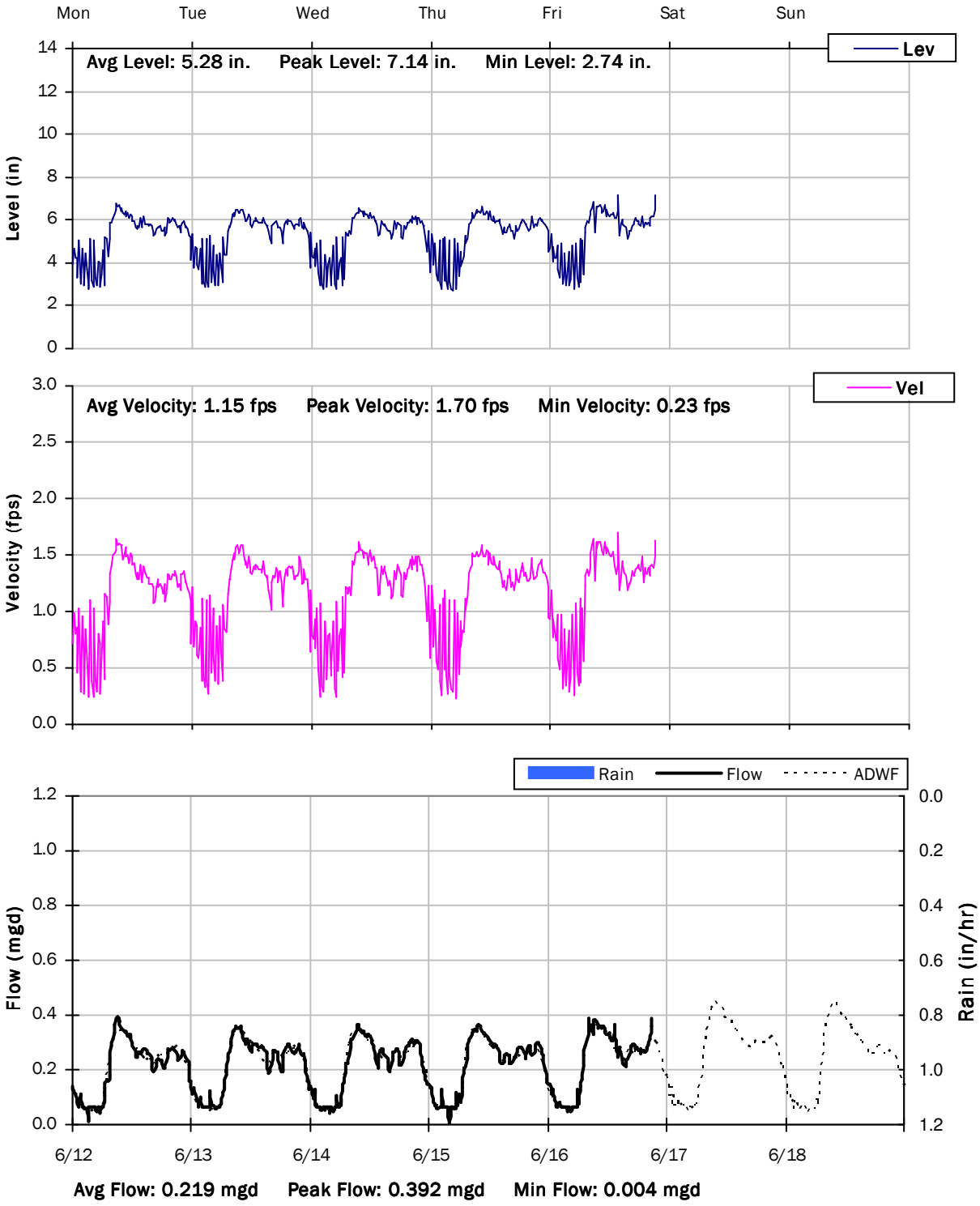
6/5/2017 to 6/12/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

6/12/2017 to 6/19/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

6/19/2017 to 6/26/2017

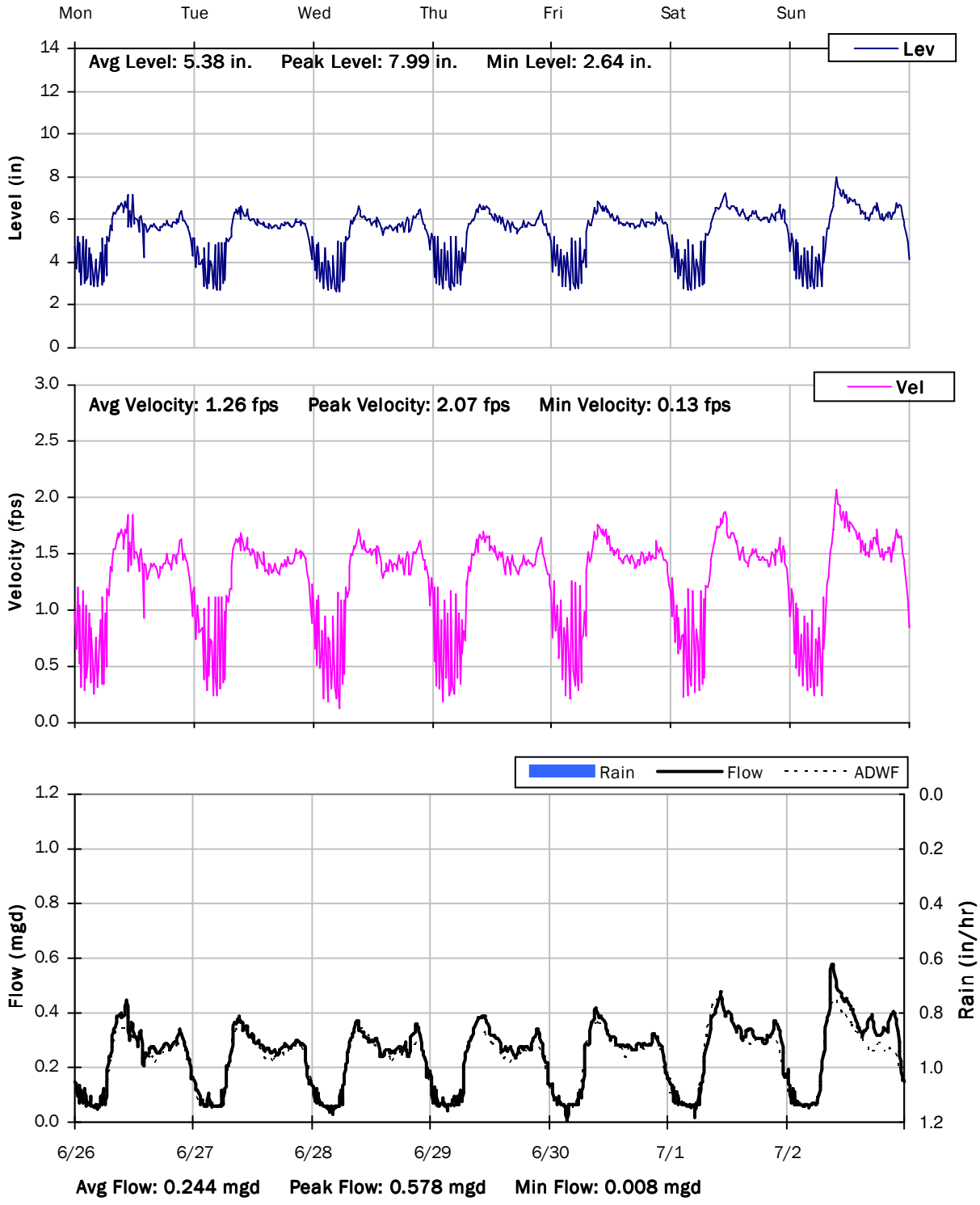
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 04

Weekly Level, Velocity and Flow Hydrographs

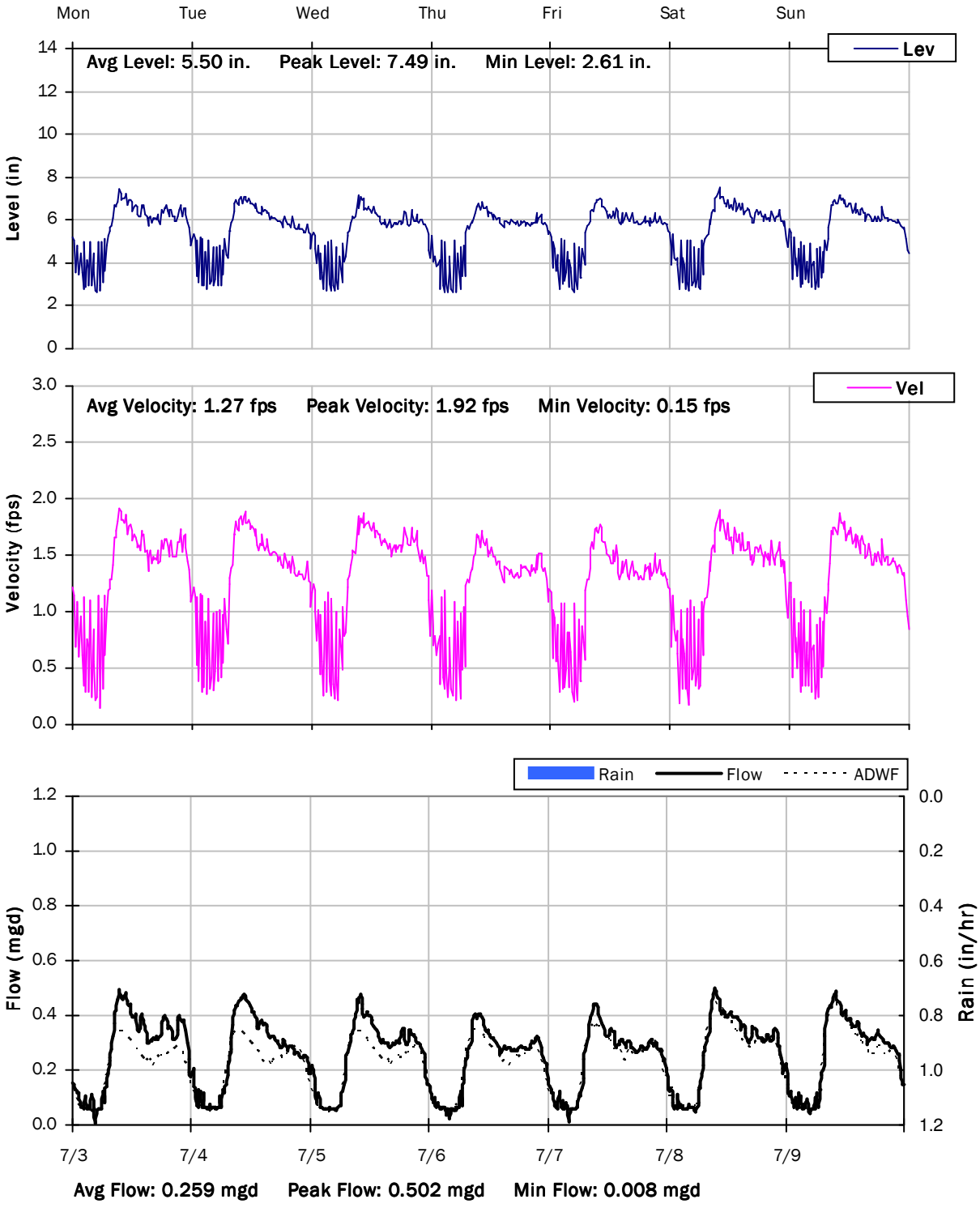
6/26/2017 to 7/3/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

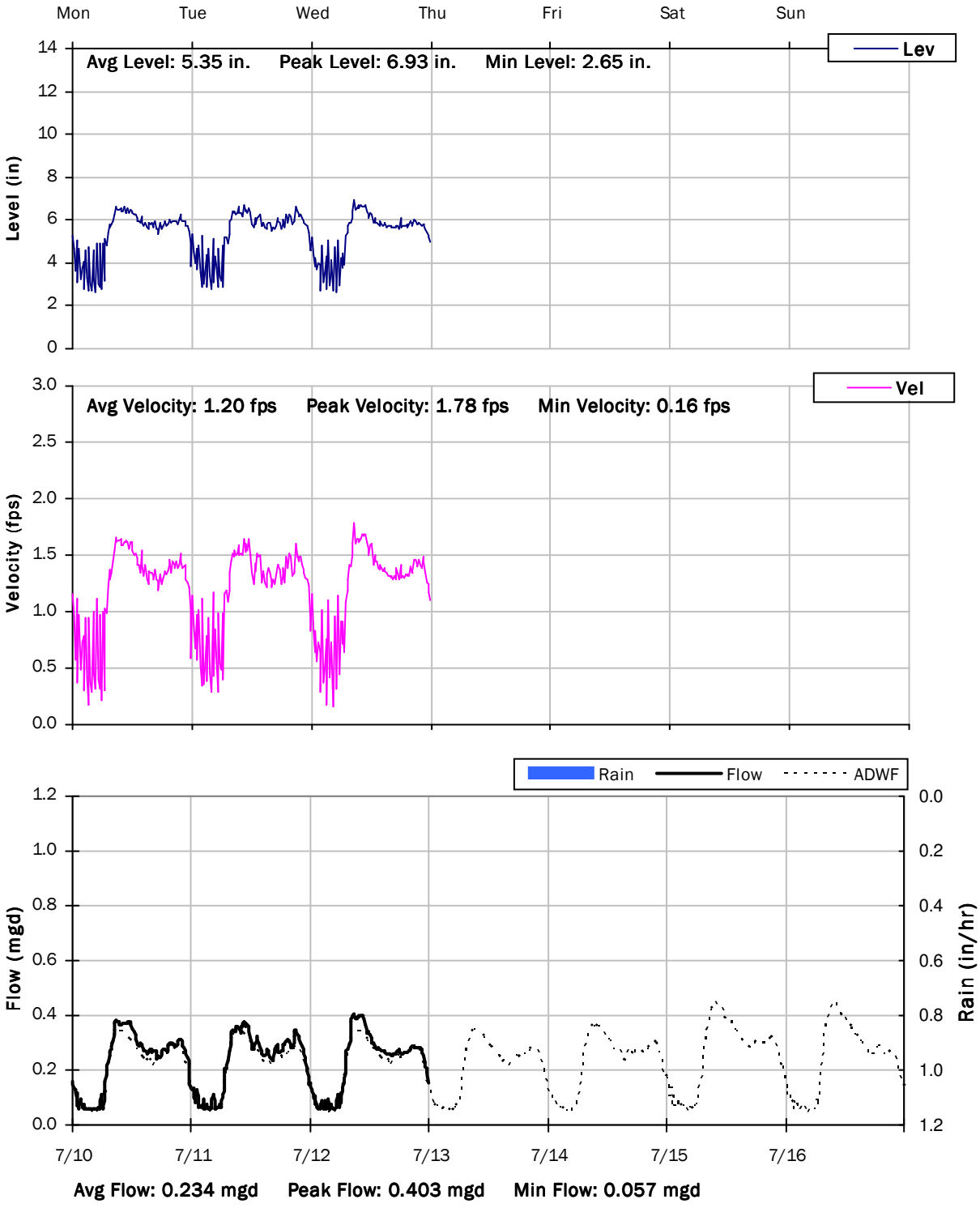
7/3/2017 to 7/10/2017



SITE 04

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

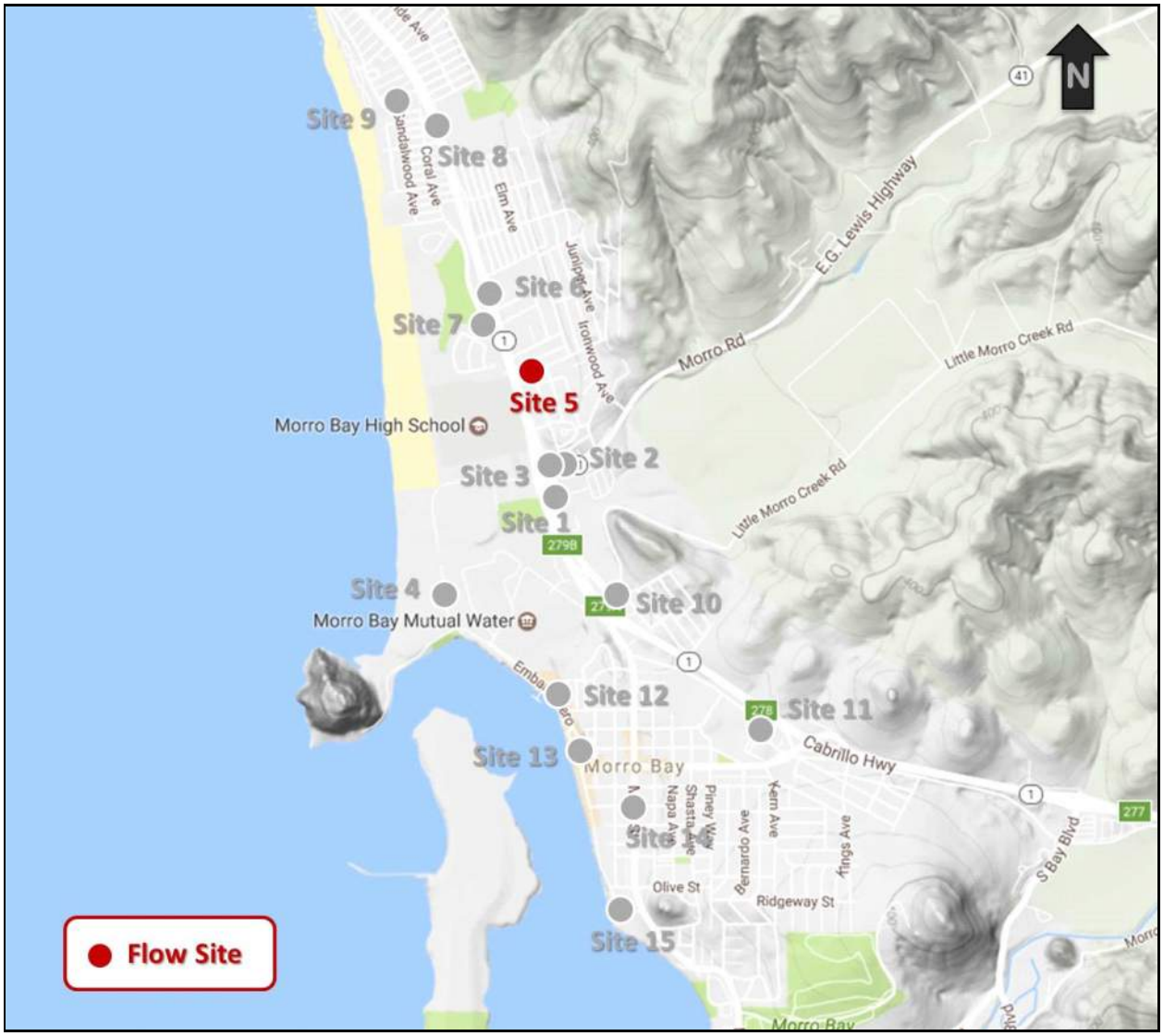
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 05

Location: 371 Avalon Street, meter on east 8" inlet

Data Summary Report



Vicinity Map: Site 05

SITE 05

Site Information

Location: 371 Avalon Street, meter on east 8" inlet

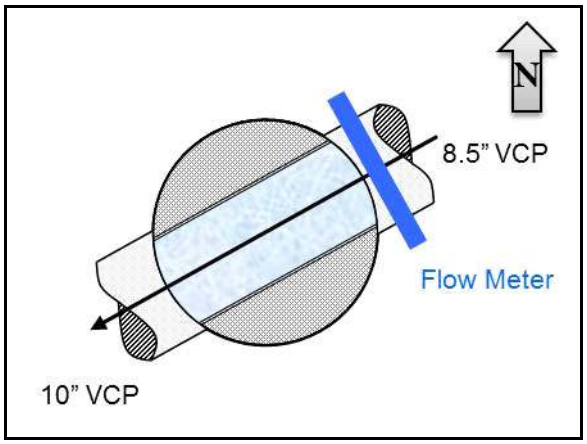


Pipe Diameter: 8 inches

ADWF: 0.091 mgd

Peak Measured Flow: 0.285 mgd









SITE 05

Additional Site Photos



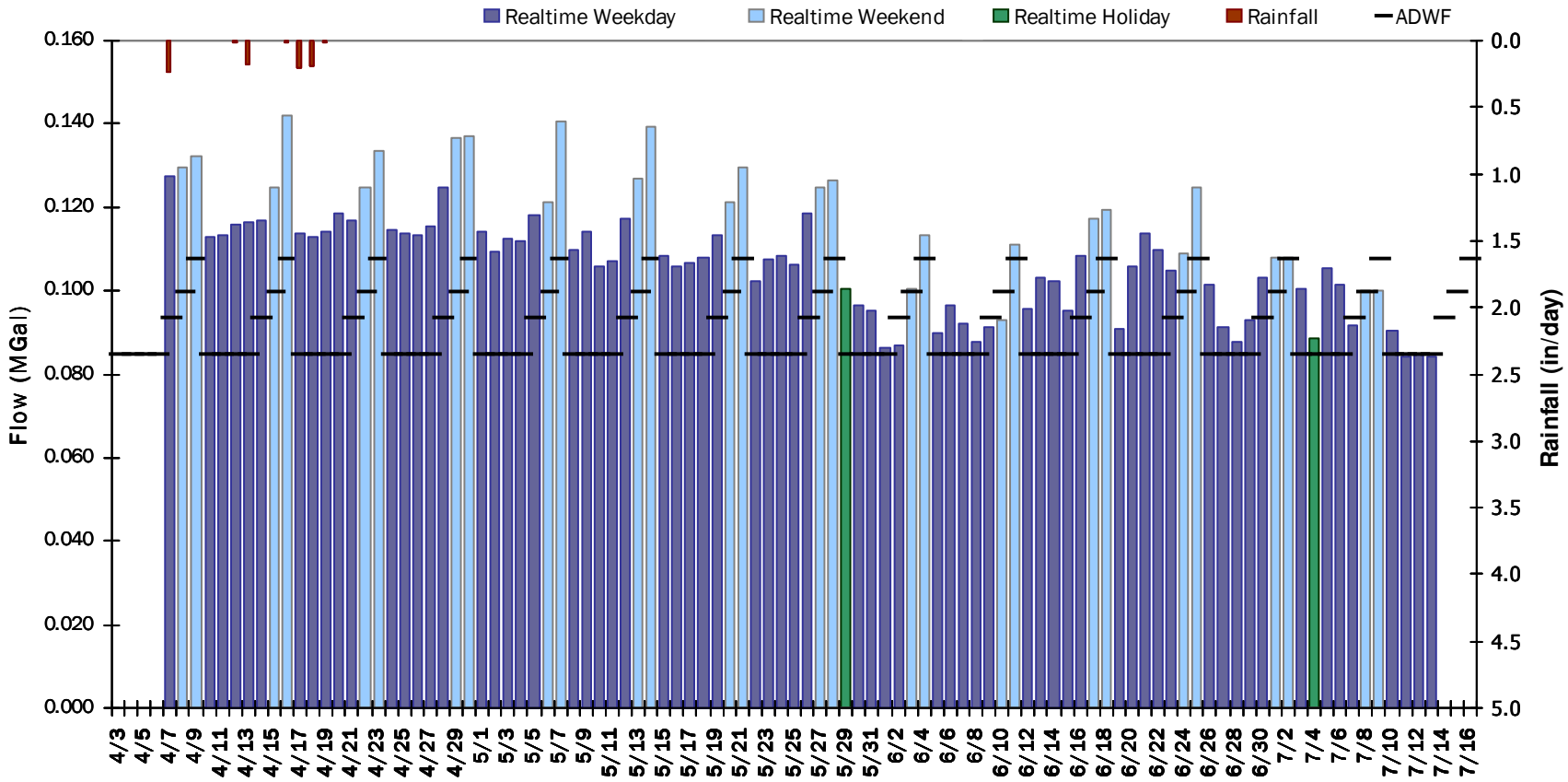


SITE 05

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.109 MGal Peak Daily Flow: 0.142 MGal Min Daily Flow: 0.084 MGal

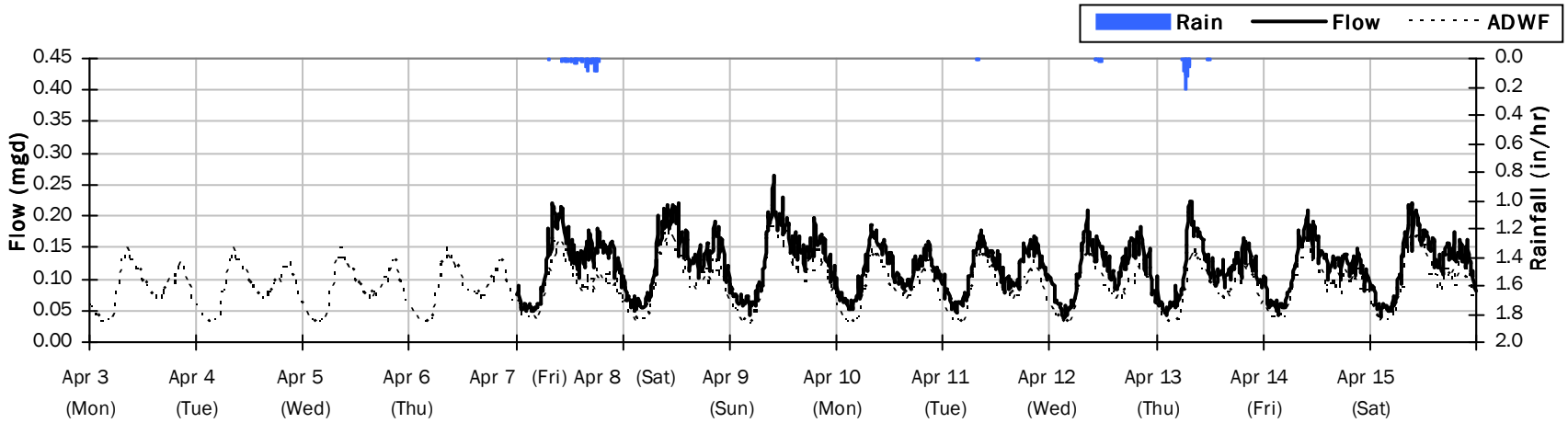
Total Period Rainfall: 0.85 inches

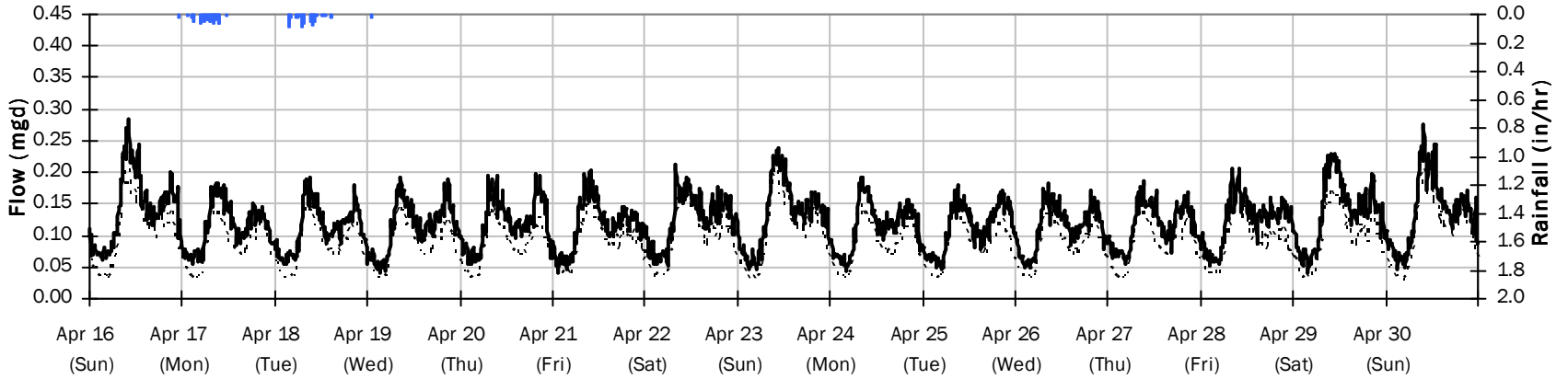


SITE 05

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.122 mgd** **Peak Flow: 0.285 mgd** **Min Flow: 0.038 mgd**

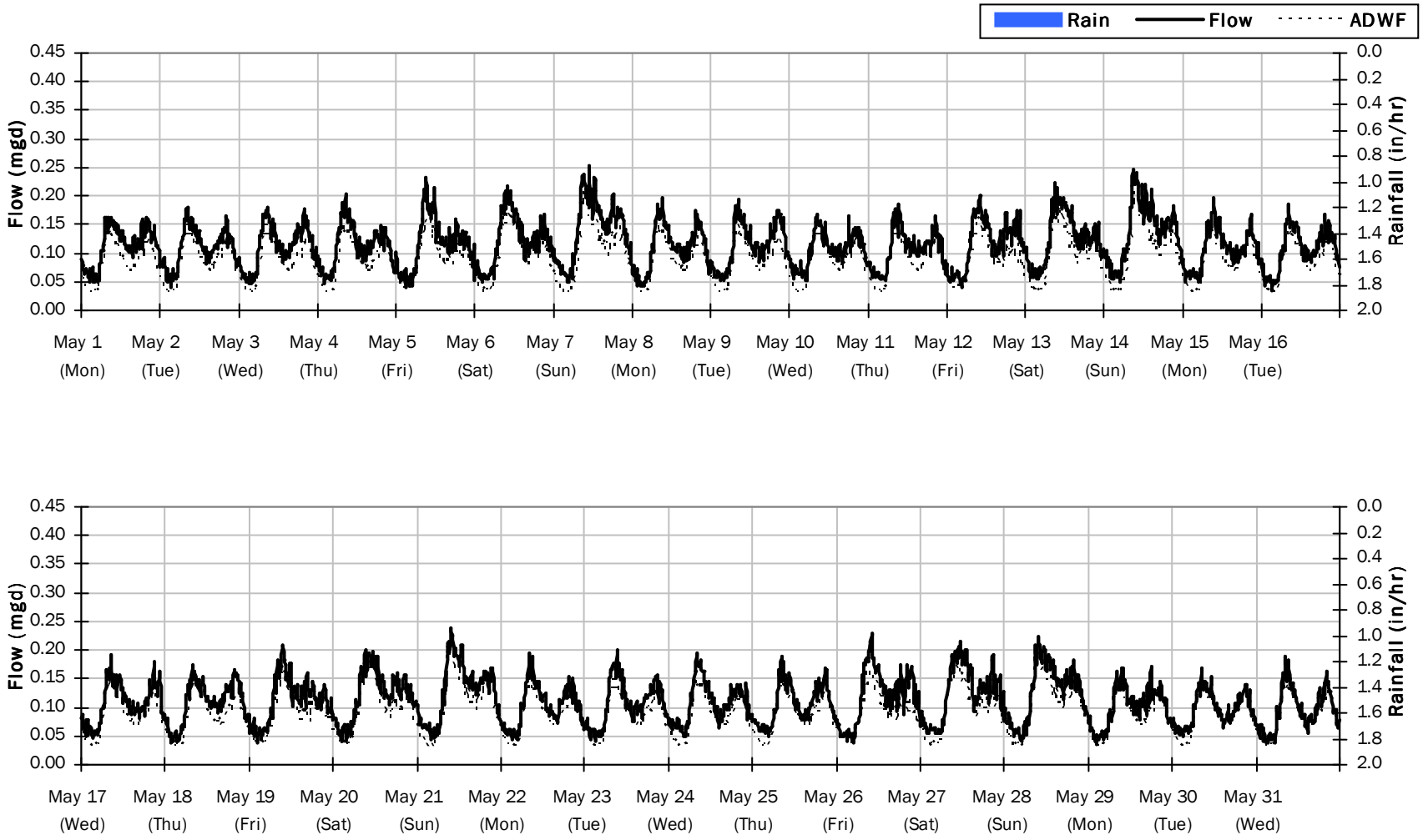




SITE 05

Flow Summary: 5/1/2017 to 5/31/2017

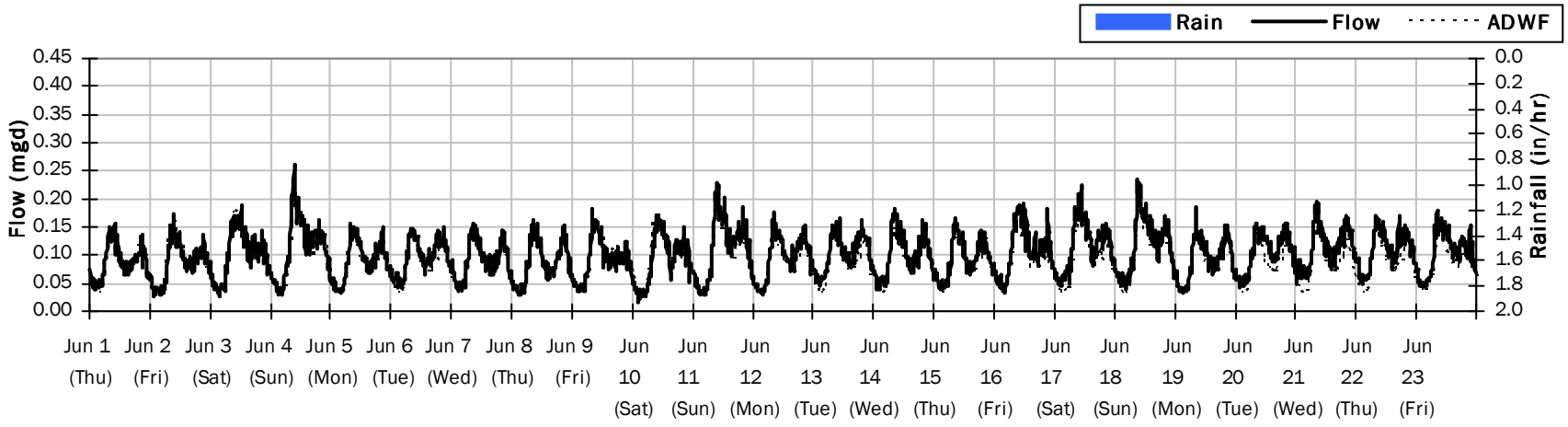
Total Period Rainfall: 0.00 inches **Avg Flow: 0.114 mgd** **Peak Flow: 0.252 mgd** **Min Flow: 0.035 mgd**

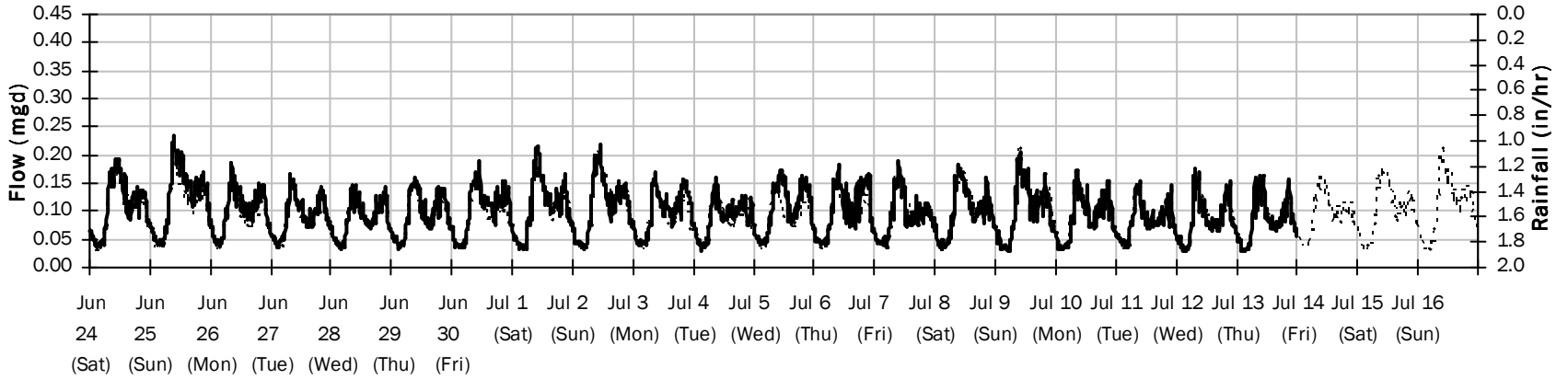


SITE 05

Flow Summary: 6/1/2017 to 7/16/2017

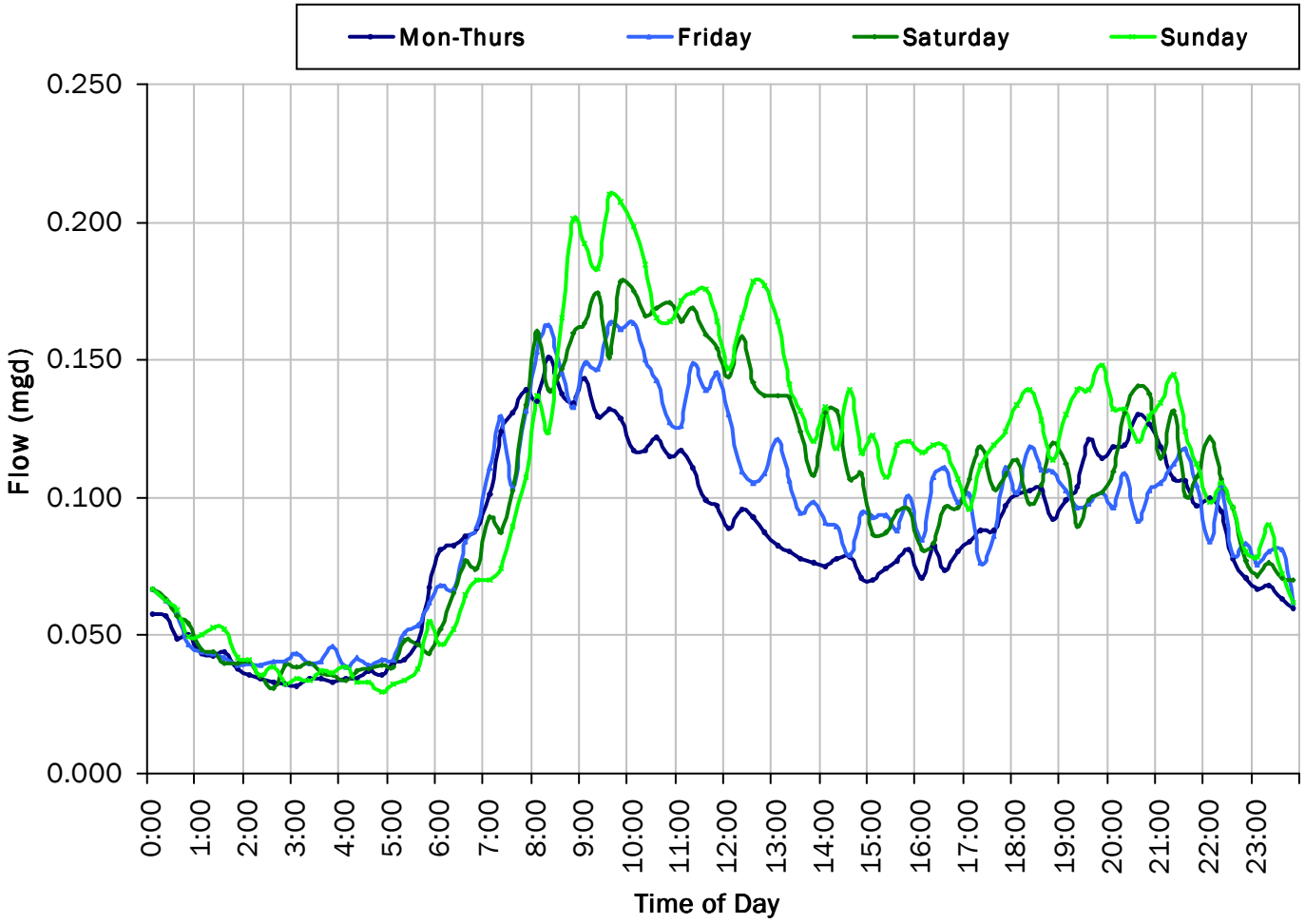
Total Period Rainfall: 0.00 inches **Avg Flow: 0.099 mgd** **Peak Flow: 0.262 mgd** **Min Flow: 0.016 mgd**





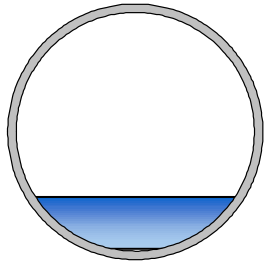
SITE 05

Average Dry Weather Flow Hydrographs



ADWF:

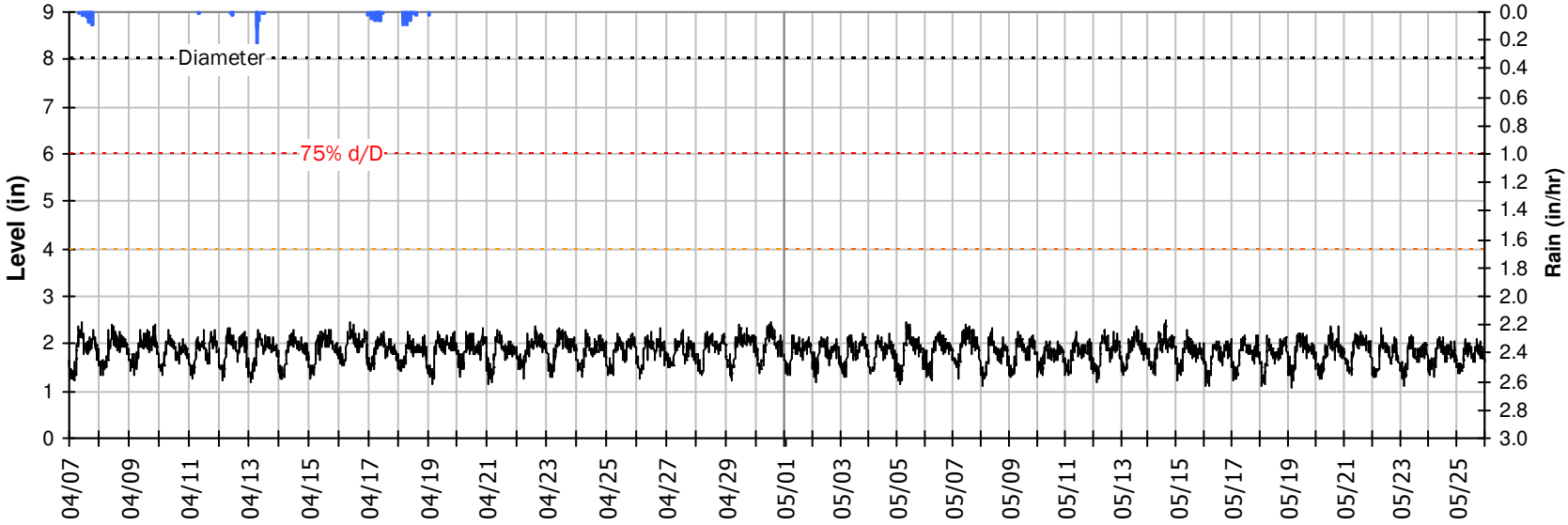
0.091 *mgd*

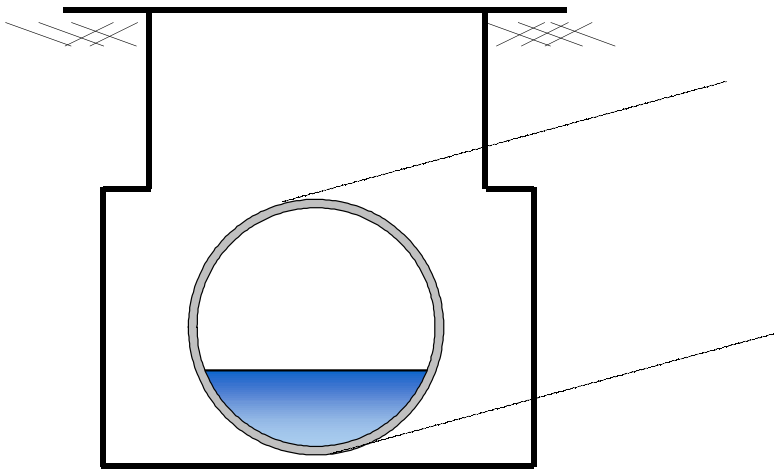


SITE 05

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



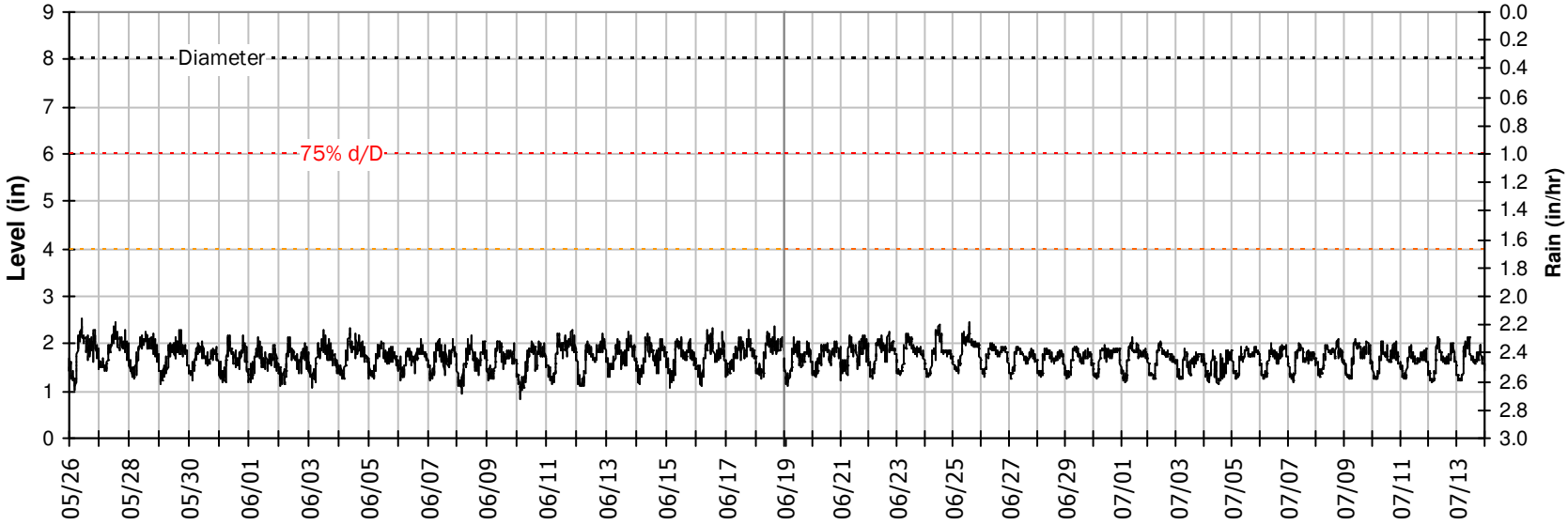


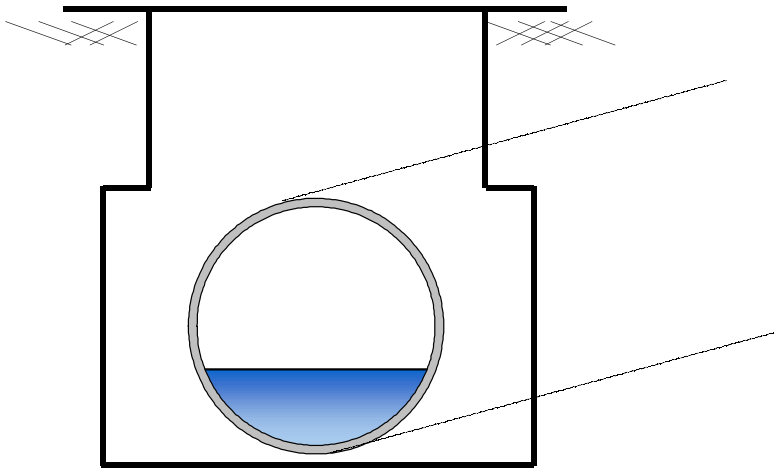
Pipe Diameter:	8	*inches*
Peak Measured Level:	2.53	*inches*
Peak d/D Ratio:	0.32	

SITE 05

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



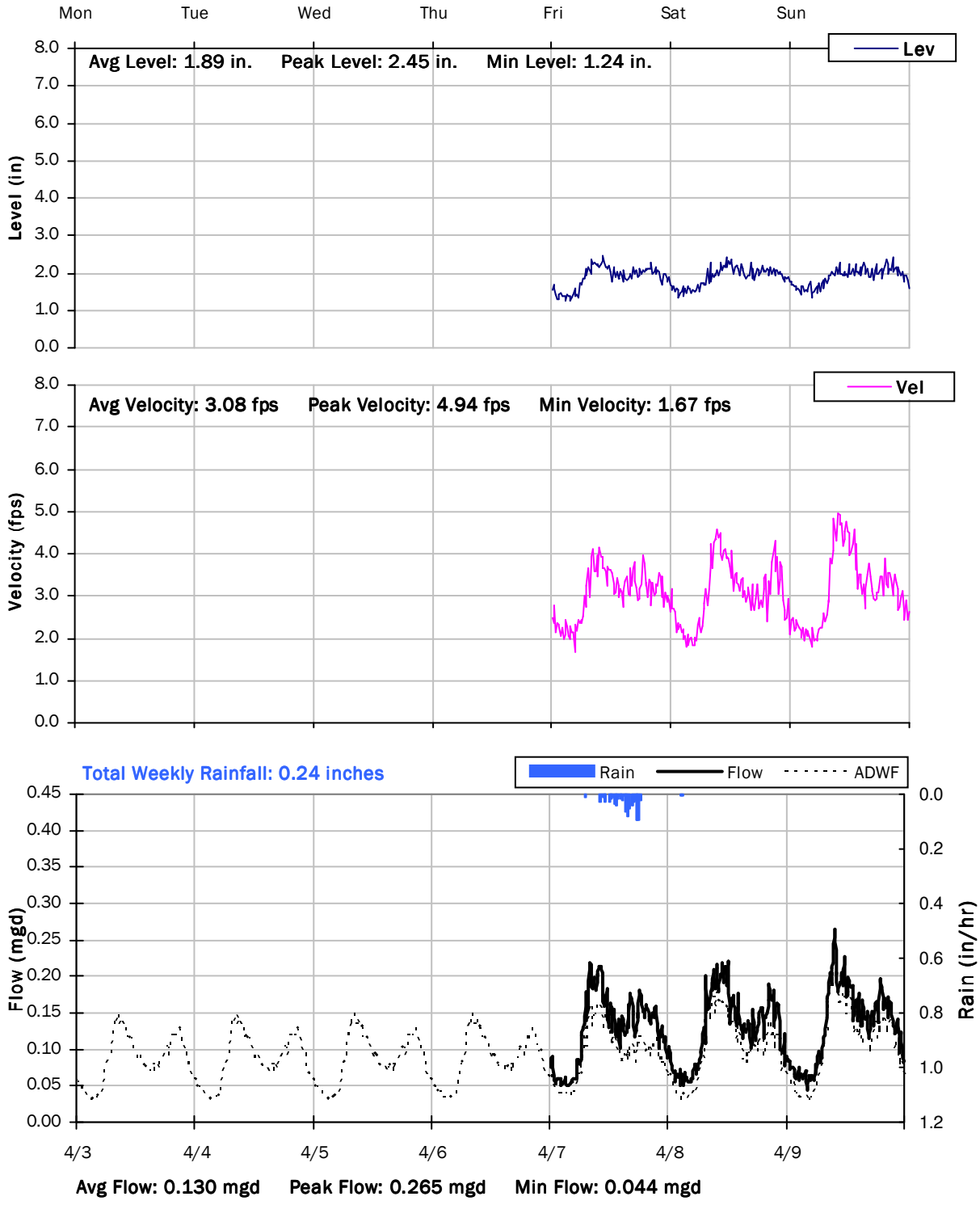


Pipe Diameter:	8	*inches*
Peak Measured Level:	2.53	*inches*
Peak d/D Ratio:	0.32	

SITE 05

Weekly Level, Velocity and Flow Hydrographs

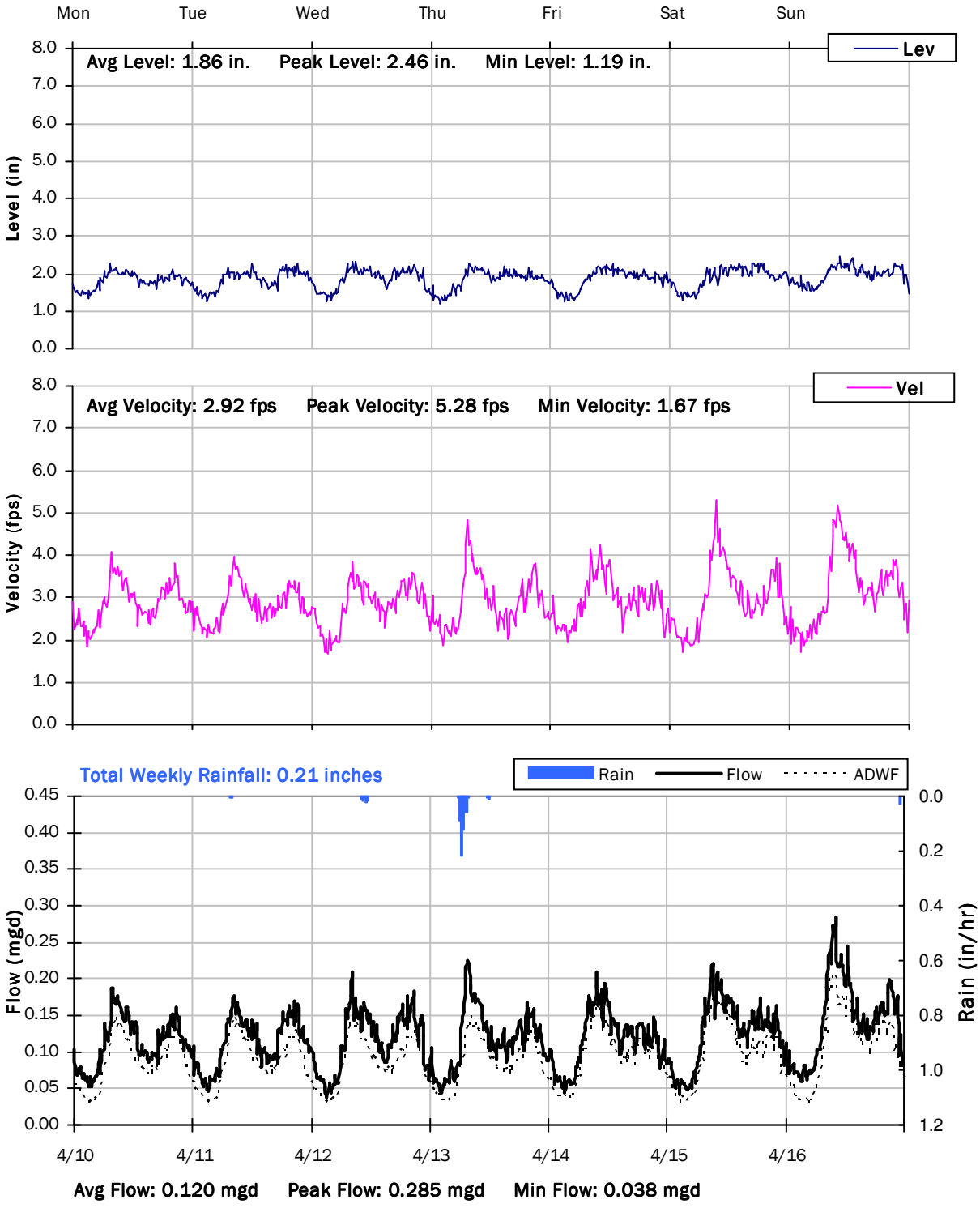
4/3/2017 to 4/10/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

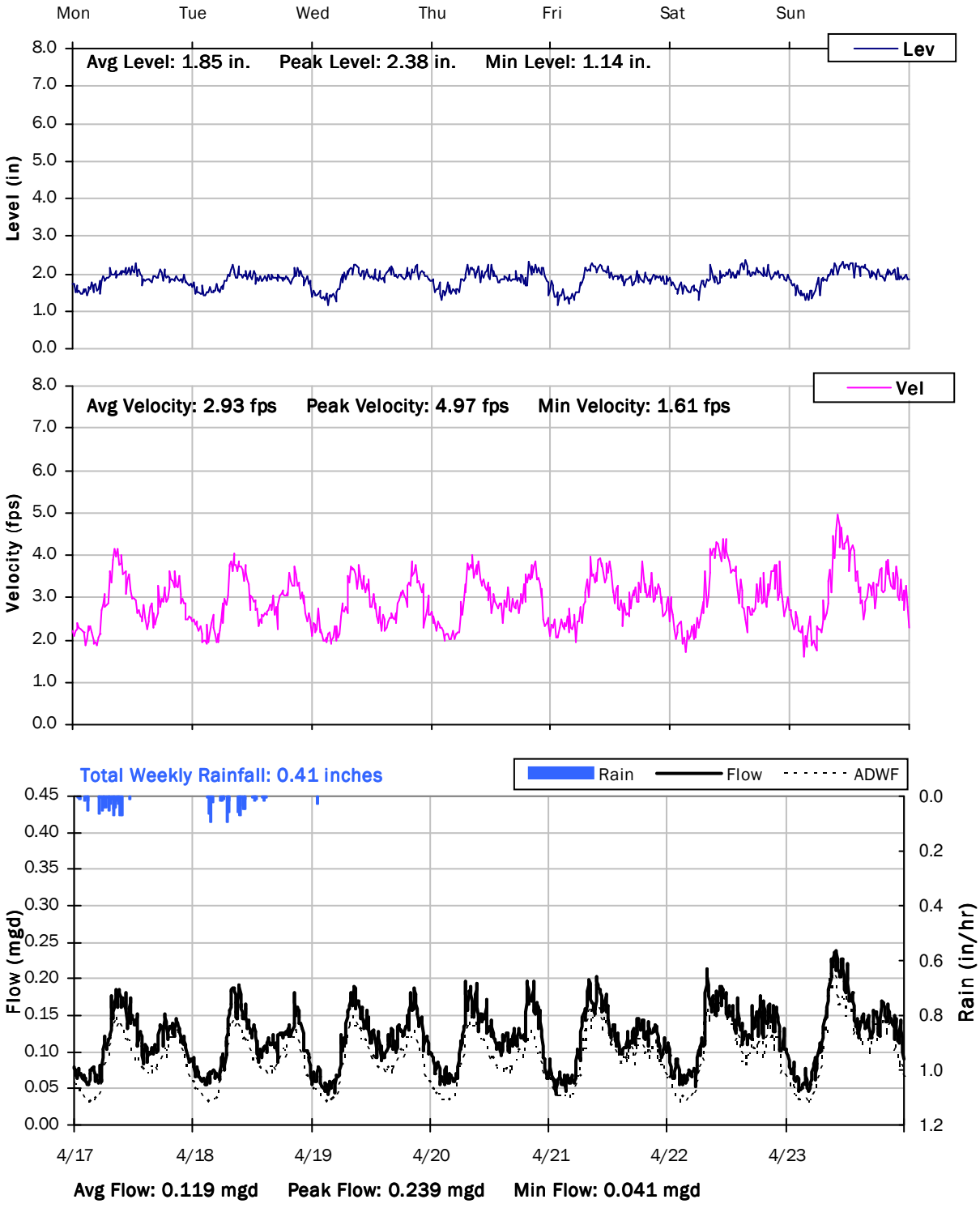
4/10/2017 to 4/17/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

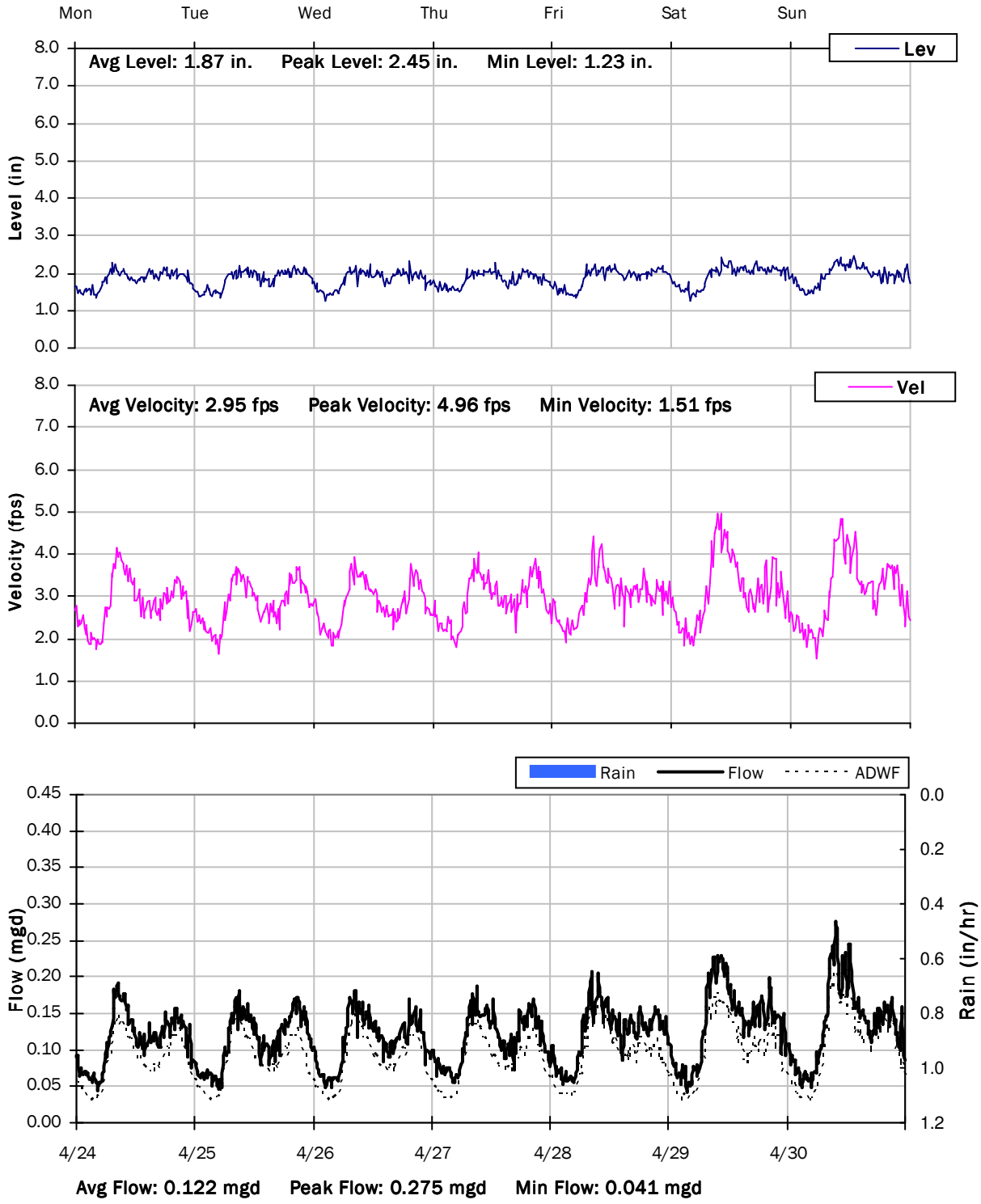
4/17/2017 to 4/24/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

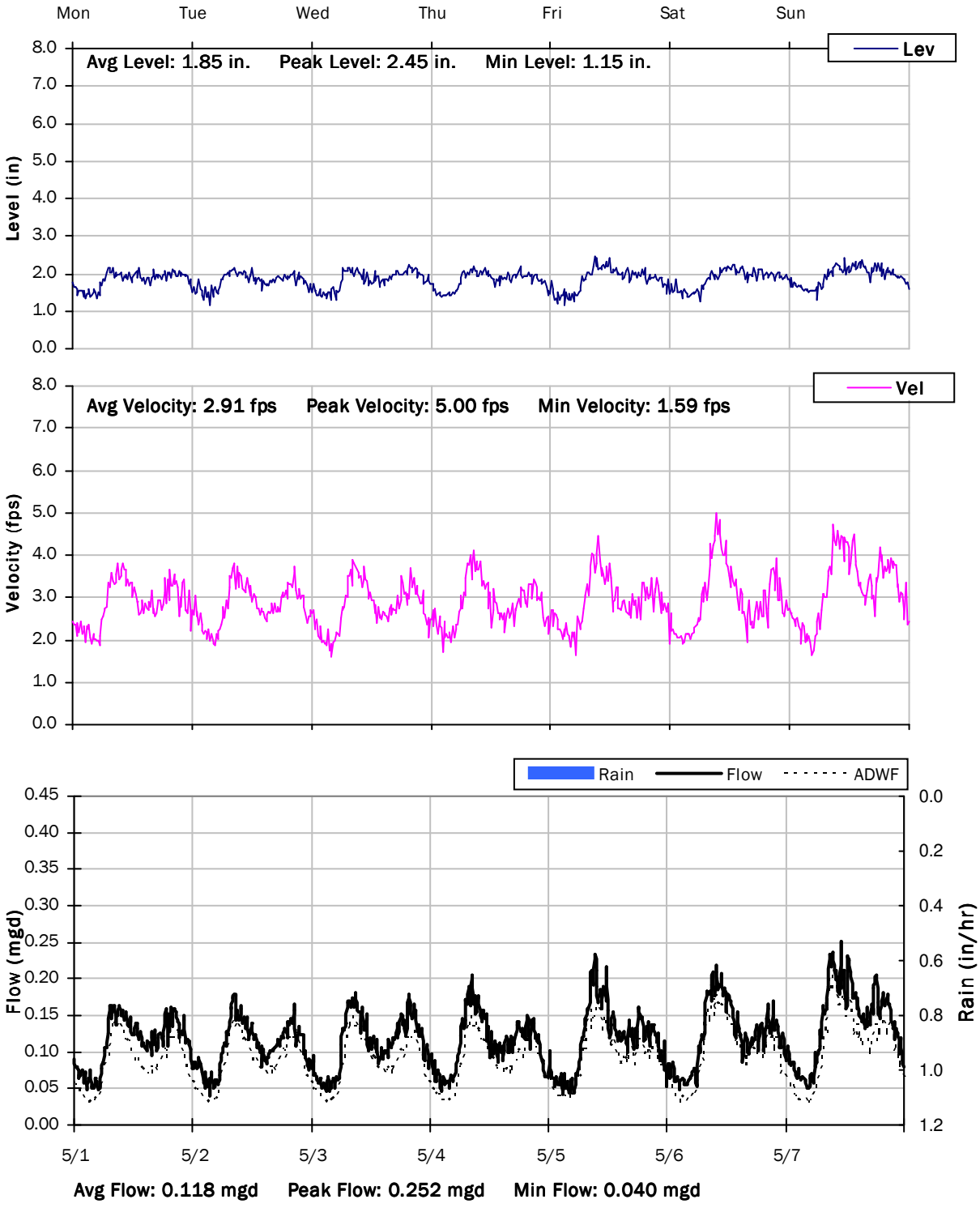
4/24/2017 to 5/1/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

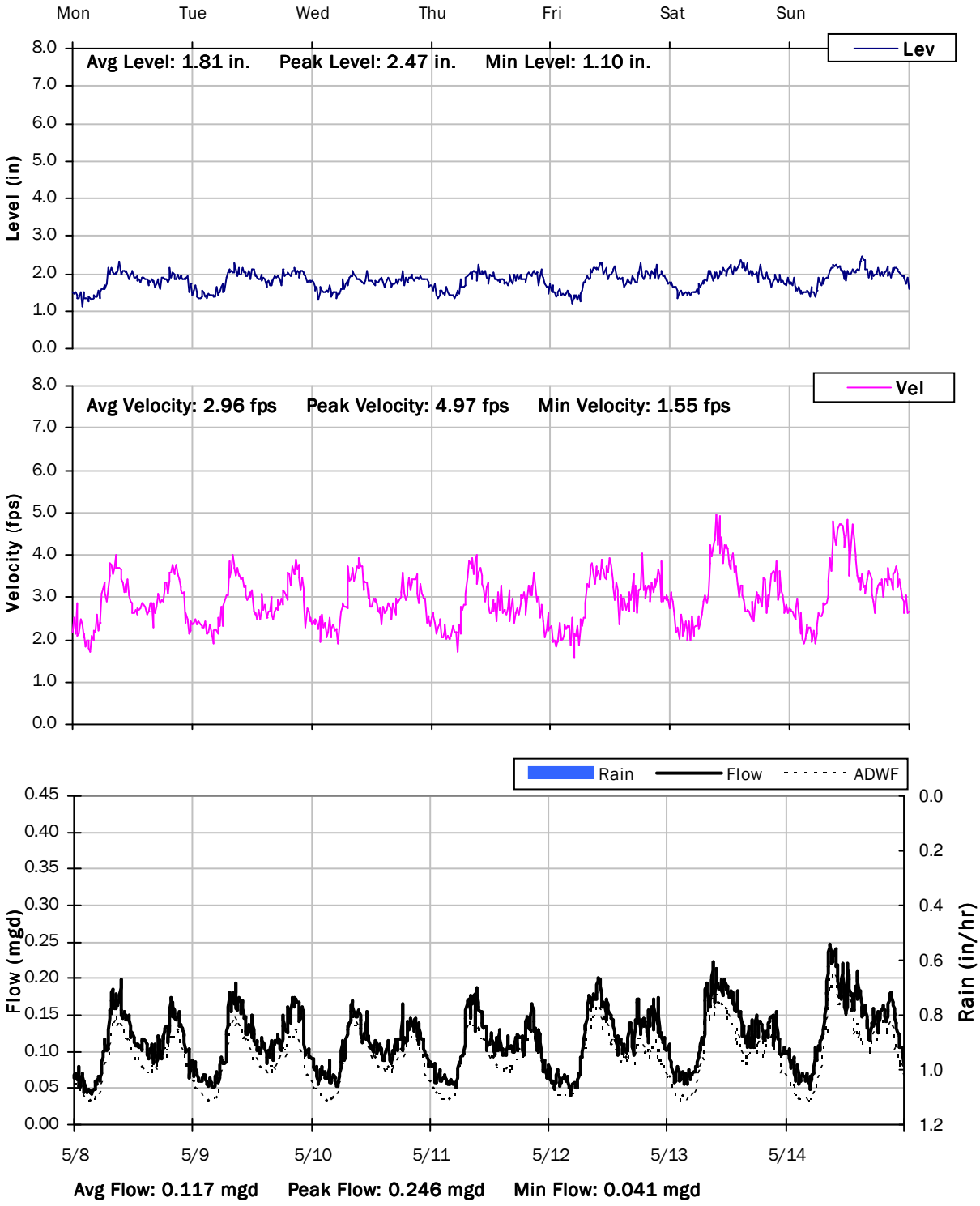
5/1/2017 to 5/8/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

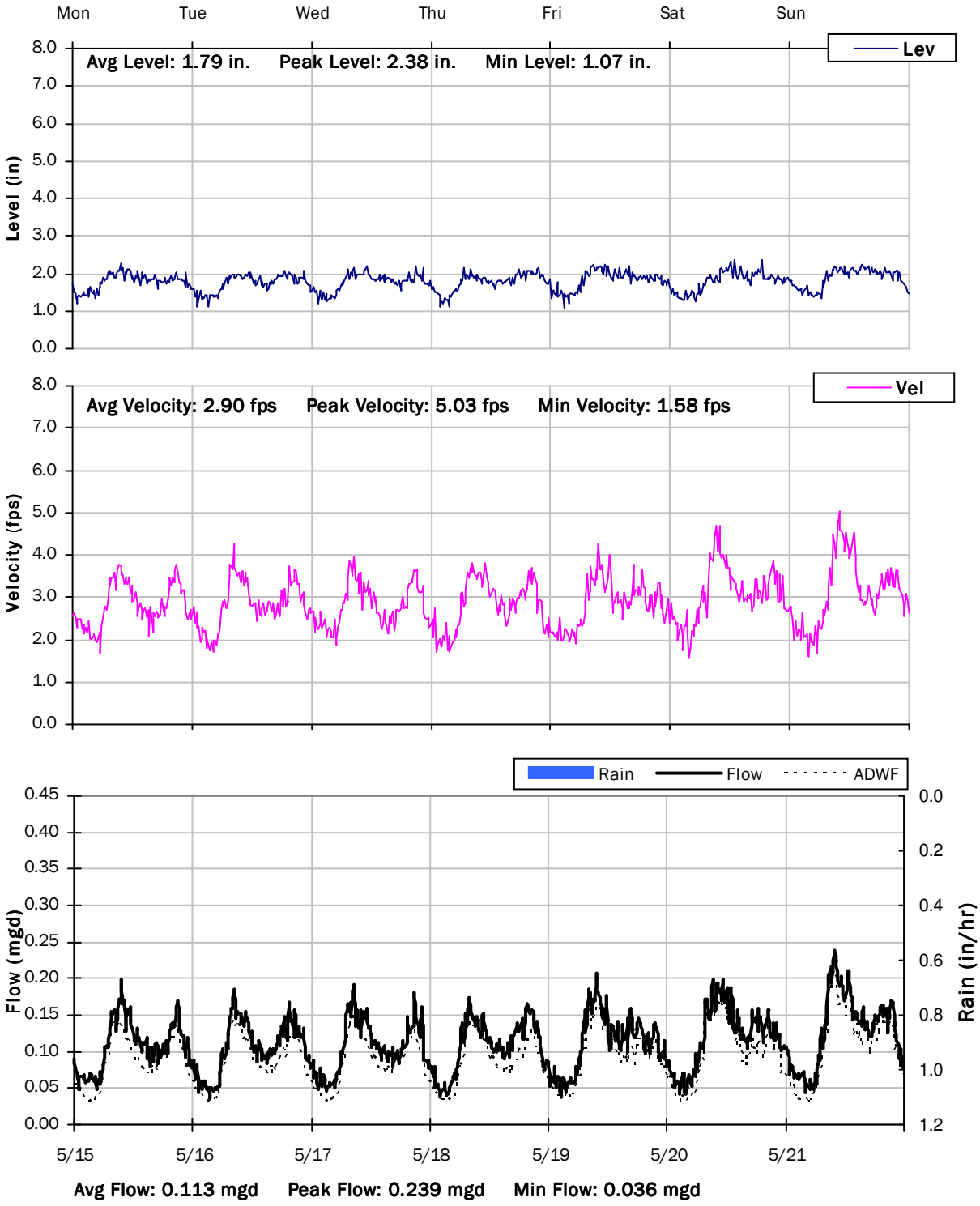
5/8/2017 to 5/15/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

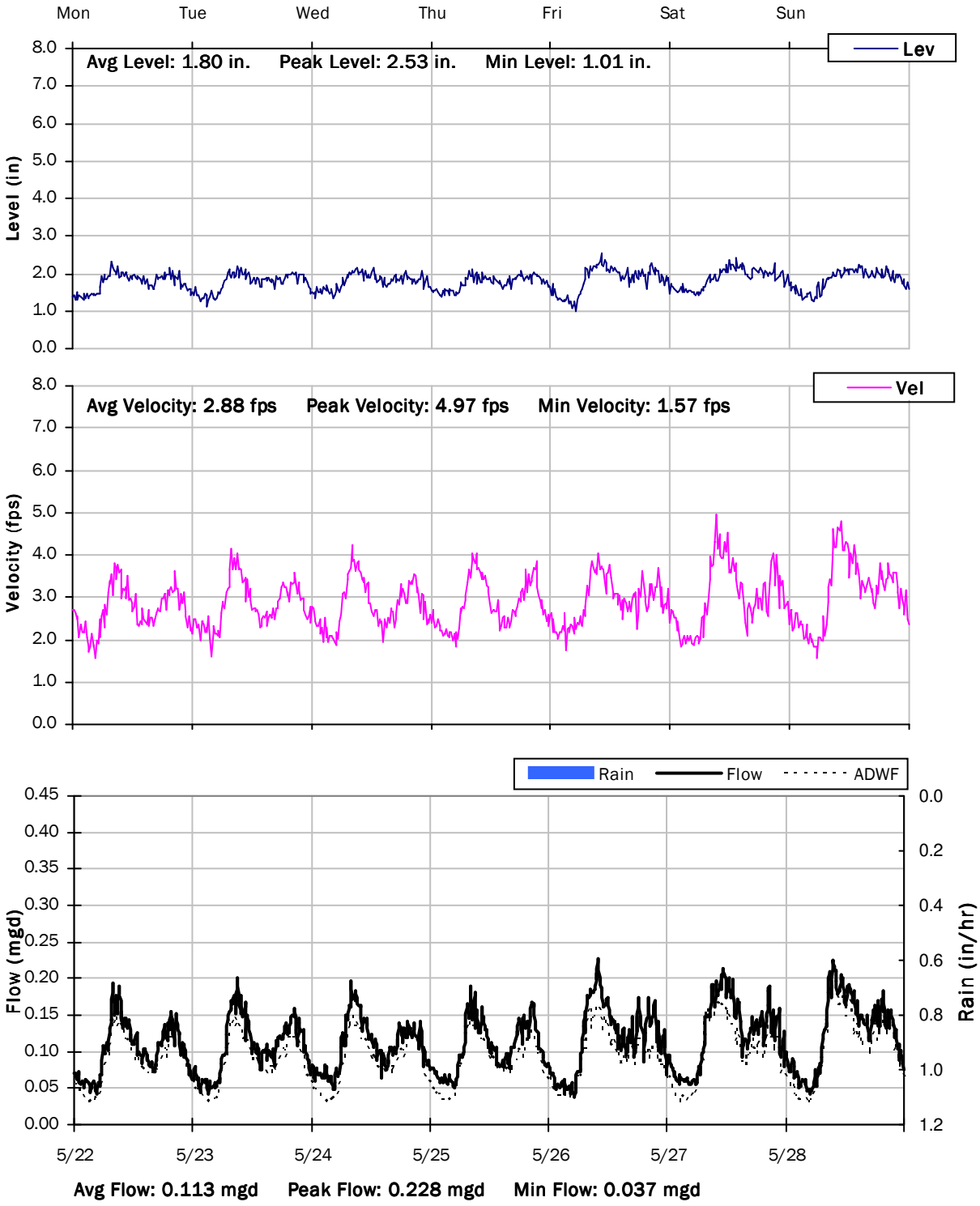
5/15/2017 to 5/22/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

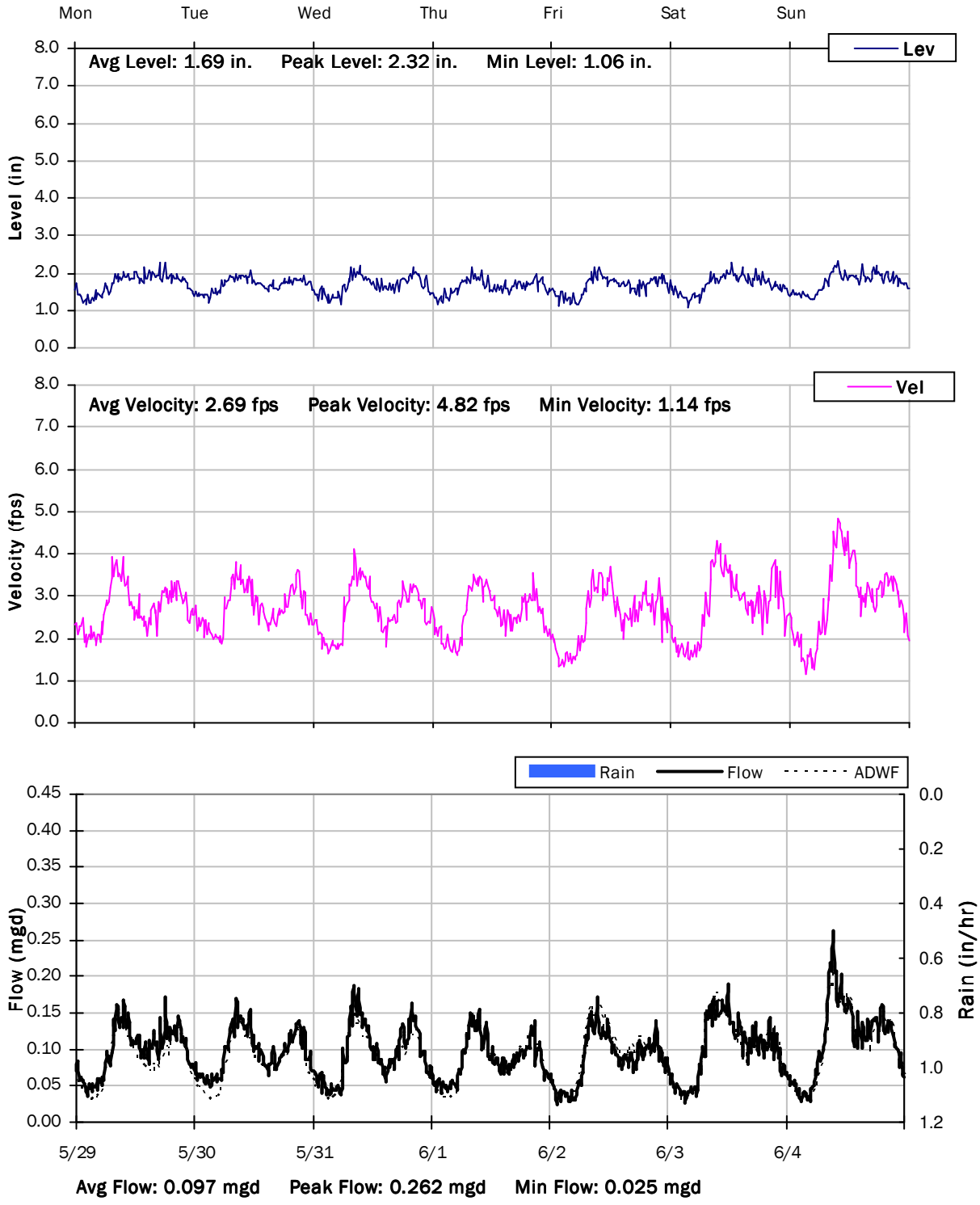
5/22/2017 to 5/29/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

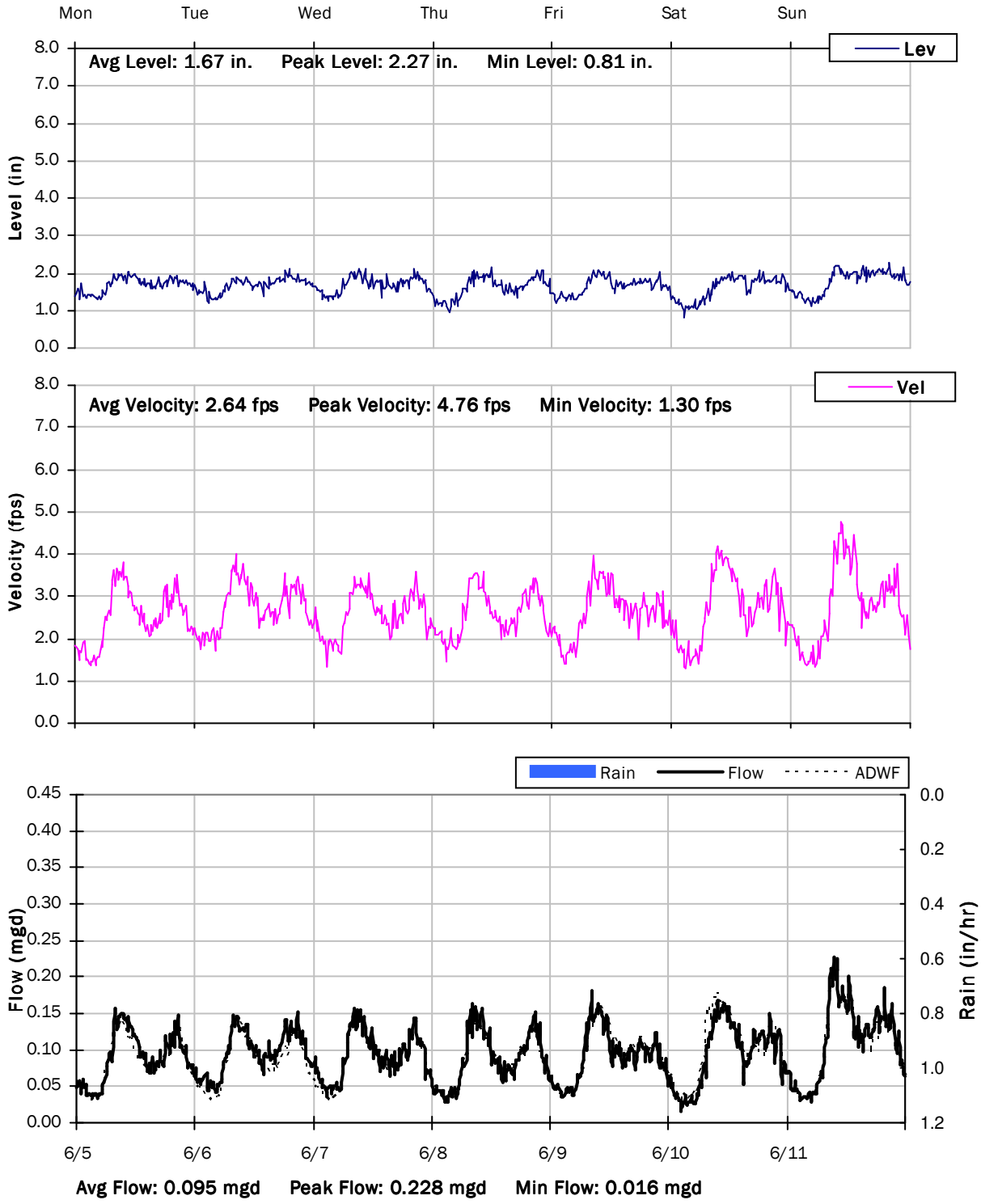
5/29/2017 to 6/5/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

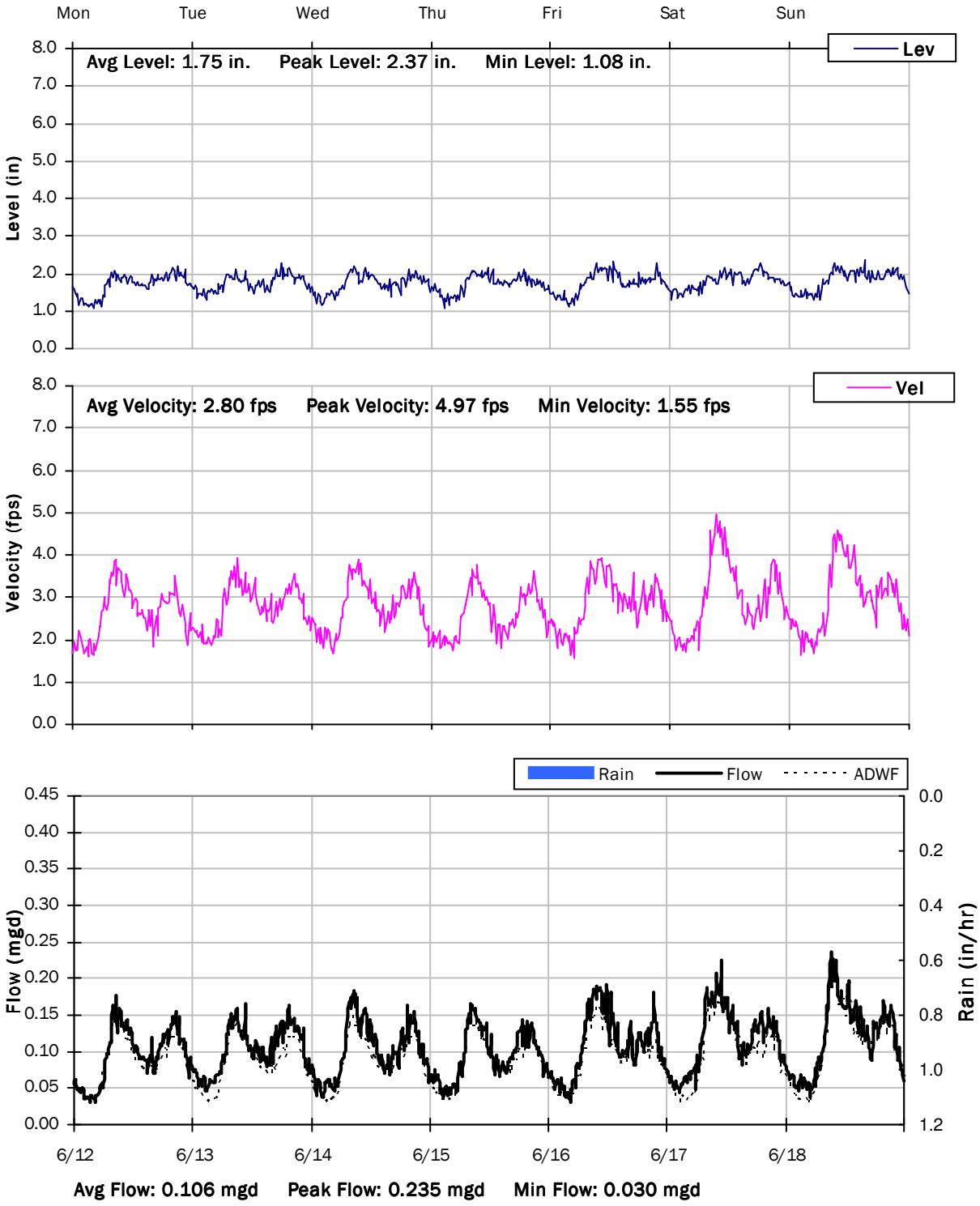
6/5/2017 to 6/12/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

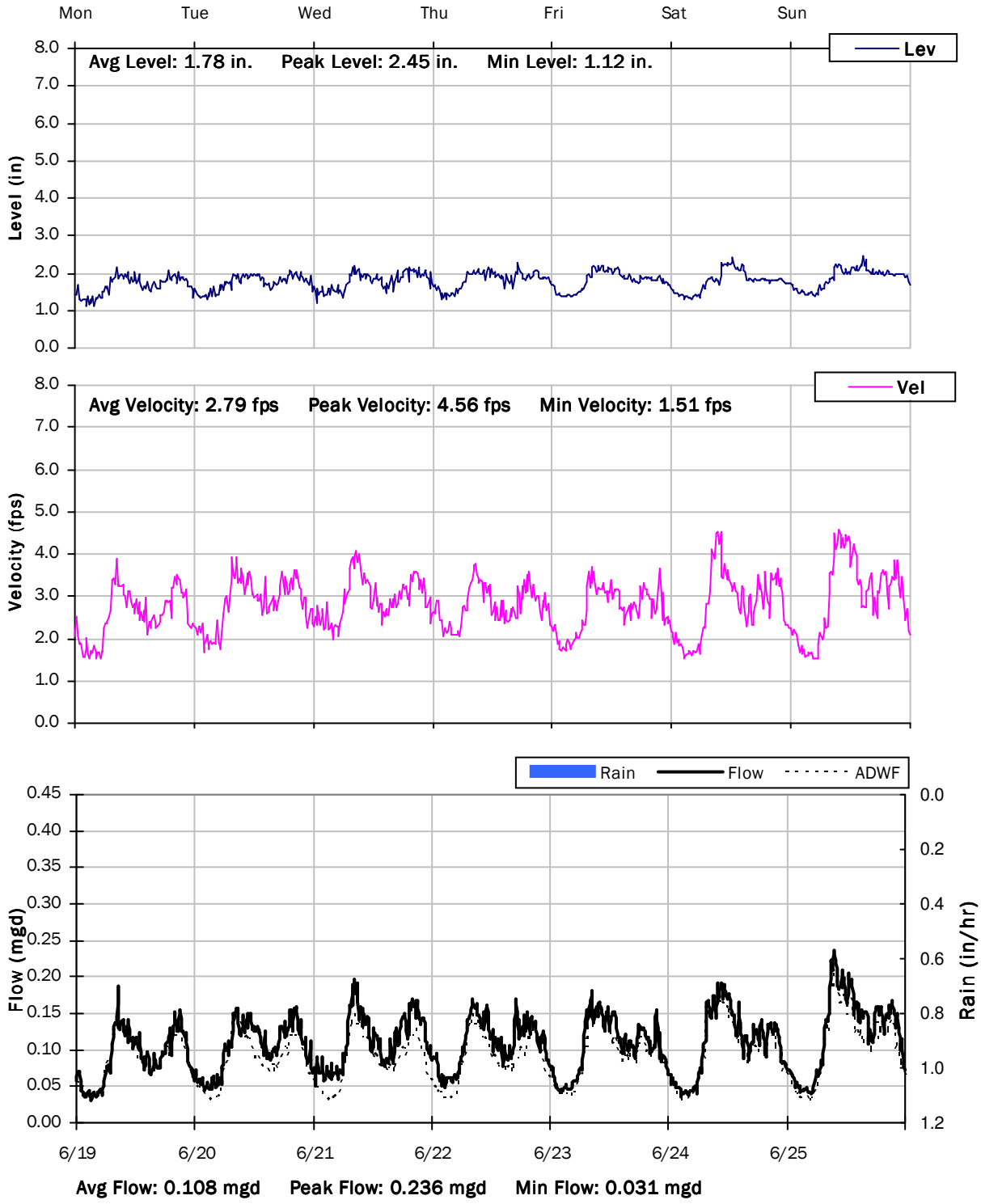
6/12/2017 to 6/19/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

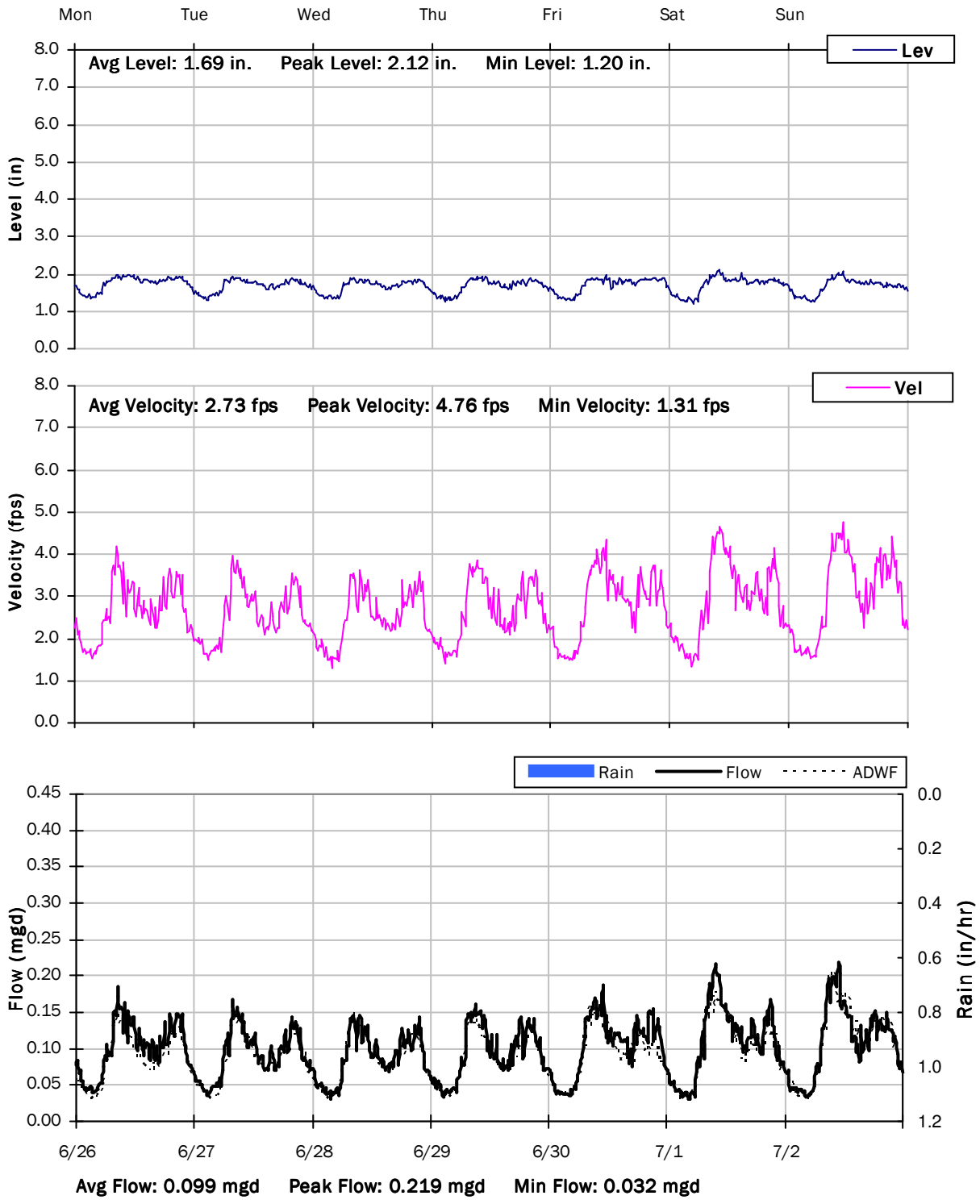
6/19/2017 to 6/26/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

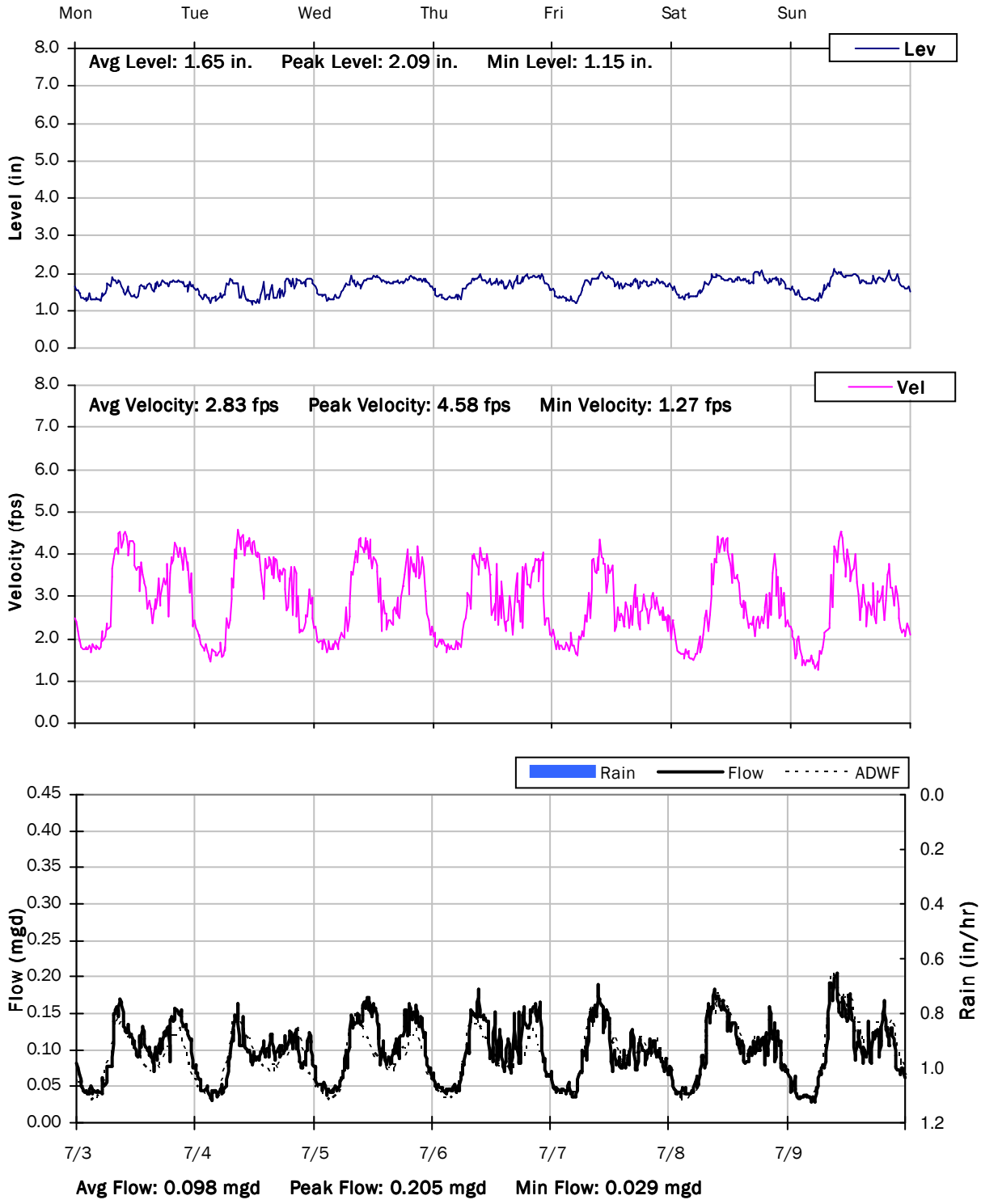
6/26/2017 to 7/3/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

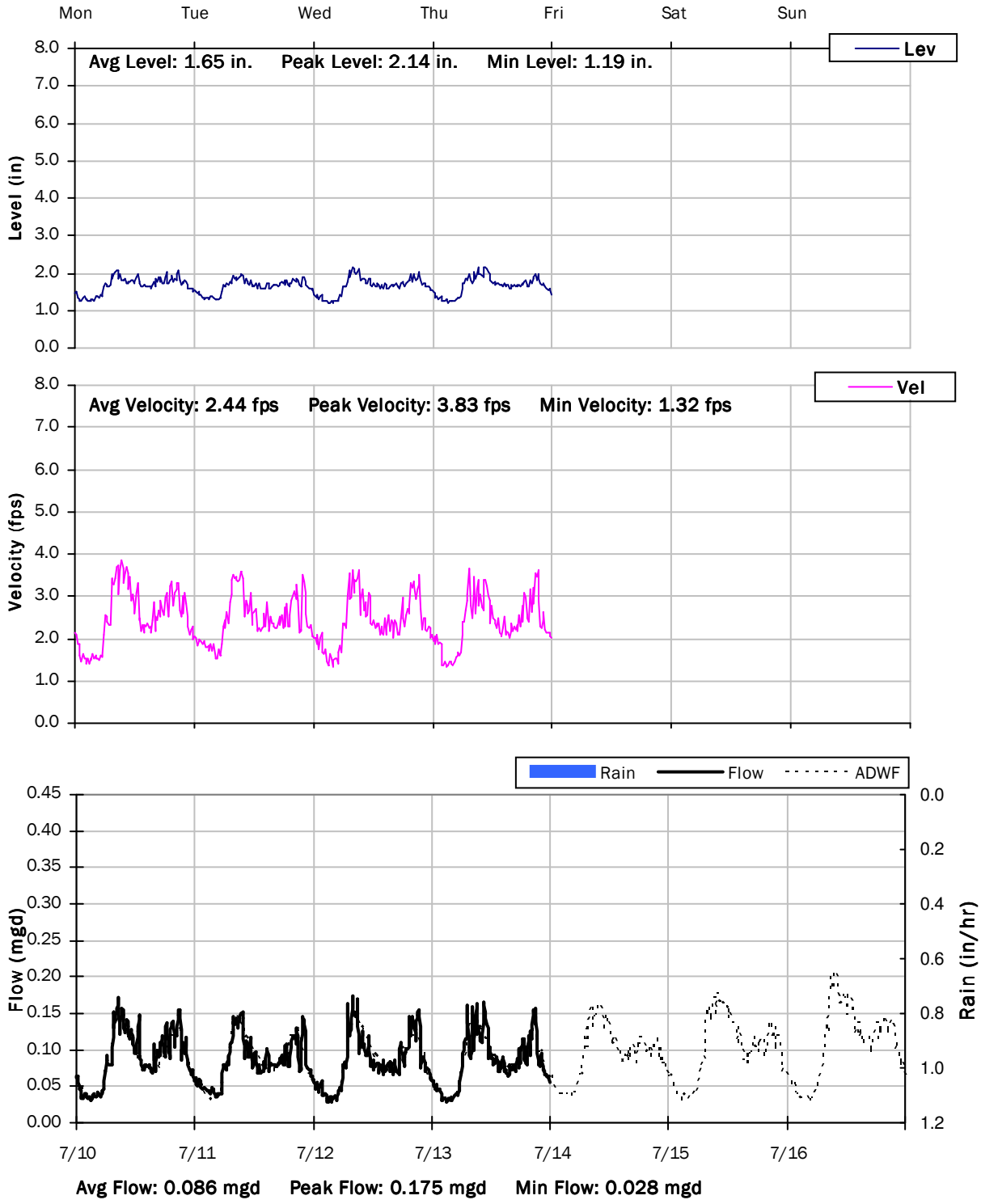
7/3/2017 to 7/10/2017



SITE 05

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

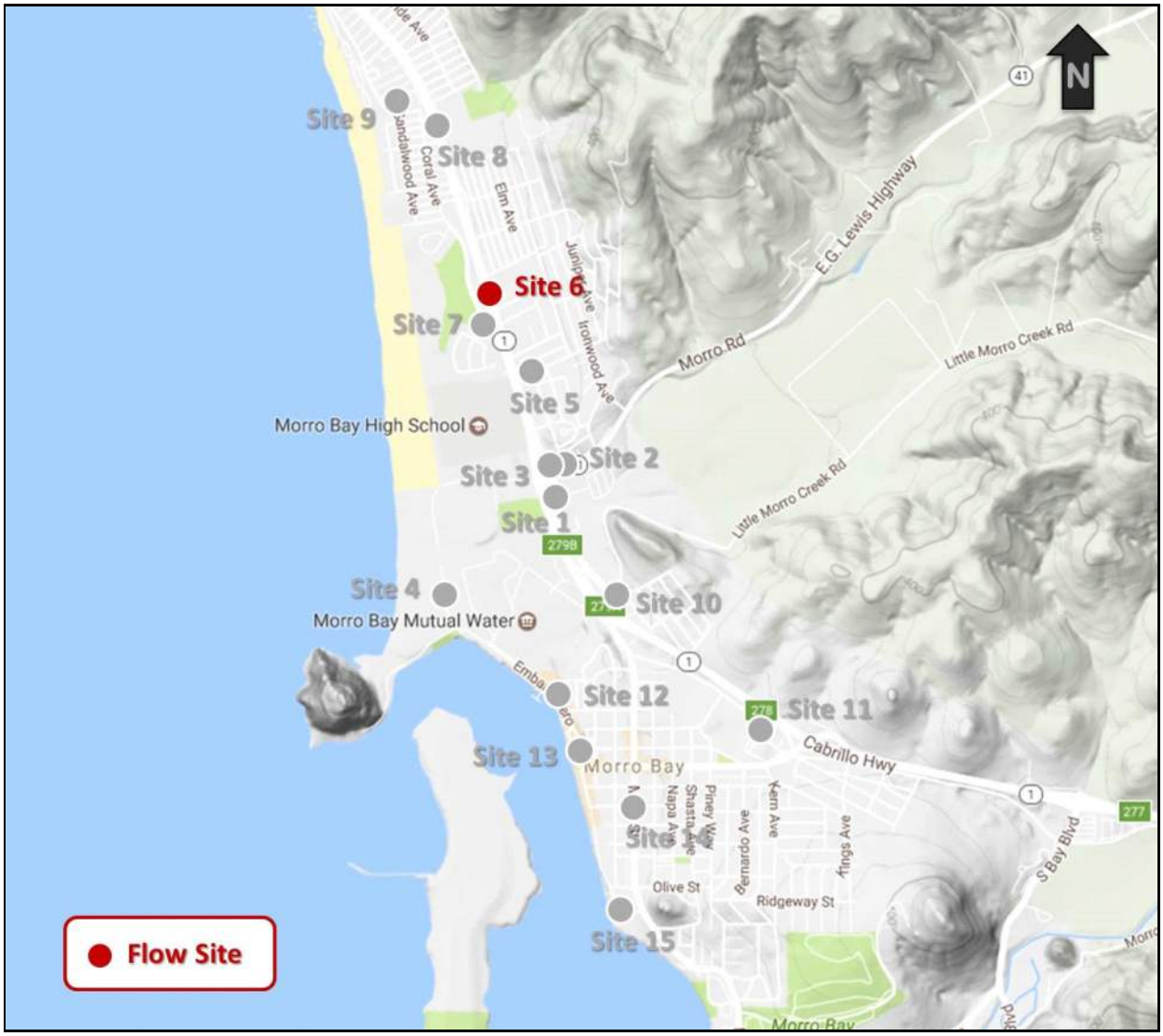
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 06

Location: Main Street, ~290 feet south of Elena Street, meter on north 13" inlet

Data Summary Report



Vicinity Map: Site 06

SITE 06

Site Information

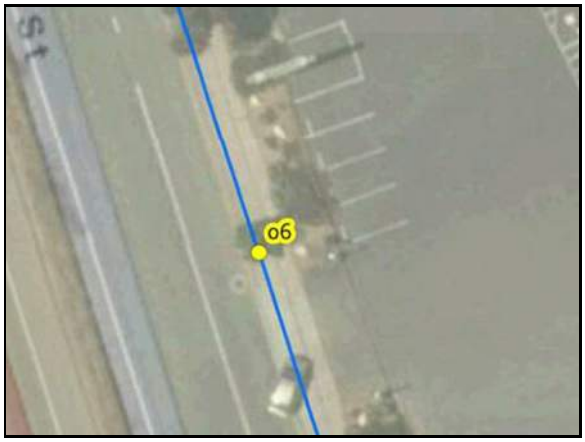
Location: Main Street, ~290 feet south of Elena Street, meter on north 13" inlet

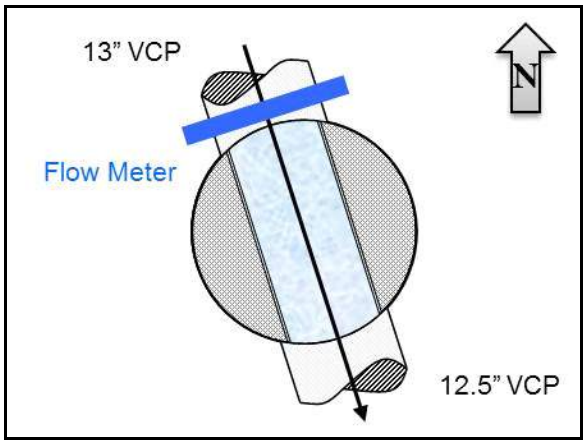


Pipe Diameter: 13 inches

ADWF: 0.112 mgd

Peak Measured Flow: 0.351 mgd









SITE 06

Additional Site Photos



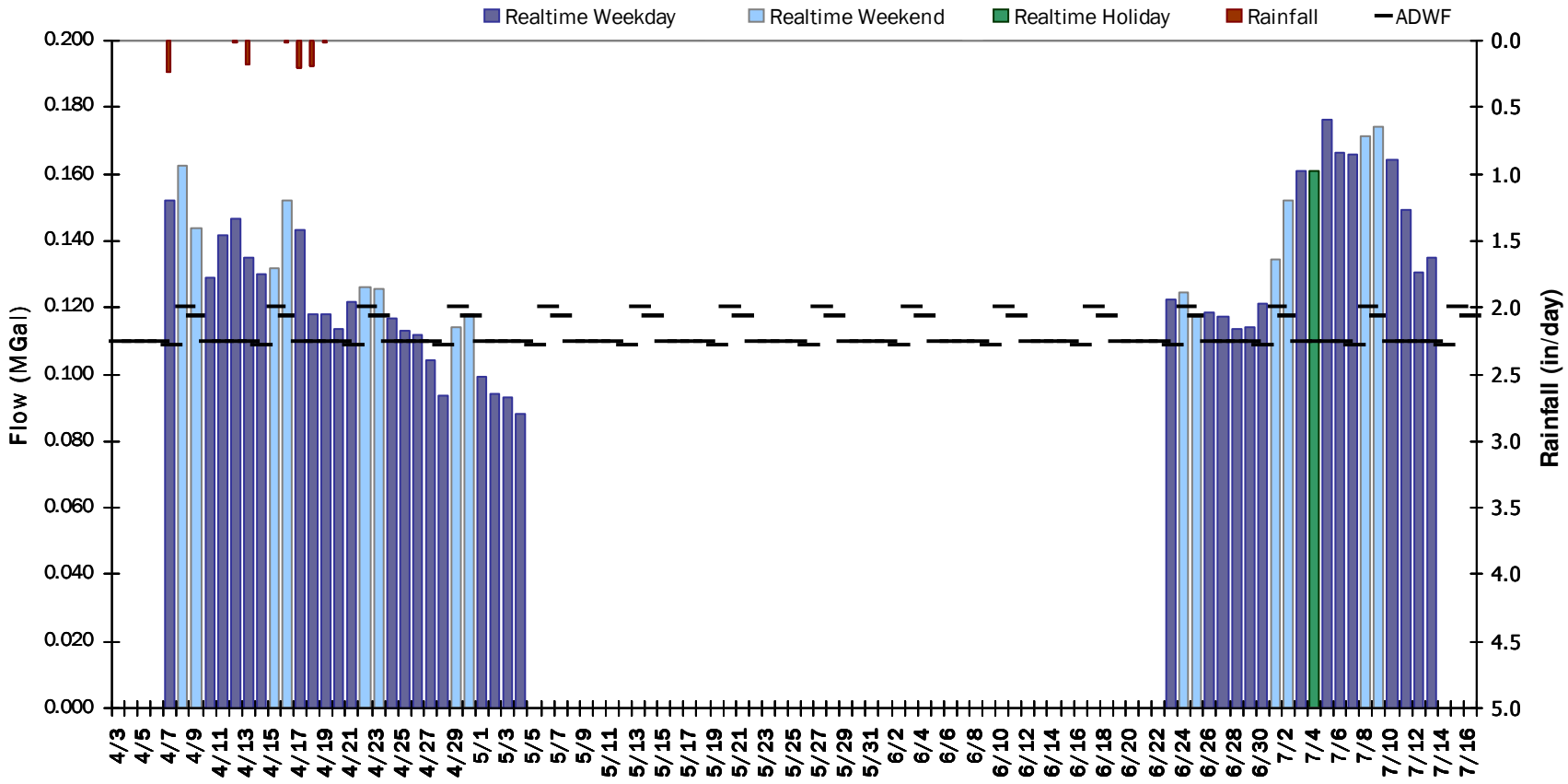


SITE 06

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.131 MGal Peak Daily Flow: 0.176 MGal Min Daily Flow: 0.088 MGal

Total Period Rainfall: 0.85 inches

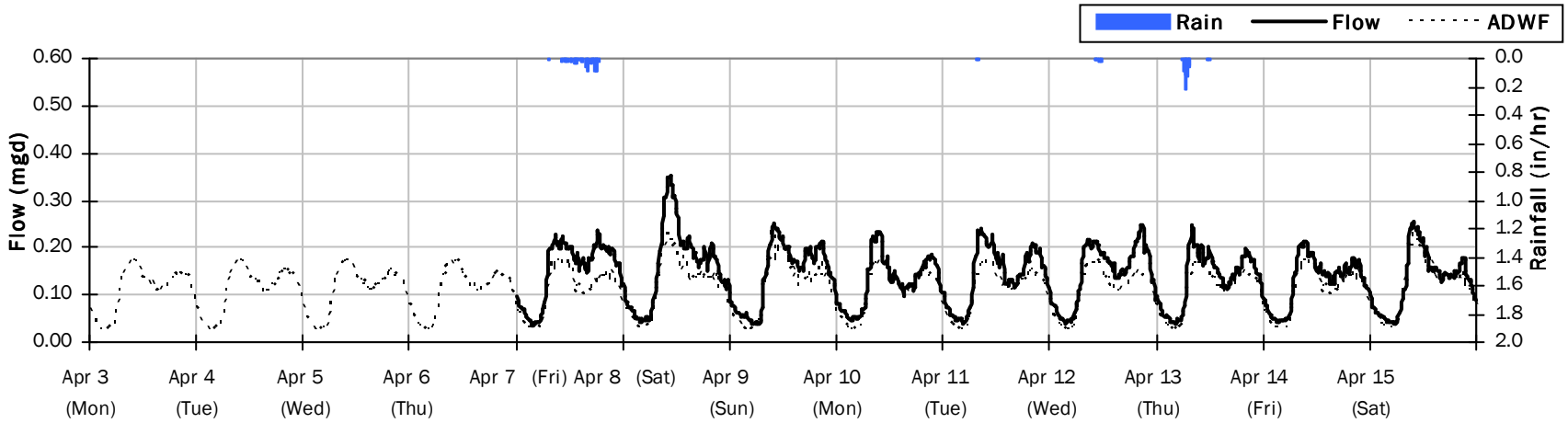


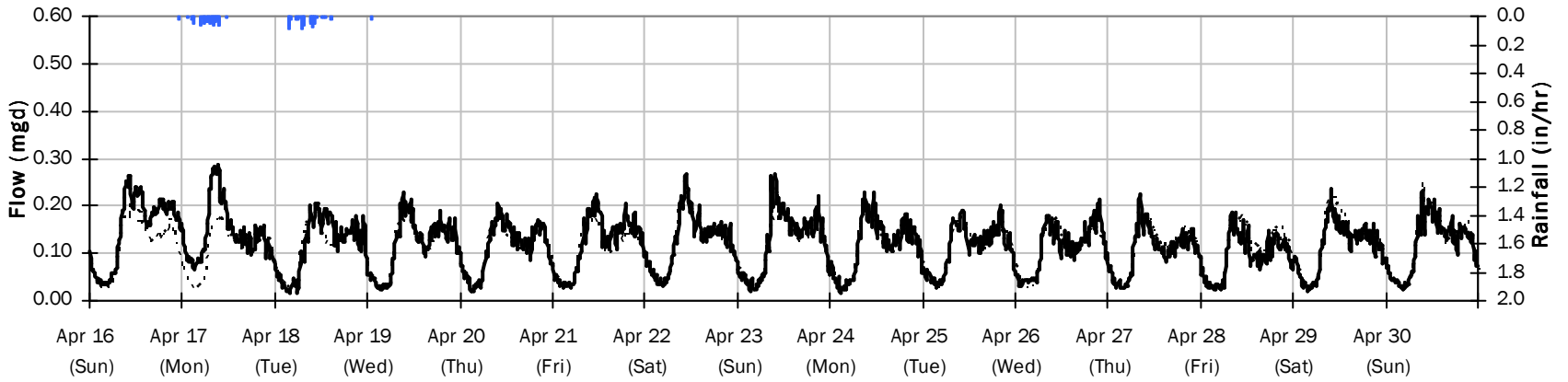
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 06

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.128 mgd** **Peak Flow: 0.351 mgd** **Min Flow: 0.014 mgd**

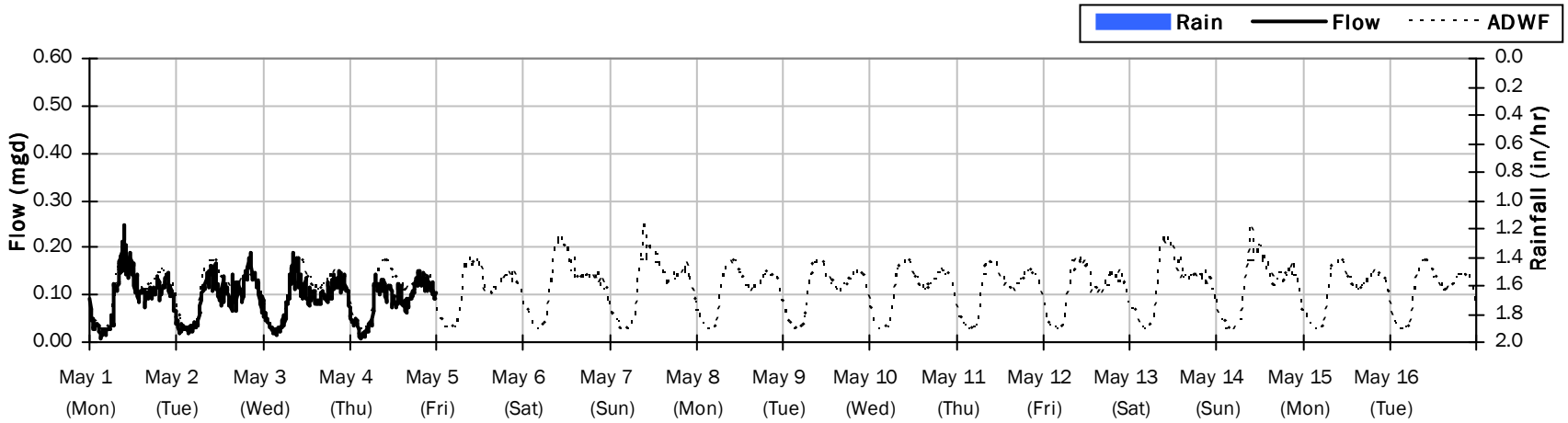


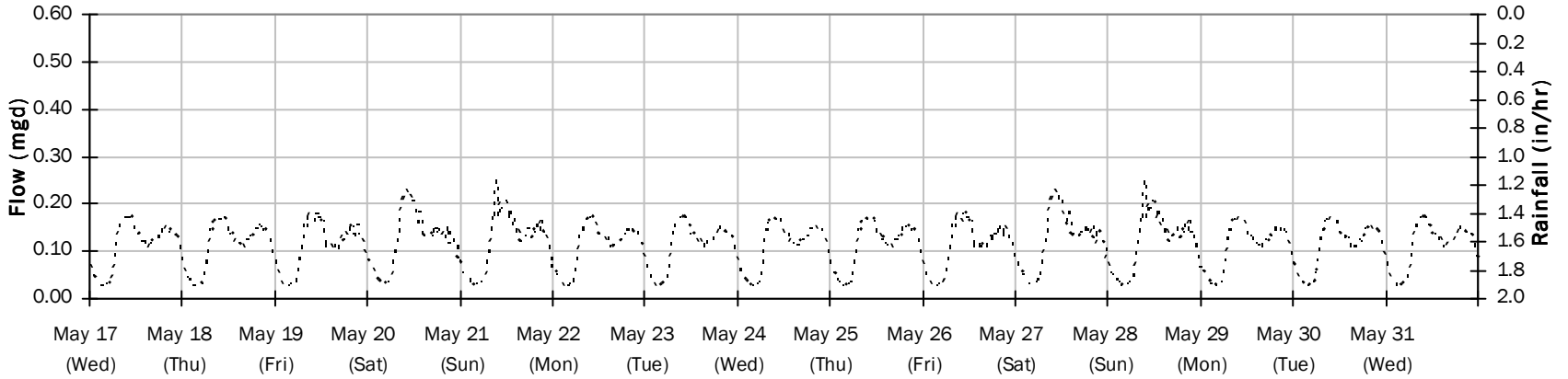


SITE 06

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.094 mgd** **Peak Flow: 0.248 mgd** **Min Flow: 0.008 mgd**



