

Appendix I: Summary of Flow Monitoring Results

APPENDIX I – SUMMARY OF FLOW MONITORING RESULTS

Continuous flow was monitored at seven sampling locations according to methods described in the Quality Assurance Project Plan (QAPP; King County 2016) and Appendix C. Autosamplers were programmed to collect 36 flow-weighted aliquots into a single collection bottle. Occasionally, if a storm was less intense than predicted or if the sampler malfunctioned, fewer than 36 samples were collected. Sampling criteria were met if the aliquots were collected over an interval that included the peak flow rate or at least 50% of the flow volume that occurred at that location within 24 hours of the beginning of the storm event.

Data from each sampled storm are summarized in the following tables and figures. The summary statistics in the tables reflect the measurements taken during each storm event and sampling interval. The information included in the tables is described in Tables 1 and 2 below.

Table 1. Definitions of precipitation summary statistics provided for each storm.

Precipitation Information	Storm #
	Date
Dry antecedent period (hr)	Number of hours before start of storm event in which there was no more than a total sum of 0.04 inches of rain.
Rainfall in 4 days before storm (in)	Cumulative rainfall during the four days before the start of the storm event.
Rainfall in 48 hours before storm (in)	Cumulative rainfall during the 48 hours before the start of the storm event.
Rainfall in 24 hours before storm (in)	Cumulative rainfall during the 24 hours before the start of the storm event.
Rainfall in 6 hours before storm (in)	Cumulative rainfall during the six hours before the start of the storm event.
Rainfall during storm (in)	Cumulative rainfall between the beginning and end of the storm event.
Peak rainfall (date, time)	The time at which the greatest amount of rainfall was recorded.
Rainfall volume in bioretention basin (cf)	The estimated total volume of rainfall on the basins that contribute flow to the bioretention facilities; calculation is area of basins multiplied by rainfall depth.
Rainfall volume in wetland complex basin (cf)	The estimated total volume of rainfall on the basins that contribute flow to the wetland complex; calculation is area of basins multiplied by rainfall depth.

Table 2. Definitions of sampling information summarized in tables for each storm event.

Sampling Information	Storm # - Date						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	Cumulative volume of water measured passing through sampling location during each storm event; beginning and end times were estimated visually.						
Start of flow (hhmm)	Beginning of storm event, identified by rising hydrograph.						
Average flow rate for entire storm (cfs)	Average flow rate from the beginning and end of the storm event.						
Duration of flow (hr)	Number of hours between the beginning and end of the storm event.						
Runoff first 24 hrs of event (start at time of first sample) (cf)	Cumulative volume of water measured passing through sampling location for 24 hours, starting when the first sample aliquot was collected.						
Runoff volume sampled (cf)	Cumulative volume of water measured passing through sampling location between the time the first and last sample aliquots were collected.						
% of runoff volume sampled	The percent of total water volume measured in 24 hours that was sampled. If the sampler collected the first and last aliquot exactly 24 hours apart, this value would be 100%.						
Average flow rate during sampling interval (cfs)	Average flow rate between the time the first and last aliquots were collected.						
Peak of hydrograph captured?	A yes or know question about whether the sampling interval included the time at which the maximum flow rate for that event was recorded.						
Number of aliquots collected	The number of aliquots collected and combined for the storm event.						
Peak flow rate (cfs)	The maximum measured flow rate during the storm event.						
Peak hydrograph (date, time)	The time that the maximum flow rate was measured during the storm event.						
Time difference: peak rain to peak hydrograph (hr:min)	The difference in time between the maximum measured rainfall (in 15 minute intervals) and the maximum flow rate.						

The figures illustrate the depth of water in each pipe and the calculated flow rate at each location during each storm. In addition, rainfall recorded at rain gage 24V during each storm is also plotted. The red diamonds on each figure illustrate when each aliquot was collected. The figures often include time before and after the storm event and sampling period to give context.

Precipitation Information	Storm 1
	3/9/2016
Dry antecedent period (hr)	12
Rainfall in 4 days before storm (in)	0.75
Rainfall in 48 hours before storm (in)	0.3
Rainfall in 24 hours before storm (in)	0.25
Rainfall in 6 hours before storm (in)	0.02
Rainfall during storm (in)	0.86
Peak rainfall (date, time)	3/10/16 2:00 AM
Rainfall volume in bioretention basin (cf)	70553
Rainfall volume in wetland complex basin (cf)	610624

Sampling Information	Storm 1 - 3/9/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	10503	19133	18587	(a)	226303	406531	430388
Start of flow (hhmm)	1320	1320	1325	(a)	1210	1328	1225
Average flow rate for entire storm (cfs)	0.137	0.108	0.252	(a)	2.754	2.283	2.45
Duration of flow (hr)	21.3	49.2	20.5	(a)	22.8	49.5	48.8
Runoff first 24 hrs of event (start at time of first sample) (cf)	10370	12600	18658	(a)	222909	238255	272265
Runoff volume sampled (cf)	6890	5978	14546	(a)	200755	197620	210972
% of runoff volume sampled	66.4	47.4	78.0	(a)	90.1	82.9	77.5
Average flow rate during sampling interval (cfs)	0.182	0.127	0.322	(a)	3.27	2.737	3.261
Peak of hydrograph captured?	yes	yes	yes	likely	yes	yes	yes
Number of aliquots collected	36	36	36	36	36	32	26
Peak flow rate (cfs)	0.36	0.18	0.46	(a)	9.33	3.6	5.27
Peak hydrograph (date, time)	3/10/2016 2:10:00 AM	3/10/2016 10:35:00 AM	3/10/2016 2:10:00 AM	(a)	3/10/2016 2:10:00 AM	3/10/2016 4:35:00 AM	3/10/2016 2:25:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	0:10	8:35	0:10	(a)	0:10	2:35	0:25

(a) Spikes in flow level due to backflow caused by high flow in adjacent pipe. Spikes obscure beginning and end of event, as well as the peak.

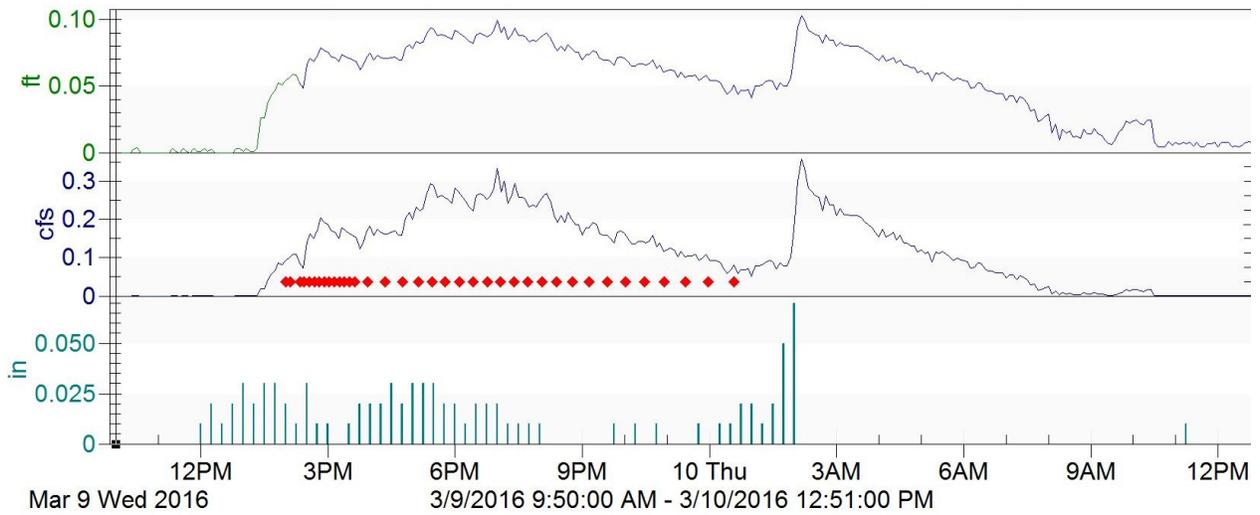


Figure 1. EBI, Storm 1.

