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TECHNICAL MEMORANDUM

DATE: January 16, 2023

Project No.: 450-60-21-16
SENT VIA: EMAIL

TO: Patrick Filipelli, Ross Valley Sanitary District

FROM: Josh Steiner, EIT #168371

REVIEWED BY: Patrick Johnston, PE, RCE #59028
Chris Malone, PE, RCE #51009

SUBJECT: Wastewater Collection System Capacity Evaluation

INTRODUCTION

The purpose of this Technical Memorandum (TM) is to present the methods, results, and conclusions from a capacity assessment of the Ross Valley Sanitary District (RVSD) wastewater collection system and to present an evaluation of the effectiveness of recent system improvements in terms of infiltration and inflow (I&I) reduction. This effort will assist RVSD in understanding the need for additional improvements and to determine if three previously identified but still unimplemented capacity improvement projects are warranted.

Flow monitoring and hydraulic analyses were conducted to evaluate the effectiveness of collection system improvements implemented from 2018 onward, to evaluate the need for several remaining potential capacity deficiencies identified for the 2006 Sanitary Sewer Hydraulic Evaluation and Capacity Assurance Plan (SHECAP), and to identify capacity deficient areas within the collection system that are heavily influenced by groundwater infiltration (GWI) and rainfall-dependent inflow and infiltration (RDII). Accordingly, this TM contains the following sections:

- Background Information
- 2021/2022 Flow Monitoring Study
- Model Infrastructure Updates
- Model Recalibration
- System Capacity Evaluation
- Summary and Recommendations

BACKGROUND INFORMATION

The RVSD collection system consists of 202 miles of gravity sewer, 19 pump stations, and 8.3 miles of force mains. All wastewater is collected by pump stations within the collection system and conveyed to the Central Marin Sanitation Agency (CMSA) for treatment.

As part of the 2006 SHECAP, 20 flow monitors were installed in the RVSD wastewater collection system to conduct hydraulic evaluations and to identify capacity improvement projects. The May 2013 Cease and Desist Order No. R2-2013-0020 (CDO) issued by the San Francisco Regional Water Quality Control Board required that RVSD implement projects identified in the SHECAP.

RVSD has made significant progress in addressing the required actions in the CDO by implementing extensive improvements and repairs to its wastewater collection system, including replacing approximately 15 percent of sewer laterals. In addition, RVSD completed an Infrastructure Asset Management Plan (IAMP) in 2013, followed by a flow monitoring study in 2014 to validate the effectiveness of the implemented capacity improvement projects identified in the 2006 SHECAP for addressing capacity concerns and reducing GWI and RDII.

In 2021, RVSD updated its IAMP, which included an update of the RVSD collection system hydraulic model to incorporate system improvements implemented between 2008 and 2018. The wastewater hydraulic model was developed in InfoWorks CS (now known as InfoWorks ICM), which is a state-of-the-art, fully dynamic software widely used for collection systems with complex hydraulics. The updated IAMP also included a plan to reduce GWI and RDII and provided flow monitoring guidelines for evaluating the effectiveness of future I&I reduction projects.

The collection system hydraulic model was initially calibrated with flow data collected during 2006, and the model was recalibrated with flow data collected in 2014 and supplemented with additional flow data collected in 2020. At RVSD's request, West Yost conducted flow monitoring during the 2021/2022 wet weather season primarily at the same locations monitored in the 2006 SHECAP study and in the 2014 Flow Monitoring Study for the purpose of updating the model calibration to reflect all recent improvements.

As is common with collection system modeling, the RVSD hydraulic model is limited to the larger diameter gravity mains and does not include most of the smaller collection gravity mains. The wastewater hydraulic model also includes most of the lift stations and force mains, and it does contain a limited number of small diameter collection gravity mains that are necessary for evaluating hydraulic connectivity. The RVSD wastewater collection system and the extents of the hydraulic model are shown on Figure 1.

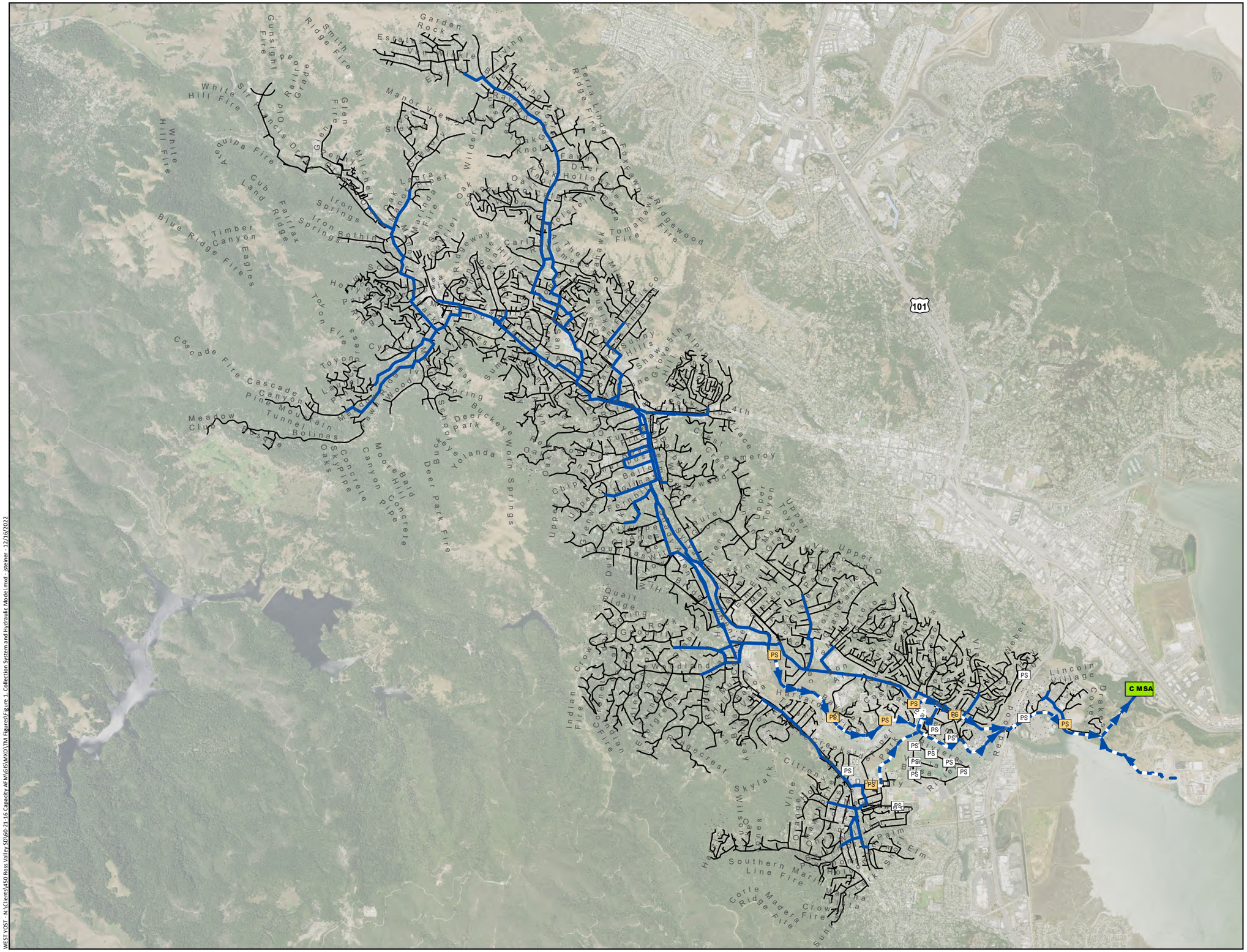
Since 2020, RVSD has continued to implement collection system improvements aimed at eliminating capacity restrictions and reducing the incidence of SSOs. These improvements have included the upsizing of gravity mains to increase capacity and projects such as spot repairs of defects and lining of small diameter collection gravity mains to reduce GWI and RDII. All such improvements need to be reflected in the hydraulic model to maintain its reliability for planning purposes.

2021/2022 FLOW MONITORING STUDY

The February 8, 2021, Infiltration and Inflow Reduction Plan prepared for RVSD as part of the 2021 IAMP Update found that I&I reduction effectiveness must account for soil saturation periods to make sure that any year-over-year comparisons are meaningful. Accordingly, flow monitoring was conducted from December 13, 2021, to February 11, 2022, after soils in the RVSD service area were sufficiently saturated. Following completion of the 2021/2022 Flow Monitoring Study, the following steps were undertaken:

1. The hydraulic model network was updated to reflect improvements implemented since 2018.
2. The hydraulic model was recalibrated using data collected during the 2021/2022 Flow Monitoring Study.
3. The updated model was used to assess the effectiveness of the improvements and to reevaluate the capacity restrictions previously identified by the model.

These three steps are described in greater detail in the following sections of this TM.



N

0 1,750 3,500

Scale in Feet

Modeled Gravity Main

Modeled Force Main

Unmodeled Sewer Line

Modeled Pump Station

Other Pump Station

Outlet to CMSA

Figure 1

RVSD Collection System Facilities and Hydraulic Model Extents

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

WEST YOST - N:\Clients\450 Ross Valley SD\60-21-16 Capacity AFM\GIS\MXD\TM Figures\Figure 1 Collection System and Hydraulic Model.mxd - jsteiner - 12/16/2022

The flow metering locations and their associated tributary areas are shown on Figure 2. A complete list of all the 2021 flow monitoring locations and how they compare to the 2014 and 2020 flow monitoring locations is shown in Table 1. The detailed results from the 2021/2022 Flow Monitoring Study can be found in the Flow Monitoring Site Reports in Attachment A.

INFRASTRUCTURE UPDATES

The previous hydraulic model included all collection system improvements constructed before 2018. For this evaluation, RVSD provided GIS data for the improvement projects that have been implemented since 2018 for the purpose of updating the hydraulic model configuration. Where necessary, the GIS information was supplemented with record drawings. As a result of this update, new gravity mains were added to the hydraulic model, abandoned gravity mains were removed, and gravity main sizes and configurations were updated. These improvements are shown on Figure 2.

MODEL RECALIBRATION

Key topics relevant to model recalibration that are addressed in this section include:

- Wastewater Flow Components
- Dry Weather Flow Description
- Diurnal Flow Pattern Description
- Wet Weather Flow Description
- Dry Weather Flow Recalibration
- Wet Weather Flow Recalibration

Wastewater Flow Components

Wastewater collection systems typically convey both sanitary flow and non-sanitary flows that enter the collection system infrastructure in the form of GWI and RDII, as noted above. A realistic model calibration must adequately consider both sanitary flows and non-sanitary flows. Key wastewater flow conditions of interest identified in flow metering data analysis and hydraulic model development include:

- Average Dry Weather Flow (ADWF)
- Peak Dry Weather Flow (PDWF)
- Peak Wet Weather Flow (PWWF)

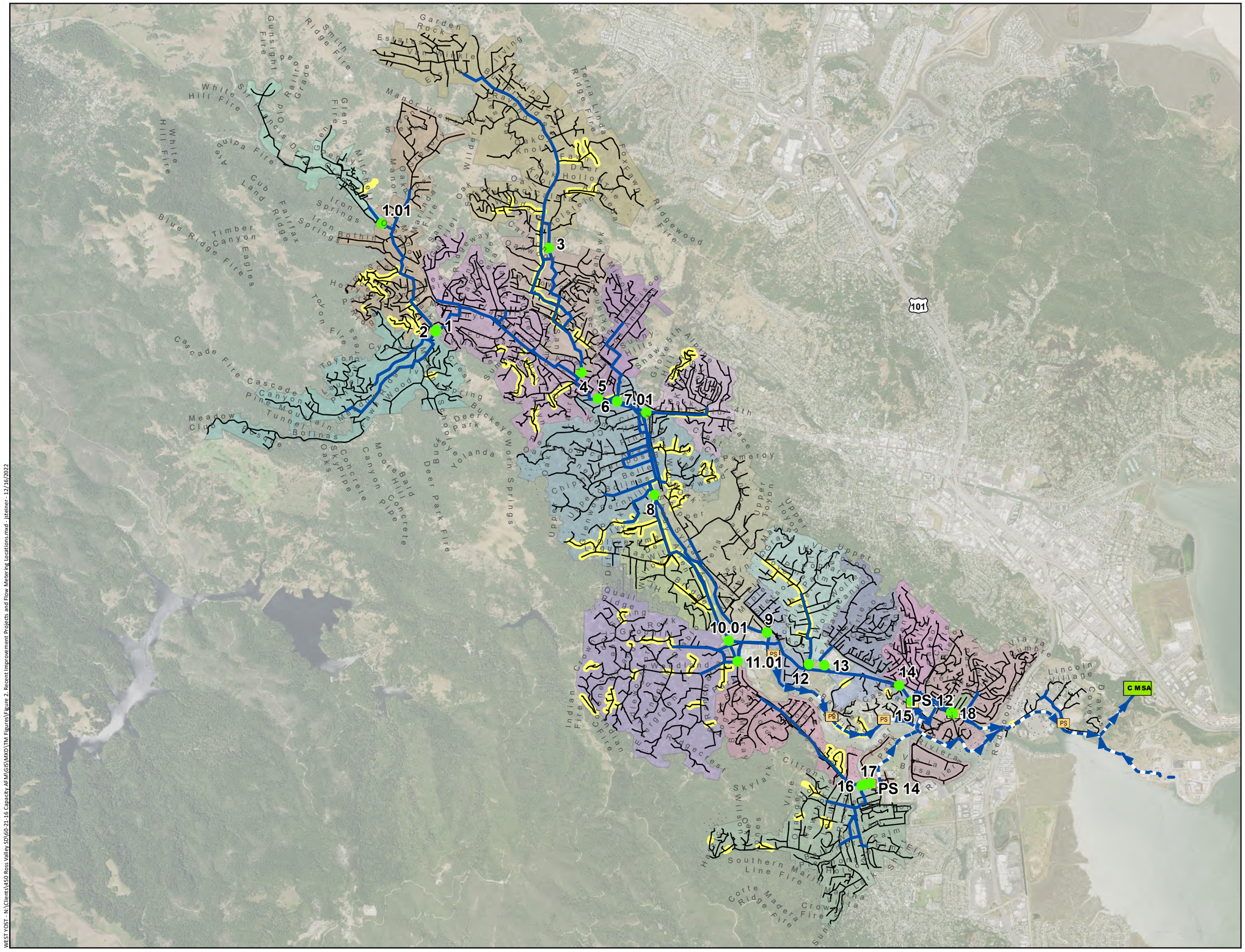
These wastewater flow conditions are depicted conceptually over a typical 24-hour period on Figure 3, and the individual components of each flow condition are discussed in the following subsections.

Dry Weather Flow Description

ADWF generally includes two components: sanitary flow and GWI. Sanitary flow represents discharges to the collection system from residential, commercial, institutional, and industrial dischargers. GWI refers to groundwater and/or tidal infiltration into the collection system via defects in sewer pipes and manholes. While GWI is often constant over a typical 24-hour cycle as depicted on Figure 3, it also tends to increase following rainfall events and generally tends to be highest in winter and springtime, and in low-lying areas. In some collection systems, GWI is low enough compared to sanitary flow that it can be assumed to be negligible. As described in more detail below, GWI is significant in some parts of the RVSD collection system and needs to be accounted for explicitly in the hydraulic model.

Table 1. Flow Monitoring Locations and Comparison to Previous Calibration Efforts

Flow Meter ID	Monitored Pipe	Pipe Diameter, in	Location	2014/2020 Purpose	2021 Purpose
1	F003.02.1	15	Easement between Dominga Ave and Bolinas Rd	Confirm 2006 SHECAP Project 2 - Spruce Park/Merwin/Broadway	Confirm 2006 SHECAP Project 2 - Spruce Park/Merwin/Broadway and monitor RDII/GWI progression for 16/17 sewer lateral repairs
1.01	F700.03.1	8	30 Westbrae Dr	Confirm 2006 SHECAP Project 1 - Westbrae/Hawthorne	Confirm 2006 SHECAP Project 1 - Westbrae/Hawthorne
2	F002.11.1	18	Dominga Ave at Court Ln	Update 2006 SHECAP high GWI, RDII basin	Monitor RDII/GWI progresssion for 16/17 sewer lateral repairs
3	S900.22.1	18	The Alameda north of Arroyo Ave	Confirm 2006 SHECAP Project 5 - Upper Butterfield	Confirm 2006 SHECAP Project 5 - Upper Butterfield and monitor RDII/GWI progression for sewer 16/17 sewer lateral repairs
4	S800.02.1	24	Saunders Ave near Berlin Ave	Confirm 2006 SHECAP Project 6 - Lower Butterfield Meadowcroft	Monitor RDII/GWI progression for implemented SHECAP Project 6, Meadowcroft and Arroyo sewer lateral repairs, and 16/17 sewer lateral repairs
5	S000.53.1	36	San Anselmo Ave at Hazel Ave	Update hydraulic model (general)	Monitor RDII/GWI progression for 16/17 sewer lateral repairs
6	S600.01.1	12	Madrone Ave near Nokomis Ave	Confirm 2006 SHECAP Project 8 - Sonoma Nokomis; update 2006 SHECAP high GWI, RDII basin post-rehabilitation	Monitor RDII/GWI progression for implemented SHECAP Project 8 and Nokomis and Meadowcroft sewer lateral repairs
7.01	S400.03.1	10	79 Center Boulevard	Confirm 2006 SHECAP Project 9 - Miracle Mile	Monitor RDII/GWI progression for implemented SHECAP Project 9
8	R000.31.1	36	Shady Lane south of Fern Hill Ave	Confirm 2006 SHECAP Project 12 – Upper Shady Ln	Monitor RDII/GWI progression for implemented SHECAP Project 12 and 15/16 sewer lateral repairs
9	K000.05.1	39	Back of 913 Sir Francis Drake Blvd	Confirm trunk flows near Kentfield PS, Greenbrae PS gravity bypass, 2006 SHECAP Project 13 - Sir Francis Drake/Berry	Monitor RDII/GWI progression for implemented SHECAP Project 13 and 15/16 sewer lateral repairs
10.01	R500.02.1	27	Kent Ave north of Stadium Way	Confirm Shady Ln Trunk sewer flows, 2006 SHECAP Project 12 Upper Shady Ln	Monitor RDII/GWI progression for implemented SHECAP Project 12 and 15/16 sewer lateral repairs
11.01	W512.02.1	24	Woodland Rd between Kent Ave and College Ave	Update hydraulic model basins post Woodland College + Goodhill Project; update 2006 SHECAP high GWI, RDII basin	Monitor RDII/GWI progression for 15/16 sewer lateral repairs
12	K200.02.1	16	McAllister Ave at Berens Dr	Confirm 2006 SHECAP Project 17 - Laurel Grove/McAllister	Monitor RDII/GWI progression for implemented SHECAP Project 17
13	G300.01.1	18	Easement south of Manor Dr	Confirm 2006 SHECAP Project 18 – Manor easement; update 2006 SHECAP high GWI, RDII basin	Monitor RDII/GWI progression for implemented SHECAP Project 18 and 16/17 sewer lateral repairs
14	G000.11.1	30	Parking lot at 575 Sir Francis Drake Blvd	Confirm Greenbrae PS-13 Project, identify salt water intrusion	Monitor flows to PS-13 from the northwest
15	G200.01.1	10	Upstream of Greenbrae PS	Confirm Greenbrae PS-13 Project; update hydraulic model (general)	Monitor flows to PS-13 from the northeast
16	L180.050.1	24	Doherty Dr at Camellia Cir	Update 2006 SHECAP high GWI, RDII basin, post William/Holcomb/Meadwood projects	Monitor RDII/GWI progression
17	L152.04.1	22	Doherty Dr west of Larkspur Main PS	Confirm Magnolia Ave Trunk flows; update 2006 SHECAP high GWI, RDII basin, identify salt water intrusion	Monitor RDII/GWI progression
18	B210.01.1	12	Bon Air Center northwest of Barry Way and Bon Air PS	Identify salt water intrusion; update 2006 SHECAP high GWI, RDII basin	Monitor RDII/GWI progression
PS12	PS12-FM.1	8	Larkspur PS on Doherty Dr east of Rose Ln	Monitor area not previously monitored	Monitor flows discharged by PS-12
PS14	PS14-FM.1	18	Bon Air PS near Bon Air Ctr and Barry Way	Monitor area not previously monitored	Monitor flows discharged by PS-14



WEST YOST - N:\Clients\450 Ross Valley SD\60-21-16 Capacity AFM\GIS\MXD\TM Figures\Figure 2. Recent Improvement Projects and Flow Metering Locations.mxd - jsteiner - 12/16/2022

Figure 2

Recent Improvement Projects and Flow Monitoring Locations

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

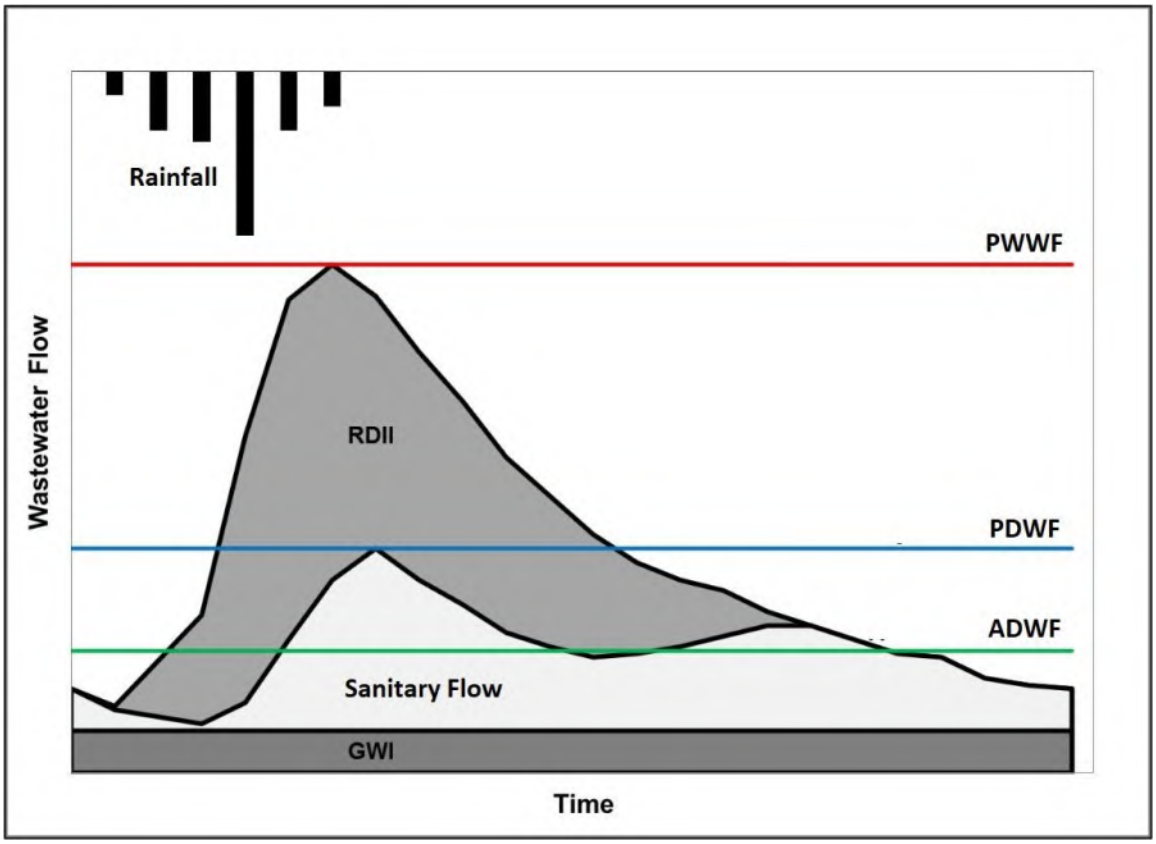


Figure 3. Typical 24-Hour Cycle of Wastewater Components for PWWF Conditions

The flow monitoring basins shown in Figure 2 are divided into areas tributary to specific model manholes called subcatchment areas. Sanitary flow is calculated in the model for each subcatchment area and modeled separately for residential and non-residential sources. Residential flows are calculated by multiplying a population estimate by a flow generation value of 60 gallons per capita per day (gpcpd) developed during the previous model calibration. Non-residential flows are entered in the model for each subcatchment as a flow value in million gallons per day (MGD) and was also determined during previous model calibrations and verified in the current analysis.

Diurnal Flow Pattern Description

Dry weather flows tend to follow predictable diurnal patterns depending on the type of land use generating the flow. PDWF is defined as the high point in the diurnal flow pattern. The diurnal patterns in the RVSD hydraulic model were developed from flow monitoring data used for the original calibration of the model, and the 2021 flow monitoring indicates that the assumed diurnal patterns and flow rates are consistent with current data and do not require adjustment.

Diurnal flow patterns in the collection system are patterns that recur every 24 hours and define the change in flows over the course of the day. For example, residential flow generation tends to produce higher flows in the morning hours and in the evening hours, while commercial flow generation tends to have fairly steady discharge during business hours but very low discharge outside of business hours. Industrial flow generation has flow patterns that depend upon their individual processes. Diurnal patterns are assigned separately to the residential and non-residential dry weather flows in the hydraulic model. Each set of diurnal patterns includes separate patterns for weekdays and weekends.

Wet Weather Flow Description

PWWF is composed of PDWF and RDII, which consists of stormwater that enters the system in direct response to rainfall events, either through direct connections such as porous maintenance hole covers, illicitly connected roof leaders or area drains, or defects in wastewater pipes, maintenance holes, and service laterals. RDII is typically characterized by short-term peak flows that recede relatively quickly after a given rainfall event ends. The magnitude of RDII flows are related to the intensity and duration of the rainfall event but are also related to the degree of soil saturation arising from antecedent rainfall conditions.

The InfoWorks ICM software used for the collection system model simulates wet weather flow by applying a synthetic storm hyetograph (rainfall pattern) to the model simulation and applying unit hydrographs that define the timing and amount of rainfall entering the collection system from each flow monitoring basin. During the calibration process, the components of each hydrograph were adjusted until the timing, volume, and peak flow simulated by the model match the flow monitoring data for the calibration storm, as described below (see Wet Weather Flow Recalibration).

Dry Weather Flow Recalibration

The dry weather flow parameters include the per capita residential flow factor or 60 gpcpd (noted above), the non-residential flow contributions from each flow metering area, and the GWI from each flow metering area. The previously used dry weather flow parameters served as the starting point for the current analysis. Based on the dry weather data collected during the 2021 Flow Monitoring Study, it was determined that the previously calibrated residential and non-residential flow values are still valid, and that minor GWI adjustments were needed in some of the flow metering areas. GWI values in the subcatchments were adjusted if the difference between the modeled and measured flows was significant during the minimum flow period at night.

Data from December 19–22, 2021 was used as the basis for the dry weather calibration because it served as a good representation of dry weather flow conditions following antecedent rainfall conditions earlier in the month. Furthermore, the dry weather flow monitoring data from this period immediately precedes the December 23, 2021, storm used for wet weather recalibration, and therefore serves as a reliable representation of pre-storm conditions.

Figures comparing the model flows with the measured dry weather hydrographs were prepared for each flow monitoring location and are included as Attachment B. Table 2 summarizes the residential flows, non-residential flows and GWI for each flow monitoring basin. Values are included for the original calibration of the model, for the 2014/2020 recalibration, and for the current recalibration to 2021 data. Values highlighted in green are those that were decreased from the 2006 model and values highlighted in red are those that were increased from the 2006 model.

As shown in the table, dry weather residential and non-residential flows remain unchanged from the recalibrated 2014/2020 hydraulic model. GWI values decreased substantially from the original 2006 model to the recalibrated 2014/2020 hydraulic model; however, GWI generally increased from 2014/2020 to 2021, with the only decrease in GWI from the 2006 model occurring in flow monitoring basins 2,3, 5, 6, 7,01, 11.01, and PS14. This result is likely attributable to the fact that the 2014 flow monitoring period saw very little antecedent rainfall, resulting in lower groundwater levels when compared to the 2006 and 2021 flow monitoring efforts. GWI that decreased from 2006 to 2021 was mainly located in the northern part of the system, likely due to RVSD's investment in collection system infrastructure improvements and lateral repairs to eliminate defects. All flow monitoring basins that saw a decrease in GWI from 2006 to 2021, except for PS14, were subject to recent improvement projects or lateral repairs, indicating that recent efforts to eliminate GWI in these areas has been effective.

The lack of decreases in GWI in the southern portion of the collection system may be partly due to the proximity of this portion of the collection system to Corte Madera Creek and to the San Francisco Bay. Collection system infrastructure that is closer to sea level usually has higher relative groundwater levels and is more prone to GWI; therefore, infrastructure improvements in the northern portion of the system are more likely to result in tangible reductions in GWI. The most significant increases in GWI occurred in flow monitoring basins 4, 8, and 16. All three of these basins appear to contain aging infrastructure that could benefit from capacity improvements, pipeline rehabilitation, and service lateral repairs aimed at reducing influences from GWI. Overall, GWI has increased 31 percent from the original 2006 hydraulic model and 62 percent from the 2014/2020 hydraulic model. Most of the increase since 2006 is concentrated in six basins: 4, 8, 10.01, 16, 17 and PS12, which suggests that future improvements geared toward GWI reduction may be justified in these areas.

In addition to the above calibration process, SmartCover data provided by RVSD was used to verify the hydraulic model flow depths at flow monitoring locations where SmartCover data was available. Figures comparing the model flow depths with the measured SmartCover depths are included as Attachment C. Except for wet weather flows in monitoring basin 11.01, the model was found to be sufficient in simulating flow depths at all locations where SmartCover data was available.

Table 2. Ross Valley Hydraulic Model Dry Weather Calibration Summary

Flow Meter ID	Model Location	Original Residential Flow, MGD	2014/2020 Calibrated Residential Flow, MGD	2021 Calibrated Residential Flow, MGD	Original Non-Residential Flow, MGD	2014/2020 Calibrated Non-Residential Flow, MGD	2021 Calibrated Non-Residential Flow, MGD	Original GWI, MGD	2014/2020 Calibrated GWI, MGD	2021 Calibrated GWI, MGD
1	F003.02.1	0.198	0.198	0.198	0.014	0.014	0.014	0.099	0.000	0.191
1.01	F700.03.1	0.049	0.049	0.049	0.005	0.005	0.005	0.047	0.000	0.118
2	F002.11.1	0.150	0.050	0.050	0.006	0.006	0.006	0.415	0.207	0.245
3	S900.22.1	0.183	0.146	0.146	0.017	0.017	0.017	0.330	0.330	0.264
4	S800.02.1	0.170	0.119	0.119	0.006	0.006	0.006	0.032	0.032	0.338
5	S000.53.1	0.293	0.322	0.322	0.068	0.068	0.068	0.053	0.000	0.000
6	S600.01.1	0.082	0.041	0.041	0.118	0.000	0.000	0.194	0.000	0.143
7.01	S400.03.1	0.080	0.160	0.160	0.016	0.016	0.016	0.032	0.000	0.000
8	R000.31.1	0.240	0.071	0.071	0.082	0.082	0.082	0.184	0.000	0.612
9	K000.05.1	0.066	0.066	0.066	0.033	0.033	0.033	0.032	0.032	0.032
10.01	R500.02.1	0.059	0.059	0.059	0.005	0.005	0.005	0.111	0.162	0.293
11.01	W512.02.1	0.097	0.097	0.097	0.019	0.019	0.019	0.441	0.187	0.107
12	K200.02.1	0.077	0.054	0.054	0.000	0.000	0.000	0.129	0.000	0.180
13	G300.01.1	0.058	0.058	0.058	0.038	0.000	0.000	0.045	0.000	0.049
14	G000.11.1	0.099	0.119	0.119	0.008	0.008	0.008	0.077	0.077	0.077
15	G200.01.1	0.087	0.061	0.061	0.012	0.012	0.012	0.045	0.006	0.106
16	L180.050.1	0.196	0.117	0.117	0.025	0.025	0.025	0.018	0.018	0.263
17	L152.04.1	0.133	0.133	0.133	0.027	0.027	0.027	0.017	0.206	0.141
18	B210.01.1	0.057	0.029	0.029	0.000	0.000	0.000	0.006	0.006	0.006
PS12	PS12-FM.1	0.064	0.032	0.032	0.029	0.015	0.015	0.007	0.007	0.187
PS14	PS14-FM.1	0.012	0.011	0.011	0.014	0.014	0.014	0.003	0.020	0.000

Note: Values highlighted in green decreased from the preceding calibrated model. Values highlighted in red increased from the preceding calibrated model.

Wet Weather Flow Recalibration

As noted above, the InfoWorks ICM software used for the collection system model applies a storm hyetograph to the model simulation and calculates the amount of RDII that enters the system based on unit hydrographs as described above. Recalibration of the model involved comparing the modeled 2014 RDII to the RDII observed in the flow meter data during the December 23, 2021, storm event. The contributions of RDII from each unit hydrograph were adjusted until the flow generated by the model matched the flow monitoring results. Each flow monitoring location was analyzed separately, starting with the upstream-most flow monitoring locations and working downstream. Figures comparing modeled versus the measured wet weather hydrographs for the calibration storm at each flow monitoring location are included in Attachment B.

In addition to the inclusion of recent collection system improvement projects in the hydraulic model network, the model was modified to incorporate variable frequency drive (VFD) controls, wet well set points, pumping speeds, head-discharge curves, and on/off levels at Pump Station 12 and Pump Station 14, based on information provided by RVSD. Results from implementing these adjustments at these two pump stations can be seen in the calibration hydrographs for these locations in Attachment B.

Table 3 shows a summary of the R-values associated with the wet weather calibration. These values reflect the percent of the total rainfall entering the system from each flow monitoring basin and are therefore an indicator of the RDII generated. R-values are shown for the original calibration of the model, for the 2014/2020 recalibration, and for the current recalibration to 2021 data. Values highlighted in green indicate the values that were decreased from the 2006 model and values highlighted in red are those that were increased form the 2006 model.

Table 3 show an overall decrease in the R-values in 14 of the 21 flow monitoring basins when compared to 2006, indicating that recent capacity improvement projects and lateral replacements have been paying dividends regarding reductions in peak flow from RDII. Flow monitoring basins that saw an increase in the R-values from 2006 include basins 5, 8, 9, 14, 15, 18, and PS12. Overall, the R-values have decreased 28 percent from the 2006 hydraulic model and 34 percent from the 2014/2020 hydraulic model.

The flow data collected from monitoring basin 11.01 (Kent Woodlands) indicates possible concerns with the local storm drainage infrastructure. As seen in the wet weather calibration hydrographs in Attachment B and the wet weather recalibration depths in Attachment C, there appears to be sudden jump in flow and depth at flow monitoring basin 11.01 during the peak of the storm, which cannot be matched by the hydraulic model. This hydraulic behavior was confirmed for other storms captured in the 2021 flow monitoring effort, indicating that there may be some outside drainage influence that makes its way into the collection system during periods of heavy rainfall. It is not possible to identify the source of this influence using the hydraulic model, and thus it is recommended that RVSD further investigate this issue.

Table 3. Summary of R-Values, Hydraulic Model Wet Weather Calibration

Flow Meter ID	Model Location	2006 Total R-Value	2014/2020 Total R-Value	2021 Total R-Value
1	F003.02.1	5.30	3.25	4.28
1.01	F700.03.1	5.30	3.25	1.28
2	F002.11.1	10.00	2.35	4.72
3	S900.22.1	5.40	5.00	4.66
4	S800.02.1	7.80	5.00	4.31
5	S000.53.1	3.30	0.85	5.04
6	S600.01.1	8.00	10.00	4.57
7.01	S400.03.1	5.50	11.50	4.00
8	R000.31.1	5.79	4.51	11.07
9	K000.05.1	4.80	1.20	7.14
10.01	R500.02.1	4.90	21.50	2.60
11.01	W512.02.1	4.90	15.43	3.00
12	K200.02.1	3.10	5.50	2.20
13	G300.01.1	11.00	5.50	2.20
14	G000.11.1	4.20	5.28	7.87
15	G200.01.1	6.20	10.25	8.60
16	L180.050.1	13.10	6.06	6.88
17	L152.04.1	8.00	8.50	7.55
18	B210.01.1	2.00	2.25	7.50
PS12	PS12-FM.1	2.00	6.50	3.17
PS14	PS14-FM.1	10.55	8.00	5.50

Note: Values highlighted in green are those that were decreased from the 2006 calibrated model. Values highlighted in red are those that were increased from the 2006 calibrated model.

SYSTEM CAPACITY EVALUATION

The evaluation of RVSD collection system capacity is described in the following sections of this TM:

- Hydraulic Evaluation Overview
- Analysis of SHECAP Projects
- Pump Station Capacity Assessment
- Additional Existing Capacity Concerns Issues

Hydraulic Evaluation Overview

The recalibrated hydraulic model was used to simulate design PWWF conditions based upon the 2021 infrastructure network using a design storm. Design storms are synthetic rainfall events used to evaluate collection system capacity under wet weather flow conditions and have a specific recurrence interval and rainfall duration. Based on the standards established in the SHECAP, both a 5-year design storm and a 10-year design storm are considered in this analysis. In general, the 10-year design storm provides the basis for sizing of future facilities, but the 5-year design storm provides some additional information on the frequency and likelihood of system capacity exceedances.

The design storm hyetograph (a graph showing the distribution of rainfall intensity over time) uses a 24-hour rainfall total defined by the National Oceanic and Atmospheric Administration (NOAA) and a Type 1A rainfall distribution pattern developed by the Soil Conservation Services (SCS). The design storm was loaded into the model for both the existing and proposed infrastructure scenarios. Because rainfall amounts vary across the RVSD service area for any particular storm, different design storm rainfall depths were used for different parts of the system. As per the previous modeling analyses of the RVSD collection system, three different rain gauge locations were used for the analysis of the system under design storm conditions. A rain gauge at Fairfax City Hall was used to represent the upper part the system, a rain gauge at Ross Town Hall was used to represent the middle part of the system, and a rain gauge at Larkspur Main Pump Station was used to represent the lower part of the system. The 5-year and 10-year 24-hour storm amounts at each location are summarized in Table 4, as per NOAA estimates.

Table 4. Design Storm 24-Hour Rainfall Totals

Rain Gauge Location	5-Year 24-Hour Storm Depth, in	10-Year 24-Hour Storm Depth, in
Fairfax City Hall	5.0	5.4
Ross Town Hall	7.2	8.0
Larkspur Main Pump Station	4.0	4.3

The 2006 SHECAP report based its assessment of gravity sewer capacity on a single criterion, namely under design storm conditions, if a pipe is surcharged, the distance between the maintenance hole rim and the flow surface should be greater than 10 feet. This criterion does not differentiate between sewers that are surcharging due to lack of capacity and sewers that are surcharging due to backwater conditions (i.e., when downstream pipelines are over capacity and flows surcharge excessively in upstream pipelines that are not over capacity). Moreover, it does not distinguish between moderate surcharging in gravity sewers versus sewers that present a high risk of outflows. For these reasons, the capacity criteria summarized in Table 5 are recommended, as they offer a more refined assessment of the different types and degrees of surcharging.

Table 5. Hydraulic Evaluation Criteria for Gravity Sewers

Designation	Description
Priority 1	Peak flow exceeds full flow AND HGL is within 1 foot of ground surface or outflowing
Priority 2	Peak flow exceeds full flow AND HGL is 1 to 4 feet below ground surface
Priority 3	Peak flow exceeds full flow AND EITHER 1) HGL is 4 to 8 feet below ground surface and more than one- foot above pipe crown; OR 2) HGL is less than one-foot above pipe crown in sewers less than 8 feet deep
Priority 4	Peak flow exceeds full flow AND EITHER 1) HGL is more than eight feet below ground surface and above pipe crown; OR 2) HGL is four to eight feet below ground surface and less than one-foot above pipe crown in sewers more than eight feet deep
Approaching Capacity	Peak flow ranges between 90 and 100 percent of full flow
Severe Backwater	Peak flow does not exceed full flow, but HGL is within 1 foot of ground surface or outflowing
Less Severe Backwater	Peak flow does not exceed full flow, but HGL is 1 to 4 feet below ground surface

For the purpose of sizing collection system improvements, the following design criteria were utilized:

1. In gravity sewers, the peak flow at design storm conditions will be such that d/D (the ratio of peak flow depth to pipe diameter) will be less than or equal to 0.75 for pipes smaller than 12 inches in diameter, and less than or equal to 1.00 for pipes 12 inches in diameter or greater.
2. In force mains, the flow velocity will not exceed 10 feet per second at design storm conditions,
3. For pump stations, peak flows at design storm conditions will not exceed the firm capacity of the station (i.e., with the largest pumping unit out of service).

For this analysis, the 5-year and 10-year design storms were evaluated in the recalibrated hydraulic model and the results were compared with those from the 2006 hydraulic model and the 2014/2020 recalibration. As shown in Table 6, the 2021 recalibrated hydraulic model indicates an increase in PWWF at the exit of the RVSD collection system when compared to the 2014/2020 model but a decrease in PWWF when compared to the 2006 model. Increases from 2014/2020 can likely be attributed to the relative lack of extreme wet weather flows associated with the 2014 recalibration, whereas the decreases from 2006 is likely more due to capacity improvements and lateral repairs that RVSD has implemented since the 2006 SHECAP report. Model results displaying sewers exceeding the proposed capacity criteria for the 5-year and 10-year design storms are shown on Figures 4 and 5, respectively.

Table 6. PWWF at Model Outlet to CMSA

Description	5-Year PWWF, MGD	10-Year PWWF, MGD
2006 Calibration	68.6	69.2
2014/2020 Recalibration	60.5	60.9
2021 Recalibration	64.0	67.8

Analysis of SHECAP Projects

All but three of the projects identified in the SHECAP report have been either fully implemented or partially implemented. Only Projects 1, 2 and 5 remain unimplemented. Many of the previous flow monitoring locations were retained to maintain consistency with the prior recalibration efforts, to monitor recently implemented improvements, and to assess the need for the remaining unimplemented SHECAP projects (specifically SHECAP Projects 1, 2 and 5). Table 7 indicates the purpose of the flow monitoring locations and summarizes the findings and confirmations associated with each location.

For this evaluation, improvements were deemed necessary in Priority 1 and Priority 2 modeled gravity sewers as well as gravity sewers subject to backwater-induced surcharging. In other words, identified capacity issues focus on SSO events and surcharging less than 4 feet below the ground surface. For both the 5-year and 10-year design storm, only SHECAP Project 2 was found to be necessary. In the case of SHECAP Projects 1 and 5, the model indicated Priority 3 surcharging at design flow conditions. As a result, the need for these two projects is less urgent than for Project 2 and RVSD should consider monitoring flow in basins 1.01 and 3 to ascertain when their priority levels change.

The collection system was also analyzed for the hypothetical scenario where the three remaining SHECAP projects were implemented to determine if the projects are appropriately sized based on the above sizing criteria. Results from the model show that Project 2 is adequately sized but Projects 1 and 5 would require some modification should RVSD decide to move forward with those improvements. The updated SHECAP projects discussed in the following subsections were established by using the recalibrated 2021 flows and updated model network in conjunction with the proposed capacity and design criteria. Recommended improvements for SHECAP Projects 1, 2, and 5 are shown on Figure 6.

Table 7. Purpose and Findings/Confirmations of RVSD Flow Monitoring Locations

Flow Meter ID	2021 Purpose	2021 Findings/Confirmations
1	Confirm 2006 SHECAP Project 2 - Spruce Park/Merwin/Broadway; monitor RDII/GWI progression for 16/17 sewer lateral repairs	Basin shows increases in GWI but decreases in RDII when compared to 2006. Recalibration model confirms SHECAP project is necessary and will be sufficient. Capacity Issue 8 identified upstream of flow monitor location (see Additional Capacity Concerns).
1.01	Confirm 2006 SHECAP Project 1 - Westbrae/Hawthorne	Basin shows increases in GWI but decreases in RDII when compared to 2006. Recalibration model identifies Priority 3 surcharging for SHECAP project; therefore, the project may not be necessary at this time.
2	Monitor RDII/GWI progression for 16/17 sewer lateral repairs	Basin shows decreases in GWI and RDII when compared to 2006. No additional capacity issues have been identified.
3	Confirm 2006 SHECAP Project 5 - Upper Butterfield; monitor RDII/GWI progression for sewer 16/17 sewer lateral repairs	Basin shows decreases in GWI and RDII when compared to 2006. Recalibration model identifies Priority 3 surcharging for SHECAP project; therefore, the project may not be necessary at this time.
4	Monitor RDII/GWI progression for implemented SHECAP Project 6, Meadowcroft and Arroyo sewer lateral repairs, and 16/17 sewer lateral repairs	Basin shows increases in GWI but decreases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce GWI may be warranted.
5	Monitor RDII/GWI progression for 16/17 sewer lateral repairs	Basin shows decreases in GWI but increases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce RDII may be warranted.
6	Monitor RDII/GWI progression for implemented SHECAP Project 8 and Nokomis and Meadowcroft sewer lateral repairs	Basin shows decreases in GWI and RDII when compared to 2006. Capacity Issue 7 identified upstream of flow monitor location (see Additional Capacity Concerns). Additional efforts to reduce GWI/RDII may be warranted.
7.01	Monitor RDII/GWI progression for implemented SHECAP Project 9	Basin shows decreases in GWI and RDII when compared to 2006. Capacity Issue 6 identified upstream of flow monitor location (see Additional Capacity Concerns).
8	Monitor RDII/GWI progression for implemented SHECAP Project 12 and 15/16 sewer lateral repairs	Basin shows increases in GWI and RDII when compared to 2006. Capacity issues 1.2, 4, and 5 identified upstream of flow monitor location (see Additional Capacity Concerns). Additional efforts to reduce GWI/RDII may be warranted.
9	Monitor RDII/GWI progression for implemented SHECAP Project 13 and 15/16 sewer lateral repairs	Basin shows no change in GWI and increases in RDII when compared to 2006. Capacity issue 1.2 identified upstream of flow monitor location and Capacity issue 1.1 identifed downstream of flow monitor location (see Additional Capacity Concerns). Additional efforts to reduce RDII may be warranted.
10.01	Monitor RDII/GWI progression for implemented SHECAP Project 12 and 15/16 sewer lateral repairs	Basin shows increases in GWI but decreases in RDII when compared to 2006. Capacity issue 3 identified upstream of flow monitor location (see Additional Capacity Concerns). Additional efforts to reduce GWI may be warranted.
11.01	Monitor RDII/GWI progression for 15/16 sewer lateral repairs	Basin shows decreases in GWI and RDII when compared to 2006. No additional capacity issues identified, however, drainage influence should be investigated.
12	Monitor RDII/GWI progression for implemented SHECAP Project 17	Basin shows increases in GWI but decreases in RDII when compared to 2006. Capacity issue 2 identified upstream of flow monitor location (see Additional Capacity Concerns). Additional efforts to reduce GWI/RDII may be warranted.
13	Monitor RDII/GWI progression for implemented SHECAP Project 18 and 16/17 sewer lateral repairs	Basin shows increases in GWI but decreases in RDII when compared to 2006. No additional capacity issues identified.
14	Monitor flows to PS-13 from the northwest	Basin shows no change in GWI and increases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce RDII may be warranted.
15	Monitor flows to PS-13 from the northeast	Basin shows increases in GWI and RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce GWI/RDII may be warranted.
16	Monitor RDII/GWI progression	Basin shows increases in GWI but decreases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce GWI may be warranted.
17	Monitor RDII/GWI progression	Basin shows increases in GWI but decreases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce GWI may be warranted.
18	Monitor RDII/GWI progression	Basin shows no change in GWI and increases in RDII when compared to 2006. No additional capacity issues identified. Additional efforts to reduce RDII may be warranted.
PS12	Monitor flows discharged by PS-12	Basin shows increases in GWI and RDII when compared to 2006. PS12 has been identified as over capacity. dditional efforts to reduce GWI/RDII may be warranted.
PS14	Monitor flows discharged by PS-14	Basin shows decreases in GWI and RDII when compared to 2006. No additional capacity issues have been identified.

SHECAP Project 1

As described in the 2006 SHECAP Report, SHECAP Project 1 involves upsizing 1,278 lineal-feet of existing 8-inch diameter gravity main to 10-inch diameter gravity main parallel to Sir Francis Drake Boulevard. The existing gravity main is located in an easement through an apartment complex and along Westbrae Drive, ending at Hawthorne Court. This improvement encompasses six modeled gravity sewer segments, all of which are modeled as having Priority 3 level surcharging with peak freeboard ranging from 5.0 feet to 7.6 feet for the 5-year design storm and 4.6 to 6.0 feet for the 10-year design storm. For these reasons, SHECAP Project 1 was not found to be a high priority improvement and RVSD should consider monitoring flow in basin 1.01 to ascertain when its priority level changes.

If the proposed SHECAP Project is assumed to be implemented in the recalibrated 2021 hydraulic model, upsizing the required pipe from 8-inch diameter to 10-inch diameter results in the elimination of surcharging throughout the improved gravity main, however, peak d/D values for the 10-year design storm range from 0.72 to 0.86, which exceeds the d/D criteria for improved sewers less than 12 inches in diameter. Increasing the pipe diameters to 12 inches reduces the 10-year, 24-hour d/D to a range of 0.52 to 0.58, which satisfies the recommended d/D criteria for new sewers with diameters 12 inches or greater. If RVSD decides to move forward with SHECAP Project 1, it is recommended that the improved sewer diameter be increased to 12 inches to satisfy the recommended design criteria.

SHECAP Project 2

As described in the 2006 SHECAP Report, SHECAP Project 2 involves upsizing 405 lineal-feet of existing 15-inch diameter gravity main to 18-inch diameter gravity main on Spruce Road and Park Road from Arroyo Road to Merwin Avenue, with a parallel siphon (10-inch diameter and 15-inch diameter) to cross the creek on Merwin Avenue. This project also involves installing approximately 2,000 lineal-feet of 18-inch gravity main on Merwin Avenue from Park Road to Broadway and then eastward along Broadway to Pacheco Avenue, where it would connect into the existing 30-inch gravity sewer at Pacheco Avenue and Broadway. This improvement relieves peak sewer flows in 16 modeled gravity sewer segments along Park Road, Dominga Avenue, Napa Avenue, and Pacheco Avenue. Of those 16 segments, two are modeled as having Priority 1 surcharging, with the remaining gravity sewers consisting of a mixture of Priority 2 and Priority 3 surcharging, and other pipes approaching full capacity. For the both the 5-year and 10-year design storms, peak freeboards range from zero to 6.6. For this reason, it is recommended that SHECAP Project 2 be implemented by RVSD.

If the proposed SHECAP Project is assumed to be implemented in the recalibrated 2021 hydraulic model, upsizing the required pipe from 15-inch diameter to 18-inch diameter results in the elimination of surcharging for all but one sewer located upstream on Dominga Avenue, for which Priority 4 surcharging is indicated for the 10-year design storm. Peak freeboards for the relieved sewers range from 7.5 feet to 12.4 feet for the 5-year design storm and 7.4 feet to 12.3 feet for the 10-year design storm. Except for the proposed siphon, the gravity sewers constructed with SHECAP Project 2 are projected to have d/D ranges of 0.61 to 0.77 for the 5-year design storm and 0.63 to 0.79 for the 10-year design storm, which satisfies the recommended d/D criteria for new sewers with diameters 12 inches or greater. It is therefore recommended that RVSD proceed with implementation of SHECAP Project 2 as proposed in the 2006 SHECAP Report.

SHECAP Project 5

As described in the 2006 SHECAP Report, SHECAP Project 5 involves upsizing 3,836 lineal-feet of existing 10-inch and 12-inch diameter gravity main located on Butterfield Road from Van Tassel Court to Fawn Drive. The upsized pipe diameters would be 12 inches upstream of Legend Road and 15 inches downstream of Legend Road. This improvement encompasses 15 modeled gravity sewer segments, 13 of which are projected to be between 90 percent full and at a Priority 3 surcharge event with peak freeboards ranging from 4.4 feet to 7.3 feet for the 5-year design storm and 4.1 feet to 6.8 feet for the 10-year design storm. For these reasons, SHECAP Project 5 was not found to be a high priority improvement and RVSD should consider monitoring flow in basin 3 to ascertain when its priority level changes.

If the proposed SHECAP Project is assumed to be implemented in the recalibrated 2021 hydraulic model, upsizing the required pipe from 10-inch and 12-inch diameter to 12-inch and 15-inch diameter eliminates surcharging in all but four 15-inch diameter modeled gravity sewers located on the downstream end of the improvement. Extending SHECAP Project 5 to the intersection of Oak Knoll Drive and upsizing the sewers between Oak Knoll Drive and Baltus Lane to 18-inch diameter reduces the 10-year peak d/D to a range of 0.53 to 0.87, which satisfies the recommended d/D criteria for new sewers with diameters 12 inches or greater. If RVSD decides to move forward with SHECAP Project 5, it is recommended that the improvement be extended to Oak Knoll Drive and the sewers located between Oak Knoll Drive and Baltus Lane be upsized to 18-inch diameter.

Pump Station Capacity Assessment

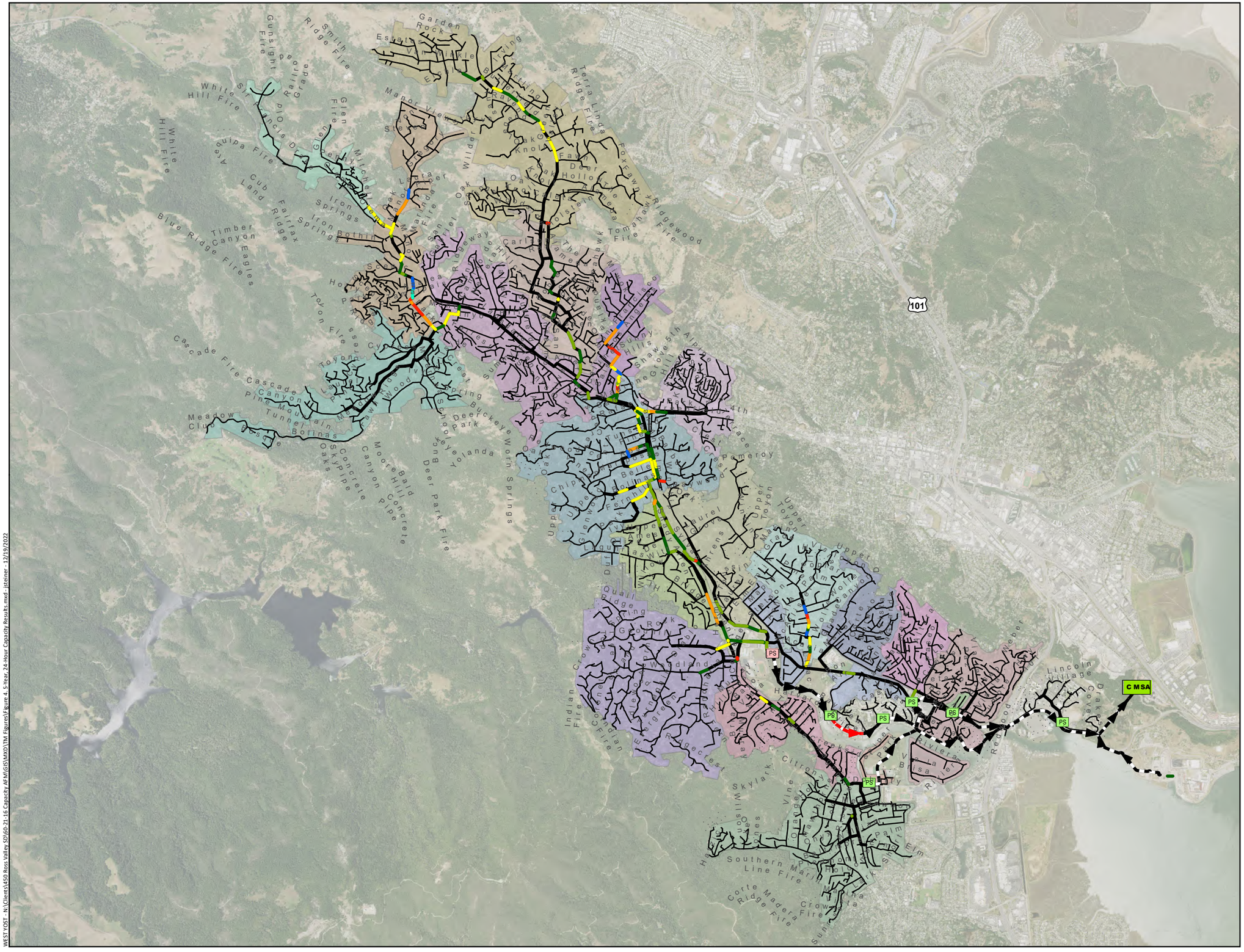
For this analysis, a capacity assessment was performed on the eight RVSD pump stations discussed in the 2006 SHECAP report and summarized in Table 8. Specifically, firm capacities for each pump station were compared with results from the 2021 recalibrated model. (The term “firm capacity” refers to the station capacity when the largest pump is out of service.)

Table 8 compares the modeled peak flows with the firm capacity at each pump station. The model results from the 2006 analysis are also included for comparison purposes. Besides PS15, all the pump stations were found to have sufficient capacity for both the 5-year and 10-year design storms. Capacity deficiencies associated with PS15 for the 5-year and 10-year design storms are discussed in the following subsections.

Table 8. RVSD Pump Station Capacity

Pump Station	Firm Capacity, MGD	2006 5-Year Design Storm Peak Flow, MGD	2021 5-Year Design Storm Peak Flow, MGD	2021 10-Year Design Storm Peak Flow, MGD
PS10 (Landing B)	1.37	1.12	0.69	0.71
PS11 (San Quentin)	2.88	1.67	1.39	1.39
PS12 (Bon Air)	3.00	1.86	1.55	1.57
PS13 (Greenbrae)	12.70	5.51	5.72	6.08
PS14 (Larkspur Main)	8.74	8.56	4.86	5.18
PS15 (Kentfield)	37.90	39.00	**41.80**	**44.91**
PS24	1.54	0.45	0.31	0.33
PS25	1.83	0.70	0.44	0.46

Note: Firm capacity is defined as the pump station capacity with the largest pump out of service. Firm capacities for PS12 and PS13 were provided by RVSD and the remaining firm capacities were established in the 2013 Sanitary Sewer Pump Station Evaluation prepared by Shaaf & Wheeler.
Bold red values indicate pump stations where the modeled 2021 peak flow exceeds the listed firm capacity.



N

0 1,750 3,500

Scale in Feet

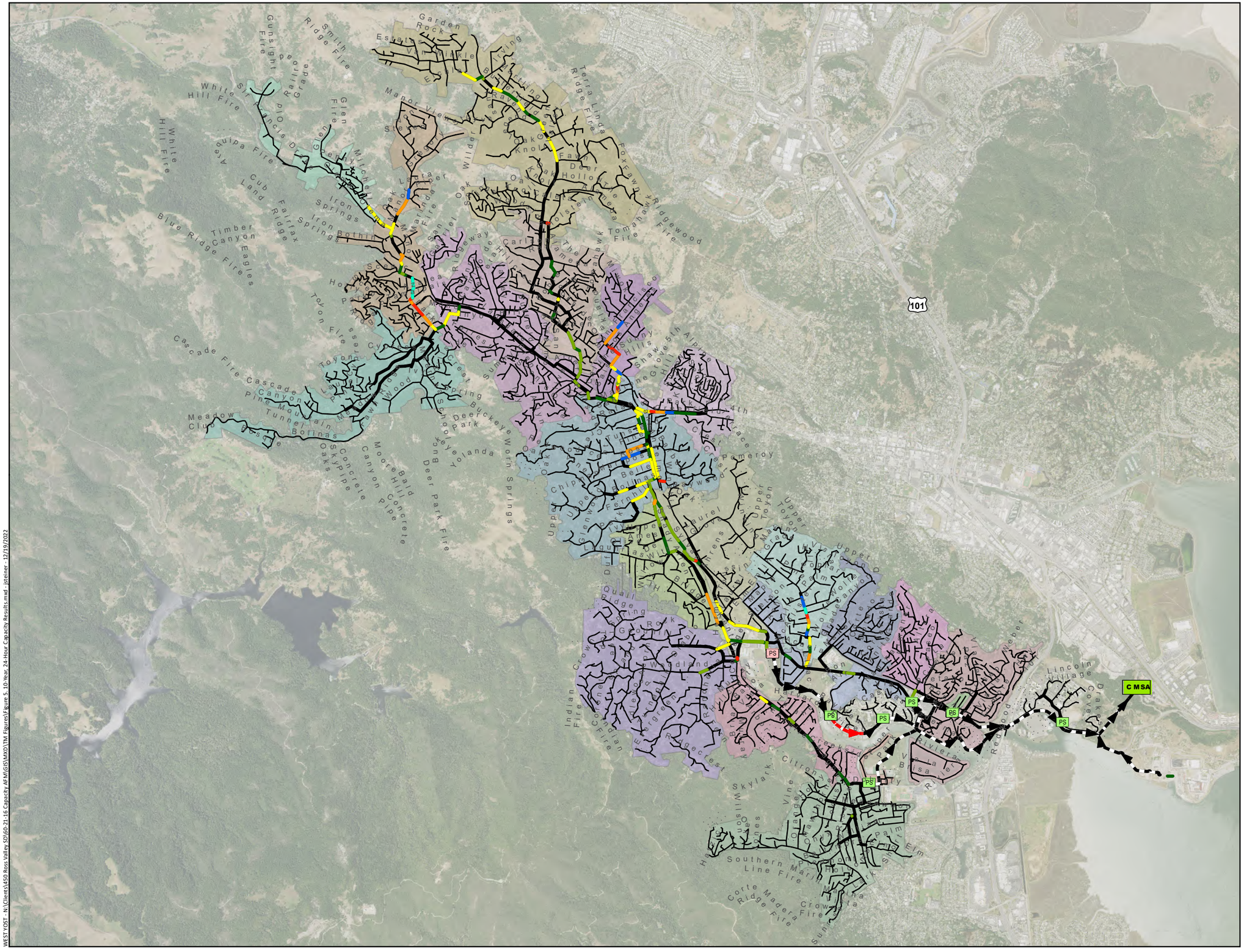
- Priority 1 Surcharging
- Priority 2 Surcharging
- Priority 3 Surcharging
- Priority 4 Surcharging
- 90% capacity
- Backwater outflow
- Backwater 1–4'
- Other Modeled Gravity Main
- Force Main at Capacity
- Other Modeled Force Main
- Existing Collection System
- PS Pump Station at Capacity
- PS Other Modeled Pump Station
- CMSA Outlet to CMSA

Figure 4

Existing System Capacity Assessment
5-Year, 24-Hour
Design Flow Conditions

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

WEST YOST - N:\Clients\450 Ross Valley SD\6D-21-16 Capacity AFM\GIS\MPO\TM Figures\Figure 4, 5-Year, 24-Hour Capacity Results.mxd - jsteiner - 12/19/2022



N

0 1,750 3,500

Scale in Feet

- Priority 1 Surcharging
- Priority 2 Surcharging
- Priority 3 Surcharging
- Priority 4 Surcharging
- 90% capacity
- Backwater outflow
- Backwater 1–4'
- Other Modeled Gravity Main
- Force Main at Capacity
- Other Modeled Force Main
- Existing Collection System
- PS Pump Station at Capacity
- PS Other Modeled Pump Station
- CMSA Outlet to CMSA

Figure 5

Existing System Capacity Assessment
10-Year, 24-Hour
Design Flow Conditions

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

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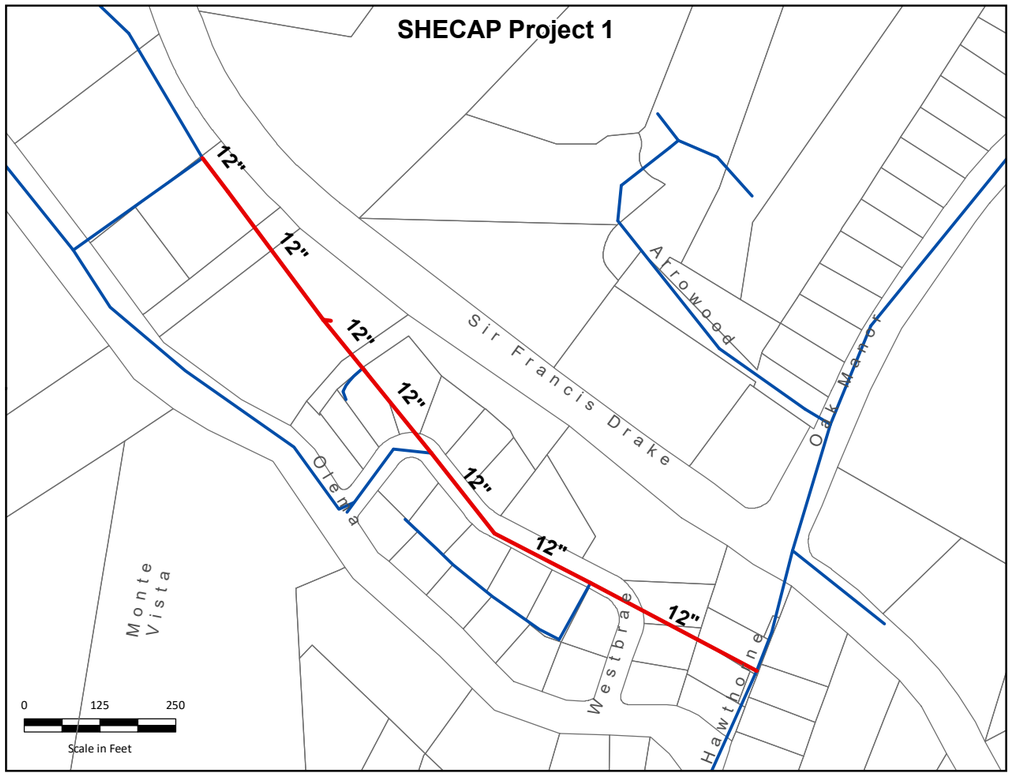
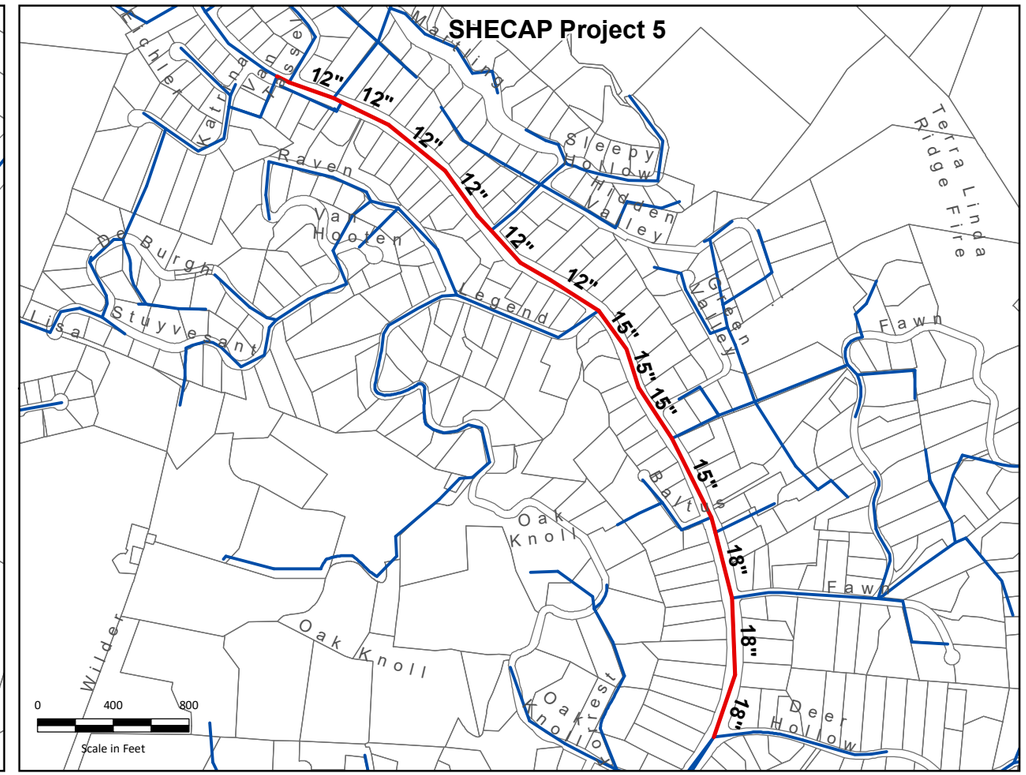
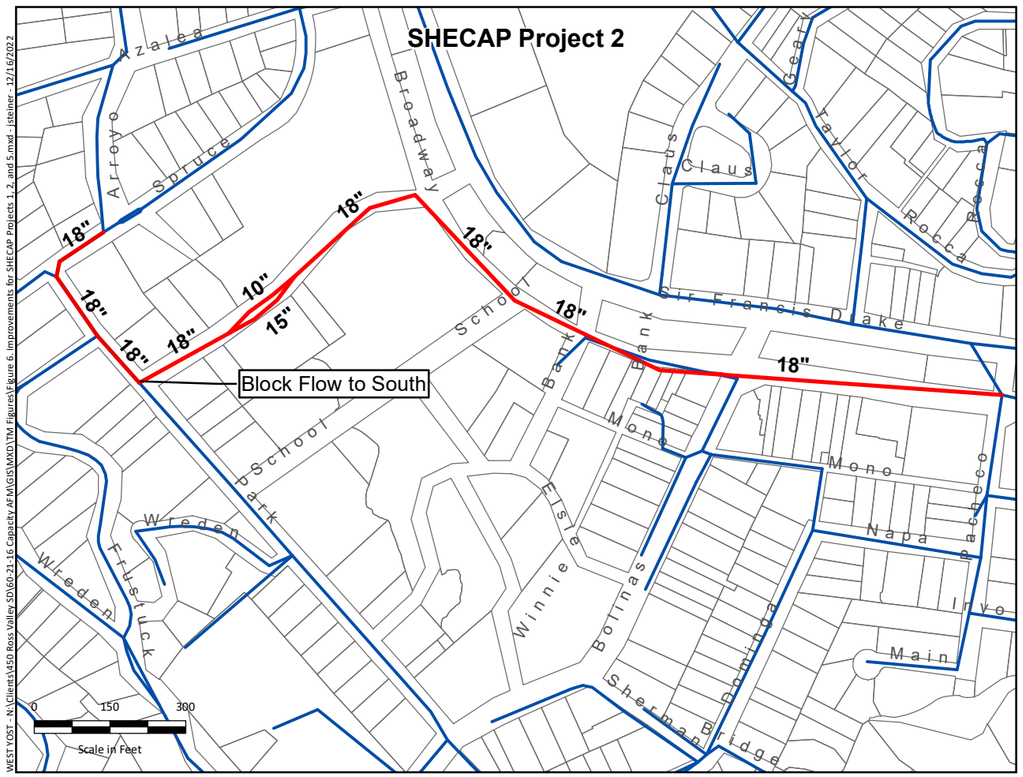
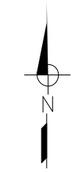








SHECAP Projects

Existing Collection System

Parcels

Figure 6

Recommended Improvements for SHECAP Projects 1, 2, and 5

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

WEST YOST - N:\Clients\450 Ross Valley SD\60-21-16 Capacity Alt\MXD\TM Figures\Figure 6. Improvements for SHECAP Projects 1, 2, and 5.mxd - jsteiner - 12/16/2022

Additional Capacity Concerns

Eight additional capacity issues beyond the remaining SHECAP Projects were identified by Priority 1 and Priority 2 surcharging in modeled gravity sewers, as well as gravity sewers subject to backwater-induced surcharging. The identified capacity issues are indicated along with the SHECAP improvements on Figure 7. Model results indicating system performance relative to the applied capacity criteria are indicated on Figure 8. The following key points and assumptions are important to understand when analyzing the additional capacity issues:

1. In identifying possible improvements to address the identified capacity issues, prior implementation of SHECAP Project 2 is assumed.
2. While both the 5-year and 10-year design storms were used to identify additional capacity issues, the 10-year design storm was used to size improvements to address those issues.
3. Multiple options may exist for RVSD to address the identified capacity issues. Improvements may involve GWI/RDII reduction through lateral and small diameter sewer repairs, upsizing capacity deficient sewers, constructing diversion sewers upstream of capacity issues, or a combination of all three approaches.

Capacity Issue 1.1 - Kentfield Pump Station and Force Main: This capacity issue involves the Kentfield Pump Station (PS15) and PS15 force main, which lacks capacity to adequately convey peak 5-year and 10-year sewer flows when the remaining capacity concerns discussed in this section are addressed. The need to increase capacity at PS15 stems from the need to sustain a 10.5-foot water level in the PS15 wet well. Maintaining a water level of 10.5 feet at PS15 ensures two hydraulic properties in the RVSD collection system: 1) it eliminates surcharging in upstream sewers that would otherwise be adequately sized and 2) it prevents surcharging and capacity issues at the Greenbrae Pump Station (PS13), located downstream of PS15, and its tributary gravity sewers. When capacity for PS15 is exceeded and the water level in the PS15 wet well rises above 10.5 feet, the excess flow gets diverted east towards PS13, which results in capacity issues for PS13.

Results from the hydraulic model indicate that the firm capacity for PS15 would need to be increased from 37.9 MGD to 45.0 MGD to maintain a wet well water level of 10.5 feet for the 10-year design storm. Increasing the capacity of PS15 would result in peak velocity exceedances in the 1,522-foot section of 32-inch diameter force main along South Eliseo Drive from Bon Air Road to just west of Corte Real, which would need to be addressed by pipe upsizing or constructing a parallel relief force main.

Capacity Issue 1.2 – Corte Madera Creek and Bolinas Avenue Sewer Trunks: This capacity issue involves the following sections of the RVSD collection system:

1. 422 lineal-feet of 42-inch diameter gravity sewer from PS15 to Stadium Way just east of Corte Madera Creek
2. 4,675 lineal-feet of 39-inch diameter gravity sewer from Stadium Way just east of the Corte Madera Creek to a parallel 24-inch diameter siphon crossing the Corte Madera Creek east of Ross Common Park (siphon not included as part of this capacity issue)
3. 2,712 lineal-feet of 36-inch diameter gravity sewer until the intersection of Bolinas Avenue and Shady Lane
4. 1,381 feet of 36-inch diameter gravity sewer from the intersection of Bolinas Avenue and Shady Lane until the intersection of San Anselmo Avenue and Ross Avenue

Capacity Issue 1.2 exists only to facilitate increased peak flow rates to PS15 and to relieve surcharging elsewhere in the system. It may be possible to reduce the need for improvements to address Capacity Issues 1.1 and 1.2 as GWI/RDII reduction improvements are implemented. Accordingly, the facilities associated with Capacity Issues 1.1 and 1.2 should be monitored as RVSD continues to implement GWI/RDII reduction improvements.

Capacity Issue 2 – McAllister Avenue and Laurel Grove Avenue: This capacity issue encompasses 1,329 lineal-feet of 16-inch diameter gravity sewer from the intersection of Berens Drive and McAllister Avenue to an unnamed creek just south of Sir Francis Drake Boulevard. Underneath the creek, there exists a parallel siphon (8-inch and 12-inch diameter) that is modeled as flowing at less than full capacity. Upstream of the siphon, 1,628 lineal-feet of 10-inch and 12-inch diameter gravity sewer along Laurel Grove Avenue until Palm Avenue is modeled as flowing at capacity. Capacity issues were identified in these sewers in the 2006 SHECAP report and improvements were recommended as SHECAP Project 17. RVSD has since upsized 2,256 lineal-feet of 8-inch, 10-inch, and 12-inch sewers to 10-inch, 12-inch, and 15-inch sewers on Laurel Grove Avenue, Sir Francis Drake Boulevard, and McAllister Avenue from Cypress Avenue to Berens Drive; however, modeled capacity issues persist in this area. Potential improvements to address these capacity issues include reducing influences from RDII/GWI in sewer laterals and smaller diameter pipes upstream and/or upsizing the capacity deficient pipes.

Capacity Issue 3 – Kent Avenue to College Avenue: This capacity issue encompasses 993 lineal-feet of 27-inch diameter gravity sewer located on Kent Avenue and the parking lot adjacent to Stadium Way and 589 lineal-feet of 24-inch diameter gravity sewer from the intersection of Hillside Avenue and Kent Avenue approximately to 529 Kent Avenue. Potential improvements to address this capacity issue include reducing influences from RDII/GWI in flow monitoring basin 10.01 and flow monitoring basins tributary to 10.01 and/or upsizing the capacity deficient pipes.

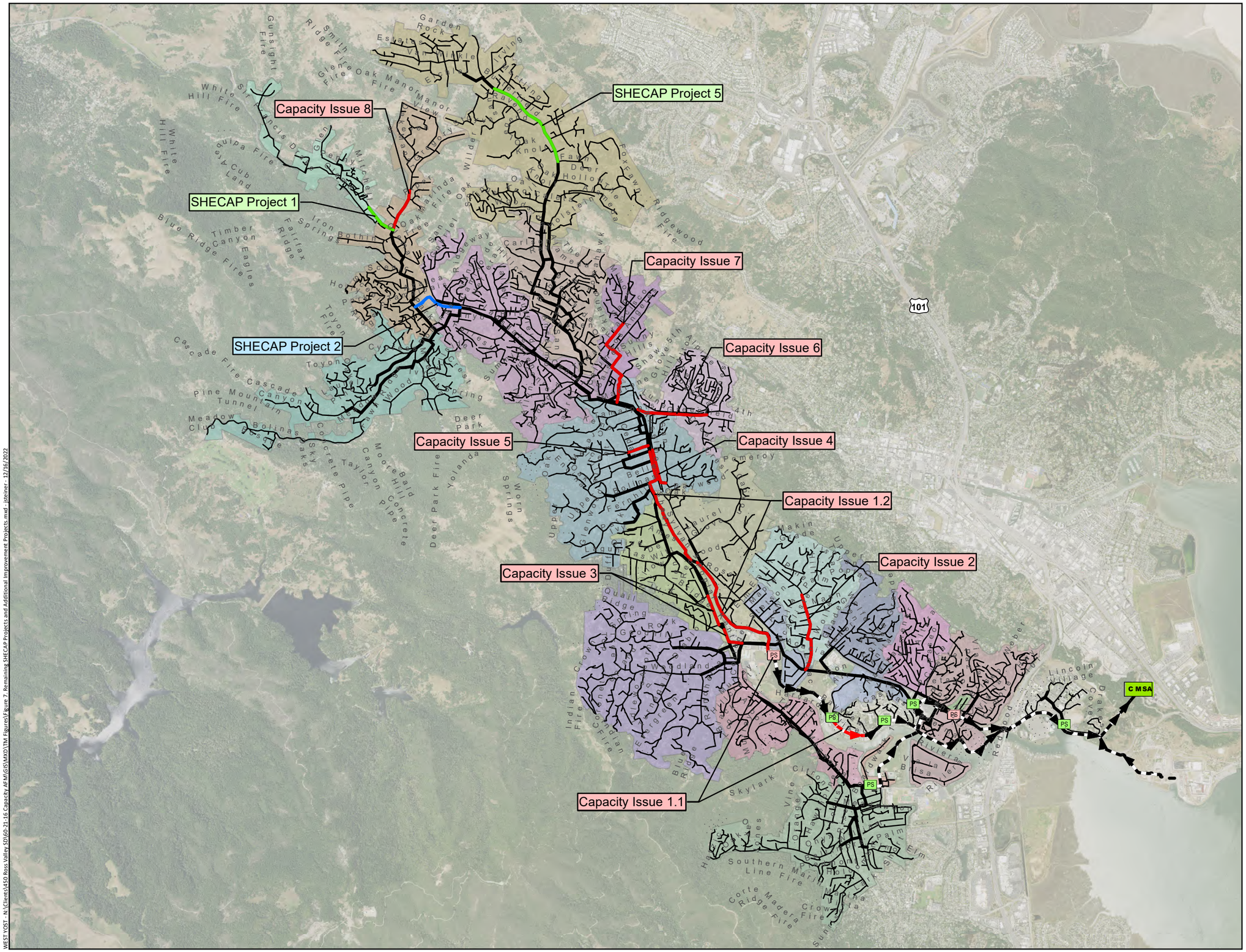
Capacity Issue 4 – Sir Francis Drake Boulevard at Bolinas Avenue: This capacity issue encompasses 1,601 lineal-feet of 6-inch, 8-inch, and 10-inch diameter gravity sewer located on Sir Francis Drake Boulevard, Bolinas Avenue, and the Winship Avenue Bridge. Capacity issues were identified in these sewers in the 2006 SHECAP report and improvements were recommended as SHECAP Project 10. RVSD has since upsized 140 lineal-feet of 8-inch diameter sewer to 10-inch diameter sewer along Bolinas Avenue; however, modeled capacity issues persist in this area. Potential improvements to address these capacity issues include reducing influences from RDII/GWI in sewer lateral and smaller diameter pipes upstream, constructing the 12-inch relief sewer from Sir Francis Drake Boulevard to Shady Lane as proposed with SHECAP Project 10, constructing the 8-inch parallel sewer along the Winship Avenue Bridge as proposed with SHECAP Project 10, and/or upsizing the capacity deficient pipes.

Capacity Issue 5 – Woodland Avenue: This capacity issue encompasses 799 lineal-feet of 8-inch diameter gravity sewer from along Woodland Avenue from Cedar Street to San Anselmo Avenue. Potential improvements to address this capacity issue include reducing influences from RDII/GWI in sewer laterals and smaller diameter pipes upstream and/or upsizing the capacity deficient pipes.

Capacity Issue 6 – Greenfield Avenue and Center Boulevard: This capacity issue encompasses 2,634 lineal-feet of 10-inch diameter gravity sewer along Greenfield Avenue and Center Boulevard. Capacity issues were identified in these sewers in the 2006 SHECAP report and improvements were recommended as SHECAP Project 9. RVSD has since upsized 1,865 lineal-feet of 6-inch and 8-inch diameter sewers to 10-inch diameter along Greenfield Avenue from Hilldale Drive to Sir Francis Drake Boulevard; however, modeled capacity issues persist in this area. Potential improvements to address these capacity issues include reducing influences from RDII/GWI in sewer laterals and smaller diameter pipes upstream, constructing the 12-inch diameter relief sewer along Sir Francis Drake Boulevard south to Tunstead Avenue as proposed with SHECAP Project 9, and/or upsizing the capacity deficient pipes.

Capacity Issue 7 – Sycamore Avenue to Santa Cruz Avenue: This capacity issue encompasses 470 lineal-feet of 12-inch diameter gravity sewer from Sycamore Avenue east of Madrone Avenue to San Anselmo Creek, a parallel siphon (8-inch and 10-inch diameter) underneath San Anselmo Creek, 1,501 lineal-feet of 12-inch diameter gravity sewer upstream of the siphon to San Anselmo Memorial Park, and 1,720 lineal-feet of 10-inch diameter gravity sewer from San Anselmo Memorial Park to the intersection of San Francisco Boulevard and Santa Cruz Avenue. Capacity issues were identified in these sewers in the 2006 SHECAP report and improvements were recommended as SHECAP Project 8. RVSD has since constructed an 18-inch diversion sewer along Madrone Avenue and Center Boulevard; however, modeled capacity issues persist in this area. Potential improvements to address these capacity issues include reducing influences from RDII/GWI in sewer laterals and smaller diameter pipes upstream, extending the diversion sewer along Nakomis Avenue as proposed with SHECAP Project 8, and/or upsizing the capacity deficient pipes.

Capacity Issue 8 – Oak Manor Drive: This capacity issue involves 1,565 lineal-feet of 8-inch diameter gravity sewer along Oak Manor Drive from Westbrae Drive to Laura Lane. Potential improvements to address this capacity issue include reducing influences from RDII/GWI in sewer laterals and smaller diameter pipes upstream and/or upsizing the capacity deficient pipes.



N

0 1,750 3,500

Scale in Feet

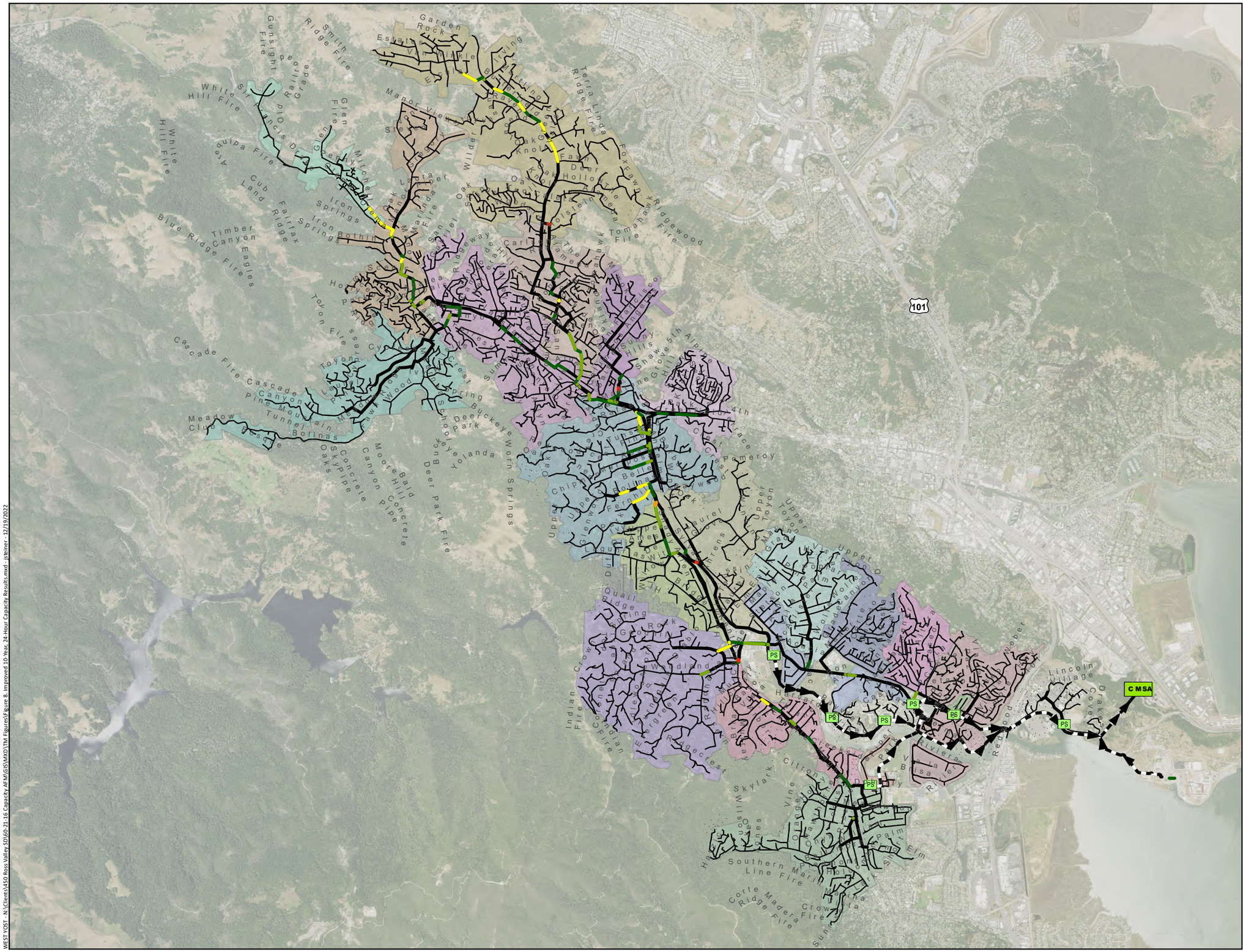
- Additional Capacity Issues
- Implemented SHECAP Project
- Unimplemented SHECAP Project
- Other Modeled Gravity Main
- Other Modeled Force Main
- Force Main at Capacity
- Existing Collection System
- PS Pump Station at Capacity
- PS Other Modeled Pump Station
- CMSA Outlet to CMSA

Figure 7

SHECAP Projects and Additional Capacity Issues

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

WEST YOST - N:\Clients\450 Ross Valley\SD\69-21-16 Capacity AFW\GIS\MXD\TM Figures\Figure 7. Remaining SHECAP Projects and Additional Improvement Projects.mxd - jsteiner - 12/16/2022



N

0 1,750 3,500

Scale in Feet

- Priority 1 Surcharging
- Priority 2 Surcharging
- Priority 3 Surcharging
- Priority 4 Surcharging
- 90% capacity
- Backwater outflow
- Backwater 1–4'
- Other Modeled Gravity Main
- Other Modeled Force Main
- Existing Collection System
- PS Modeled Pump Station
- CMSA Outlet to CMSA

Figure 8

System Assessment with Capacity Issues Addressed 10-Year, 24-Hour Design Flow Conditions

Ross Valley Sanitary District
Wastewater Collection System
Capacity Evaluation

WEST YOST - N:\Clients\450 Ross Valley SD\69-21-16 Capacity AFW\GIS\MXD\TM Figures\Figure 8. Improved 10-Year, 24-Hour Capacity Results.mxd - jstbiner - 12/19/2022

SUMMARY AND RECOMMENDATIONS

The flow data used throughout model calibrations was collected over multiple years and is impacted by the changing condition of the RVSD collection system, highly variable storm patterns, and changing climatic conditions in Northern California. As with all collection systems, it can be difficult identifying and quantifying all contributions to changing flows as well as separating actual trends from noise in the data.

Table 7 above summarizes the purpose of the findings obtained from each flow monitoring site. Future evaluations are recommended to investigate the potential for further reductions of GWI and RDII and to confirm capacity concerns in various parts of the RVSD collection system. As shown in Table 6 above, design flows predicted by the hydraulic model using the 2021 recalibrated data suggest the infrastructure improvements implemented since 2006 have been successful at reducing the influence of GWI and RDII. Table 7 provides recommendations for which flow monitoring basins will benefit the most from future improvements aimed at reducing peak flow rates and what actions are necessary to achieve a higher degree of system capacity. The following list summarizes conclusions regarding influences from GWI and RDII in the 2021 recalibrated hydraulic model:

1. GWI that decreased from 2006 to 2021 was mainly located in the northern part of the system, likely due to RVSD's investment in collection system infrastructure improvements in these areas. Lack of decreases in GWI in the southern portion of the collection system may be partly due to the proximity of this portion of the collection system to Corte Madera Creek and San Francisco Bay.
2. The most significant increases in GWI occurred in flow monitoring basins 4, 8, and 16. All three of these flow monitoring basins appear to contain aging infrastructure that could benefit from capacity improvements, pipeline rehabilitation, and service lateral repairs.
3. Overall, GWI has increased 31 percent from the original 2006 hydraulic model and 62 percent from the 2014/2020 hydraulic model. Most of the increase since 2006 is concentrated in six basins: 4, 8, 10.01, 16, 17 and PS12, which suggests that future improvements geared toward GWI reduction could focus on these areas.
4. From 2006 to 2021, RDII decreased in 14 of the 21 flow monitoring basins, indicating that recent capacity improvement projects and lateral replacements have paid off regarding reductions in peak flow from RDII.
5. Overall, RDII has decreased 28 percent from the 2006 hydraulic model and 34 percent from the 2014/2020 hydraulic model. Flow monitoring basins that saw an increase in RDII from 2006 include basins 5, 8, 9, 14, 15, 18, and PS12.

Currently unimplemented SHECAP Projects 1, 2, and 5 were evaluated using the 2021 recalibrated hydraulic model for 5-year and 10-year design storm conditions. Implementation of SHECAP Projects is recommended for Priority 1 and Priority 2 modeled gravity sewers as well as gravity sewers subject to backwater-induced surcharging. Prioritization of capacity concerns is presented in Table 5 above. The proposed improvements for the currently unimplemented SHECAP projects are shown Figure 6. The following list summarizes the findings of the evaluation of those projects:

1. SHECAP Project 1 was not found to be a high priority due to Priority 3 surcharging and RVSD should consider monitoring flow in basin 1.01 to ascertain when its priority level changes. If RVSD does proceed with implementation, modification of the improvement specified in the SHECAP would be required to comply with d/D design criteria.

2. Implementation of SHECAP Project 2 is recommended as proposed in the 2006 SHECAP Report due to Priority 1 surcharging. No modifications of the improvement specified in the SHECAP would be required. SHECAP Project 2 involves upsizing 405 lineal-feet of existing 15-inch diameter gravity main to 18-inch diameter gravity main on Spruce Road and Park Road from Arroyo Road to Merwin Avenue, with a parallel siphon (10-inch diameter and 15-inch diameter) to cross the creek on Merwin Avenue. This project also involves installing approximately 2,000 lineal-feet of 18-inch gravity main on Merwin Avenue from Park Road to Broadway and then eastward along Broadway to Pacheco Avenue, where it would connect into the existing 30-inch gravity sewer at Pacheco Avenue and Broadway.
3. SHECAP Project 5 was not found to be a high priority due to Priority 3 and Priority 4 surcharging and RVSD should consider monitoring flow in basin 3 to ascertain when its priority level changes. If RVSD does proceed with implementation, modification would be required to comply with d/D design criteria.

Eight additional capacity issues were identified because of Priority 1 and Priority 2 surcharging in modeled gravity sewers as well as gravity sewers subject to backwater-induced surcharging. Identified capacity issues are shown on Figure 7. Results of applying the proposed capacity criteria to the modeled collection system with SHECAP Project 2 implemented and the eight additional capacity issues addressed are shown on Figure 8.

Overall, the recalibration of the hydraulic model indicates that the predicted peak design flows in the RVSD collection system are decreasing when compared to 2006. Based on the results summarized in this TM, it is clear that RVSD's investment in collection system upgrades and GWI/RDII reduction methods has had a measurable impact in peak modeled flows. Moving forward, it is recommended that RVSD implement SHECAP Project 2 and investigate the eight additional capacity issues identified in this analysis. Multiple options may exist for RVSD to address the identified capacity issues. Capacity issues identified in this analysis can be addressed through a variety of means, including capital projects with pipe diameter increases, parallel relief sewers, or upstream pipeline rehabilitation to reduce GWI and RDII. Capacity issues can also be addressed through non-capital means, such as in-house repair of major pipe defects to reduce GWI and RDII, service lateral repairs, and monitoring during wet weather using flow monitors or SmartCovers.

Attachment A

Flow Monitoring Site Reports

Monitoring Site: Site 01

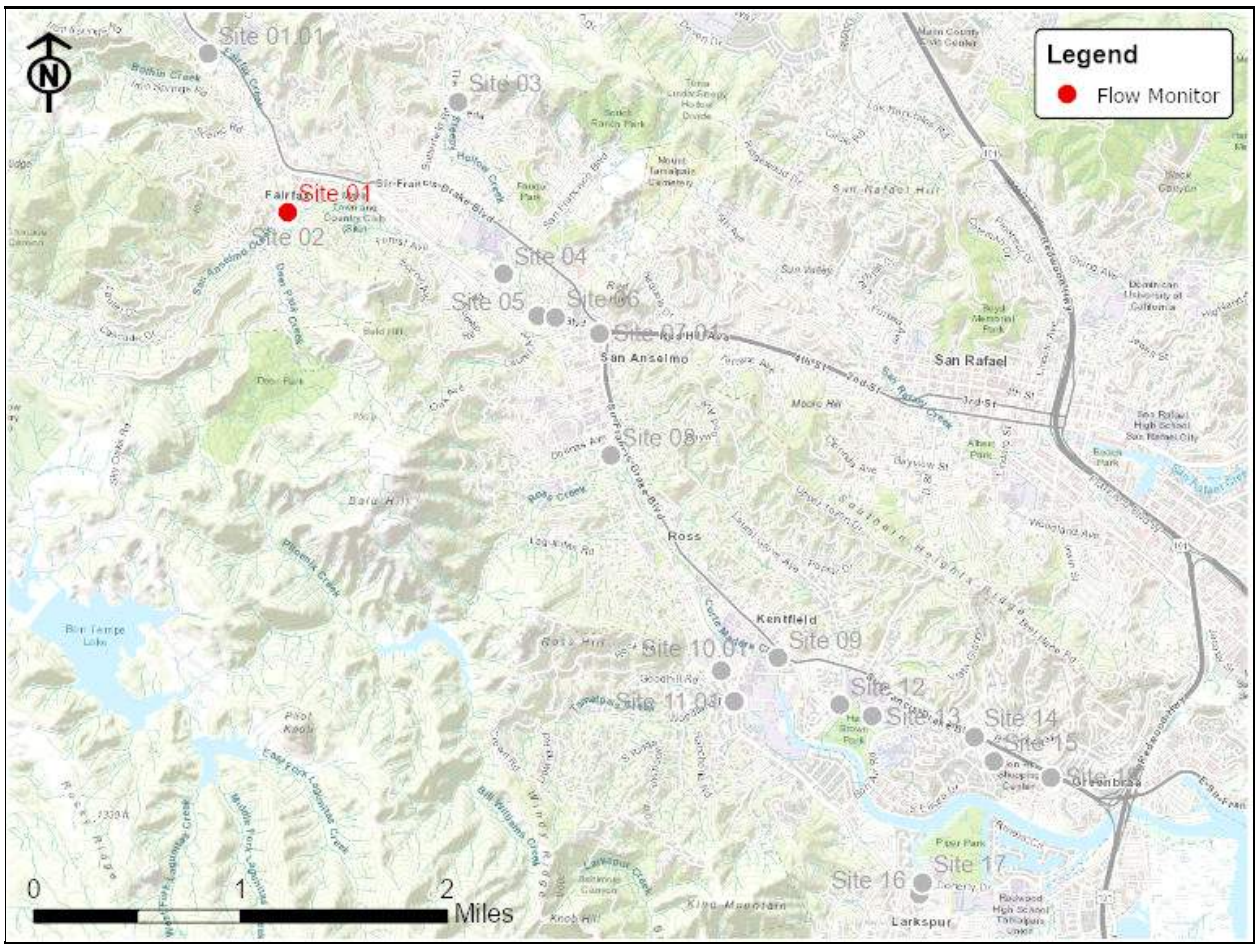
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 120 Dominga Ave

Data Summary Report



Vicinity Map: Site 01

SITE 01

Site Information MH ID: F003.010

Location: 120 Dominga Ave

Coordinates: 122.5902° W, 37.9845° N

Rim Elevation (Earth): 111 feet

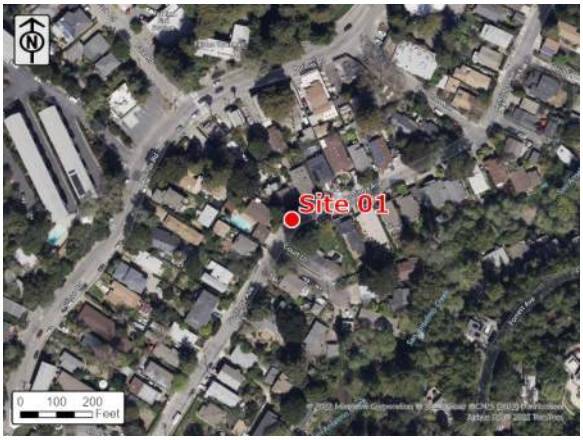
Expected Pipe Diameter: 15 inches

Measured Pipe Diameter: 15 inches

ADWF: 0.234 mgd

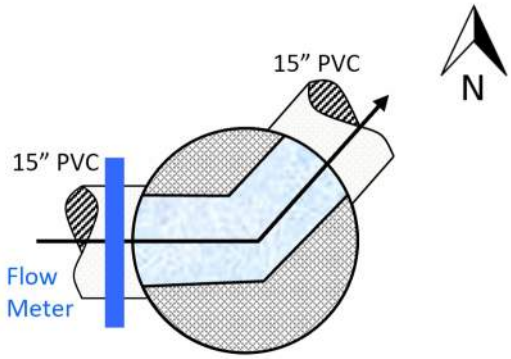
Peak Measured Flow: 2.991 mgd

Sediment: None



Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 01

Additional Site Photos

Effluent Pipe

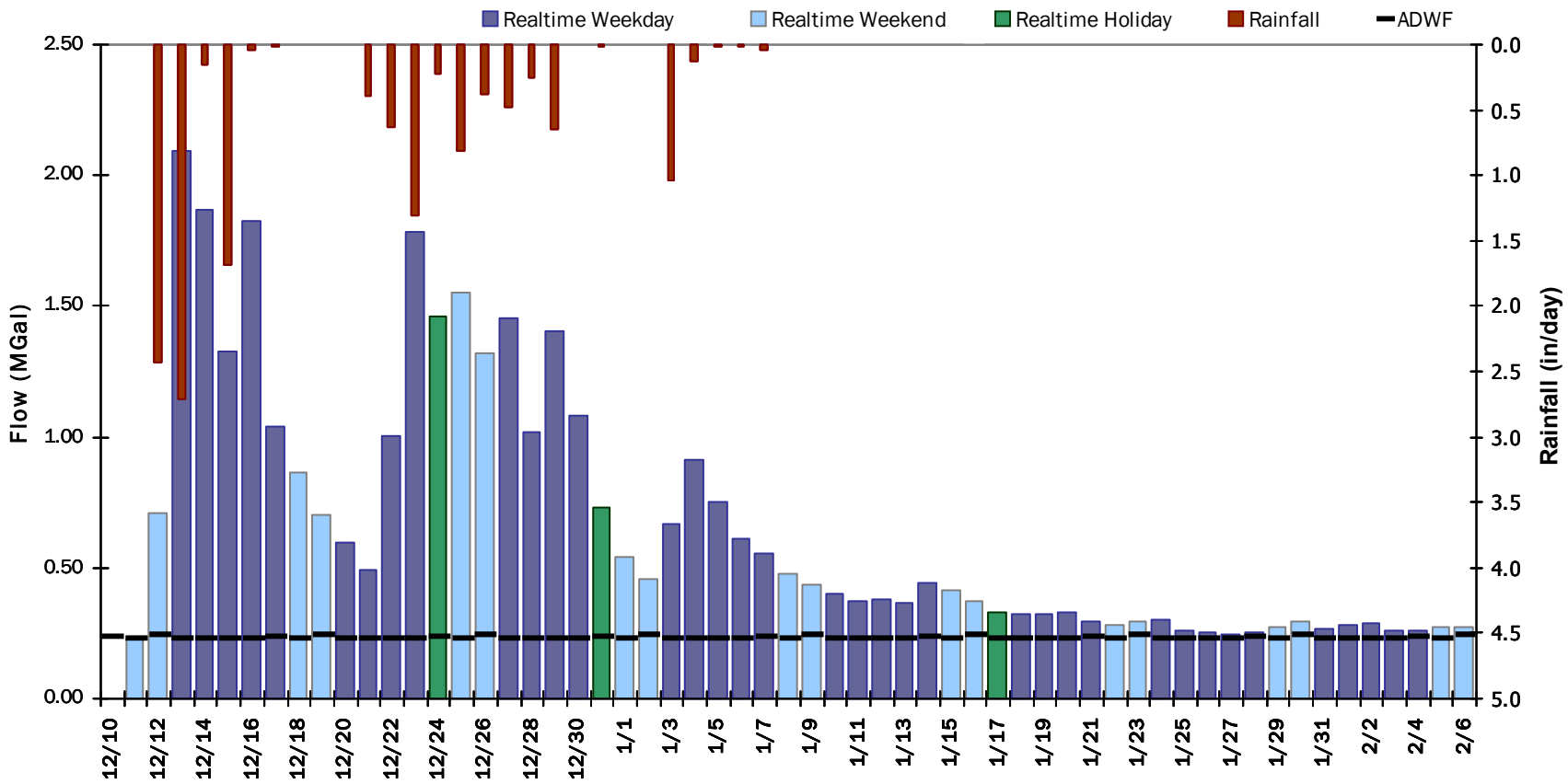
Monitored Northwest Influent Pipe

SITE 01

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.667 MGal Peak Daily Flow: 2.091 MGal Min Daily Flow: 0.229 MGal

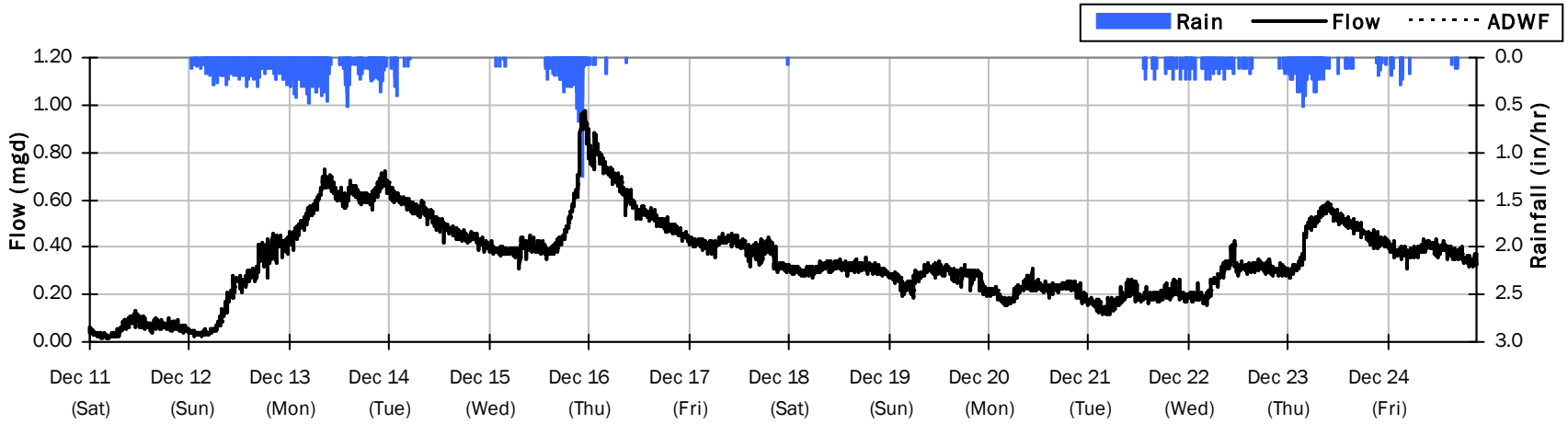
Total Rainfall: 13.40 inches

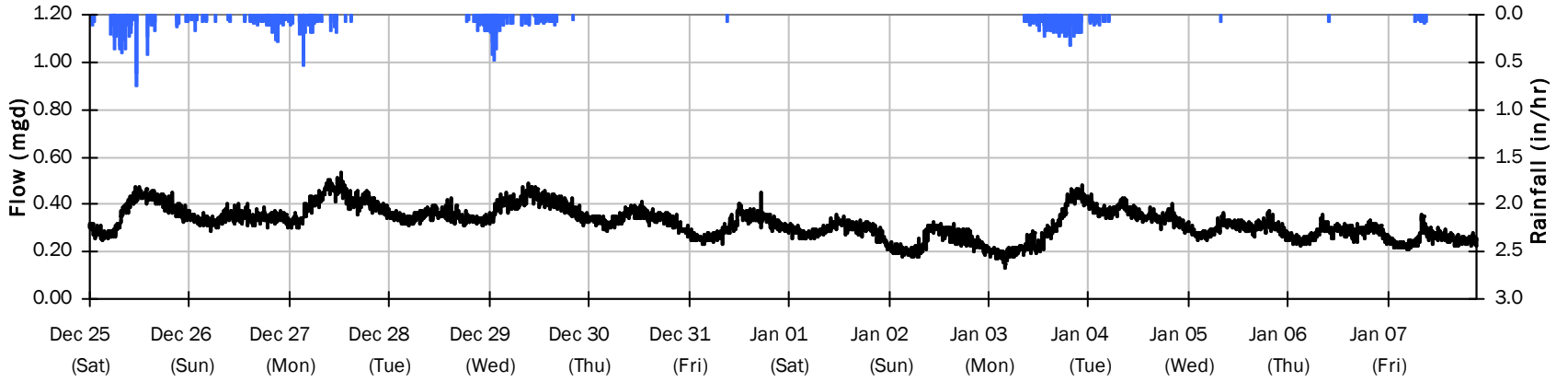


SITE 01.01

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 13.20 inches Period Avg Flow: 0.334 mgd Period Peak Flow: 0.979 mgd Period Min Flow: 0.018 mgd

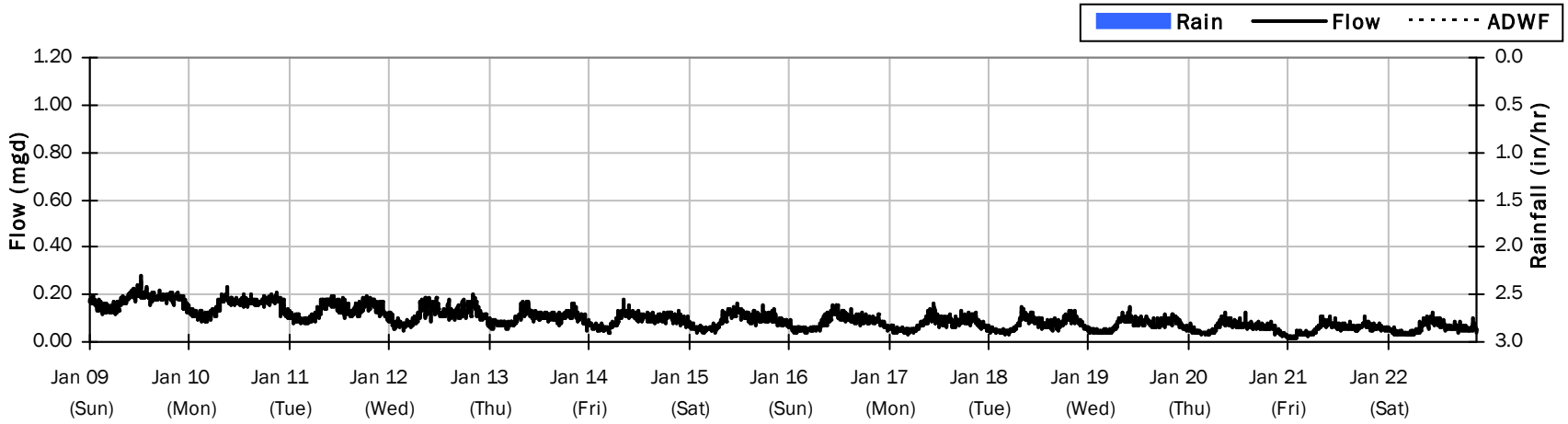


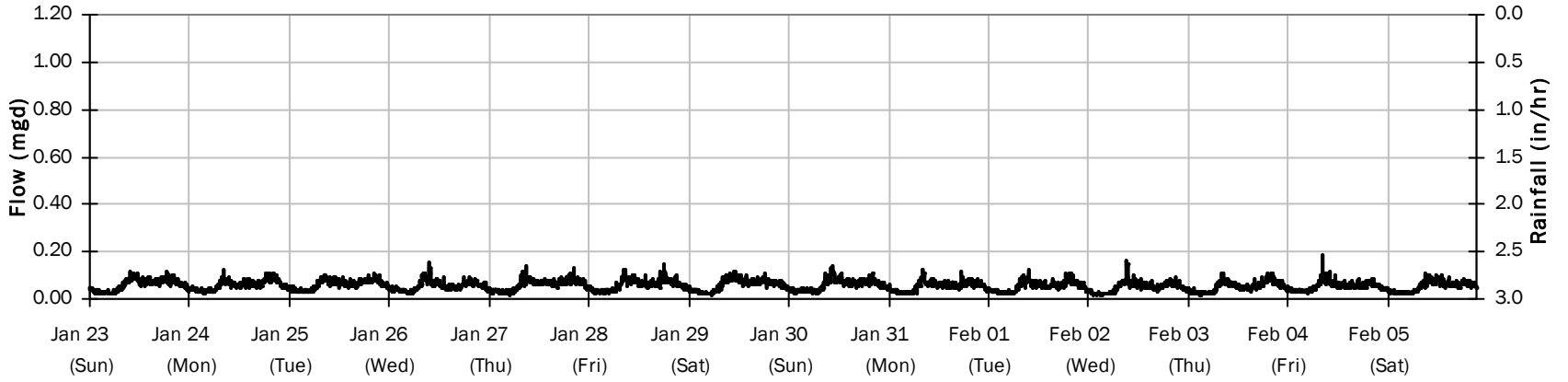


SITE 01.01

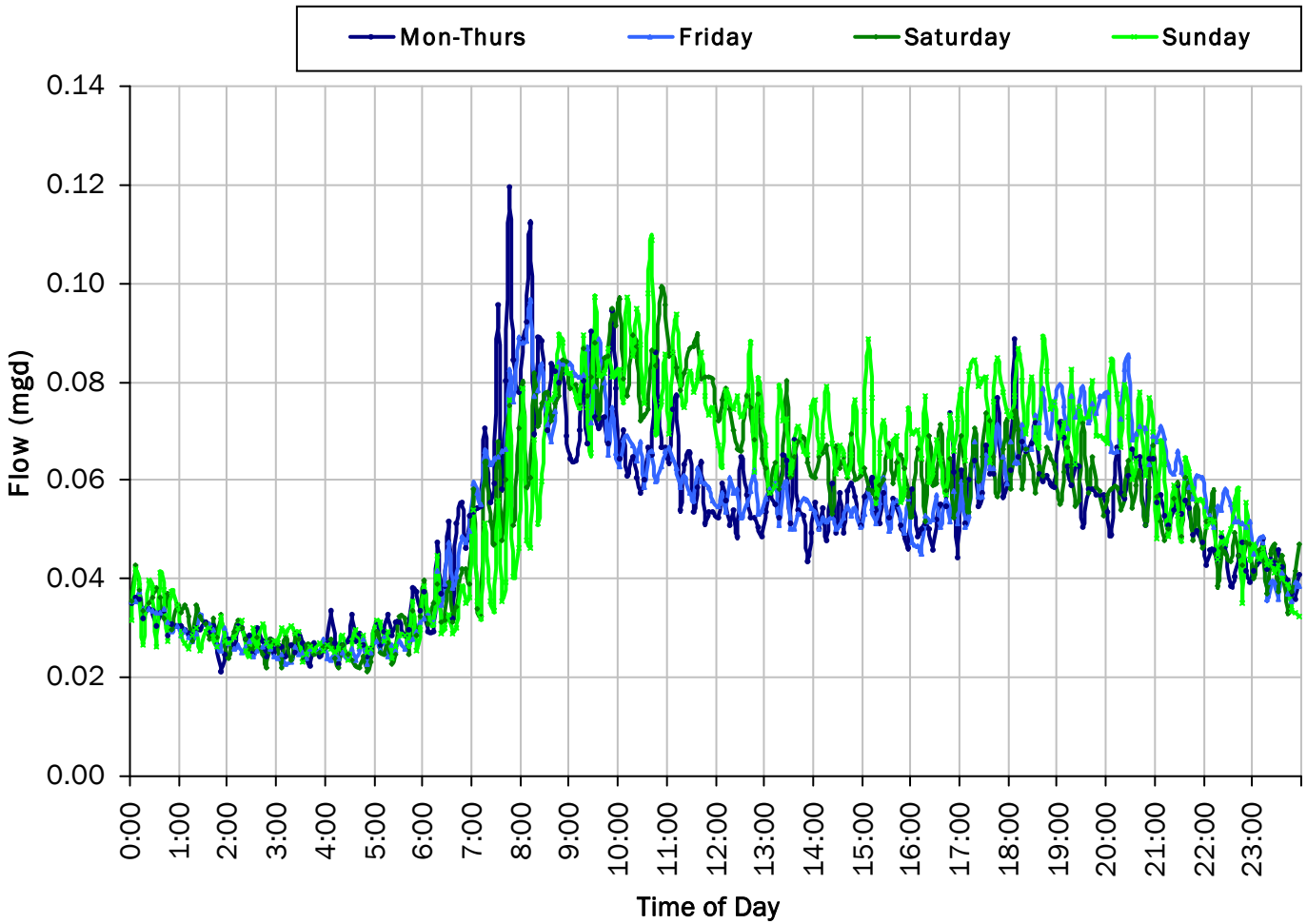
Flow Summary: 1/9/2022 to 2/5/2022

Period Rainfall: 0.00 inches Period Avg Flow: 0.077 mgd Period Peak Flow: 0.280 mgd Period Min Flow: 0.016 mgd



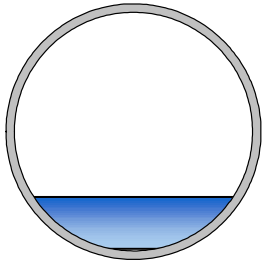


SITE 01.01
Average Dry Weather Flow Hydrographs



ADWF:

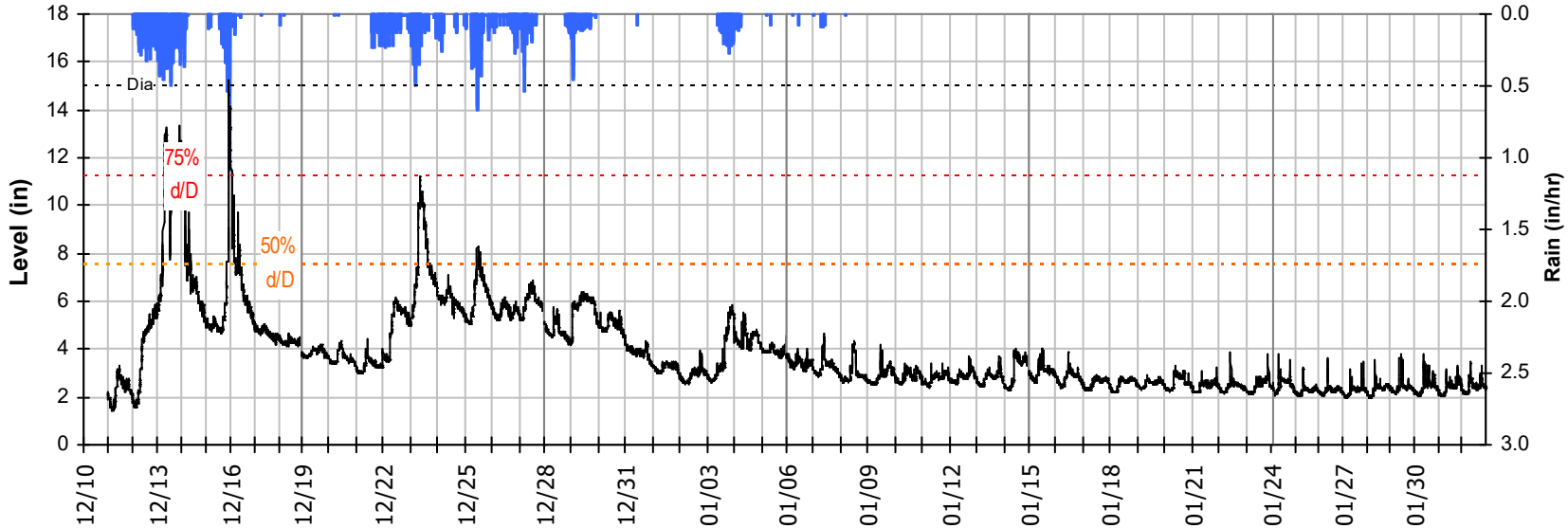
0.053 *mgd*

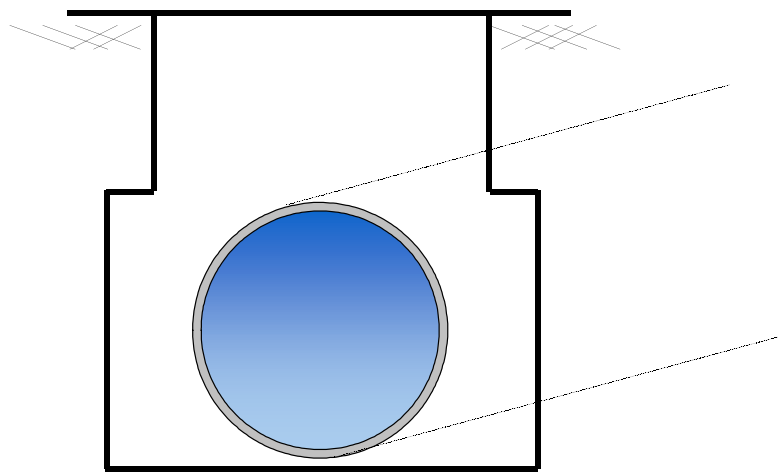


SITE 01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



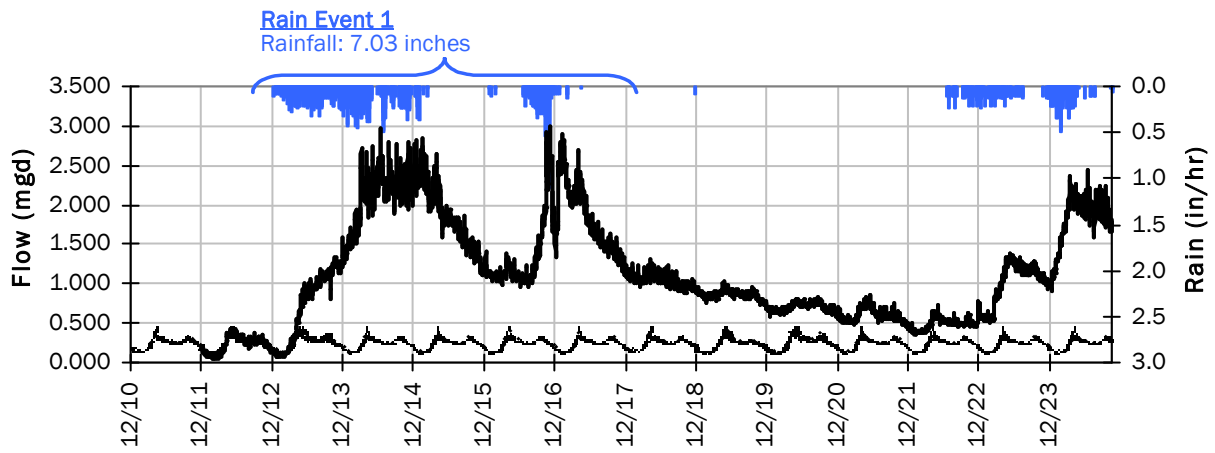


Pipe Diameter:	15	*inches*
Peak Measured Level:	15.3	*inches*
Peak d/D Ratio:	1.02	

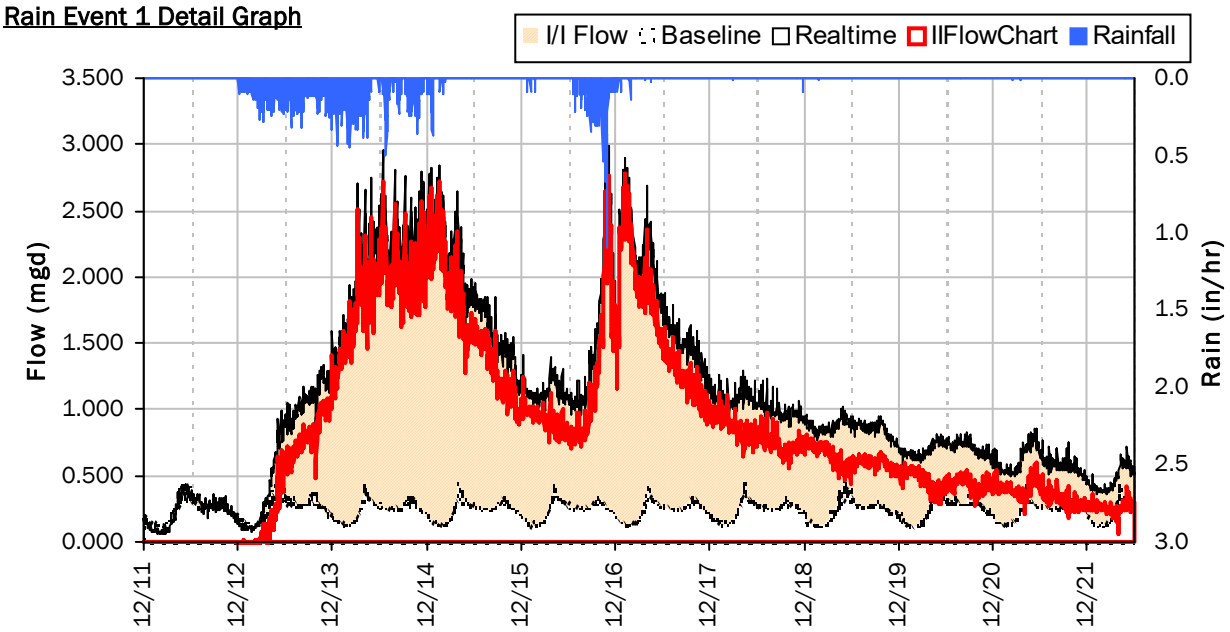
Surcharged 0.3 inches over crown

SITE 01
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

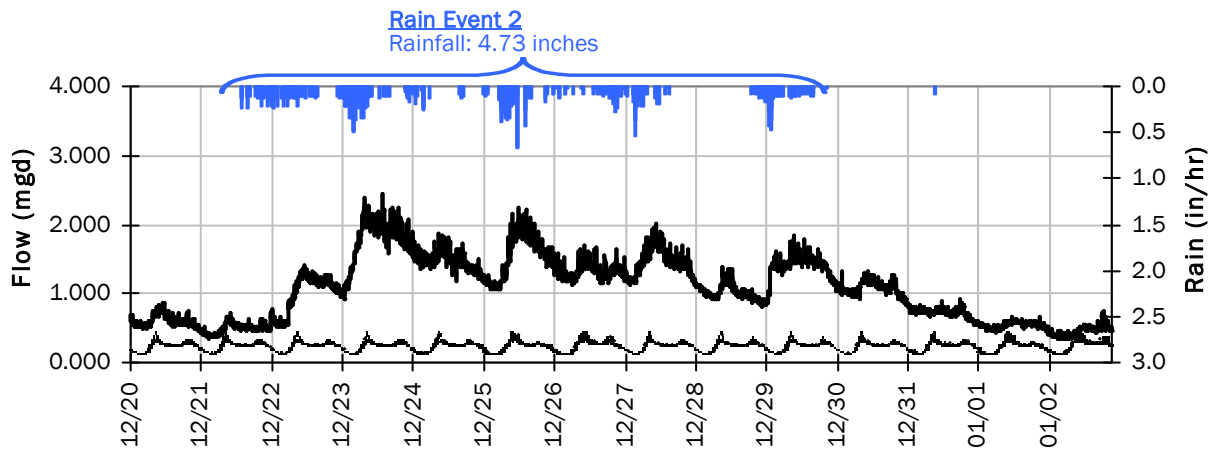


Storm Event I/I Analysis (Rain = 7.03 inches)

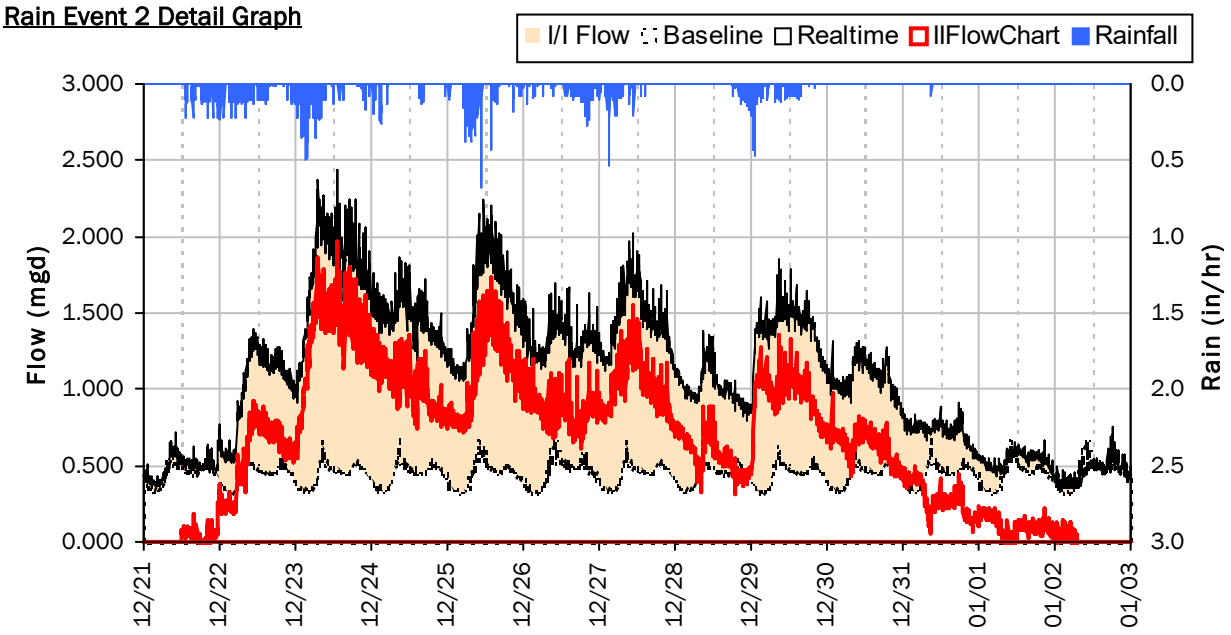
Capacity		Inflow / Infiltration	
Peak Flow:	2.991 *mgd*	Peak I/I Rate:	2.773 *mgd*
PF:	12.78	Total I/I:	8,997,000 *gallons*
Peak Level:	15.25 *in*		
d/D Ratio:	1.02		

SITE 01
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



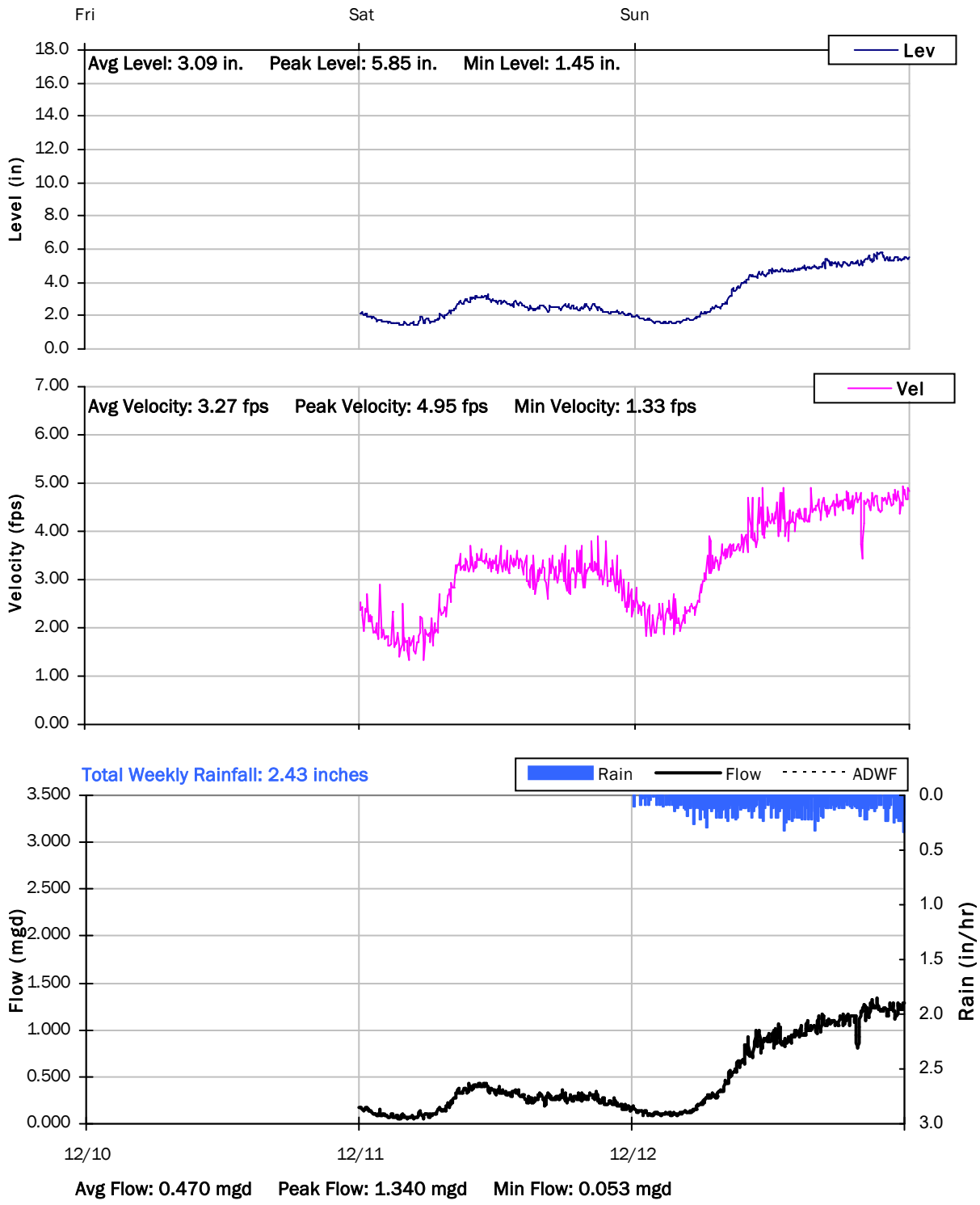
Storm Event I/I Analysis (Rain = 4.73 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	2.436 *mgd*	**Peak I/I Rate:**	1.971 *mgd*
PF:	10.41	**Total I/I:**	8,547,000 *gallons*
Peak Level:	11.24 *in*		
d/D Ratio:	0.75		

SITE 01

Weekly Level, Velocity and Flow Hydrographs

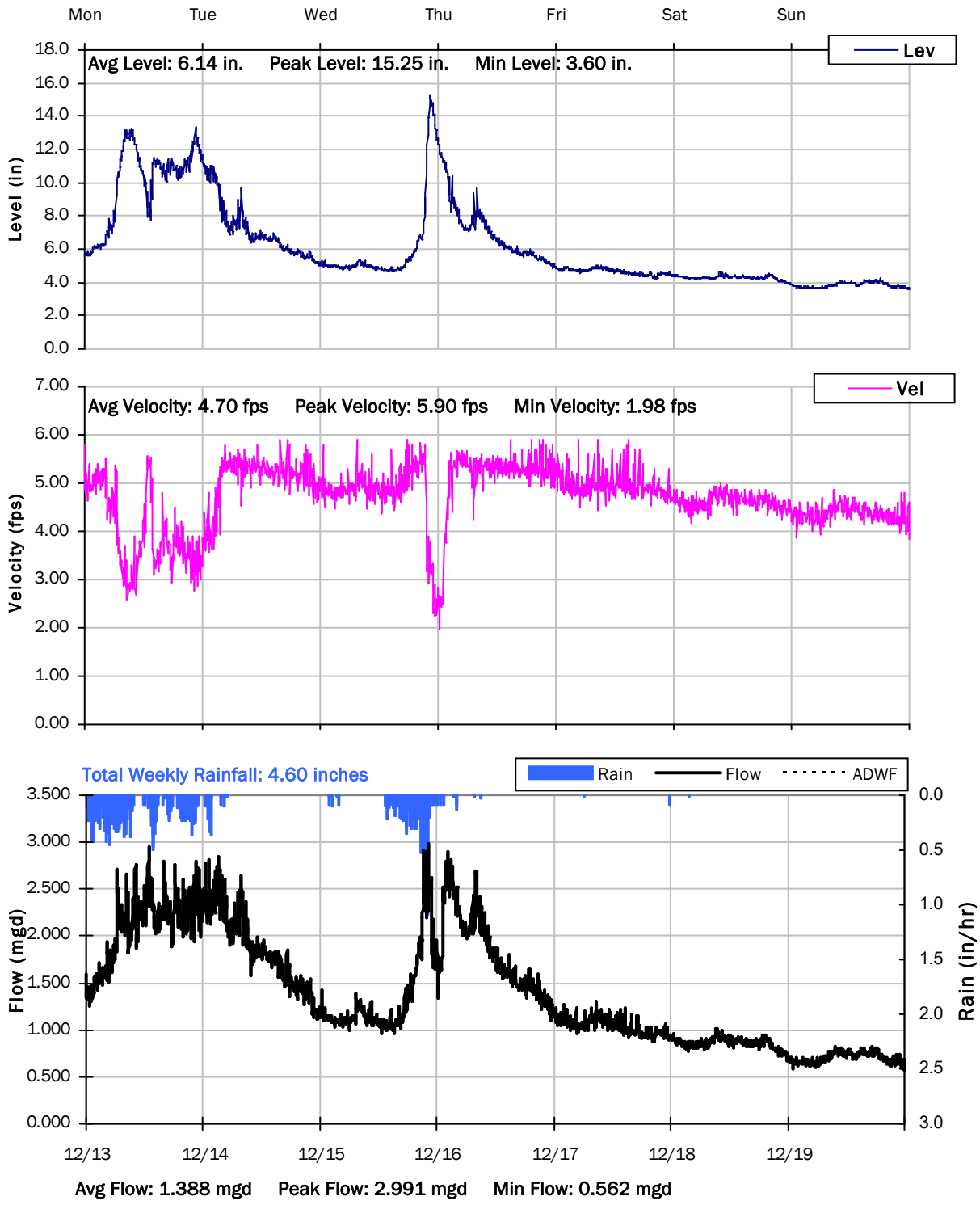
12/10/2021 to 12/13/2021



SITE 01

Weekly Level, Velocity and Flow Hydrographs

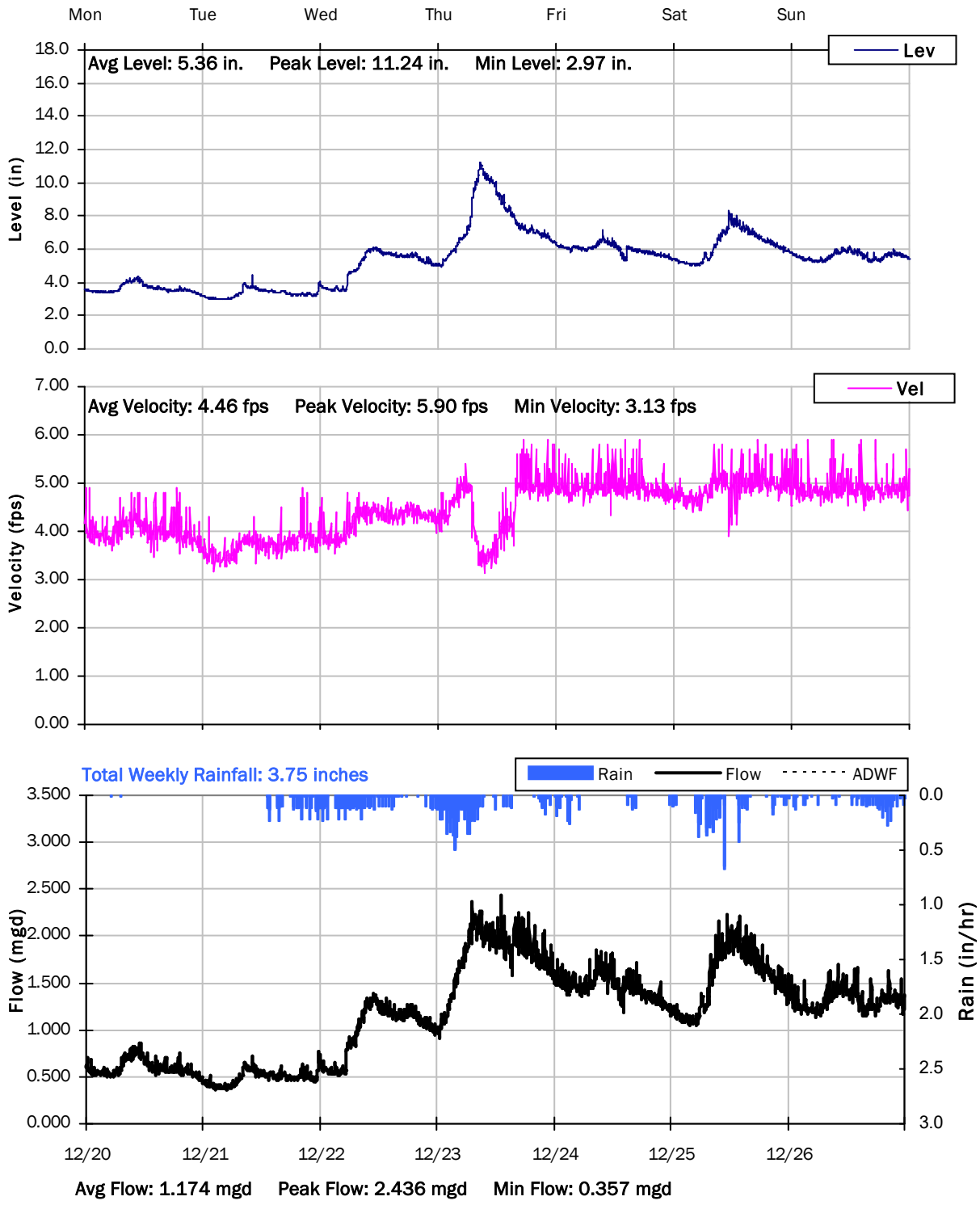
12/13/2021 to 12/20/2021



SITE 01

Weekly Level, Velocity and Flow Hydrographs

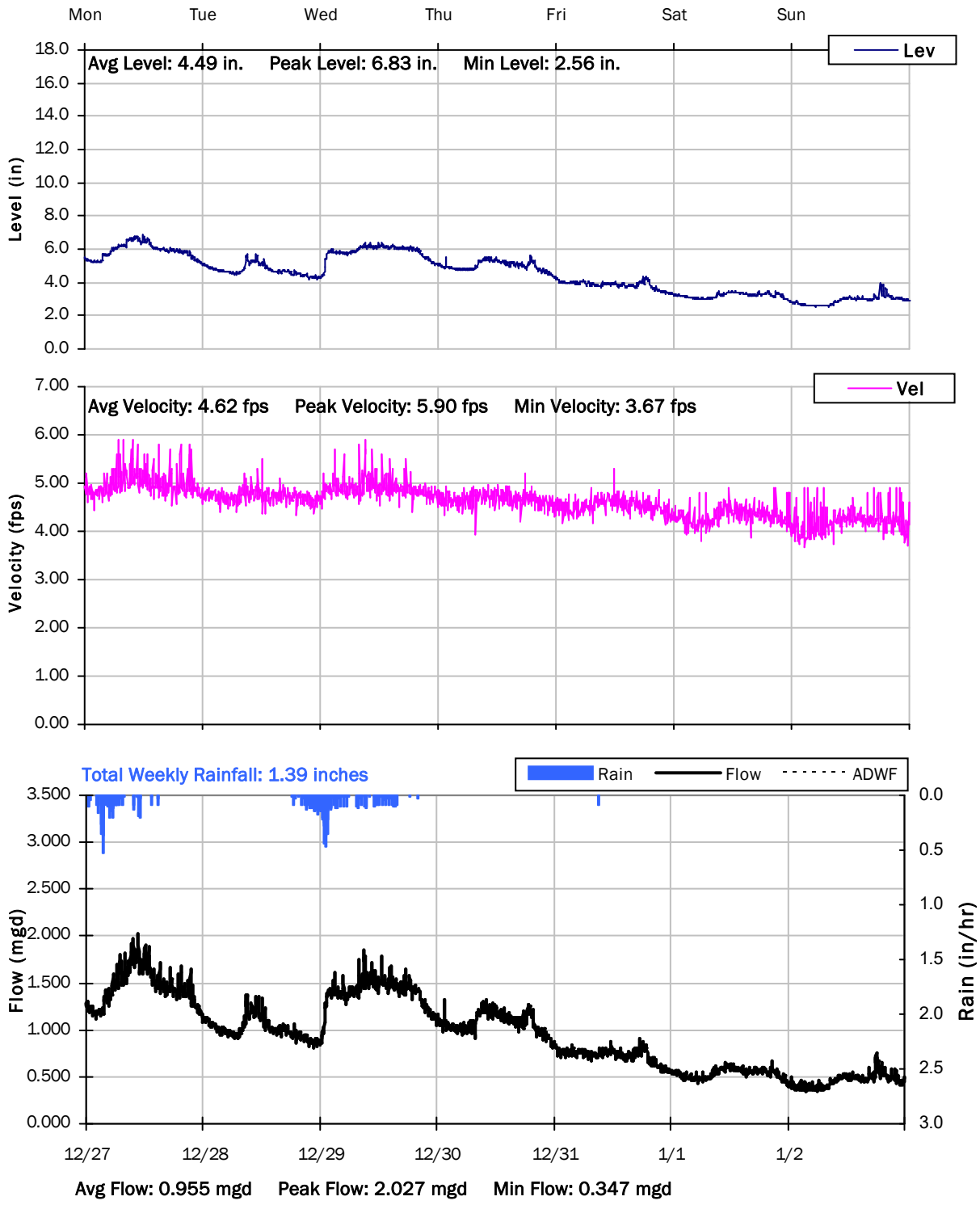
12/20/2021 to 12/27/2021



SITE 01

Weekly Level, Velocity and Flow Hydrographs

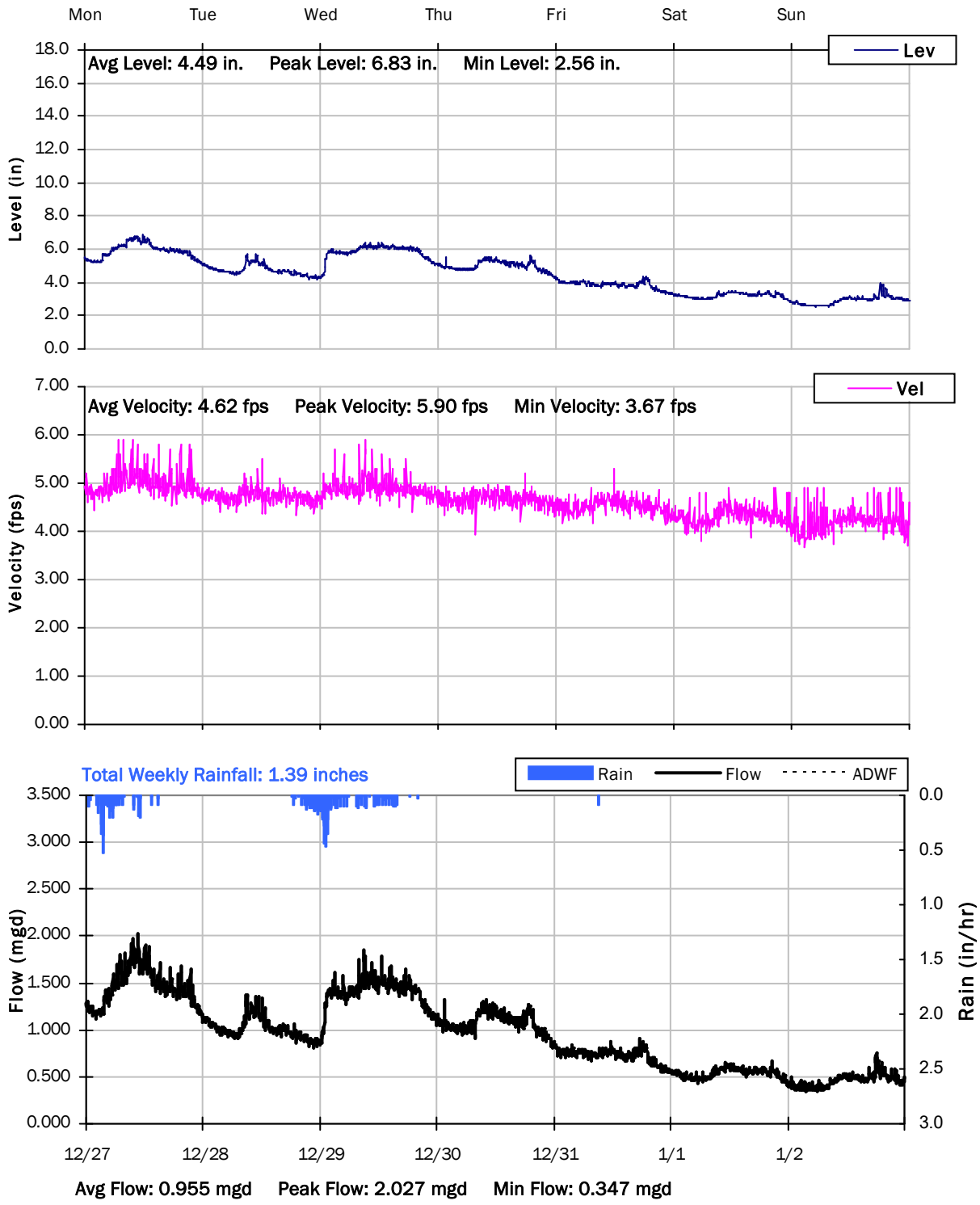
12/27/2021 to 1/3/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

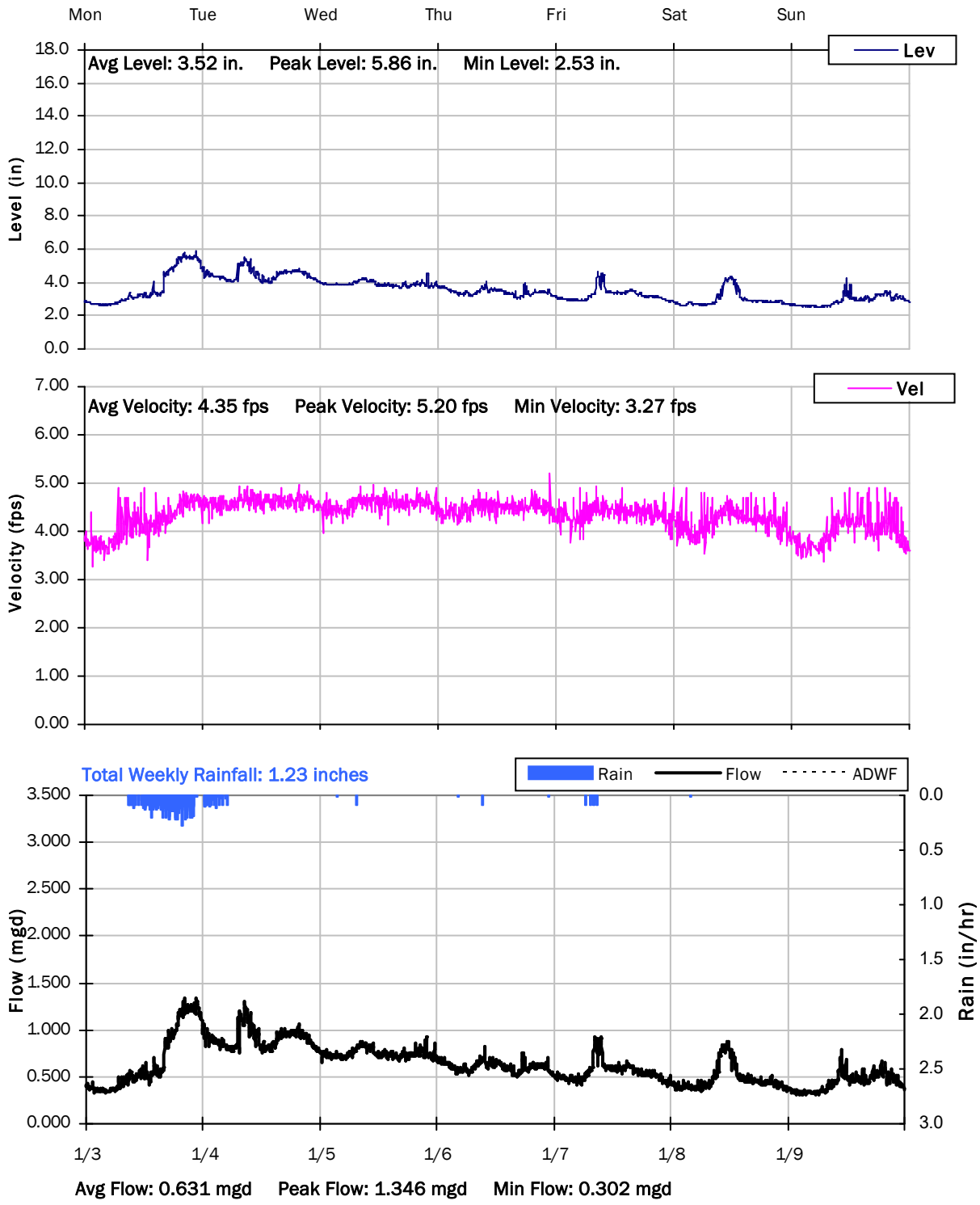
12/27/2021 to 1/3/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

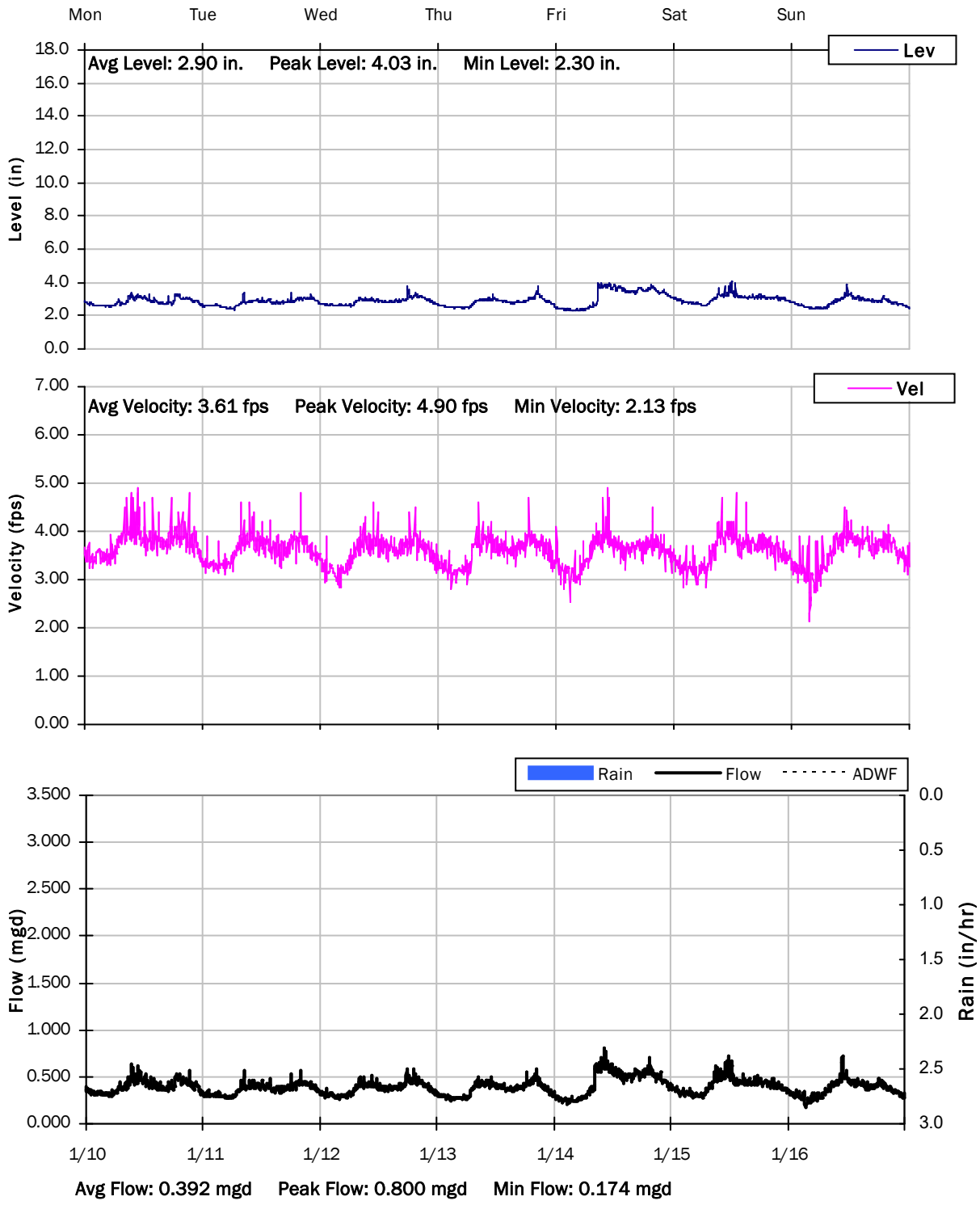
1/3/2022 to 1/10/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

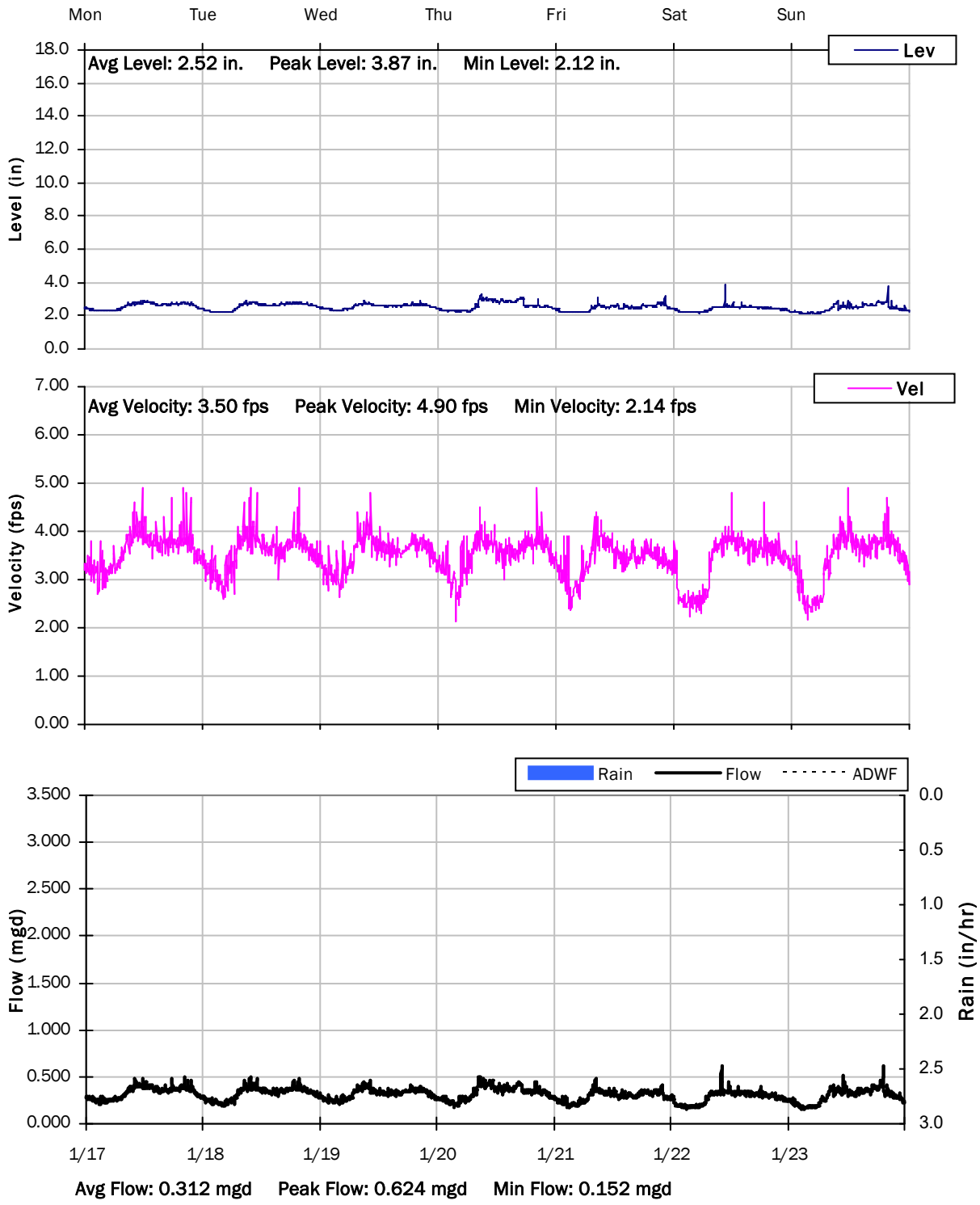
1/10/2022 to 1/17/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

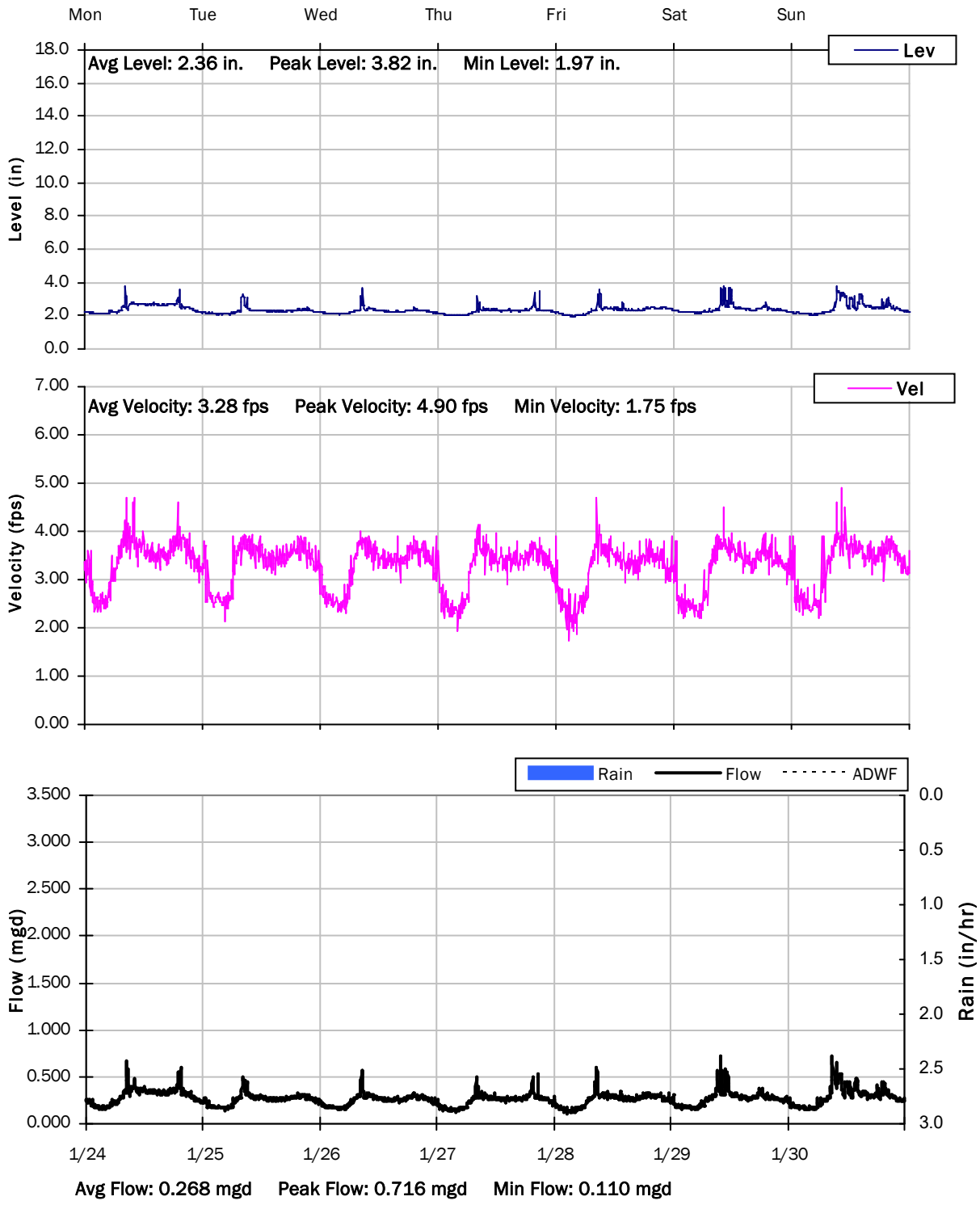
1/17/2022 to 1/24/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

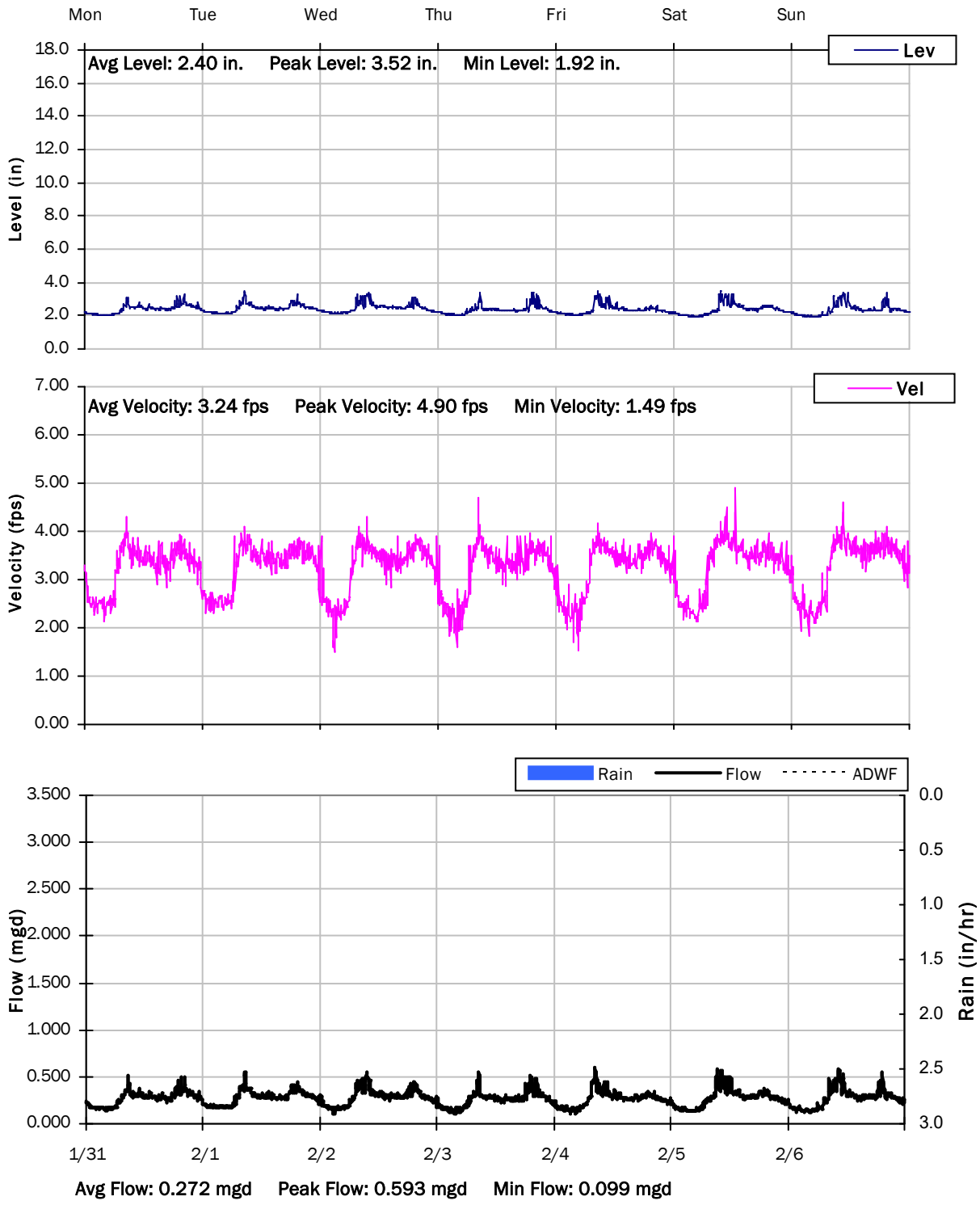
1/24/2022 to 1/31/2022



SITE 01

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 01.01

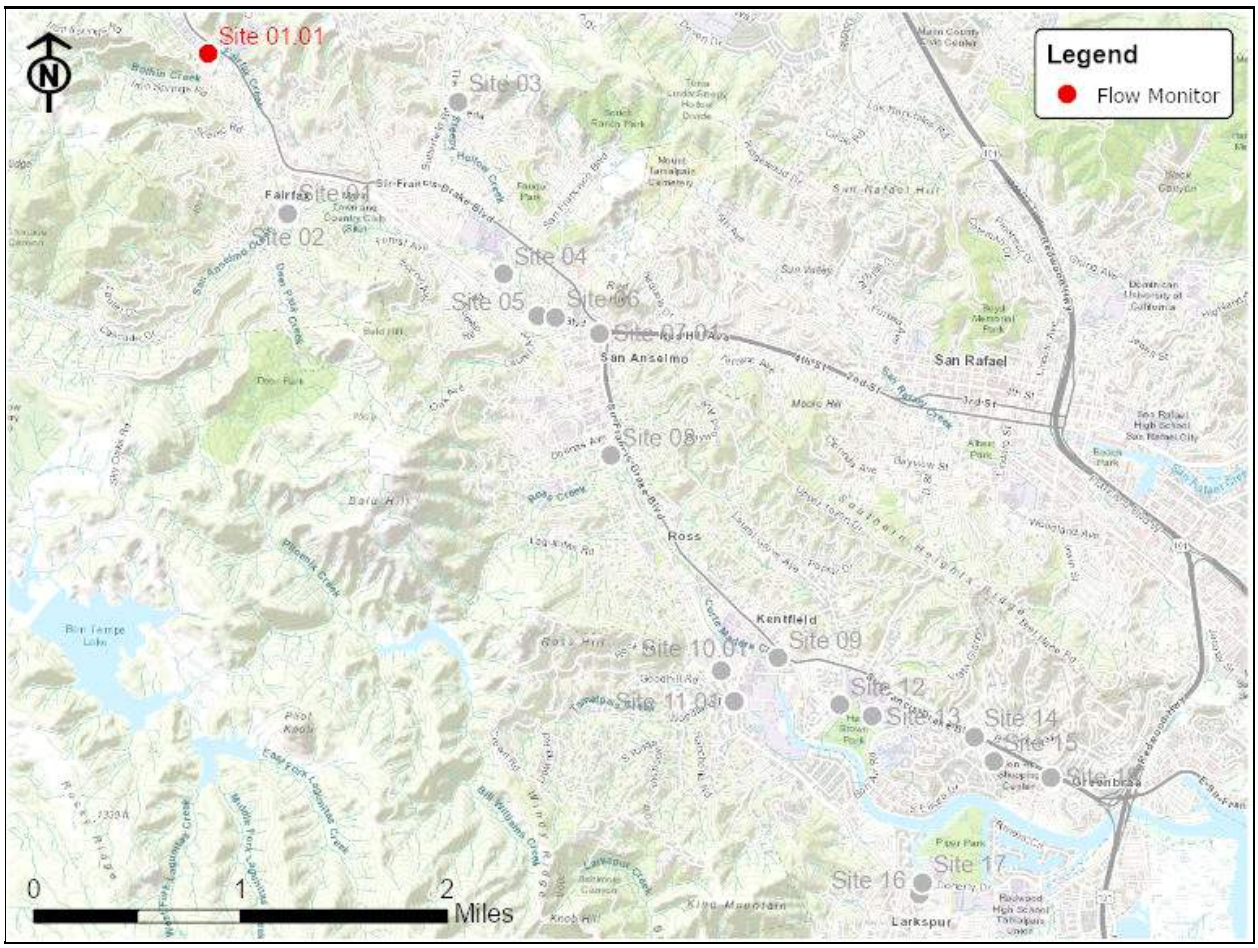
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 29 Westbrae Drive

Data Summary Report



Vicinity Map: Site 01.01

SITE 01.01

Site Information MH ID: F700.020

Location: 29 Westbrae Drive

Coordinates: 122.5977° W, 37.9954° N

Rim Elevation (Earth): 169 feet

Expected Pipe Diameter: 8 inches

Measured Pipe Diameter: 8 inches

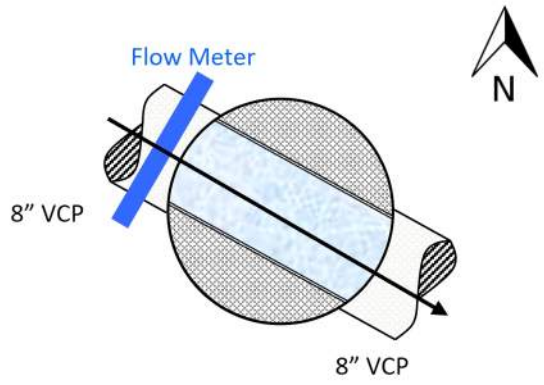
ADWF: 0.053 mgd

Peak Measured Flow: 0.979 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 01.01

Additional Site Photos

Effluent Pipe

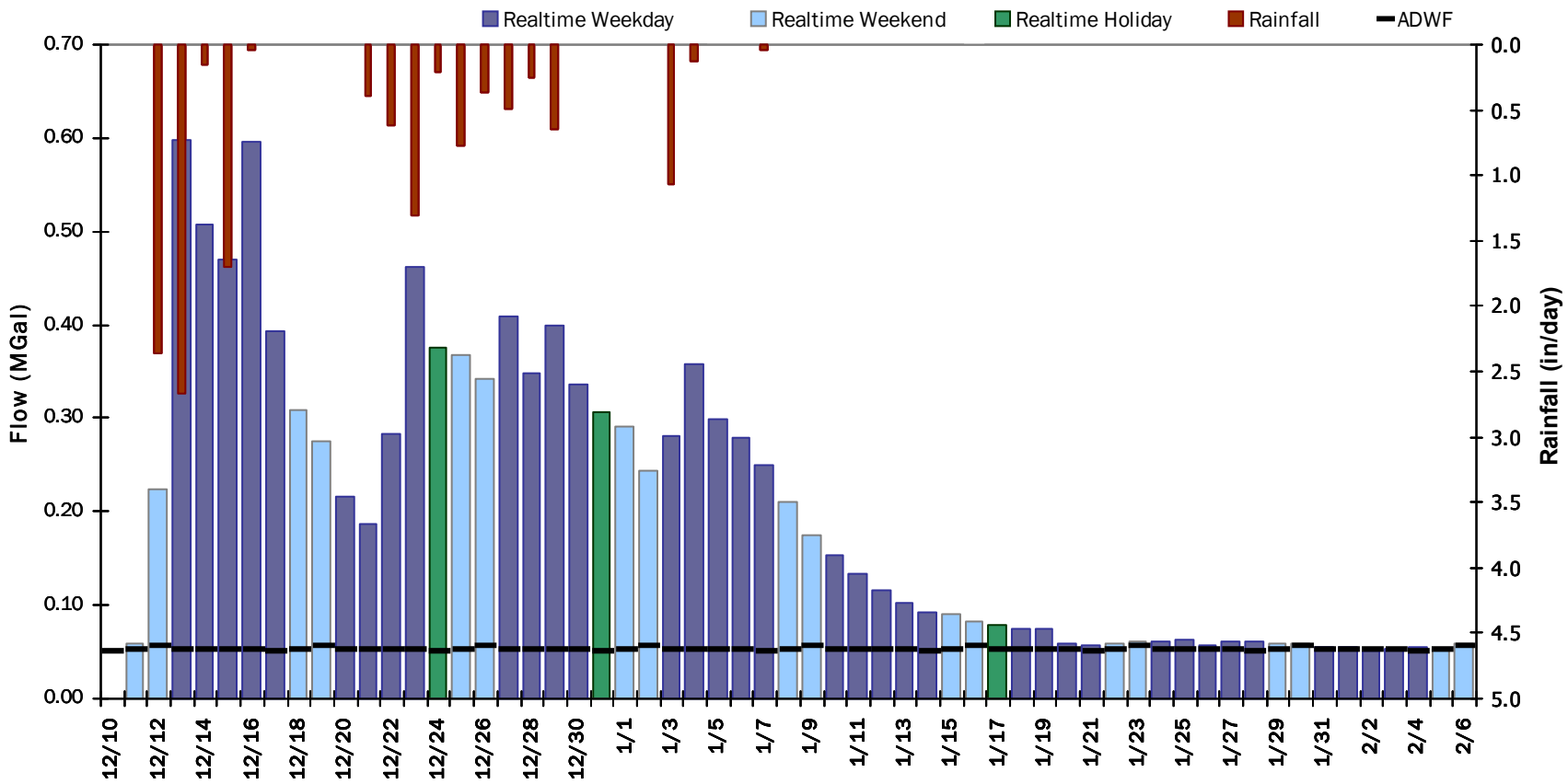
Monitored Northwest Influent Pipe

SITE 01.01

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.205 MGal Peak Daily Flow: 0.598 MGal Min Daily Flow: 0.051 MGal

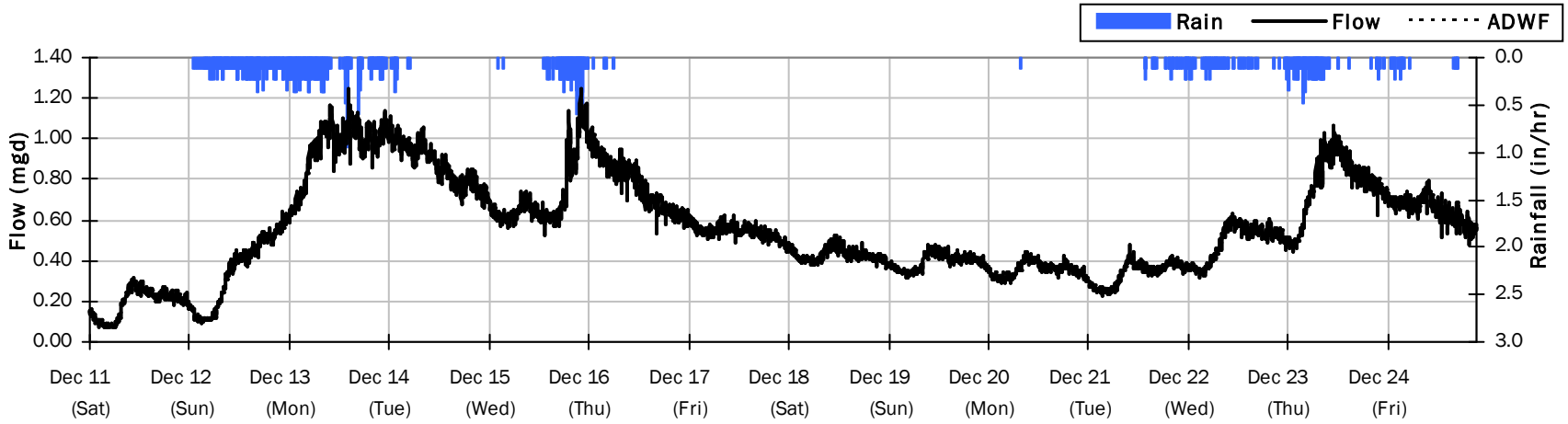
Total Rainfall: 13.20 inches

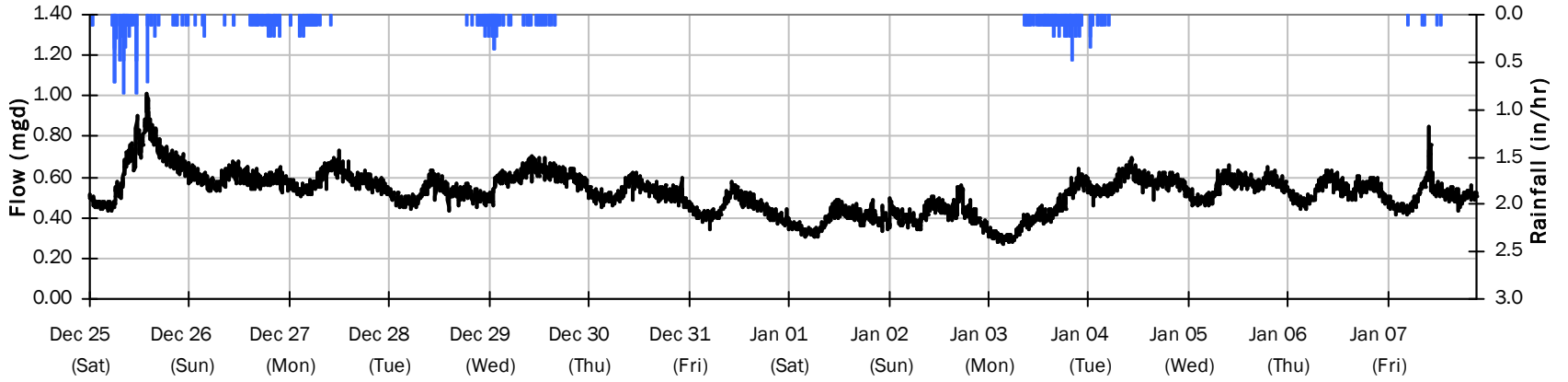


SITE 02

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 11.47 inches Period Avg Flow: 0.539 mgd Period Peak Flow: 1.248 mgd Period Min Flow: 0.068 mgd

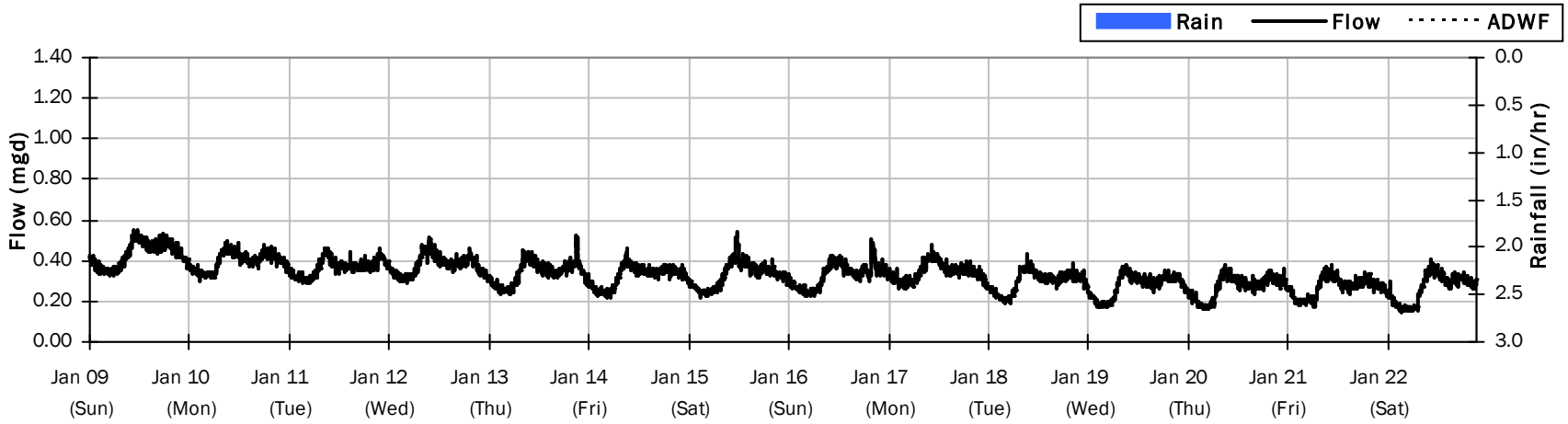


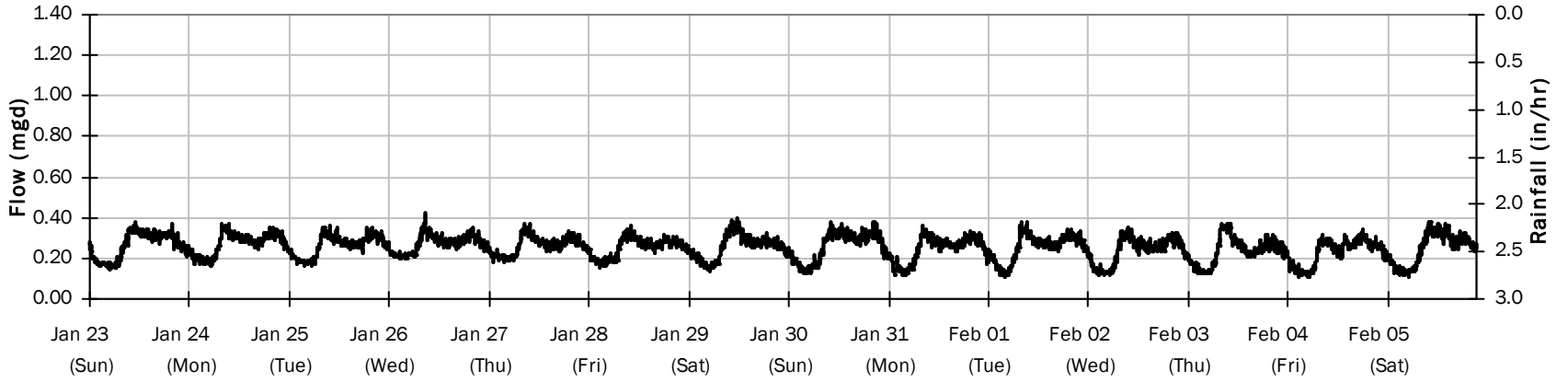


SITE 02

Flow Summary: 1/9/2022 to 2/5/2022

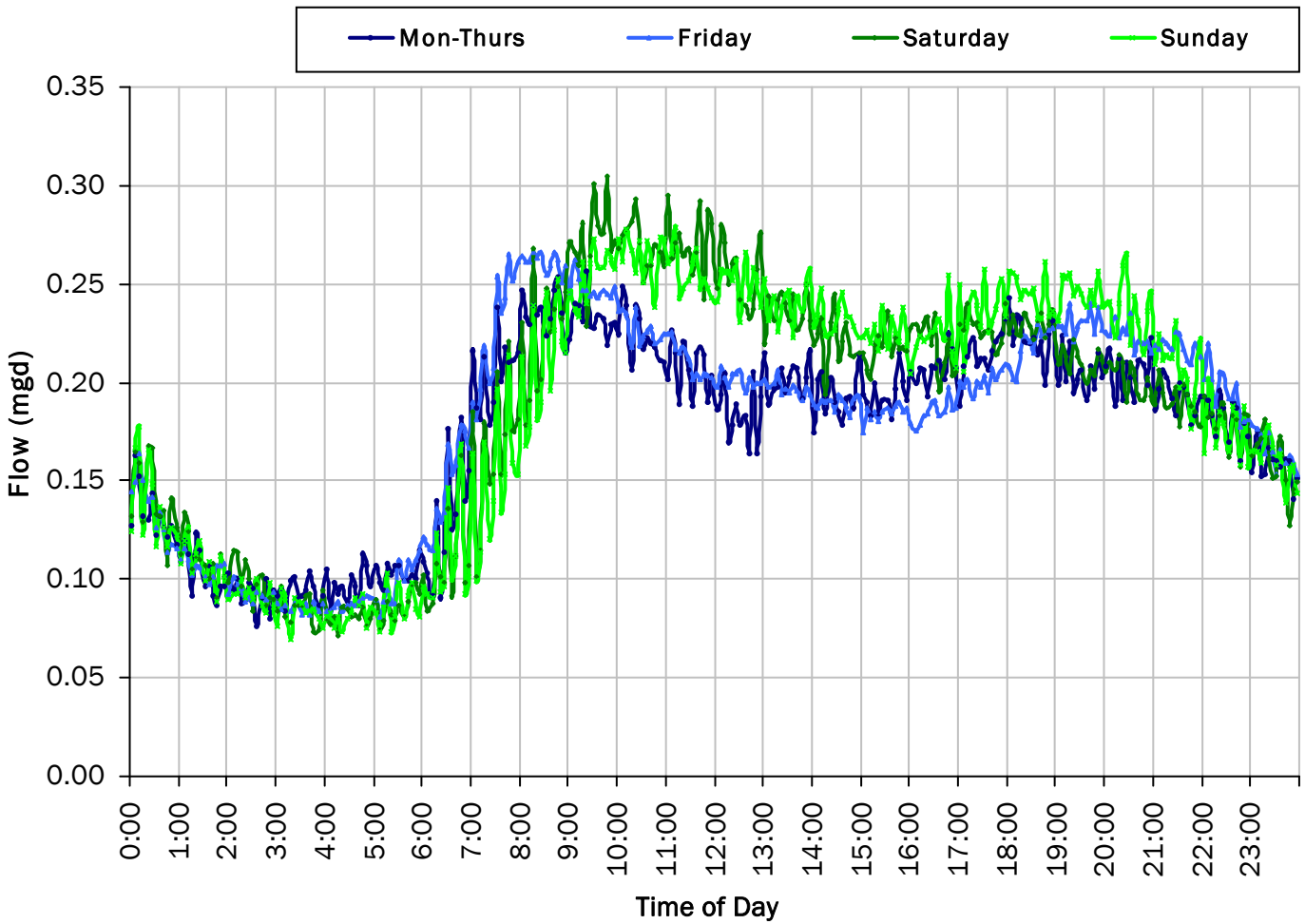
Period Rainfall: 0.00 inches Period Avg Flow: 0.292 mgd Period Peak Flow: 0.554 mgd Period Min Flow: 0.109 mgd





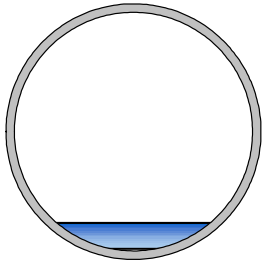
SITE 02

Average Dry Weather Flow Hydrographs



ADWF:

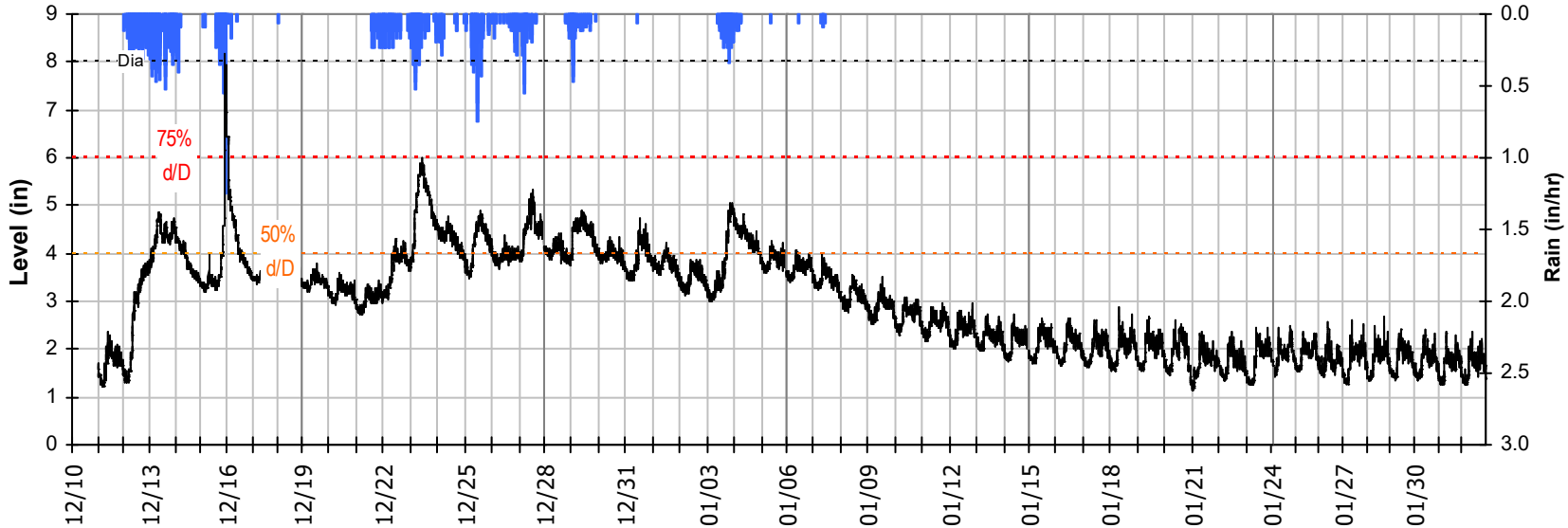
0.180 *mgd*

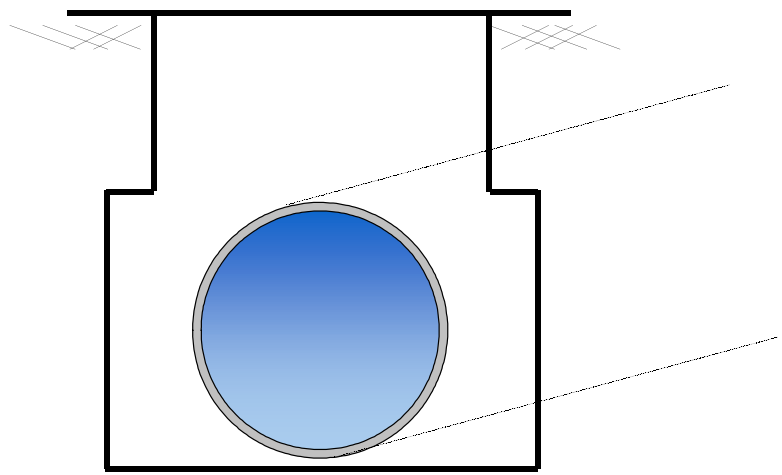


SITE 01.01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



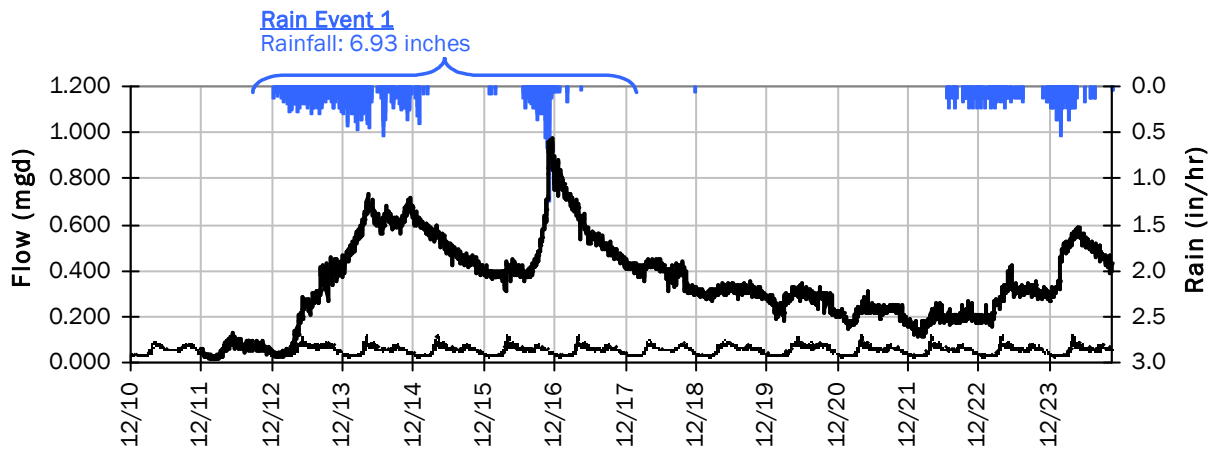


Pipe Diameter:	8	*inches*
Peak Measured Level:	8.18	*inches*
Peak d/D Ratio:	1.02	

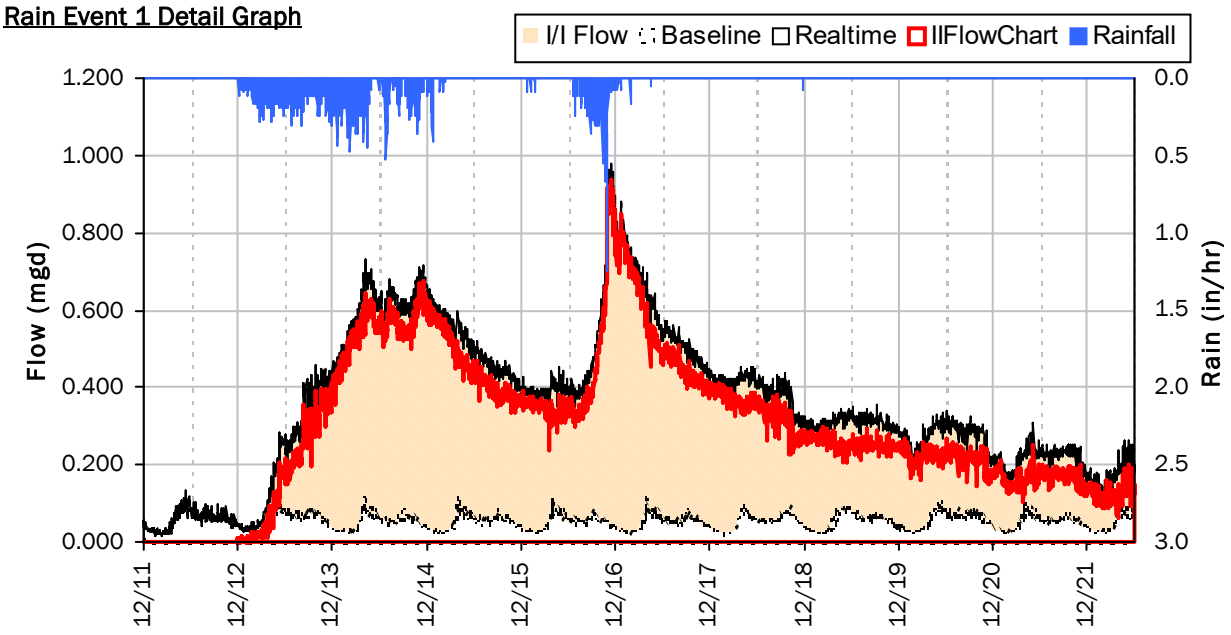
Surcharged 0.2 inches over crown

SITE 01.01
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

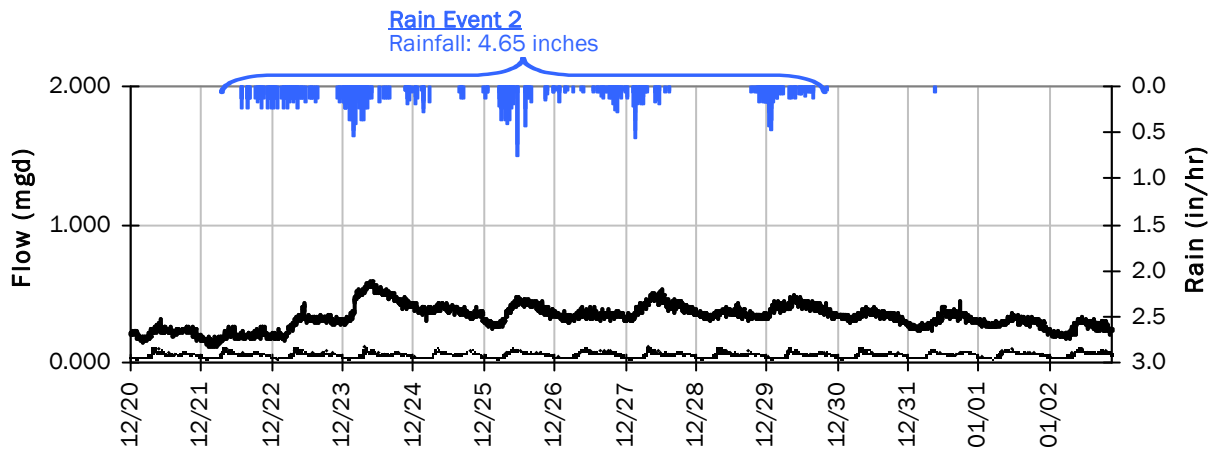


Storm Event I/I Analysis (Rain = 6.93 inches)

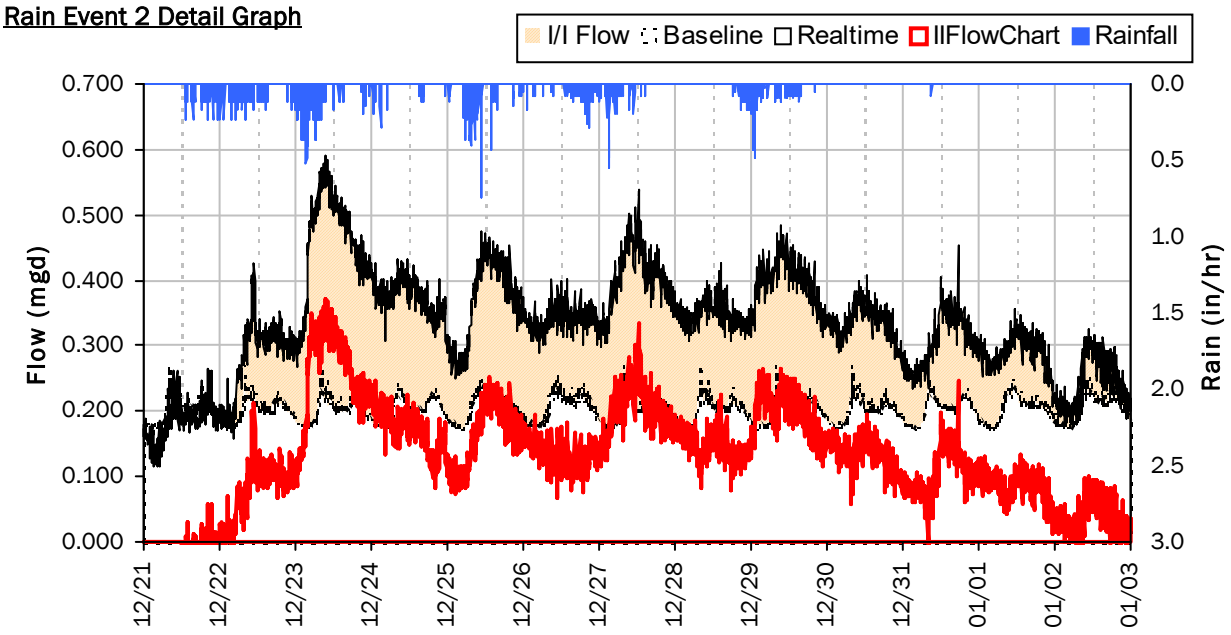
Capacity		Inflow / Infiltration	
Peak Flow:	0.979 *mgd*	**Peak I/I Rate:**	0.938 *mgd*
PF:	18.60	**Total I/I:**	3,178,000 *gallons*
Peak Level:	8.18 *in*		
d/D Ratio:	1.02		

SITE 01.01
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



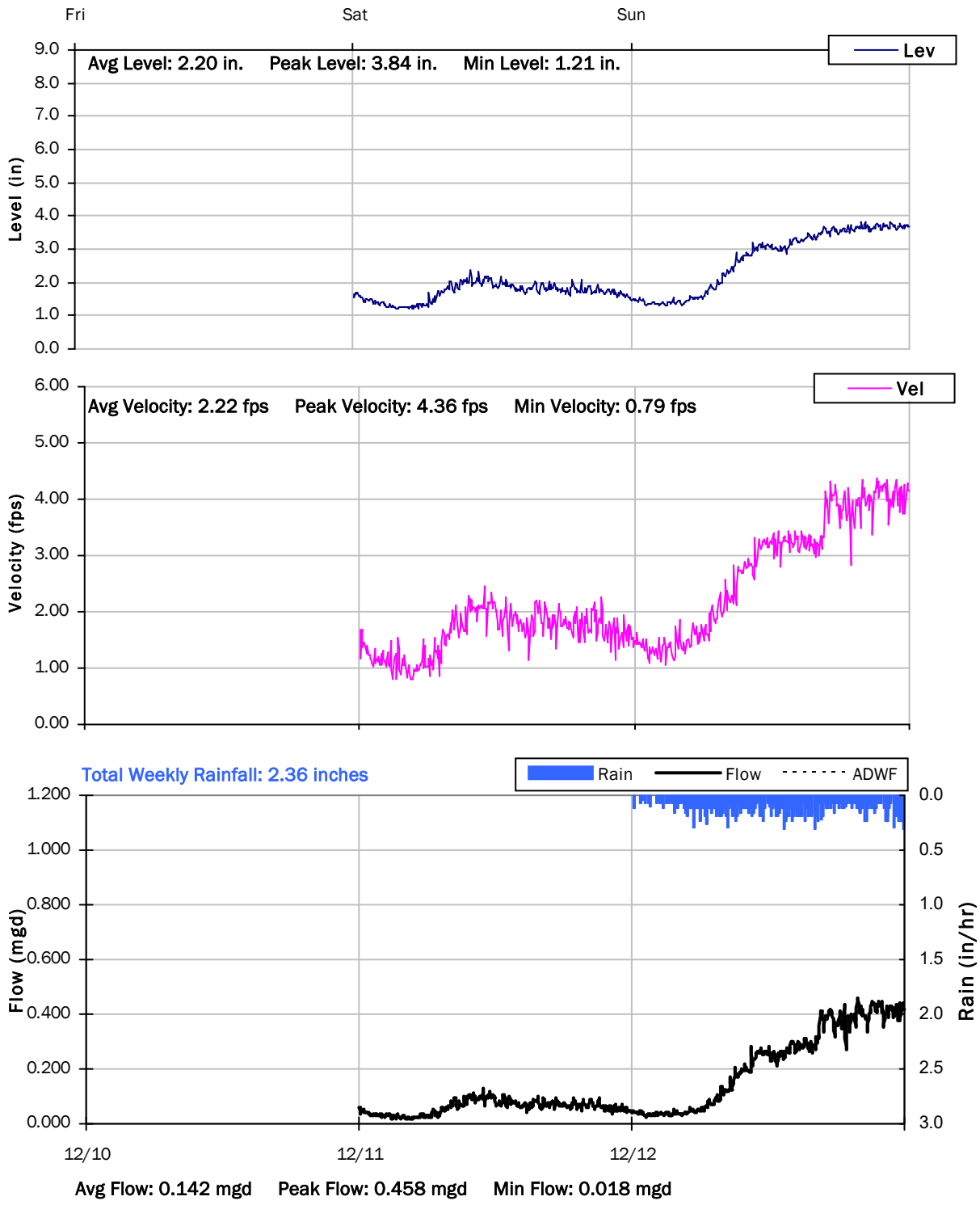
Storm Event I/I Analysis (Rain = 4.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.589 *mgd*	**Peak I/I Rate:**	0.372 *mgd*
PF:	11.19	**Total I/I:**	1,727,000 *gallons*
Peak Level:	5.99 *in*		
d/D Ratio:	0.75		

SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

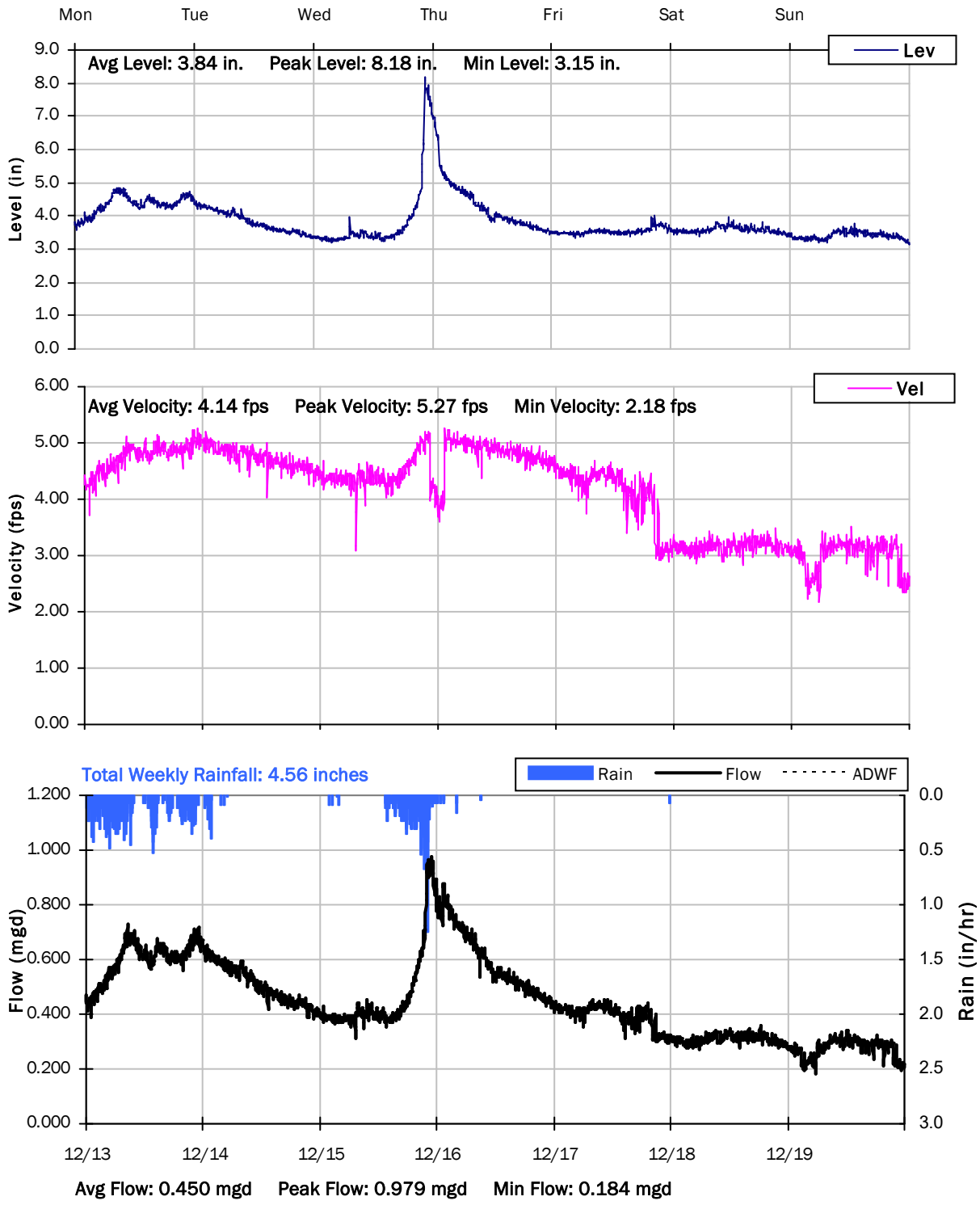
12/10/2021 to 12/13/2021



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

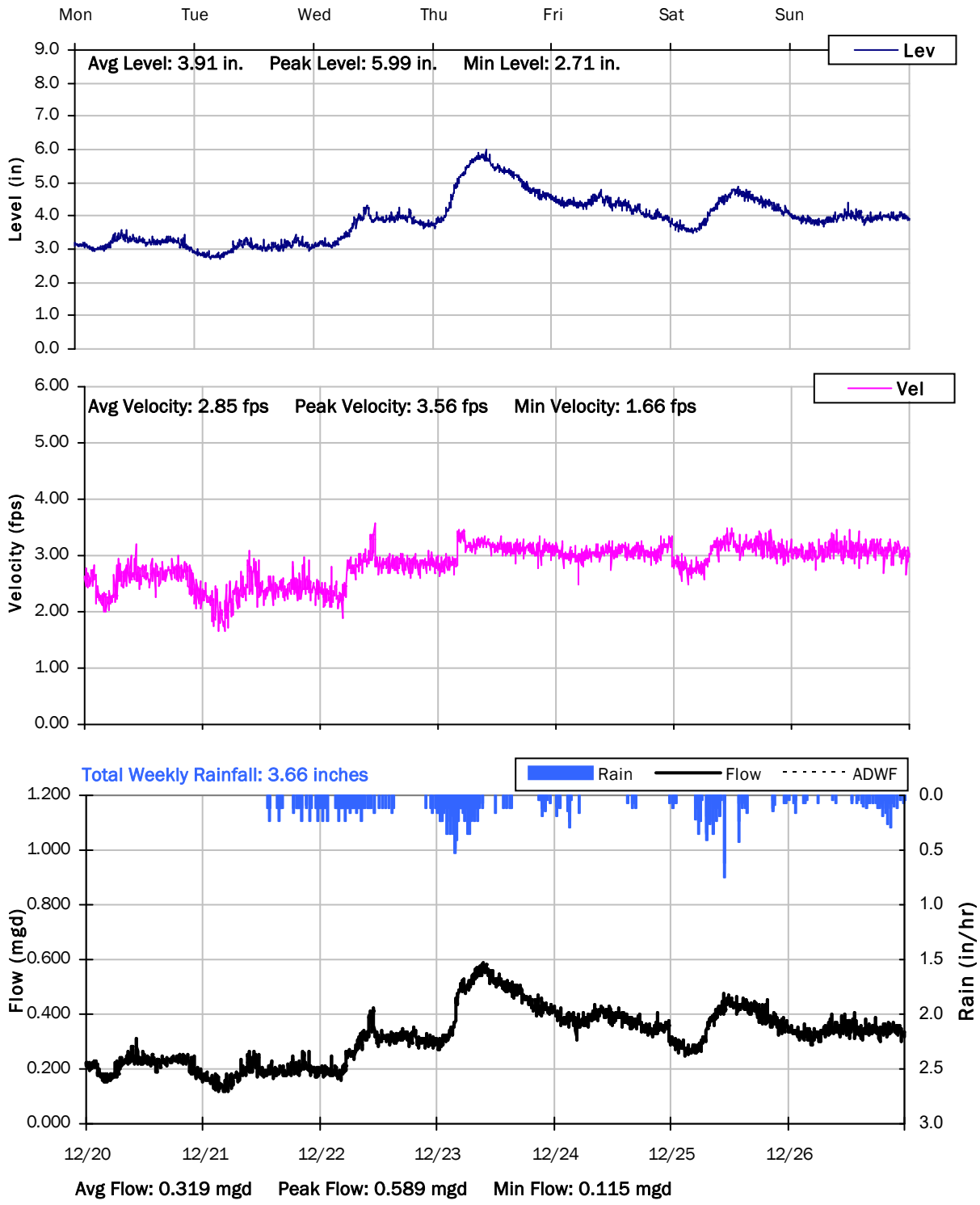
12/13/2021 to 12/20/2021



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

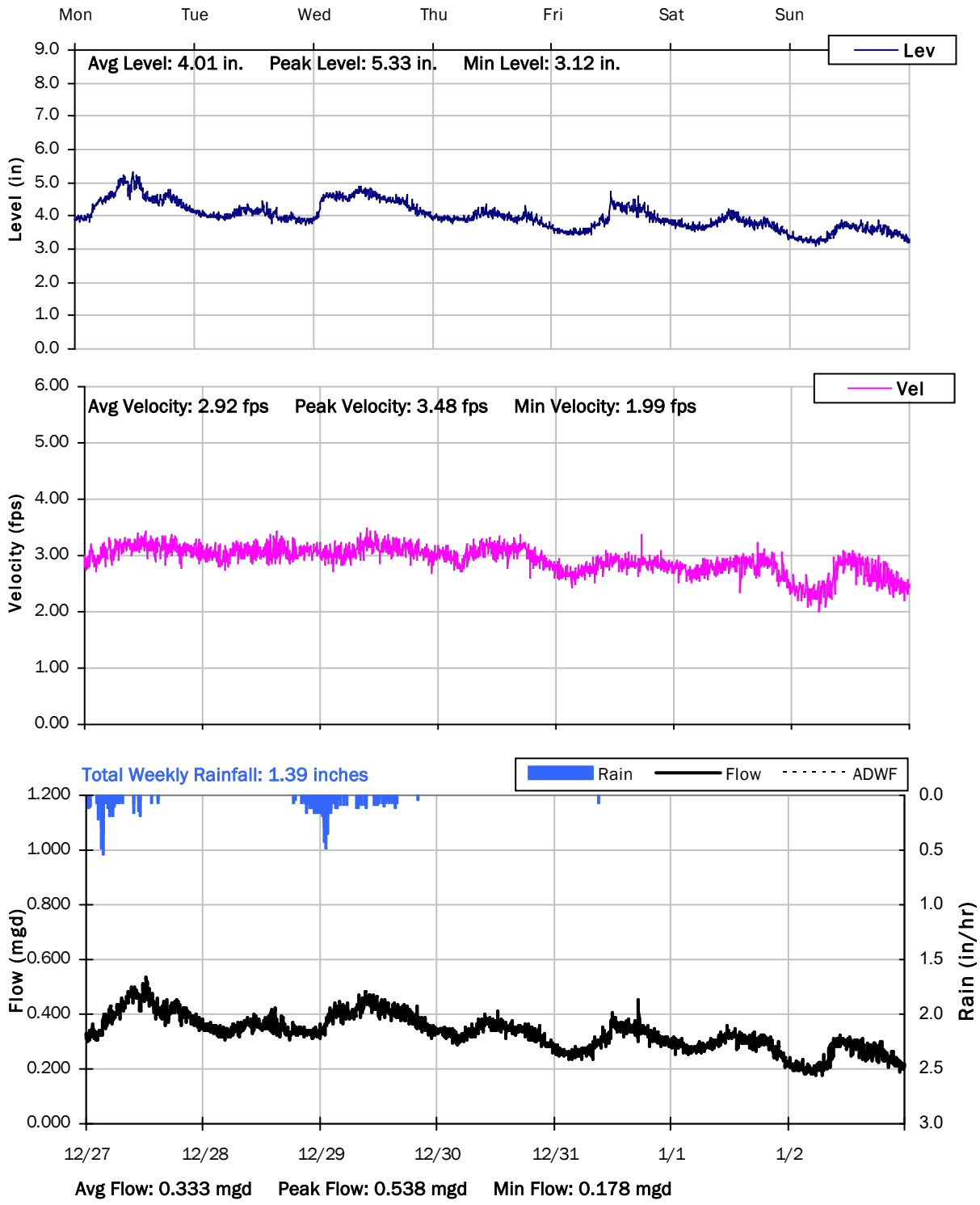
12/20/2021 to 12/27/2021



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

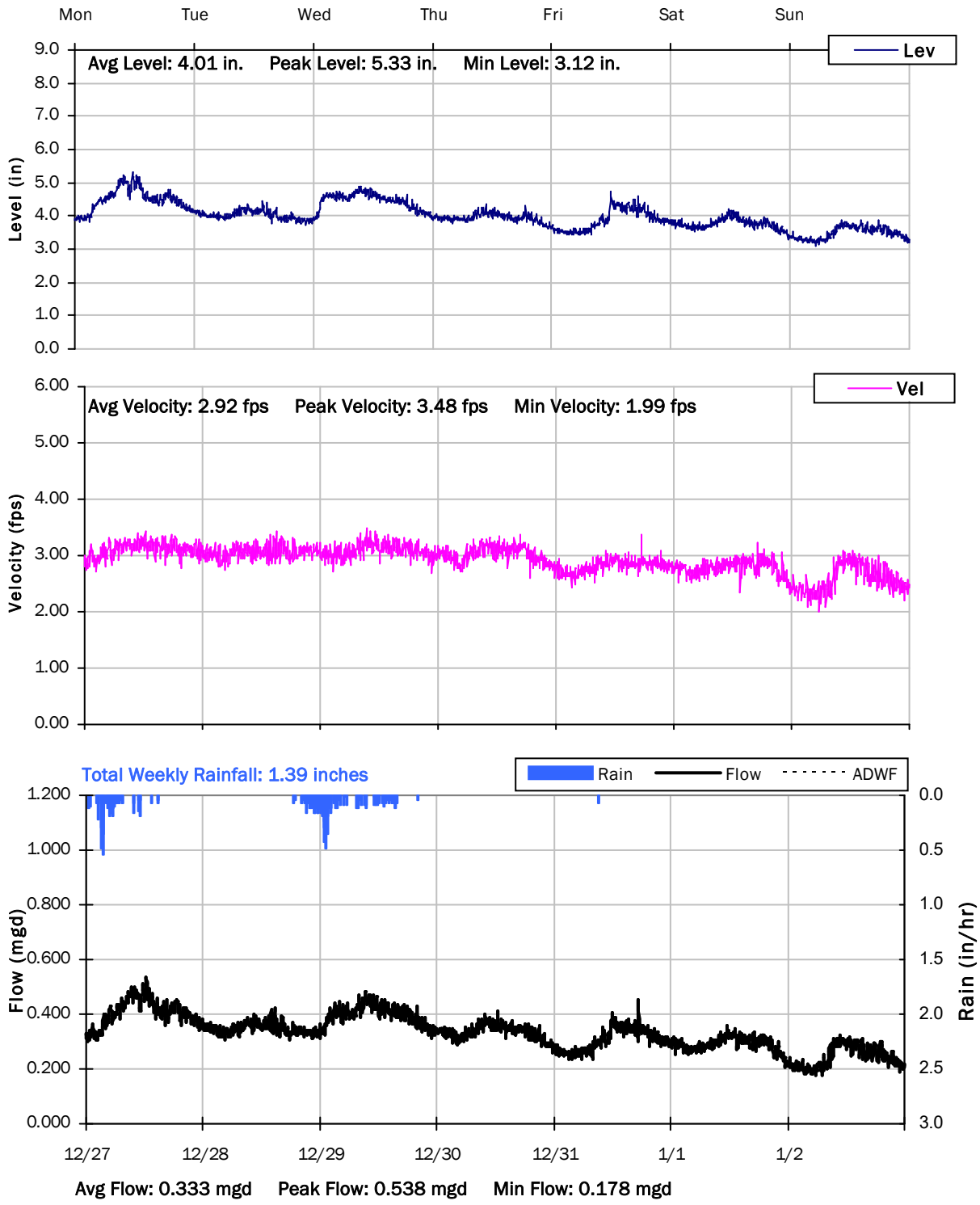
12/27/2021 to 1/3/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