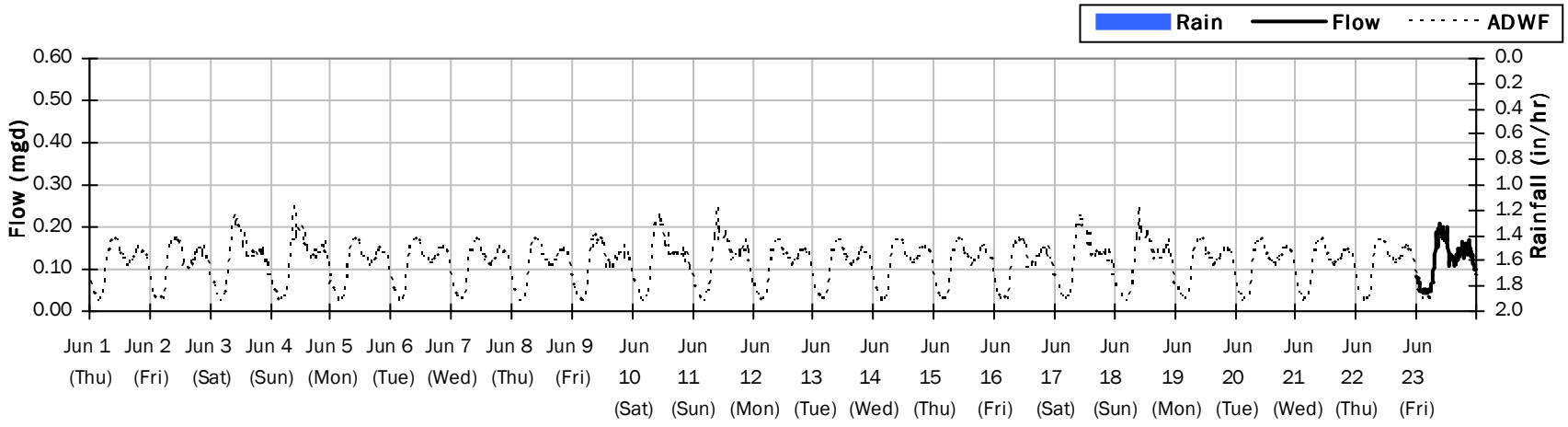


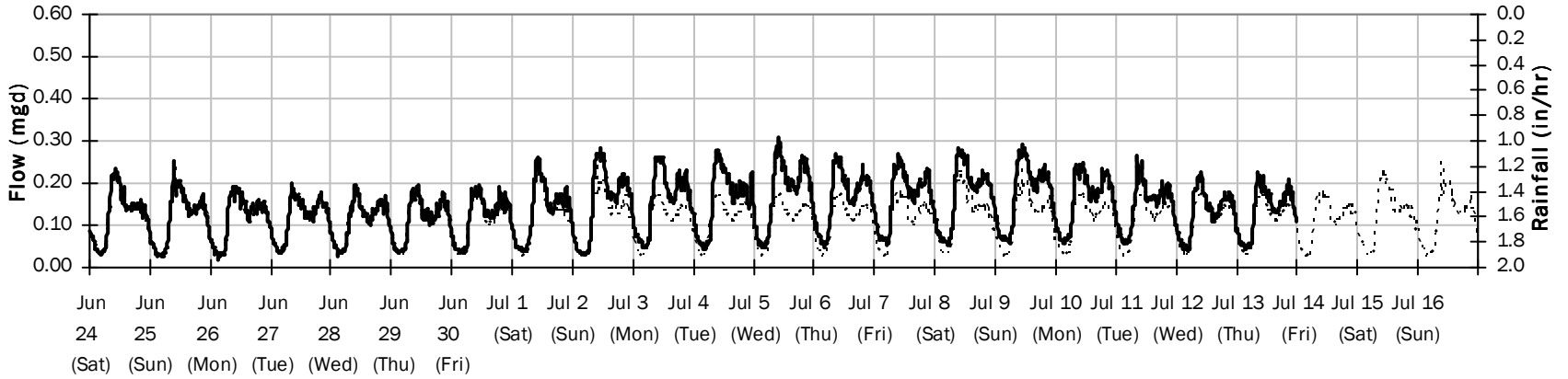
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 06

Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.142 mgd** **Peak Flow: 0.311 mgd** **Min Flow: 0.019 mgd**

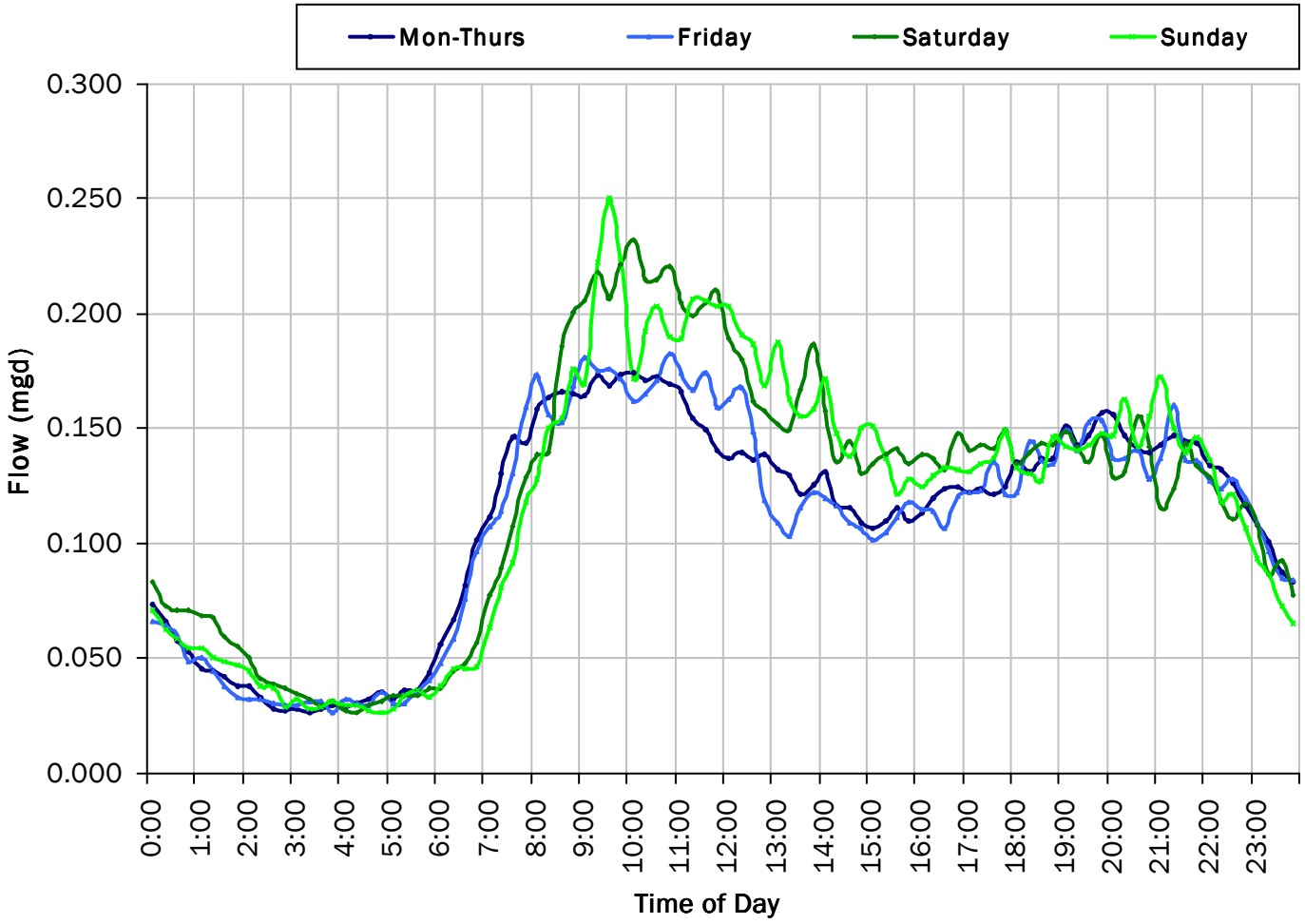




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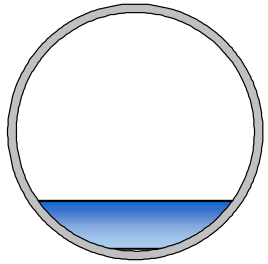
SITE 06

Average Dry Weather Flow Hydrographs



ADWF:

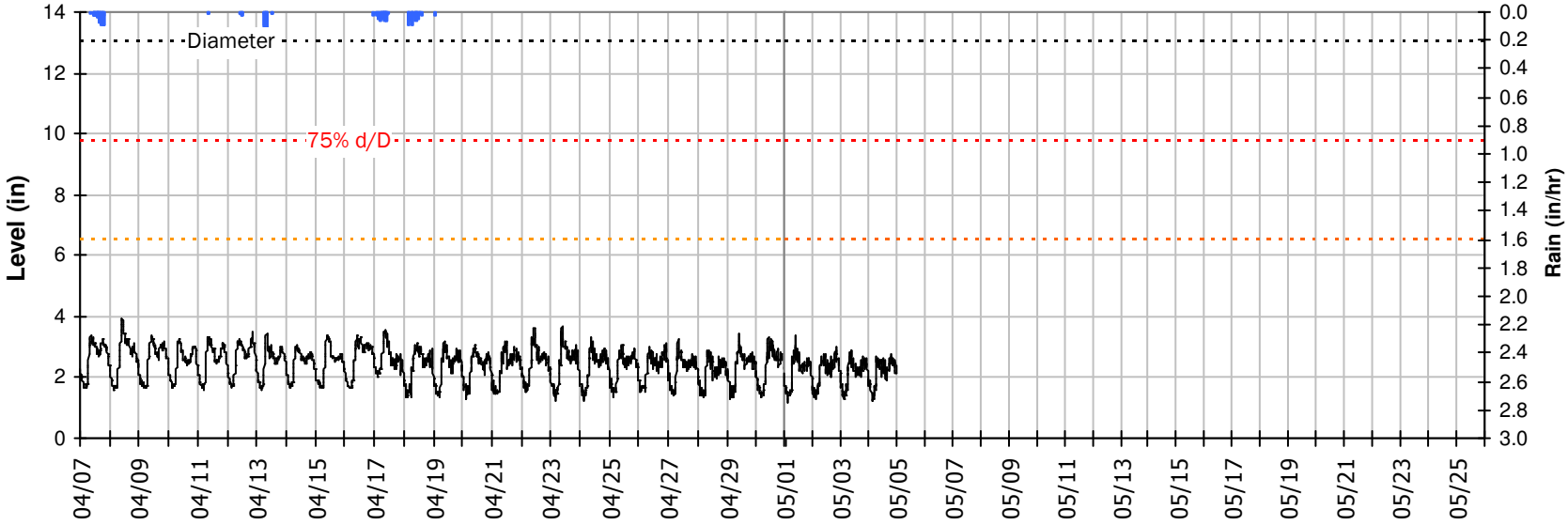
0.112 *mgd*

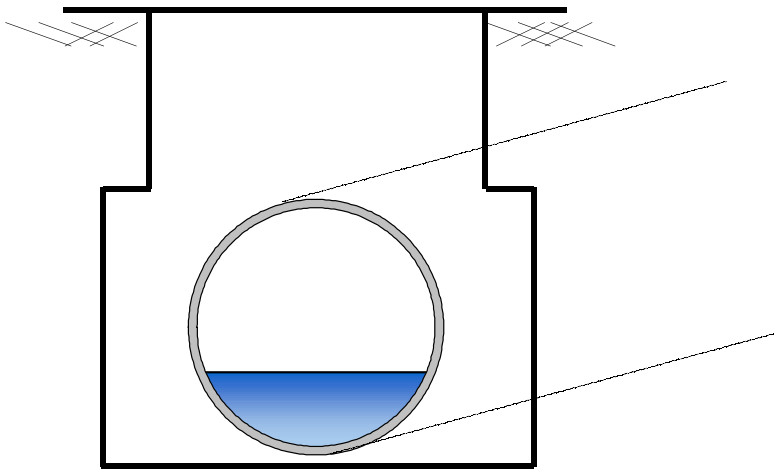


SITE 06

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





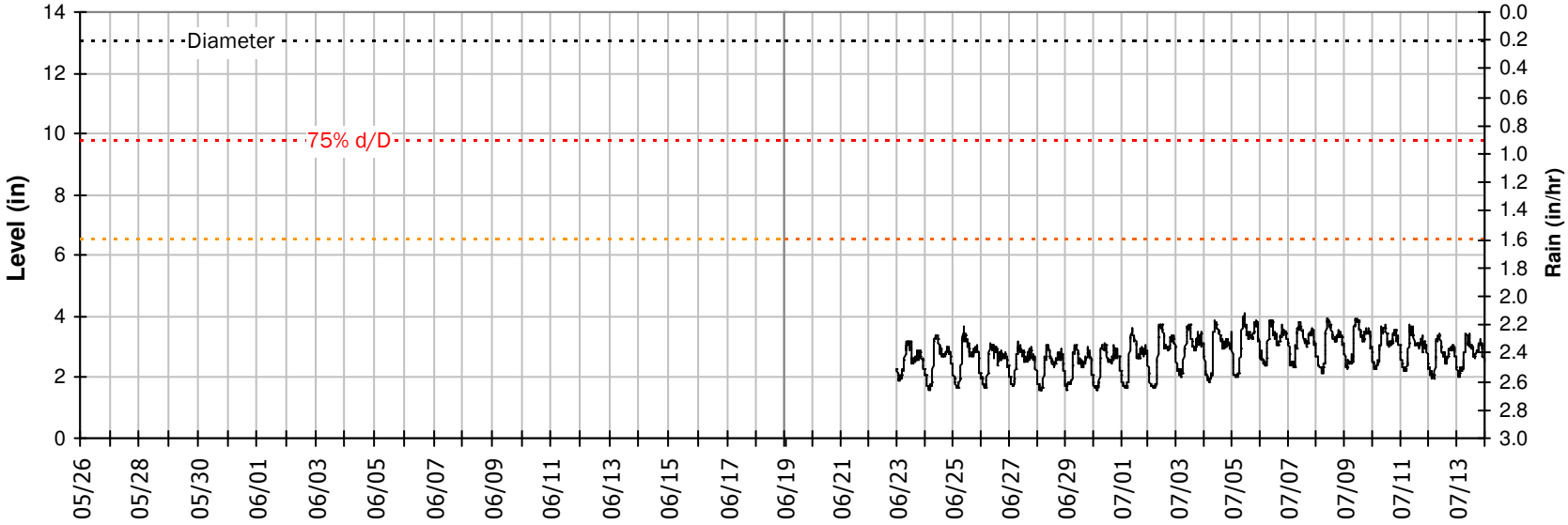
Pipe Diameter:	13	*inches*
Peak Measured Level:	4.1	*inches*
Peak d/D Ratio:	0.32	

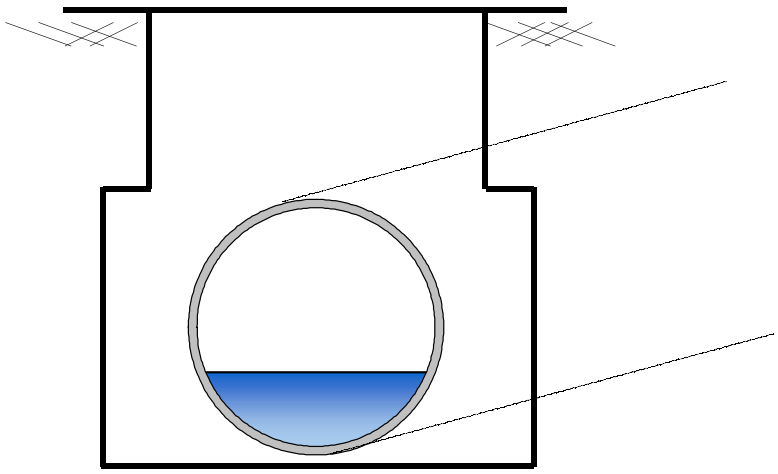
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SITE 06

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





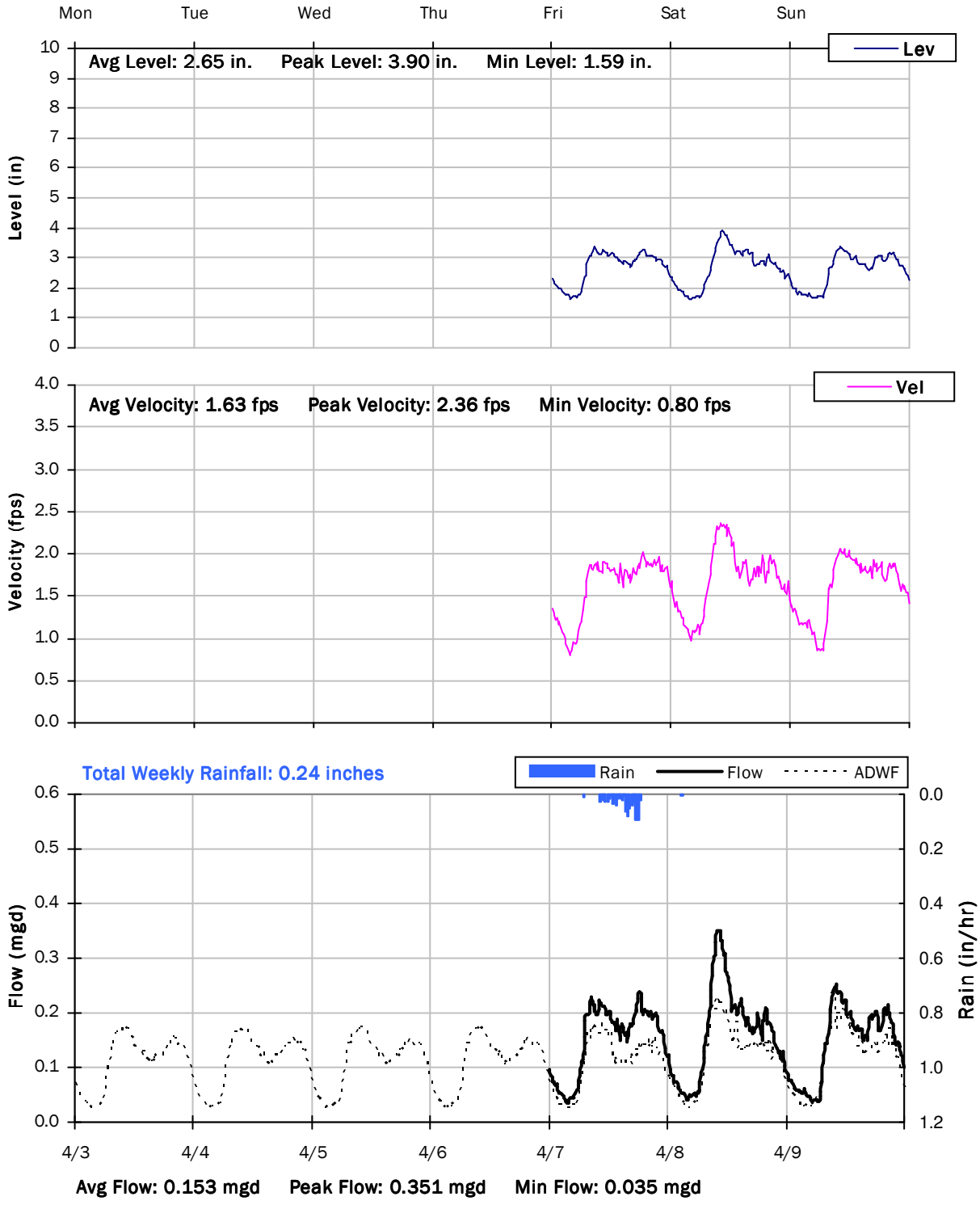
Pipe Diameter:	13	*inches*
Peak Measured Level:	4.1	*inches*
Peak d/D Ratio:	0.32	

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

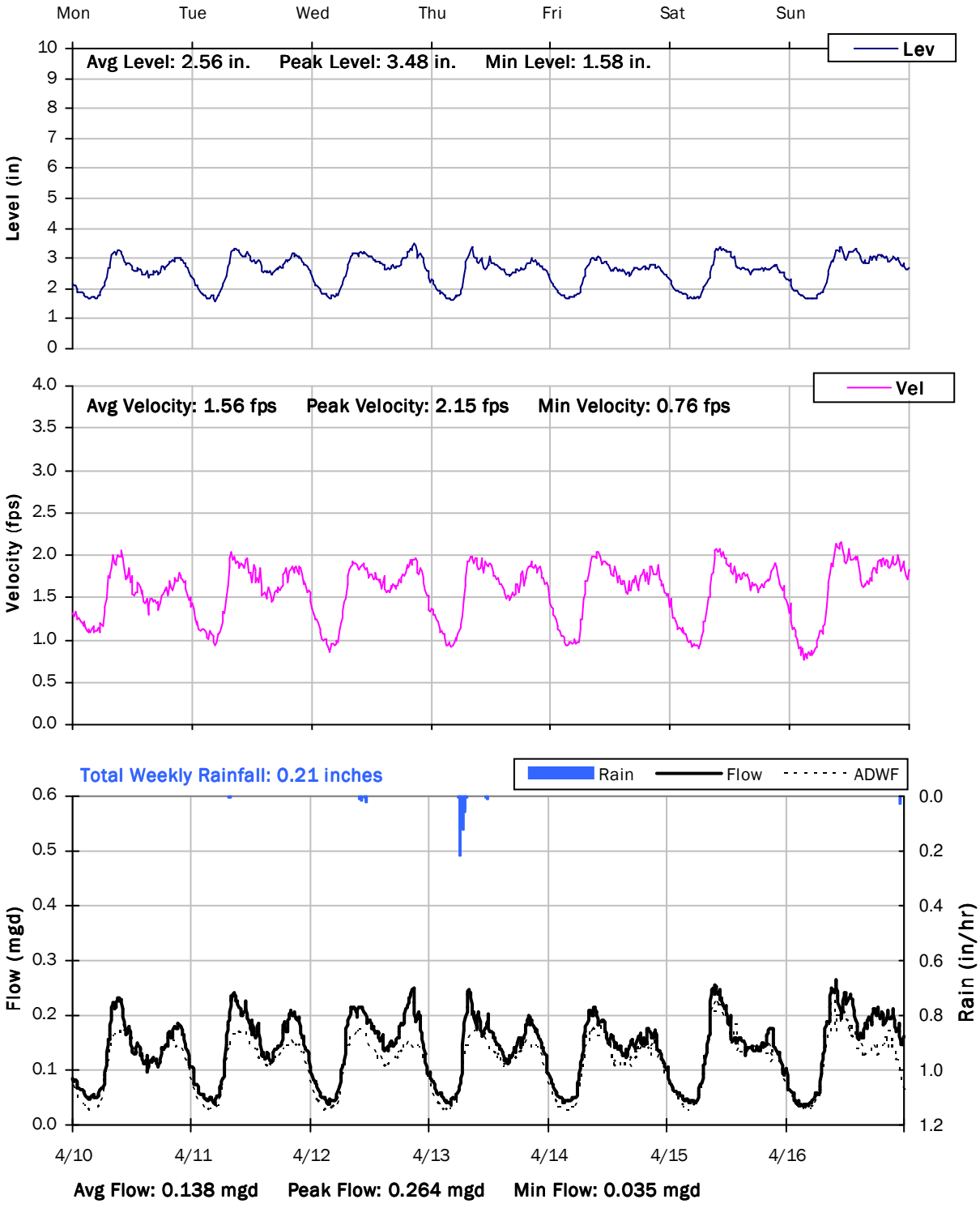
4/3/2017 to 4/10/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

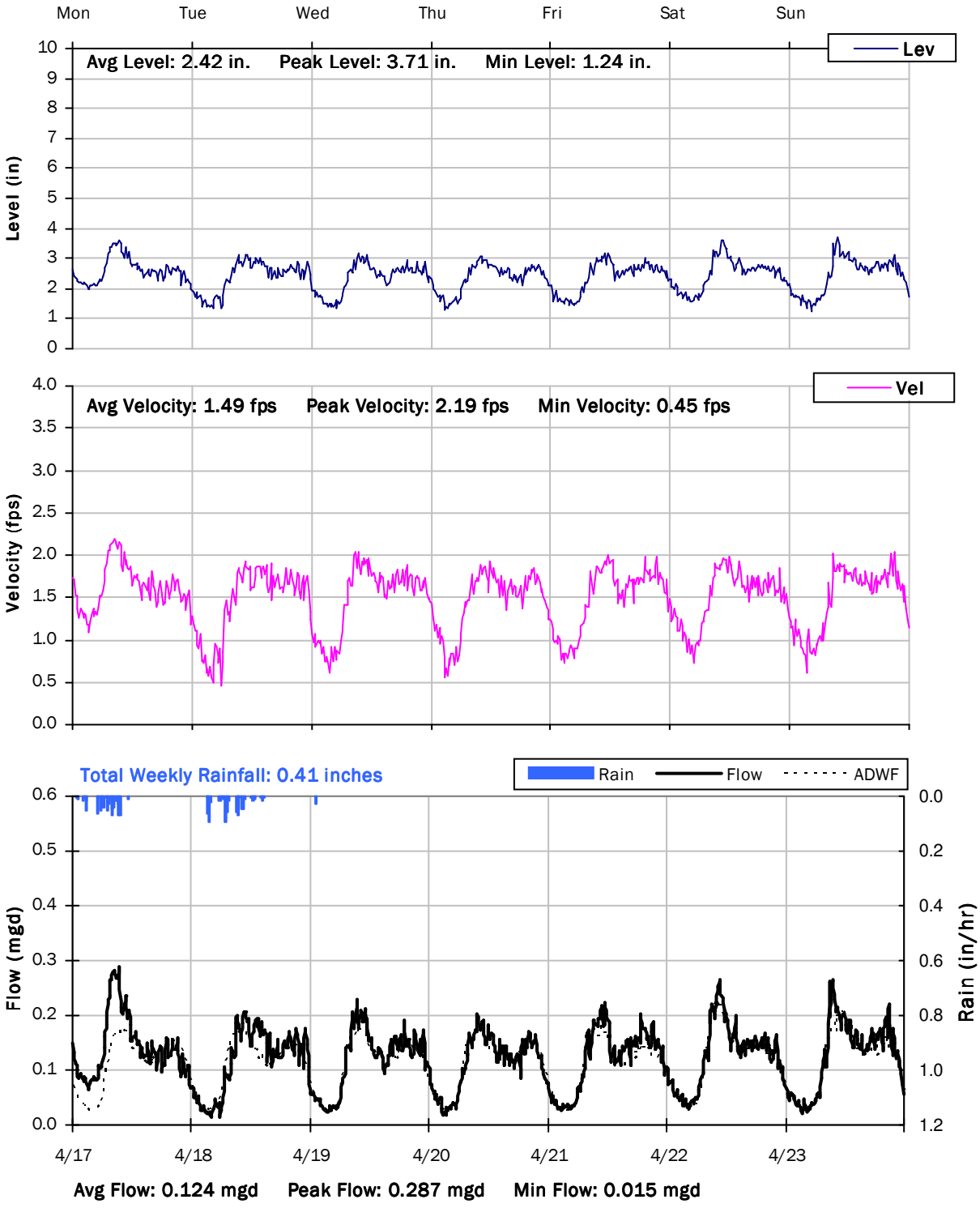
4/10/2017 to 4/17/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

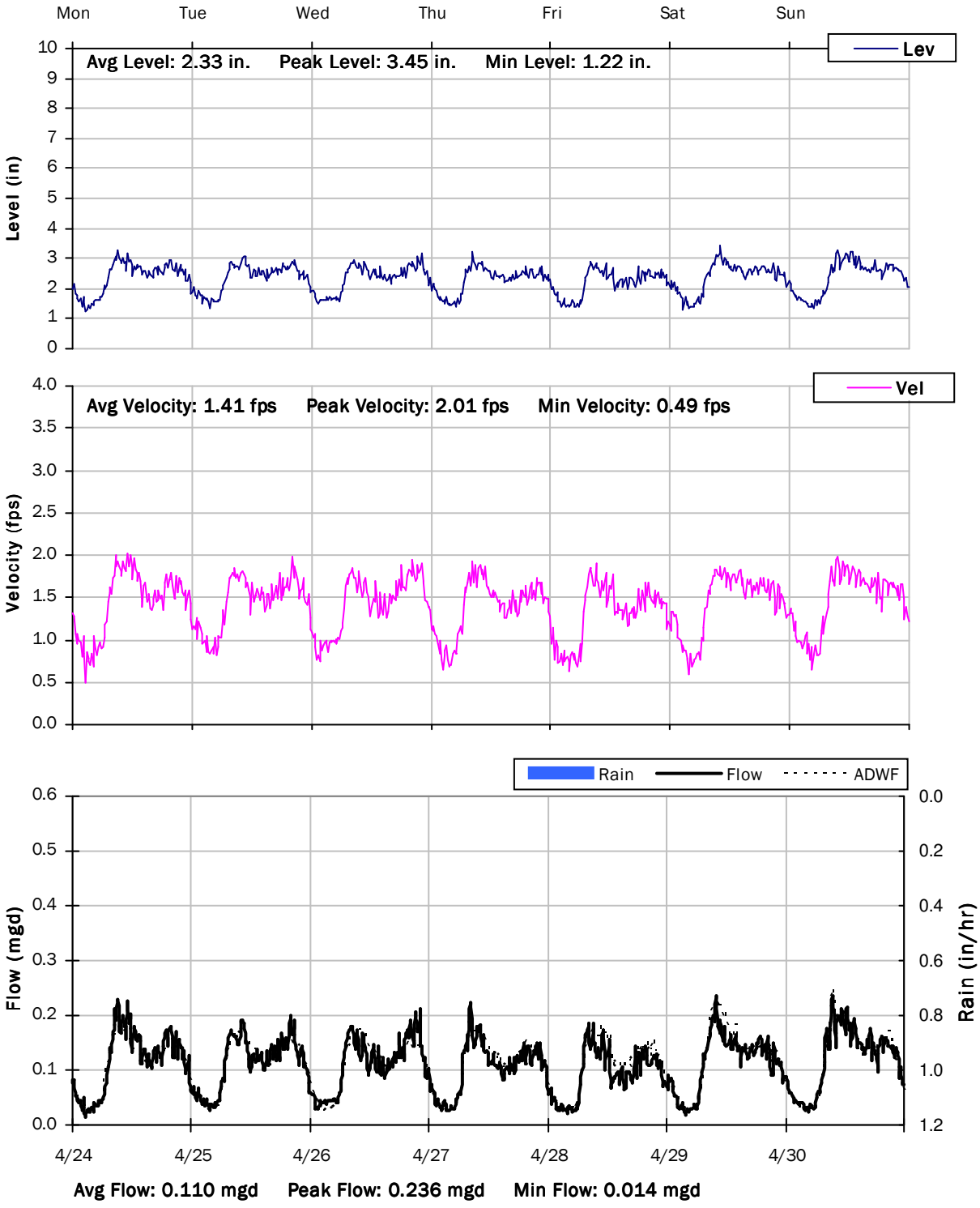
4/17/2017 to 4/24/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

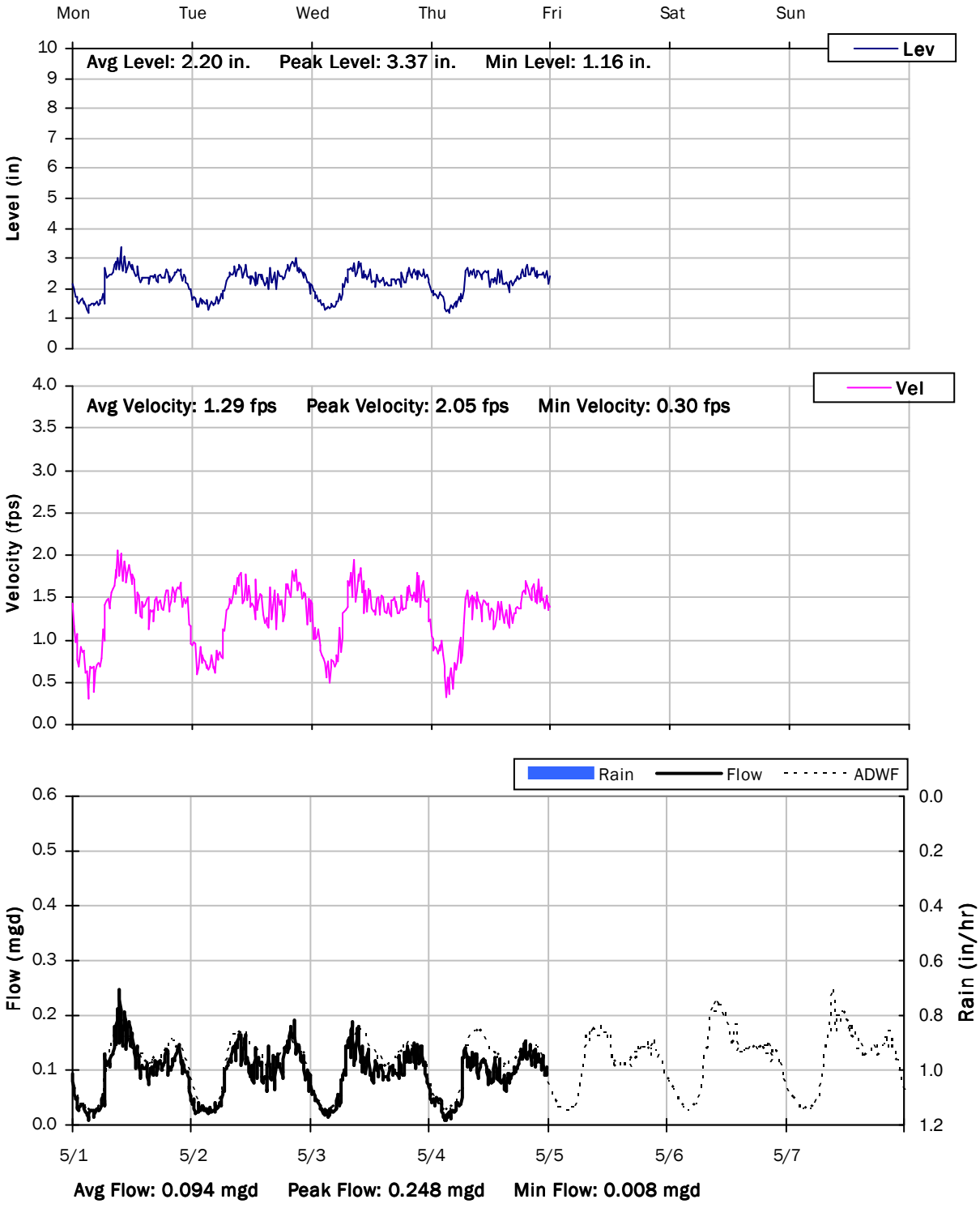
4/24/2017 to 5/1/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

5/1/2017 to 5/8/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

5/8/2017 to 5/15/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

5/15/2017 to 5/22/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

5/22/2017 to 5/29/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

5/29/2017 to 6/5/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

6/5/2017 to 6/12/2017

As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

6/12/2017 to 6/19/2017

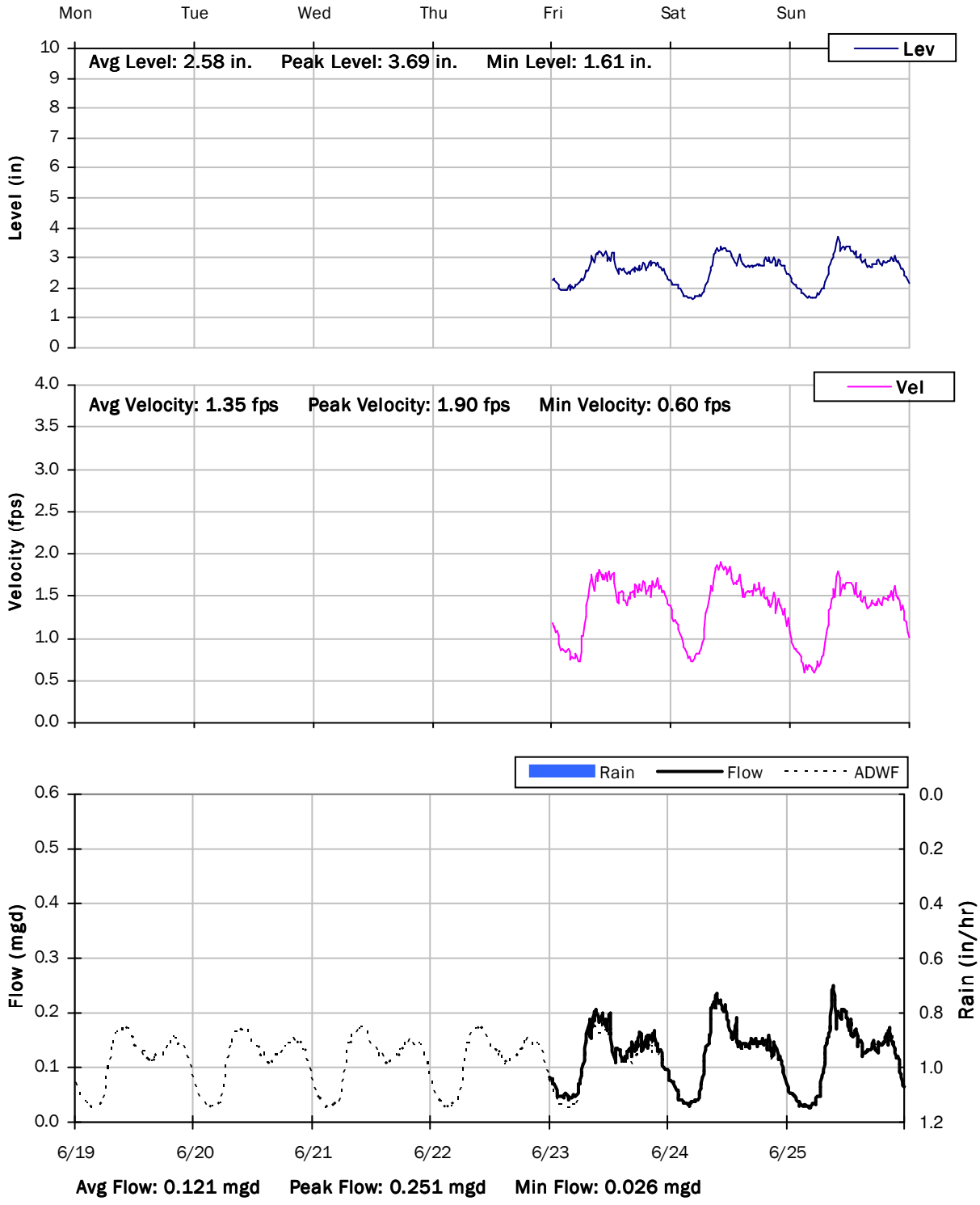
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No reportable data this week.

SITE 06

Weekly Level, Velocity and Flow Hydrographs

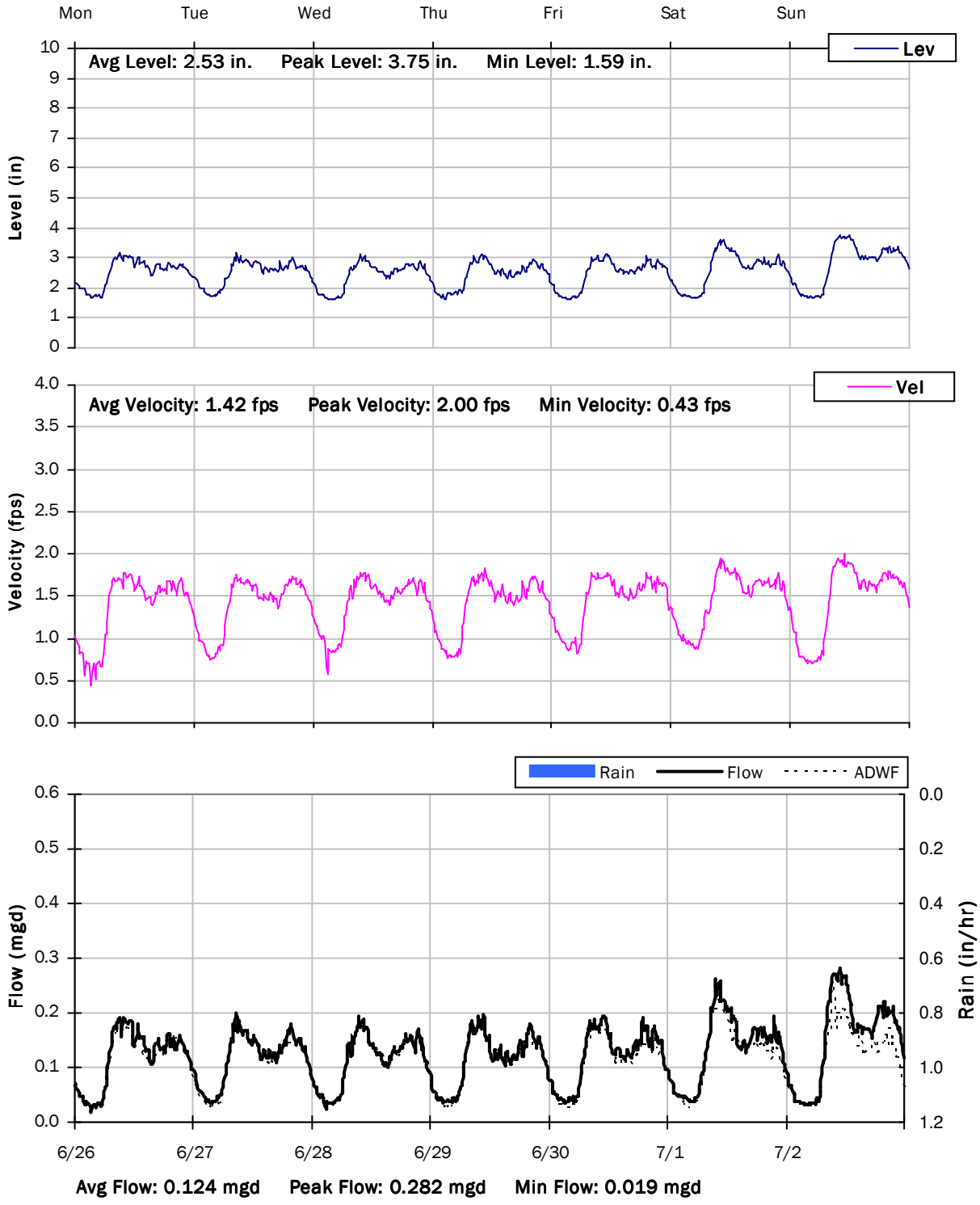
6/19/2017 to 6/26/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

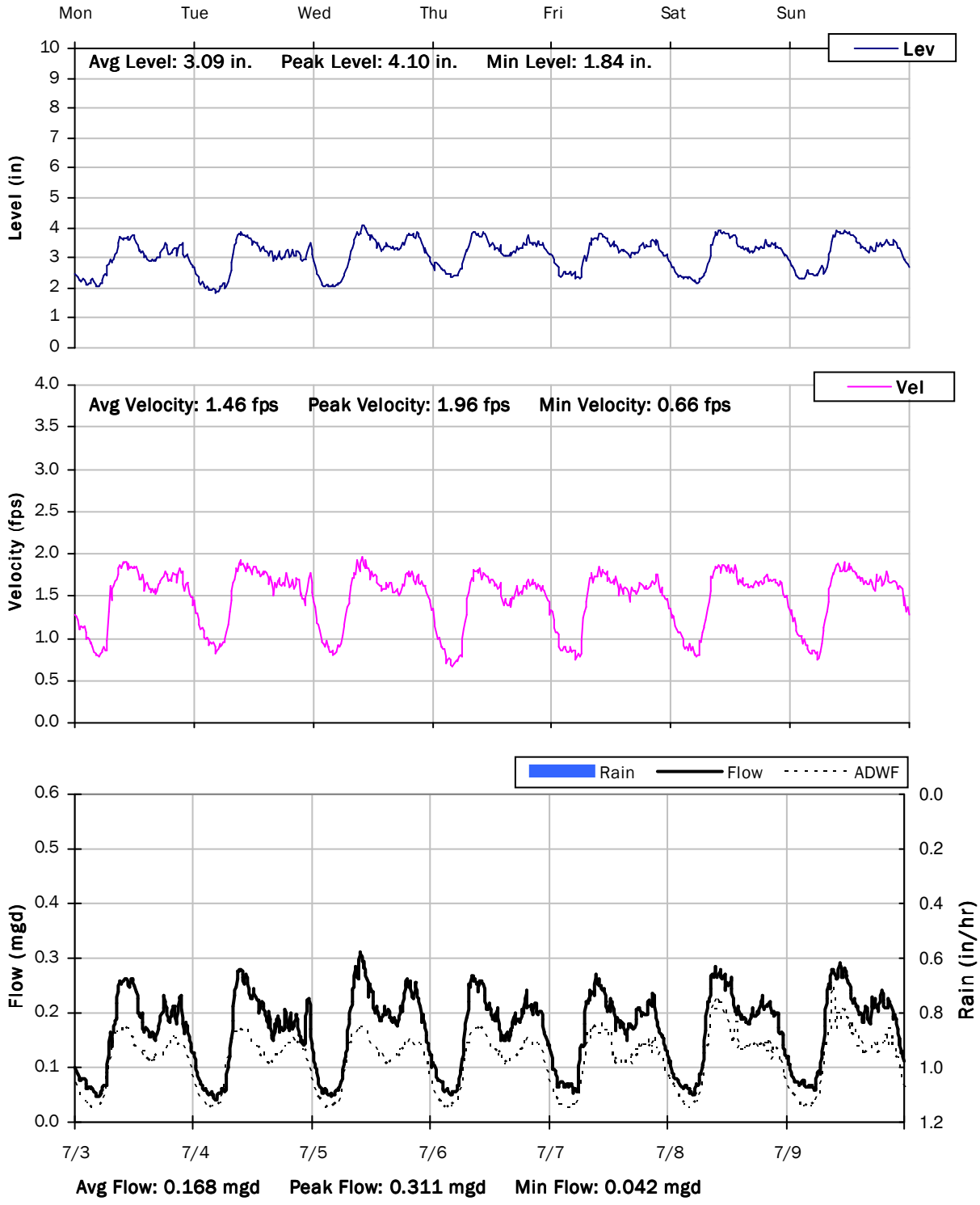
6/26/2017 to 7/3/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

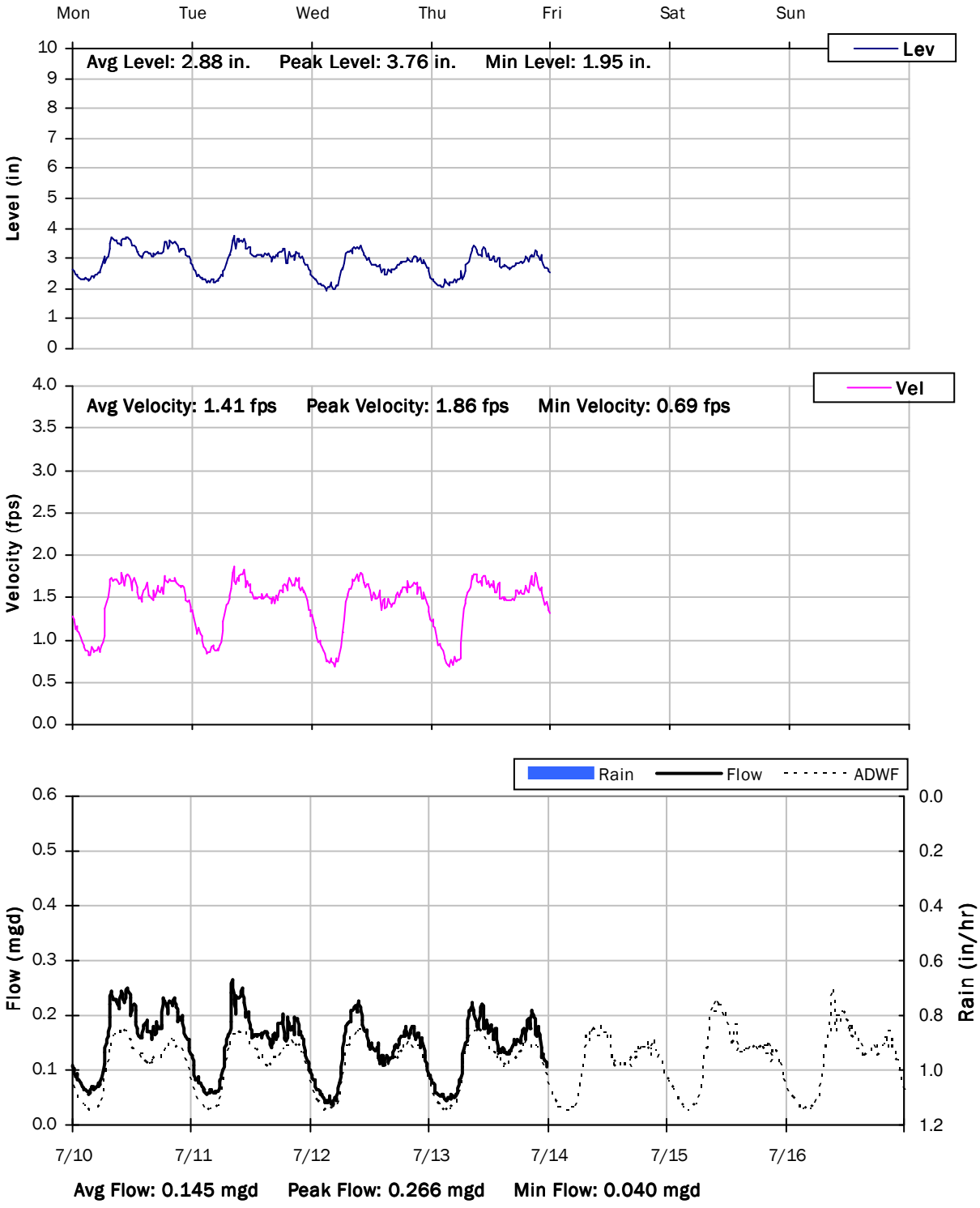
7/3/2017 to 7/10/2017



SITE 06

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

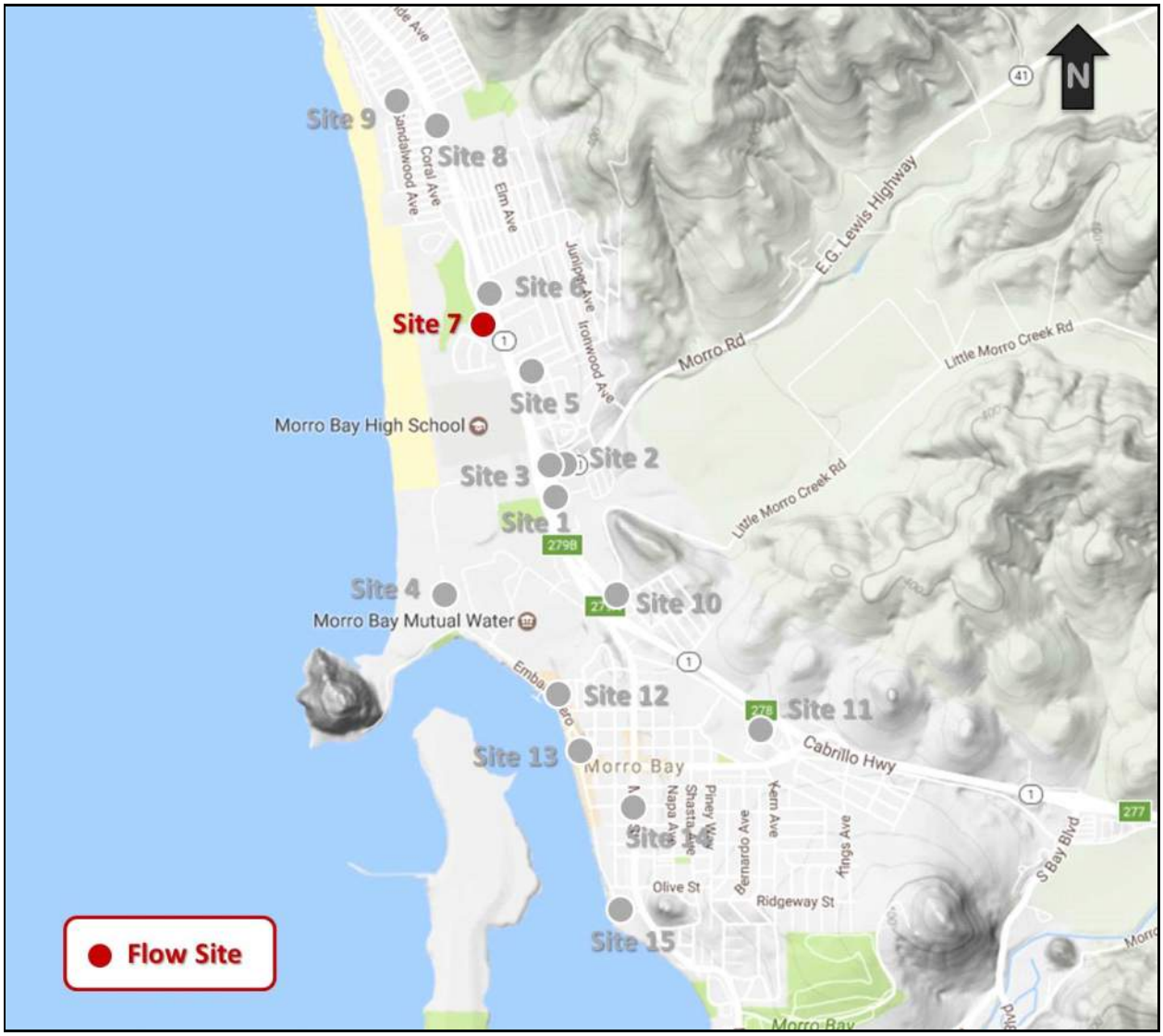
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 07

Location: Coral Avenue, ~630 feet north of Emerald Circle, meter on north 9.75" inlet

Data Summary Report



Vicinity Map: Site 07

SITE 07

Site Information

Location: Coral Avenue, ~630 feet north of Emerald Circle, meter on north 9.75" inlet

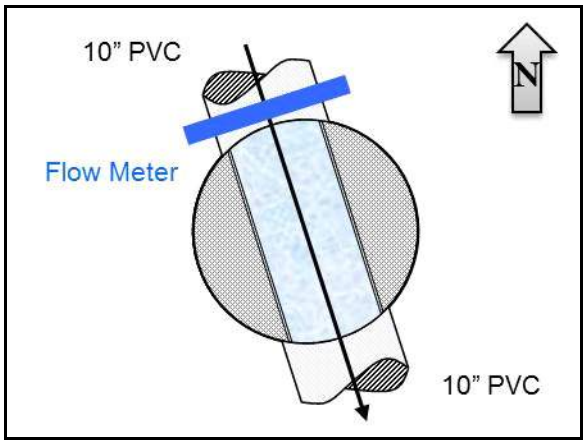


Pipe Diameter: 9.75 inches

ADWF: 0.040 mgd

Peak Measured Flow: 0.164 mgd









SITE 07

Additional Site Photos



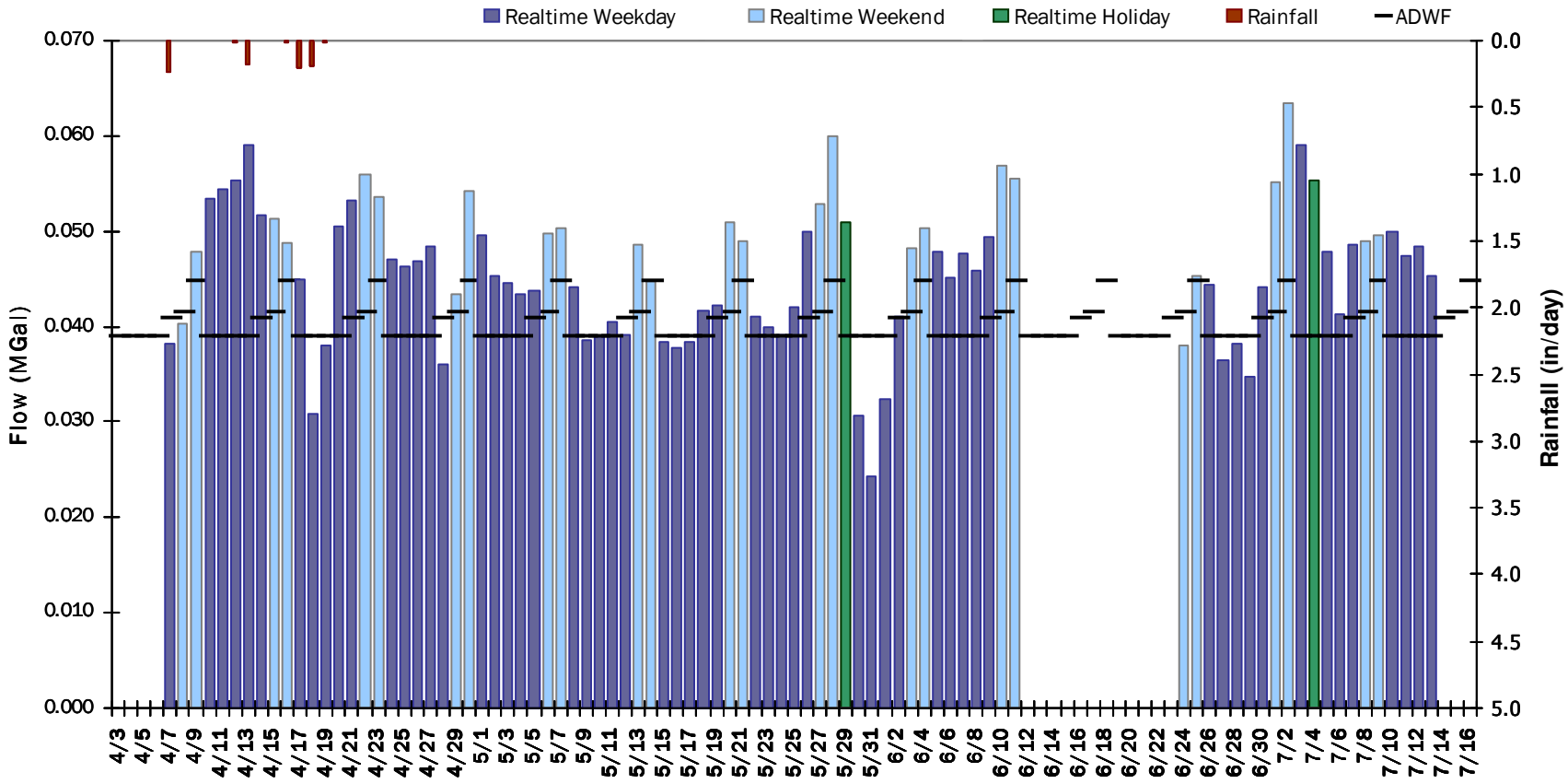


SITE 07

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.046 MGal Peak Daily Flow: 0.063 MGal Min Daily Flow: 0.024 MGal

Total Period Rainfall: 0.85 inches

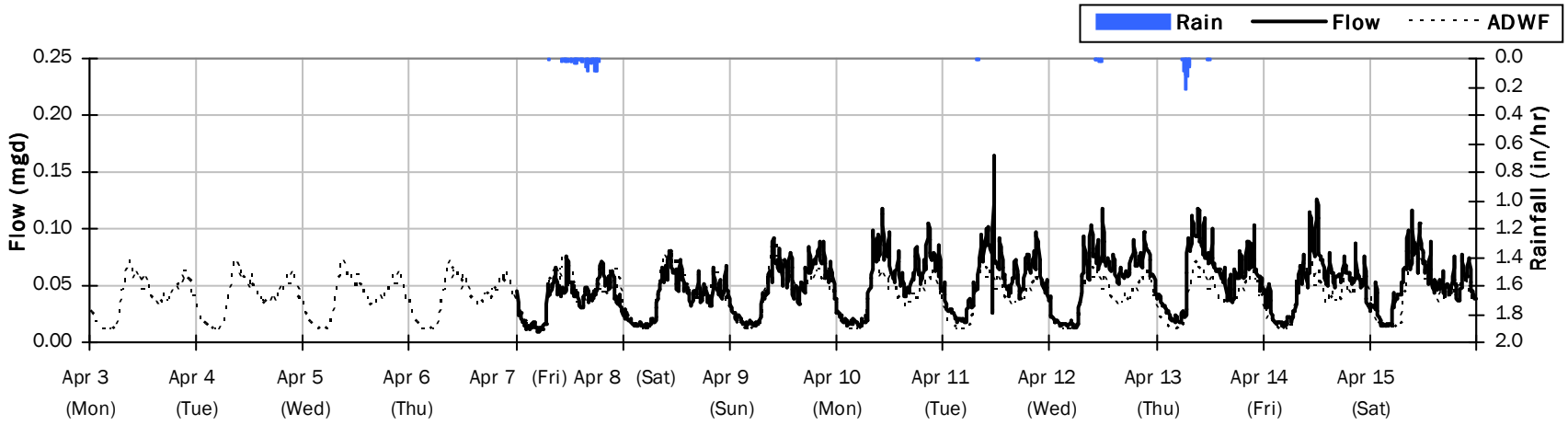


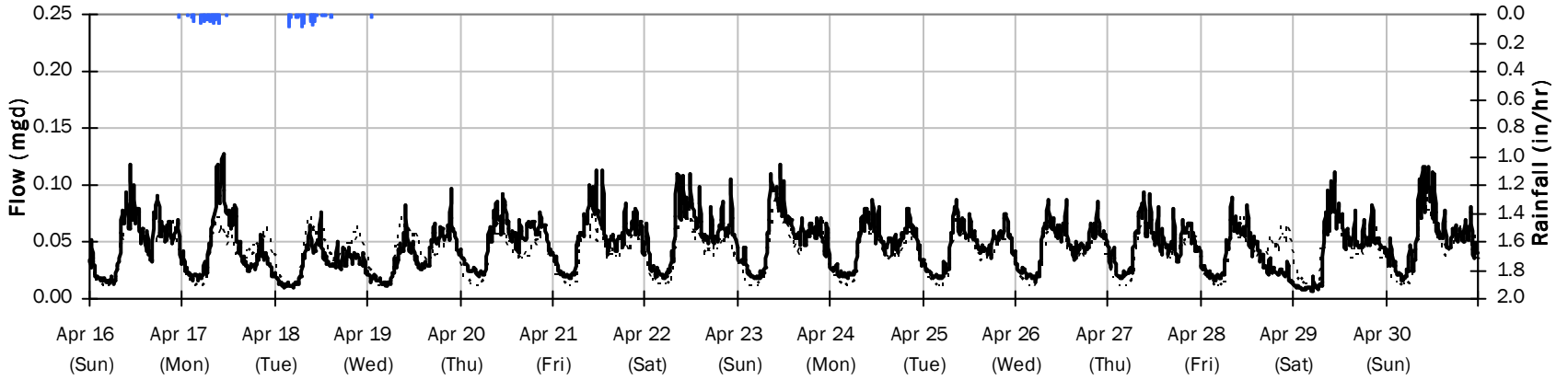
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SITE 07

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.048 mgd** **Peak Flow: 0.164 mgd** **Min Flow: 0.006 mgd**

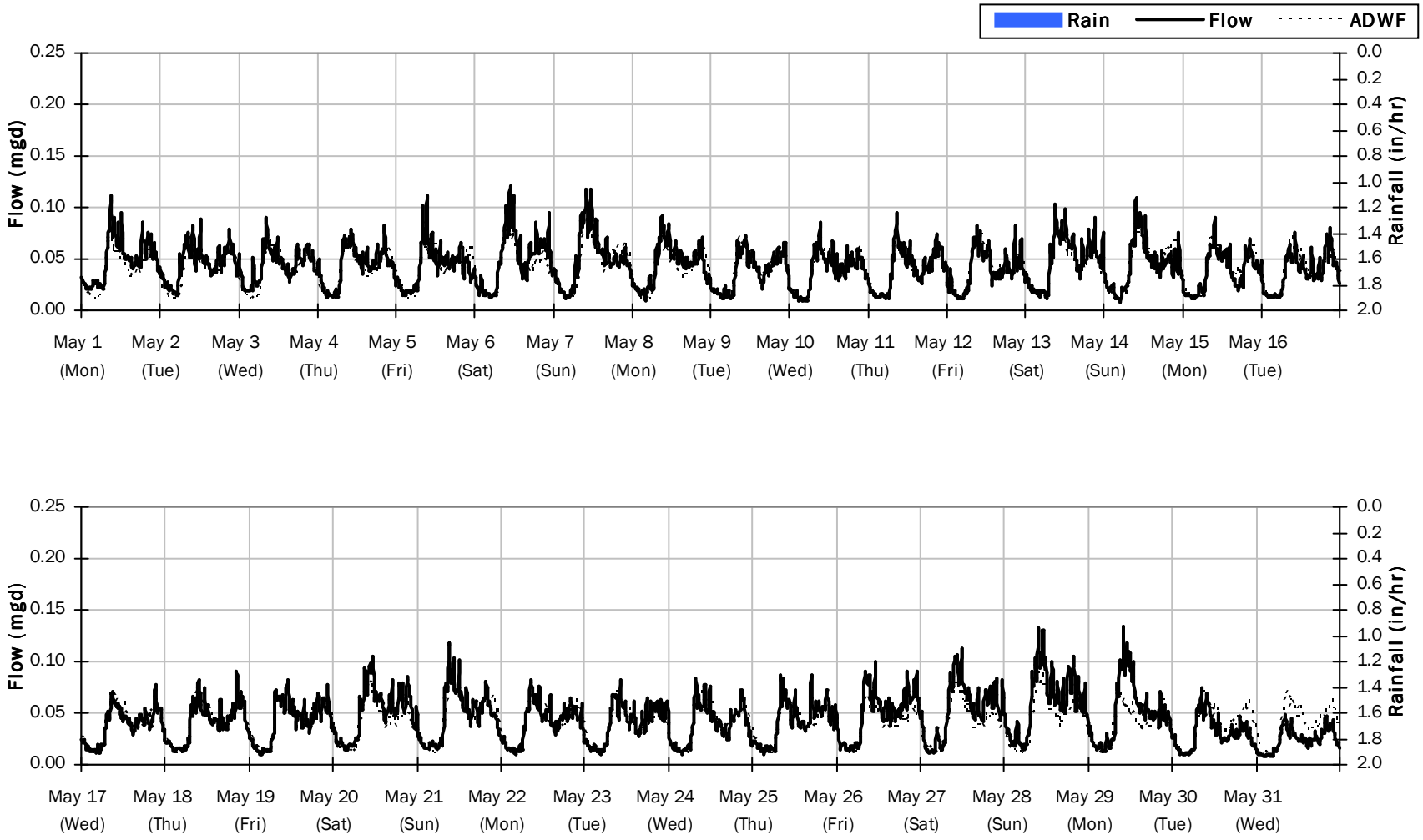




SITE 07

Flow Summary: 5/1/2017 to 5/31/2017

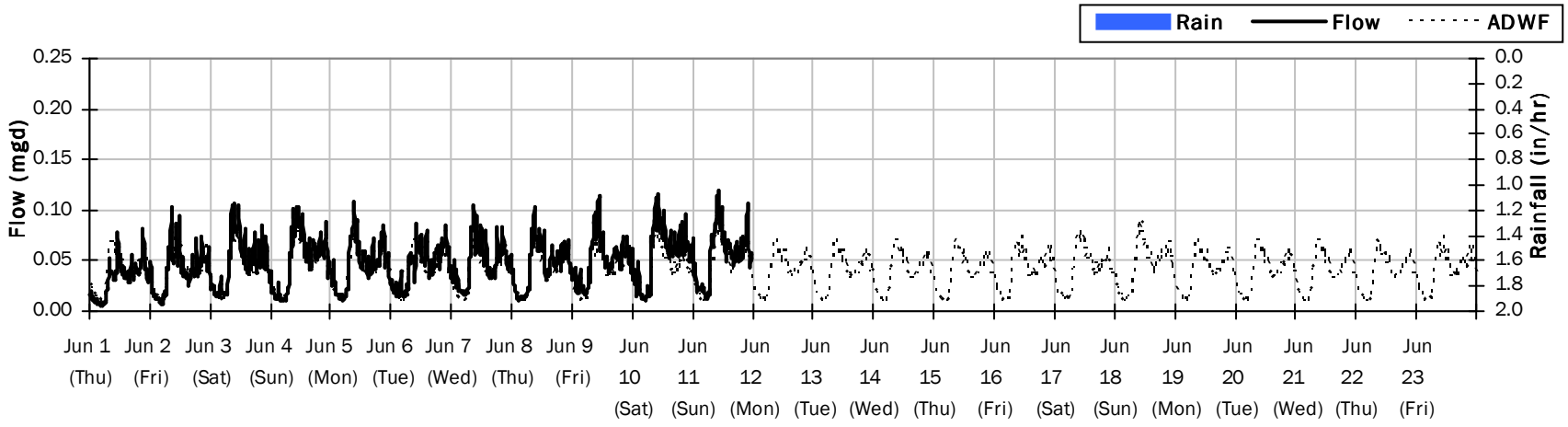
Total Period Rainfall: 0.00 inches **Avg Flow: 0.044 mgd** **Peak Flow: 0.134 mgd** **Min Flow: 0.007 mgd**

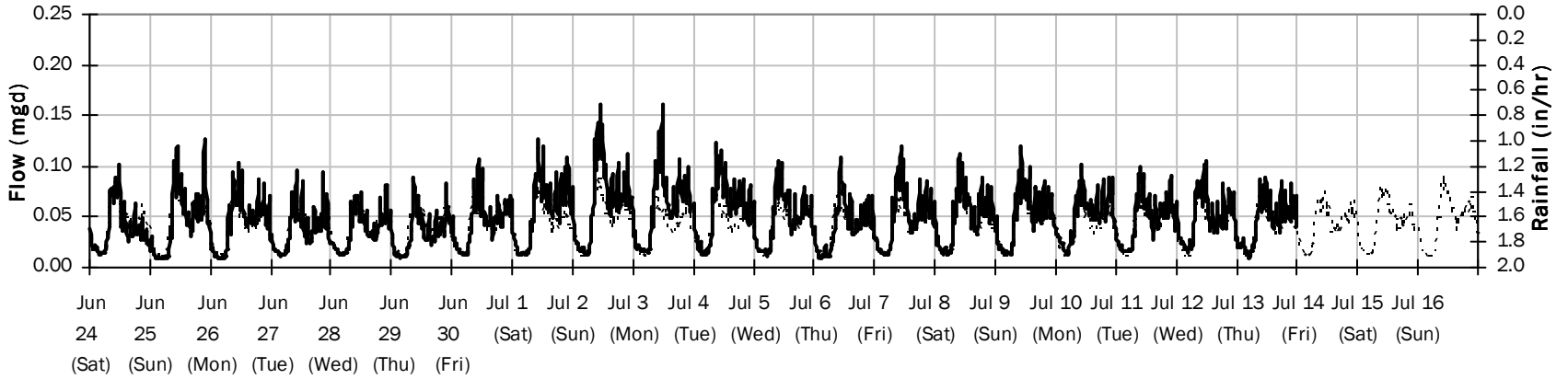


SITE 07

Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.047 mgd Peak Flow: 0.161 mgd Min Flow: 0.006 mgd**

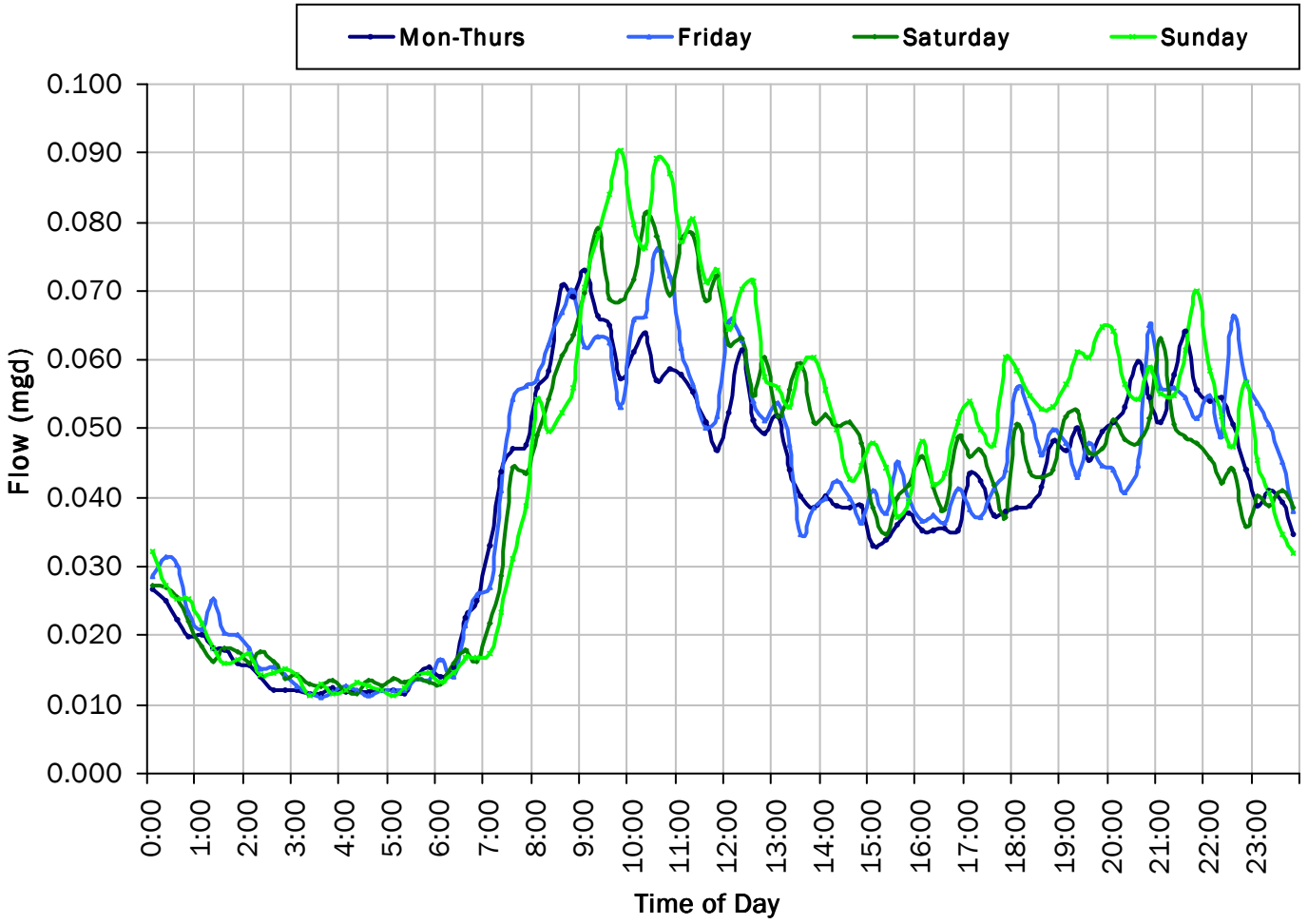




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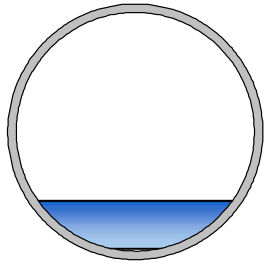
SITE 07

Average Dry Weather Flow Hydrographs



ADWF:

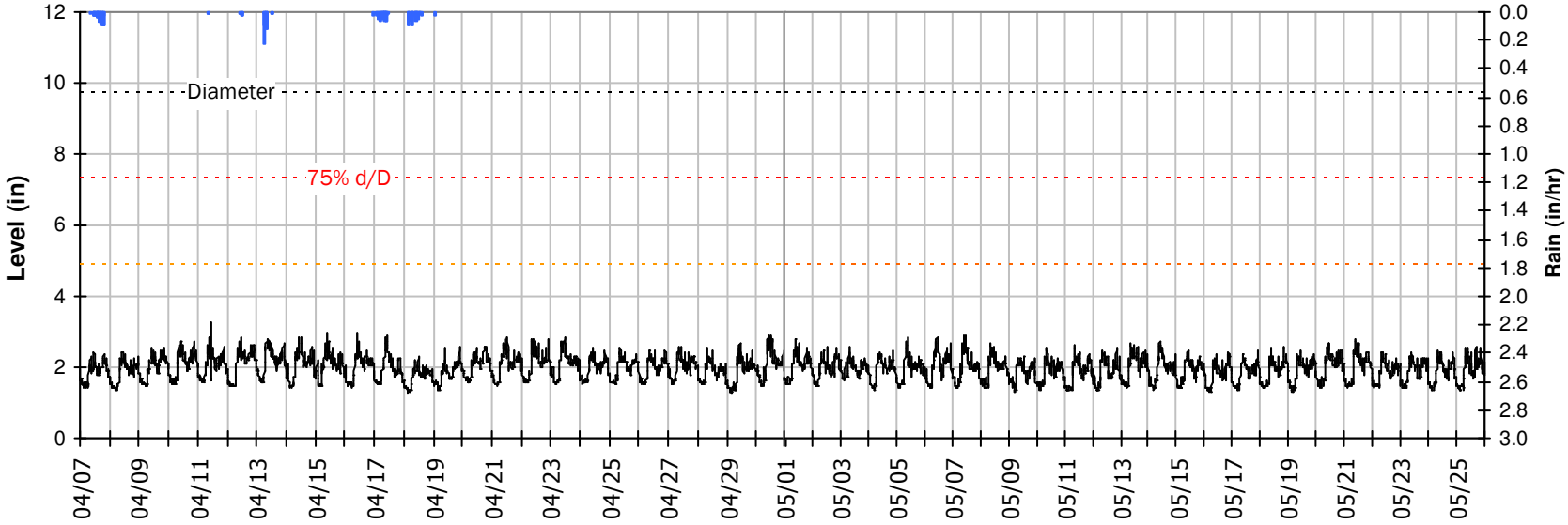
0.040 *mgd*

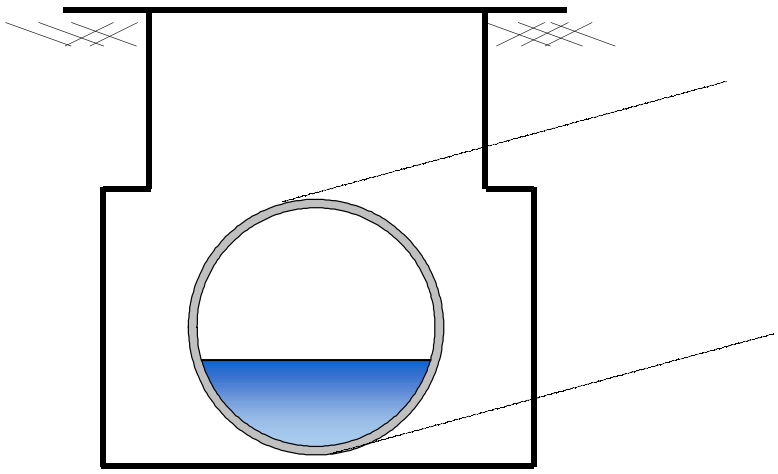


SITE 07

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



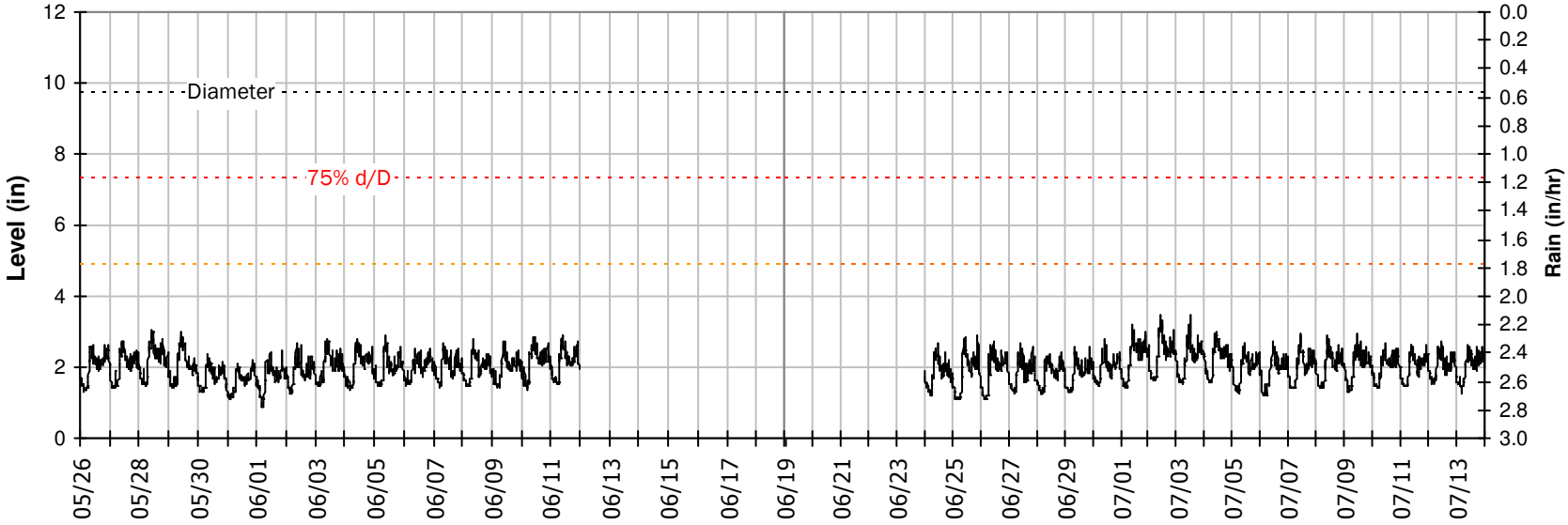


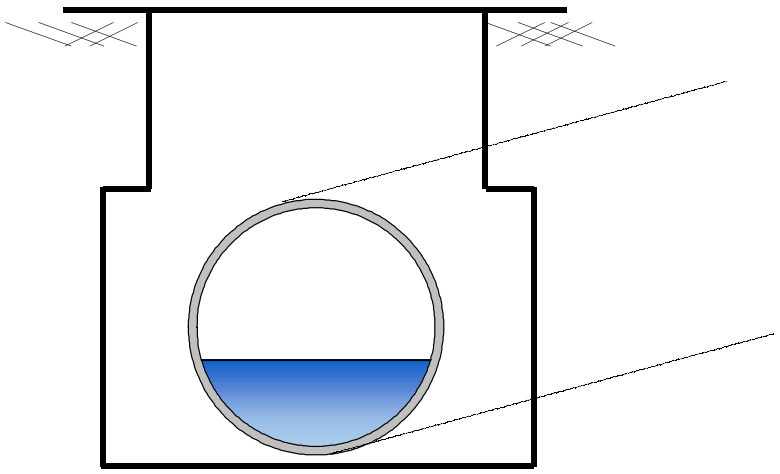
Pipe Diameter:	9.75	*inches*
Peak Measured Level:	3.5	*inches*
Peak d/D Ratio:	0.36	

SITE 07

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





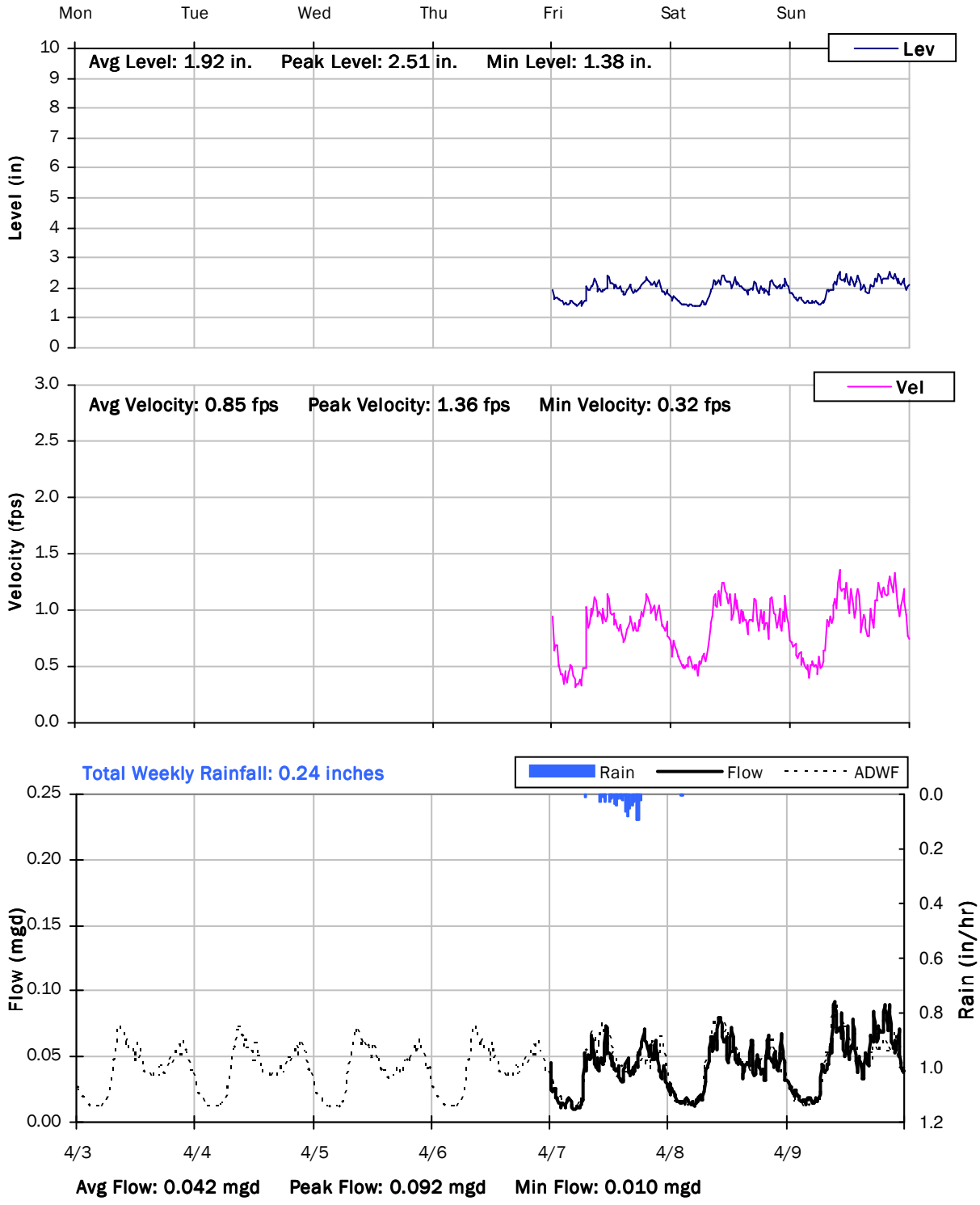
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Peak d/D Ratio:	0.36	

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SITE 07

Weekly Level, Velocity and Flow Hydrographs

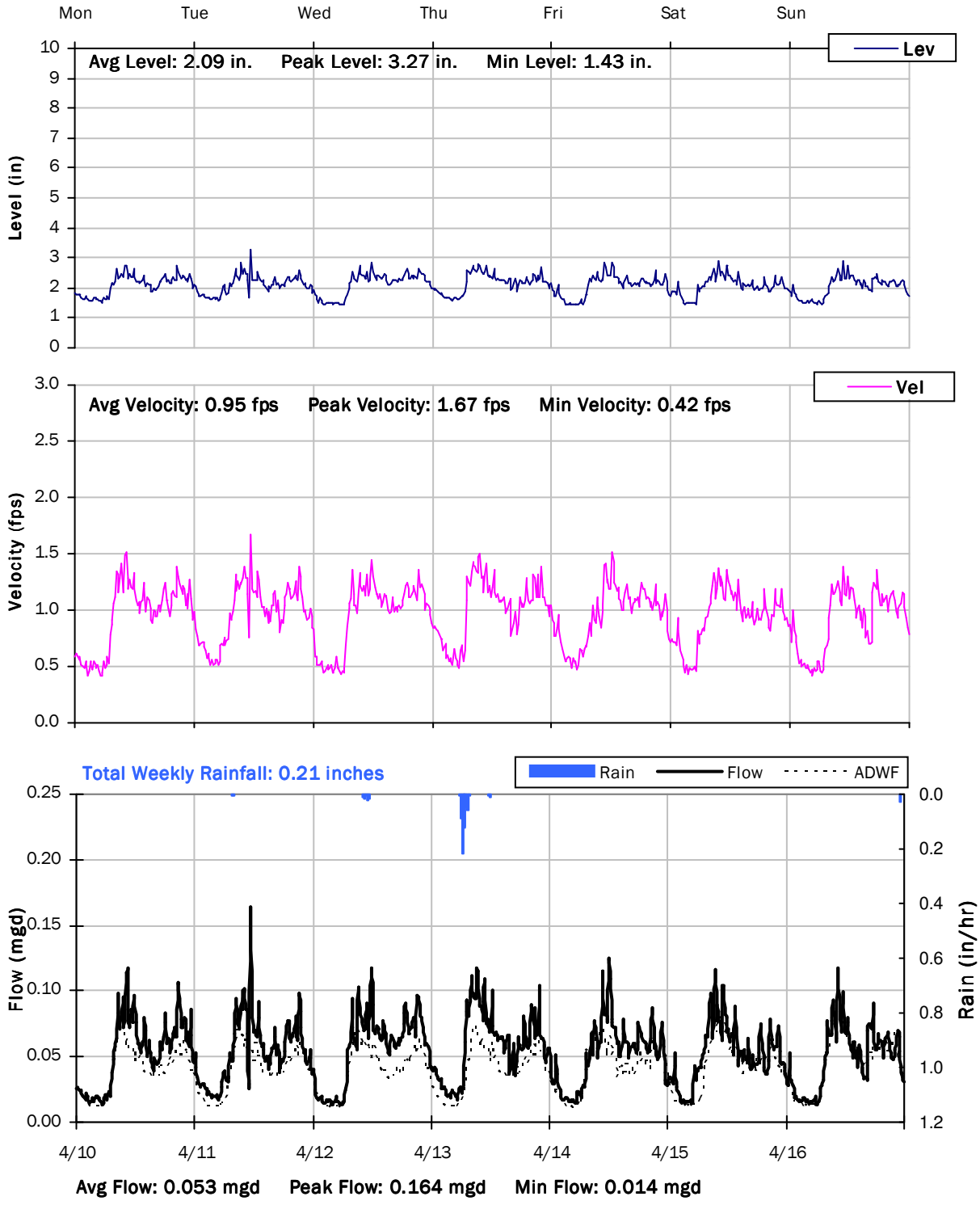
4/3/2017 to 4/10/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

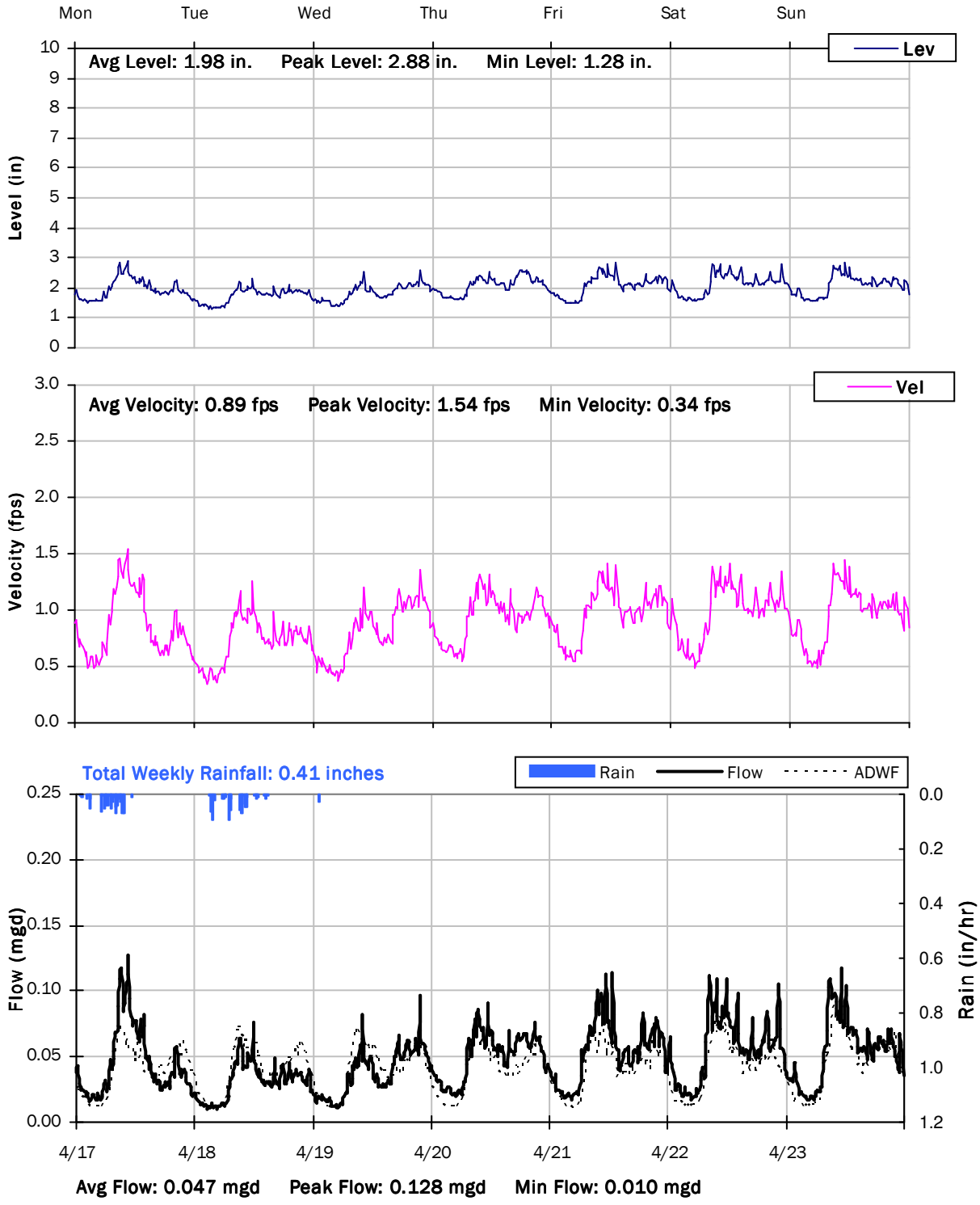
4/10/2017 to 4/17/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

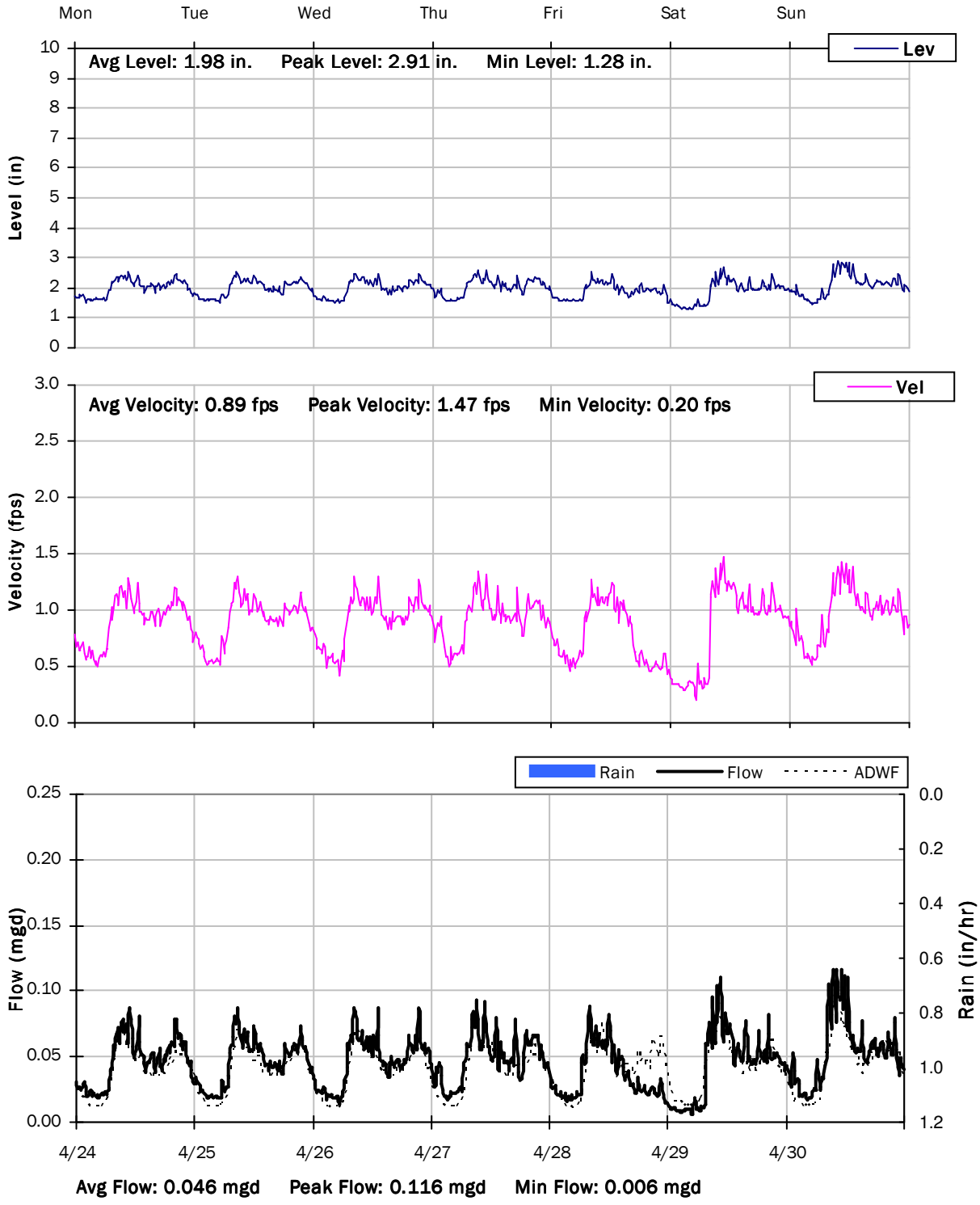
4/17/2017 to 4/24/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

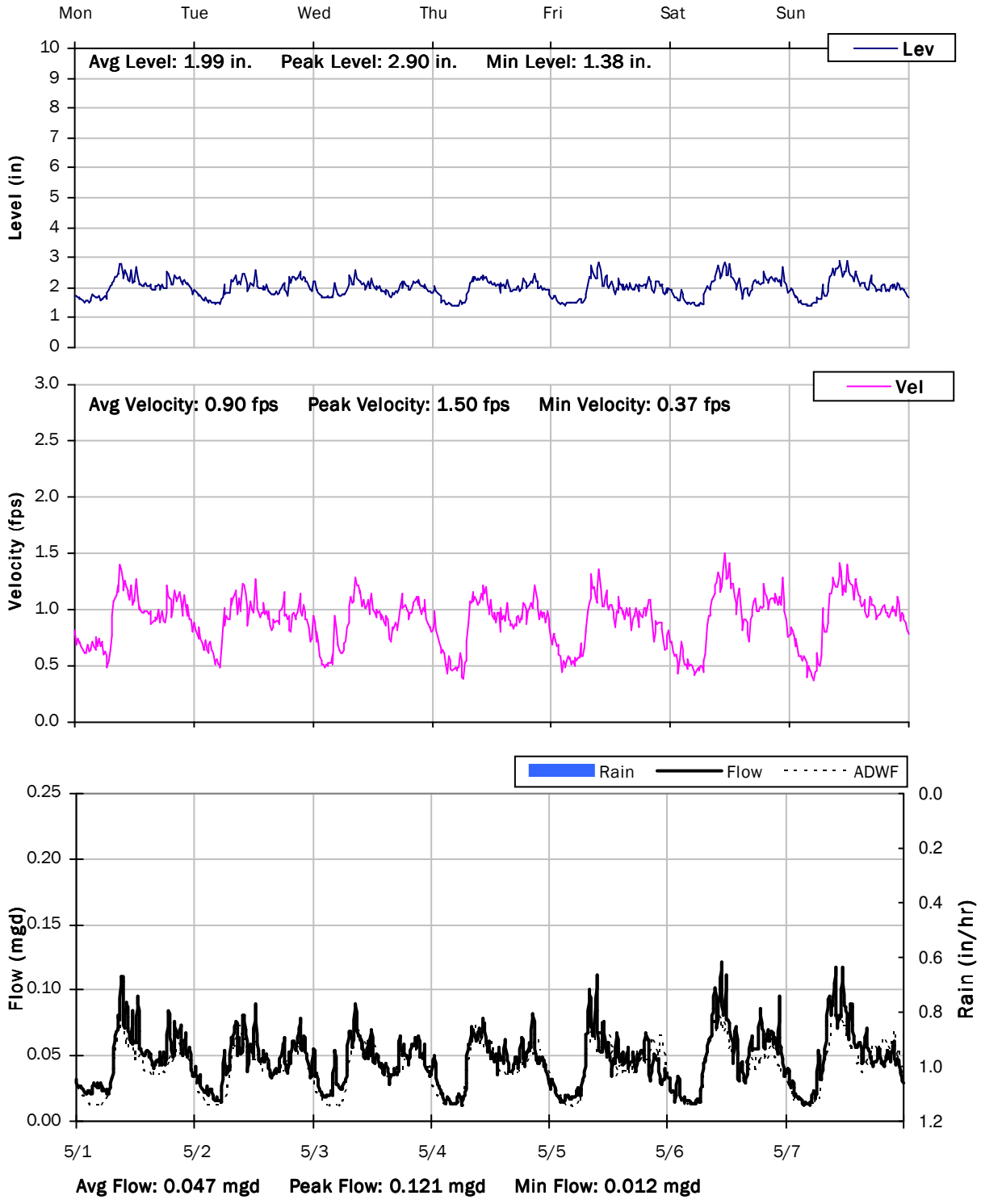
4/24/2017 to 5/1/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

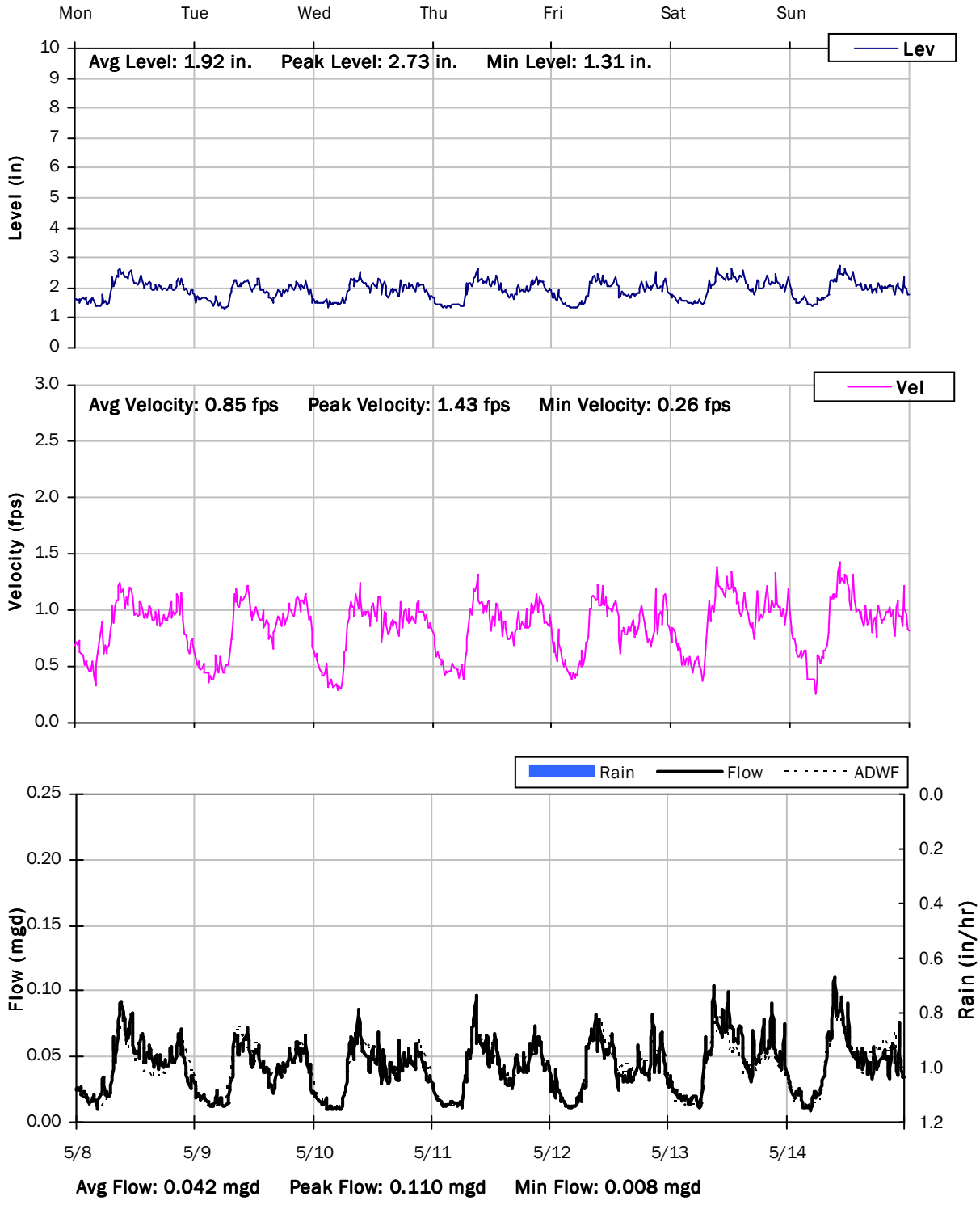
5/1/2017 to 5/8/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

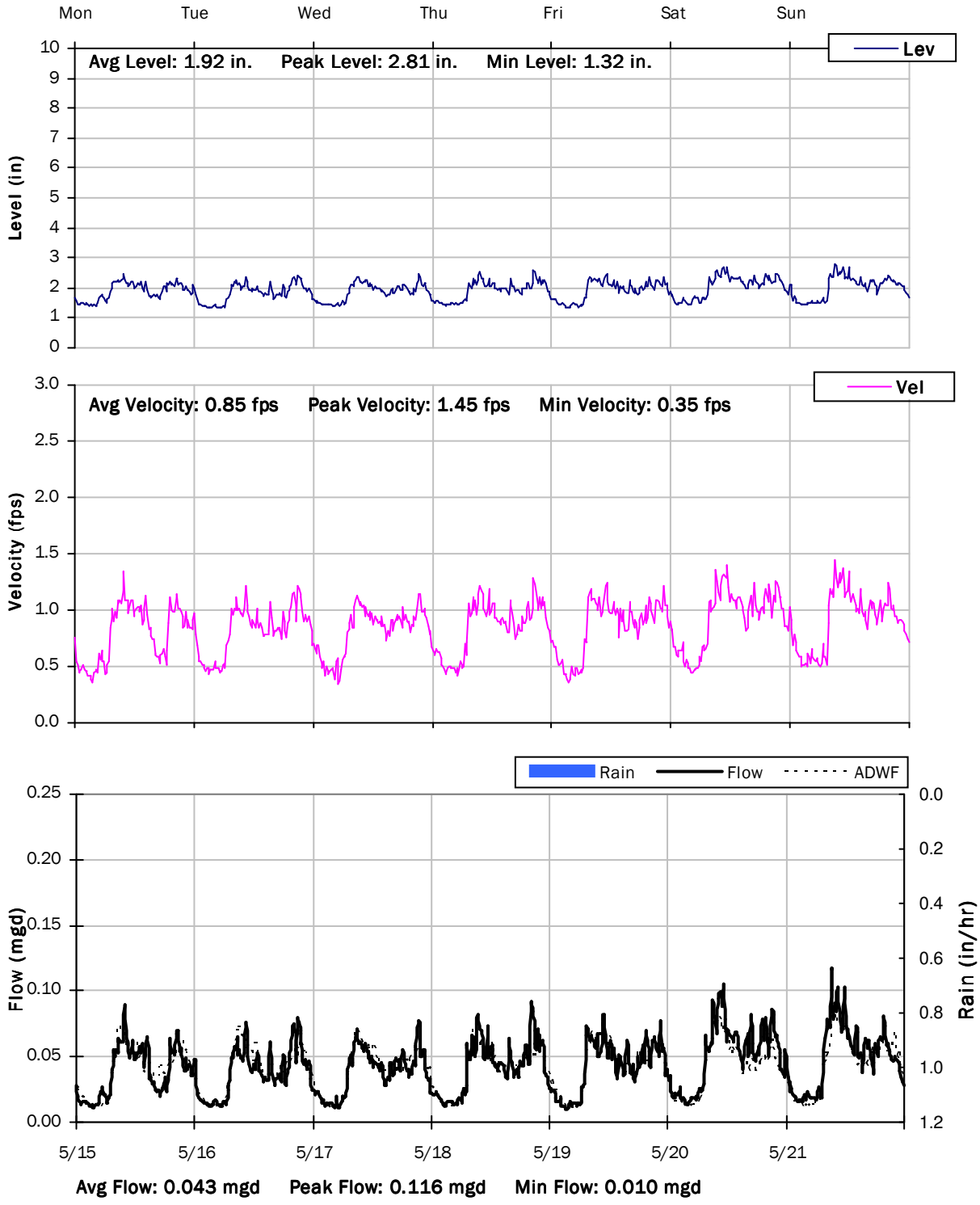
5/8/2017 to 5/15/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

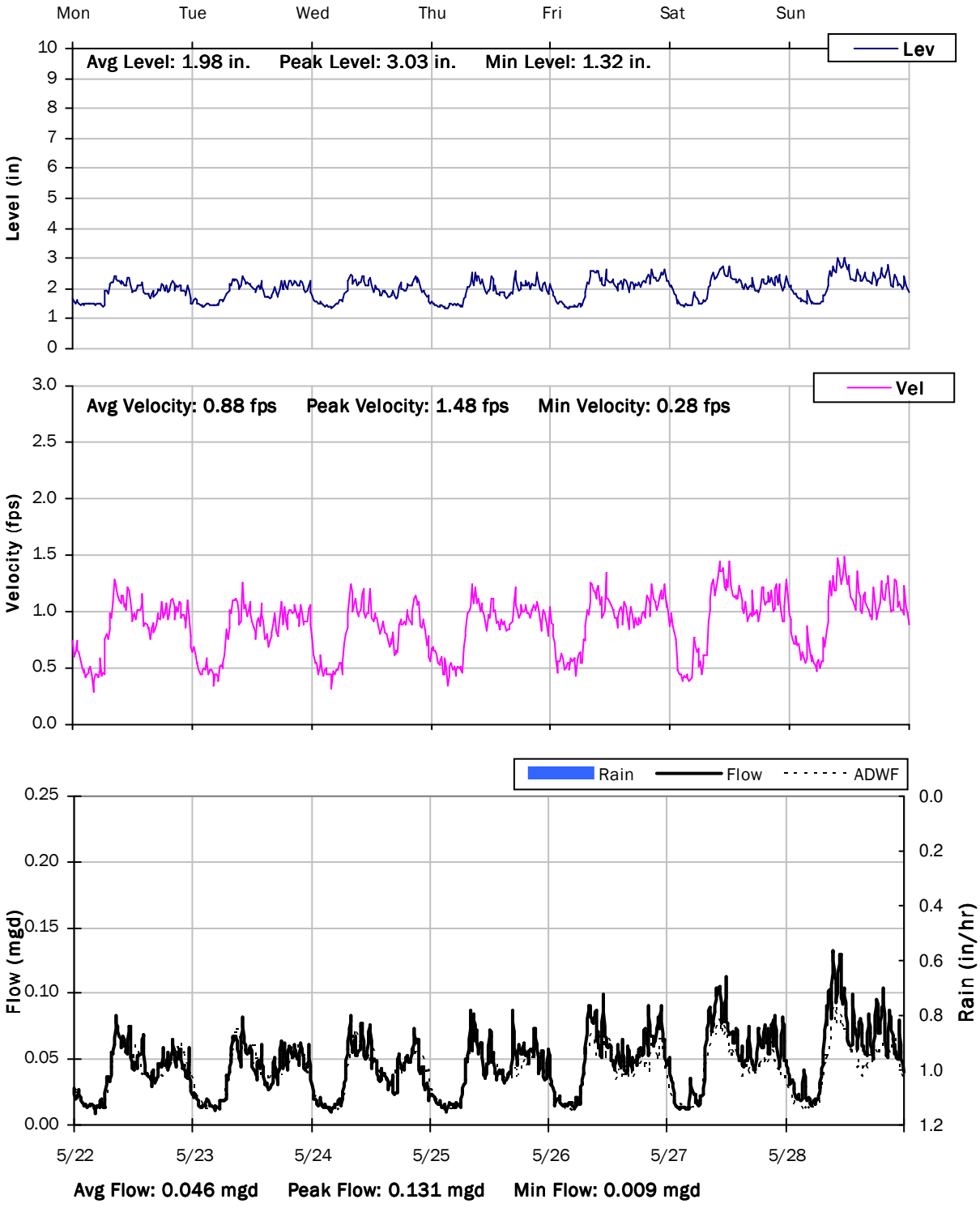
5/15/2017 to 5/22/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

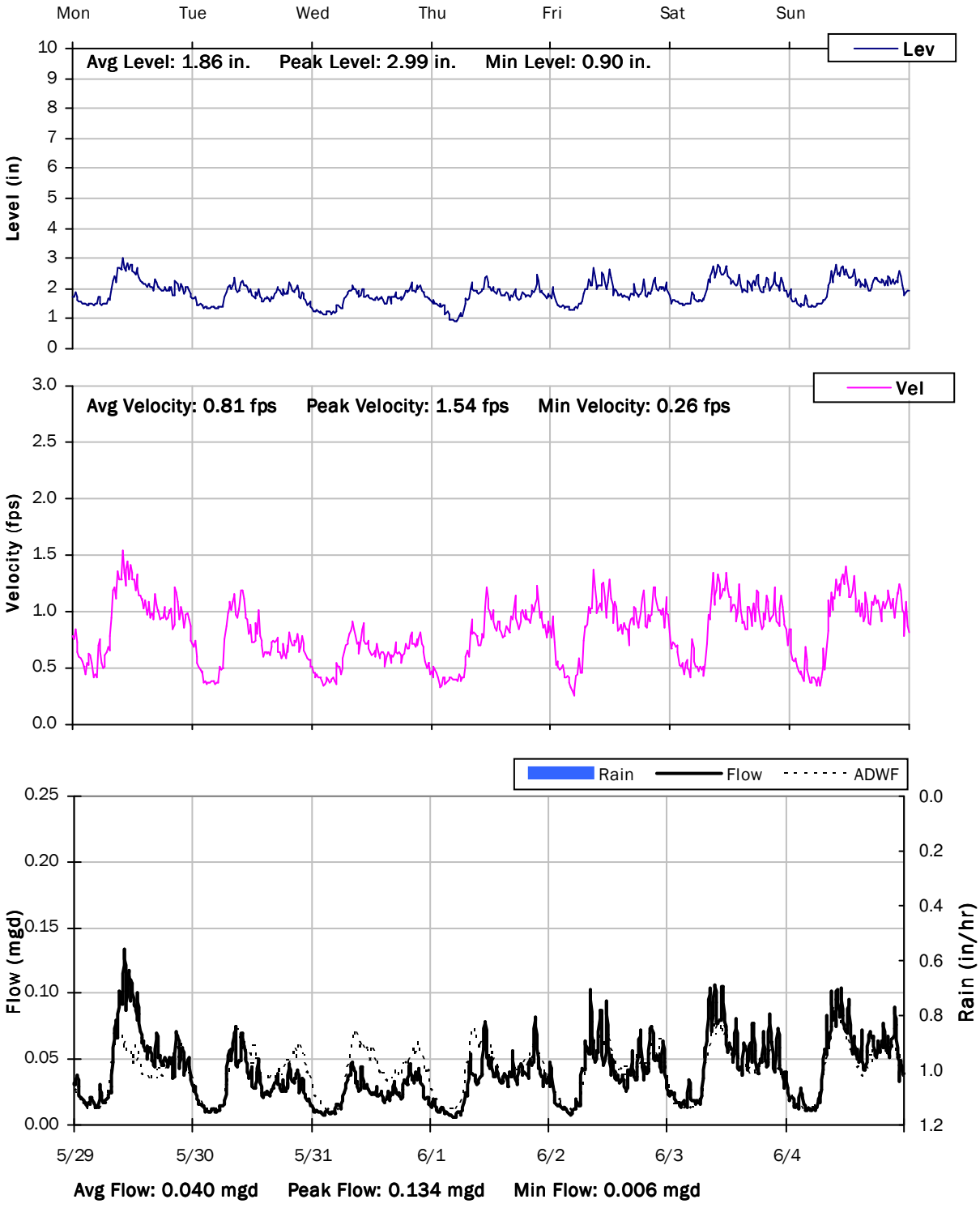
5/22/2017 to 5/29/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

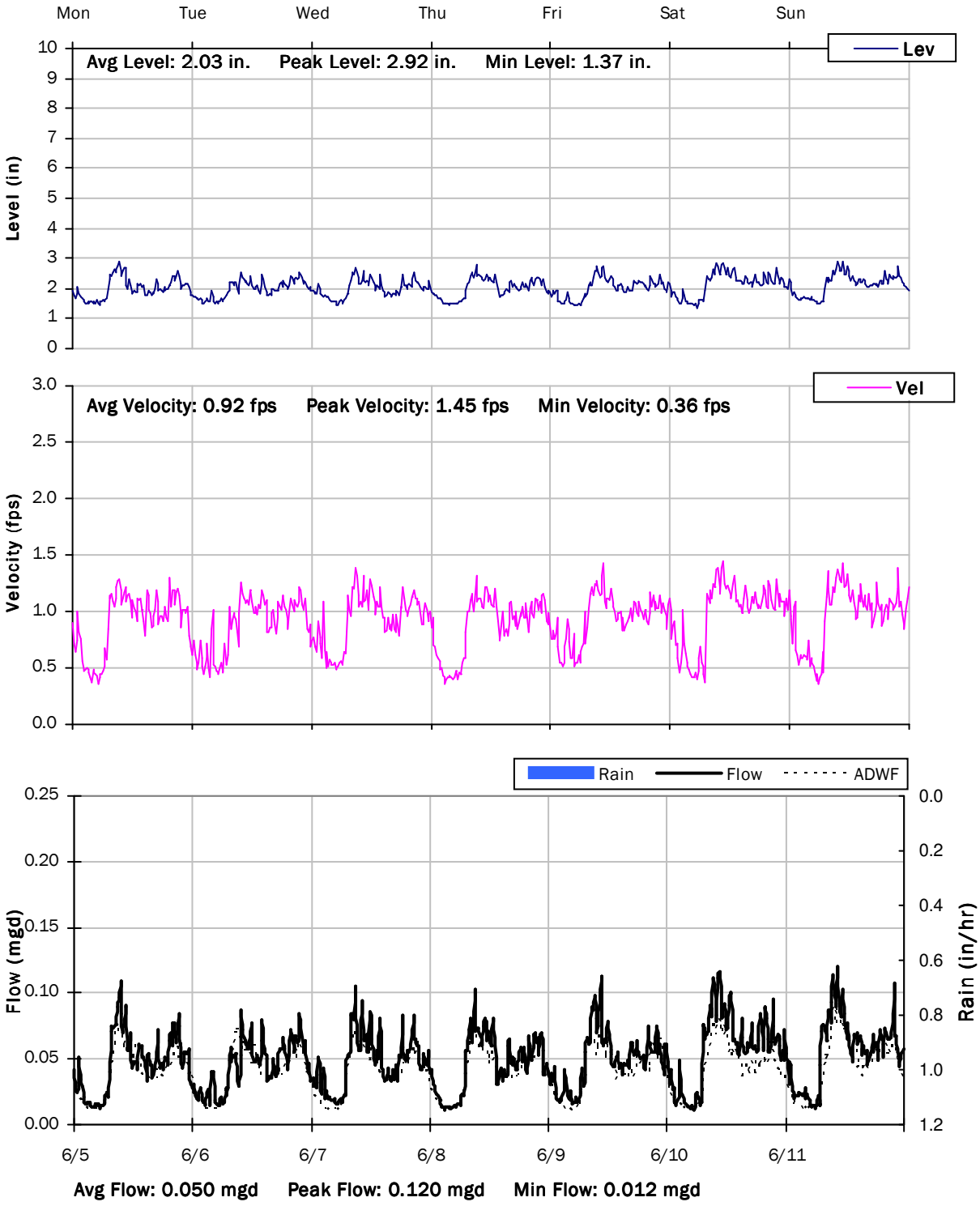
5/29/2017 to 6/5/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

6/5/2017 to 6/12/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

6/12/2017 to 6/19/2017

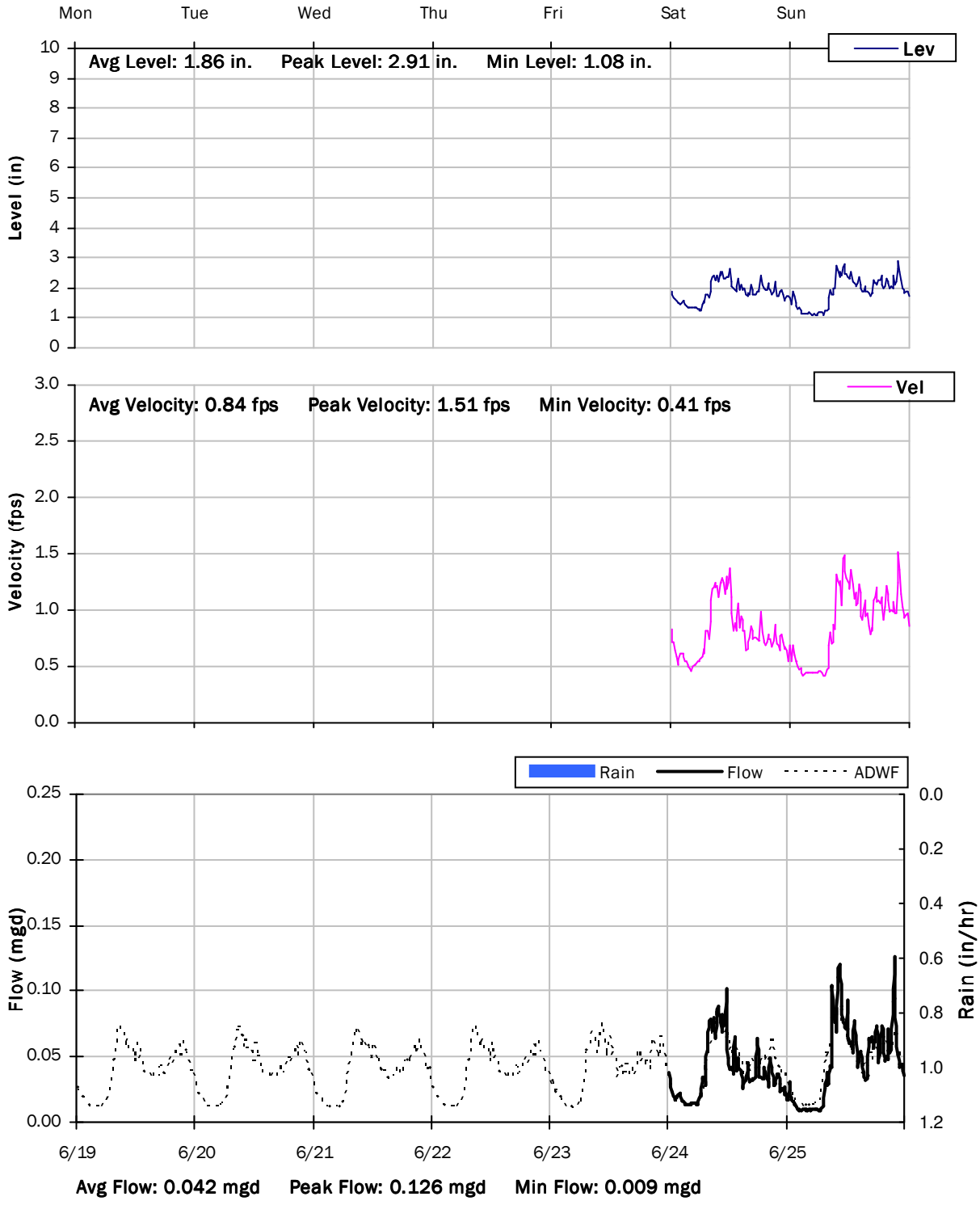
As a part of the scope of work, flow meters were intermittently and permissibly suspended in place, without maintenance, throughout this study. Data gaps indicate unreportable data due to the suspended and unmaintained state of the flow meter.

