

3.5.4 Timing of Proposed Improvement Projects

While Project 1 is needed for current demands, Project 2 and Project 3 are expected to be triggered by future development. For the purpose of this Systems Evaluation, an approximate number of equivalent dwelling units upstream of the capacity deficiency that would trigger the need for a project has been estimated by applying a reduction factor to future flows to represent percentage of buildout. Nearly all of the future growth that would trigger the projects would occur in SMD-2 and SMD-3 (with less than 100 EDUs of future growth anticipated for SPMUD and Roseville). Based on the SMD2 and SMD3 growth projections provided by Placer County, this would occur beyond the 2060 planning horizon provided.

The timing estimated here is subject to change, and could be impacted by the following assumptions:

- Inflow and Infiltration rates for existing sewers are assumed to remain approximately the same. These rates could change based on pipe condition and maintenance activities (such as rehabilitation and repair) in the collection system.
- Inflow and Infiltration rates for new sewers are assumed based on typical values. Actual I/I rates could be higher or lower than assumed.
- The estimates are based on an assumed rebound of dry weather flows to 190 gpd per EDU. If dry weather flows do not rebound, the timing for Project 2 and Project 3 could be somewhat delayed.

Future studies should monitor the I/I rates and update these estimates as needed. The number of EDUs in SMD2/SMD3 that would trigger the proposed project are summarized in **Table 3-11**.

Table 3-11: Timing of Proposed Capacity Improvement Projects

Project	Description	Estimated Capital Improvement Cost	Approximate Additional EDUs in SMD2/SMD3 to Trigger Project ^a
1	Increased Capacity of PS 26 and sewers on Sierra College Blvd directly downstream of PS 26 to relieve Old Auburn Trunk sewer (Area A)	\$1,606,000	Existing
2	Redirect flows from PS 26 and Sierra College Blvd down Eureka Road to relieve Area E.	\$1,831,000	~1,800 ^b
3	Increased Firm capacity of PS 25 to meet Buildout PWWF (depends on alternative). New weir structure or adjustments to existing structure at PS 25 to convey the maximum potential flow through PS 25 without any dry weather flows.	\$758,000	~1,800 ^c

Notes:

- Based on a percentage of buildout factor applied to future model loads.
- Represents approximately 60% of buildout. There are approximately 8,400 Existing EDUs upstream of the deficiency triggering Improvement Project 2, and approximately 10,200 EDUs would trigger the need for improvement.
- Represents approximately 60% of buildout. There are approximately 11,900 Existing EDUs upstream of the deficiency triggering Improvement Project 3, including 7,600 in Placer County, 4,200 in Roseville, and less than 100 in SPMUD. Approximately 13,700 EDUs would trigger the need for the improvement.

4. WASTEWATER TREATMENT PLANT EXPANSION EVALUATION

4.1 Introduction

Based on the updated growth projections provided by the SPWA partners through fiscal year 2059-2060 and at buildout, this section provides facility expansion recommendations for Dry Creek Wastewater Treatment Plant (DCWWTP) and Pleasant Grove Wastewater Treatment Plant (PGWWTP), which treat the entirety of flows from the SPWA service area. The recommendations address timing, phasing, and preliminary conceptual costs of the expansions required through buildout to address both flows and loads, as well as identifying next steps for confirming current plant capacity to accurately reflect recent and ongoing capital improvements.

The analysis provides updates to the following flow and loading parameters for DCWWTP and PGWWTP:

- Flows: existing and projected influent flow through buildout:
 - Average Dry Weather Flow (ADWF)
 - Average Annual flow (AA)
 - Peak Month Flow (PMF)
 - Peak Day Wet Weather Flow (PDWWF)
 - Peak Hour Wet Weather Flow (PHWWF)
- Loads: existing and projected influent loads through buildout:
 - Biochemical Oxygen Demand (BOD), Annual Average (AA) and Maximum Month (MM)
 - Total Suspended Solids (TSS), AA and MM
 - Ammonia (NH₃), AA and MM

4.1.1 Dry Creek Wastewater Treatment Plant

Much of the DCWWTP was constructed in 1974 and was expanded in 1991 to treat an ADWF of 18 mgd. In June of 2004, a portion of the influent flow was diverted to the newly constructed PGWWTP, freeing up some treatment capacity at the time. Recently, nutrient removal upgrades were completed at DCWWTP to ensure reliable compliance with the NPDES permit limits (including the 10 mg/L average monthly limit for nitrate plus nitrite).¹ Currently, the flow meter on the discharge of the Influent Pump Station is being modified to increase the PHWWF hydraulic capacity to 36 mgd.

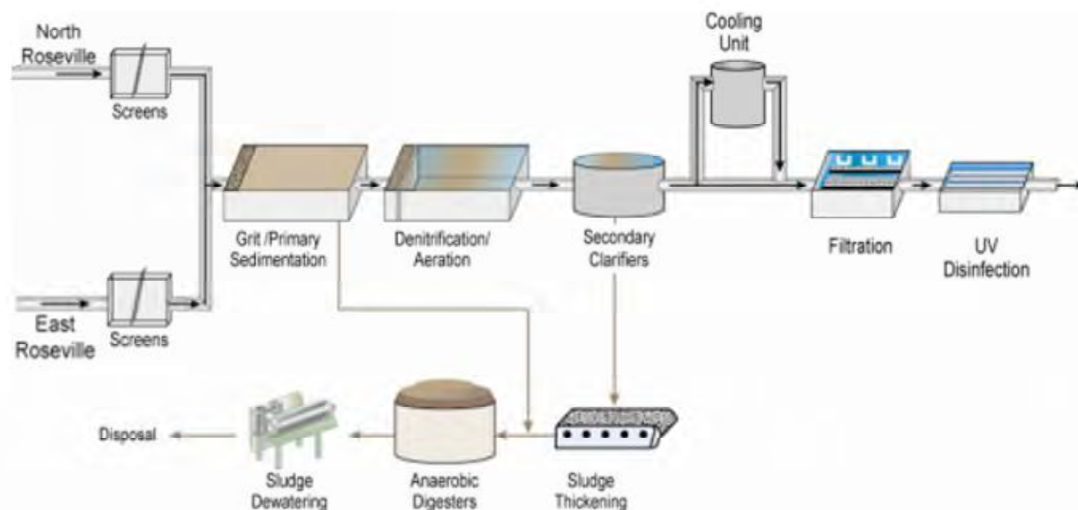
Population in the SPWA service area has continued to grow steadily, with loadings increasing substantially while ADWF decreased. The ADWF at DWWTP has decreased from 10.5 mgd in 2009 to approximately 8.6 mgd as of 2019.

Equally as important as the hydraulic capacity of a plant is its biological treatment capacity. Design of the 1991 expansion of the plant was based on an influent BOD concentration of 160 mg/L, and the corresponding AA and MM loadings of 24,000 lbs/day and 36,000 lbs/day. Since 1991, the influent BOD concentration has increased to 425 mg/L, resulting in much higher BOD loadings than in previous projections. The impact of higher influent BOD concentration and loadings is discussed in Section 4.3.1.

A schematic of the DCWWTP liquid and solids treatment train is shown in **Figure 4-1**.

¹ Source: City of Roseville, DCWWTP Nitrate Reduction Improvements Project, Basis of Design Report (May 2017).

Figure 4-1: DCWWTP Treatment Schematic



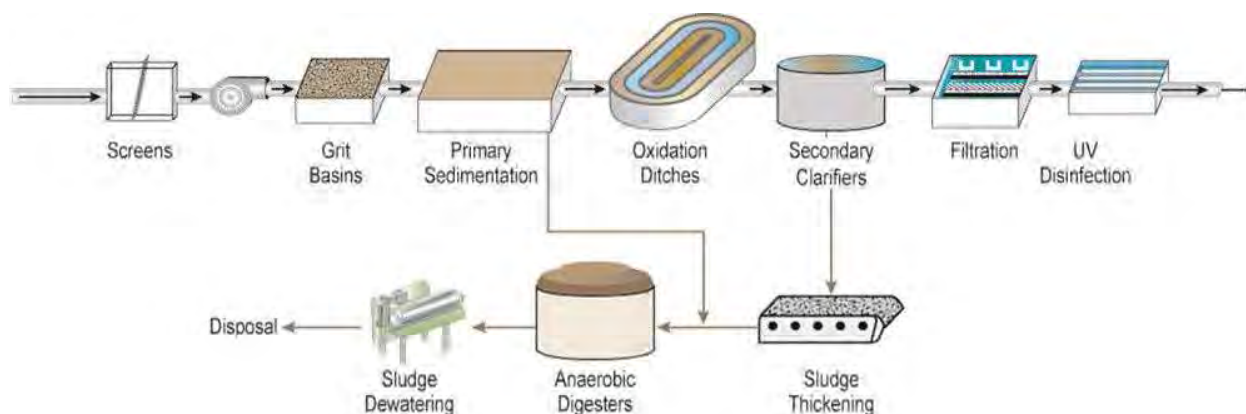
4.1.2 Pleasant Grove Wastewater Treatment Plant

Construction of the PGWWTP was completed in 2004. It was designed for an ADWF of 12 mgd, assuming historical domestic strength wastewater, similar to the Dry Creek Plant. Subsequent study of the plant's treatment processes and influent loading resulted in PGWWTP's capacity being lowered to an equivalent flow of 9.5 mgd. Like the DCWWTP, this was partially a result of influent BOD concentrations trending much higher over time than anticipated in the initial design. Current ADWF is approximately 7.6 mgd with an average influent BOD concentration of 358 mg/L.

To ensure the plant can reliably treat 12 mgd ADWF at the current higher loadings, an expansion project is currently underway, with anticipated completion/commissioning by fiscal year (FY) 22/23.¹ The expansion will add a primary sedimentation process to the liquid treatment train, which currently includes influent screening and grit removal, secondary treatment/denitrification in oxidation ditches, secondary clarification, filtration, and disinfection. The solids treatment process is being upgraded with sludge thickening using rotary drum thickeners and anaerobic digestion of the combined thickened secondary sludge and primary sludge, upstream of the existing dewatering centrifuges (which currently dewater only the secondary sludge). These upgrades will provide additional solids treatment capacity as well as biological treatment capacity. **Figure 4-2** shows a schematic of the PGWWTP treatment train reflecting the upgrades currently under construction.

¹ Source: City of Roseville, PGWWTP Expansion Basis of Design Report (March 2016).

Figure 4-2: PGWWTP Treatment Schematic



4.2 Flows and Loadings

Influent flows and loading (organic loading as measured by BOD and solids loading as measured by TSS) for both the DCWWTP and PGWWTP were established by analyzing daily plant influent data provided by the City of Roseville for the period from January 1, 2016 through September 19, 2019 for influent flow and from January 1, 2013 through September 19, 2019 for loadings. In addition, hourly flow data from December 1, 2016 to September 17, 2019 (which incorporated high winter flow periods) was used to establish peak hour flows.

Projected flows for both the DCWWTP and PGWWTP were calculated based on population and non-residential growth, normalized to account for diversity in land uses by establishing equivalent dwelling units (EDUs). EDU projection data were provided by each of the SPWA JPA Partners (City of Roseville, Placer County, and South Placer Municipal Utility District)¹. Flow projections were developed by multiplying the projected EDUs by an ADWF contribution of 190 gallons per day (gpd) per EDU, in accordance with the estimate developed in the 2009 Systems Evaluation.

4.2.1 Current Flows and Peaking Factors

Current ADWF was established by averaging flows observed at each plant for the period of July through September. While the ADWF is usually thought of as the rated capacity of a treatment plant, the design of treatment systems must also accommodate significant seasonal and diurnal variations in influent flow. A treatment plant must be designed to prevent hydraulic overloads and wash out of solids during peak day and peak hour events. Generally, preliminary and primary treatment systems are sized for peak day or peak hour flow, while secondary treatment systems must meet maximum month organic loading peaks. Sizing treatment processes appropriately aids treatment plants in meeting discharge limits during the higher flows and loading periods that can otherwise stress or overwhelm the plant processes.

Current flow conditions and the associated peaking factors for both plants are summarized in **Table 4-1**.

¹ Data provided on July 2019 for Placer County, August 2019 for SPMUD, and November 2016 for the City of Roseville

Table 4-1: Current Flows and Peaking Factors

Flow Condition	DCWWTP		PGWWTP	
	Current Flow, mgd	Peaking Factor	Current Flow, mgd	Peaking Factor
ADWF	8.6	1.0	7.6	1.0
AA	10.8	1.2	8.1	1.07
PMF	18.4	2.12	10.3	1.36
PDWWF	27.9	3.22	16.9	2.23
PHWWF	36.0	4.19	20.4	2.69

It should be noted that the current plant data reflect a significantly lower flow contribution per EDU than the previously established unit flow factor of 190 gpd/EDU. Approximately 57,747 EDUs are tributary to DCWWTP for FY 19/20. Based on the current ADWF, the equivalent unit flow contribution is approximately 150 gpd/EDU. At PGWWTP, there are approximately 54,907 EDU tributary to the plant for FY19/20, which reflects a flow contribution of 138 gpd/EDU. This is likely the result of several factors, including water conservation efforts over the past decade, drought conditions that were experienced throughout California from 2011-2016, and lower levels of development than previously anticipated prior to the impacts of the recession in 2008-2009.

These flow contributions per EDU may rebound back to historical levels and, to provide a safety factor, the 190 gpd/EDU will continue to be used for this analysis. This unit flow factor should be tracked closely and, if warranted, the per EDU value adjusted accordingly over time.

4.2.2 Projected Plant Influent Flows

Future plant flows were projected over the planning horizon to fiscal year 2059-2060 (FY 59/60)¹ and to ultimate buildout conditions, based on the information provided in Chapter 2. ADWF projections at FY 59/60 and buildout are calculated by multiplying the EDU projection by the flow contribution per EDU. Peaking factors from **Table 4-1** were then applied to established ADWF per EDU based on current flows (138 gpd/EDU at PGWWTP and 150 gpd/EDU at DCWWTP) and added to ADWFs difference calculated from 190 gpd/EDU and current ADWF/EDU to project the additional flow conditions. This approach avoids using peaking factors on projected ADWF calculated from 190 gpd/EDU for a more realistic flow estimate. These flows are summarized in **Table 4-2** and **Table 4-3**.

Table 4-2: Projected FY 59/60 and Buildout EDUs and Flows at DCWWTP

Condition	DCWWTP			
	FY 59/60 EDU	FY 59/60 Flow, mgd	Buildout EDU	Buildout Flow, mgd
ADWF	87,772	16.7	96,000	18.2
AA	---	19.9	---	21.8
PMF	---	31.5	---	34.4
PDWWF	---	45.9	---	50.2
PHWWF	---	58.6	---	64.1

¹SPWA's fiscal year runs from July 1 to June 30.

Table 4-3: Projected FY 59/60 and Buildout EDUs and Flows at PGWWTP

Condition	PGWWTP			
	FY 59/60 EDU	FY 59/60 Flow, mgd	Buildout EDU	Buildout Flow, mgd
ADWF	92,864	17.6	145,000	27.6
AA	---	18.6	---	29.0
PMF	---	22.2	---	34.8
PDWWF	---	33.4	---	52.3
PHWWF	---	39.3	---	61.5

4.2.3 Current BOD Loadings

In previous studies, design parameters were established based on much lower influent BOD concentrations, ranging from 248 mg/L at DCWWTP to 285 mg/L at PGWWTP. The plant data set provided for this TM (which is an extended data set from 2013-2019) indicates an average influent BOD concentration of 425 mg/L at DCWWTP, and 358 mg/L at PGWWTP. The range in influent BOD concentrations at both plants are shown in **Figure 4-3** and **Figure 4-4**.

Figure 4-3: Influent BOD Concentrations at DCWWTP

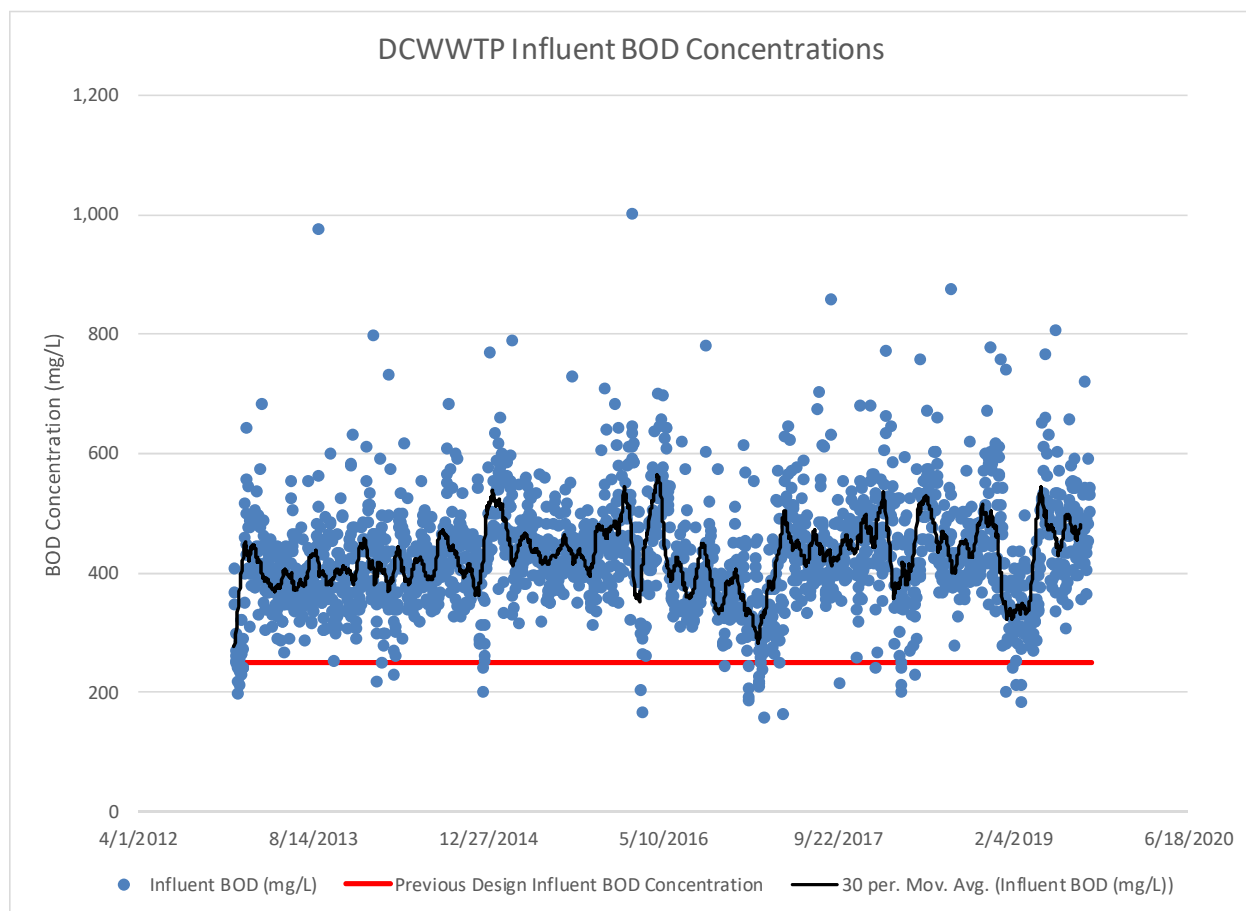
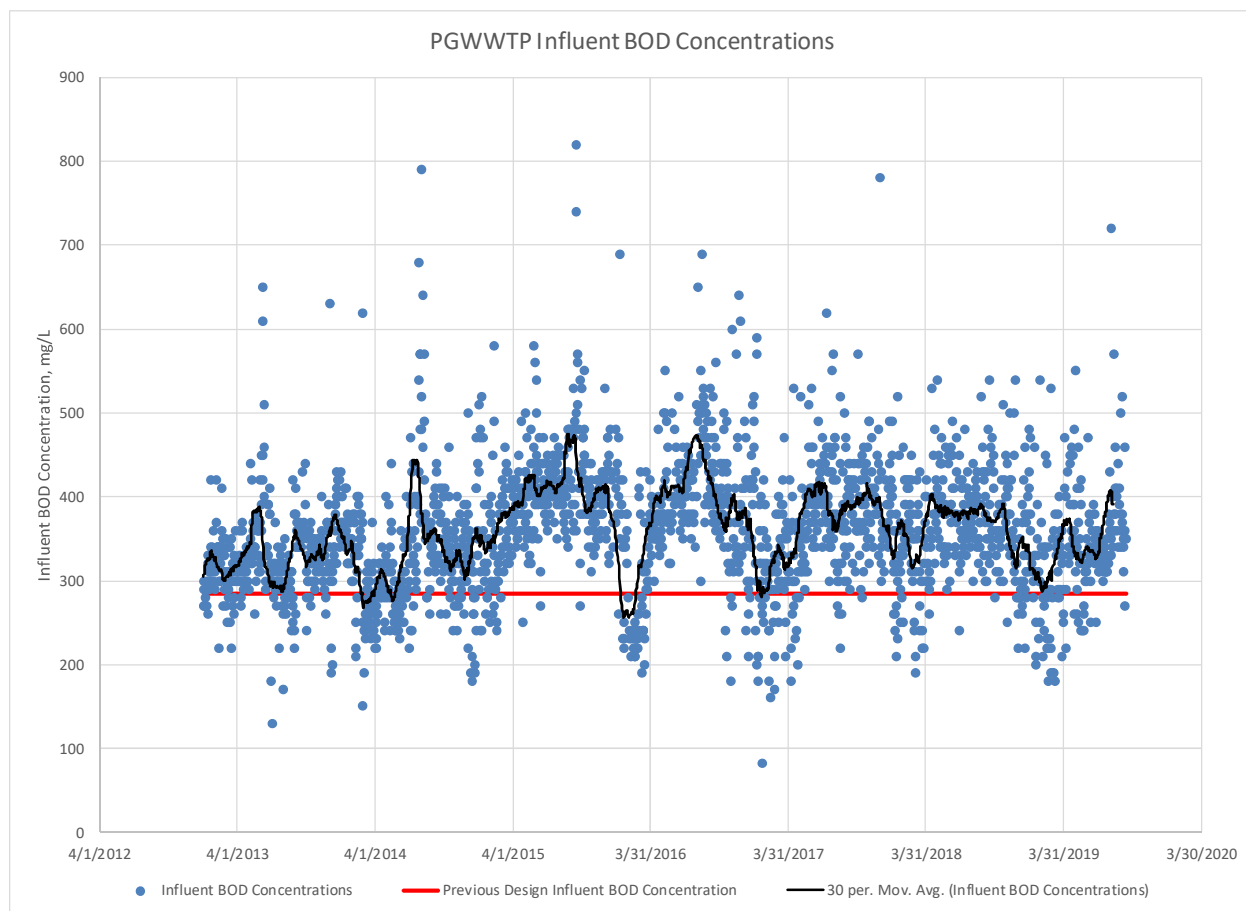


Figure 4-4: Influent BOD Concentrations at PGWWTP



These higher concentrations are likely a result of water conservation efforts over the past decade, combined with the drought conditions that were experienced throughout California from 2011-2016, though the relatively high concentrations at DCWWTP should be confirmed. The effect of conservation is on top of the demographic changes in the SPWA service area since the treatment plants were designed that brought much more commercial flows and loadings along with changing development patterns, such that the strength of the wastewater at both plants evolved from low strength domestic wastewater to moderate strength commercial wastewater, influenced by more food service, restaurant, brewery and other contributions.

A 30-day moving average of influent BOD concentrations is also shown on these figures. This moving average shows that current influent concentrations are now holding relatively constant, though they are higher than previous designs accounted for. This is an indication that influent BOD concentrations have now leveled off, however we recommend the SPWA monitor this parameter in the long term. When the State experiences another drought or there are changes to land use within the service area such as densification, influent loading concentrations may increase further.

4.2.4 Current and Projected Plant Influent Loadings

The January 1, 2013 through September 19, 2019 data set also included daily influent plant loadings for BOD, TSS, and NH_3 . These data were analyzed to establish current annual average (AA) and maximum month (MM) pollutant loadings. Current MM loadings were established by taking the maximum value of a 30-day running average of the daily influent data provided. The peaking factors for each parameter were established by dividing the MM loading by the AA loading.

Projected loads, shown in **Table 4-4** and **Table 4-5**, were calculated by using the average loadings from the data set provided and establishing AA loading per EDU. Peaking factors were then applied to establish the FY 59/60 and buildout MM loads.

Table 4-4: Current and Projected Influent Loading at DCWWTP

Parameter	Condition	Unit	DCWWTP			
			Current	FY59/60	Buildout	Peaking Factor
BOD	Average Concentration	mg/L	425	---	---	---
	AA Loading	lbs/day	33,900	52,000	56,000	---
	MM Loading	lbs/day	47,600	73,000	79,000	1.41
TSS	Average Concentration	mg/L	540	---	---	---
	AA Loading	lbs/day	42,800	65,000	71,000	---
	MM Loading	lbs/day	60,800	92,000	101,000	1.42
NH ₃	Average Concentration	mg/L	23	---	---	---
	AA Loading	lbs/day	1,800	2,800	3,100	---
	MM Loading	lbs/day	2,500	4,000	4,200	1.35

Table 4-5: Current and Projected Influent Loading at PGWWTP

Parameter	Condition	Unit	PGWWTP			
			Current	FY59/60	Buildout	Peaking Factor
BOD	Average Concentration	mg/L	358	---	---	---
	AA Loading	lbs/day	22,400	38,000	60,000	---
	MM Loading	lbs/day	28,000	48,000	75,000	1.25
TSS	Average Concentration	mg/L	291	---	---	---
	AA Loading	lbs/day	18,100	31,000	48,000	---
	MM Loading	lbs/day	26,400	45,000	70,000	1.46
NH ₃	Average Concentration	mg/L	40	---	---	---
	AA Loading	lbs/day	2,400	4,100	6,400	---
	MM Loading	lbs/day	2,700	4,600	7,100	1.11

4.3 Plant Capacity Comparison and Expansion Phasing

This comparison of current plant capacity and projected future flows and loads accounts for only hydraulic and carbonaceous BOD treatment capacity because these parameters have driven capacity expansion timing in the past. Potential nutrient removal requirements have not been considered in expansion timing and phasing. Evaluation of plant capacity with respect to TSS and ammonia removal should be incorporated into a subsequent analysis of plant capacity. Existing plant capacity was provided in the following documents:

- South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December, 2009
- Technical Memorandum 4b: Wastewater Treatment Plants Expansion Requirements (TM 4b), RMC Water and Environment, March 28, 2006
- DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008
- Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016
 - Executive Summary
 - Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections, Pleasant Grove Wastewater Treatment Plant

- City of Roseville, Dry Creek Wastewater Treatment Plant, Influent Pump Station Hydraulic Analysis, Waterworks Engineers, March 2018.

Current loading capacities at each plant based on these documents are summarized in **Table 4-6**.

Table 4-6: Current Hydraulic and Organic (BOD) Capacities at DCWWTP and PGWWTP

Plant	DCWWTP Existing	PGWWTP	
		Existing	FY 22-23 ^a
ADWF Hydraulic Treatment Capacity, mgd	18 ^b	12 ^b	12 ^{a,c}
Biological Treatment Capacity, AA BOD Loading, lbs/day	26,200 ^d	22,000 ^b	34,500 ^c
Biological Treatment Capacity, MM BOD loading, lbs/day	32,500 ^d	N/A	40,100 ^c

Notes:

- Plant improvements that expand treatment capacity at PGWWTP are currently under construction and are expected to be in service by FY 22-23. Capacity comparisons in this TM take this into consideration.
- Permitted plant capacity and capacity documented in the South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December 2009.
- Source: Table 1.1, Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections. Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016
- Source: Table 5-1, DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008

The plant data show that current BOD loadings are higher than the BOD treatment capacities estimated in the reference documents at both plants (marginally higher at Pleasant Grove). However, according to City staff, the plants have consistently been in compliance with their NPDES discharge permits. This suggests that the **actual** plant capacities are beyond their nominal design capacity with respect to BOD. Additionally, it is unclear to what extent interim improvements such as the Nitrate Reduction Improvements project at DCWWTP have affected the plant capacity. For the purposes of this TM, it is assumed that the AA and MM BOD removal capacity at each plant are, at minimum, the same as their current BOD loadings. **Table 4-7** shows the revised treatment capacities based on current AA and MM BOD loadings. It is recommended that process-specific sampling, process modeling, and, if needed, stress testing be performed to determine the actual plant capacity, the limiting processes, and corresponding process improvements needed at each plant. While this evaluation will be immediately helpful at Pleasant Grove, it is essential at Dry Creek because of the large discrepancy between current loading and nominal capacity.

Table 4-7: Revised Current Hydraulic and Organic (BOD) Capacities at DCWWTP and PGWWTP

Plant	DCWWTP	PGWWTP	
		Existing	FY 22-23 ^a
ADWF Hydraulic Treatment Capacity, mgd	18 ^b	12 ^b	12 ^{a,c}
Biological Treatment Capacity AA BOD Loading, lbs/day	33,900 ^d	22,400 ^d	34,500 ^c
Biological Treatment Capacity, MM BOD Loading, lbs/day	48,000 ^d	28,000 ^d	40,100 ^c

Notes:

- Plant improvements that expand treatment capacity at PGWWTP are currently under construction and are expected to be in service by FY 22-23. Capacity comparisons in this TM take this into consideration.
- Permitted plant capacity and capacity documented in the South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December, 2009.
- Source: Table 1.1, Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections. Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016
- Current BOD loadings based on plant data from January 2013 through September 2019.

4.3.1 Dry Creek Wastewater Treatment Plant

This section discusses the hydraulic and biological capacity of the DCWWTP and preliminary phasing of future improvements. Based on the estimated plant capacity and projected flow and loading requirements, two phases of improvements are recommended.

4.3.1.1 Hydraulic Capacity and Phasing

Based on the projected ADWF of 16.7 for FY 59/60 and 18.2 mgd for buildout, the current DCWWTP ADWF hydraulic capacity of 18 mgd is effectively sufficient through buildout. **Figure 4-5** shows ADWF capacity plotted against the flow projected over the planning period. **Figure 4-5** also presents graphs for ADWF and PDWWF rebound based on a linear interpolation from 150 gpd/EDU calculated based on current flows in FY 19/20 to a potential flow factor of 190 gpd/EDU in FY 59/60. This is not to say that all unit processes are sufficient to handle future peak flows associated with wet weather; assuming peaking factors hold steady over time, or increase, unit processes based upon flow criteria (as opposed to loading) will need to be expanded as presented below.

4.3.1.2 Biological Capacity and Phasing

Preliminary biological capacity improvements for DCWWTP have been identified, which should be confirmed and refined when additional capacity testing has been completed. Based on **Table 4-7**, DCWWTP is currently running at or beyond its nominal design capacity with respect to BOD loading. It is recommended that SPWA implement Phase 1 expansion in approximately FY 24/25 which is the earliest practical time frame it could be implemented considering planning, design, and construction duration. The plant will reach 94% of the expanded Phase 1 AA and MM BOD loading capacity in FY 39/40. Therefore, it is recommended to implement Phase 2 biological improvements at this time concurrent with necessary wet weather hydraulic improvements. Phase 2 improvements in FY 39/40 are recommended to bring the plant BOD loading capacity to its buildout AA and MM projections of 56,000 and 79,000 lbs/day, respectively. **Figure 4-6** shows AA and MM biological treatment capacities plotted against the loadings projected over the planning period and the anticipated phasing. As discussed in Chapter 5, the timing and size of the recommended projects should be reviewed after additional capacity analysis and facility planning is completed.

4.3.2 Pleasant Grove Wastewater Treatment Plant

This section discusses the hydraulic and biological capacity of the PGWWTP and the recommended phasing of future improvements. This phasing includes improvements that are currently under design and are expected to be in service by FY 22-23. Based on the estimated plant capacity and projected flow and loading requirements, two phases of improvements beyond the FY 22-23 project are recommended.

4.3.2.1 Hydraulic Capacity and Phasing

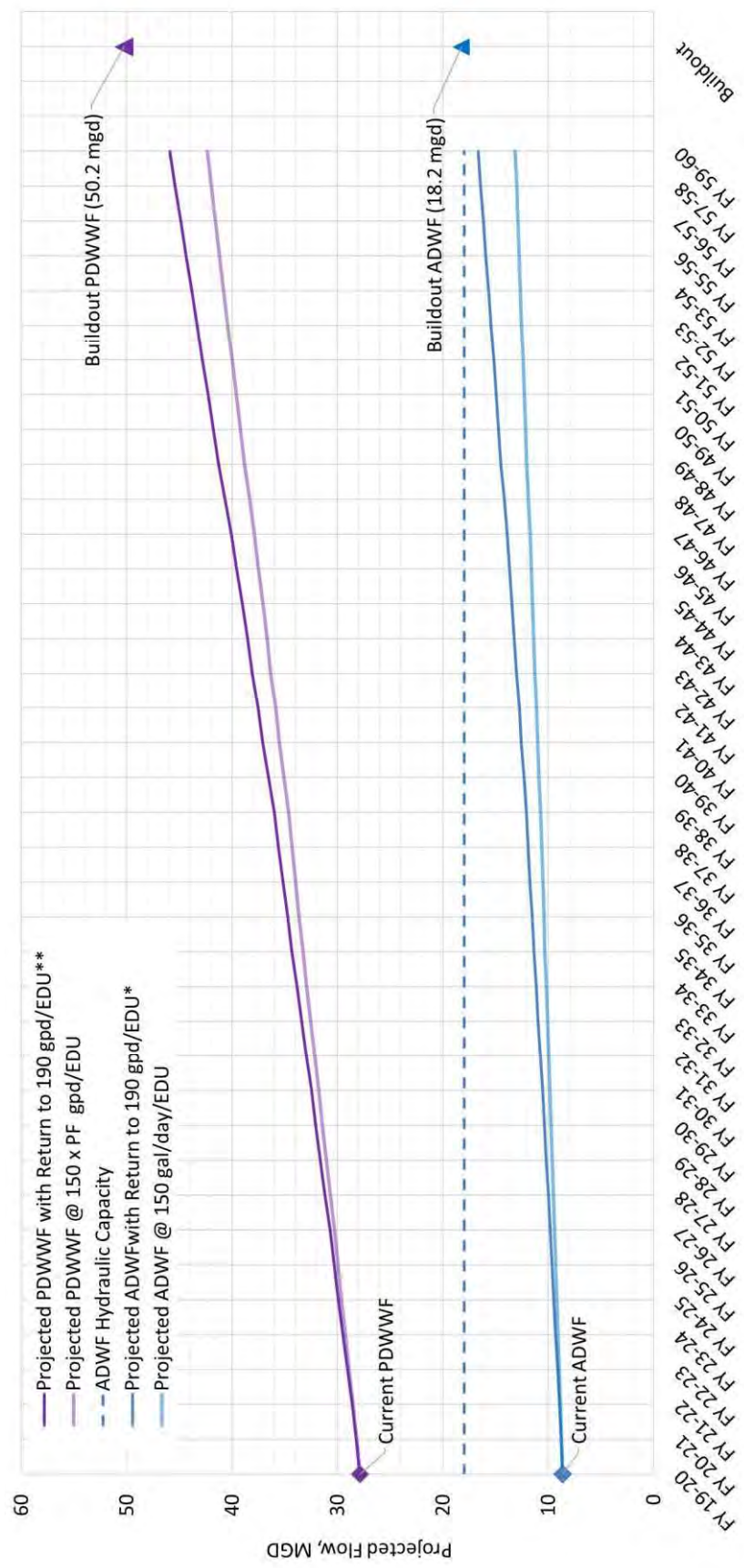
Although the PGWWTP hydraulic capacity is 12 mgd, based on the references above, the current ADWF treatment capacity at the PGWWTP is rated at 9.5 mgd. The improvements currently under construction will expand PGWWTP's treatment capacity to its hydraulic capacity rating of 12 mgd. Based on the ADWF projections calculated from a linear interpolation between current flow of 138 gpd/EDU and historic 190 gpd/EDU flow contribution, this capacity expansion should be sufficient to handle flows through approximately FY 28-29, though timing would depend on the rate of any rebound in sewer flows. It is currently recommended that Phase 1 hydraulic expansion be implemented in FY 28-29 to expand the plant ADWF to 15 mgd. Phase 1 expansion would carry the PGWWTP through FY 40-41. At that point, Phase 2 improvements may be needed to increase the plant ADWF capacity to FY 59/60 flow projections of 18 mgd. **Figure 4-7** shows ADWF plotted against the flow projected over the planning period and the anticipated phasing for improvements. **Figure 4-7** presents graphs for ADWF and PDWWF rebound based on linear interpolation from 138 gpd/EDU calculated based on current flows in FY 19/20 to a potential flow factor of 190 gpd/EDU in FY 59/60. As discussed in Chapter 5, the timing and size of the recommended projects should be reviewed after additional facility planning is completed and the gpd/EDU assumption is confirmed.

4.3.2.2 Biological Capacity and Phasing

Based on Table 4-7, PGWWTP is currently running at or beyond its nominal design capacity with respect to BOD loading. The improvements currently under design will expand the plant's AA and MM BOD loading capacities to 34,500 lbs/day and 40,100 lbs/day. These improvements should be sufficient to meet projected BOD loadings through FY 40/41 when Phase 2 hydraulic capacity improvements are recommended. During Phase 2 expansion, it is recommended that plant capacity be increased to accommodate projected FY59/60 AA and MM BOD loadings of 38,000 lbs/day and 48,000 lbs/day, respectively. The timing and magnitude of additional expansion to accommodate buildout will be determined in subsequent planning documents.

Figure 4-8 shows AA and MM biological treatment capacities plotted against the loadings projected over the planning period and the anticipated phasing.

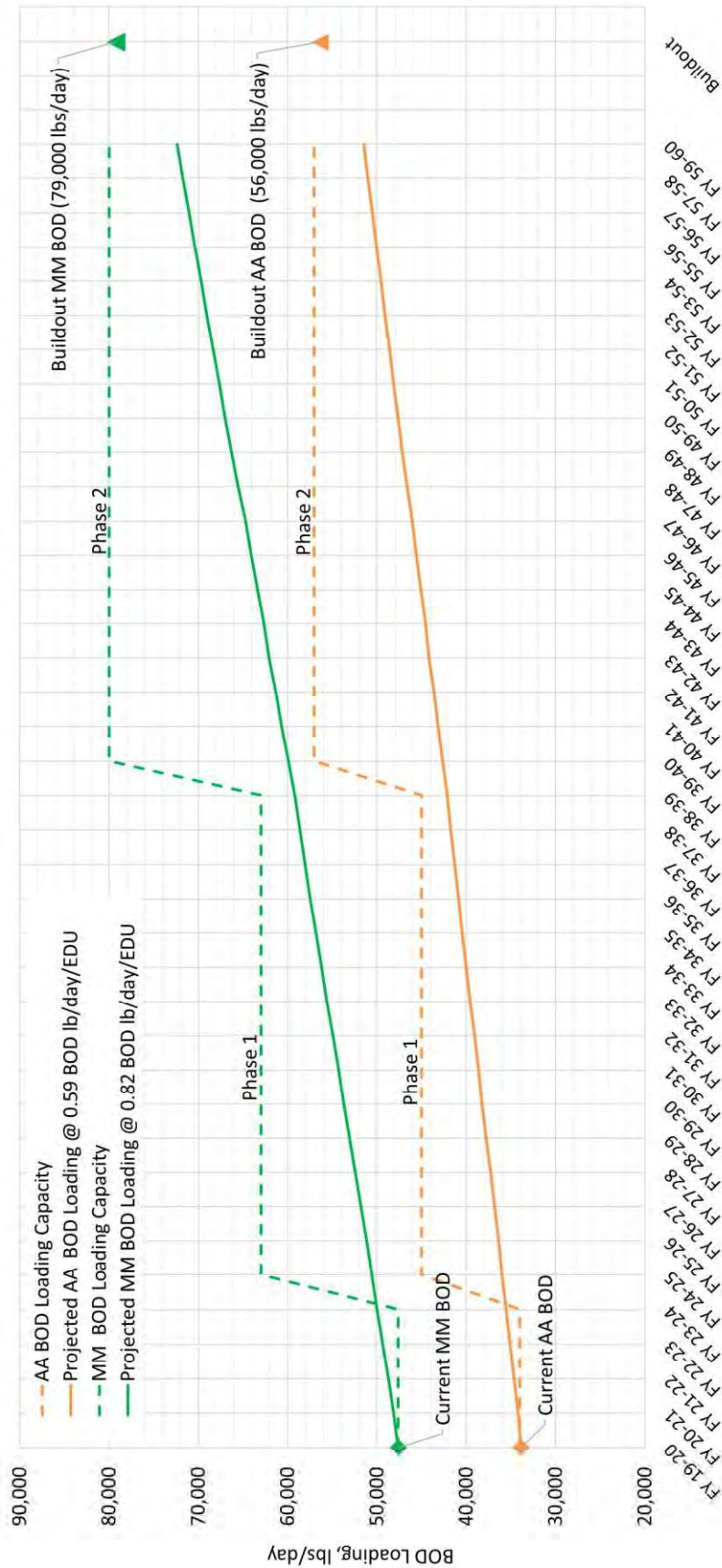
Figure 4-5: DCWWTP Hydraulic Capacity Comparison



* ADWF gpd/EDU flow factor is assumed to reach 190 gpd/EDU by FY 59/60, with a linear increase from 150 gpd/EDU at FY 19/20
 **PDWWF is assumed to be ADWF flow plus 330 gpd/EDU of wet weather flow, based on current wet weather flowrates
 *** Buildout date is currently unknown and is shown for graphical purposes only.

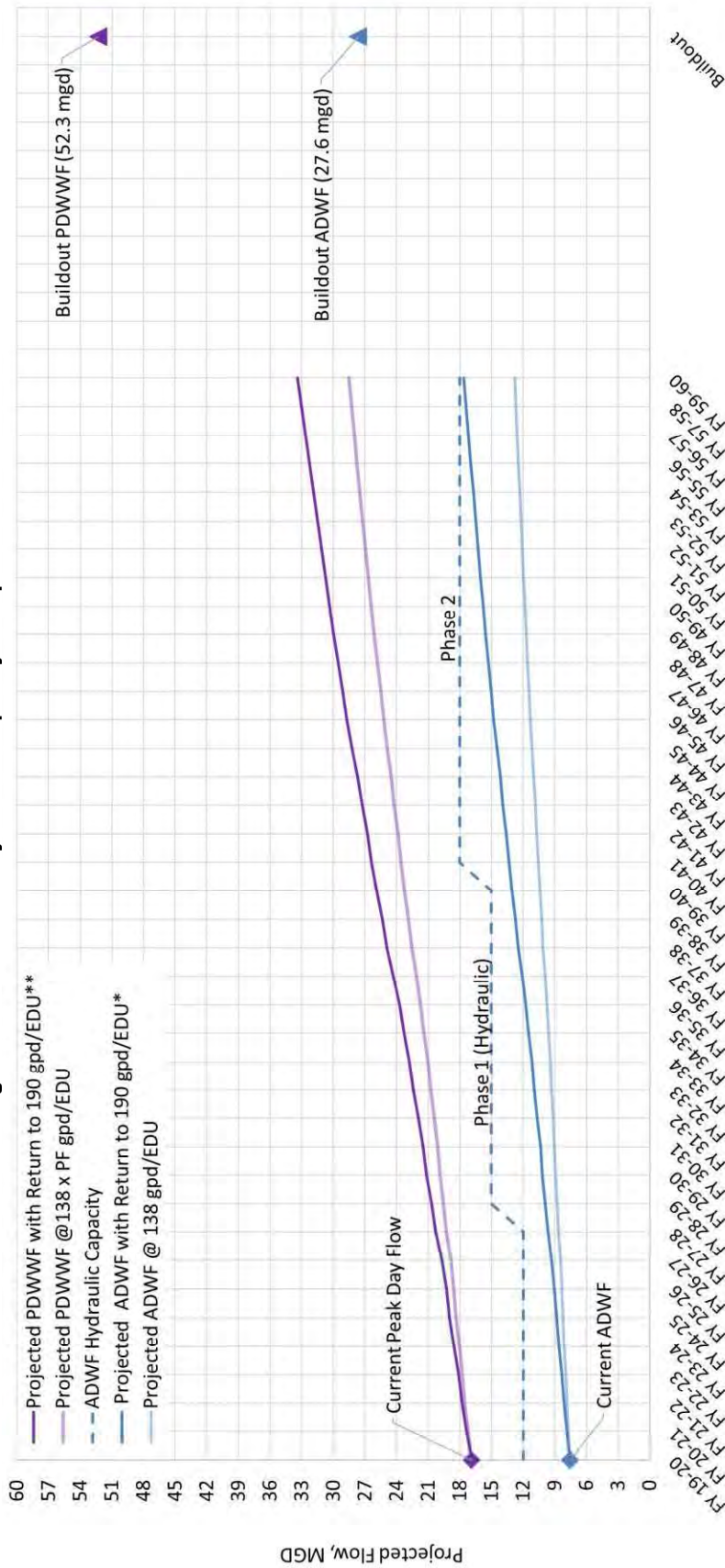


Figure 4-6: DCWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

Figure 4-7: PGWWTP Hydraulic Capacity Comparison

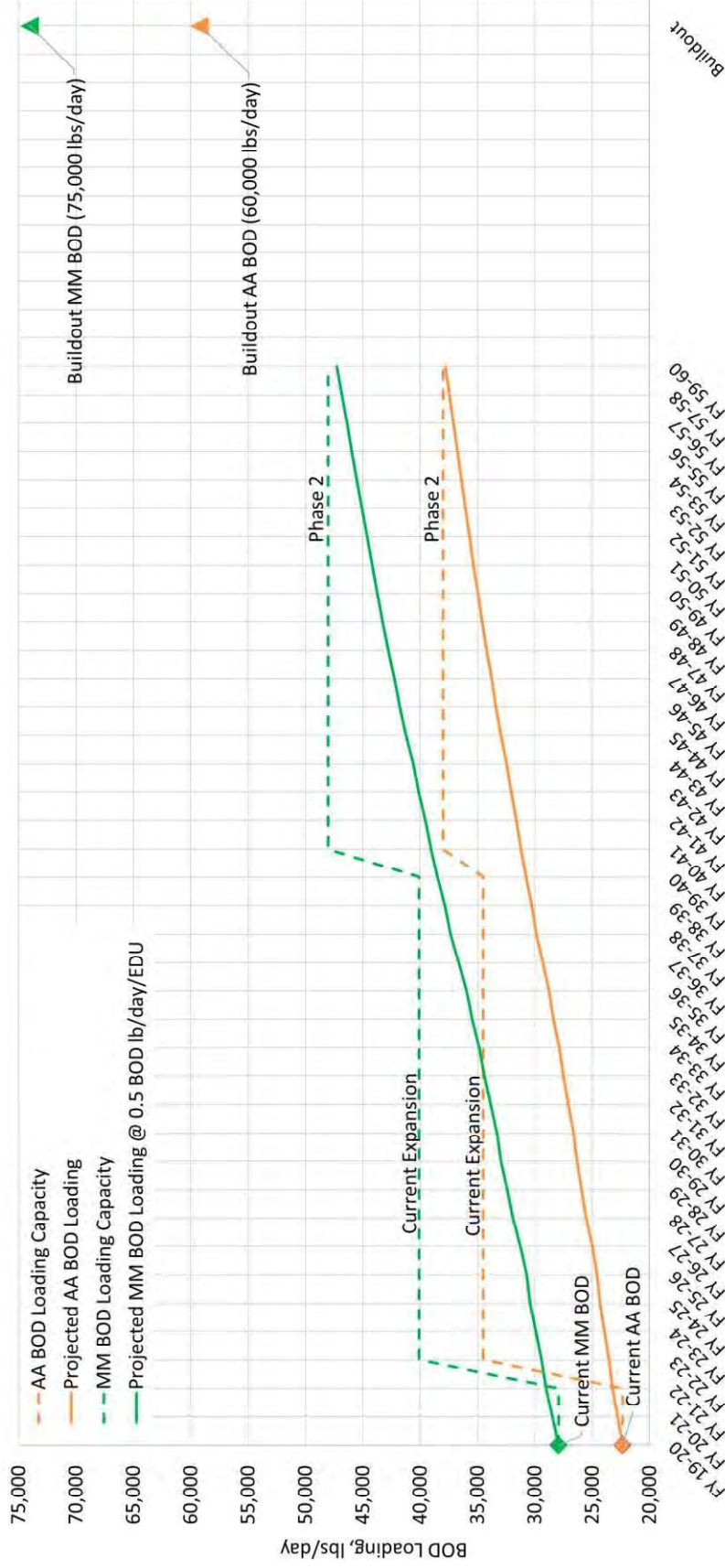


* ADWF GPD/EDU factor is assumed to reach 190 gpd/EDU by FY 59/60, with a linear increase from 138 gpd/EDU at FY 19/20

**PDWWF is assumed to be ADWF flow plus 170 gpd/EDU of wet weather flow, based on current wet weather flowrates

*** Buildout date is currently unknown and is shown for graphical purposes only.

Figure 4-8: PGWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

4.4 Conceptual Capital Cost Estimates

Opinions of probable cost were developed for the recommendations of this TM and are presented in this section. This section also provides the procedures and methodology used for developing planning-level capital cost estimates for PGWWTP and DCWWTP phased improvement projects. Note that improvements that would be required after the FY 59/60 planning horizon have not been estimated.

4.4.1 Cost Estimation Approach

This section describes the assumptions and procedures used to develop cost estimates for phased improvements at PGWWTP and DCWWTP. The cost estimates provided in this TM include improvements that would increase the plant capacity to treat the projected flows and loadings but does not include repair and replacement (R&R) projects or discretionary projects such as resource recovery improvements.

The estimated construction costs are based on a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International cost estimate classification system. **Table 4-8** provides a summary of the estimate classes and expected accuracy range. For Class 5 estimates, the expected accuracy range is -20% to -50% on the low end and +30% to +100% on the high end.

Table 4-8: Cost Estimate Classification Matrix (AACE International)

Estimate Class	Level of Project Definition	Purpose of Estimate	Methodology	Expected Accuracy Range
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgement, or analogy	Low: -20% to -50% High: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	Low: -5% to -15% High: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-cost	Low: -3% to -10% High: +3% to +15%

Source: AACE International Recommended Practice No. 18R-97

Construction costs were developed based on the improvements and unit costs provided in the prior planning documents listed below:

- Technical Memorandum 4b: Wastewater Treatment Plants Expansion Requirements, RMC Water and Environment, March 28, 2006 (TM 4b).
- DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008 (CH2M Hill, 2008)
- Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016

Raw construction costs are estimated for each component based on estimated unit costs multiplied by quantity.

Construction cost factors were used to develop and escalate unit costs to reflect the current bid environment, industry trends, and project location as well as plant capacity increase. These factors are incorporated into the unit costs and are represented in two categories:

- **Engineering News Record's (ENR) Construction Cost Index (CCI)** – All project construction cost estimates are indexed to an ENR CCI of 12115 which represents the average of the April 2020 indices for San Francisco (SF) ENR and the "20-Cities" ENR, to account for the greater Sacramento area construction market.
- **Capacity Adjustment Factor** – The number of units listed in TM 4b were associated with different capacity increases than required in proposed improvement phasing in this Systems Evaluation. Proportional adjustment factors were used to account for these capacity increase differences. Further discussion is provided below.

Based on the level of detail available for Class 5 estimates, allowances are used for some of the direct construction elements including the site electrical, and instrumentation and control (I&C), site yard piping and mechanical, and site civil work estimates (i.e. direct construction costs). Allowance estimates are made using the percentages listed in **Table 4-9**.

Table 4-9: Direct Construction Cost Allowances

Construction Cost Allowance Types	Percent
Site Yard Piping & Mechanical	5%
Site Electrical / I&C/SCADA	15%
Site Civil	5%

From the direct construction cost subtotal, indirect construction cost factors are applied to develop an estimated total construction cost. These construction cost markups include the following:

- **Overhead and Profit** – Contractor overhead and profit (O&P) represents the general contractor's operating costs and estimated profit levels. The O&P factor typically varies between 10% and 25% of the direct construction cost subtotal, depending on the size of the project and market conditions, with larger projects typically having lower O&P factors. For this Systems Evaluation, an O&P factor of 20% was used.
- **Estimating Contingency** – The estimating contingency is defined as unknown costs due to lack of detailed engineering during the planning phase that are estimated as a percentage of defined project costs (i.e. direct and indirect construction cost subtotal). For this Systems Evaluation, a contingency factor of 30% was used since the projects are at conceptual planning level.

The estimated total construction cost is then multiplied by an allowance of 25% for Engineering, Permitting, Construction Management, and Engineering Services during Construction.

4.4.2 Dry Creek WWTP Cost Estimates

The proposed Phase 1 and 2 improvements and process unit cost estimates in TM 4b were used as the basis of the cost estimate. Several revisions and updates were made to the TM 4b improvements to develop the new phased improvements list and cost estimates in this Systems Evaluation, including the following:

- **Influent Pump Station** –Several improvements have been completed at East Roseville influent pump station including installation of new pumps and emergency generator, demolition of the old East Roseville Pump Station and Pump Station Annex, and replacement of PLCs. Therefore, TM 4b Phase 1 improvements were updated to remove the influent pump installation.
- **Influent Coarse Screen** – The existing two coarse screens have a PHWWF capacity of 30 mgd each. The existing screens provide sufficient capacity through buildout with project PHWWF of 54.7 mgd with two screens in service and using the existing bypass channel in the event that one of the screens is out of service. Therefore, it is recommended that a third screen be installed in Phase 2.
- **Aeration Tanks** – TM 4b proposed installation of ten new aeration tanks including replacement of four of the exiting smaller size aeration tanks constructed in 1974 with larger tanks (same size as tanks constructed in 1991) in Phase 1. The CH2M Hill, 2008 report evaluation indicated existing aeration basin volumes were sufficient for Phase 1 improvements which assumed a projected AA BOD loading capacity about the same as the current plant loading and recommended providing additional aeration and mixed liquor recycle (MLR) pumping capacity. New MLR pumps were installed at the plant per the Nitrate Removal Project Basis of Design Report (B&C, 2017). A rough evaluation of the aeration tank sizes indicated that replacement of two aeration tanks and construction of two new ones (total of four) in Phase 1 and replacement of the remaining 2 aeration tanks and construction of 4 new ones in Phase 2 (total of six) would provide sufficient capacity at each of the 2 phases.
- **Capacity Increase Adjustment Factor** – Biological treatment capacity increases for AA BOD loading were used to calculate the DCWWTP adjustment factor. The Adjustment Factor was obtained from the ratio between incremental capacity increases proposed in TM 4b and in this TM.

BOD loading increase in Phase 1 based on TM 4b was 10,500 lb/day and the required capacity increase per this TM is 11,100. An adjustment factor of 1.06 was calculated and applied to the number of units.

BOD loading increase in Phase 2 based on TM 4b was 13,700 lb/day and the required capacity increase per this TM is 12,000 lb/day. An adjustment factor of 0.88 was calculated and applied to the number of units.

The preliminary phased improvements are provided in **Table 4-10**. The listed improvements increase the plant ADWF capacity based on AA BOD loading from 11.5 mgd to 14.5 mgd in Phase 1 and to 18 mgd in Phase 2. It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined, and phased improvement projects are updated accordingly.

Table 4-10: DCWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)^a

Process	Process Unit Cost	Phase 1 FY 24/25	Phase 2 FY 39/40
		# of units	# of units
Coarse Screens	\$280,000	-	1
Influent Pump Station	\$2,000,000	-	1
Fine Screens	\$170,000	2	1
Odor Control	\$210,000	1	1
Grit Basins	\$290,000	-	1
Primary Sedimentation	\$3,400,000	-	2
Aeration Basins	\$2,600,000	4	6
Blower	\$290,000	1	-
Mixed Liquor Return Pumps	\$150,000	4	6
Rehab Existing Anoxic Zones	\$290,000	1	
Secondary Clarifiers	\$4,100,000	4	2
RAS/WAS Pump Station	\$860,000	1	1
Tertiary Filtration	\$730,000		2
Waste Backwash Pumps	\$100,000		1
UV Disinfection	\$2,100,000		1
Anaerobic Digesters	\$3,300,000	1	1
Centrifuges	\$650,000	2	
Cooling Units	\$290,000		2
Total Unit Process Costs		\$34,000,000	\$43,000,000
Site Yard Piping & Mechanical (5%)		\$1,700,000	\$2,200,000
Site Electrical / I&C/SCADA (15%)		\$5,100,000	\$6,500,000
Site Civil (5%)		\$1,700,000	\$2,200,000
Subtotal of Direct Construction Costs		\$43,000,000	\$54,000,000
Mobilization/Demobilization (5%)		\$2,200,000	\$2,700,000
Contractor Overhead & Profit (20%)		\$8,600,000	\$10,800,000
Subtotal of Direct and Indirect Costs		\$54,000,000	\$68,000,000
Contingency (30%)		\$16,000,000	\$20,000,000
Total Estimated Construction Cost		\$70,000,000	\$88,000,000
Engineering, Permitting, CM, ESDC (25%)		\$18,000,000	\$22,000,000
Total Estimated Capital Cost		\$88,000,000	\$110,000,000

Notes:

- a. Costs based on Average of SF and "20 Cities" ENR for April 2020: 12115

4.4.3 PGWWTP Cost Estimates

The proposed Phase 1 and 2 improvements and cost estimates in TM 4b were used as the basis of the cost estimate. Several revisions and updates were implemented on these proposed improvements for Phase 1 and Phase 2 to develop the new phased improvements cost estimates, including the following:

- **Current Expansion** – As described in 1.2, several improvements are currently being constructed at PGWWTP per the Pleasant Grove Wastewater Treatment Plant Expansion BODR (Kennedy/Jenks, 2016). Therefore, TM 4b Phase 1 improvements were updated by removing the current expansion projects from Phase 1 scope, including the following:
 - Installation of four new primary sedimentation basins
 - Installation of 1 odor control system
 - Installation of 2 new solid thickening systems and building
 - Installation of 2 new digesters and building
 - Installation of 1 new co-generation system
- **Hydraulic Capacity Increase** – Proposed Phase 1 improvements in this TM are to increase PGWWTP peak day hydraulic capacity. Therefore, proposed projects in Phase 1 improvements in TM 4b were revised to include only improvements to unit process that increase the plant hydraulic capacity and the remaining projects associated with BOD removal capacity including installation of one digester and one oxidation ditch, and construction of associated buildings were moved to Phase 2 improvements .
- **Capacity Increase Adjustment Factor** – For Phase 1, since only hydraulic capacity increase is required, an Adjustment Factor was obtained from the ratio between the hydraulic capacity increase in TM 4b and in this TM. Both TMs propose 3 mgd hydraulic capacity increases in Phase 1, therefore the adjustment factor of 1 was multiplied by the number of units proposed in TM 4b.

For Phase 2, biological treatment capacity increases for AA BOD loading were used. The Phase 2 BOD loading capacity increase in TM 4b was 21,000 lb/day and the proposed capacity increase in this TM is 3,500 lb/day. An adjustment Factor of 0.17 was calculated from TM 4b and proposed capacity increase ratio and was multiplied by the number of units proposed in TM 4b.

An adjustment factor was not applied to building modifications.

The updated opinion of probable cost for the phased improvements is provided in **Table 4-11**. The recommended phased improvements increase the plant ADWF capacity from 12 mgd to 15 mgd in Phase 1 and from 15 mgd to 18 mgd in Phase 2. It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined, and phased improvement projects are updated accordingly.

Table 4-11: PGWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)^a

Process	Process Unit Cost	Phase 1 FY 28/29	Phase 2 FY 39/40
		# of units	# of units
Influent Pumps	\$120,000	1	-
Grit Basins	\$290,000	1	-
Fine Screens	\$170,000	2	-
Primary Sedimentation	\$3,400,000	-	1
Oxidation Ditches	\$7,100,000	-	1
Secondary Clarifiers	\$4,100,000	1	1
RAS/WAS Pump Station	\$860,000	1	-
Tertiary Filtration	\$730,000	2	1
UV Disinfection	\$2,100,000	3	-
Thickeners Building Modification	\$490,000	-	1
Digesters Building Modification	\$490,000	-	1
Total		\$13,000,000	\$16,000,000
Site Yard Piping & Mechanical (5%)		\$650,000	\$800,000
Site Electrical / I&C/SCADA (15%)		\$2,000,000	\$2,400,000
Site Civil (5%)		\$650,000	\$800,000
Subtotal of Direct Costs		\$16,000,000	\$20,000,000
Mobilization/Demobilization (5%)		\$800,000	\$1,000,000
Contractor Overhead & Profit (20%)		\$3,200,000	\$4,000,000
Subtotal of Direct and Indirect Costs		\$20,000,000	\$25,000,000
Contingency (30%)		\$6,000,000	\$7,500,000
Total Estimated Construction Cost		\$26,000,000	\$33,000,000
Engineering, Permitting, CM, ESDC (25%)		\$6,500,000	\$8,300,000
Total Estimated Capital Cost		\$33,000,000	\$41,000,000

Notes:

- a. Costs based on Average of SF and "20 Cities" ENR for April 2020: 12115

5. CAPACITY IMPROVEMENT PROJECT SUMMARY & NEXT STEPS

Table 5-1 summarizes the capacity improvements identified in this systems evaluation. Note that the improvement needs projected for Dry Creek and Pleasant Grove WWTPs are significantly larger and more expensive than the improvement projects projected for the collection system, but are based on limited available data. The estimated costs for Dry Creek WWTP are especially high because of the size and age of that plant; when it was designed, the organic loading in Roseville was far lower than when Pleasant Grove was designed; since the mid 2000's organic loading to both plants has continued to increase. Further studies, as described in Chapter 4, should be undertaken for both treatment plants, and the capacity improvement projects should be refined based on those findings.

Note that only capacity improvement projects have been identified; condition and reliability related improvement needs have not been evaluated in this study.

Table 5-1: Proposed Capacity Improvement Projects

		Existing	FY 24/25	FY 39/40	After FY 59/60
Collection System	Description	Improvement Project 1 (Increased Capacity of PS 26 and sewers on Sierra College Blvd)	None	None	Improvement Project 2 (Redirect flows from PS 26 and Sierra College Blvd down Eureka Road) Improvement Project 3 (Increased Firm capacity of PS 25 with diversion structure improvements)
	Estimated Capital Cost	\$1,610,000	-	-	\$2,590,000
Dry Creek WWTP	Description	Plant Capacity Analysis, Condition Assessment, and Facilities Plan	Phase 1 (Increase AA BOD Capacity to ~45,000 lbs/day)	Phase 2 (Increase AA BOD Capacity to ~57,000 lbs/day)	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	\$550,000	\$88,000,000	\$110,000,000	Not Estimated
Pleasant Grove WWTP	Description	Plant Capacity Analysis, Condition Assessment, and Facilities Plan	Increase ADWF hydraulic capacity to 15 mgd	Increase ADWF hydraulic capacity to 18 mgd. Increase AA BOD Loading Capacity to 38,000 lbs/day	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	\$450,000	\$33,000,000	\$41,000,000	Not Estimated

5.1 Next Steps

Based on the findings of this preliminary evaluation, and discussions with the project team, the following next steps are recommended for consideration by SPWA:

- Conduct an analysis of process performance and current biological treatment and hydraulic capacity at both DCWWTP and PGWWTP. This will likely require process-specific sampling and development of calibrated process models. Biological treatment capacity should consider both BOD and nitrate plus nitrite permit limitations set forth within each plant's respective NPDES permit. Results of this study should determine a capacity rating for each unit process at the plant and the limiting processes. This analysis will provide a sound basis for the planning of new facilities and is integral to determining required future capital improvement projects during phased expansions. It is recommended that DCWWTP capacity analysis take precedence over PGWWTP considering DCWWTP is currently operating well beyond its nominal BOD removal capacity.
- Review previous condition assessment work conducted on the plant assets and perform additional assessment needed to identify and prioritize repair and replacement (R&R) projects. This effort would include a risk assessment to identify likelihood of failure and criticality of each asset. Results of this study would identify R&R projects which may need to be implemented prior to or concurrent with phased expansions.
- Based on the capacity analysis and R&R project planning, develop Facilities Plans for DCWWTP and PGWWTP. Considering both plants are running at or above their nominal design capacities, it is recommended that facilities planning begin immediately after the capacity analysis. This effort would evaluate various process optimization steps and upgrade alternatives and provide recommended improvements for phased expansions. The Facilities Plans would include review of the 190 gpd/EDU flow factor that is critical to the timing and magnitude of any hydraulic capacity improvements.
- Develop Class 4 cost estimates for recommended improvements at the WWTPs under each expansion phase and for R&R projects to assist SPWA partners in assessing capital needs in the future.
- For the collection system, periodically update the model network based on any configuration changes, perform re-calibration to confirm the actual and anticipated flows, and to update future loads into the model network. An update frequency of every 5-10 years is recommended, depending on changes in development planning and/or system configuration.

We also recommend that SPWA evaluate funding and financing options to support implementation of the recommended capital improvements, especially Phase 1 at Dry Creek, given its size and relative immediacy. With the implementation of the steps above, and the ongoing high level performance of the SPWA Regional System, SPWA will be able to continue its excellent level of service to the Regional Partners.

APPENDIX A – PLACER COUNTY GENERAL PLAN DENSITIES

General Plan Designation	Maximum Density (EDU/Acre)	Diurnal Profile
Commercial	21	Commercial
Greenbelt & Open Space	0	Residential
High Density Residential 4 - 10 DU/Ac.	10	Residential
Industrial	4.356	Commercial
Low Density Residential 0.4 - 0.9 Ac. M	2.5	Residential
Low Density Residential 1 - 2 DU./Ac.	2	Residential
Low Density Residential Density Transf	2.5	Residential
Low Density Residential Development	2	Residential
Medium Density Residential 2 - 4 DU/A	4	Residential
Open Space	0	Residential
Professional Office	4.356	Commercial
Public Facility	0	Commercial
Rural Estate 4.6 - 20 Ac. Min.	0.21739	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.39	Residential
Rural Low Density Residential 1 - 2.3 Ac	1	Residential
Rural Residential 2.3 - 4.6 Ac. Min.	0.43478	Residential
Public Facility/Agricultural 80 Ac. Min.	0	Residential
Low Density Residential 0.4 - 2.3 Ac. M	1.11	Residential
Riparian Drainage	0	Residential
Agriculture/Timberland - 20 Ac. Min.	0	Residential
Rural Residential 1 - 10 Ac. Min.	1	Residential

APPENDIX B – URBAN GROWTH AREA LAND USE SUMMARIES

PLACER COUNTY URBAN GROWTH AREAS

Placer Ranch UGA^a

Land Use	Flow Factor	Land Use Quantities		
		Western Shed	Central Shed	Eastern Shed
Single Family Residential (Units)	190 gpd/DU	2,244	1,254	320
Multi Family Residential (Units)	130 gpd/DU	397	782	831
Mixed Use (acres)	2,300 gpd/ac	-	33.8	15.1
Commercial (acres)	850 gpd/ac	73.2	309.9	38.0
Parks > 10 acres (acres)	10 gpd/ac	37.8	17.1	-
Public/Quasi-Public (acres)	660 gpd/ac	0.8	0.8	3.9
Schools (acres)	170 gpd/ac	32.0	-	-
Total ADWF (mgd)		0.55	1.95	0.24

Footnotes:

- See Exhibit D of the Placer Ranch Sewer Master Plan (Mackay & Soms, 2017). Approximately 1,300 acres in the Sunset Industrial Area outside of Placer Ranch are anticipated to drain through Placer Ranch sewers, when fully developed.