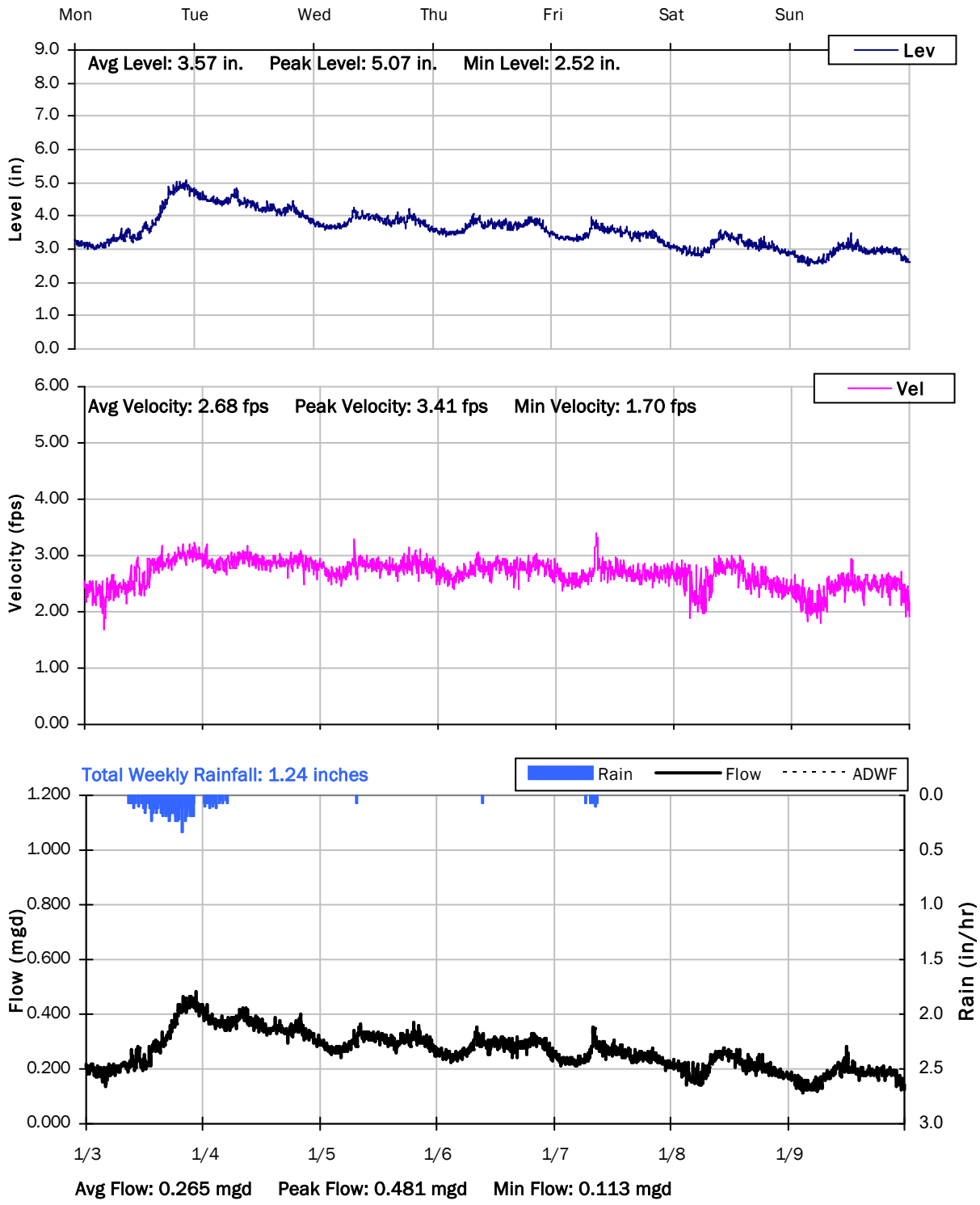
12/27/2021 to 1/3/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

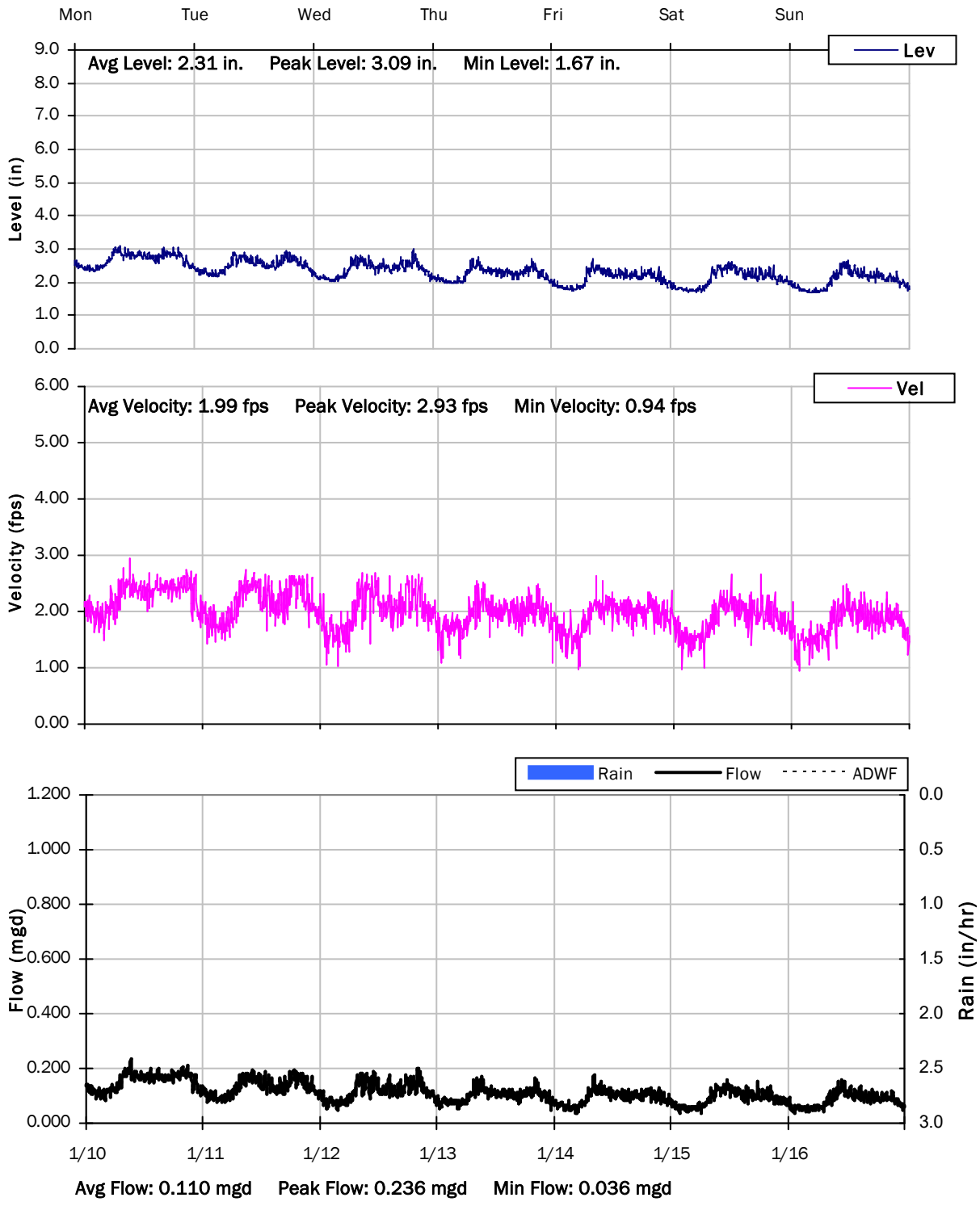
1/3/2022 to 1/10/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

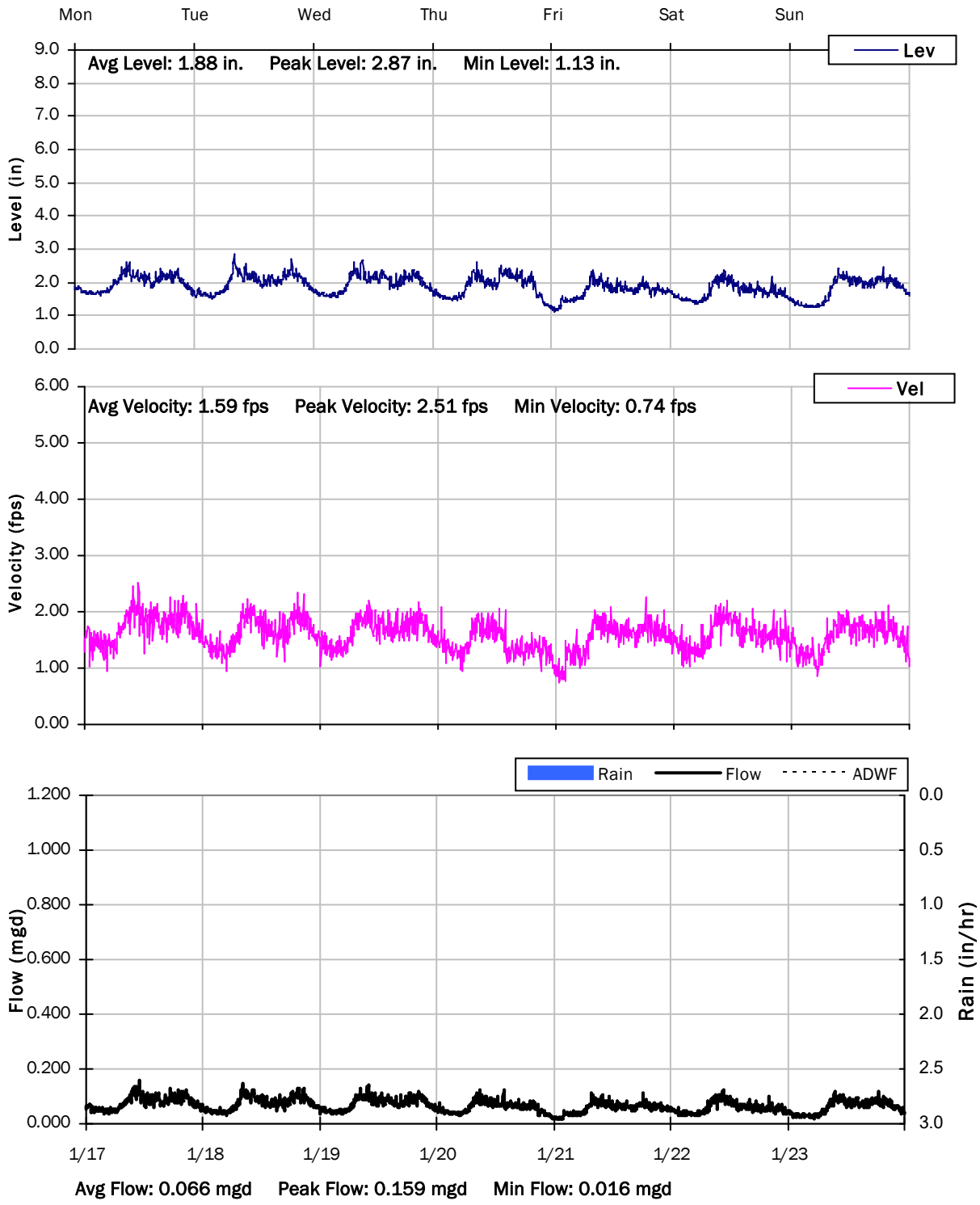
1/10/2022 to 1/17/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

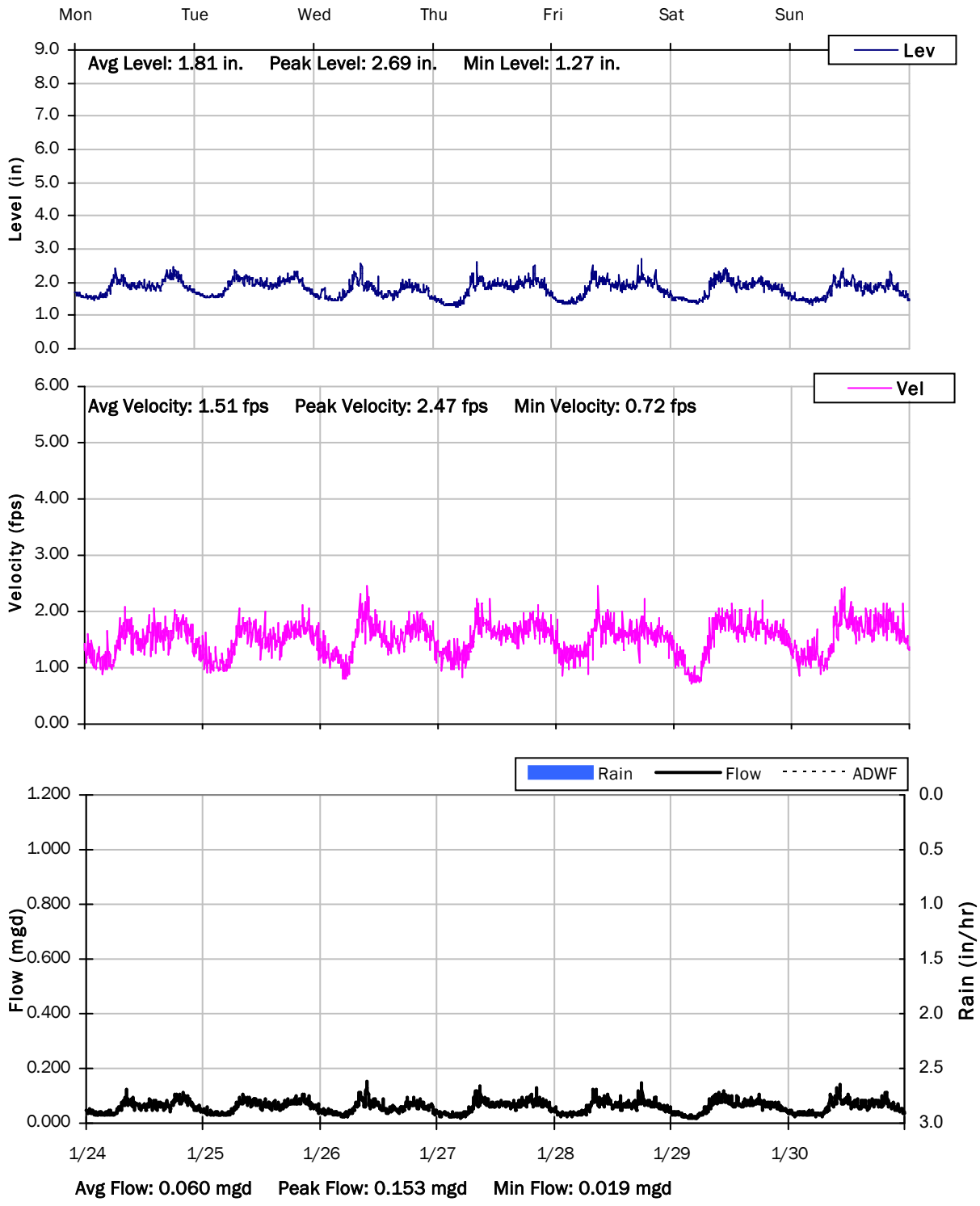
1/17/2022 to 1/24/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

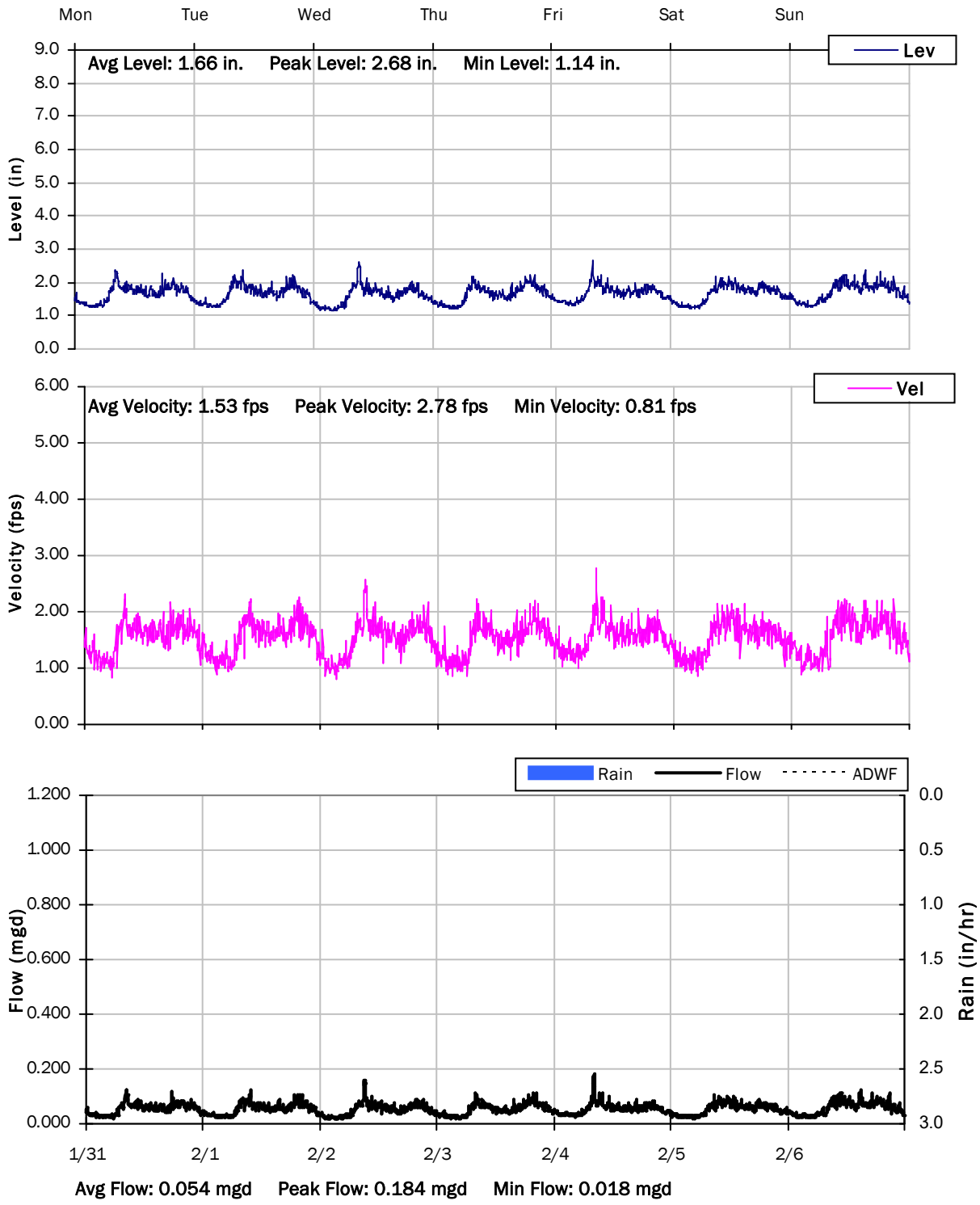
1/24/2022 to 1/31/2022



SITE 01.01

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 02

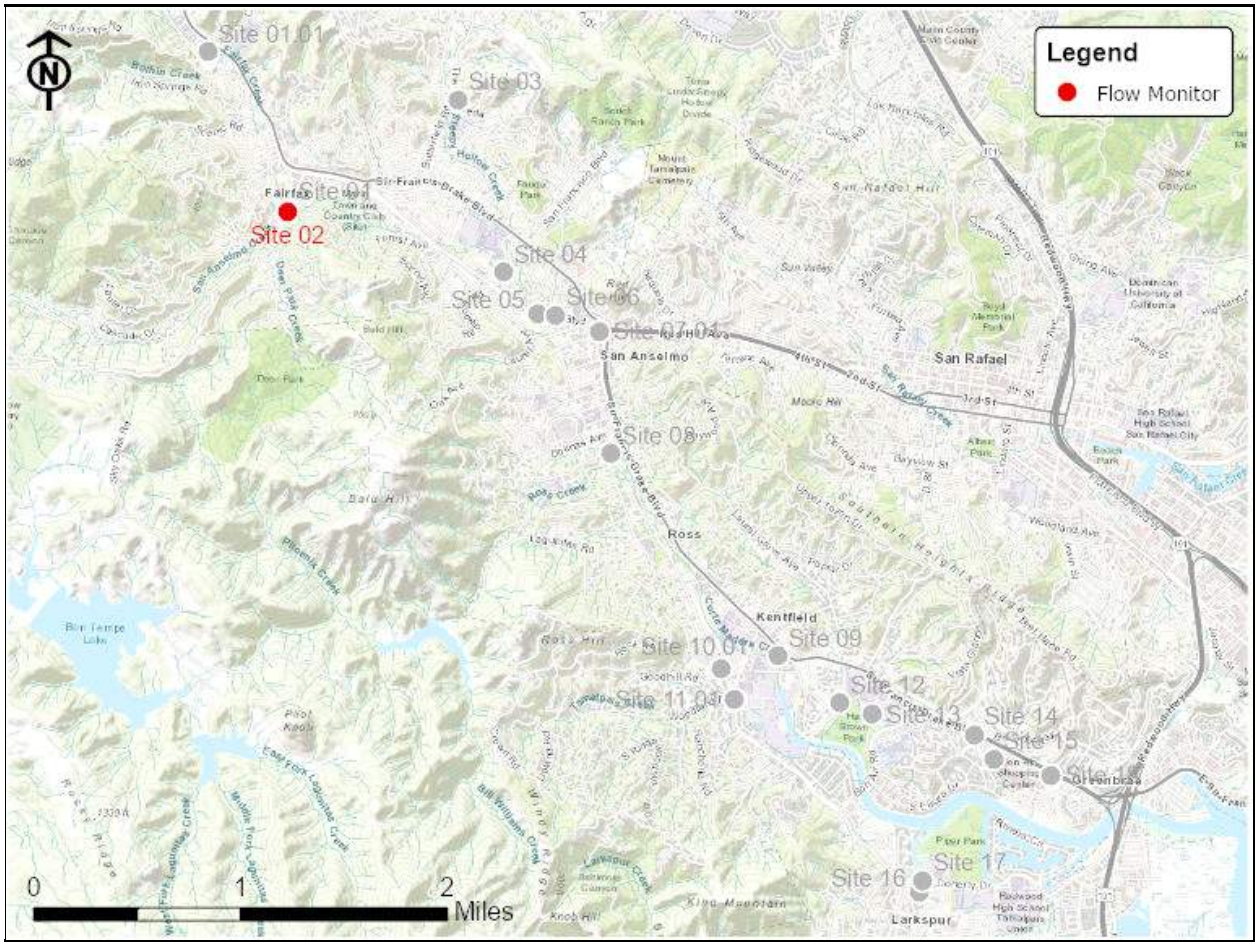
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 8 Court Lane

Data Summary Report



Vicinity Map: Site 02

SITE 02

Site Information MH ID: F002.100

Location: 8 Court Lane

Coordinates: 122.5903° W, 37.9843° N

Rim Elevation (Earth): 112 feet

Expected Pipe Diameter: 18 inches

Measured Pipe Diameter: 18 inches

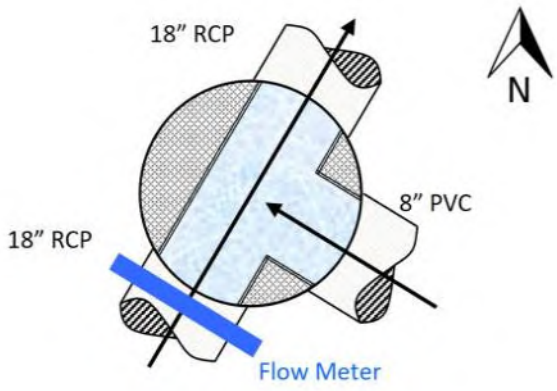
ADWF: 0.187 mgd

Peak Measured Flow: 1.248 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 02

Additional Site Photos

Effluent Pipe

Southeast Influent Pipe

SITE 02

Additional Site Photos

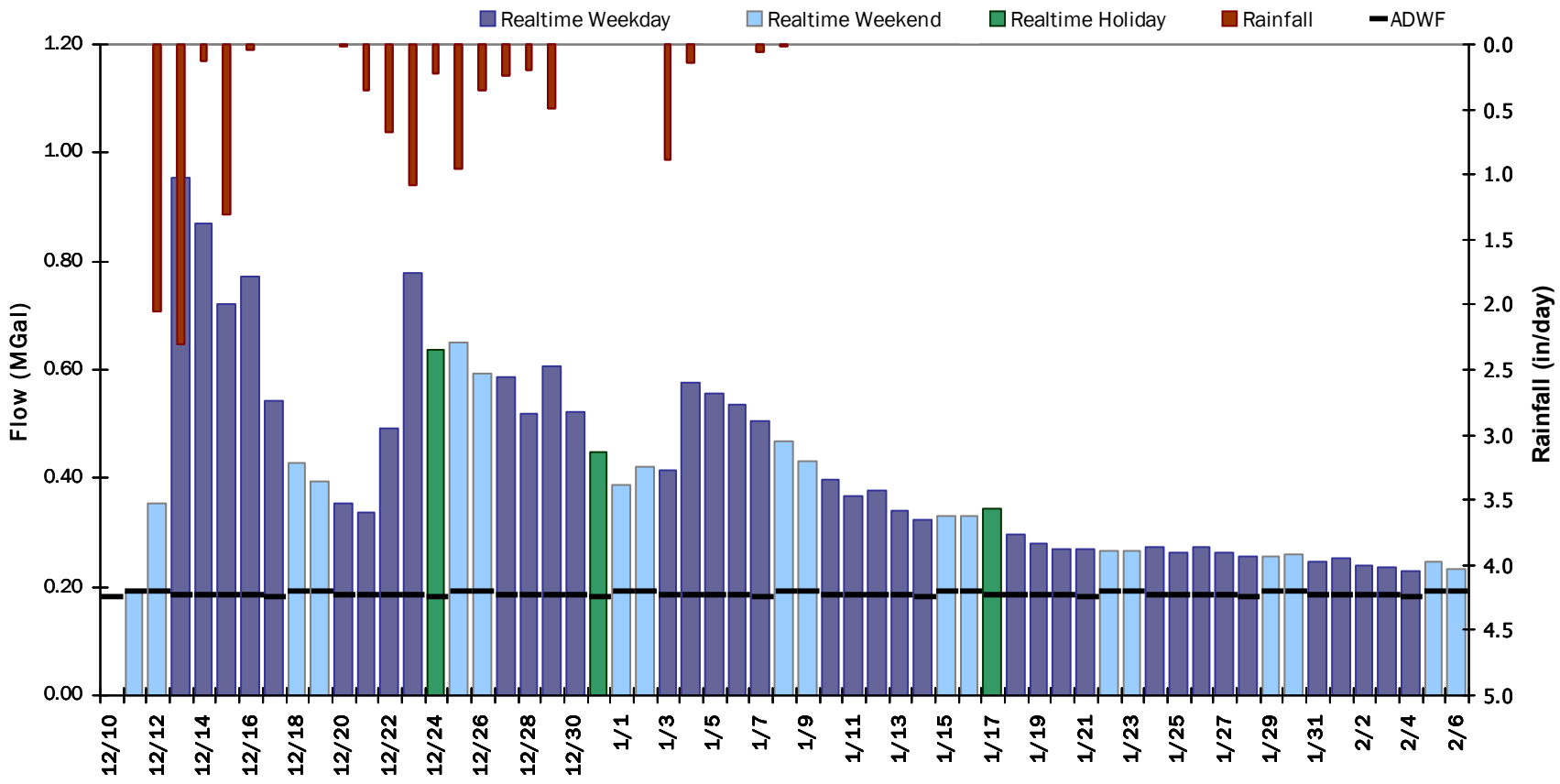
Monitored Southwest Influent Pipe

SITE 02

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.414 MGal Peak Daily Flow: 0.954 MGal Min Daily Flow: 0.192 MGal

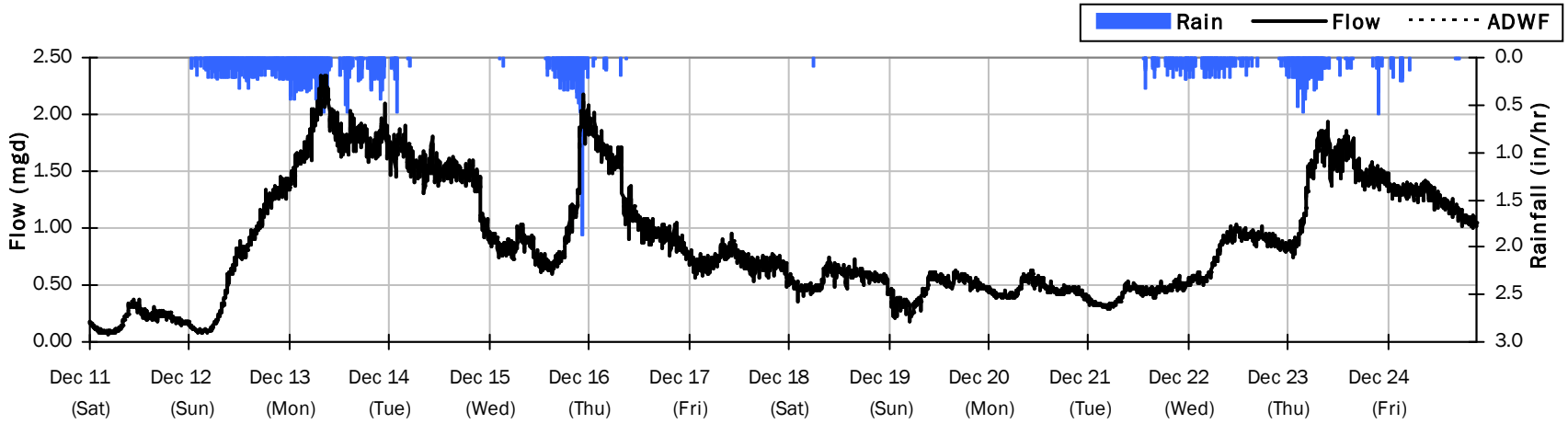
Total Rainfall: 11.47 inches

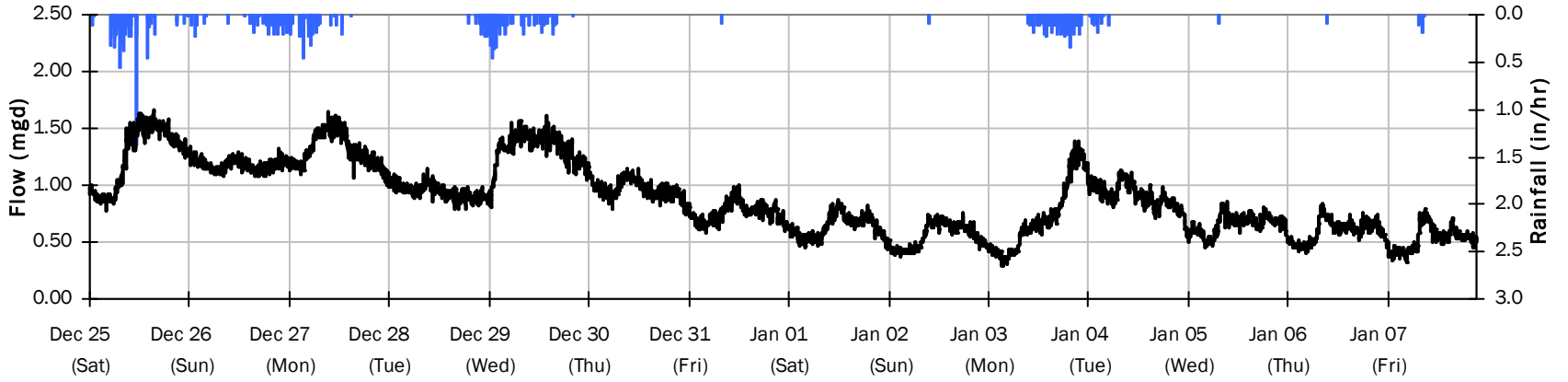


SITE 03

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 12.62 inches Period Avg Flow: 0.870 mgd Period Peak Flow: 2.334 mgd Period Min Flow: 0.065 mgd

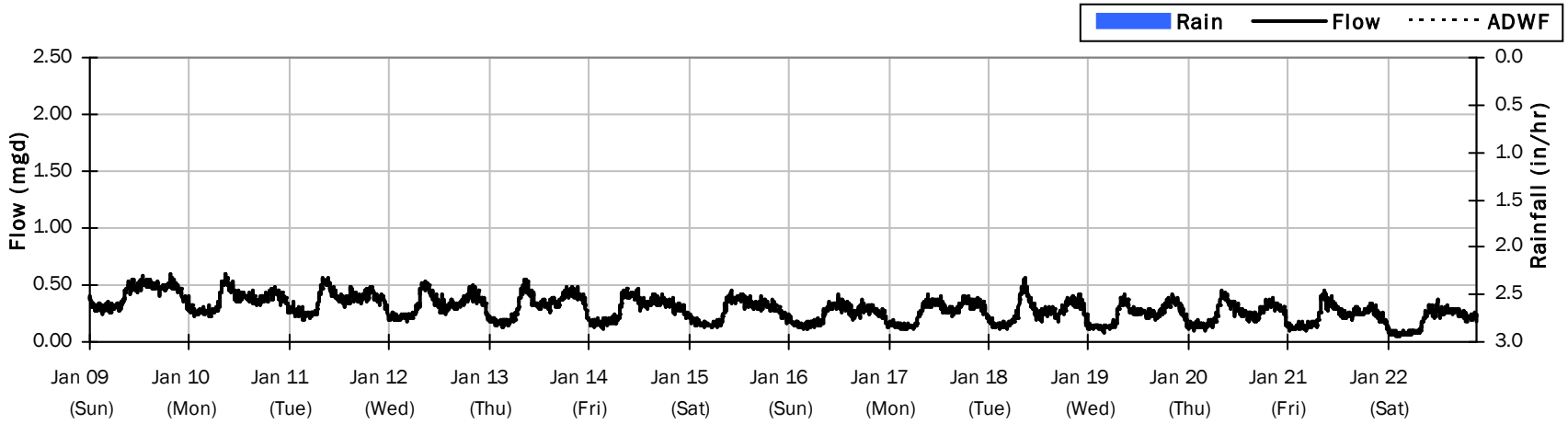


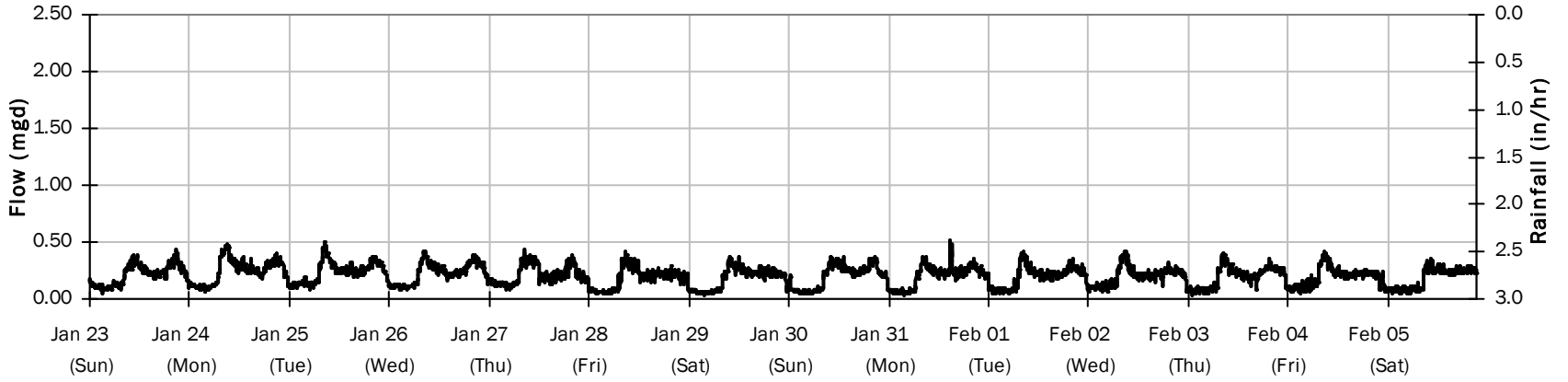


SITE 03

Flow Summary: 1/9/2022 to 2/5/2022

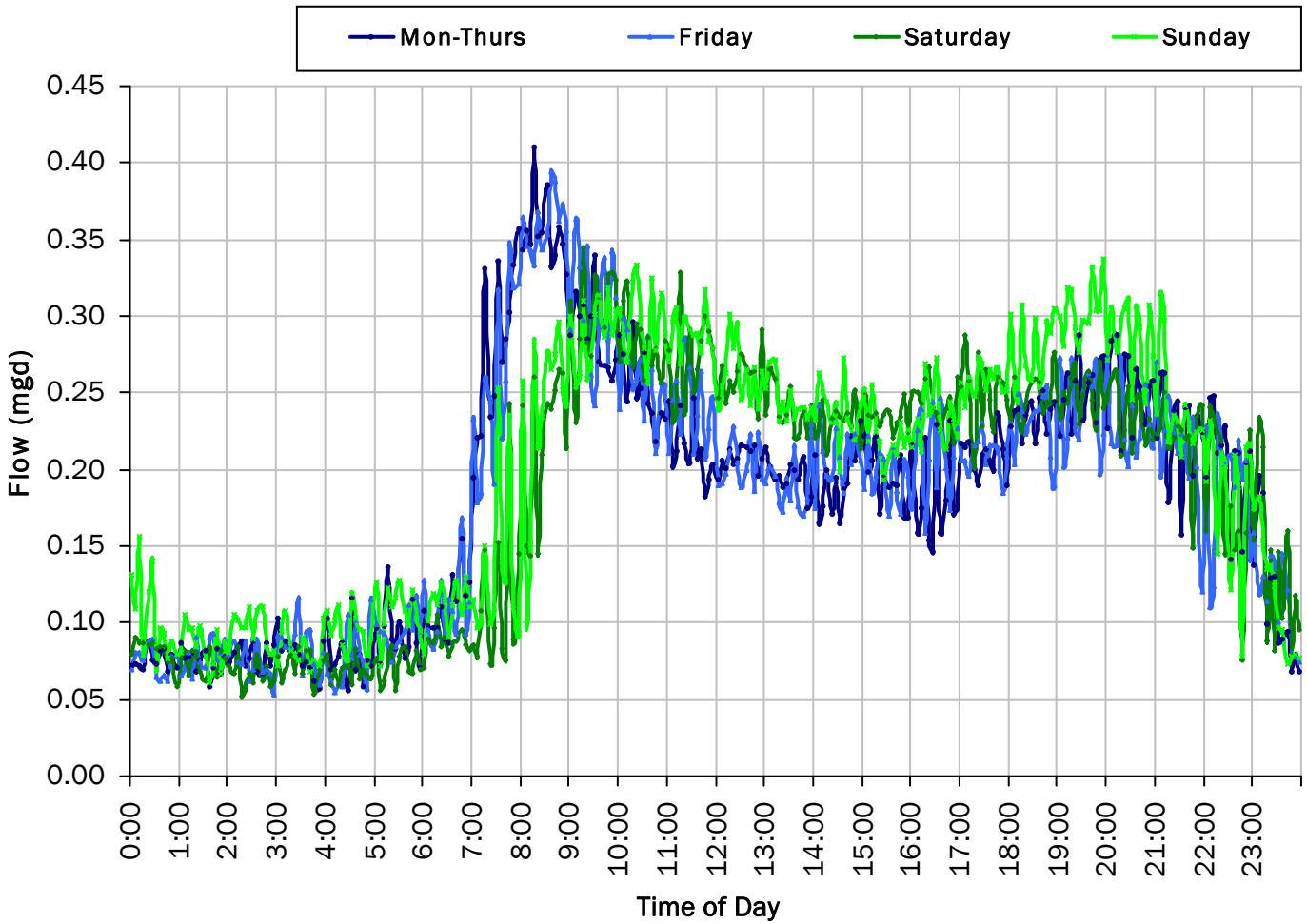
Period Rainfall: 0.00 inches Period Avg Flow: 0.248 mgd Period Peak Flow: 0.600 mgd Period Min Flow: 0.034 mgd





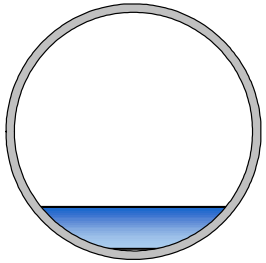
SITE 03

Average Dry Weather Flow Hydrographs



ADWF:

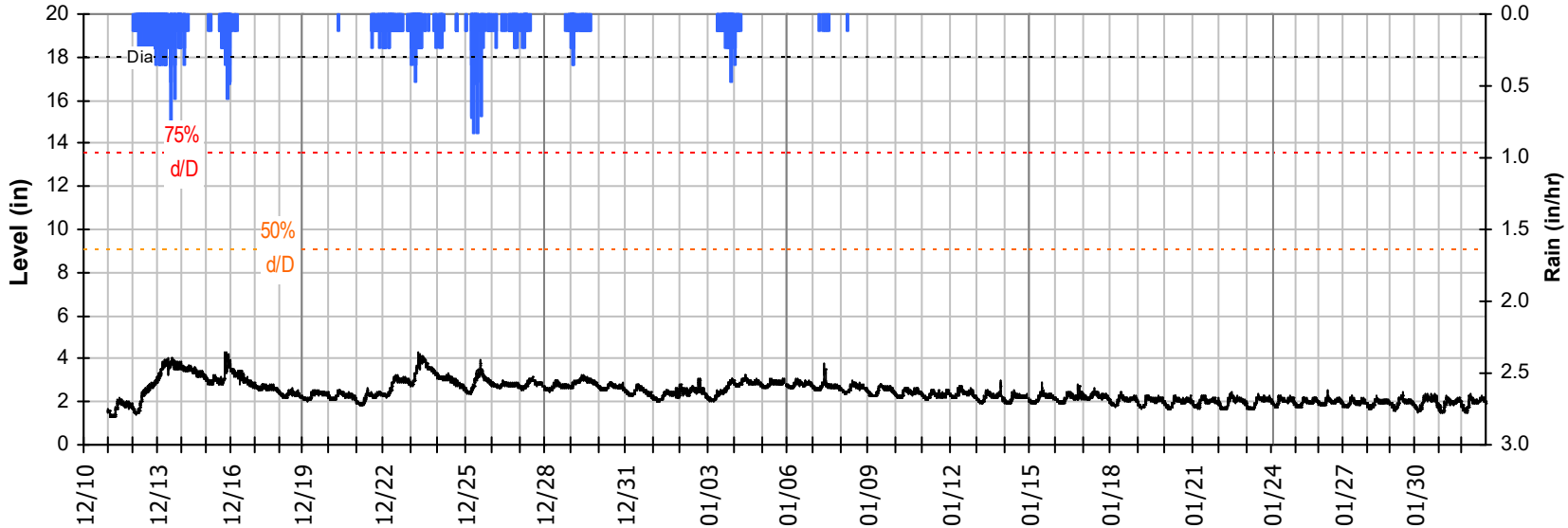
0.187 *mgd*

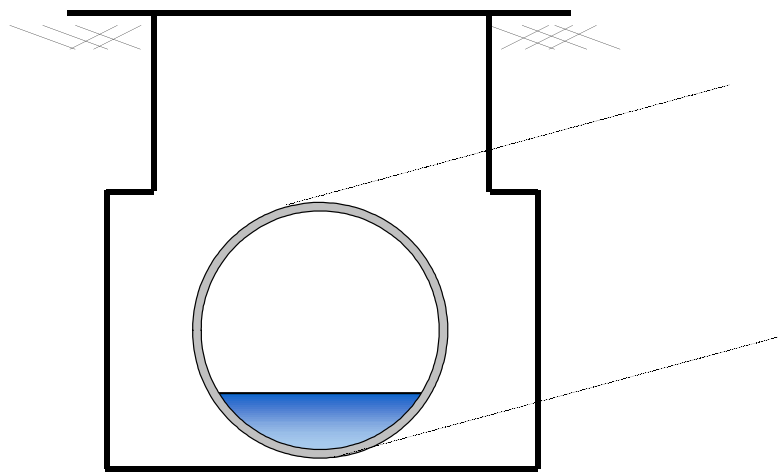


SITE 02

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

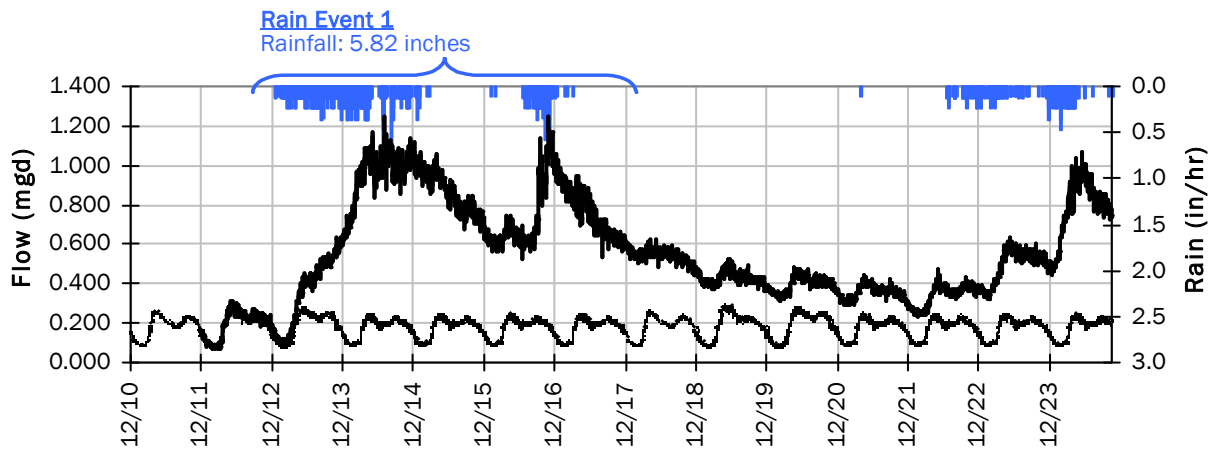




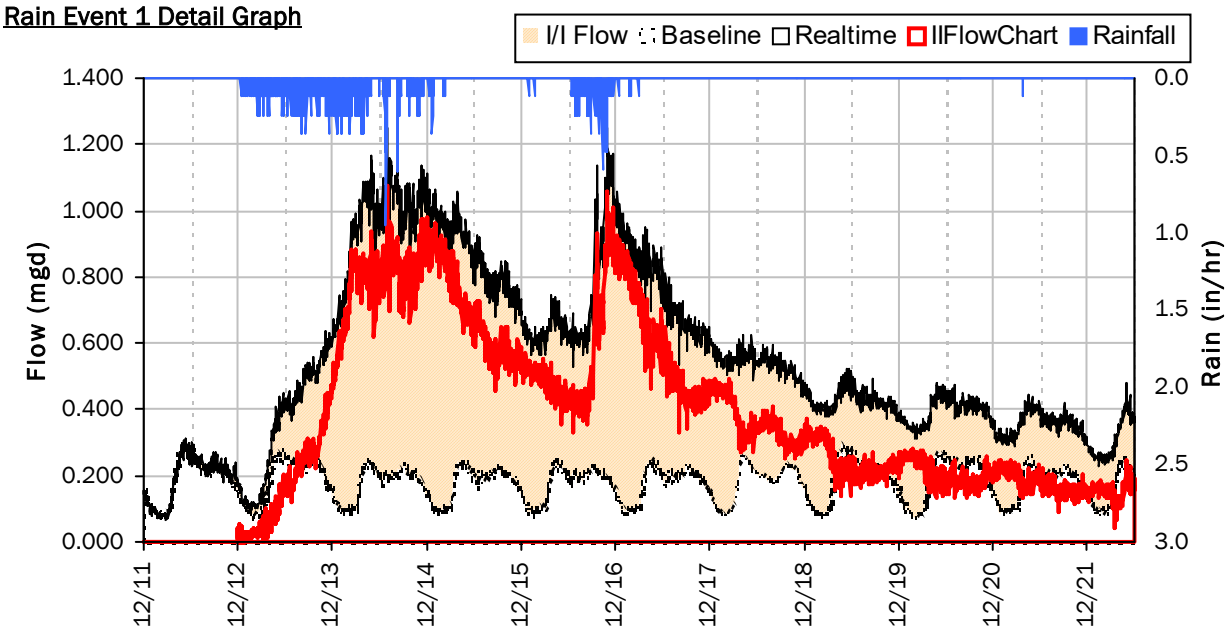
Pipe Diameter:	18	*inches*
Peak Measured Level:	4.29	*inches*
Peak d/D Ratio:	0.24	

SITE 02
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

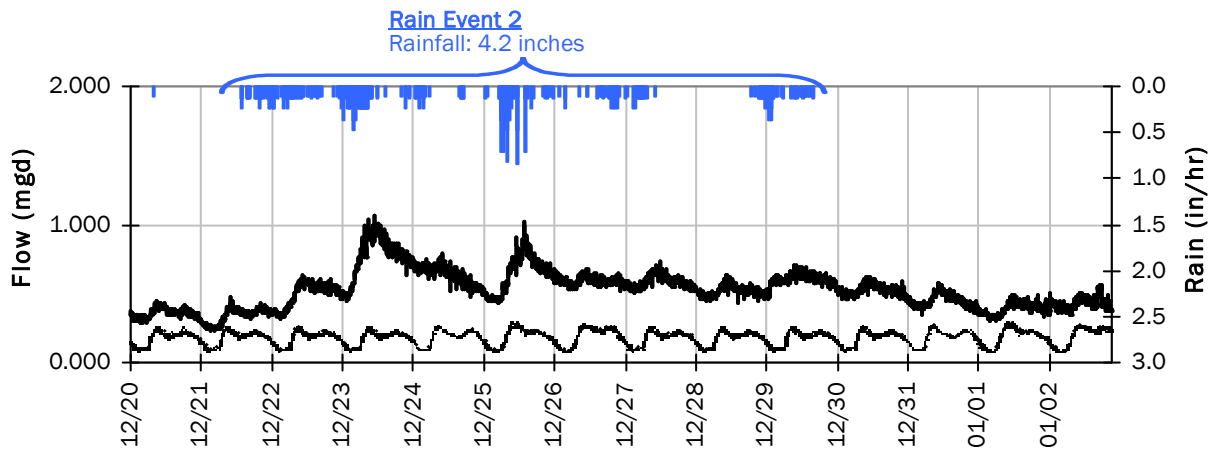


Storm Event I/I Analysis (Rain = 5.82 inches)

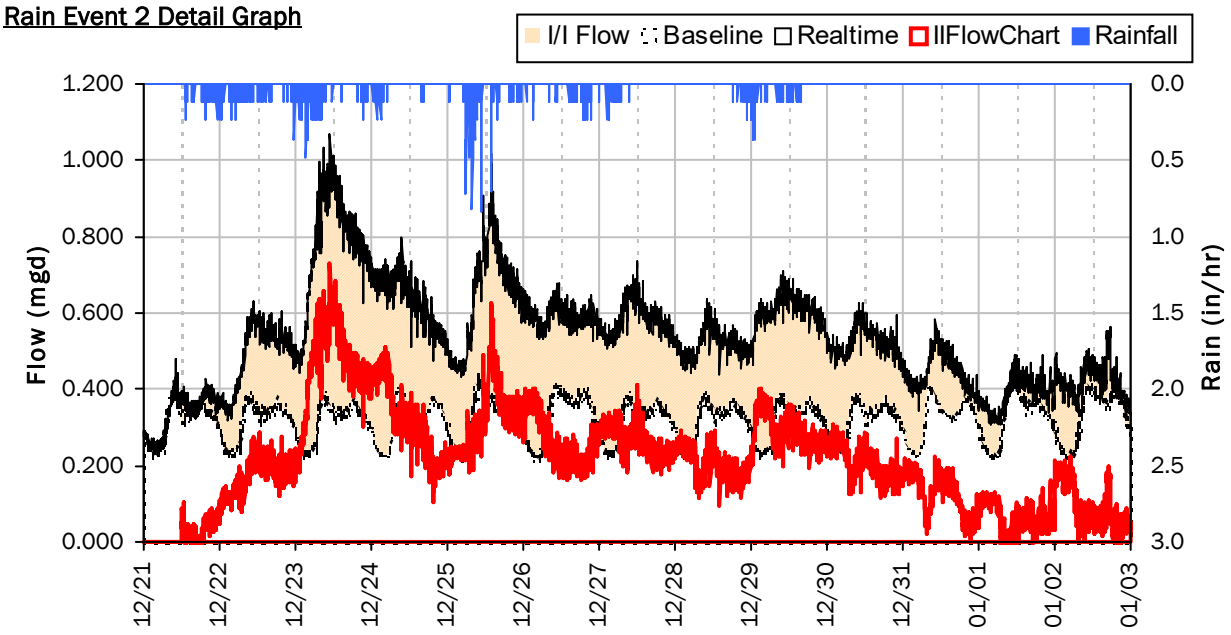
Capacity		Inflow / Infiltration	
Peak Flow:	1.248 *mgd*	Peak I/I Rate:	1.073 *mgd*
PF:	6.95	Total I/I:	3,845,000 *gallons*
Peak Level:	4.29 *in*		
d/D Ratio:	0.24		

SITE 02
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



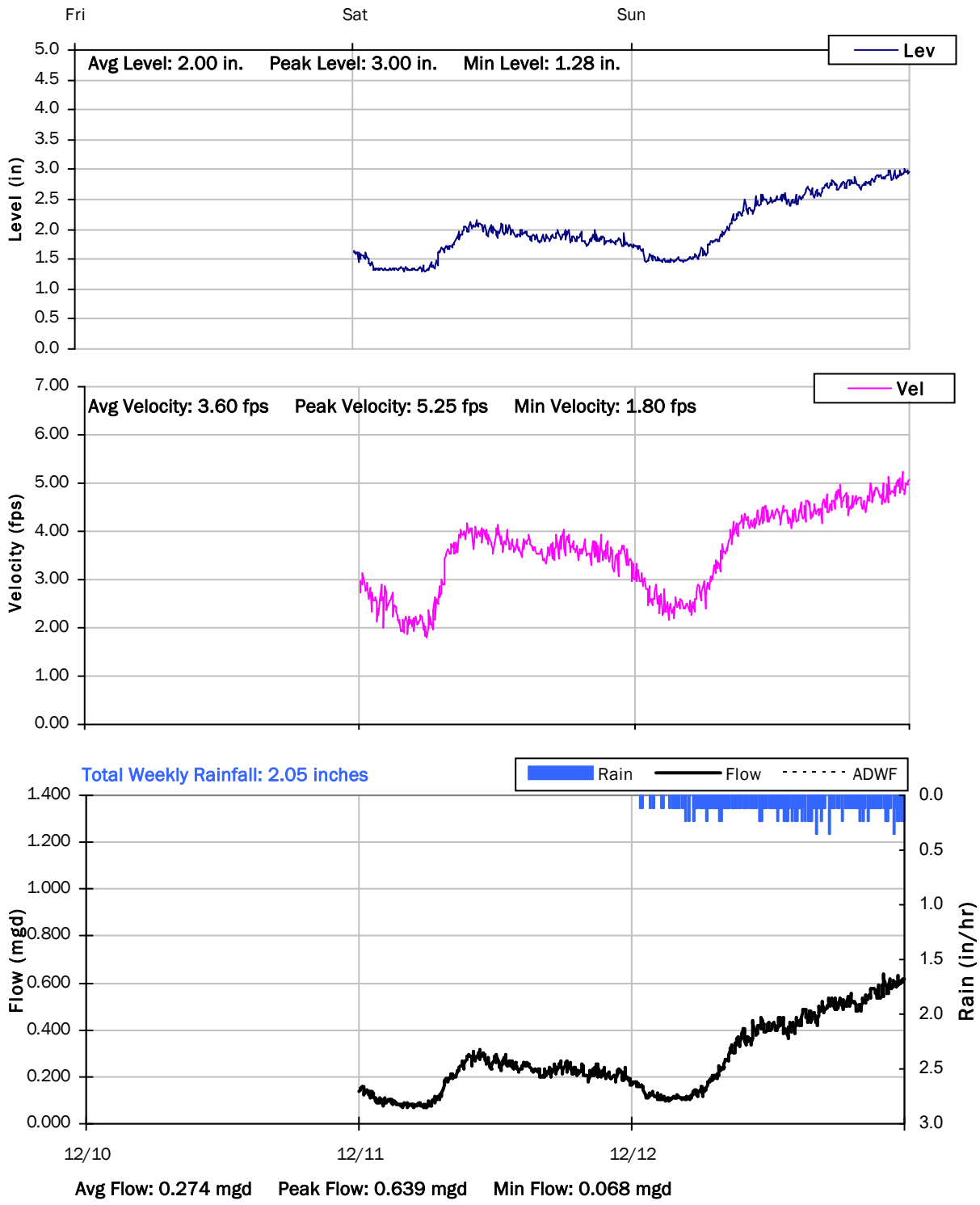
Storm Event I/I Analysis (Rain = 4.20 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.070 *mgd*	**Peak I/I Rate:**	0.728 *mgd*
PF:	5.96	**Total I/I:**	2,815,000 *gallons*
Peak Level:	4.28 *in*		
d/D Ratio:	0.24		

SITE 02

Weekly Level, Velocity and Flow Hydrographs

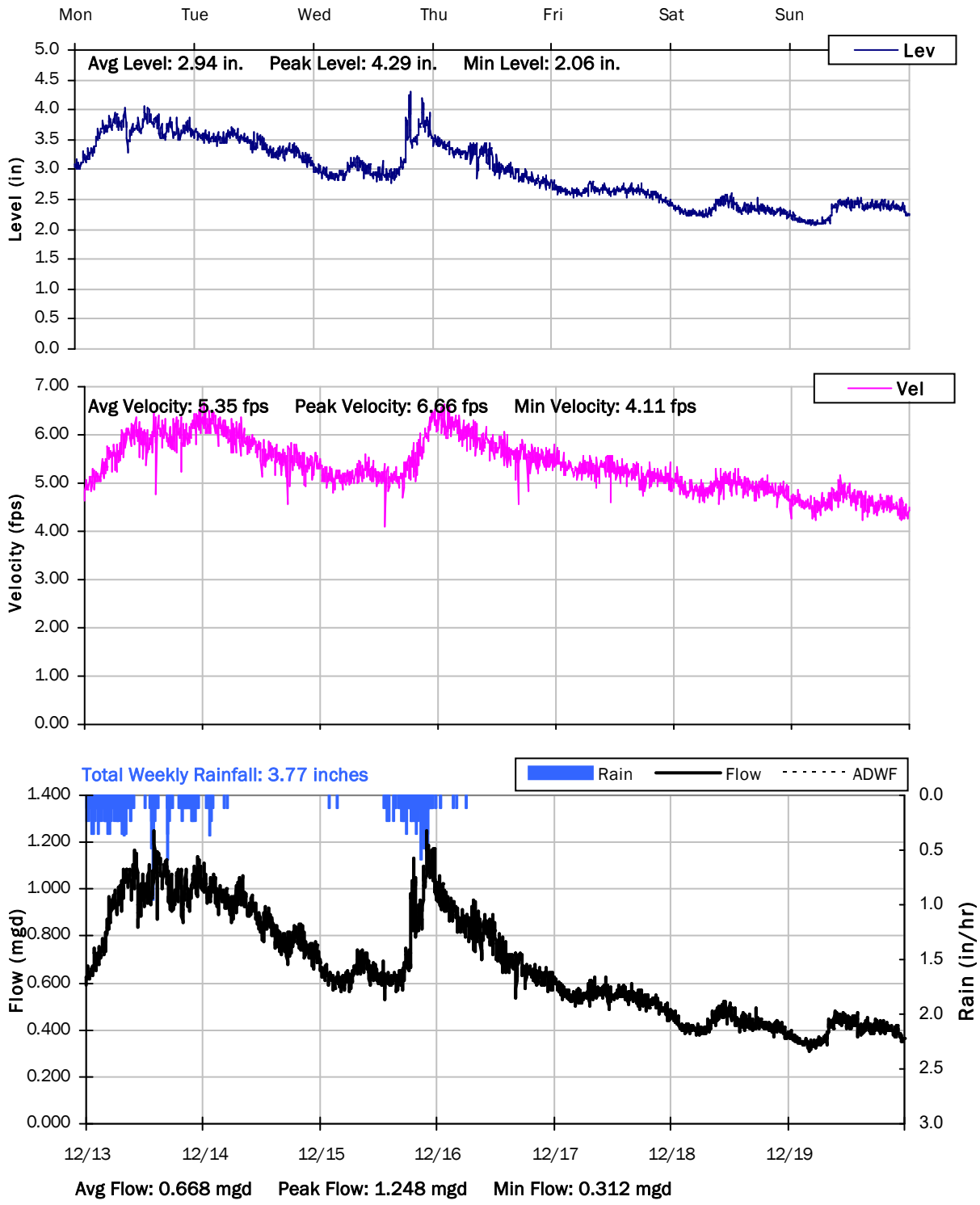
12/10/2021 to 12/13/2021



SITE 02

Weekly Level, Velocity and Flow Hydrographs

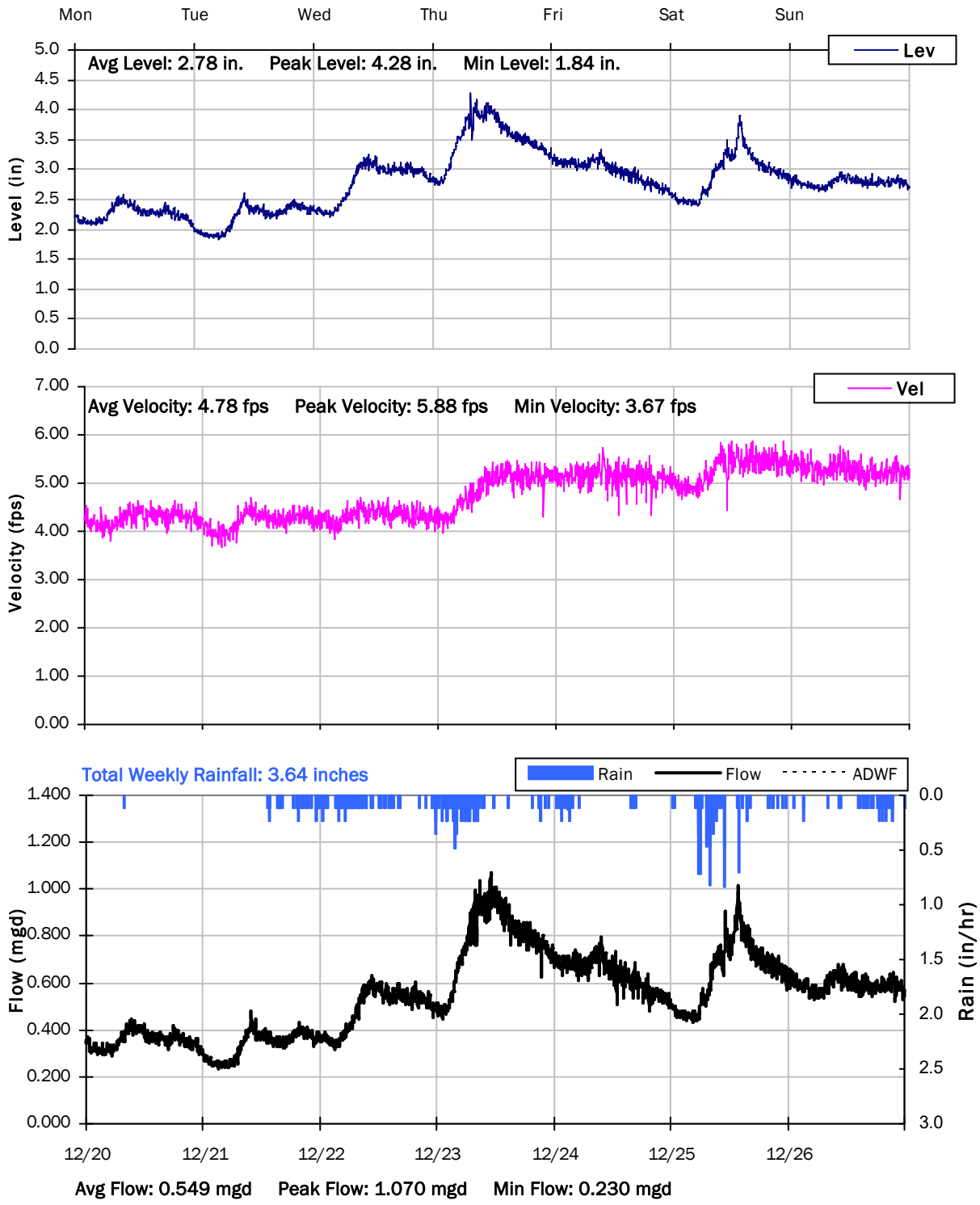
12/13/2021 to 12/20/2021



SITE 02

Weekly Level, Velocity and Flow Hydrographs

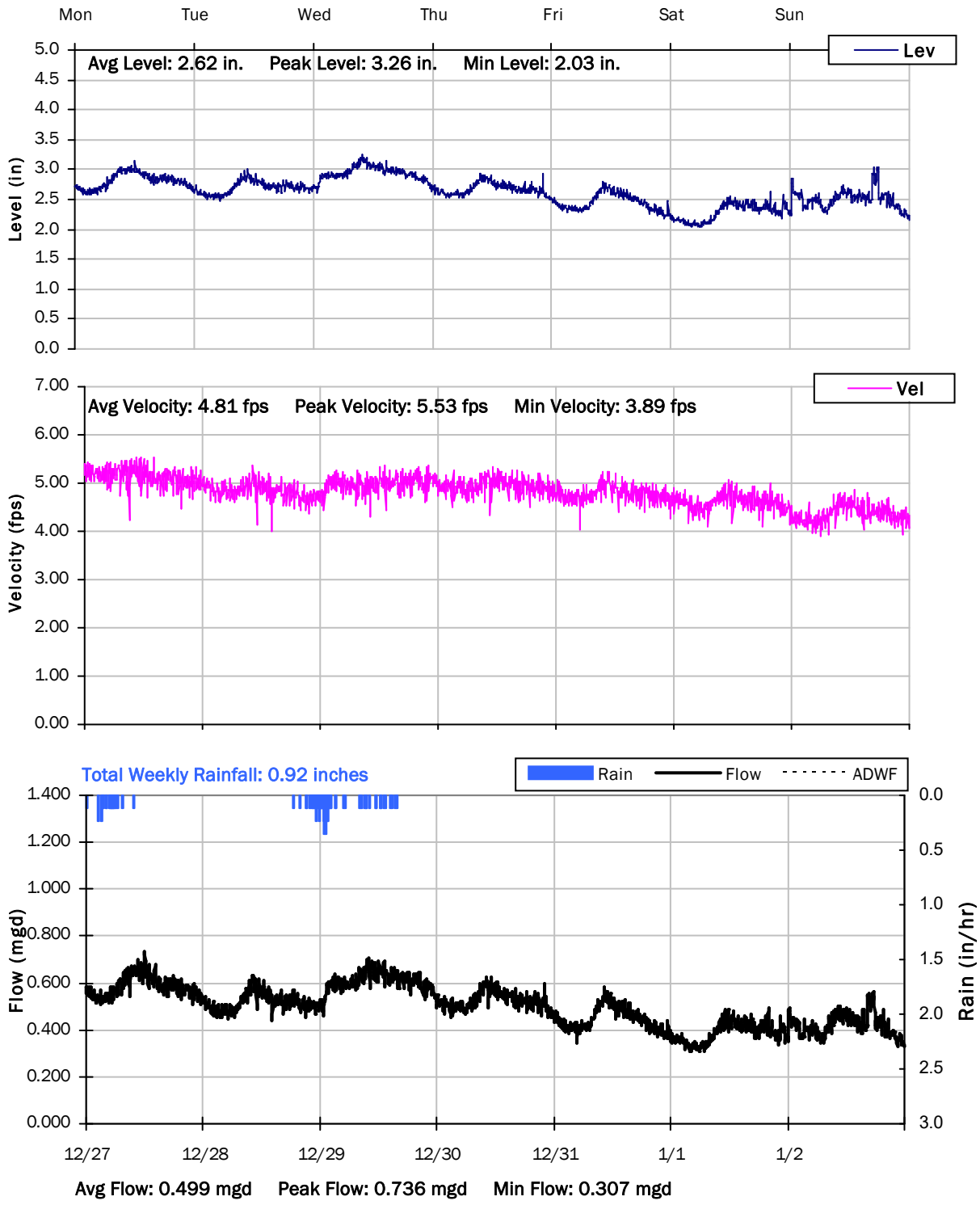
12/20/2021 to 12/27/2021



SITE 02

Weekly Level, Velocity and Flow Hydrographs

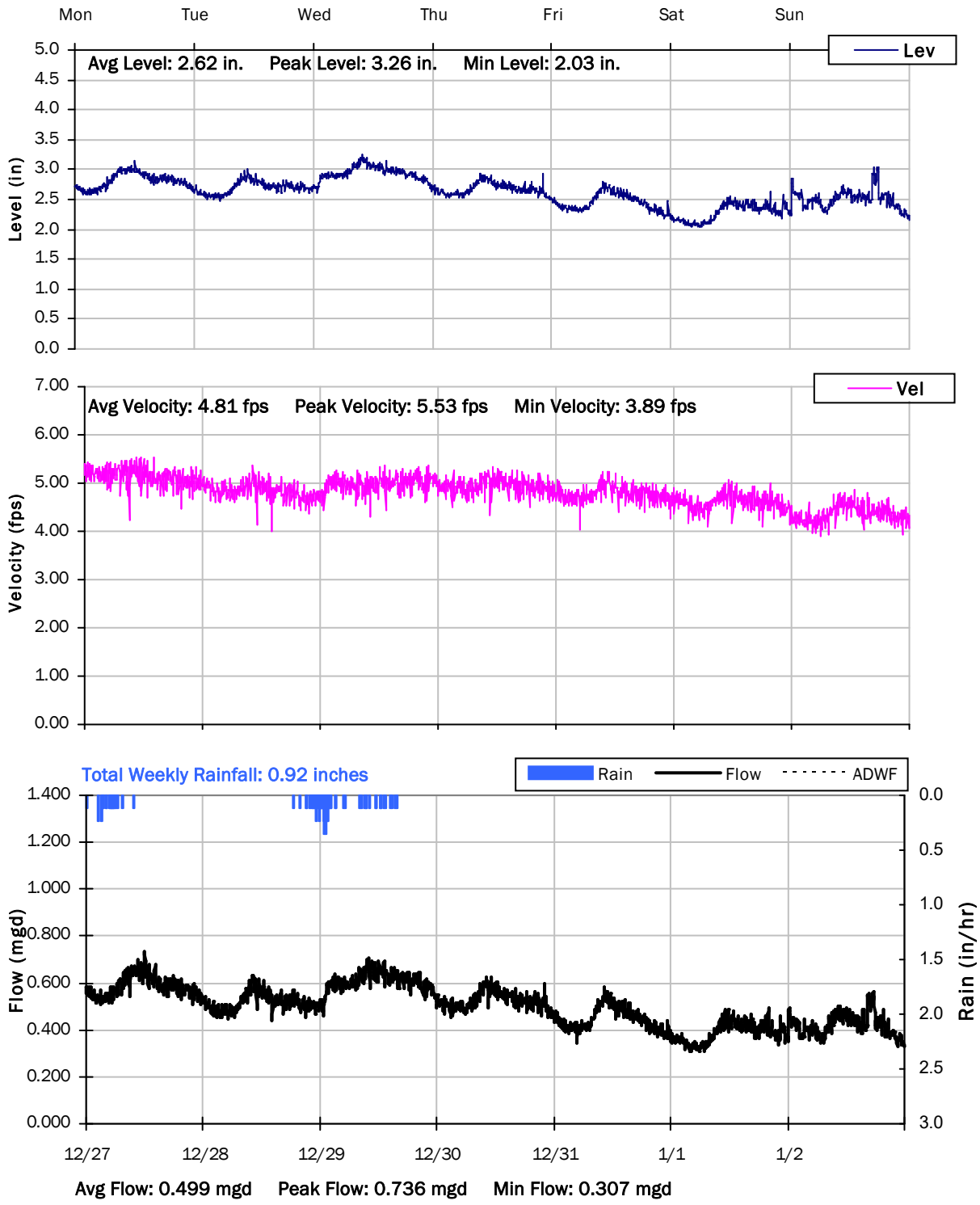
12/27/2021 to 1/3/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

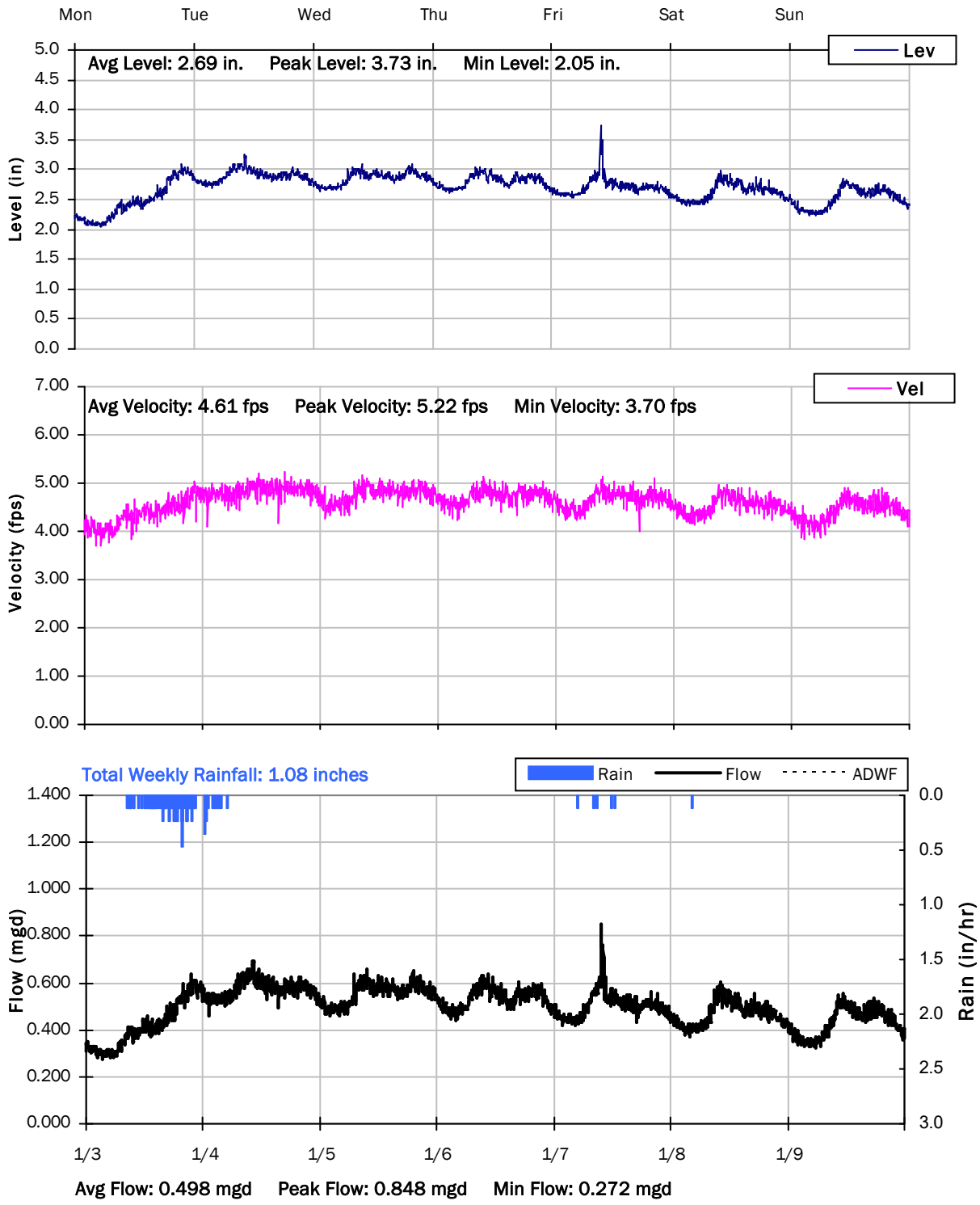
12/27/2021 to 1/3/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

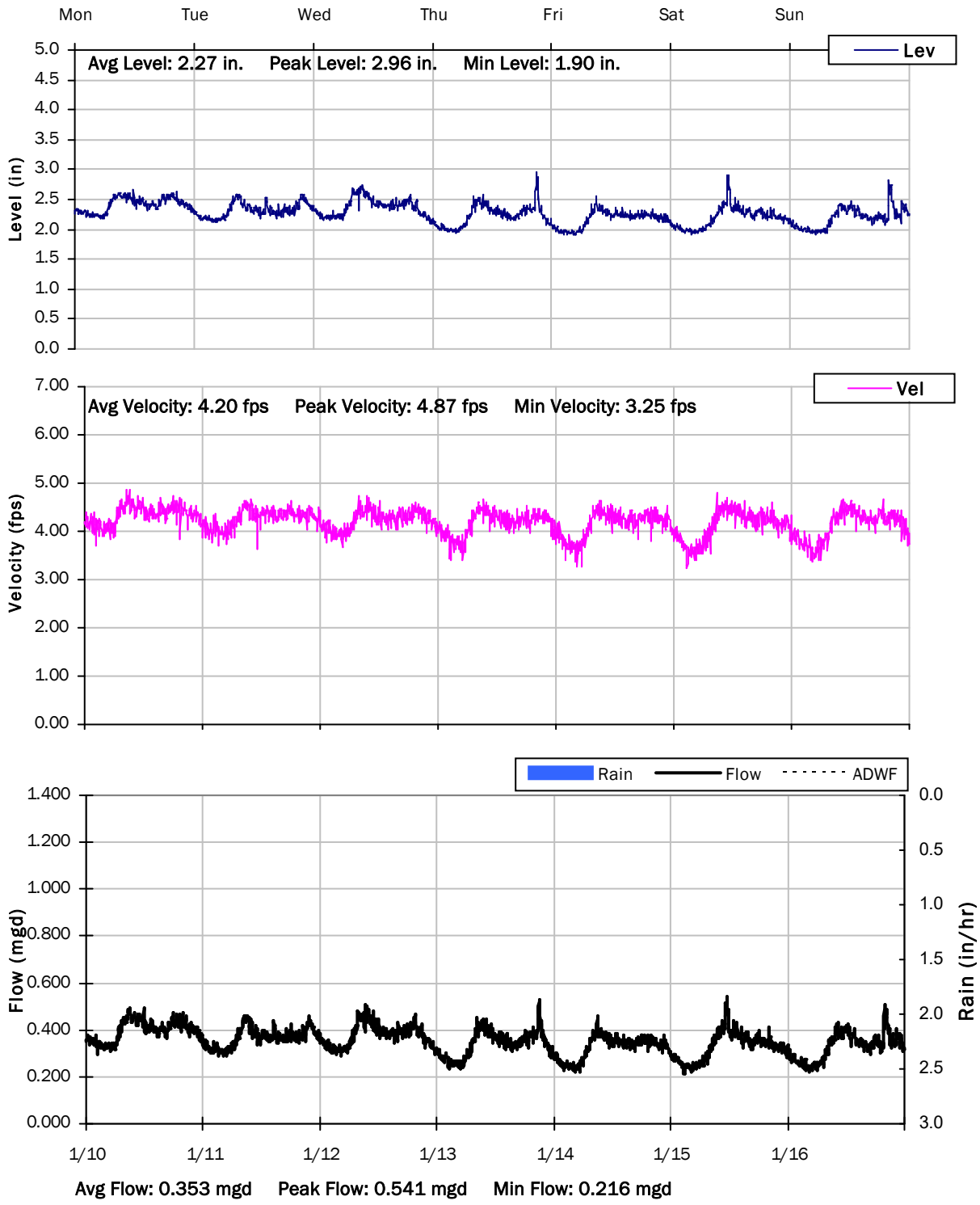
1/3/2022 to 1/10/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

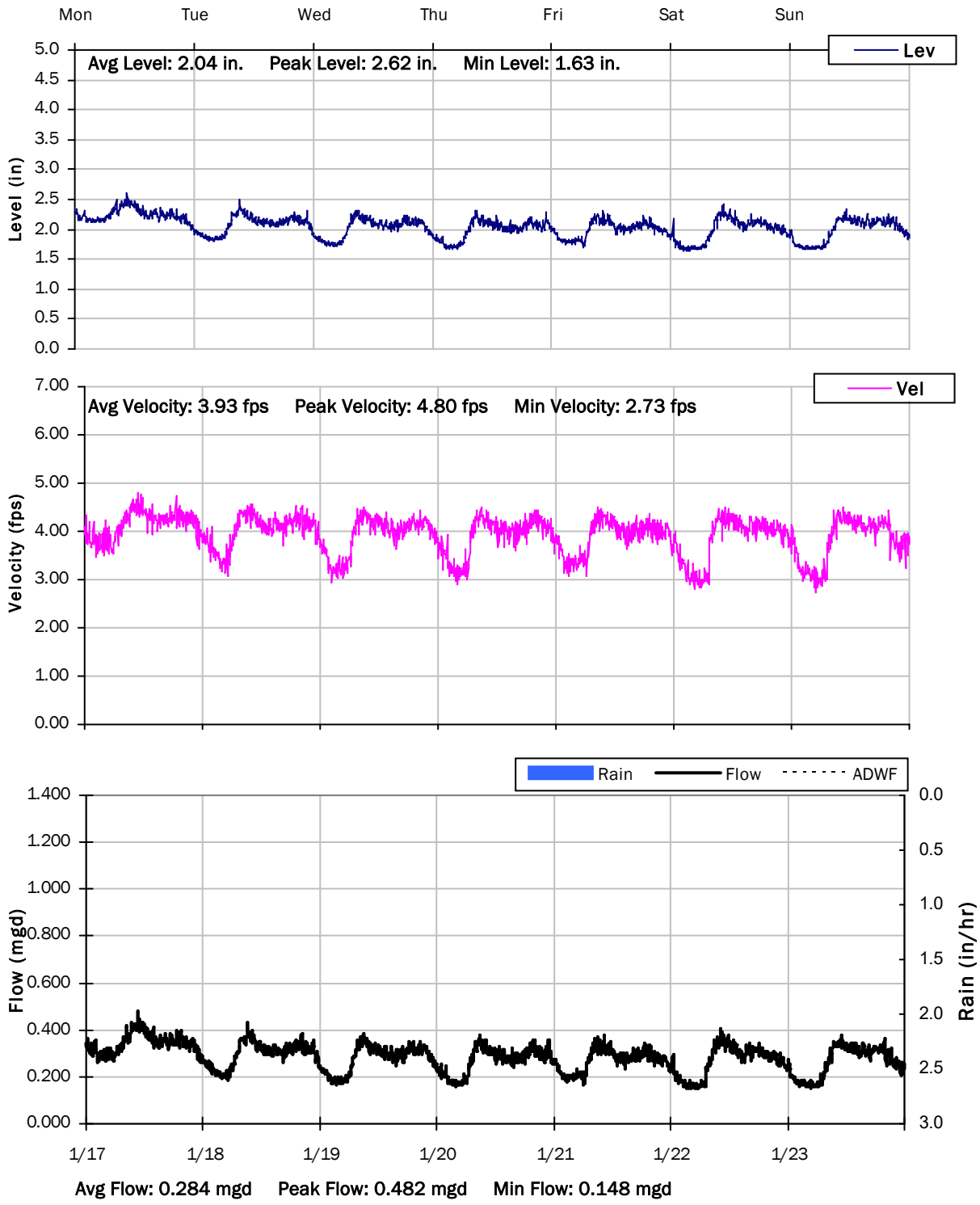
1/10/2022 to 1/17/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

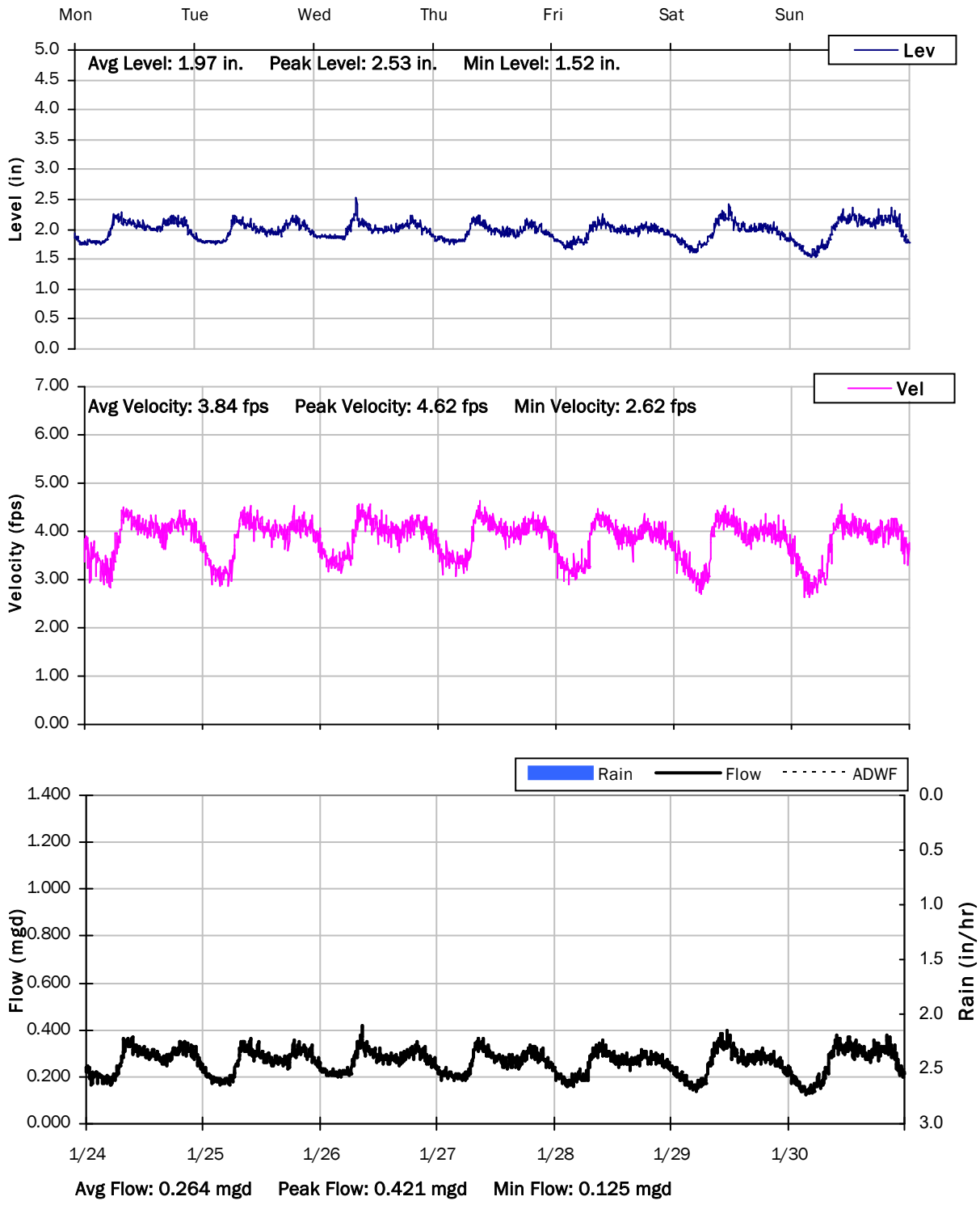
1/17/2022 to 1/24/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

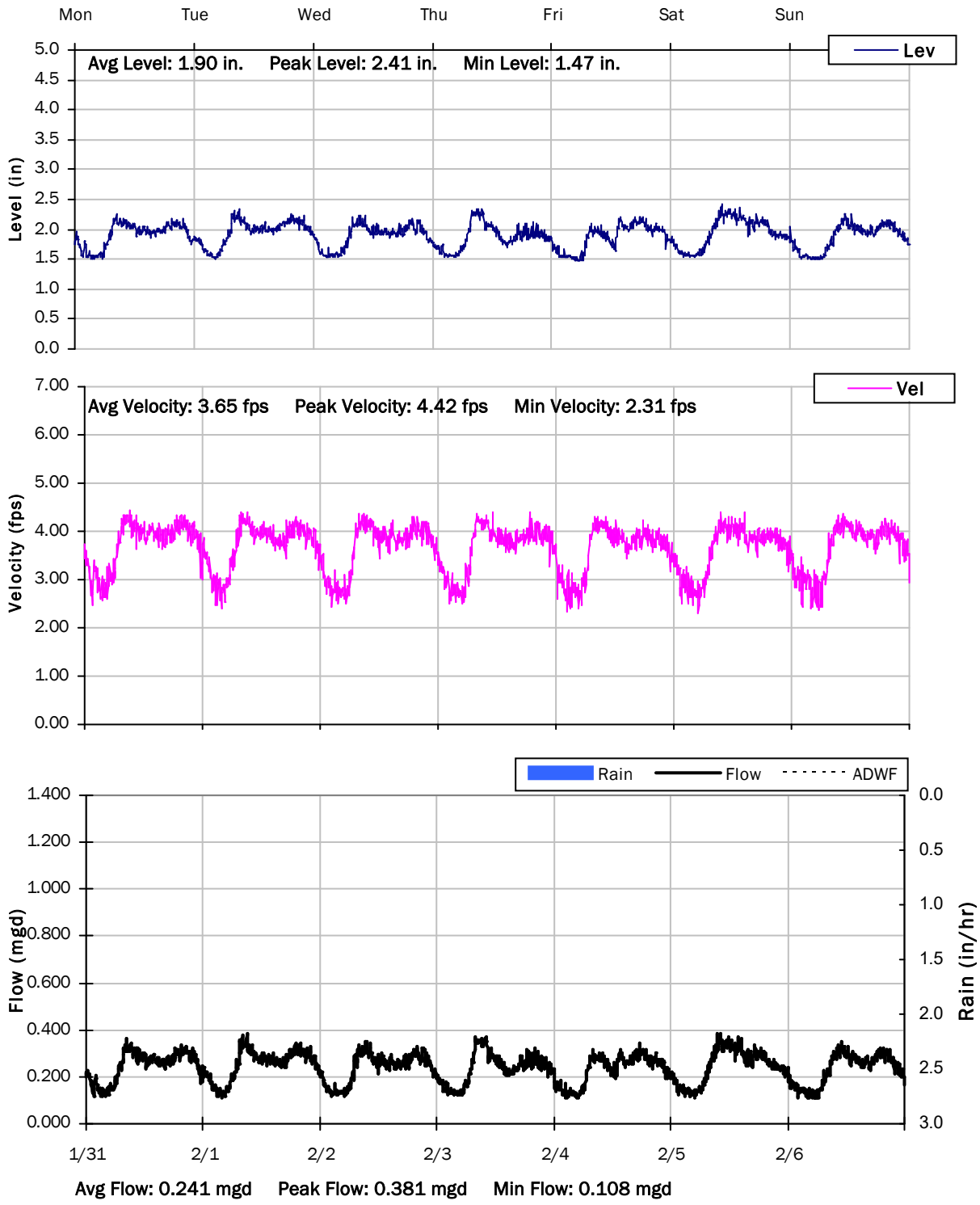
1/24/2022 to 1/31/2022



SITE 02

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 03

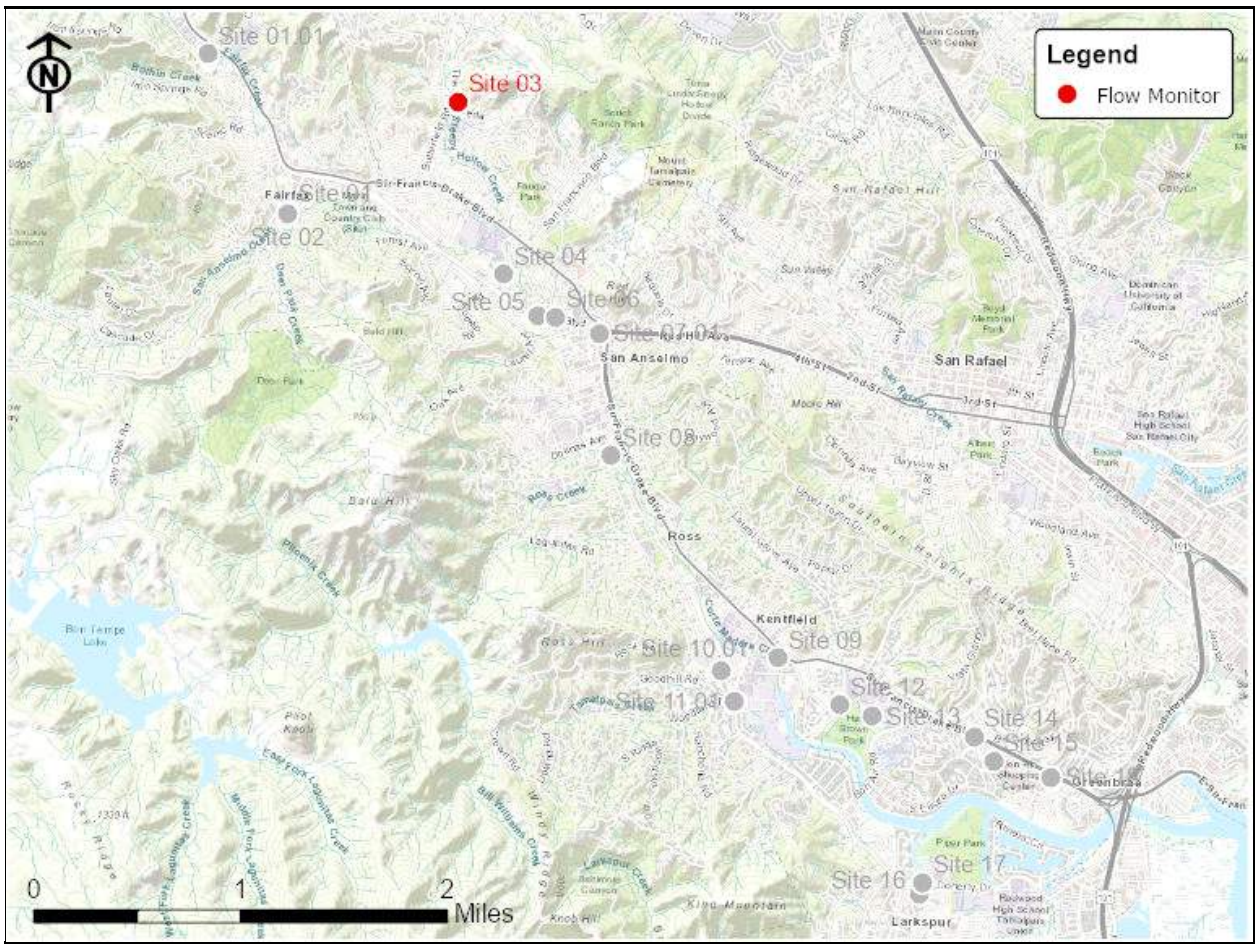
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 156 The Alameda

Data Summary Report



Vicinity Map: Site 03

SITE 03

Site Information MH ID: S900.210

Location: 156 The Alameda

Coordinates: 122.5754° W, 37.9925° N

Rim Elevation (Earth): 98 feet

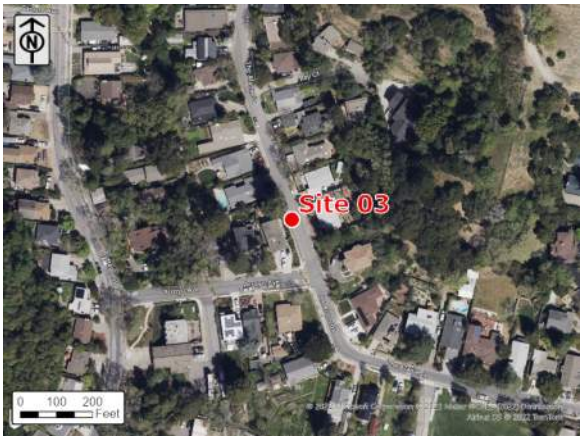
Expected Pipe Diameter: 18 inches

Measured Pipe Diameter: 18 inches

ADWF: 0.187 mgd

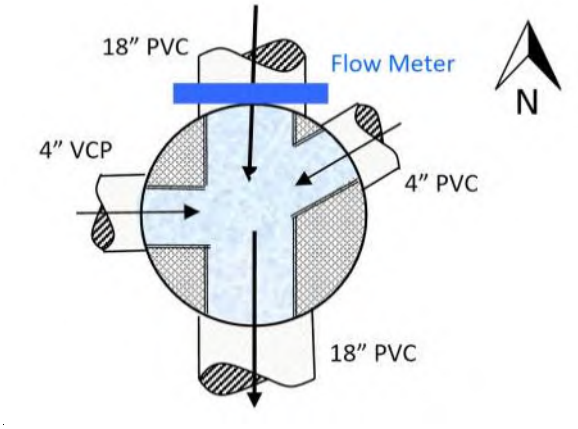
Peak Measured Flow: 2.334 mgd

Sediment: None



Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 03

Additional Site Photos

Effluent Pipe

West Influent Pipe

SITE 03

Additional Site Photos

Monitored North Influent Pipe

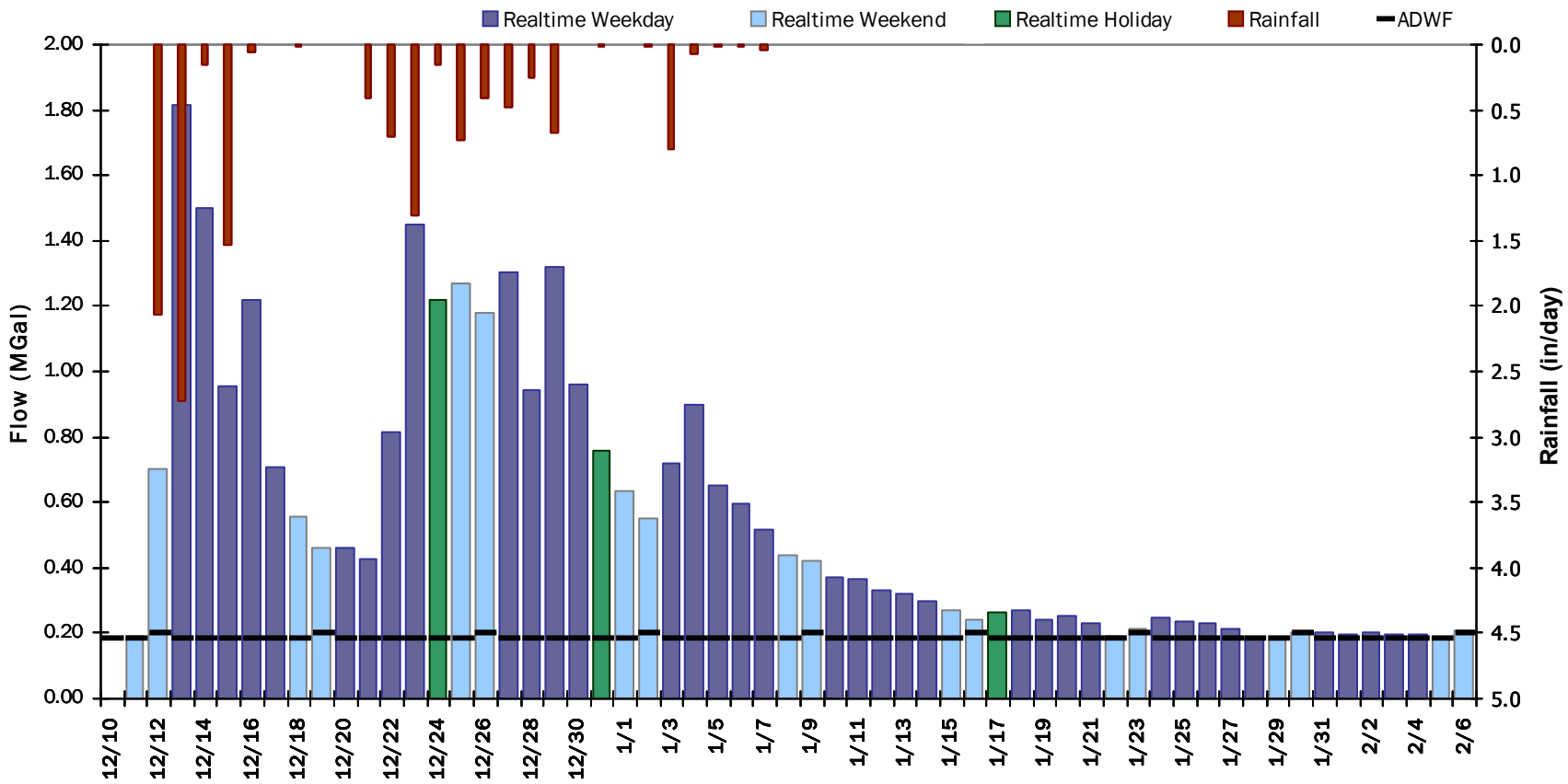
Northeast Influent Pipe

SITE 03

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.558 MGal Peak Daily Flow: 1.817 MGal Min Daily Flow: 0.182 MGal

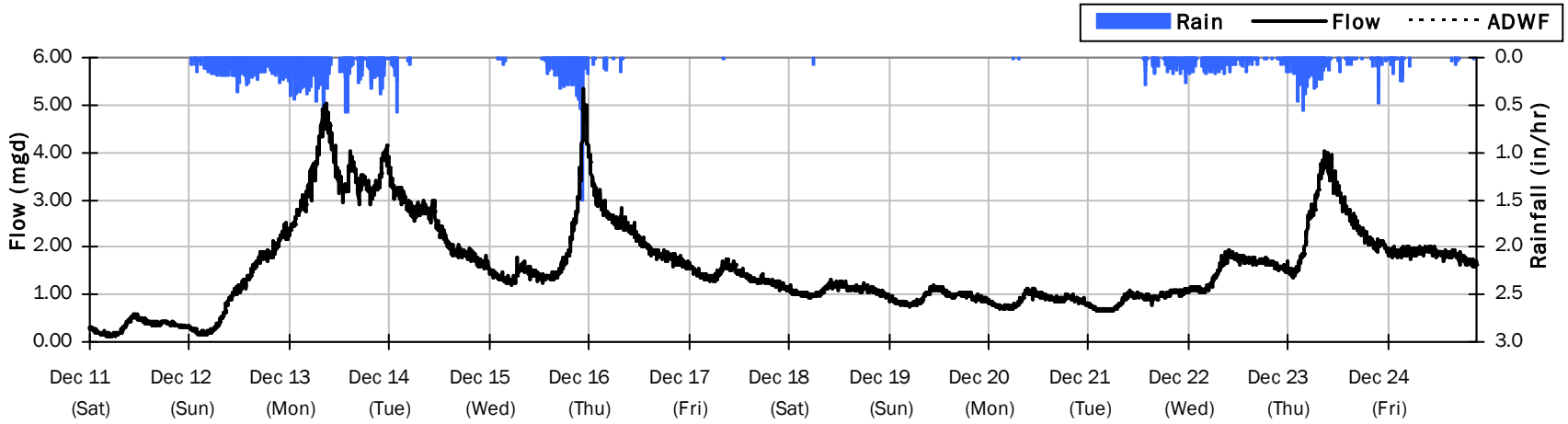
Total Rainfall: 12.62 inches

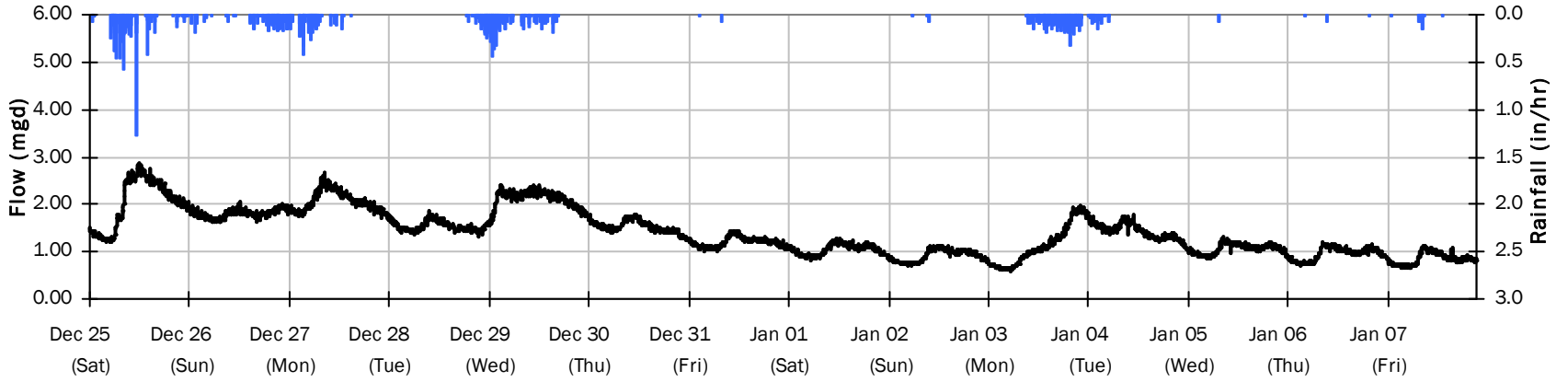


SITE 04

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 12.92 inches Period Avg Flow: 1.479 mgd Period Peak Flow: 5.344 mgd Period Min Flow: 0.110 mgd

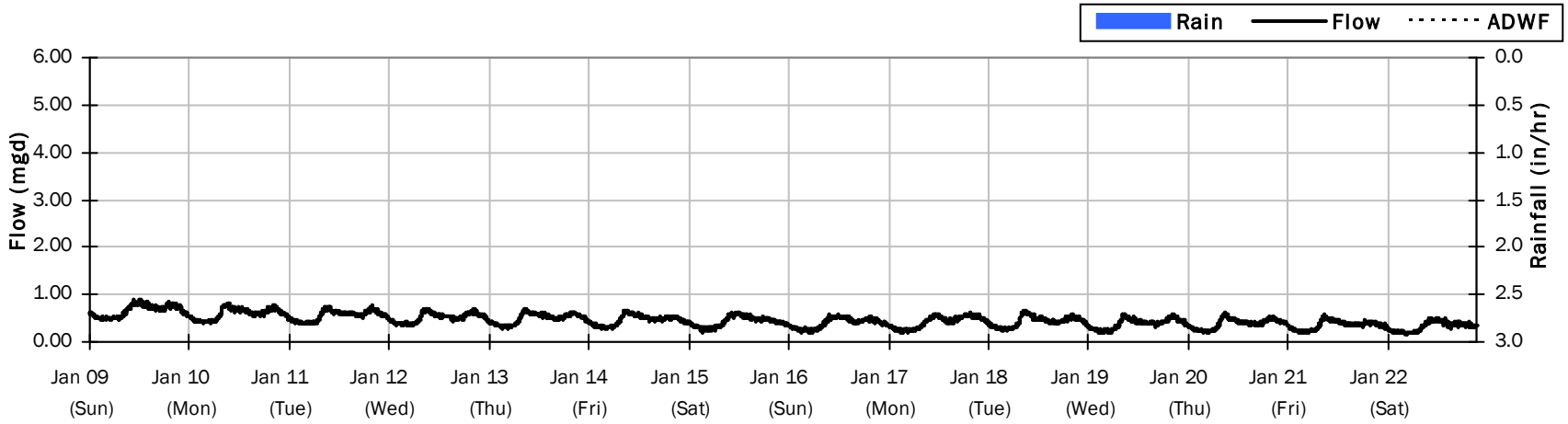


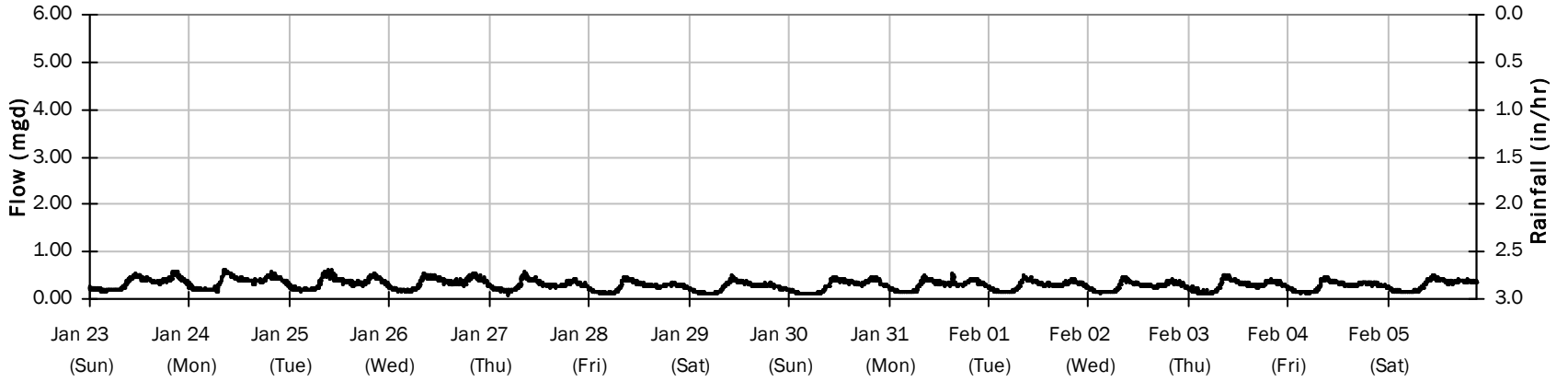


SITE 04

Flow Summary: 1/9/2022 to 2/5/2022

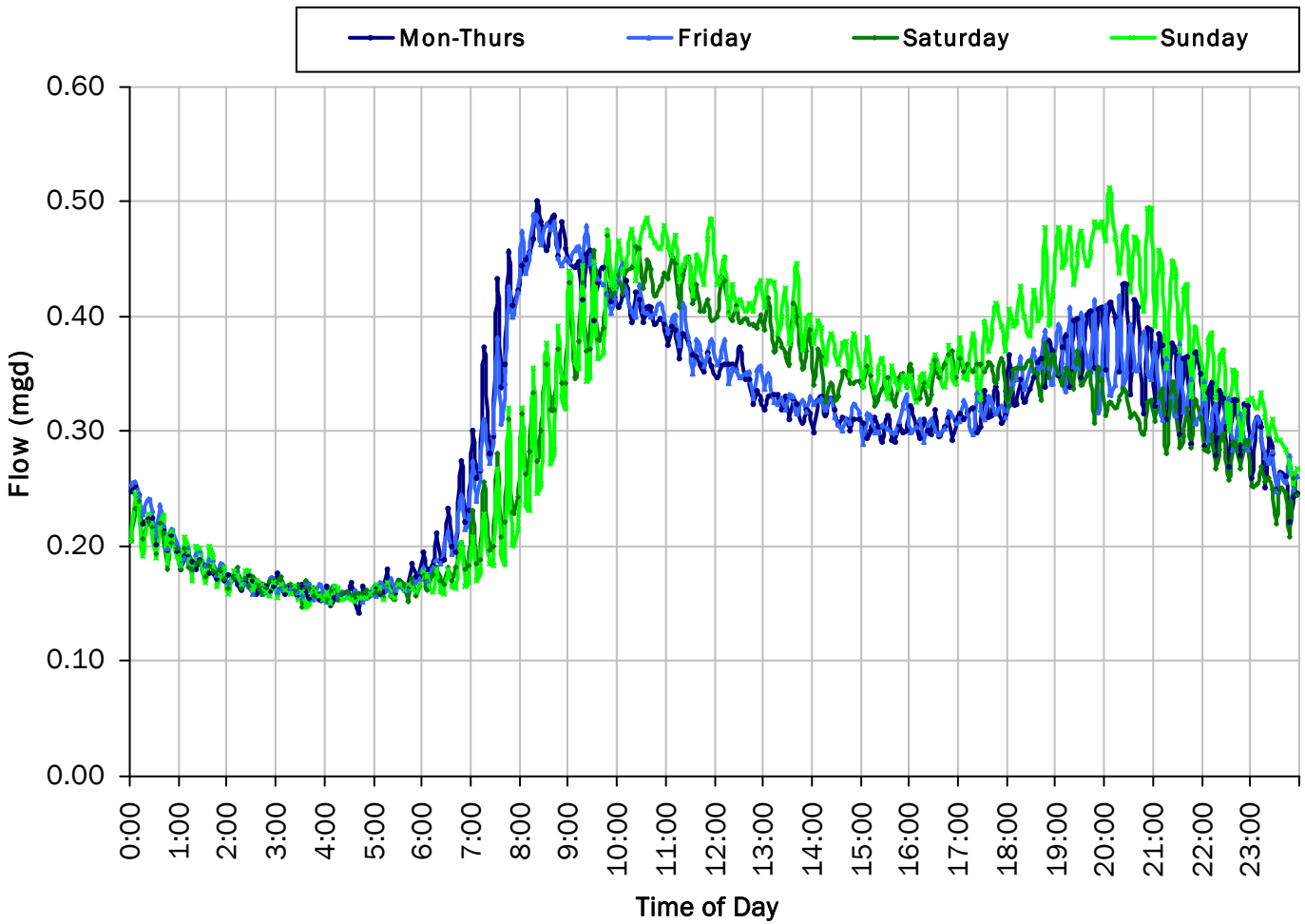
Period Rainfall: 0.00 inches Period Avg Flow: 0.380 mgd Period Peak Flow: 0.889 mgd Period Min Flow: 0.096 mgd





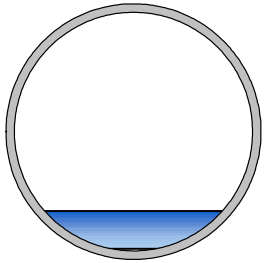
SITE 04

Average Dry Weather Flow Hydrographs



ADWF:

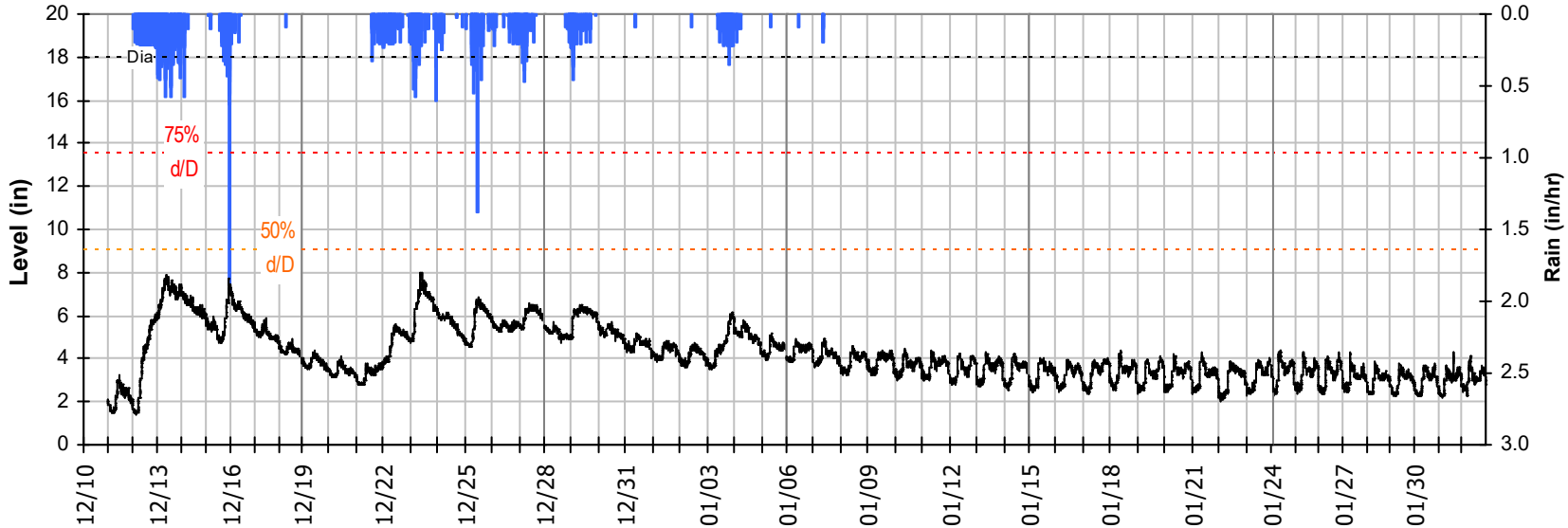
0.303 *mgd*

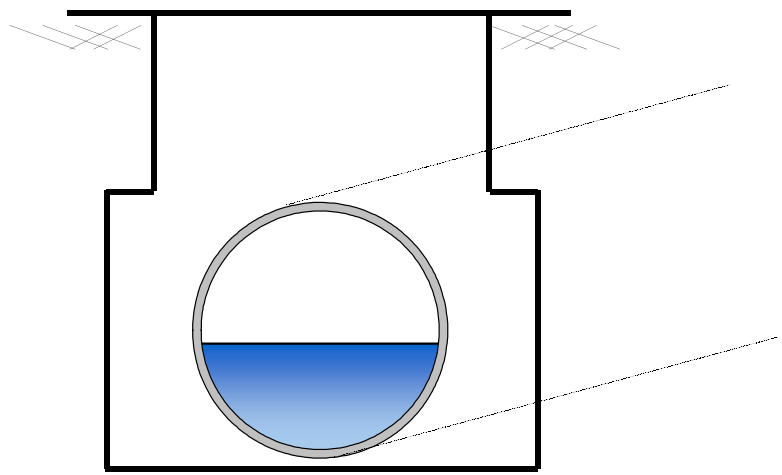


SITE 03

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

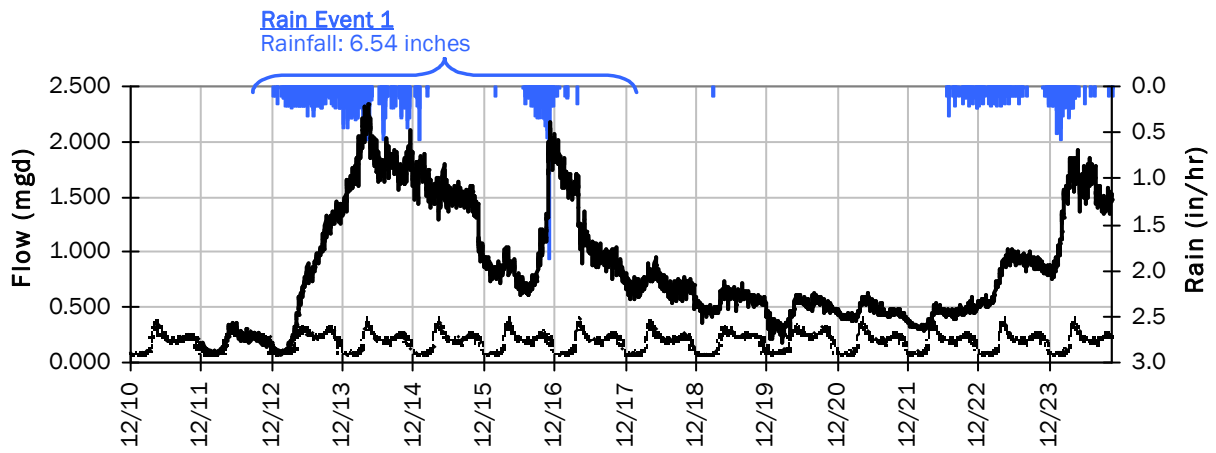




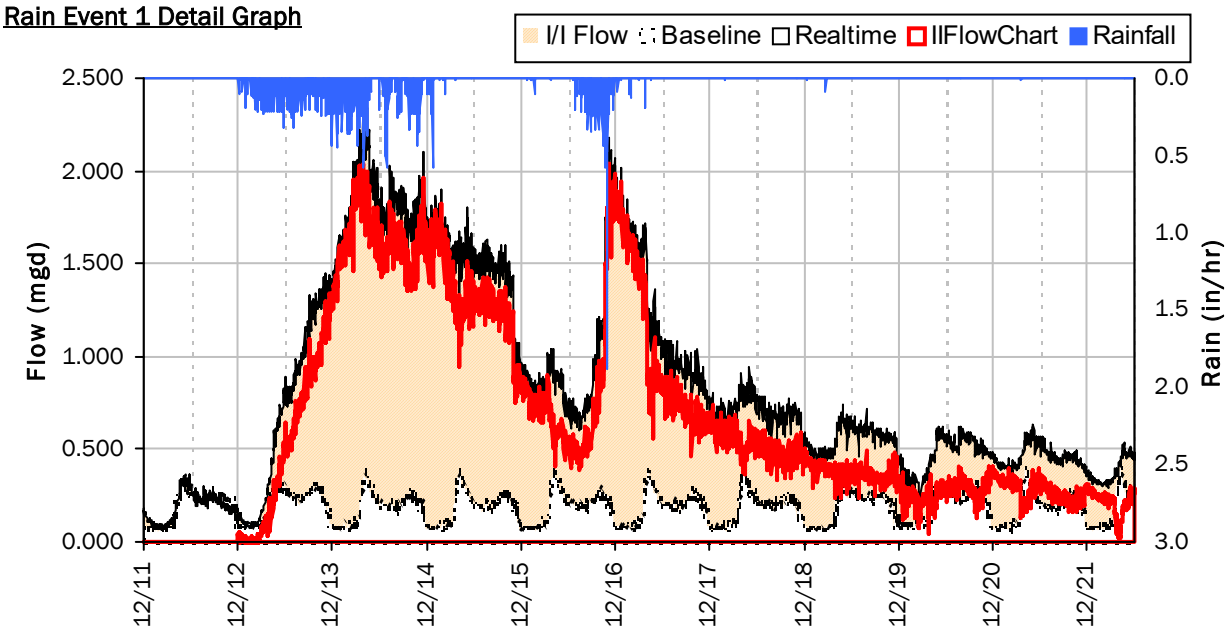
Pipe Diameter:	18	*inches*
Peak Measured Level:	7.98	*inches*
Peak d/D Ratio:	0.44	

SITE 03
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

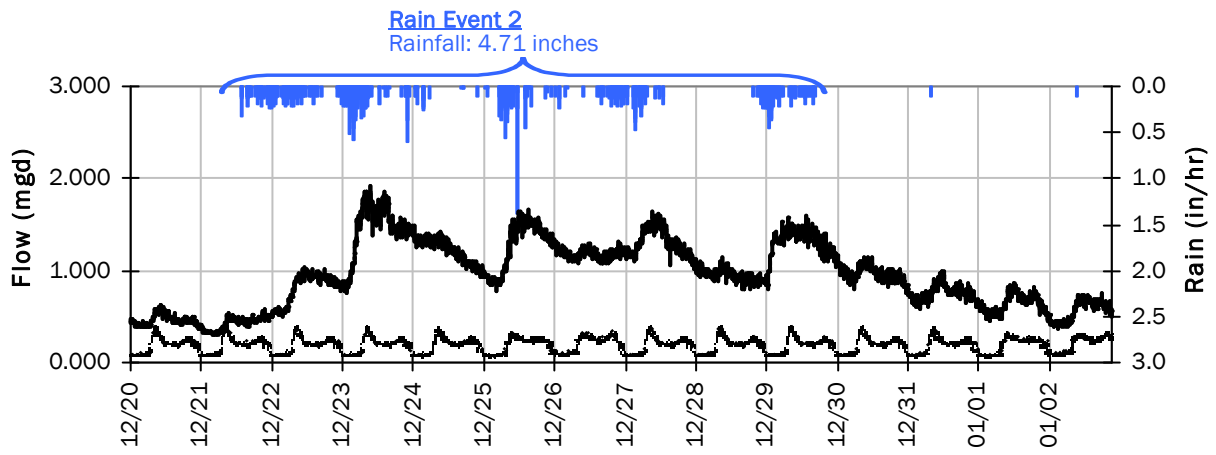


Storm Event I/I Analysis (Rain = 6.54 inches)

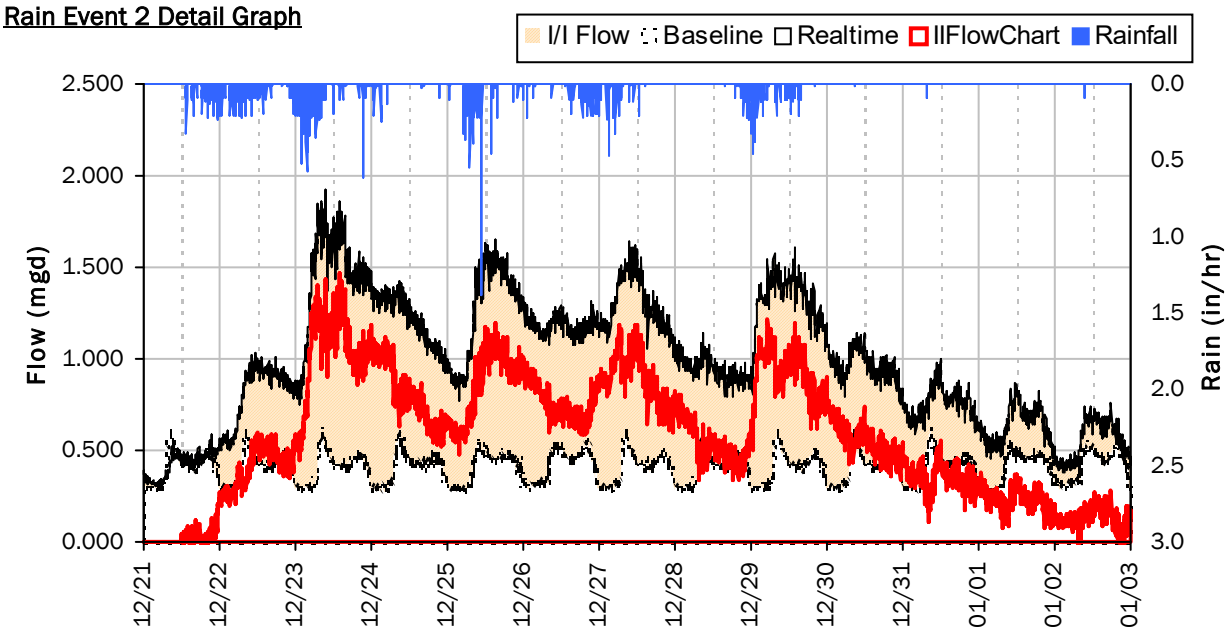
Capacity		Inflow / Infiltration	
Peak Flow:	2.334 *mgd*	**Peak I/I Rate:**	2.036 *mgd*
PF:	12.46	**Total I/I:**	6,795,000 *gallons*
Peak Level:	7.89 *in*		
d/D Ratio:	0.44		

SITE 03
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



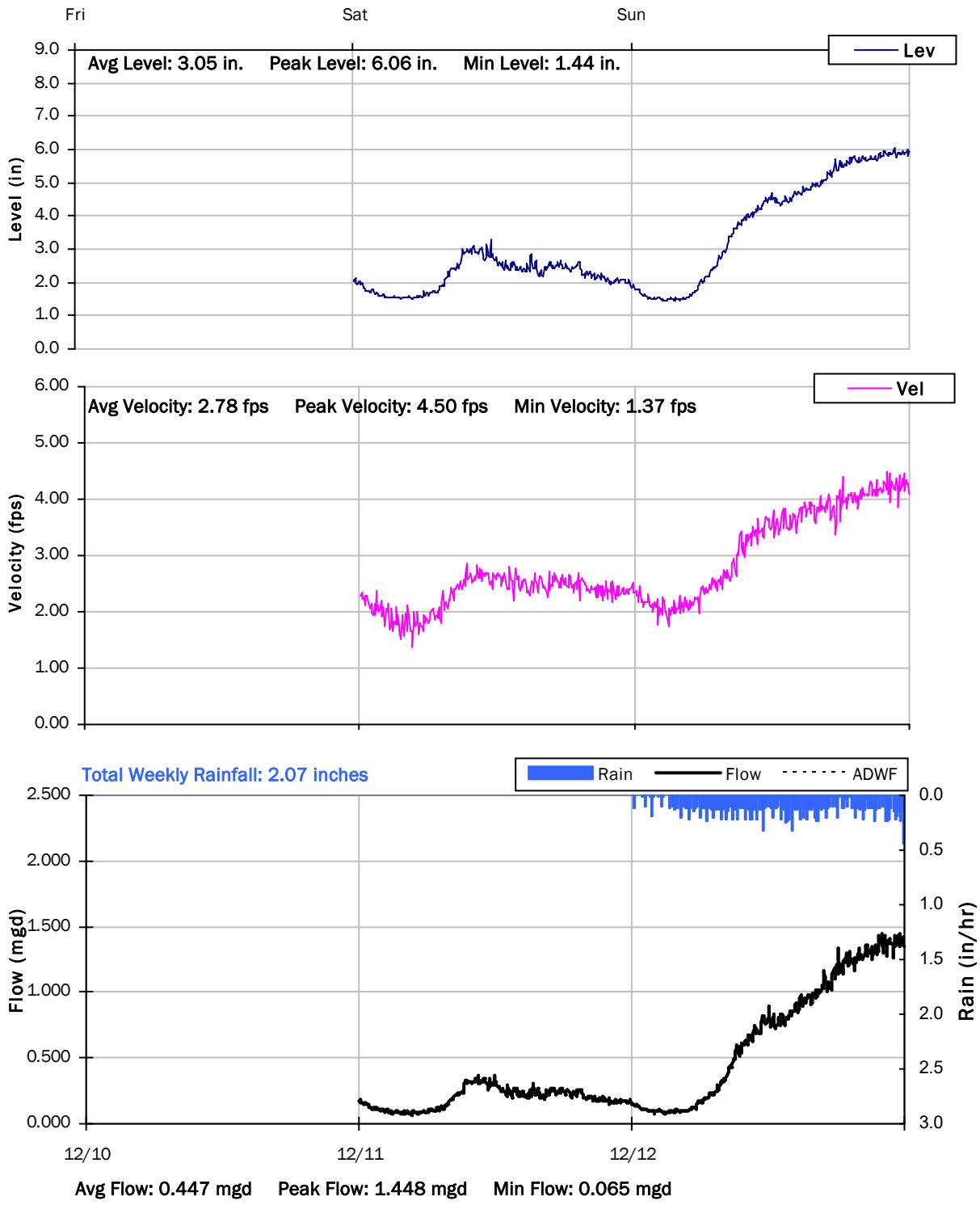
Storm Event I/I Analysis (Rain = 4.71 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.928 *mgd*	**Peak I/I Rate:**	1.464 *mgd*
PF:	10.29	**Total I/I:**	7,544,000 *gallons*
Peak Level:	7.98 *in*		
d/D Ratio:	0.44		

SITE 03

Weekly Level, Velocity and Flow Hydrographs

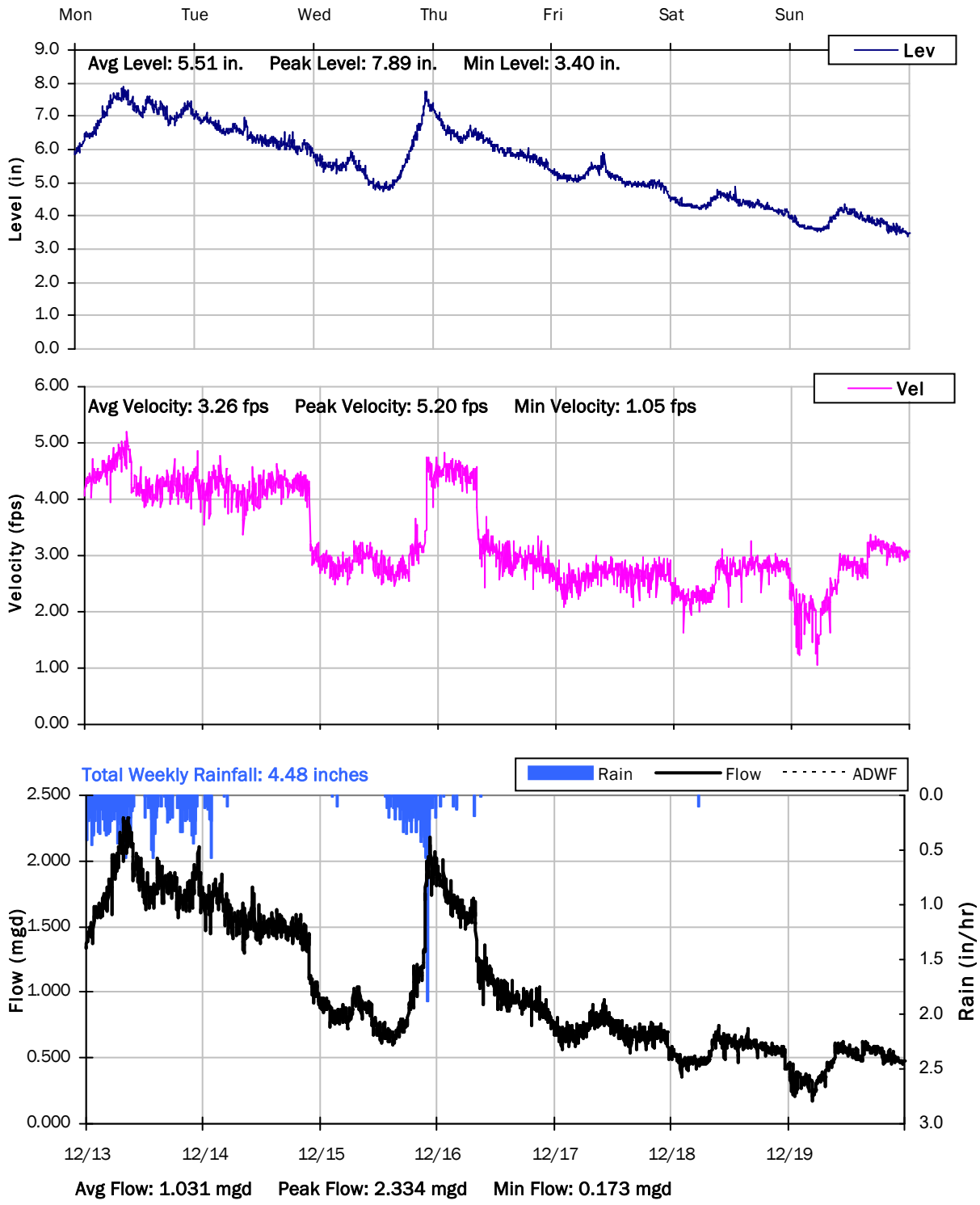
12/10/2021 to 12/13/2021



SITE 03

Weekly Level, Velocity and Flow Hydrographs

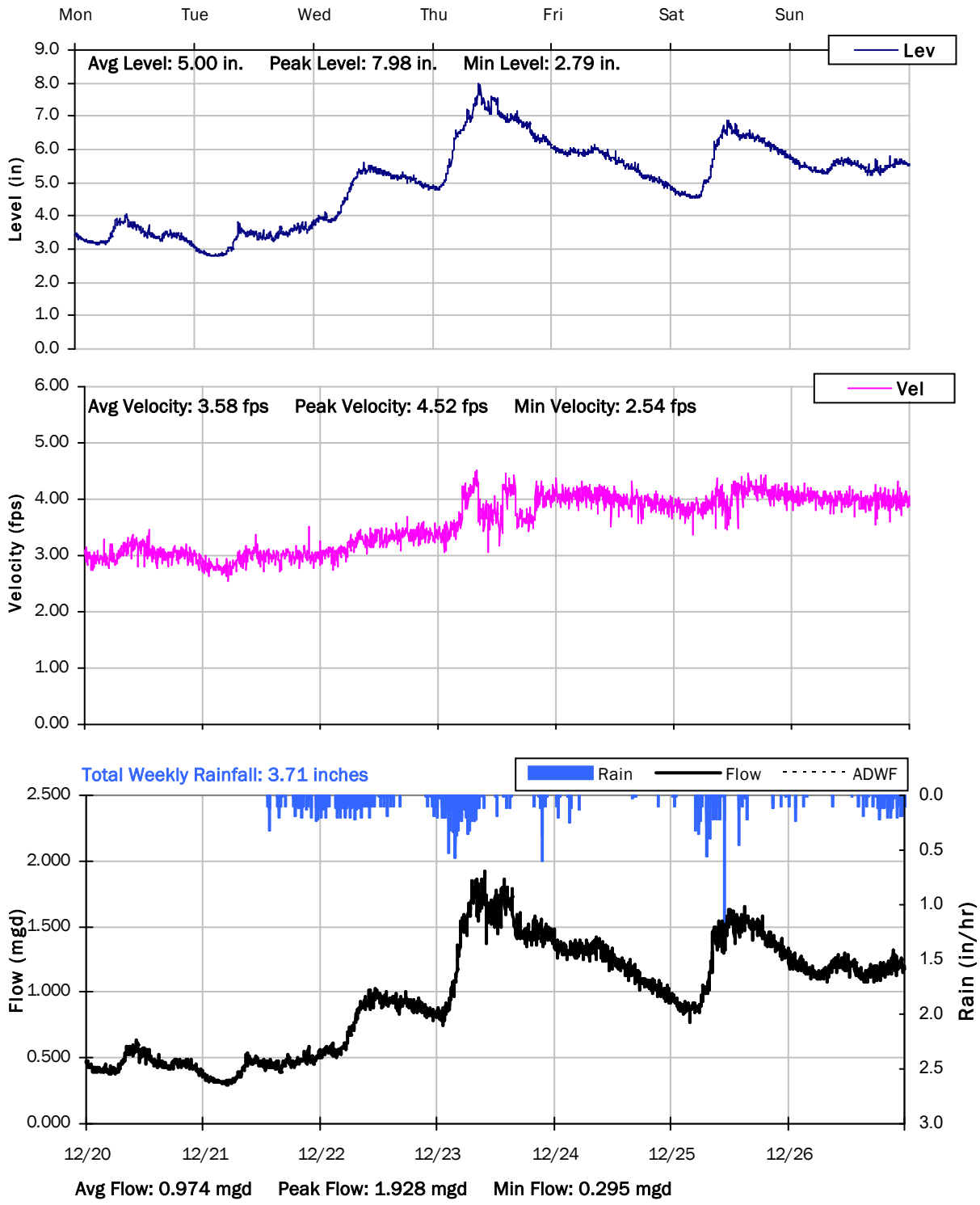
12/13/2021 to 12/20/2021



SITE 03

Weekly Level, Velocity and Flow Hydrographs

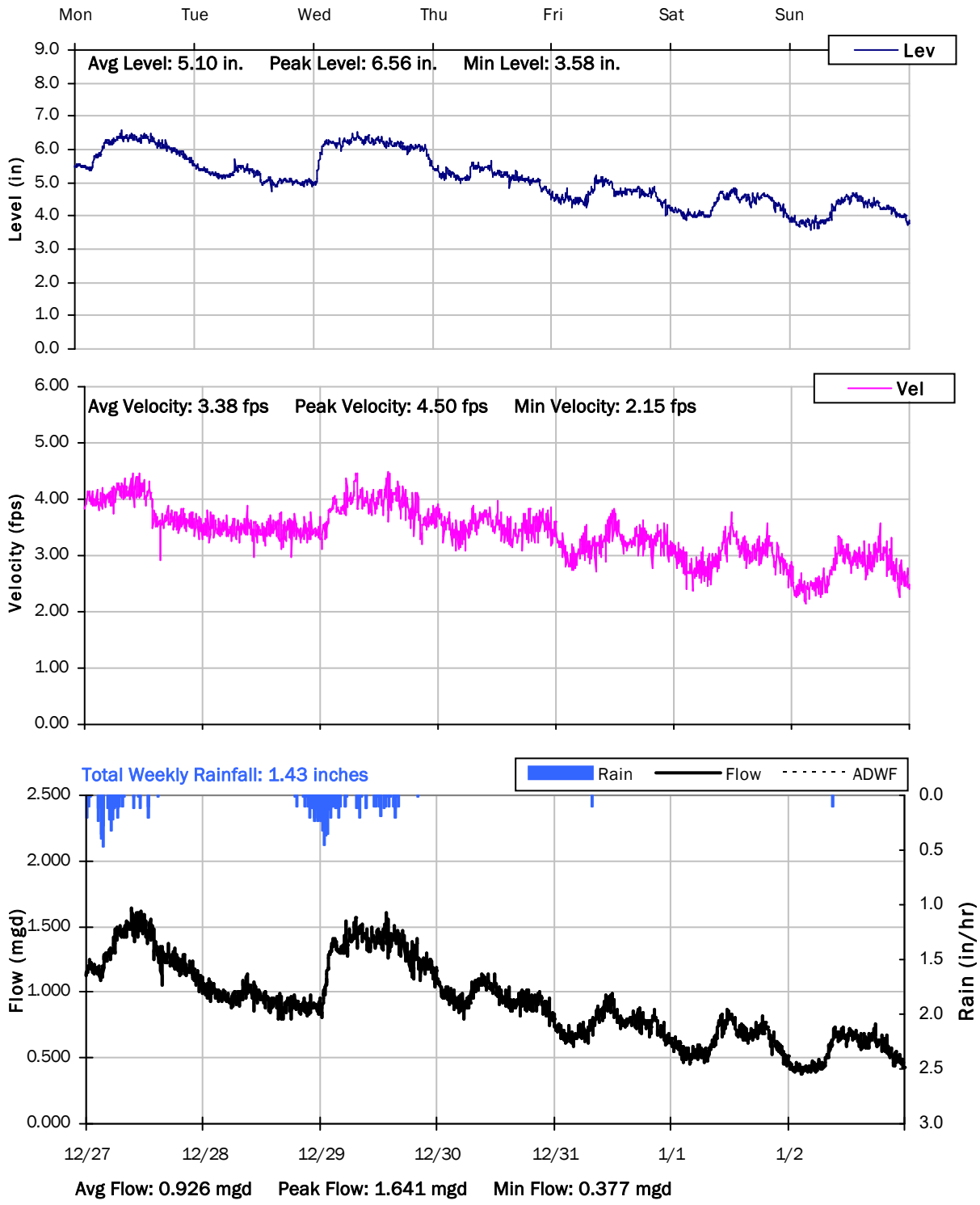
12/20/2021 to 12/27/2021



SITE 03

Weekly Level, Velocity and Flow Hydrographs

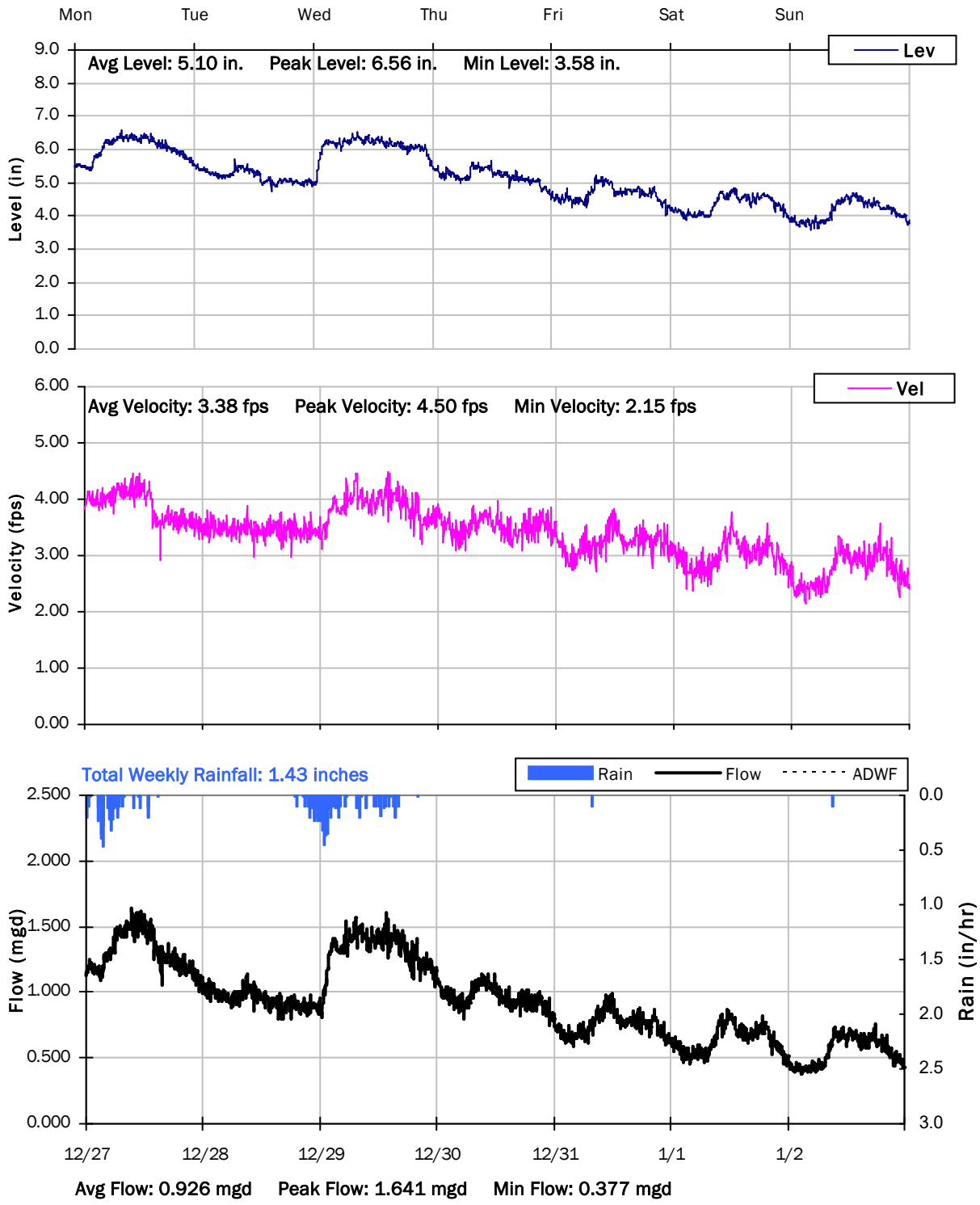
12/27/2021 to 1/3/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

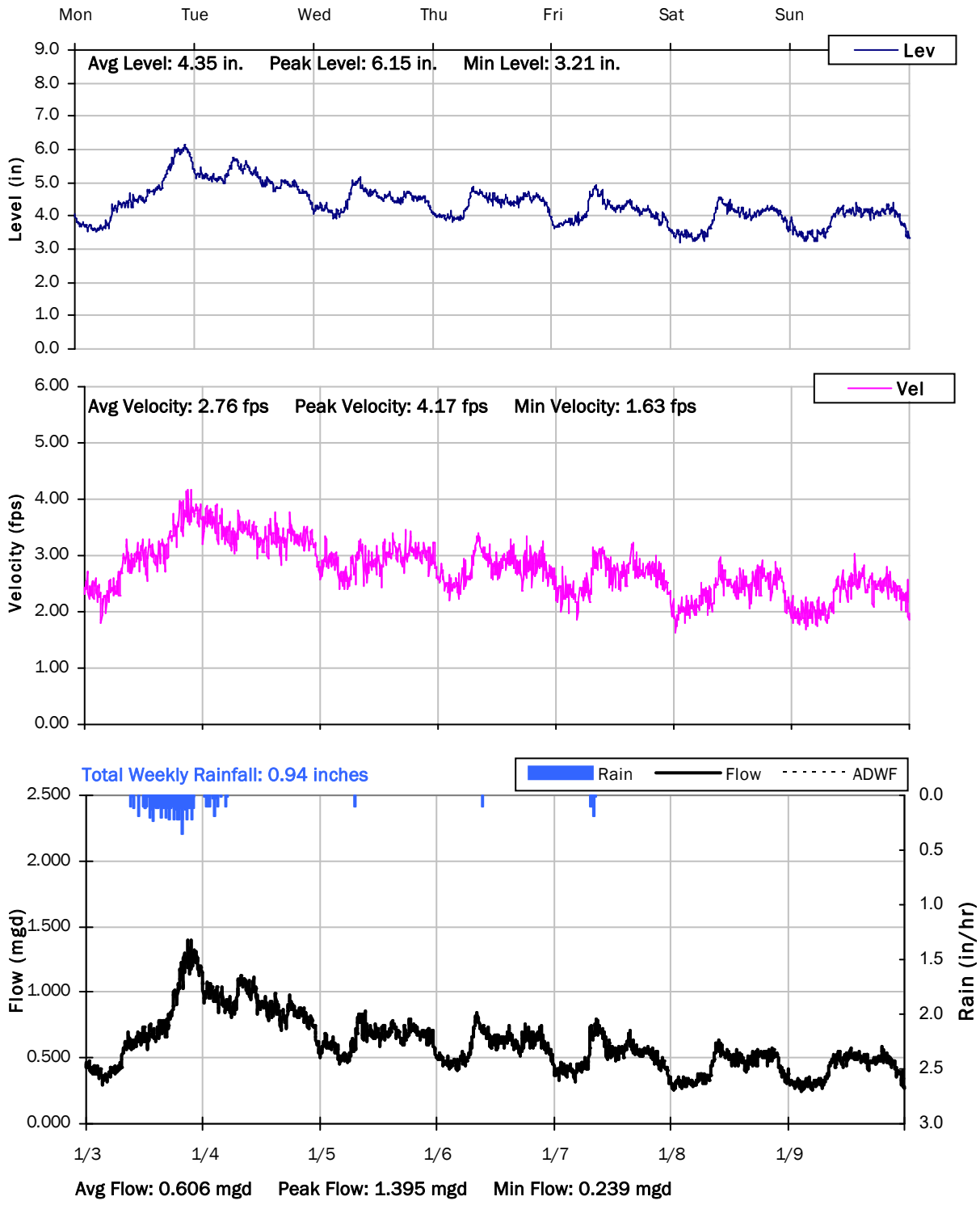
12/27/2021 to 1/3/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

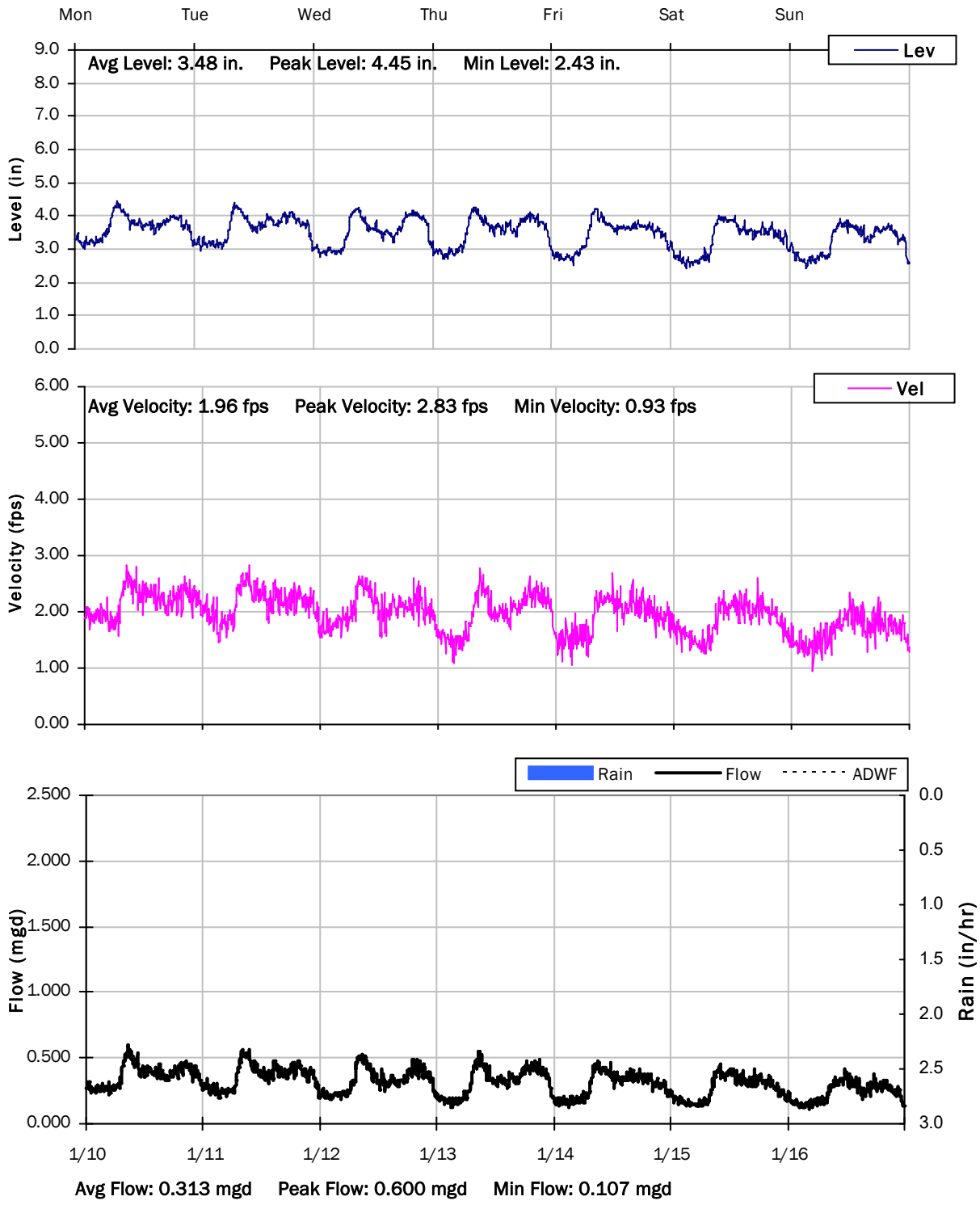
1/3/2022 to 1/10/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

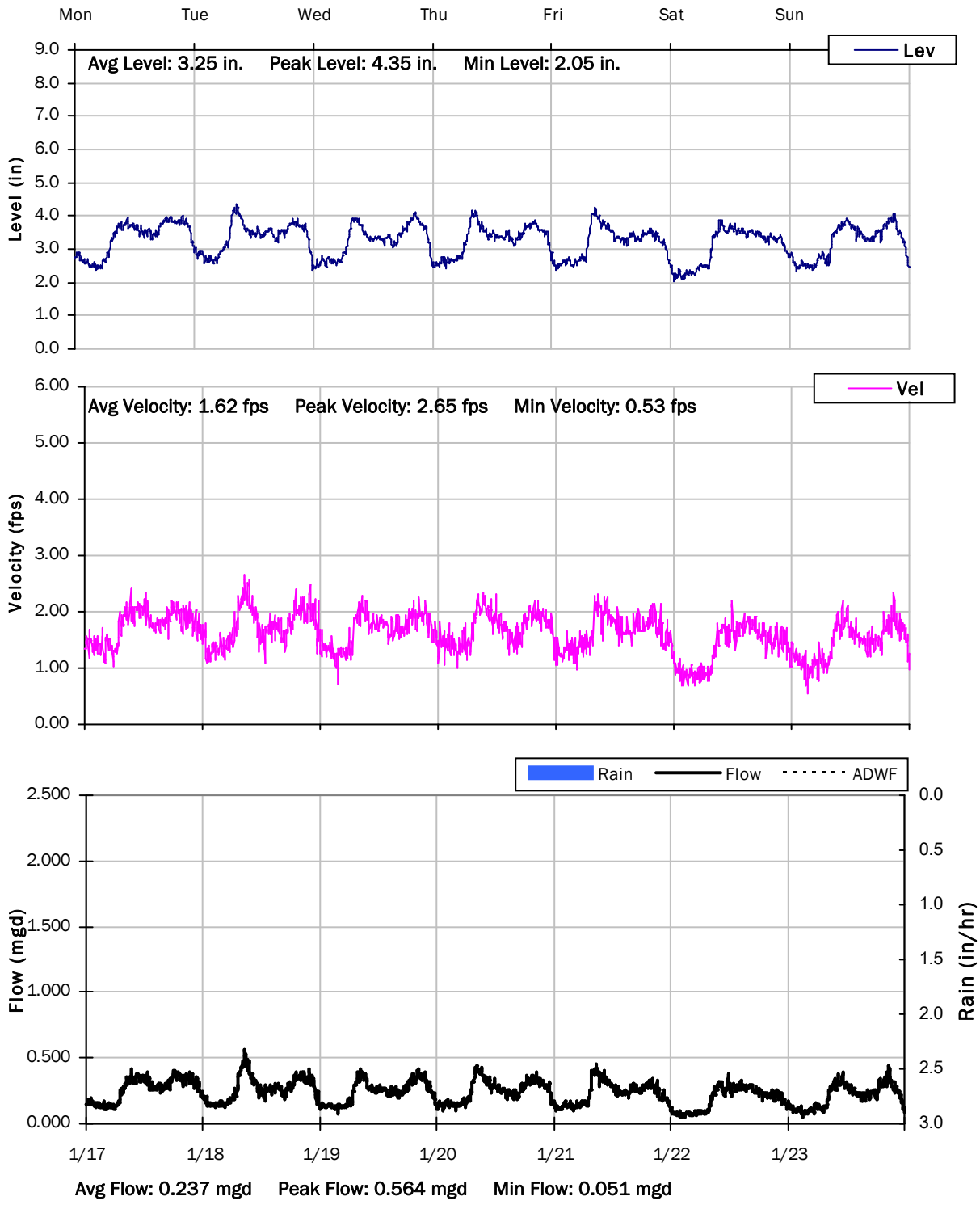
1/10/2022 to 1/17/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

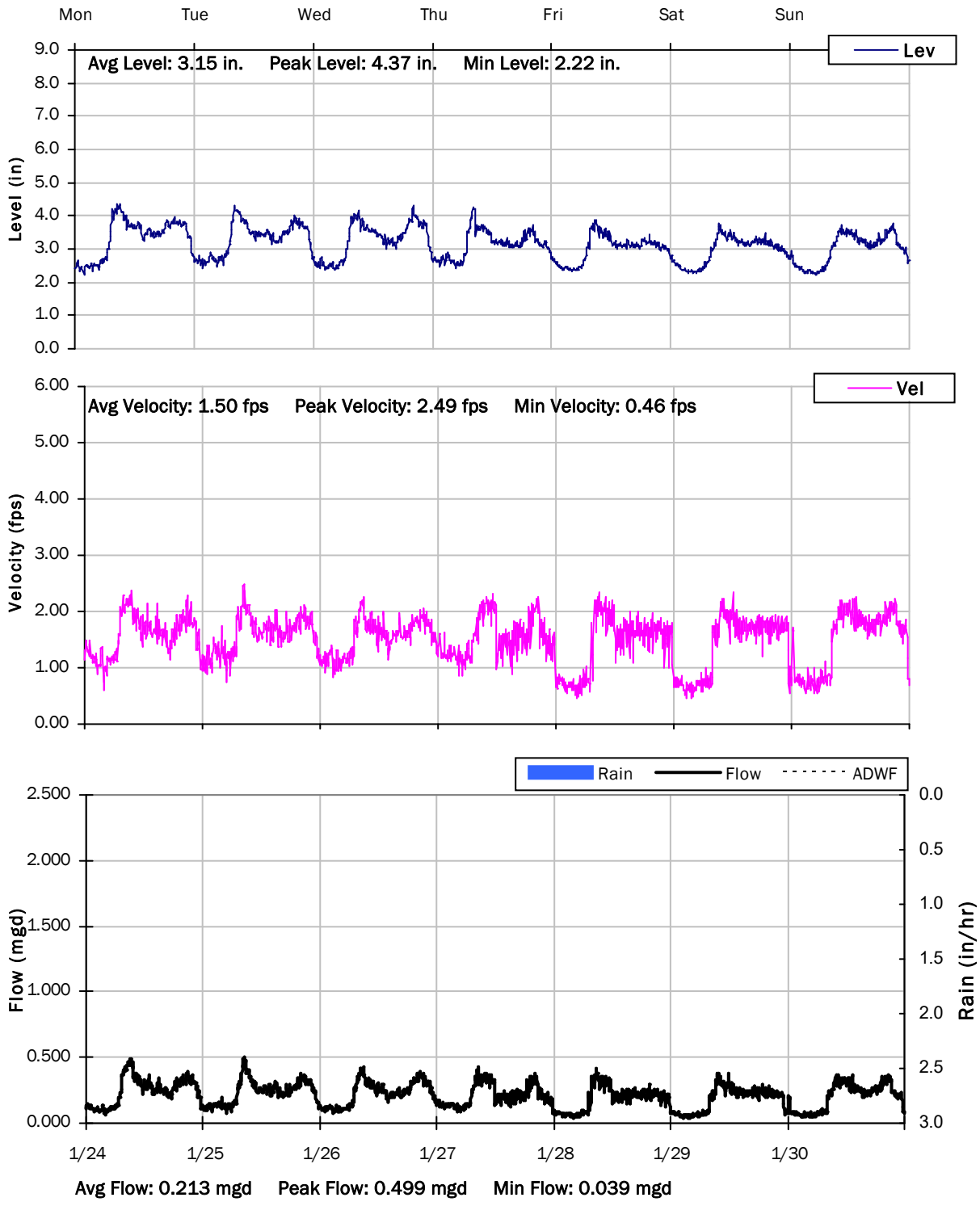
1/17/2022 to 1/24/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

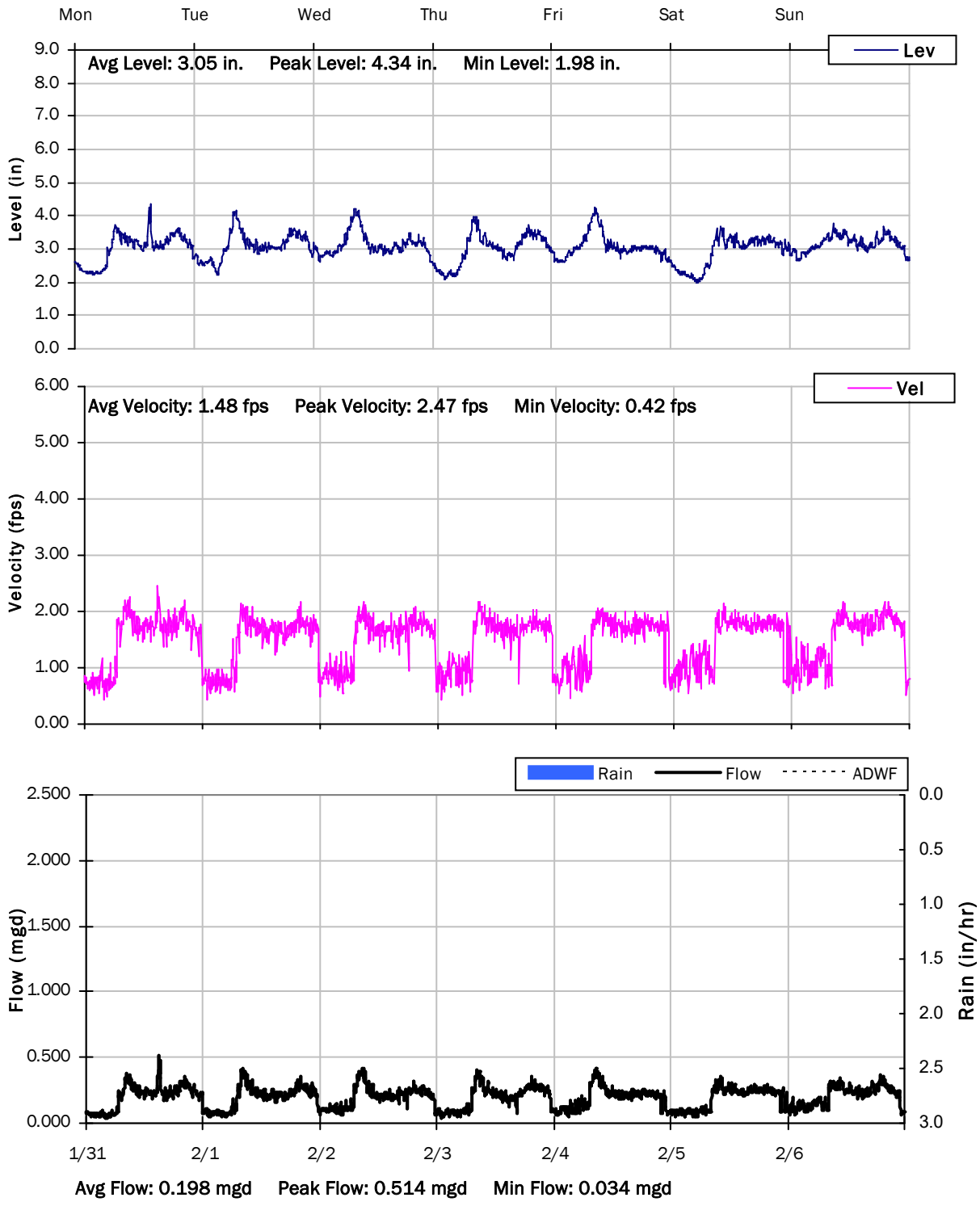
1/24/2022 to 1/31/2022



SITE 03

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 04

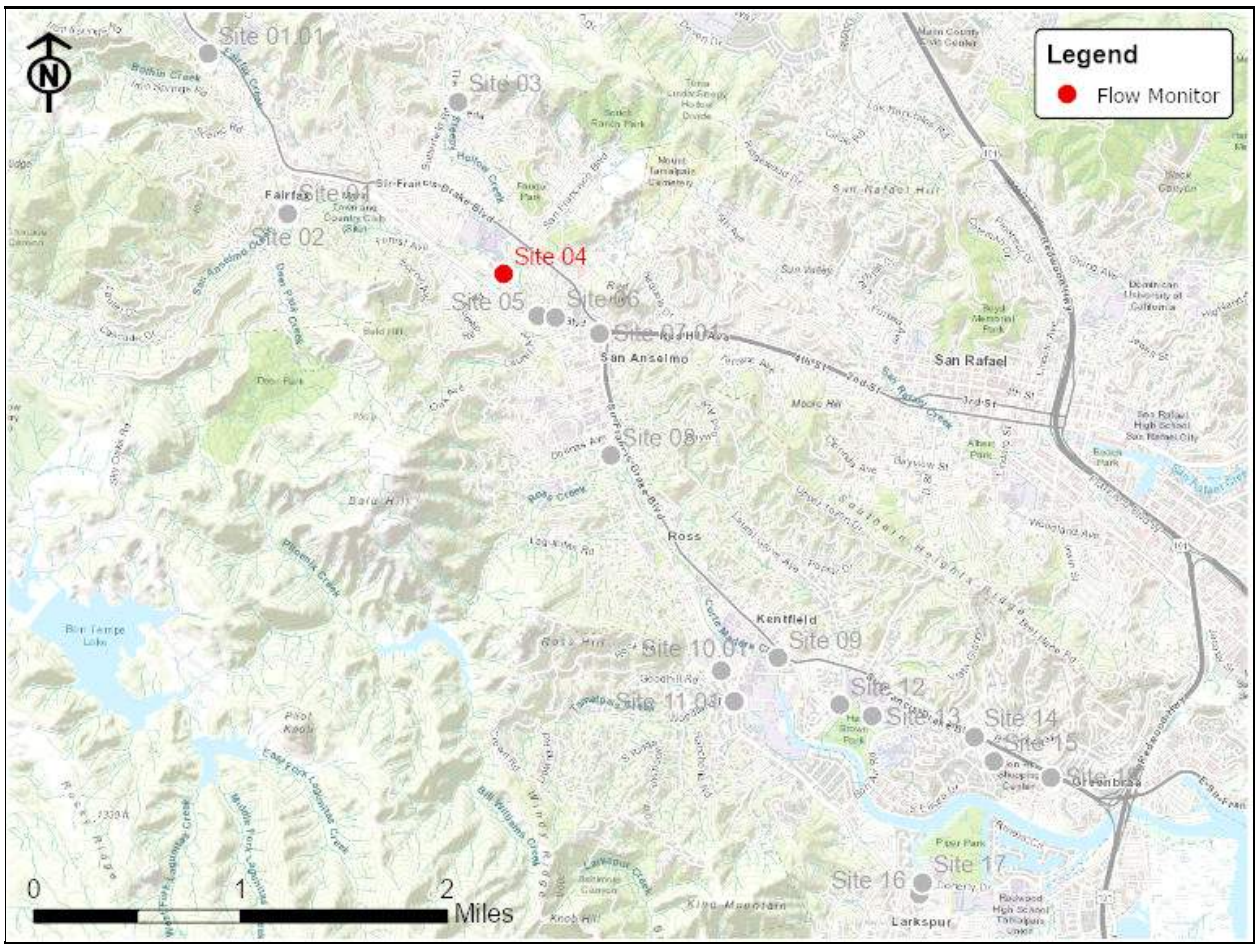
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 124 Saunders Ave

Data Summary Report



Vicinity Map: Site 04

SITE 04

Site Information MH ID: S800.10

Location: 124 Saunders Ave

Coordinates: 122.5710° W, 37.9804° N

Rim Elevation (Earth): 66 feet

Expected Pipe Diameter: 24 inches

Measured Pipe Diameter: 24.75 inches

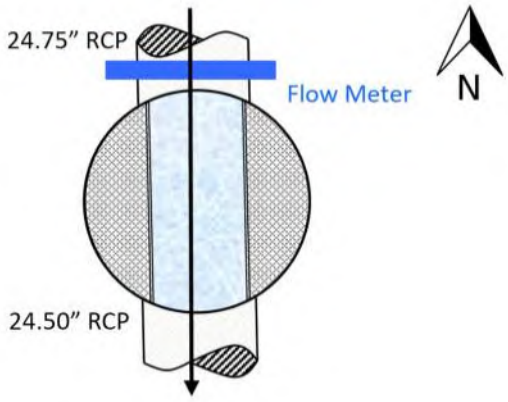
ADWF: 0.304 mgd

Peak Measured Flow: 5.344 mgd

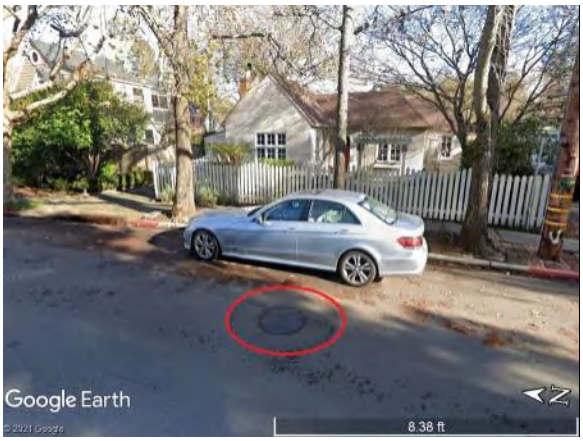
Sediment: None

Satellite Map

Sanitary Map



Flow Sketch



Street View

Plan View

SITE 04

Additional Site Photos

Effluent Pipe

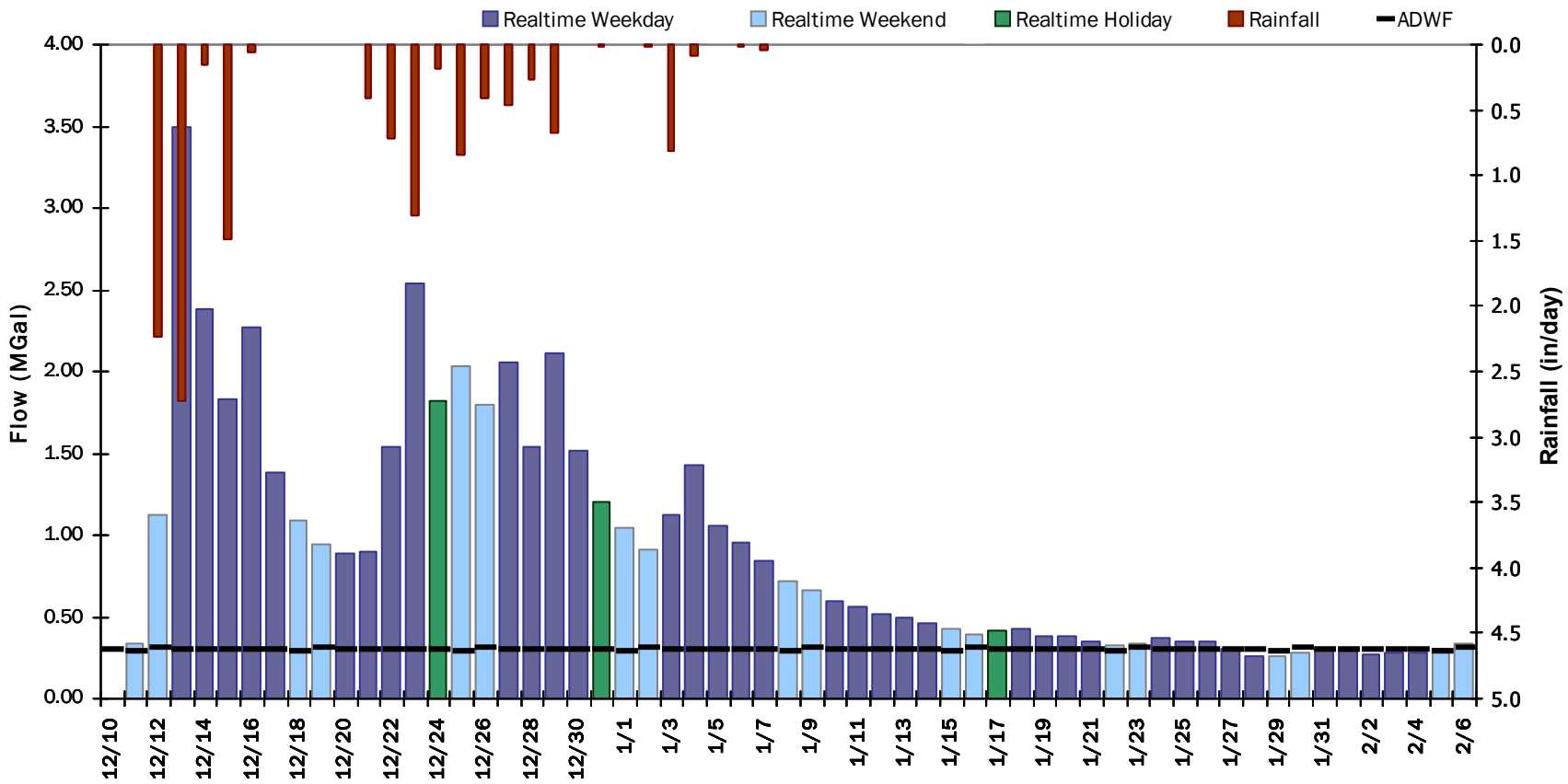
Monitored North Influent Pipe

SITE 04

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.928 MGal Peak Daily Flow: 3.499 MGal Min Daily Flow: 0.255 MGal

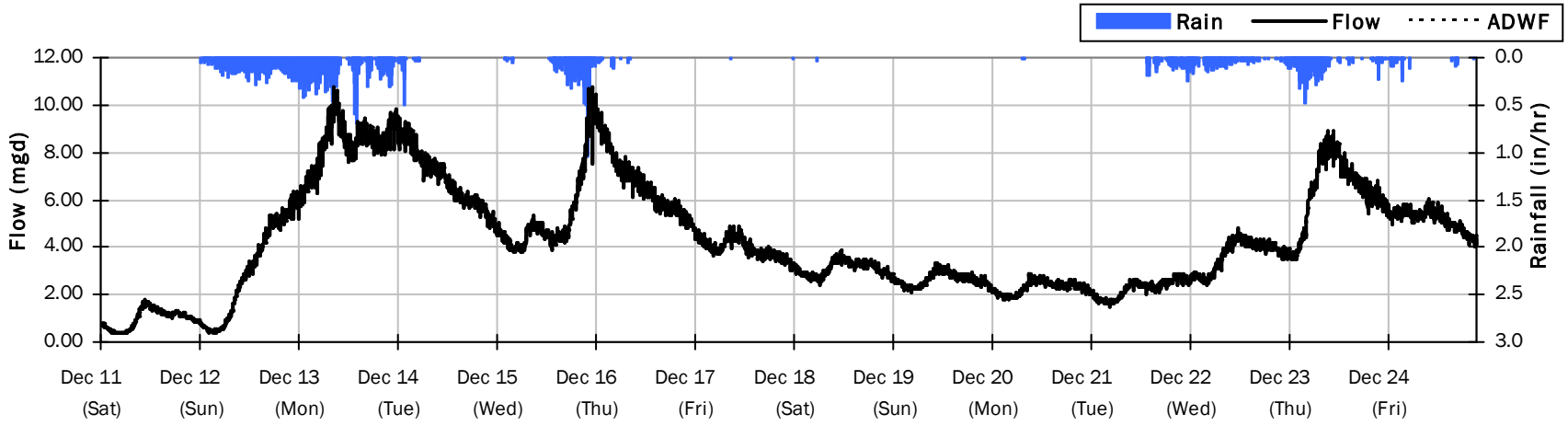
Total Rainfall: 12.92 inches

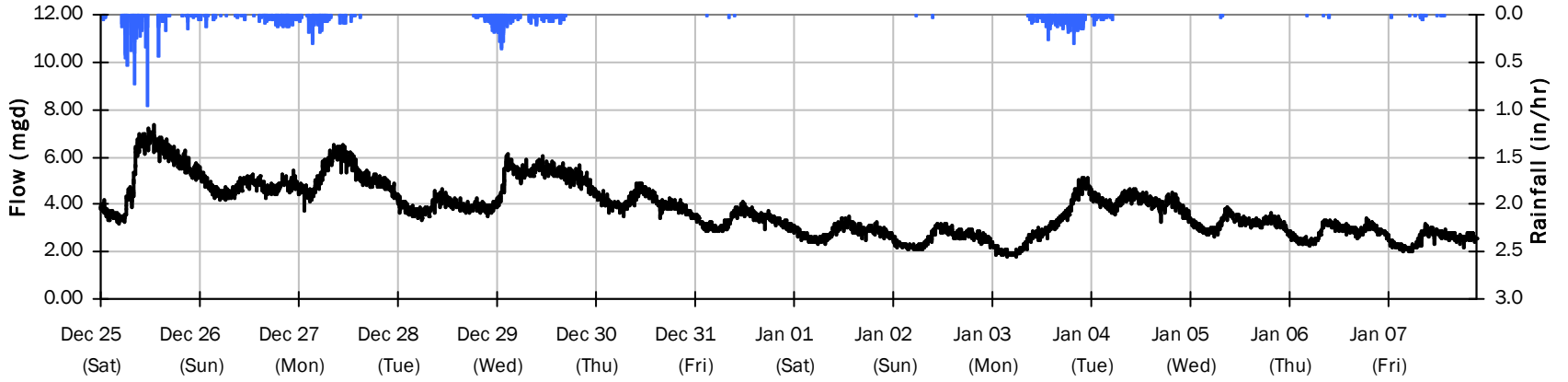


SITE 05

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 13.06 inches Period Avg Flow: 3.993 mgd Period Peak Flow: 10.759 mgd Period Min Flow: 0.360 mgd

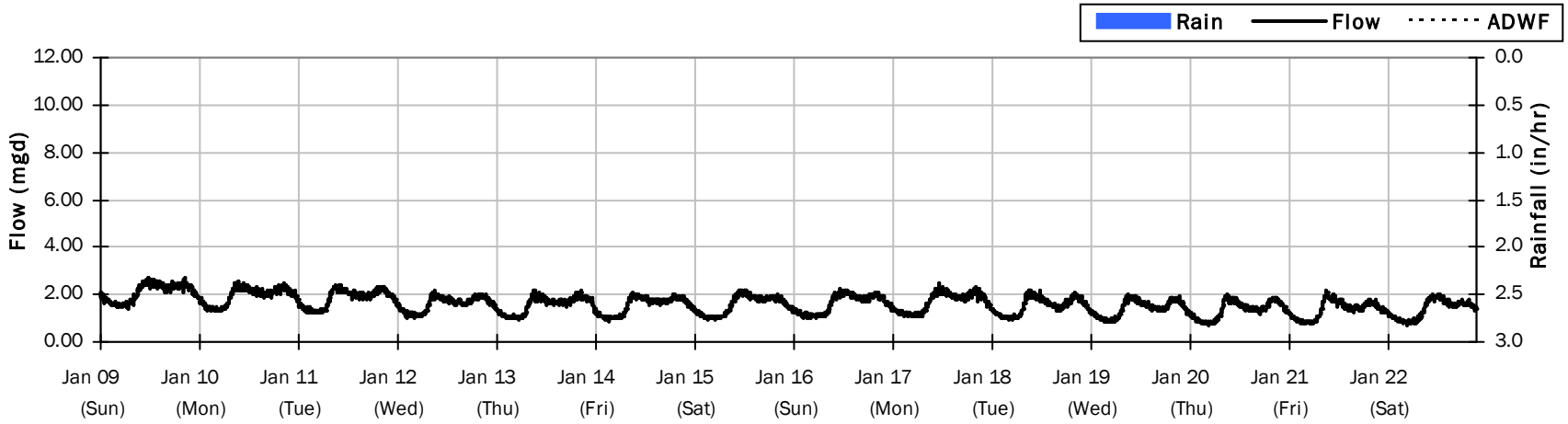


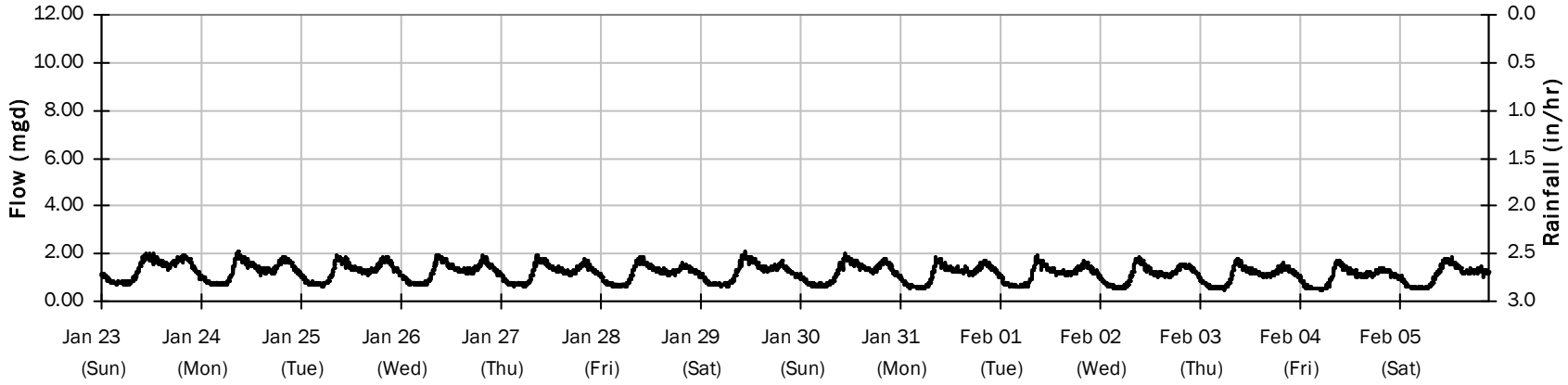


SITE 05

Flow Summary: 1/9/2022 to 2/5/2022

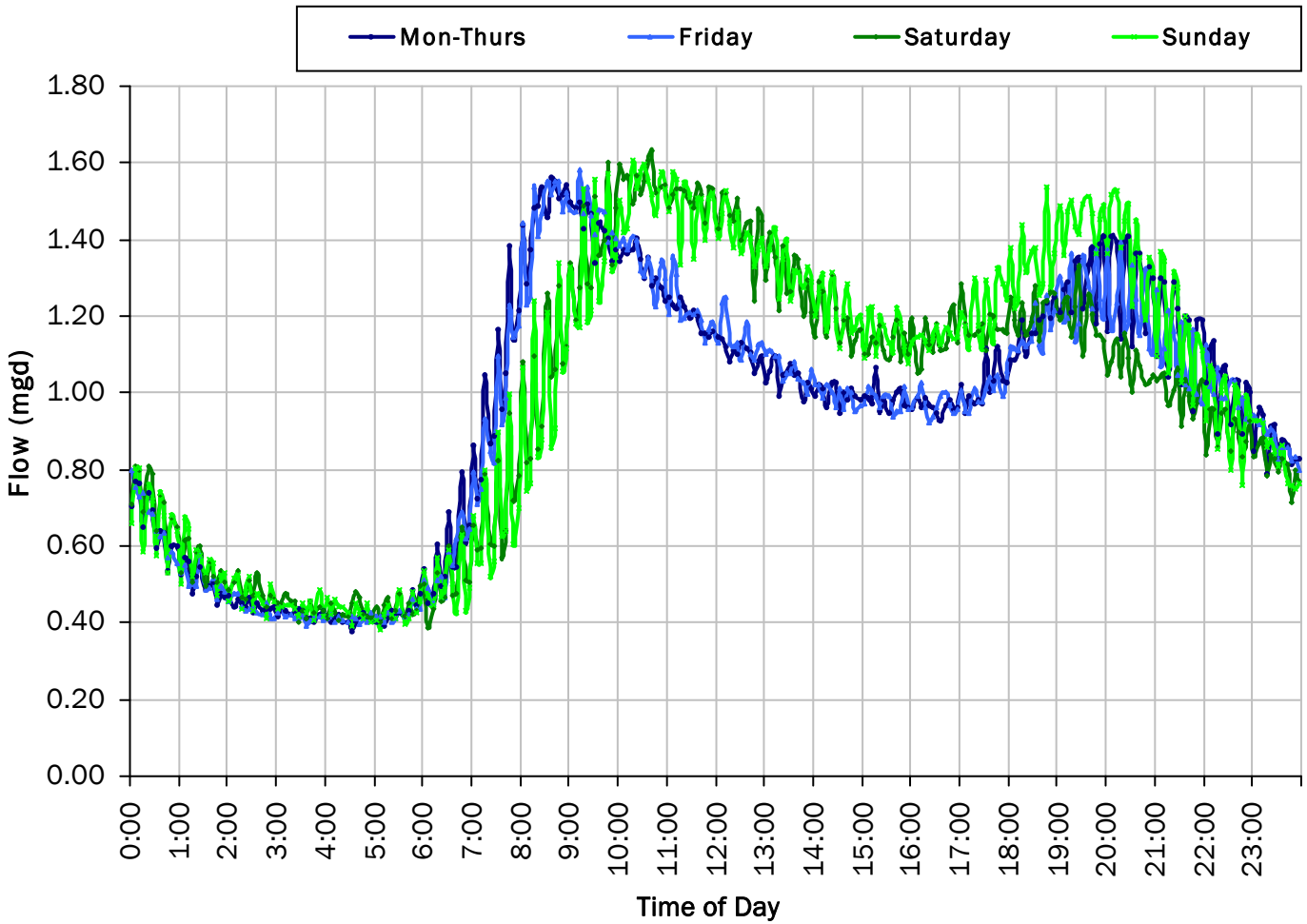
Period Rainfall: 0.00 inches Period Avg Flow: 1.399 mgd Period Peak Flow: 2.718 mgd Period Min Flow: 0.441 mgd





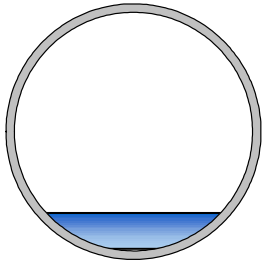
SITE 05

Average Dry Weather Flow Hydrographs



ADWF:

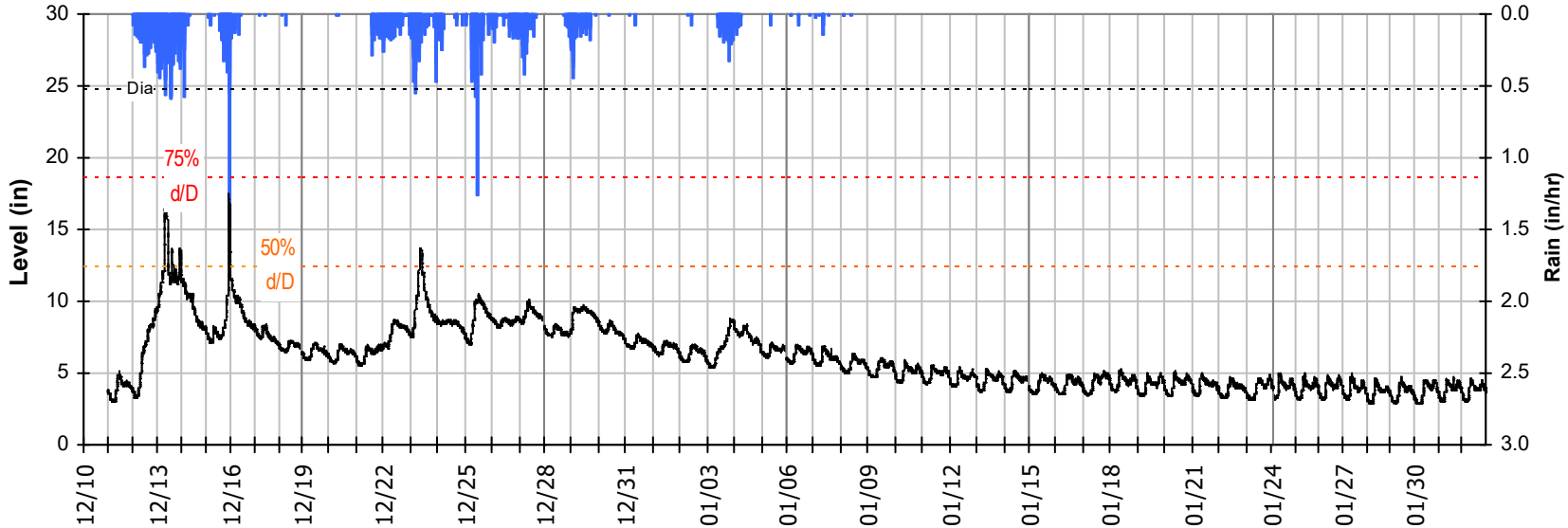
0.960 *mgd*

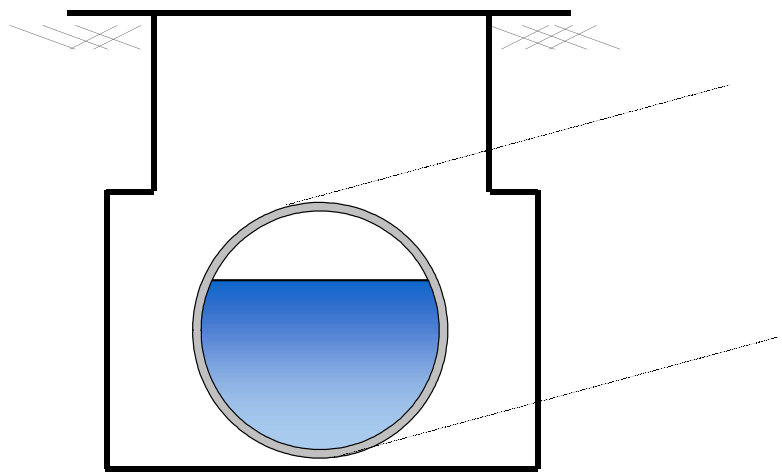


SITE 04

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

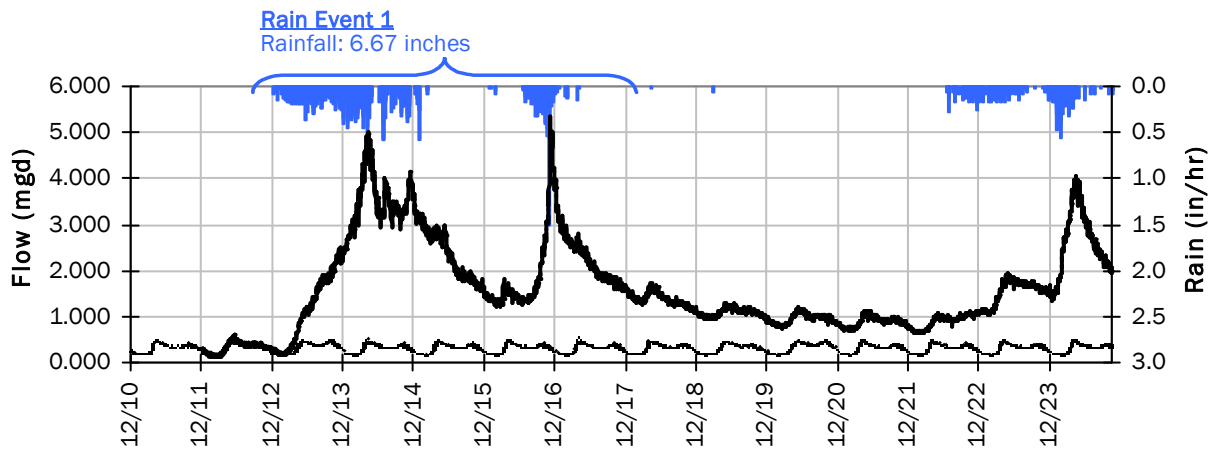




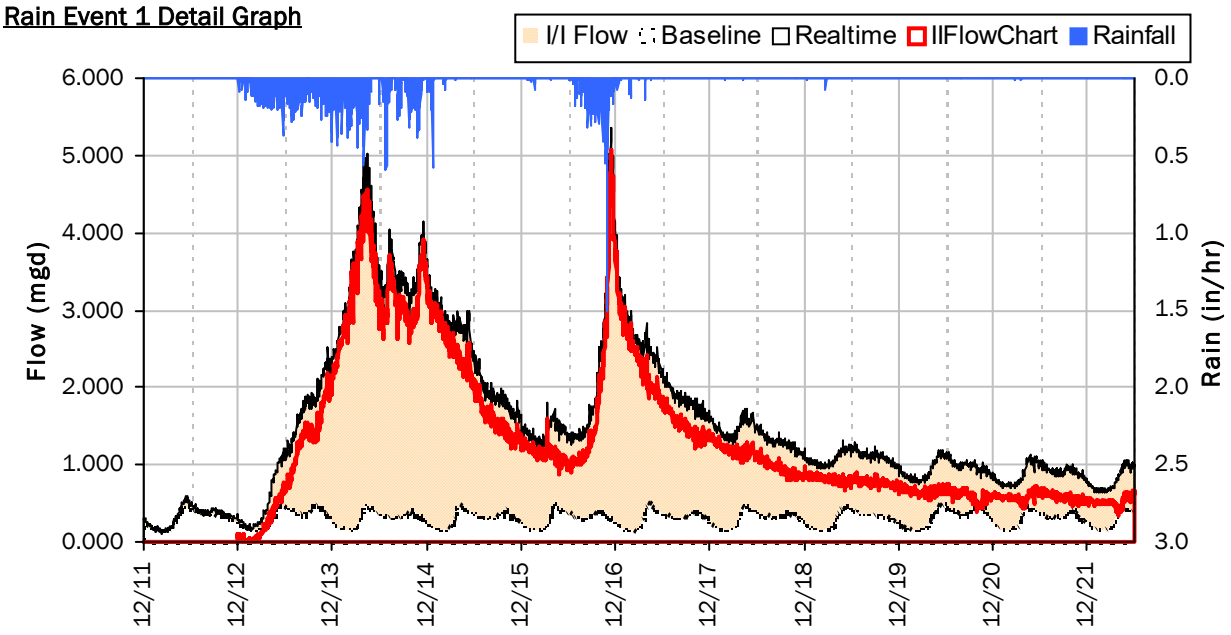
Pipe Diameter:	24.8	*inches*
Peak Measured Level:	17.5	*inches*
Peak d/D Ratio:	0.71	

SITE 04
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

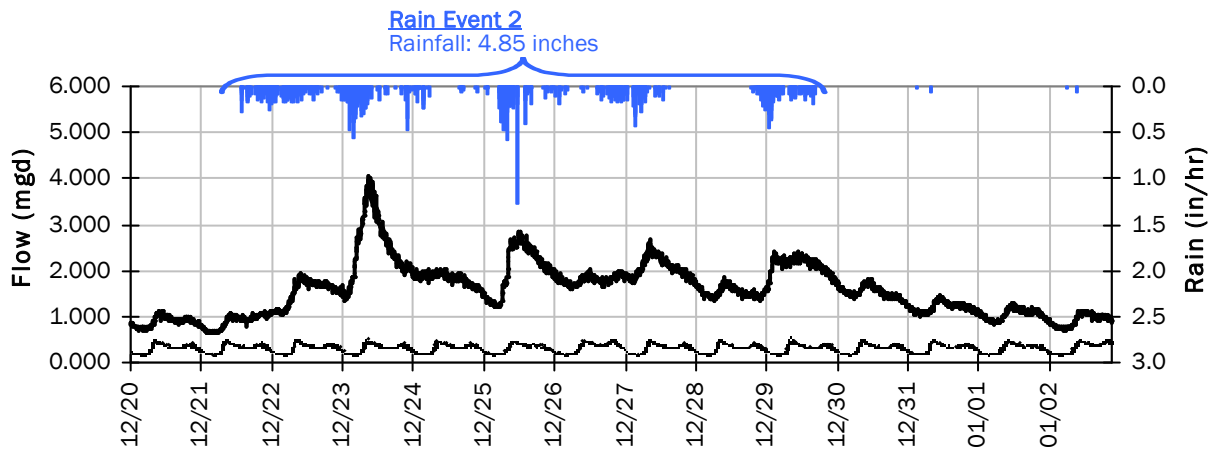


Storm Event I/I Analysis (Rain = 6.67 inches)

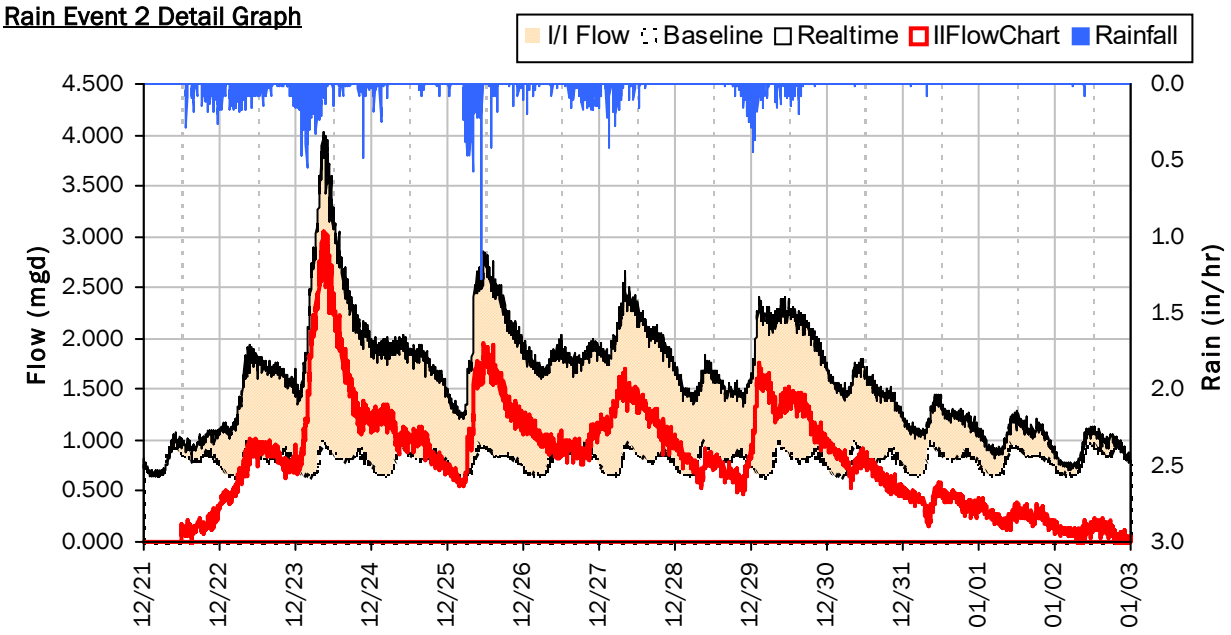
Capacity		Inflow / Infiltration	
Peak Flow:	5.344 *mgd*	Peak I/I Rate:	5.064 *mgd*
PF:	17.62	Total I/I:	12,932,000 *gallons*
Peak Level:	17.47 *in*		
d/D Ratio:	0.71		

SITE 04
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



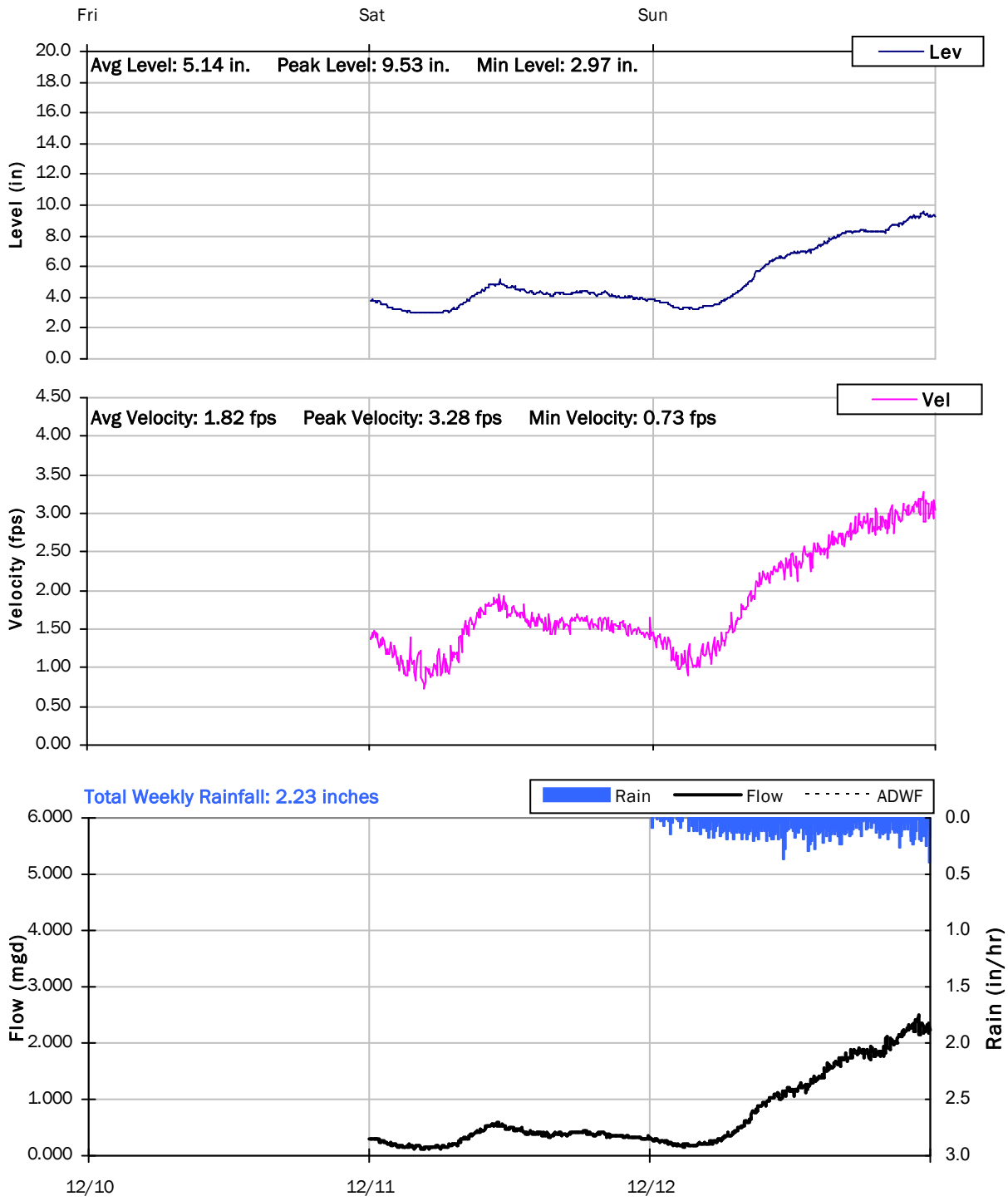
Storm Event I/I Analysis (Rain = 4.85 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	4.036 *mgd*	**Peak I/I Rate:**	3.058 *mgd*
PF:	13.31	**Total I/I:**	10,605,000 *gallons*
Peak Level:	13.72 *in*		
d/D Ratio:	0.55		

SITE 04

Weekly Level, Velocity and Flow Hydrographs

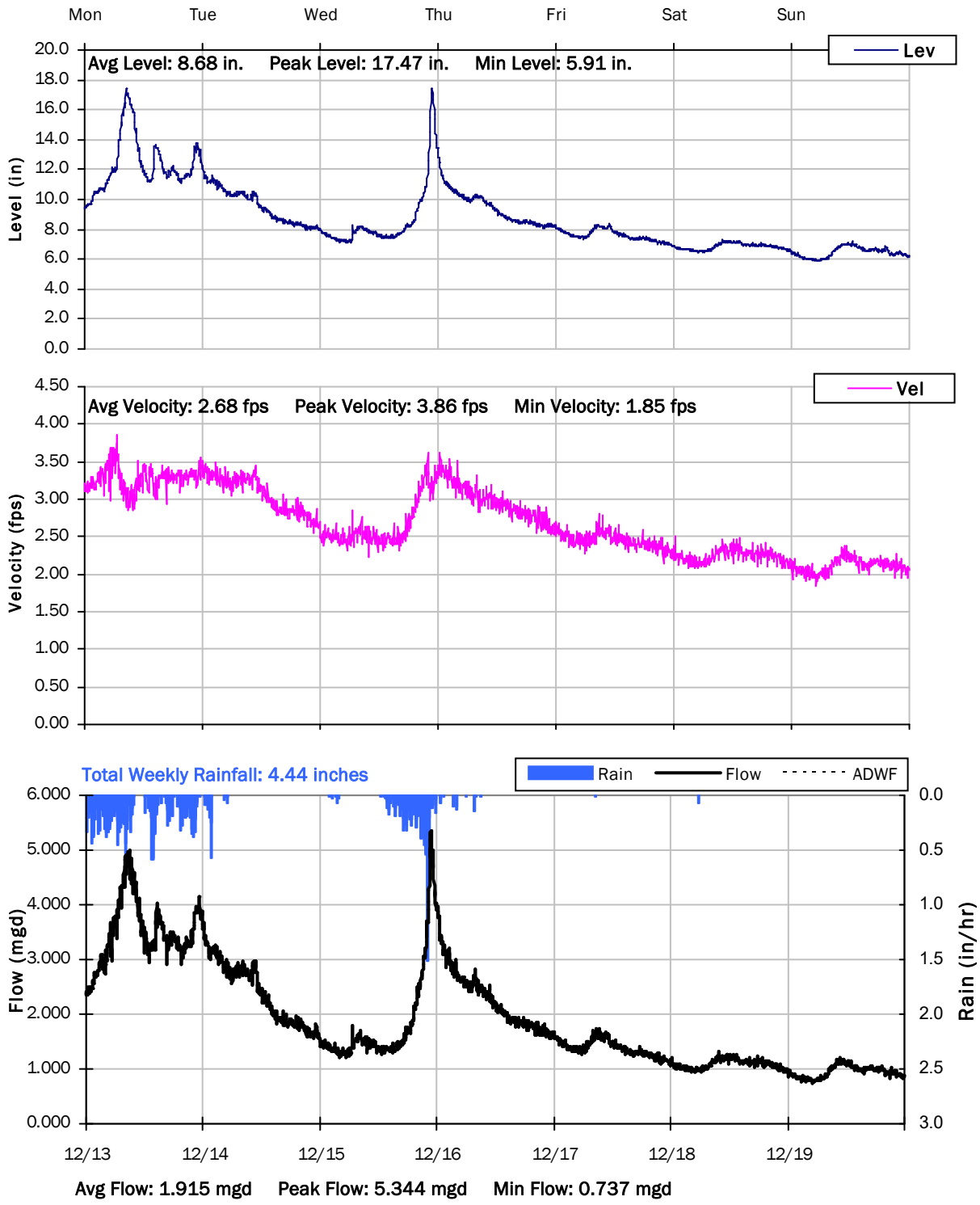
12/10/2021 to 12/13/2021



SITE 04

Weekly Level, Velocity and Flow Hydrographs

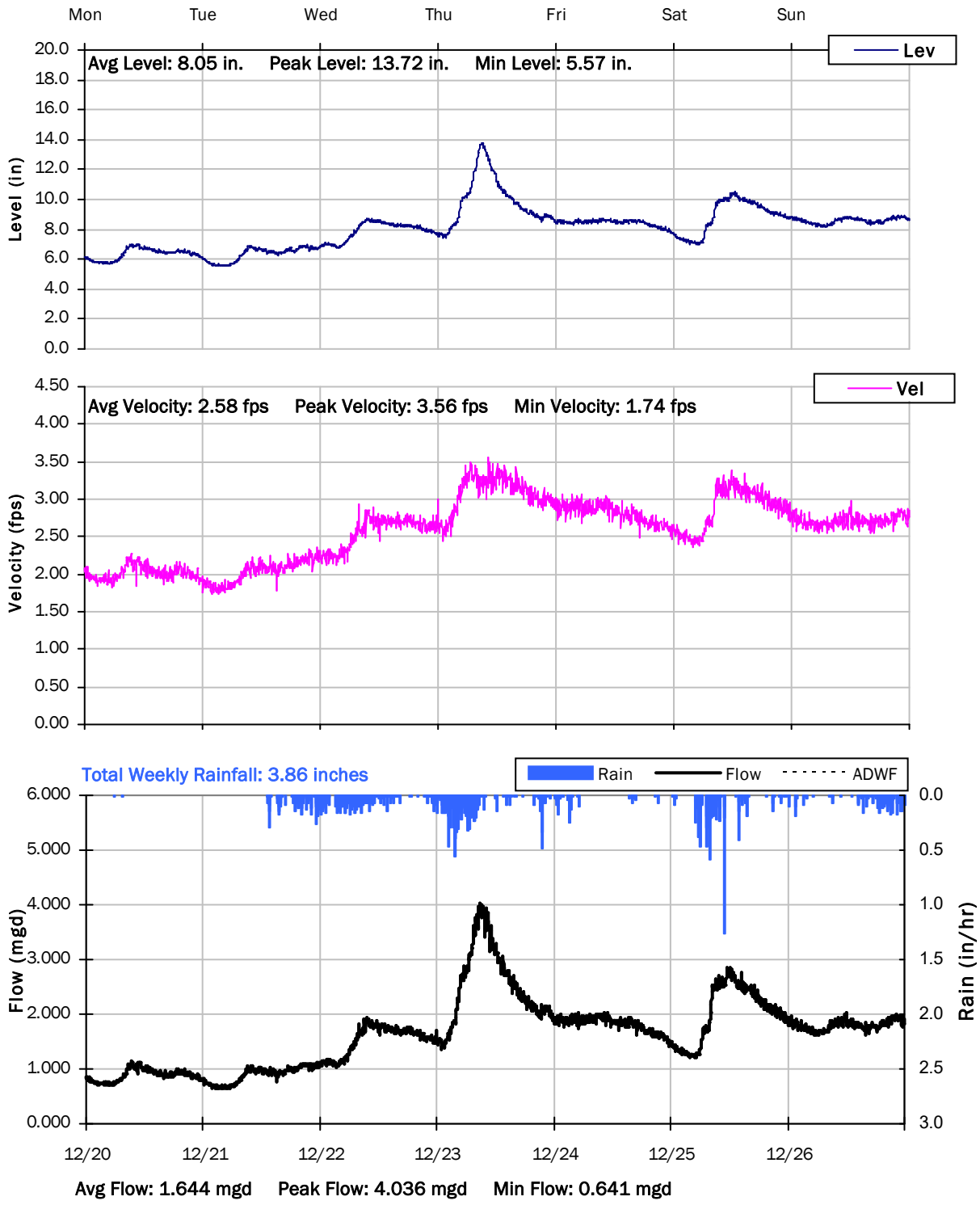
12/13/2021 to 12/20/2021



SITE 04

Weekly Level, Velocity and Flow Hydrographs

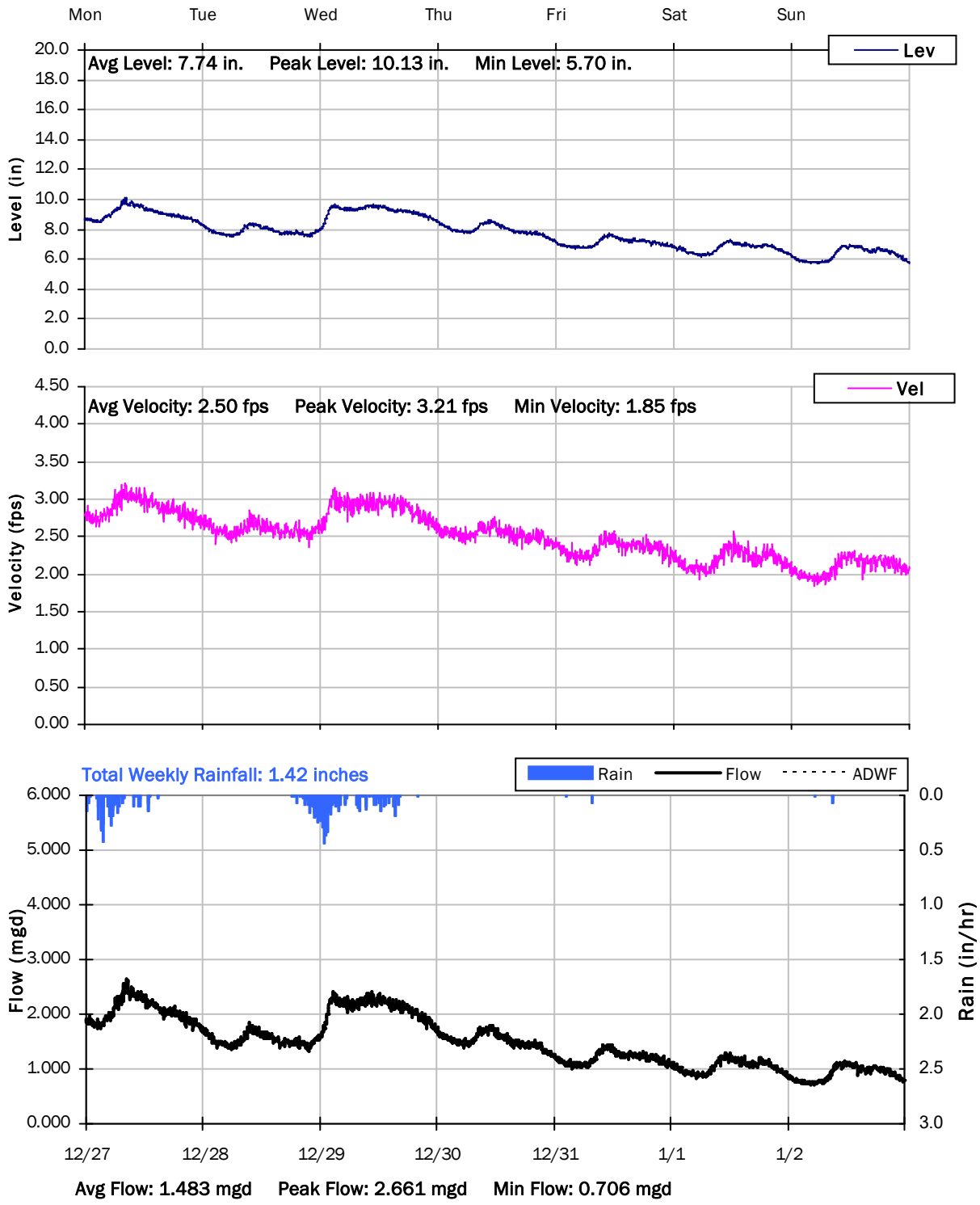
12/20/2021 to 12/27/2021



SITE 04

Weekly Level, Velocity and Flow Hydrographs

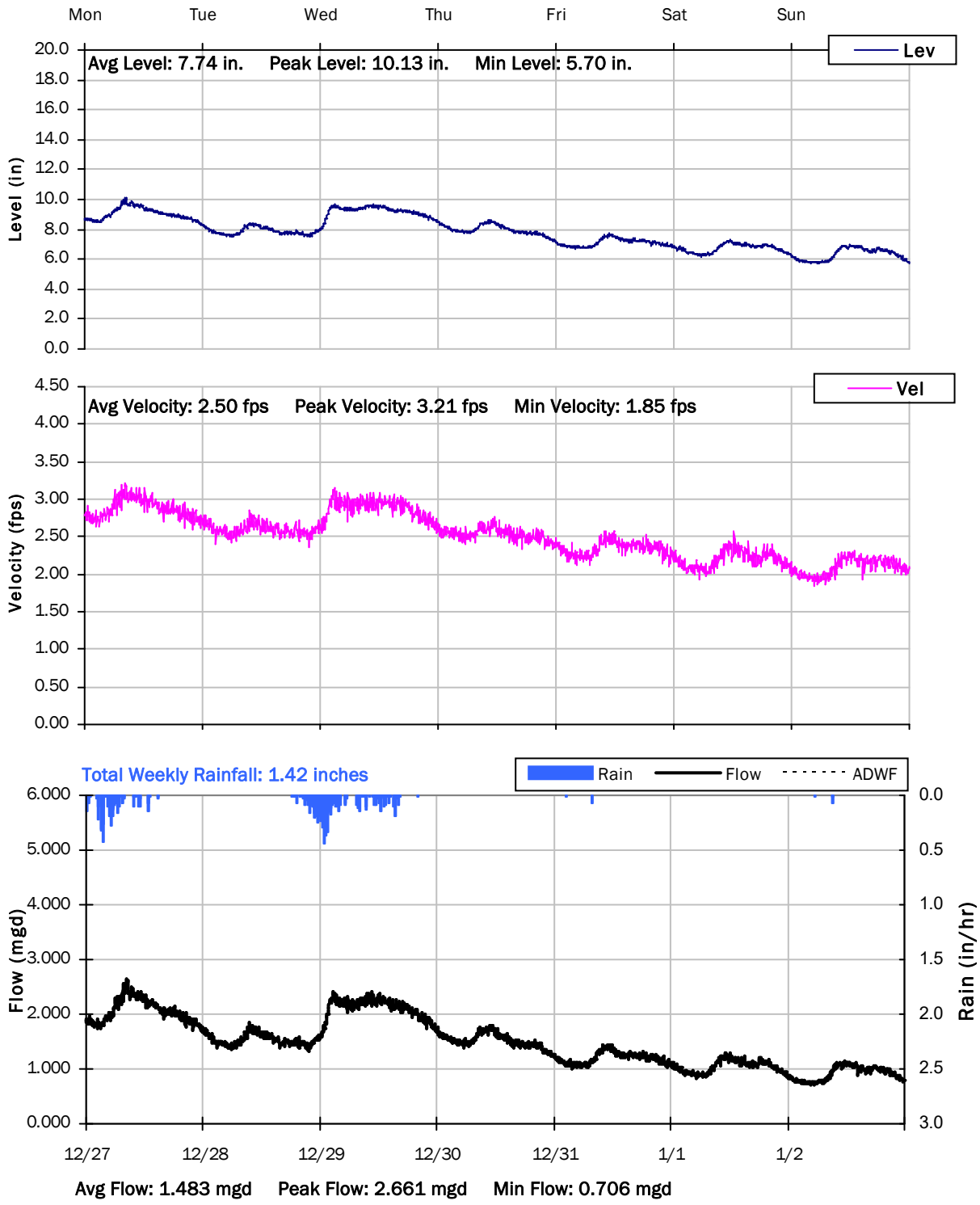
12/27/2021 to 1/3/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