No reportable data this week.

SITE 07

Weekly Level, Velocity and Flow Hydrographs

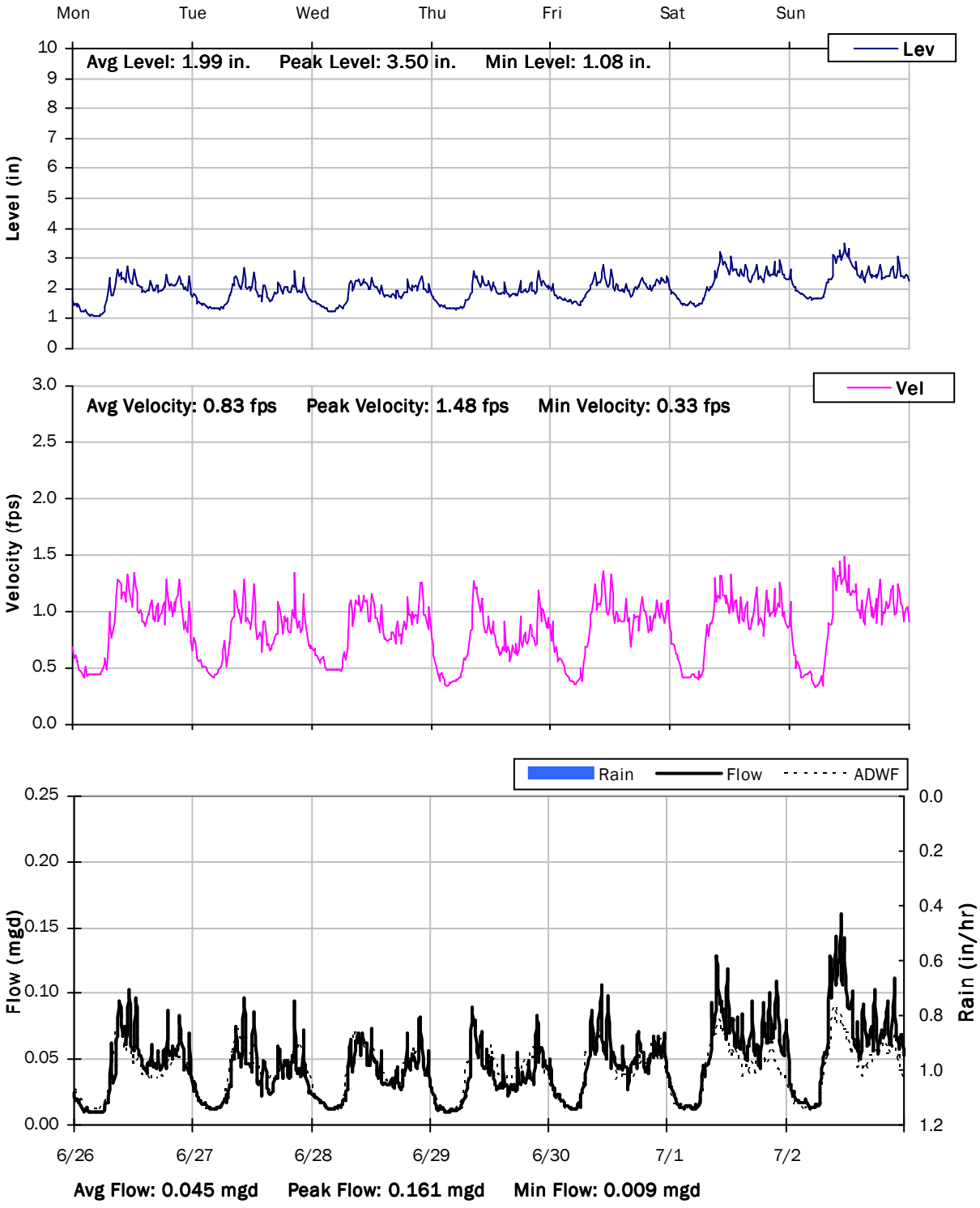
6/19/2017 to 6/26/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

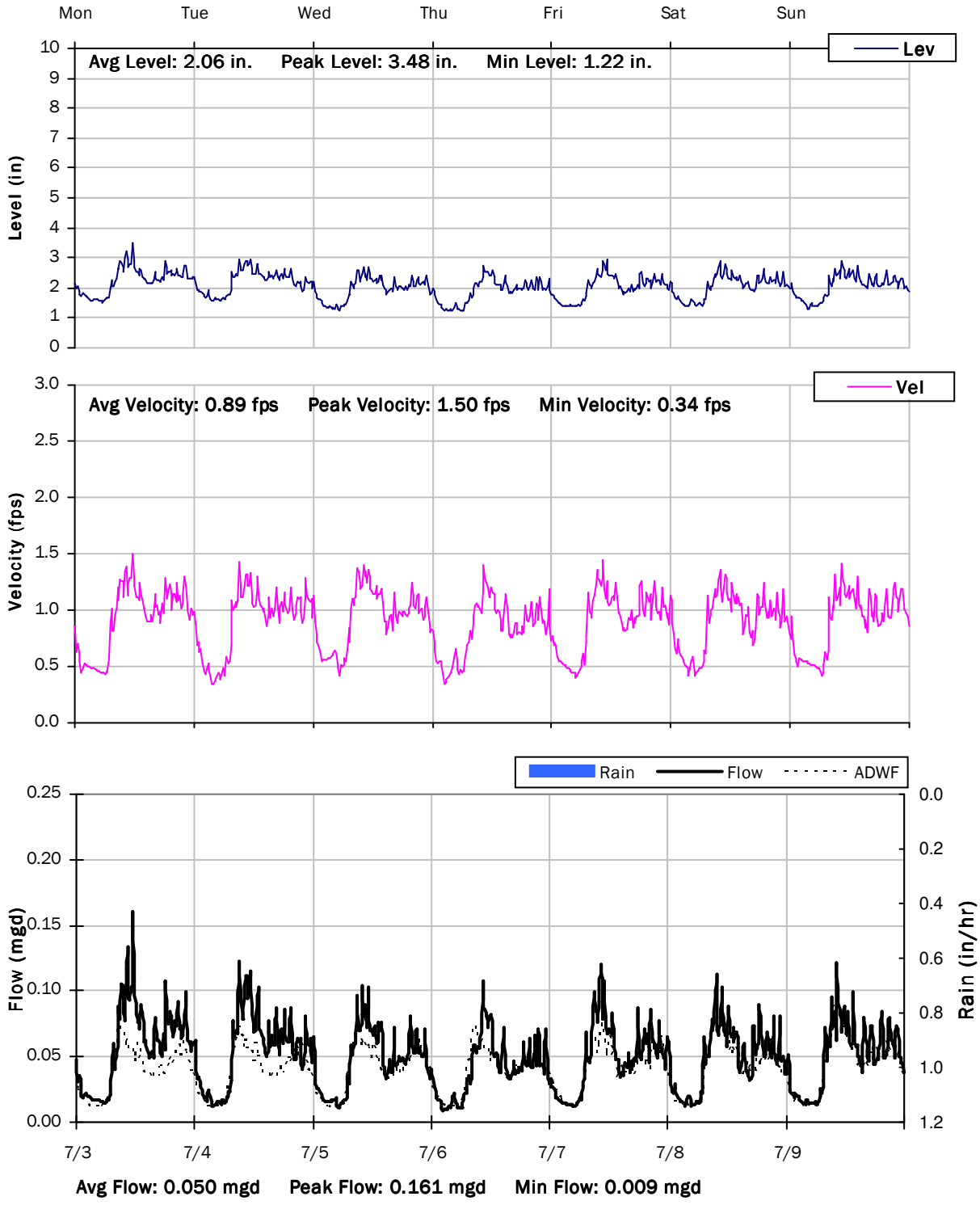
6/26/2017 to 7/3/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

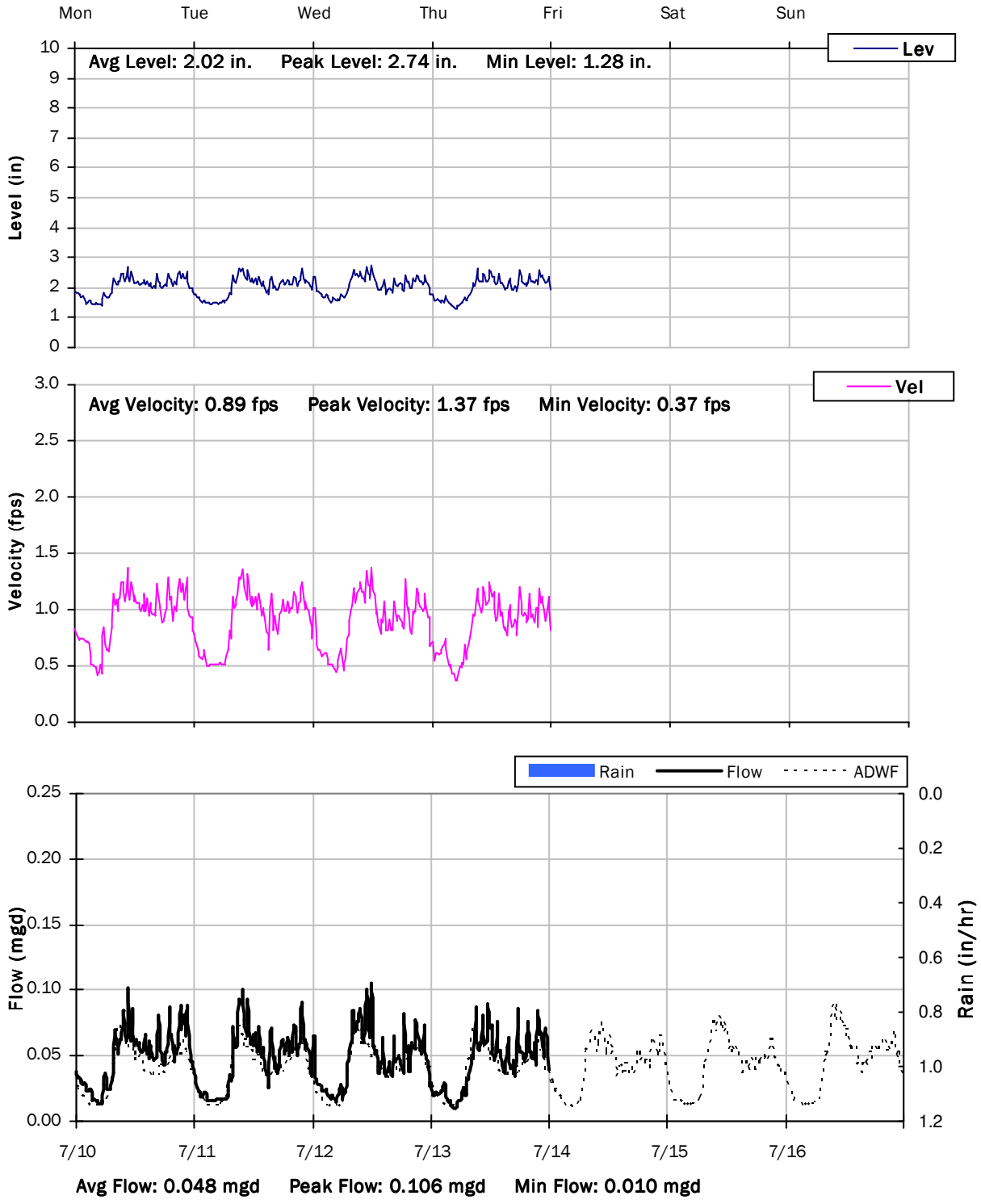
7/3/2017 to 7/10/2017



SITE 07

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

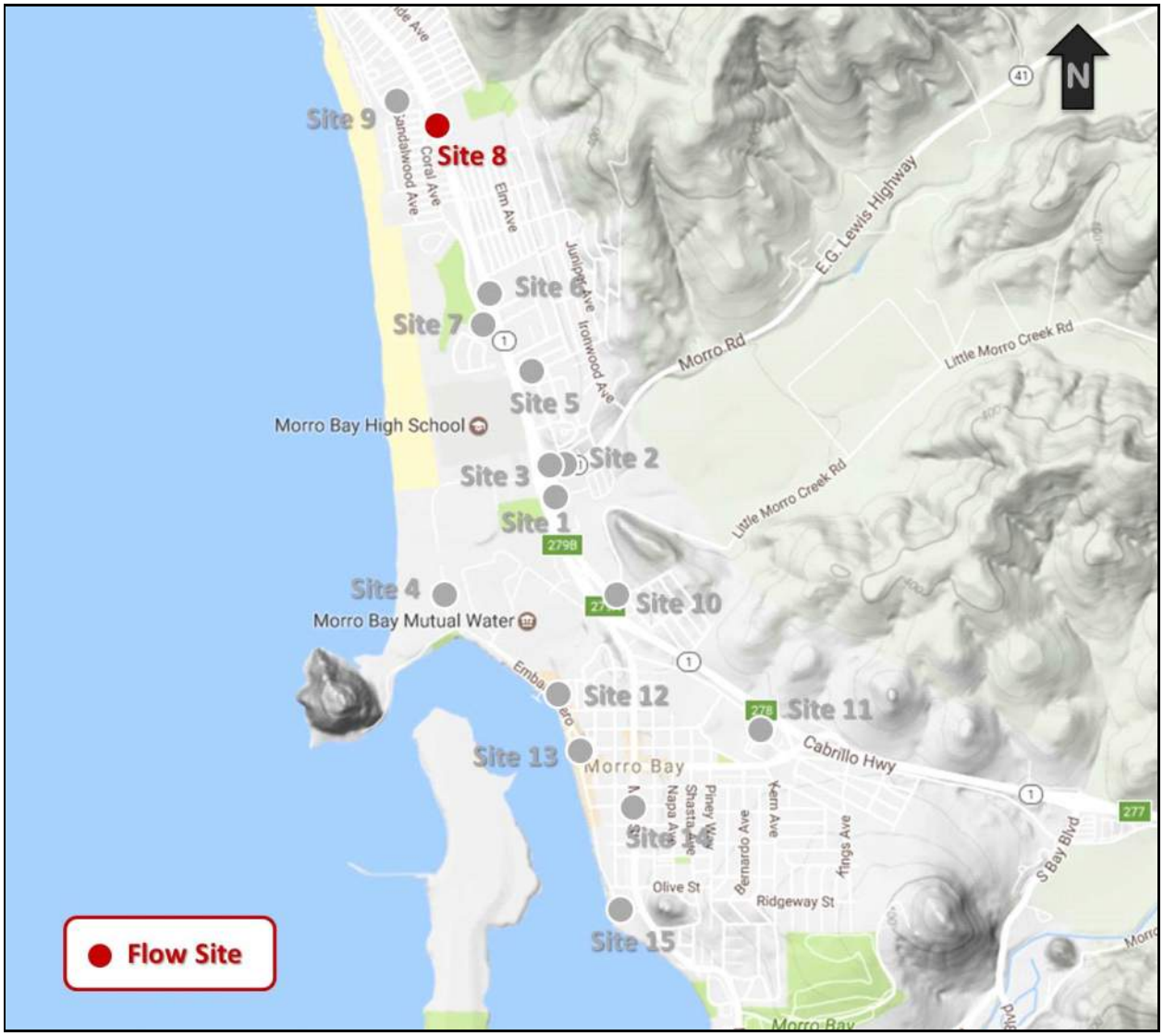
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 08

Location: Main Street, ~400 feet south of Island Street, meter on north 13" inlet

Data Summary Report



Vicinity Map: Site 08

SITE 08

Site Information

Location: Main Street, ~400 feet south of Island Street, meter on north 13" inlet

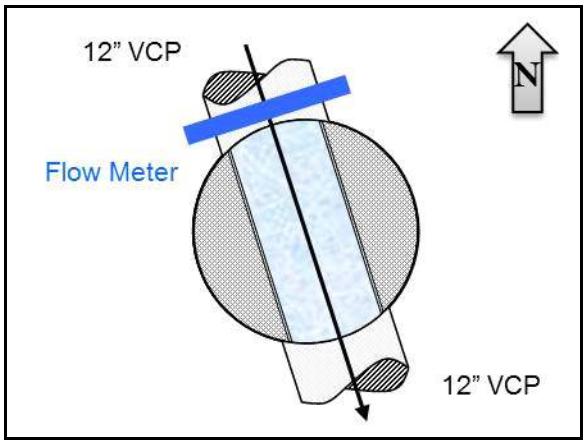


Pipe Diameter: 13 inches

ADWF: 0.069 mgd

Peak Measured Flow: 0.212 mgd









SITE 08

Additional Site Photos



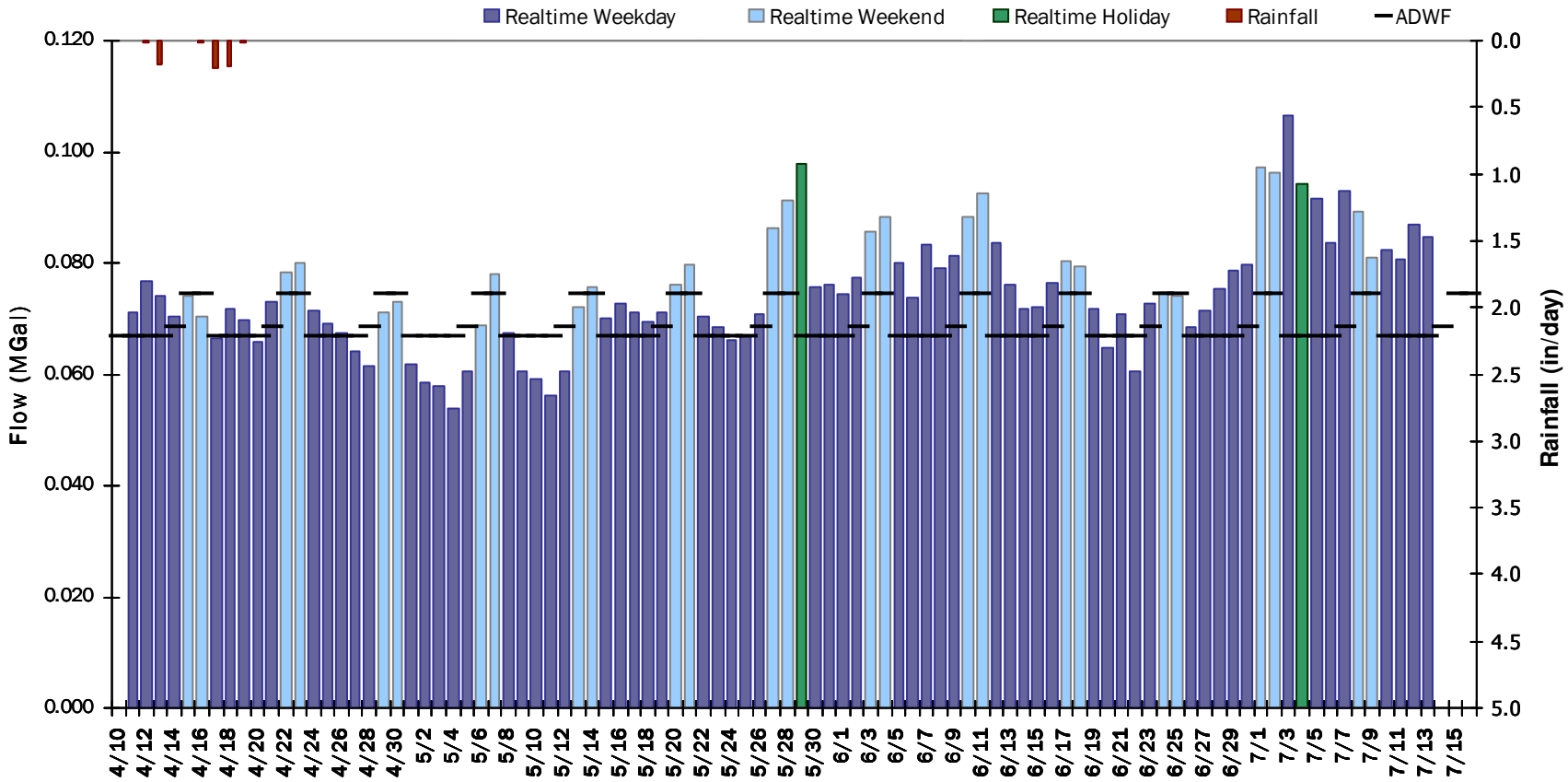


SITE 08

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.075 MGal Peak Daily Flow: 0.106 MGal Min Daily Flow: 0.054 MGal

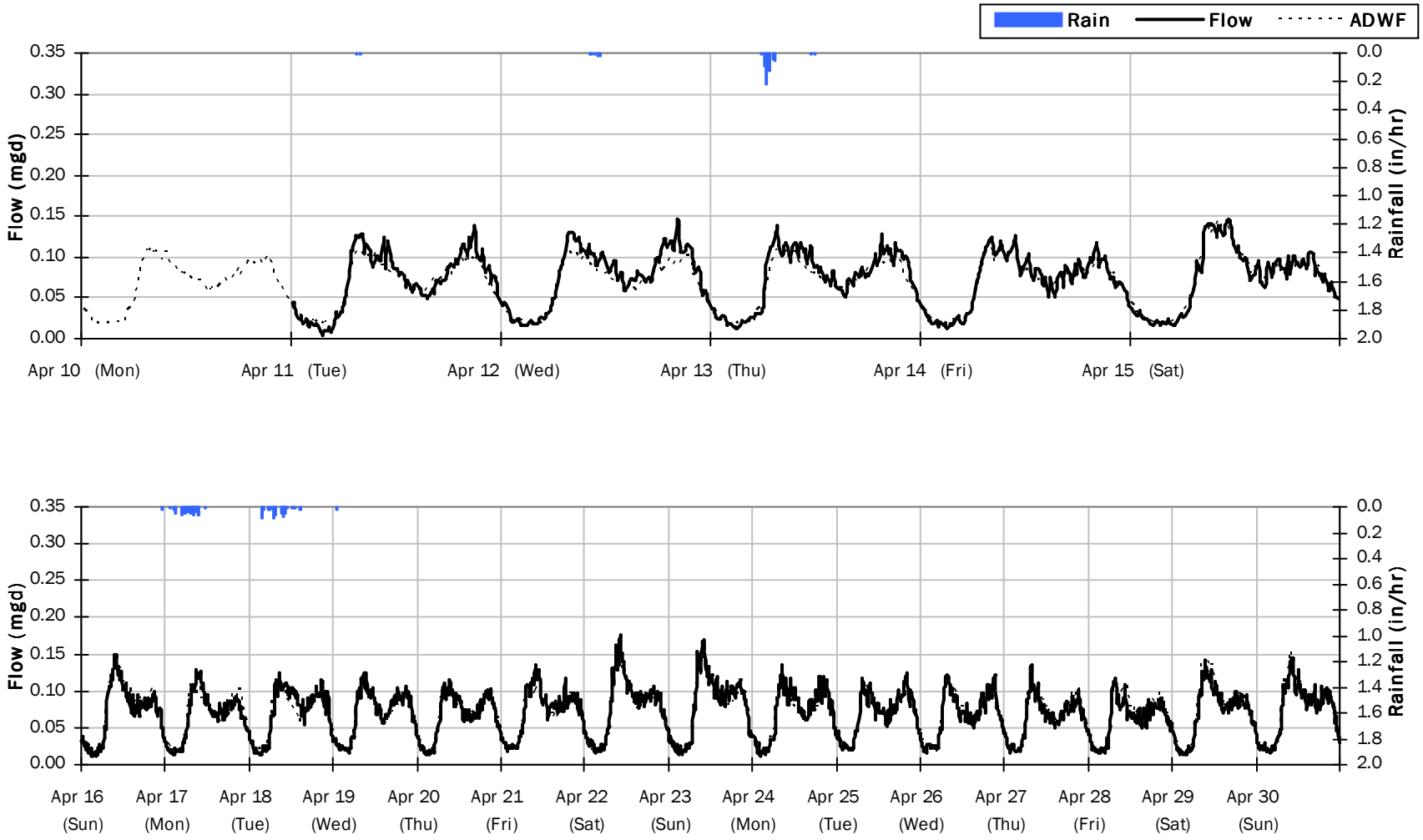
Total Period Rainfall: 0.61 inches



SITE 08

Flow Summary: 4/1/2017 to 4/30/2017

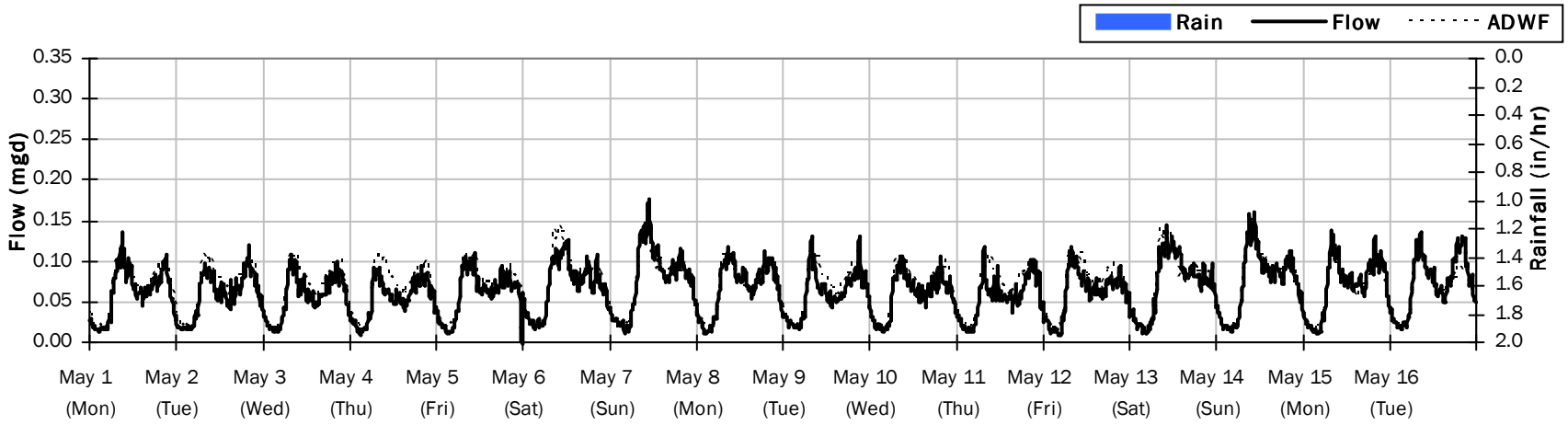
Total Period Rainfall: 0.61 inches **Avg Flow: 0.071 mgd** **Peak Flow: 0.176 mgd** **Min Flow: 0.004 mgd**

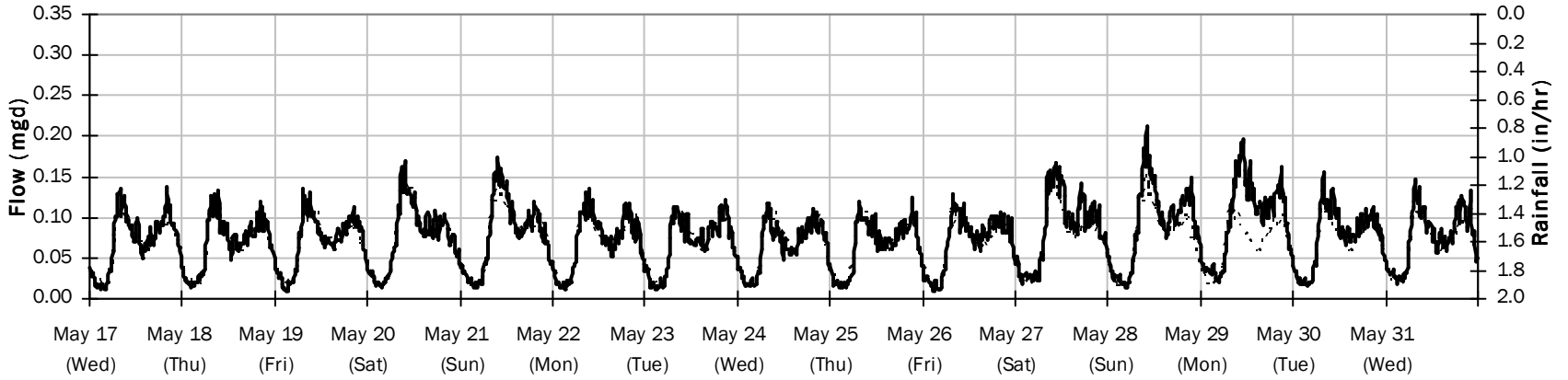


SITE 08

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.070 mgd** **Peak Flow: 0.212 mgd** **Min Flow: 0.000 mgd**

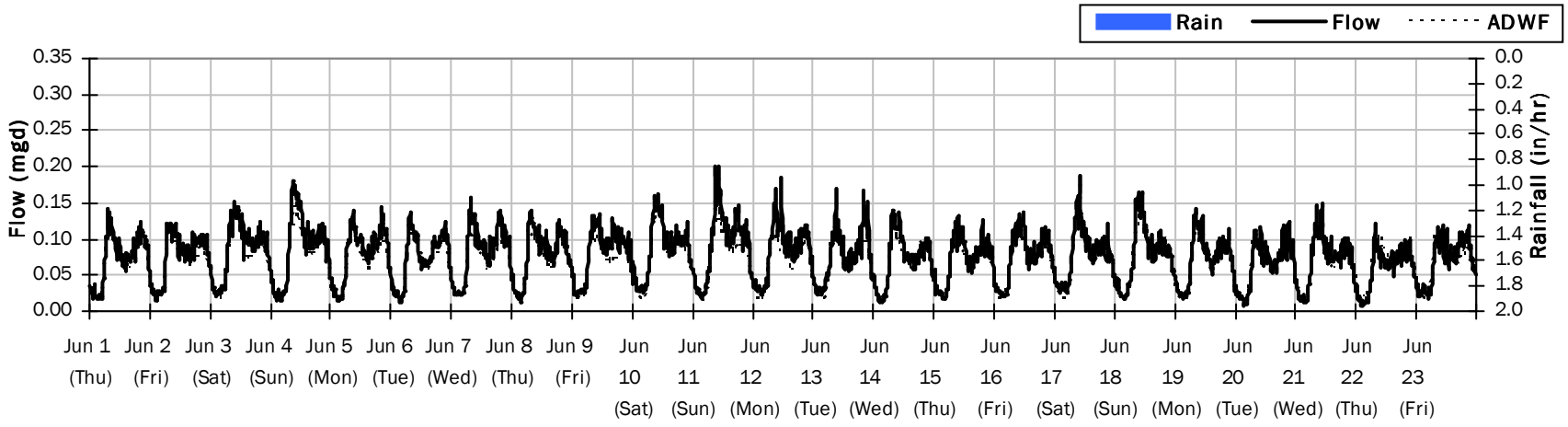


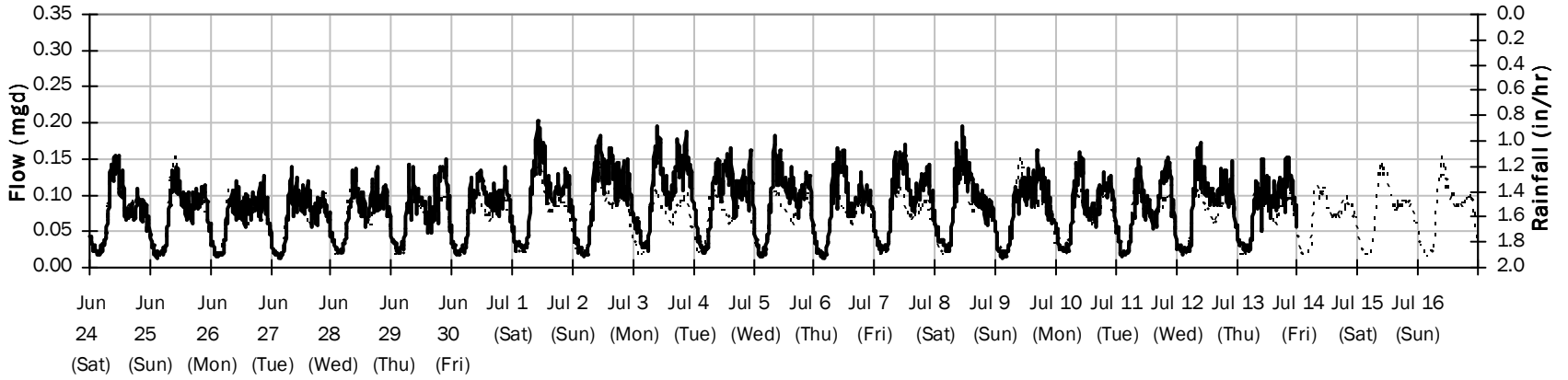


SITE 08

Flow Summary: 6/1/2017 to 7/16/2017

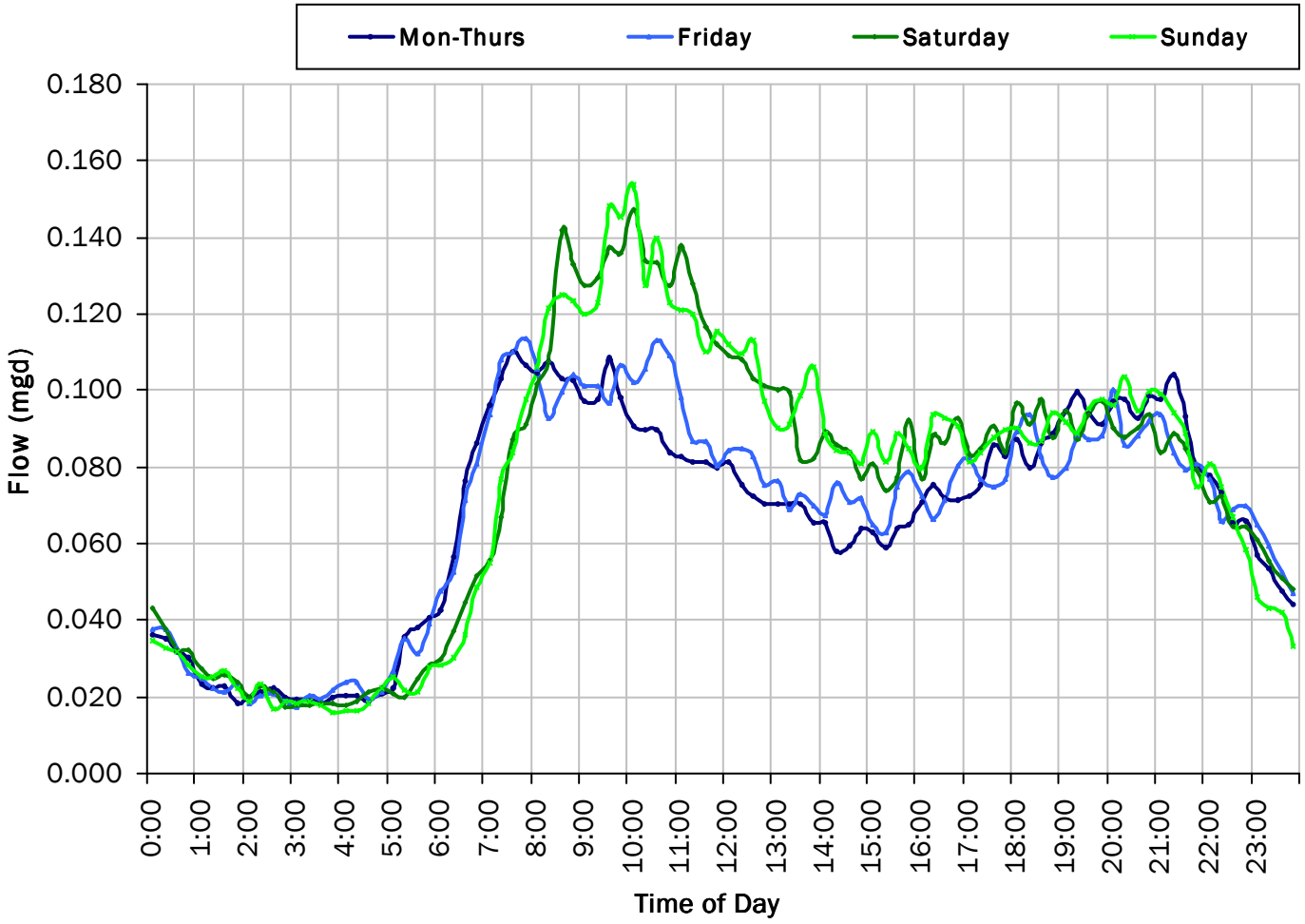
Total Period Rainfall: 0.00 inches **Avg Flow: 0.081 mgd** **Peak Flow: 0.203 mgd** **Min Flow: 0.008 mgd**





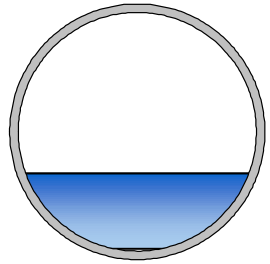
SITE 08

Average Dry Weather Flow Hydrographs



ADWF:

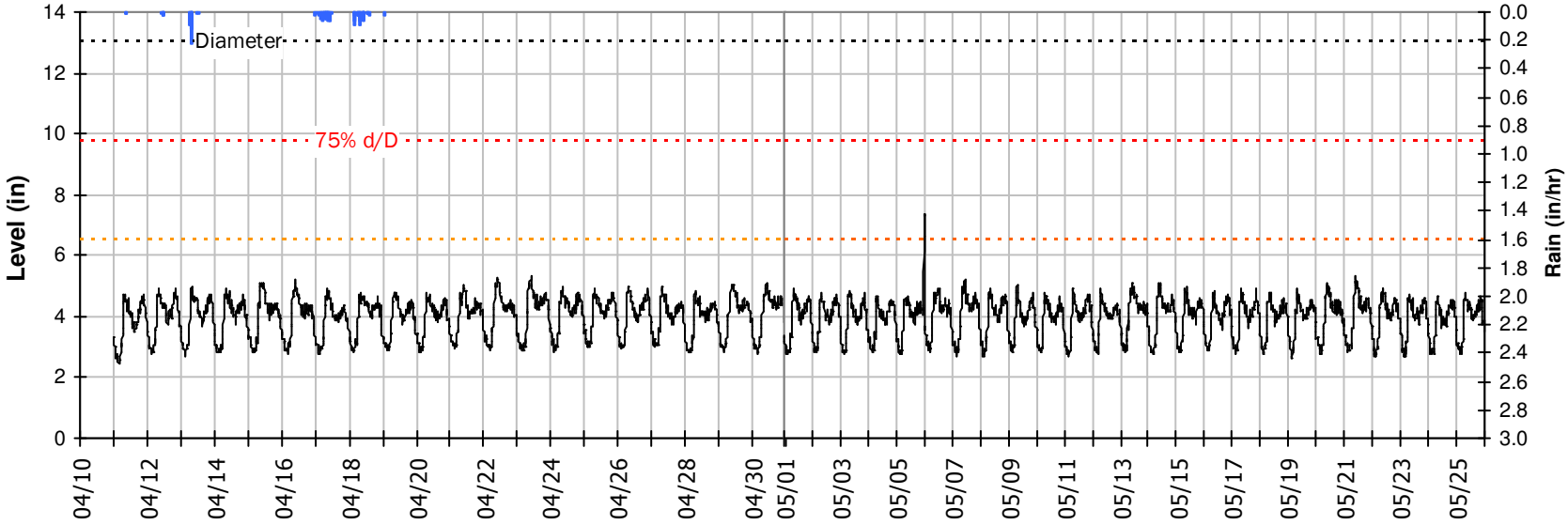
0.069 *mgd*

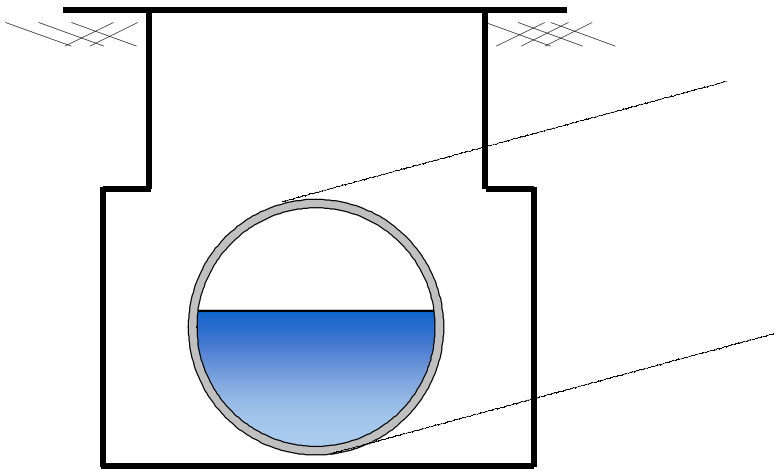


SITE 08

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



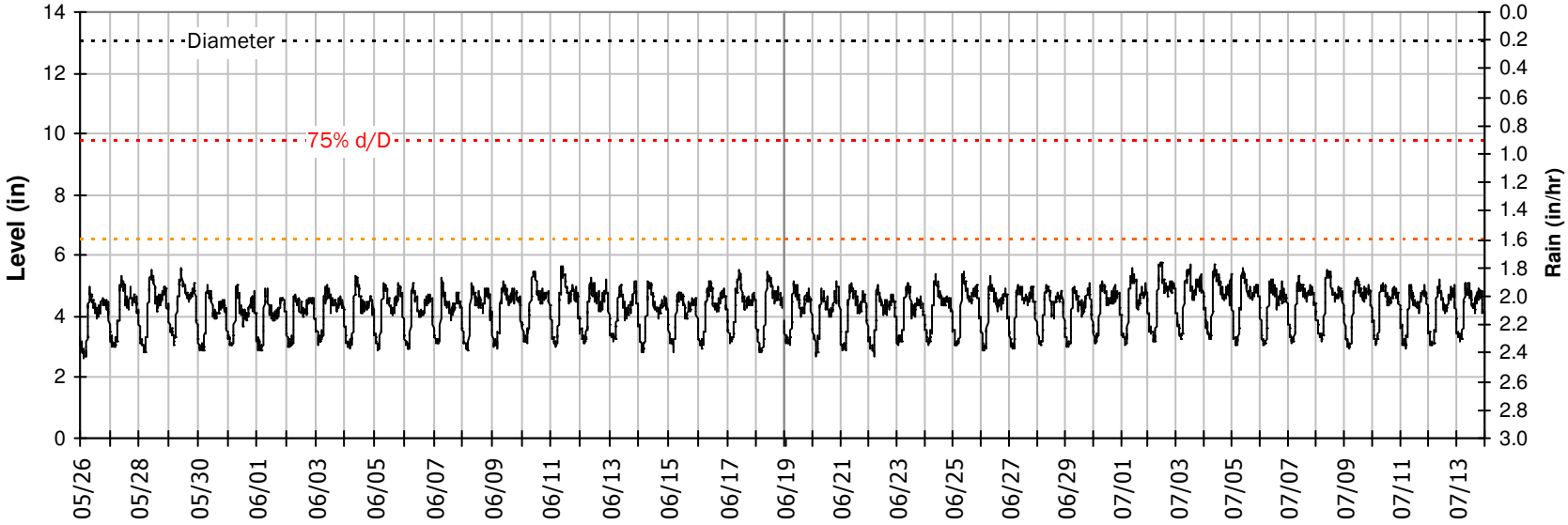


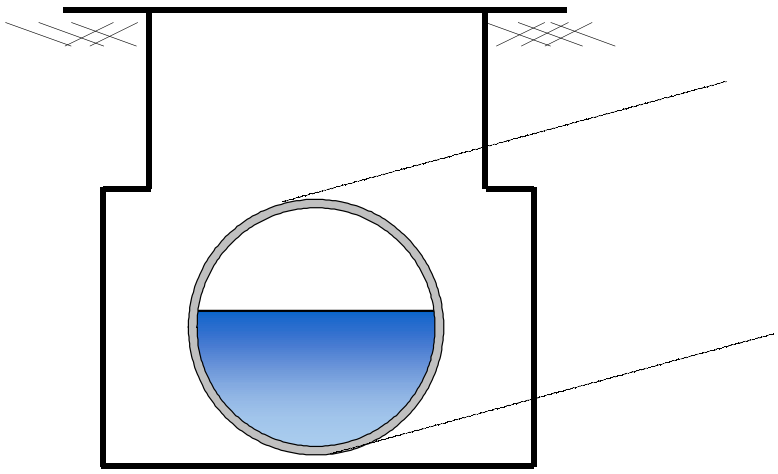
Pipe Diameter:	13	*inches*
Peak Measured Level:	7.32	*inches*
Peak d/D Ratio:	0.56	

SITE 08

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



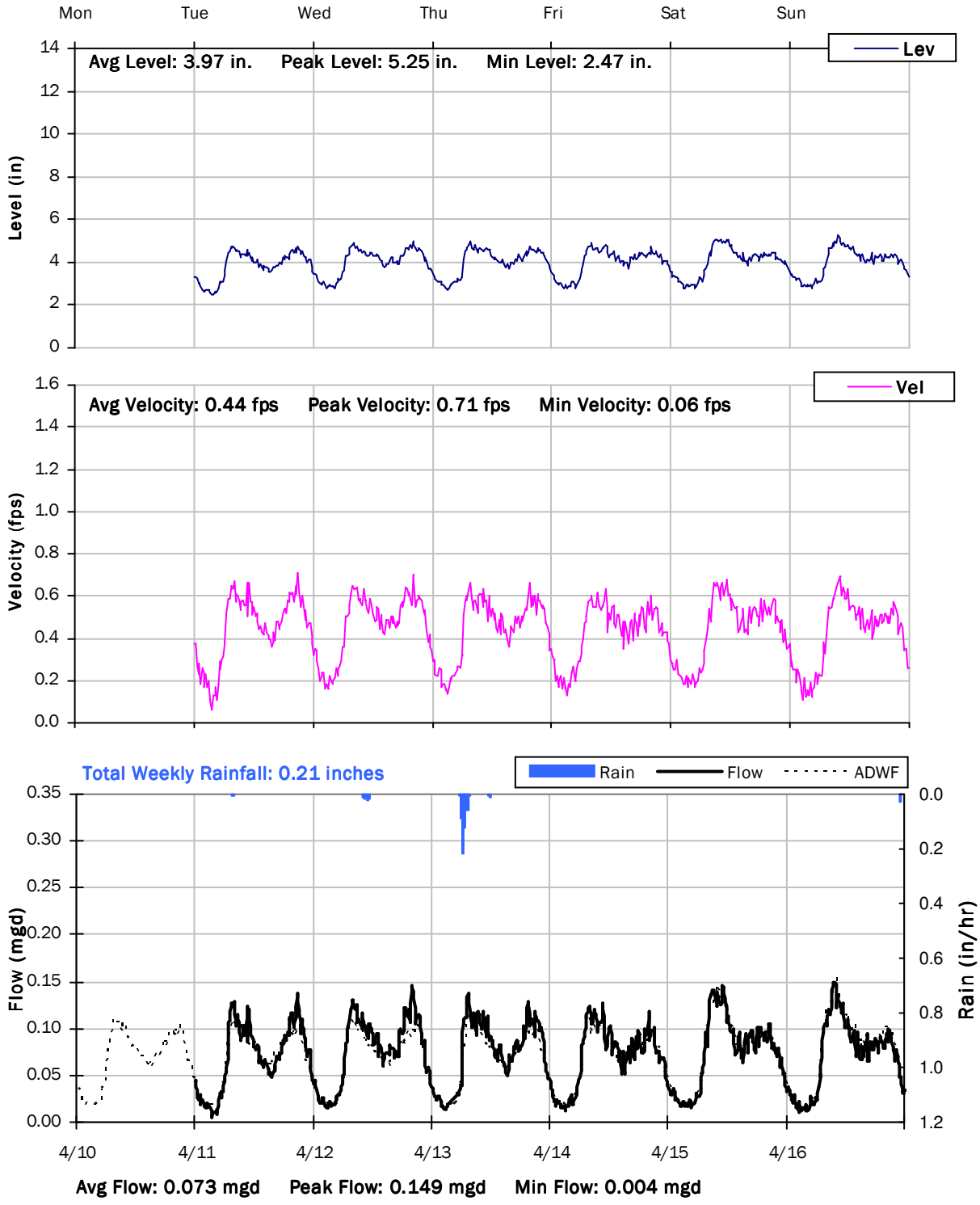


Pipe Diameter:	13	*inches*
Peak Measured Level:	7.32	*inches*
Peak d/D Ratio:	0.56	

SITE 08

Weekly Level, Velocity and Flow Hydrographs

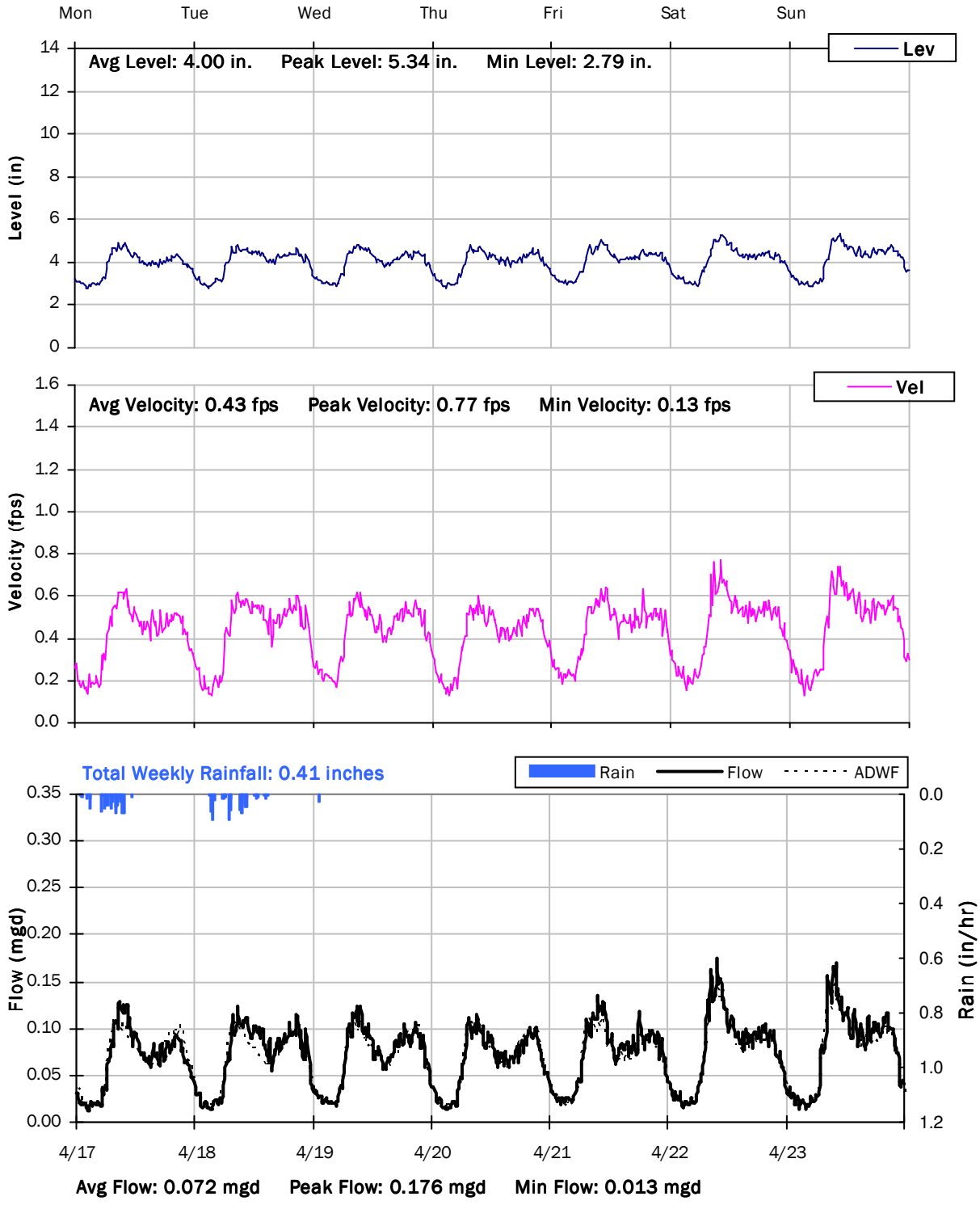
4/10/2017 to 4/17/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

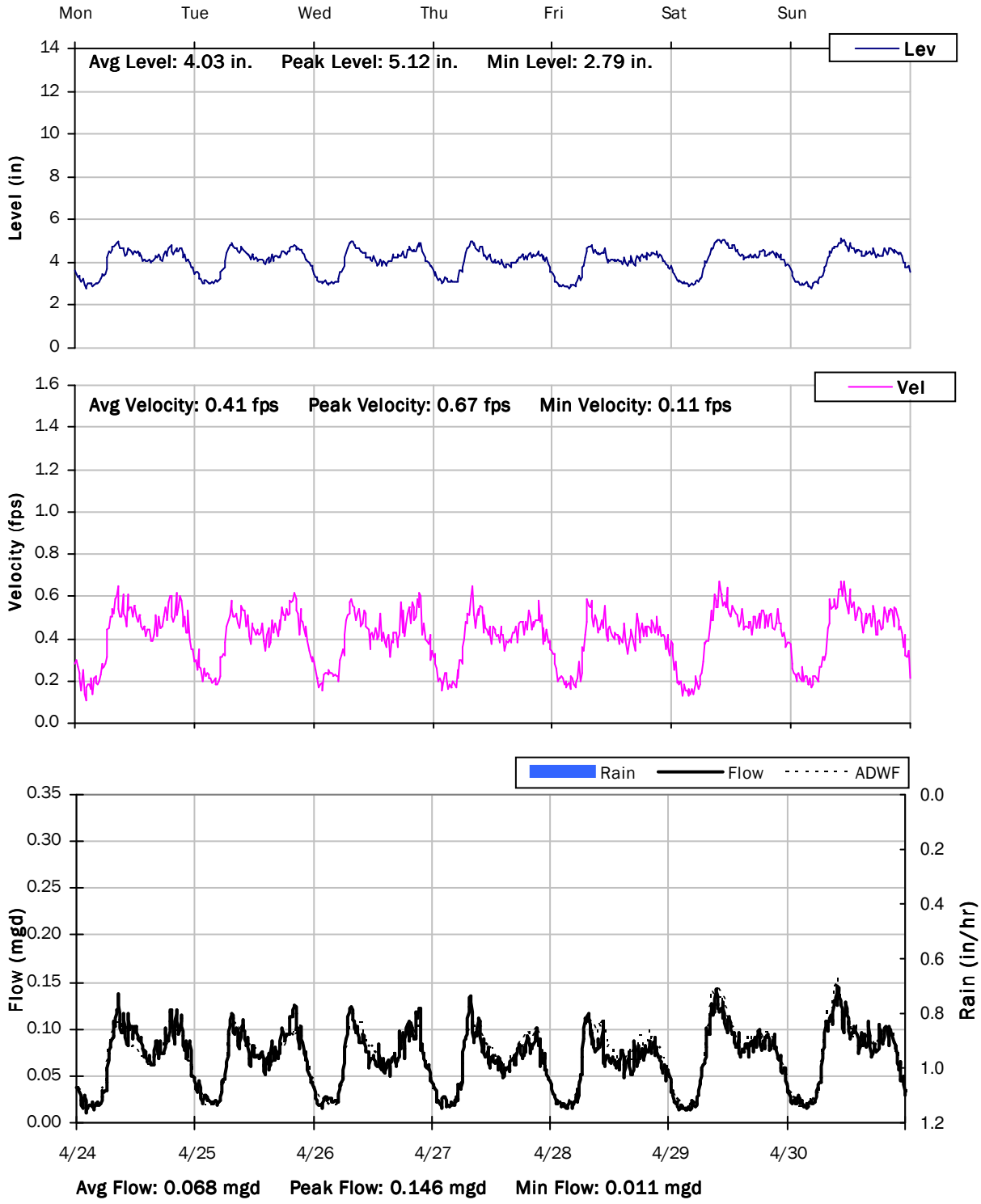
4/17/2017 to 4/24/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

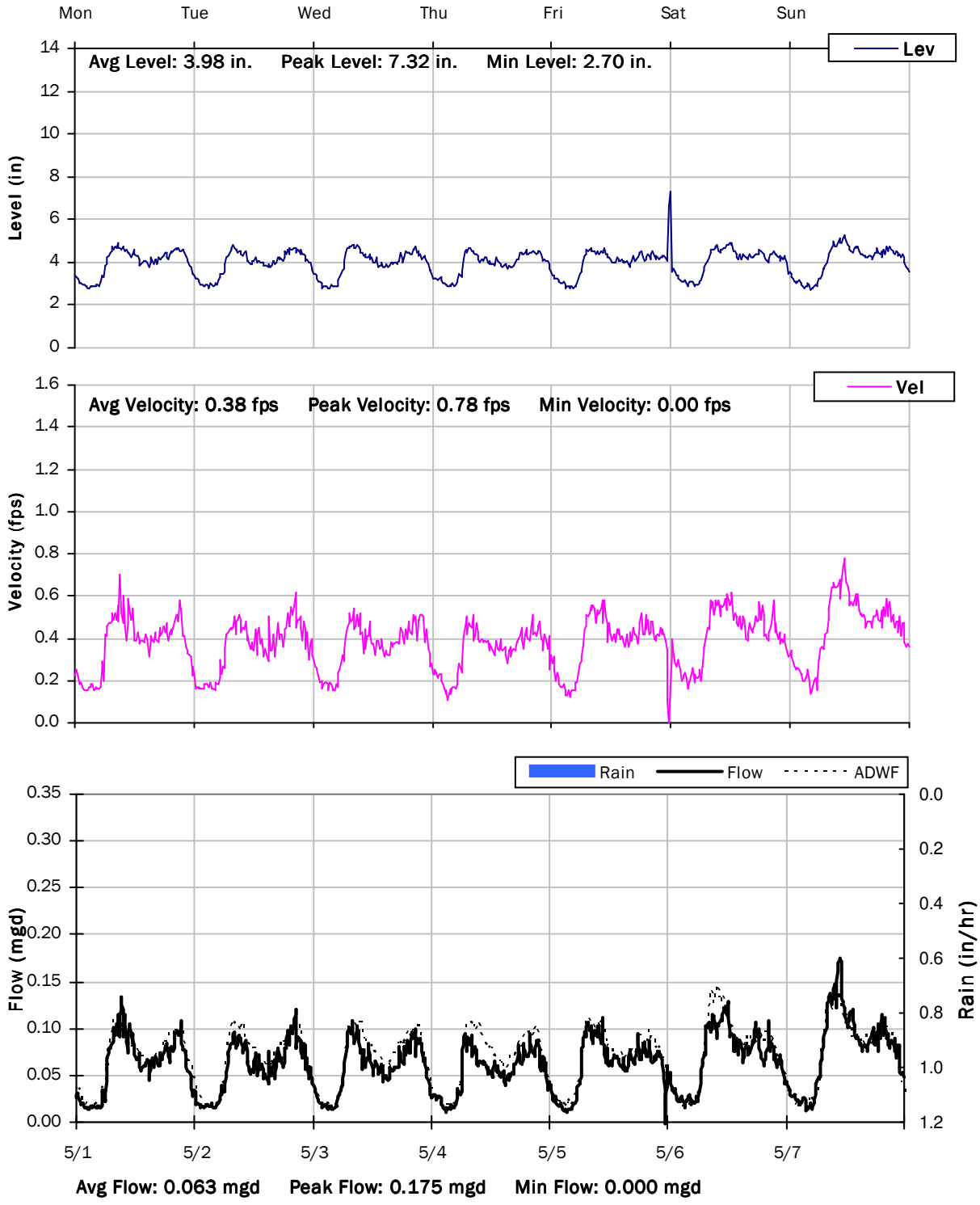
4/24/2017 to 5/1/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

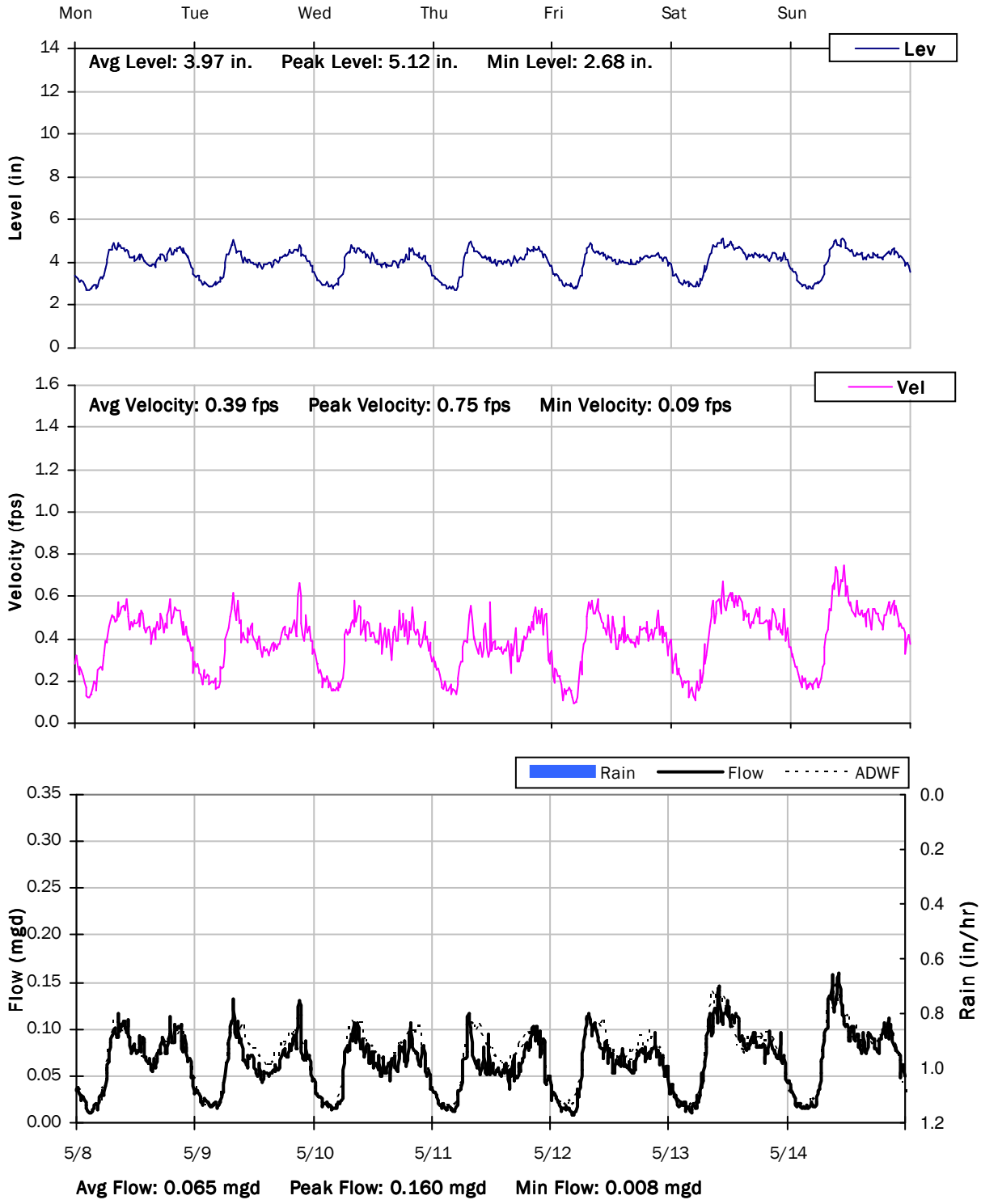
5/1/2017 to 5/8/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

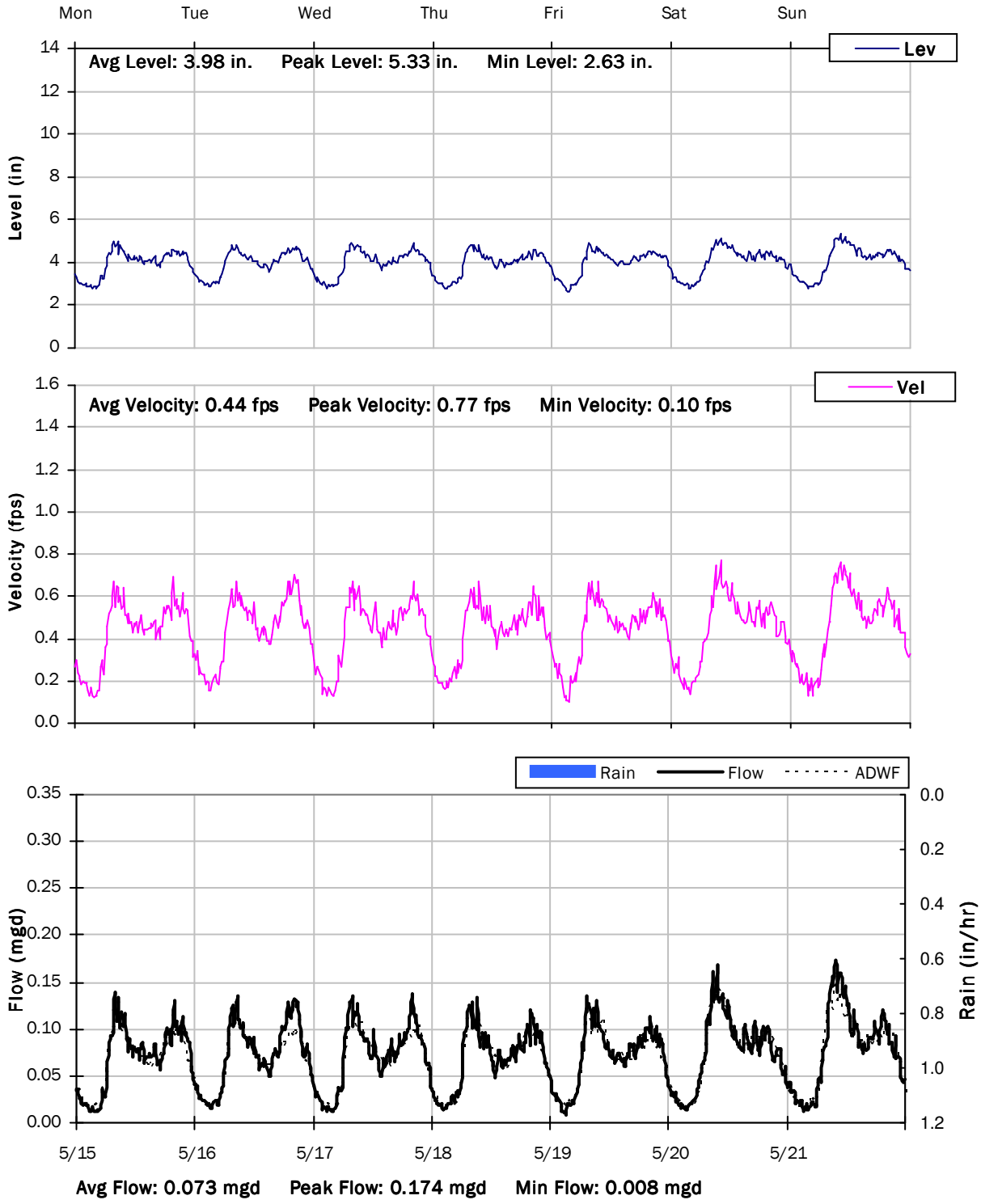
5/8/2017 to 5/15/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

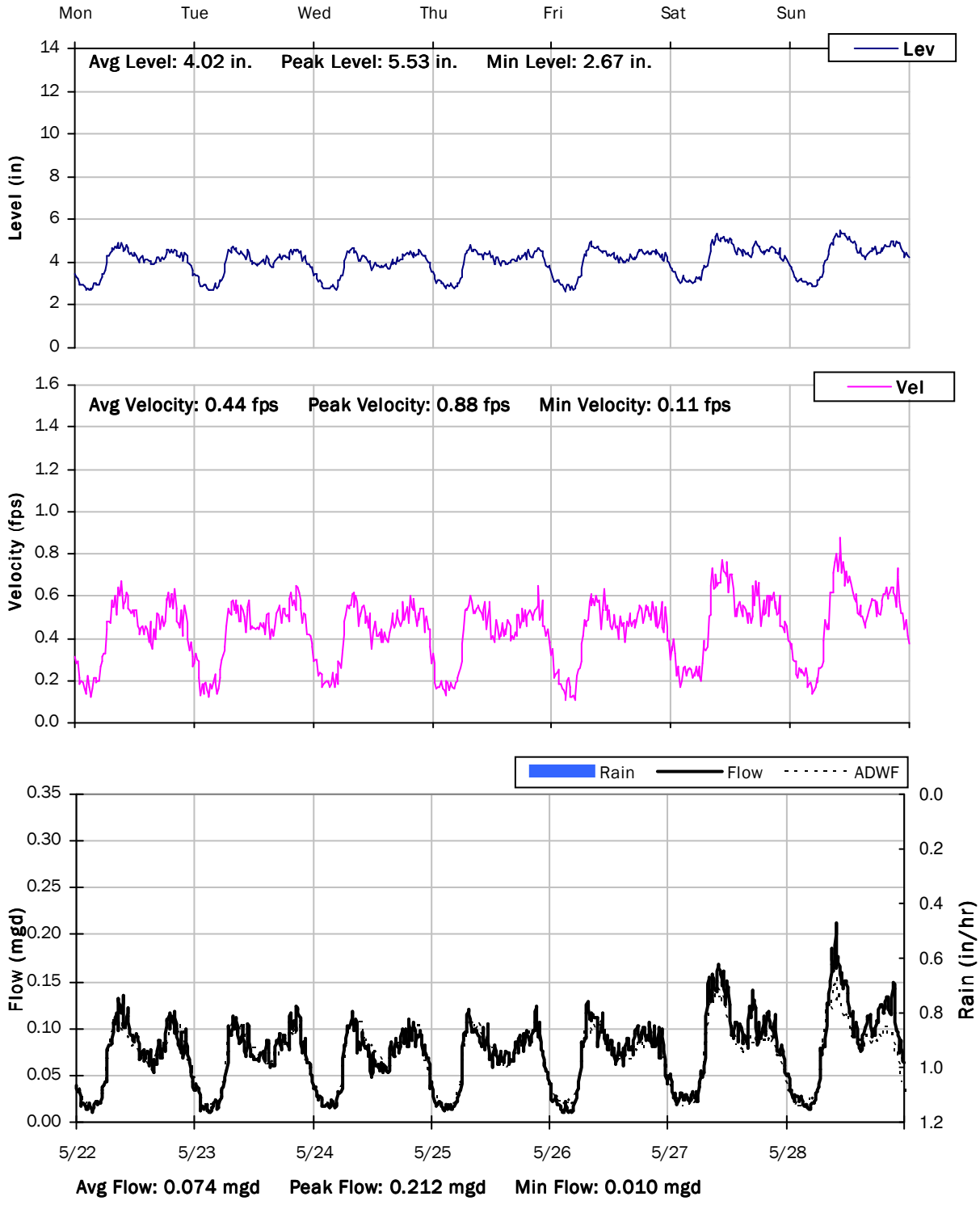
5/15/2017 to 5/22/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

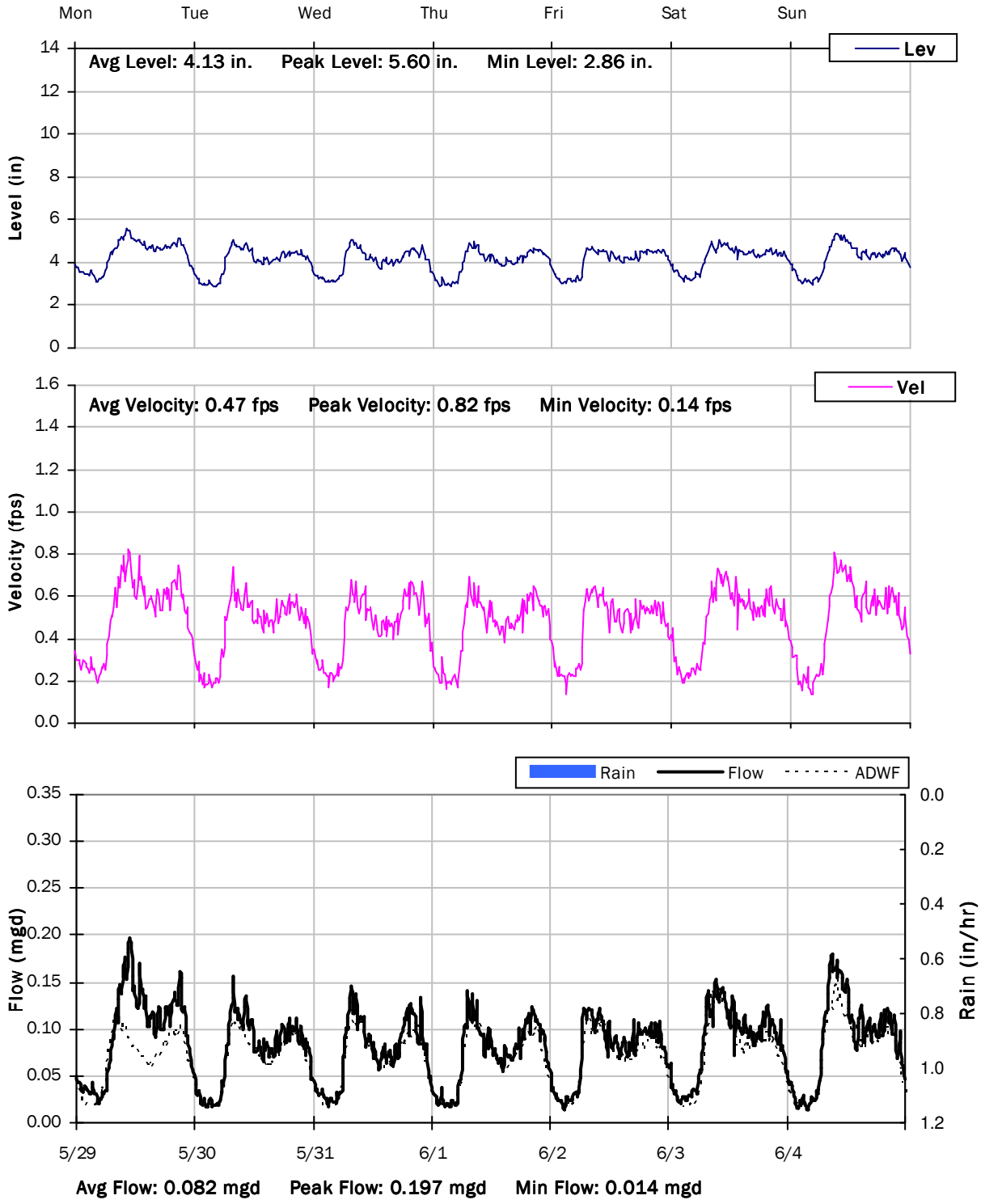
5/22/2017 to 5/29/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

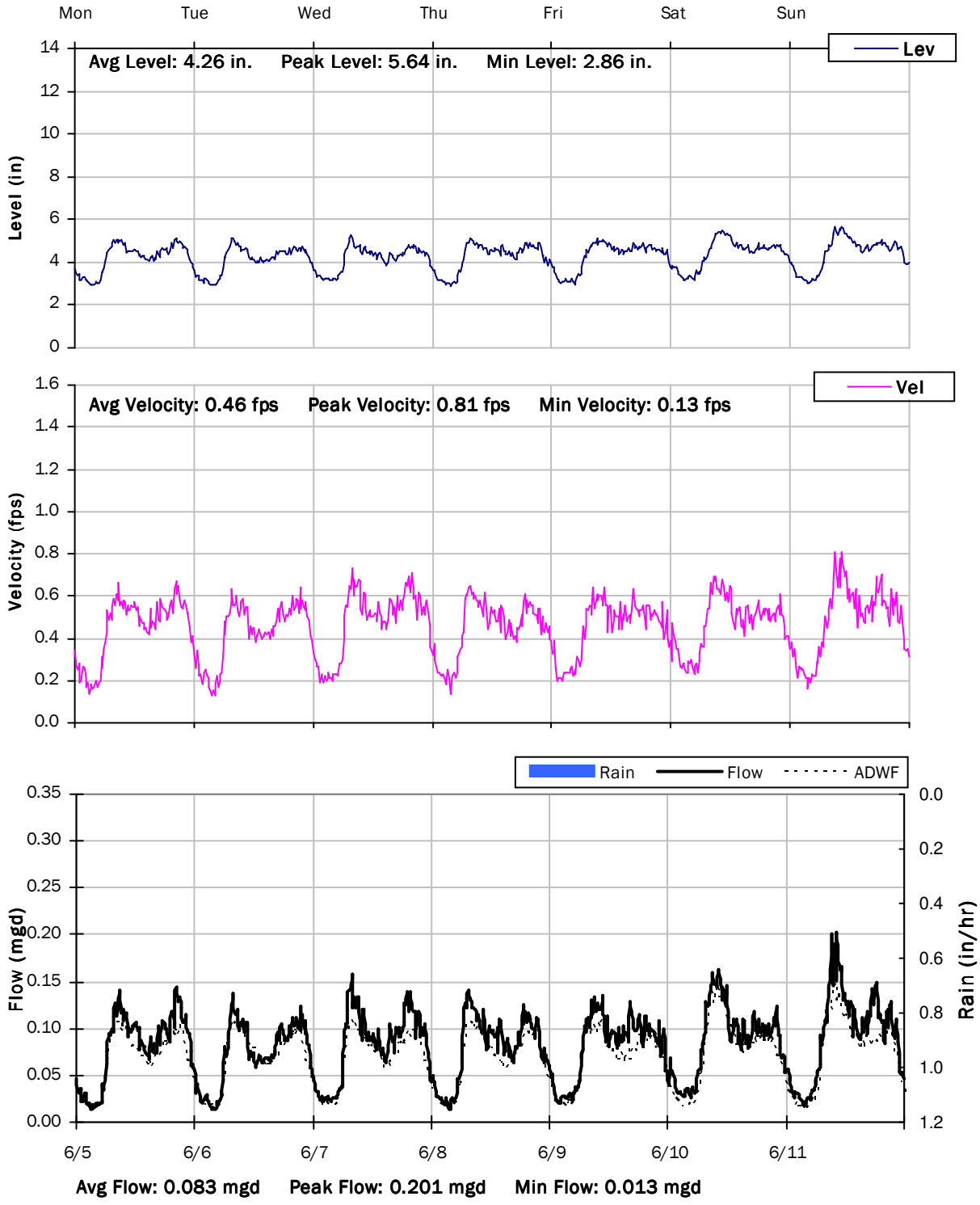
5/29/2017 to 6/5/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

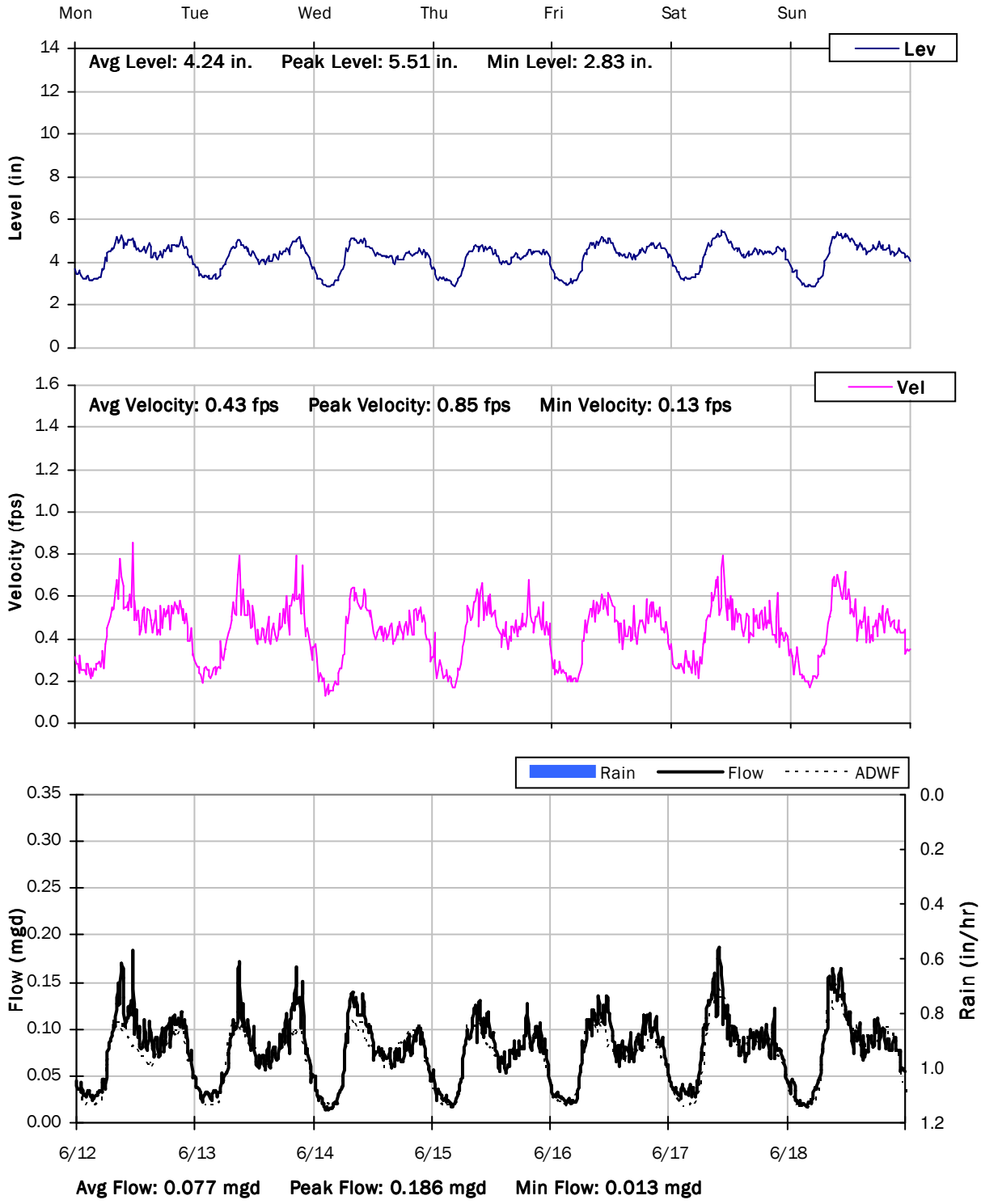
6/5/2017 to 6/12/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

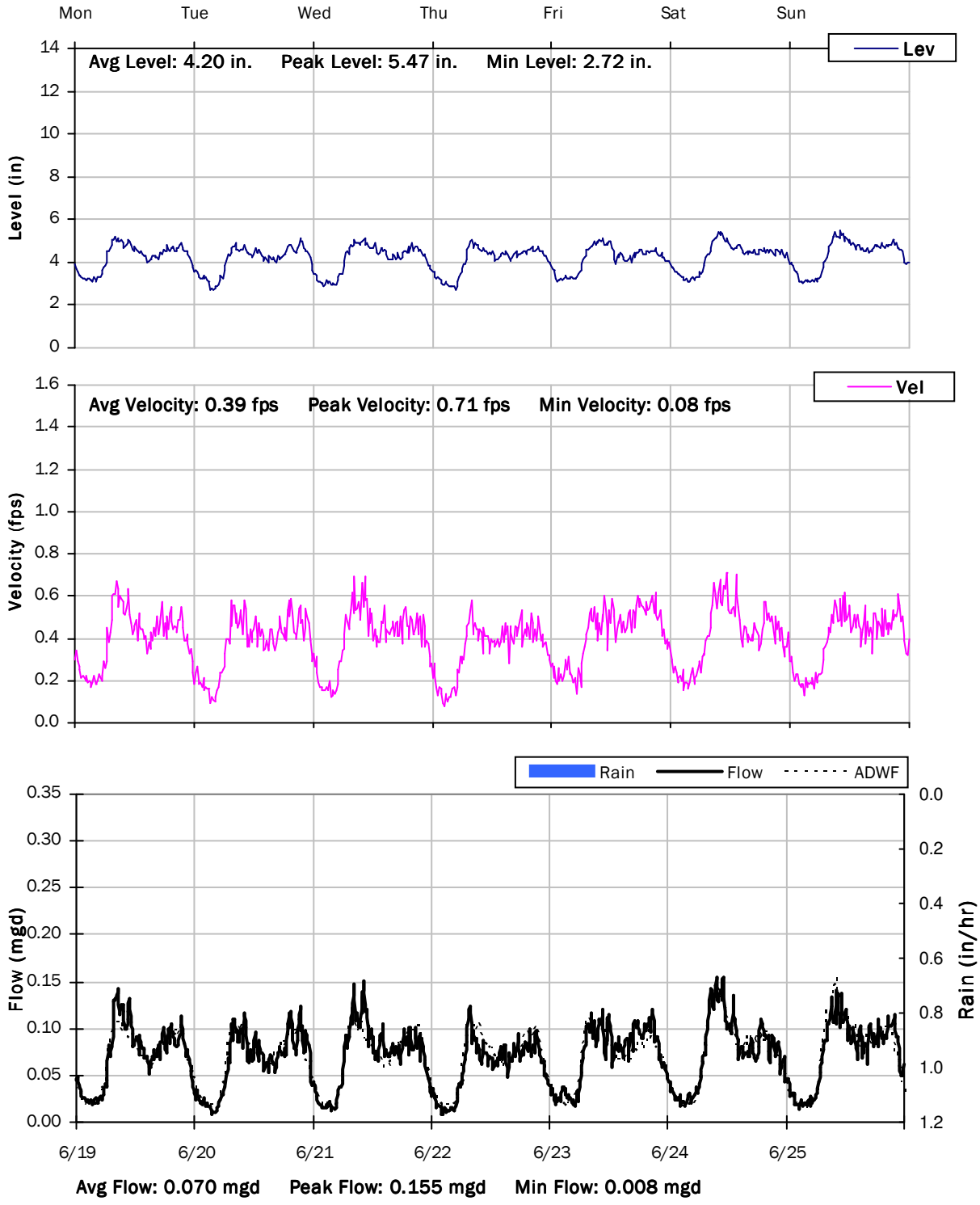
6/12/2017 to 6/19/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

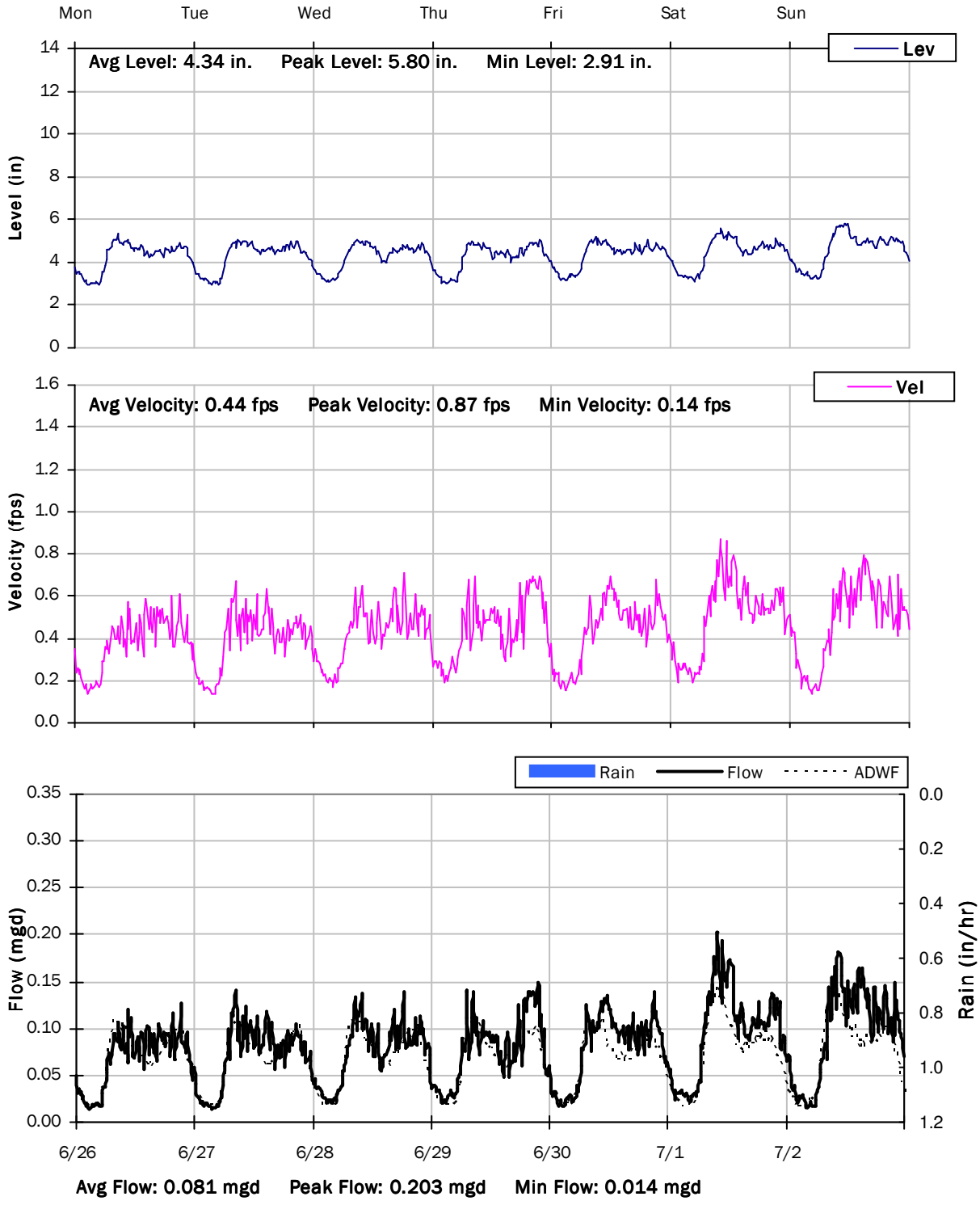
6/19/2017 to 6/26/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

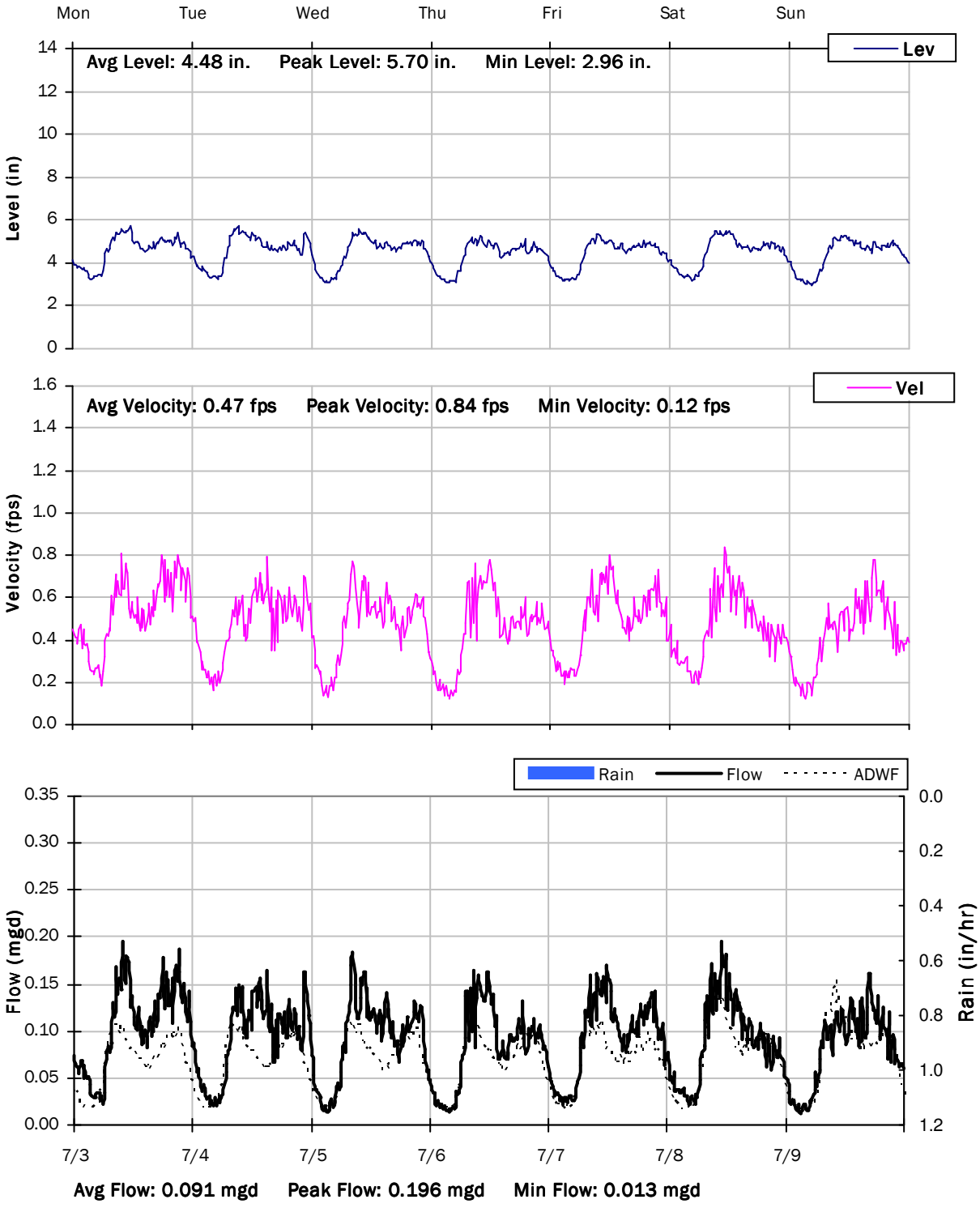
6/26/2017 to 7/3/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

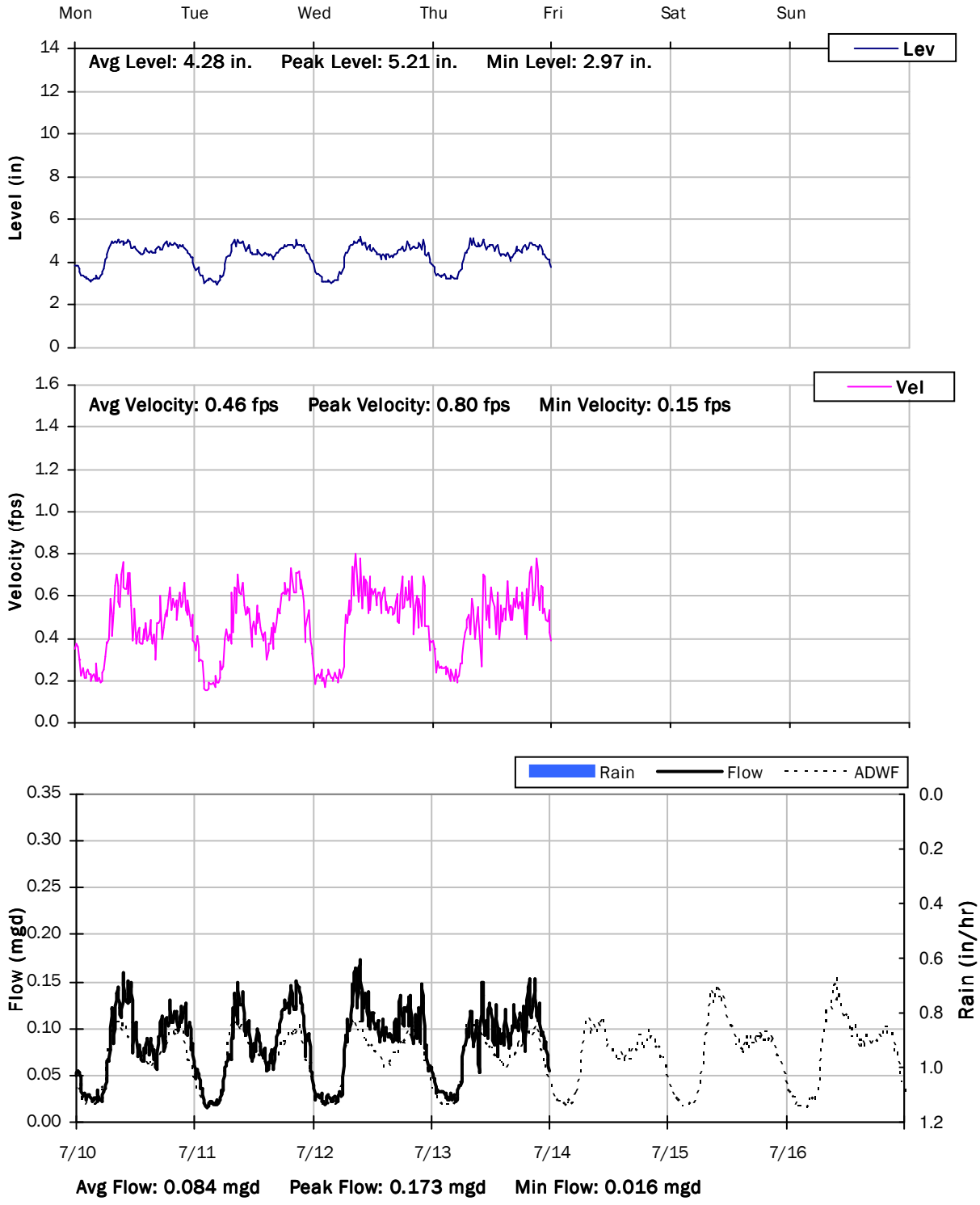
7/3/2017 to 7/10/2017



SITE 08

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

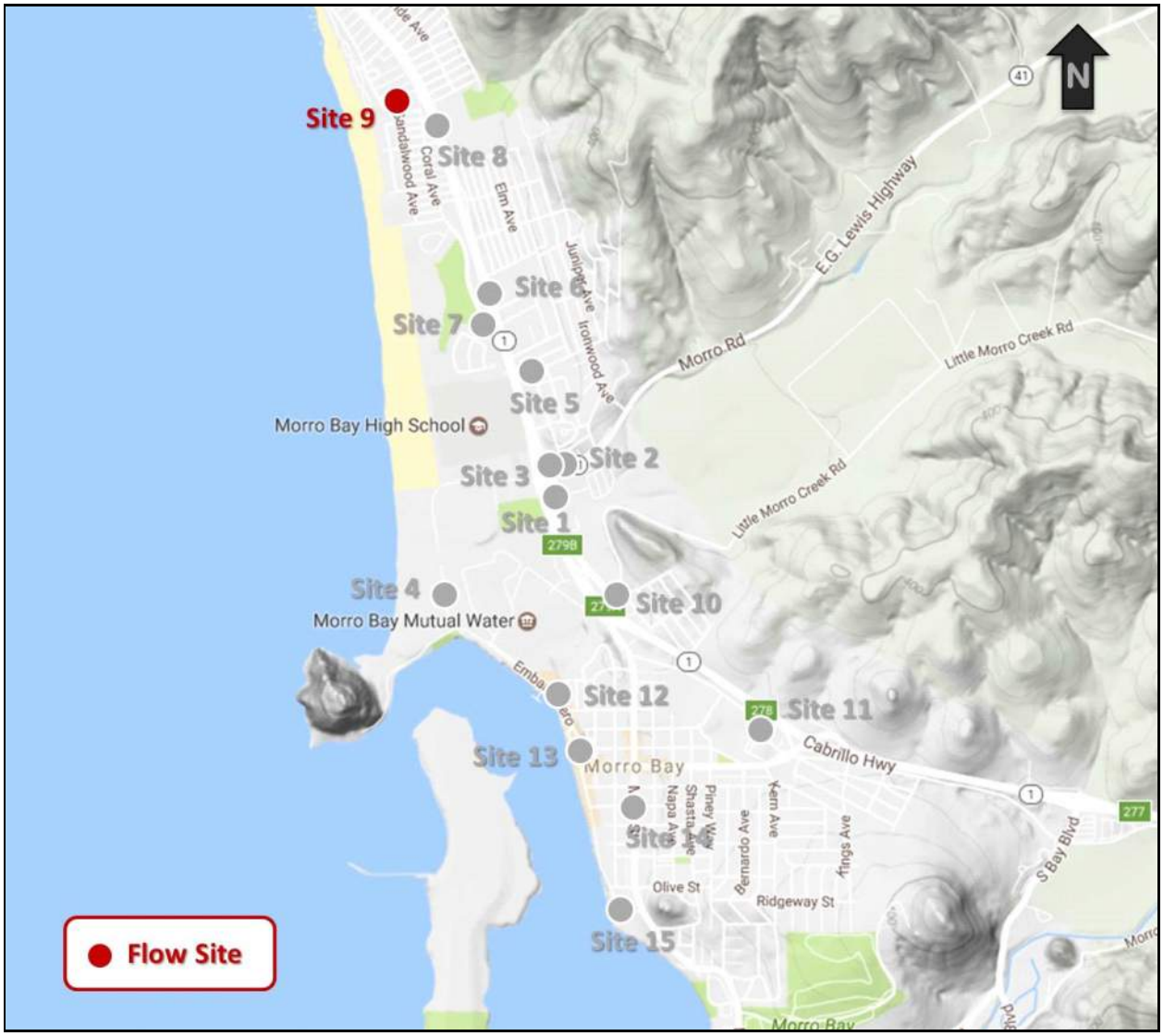
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 09

Location: 125 Java Street (near intersection of Sandalwood Avenue), meter on west 12" inlet

Data Summary Report



Vicinity Map: Site 09

SITE 09

Site Information

Location: 125 Java Street (near intersection of Sandalwood Avenue), meter on west 12" inlet

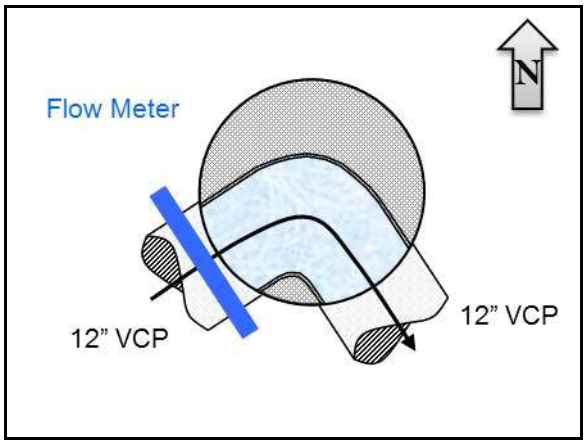


Pipe Diameter: 12 inches

ADWF: 0.020 mgd

Peak Measured Flow: 0.096 mgd









SITE 09

Additional Site Photos



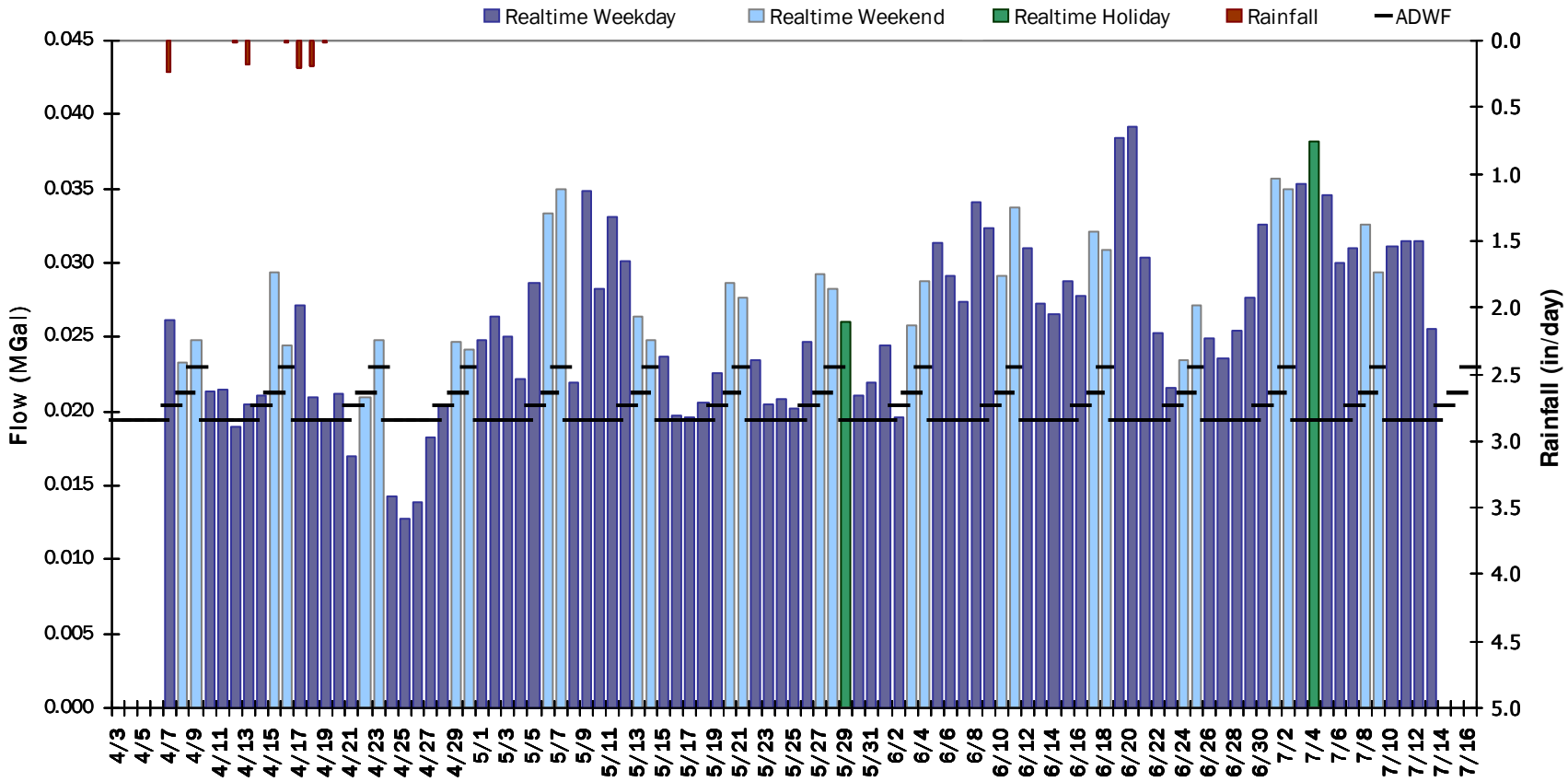


SITE 09

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.026 MGal Peak Daily Flow: 0.039 MGal Min Daily Flow: 0.013 MGal

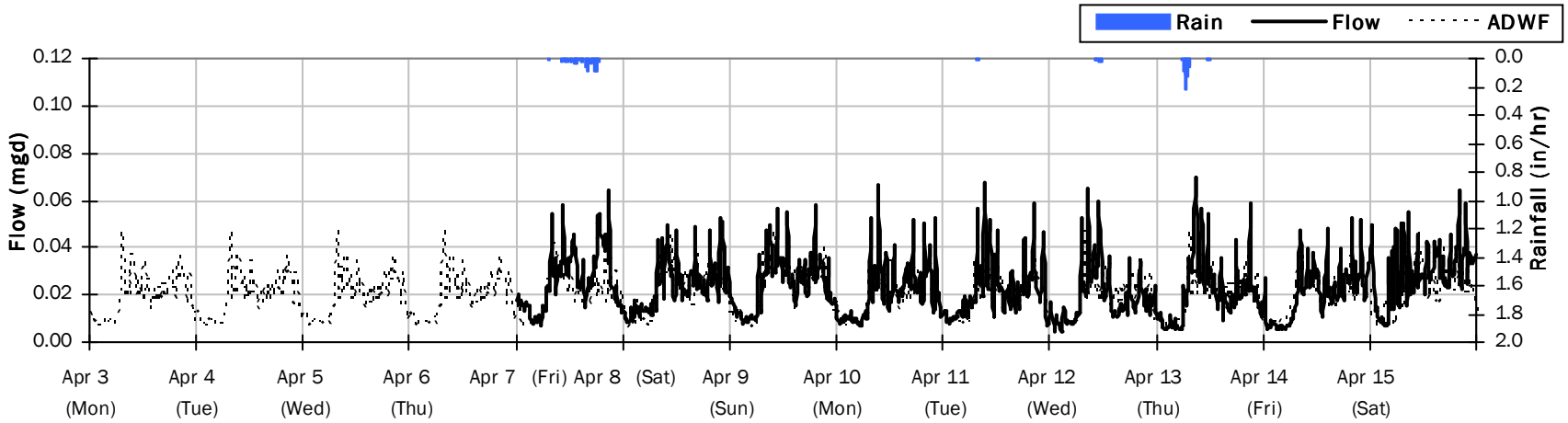
Total Period Rainfall: 0.85 inches

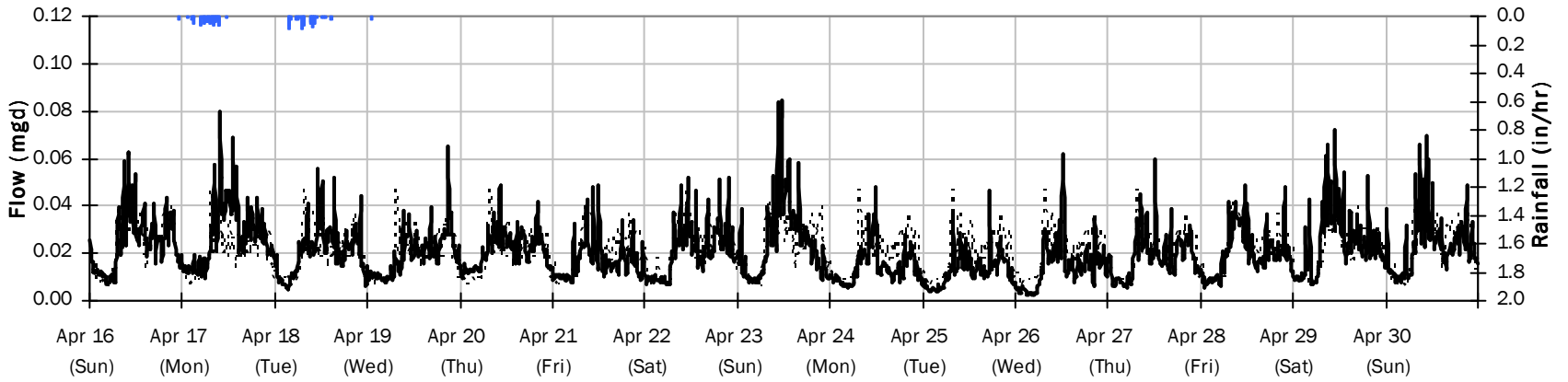


SITE 09

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.021 mgd** **Peak Flow: 0.084 mgd** **Min Flow: 0.002 mgd**

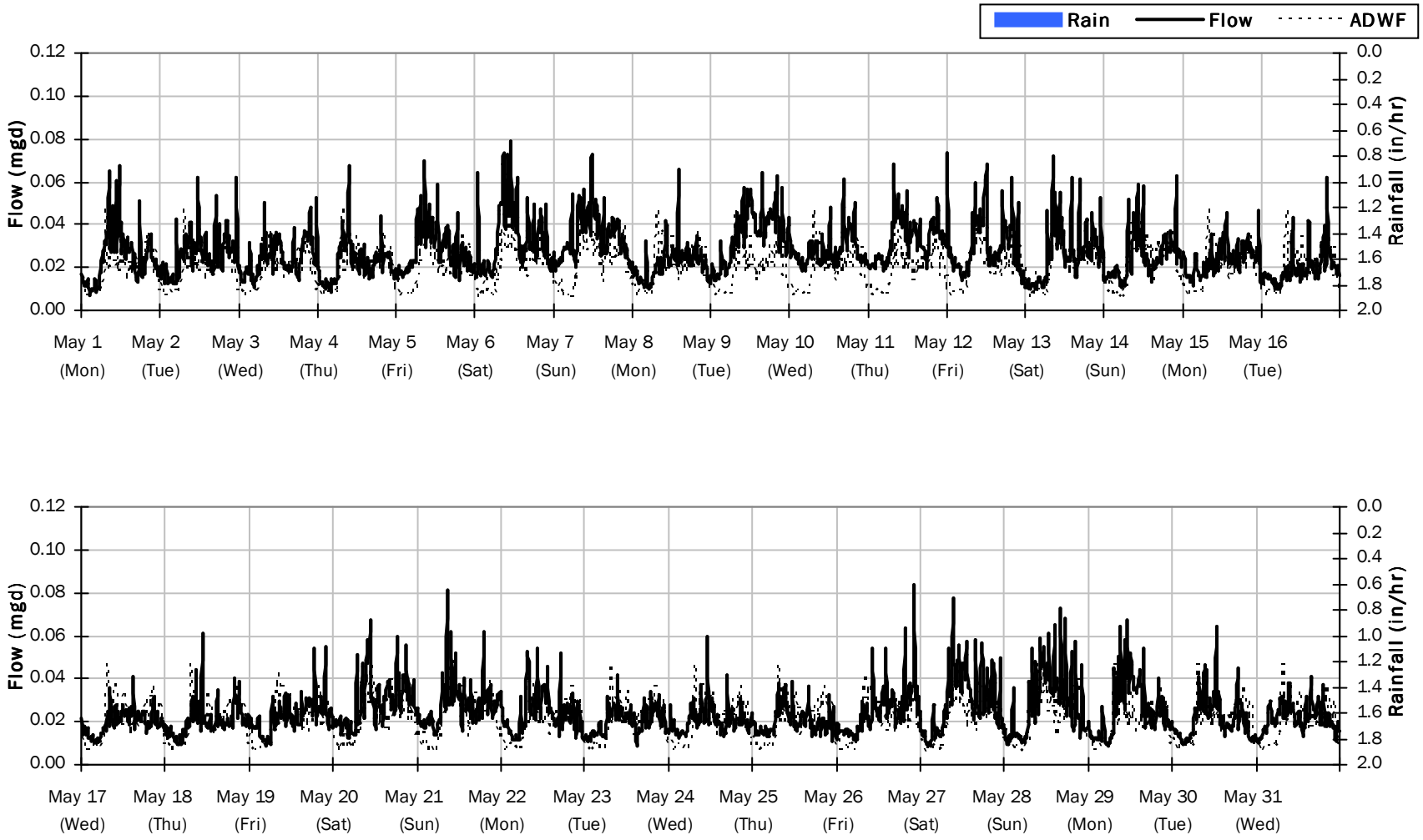




SITE 09

Flow Summary: 5/1/2017 to 5/31/2017

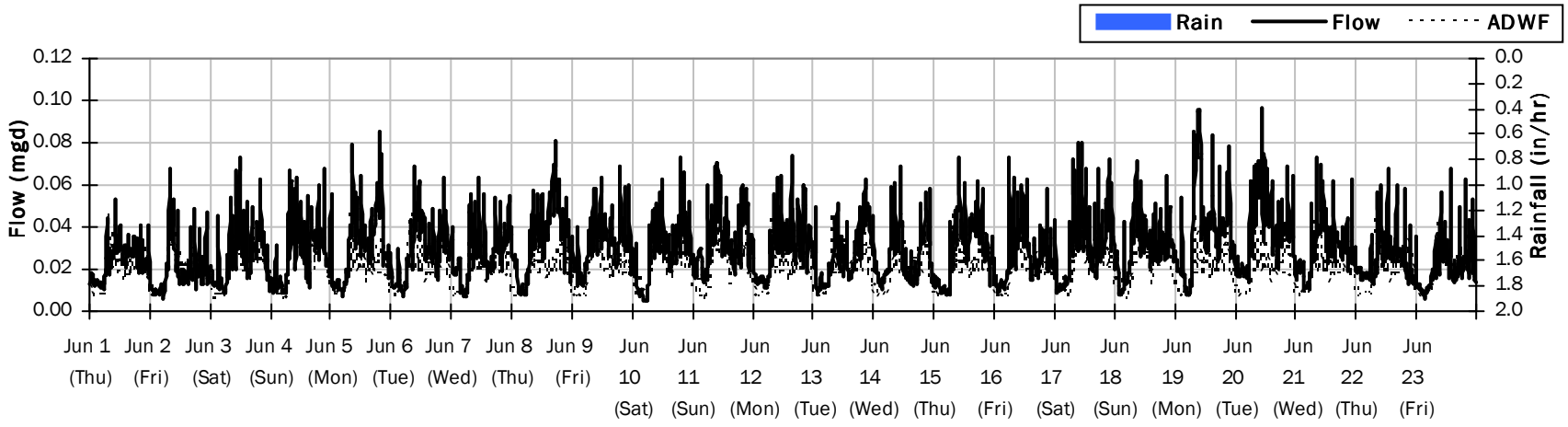
Total Period Rainfall: 0.00 inches **Avg Flow: 0.026 mgd** **Peak Flow: 0.084 mgd** **Min Flow: 0.007 mgd**