Sunset Industrial Area^a

Land Use	Flow Factor	Land Use Quantities			
		PR-POC 1	PR-POC 2	Existing POC 1	Existing POC 2
Single Family Residential (Units)	190 gpd/DU	2,361	297	0	0
Multi Family Residential (Units)	130 gpd/DU	0	0	0	0
Mixed Use (acres)	2,300 gpd/ac	257	161	0	0
Commercial/Industrial (acres)	850 gpd/ac	1,287	85	531	277
Parks > 10 acres (acres)	10 gpd/ac	0	0	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0	0	0
Schools (acres)	170 gpd/ac	0	0	0	0
Point Sources ^d	gpd	480,000	0	0	0
Total ADWF (mgd)		2.61	0.50	0.45	0.24

Footnotes:

- Sunset Area Water, Wastewater, and Recycled Water Technical Report (Psomas, October 2017)
- Includes low density residential and medium density residential units.
- Approximately 1,300 acres in the Sunset Industrial Area outside of Placer Ranch are anticipated to drain through Placer Ranch sewers, when fully developed.
- Includes Thunder Valley Casino and Area L270 (County area east of the Sunset Area proposed to drain through the Sunset Area)

Placer Vineyards^a

Land Use	Flow Factor	Land Use Quantities		
		Shed A1	Shed A2	Shed B
Single Family Residential (Units)	190 gpd/DU	1,723	7,051	1,951
Multi Family Residential (Units)	130 gpd/DU	0	2,822	270
Mixed Use (acres)	2,300 gpd/ac	0	50.5	0
Commercial/ Industrial (acres)	850 gpd/ac	0	234.2	25.0
Parks > 10 acres (acres)	10 gpd/ac	0	30	12.0
Public/Quasi-Public (acres)	660 gpd/ac	0	113	27.2
Schools (acres)	170 gpd/ac	12	155	0
Total ADWF (mgd)		0.33	2.12	0.45

Footnotes:

- a. Placer Vineyards Specific Plan; Sanitary Sewer Master Plan Addendum 1 (Mackay & Soms, May 20, 2019)

Table 0-1: Regional University^a

Land Use	Flow Factor	Land Use Quantities
Single Family Residential (Units)	190 gpd/DU	1,845
Multi Family Residential (Units)	130 gpd/DU	349
Mixed Use (acres)	2,300 gpd/ac	10.98
Commercial/ Industrial (acres)	850 gpd/ac	25
Parks > 10 acres (acres)	10 gpd/ac	27.3
Public/Quasi-Public (acres)	660 gpd/ac	5.0
Schools (acres)	170 gpd/ac	32.6
University	mgd	0.725
Total ADWF (mgd)		1.18

Footnotes:

- a. Regional University Specific Plan, Sanitary Sewer Demand (Mackay & Soms, September 1, 2017)

Riolo Vineyards^a

Land Use	Flow Factor	Land Use Quantities		
		Lift Station Shed	Gravity Shed 1	Gravity Shed 2
Single Family Residential (Units)	190 gpd/DU	673 ^b	172	153
Multi Family Residential (Units)	130 gpd/DU	0	0	0
Mixed Use (acres)	2,300 gpd/ac	0	0	0
Commercial/Industrial (acres)	850 gpd/ac	26.5 ^b	0	10
Parks > 10 acres (acres)	10 gpd/ac	0	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0	11
Schools (acres)	170 gpd/ac	0	16	0
Total ADWF (mgd)		0.15	0.035	0.045

Footnotes:

- Riolo Vineyards Sanitary Sewer Master Plan Update (Unico Engineering, April 2016)
- Includes flows from offsite draining through these sheds

Placer UGA^a

Land Use	Flow Factor	Land Use Quantities	
		North Shed	South Shed
Single Family Residential (Units)	190 gpd/DU	147	41.7
Multi Family Residential (Units)	130 gpd/DU	0	0
Mixed Use (acres)	2,300 gpd/ac	0	0
Commercial/Industrial (acres)	850 gpd/ac	0	0
Parks > 10 acres (acres)	10 gpd/ac	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0
Schools (acres)	170 gpd/ac	0	0
Total ADWF (mgd)		0.028	0.008

Footnotes:

- Hawk Homestead Sewer Analysis – Supplementary Information Requested by Placer County Environmental Engineering, Derrick Whitehead, Municipal Consulting Group, January 29, 2016

CITY OF ROSEVILLE URBAN GROWTH AREAS

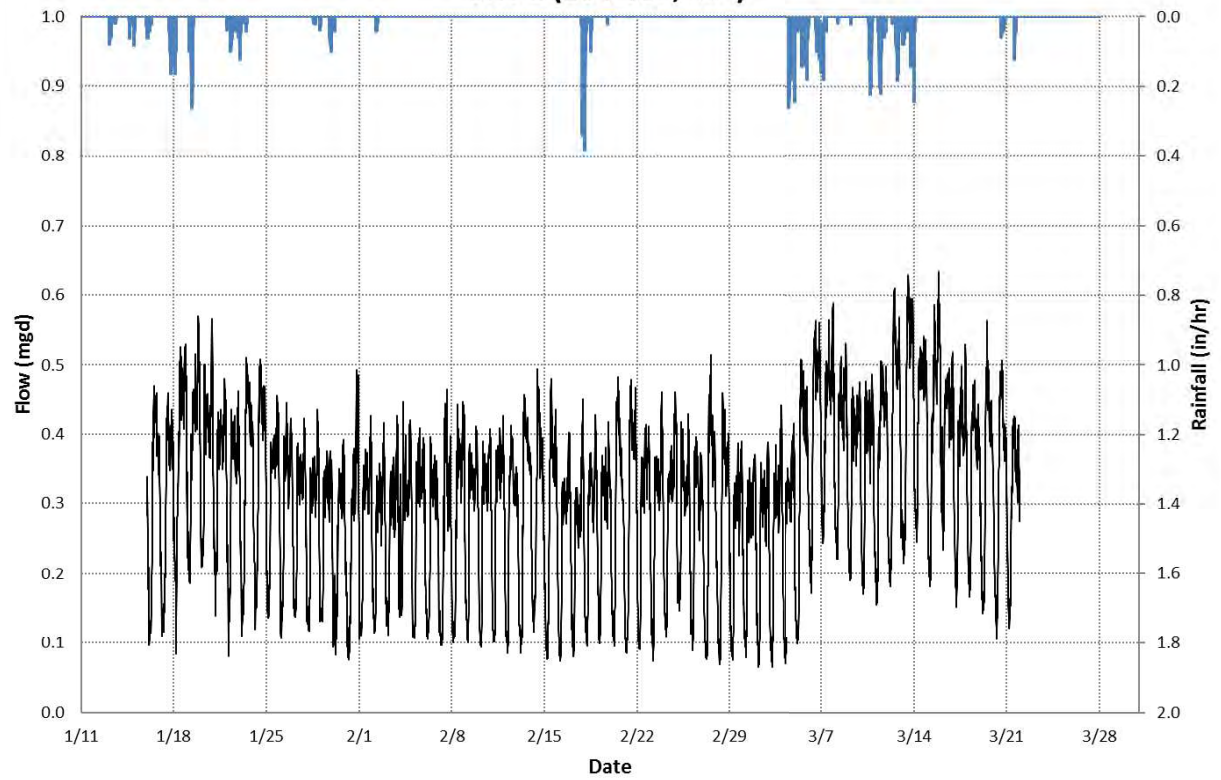
Land Use	Flow Factor	Creekview ^a	Amoruso ^b	Sierra Vista ^c	
				North Shed ^d	South Shed
Single Family Residential (Units)	190 gpd/DU	2,019	4,239 ^e	1,658	2,118
Multi Family Residential (Units)	130 gpd/DU	758	873	1,058	1,478
Mixed Use (acres)	2,300 gpd/ac	0.0	27.3	13.3	34.9
Commercial (acres)	850 gpd/ac	15.5	23.9	37.7	181.0
Parks > 10 acres (acres)	10 gpd/ac	0.0	0.0	10.0	39.9
Public/Quasi-Public (acres)	660 gpd/ac	2.6	7.6	10.1	6.6
Schools (acres)	170 gpd/ac	7.0	9.6	10.0	45.6
Total ADWF (mgd)		0.43	0.61	0.59	1.24

Footnotes:

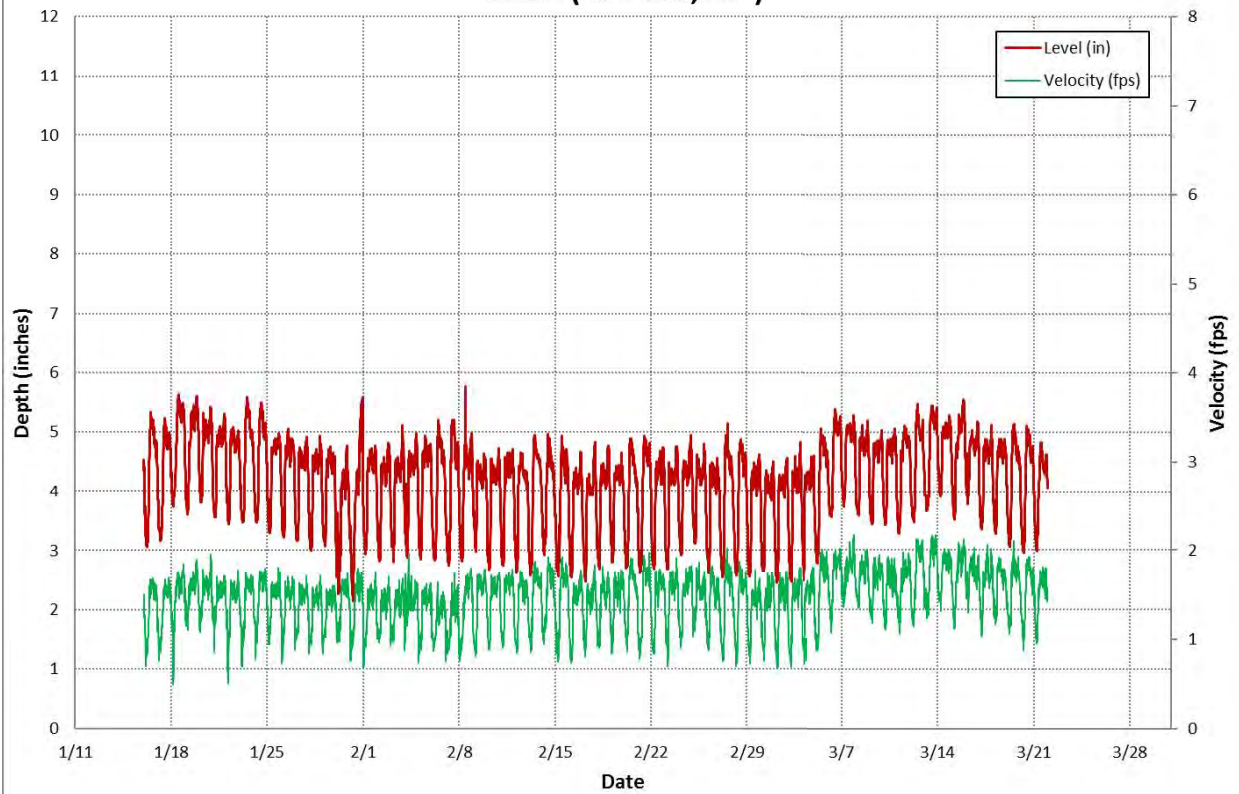
- Creekview Specific Plan Sanitary Sewer Master Plan*, Mackay & Soms Civil Engineers, November 2010
- Amoruso Ranch Specific Plan Area Wastewater Master Plan*, Kimley Horn, September 2015
- Sierra Vista Specific Plan Sanitary Sewer Master Plan*, Mackay & Soms Civil Engineers, July 2009
- Includes the Westbrook portion of Sierra Vista
- Includes 274 units north of Amoruso that would contribute flow through sewers in Amoruso (Toad Hill)

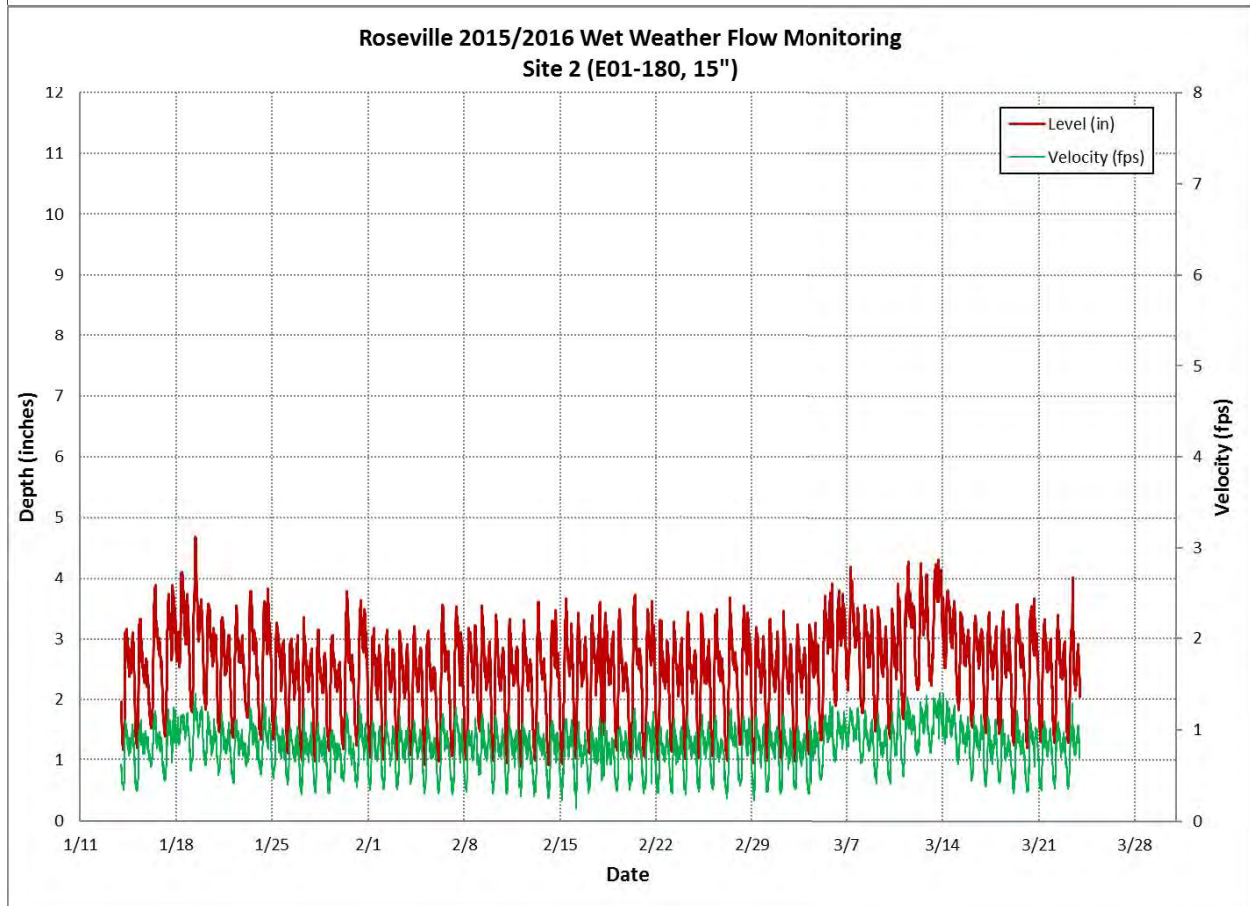
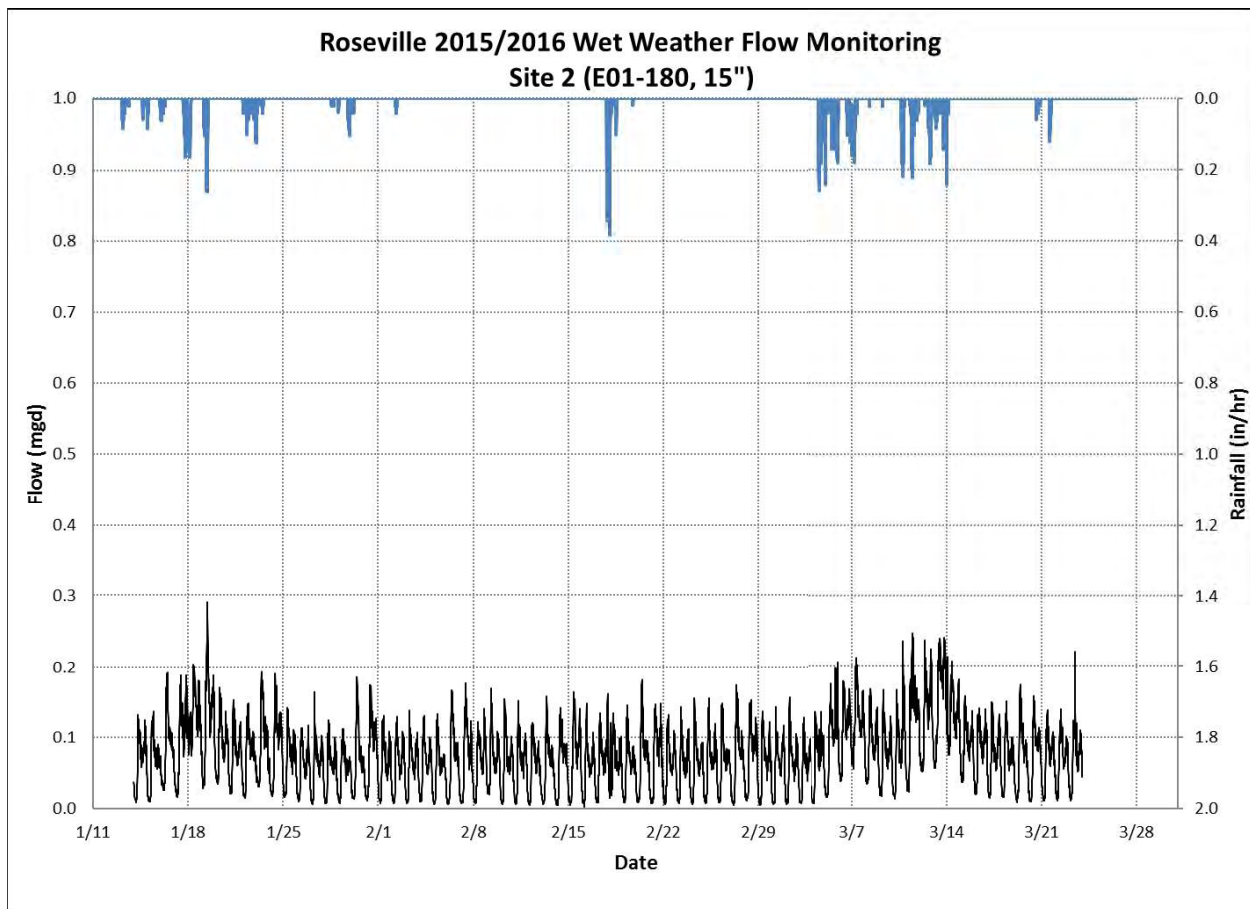
APPENDIX C – FLOW MONITORING DATA

**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 1 (E04-039, 18")**

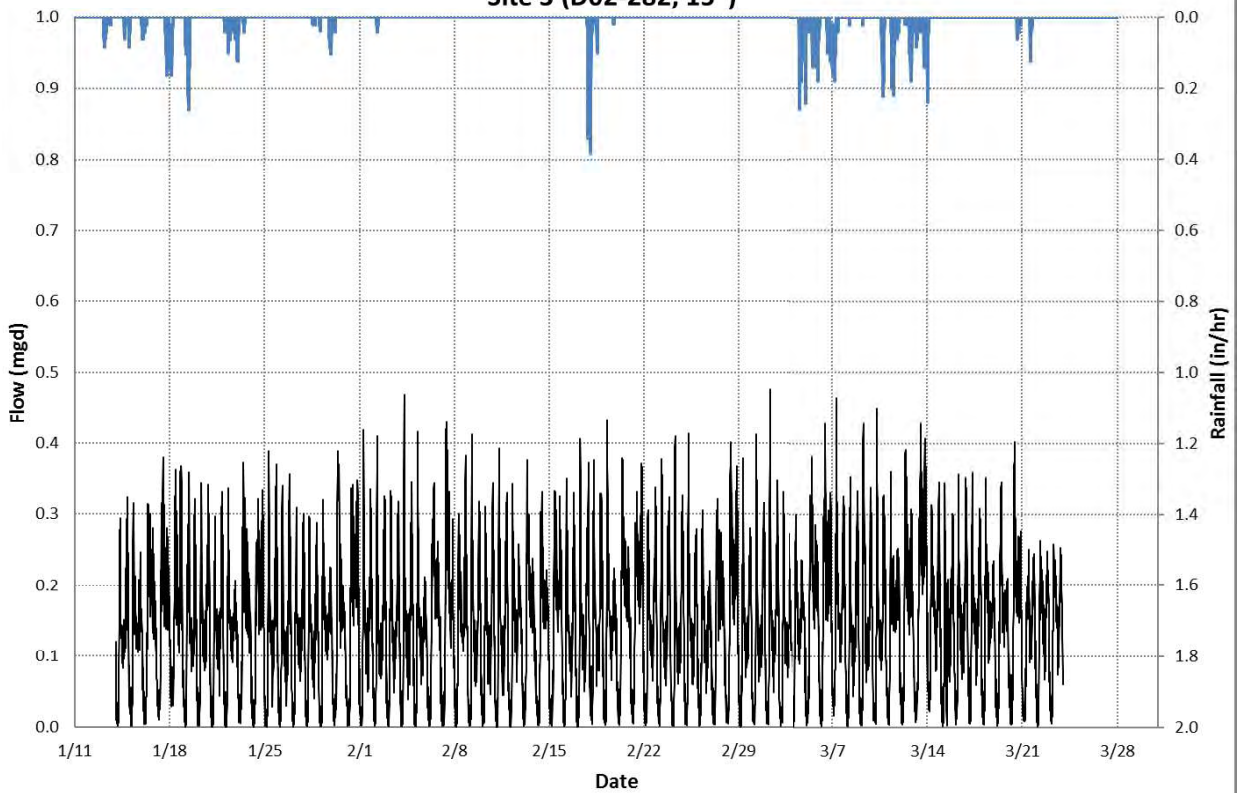


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 1 (E04-039, 18")**

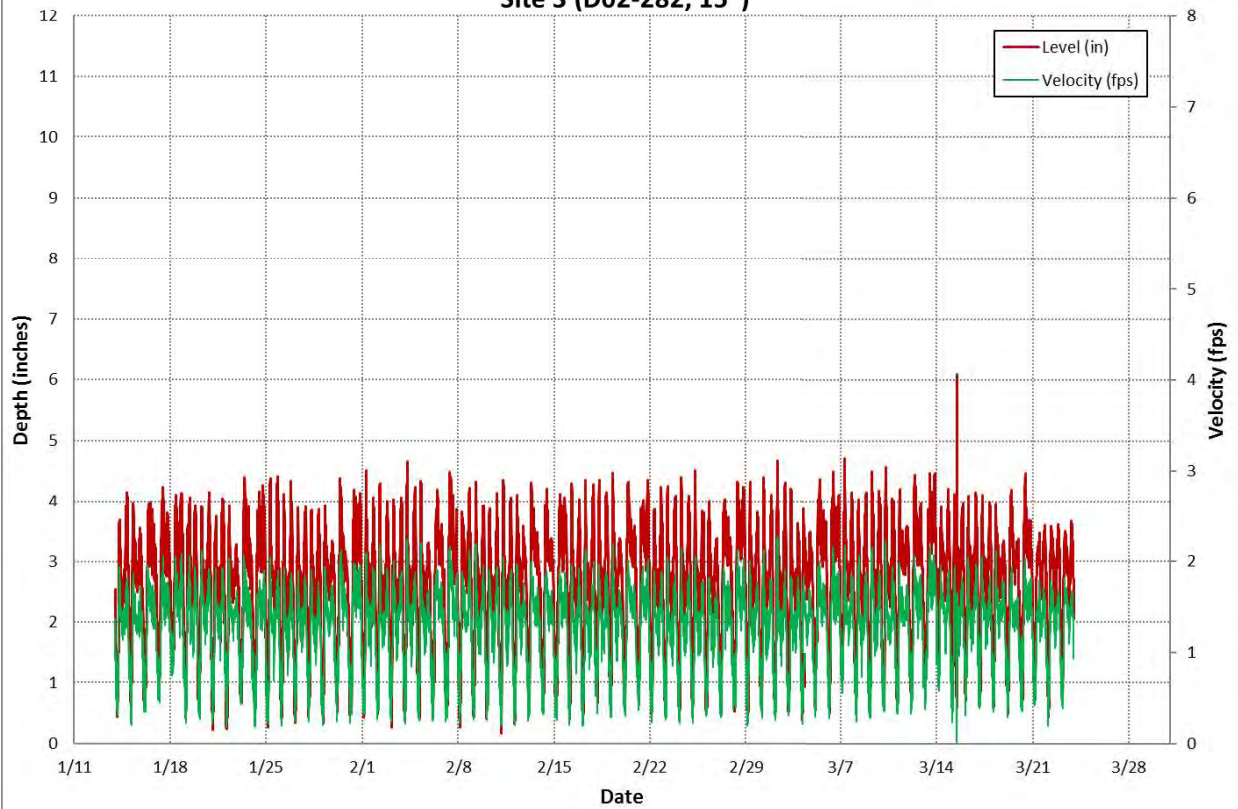


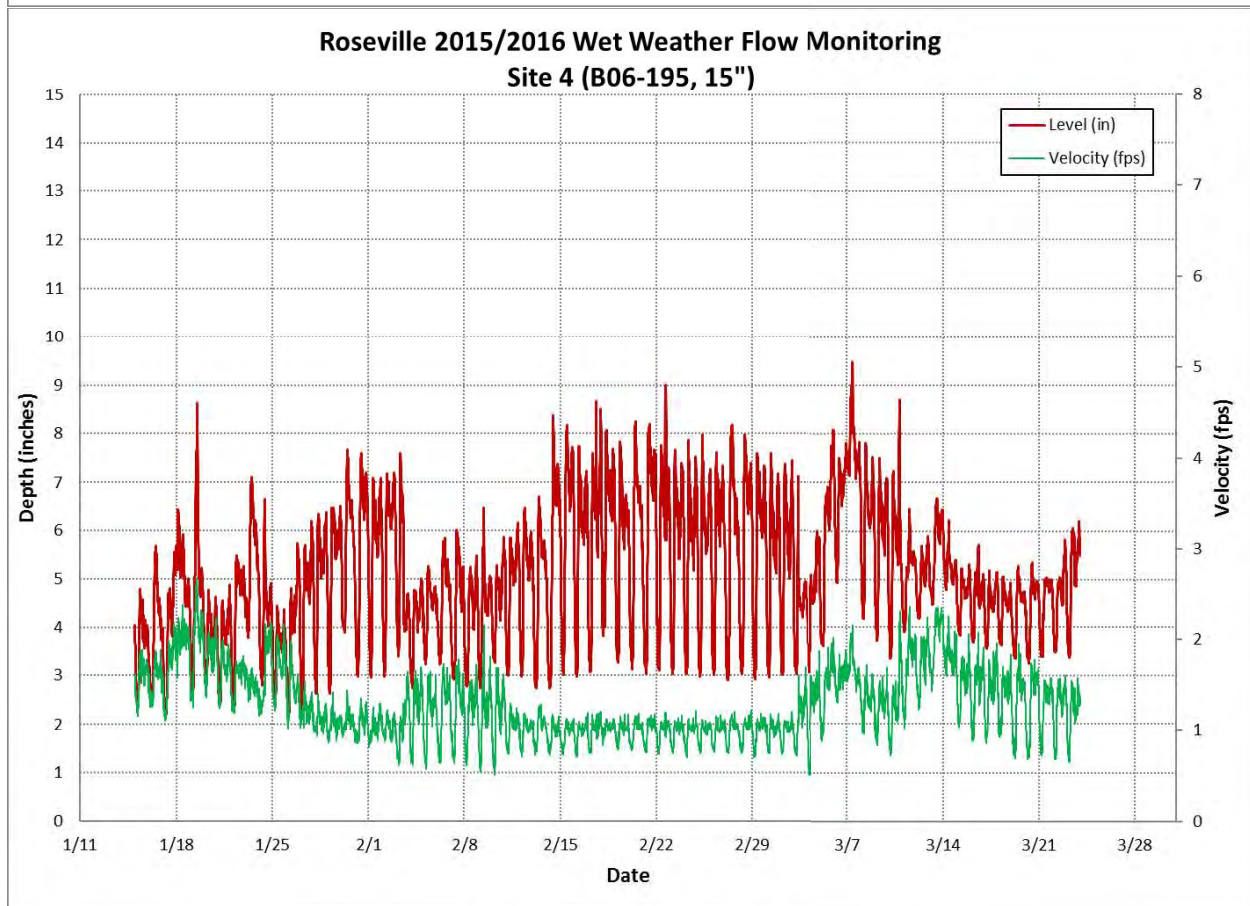
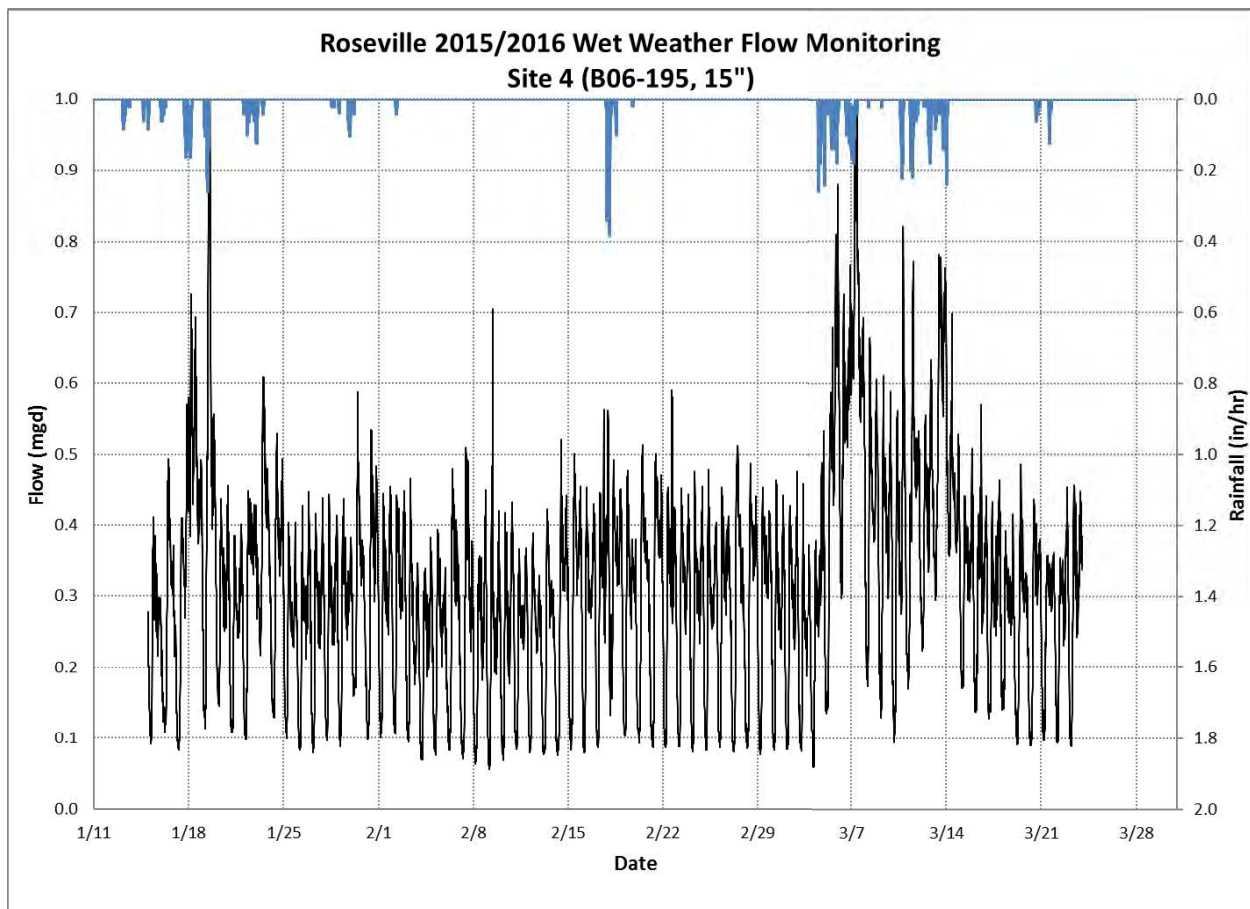


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 3 (D02-282, 15")**

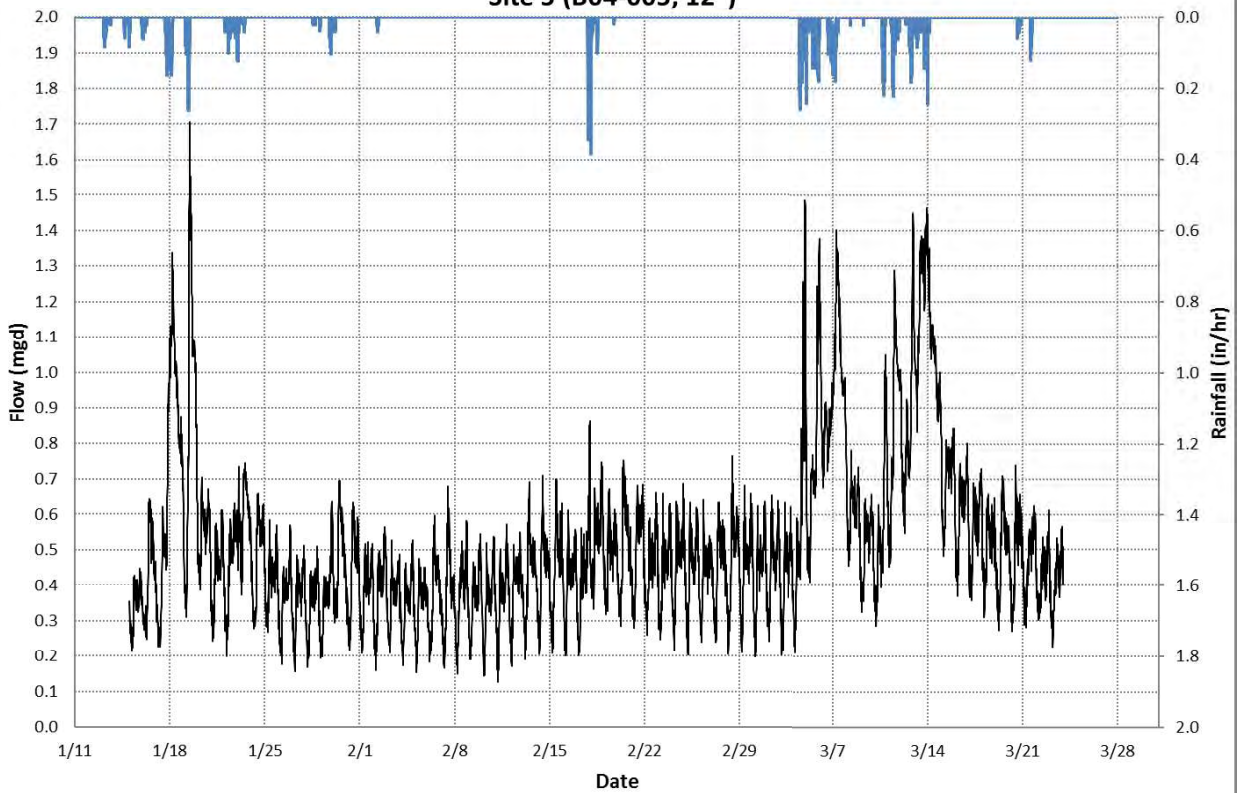


**Roseville 2014/2015 Wet Weather Flow Monitoring
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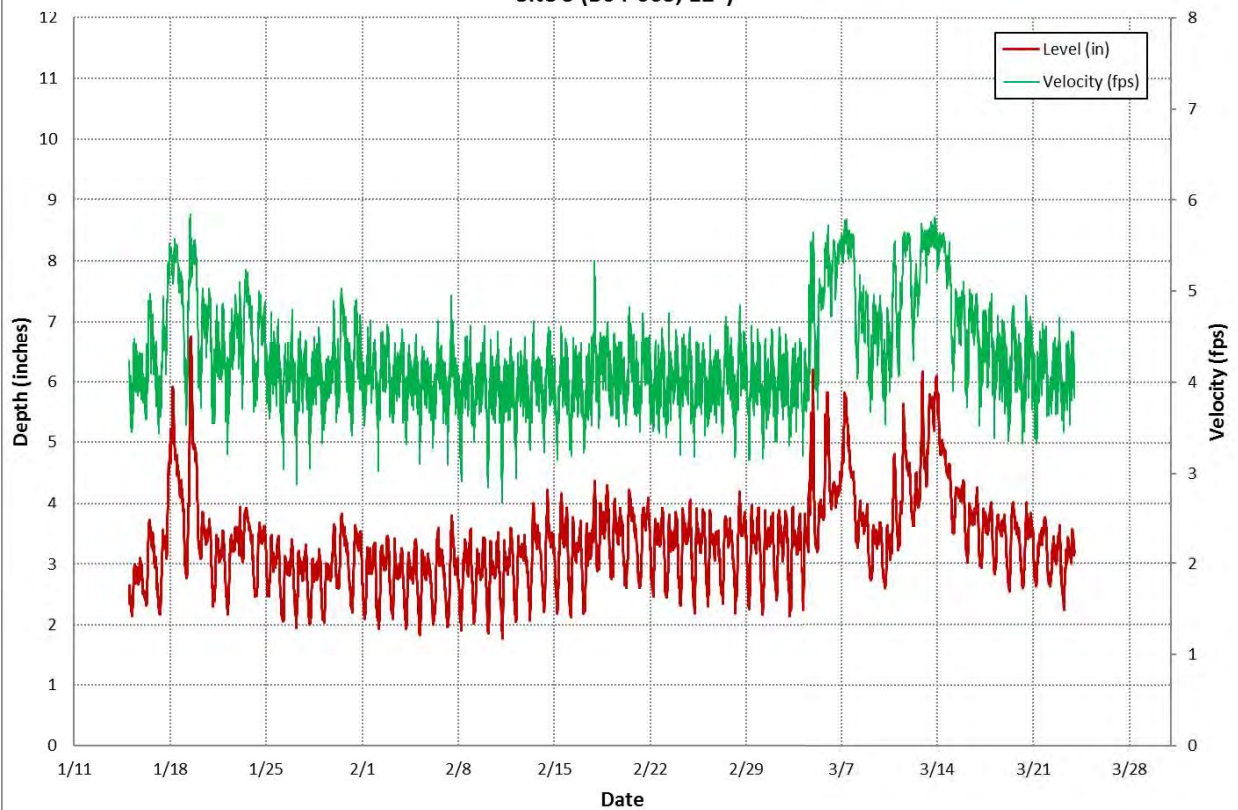




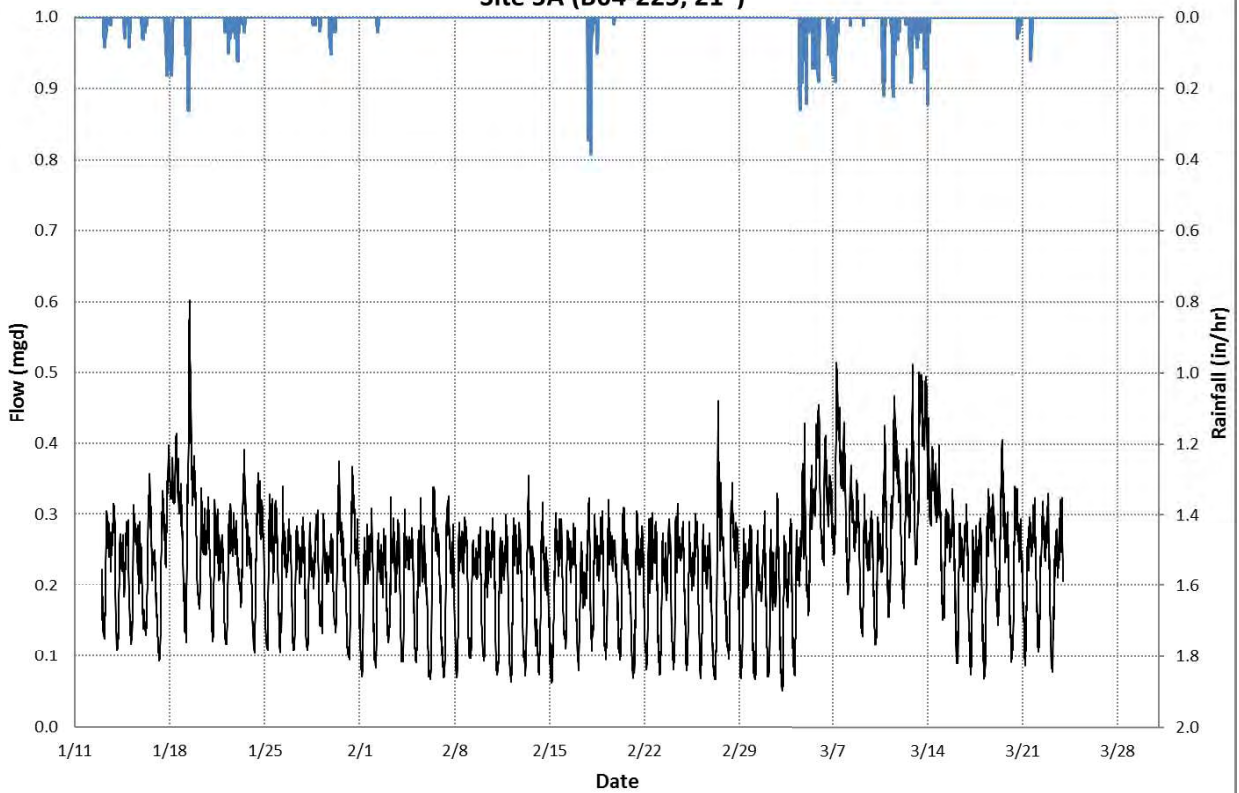
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5 (B04-005, 12")



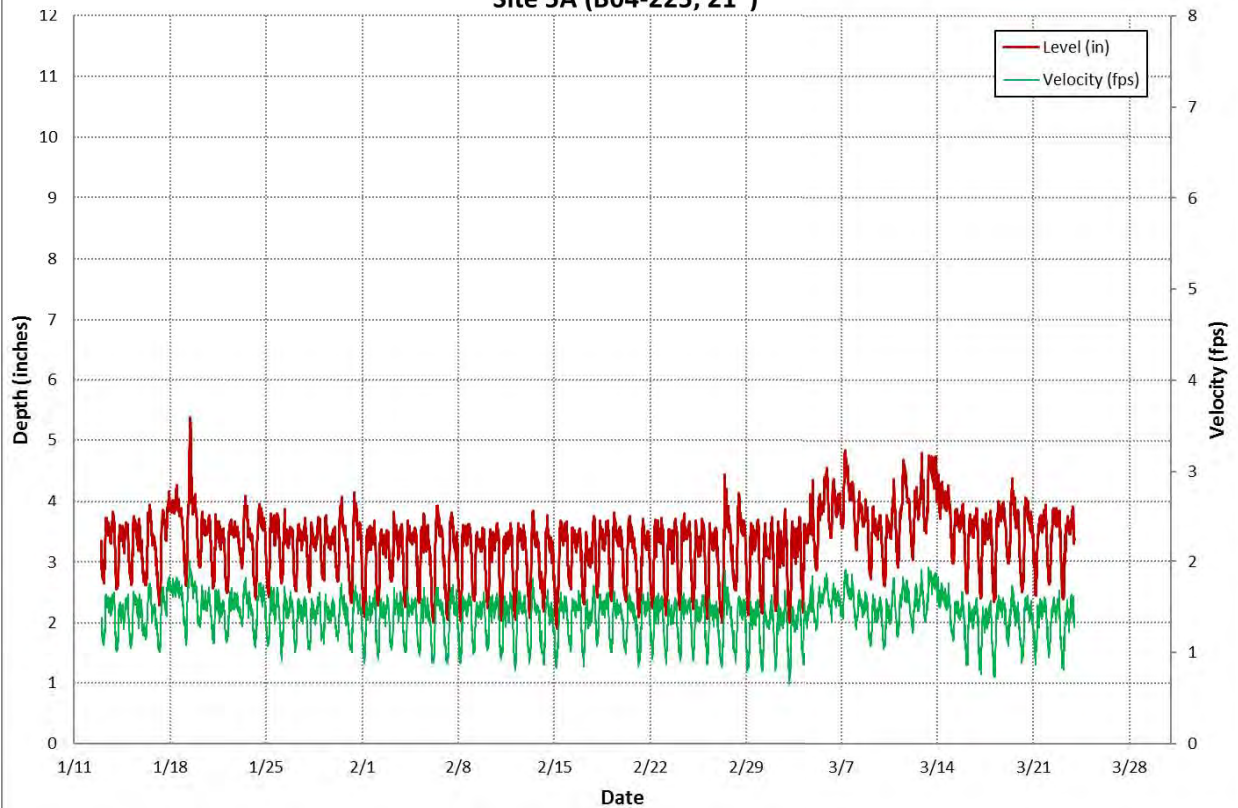
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5 (B04-005, 12")



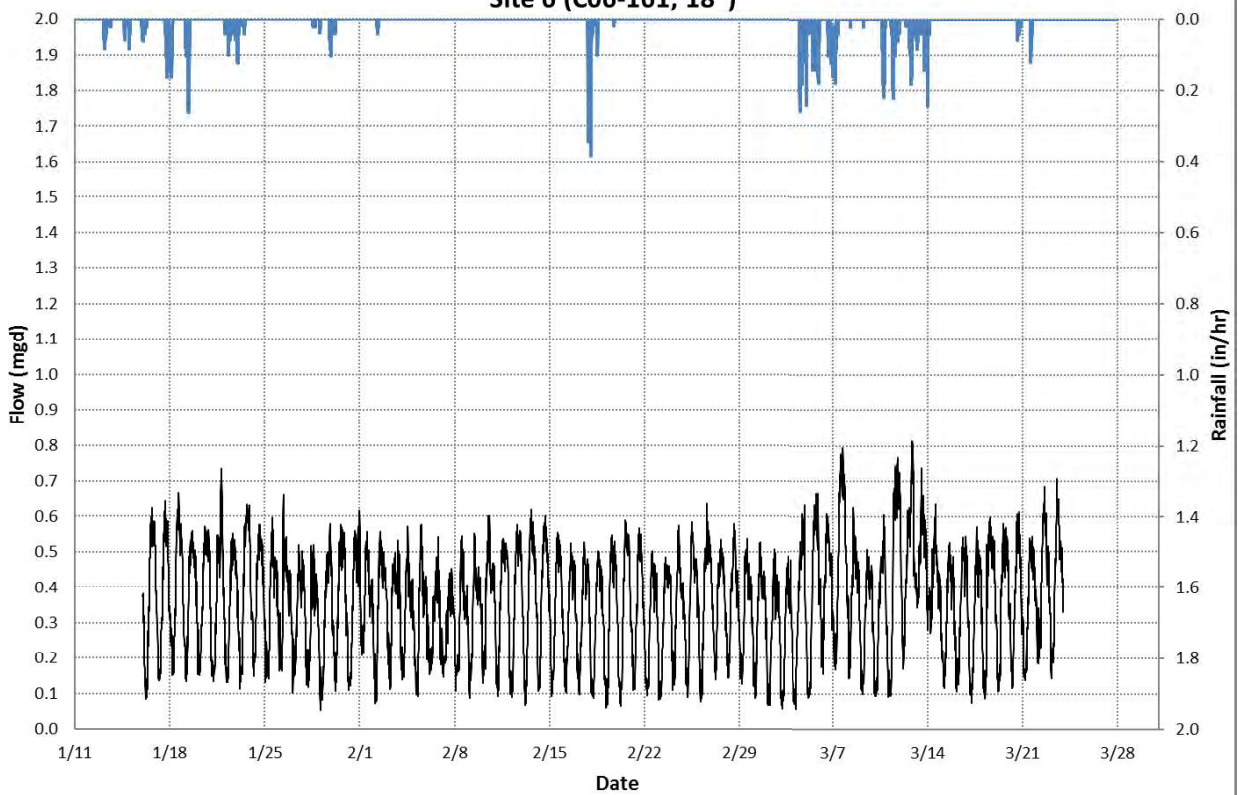
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5A (B04-225, 21")**



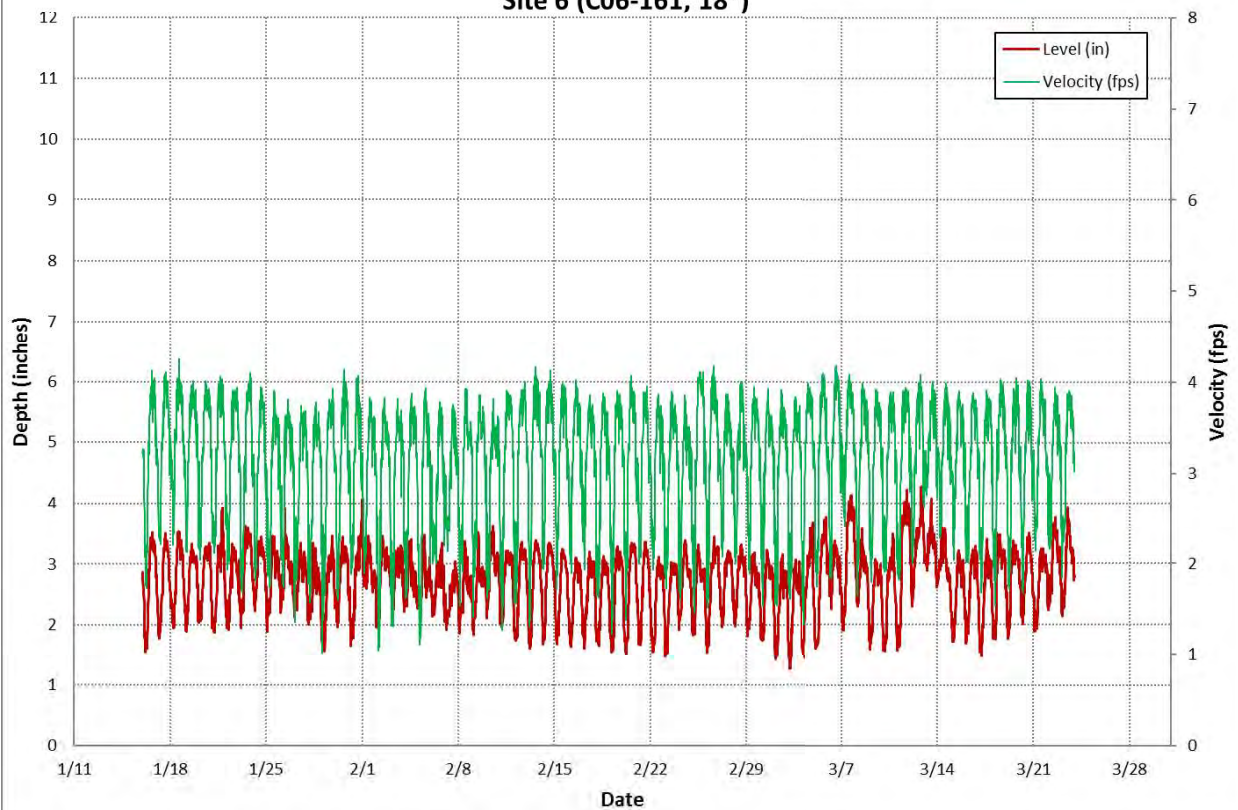
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5A (B04-225, 21")**

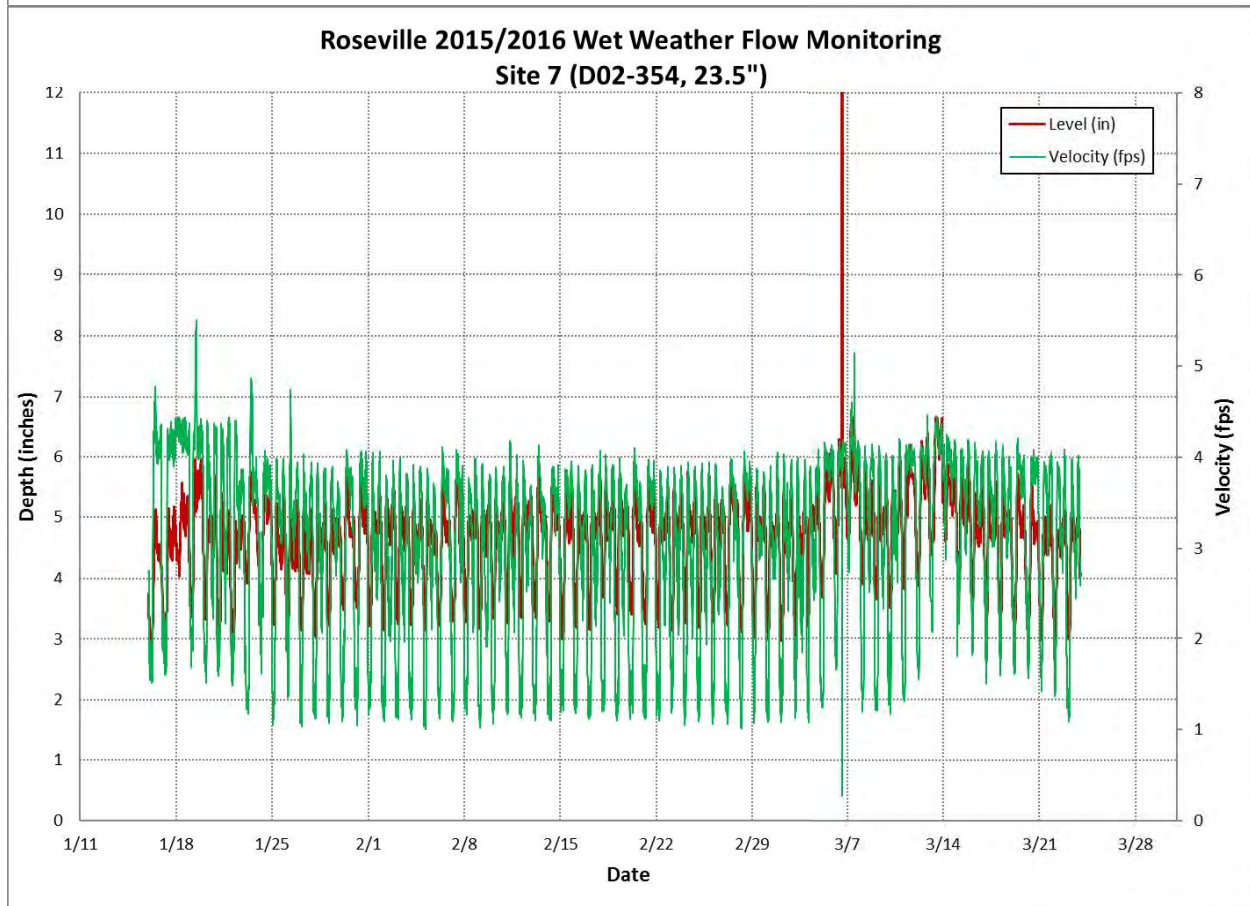
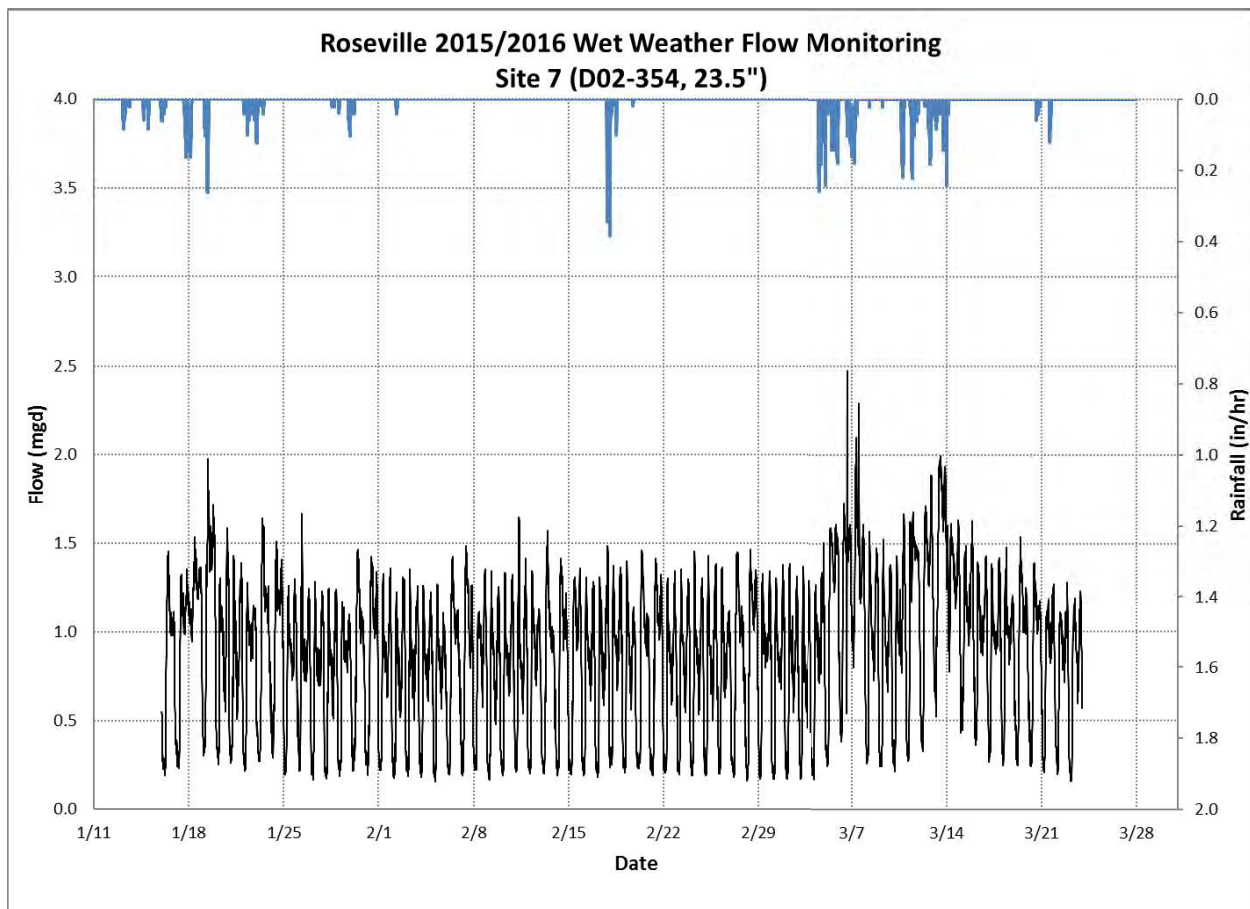


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 6 (C06-161, 18")**

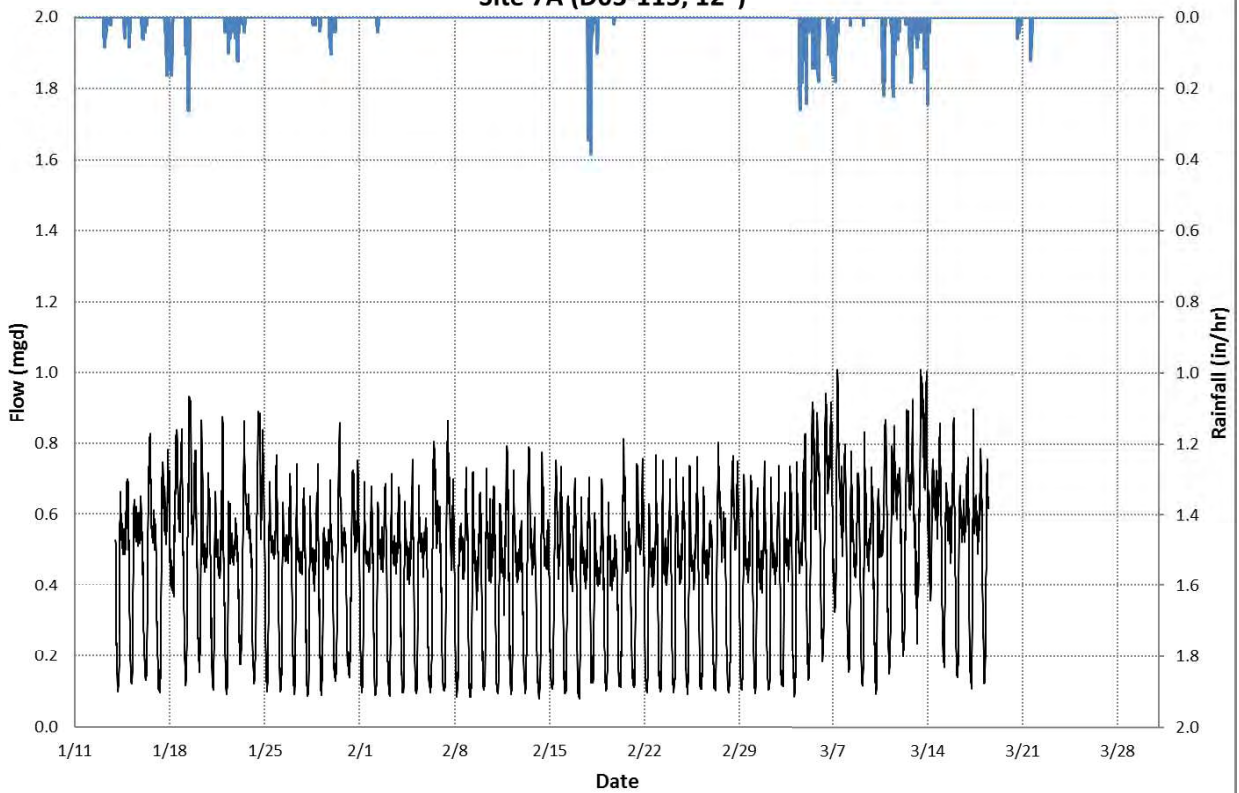


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 6 (C06-161, 18")**

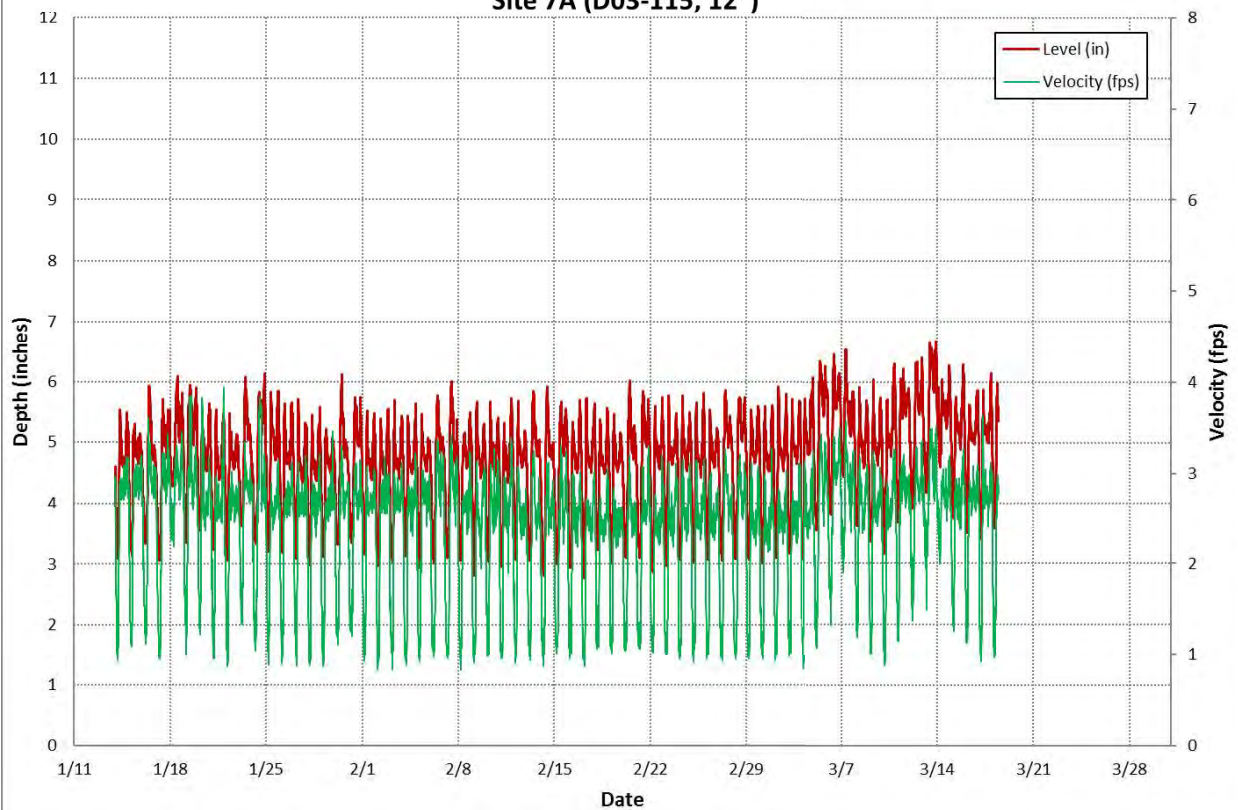


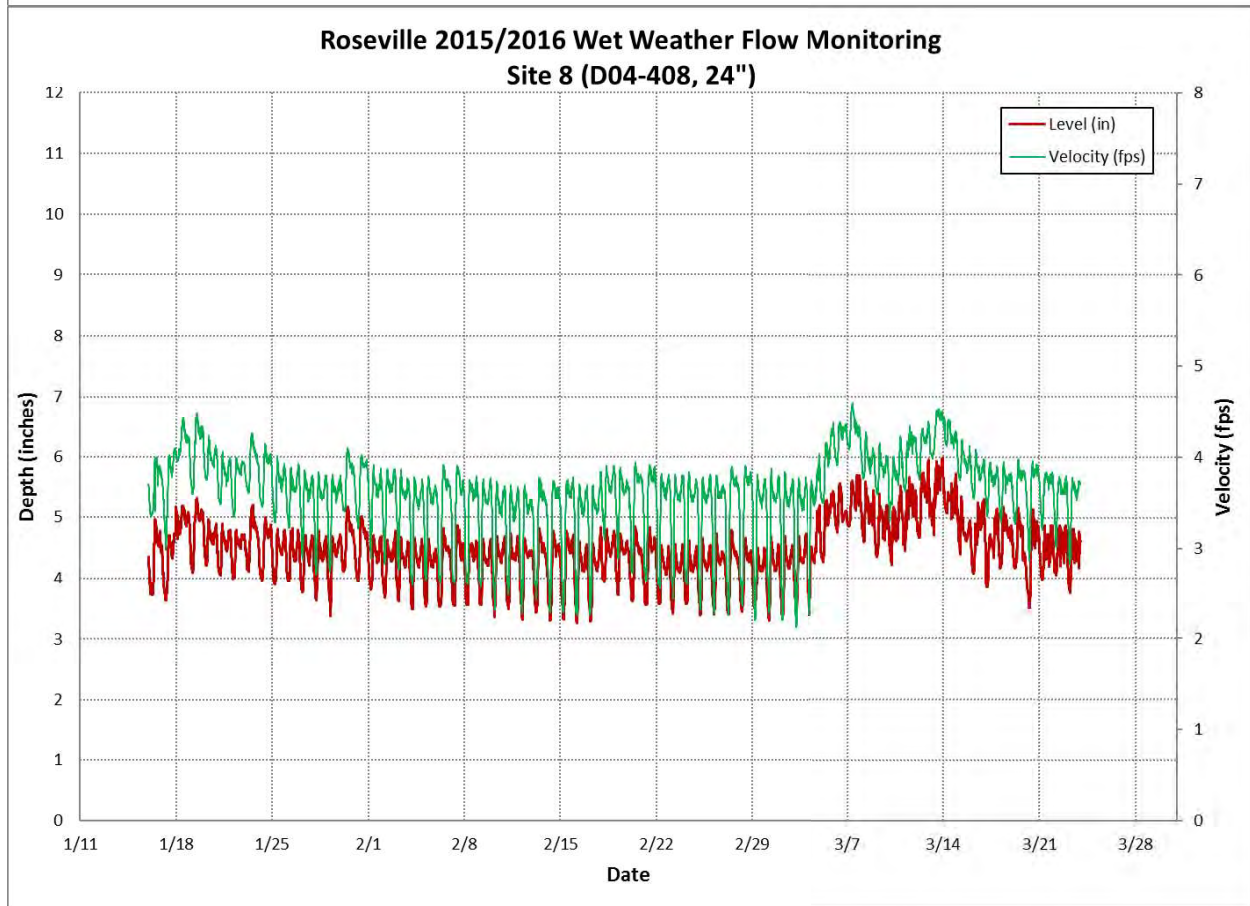
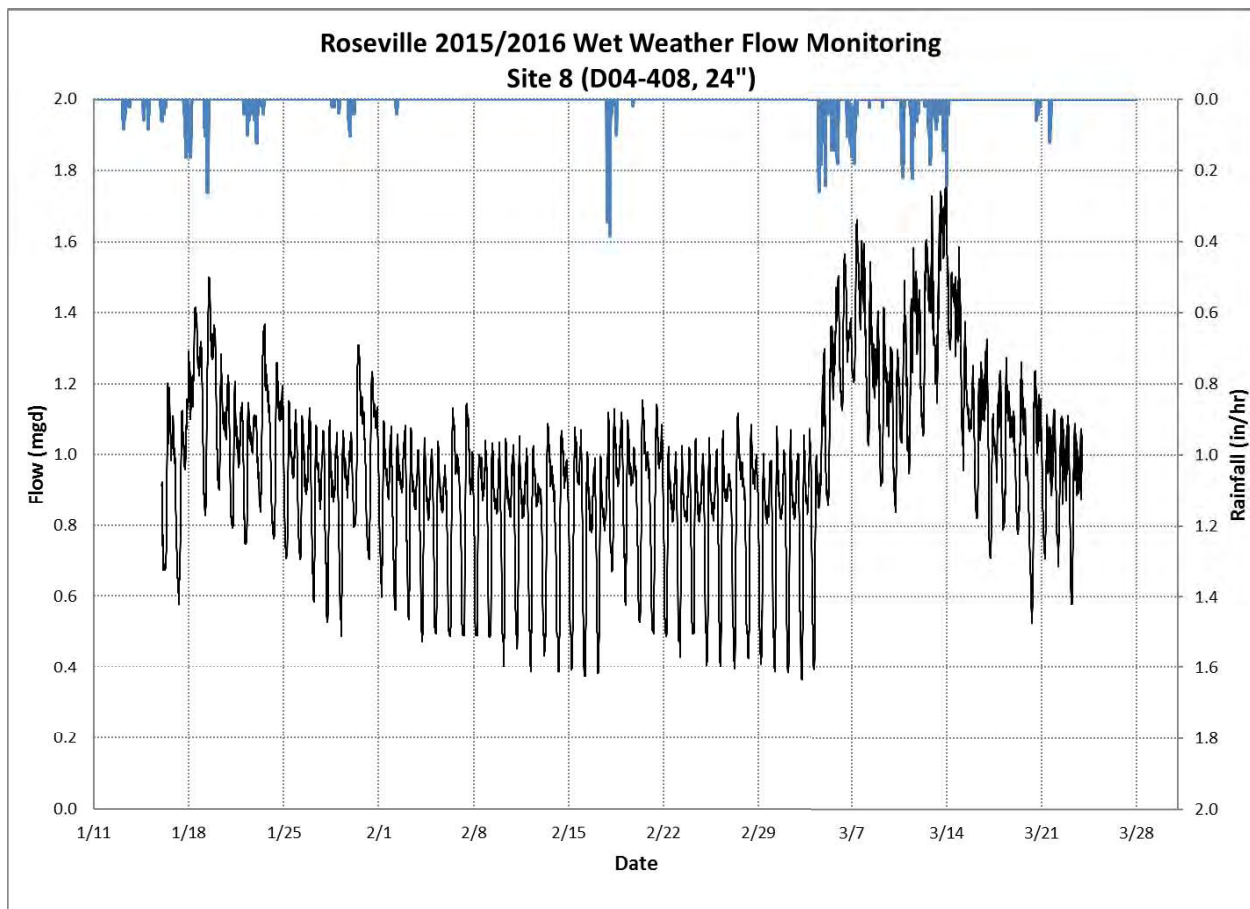