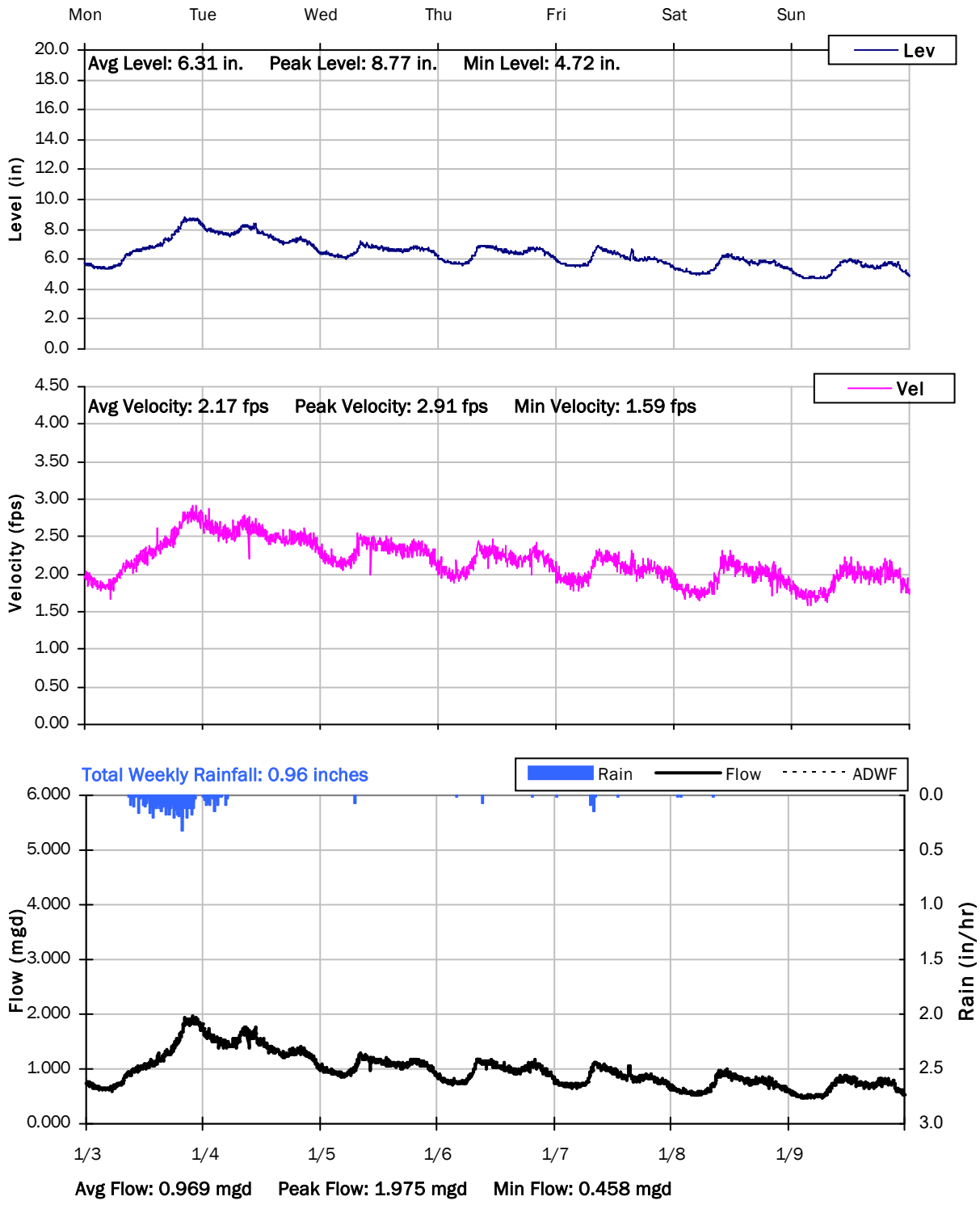
12/27/2021 to 1/3/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

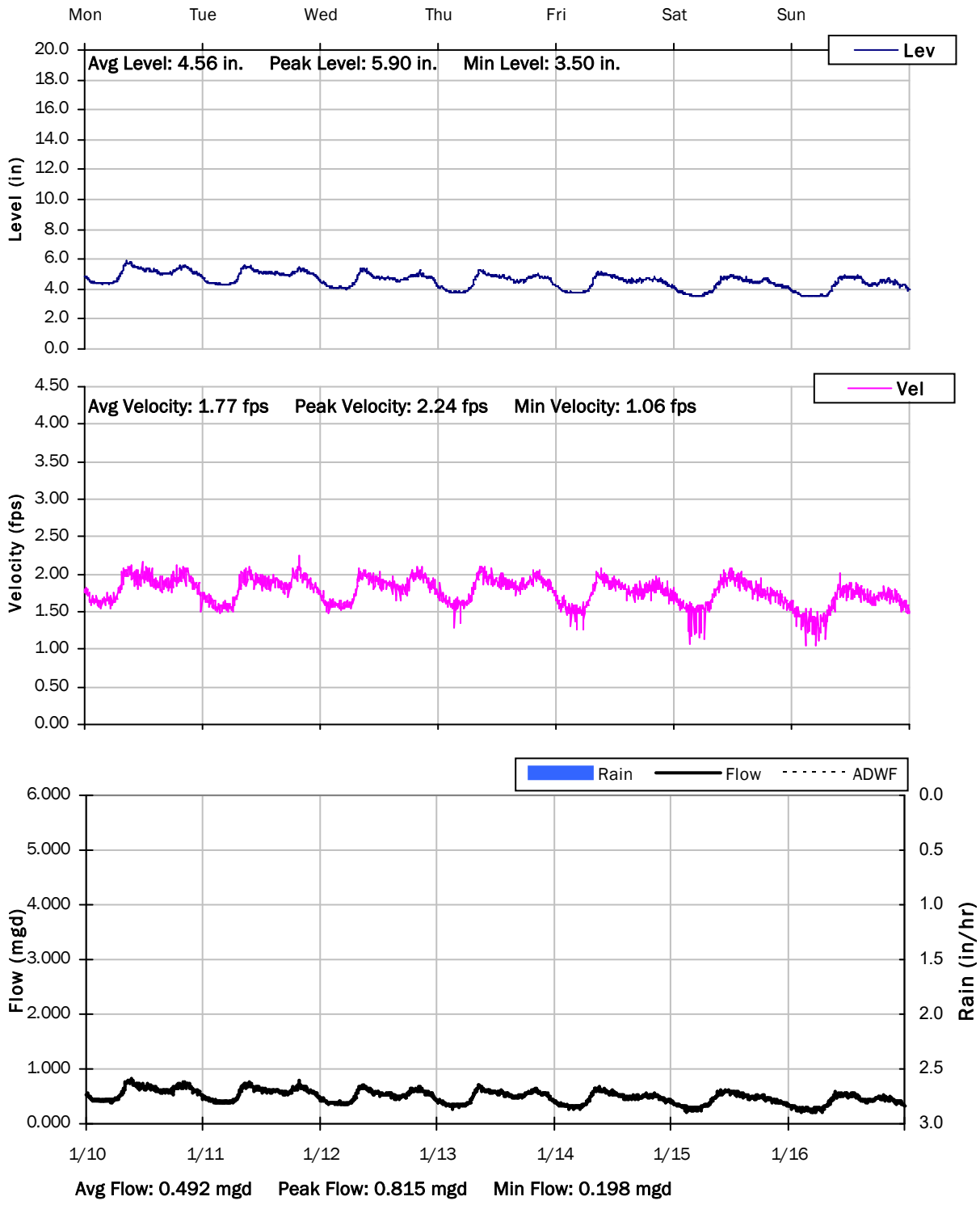
1/3/2022 to 1/10/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

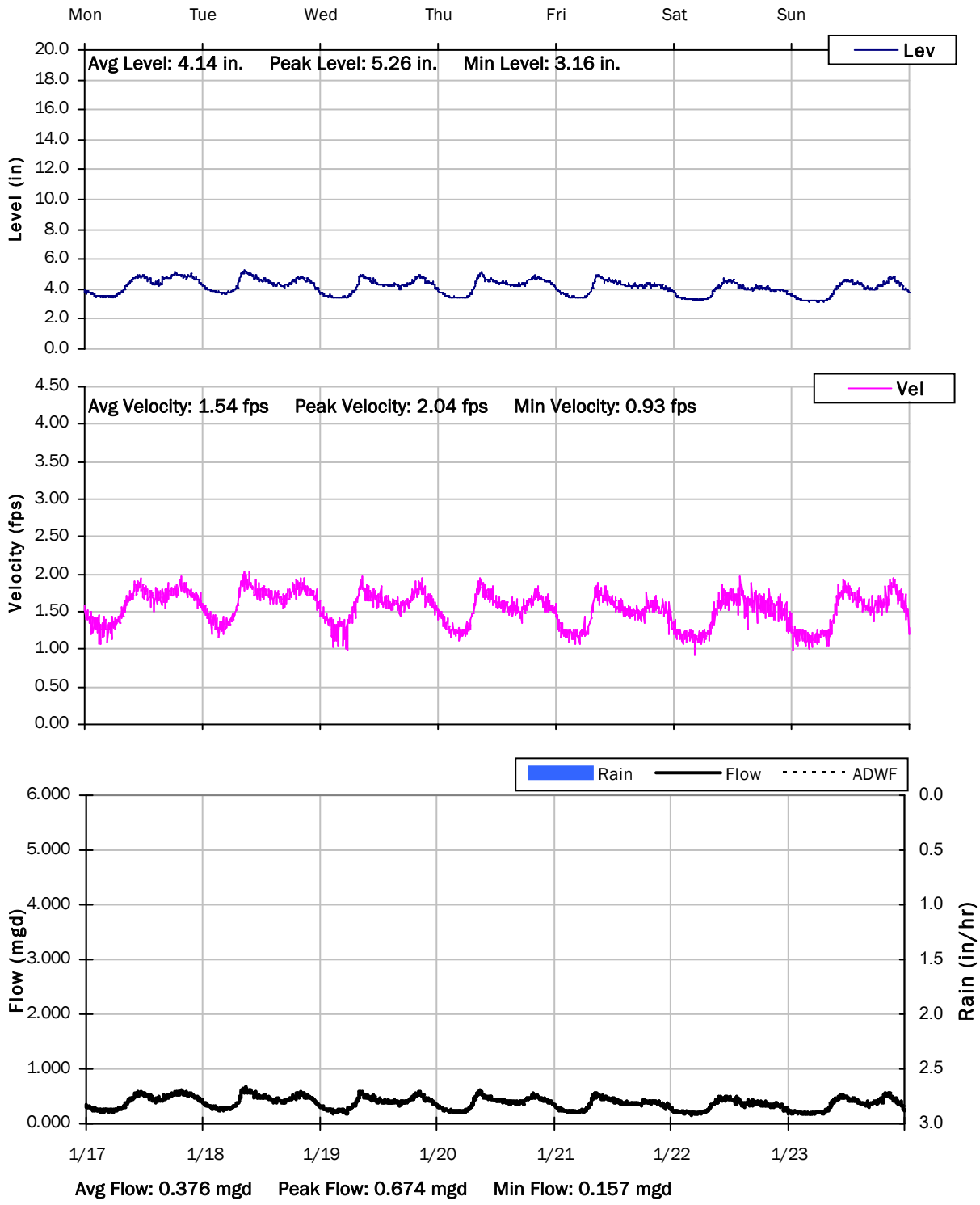
1/10/2022 to 1/17/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

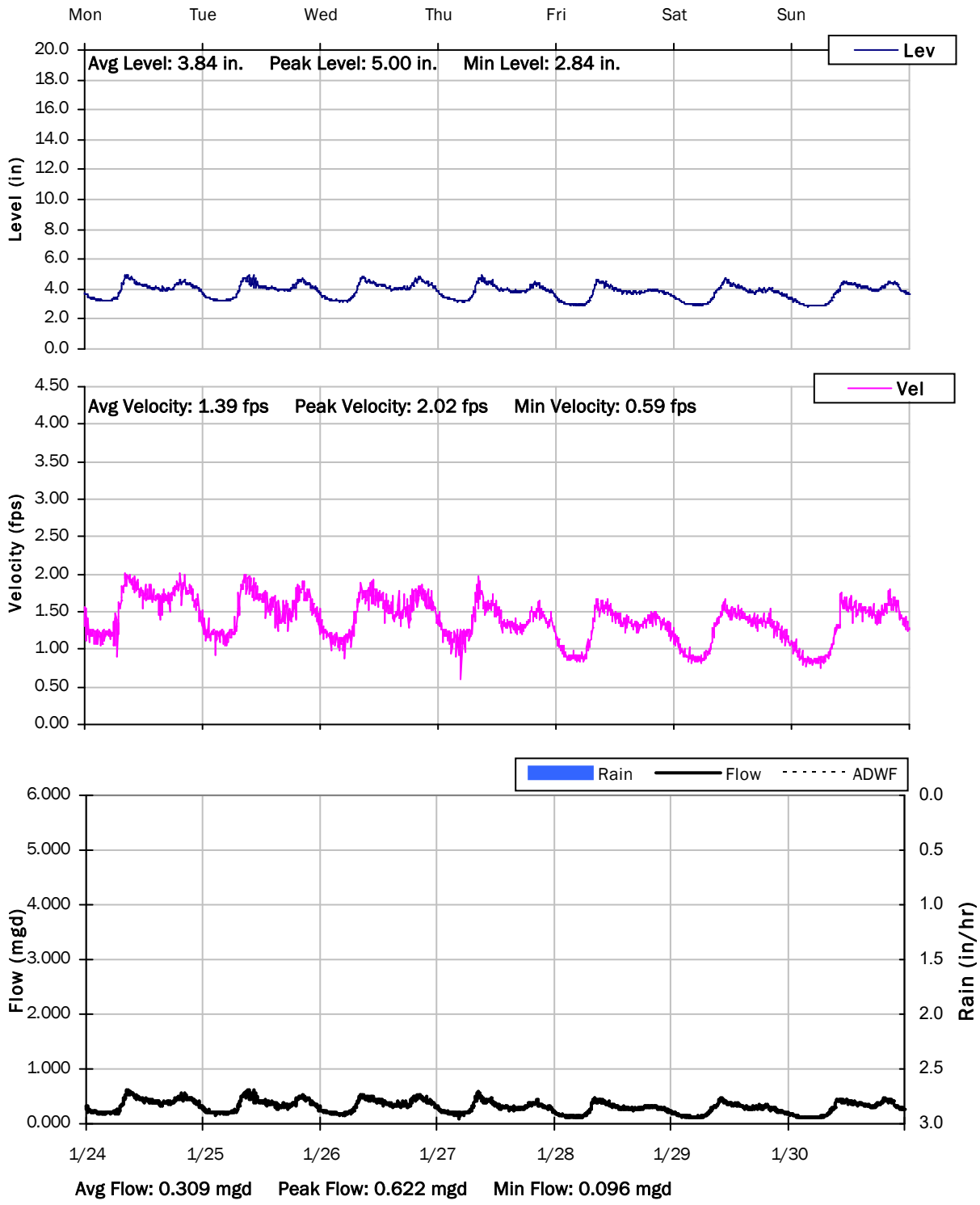
1/17/2022 to 1/24/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

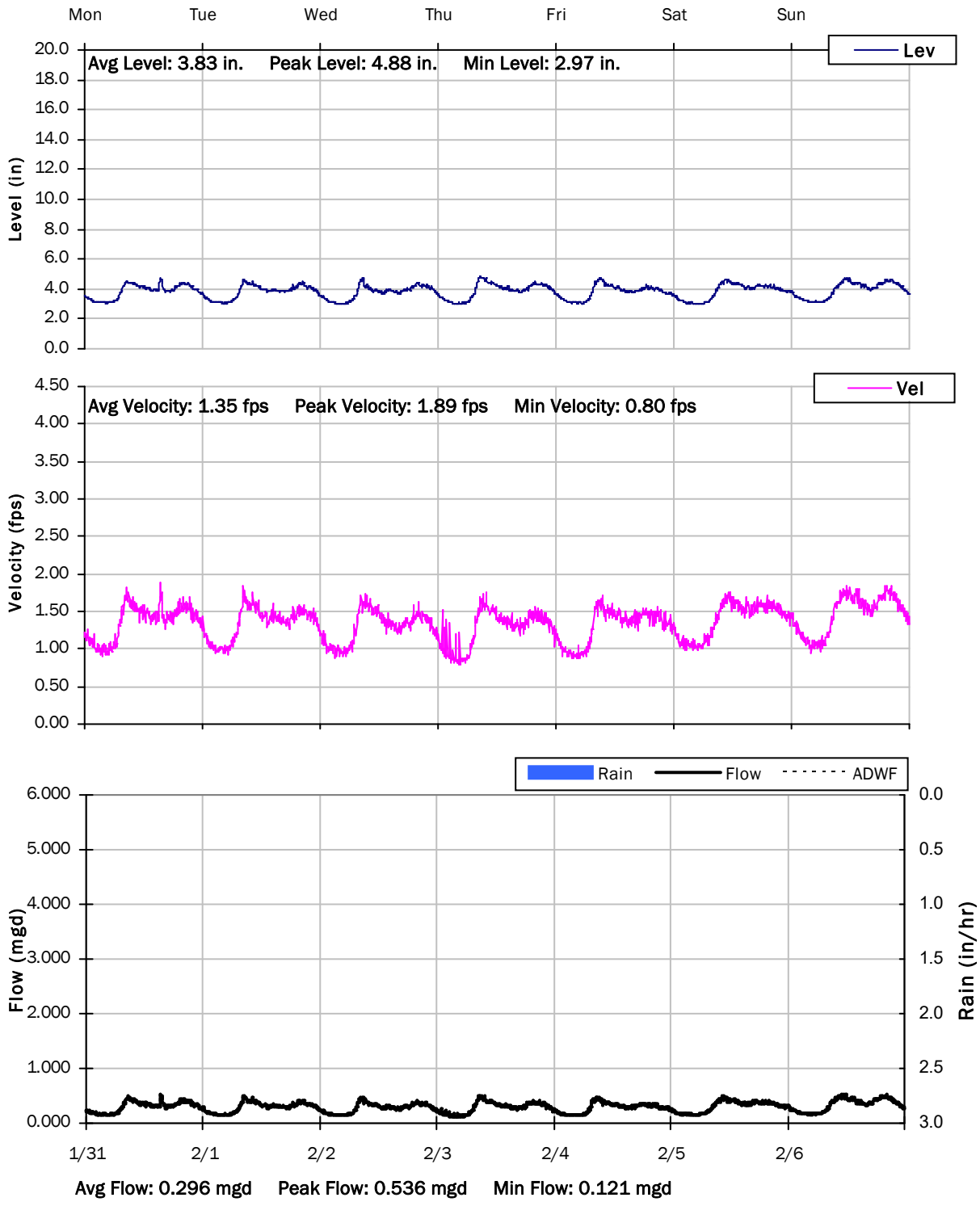
1/24/2022 to 1/31/2022



SITE 04

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 05

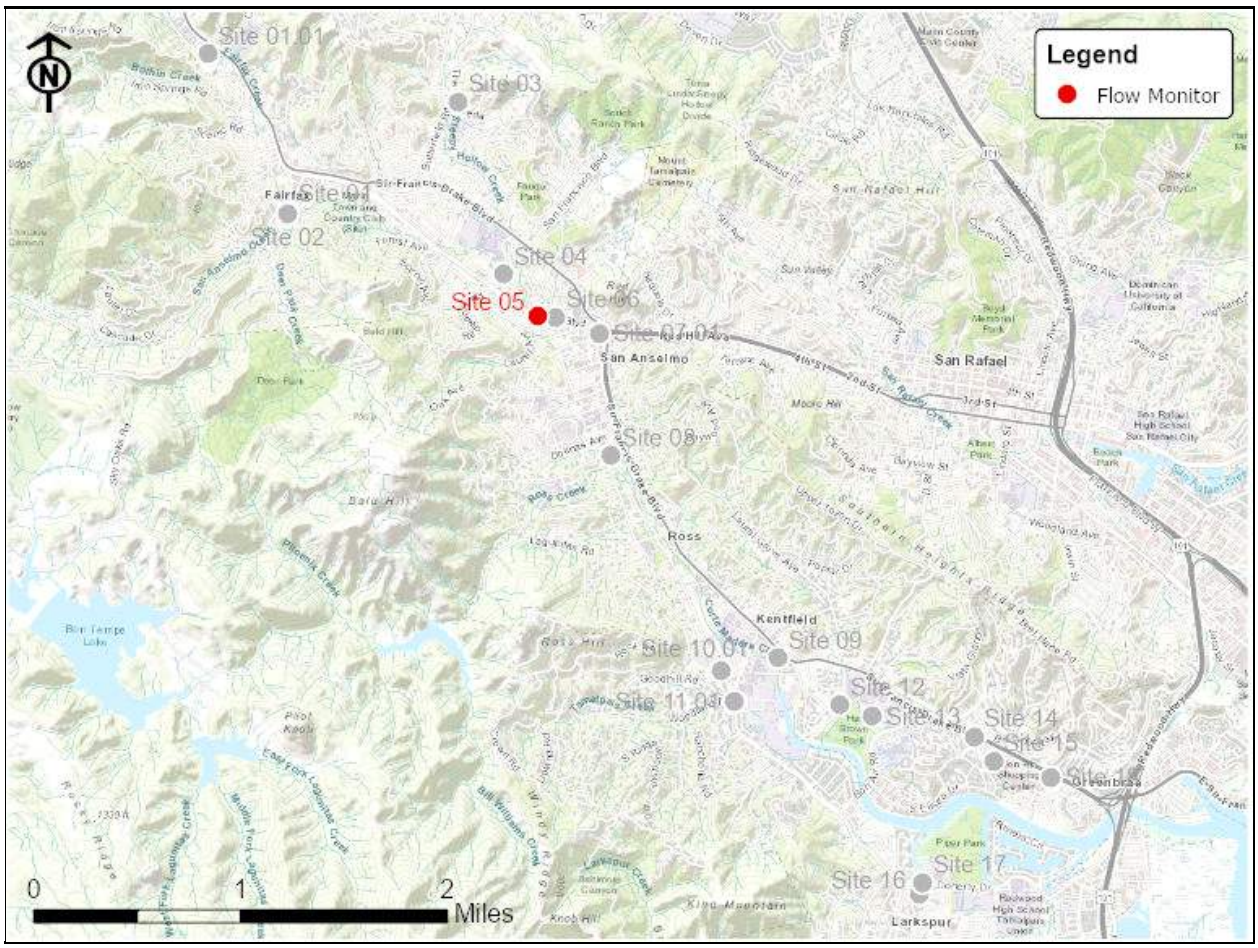
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 901 San Anselmo Avenue

Data Summary Report



Vicinity Map: Site 05

SITE 05

Site Information MH ID: S000.525

Location: 901 San Anselmo Avenue

Coordinates: 122.5679° W, 37.9776° N

Rim Elevation (Earth): 59 feet

Expected Pipe Diameter: 36 inches

Measured Pipe Diameter: 36 inches

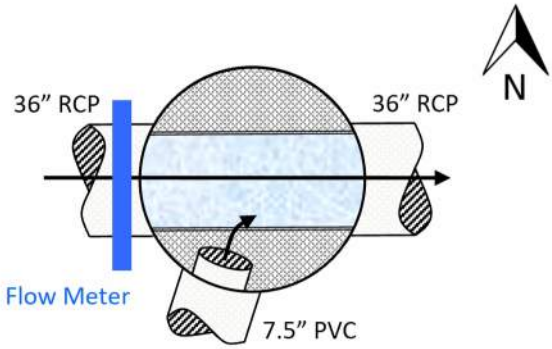
ADWF: 0.964 mgd

Peak Measured Flow: 10.759 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

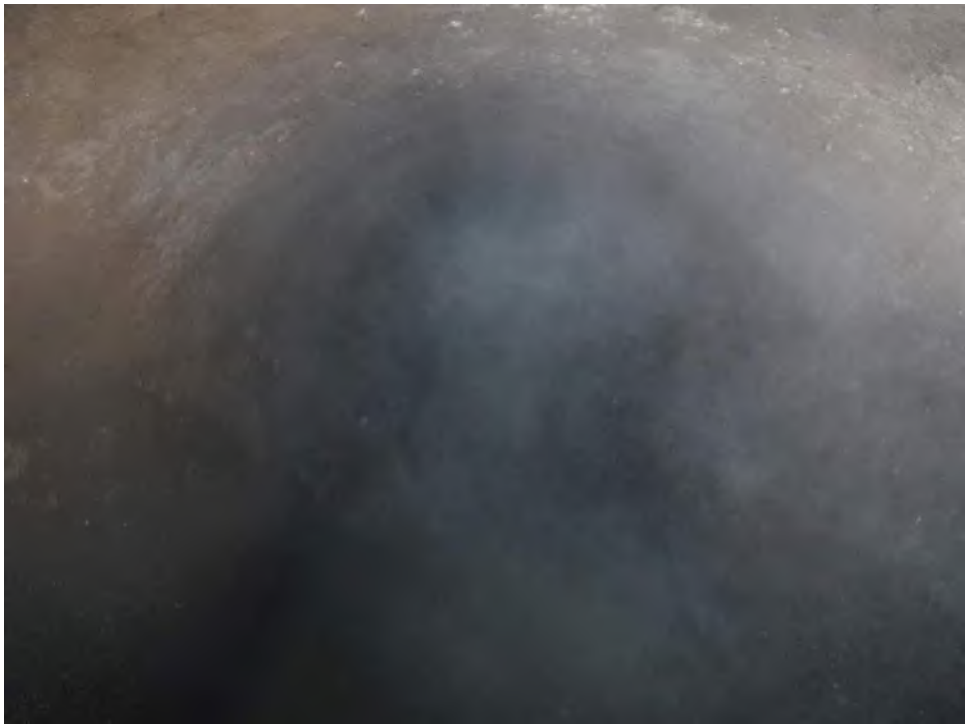
Plan View

SITE 05

Additional Site Photos

Effluent Pipe

South Influent Pipe



SITE 05

Additional Site Photos

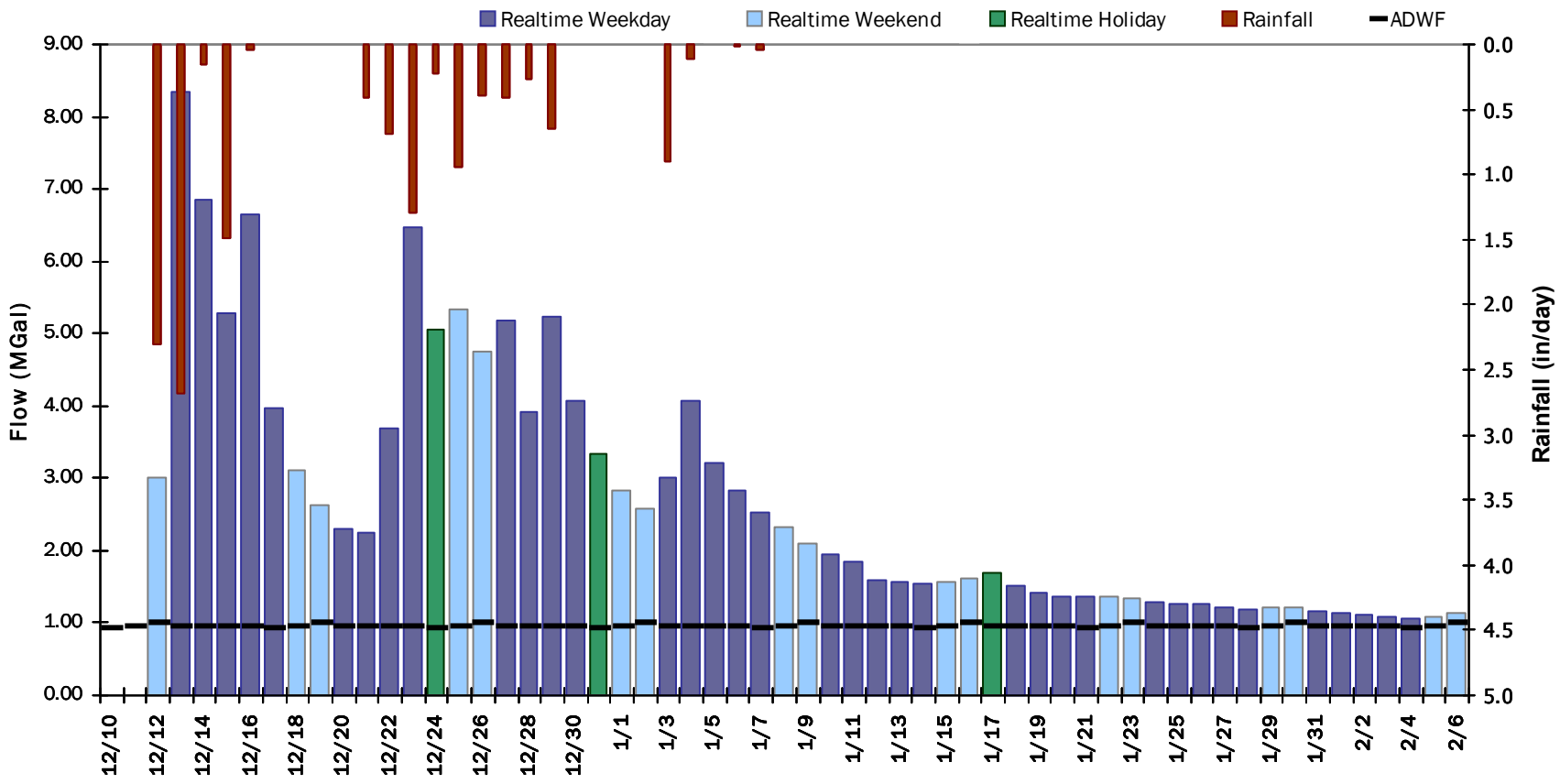
Monitored West Influent Pipe

SITE 05

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 2.691 MGal Peak Daily Flow: 8.337 MGal Min Daily Flow: 0.974 MGal

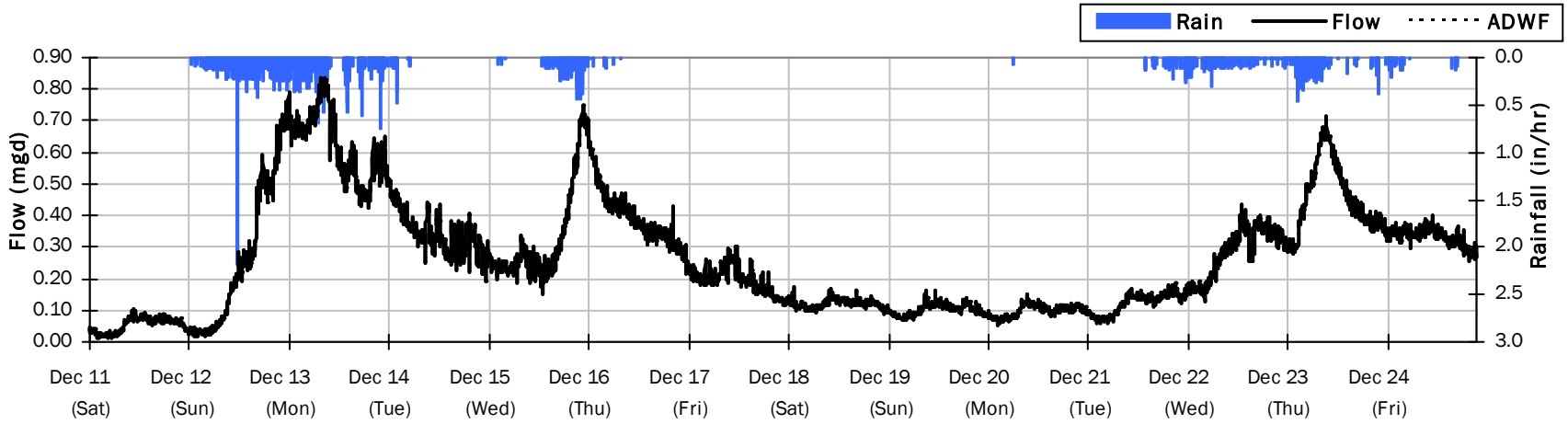
Total Rainfall: 13.06 inches

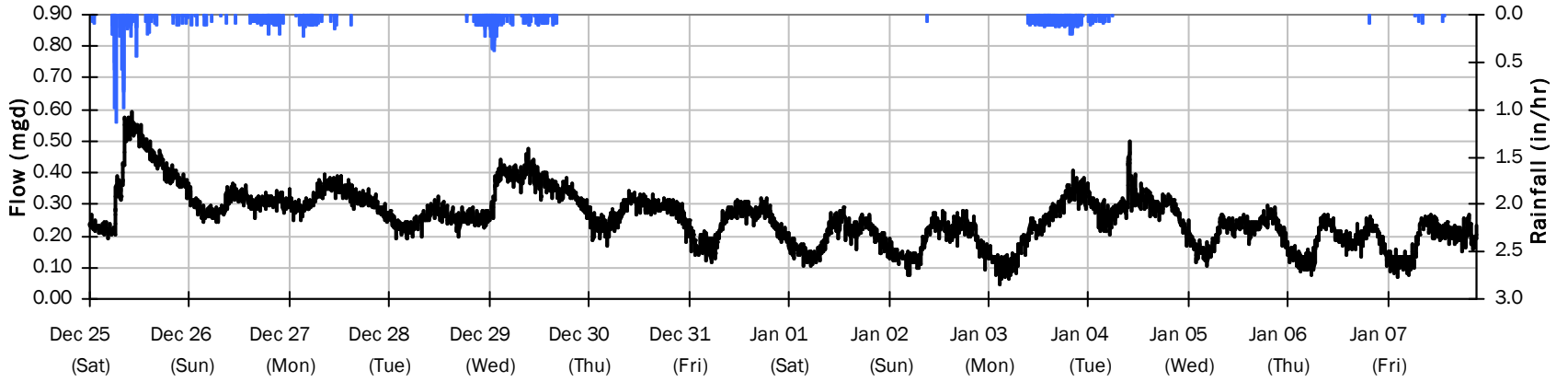


SITE 06

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 13.52 inches Period Avg Flow: 0.258 mgd Period Peak Flow: 0.837 mgd Period Min Flow: 0.011 mgd

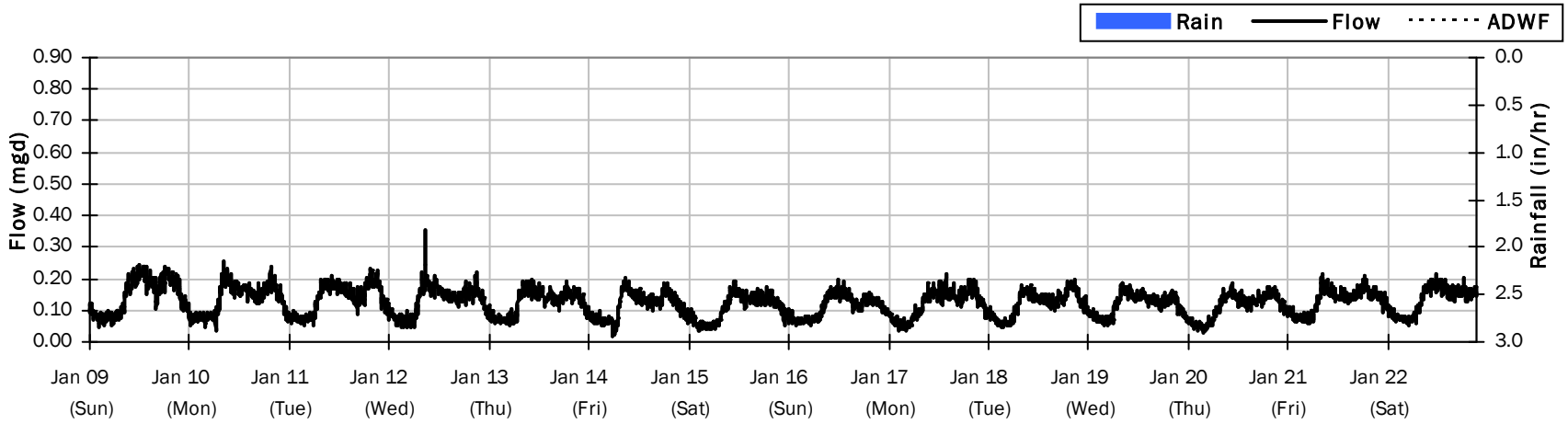


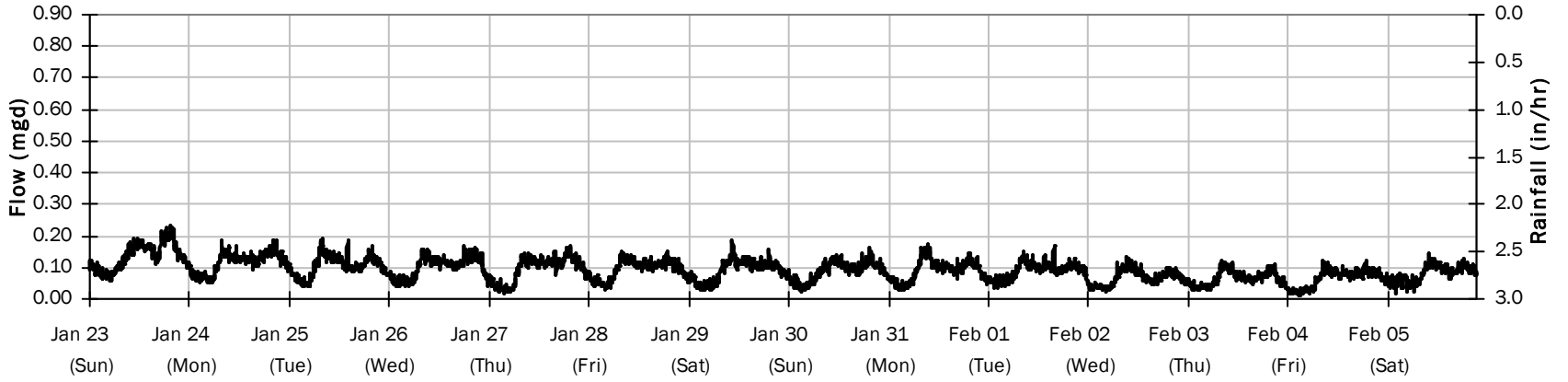


SITE 06

Flow Summary: 1/9/2022 to 2/5/2022

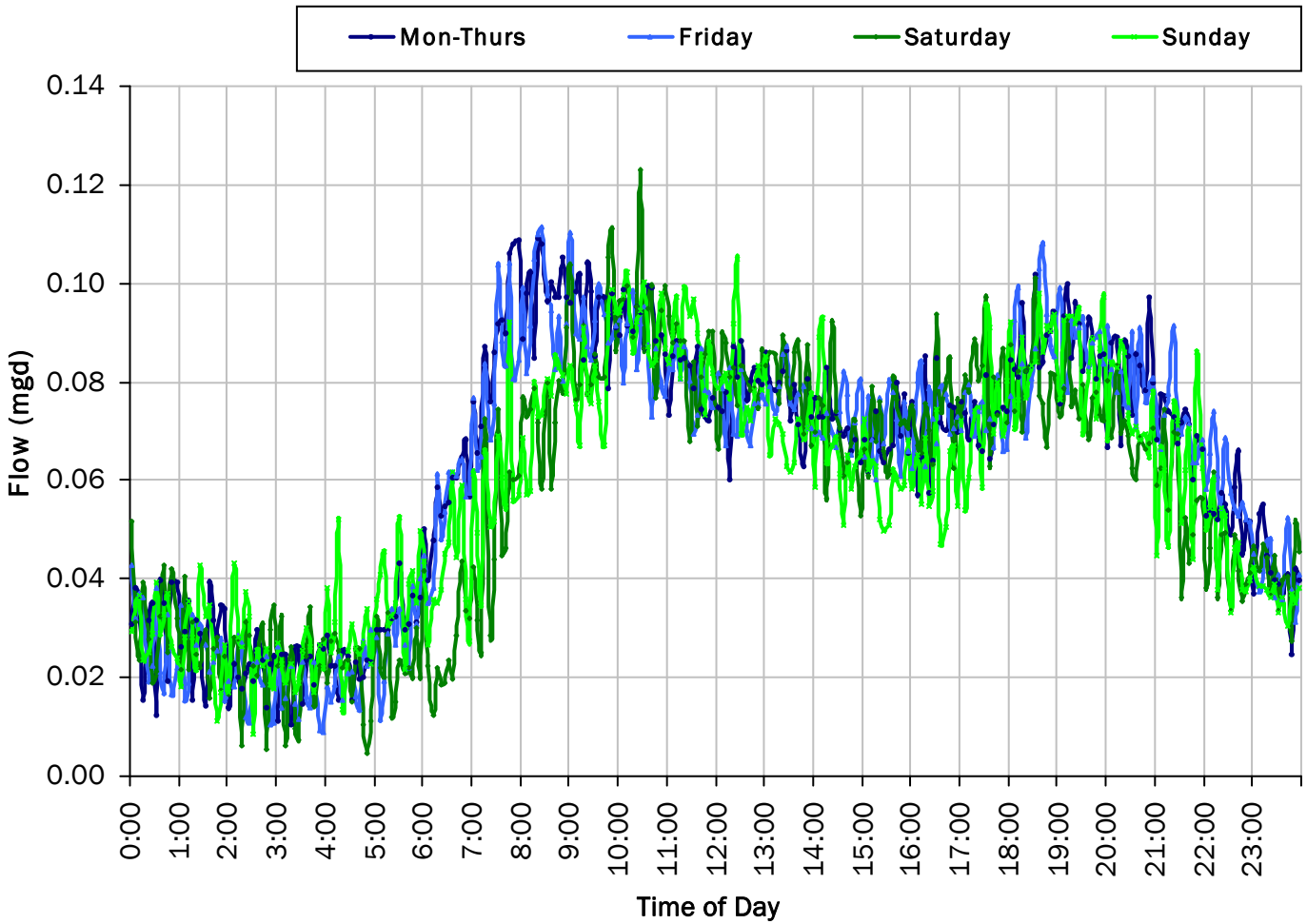
Period Rainfall: 0.00 inches Period Avg Flow: 0.109 mgd Period Peak Flow: 0.355 mgd Period Min Flow: 0.011 mgd





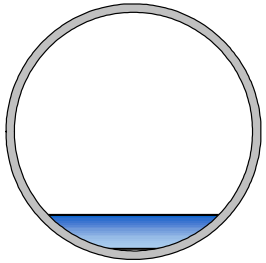
SITE 06

Average Dry Weather Flow Hydrographs



ADWF:

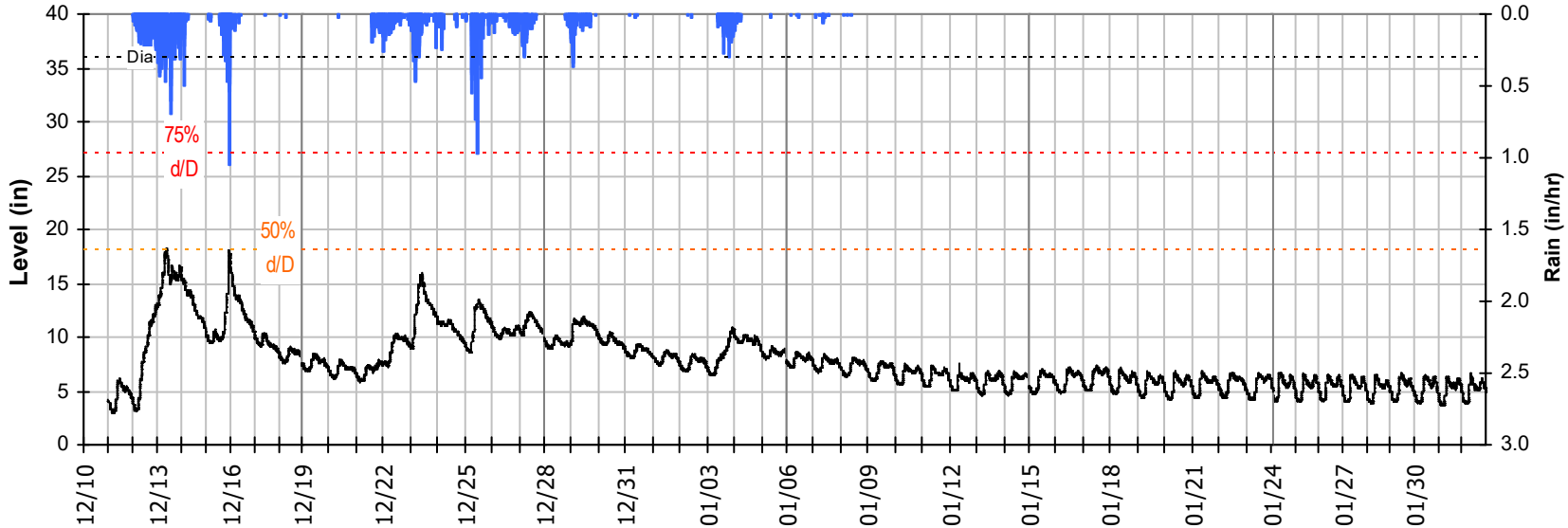
0.062 *mgd*

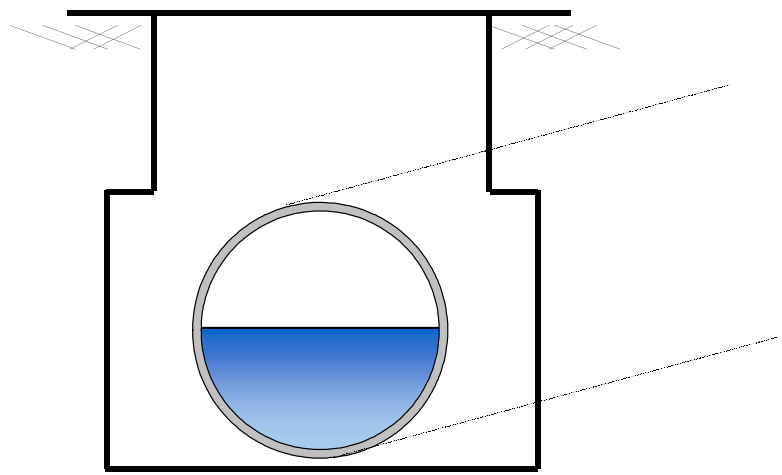


SITE 05

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

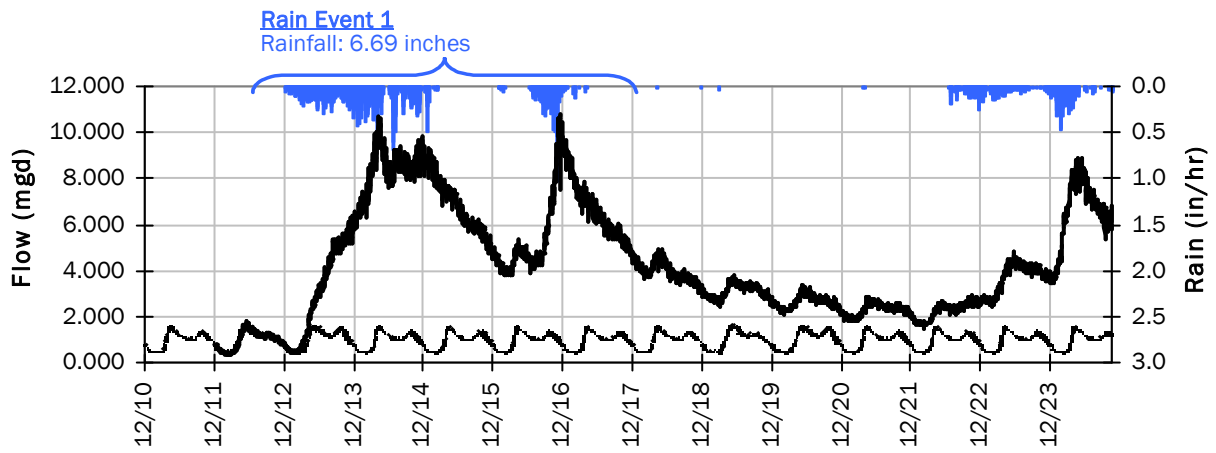




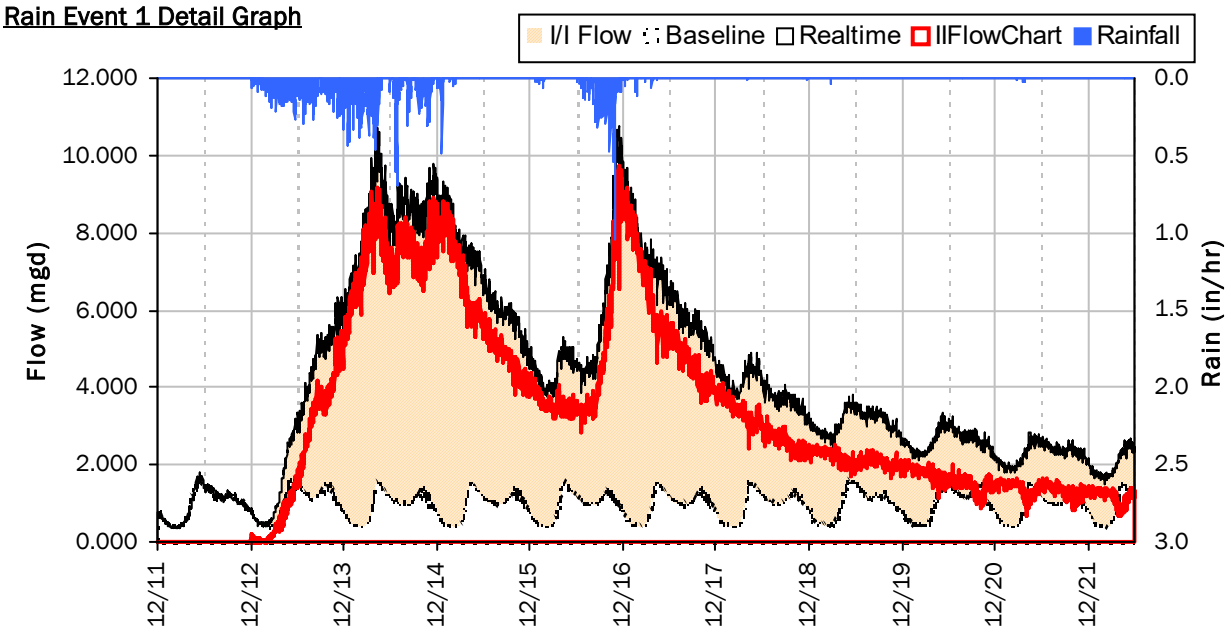
Pipe Diameter:	36	*inches*
Peak Measured Level:	18.3	*inches*
Peak d/D Ratio:	0.51	

SITE 05
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

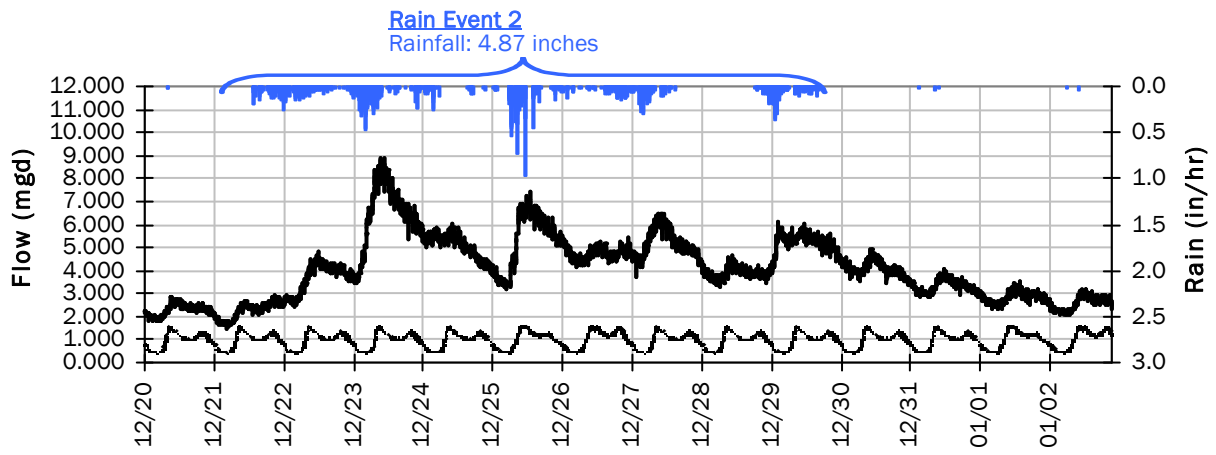


Storm Event I/I Analysis (Rain = 6.69 inches)

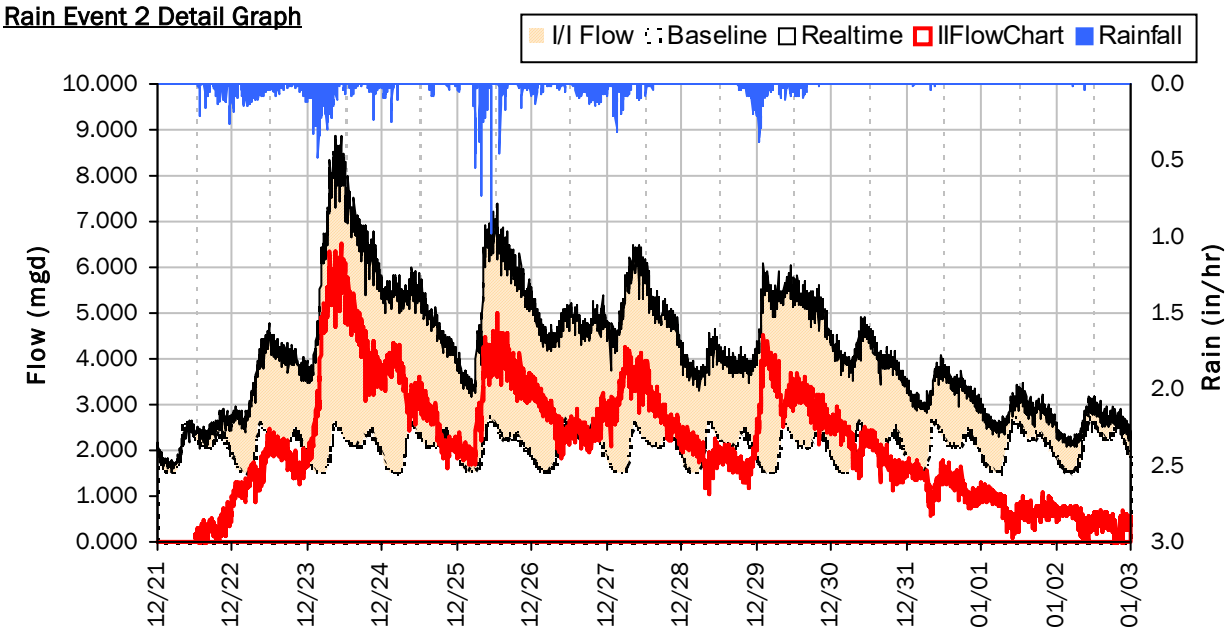
Capacity		Inflow / Infiltration	
Peak Flow:	10.759 *mgd*	**Peak I/I Rate:**	9.735 *mgd*
PF:	11.21	**Total I/I:**	34,041,000 *gallons*
Peak Level:	18.33 *in*		
d/D Ratio:	0.51		

SITE 05
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



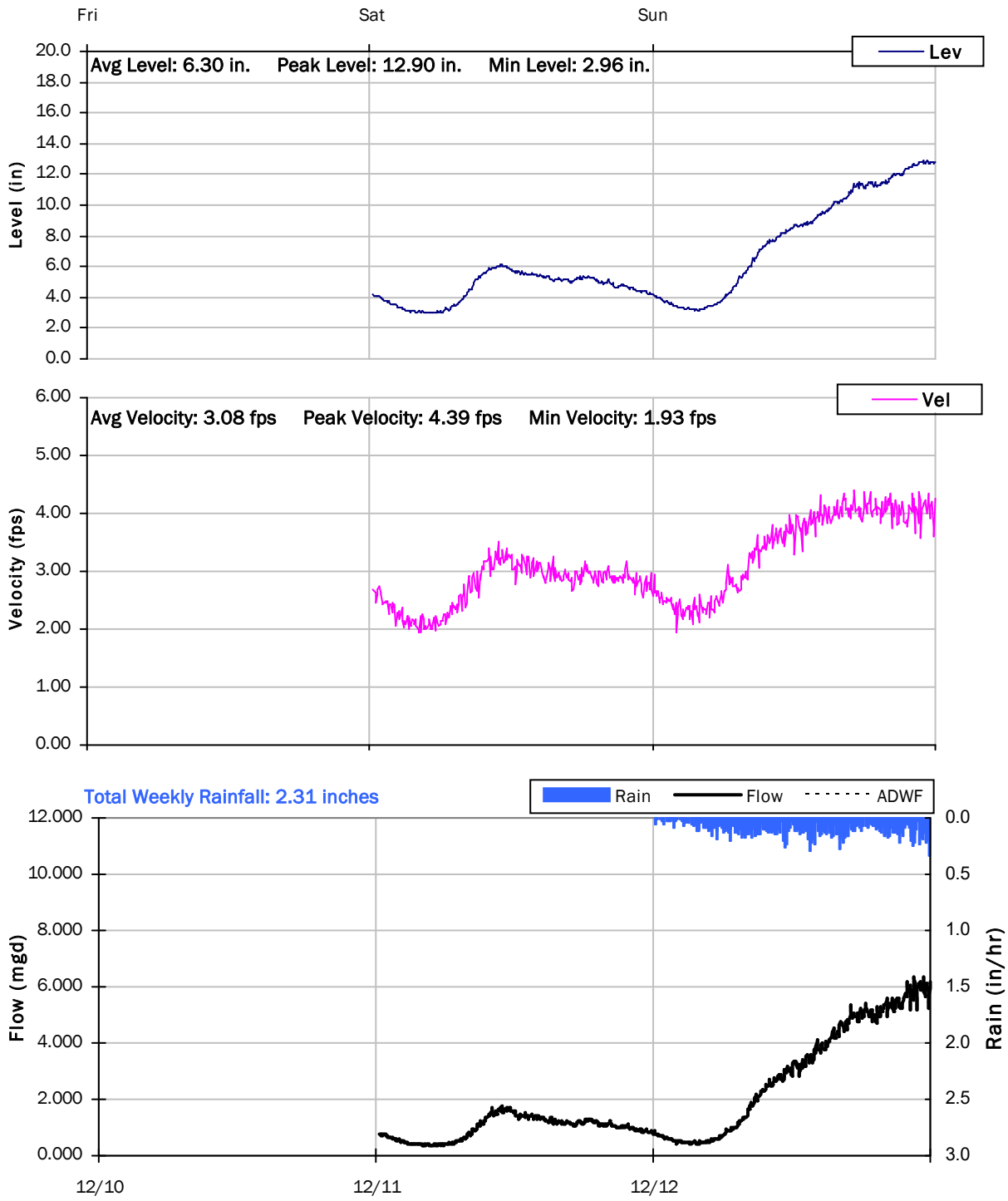
Storm Event I/I Analysis (Rain = 4.87 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	8.884 *mgd*	**Peak I/I Rate:**	6.505 *mgd*
PF:	9.25	**Total I/I:**	27,870,000 *gallons*
Peak Level:	15.89 *in*		
d/D Ratio:	0.44		

SITE 05

Weekly Level, Velocity and Flow Hydrographs

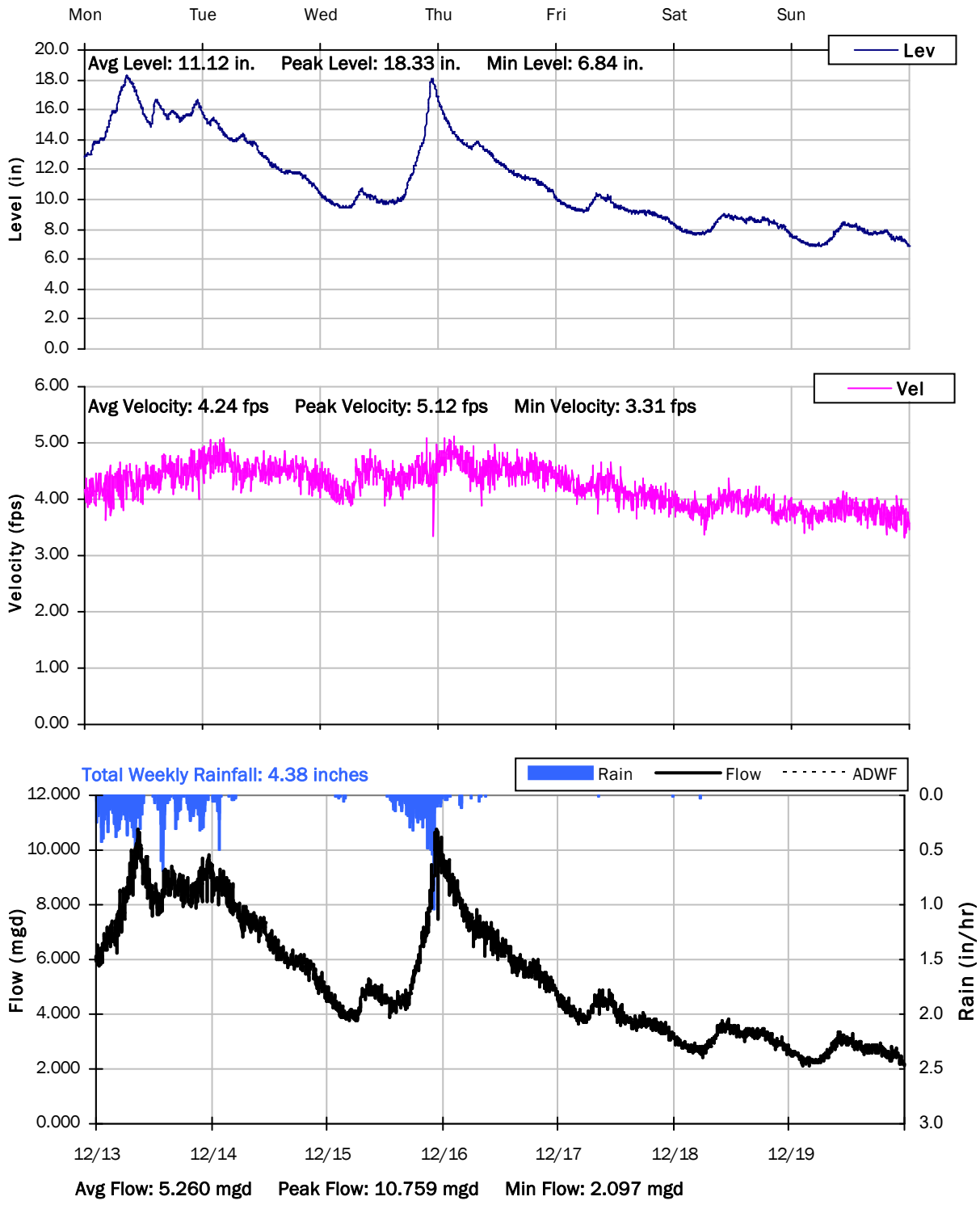
12/10/2021 to 12/13/2021



SITE 05

Weekly Level, Velocity and Flow Hydrographs

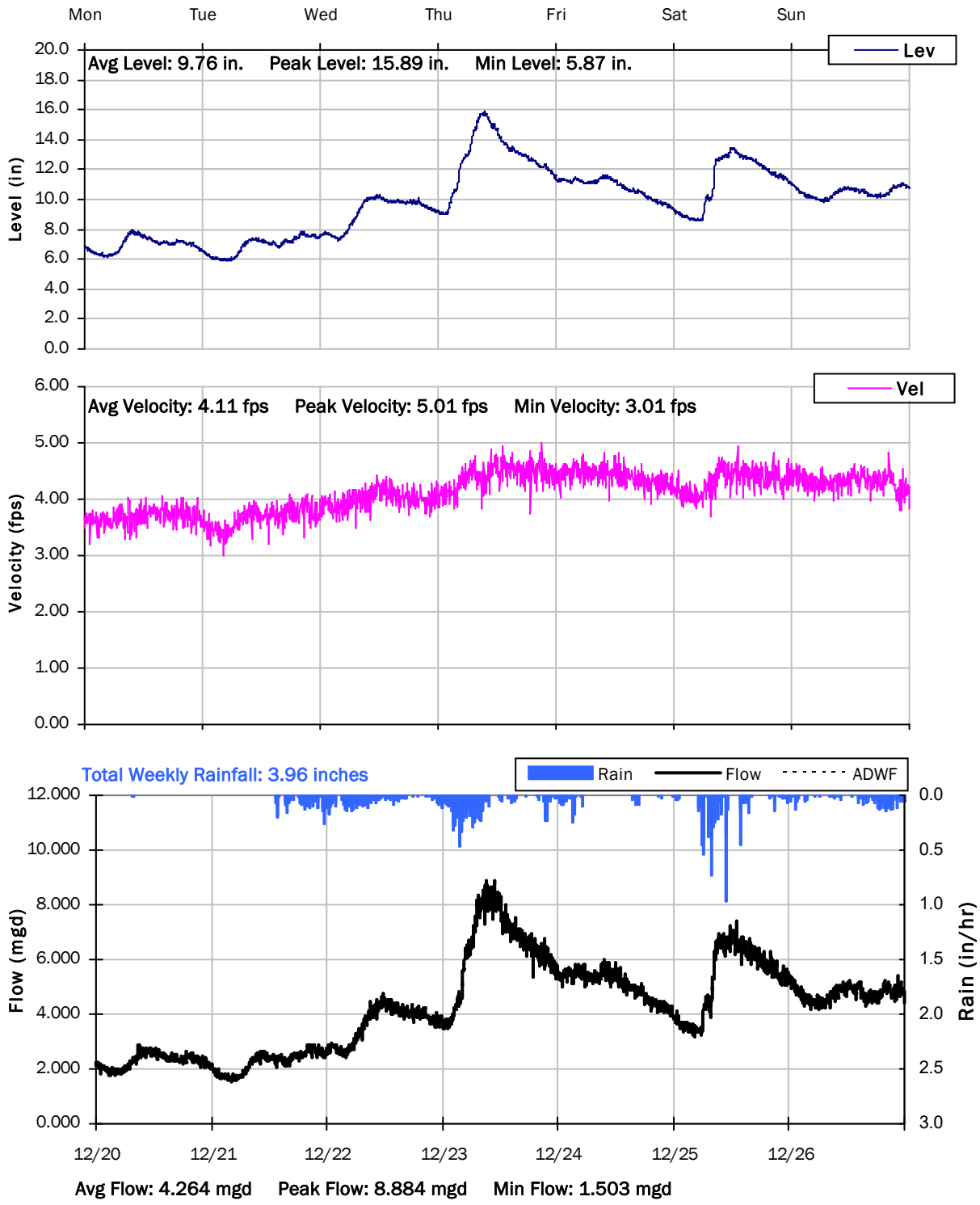
12/13/2021 to 12/20/2021



SITE 05

Weekly Level, Velocity and Flow Hydrographs

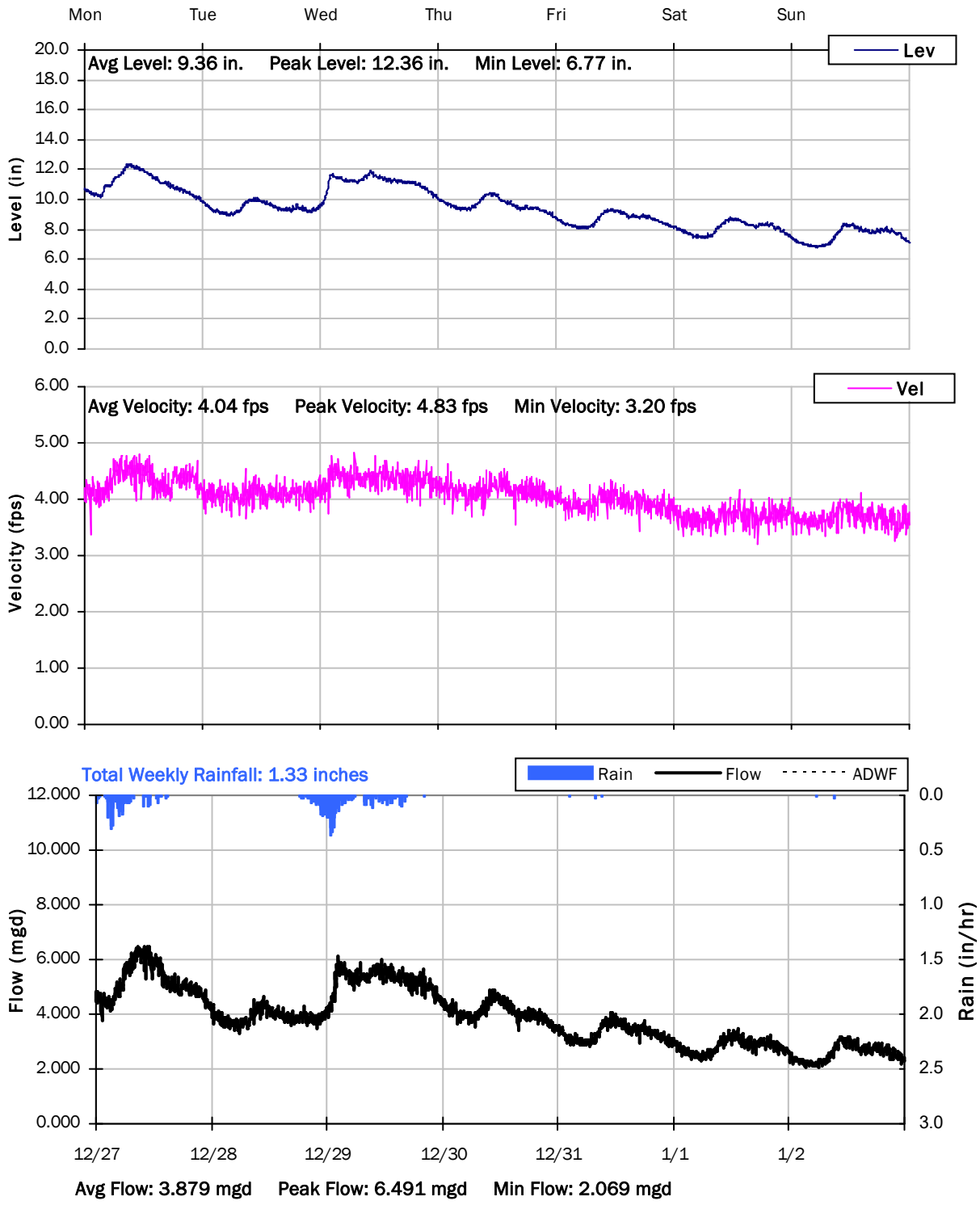
12/20/2021 to 12/27/2021



SITE 05

Weekly Level, Velocity and Flow Hydrographs

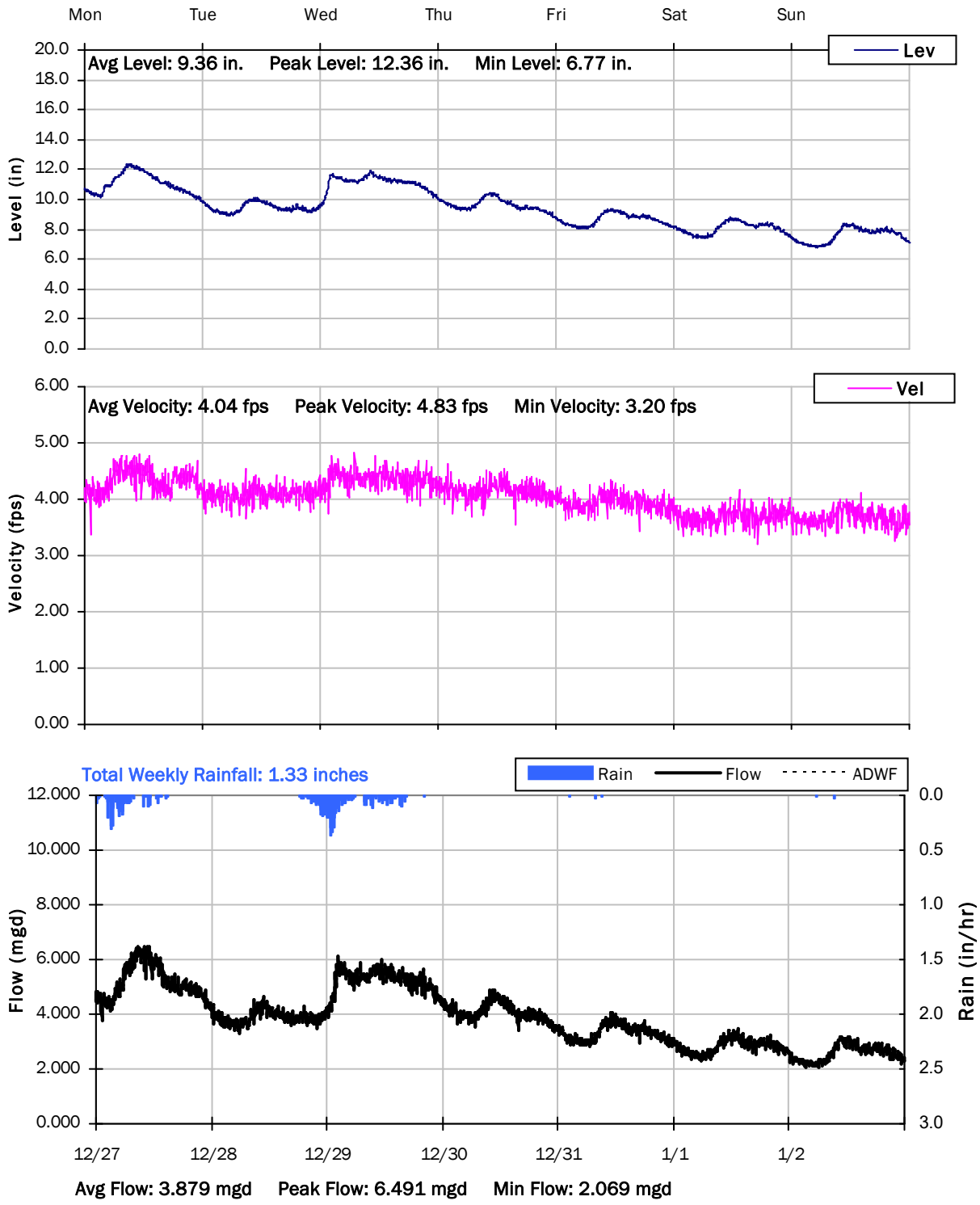
12/27/2021 to 1/3/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

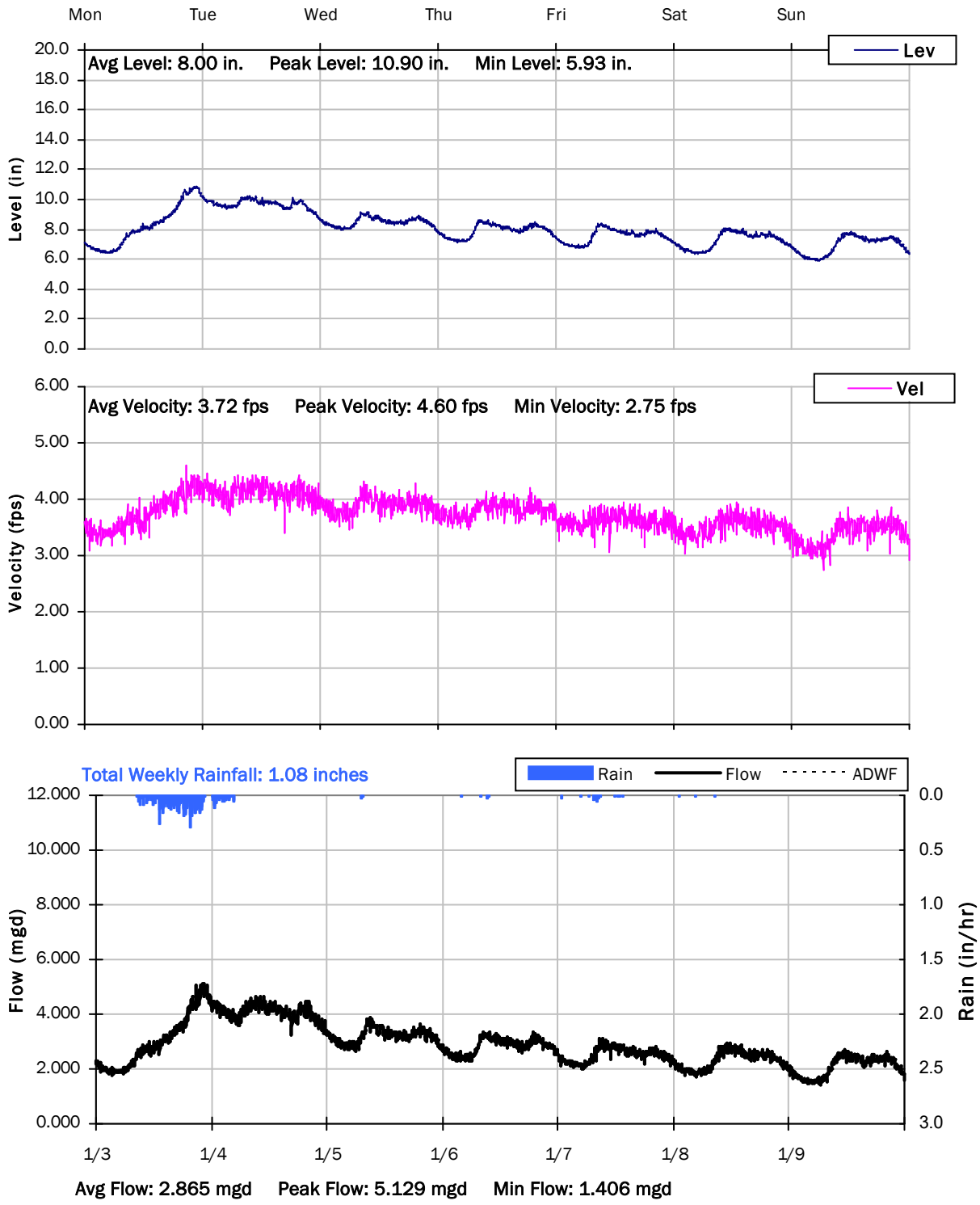
12/27/2021 to 1/3/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

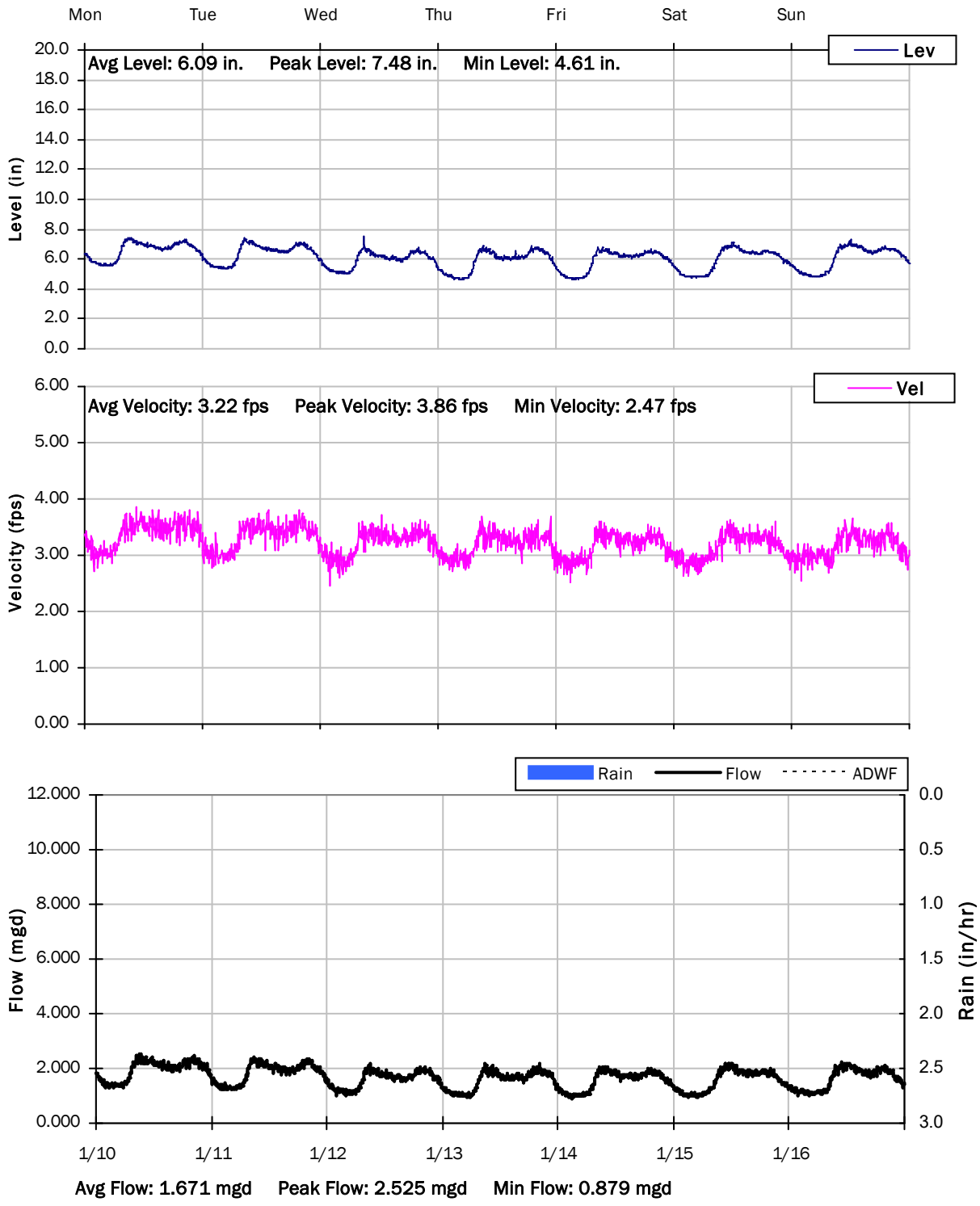
1/3/2022 to 1/10/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

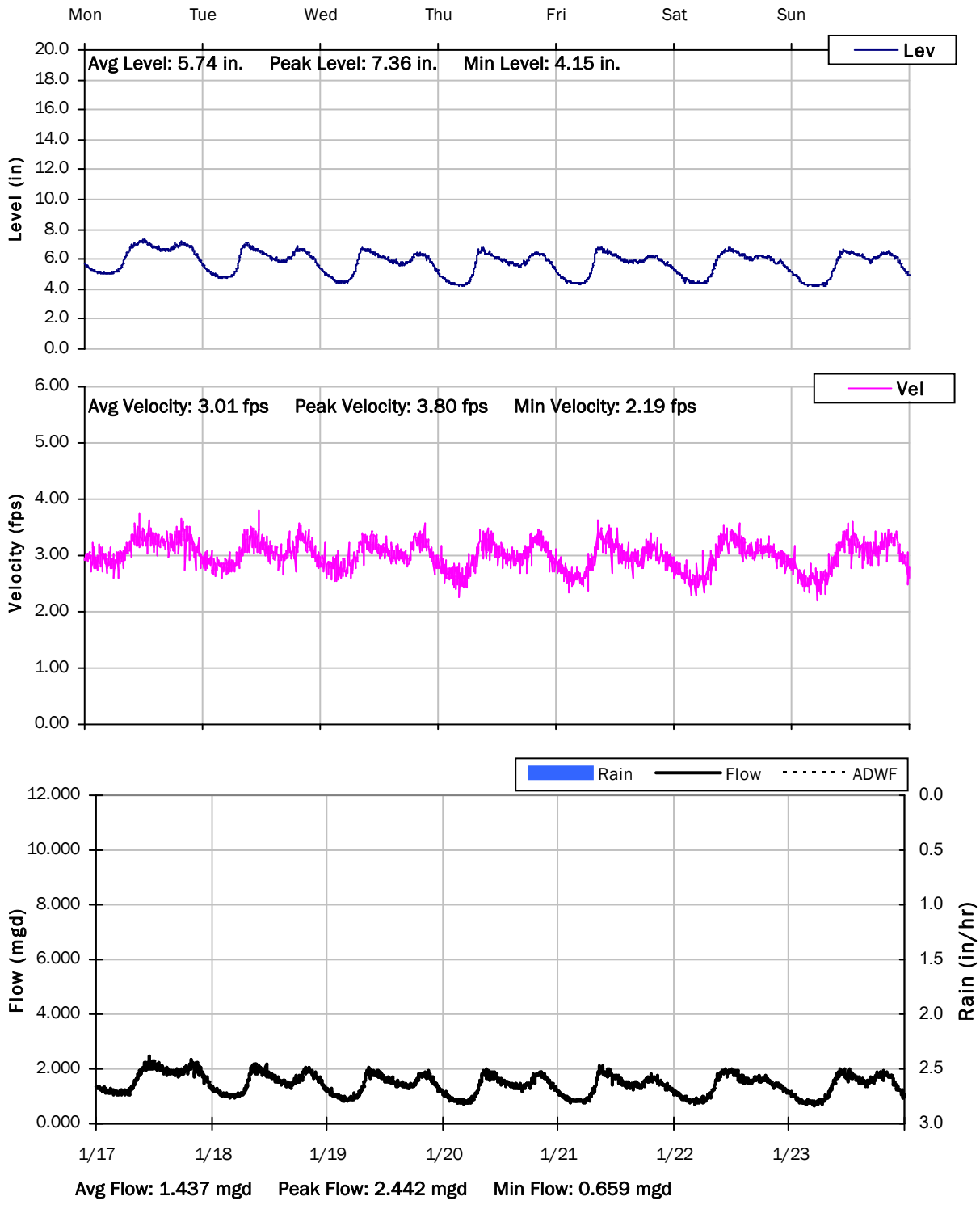
1/10/2022 to 1/17/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

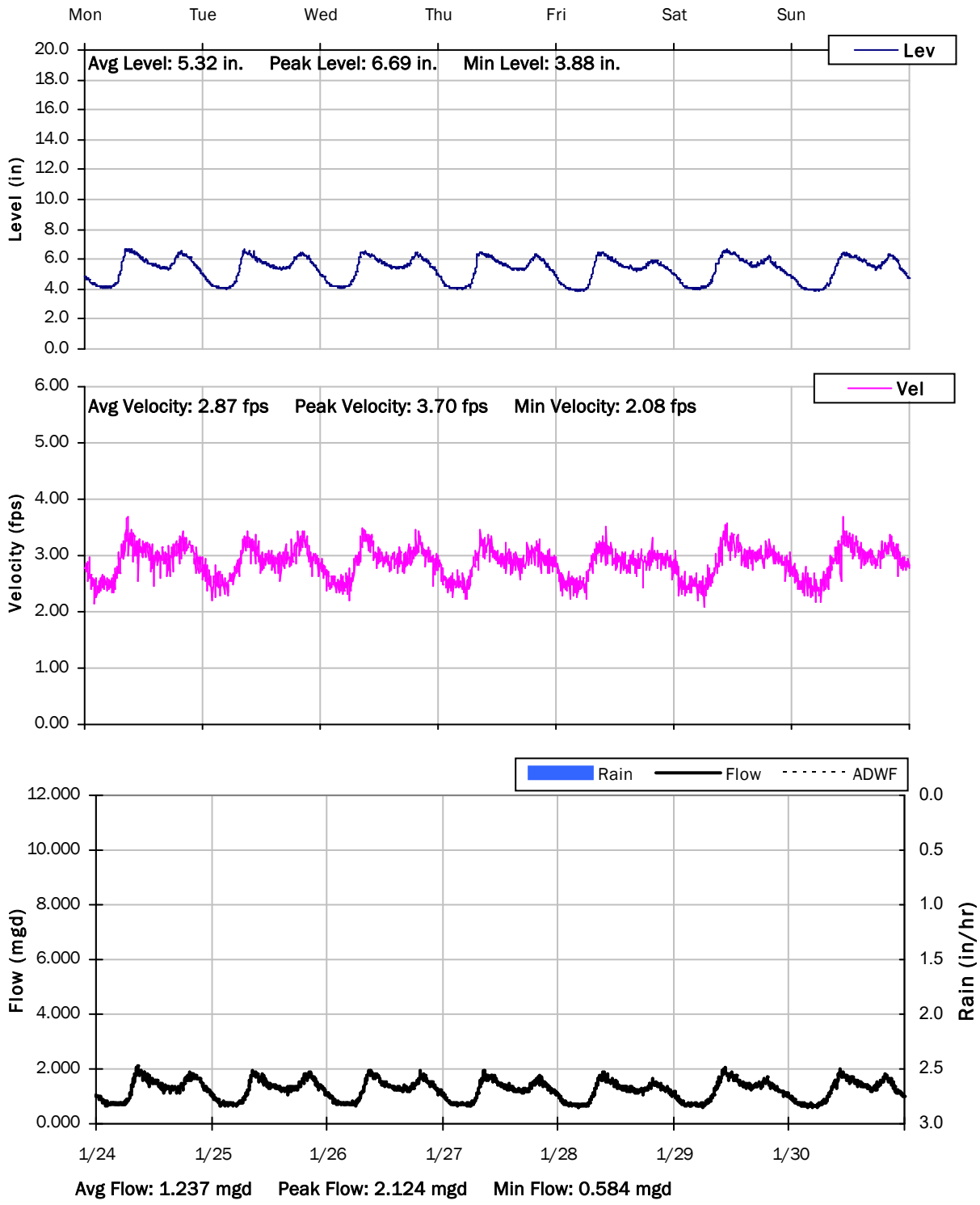
1/17/2022 to 1/24/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

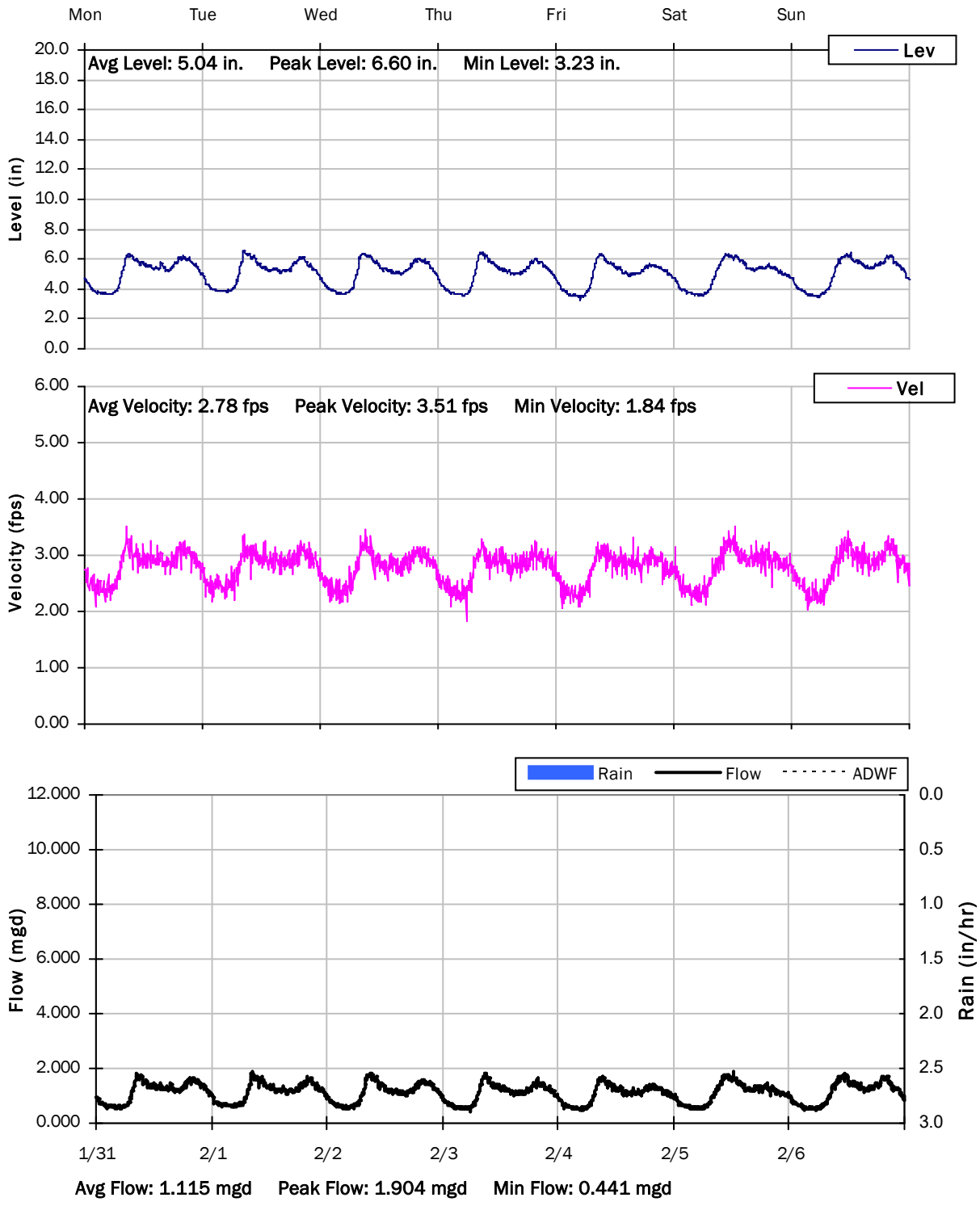
1/24/2022 to 1/31/2022



SITE 05

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 06

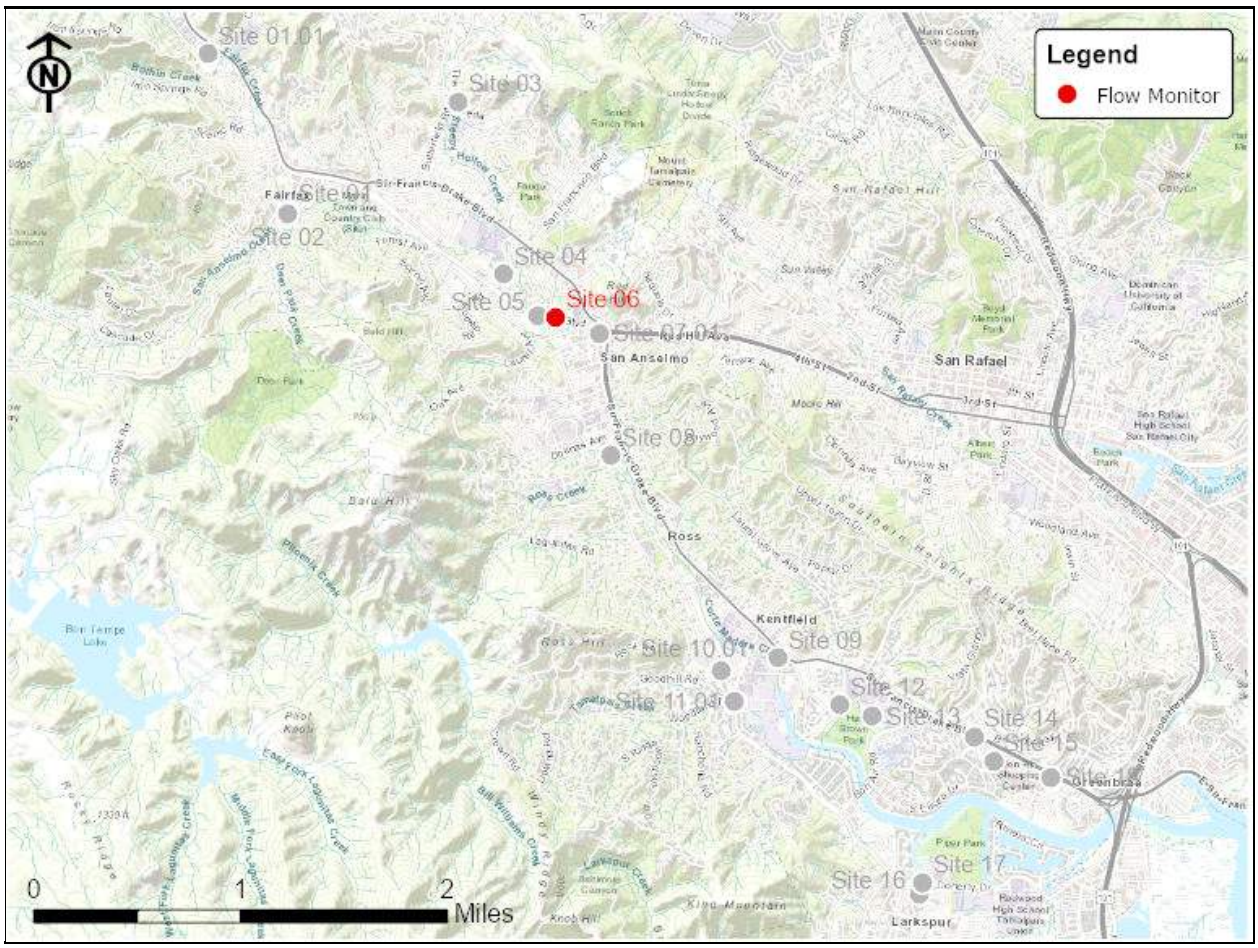
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 146 Sycamore Avenue

Data Summary Report



Vicinity Map: Site 06

SITE 06

Site Information MH ID: S001.100

Location: 146 Sycamore Avenue

Coordinates: 122.5663° W, 37.9775° N

Rim Elevation (Earth): 51 feet

Expected Pipe Diameter: 12 inches

Measured Pipe Diameter: 12.5 inches

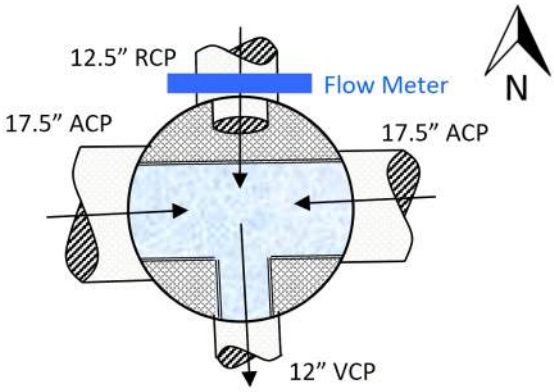
ADWF: 0.056 mgd

Peak Measured Flow: 0.837 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 06

Additional Site Photos

Effluent Pipe

West Influent Pipe

SITE 06

Additional Site Photos

Monitored North Influent Pipe

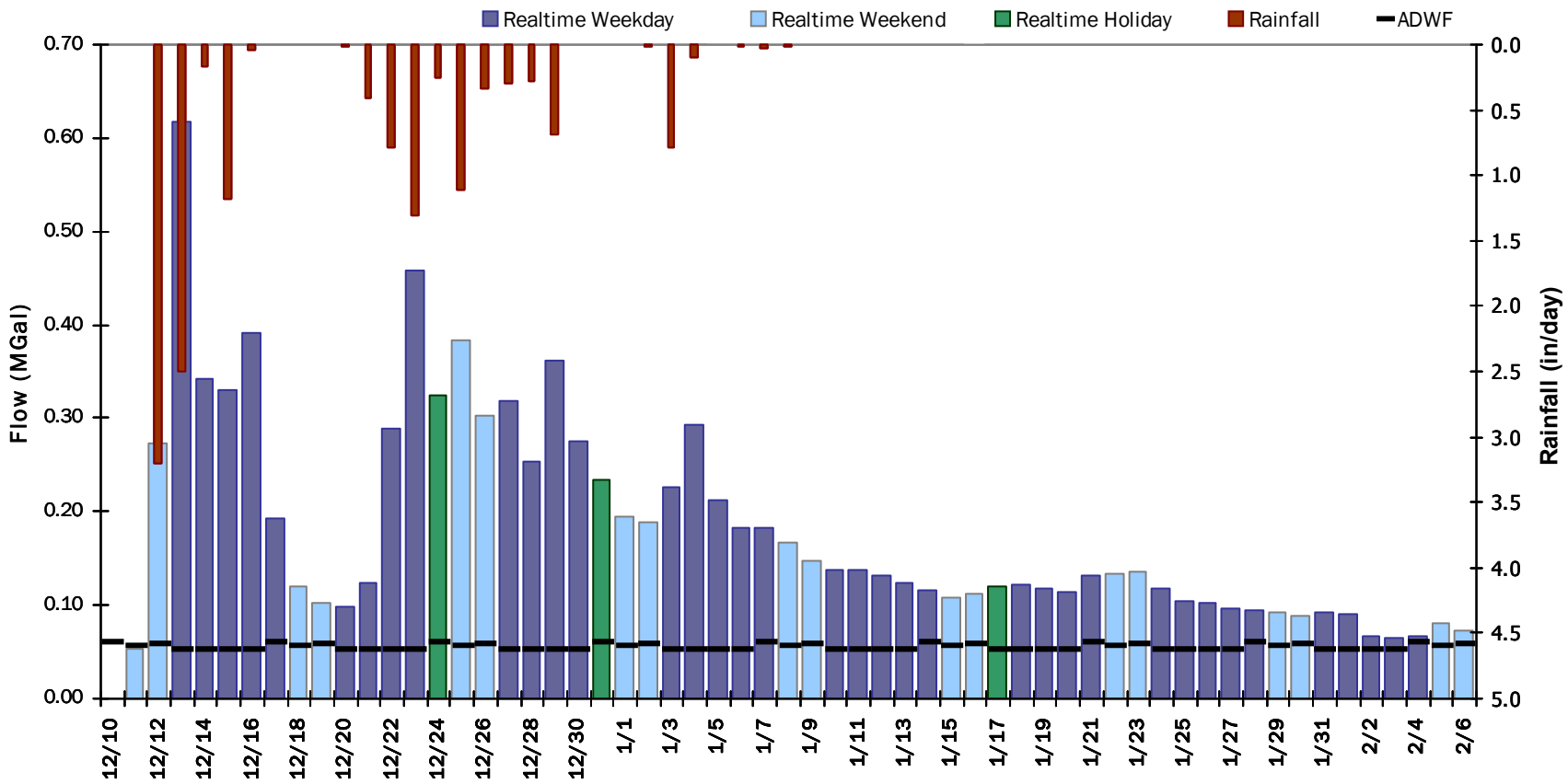
East Influent Pipe

SITE 06

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.183 MGal Peak Daily Flow: 0.618 MGal Min Daily Flow: 0.053 MGal

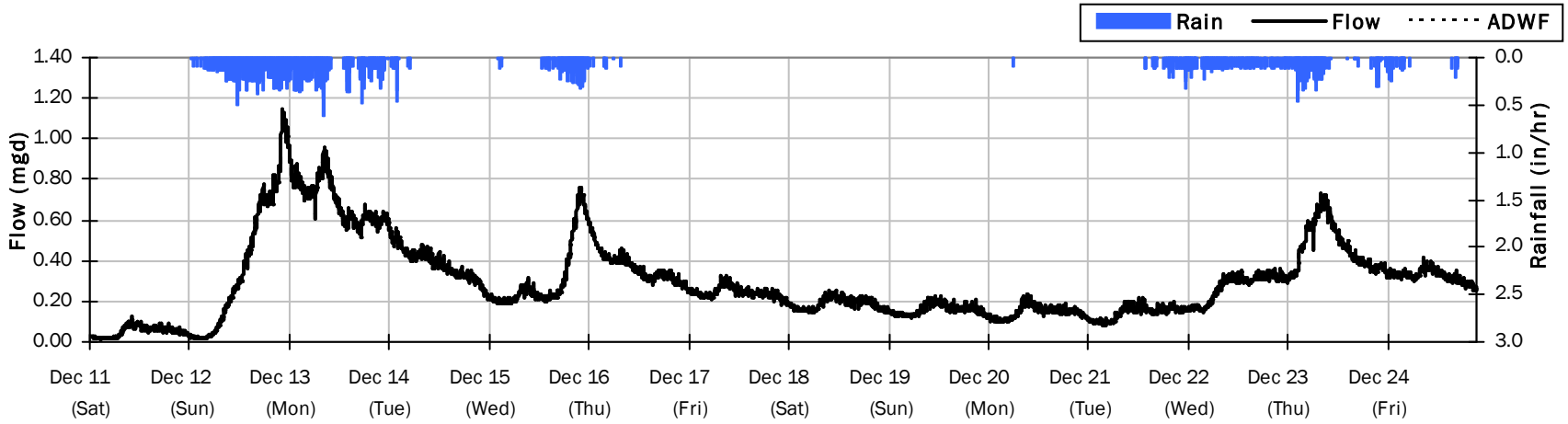
Total Rainfall: 13.52 inches

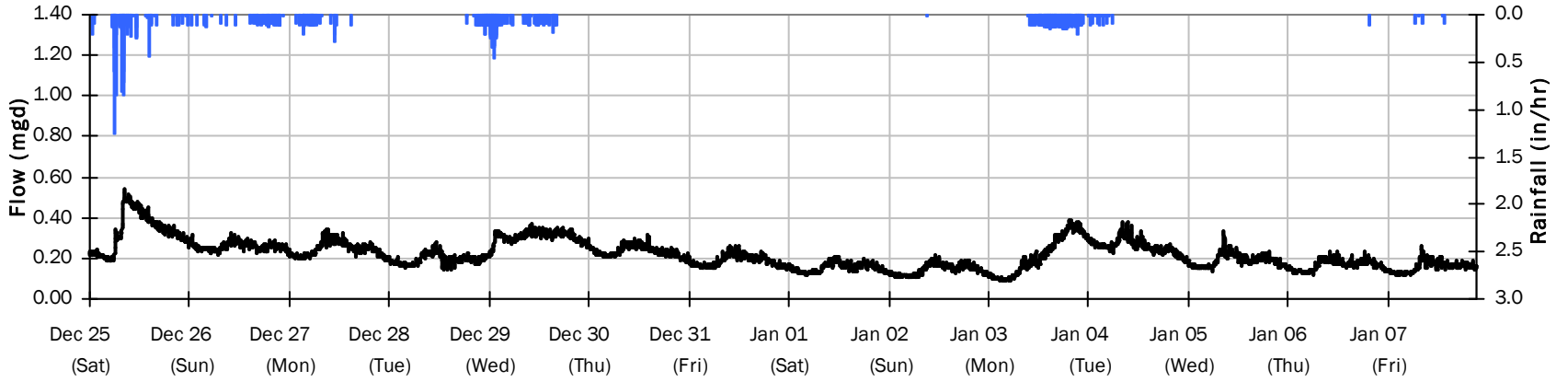


SITE 07.01

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 13.44 inches Period Avg Flow: 0.253 mgd Period Peak Flow: 1.149 mgd Period Min Flow: 0.013 mgd

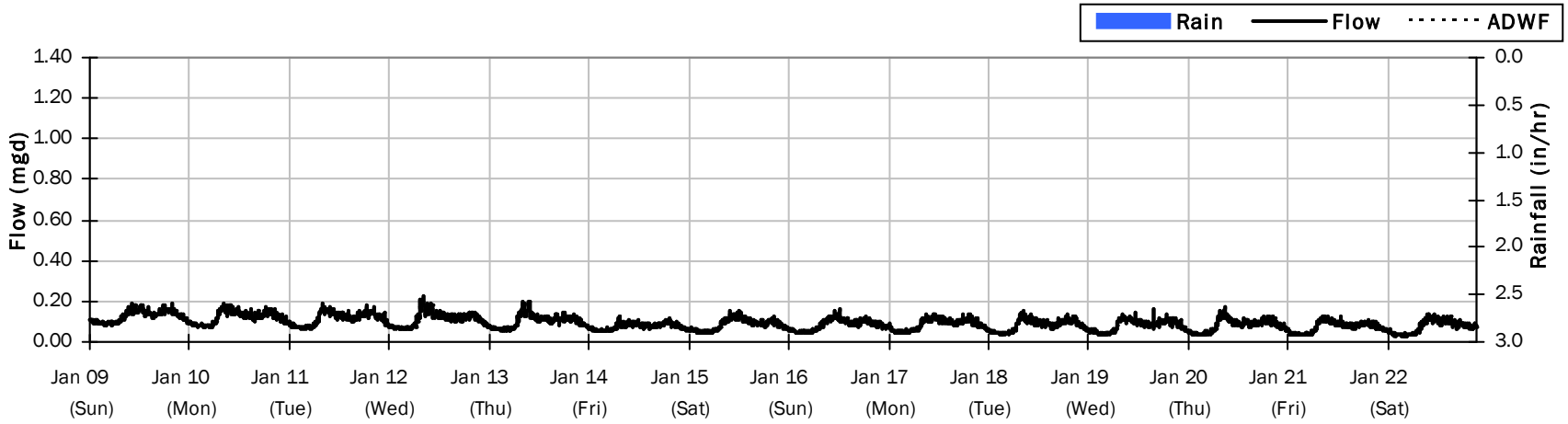


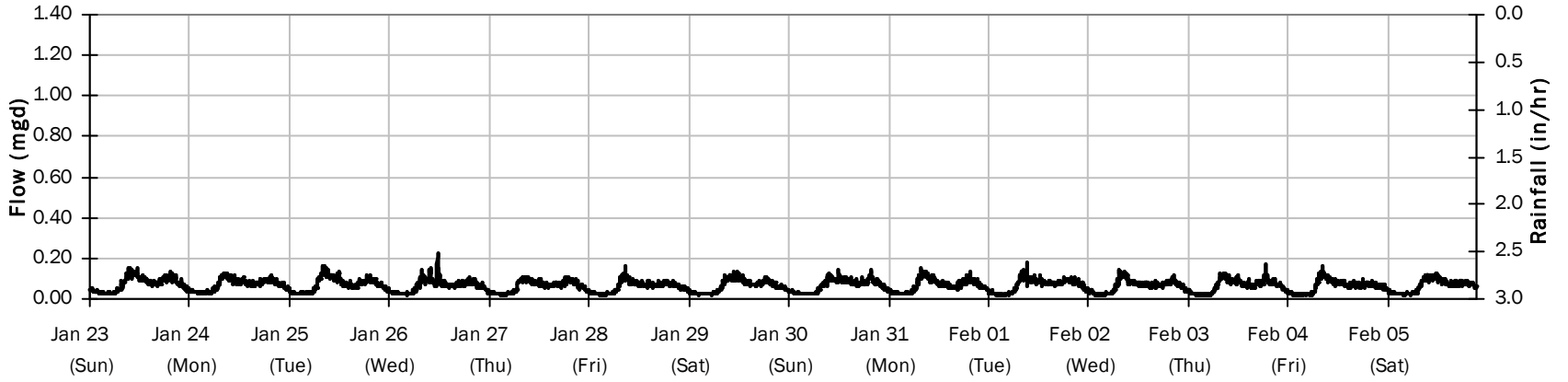


SITE 07.01

Flow Summary: 1/9/2022 to 2/5/2022

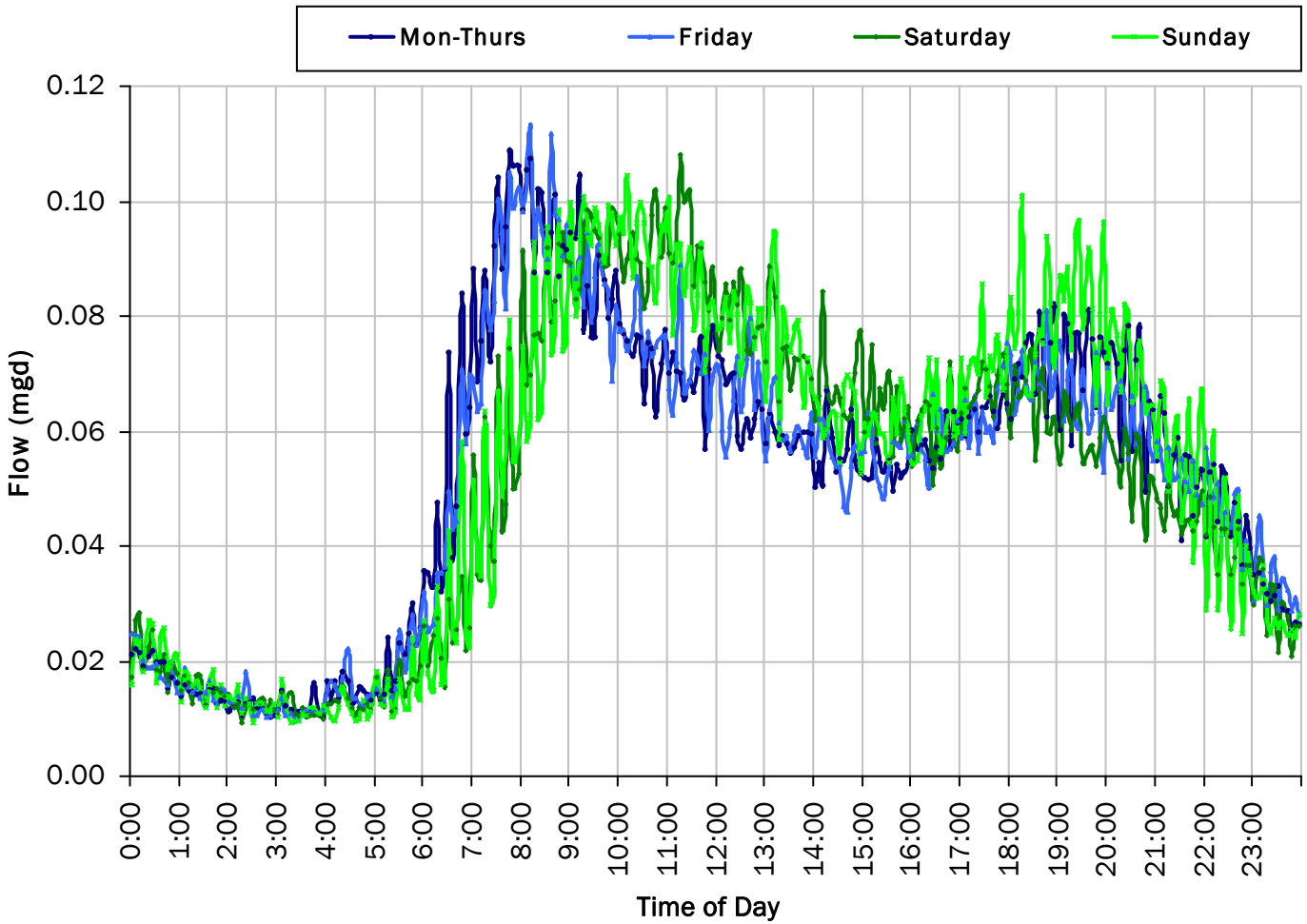
Period Rainfall: 0.00 inches Period Avg Flow: 0.080 mgd Period Peak Flow: 0.228 mgd Period Min Flow: 0.018 mgd





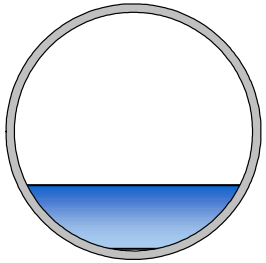
SITE 07.01

Average Dry Weather Flow Hydrographs



ADWF:

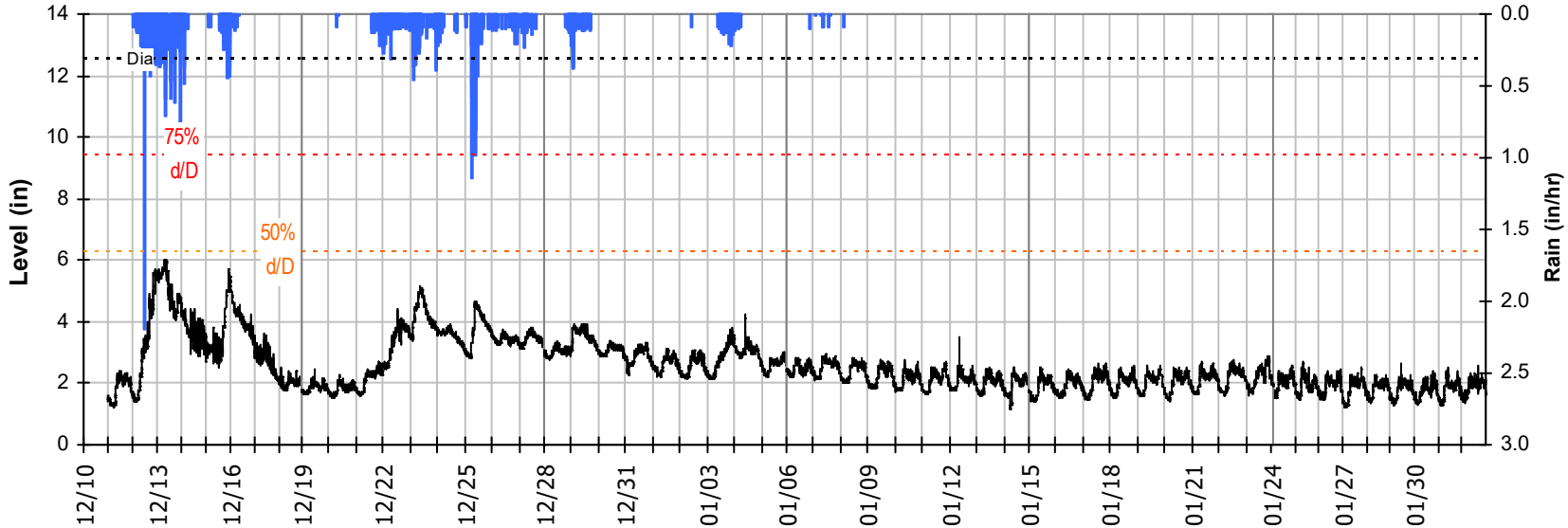
0.052 *mgd*

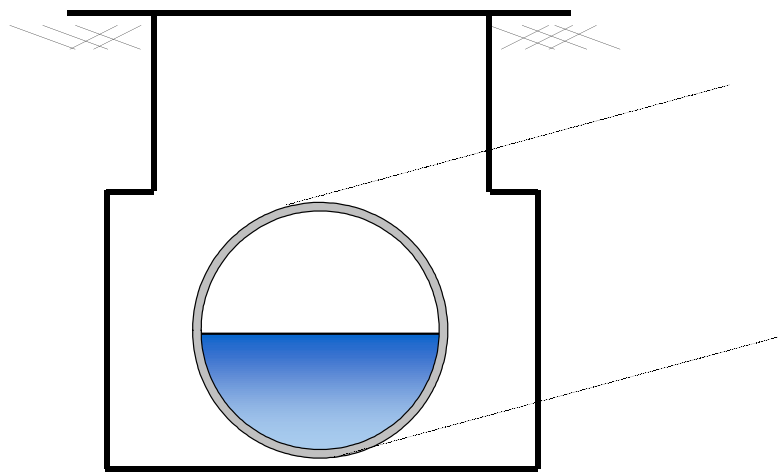


SITE 06

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

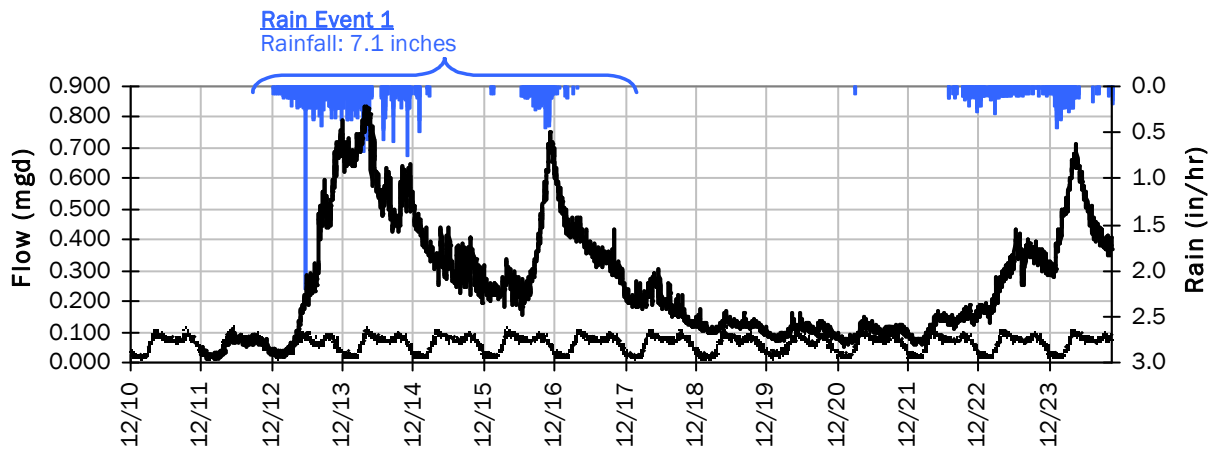




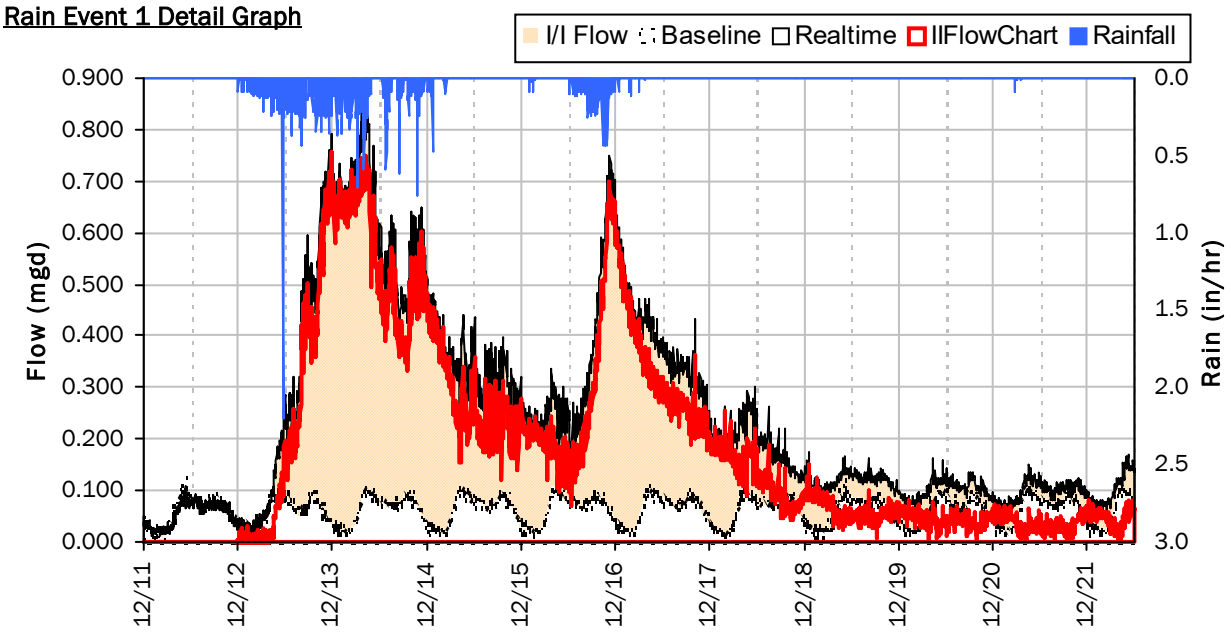
Pipe Diameter:	12.5	*inches*
Peak Measured Level:	6.02	*inches*
Peak d/D Ratio:	0.48	

SITE 06
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

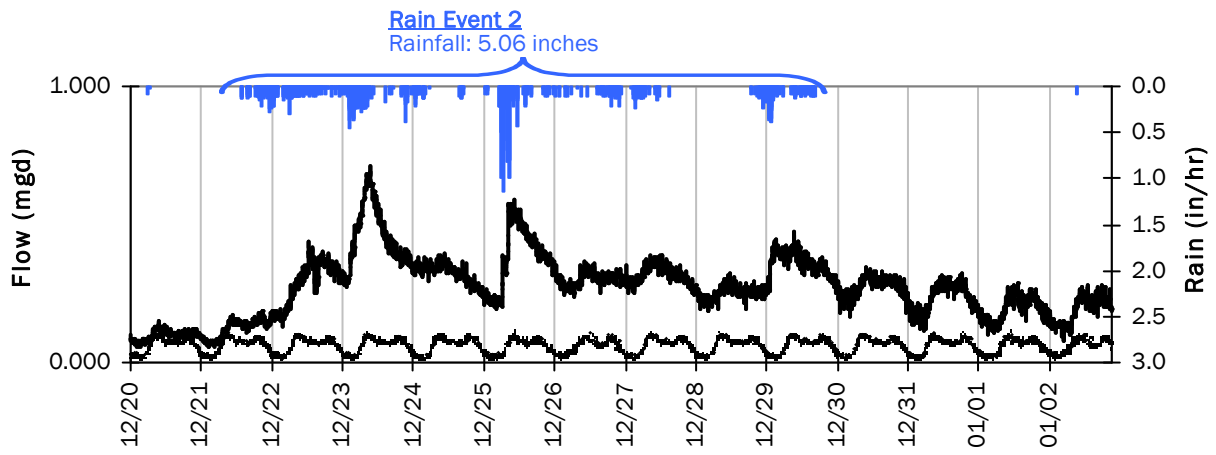


Storm Event I/I Analysis (Rain = 7.10 inches)

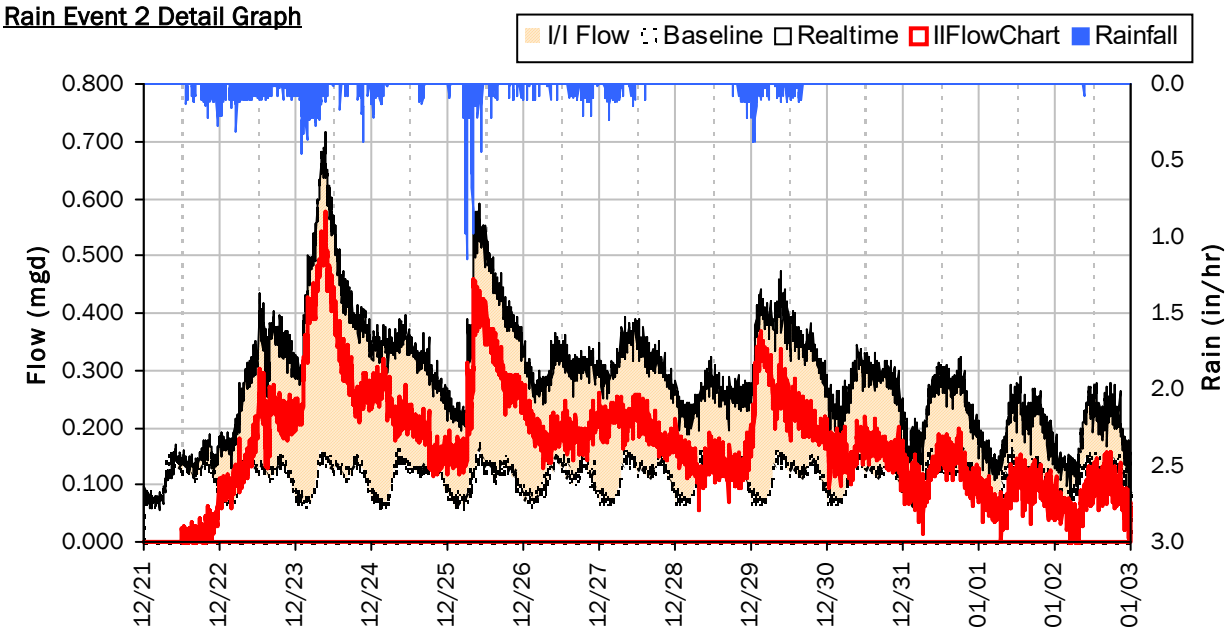
Capacity		Inflow / Infiltration	
Peak Flow:	0.837 *mgd*	Peak I/I Rate:	0.757 *mgd*
PF:	13.50	Total I/I:	1,935,000 *gallons*
Peak Level:	6.02 *in*		
d/D Ratio:	0.48		

SITE 06
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



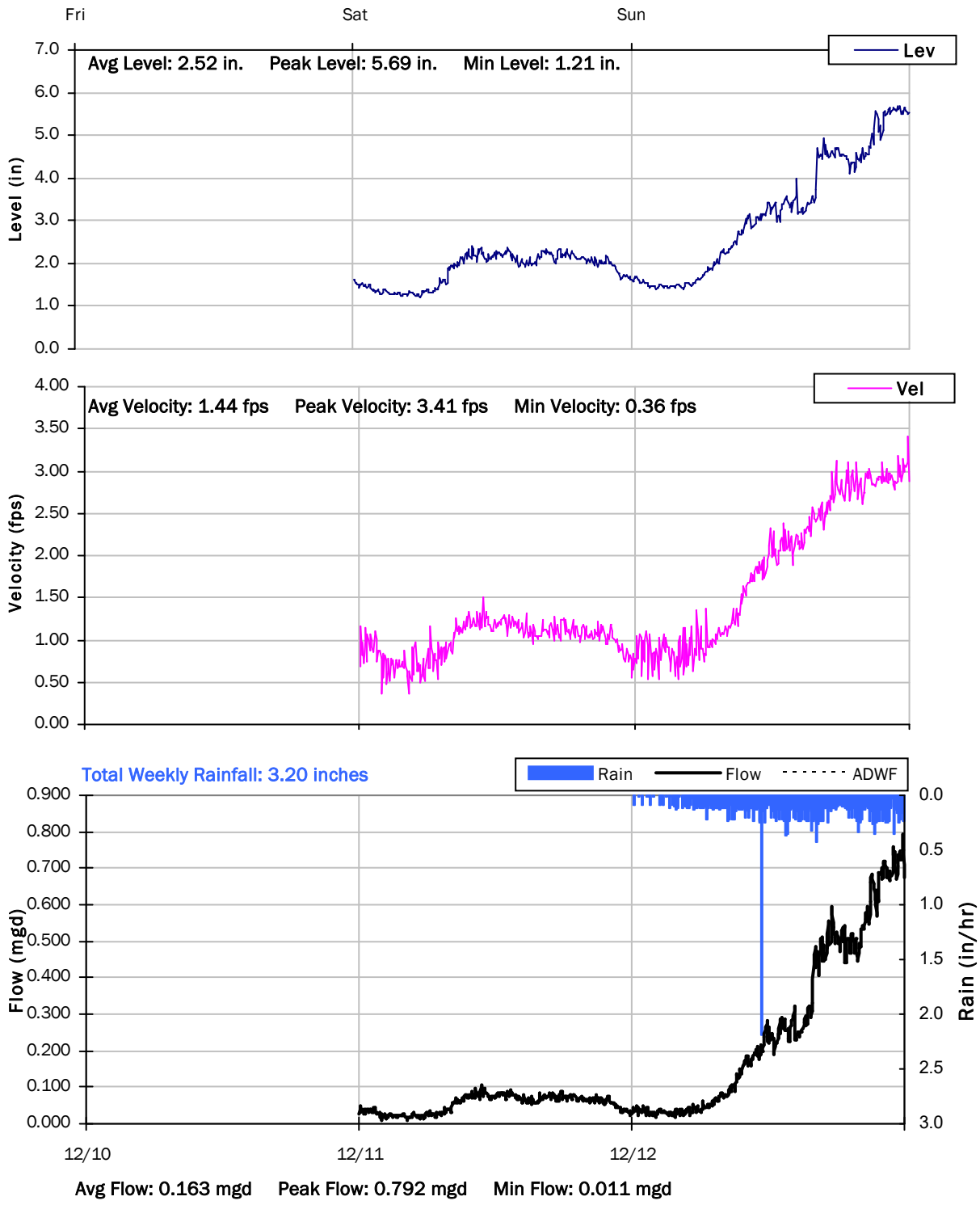
Storm Event I/I Analysis (Rain = 5.06 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.715 *mgd*	**Peak I/I Rate:**	0.579 *mgd*
PF:	11.53	**Total I/I:**	2,240,000 *gallons*
Peak Level:	5.15 *in*		
d/D Ratio:	0.41		

SITE 06

Weekly Level, Velocity and Flow Hydrographs

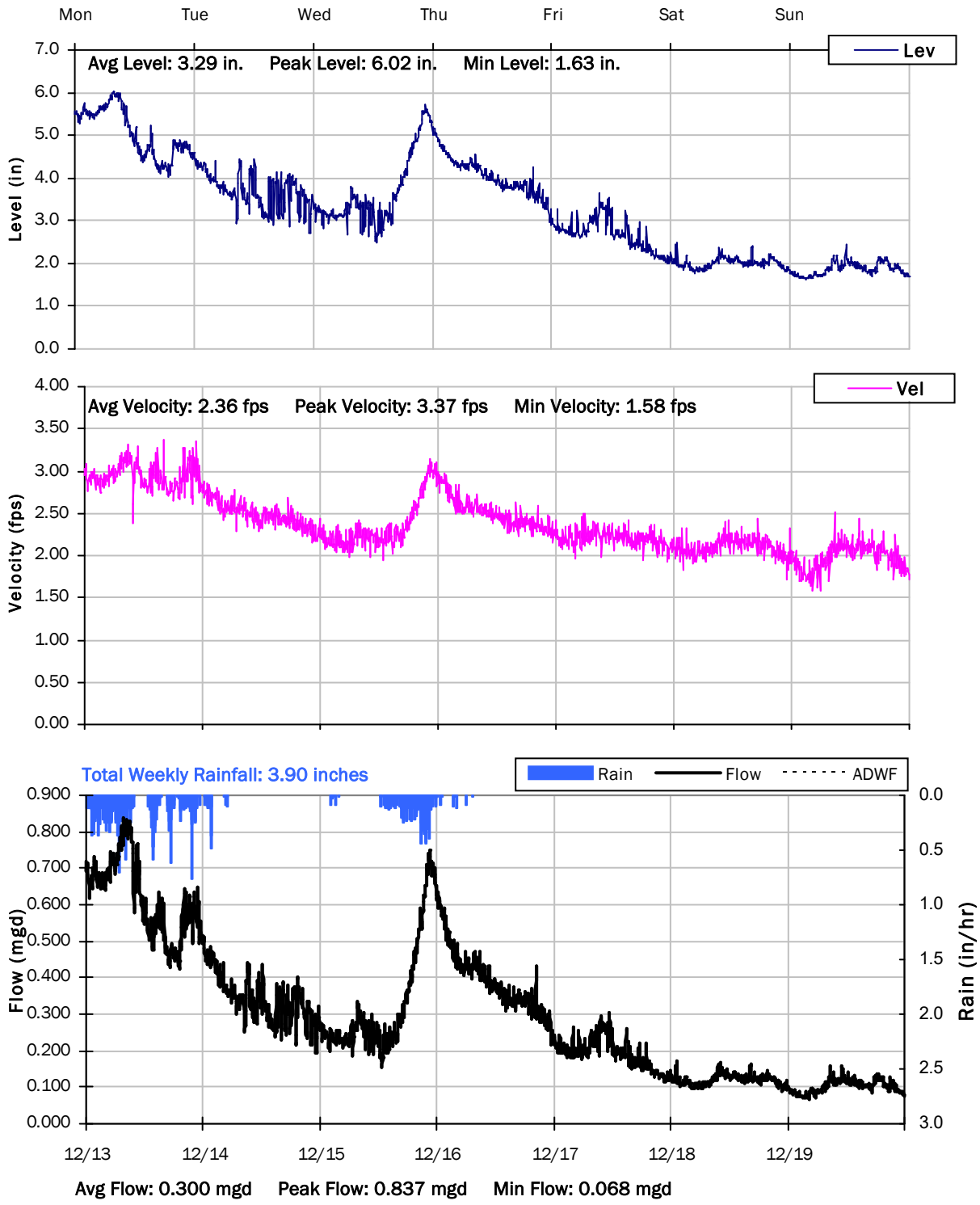
12/10/2021 to 12/13/2021



SITE 06

Weekly Level, Velocity and Flow Hydrographs

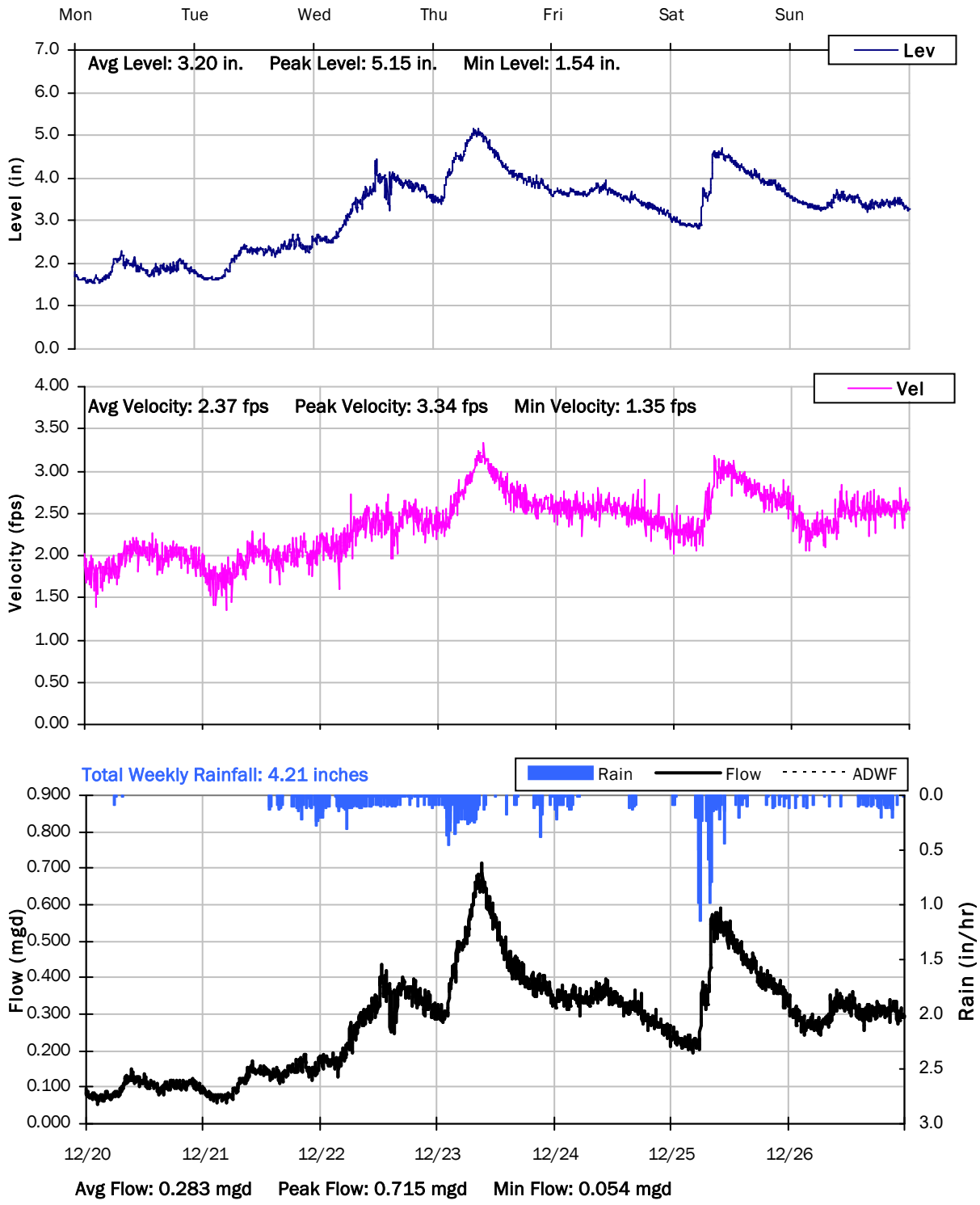
12/13/2021 to 12/20/2021



SITE 06

Weekly Level, Velocity and Flow Hydrographs

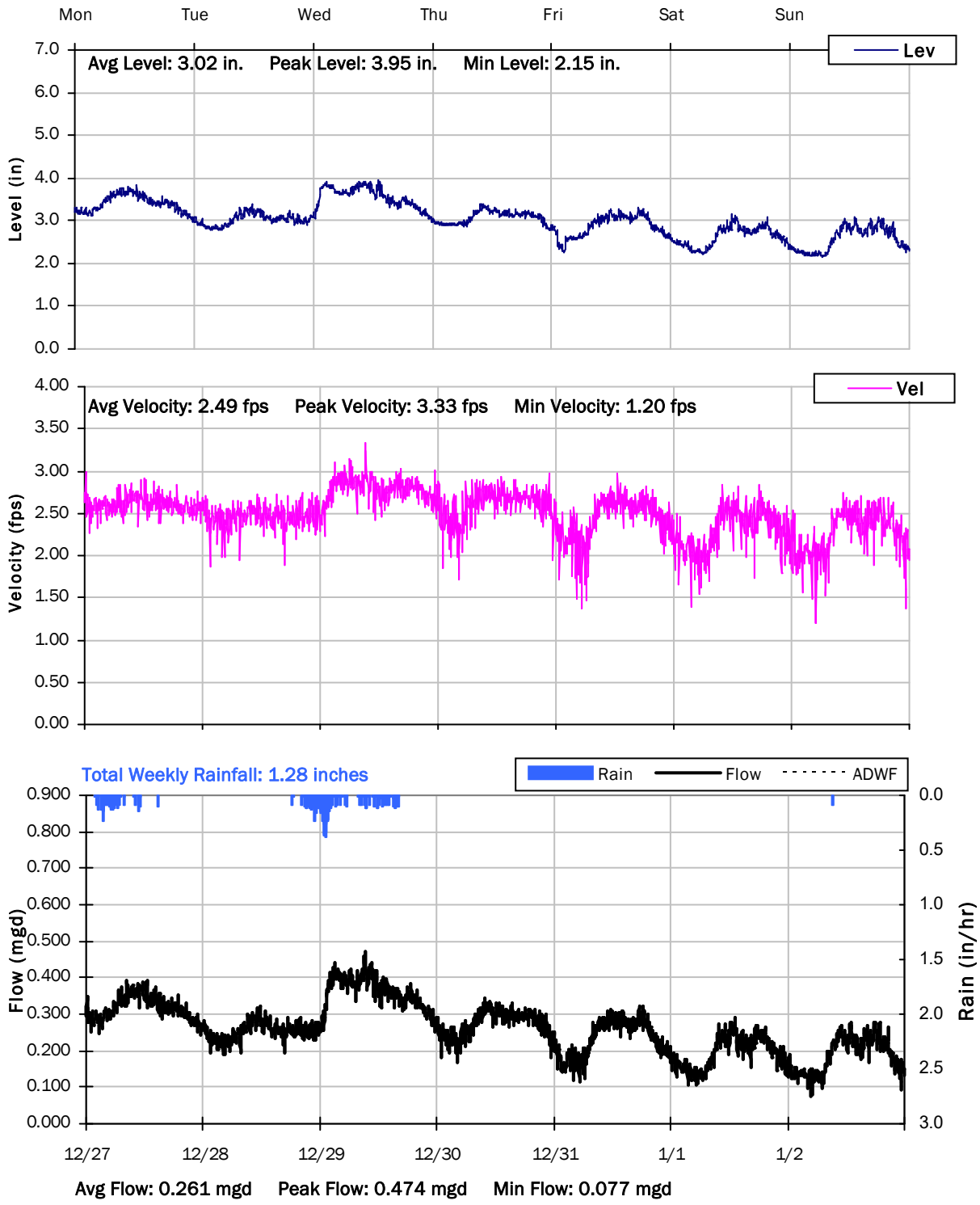
12/20/2021 to 12/27/2021



SITE 06

Weekly Level, Velocity and Flow Hydrographs

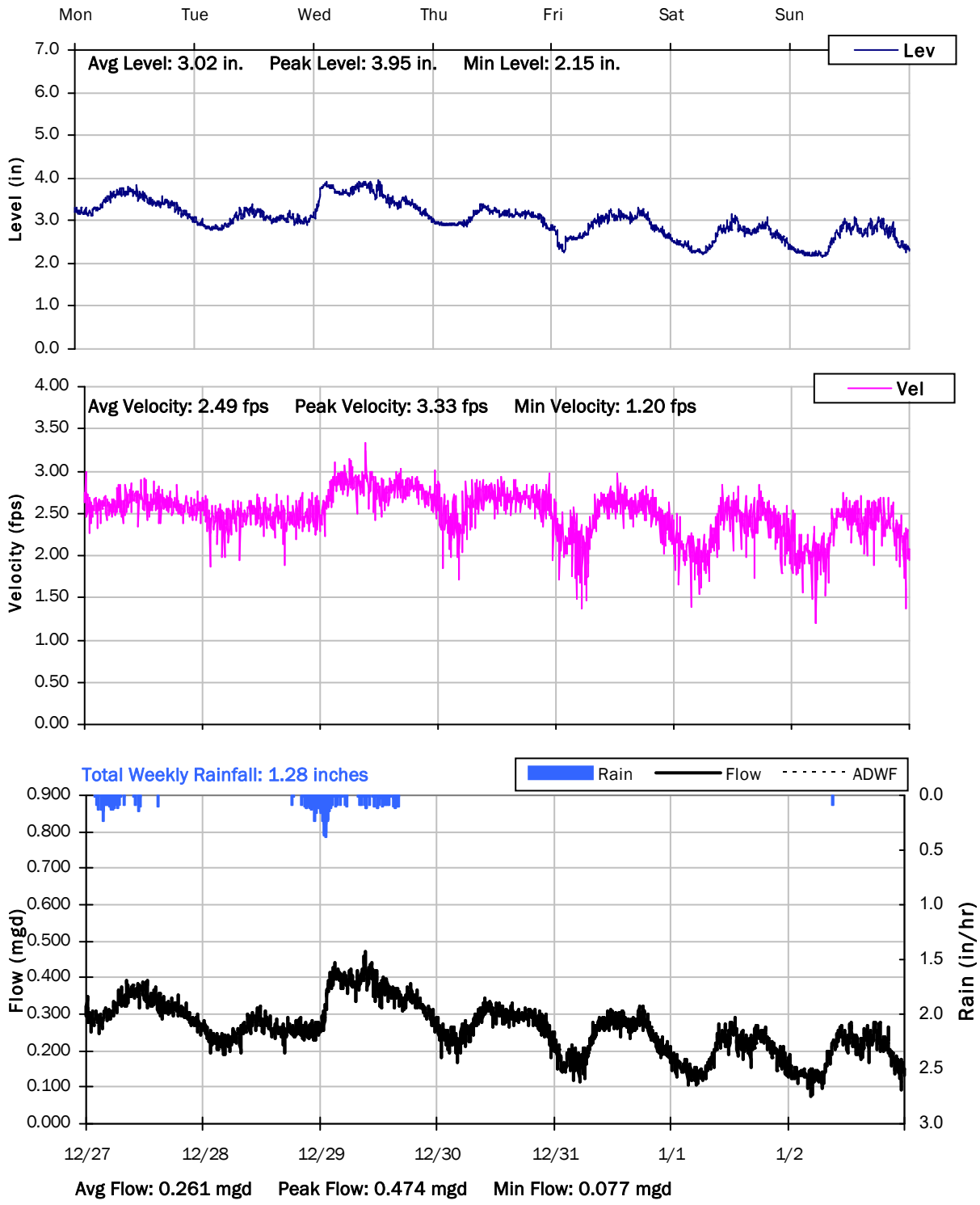
12/27/2021 to 1/3/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

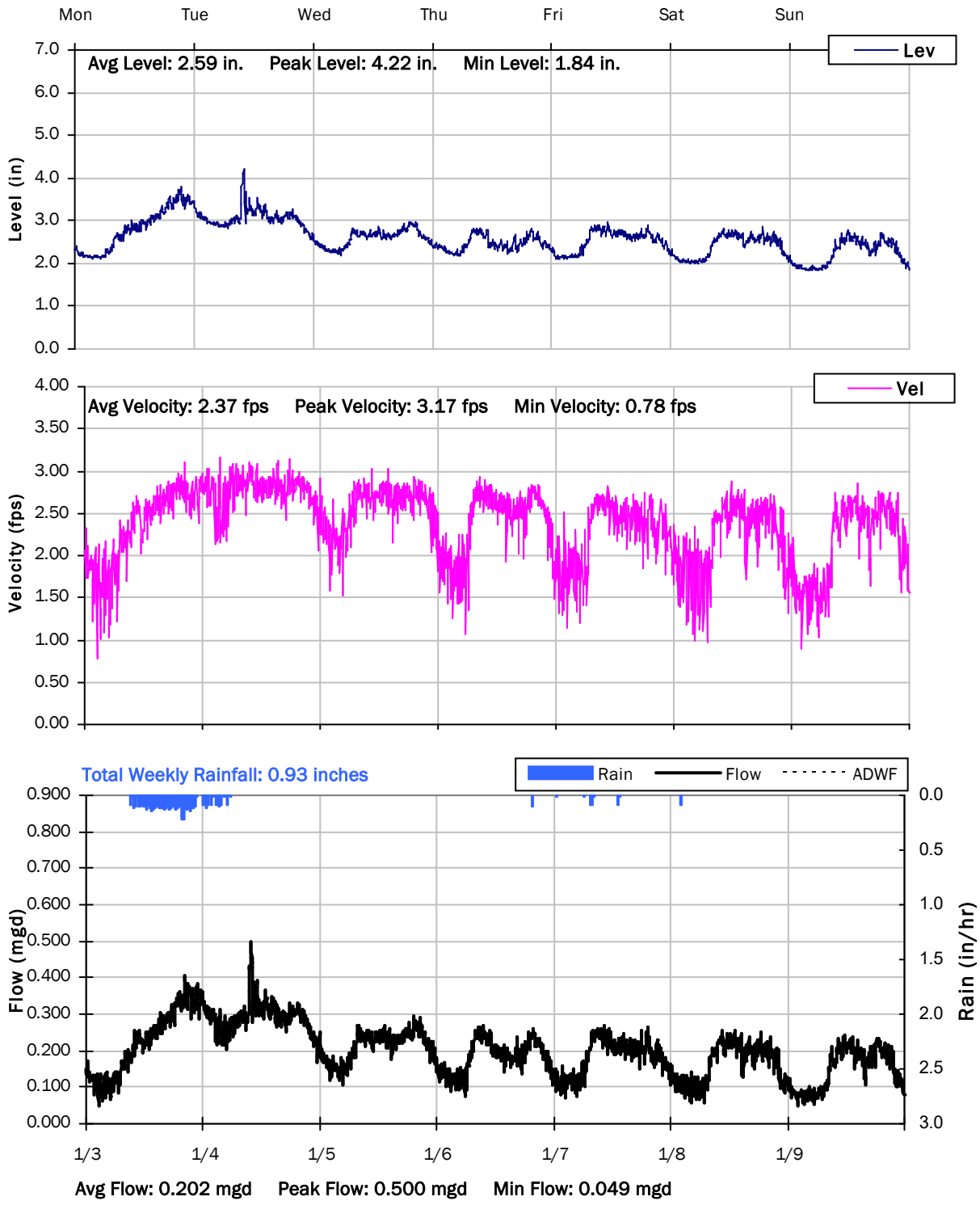
12/27/2021 to 1/3/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

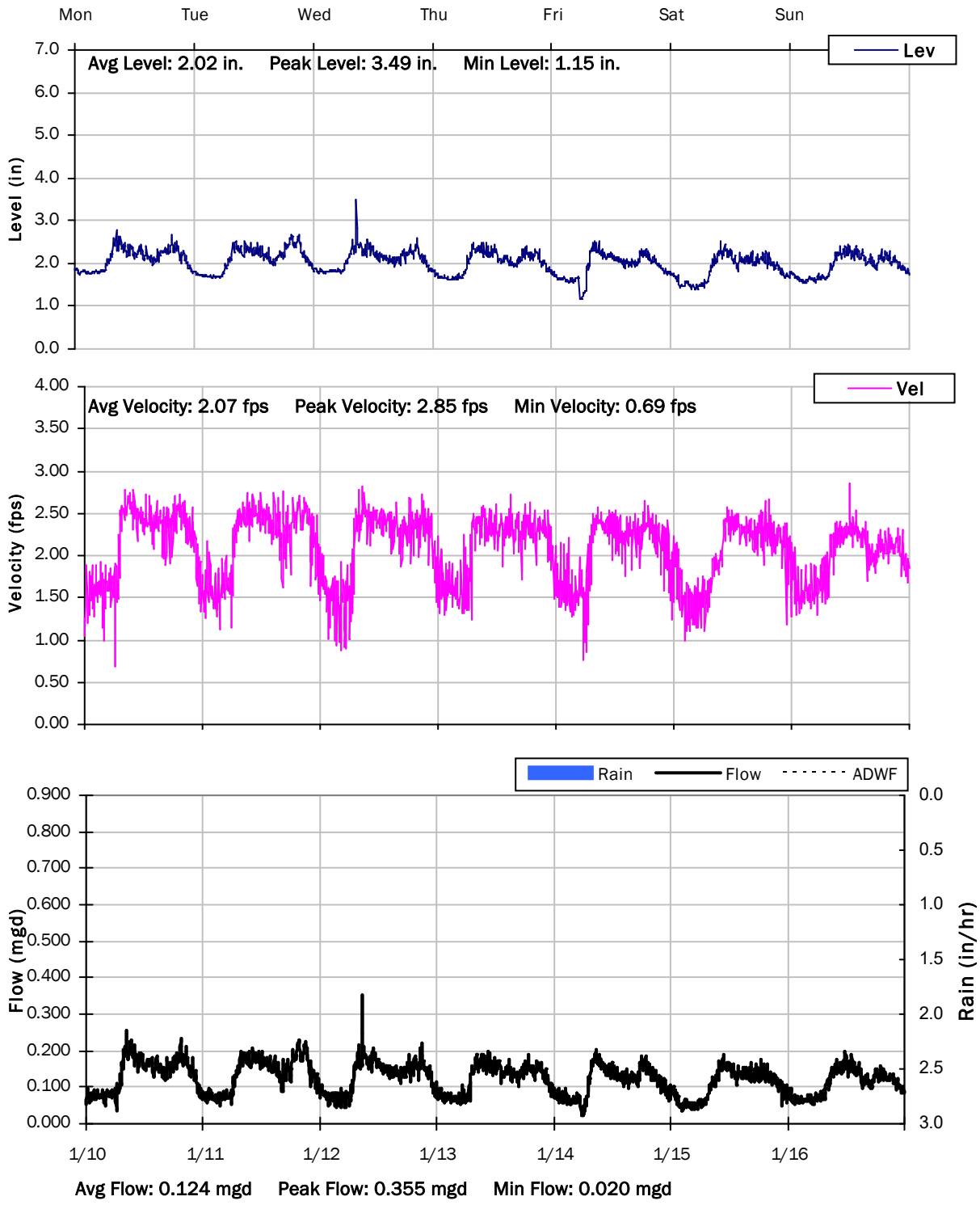
1/3/2022 to 1/10/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

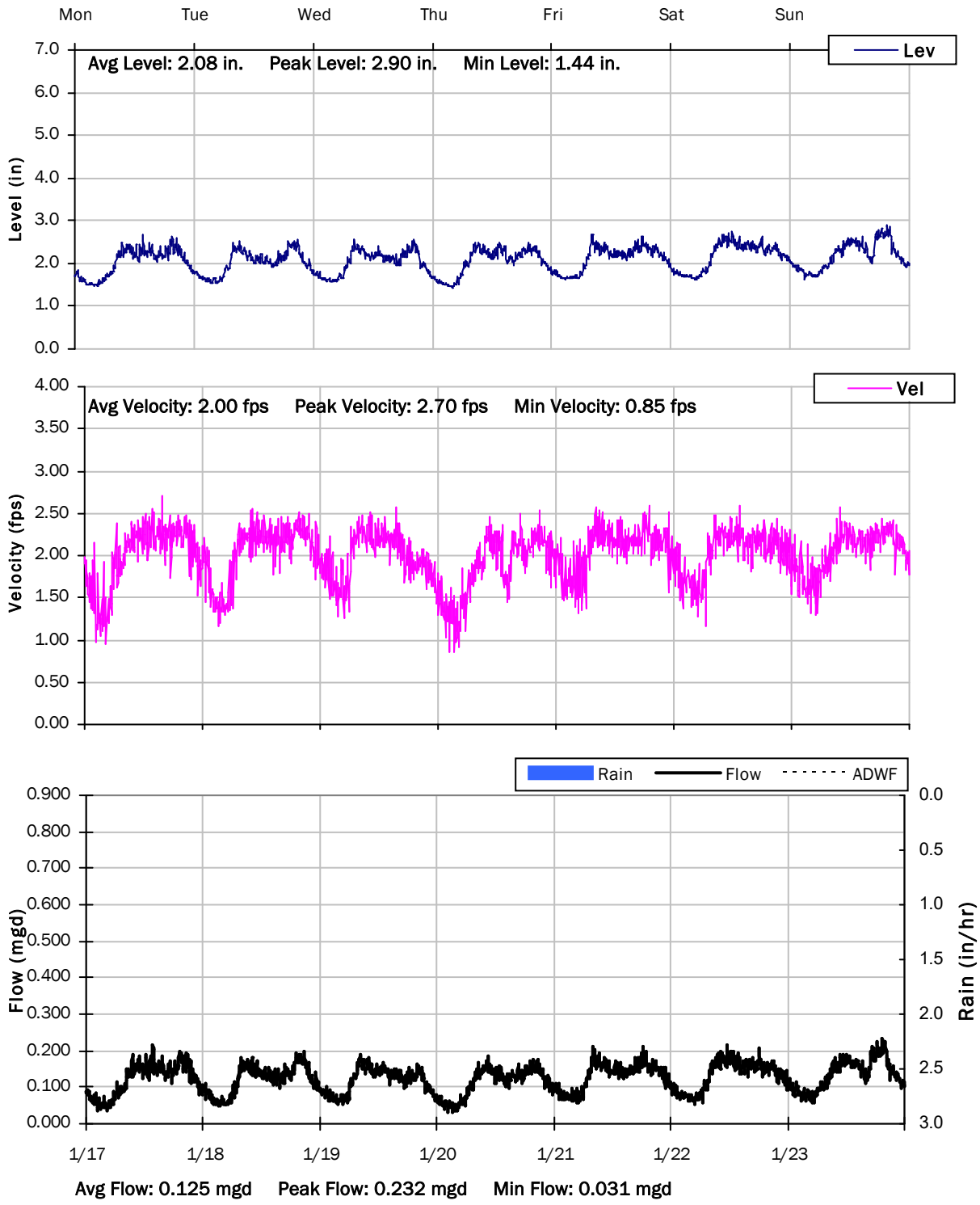
1/10/2022 to 1/17/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

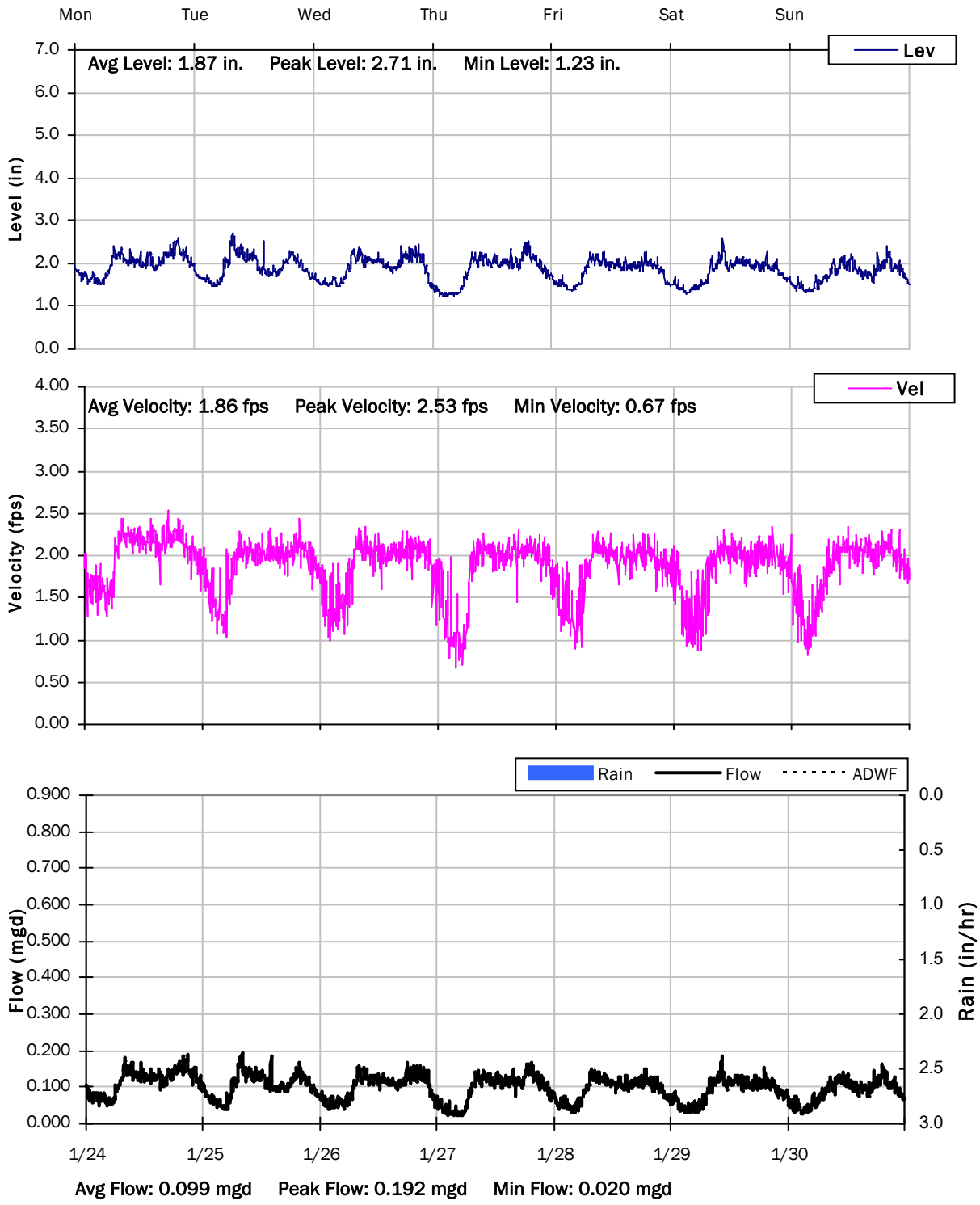
1/17/2022 to 1/24/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

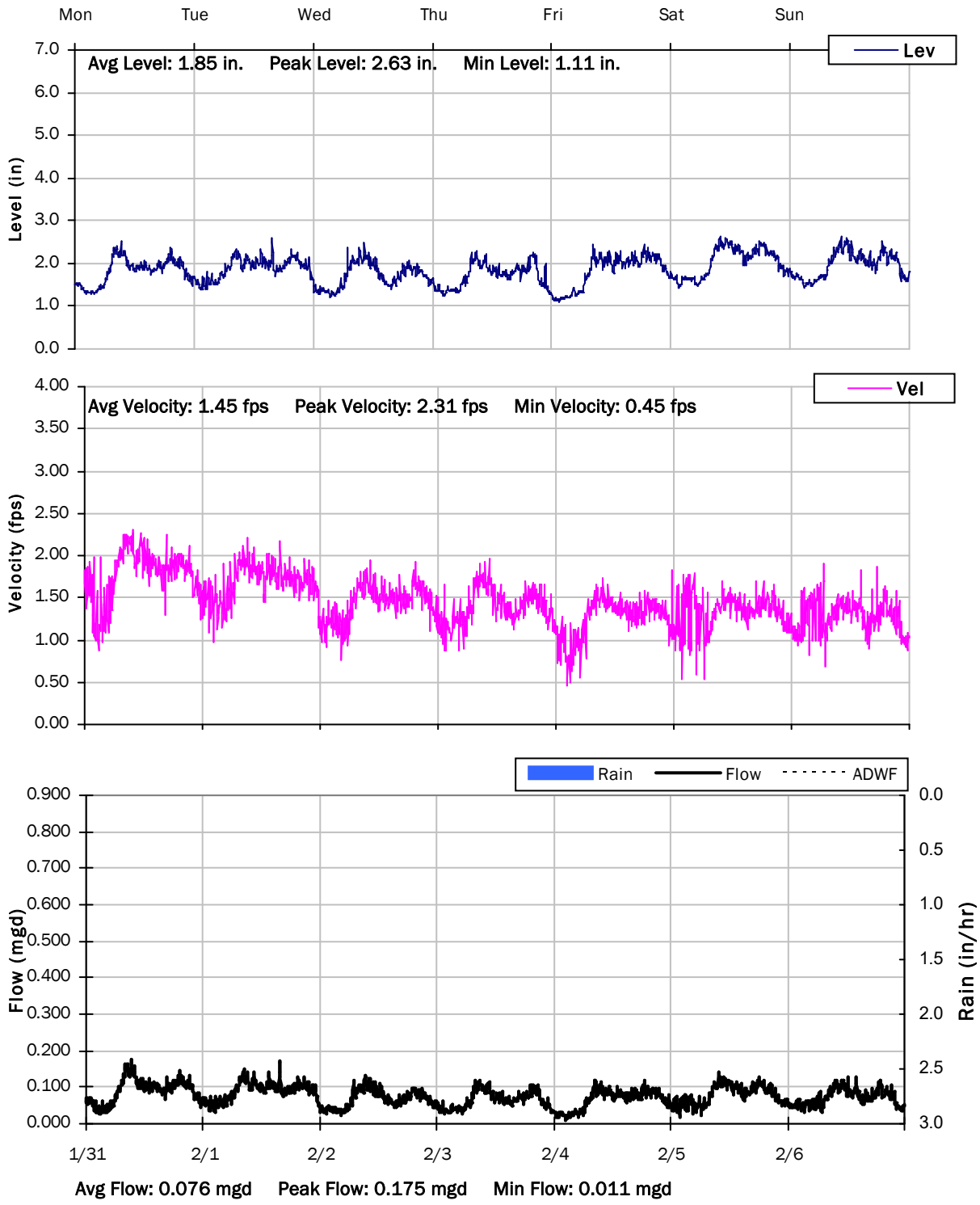
1/24/2022 to 1/31/2022



SITE 06

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 07.01

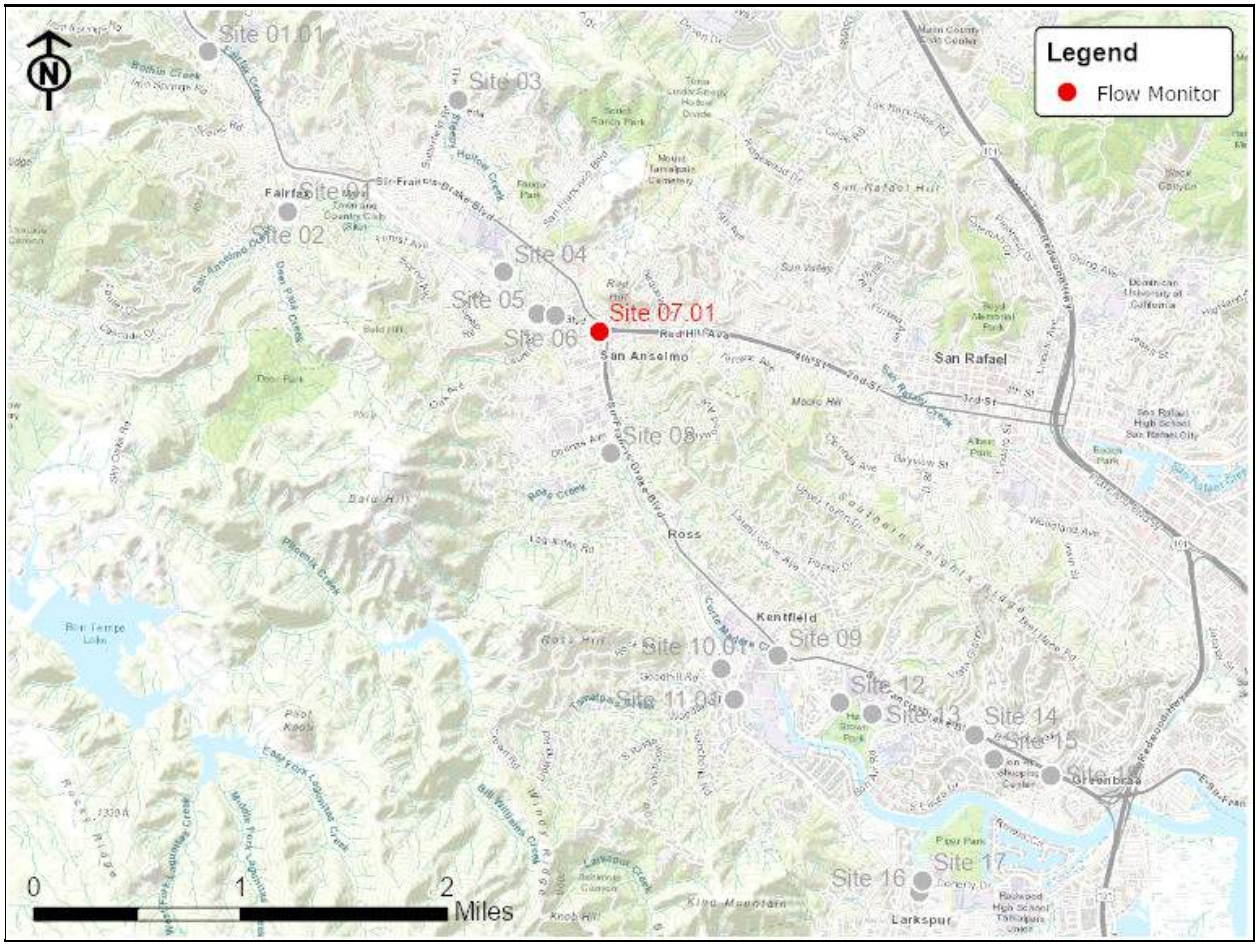
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 85 Center Boulevard

Data Summary Report



Vicinity Map: Site 07.01

SITE 07.01

Site Information MH ID: S400.020

Location: 85 Center Boulevard

Coordinates: 122.5625° W, 37.9764° N

Rim Elevation (Earth): 55 feet

Expected Pipe Diameter: 10 inches

Measured Pipe Diameter: 10 inches

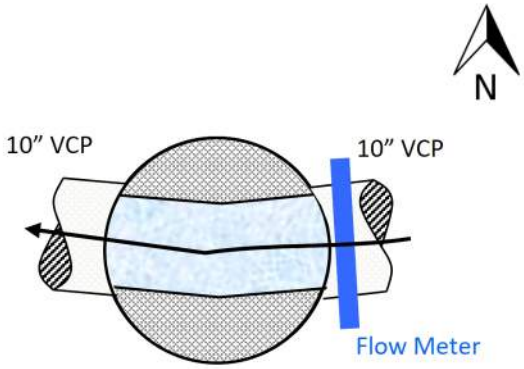
ADWF: 0.052 mgd

Peak Measured Flow: 1.149 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 07.01

Additional Site Photos

Effluent Pipe

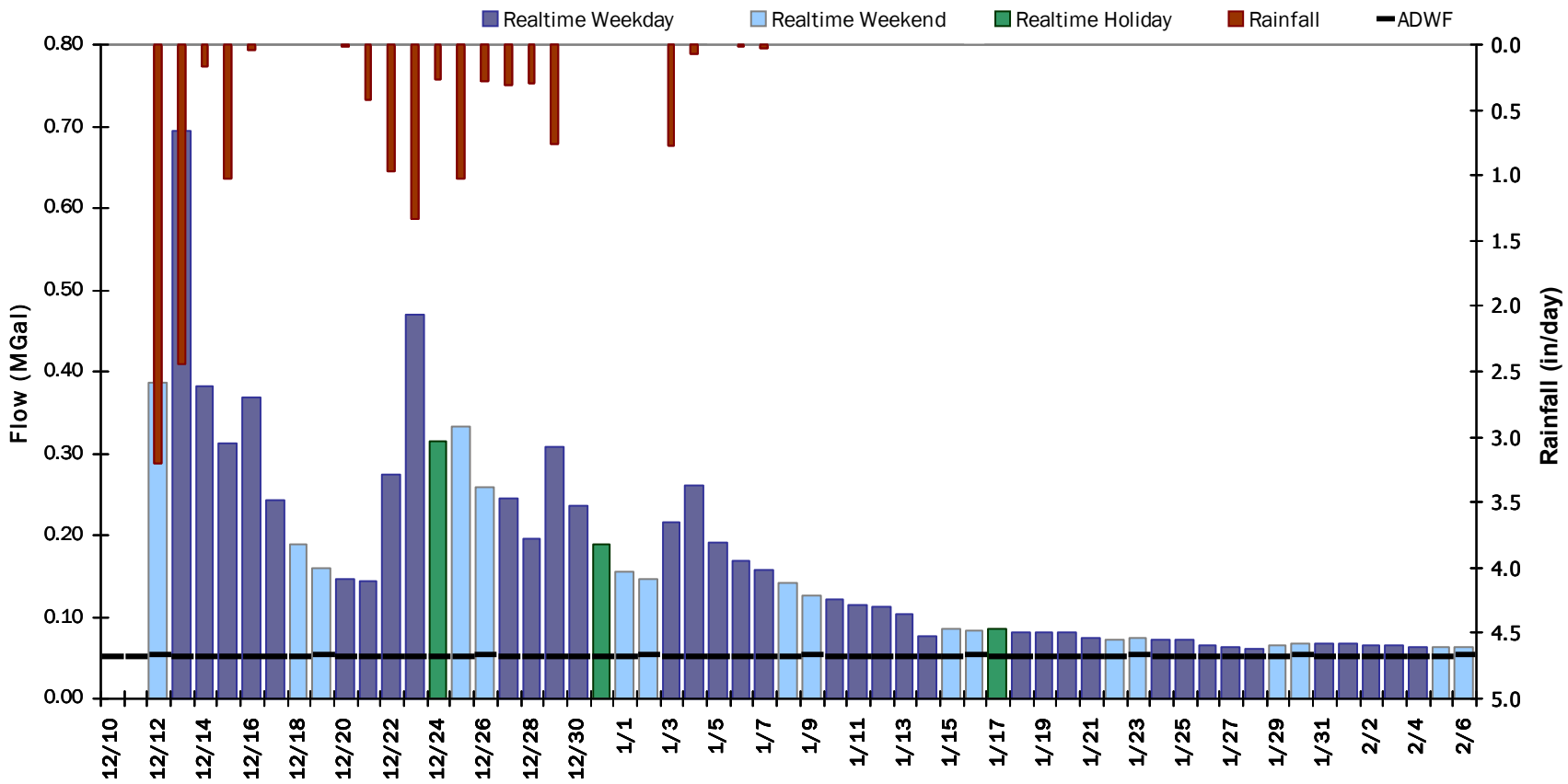
Monitored East Influent Pipe

SITE 07.01

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.166 MGal Peak Daily Flow: 0.694 MGal Min Daily Flow: 0.051 MGal

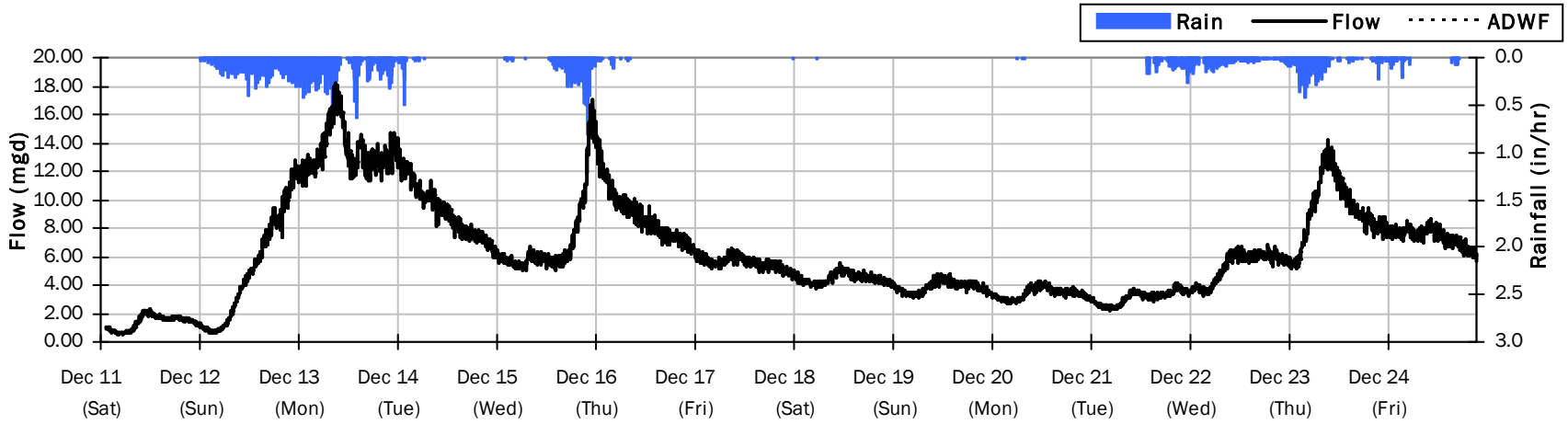
Total Rainfall: 13.44 inches

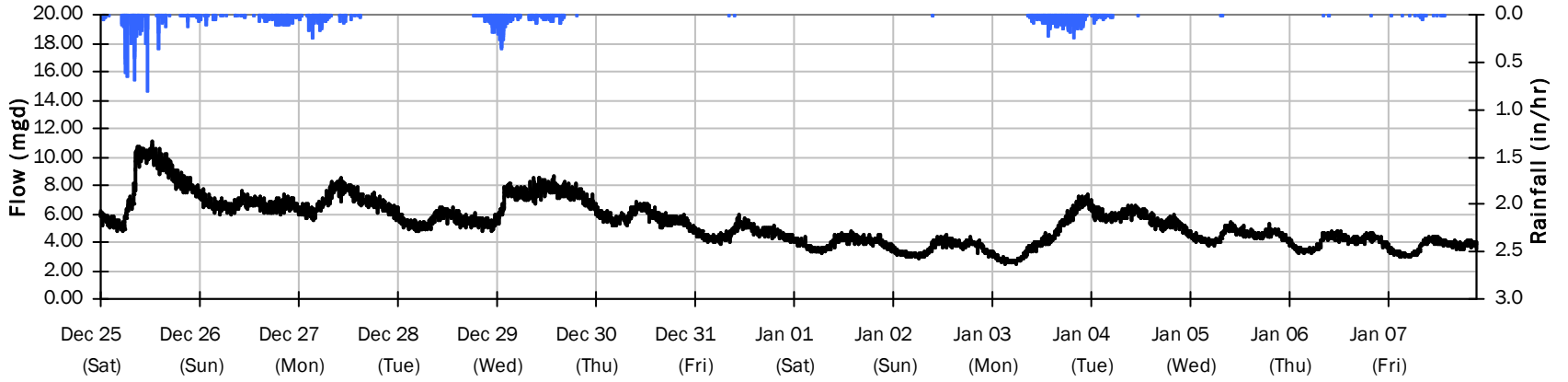


SITE 08

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 13.90 inches Period Avg Flow: 5.702 mgd Period Peak Flow: 18.179 mgd Period Min Flow: 0.578 mgd

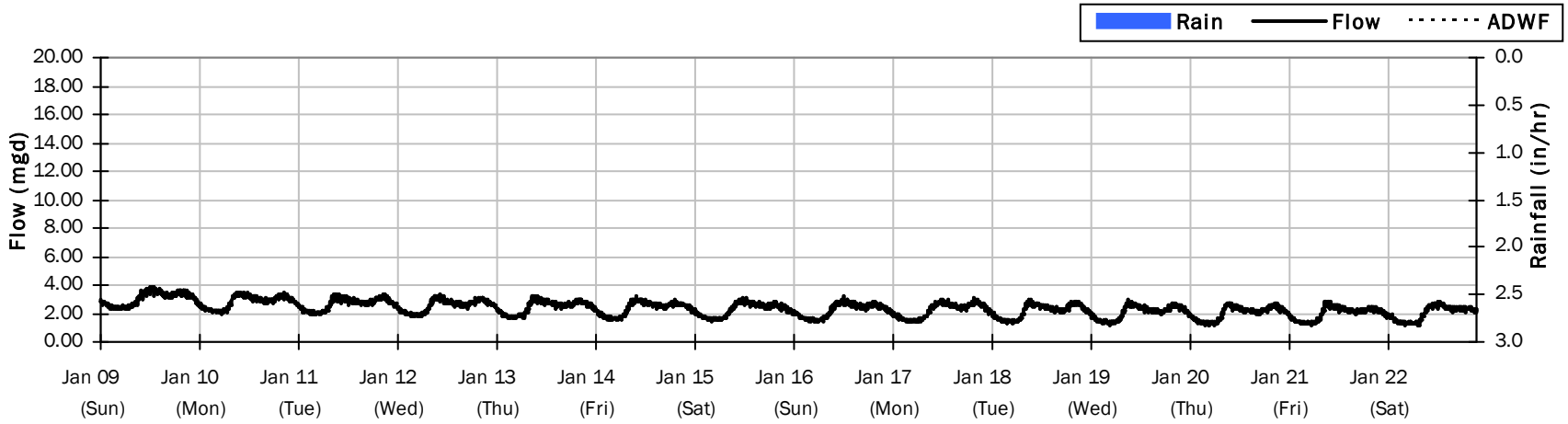


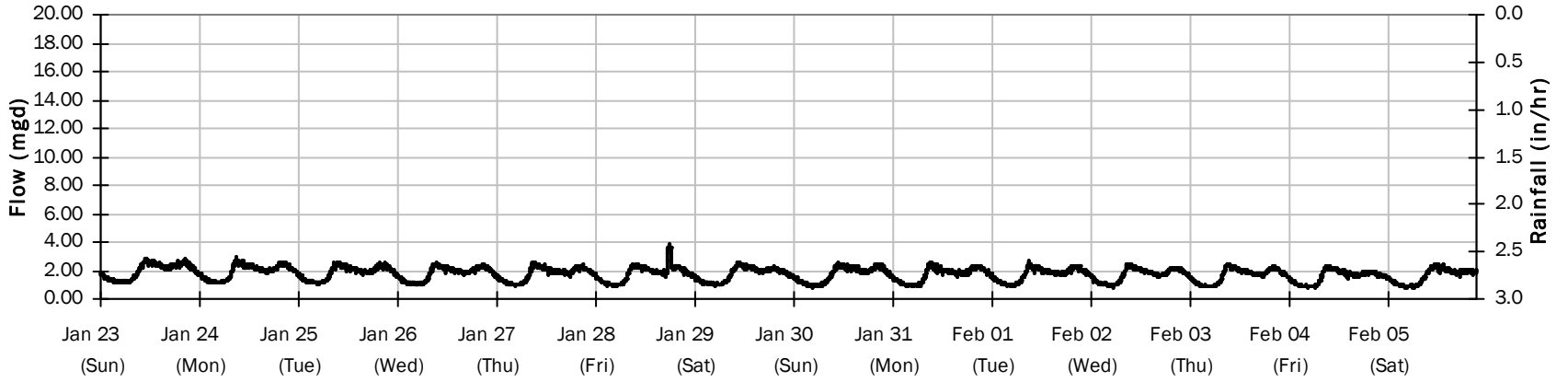


SITE 08

Flow Summary: 1/9/2022 to 2/5/2022

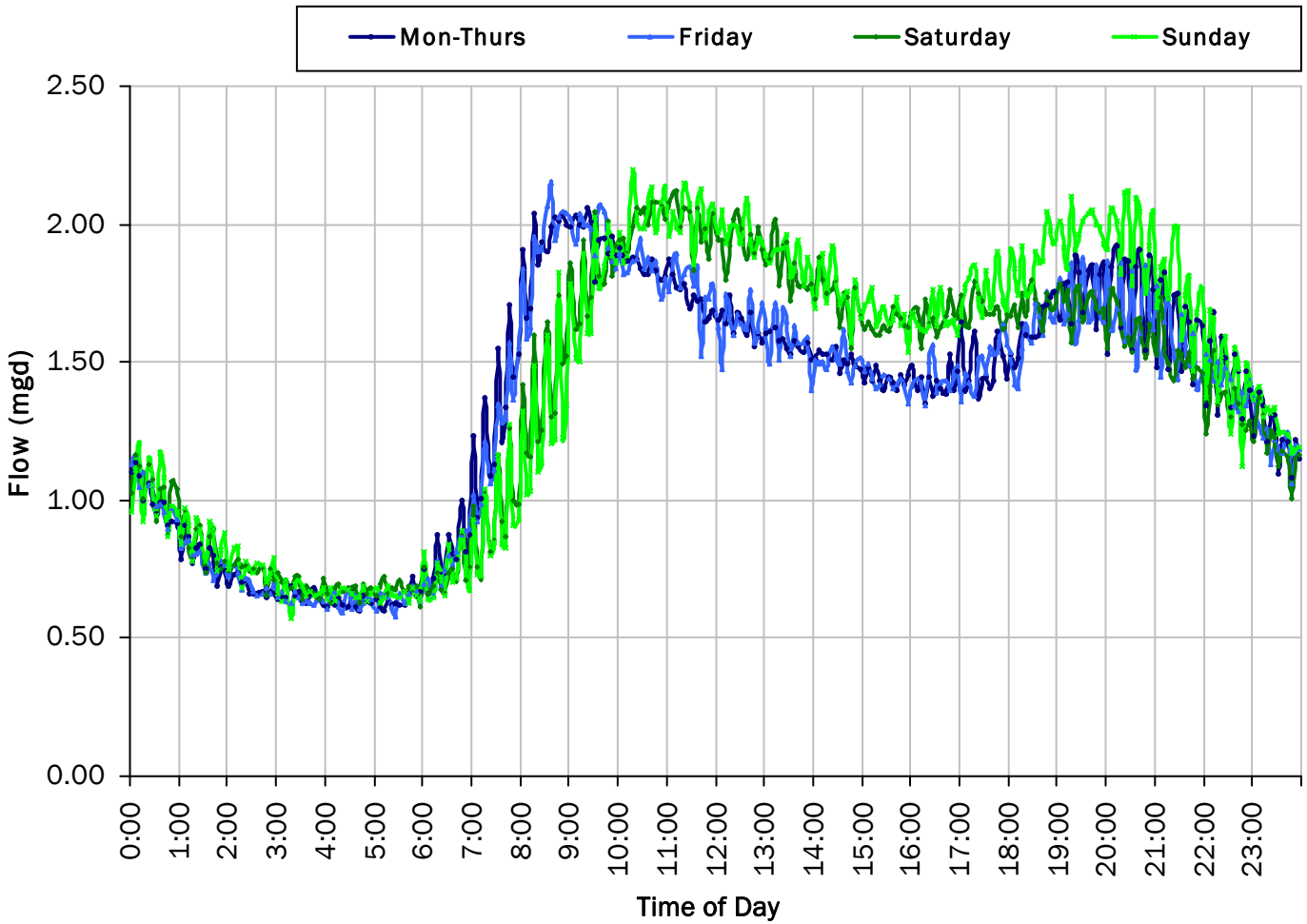
Period Rainfall: 0.00 inches Period Avg Flow: 2.060 mgd Period Peak Flow: 3.881 mgd Period Min Flow: 0.802 mgd





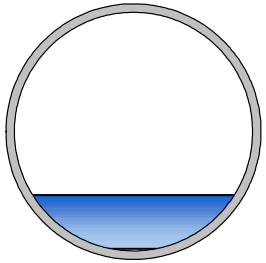
SITE 08

Average Dry Weather Flow Hydrographs



ADWF:

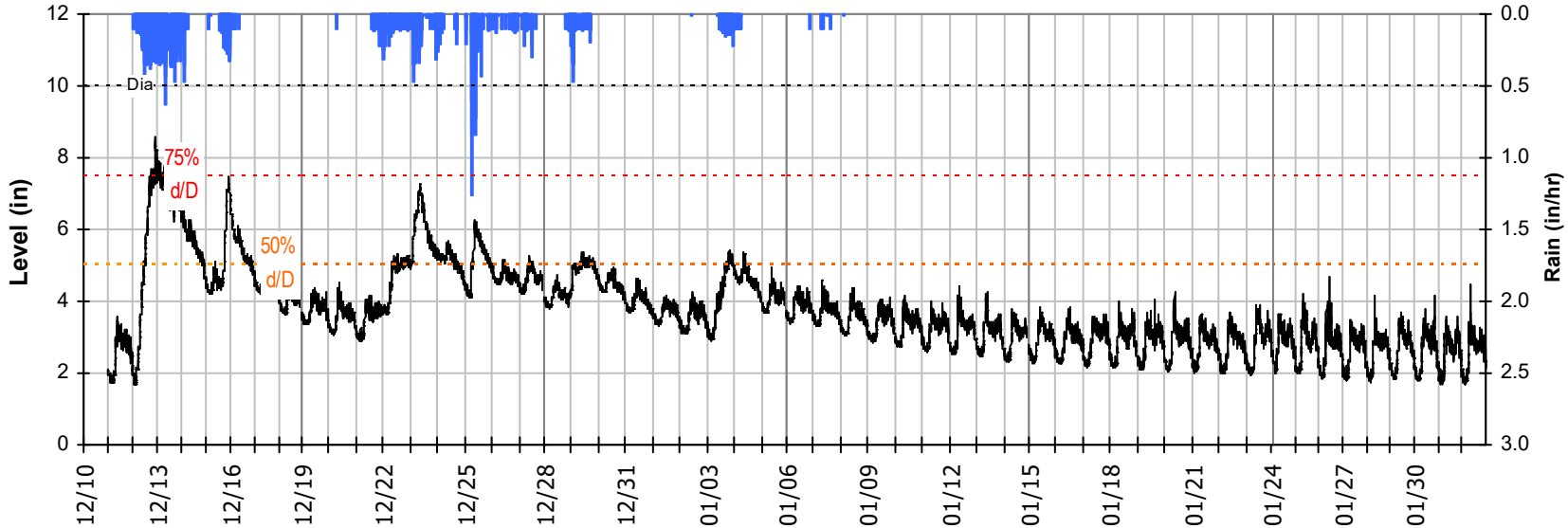
1.368 *mgd*

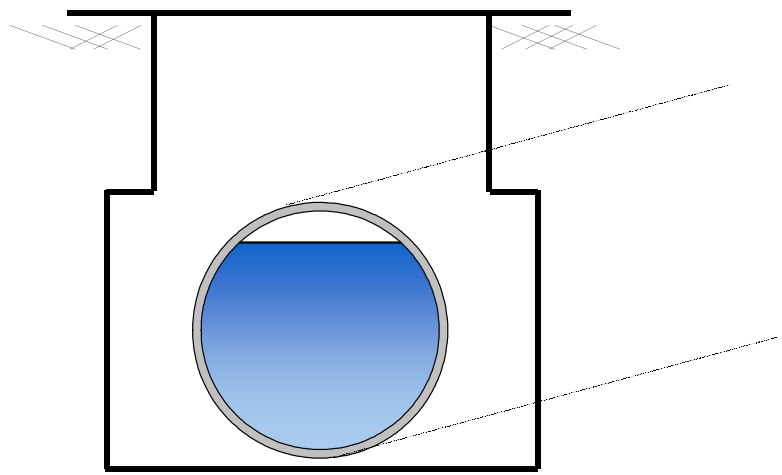


SITE 07.01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

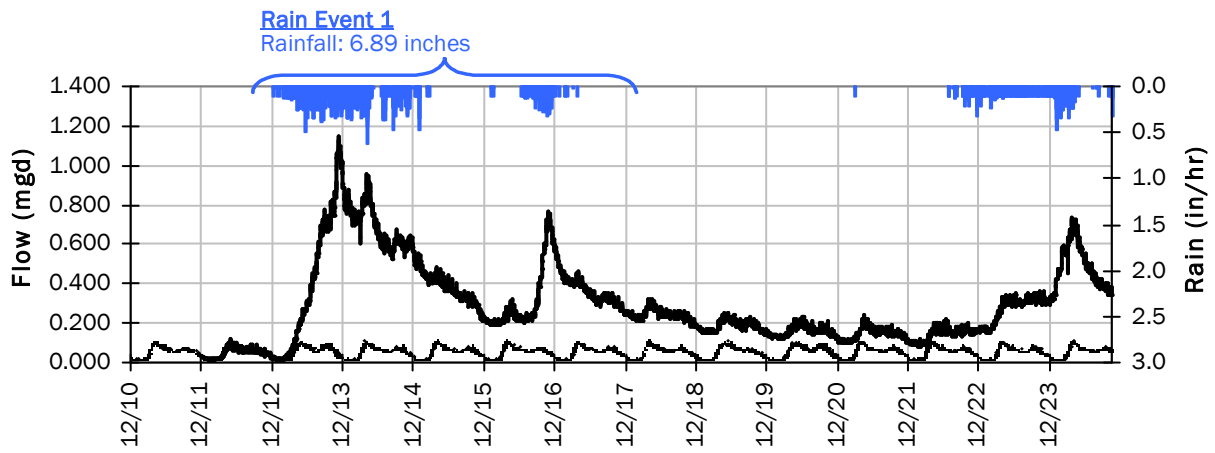




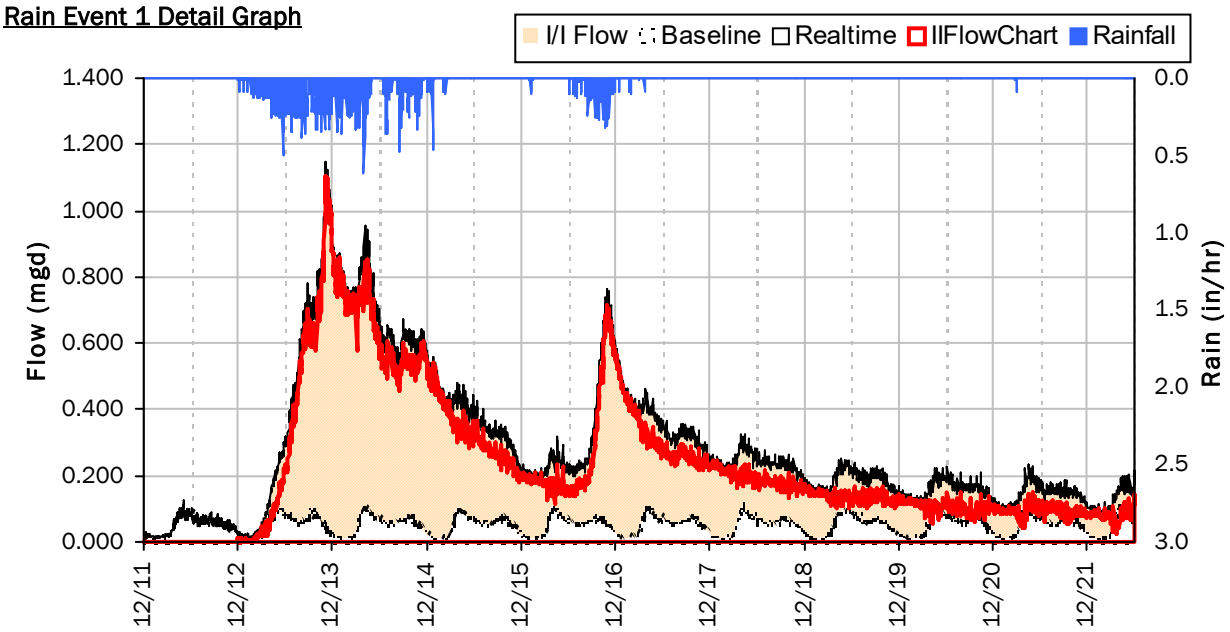
Pipe Diameter:	10	*inches*
Peak Measured Level:	8.58	*inches*
Peak d/D Ratio:	0.86	

SITE 07.01
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

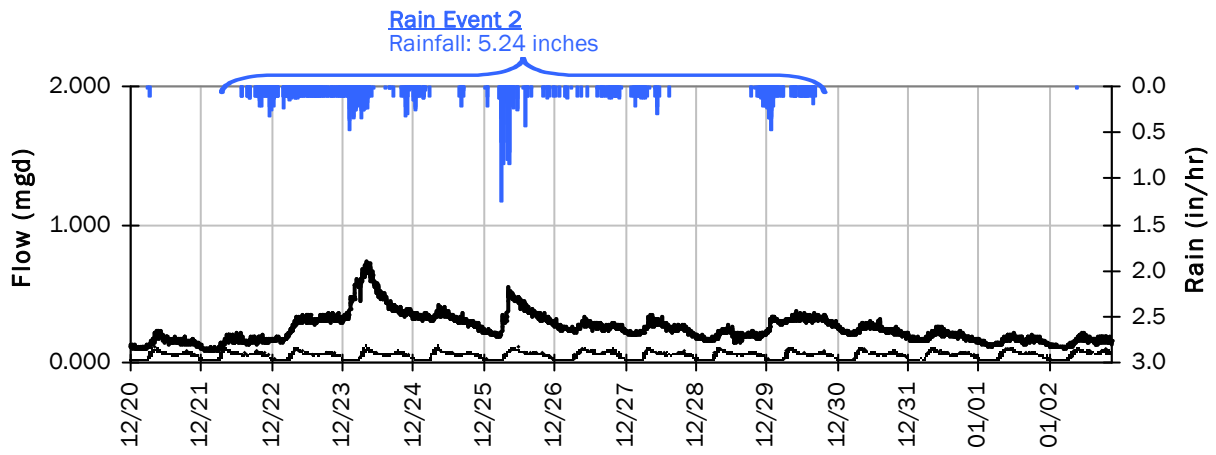


Storm Event I/I Analysis (Rain = 6.89 inches)

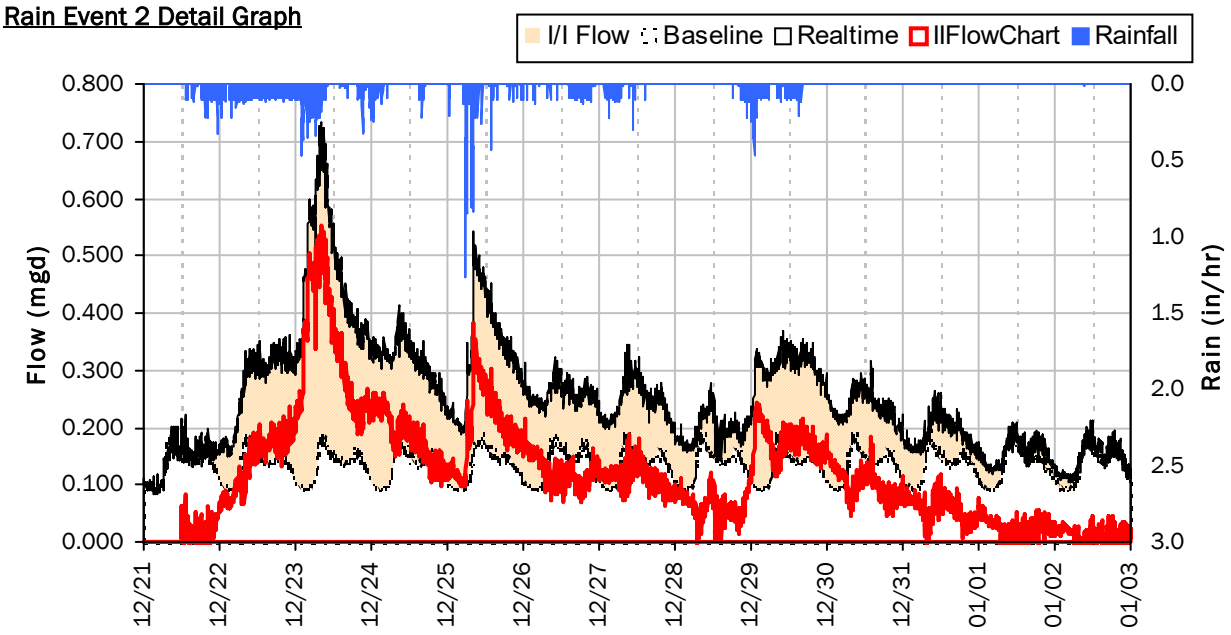
Capacity		Inflow / Infiltration	
Peak Flow:	1.149 *mgd*	**Peak I/I Rate:**	1.107 *mgd*
PF:	21.98	**Total I/I:**	2,449,000 *gallons*
Peak Level:	8.58 *in*		
d/D Ratio:	0.86		

SITE 07.01
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



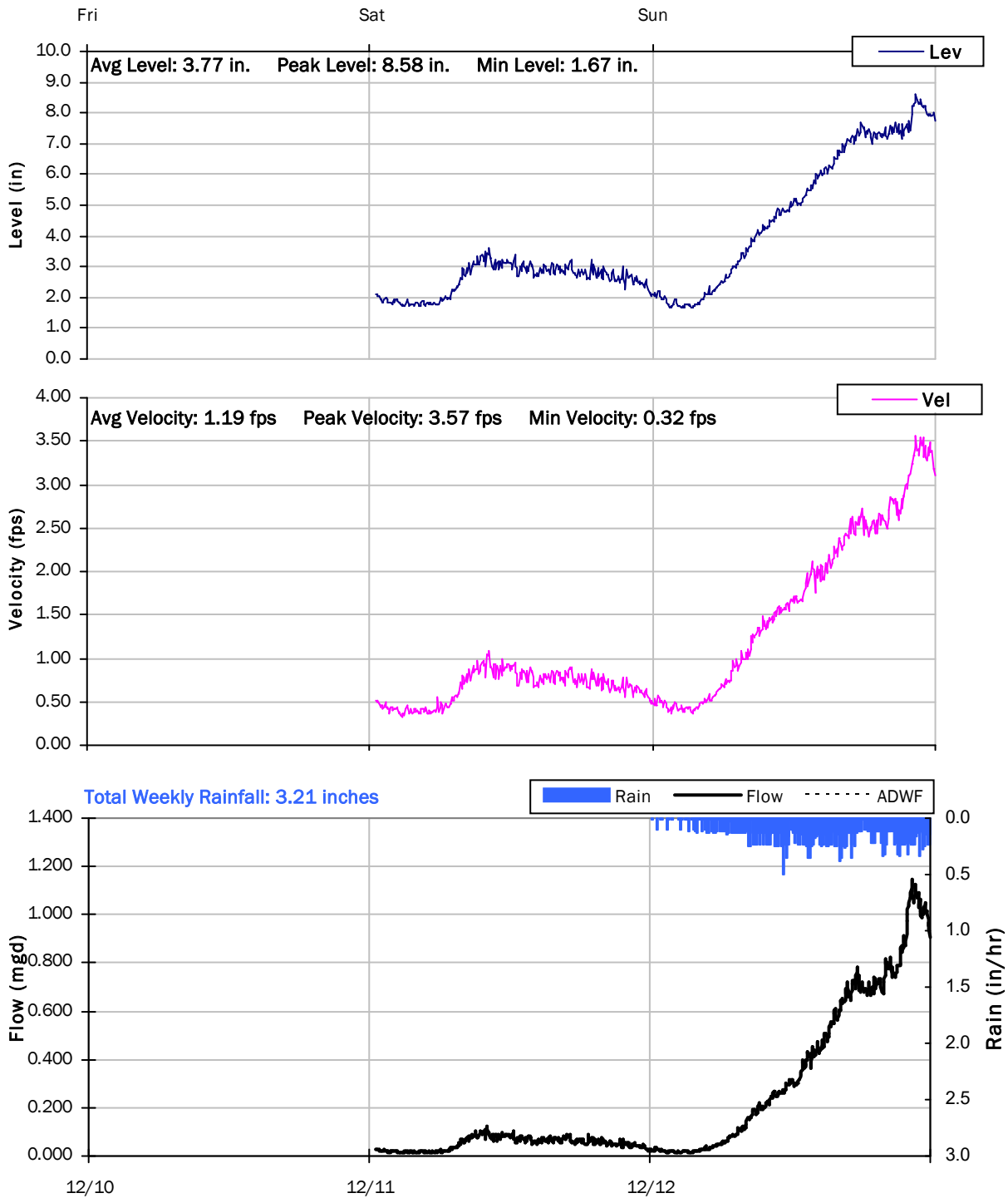
Storm Event I/I Analysis (Rain = 5.24 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.733 *mgd*	**Peak I/I Rate:**	0.554 *mgd*
PF:	14.02	**Total I/I:**	1,539,000 *gallons*
Peak Level:	7.27 *in*		
d/D Ratio:	0.73		

SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

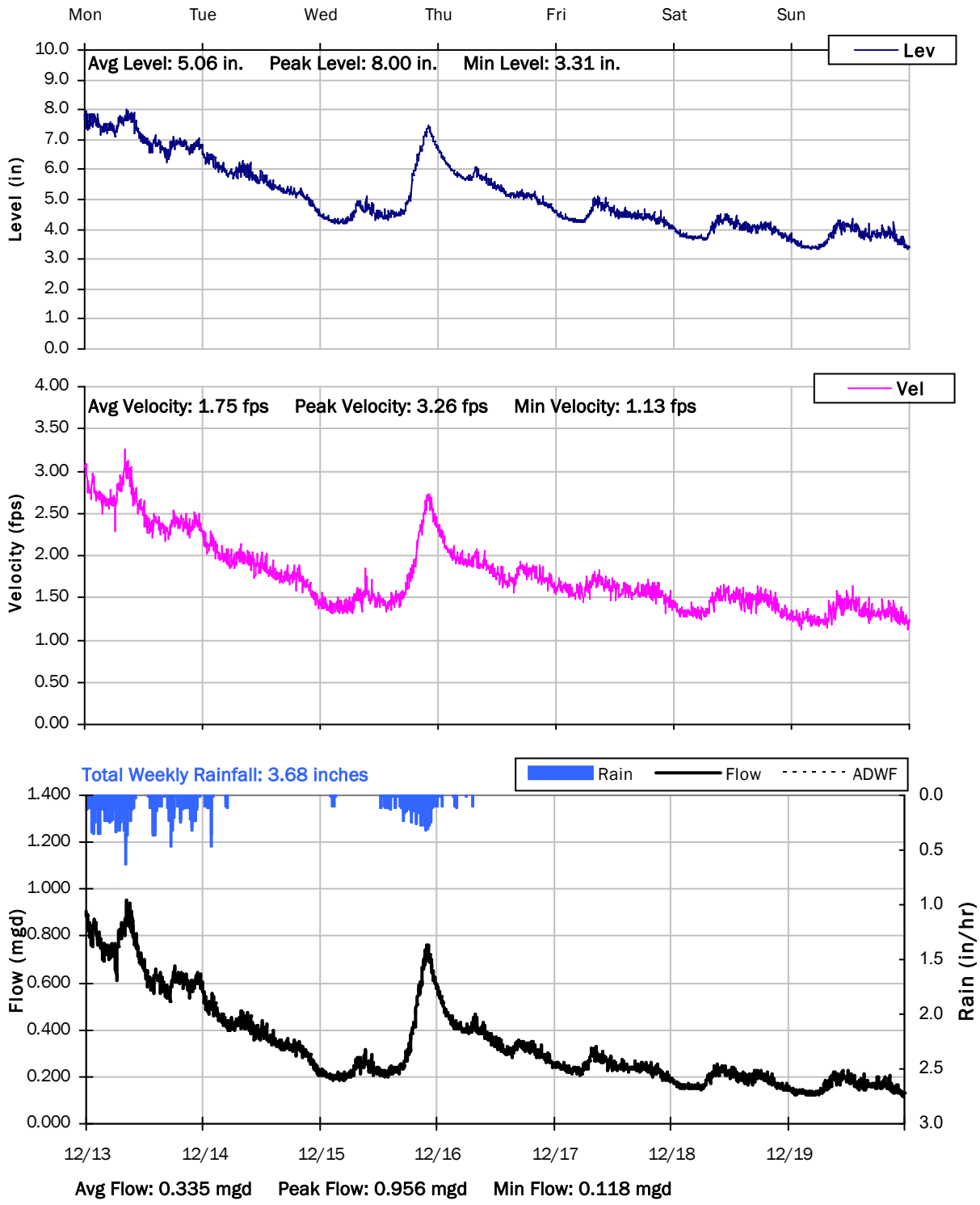
12/10/2021 to 12/13/2021



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

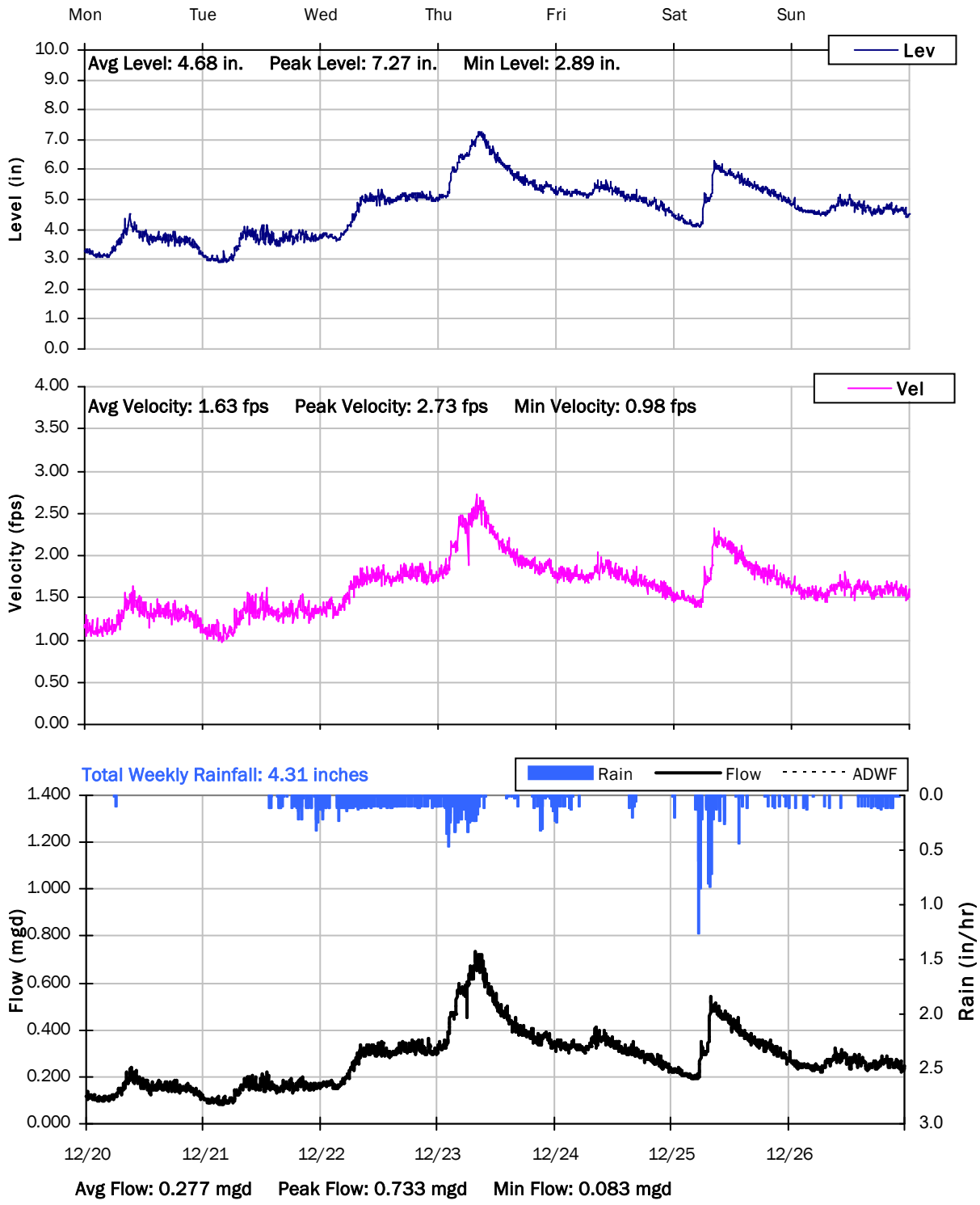
12/13/2021 to 12/20/2021



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

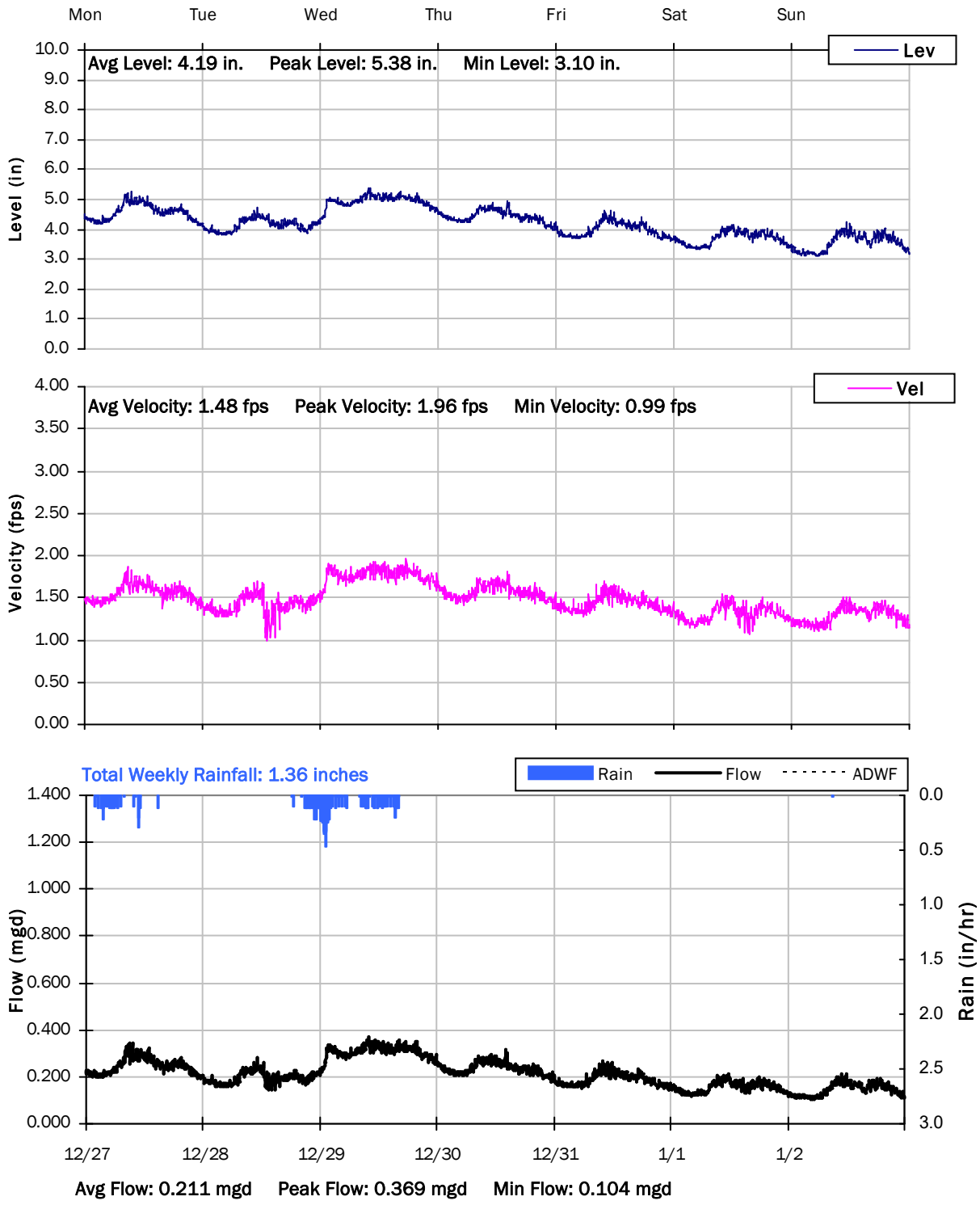
12/20/2021 to 12/27/2021



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

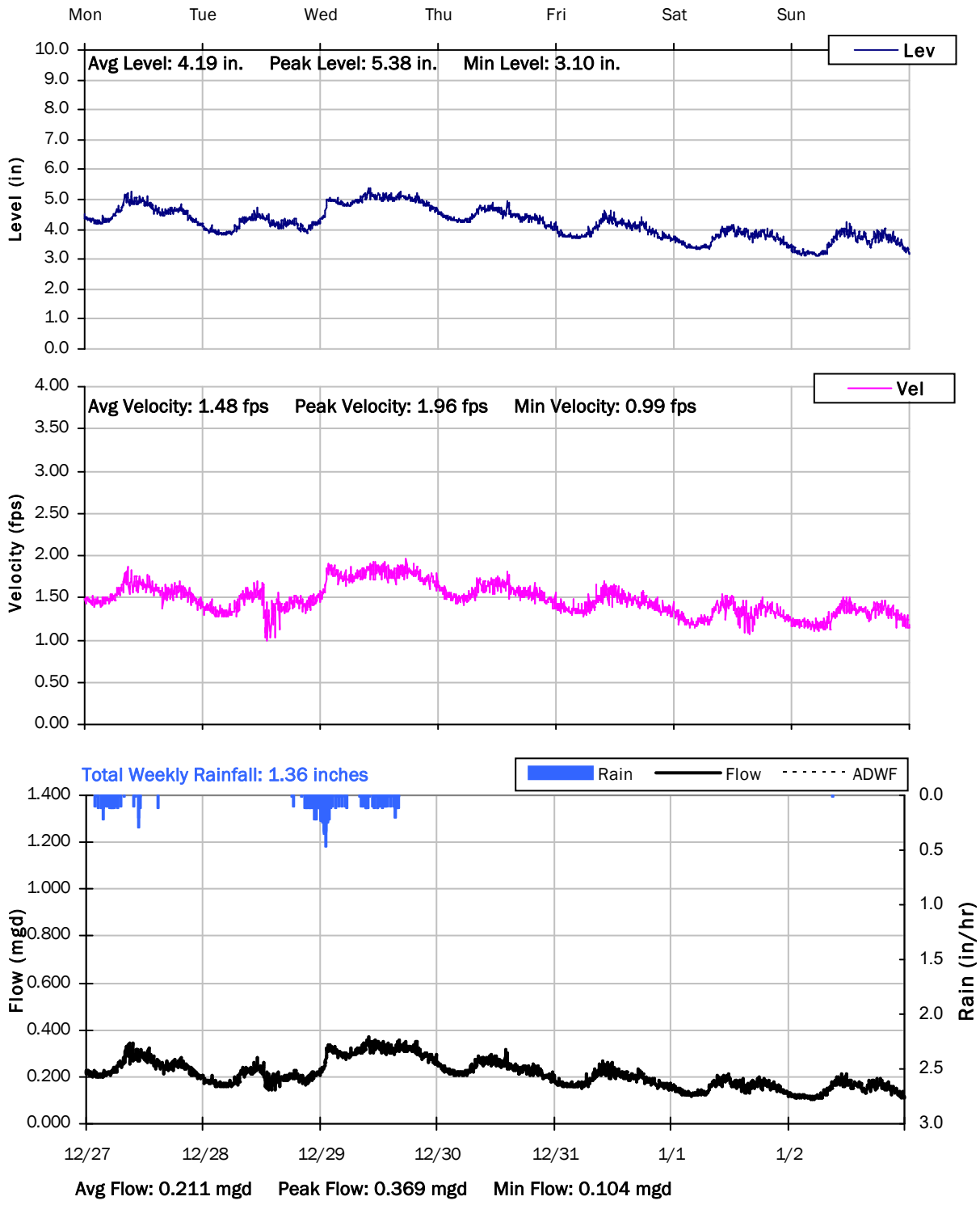
12/27/2021 to 1/3/2022



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

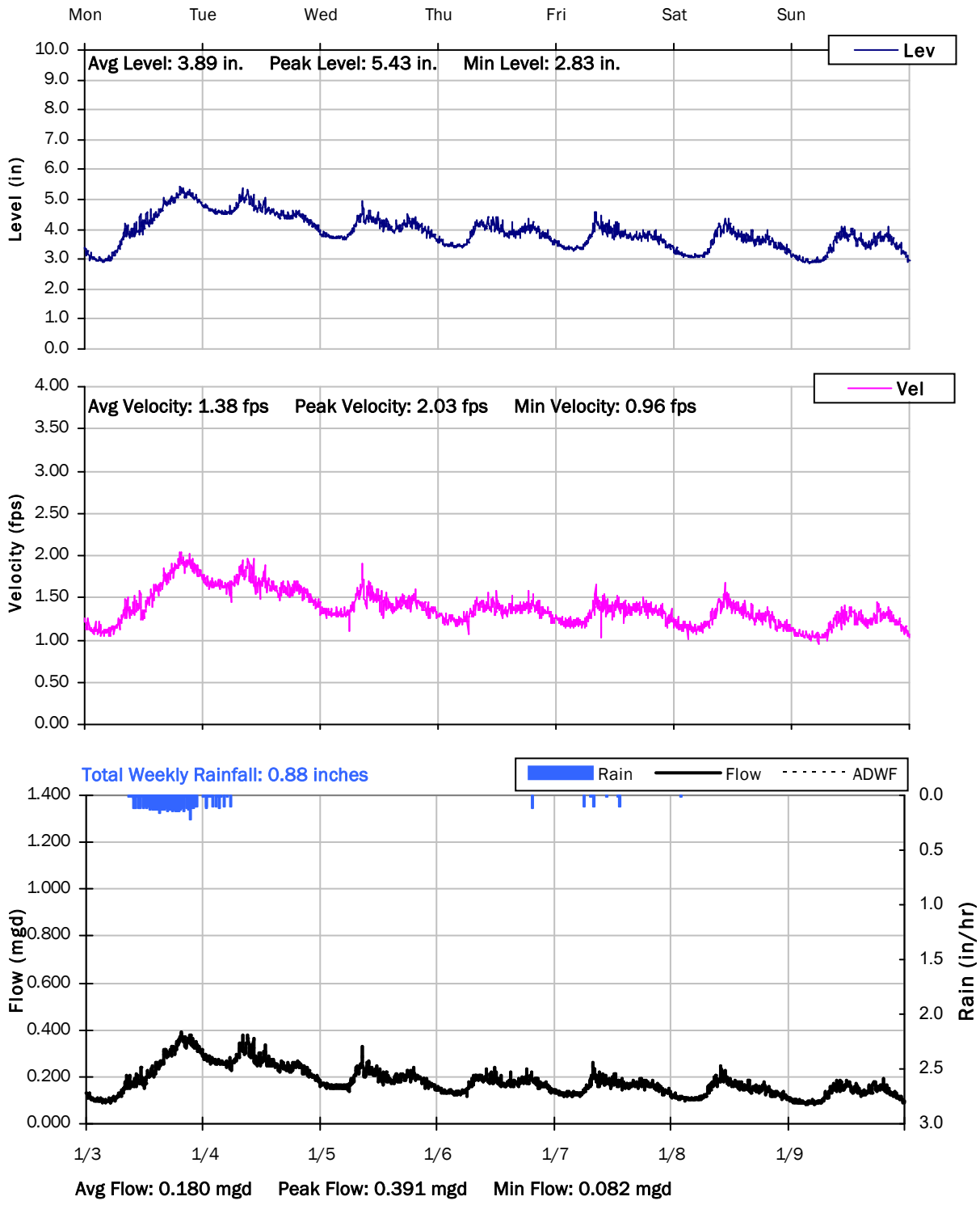
12/27/2021 to 1/3/2022



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

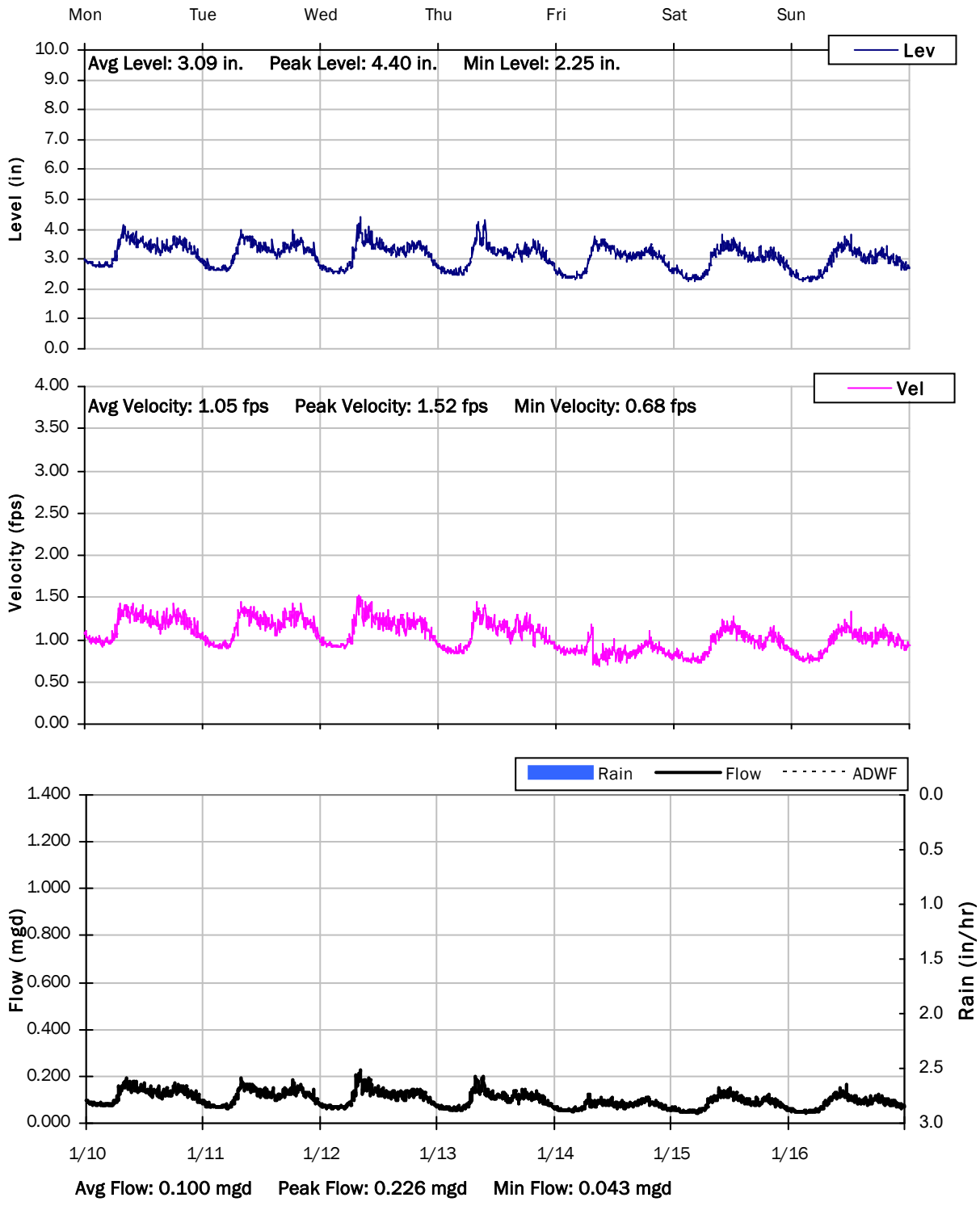
1/3/2022 to 1/10/2022



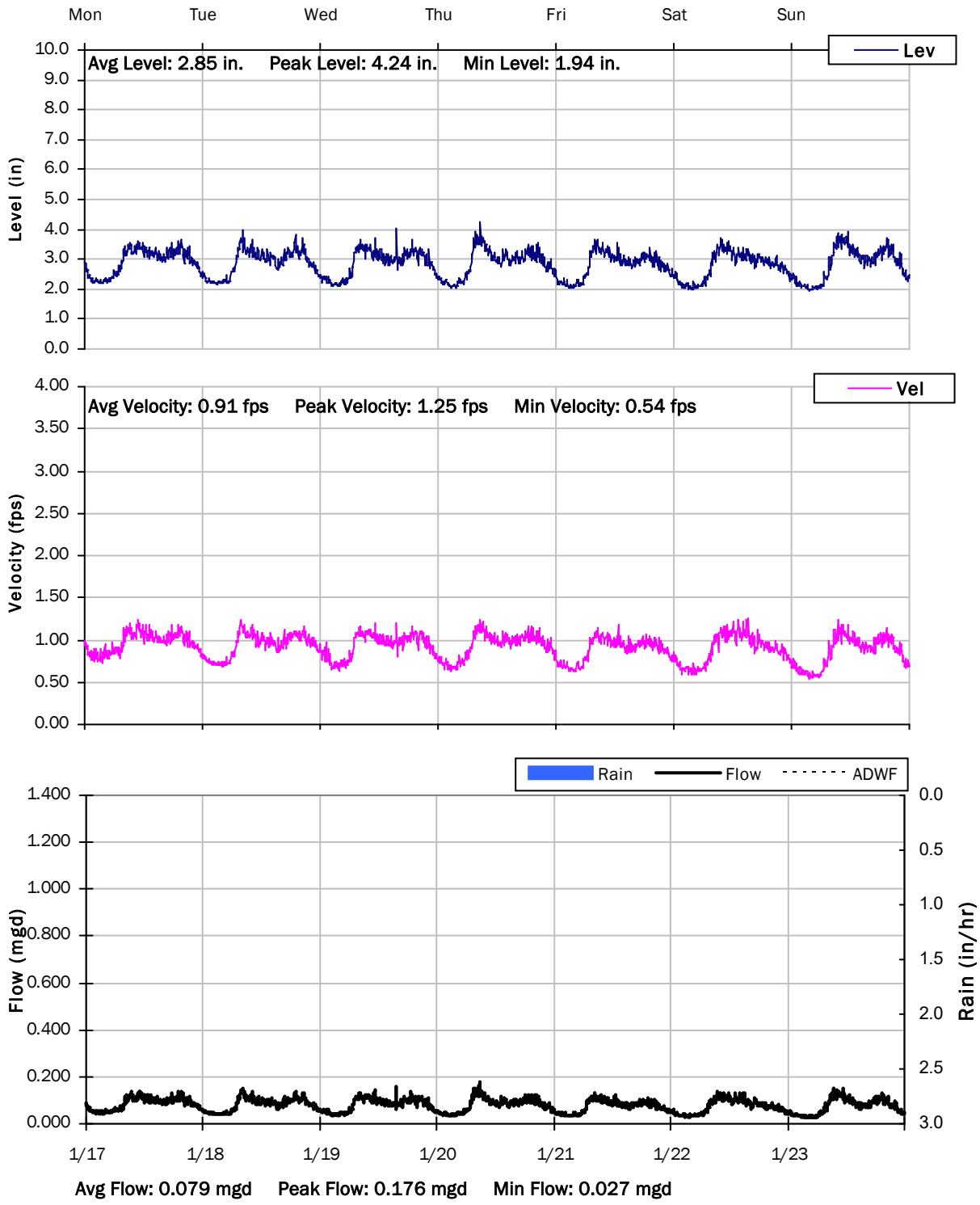
SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