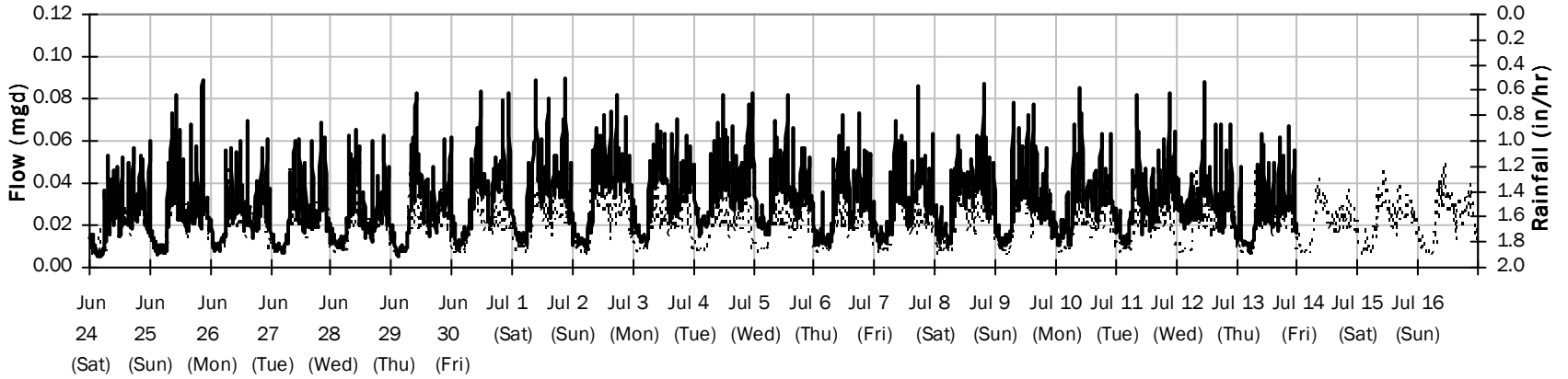


SITE 09

Flow Summary: 6/1/2017 to 7/16/2017

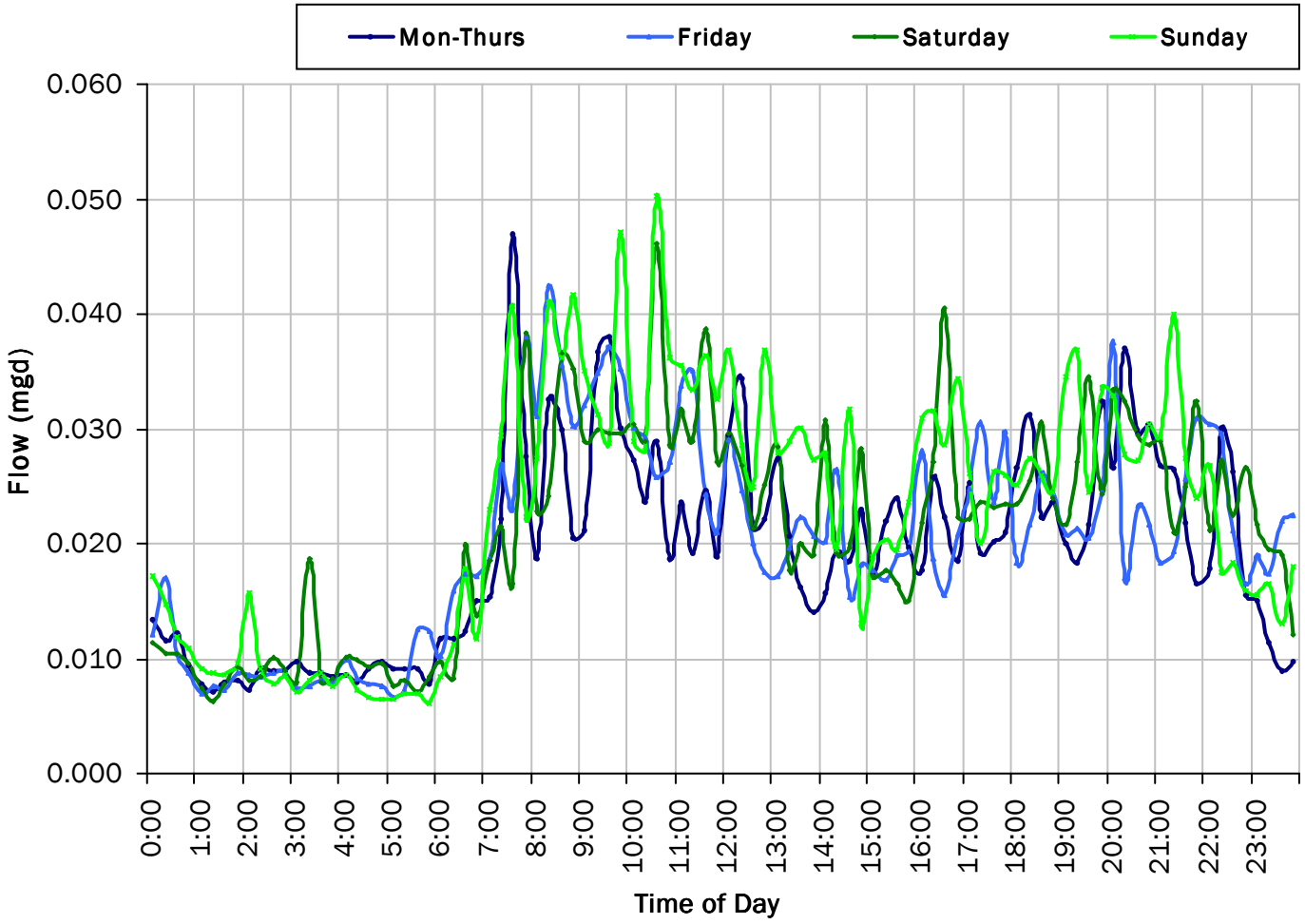
Total Period Rainfall: 0.00 inches **Avg Flow: 0.030 mgd** **Peak Flow: 0.096 mgd** **Min Flow: 0.005 mgd**





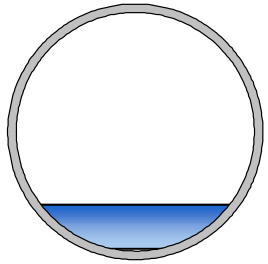
SITE 09

Average Dry Weather Flow Hydrographs



ADWF:

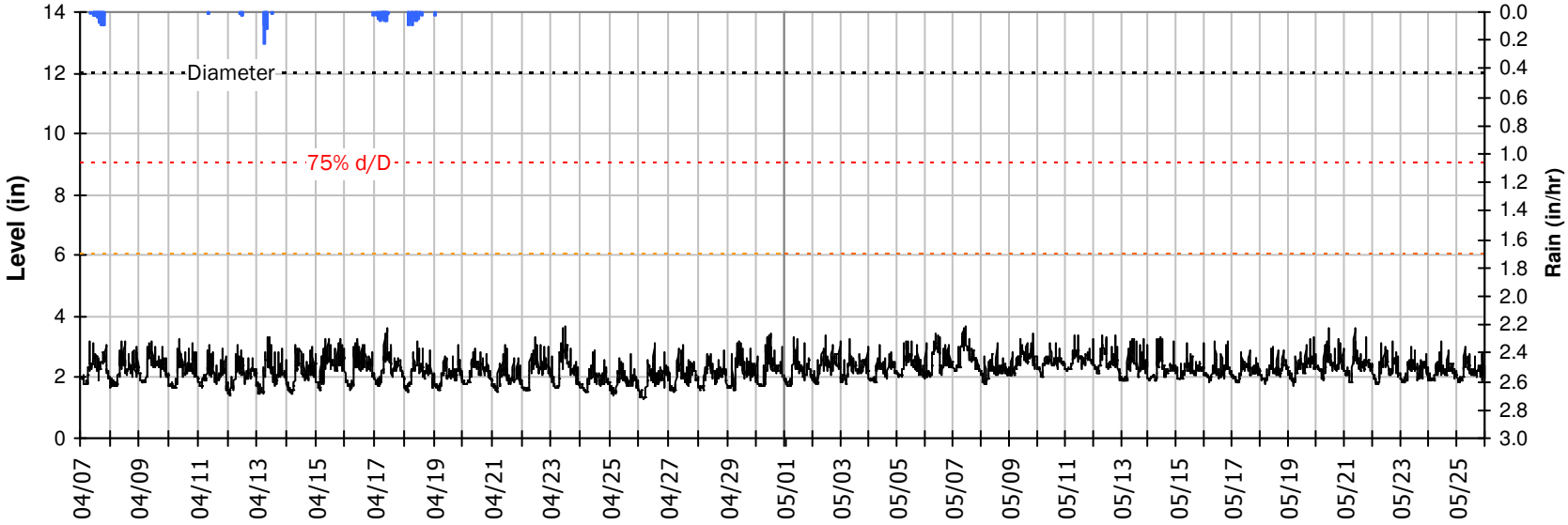
0.020 *mgd*

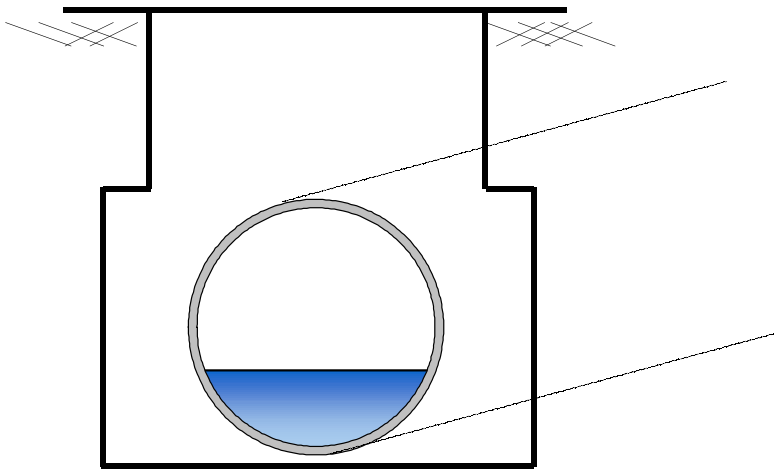


SITE 09

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



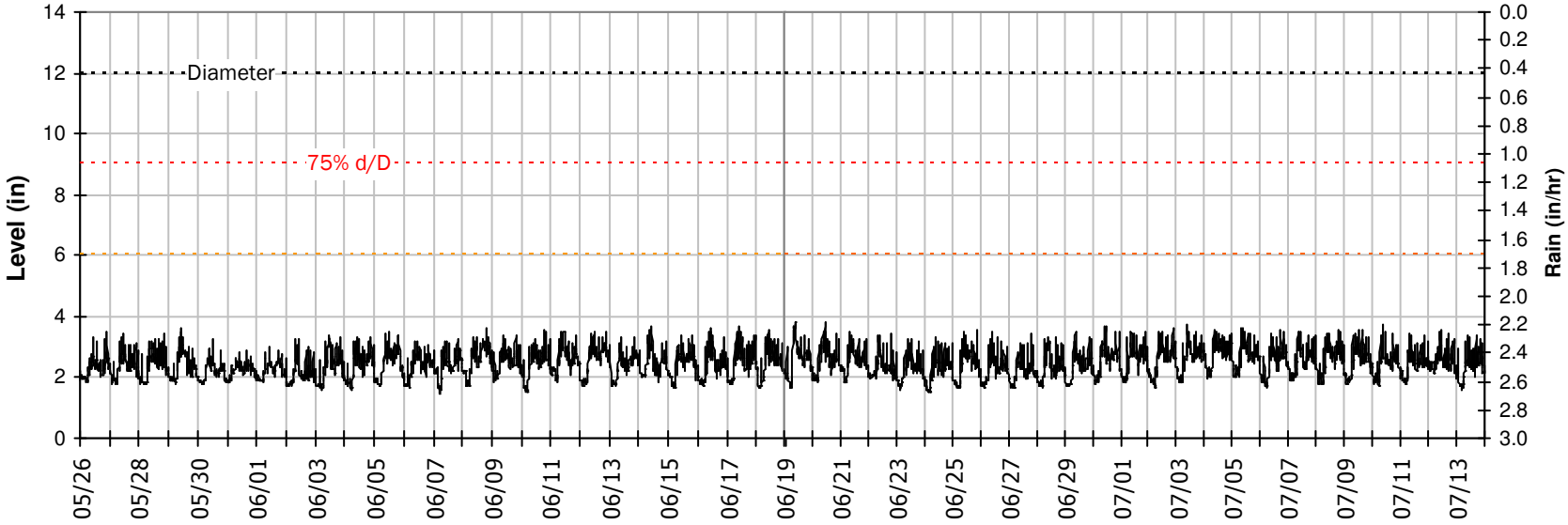


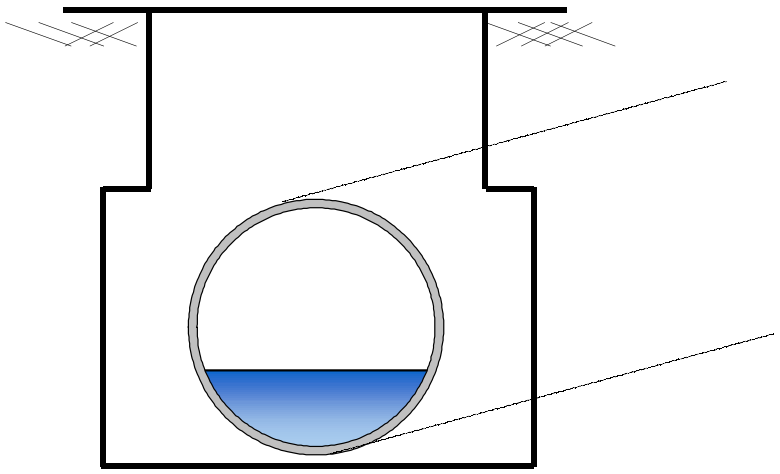
Pipe Diameter:	12	*inches*
Peak Measured Level:	3.82	*inches*
Peak d/D Ratio:	0.32	

SITE 09

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



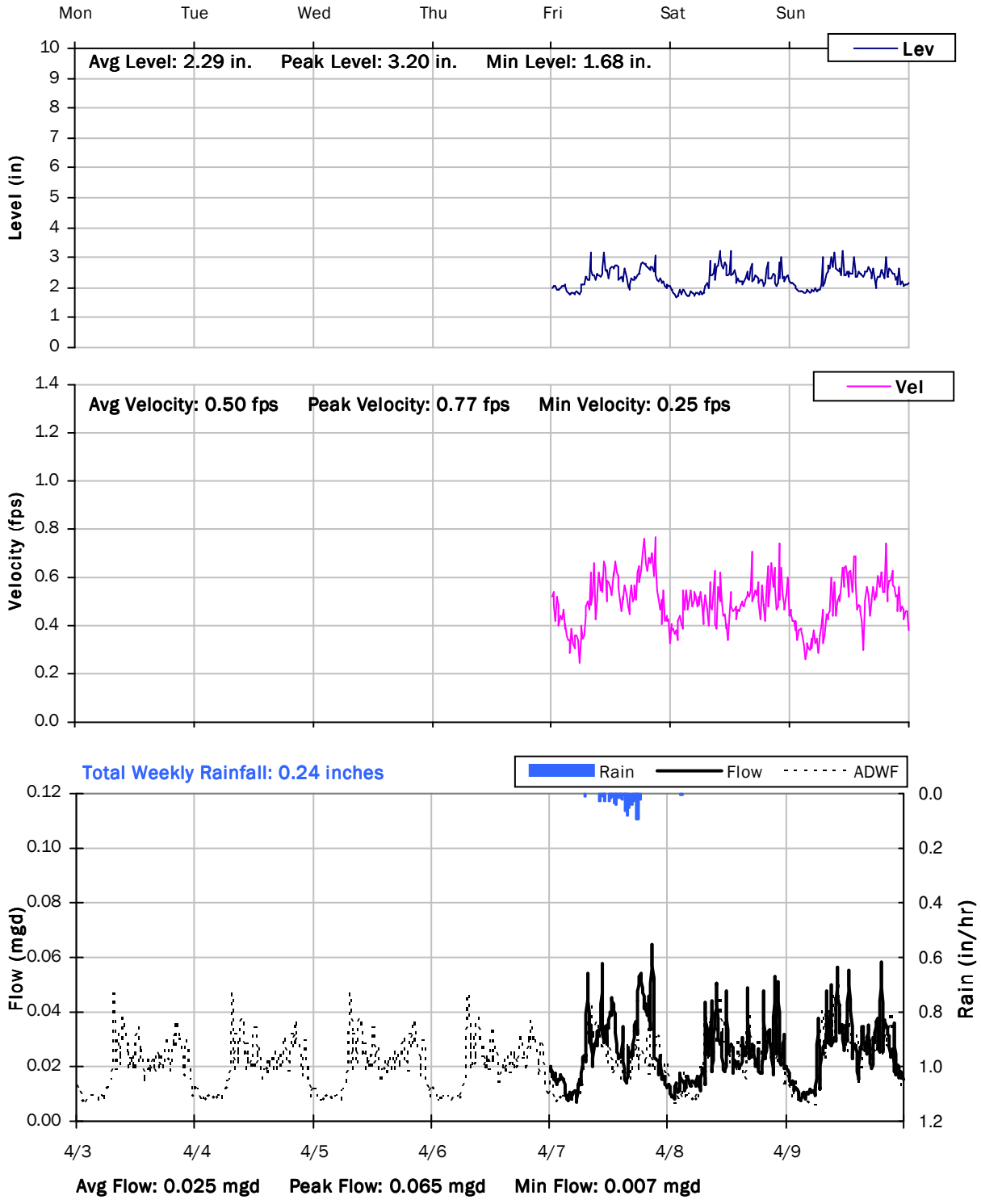


Pipe Diameter:	12	*inches*
Peak Measured Level:	3.82	*inches*
Peak d/D Ratio:	0.32	

SITE 09

Weekly Level, Velocity and Flow Hydrographs

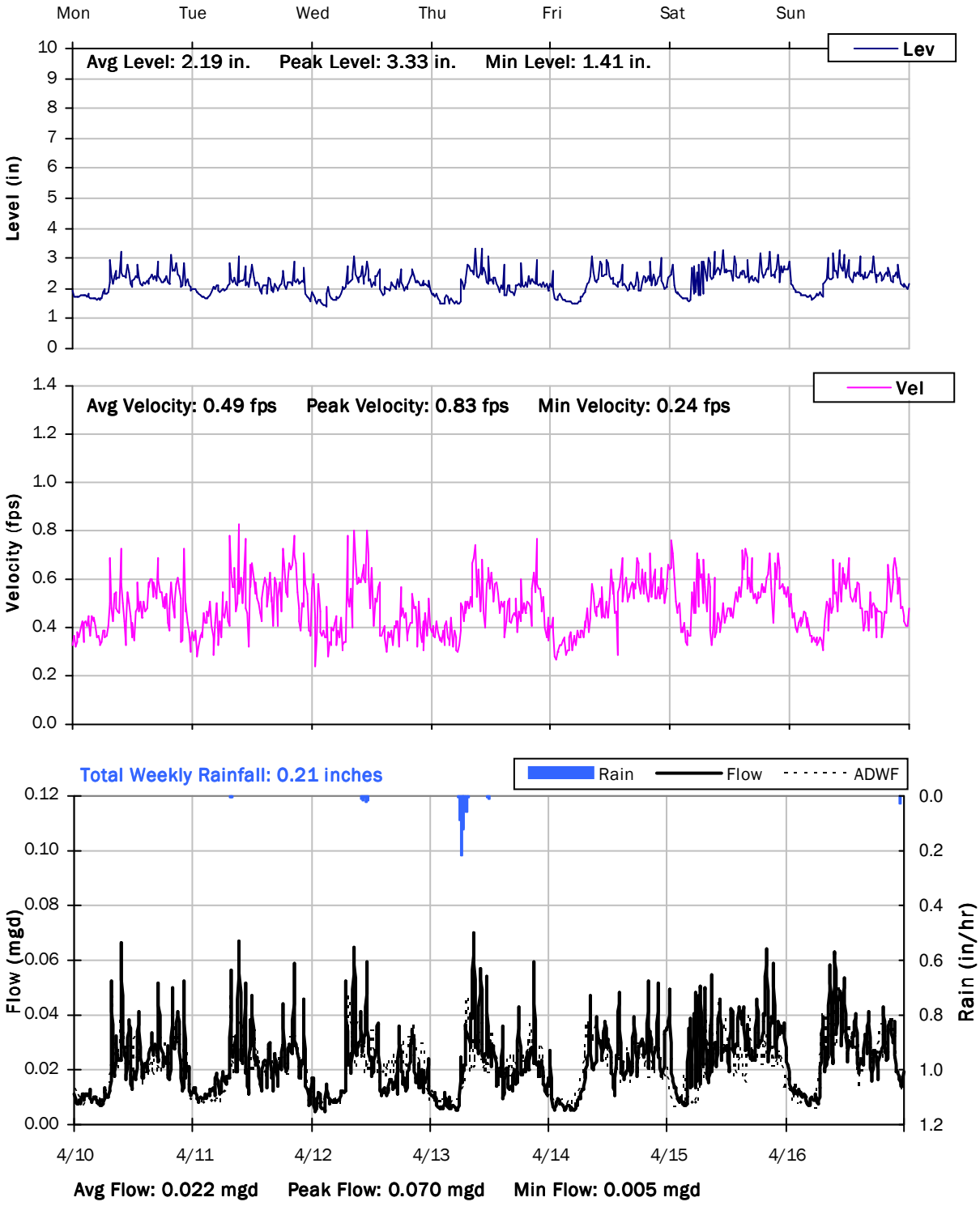
4/3/2017 to 4/10/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

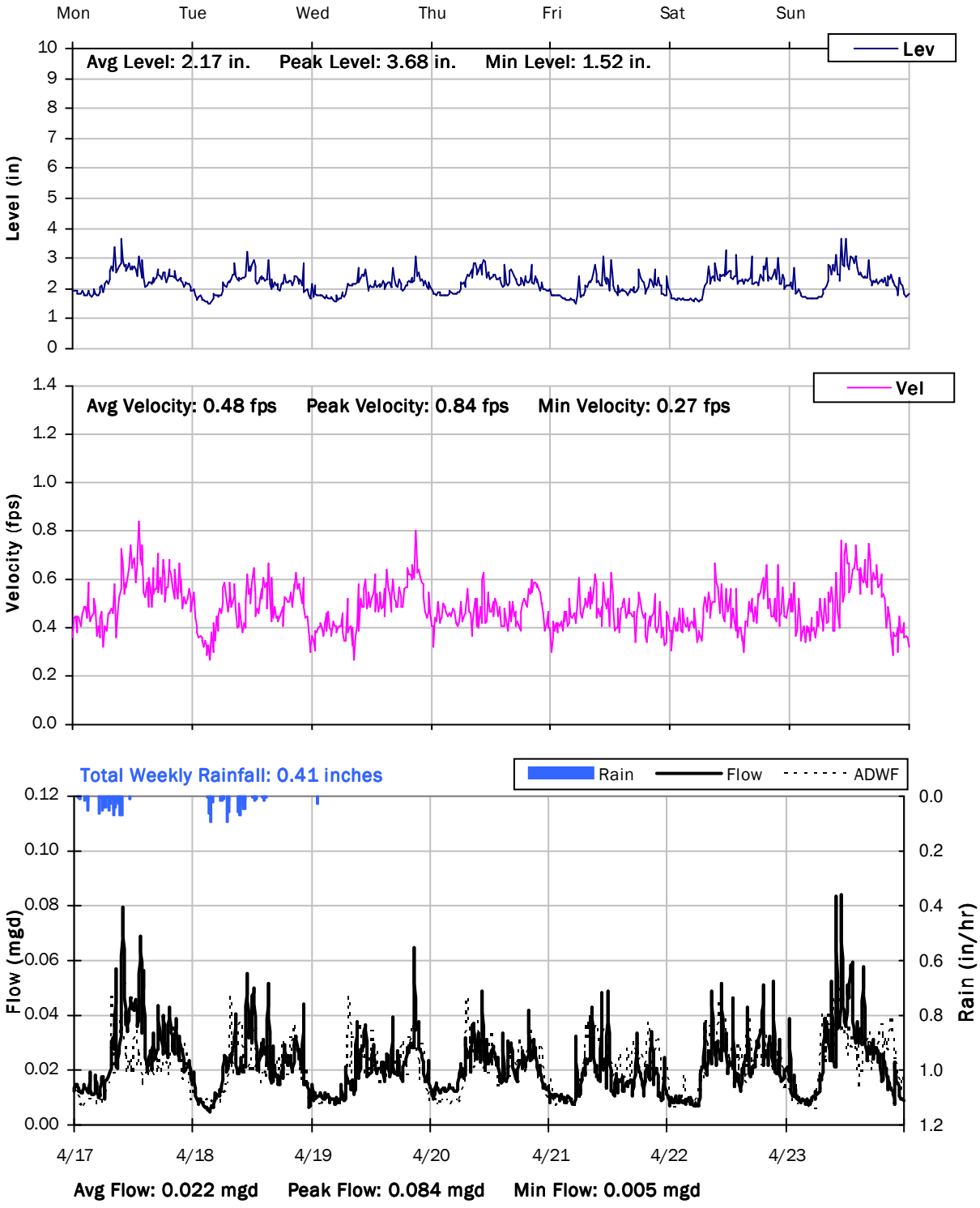
4/10/2017 to 4/17/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

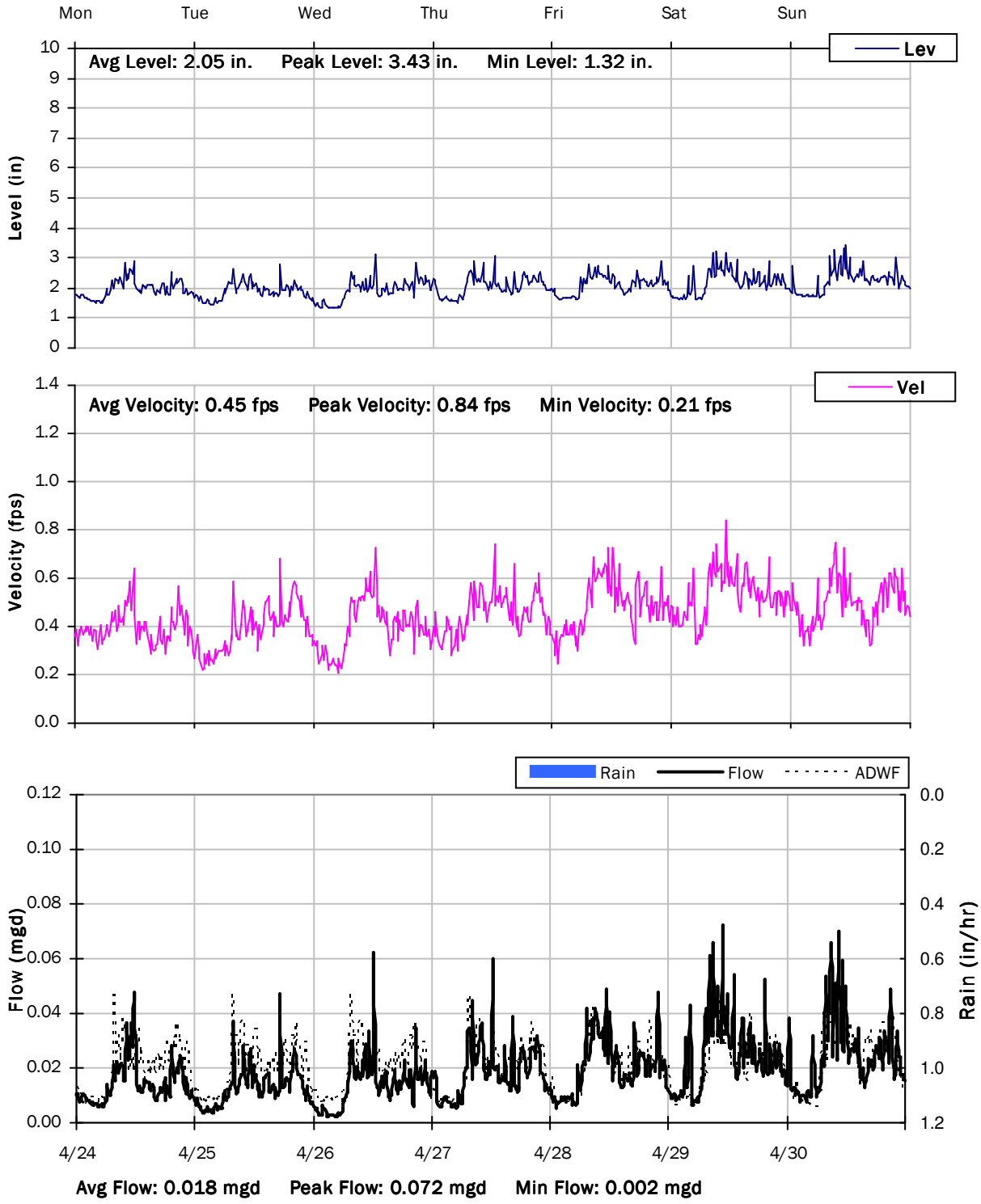
4/17/2017 to 4/24/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

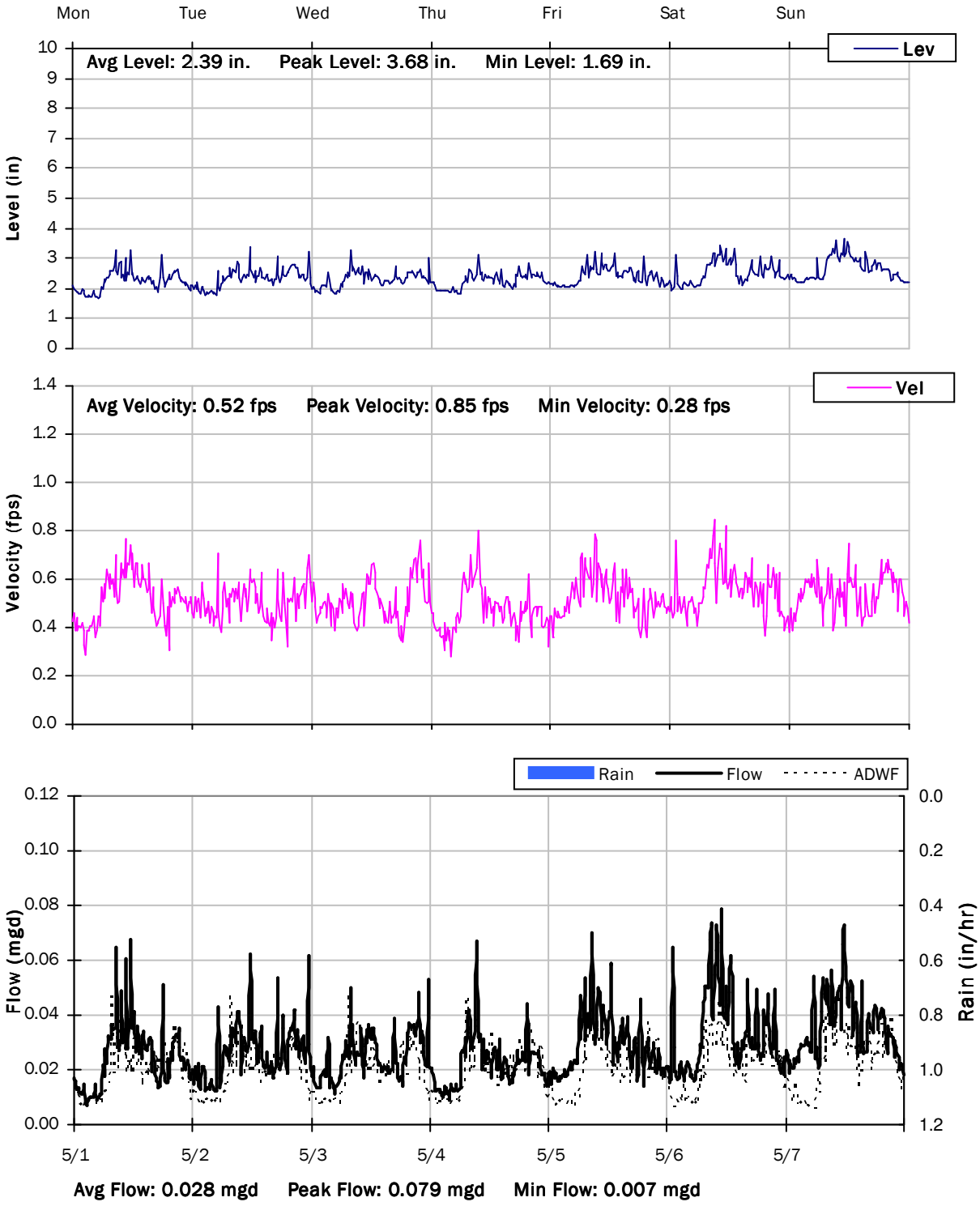
4/24/2017 to 5/1/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

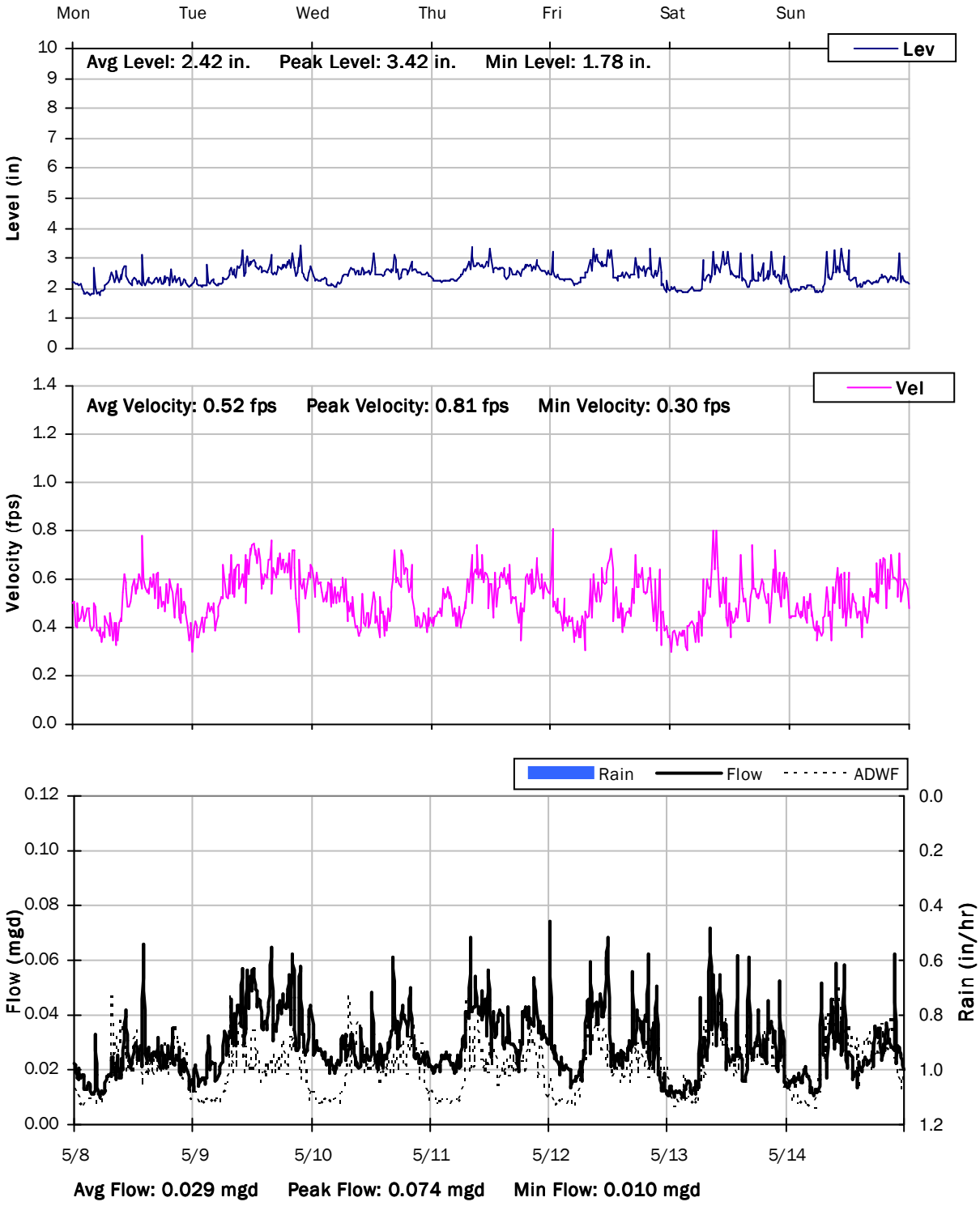
5/1/2017 to 5/8/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

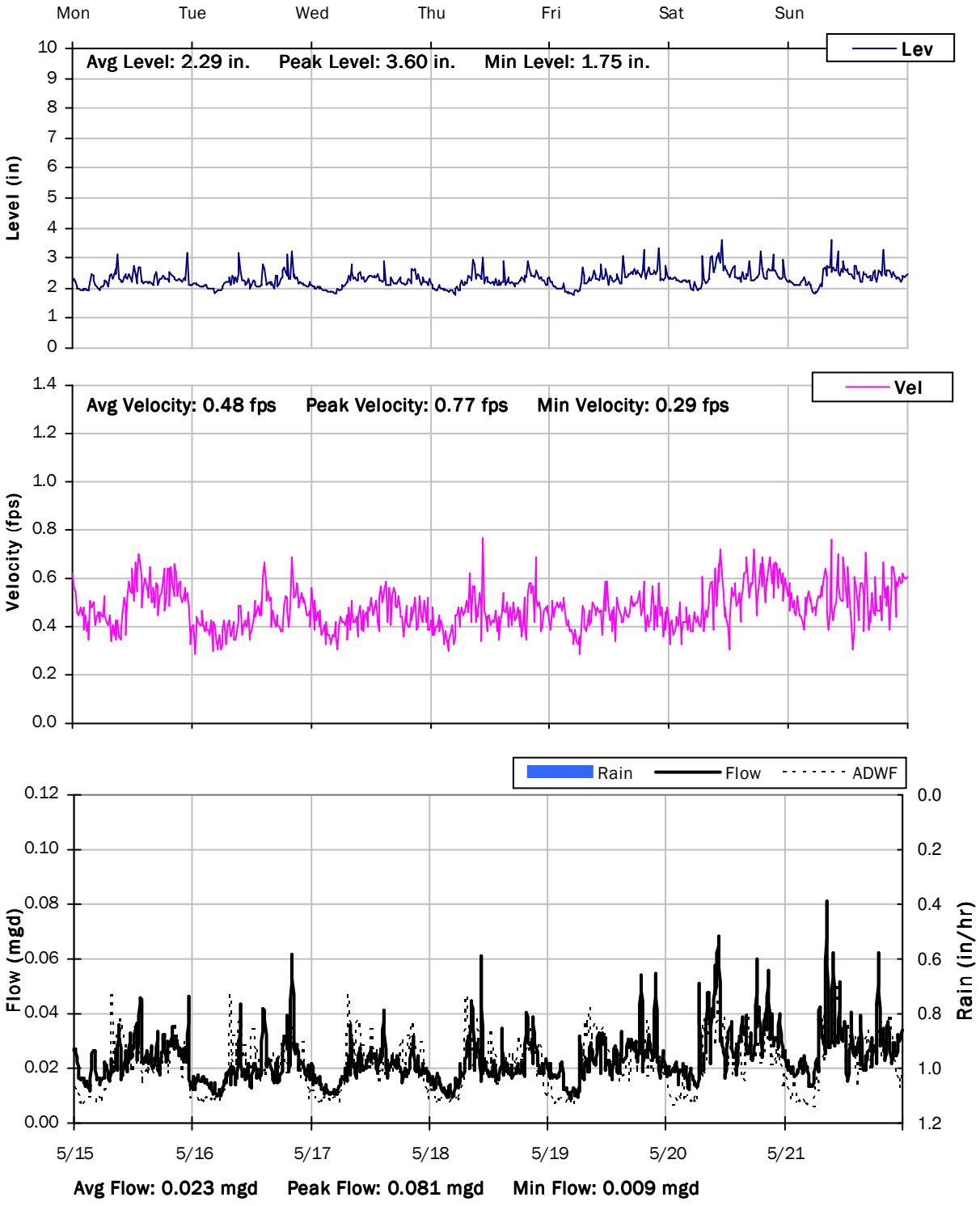
5/8/2017 to 5/15/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

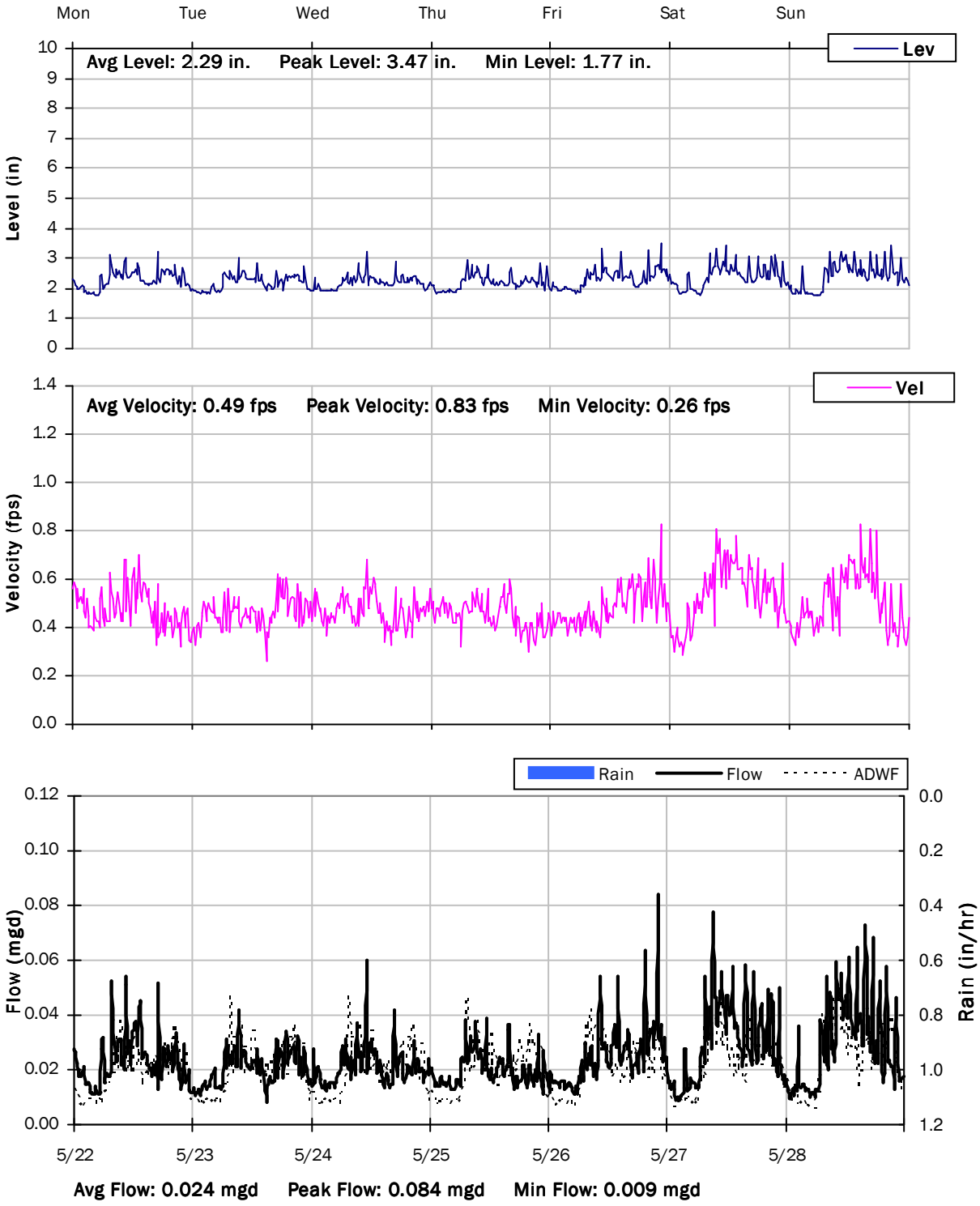
5/15/2017 to 5/22/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

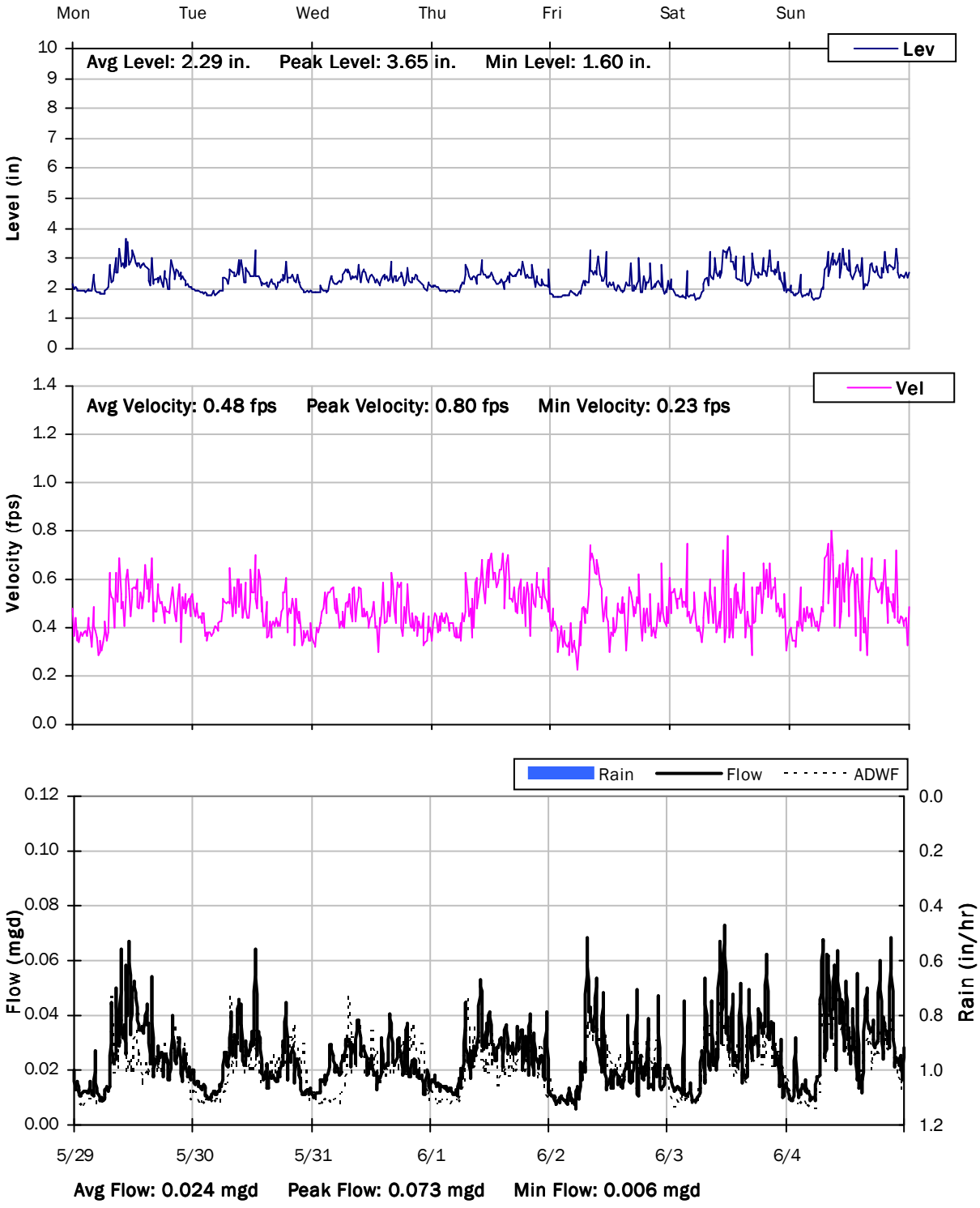
5/22/2017 to 5/29/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

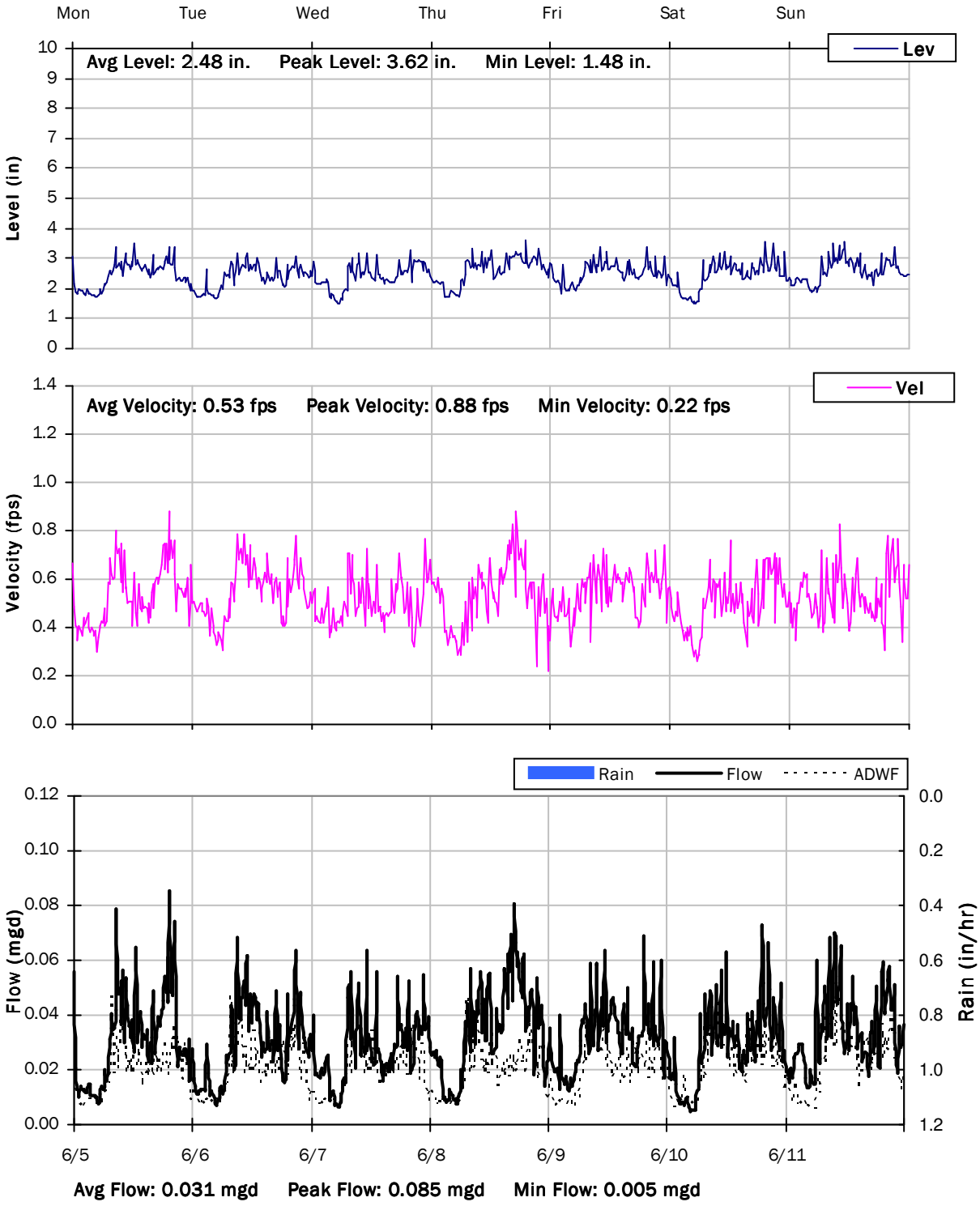
5/29/2017 to 6/5/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

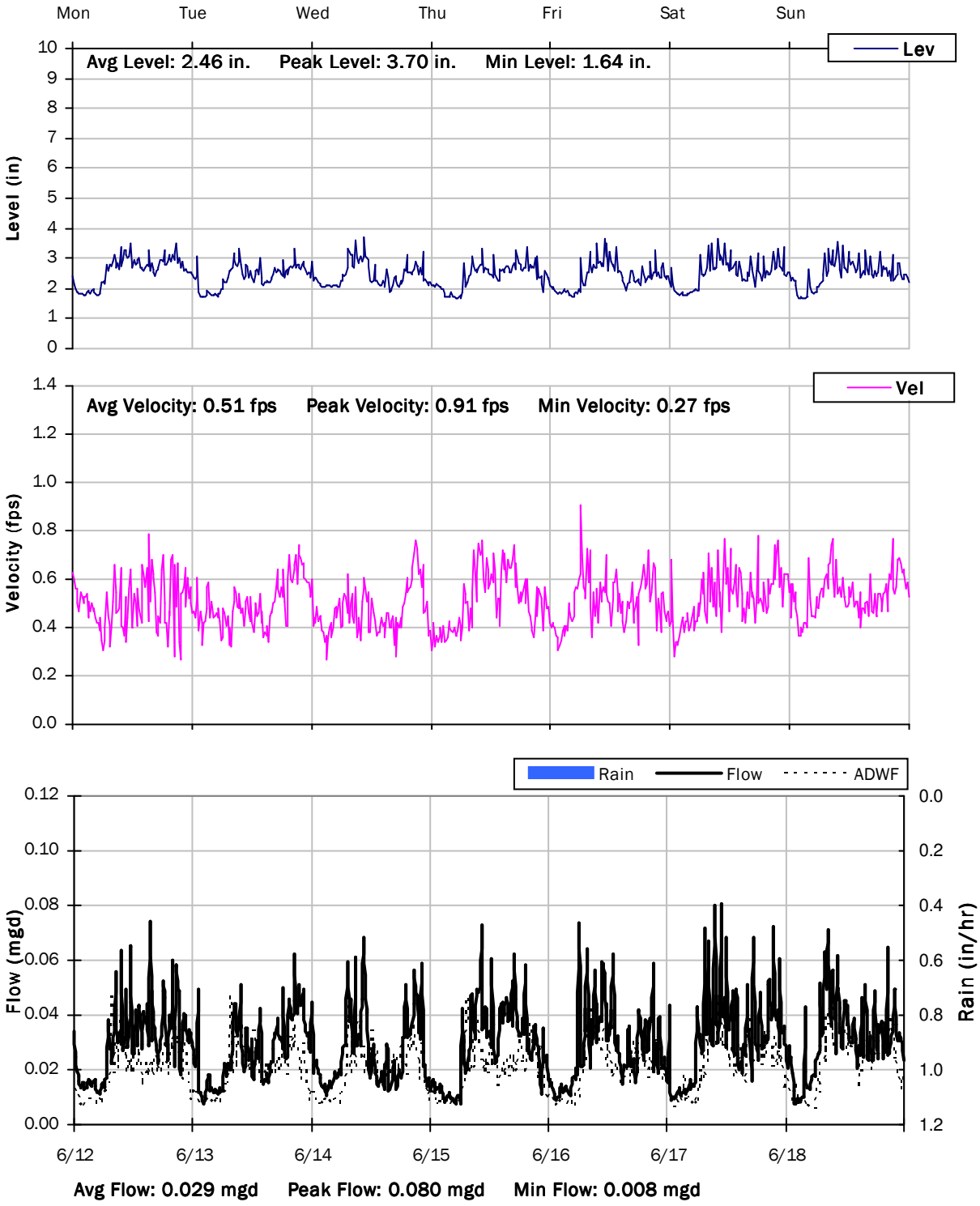
6/5/2017 to 6/12/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

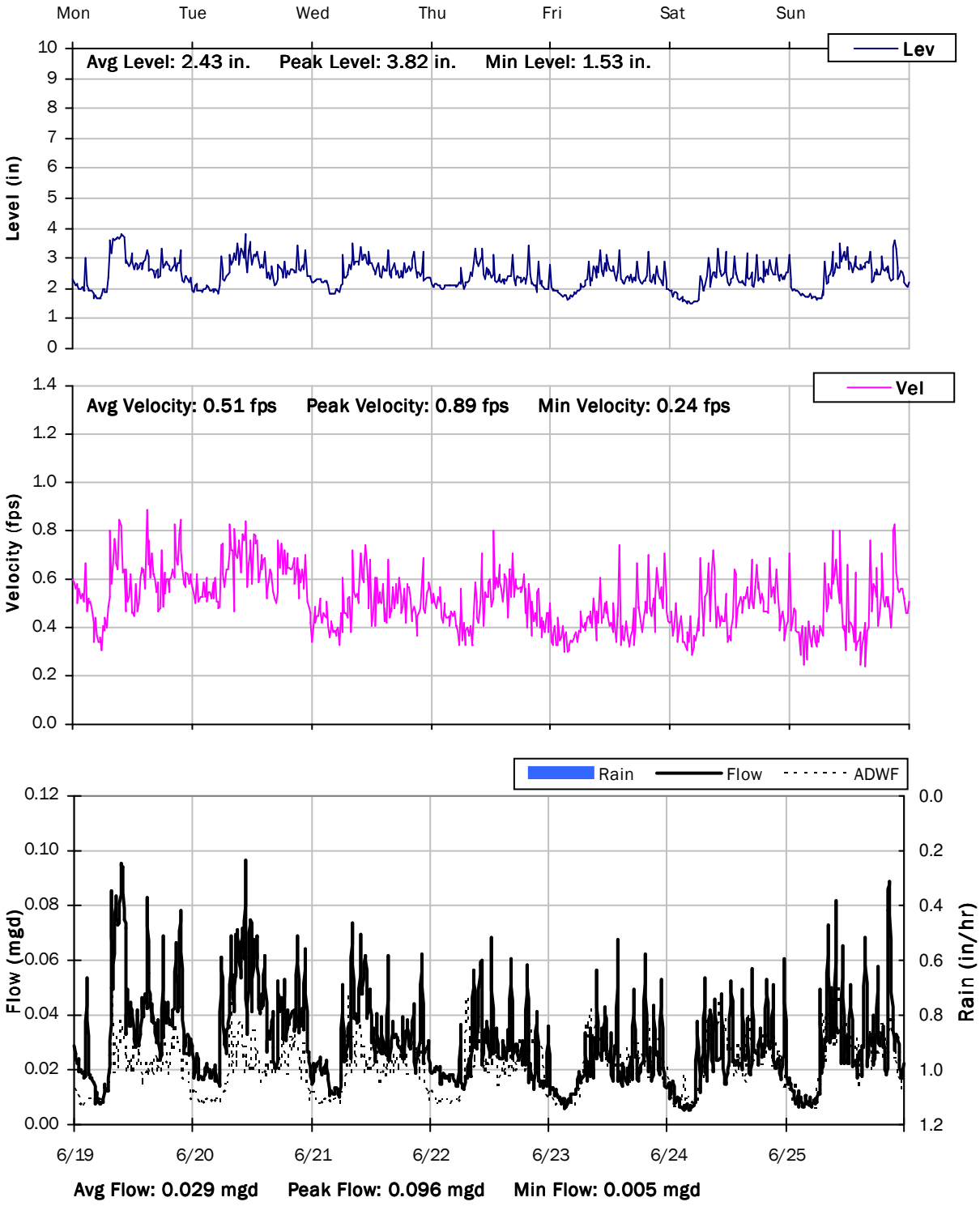
6/12/2017 to 6/19/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

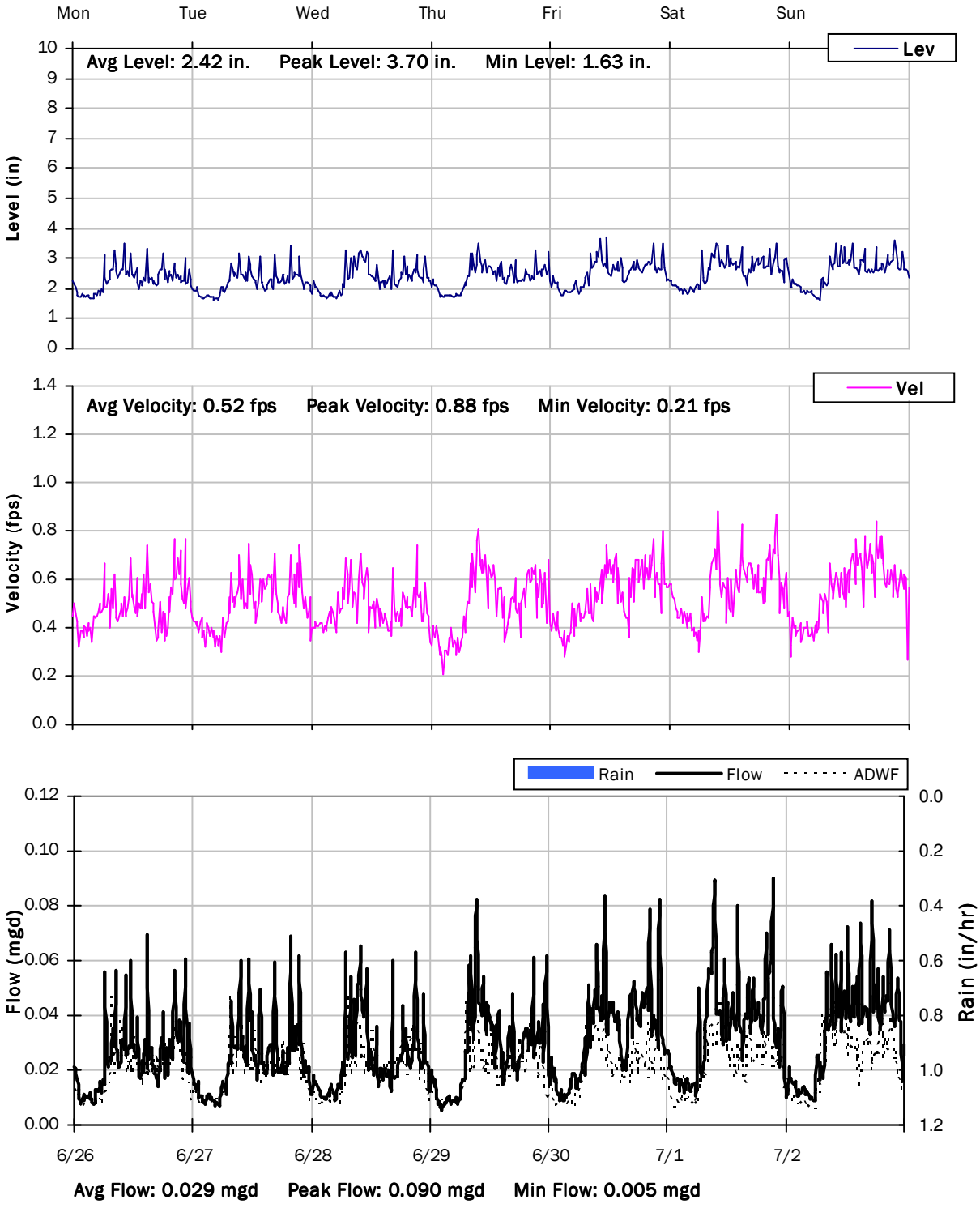
6/19/2017 to 6/26/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

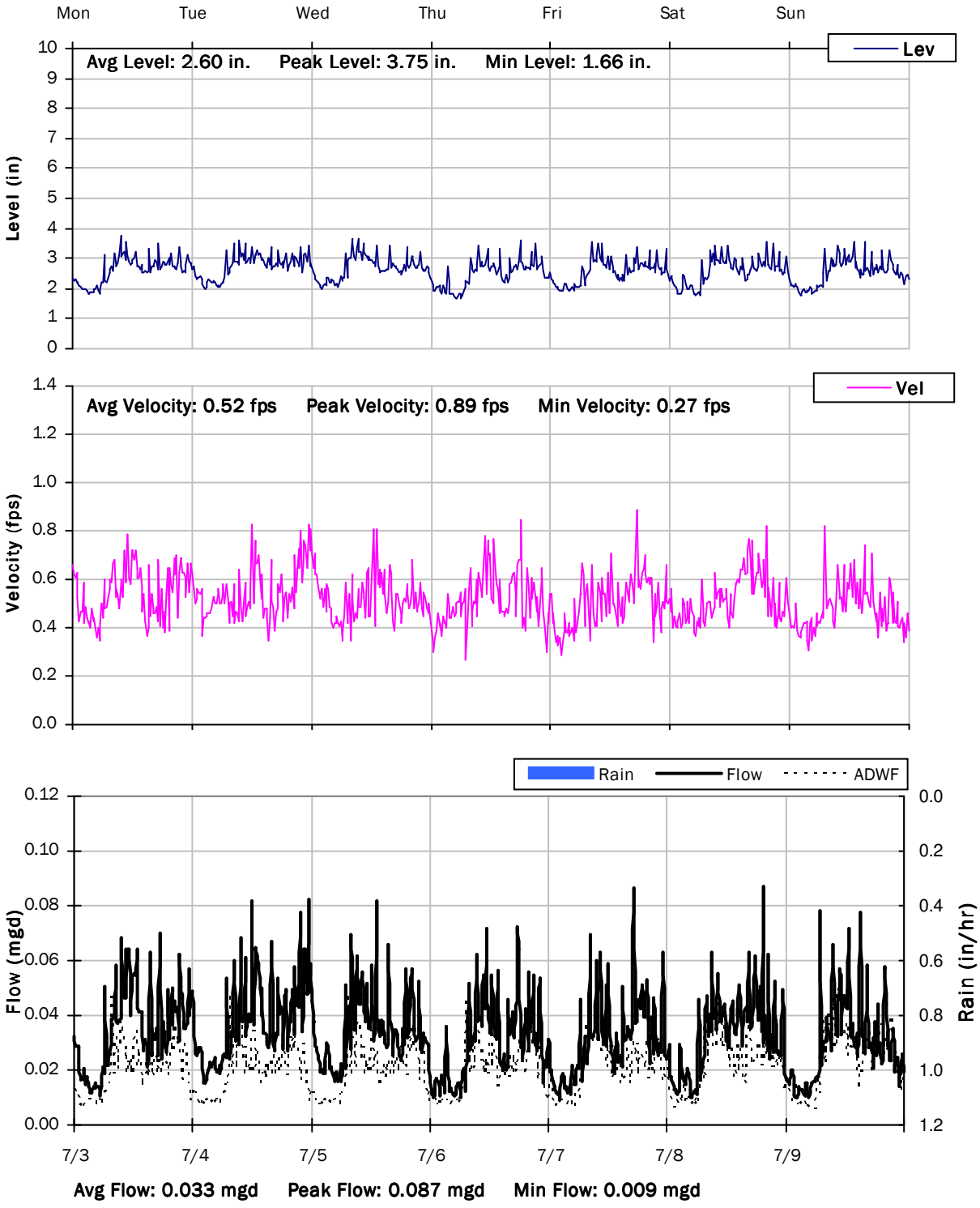
6/26/2017 to 7/3/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

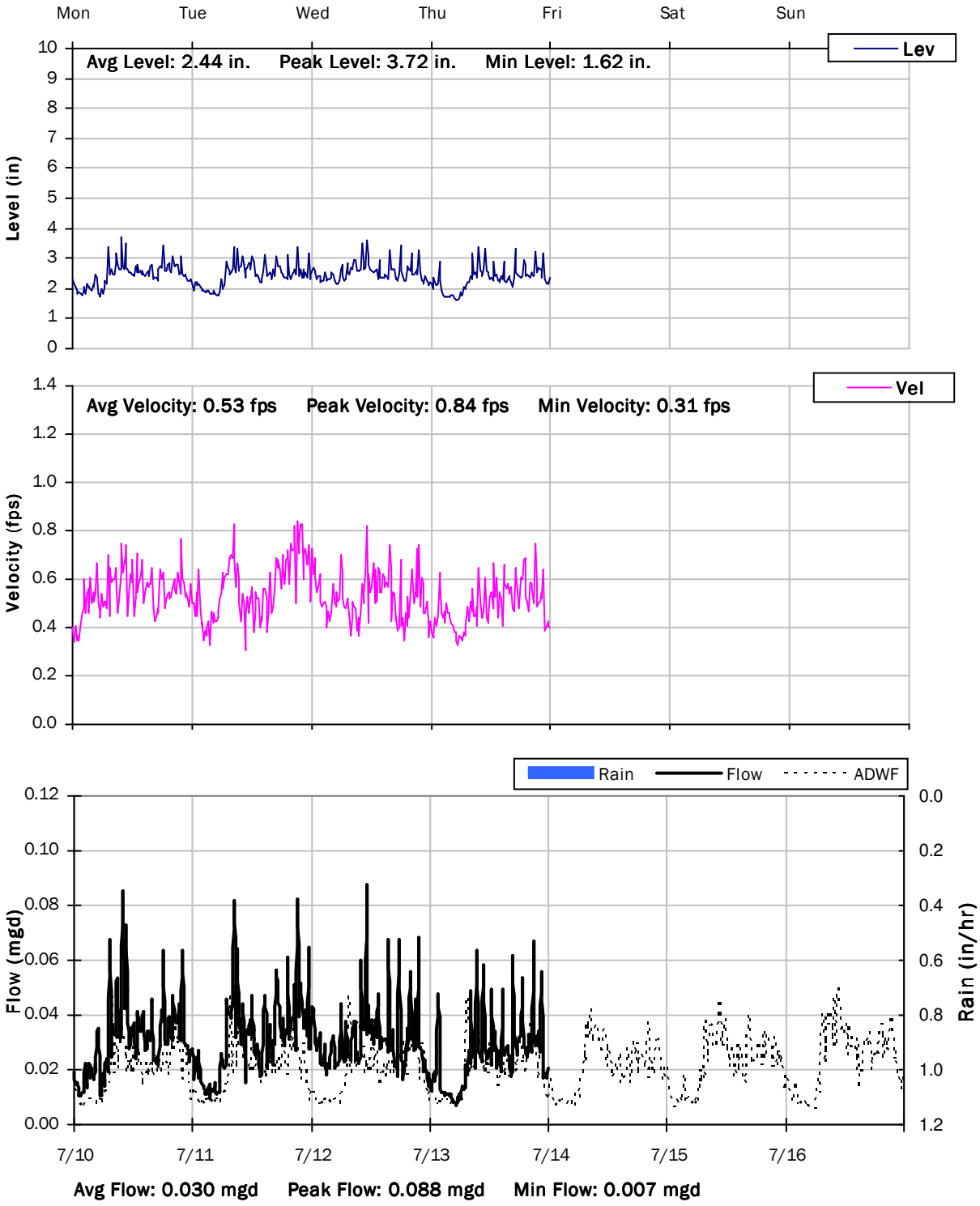
7/3/2017 to 7/10/2017



SITE 09

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

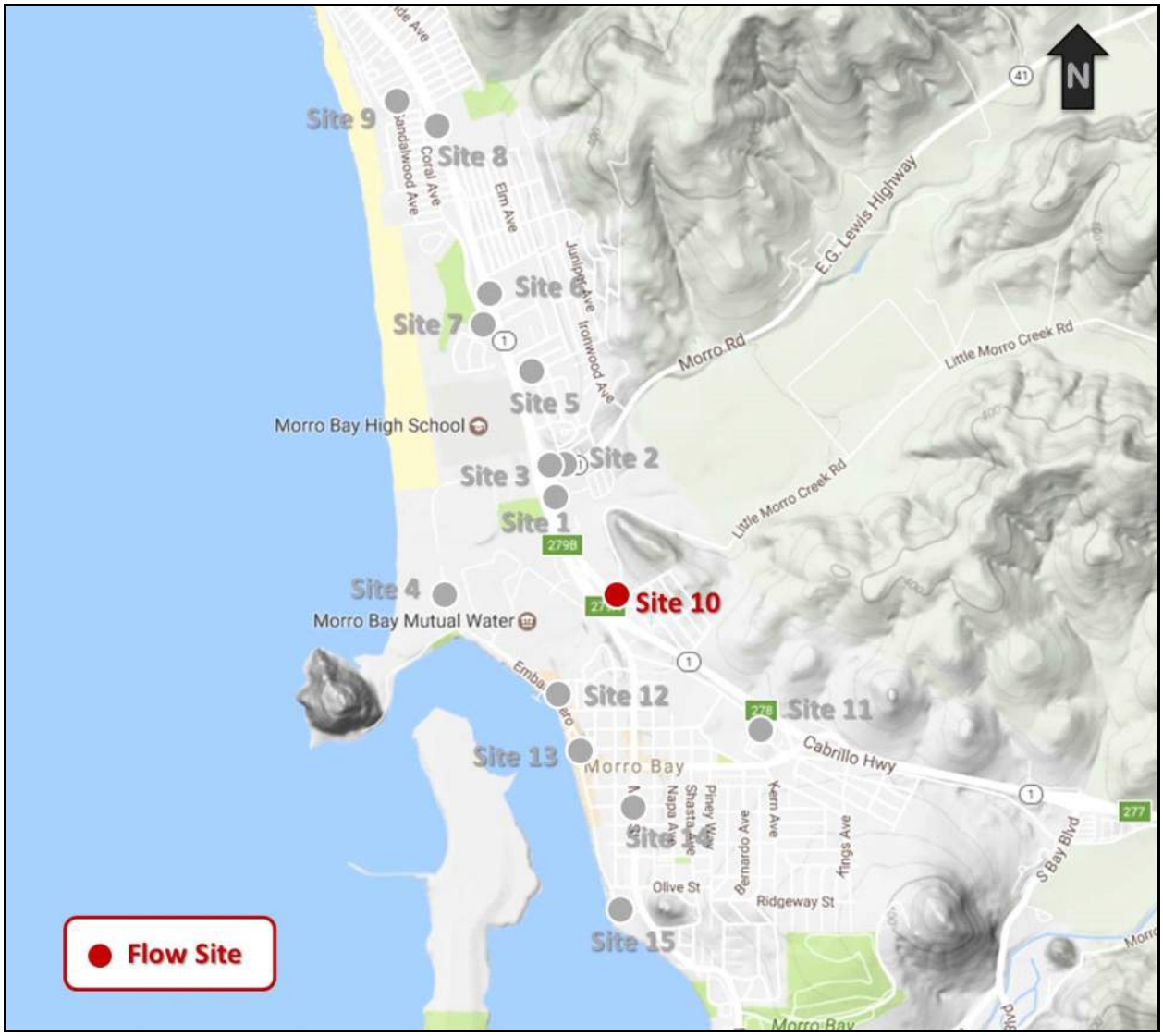
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 10

Location: Main Street, just north of intersection with Radcliff Avenue, meter on south 8" inlet

Data Summary Report



Vicinity Map: Site 10

SITE 10

Site Information

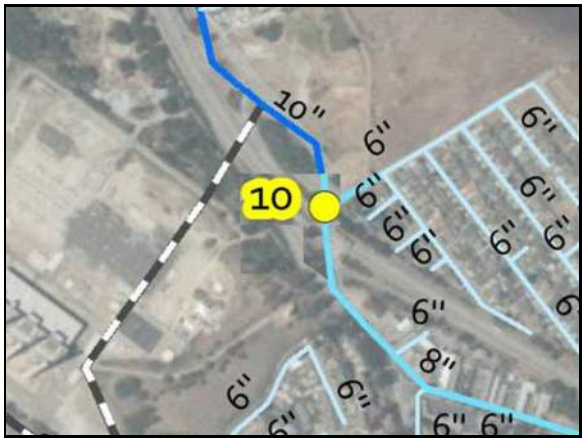
Location: Main Street, just north of intersection with Radcliff Avenue, meter on south 8" inlet

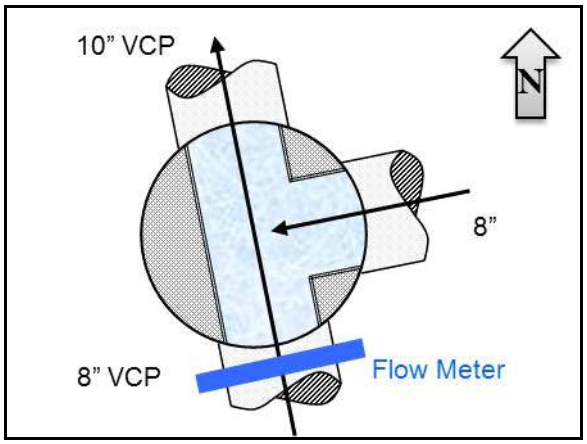


Pipe Diameter: 8 inches

ADWF: 0.070 mgd

Peak Measured Flow: 0.325 mgd









SITE 10

Additional Site Photos





SITE 10

Additional Site Photos

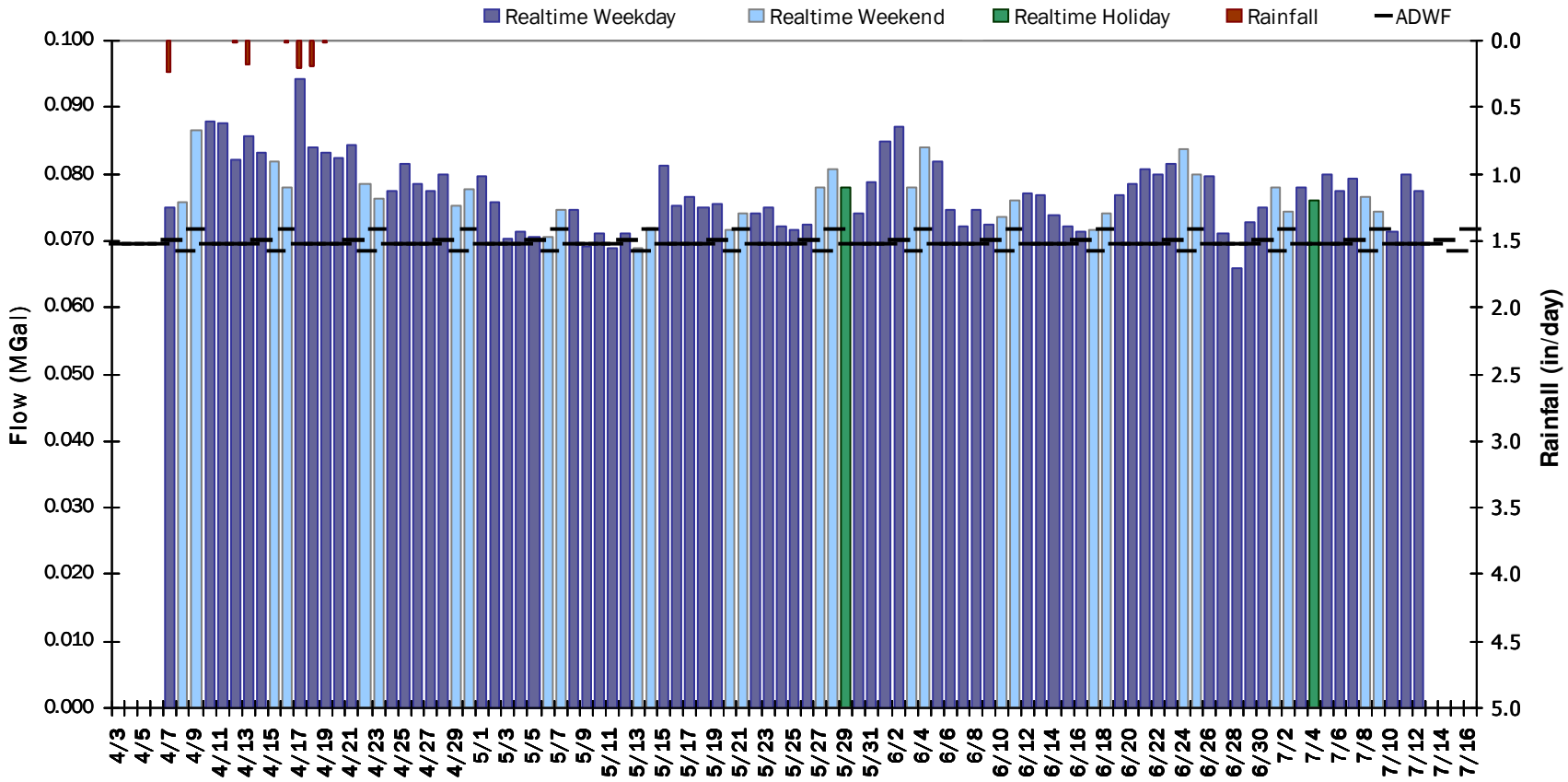


SITE 10

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.077 MGal Peak Daily Flow: 0.094 MGal Min Daily Flow: 0.066 MGal

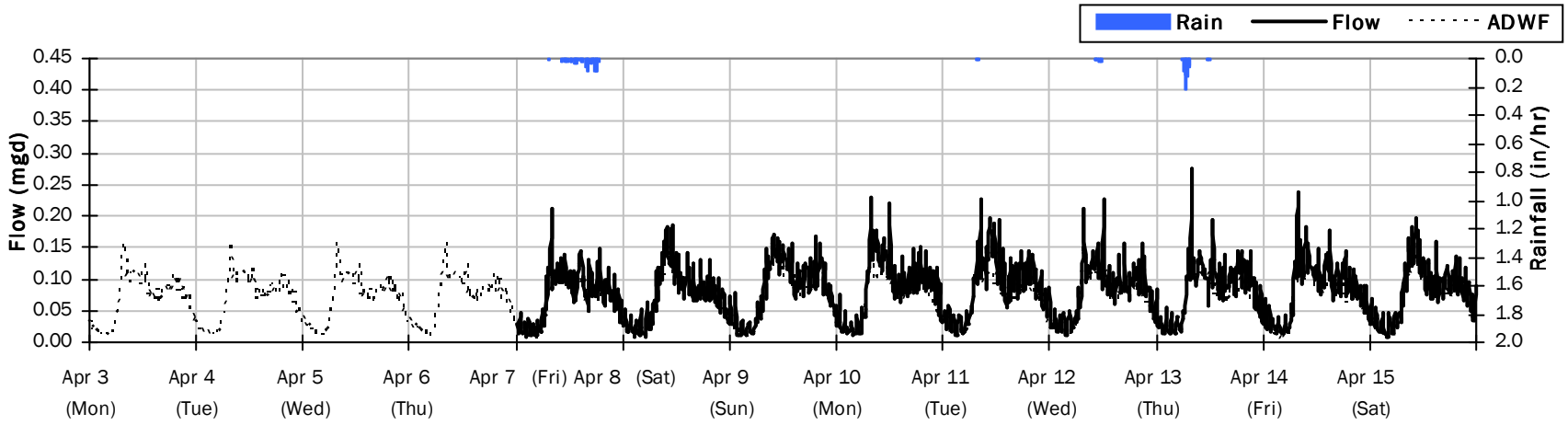
Total Period Rainfall: 0.85 inches

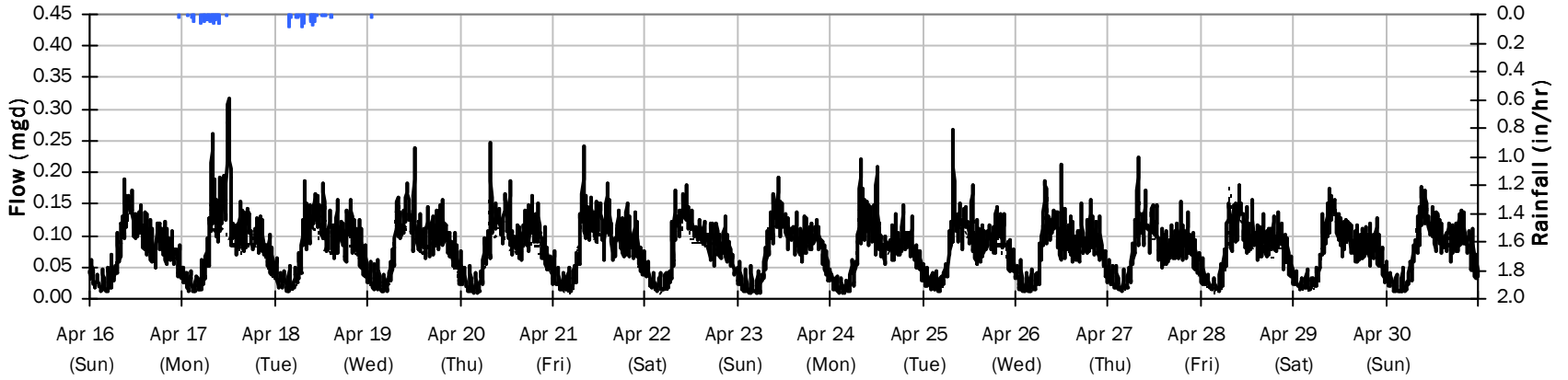


SITE 10

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.081 mgd** **Peak Flow: 0.316 mgd** **Min Flow: 0.009 mgd**

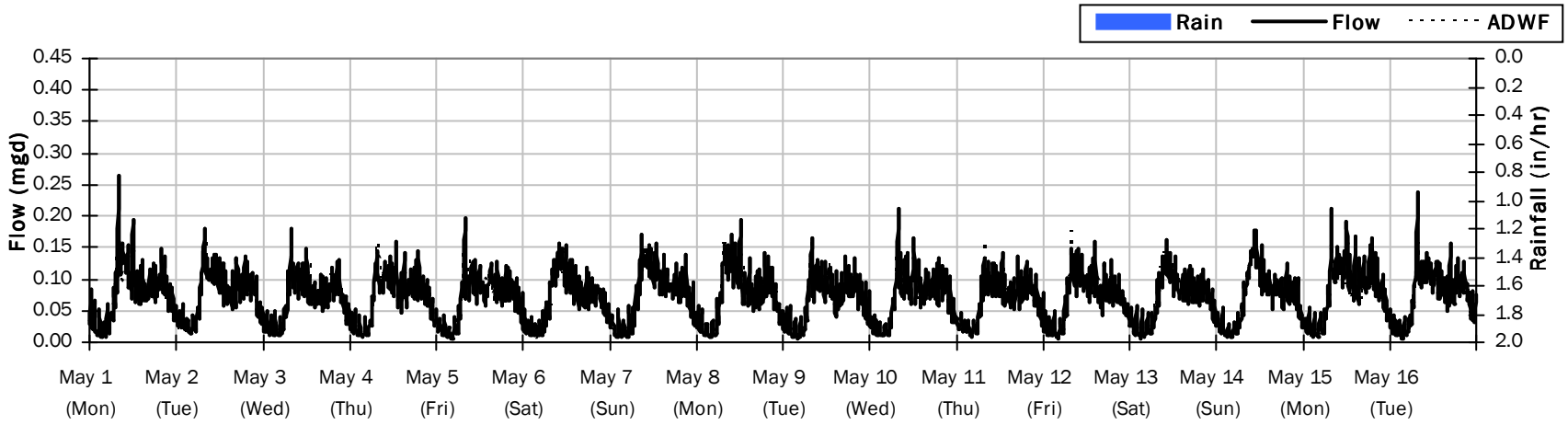


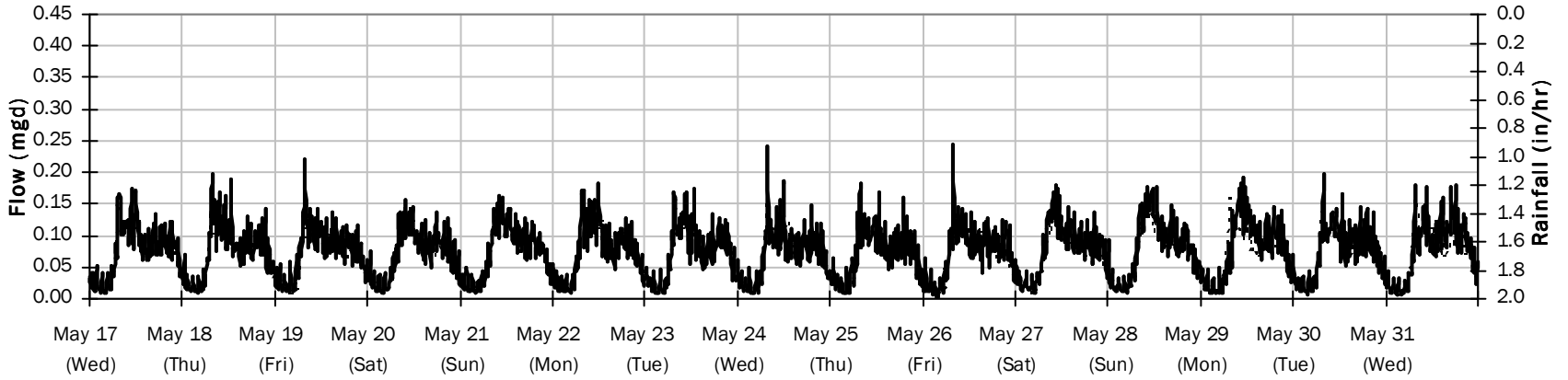


SITE 10

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.074 mgd** **Peak Flow: 0.264 mgd** **Min Flow: 0.004 mgd**

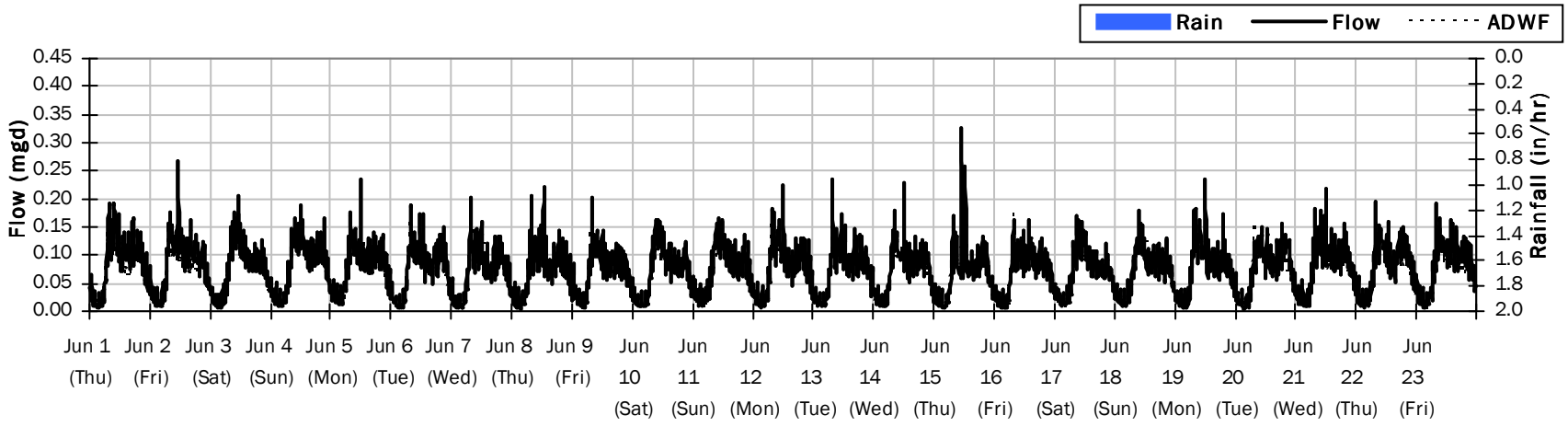


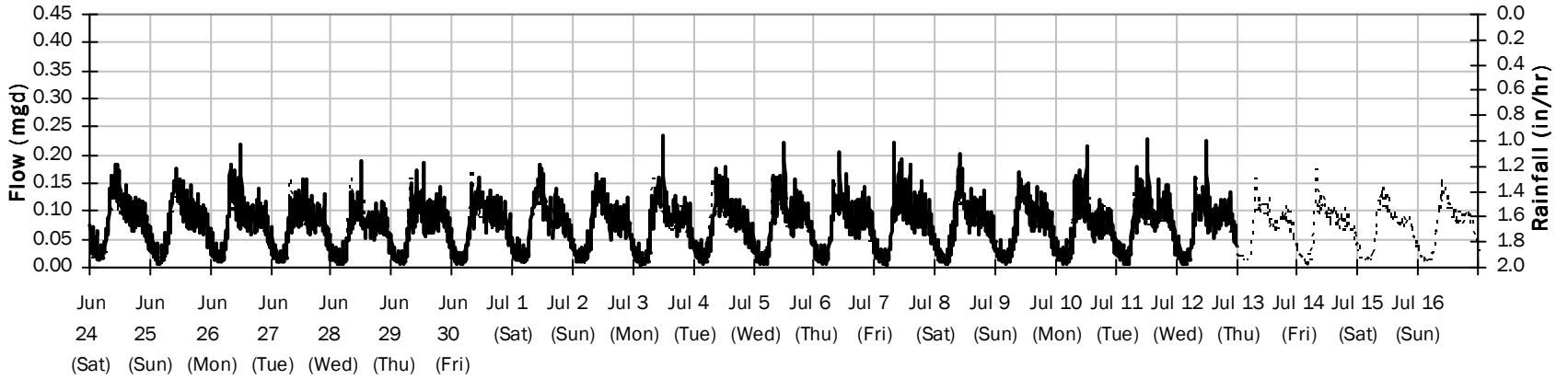


SITE 10

Flow Summary: 6/1/2017 to 7/16/2017

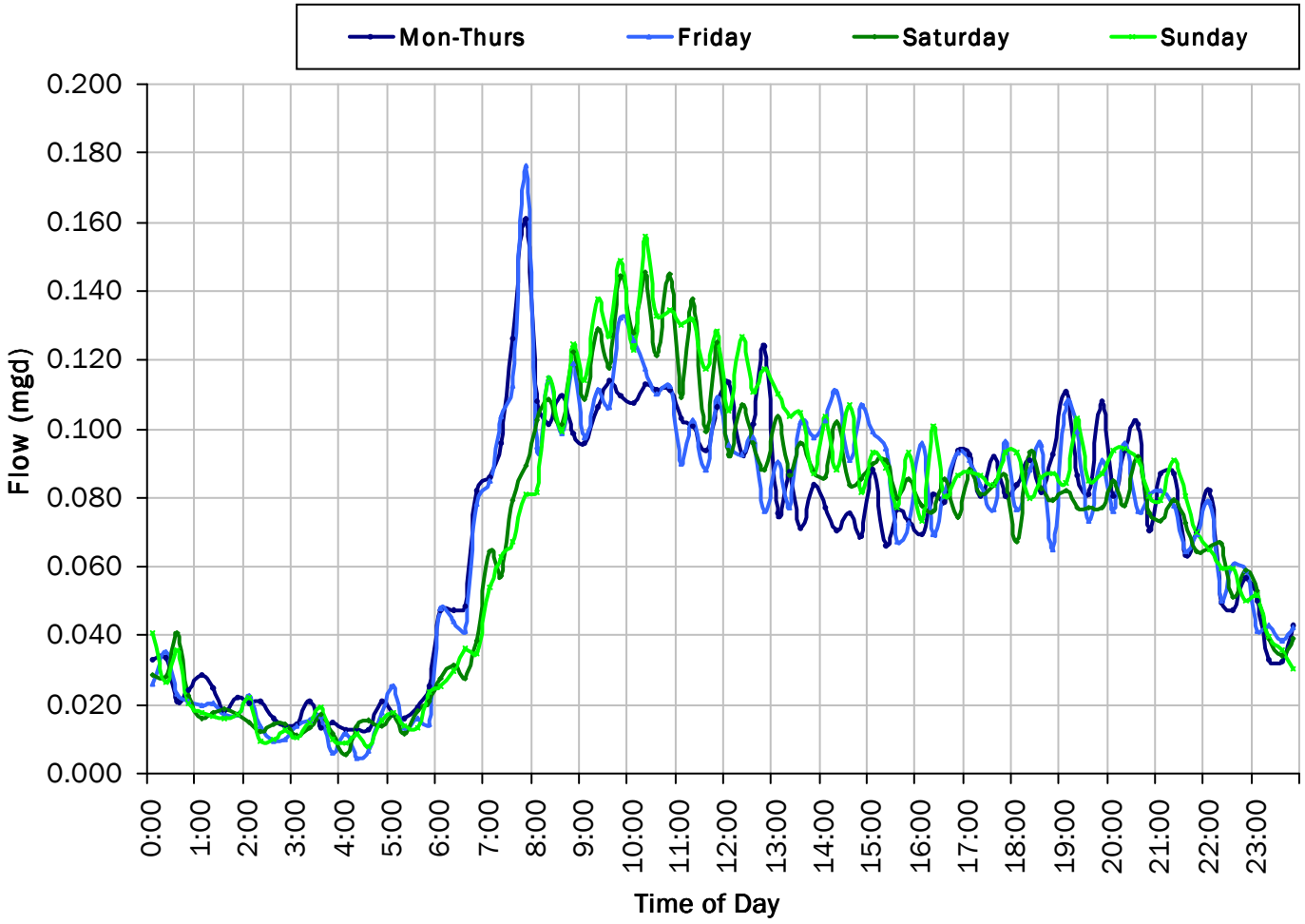
Total Period Rainfall: 0.00 inches **Avg Flow: 0.077 mgd Peak Flow: 0.325 mgd Min Flow: 0.004 mgd**





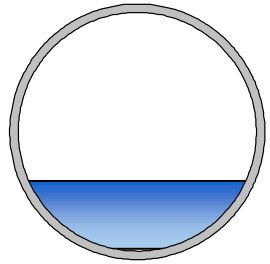
SITE 10

Average Dry Weather Flow Hydrographs



ADWF:

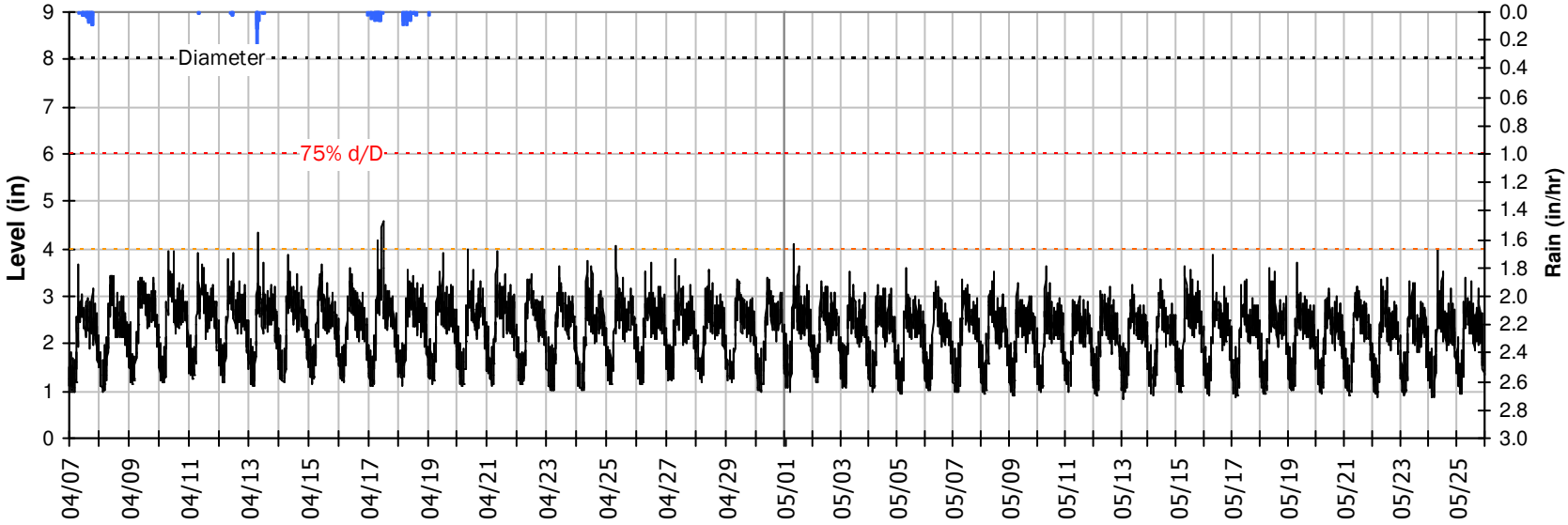
0.070 *mgd*

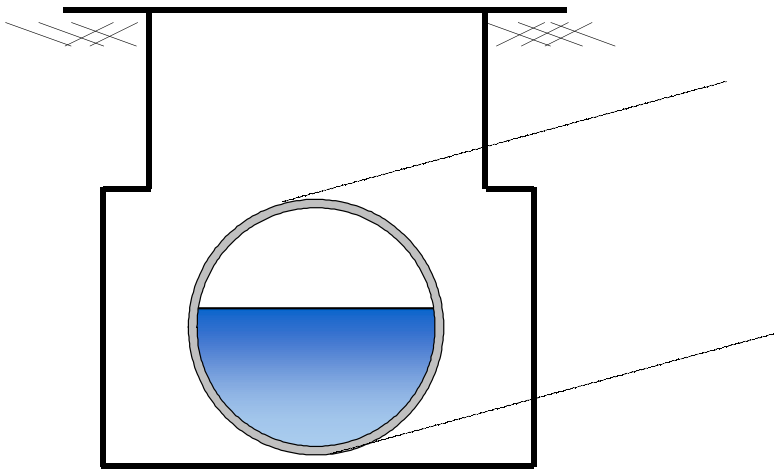


SITE 10

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



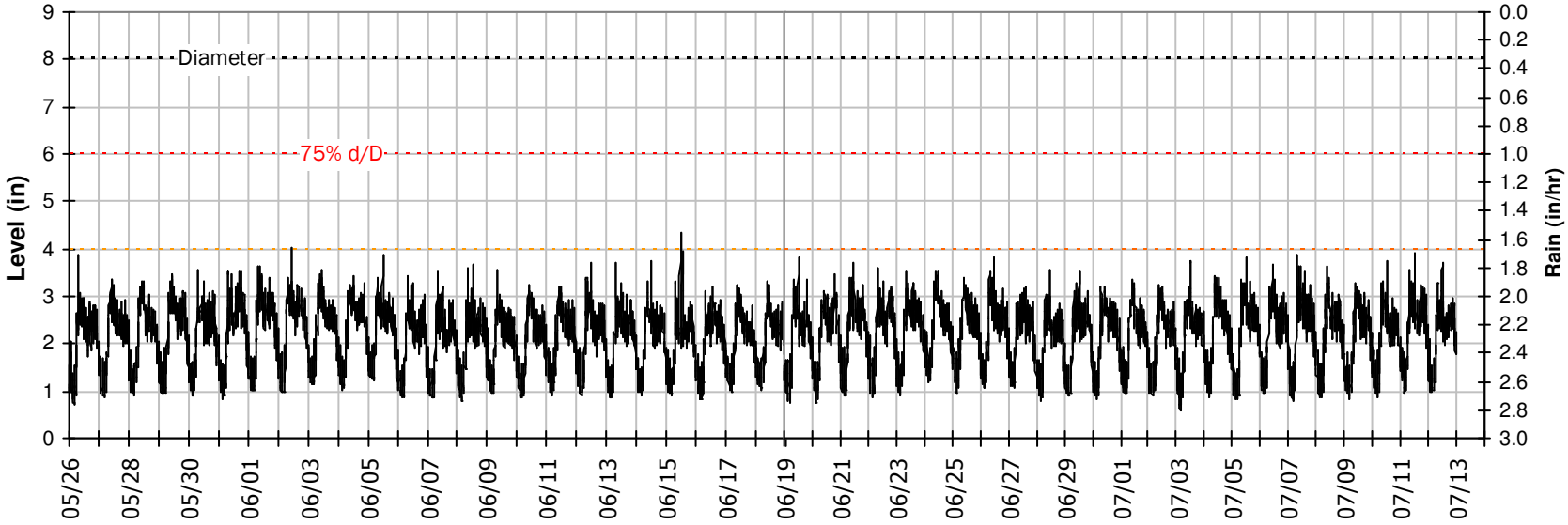


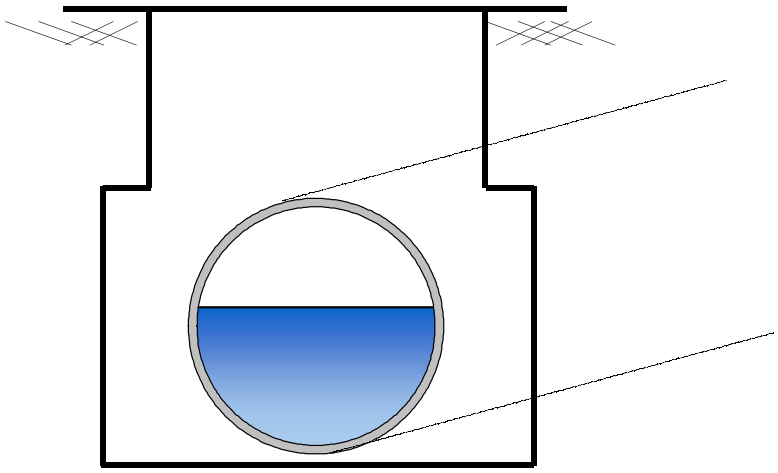
Pipe Diameter:	8	*inches*
Peak Measured Level:	4.57	*inches*
Peak d/D Ratio:	0.57	

SITE 10

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



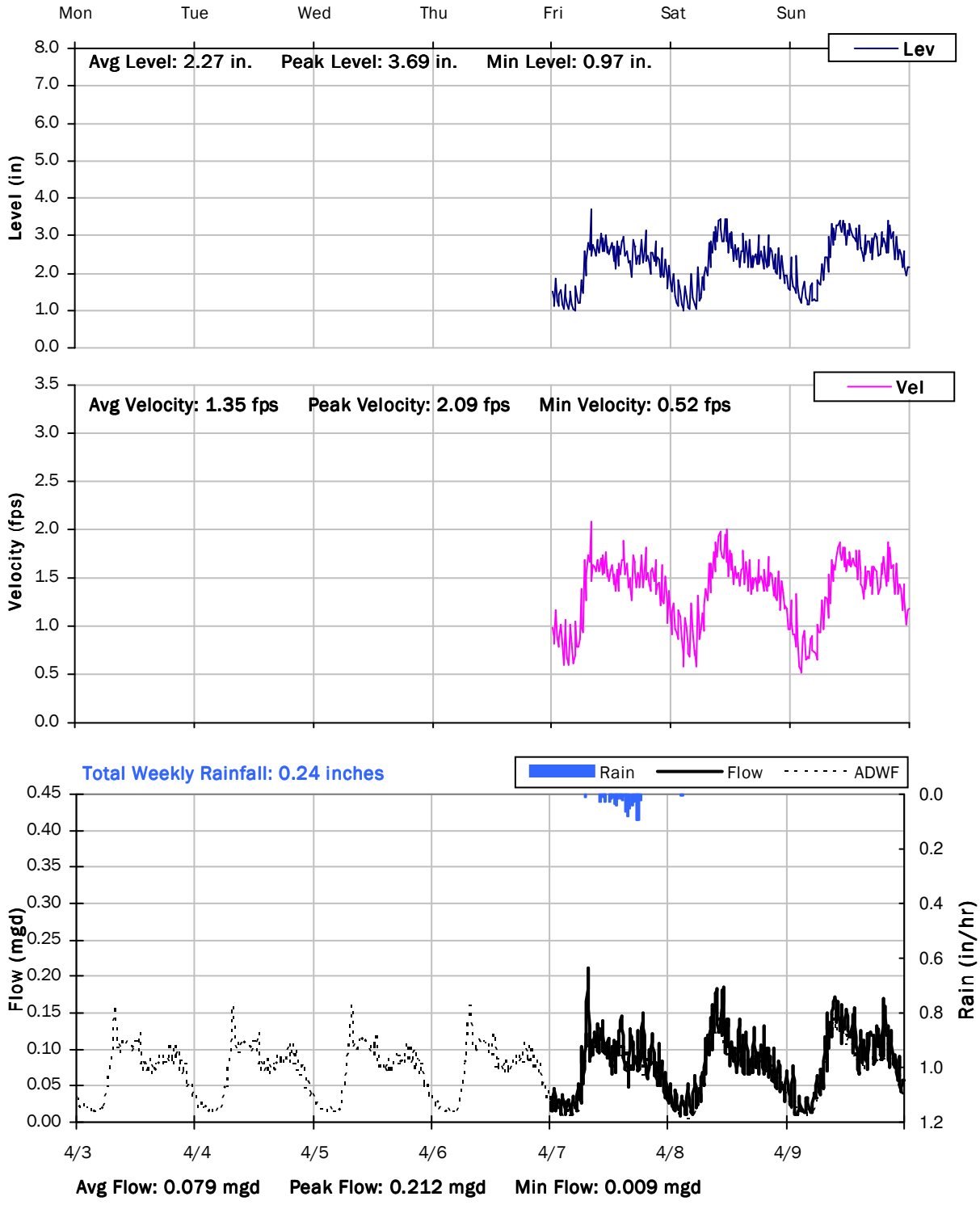


Pipe Diameter:	8	*inches*
Peak Measured Level:	4.57	*inches*
Peak d/D Ratio:	0.57	

SITE 10

Weekly Level, Velocity and Flow Hydrographs

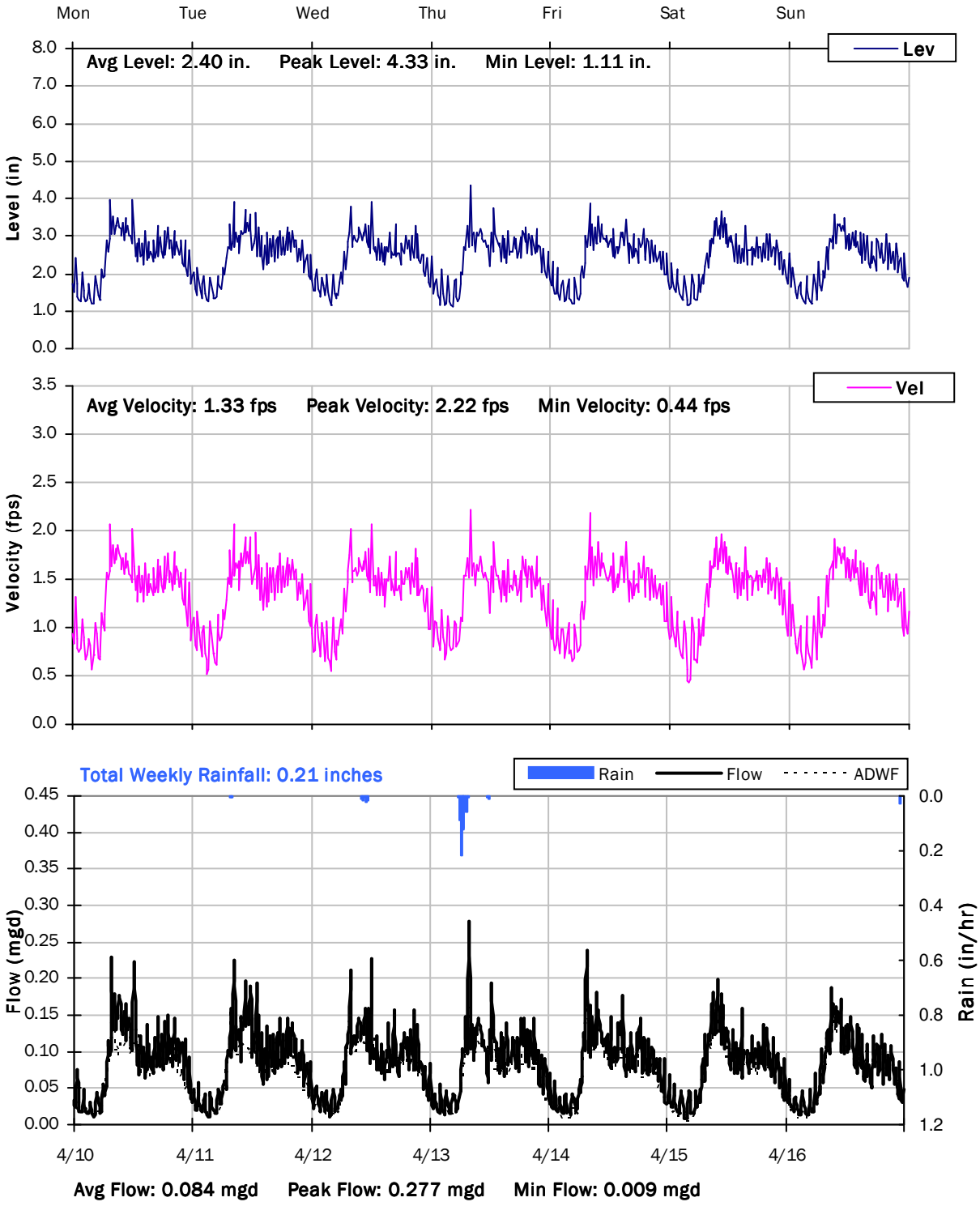
4/3/2017 to 4/10/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

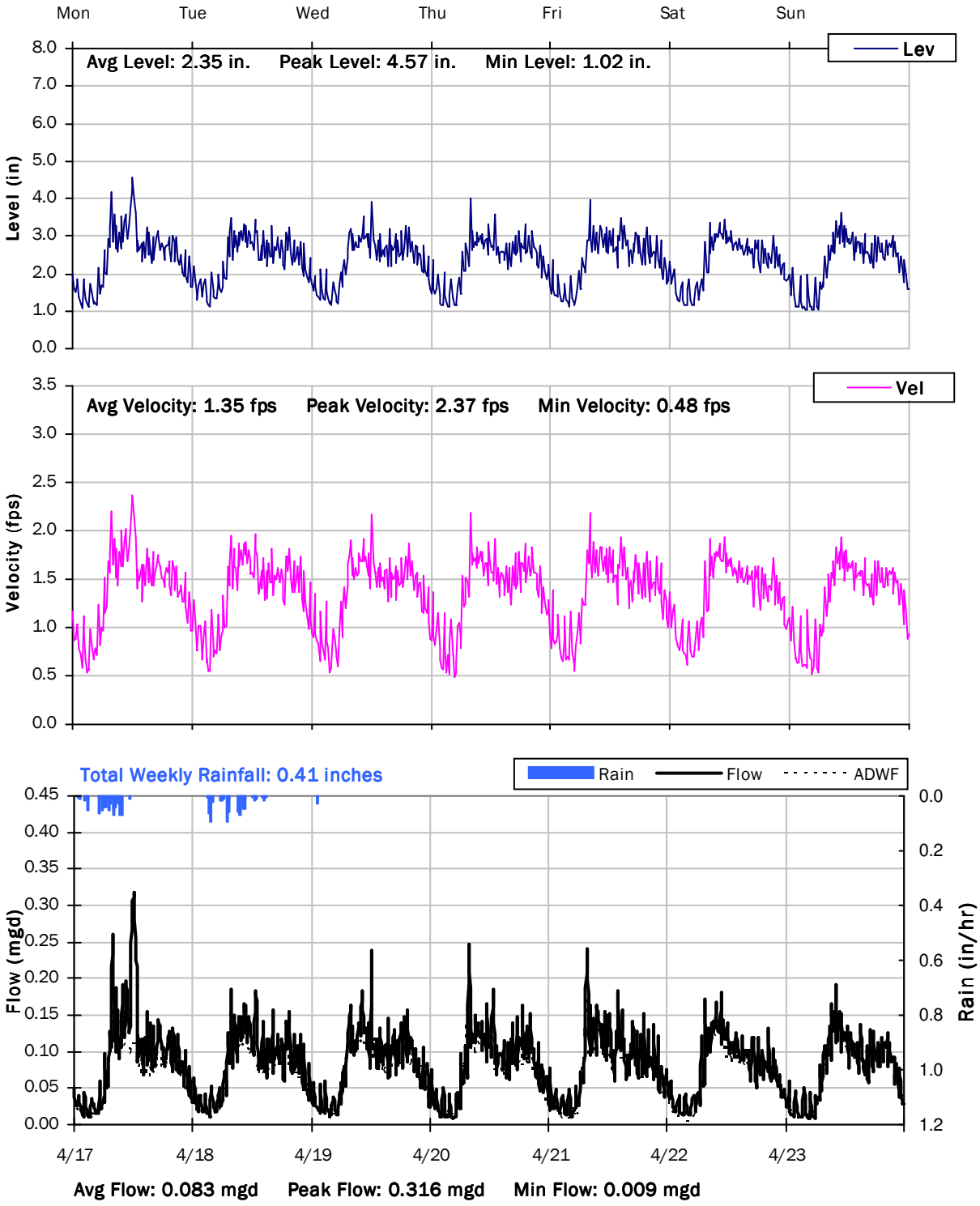
4/10/2017 to 4/17/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

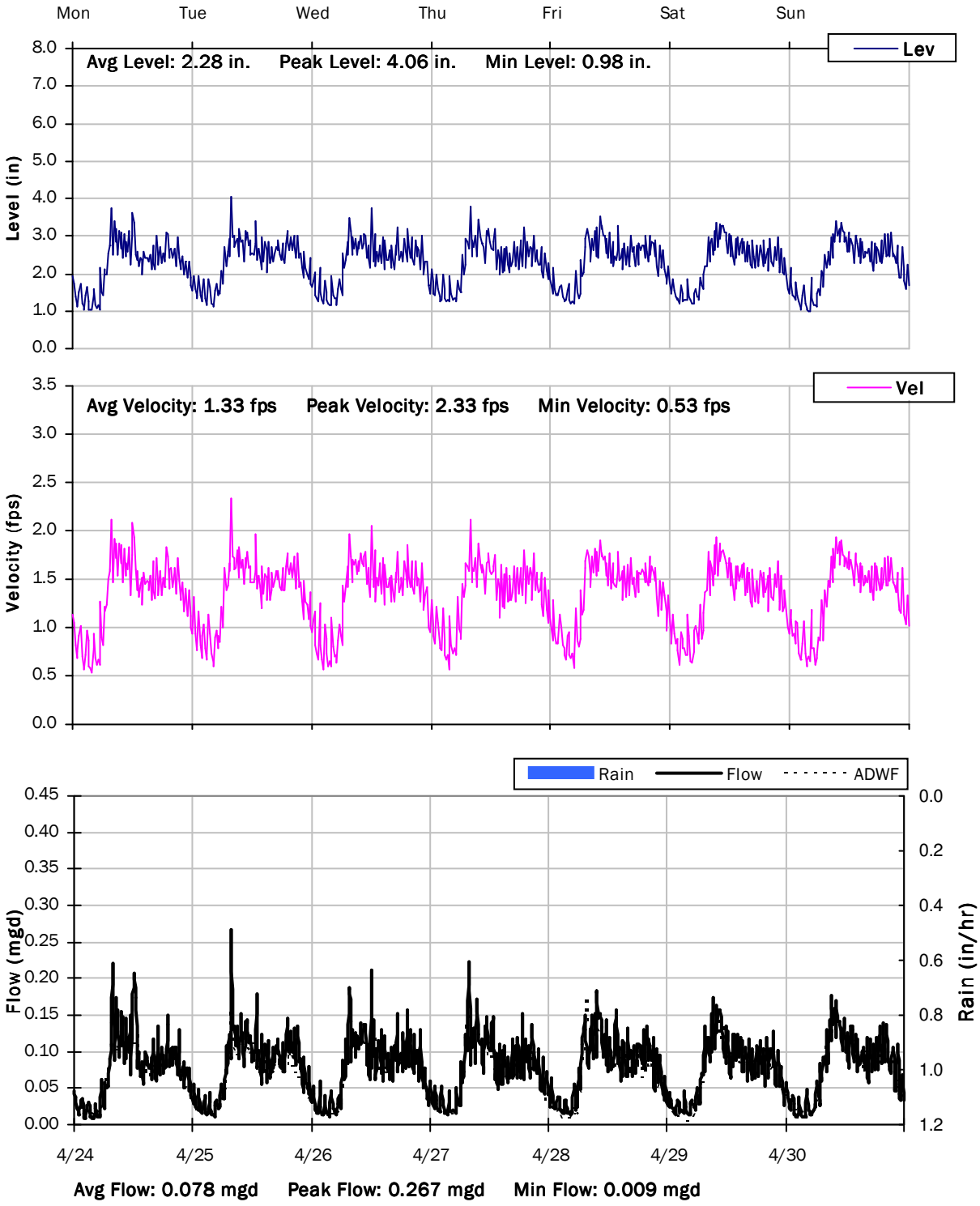
4/17/2017 to 4/24/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

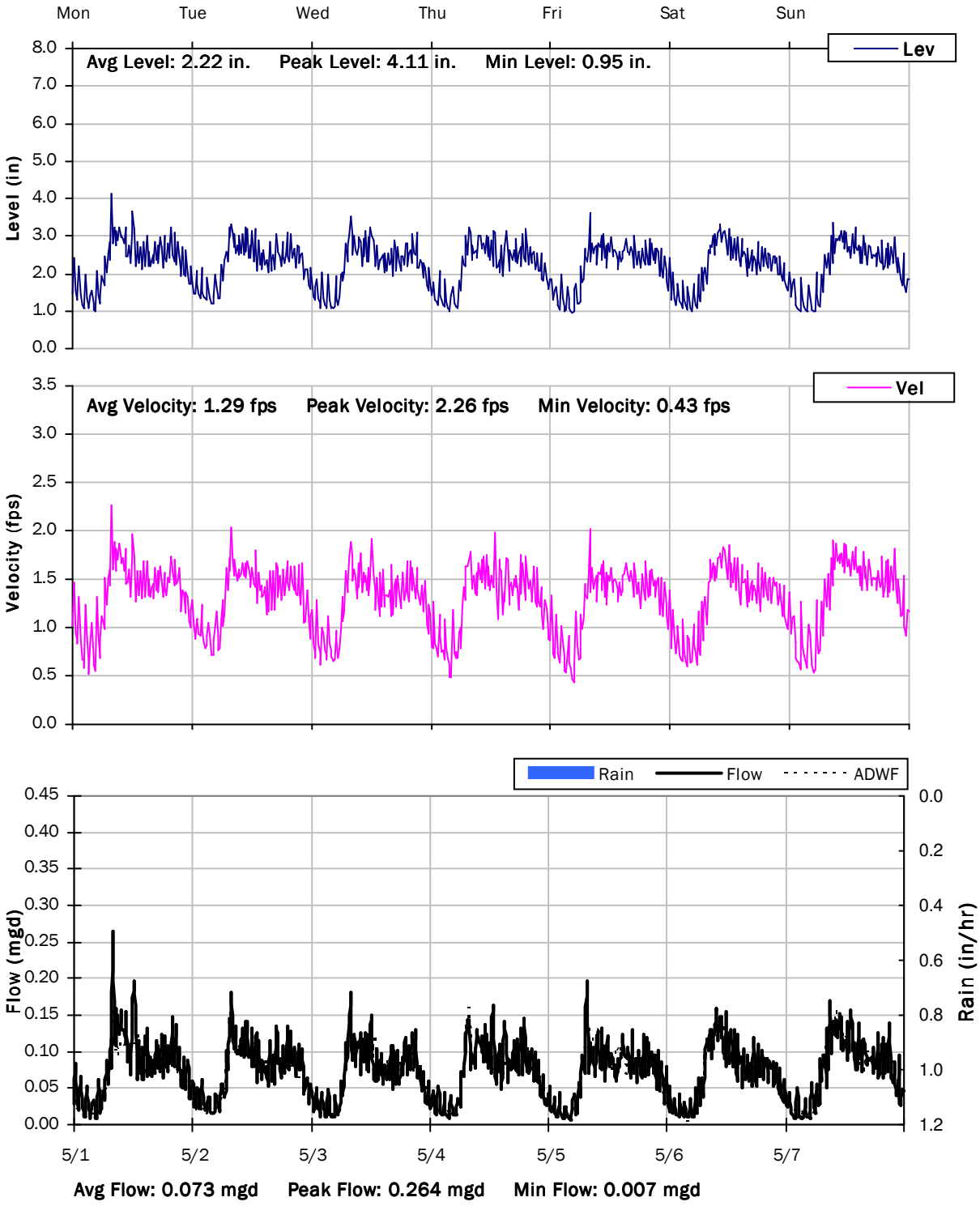
4/24/2017 to 5/1/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