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7A (D03-115, 12")**

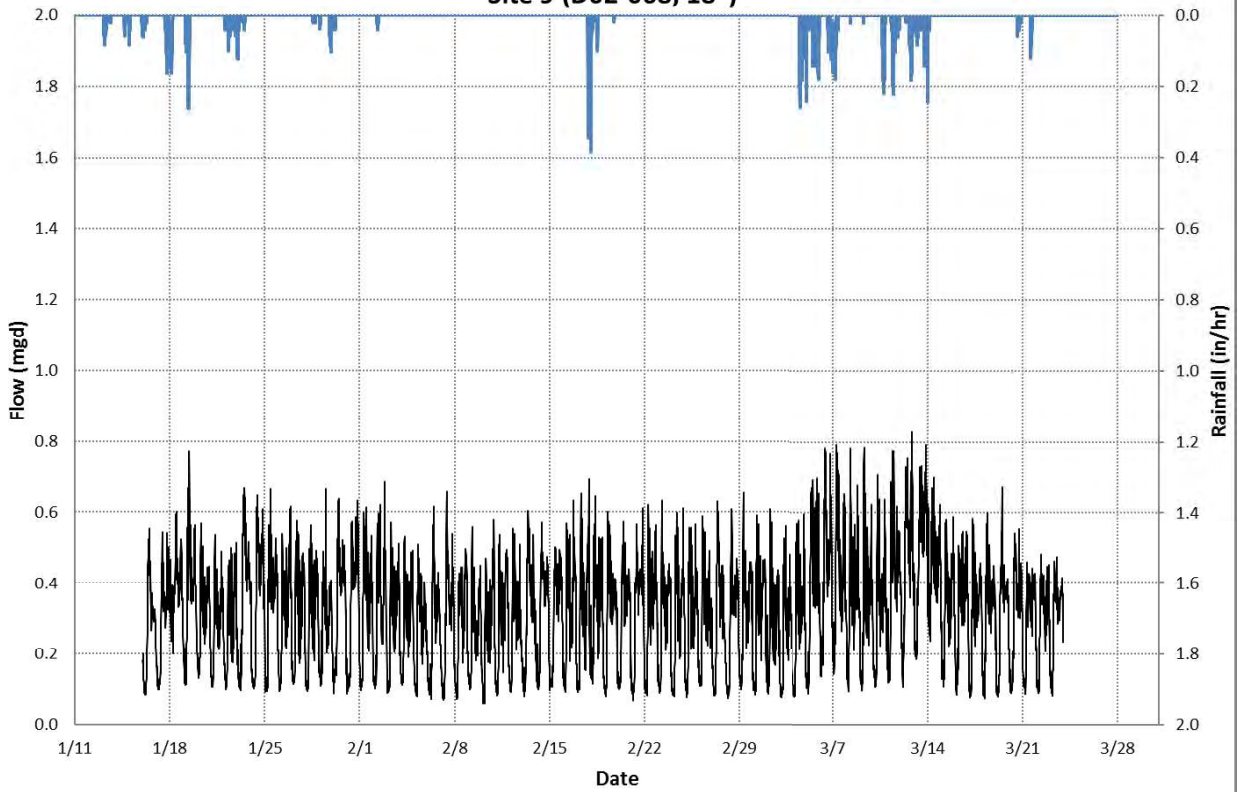


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7A (D03-115, 12")**

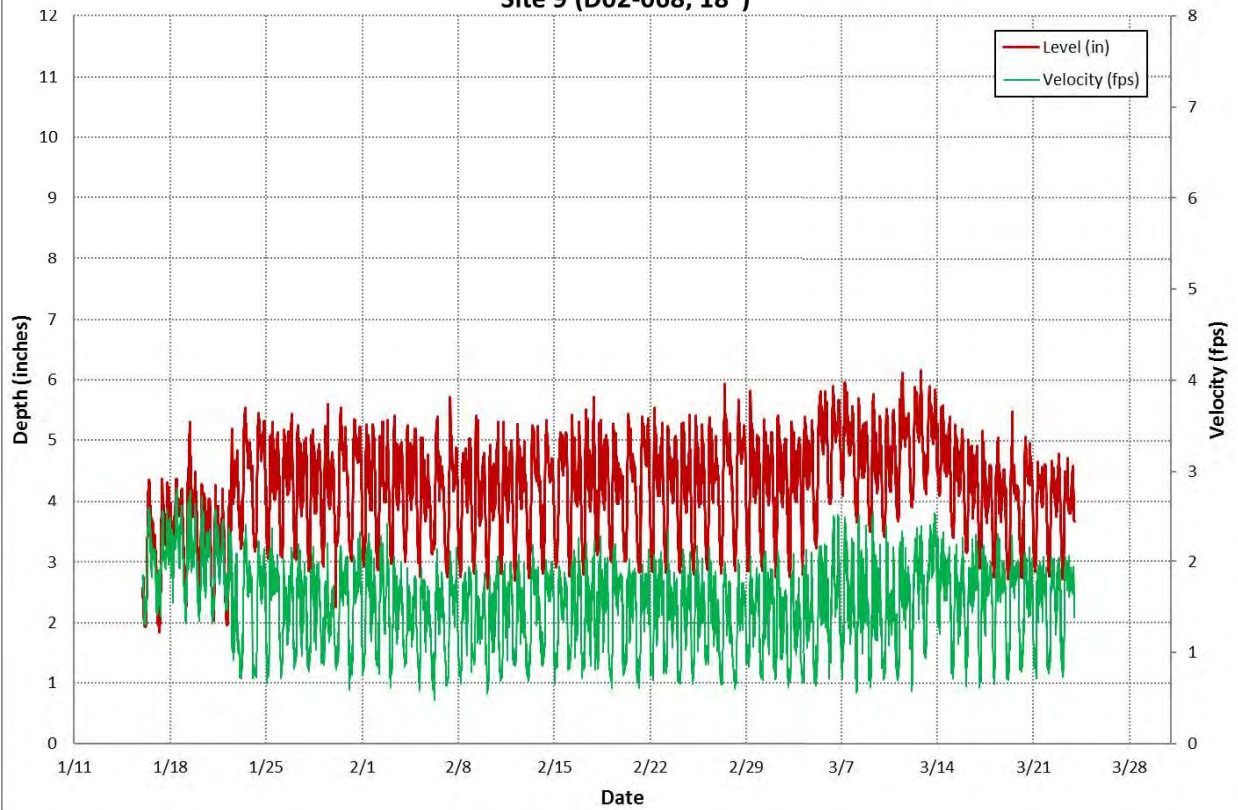


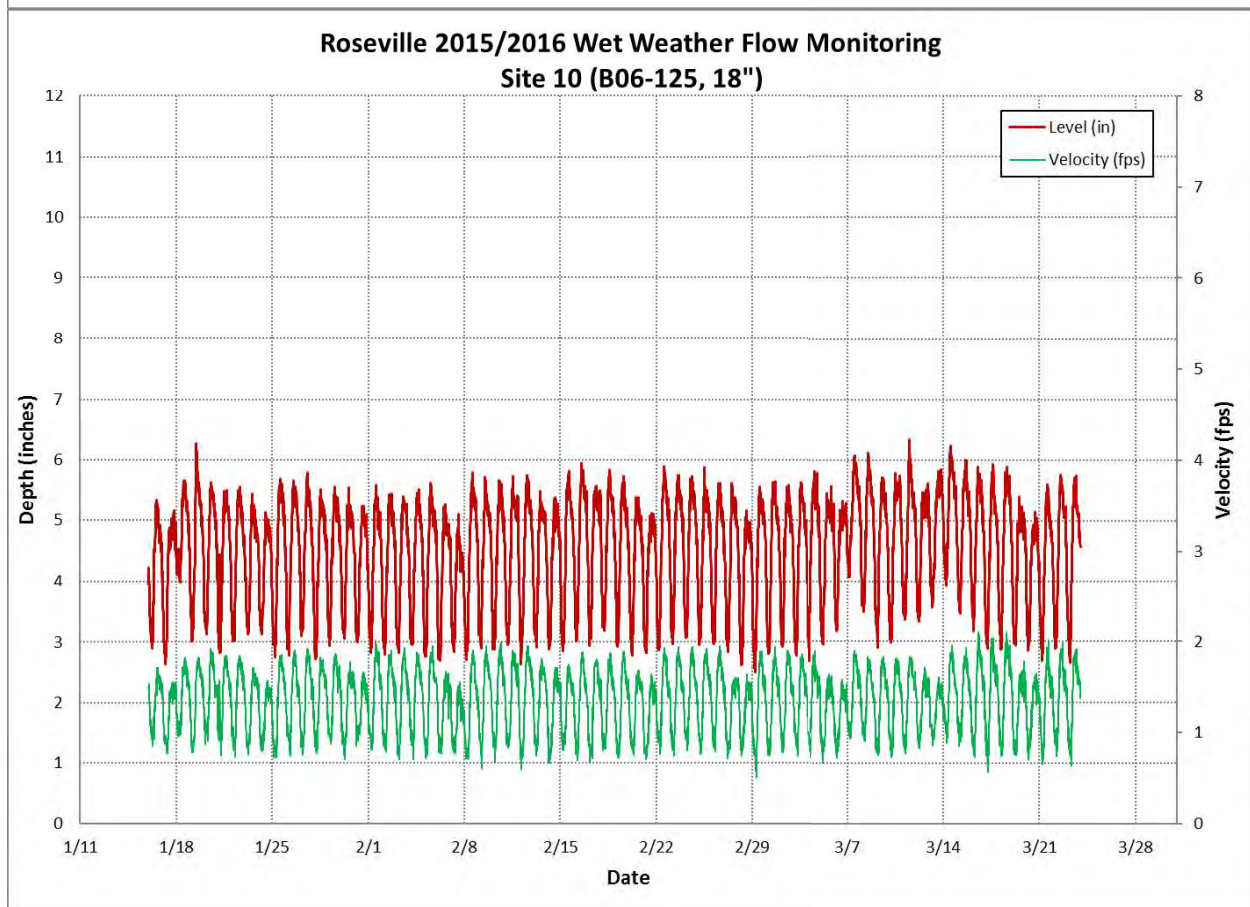
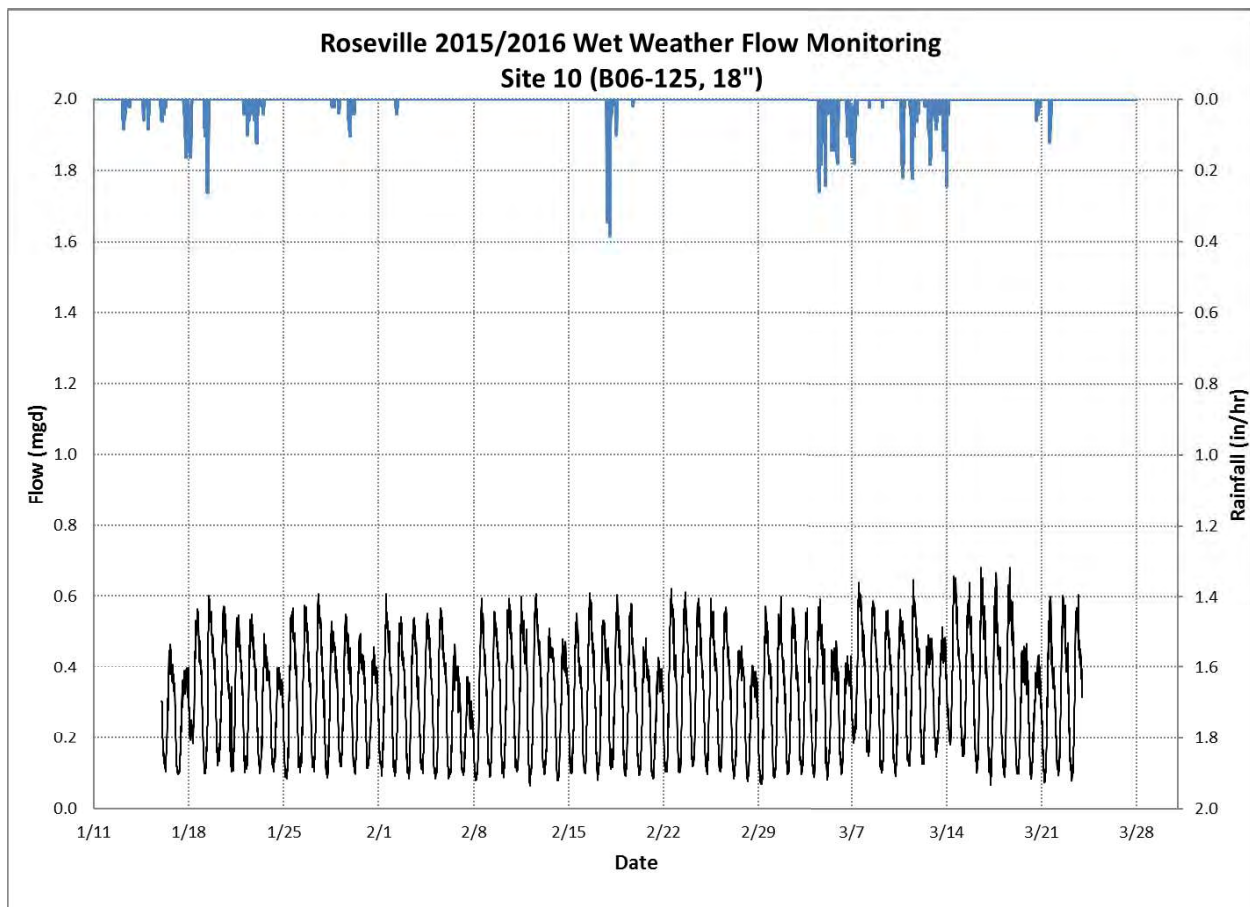


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 9 (D02-068, 18")**

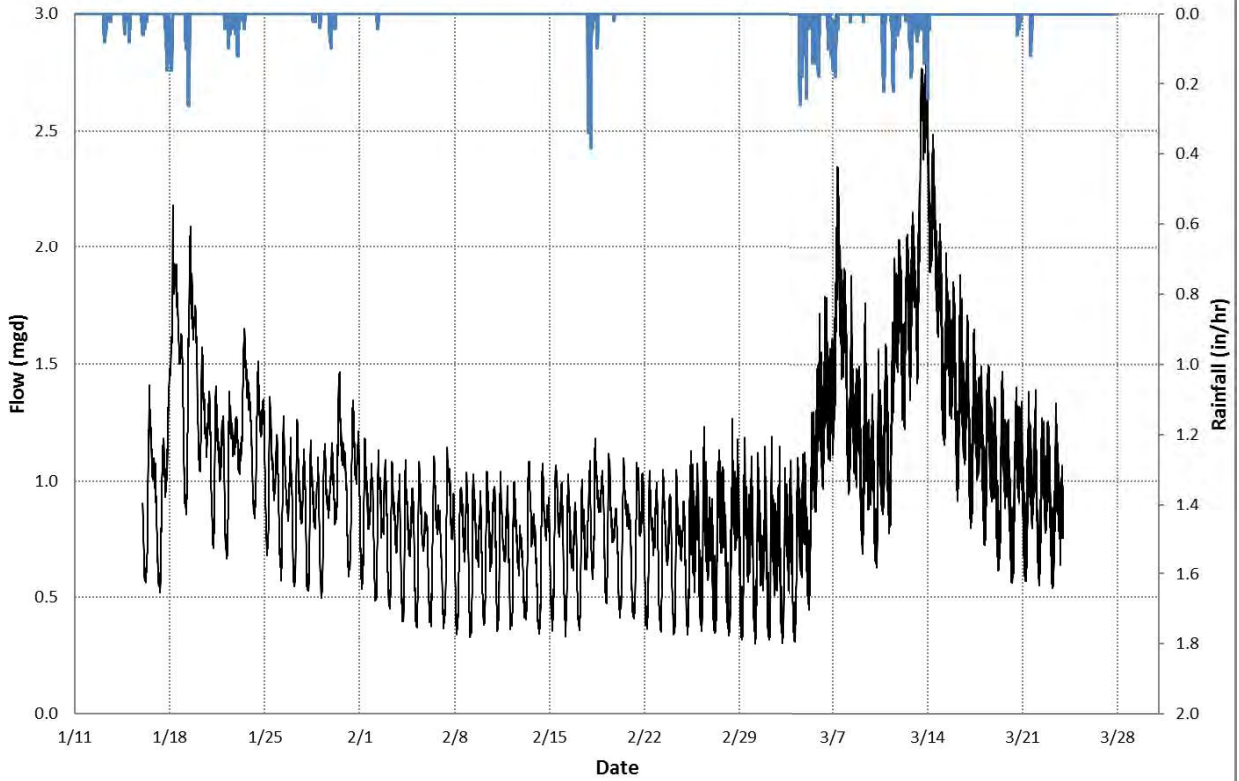


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 9 (D02-068, 18")**

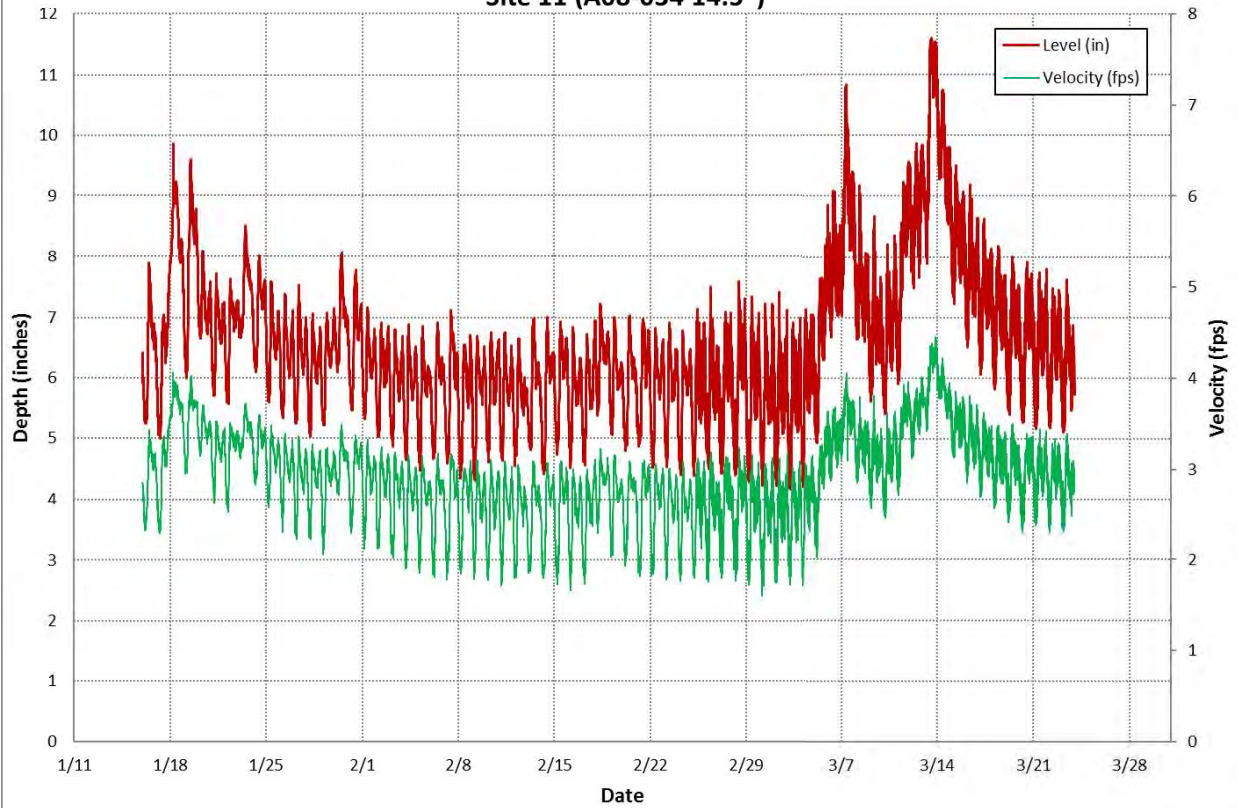




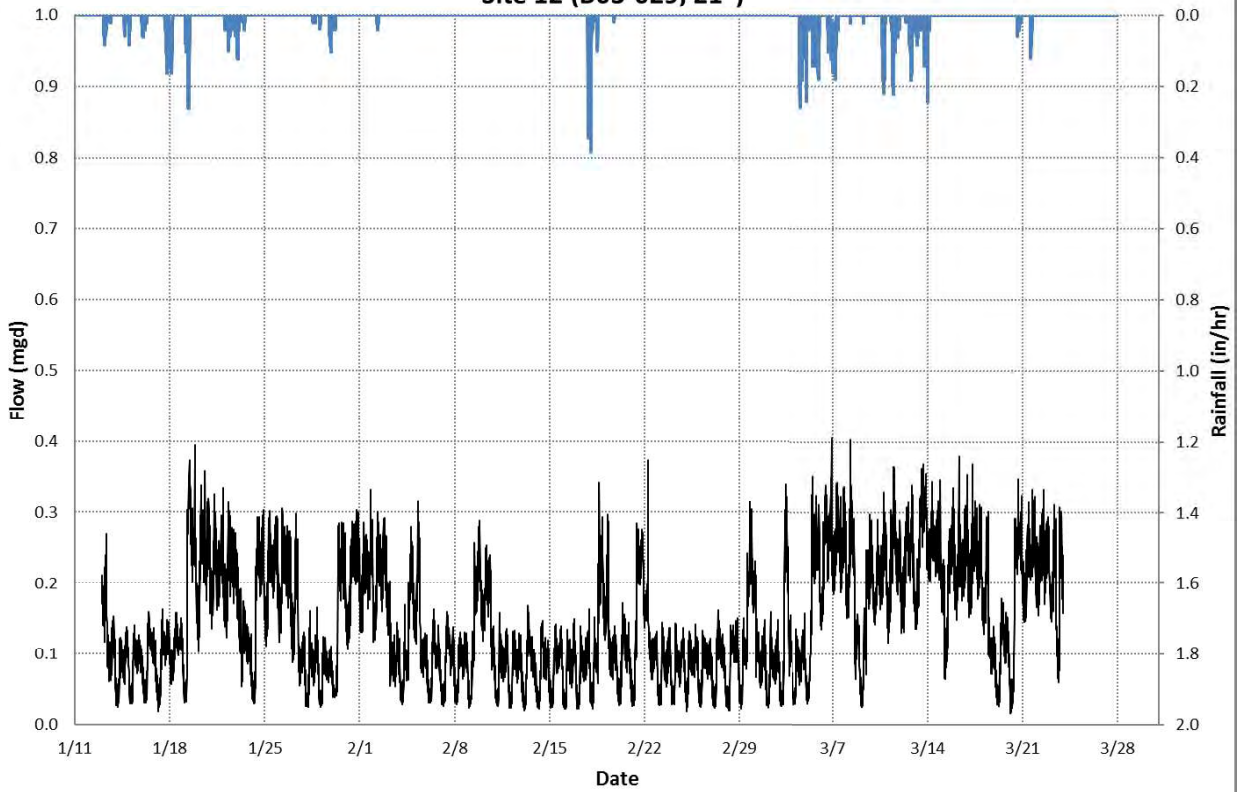
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 11 (A08-034 14.5")**



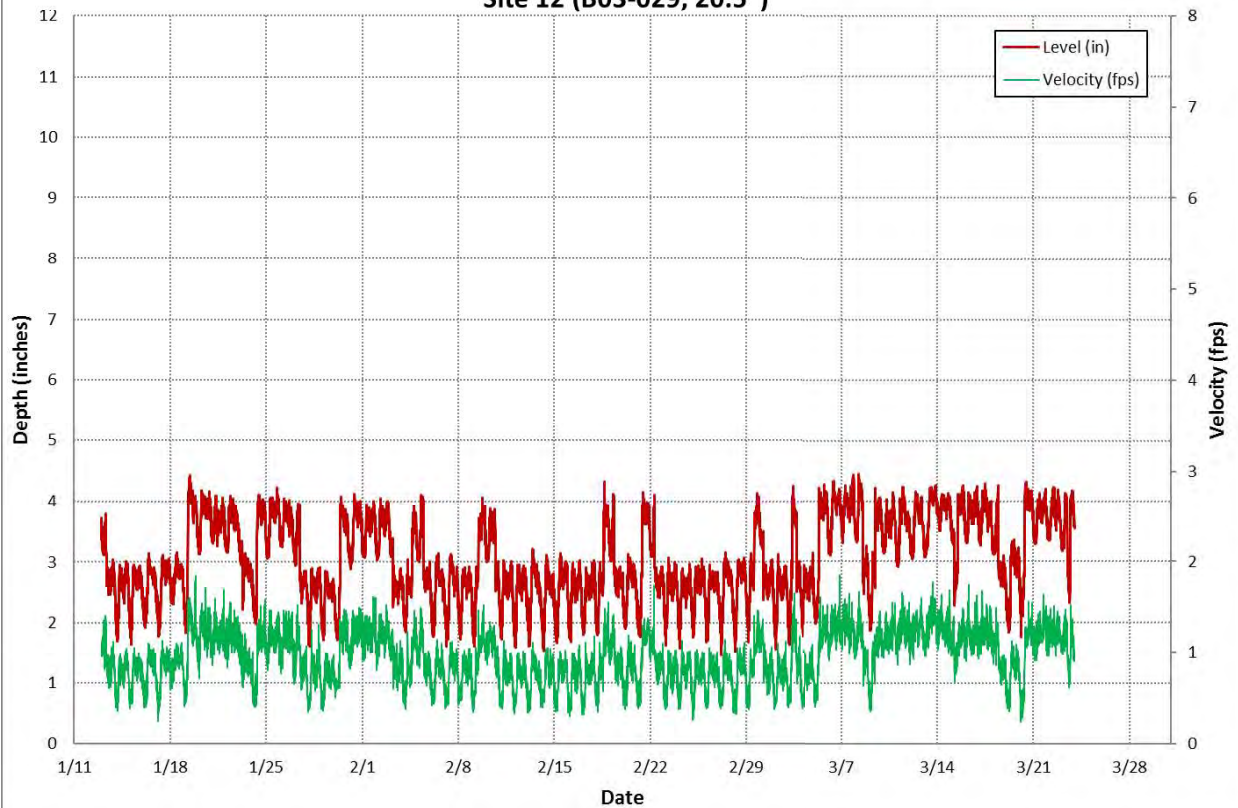
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 11 (A08-034 14.5")**

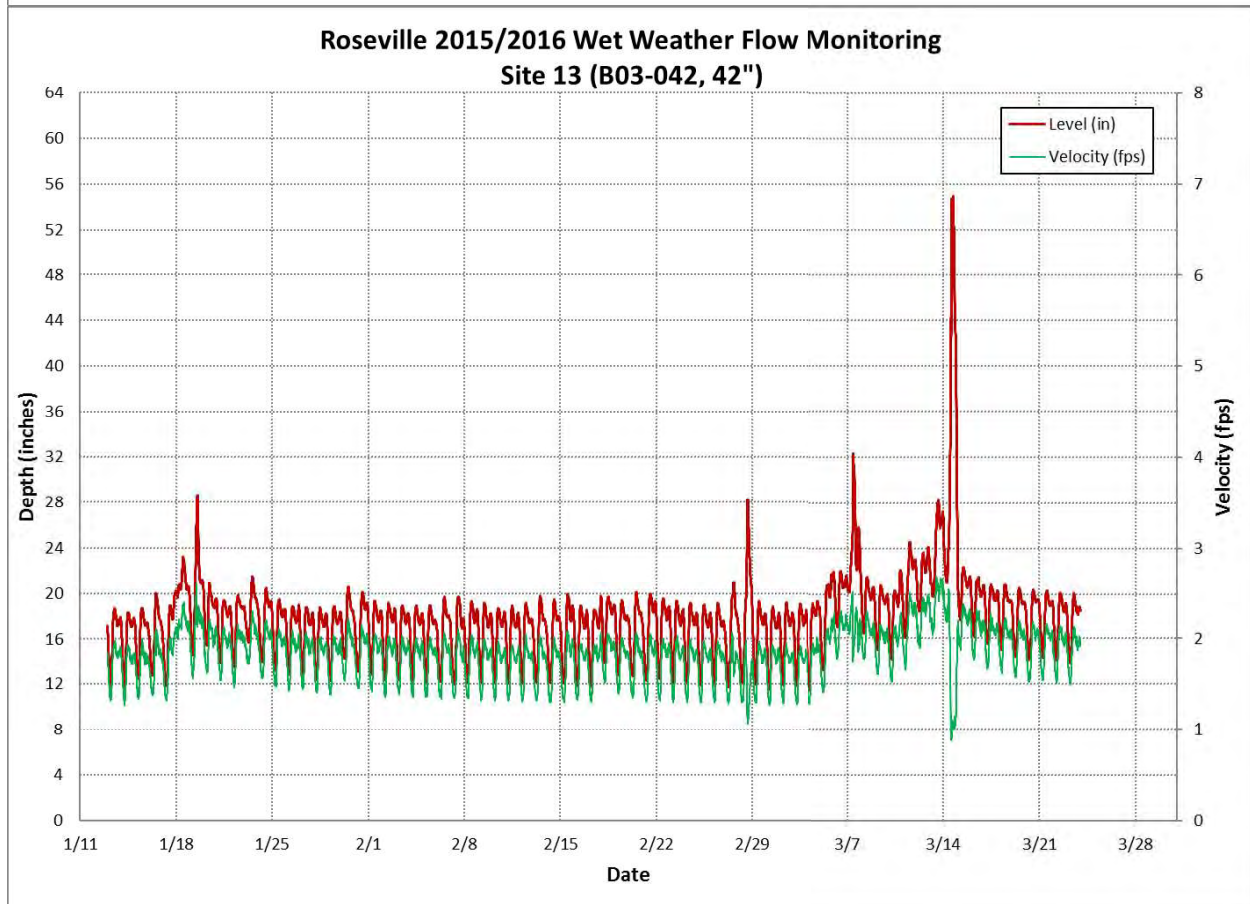
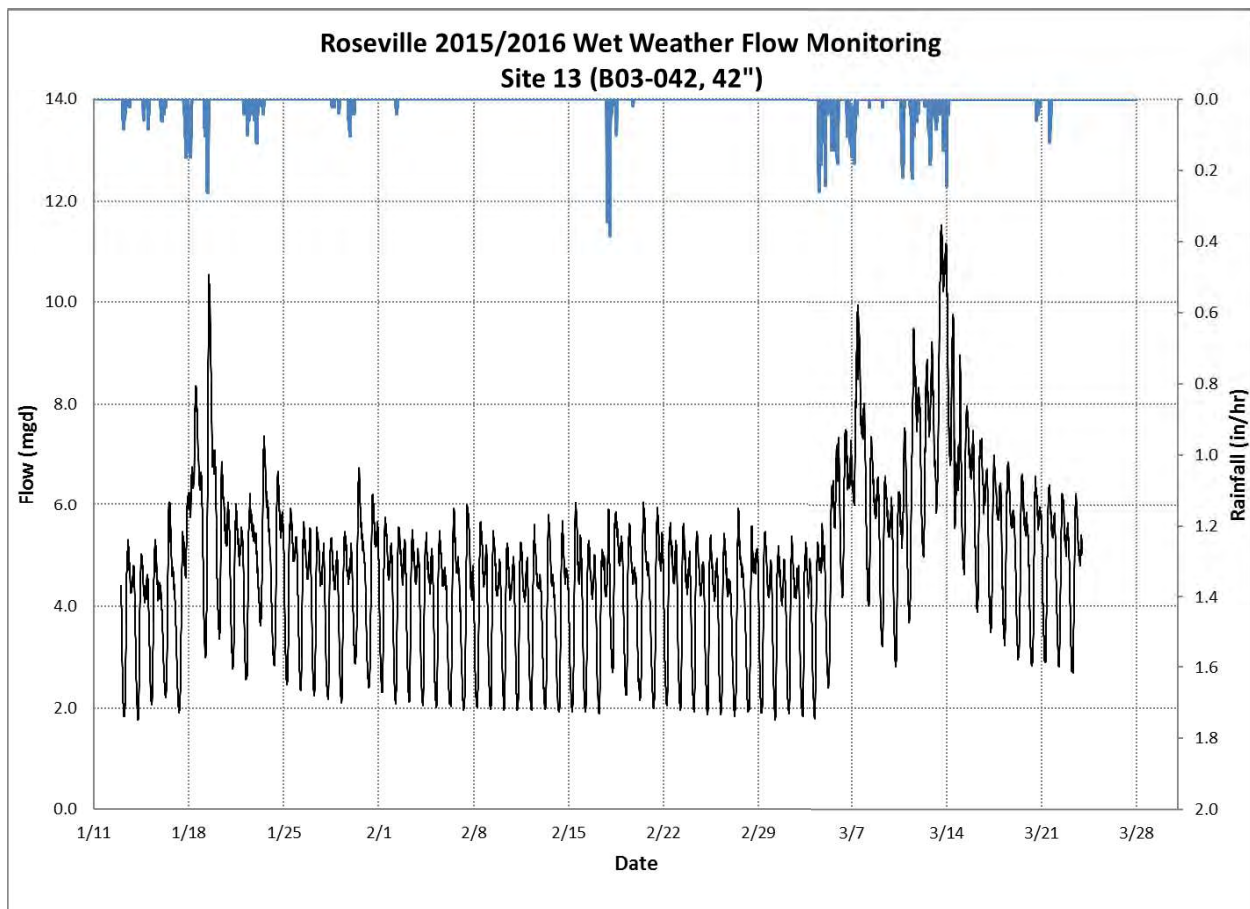


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 12 (B03-029, 21")**

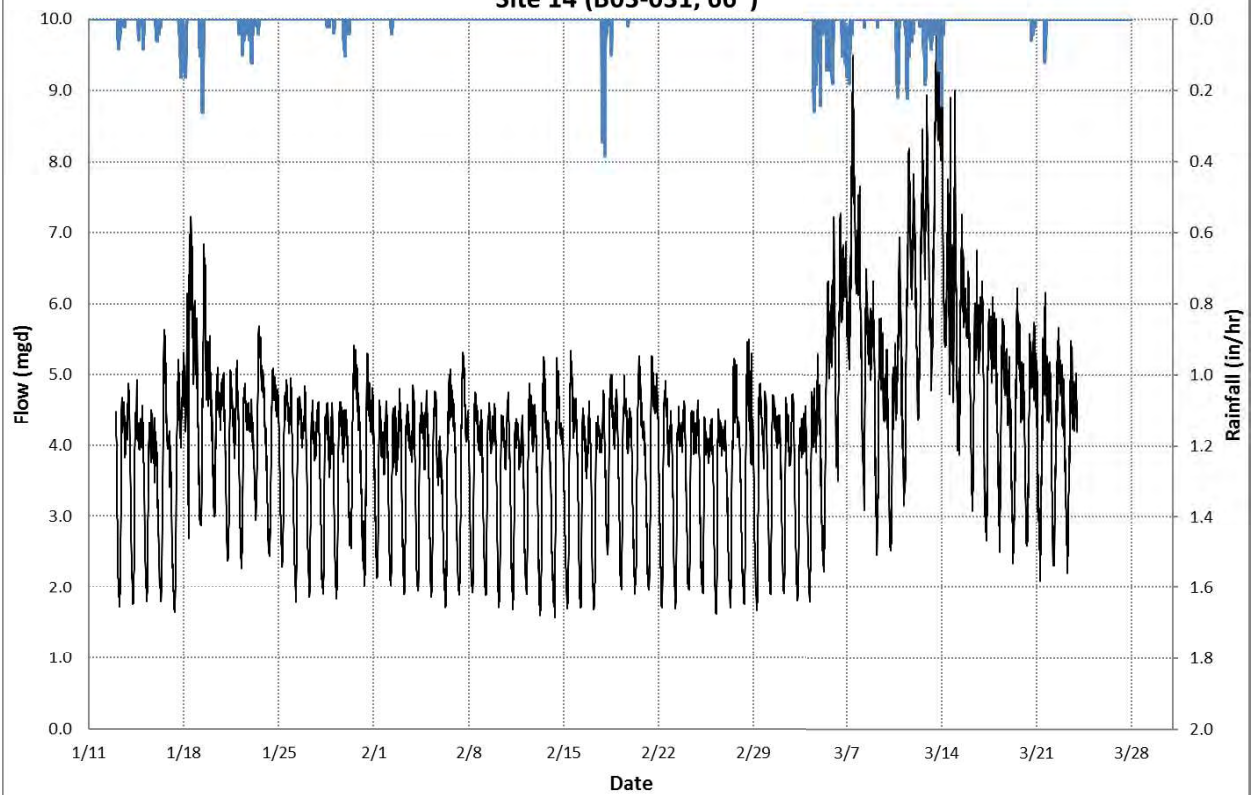


**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 12 (B03-029, 20.5")**

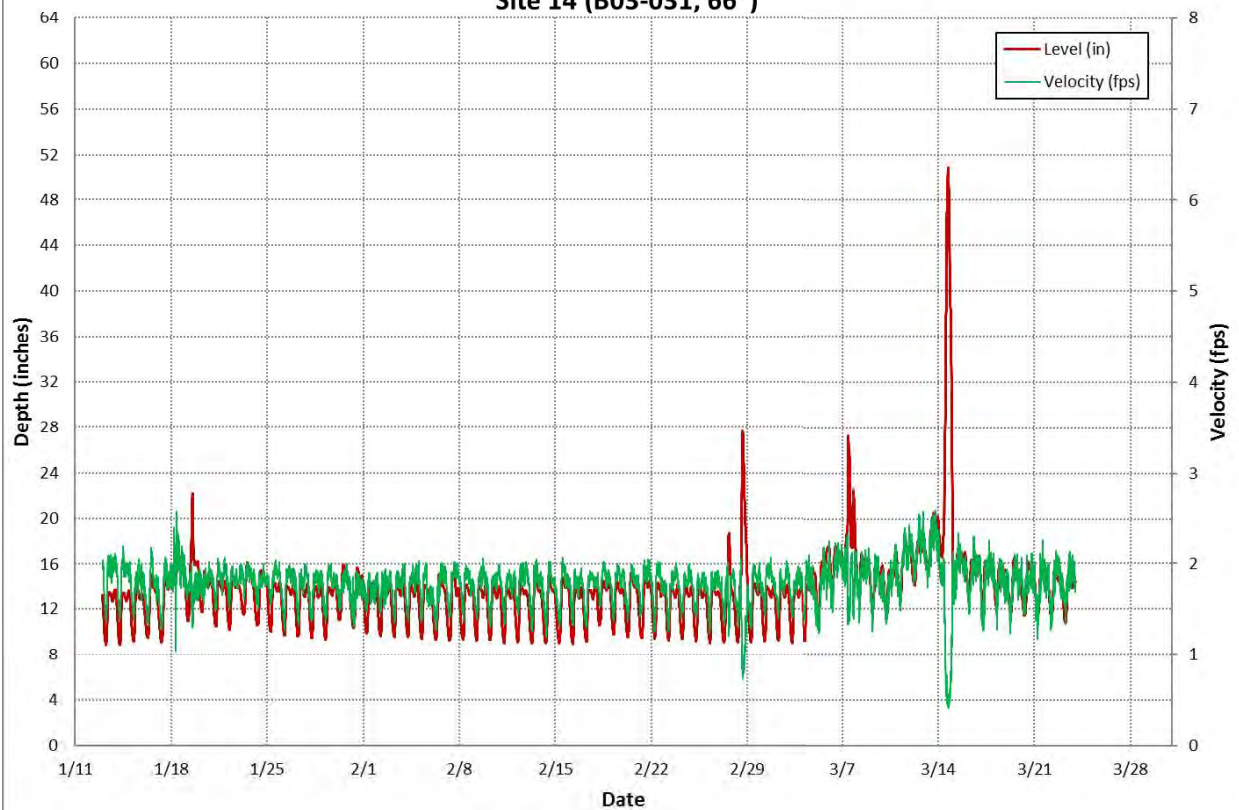


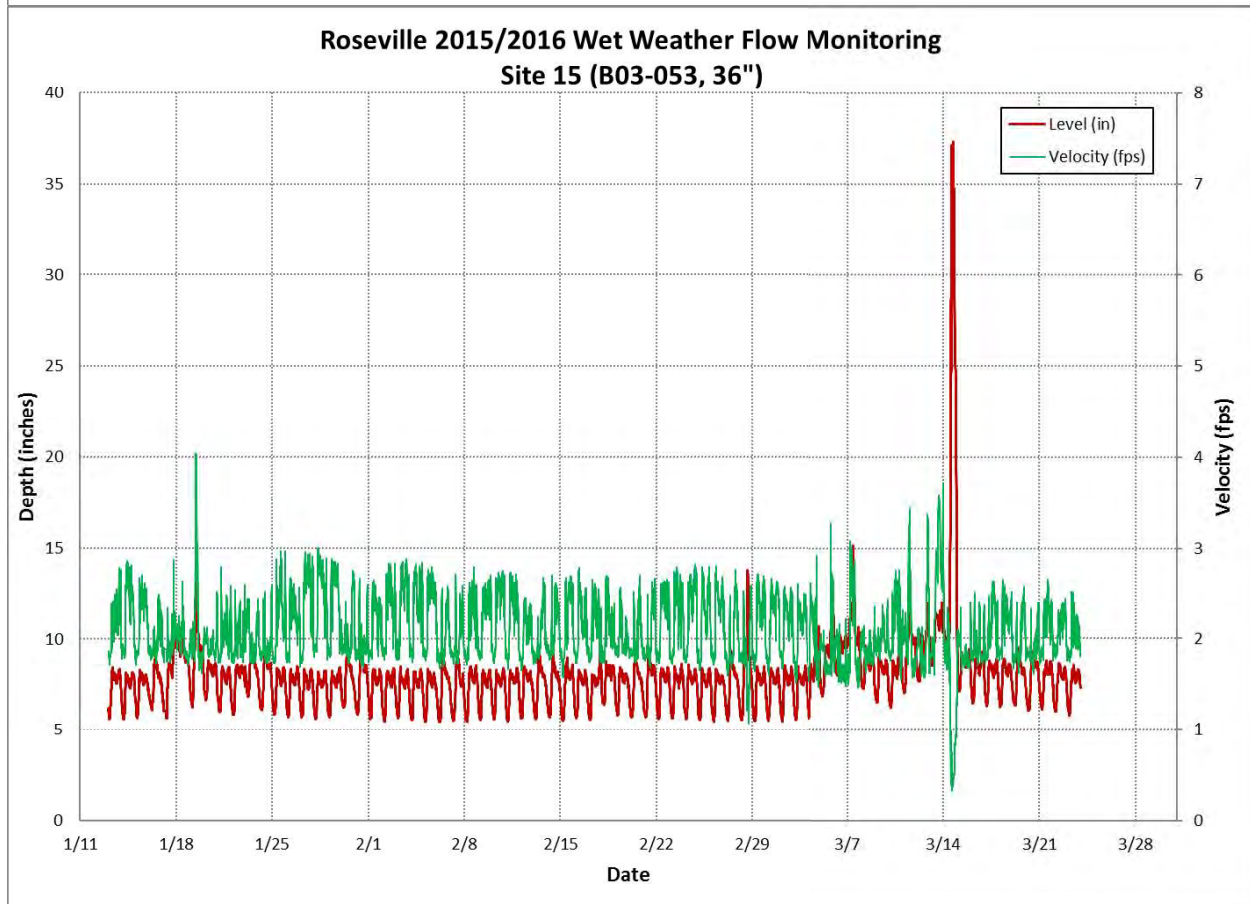
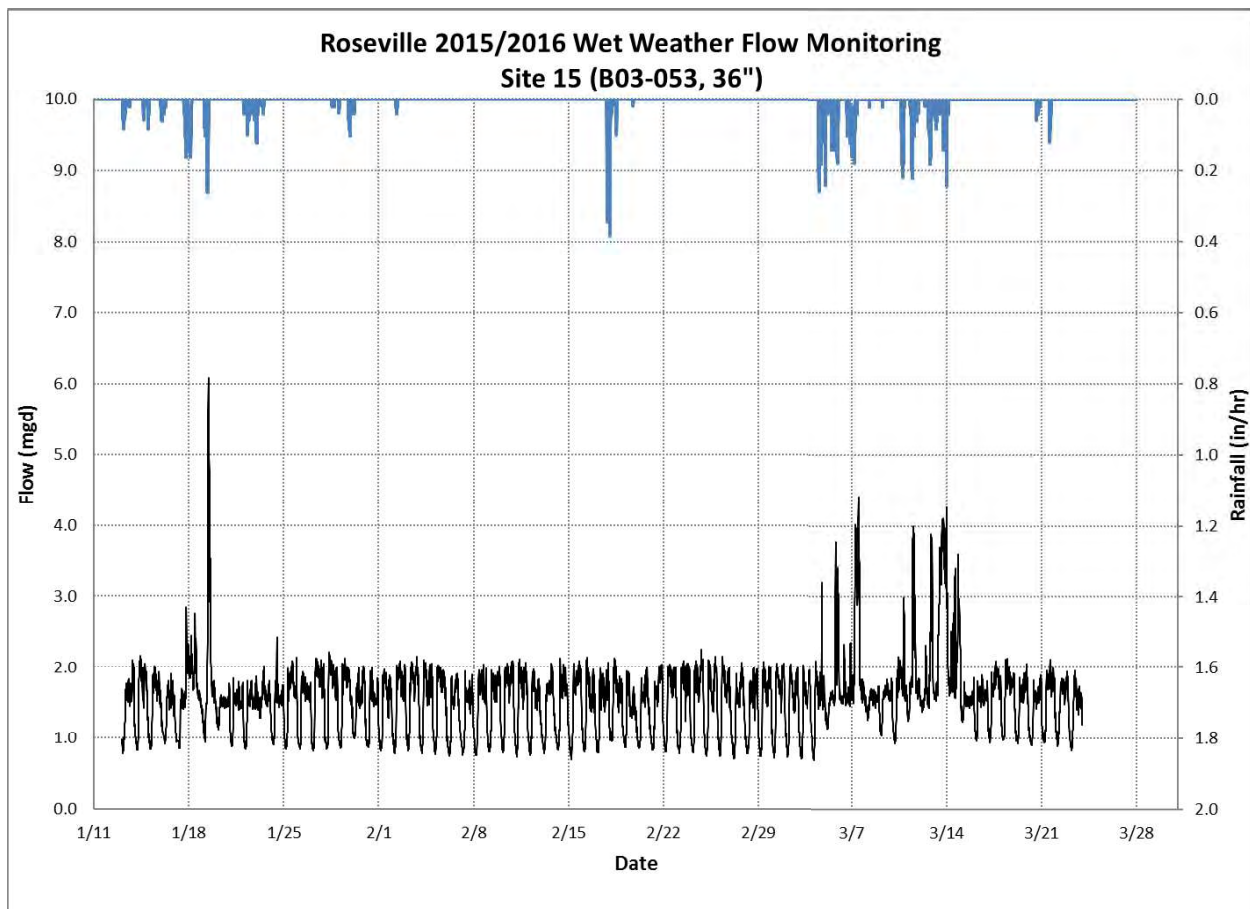


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 14 (B03-031, 66")

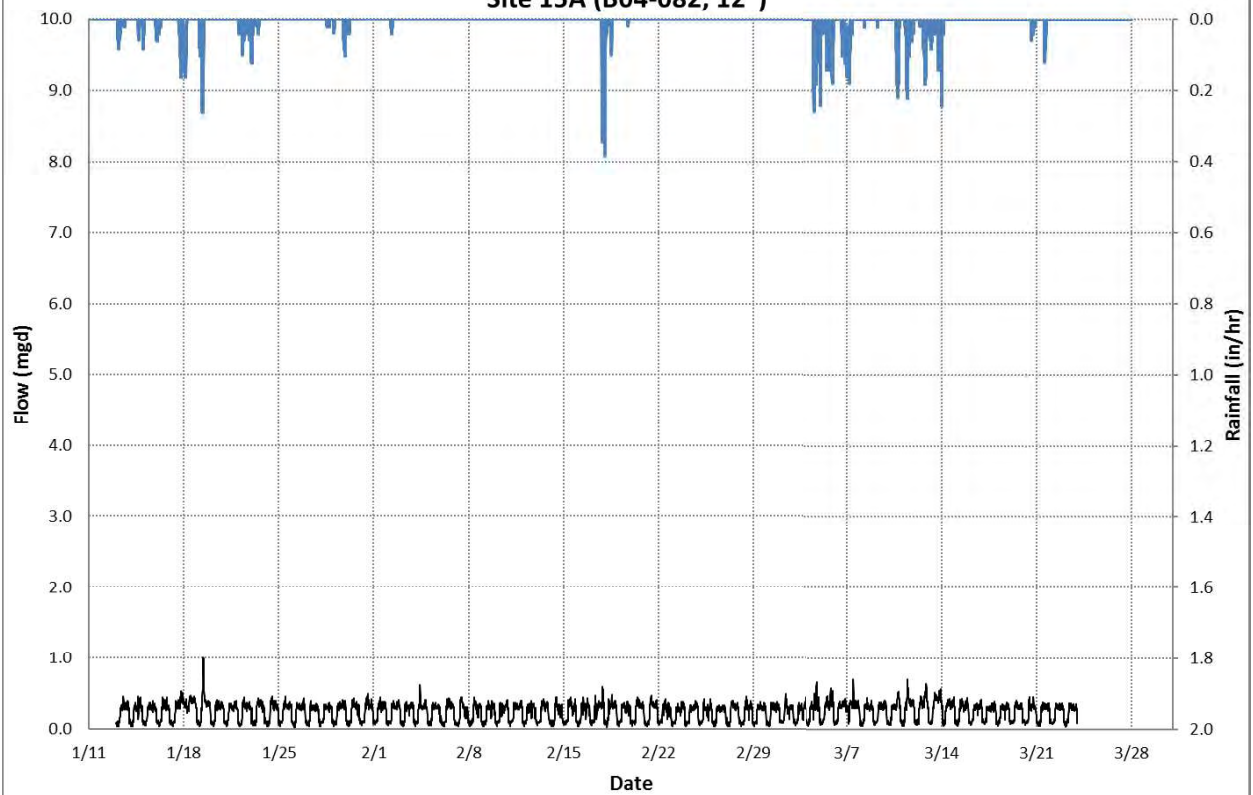


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 14 (B03-031, 66")

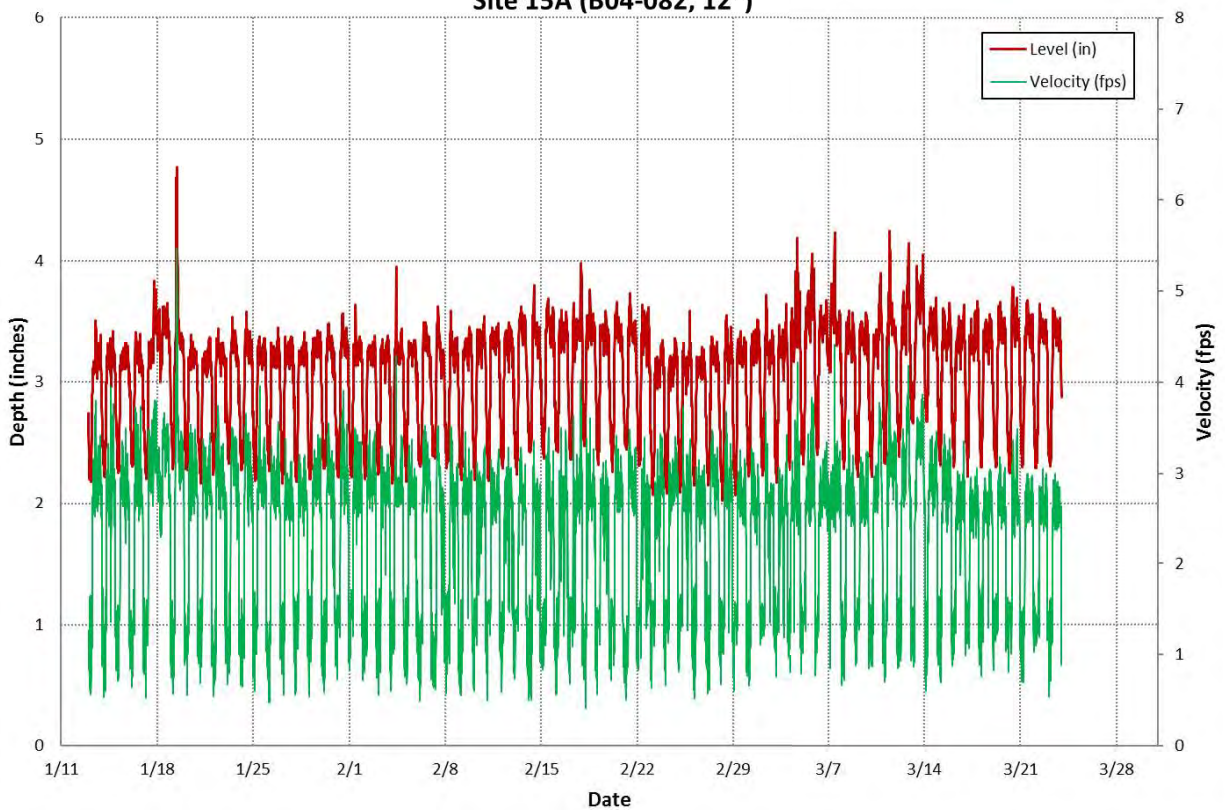


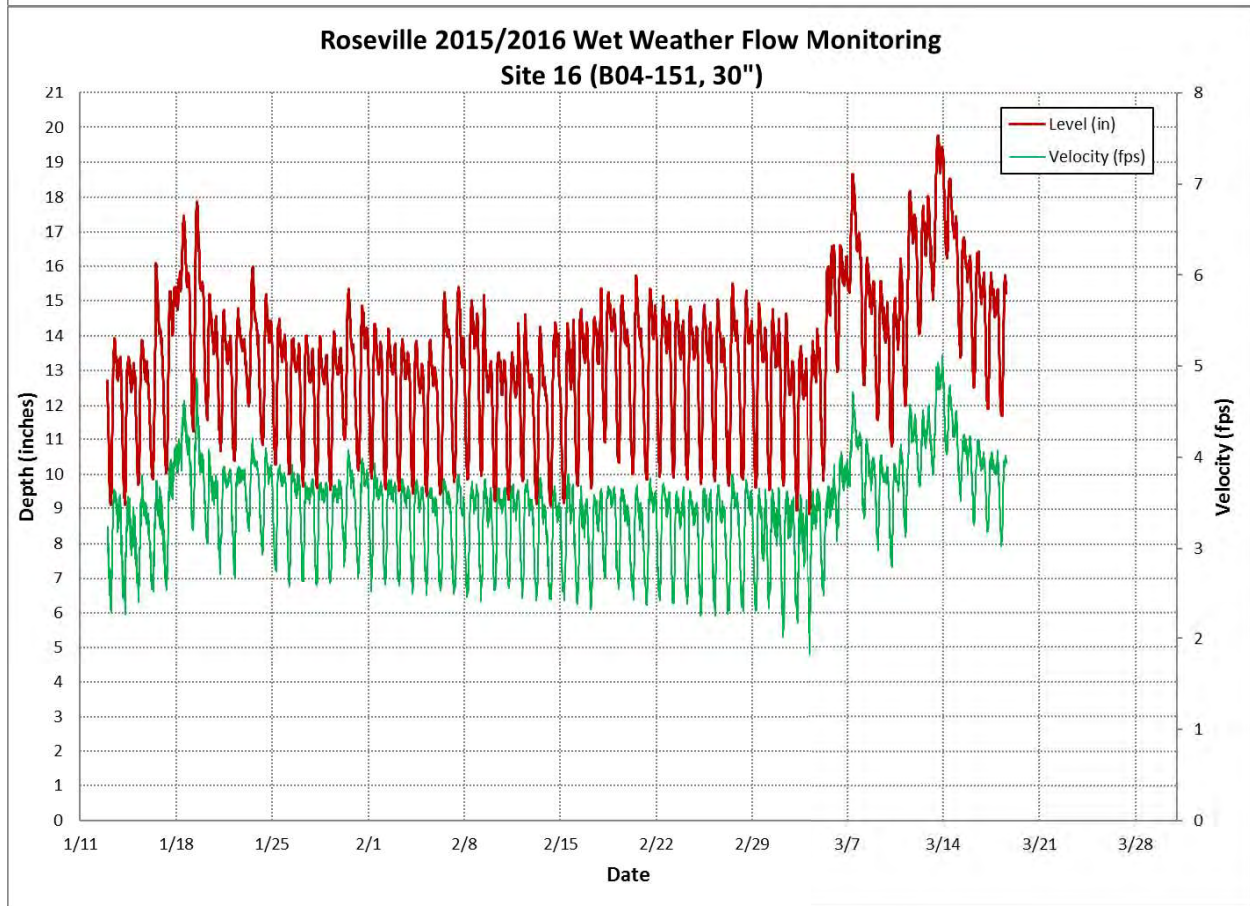
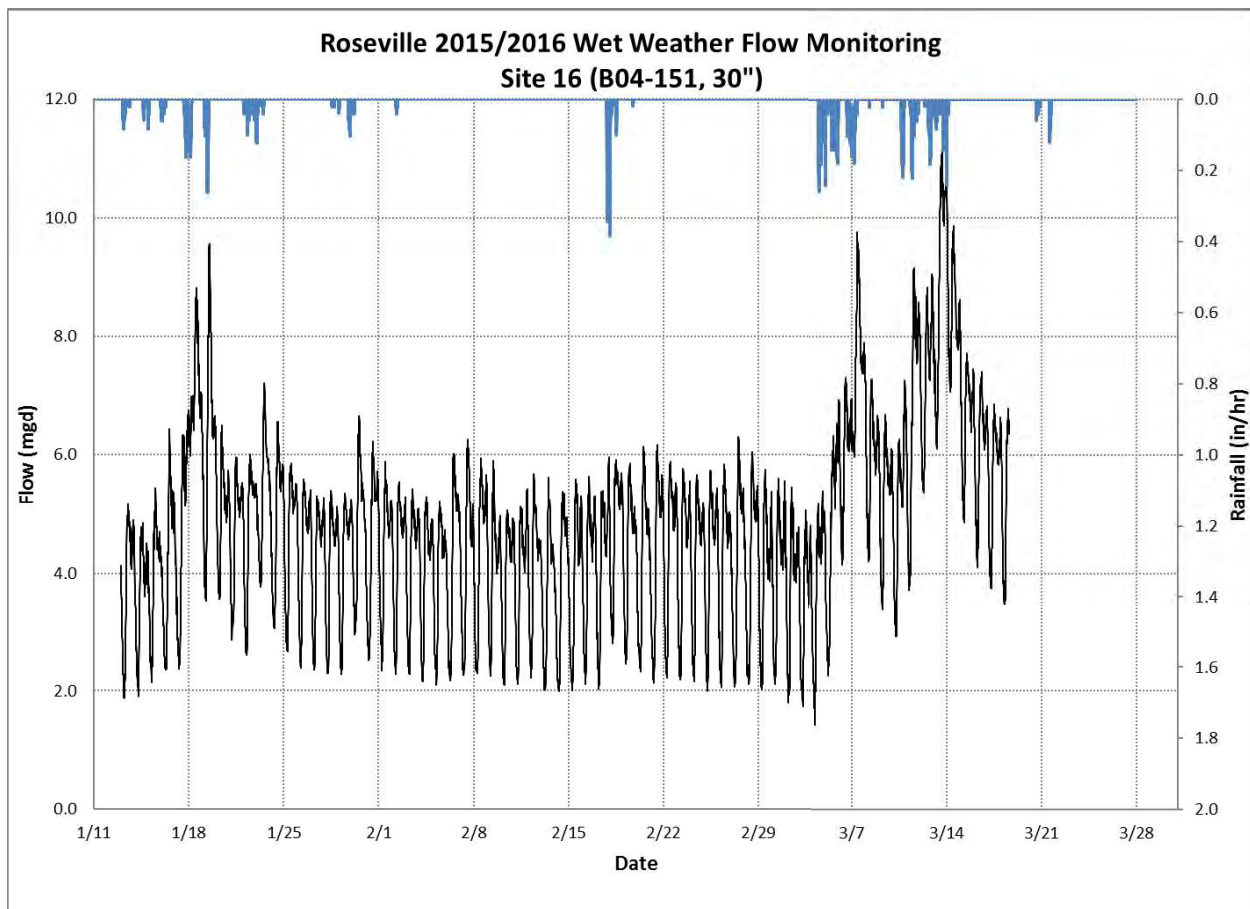