1/10/2022 to 1/17/2022



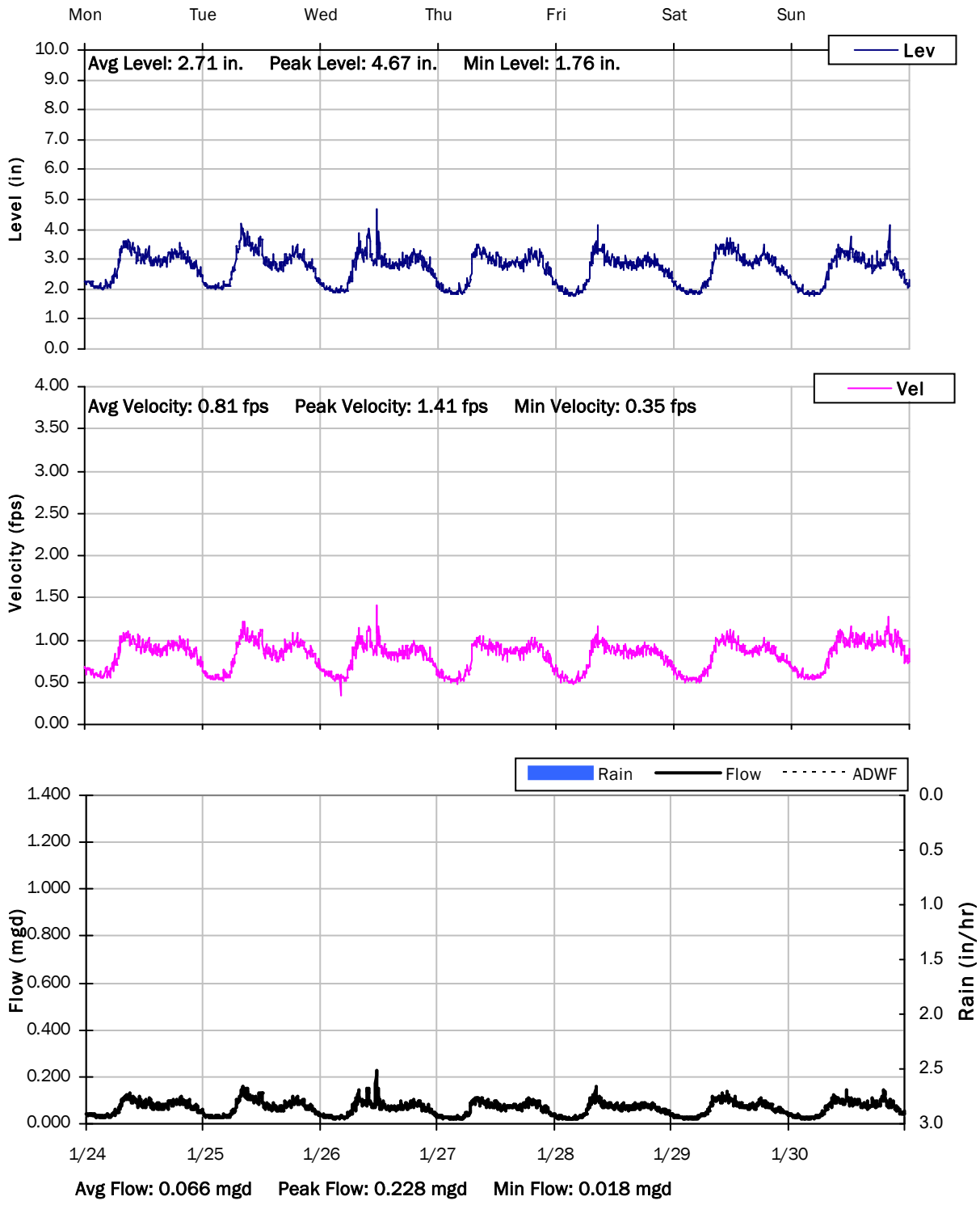
SITE 07.01
Weekly Level, Velocity and Flow Hydrographs
1/17/2022 to 1/24/2022



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

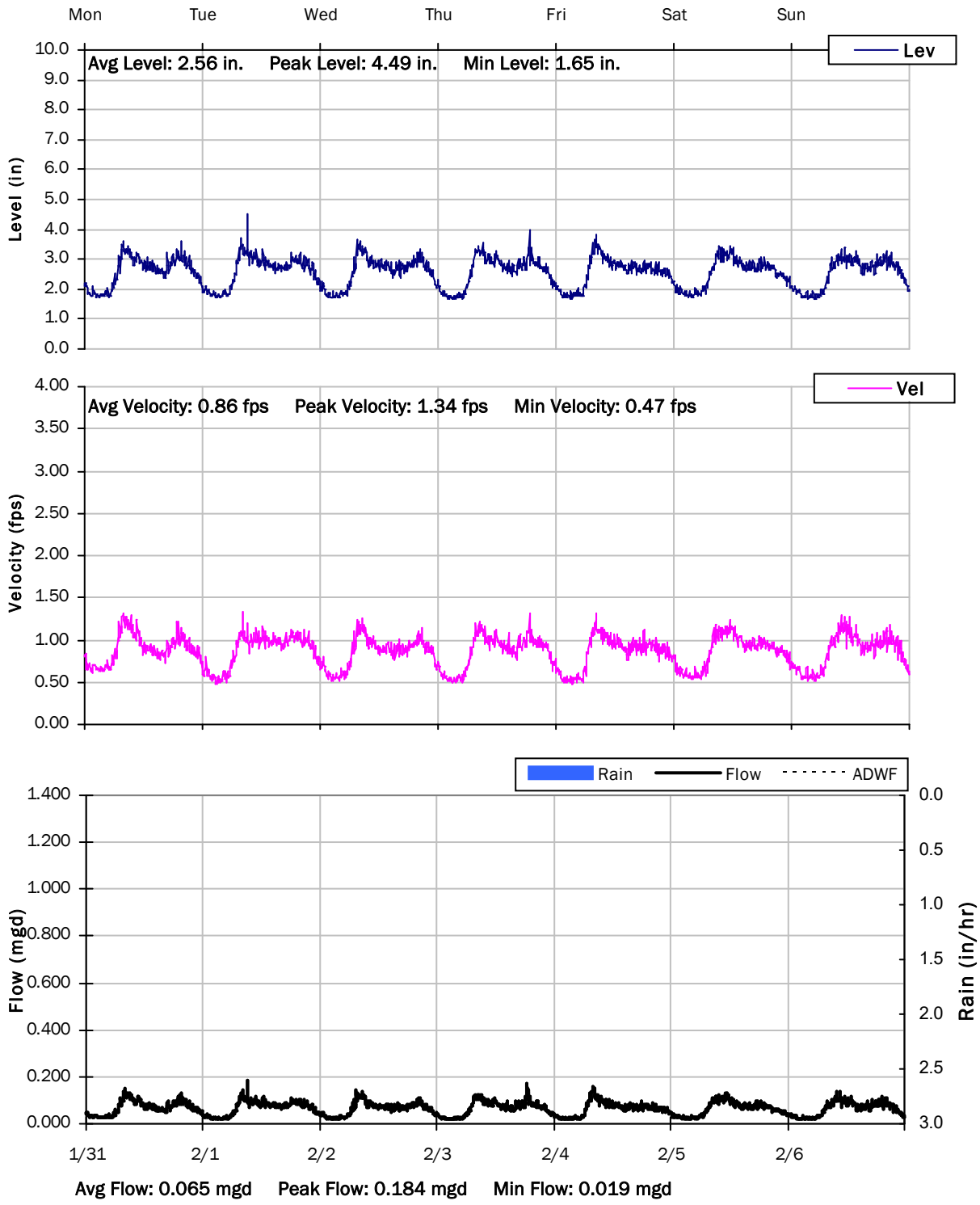
1/24/2022 to 1/31/2022



SITE 07.01

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 08

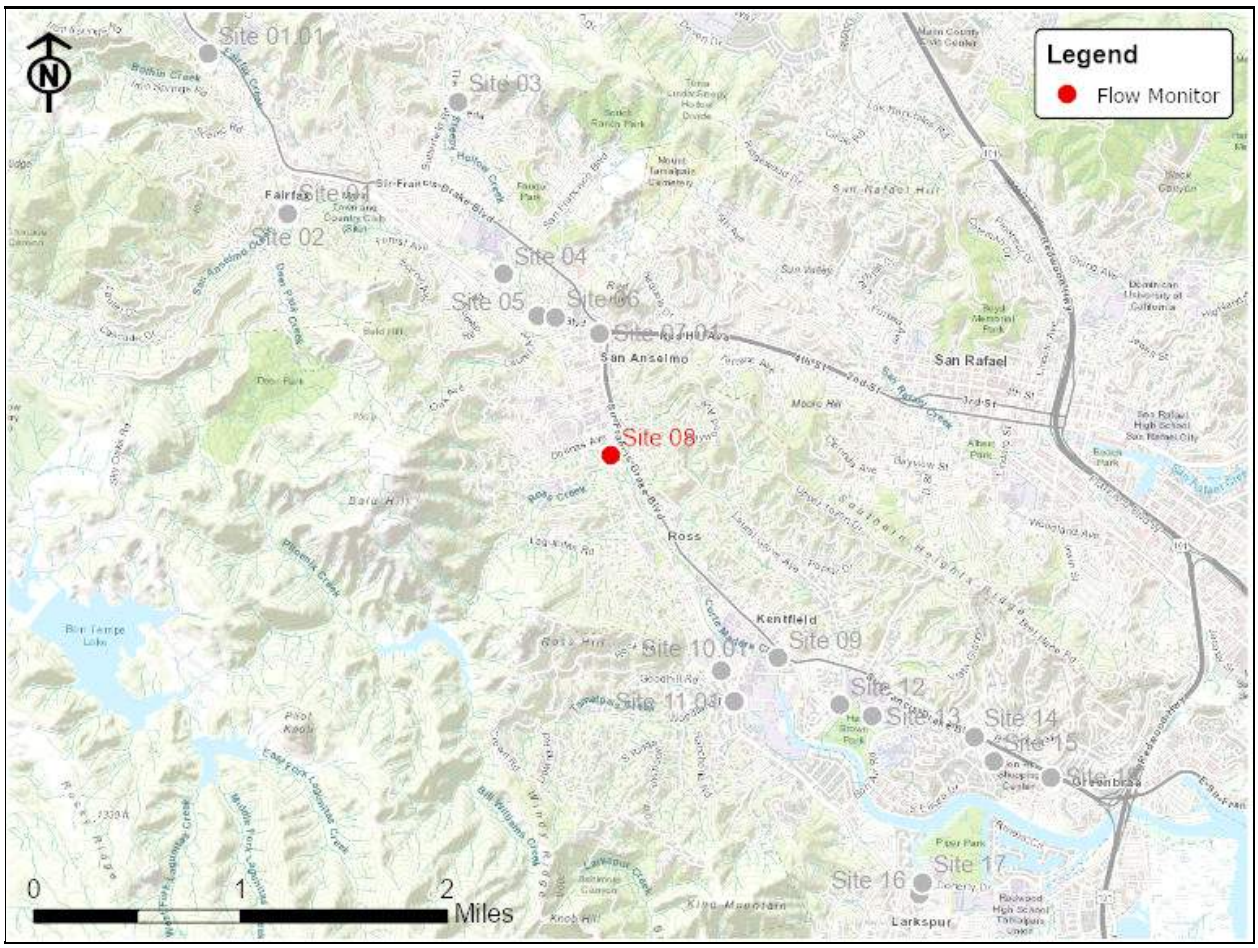
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 83 Shady Lane

Data Summary Report



Vicinity Map: Site 08

SITE 08

Site Information MH ID: R000.300

Location: 83 Shady Lane

Coordinates: 122.5611° W, 37.9678° N

Rim Elevation (Earth): 36 feet

Expected Pipe Diameter: 36 inches

Measured Pipe Diameter: 36 inches

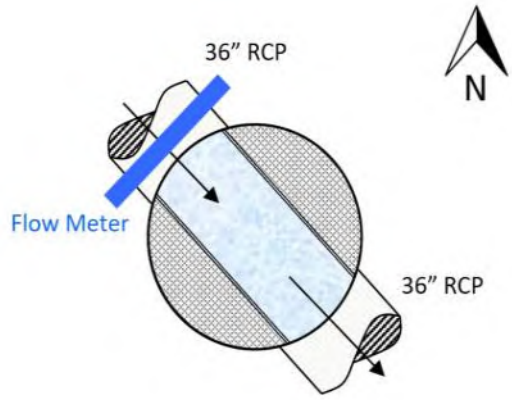
ADWF: 1.371 mgd

Peak Measured Flow: 18.179 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

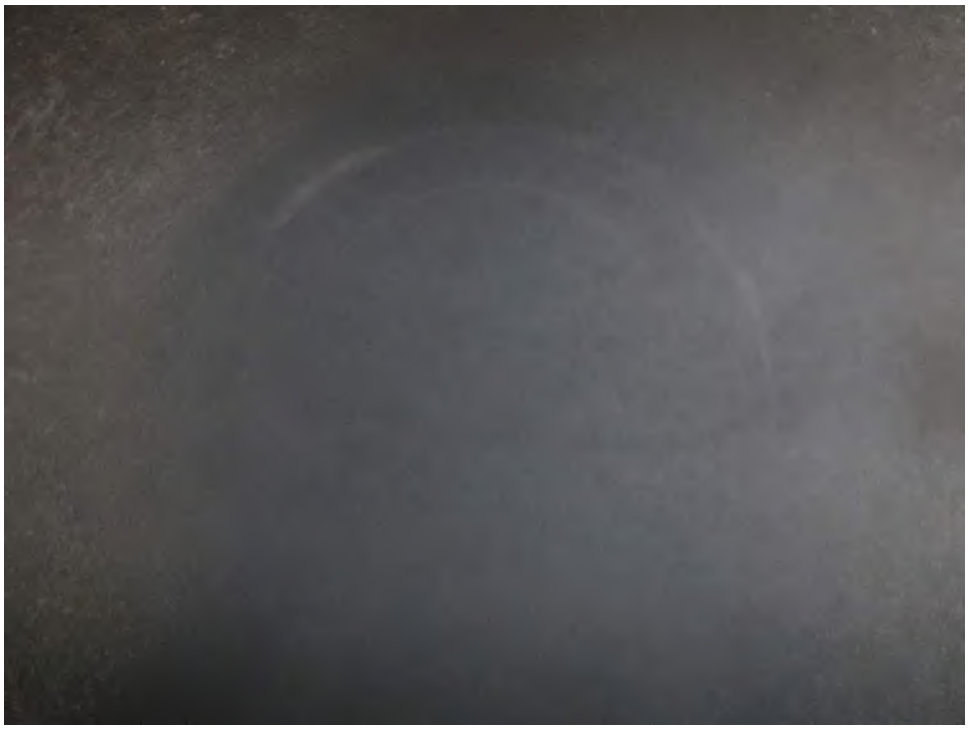
Street View

Plan View

SITE 08

Additional Site Photos

Effluent Pipe



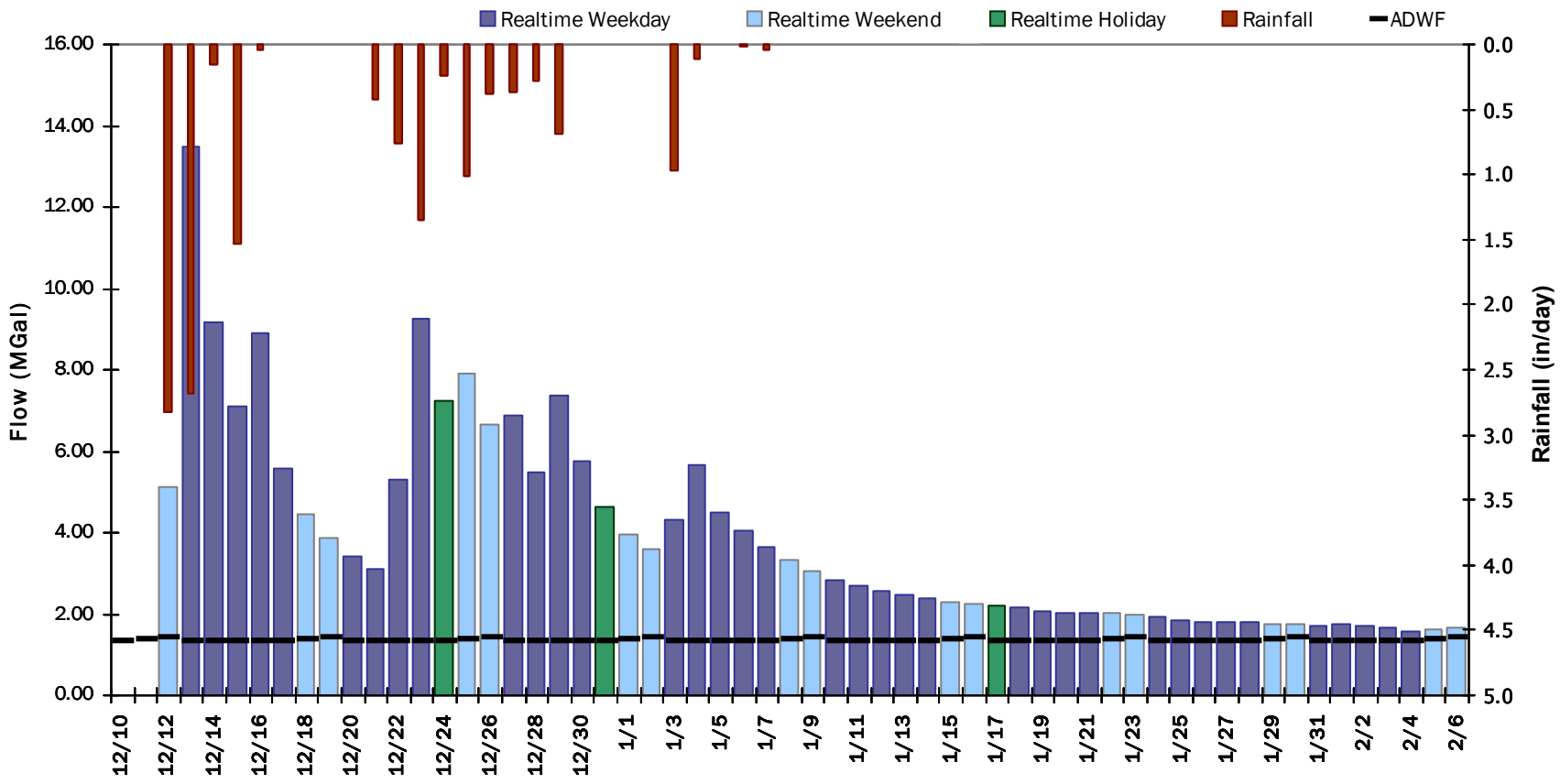
Monitored Northwest Influent Pipe

SITE 08

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 3.870 MGal Peak Daily Flow: 13.478 MGal Min Daily Flow: 1.381 MGal

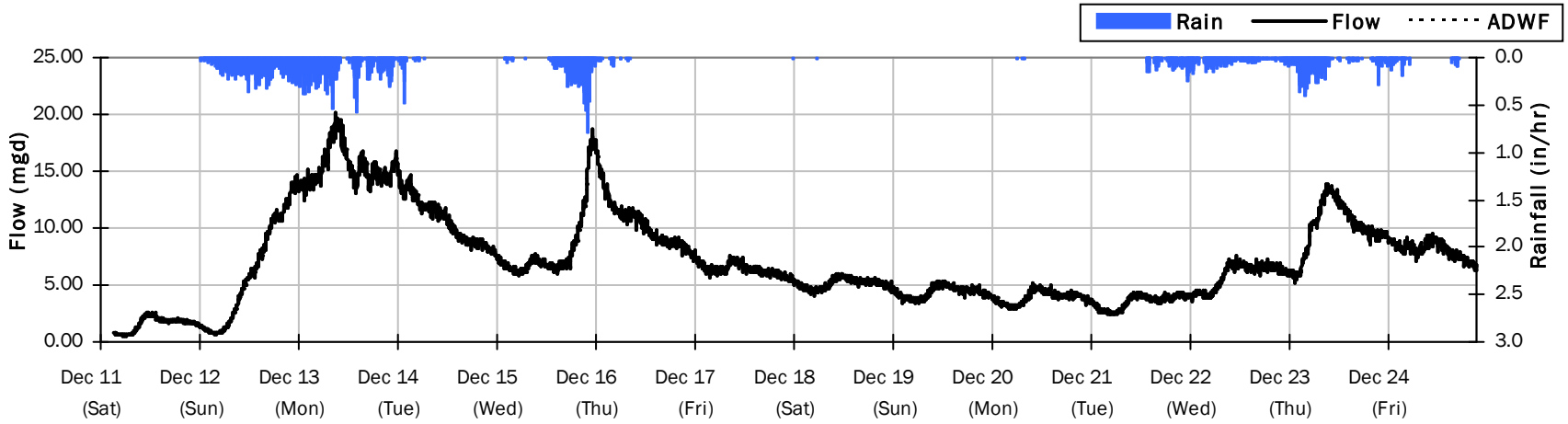
Total Rainfall: 13.90 inches

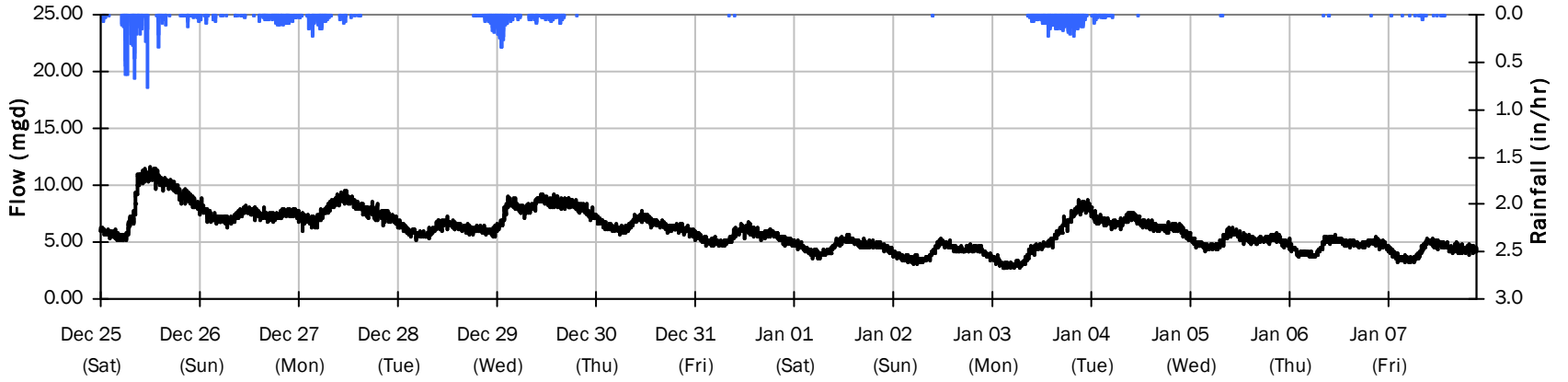


SITE 09

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 14.28 inches Period Avg Flow: 6.490 mgd Period Peak Flow: 20.221 mgd Period Min Flow: 0.546 mgd

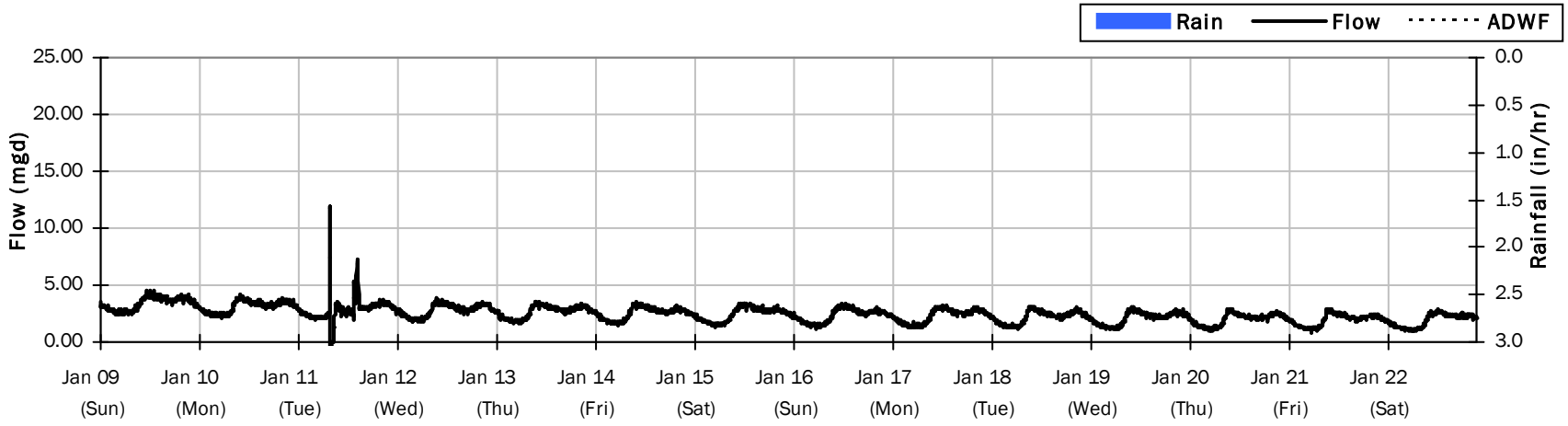


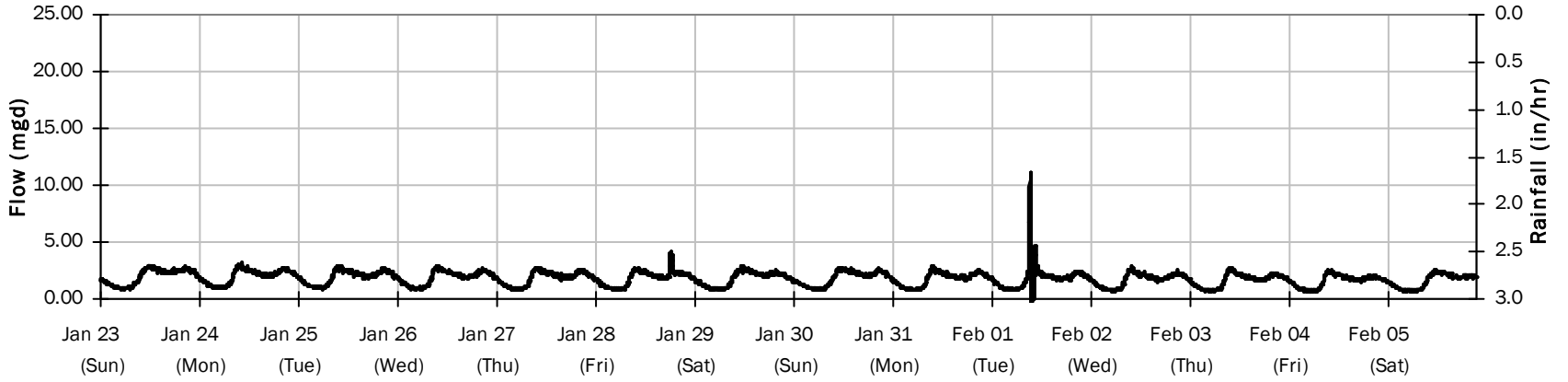


SITE 09

Flow Summary: 1/9/2022 to 2/5/2022

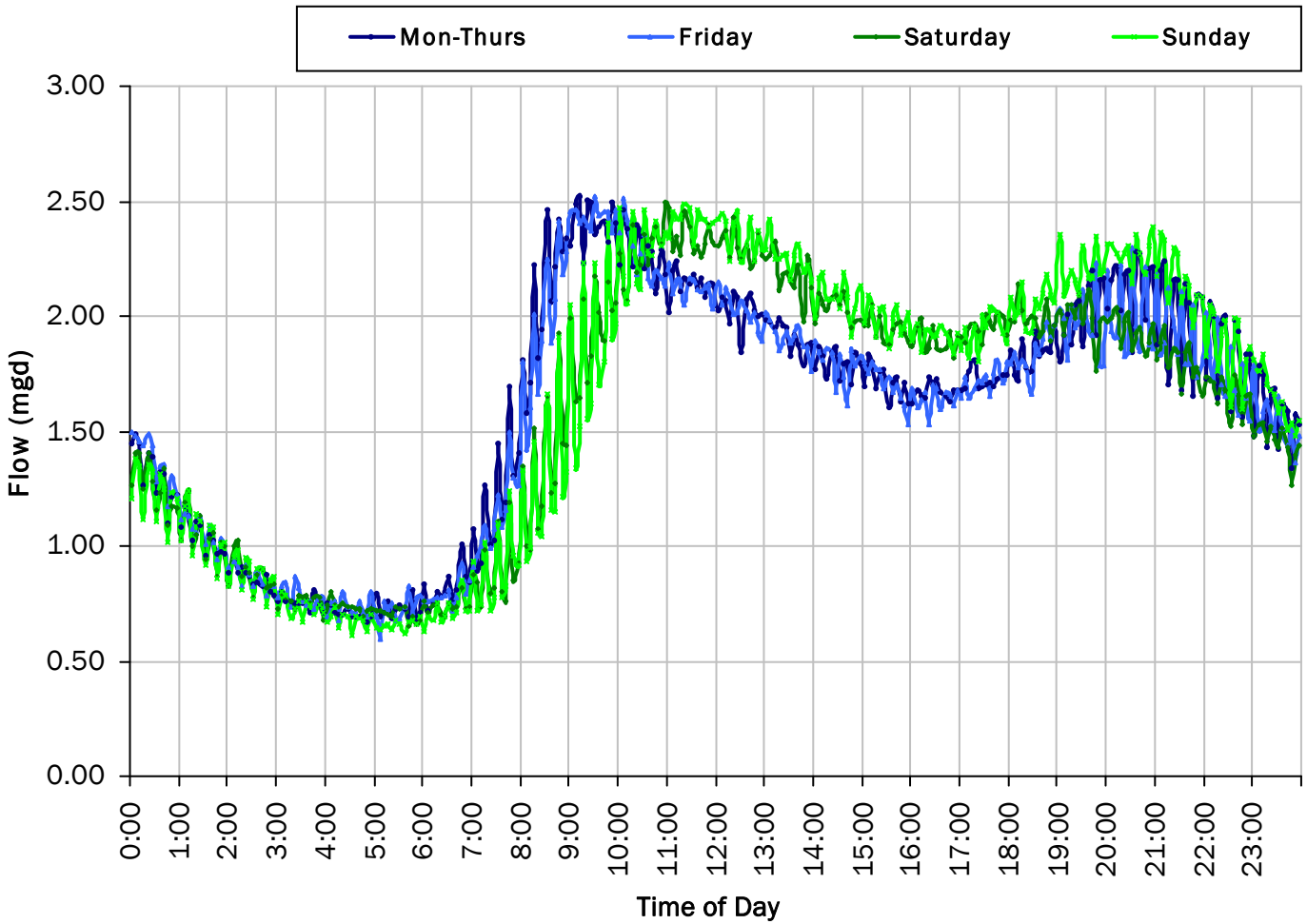
Period Rainfall: 0.00 inches Period Avg Flow: 2.134 mgd Period Peak Flow: 11.816 mgd Period Min Flow: -1.078 mgd





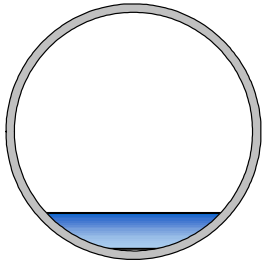
SITE 09

Average Dry Weather Flow Hydrographs



ADWF:

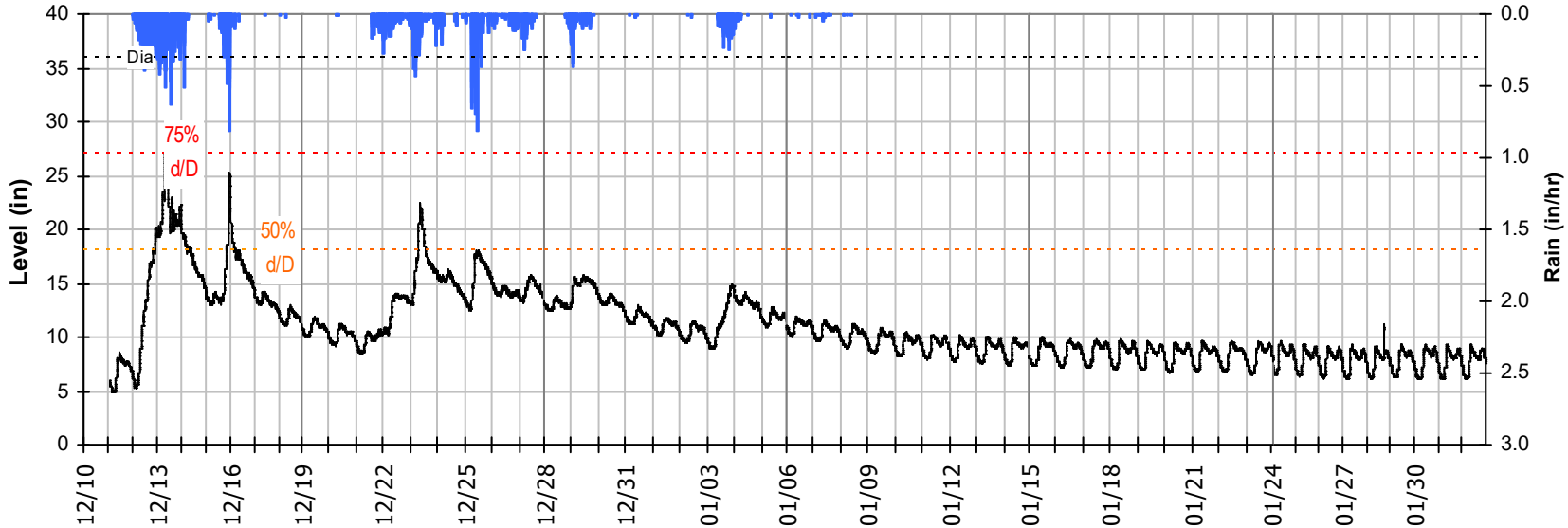
1.607 *mgd*

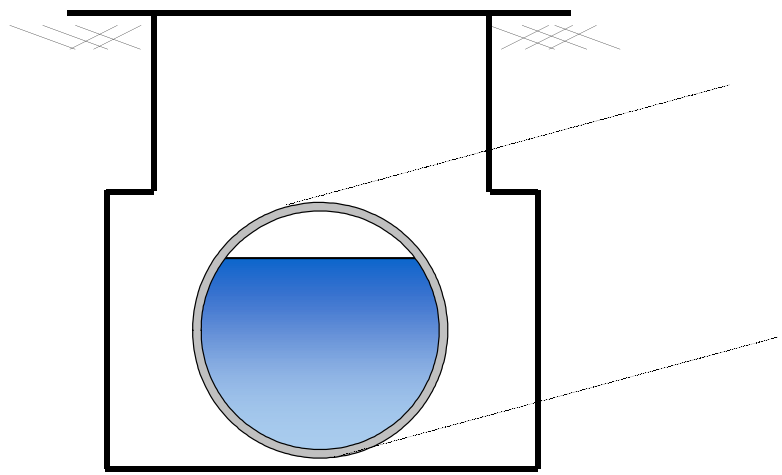


SITE 08

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

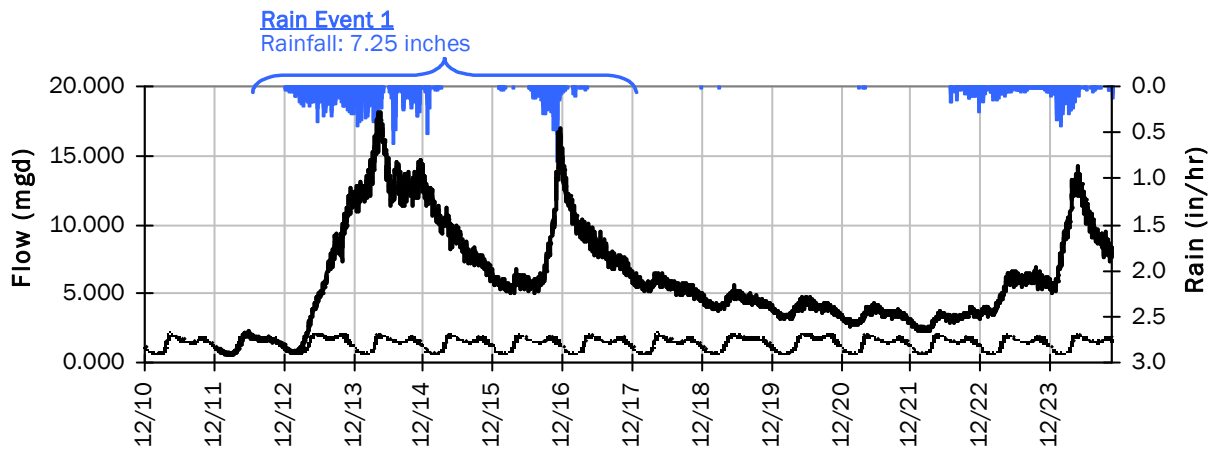




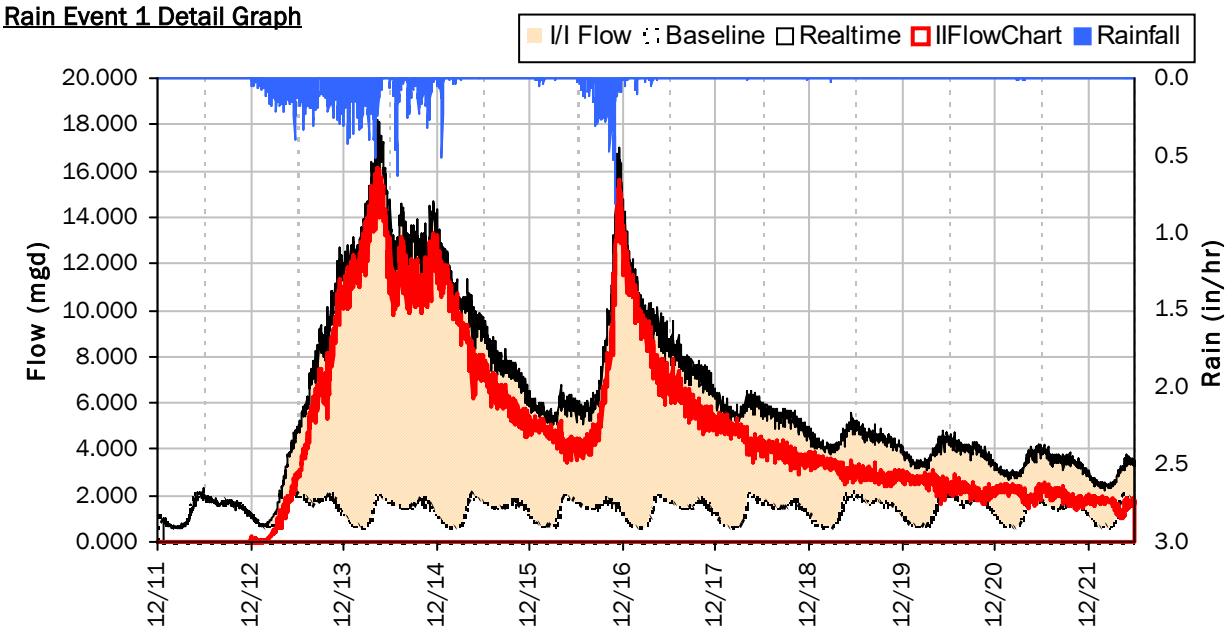
Pipe Diameter:	36	*inches*
Peak Measured Level:	28.7	*inches*
Peak d/D Ratio:	0.80	

SITE 08
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

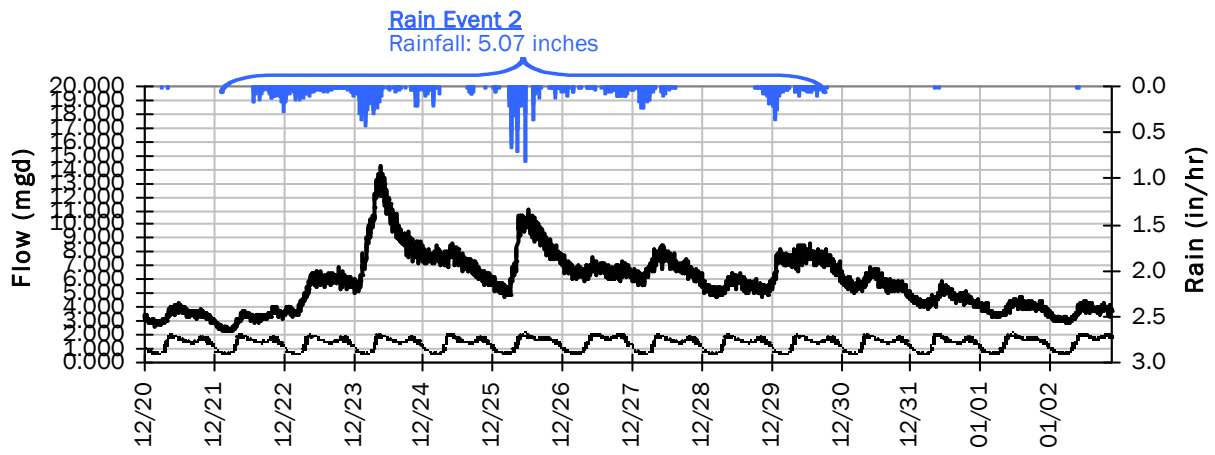


Storm Event I/I Analysis (Rain = 7.25 inches)

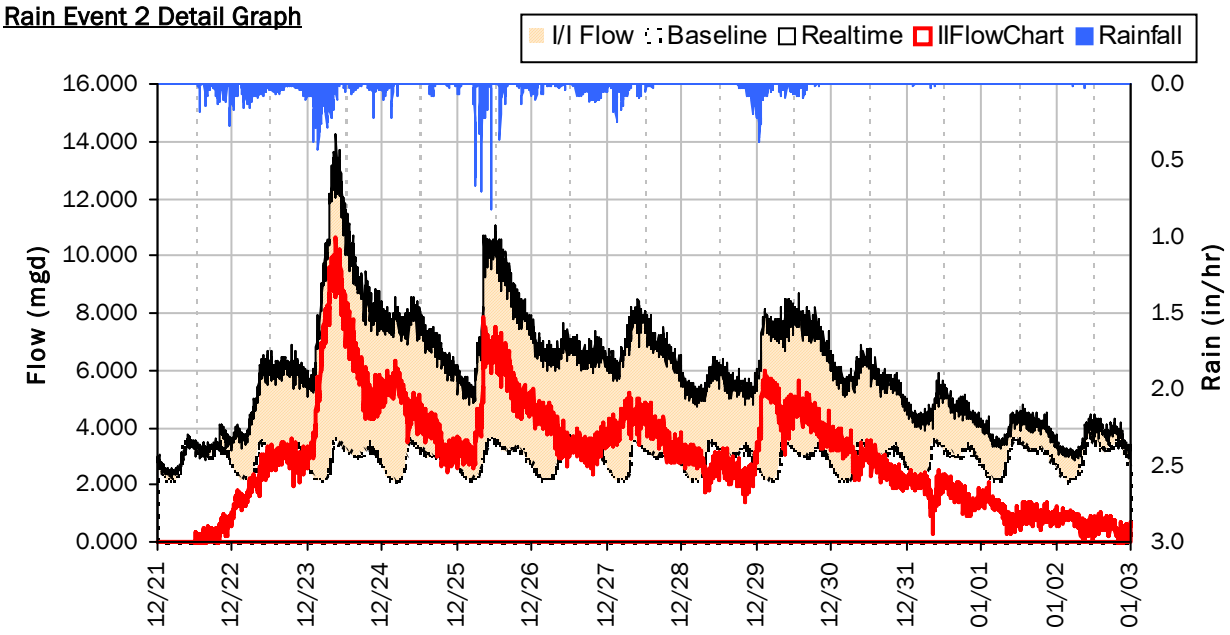
Capacity		Inflow / Infiltration	
Peak Flow:	18.179 *mgd*	Peak I/I Rate:	16.169 *mgd*
PF:	13.29	Total I/I:	49,561,000 *gallons*
Peak Level:	28.67 *in*		
d/D Ratio:	0.80		

SITE 08
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



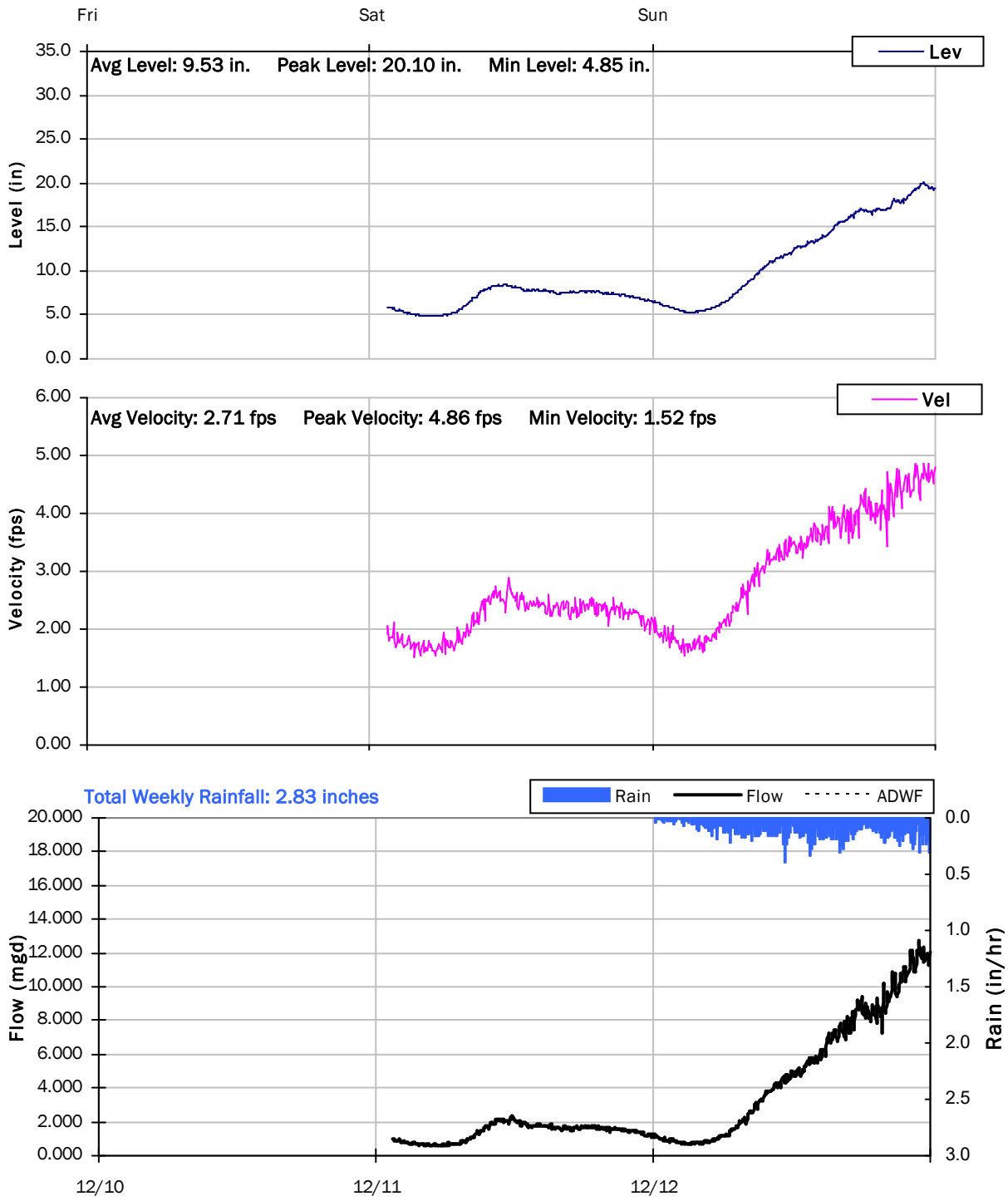
Storm Event I/I Analysis (Rain = 5.07 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	14.252 *mgd*	**Peak I/I Rate:**	10.653 *mgd*
PF:	10.42	**Total I/I:**	39,435,000 *gallons*
Peak Level:	22.49 *in*		
d/D Ratio:	0.62		

SITE 08

Weekly Level, Velocity and Flow Hydrographs

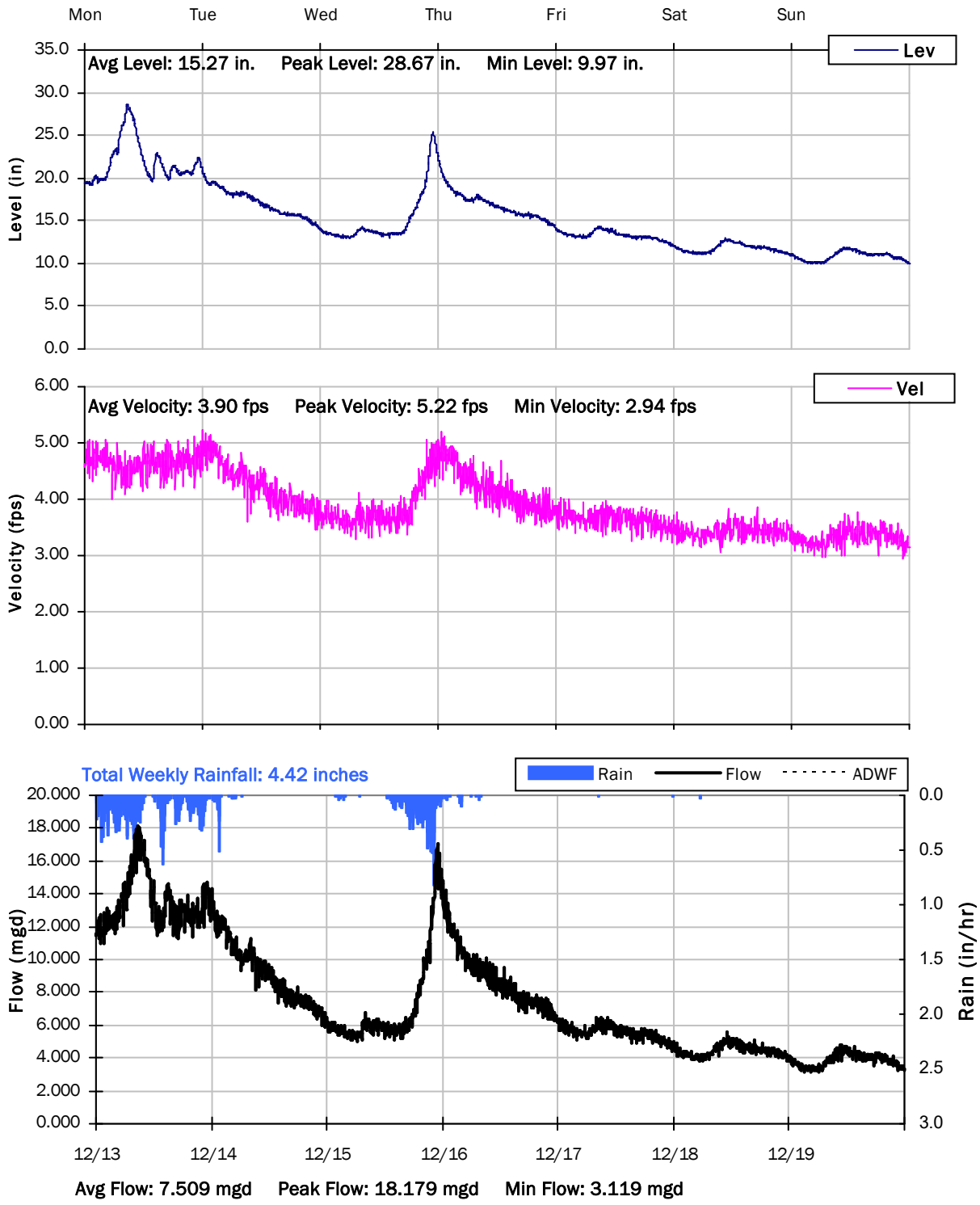
12/10/2021 to 12/13/2021



SITE 08

Weekly Level, Velocity and Flow Hydrographs

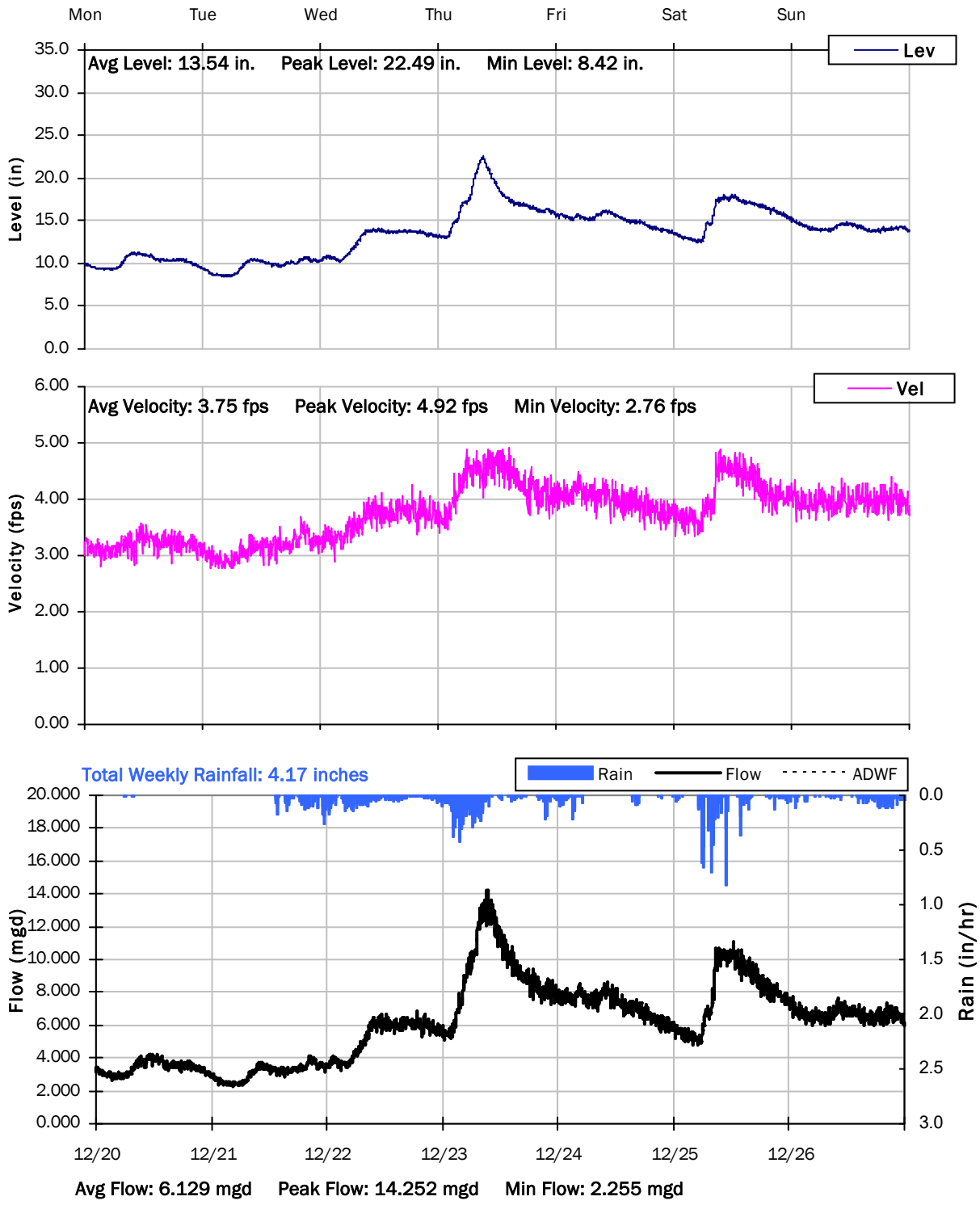
12/13/2021 to 12/20/2021



SITE 08

Weekly Level, Velocity and Flow Hydrographs

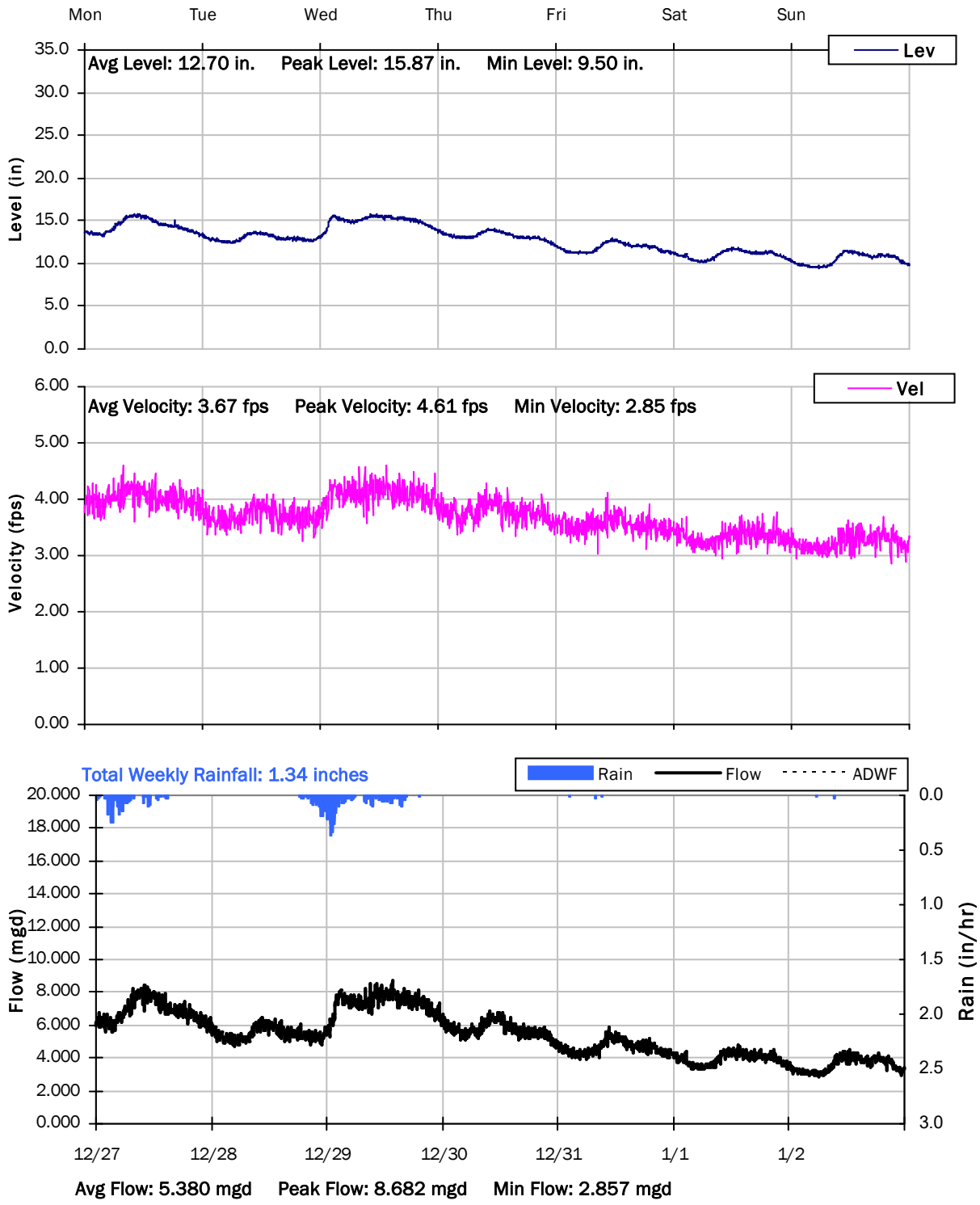
12/20/2021 to 12/27/2021



SITE 08

Weekly Level, Velocity and Flow Hydrographs

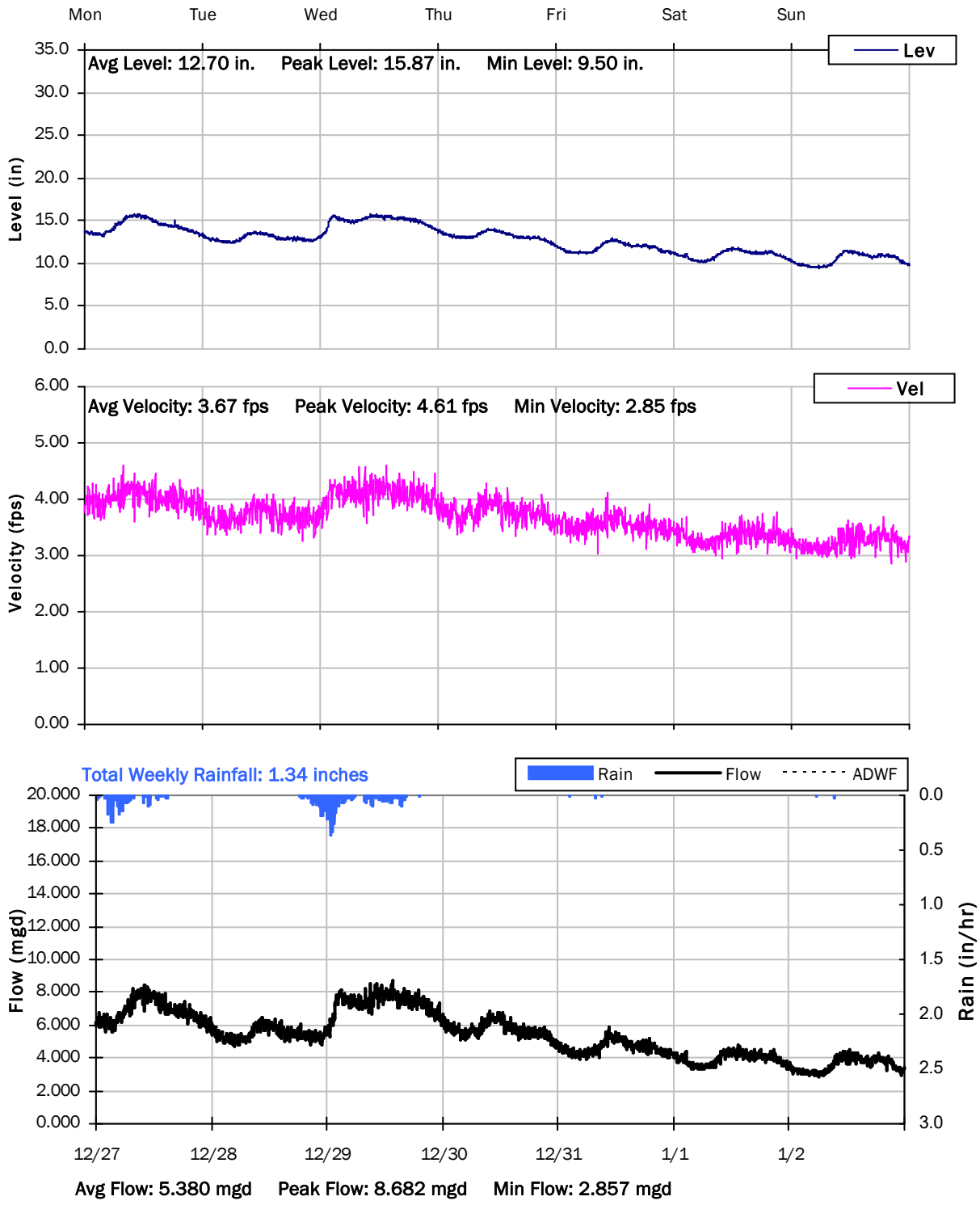
12/27/2021 to 1/3/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

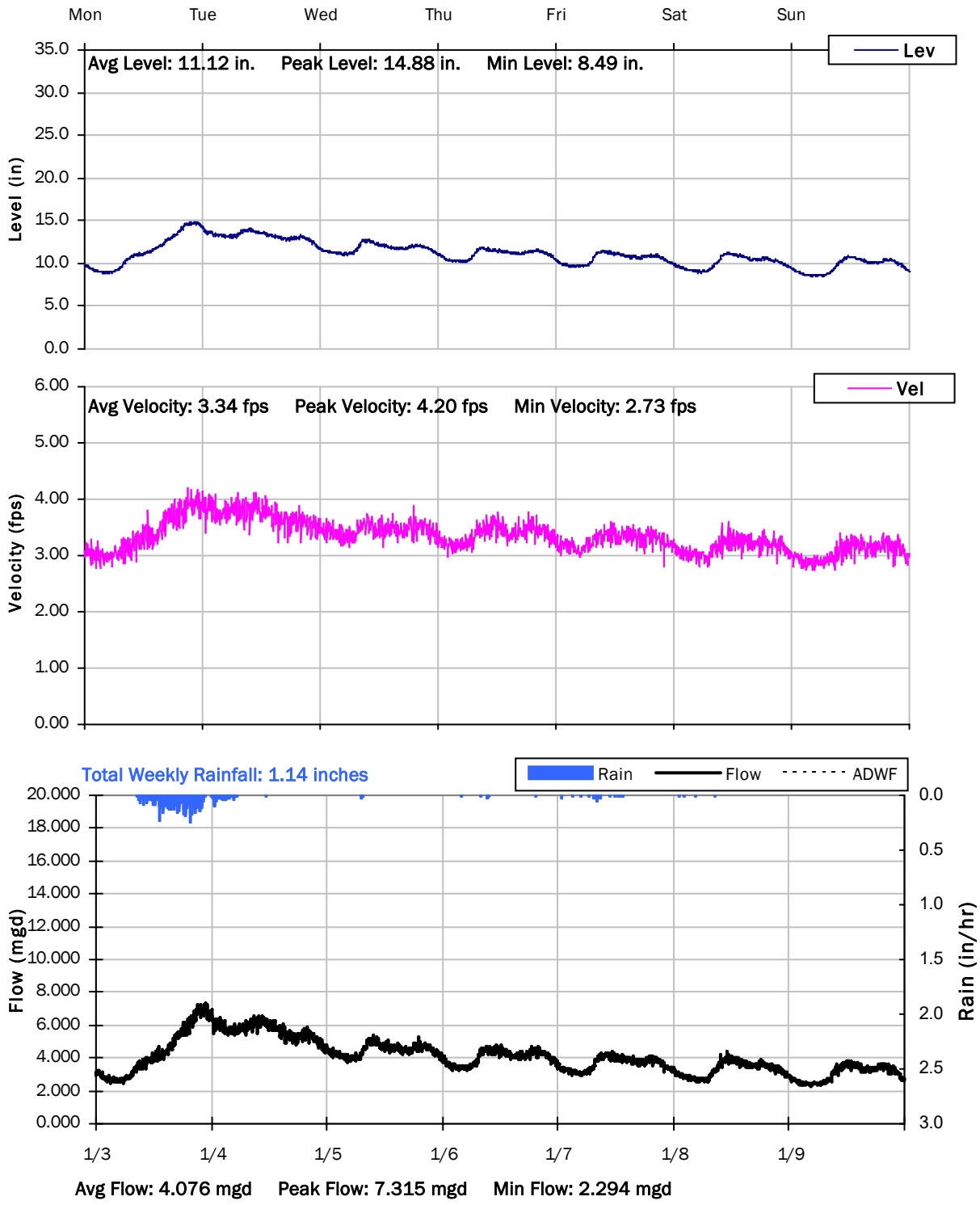
12/27/2021 to 1/3/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

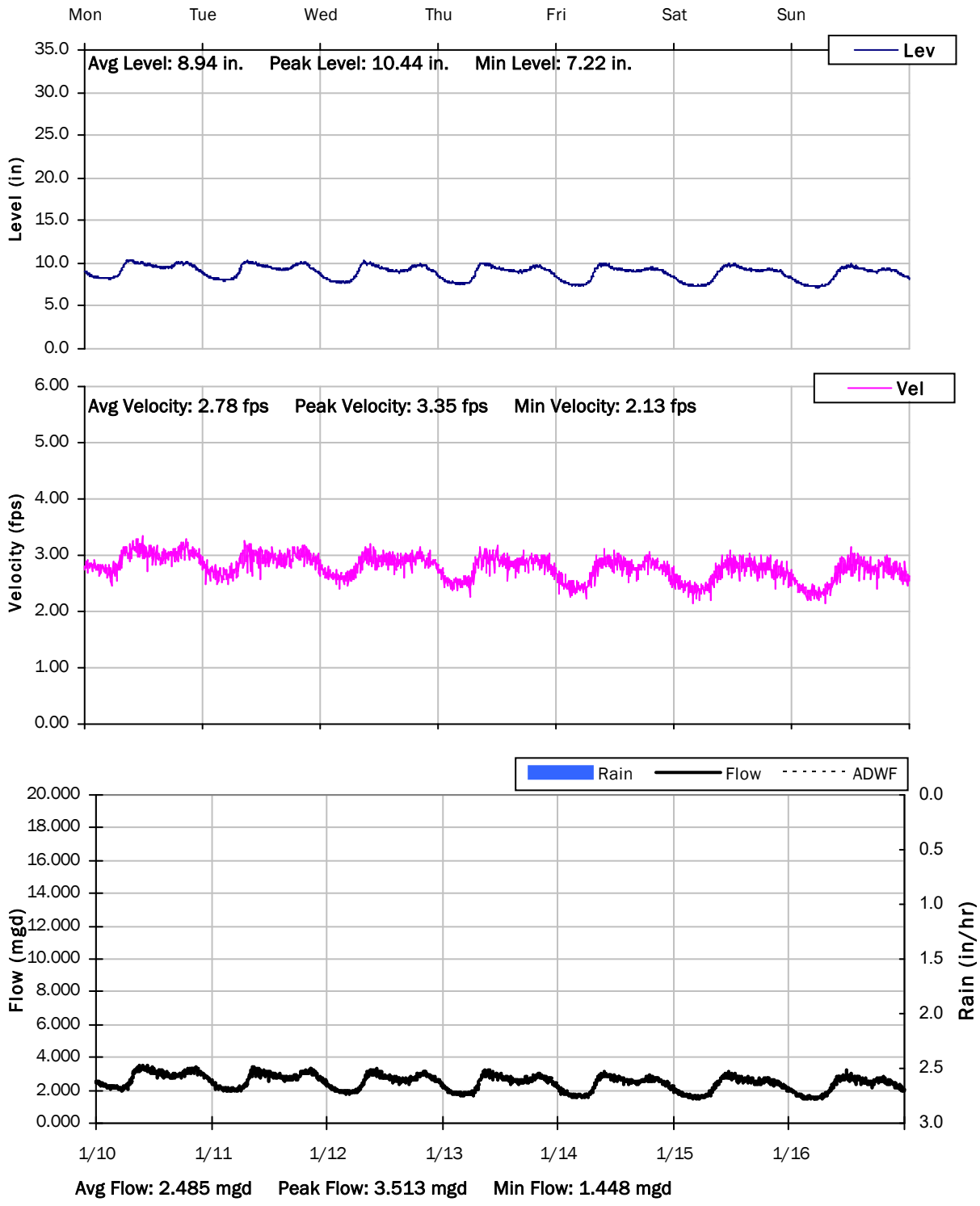
1/3/2022 to 1/10/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

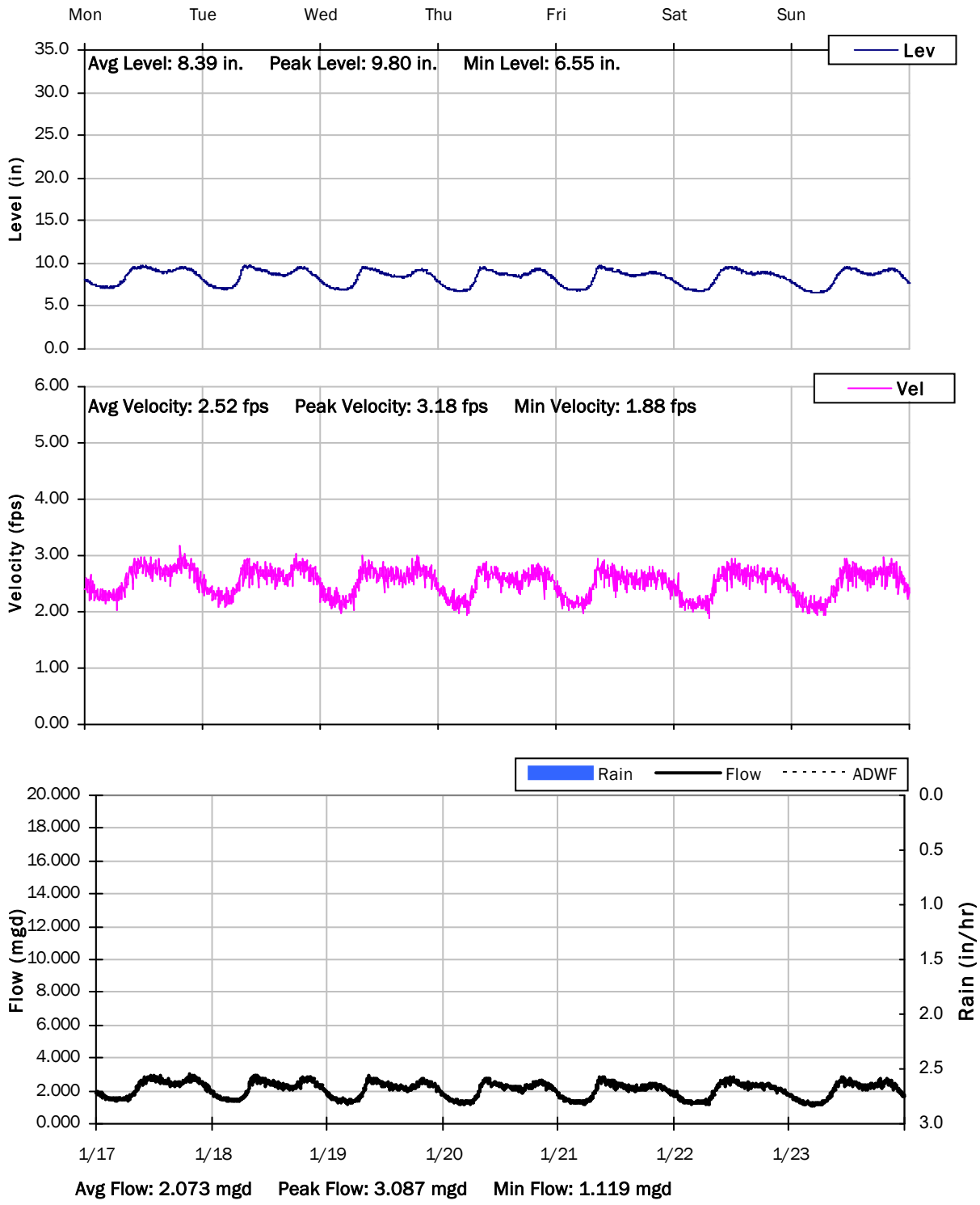
1/10/2022 to 1/17/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

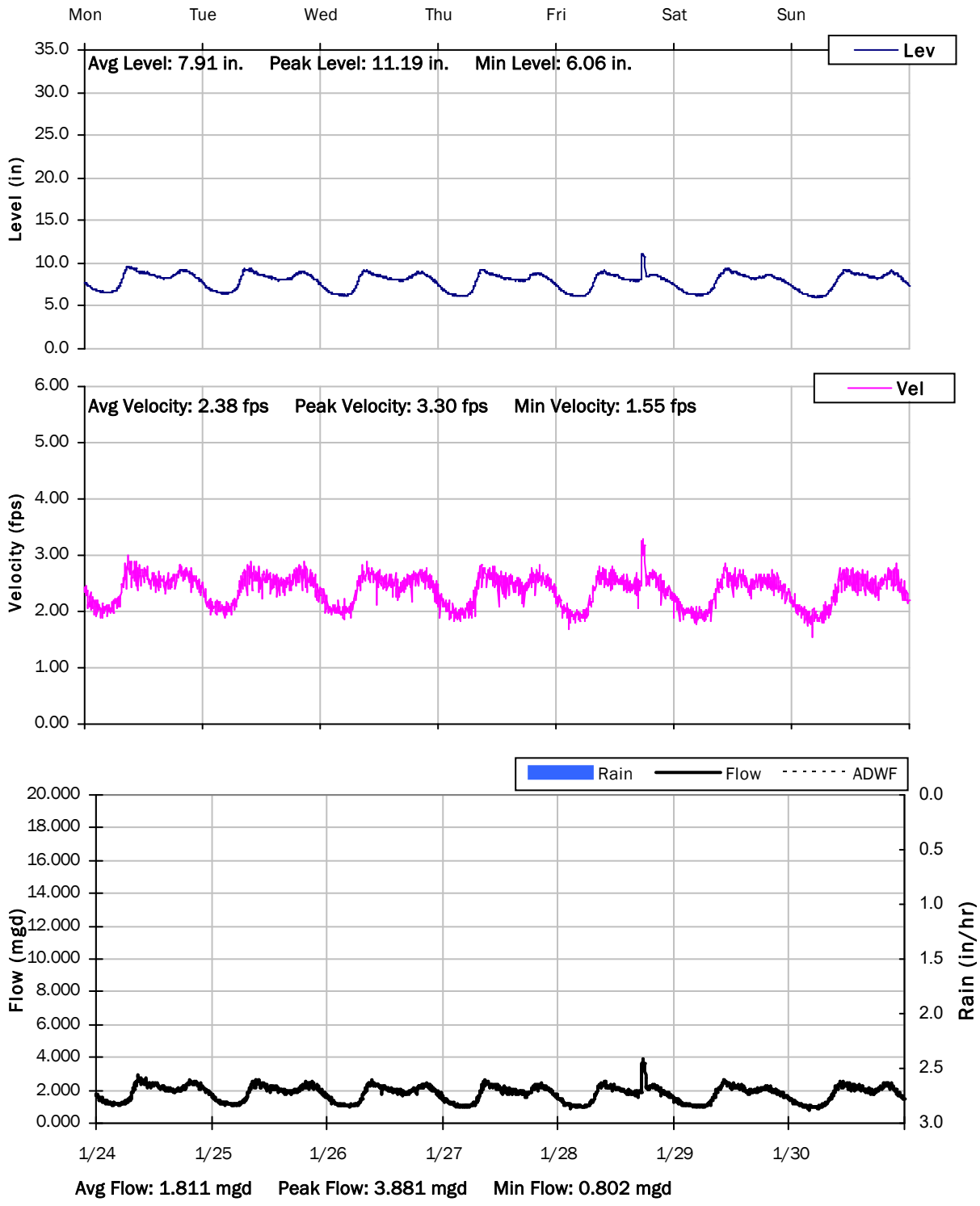
1/17/2022 to 1/24/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

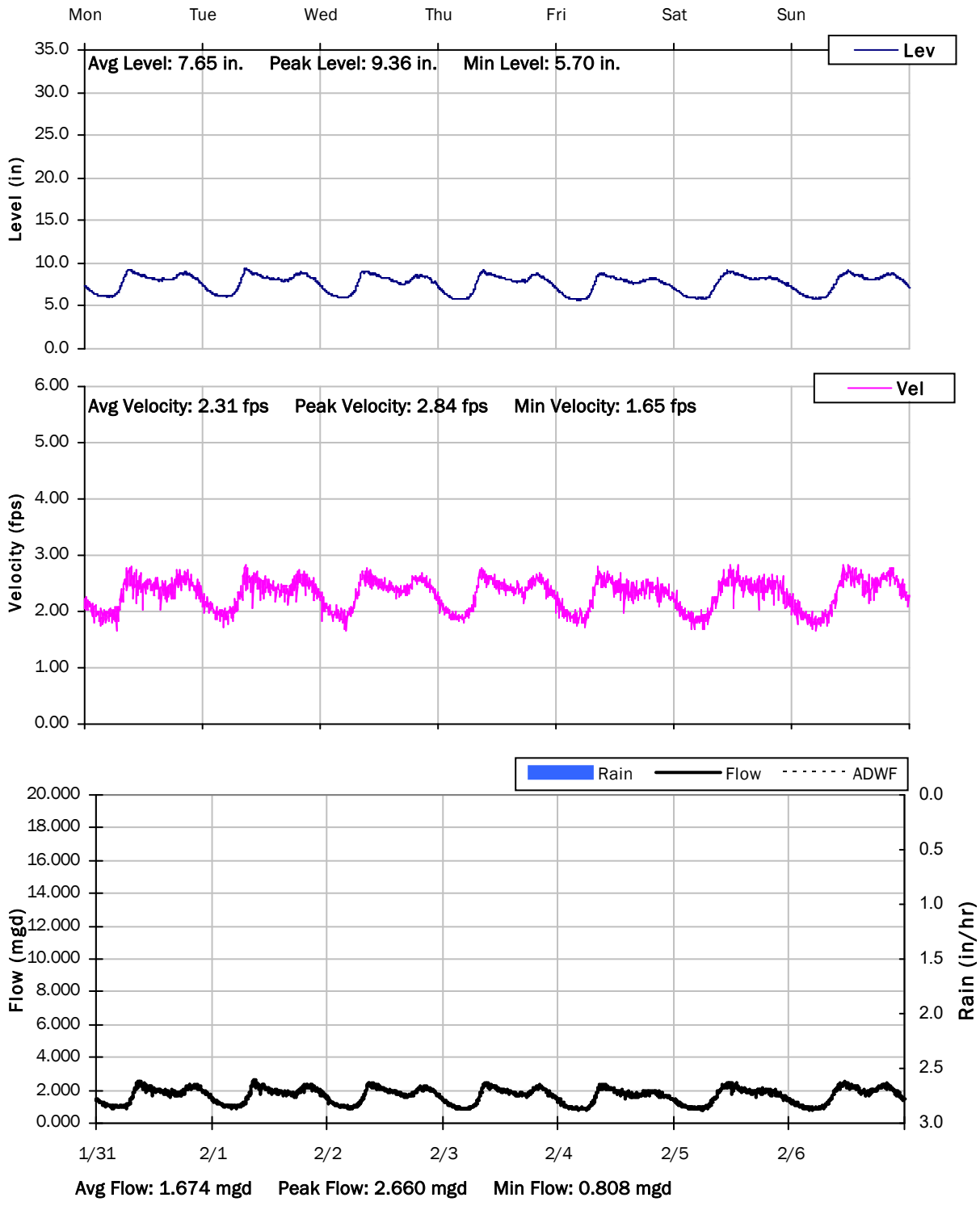
1/24/2022 to 1/31/2022



SITE 08

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 09

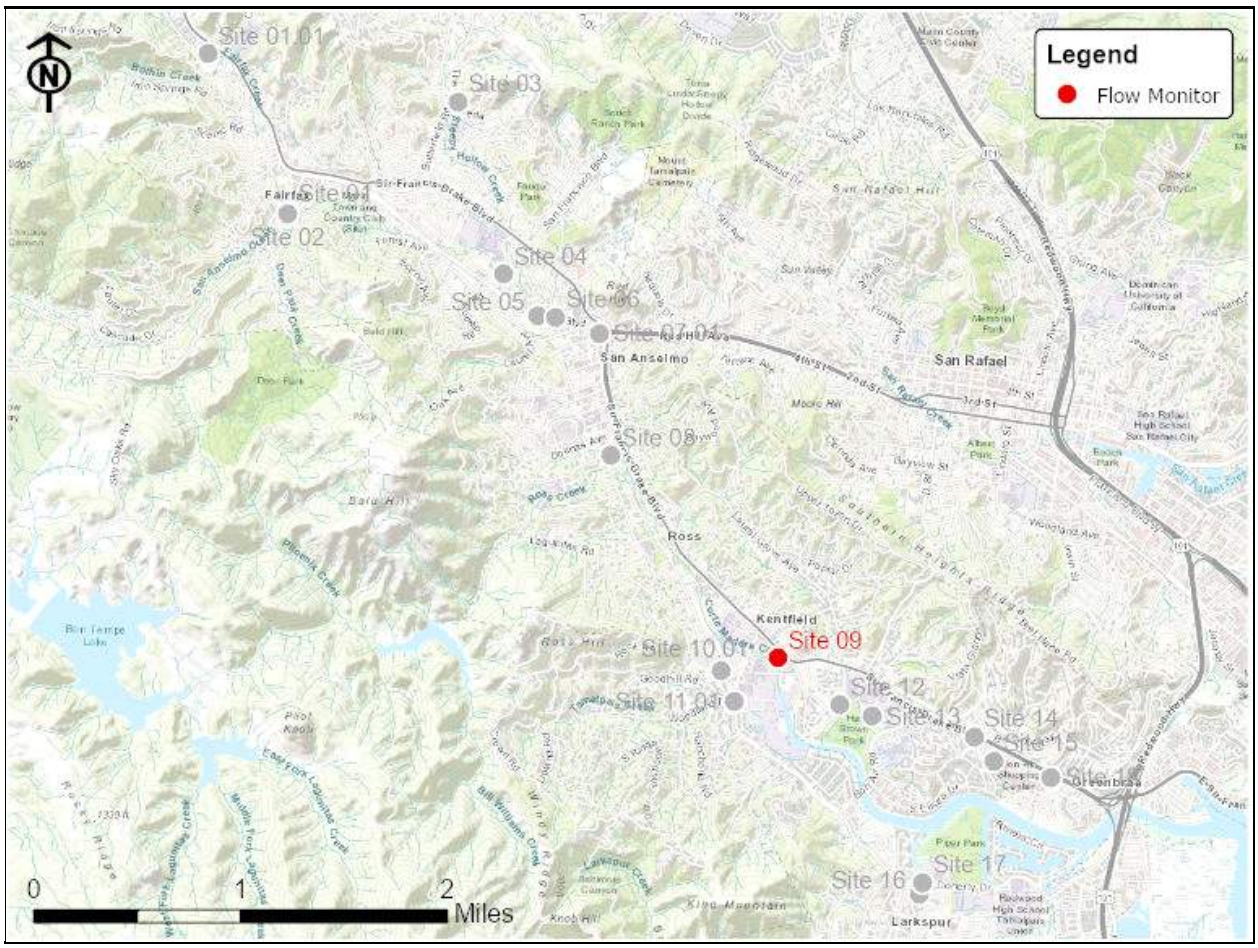
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Back of 913 Sir Francis Drake Blvd.

Data Summary Report



Vicinity Map: Site 09

SITE 09

Site Information MH ID: K000.040

Location: Back of 913 Sir Francis Drake Blvd.

Coordinates: 122.5460° W, 37.9538° N

Rim Elevation (Earth): 10 feet

Expected Pipe Diameter: 39 inches

Measured Pipe Diameter: 39 inches

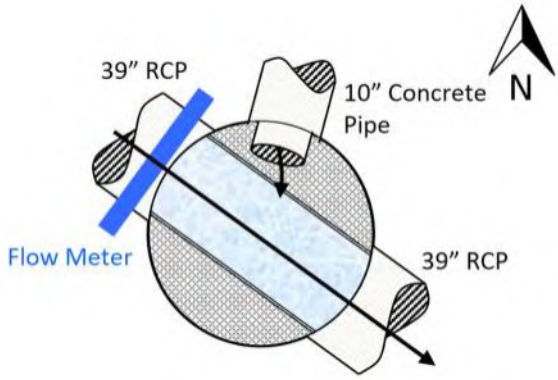
ADWF: 1.613 mgd

Peak Measured Flow: 20.221 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 09

Additional Site Photos

Effluent Pipe

Monitored Northwest Influent Pipe

SITE 09

Additional Site Photos

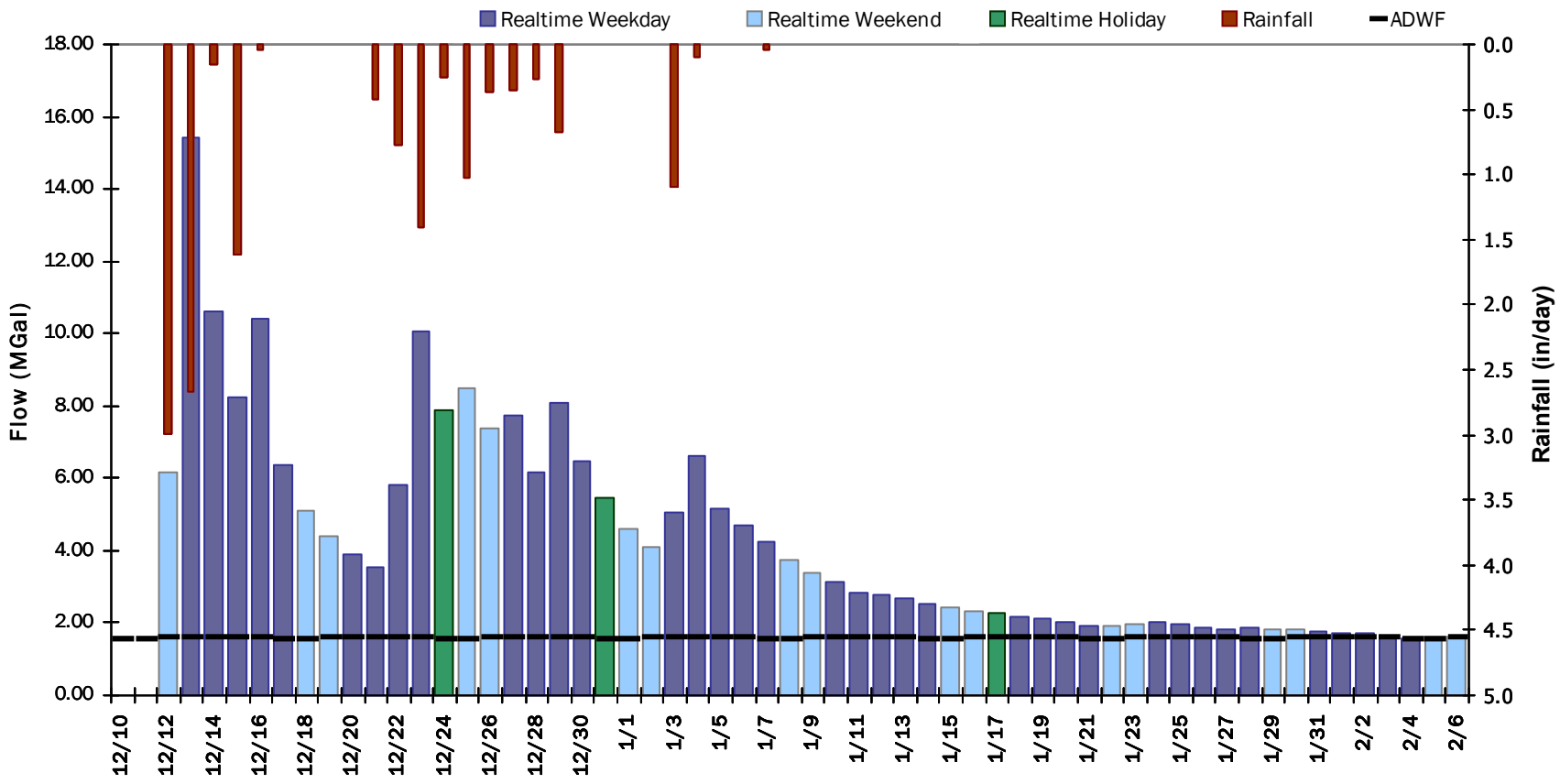
North Influent Pipe

SITE 09

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 4.292 MGal Peak Daily Flow: 15.400 MGal Min Daily Flow: 1.577 MGal

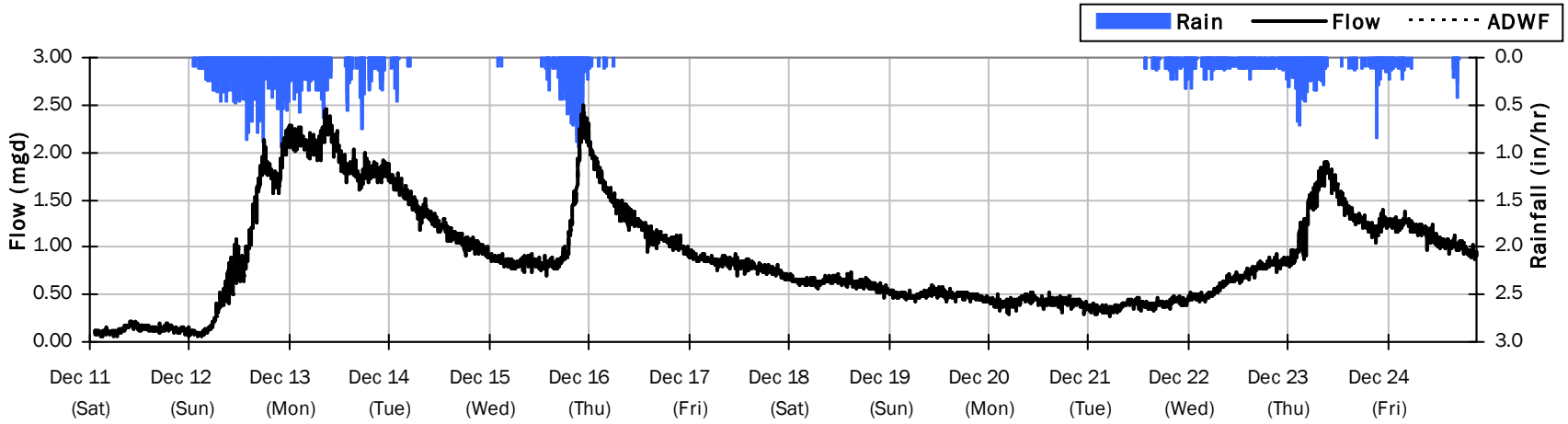
Total Rainfall: 14.28 inches

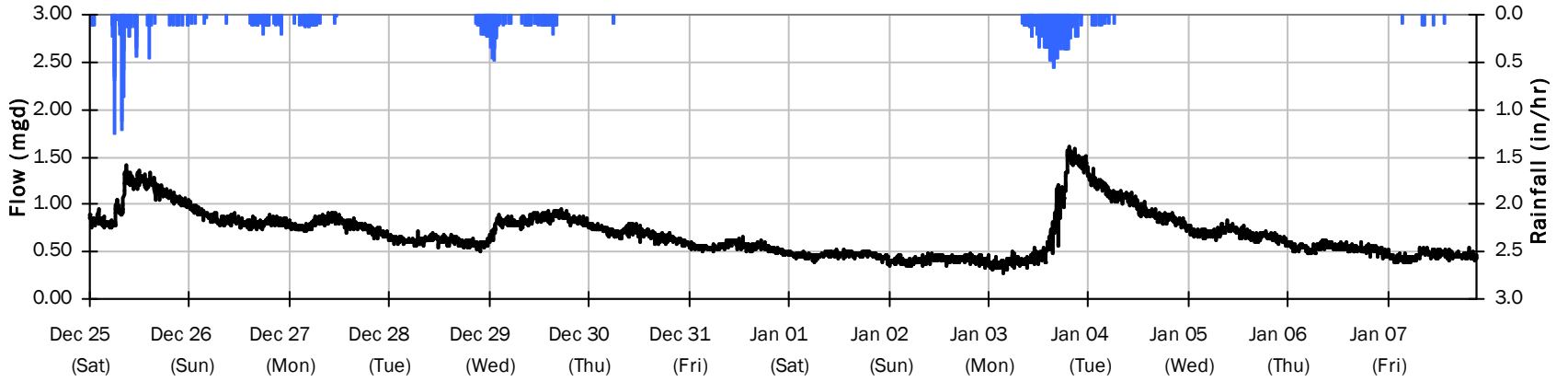


SITE 10.01

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 22.48 inches Period Avg Flow: 0.780 mgd Period Peak Flow: 2.489 mgd Period Min Flow: 0.056 mgd

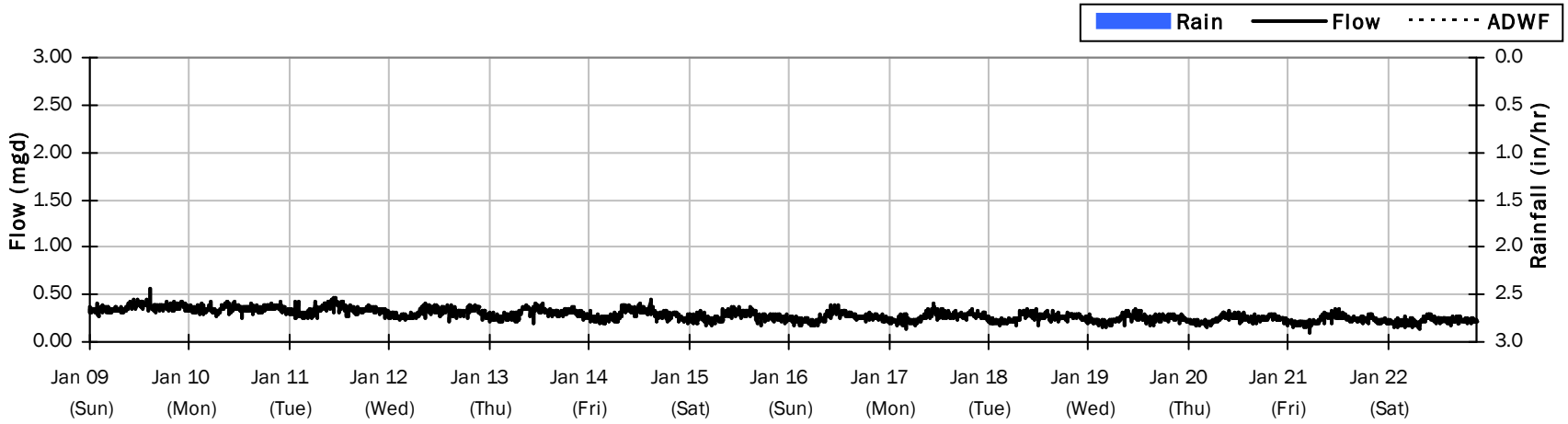


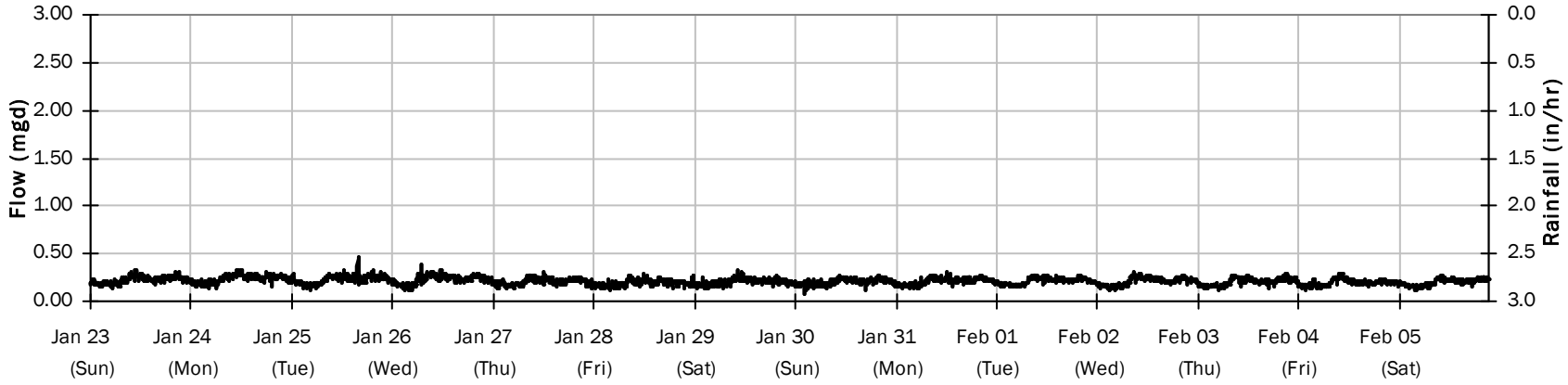


SITE 10.01

Flow Summary: 1/9/2022 to 2/5/2022

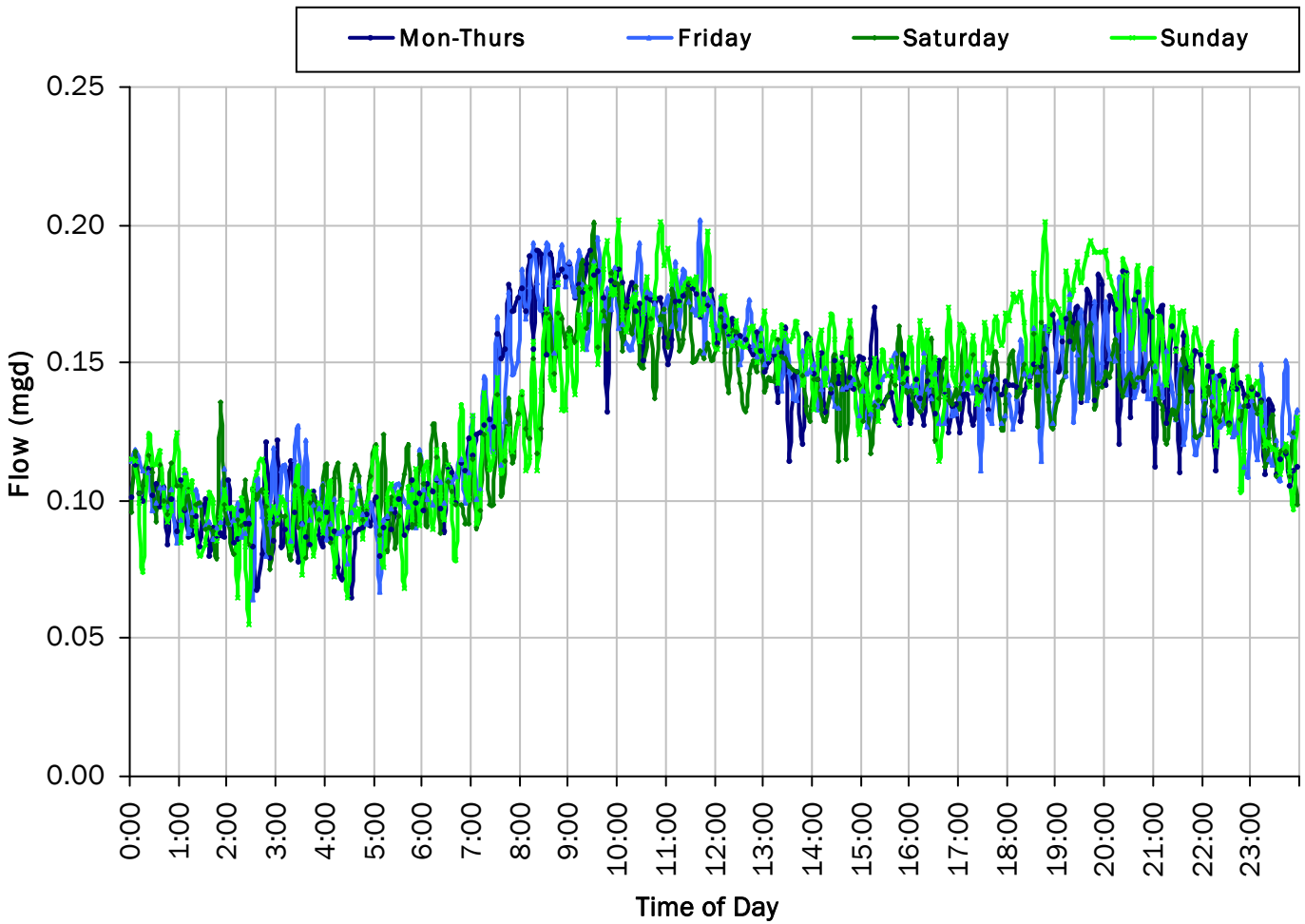
Period Rainfall: 0.00 inches Period Avg Flow: 0.247 mgd Period Peak Flow: 0.565 mgd Period Min Flow: 0.080 mgd





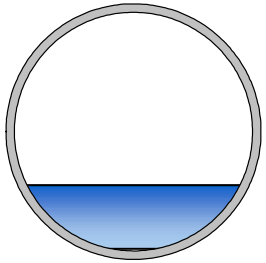
SITE 10.01

Average Dry Weather Flow Hydrographs



ADWF:

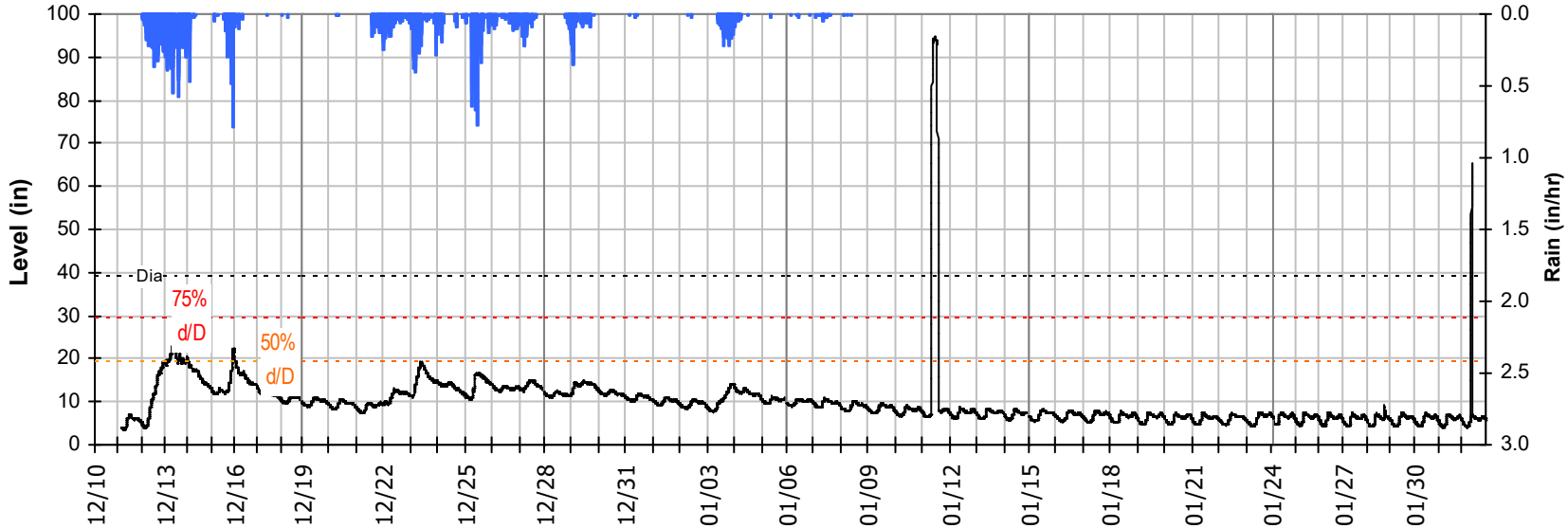
0.135 *mgd*

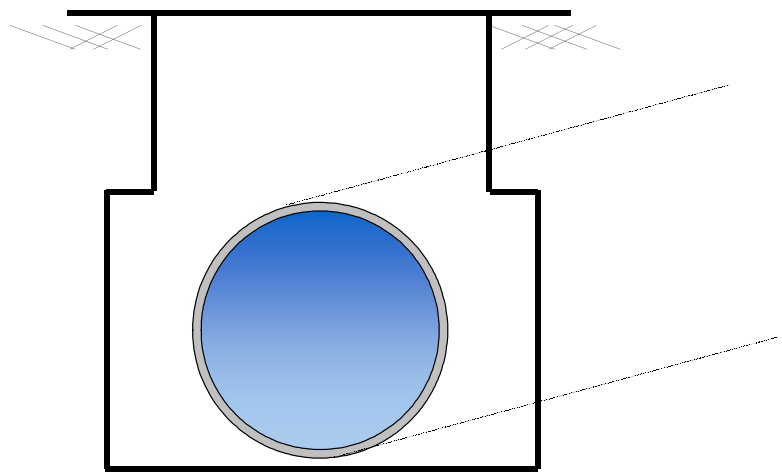


SITE 09

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



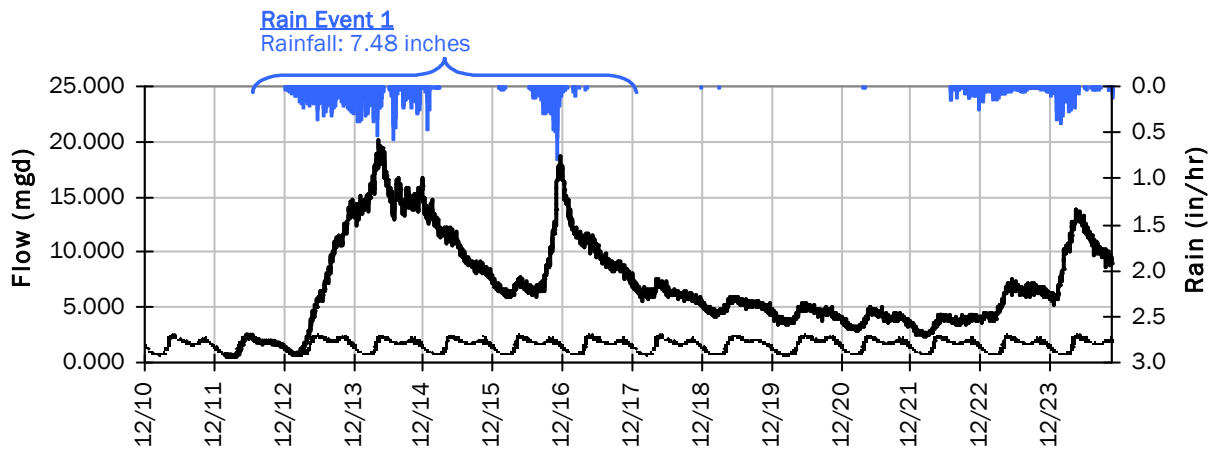


Pipe Diameter:	39	*inches*
Peak Measured Level:	94.6	*inches*
Peak d/D Ratio:	2.43	

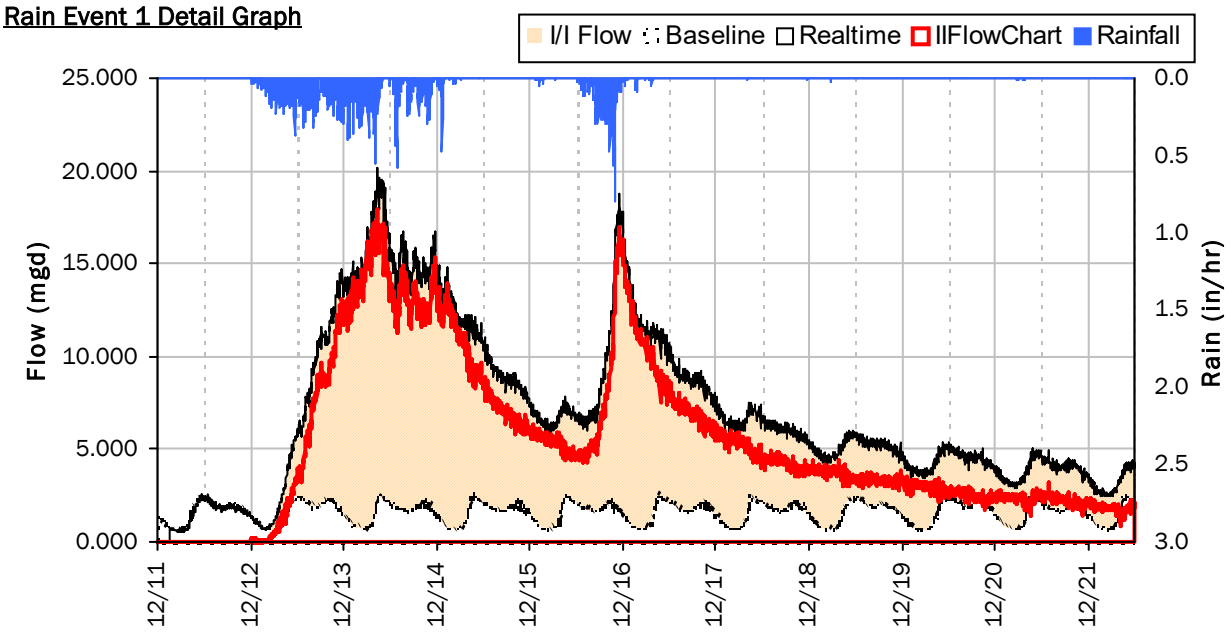
Surcharged 55.6 inches over crown

SITE 09
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph



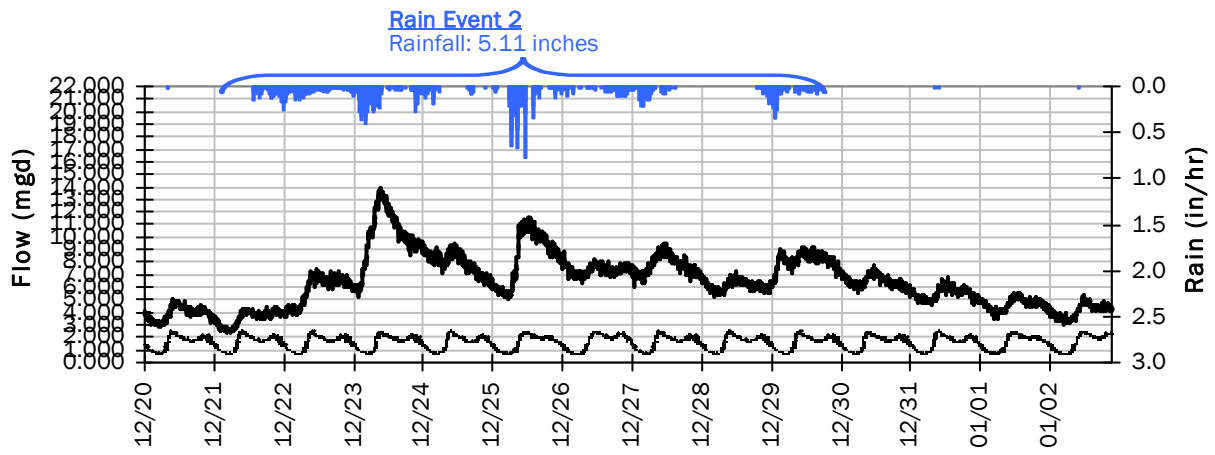
Storm Event I/I Analysis (Rain = 7.48 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	20.221 *mgd*	**Peak I/I Rate:**	17.944 *mgd*
PF:	12.59	**Total I/I:**	56,998,000 *gallons*
Peak Level:	23.51 *in*		
d/D Ratio:	0.60		

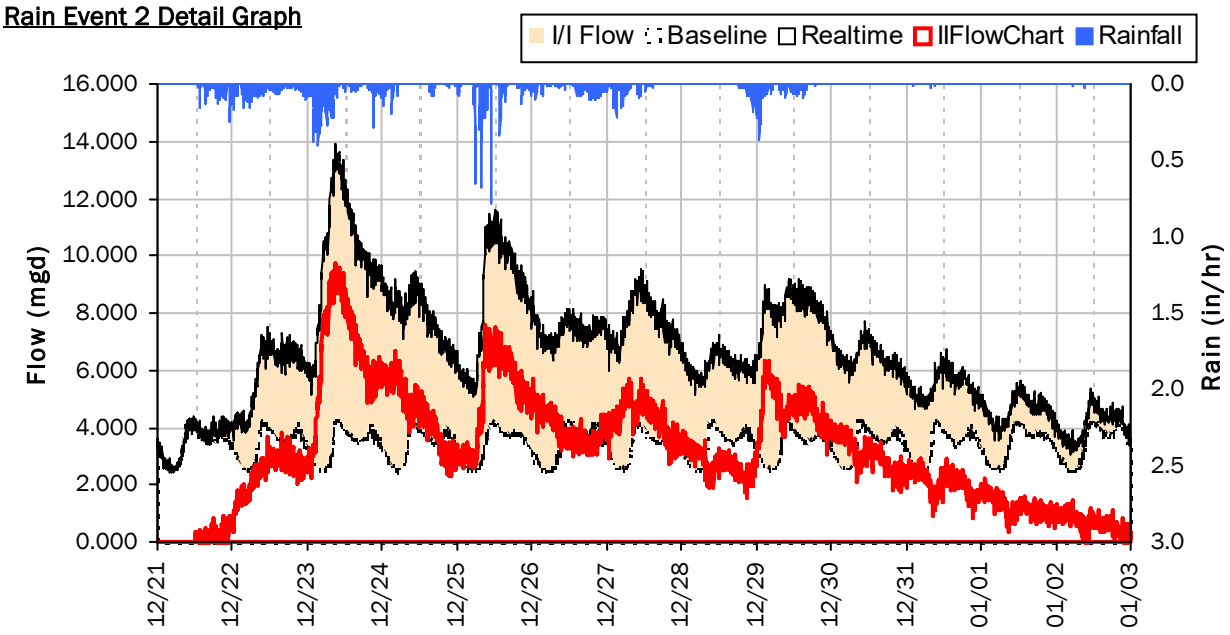
SITE 09

I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



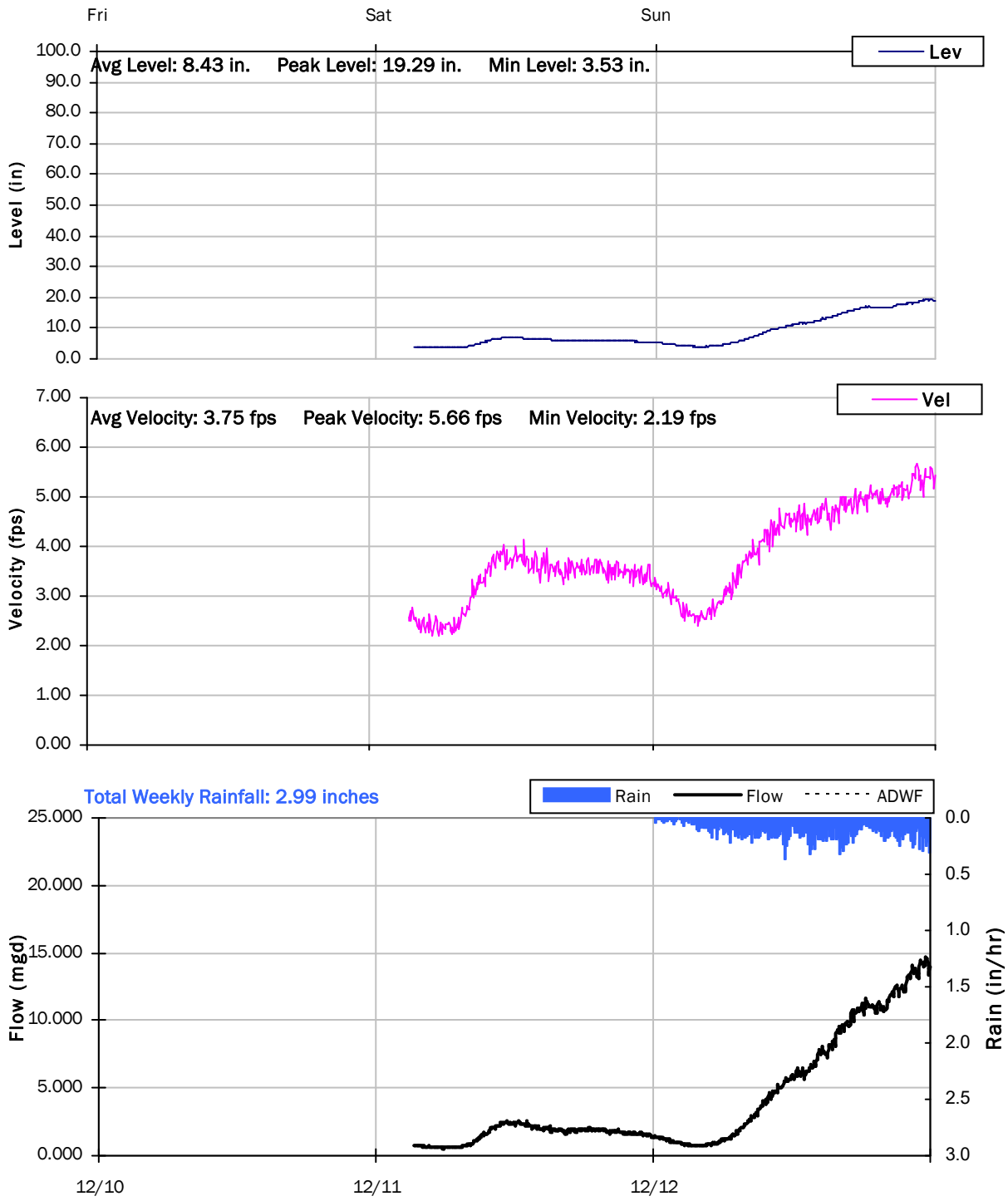
Storm Event I/I Analysis (Rain = 5.11 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	13.914 *mgd*	**Peak I/I Rate:**	9.772 *mgd*
PF:	8.66	**Total I/I:**	41,588,000 *gallons*
Peak Level:	19.15 *in*		
d/D Ratio:	0.49		

SITE 09

Weekly Level, Velocity and Flow Hydrographs

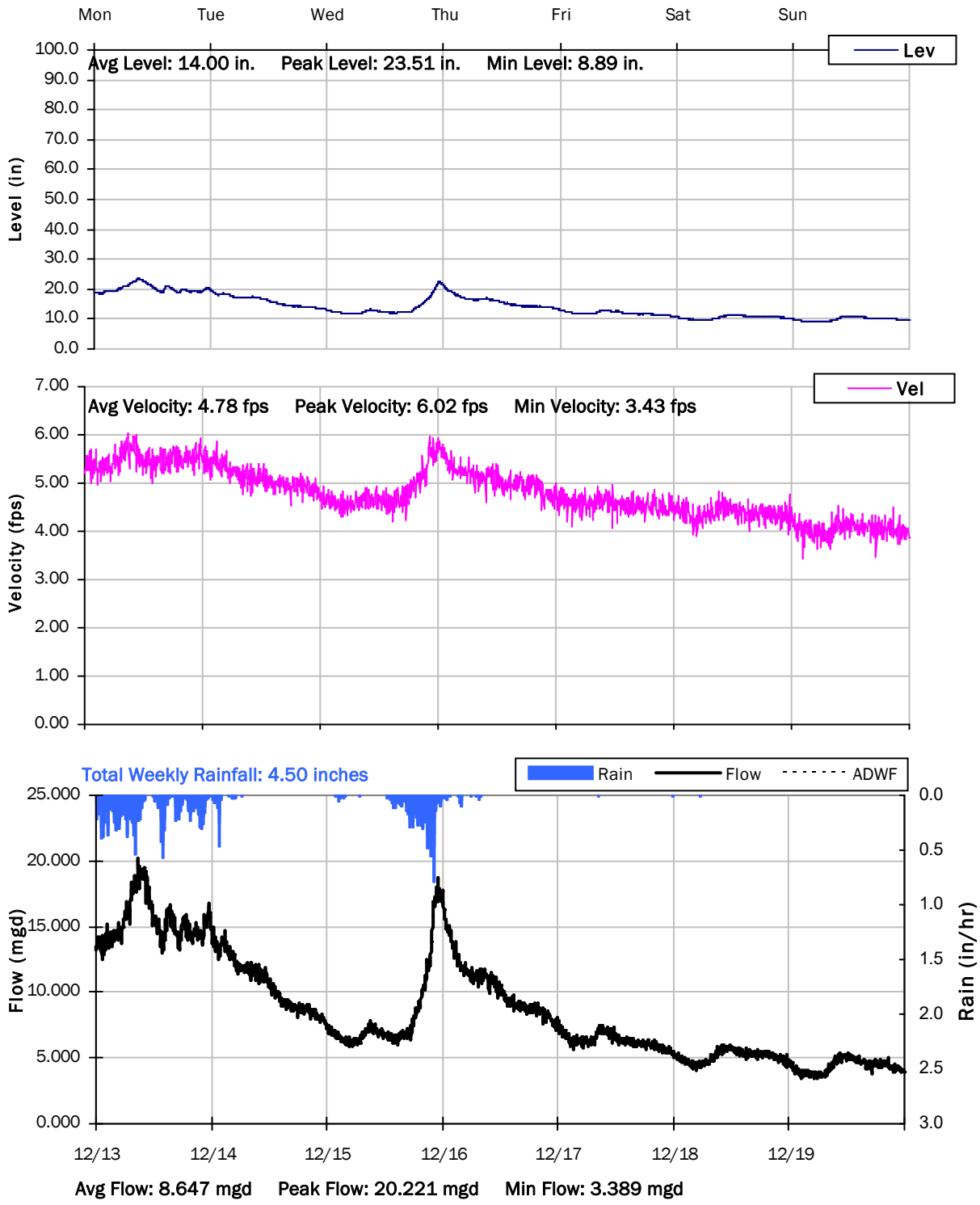
12/10/2021 to 12/13/2021



SITE 09

Weekly Level, Velocity and Flow Hydrographs

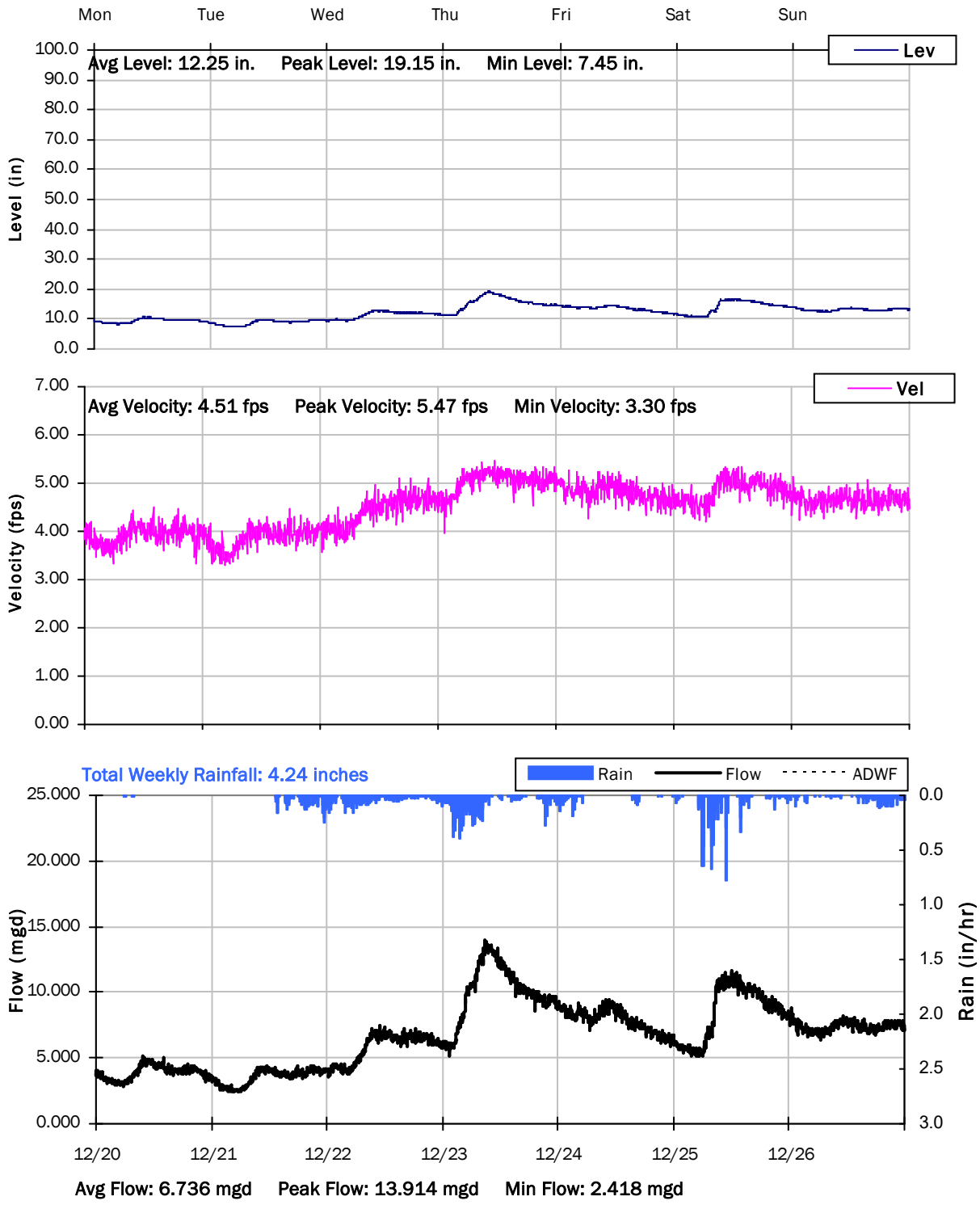
12/13/2021 to 12/20/2021



SITE 09

Weekly Level, Velocity and Flow Hydrographs

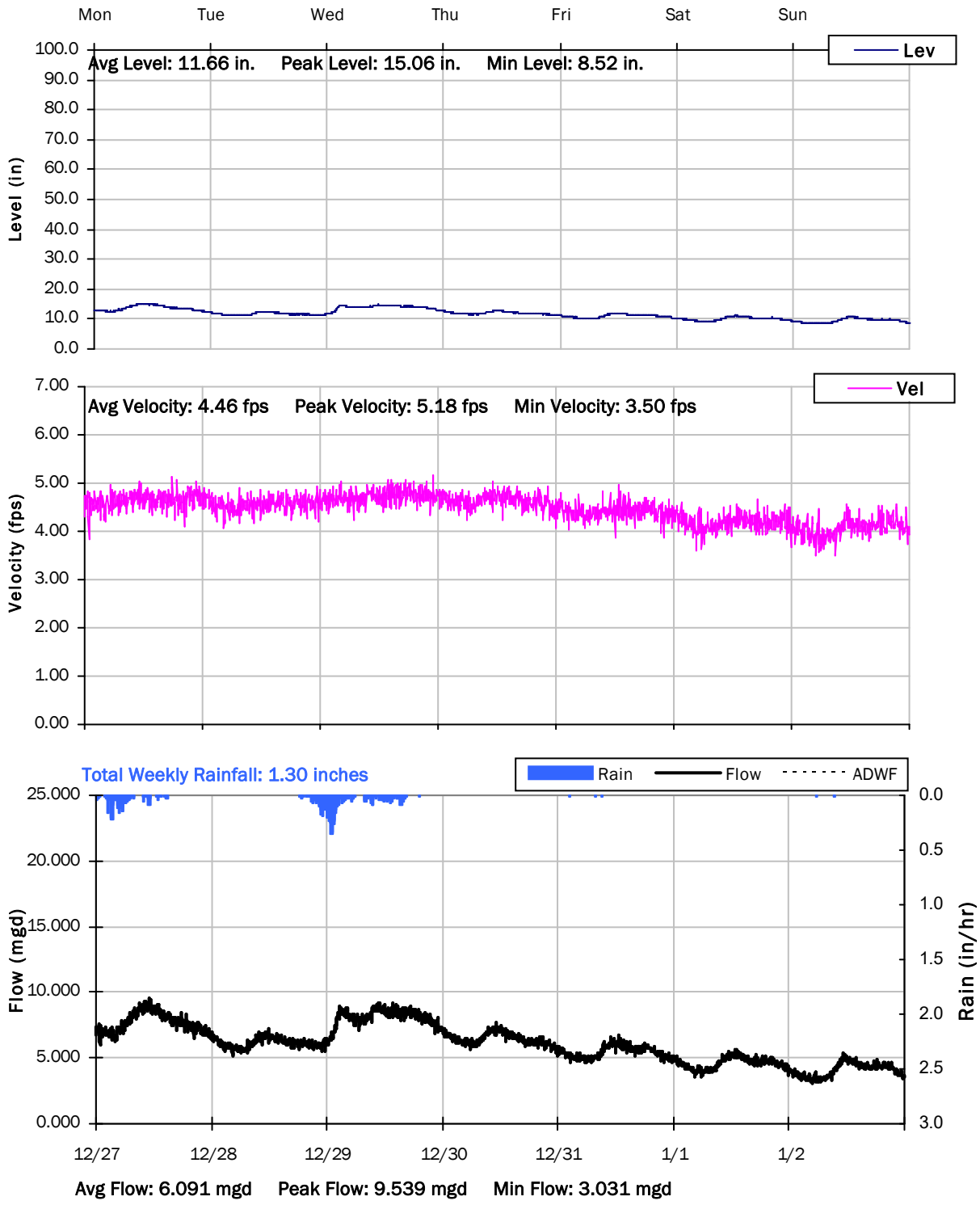
12/20/2021 to 12/27/2021



SITE 09

Weekly Level, Velocity and Flow Hydrographs

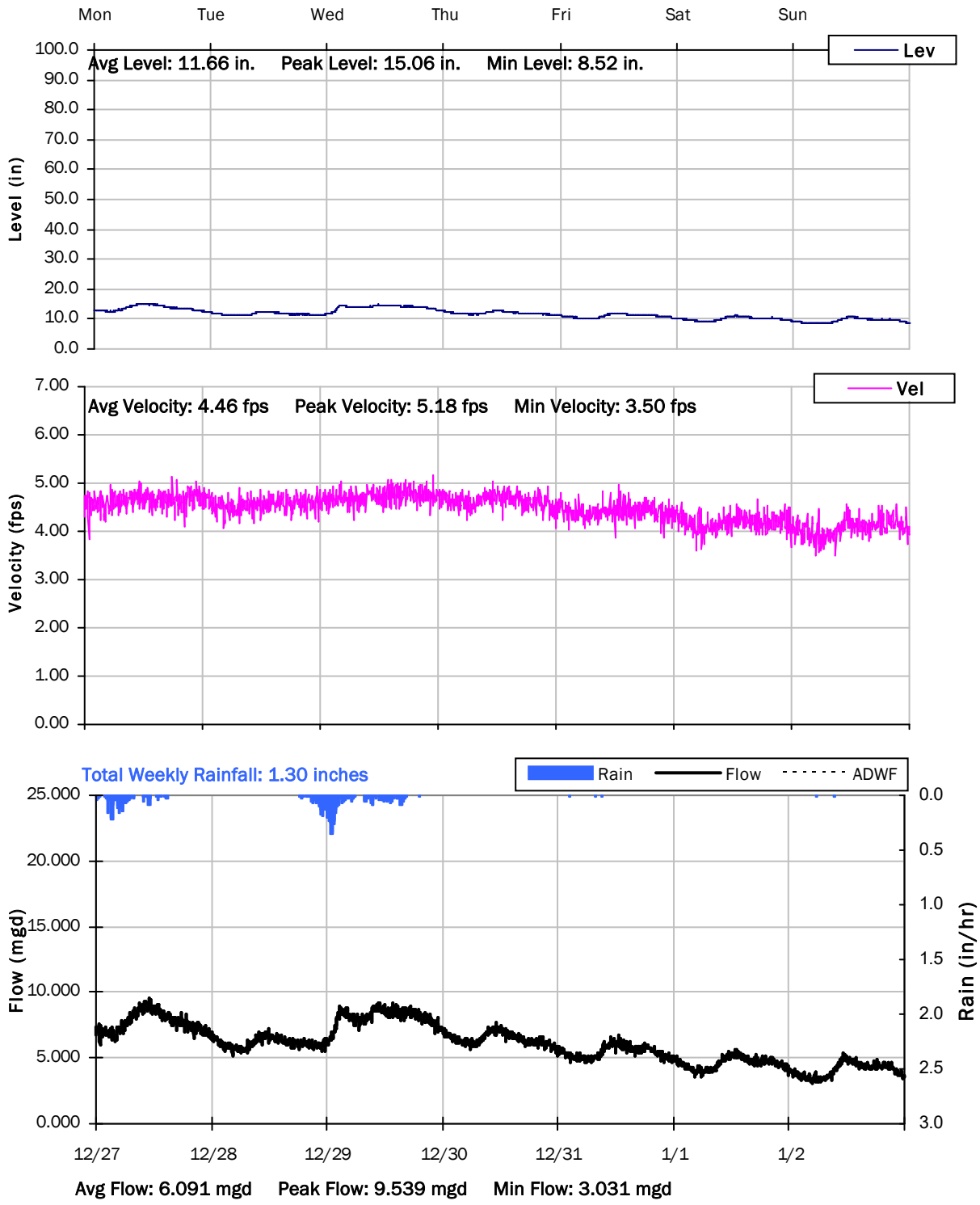
12/27/2021 to 1/3/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

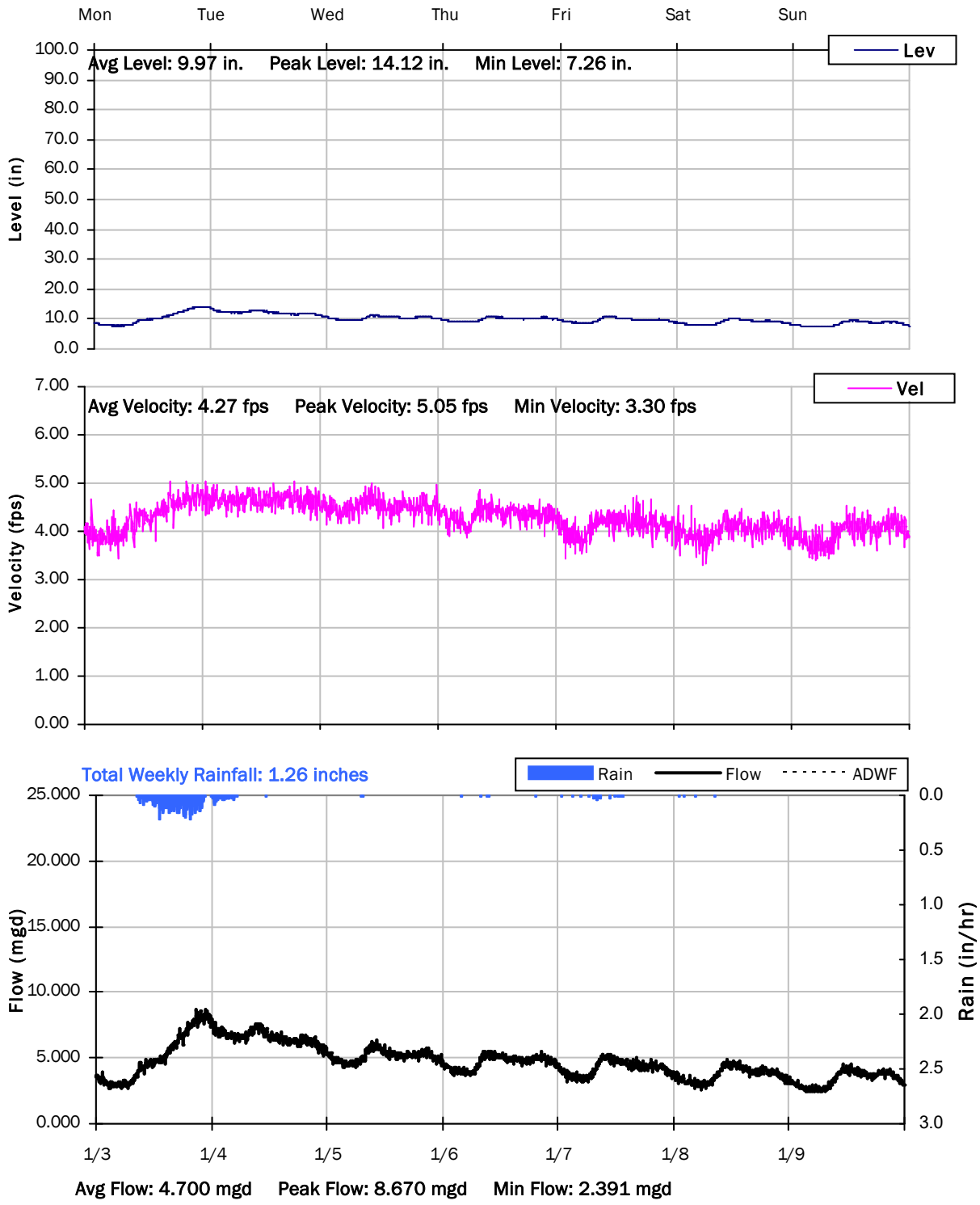
12/27/2021 to 1/3/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

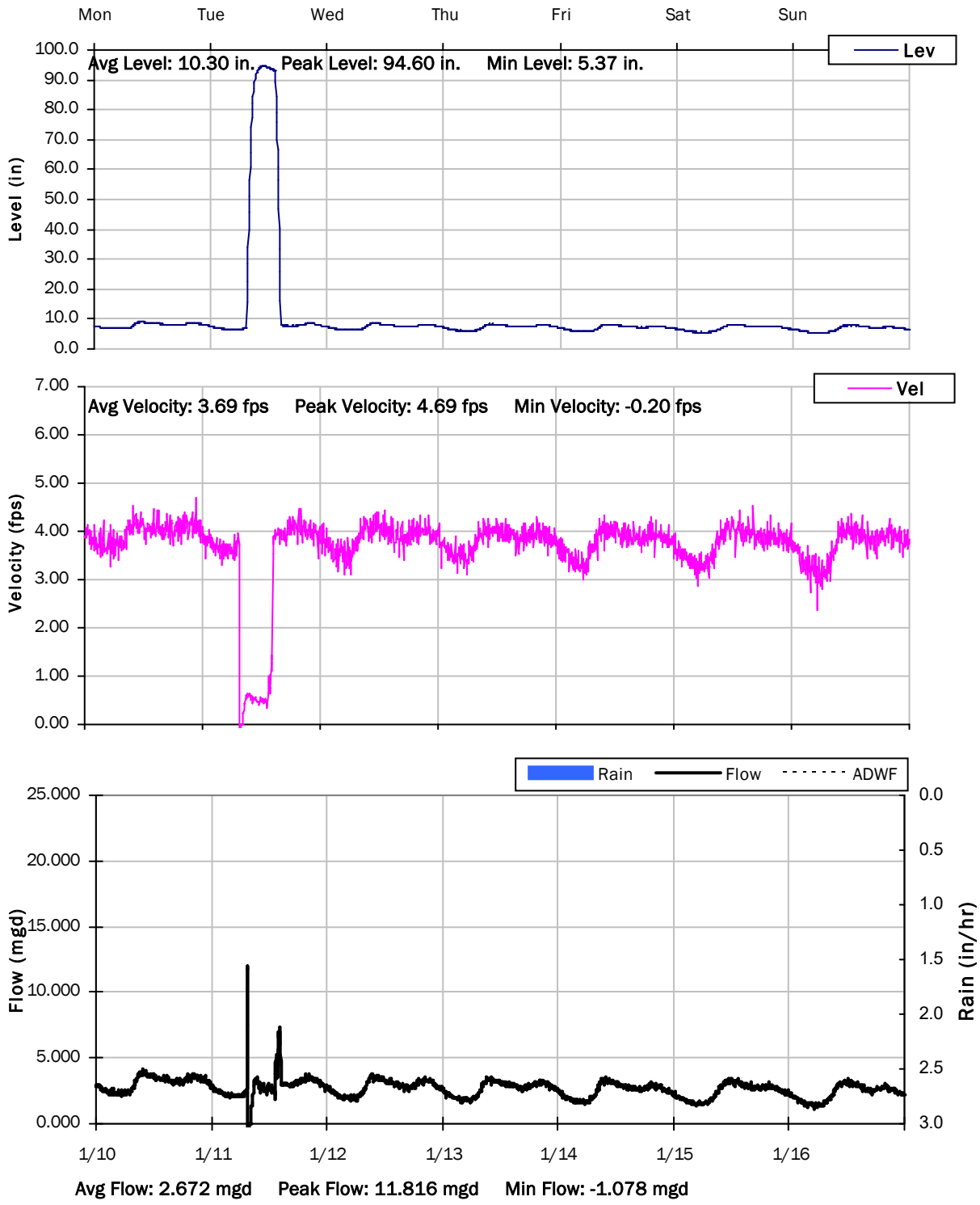
1/3/2022 to 1/10/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

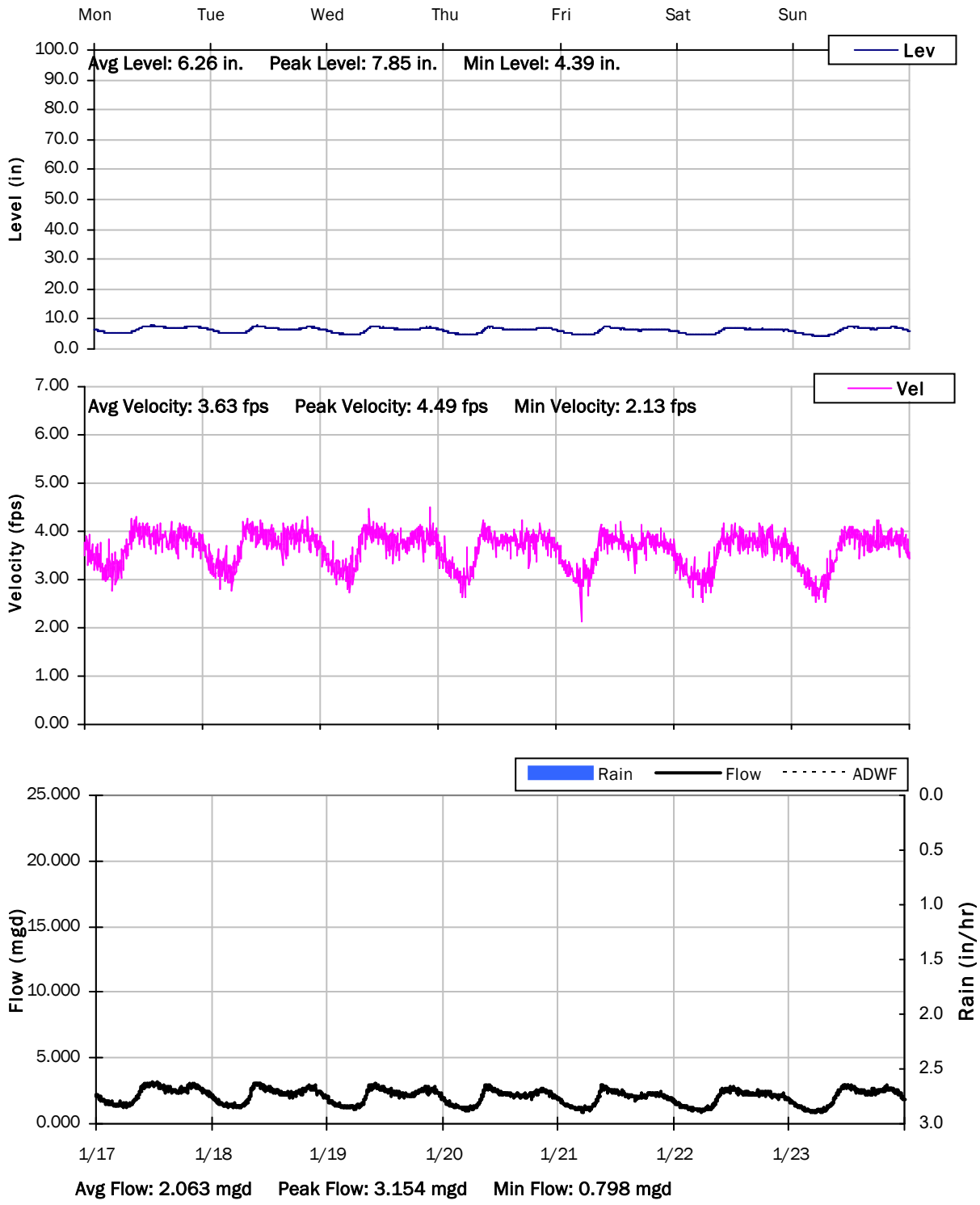
1/10/2022 to 1/17/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

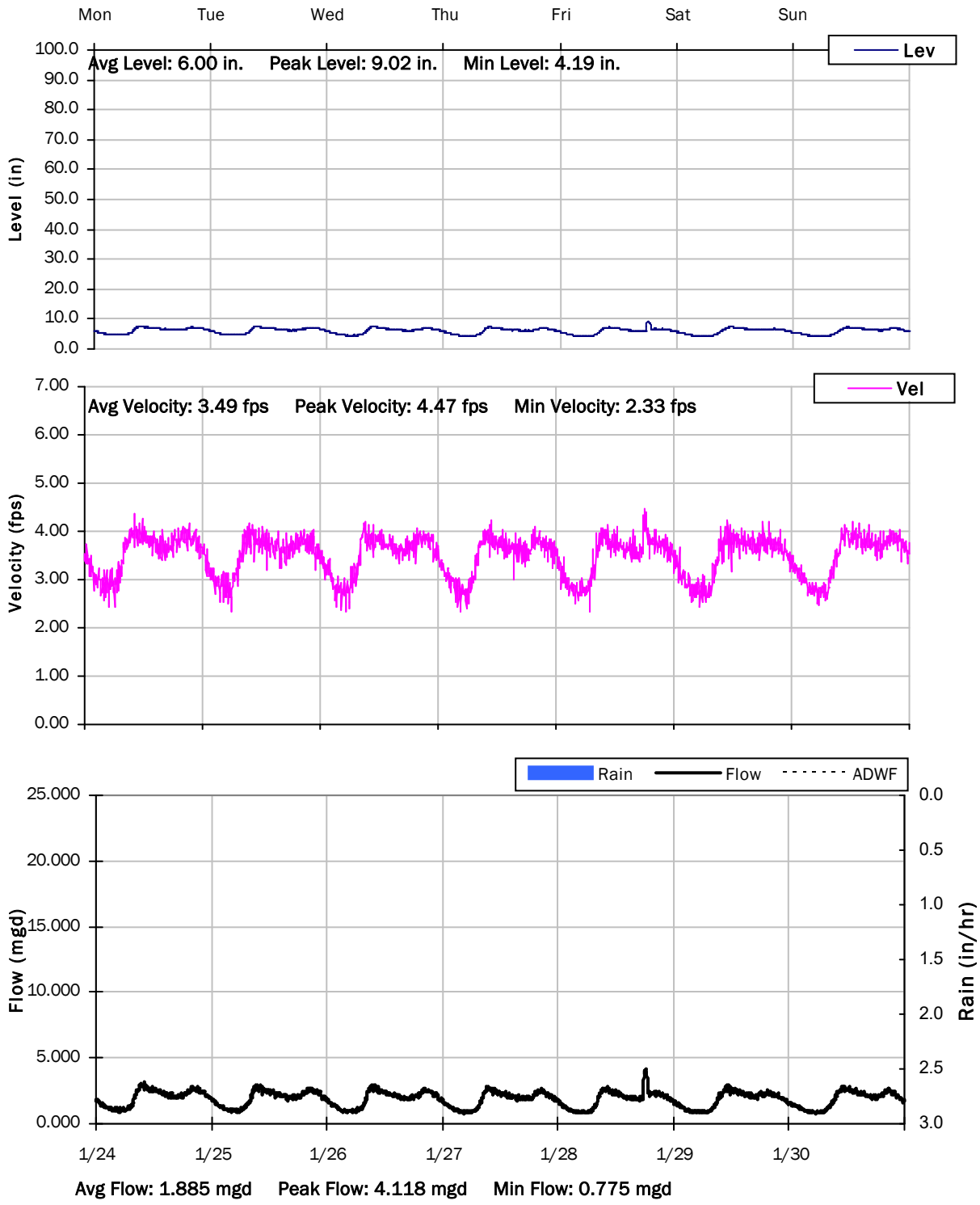
1/17/2022 to 1/24/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

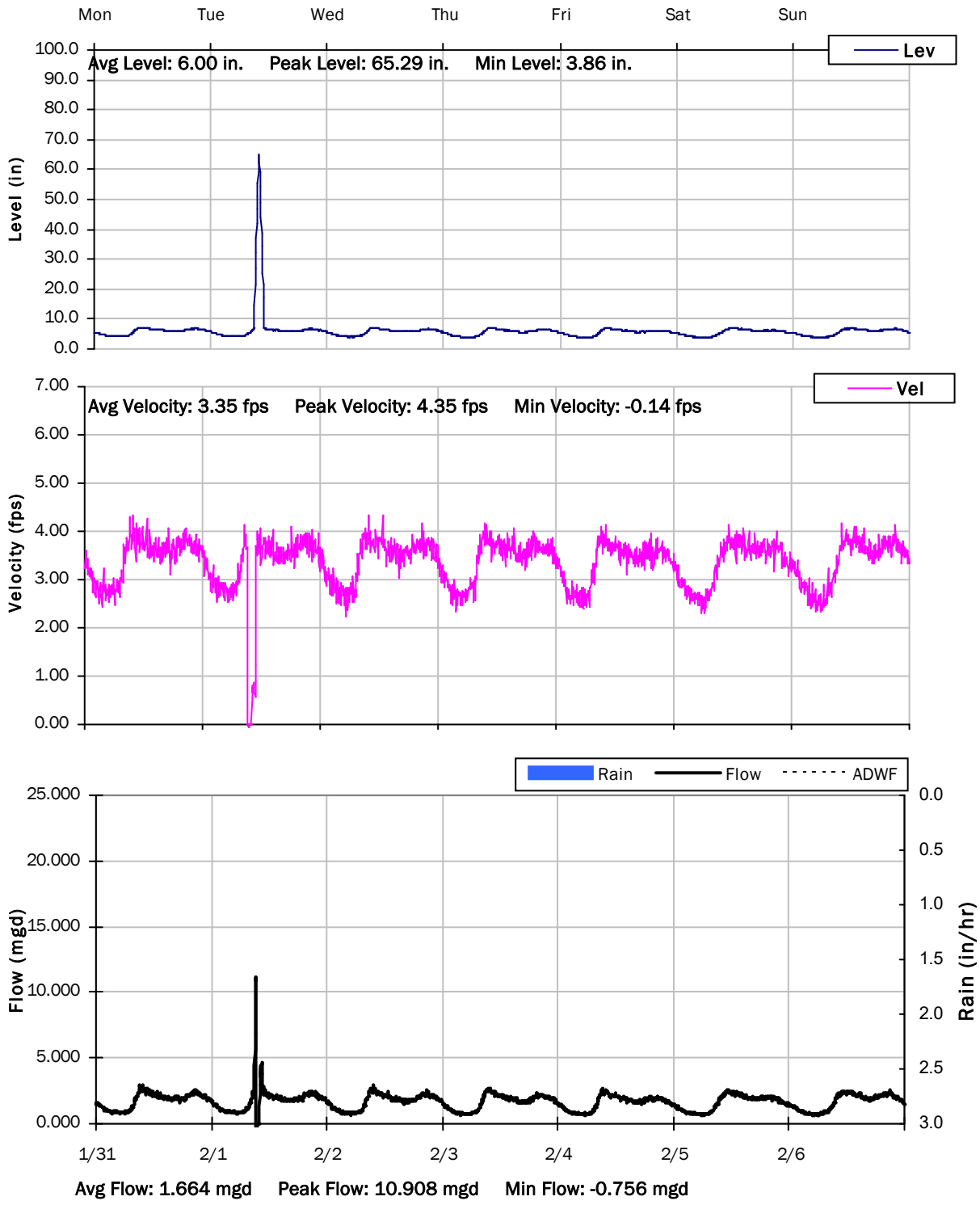
1/24/2022 to 1/31/2022



SITE 09

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 10.01

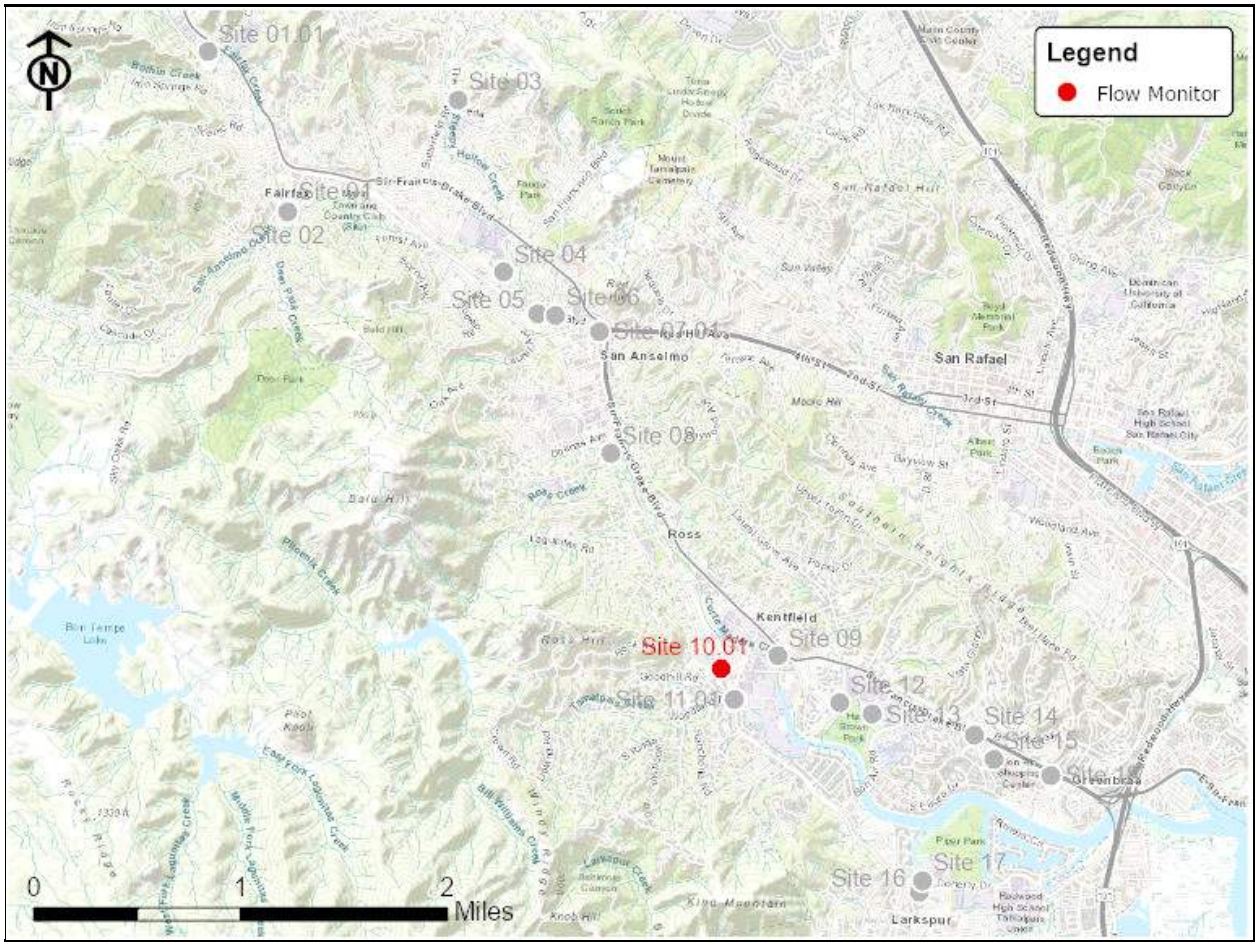
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 121 Kent Avenue

Data Summary Report



Vicinity Map: Site 10.01

SITE 10.01

Site Information MH ID: R500.010

Location: 121 Kent Avenue

Coordinates: 122.5510° W, 37.9529° N

Rim Elevation (Earth): 11 feet

Expected Pipe Diameter: 21 inches

Measured Pipe Diameter: 27 inches

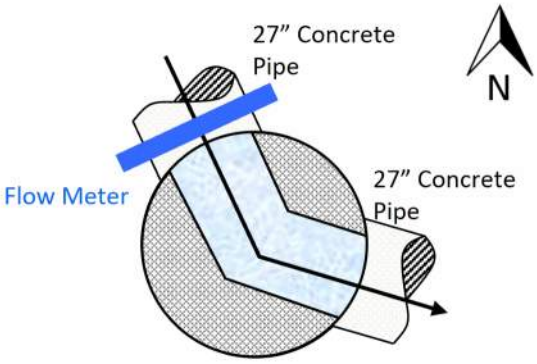
ADWF: 0.136 mgd

Peak Measured Flow: 2.489 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 10.01

Additional Site Photos

Effluent Pipe

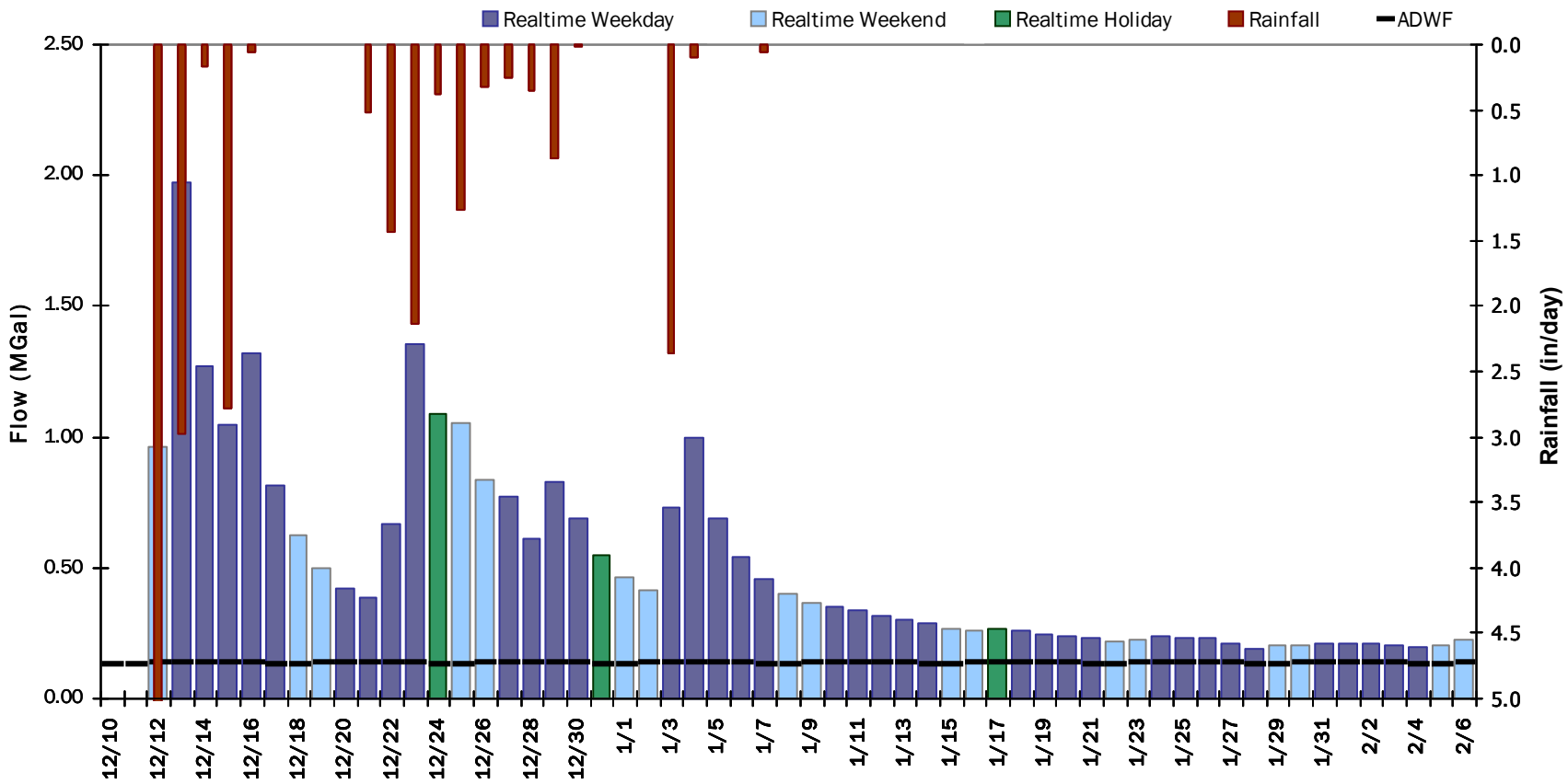
Monitored Northwest Influent Pipe

SITE 10.01

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.513 MGal Peak Daily Flow: 1.974 MGal Min Daily Flow: 0.131 MGal

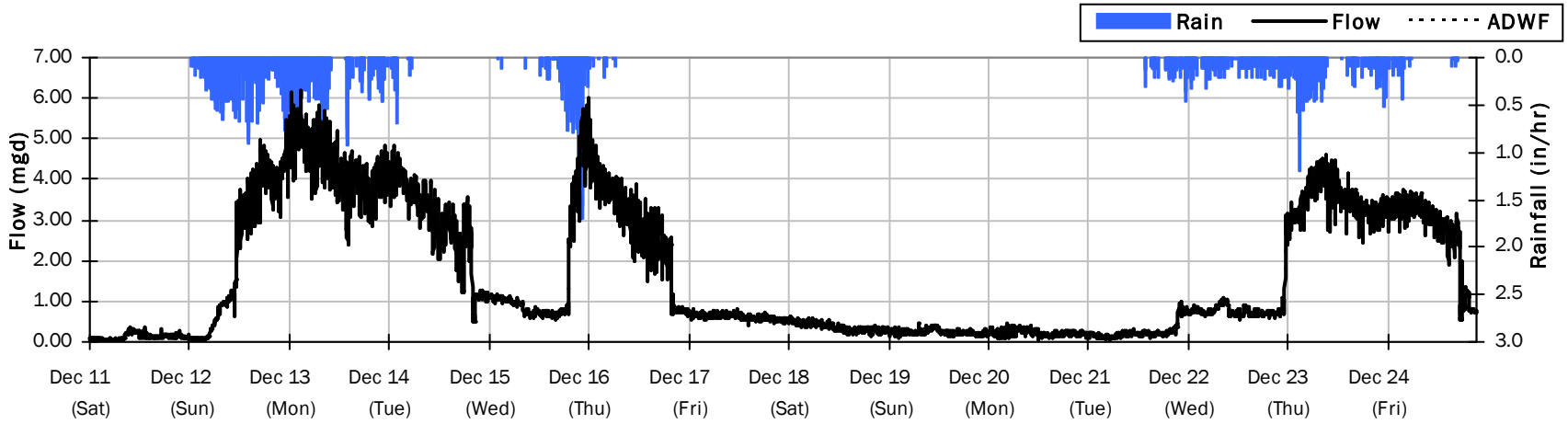
Total Rainfall: 22.48 inches

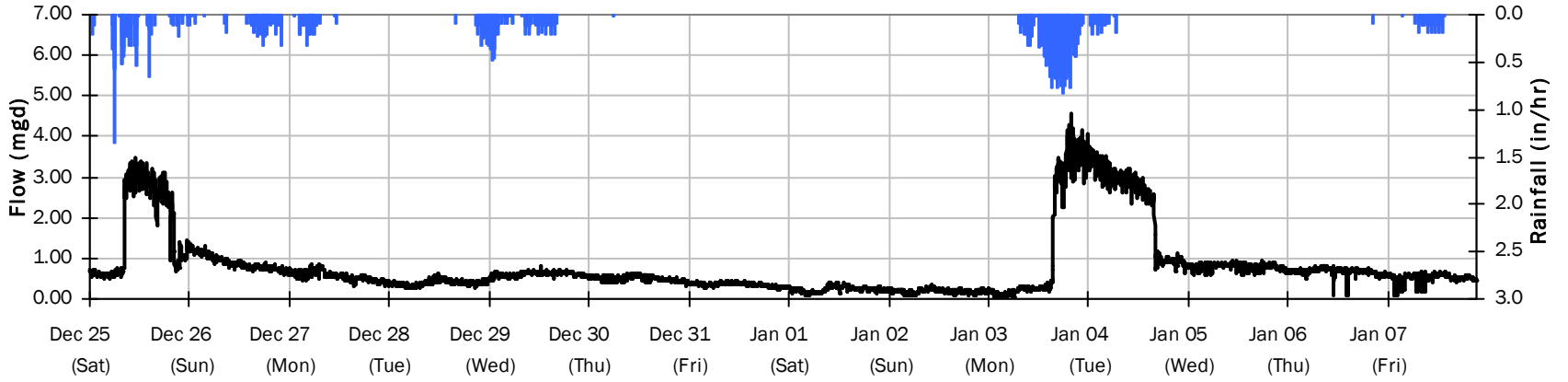


SITE 11.01

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 25.33 inches Period Avg Flow: 1.168 mgd Period Peak Flow: 6.192 mgd Period Min Flow: 0.030 mgd

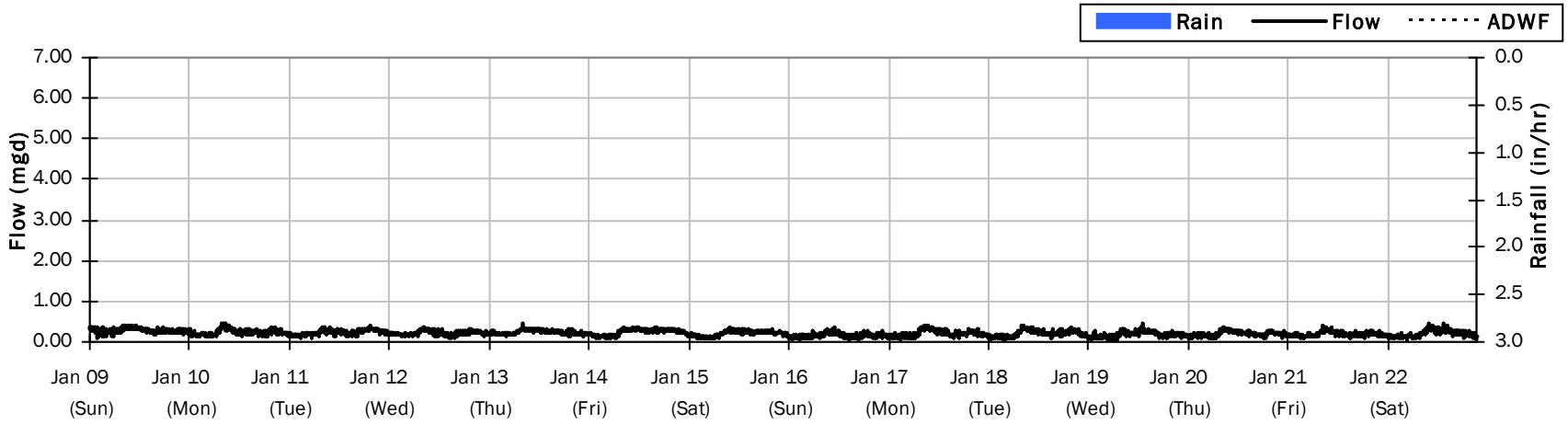


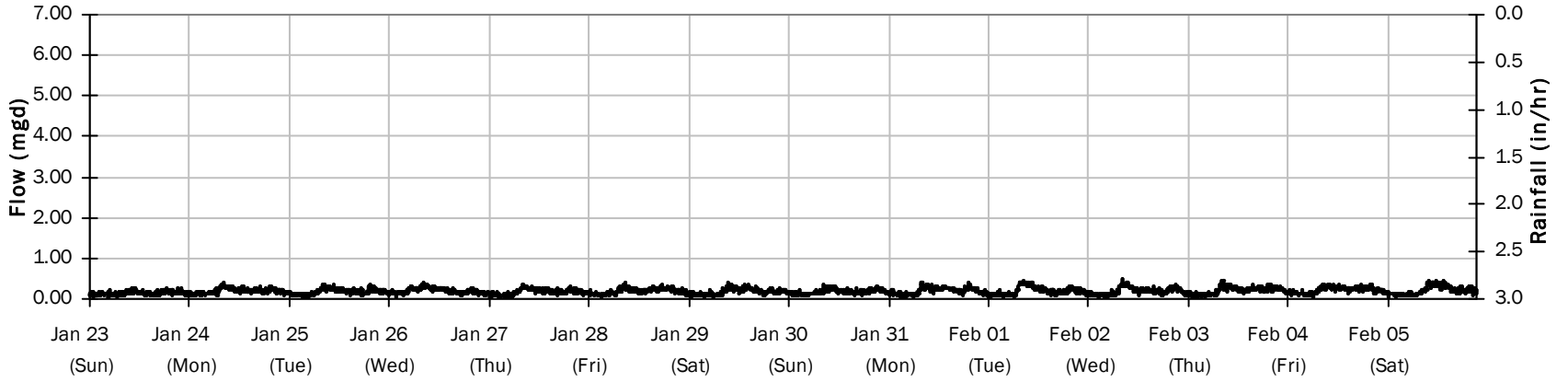


SITE 11.01

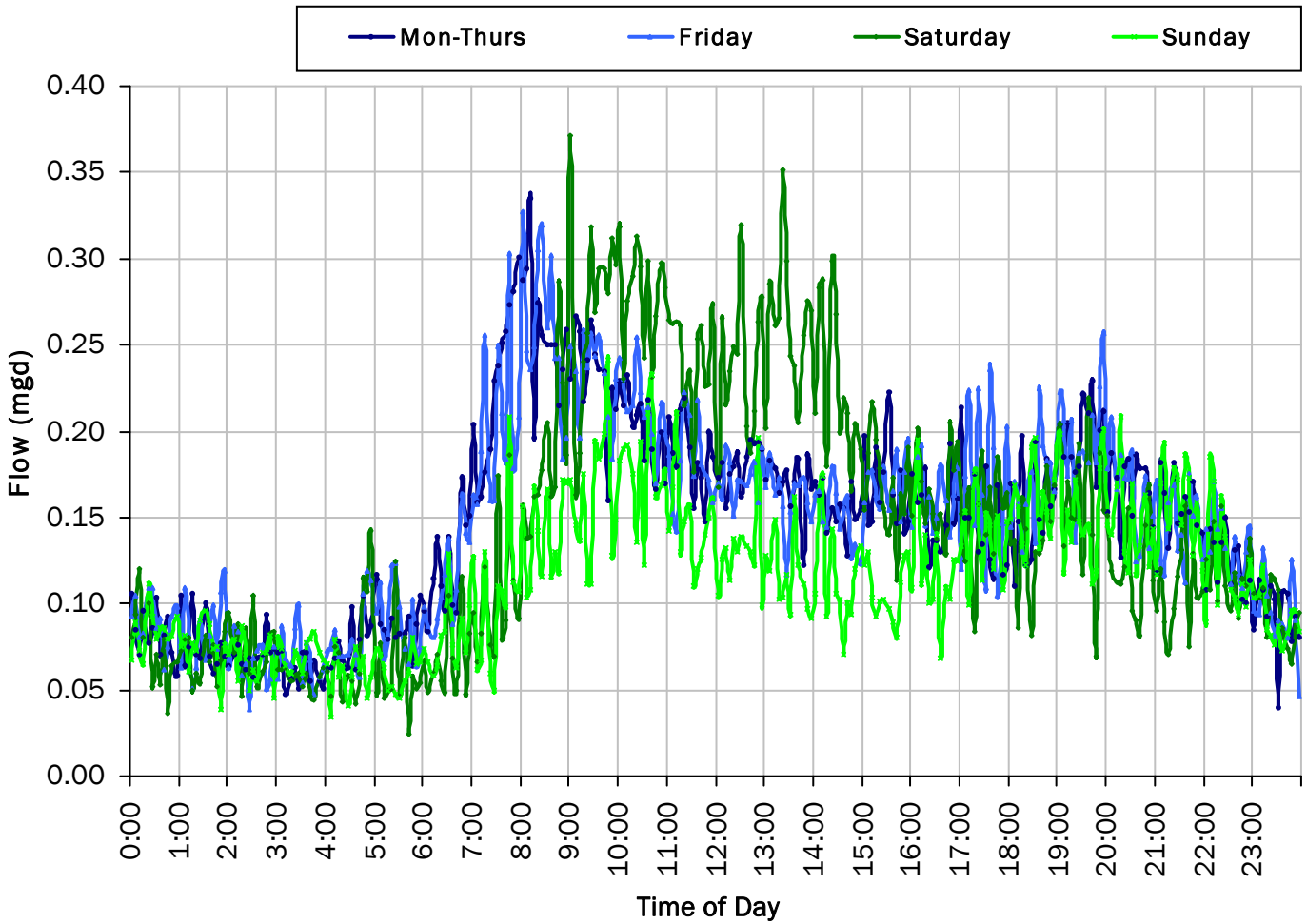
Flow Summary: 1/9/2022 to 2/5/2022

Period Rainfall: 0.00 inches Period Avg Flow: 0.206 mgd Period Peak Flow: 0.481 mgd Period Min Flow: 0.034 mgd



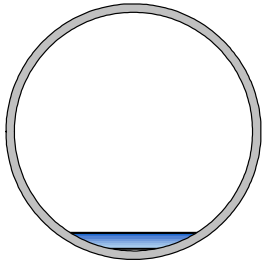


SITE 11.01
Average Dry Weather Flow Hydrographs



ADWF:

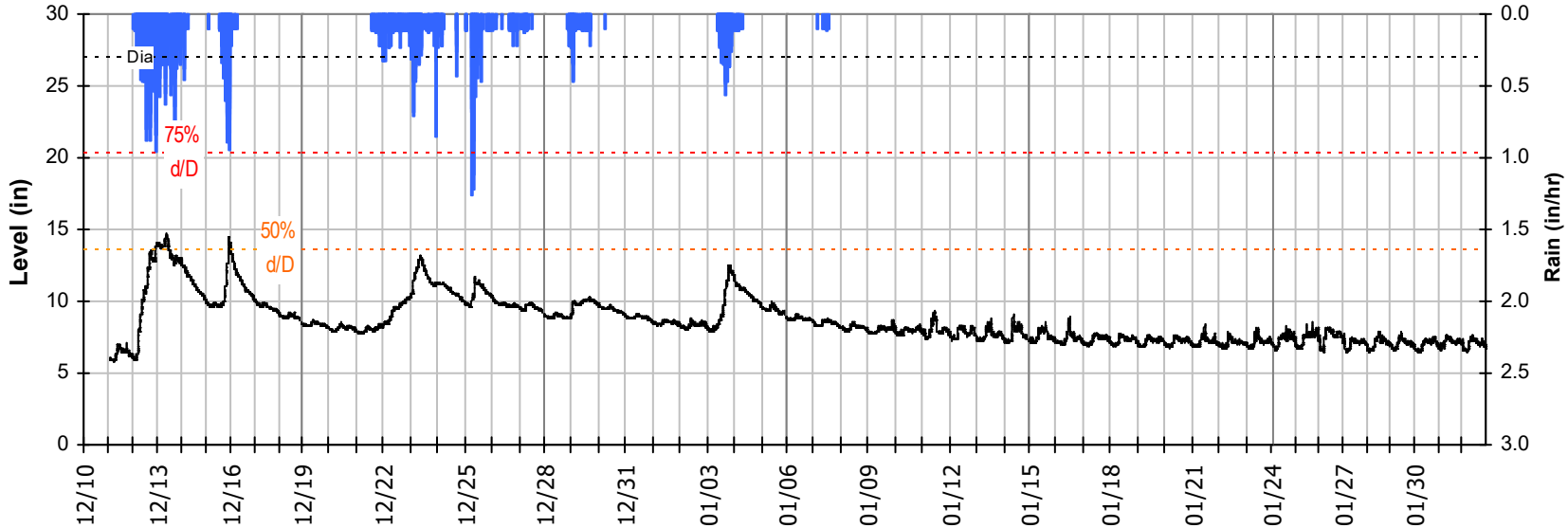
0.143 *mgd*

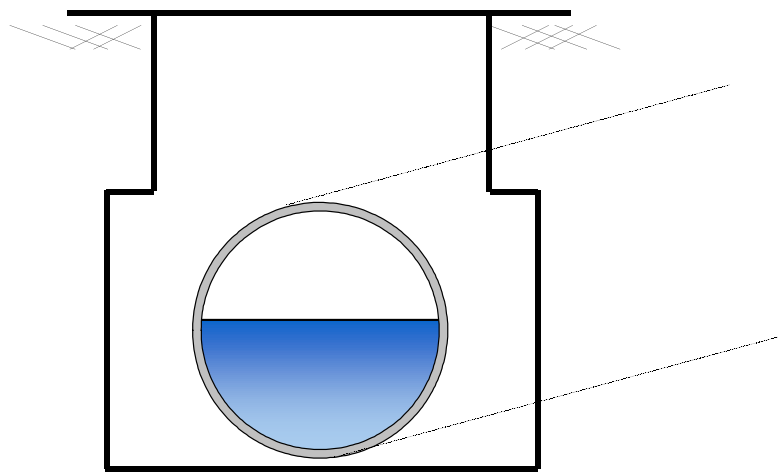


SITE 10.01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

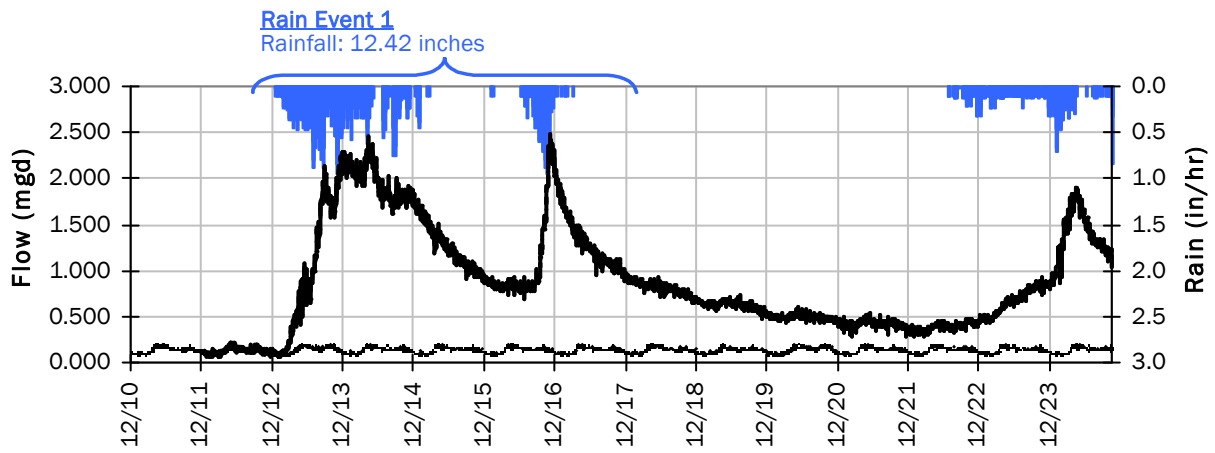




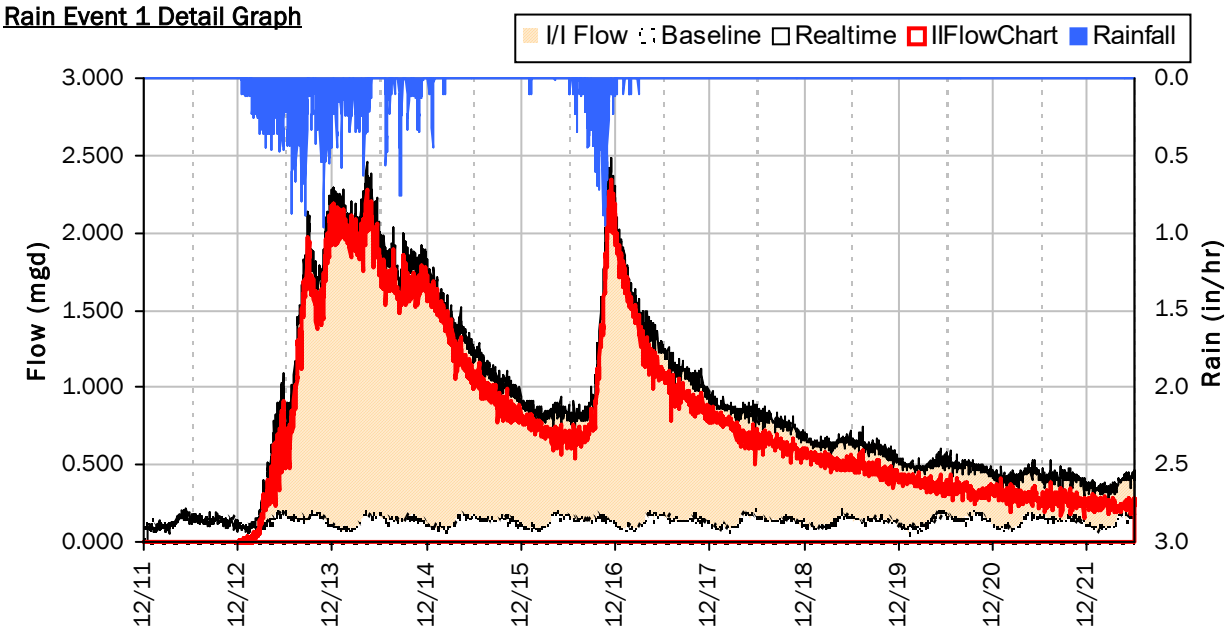
Pipe Diameter:	27	*inches*
Peak Measured Level:	14.7	*inches*
Peak d/D Ratio:	0.54	

SITE 10.01
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

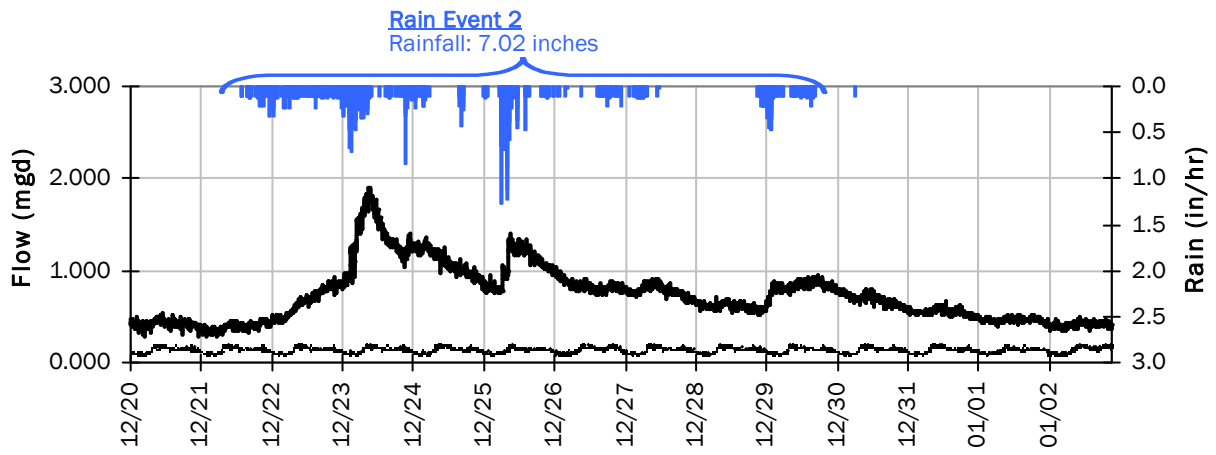


Storm Event I/I Analysis (Rain = 12.42 inches)

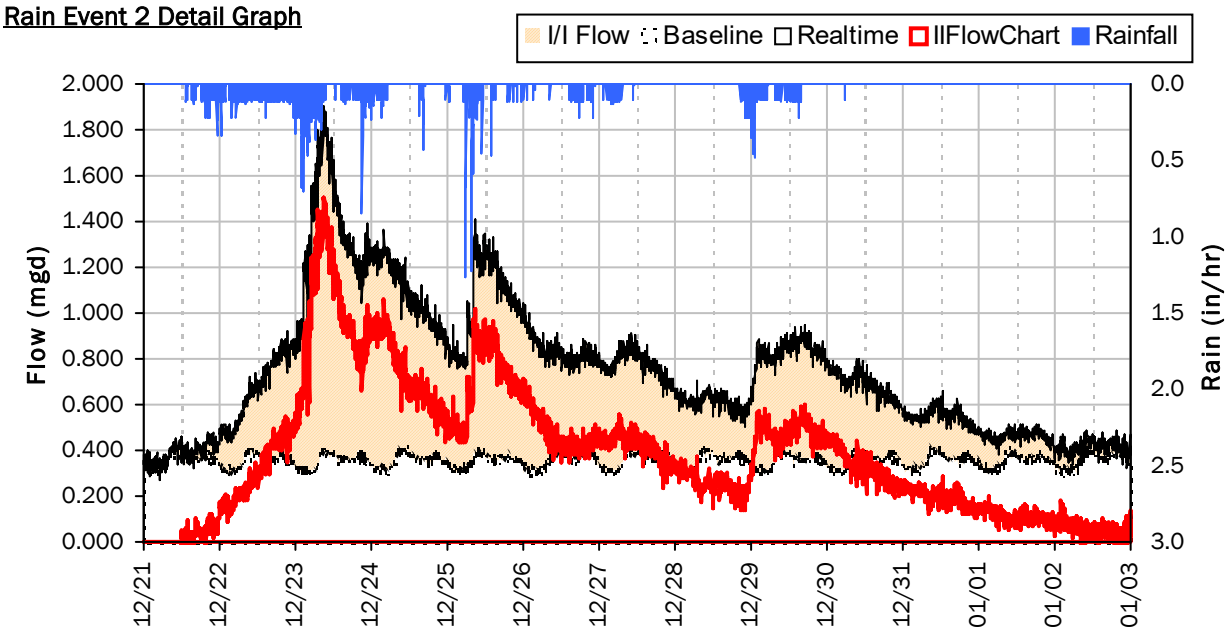
Capacity		Inflow / Infiltration	
Peak Flow:	2.489 *mgd*	**Peak I/I Rate:**	2.346 *mgd*
PF:	18.44	**Total I/I:**	7,840,000 *gallons*
Peak Level:	14.69 *in*		
d/D Ratio:	0.54		

SITE 10.01
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



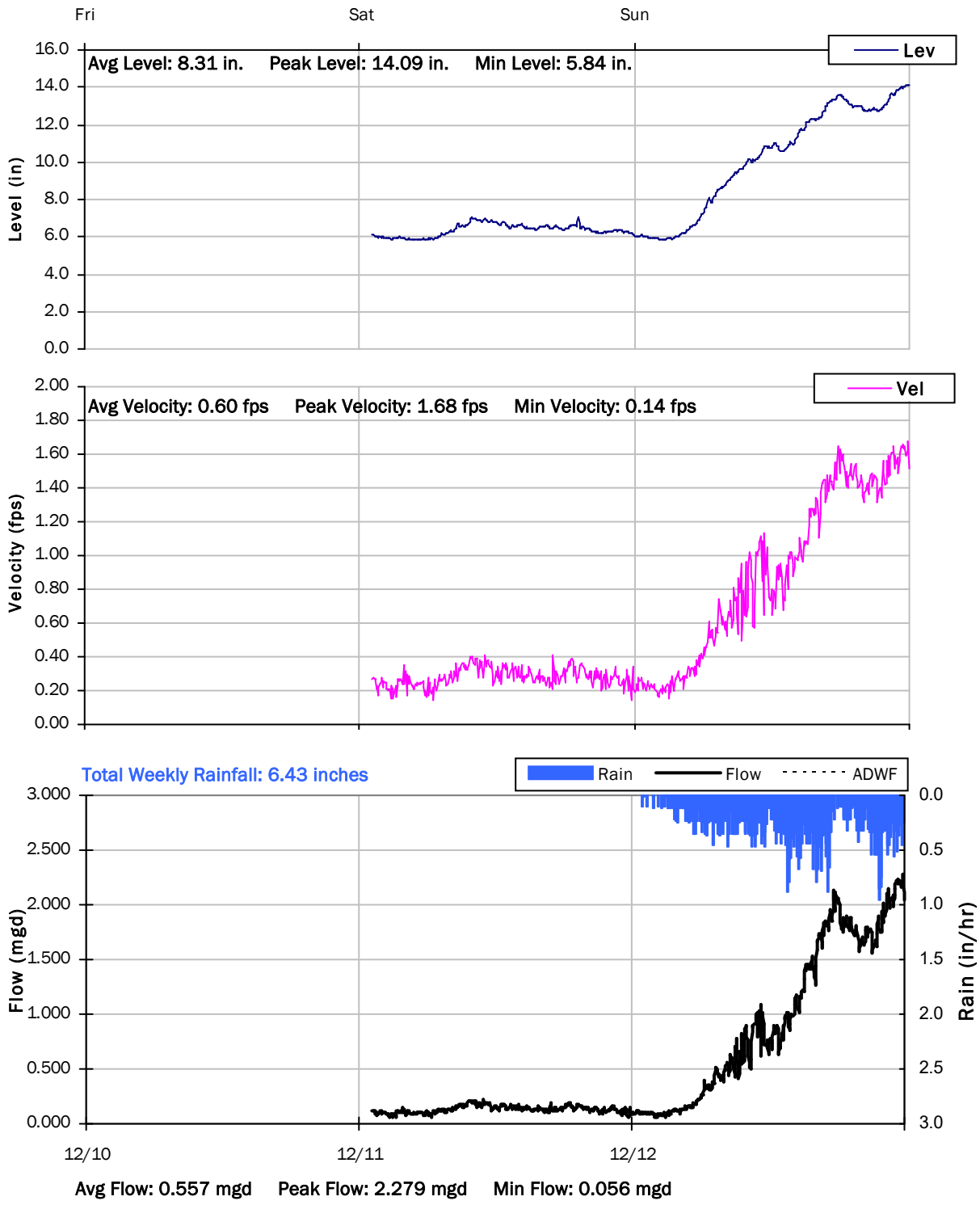
Storm Event I/I Analysis (Rain = 7.02 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.904 *mgd*	Peak I/I Rate:	1.506 *mgd*
PF:	14.11	Total I/I:	5,098,000 *gallons*
Peak Level:	13.21 *in*		
d/D Ratio:	0.49		

SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

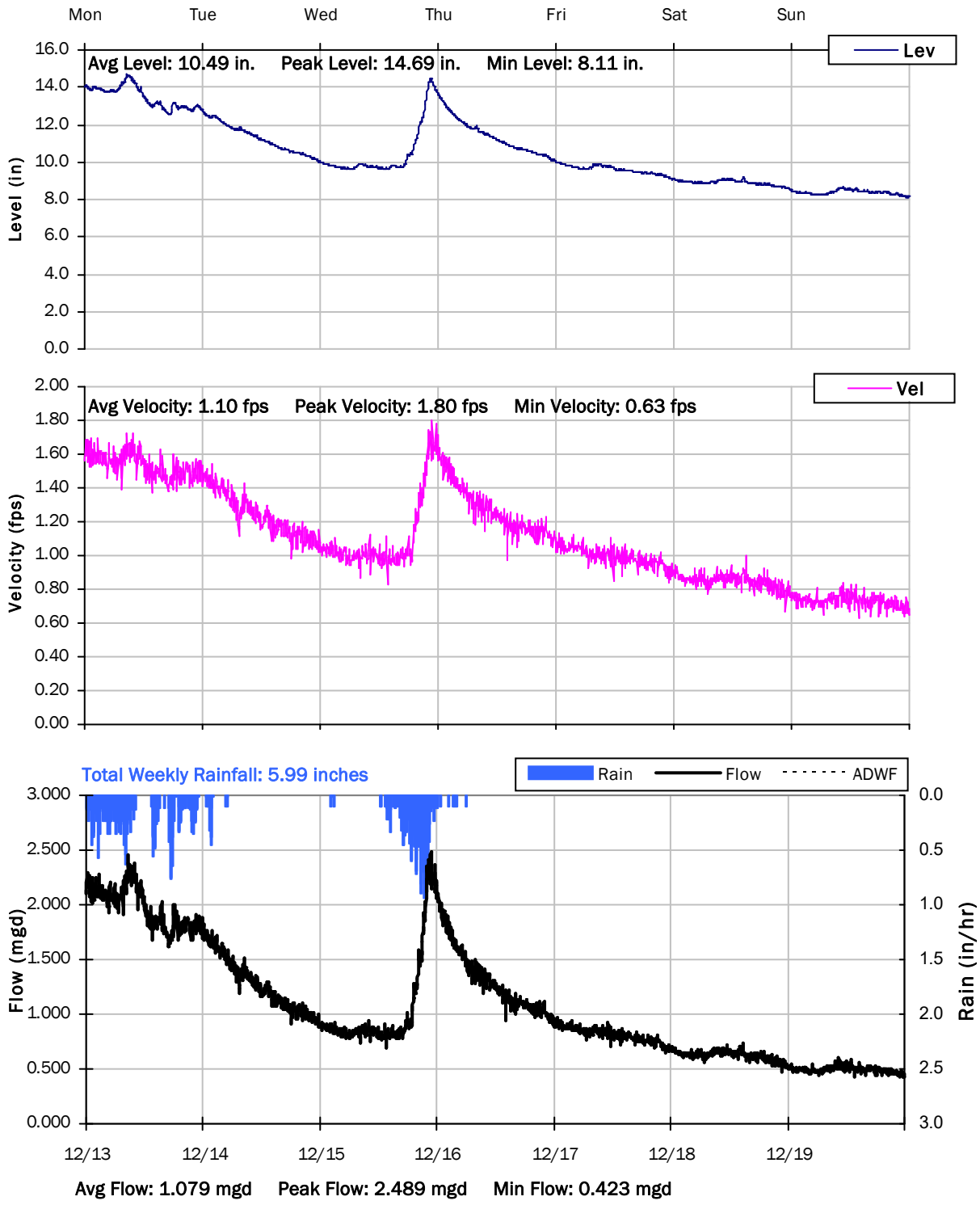
12/10/2021 to 12/13/2021



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

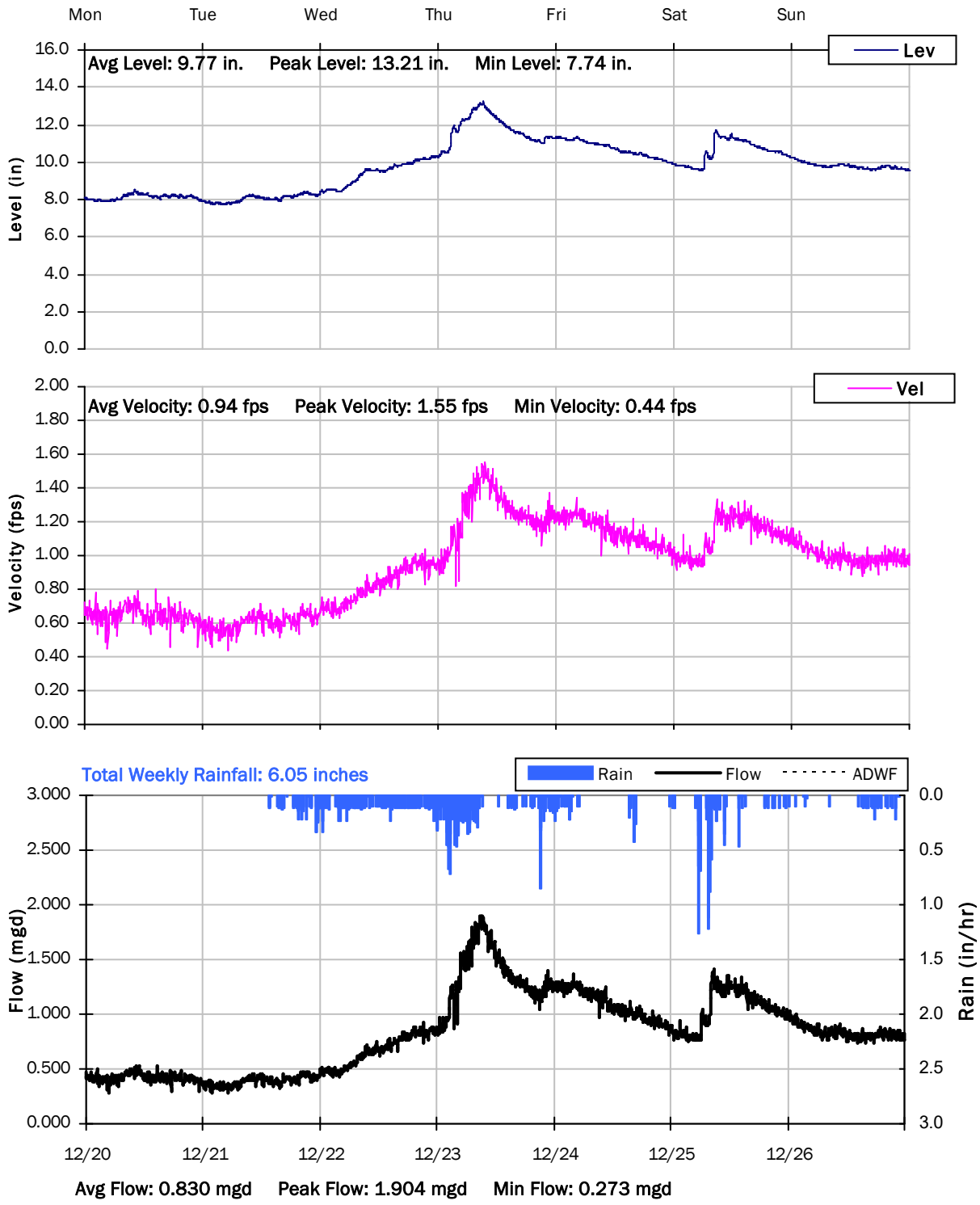
12/13/2021 to 12/20/2021



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

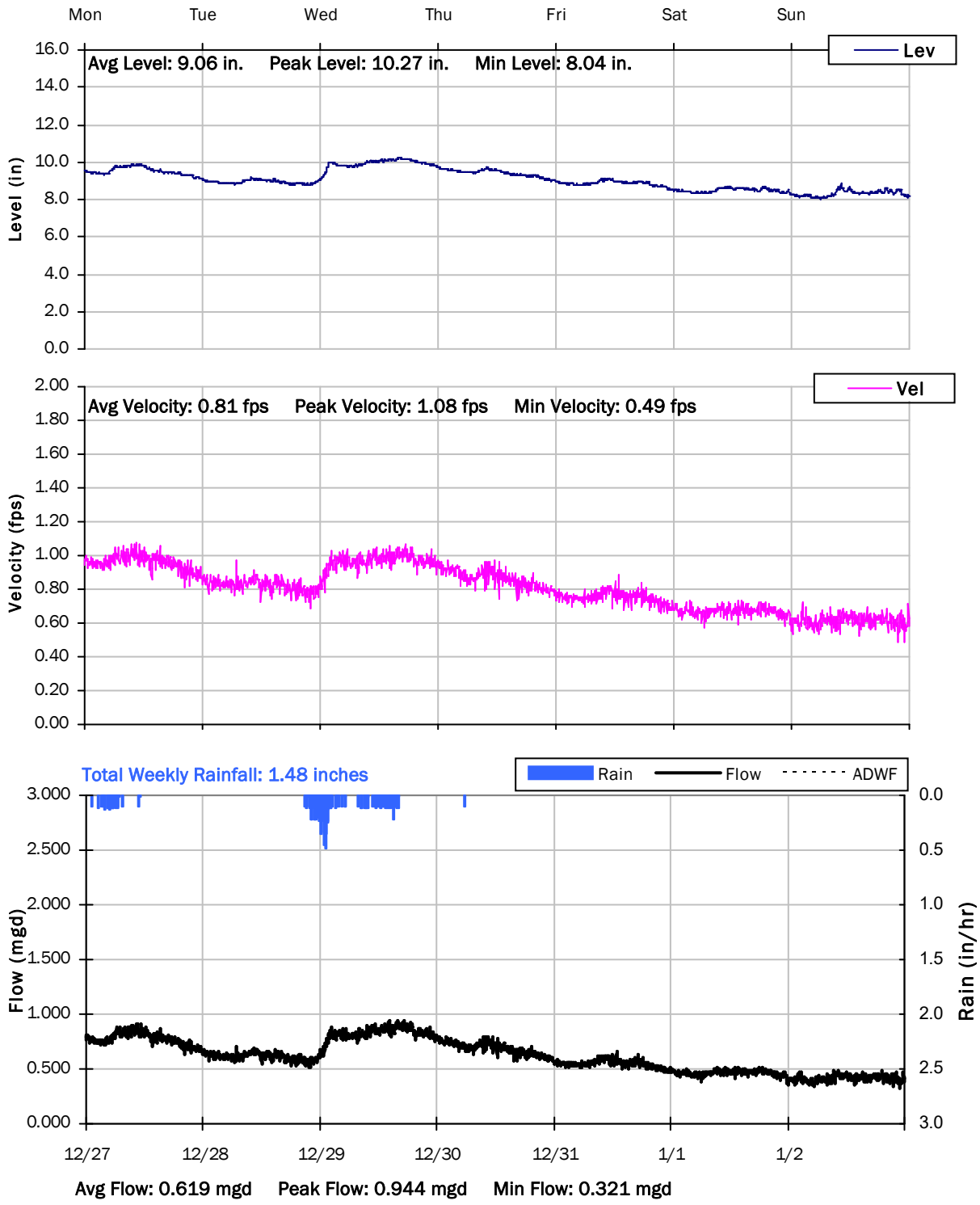
12/20/2021 to 12/27/2021



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

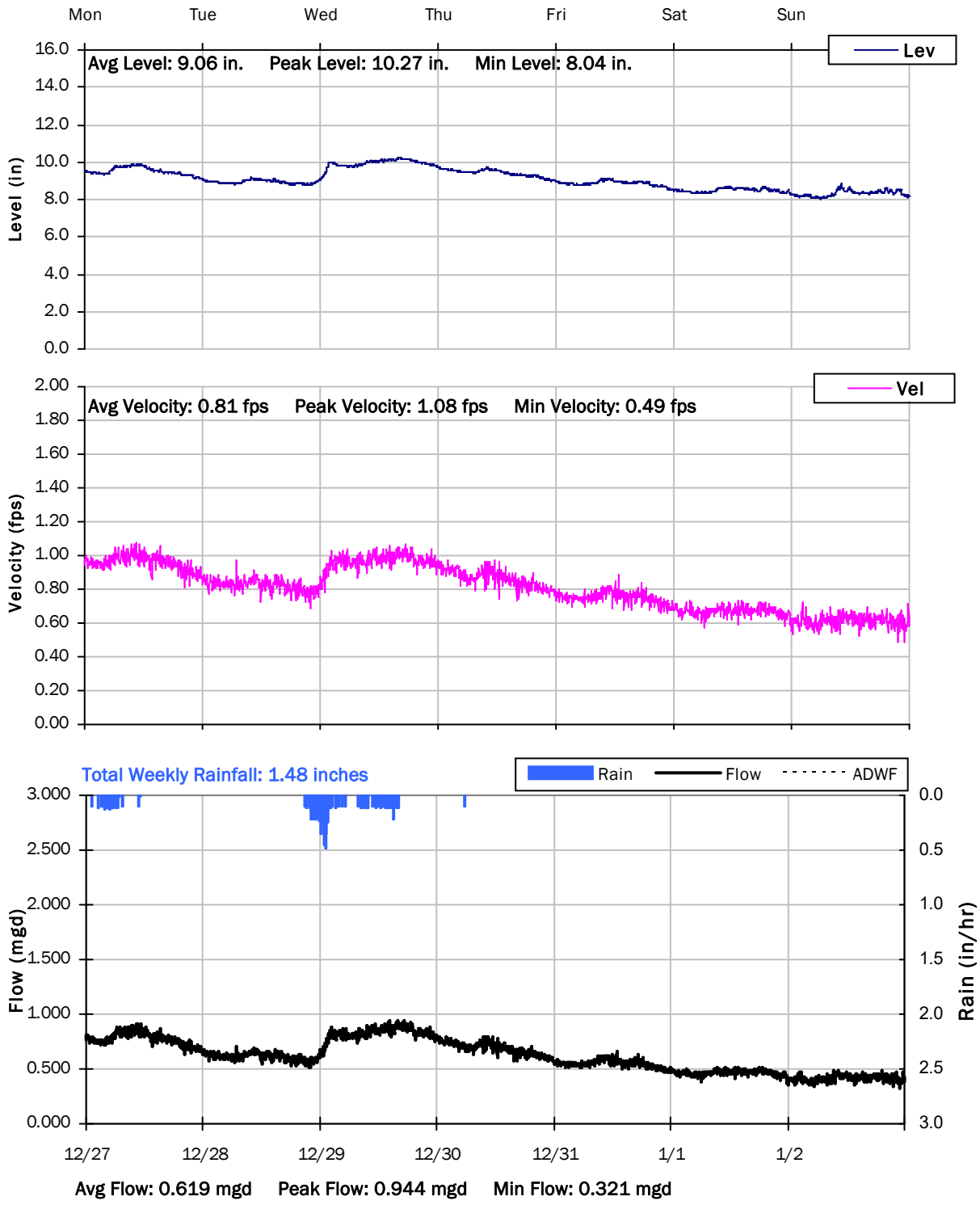
12/27/2021 to 1/3/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