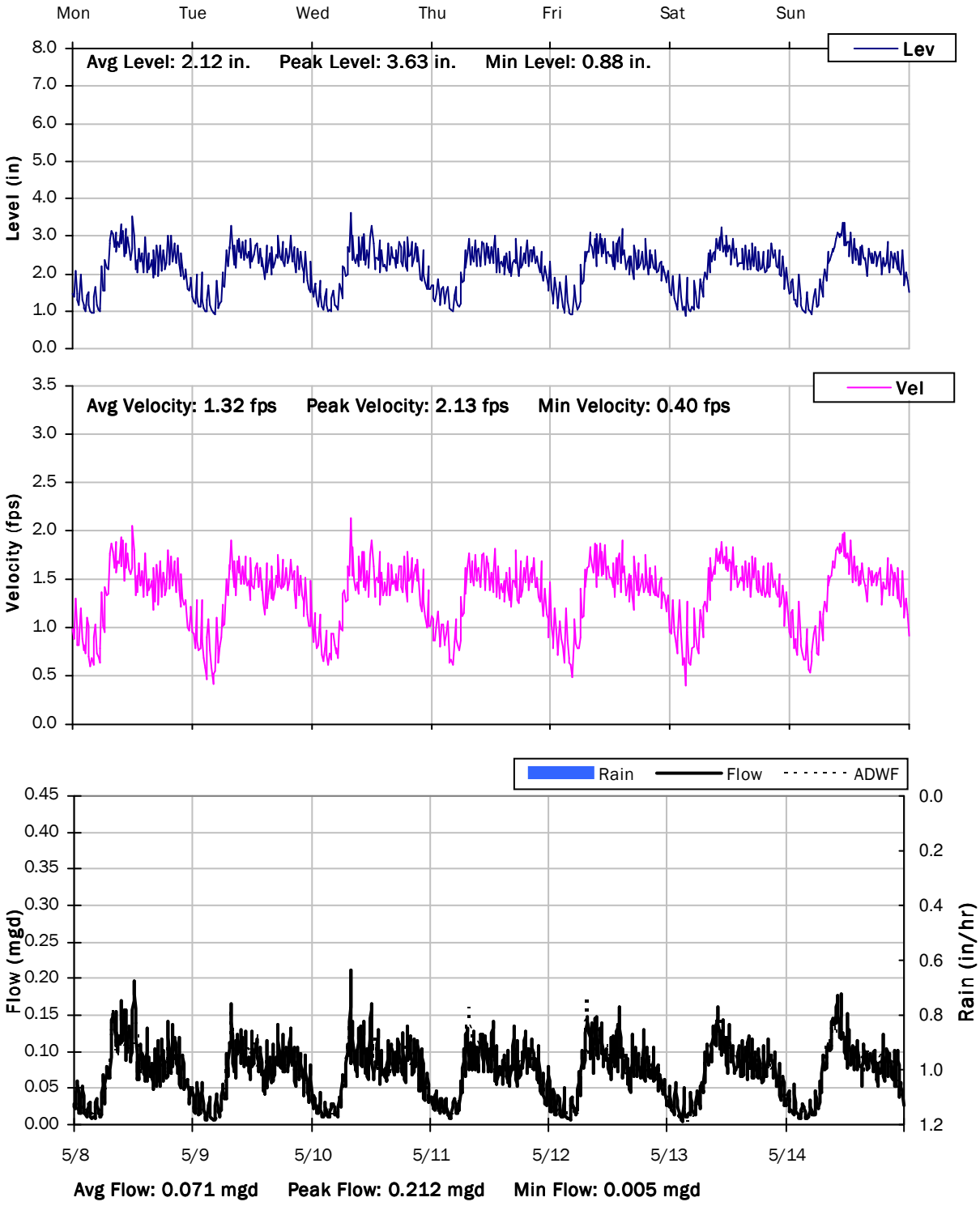
5/1/2017 to 5/8/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

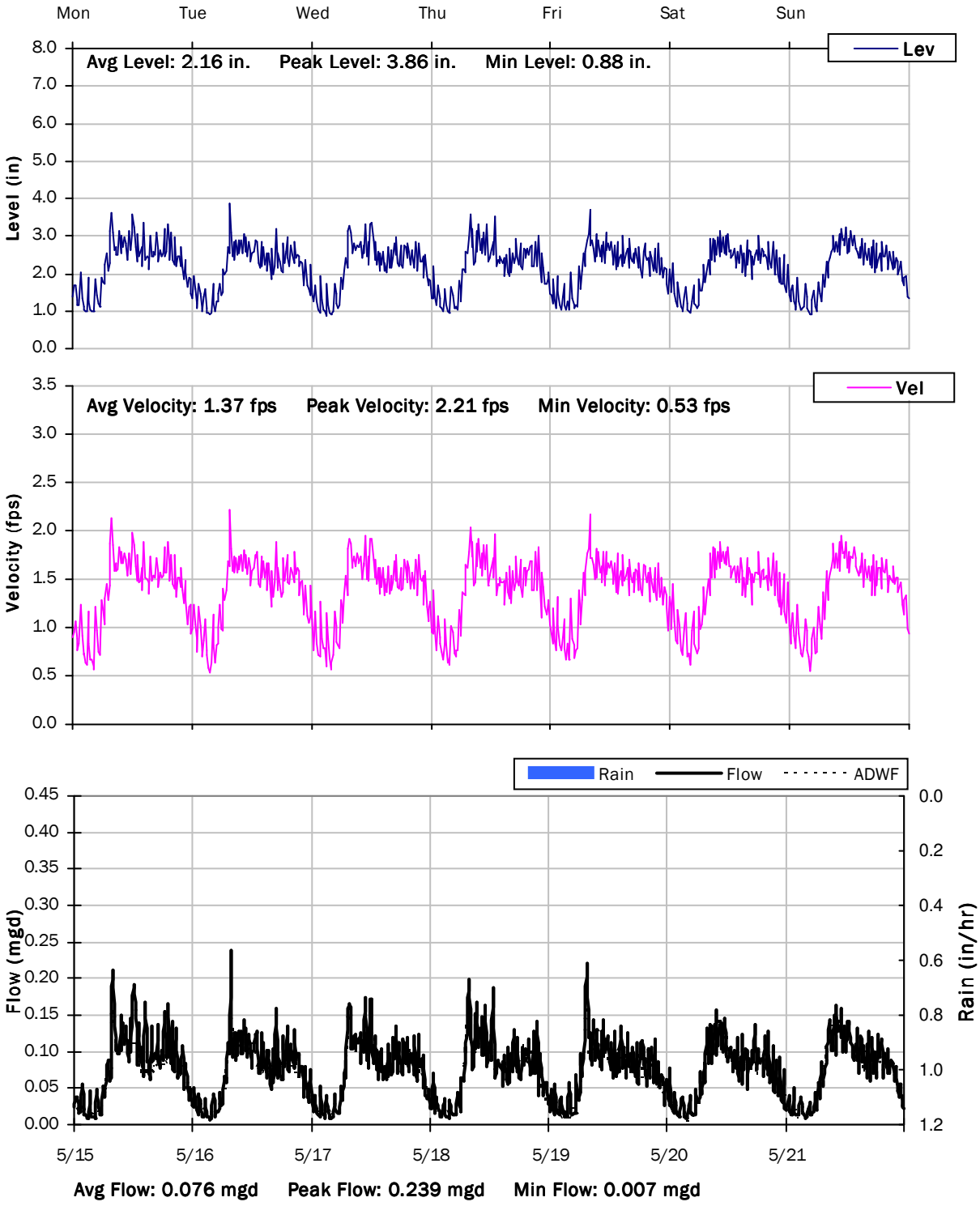
5/8/2017 to 5/15/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

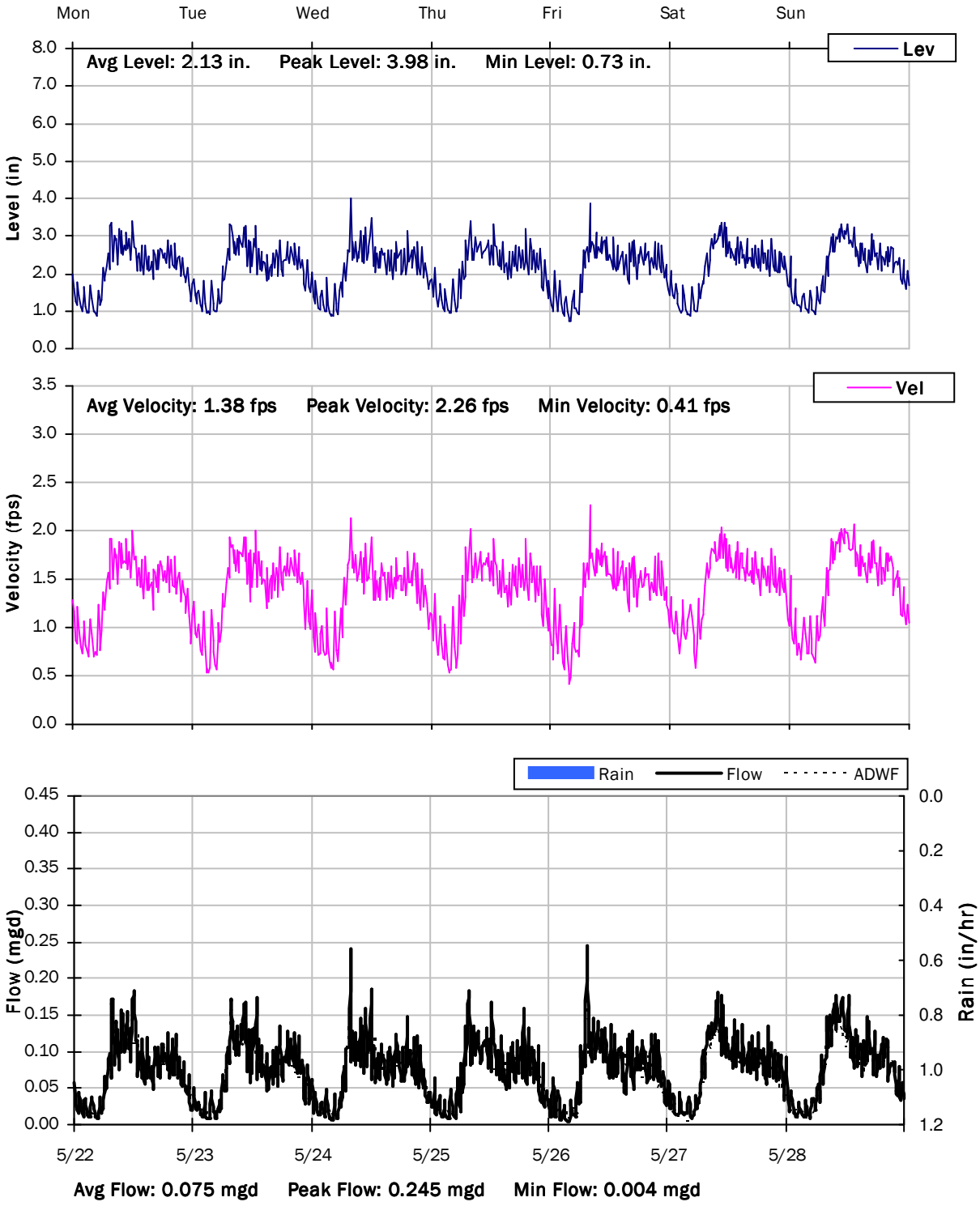
5/15/2017 to 5/22/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

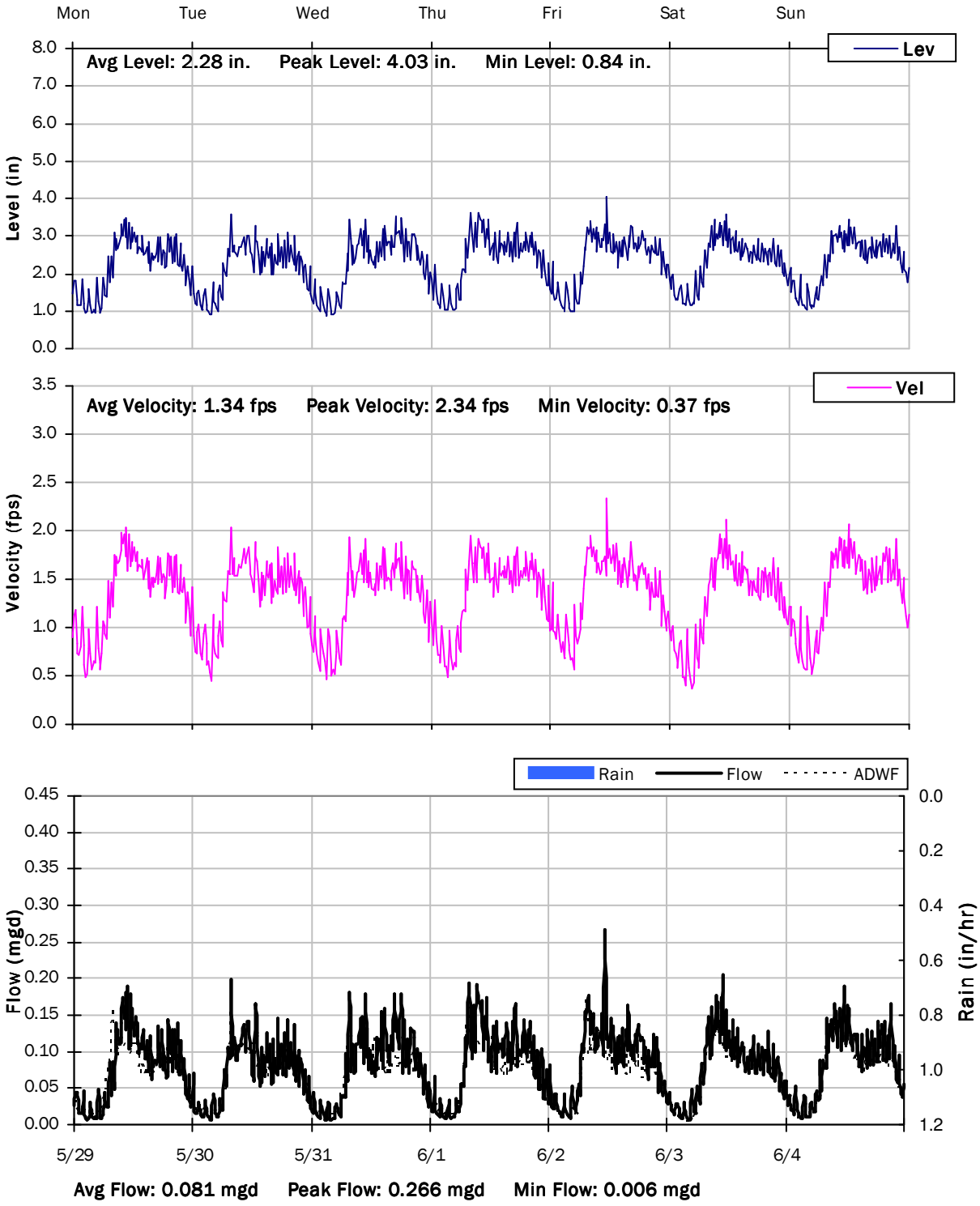
5/22/2017 to 5/29/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

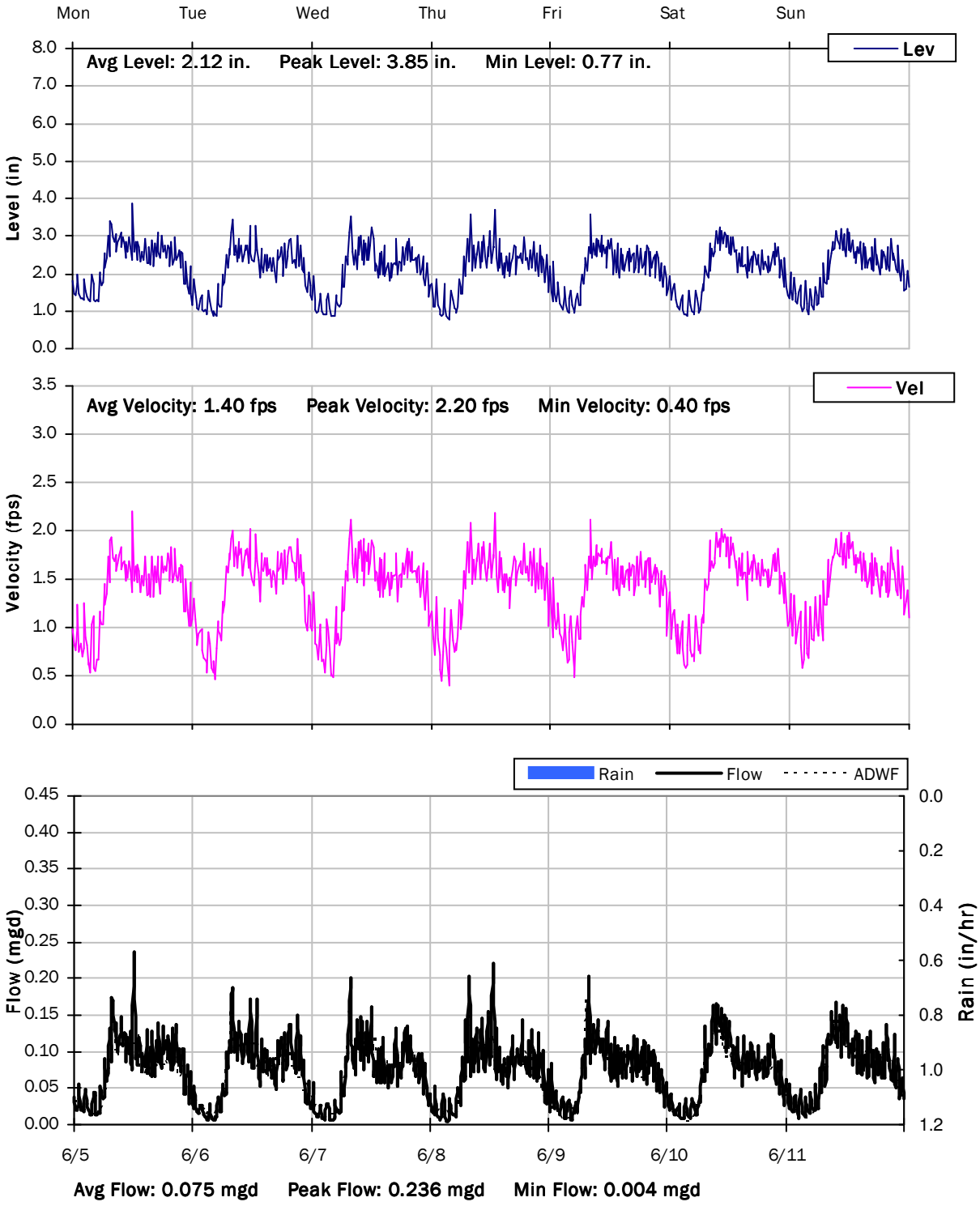
5/29/2017 to 6/5/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

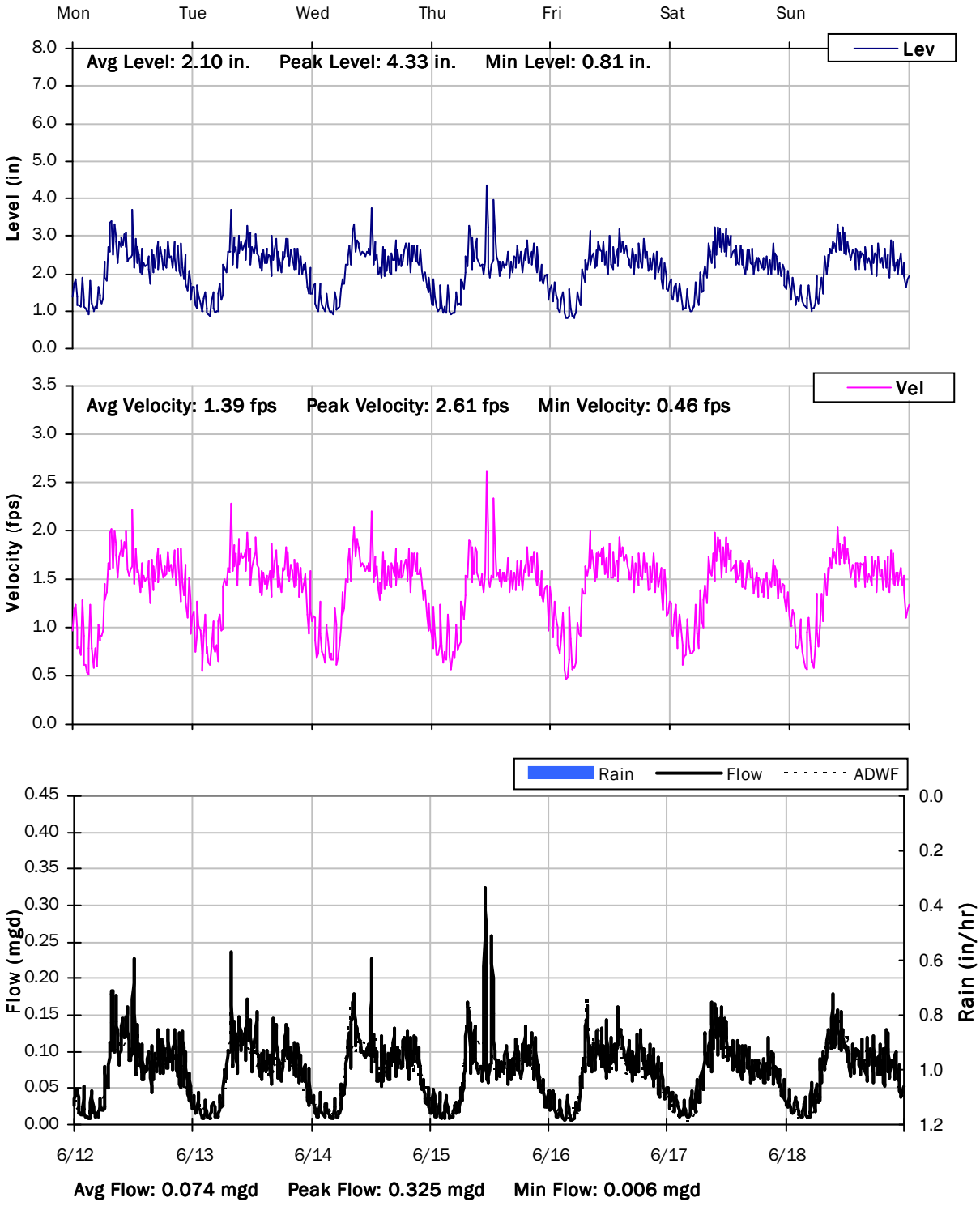
6/5/2017 to 6/12/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

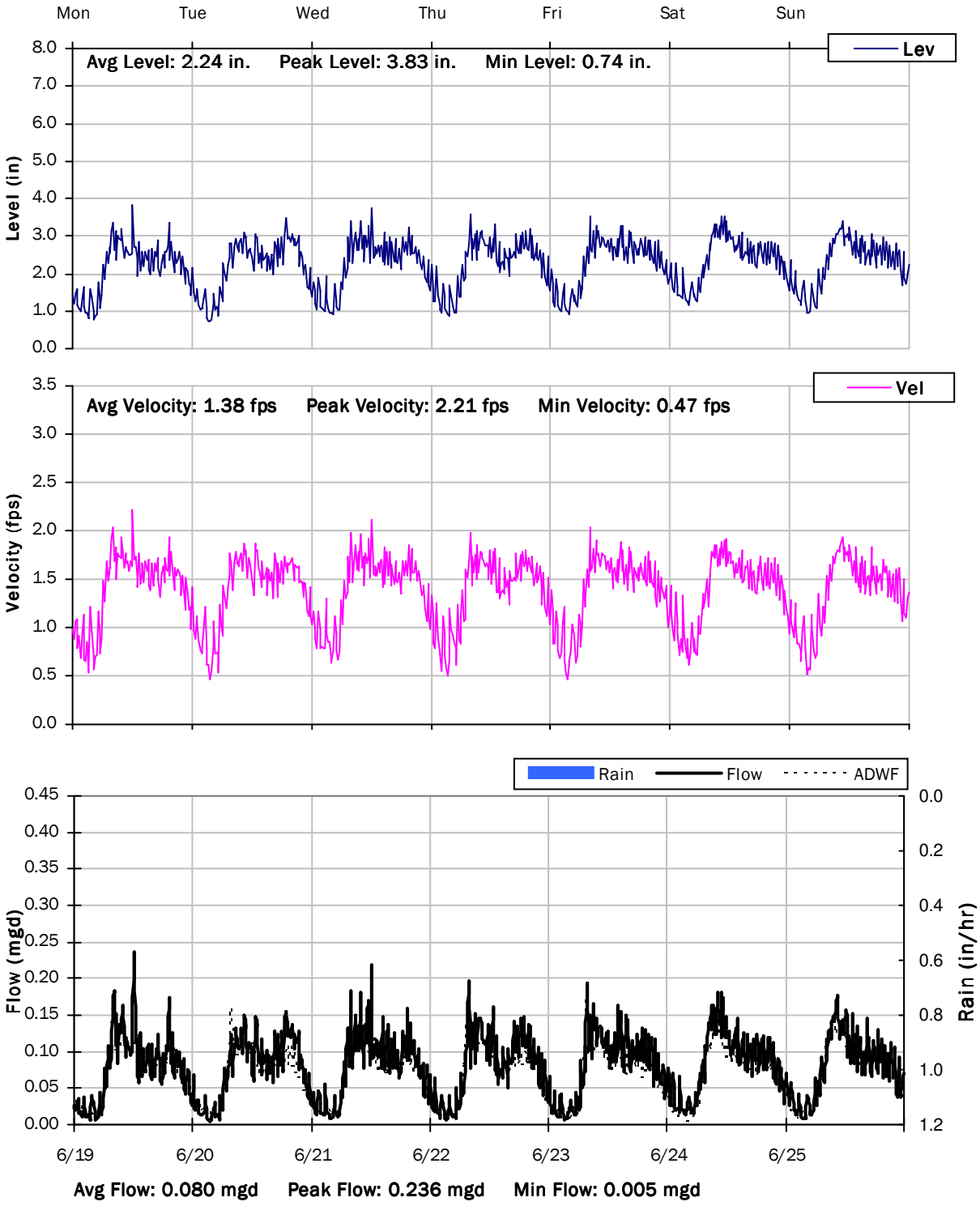
6/12/2017 to 6/19/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

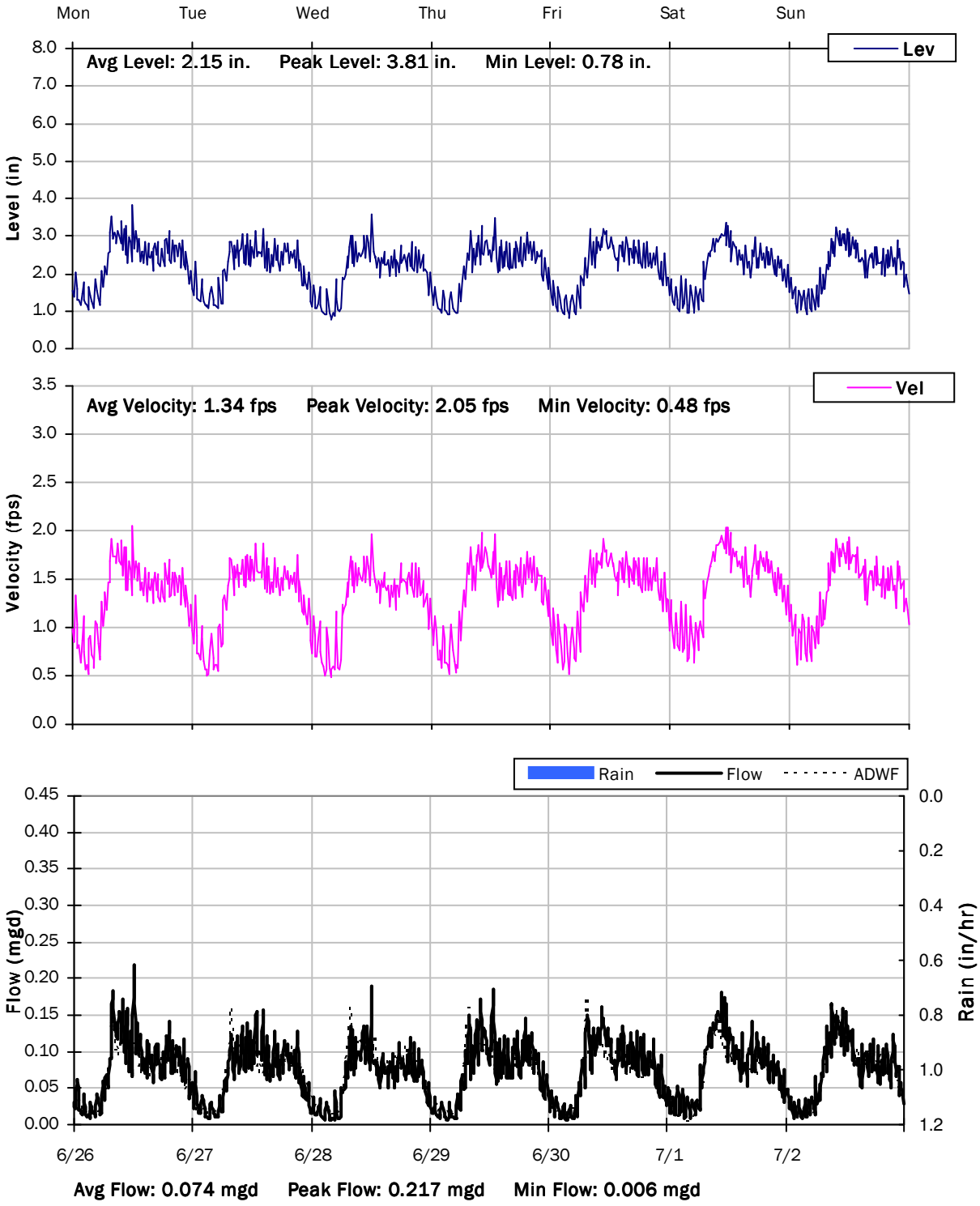
6/19/2017 to 6/26/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

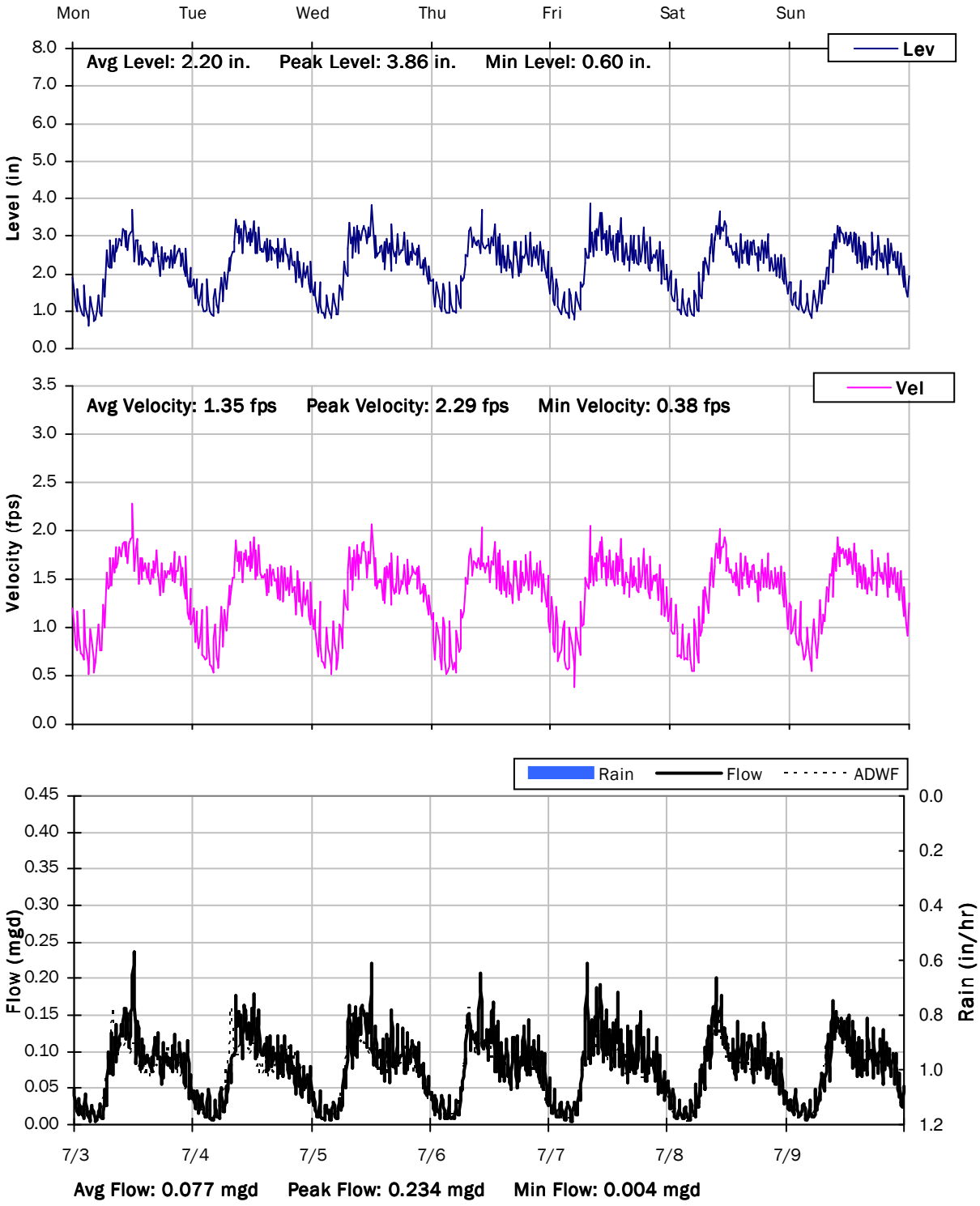
6/26/2017 to 7/3/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

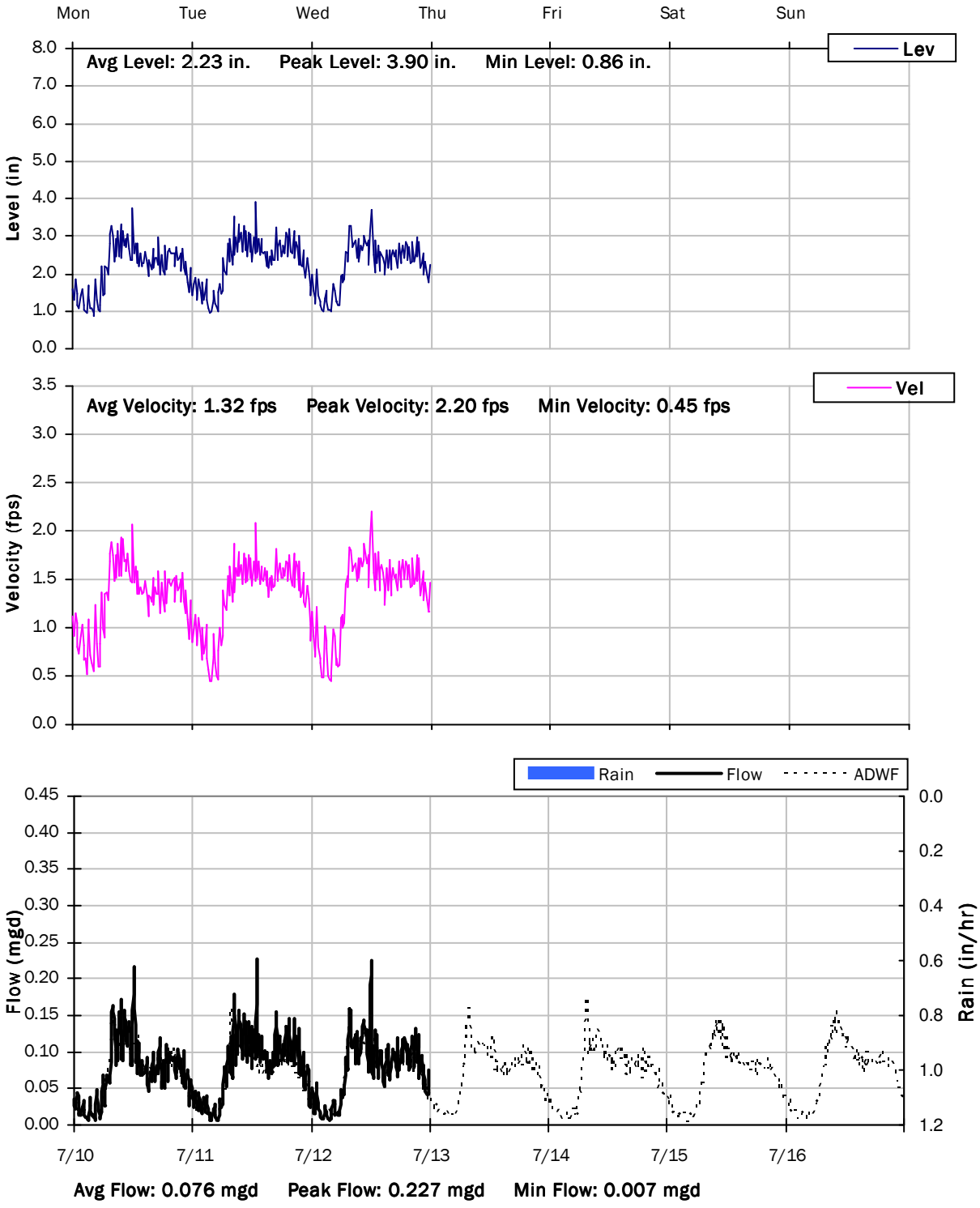
7/3/2017 to 7/10/2017



SITE 10

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

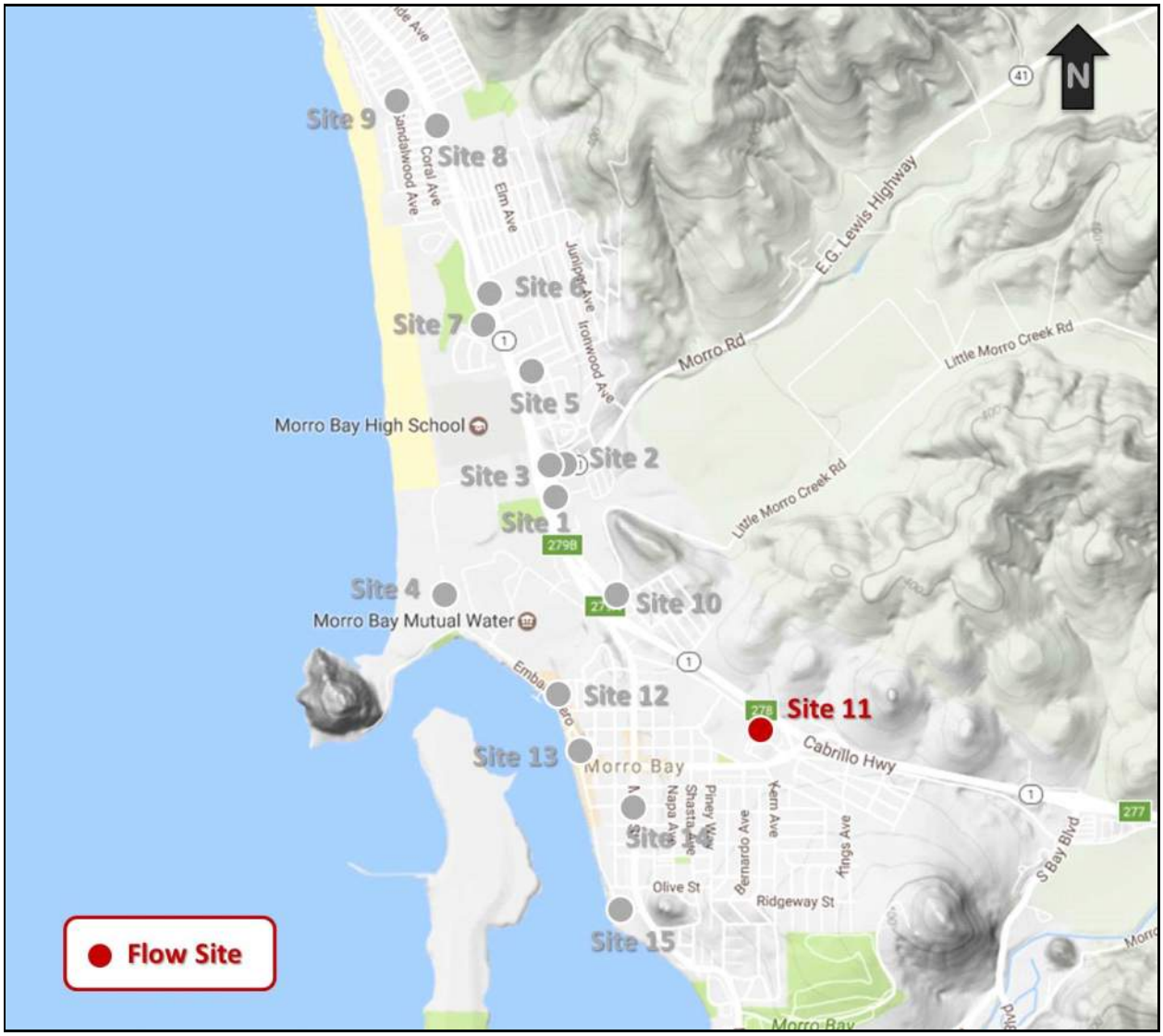
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 11

Location: 785 Quintana Road, meter on east 8" inlet

Data Summary Report



Vicinity Map: Site 11

SITE 11

Site Information

Location: 785 Quintana Road, meter on east 8" inlet

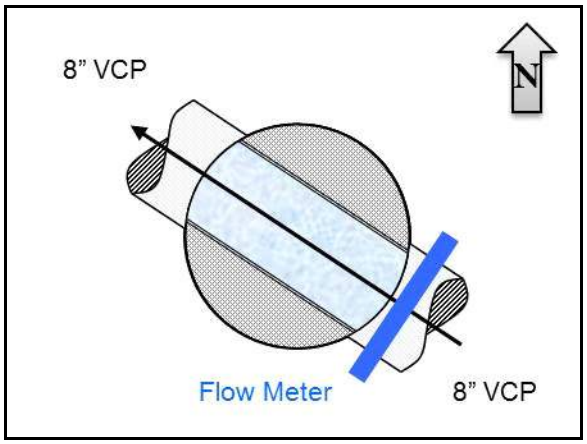


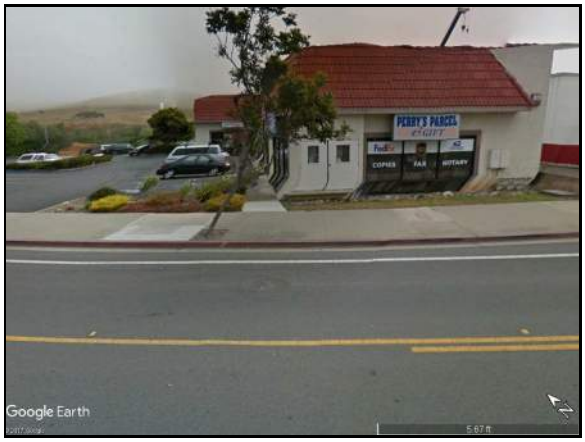
Pipe Diameter: 8 inches

ADWF: 0.064 mgd

Peak Measured Flow: 0.248 mgd









SITE 11

Additional Site Photos



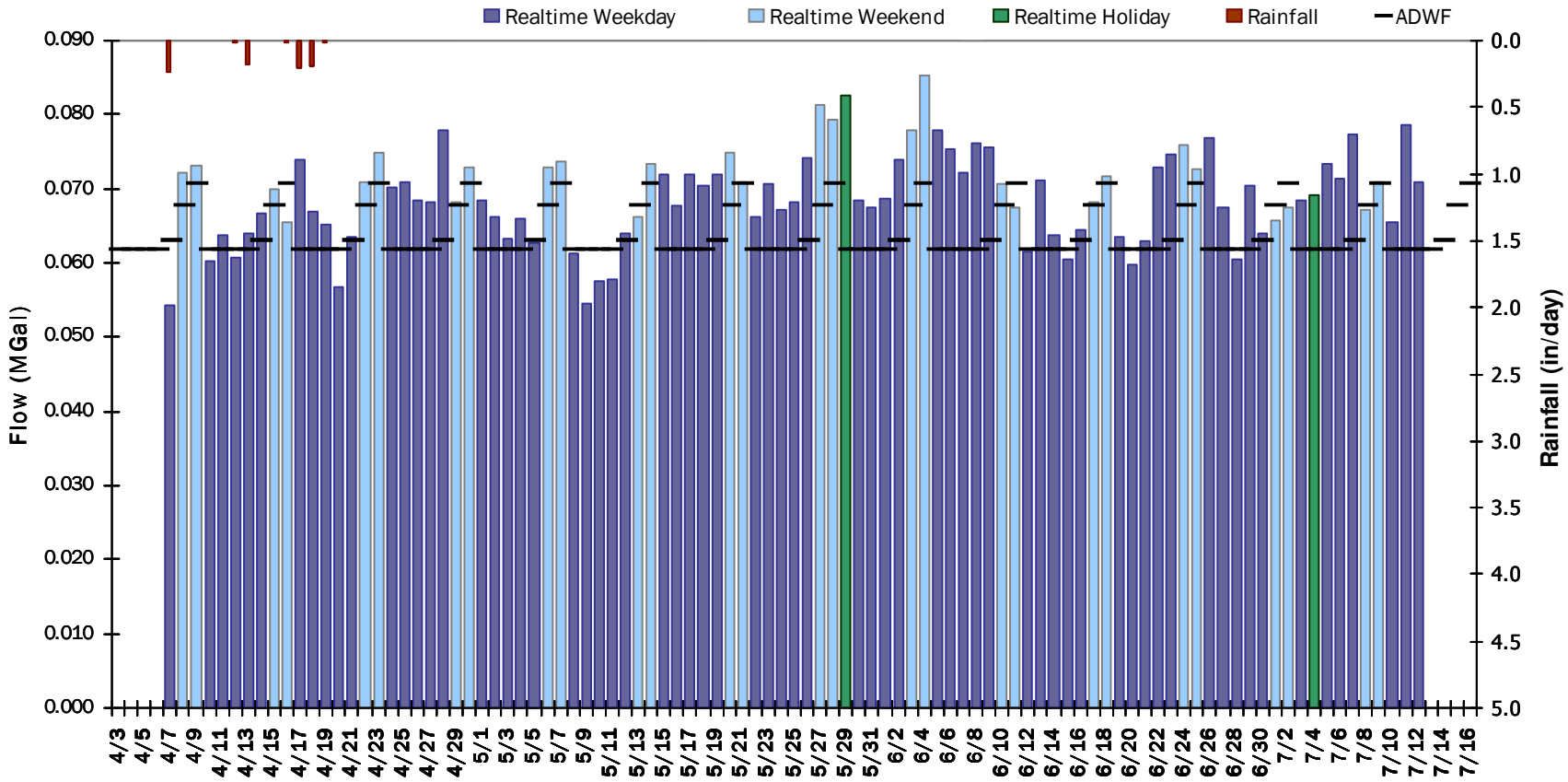


SITE 11

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.069 MGal **Peak Daily Flow: 0.085 MGal** **Min Daily Flow: 0.054 MGal**

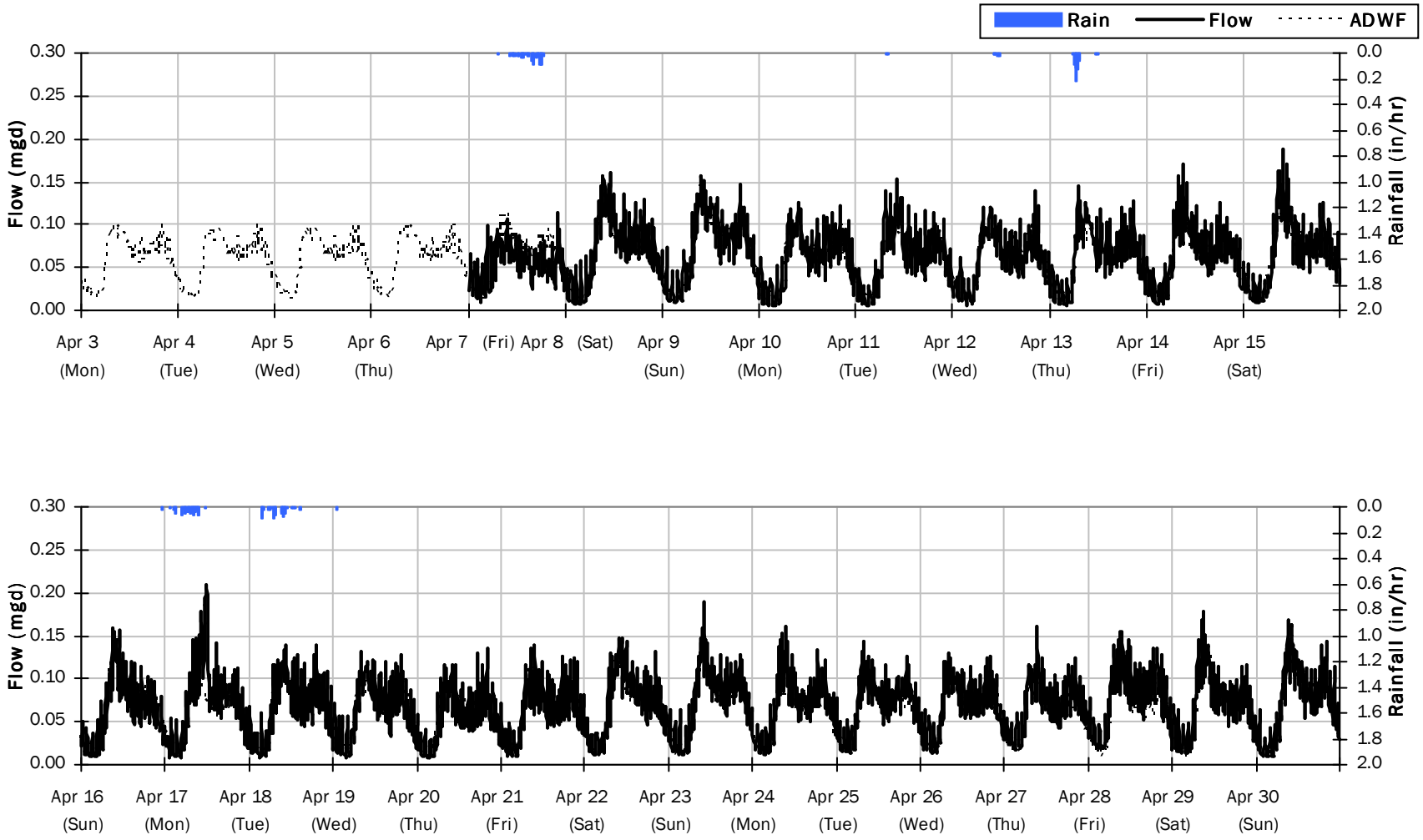
Total Period Rainfall: 0.85 inches



SITE 11

Flow Summary: 4/1/2017 to 4/30/2017

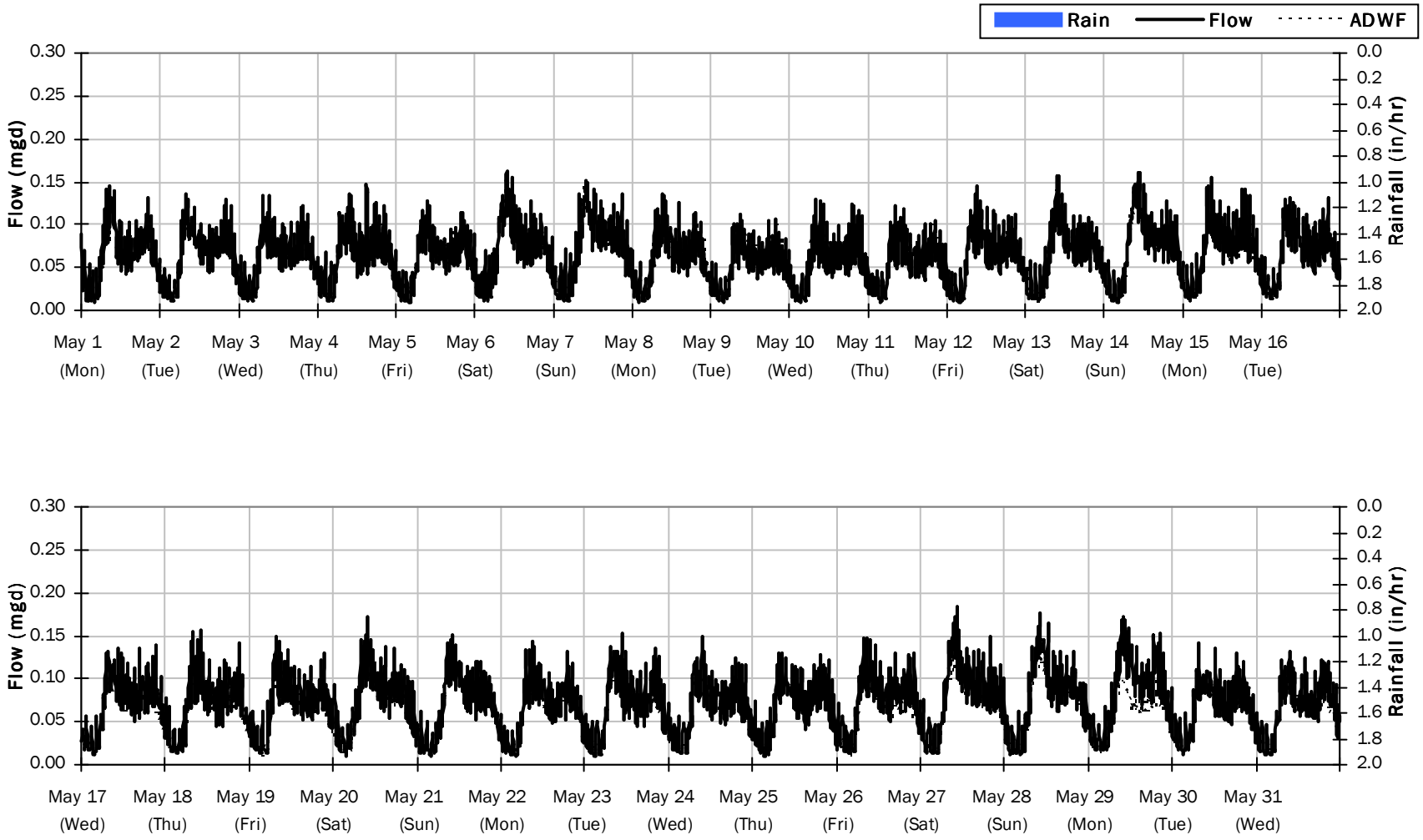
Total Period Rainfall: 0.85 inches **Avg Flow: 0.067 mgd** **Peak Flow: 0.208 mgd** **Min Flow: 0.006 mgd**



SITE 11

Flow Summary: 5/1/2017 to 5/31/2017

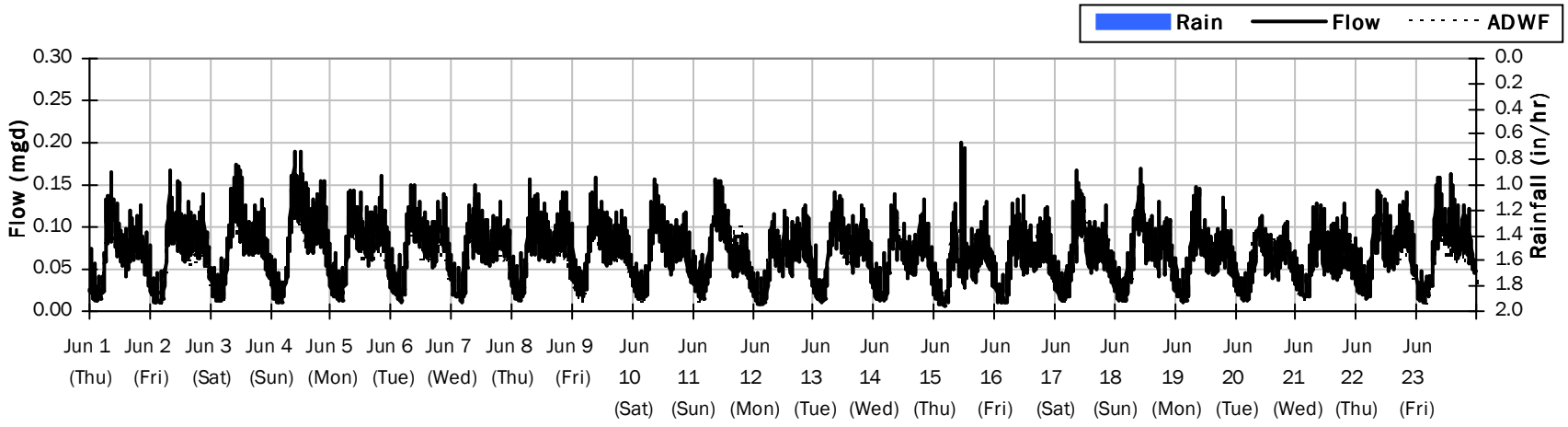
Total Period Rainfall: 0.00 inches **Avg Flow: 0.069 mgd** **Peak Flow: 0.184 mgd** **Min Flow: 0.009 mgd**

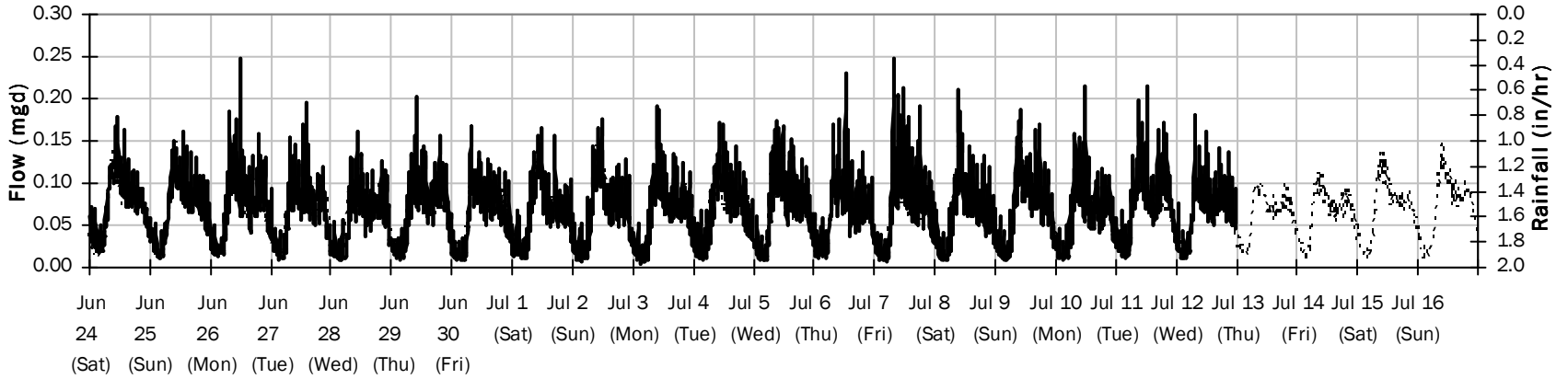


SITE 11

Flow Summary: 6/1/2017 to 7/16/2017

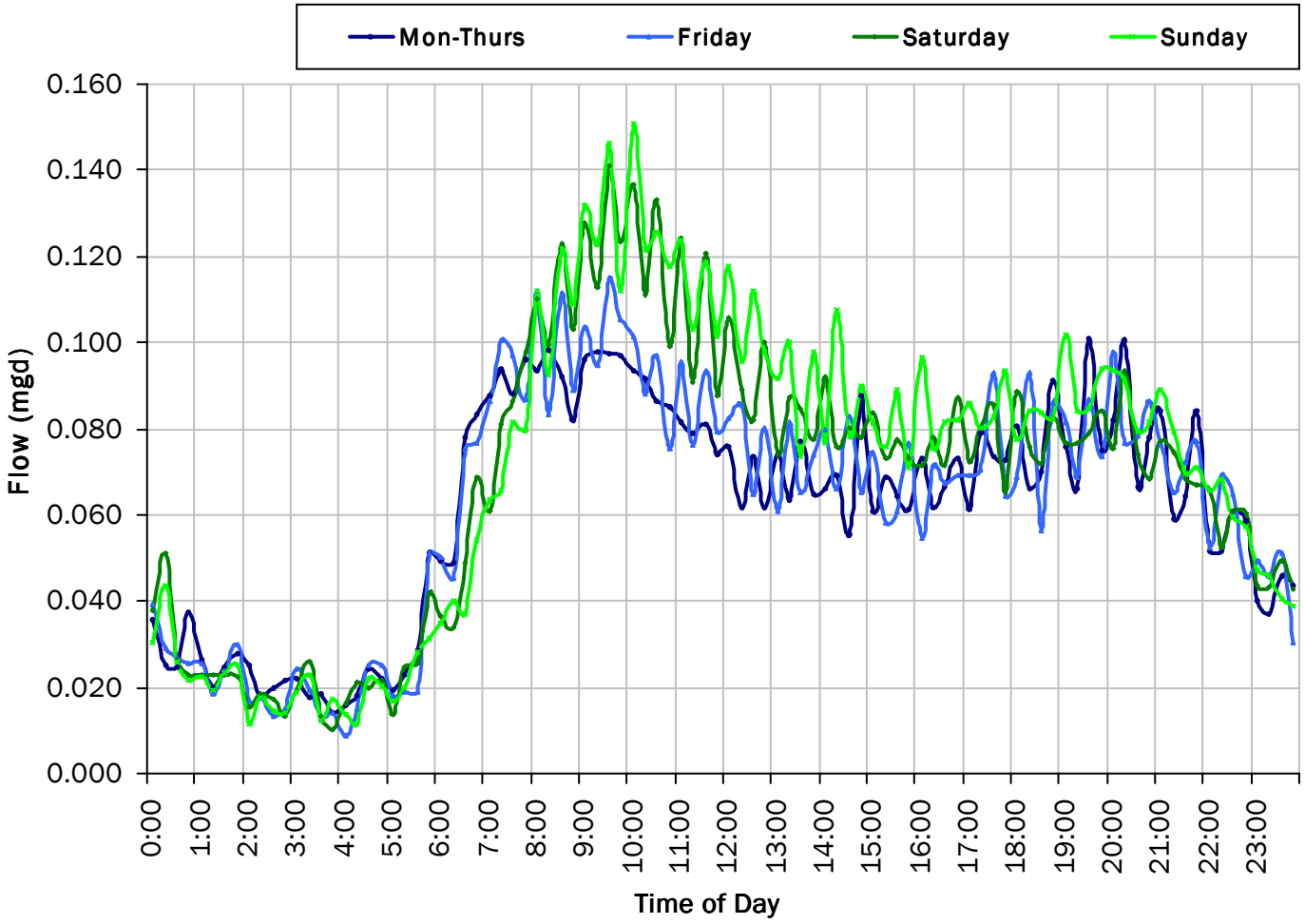
Total Period Rainfall: 0.00 inches **Avg Flow: 0.070 mgd** **Peak Flow: 0.248 mgd** **Min Flow: 0.005 mgd**





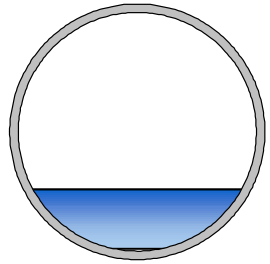
SITE 11

Average Dry Weather Flow Hydrographs



ADWF:

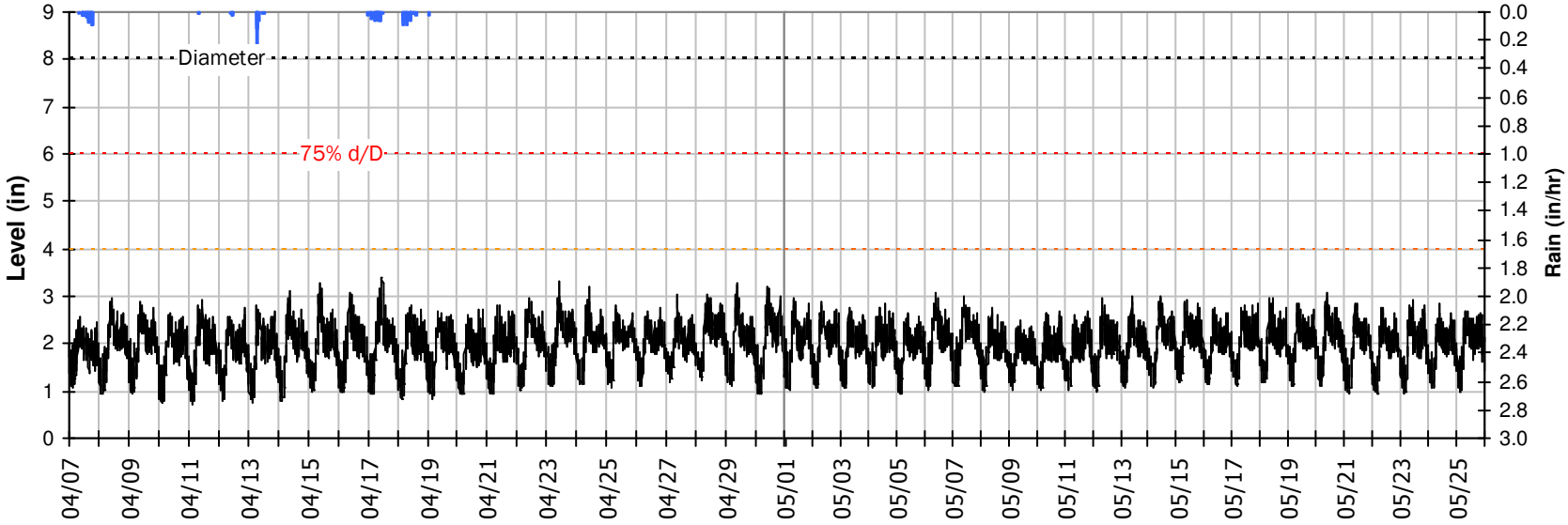
0.064 *mgd*

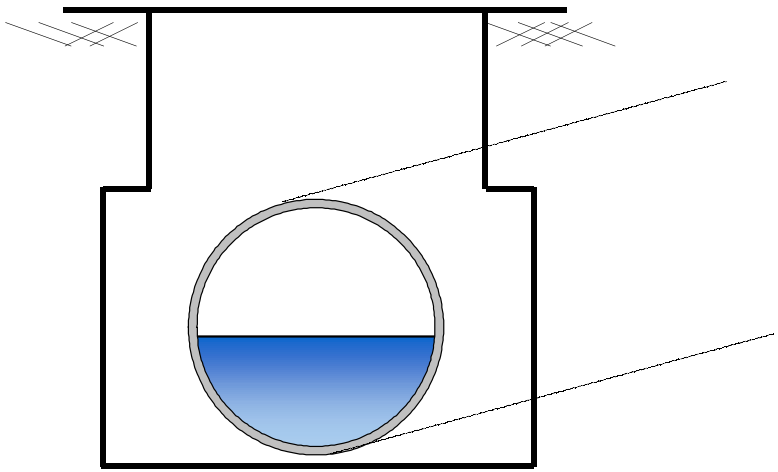


SITE 11

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



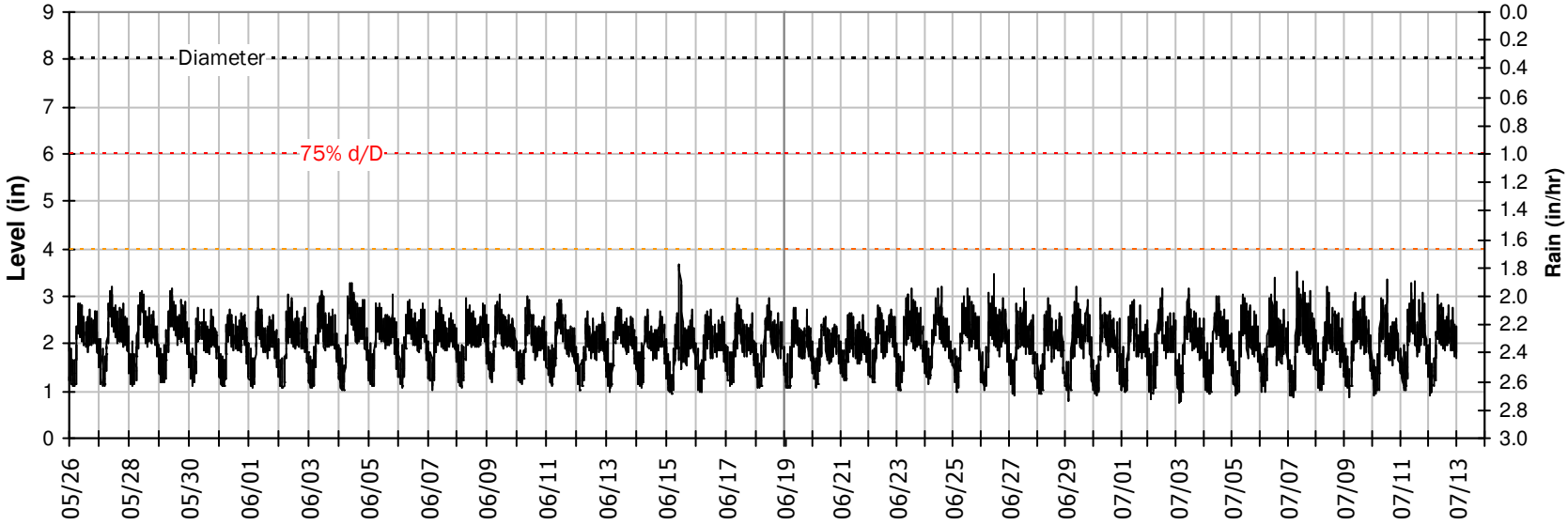


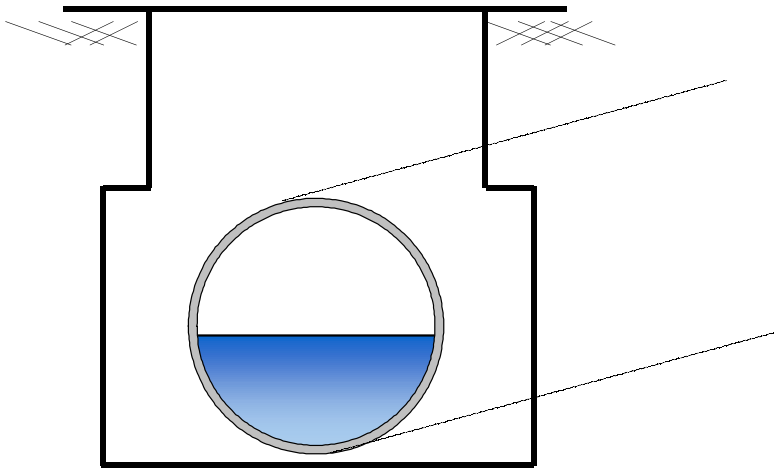
Pipe Diameter:	8	*inches*
Peak Measured Level:	3.64	*inches*
Peak d/D Ratio:	0.46	

SITE 11

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



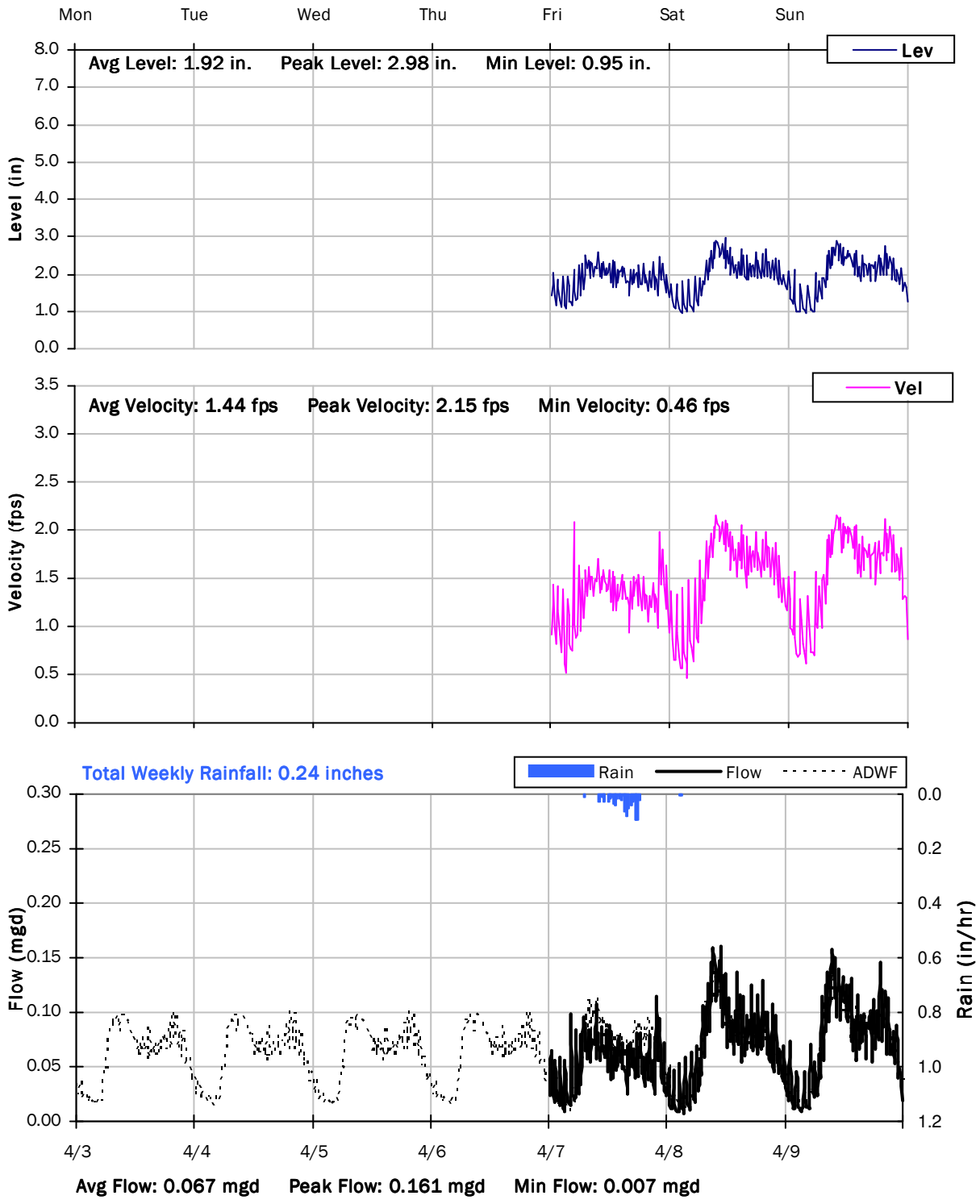


Pipe Diameter:	8	*inches*
Peak Measured Level:	3.64	*inches*
Peak d/D Ratio:	0.46	

SITE 11

Weekly Level, Velocity and Flow Hydrographs

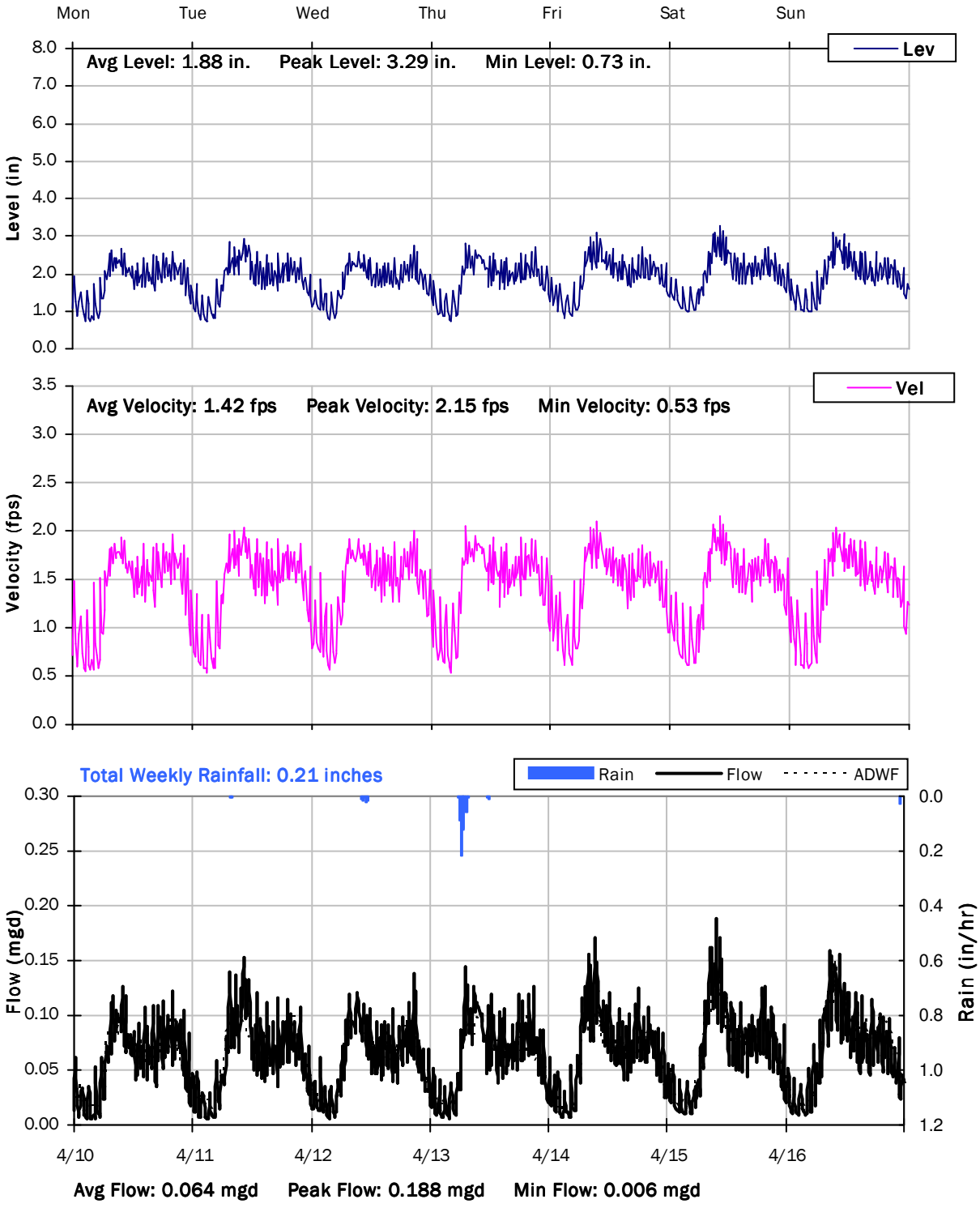
4/3/2017 to 4/10/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

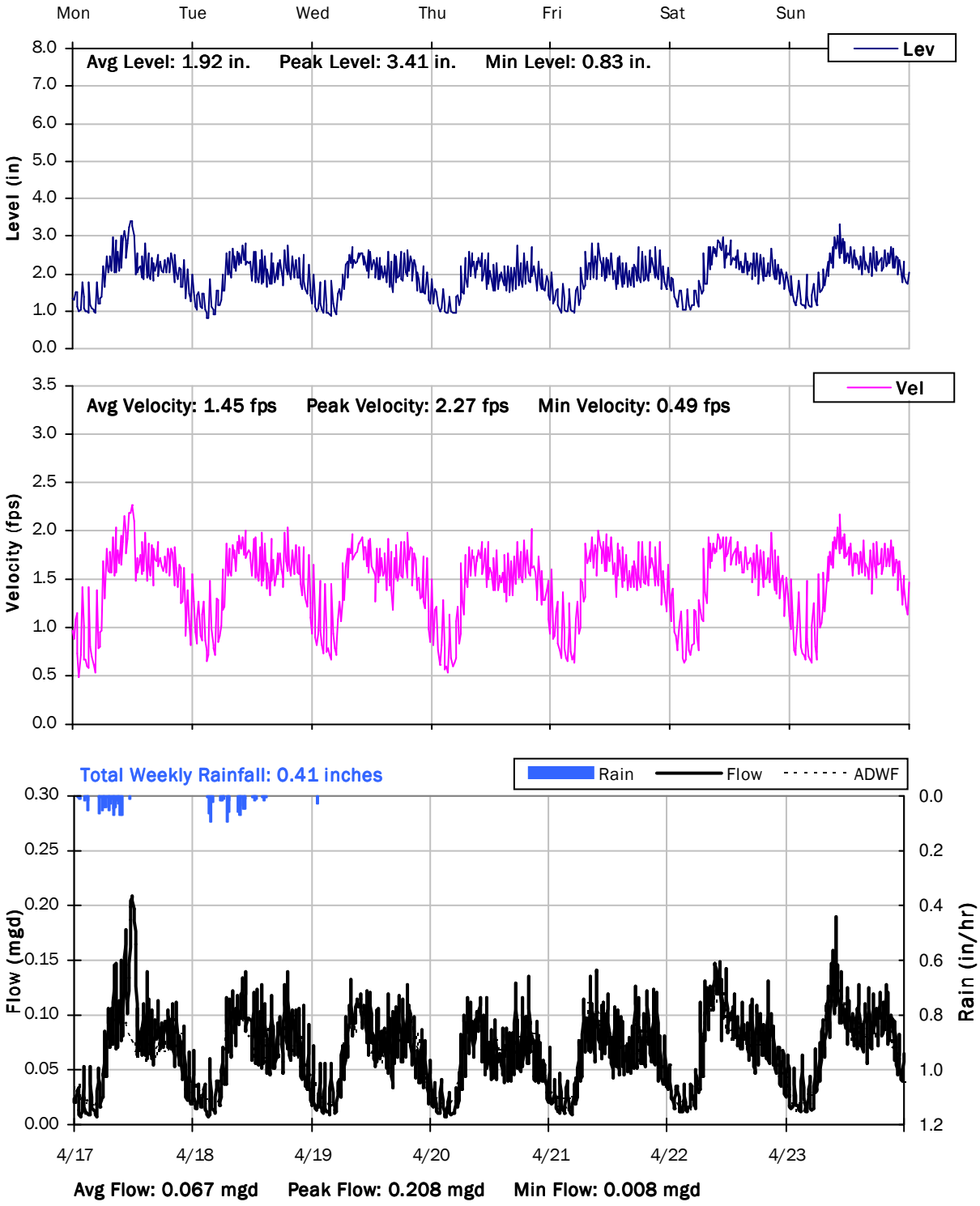
4/10/2017 to 4/17/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

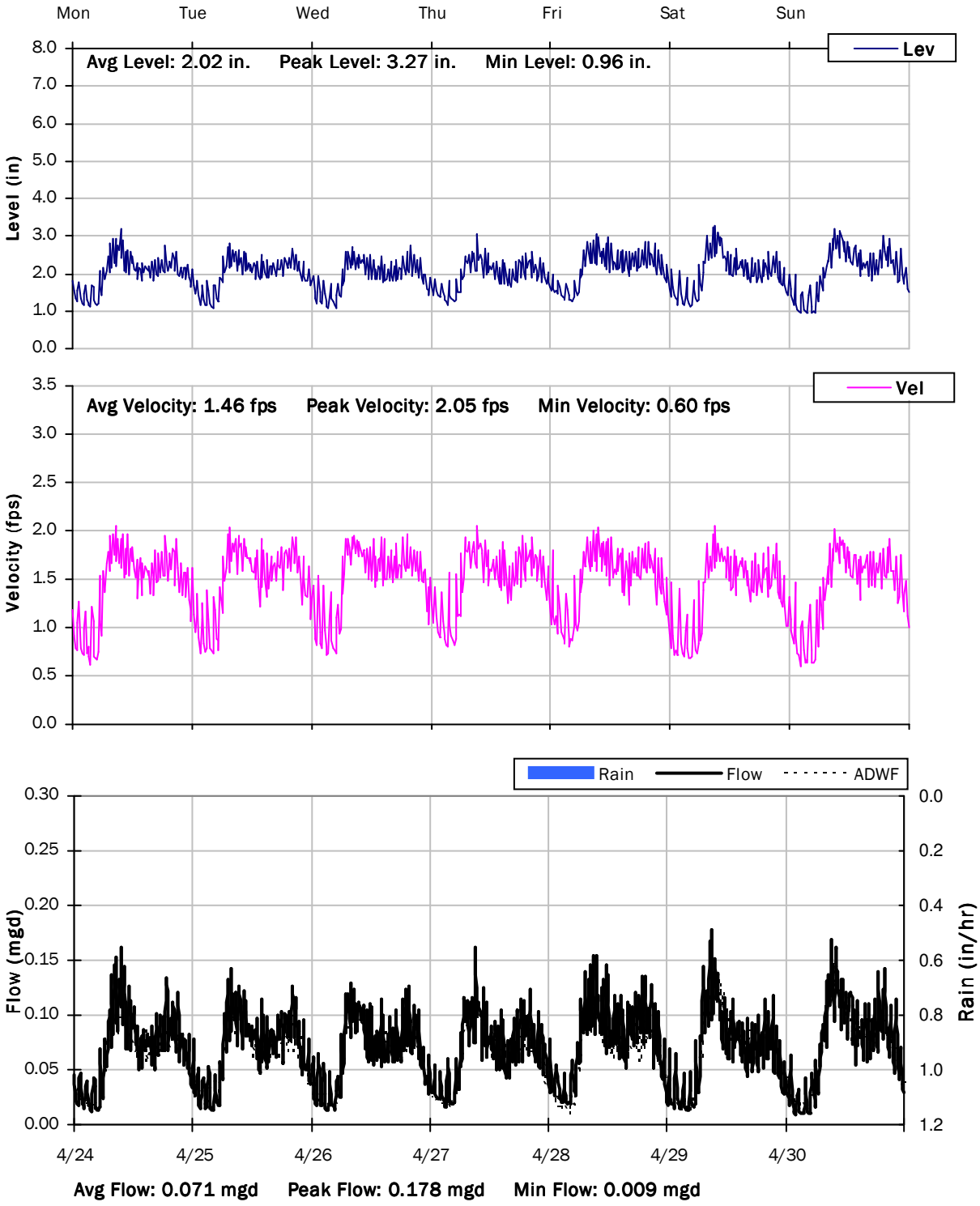
4/17/2017 to 4/24/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

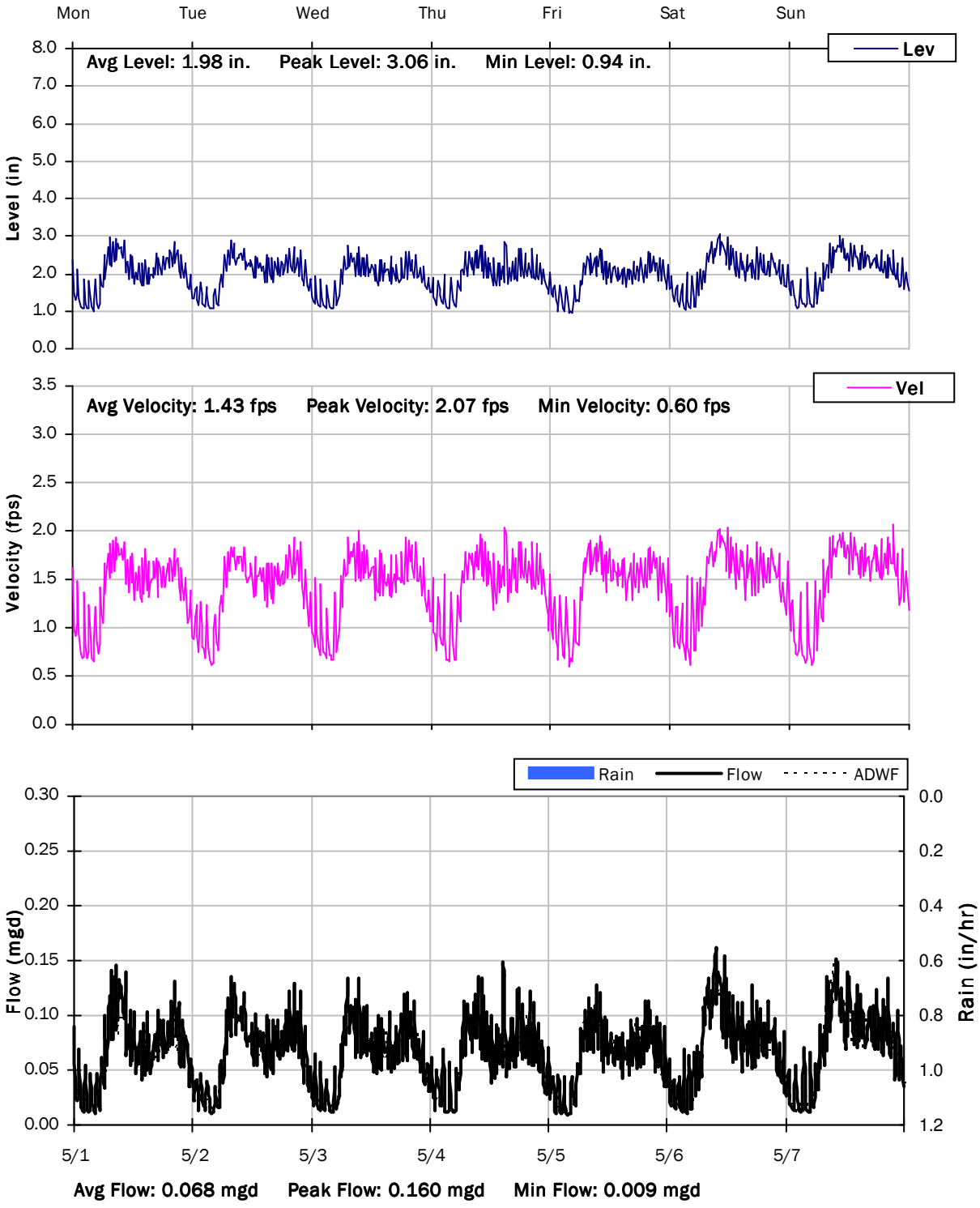
4/24/2017 to 5/1/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

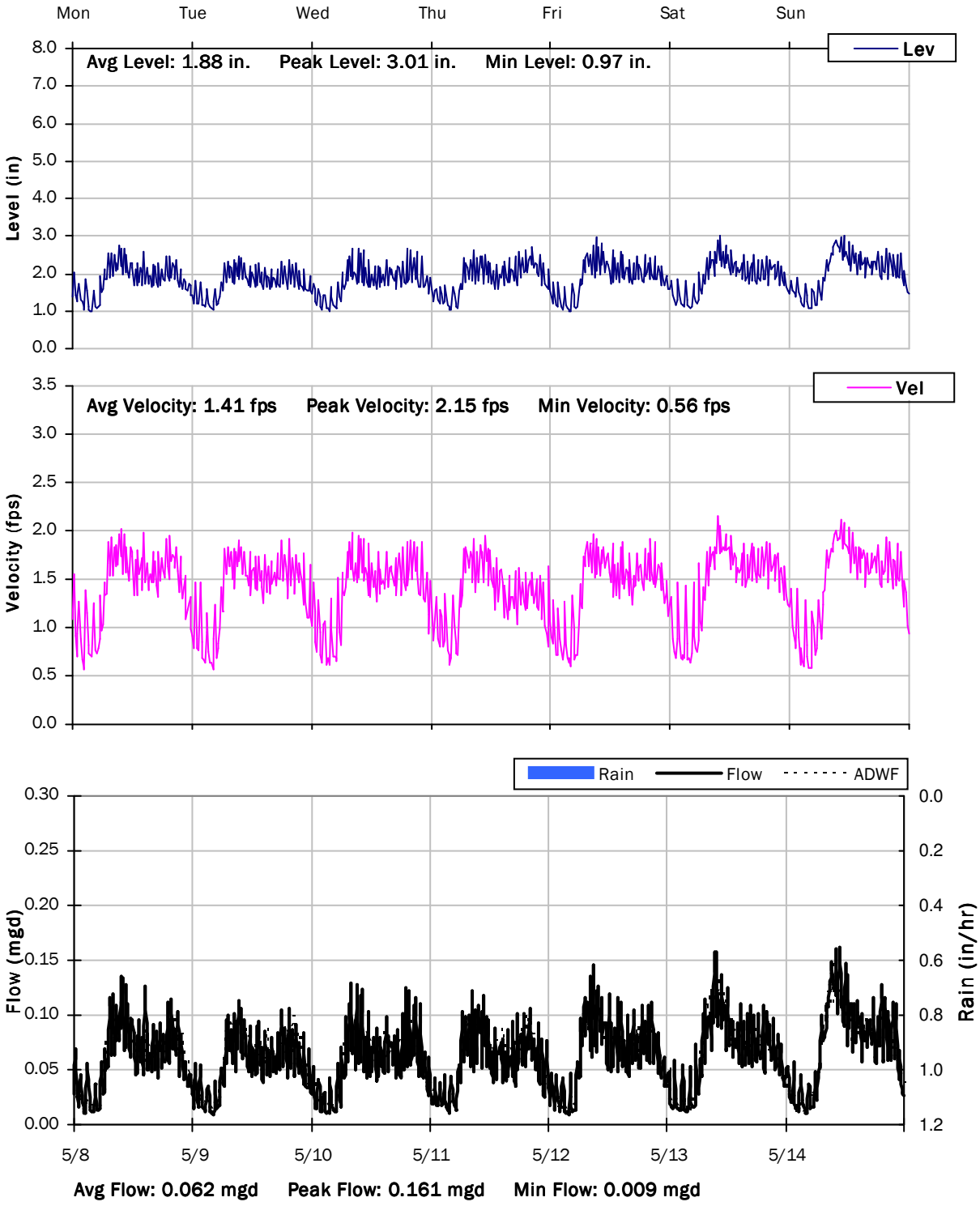
5/1/2017 to 5/8/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

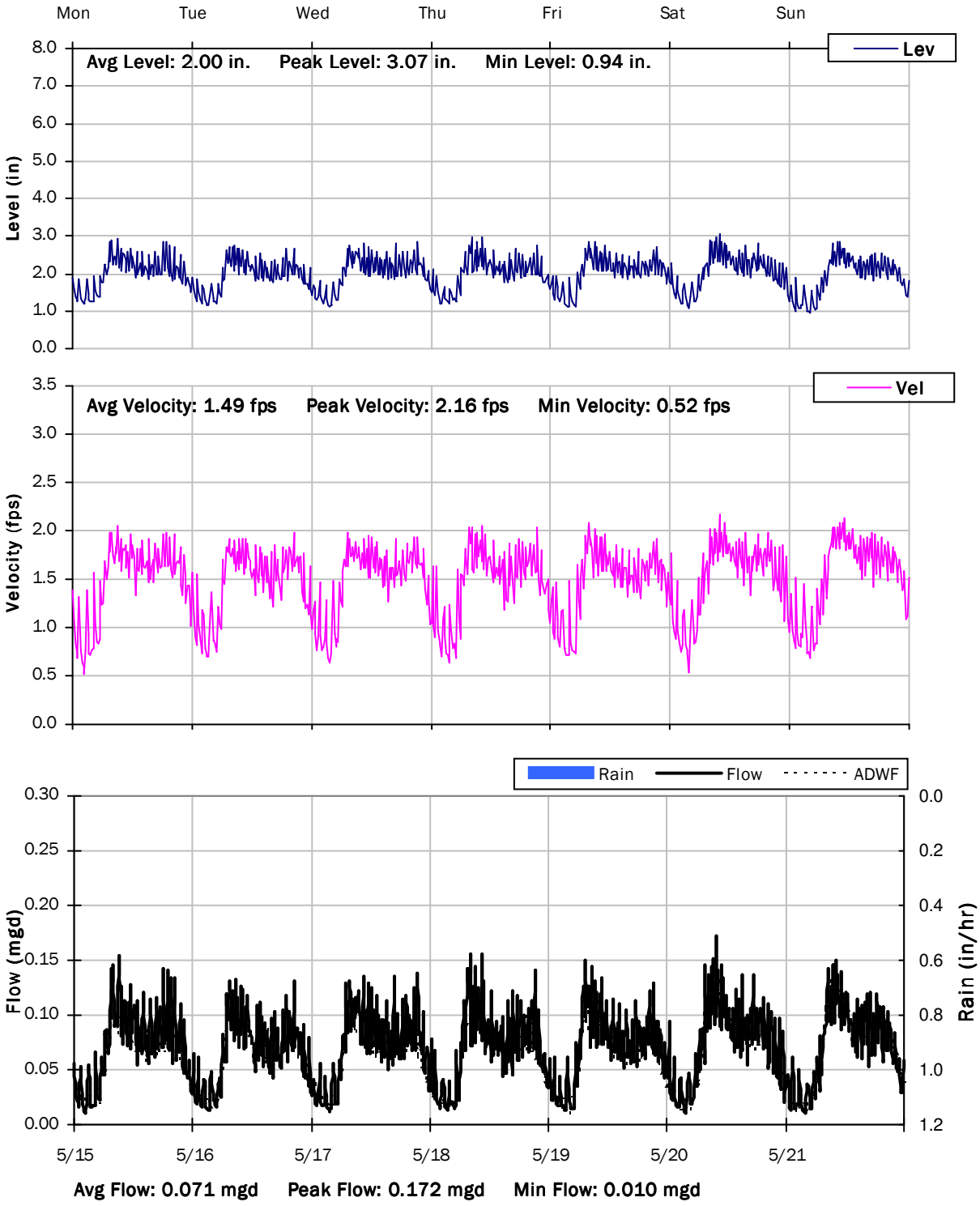
5/8/2017 to 5/15/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

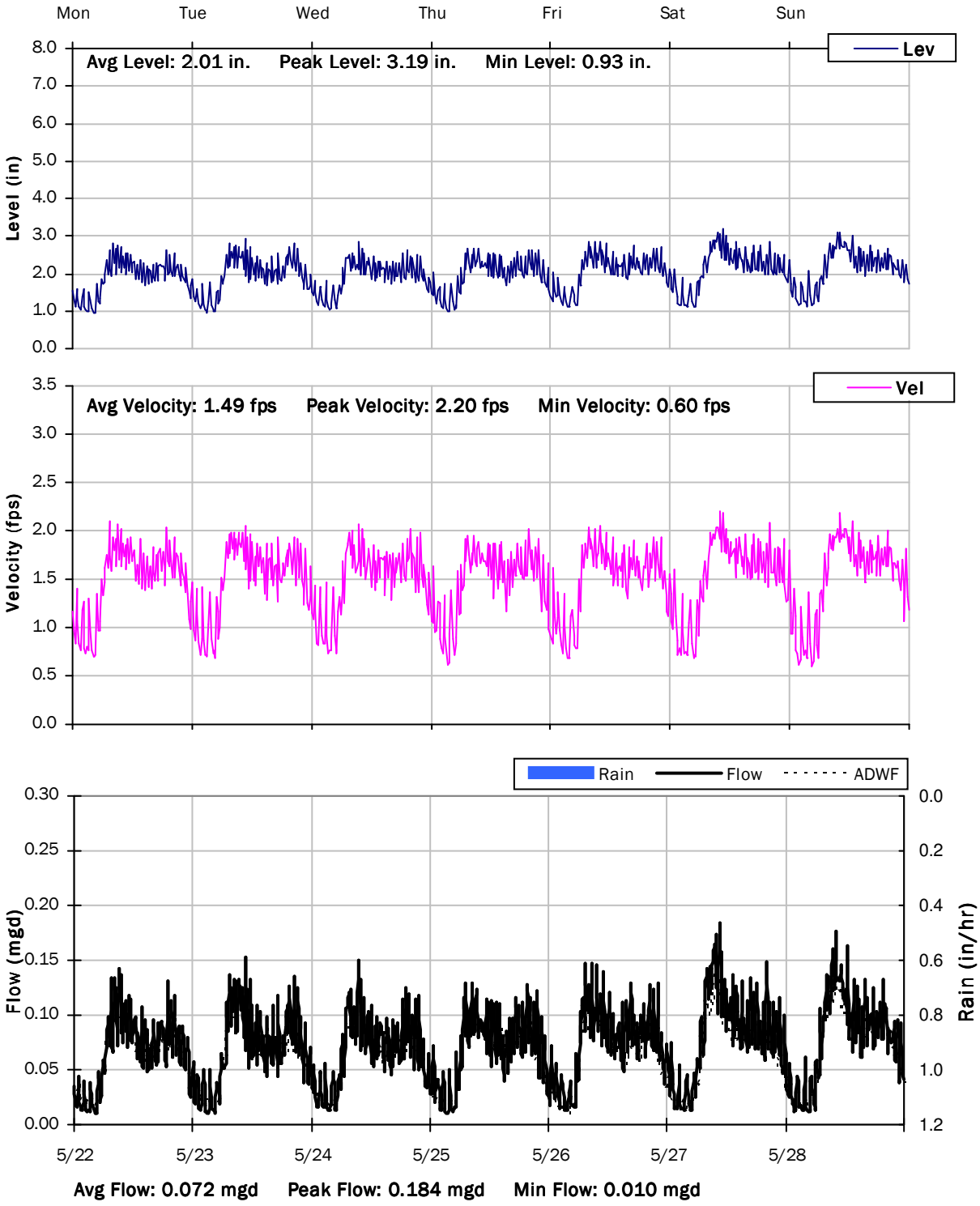
5/15/2017 to 5/22/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

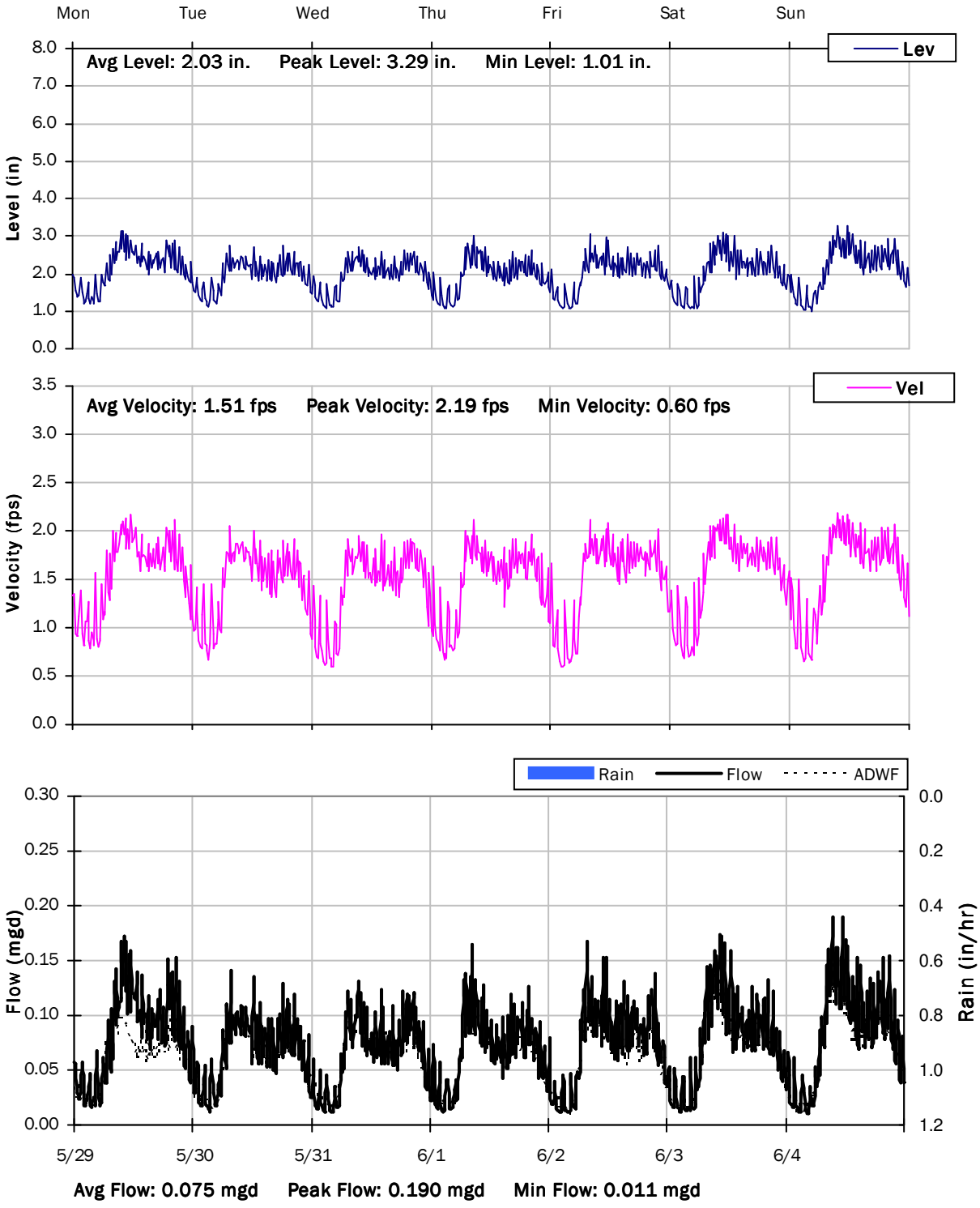
5/22/2017 to 5/29/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

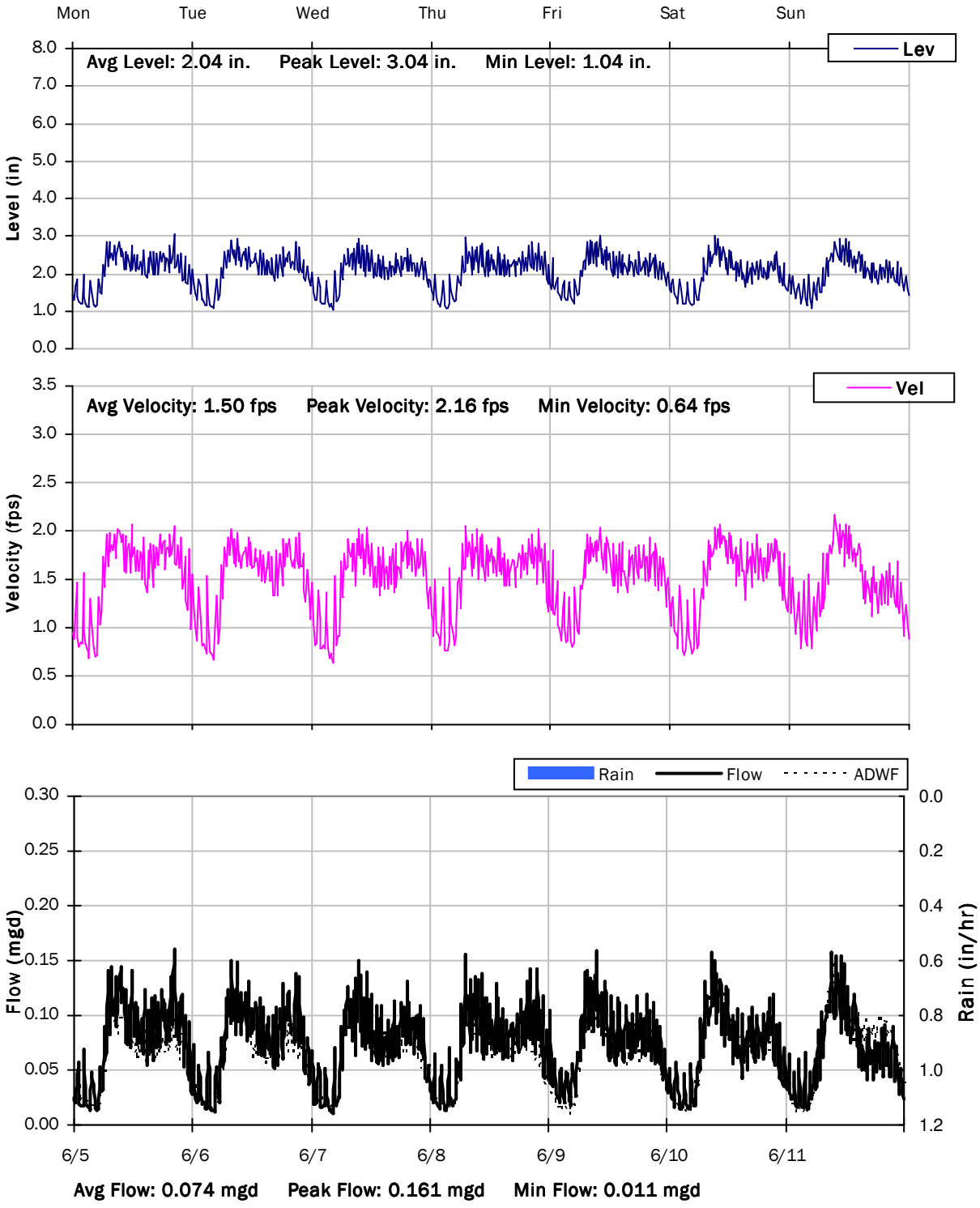
5/29/2017 to 6/5/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

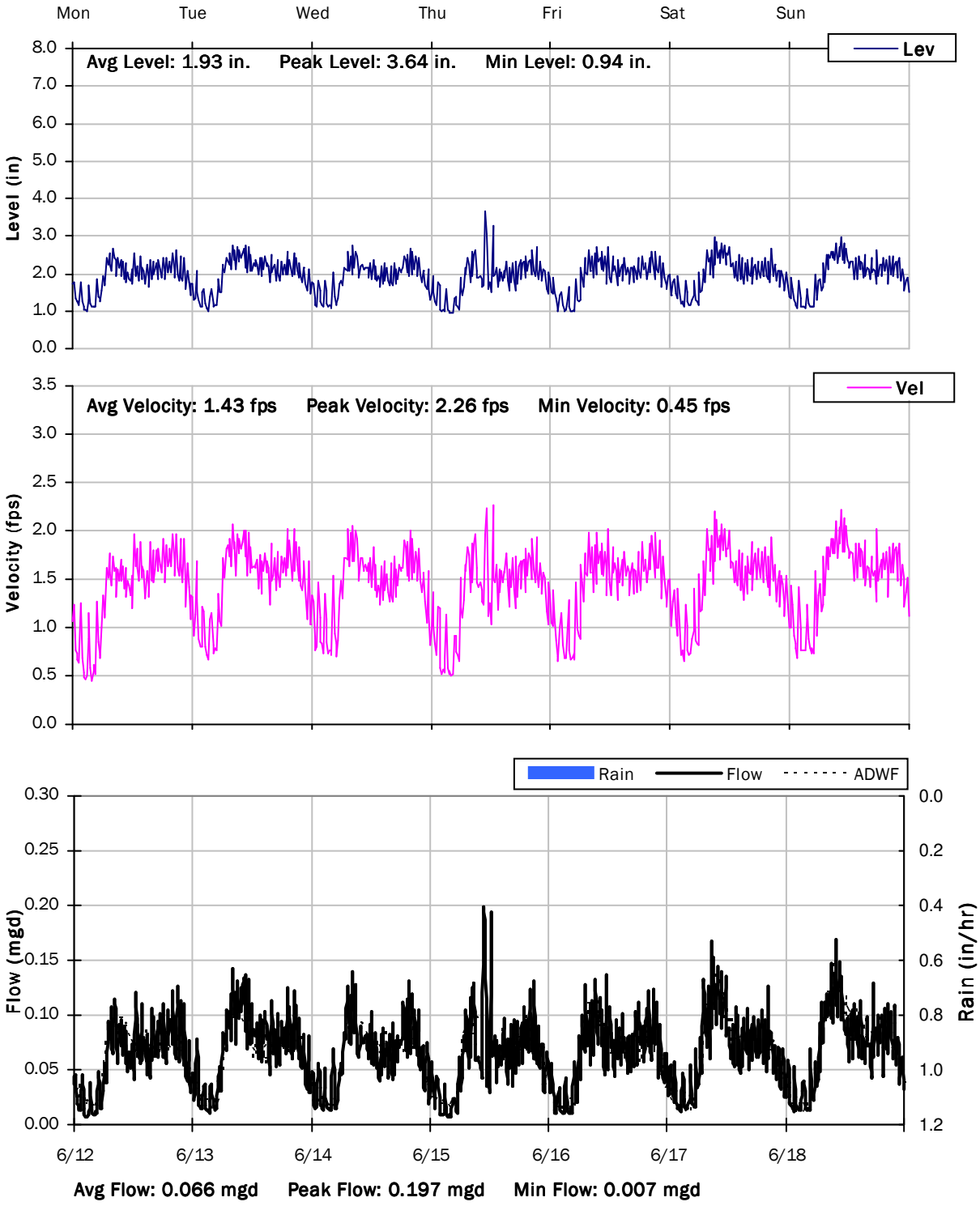
6/5/2017 to 6/12/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

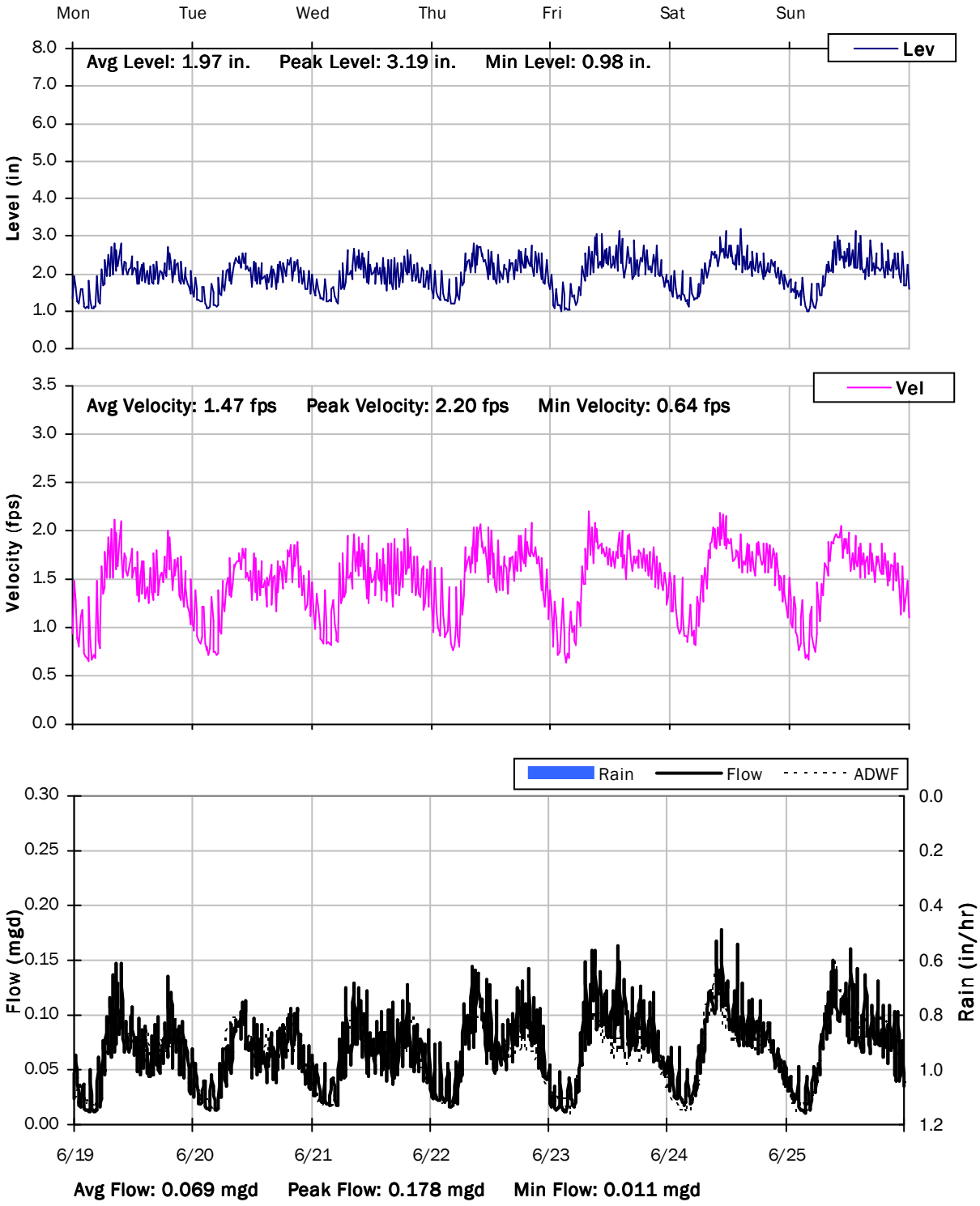
6/12/2017 to 6/19/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

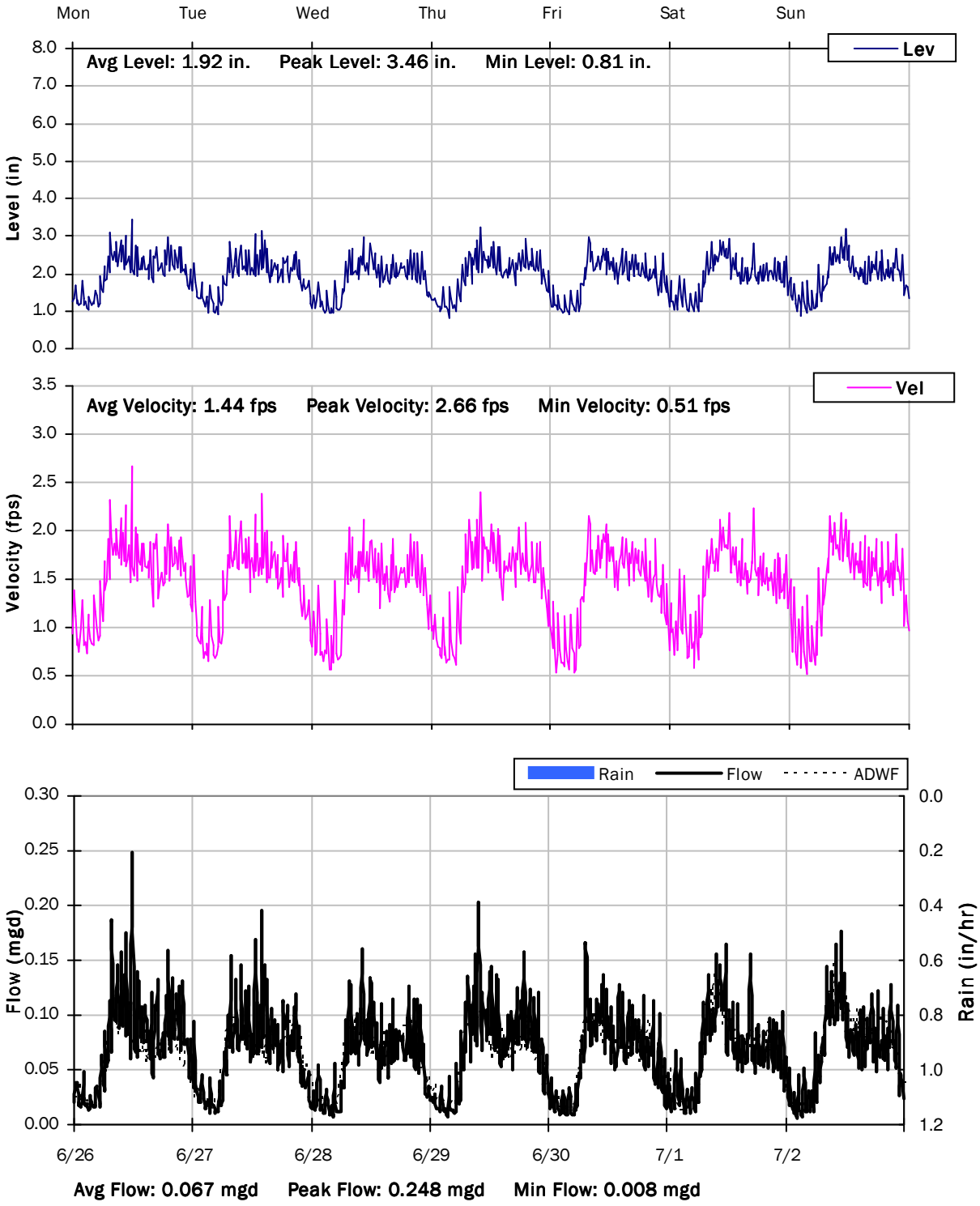
6/19/2017 to 6/26/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