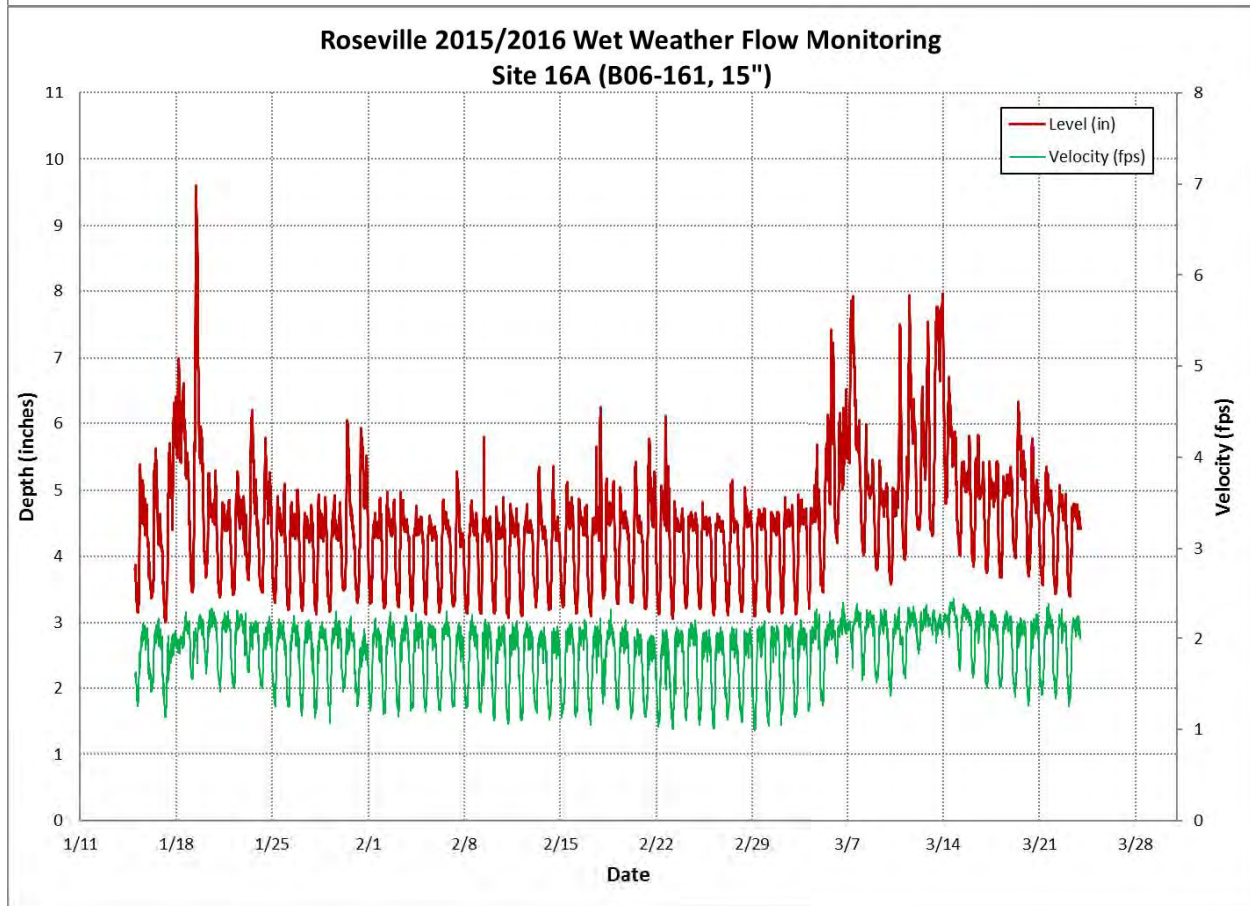
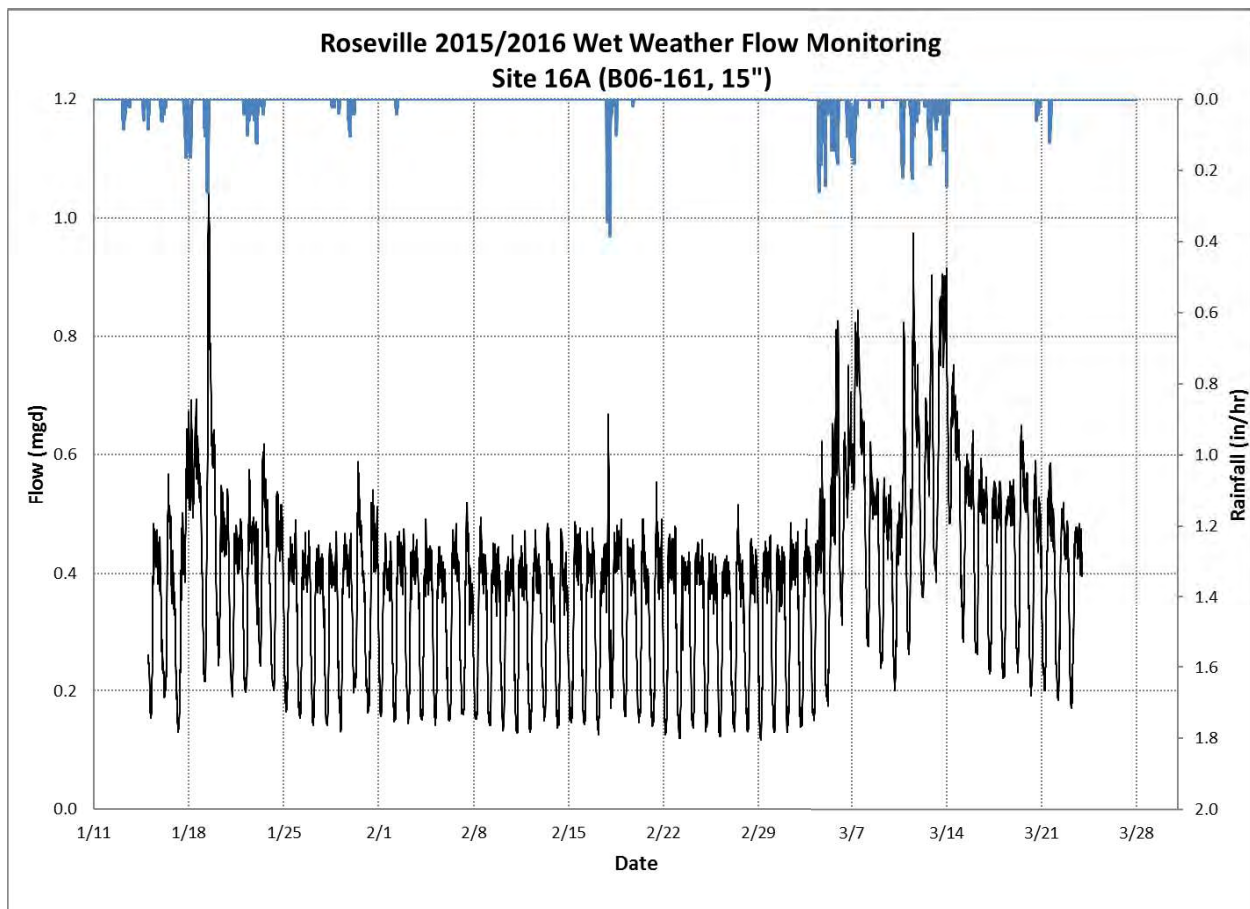
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15A (B04-082, 12")**



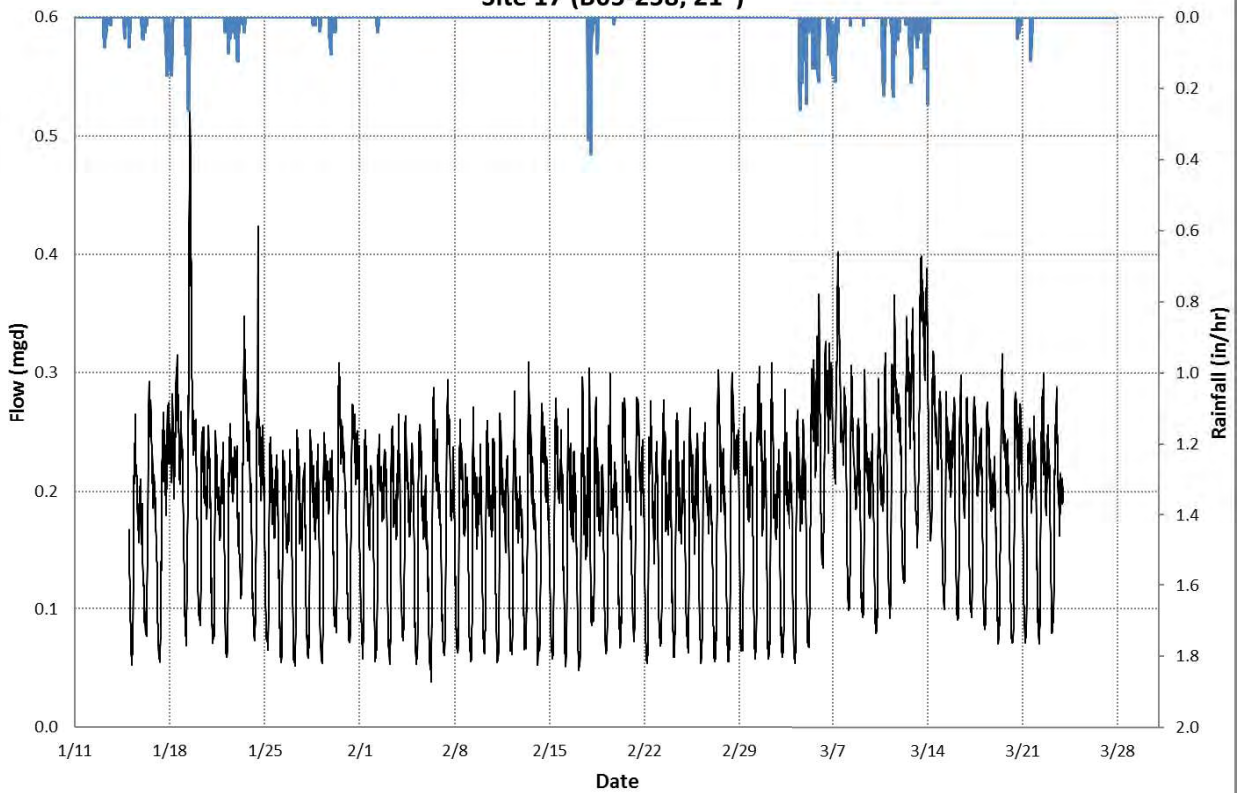
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15A (B04-082, 12")**



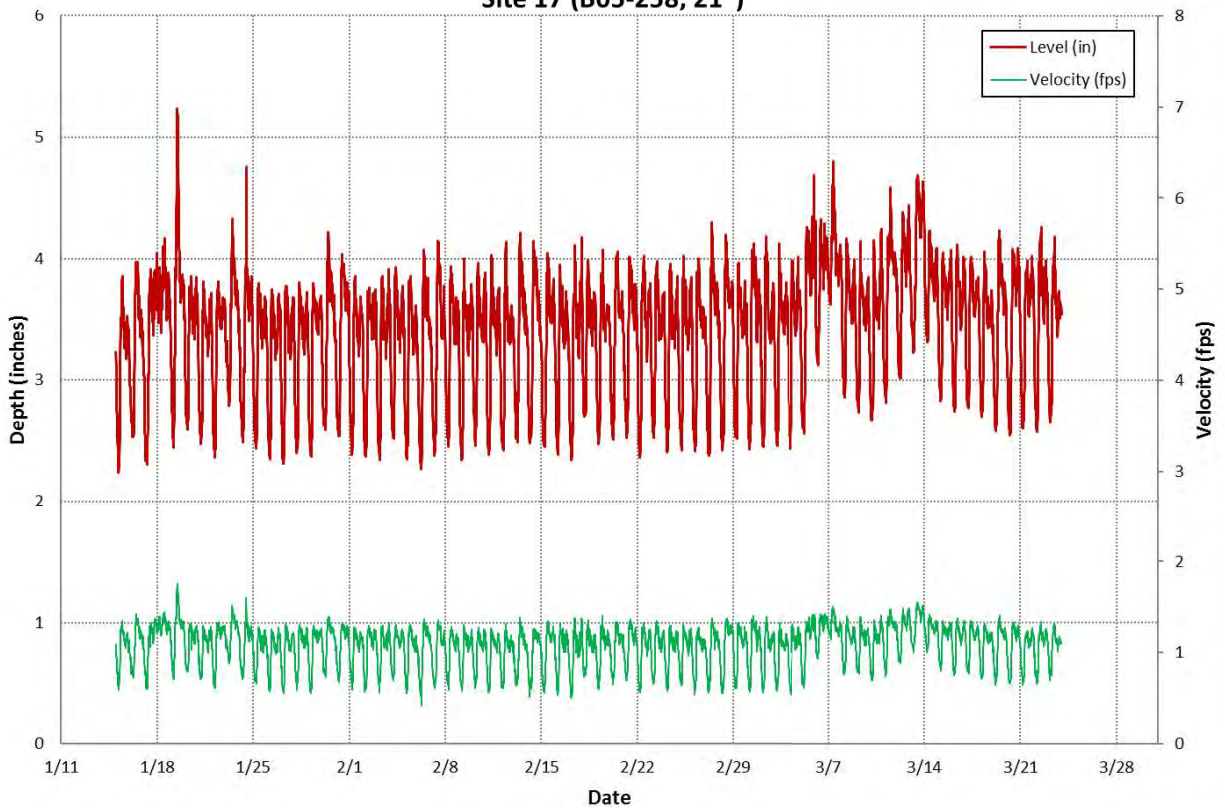


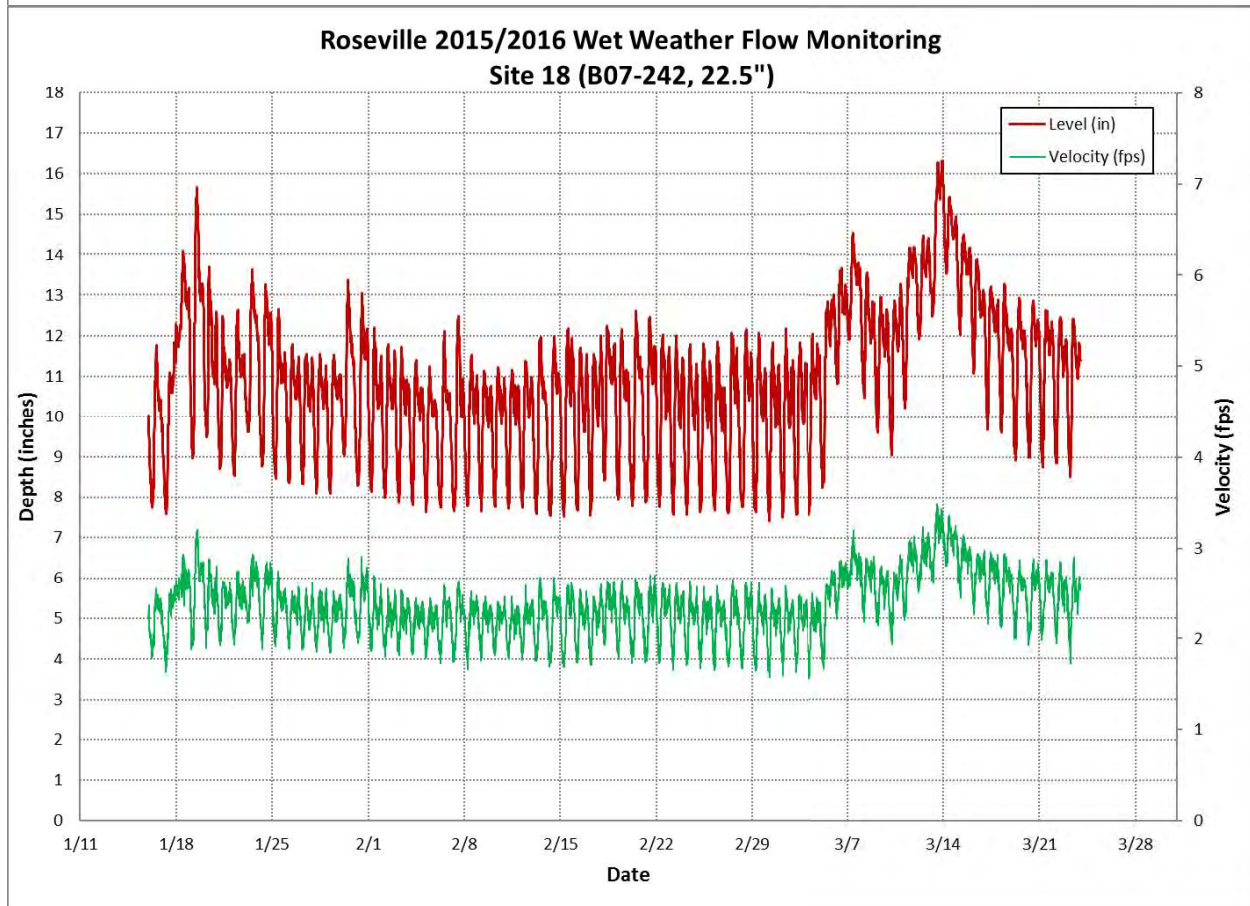
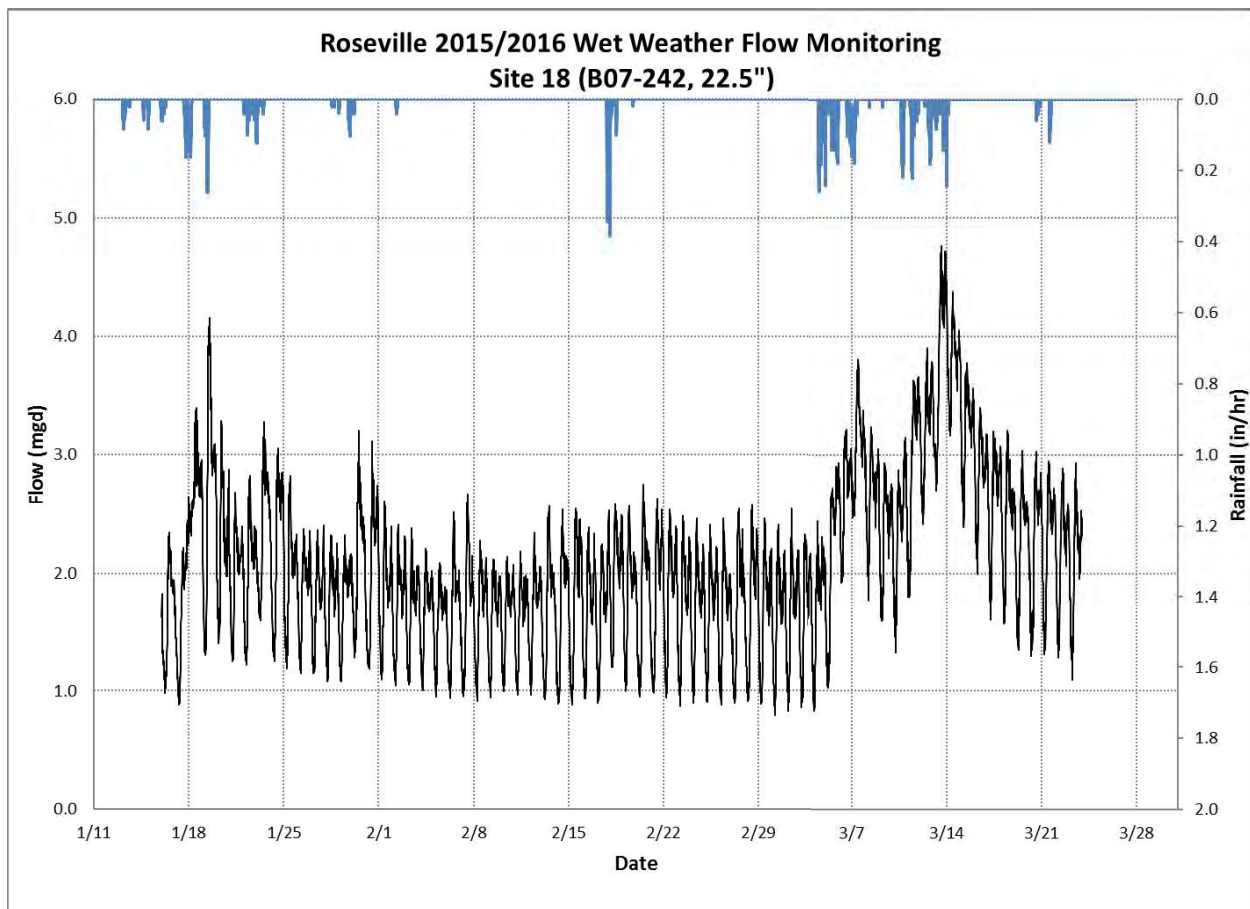


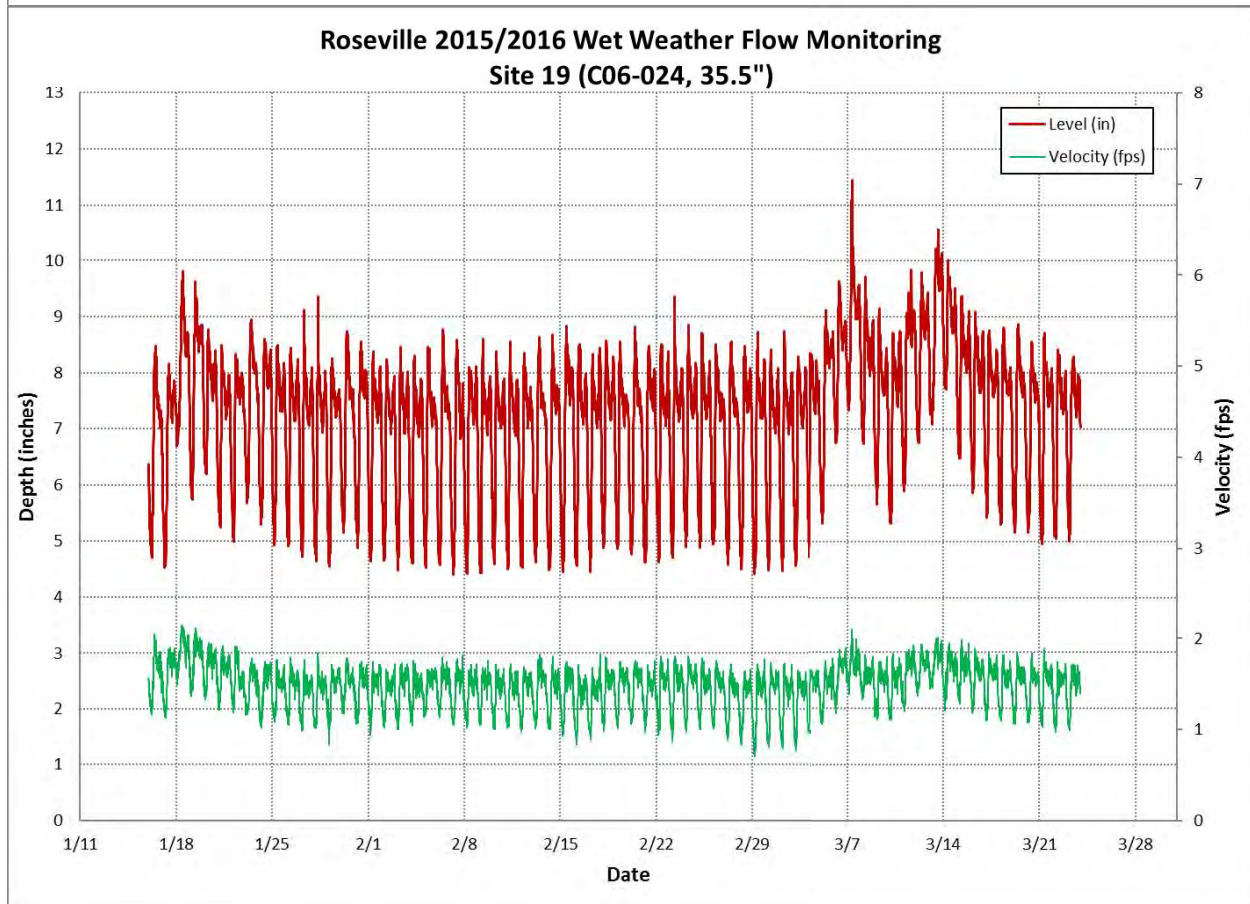
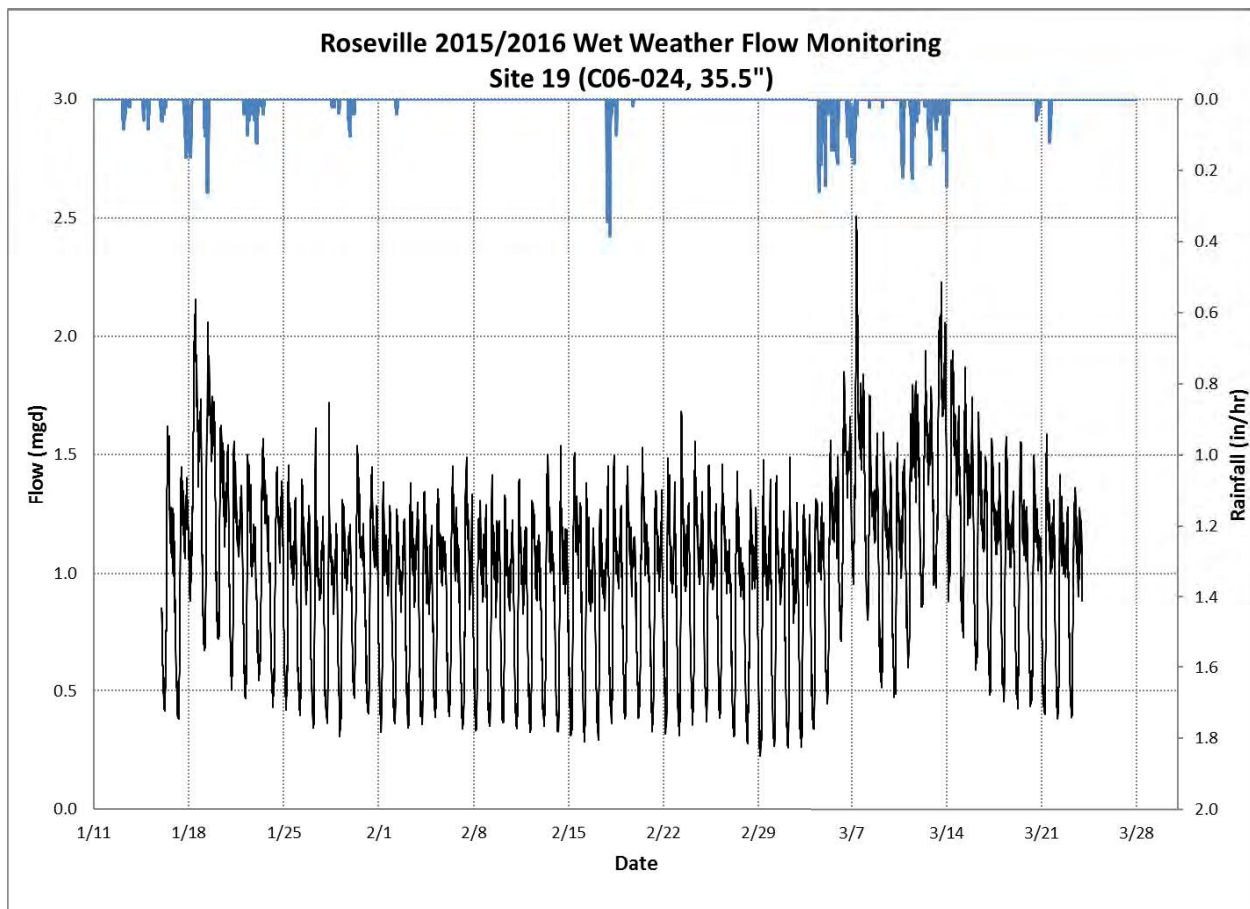
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 17 (B05-258, 21")**



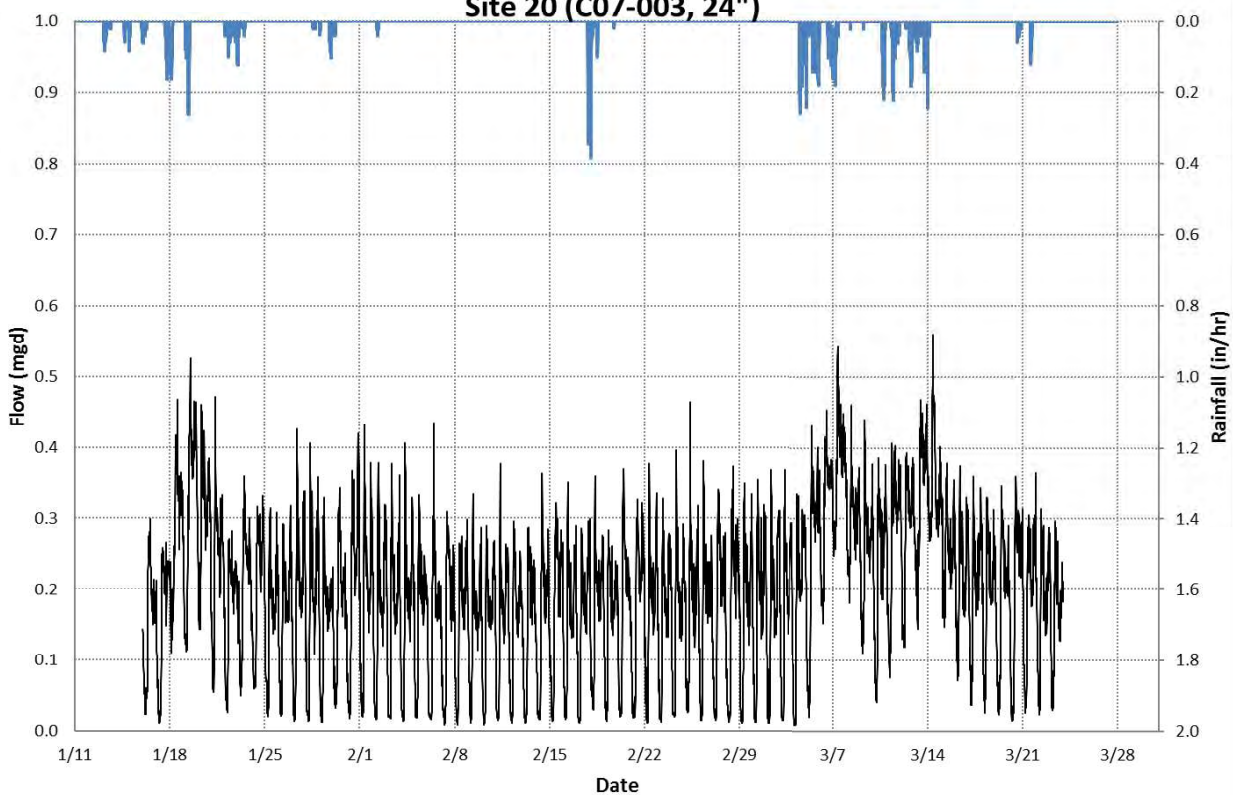
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 17 (B05-258, 21")**



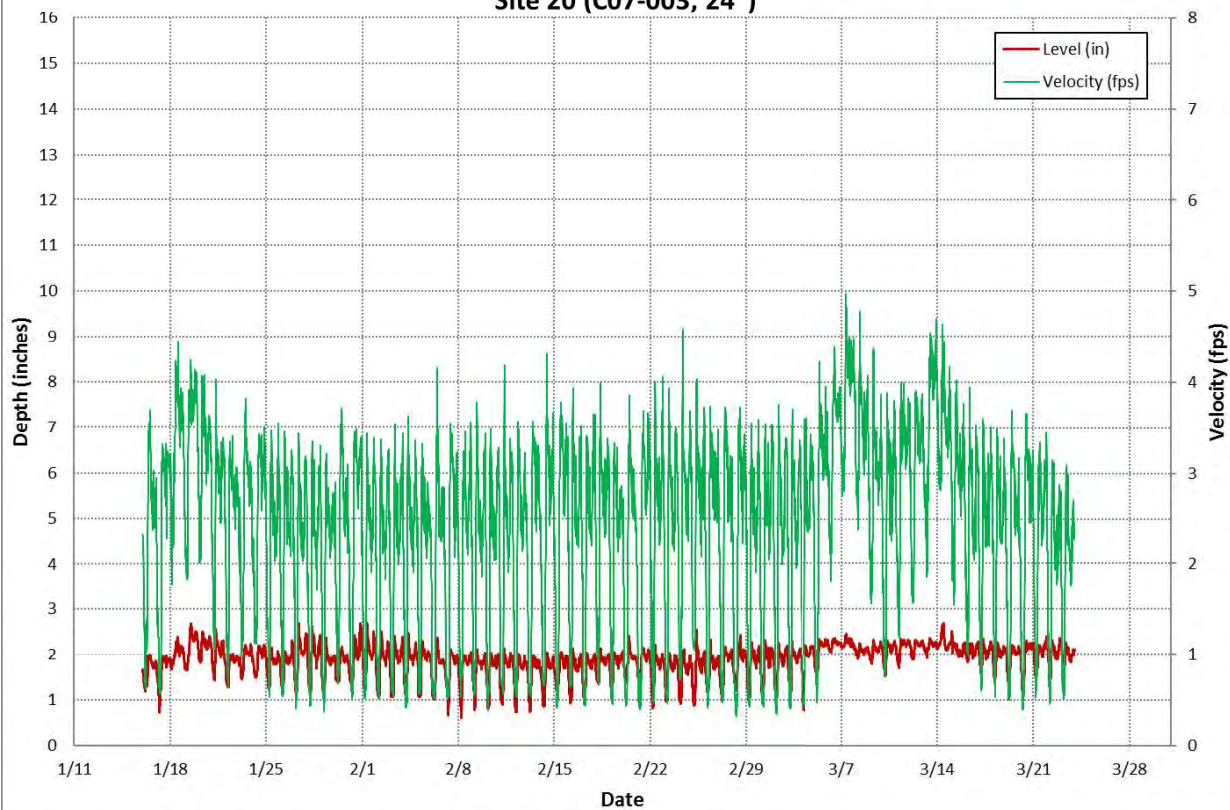




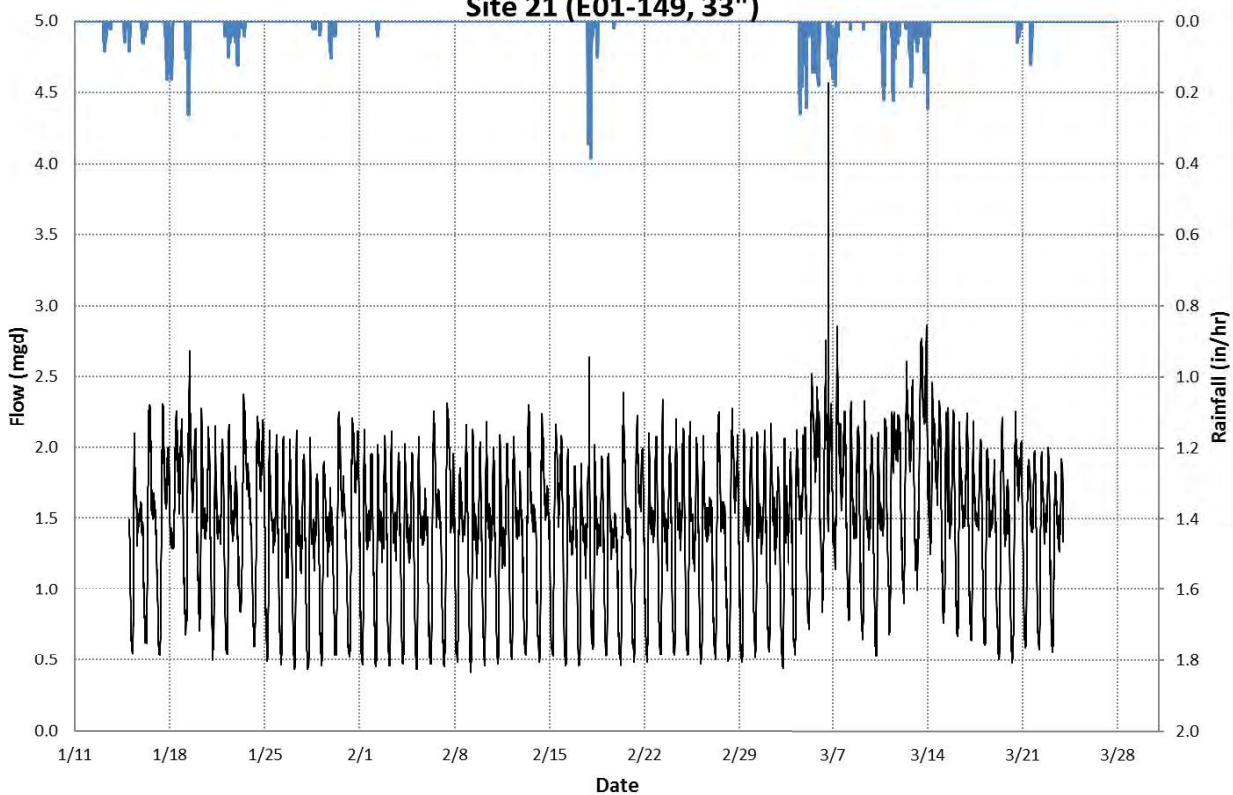
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 20 (C07-003, 24")**



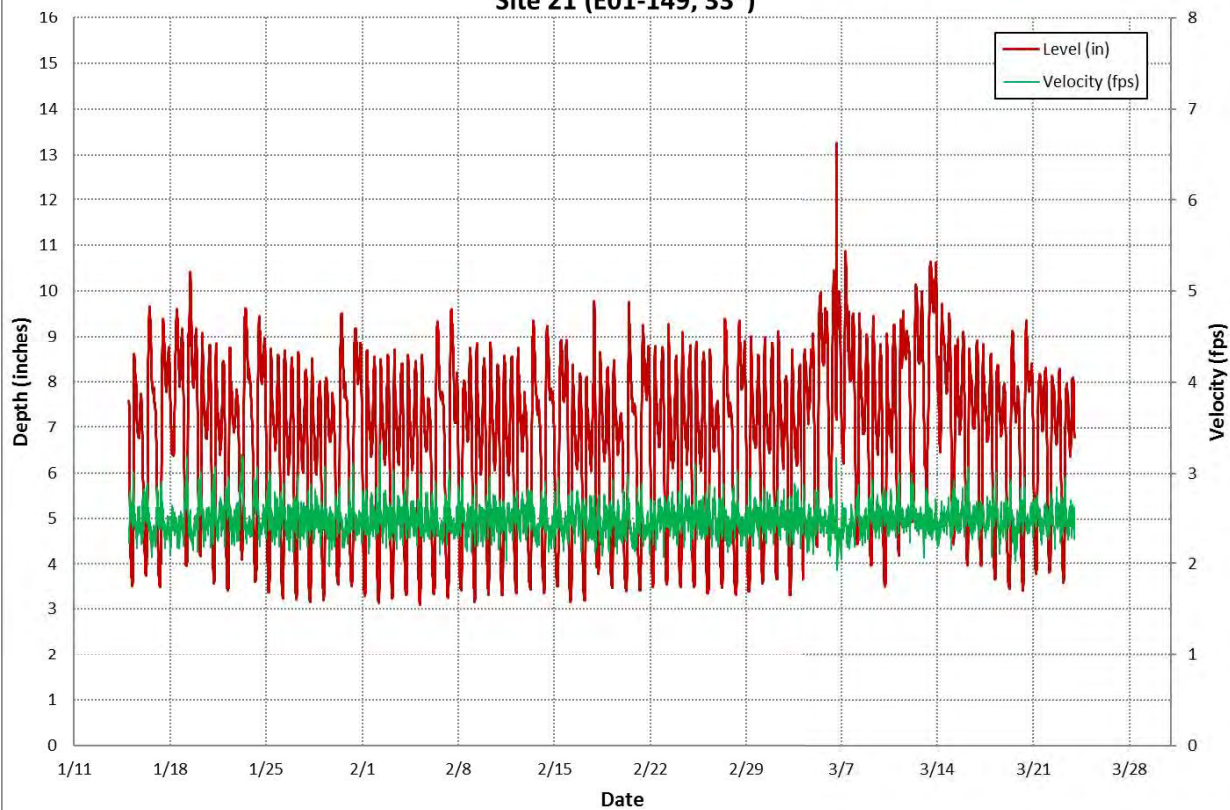
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 20 (C07-003, 24")**



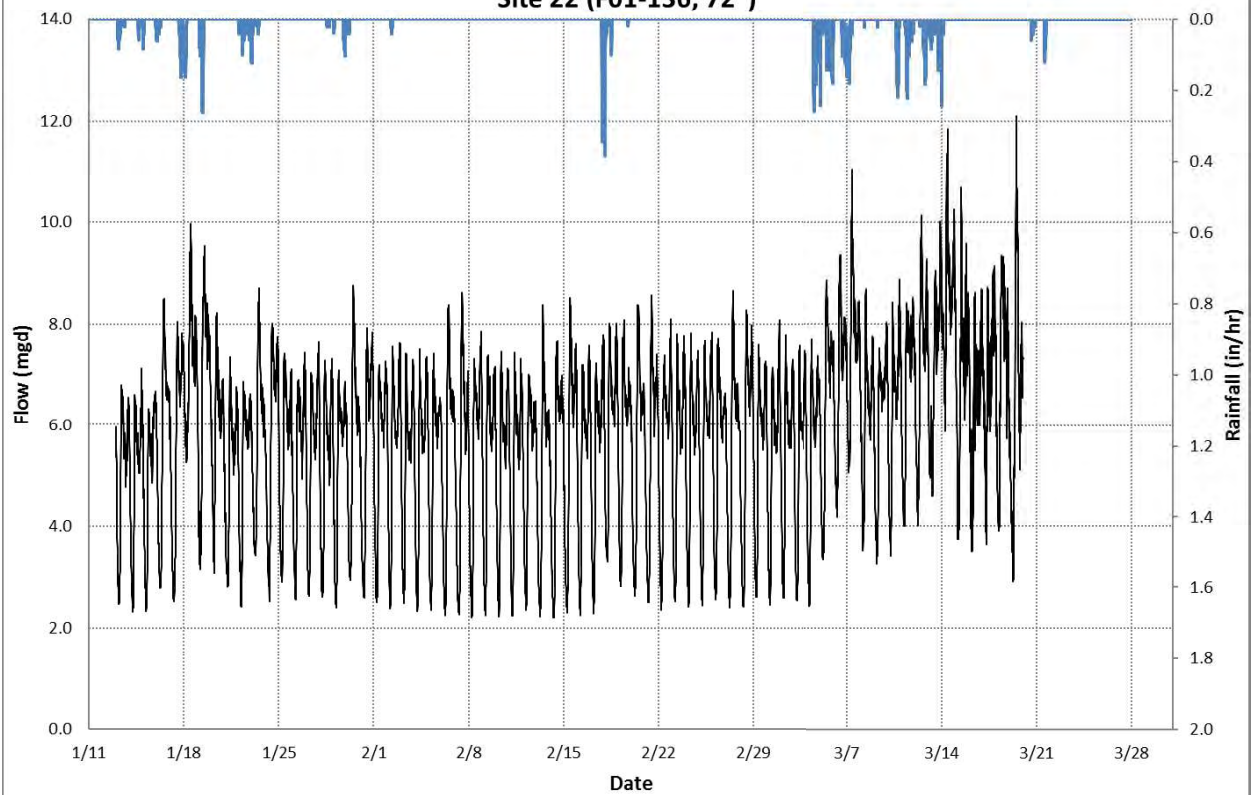
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 21 (E01-149, 33")**



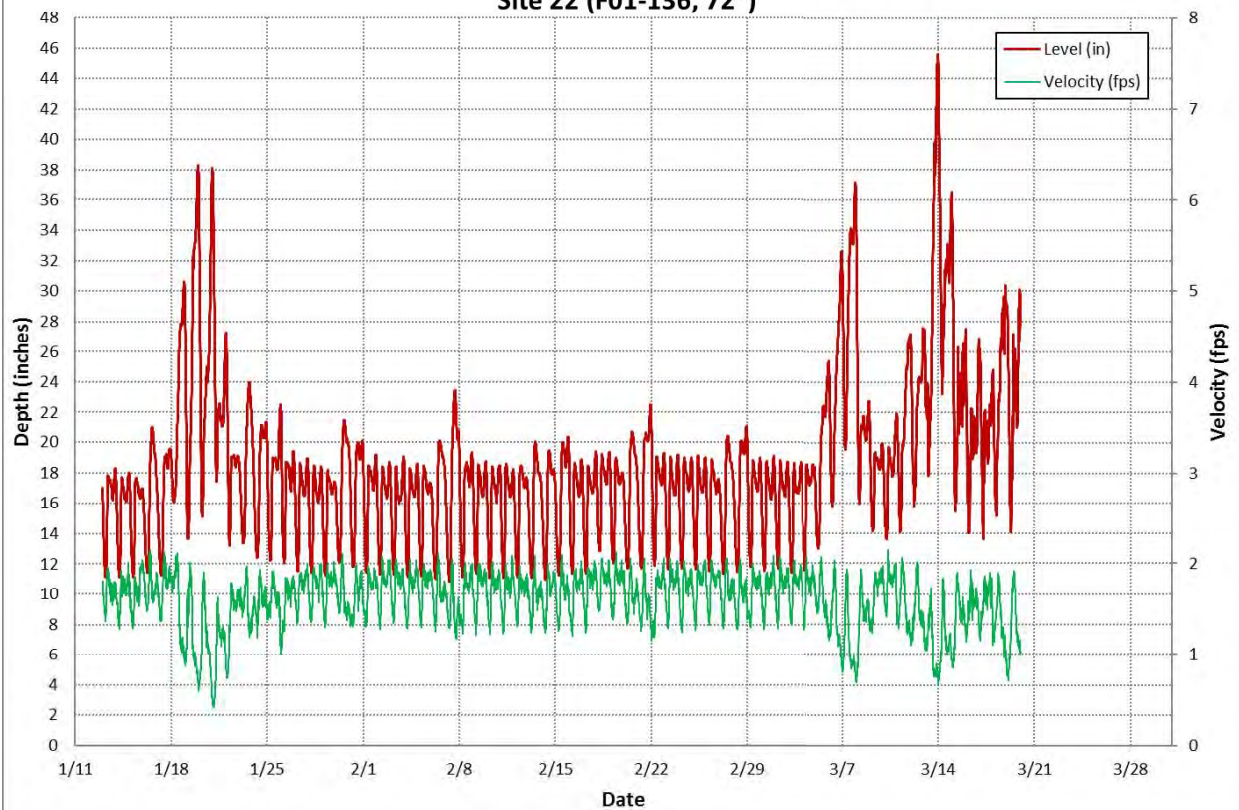
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 21 (E01-149, 33")**



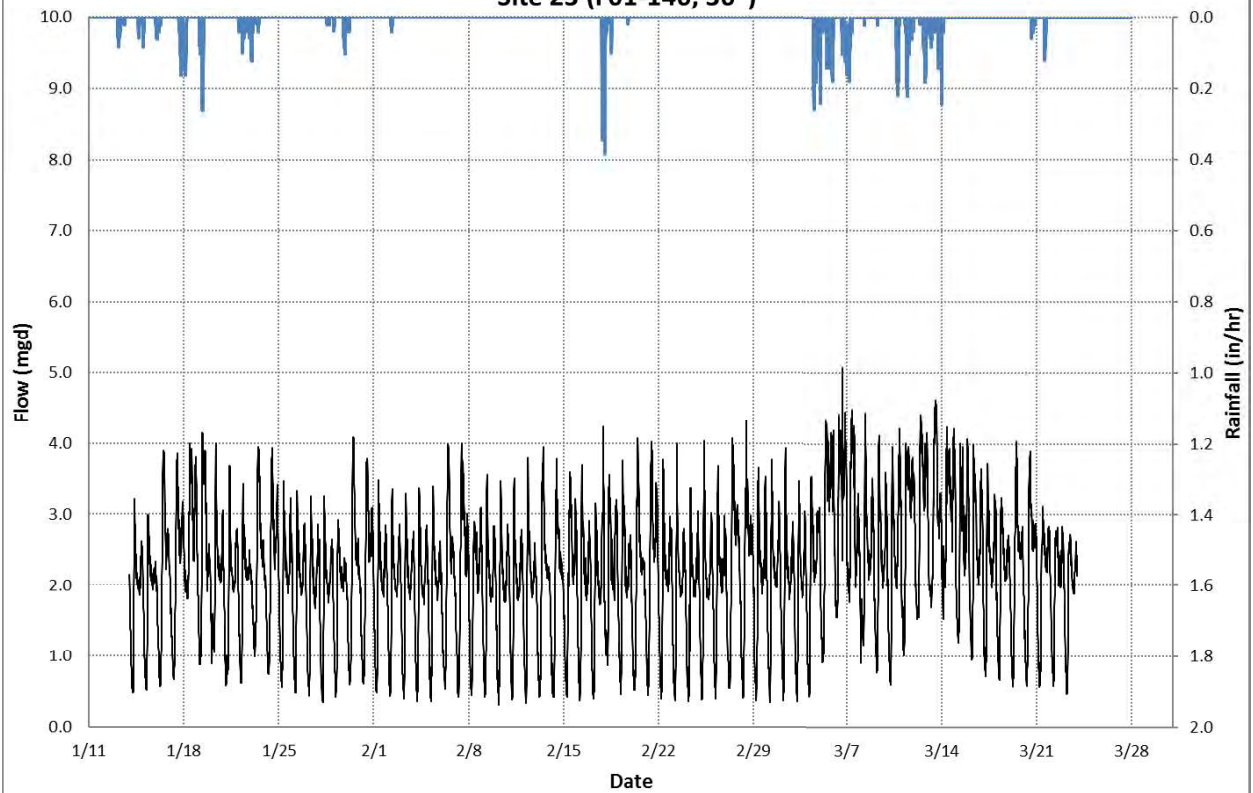
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 22 (F01-136, 72")



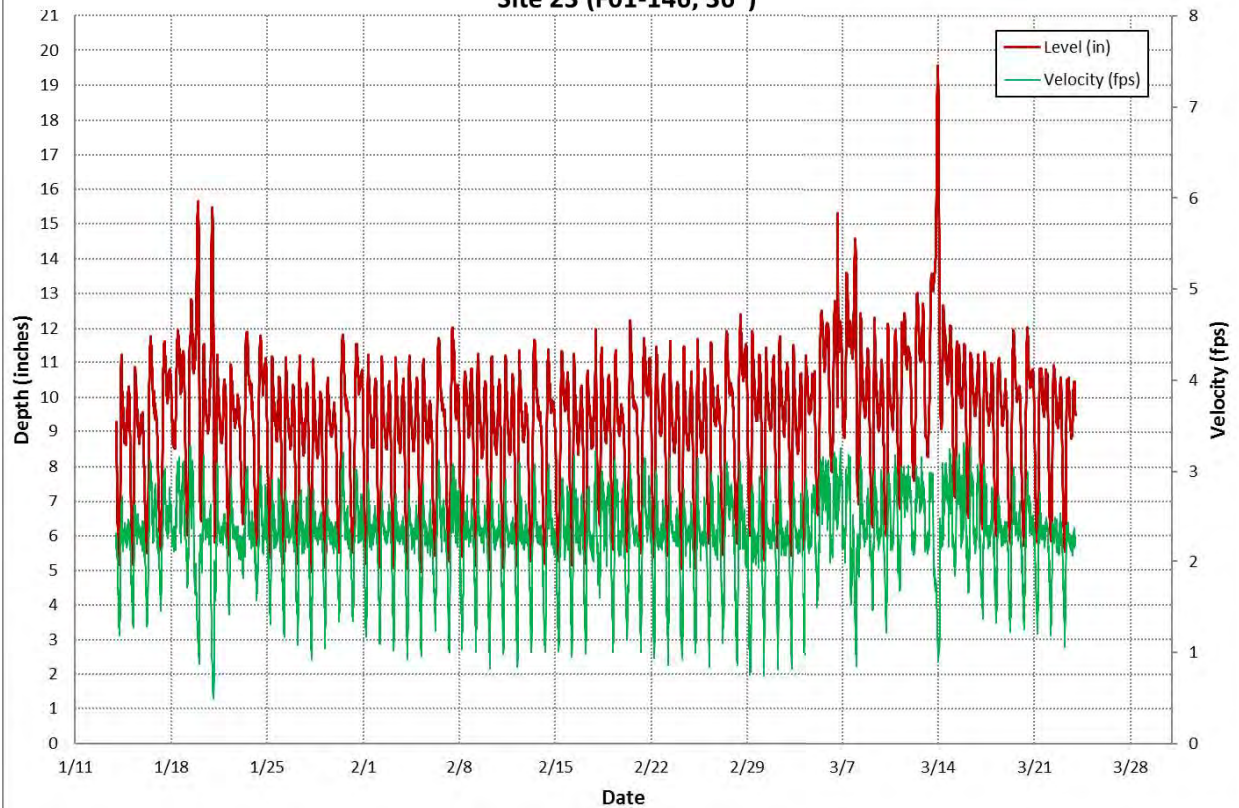
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 22 (F01-136, 72")

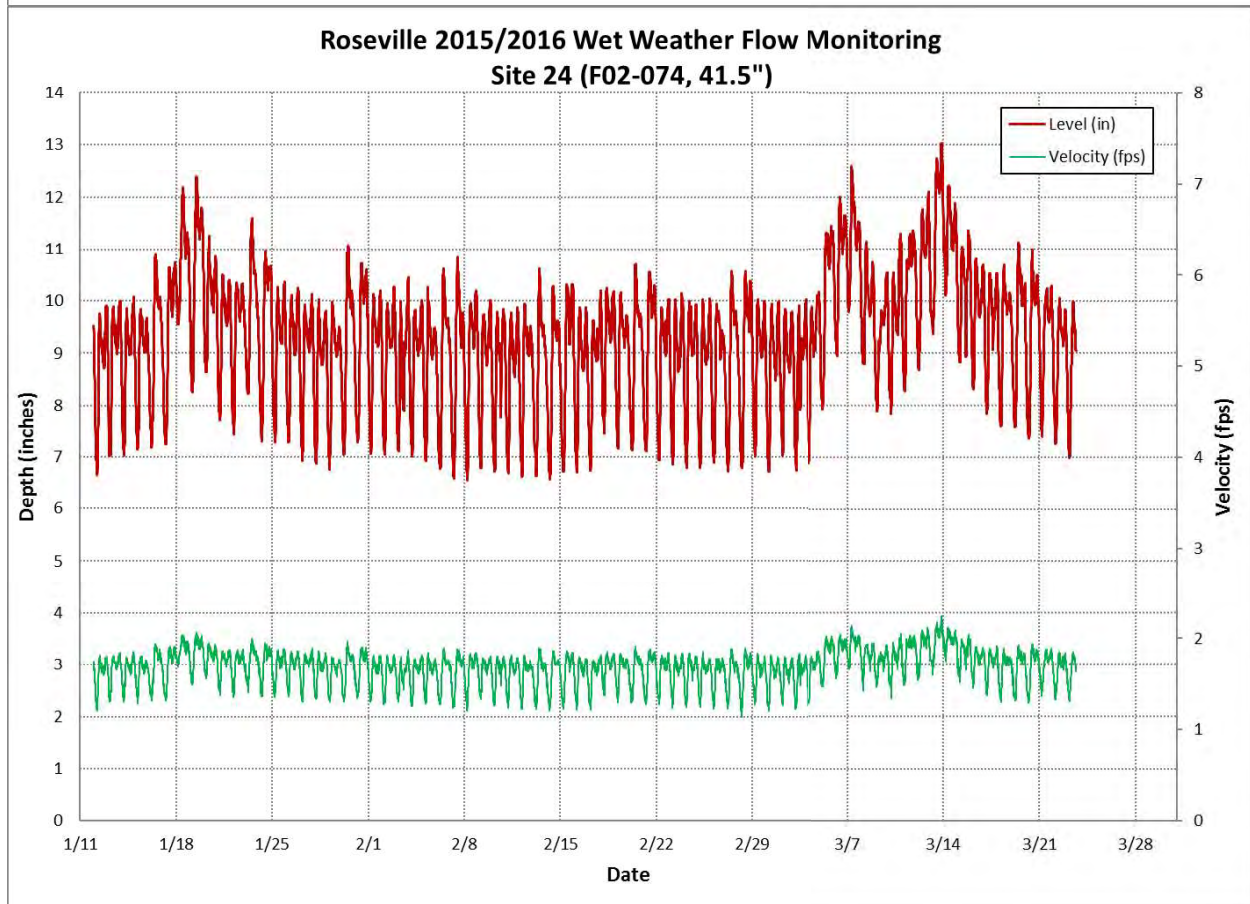
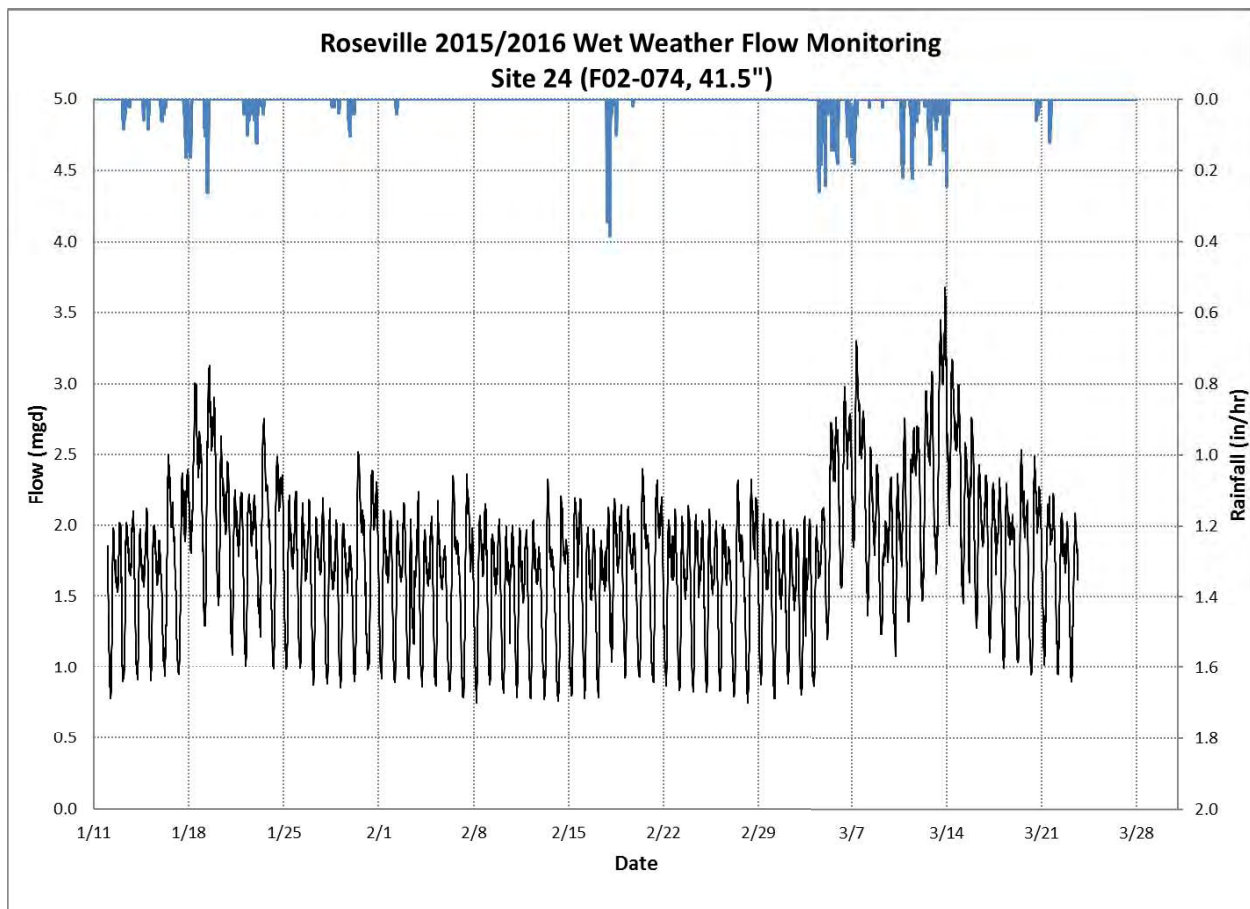


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 23 (F01-146, 36")

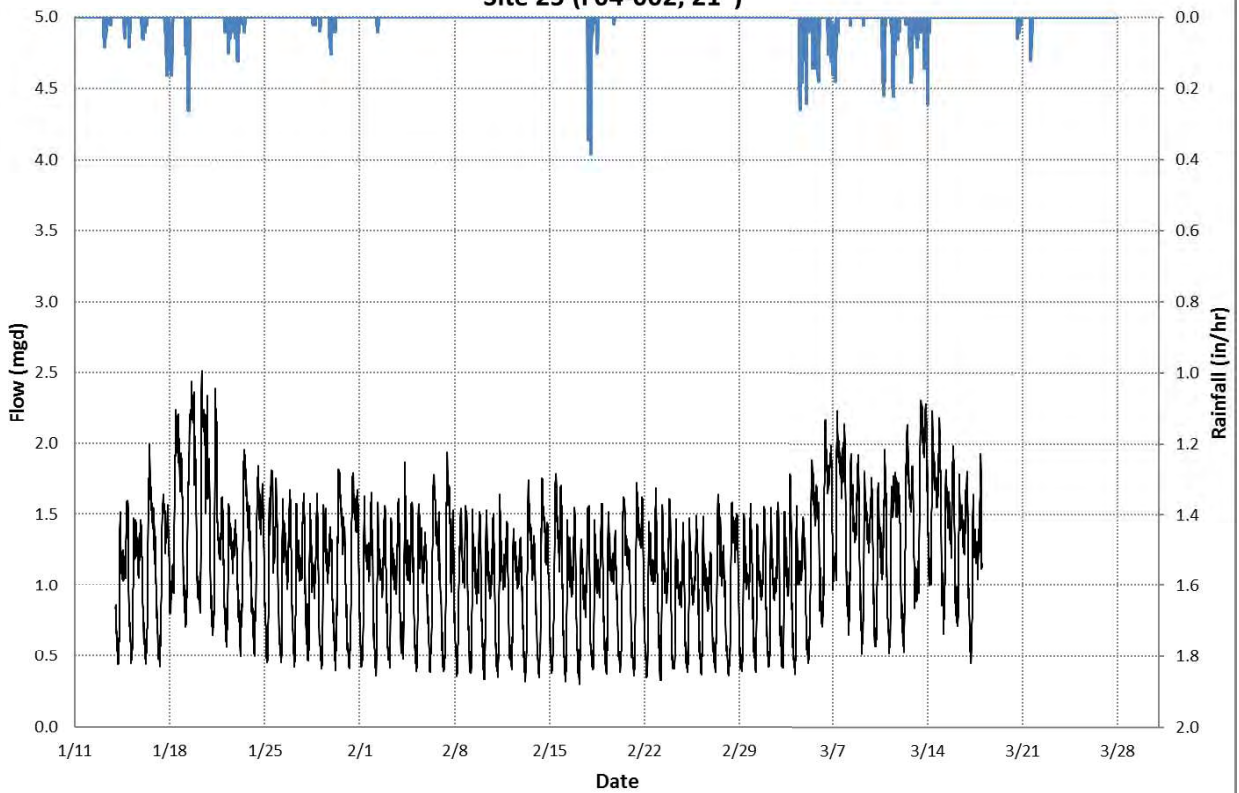


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 23 (F01-146, 36")