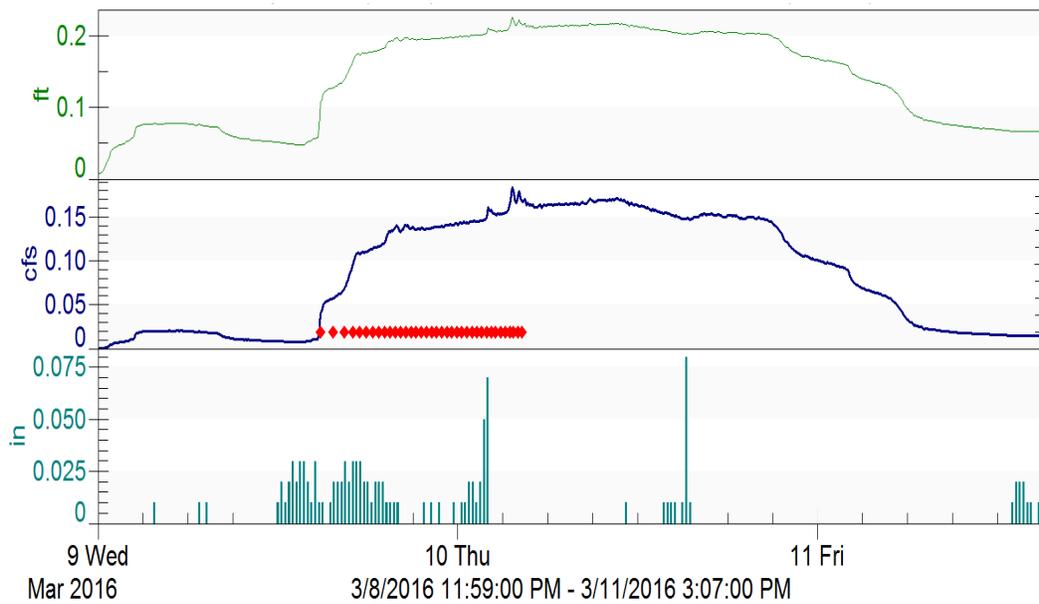


Figure 2. EBO, Storm 1.

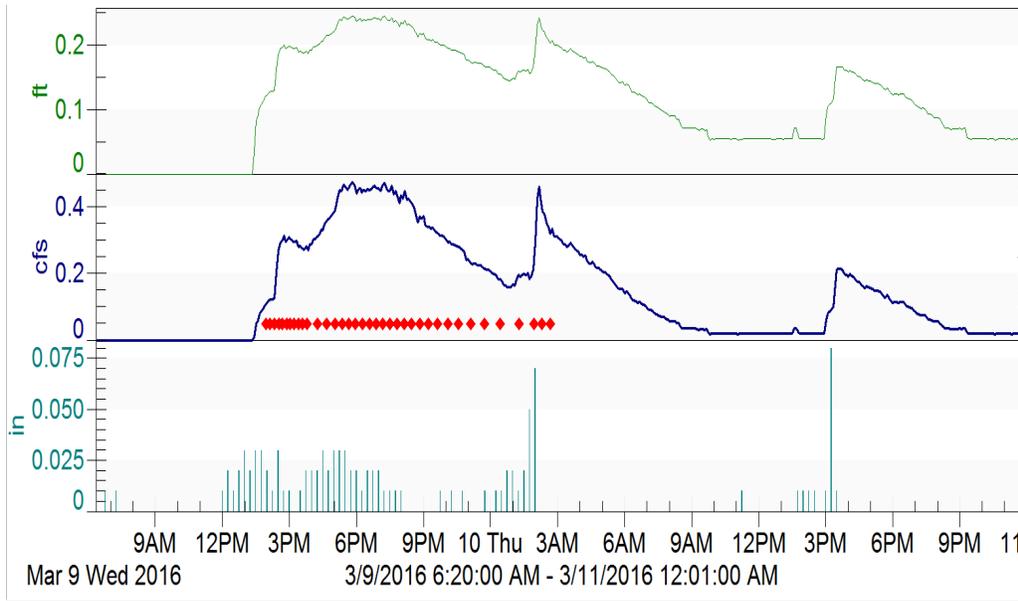


Figure 3. WBI, Storm 1.

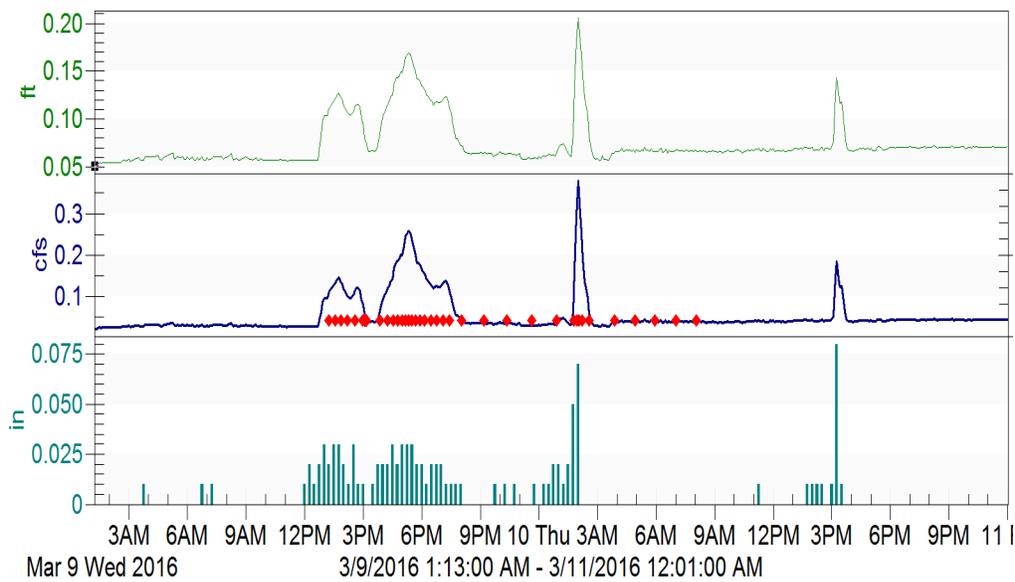


Figure 4. WBO, Storm1.

Note: Spikes in water level in WBO are due to backflow into pipe; flow rates are not accurate.

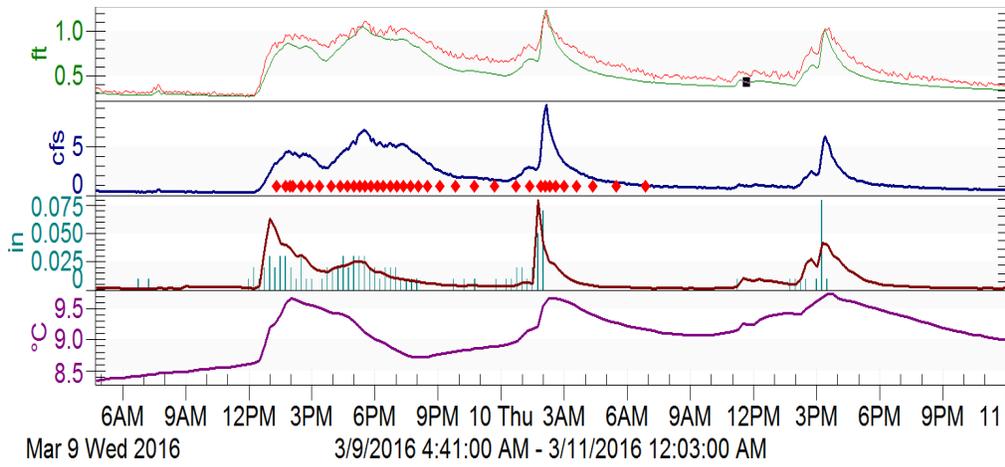


Figure 5. WCI, Storm 1.

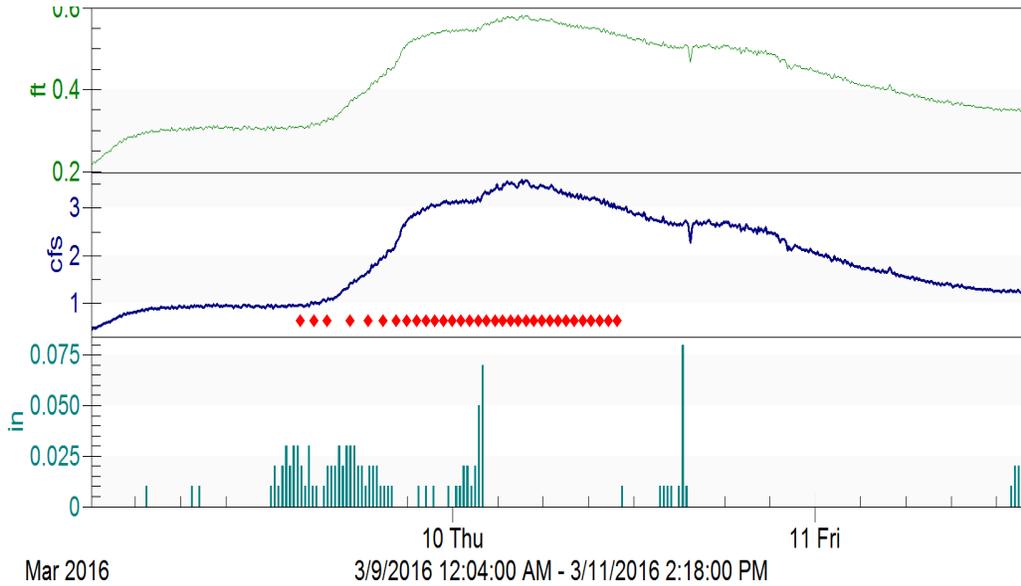


Figure 6. WCEBO, Storm 1.