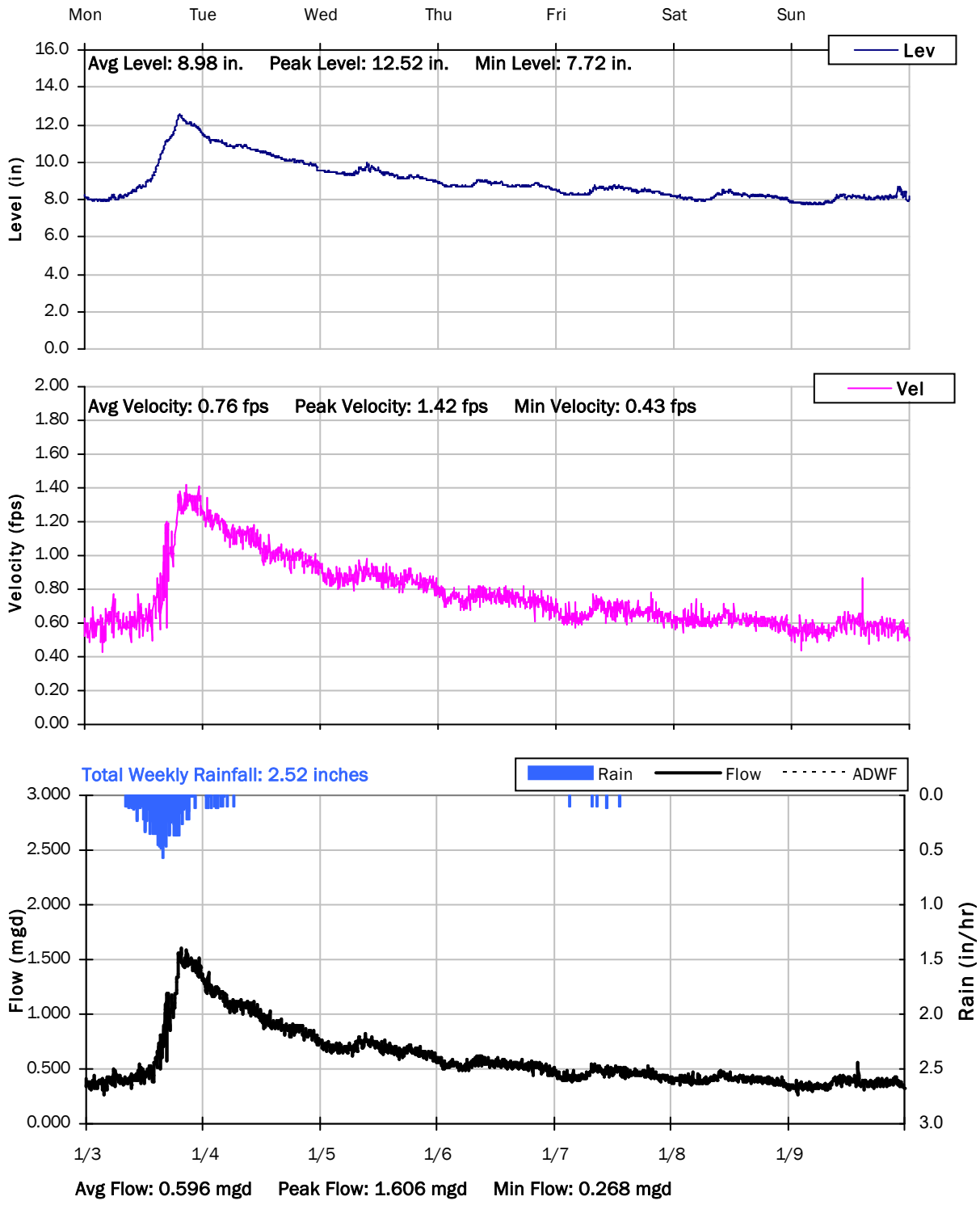
12/27/2021 to 1/3/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

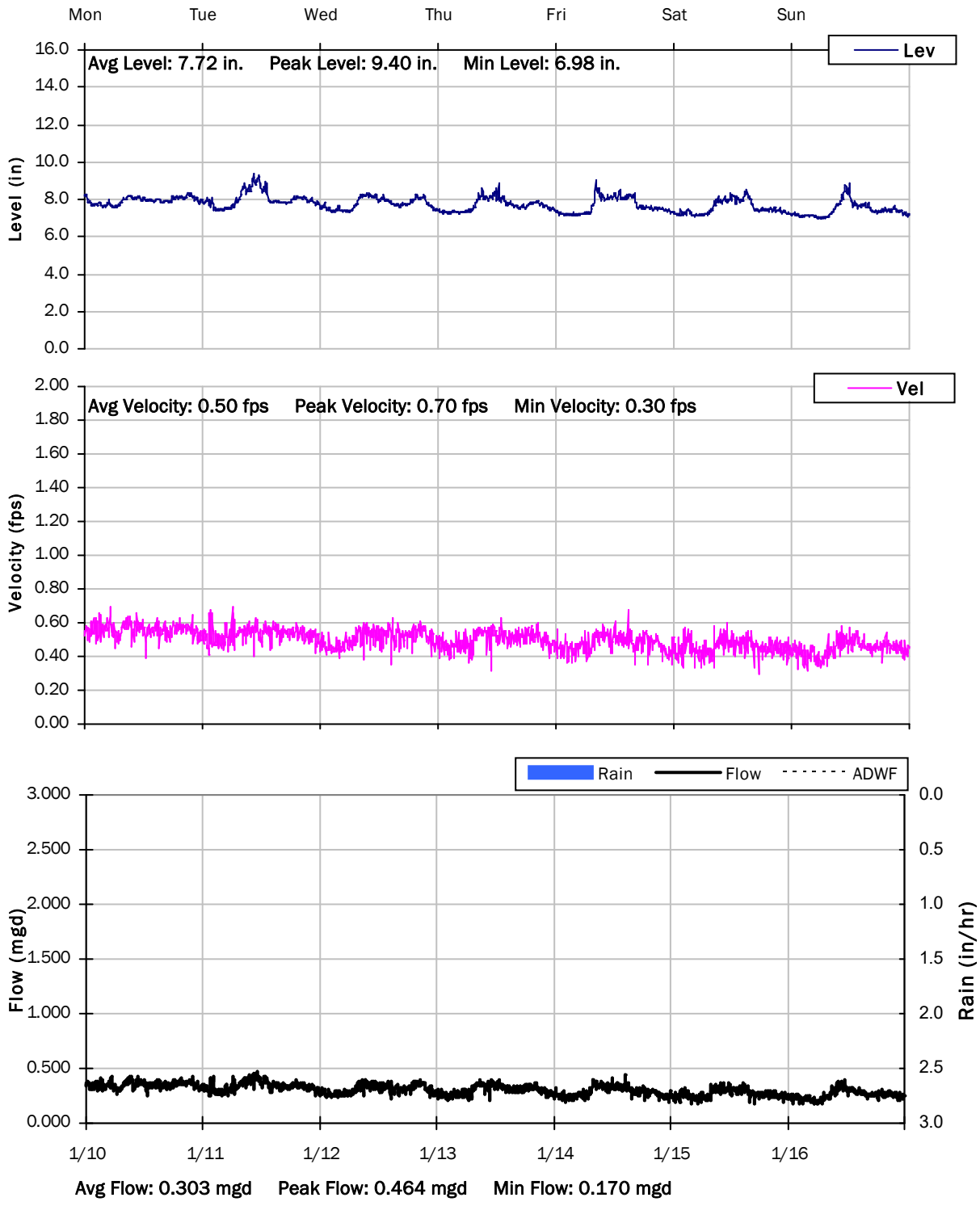
1/3/2022 to 1/10/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

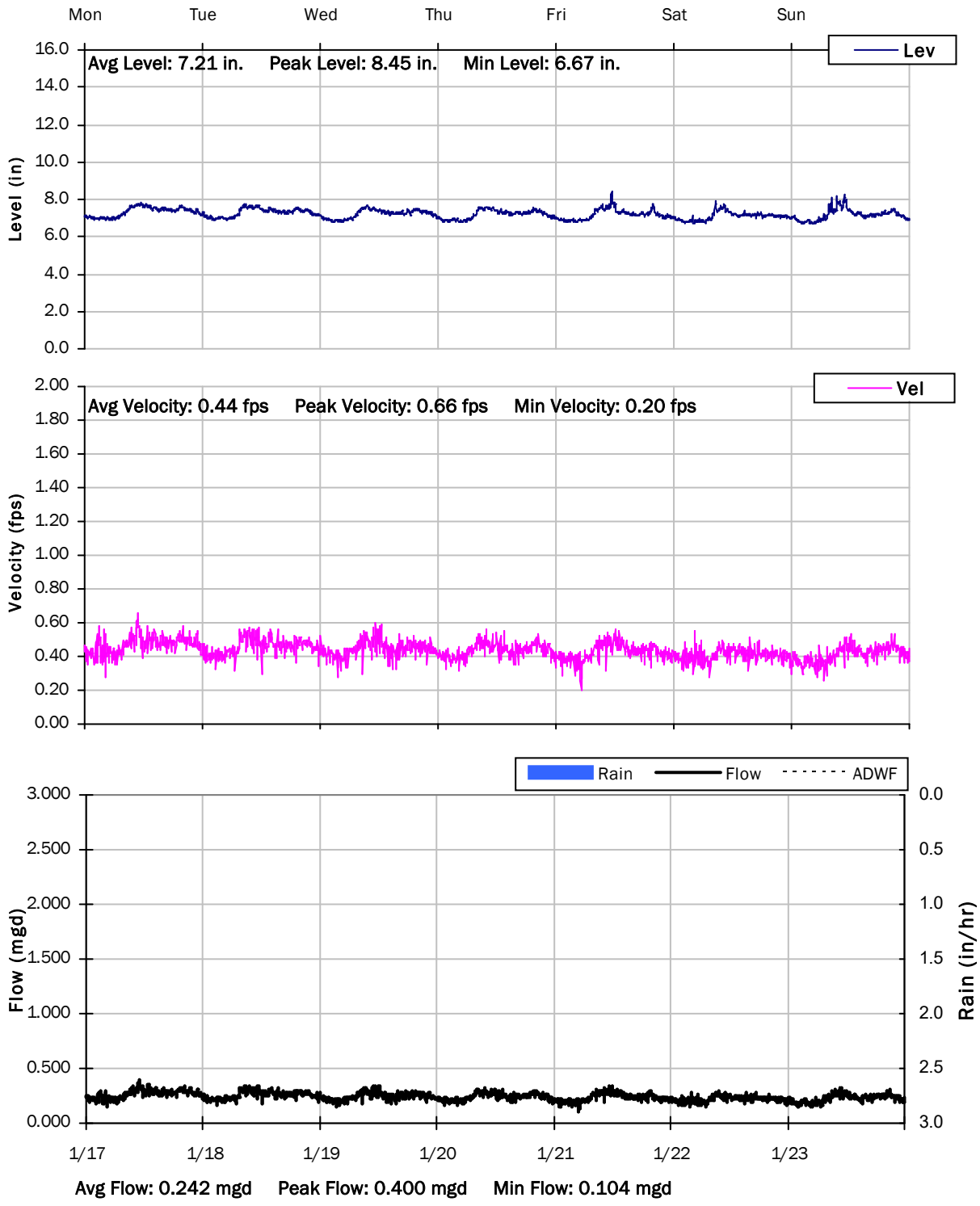
1/10/2022 to 1/17/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

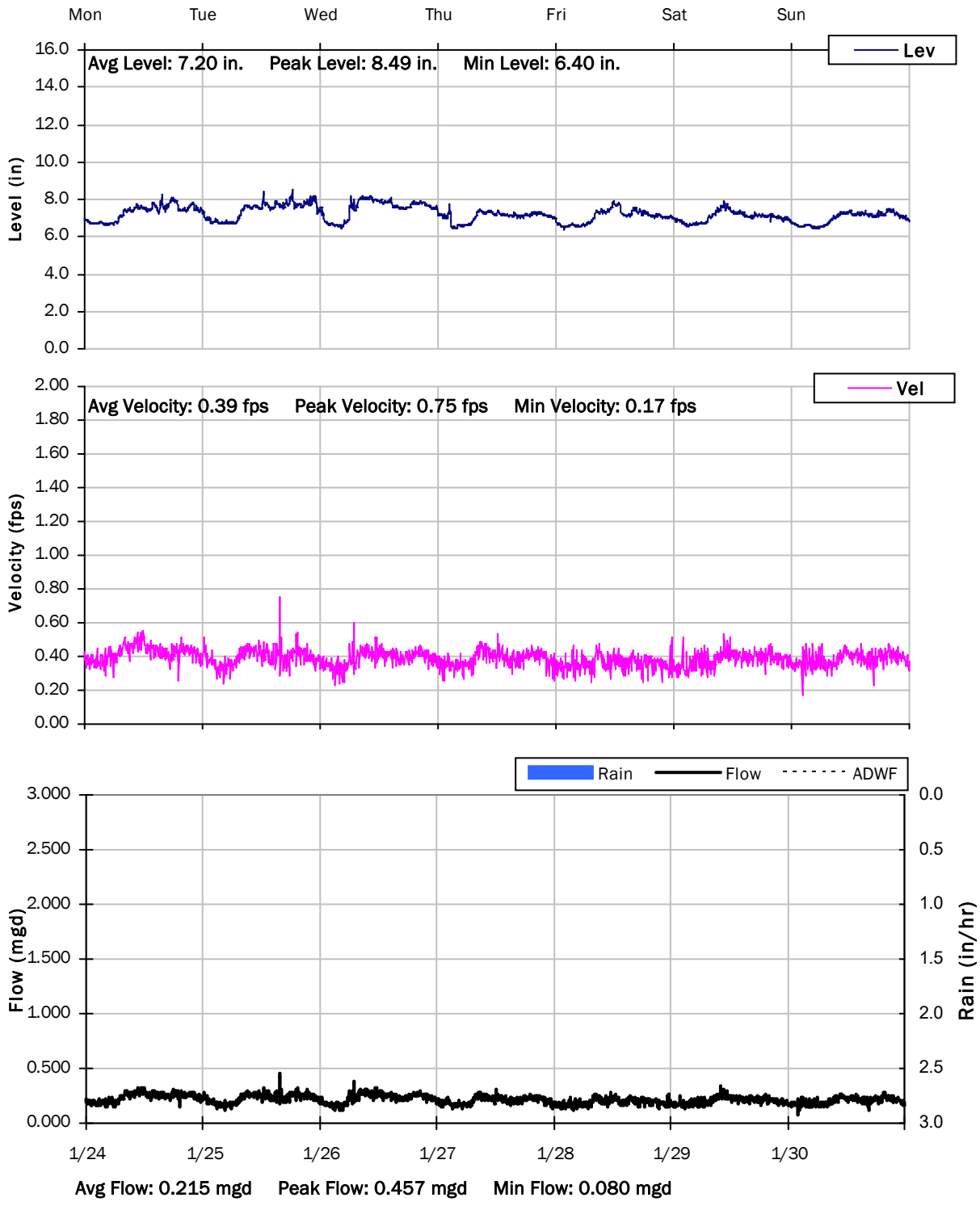
1/17/2022 to 1/24/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

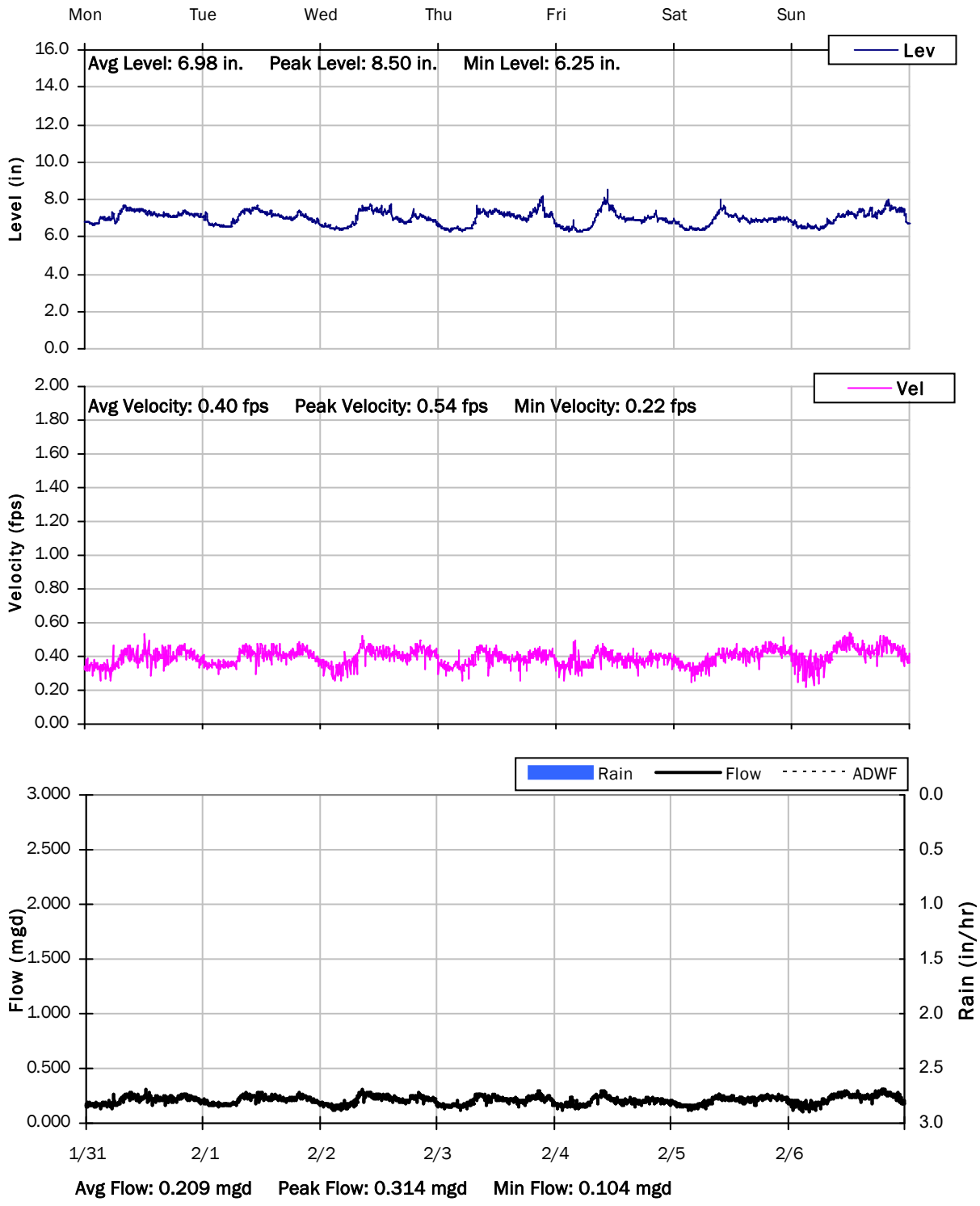
1/24/2022 to 1/31/2022



SITE 10.01

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 11.01

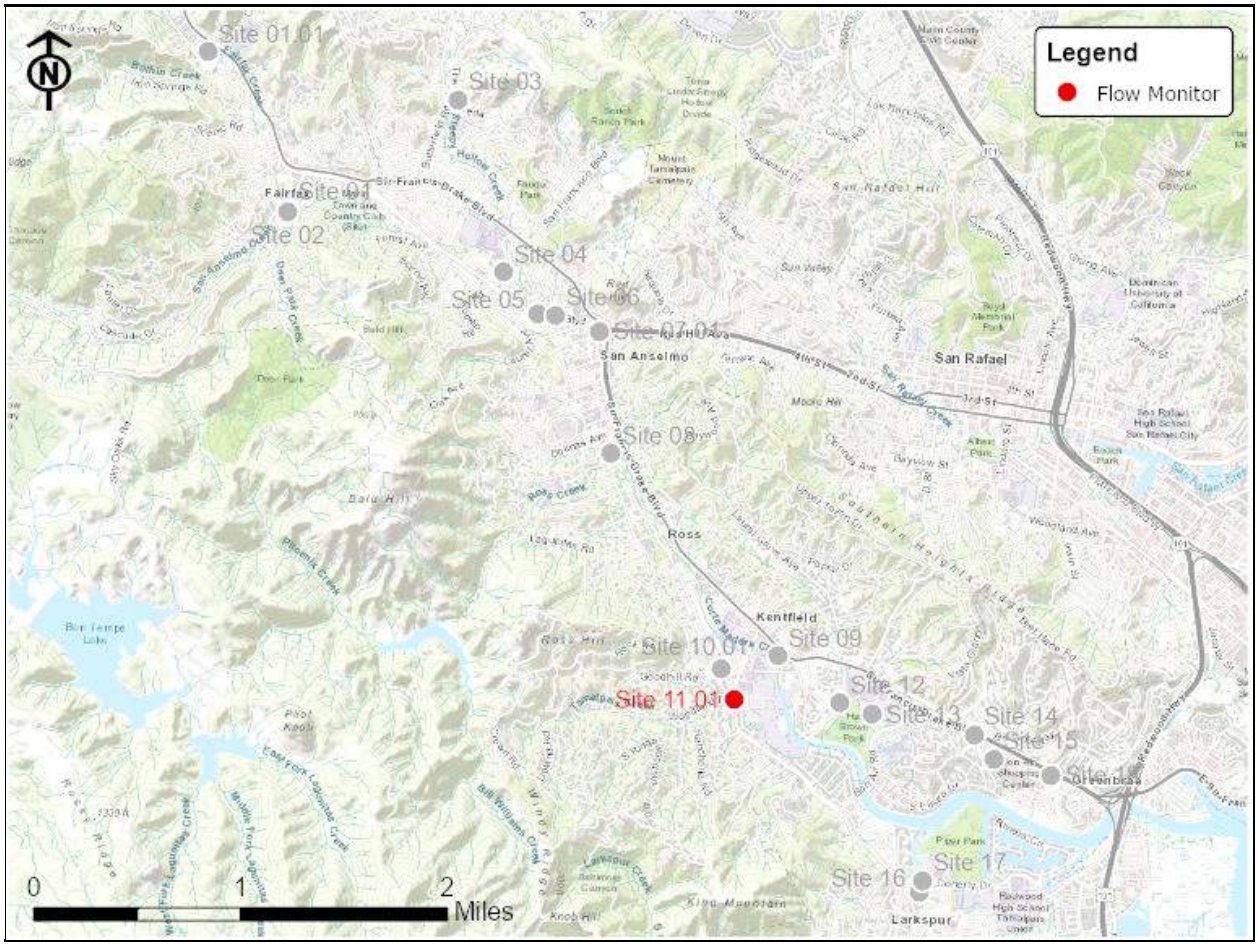
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Intersection of Woodland Rd, Kent Ave, and College Ave

Data Summary Report



Vicinity Map: Site 11.01

SITE 11.01

Site Information MH ID: W512.018

Location: Intersection of Woodland Rd, Kent Ave, and College Ave

Coordinates: 122.5498° W, 37.9508° N

Rim Elevation (Earth): 12 feet

Expected Pipe Diameter: 24 inches

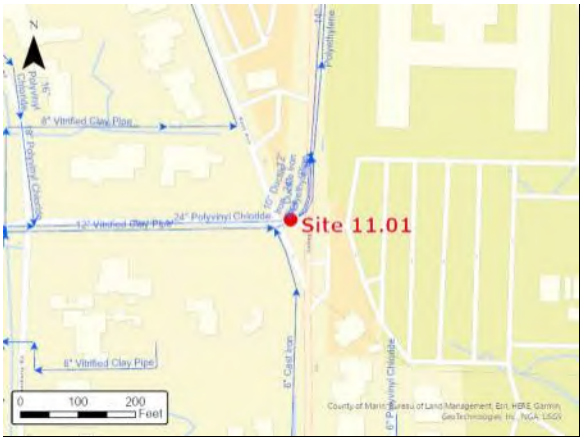
Measured Pipe Diameter: 22.75 inches

ADWF: 0.142 mgd

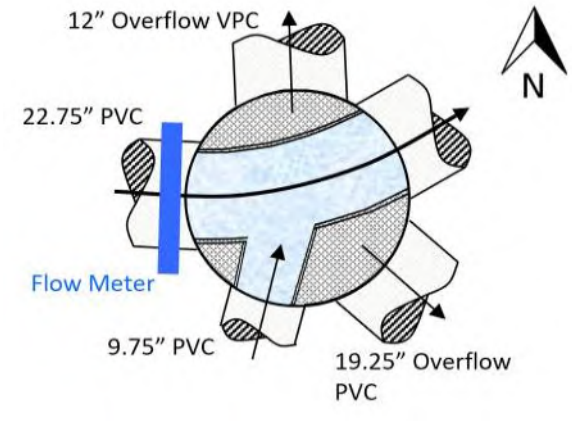
Peak Measured Flow: 6.192 mgd

Sediment: None

Satellite Map



Sanitary Map



Flow Sketch

Street View

Plan View

SITE 11.01

Additional Site Photos

Northeast Main Effluent Pipe

Southeast Overflow Effluent Pipe

SITE 11.01

Additional Site Photos

Southwest Influent Pipe

Monitored West Influent Pipe

SITE 11.01

Additional Site Photos

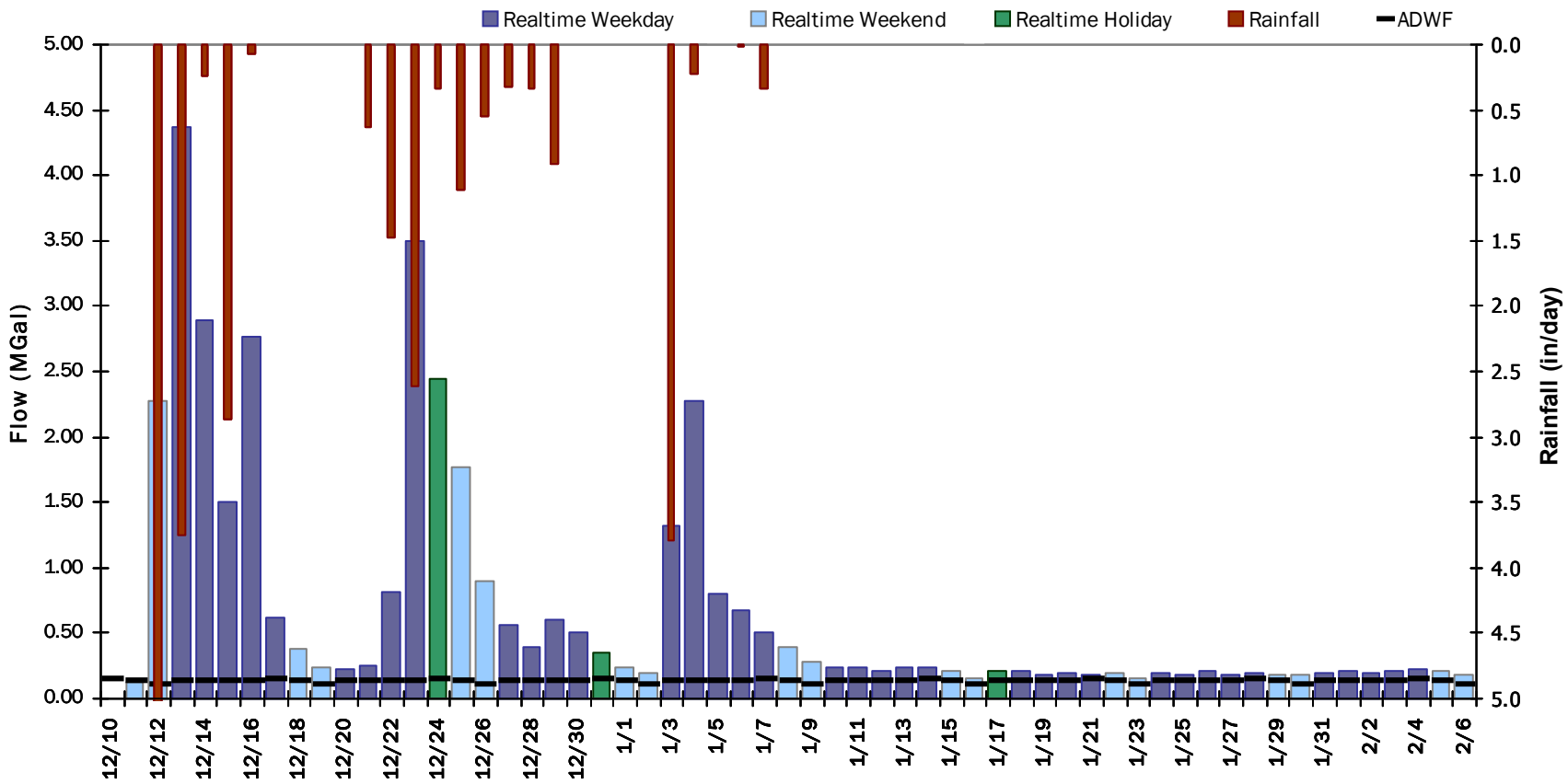
North Overflow Effluent Pipe

SITE 11.01

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.687 MGal Peak Daily Flow: 4.369 MGal Min Daily Flow: 0.125 MGal

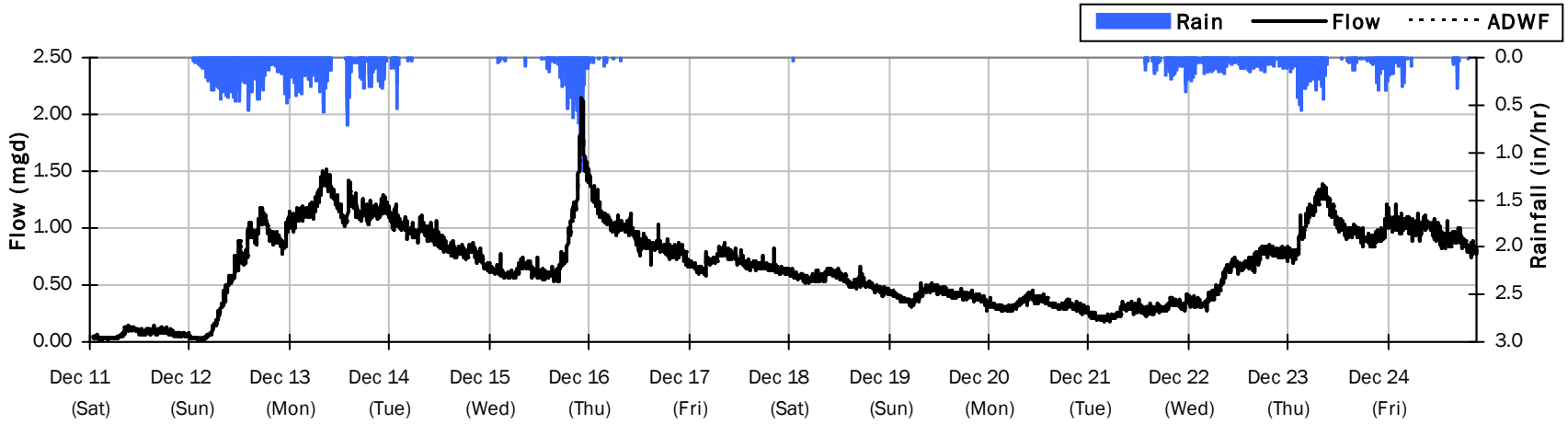
Total Rainfall: 25.33 inches

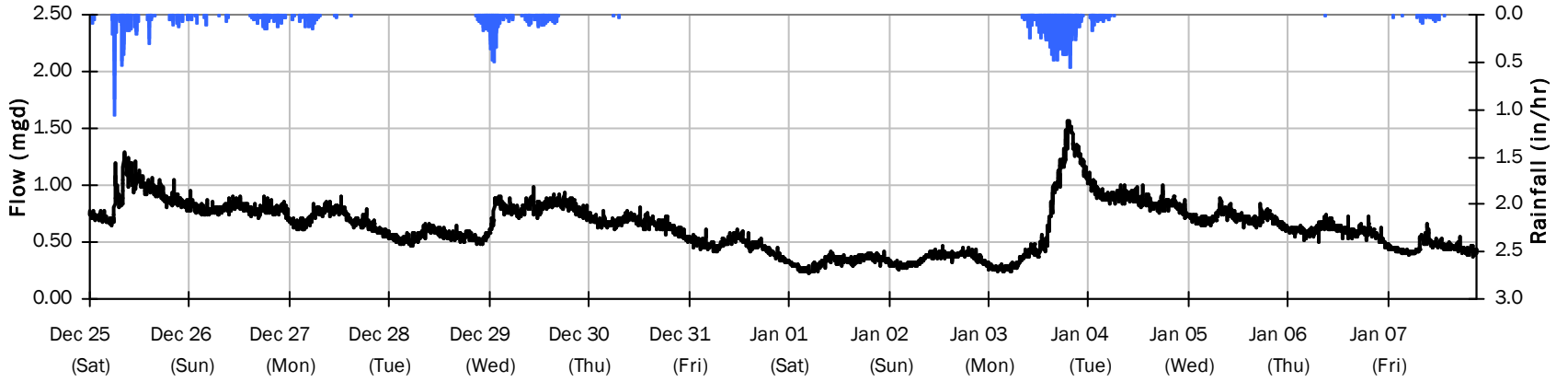


SITE 12

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 18.33 inches Period Avg Flow: 0.641 mgd Period Peak Flow: 2.150 mgd Period Min Flow: 0.018 mgd

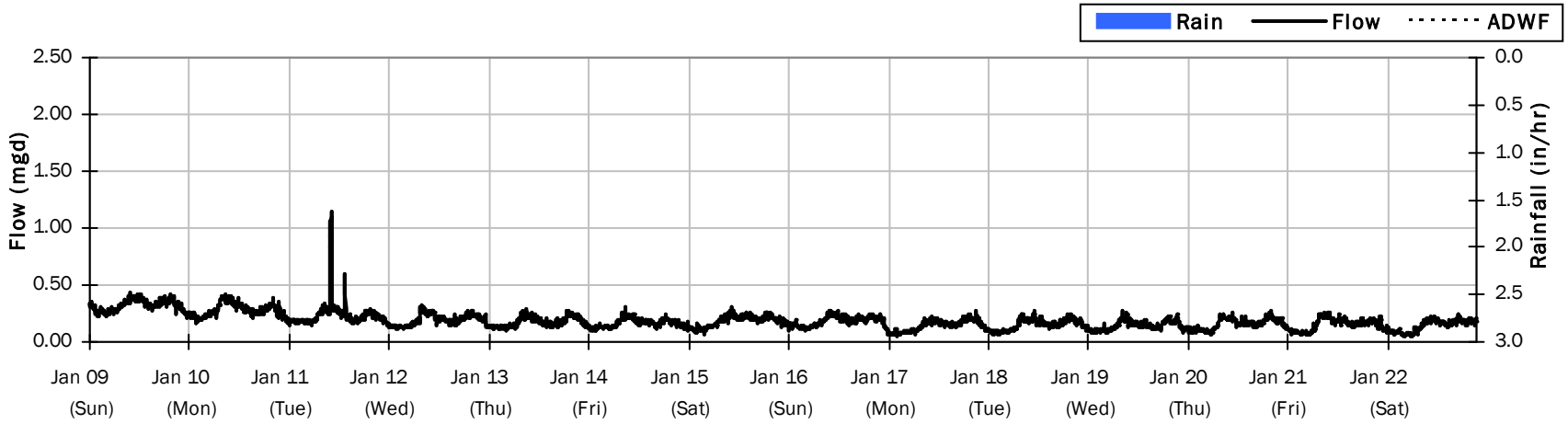


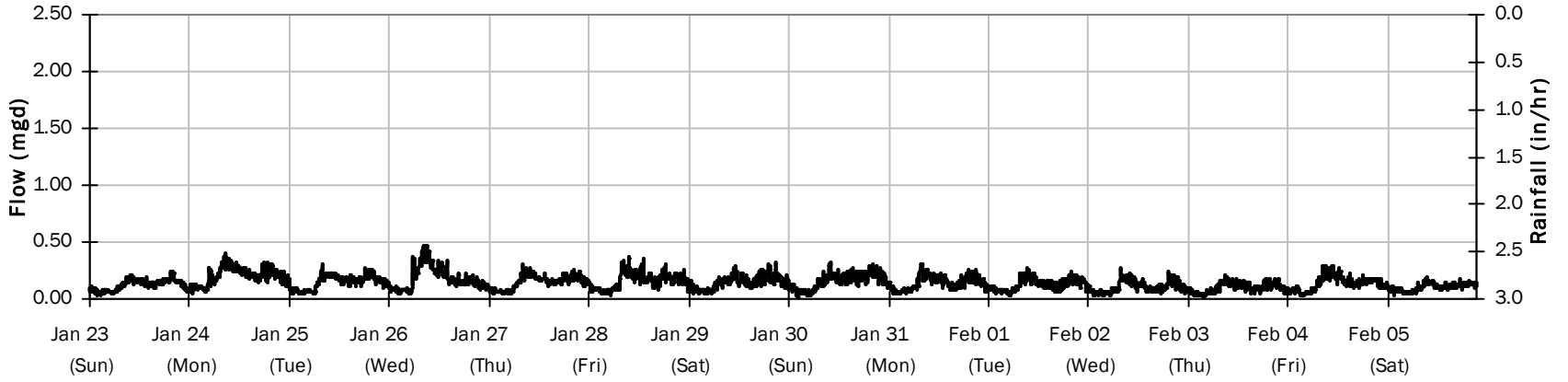


SITE 12

Flow Summary: 1/9/2022 to 2/5/2022

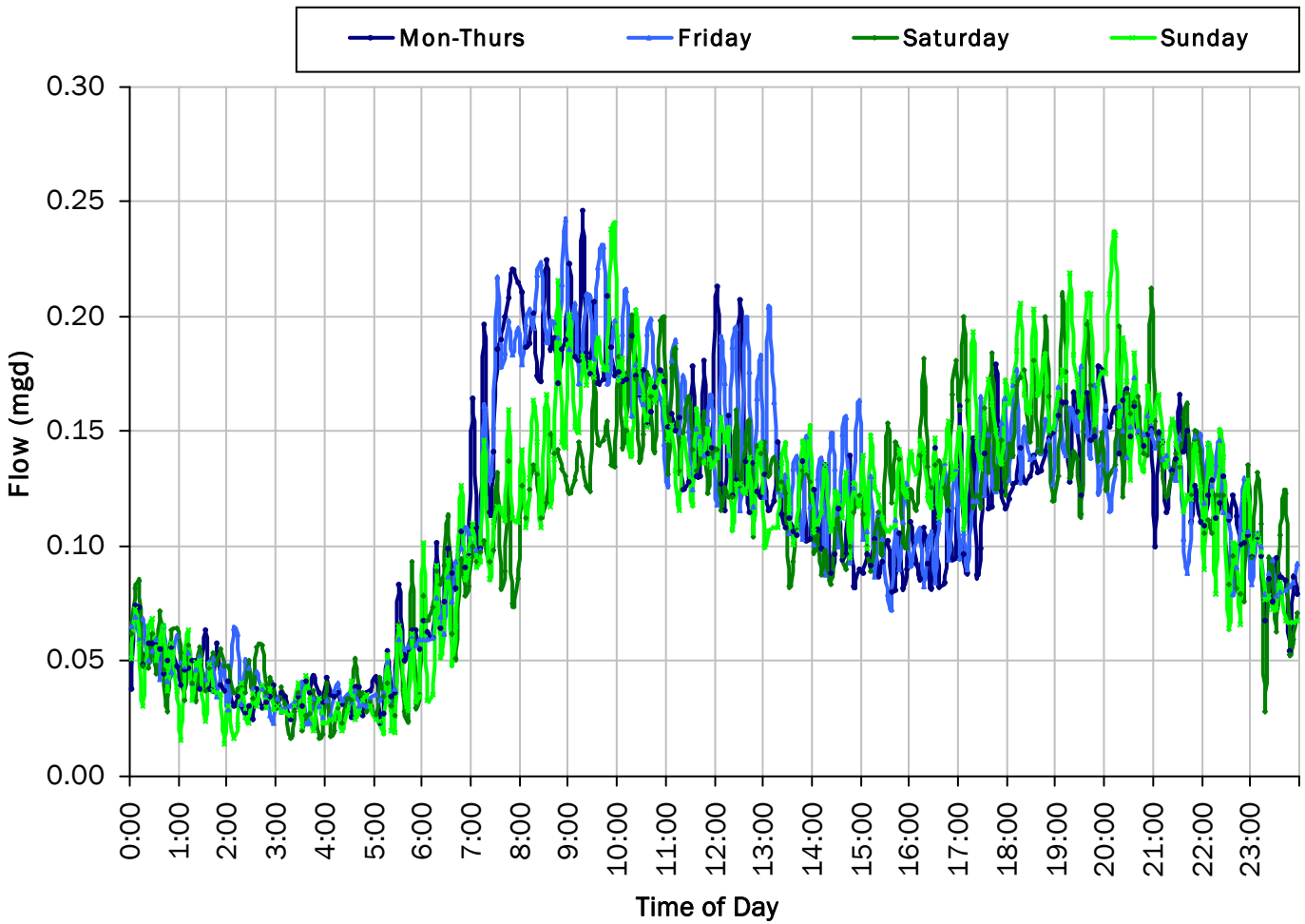
Period Rainfall: 0.00 inches Period Avg Flow: 0.166 mgd Period Peak Flow: 1.146 mgd Period Min Flow: 0.018 mgd





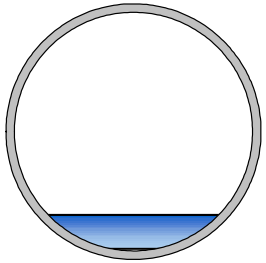
SITE 12

Average Dry Weather Flow Hydrographs



ADWF:

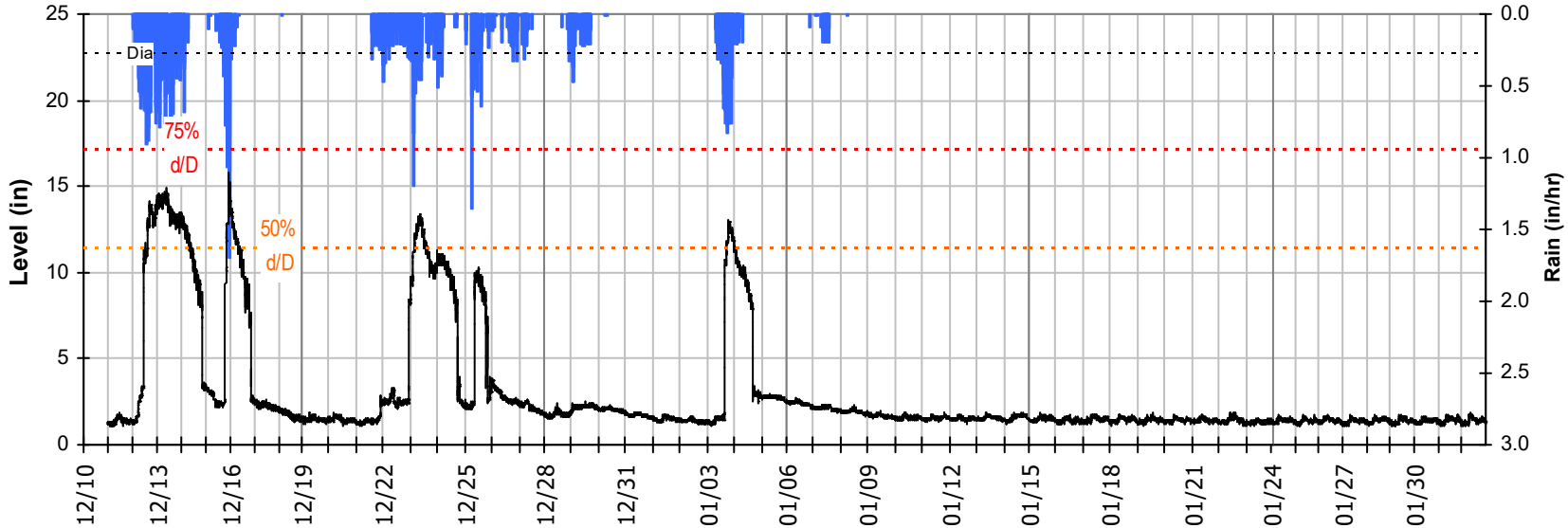
0.111 *mgd*

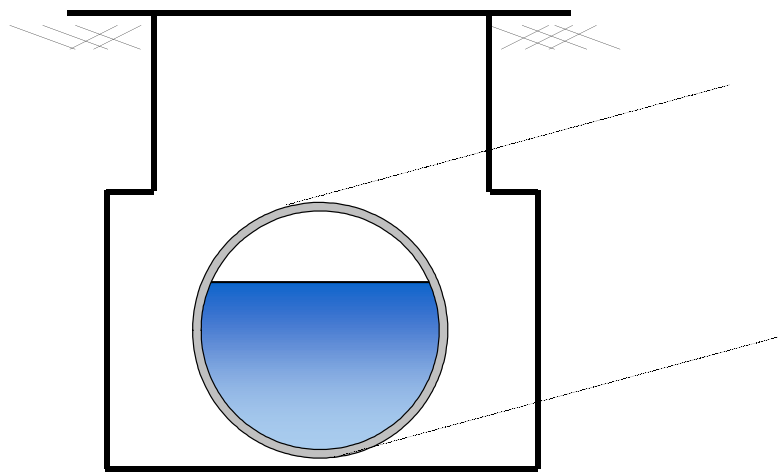


SITE 11.01

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

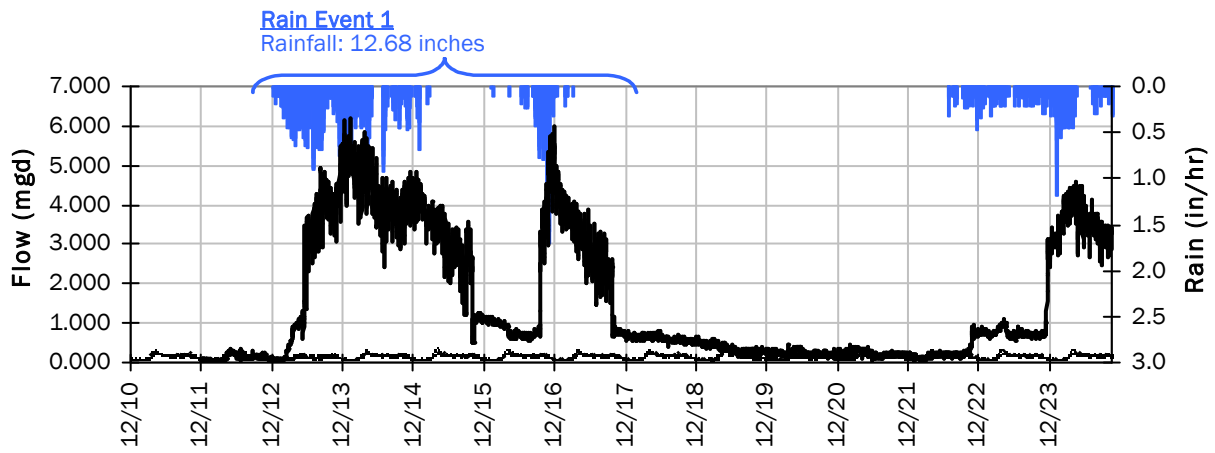




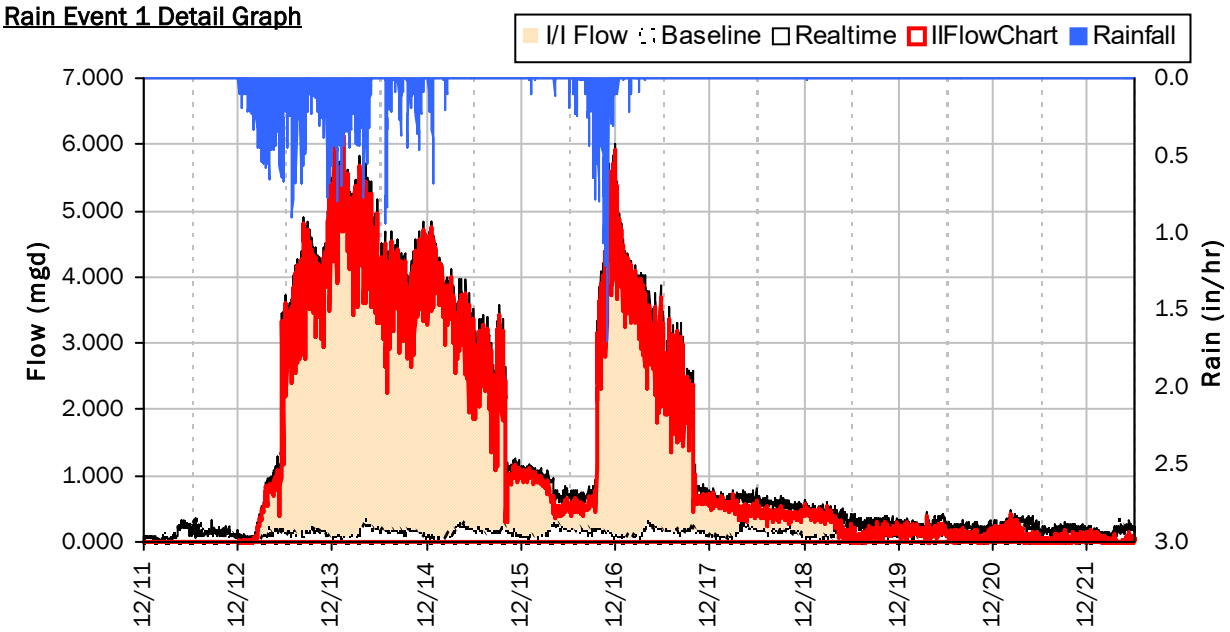
Pipe Diameter:	22.8	*inches*
Peak Measured Level:	15.8	*inches*
Peak d/D Ratio:	0.69	

SITE 11.01
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

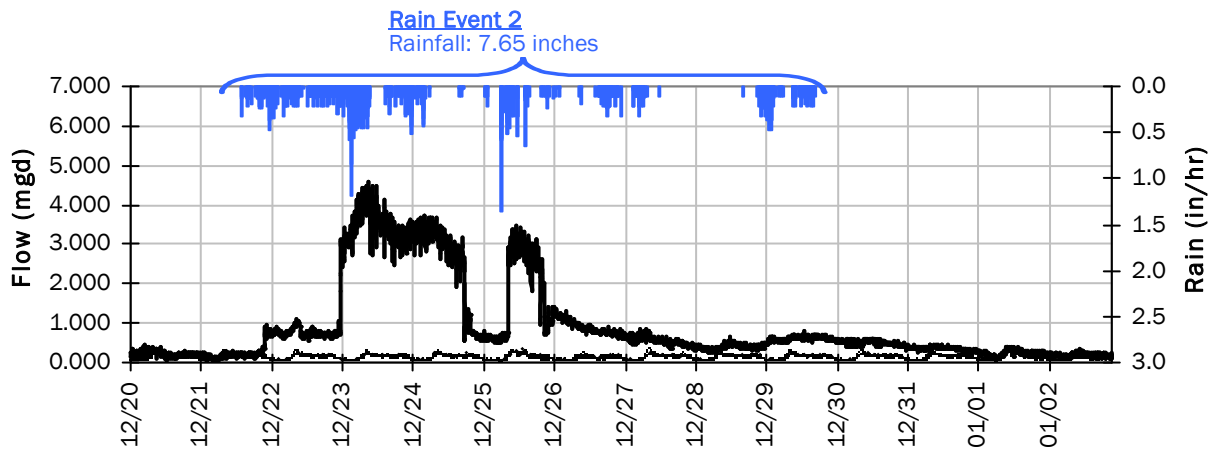


Storm Event I/I Analysis (Rain = 12.68 inches)

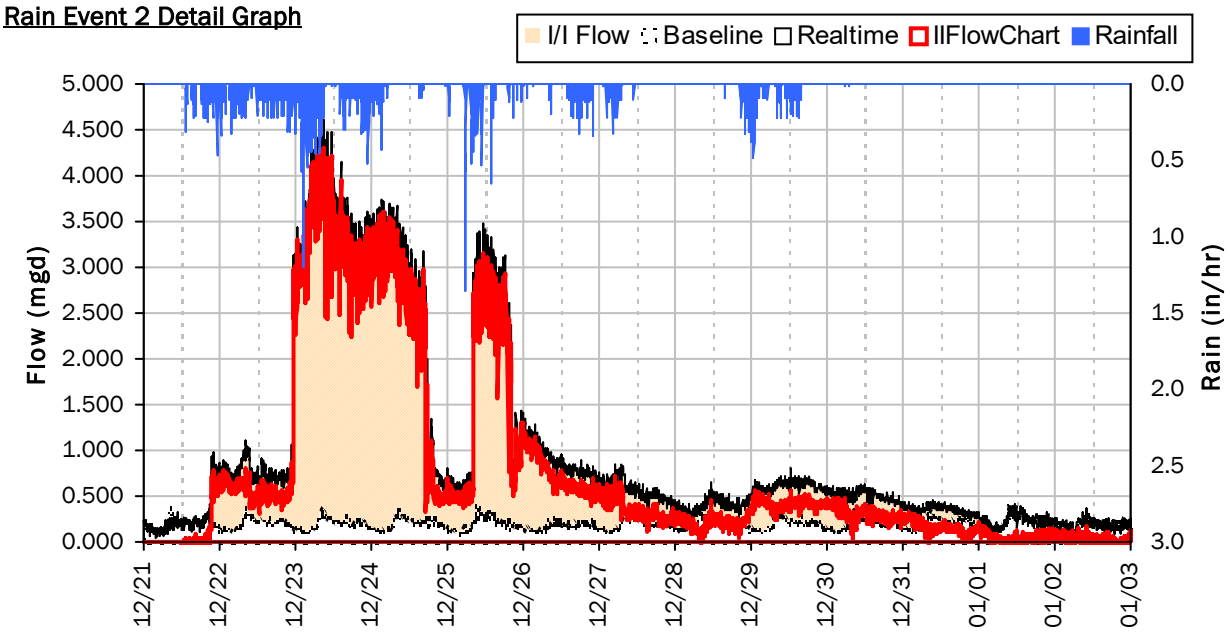
Capacity		Inflow / Infiltration	
Peak Flow:	6.192 *mgd*	**Peak I/I Rate:**	6.121 *mgd*
PF:	43.25	**Total I/I:**	14,009,000 *gallons*
Peak Level:	15.81 *in*		
d/D Ratio:	0.69		

SITE 11.01
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



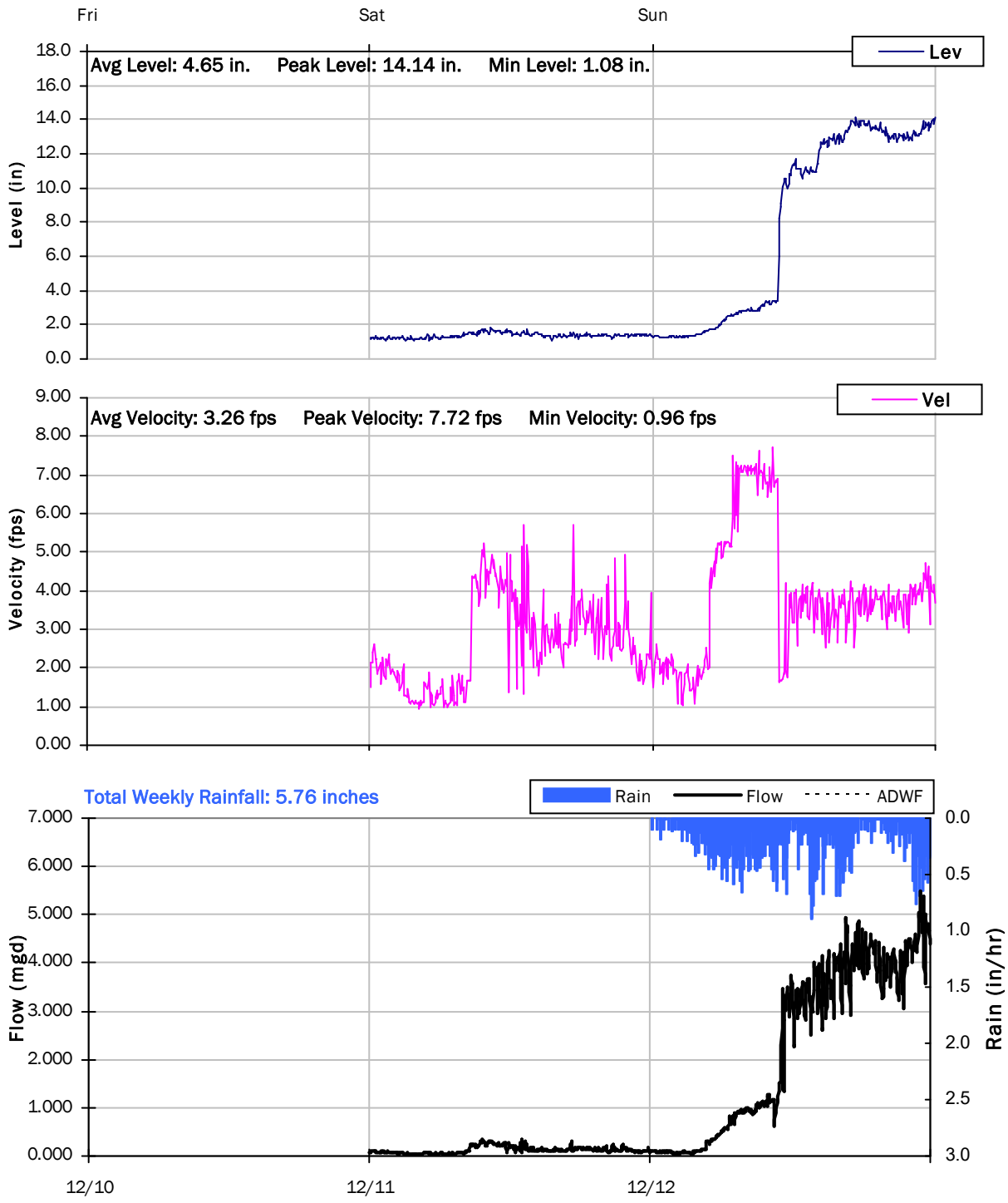
Storm Event I/I Analysis (Rain = 7.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	4.607 *mgd*	**Peak I/I Rate:**	4.298 *mgd*
PF:	32.18	**Total I/I:**	10,026,000 *gallons*
Peak Level:	13.43 *in*		
d/D Ratio:	0.59		

SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

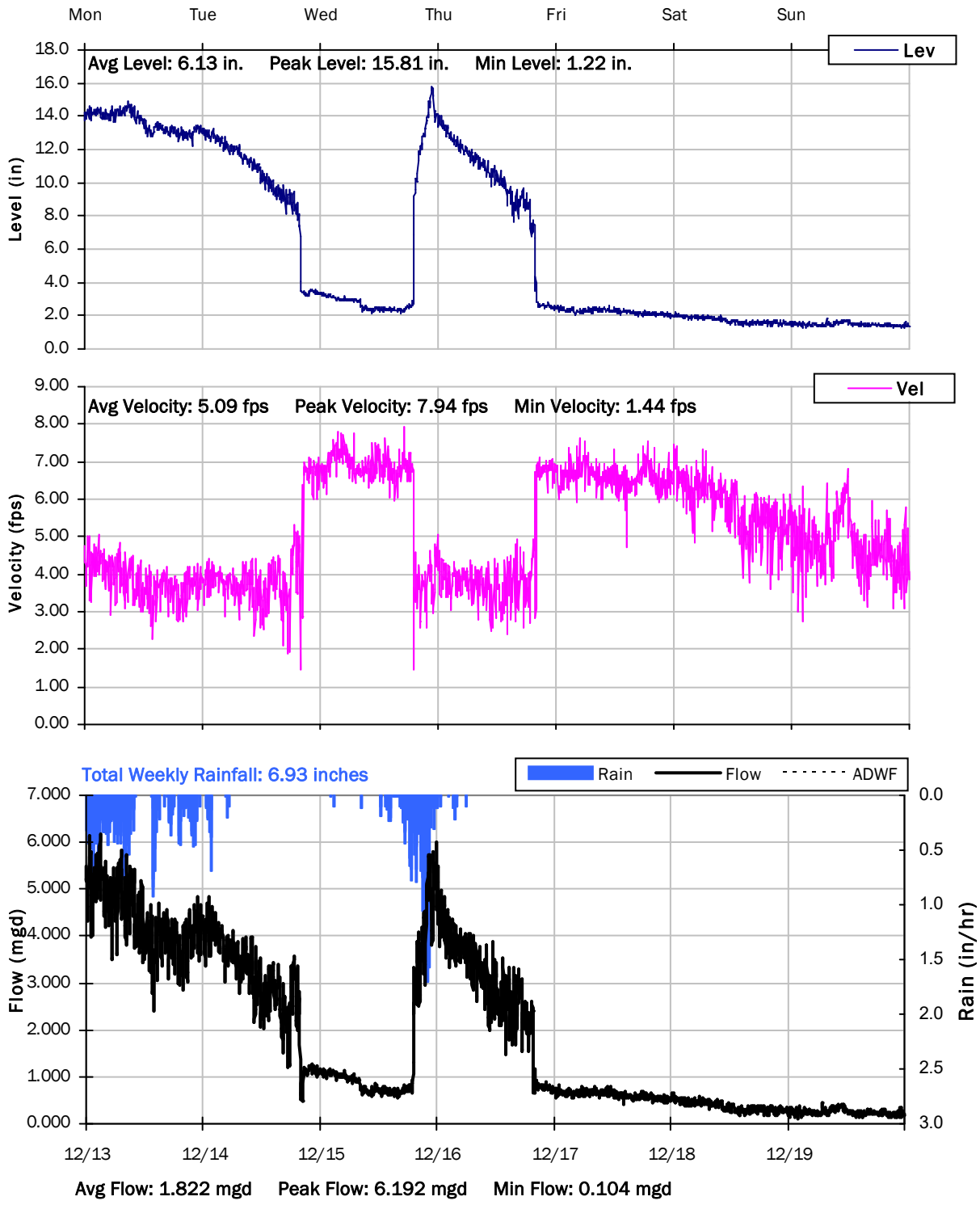
12/10/2021 to 12/13/2021



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

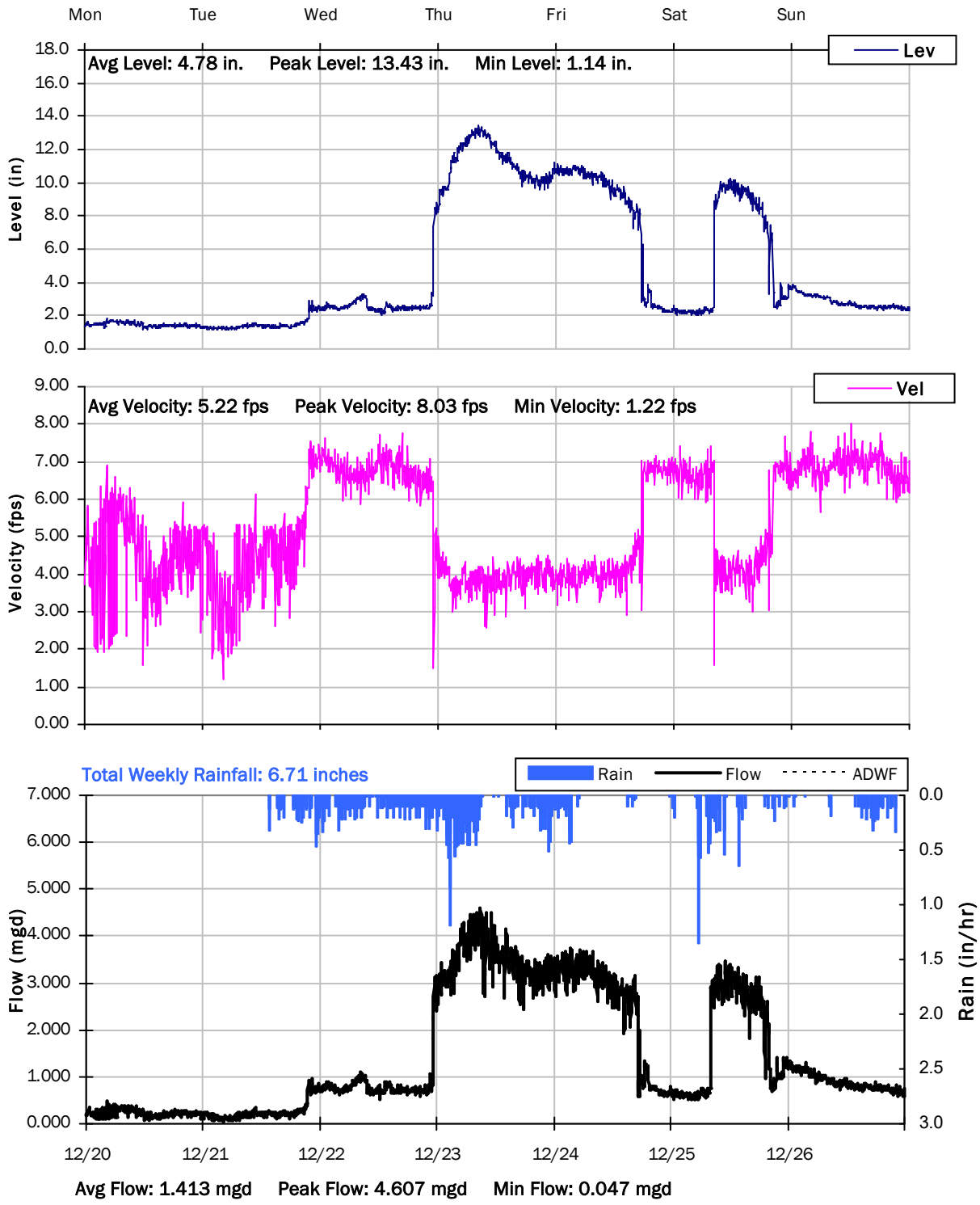
12/13/2021 to 12/20/2021



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

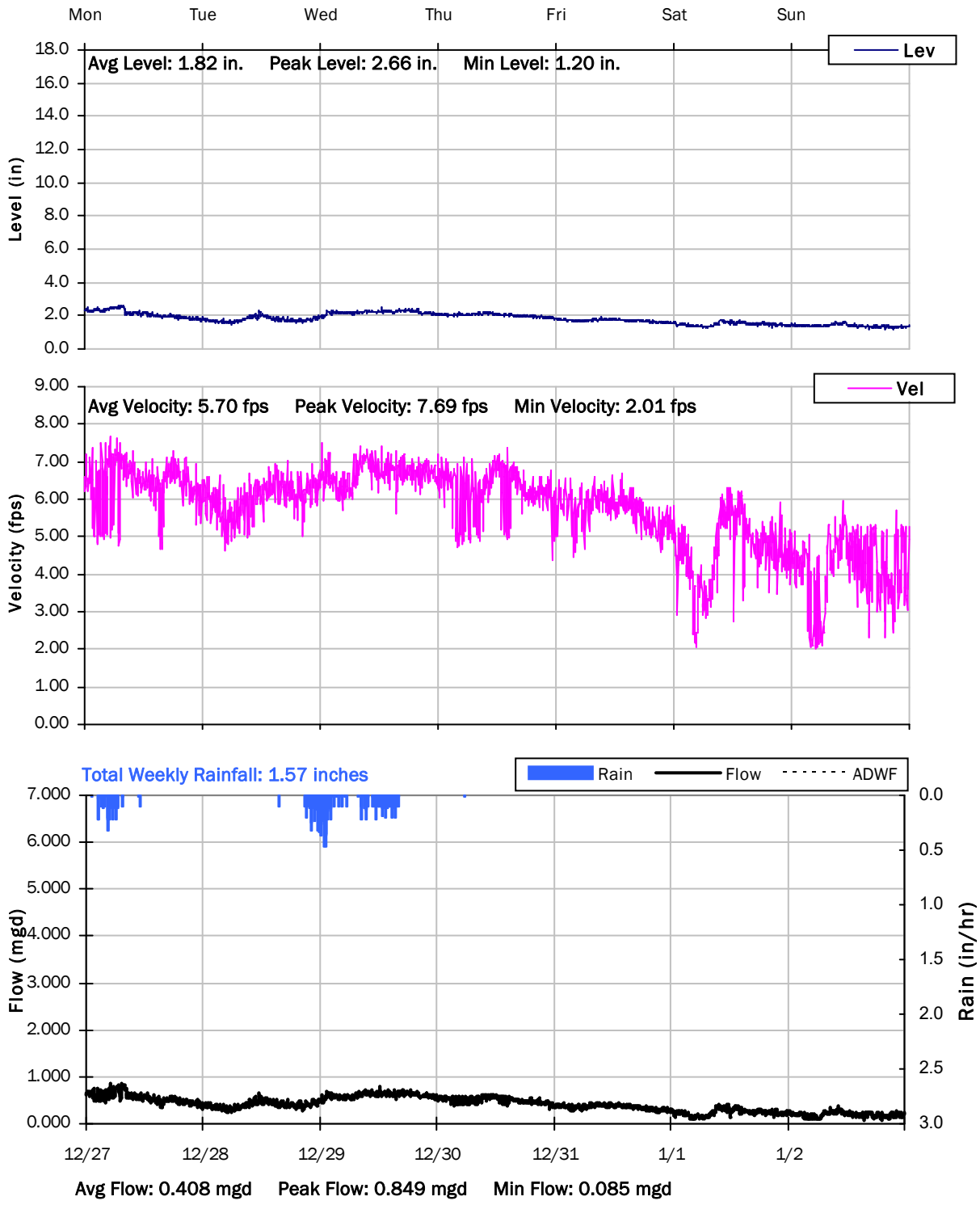
12/20/2021 to 12/27/2021



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

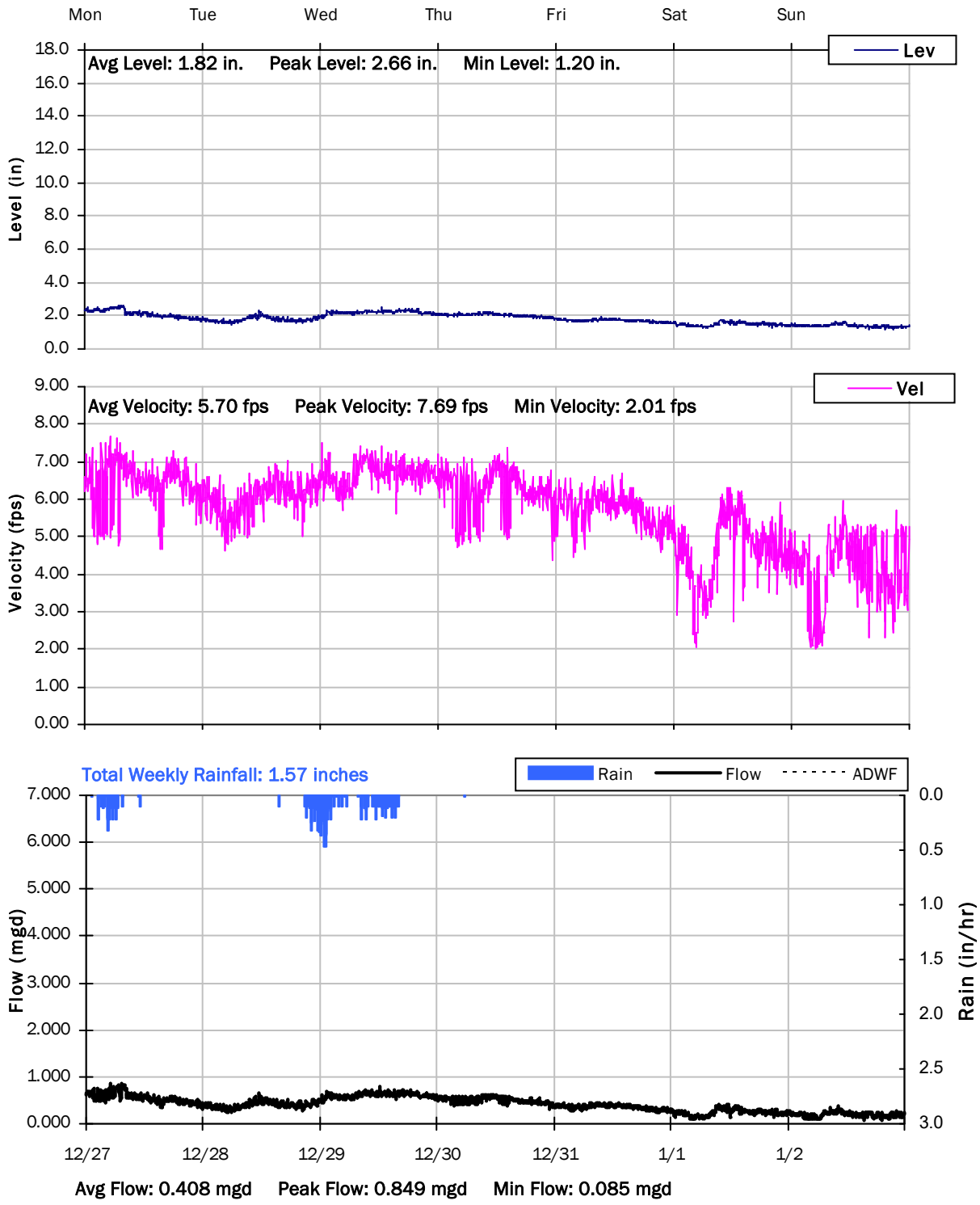
12/27/2021 to 1/3/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

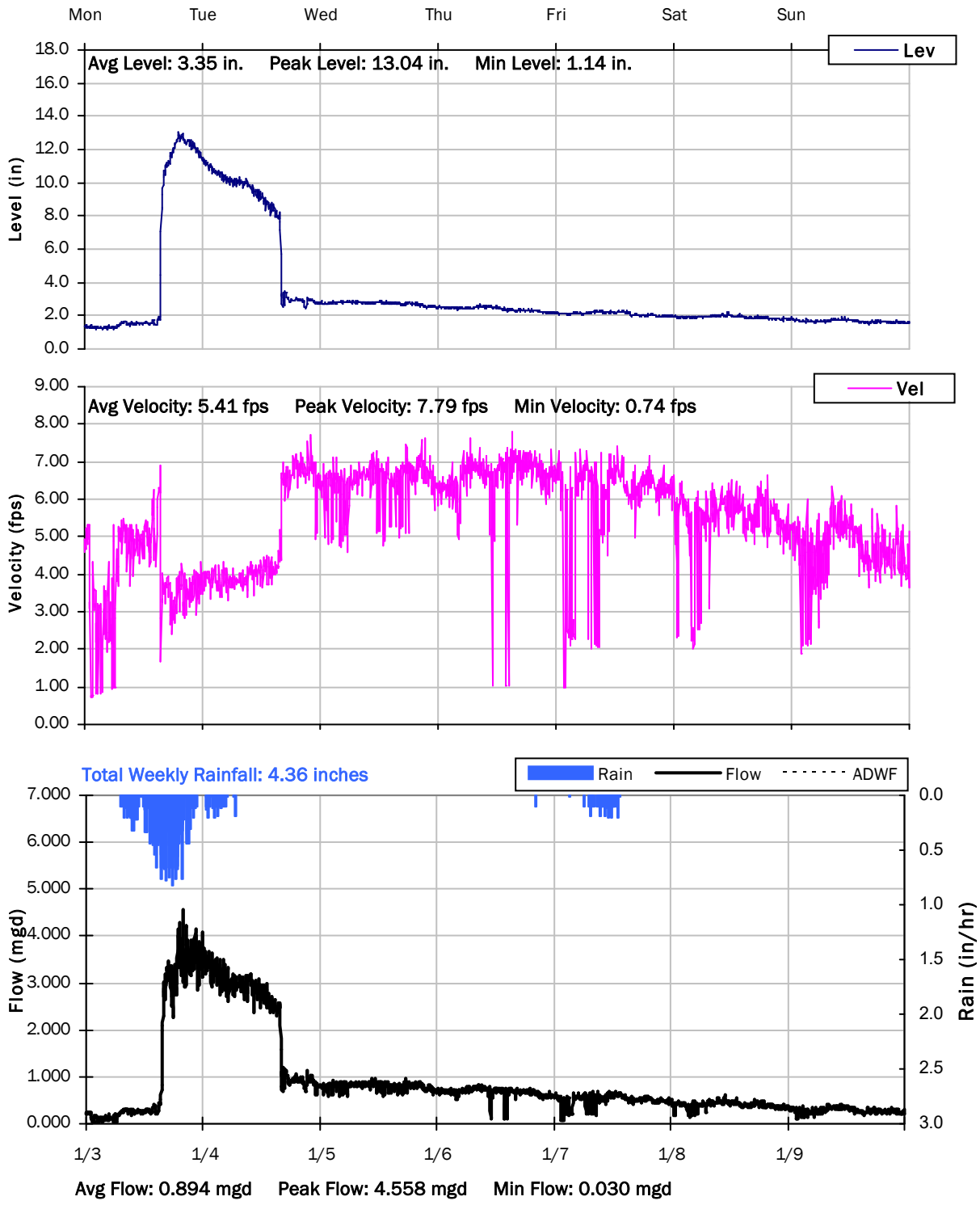
12/27/2021 to 1/3/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

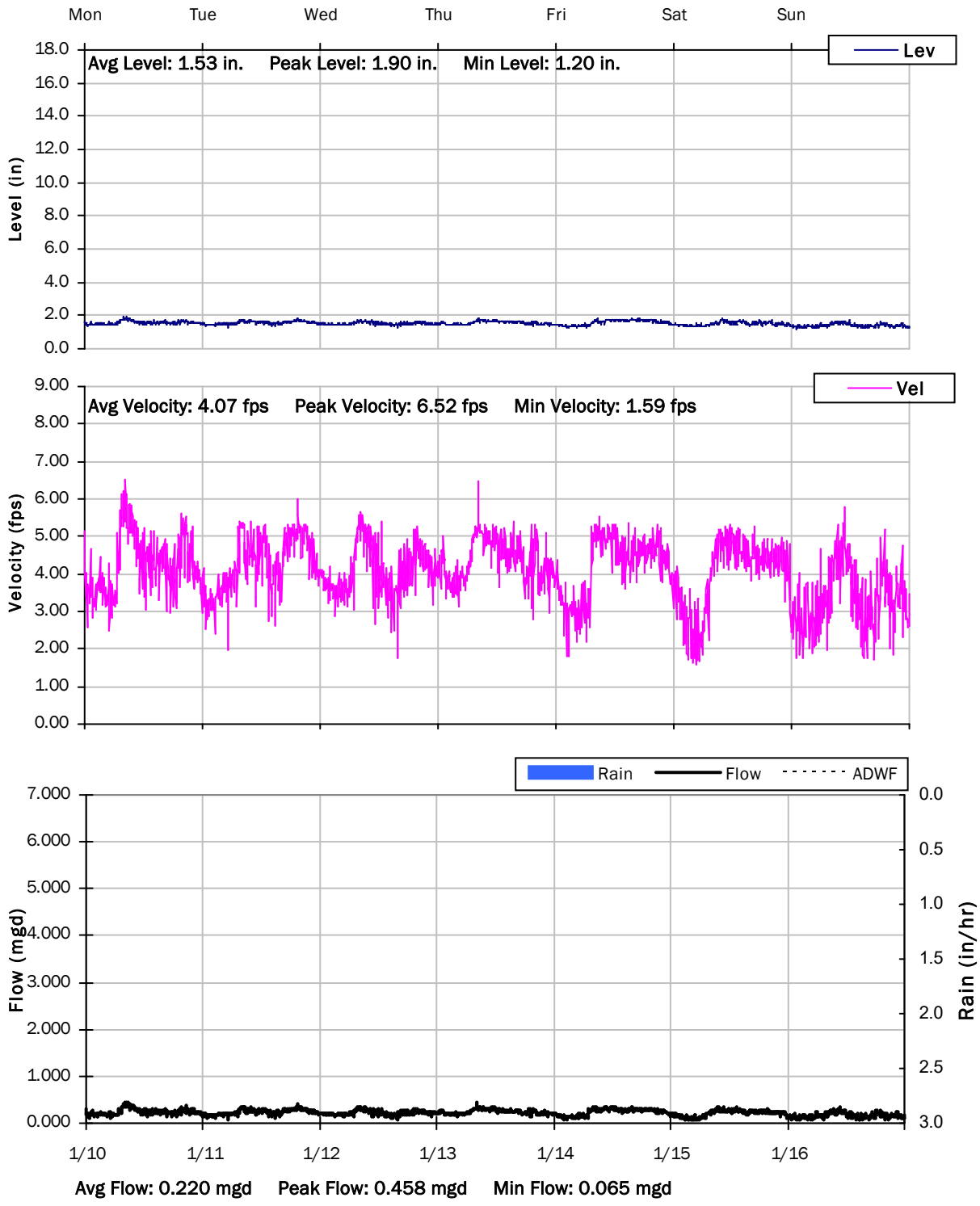
1/3/2022 to 1/10/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

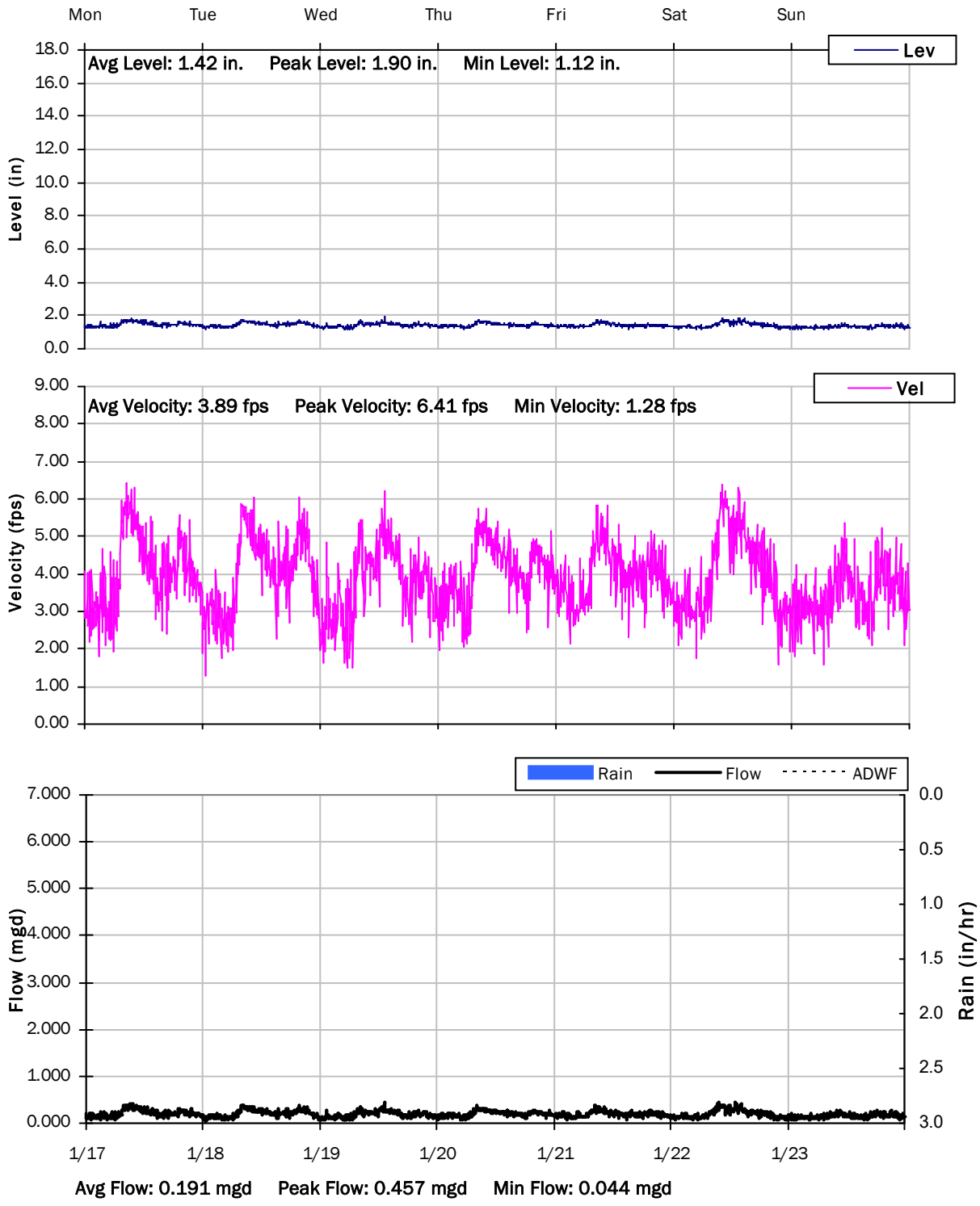
1/10/2022 to 1/17/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

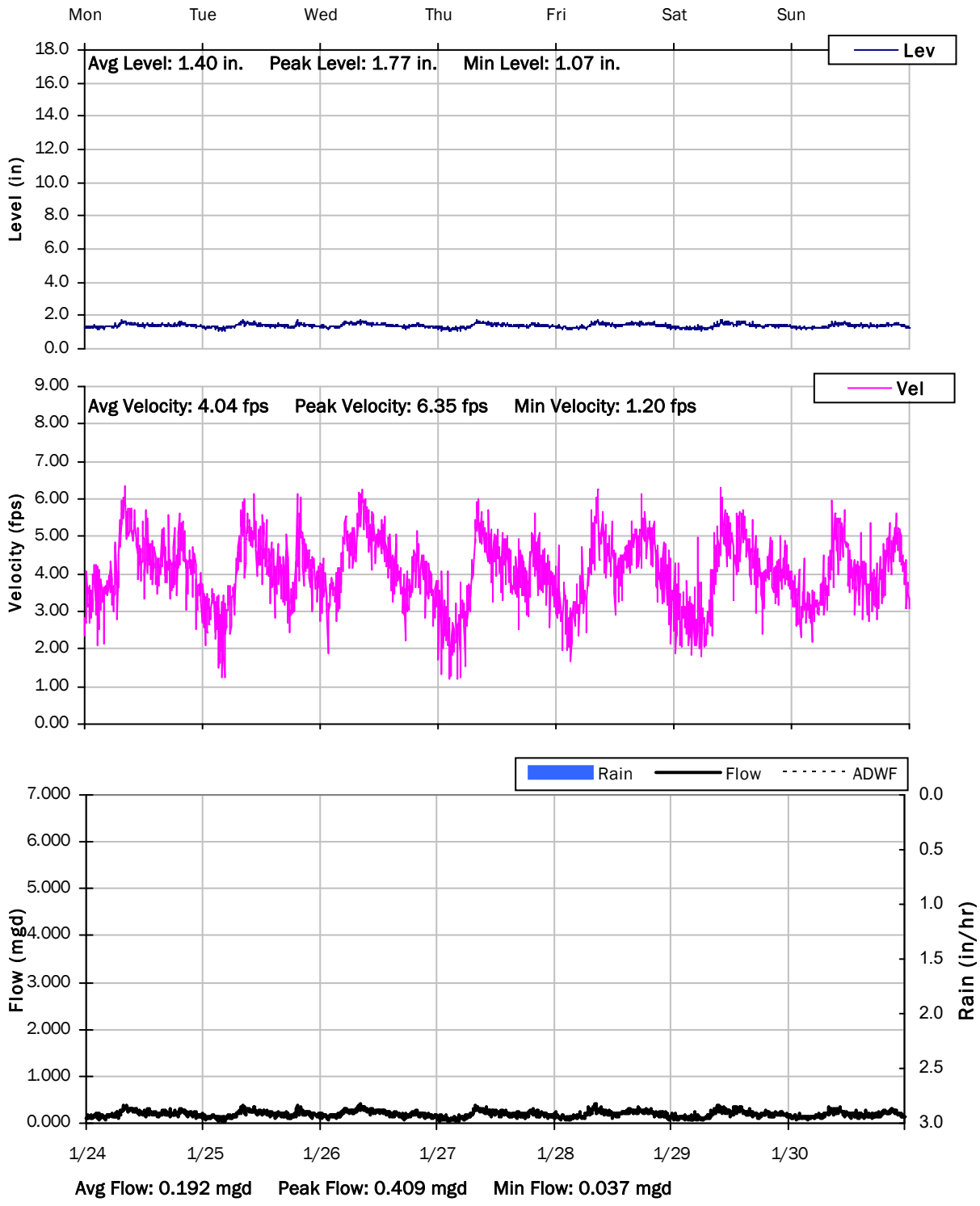
1/17/2022 to 1/24/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

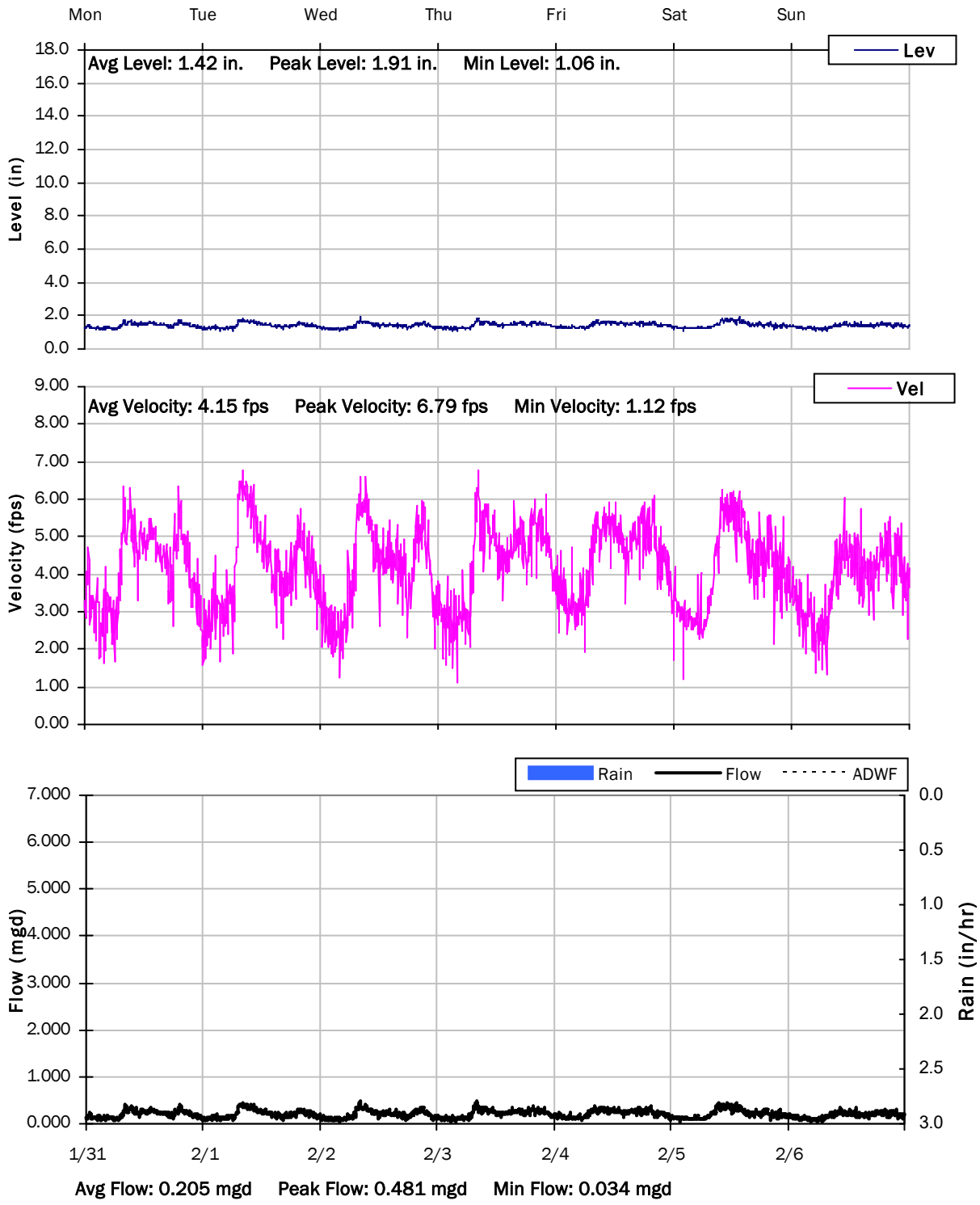
1/24/2022 to 1/31/2022



SITE 11.01

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 12

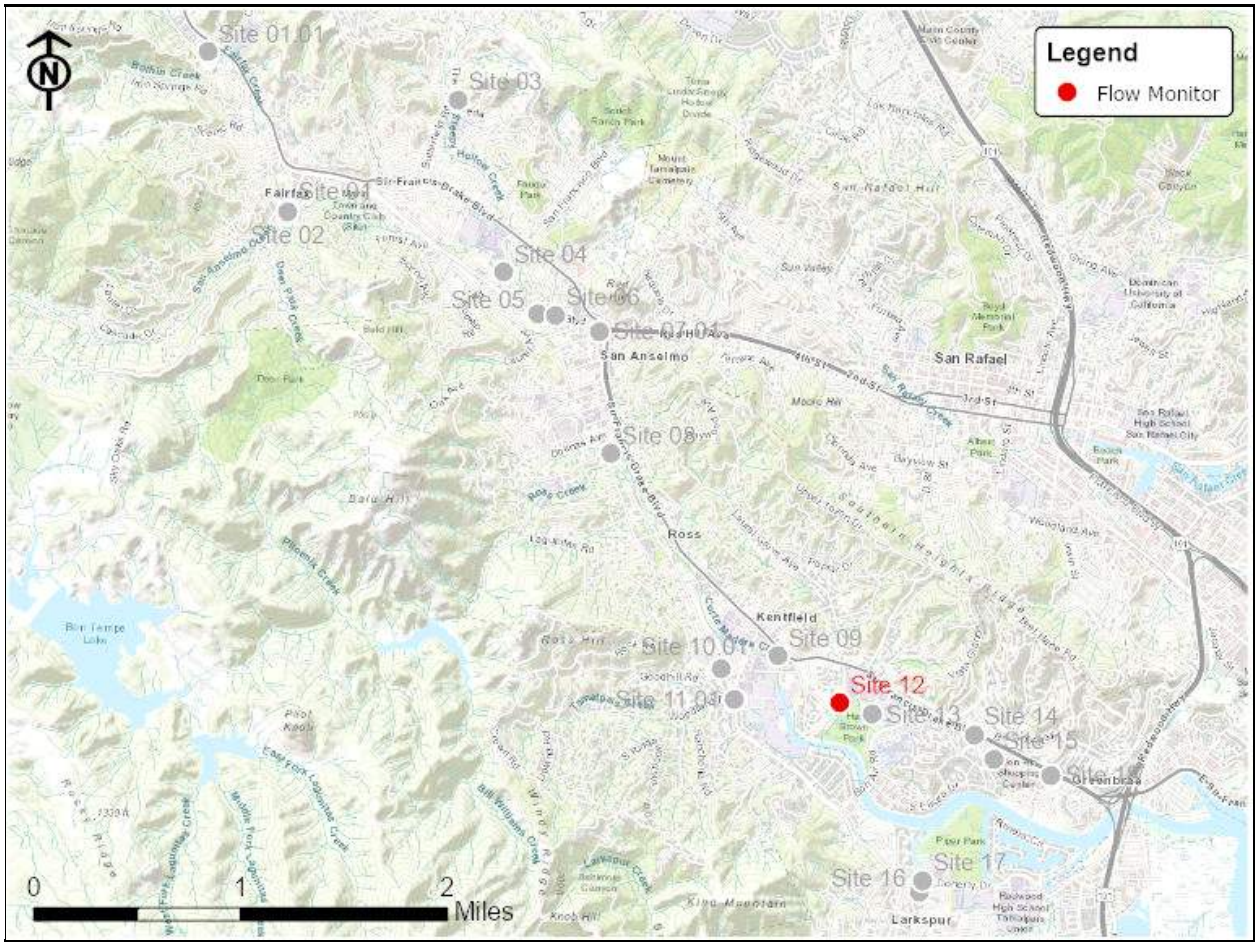
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 37 McAllister Avenue

Data Summary Report



Vicinity Map: Site 12

SITE 12

Site Information MH ID: K200.015

Location: 37 McAllister Avenue

Coordinates: 122.5404° W, 37.9507° N

Rim Elevation (Earth): 9 feet

Expected Pipe Diameter: 12 inches

Measured Pipe Diameter: 15.5 inches

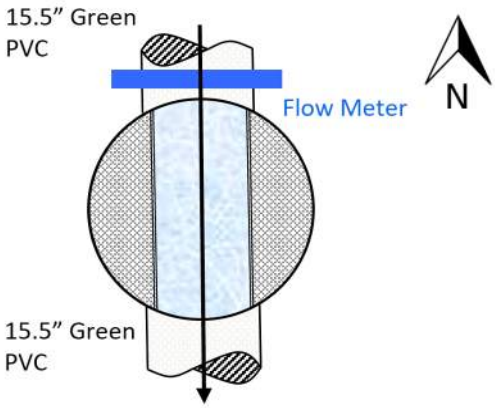
ADWF: 0.109 mgd

Peak Measured Flow: 2.150 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 12

Additional Site Photos

Effluent Pipe

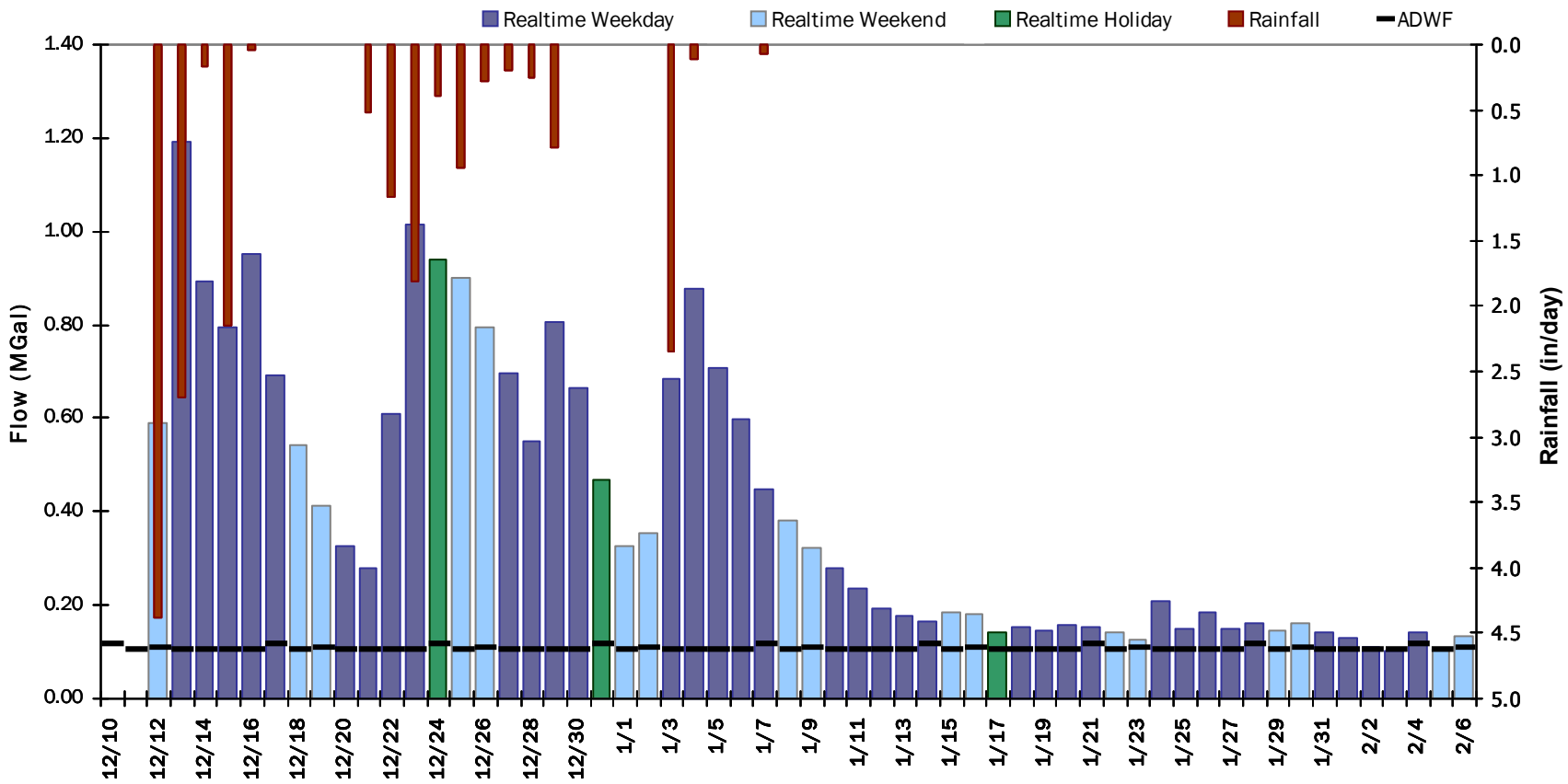
Monitored North Influent Pipe

SITE 12

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.402 MGal Peak Daily Flow: 1.190 MGal Min Daily Flow: 0.072 MGal

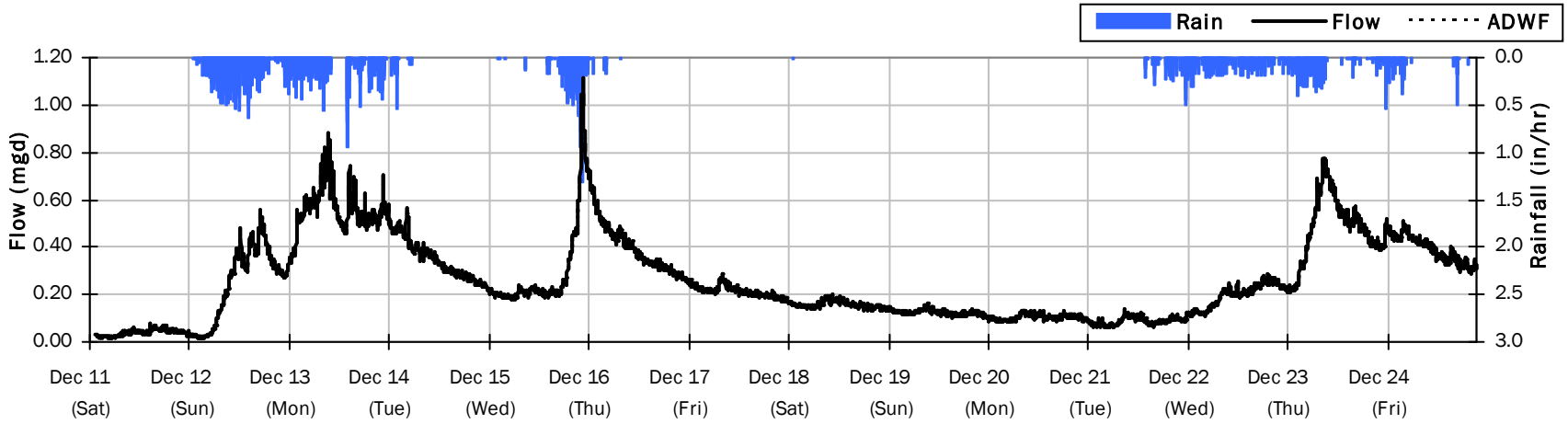
Total Rainfall: 18.33 inches

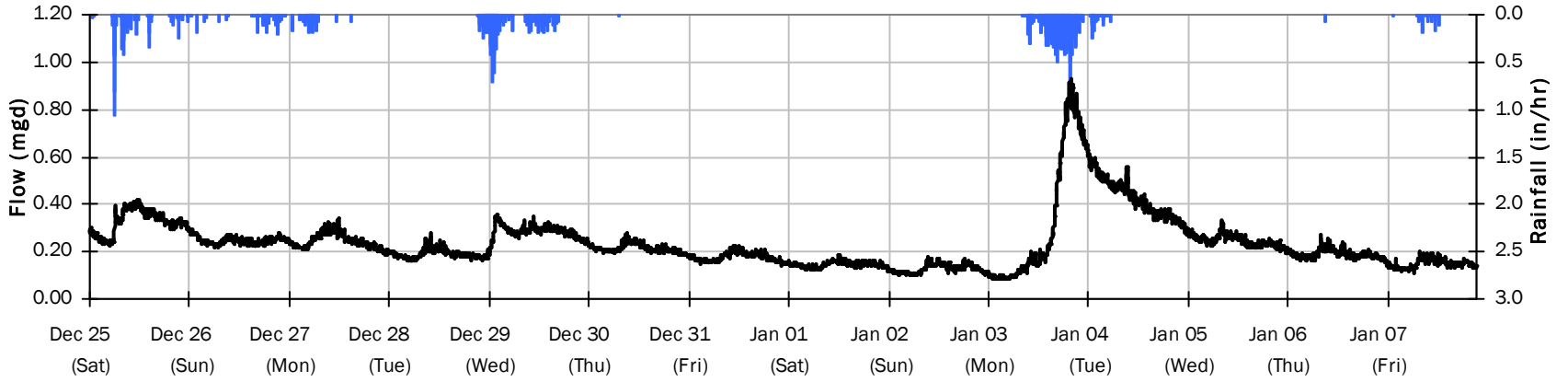


SITE 13

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 16.32 inches Period Avg Flow: 0.243 mgd Period Peak Flow: 1.113 mgd Period Min Flow: 0.015 mgd

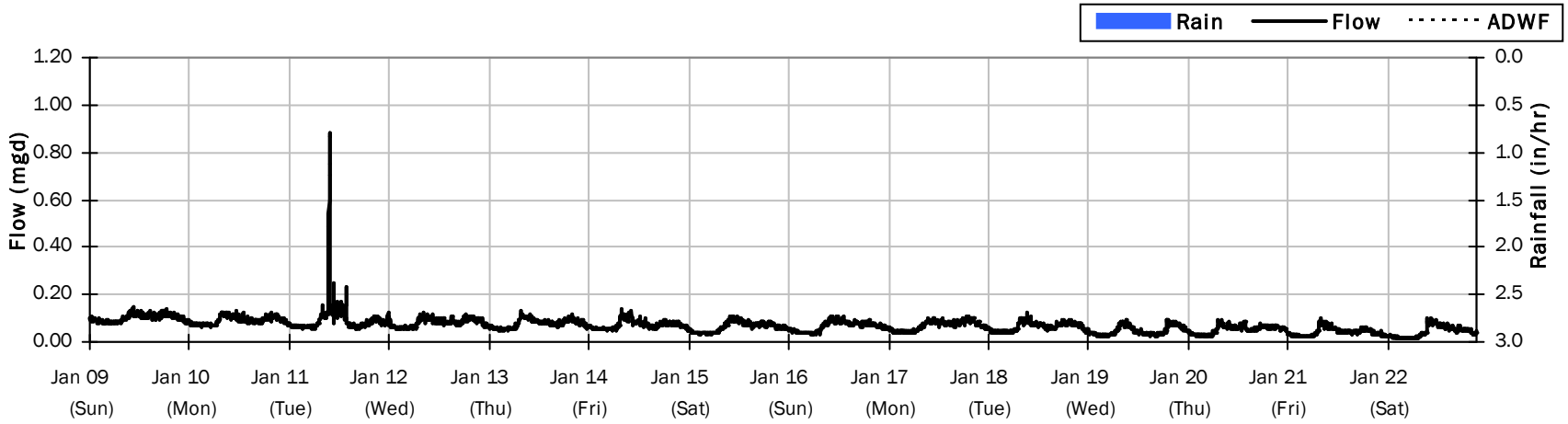


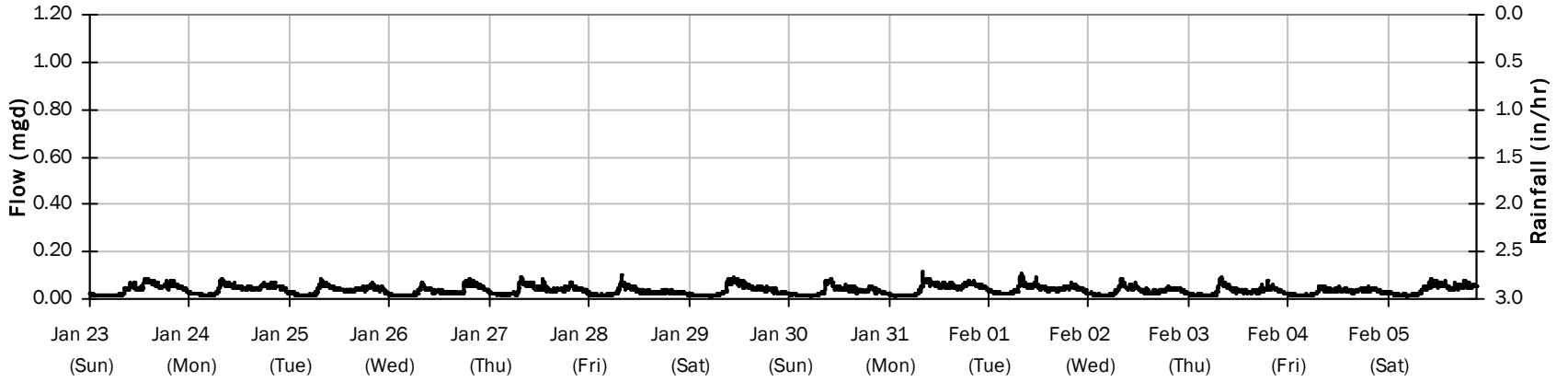


SITE 13

Flow Summary: 1/9/2022 to 2/5/2022

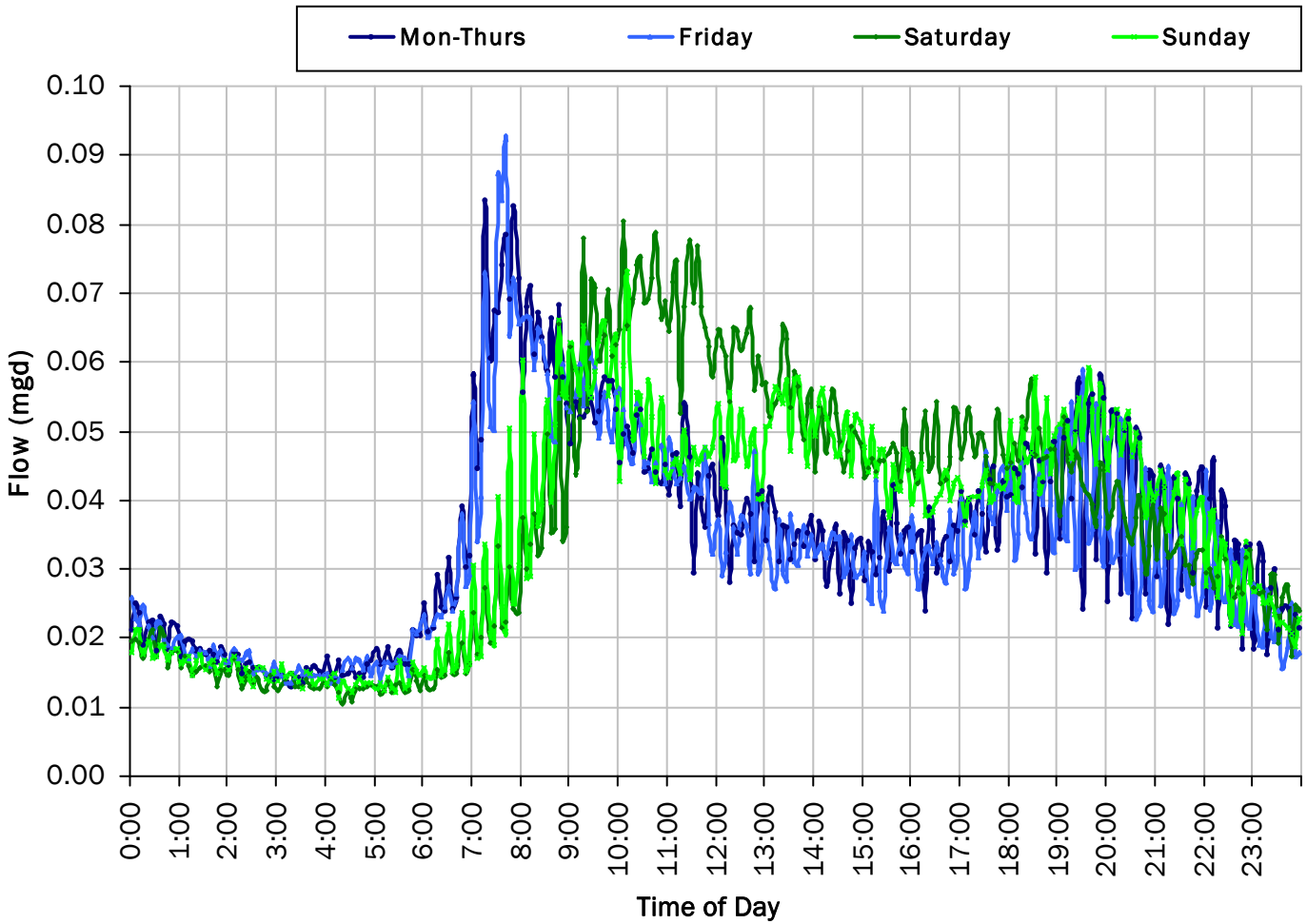
Period Rainfall: 0.00 inches Period Avg Flow: 0.054 mgd Period Peak Flow: 0.869 mgd Period Min Flow: 0.010 mgd





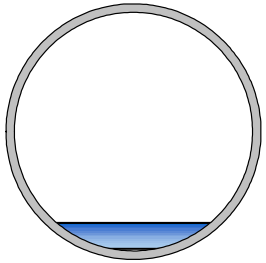
SITE 13

Average Dry Weather Flow Hydrographs



ADWF:

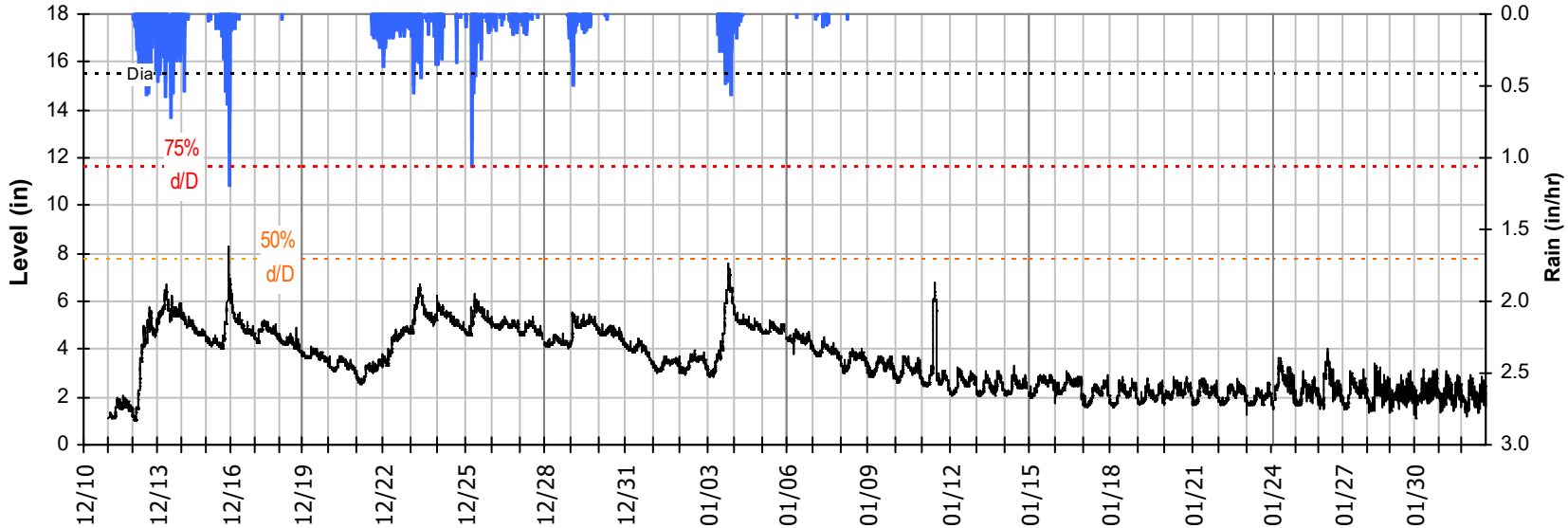
0.035 *mgd*

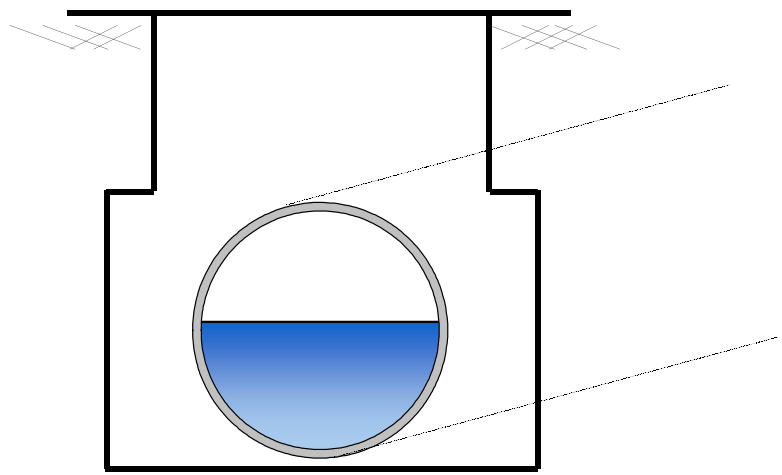


SITE 12

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

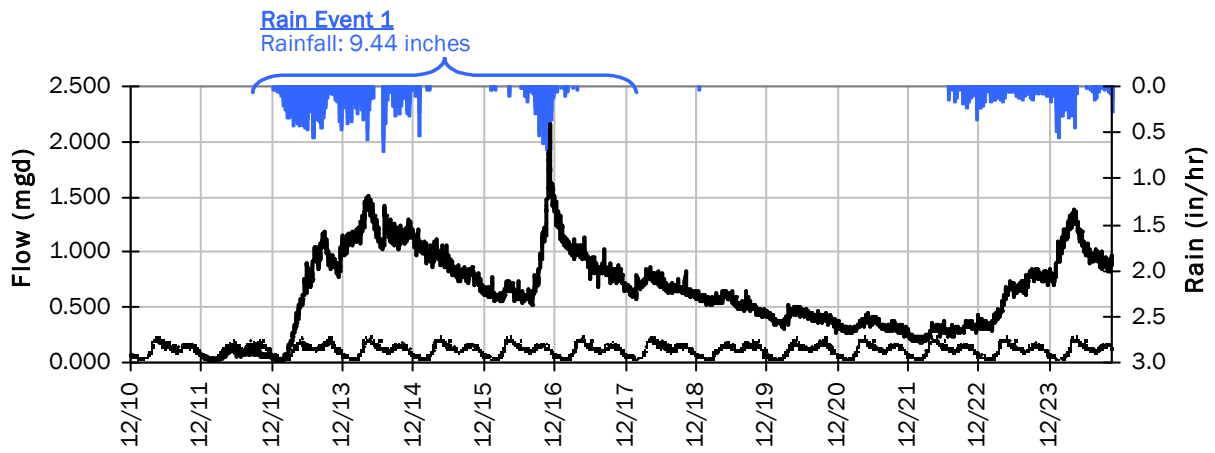




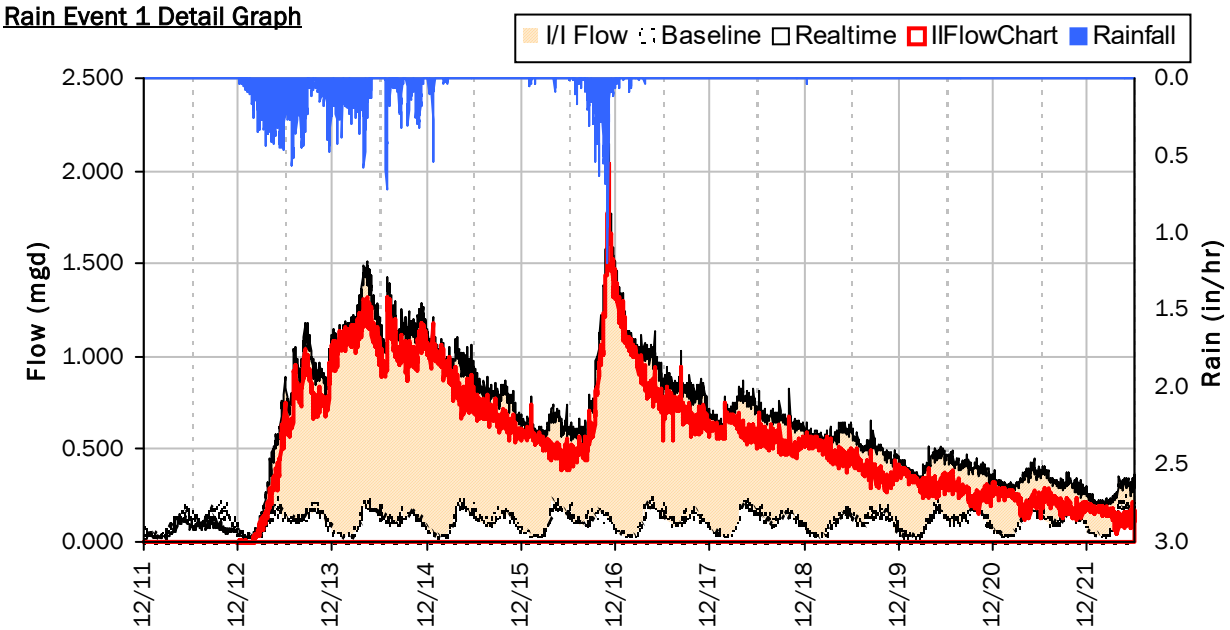
Pipe Diameter:	15.5	*inches*
Peak Measured Level:	8.27	*inches*
Peak d/D Ratio:	0.53	

SITE 12
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

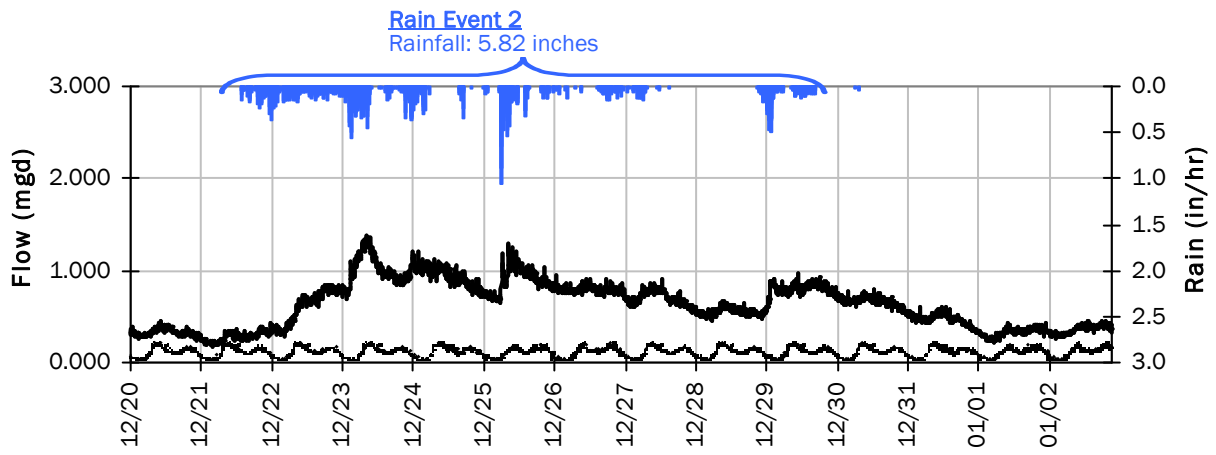


Storm Event I/I Analysis (Rain = 9.44 inches)

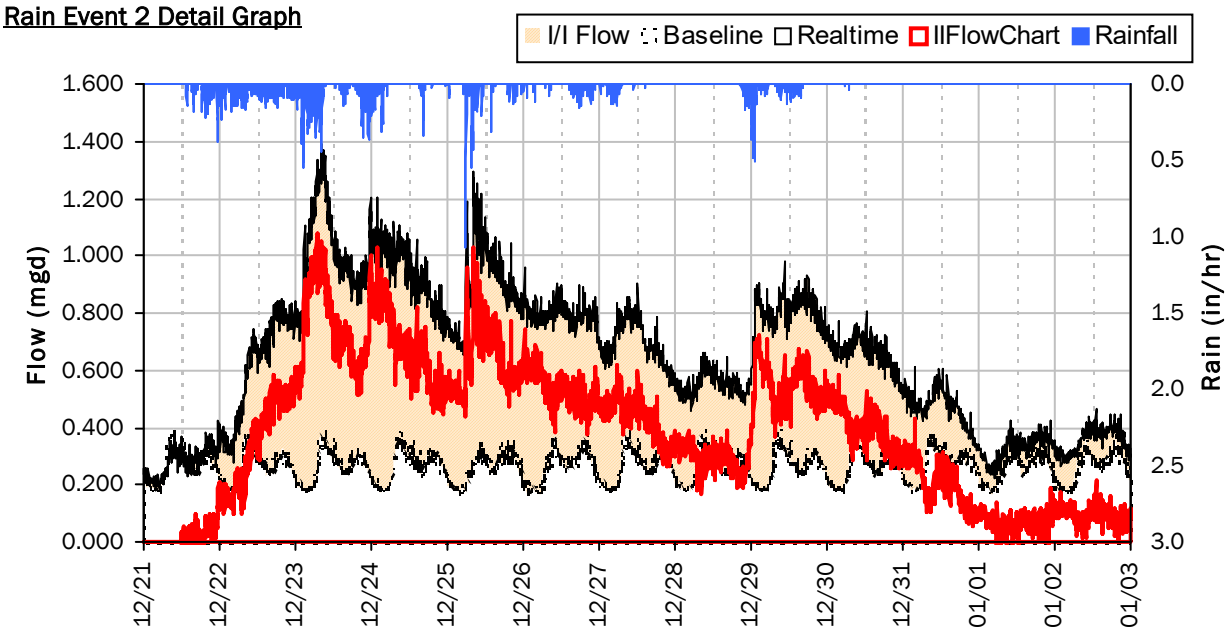
Capacity		Inflow / Infiltration	
Peak Flow:	2.150 *mgd*	**Peak I/I Rate:**	2.038 *mgd*
PF:	19.35	**Total I/I:**	5,466,000 *gallons*
Peak Level:	8.27 *in*		
d/D Ratio:	0.53		

SITE 12
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



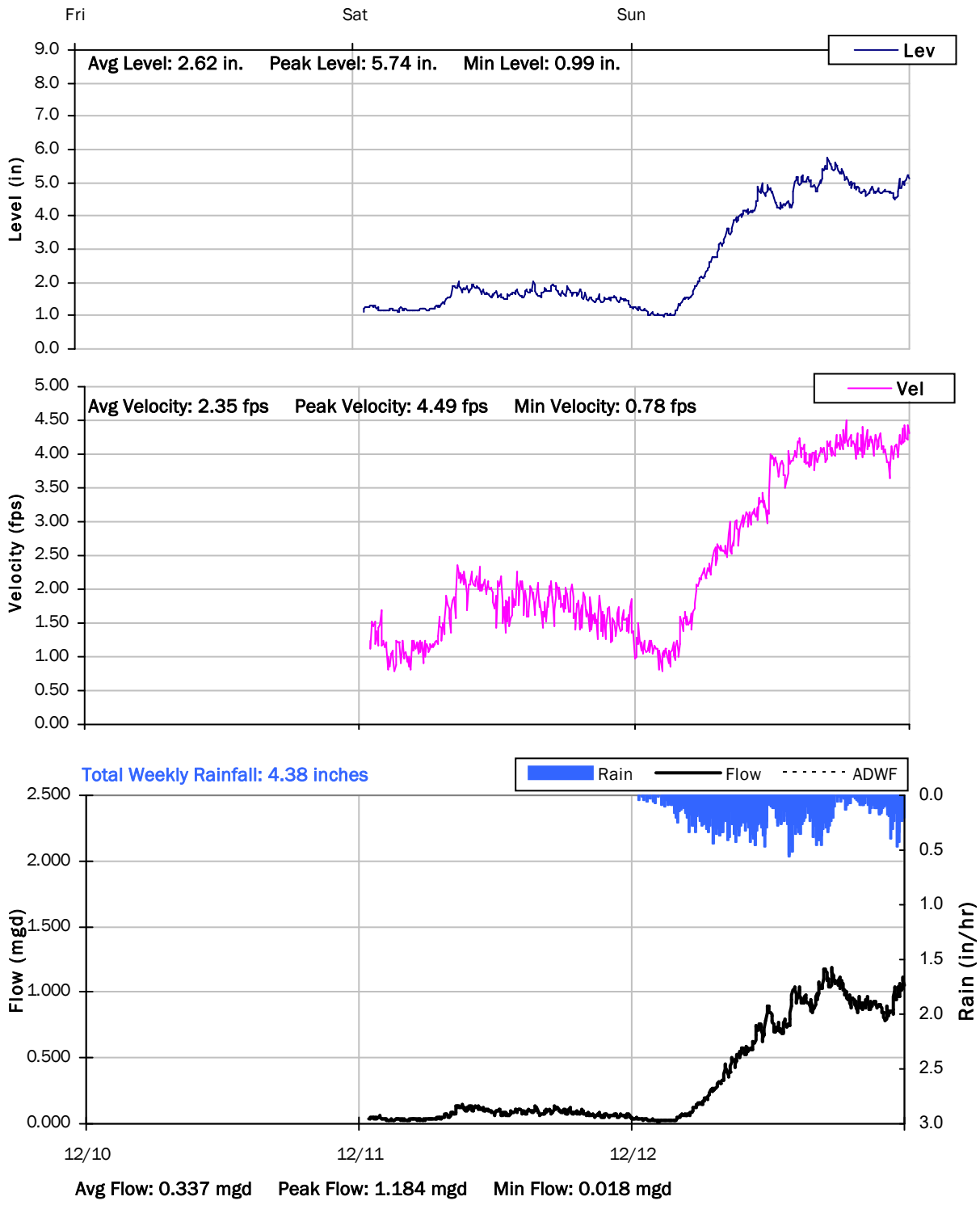
Storm Event I/I Analysis (Rain = 5.82 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.389 *mgd*	**Peak I/I Rate:**	1.079 *mgd*
PF:	12.50	**Total I/I:**	5,013,000 *gallons*
Peak Level:	6.71 *in*		
d/D Ratio:	0.43		

SITE 12

Weekly Level, Velocity and Flow Hydrographs

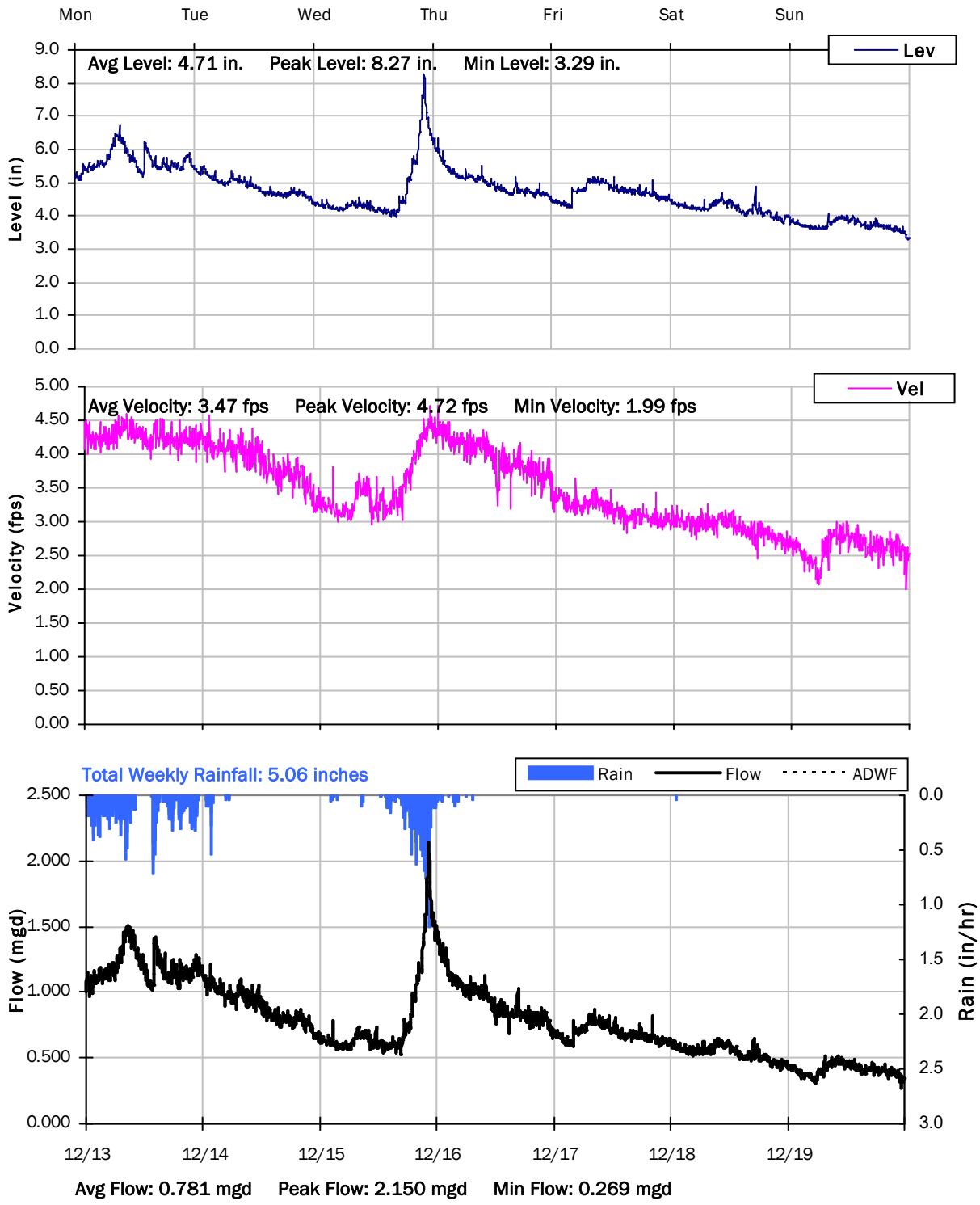
12/10/2021 to 12/13/2021



SITE 12

Weekly Level, Velocity and Flow Hydrographs

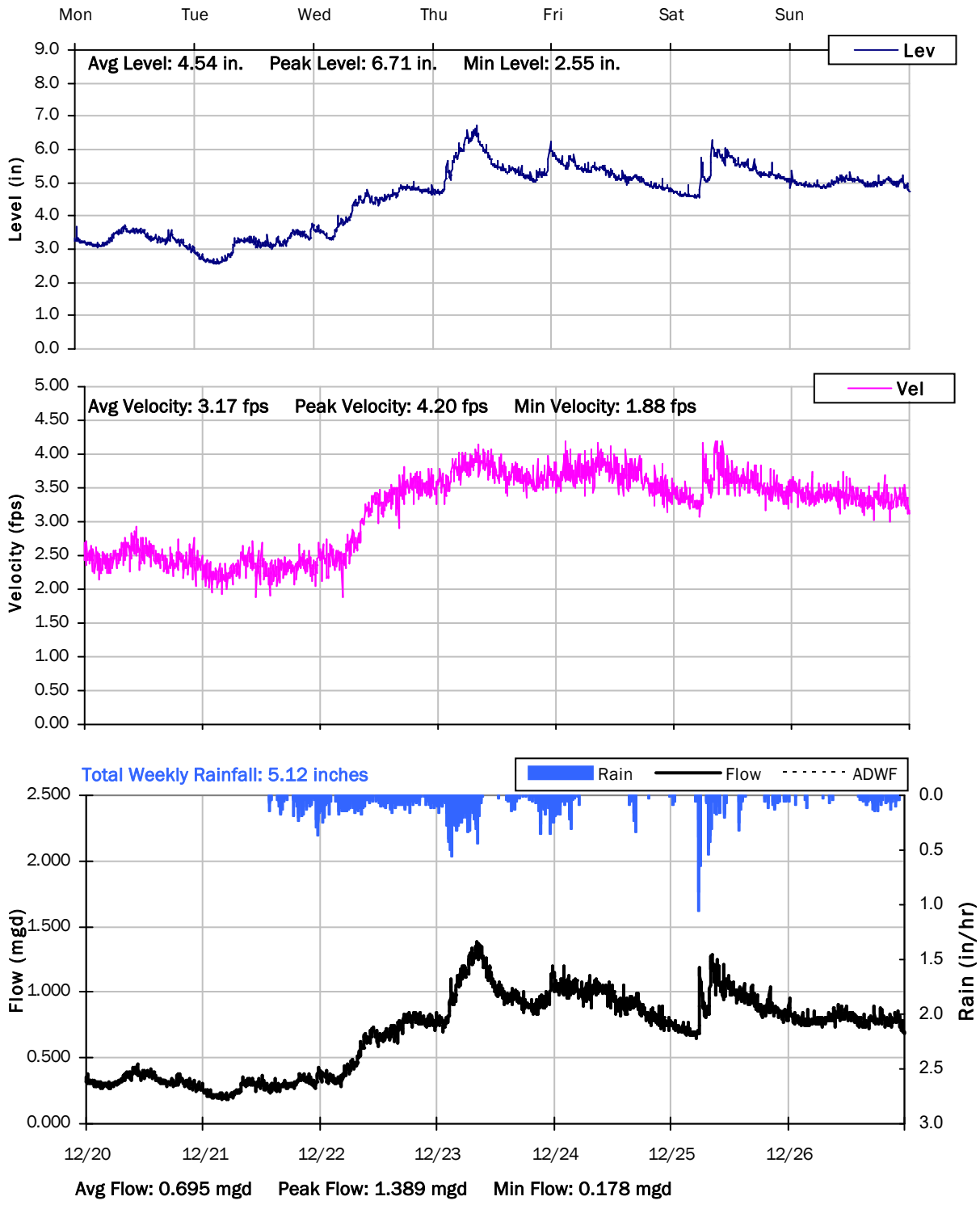
12/13/2021 to 12/20/2021



SITE 12

Weekly Level, Velocity and Flow Hydrographs

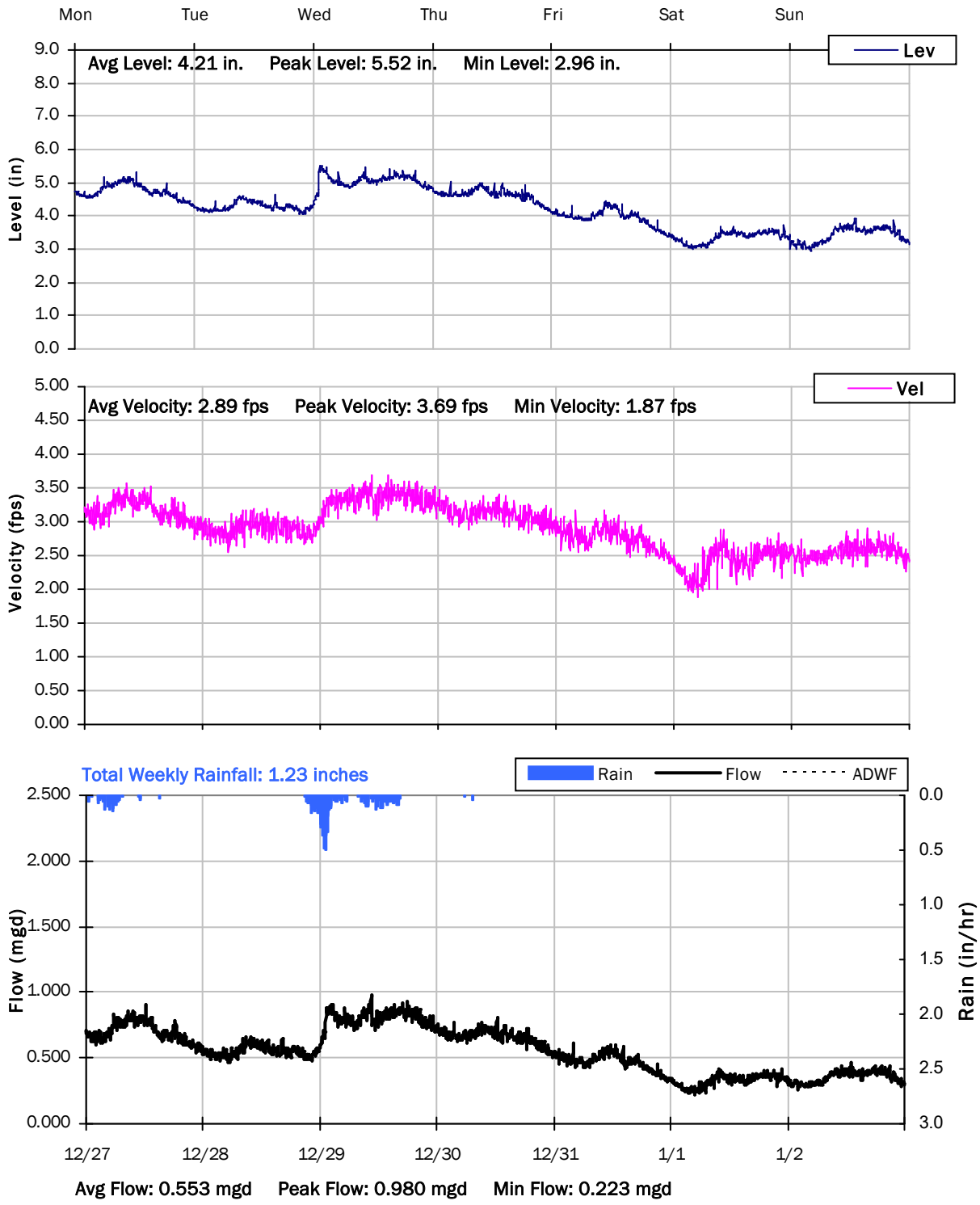
12/20/2021 to 12/27/2021



SITE 12

Weekly Level, Velocity and Flow Hydrographs

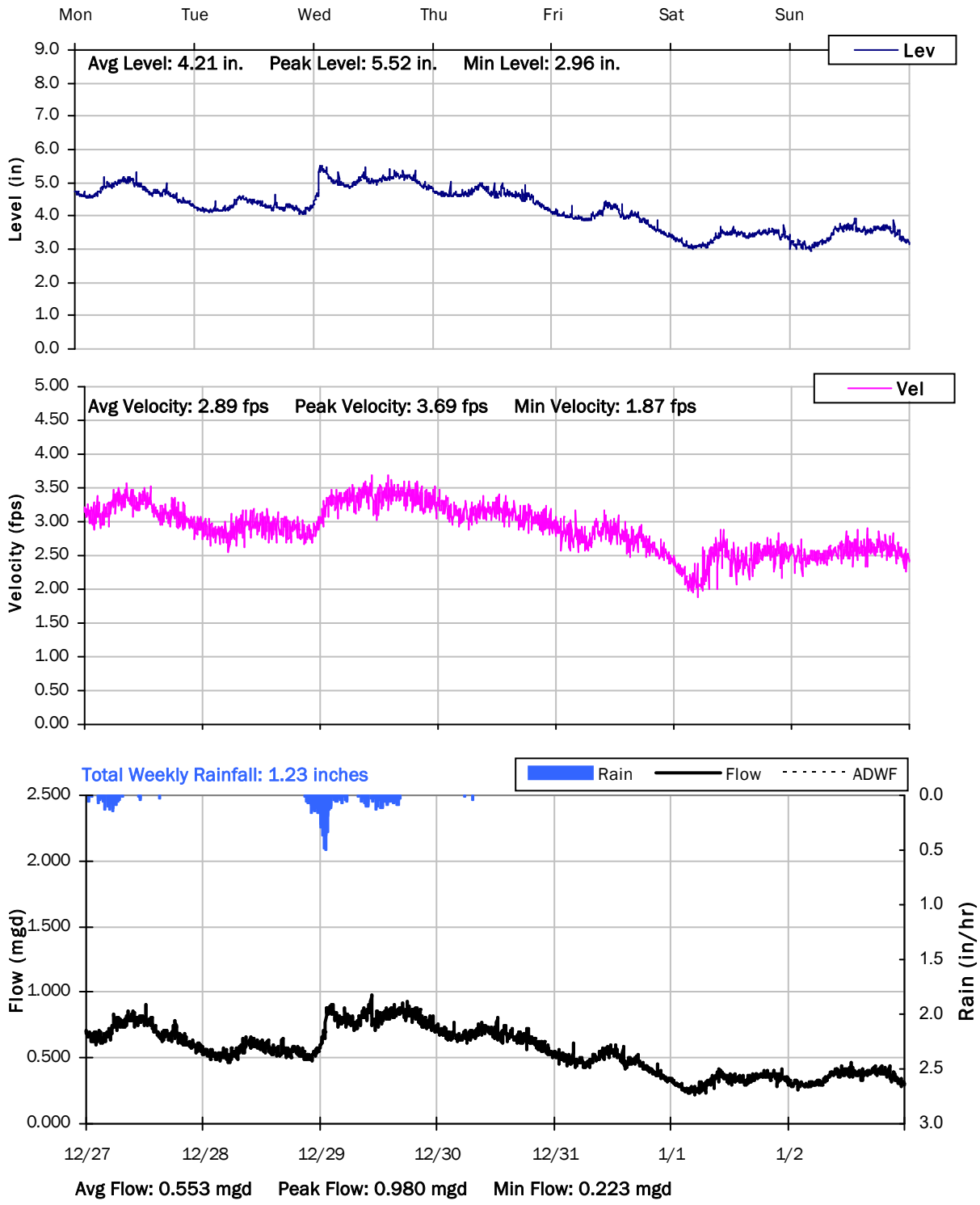
12/27/2021 to 1/3/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

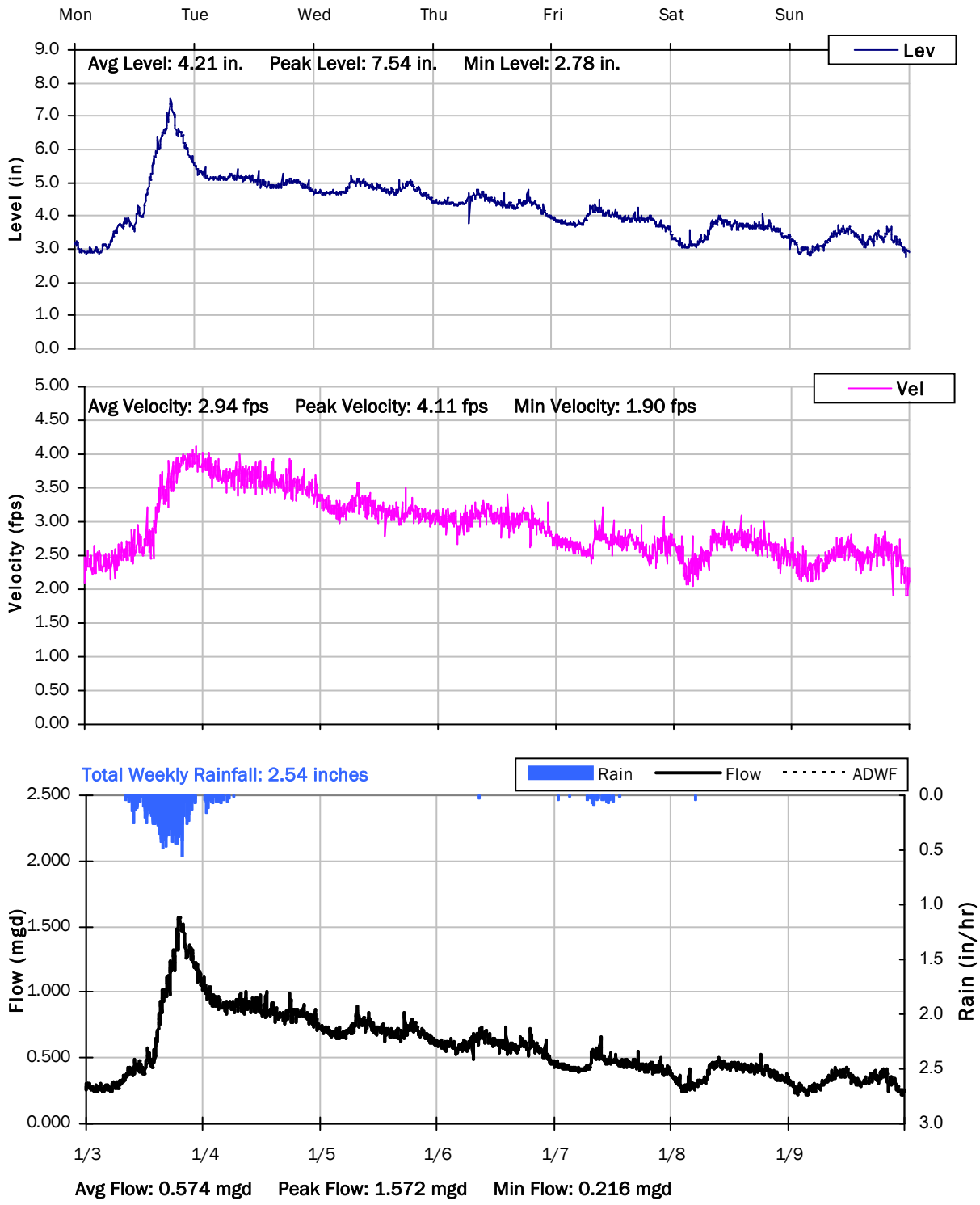
12/27/2021 to 1/3/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

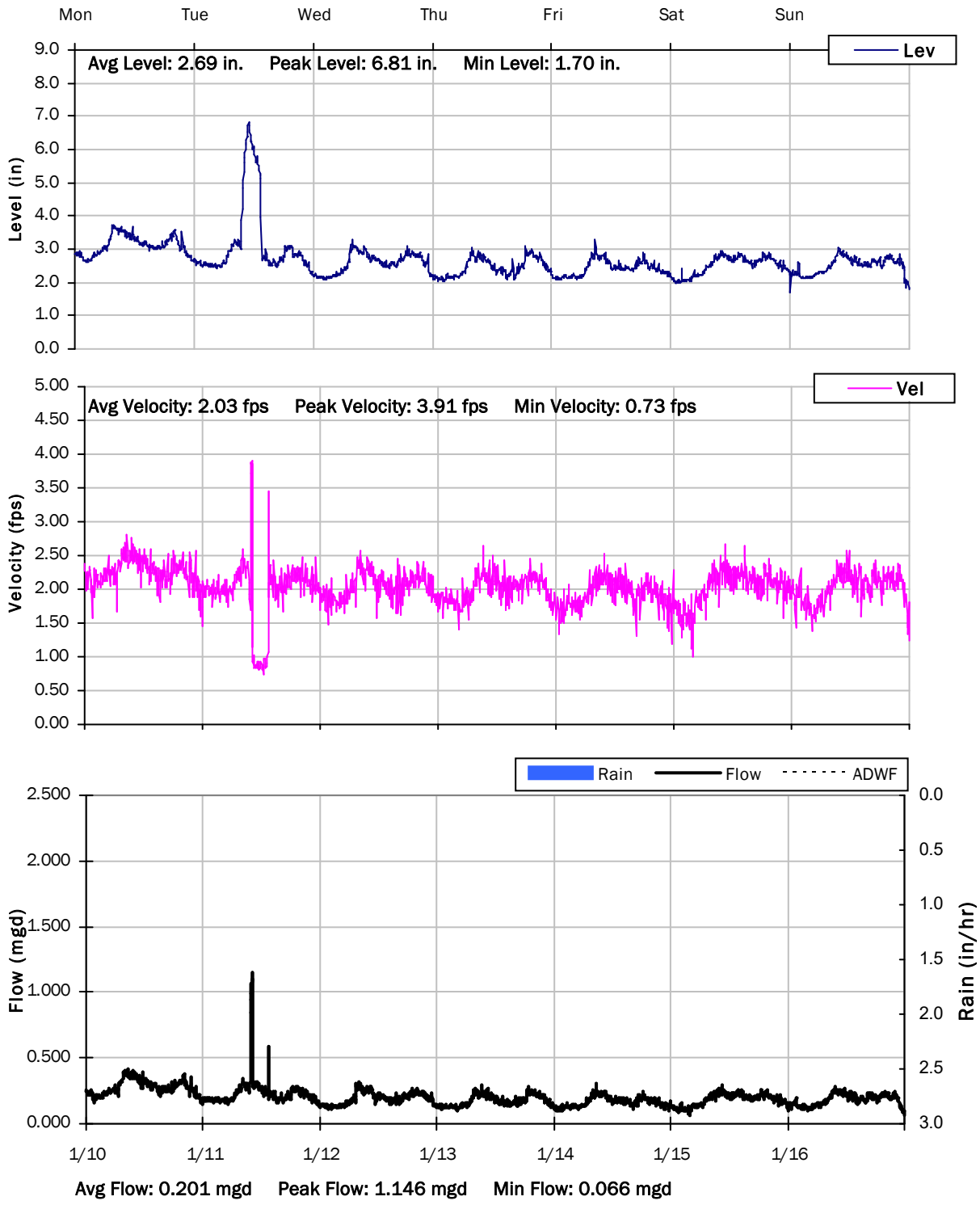
1/3/2022 to 1/10/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

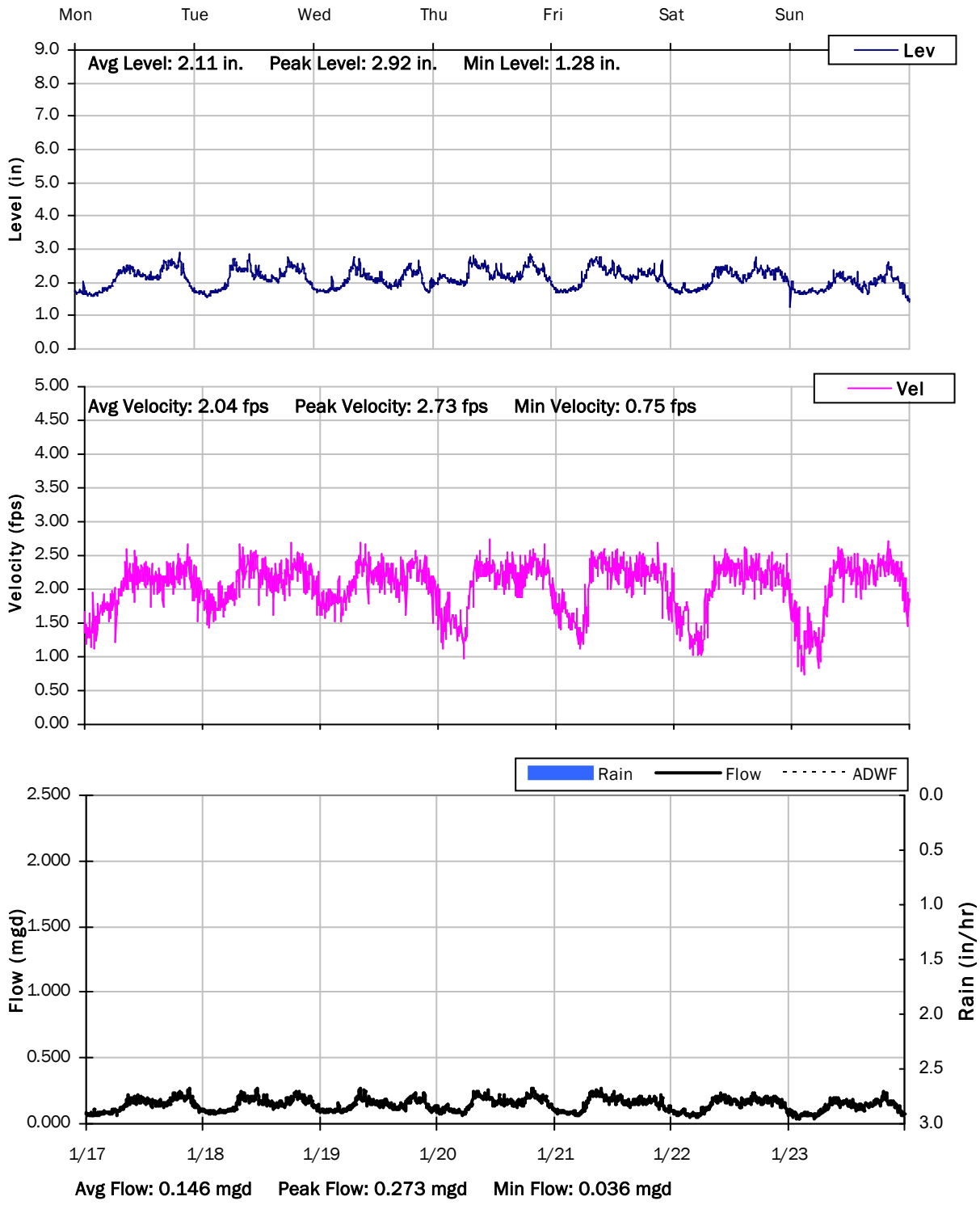
1/10/2022 to 1/17/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

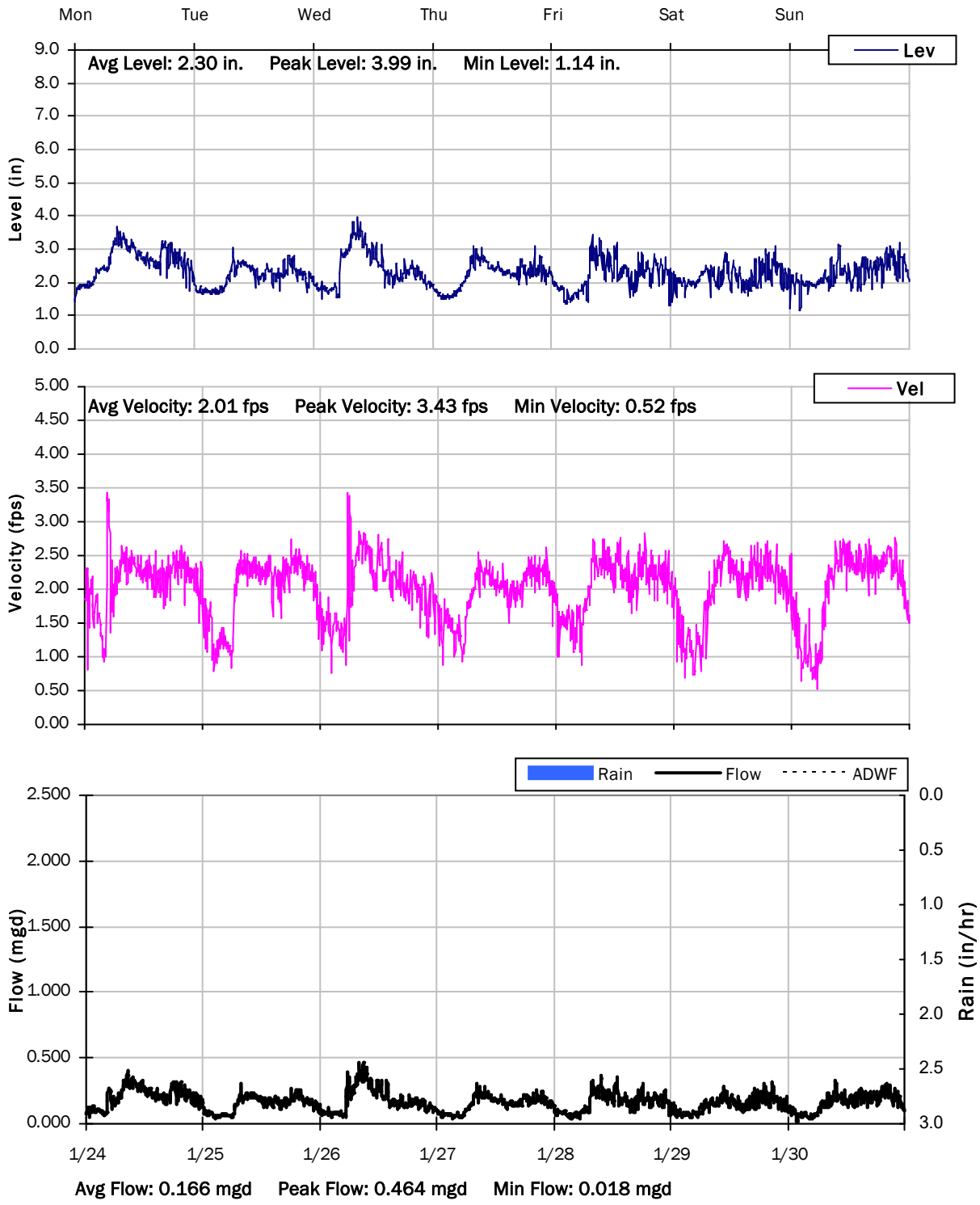
1/17/2022 to 1/24/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

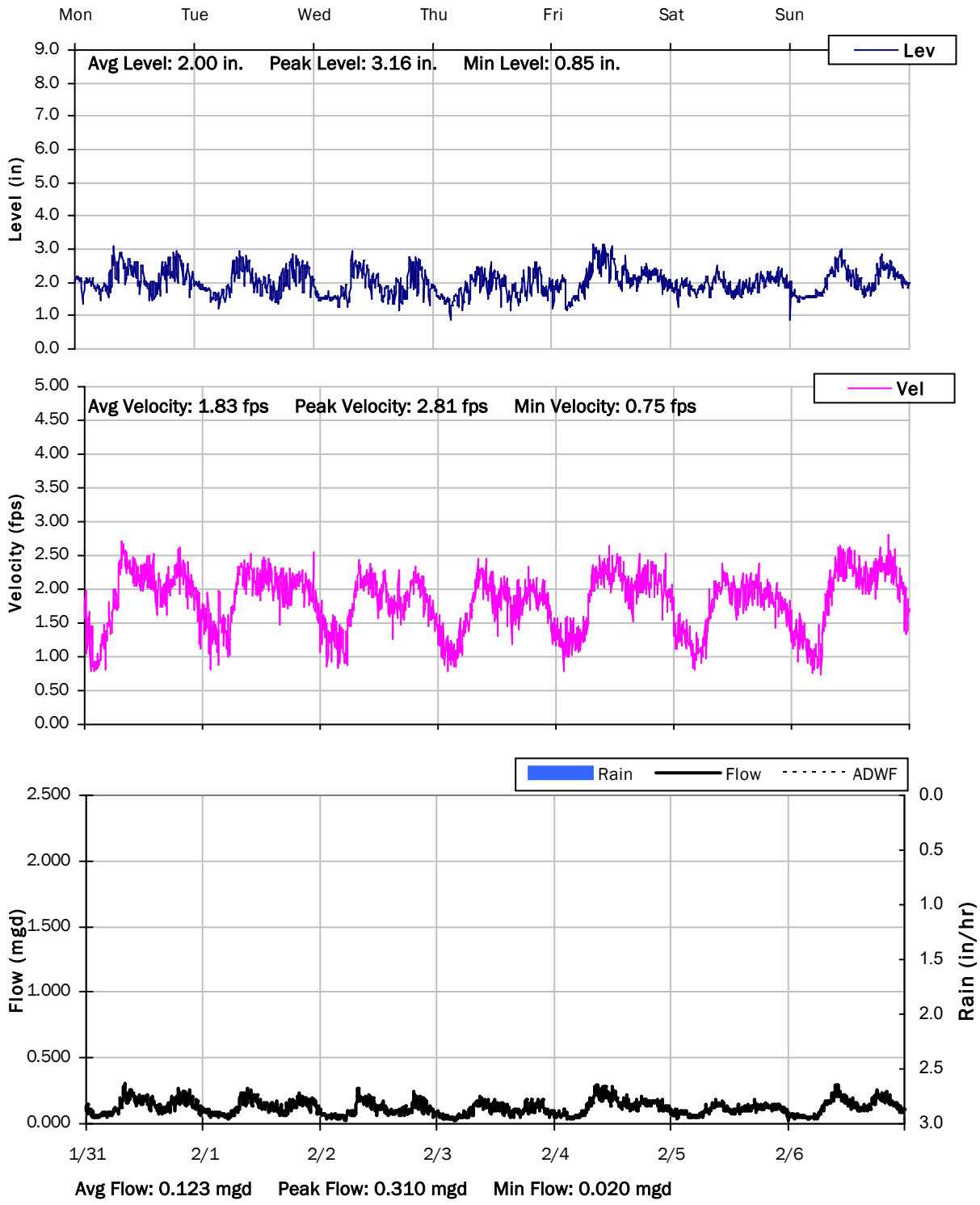
1/24/2022 to 1/31/2022



SITE 12

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 13

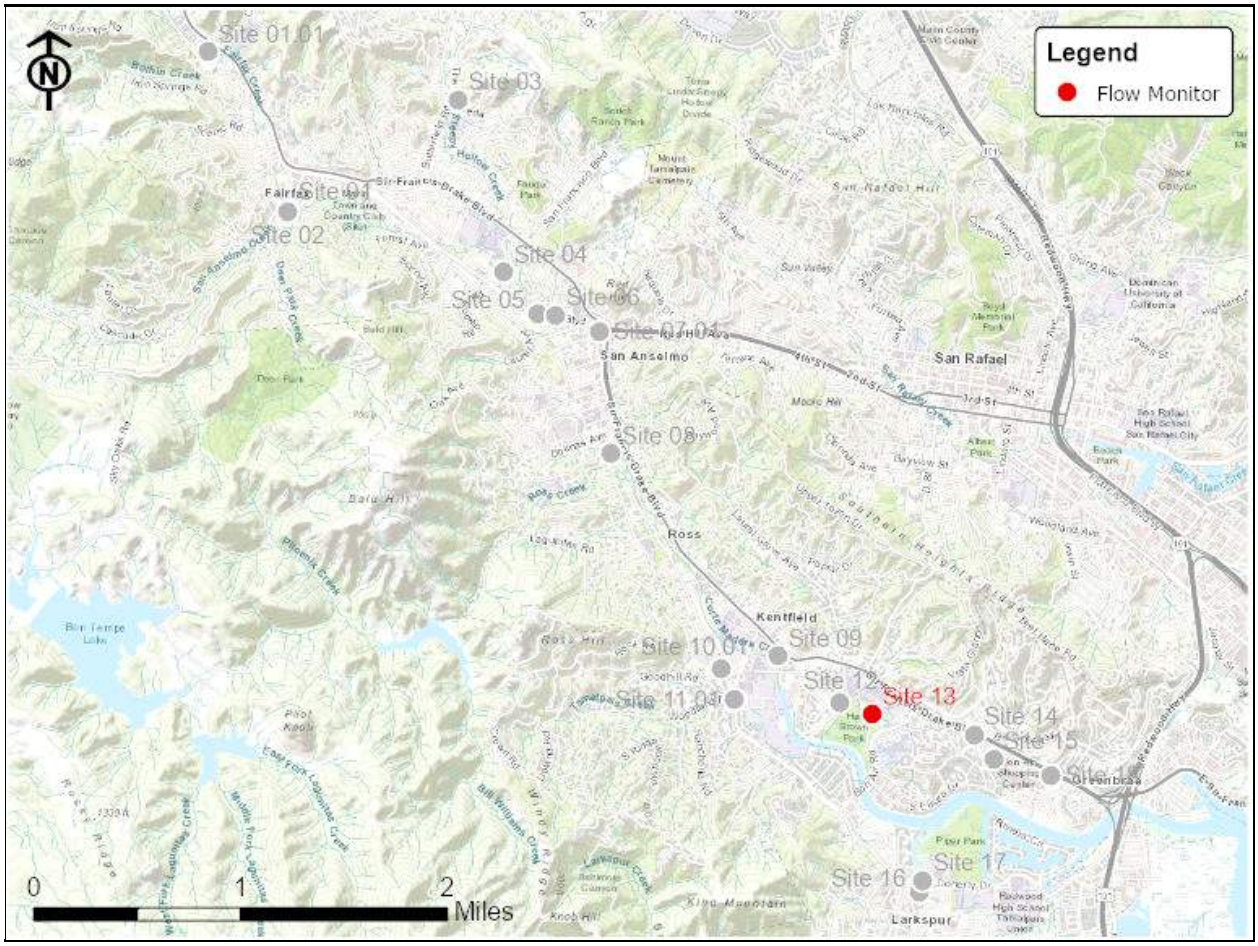
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Parking lot behind Marin Catholic High School

Data Summary Report



Vicinity Map: Site 13

SITE 13

Site Information MH ID: G000.150

Location: Parking lot behind Marin Catholic High School

Coordinates: 122.5376° W, 37.9499° N

Rim Elevation (Earth): 18 feet

Expected Pipe Diameter: 12 inches

Measured Pipe Diameter: 15 inches

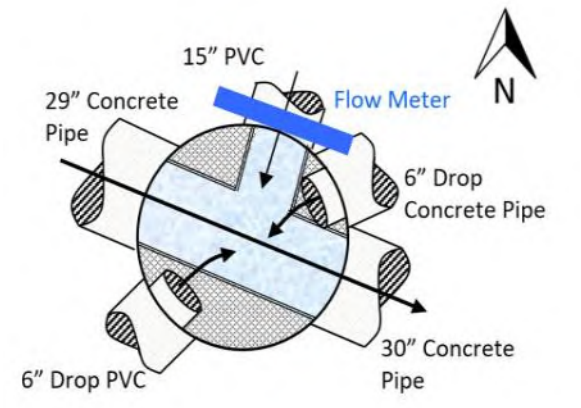
ADWF: 0.036 mgd

Peak Measured Flow: 1.113 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 13

Additional Site Photos

Effluent Pipe

Southwest Influent Pipe

SITE 13

Additional Site Photos

West Influent Pipe

Monitored North Influent Pipe

SITE 13

Additional Site Photos

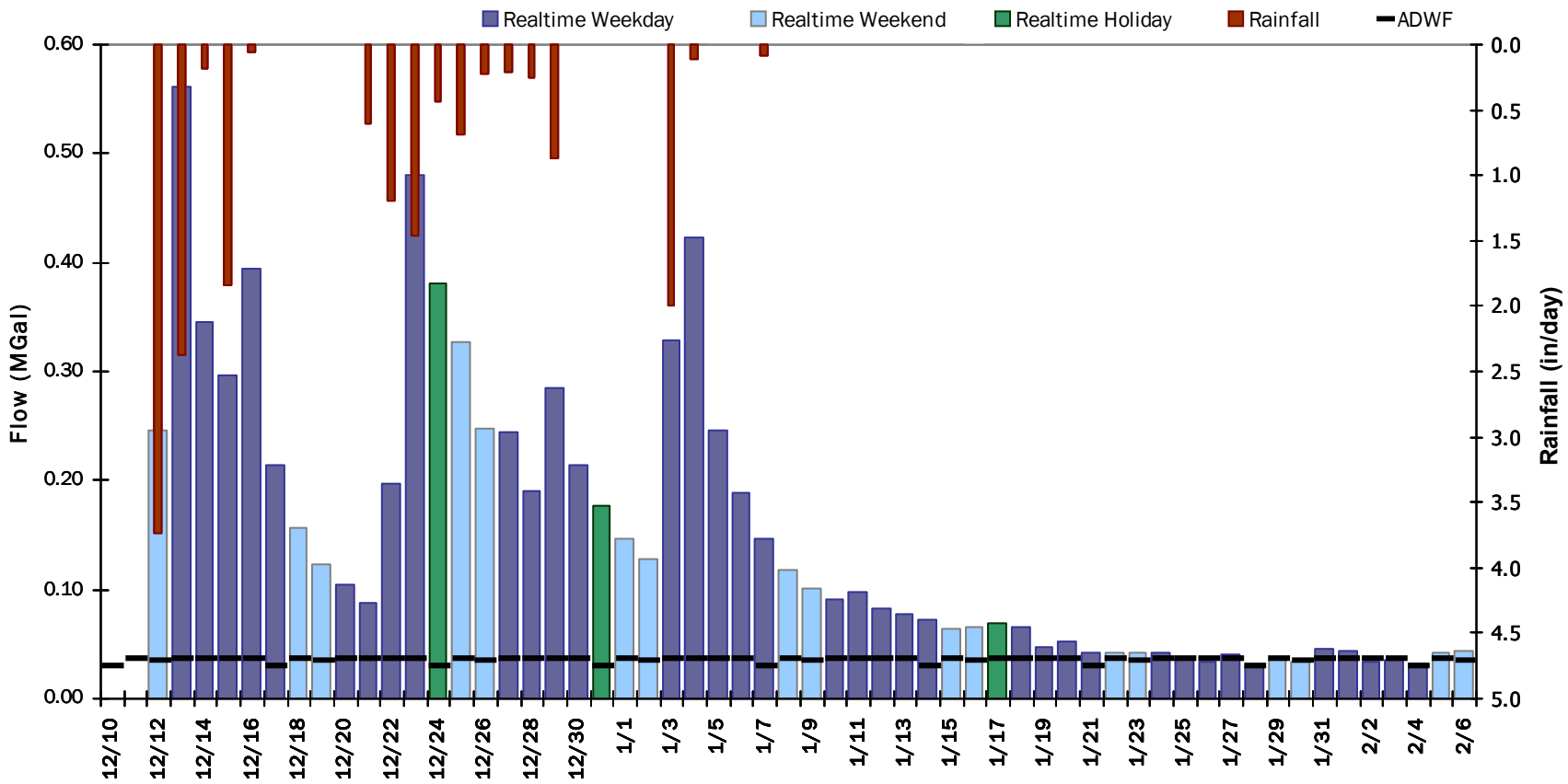
Northeast Influent Pipe

SITE 13

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.148 MGal Peak Daily Flow: 0.562 MGal Min Daily Flow: 0.031 MGal

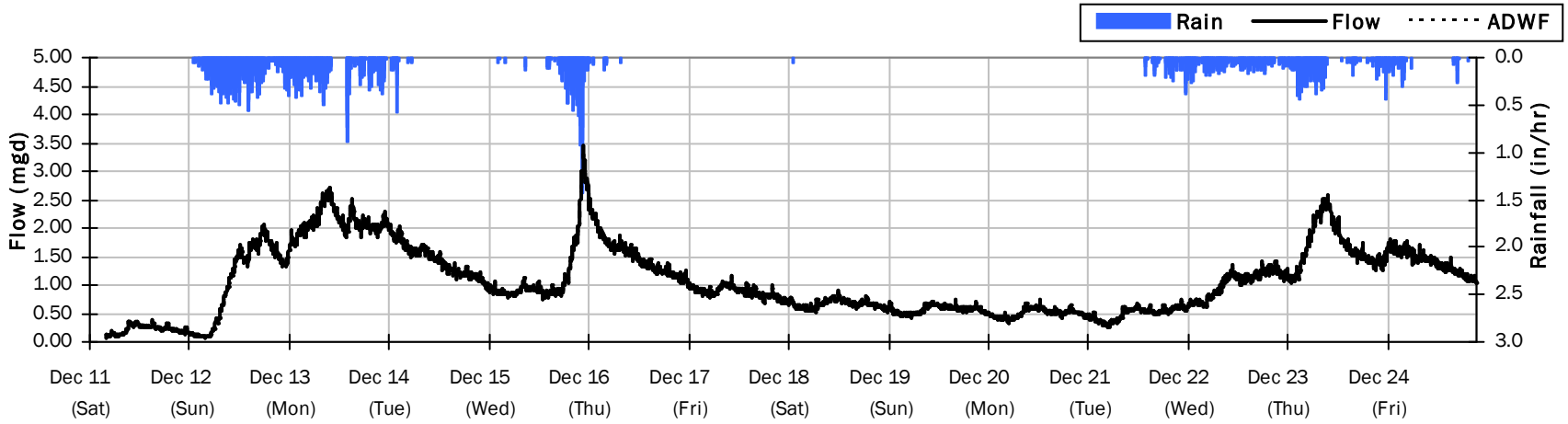
Total Rainfall: 16.32 inches

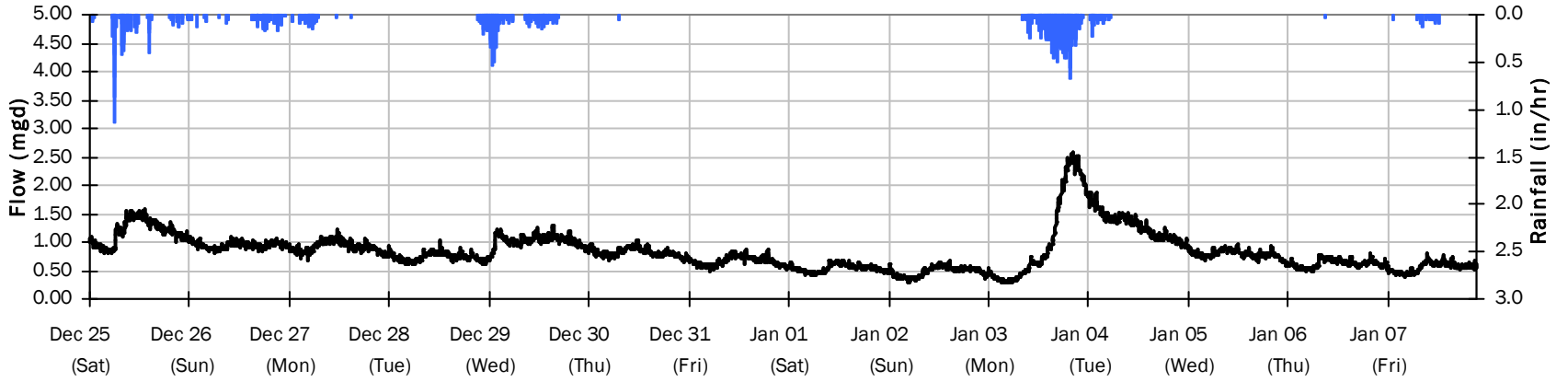


SITE 14

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 17.68 inches Period Avg Flow: 0.930 mgd Period Peak Flow: 3.451 mgd Period Min Flow: 0.077 mgd

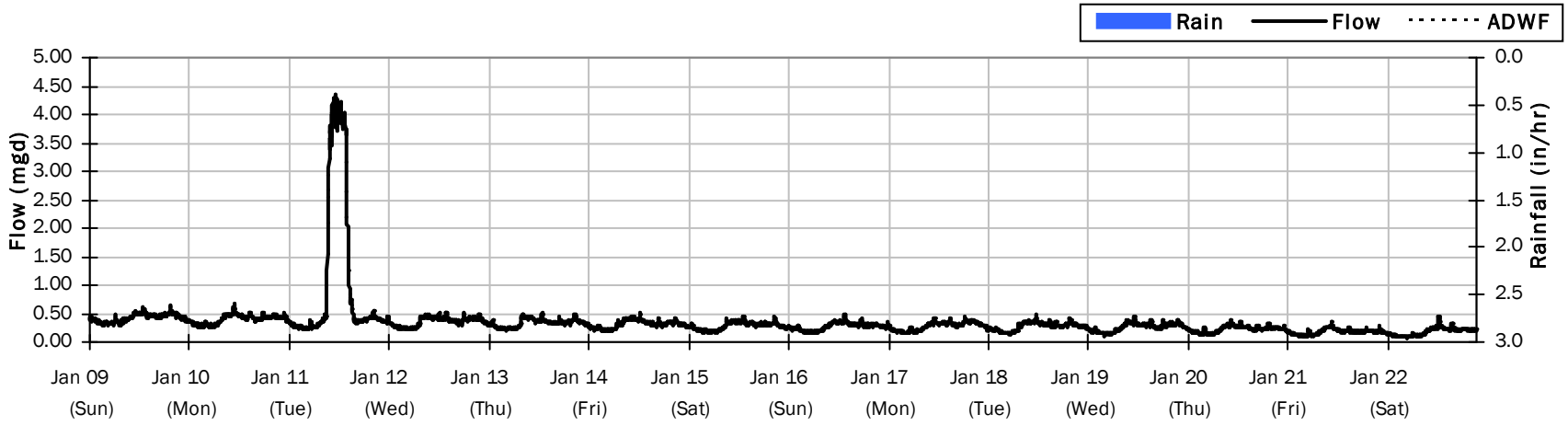


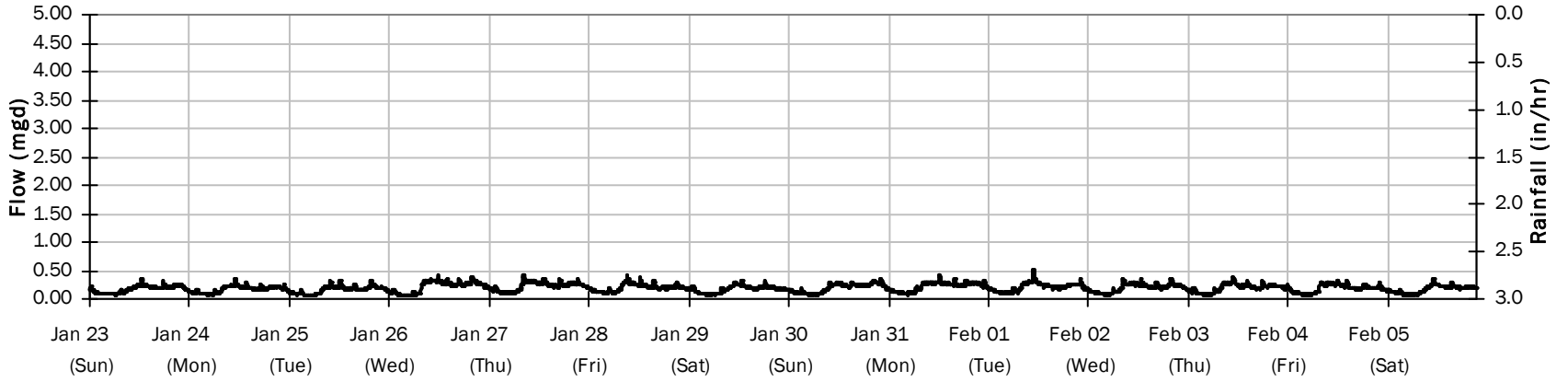


SITE 14

Flow Summary: 1/9/2022 to 2/5/2022

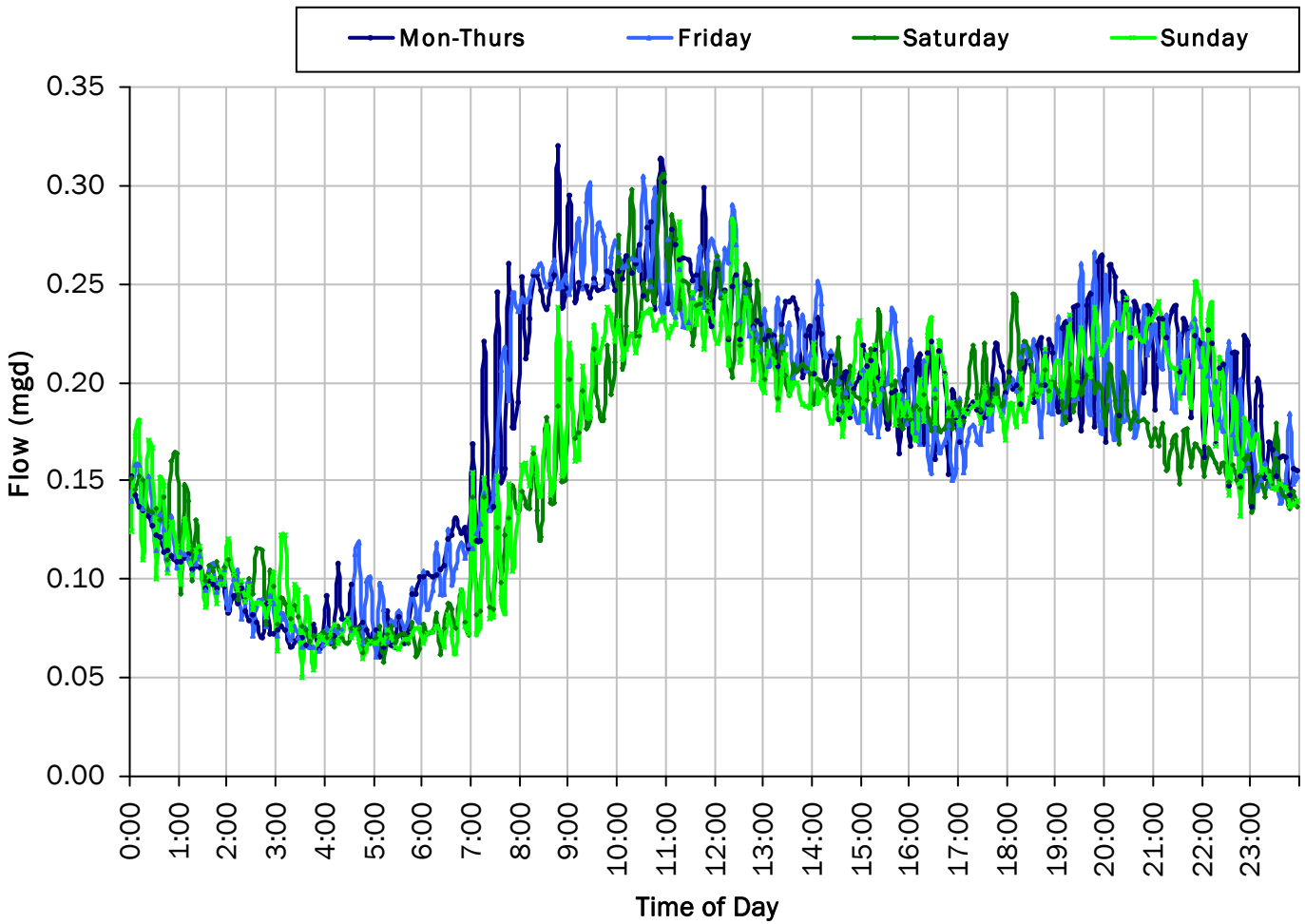
Period Rainfall: 0.00 inches Period Avg Flow: 0.272 mgd Period Peak Flow: 4.353 mgd Period Min Flow: 0.050 mgd





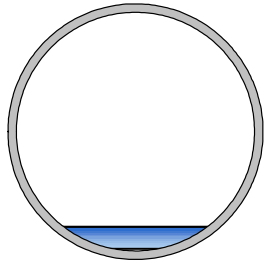
SITE 14

Average Dry Weather Flow Hydrographs



ADWF:

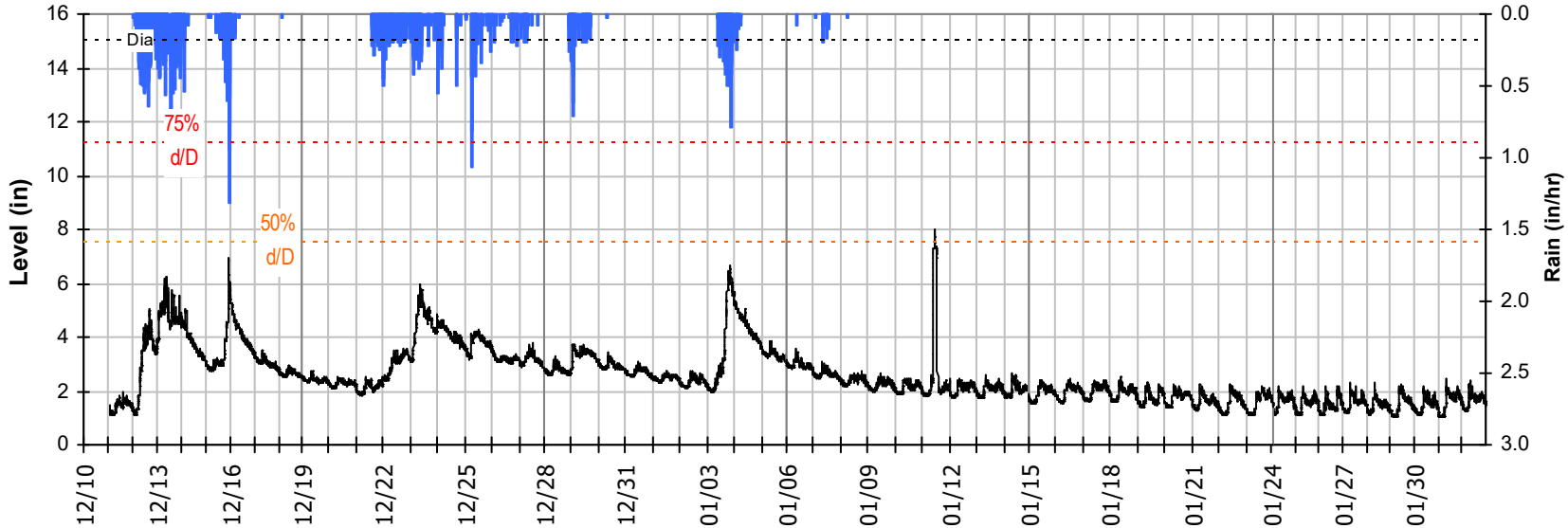
0.176 *mgd*

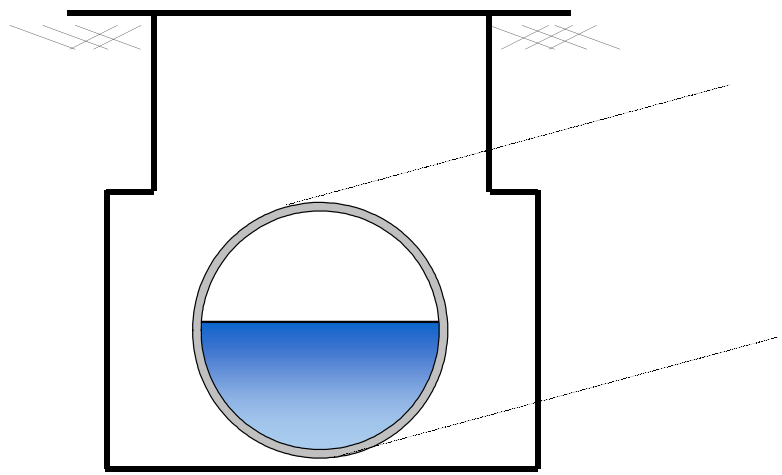


SITE 13

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

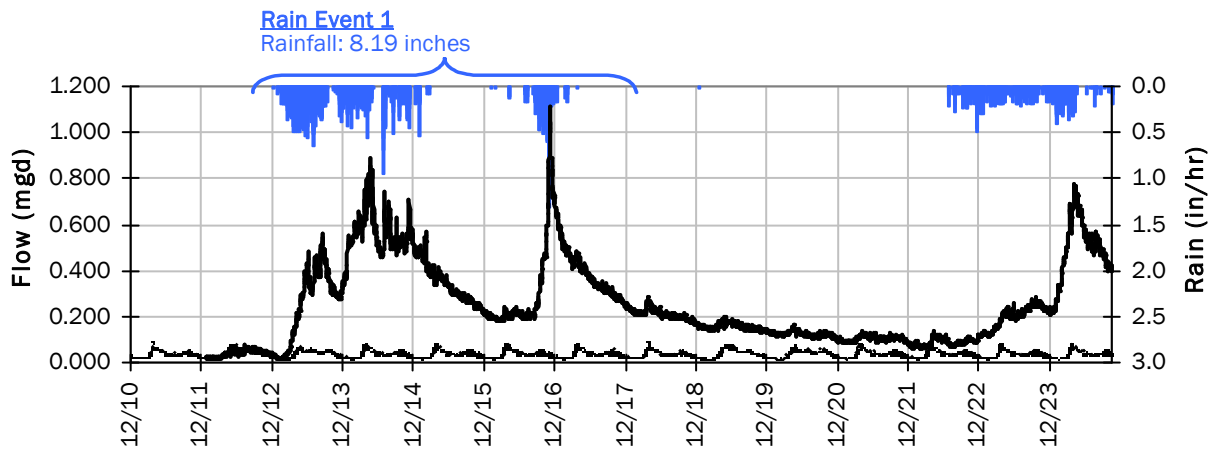




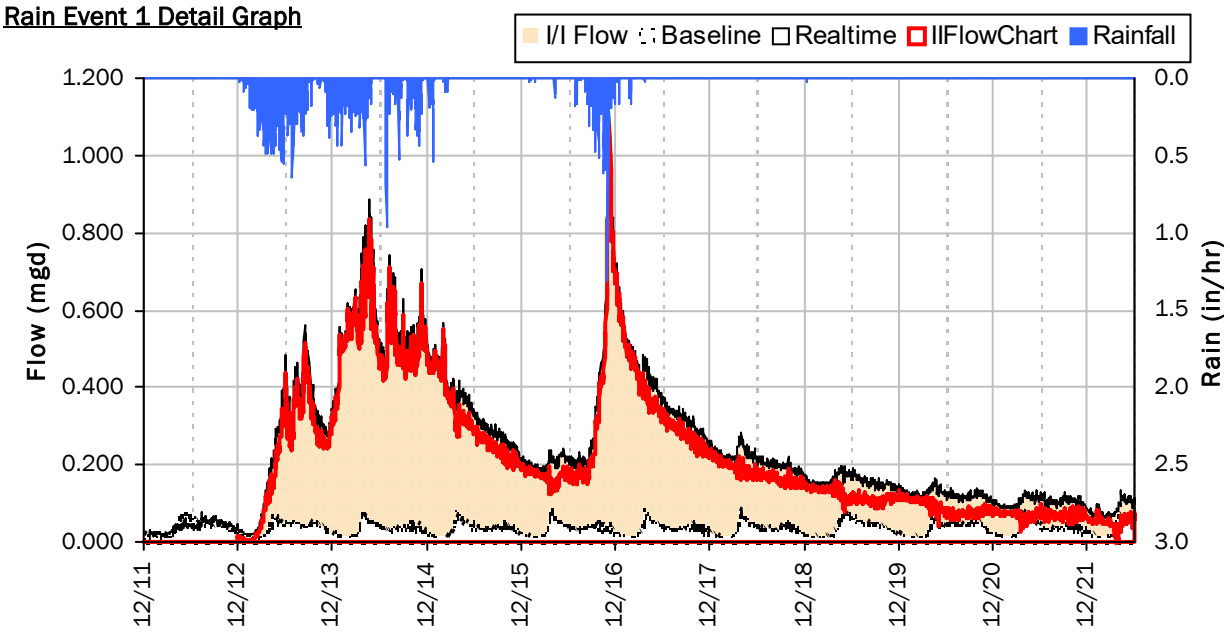
Pipe Diameter:	15	*inches*
Peak Measured Level:	7.99	*inches*
Peak d/D Ratio:	0.53	

SITE 13
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

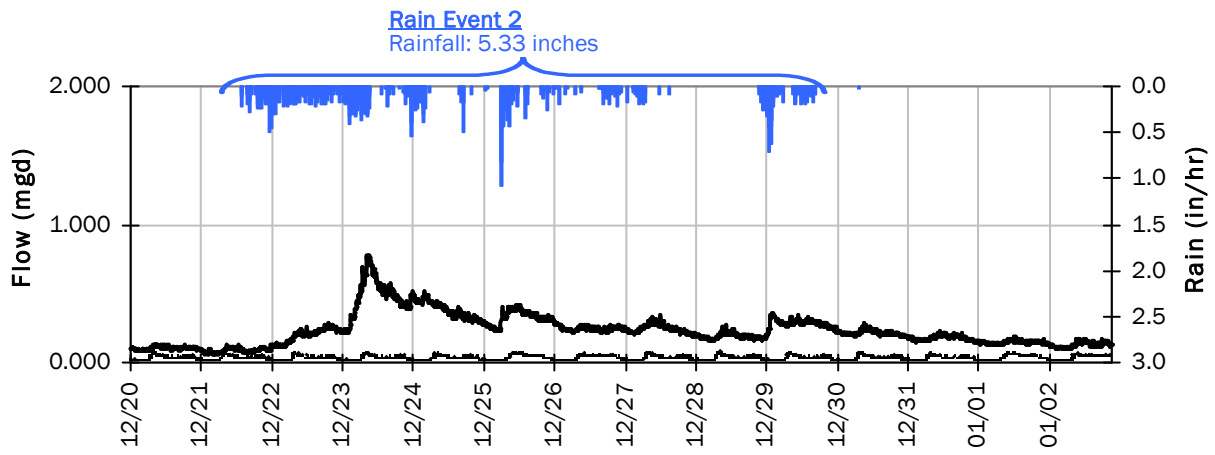


Storm Event I/I Analysis (Rain = 8.19 inches)

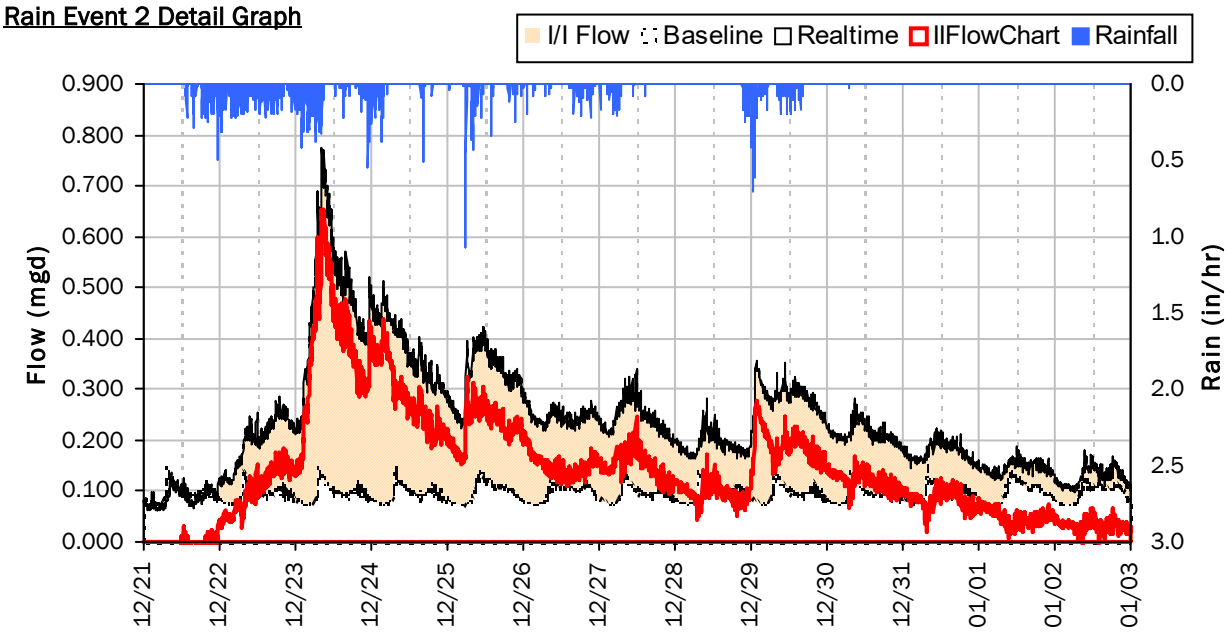
Capacity		Inflow / Infiltration	
Peak Flow:	1.113 *mgd*	**Peak I/I Rate:**	1.079 *mgd*
PF:	31.67	**Total I/I:**	2,153,000 *gallons*
Peak Level:	6.96 *in*		
d/D Ratio:	0.46		

SITE 13
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



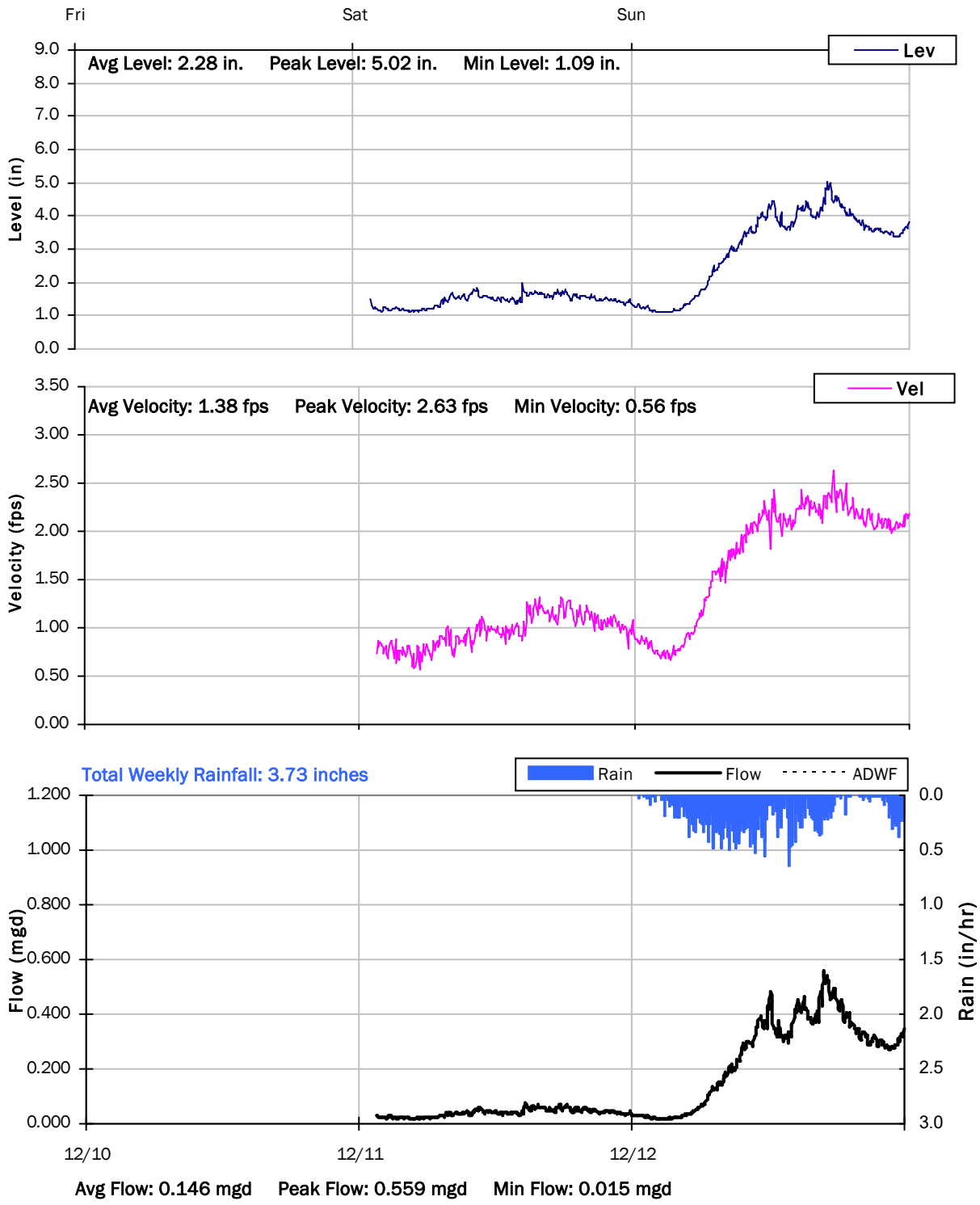
Storm Event I/I Analysis (Rain = 5.33 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.774 *mgd*	**Peak I/I Rate:**	0.655 *mgd*
PF:	22.02	**Total I/I:**	1,877,000 *gallons*
Peak Level:	5.95 *in*		
d/D Ratio:	0.40		

SITE 13

Weekly Level, Velocity and Flow Hydrographs

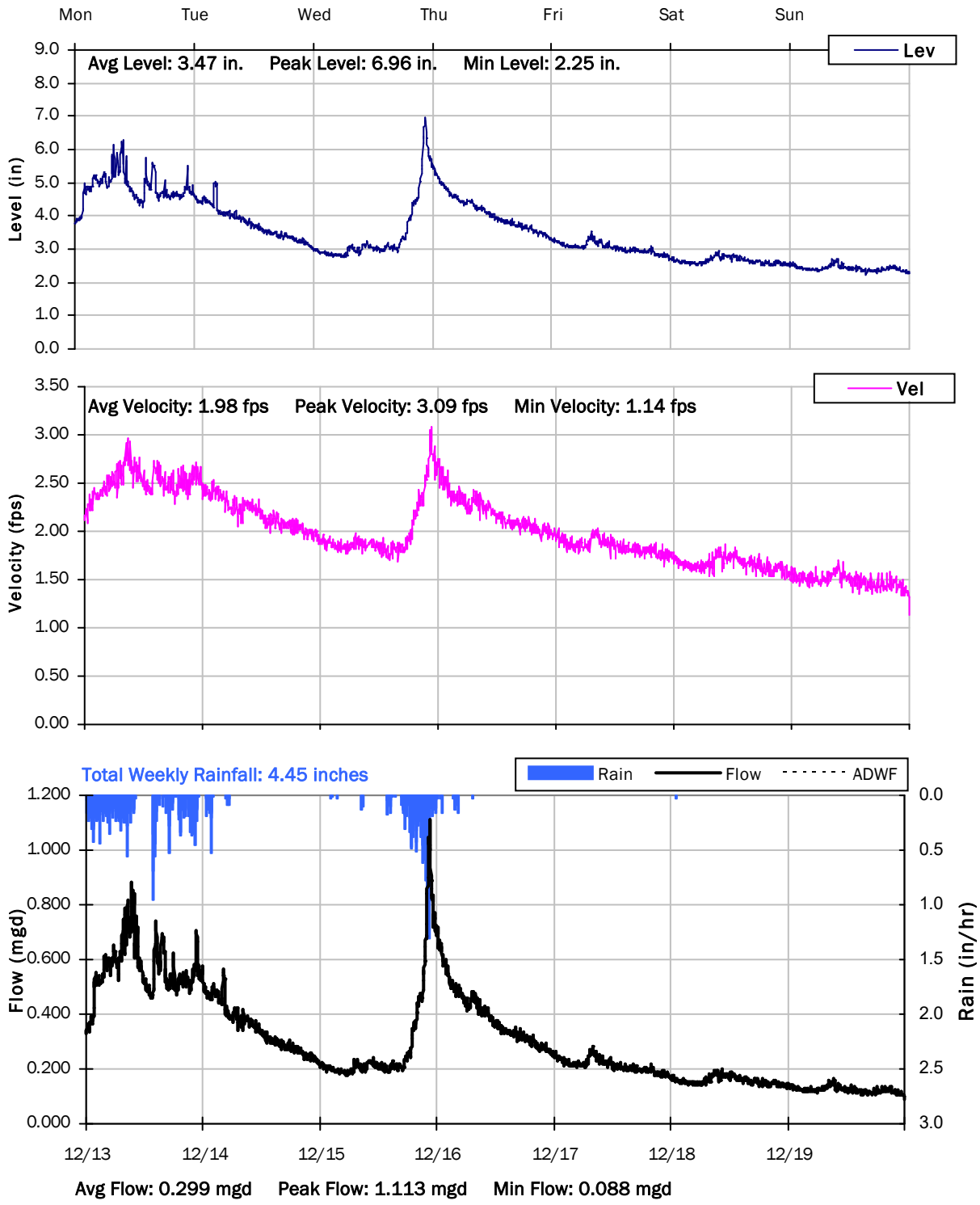
12/10/2021 to 12/13/2021



SITE 13

Weekly Level, Velocity and Flow Hydrographs

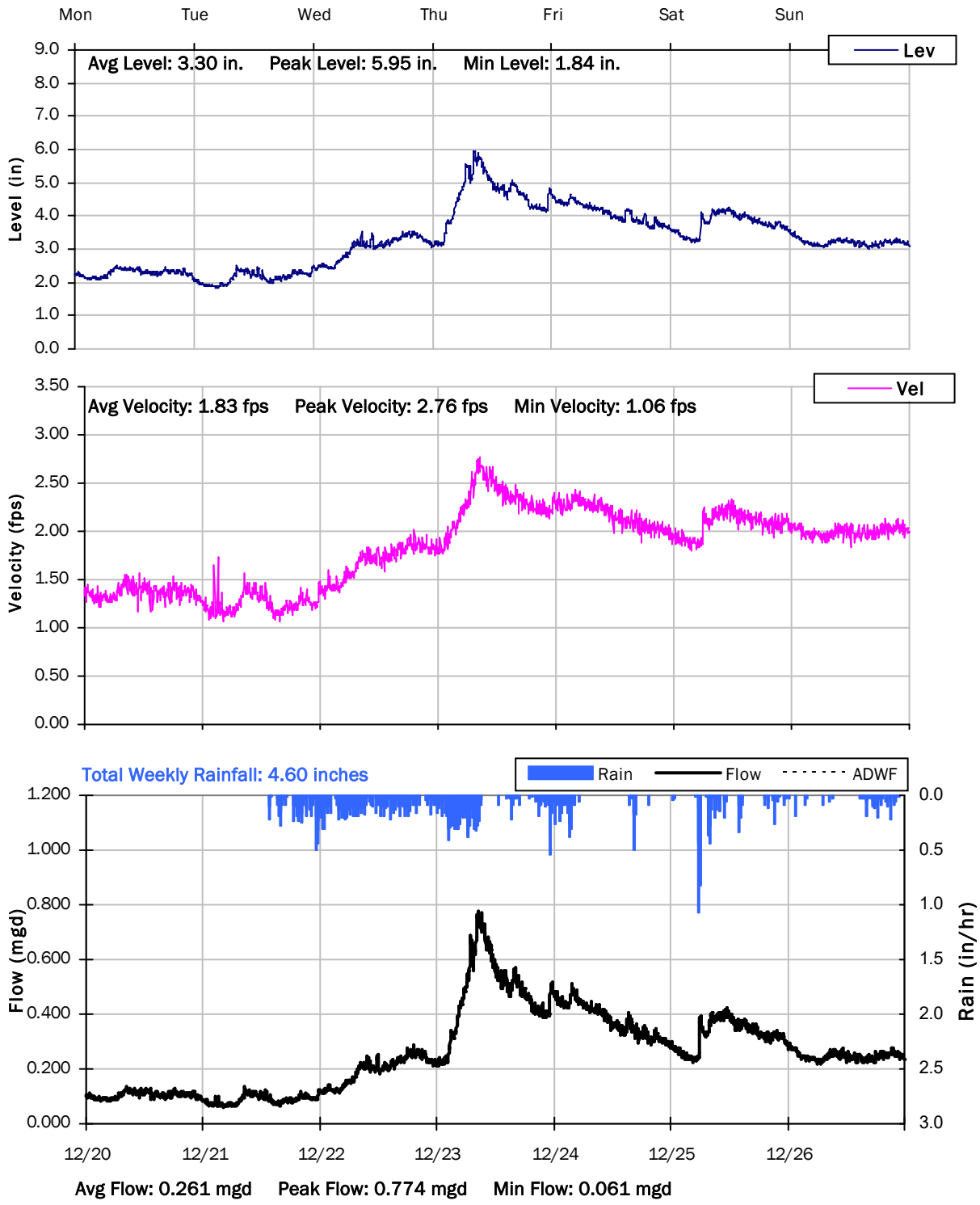
12/13/2021 to 12/20/2021



SITE 13

Weekly Level, Velocity and Flow Hydrographs

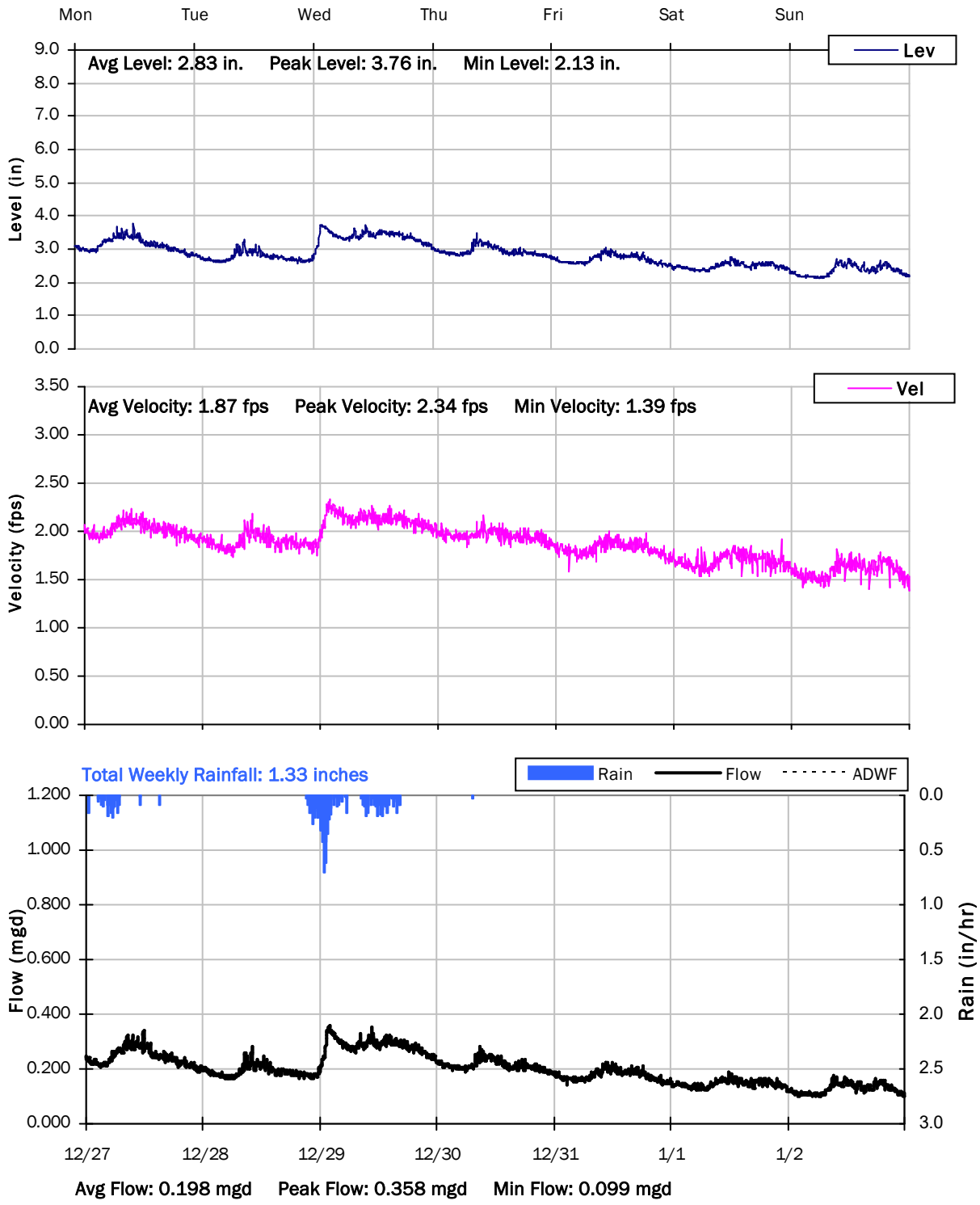
12/20/2021 to 12/27/2021



SITE 13

Weekly Level, Velocity and Flow Hydrographs

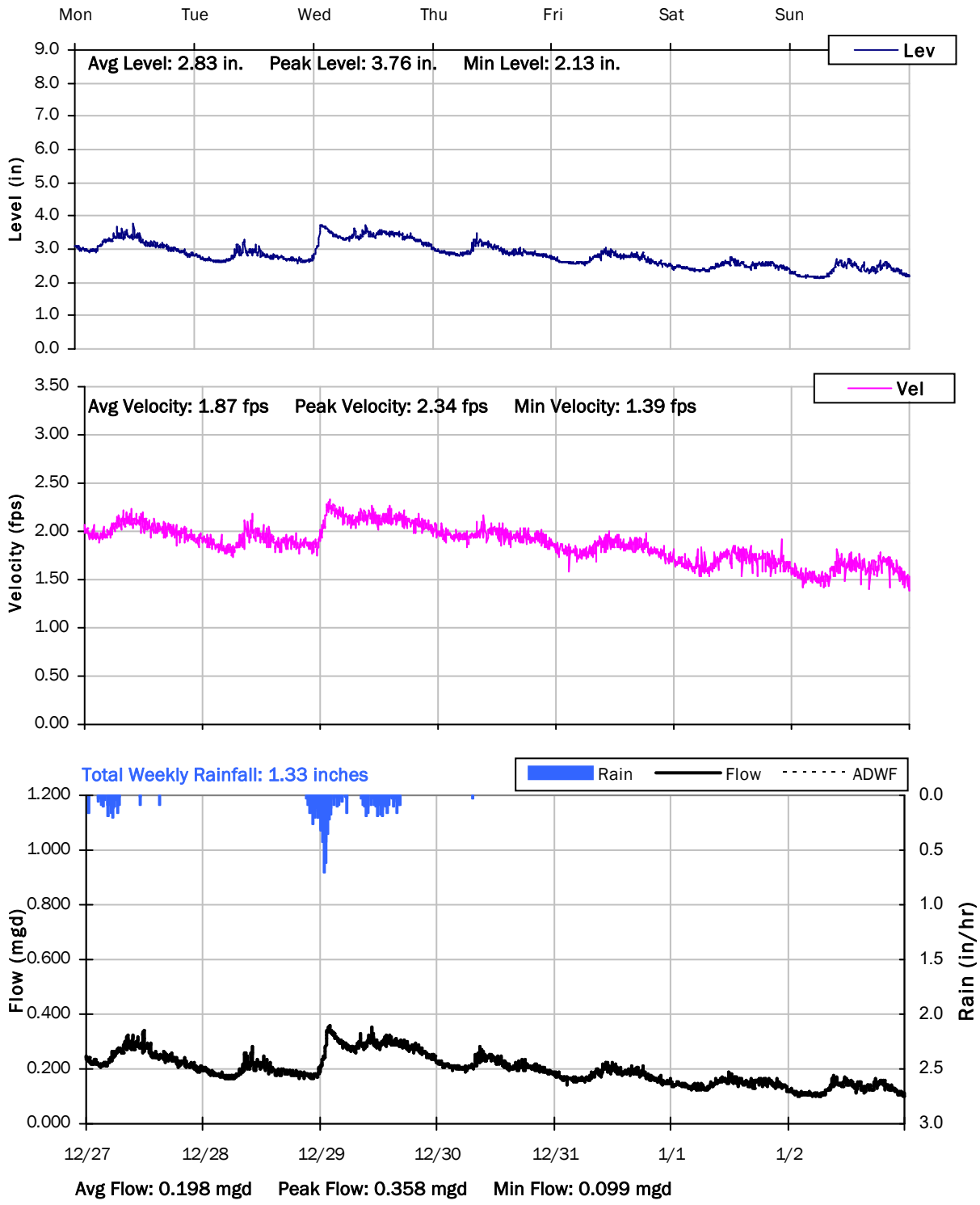
12/27/2021 to 1/3/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

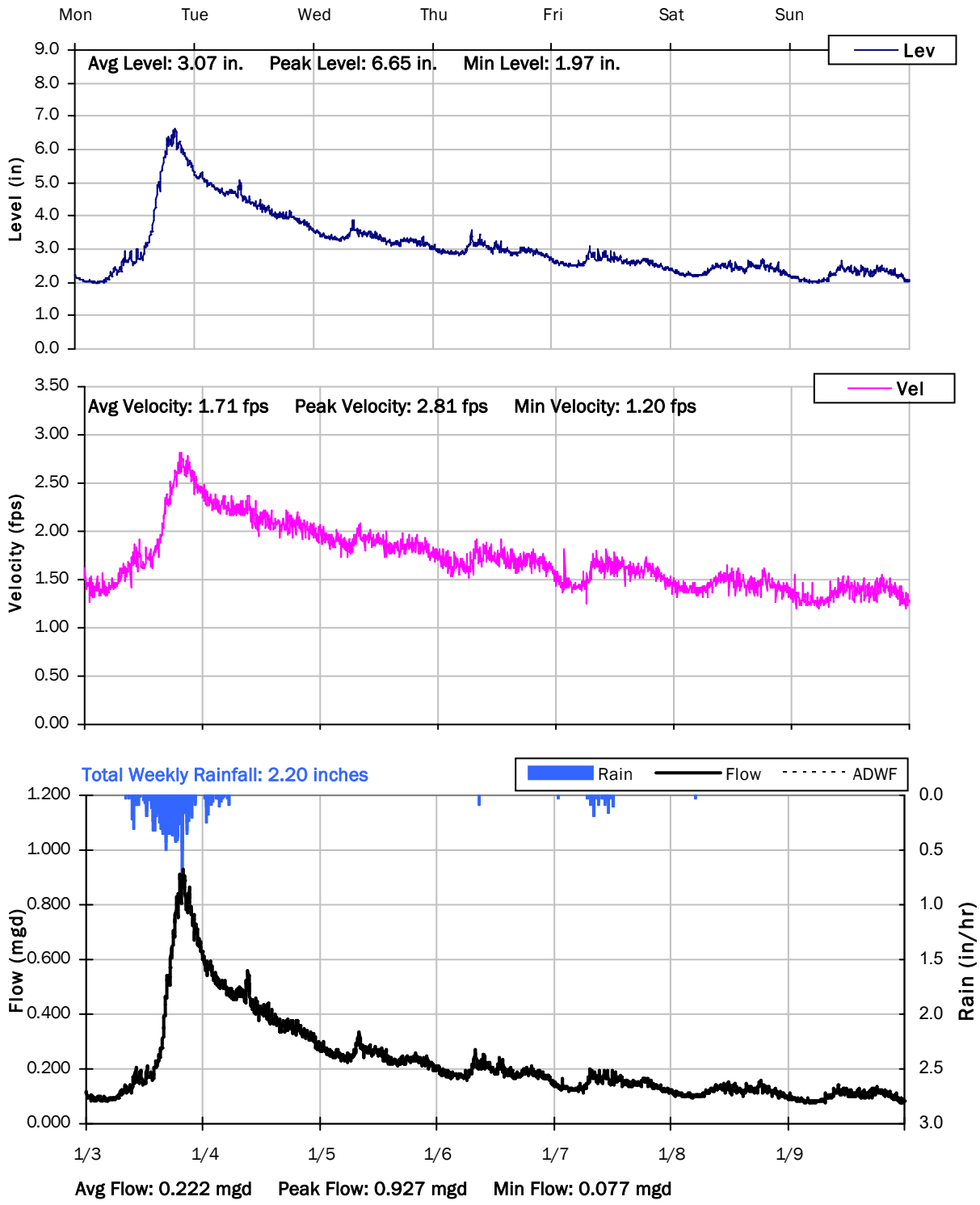
12/27/2021 to 1/3/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

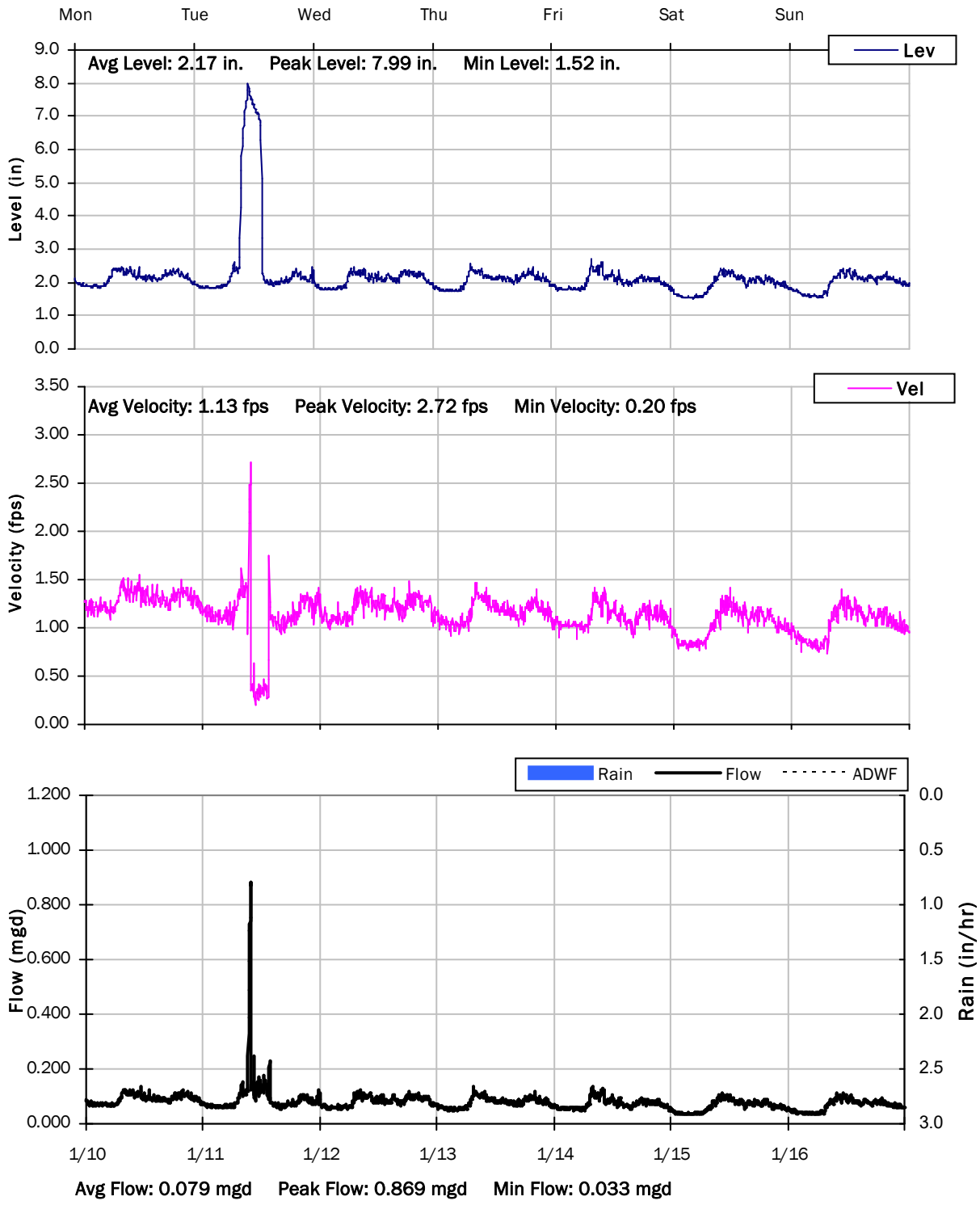
1/3/2022 to 1/10/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

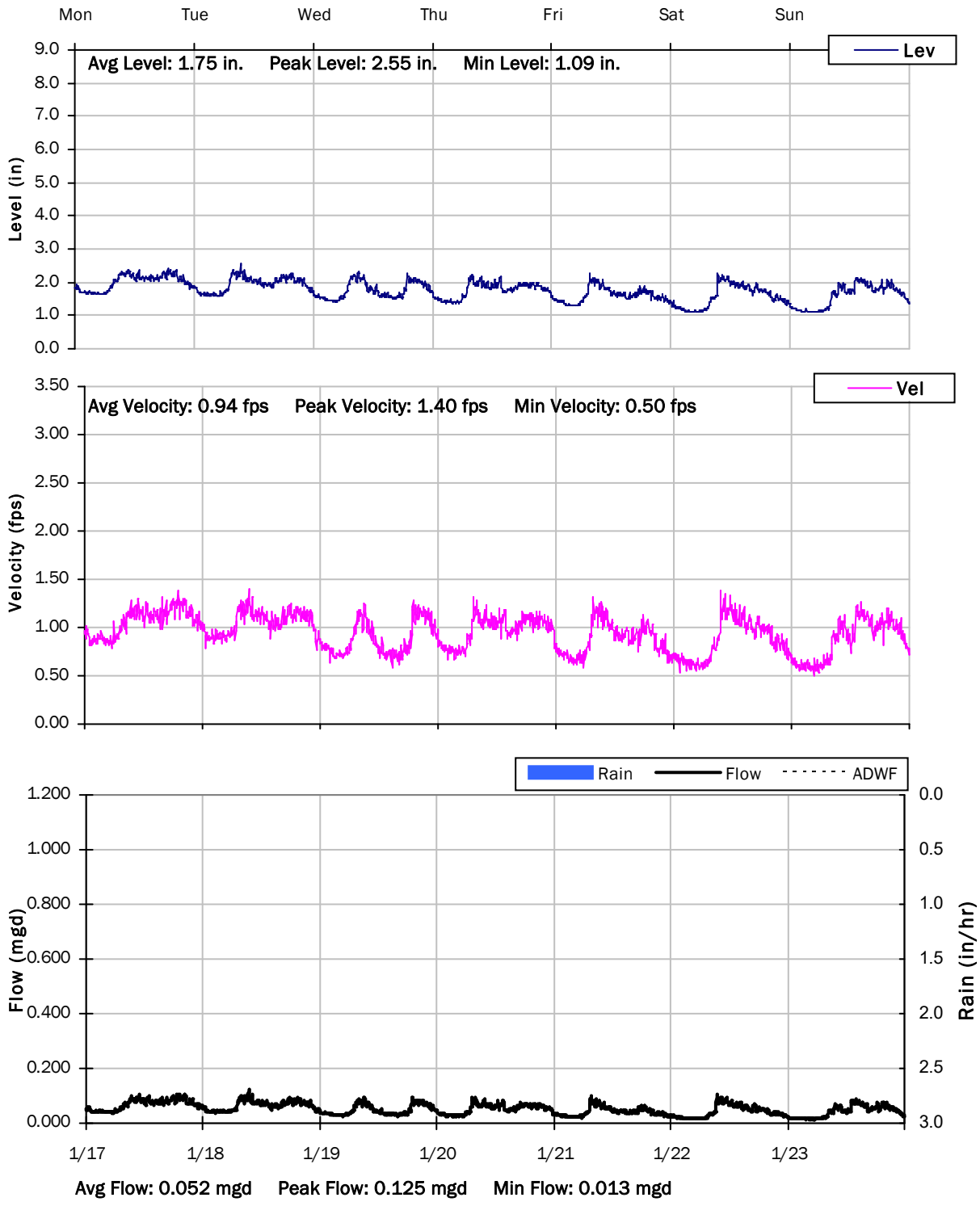
1/10/2022 to 1/17/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

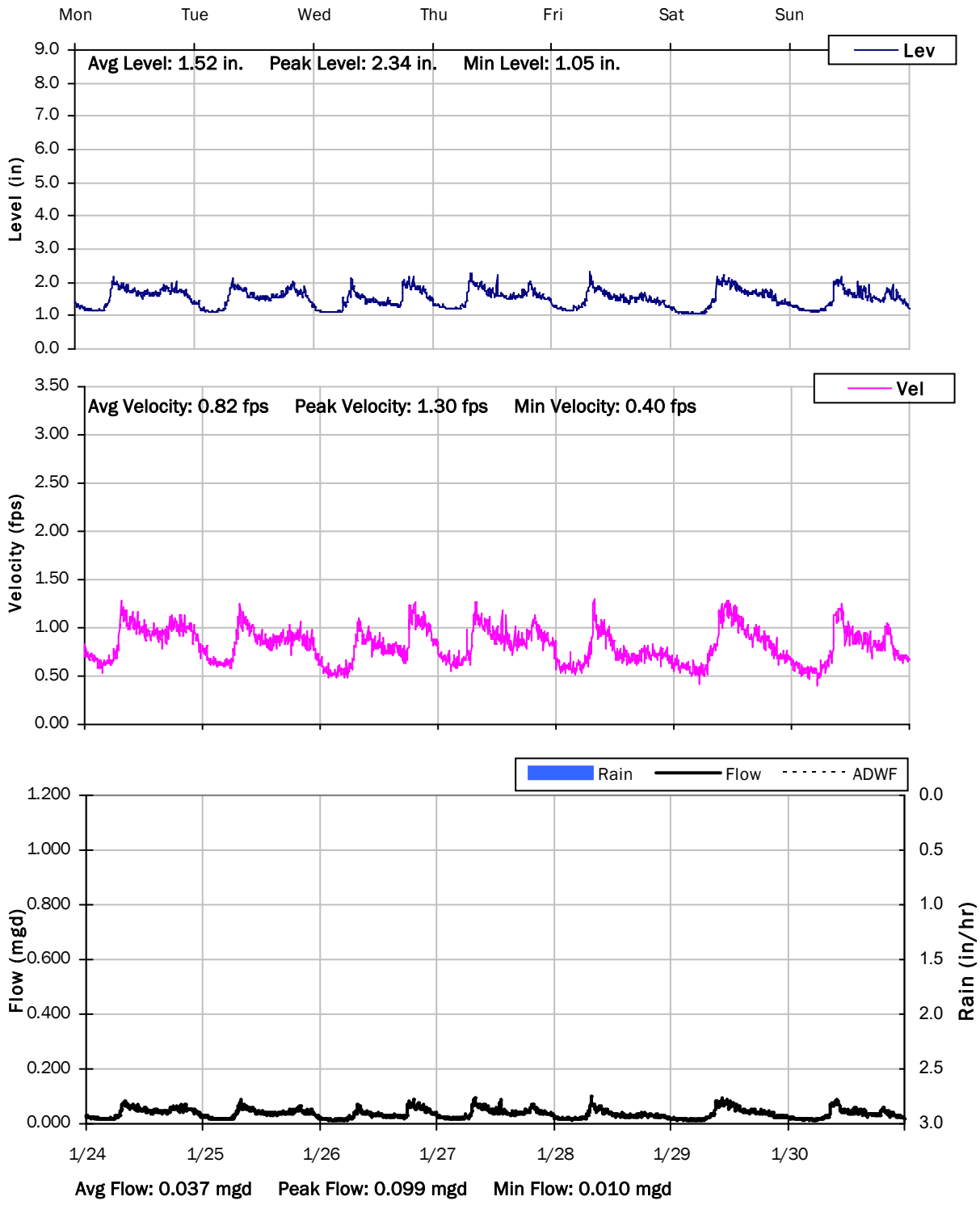
1/17/2022 to 1/24/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

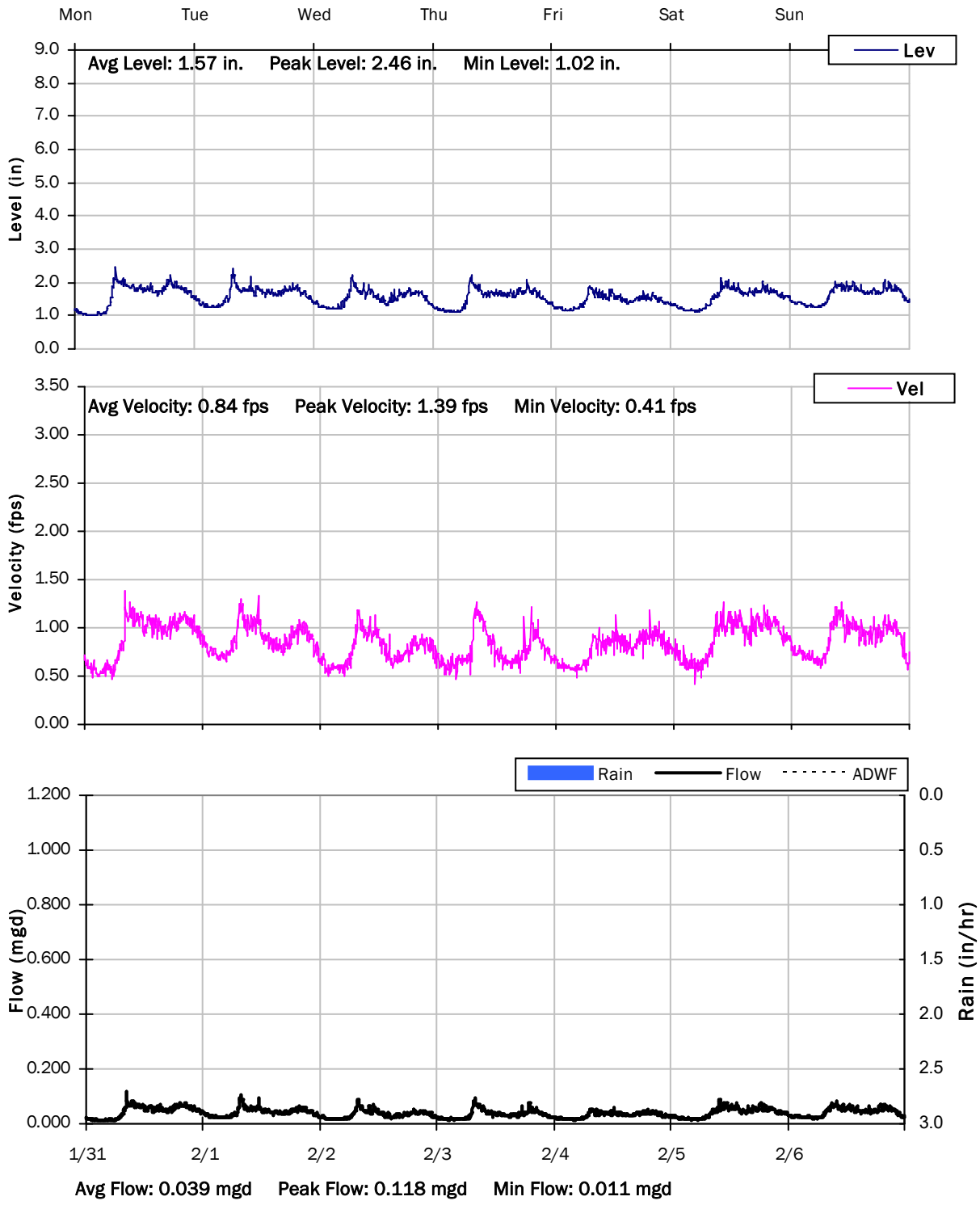
1/24/2022 to 1/31/2022



SITE 13

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 14

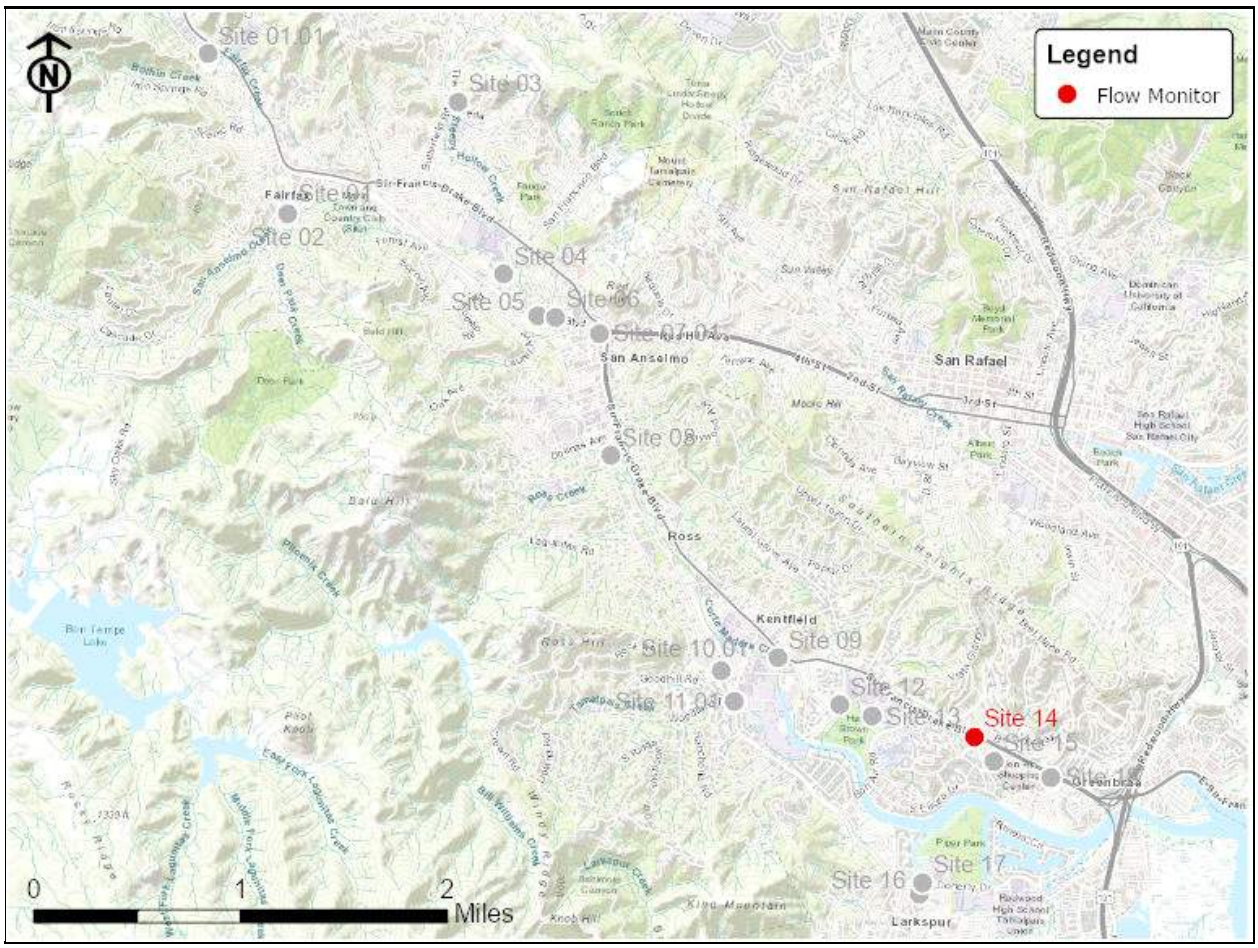
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Parking lot at 575 Sir Francis Drake Blvd.