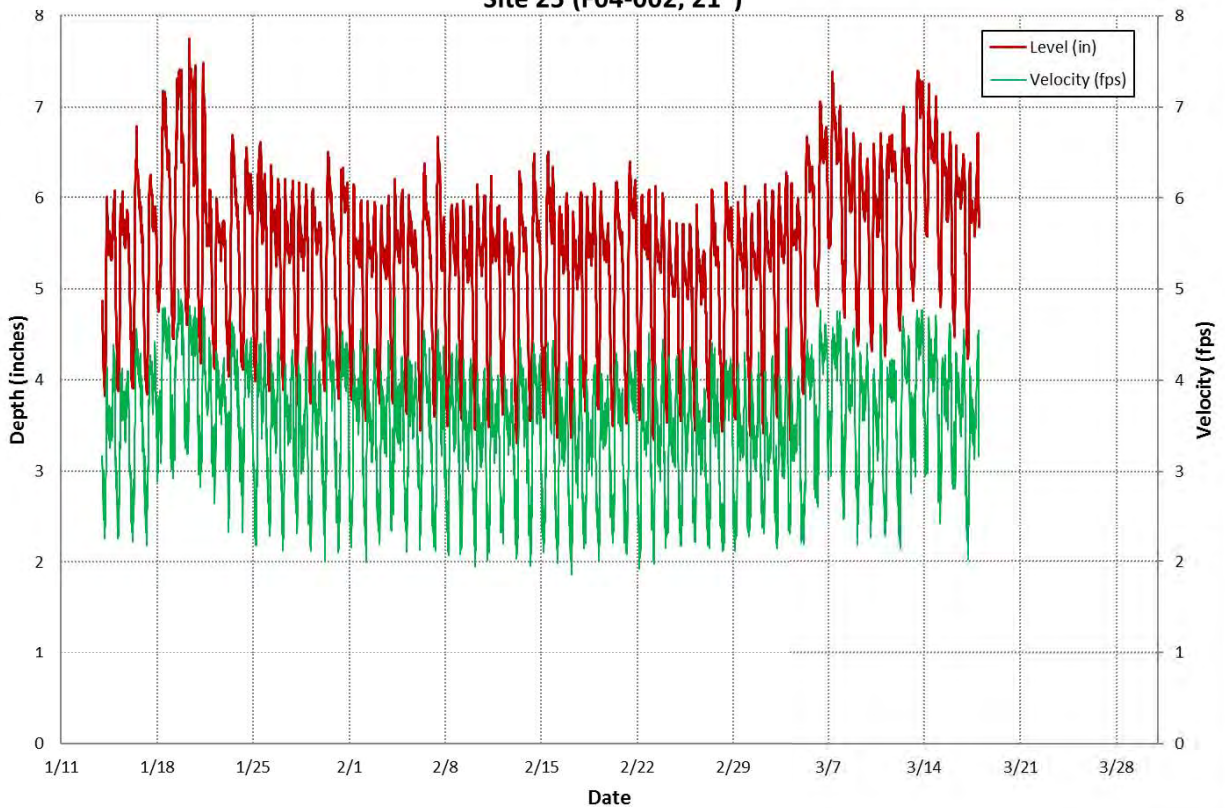




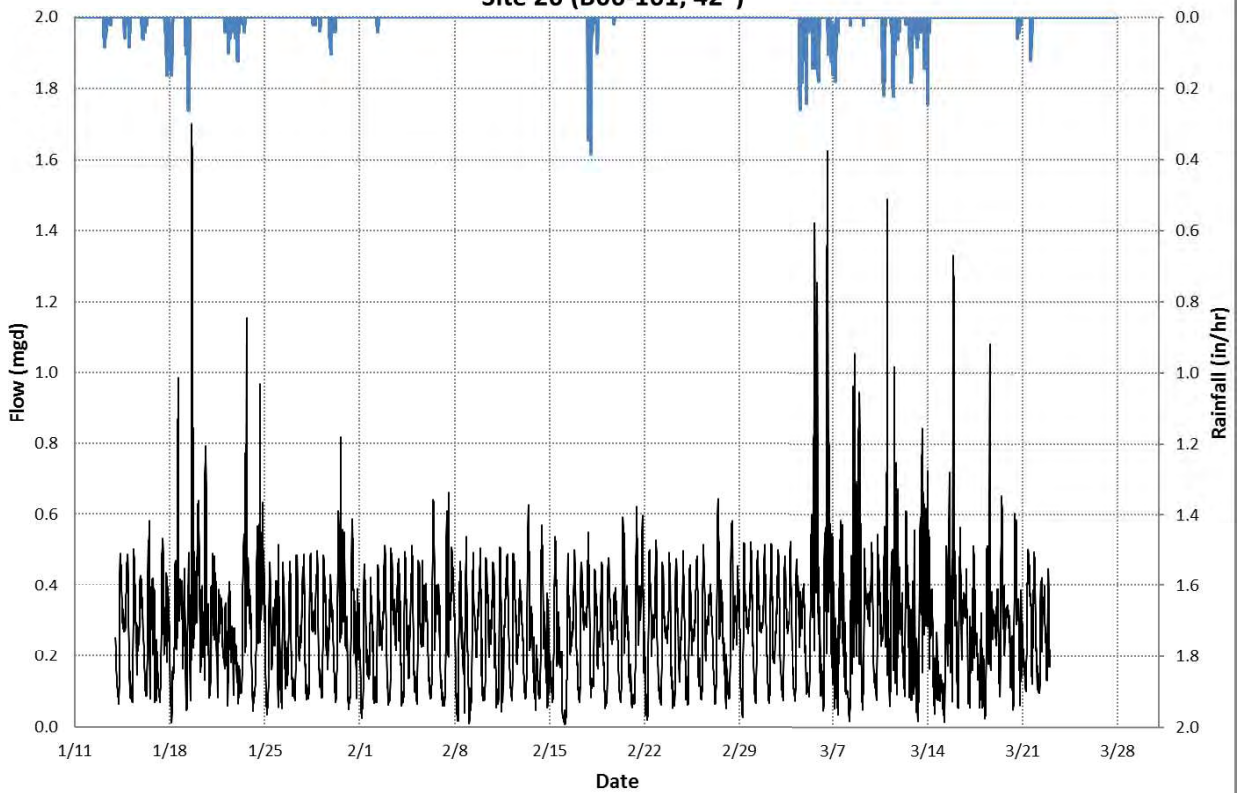
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 25 (F04-002, 21")



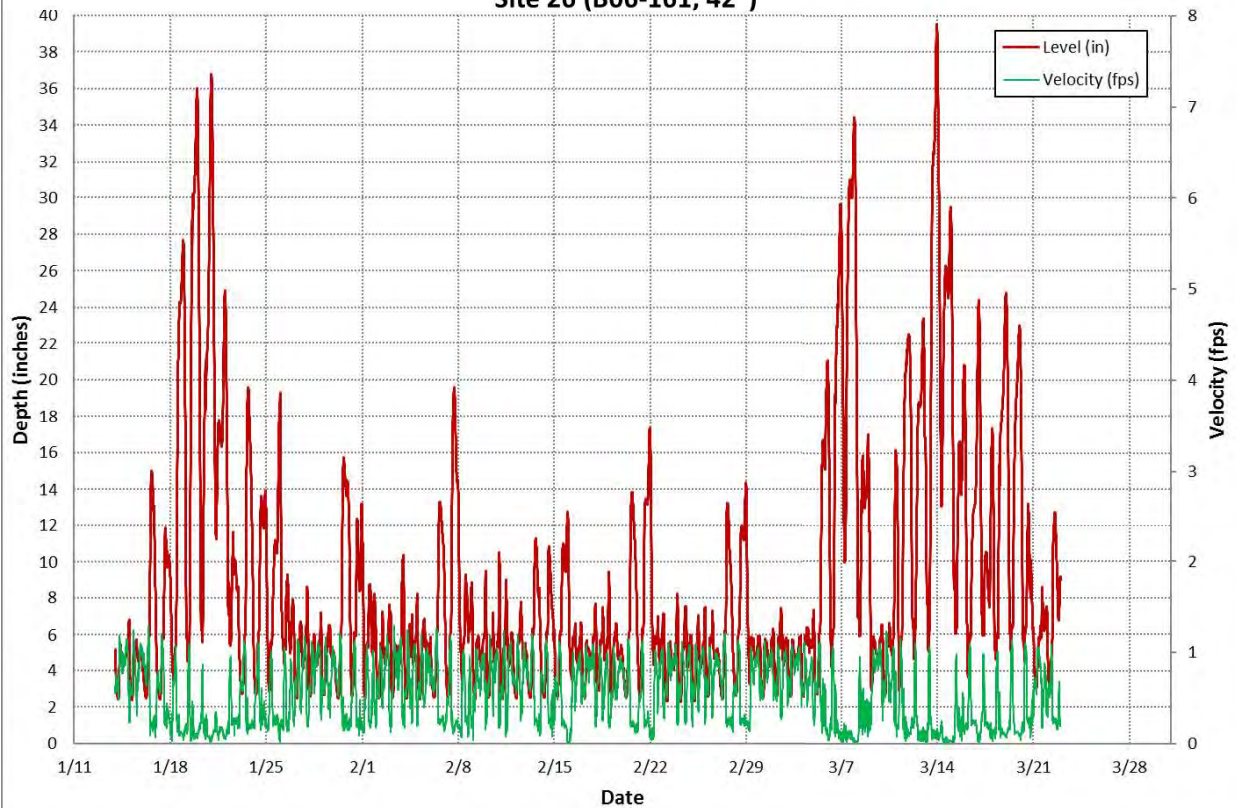
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 25 (F04-002, 21")



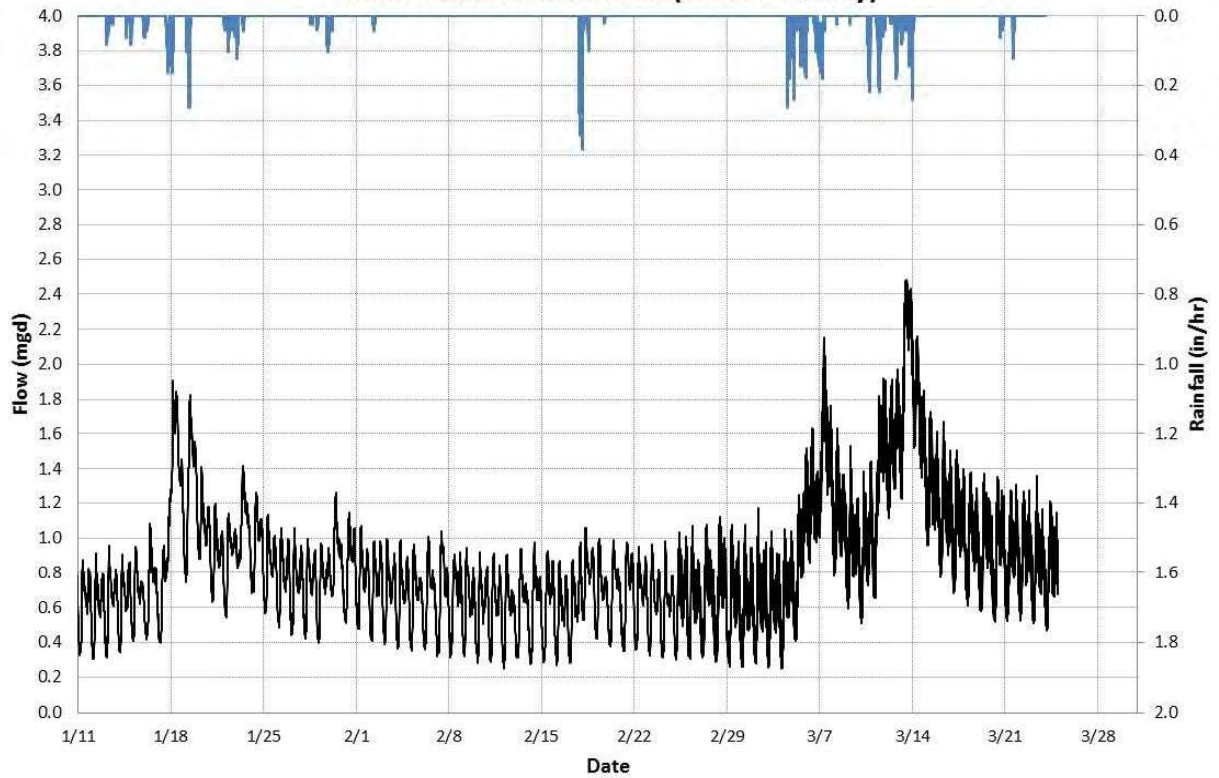
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 26 (B06-161, 42")**



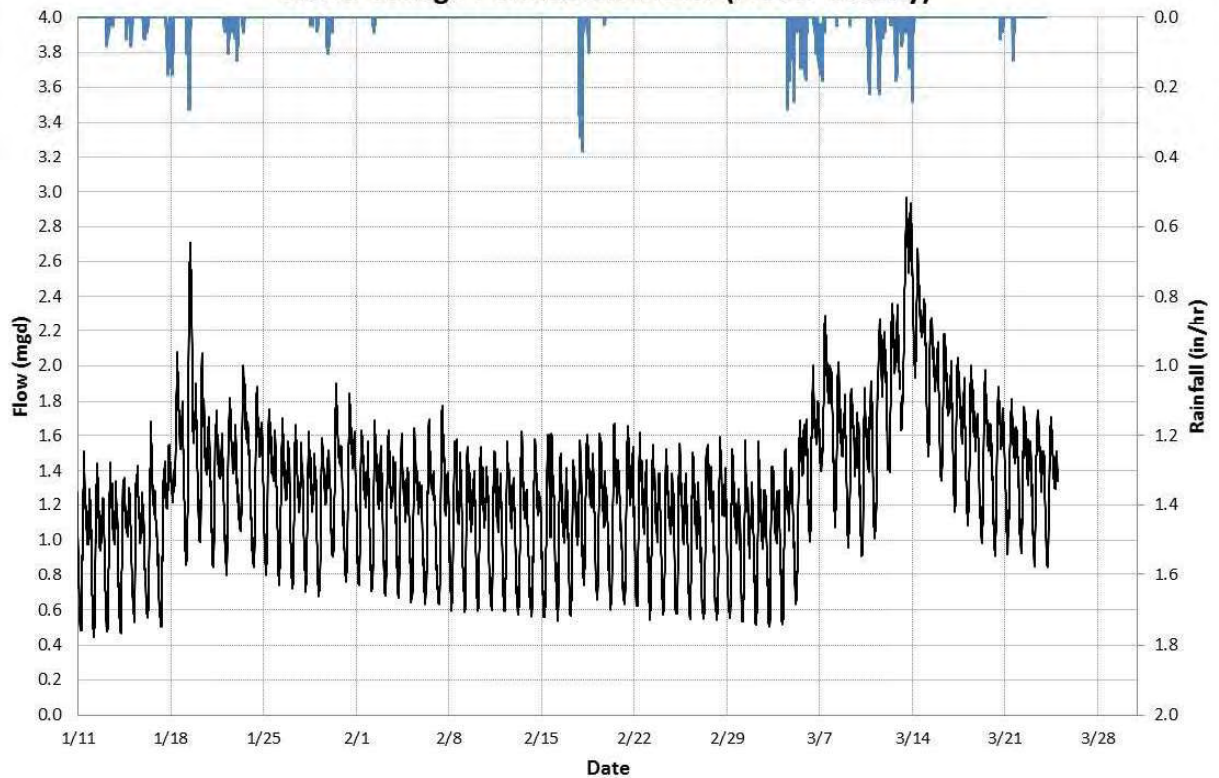
**Roseville 2015/2016 Wet Weather Flow Monitoring
Site 26 (B06-161, 42")**



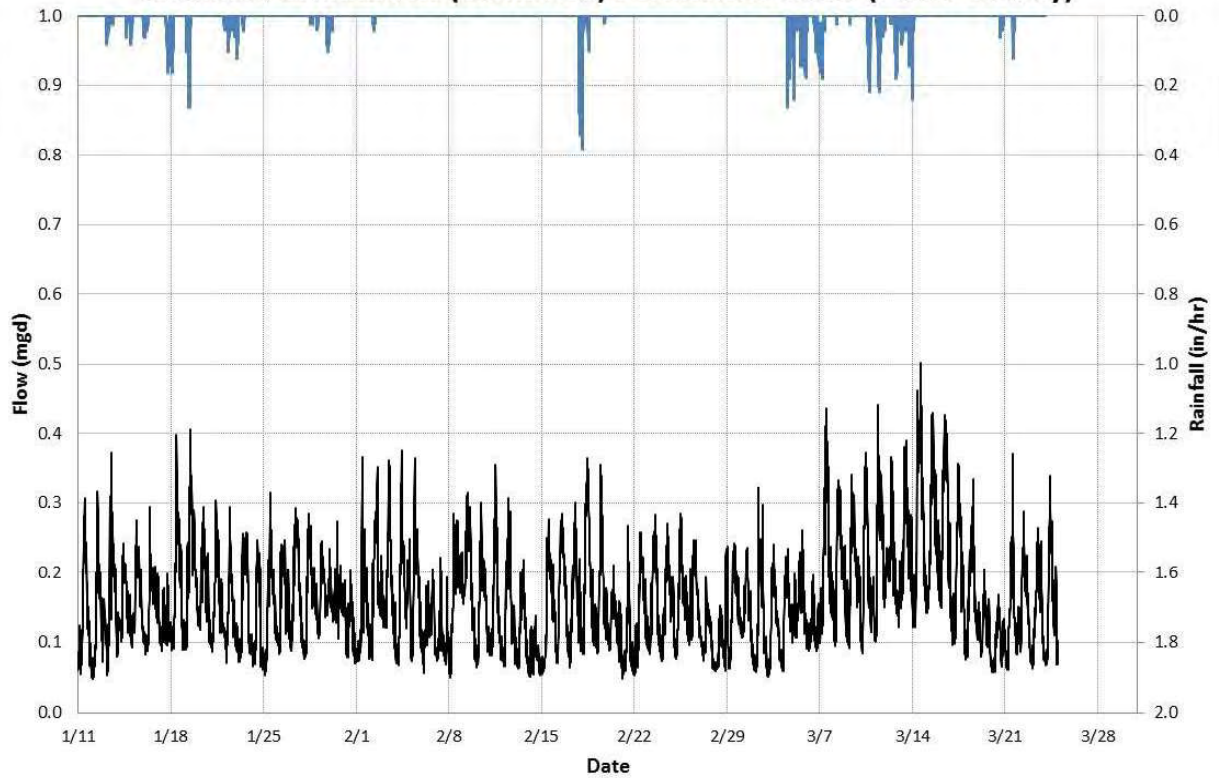
**Roseville 2016 Wet Weather Flow Monitoring
SMD2 Permanent Meter (Placer County)**



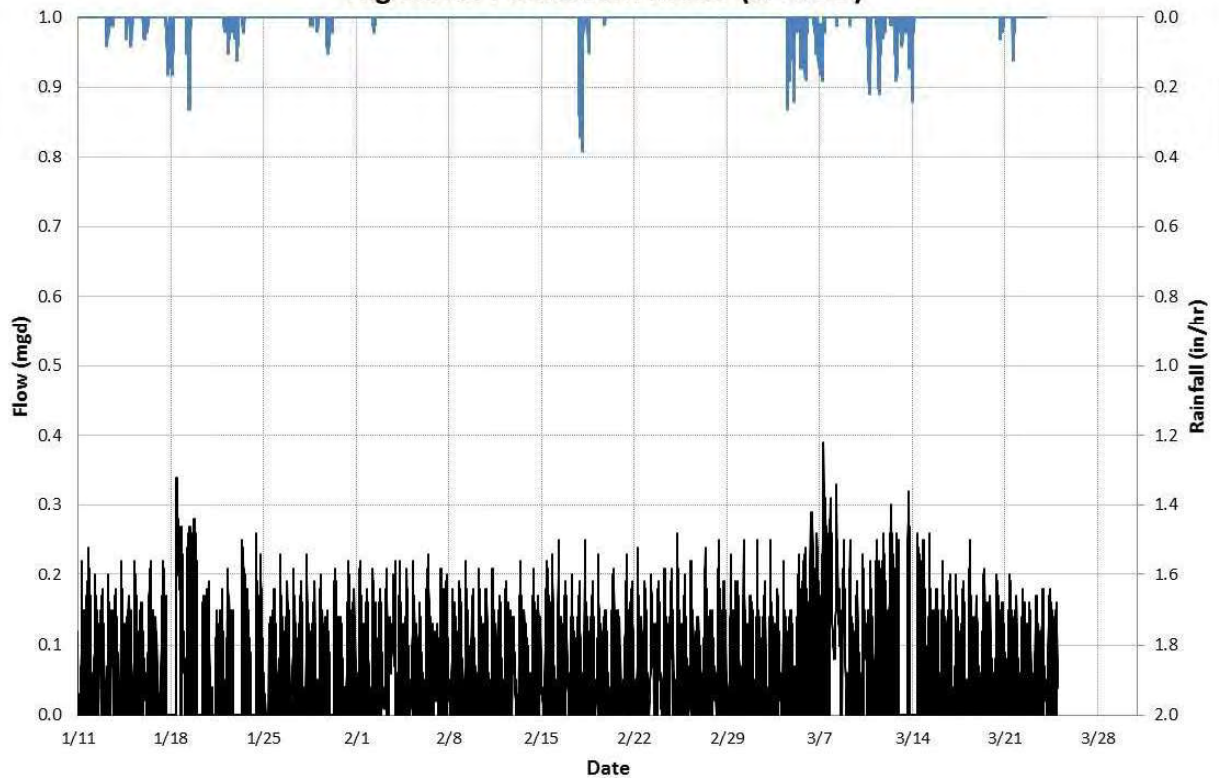
**Roseville 2016 Wet Weather Flow Monitoring
Sierra College Permanent Meter (Placer County)**



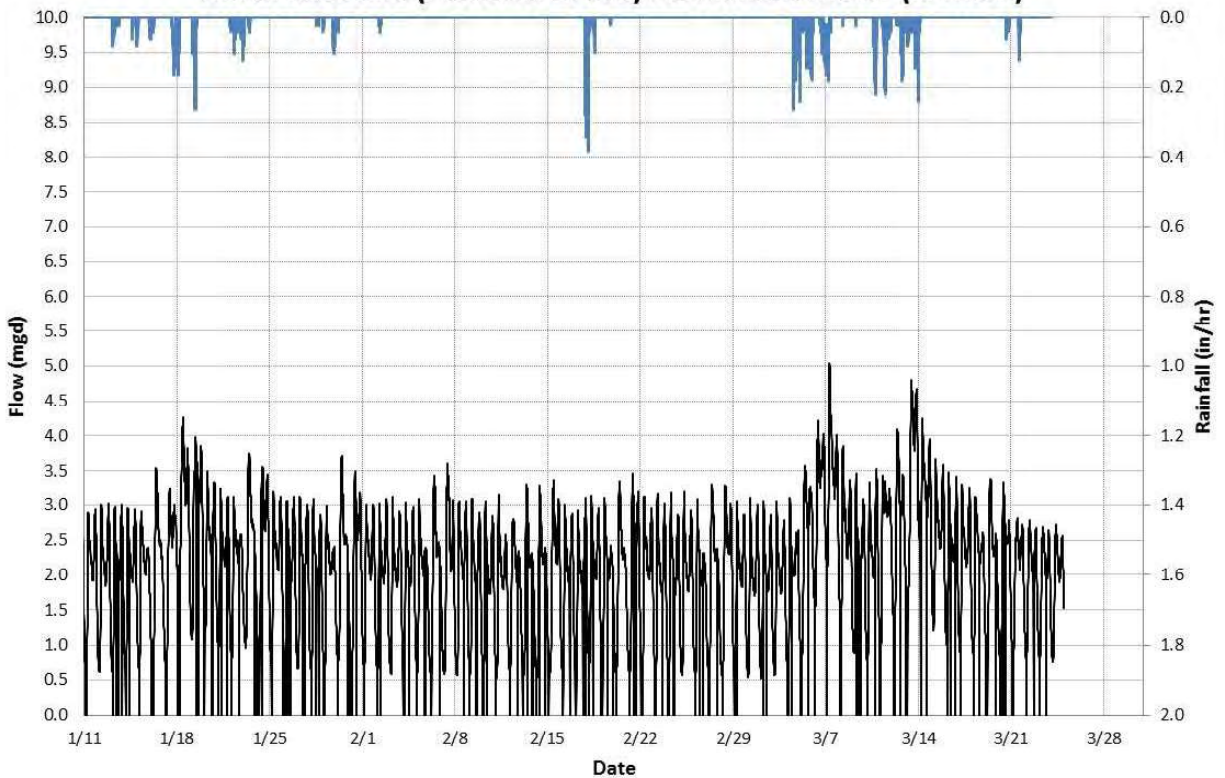
**Roseville 2016 Wet Weather Flow Monitoring
Cincinnati & Industrial (Combined) Permanent Meter (Placer County)**



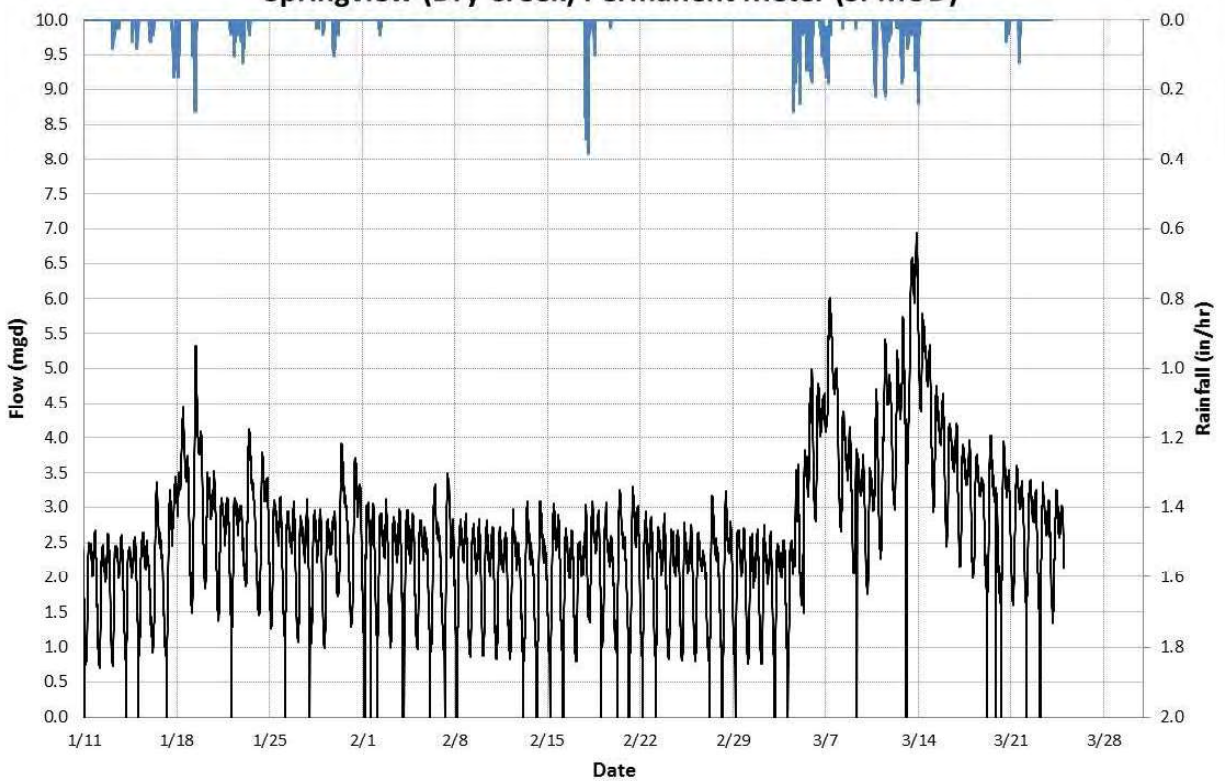
**Roseville 2016 Wet Weather Flow Monitoring
Highlands Permanent Meter (SPMUD)**

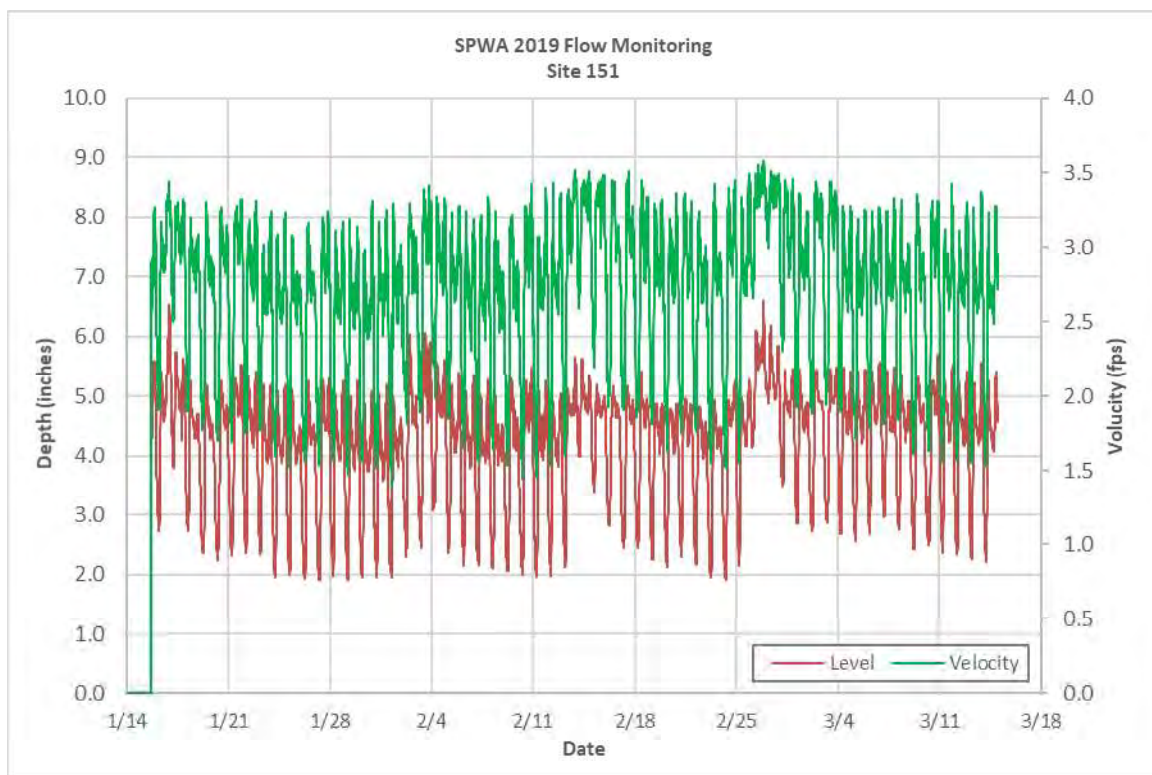
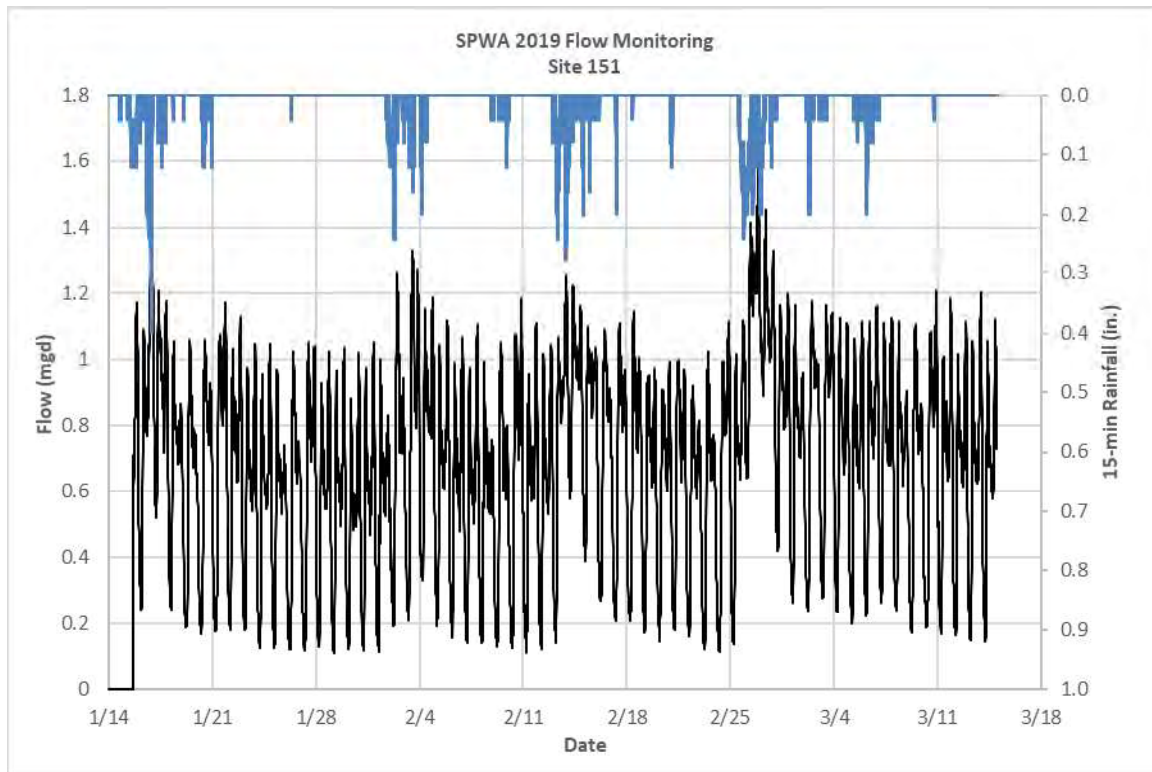


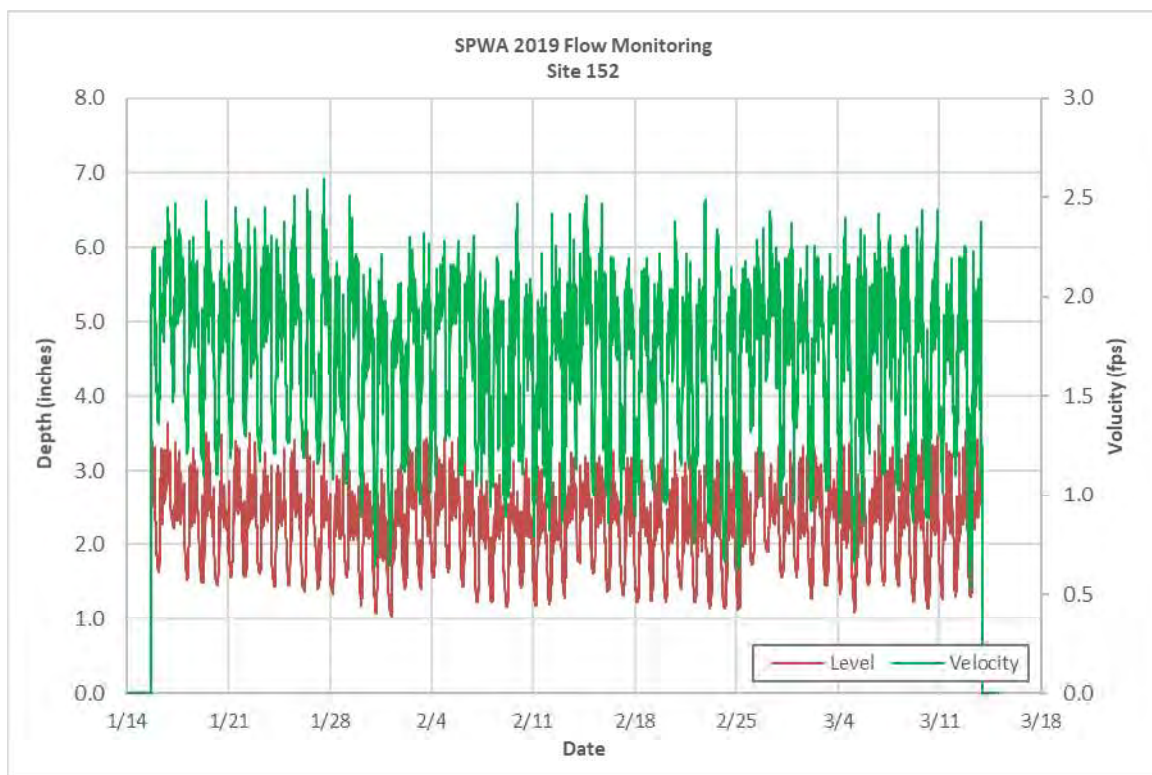
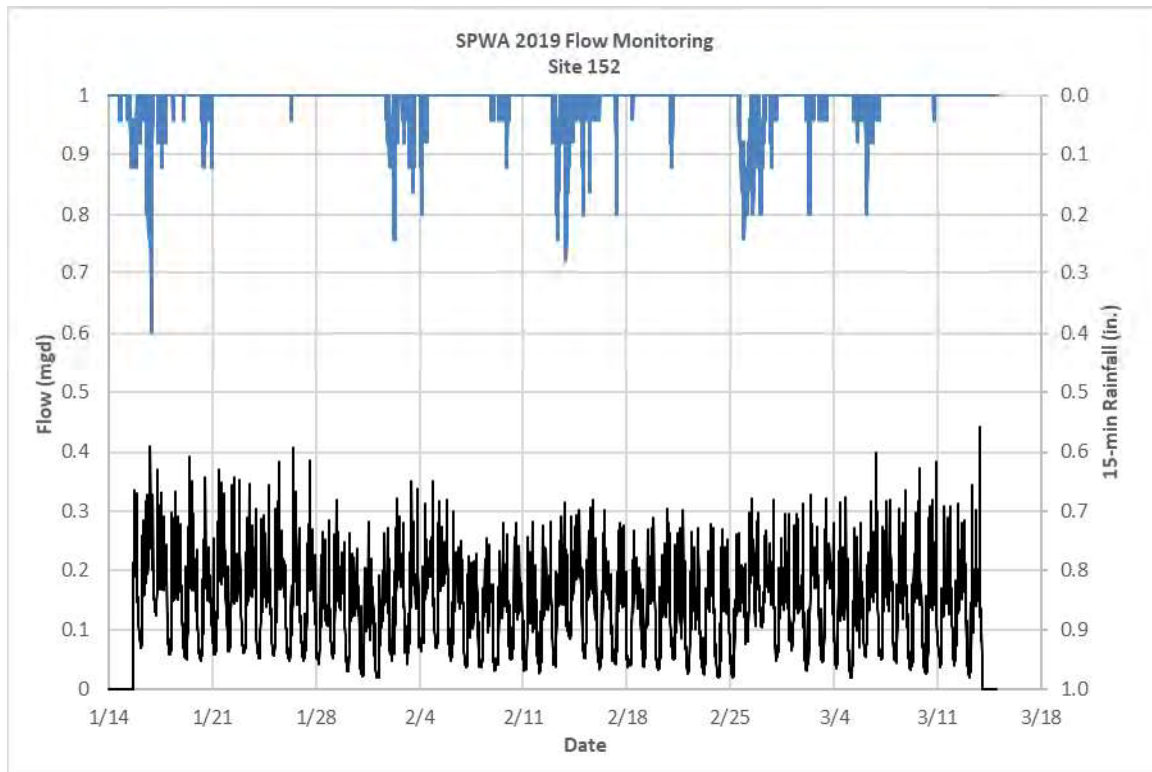
**Roseville 2016 Wet Weather Flow Monitoring
North Roseville (Pleasant Grove) Permanent Meter (SPMUD)**

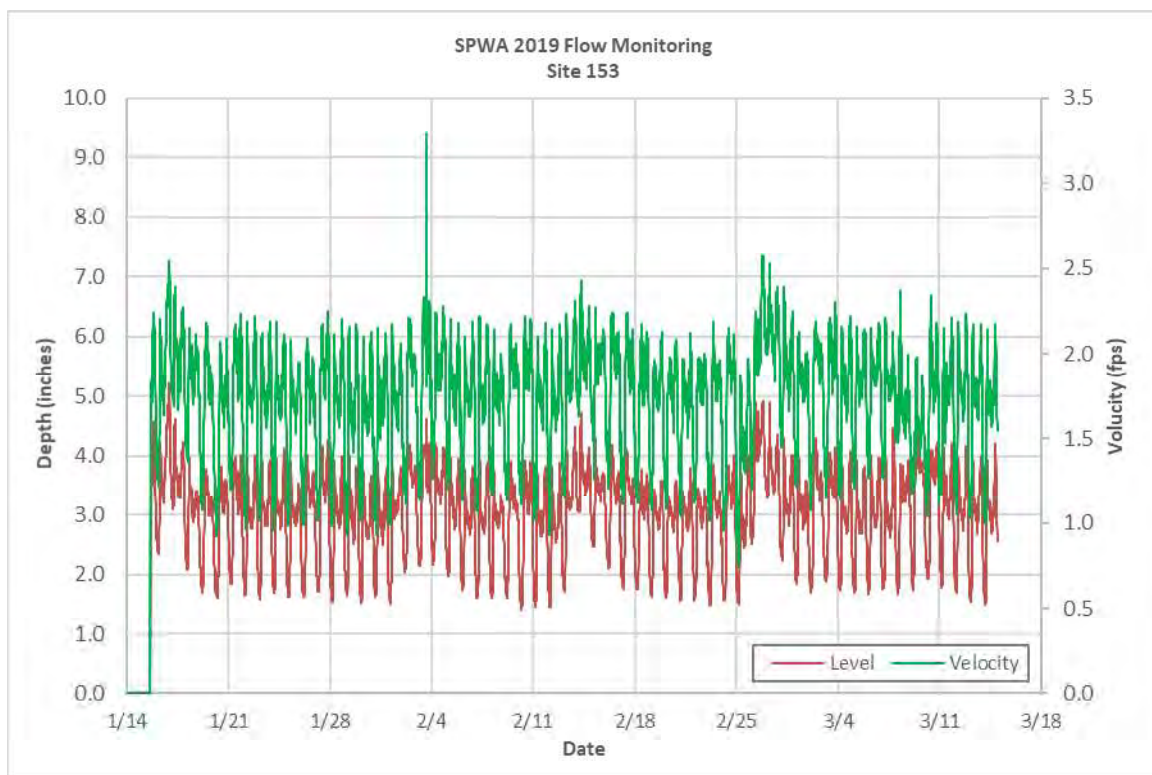
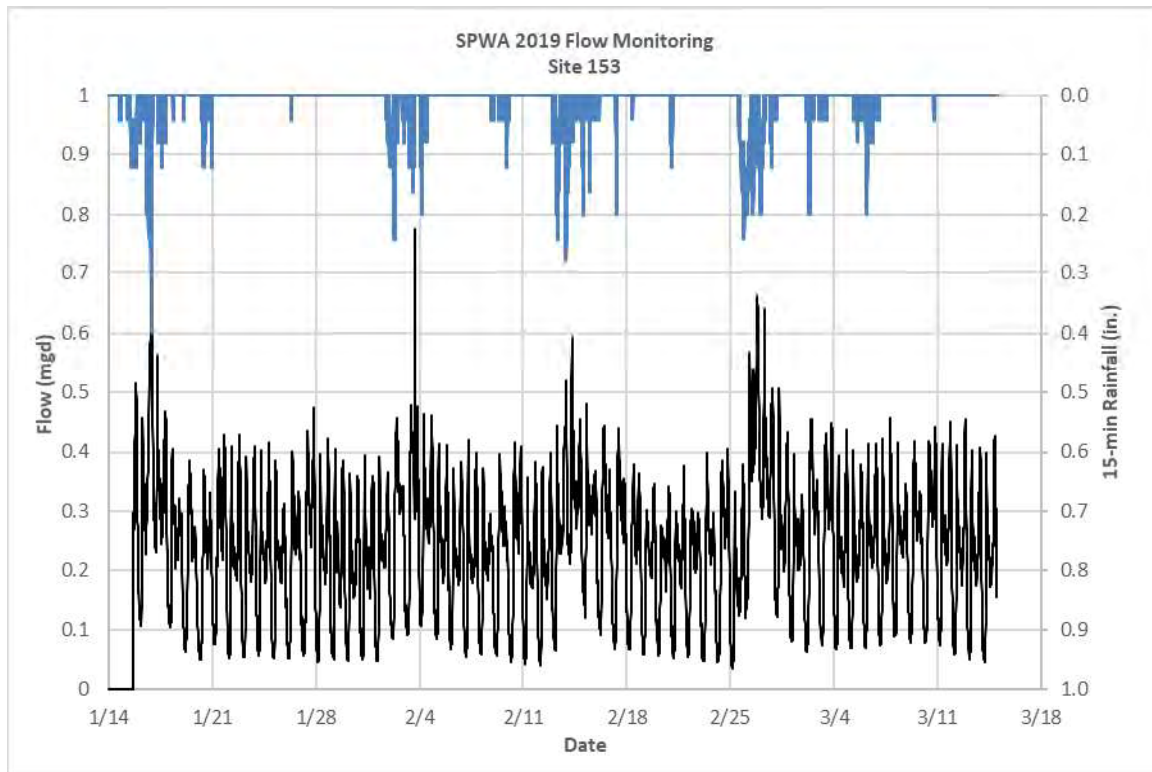


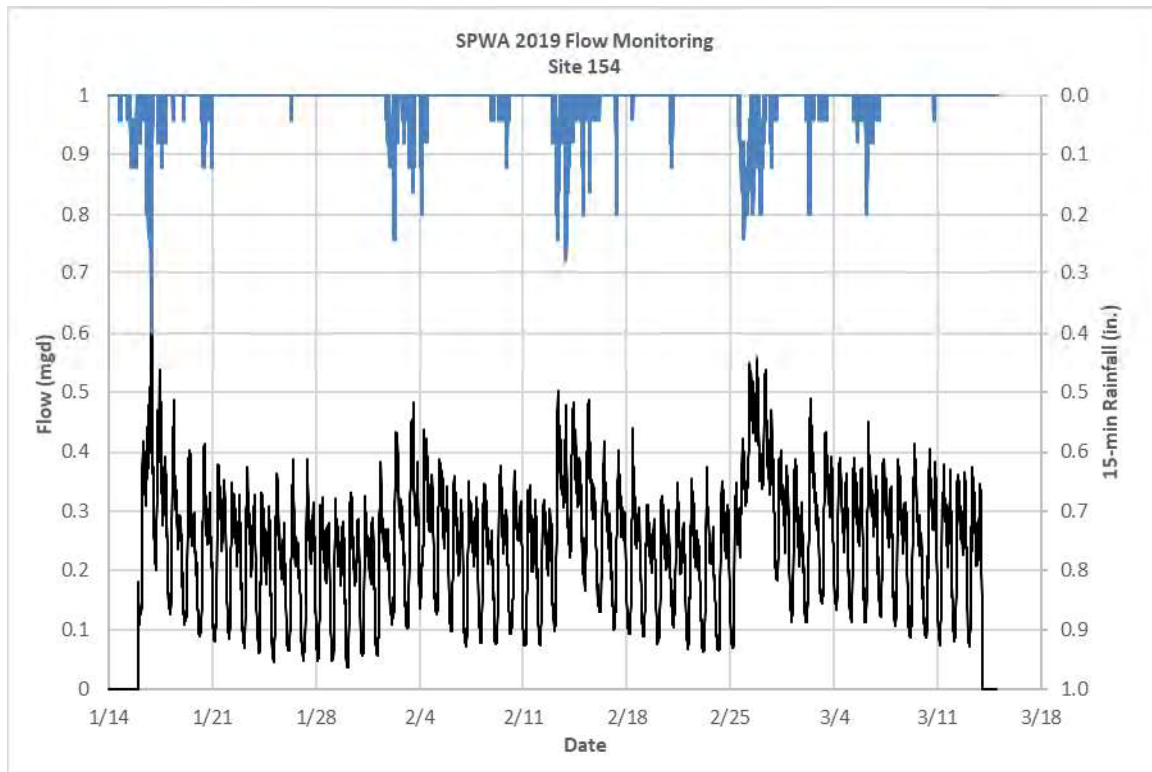
**Roseville 2016 Wet Weather Flow Monitoring
Springview (Dry Creek) Permanent Meter (SPMUD)**

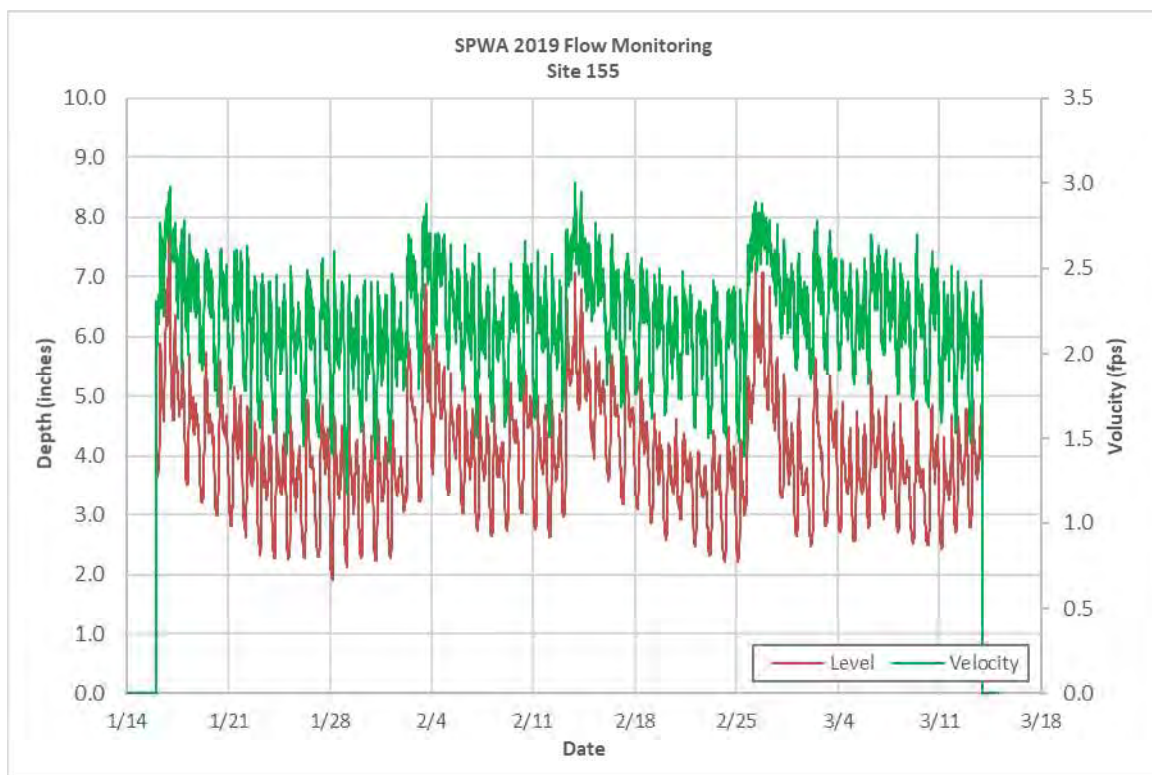
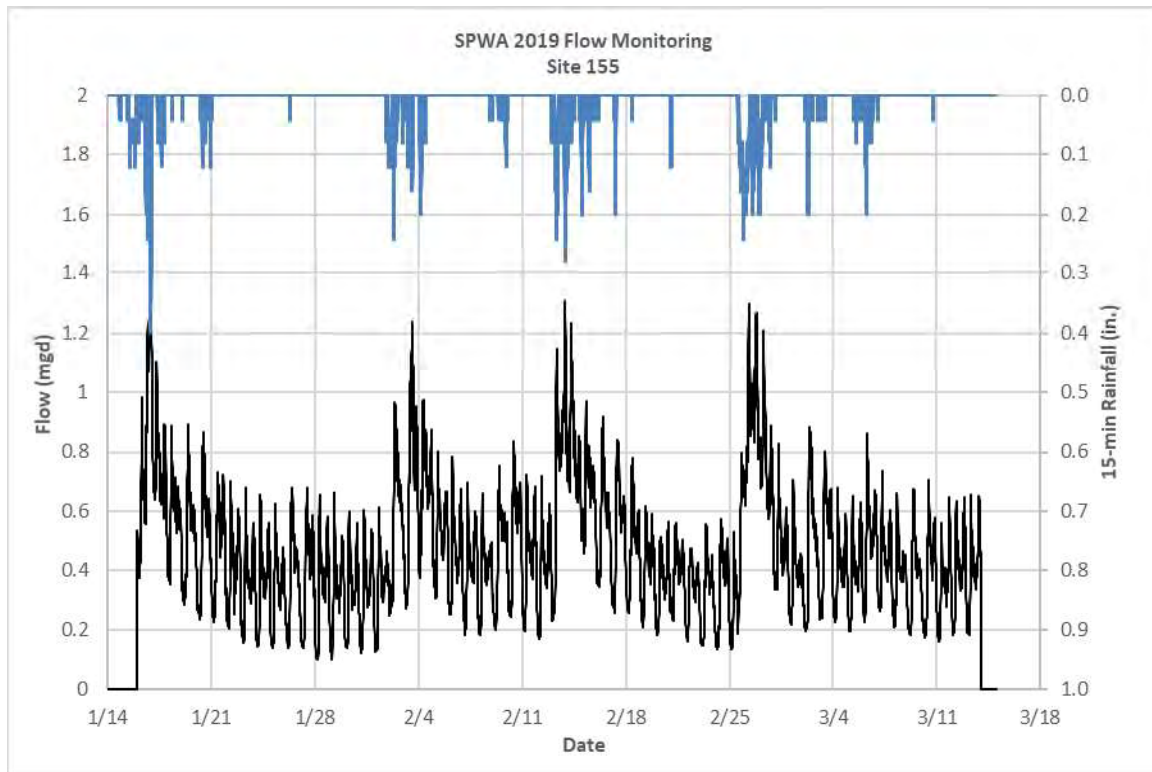


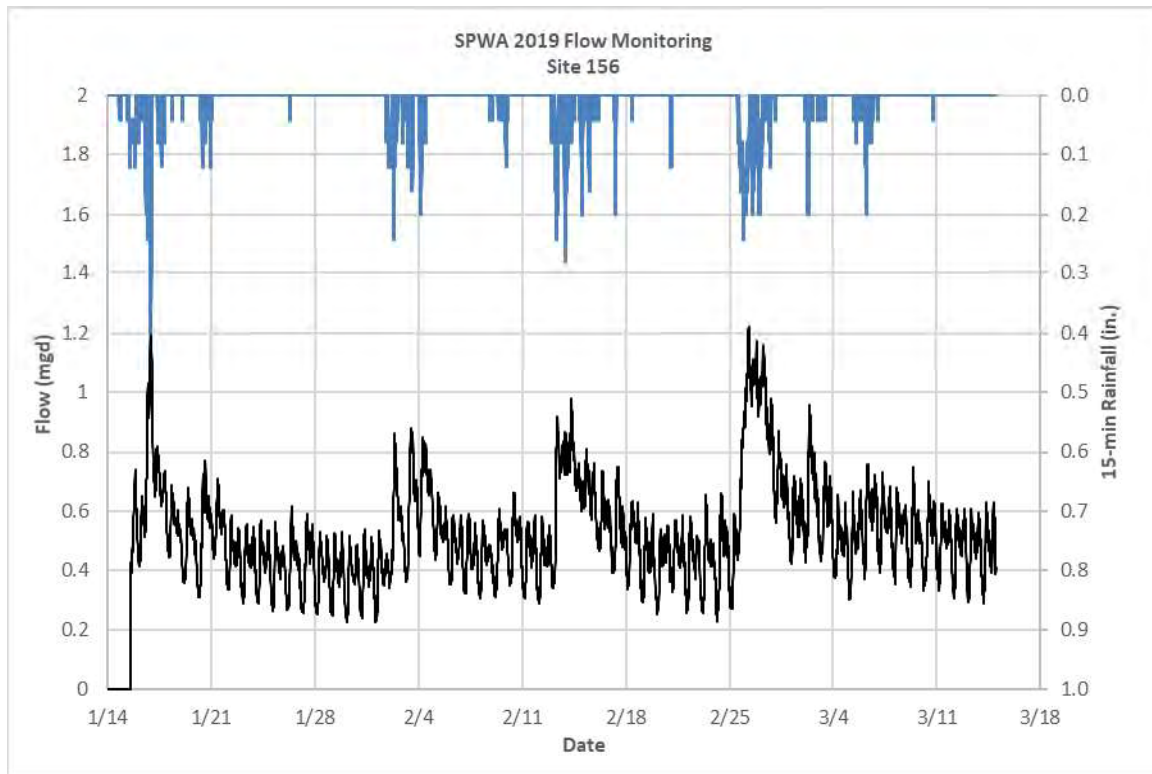


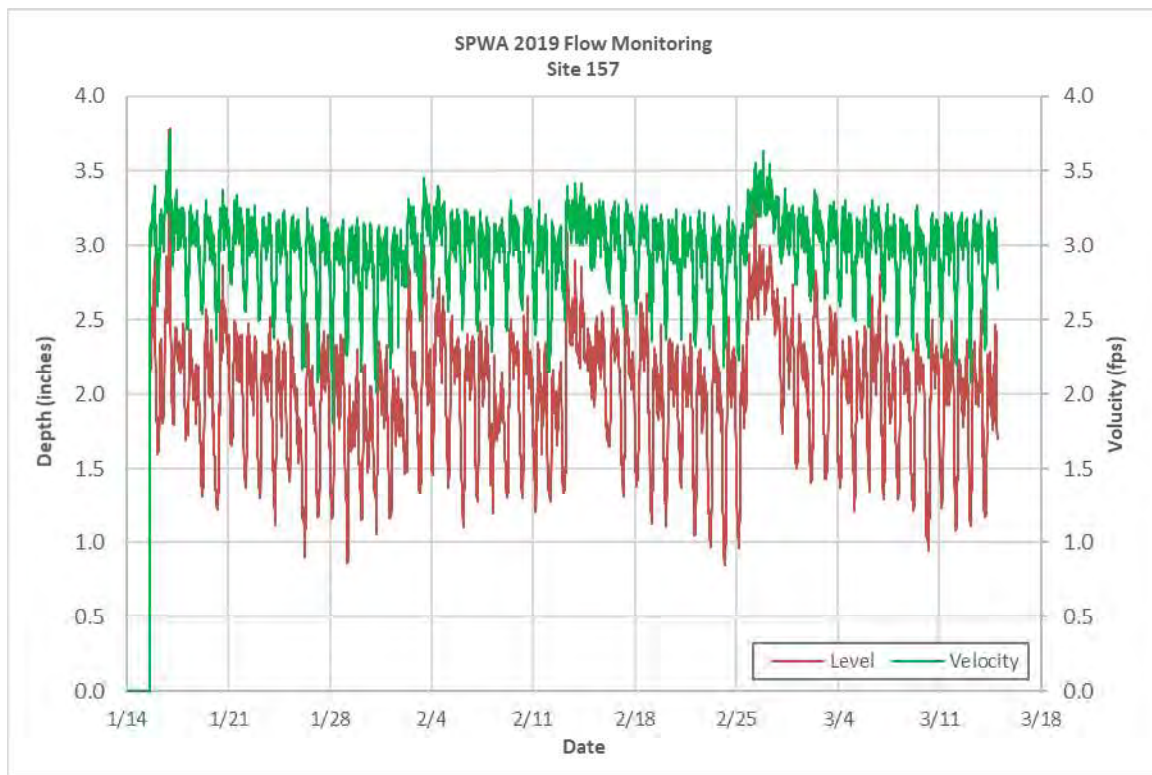
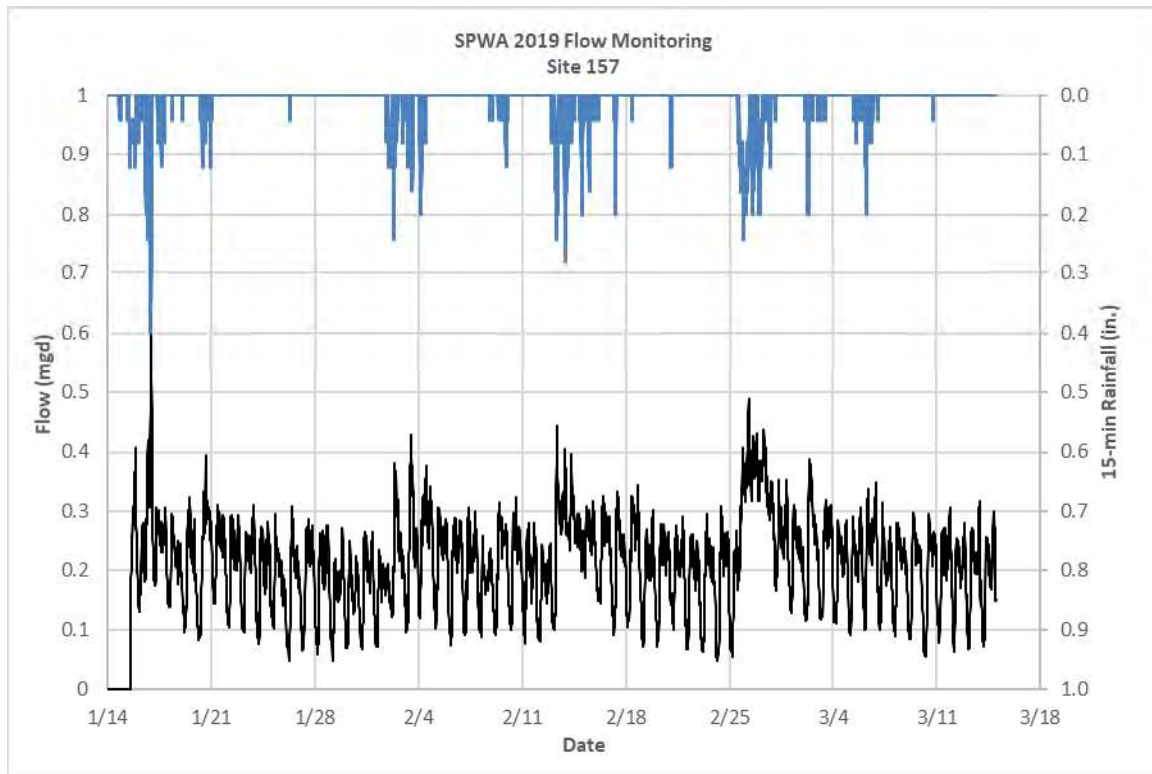


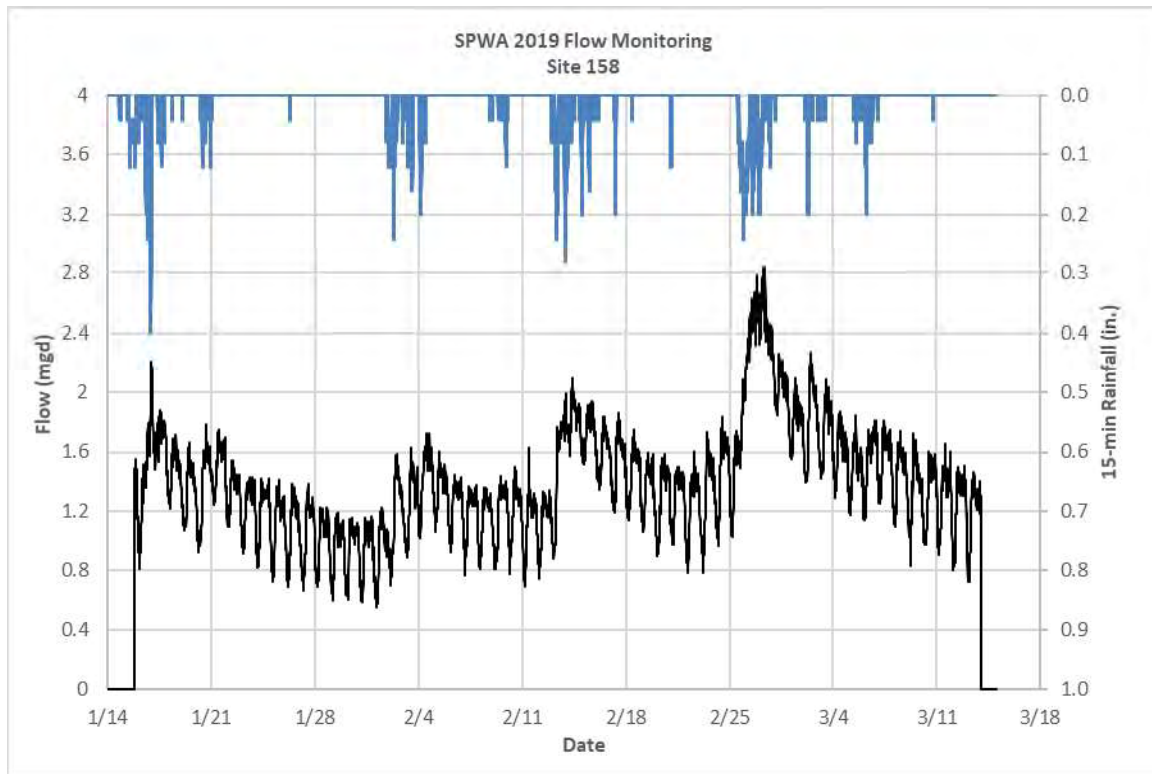


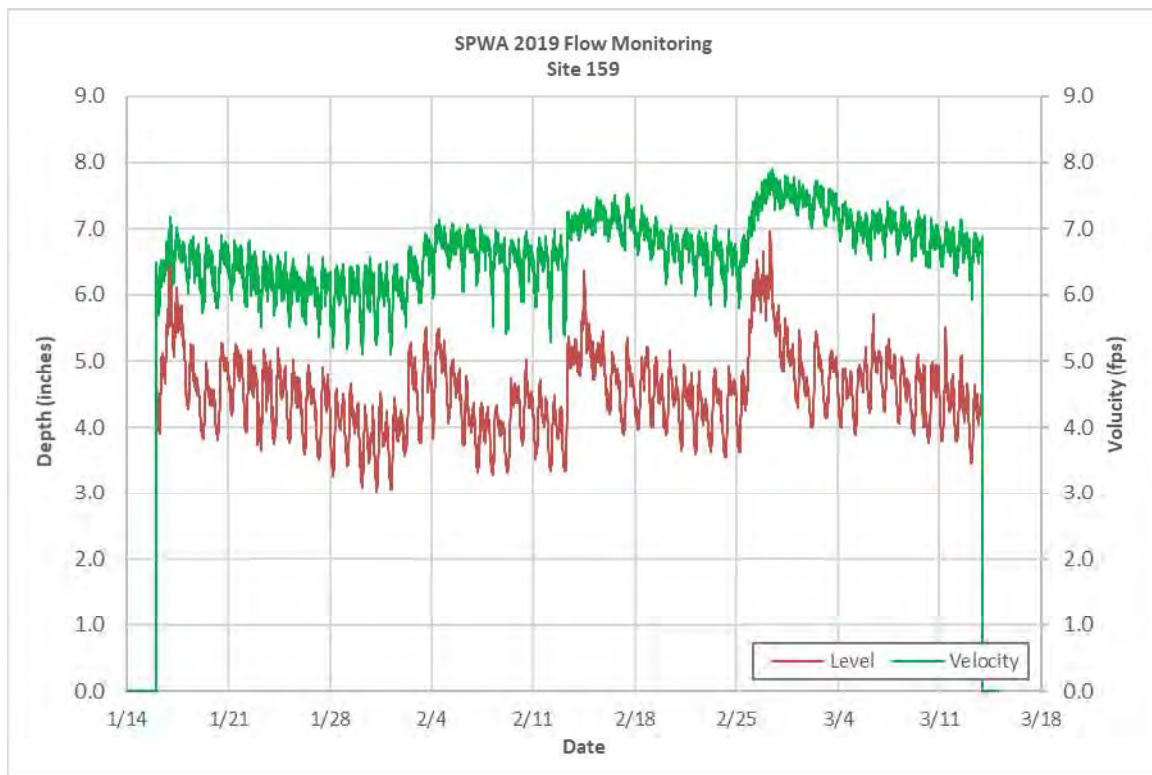
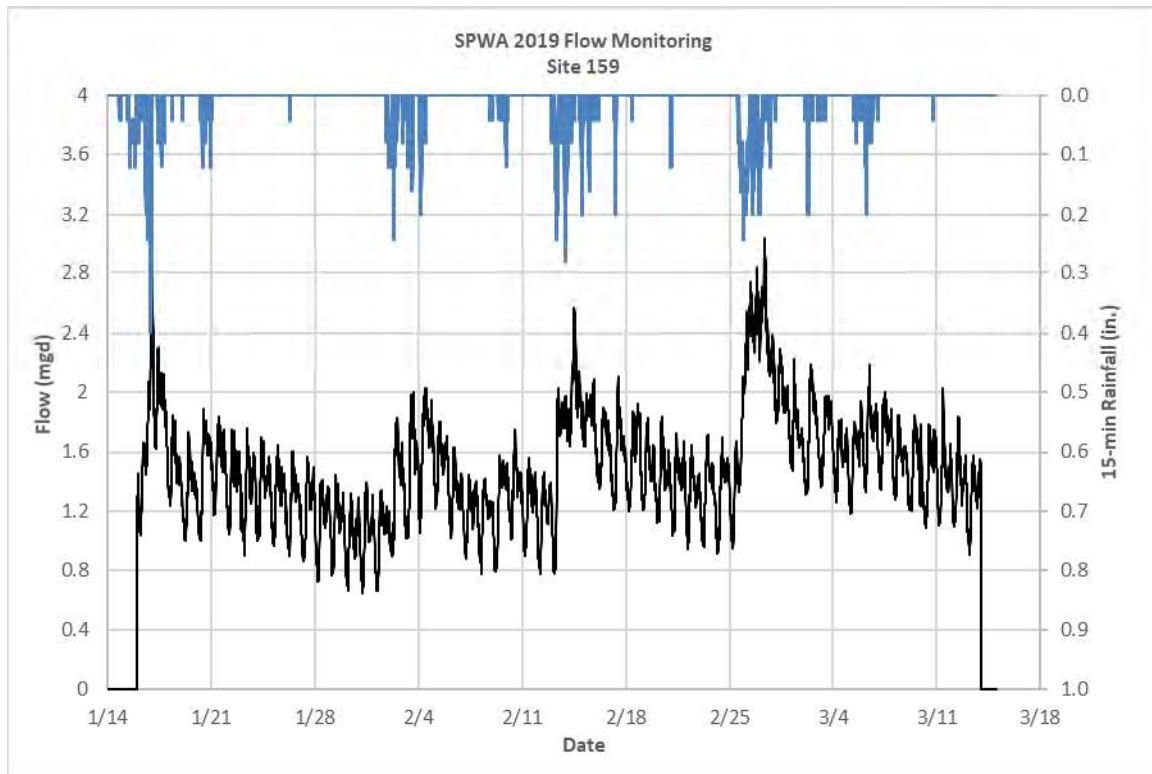