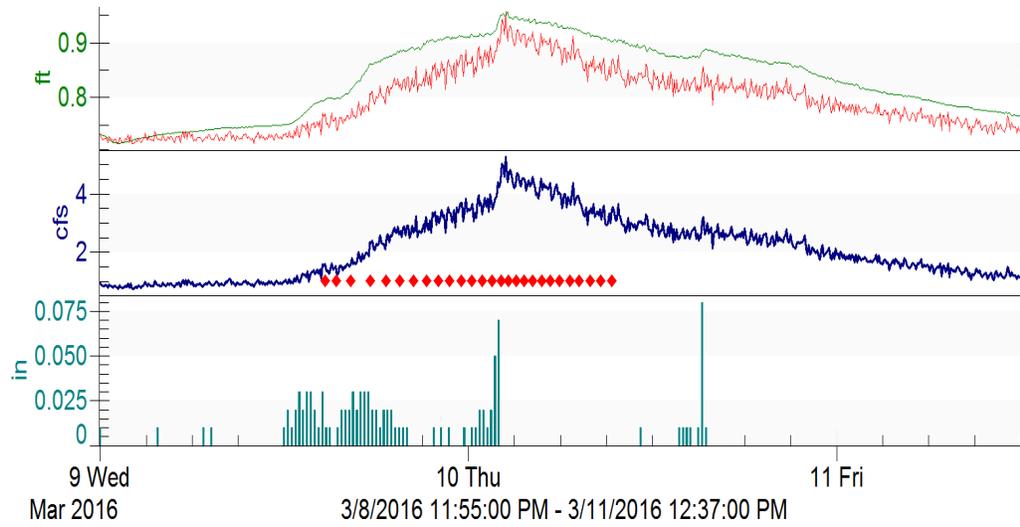


Figure 7. NFWHC, Storm 1.

Precipitation Information	Storm 2
	3/23/2016
Dry antecedent period (hr)	39
Rainfall in 4 days before storm (in)	0.54
Rainfall in 48 hours before storm (in)	0.19
Rainfall in 24 hours before storm (in)	0
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.29
Peak rainfall (date, time)	3/23/16 11:00 PM
Rainfall volume in bioretention basin (cf)	23791
Rainfall volume in wetland complex basin (cf)	205908

Sampling Information	Storm 2 - 3/23/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	886	3948	276	(a)	60126	143208	139481
Start of flow (hhmm)	1730	1845	1145	(a)	230	1655	1350
Average flow rate for entire storm (cfs)	0.017	0.015	0.009	(a)	0.499	0.512	0.578
Duration of flow (hr)	14.5	73.1	8.5	(a)	33.5	77.7	67.0
Runoff first 24 hrs of event (start at time of first sample) (cf)	867	2458	259	(b)	51647	69661	62412
Runoff volume sampled (cf)	737	1280	225	(b)	44309	38007	32398
% of runoff volume sampled	85.01	52.07	86.87	(b)	85.79	54.56	51.91
Average flow rate during sampling interval (cfs)	0.017	0.033	0.013	(b)	0.727	0.79	0.765
Peak of hydrograph captured?	yes	yes	yes	no	yes	yes	yes
Number of aliquots collected	36	36	6	0 (b)	21	19	13
Peak flow rate (cfs)	0.035	0.06	0.02	(c)	2.3	1.06	0.94
Peak hydrograph (date, time)	3/24/2016 1:35:00 AM	3/24/2016 6:25:00 AM	3/24/2016 12:45:00 AM	(c)	3/23/2016 11:15:00 PM	3/24/2016 8:25:00 AM	3/24/2016 7:45:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	2:35	7:25	1:45	(c)	0:15	9:25	8:45

(a) Unable to discern beginning and end of storm flow.

(b) No aliquots taken during storm. 4L grab sample collected on 3/25/16.

(c) Flow spikes obscure actual peak hydrograph.

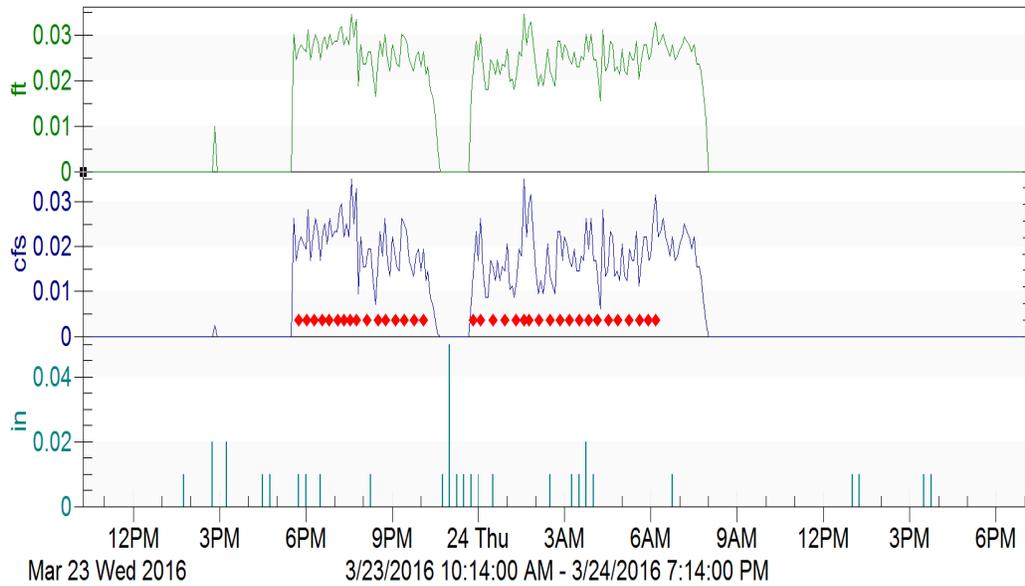


Figure 8. EBI, Storm 2.

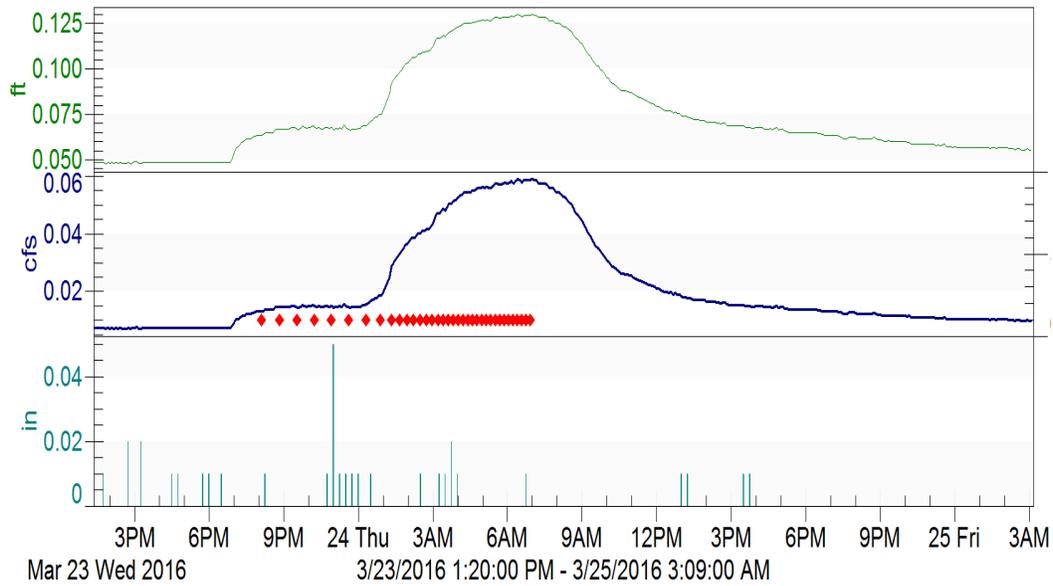


Figure 9. EBO, Storm 2.