Data Summary Report



Vicinity Map: Site 14

SITE 14

Site Information MH ID: G000.100

Location: Parking lot at 575 Sir Francis Drake Blvd.

Coordinates: 122.5285° W, 37.9487° N

Rim Elevation (Earth): 27 feet

Expected Pipe Diameter: 30 inches

Measured Pipe Diameter: 29.25 inches

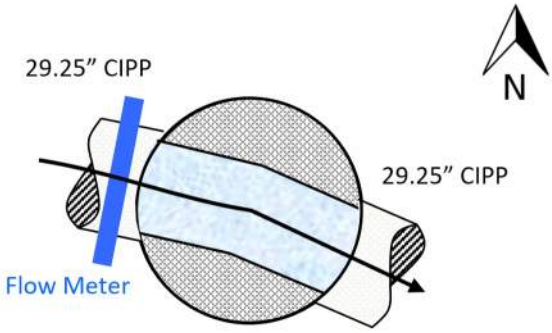
ADWF: 0.174 mgd

Peak Measured Flow: 4.353 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 14

Additional Site Photos

Effluent Pipe

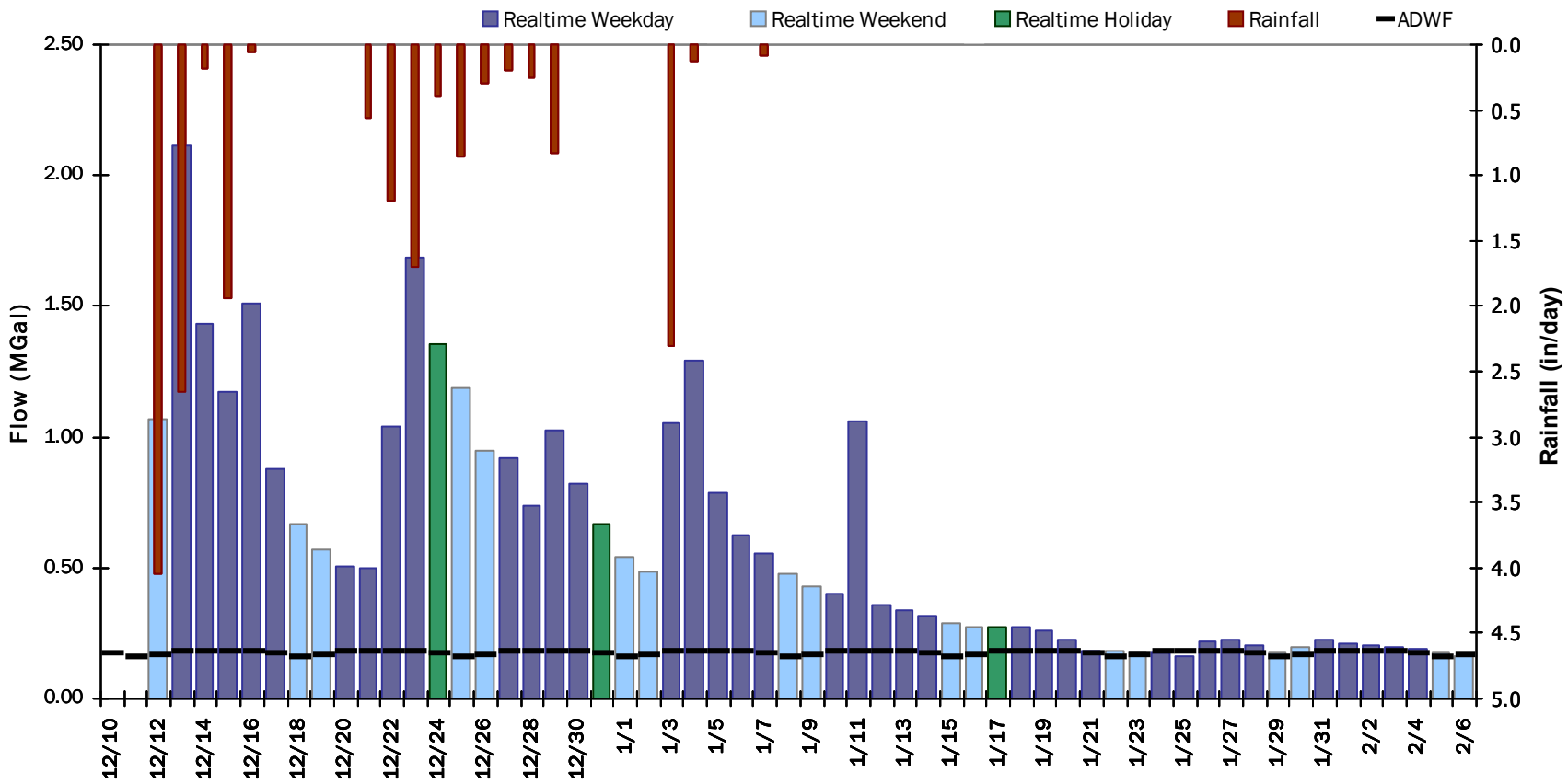
Monitored West Influent Pipe

SITE 14

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.597 MGal Peak Daily Flow: 2.116 MGal Min Daily Flow: 0.159 MGal

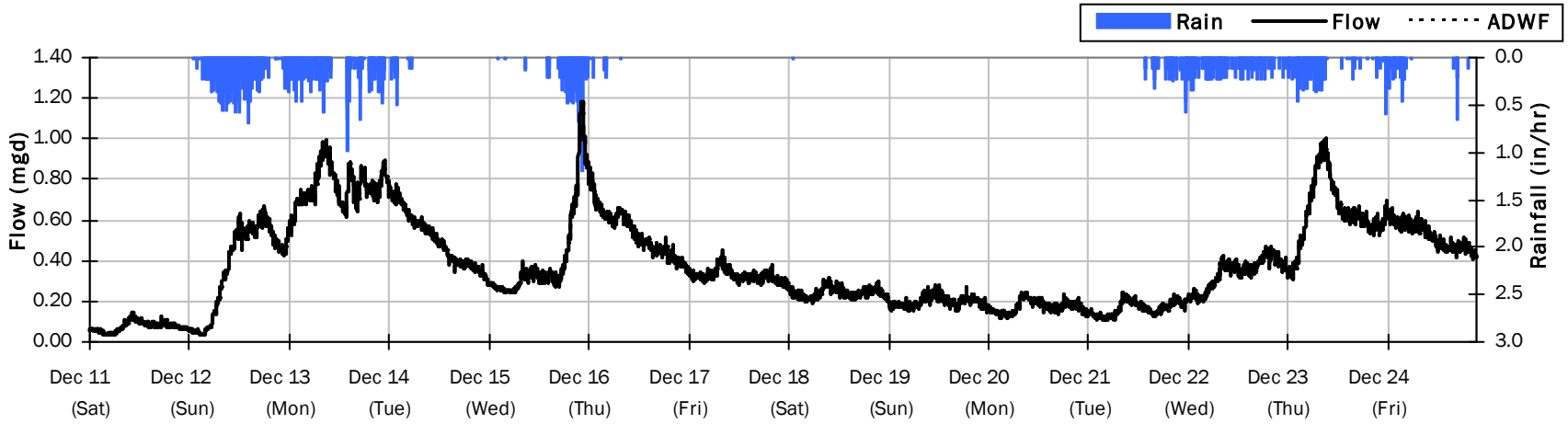
Total Rainfall: 17.68 inches

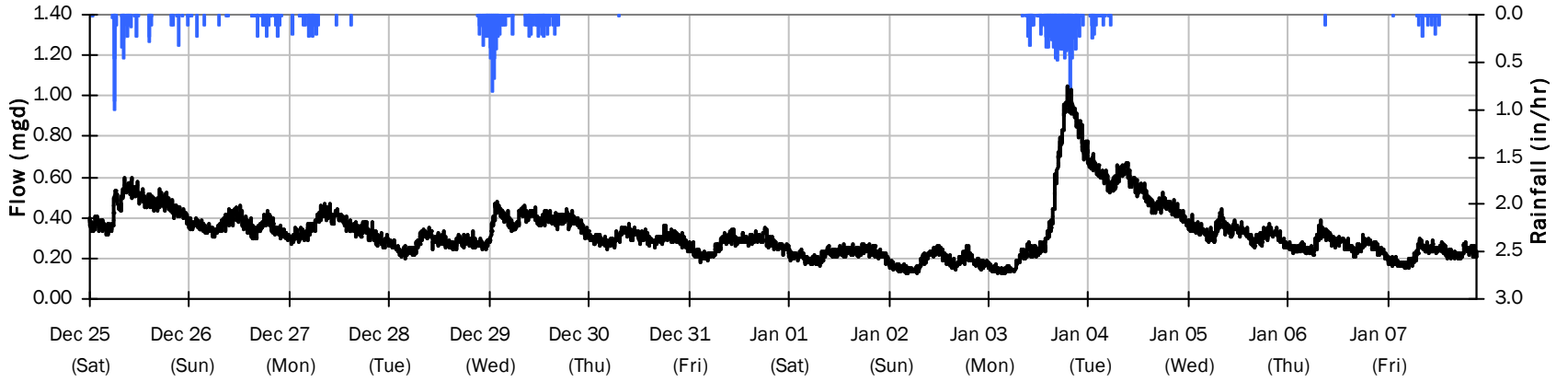


SITE 15

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 15.67 inches Period Avg Flow: 0.345 mgd Period Peak Flow: 1.187 mgd Period Min Flow: 0.034 mgd

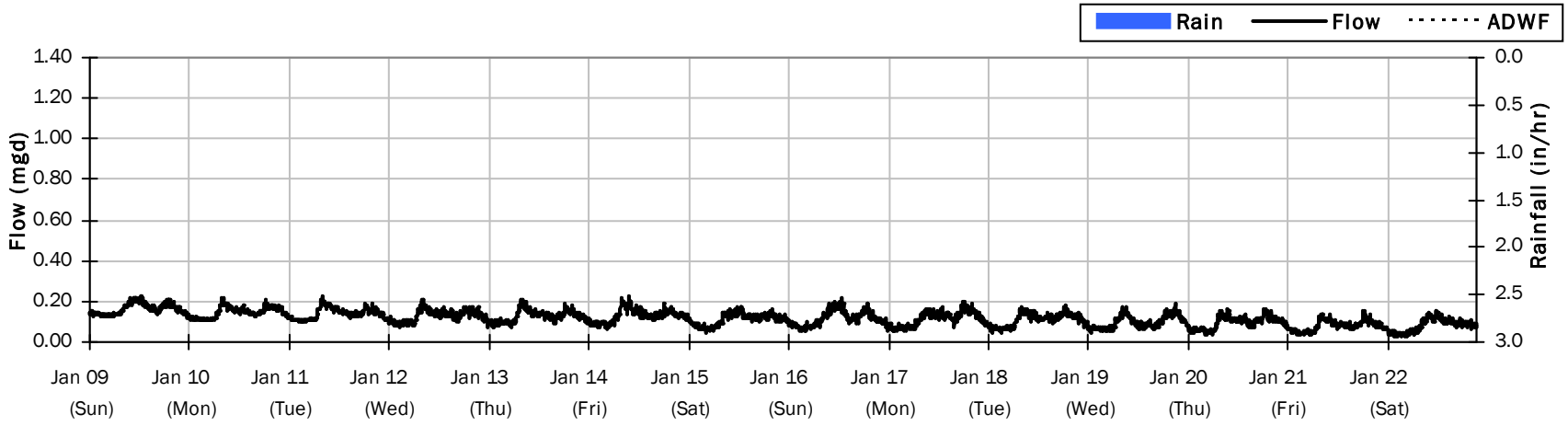


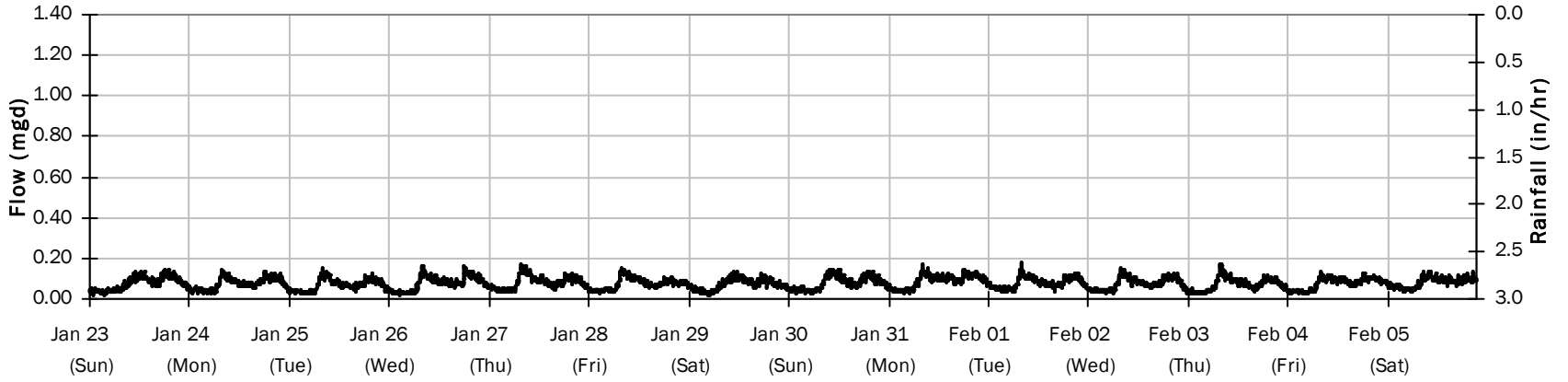


SITE 15

Flow Summary: 1/9/2022 to 2/5/2022

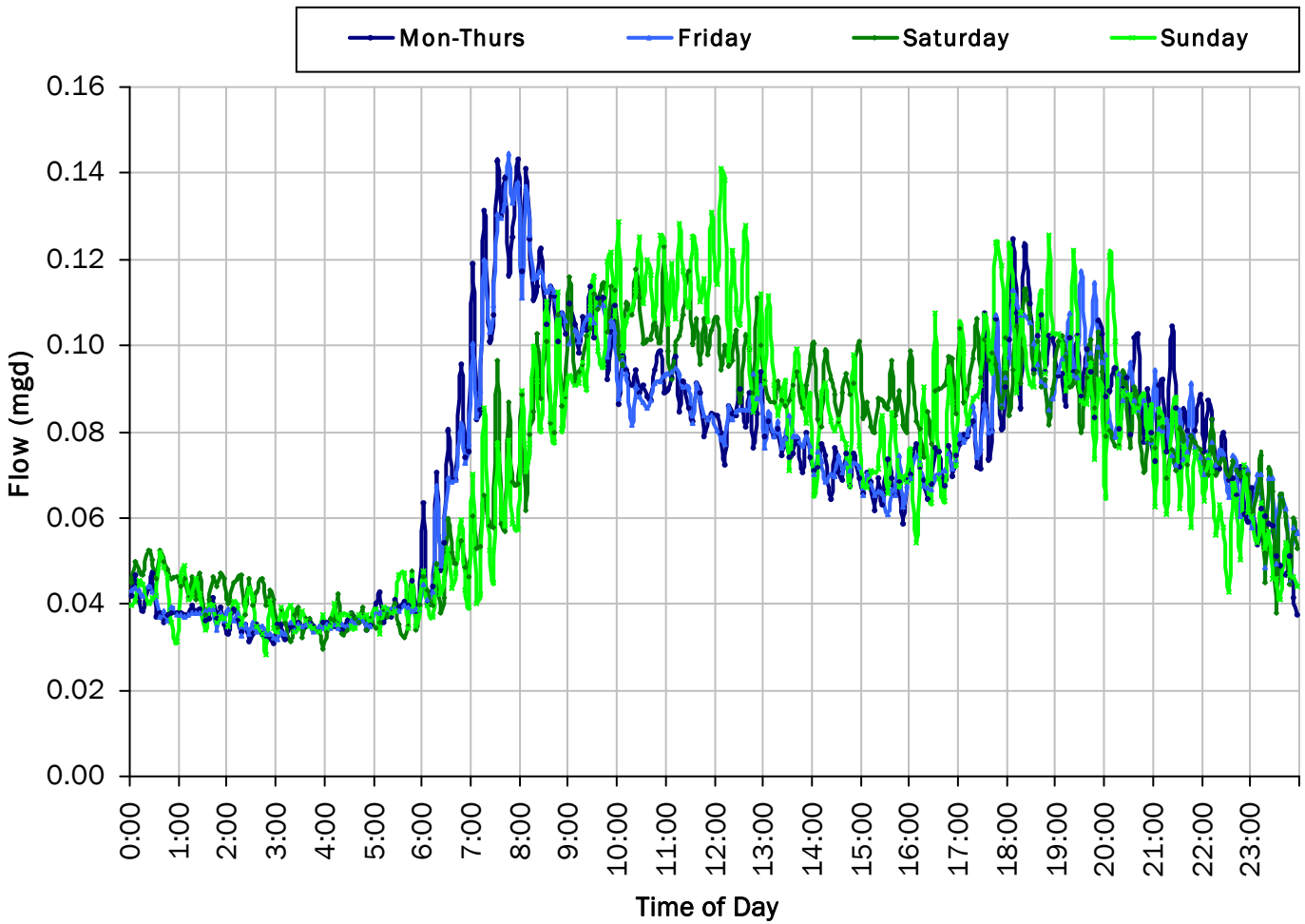
Period Rainfall: 0.00 inches Period Avg Flow: 0.097 mgd Period Peak Flow: 0.230 mgd Period Min Flow: 0.021 mgd





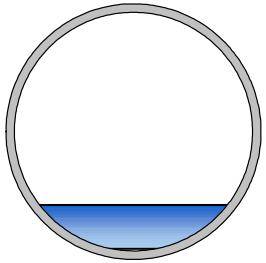
SITE 15

Average Dry Weather Flow Hydrographs



ADWF:

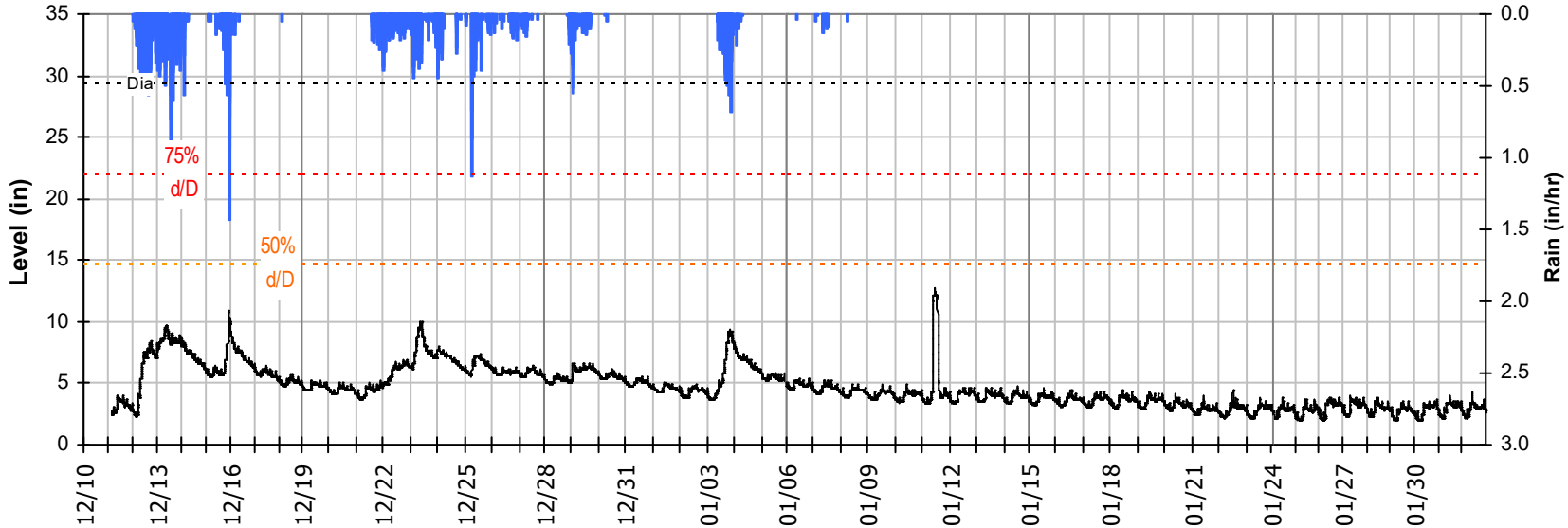
0.073 *mgd*

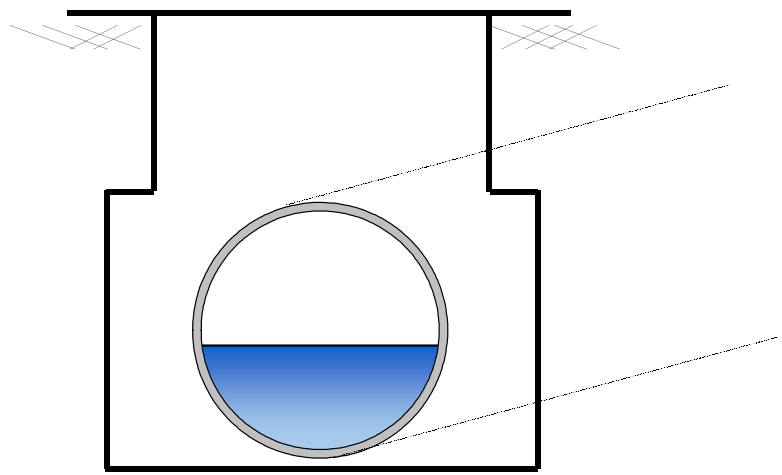


SITE 14

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

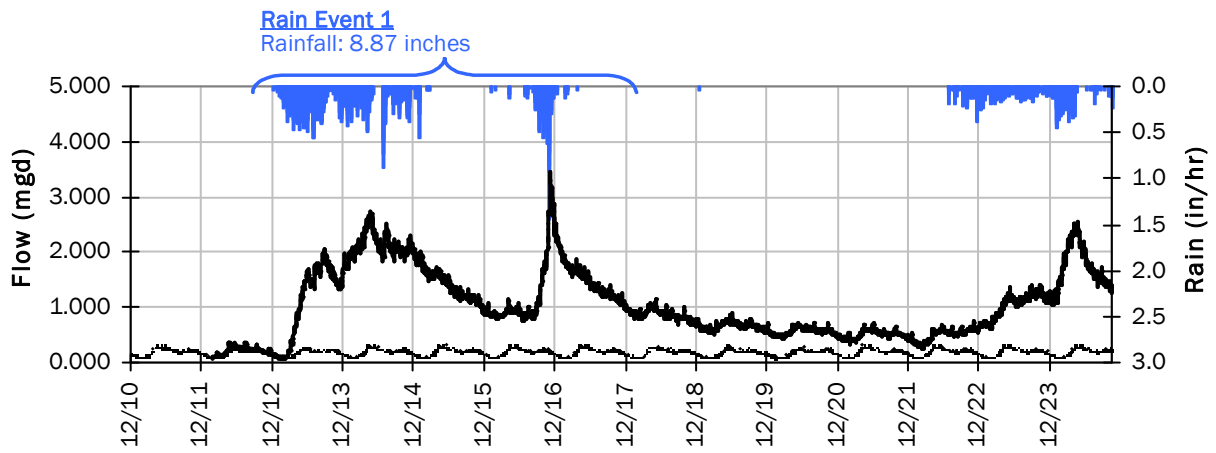




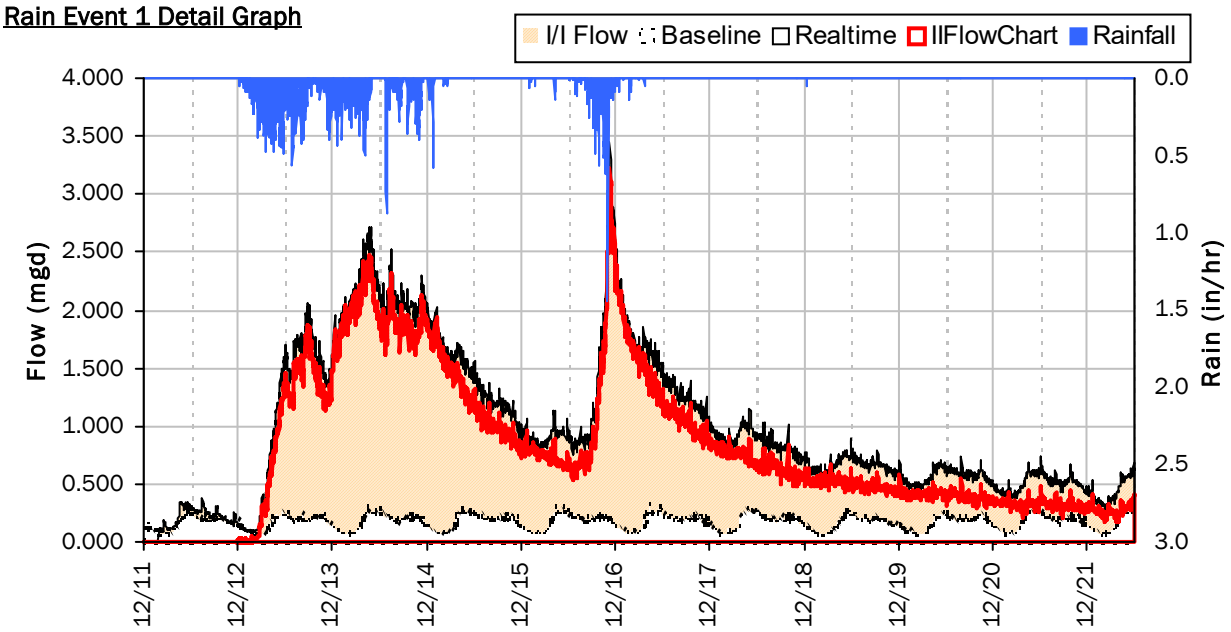
Pipe Diameter:	29.3	*inches*
Peak Measured Level:	12.7	*inches*
Peak d/D Ratio:	0.43	

SITE 14
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

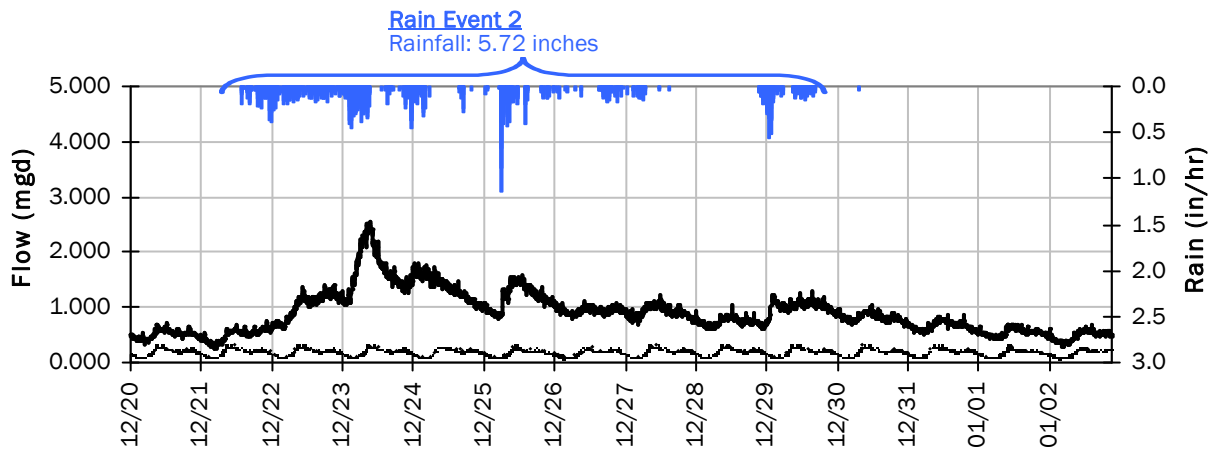


Storm Event I/I Analysis (Rain = 8.87 inches)

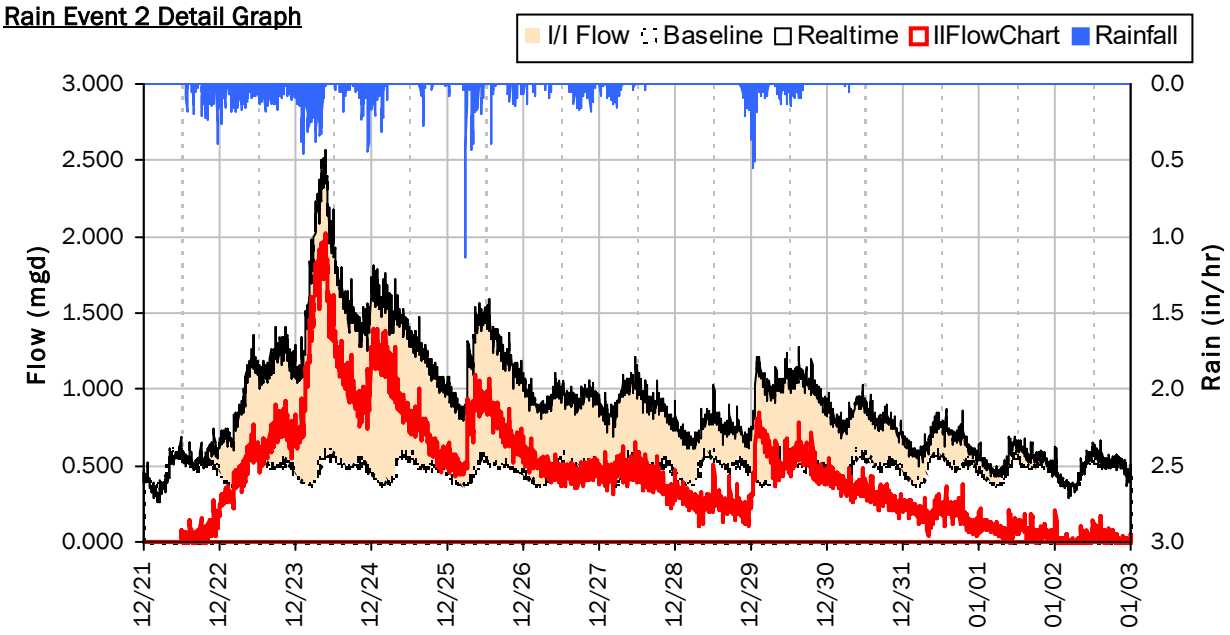
Capacity		Inflow / Infiltration	
Peak Flow:	3.451 *mgd*	Peak I/I Rate:	3.236 *mgd*
PF:	19.65	Total I/I:	8,495,000 *gallons*
Peak Level:	10.85 *in*		
d/D Ratio:	0.37		

SITE 14
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



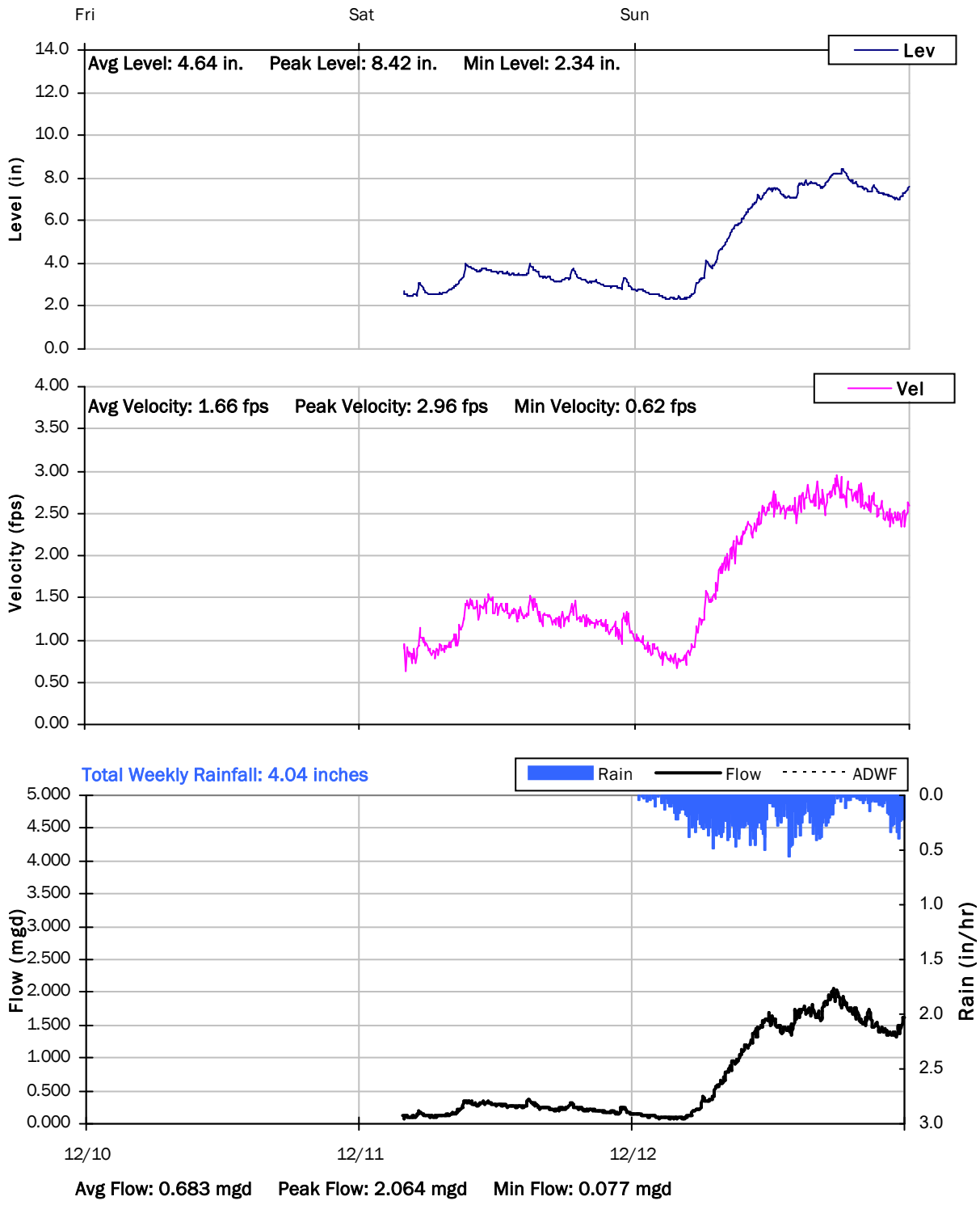
Storm Event I/I Analysis (Rain = 5.72 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	2.569 *mgd*	**Peak I/I Rate:**	2.022 *mgd*
PF:	14.63	**Total I/I:**	5,745,000 *gallons*
Peak Level:	10.03 *in*		
d/D Ratio:	0.34		

SITE 14

Weekly Level, Velocity and Flow Hydrographs

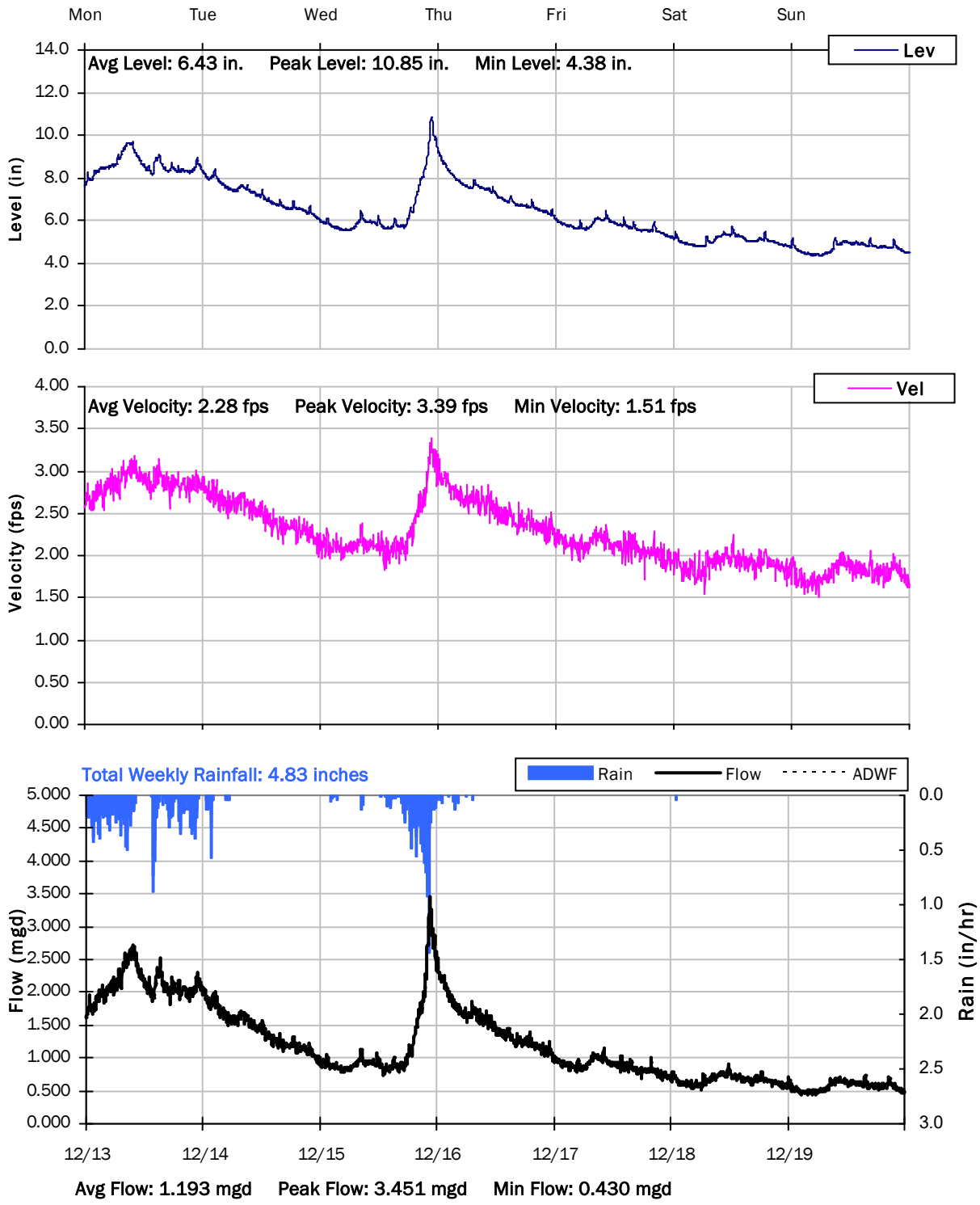
12/10/2021 to 12/13/2021



SITE 14

Weekly Level, Velocity and Flow Hydrographs

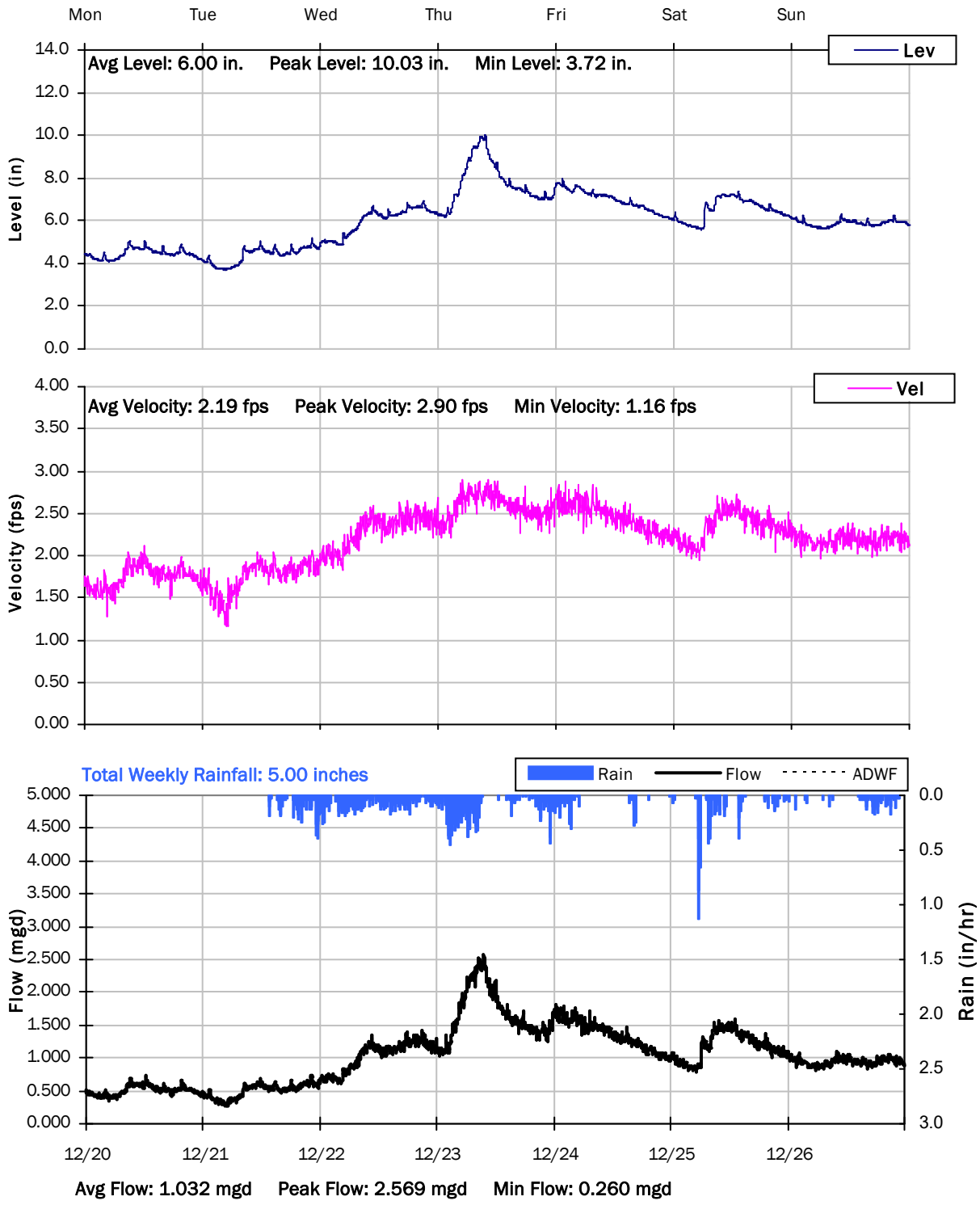
12/13/2021 to 12/20/2021



SITE 14

Weekly Level, Velocity and Flow Hydrographs

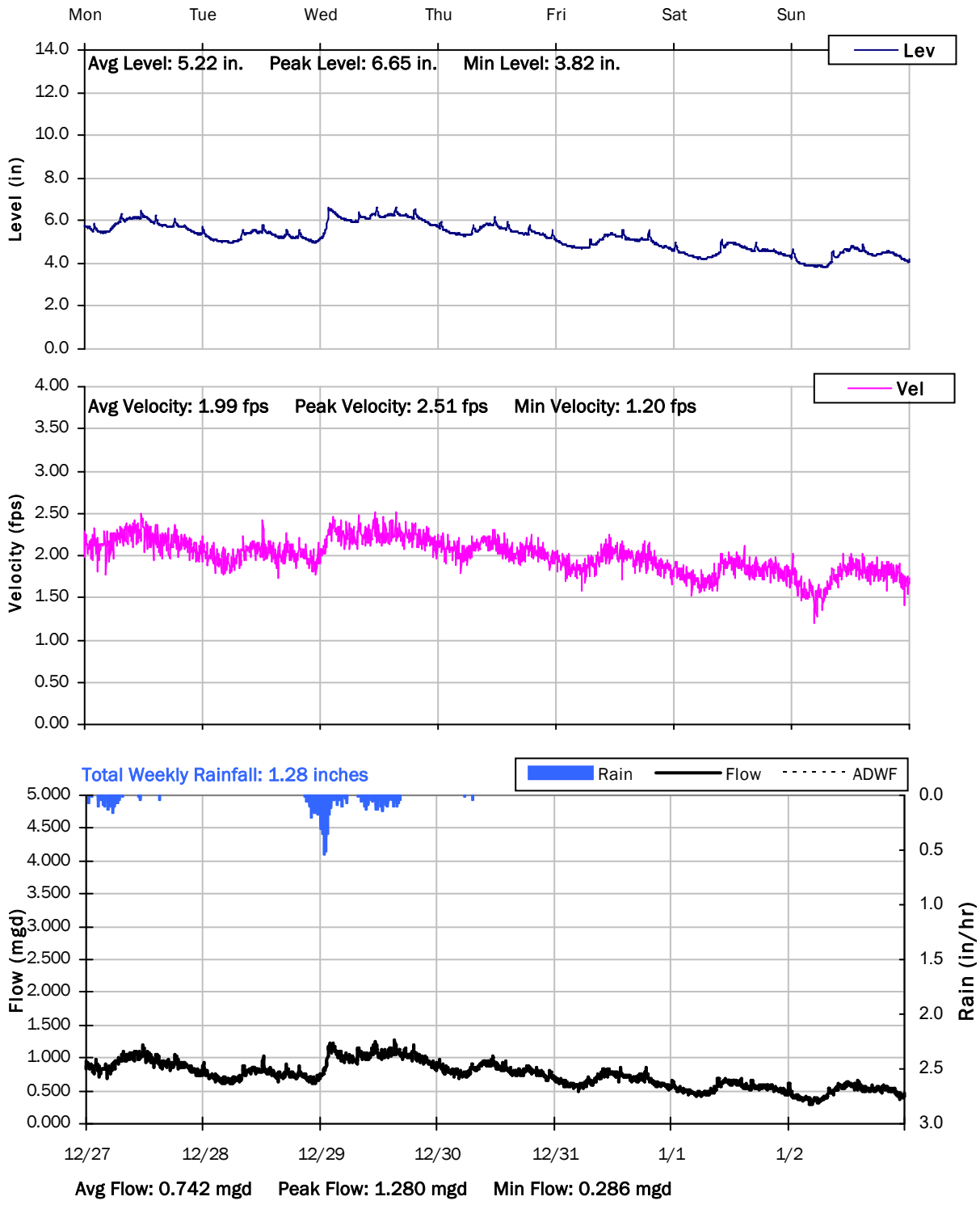
12/20/2021 to 12/27/2021



SITE 14

Weekly Level, Velocity and Flow Hydrographs

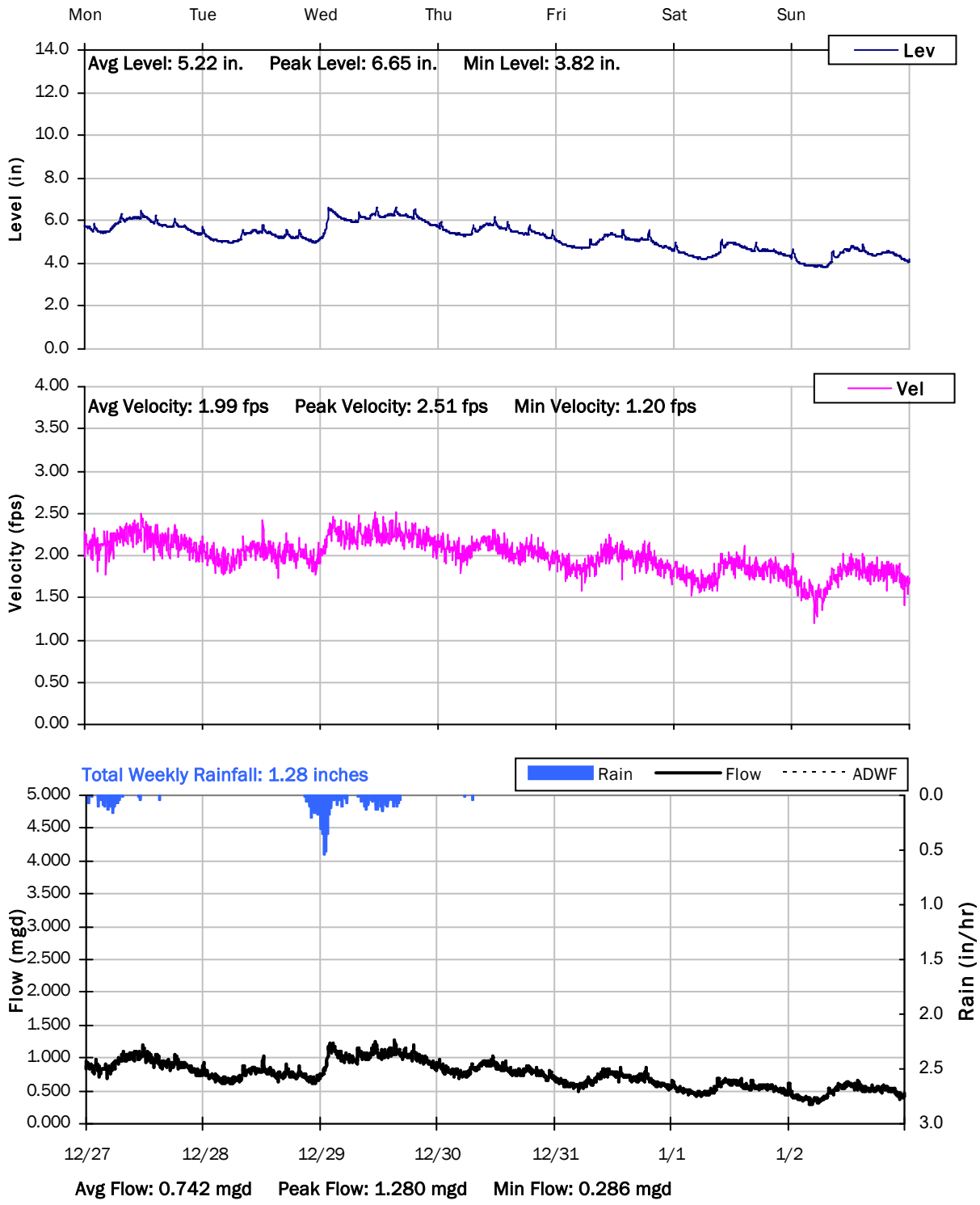
12/27/2021 to 1/3/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

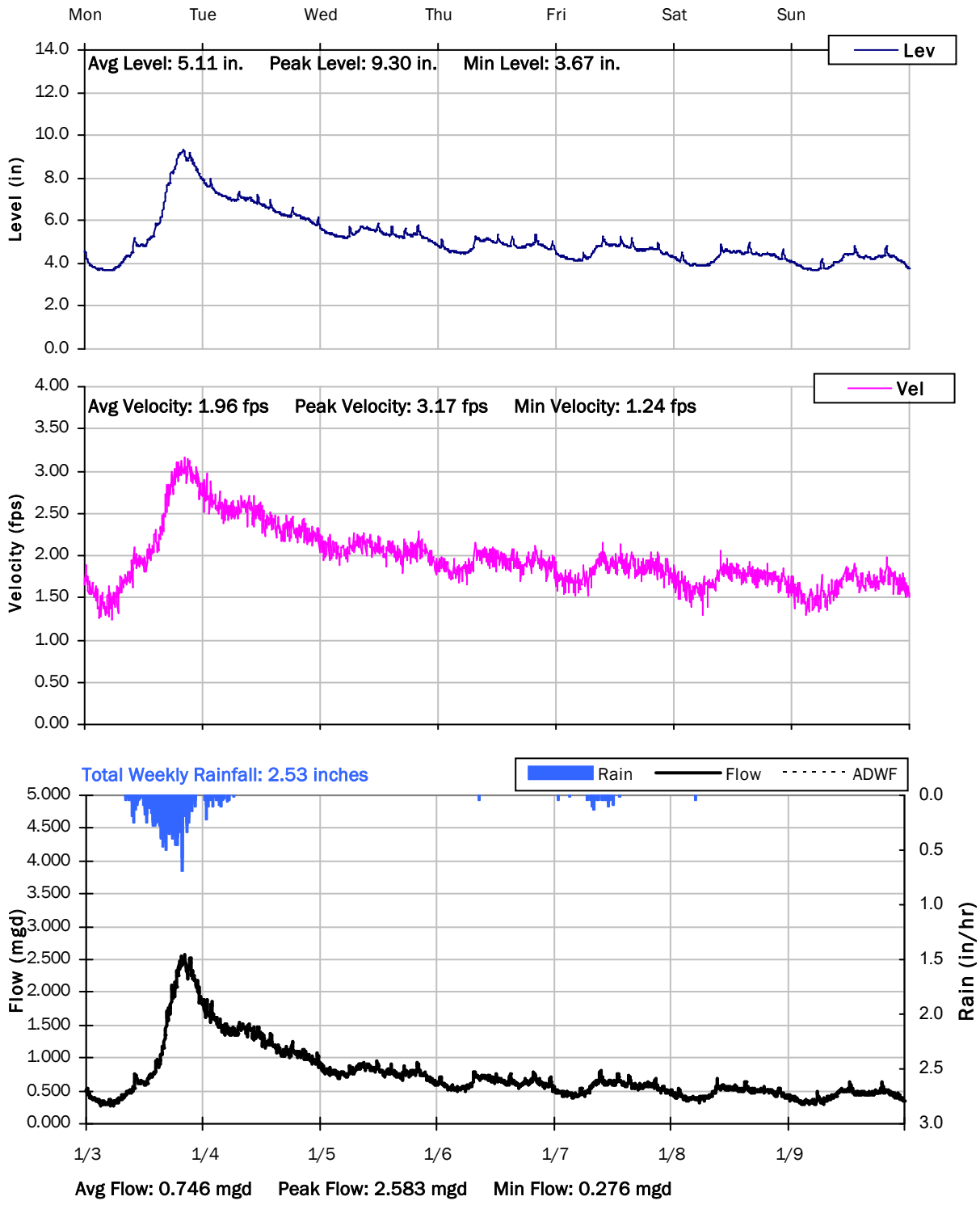
12/27/2021 to 1/3/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

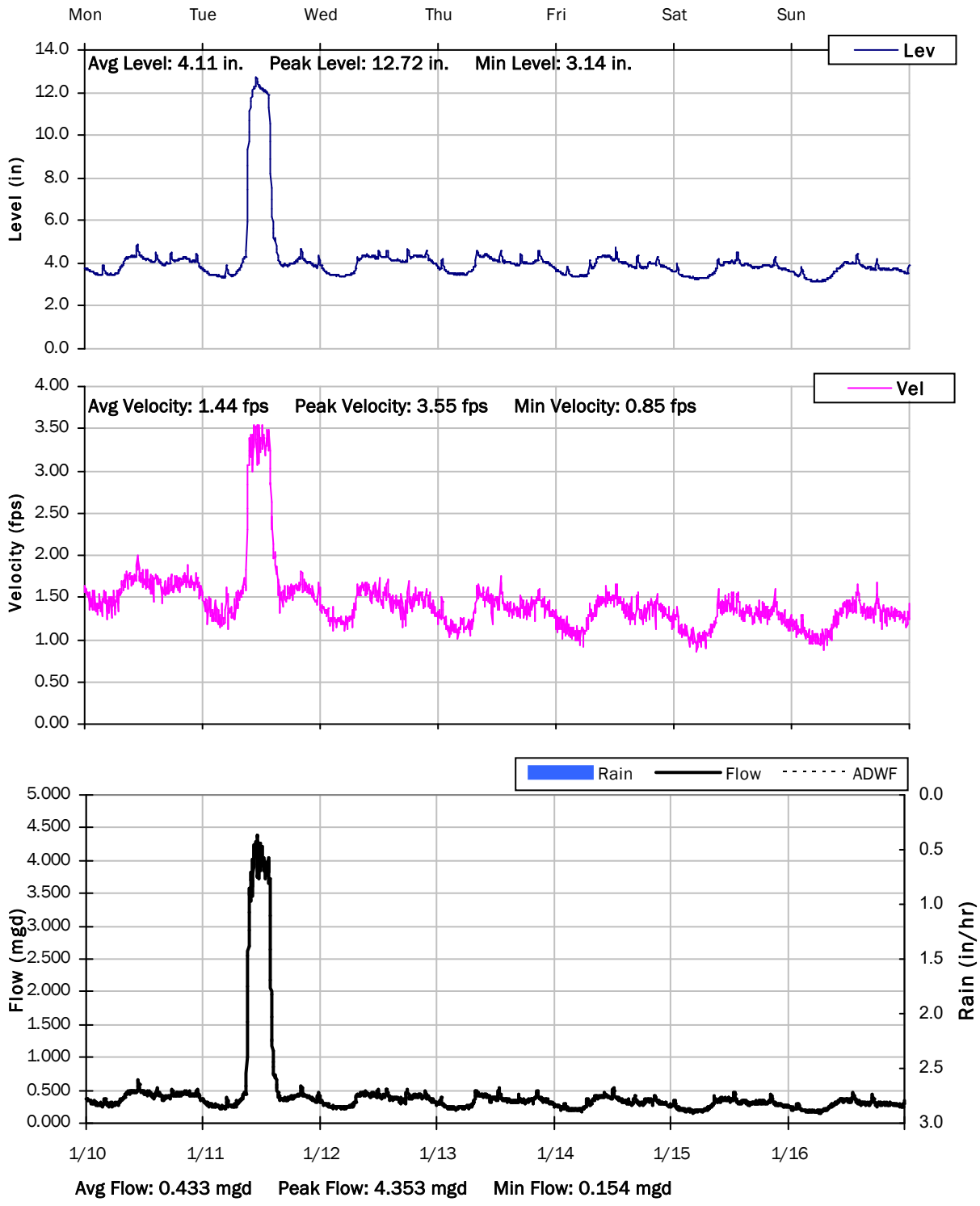
1/3/2022 to 1/10/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

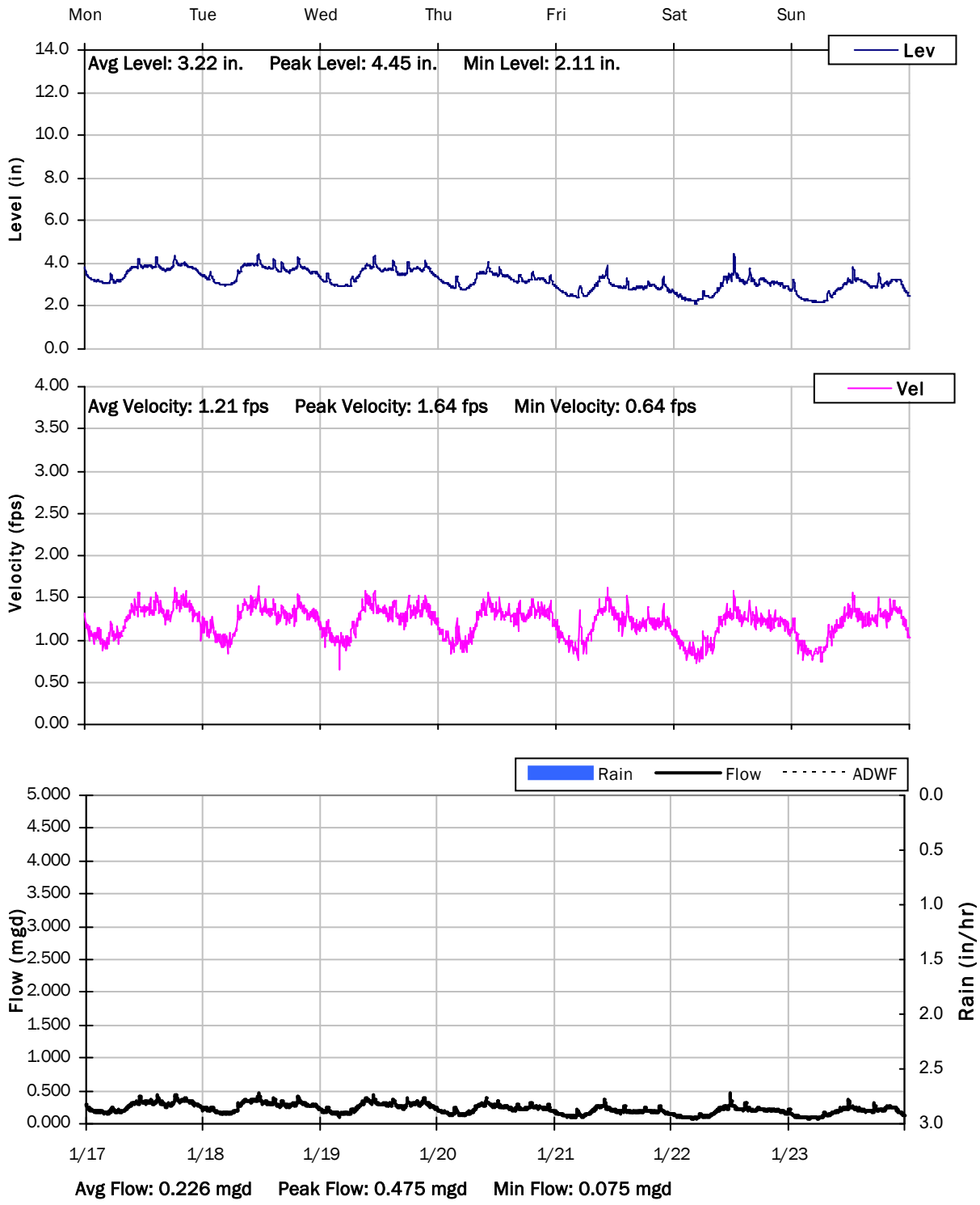
1/10/2022 to 1/17/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

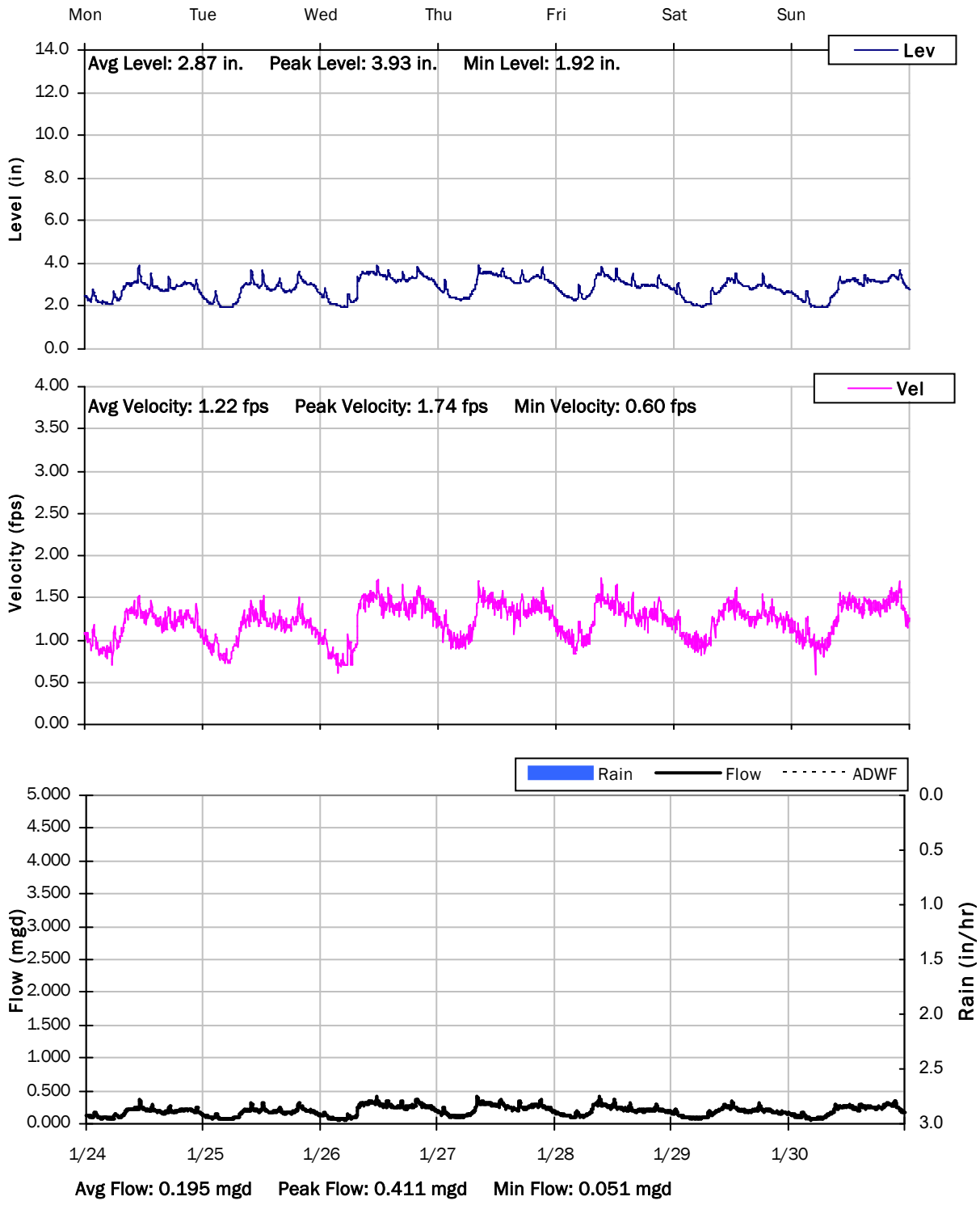
1/17/2022 to 1/24/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

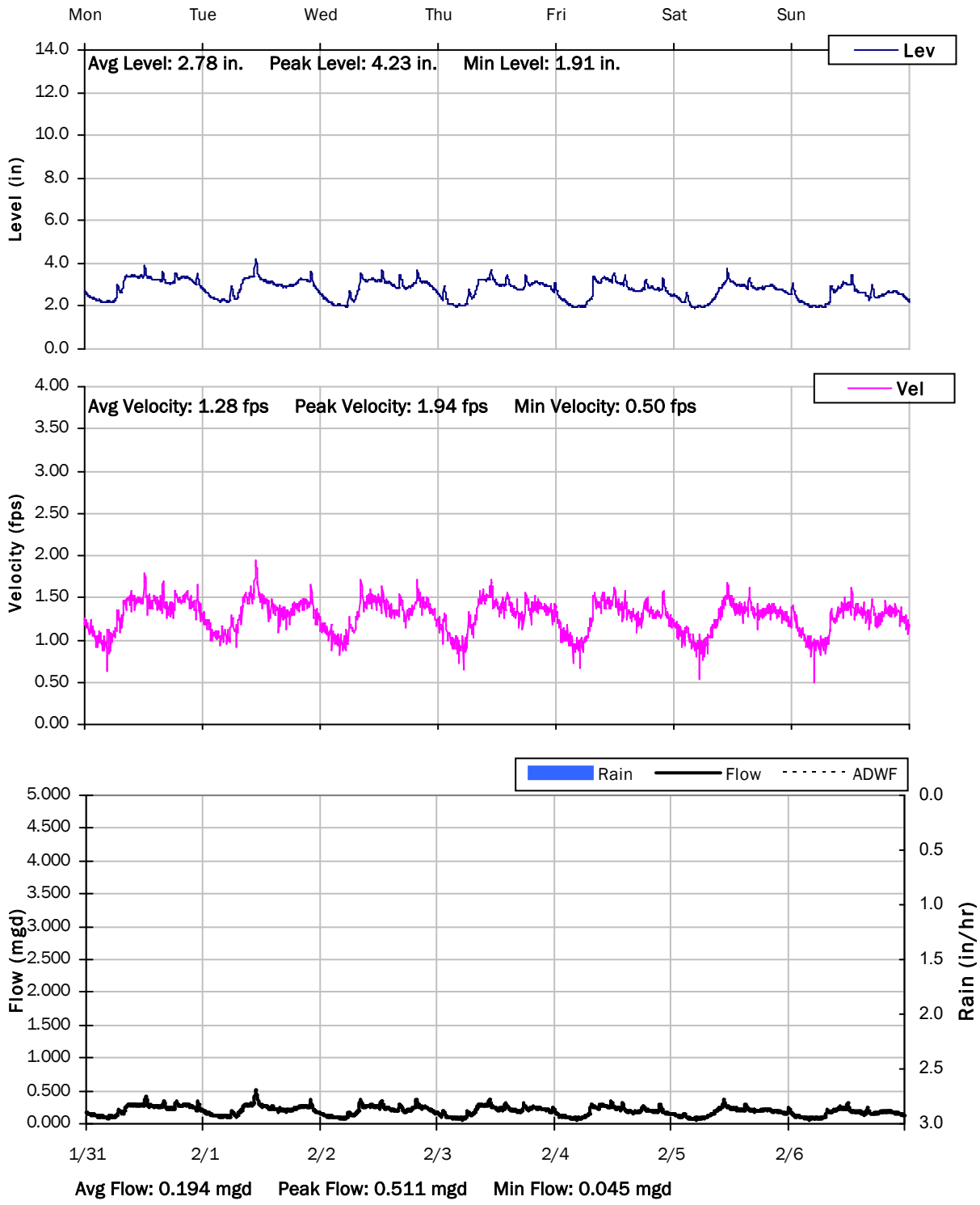
1/24/2022 to 1/31/2022



SITE 14

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 15

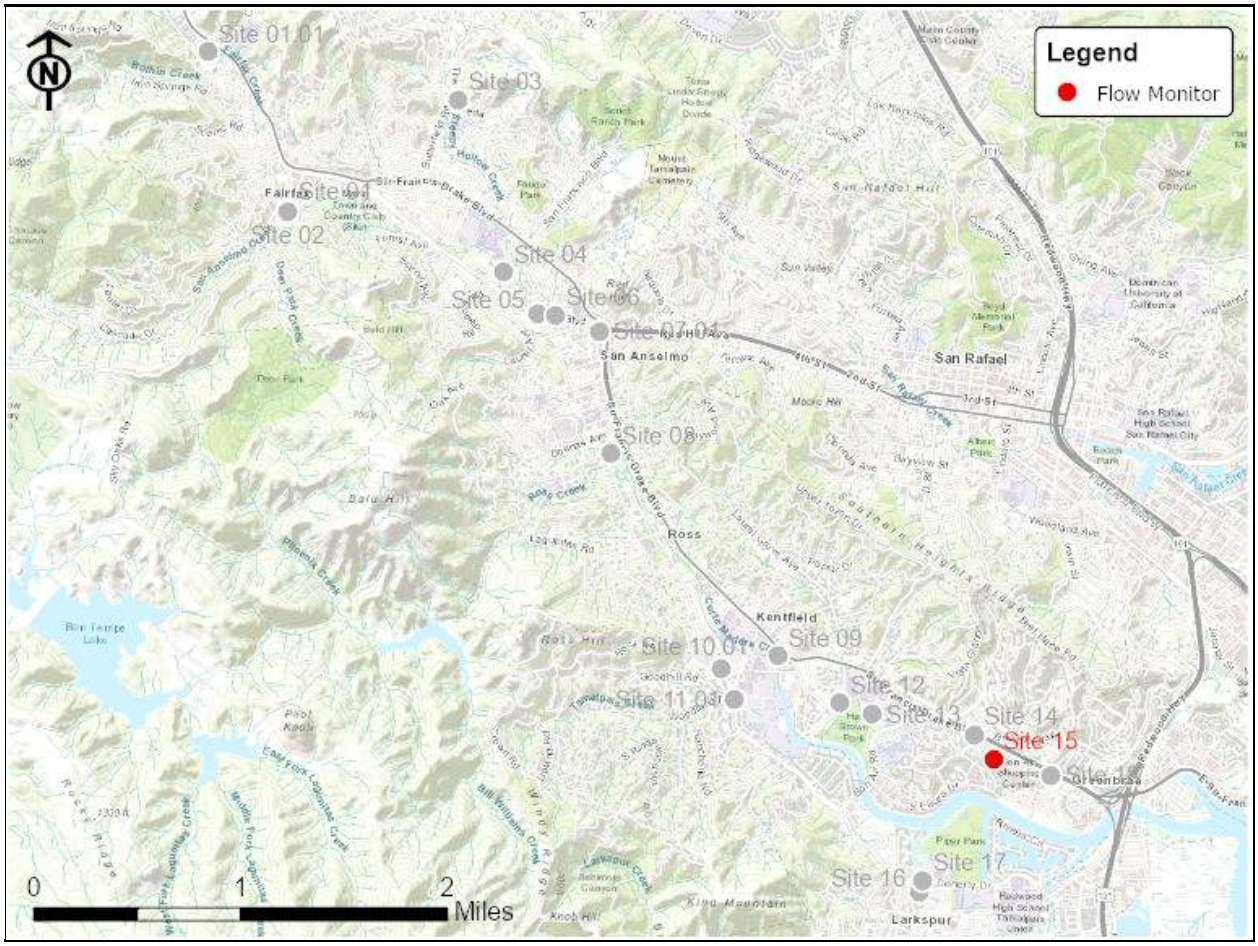
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Parking lot behind 50 Bon Air Center

Data Summary Report



Vicinity Map: Site 15

SITE 15

Site Information MH ID: G000.020

Location: Parking lot behind 50 Bon Air Center

Coordinates: 122.5267° W, 37.9470° N

Rim Elevation (Earth): 13 feet

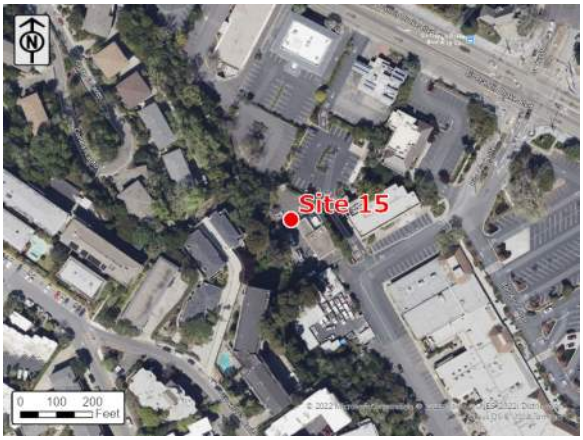
Expected Pipe Diameter: 10 inches

Measured Pipe Diameter: 10 inches

ADWF: 0.073 mgd

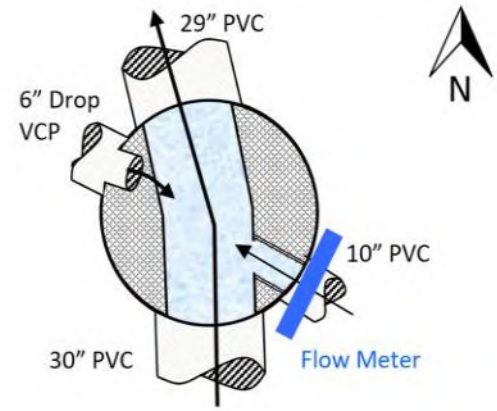
Peak Measured Flow: 1.187 mgd

Sediment: None



Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 15

Additional Site Photos

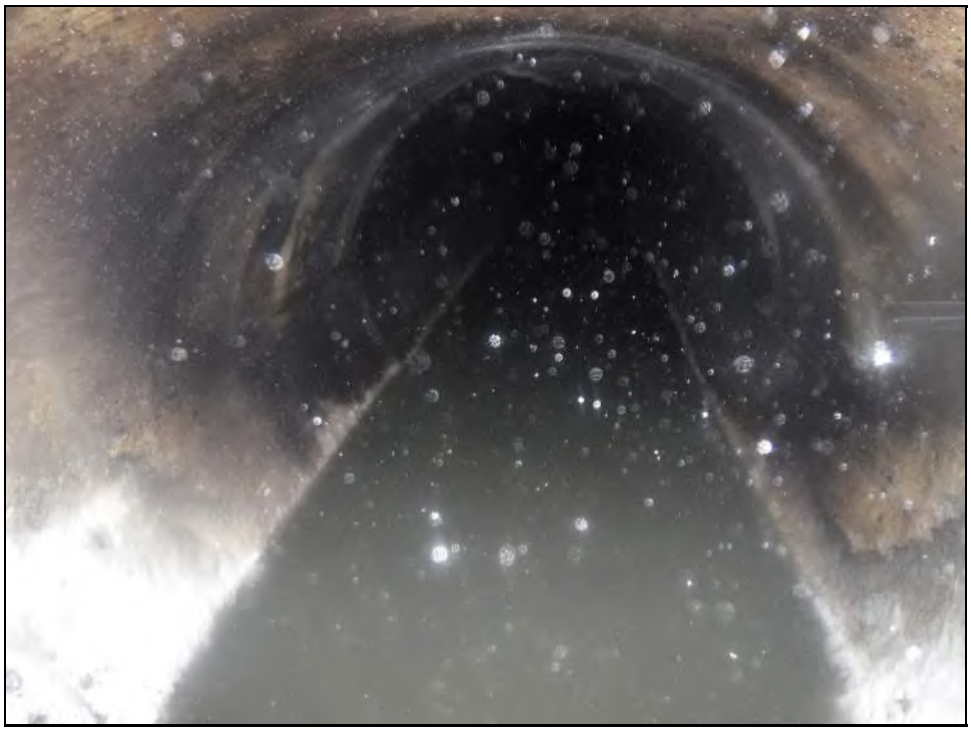
Effluent Pipe

Southeast Influent Pipe

SITE 15

Additional Site Photos

Monitored South Influent Pipe

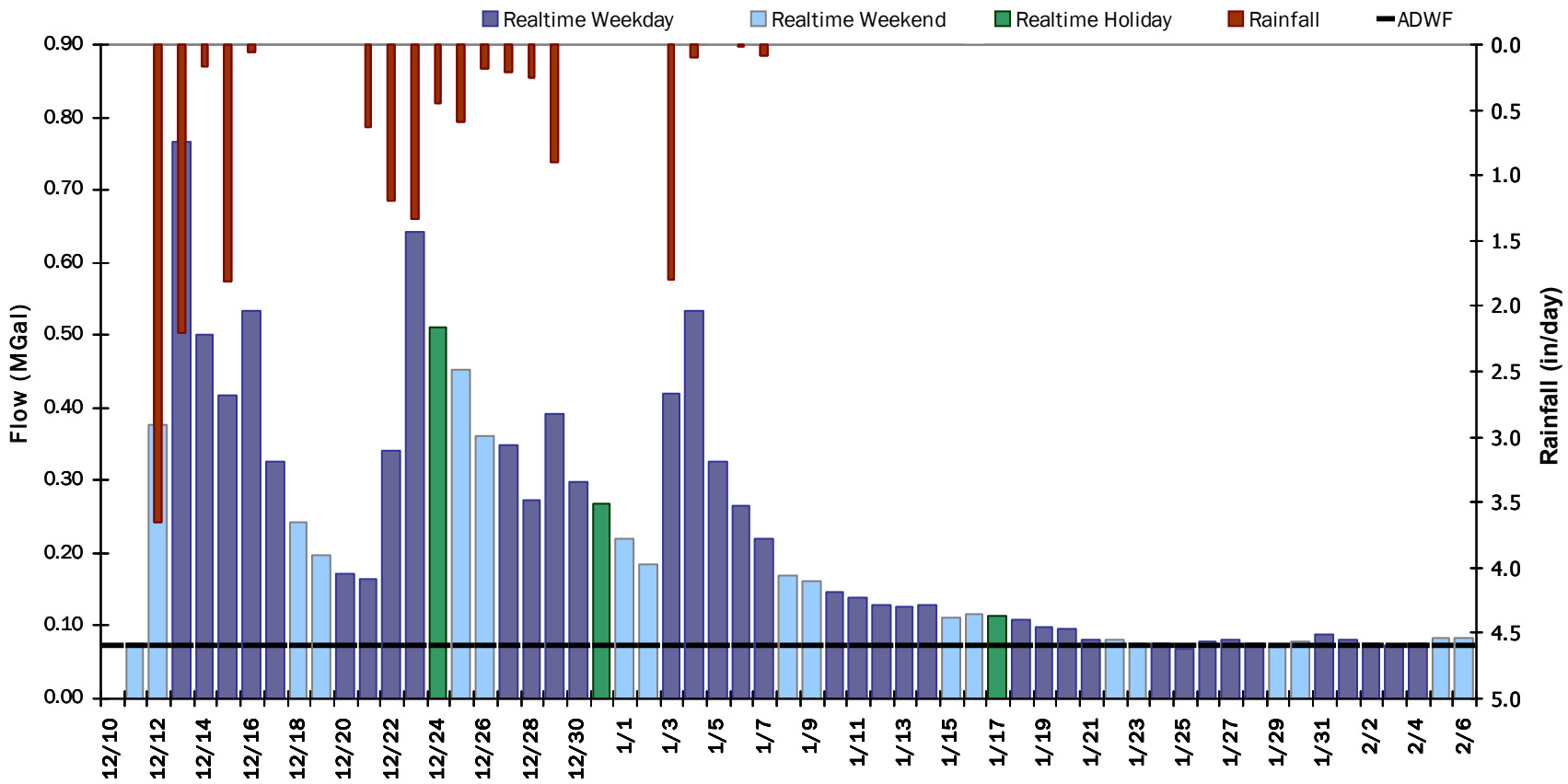


SITE 15

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.221 MGal Peak Daily Flow: 0.767 MGal Min Daily Flow: 0.068 MGal

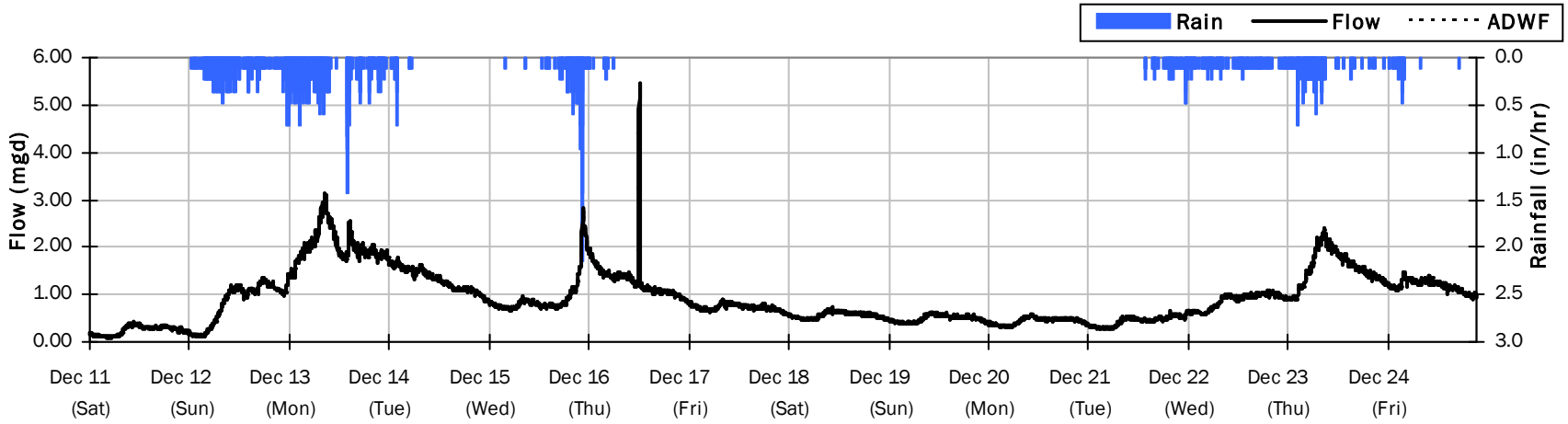
Total Rainfall: 15.67 inches

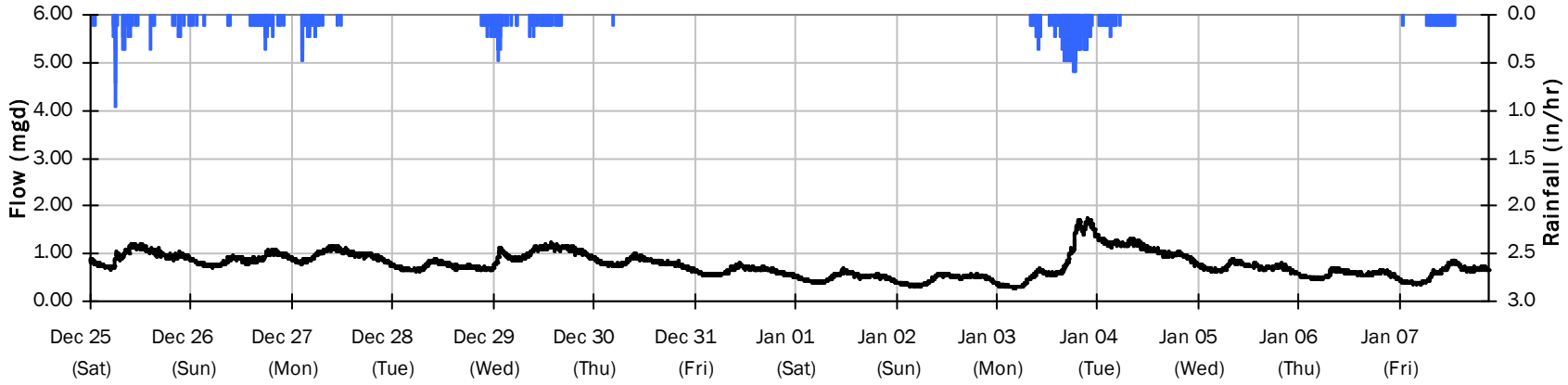


SITE 16

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 17.40 inches Period Avg Flow: 0.832 mgd Period Peak Flow: 5.451 mgd Period Min Flow: 0.085 mgd

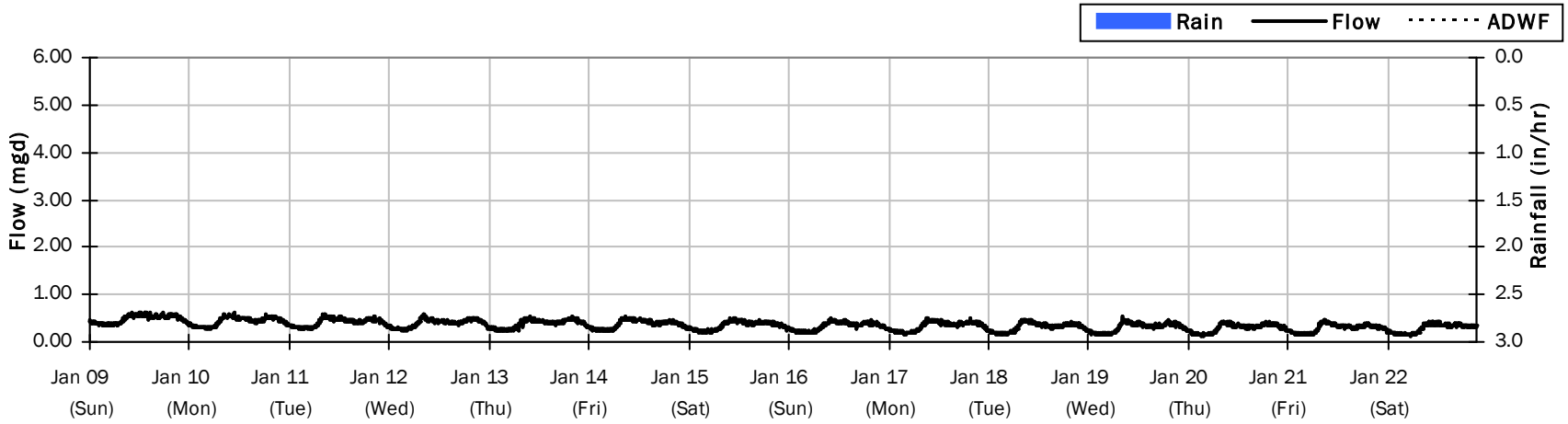


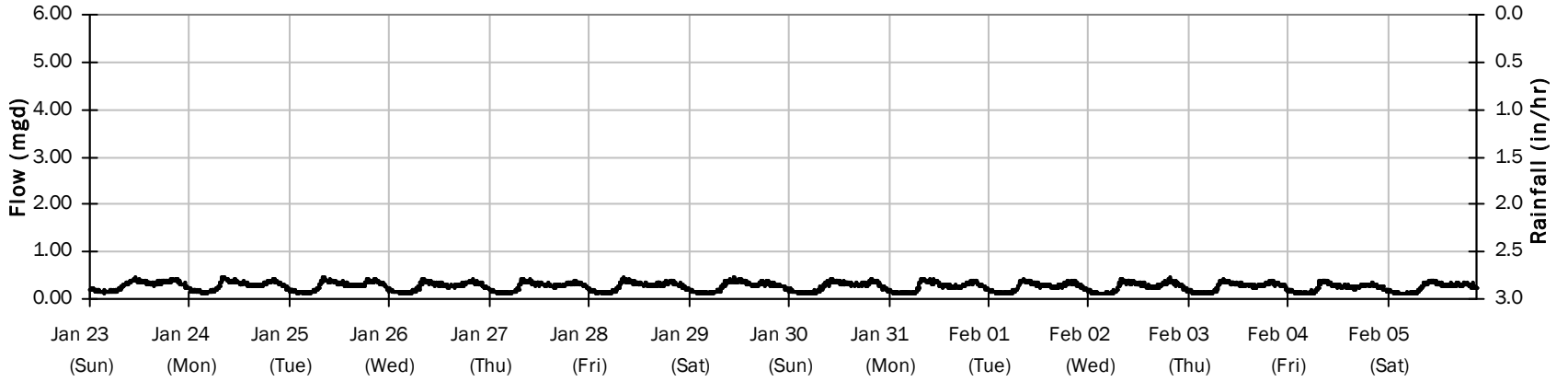


SITE 16

Flow Summary: 1/9/2022 to 2/5/2022

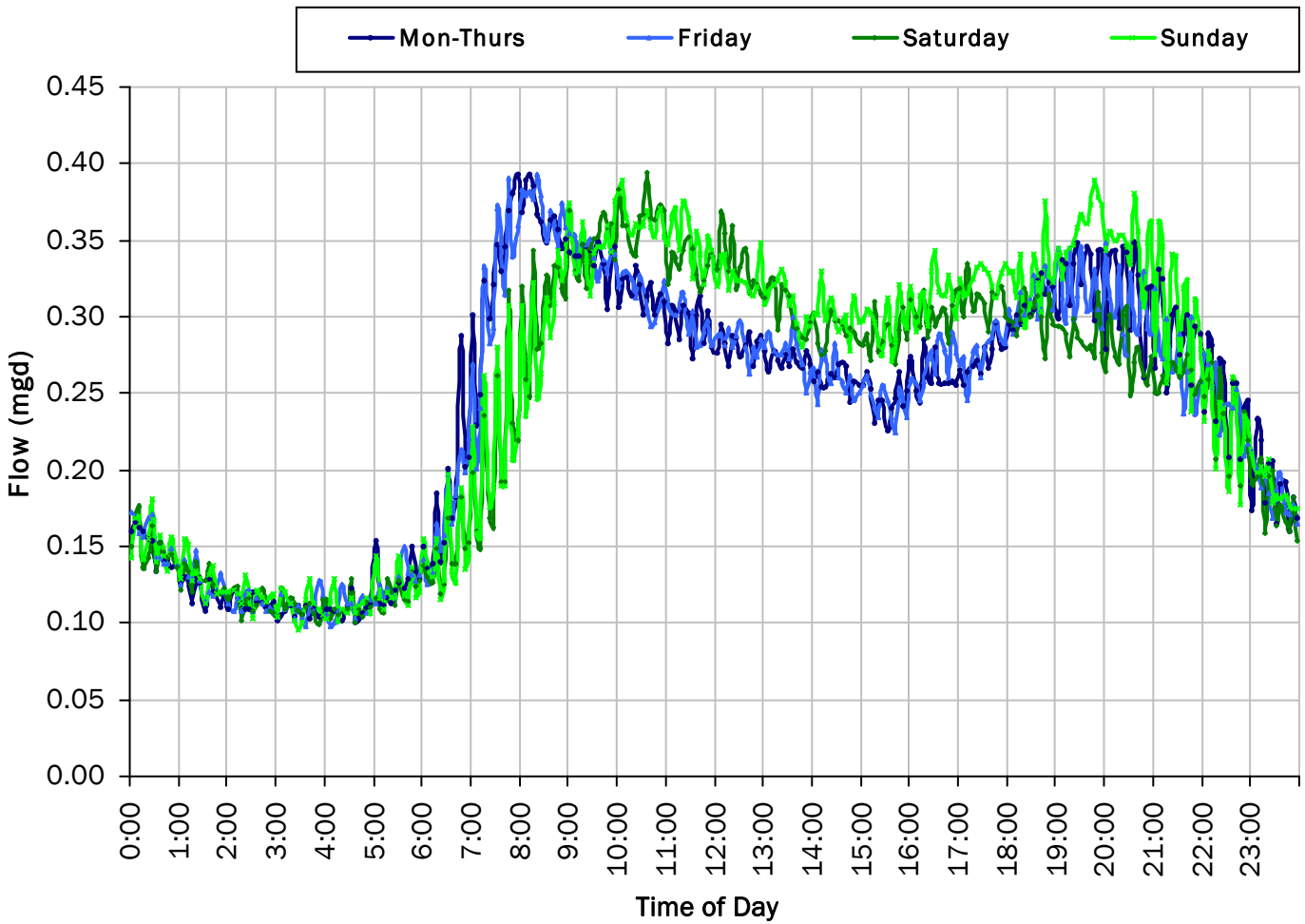
Period Rainfall: 0.00 inches Period Avg Flow: 0.311 mgd Period Peak Flow: 0.617 mgd Period Min Flow: 0.100 mgd





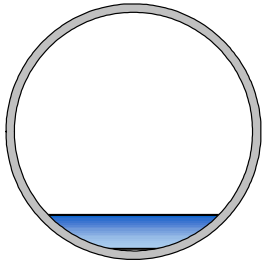
SITE 16

Average Dry Weather Flow Hydrographs



ADWF:

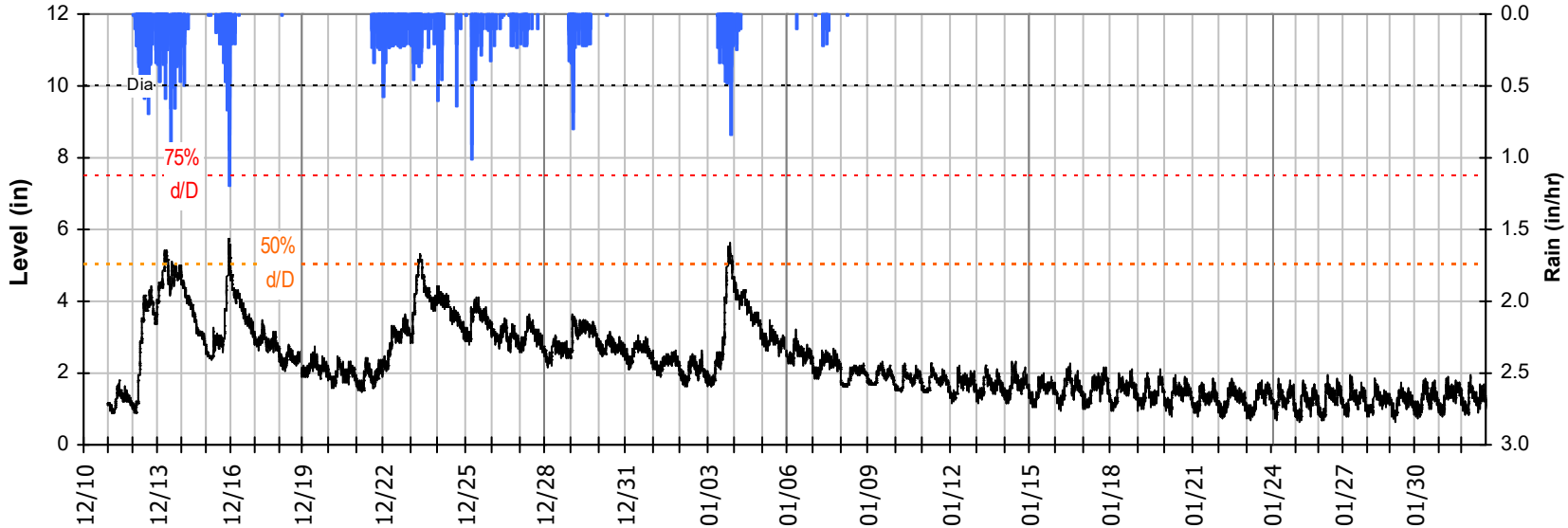
0.244 *mgd*

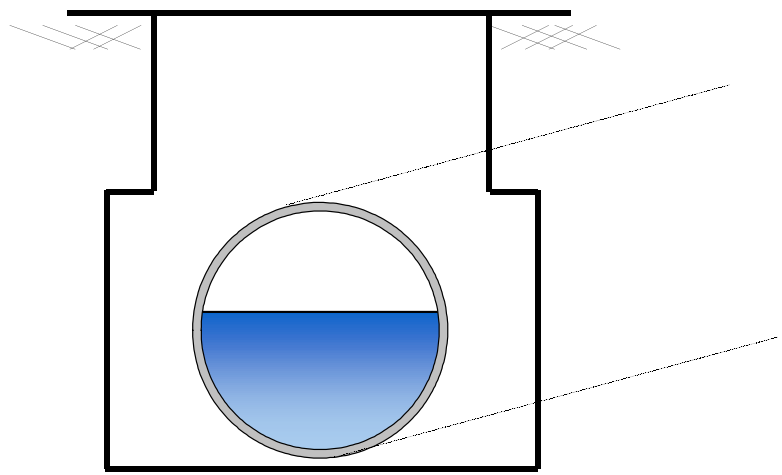


SITE 15

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

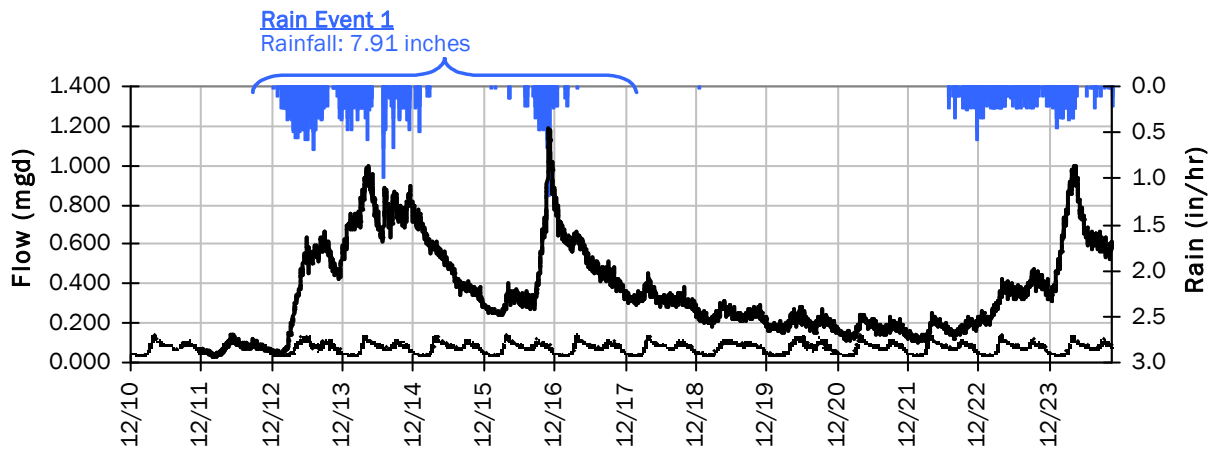




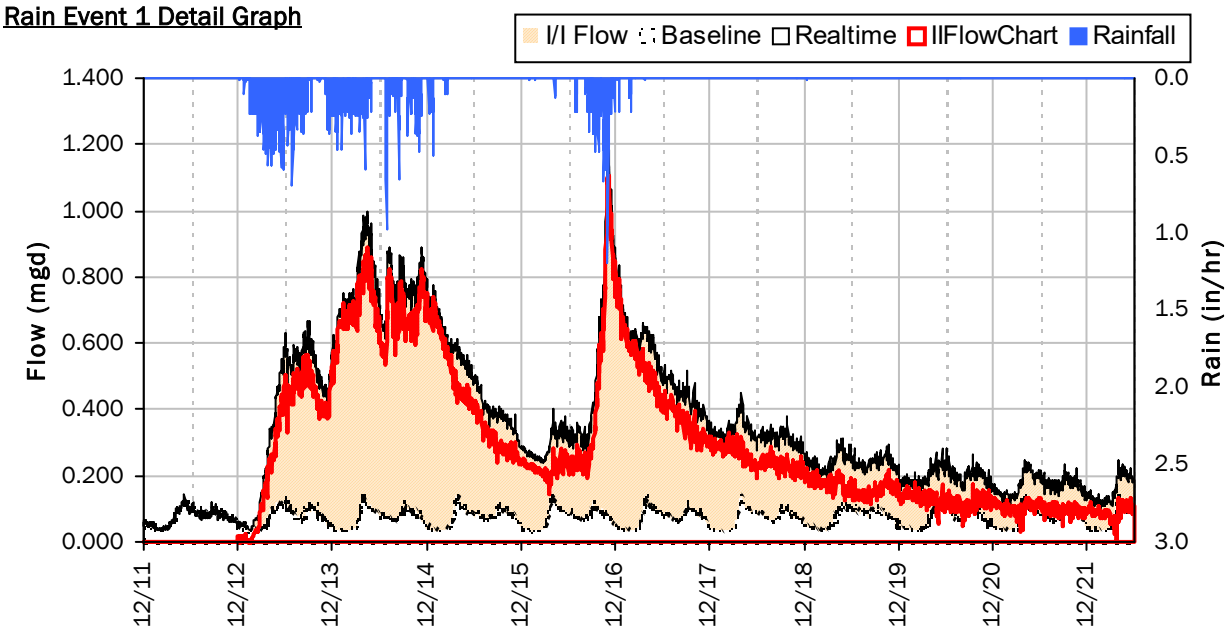
Pipe Diameter:	10	*inches*
Peak Measured Level:	5.76	*inches*
Peak d/D Ratio:	0.58	

SITE 15
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

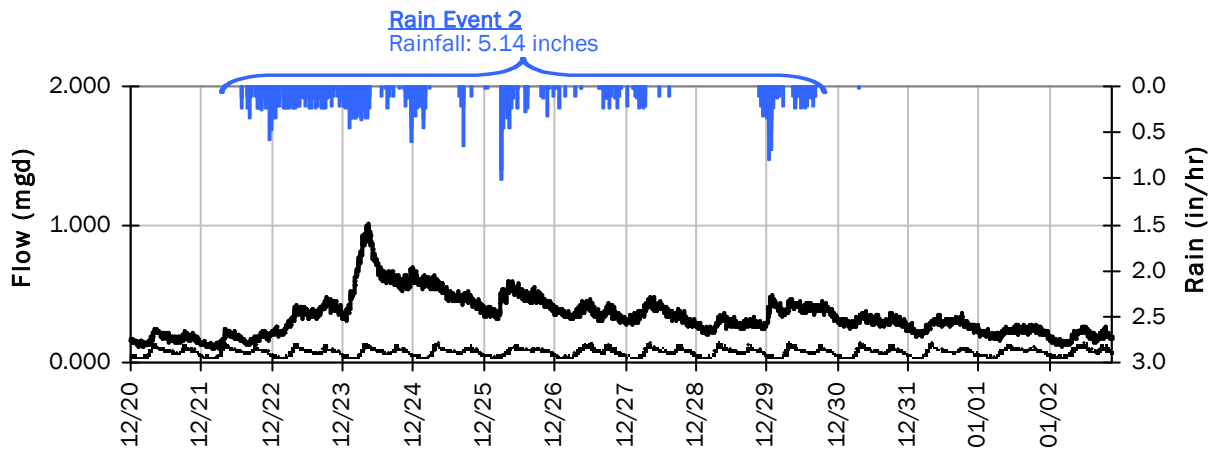


Storm Event I/I Analysis (Rain = 7.91 inches)

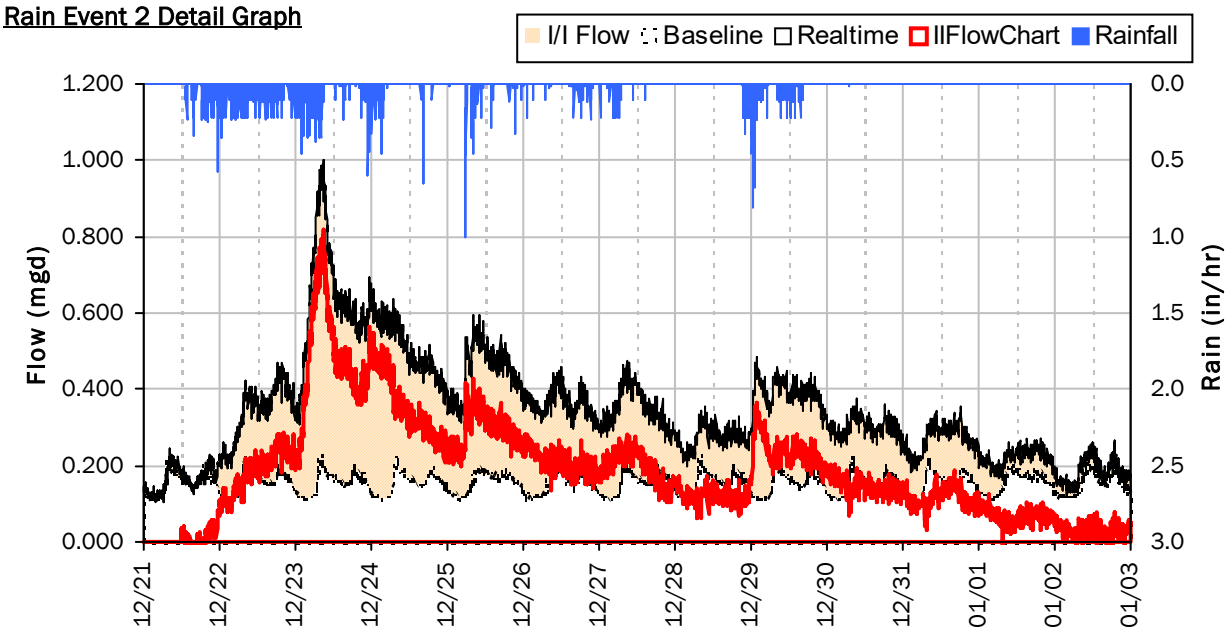
Capacity		Inflow / Infiltration	
Peak Flow:	1.187 *mgd*	**Peak I/I Rate:**	1.103 *mgd*
PF:	16.18	**Total I/I:**	2,917,000 *gallons*
Peak Level:	5.76 *in*		
d/D Ratio:	0.58		

SITE 15
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



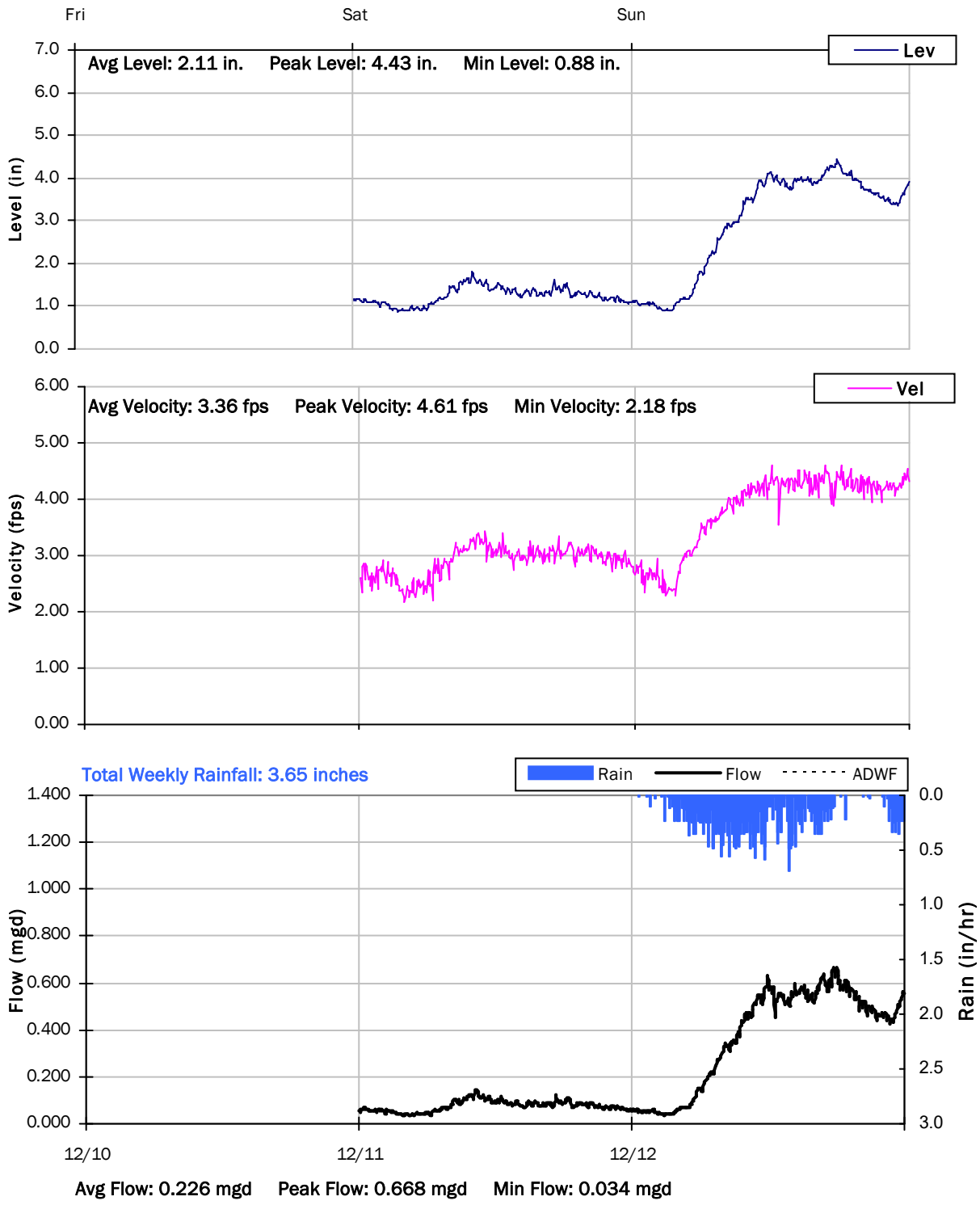
Storm Event I/I Analysis (Rain = 5.14 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.002 *mgd*	**Peak I/I Rate:**	0.819 *mgd*
PF:	13.66	**Total I/I:**	2,459,000 *gallons*
Peak Level:	5.34 *in*		
d/D Ratio:	0.53		

SITE 15

Weekly Level, Velocity and Flow Hydrographs

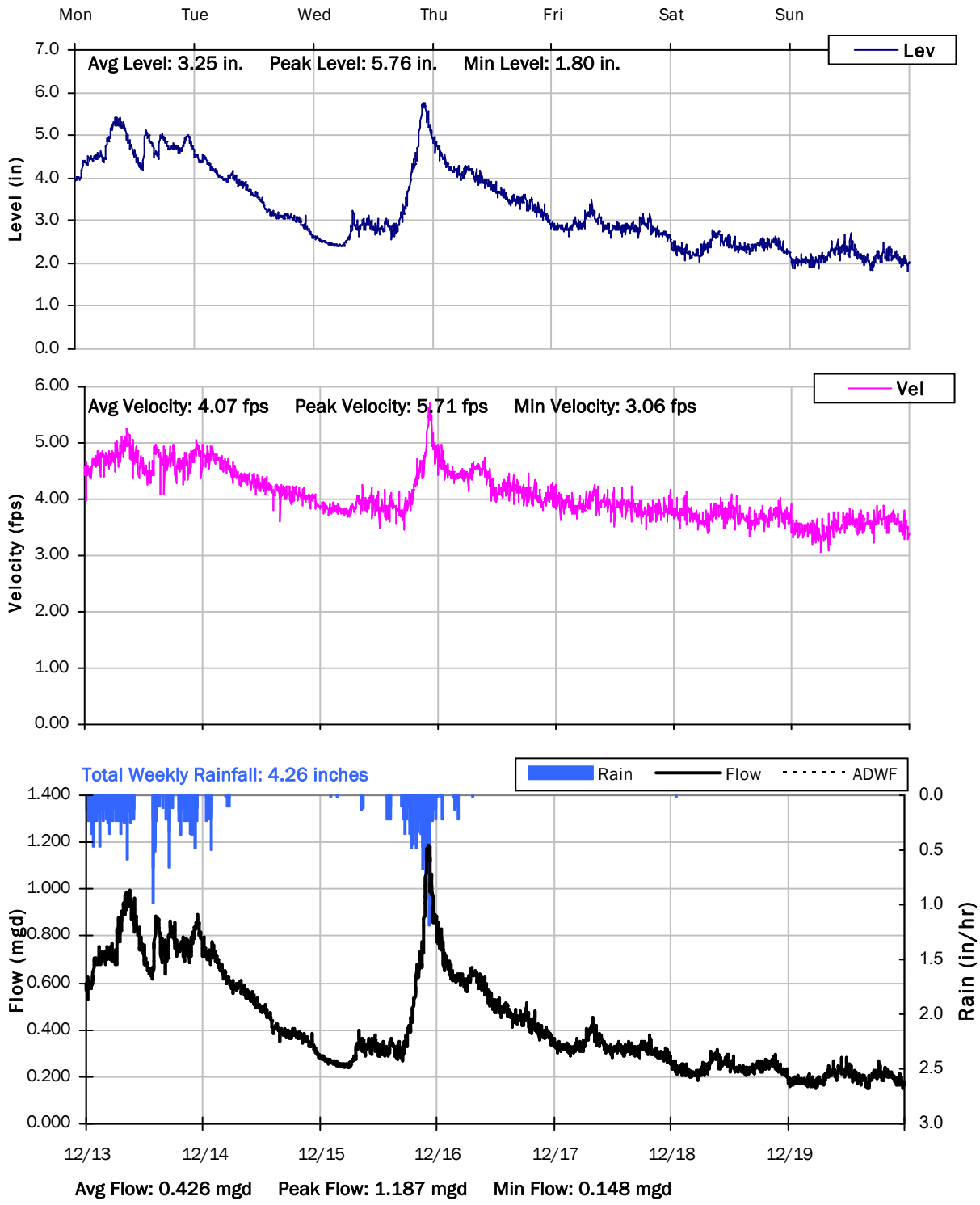
12/10/2021 to 12/13/2021



SITE 15

Weekly Level, Velocity and Flow Hydrographs

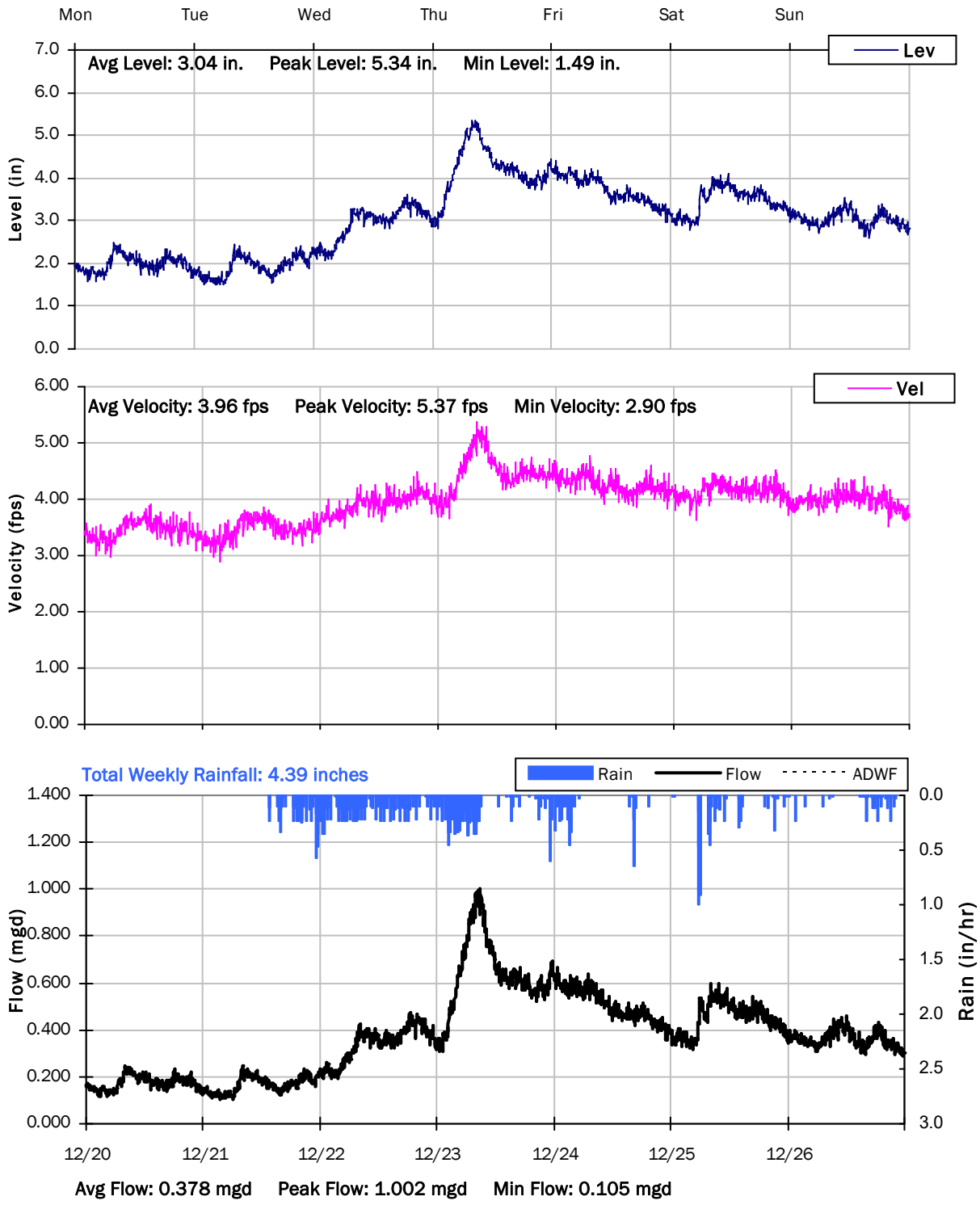
12/13/2021 to 12/20/2021



SITE 15

Weekly Level, Velocity and Flow Hydrographs

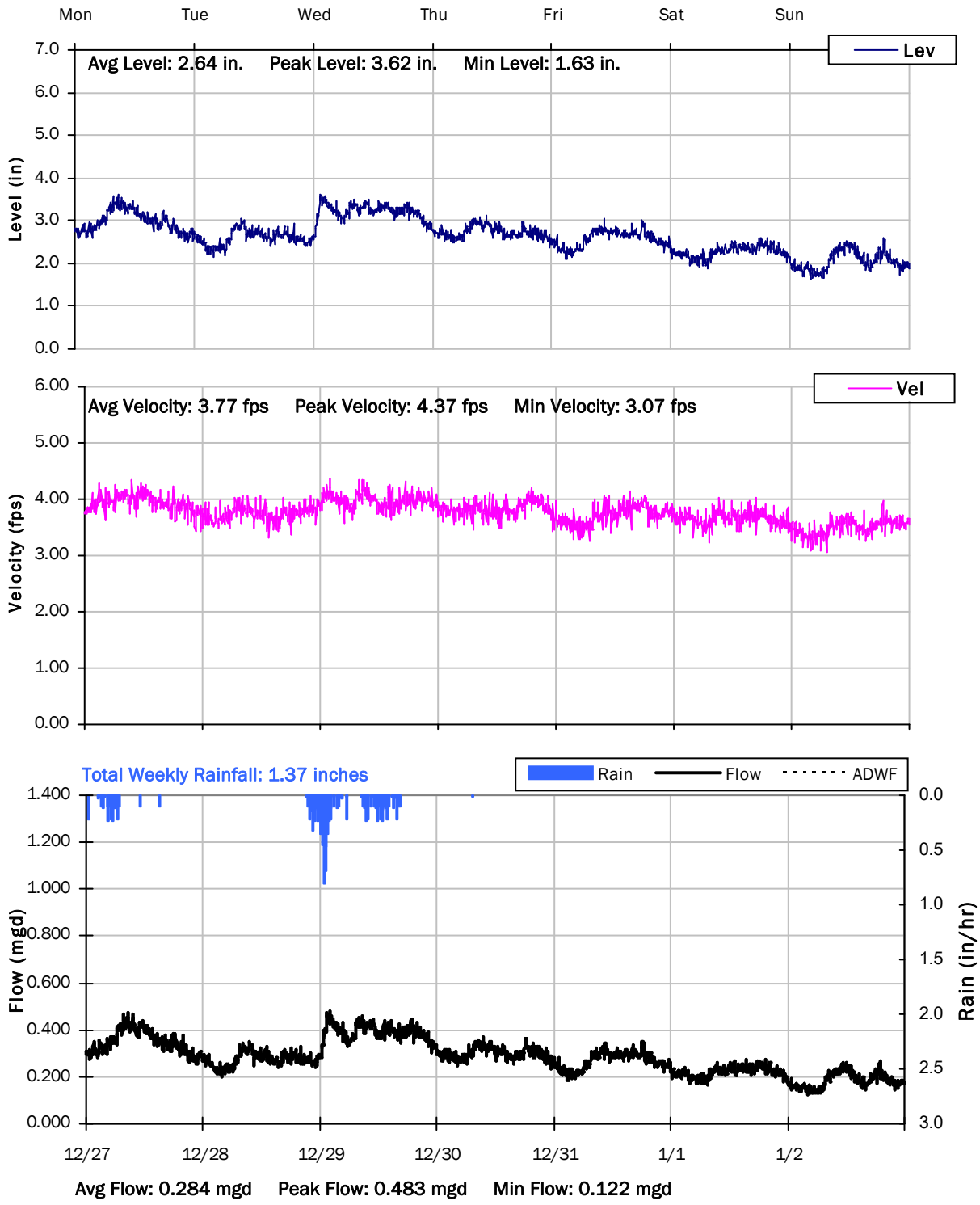
12/20/2021 to 12/27/2021



SITE 15

Weekly Level, Velocity and Flow Hydrographs

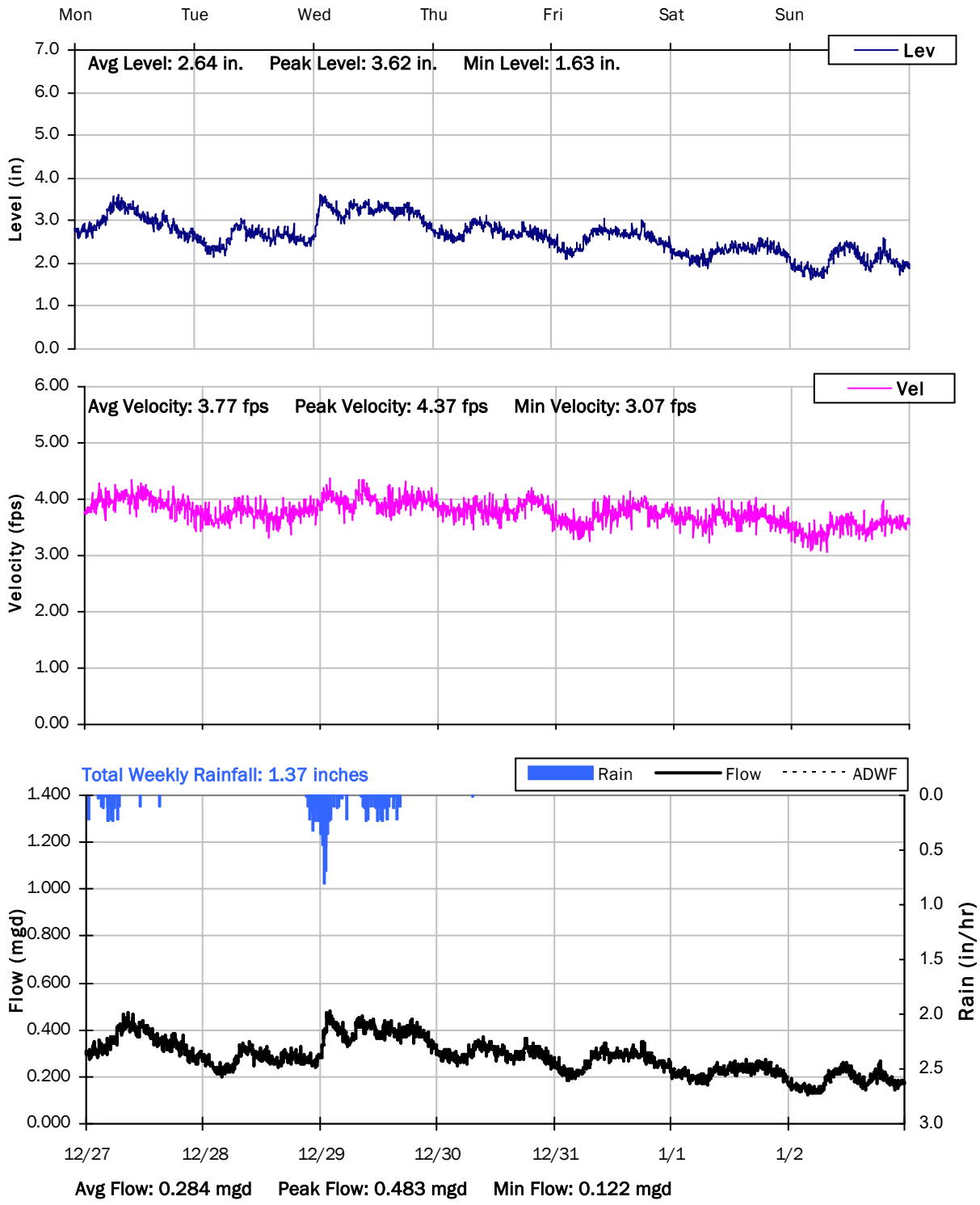
12/27/2021 to 1/3/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

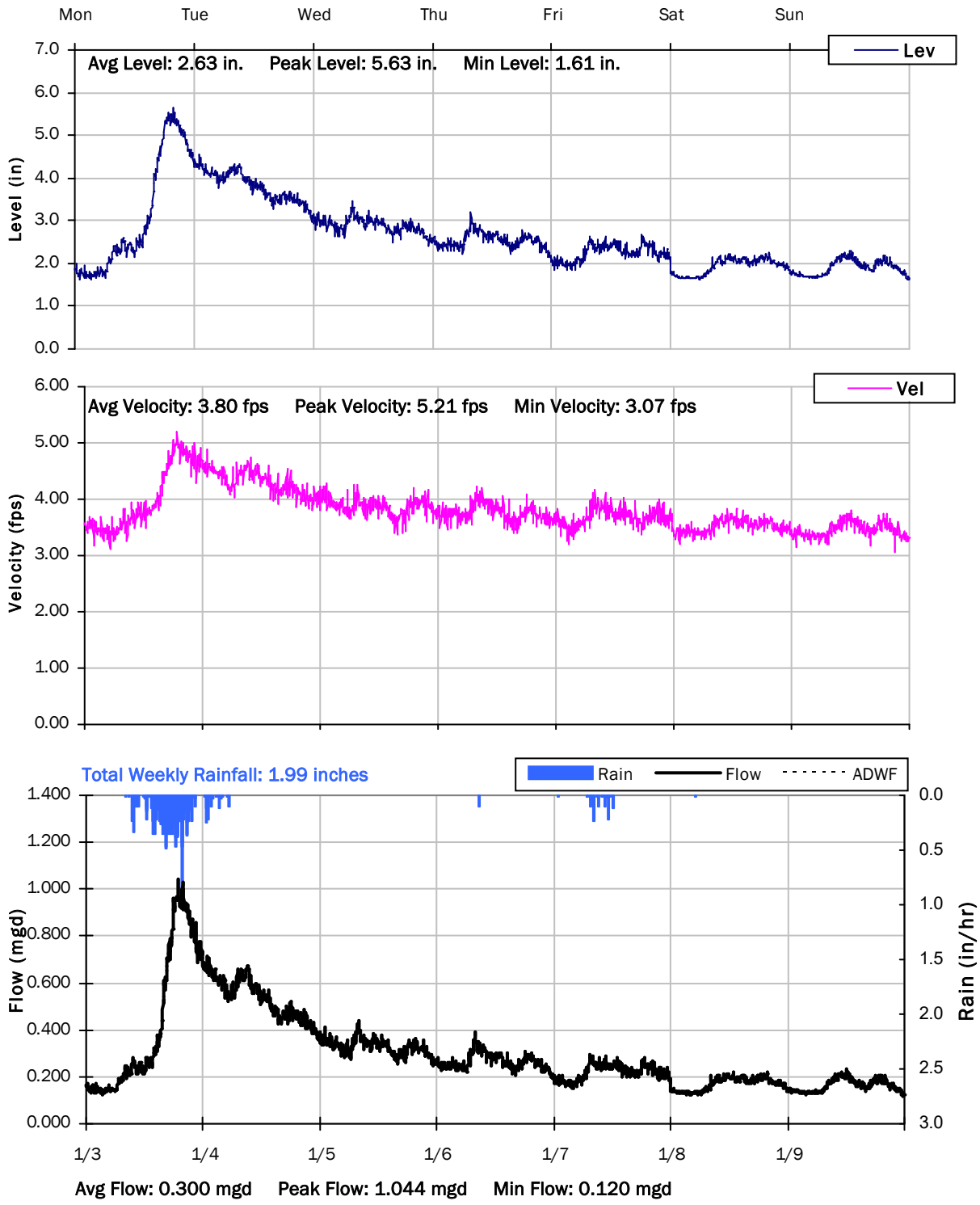
12/27/2021 to 1/3/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

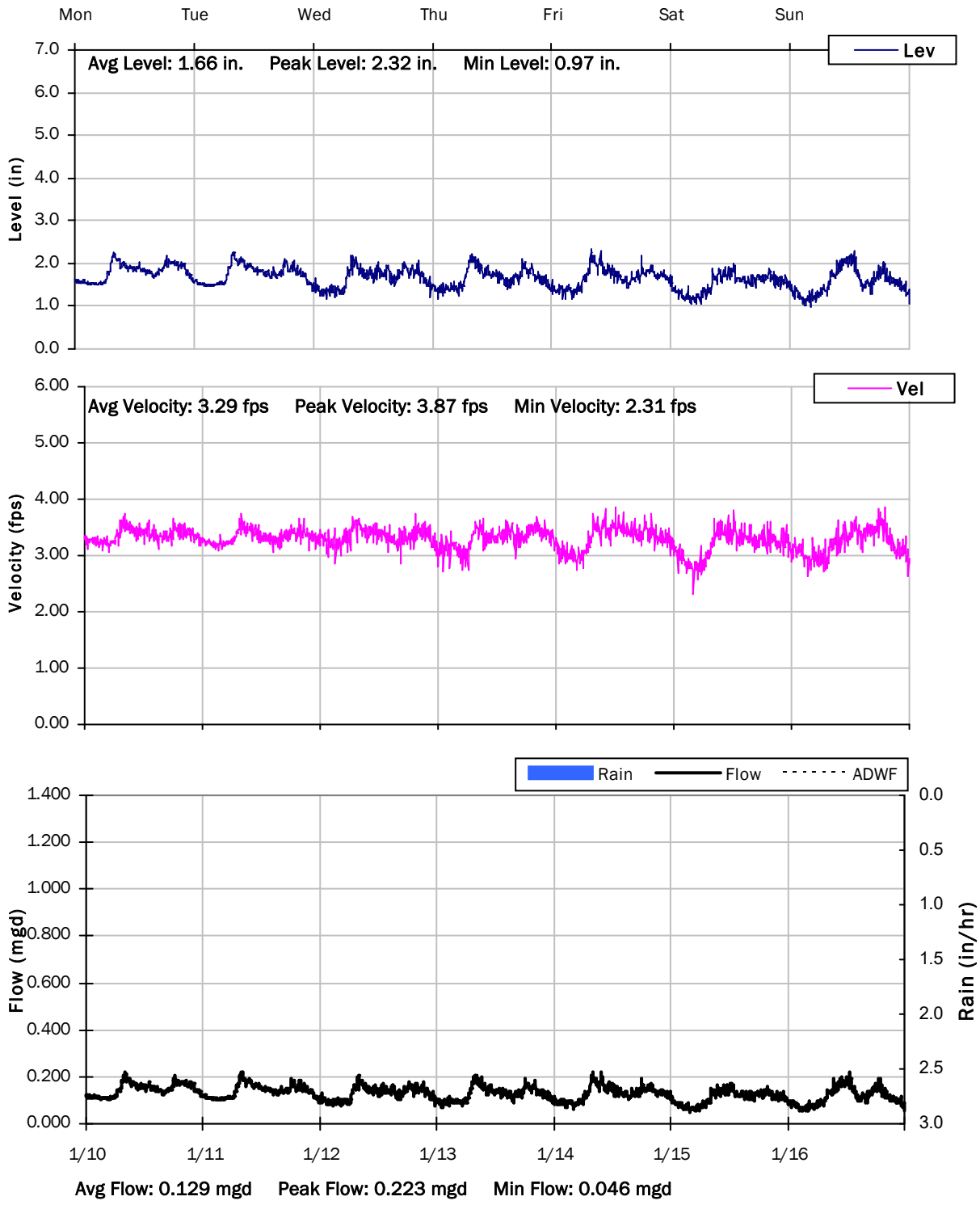
1/3/2022 to 1/10/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

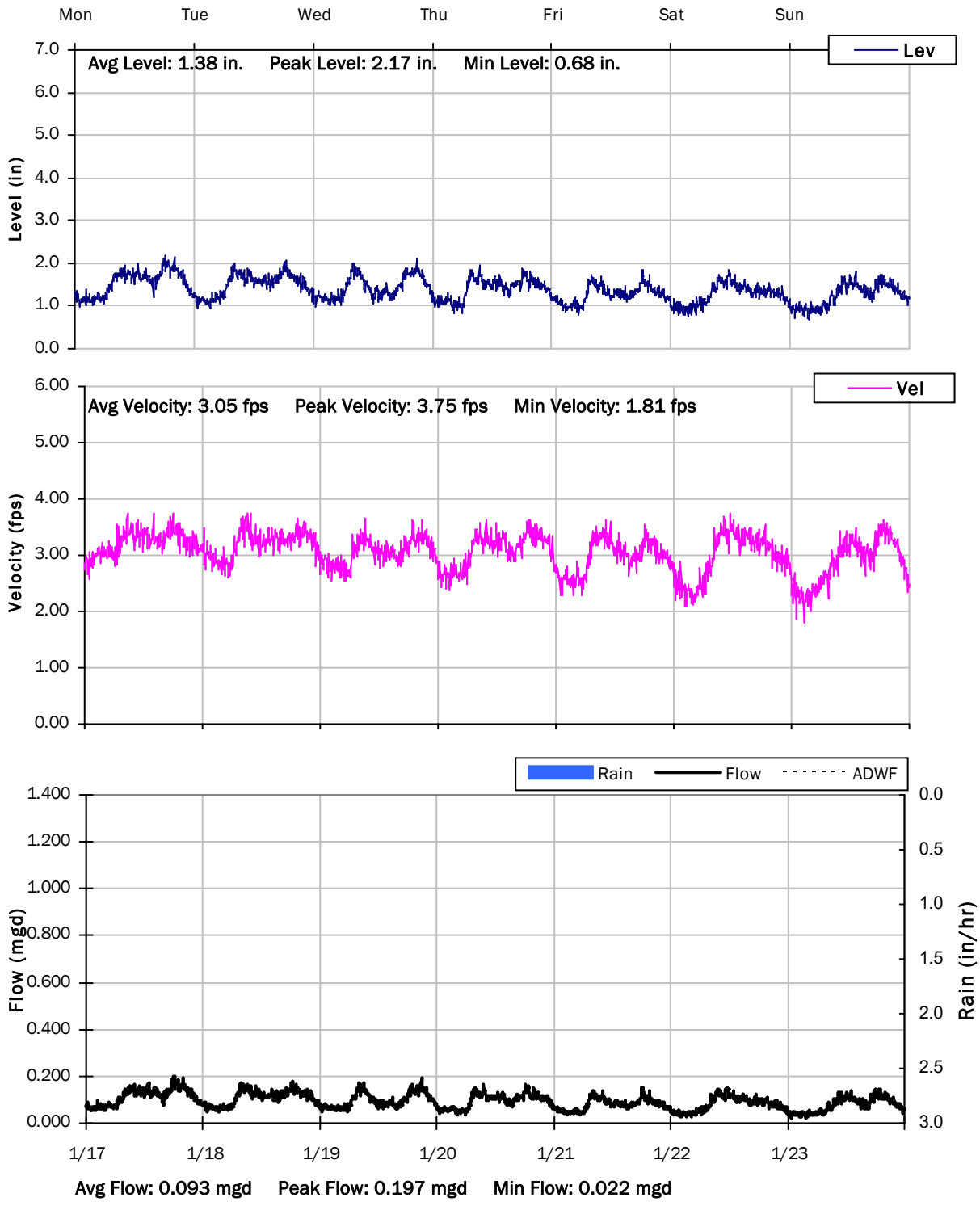
1/10/2022 to 1/17/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

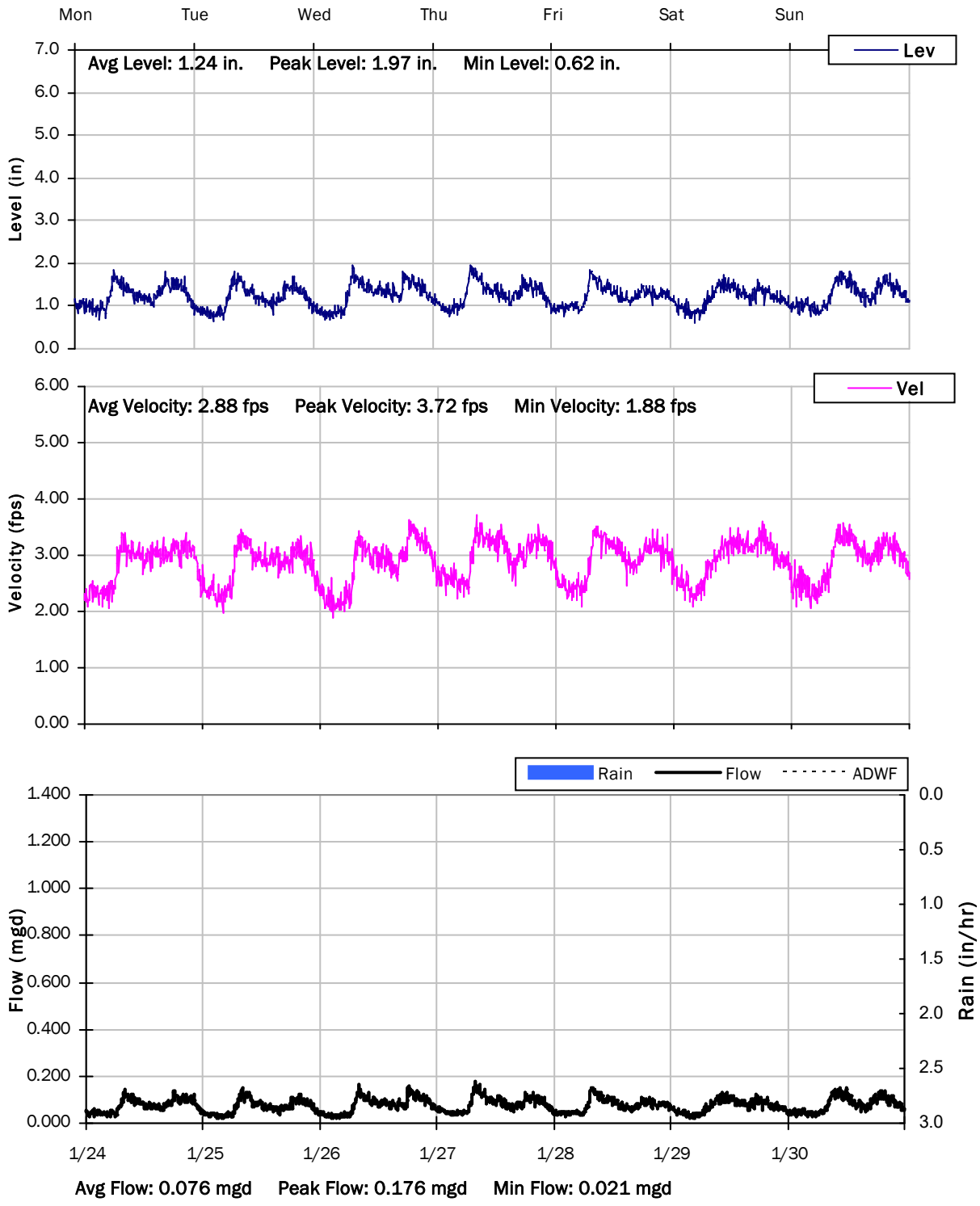
1/17/2022 to 1/24/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

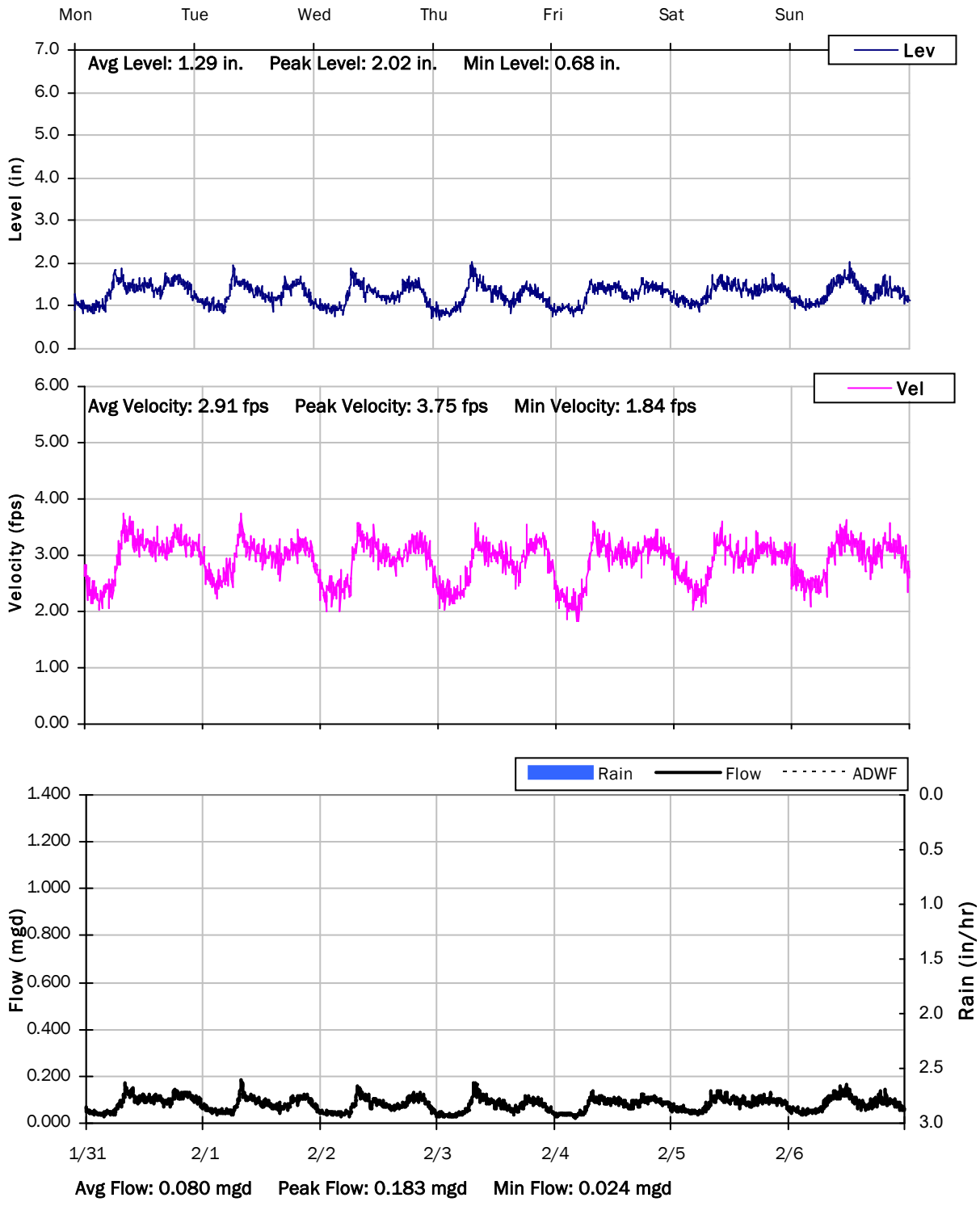
1/24/2022 to 1/31/2022



SITE 15

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 16

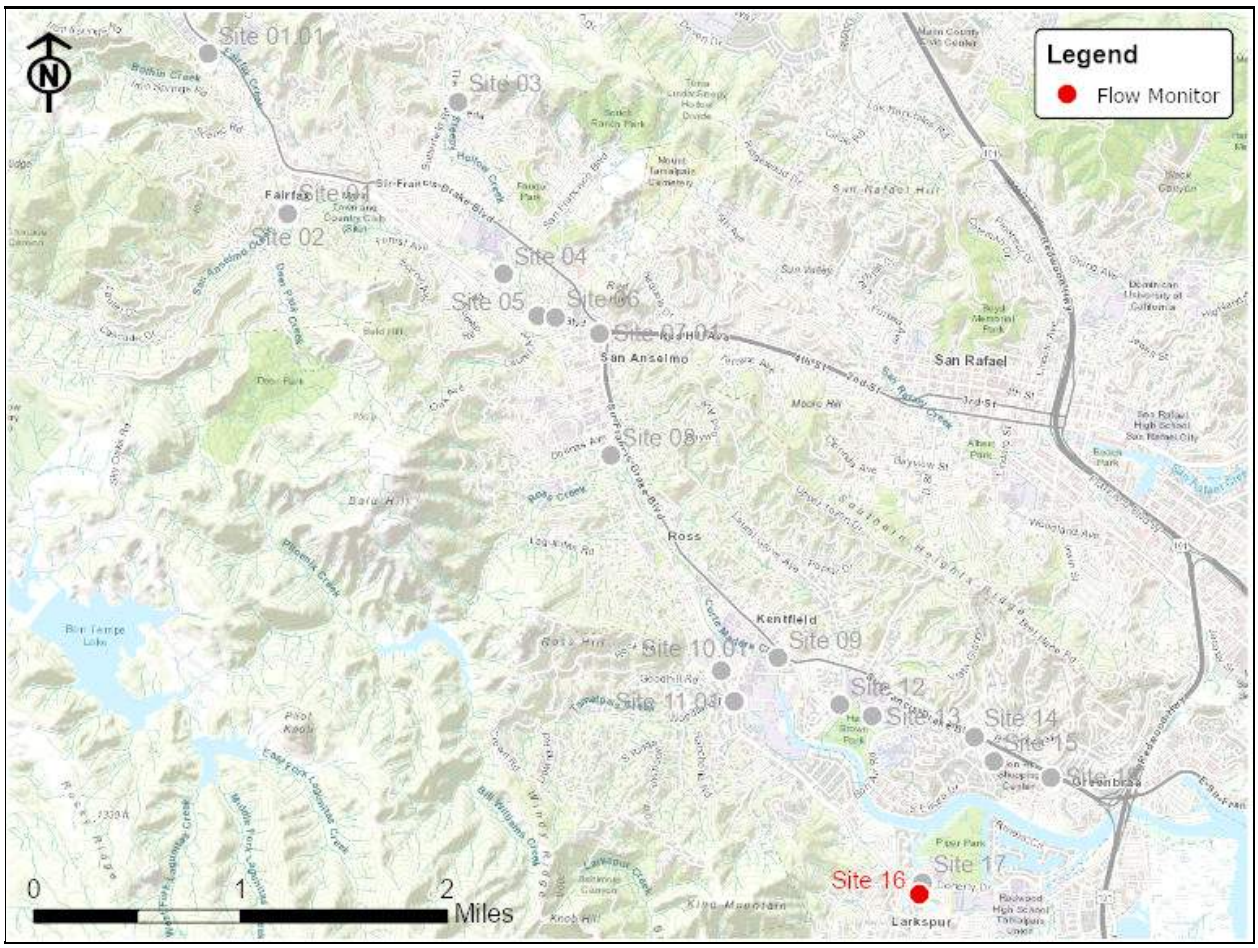
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: 10 Rose Ln

Data Summary Report



Vicinity Map: Site 16

SITE 16

Site Information MH ID: L180.030

Location: 10 Rose Ln

Coordinates: 122.5331° W, 37.9375° N

Rim Elevation (Earth): 10 feet

Expected Pipe Diameter: 24 inches

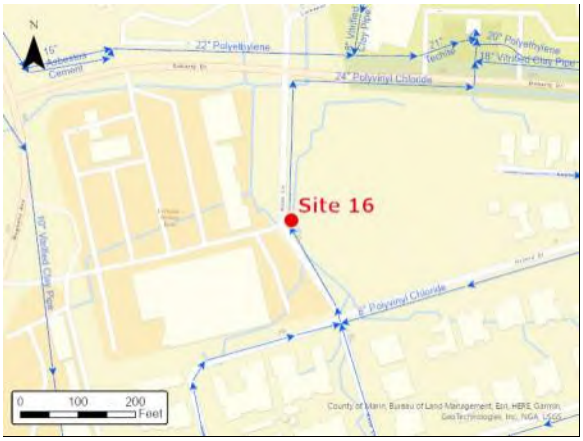
Measured Pipe Diameter: 23.5 inches

ADWF: 0.245 mgd

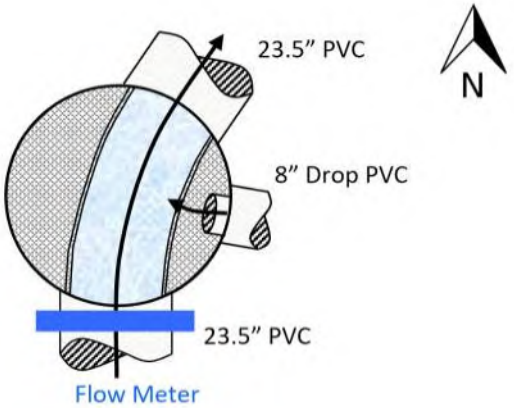
Peak Measured Flow: 5.451 mgd

Sediment: None

Satellite Map



Sanitary Map



Flow Sketch

Street View

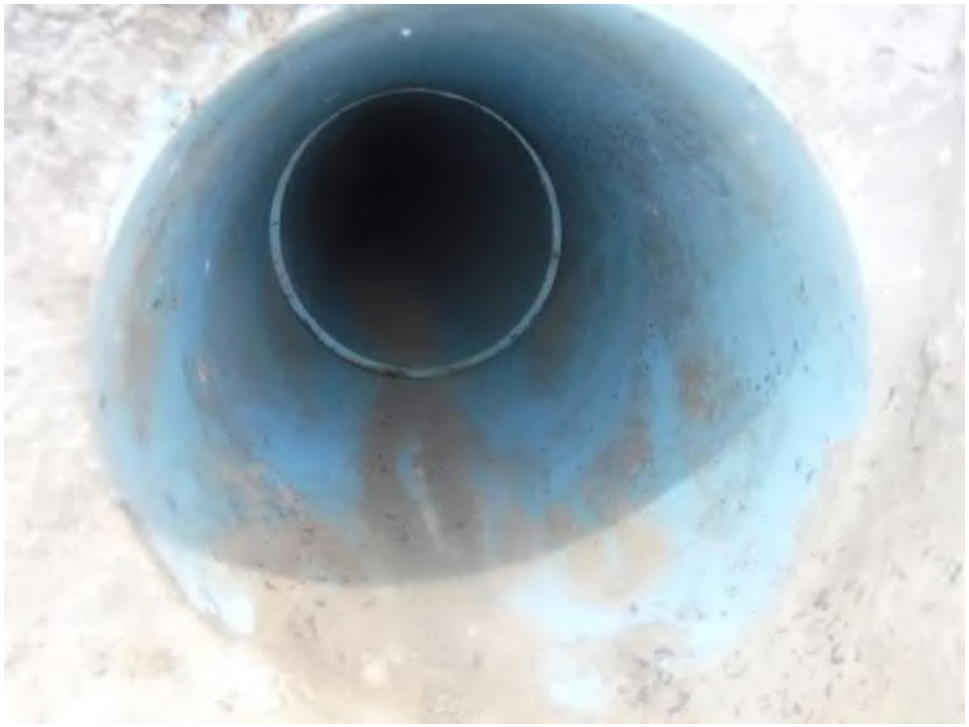
Plan View

SITE 16

Additional Site Photos

Effluent Pipe

East Influent Pipe



SITE 16

Additional Site Photos

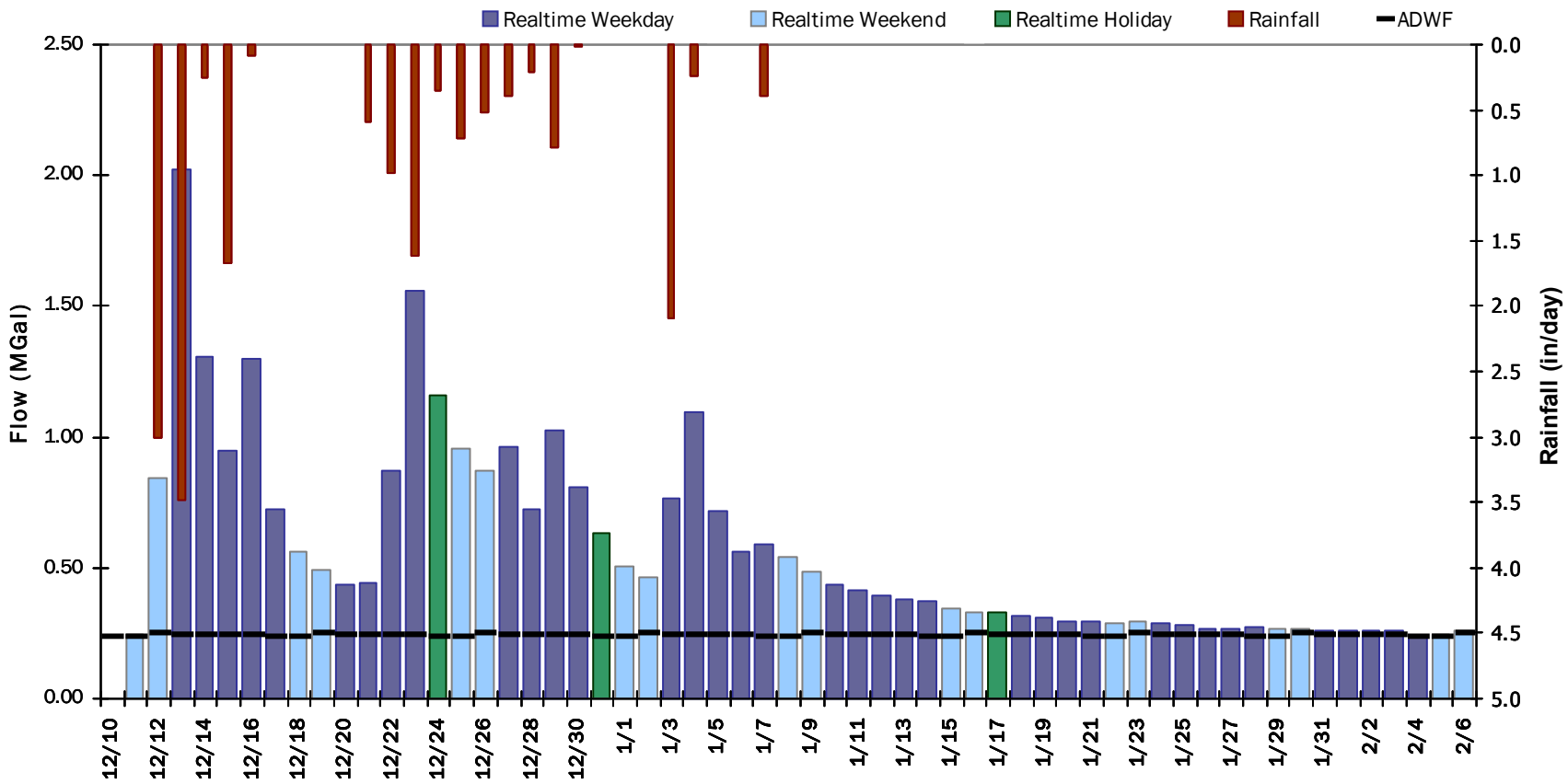
Monitored South Influent Pipe

SITE 16

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.570 MGal Peak Daily Flow: 2.026 MGal Min Daily Flow: 0.242 MGal

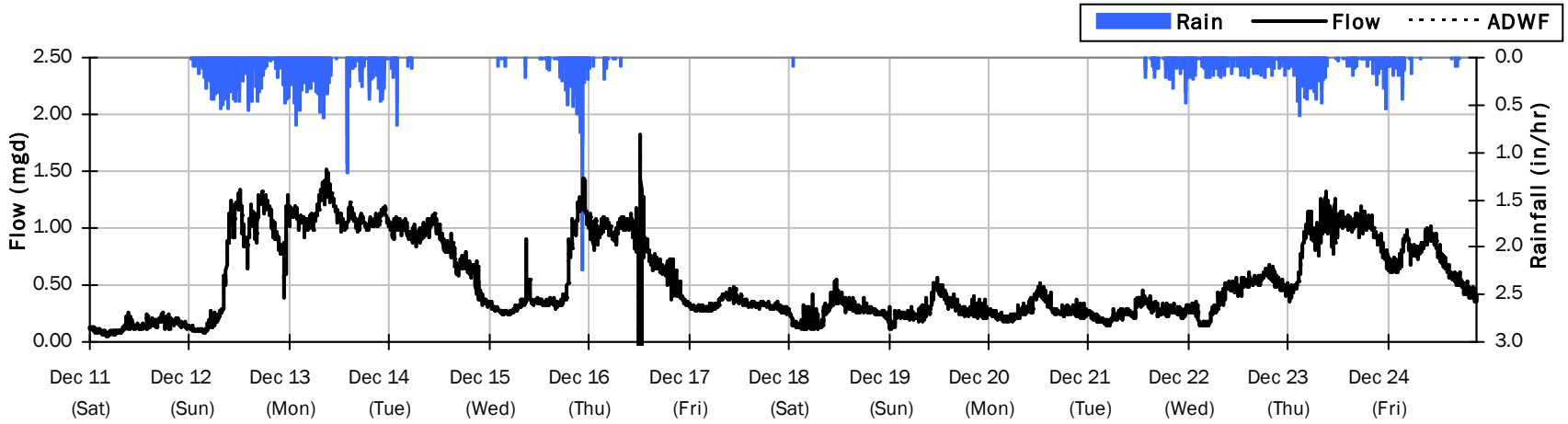
Total Rainfall: 17.40 inches

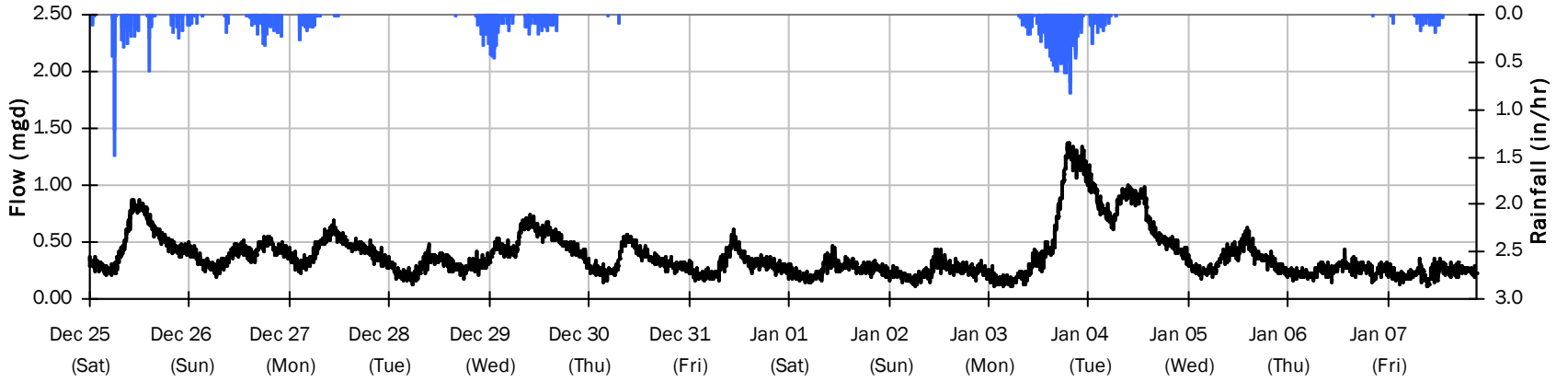


SITE 17

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 19.09 inches Period Avg Flow: 0.451 mgd Period Peak Flow: 1.802 mgd Period Min Flow: -0.738 mgd

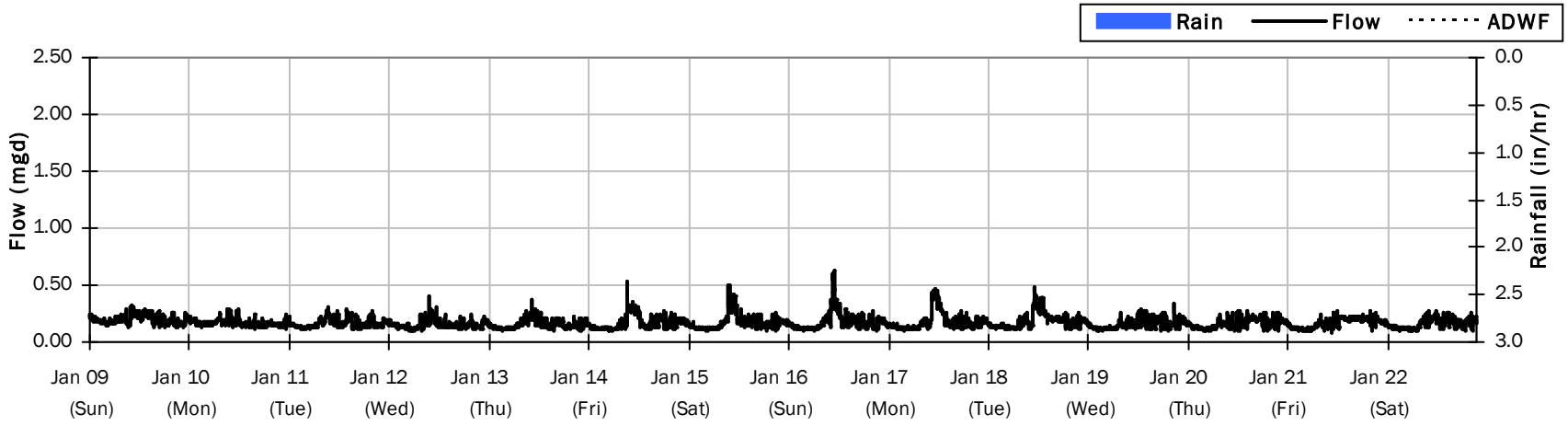


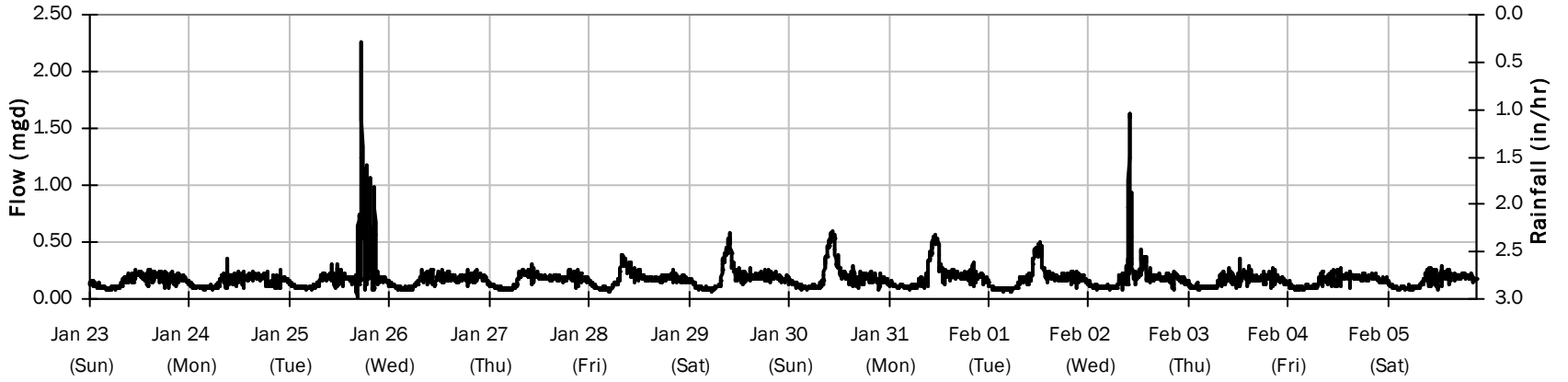


SITE 17

Flow Summary: 1/9/2022 to 2/5/2022

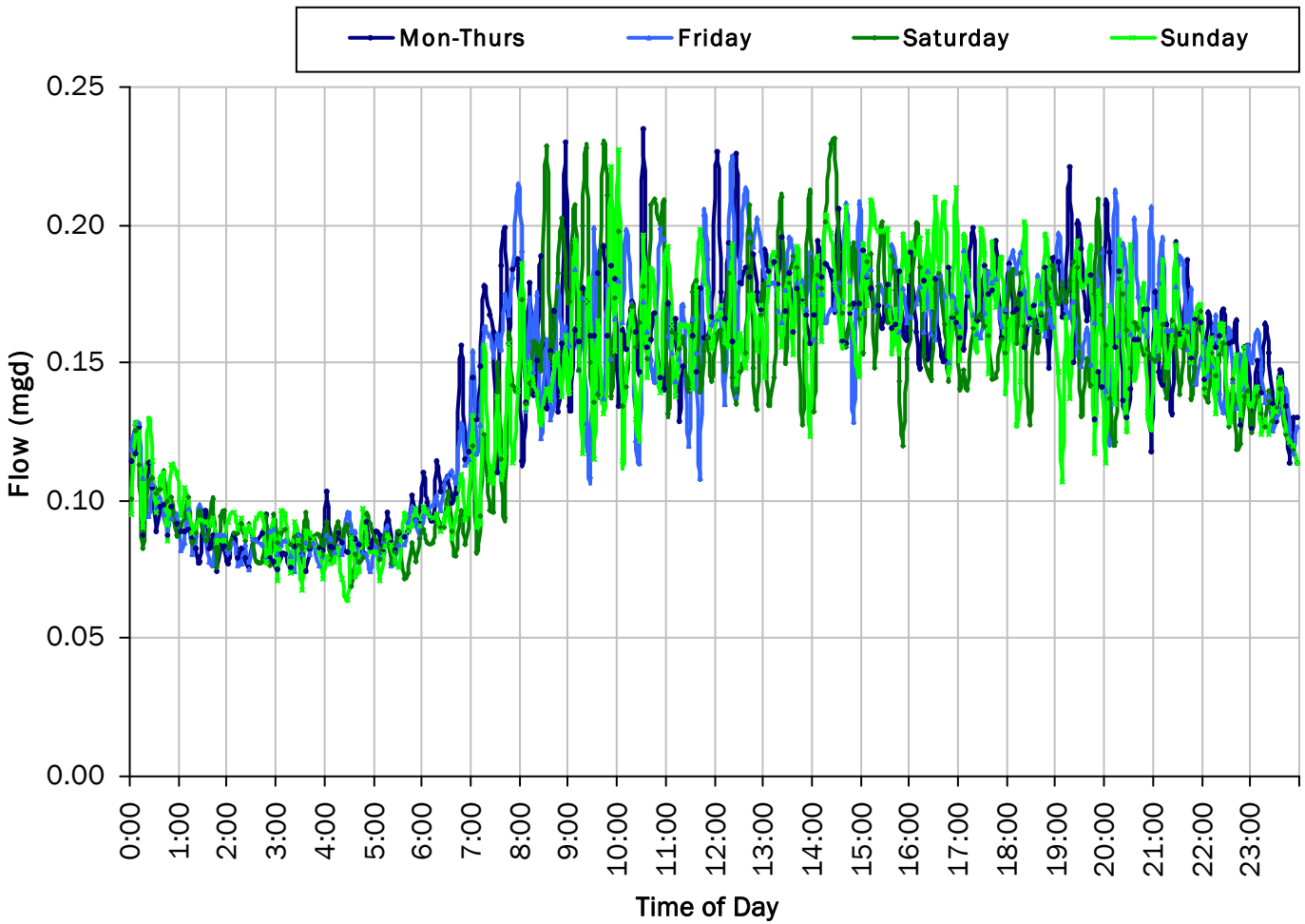
Period Rainfall: 0.00 inches Period Avg Flow: 0.173 mgd Period Peak Flow: 2.256 mgd Period Min Flow: 0.024 mgd





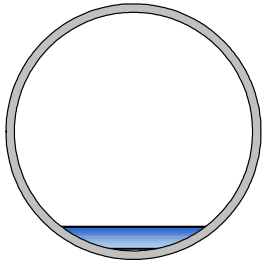
SITE 17

Average Dry Weather Flow Hydrographs



ADWF:

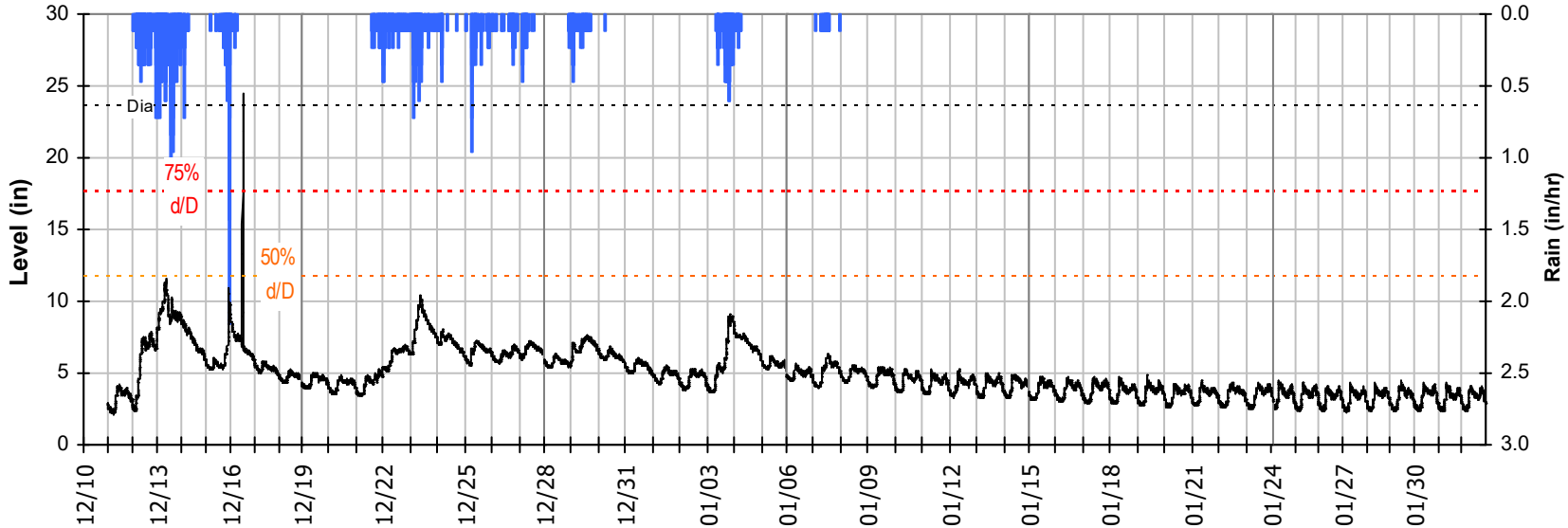
0.142 *mgd*

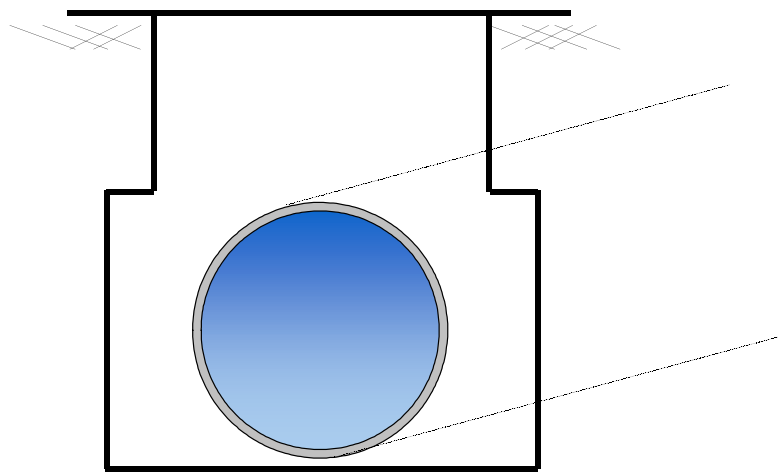


SITE 16

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



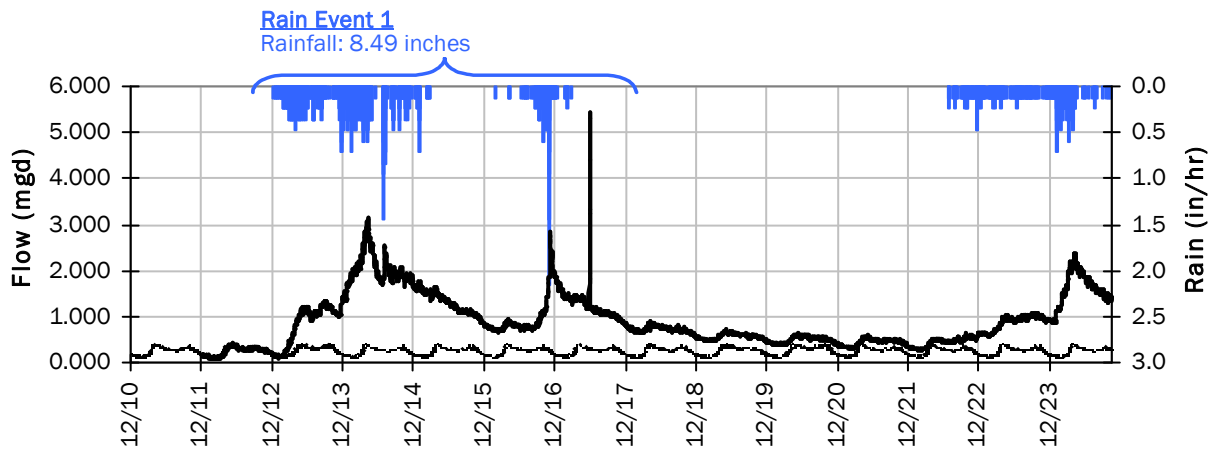


Pipe Diameter:	23.5	*inches*
Peak Measured Level:	24.4	*inches*
Peak d/D Ratio:	1.04	

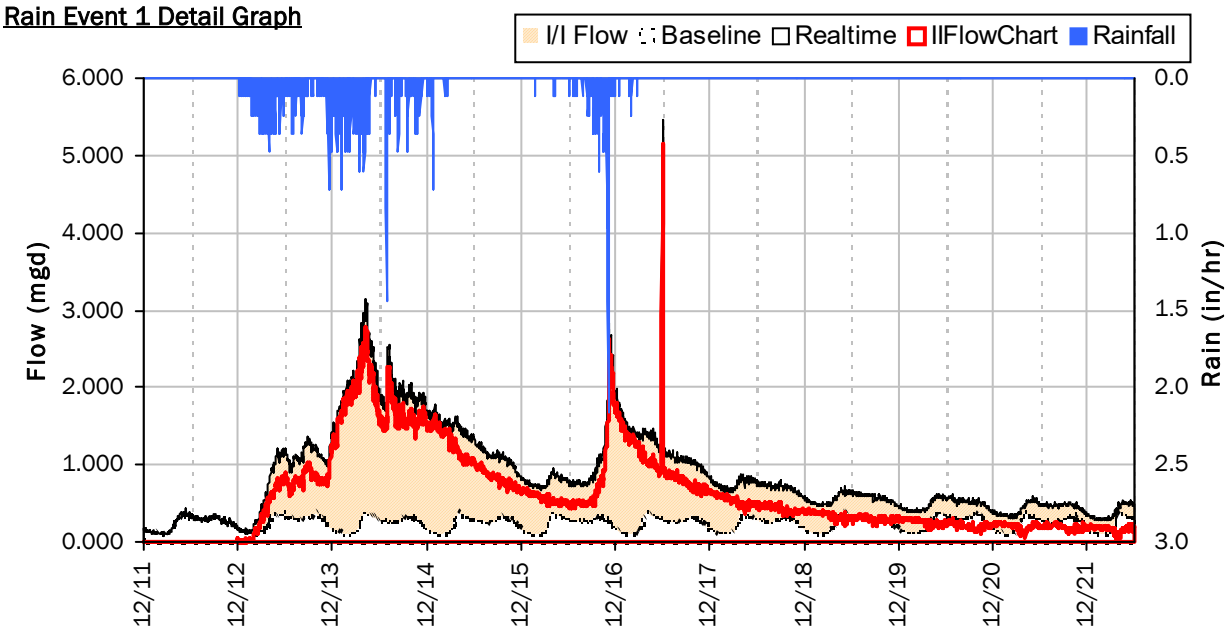
Surcharged 0.9 inches over crown

SITE 16
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

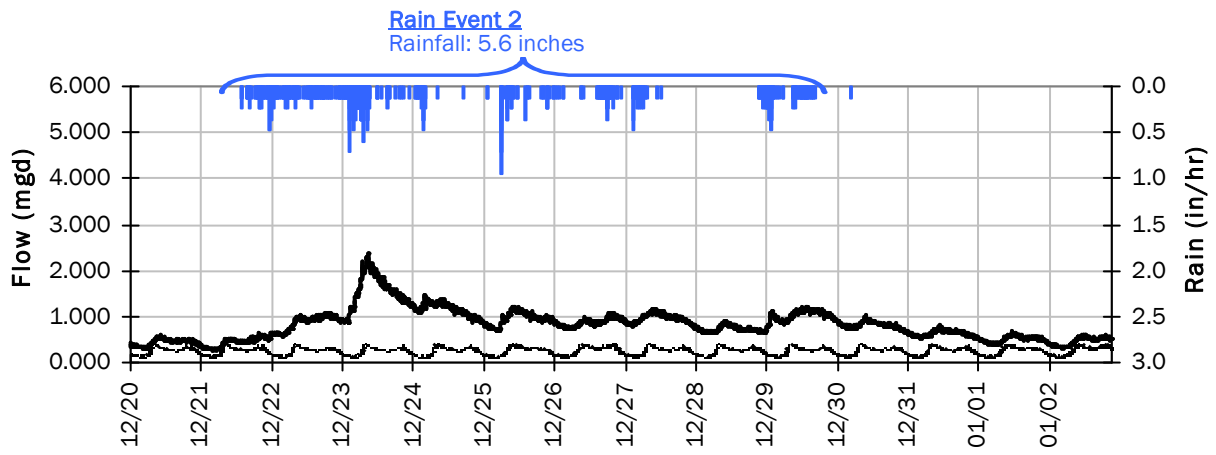


Storm Event I/I Analysis (Rain = 8.49 inches)

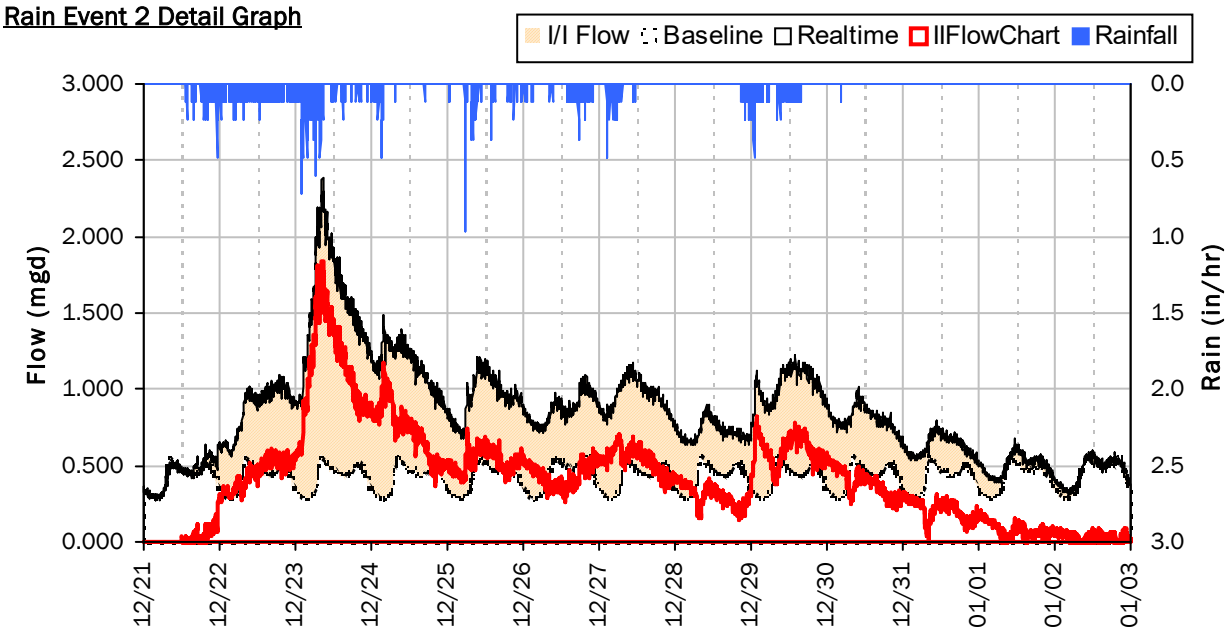
Capacity		Inflow / Infiltration	
Peak Flow:	5.451 *mgd*	**Peak I/I Rate:**	5.156 *mgd*
PF:	22.34	**Total I/I:**	6,520,000 *gallons*
Peak Level:	24.41 *in*		
d/D Ratio:	1.04		

SITE 16
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



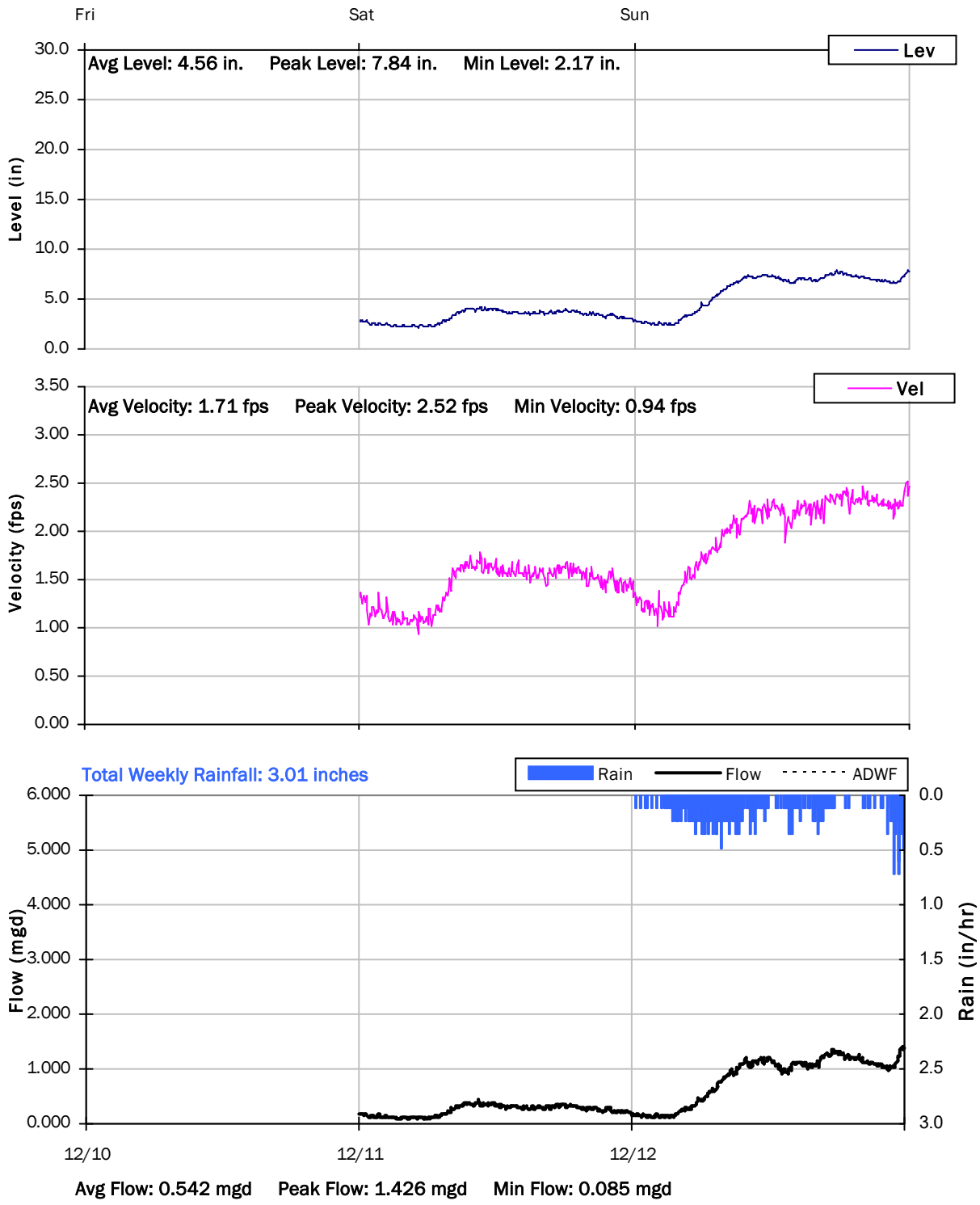
Storm Event I/I Analysis (Rain = 5.60 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	2.382 *mgd*	Peak I/I Rate:	1.843 *mgd*
PF:	9.76	Total I/I:	5,458,000 *gallons*
Peak Level:	10.40 *in*		
d/D Ratio:	0.44		

SITE 16

Weekly Level, Velocity and Flow Hydrographs

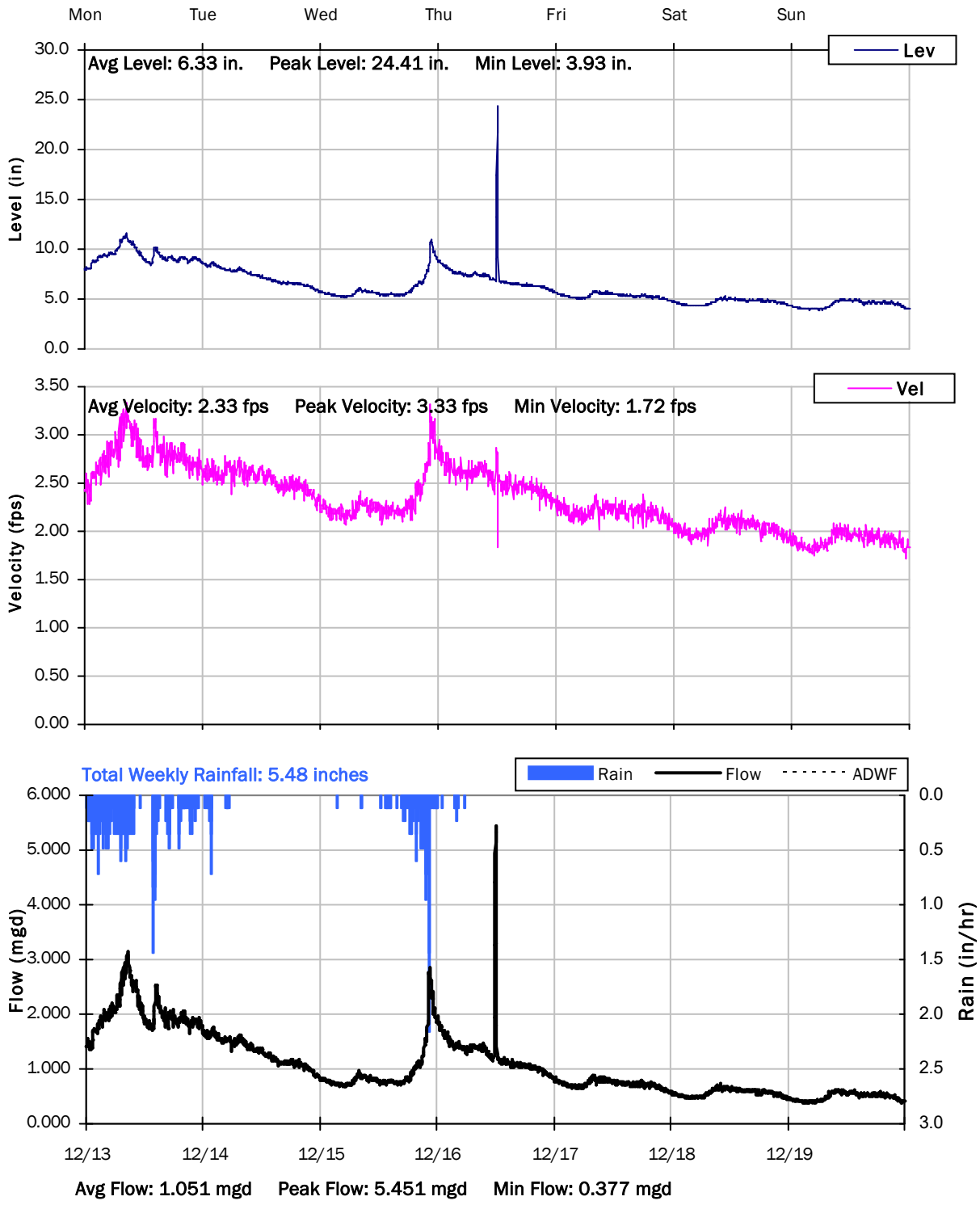
12/10/2021 to 12/13/2021



SITE 16

Weekly Level, Velocity and Flow Hydrographs

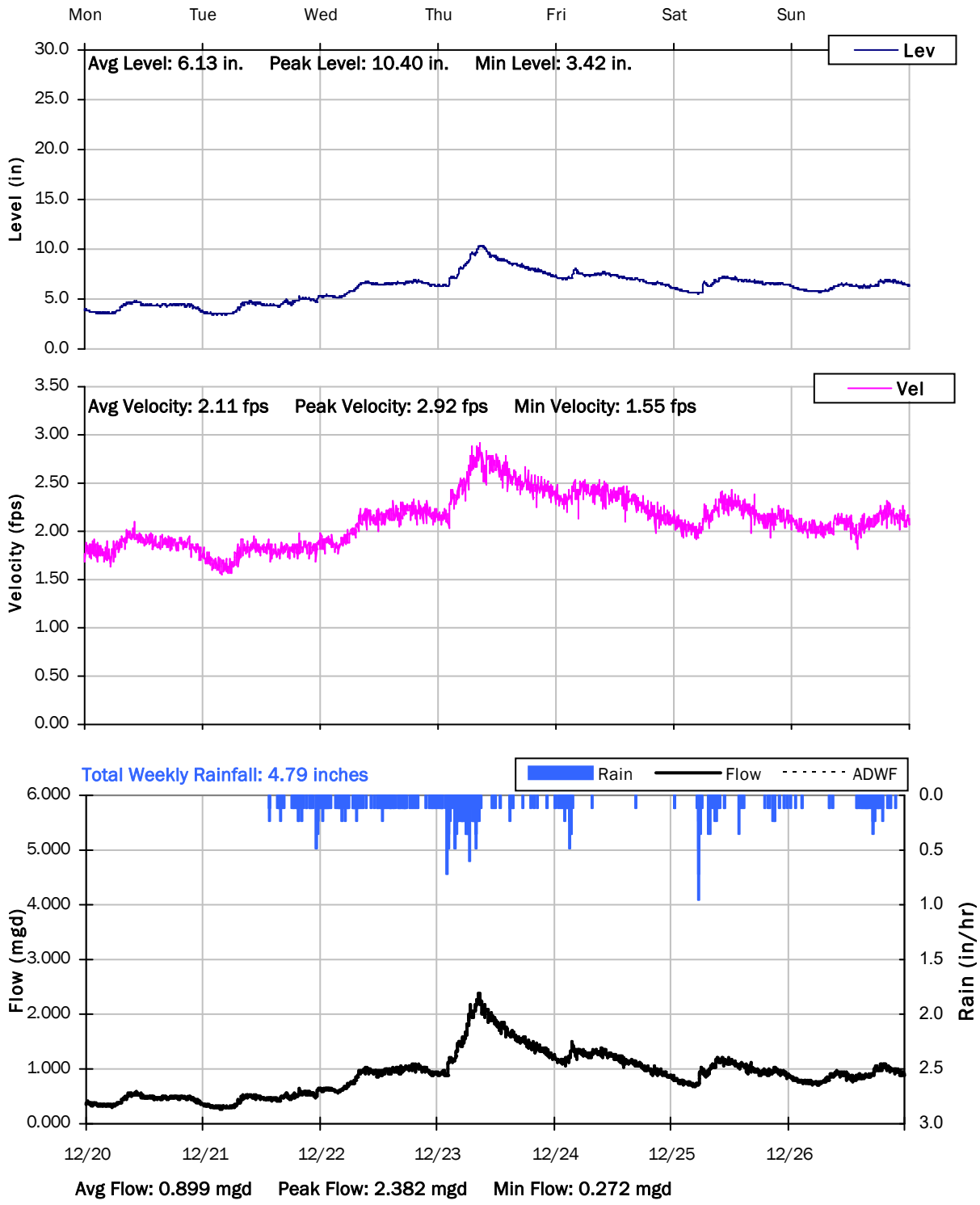
12/13/2021 to 12/20/2021



SITE 16

Weekly Level, Velocity and Flow Hydrographs

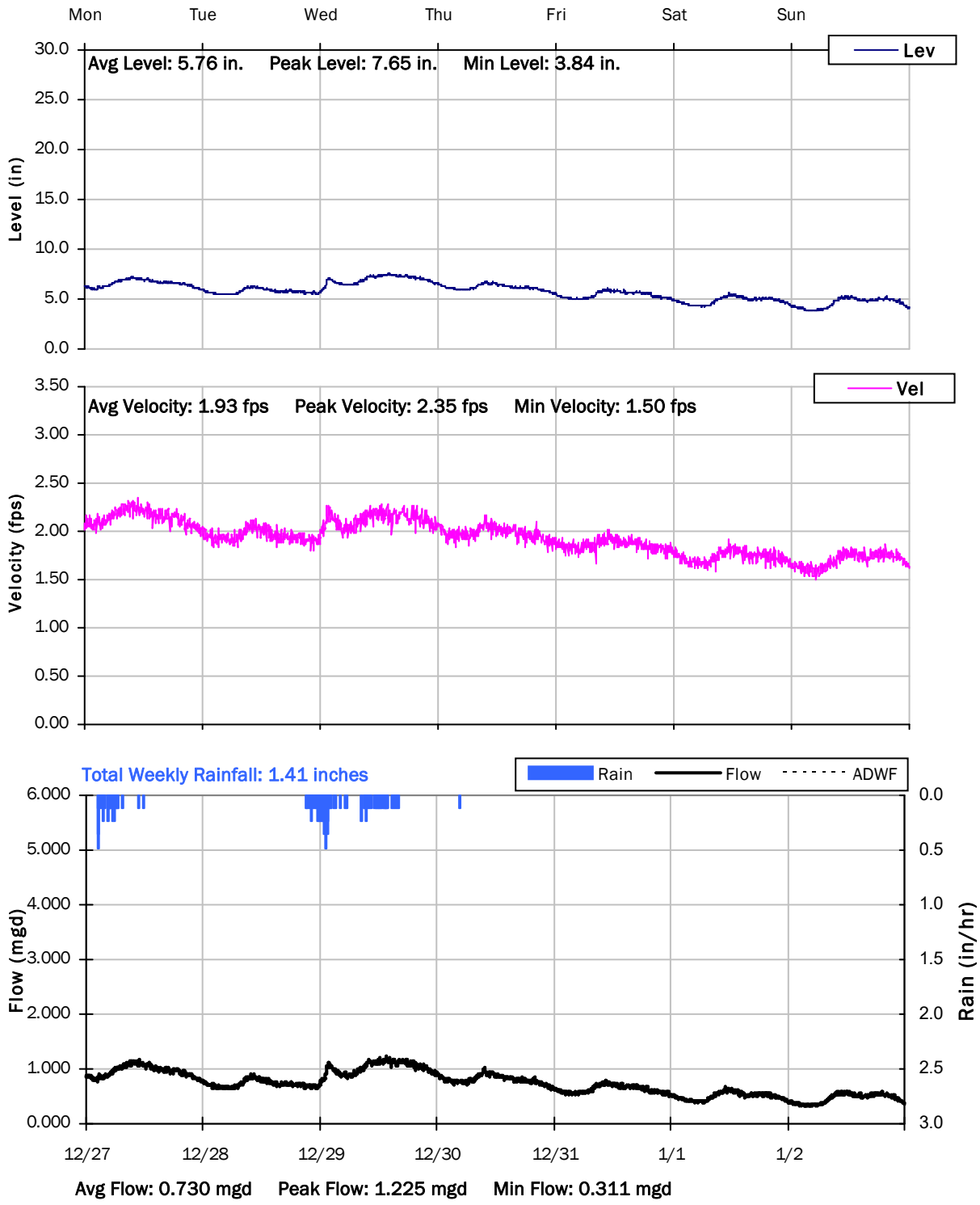
12/20/2021 to 12/27/2021



SITE 16

Weekly Level, Velocity and Flow Hydrographs

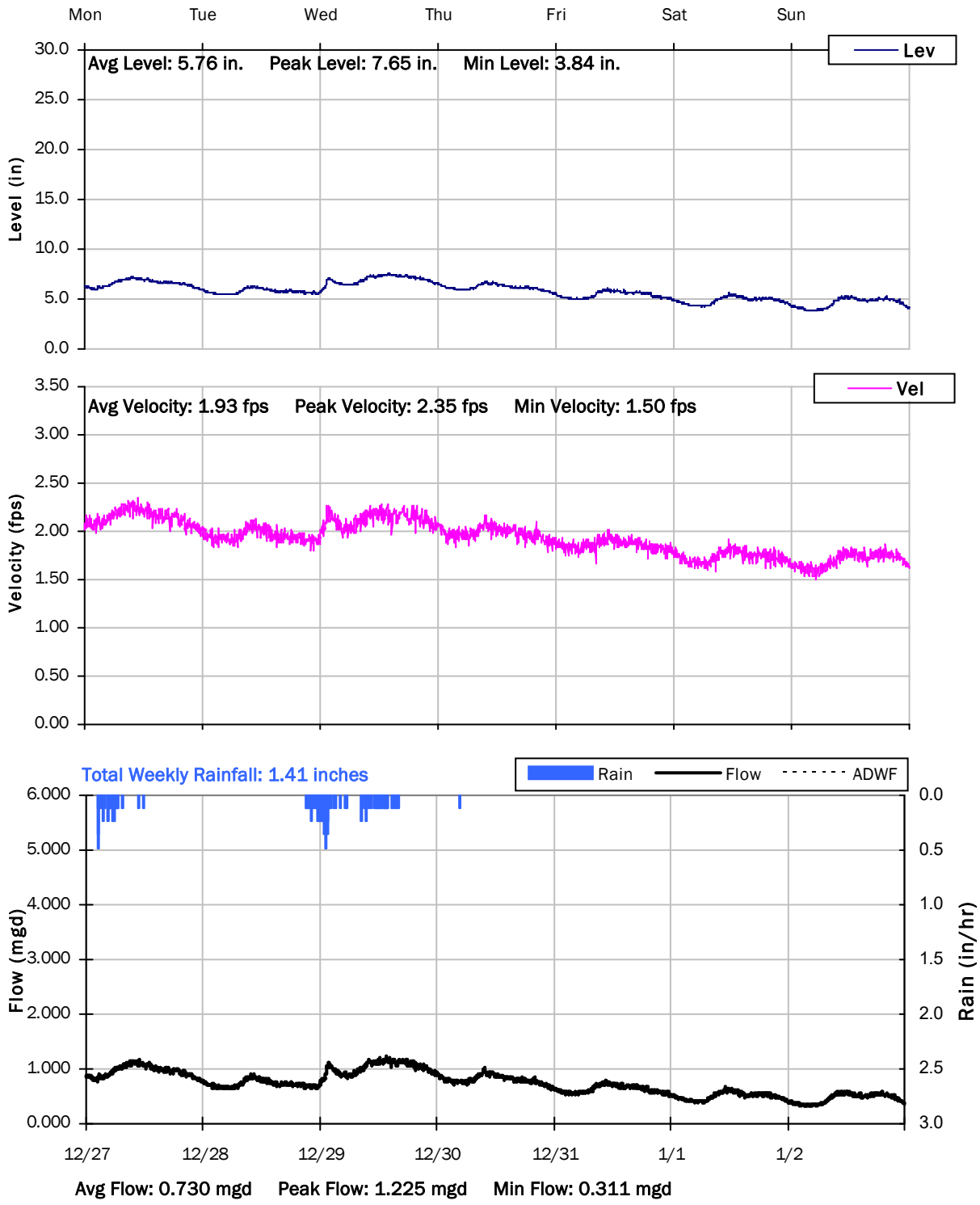
12/27/2021 to 1/3/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