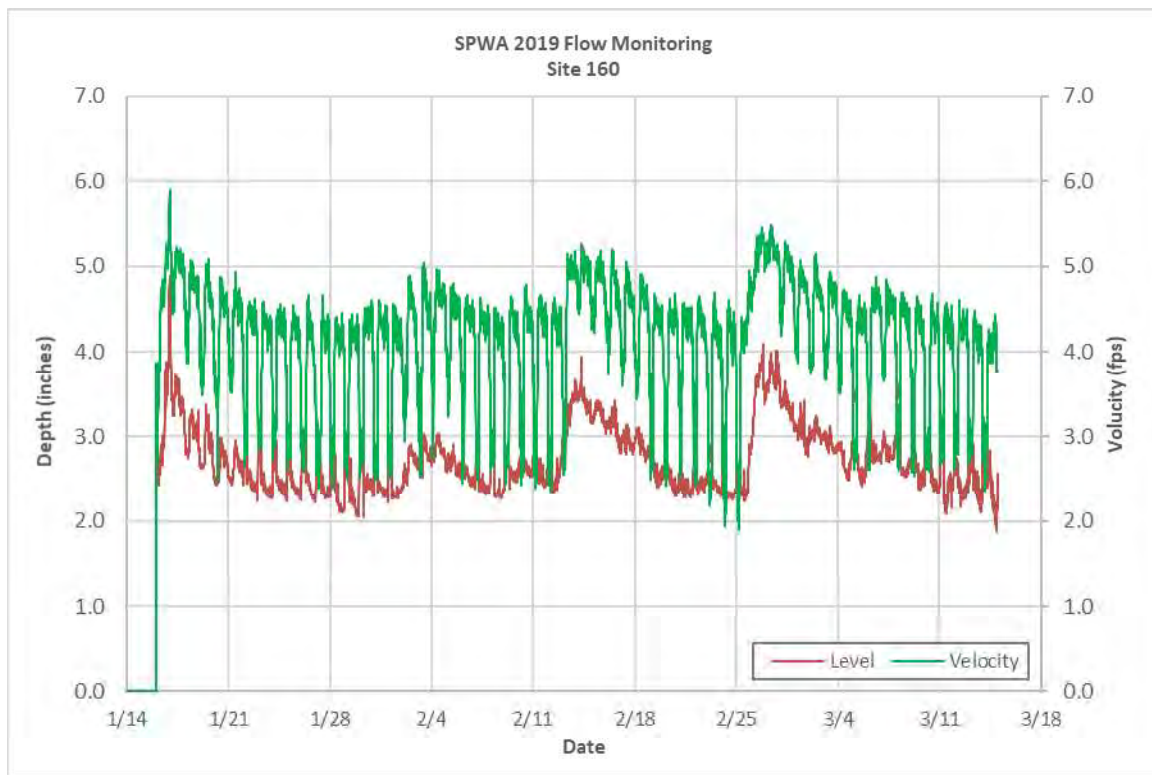
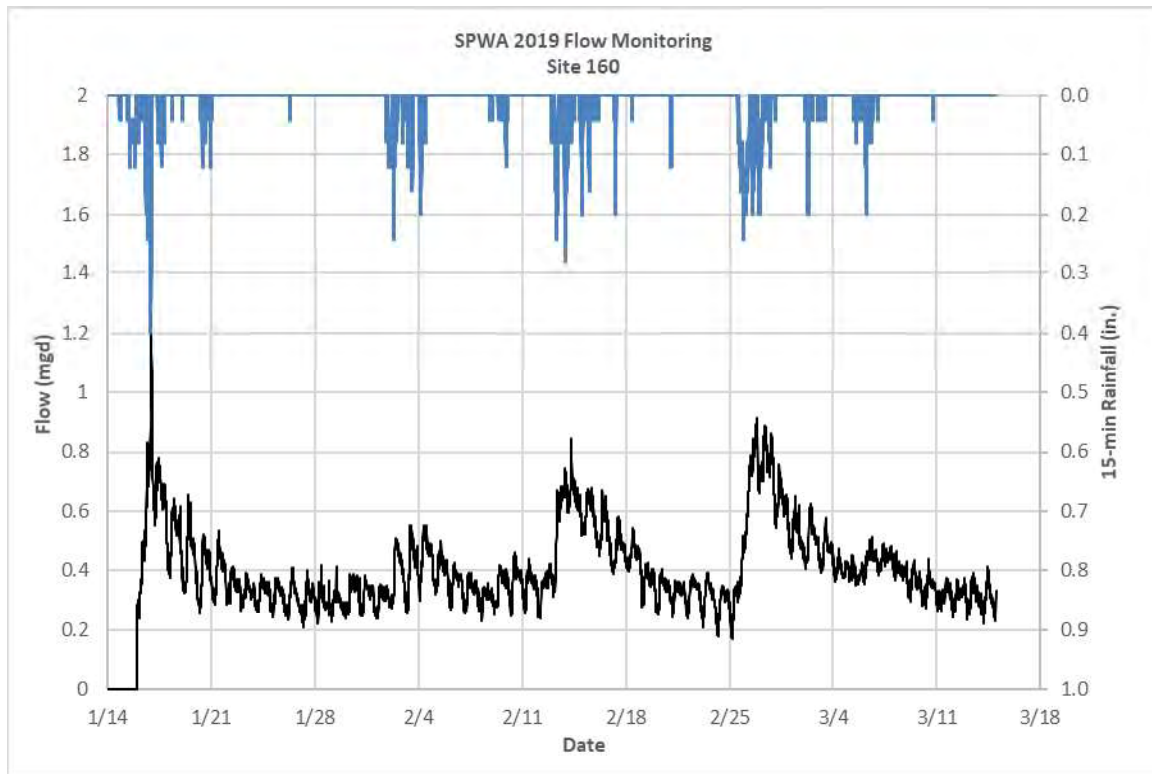


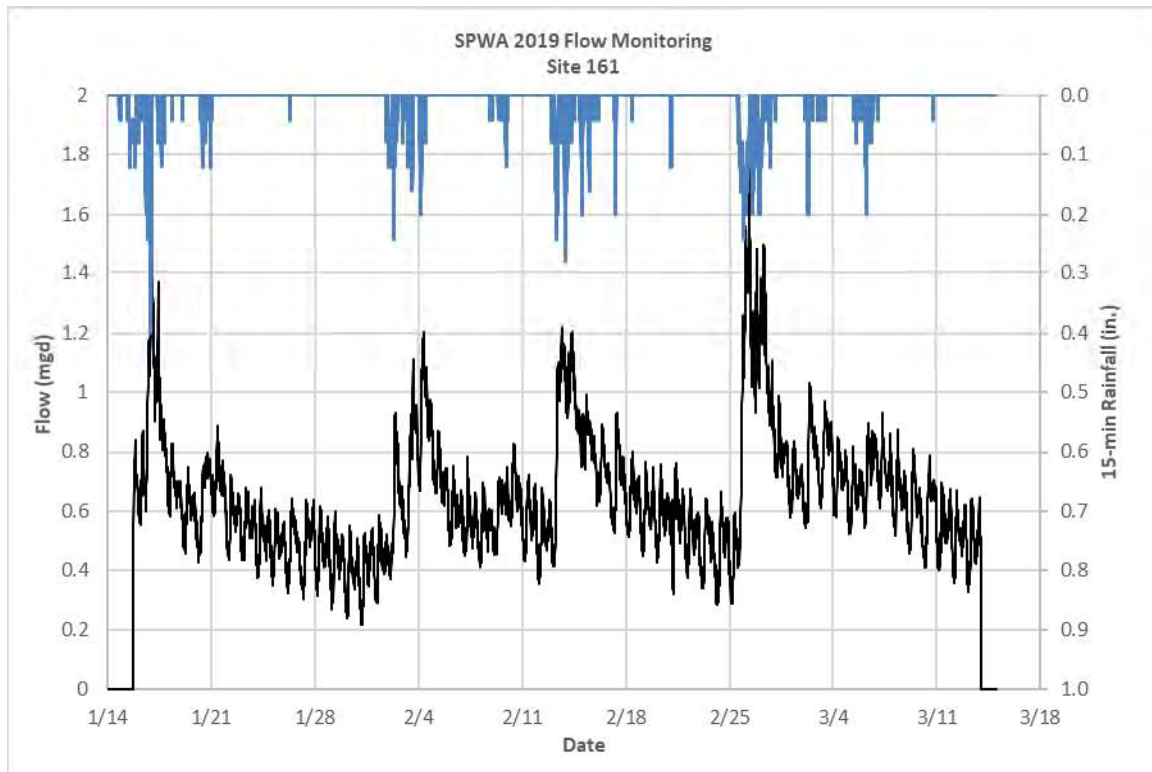


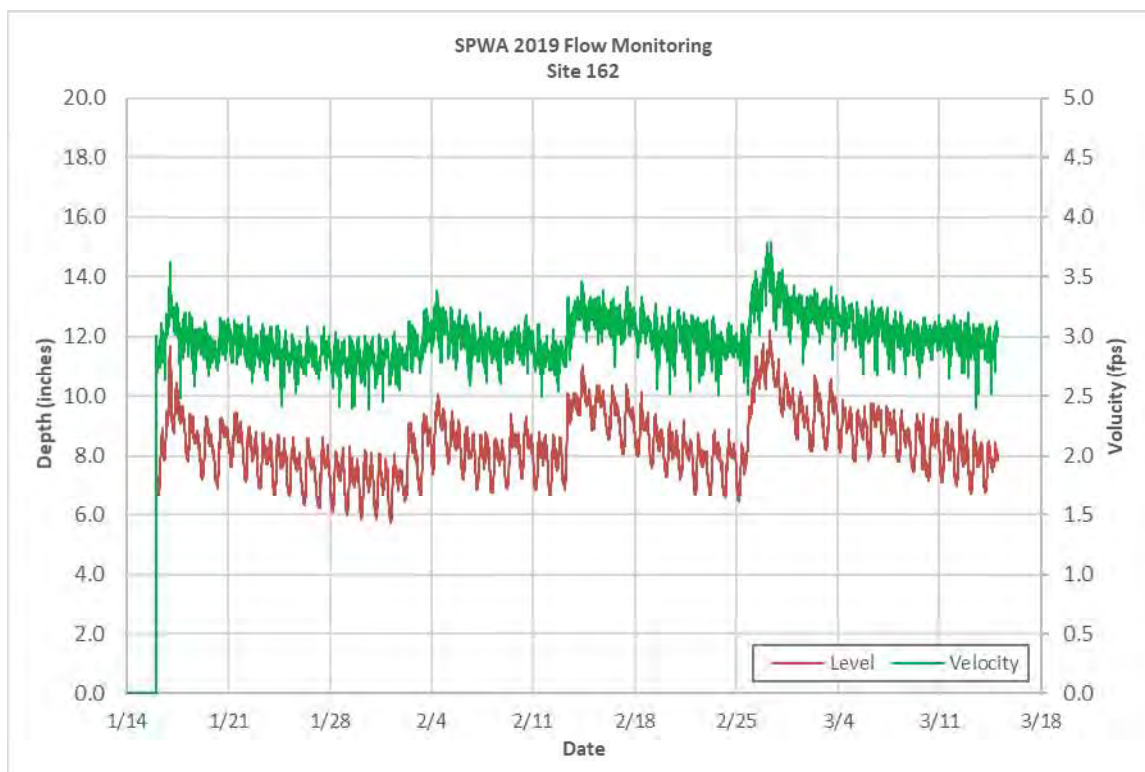
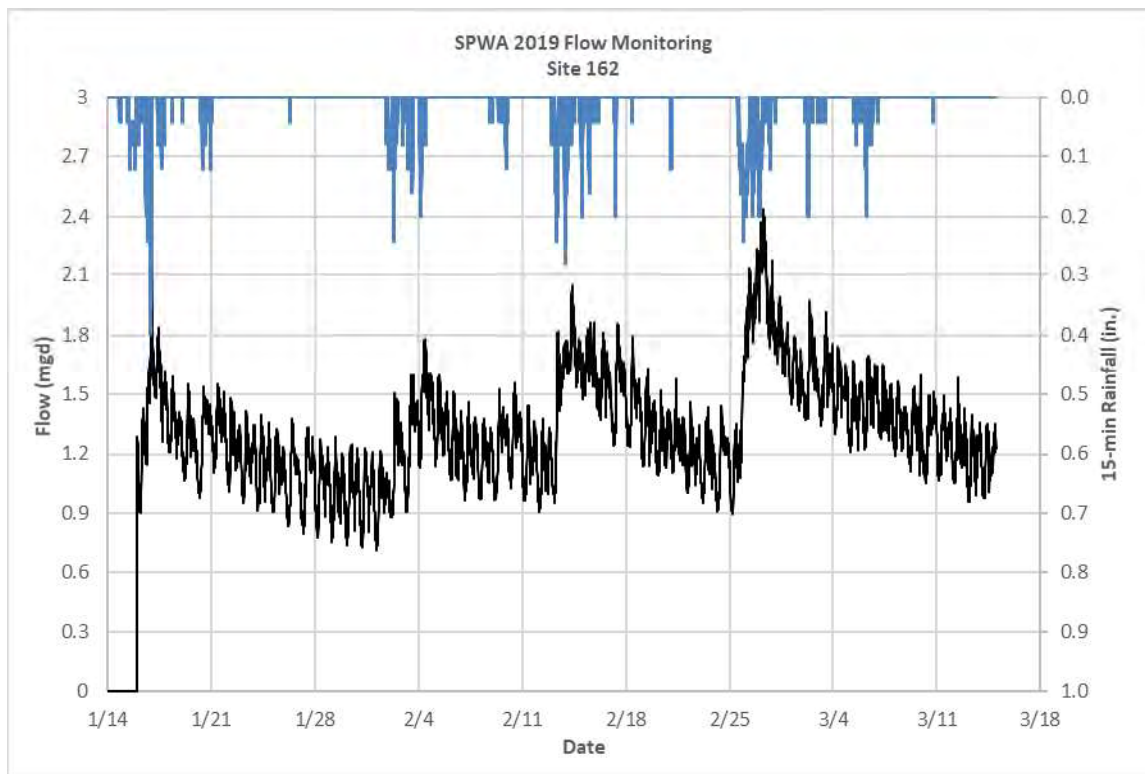


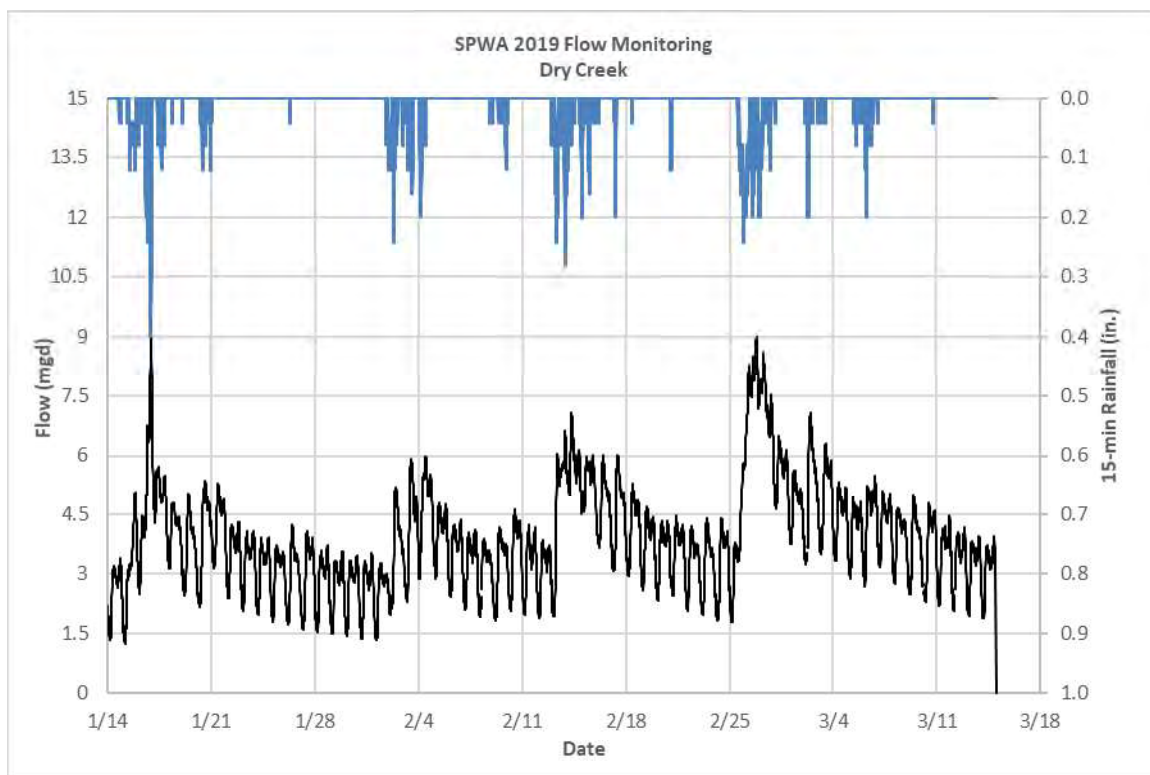
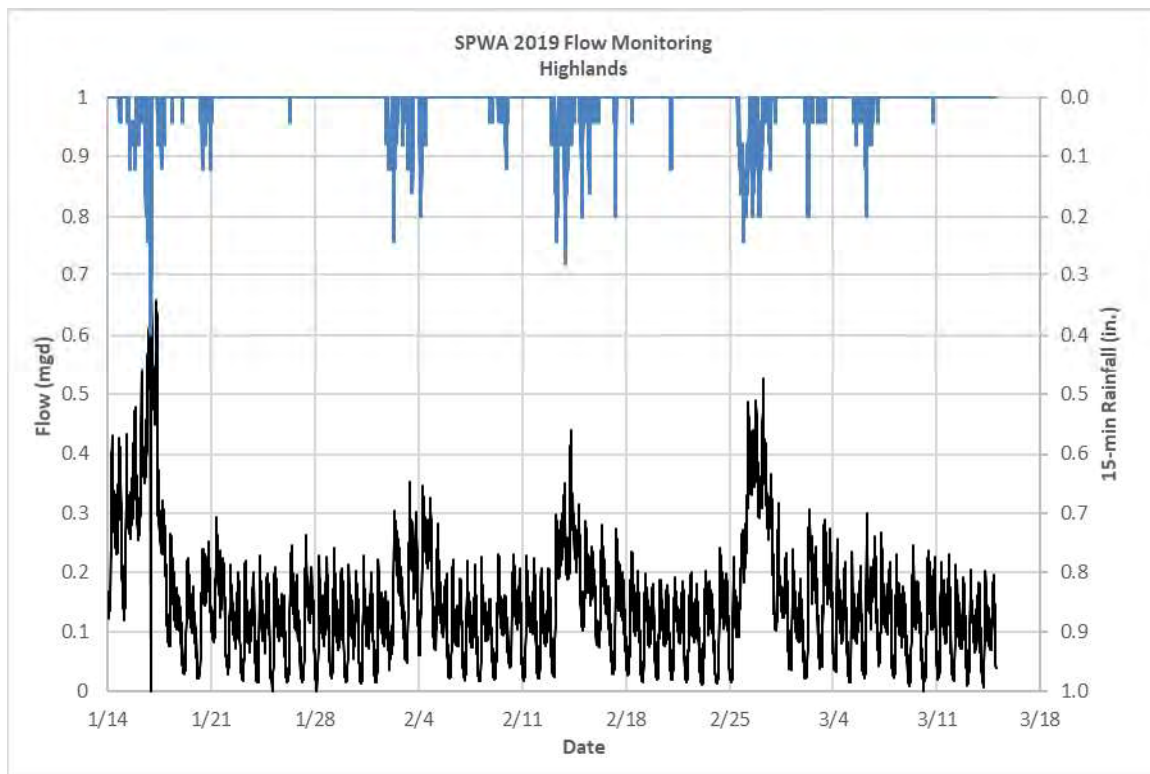


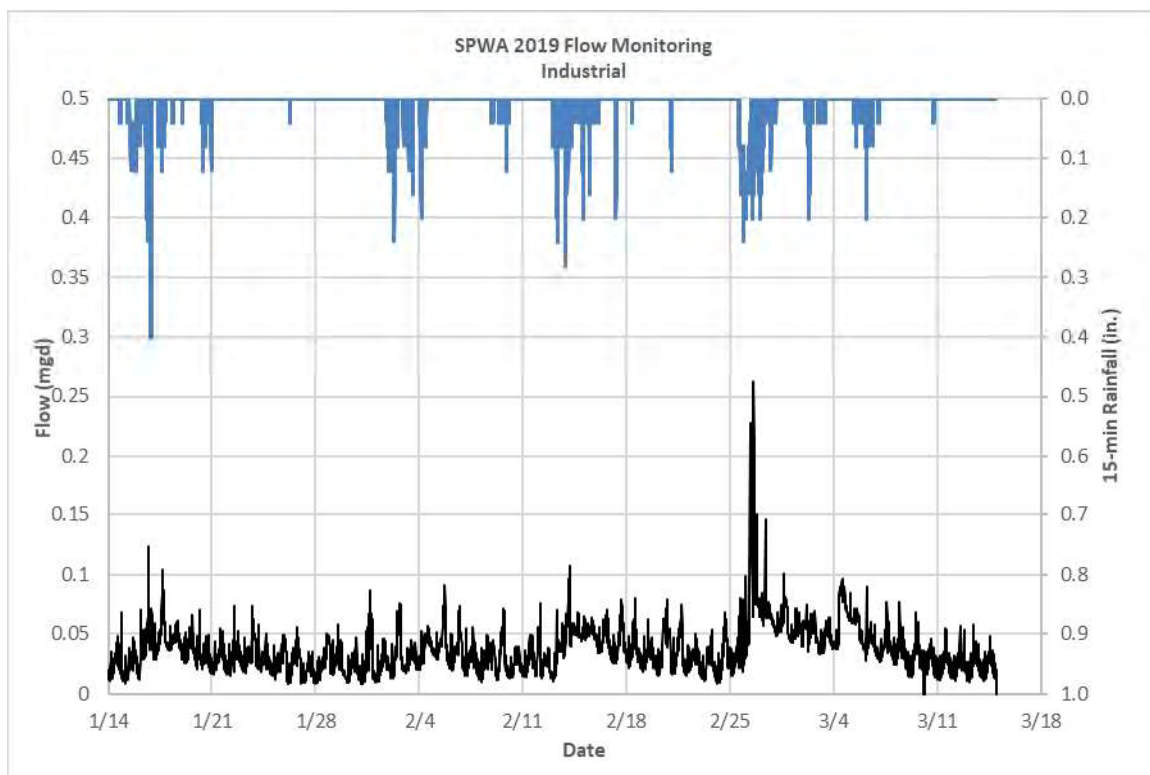
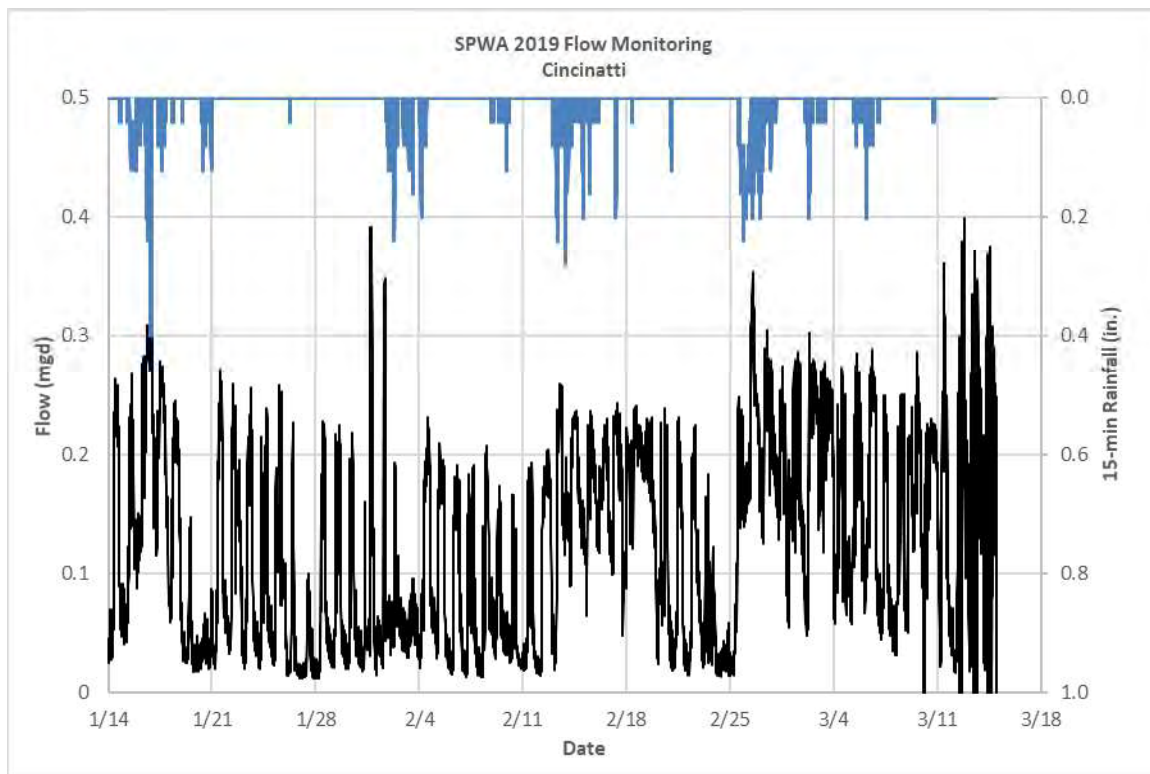


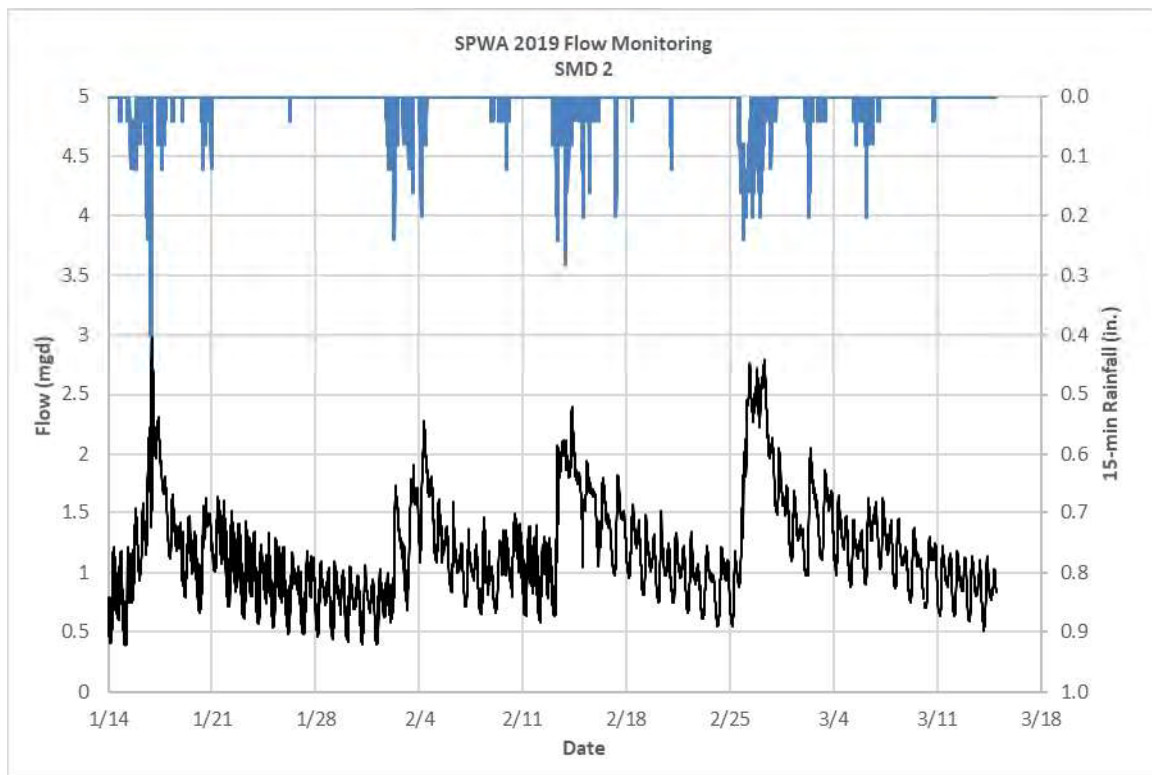
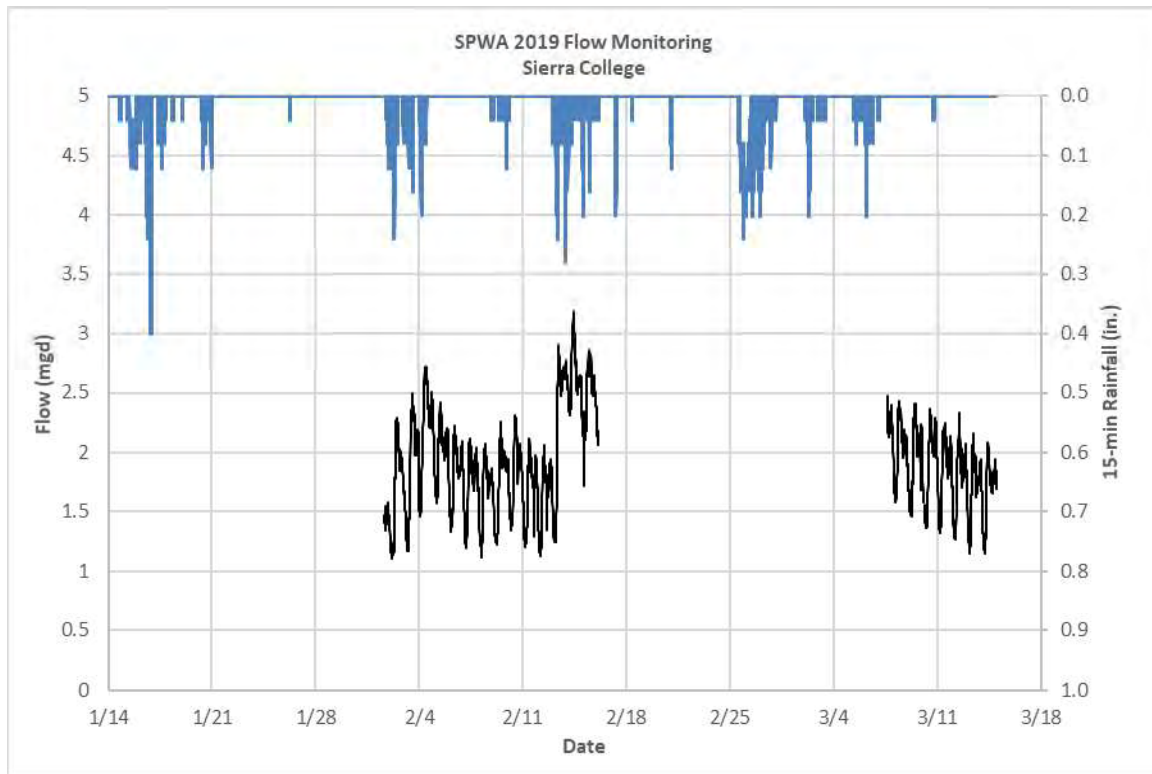






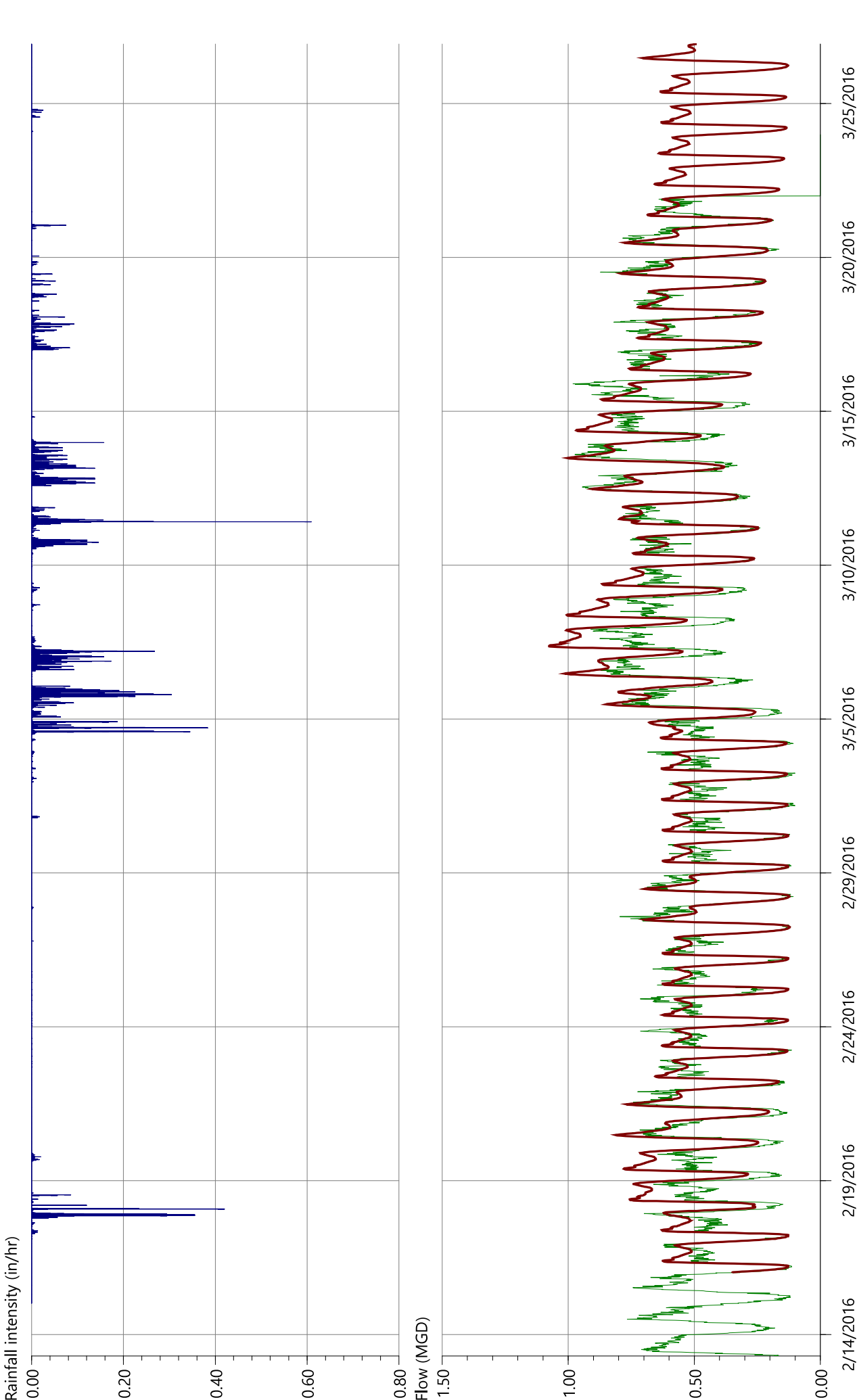






APPENDIX D – CALIBRATION GRAPHS

Flow Survey Location (Obs.) FM 1, Model Location (Pred.) D/S SMH E04-043.1, Rainfall Profile: 311

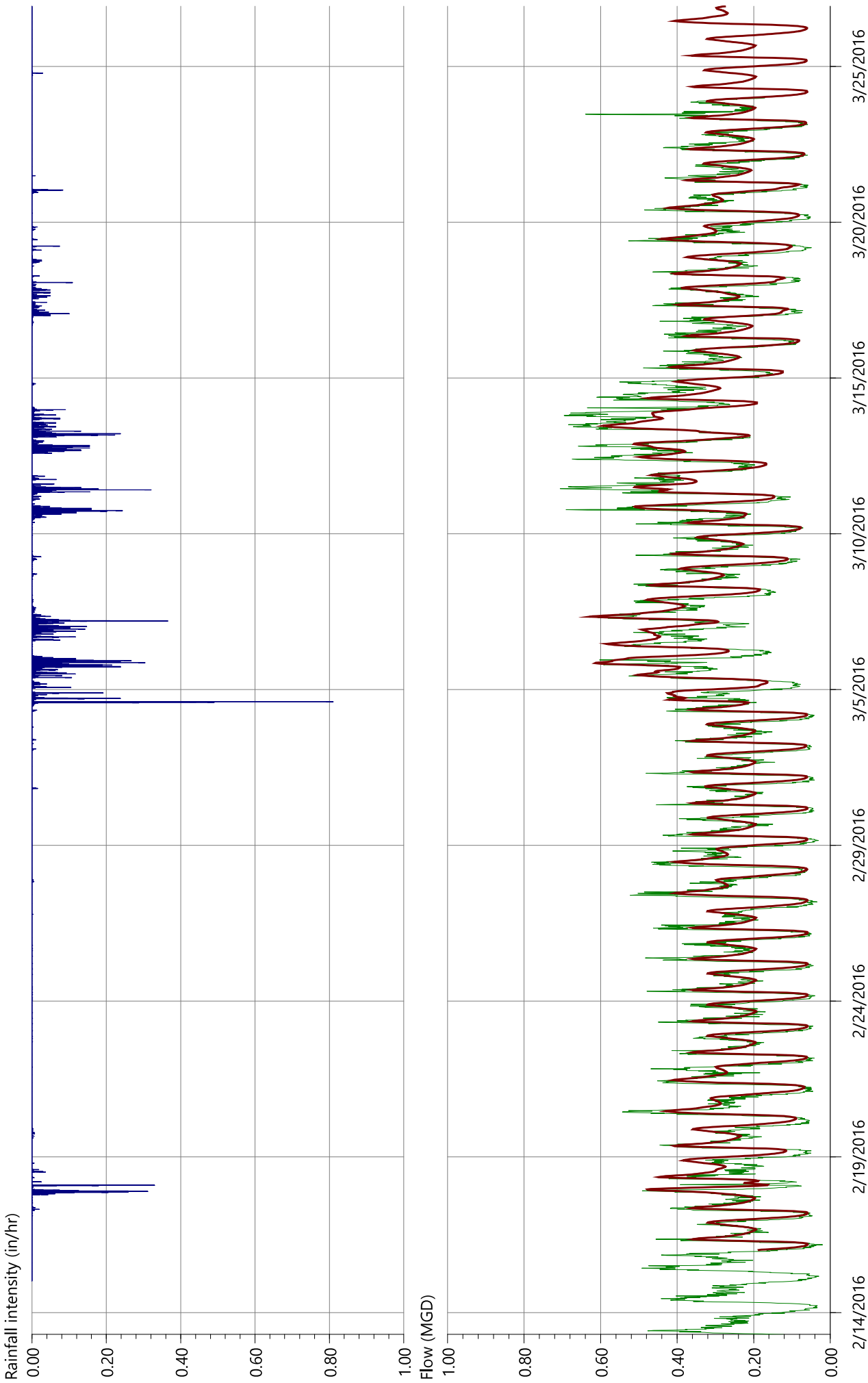


Rain	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Observed	6.950	0.609	0.007	0.000	0.981	1628041.595
...ta20160215_20160315				0.121	1.076	1849194.017

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 2, Model Location (Pred.) D/S SMH E01-166.1, Rainfall Profile: 305

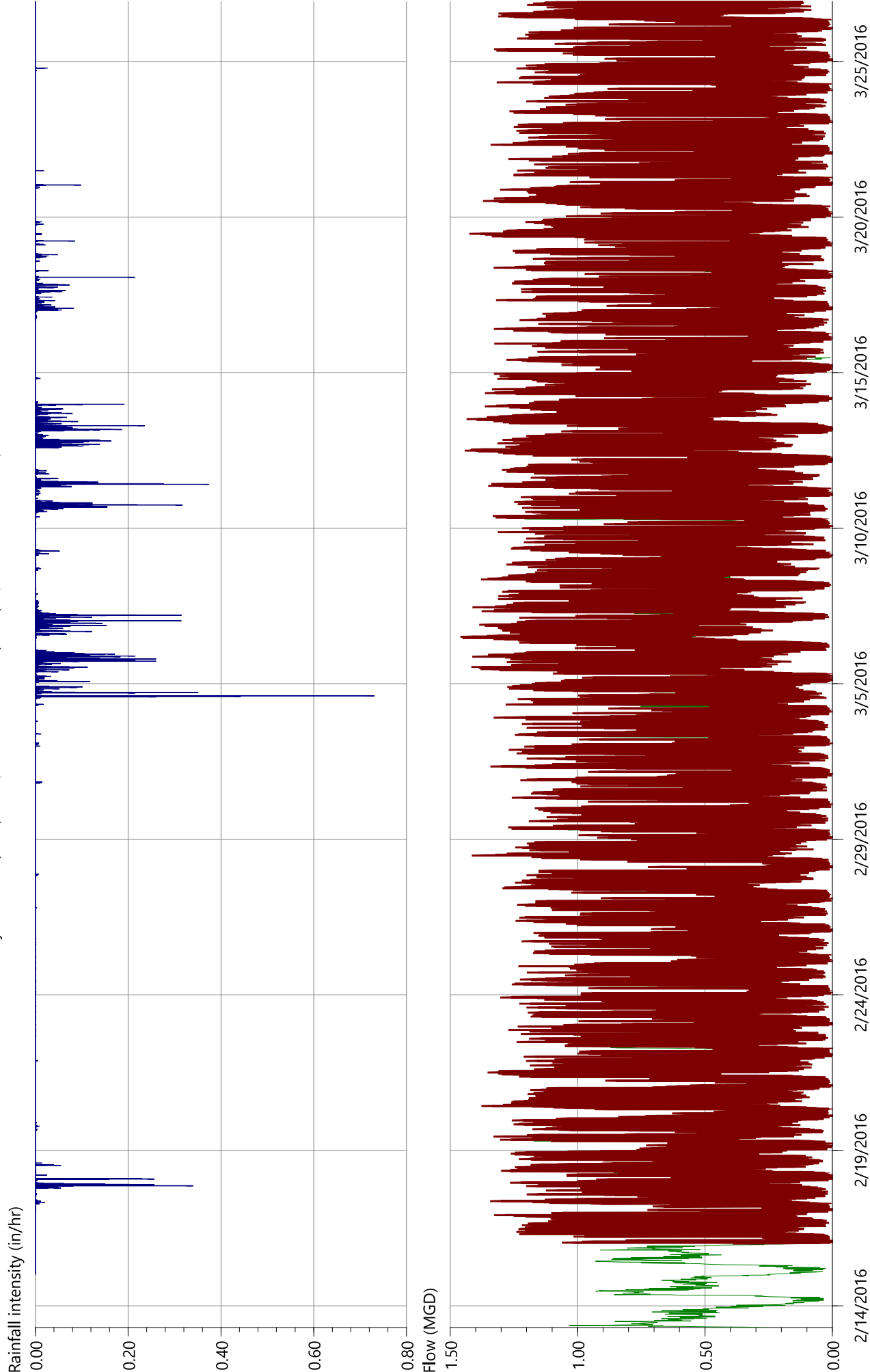


	Rainfall			Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	
Rain	7.168	0.810	0.007			
Observed				0.020	0.706	914240.023
..ta20160215_20160315				0.059	0.629	906202.549

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 3, Model Location (Pred.) D/S SMH D01-090.1, Rainfall Profile: 273

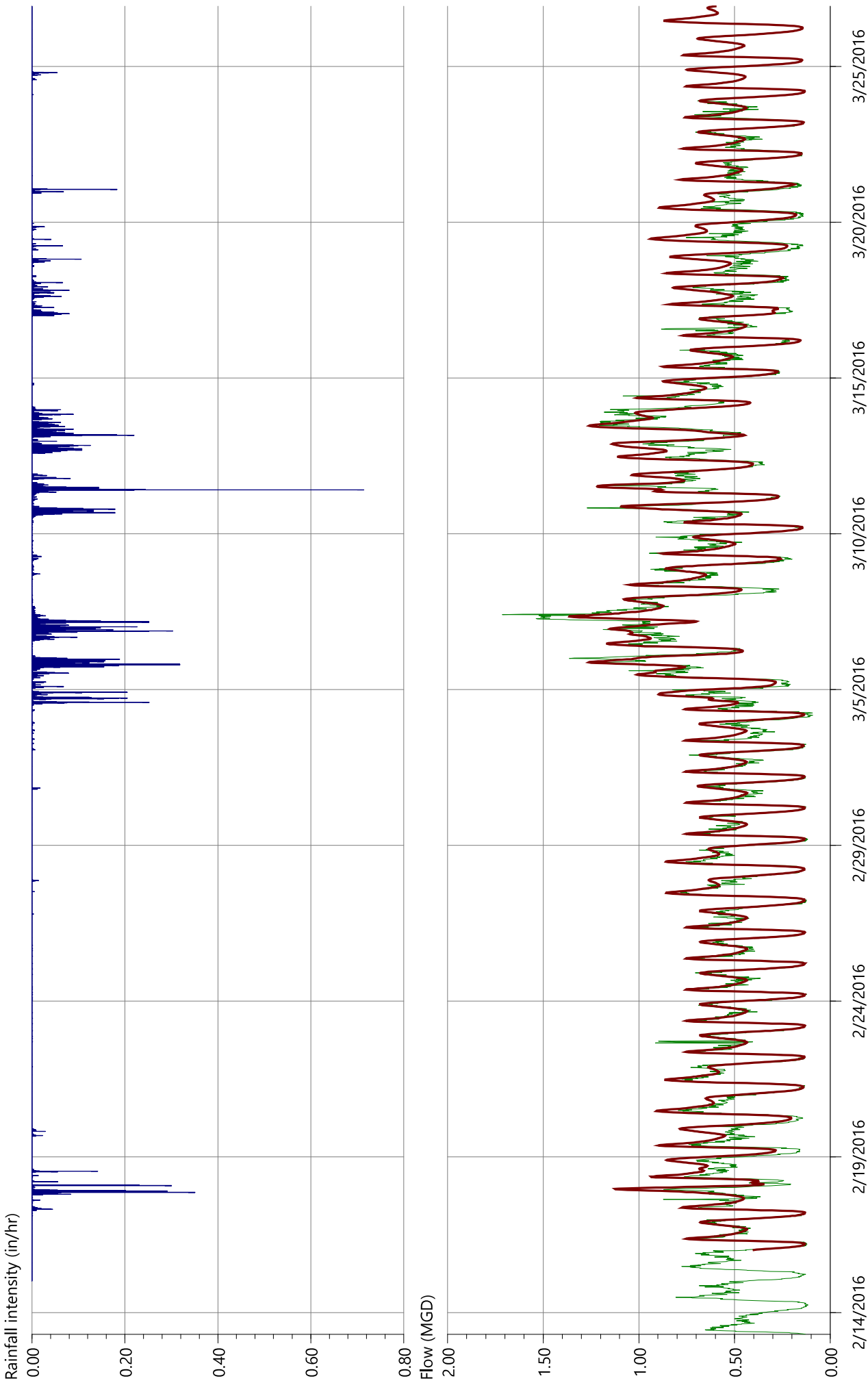


Rain Observed ...ta20160215_20160315	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
	7.131	0.007	0.007	1.272
			0.014	1.417
				1577879.095
				1694134.628

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 4, Model Location (Pred.) D/S SMH B06-185.1, Rainfall Profile: 182

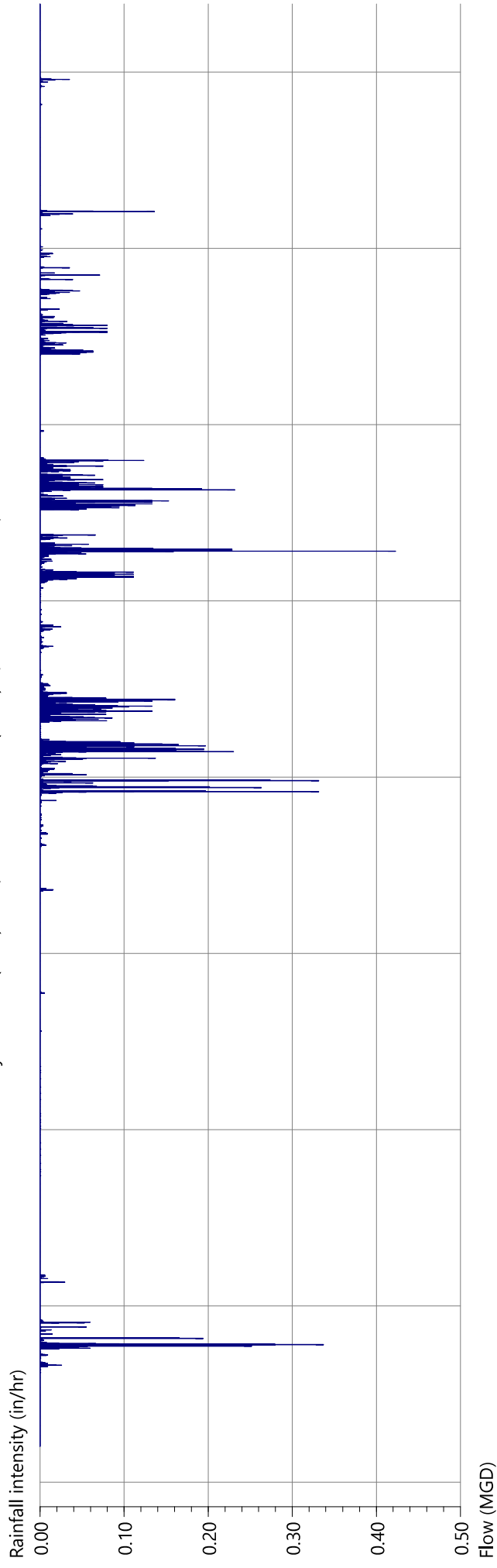


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.006	0.714	0.007	0.092	1.713
...ta20160215_20160315				0.132	1.364
					1767988.571
					1962773.049

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 5, Model Location (Pred.) D/S SMH B04-006.1, Rainfall Profile: 179

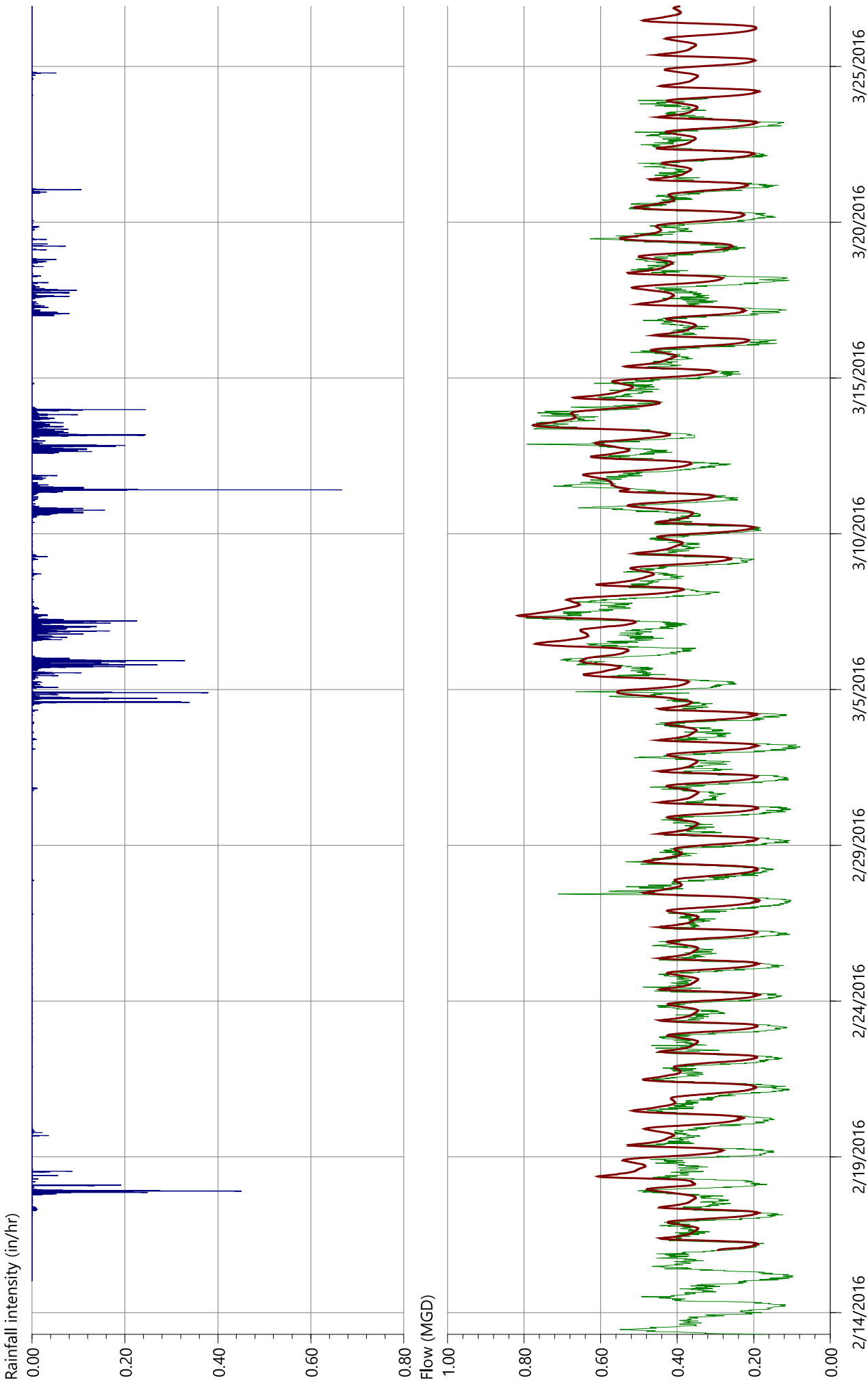


Rain	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	6.524	0.007	0.308	2.299
...ta20160215_20160315			0.267	2.627
				Volume (ft3)
				3030867.347
				3046741.062

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 5A, Model Location (Pred.) D/S SMH B04-001.1, Rainfall Profile: 178

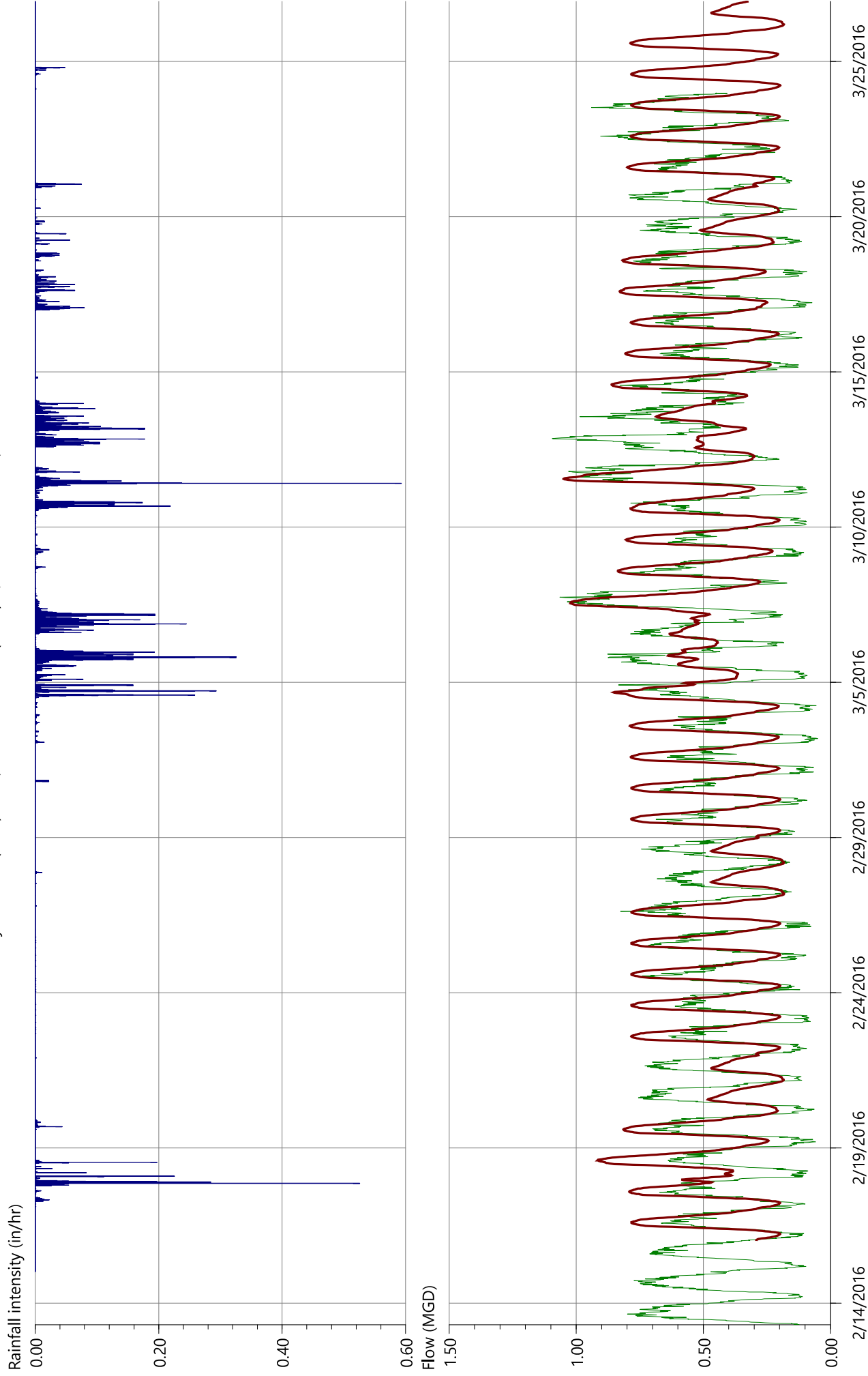


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	6.650	0.666	0.007	0.078
...ta20160215_20160315				0.815
				1250814.058
				1385997.841

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 6, Model Location (Pred.) D/S SMH C06-160.1, Rainfall Profile: 248

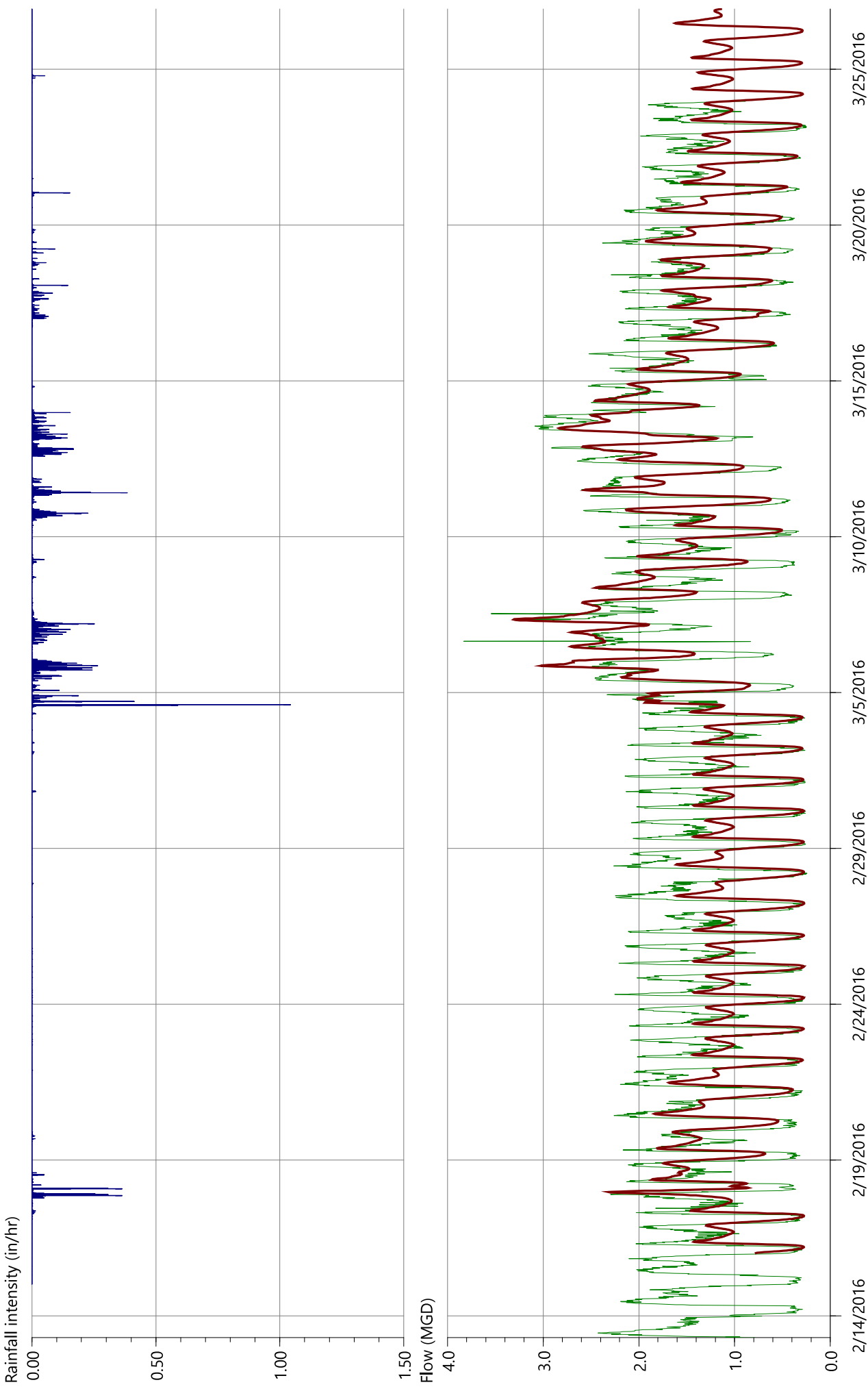


Rain	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
	6.748	0.593	0.007			
Observed				0.050	1.095	1561247.890
...ta20160215_20160315				0.182	1.050	1627844.217

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 7, Model Location (Pred.) D/S SMH D02-353.1, Rainfall Profile: 274

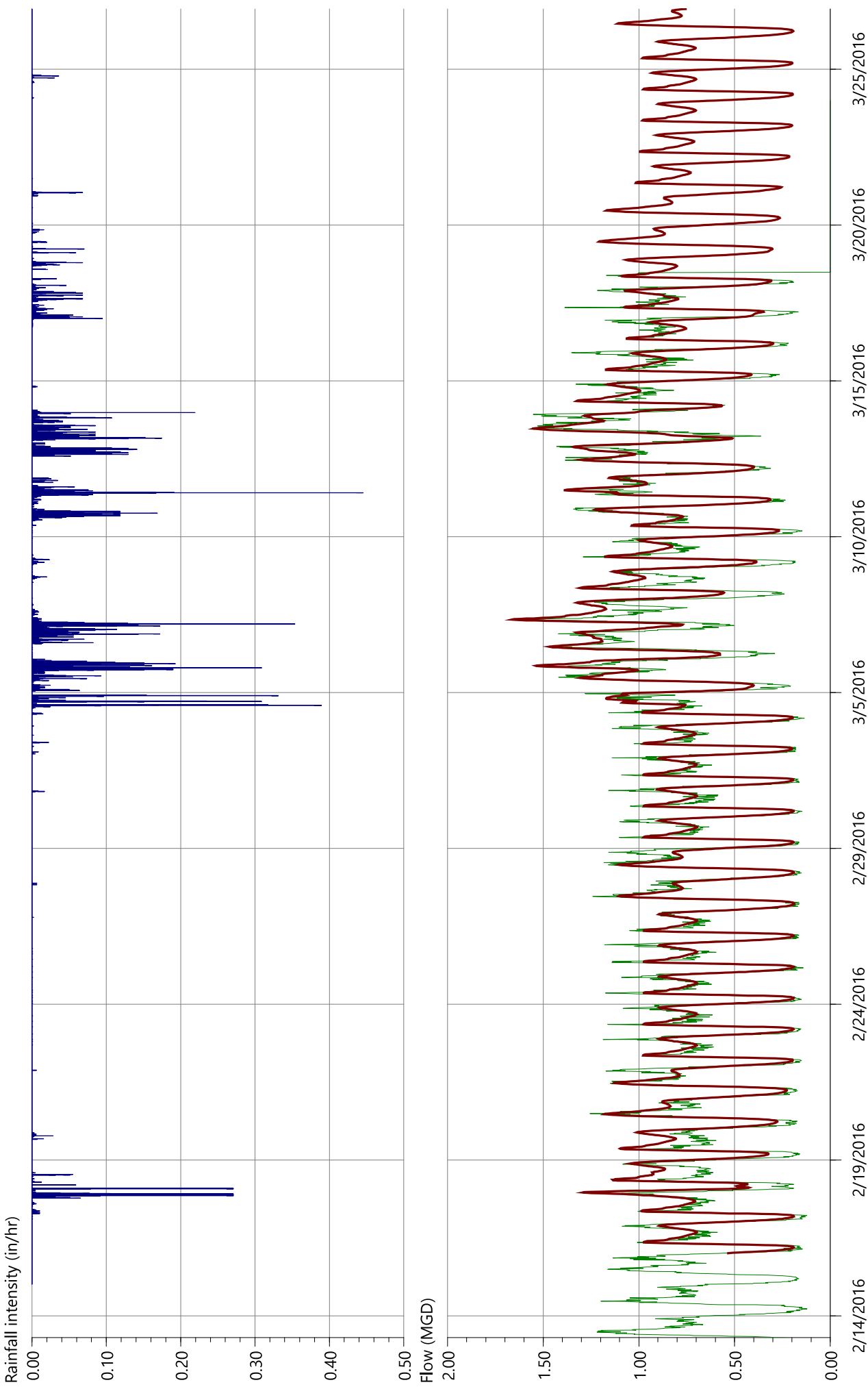


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.005	1.043	0.007	0.243	3.830
...ta20160215_20160315				0.272	3.309
					4848161.759
					4389105.386