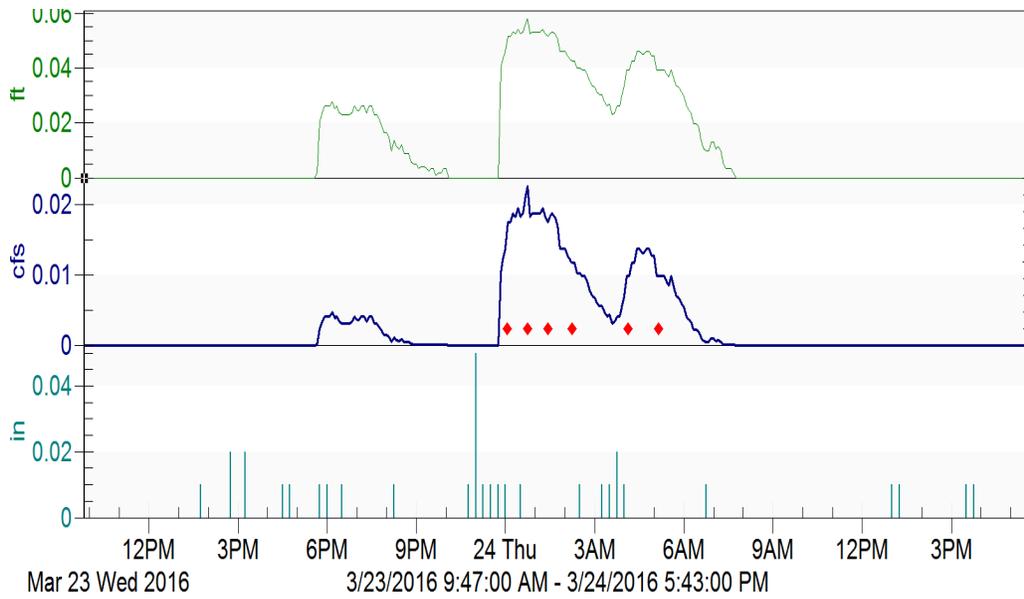


Figure 10. WBI, Storm 2.

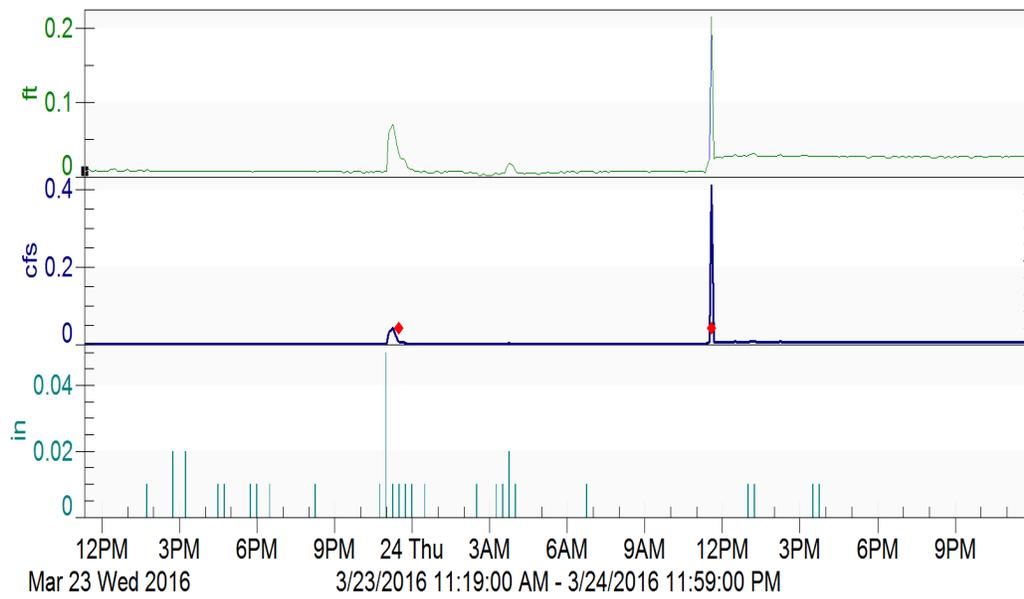


Figure 11. WBO, Storm 2.

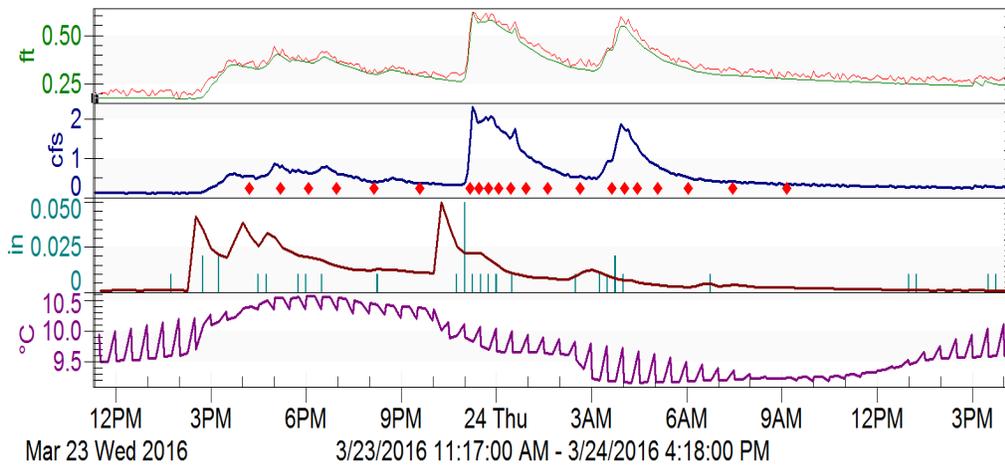


Figure 12. WCI, Storm 2.

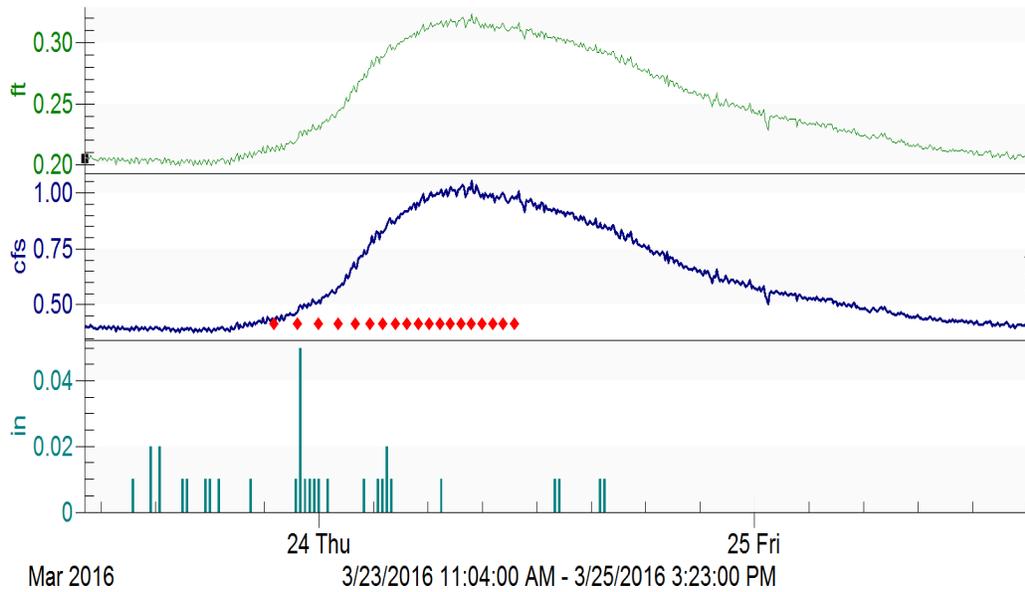


Figure 13. WCEBO, Storm 2.