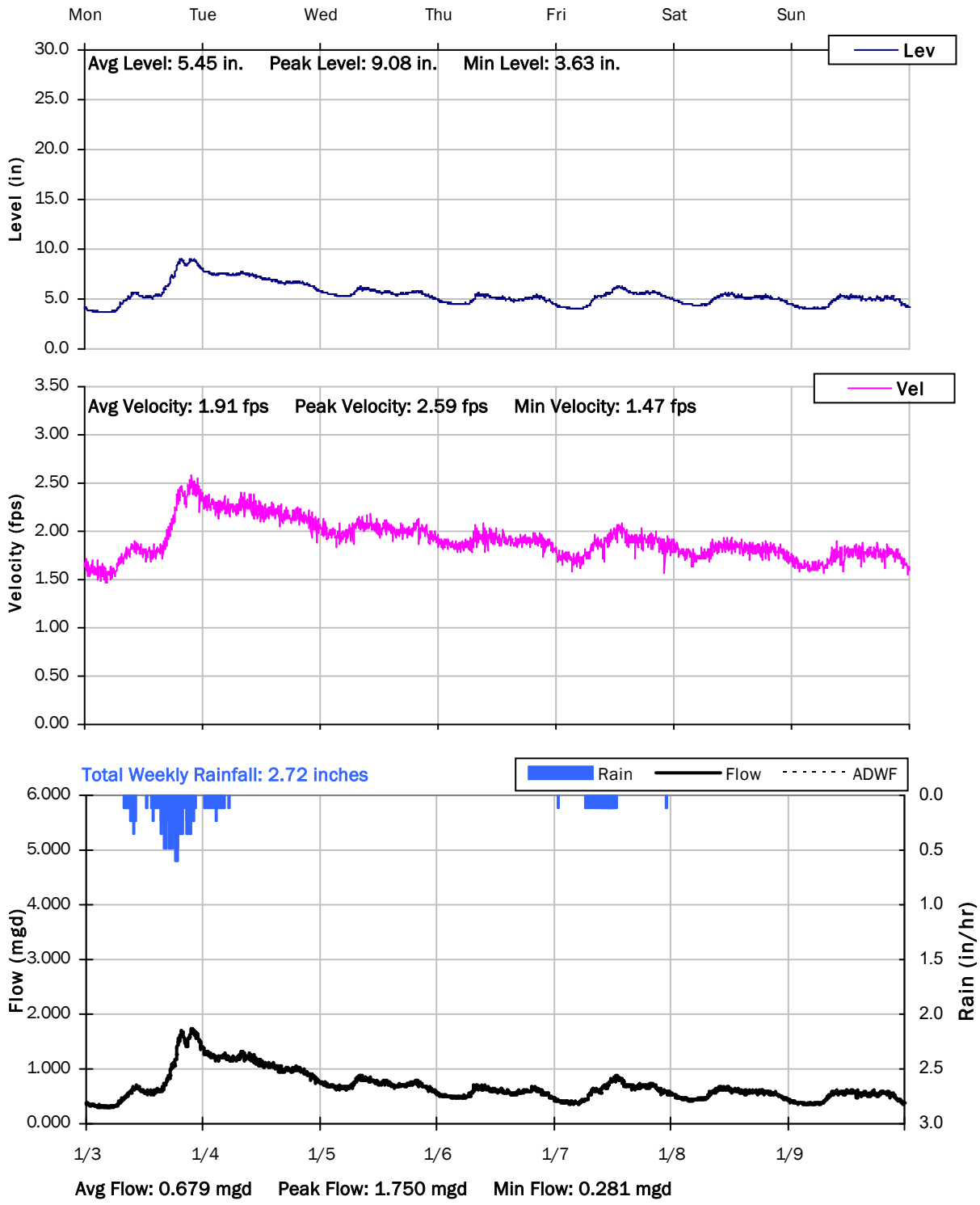
12/27/2021 to 1/3/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

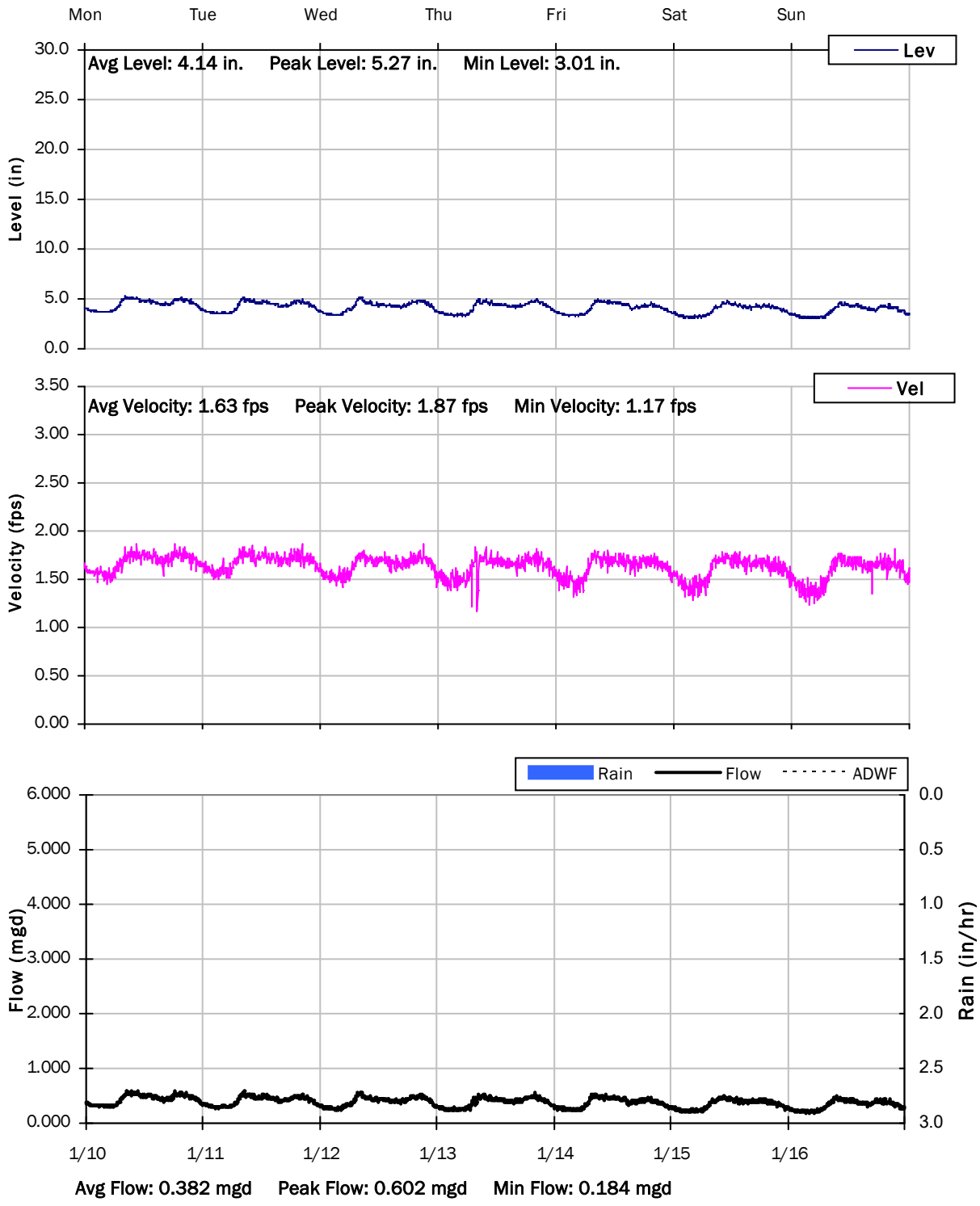
1/3/2022 to 1/10/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

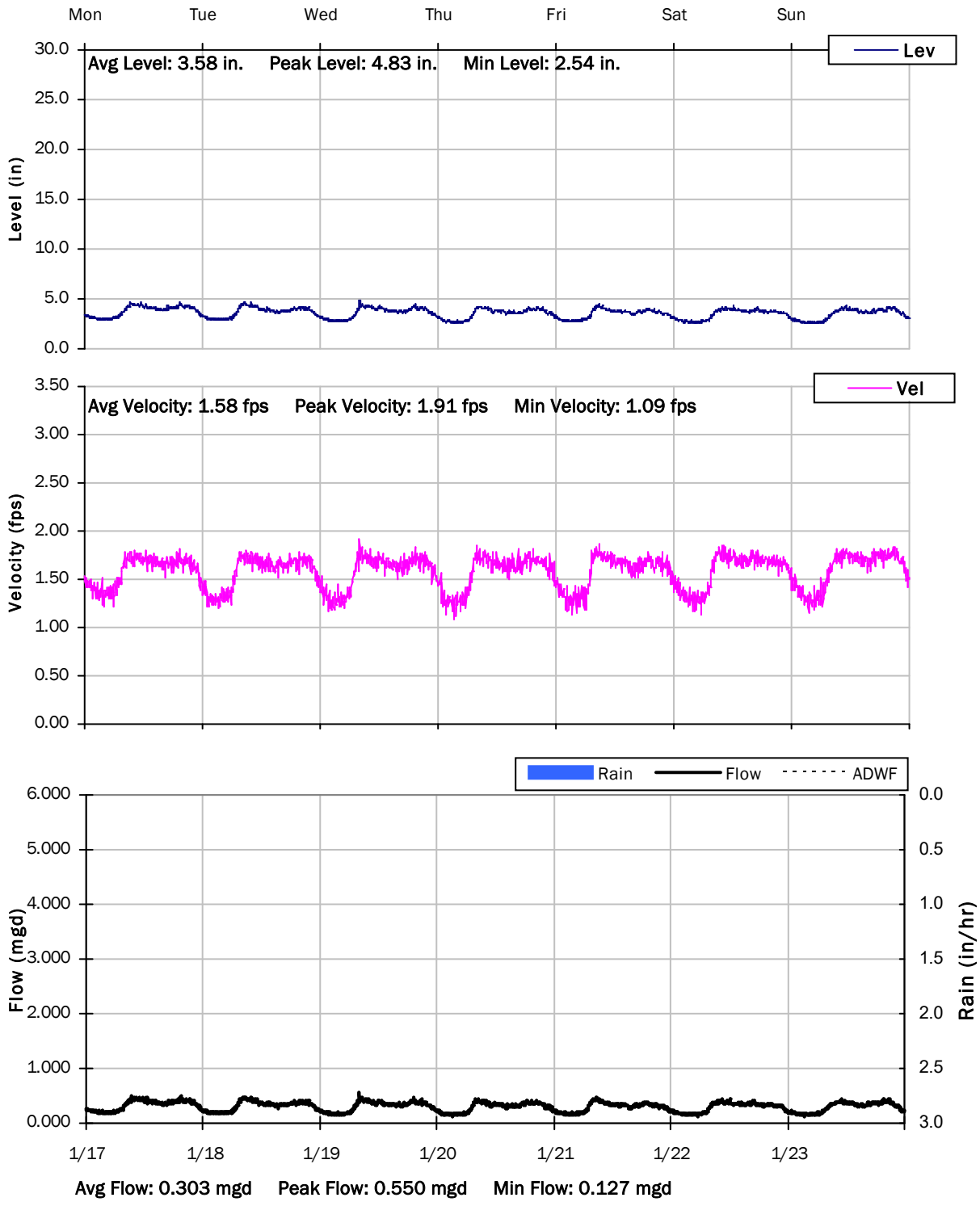
1/10/2022 to 1/17/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

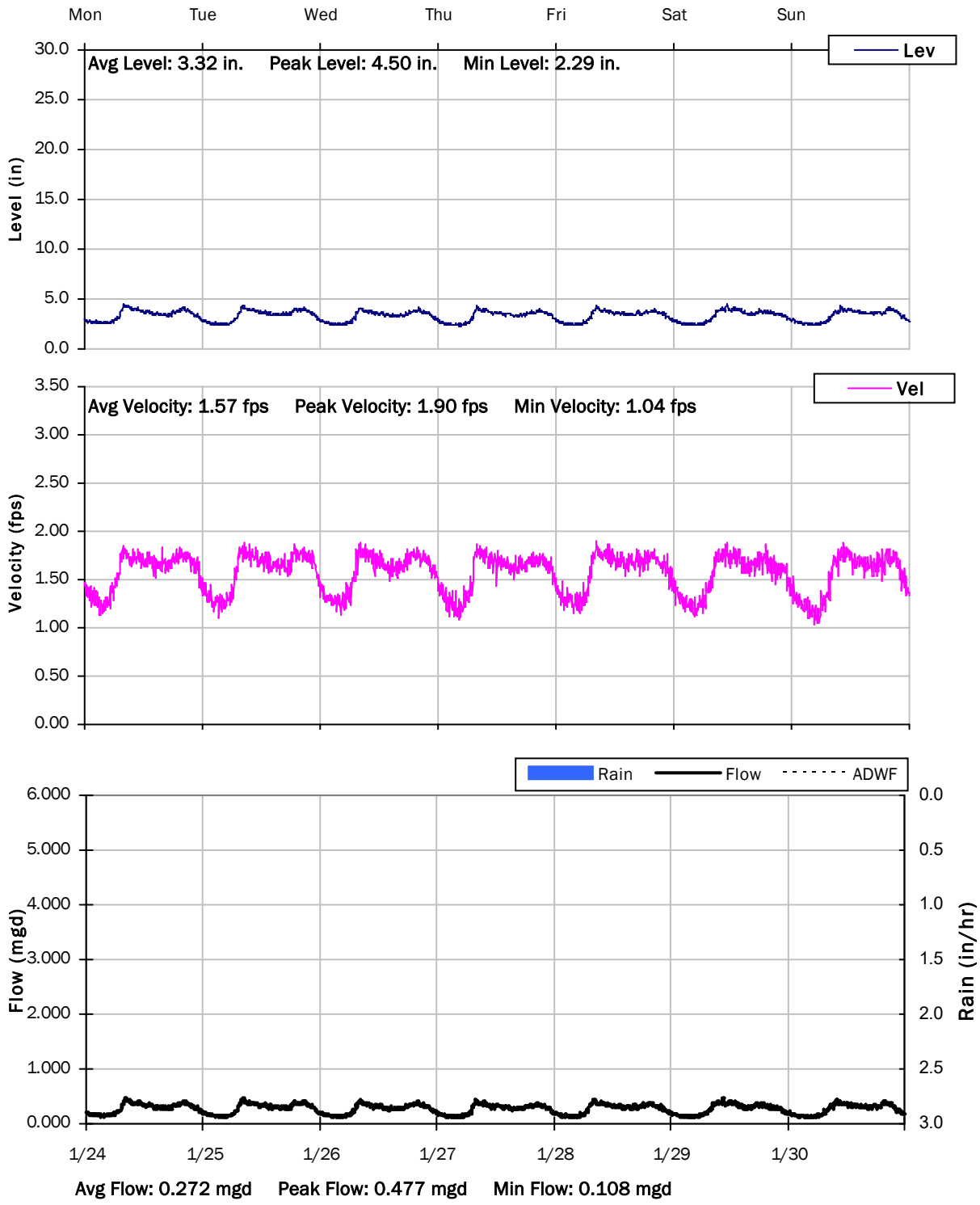
1/17/2022 to 1/24/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

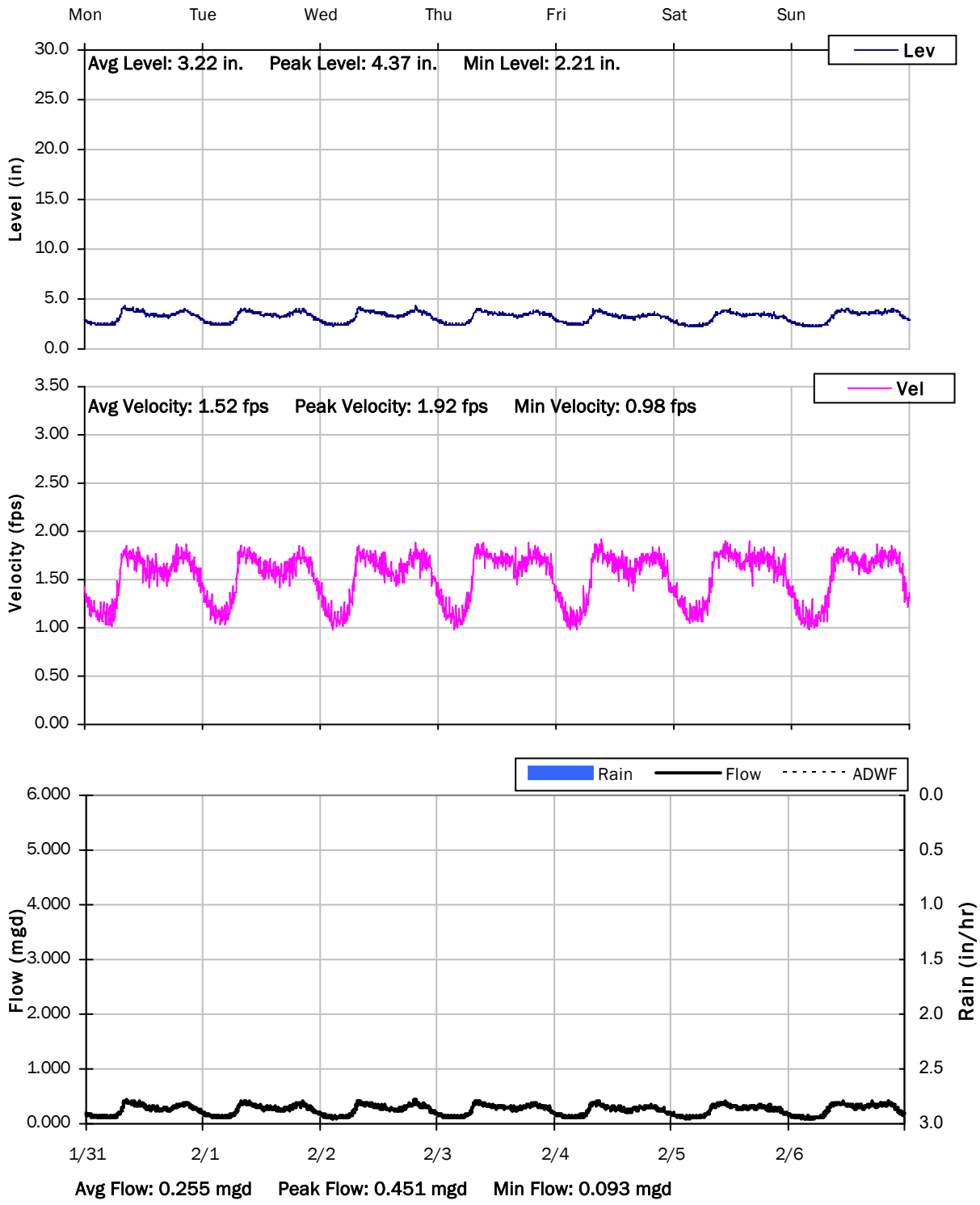
1/24/2022 to 1/31/2022



SITE 16

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 17

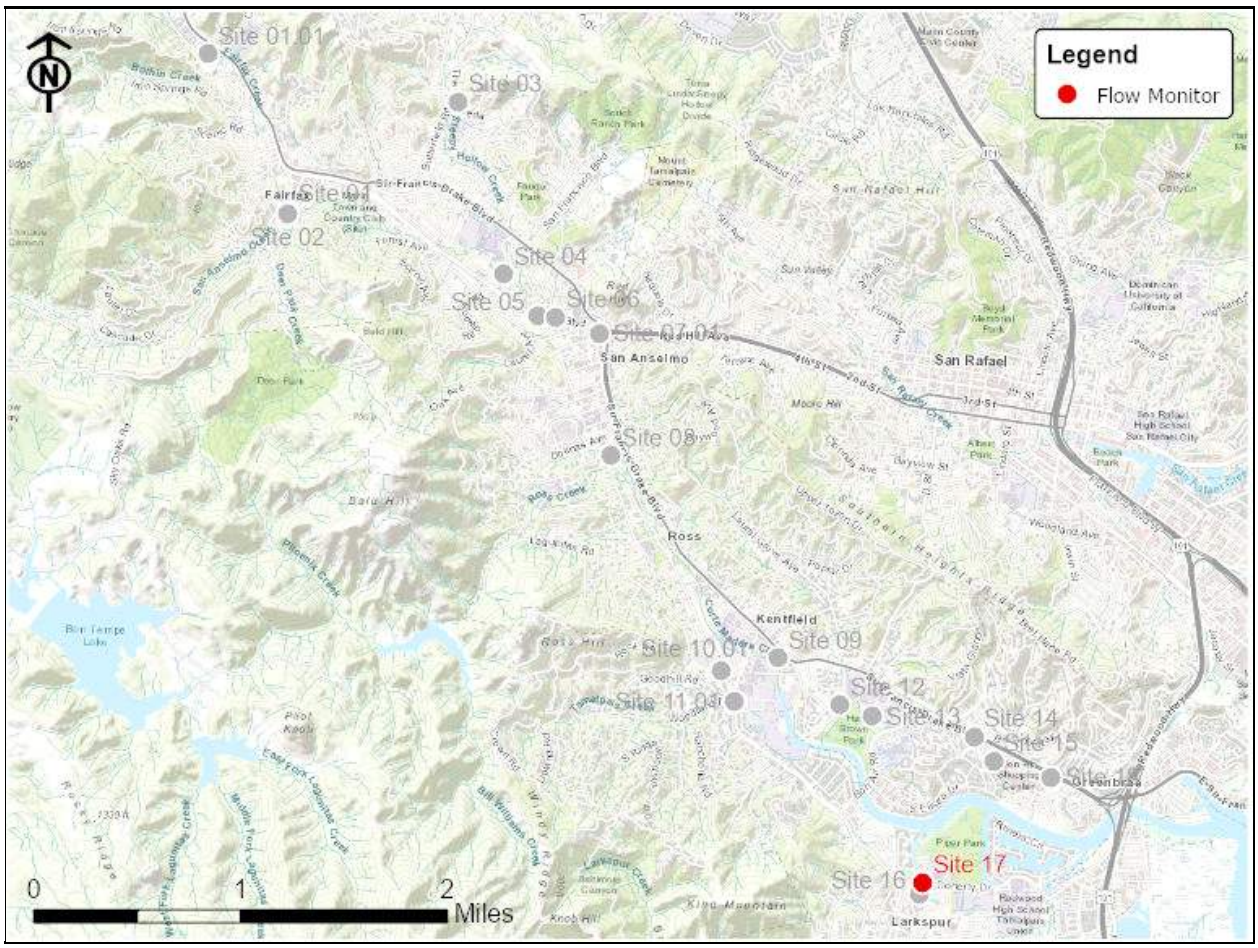
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Sidewalk on Doherty Drive west of Larkspur Main PS and Hall Middle School

Data Summary Report



Vicinity Map: Site 17

SITE 17

Site Information MH ID: L152.030

Location: Sidewalk on Doherty Drive west of Larkspur Main PS and Hall Middle School

Coordinates: 122.5327° W, 37.9383° N

Rim Elevation (Earth): 12 feet

Expected Pipe Diameter: 21 inches

Measured Pipe Diameter: 19 inches

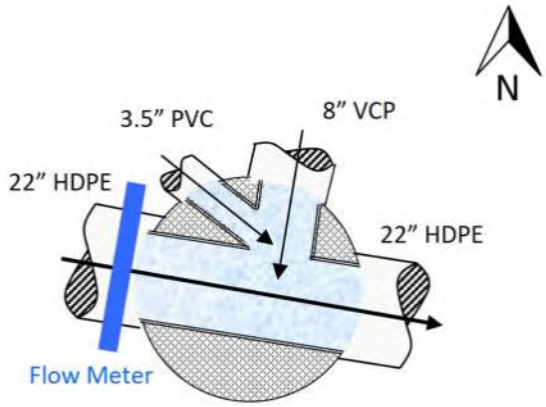
ADWF: 0.142 mgd

Peak Measured Flow: 2.256 mgd

Sediment: None

Satellite Map

Sanitary Map



Flow Sketch

Street View

Plan View

SITE 17

Additional Site Photos

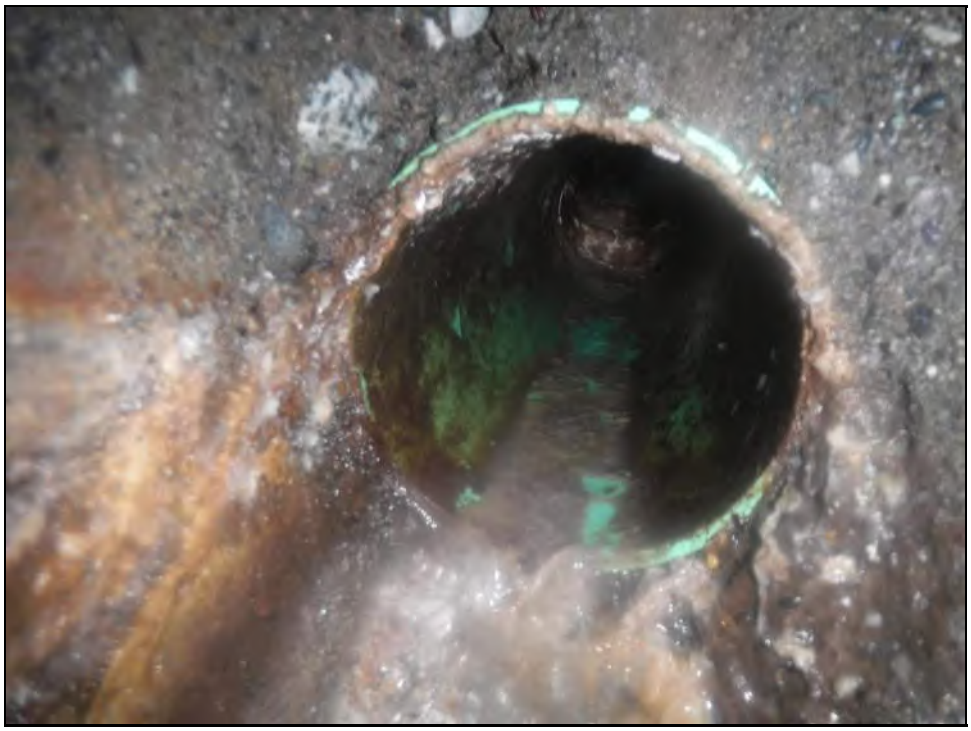
Effluent Pipe

Monitored West Influent Pipe

SITE 17

Additional Site Photos

Northwest Influent Pipe

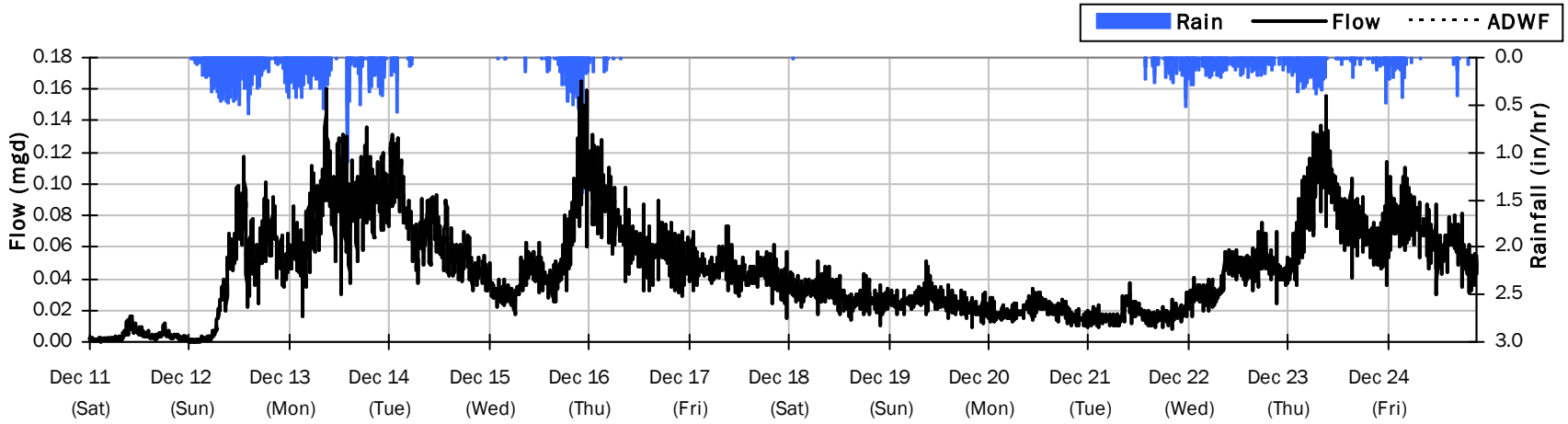


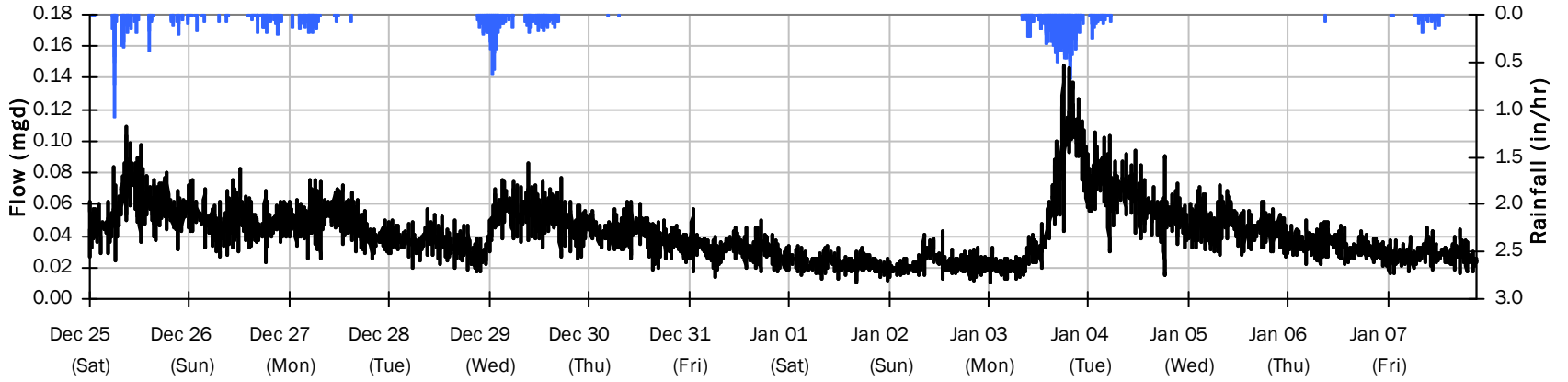
North Influent Pipe

SITE 18

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 16.45 inches Period Avg Flow: 0.043 mgd Period Peak Flow: 0.164 mgd Period Min Flow: 0.000 mgd

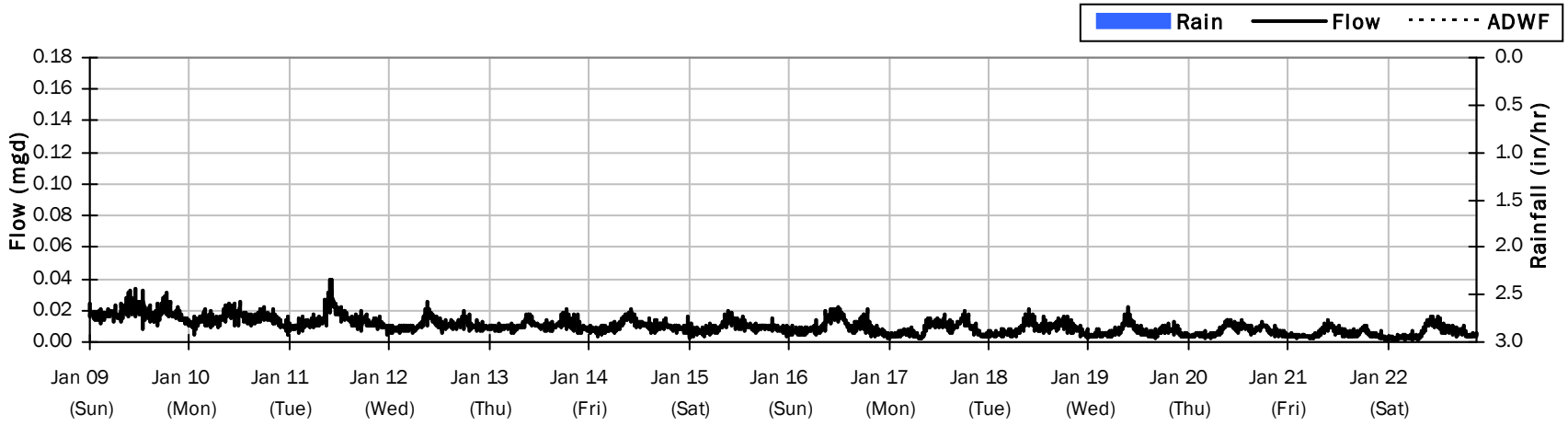


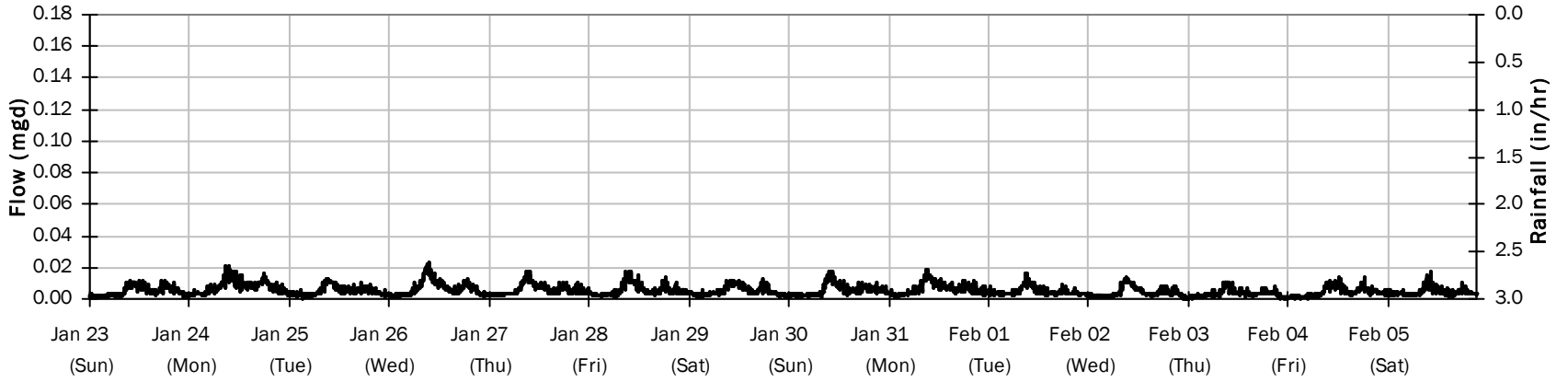


SITE 18

Flow Summary: 1/9/2022 to 2/5/2022

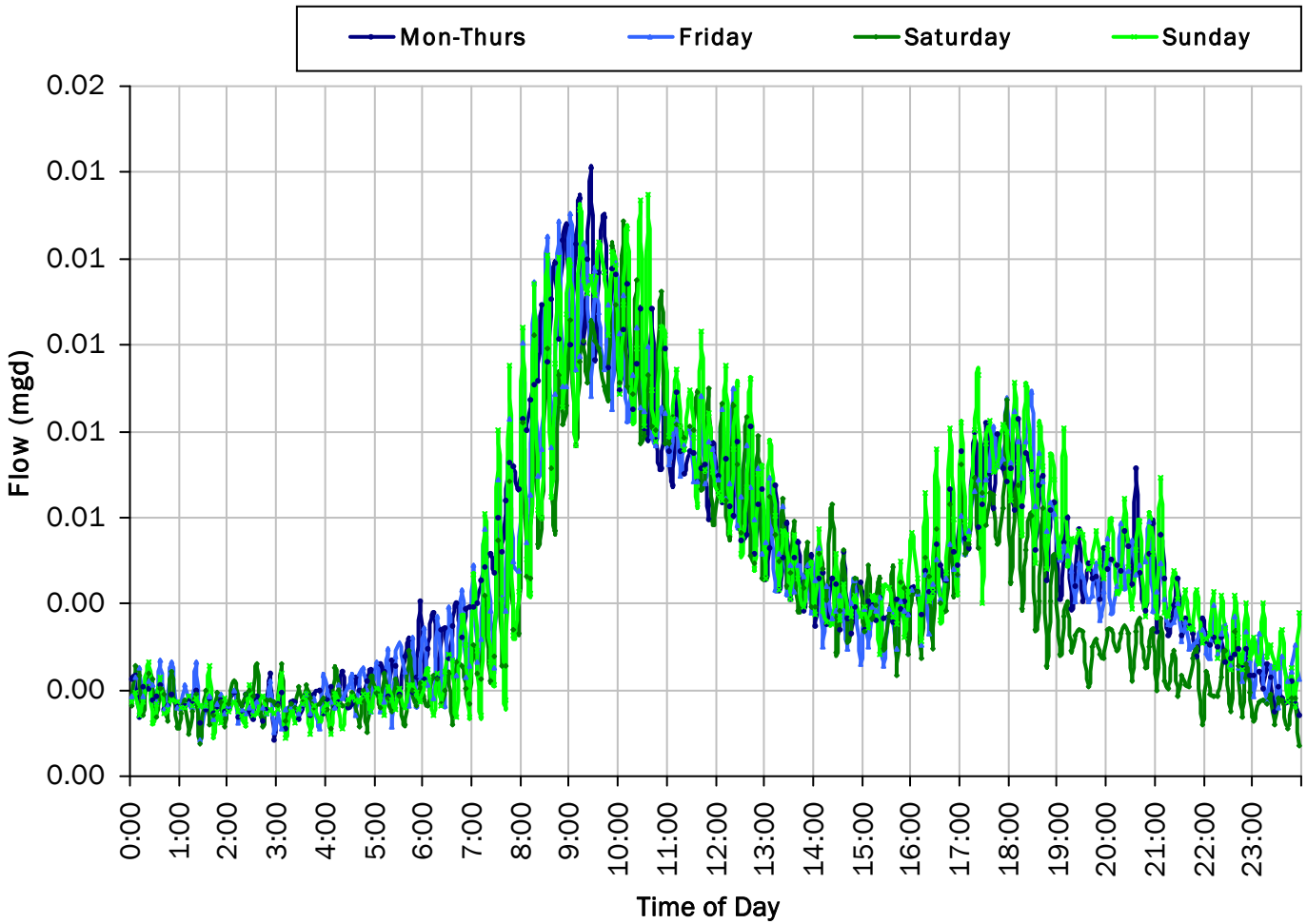
Period Rainfall: 0.00 inches Period Avg Flow: 0.008 mgd Period Peak Flow: 0.040 mgd Period Min Flow: 0.000 mgd





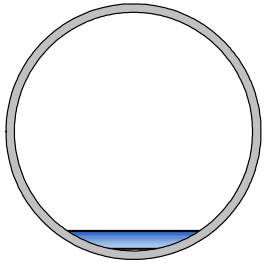
SITE 18

Average Dry Weather Flow Hydrographs



ADWF:

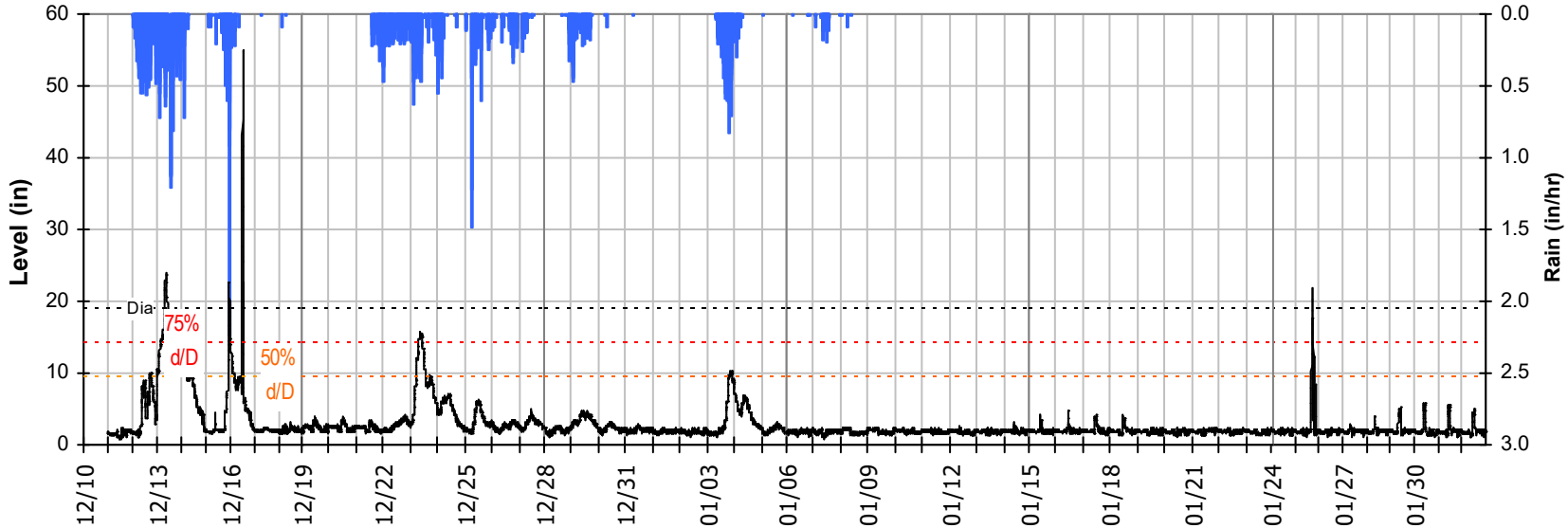
0.005 *mgd*

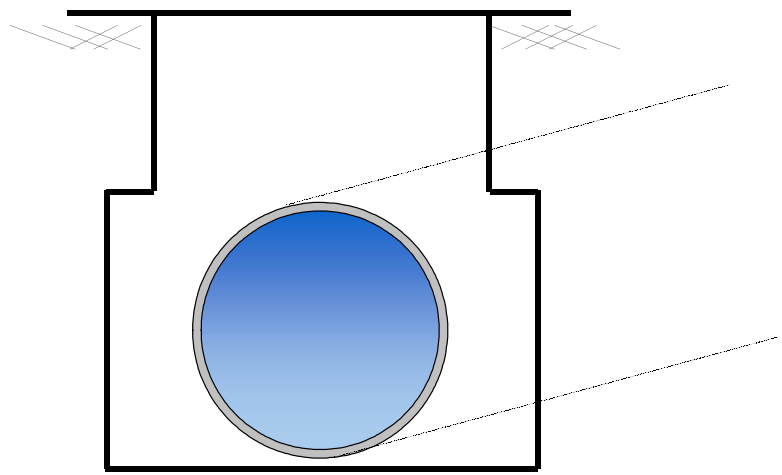


SITE 17

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



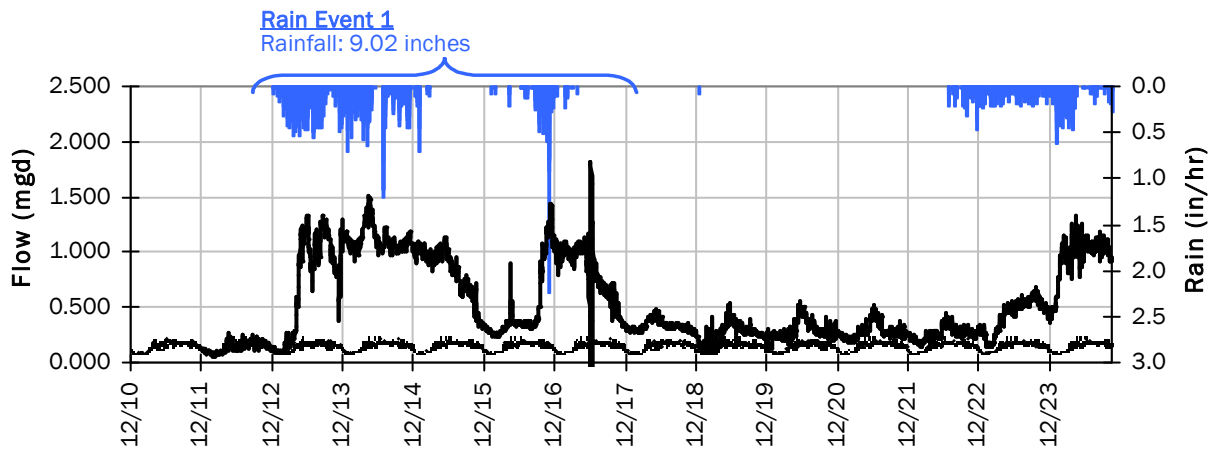


Pipe Diameter:	19	*inches*
Peak Measured Level:	54.7	*inches*
Peak d/D Ratio:	2.88	

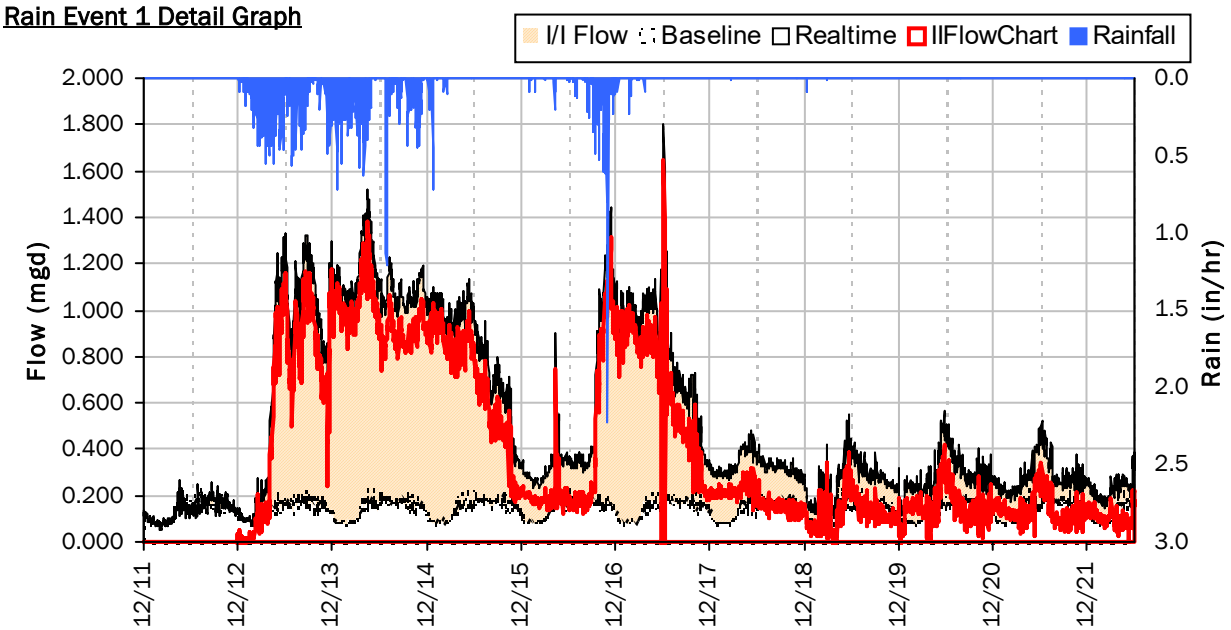
Surcharged 35.7 inches over crown

SITE 17
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

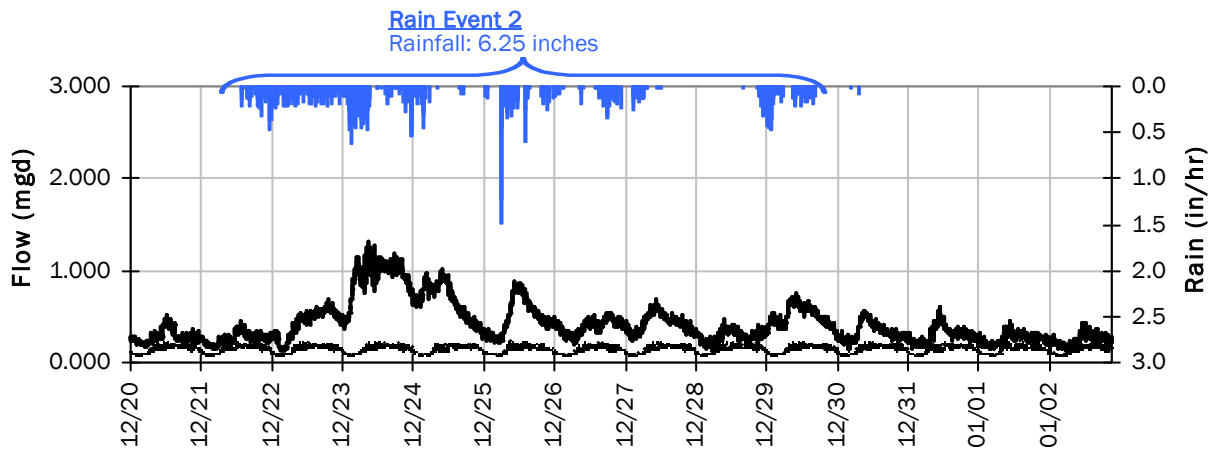


Storm Event I/I Analysis (Rain = 9.02 inches)

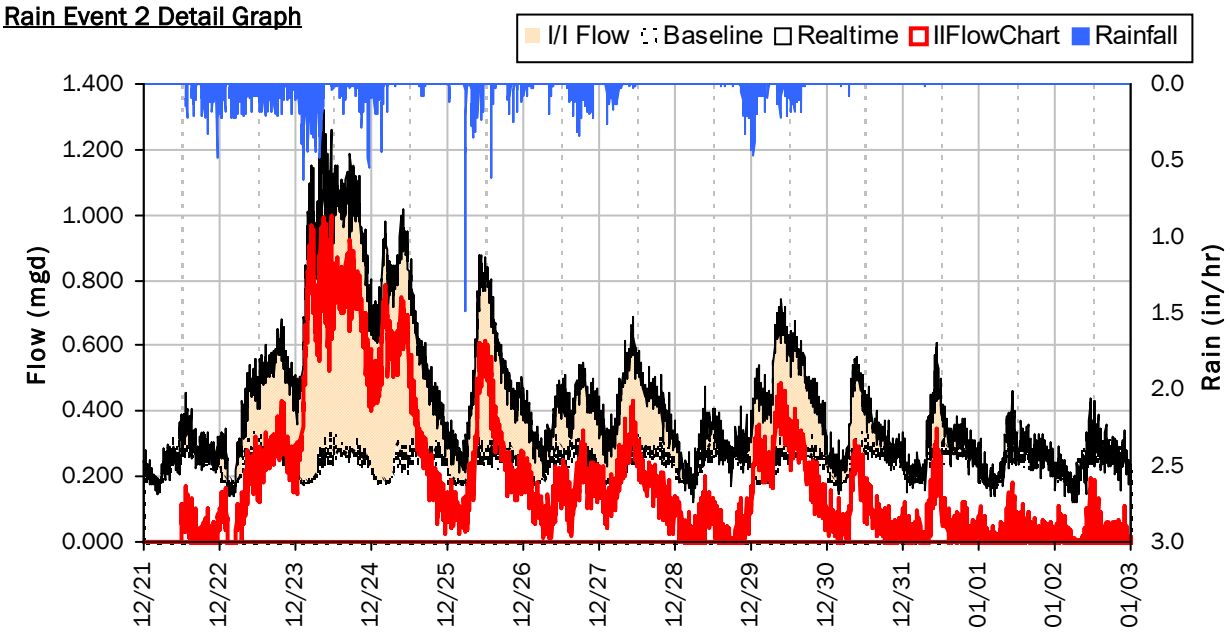
Capacity		Inflow / Infiltration	
Peak Flow:	1.802 *mgd*	Peak I/I Rate:	1.645 *mgd*
PF:	12.65	Total I/I:	3,883,000 *gallons*
Peak Level:	54.69 *in*		
d/D Ratio:	2.88		

SITE 17
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



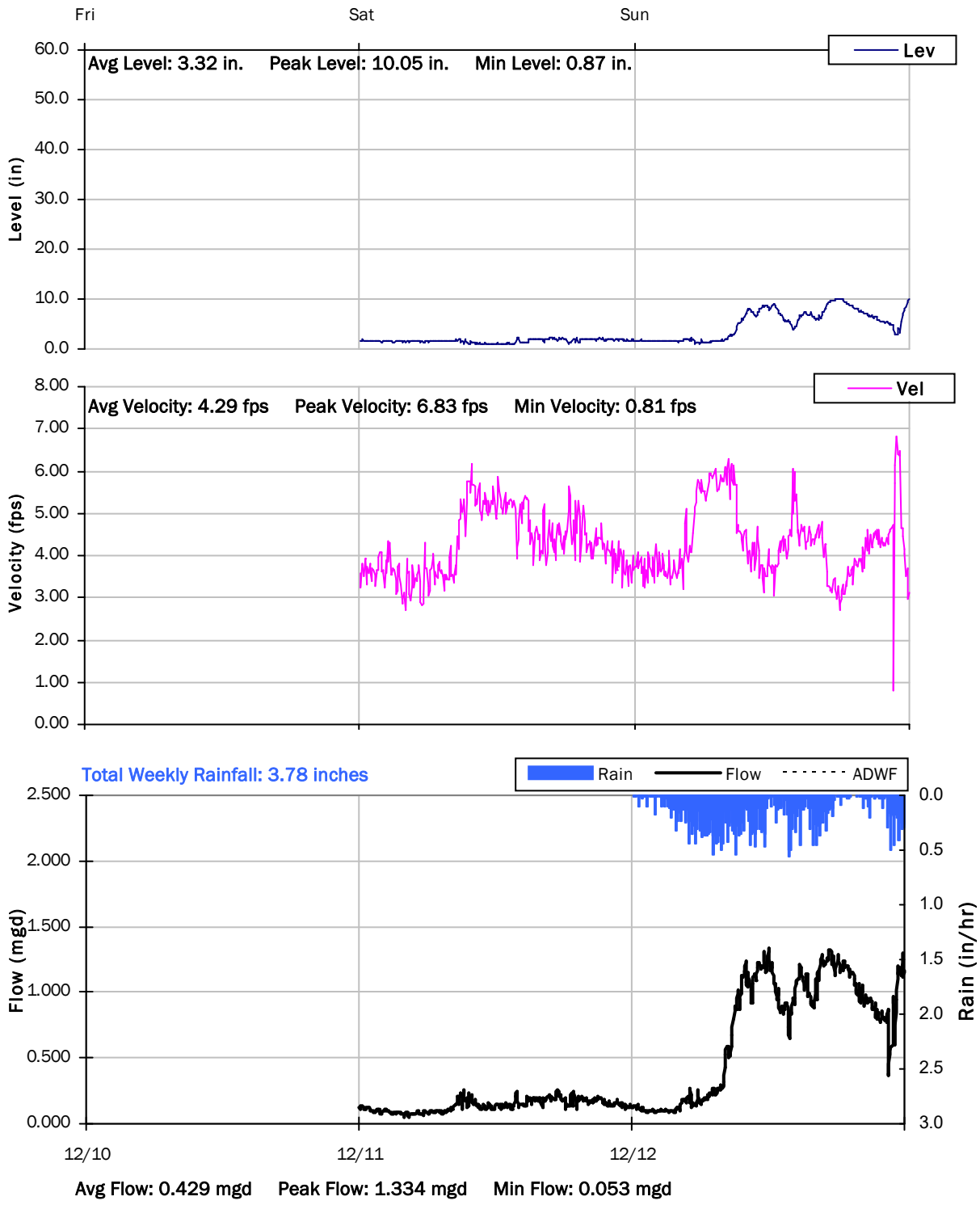
Storm Event I/I Analysis (Rain = 6.25 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.323 *mgd*	**Peak I/I Rate:**	1.000 *mgd*
PF:	9.28	**Total I/I:**	2,395,000 *gallons*
Peak Level:	15.84 *in*		
d/D Ratio:	0.83		

SITE 17

Weekly Level, Velocity and Flow Hydrographs

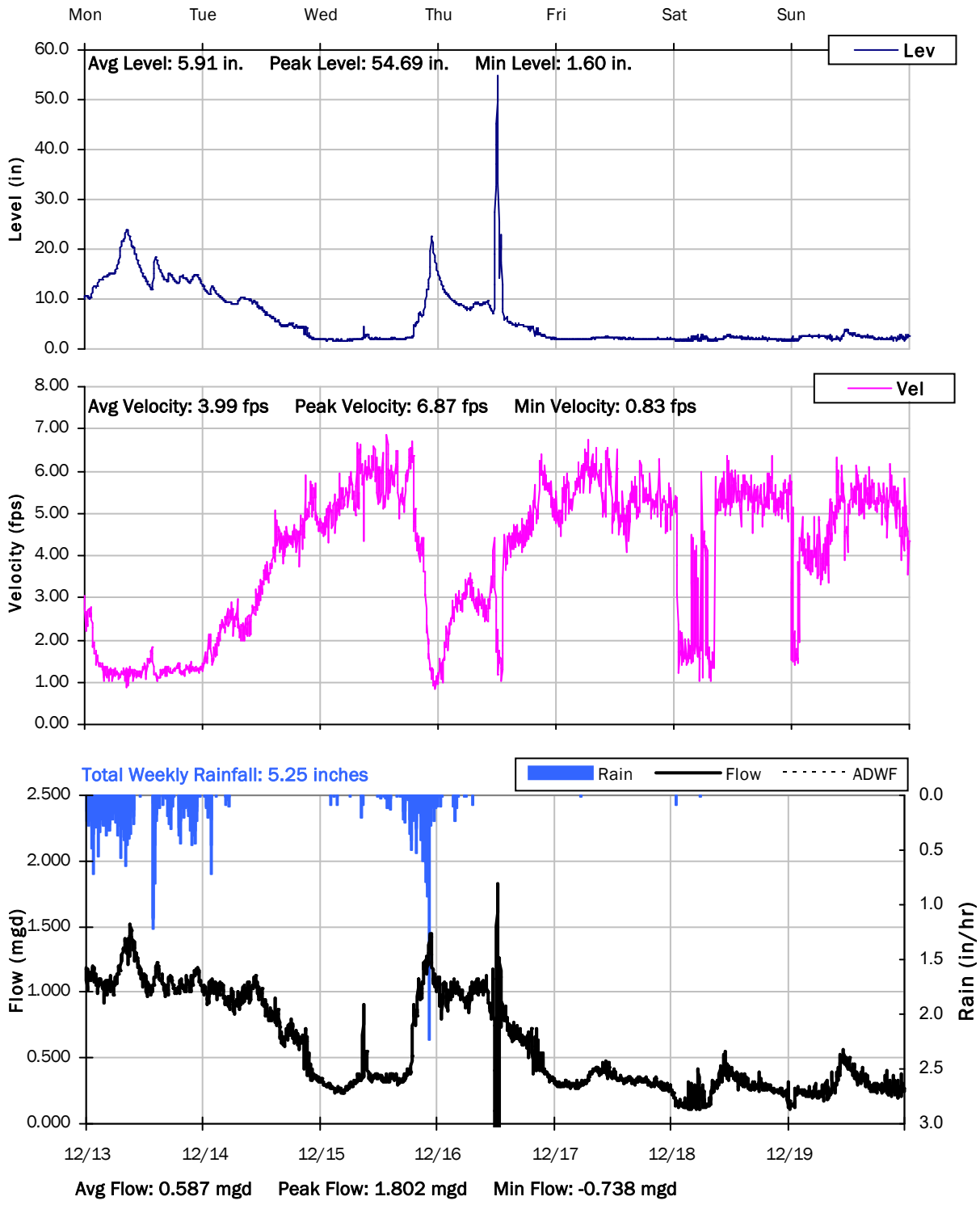
12/10/2021 to 12/13/2021



SITE 17

Weekly Level, Velocity and Flow Hydrographs

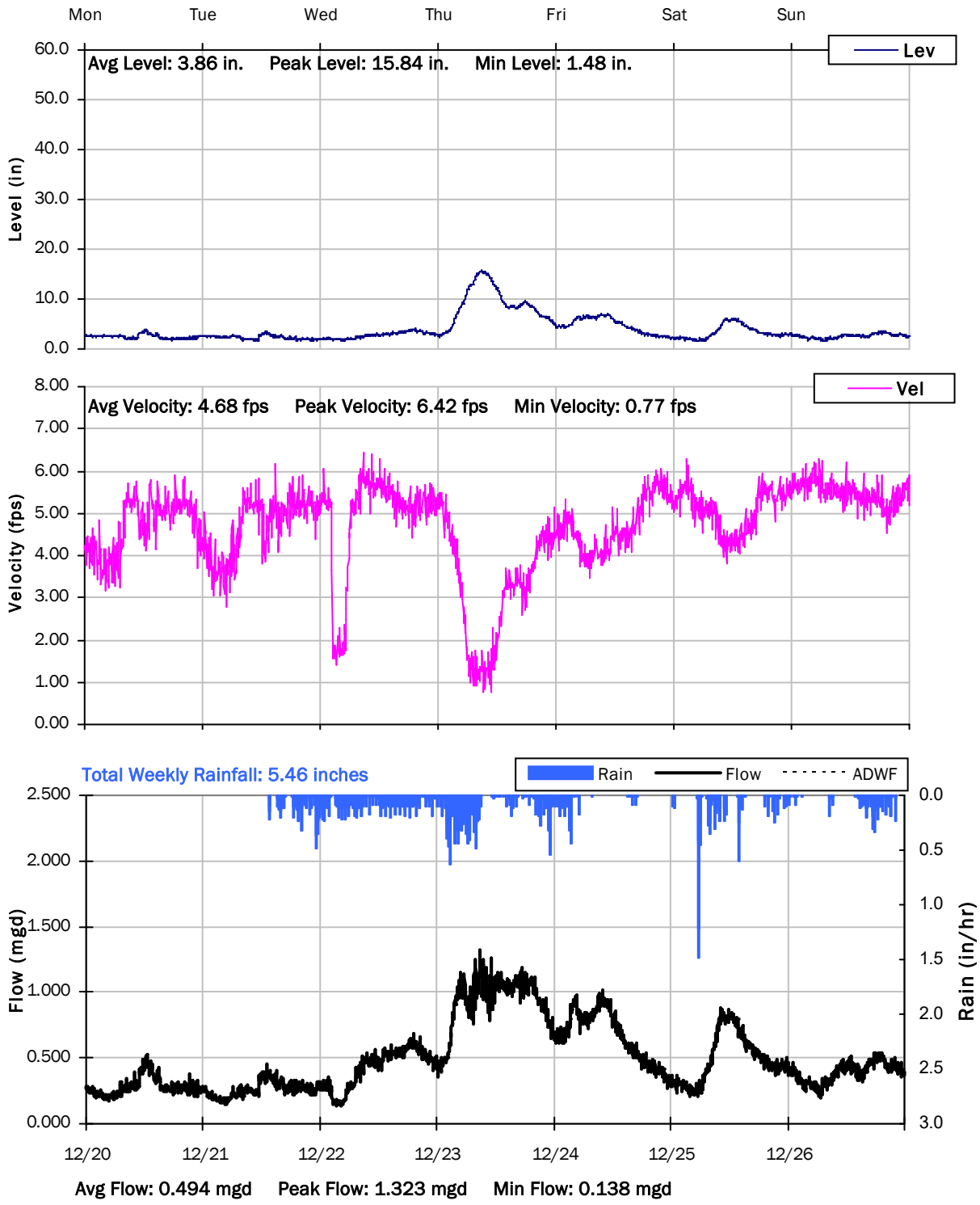
12/13/2021 to 12/20/2021



SITE 17

Weekly Level, Velocity and Flow Hydrographs

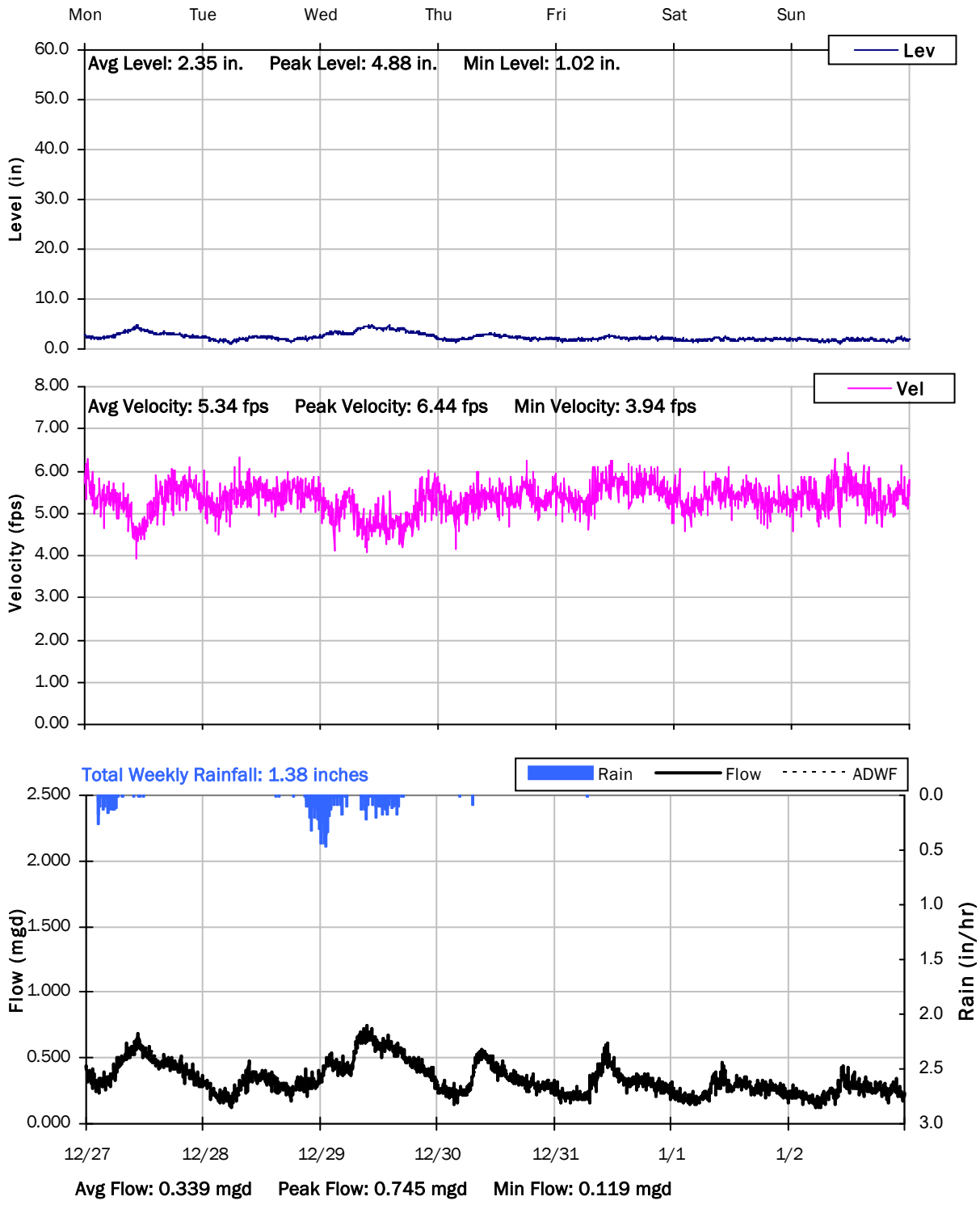
12/20/2021 to 12/27/2021



SITE 17

Weekly Level, Velocity and Flow Hydrographs

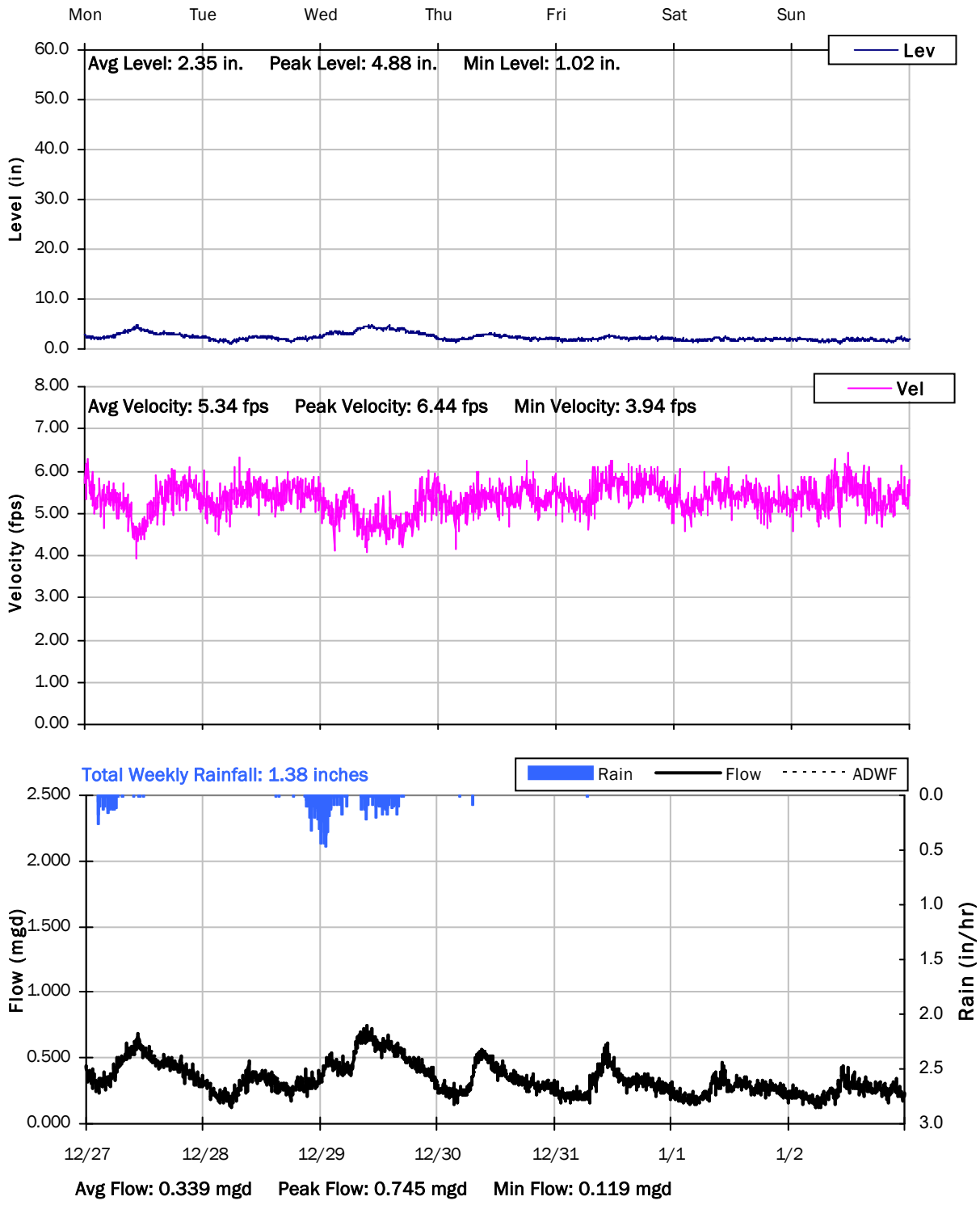
12/27/2021 to 1/3/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

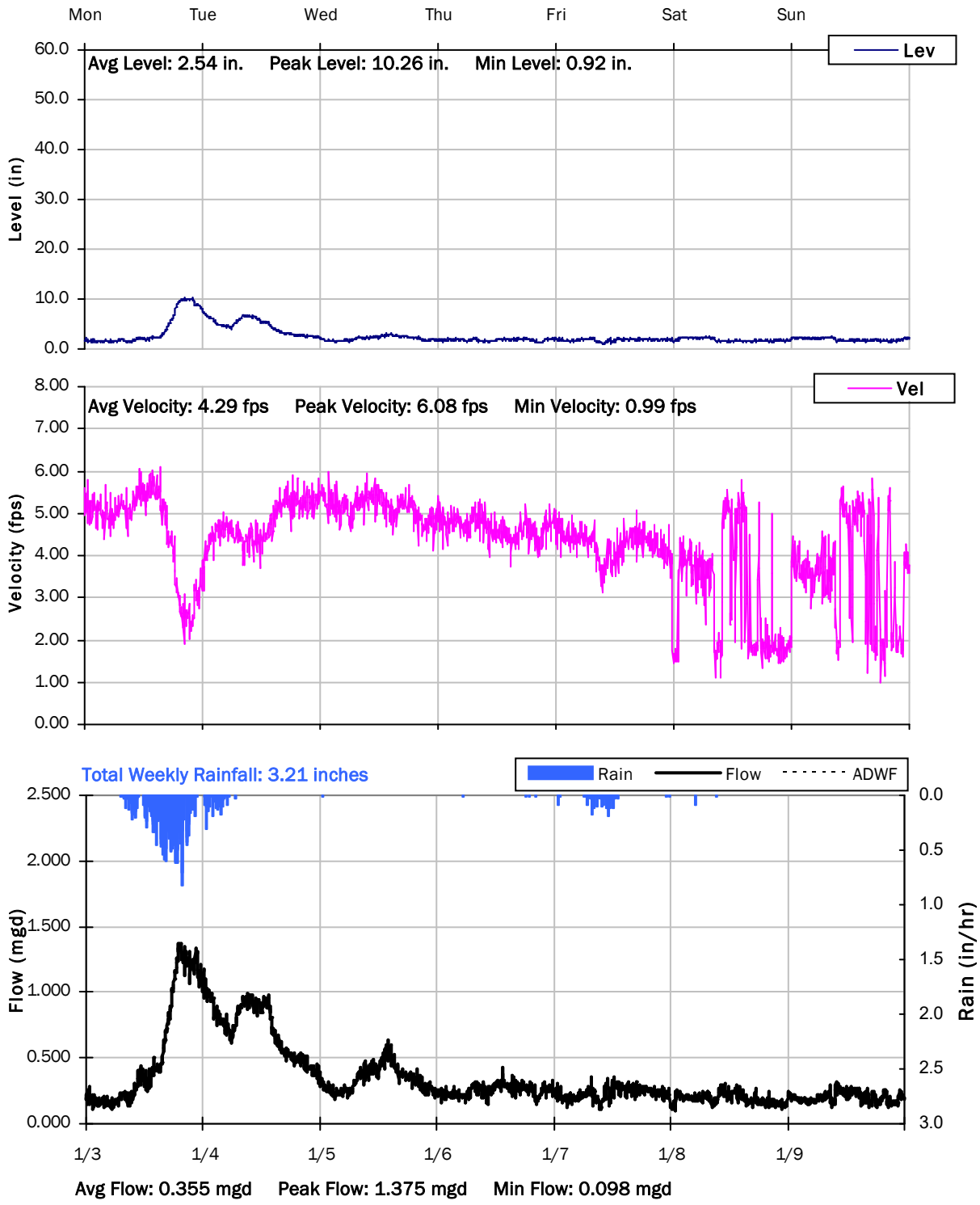
12/27/2021 to 1/3/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

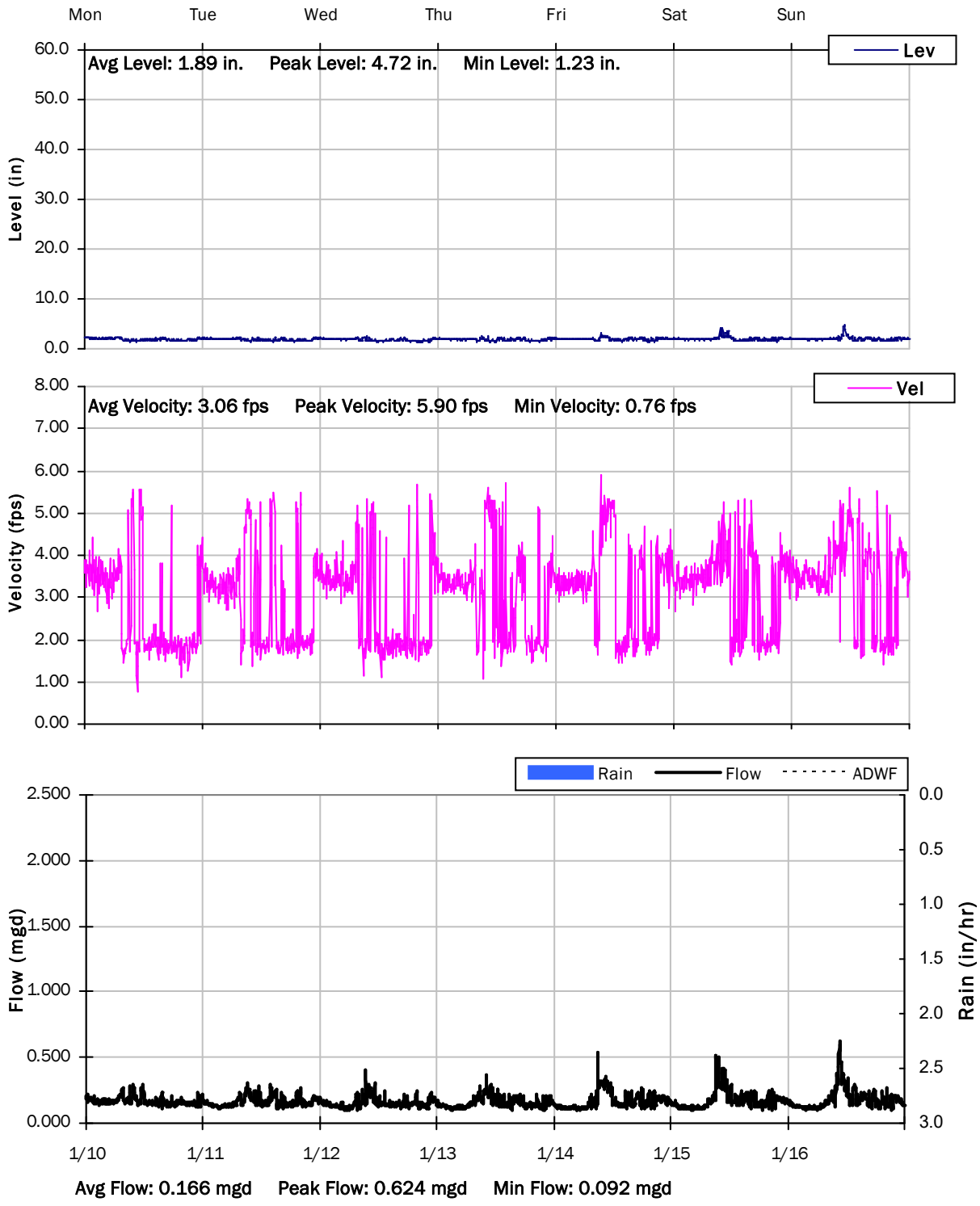
1/3/2022 to 1/10/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

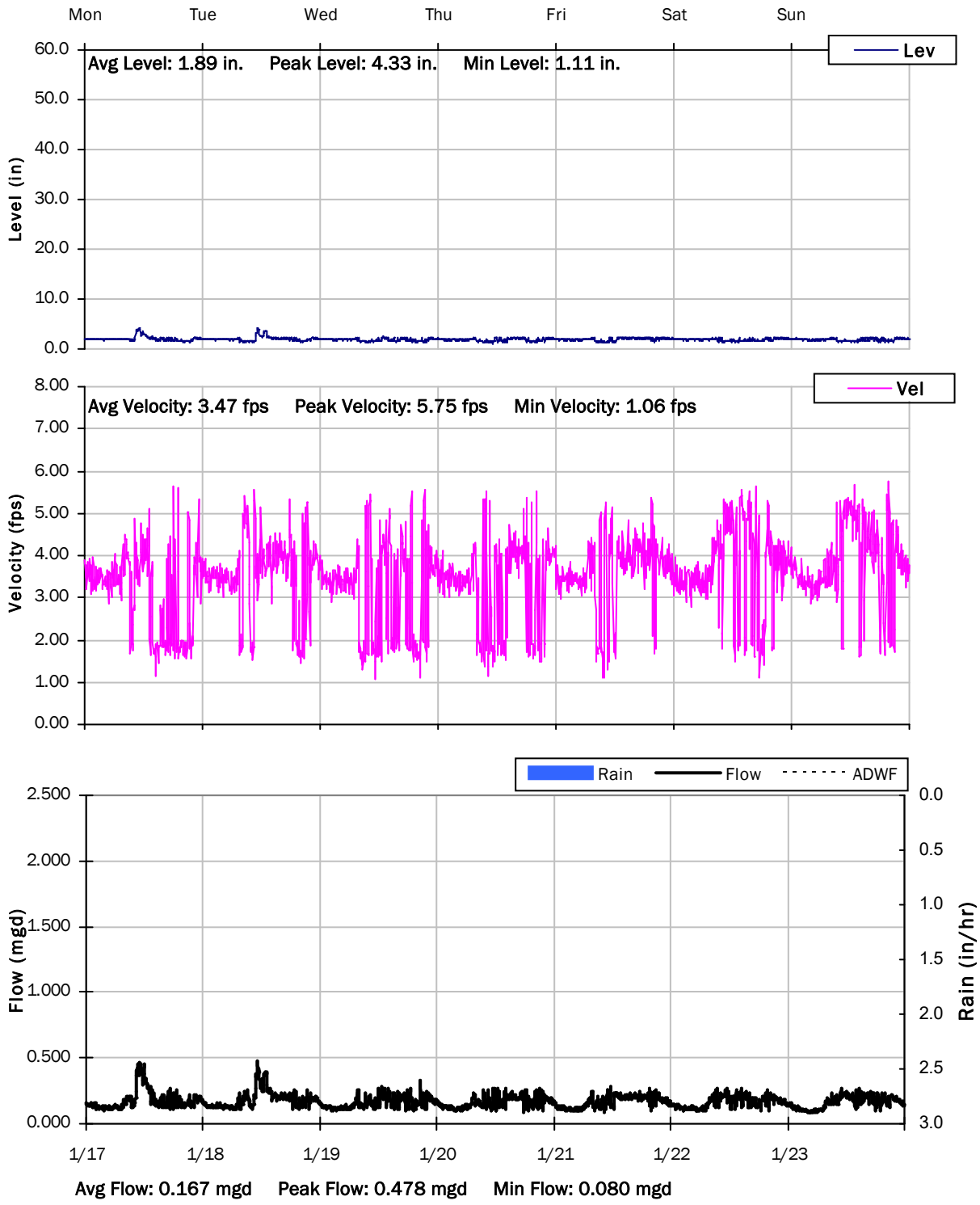
1/10/2022 to 1/17/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

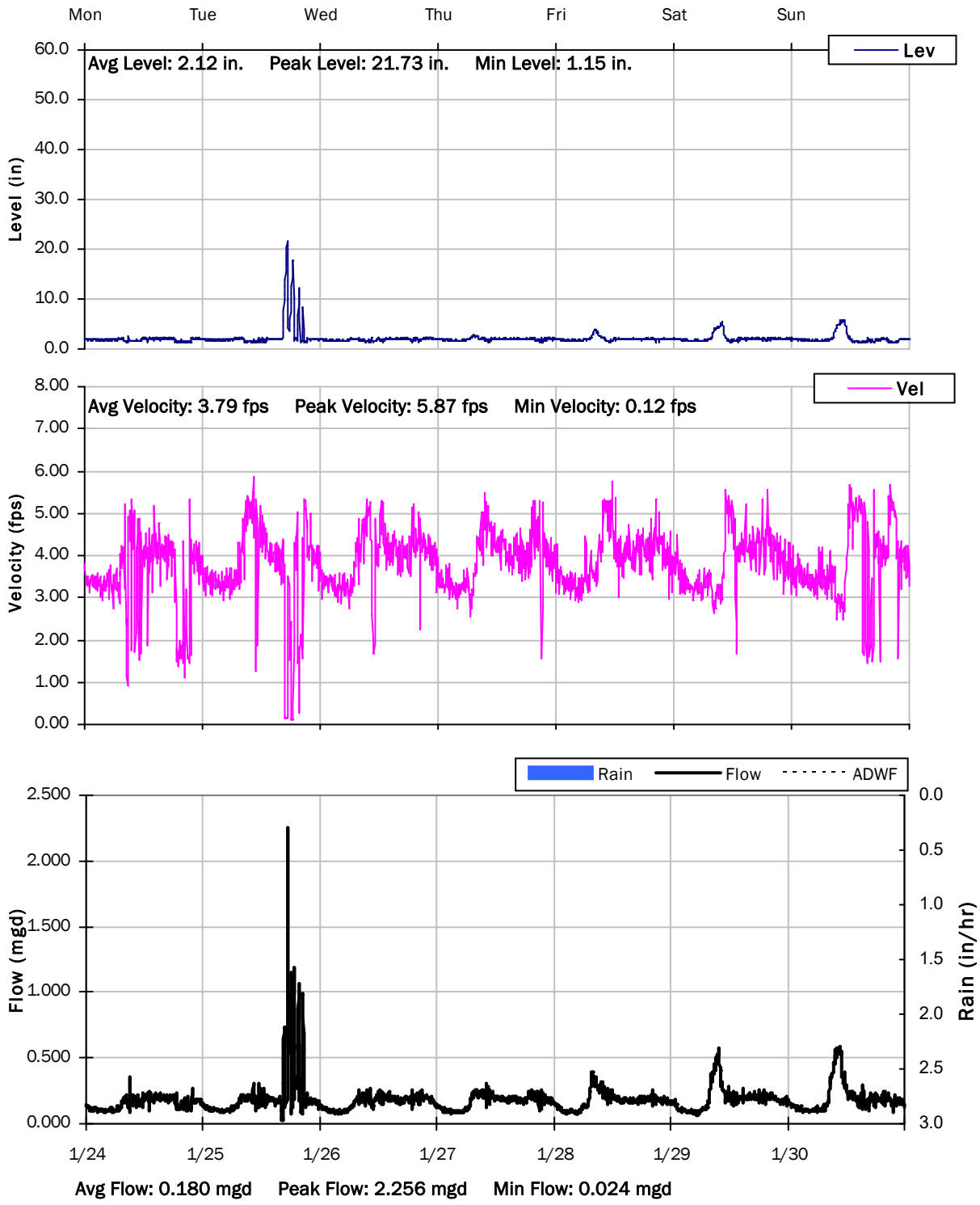
1/17/2022 to 1/24/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

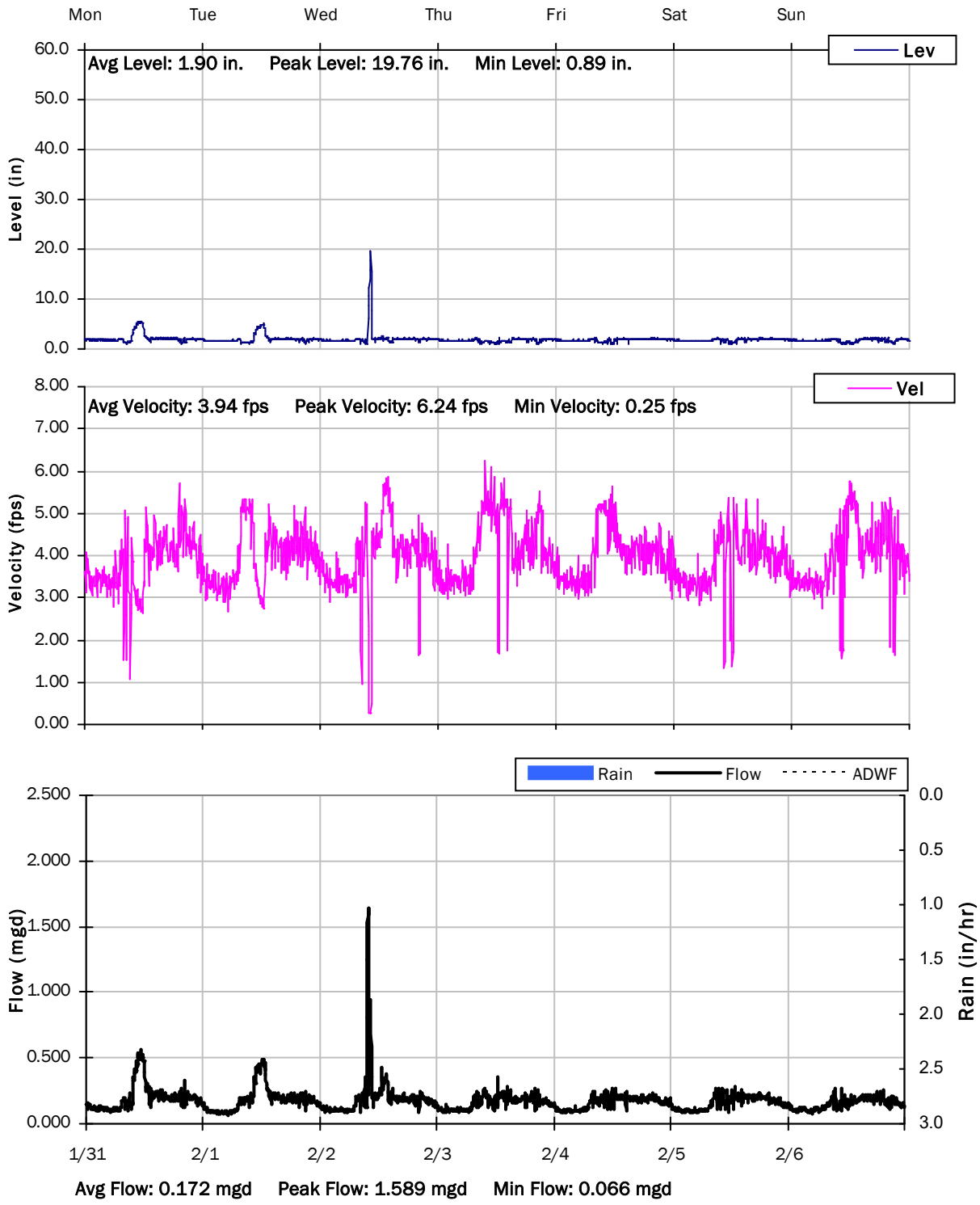
1/24/2022 to 1/31/2022



SITE 17

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: Site 18

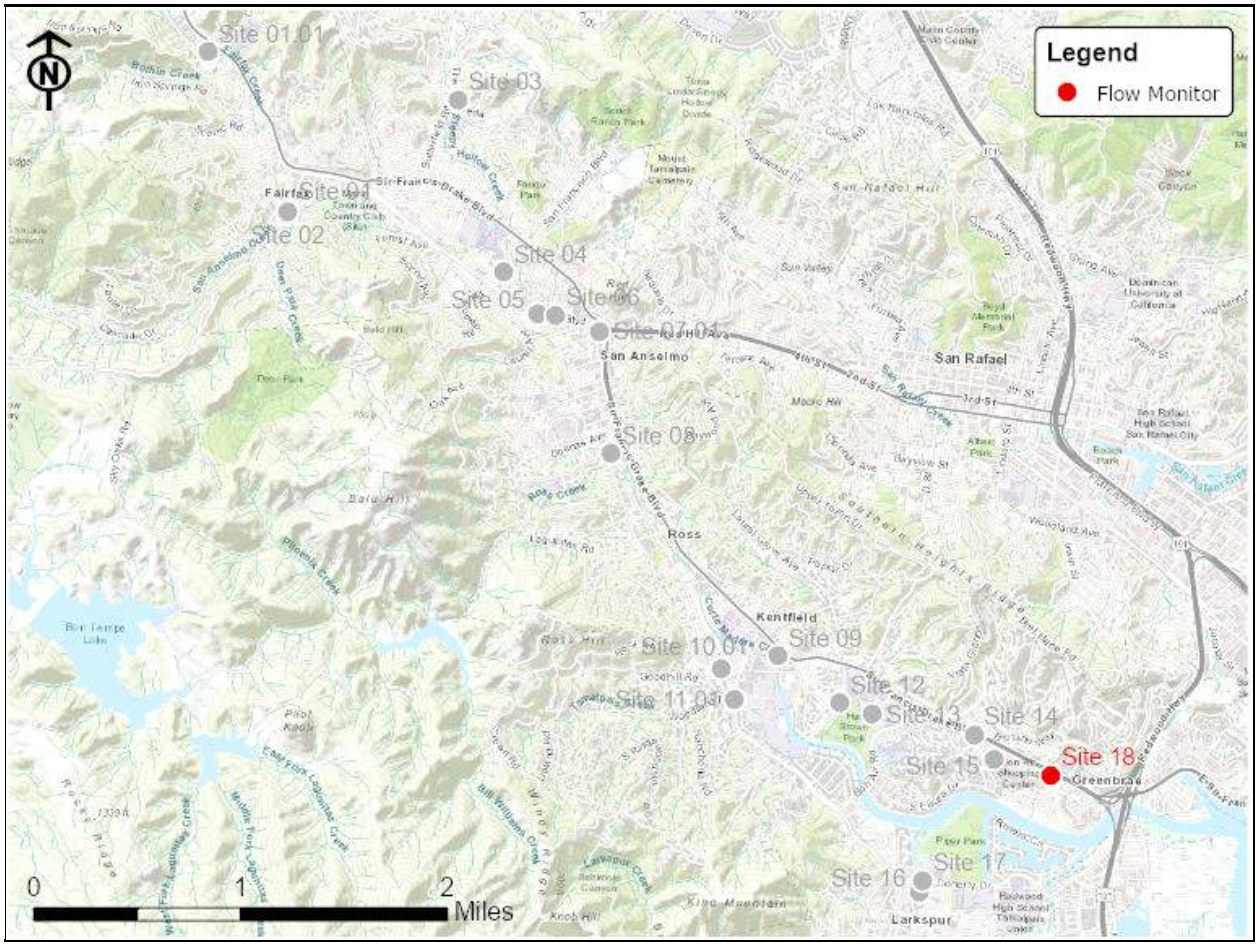
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Parking lot Bon Air Center NW of Barry Wy and PS 12

Data Summary Report



Vicinity Map: Site 18

SITE 18

Site Information MH ID: B200.010

Location: Parking lot Bon Air Center NW of Barry Wy and PS 12

Coordinates: 122.5216° W, 37.9459° N

Rim Elevation (Earth): 11 feet

Expected Pipe Diameter: 12 inches

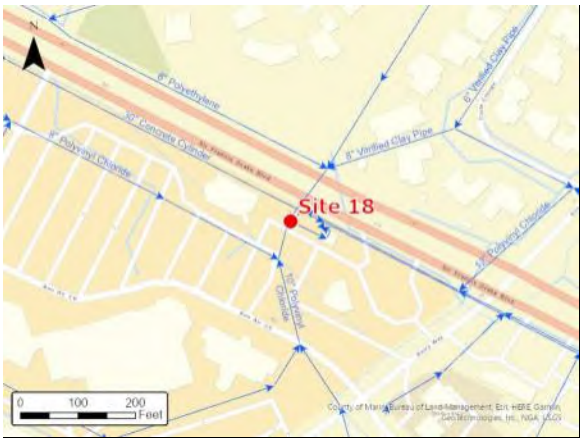
Measured Pipe Diameter: 11.75 inches

ADWF: 0.005 mgd

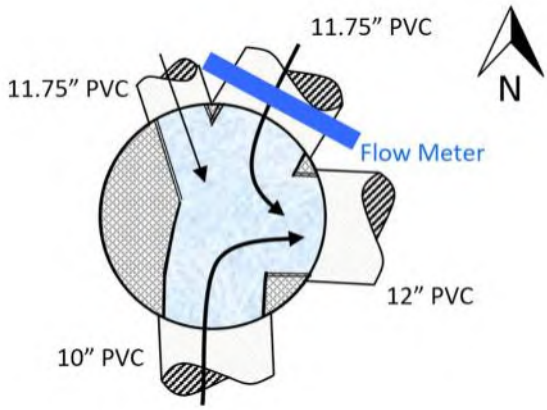
Peak Measured Flow: 0.164 mgd

Sediment: None

Satellite Map



Sanitary Map



Flow Sketch

Street View

Plan View

SITE 18

Additional Site Photos

Effluent Pipe

South Influent Pipe

SITE 18

Additional Site Photos

Northwest Influent Pipe

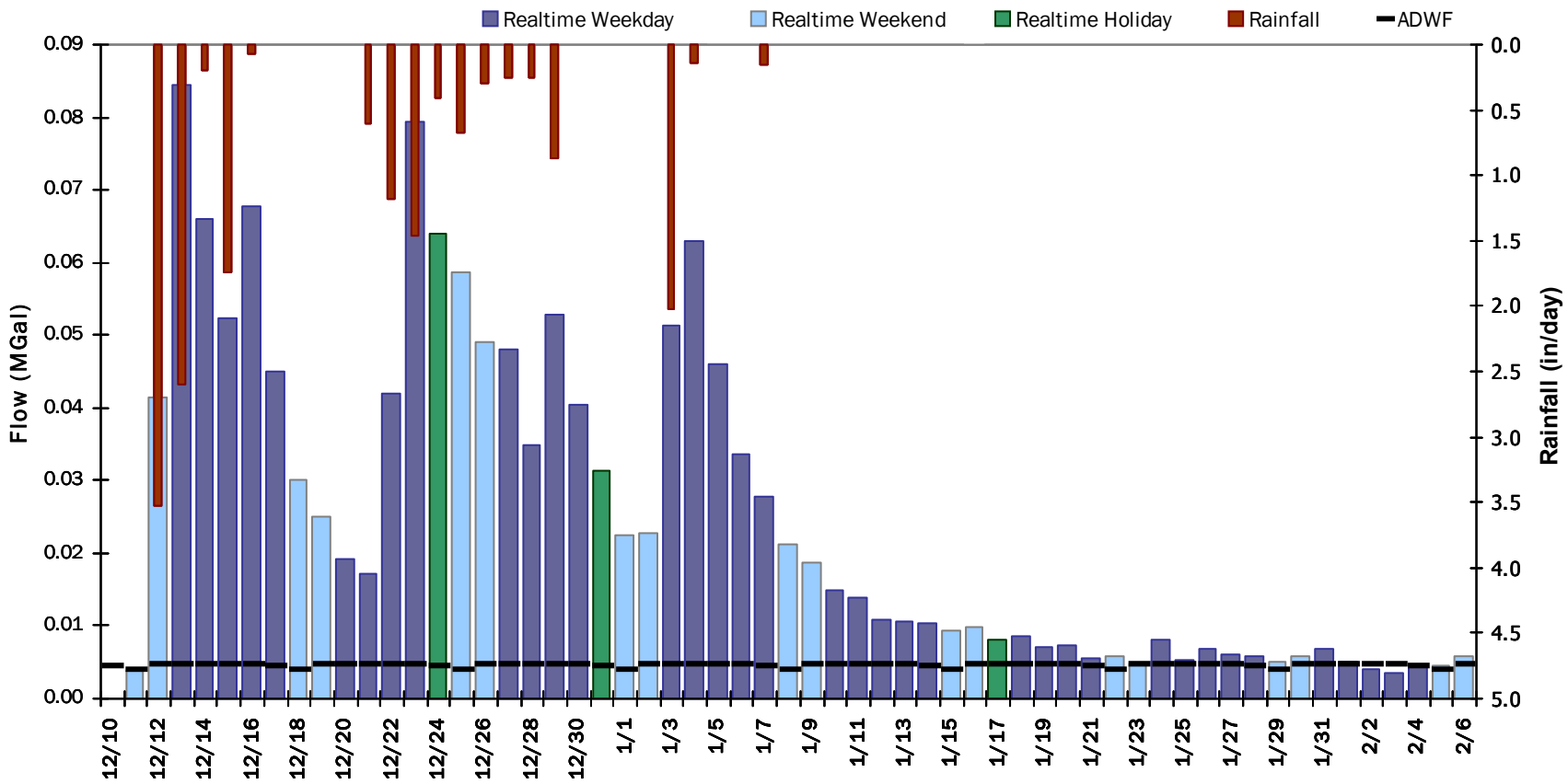
Monitored Northeast Influent Pipe

SITE 18

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.025 MGal Peak Daily Flow: 0.084 MGal Min Daily Flow: 0.004 MGal

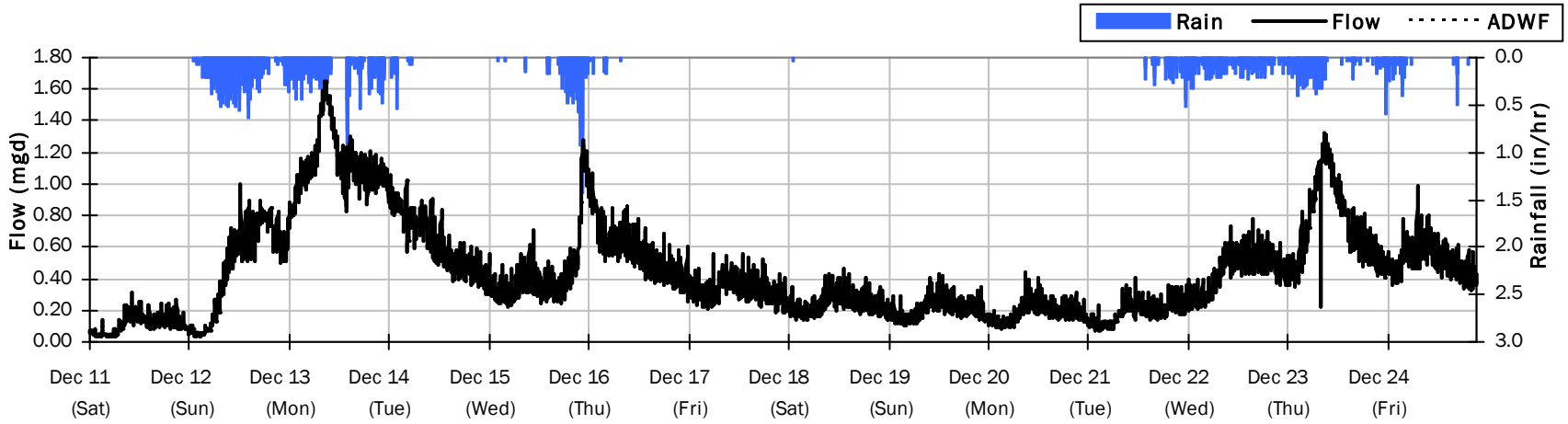
Total Rainfall: 16.45 inches

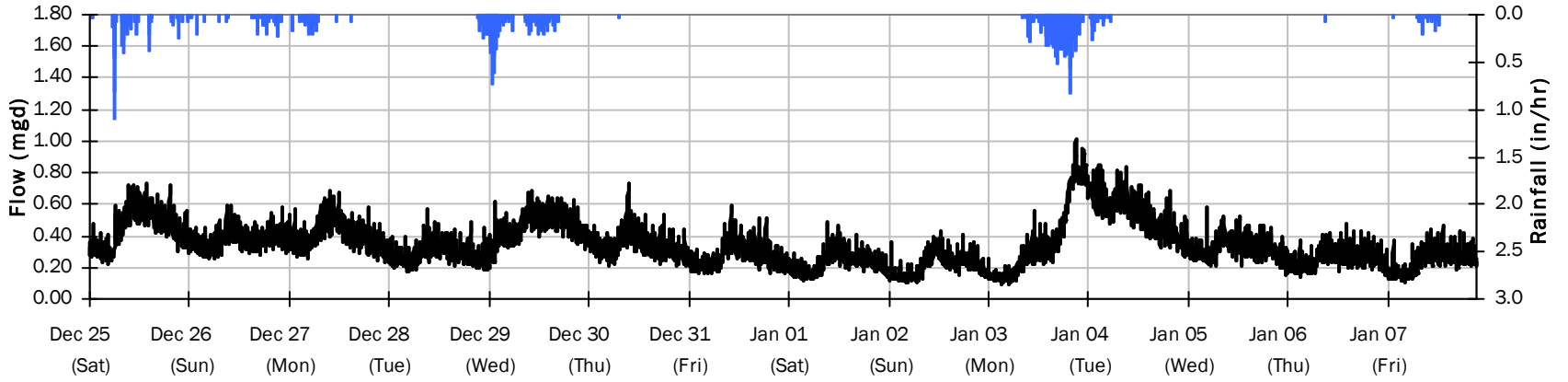


PS 12

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 16.22 inches Period Avg Flow: 0.387 mgd Period Peak Flow: 1.649 mgd Period Min Flow: 0.030 mgd

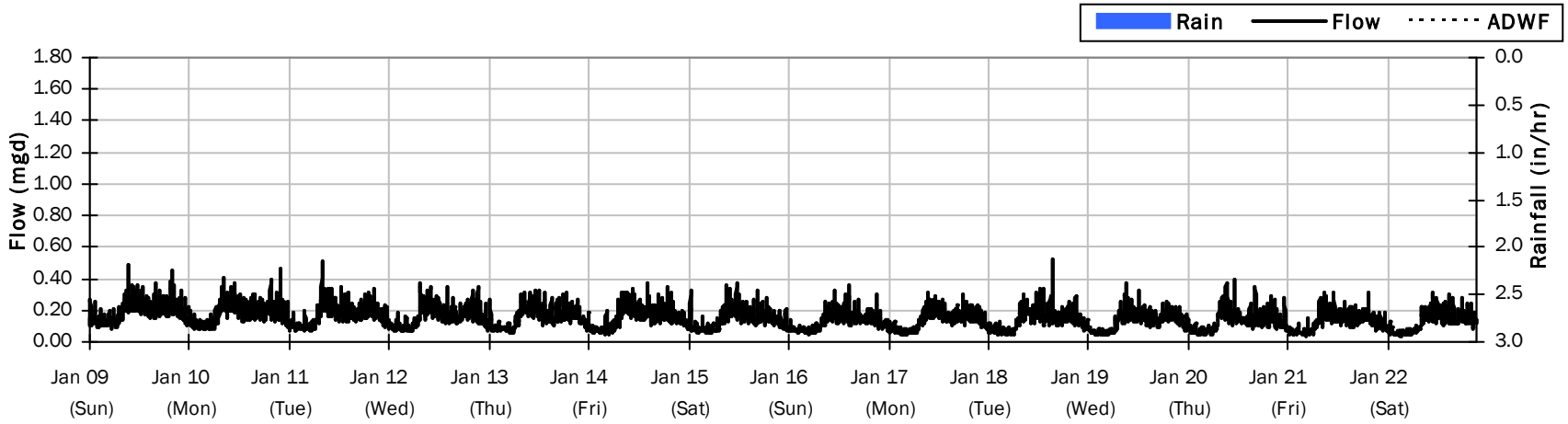


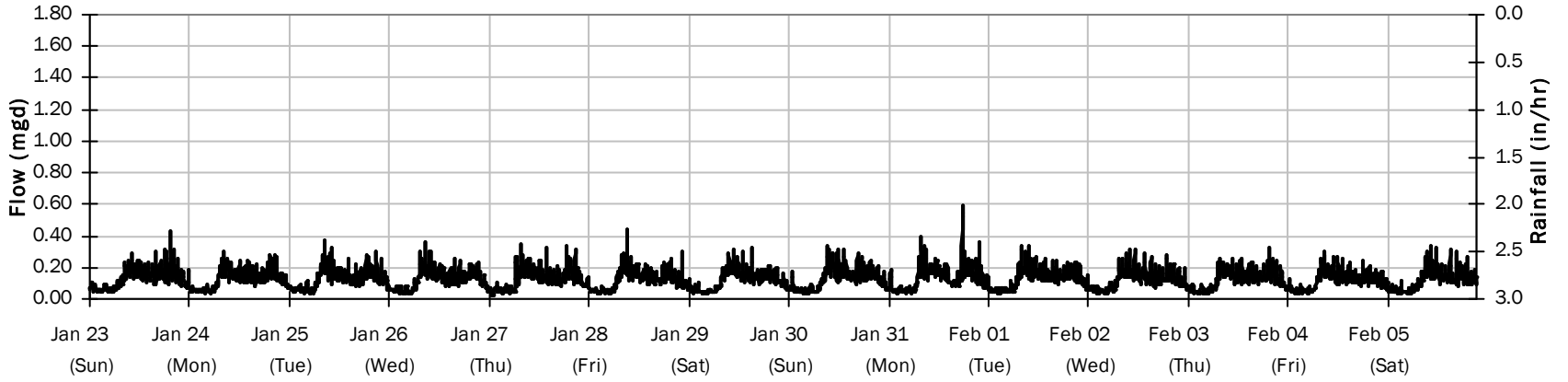


PS 12

Flow Summary: 1/9/2022 to 2/5/2022

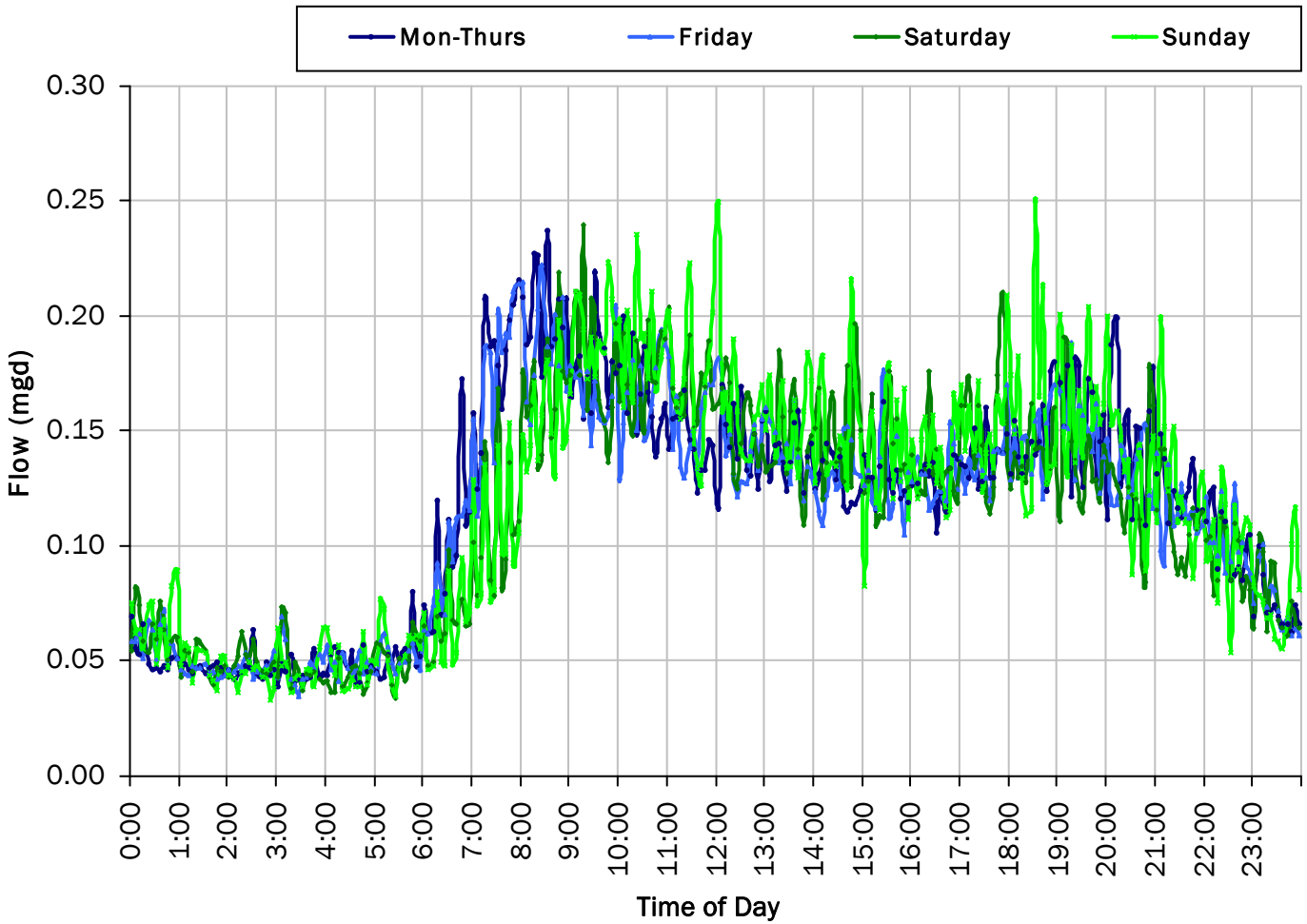
Period Rainfall: 0.00 inches Period Avg Flow: 0.138 mgd Period Peak Flow: 0.596 mgd Period Min Flow: 0.022 mgd





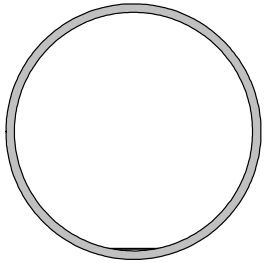
PS 12

Average Dry Weather Flow Hydrographs



ADWF:

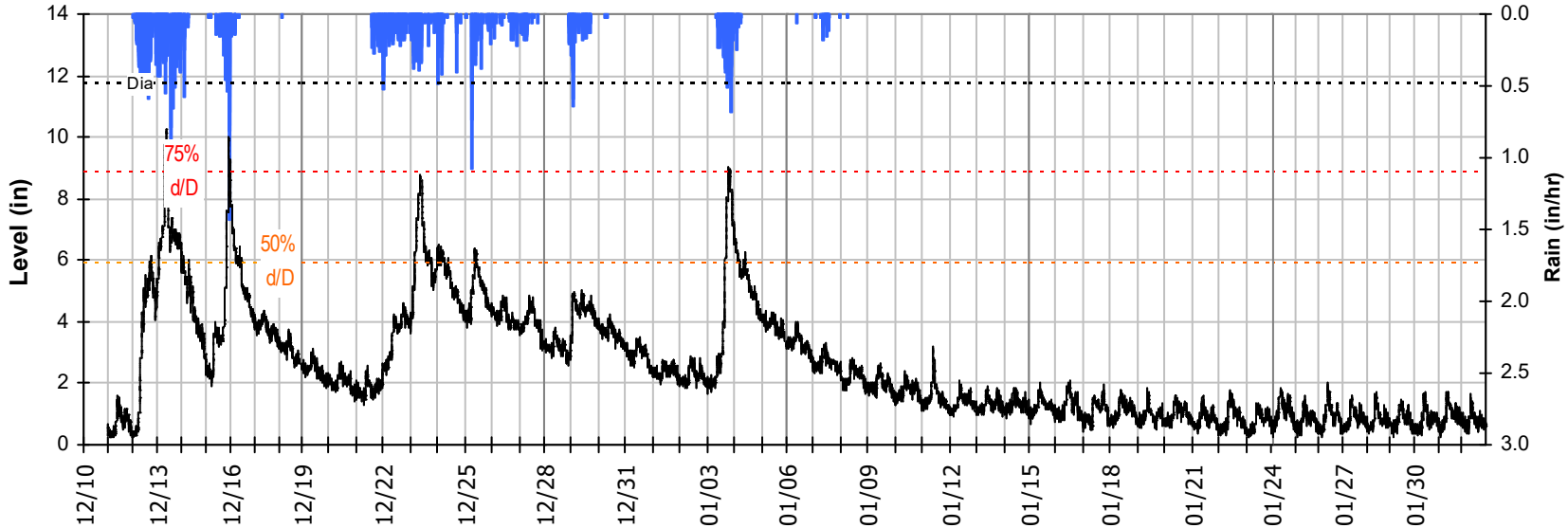
0.117 *mgd*

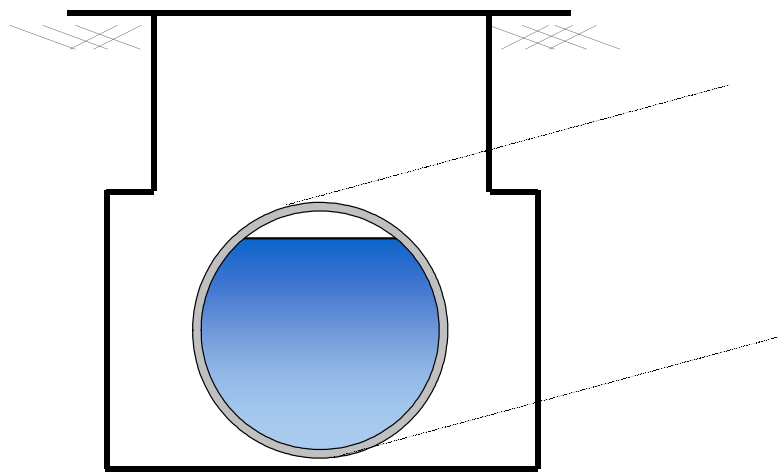


SITE 18

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

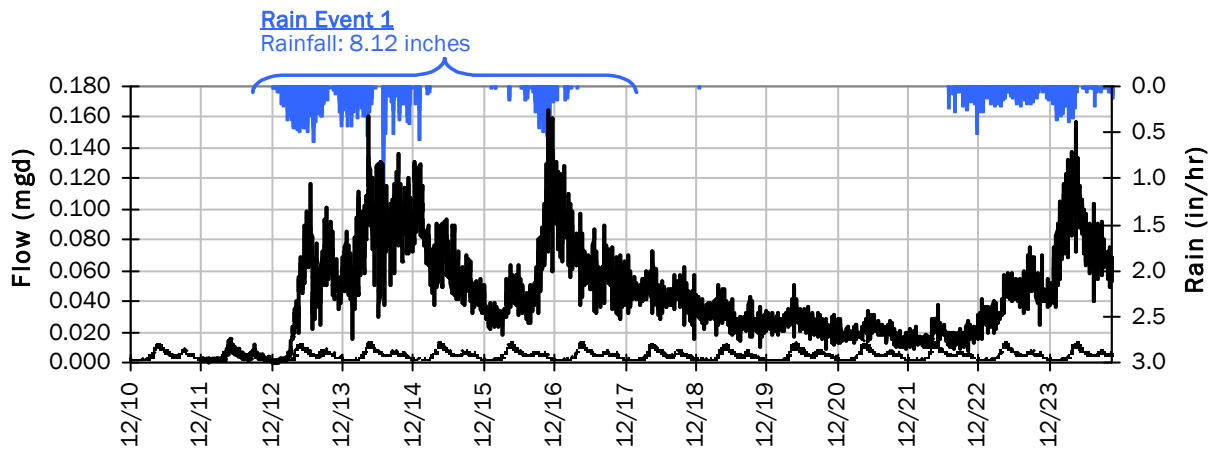




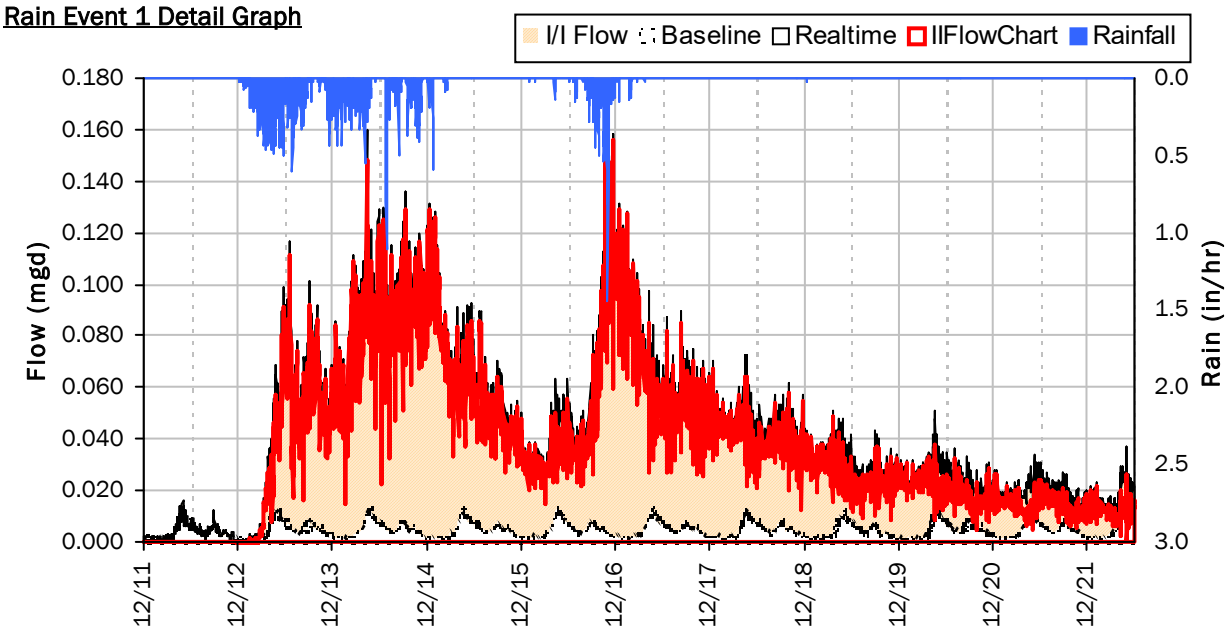
Pipe Diameter:	11.8	*inches*
Peak Measured Level:	10.3	*inches*
Peak d/D Ratio:	0.87	

SITE 18
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

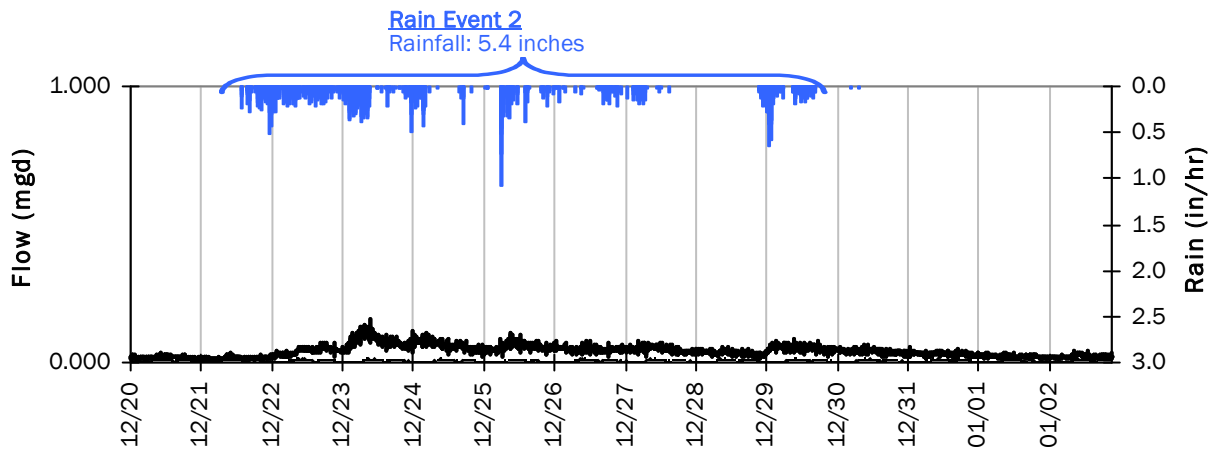


Storm Event I/I Analysis (Rain = 8.12 inches)

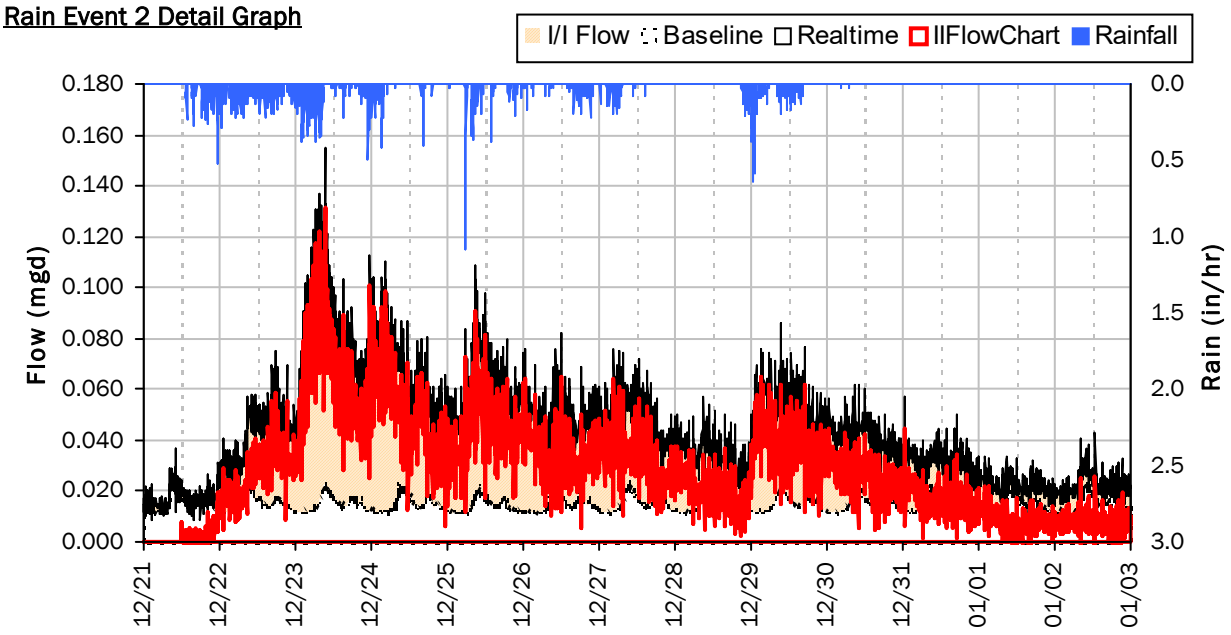
Capacity		Inflow / Infiltration	
Peak Flow:	0.164 *mgd*	Peak I/I Rate:	0.161 *mgd*
PF:	35.22	Total I/I:	396,000 *gallons*
Peak Level:	10.28 *in*		
d/D Ratio:	0.87		

SITE 18
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



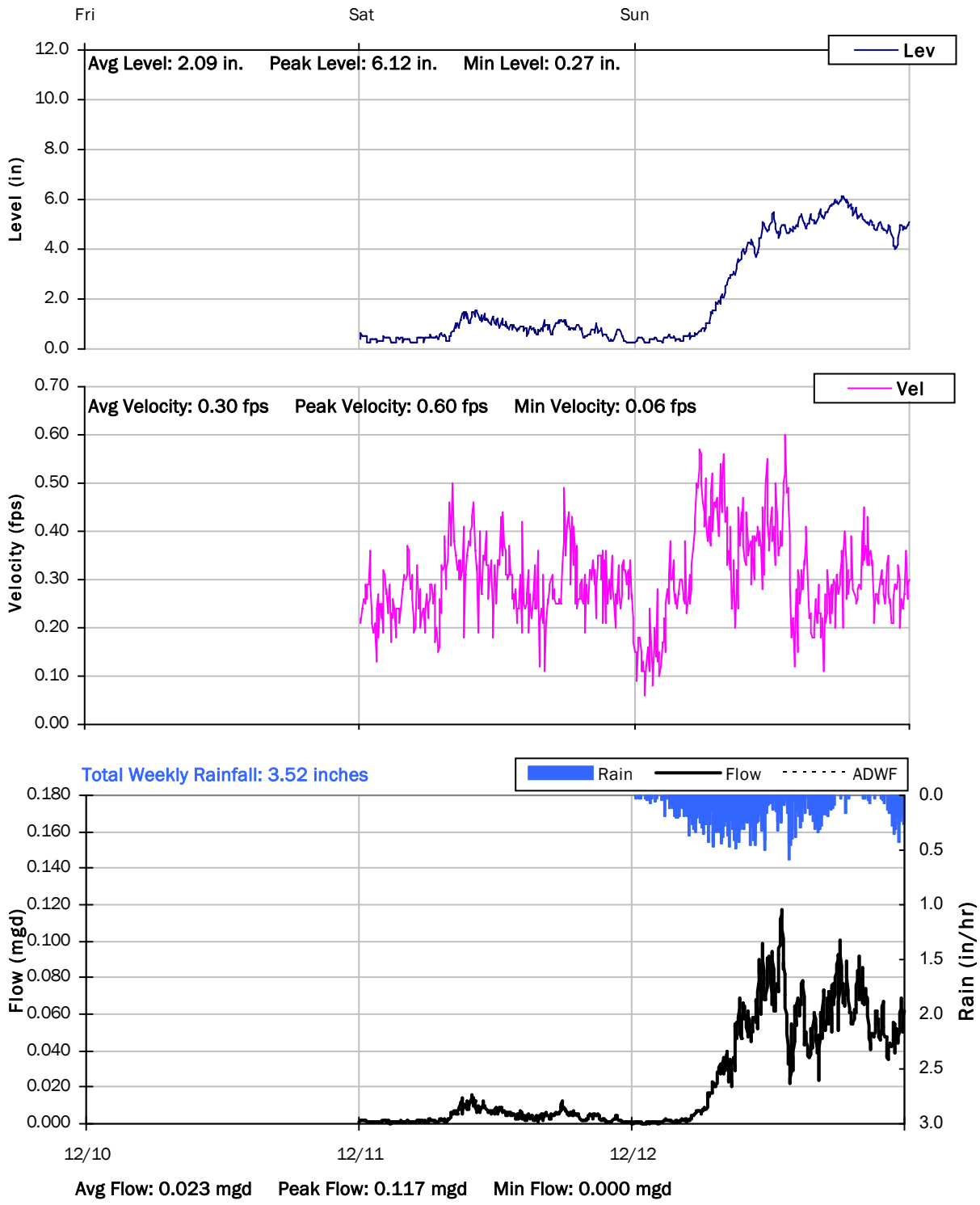
Storm Event I/I Analysis (Rain = 5.40 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.155 *mgd*	**Peak I/I Rate:**	0.132 *mgd*
PF:	33.28	**Total I/I:**	371,000 *gallons*
Peak Level:	8.80 *in*		
d/D Ratio:	0.75		

SITE 18

Weekly Level, Velocity and Flow Hydrographs

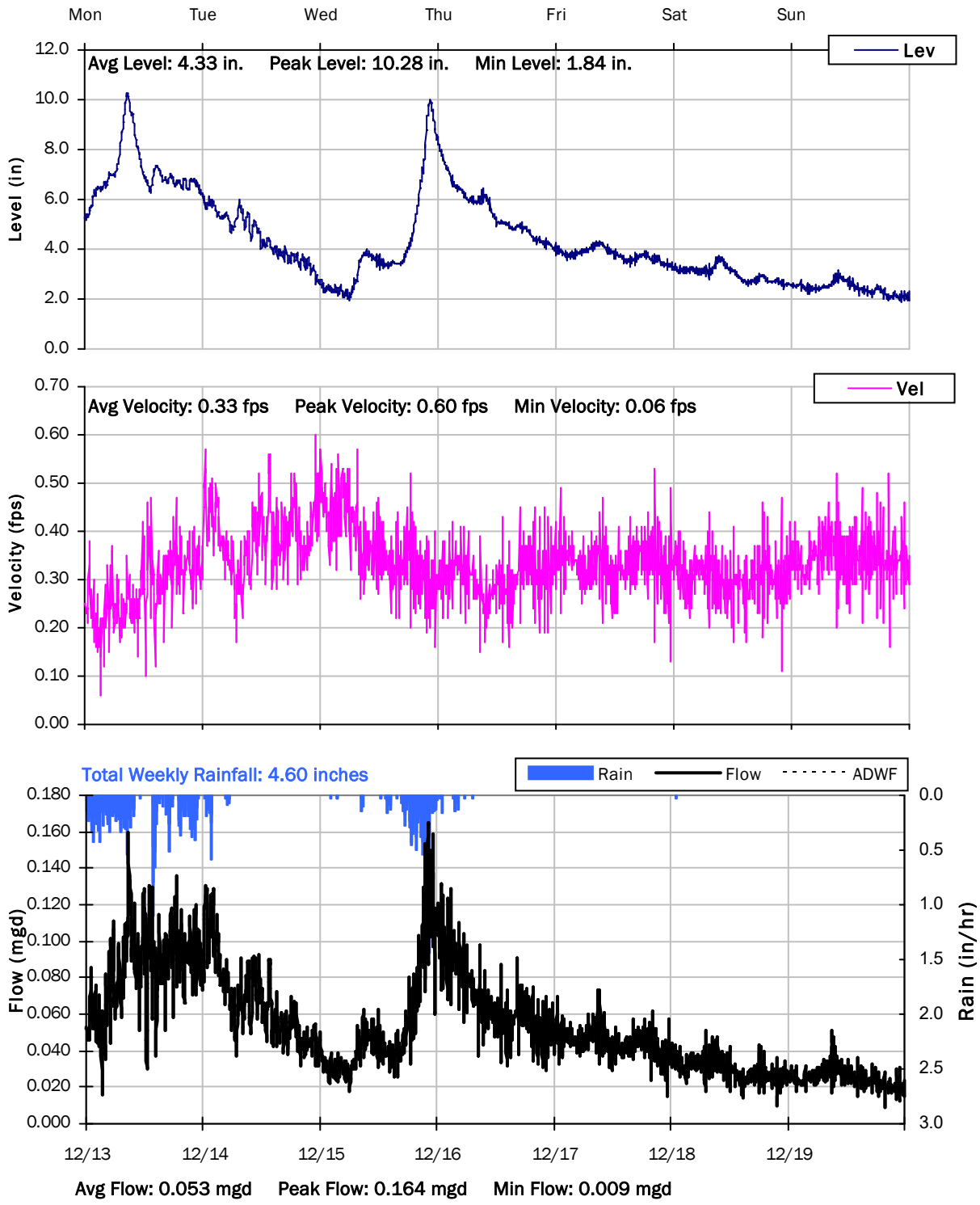
12/10/2021 to 12/13/2021



SITE 18

Weekly Level, Velocity and Flow Hydrographs

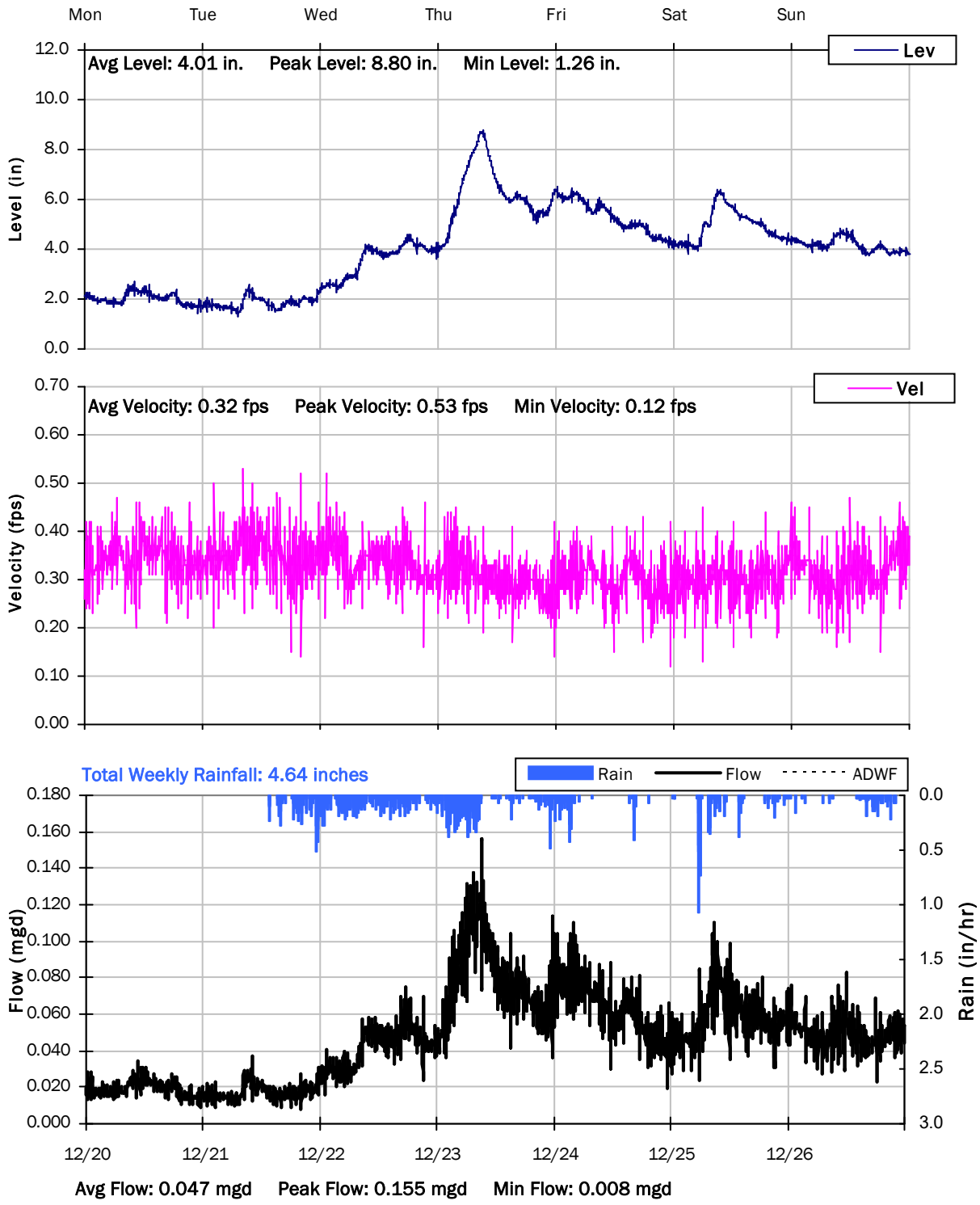
12/13/2021 to 12/20/2021



SITE 18

Weekly Level, Velocity and Flow Hydrographs

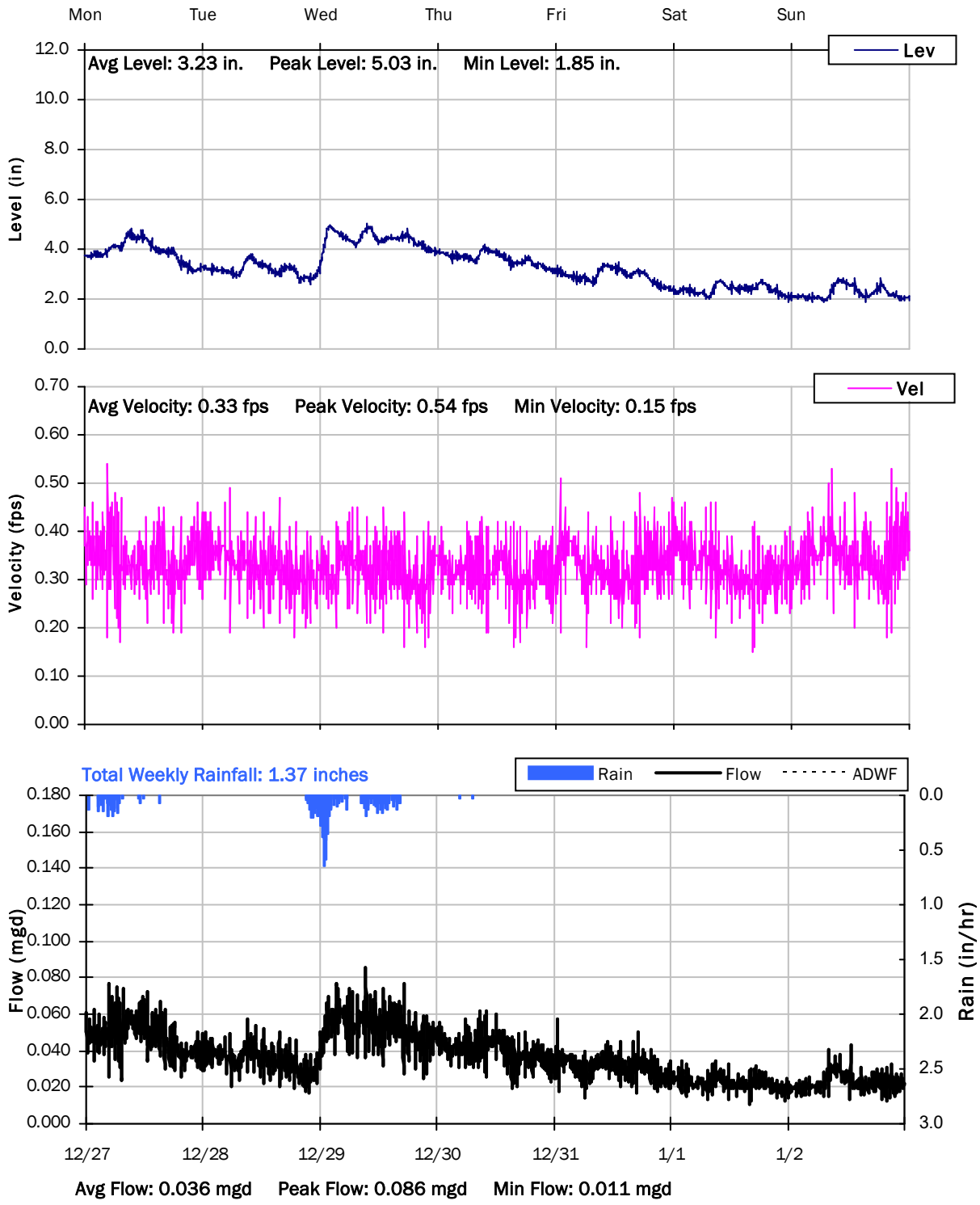
12/20/2021 to 12/27/2021



SITE 18

Weekly Level, Velocity and Flow Hydrographs

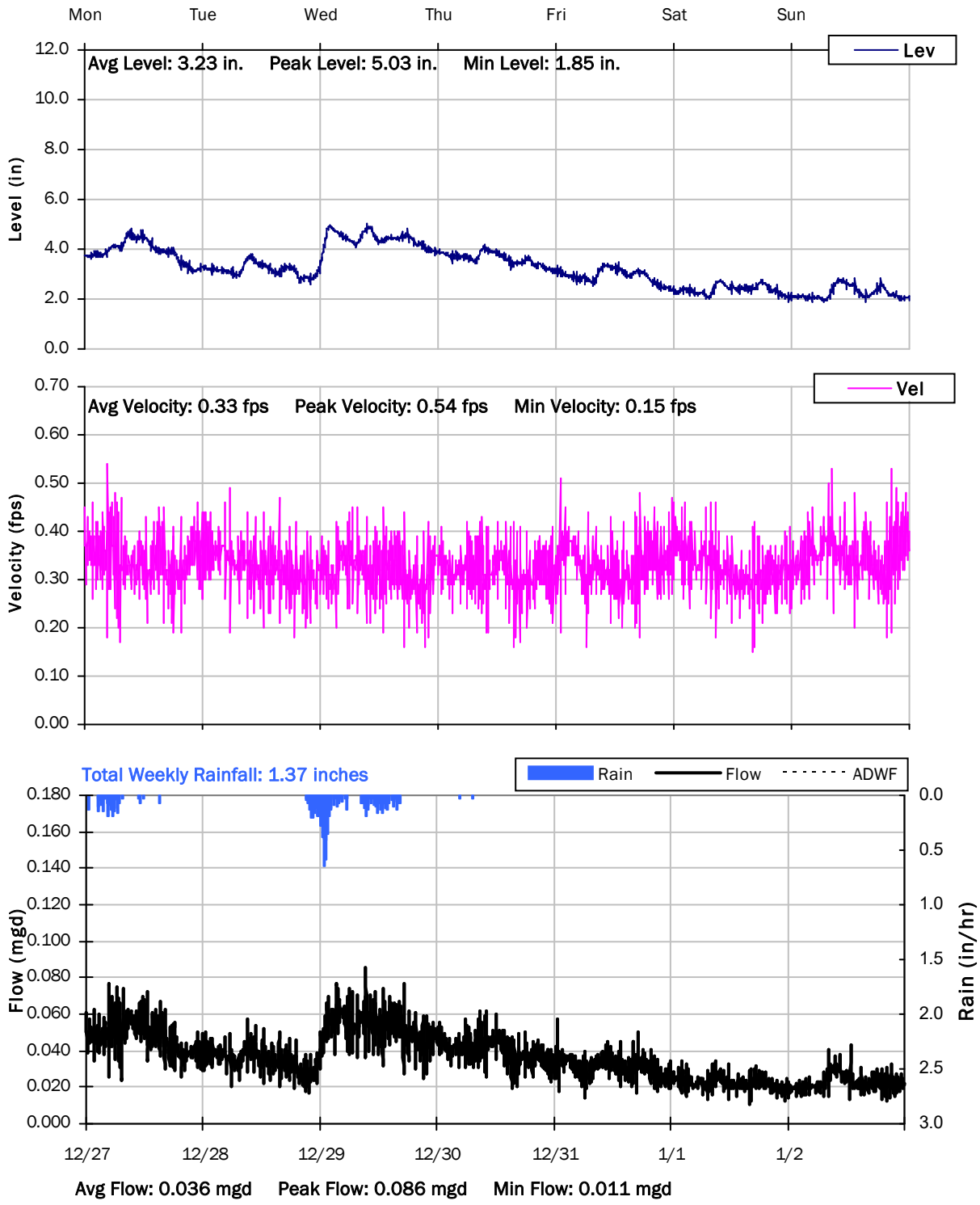
12/27/2021 to 1/3/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

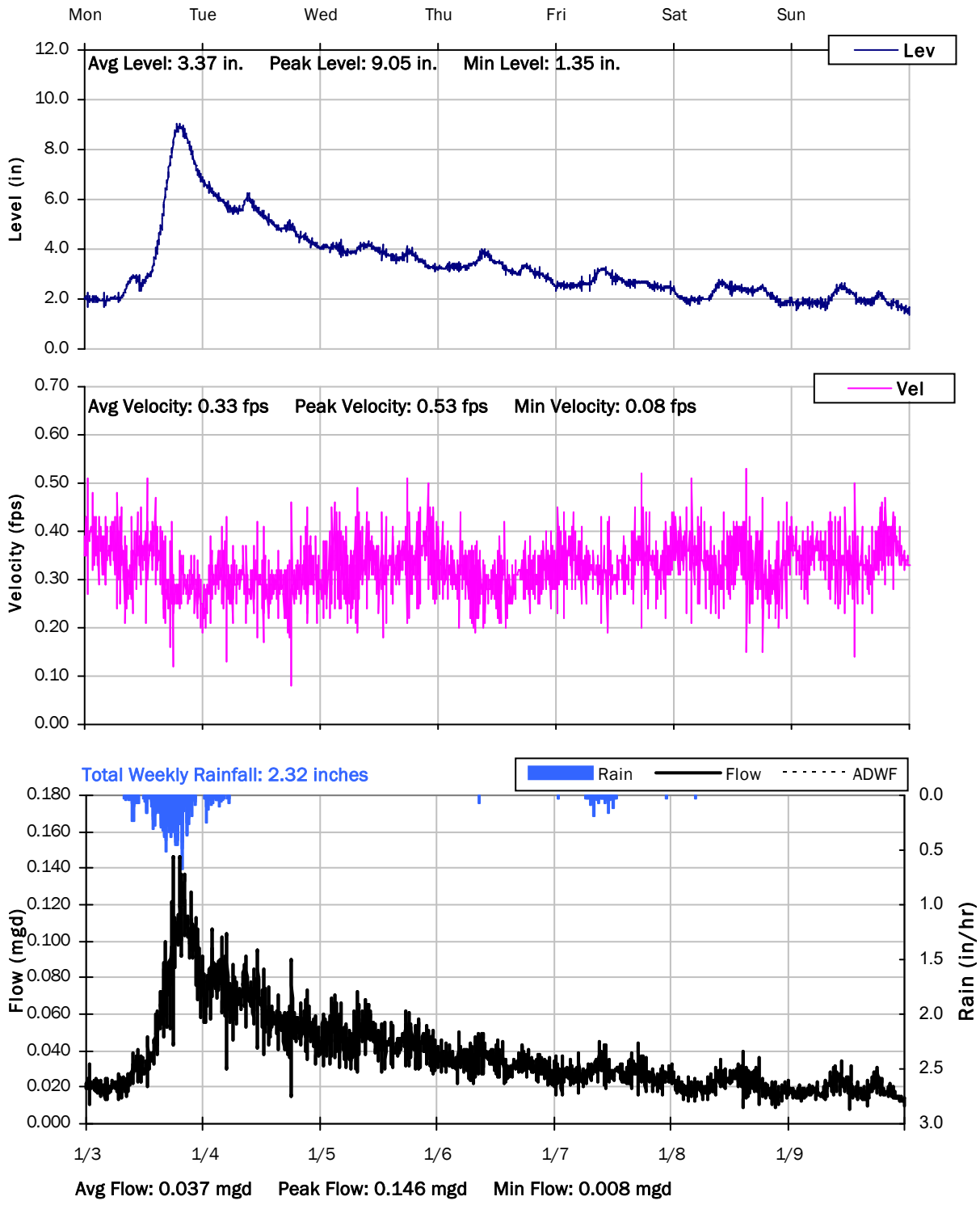
12/27/2021 to 1/3/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

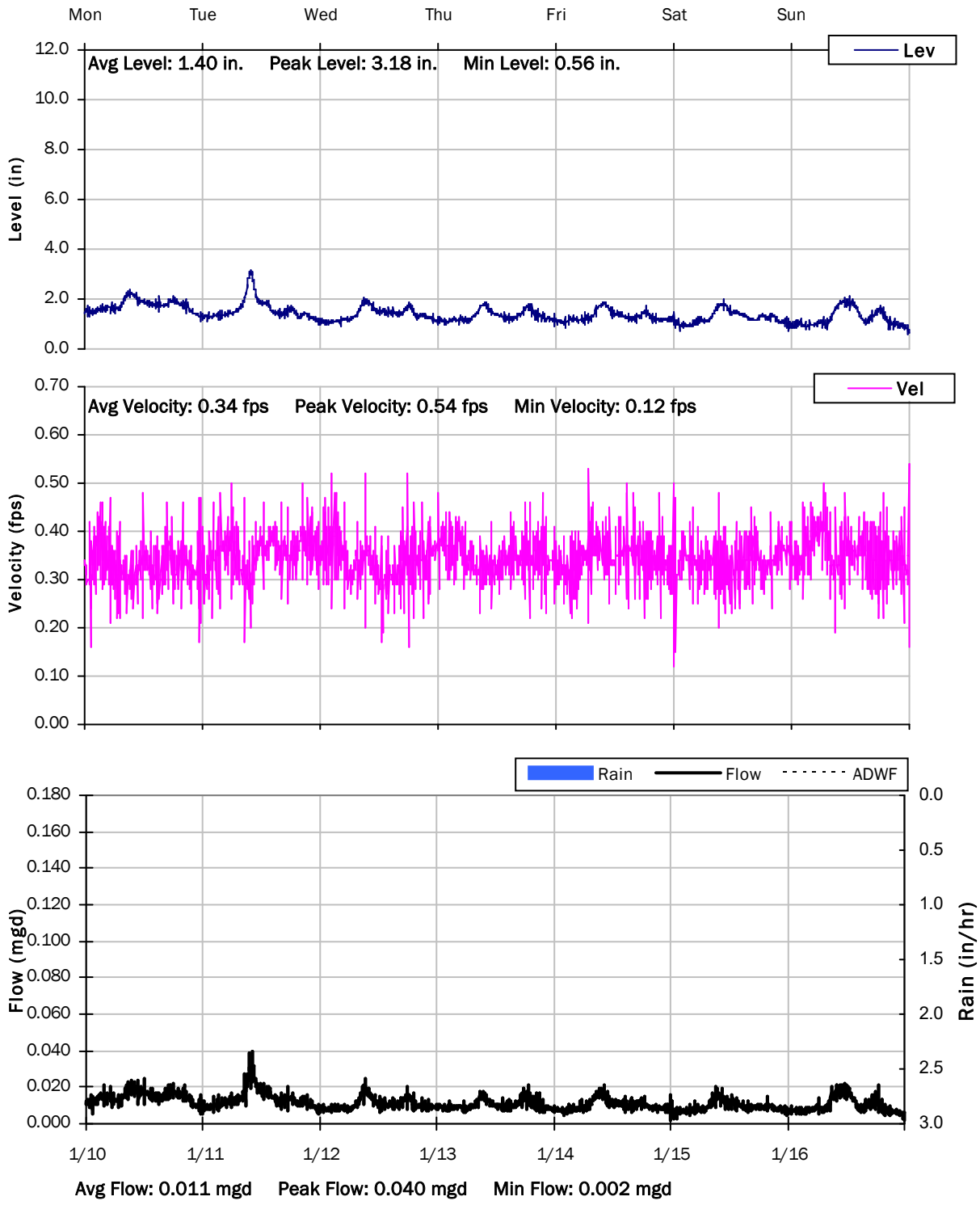
1/3/2022 to 1/10/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

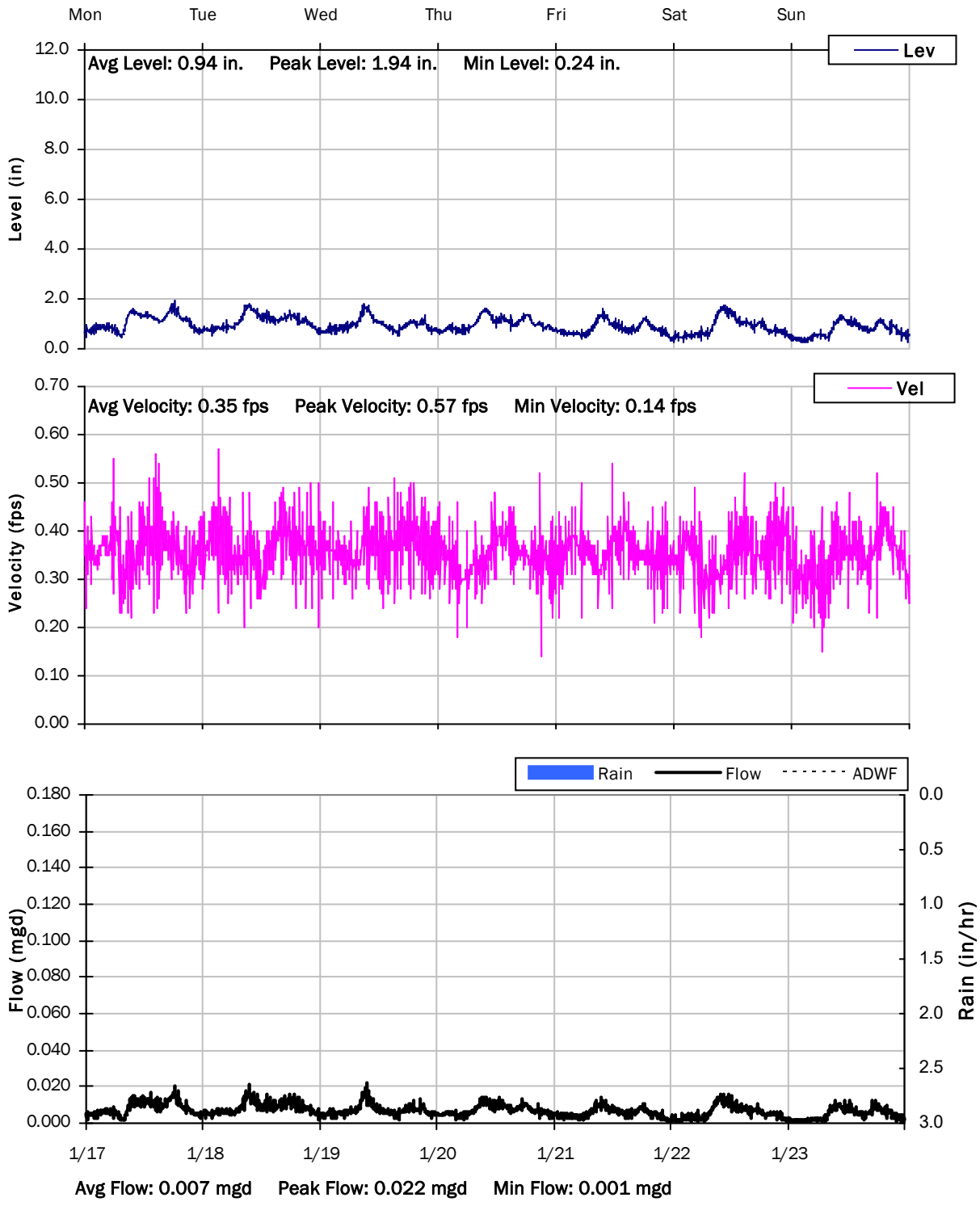
1/10/2022 to 1/17/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

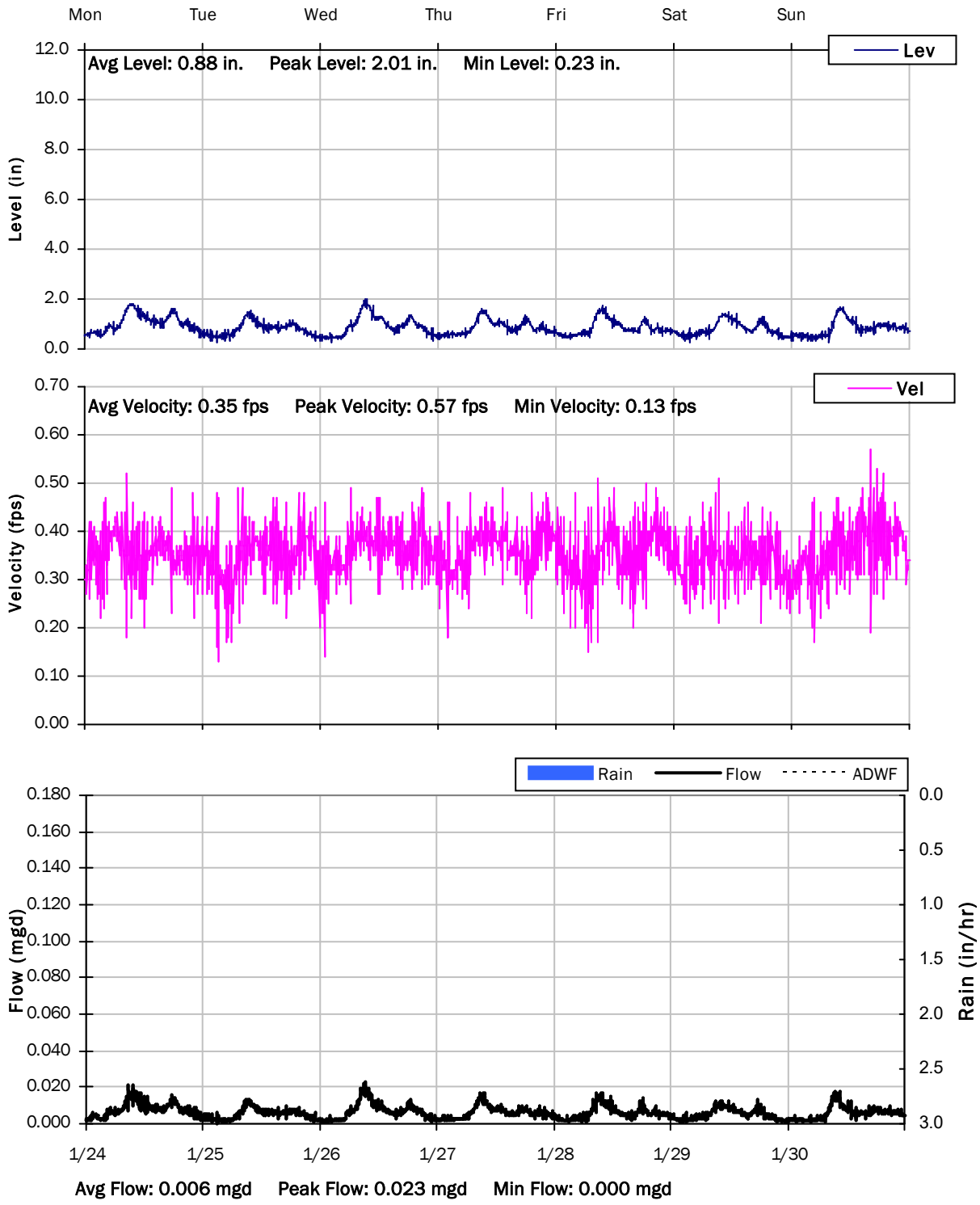
1/17/2022 to 1/24/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

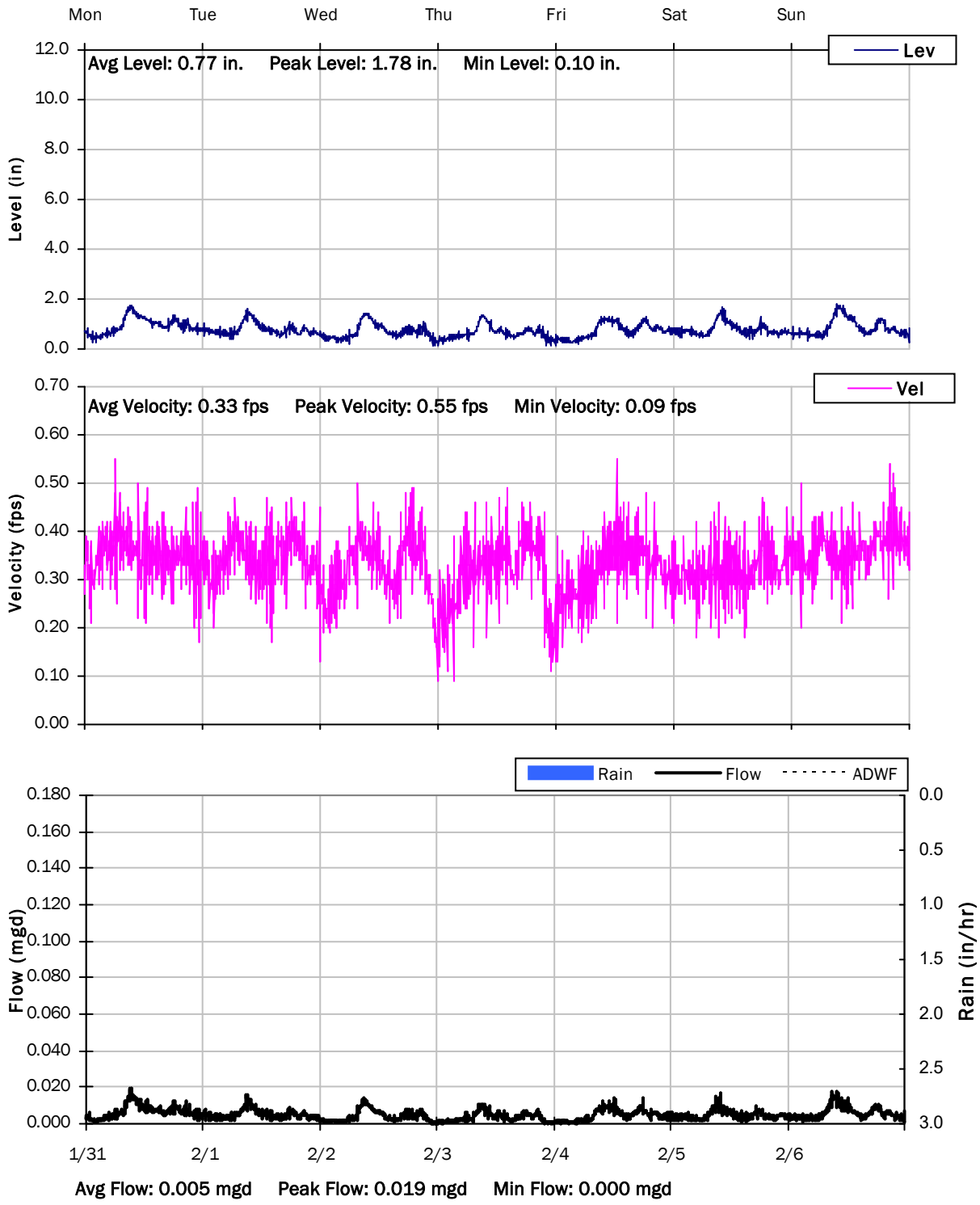
1/24/2022 to 1/31/2022



SITE 18

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: PS 12

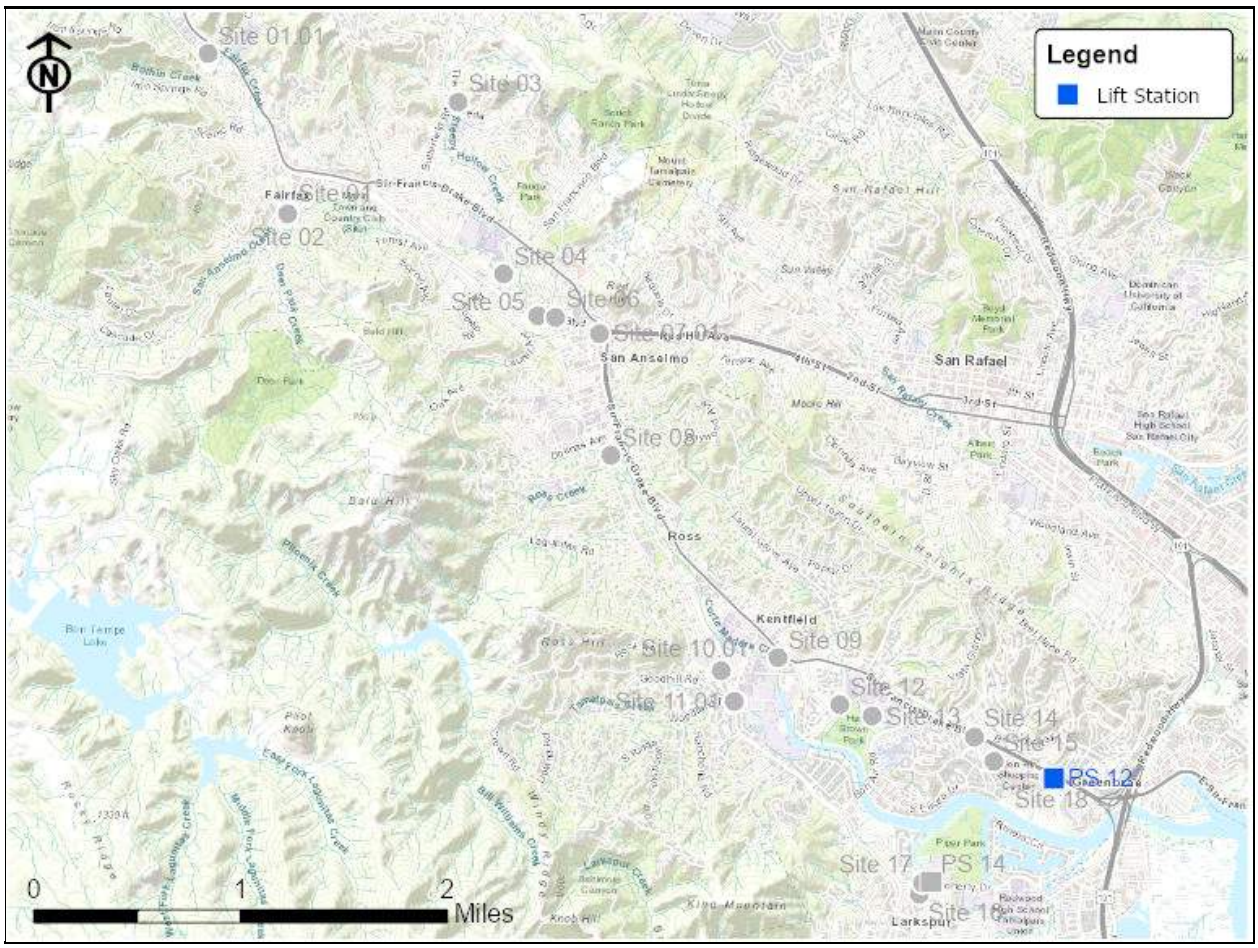
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Parking lot Bon Air Center NW of Barry Wy

Data Summary Report



Vicinity Map: PS 12

PS 12

Site Information MH ID: N/A

Location: Parking lot Bon Air Center NW of Barry Wy

Coordinates: 122.5214° W, 37.9459° N

Rim Elevation (Earth): 11 feet

Expected Pipe Diameter: 0 inches

Measured Pipe Diameter: 0 inches

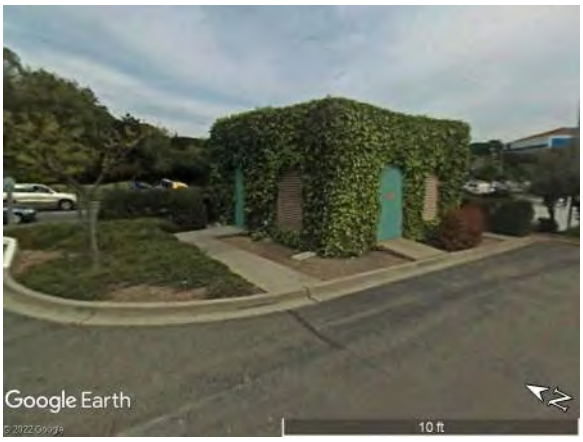
ADWF: 0.117 mgd

Peak Measured Flow: 1.649 mgd

Sediment: None

Satellite Map

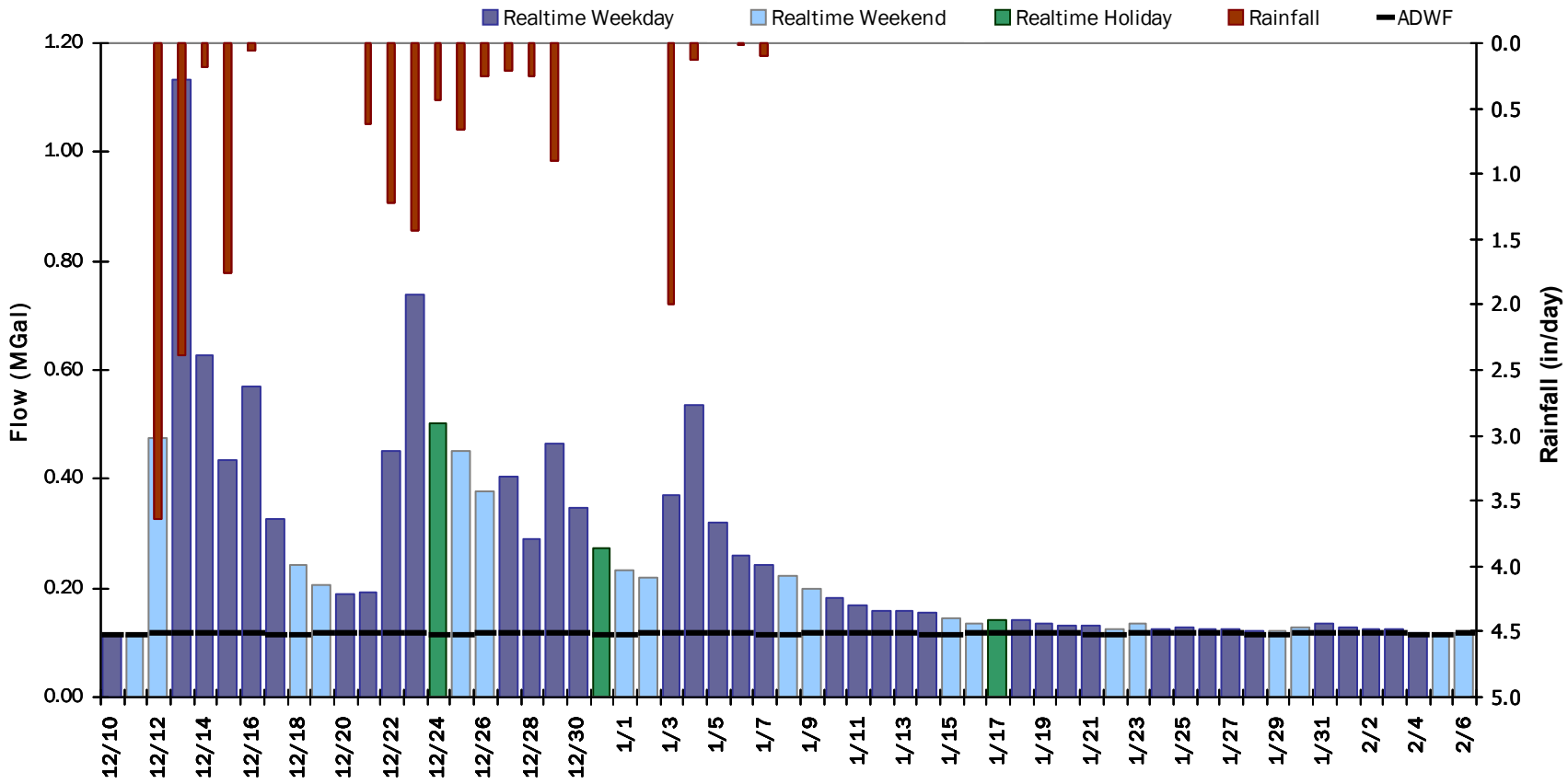
Sanitary Map



Street View

PS 12

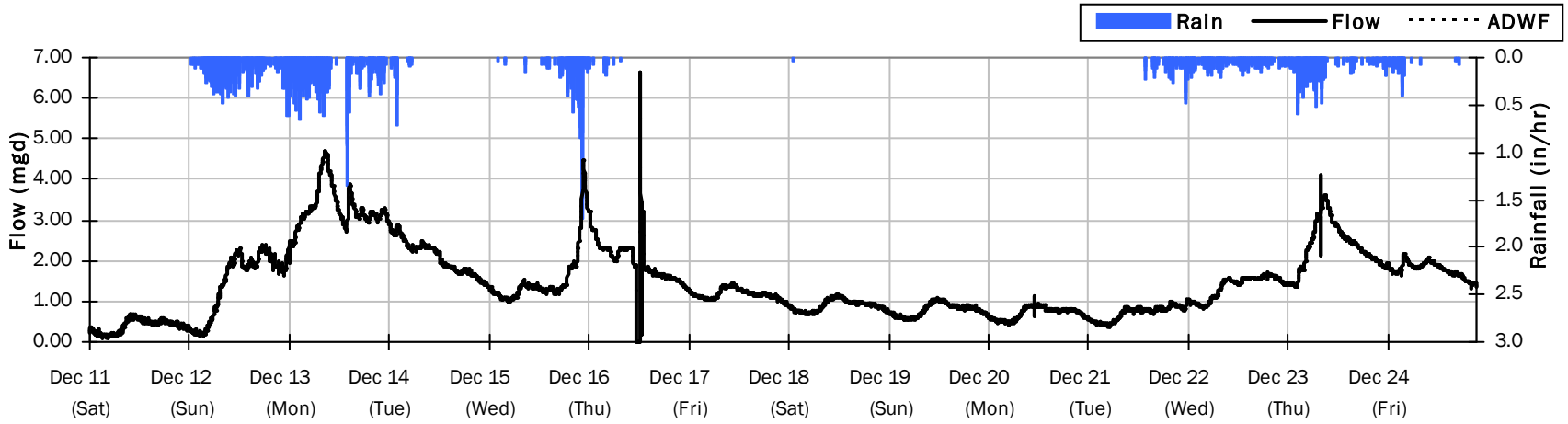
Period Flow Summary: Daily Flow Totals

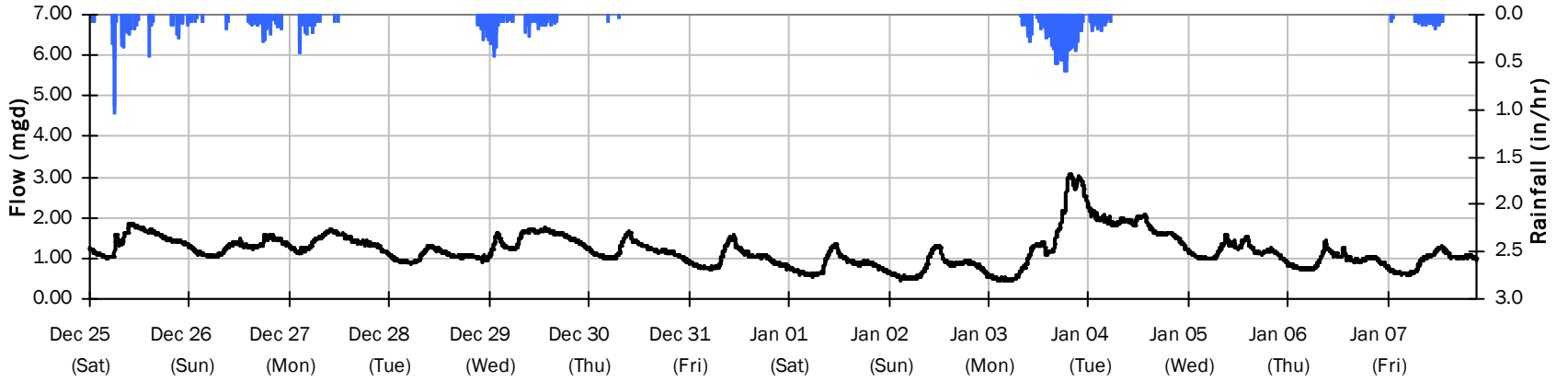


PS 14

Flow Summary: 12/11/2021 to 1/8/2022

Period Rainfall: 17.97 inches Period Avg Flow: 1.312 mgd Period Peak Flow: 6.551 mgd Period Min Flow: 0.000 mgd

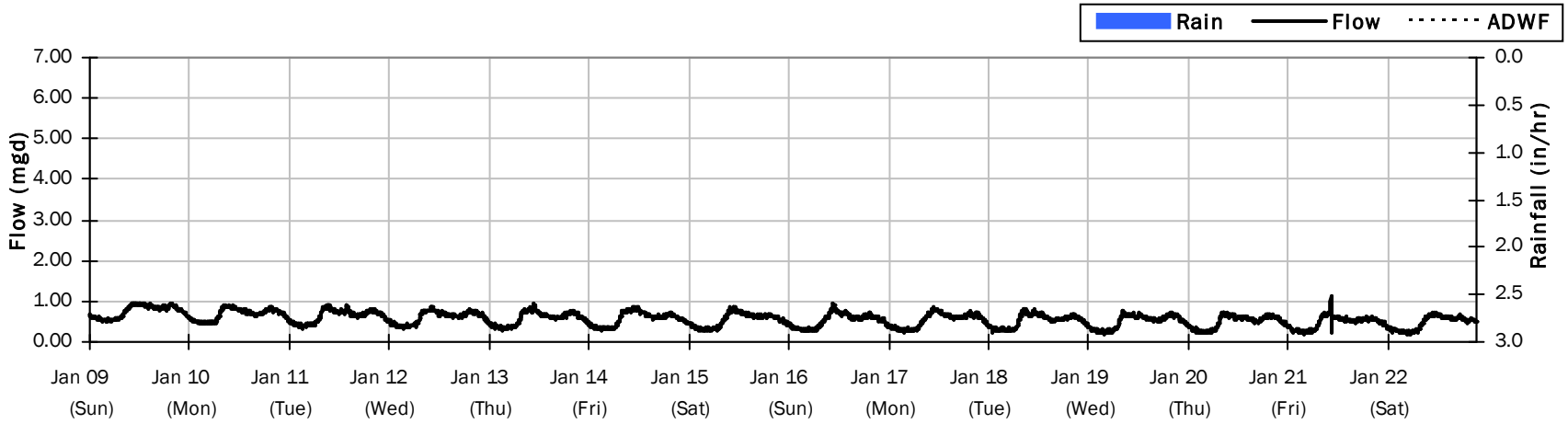


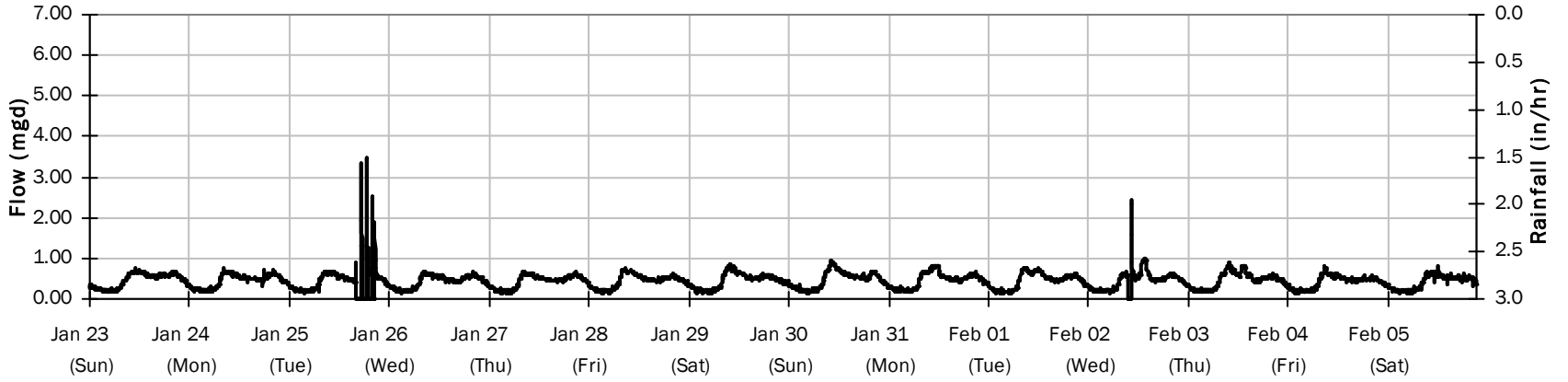


PS 14

Flow Summary: 1/9/2022 to 2/5/2022

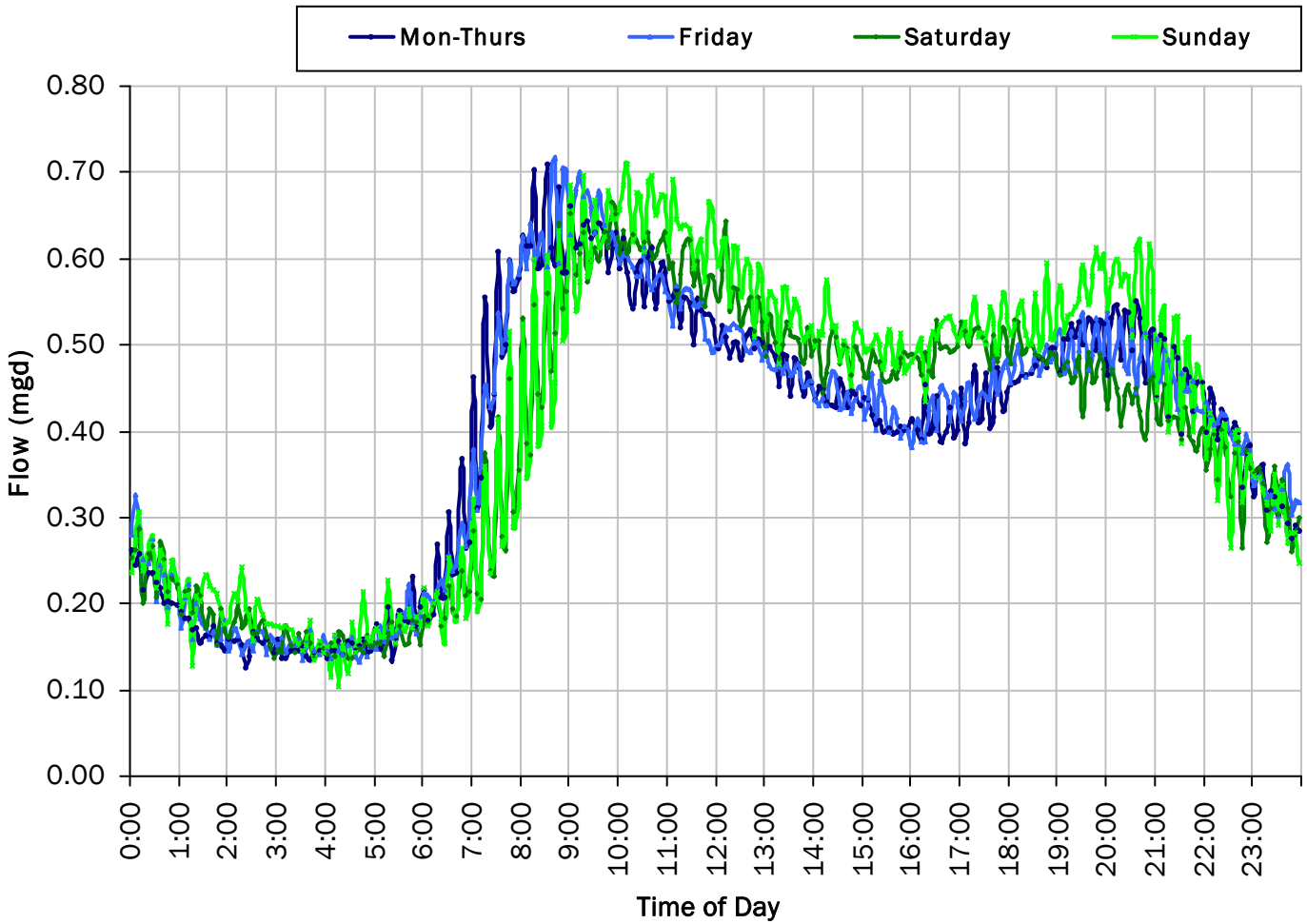
Period Rainfall: 0.00 inches Period Avg Flow: 0.506 mgd Period Peak Flow: 3.441 mgd Period Min Flow: 0.000 mgd





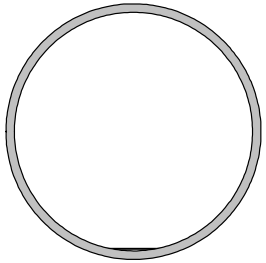
PS 14

Average Dry Weather Flow Hydrographs



ADWF:

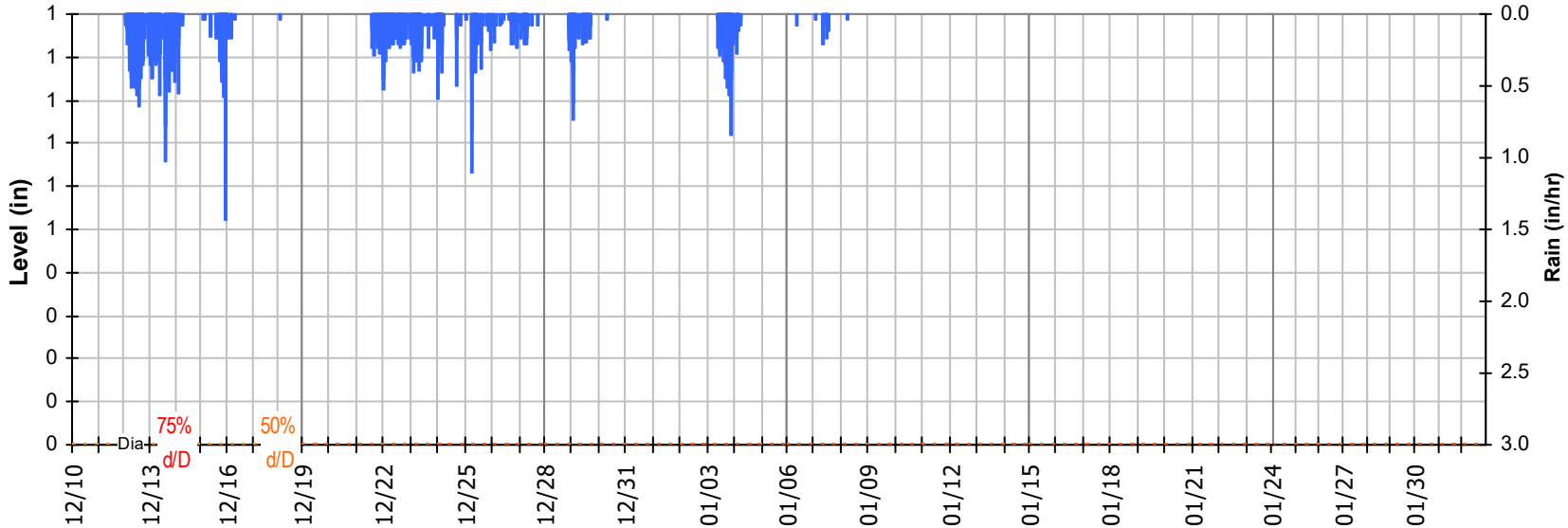
0.398 *mgd*

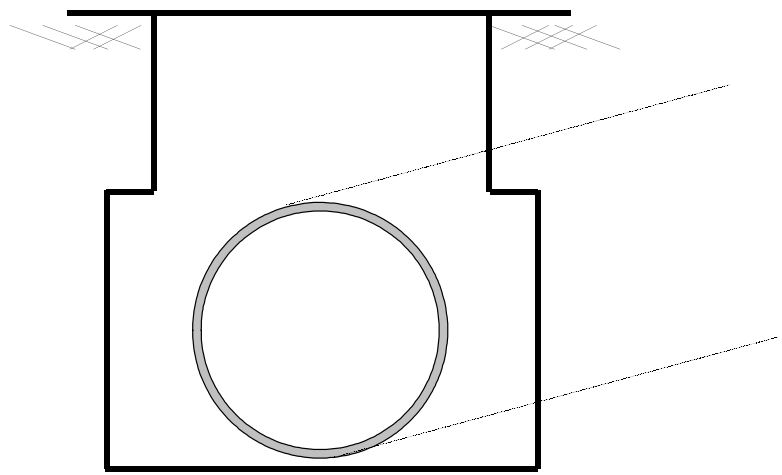


PS 12

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





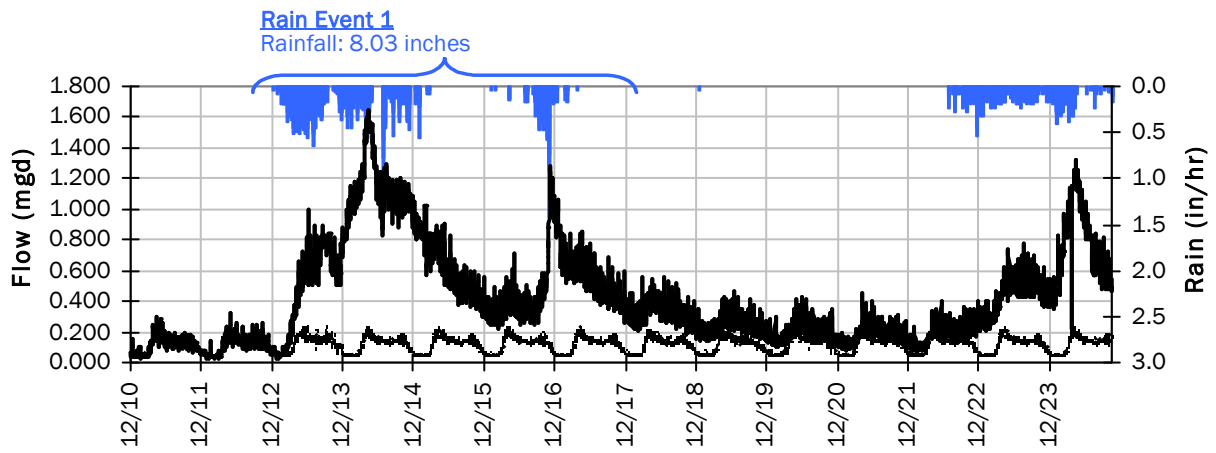
Pipe Diameter: 0 *inches*

Peak Measured Level: *inches*

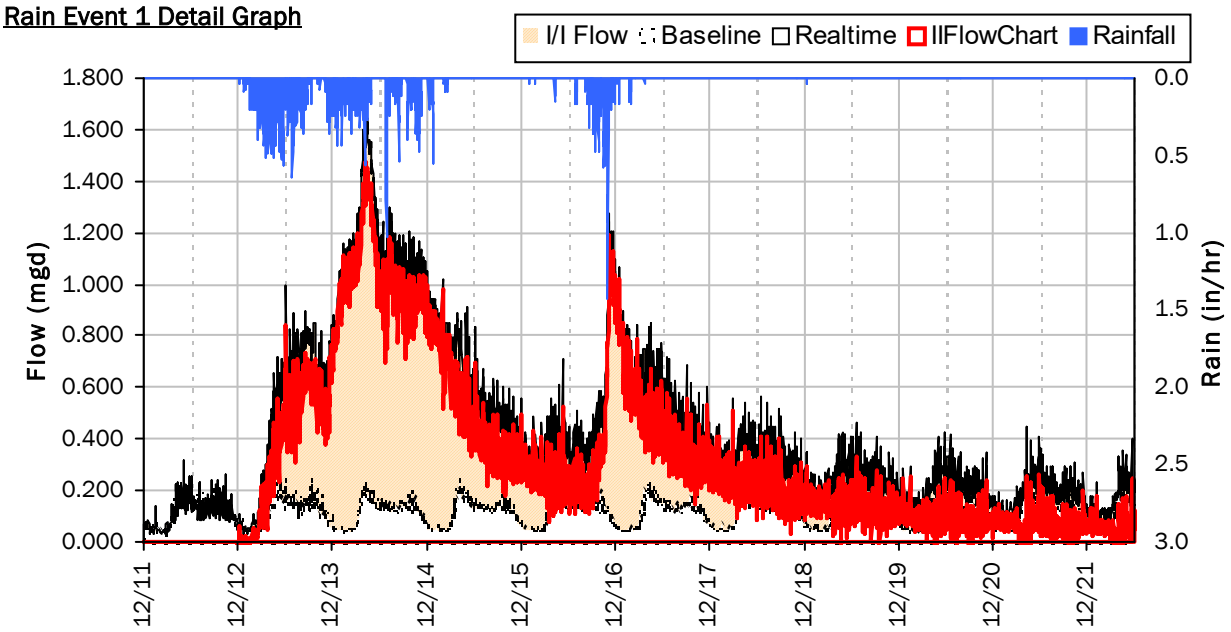
Peak d/D Ratio:

PS 12
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

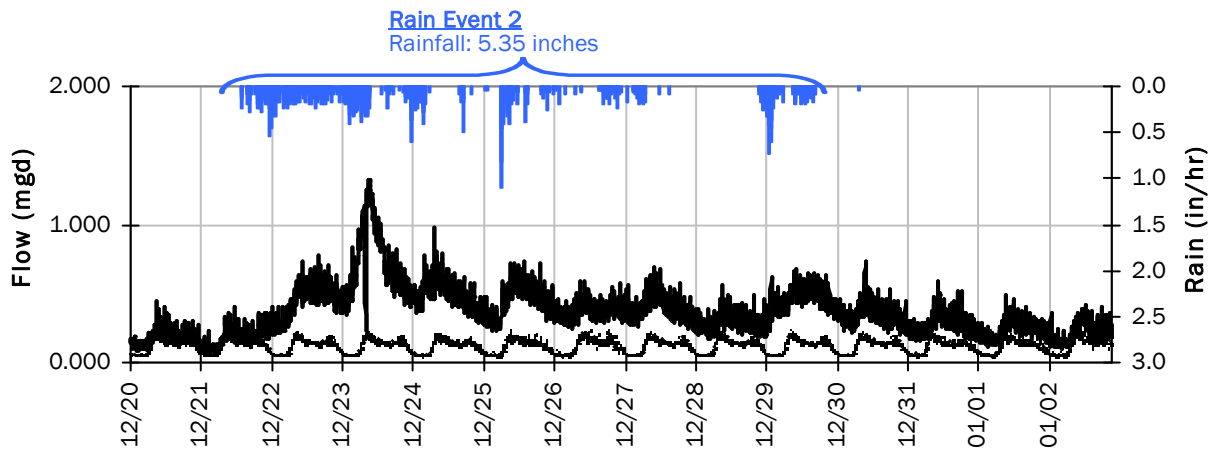


Storm Event I/I Analysis (Rain = 8.03 inches)

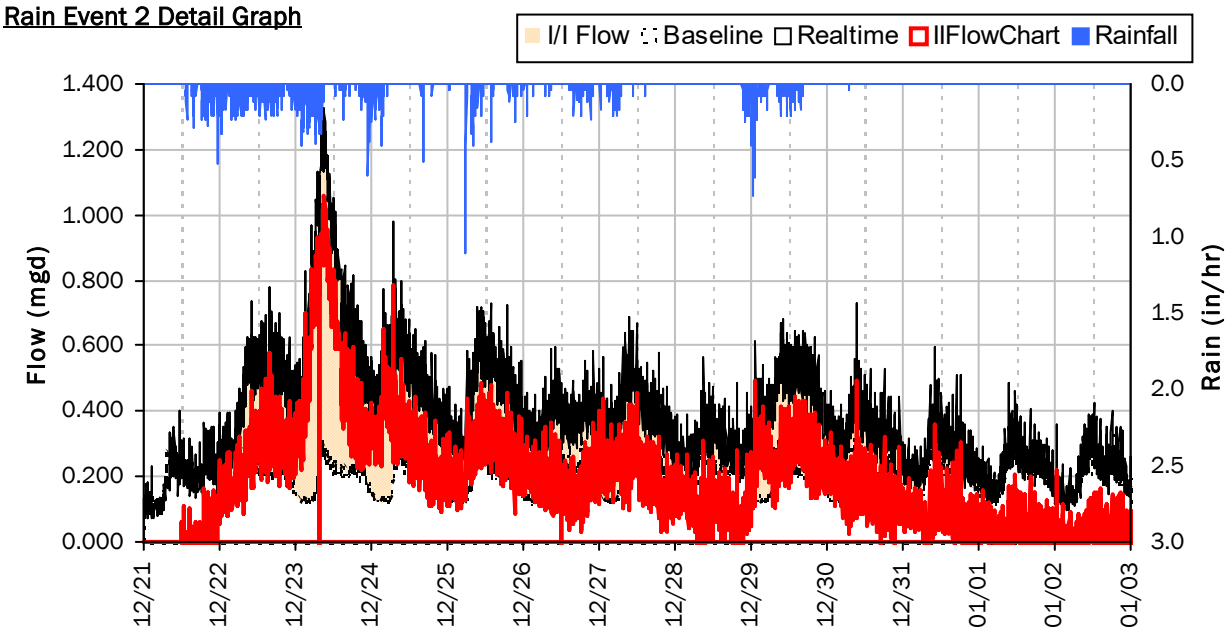
Capacity		Inflow / Infiltration	
Peak Flow:	1.649 *mgd*	Peak I/I Rate:	1.476 *mgd*
PF:	14.09	Total I/I:	3,177,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

PS 12
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



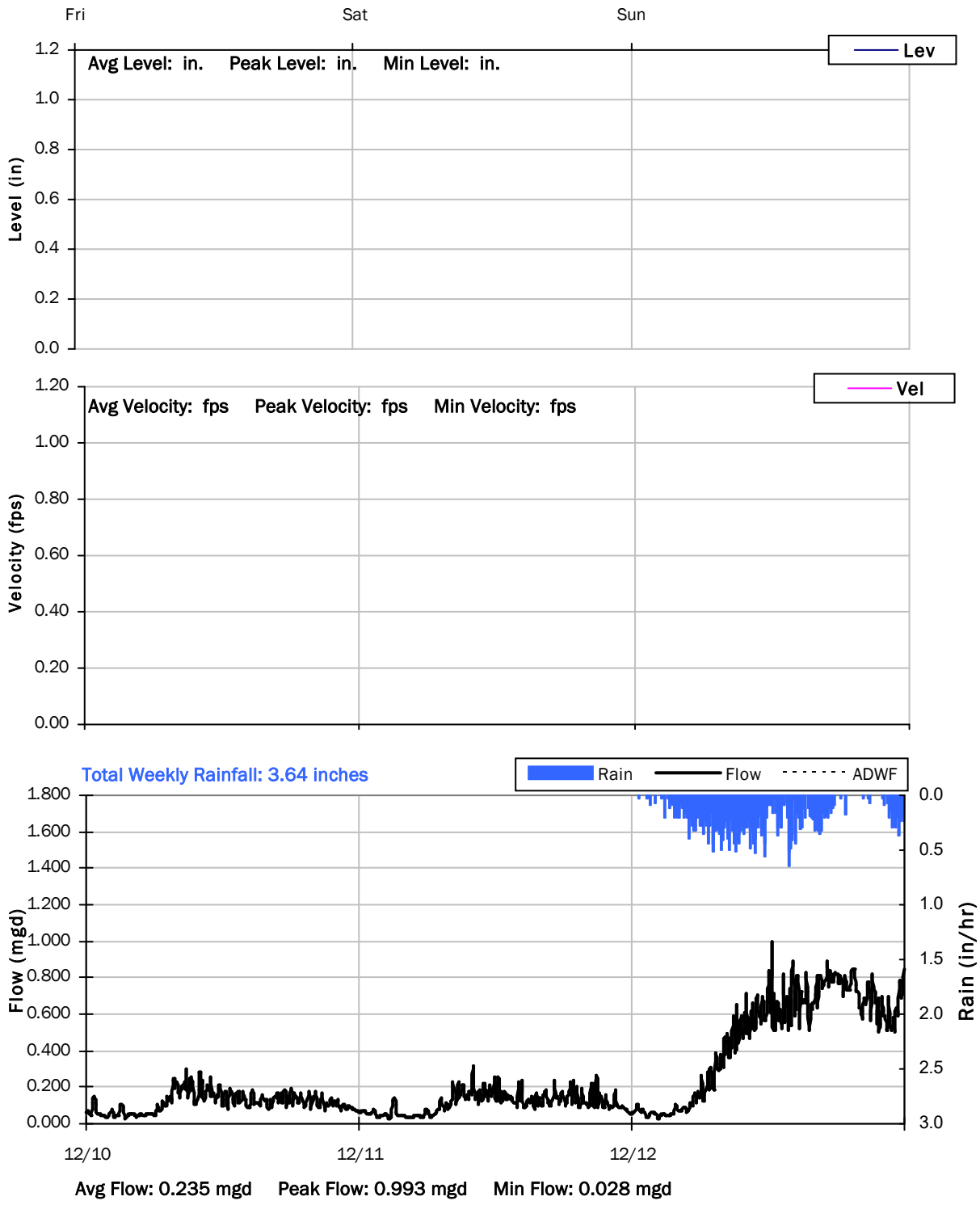
Storm Event I/I Analysis (Rain = 5.35 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.324 *mgd*	**Peak I/I Rate:**	1.060 *mgd*
PF:	11.31	**Total I/I:**	2,400,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

PS 12

Weekly Level, Velocity and Flow Hydrographs

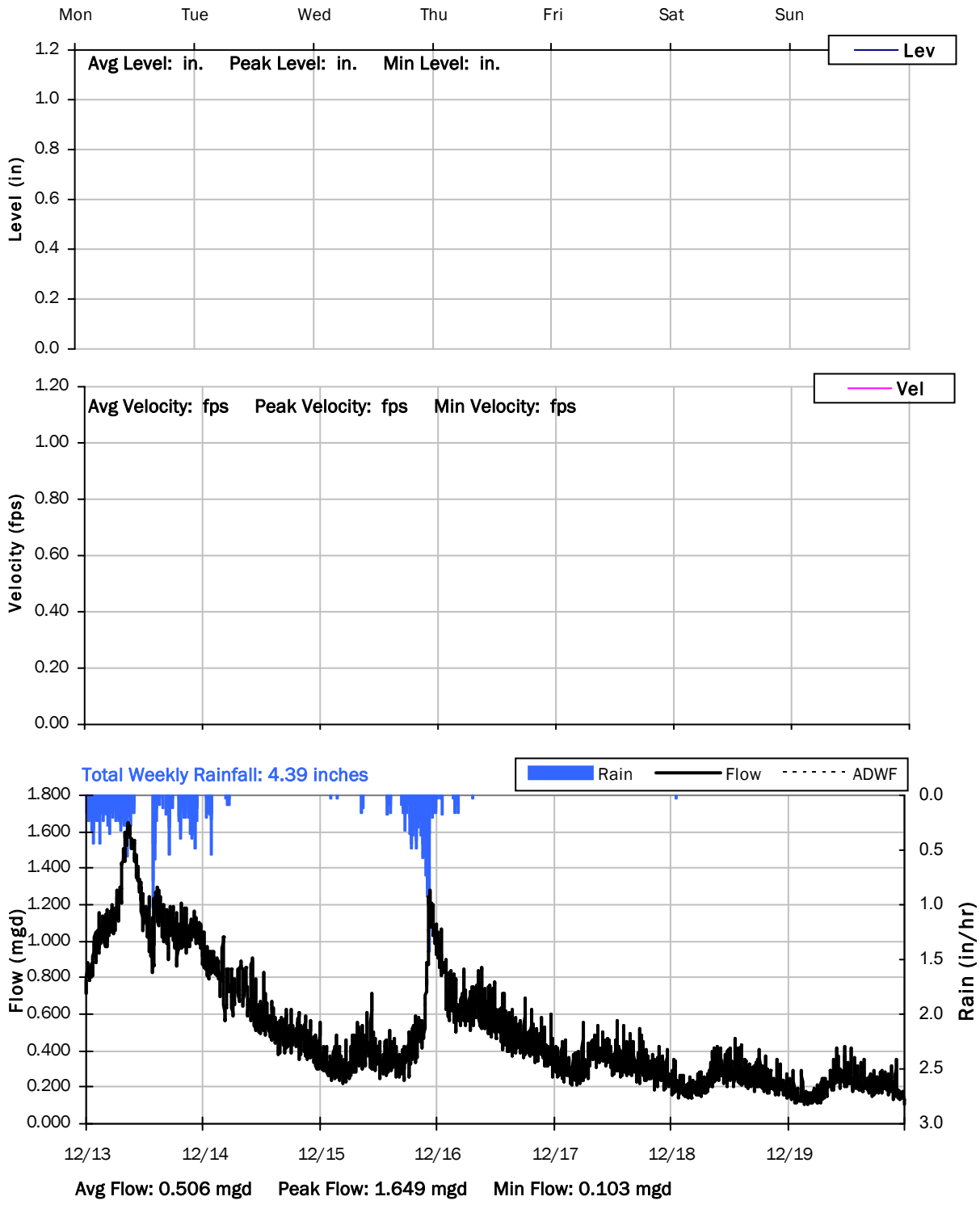
12/10/2021 to 12/13/2021



PS 12

Weekly Level, Velocity and Flow Hydrographs

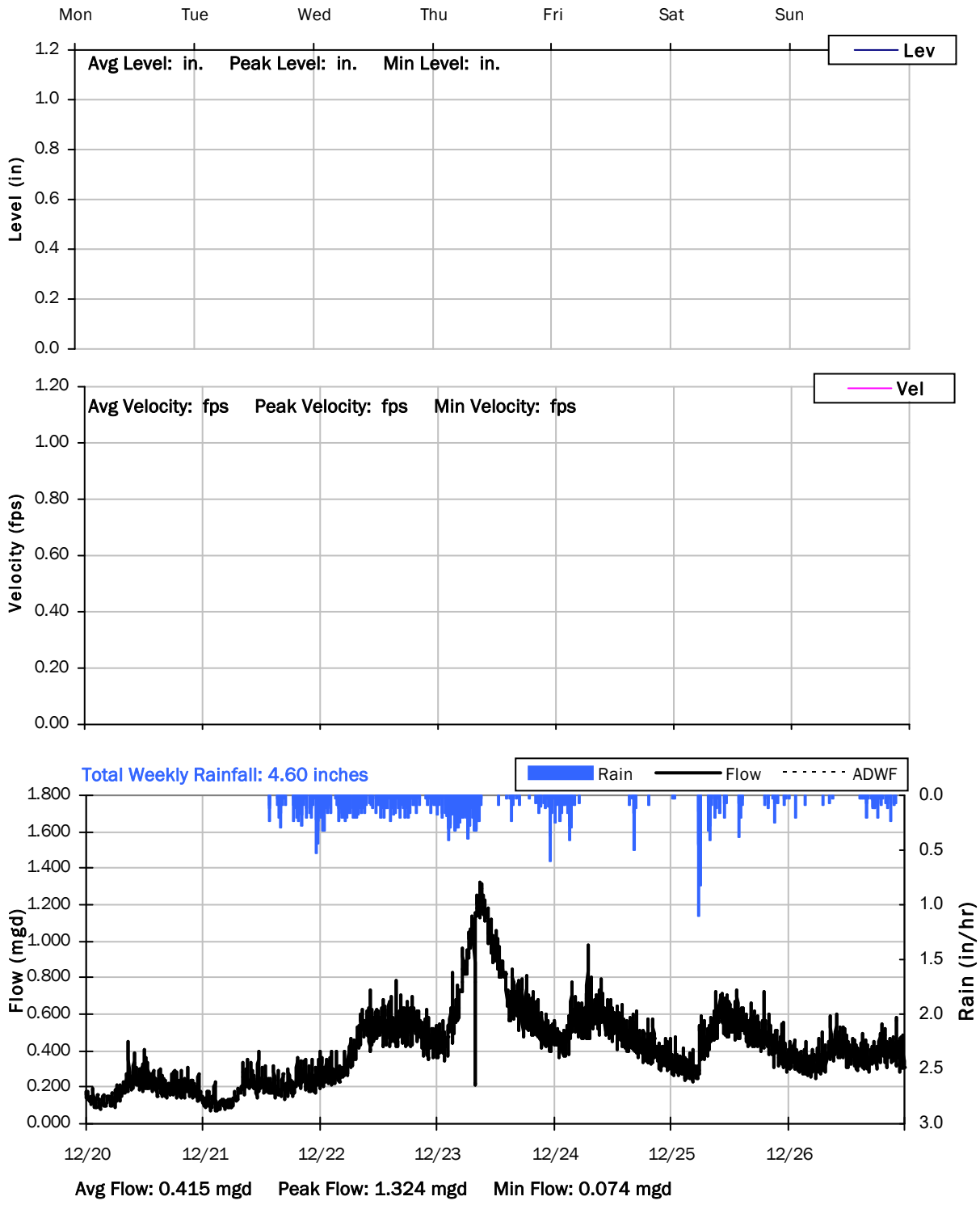
12/13/2021 to 12/20/2021



PS 12

Weekly Level, Velocity and Flow Hydrographs

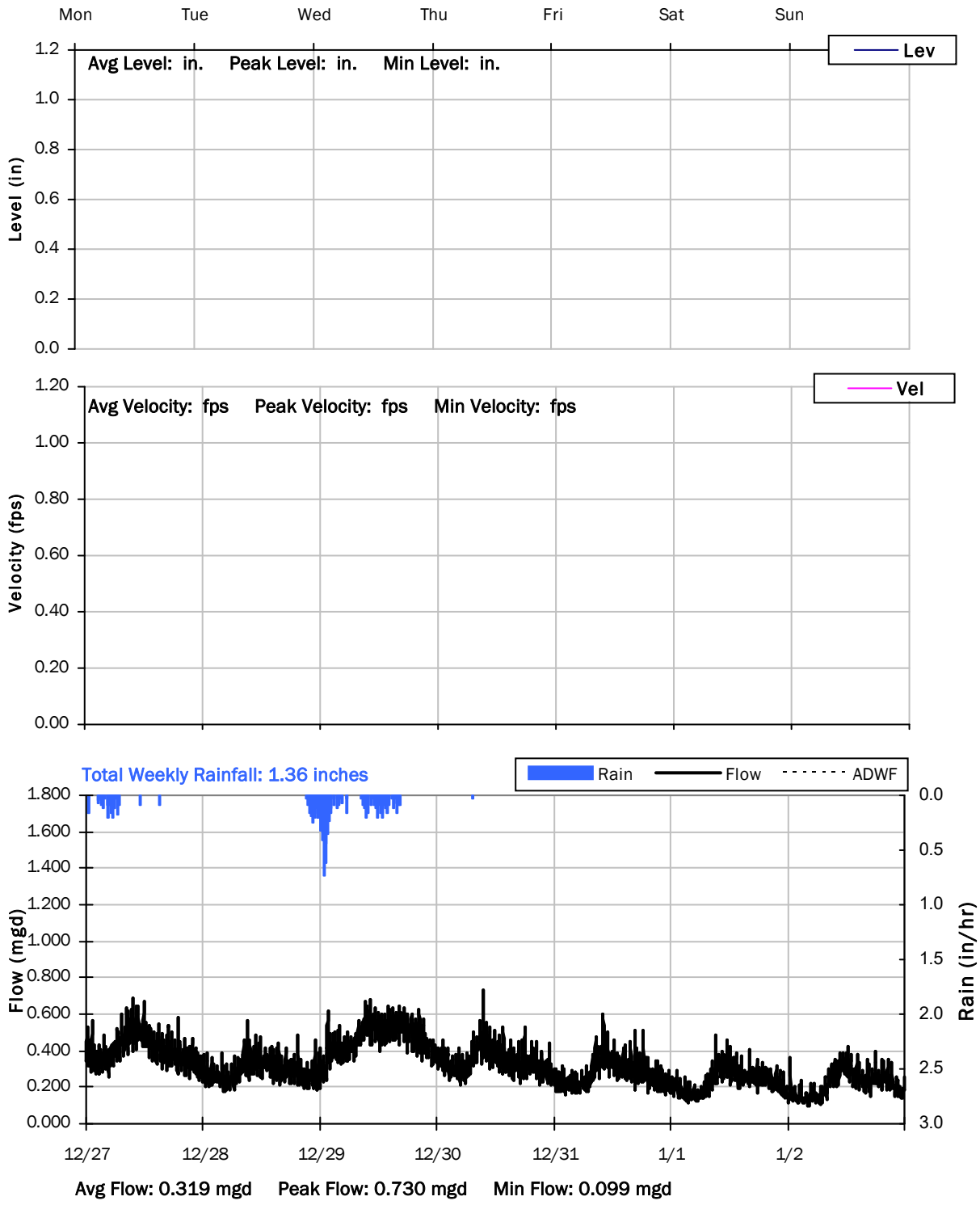
12/20/2021 to 12/27/2021



PS 12

Weekly Level, Velocity and Flow Hydrographs

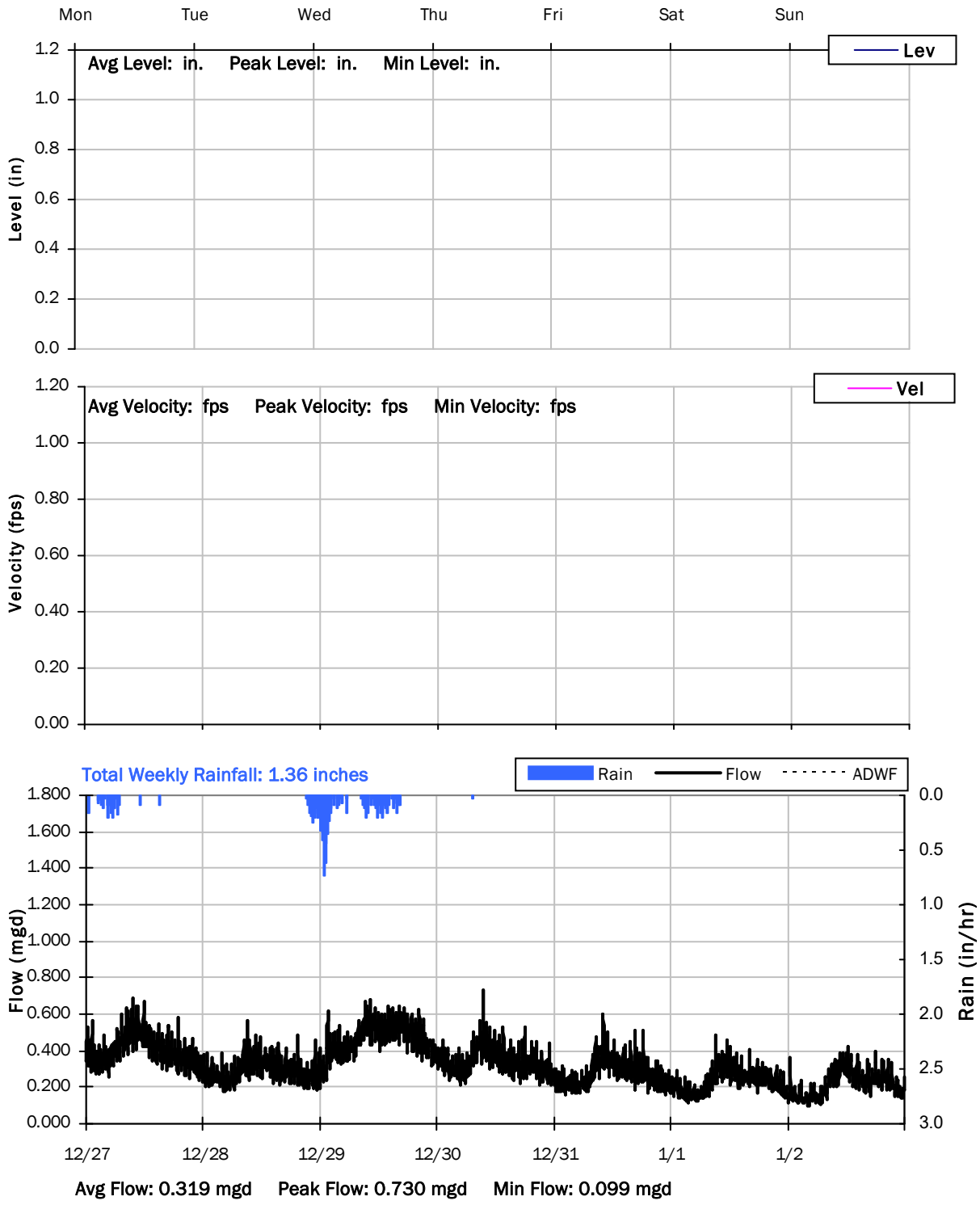
12/27/2021 to 1/3/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