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 7A, Model Location (Pred.) D/S SMH D03-116.1, Rainfall Profile: 276

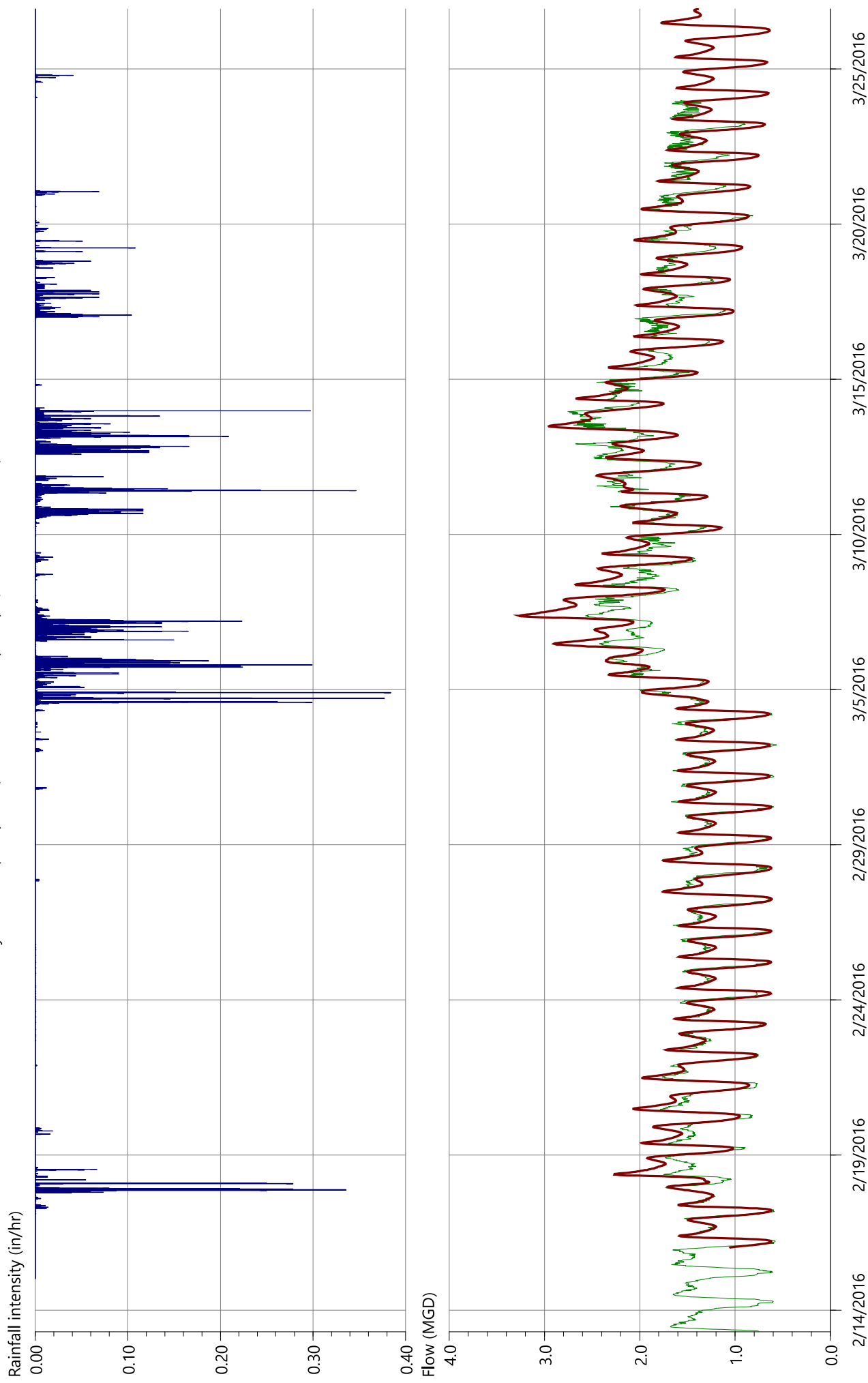


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.644	0.445	0.007			
Observed				0.000	1.560	2175152.424
...ta20160215_20160315				0.188	1.664	2640259.610

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 8, Model Location (Pred.) D/S SMH D04-201.1, Rainfall Profile: 277

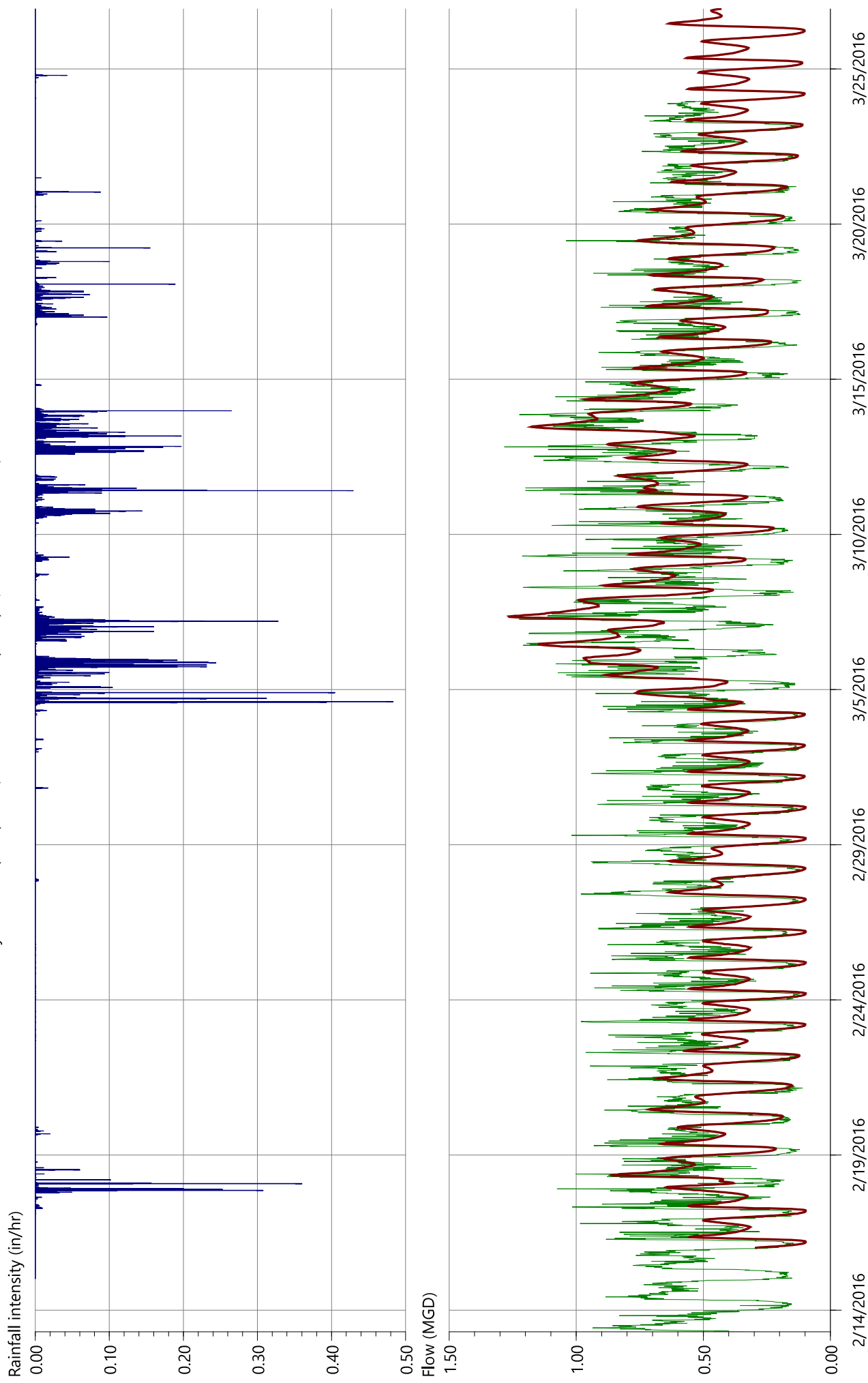


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	6.750	0.384	0.007	0.563	2.756
...ta20160215_20160315				0.617	3.265
					5257075.125
					5297174.358

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 9, Model Location (Pred.) D/S SMH D02-069.1, Rainfall Profile: 241

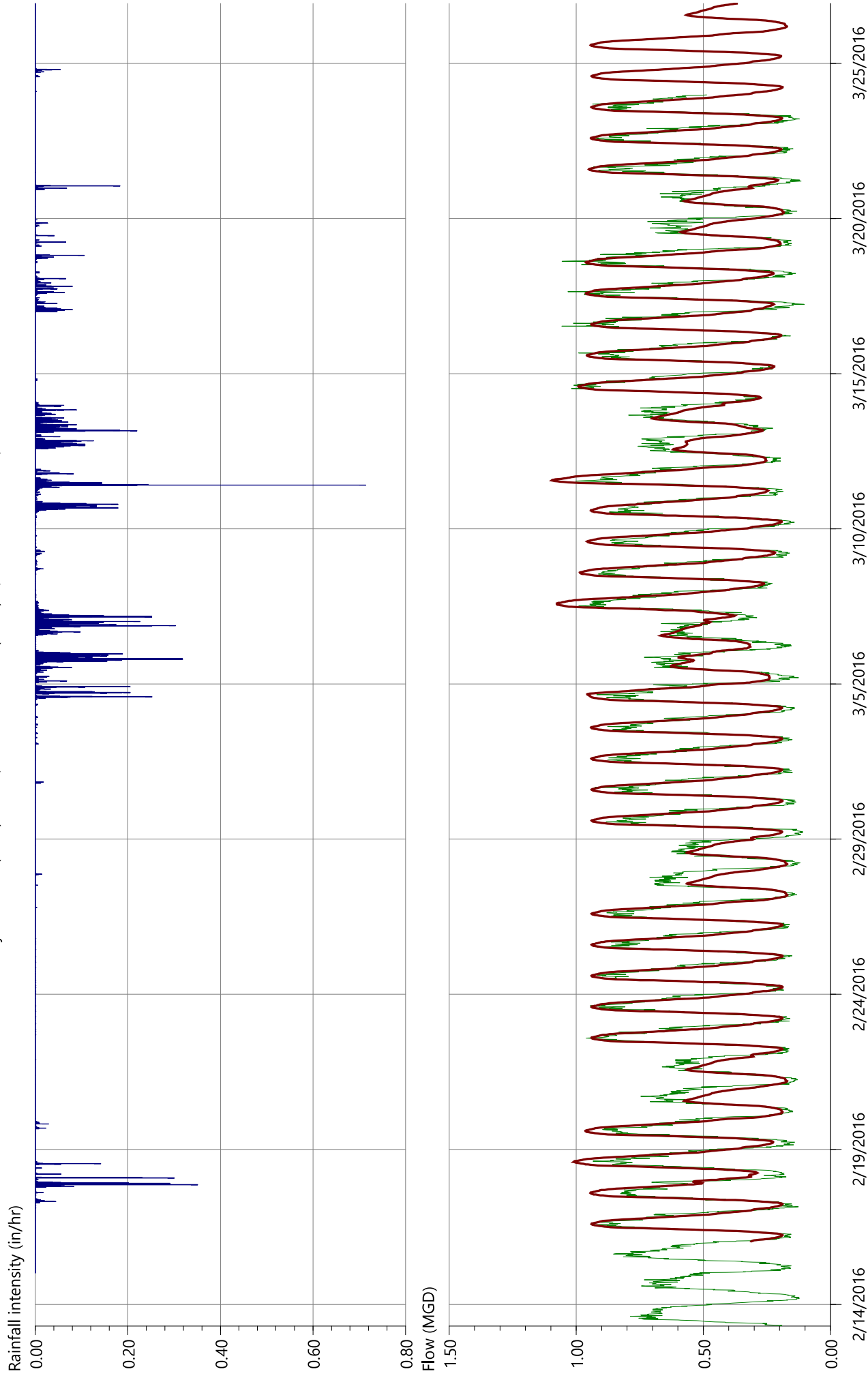


Rainfall			Flow		
Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
6.982	0.483	0.007			
			0.110	1.283	1753822.349
			0.097	1.266	1626219.910

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 10, Model Location (Pred.) D/S SMH B06-340.1, Rainfall Profile: 182

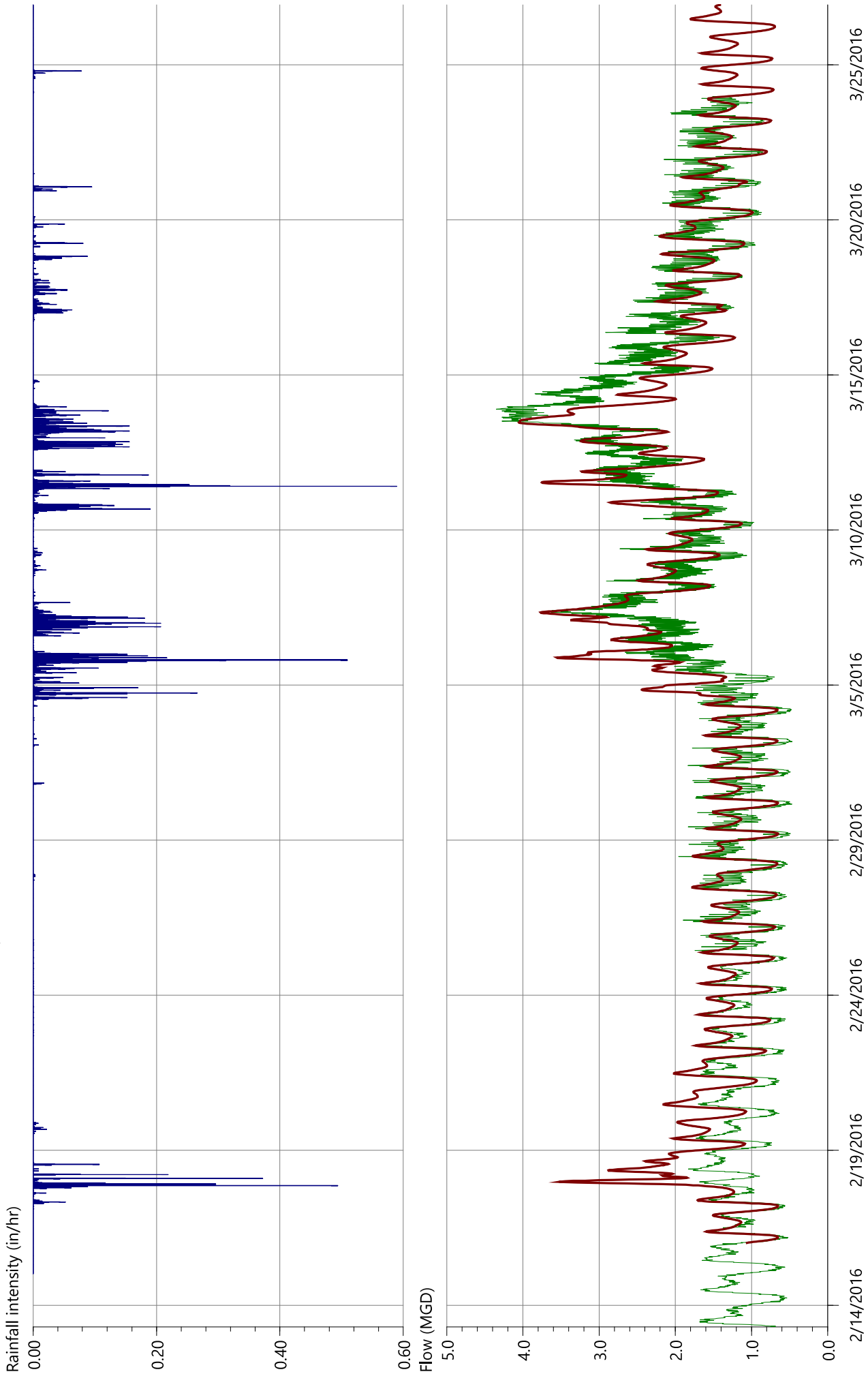


Rainfall			Flow		
Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
7.006	0.714	0.007			
			0.103	1.057	1756657.949
			0.169	1.096	1787262.390

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 11, Model Location (Pred.) D/S SMH A08-019.1, Rainfall Profile: 121

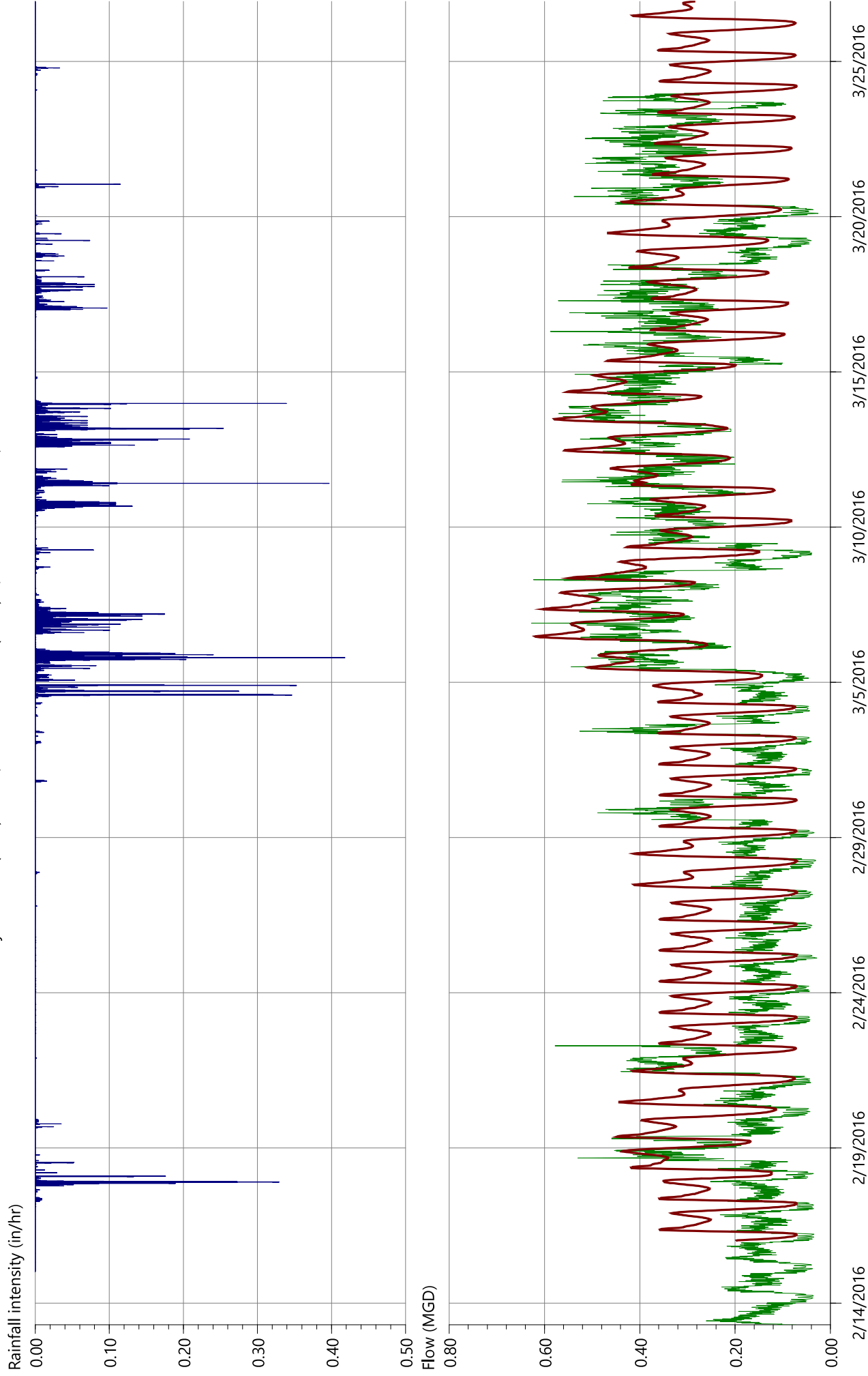


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.634	0.590	0.008	0.468	4.351
...ta20160215_20160315				0.651	4.054
					5269869.468
					5683303.761

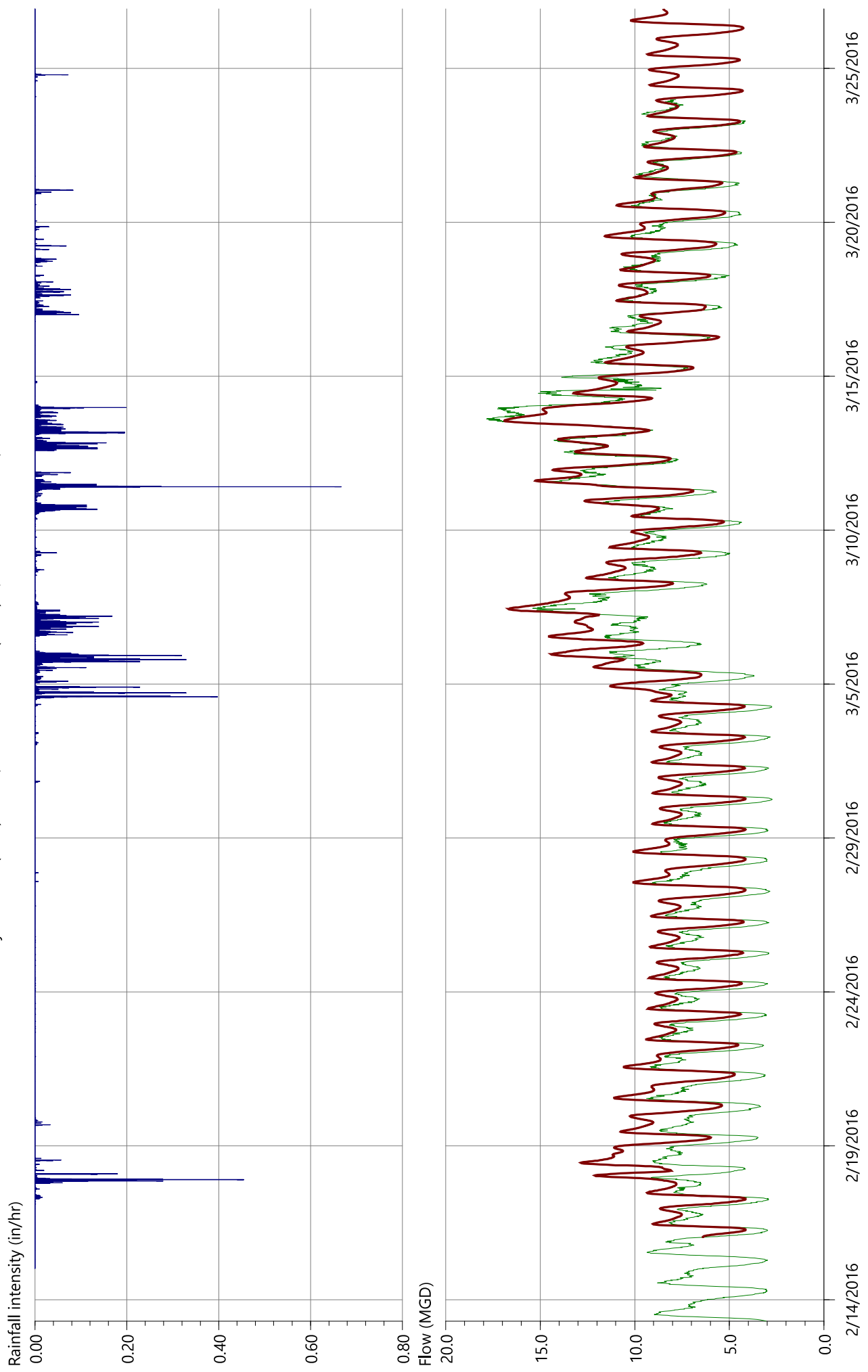
Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

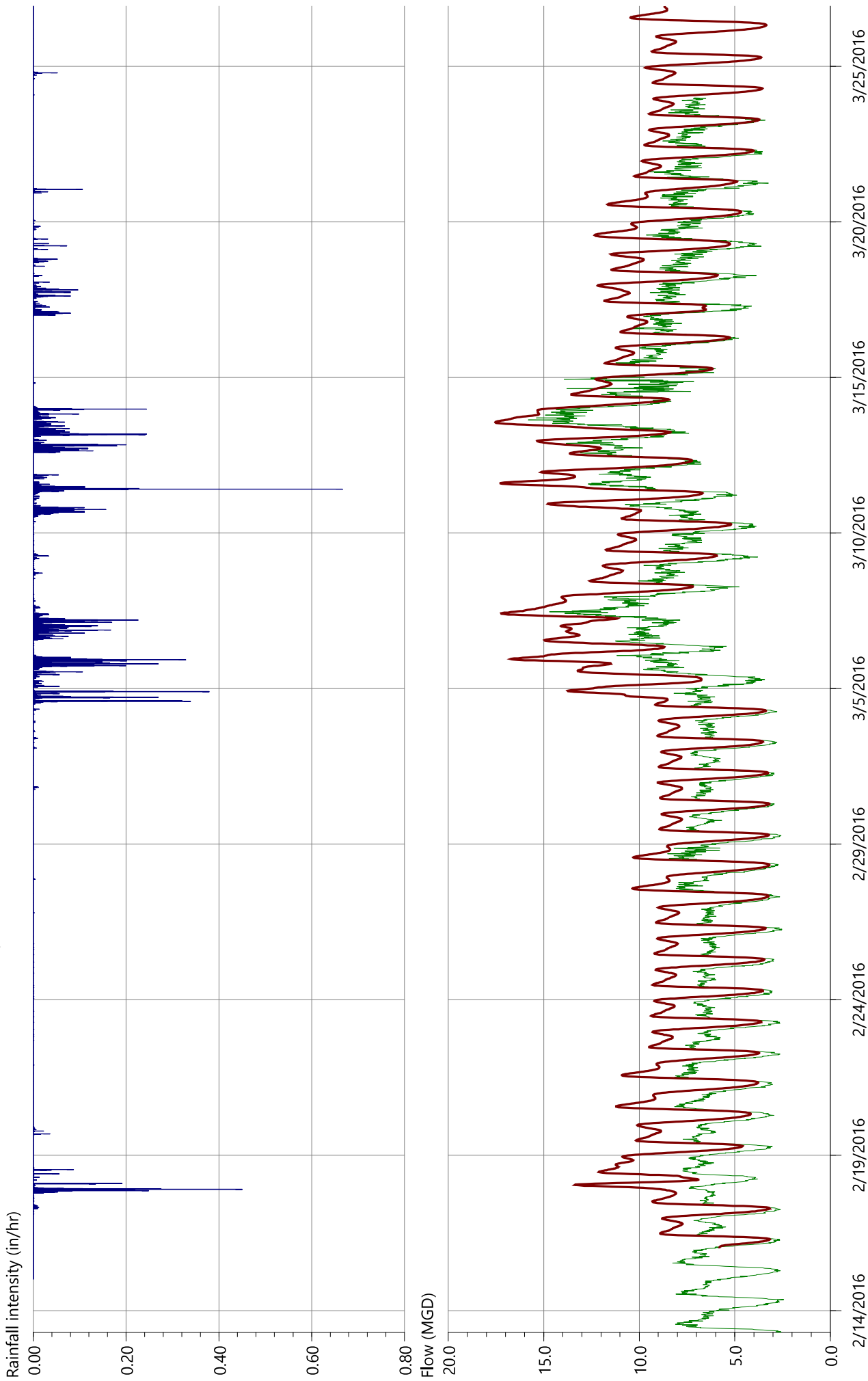
Flow Survey Location (Obs.) FM 12, Model Location (Pred.) D/S SMH B03-030.1, Rainfall Profile: 177



Rain	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Observed	6.394	0.418	0.007	0.025	0.627	798653.119
...ta20160215_20160315				0.070	0.620	991725.521



Rain Observed ...ta20160215_20160315	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
	6.618	0.666	0.007	Max (ft3/s)
				17.837
				16.903
				26538612.826
				30158188.130

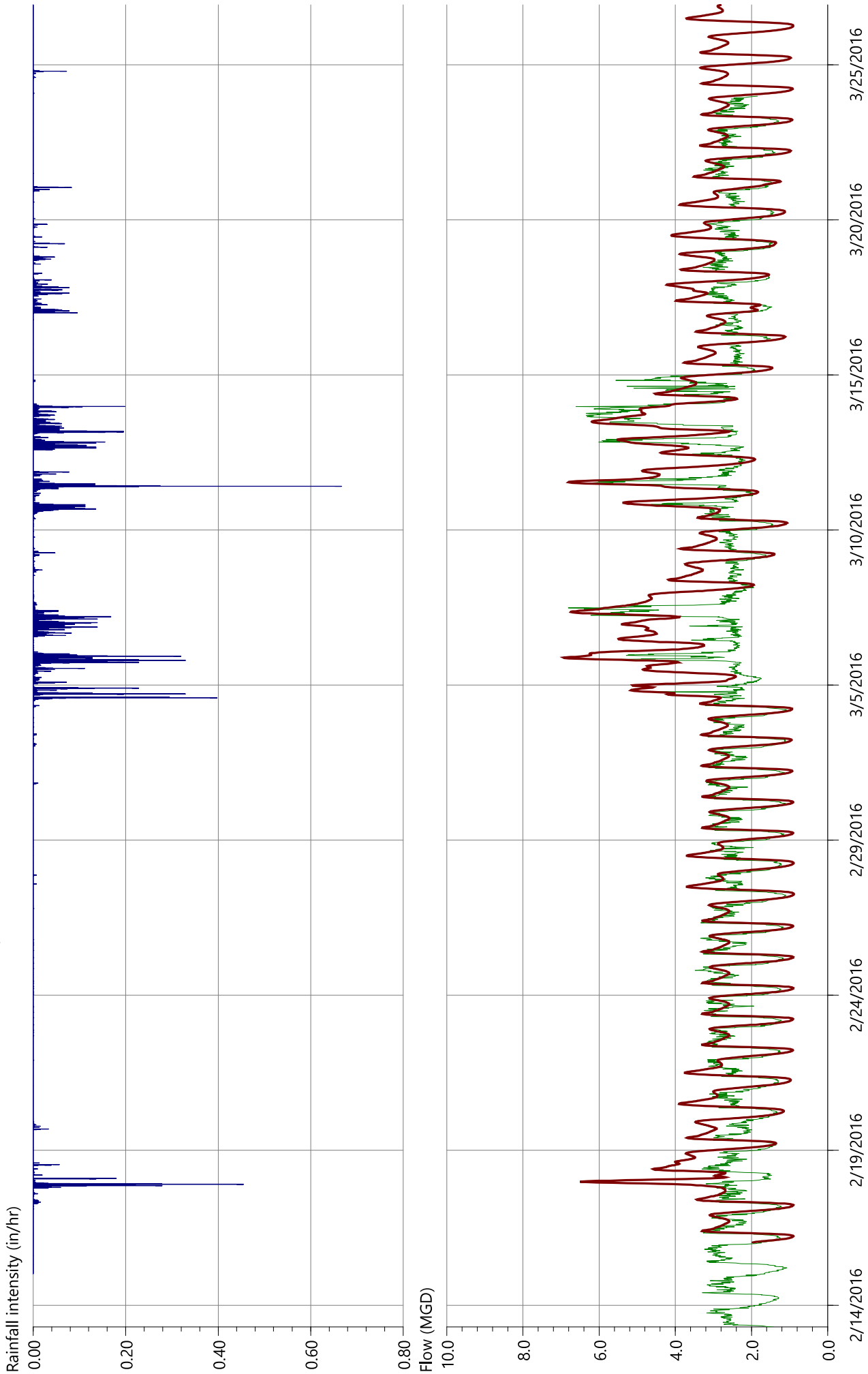


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	6.650	0.666	2.435	15.807
...ta20160215_20160315			3.164	17.544
				Volume (ft3)
				23553734.551
				30549718.631

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 15, Model Location (Pred.) D/S SMH B03-053.1, Rainfall Profile: 145

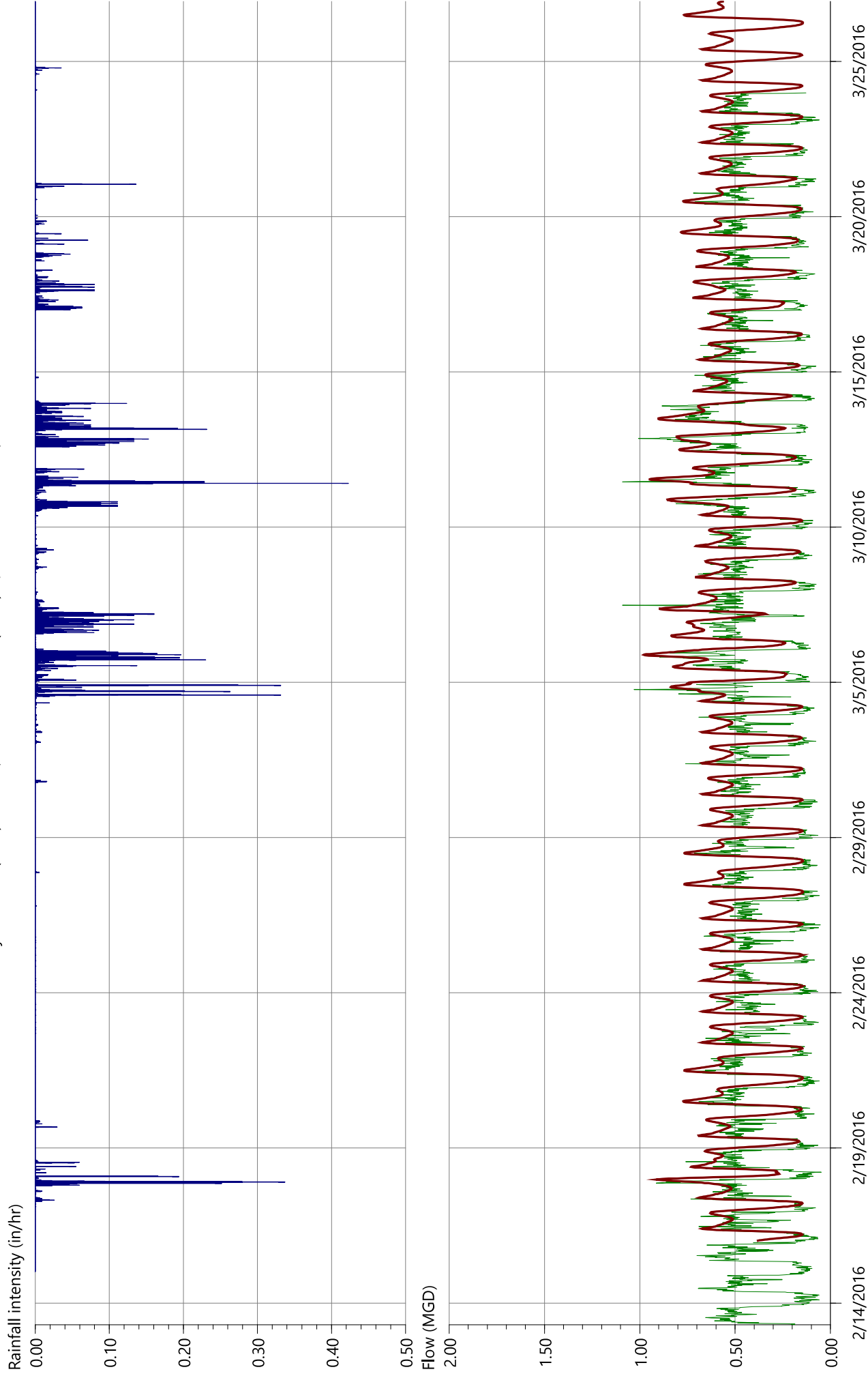


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.618	0.666	0.007			
Observed				1.071	6.810	8508039.397
...ta20160215_20160315				0.886	6.940	9988758.893

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 15A, Model Location (Pred.) D/S SMH B04-061.1, Rainfall Profile: 179

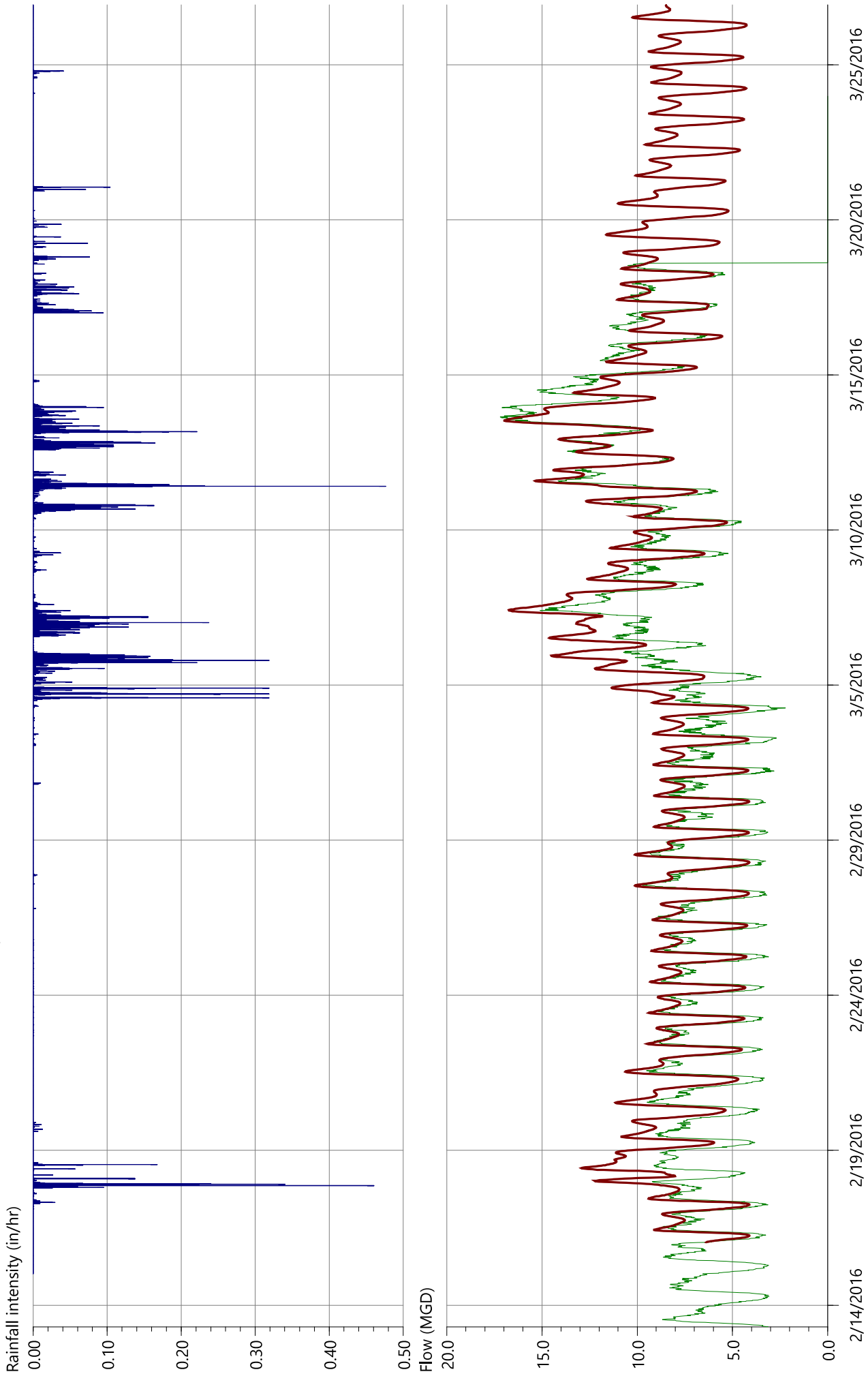


Rain	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Observed	6.524	0.423	0.007	0.048	1.091	1332963.500
...ta20160215_20160315				0.143	0.978	1724557.621

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 16, Model Location (Pred.) D/S SMH B05-230.1, Rainfall Profile: 147

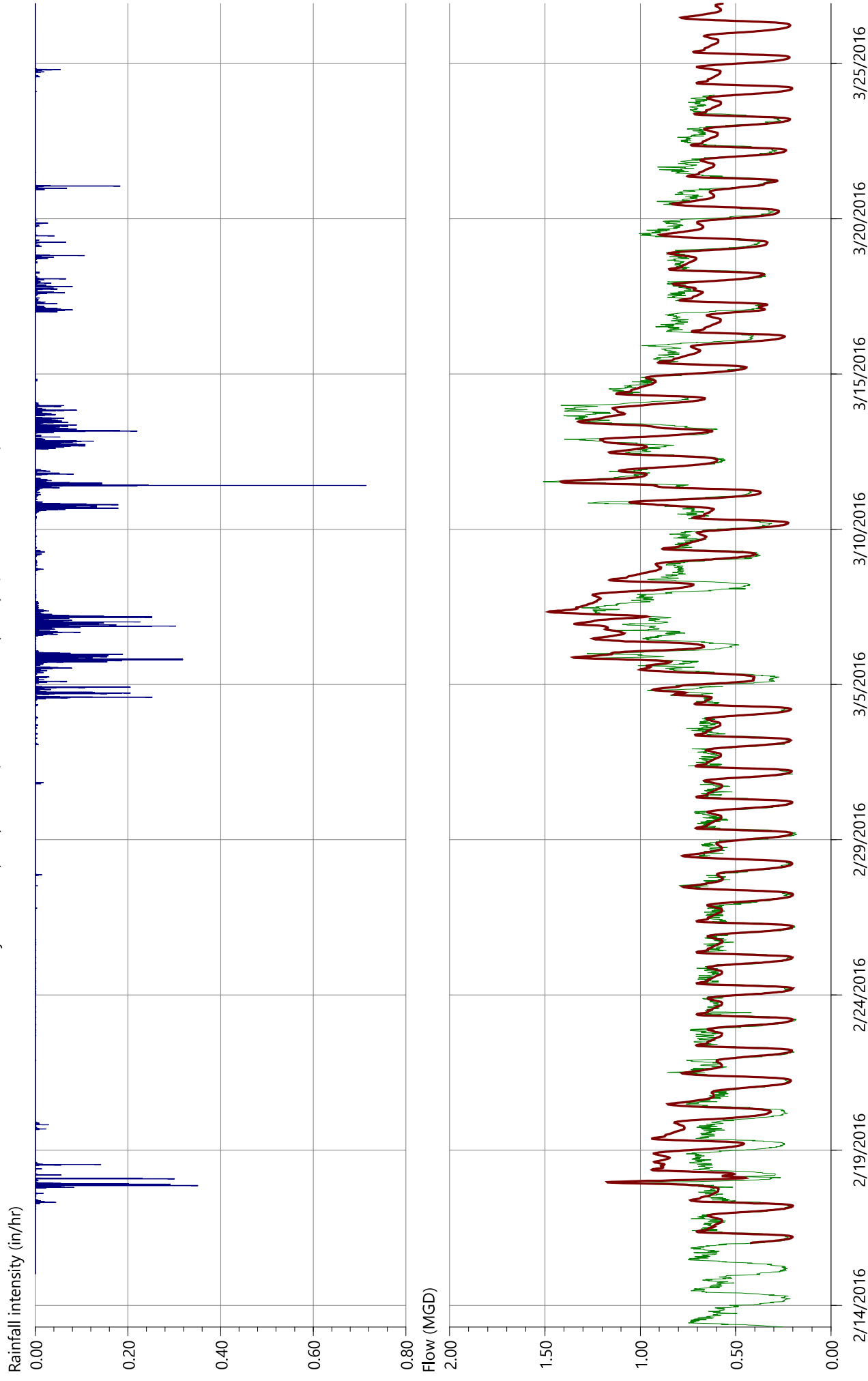


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	6.581	0.476	0.007	Max (ft3/s)
...ta20160215_20160315				17.190
				30162930.049

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 16A, Model Location (Pred.) D/S SMH B06-148.1, Rainfall Profile: 182

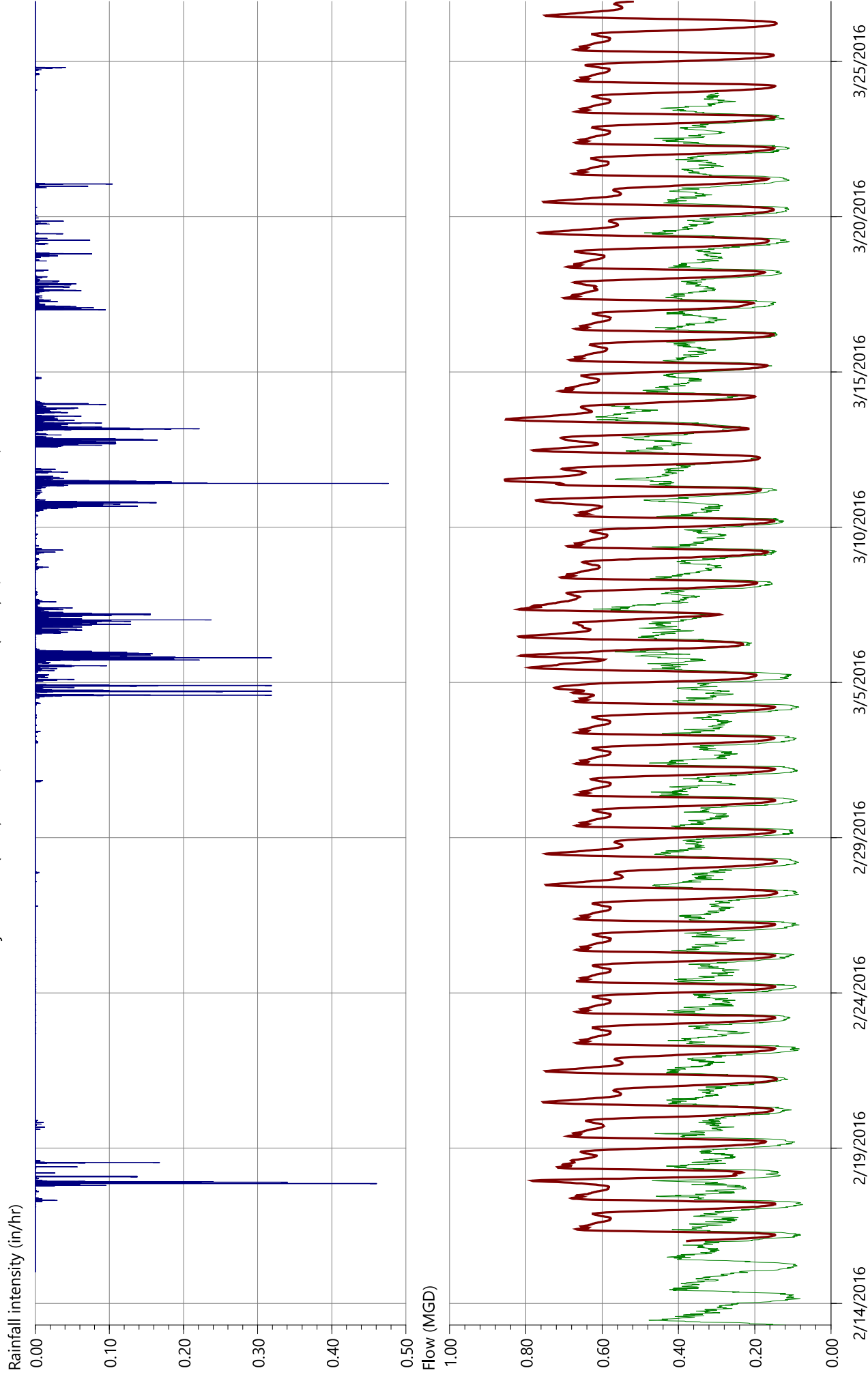


	Depth (in)	Rainfall Peak (in/hr)	Average (in/hr)	Min (ft ³ /s)	Max (ft ³ /s)	Volume (ft ³)
Rain	7.006	0.714	0.007			
Observed				0.179	1.509	2154876.607
...ta20160215_20160315				0.200	1.482	2224728.980

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 17, Model Location (Pred.) D/S SMH B05-448.1, Rainfall Profile: 147

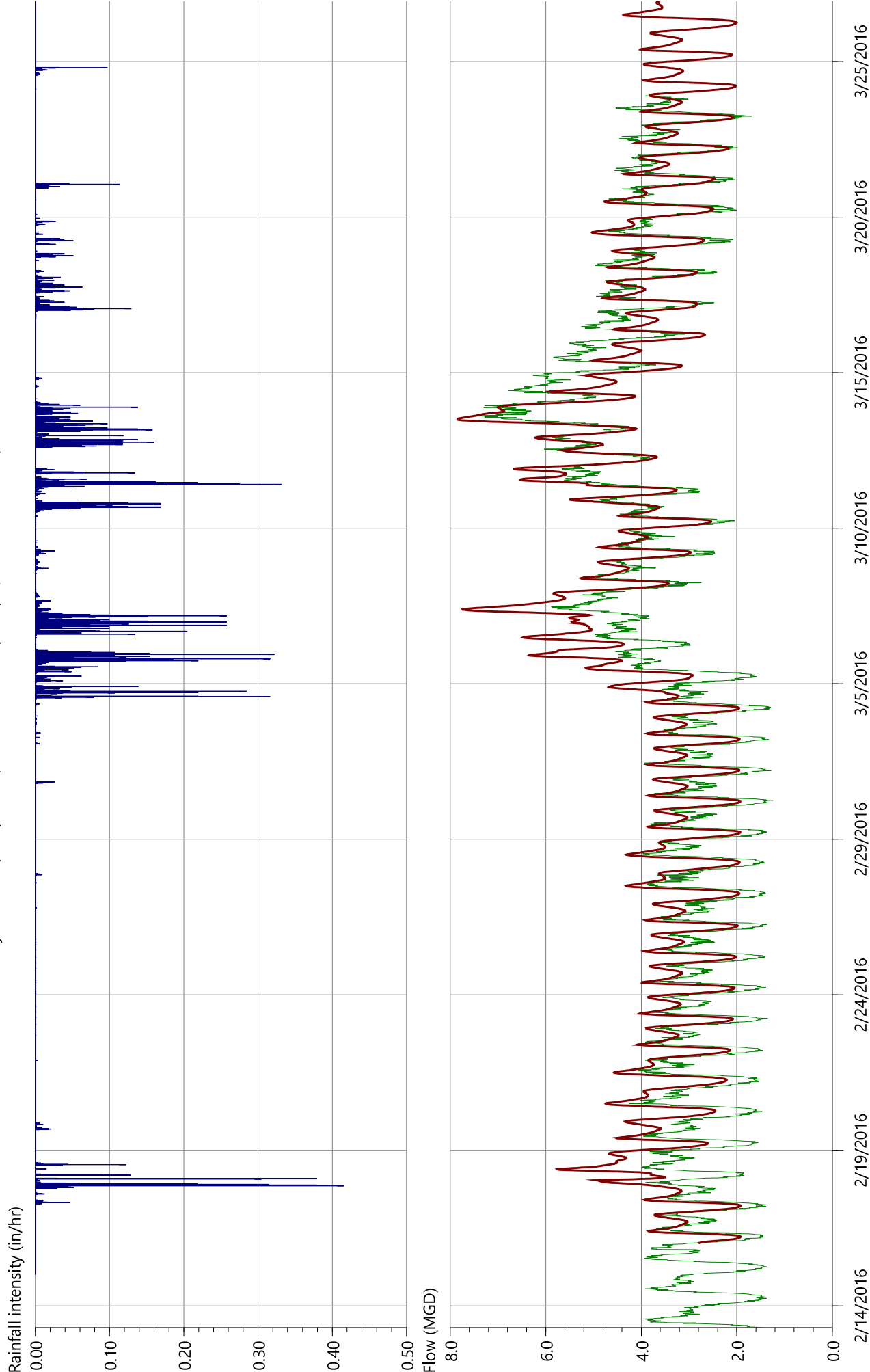


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	6.581	0.476	0.007	0.074	0.623
...ta20160215_20160315				0.141	0.855
					1027152.765
					1734444.106

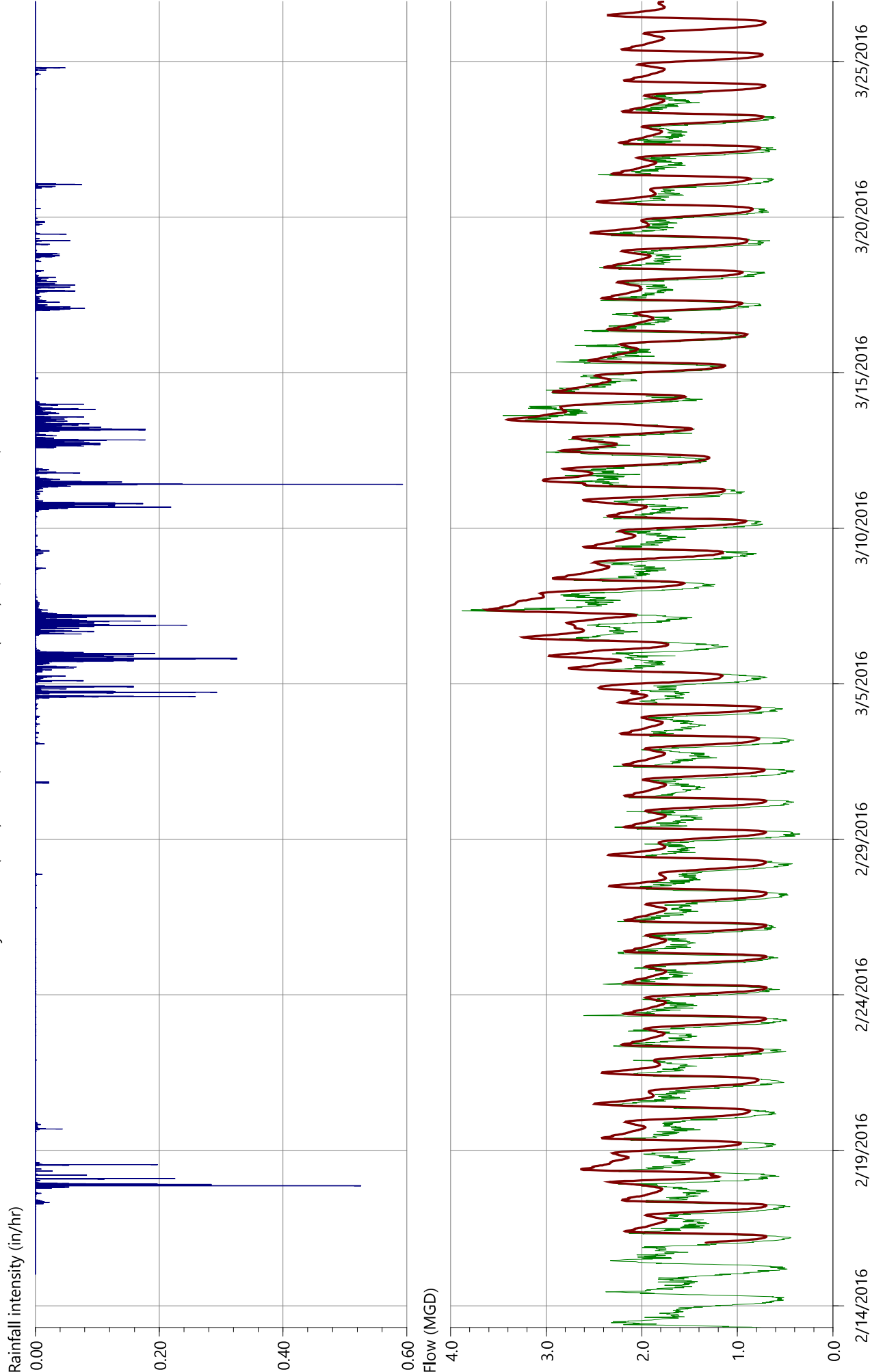
Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 18, Model Location (Pred.) D/S SMH B07-233.1, Rainfall Profile: 151



Rain	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.452	0.008	1.241	7.372
...ta20160215_20160315			1.920	7.850
				Volume (ft3)
				11745270.797
				12994404.563

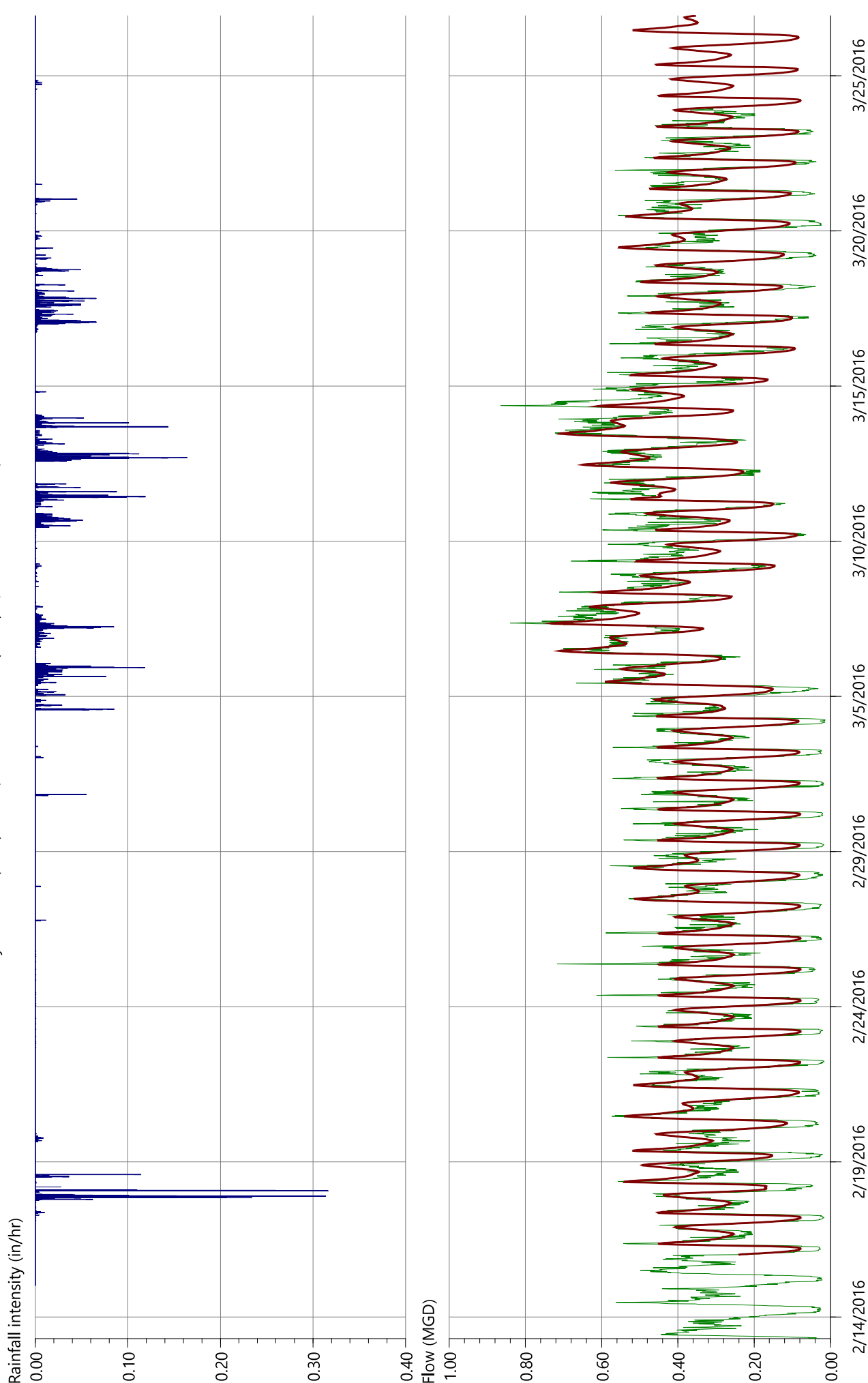


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.748	0.593	0.007			
Observed				0.347	3.882	5522255.777
ta20160215_20160315				0.691	3.629	6310657.038

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 20, Model Location (Pred.) D/S SMH C07-004.1, Rainfall Profile: 200

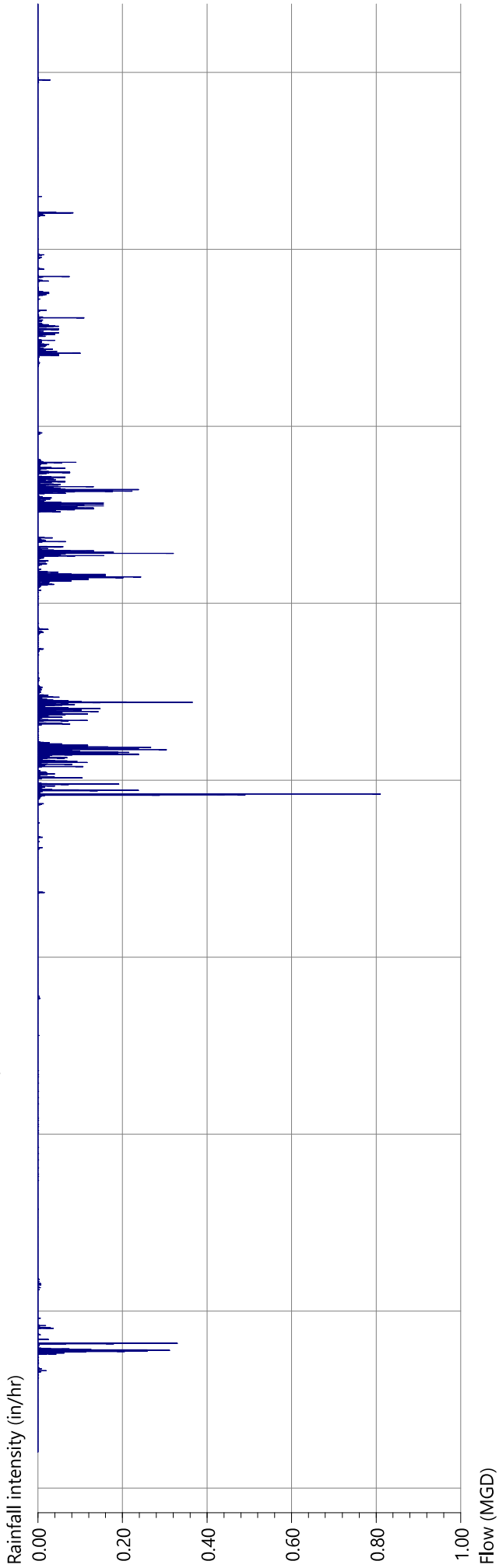


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	3.133	0.316	0.003	0.014
ta20160215_20160315				0.078
				0.865
				1110452.108
				1119212.084

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 21, Model Location (Pred.) D/S SMH E01-150.1, Rainfall Profile: 305

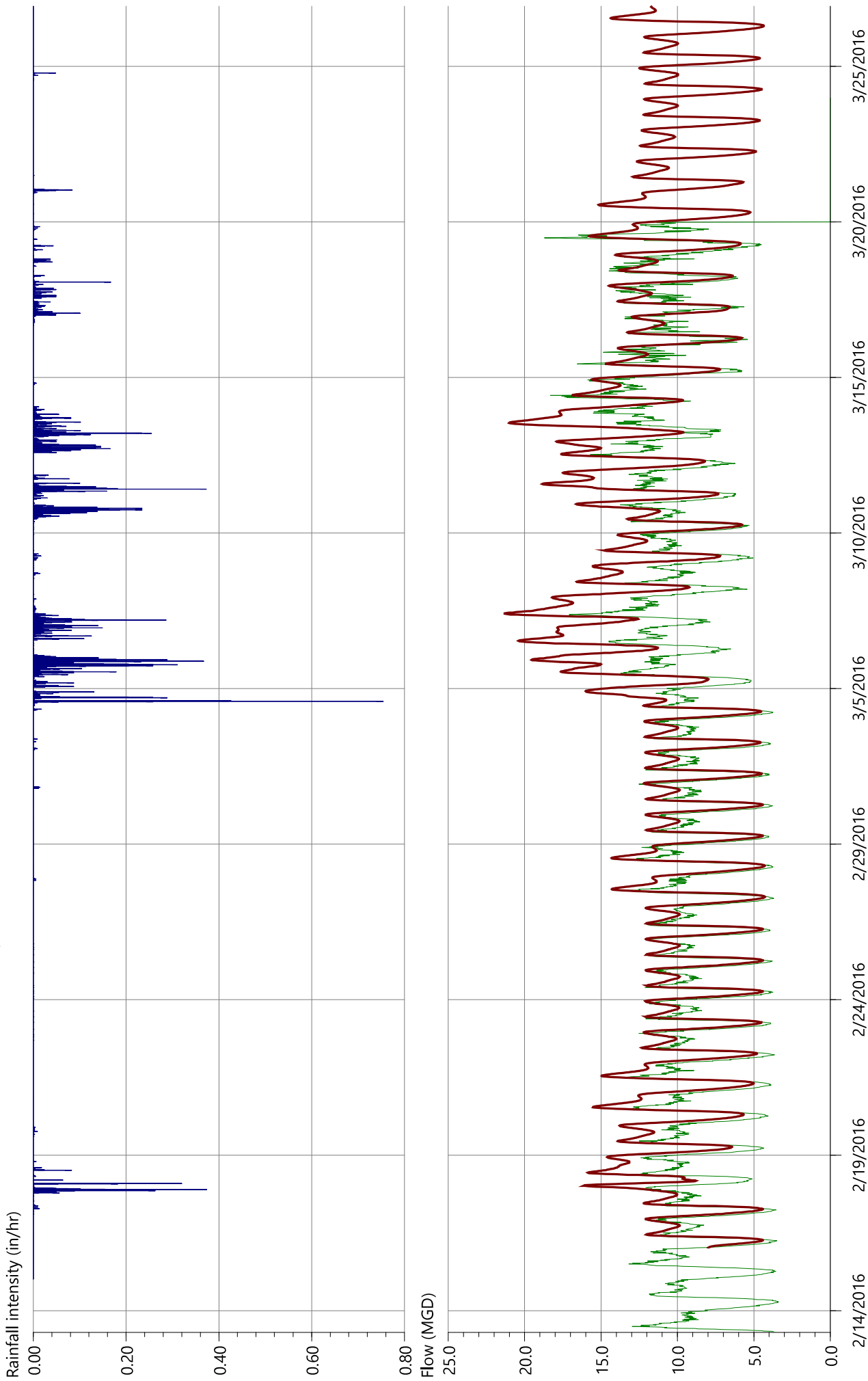


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	7.168	0.810	0.007	Max (ft3/s)
...ta20160215_20160315				7.071
				6.540
				Volume (ft3)
				7871327.215
				9303644.977

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 22, Model Location (Pred.) D/S SMH F01-135.1, Rainfall Profile: 371