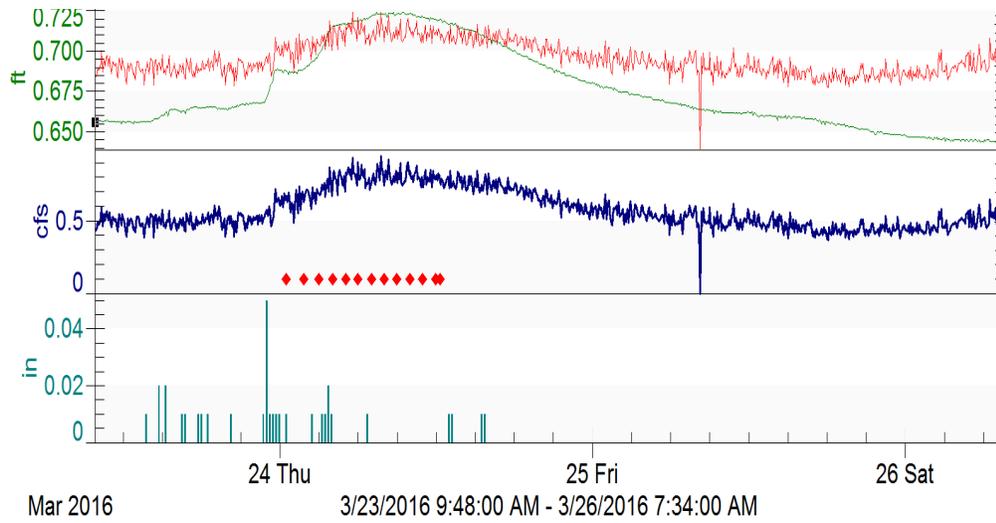


Figure 14. NFWHC, Storm 2.

Precipitation Information	Storm 3
	10/19/2016
Dry antecedent period (hr)	35
Rainfall in 4 days before storm (in)	1.32
Rainfall in 48 hours before storm (in)	0.18
Rainfall in 24 hours before storm (in)	0
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	1.16
Peak rainfall (date, time)	10/20/16 3:30 AM
Rainfall volume in bioretention basin (cf)	95164
Rainfall volume in wetland complex basin (cf)	823632

Sampling Information	Storm 3 - 10/19/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	(a)	17624	16083	9593	323365	553795	741207
Start of flow (hhmm)	(a)	1240	20	245	1940	2150	2115
Average flow rate for entire storm (cfs)	(a)	0.119	0.231	0.03	3.422	3.439	4.654
Duration of flow (hr)	(a)	41.1	19.3	88.8	26.2	44.7	44.2
Runoff first 24 hrs of event (start at time of first sample) (cf)	(a)	16675	16083	5356	316102	277571	568579
Runoff volume sampled (cf)	(a)	12200	3634	1902	152738	198533	302177
% of runoff volume sampled	(b)	73.16	22.60	35.51	48.32	71.53	53.15
Average flow rate during sampling interval (cfs)	(a)	0.326	0.234	0.052	4.052	2.726	5.632
Peak of hydrograph captured?	(b)	yes	yes	no	yes	yes	yes
Number of aliquots collected		32	34	36	36	33	32
Peak flow rate (cfs)	(a)	0.46	0.53	0.08	11.68	6.9	10.59
Peak hydrograph (date, time)	(a)	10/20/2016 10:45:00 AM	10/20/2016 4:20:00 AM	10/20/2016 2:20:00 PM	10/20/2016 4:20:00 AM	10/20/2016 1:50:00 PM	10/20/2016 10:25:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	(a)	7:15	0:50	10:50	0:50	10:20	6:55

(a) Flow meter malfunctioned during storm. Aliquots sampled using time pacing.

(b) Based on flow at WBI, which was likely very similar to flow at EBI, it appears we missed the peak hydrograph but likely sampled over 50% of the storm volume.

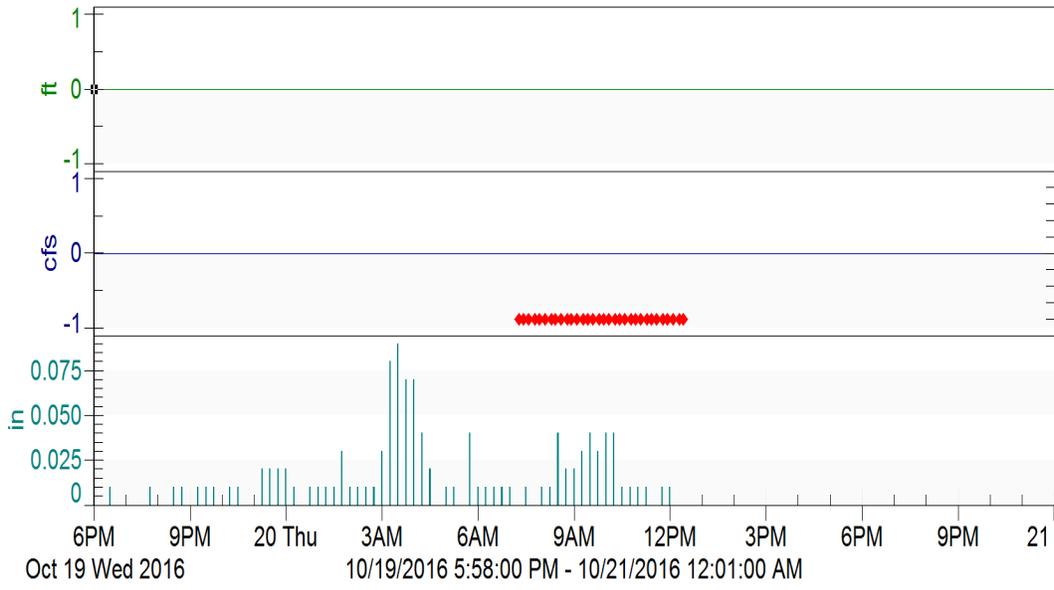


Figure 15. EBI, Storm 3.

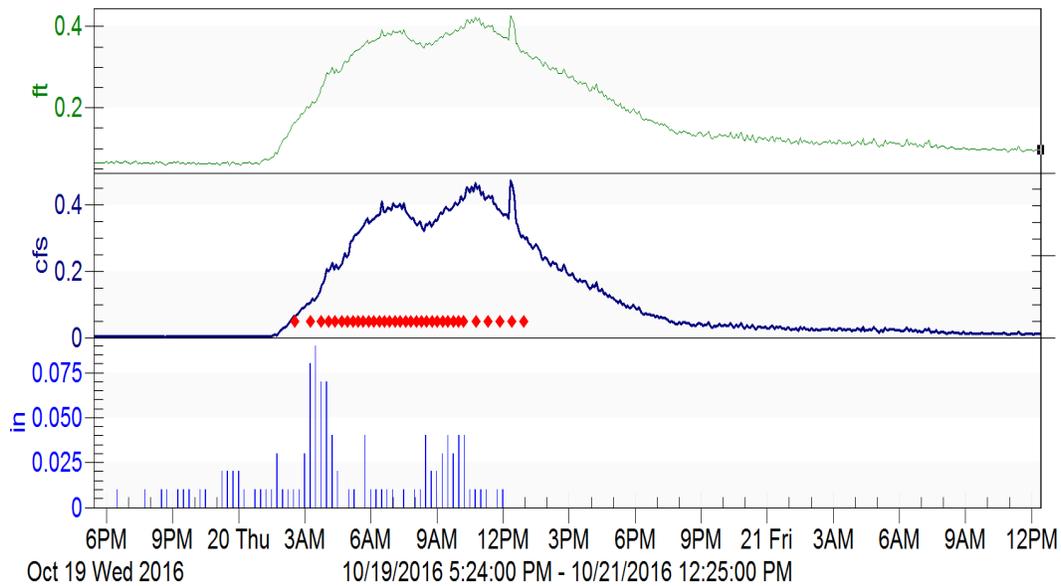


Figure 16. EBO, Storm 3.