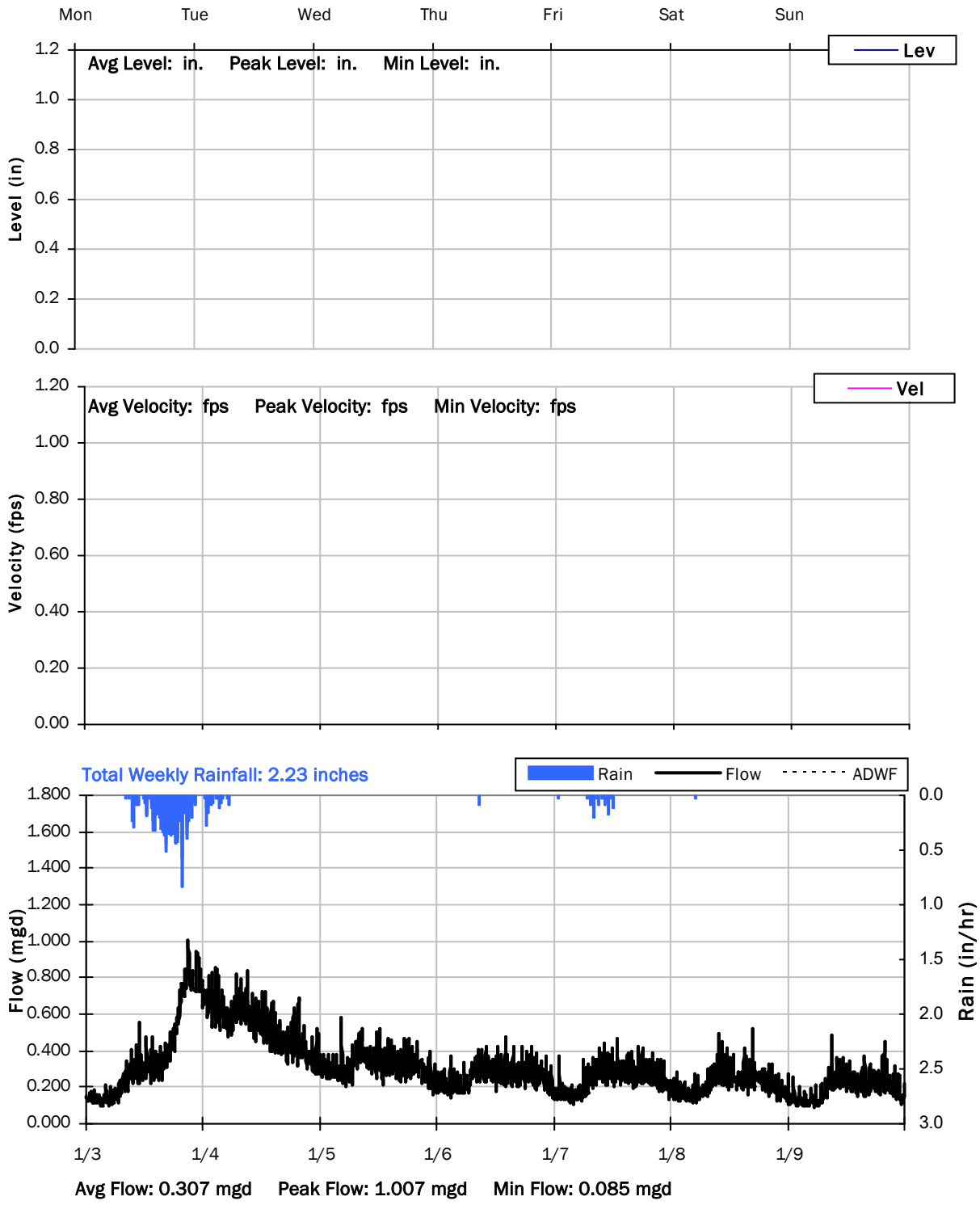
12/27/2021 to 1/3/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

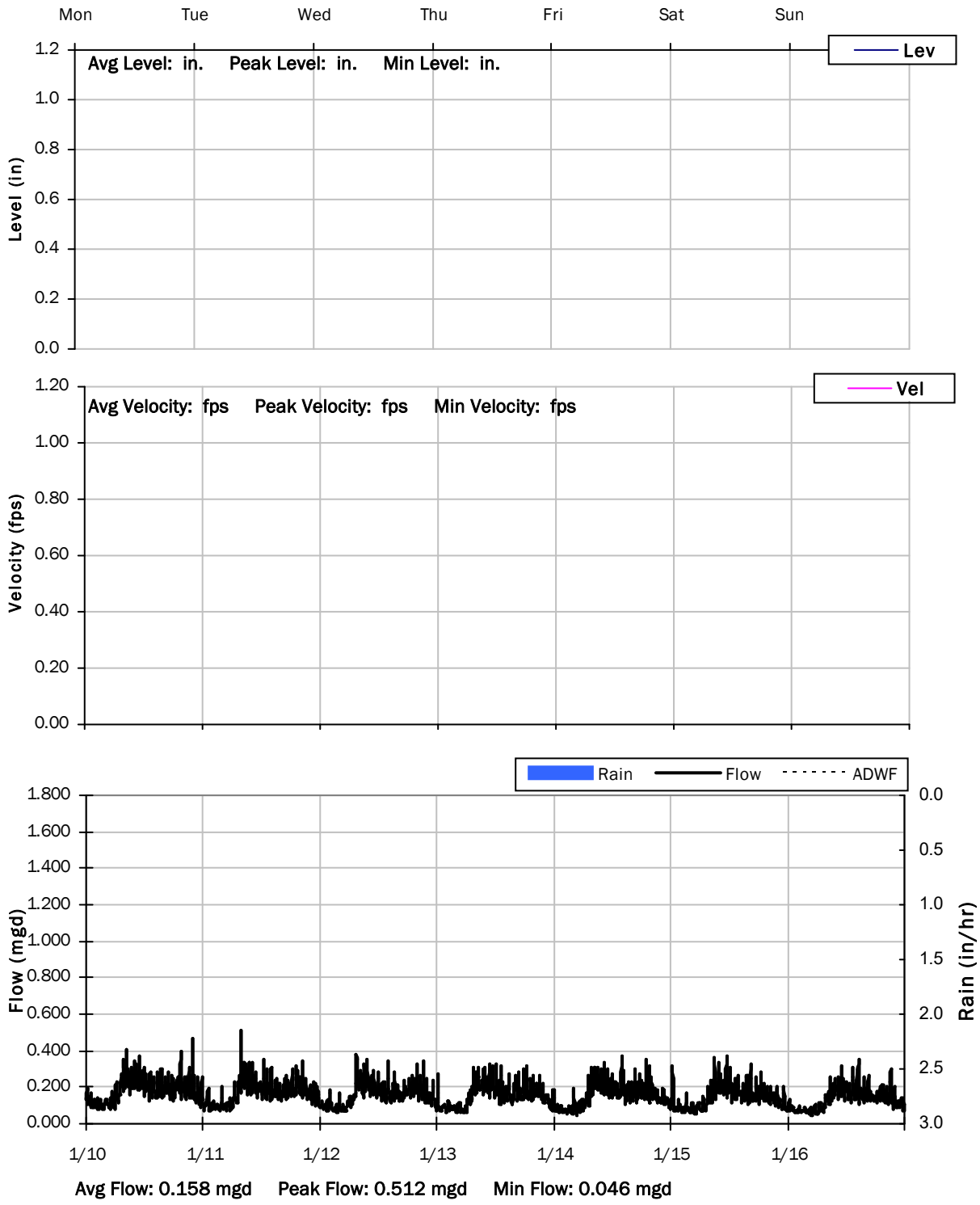
1/3/2022 to 1/10/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

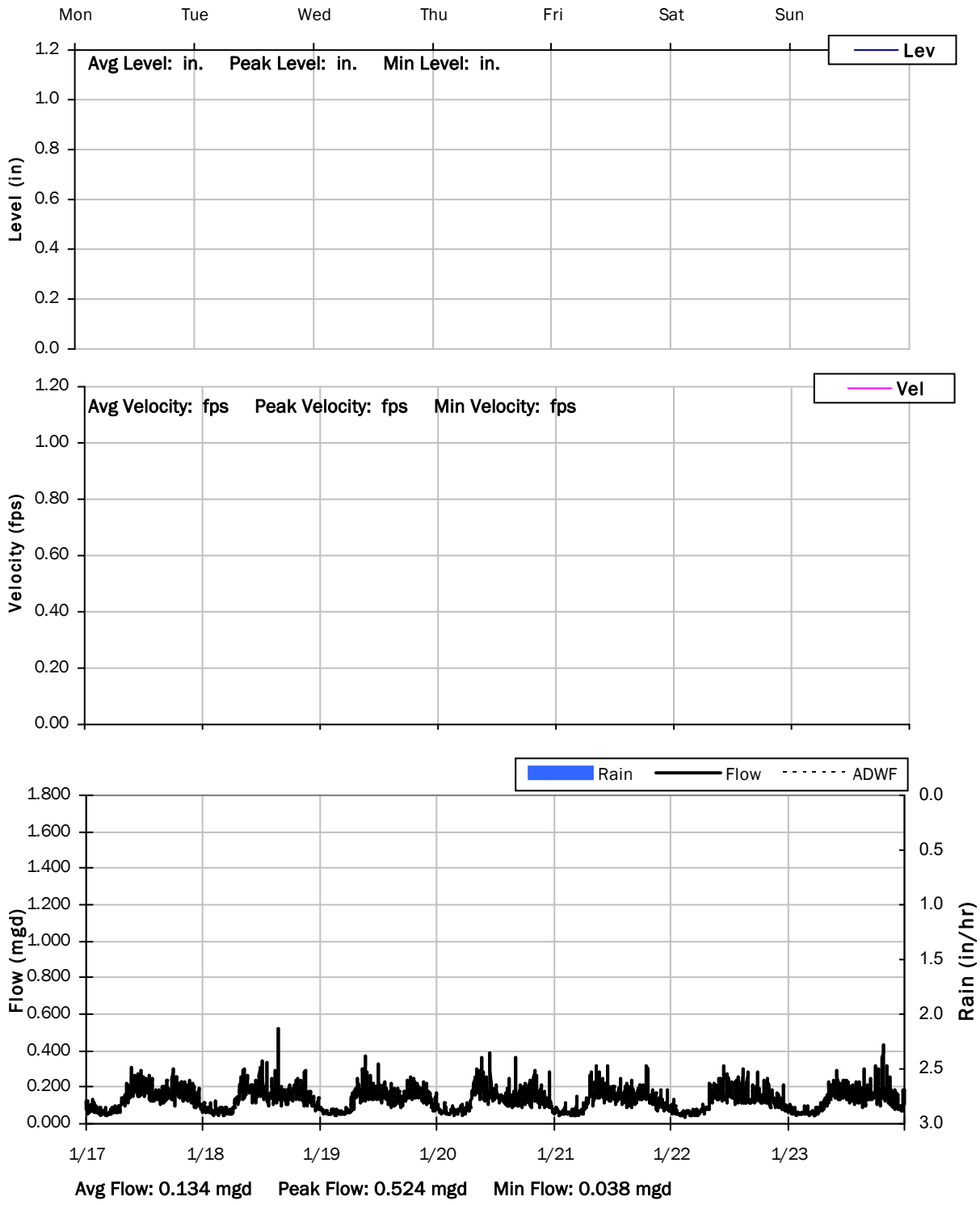
1/10/2022 to 1/17/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

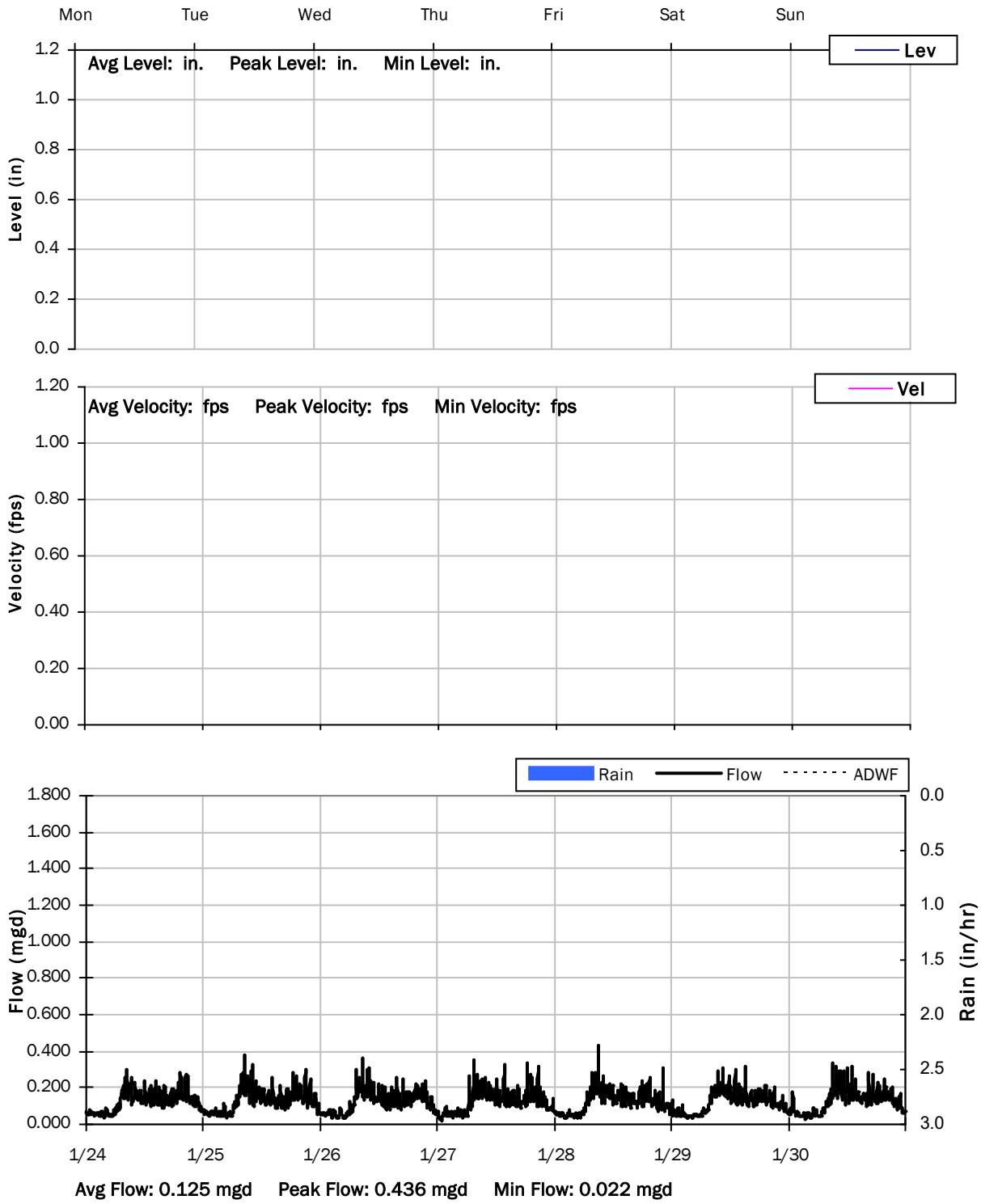
1/17/2022 to 1/24/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

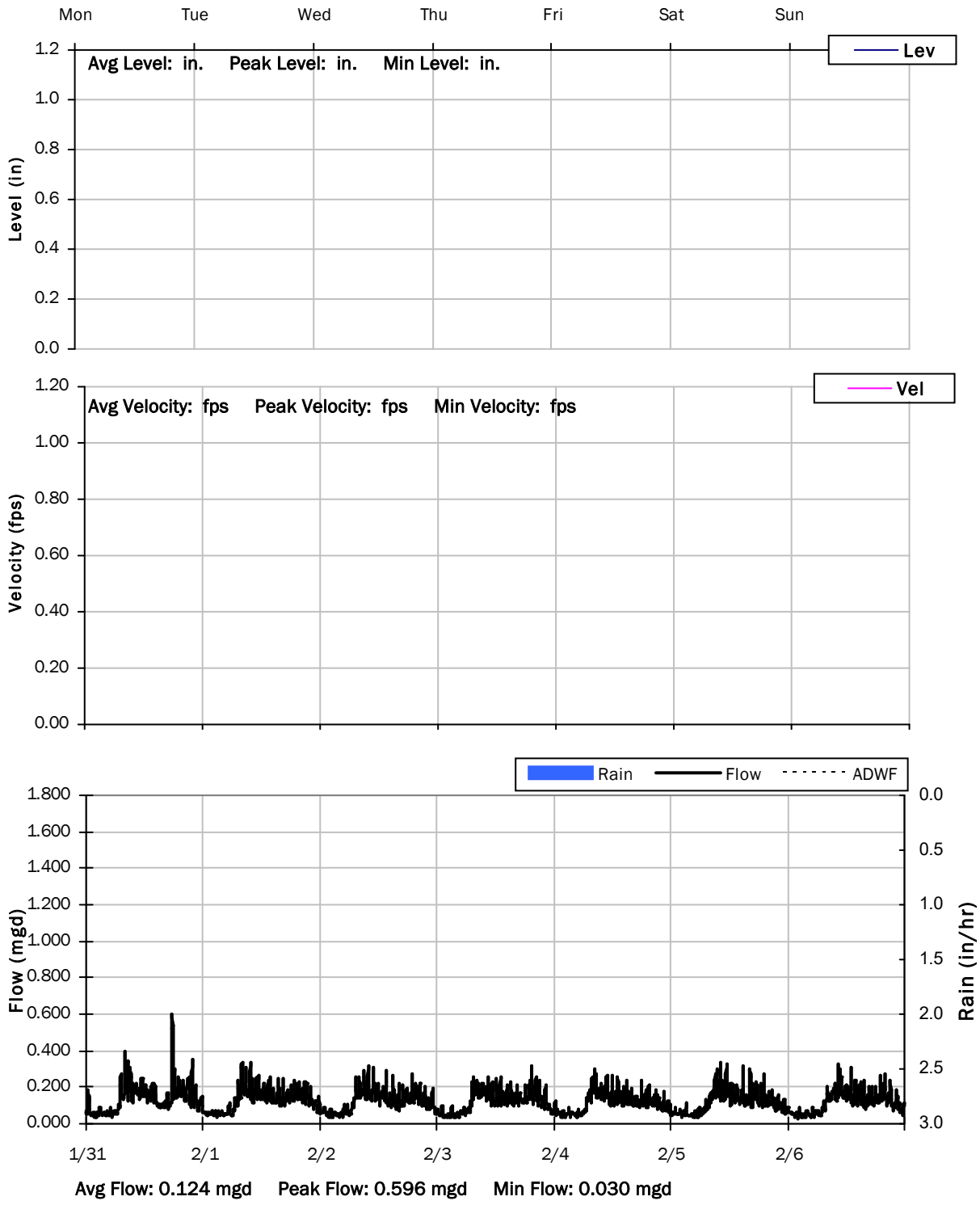
1/24/2022 to 1/31/2022



PS 12

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022



Monitoring Site: PS 14

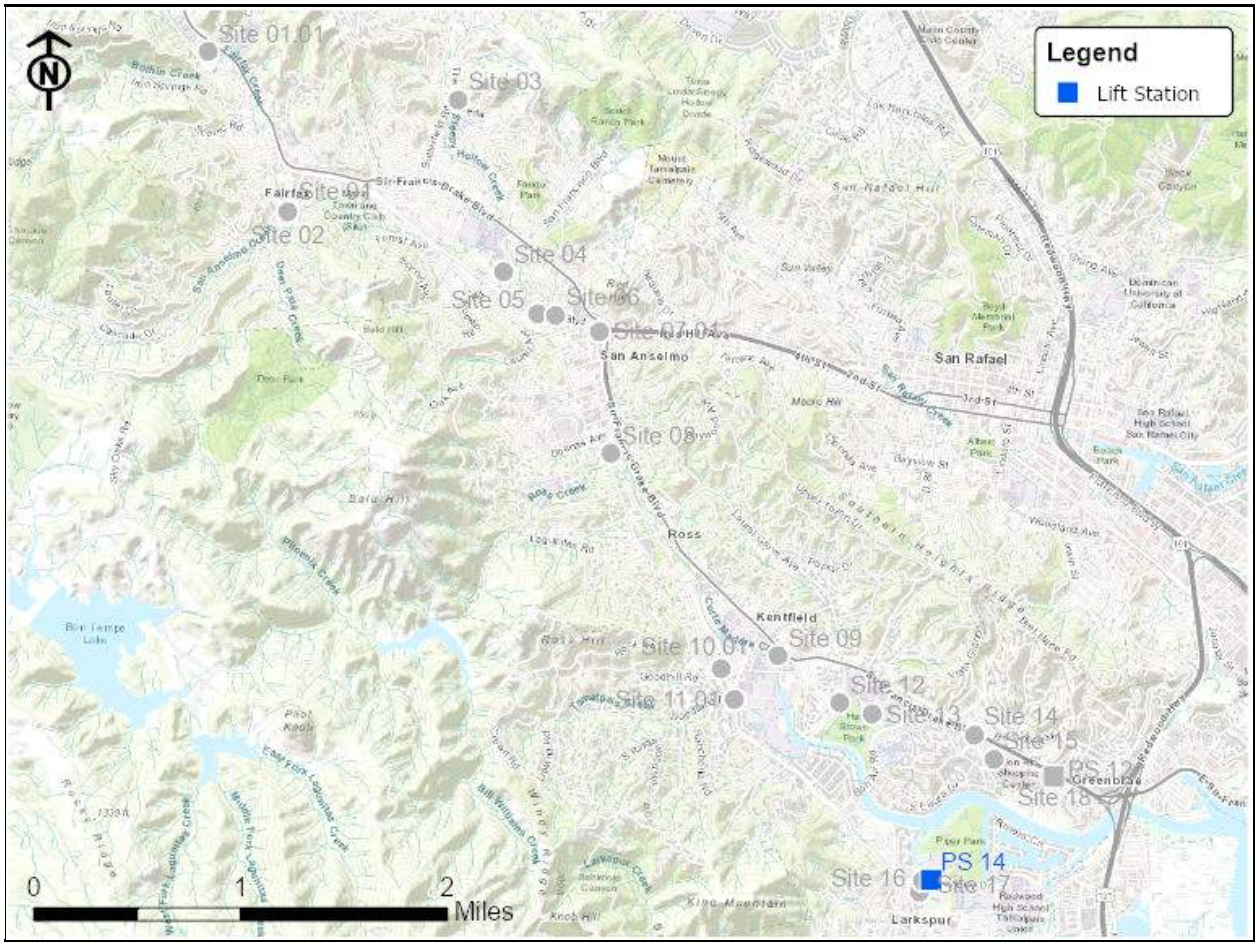
Ross Valley Sanitation District

Sanitary Sewer Flow Monitoring

December 09, 2021 - February 10, 2022

Location: Doherty Drive west of Hall Middle School

Data Summary Report



Vicinity Map: PS 14

PS 14

Site Information MH ID: N/A

Location: Doherty Drive west of Hall Middle School

Coordinates: 122.5320° W, 37.9385° N

Rim Elevation (Earth): 14 feet

Expected Pipe Diameter: 0 inches

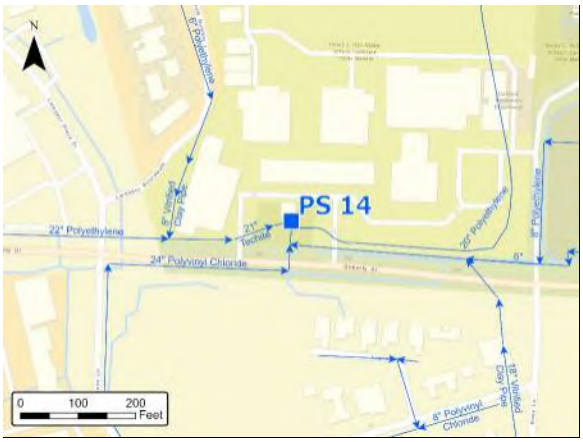
Measured Pipe Diameter: 0 inches

ADWF: 0.397 mgd

Peak Measured Flow: 6.551 mgd

Sediment: None

Satellite Map

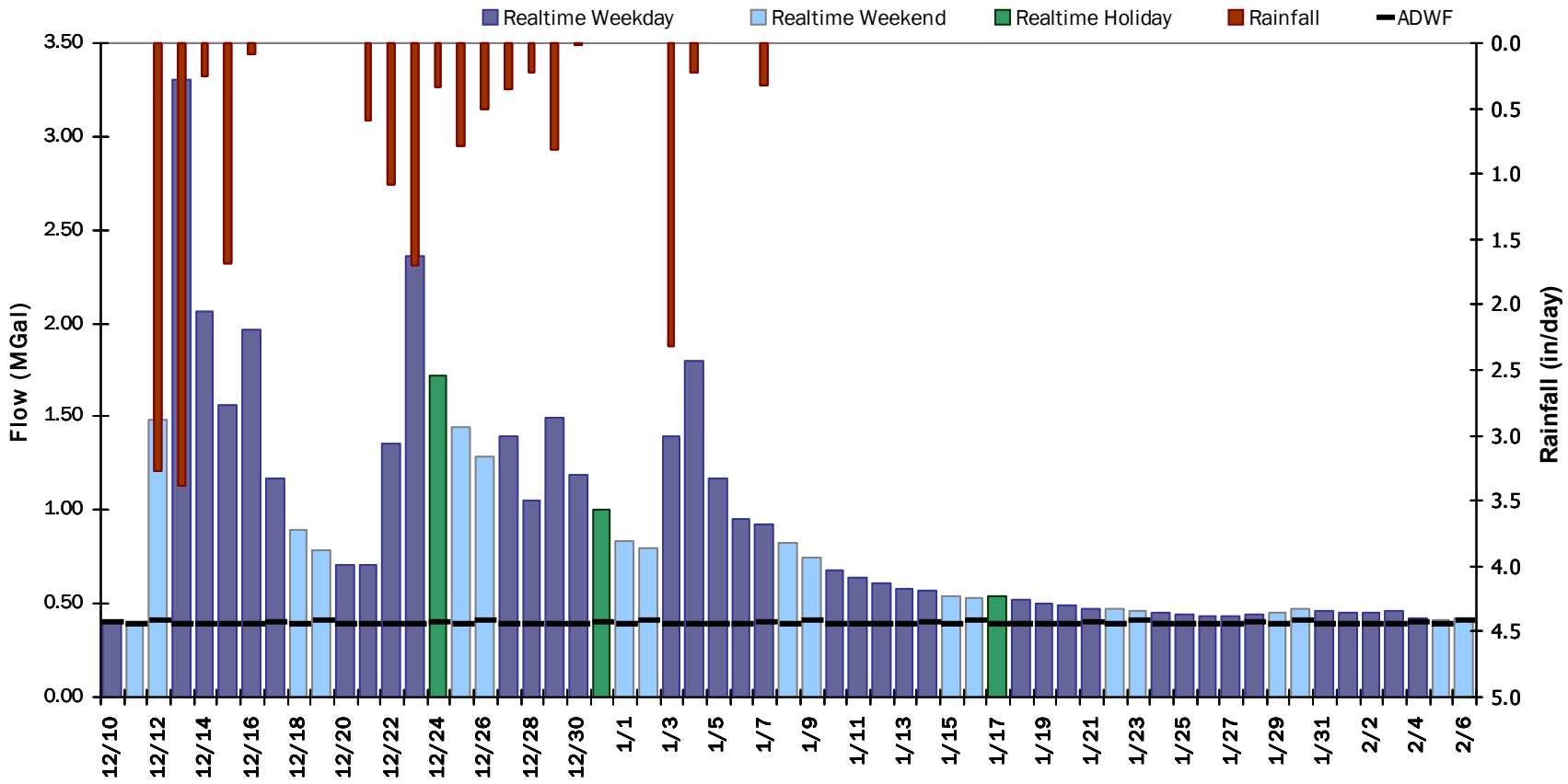


Sanitary Map

Street View

PS 14

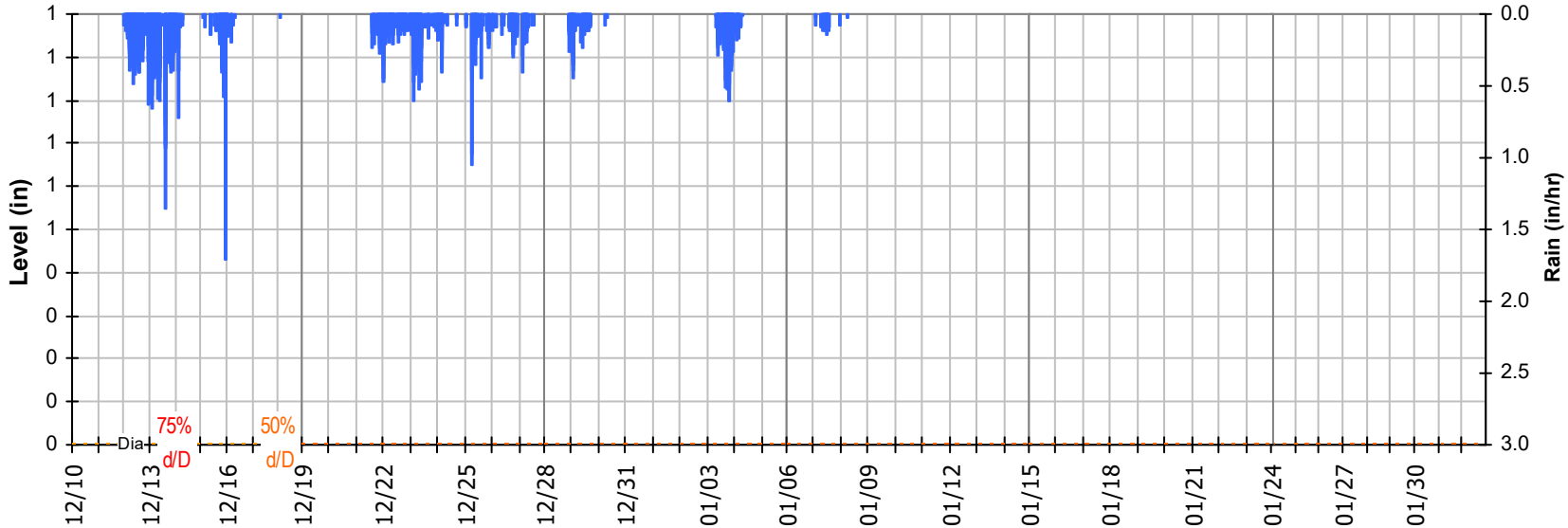
Period Flow Summary: Daily Flow Totals

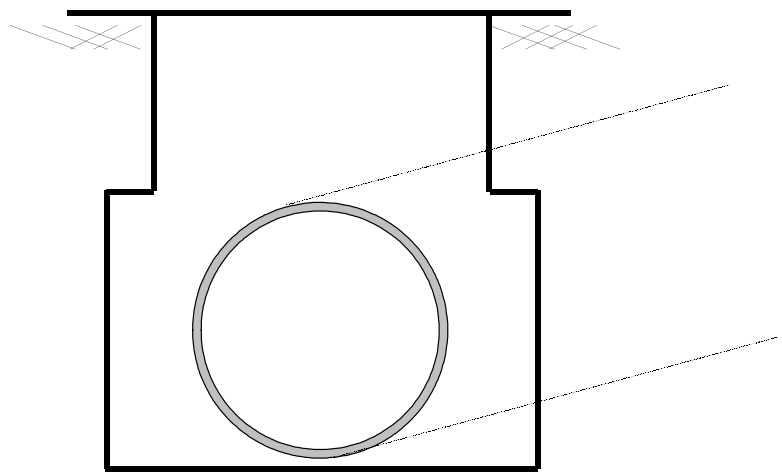


PS 14

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





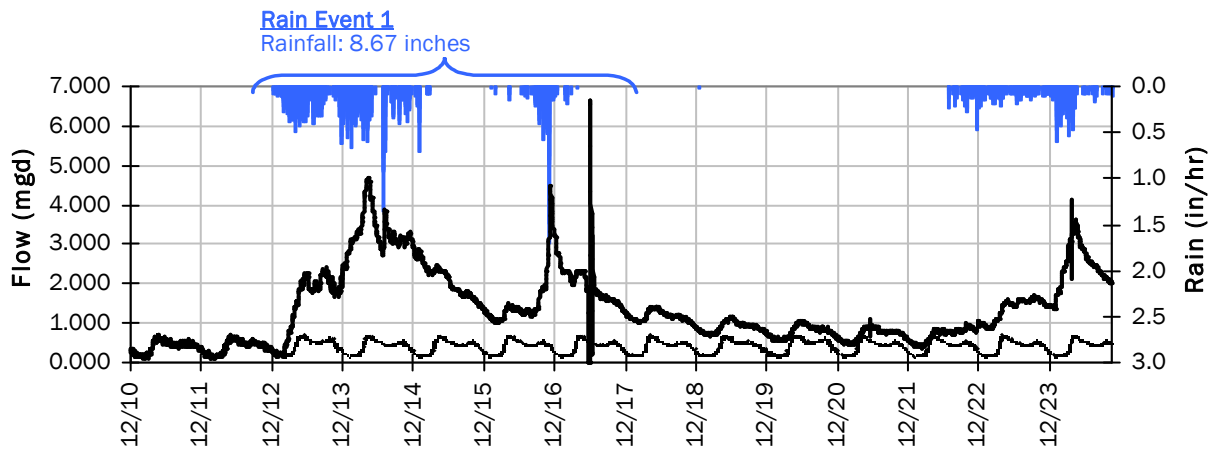
Pipe Diameter: 0 *inches*

Peak Measured Level: *inches*

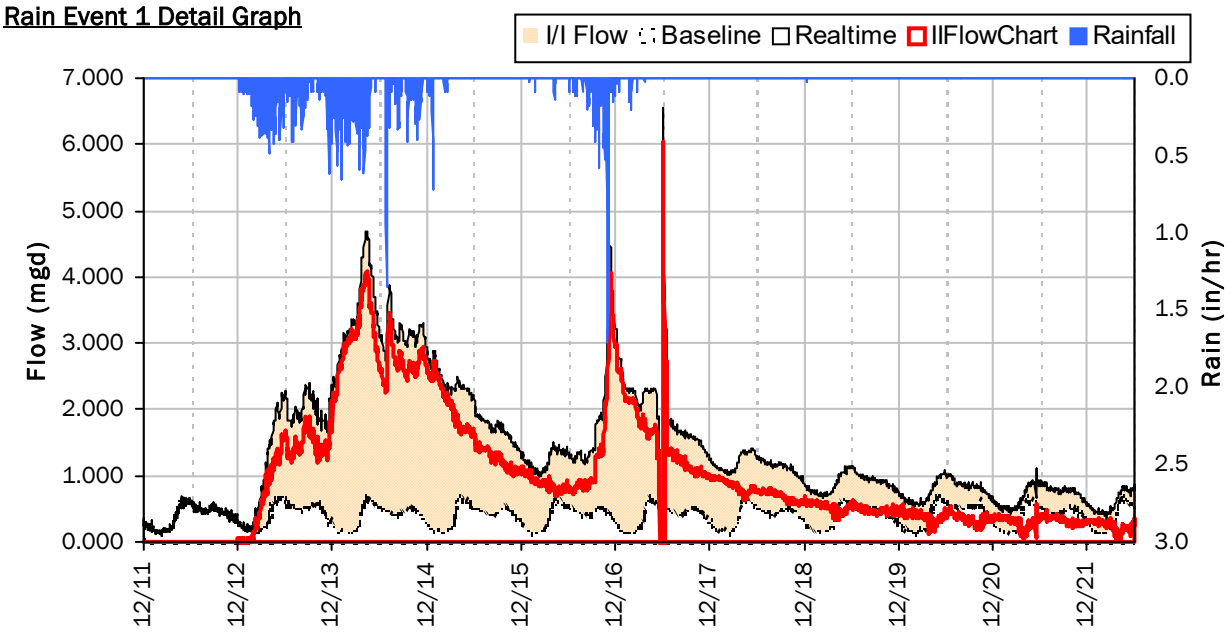
Peak d/D Ratio:

PS 14
I/I Summary: Rain Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 1 Detail Graph

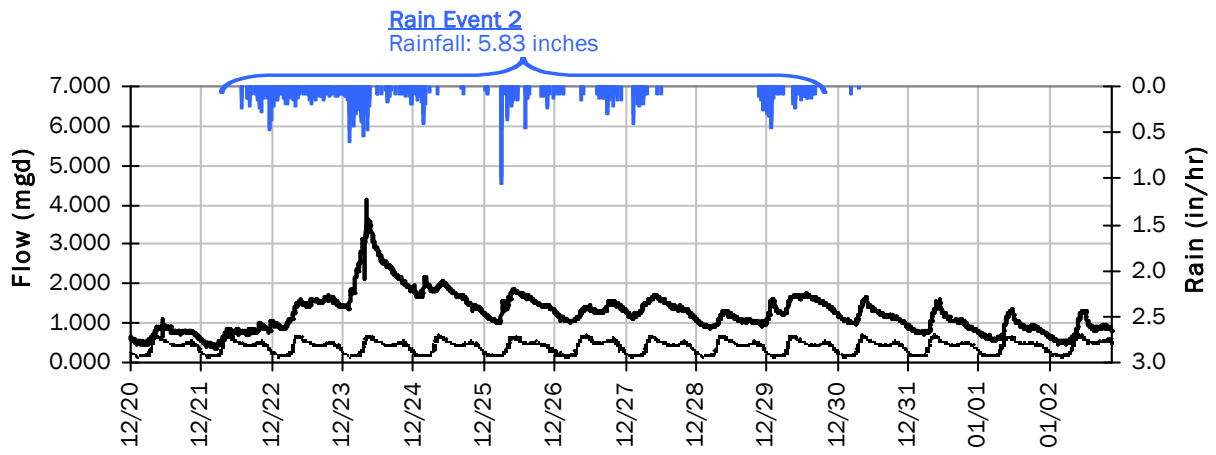


Storm Event I/I Analysis (Rain = 8.67 inches)

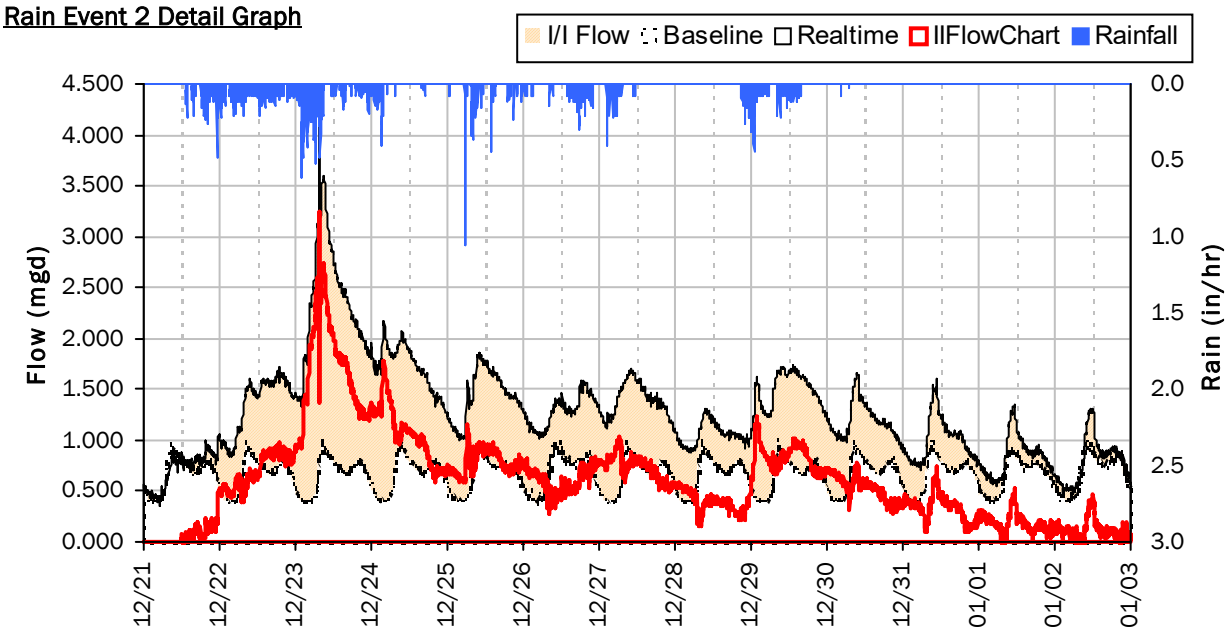
Capacity		Inflow / Infiltration	
Peak Flow:	6.551 *mgd*	Peak I/I Rate:	6.041 *mgd*
PF:	16.48	Total I/I:	10,462,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

PS 14
I/I Summary: Rain Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Rain Event 2 Detail Graph



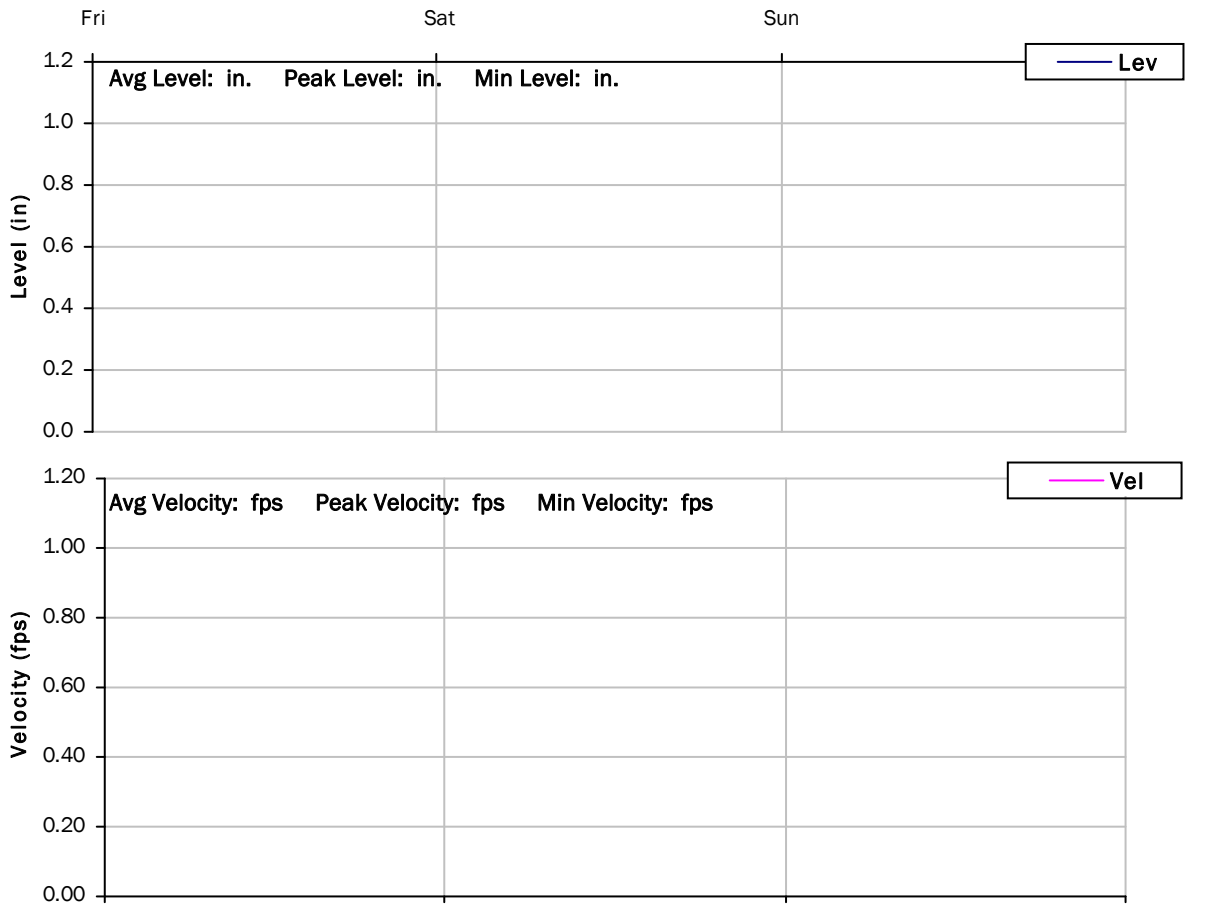
Storm Event I/I Analysis (Rain = 5.83 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	4.123 *mgd*	**Peak I/I Rate:**	3.252 *mgd*
PF:	10.37	**Total I/I:**	8,036,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

PS 14

Weekly Level, Velocity and Flow Hydrographs

12/10/2021 to 12/13/2021

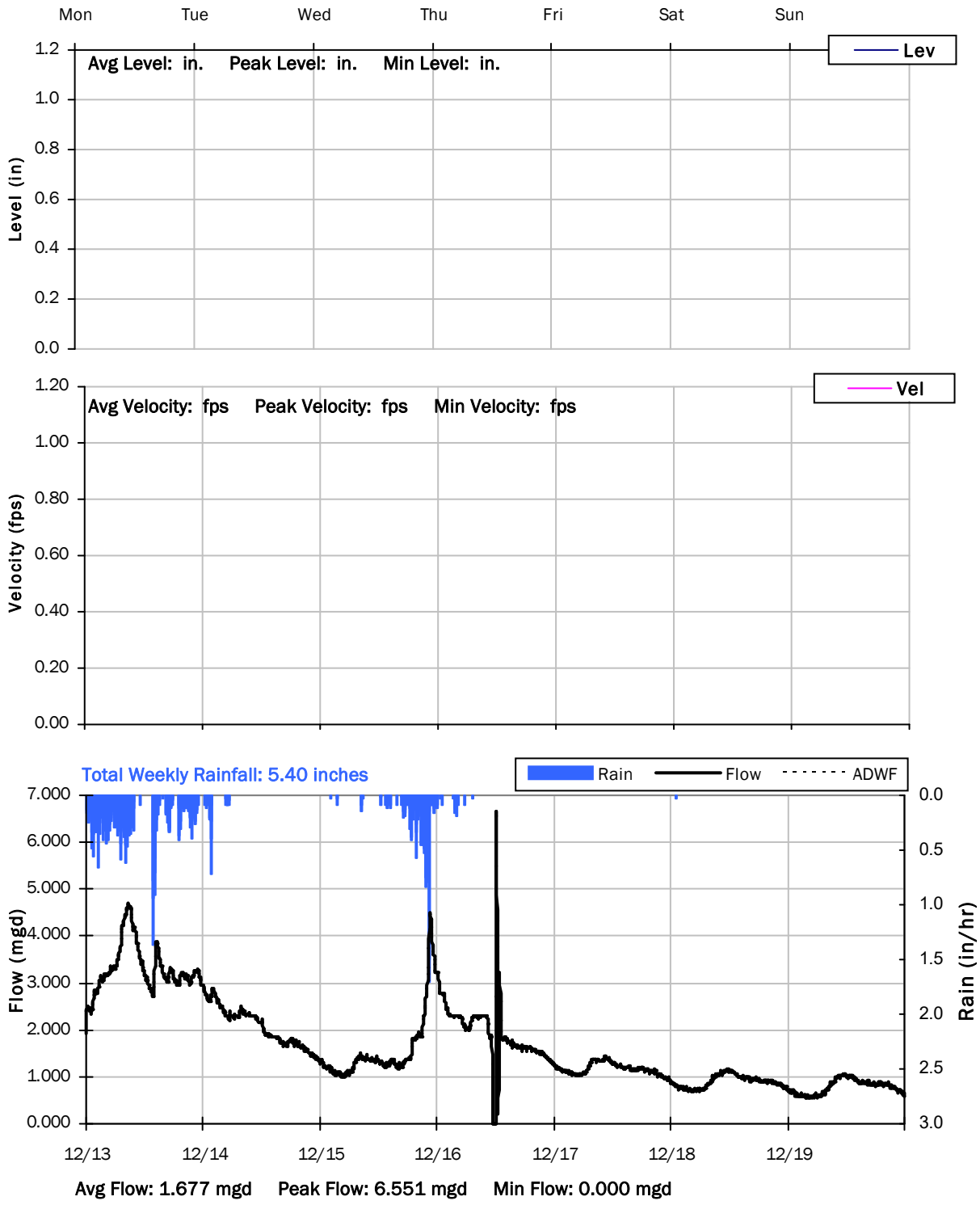


Avg Flow: 0.757 mgd Peak Flow: 2.396 mgd Min Flow: 0.092 mgd

PS 14

Weekly Level, Velocity and Flow Hydrographs

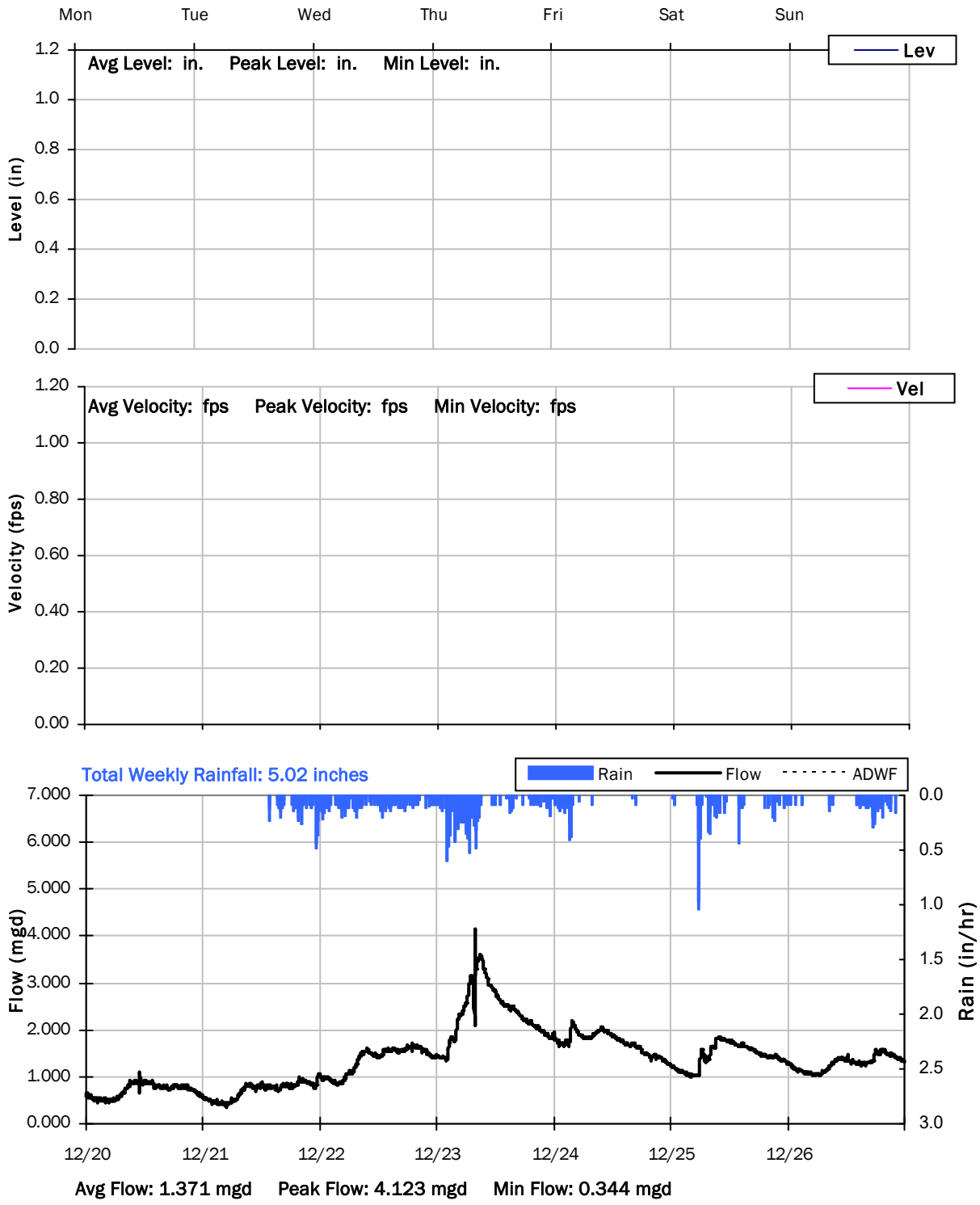
12/13/2021 to 12/20/2021



PS 14

Weekly Level, Velocity and Flow Hydrographs

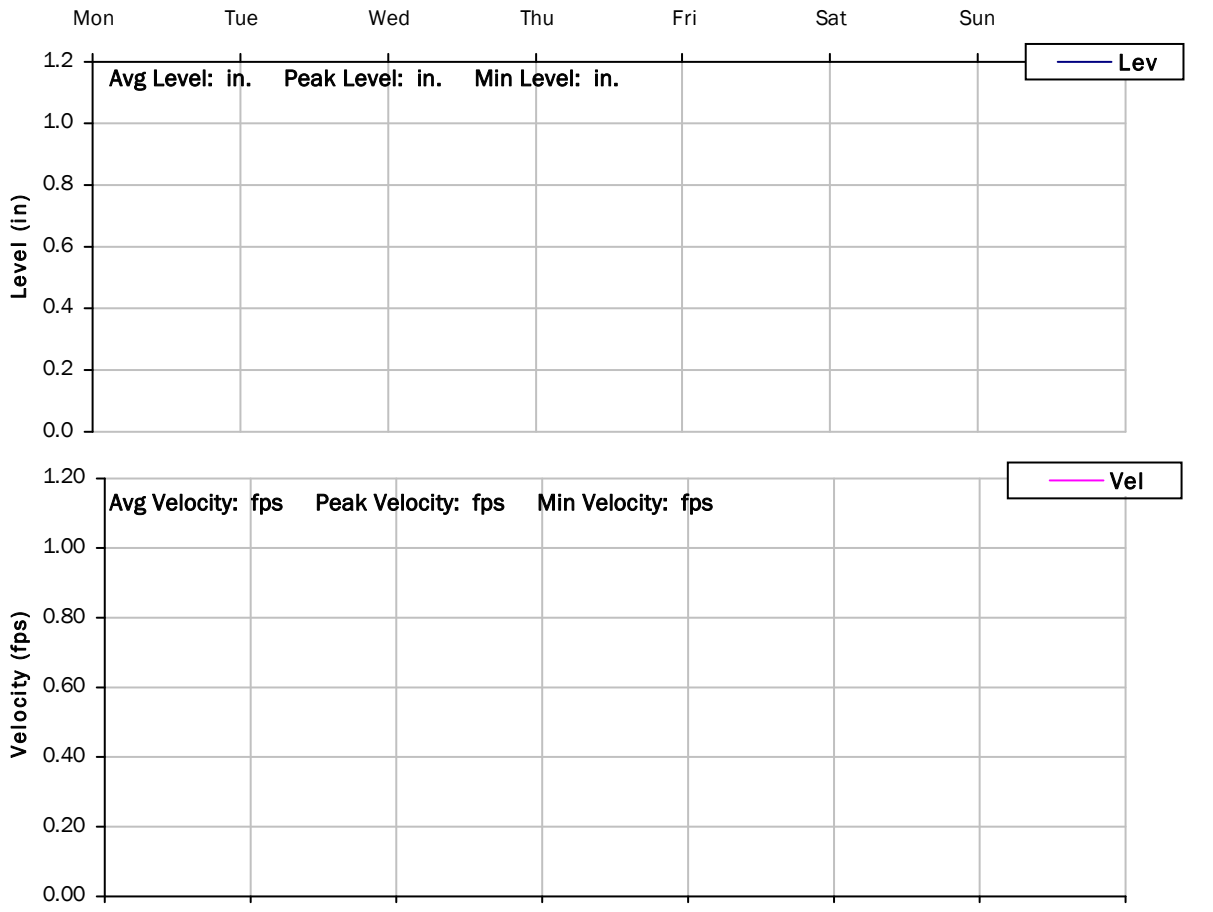
12/20/2021 to 12/27/2021



PS 14

Weekly Level, Velocity and Flow Hydrographs

12/27/2021 to 1/3/2022

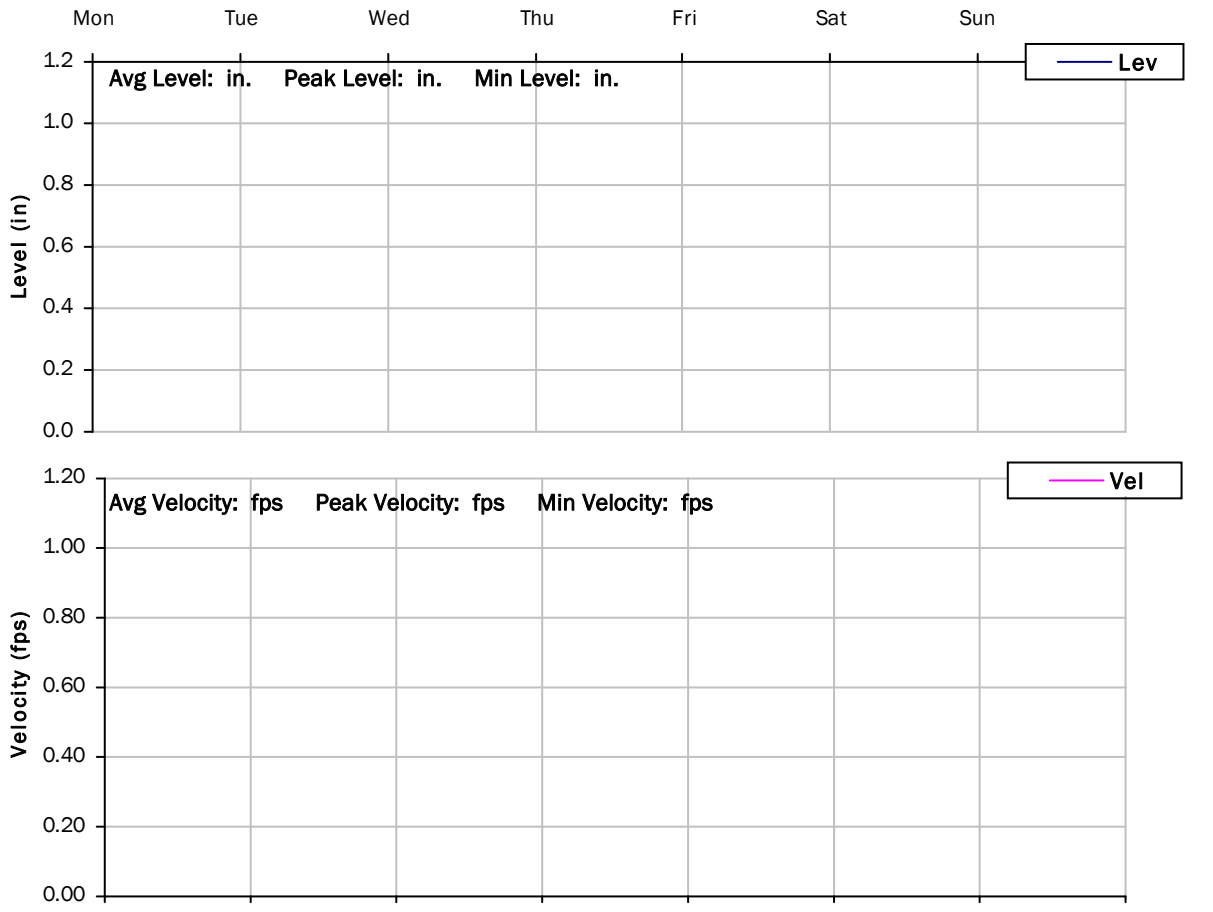


Avg Flow: 1.109 mgd Peak Flow: 1.742 mgd Min Flow: 0.463 mgd

PS 14

Weekly Level, Velocity and Flow Hydrographs

12/27/2021 to 1/3/2022

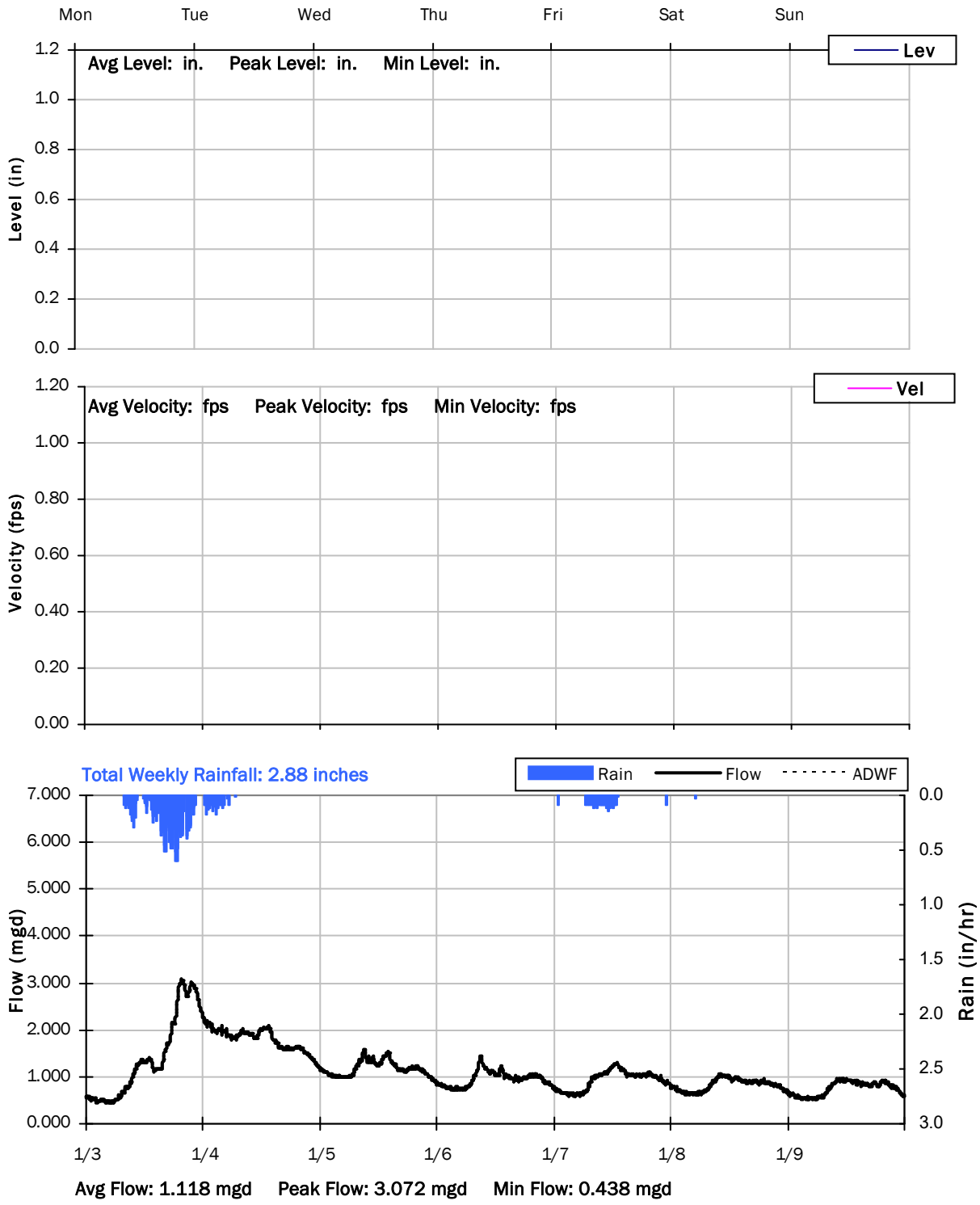


Avg Flow: 1.109 mgd Peak Flow: 1.742 mgd Min Flow: 0.463 mgd

PS 14

Weekly Level, Velocity and Flow Hydrographs

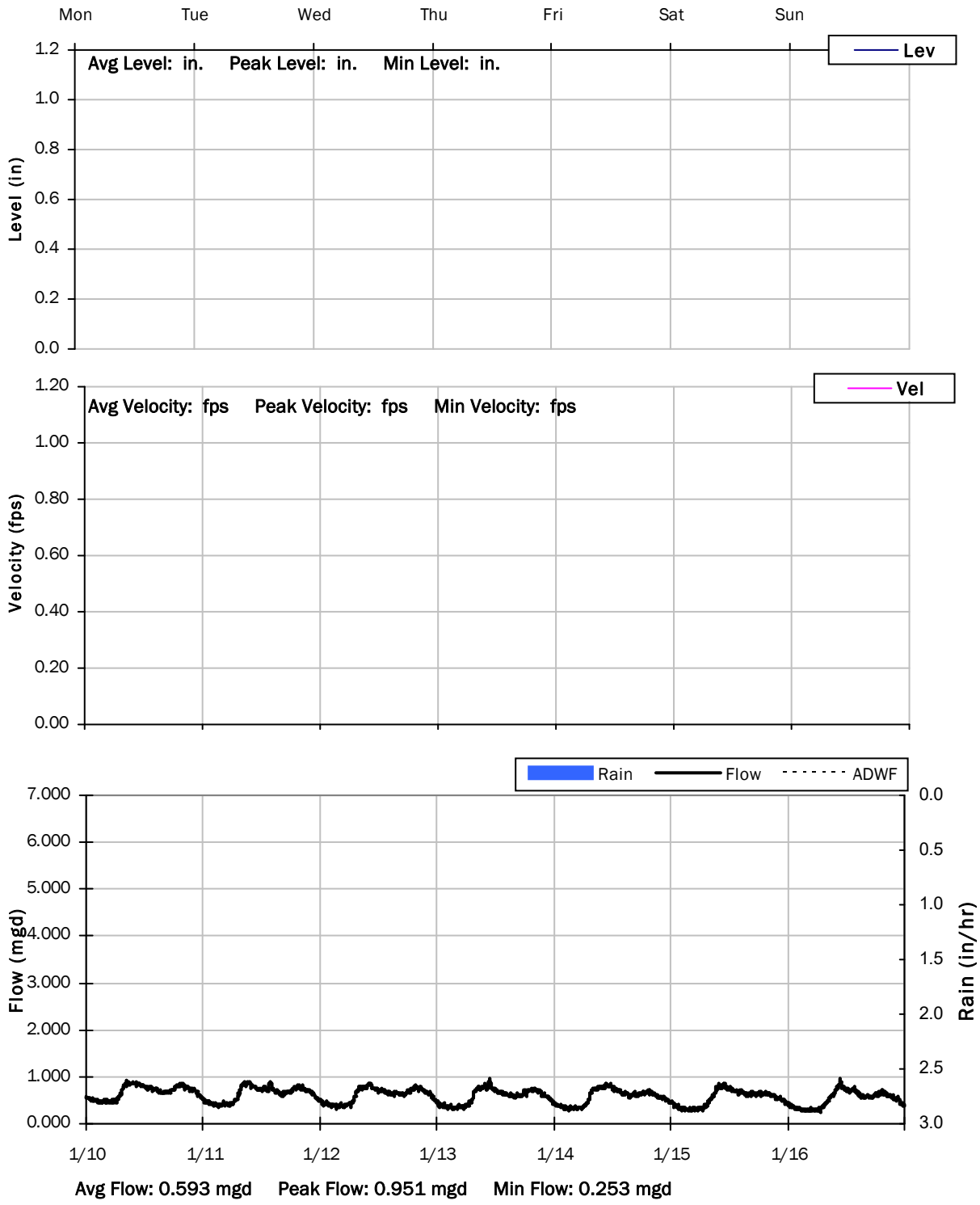
1/3/2022 to 1/10/2022



PS 14

Weekly Level, Velocity and Flow Hydrographs

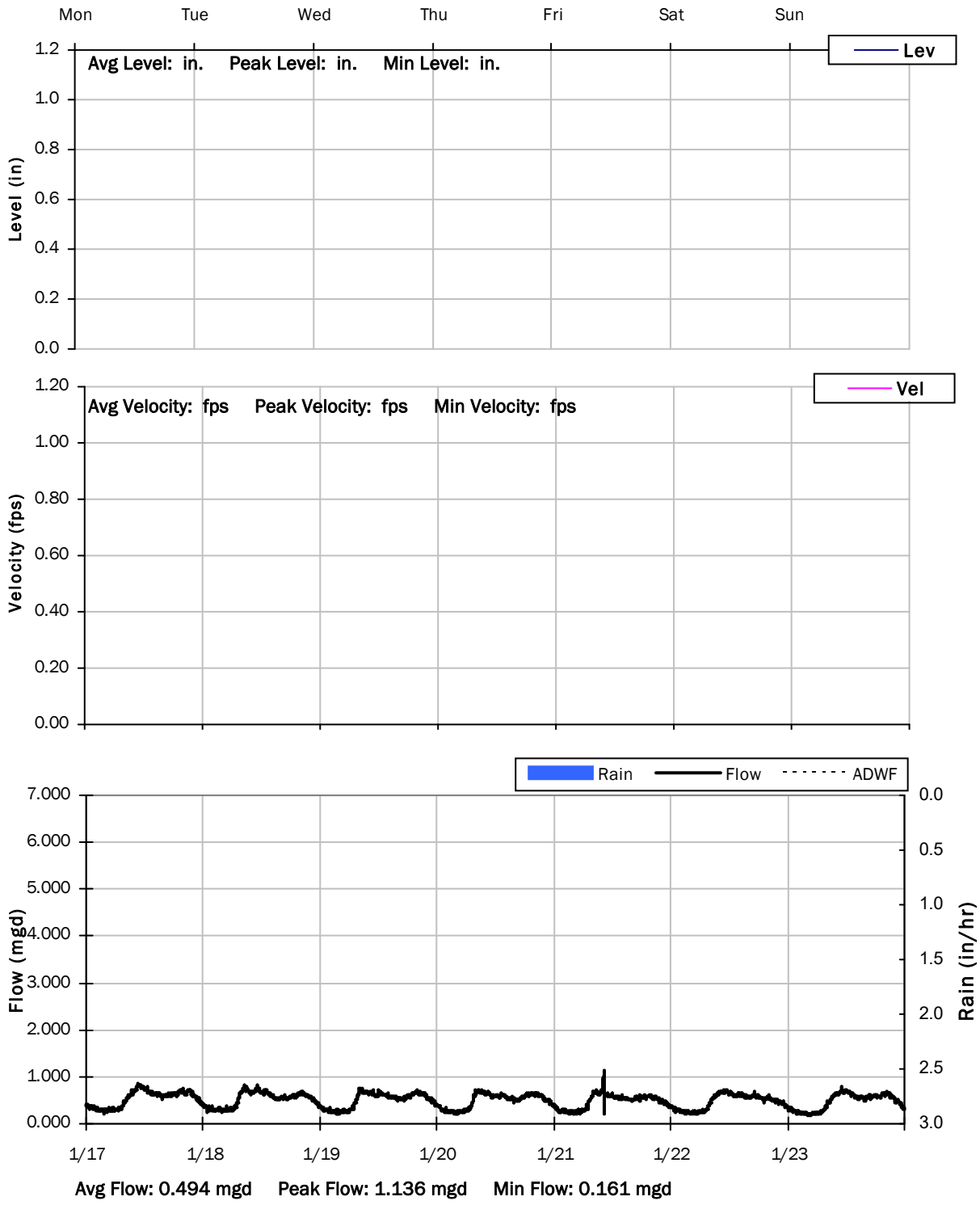
1/10/2022 to 1/17/2022



PS 14

Weekly Level, Velocity and Flow Hydrographs

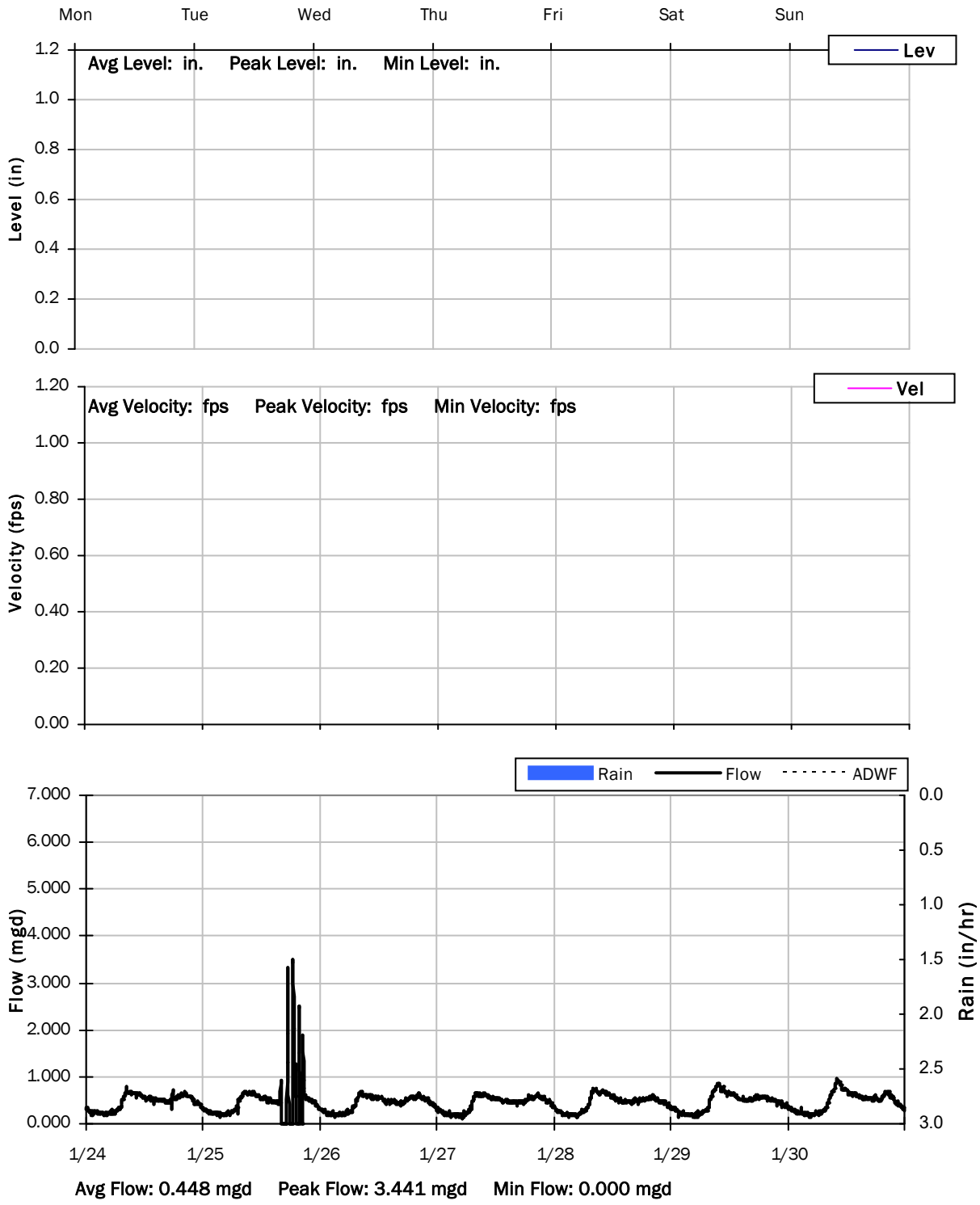
1/17/2022 to 1/24/2022



PS 14

Weekly Level, Velocity and Flow Hydrographs

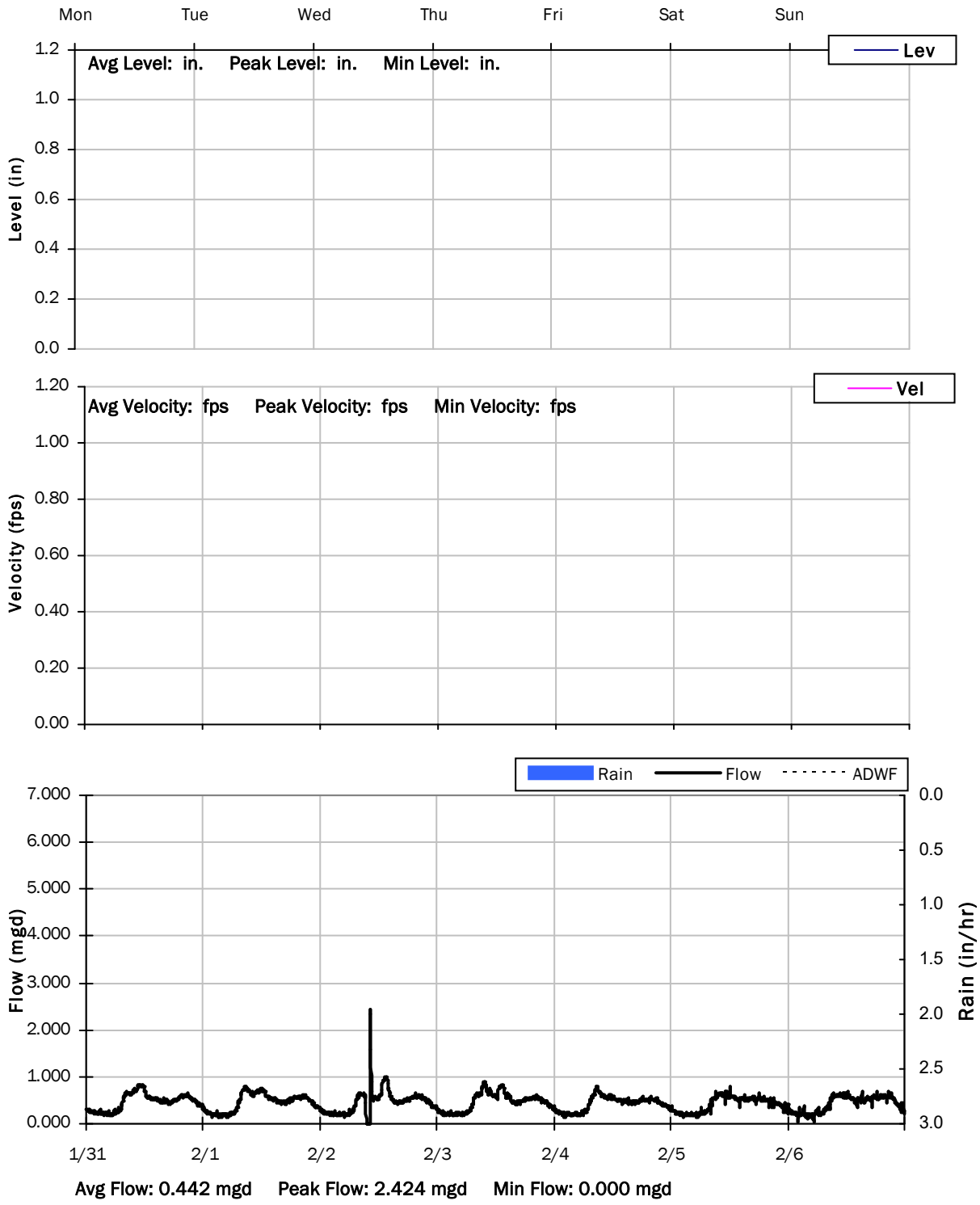
1/24/2022 to 1/31/2022



PS 14

Weekly Level, Velocity and Flow Hydrographs

1/31/2022 to 2/7/2022

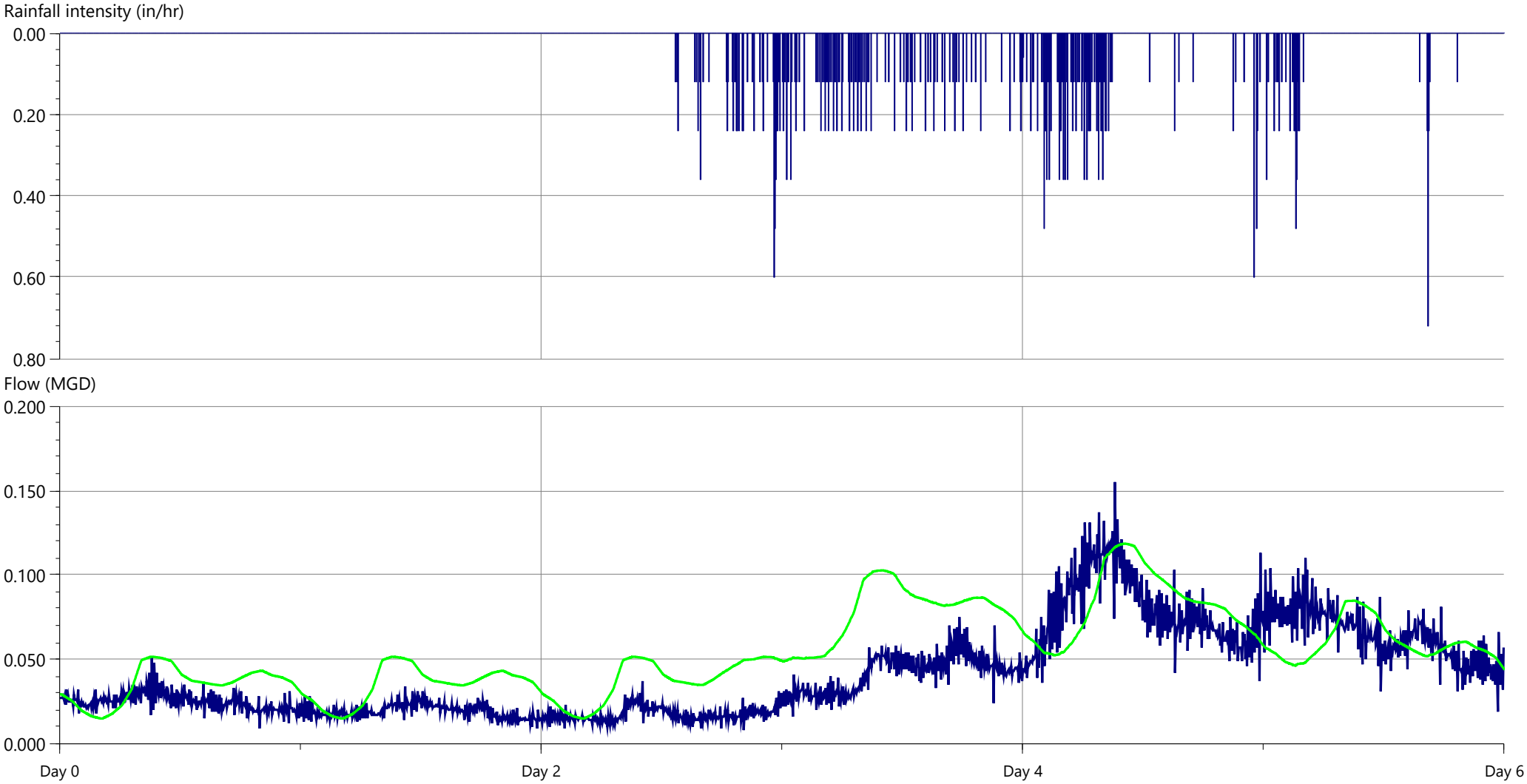


Attachment B

Dry and Wet Weather Recalibration Hydrographs

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)

Flow Survey Location (Obs.) B210.01.1, Model Location (Pred.) D/S B210.01.1, Rainfall Profile: 14



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.565	0.720	0.025			
Observed				0.008	0.155	0.247
...9-24_2021 - in/hr units				0.015	0.118	0.328

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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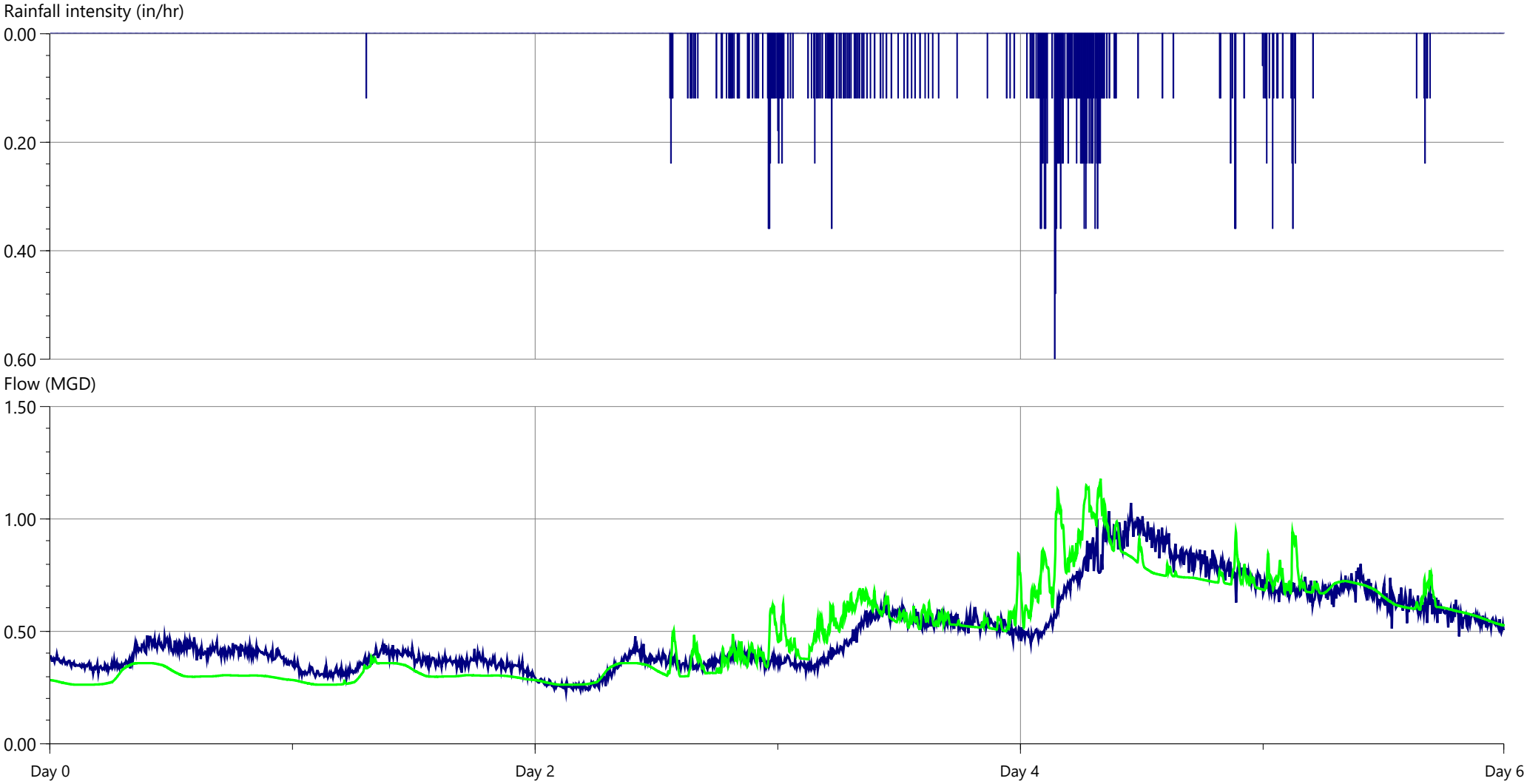
Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) F002.11.1, Model Location (Pred.) D/S F002.11.1, Rainfall Profile: 8



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.950	0.600	0.020			
Observed				0.230	1.070	2.993
...9-24_2021 - in/hr units				0.262	1.177	2.943

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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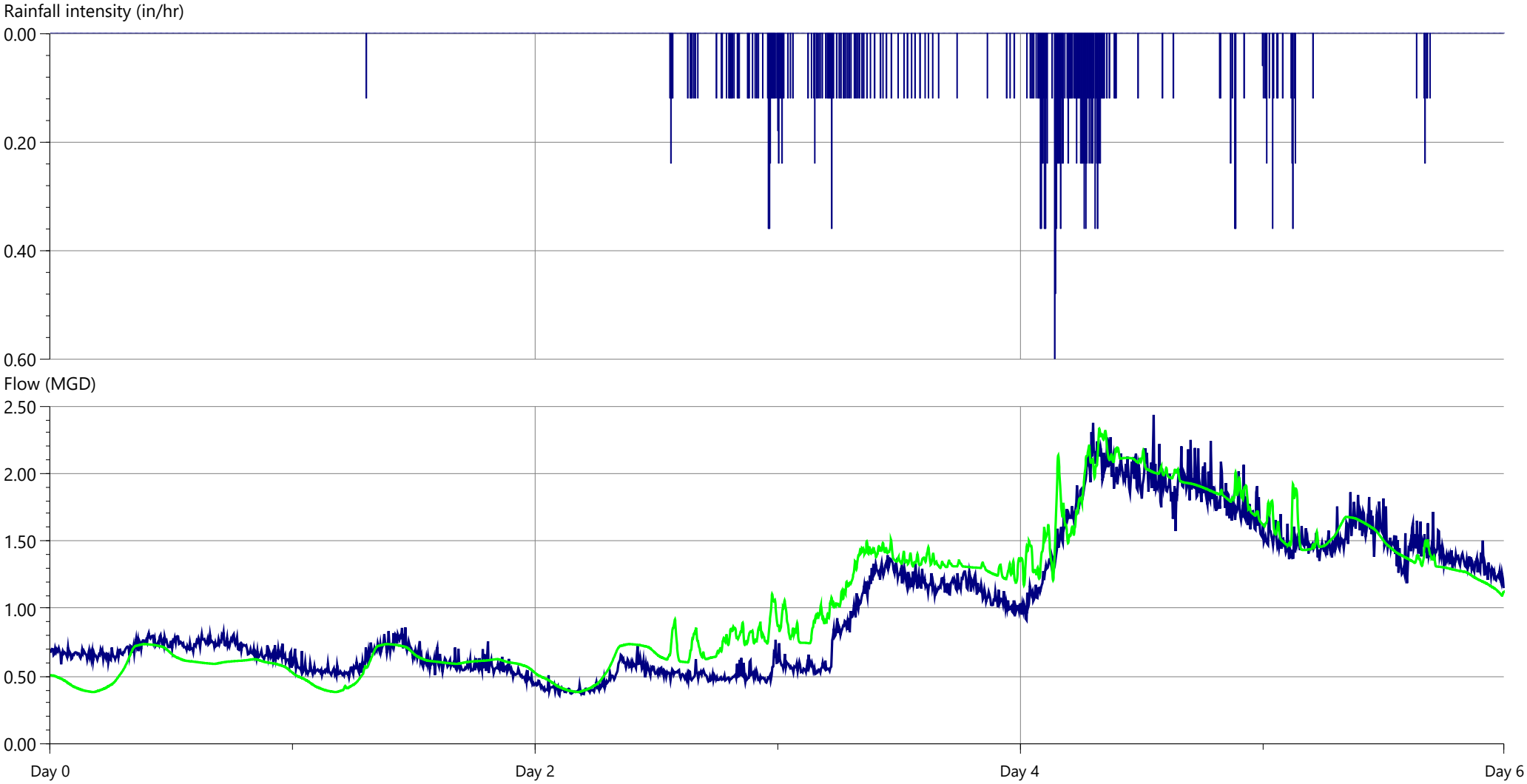
Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) F003.02.1, Model Location (Pred.) D/S F003.02.1, Rainfall Profile: 8



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.950	0.600	0.020			
Observed				0.357	2.436	6.042
...9-24_2021 - in/hr units				0.382	2.334	6.311

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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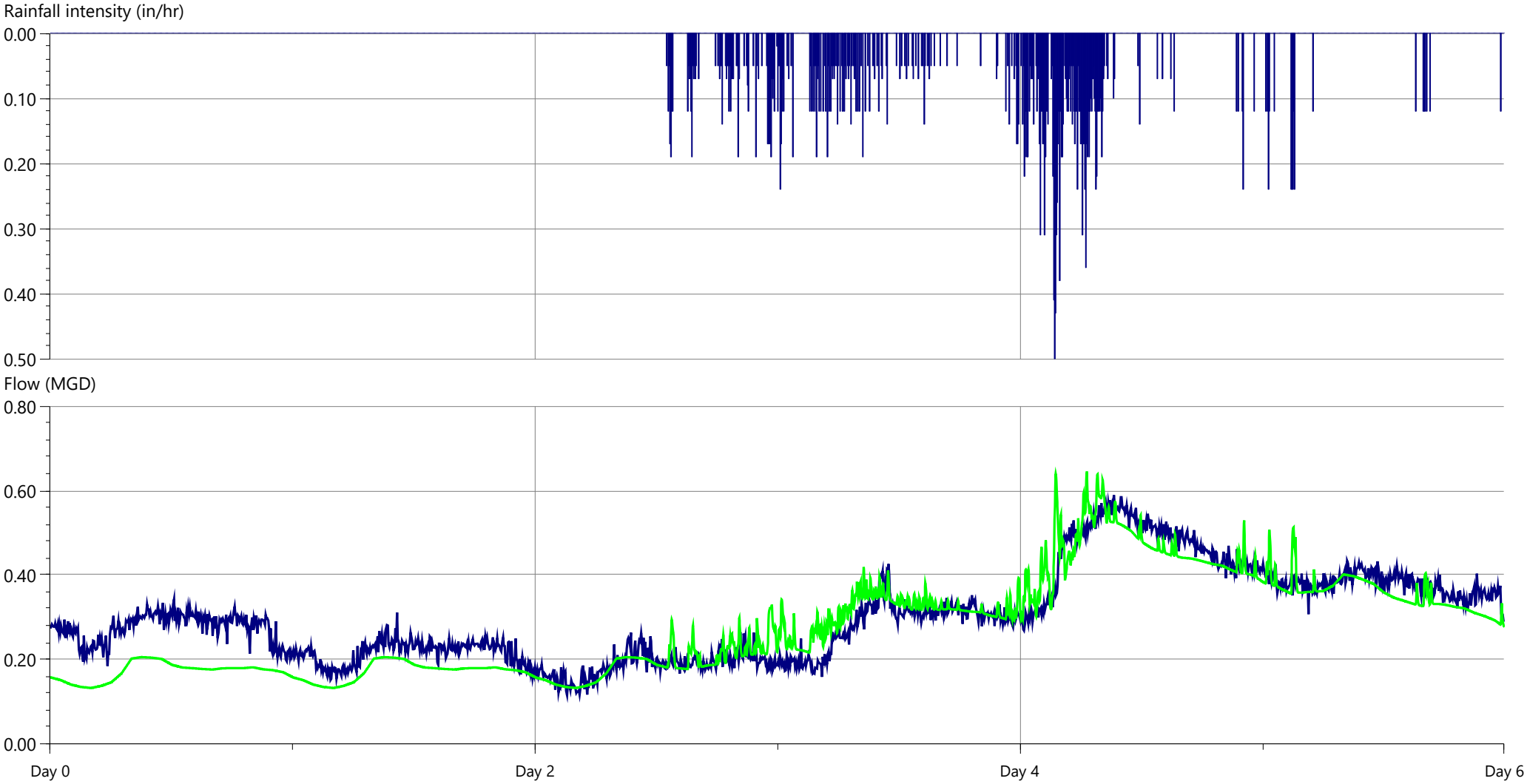
Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) F700.03.1, Model Location (Pred.) D/S F700.03.1, Rainfall Profile: 4

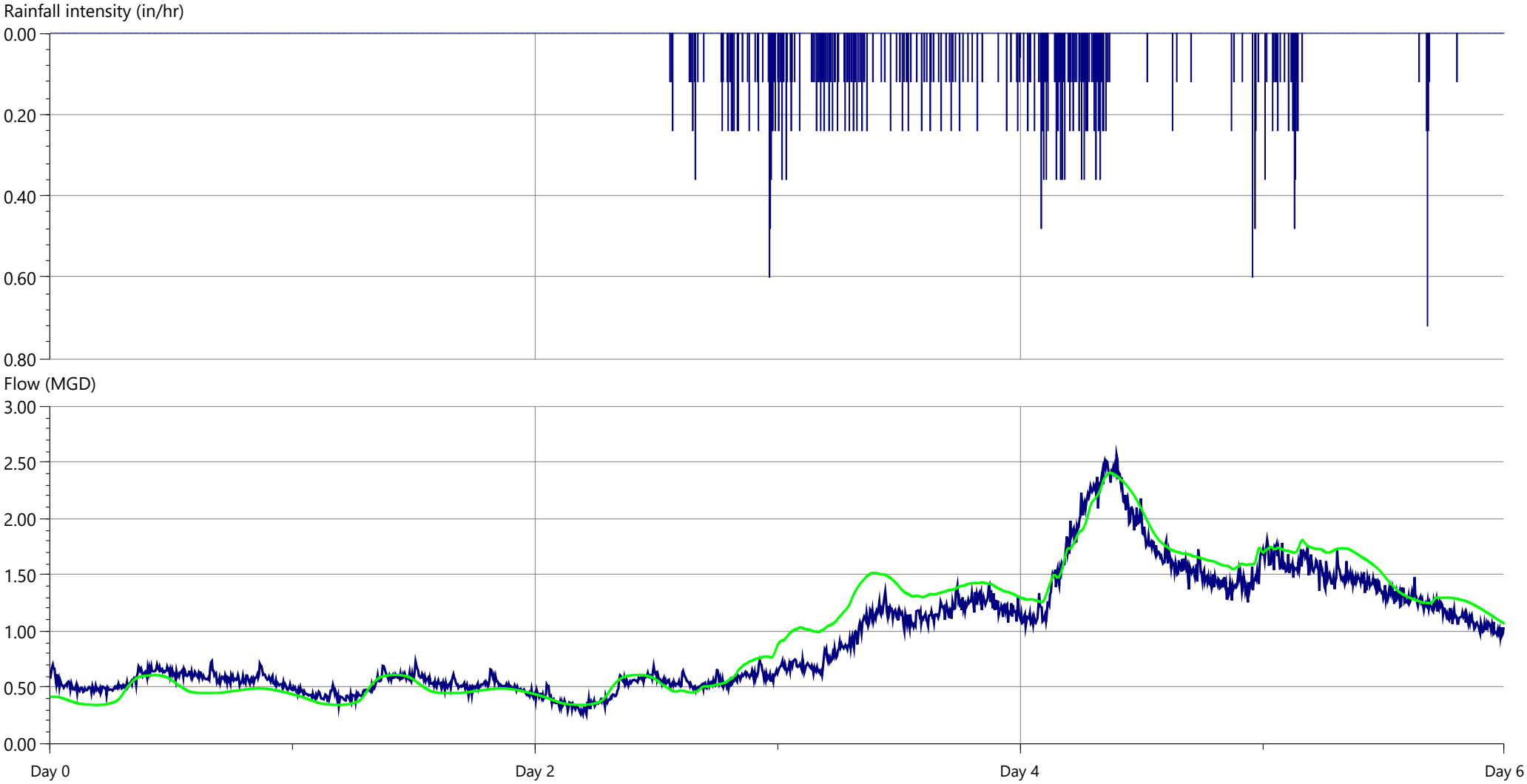


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.675	0.500	0.019			
Observed				0.115	0.589	1.798
...9-24_2021 - in/hr units				0.132	0.643	1.655

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) G000.11.1, Model Location (Pred.) D/S G000.11.1, Rainfall Profile: 14



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.565	0.720	0.025			
Observed				0.260	2.569	5.657
...9-24_2021 - in/hr units				0.344	2.408	5.988

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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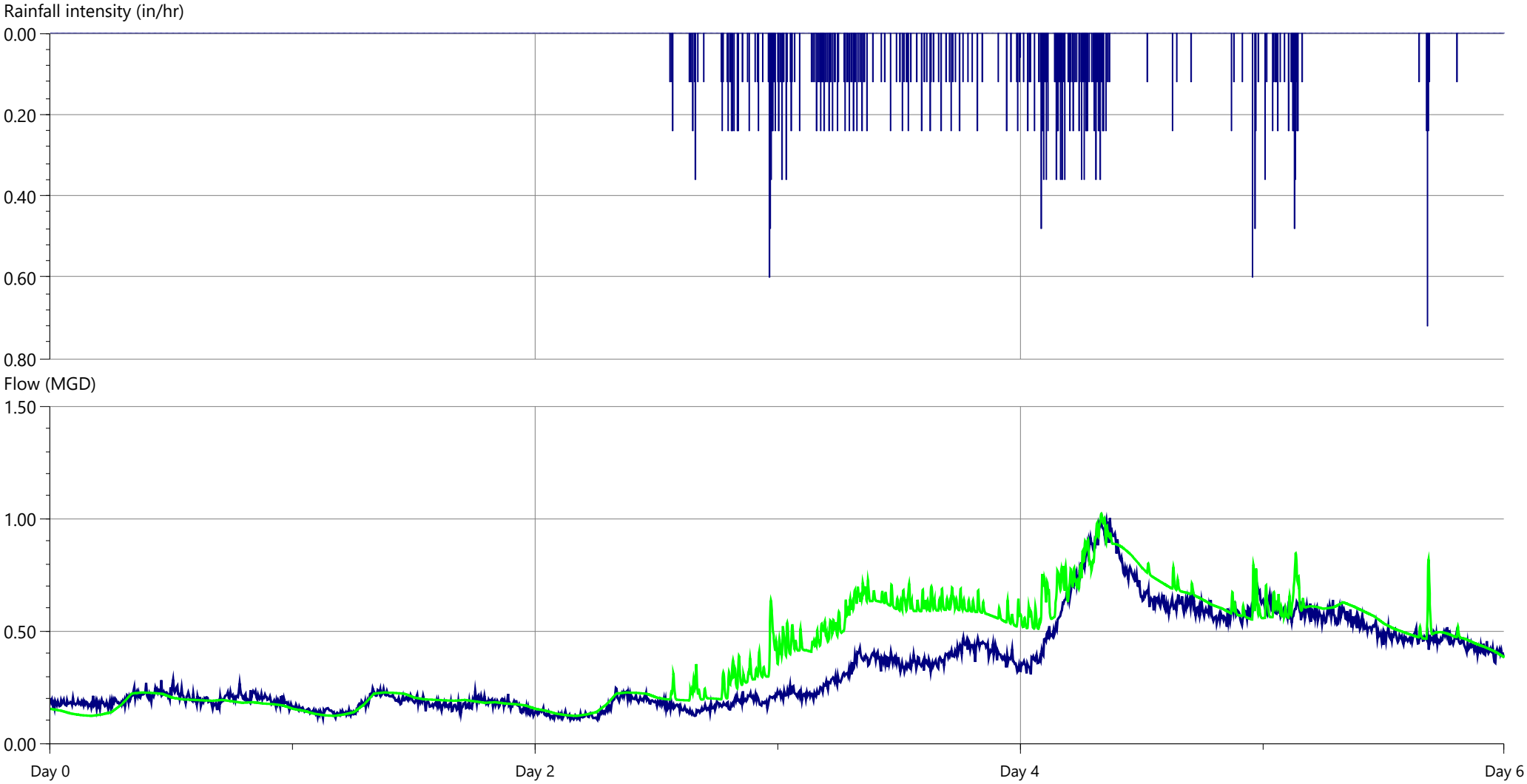
Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) G200.01.1, Model Location (Pred.) D/S G200.01.1, Rainfall Profile: 14

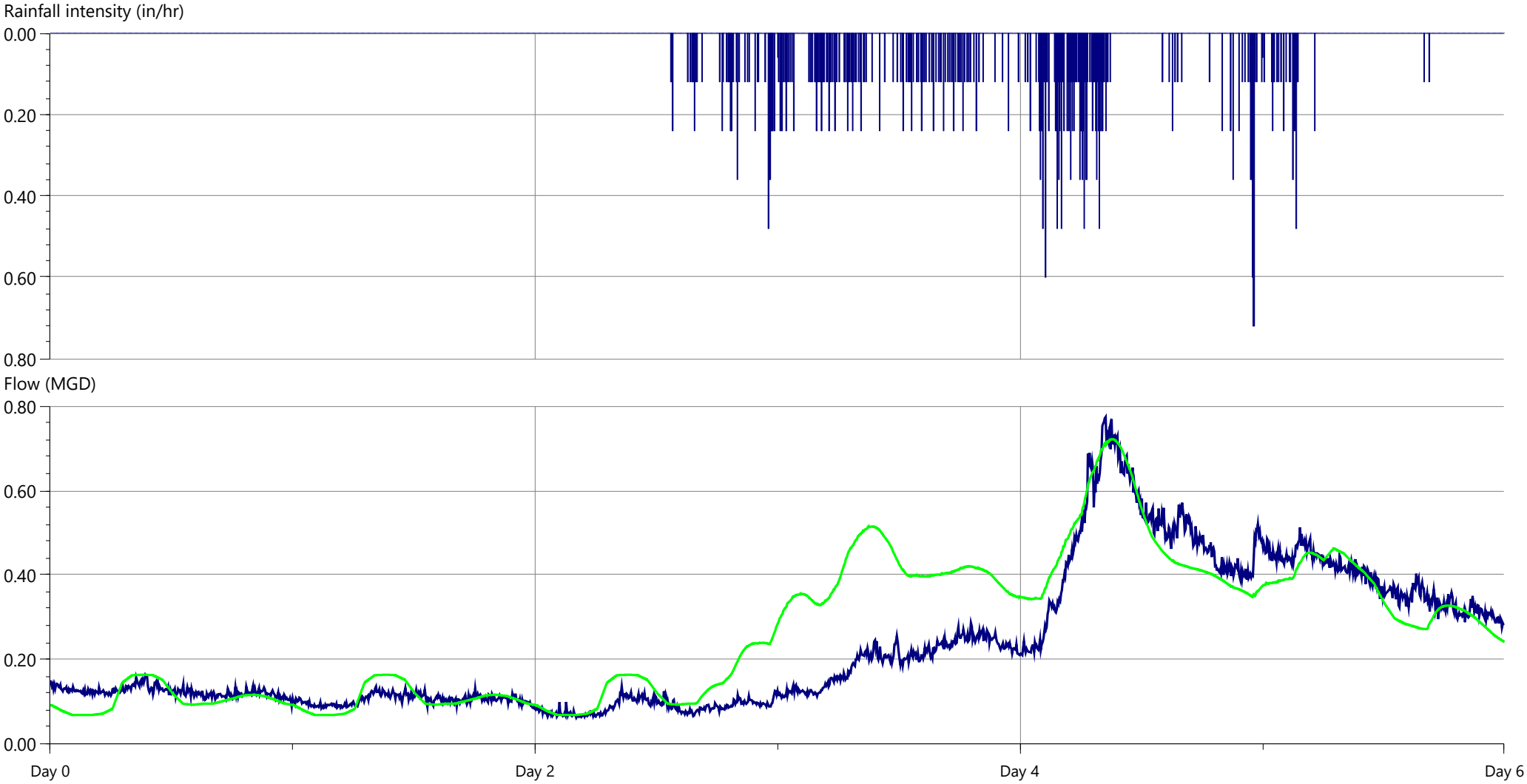


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.565	0.720	0.025			
Observed				0.105	1.002	2.028
...9-24_2021 - in/hr units				0.123	1.023	2.392

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) G300.01.1, Model Location (Pred.) D/S G300.01.1, Rainfall Profile: 16

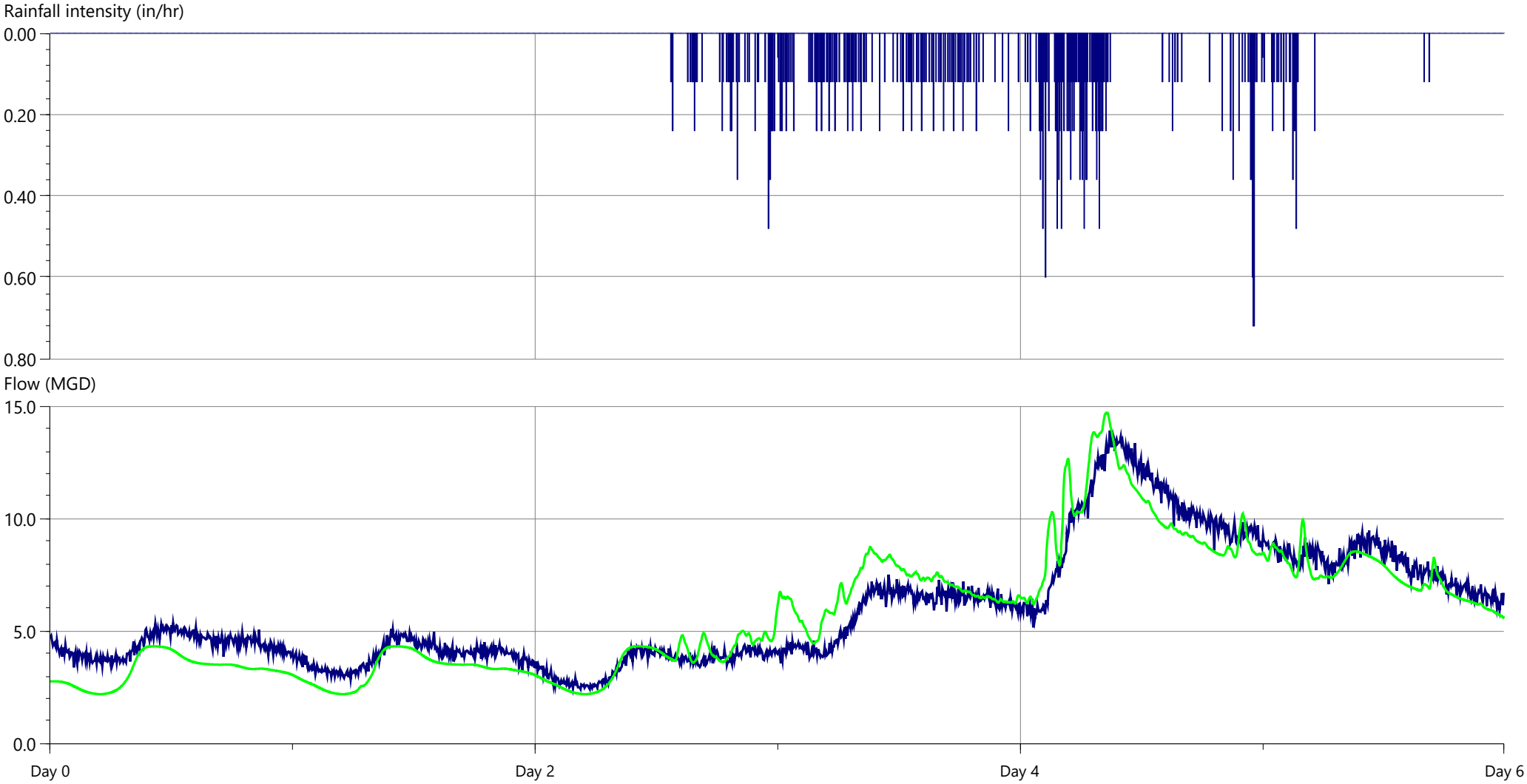


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.970	0.720	0.028			
Observed				0.061	0.774	1.375
...9-24_2021 - in/hr units				0.068	0.721	1.578

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) K000.05.1, Model Location (Pred.) D/S K000.05.1, Rainfall Profile: 16

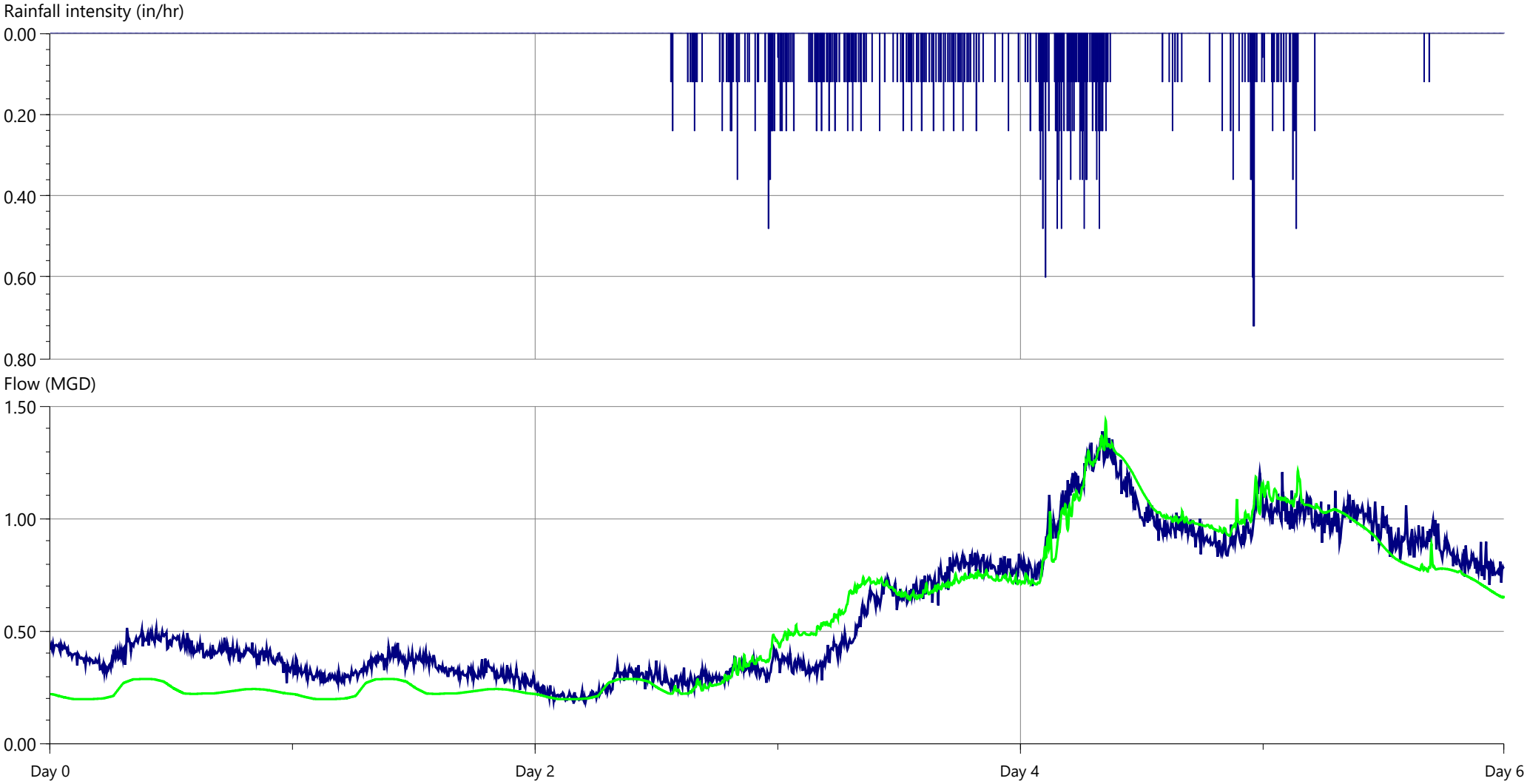


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.970	0.720	0.028			
Observed				2.418	13.914	35.619
...9-24_2021 - in/hr units				2.197	14.706	34.399

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) K200.02.1, Model Location (Pred.) D/S K200.02.1, Rainfall Profile: 16

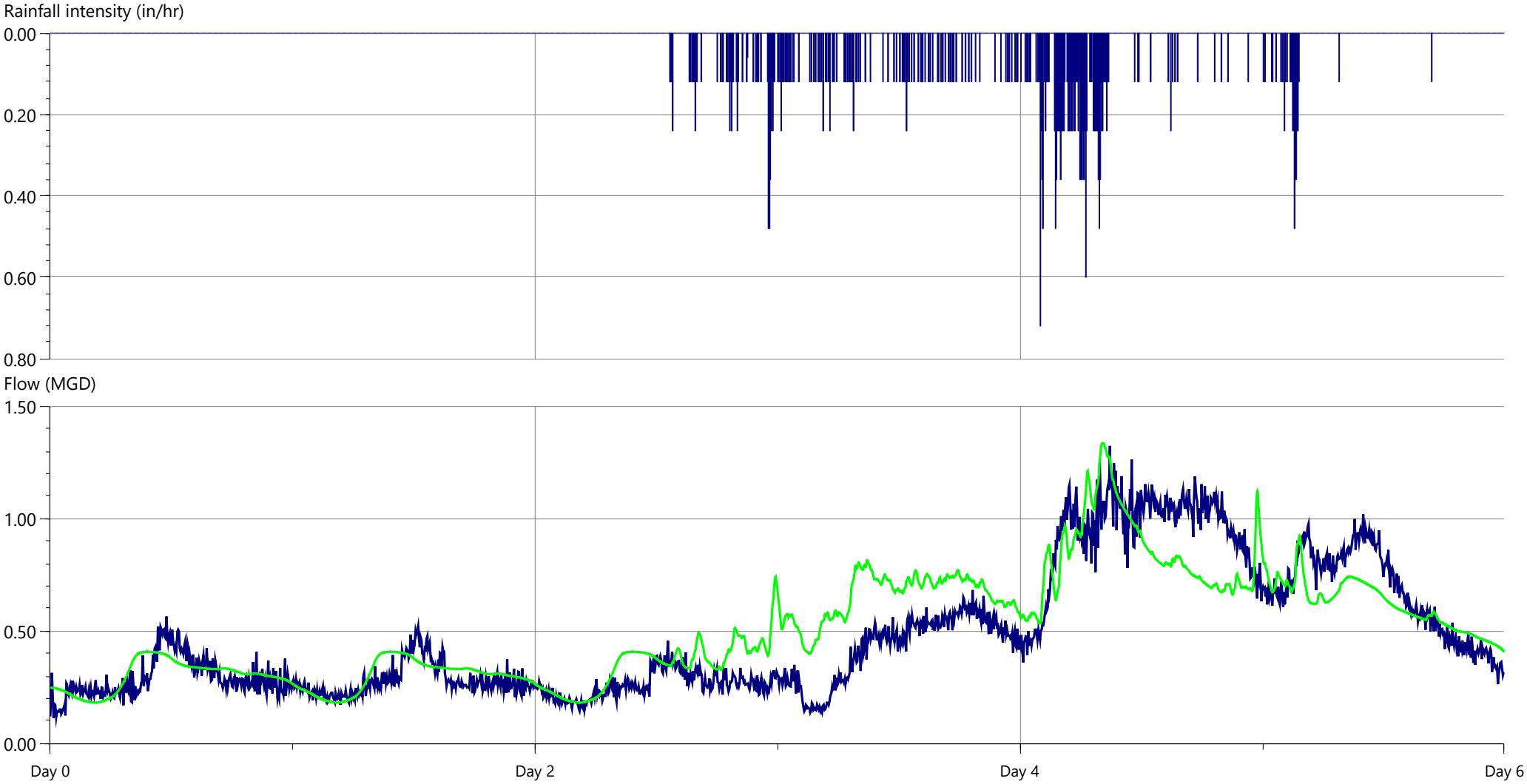


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.970	0.720	0.028			
Observed				0.178	1.389	3.580
...9-24_2021 - in/hr units				0.198	1.436	3.319

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) L152.04.1, Model Location (Pred.) D/S L152.04.1, Rainfall Profile: 18

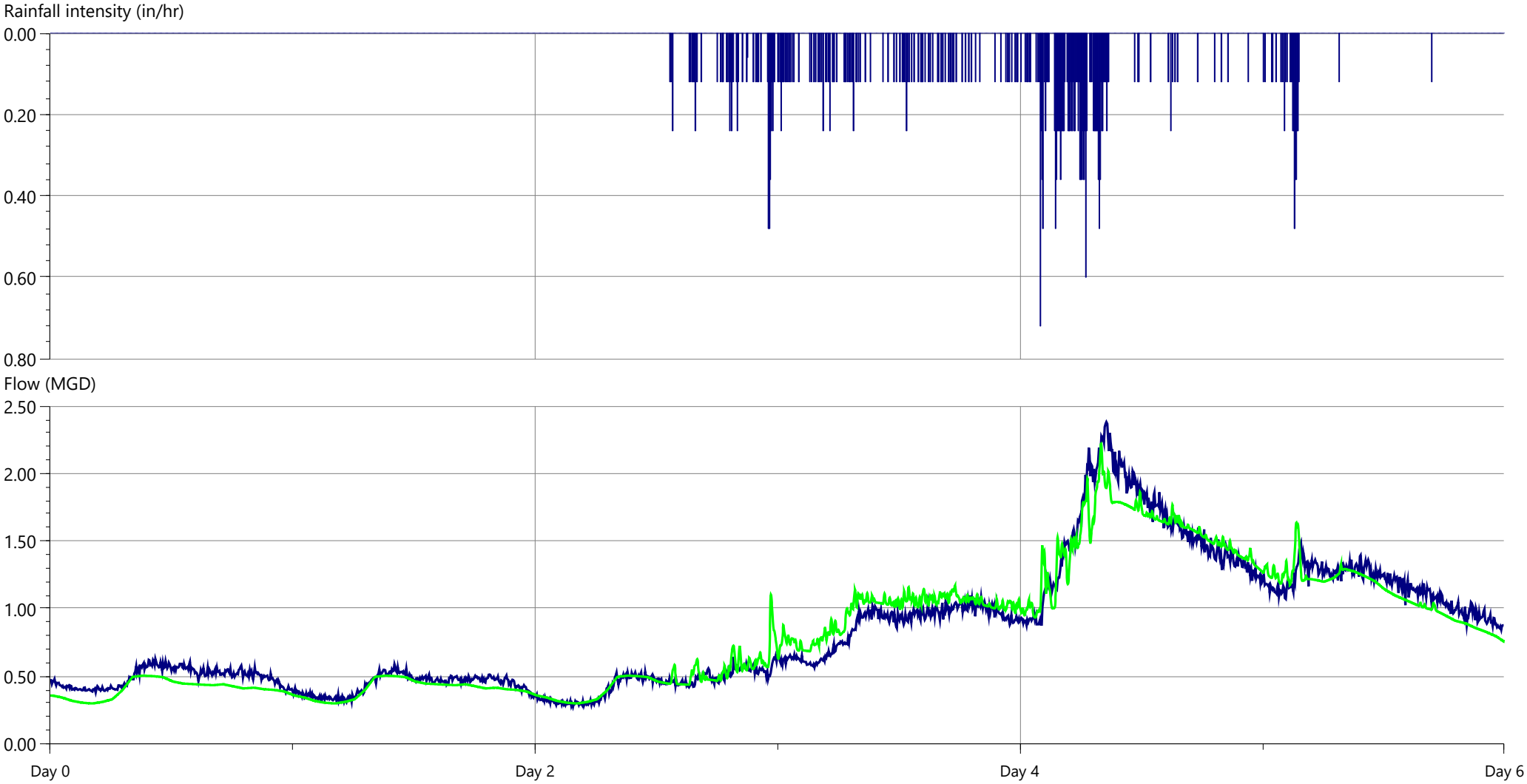


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.545	0.720	0.025			
Observed				0.114	1.323	2.862
...9-24_2021 - in/hr units				0.182	1.335	3.066

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) L180.050.1, Model Location (Pred.) D/S L180.050.1, Rainfall Profile: 18

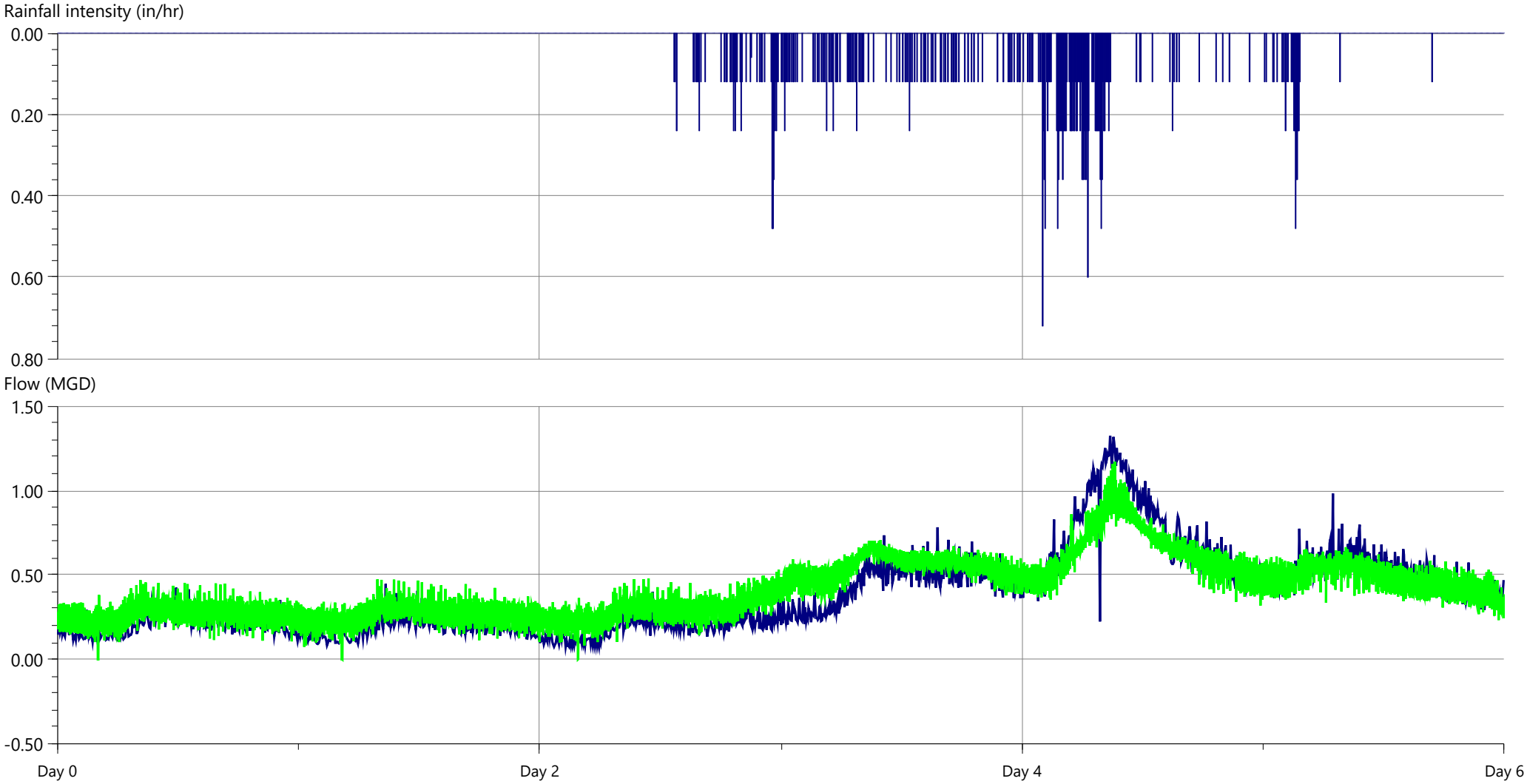


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.545	0.720	0.025			
Observed				0.272	2.382	4.956
...9-24_2021 - in/hr units				0.297	2.222	4.882

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) PS12-FM.1, Model Location (Pred.) D/S PS12-FM.1, Rainfall Profile: 18

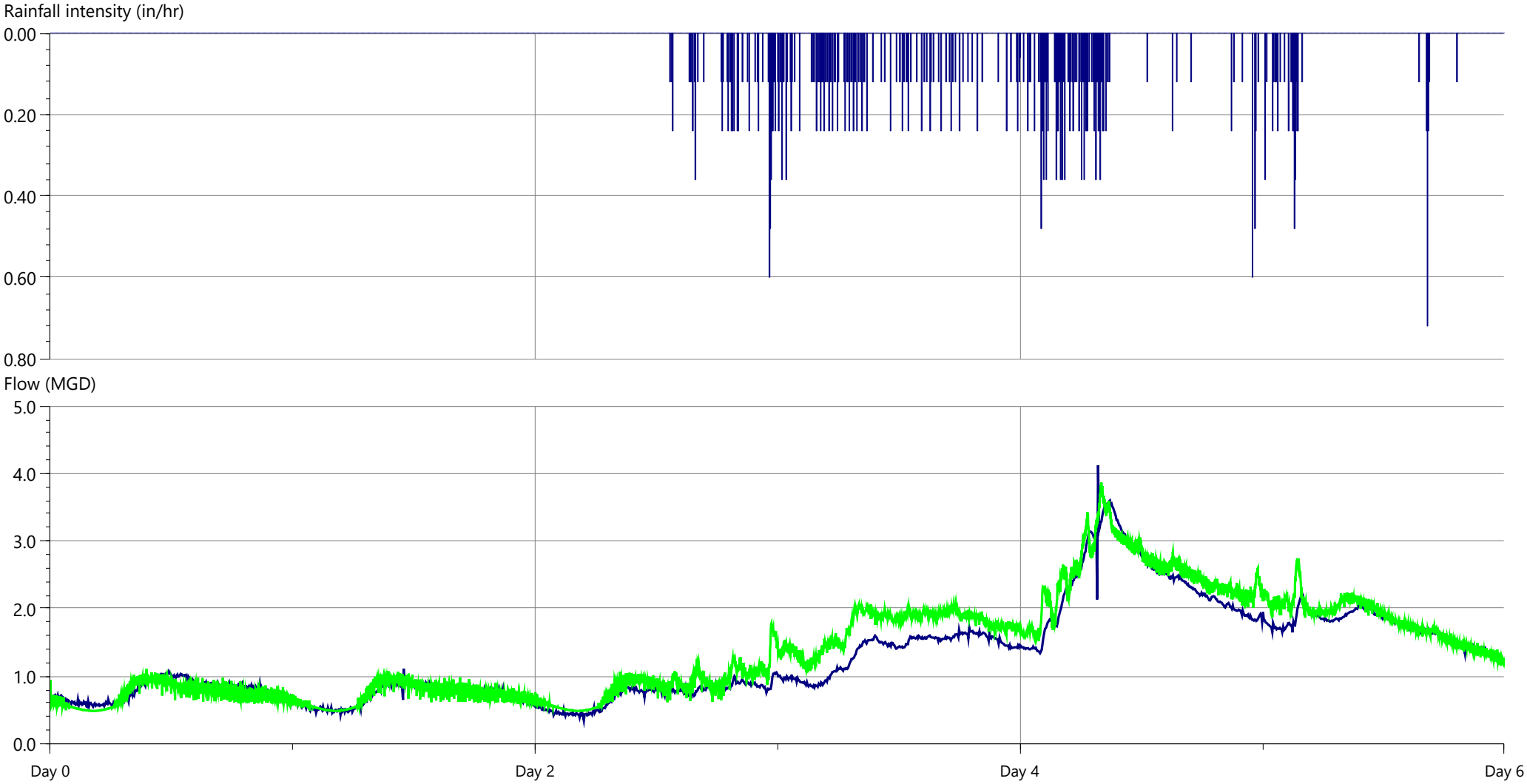


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.545	0.720	0.025			
Observed				0.074	1.324	2.276
...9-24_2021 - in/hr units				-0.000	1.170	2.497

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) PS14-FM.1, Model Location (Pred.) D/S PS14-FM.1, Rainfall Profile: 14



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.565	0.720	0.025			
Observed				0.344	4.123	7.644
...9-24_2021 - in/hr units				0.483	3.867	8.398

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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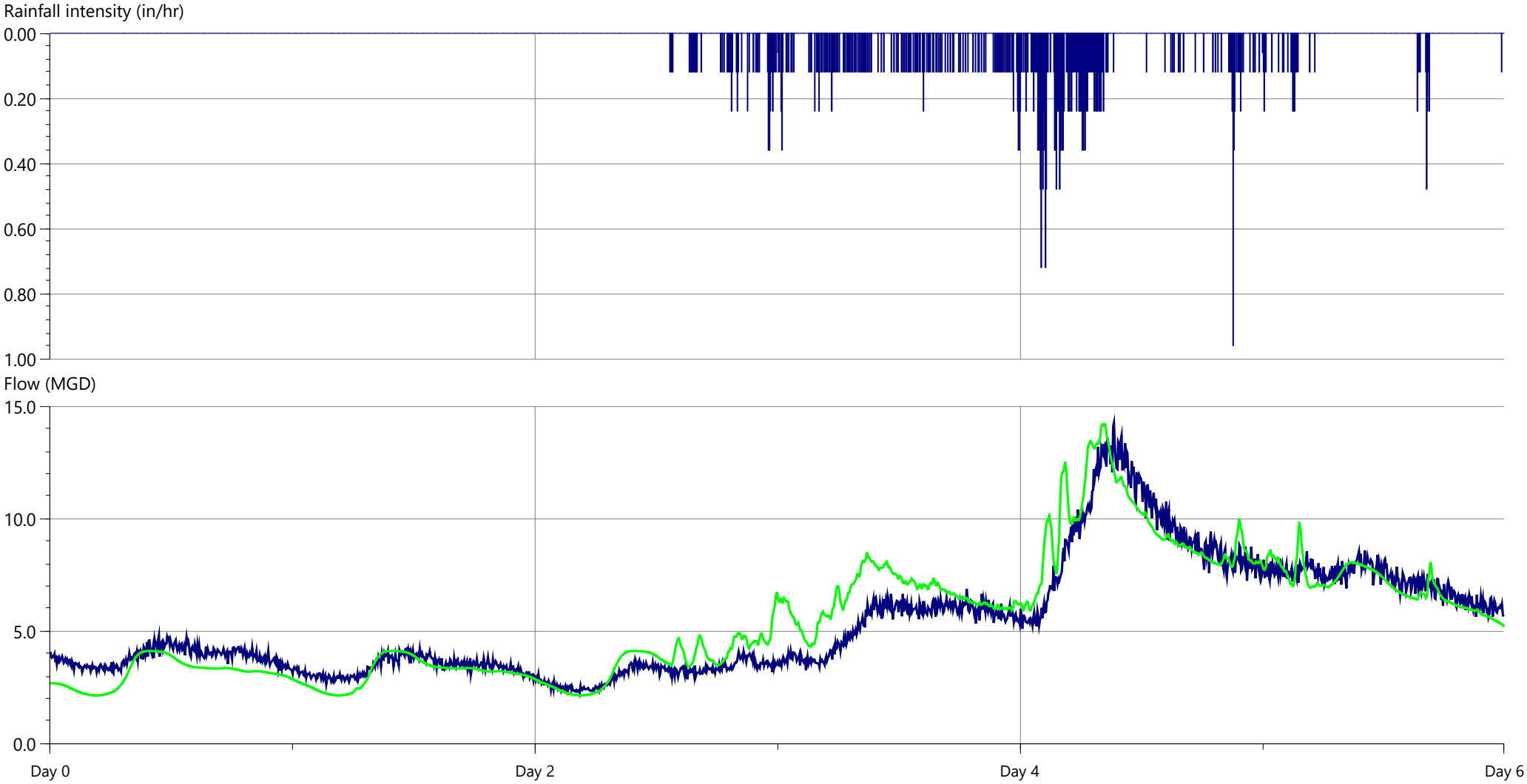
Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) R000.31.1, Model Location (Pred.) D/S R000.31.1, Rainfall Profile: 13



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	4.550	0.960	0.032			
Observed				2.255	14.252	32.184
...9-24_2021 - in/hr units				2.140	14.205	32.990

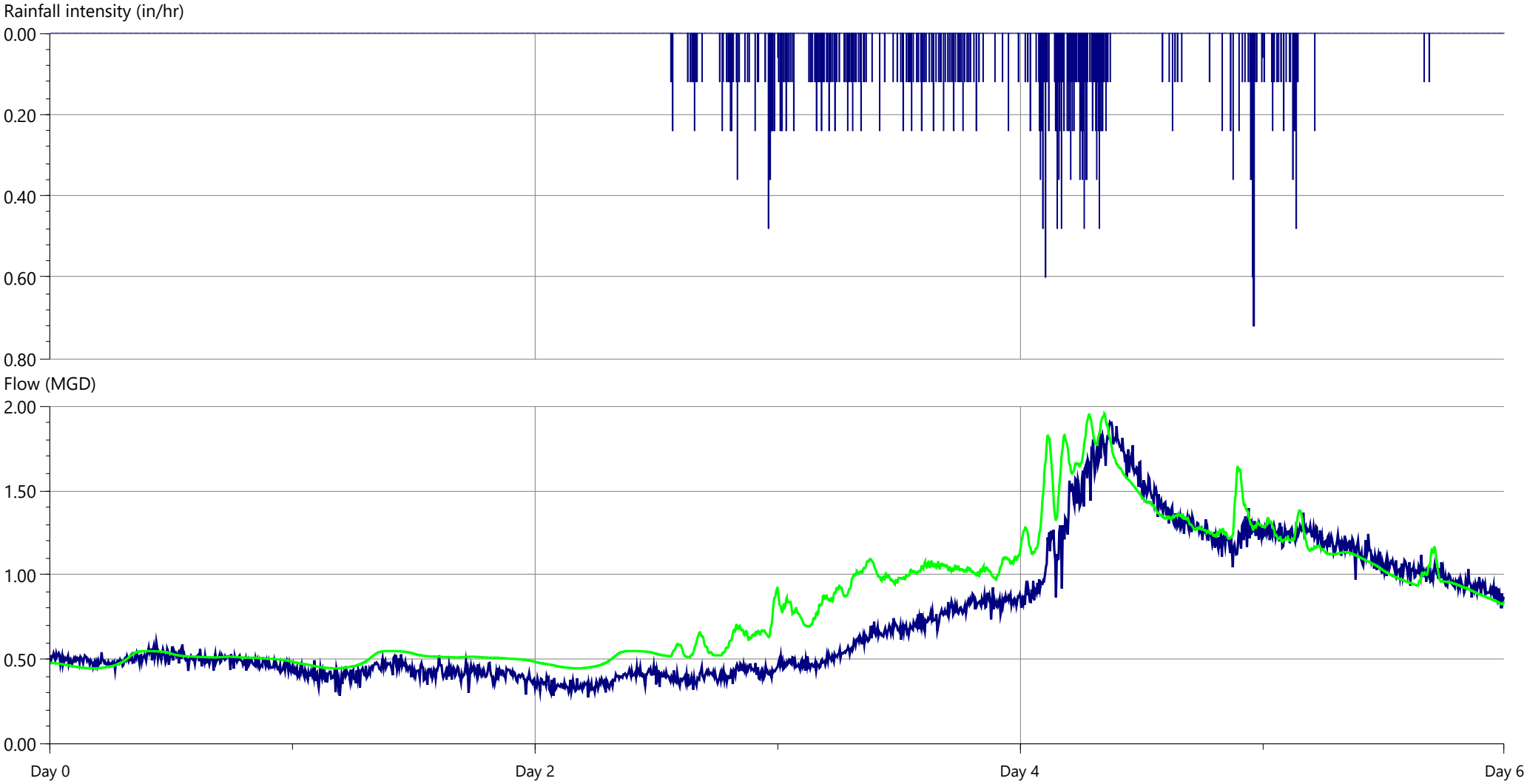
Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)

Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)

Flow Survey Location (Obs.) R500.02.1, Model Location (Pred.) D/S R500.02.1, Rainfall Profile: 16

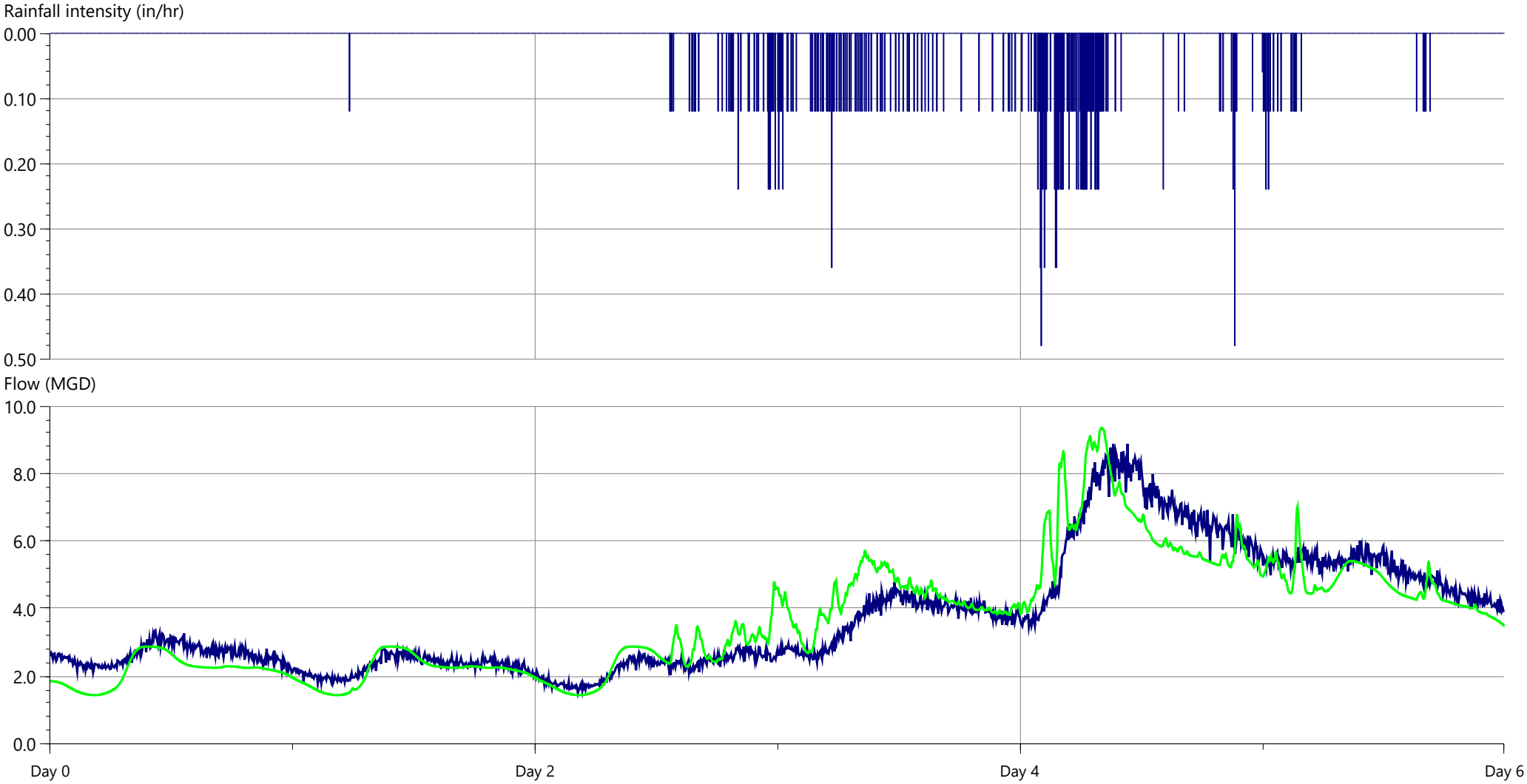


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.970	0.720	0.028			
Observed				0.273	1.904	4.417
...9-24_2021 - in/hr units				0.446	1.956	5.037

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) S000.53.1, Model Location (Pred.) D/S S000.53.1, Rainfall Profile: 9

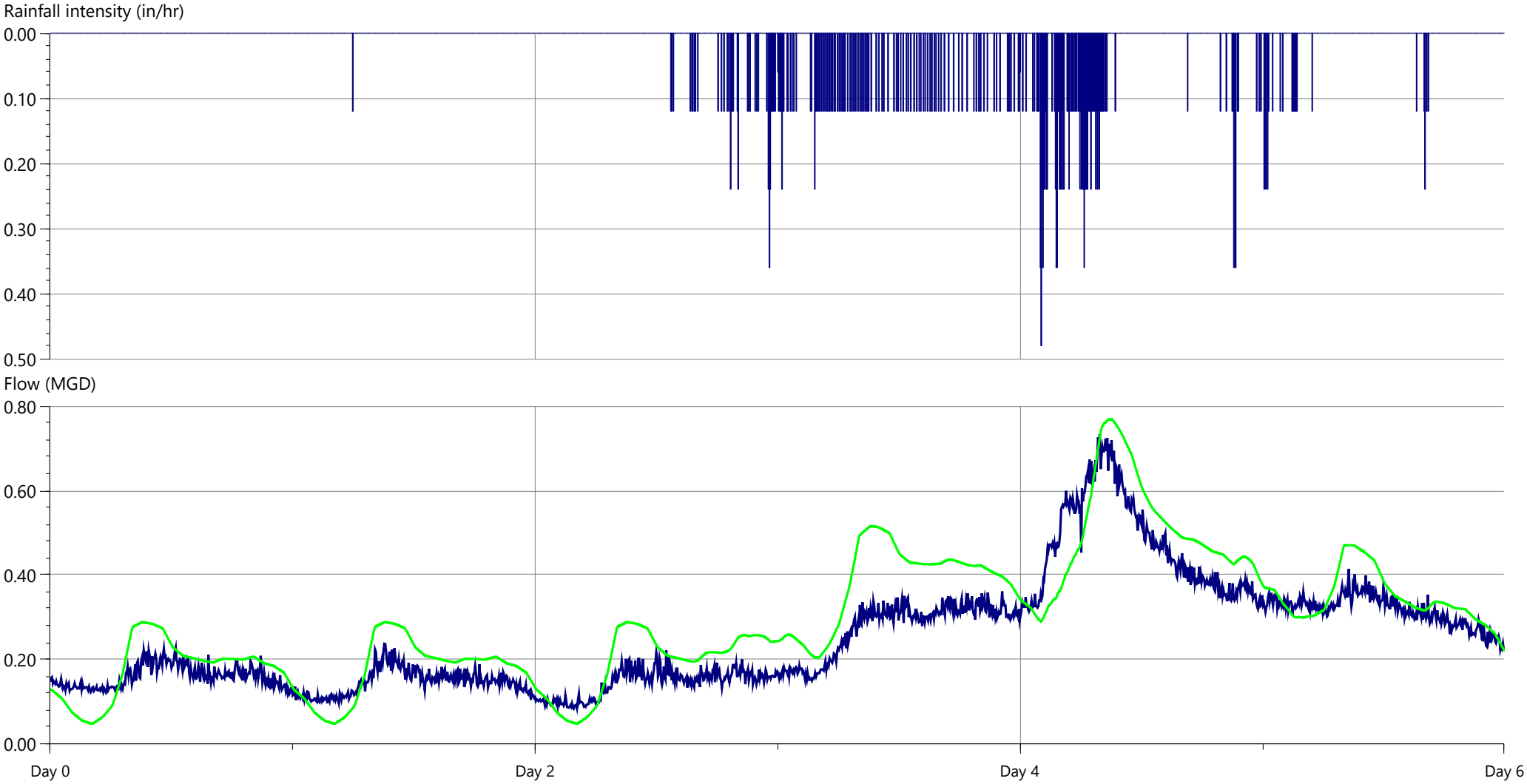


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.715	0.480	0.019			
Observed				1.503	8.884	22.389
...9-24_2021 - in/hr units				1.435	9.352	22.033

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) S400.03.1, Model Location (Pred.) D/S S400.03.1, Rainfall Profile: 10

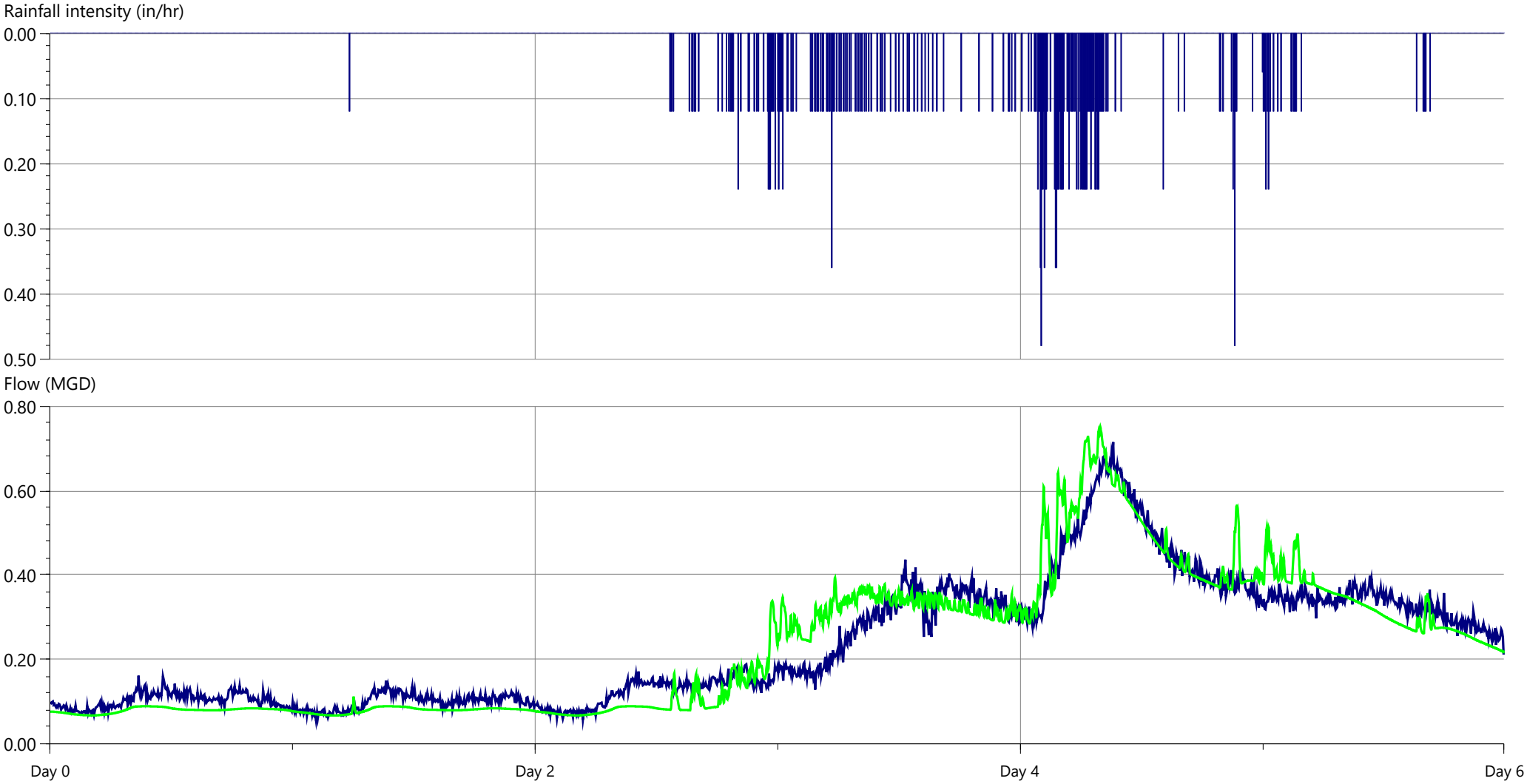


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.960	0.480	0.021			
Observed				0.083	0.733	1.508
...9-24_2021 - in/hr units				0.047	0.769	1.768

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) S600.01.1, Model Location (Pred.) D/S S600.01.1, Rainfall Profile: 9



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.715	0.480	0.019			
Observed				0.054	0.715	1.397
...9-24_2021 - in/hr units				0.067	0.752	1.389

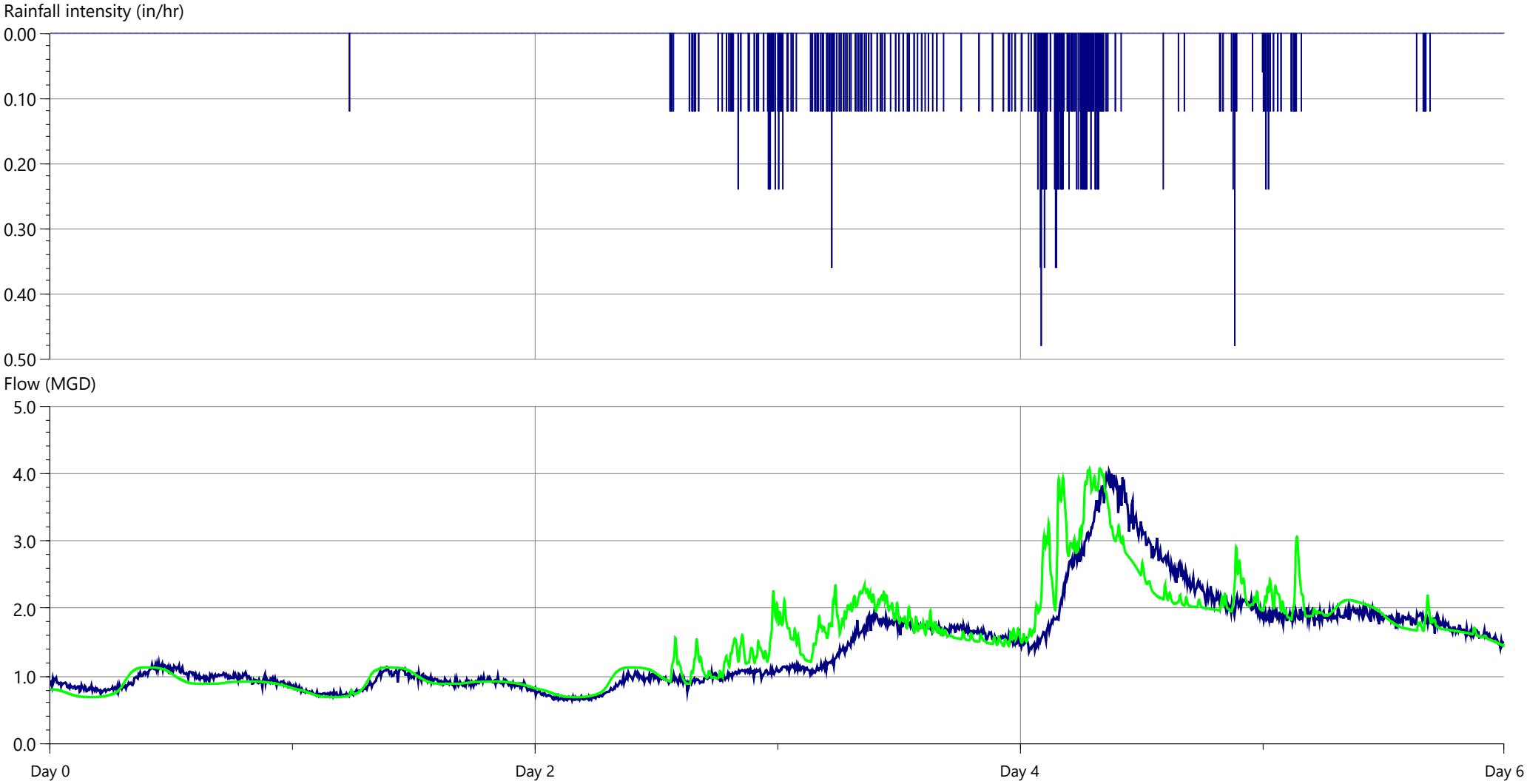
Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)

Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)

Flow Survey Location (Obs.) S800.02.1, Model Location (Pred.) D/S S800.02.1, Rainfall Profile: 9

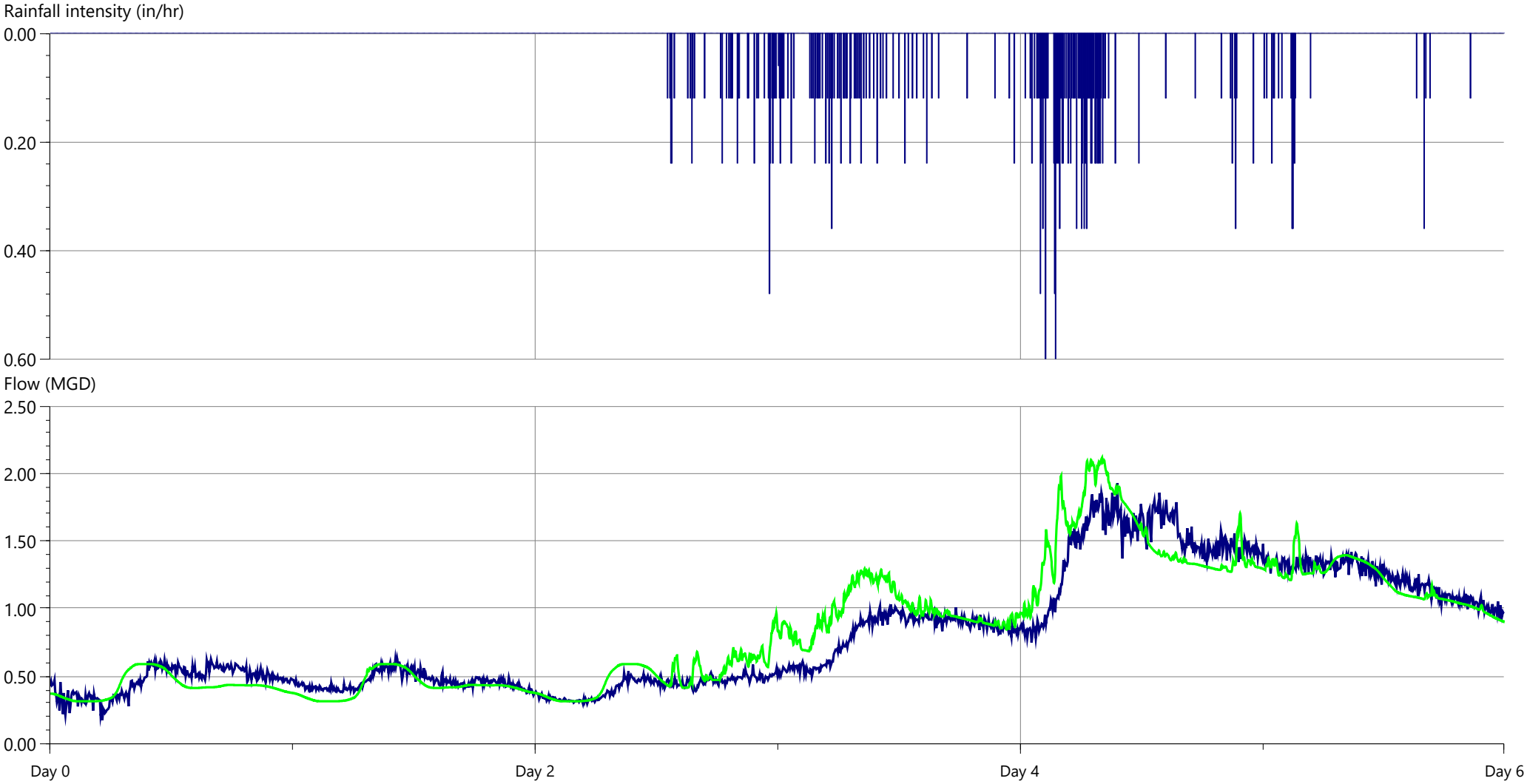


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.715	0.480	0.019			
Observed				0.641	4.036	8.615
...9-24_2021 - in/hr units				0.687	4.074	8.987

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) S900.22.1, Model Location (Pred.) D/S S900.22.1, Rainfall Profile: 5

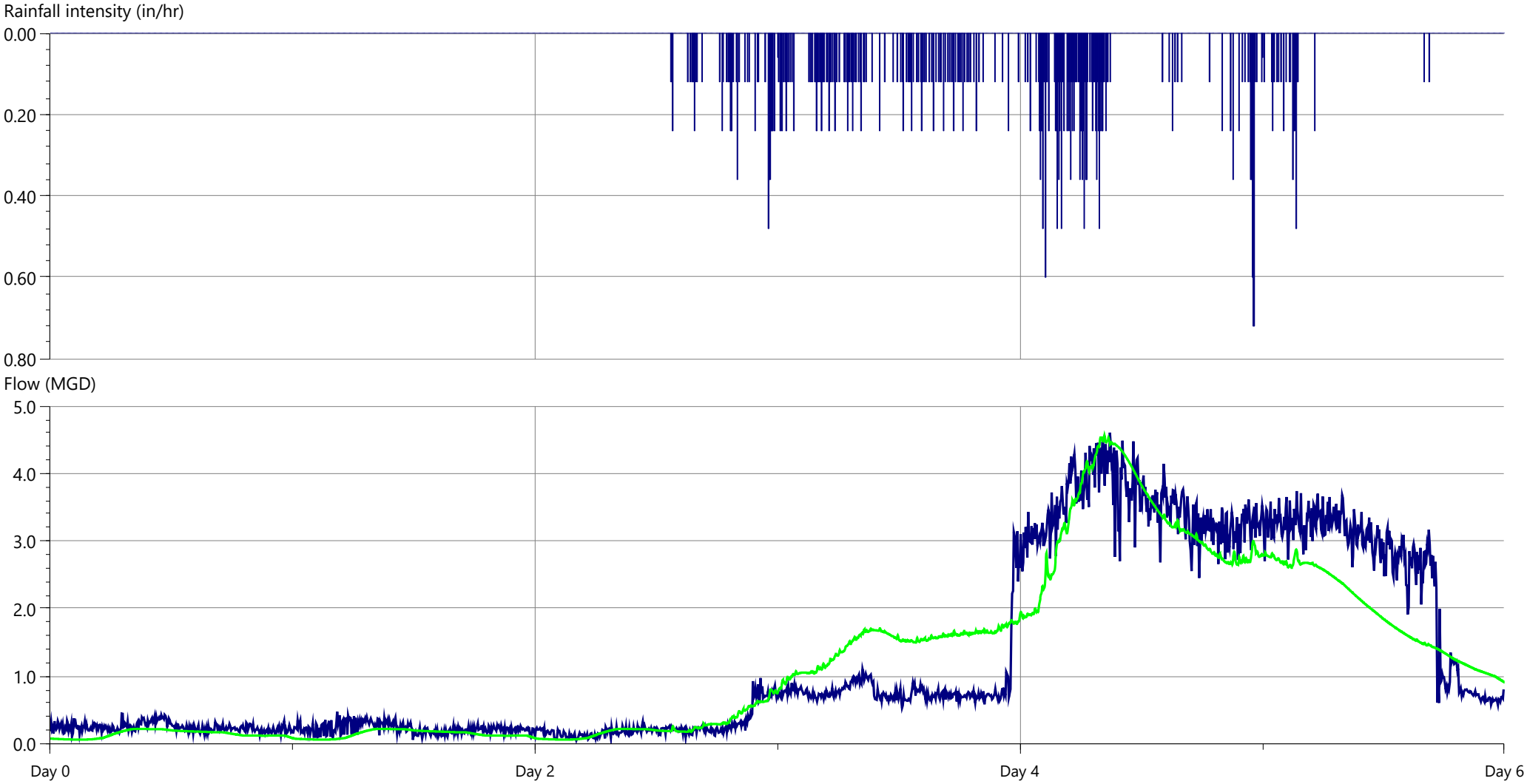


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	2.845	0.600	0.020			
Observed				0.173	1.928	4.828
...9-24_2021 - in/hr units				0.313	2.117	5.020

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

Powered by InfoWorks

Flow survey: >Ross Valley>Flow Survey Group>Flow survey - Wet - December 19-24, 2021 (4/28/2022 8:51:37 AM)
Sim: >Ross Valley>Run Group>2022 WWF Calibration - Dec 19-24, 2021 Storm - Final Calibration>Update to 2021 - Final Calibration Dec_19-24_2021 - in/hr units (10/24/2022 1:11:08 PM)
Flow Survey Location (Obs.) W512.02.1, Model Location (Pred.) D/S W512.02.1, Rainfall Profile: 16



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	3.970	0.720	0.028			
Observed				0.047	4.607	7.471
...9-24_2021 - in/hr units				0.058	4.565	7.154

Observed / Predicted Report (Custom graph) - WWF Calibration 2022 - Dec 19-24, 2021 (Final)

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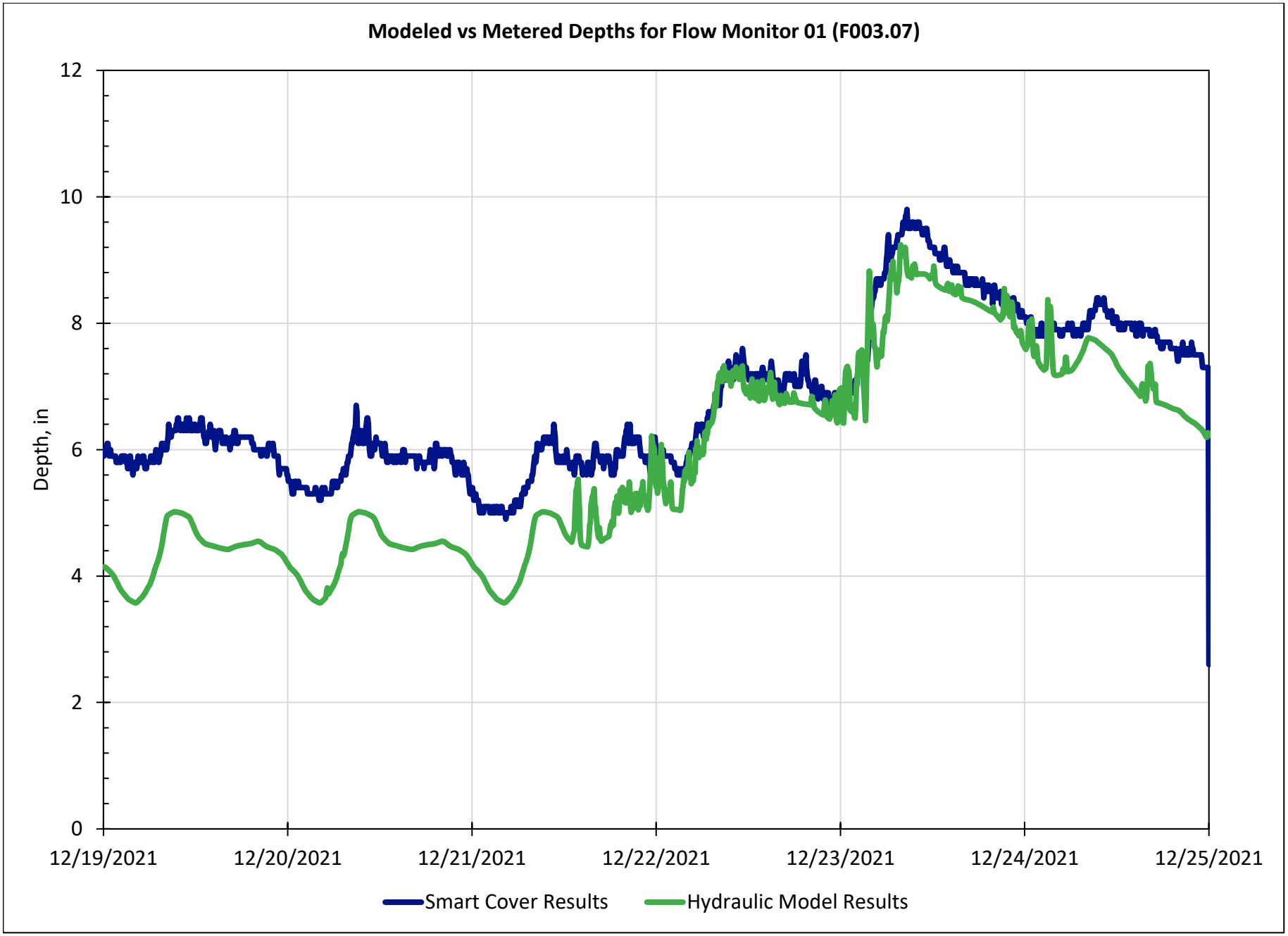
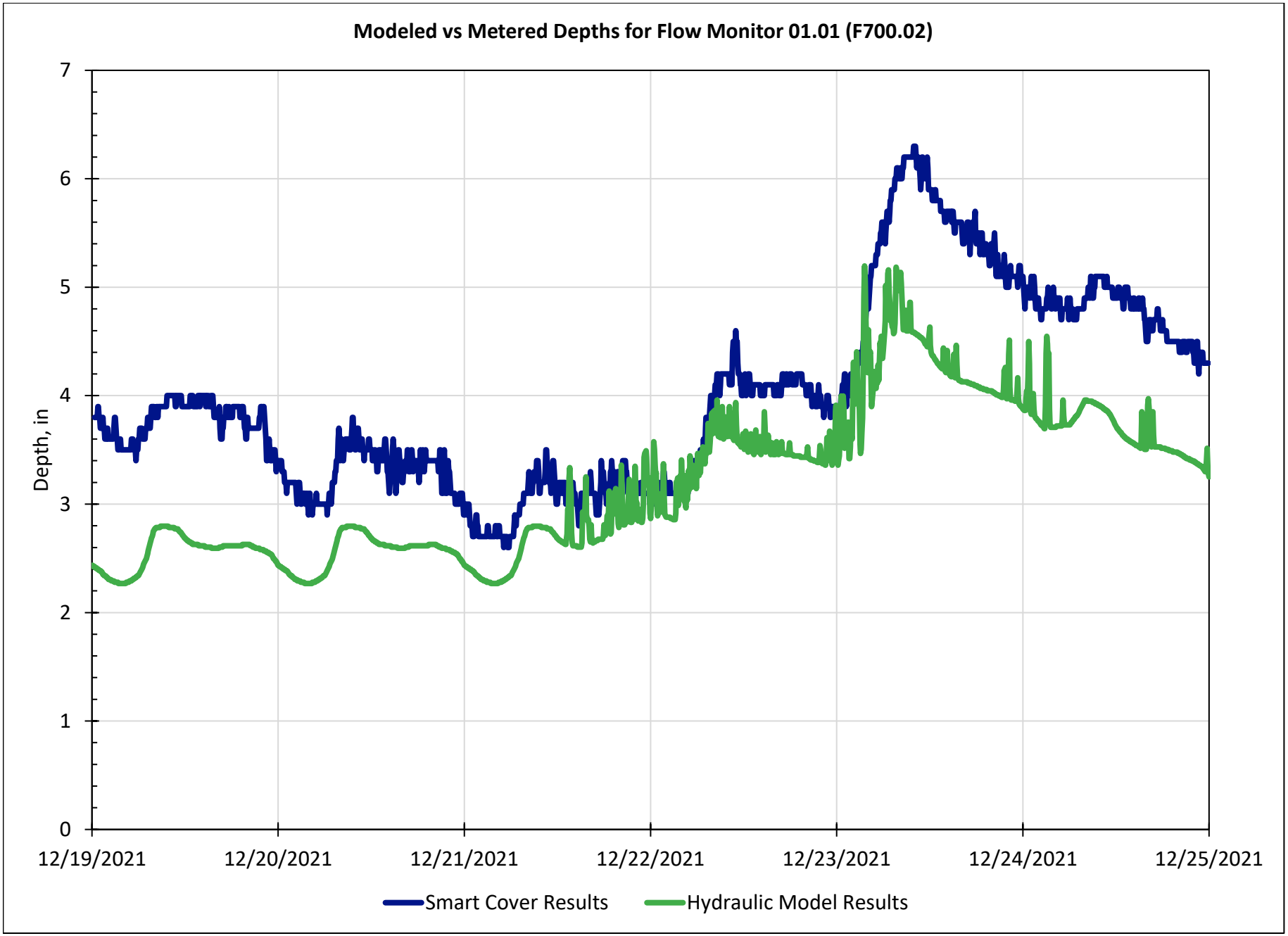
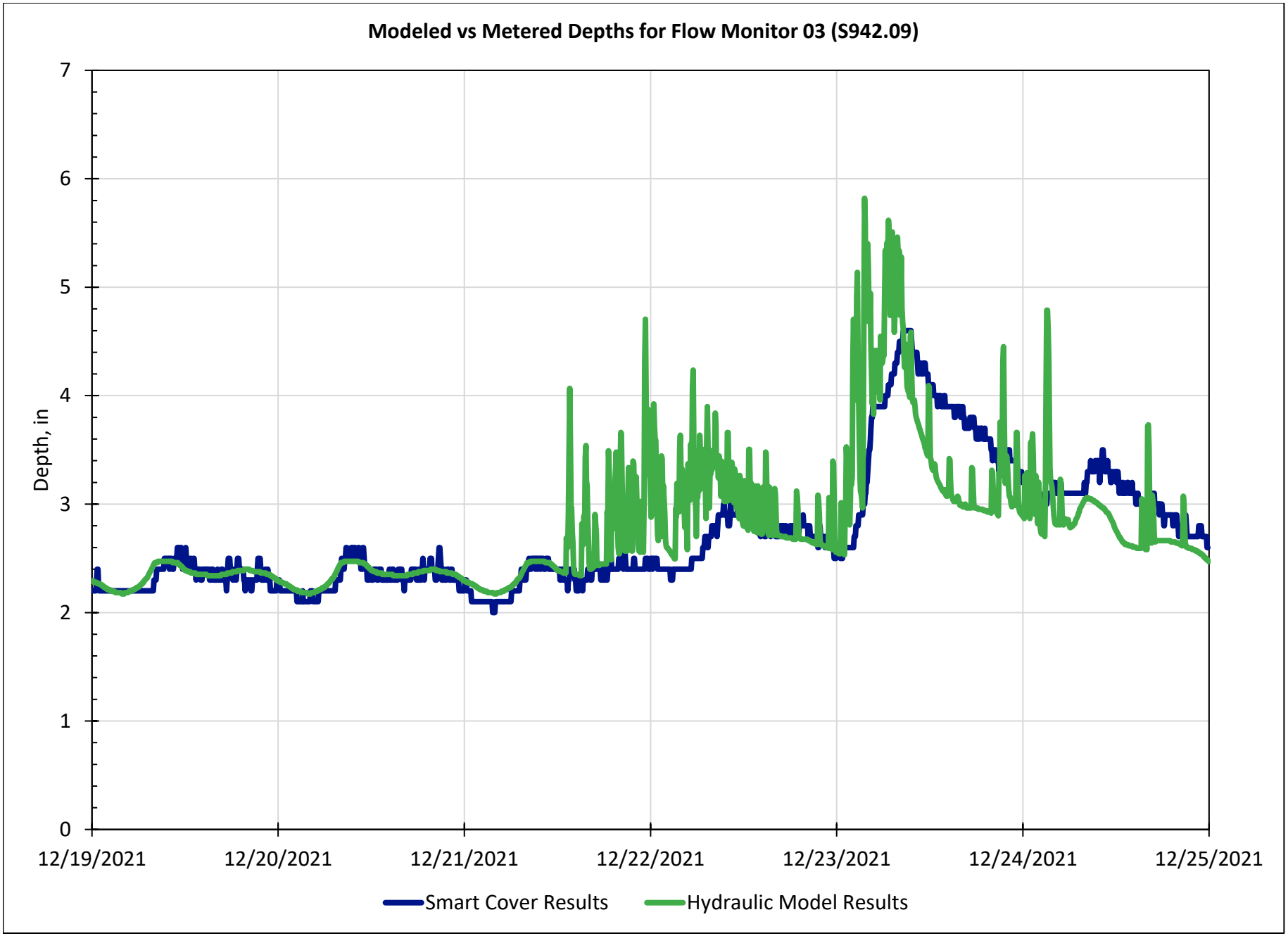
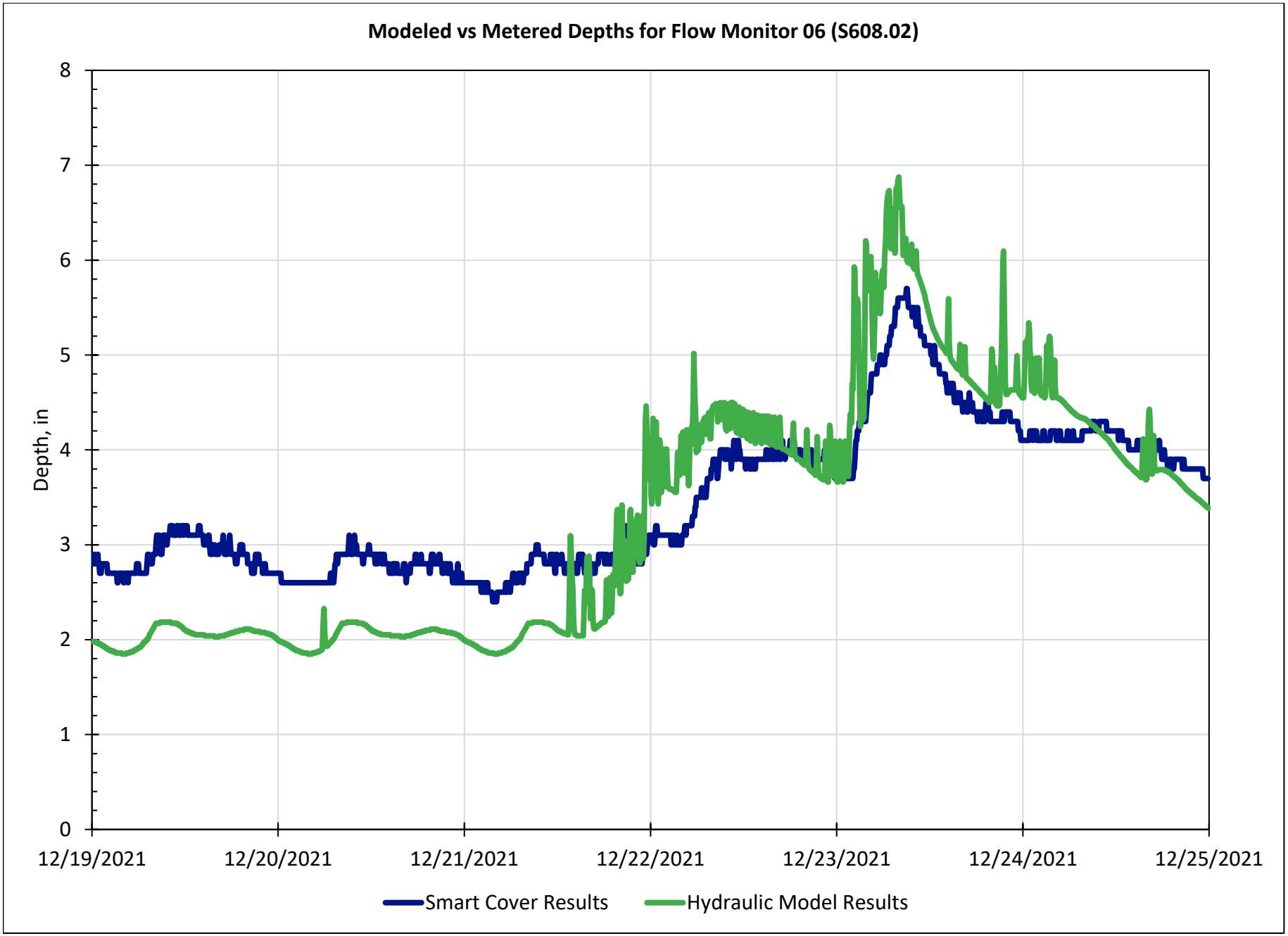
Attachment C

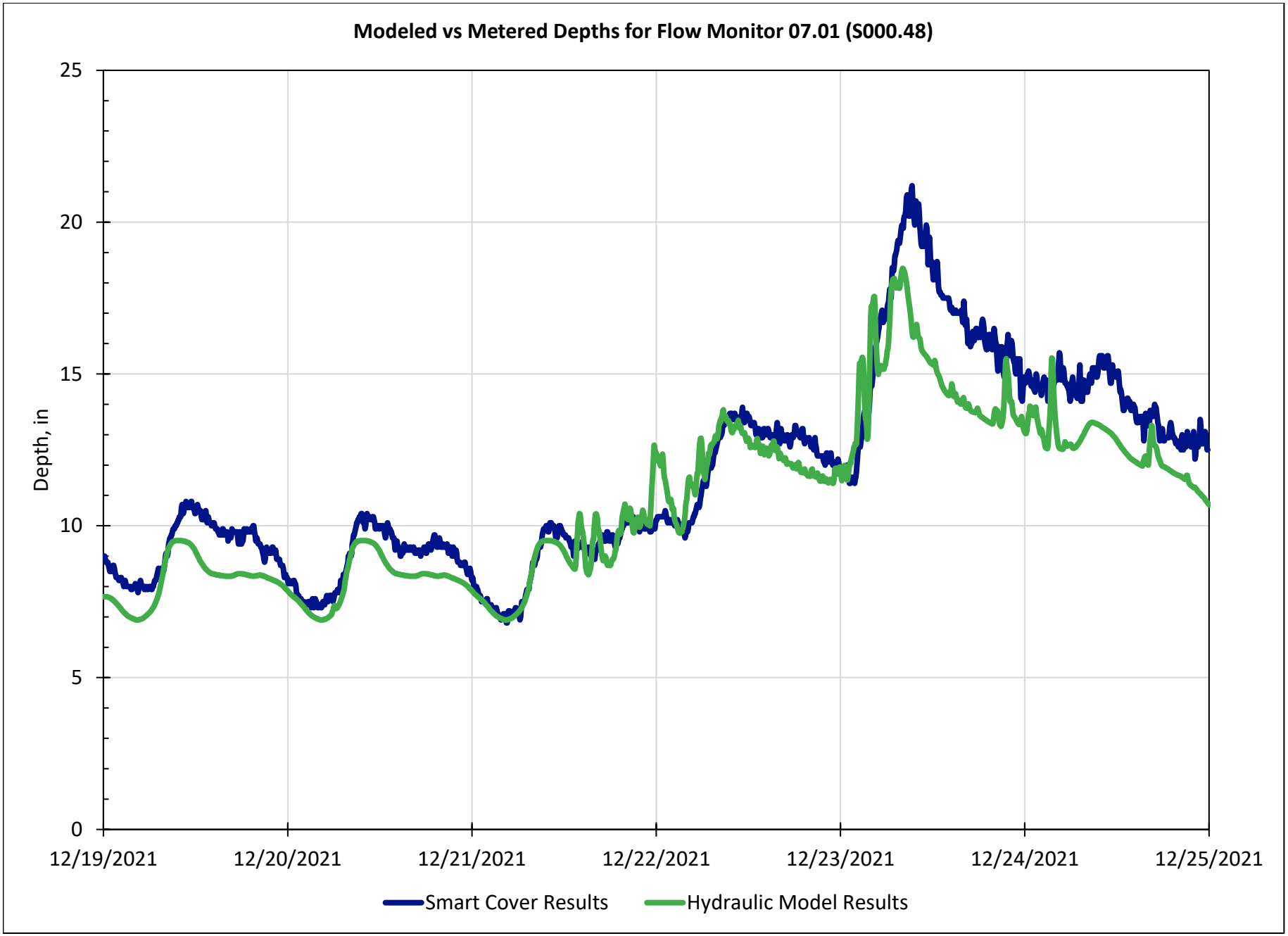
Dry and Wet Weather Recalibration Depths

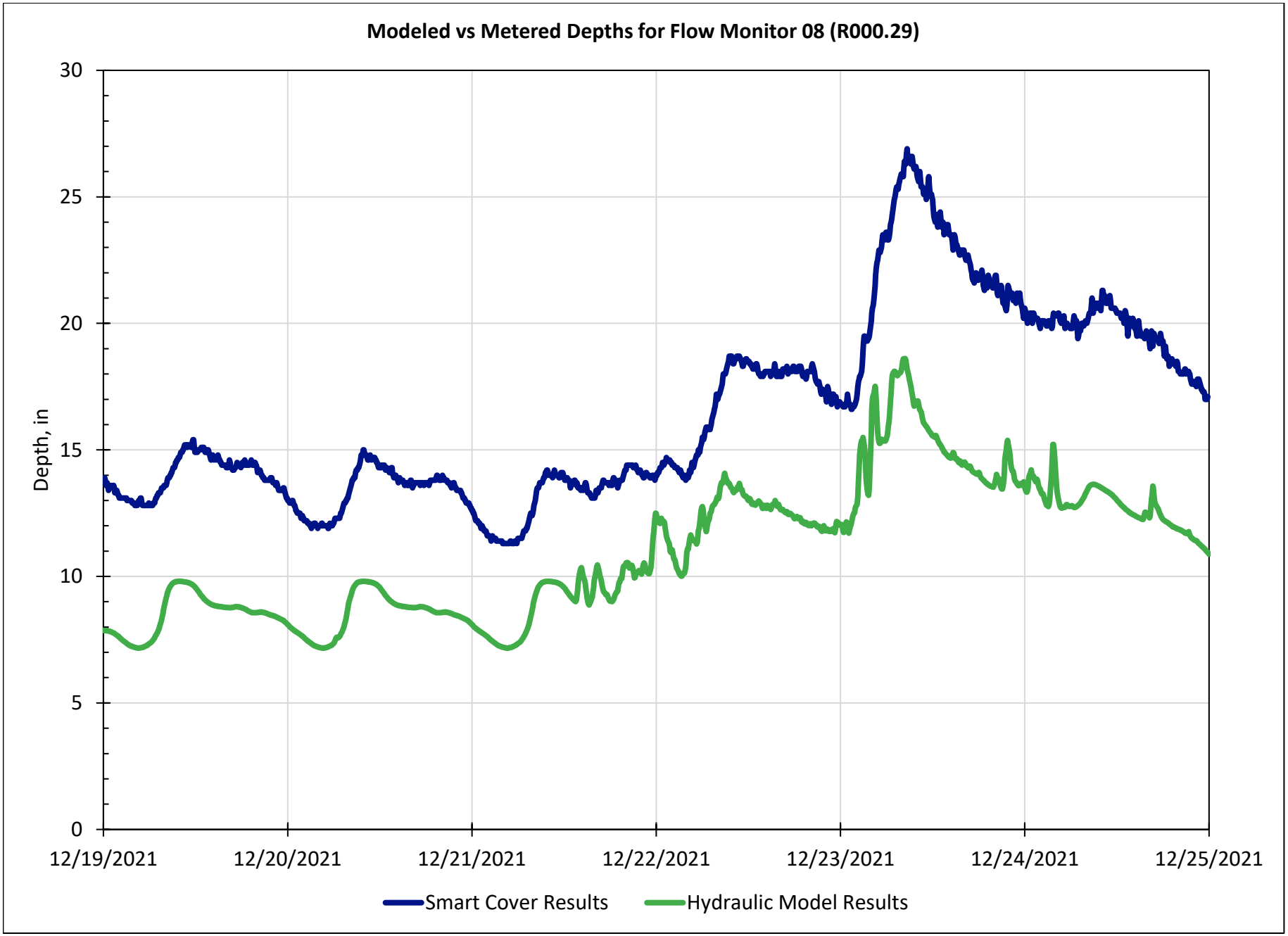

Modeled vs Metered Depths for Flow Monitor 01 (F003.07)
Depth, in
12
10
8
6
4
2
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

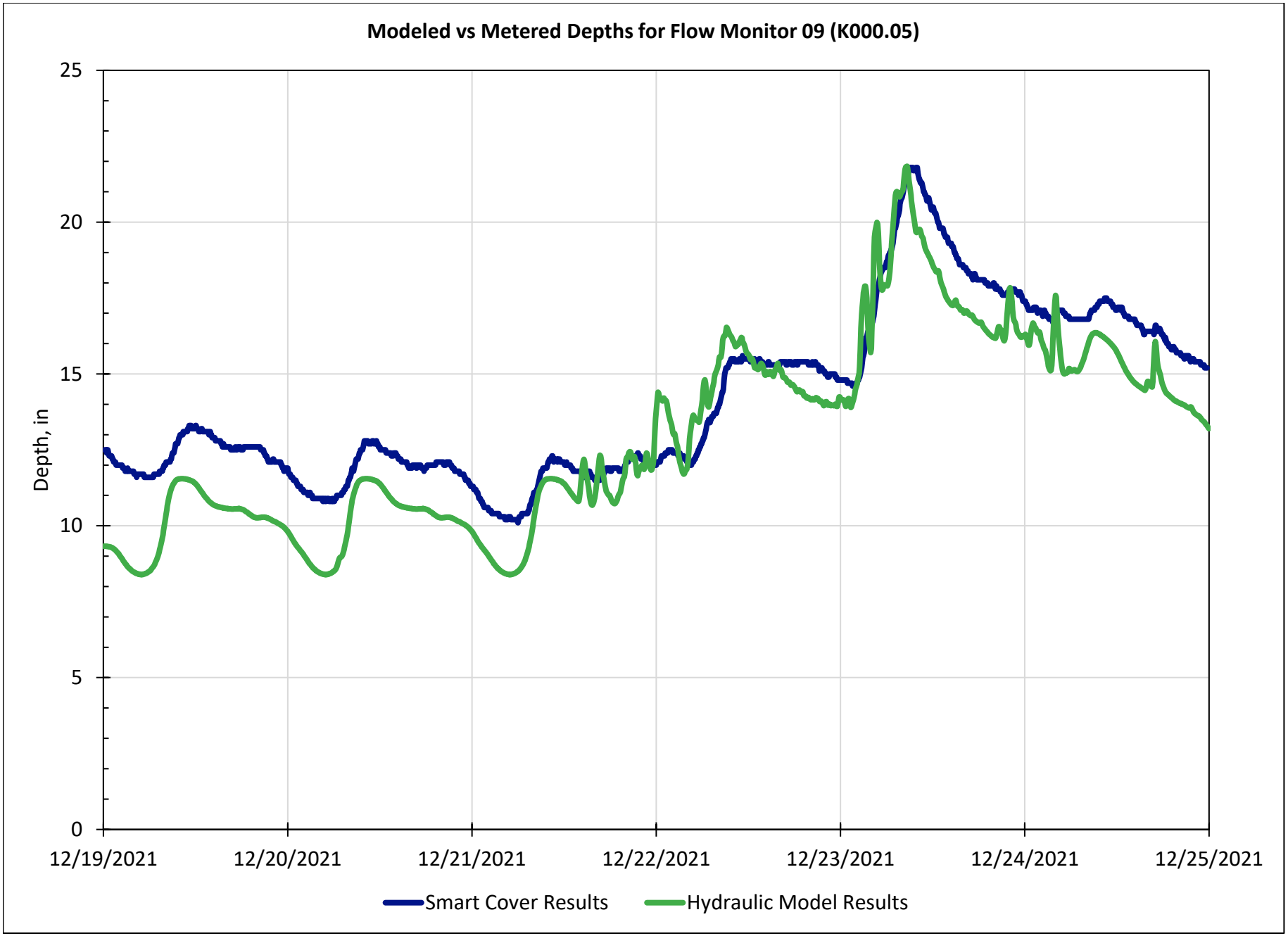

Modeled vs Metered Depths for Flow Monitor 01.01 (F700.02)
Depth, in
0
1
2
3
4
5
6
7
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

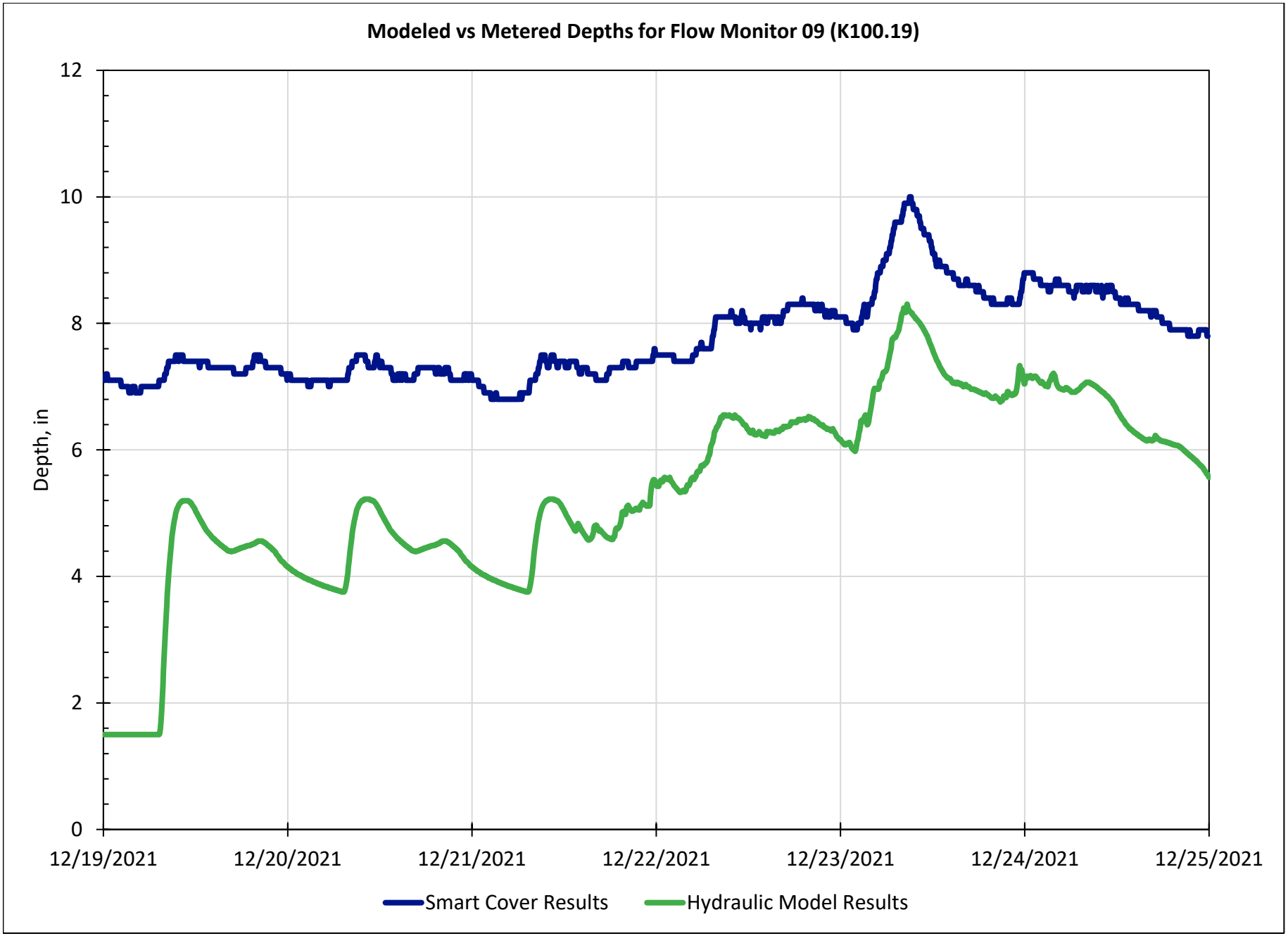

Modeled vs Metered Depths for Flow Monitor 03 (S942.09)
Depth, in
0
1
2
3
4
5
6
7
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

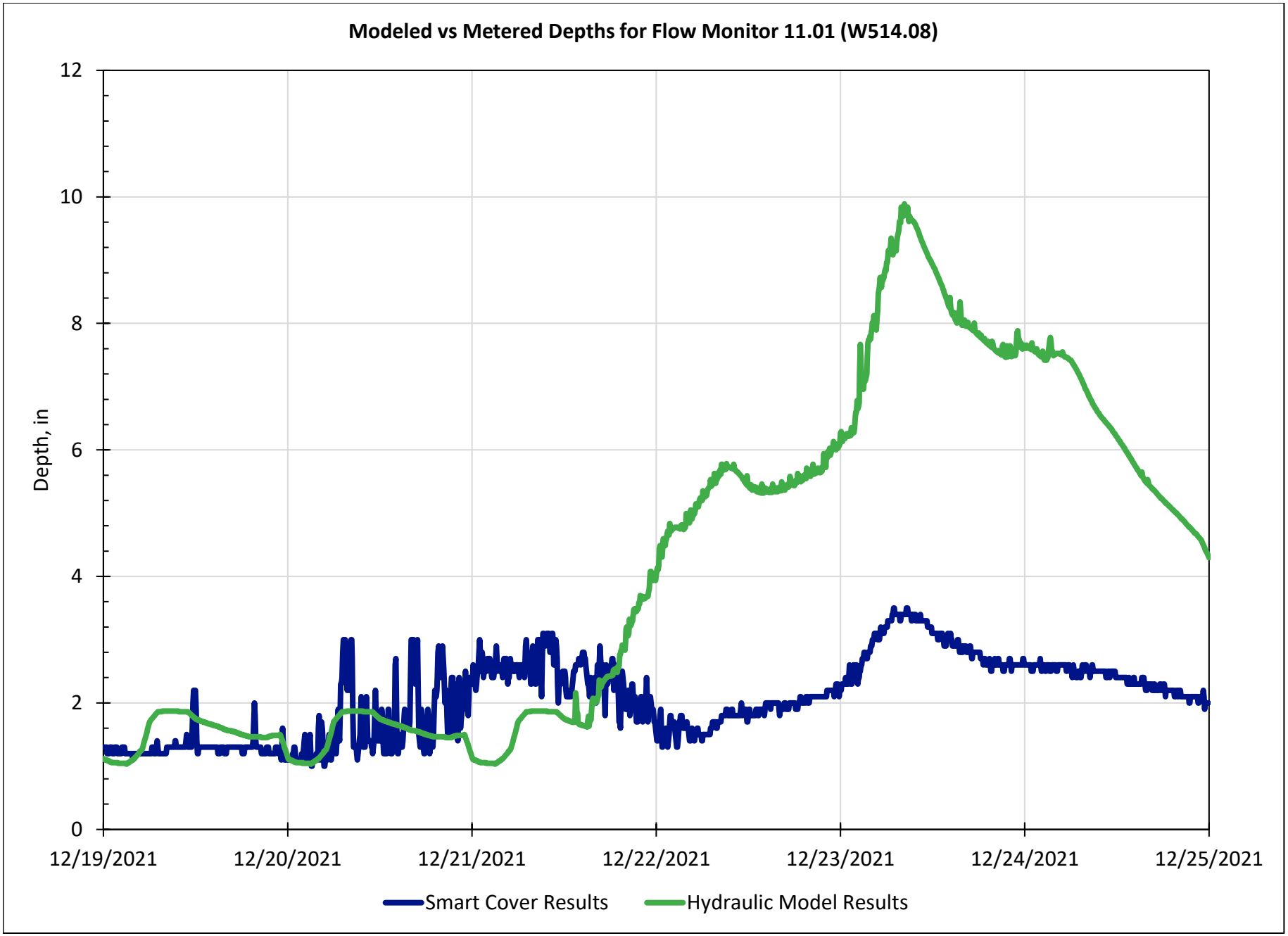

Modeled vs Metered Depths for Flow Monitor 06 (S608.02)
Depth, in
0
1
2
3
4
5
6
7
8
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

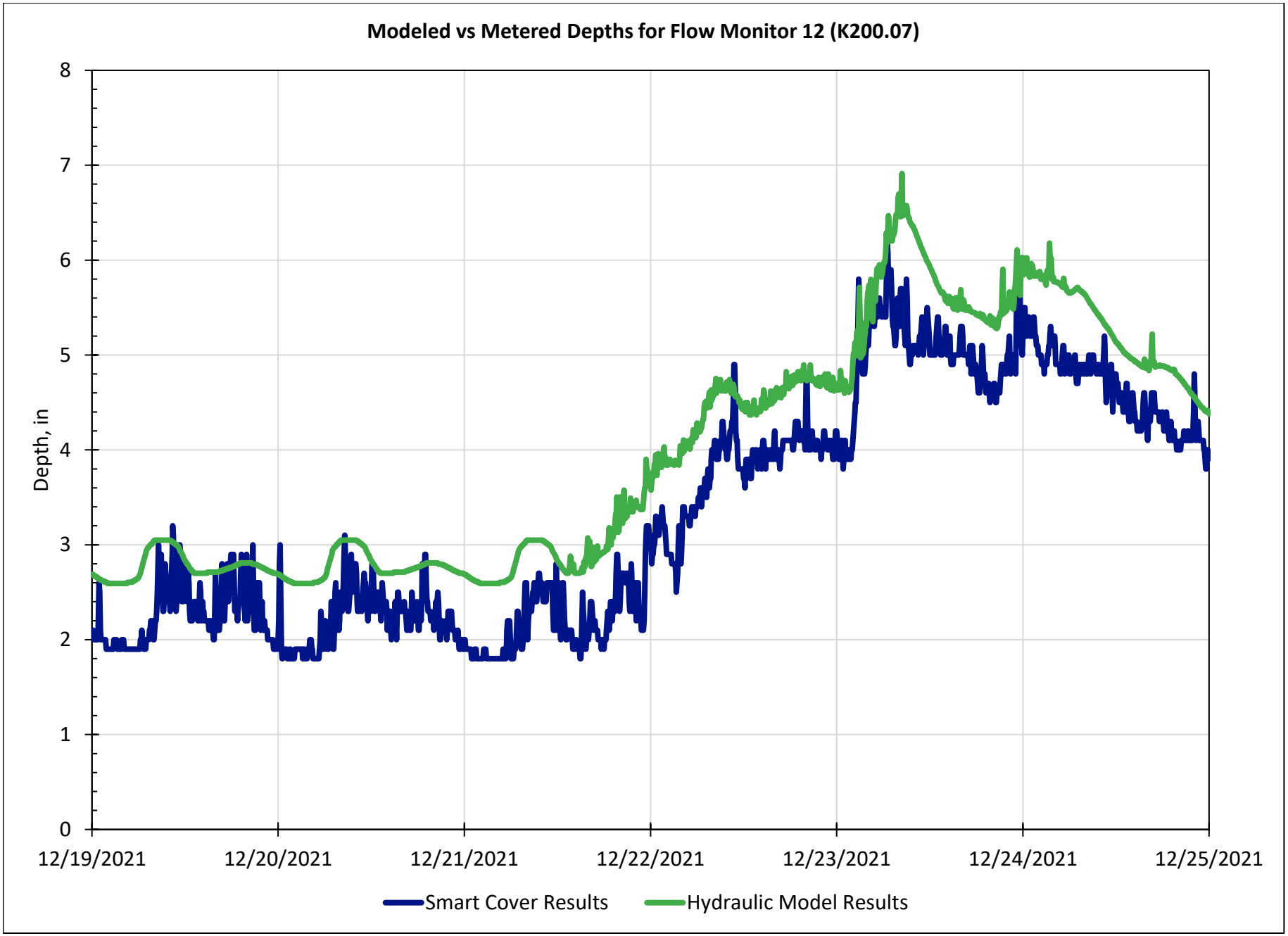

Modeled vs Metered Depths for Flow Monitor 07.01 (S000.48)
Depth, in
25
20
15
10
5
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

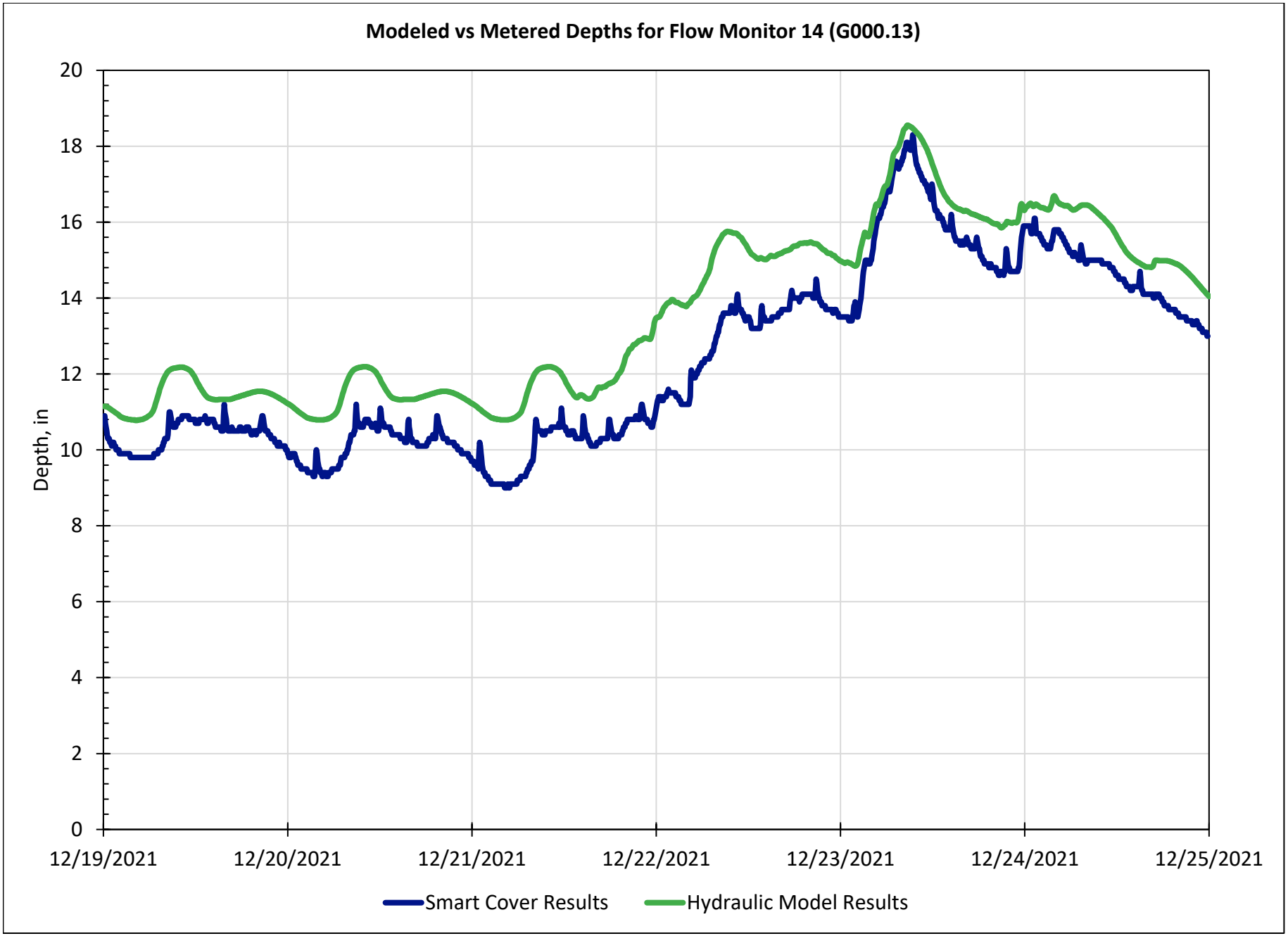

Modeled vs Metered Depths for Flow Monitor 08 (R000.29)
Depth, in
30
25
20
15
10
5
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

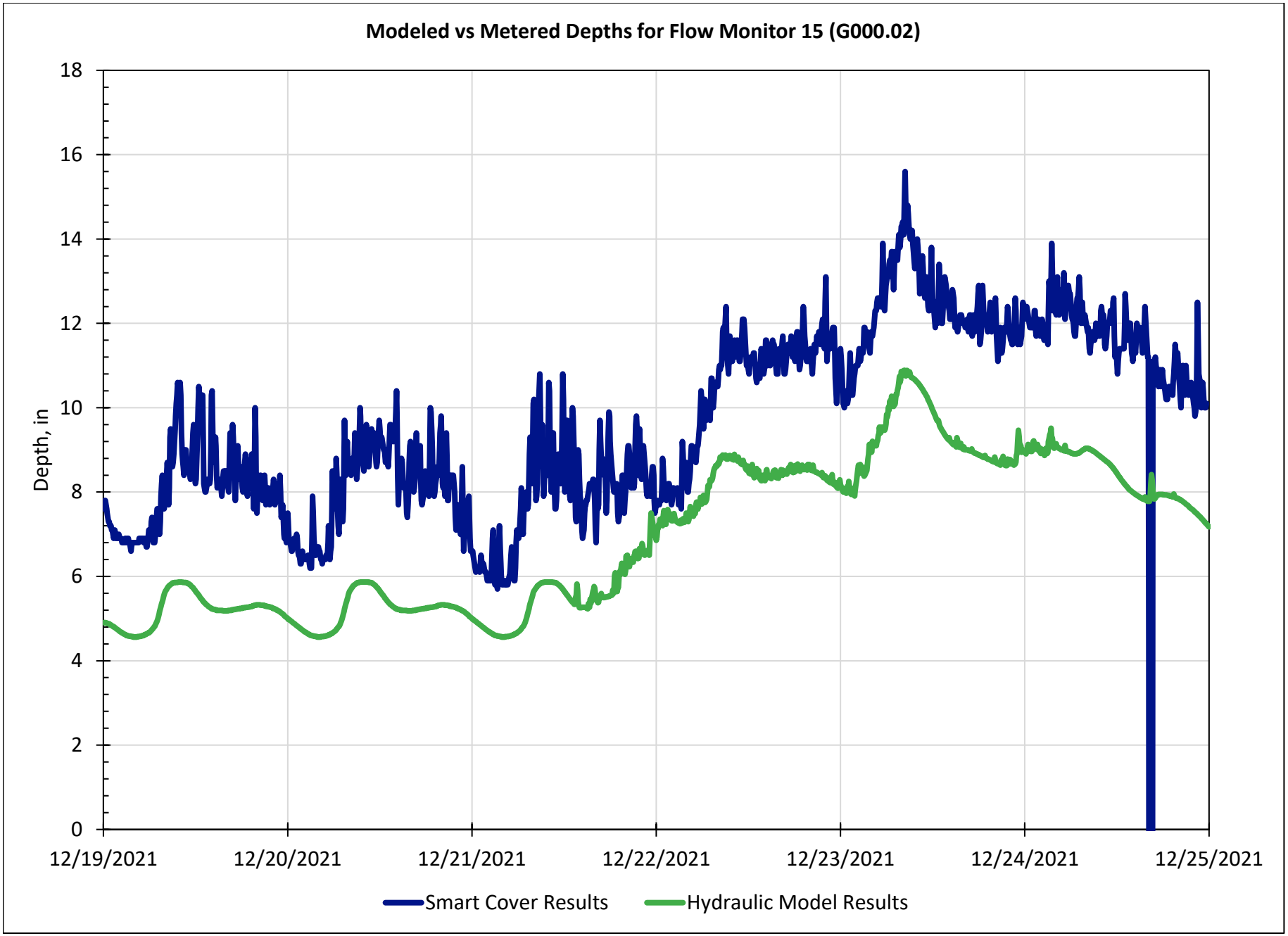

Modeled vs Metered Depths for Flow Monitor 09 (K000.05)
Depth, in
25
20
15
10
5
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

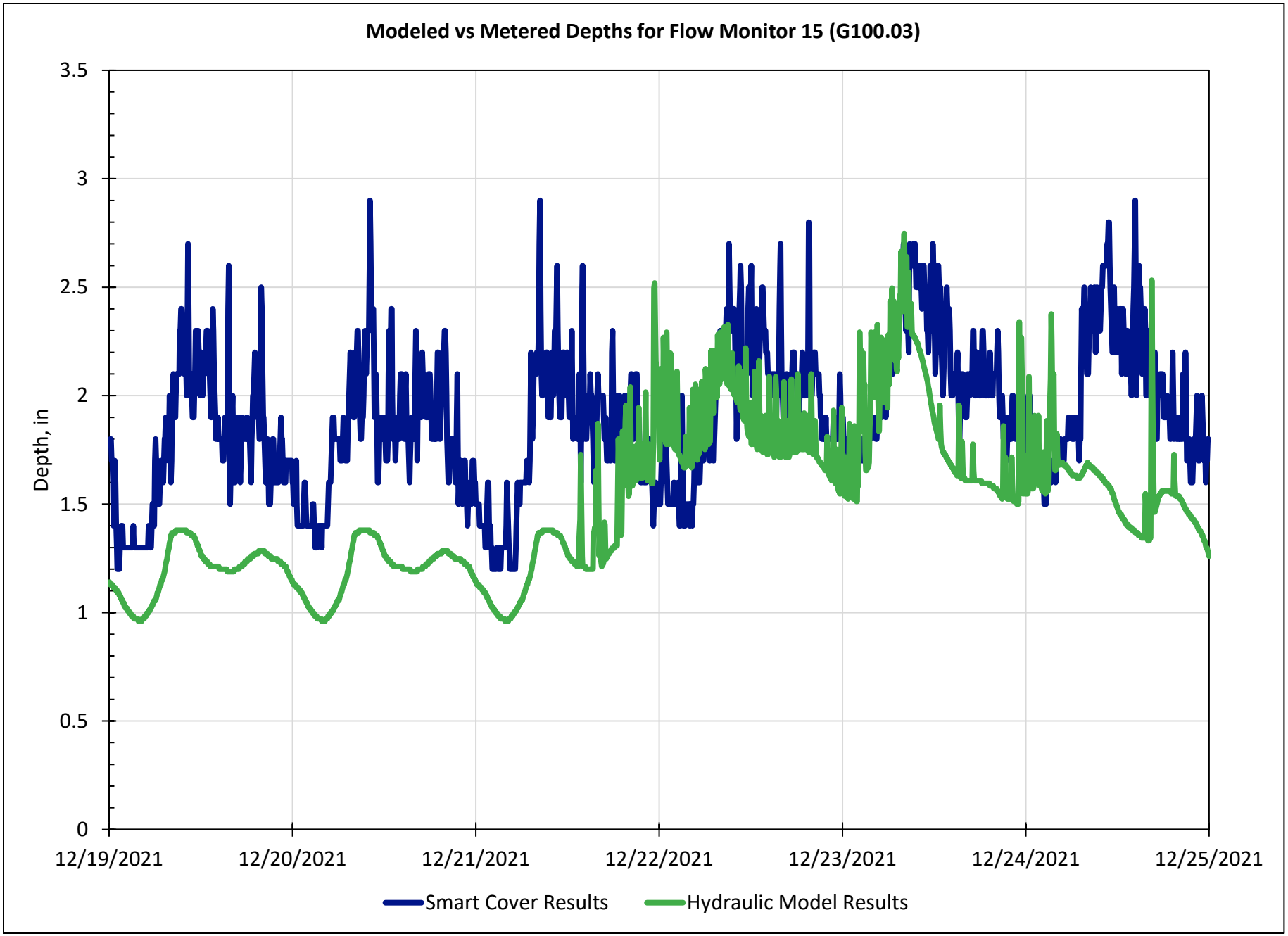

Modeled vs Metered Depths for Flow Monitor 09 (K100.19)
Depth, in
0
2
4
6
8
10
12
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results

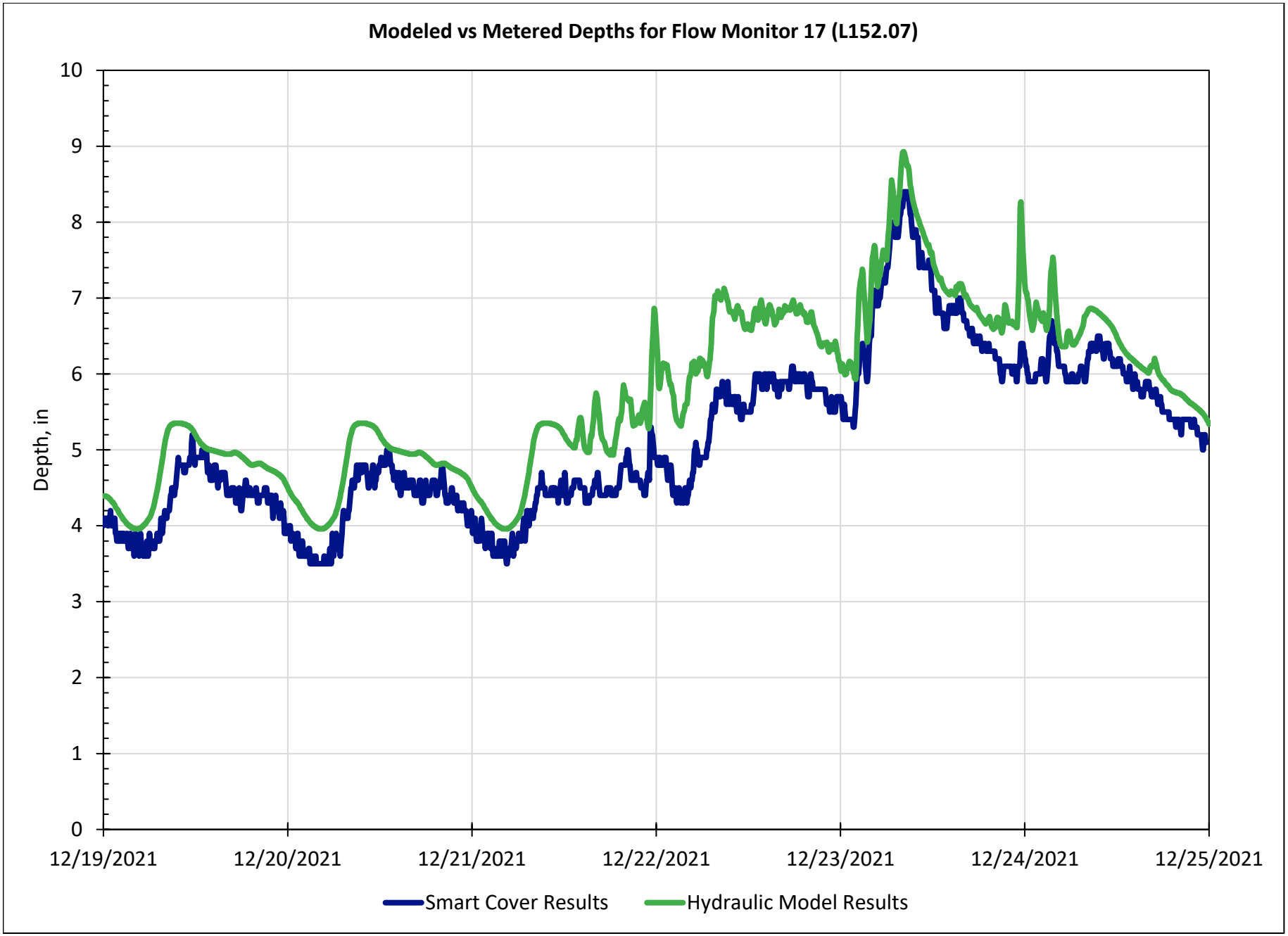

Modeled vs Metered Depths for Flow Monitor 11.01 (W514.08)
Depth, in
0
2
4
6
8
10
12
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results


Modeled vs Metered Depths for Flow Monitor 12 (K200.07)
Depth, in
0
1
2
3
4
5
6
7
8
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results


Modeled vs Metered Depths for Flow Monitor 14 (G000.13)
Depth, in
20
18
16
14
12
10
8
6
4
2
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results


Modeled vs Metered Depths for Flow Monitor 15 (G000.02)
Depth, in
18
16
14
12
10
8
6
4
2
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results


Modeled vs Metered Depths for Flow Monitor 15 (G100.03)
Depth, in
3.5
3
2.5
2
1.5
1
0.5
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results


Modeled vs Metered Depths for Flow Monitor 17 (L152.07)
Depth, in
10
9
8
7
6
5
4
3
2
1
0
12/19/2021
12/20/2021
12/21/2021
12/22/2021
12/23/2021
12/24/2021
12/25/2021
Smart Cover Results
Hydraulic Model Results