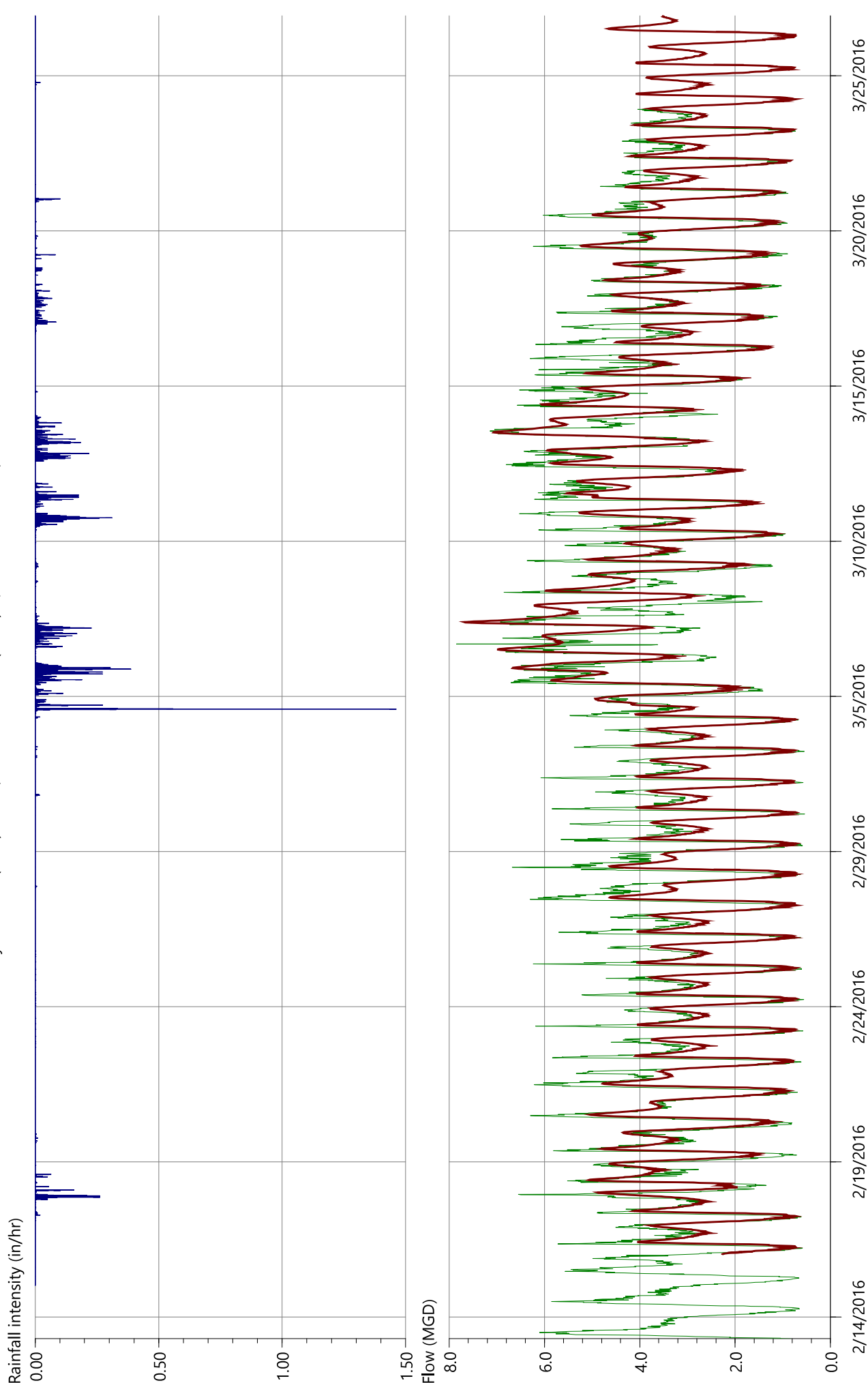


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.422	0.754	0.008	0.000	18.708
...ta20160215_20160315				4.271	21.309
					29305470.700
					38289677.747

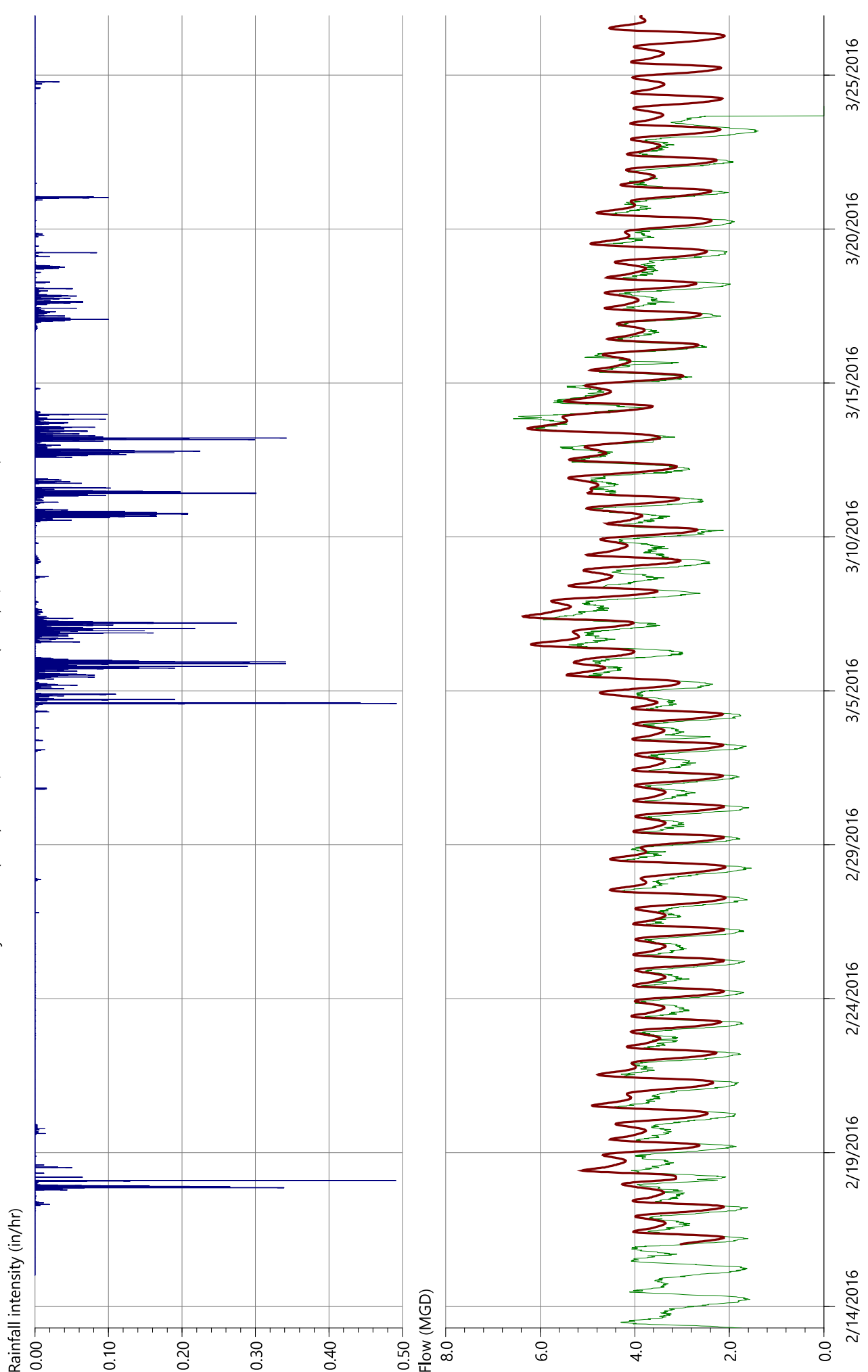
Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 23, Model Location (Pred.) D/S SMH F01-147.1, Rainfall Profile: 370



Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	7.432	1.462	0.008	Max (ft3/s)
...ta20160215_20160315				7.848
				0.542
				0.707
				Volume (ft3)
				12177525.807
				11302643.288

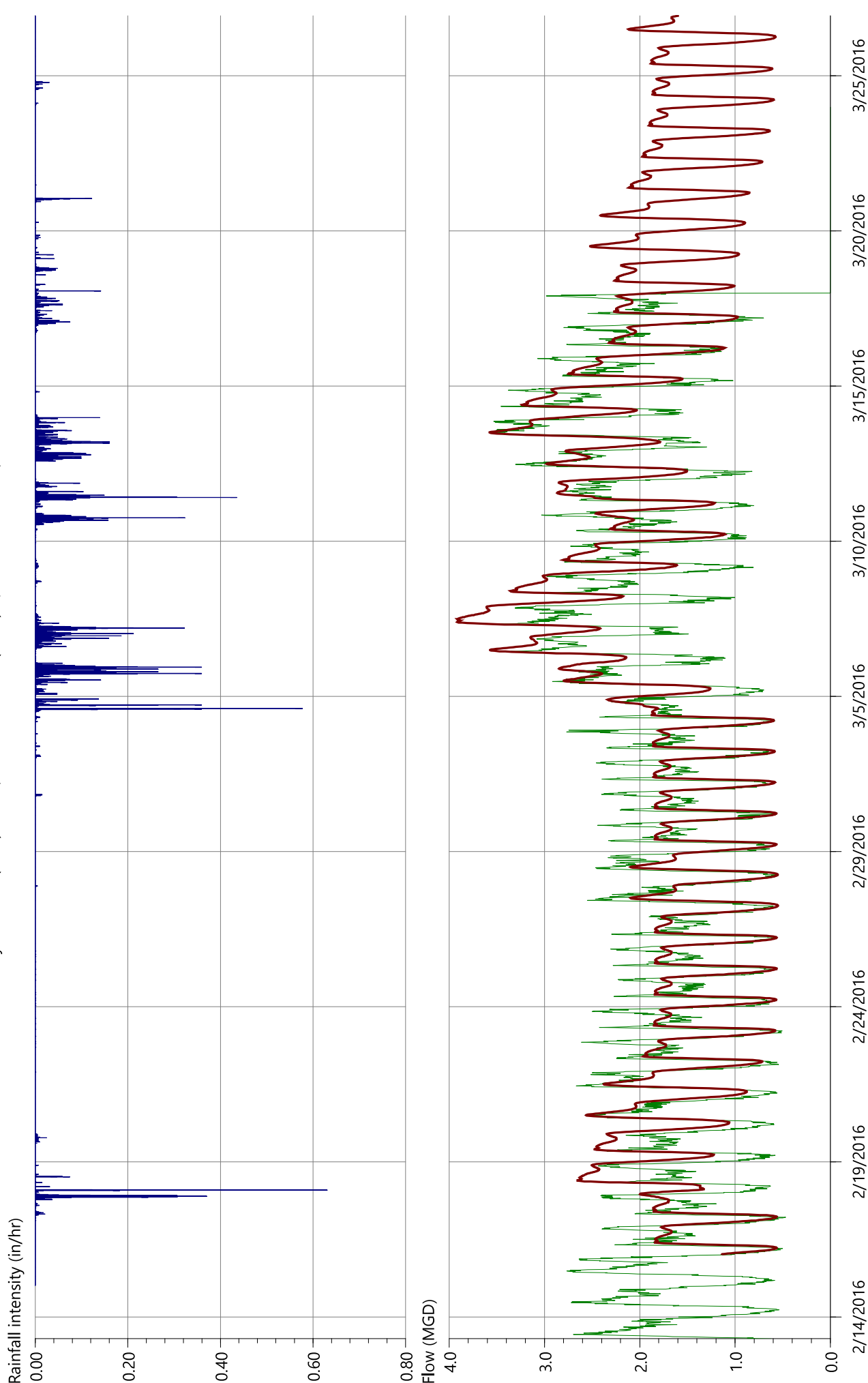


Rain Observed ...ta20160215_20160315	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
	7.235	0.492	0.007	Max (ft3/s)
				6.569
				6.365
				11673591.208
				13083521.477

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 25, Model Location (Pred.) D/S SMH F04-003.1, Rainfall Profile: 409

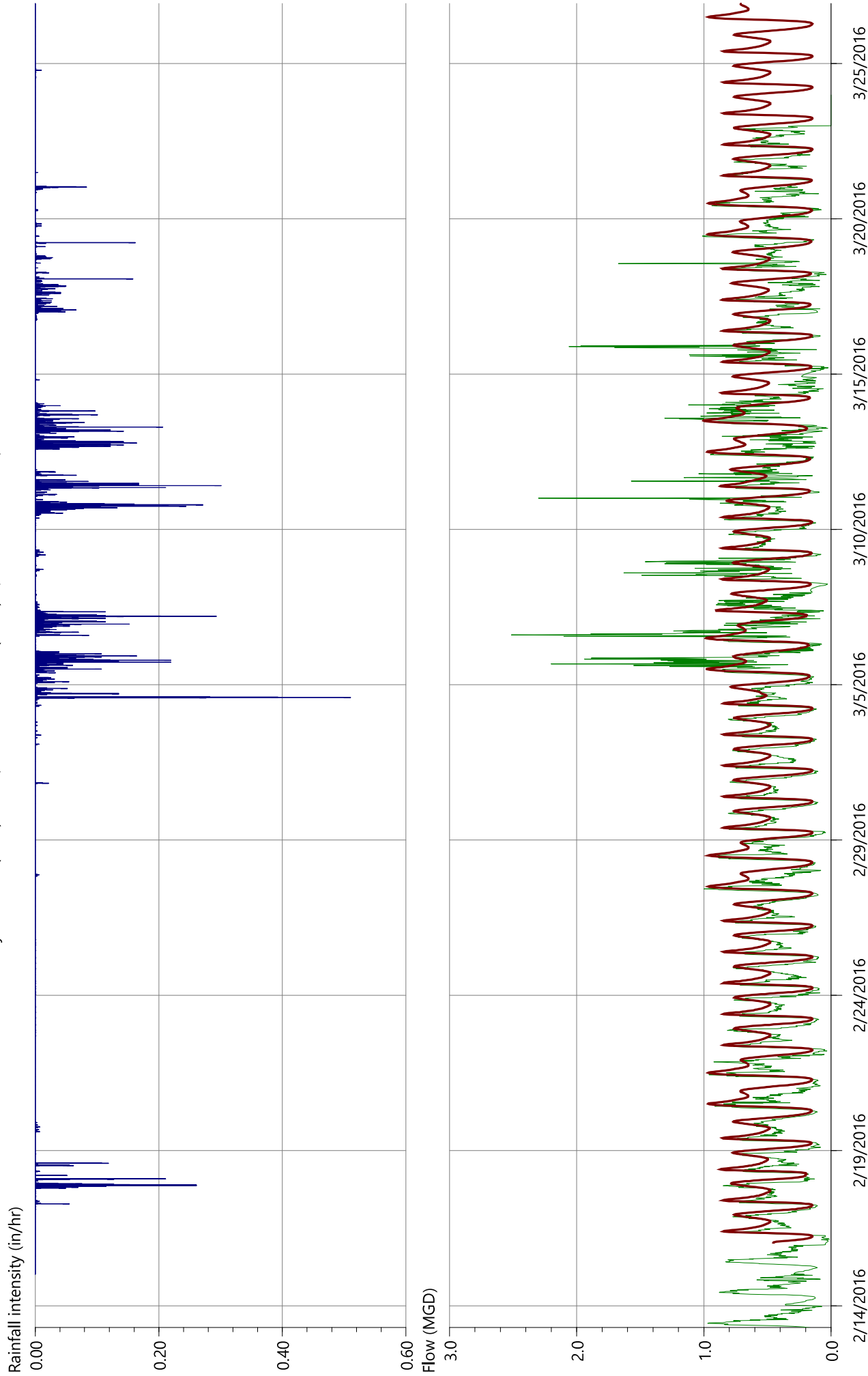


Rain	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Observed	7.213	0.631	0.007	0.000	3.566	5191133.127
...ta20160215_20160315				0.550	3.917	6371709.144

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 26, Model Location (Pred.) D/S SMH F99-034.1, Rainfall Profile: 336

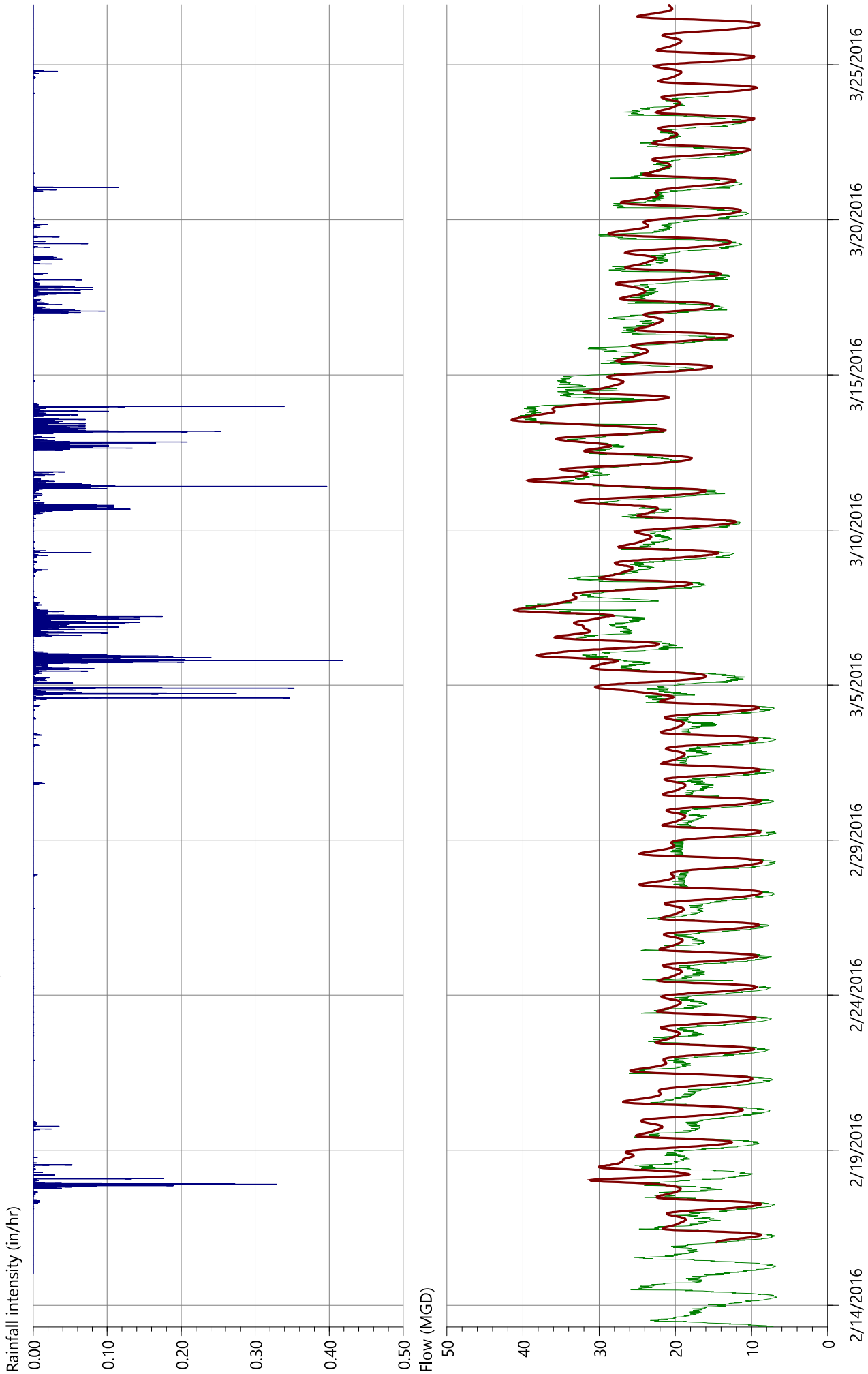


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	6.185	0.510	0.006	0.000	2.513
...ta20160215_20160315				0.146	1.003
					1488940.567
					1837826.434

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!:> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) DC WWTP, Model Location (Pred.) D/S CAP B03-DCWWTP.1, Rainfall Profile: 177

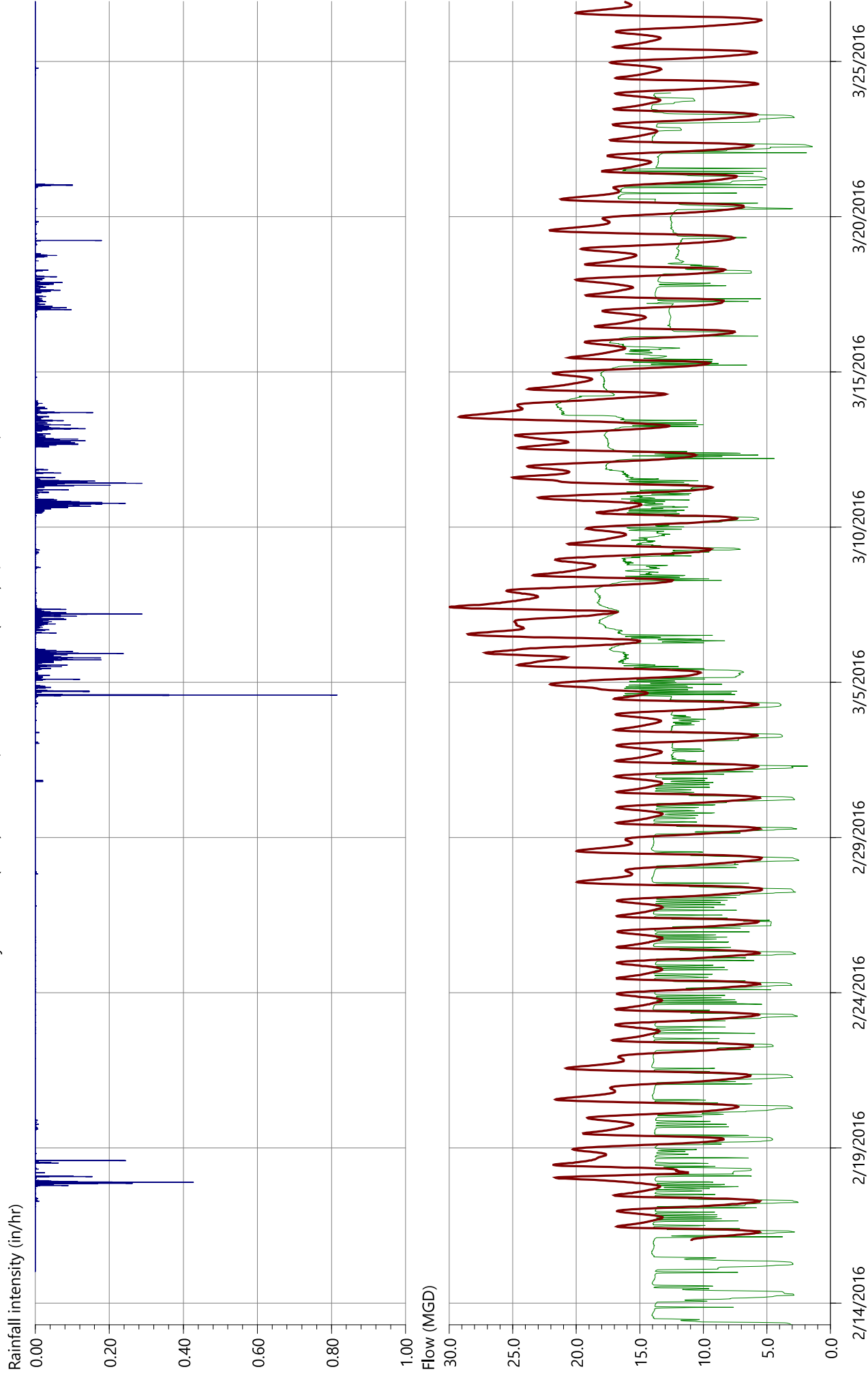


	Rainfall			Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	
Rain	6.394	0.418	0.007			
Observed				6.736	40.725	66602465.109
...ta20160215_20160315				8.618	41.482	73053377.582

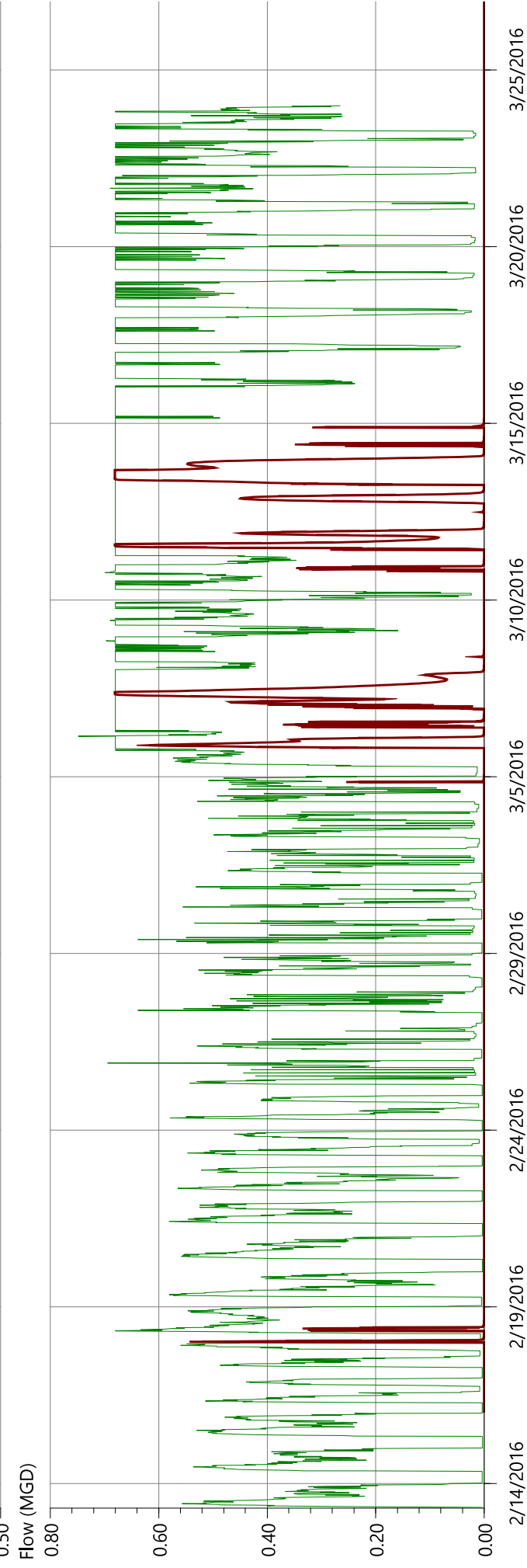
Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) PG WWTP, Model Location (Pred.) D/S SMH F99-016.1, Rainfall Profile: 368



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	5.985	0.815	0.006			
Observed				1.411	21.613	42233364.633
...ta20160215_20160315				5.391	29.963	52253557.072

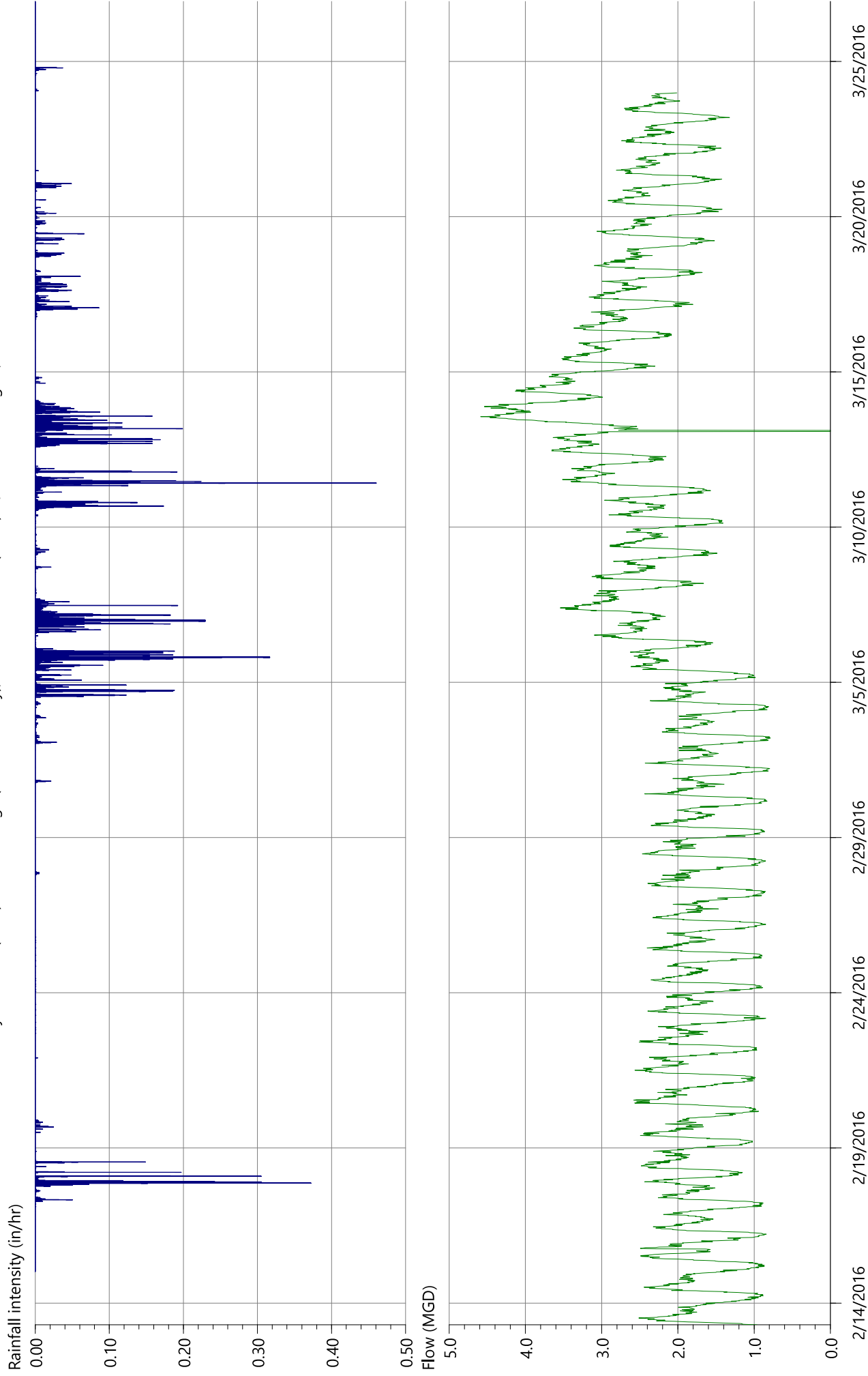


	Rainfall		Average (in/hr)	Flow		
	Depth (in)	Peak (in/hr)		Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.479	0.498	0.008			
Observed				0.003	0.748	1268714.090
...ta20160215_20160315				0.000	0.681	104826.425

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!! > OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Sierra College (Placer County), Model Location (Pred.) D/S Sierra College.1, Rainfall Profile: 289

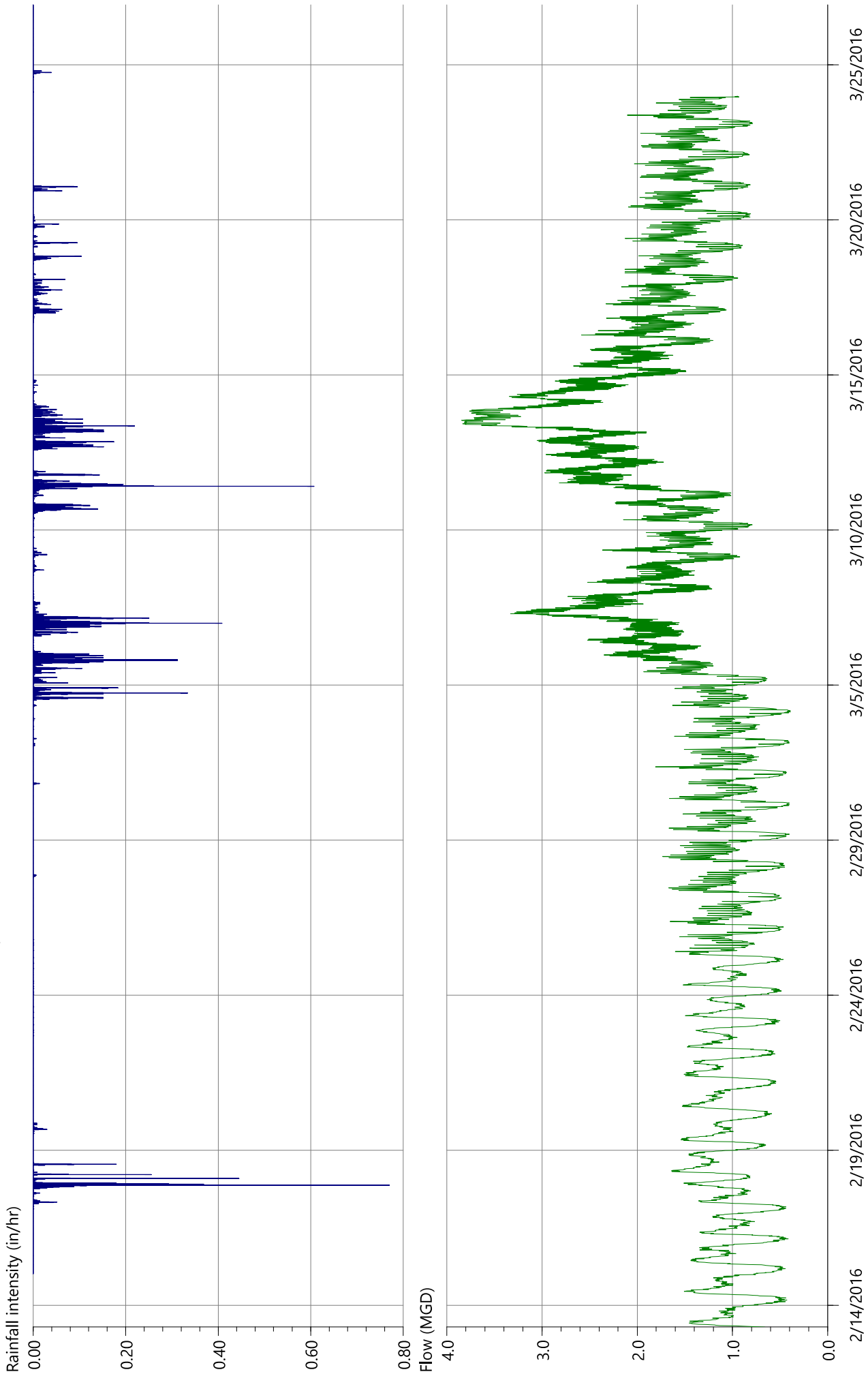


Rain	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.146	0.007	0.000	4.589
...ta20160215_20160315				7230337.020

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) SMD2, Model Location (Pred.) D/S SMH A08-023.1, Rainfall Profile: 157

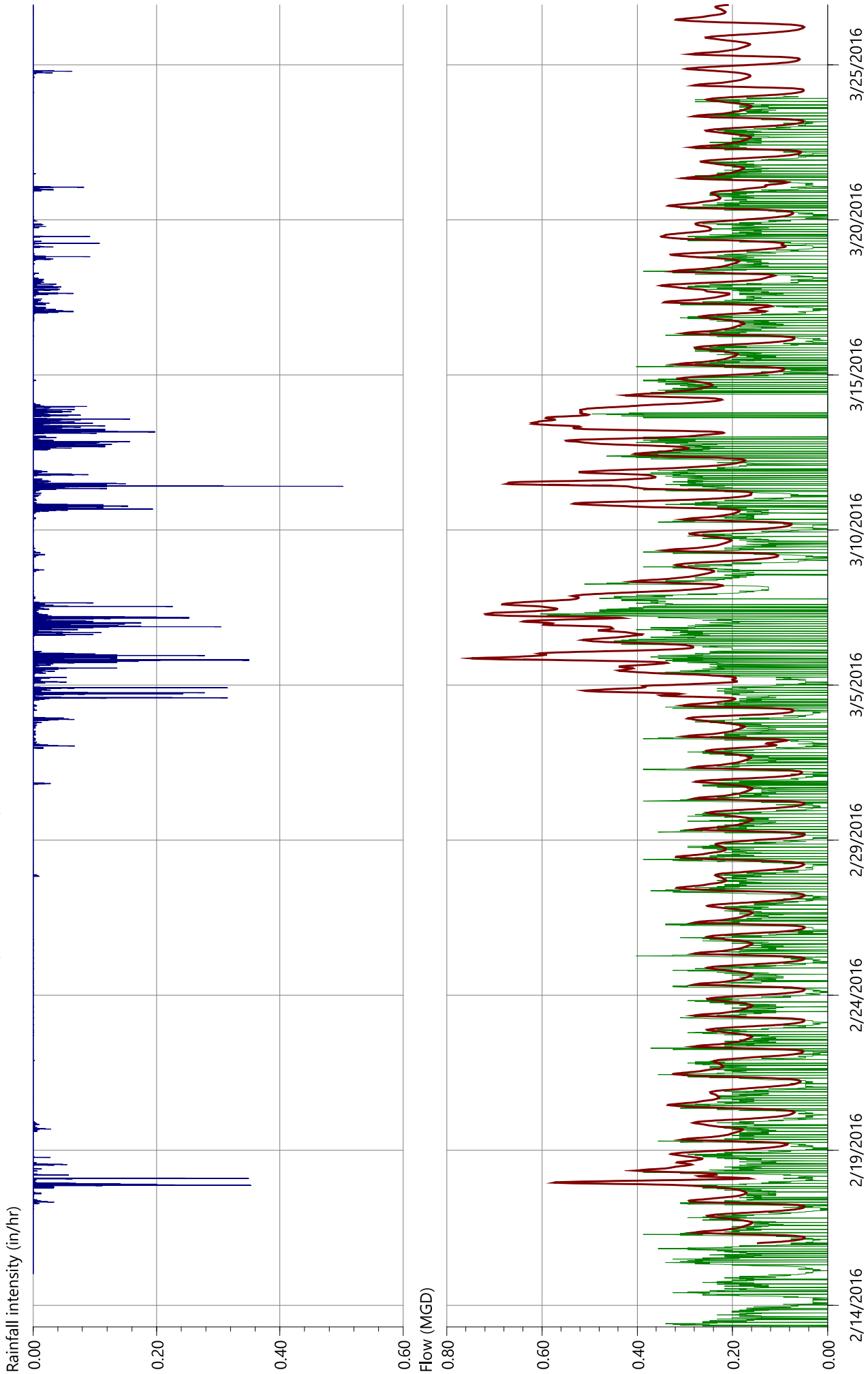


Rain	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.706	0.008	0.391	3.843
...ta20160215_20160315				4692173.351

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Highlands, Model Location (Pred.) D/S SMH D08-006.1, Rainfall Profile: 318

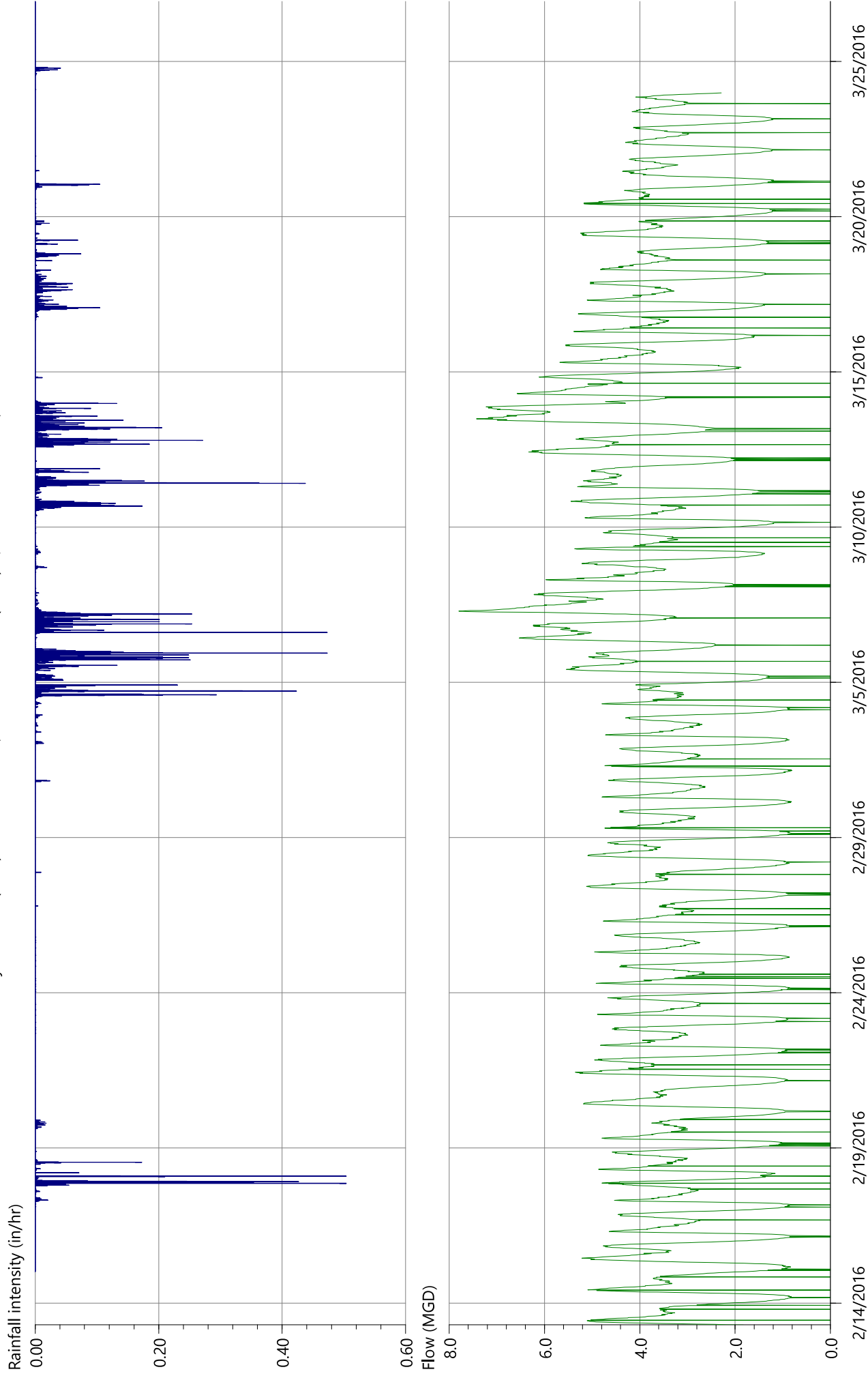


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.486	0.502	0.008	0.000	0.603
...ta20160215_20160315				0.048	0.748
					498513.323
					814212.771

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) North Roseville, Model Location (Pred.) D/S NorthRoseville.1, Rainfall Profile: 479

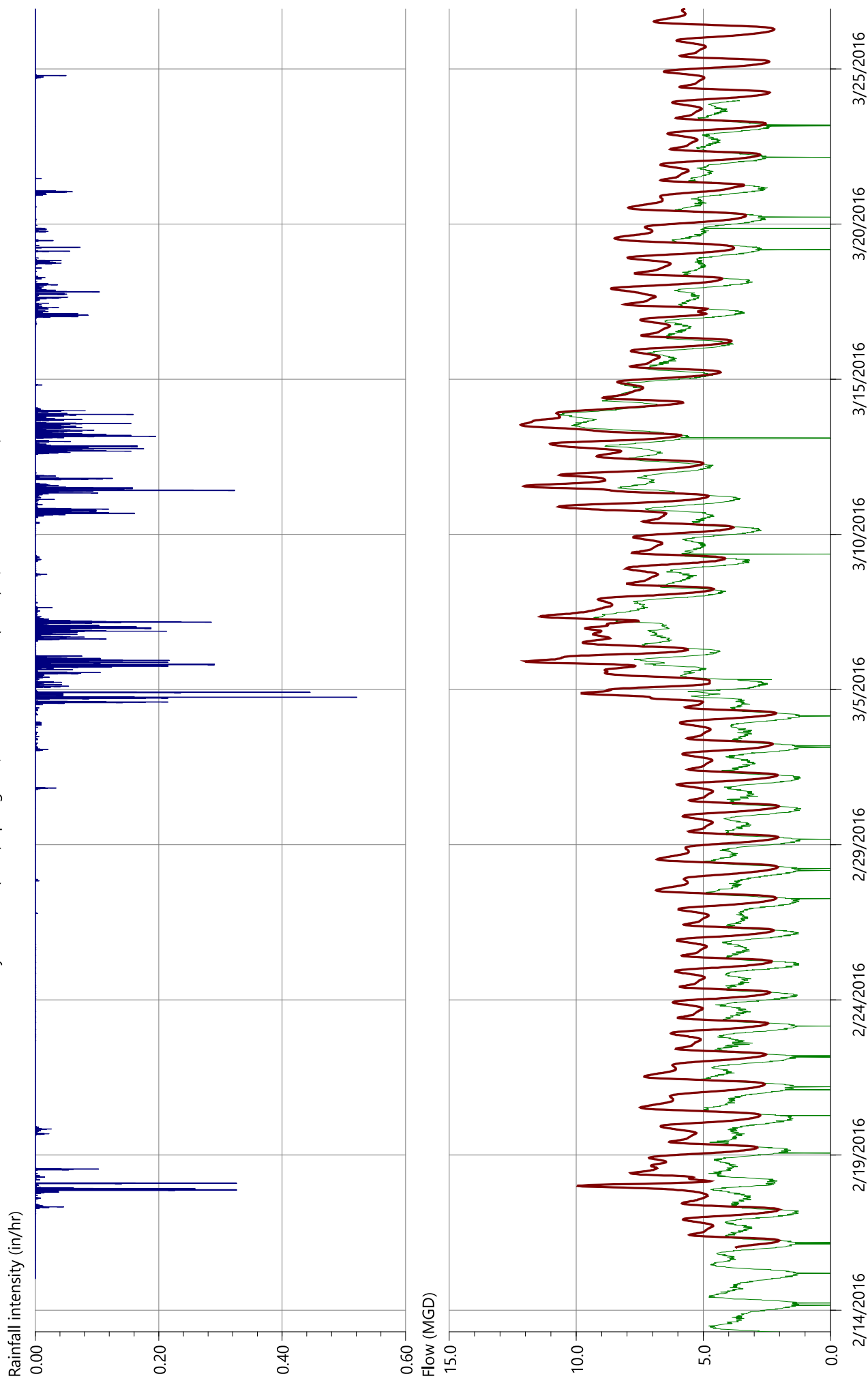


Rain	Rainfall		Flow	
	Depth (in)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.580	0.008	0.000	7.798
...ta20160215_20160315				11333261.397

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Springview, Model Location (Pred.) D/S SMH C06-213.1, Rainfall Profile: 418

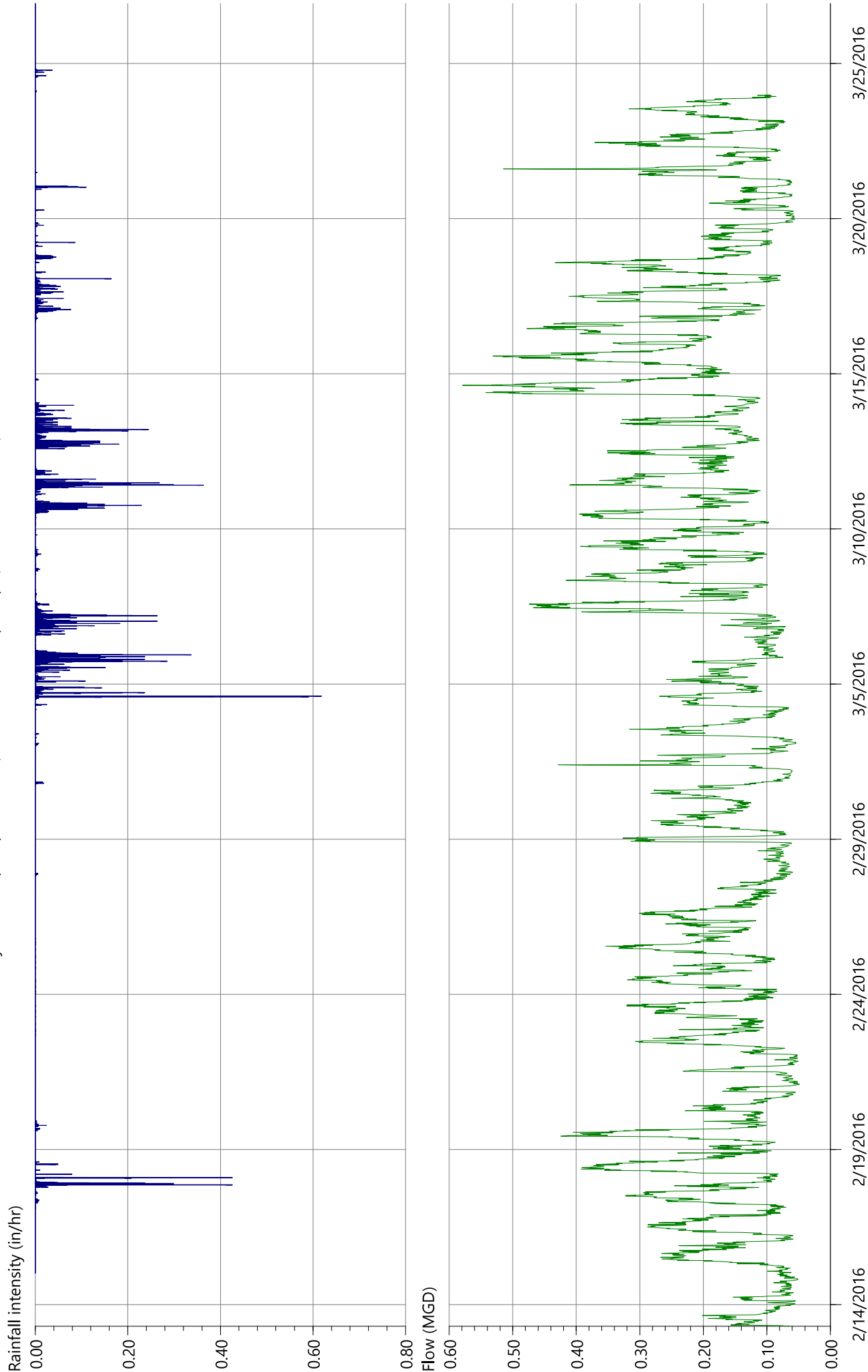


Rainfall			Flow		
Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
7.461	0.521	0.008			
Observed			0.000	10.738	14884868.215
...ta20160215_20160315			2.010	12.195	20206568.688

Flow survey: > Roseville> 3. Data> Flow Data> Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: > SPWA> 5. Model Runs> Calibration> combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Cincinnati, Model Location (Pred.) D/S SMH G03-032.1, Rainfall Profile: 441

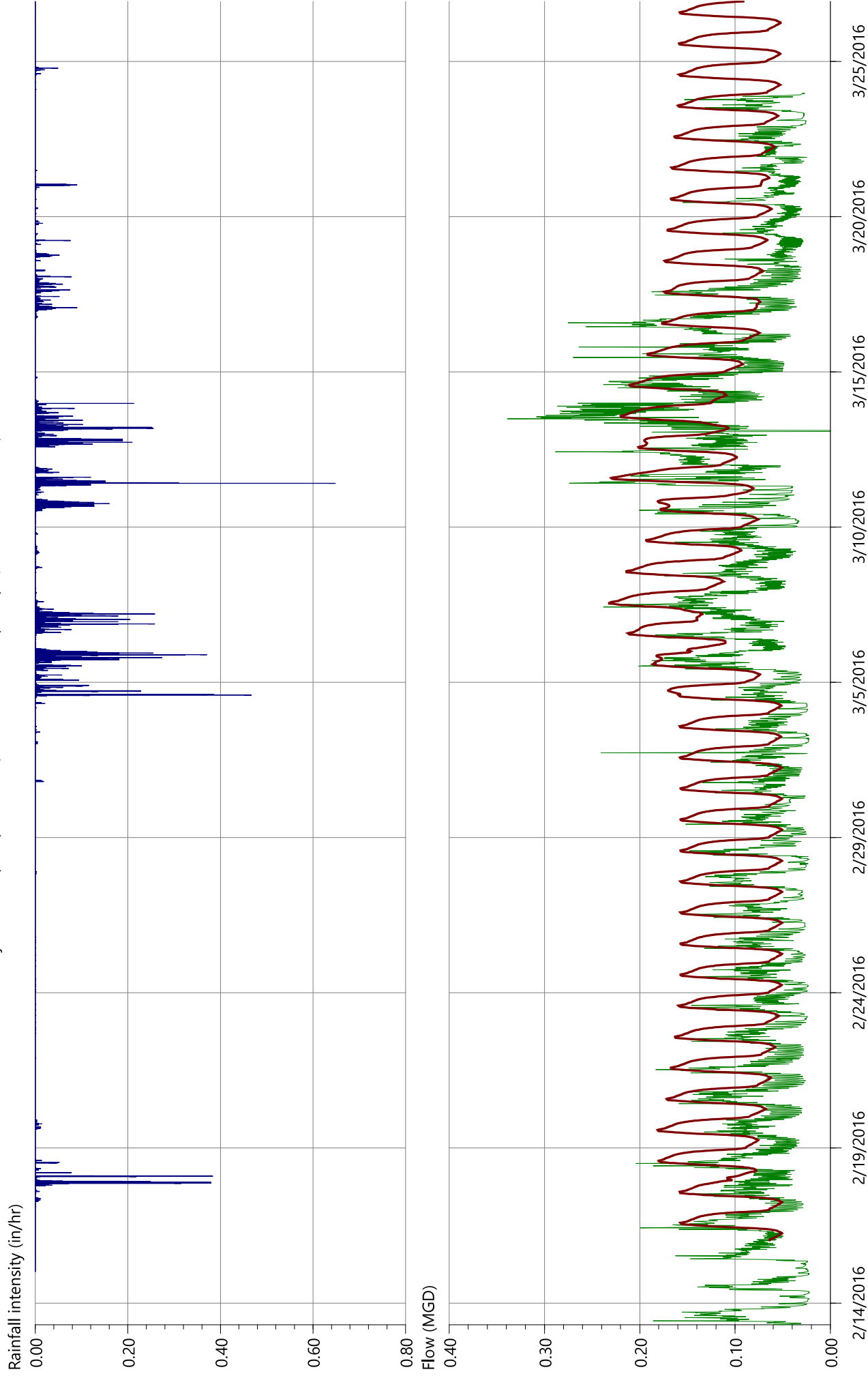


Rain	Rainfall		Flow		Volume (ft3)
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)
Observed	7.365	0.618	0.007	0.049	0.579
...ta20160215_20160315					607274.558

Flow survey: > Roseville > 3. Data > Flow Data > Flow survey - All data (12/1/2016 1:53:11 PM)

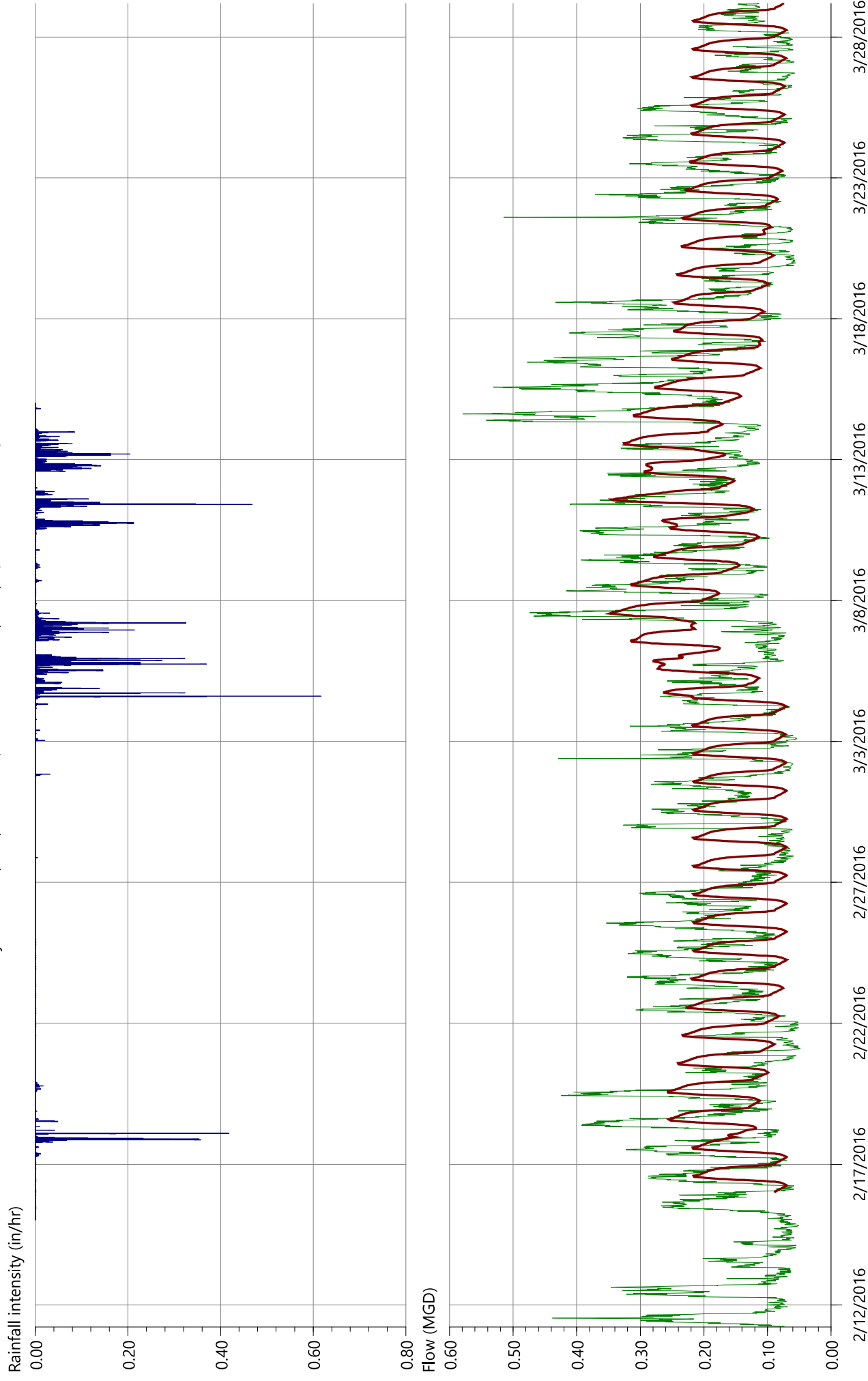
Sim: > SPWA > 5. Model Runs > Calibration > combined WWF Calibration (2016 rainfall)!> OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Industrial, Model Location (Pred.) D/S SMH G03-062.1, Rainfall Profile: 475

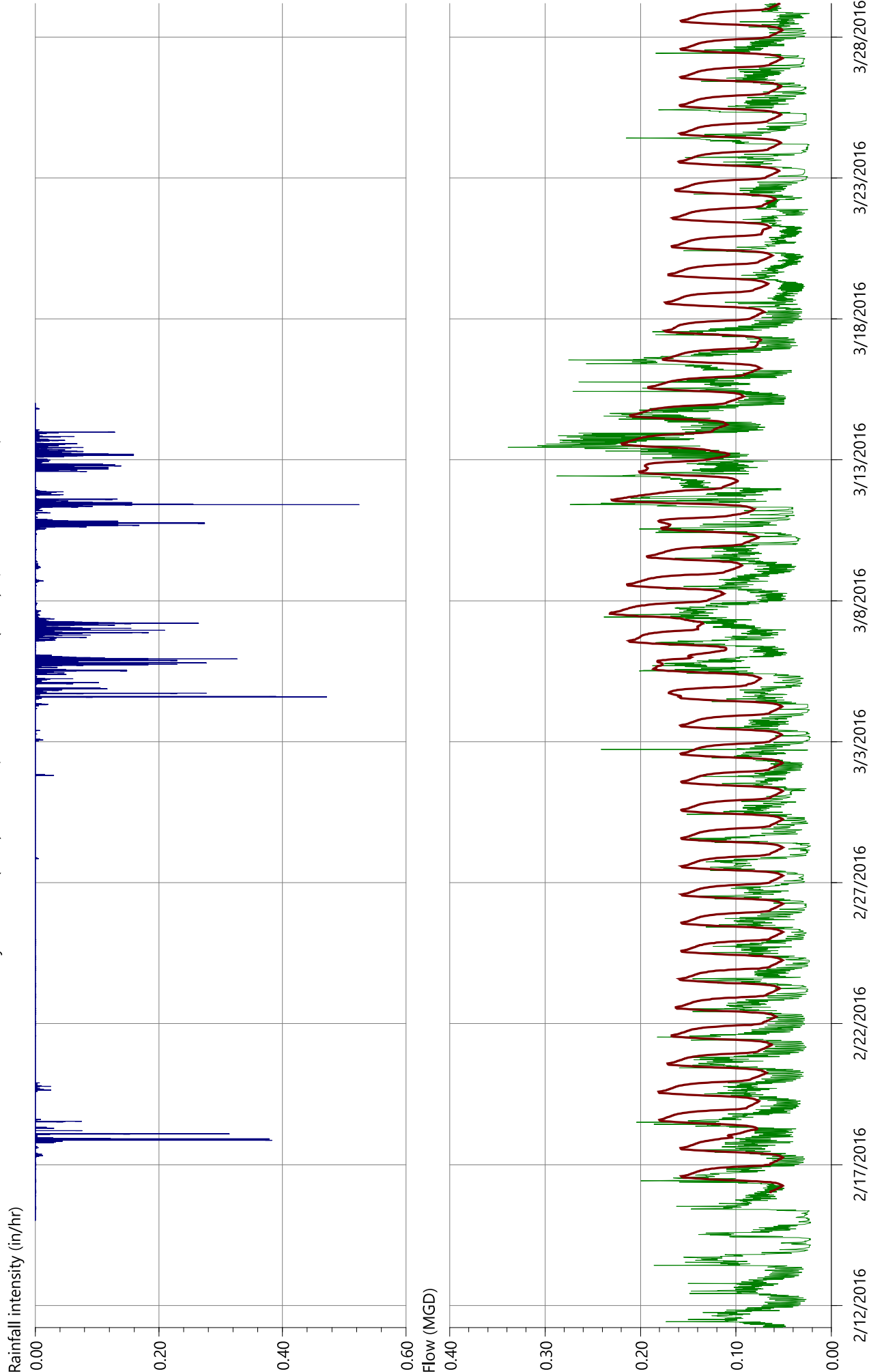


Rain	Rainfall		Flow	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)
Observed	7.576	0.648	0.008	0.000
...ta20160215_20160315				0.051
				0.339
				0.232
				266882.195
				407592.659

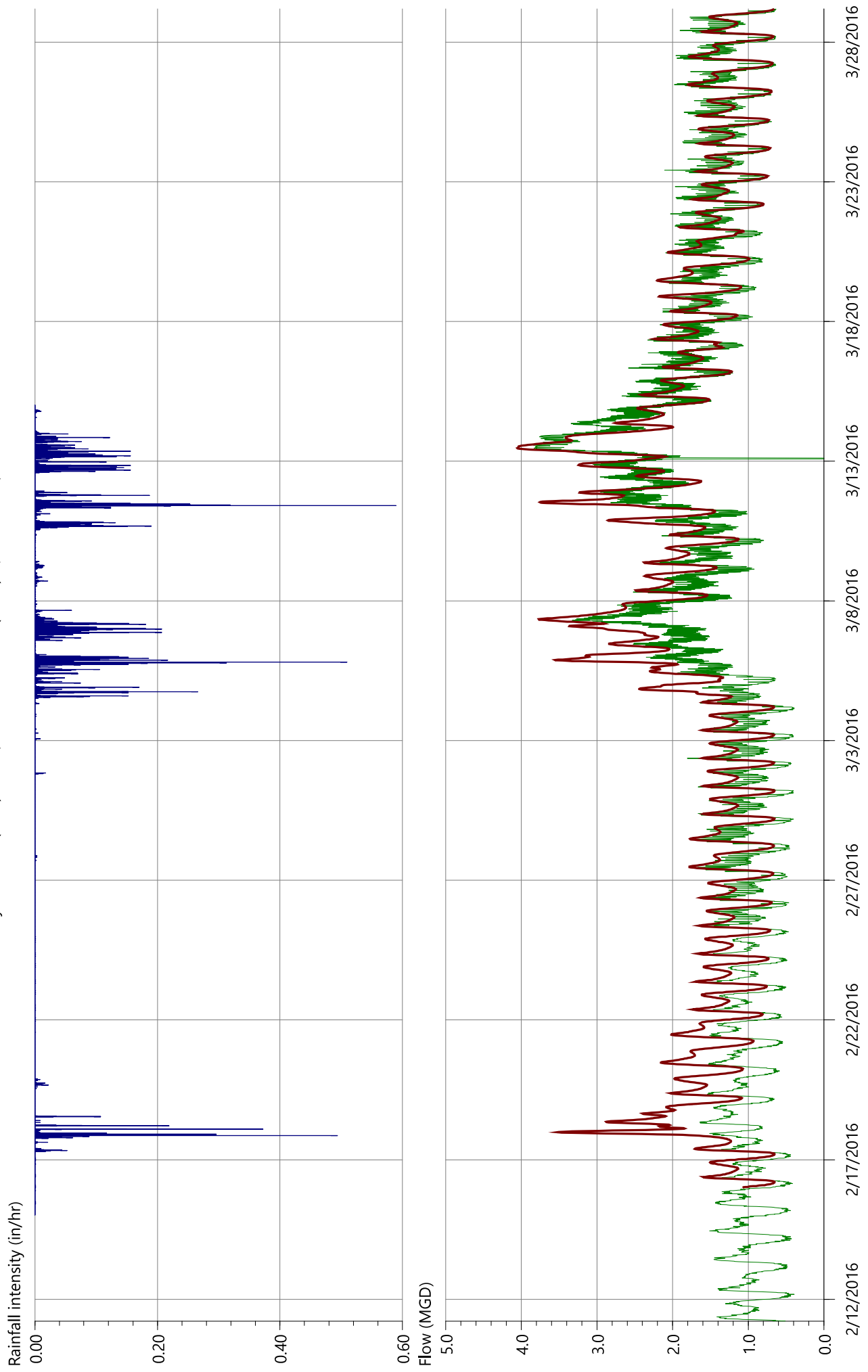
Flow Survey Location (Obs.) Cincinnati, Model Location (Pred.) D/S CA4-RSVL28.1, Rainfall Profile: 408



	Rainfall		Flow			
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.438	0.617	0.009			
Observed				0.049	0.579	695745.611
...160315_RGBoundaries				0.069	0.348	611280.586



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.635	0.524	0.010			
Observed				0.022	0.339	307302.659
...160315_RGBoundaries				0.051	0.232	426162.383



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.898	0.590	0.010			
Observed				0.000	3.843	5383819.870
...160315_RGBoundaries				0.651	4.053	5913576.081