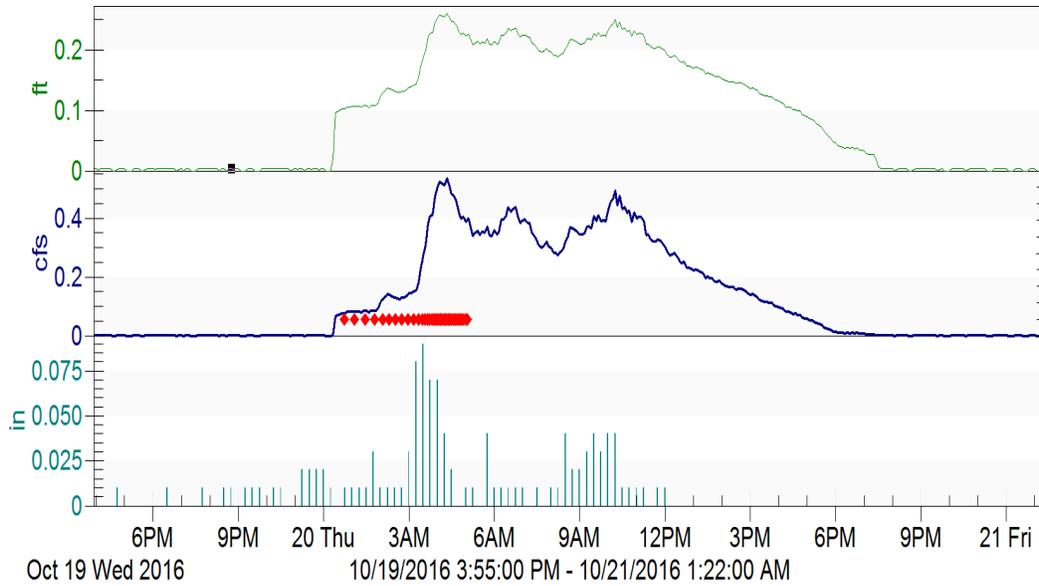


Figure 17. WBI, Storm 3.

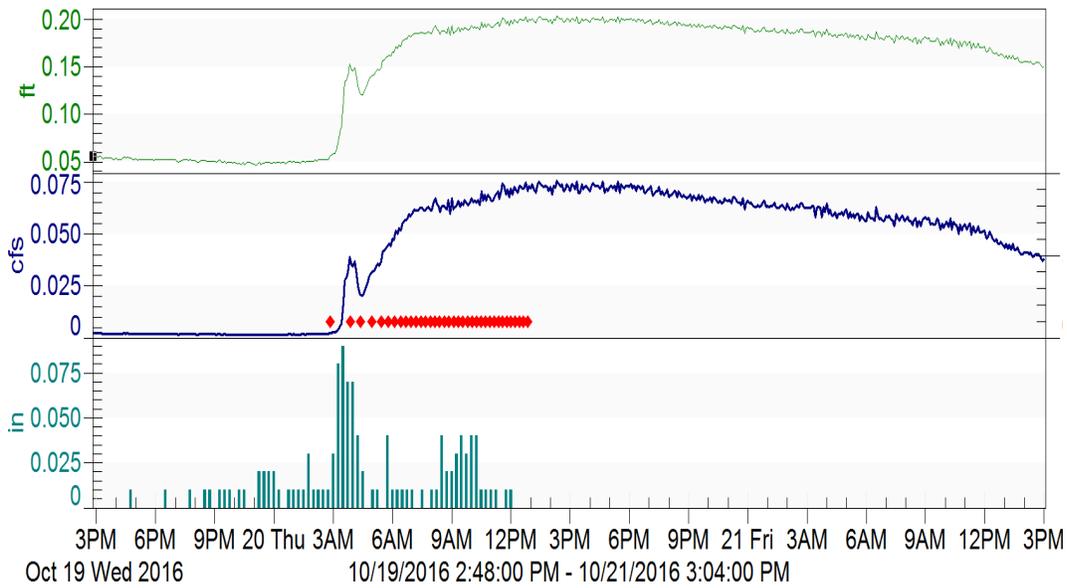


Figure 18. WBO, Storm 3.

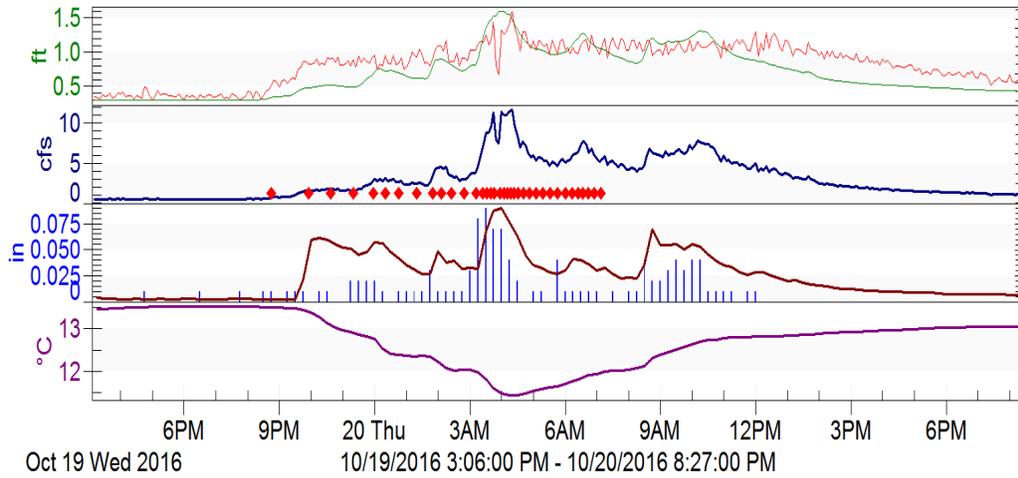


Figure 19. WCI, Storm 3.

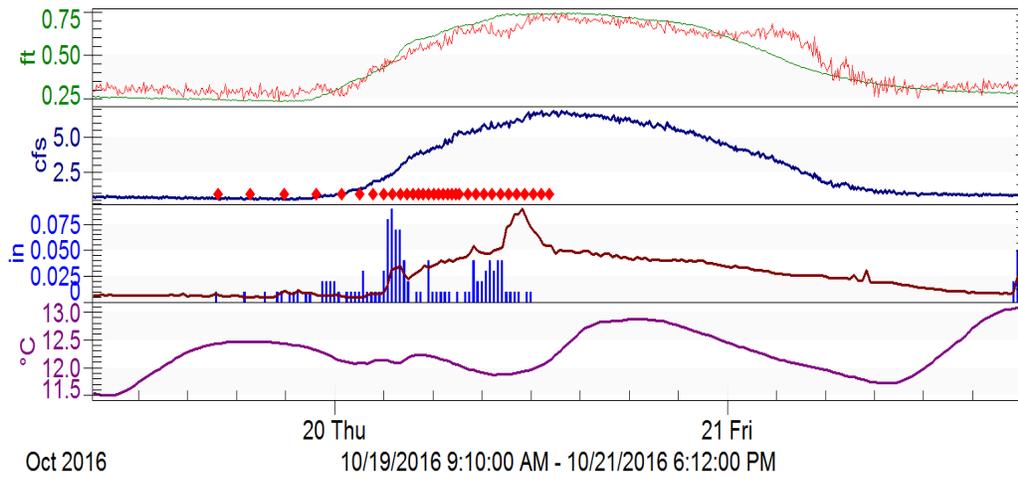


Figure 20. WCEBO, Storm 3.

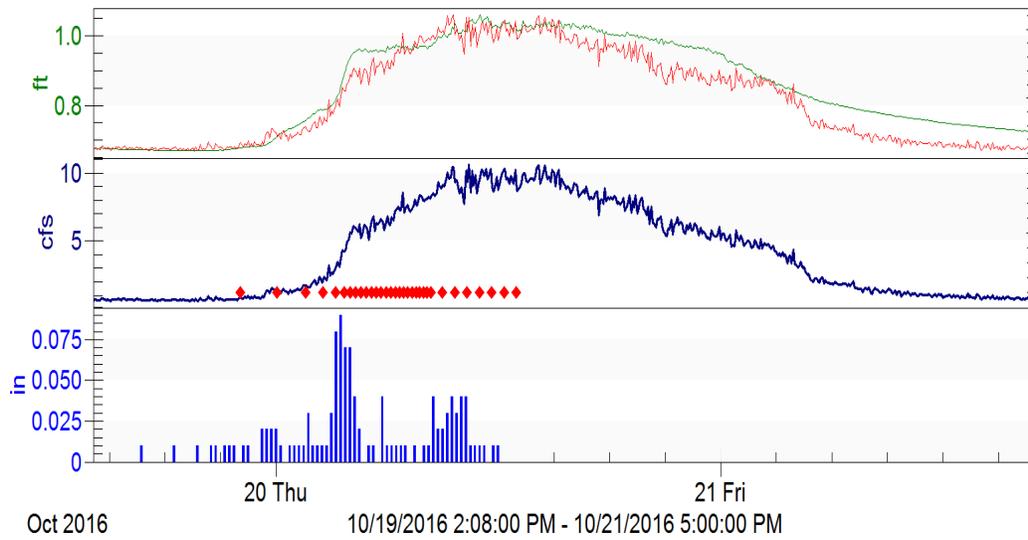


Figure 21. NFWHC, Storm 3.