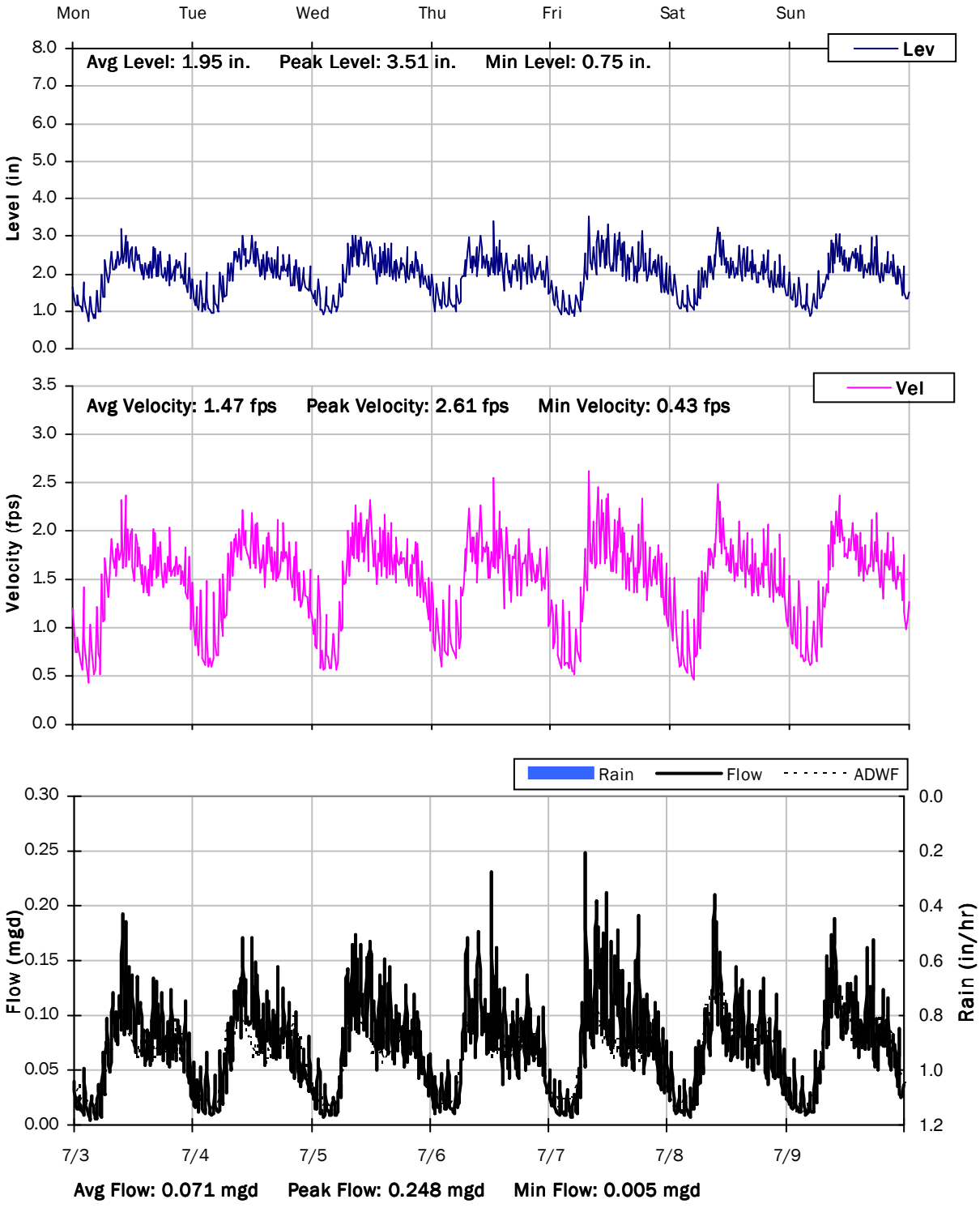
6/26/2017 to 7/3/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

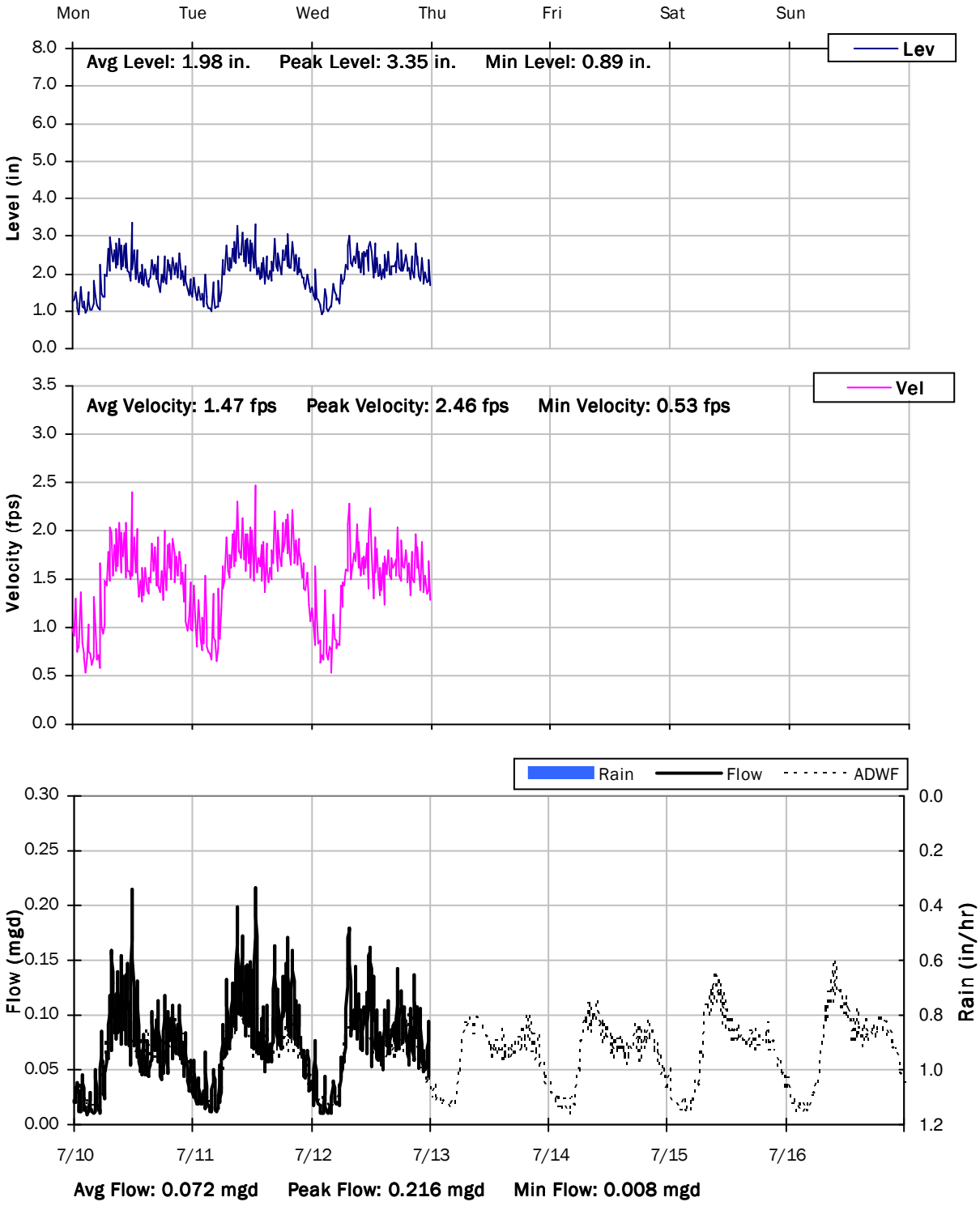
7/3/2017 to 7/10/2017



SITE 11

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

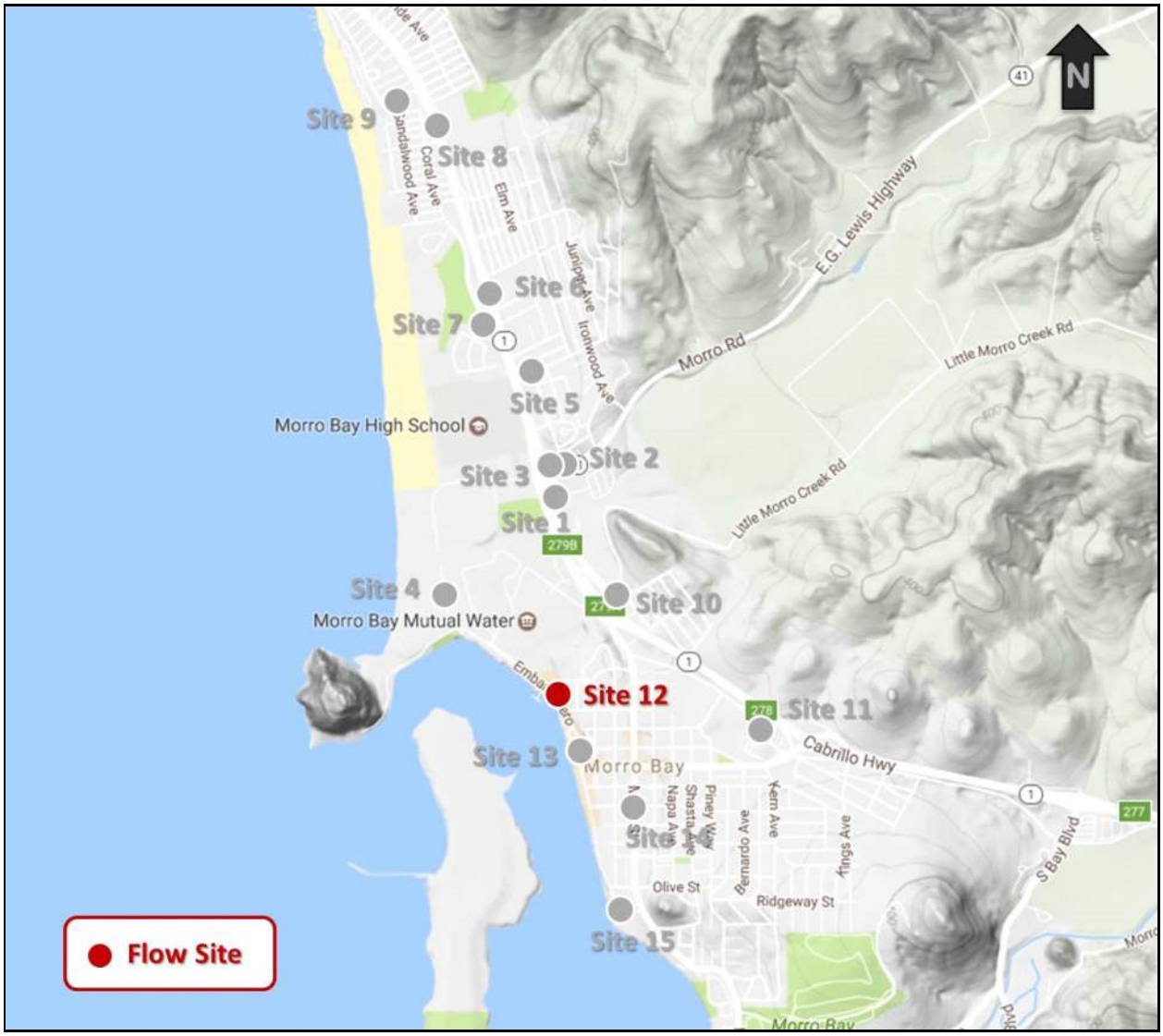
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 12

Location: Parking lot of 1154 Embarcadero, meter on south 14.375" inlet

Data Summary Report



Vicinity Map: Site 12

SITE 12

Site Information

Location: Parking lot of 1154 Embarcadero, meter on south 14.375" inlet

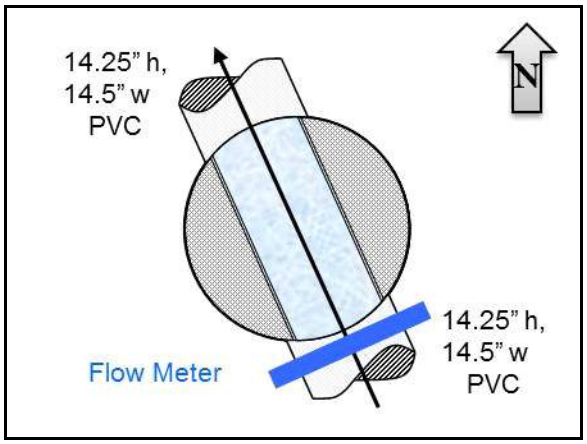


Pipe Diameter: 14.375 inches

ADWF: 0.129 mgd

Peak Measured Flow: 0.382 mgd









SITE 12

Additional Site Photos



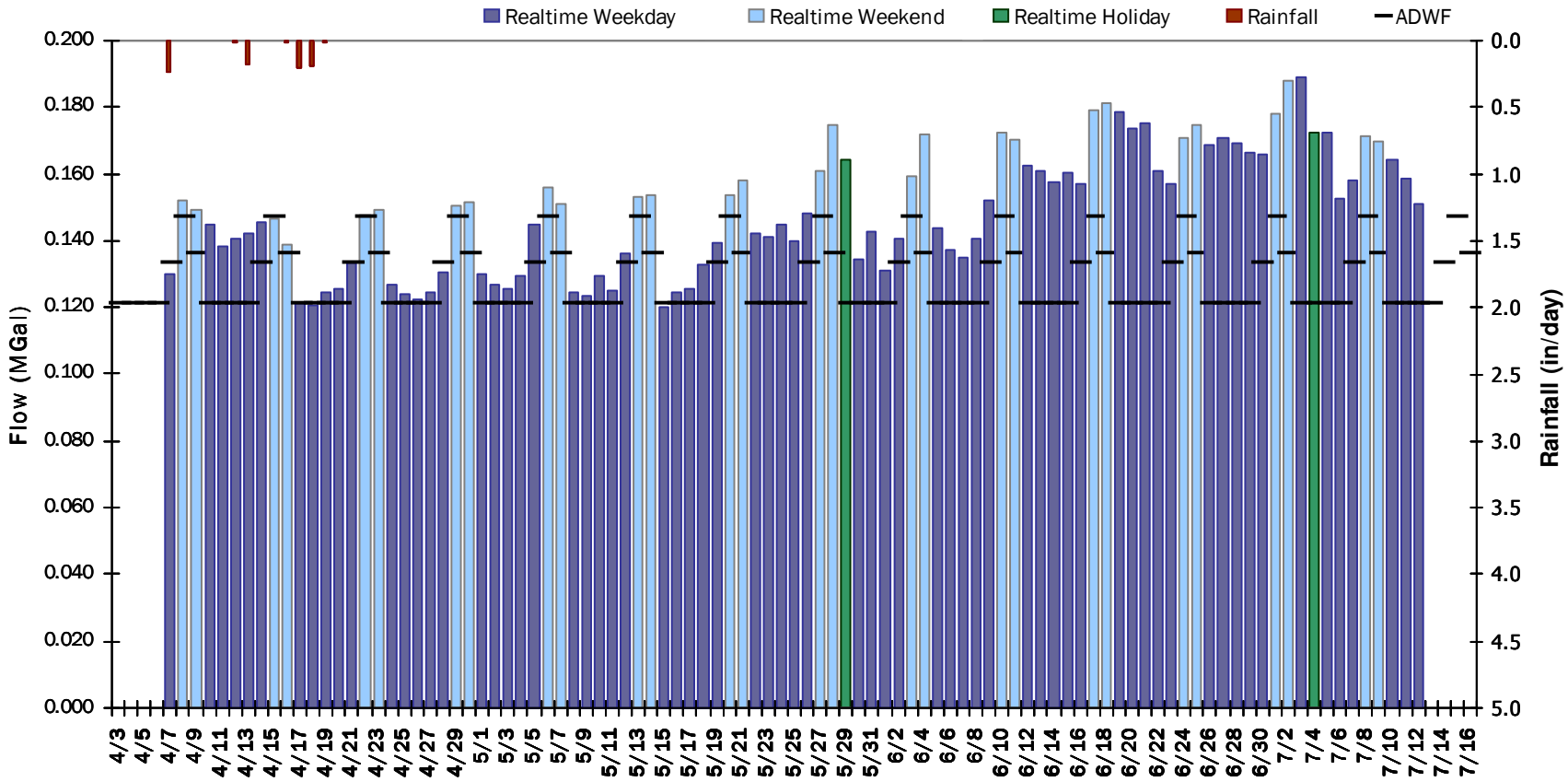


SITE 12

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.150 MGal Peak Daily Flow: 0.189 MGal Min Daily Flow: 0.120 MGal

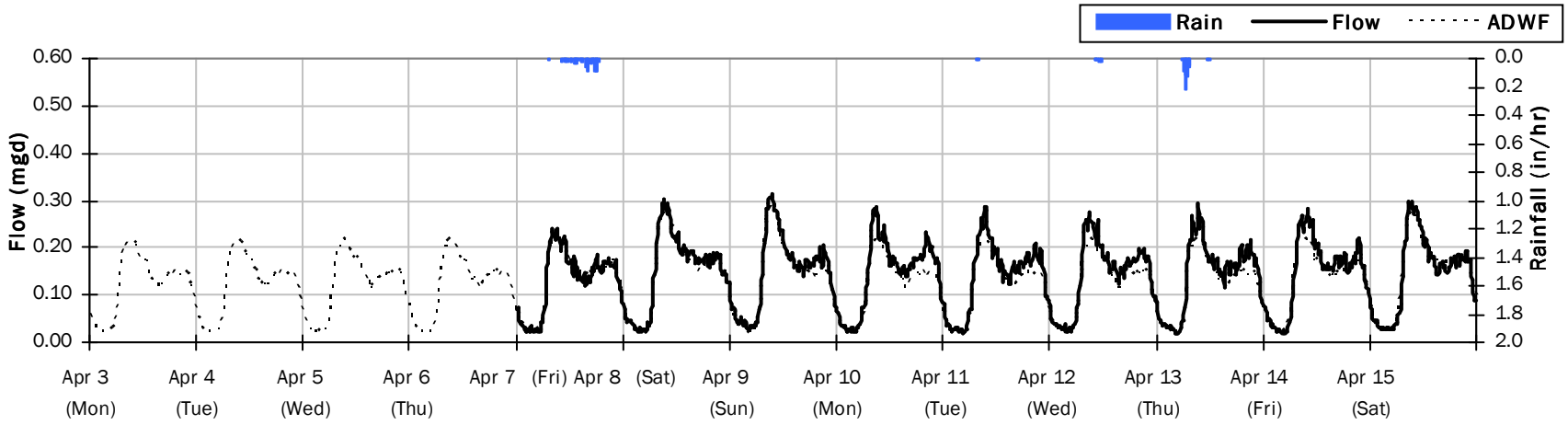
Total Period Rainfall: 0.85 inches

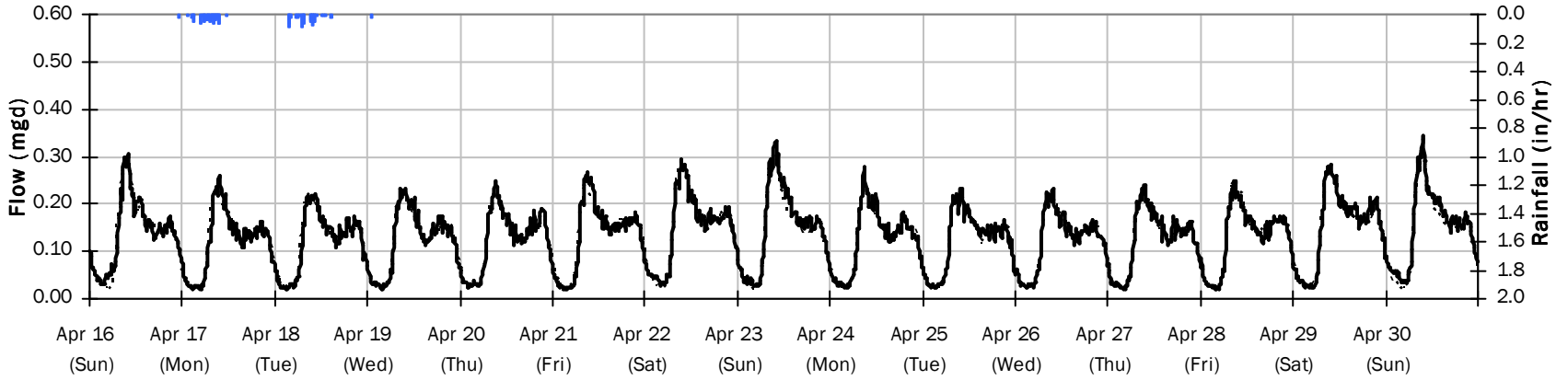


SITE 12

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.137 mgd** **Peak Flow: 0.346 mgd** **Min Flow: 0.018 mgd**

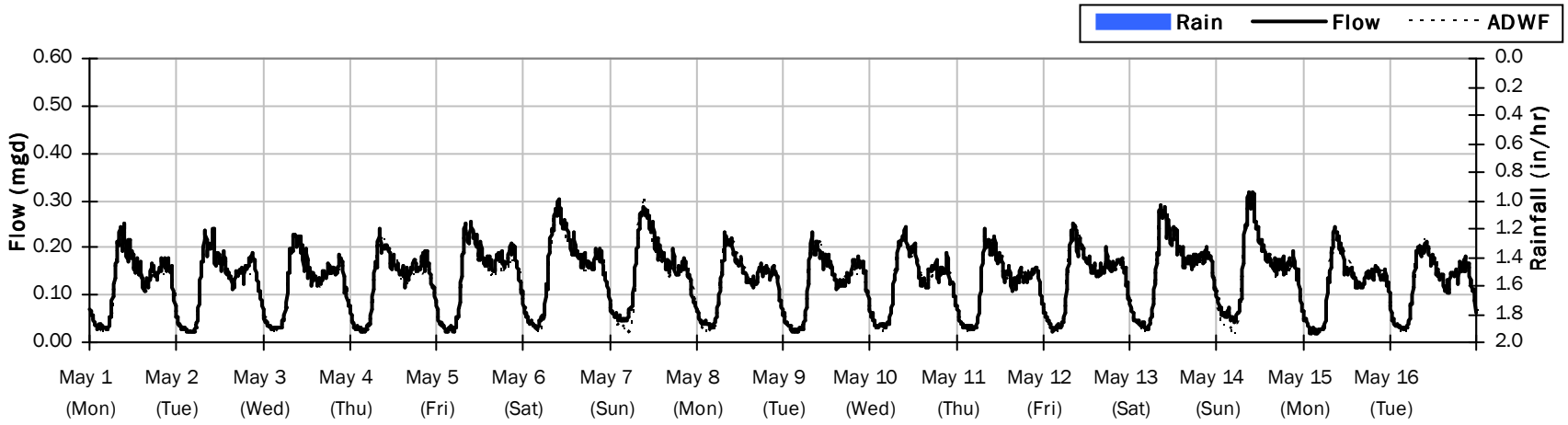


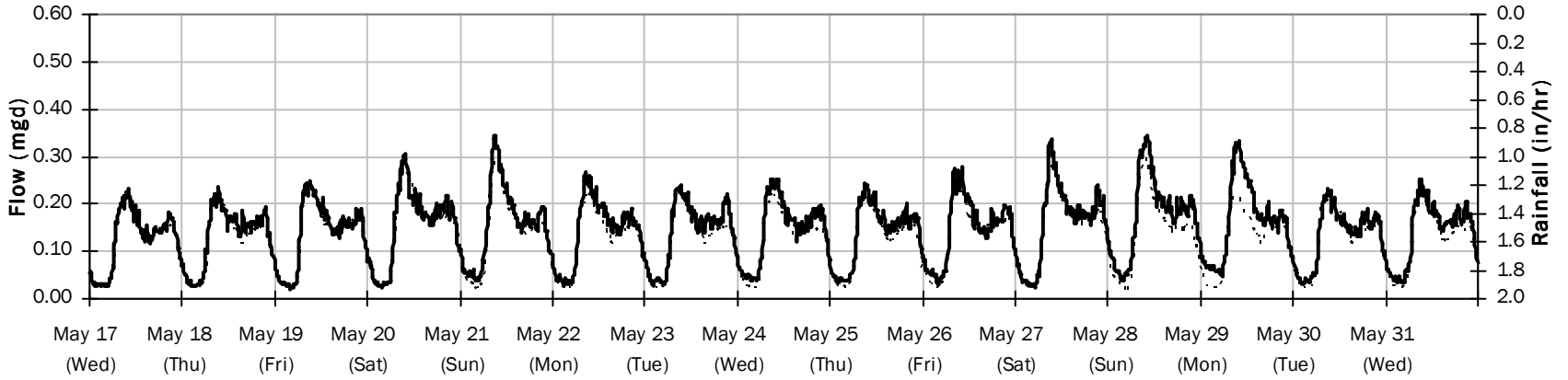


SITE 12

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.141 mgd** **Peak Flow: 0.344 mgd** **Min Flow: 0.018 mgd**

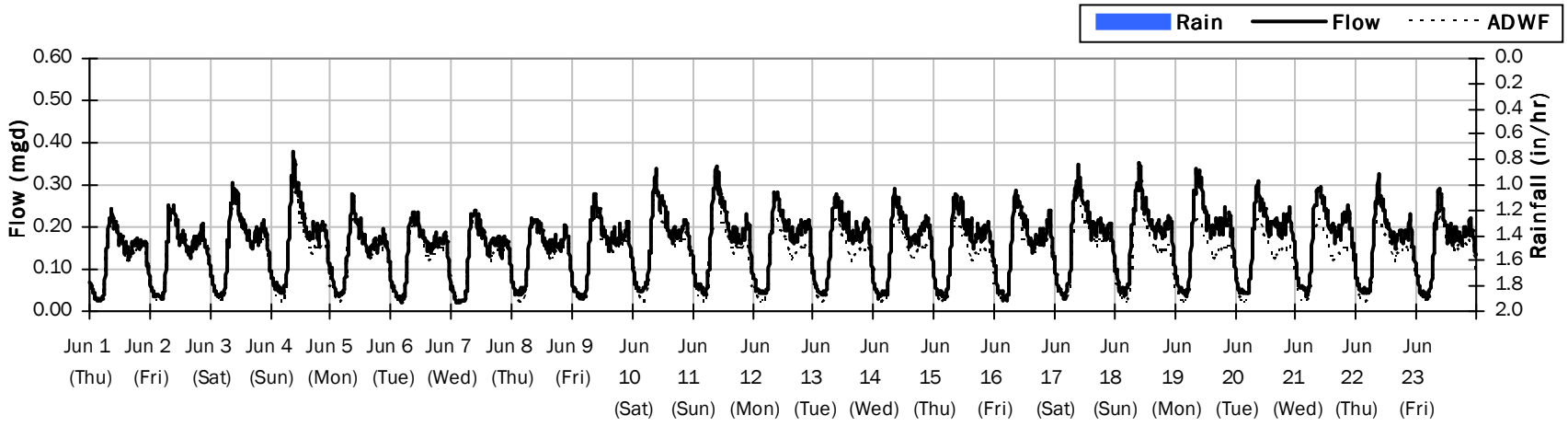


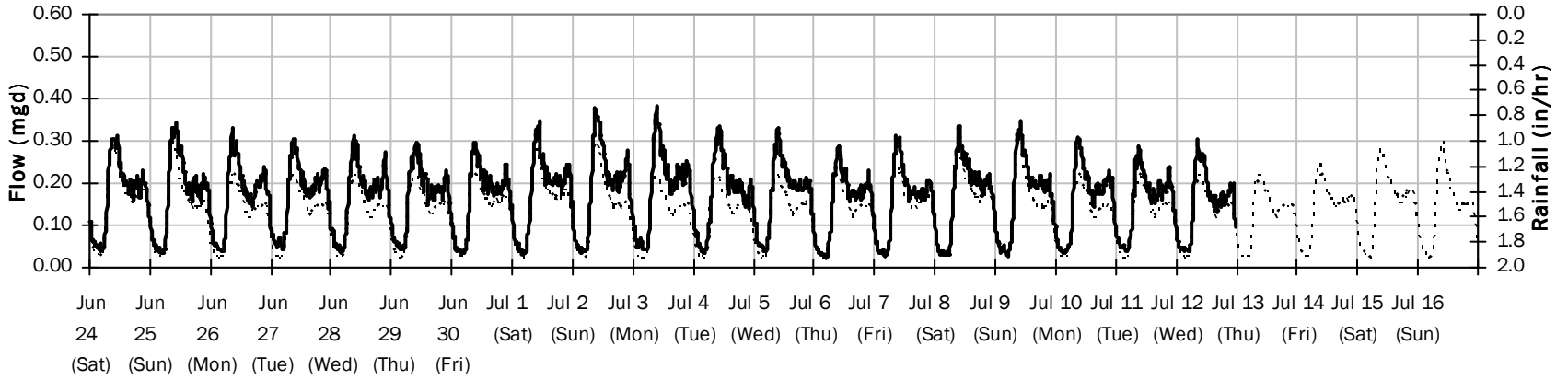


SITE 12

Flow Summary: 6/1/2017 to 7/16/2017

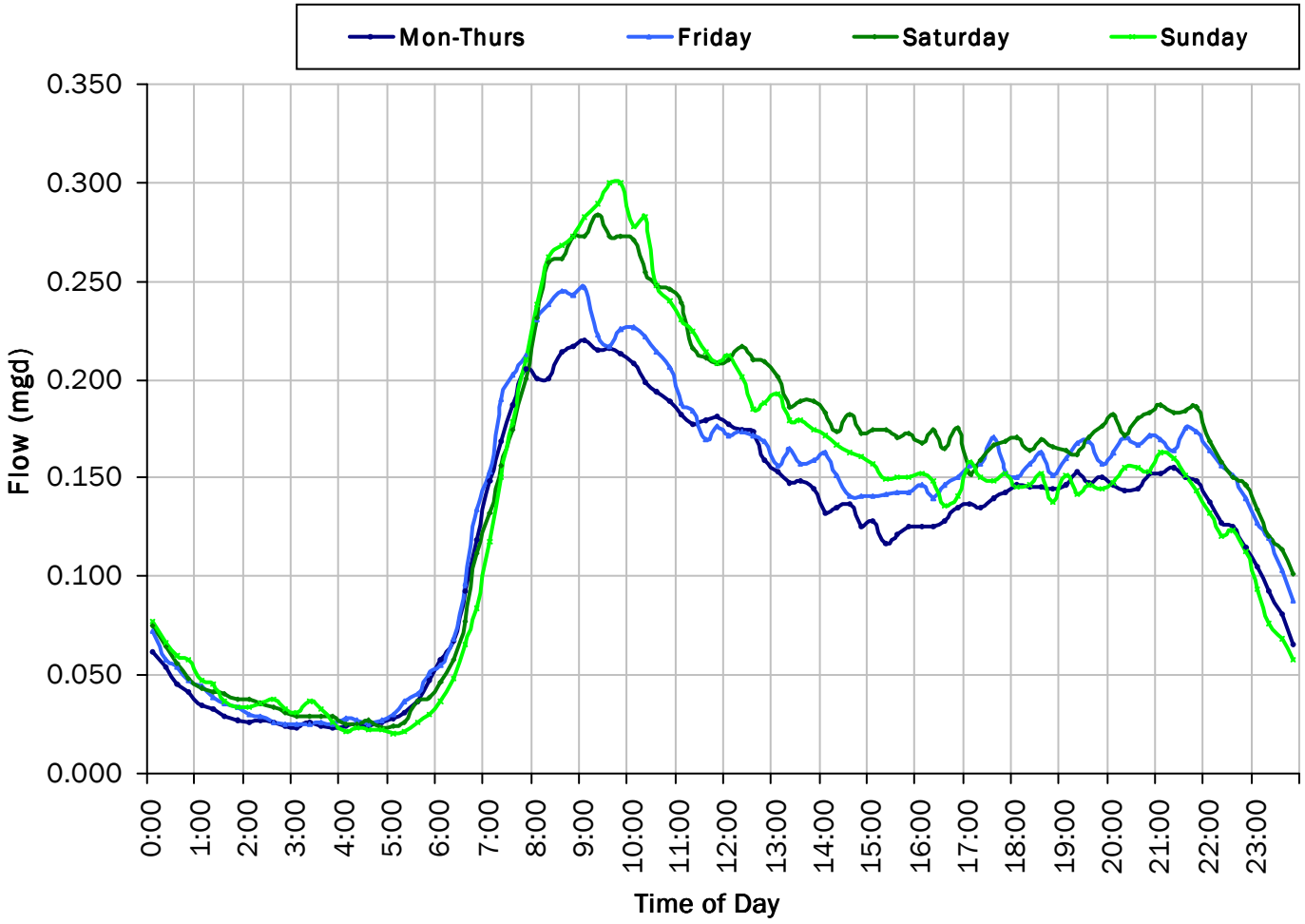
Total Period Rainfall: 0.00 inches **Avg Flow: 0.164 mgd** **Peak Flow: 0.382 mgd** **Min Flow: 0.020 mgd**





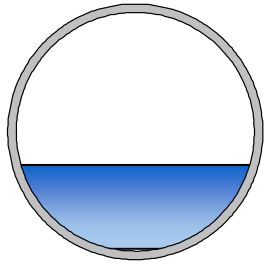
SITE 12

Average Dry Weather Flow Hydrographs



ADWF:

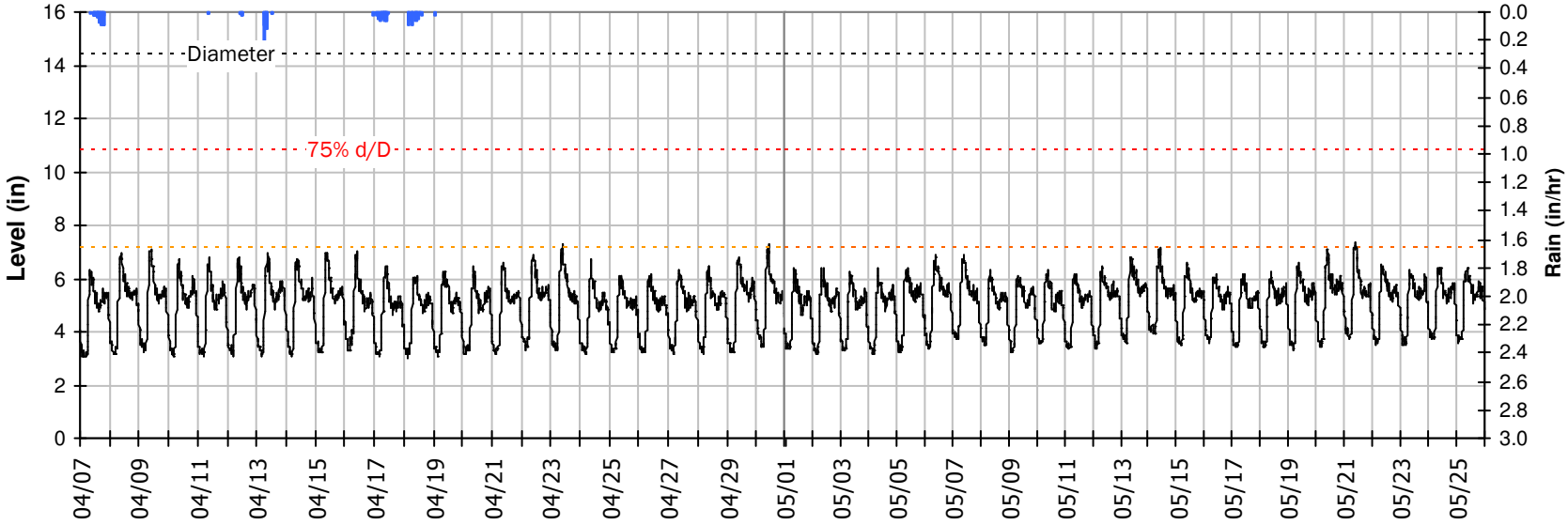
0.129 *mgd*

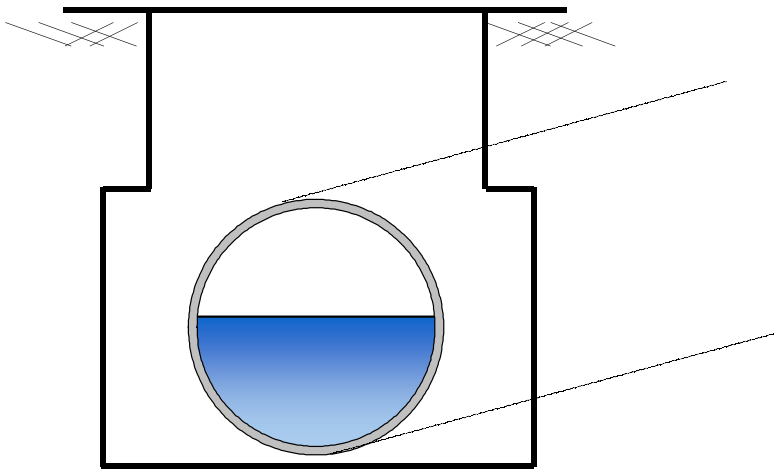


SITE 12

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



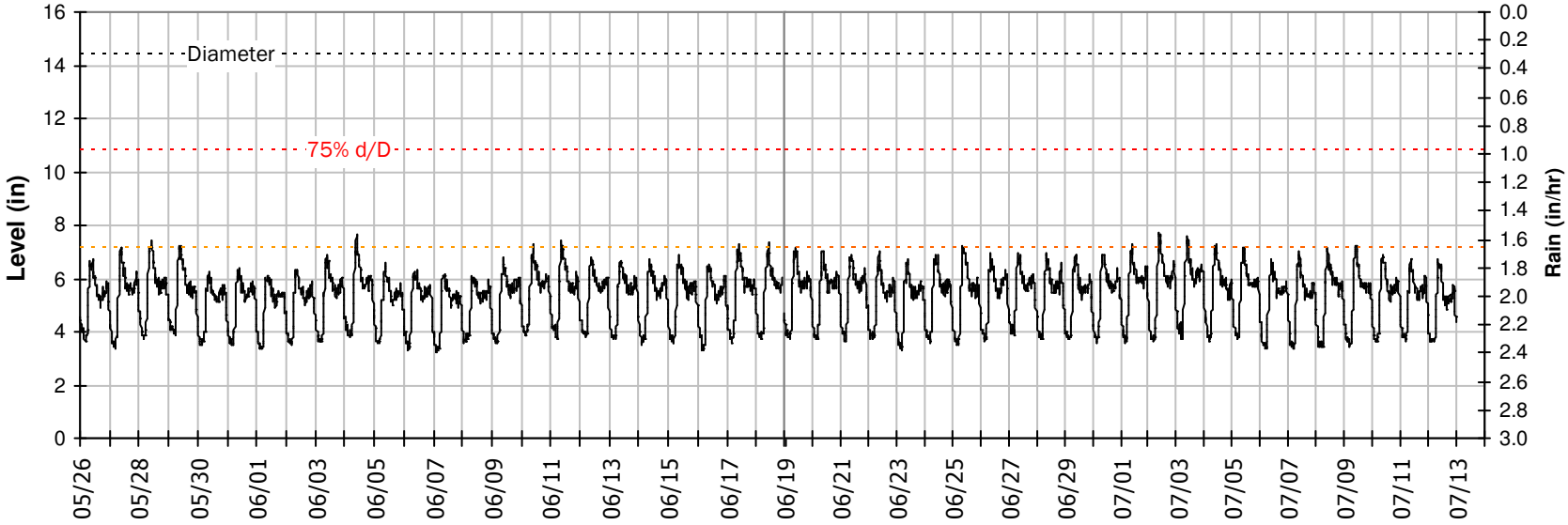


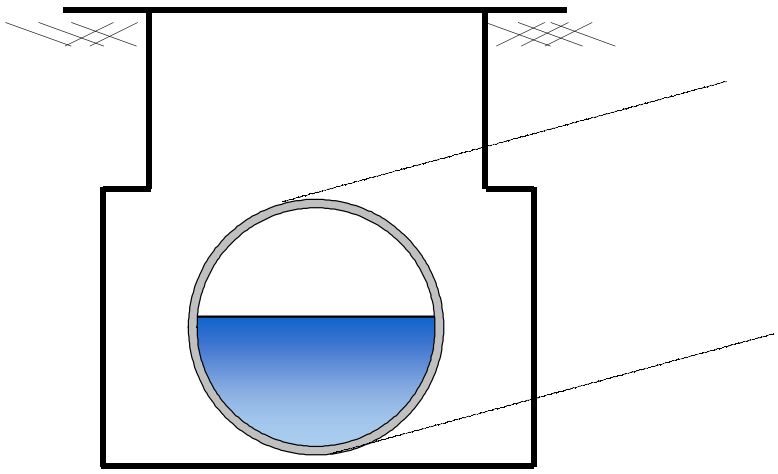
Pipe Diameter:	14.4	*inches*
Peak Measured Level:	7.73	*inches*
Peak d/D Ratio:	0.54	

SITE 12

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



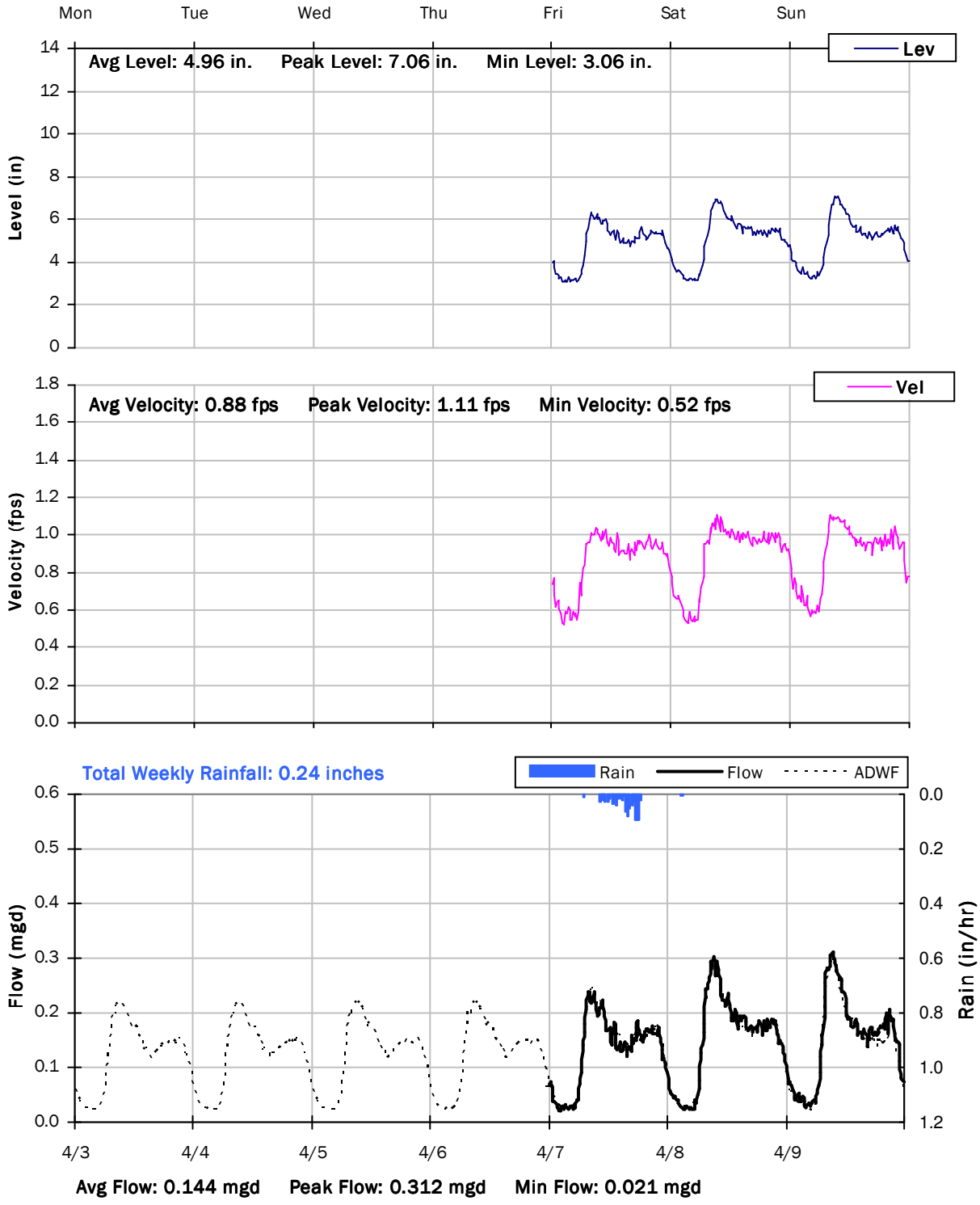


Pipe Diameter:	14.4	*inches*
Peak Measured Level:	7.73	*inches*
Peak d/D Ratio:	0.54	

SITE 12

Weekly Level, Velocity and Flow Hydrographs

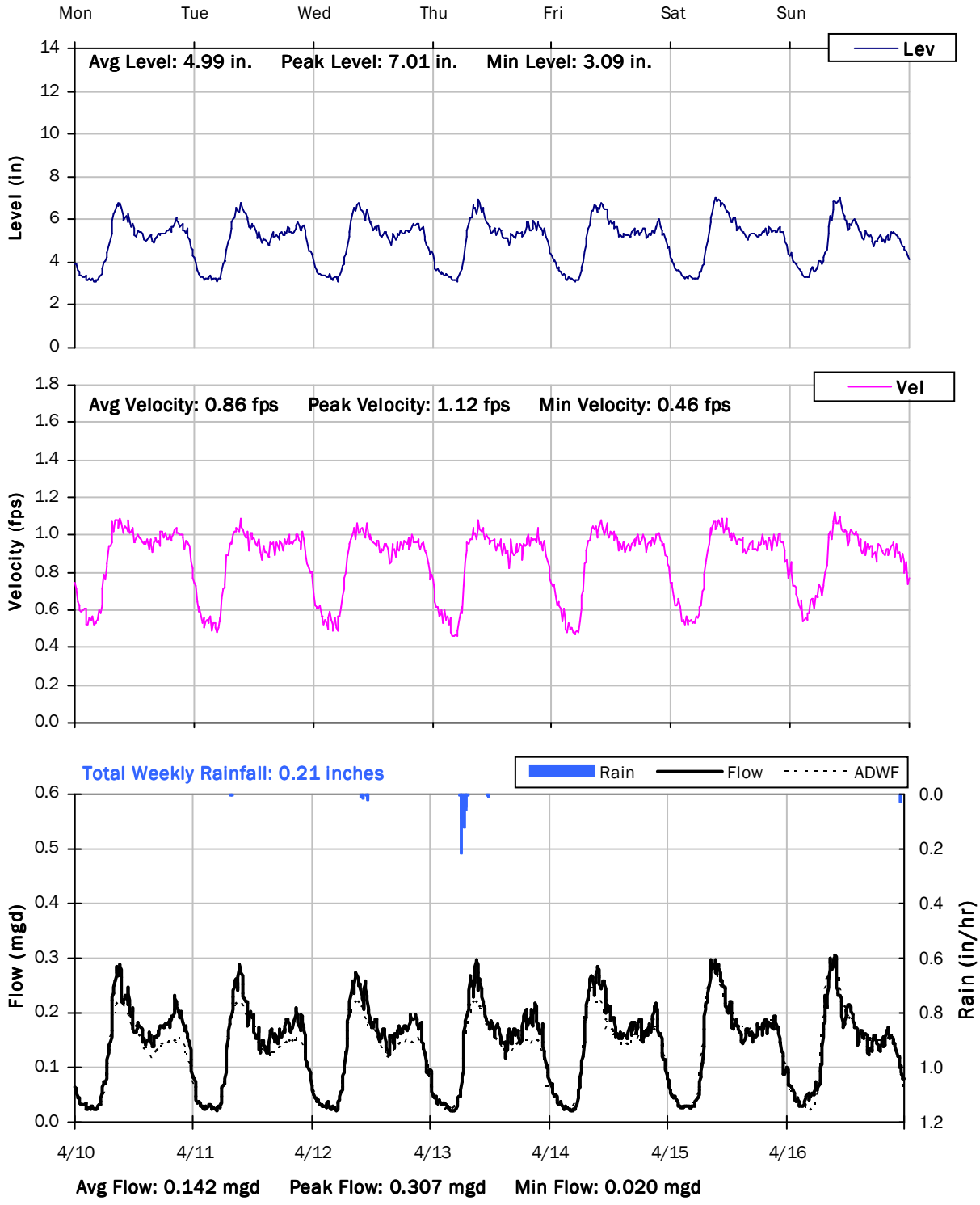
4/3/2017 to 4/10/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

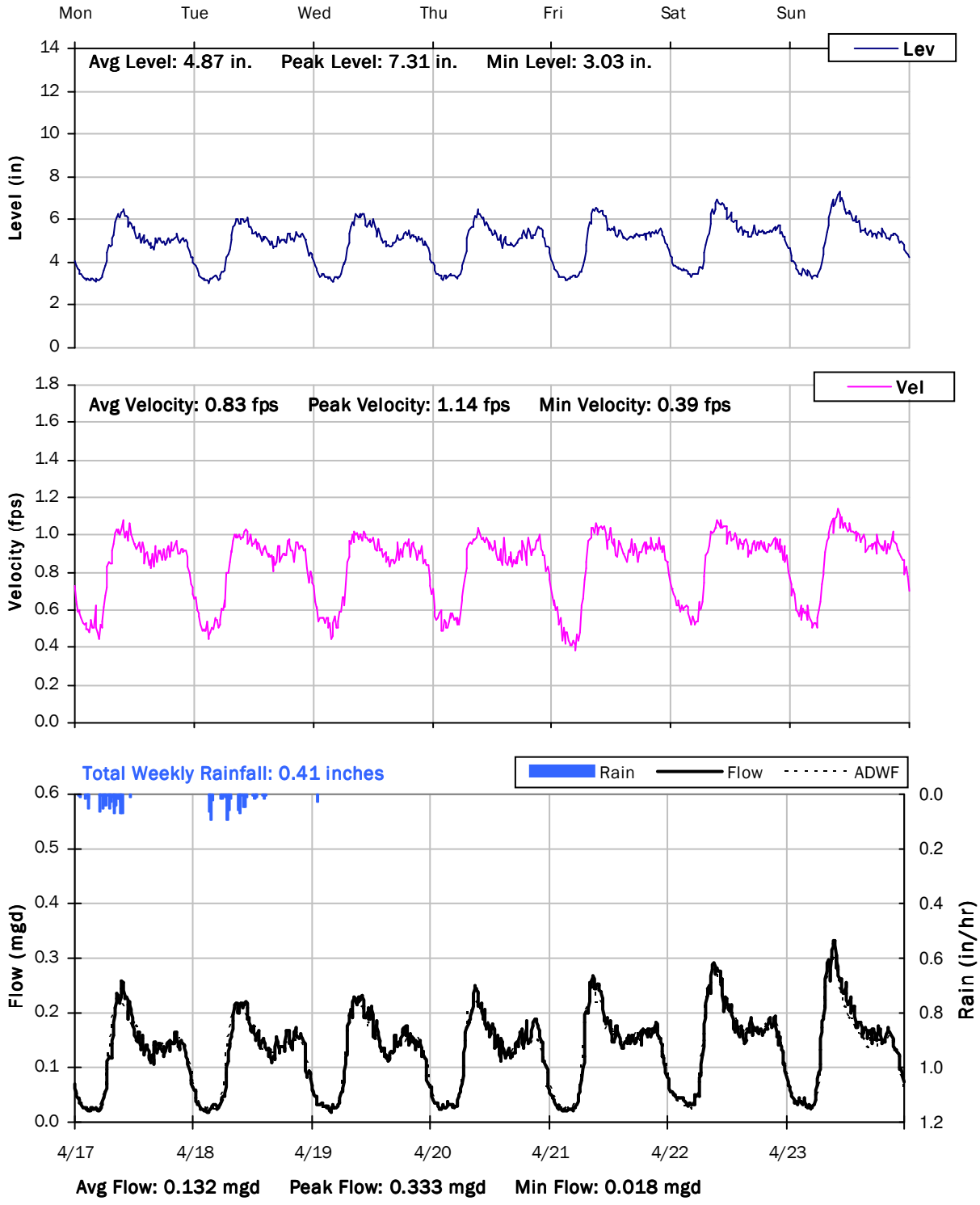
4/10/2017 to 4/17/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

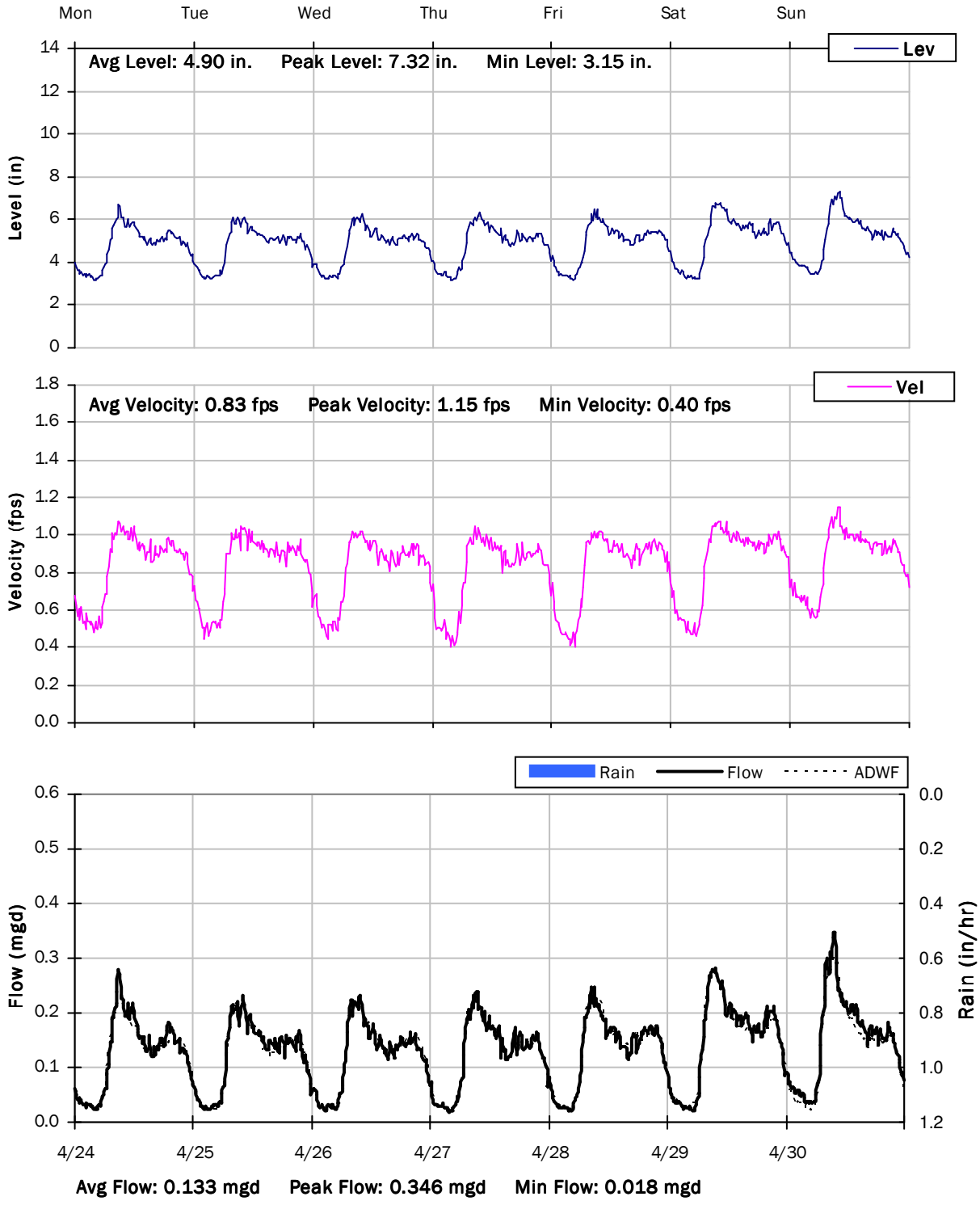
4/17/2017 to 4/24/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

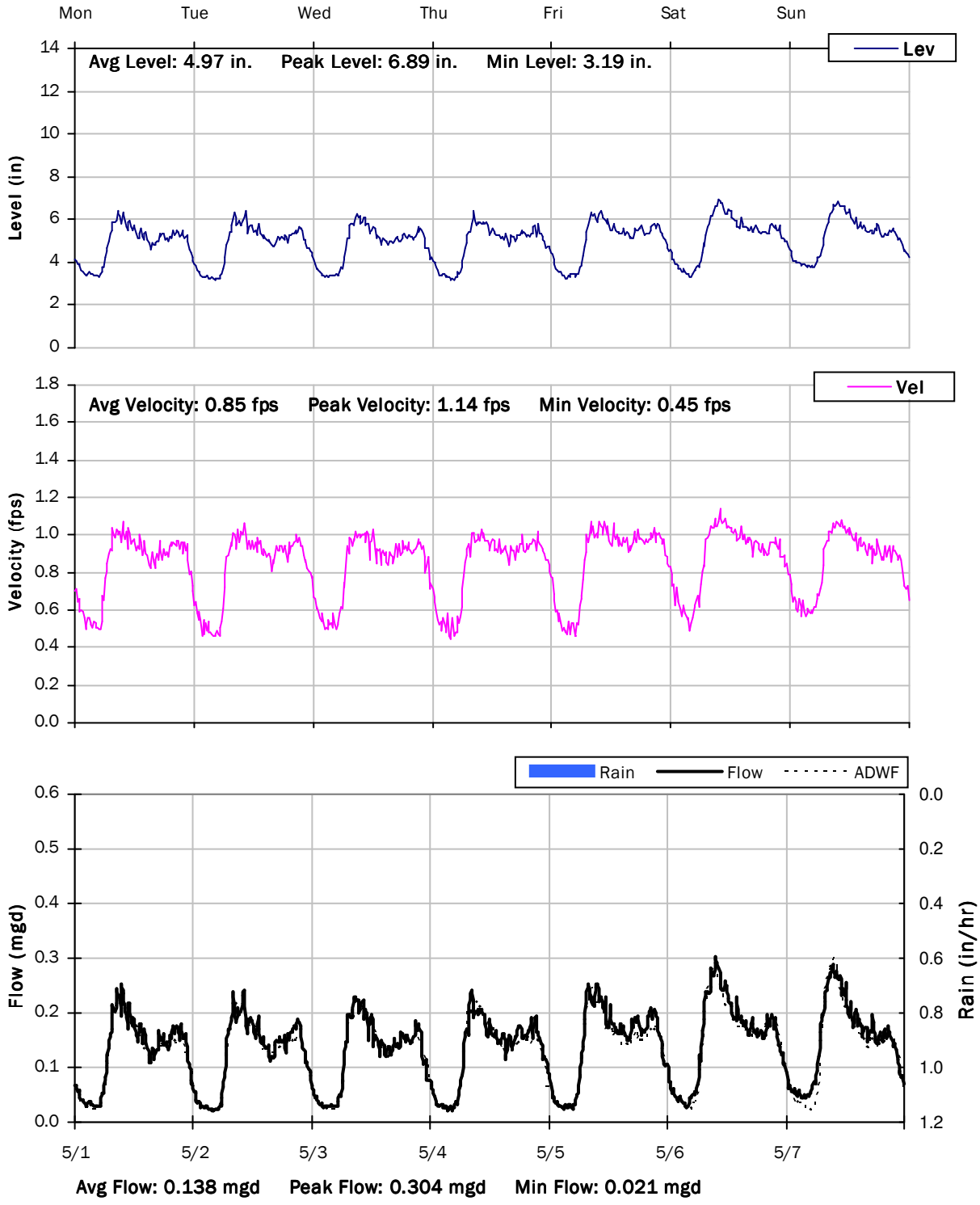
4/24/2017 to 5/1/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

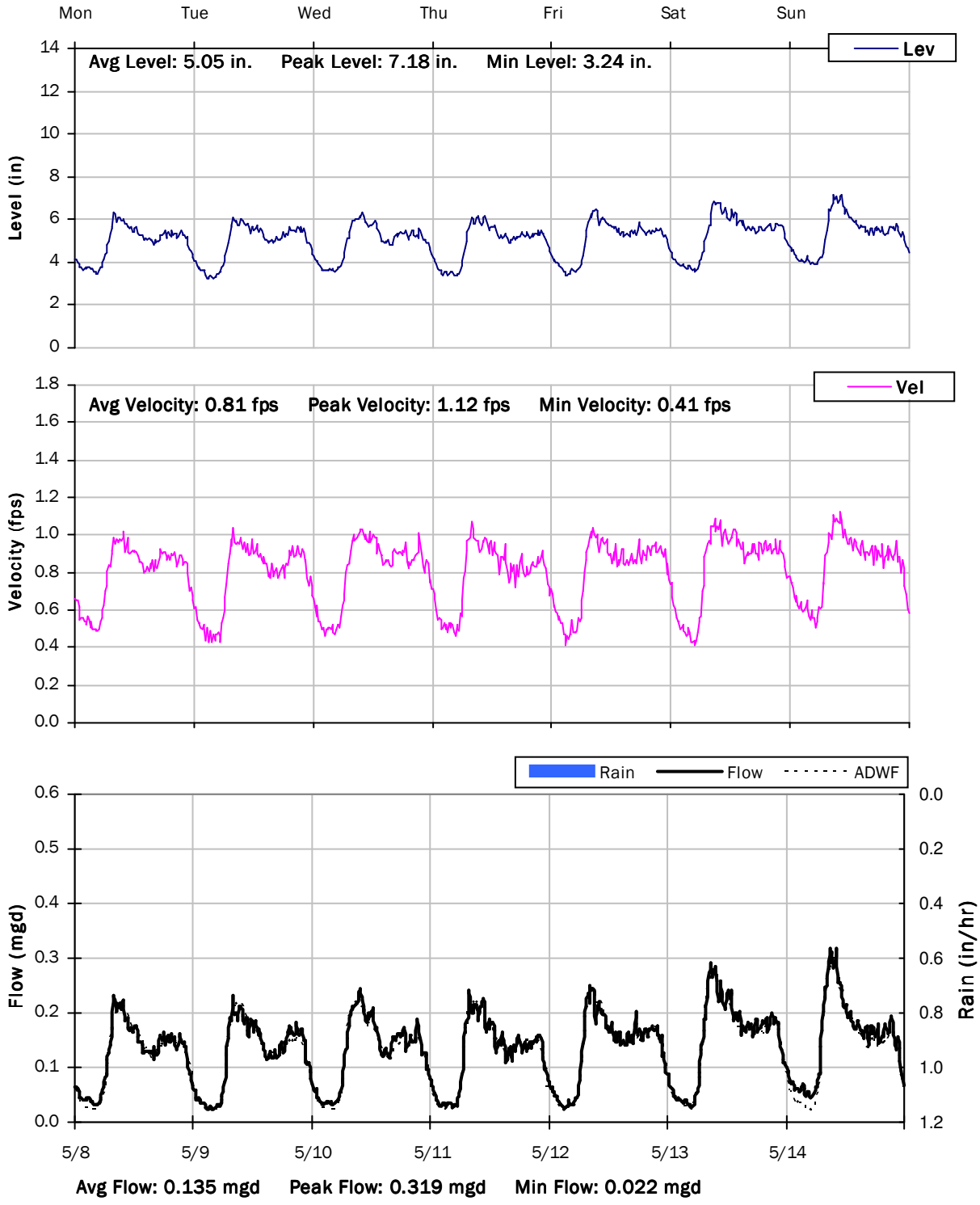
5/1/2017 to 5/8/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

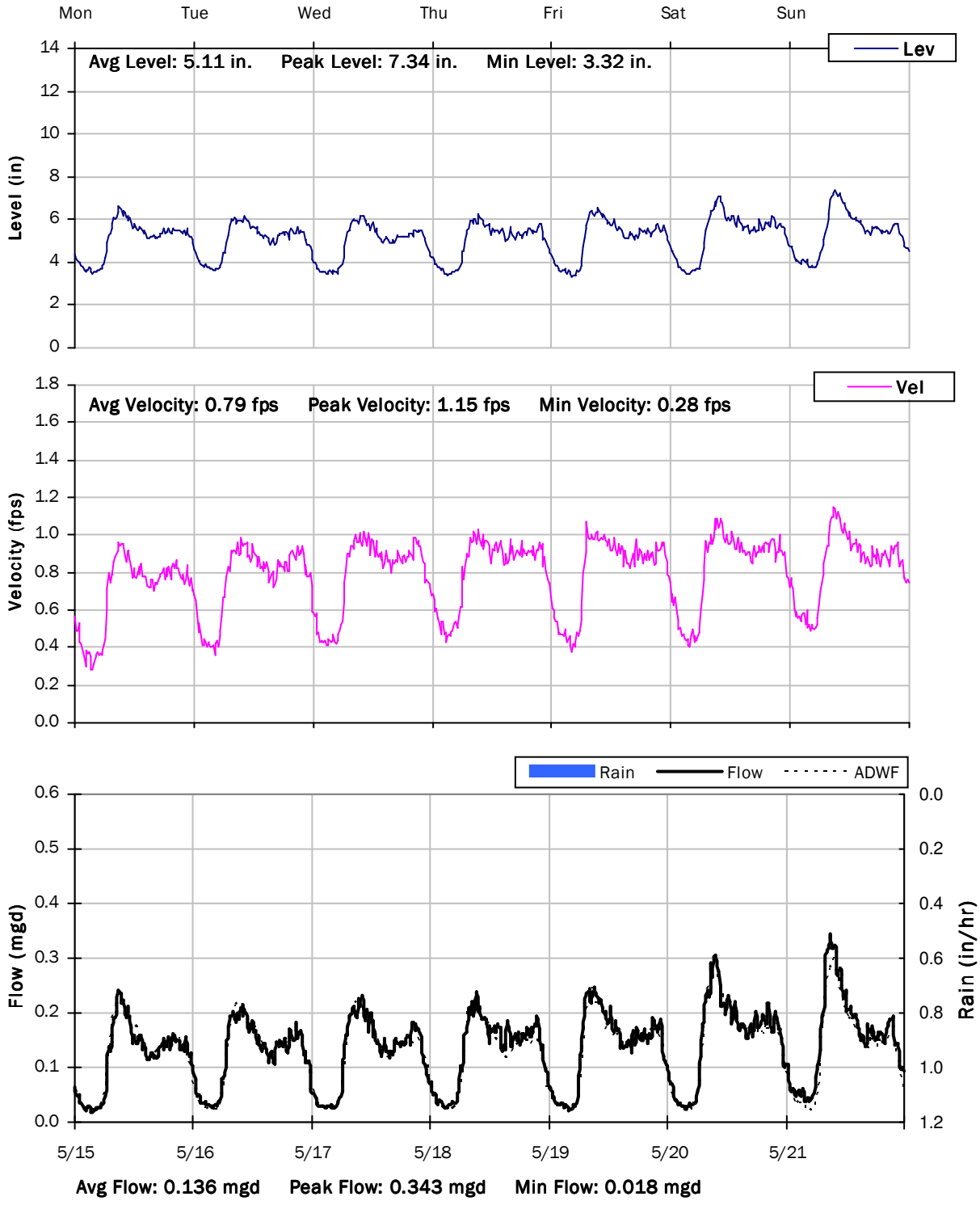
5/8/2017 to 5/15/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

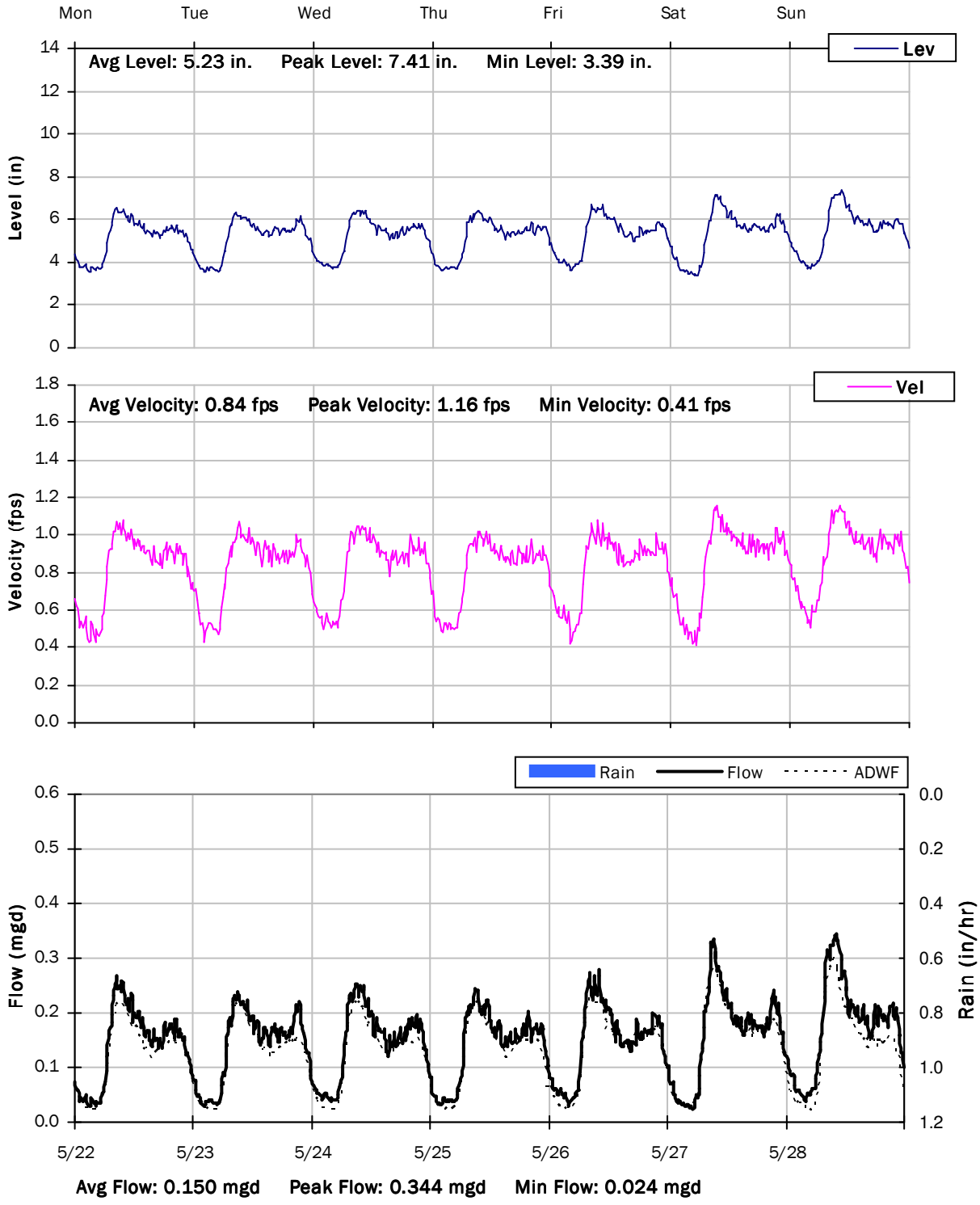
5/15/2017 to 5/22/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

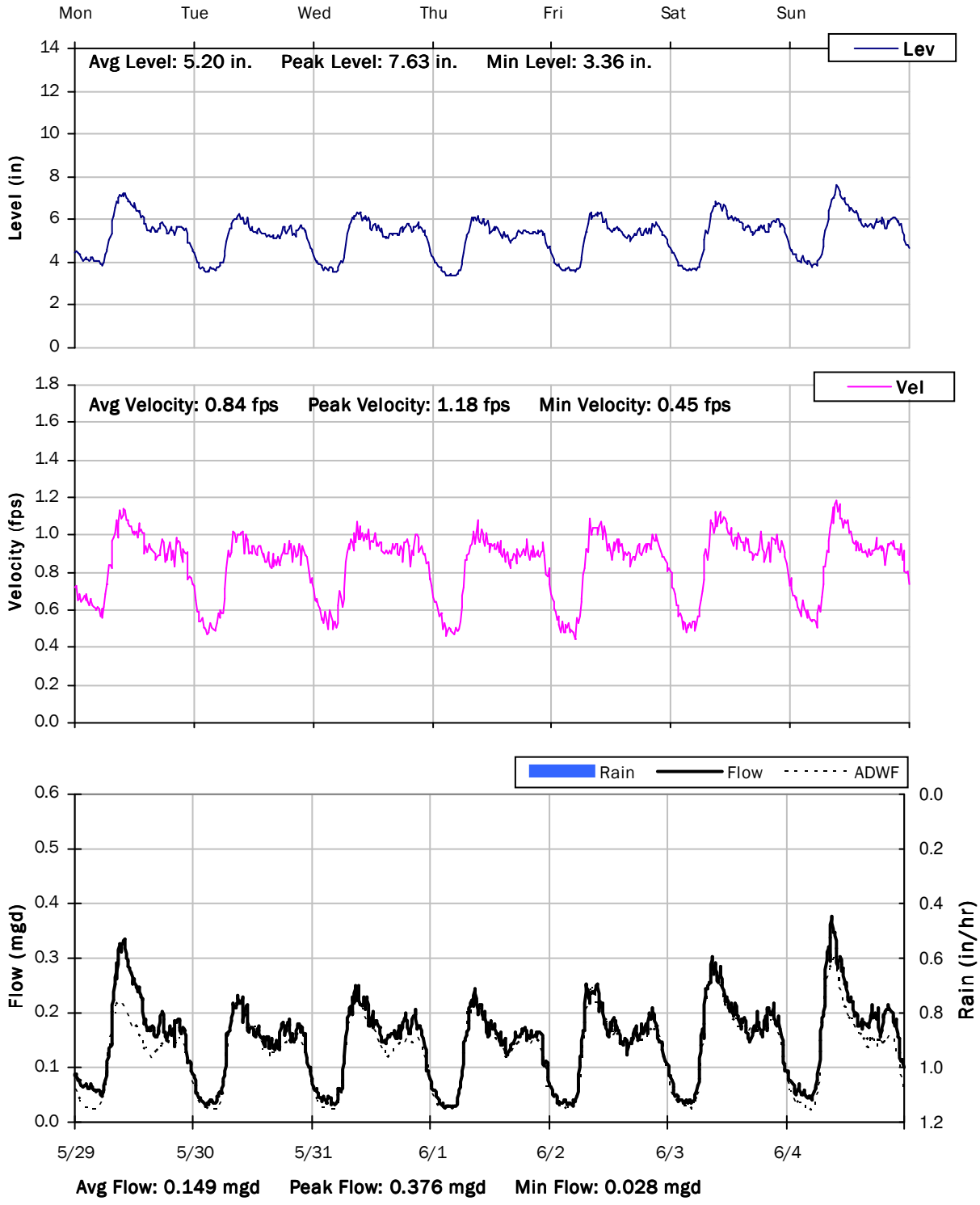
5/22/2017 to 5/29/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

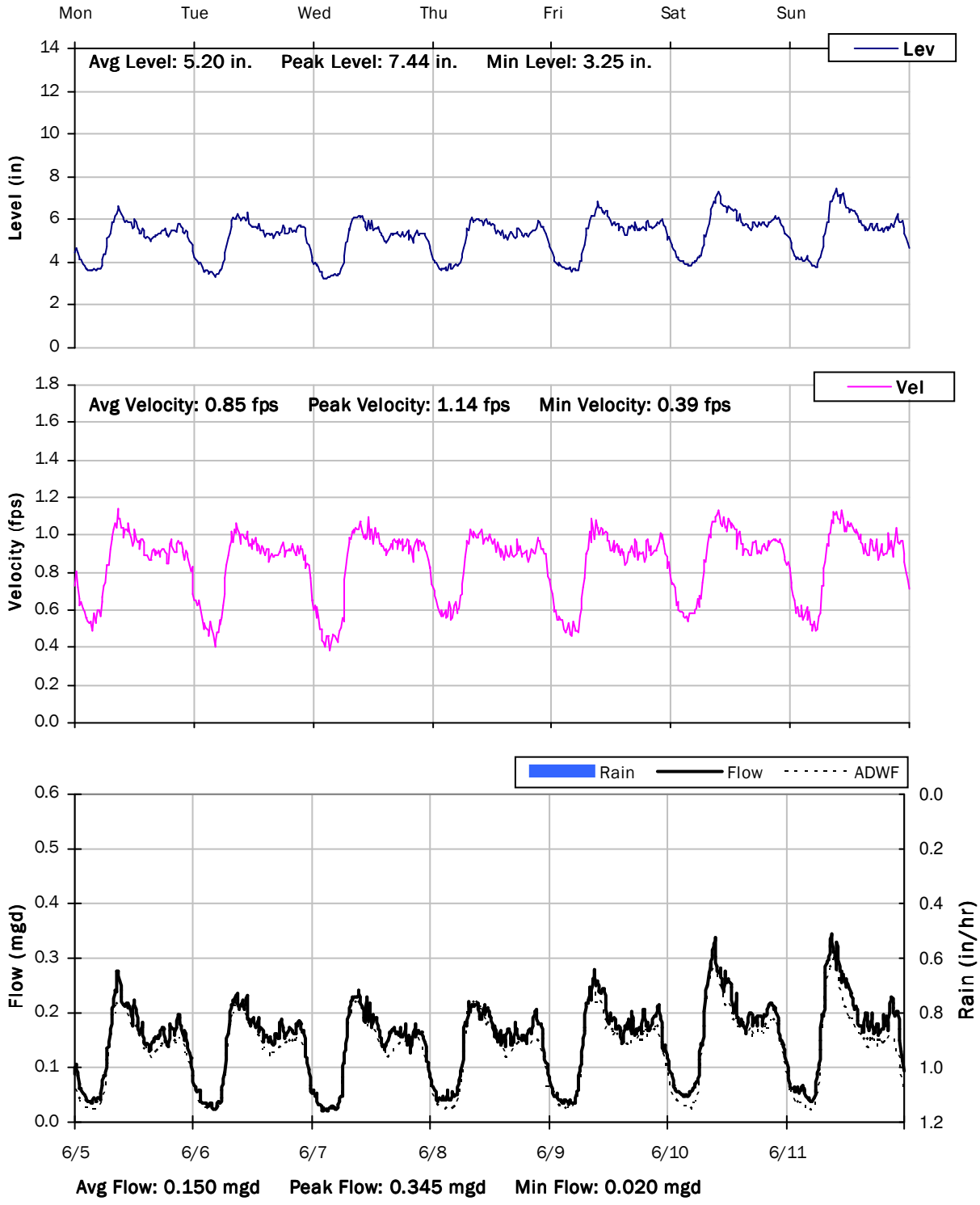
5/29/2017 to 6/5/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

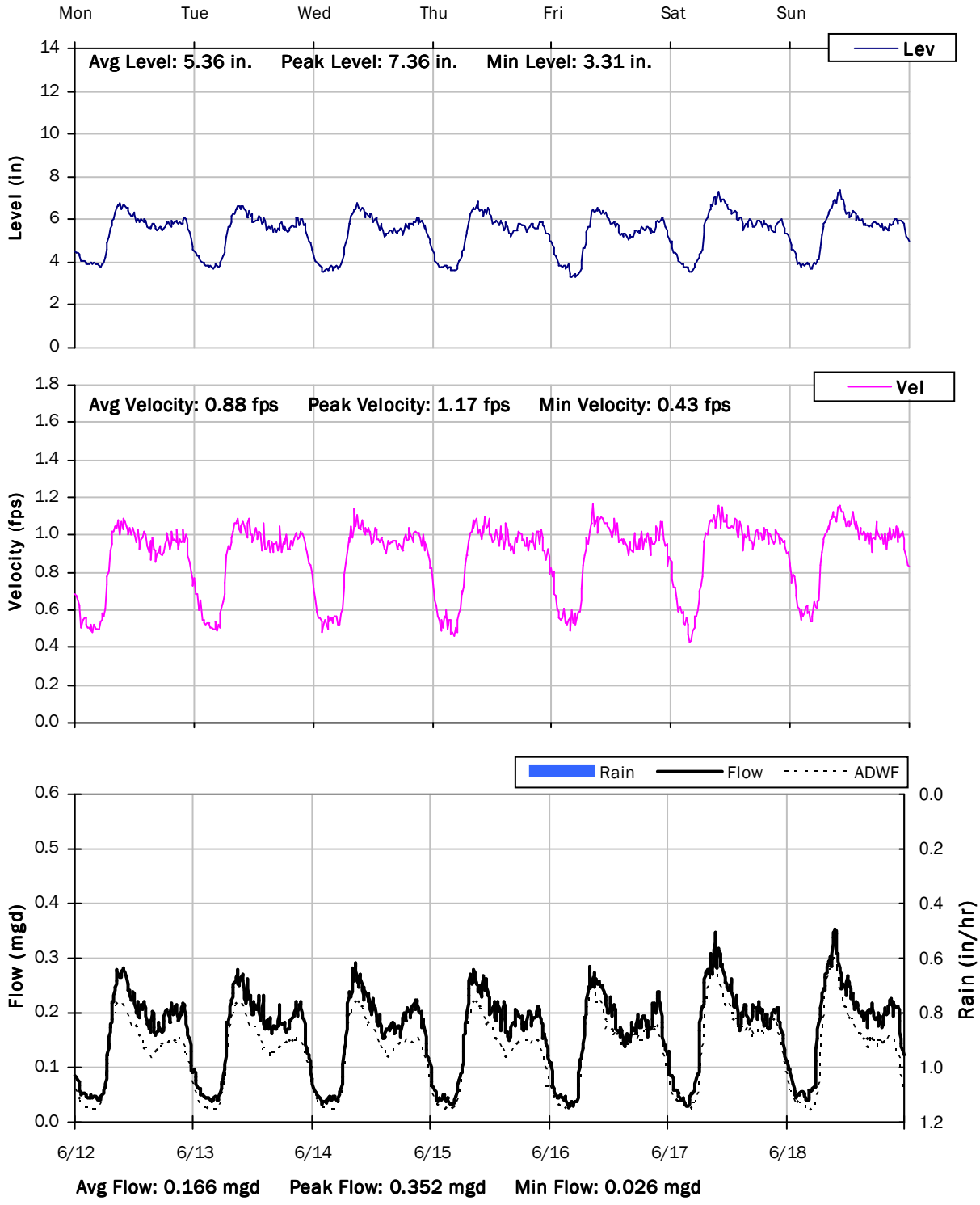
6/5/2017 to 6/12/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

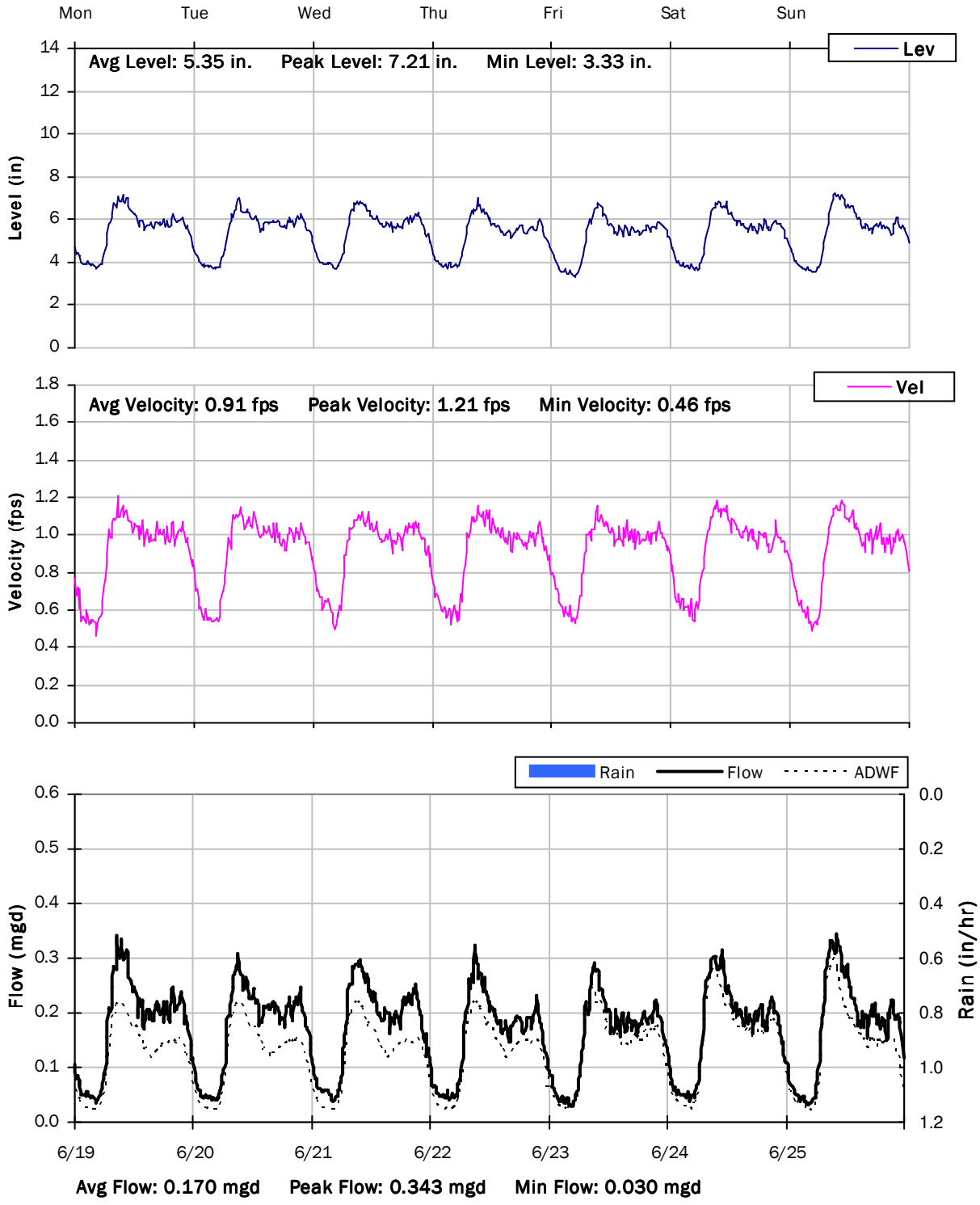
6/12/2017 to 6/19/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

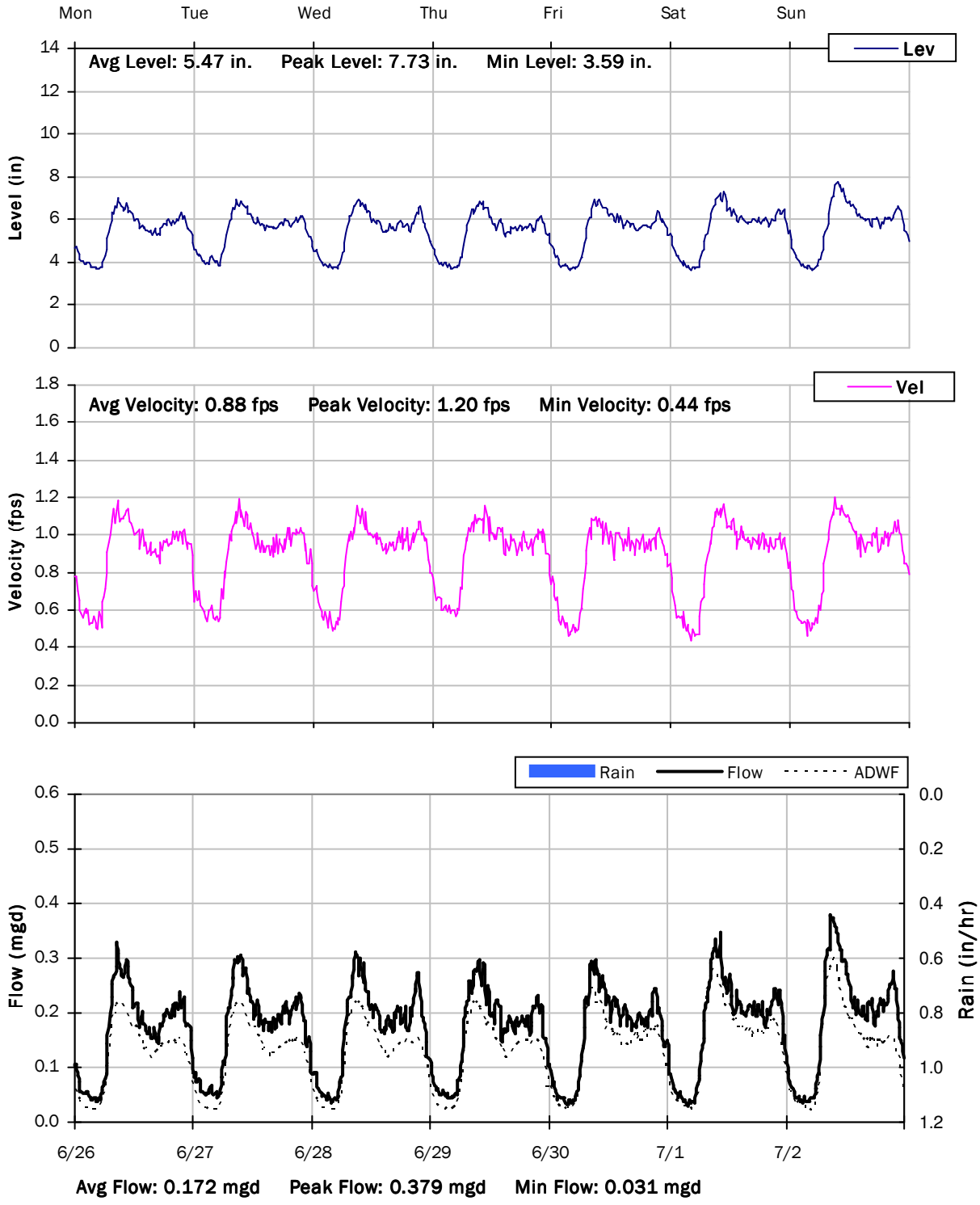
6/19/2017 to 6/26/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

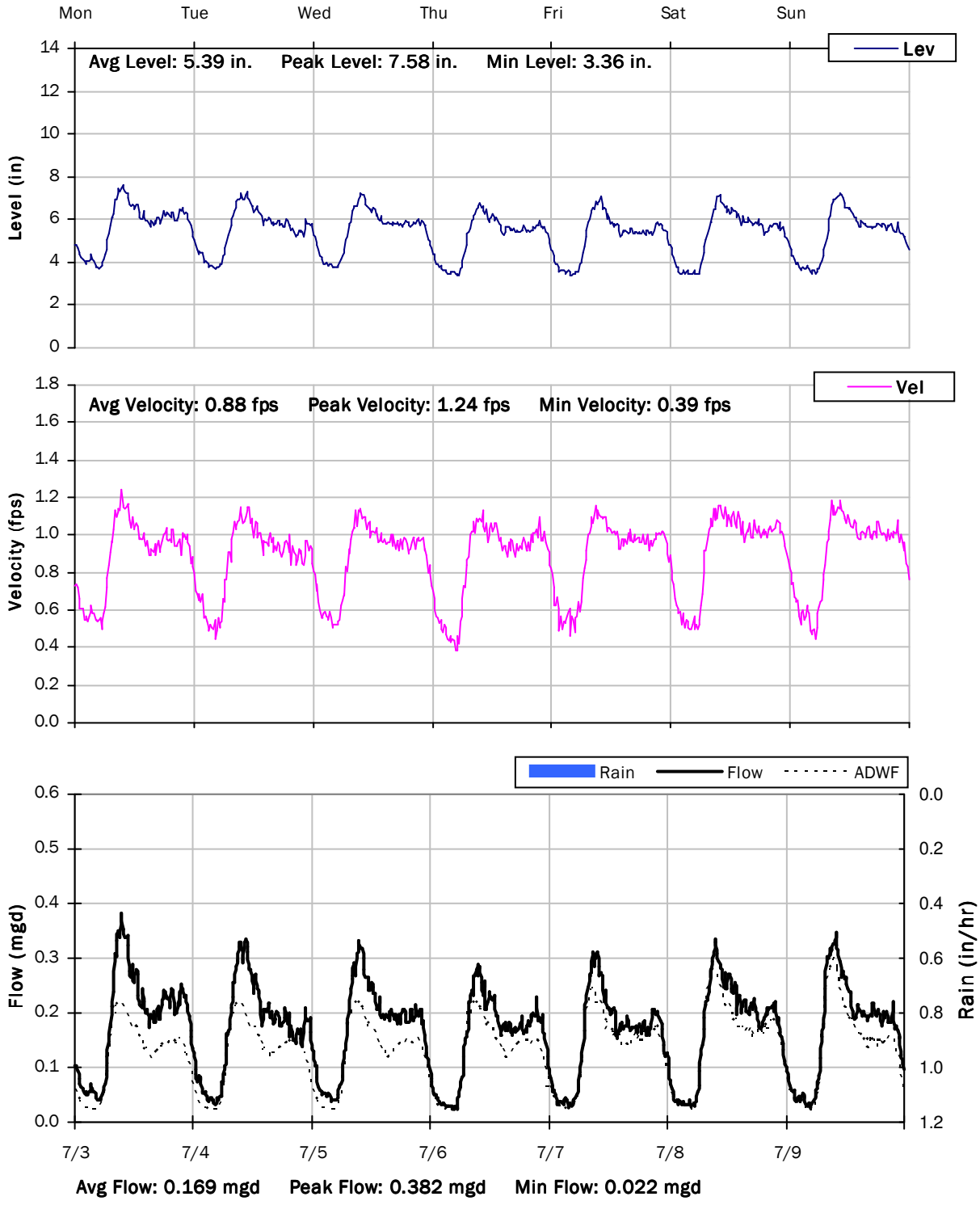
6/26/2017 to 7/3/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

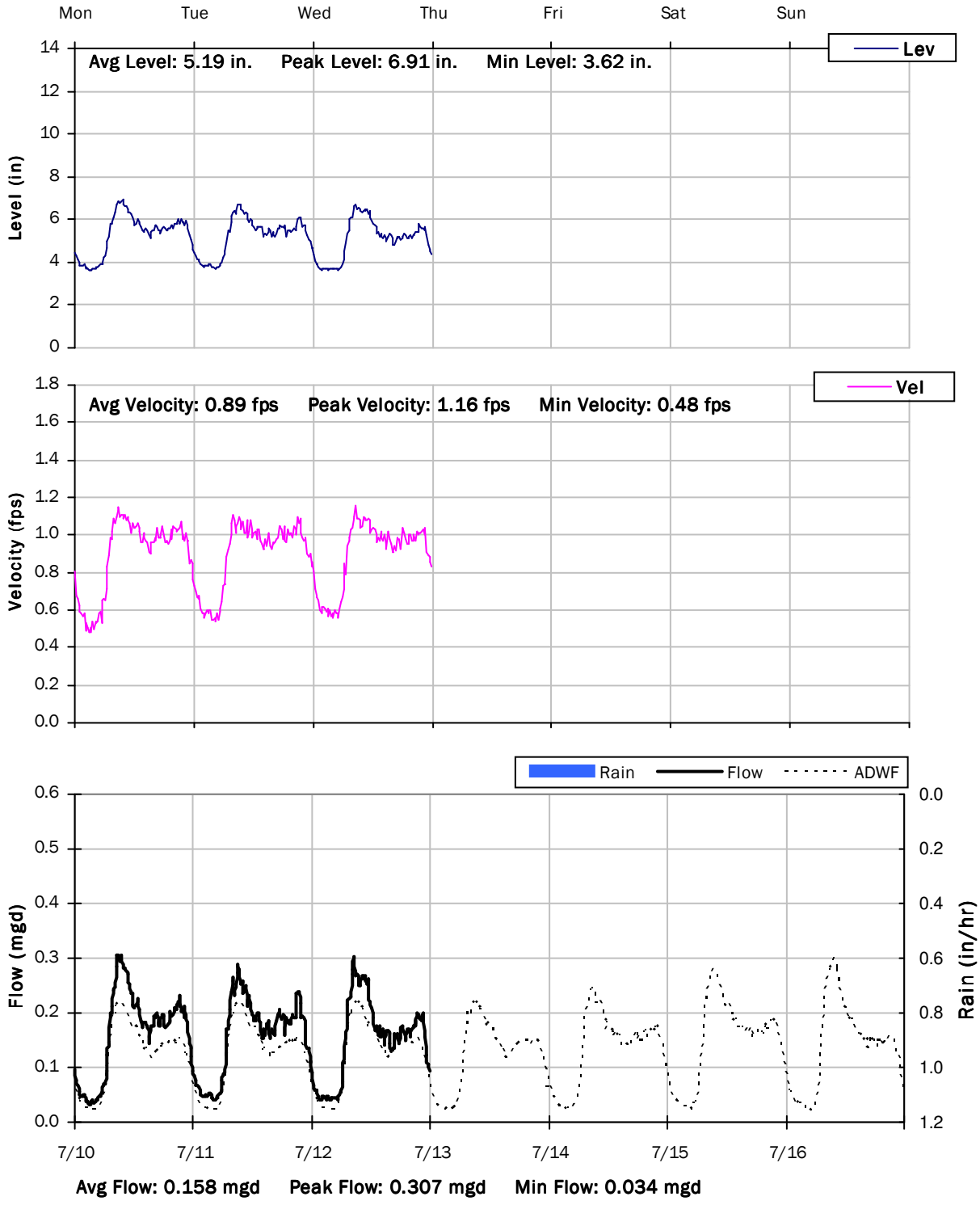
7/3/2017 to 7/10/2017



SITE 12

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

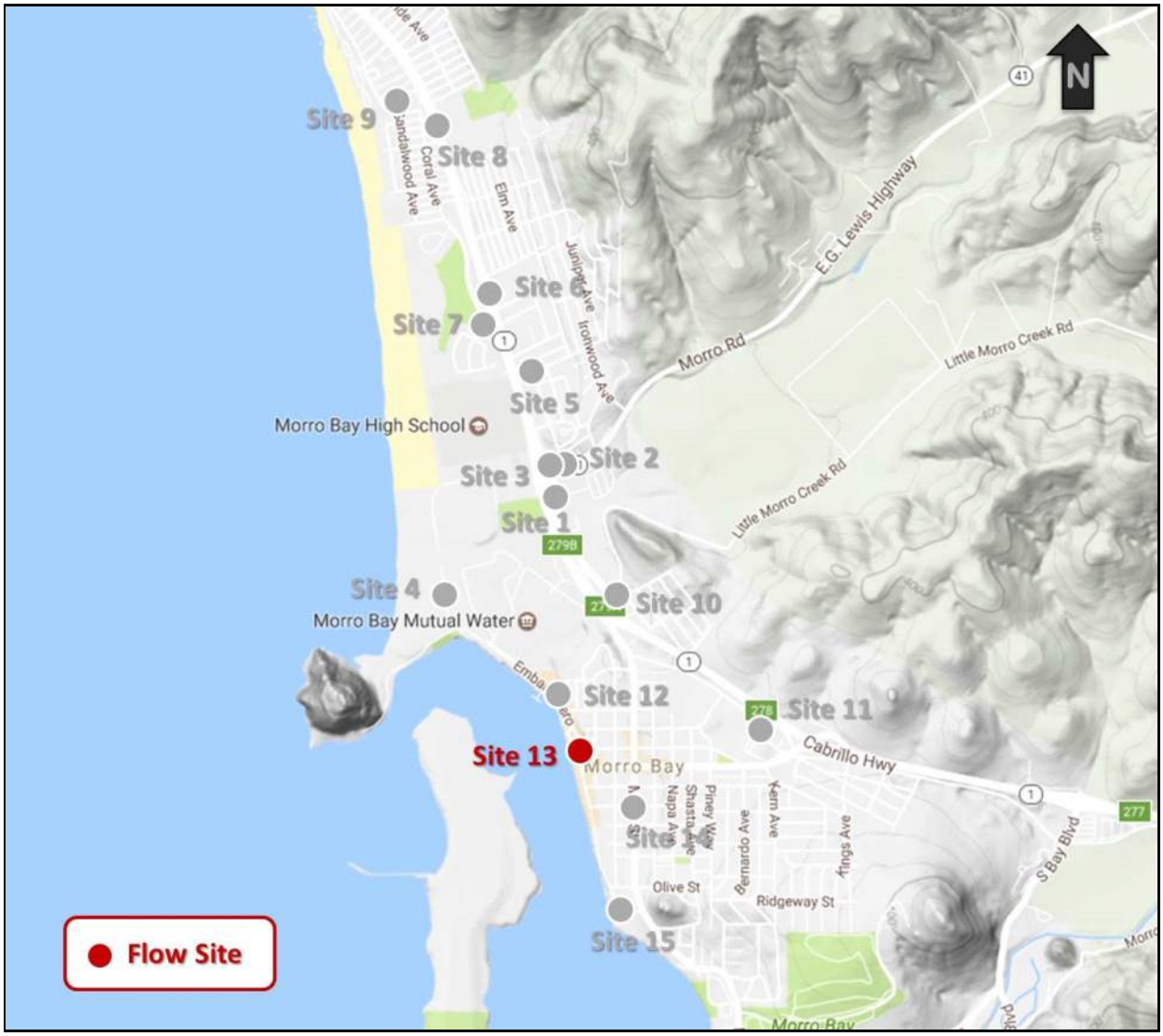
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 13

Location: Sidewalk of 910 Embarcadero, meter on south 15.5" inlet

Data Summary Report



Vicinity Map: Site 13

SITE 13

Site Information

Location: Sidewalk of 910 Embarcadero, meter on south 15.5" inlet

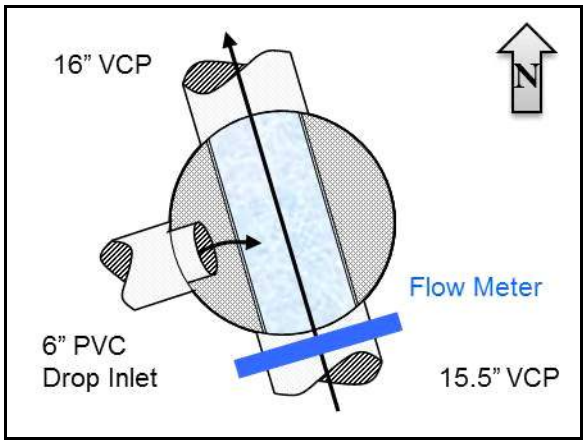


Pipe Diameter: 15.5 inches

ADWF: 0.093 mgd

Peak Measured Flow: 0.306 mgd









SITE 13

Additional Site Photos





SITE 13

Additional Site Photos

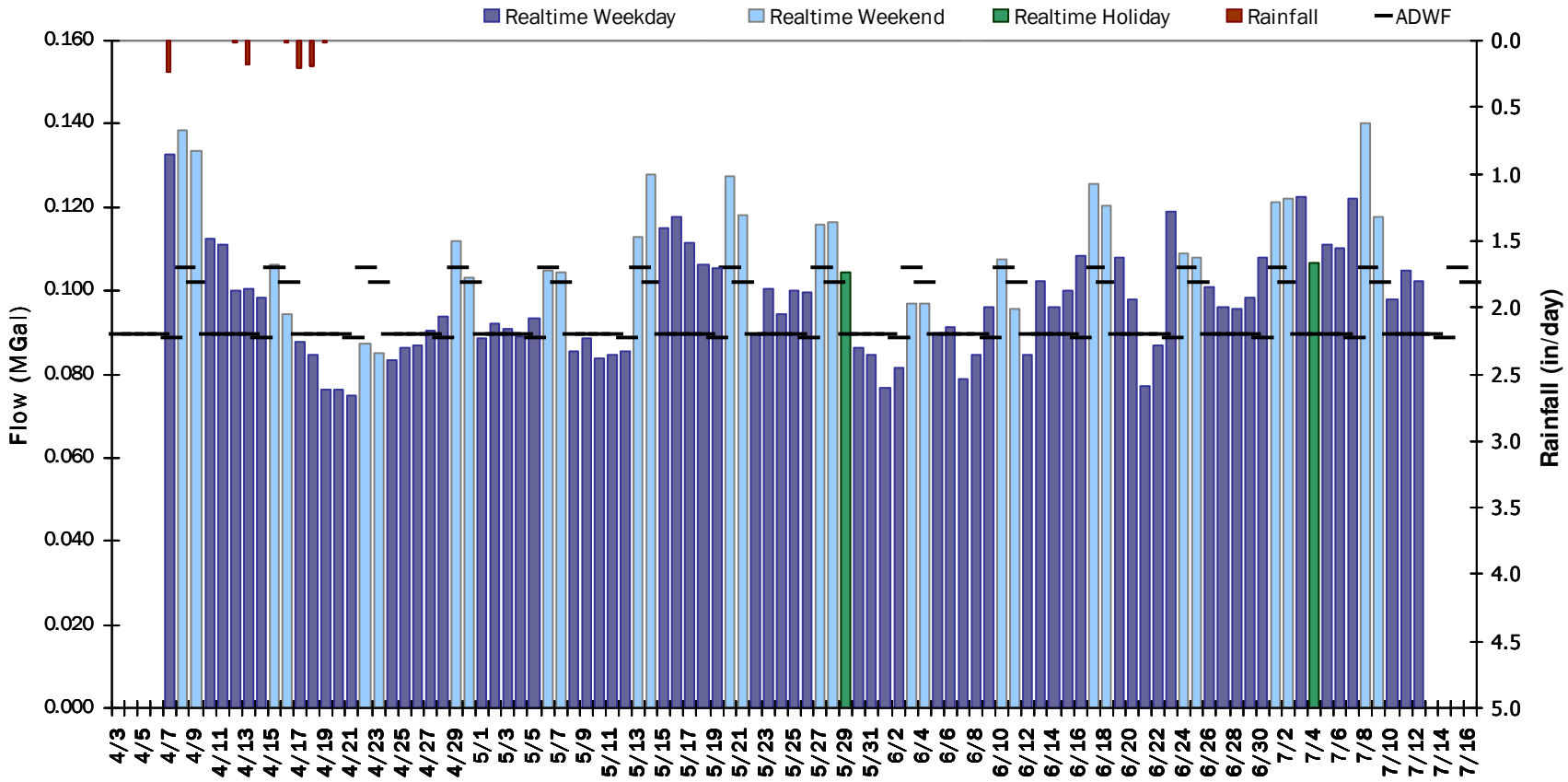


SITE 13

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.101 MGal Peak Daily Flow: 0.140 MGal Min Daily Flow: 0.075 MGal

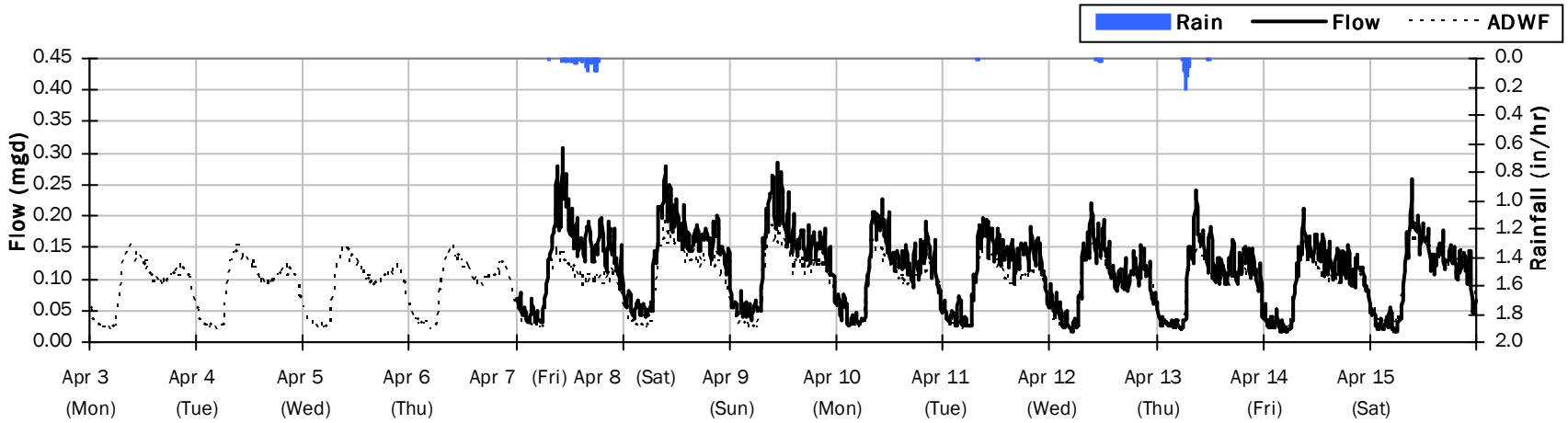
Total Period Rainfall: 0.85 inches

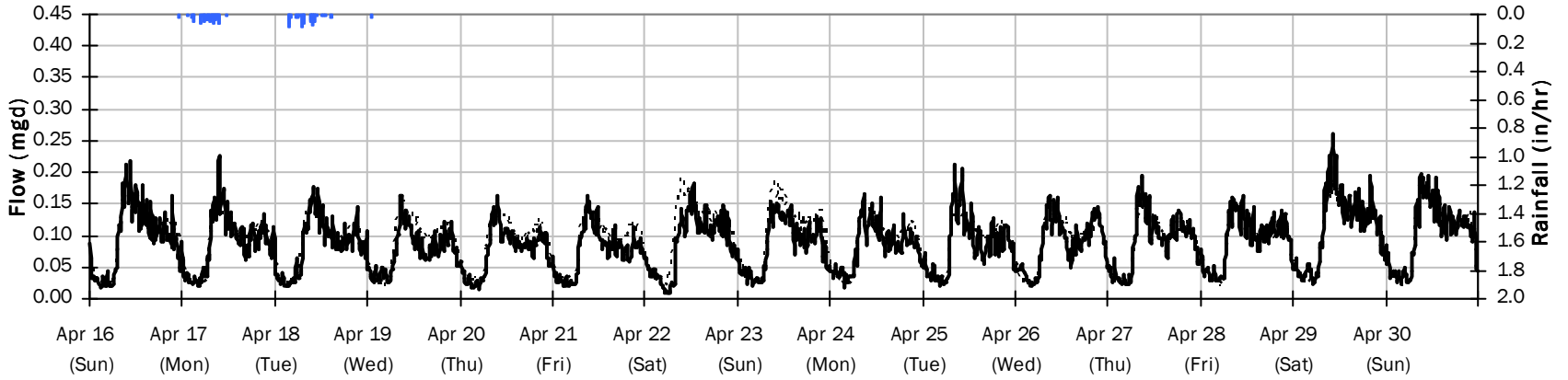


SITE 13

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.098 mgd** **Peak Flow: 0.306 mgd** **Min Flow: 0.008 mgd**

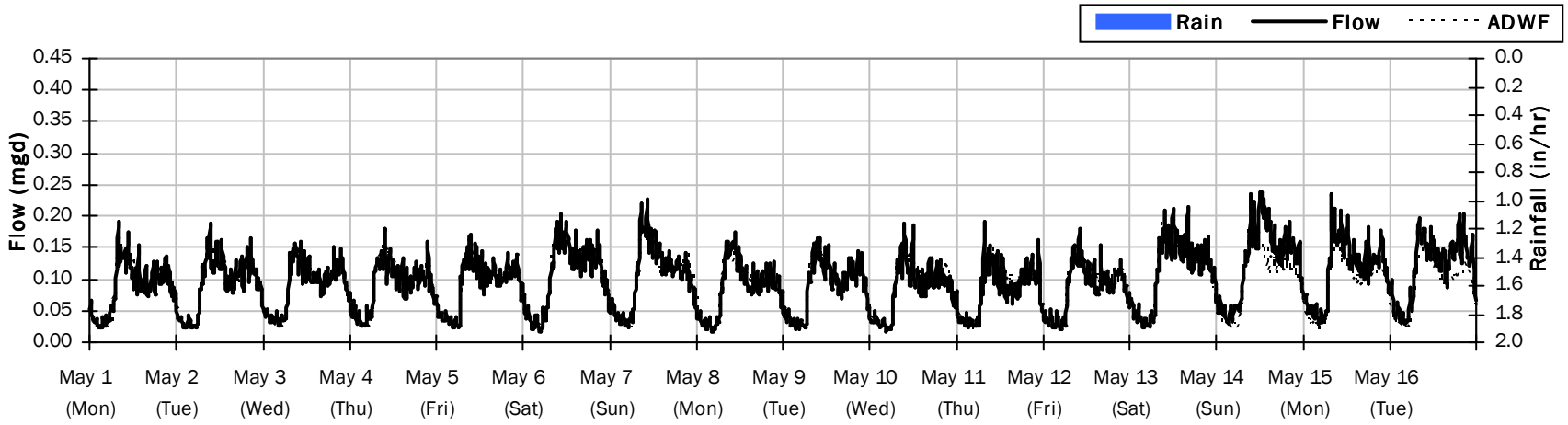


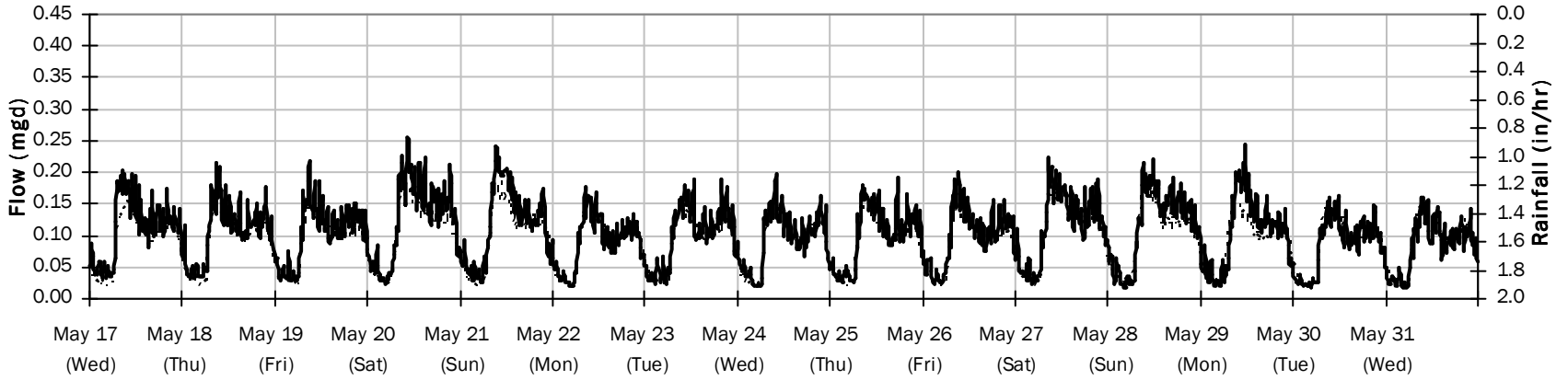


SITE 13

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.101 mgd** **Peak Flow: 0.255 mgd** **Min Flow: 0.016 mgd**

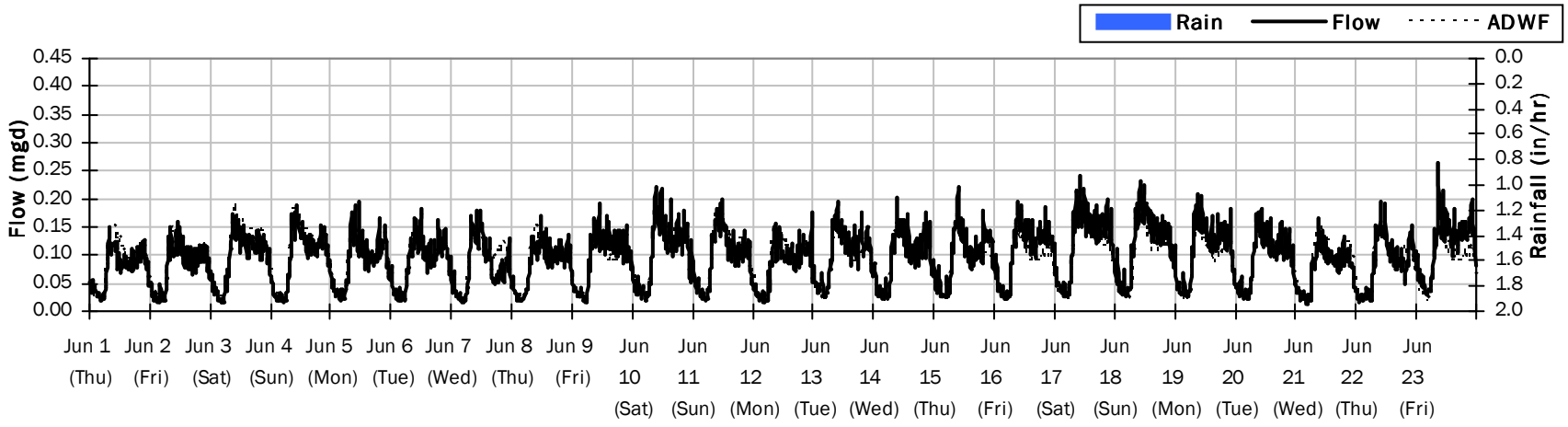


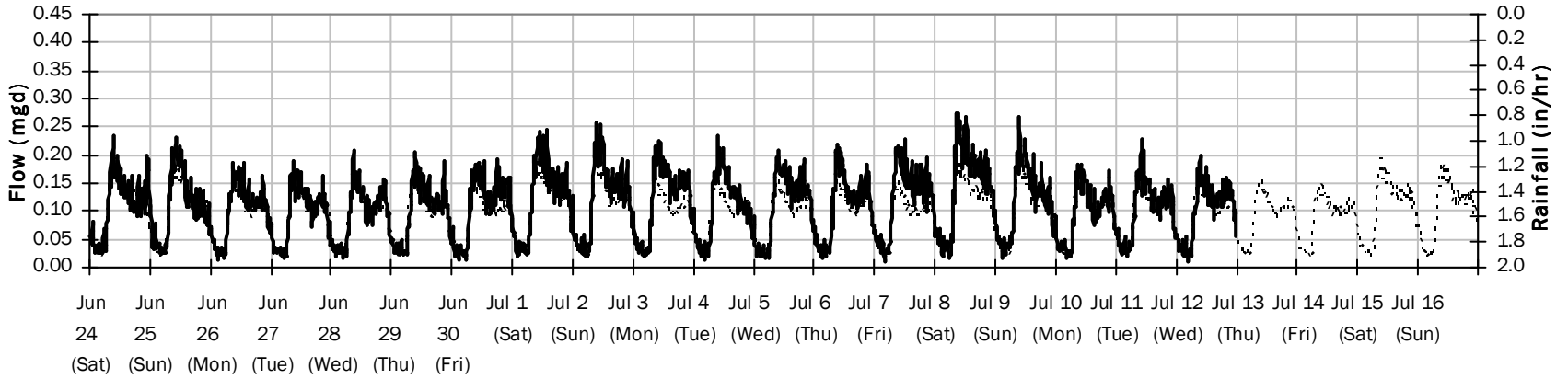


SITE 13

Flow Summary: 6/1/2017 to 7/16/2017

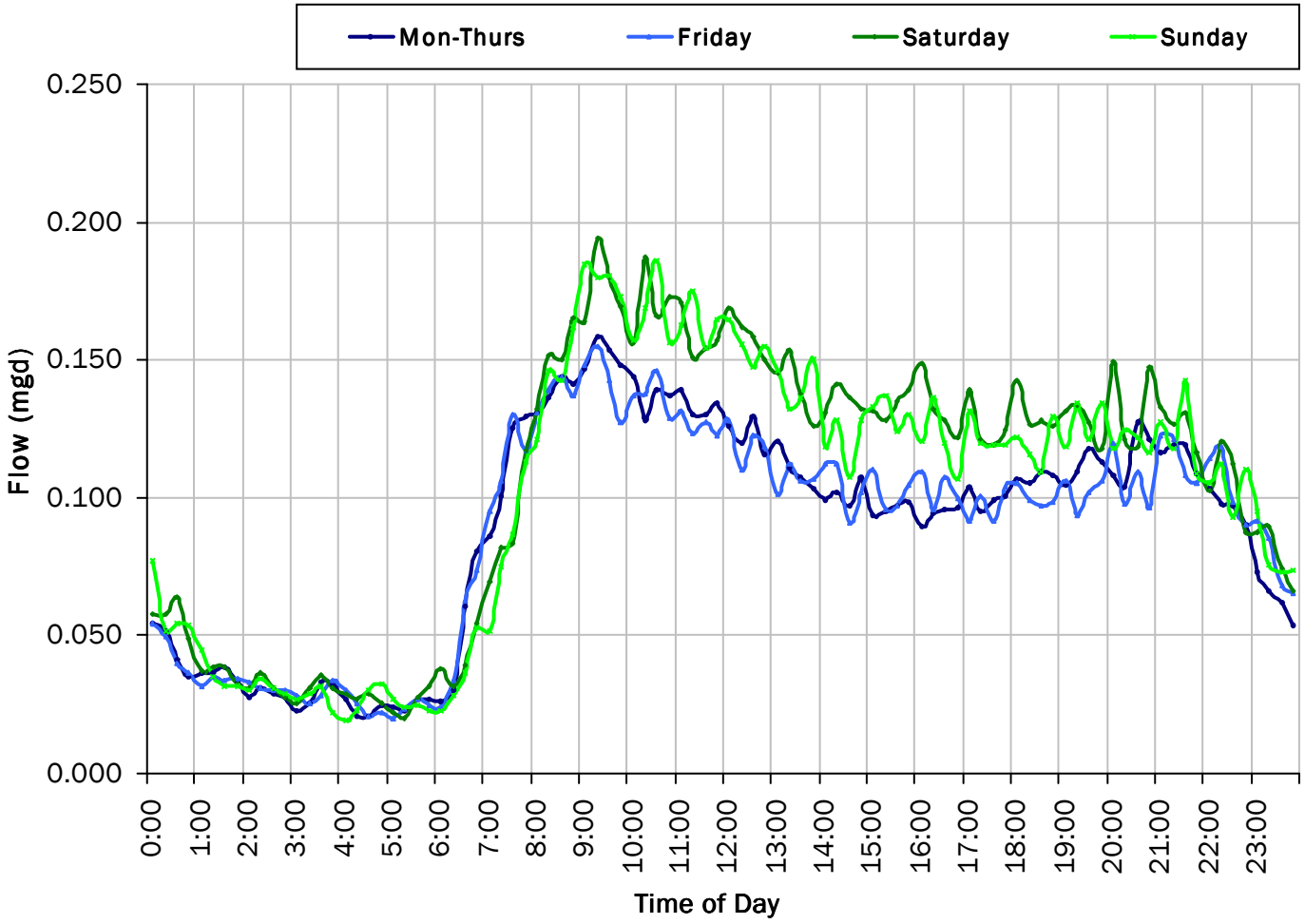
Total Period Rainfall: 0.00 inches **Avg Flow: 0.103 mgd Peak Flow: 0.274 mgd Min Flow: 0.009 mgd**





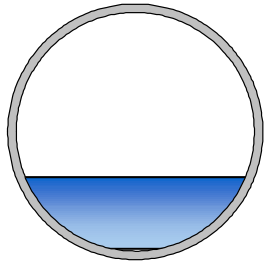
SITE 13

Average Dry Weather Flow Hydrographs



ADWF:

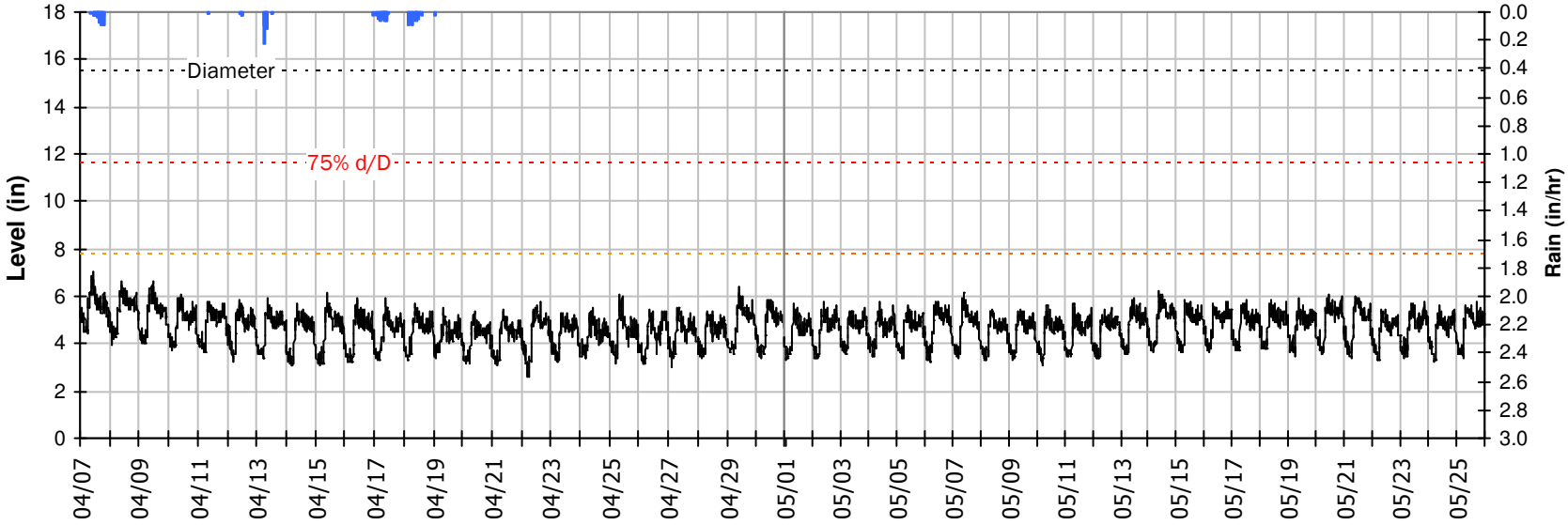
0.093 *mgd*

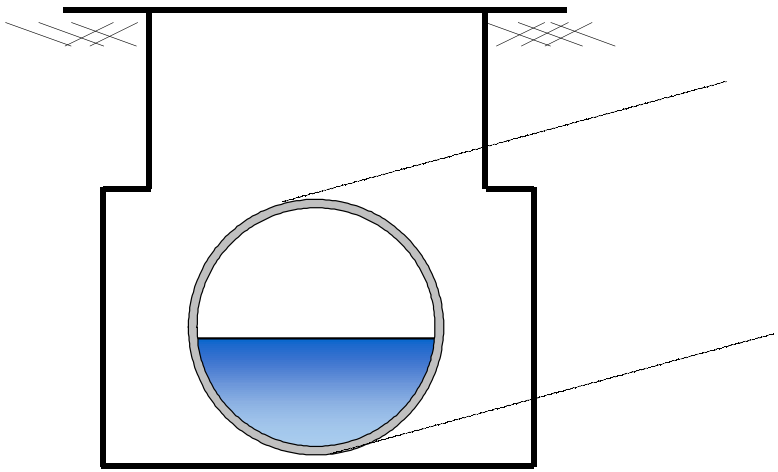


SITE 13

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



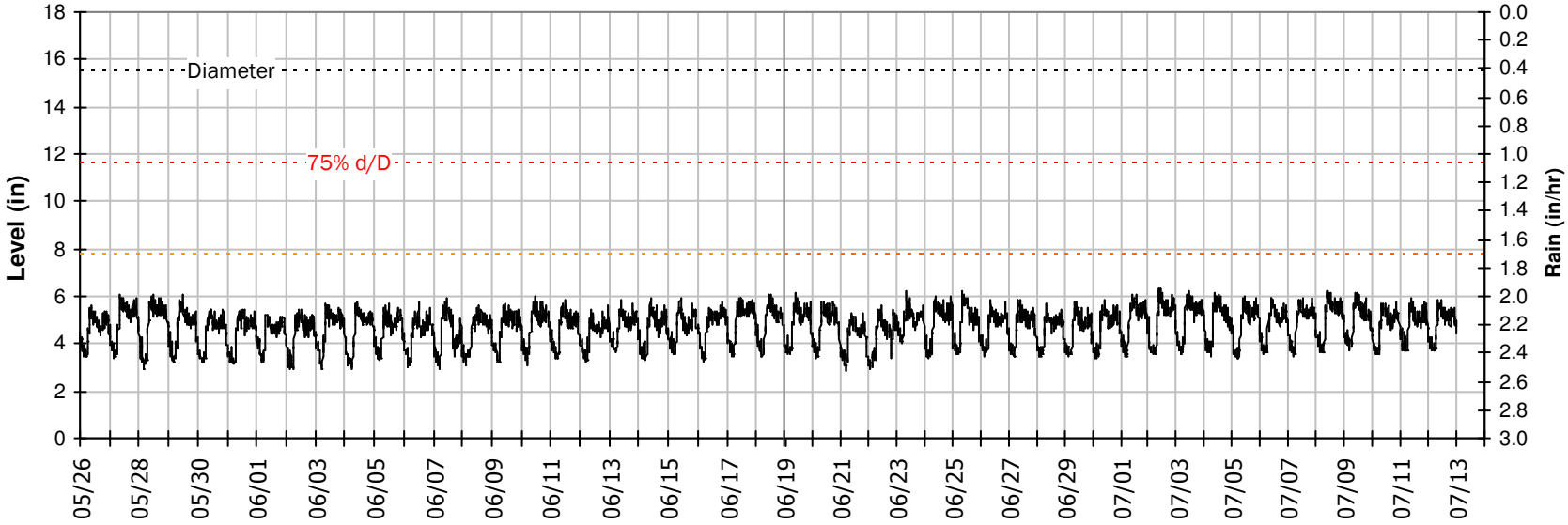


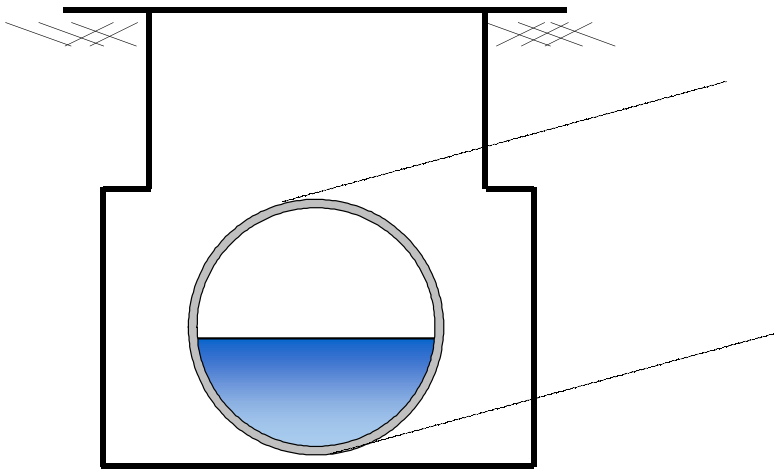
Pipe Diameter:	15.5	*inches*
Peak Measured Level:	7	*inches*
Peak d/D Ratio:	0.45	

SITE 13

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



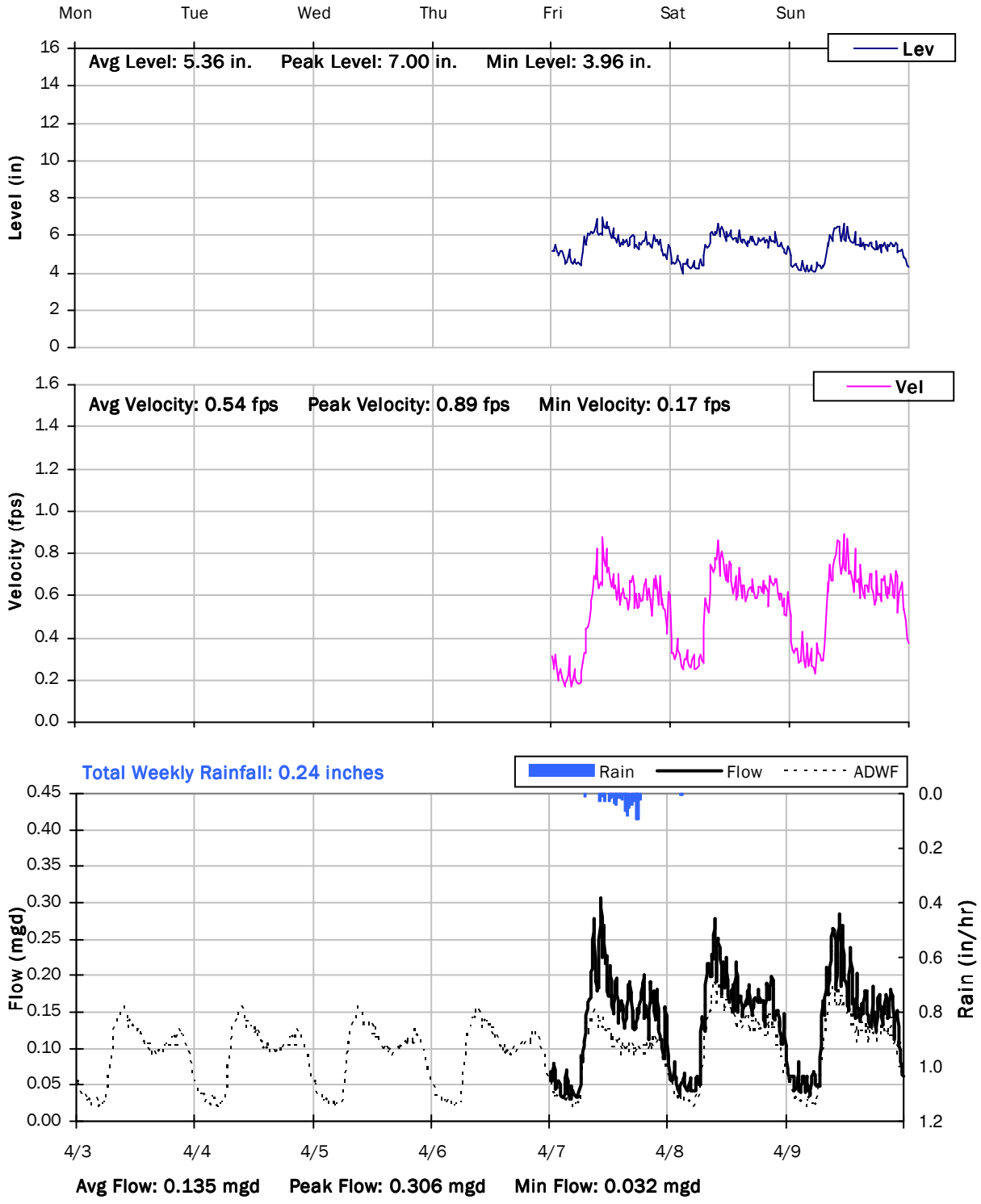


Pipe Diameter:	15.5	*inches*
Peak Measured Level:	7	*inches*
Peak d/D Ratio:	0.45	

SITE 13

Weekly Level, Velocity and Flow Hydrographs

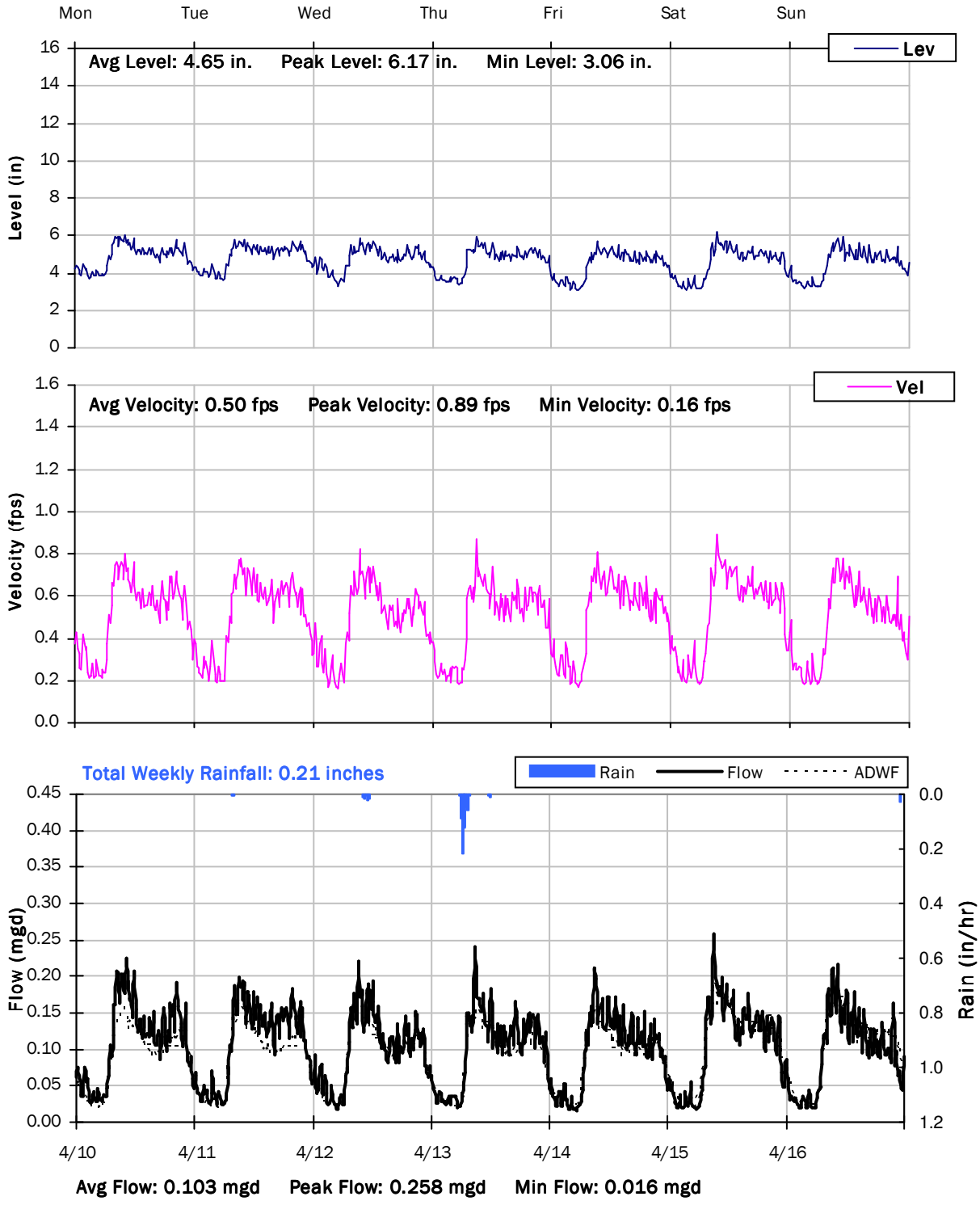
4/3/2017 to 4/10/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

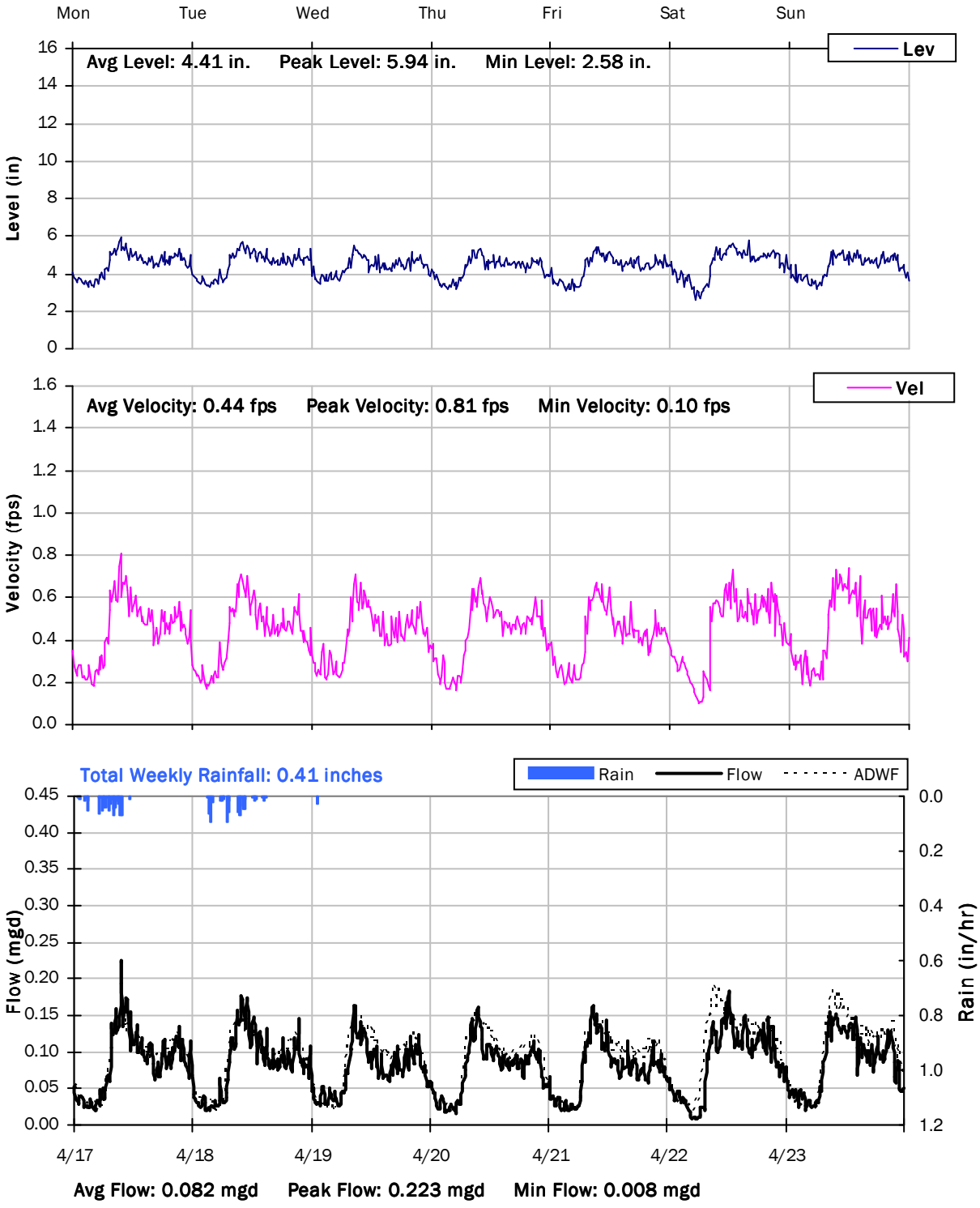
4/10/2017 to 4/17/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

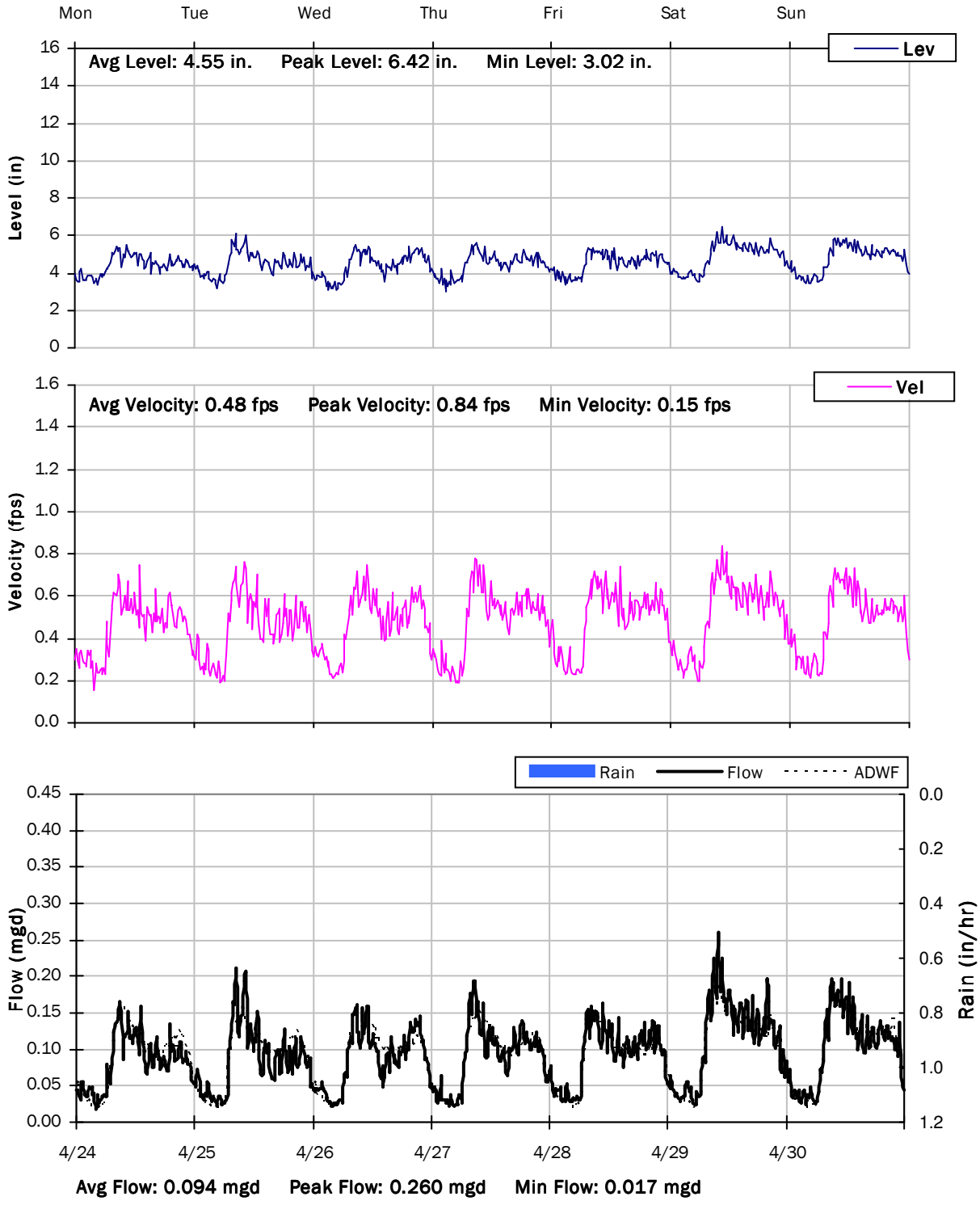
4/17/2017 to 4/24/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

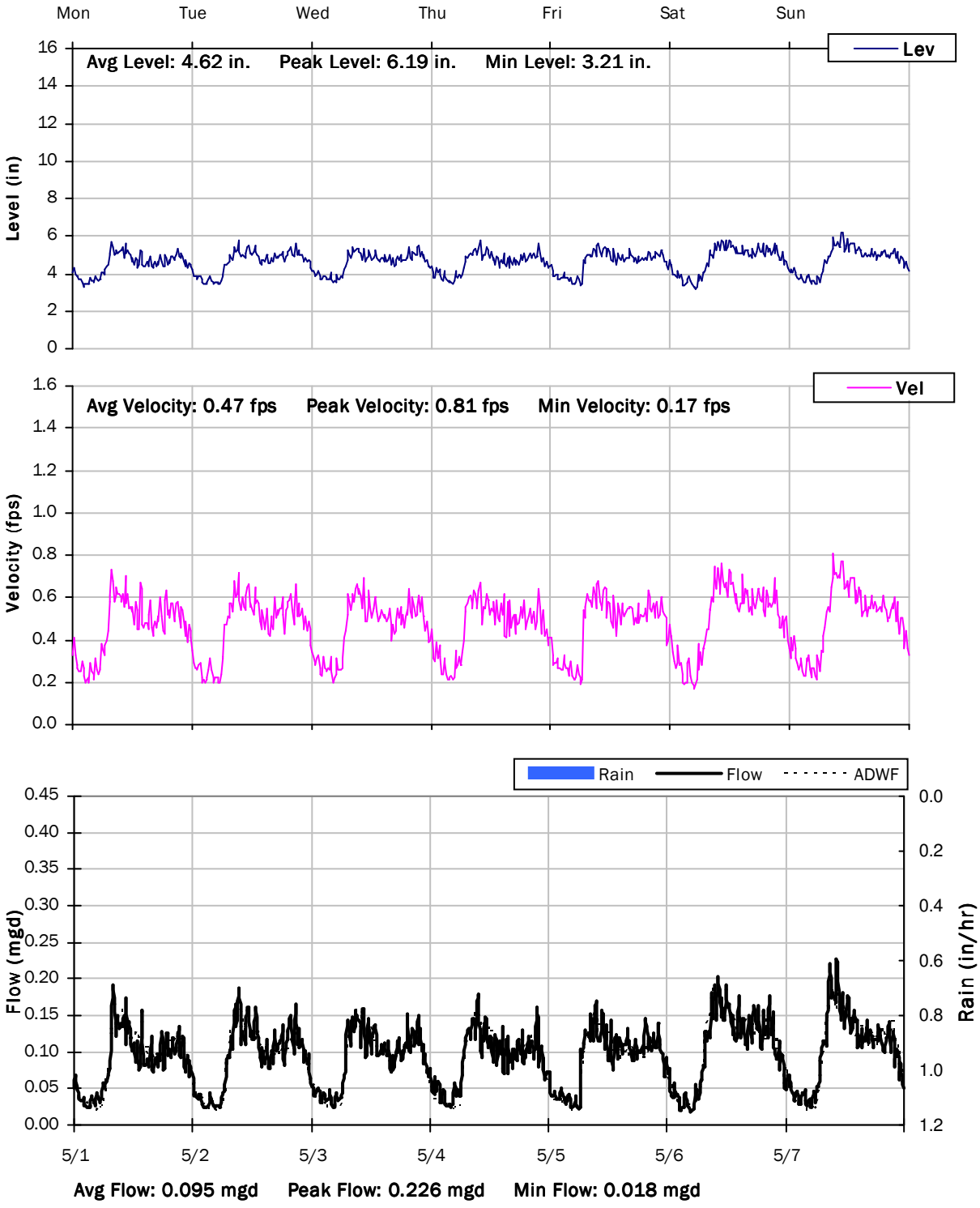
4/24/2017 to 5/1/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

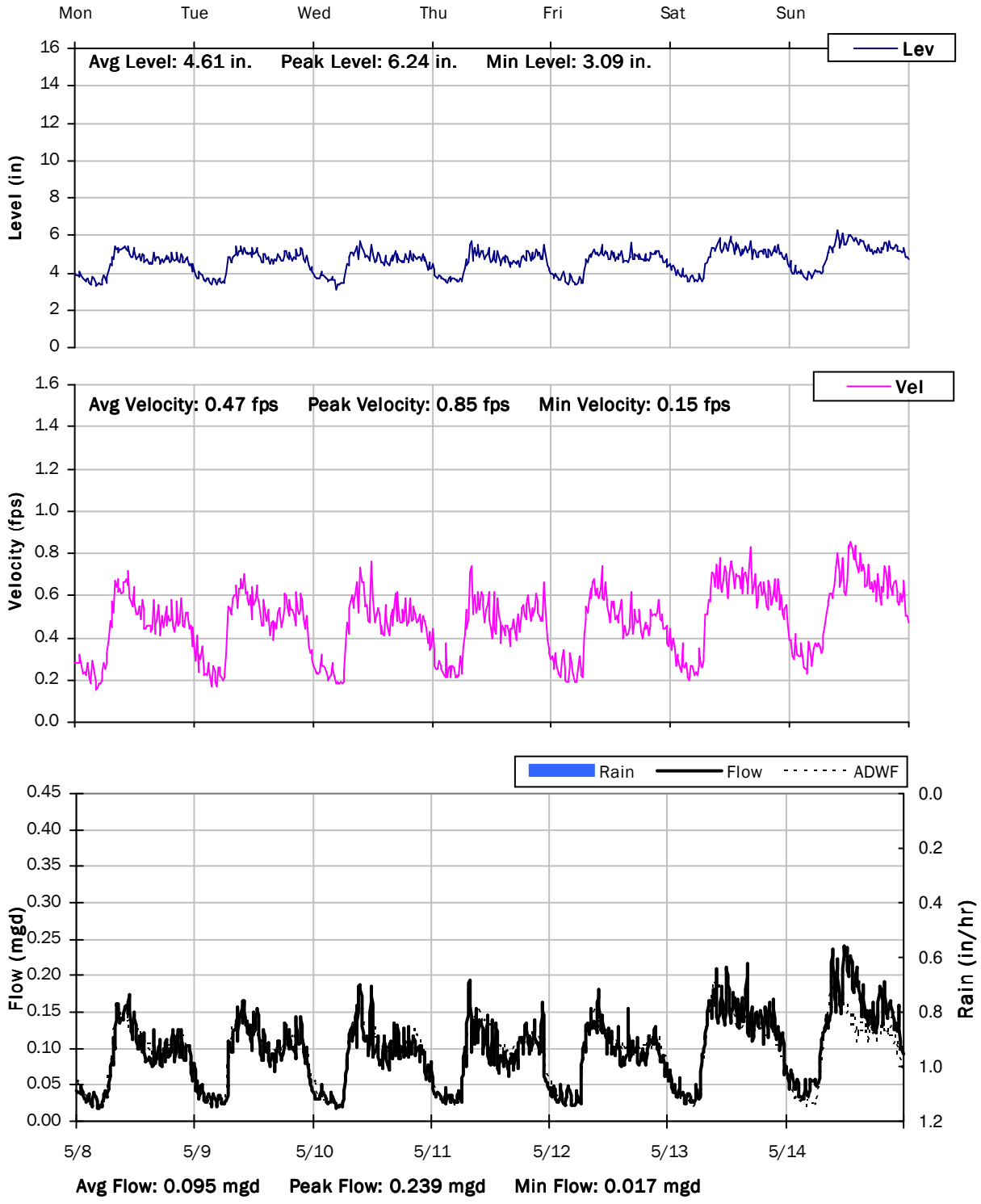
5/1/2017 to 5/8/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

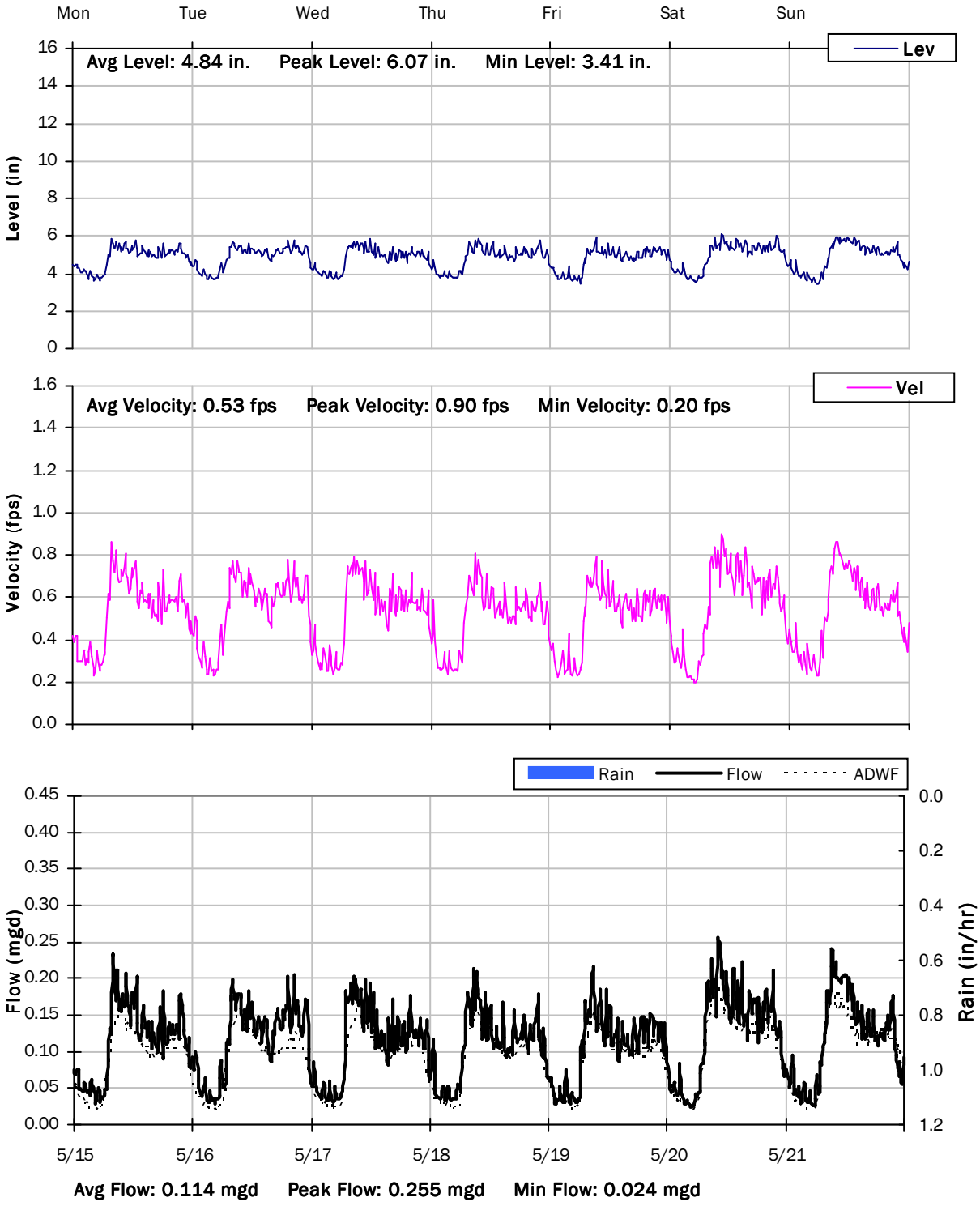
5/8/2017 to 5/15/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

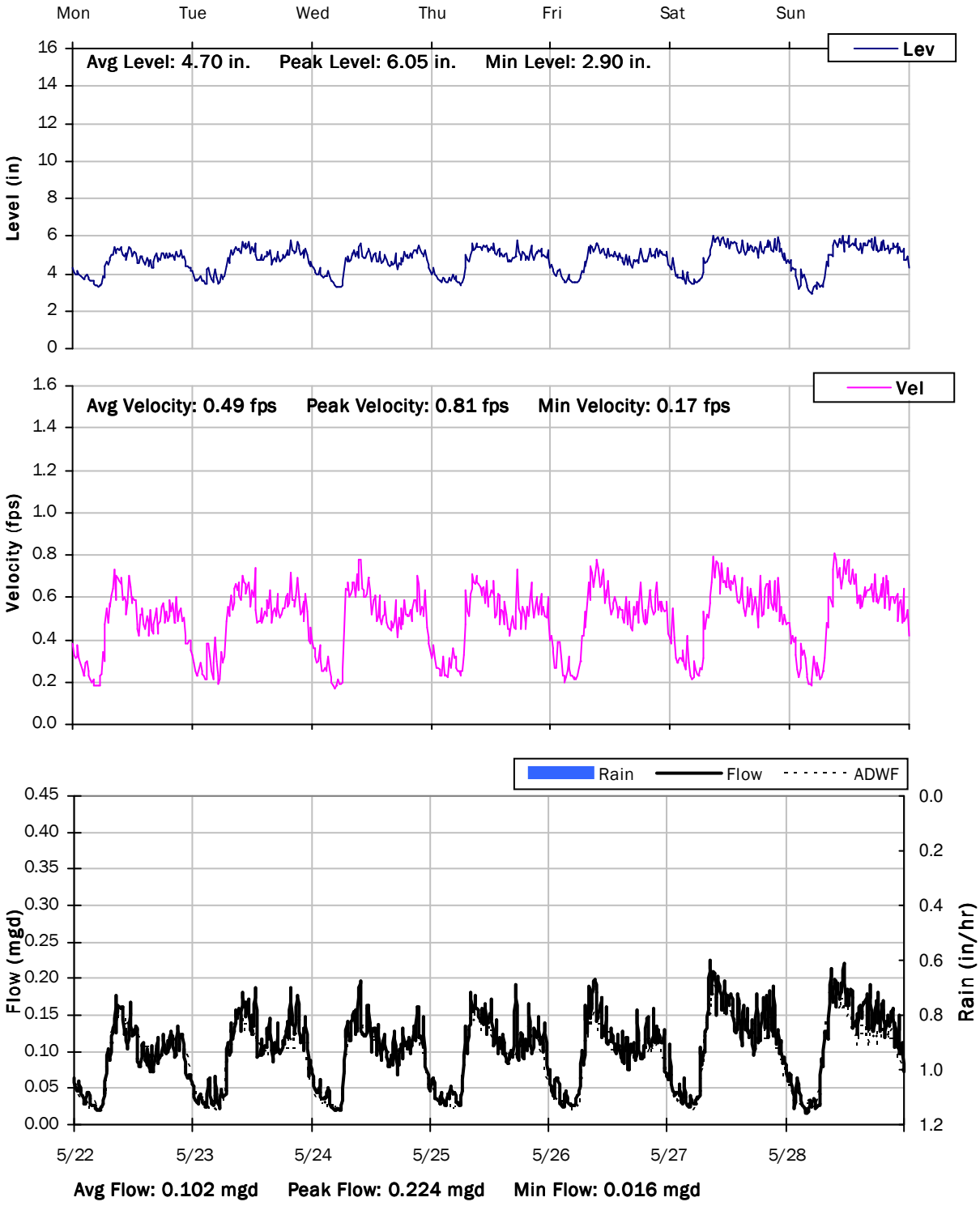
5/15/2017 to 5/22/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

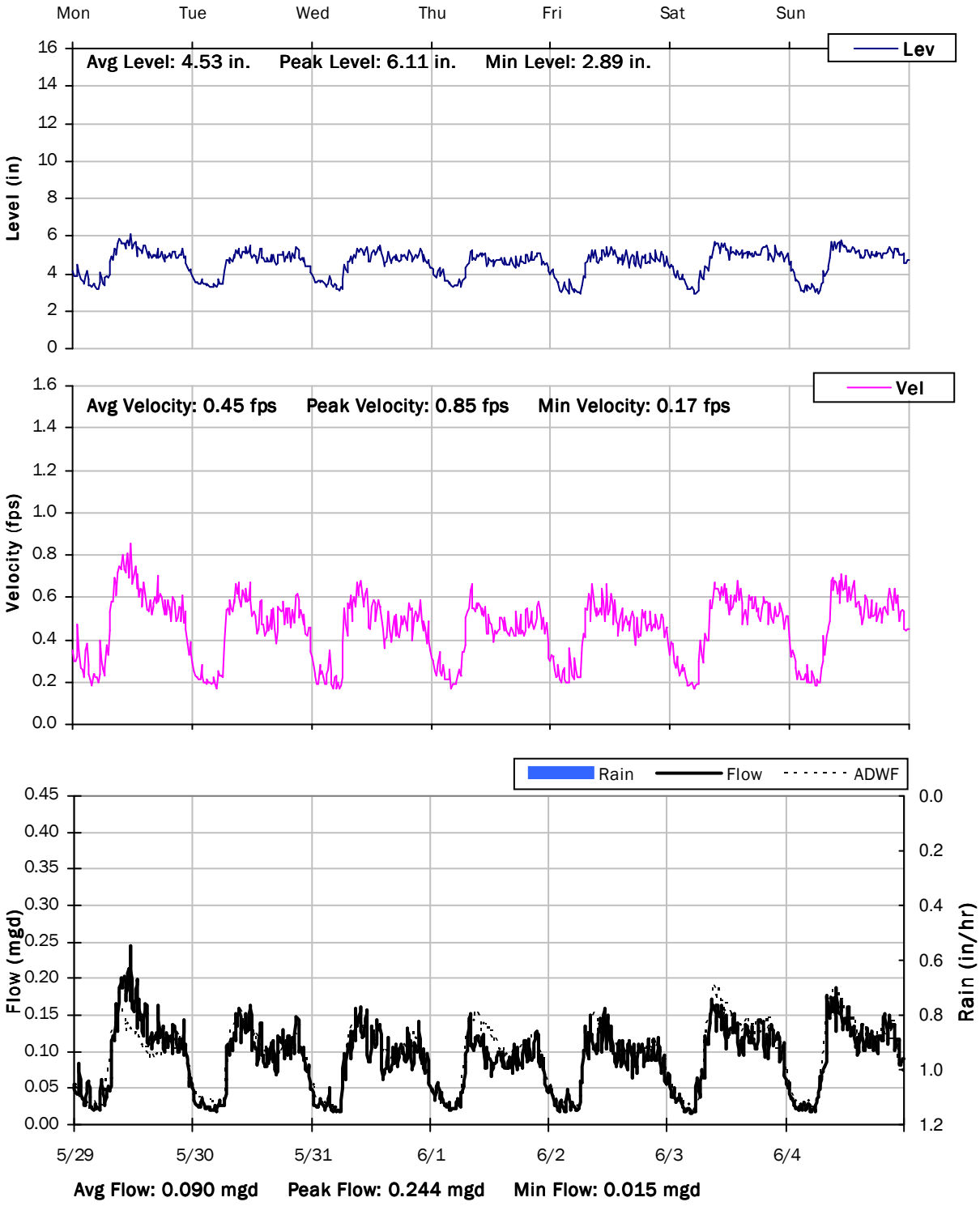
5/22/2017 to 5/29/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

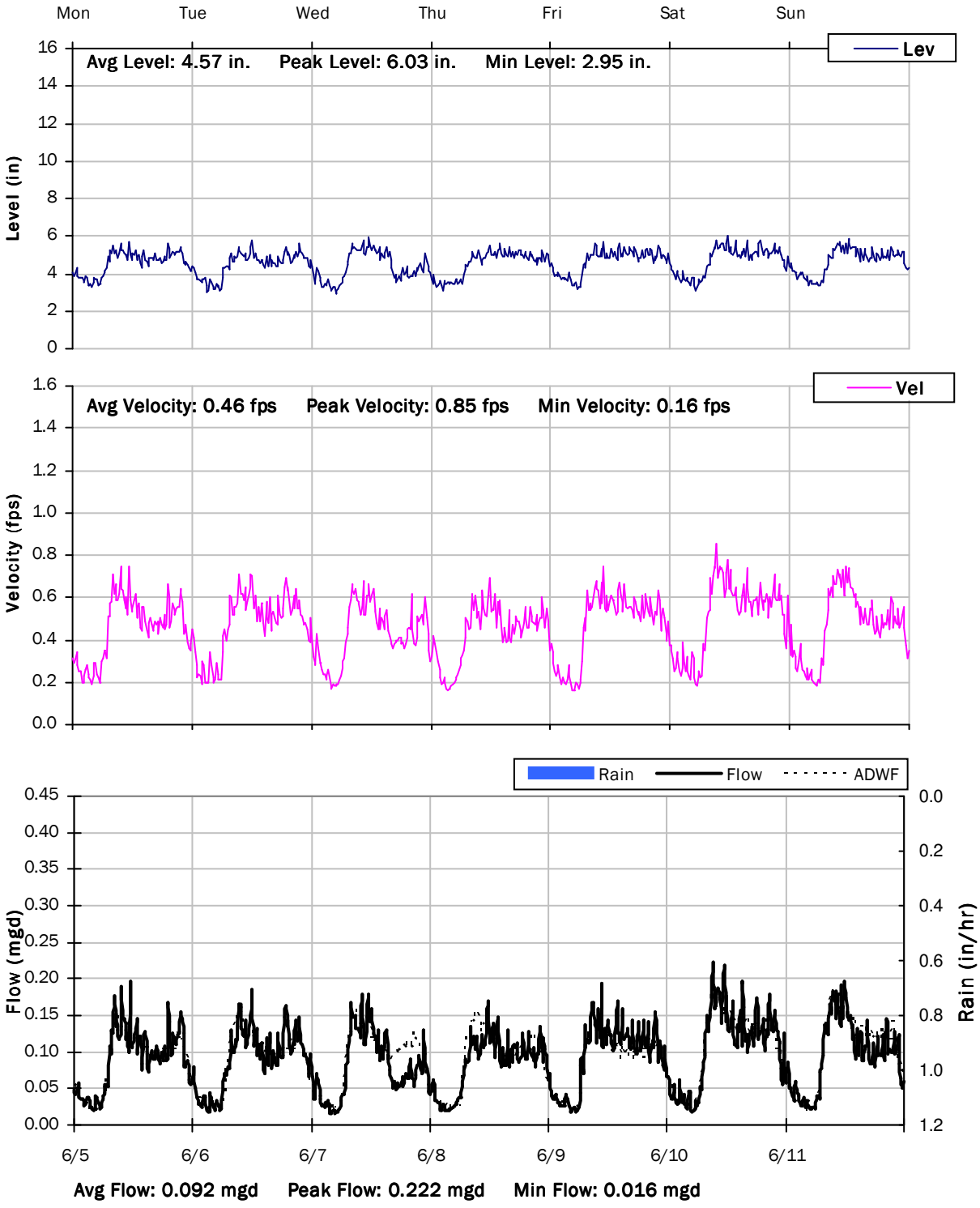
5/29/2017 to 6/5/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

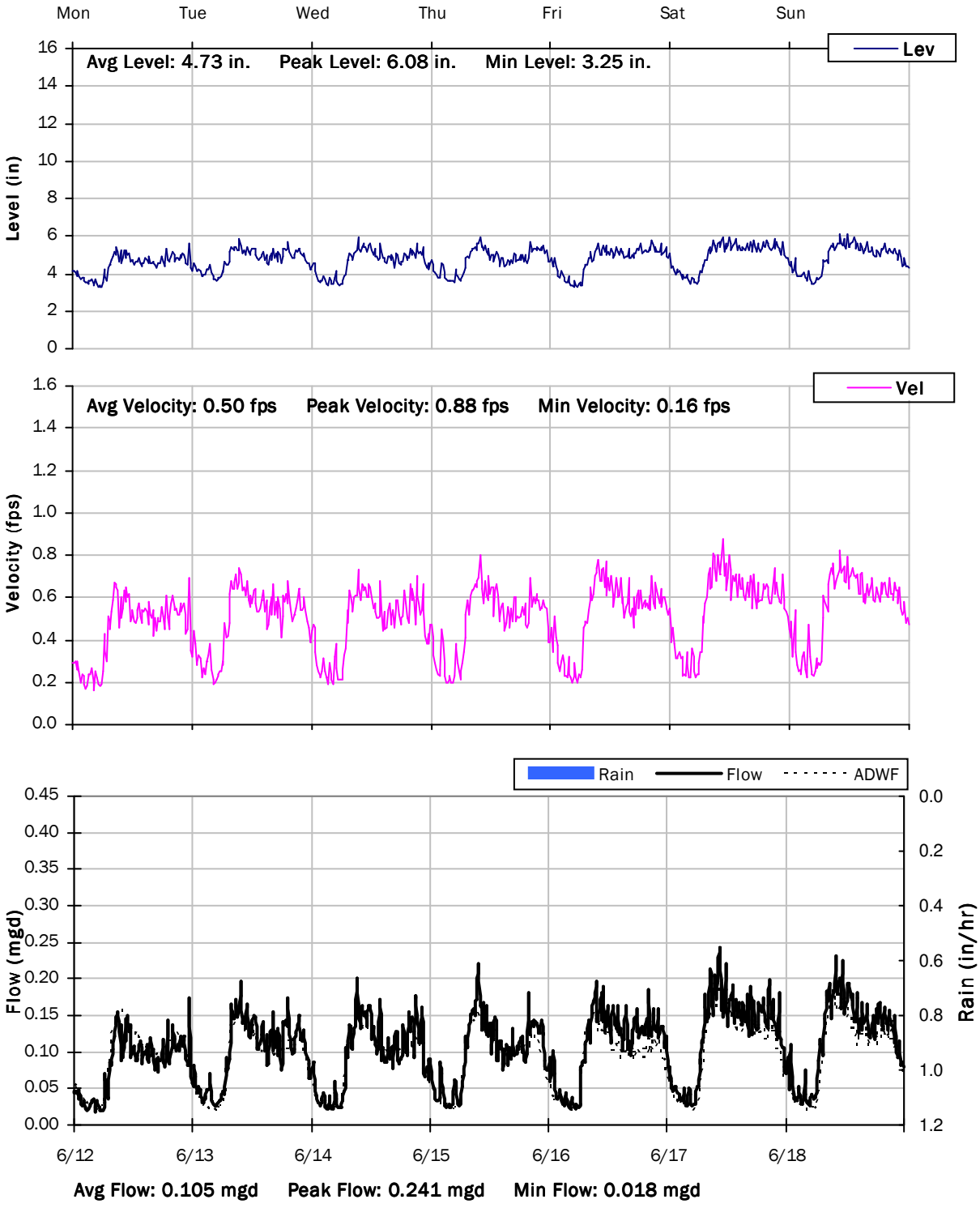
6/5/2017 to 6/12/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

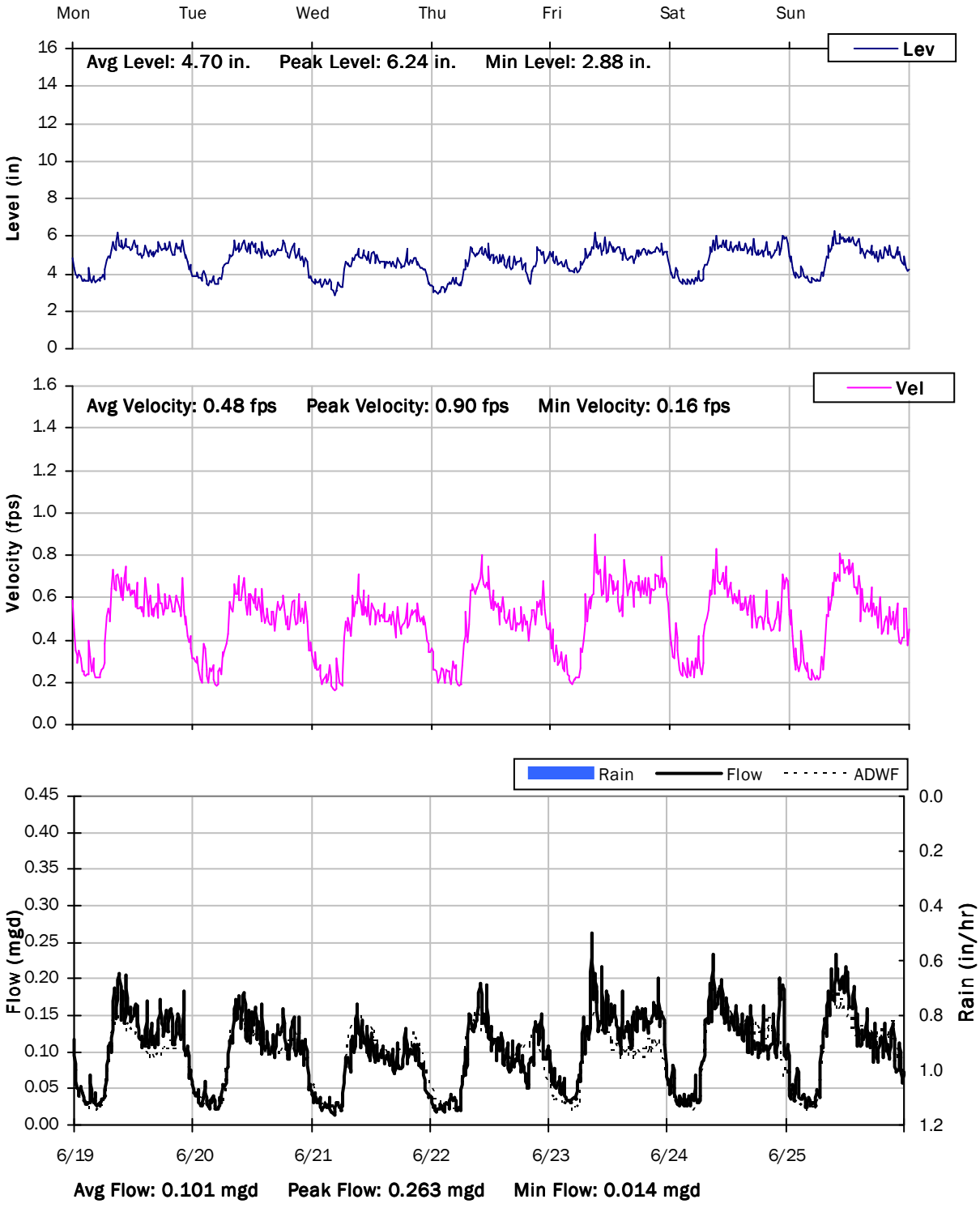
6/12/2017 to 6/19/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

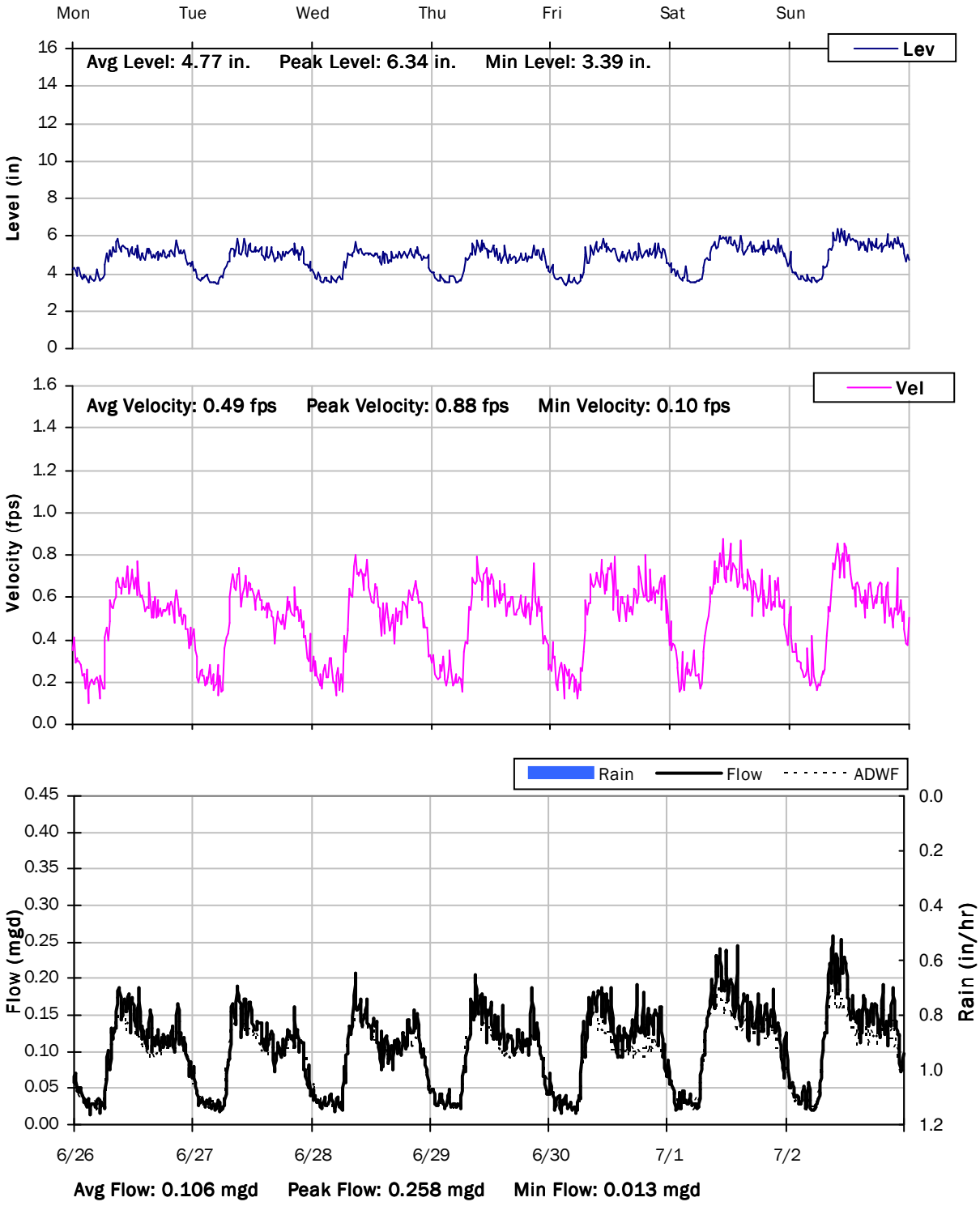
6/19/2017 to 6/26/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

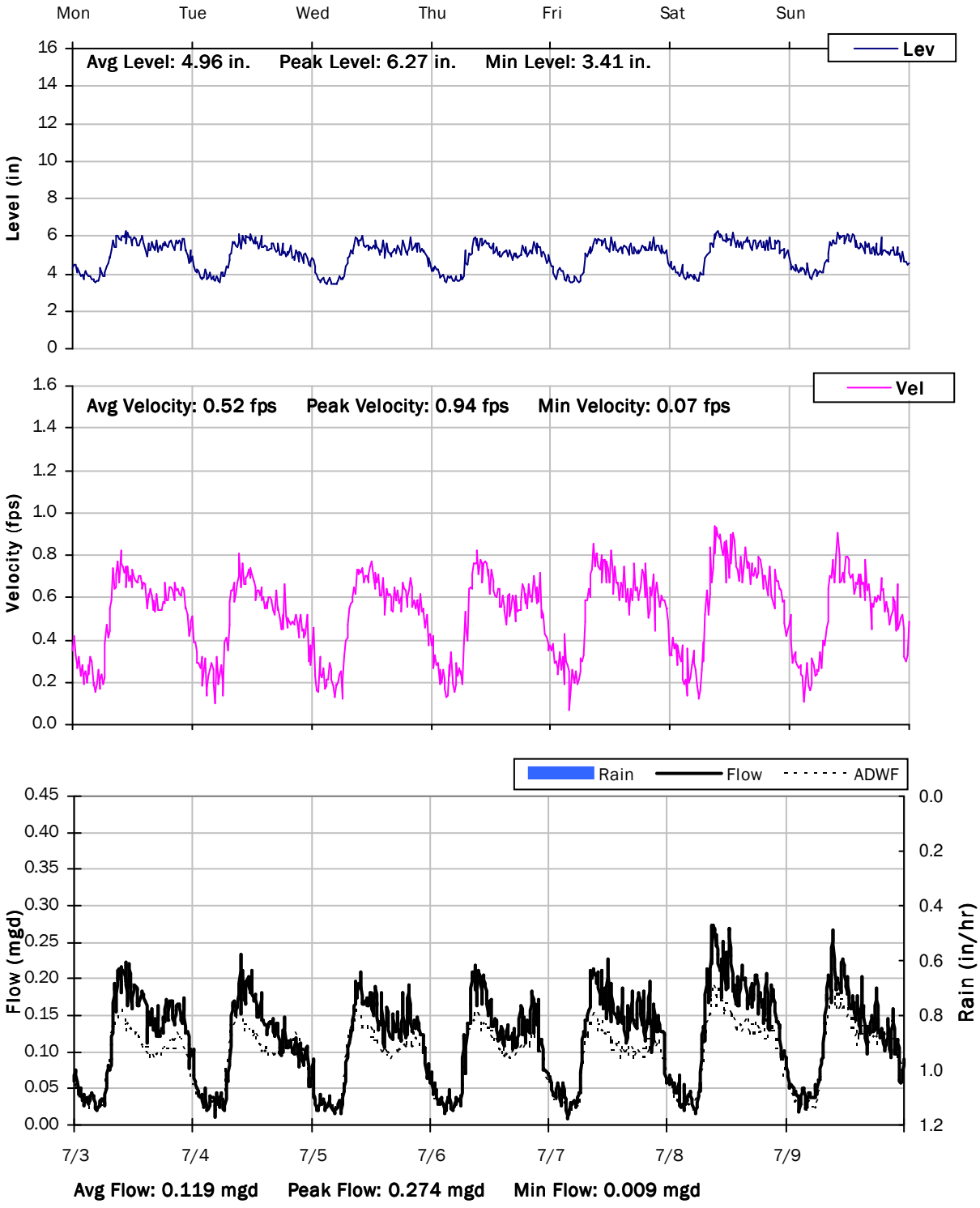
6/26/2017 to 7/3/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

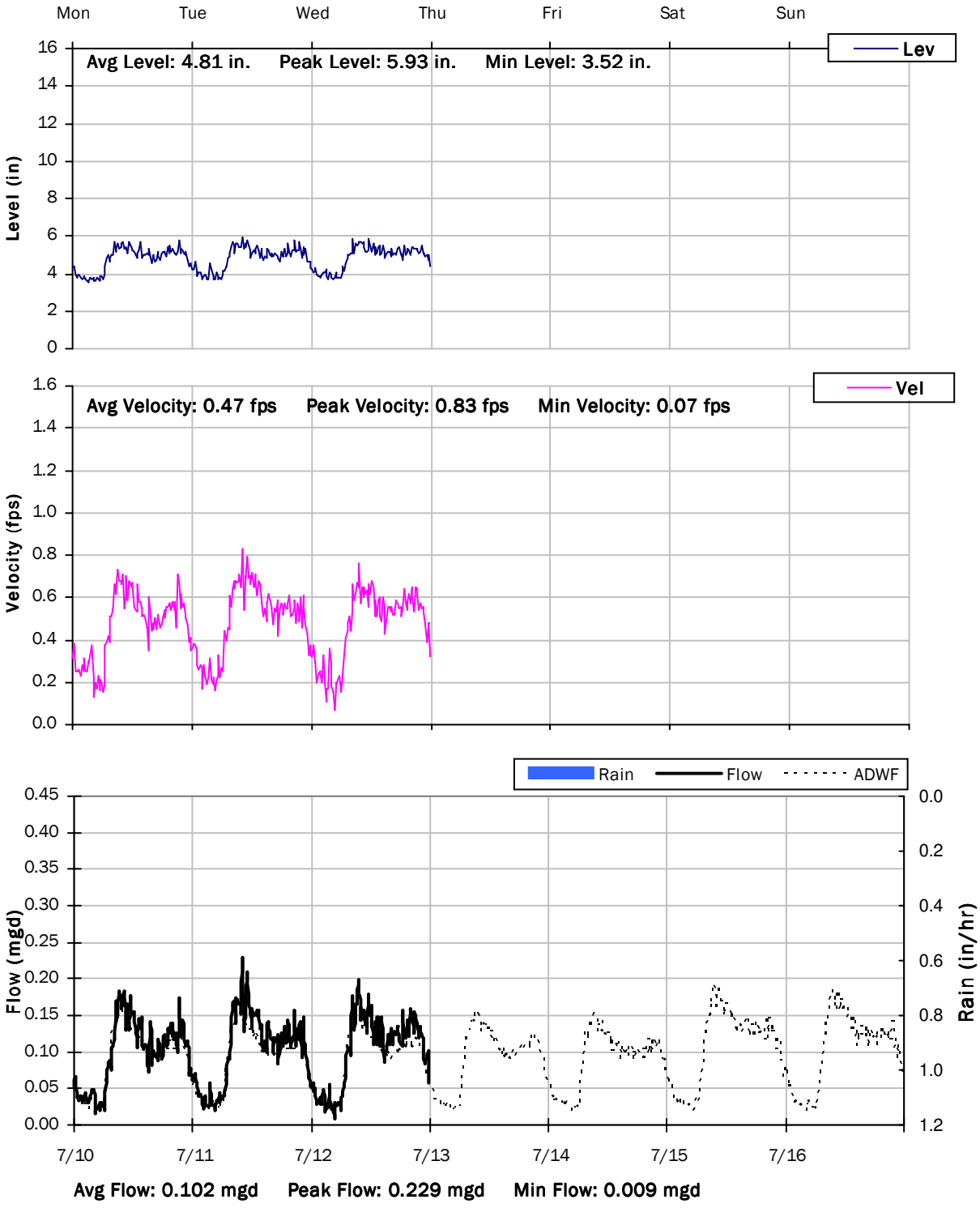
7/3/2017 to 7/10/2017



SITE 13

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

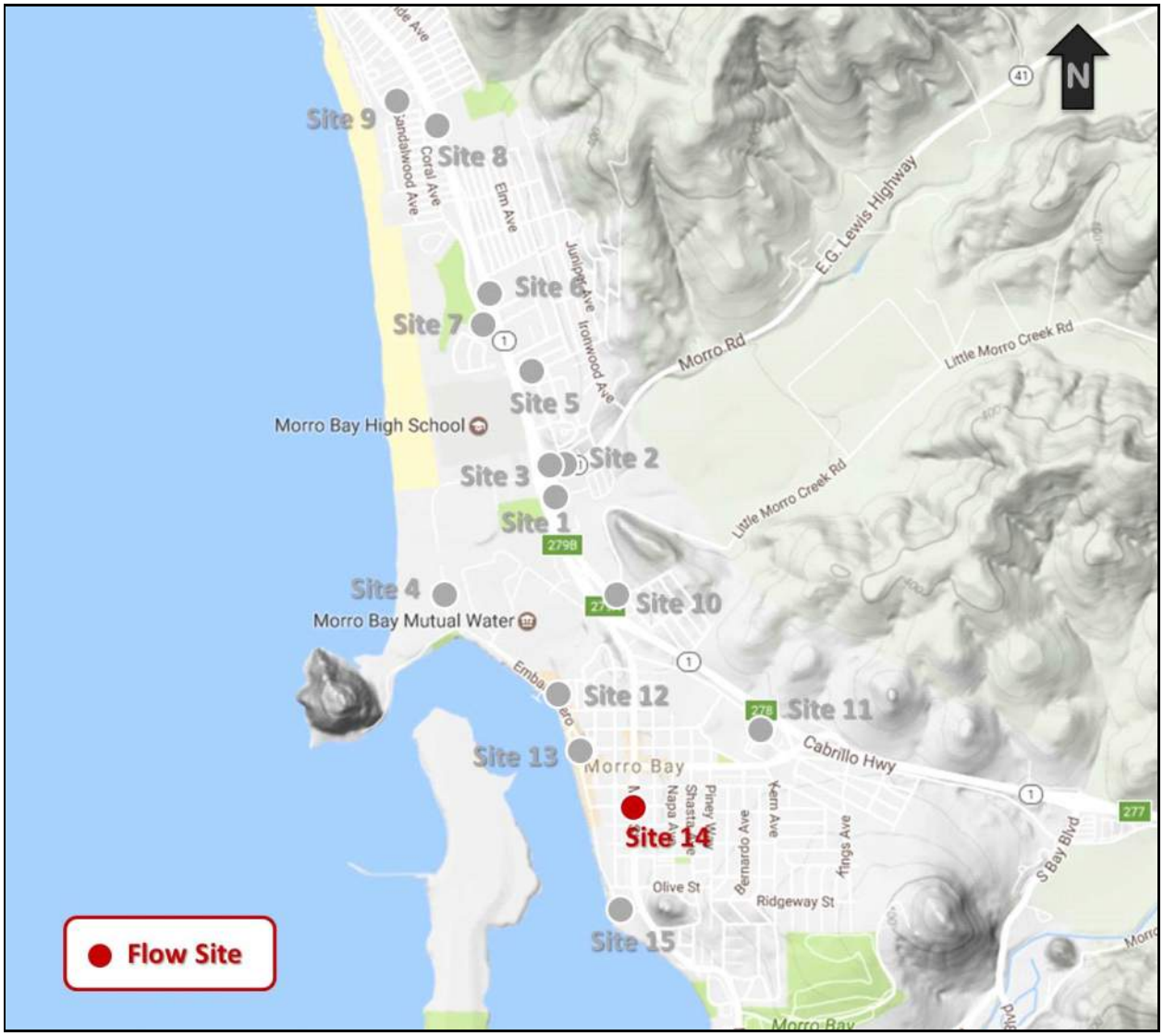
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 14

Location: Intersection of Main Street and Marina Street, meter on east 10" inlet

Data Summary Report



Vicinity Map: Site 14

SITE 14

Site Information

Location: Intersection of Main Street and Marina Street, meter on east 10" inlet

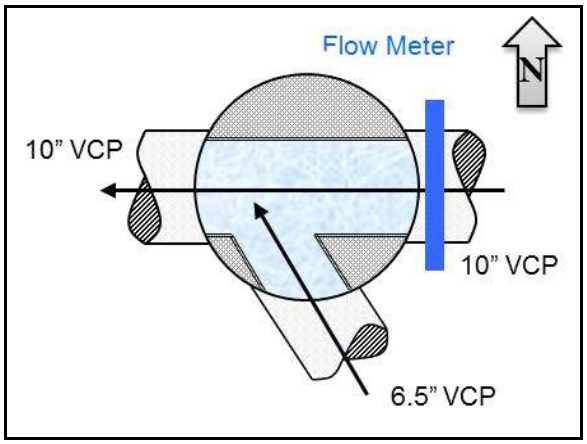


Pipe Diameter: 10 inches

ADWF: 0.092 mgd

Peak Measured Flow: 0.323 mgd









SITE 14

Additional Site Photos





SITE 14

Additional Site Photos

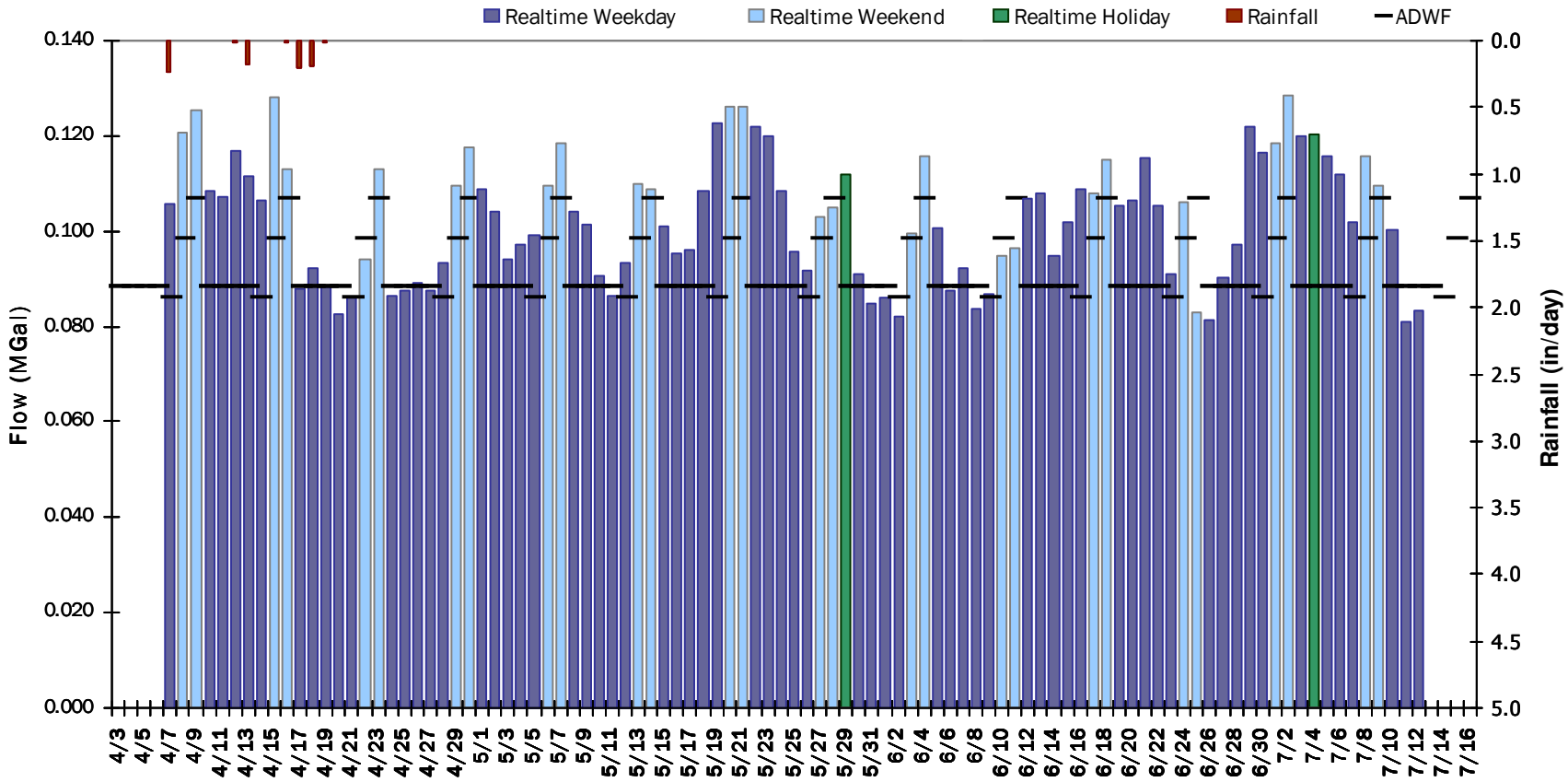


SITE 14

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.103 MGal Peak Daily Flow: 0.128 MGal Min Daily Flow: 0.081 MGal

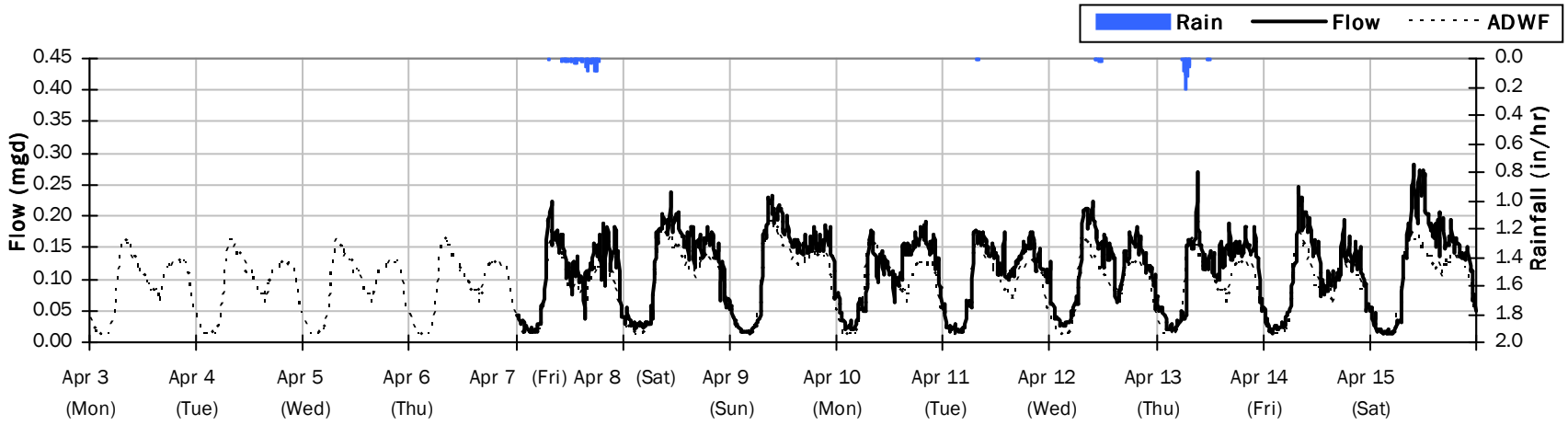
Total Period Rainfall: 0.85 inches

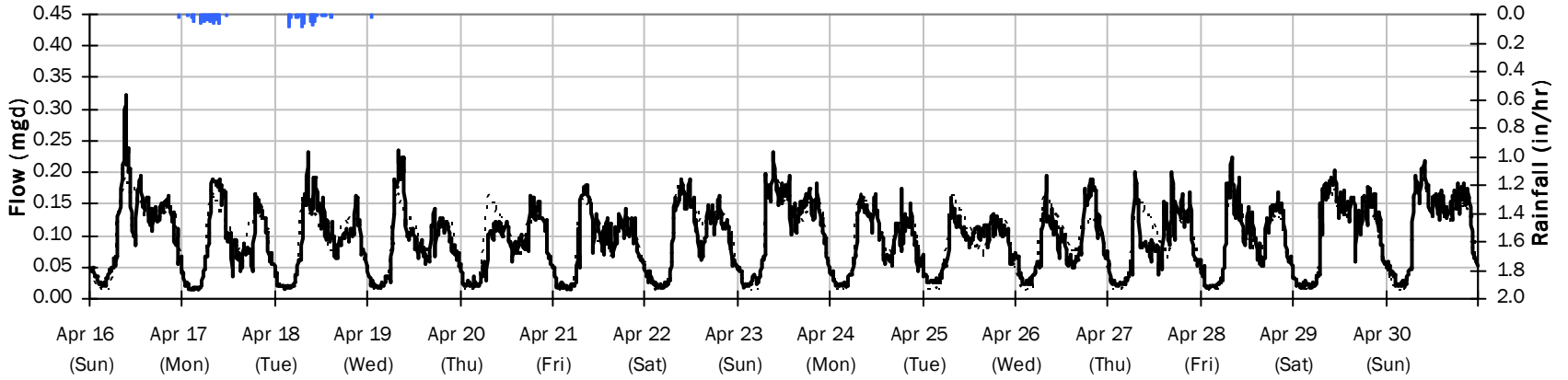


SITE 14

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.102 mgd** **Peak Flow: 0.323 mgd** **Min Flow: 0.013 mgd**

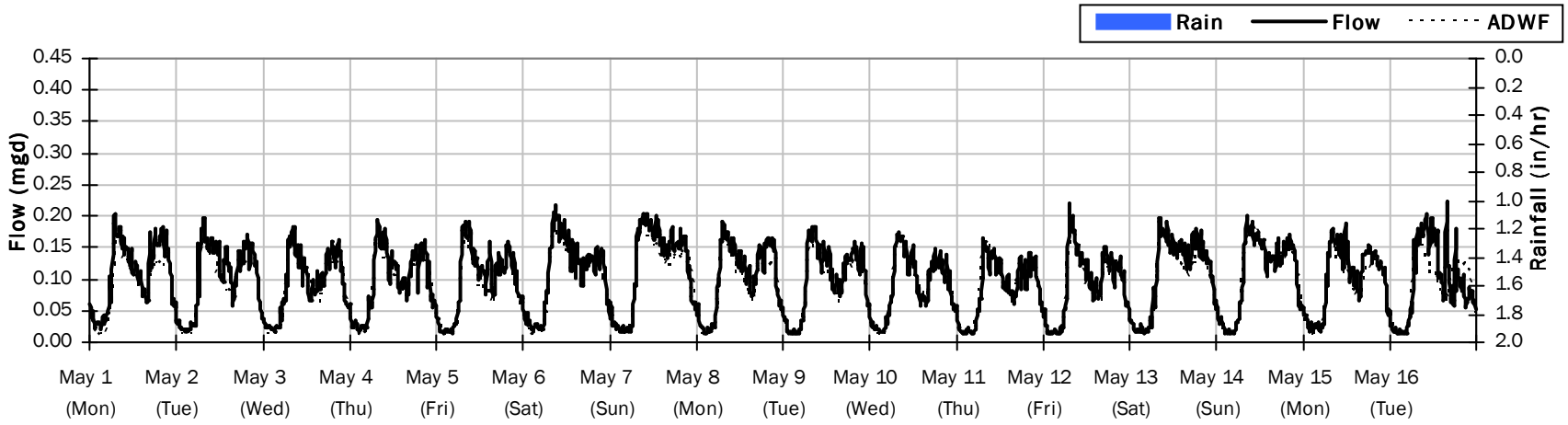


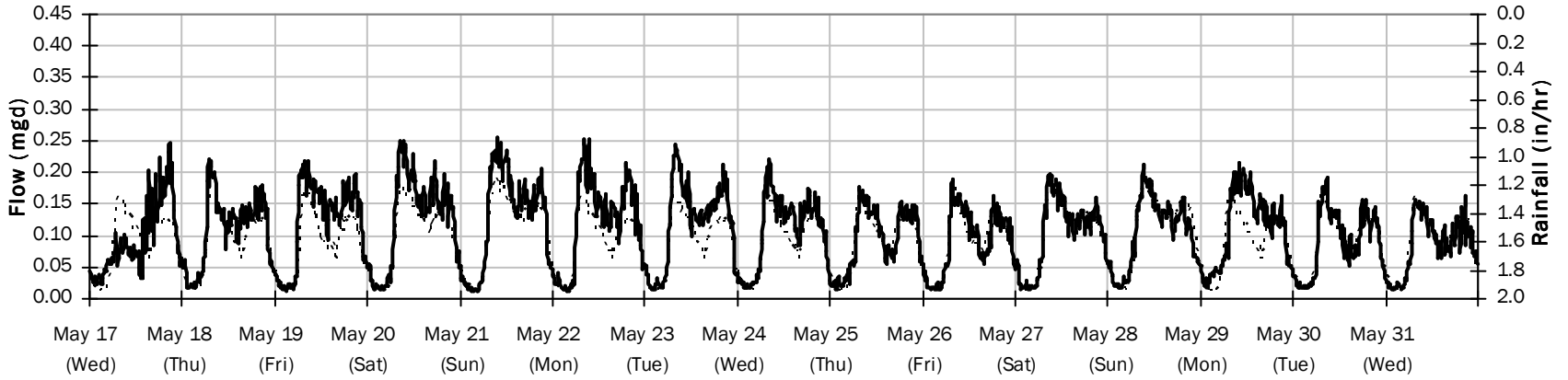


SITE 14

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.104 mgd** **Peak Flow: 0.254 mgd** **Min Flow: 0.012 mgd**

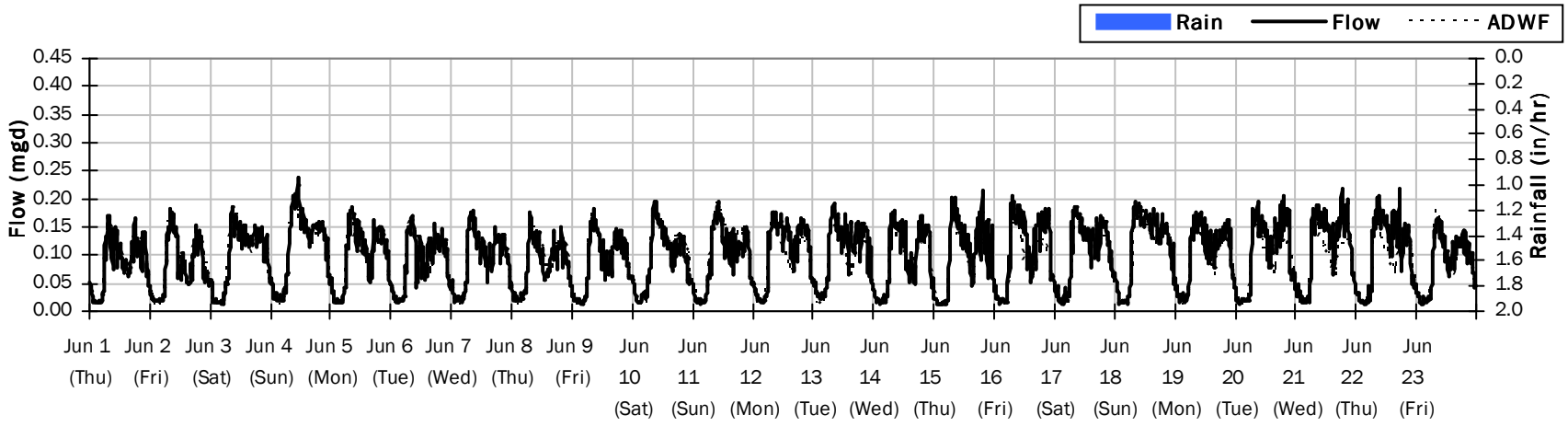


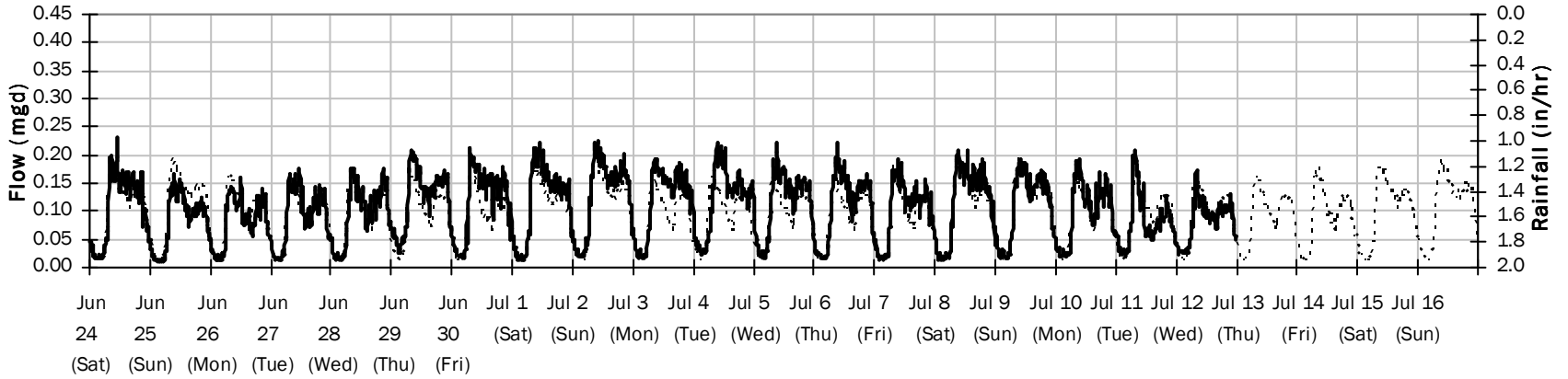


SITE 14

Flow Summary: 6/1/2017 to 7/16/2017

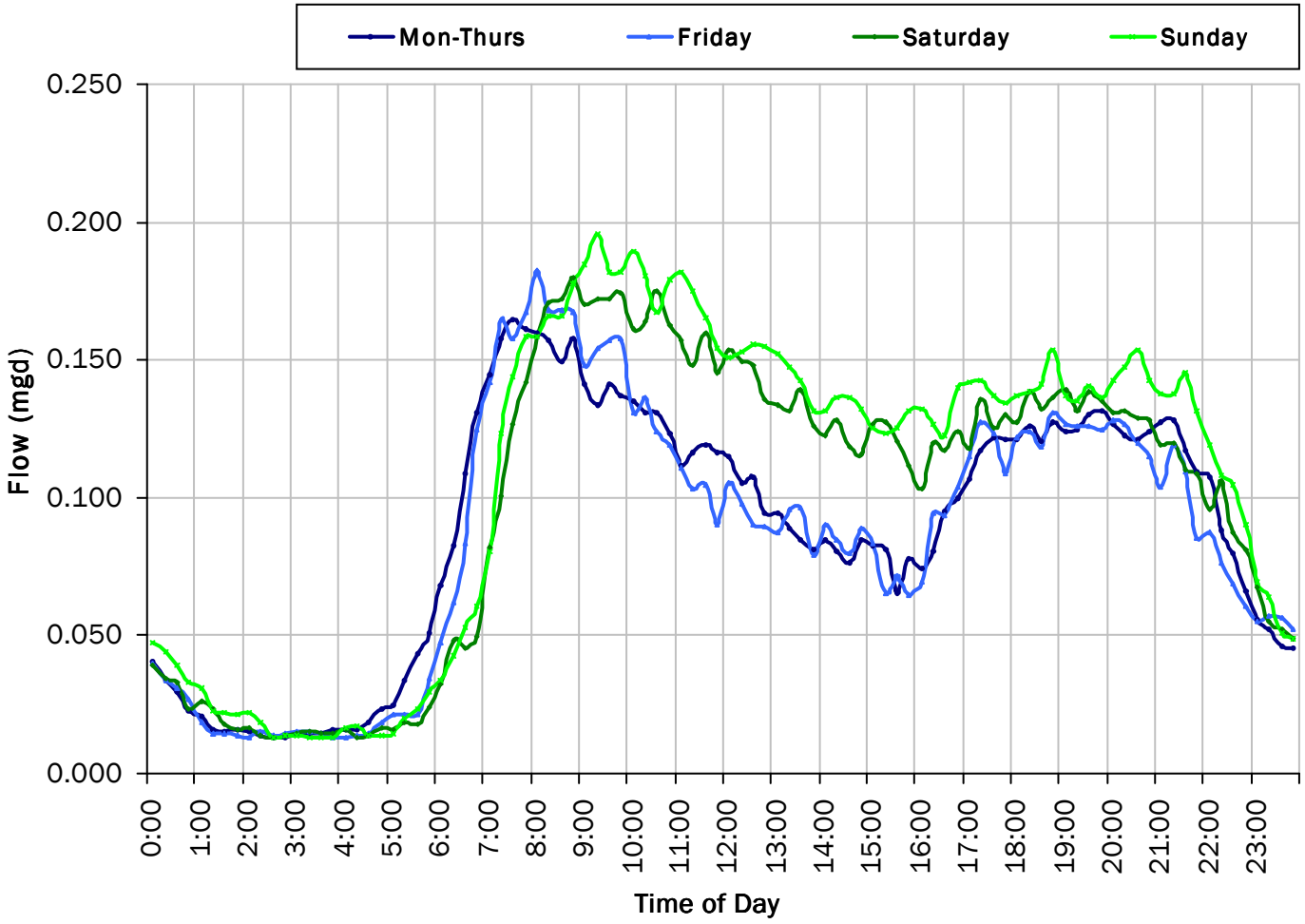
Total Period Rainfall: 0.00 inches **Avg Flow: 0.102 mgd** **Peak Flow: 0.237 mgd** **Min Flow: 0.011 mgd**





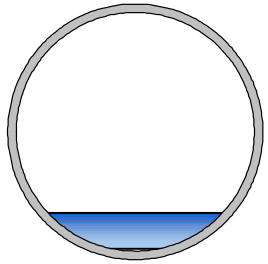
SITE 14

Average Dry Weather Flow Hydrographs



ADWF:

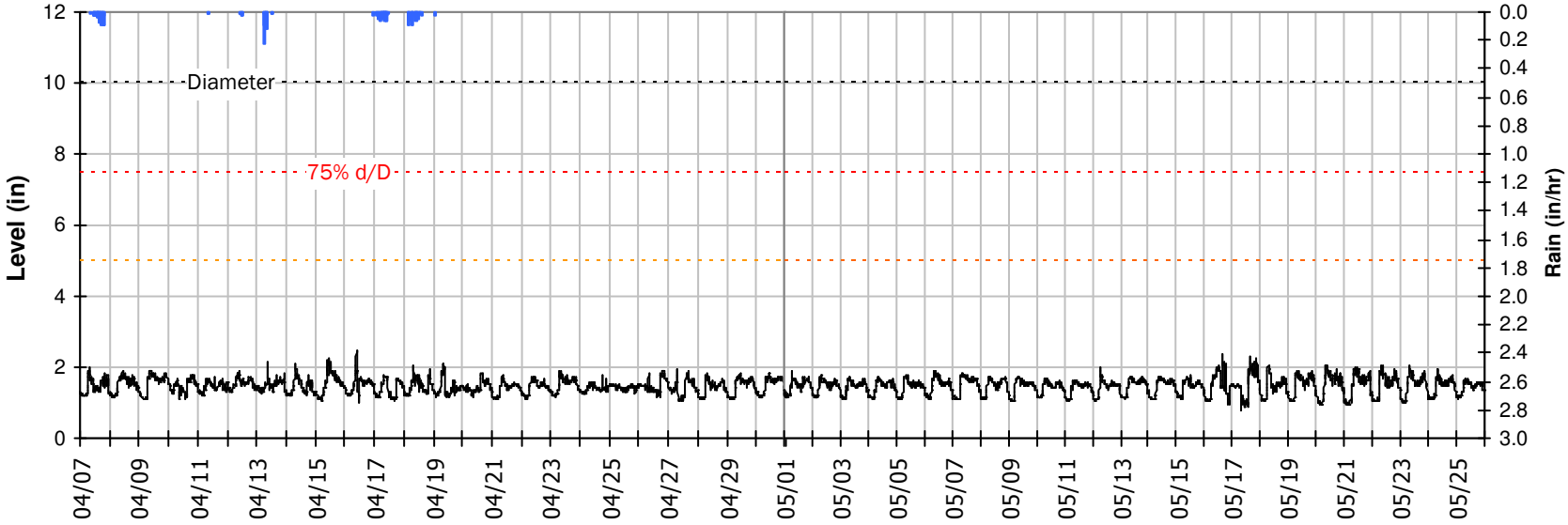
0.092 *mgd*

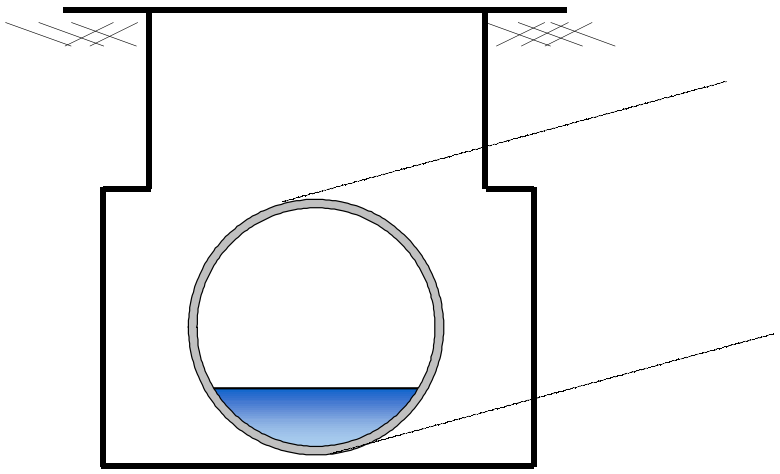


SITE 14

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



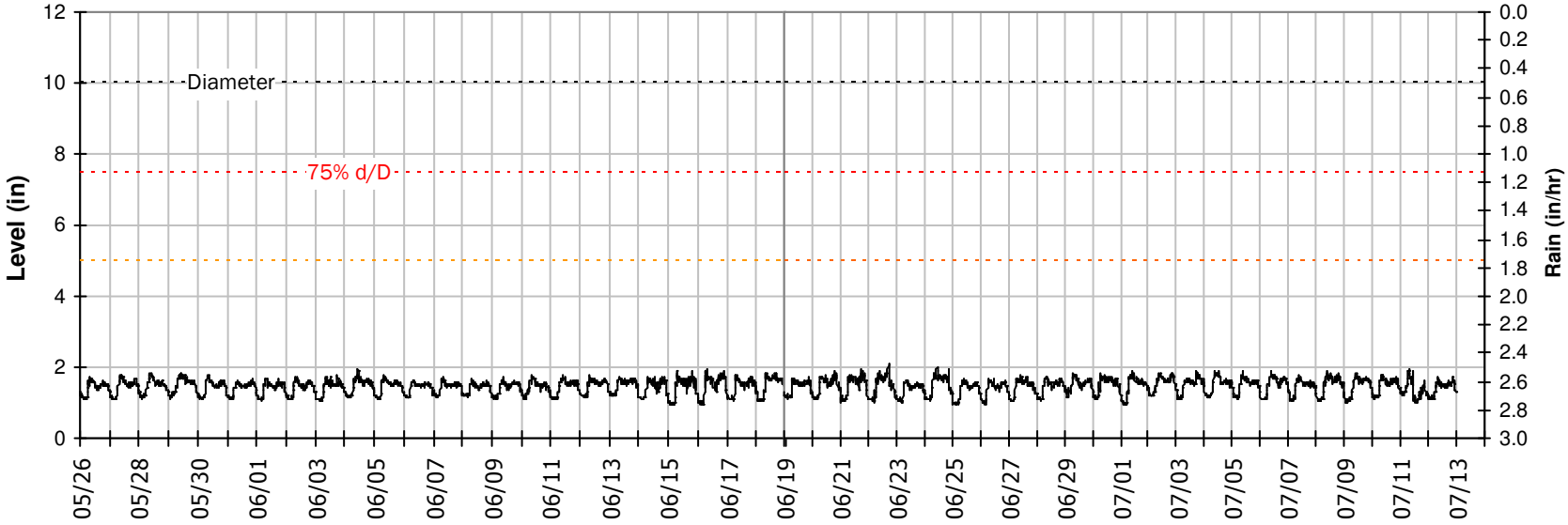


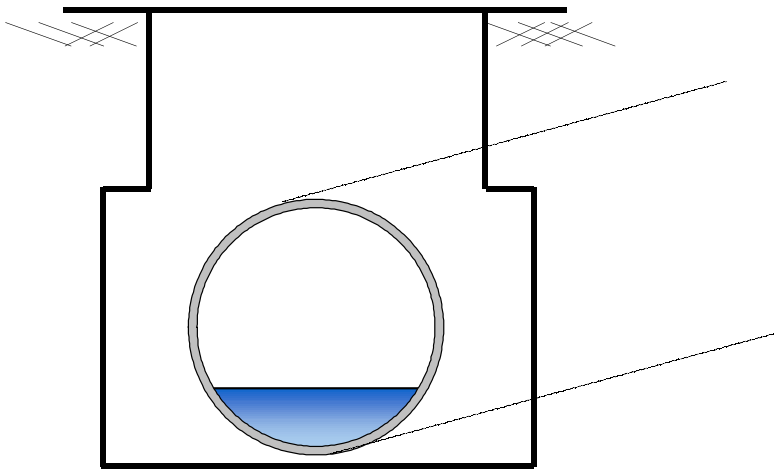
Pipe Diameter:	10	*inches*
Peak Measured Level:	2.46	*inches*
Peak d/D Ratio:	0.25	

SITE 14

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



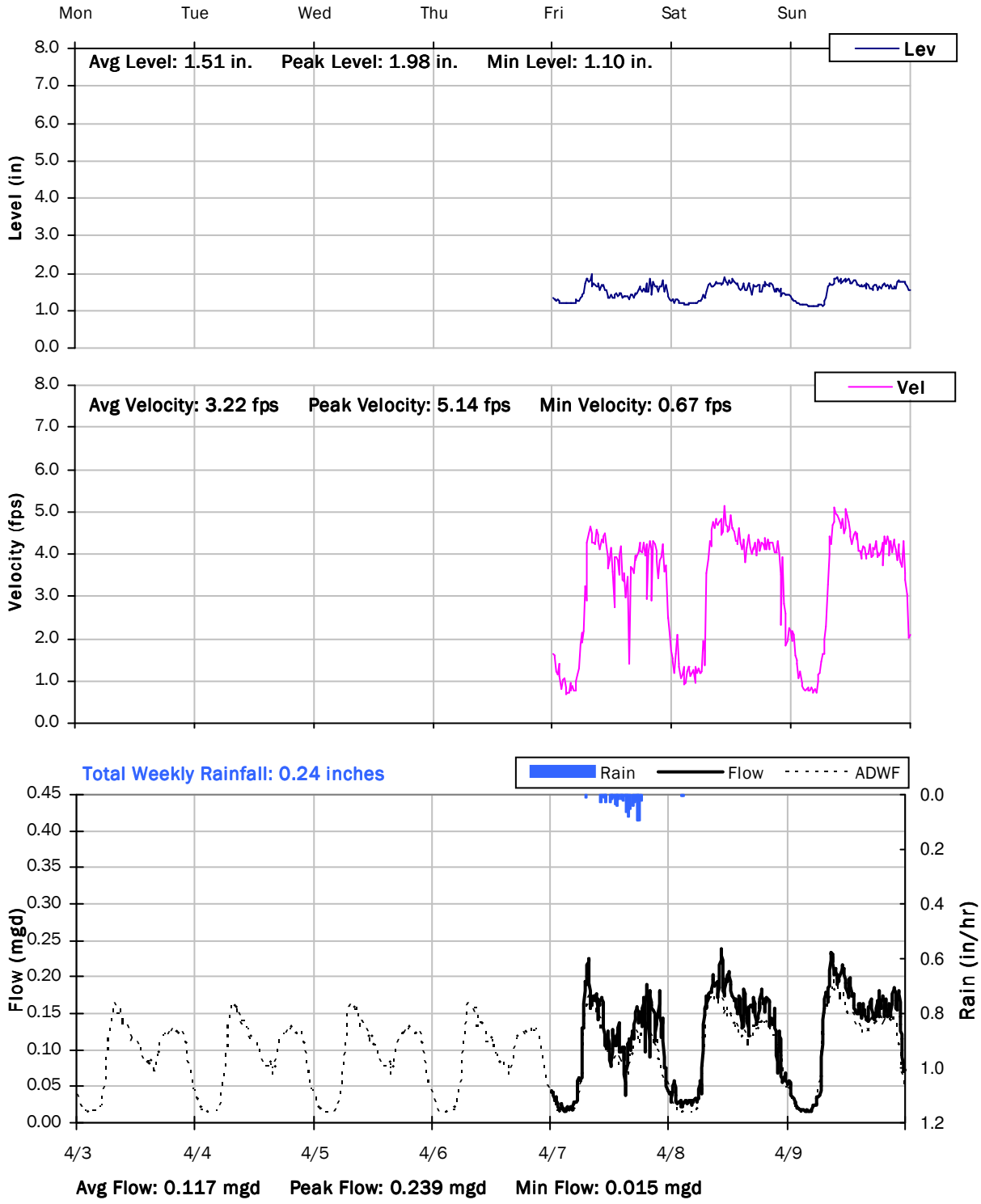


Pipe Diameter:	10	*inches*
Peak Measured Level:	2.46	*inches*
Peak d/D Ratio:	0.25	

SITE 14

Weekly Level, Velocity and Flow Hydrographs

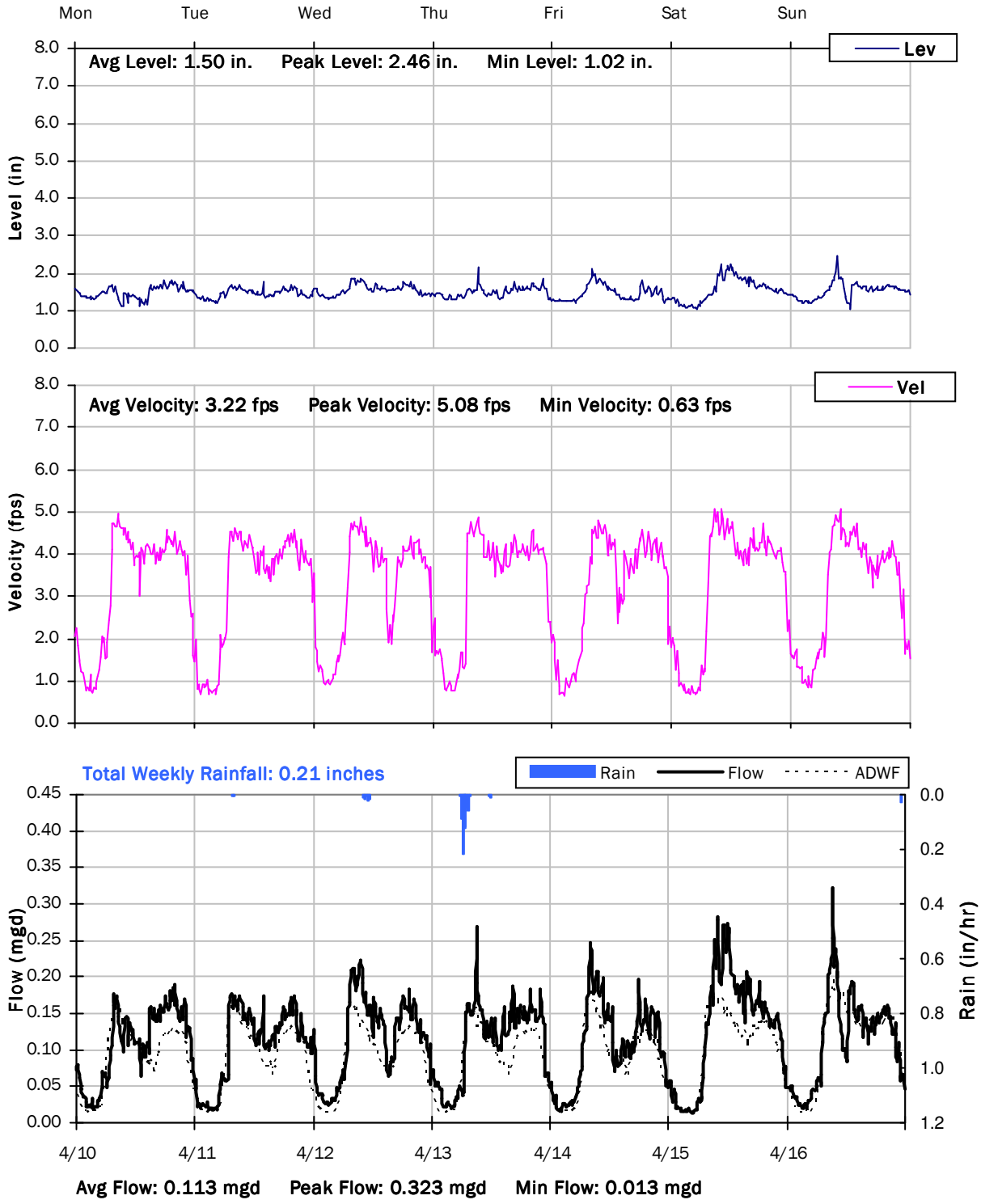
4/3/2017 to 4/10/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

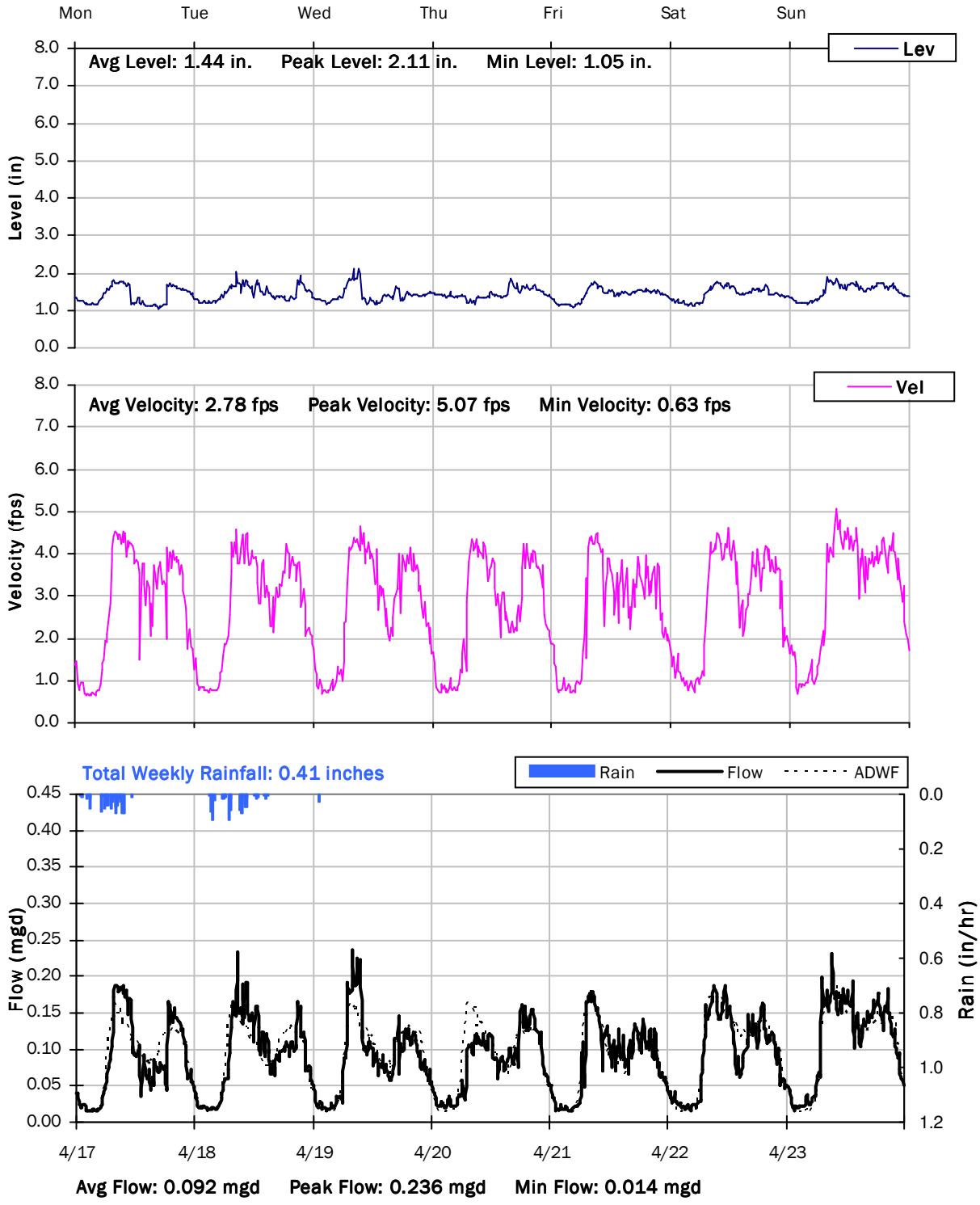
4/10/2017 to 4/17/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

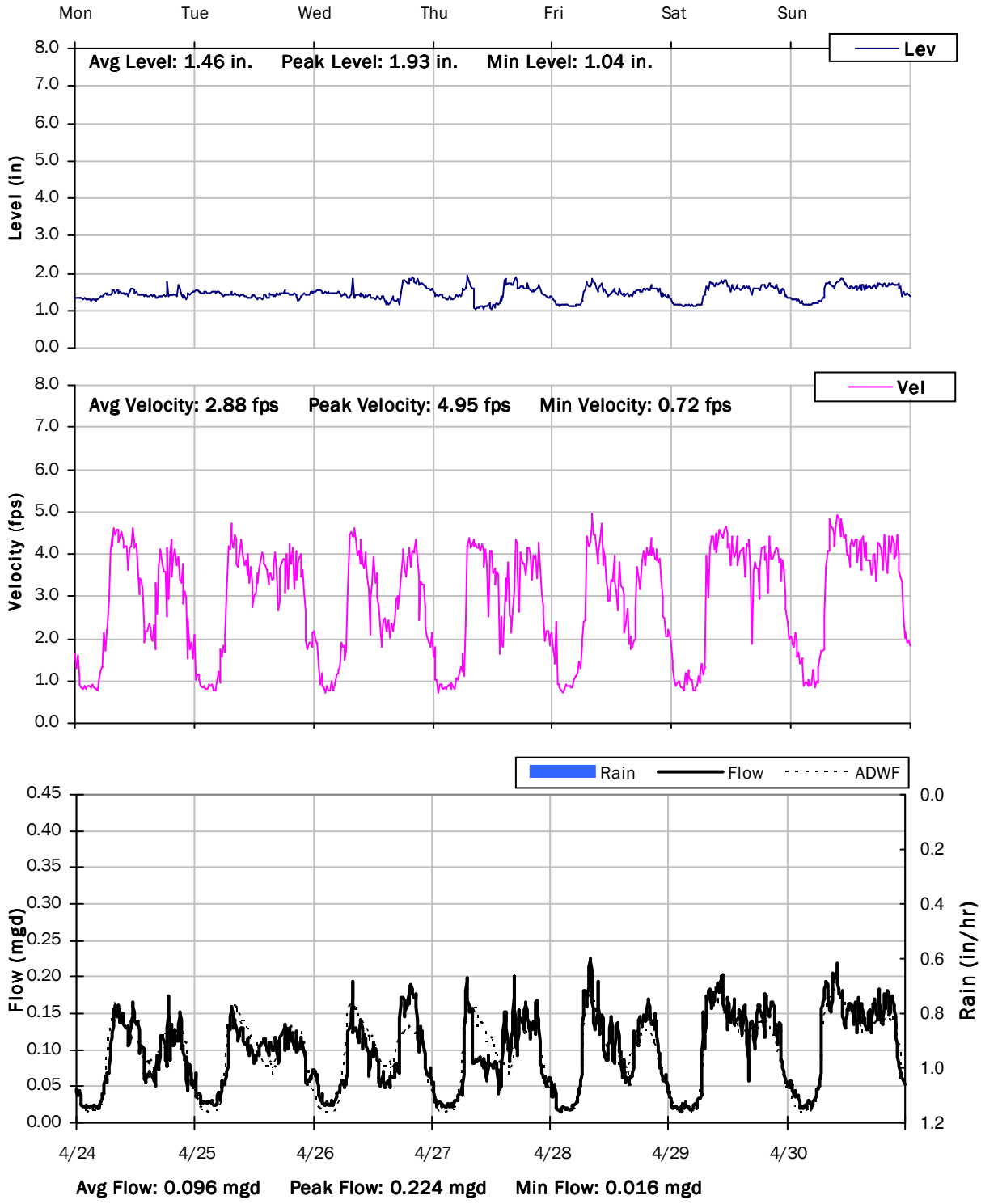
4/17/2017 to 4/24/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

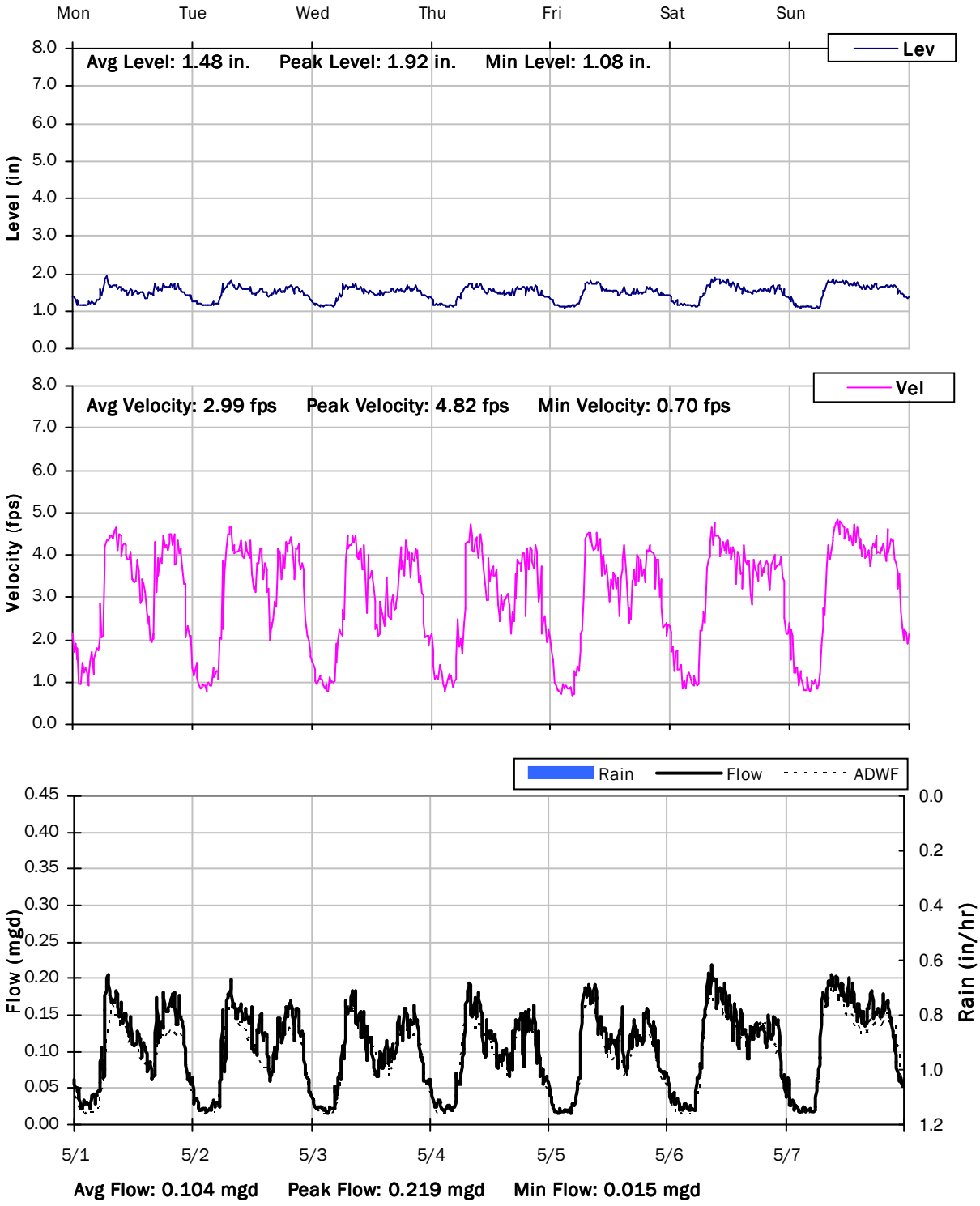
4/24/2017 to 5/1/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

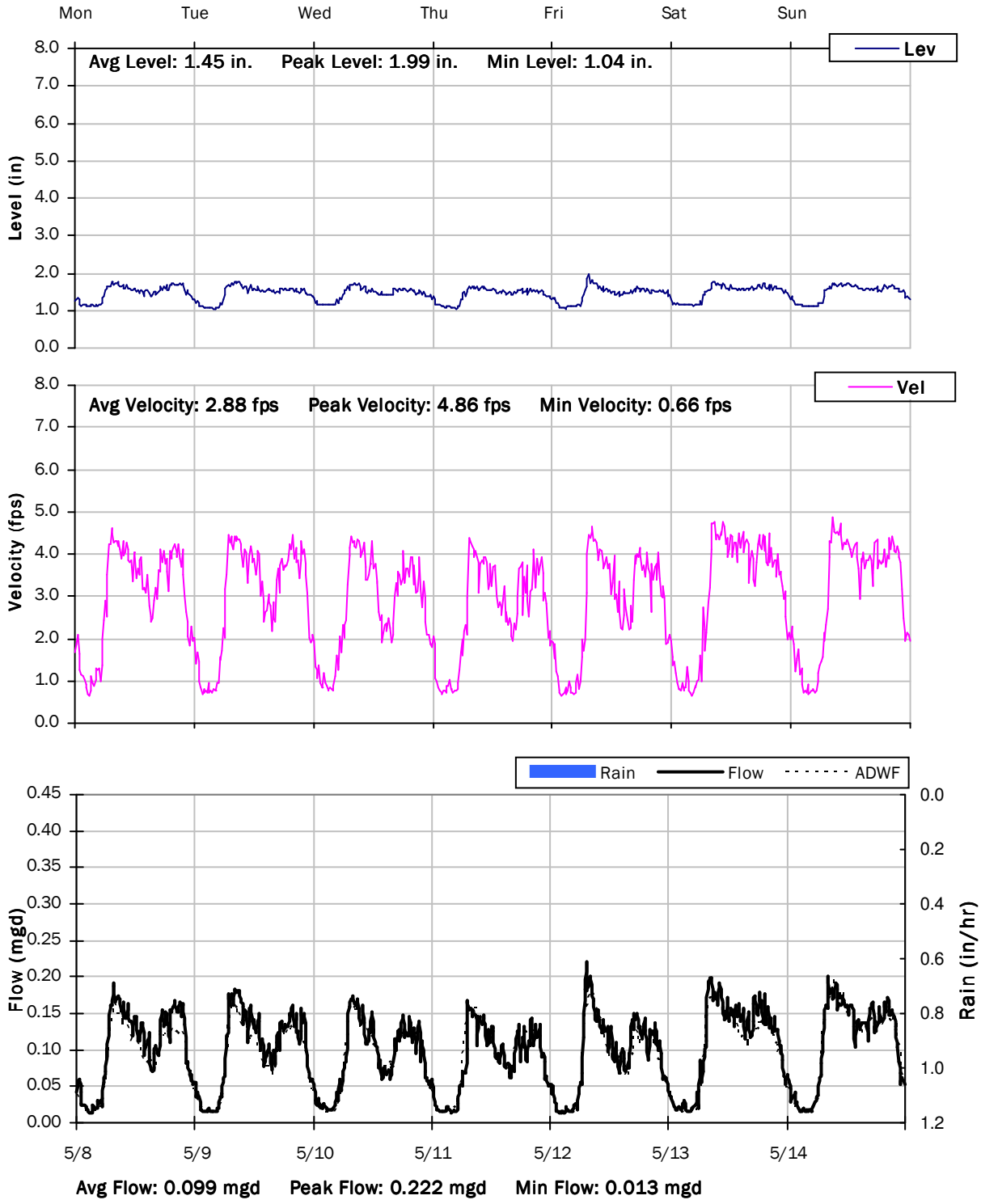
5/1/2017 to 5/8/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

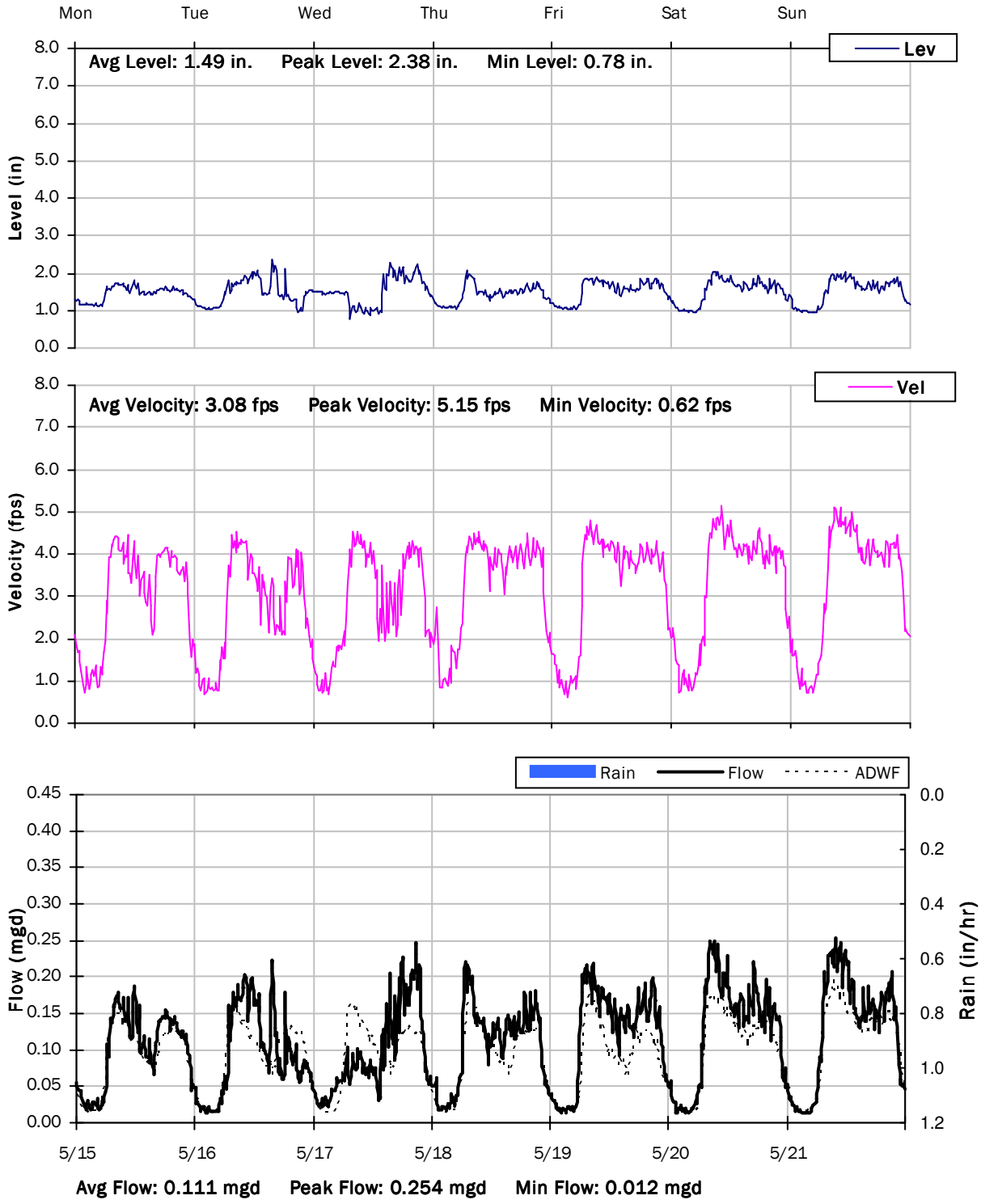
5/8/2017 to 5/15/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