Precipitation Information	Storm 4
	10/26/2016
Dry antecedent period (hr)	29.5
Rainfall in 4 days before storm (in)	0.26
Rainfall in 48 hours before storm (in)	0.15
Rainfall in 24 hours before storm (in)	0.01
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	1.29
Peak rainfall (date, time)	10/26/16 8:30 AM
Rainfall volume in bioretention basin (cf)	105829
Rainfall volume in wetland complex basin (cf)	915936

Sampling Information	Storm 4 - 10/26/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	32254	25584	17017	10154	392706	693404	946079
Start of flow (hhmm)	825	840	830	700	546	810	700
Average flow rate for entire storm (cfs)	0.415	0.1	0.21	0.028	3.979	2.645	4.411
Duration of flow (hr)	21.6	71.1	22.5	100.7	27.4	72.8	59.6
Runoff first 24 hrs of event (start at time of first sample) (cf)	32149	19665	17017	4598 (a)	378743	388339	301446
Runoff volume sampled (cf)	6342	9673	5558	4598 (a)	133854	84230	137662
% of runoff volume sampled	19.73	49.19	32.66	100 (a)	35.34	21.69	45.67
Average flow rate during sampling interval (cfs)	0.454	0.211	0.2	0.049 (a)	3.602	2.783	3.953
Peak of hydrograph captured?	no	no	no	yes (a)	no	no	no
Number of aliquots collected	36	36	32	18 (a)	23 (b)	15 (c)	17 (d)
Peak flow rate (cfs)	1.36	0.66	0.65	0.06 (a)	18.63	7.46	12.11
Peak hydrograph (date, time)	10/26/2016 9:05:00 PM	10/26/2016 9:50:00 PM	10/26/2016 7:30:00 PM	10/27/2016 1:35:00 AM	10/26/2016 7:35:00 PM	10/27/2016 12:50:00 AM	10/26/2016 9:35:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	12:35	13:20	11:00	17:05	11:05	16:20	13:05

(a) Sampler inadvertently turned off @ ~1400 on 10/26 after collecting 6 aliquots. Additional aliquots sampled using time pacing, starting the next morning. Spike likely not accurate; possibly due to black flow in pipe. Peak is estimated. Because of this facility's typical low flow rate, we decided aliquots collected morning after the event would be representative of the effluent (see WBO figure).

(b) Sampler inadvertently programmed to stopped sampling at 1626 on 10/26.

(c) Sampler inadvertently programmed to stop sampling at 1650 on 10/26.

(d) Sampler inadvertently programmed to stop sampling at 1725 on 10/26.

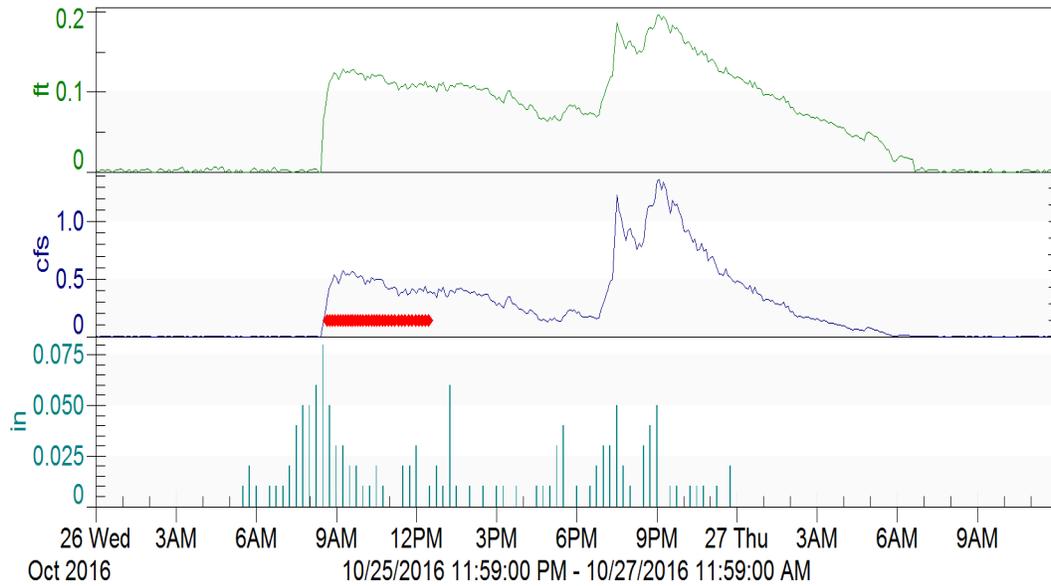


Figure 22. EBI, Storm 4.

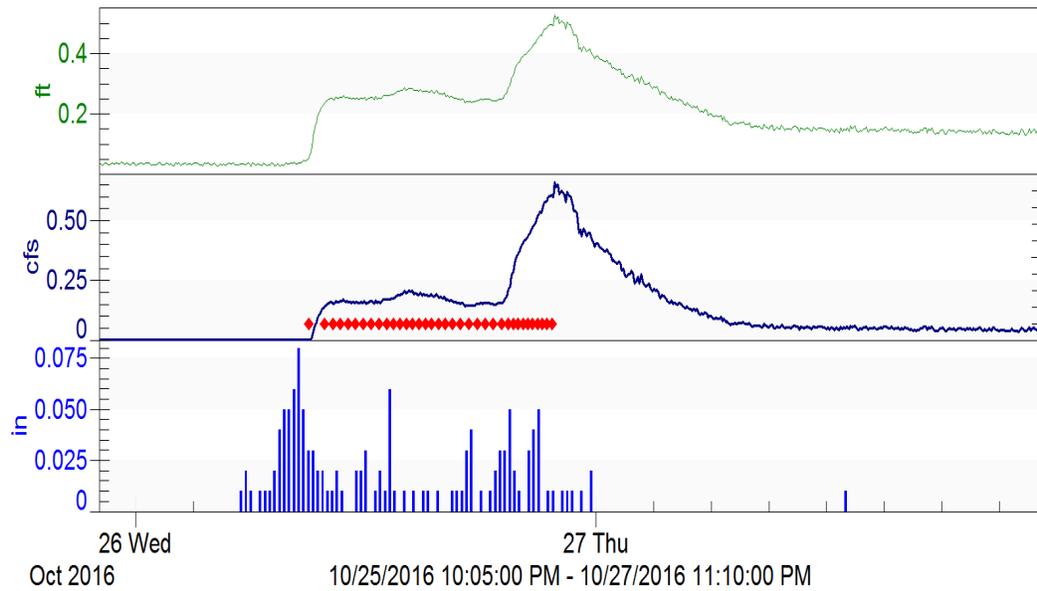


Figure 23. EBO, Storm 4.

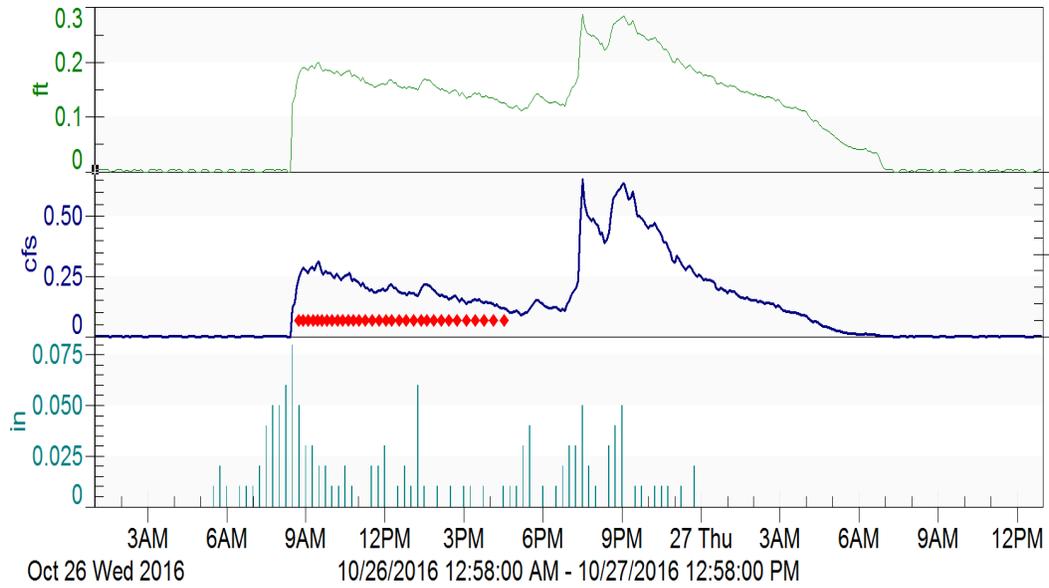


Figure 24. WBI, Storm 4.