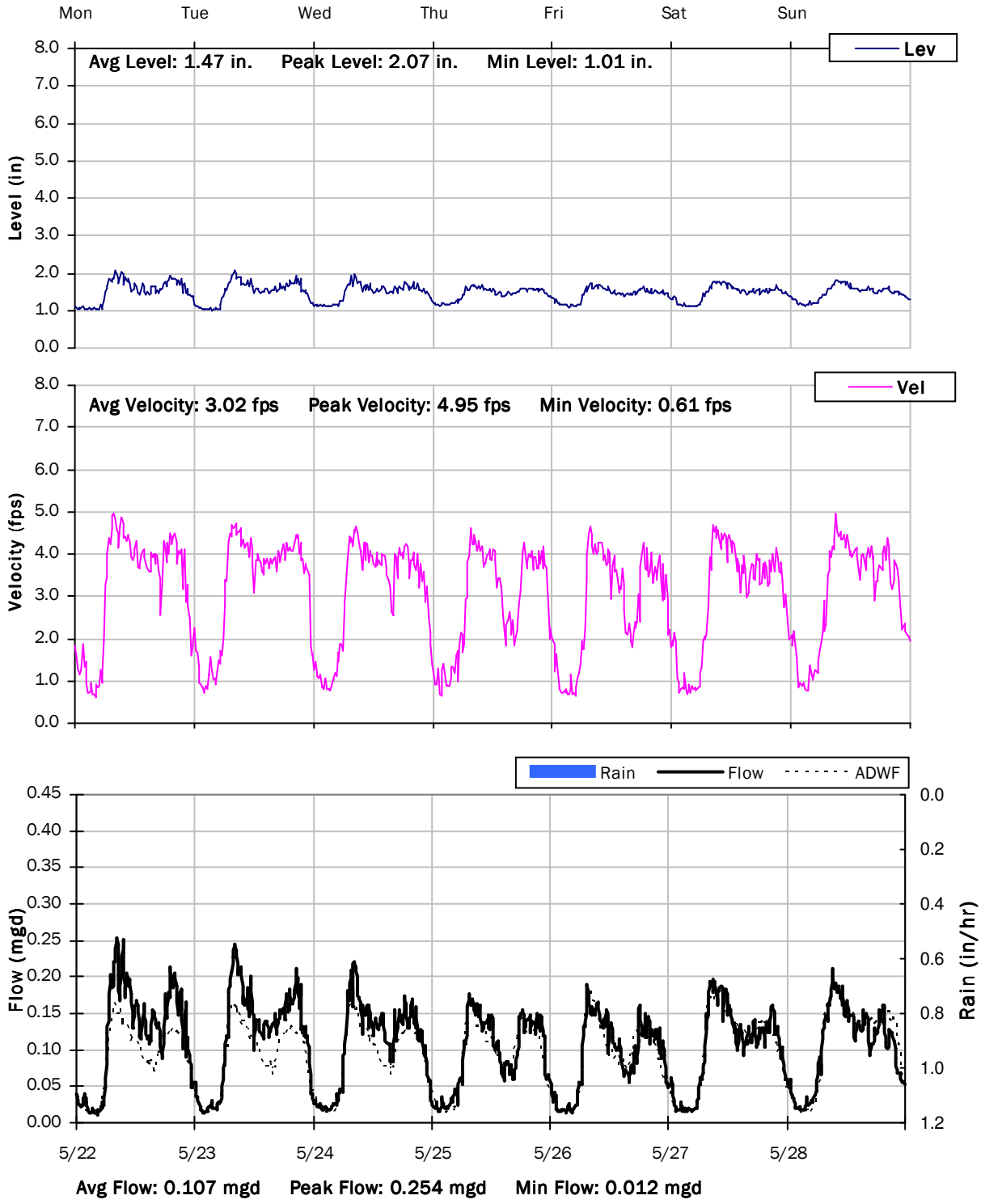
5/15/2017 to 5/22/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

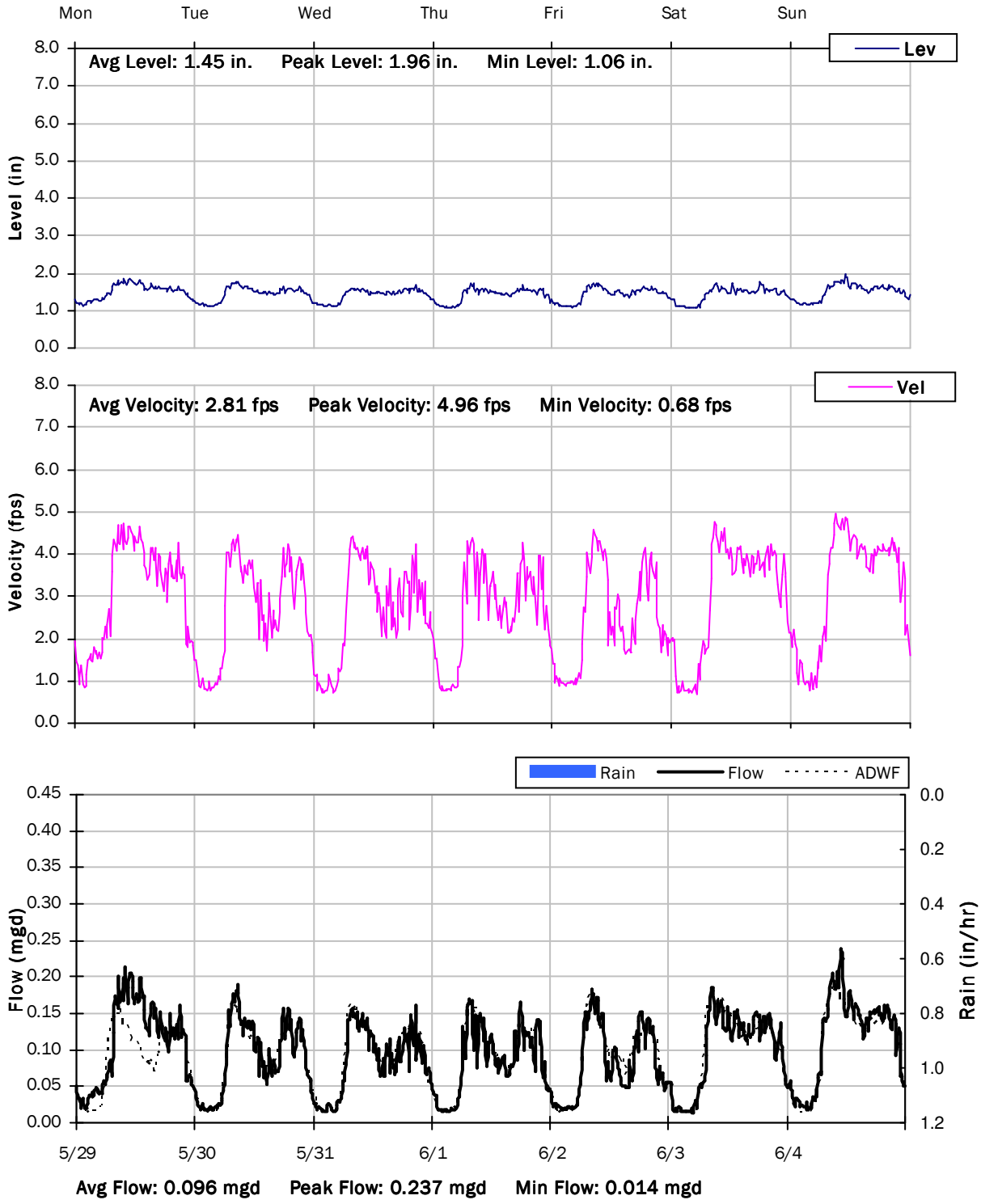
5/22/2017 to 5/29/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

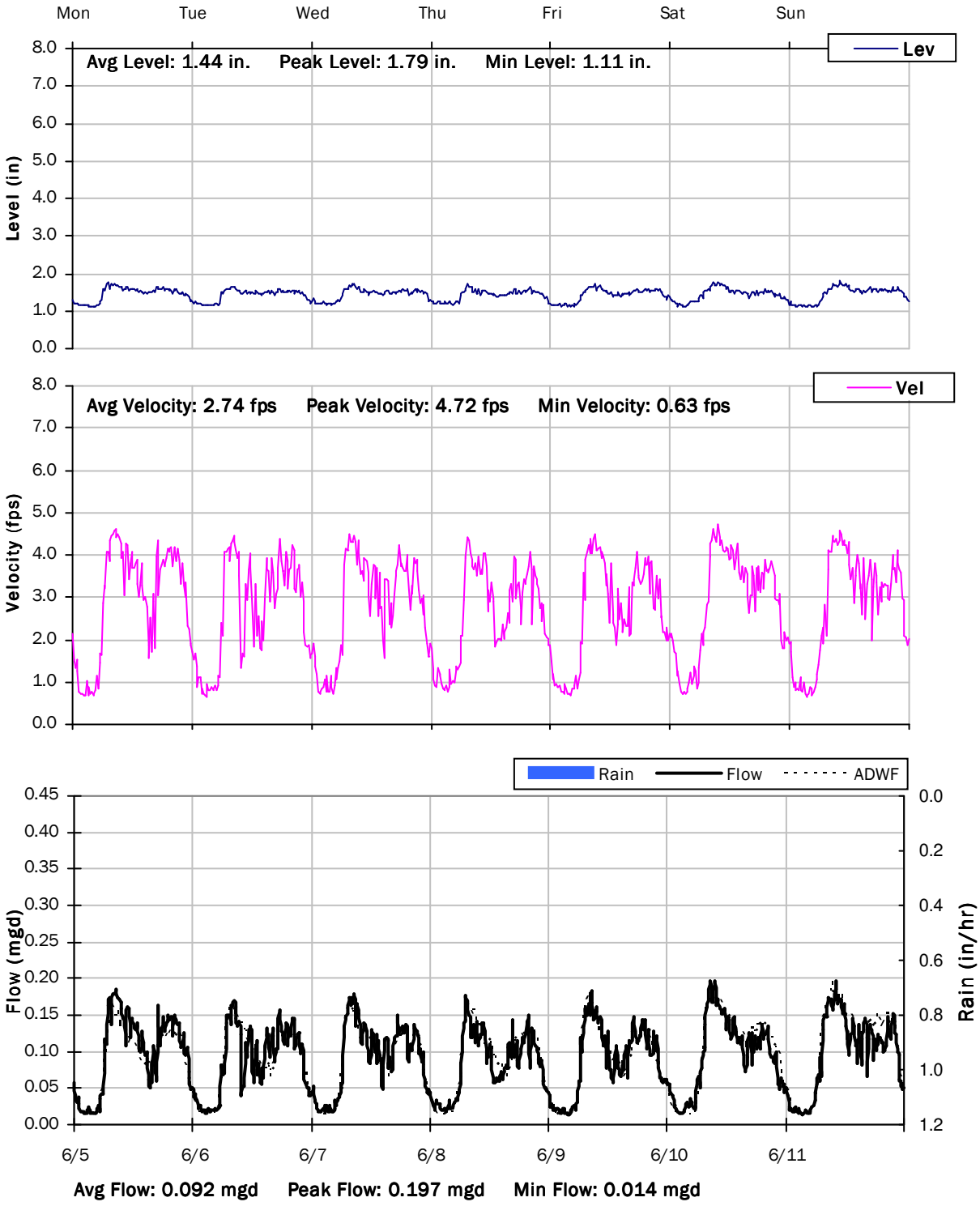
5/29/2017 to 6/5/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

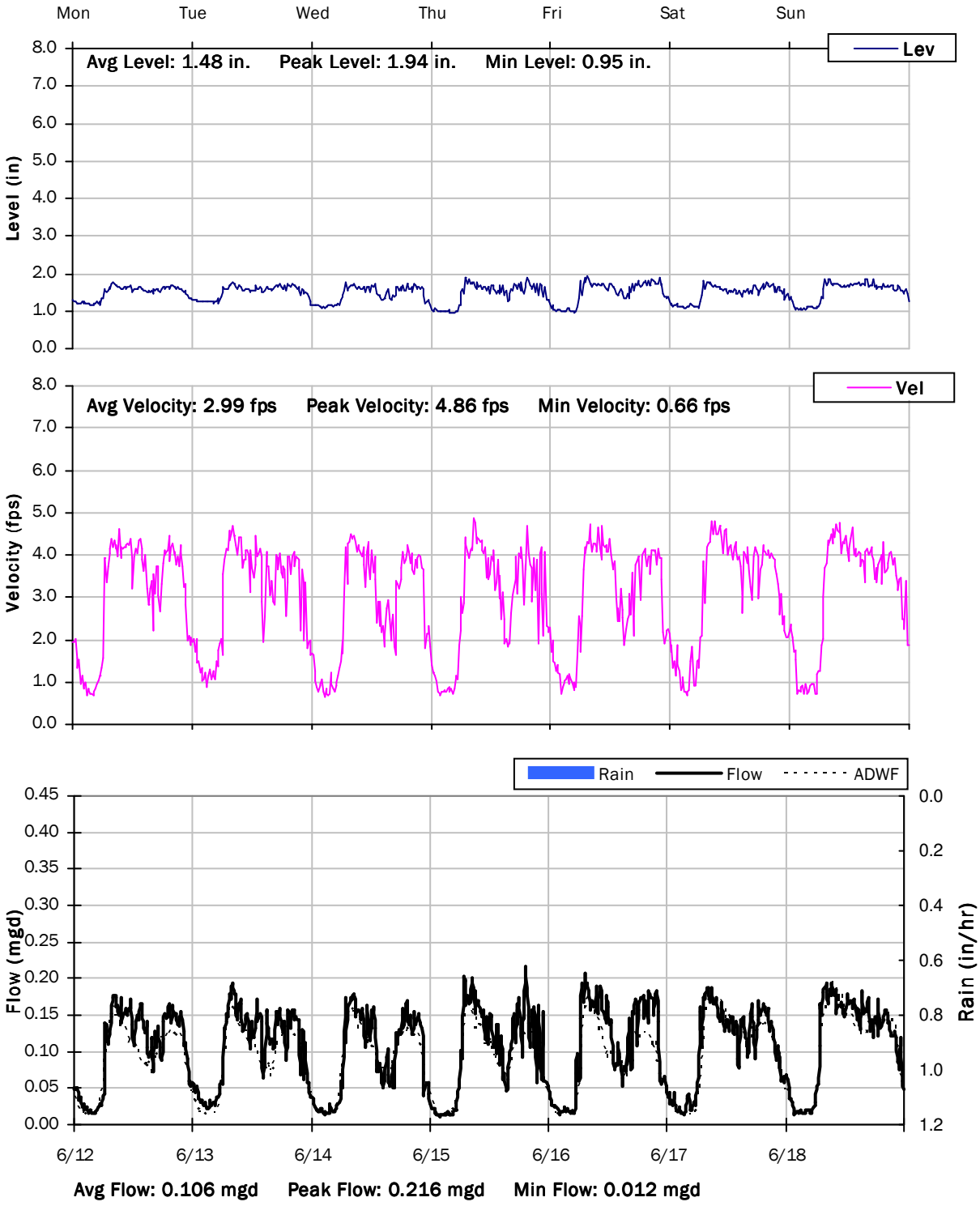
6/5/2017 to 6/12/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

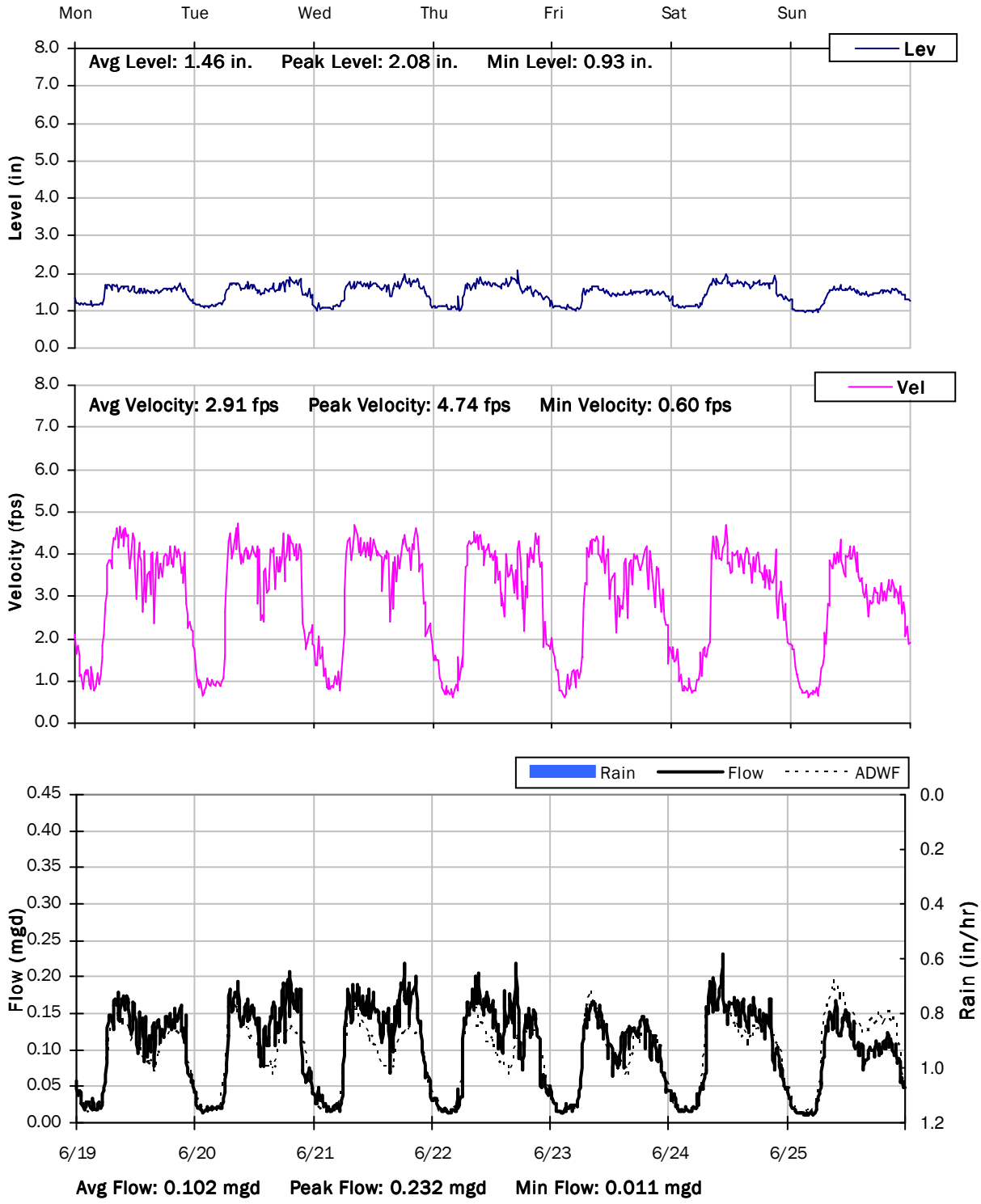
6/12/2017 to 6/19/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

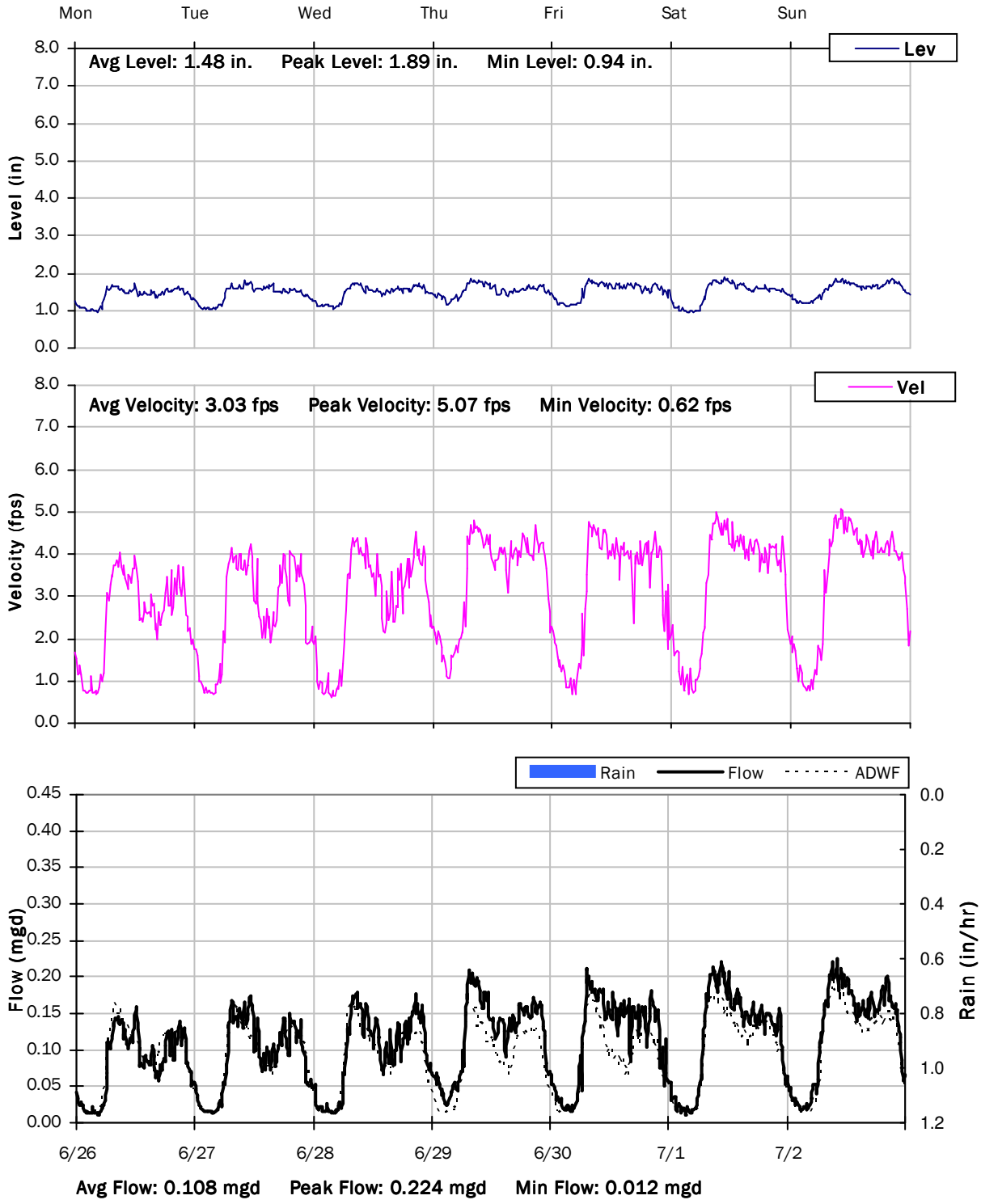
6/19/2017 to 6/26/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

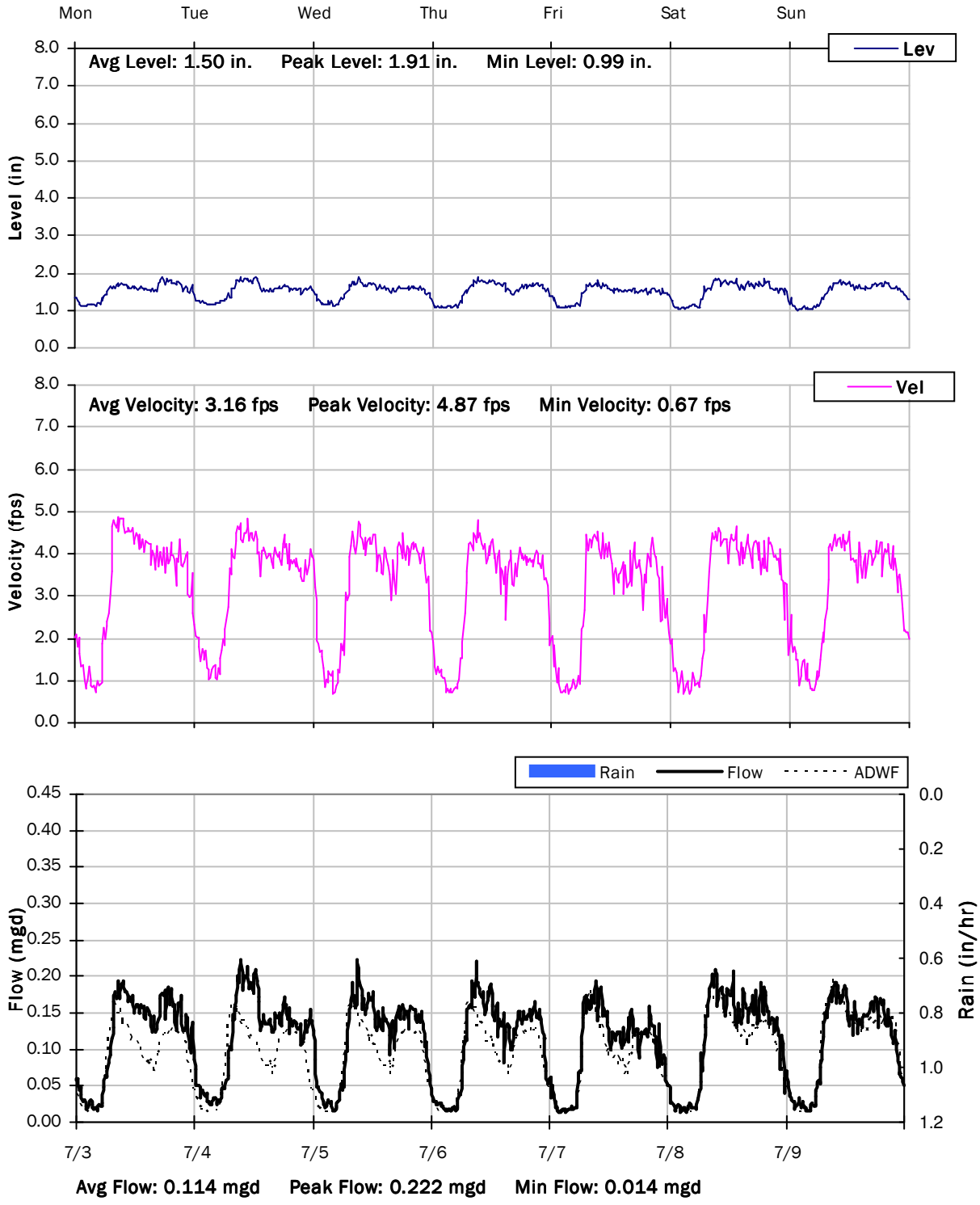
6/26/2017 to 7/3/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

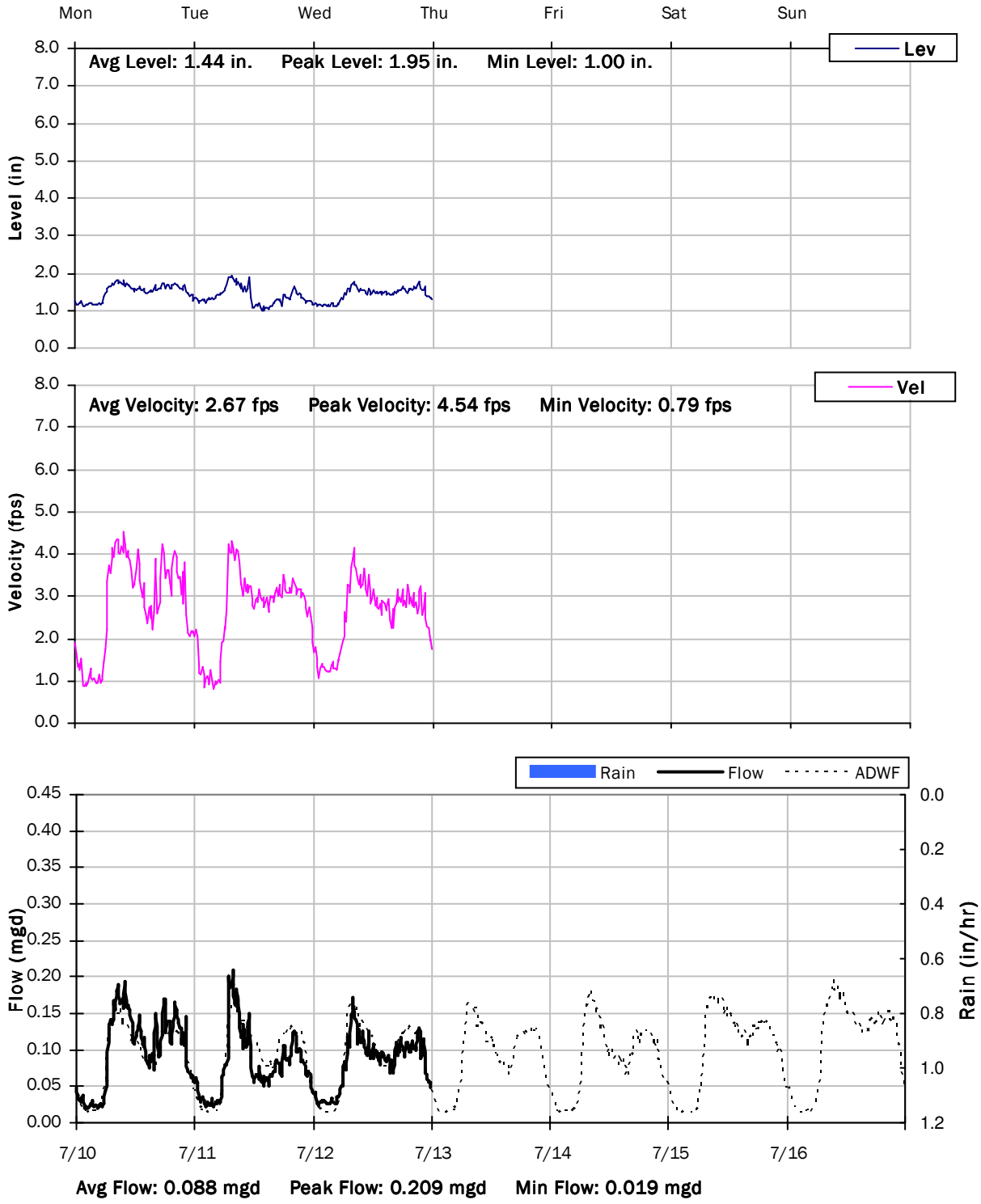
7/3/2017 to 7/10/2017



SITE 14

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



City of Morro Bay

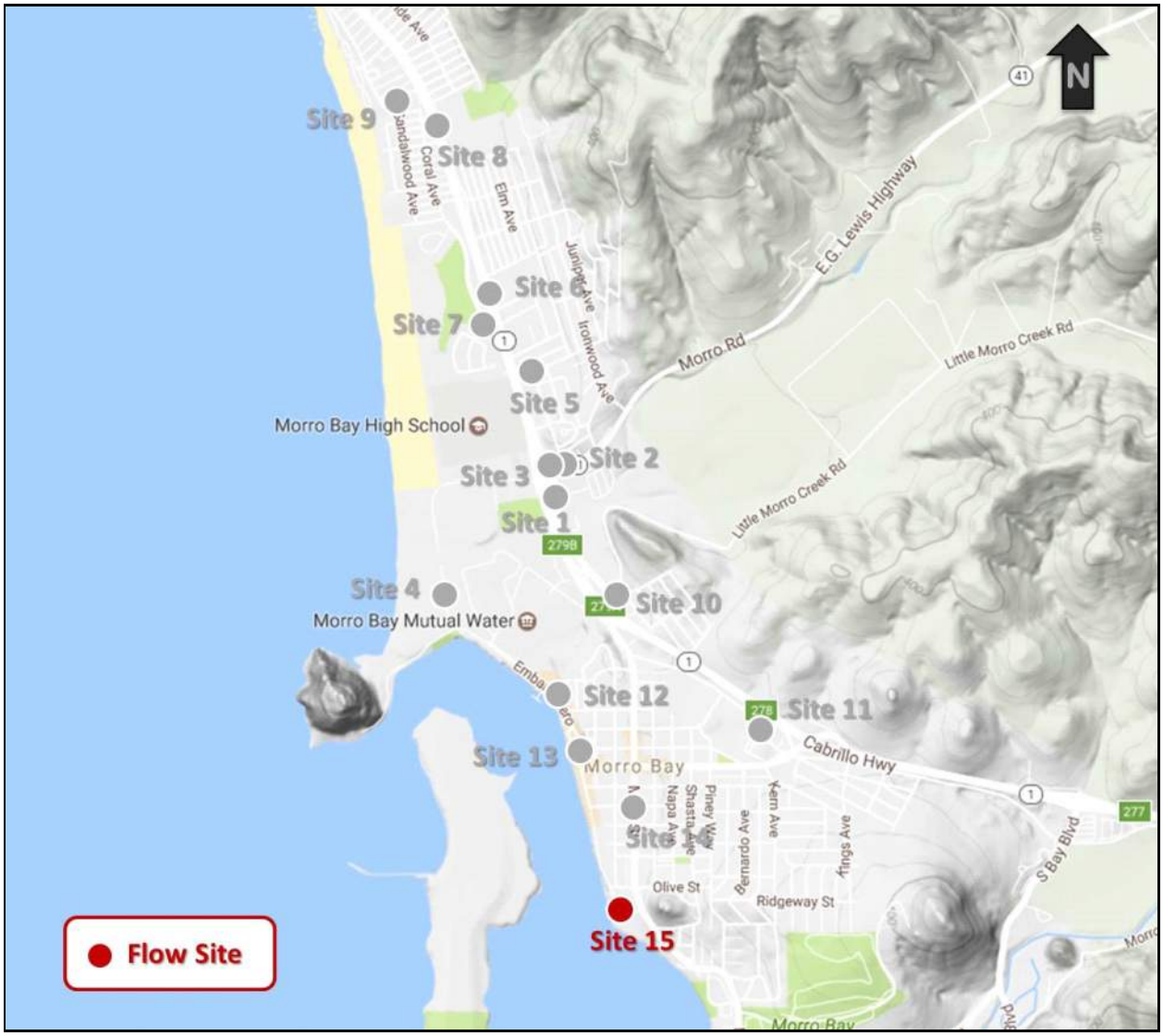
Sanitary Sewer Flow Monitoring

Temporary Monitoring: April 2017 - July 2017

Monitoring Site: Site 15

Location: 301 Embarcadero, ~90 feet north of Morro Bay Launching Facility, meter on south 10" inlet

Data Summary Report



Vicinity Map: Site 15

SITE 15

Site Information

Location: 301 Embarcadero, ~90 feet north of Morro Bay Launching Facility, meter on south 10" inlet

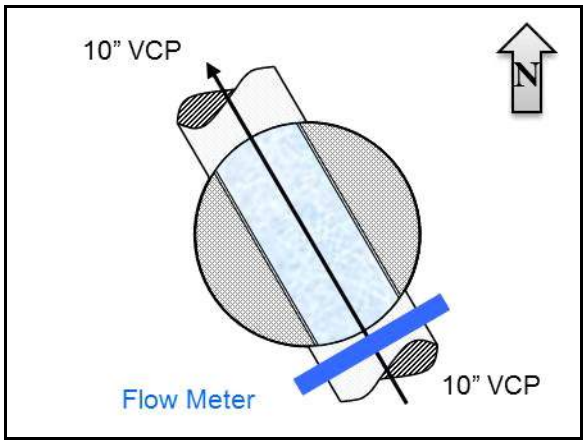


Pipe Diameter: 10 inches

ADWF: 0.046 mgd

Peak Measured Flow: 0.208 mgd









SITE 15

Additional Site Photos



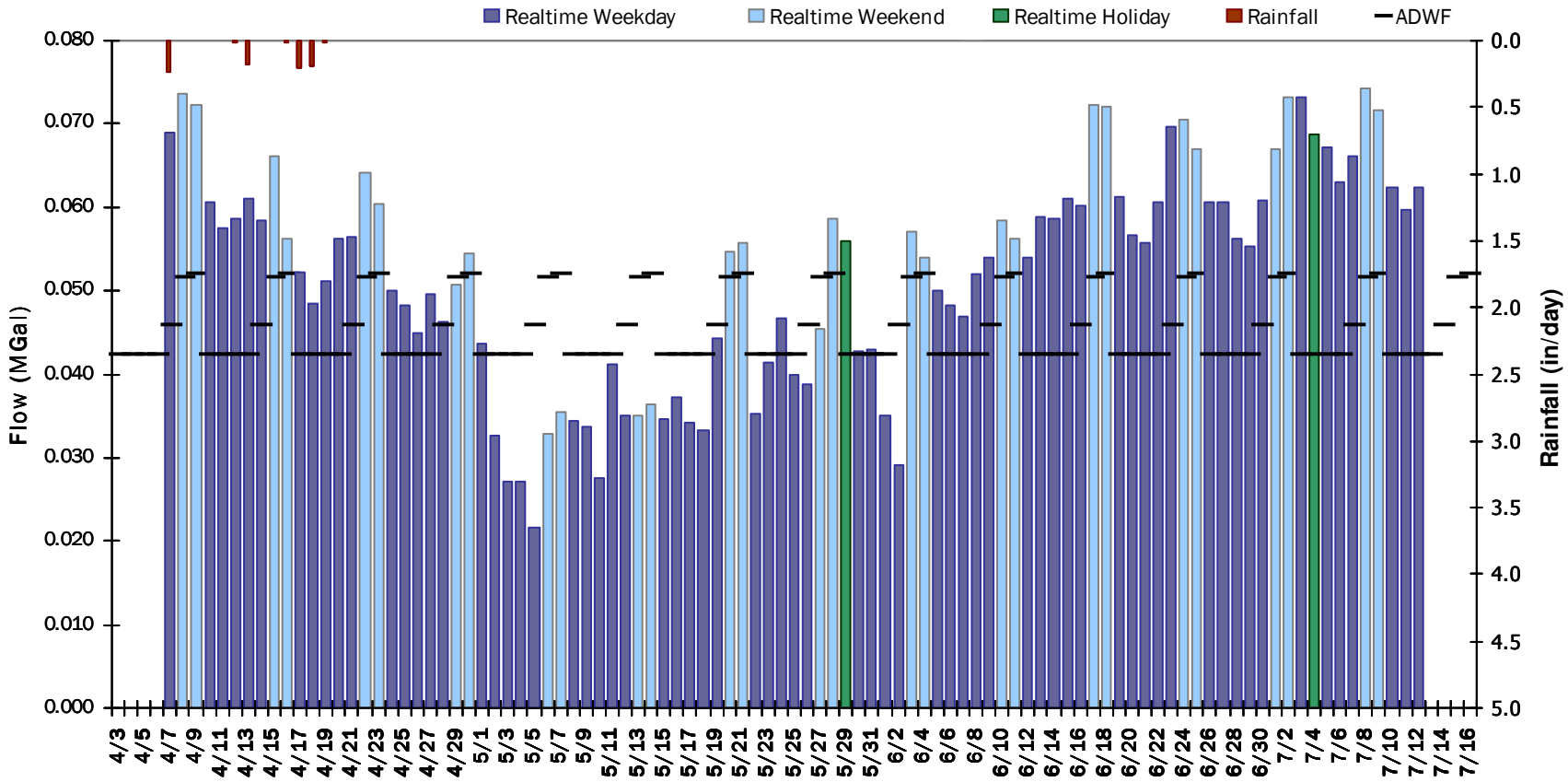


SITE 15

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.053 MGal Peak Daily Flow: 0.074 MGal Min Daily Flow: 0.022 MGal

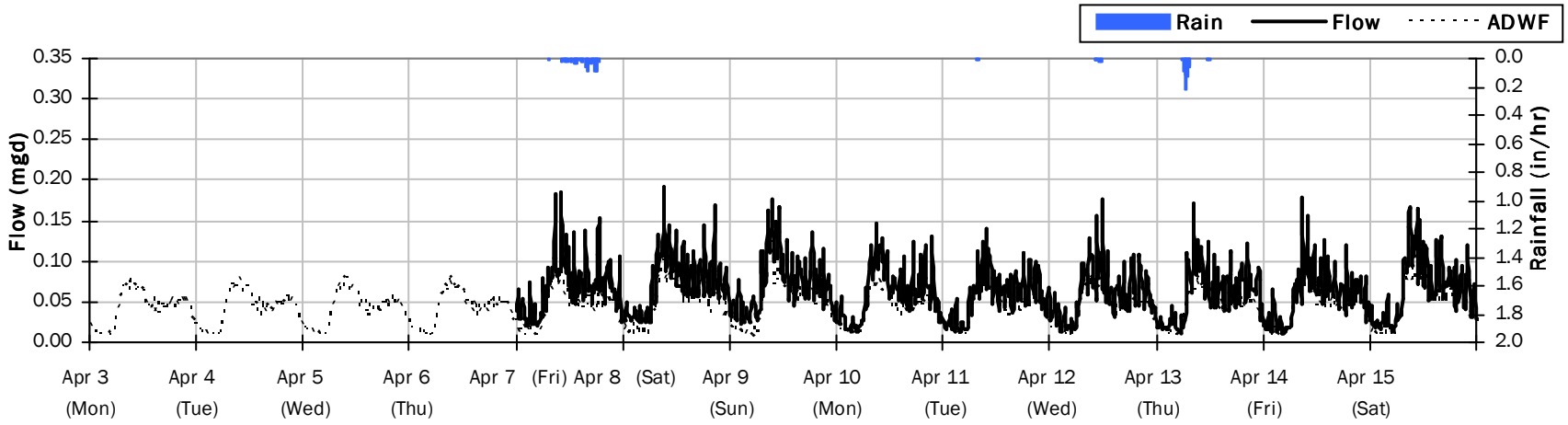
Total Period Rainfall: 0.85 inches

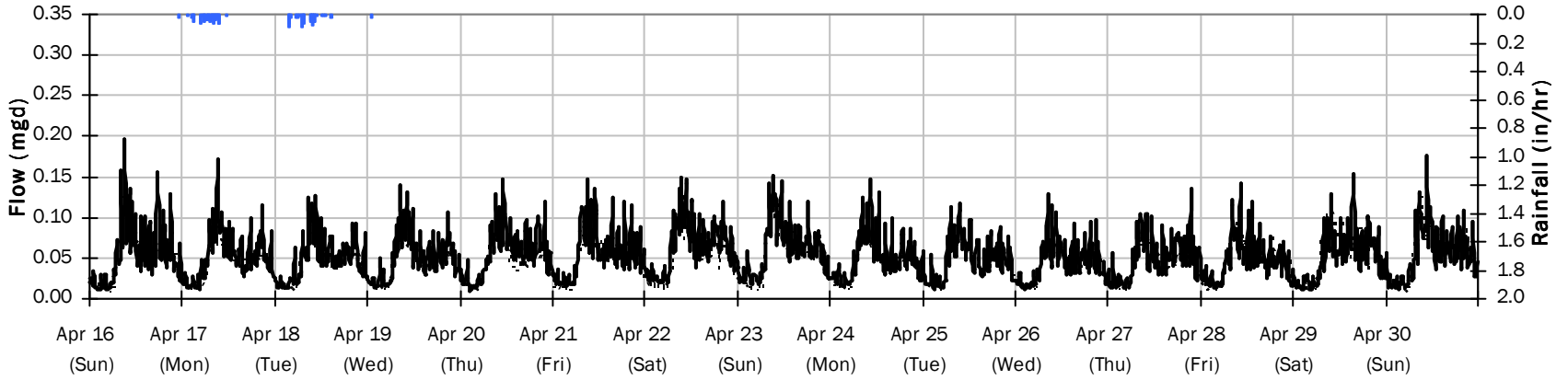


SITE 15

Flow Summary: 4/1/2017 to 4/30/2017

Total Period Rainfall: 0.85 inches **Avg Flow: 0.057 mgd** **Peak Flow: 0.196 mgd** **Min Flow: 0.009 mgd**

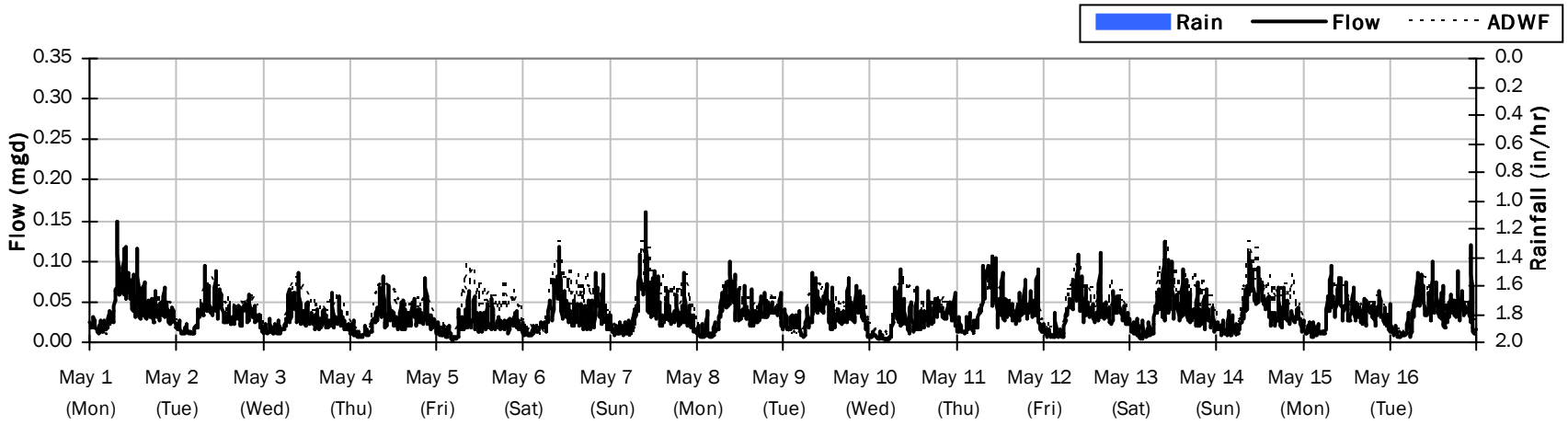


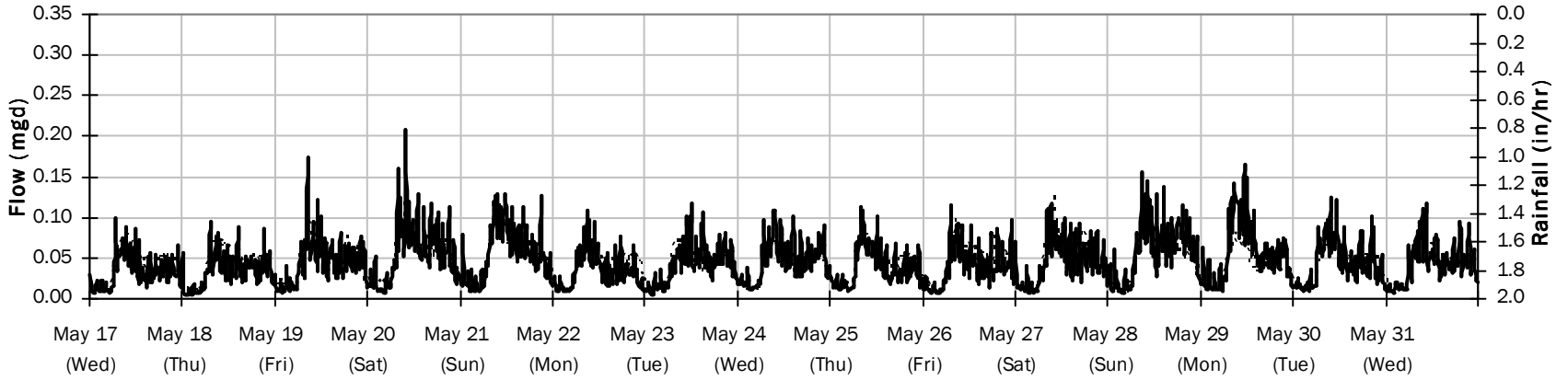


SITE 15

Flow Summary: 5/1/2017 to 5/31/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.039 mgd** **Peak Flow: 0.208 mgd** **Min Flow: 0.003 mgd**

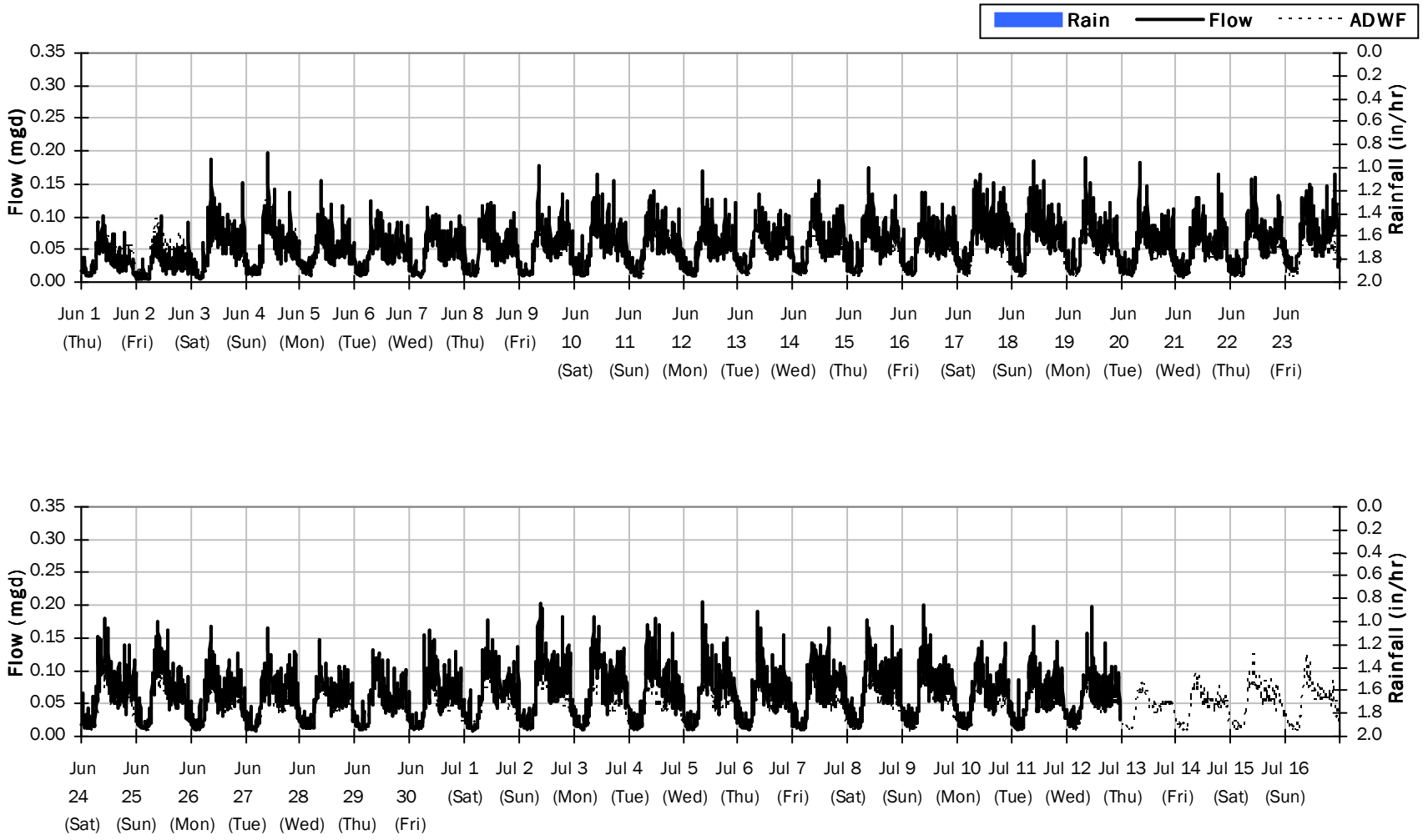




SITE 15

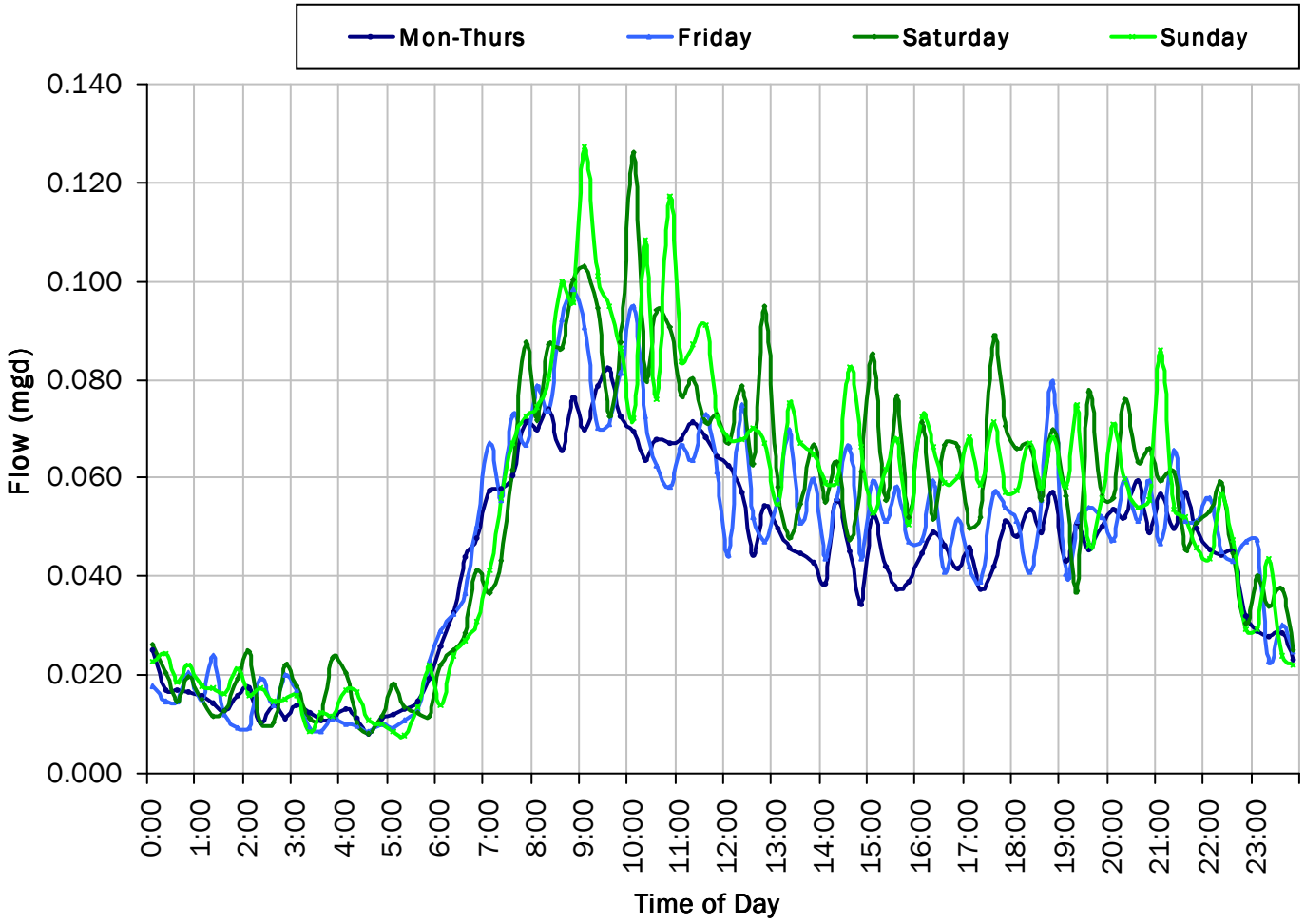
Flow Summary: 6/1/2017 to 7/16/2017

Total Period Rainfall: 0.00 inches **Avg Flow: 0.060 mgd** **Peak Flow: 0.206 mgd** **Min Flow: 0.004 mgd**



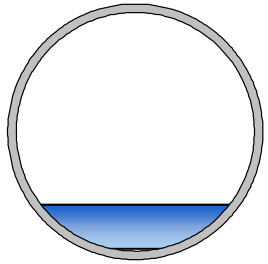
SITE 15

Average Dry Weather Flow Hydrographs



ADWF:

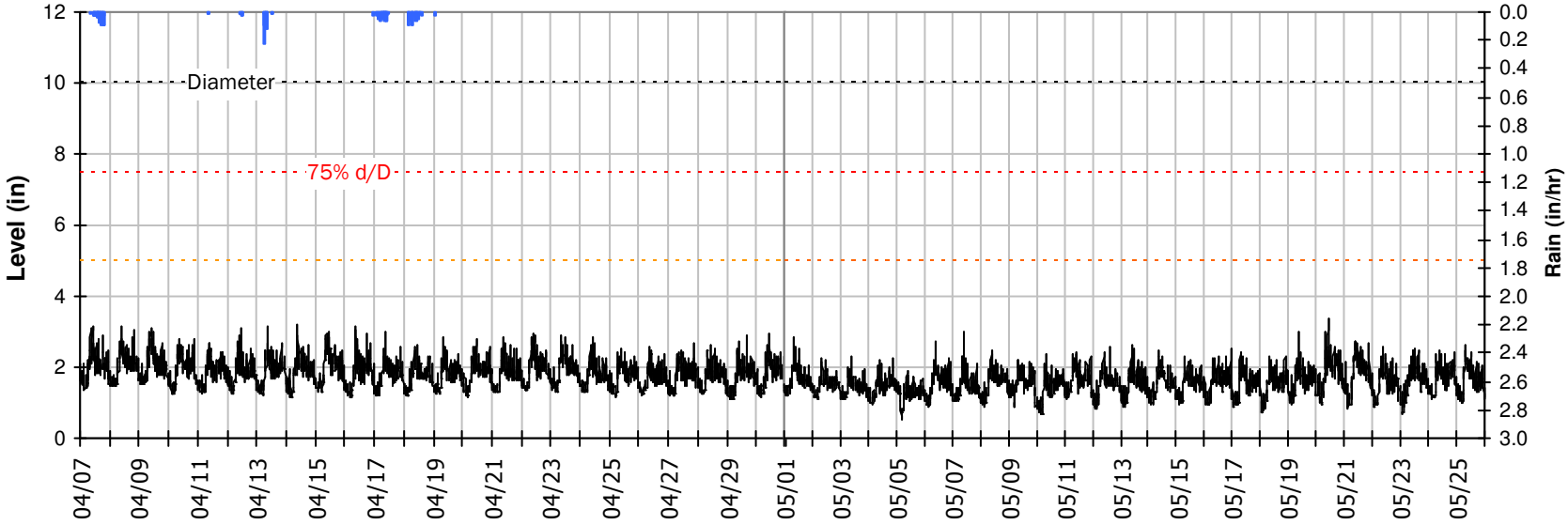
0.046 *mgd*

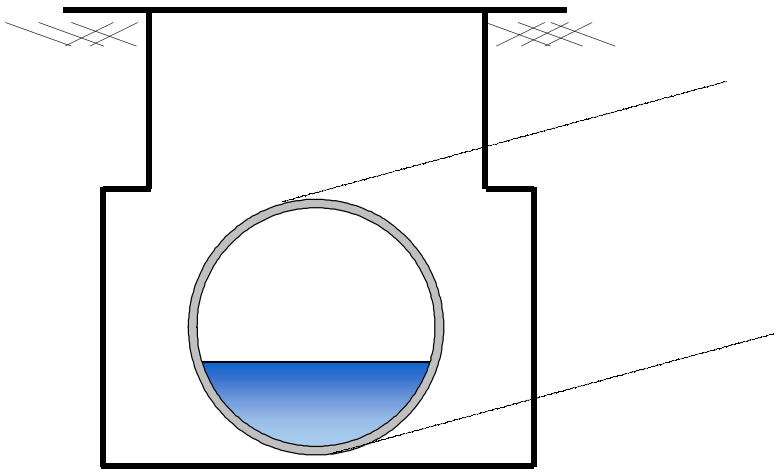


SITE 15

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



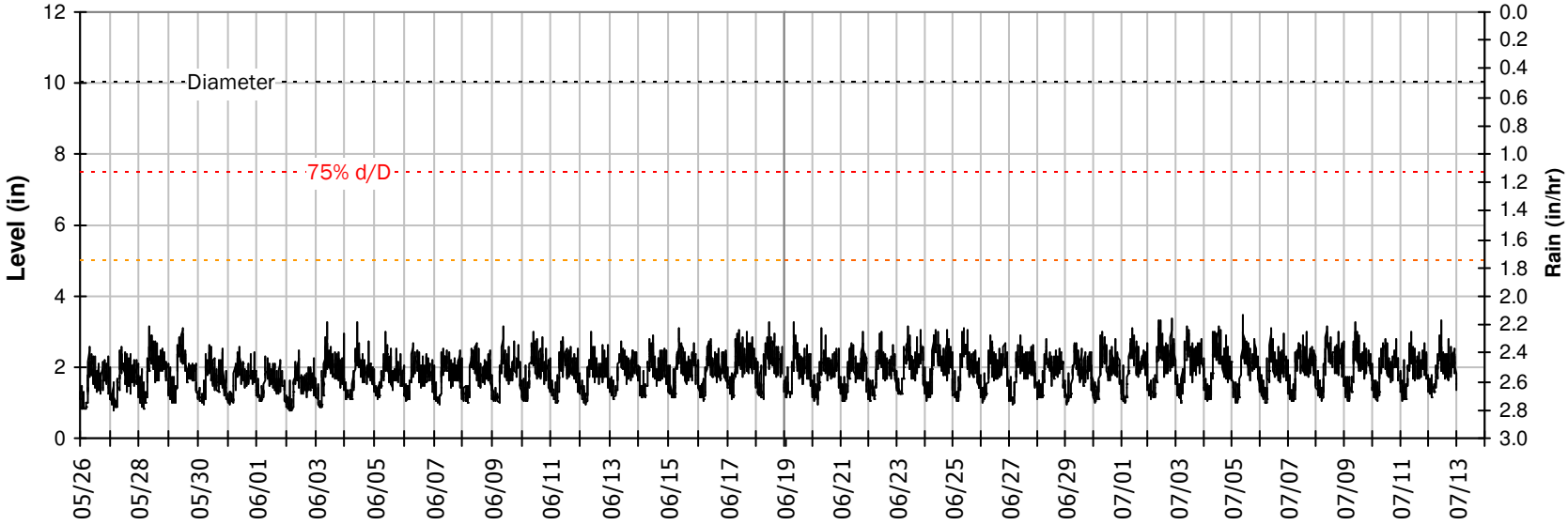


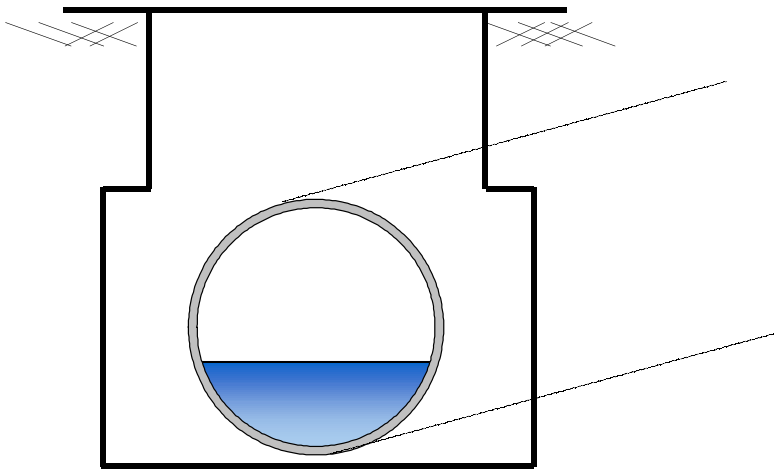
Pipe Diameter:	10	*inches*
Peak Measured Level:	3.5	*inches*
Peak d/D Ratio:	0.35	

SITE 15

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



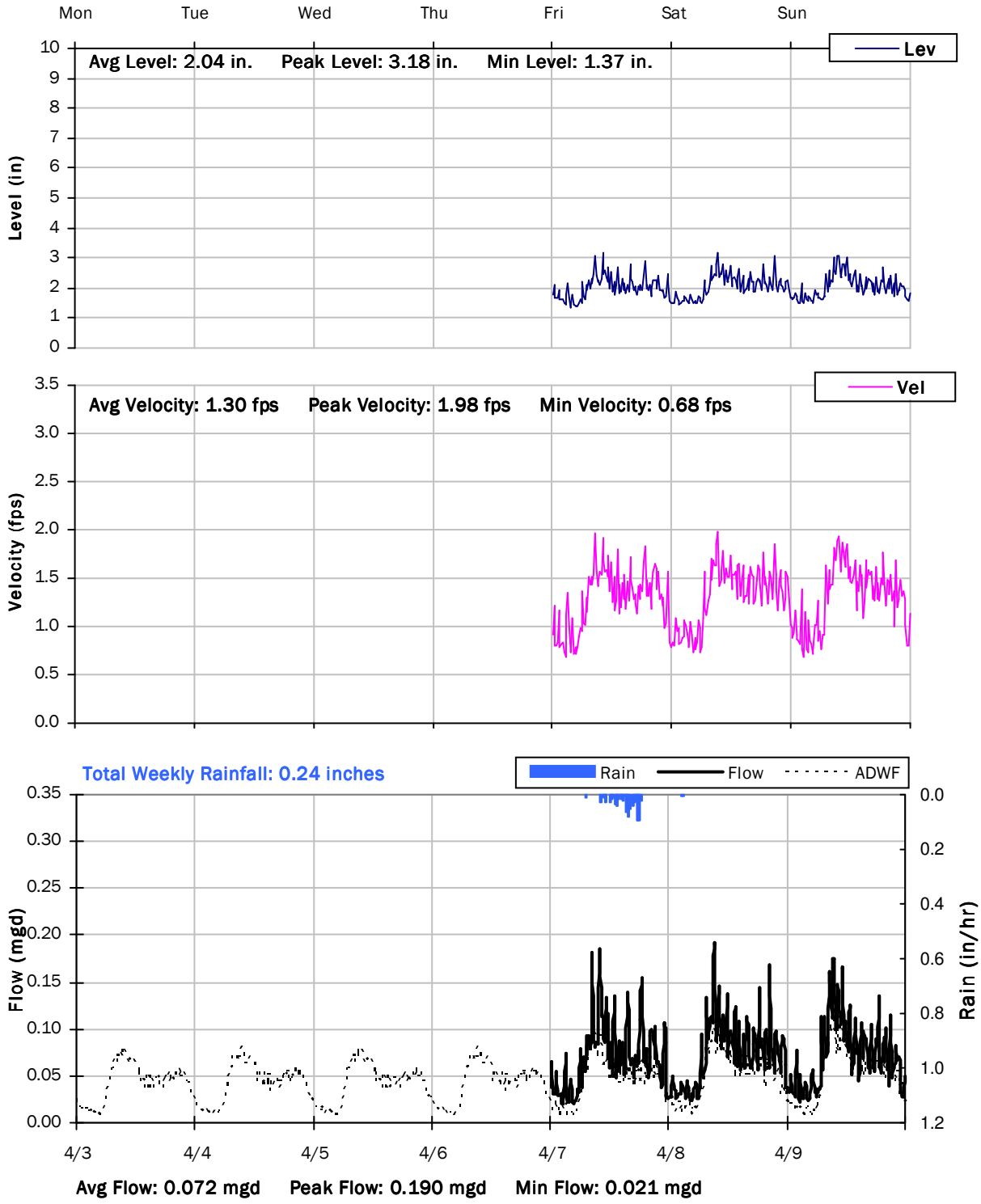


Pipe Diameter:	10	*inches*
Peak Measured Level:	3.5	*inches*
Peak d/D Ratio:	0.35	

SITE 15

Weekly Level, Velocity and Flow Hydrographs

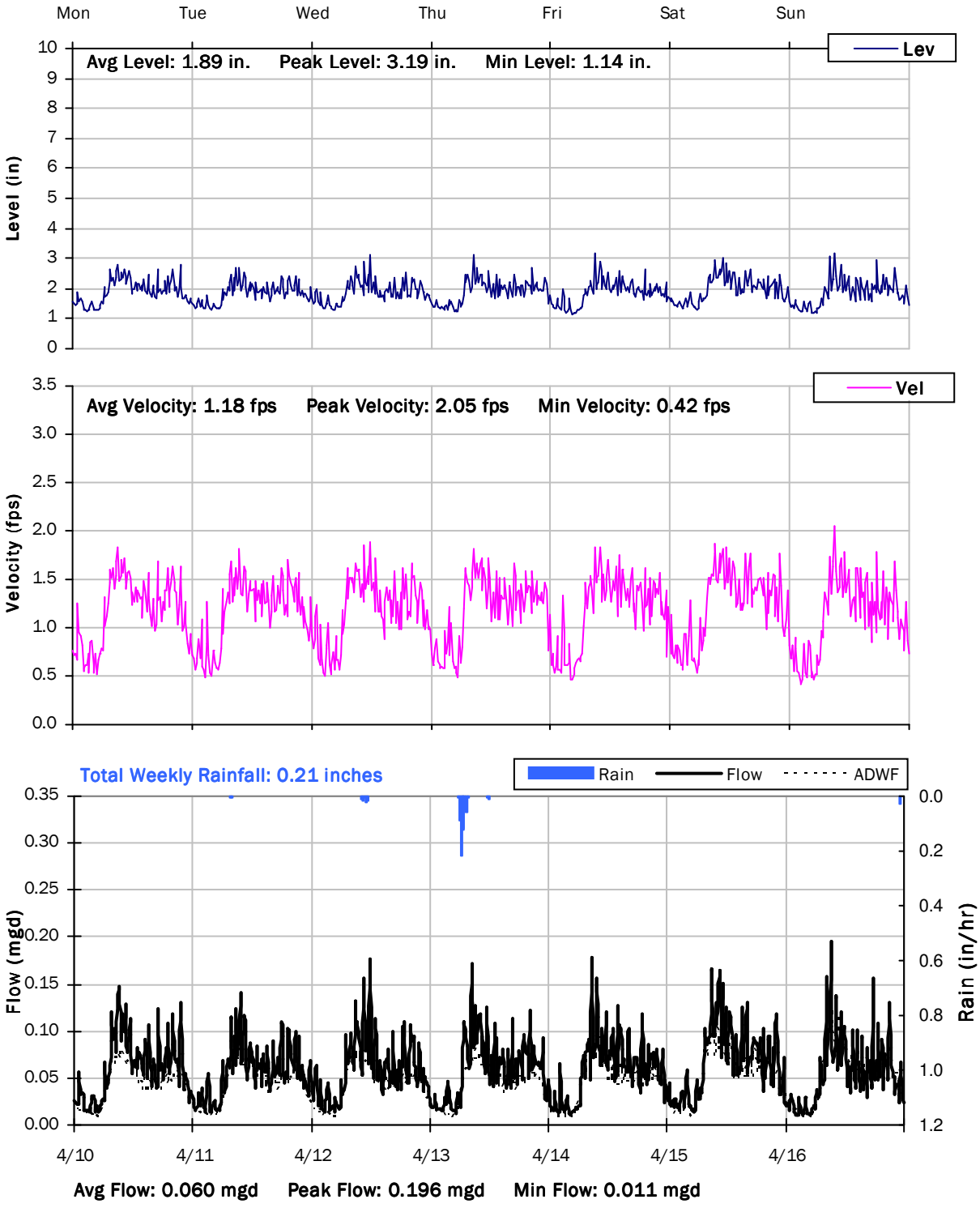
4/3/2017 to 4/10/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

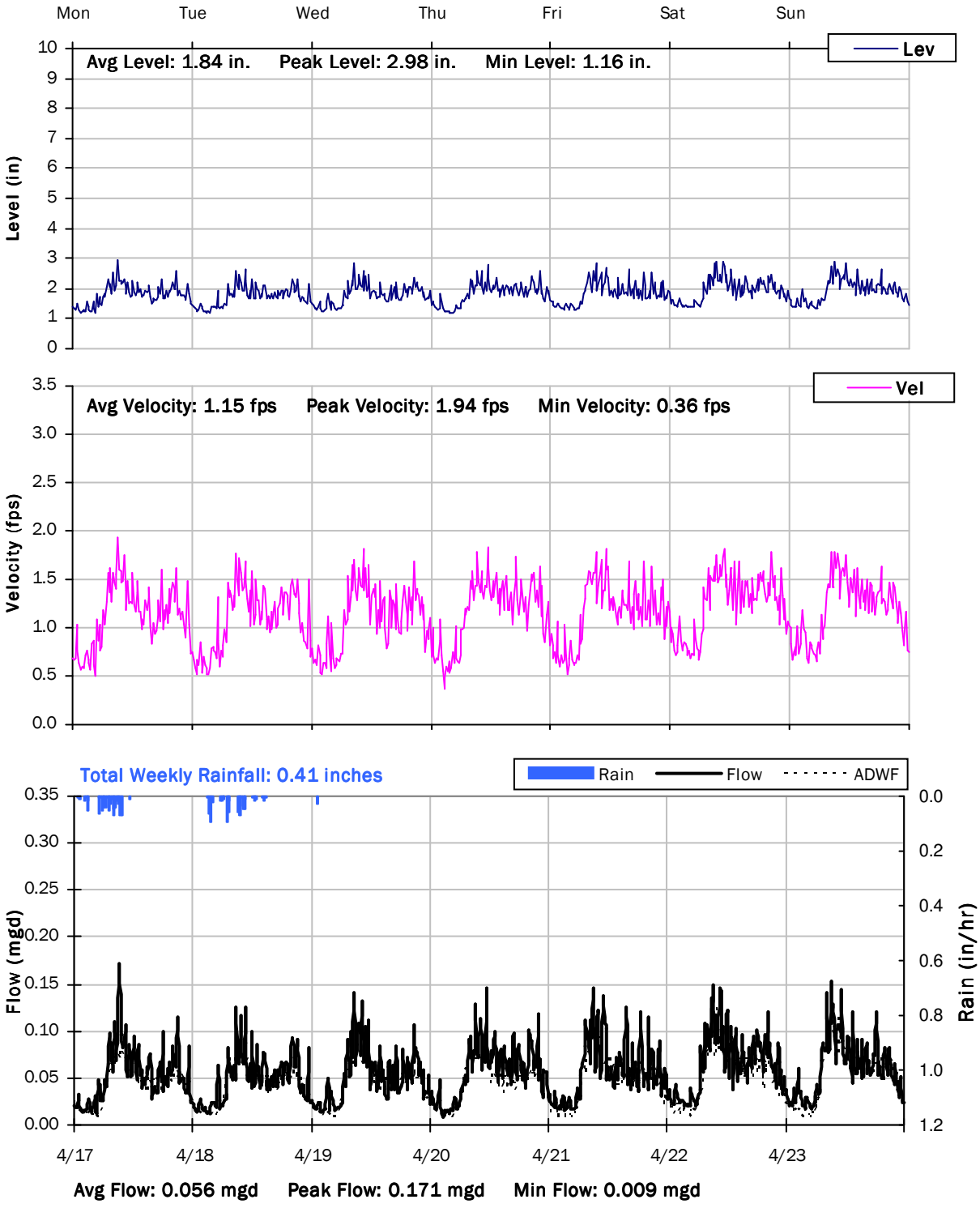
4/10/2017 to 4/17/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

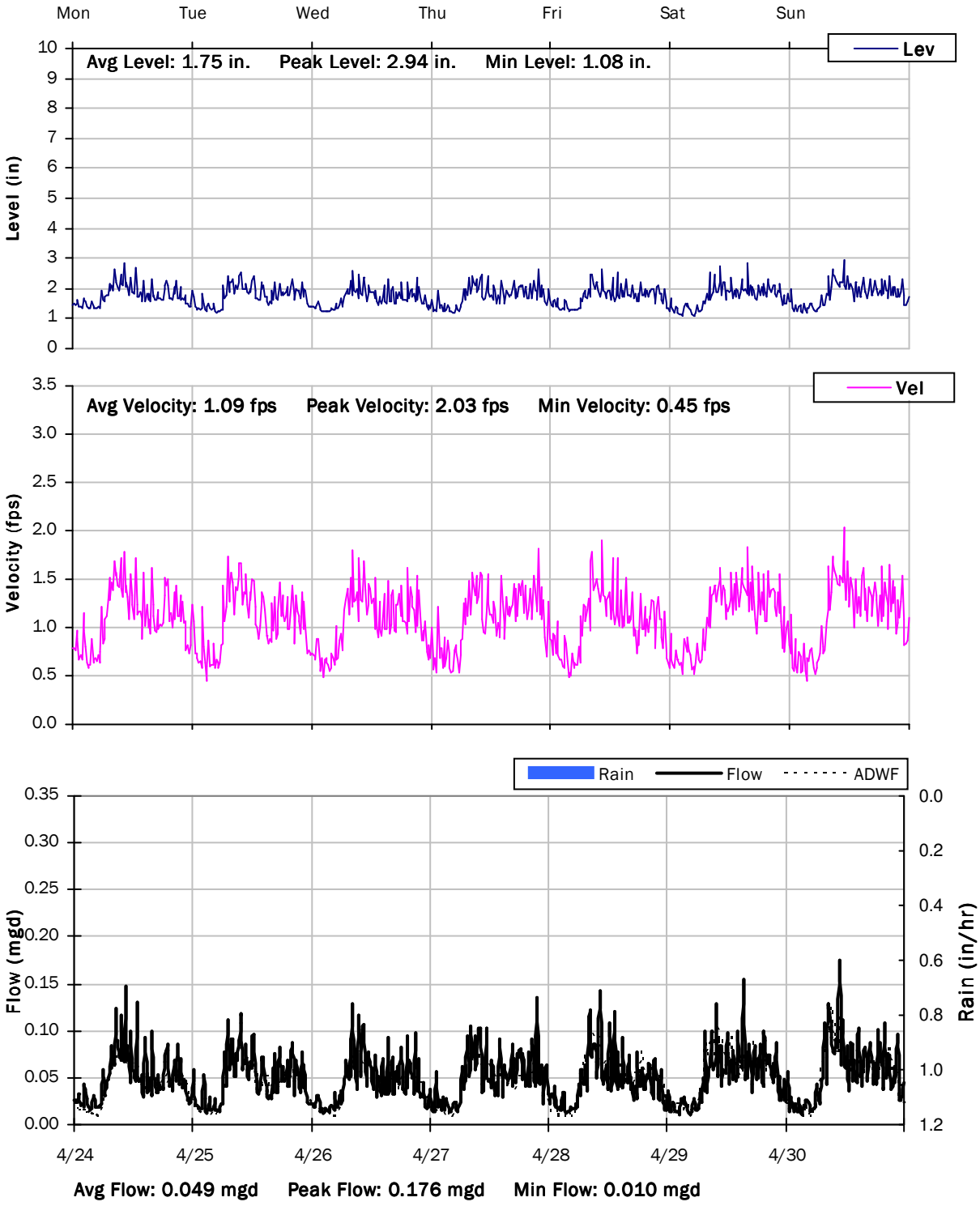
4/17/2017 to 4/24/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

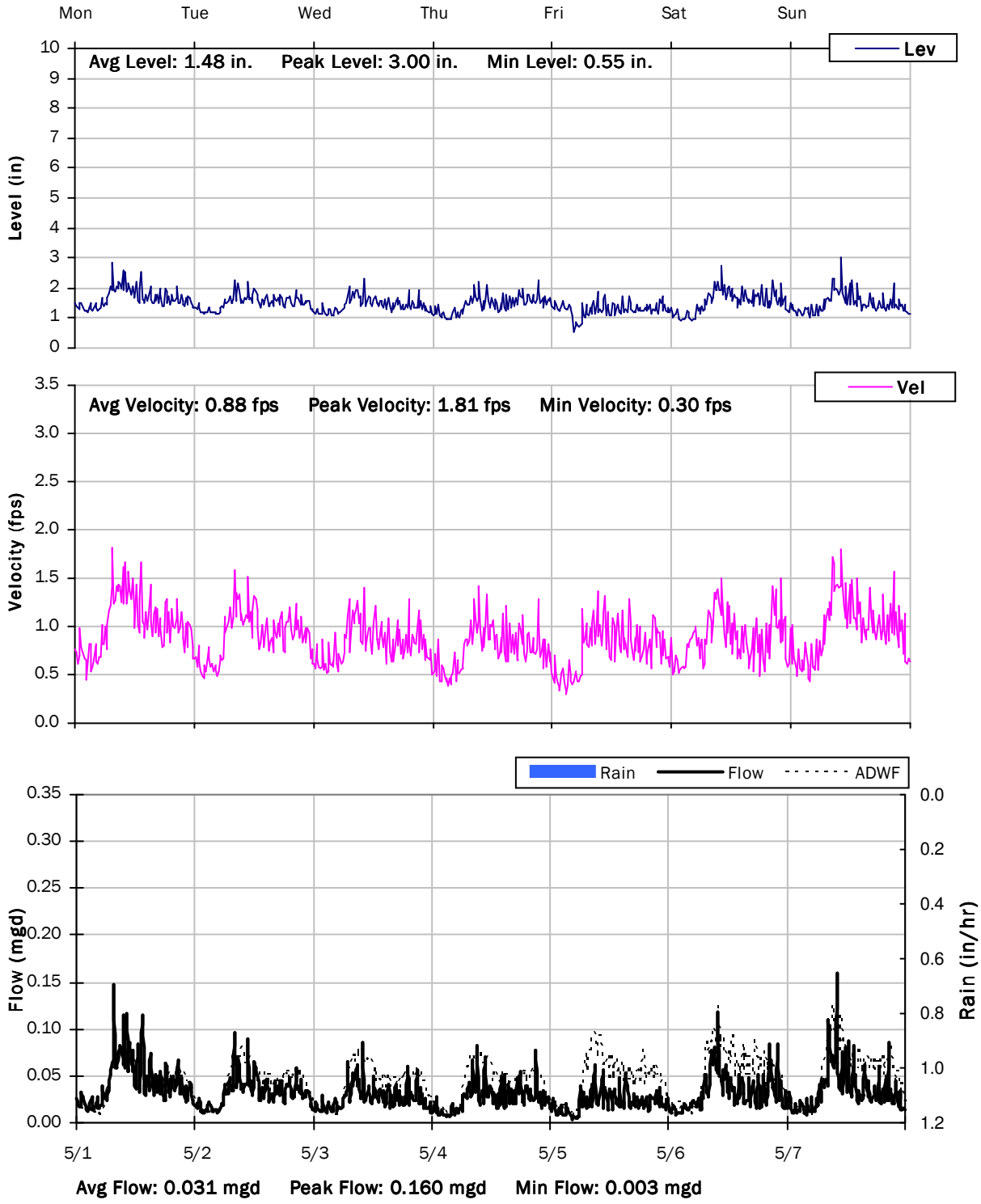
4/24/2017 to 5/1/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

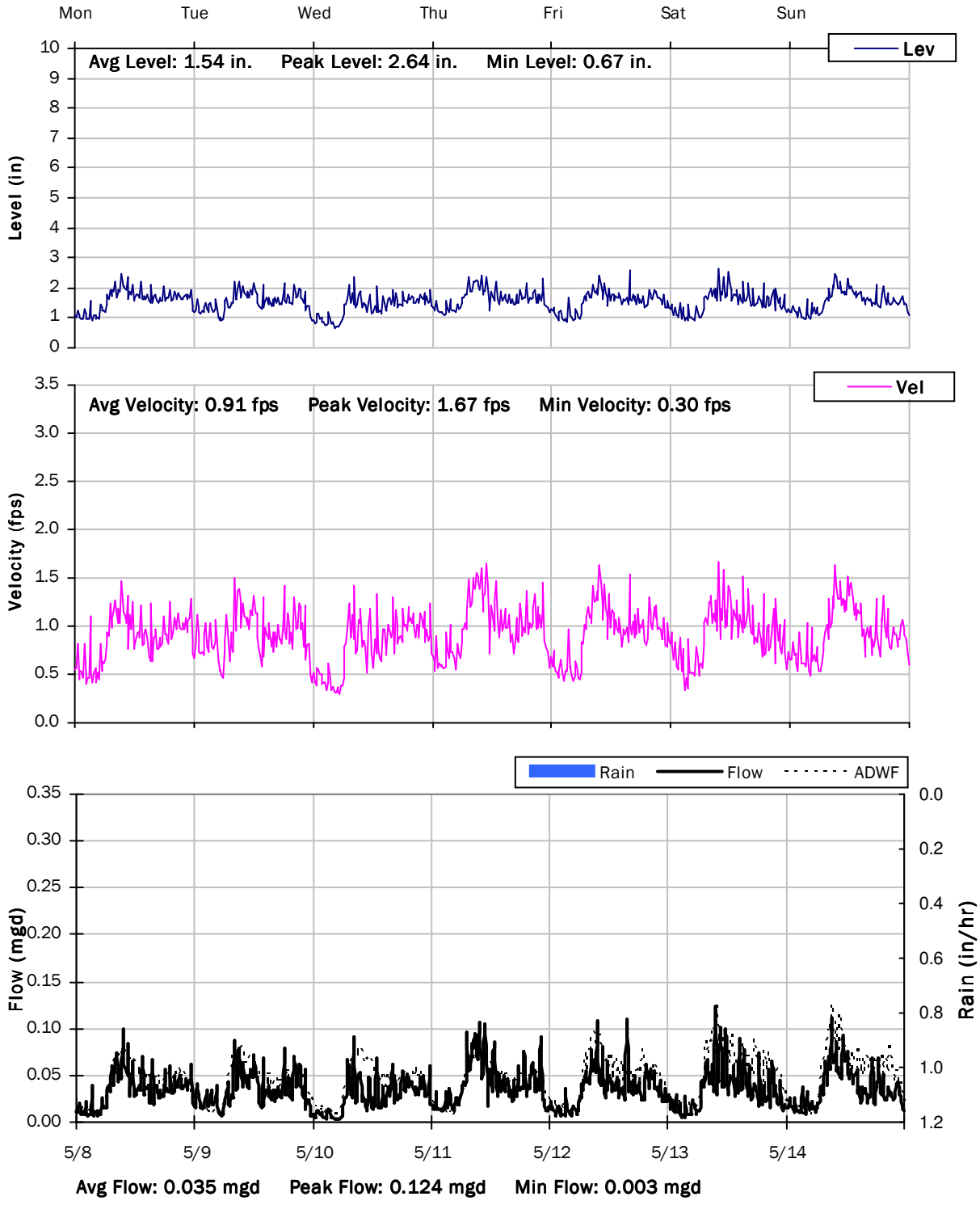
5/1/2017 to 5/8/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

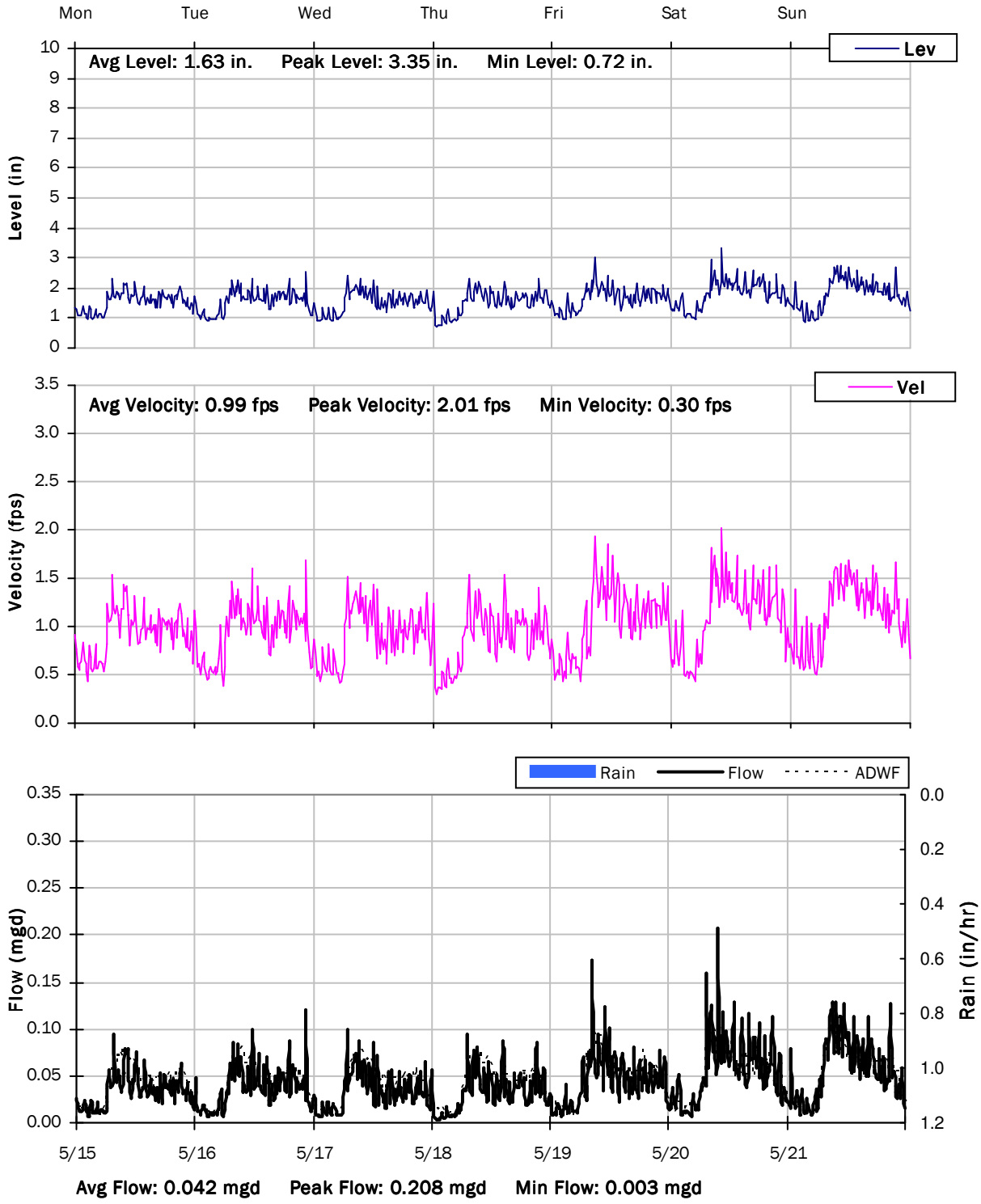
5/8/2017 to 5/15/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

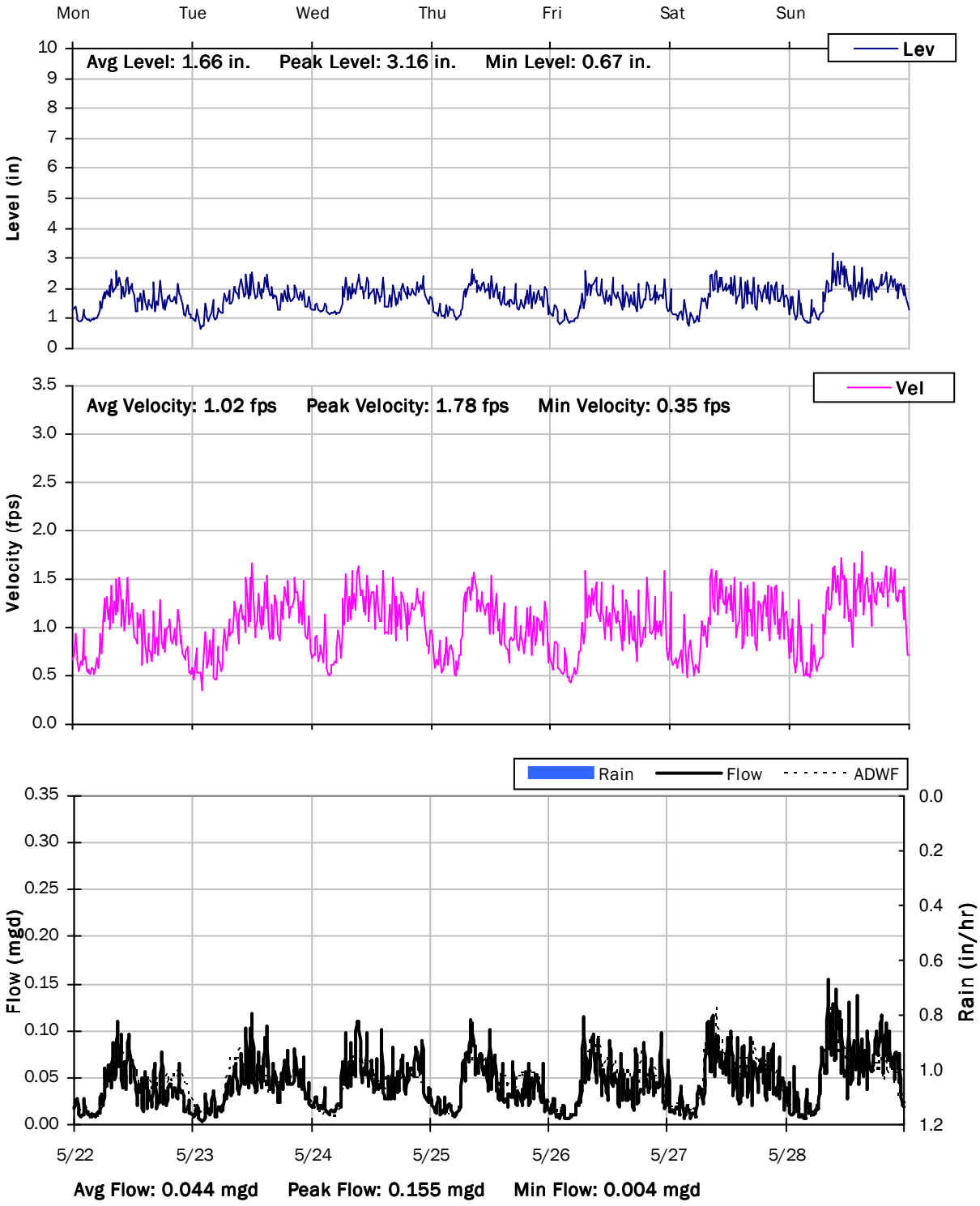
5/15/2017 to 5/22/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

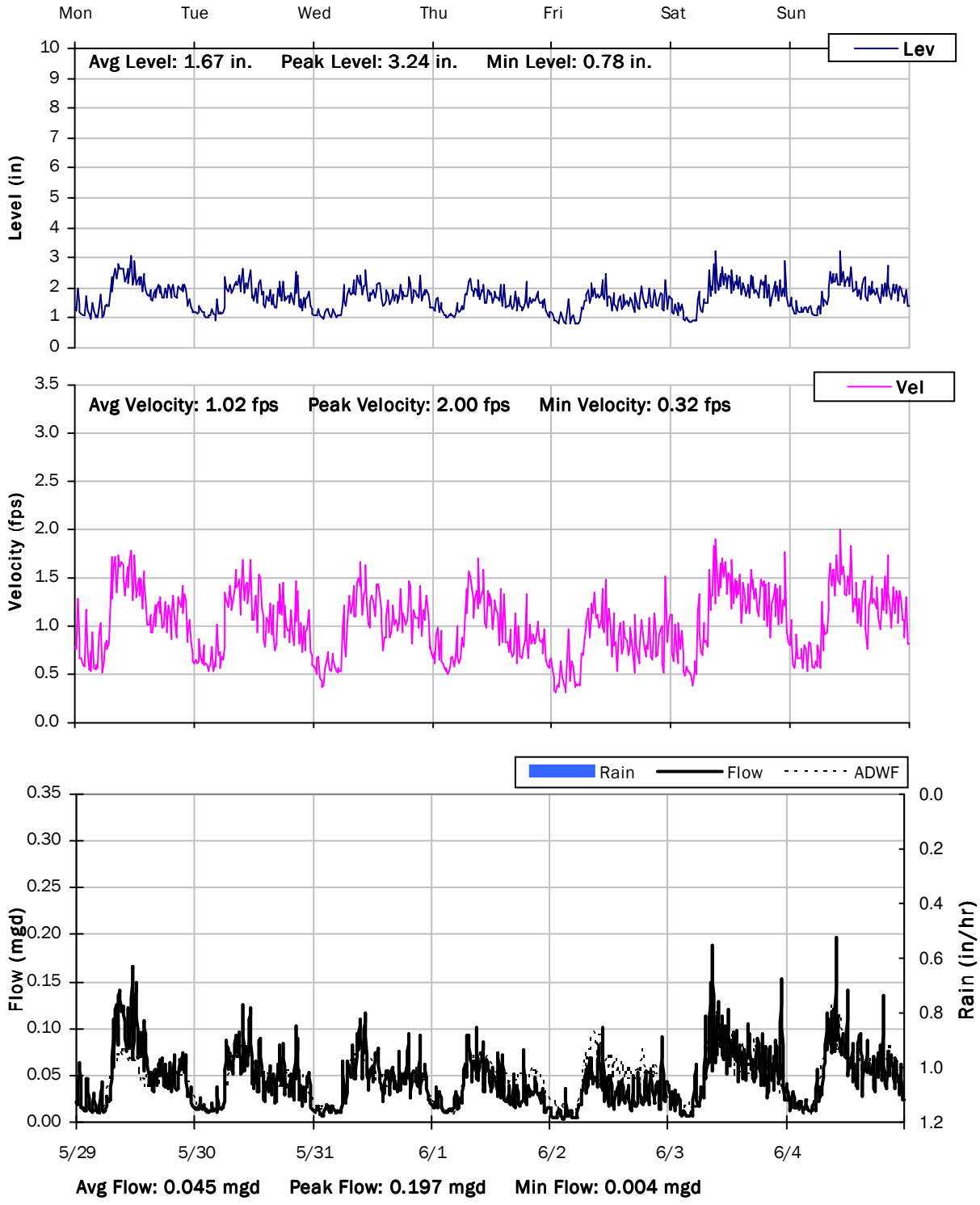
5/22/2017 to 5/29/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

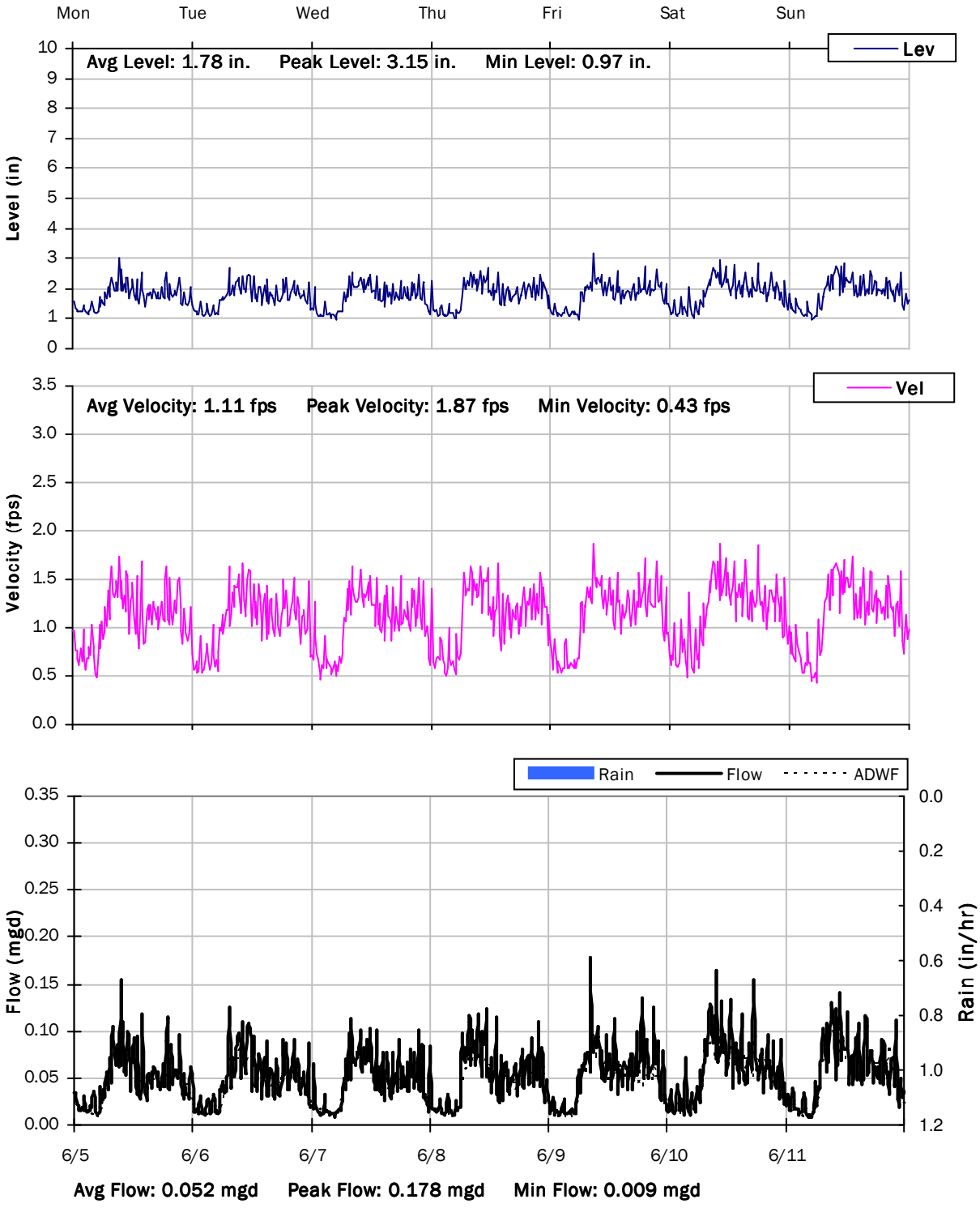
5/29/2017 to 6/5/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

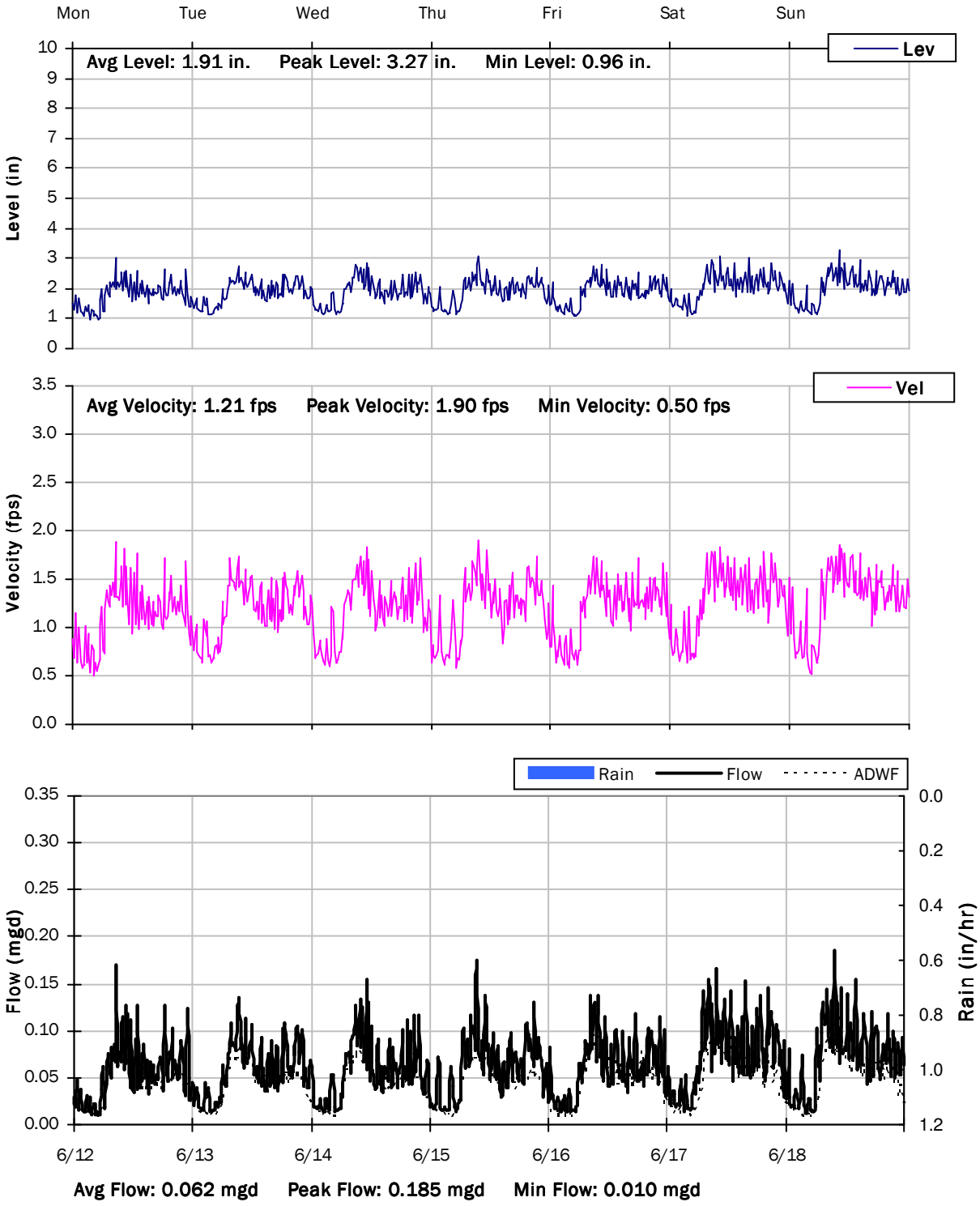
6/5/2017 to 6/12/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

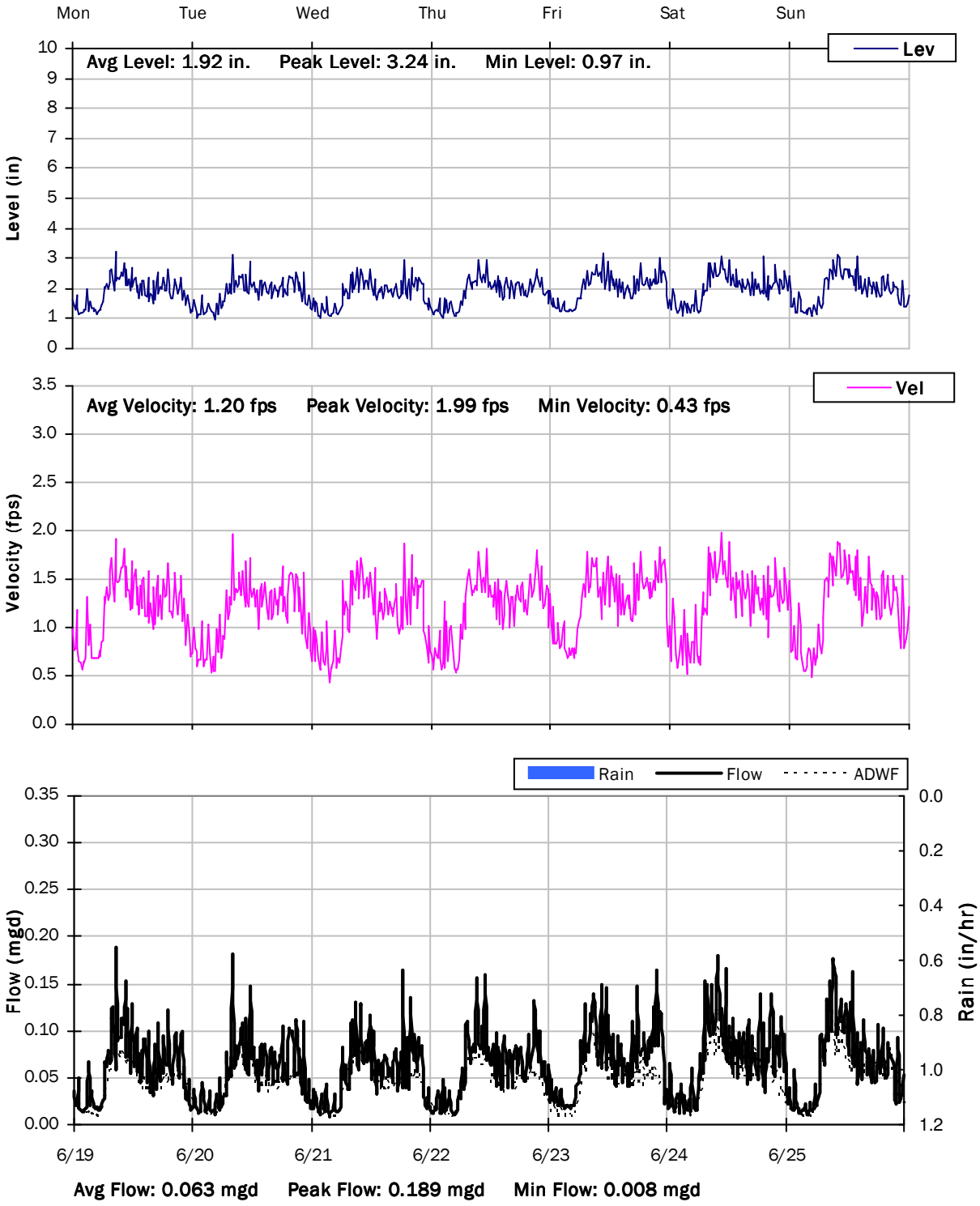
6/12/2017 to 6/19/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

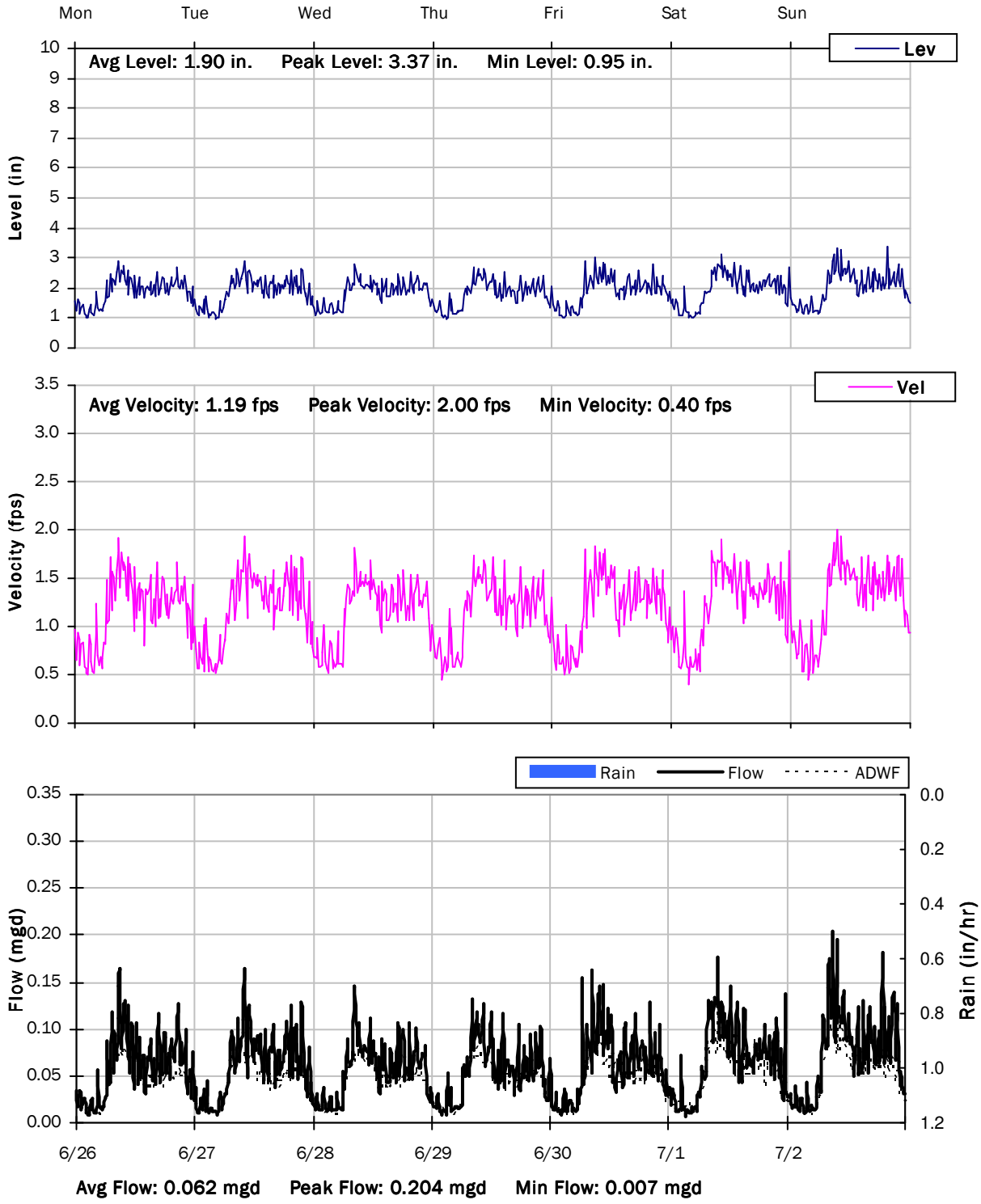
6/19/2017 to 6/26/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

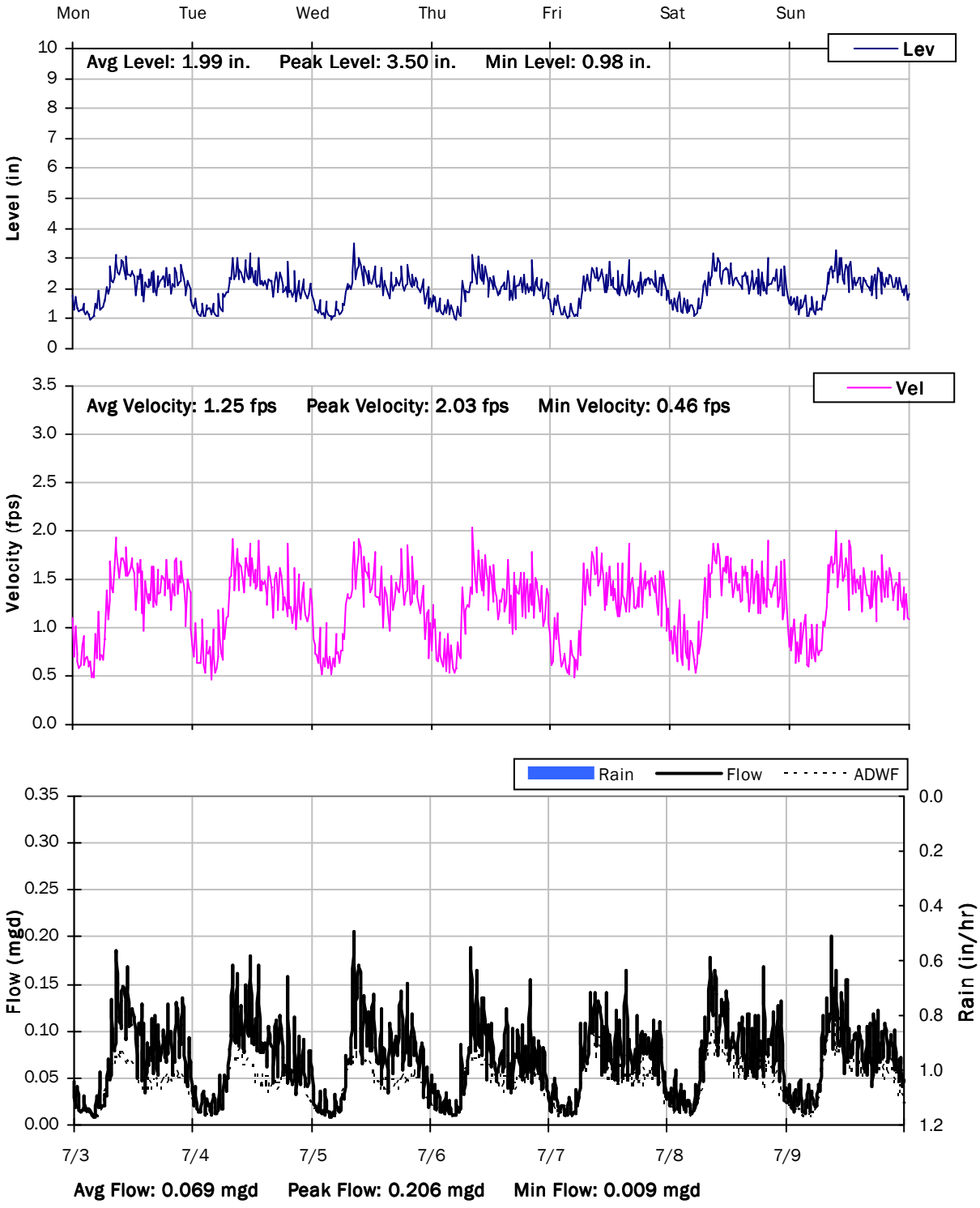
6/26/2017 to 7/3/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

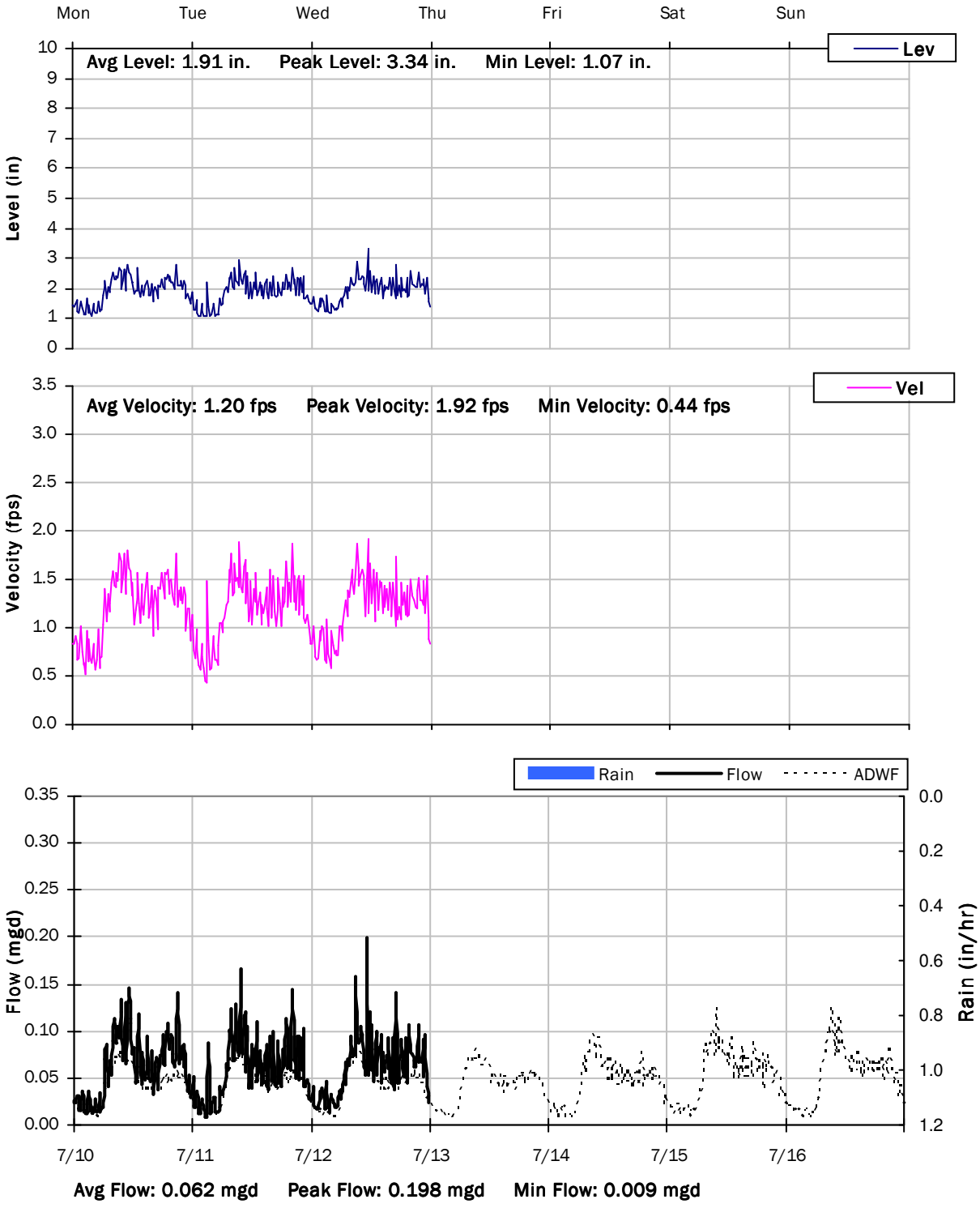
7/3/2017 to 7/10/2017



SITE 15

Weekly Level, Velocity and Flow Hydrographs

7/10/2017 to 7/17/2017



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