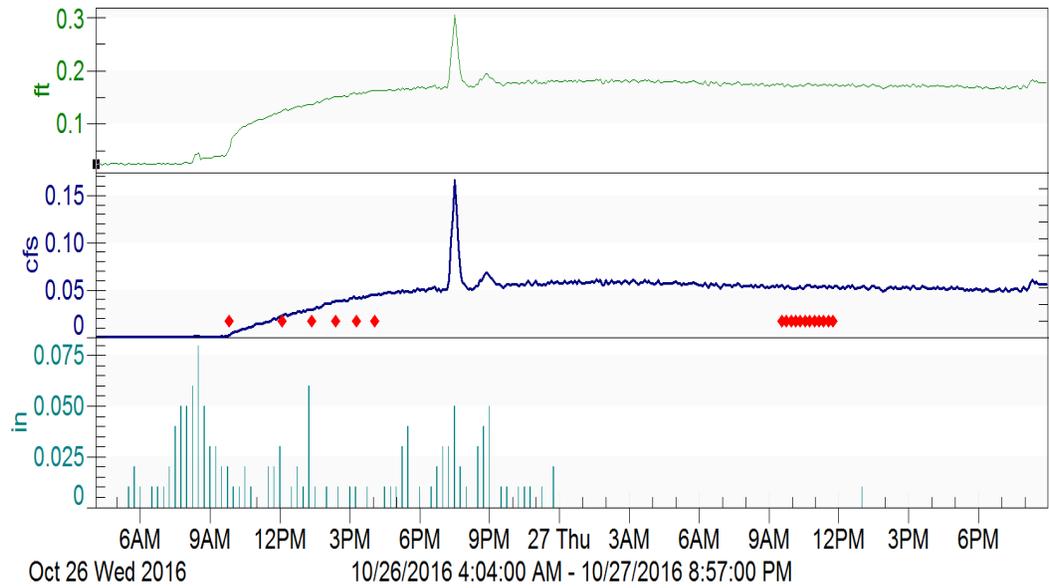


Figure 25. WBO, Storm 4.

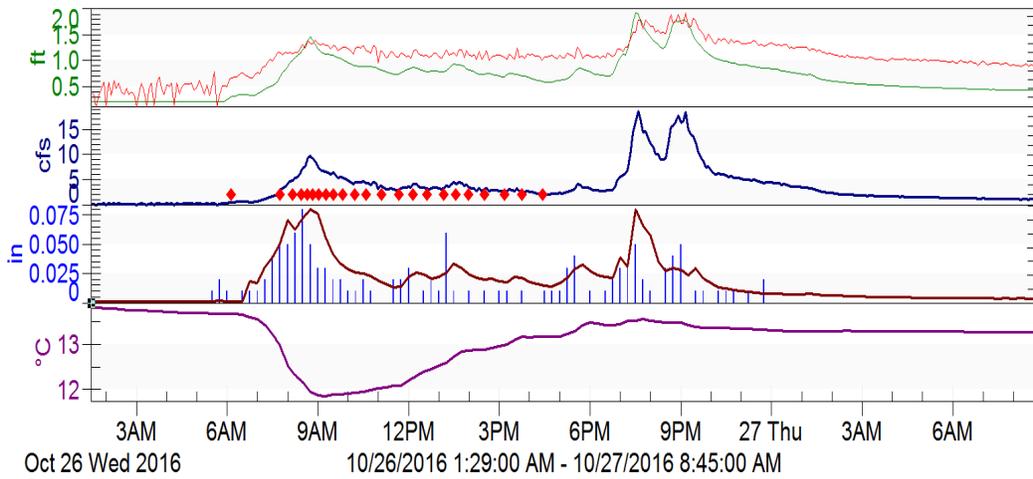


Figure 26. WCI, Storm 4.

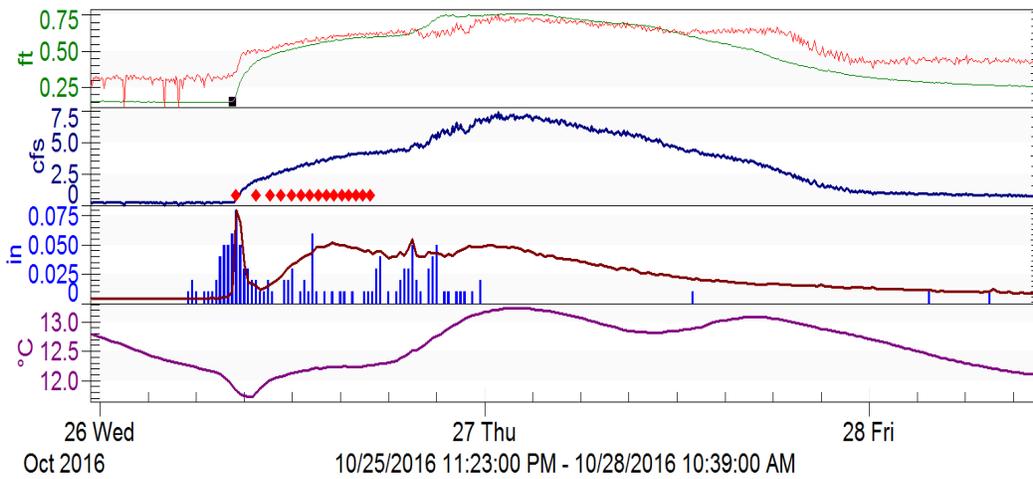


Figure 27. WCEBO, Storm 4.

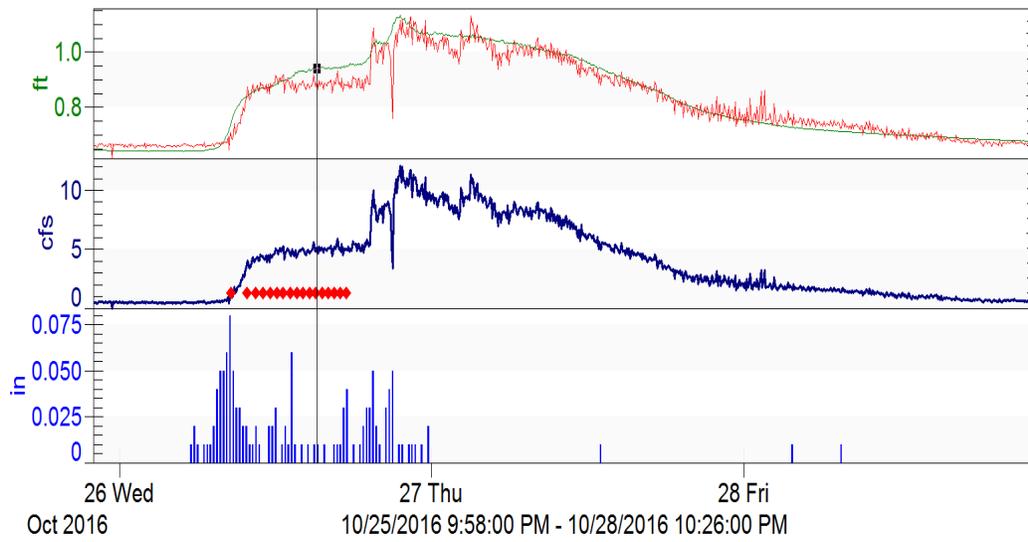


Figure 28. NFWHC, Storm 4.

Precipitation Information	Storm 5
	10/31/2016
Dry antecedent period (hr)	9.5
Rainfall in 4 days before storm (in)	0.85
Rainfall in 48 hours before storm (in)	0.71
Rainfall in 24 hours before storm (in)	0.6
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.36
Peak rainfall (date, time)	10/31/16 9:15 PM
Rainfall volume in bioretention basin (cf)	29534
Rainfall volume in wetland complex basin (cf)	255610

Sampling Information	Storm 5 - 10/31/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	4236	11105	2442	3332 (a)	140052	234200	346520
Start of flow (hhmm)	2200	2210	2205	1:45	2055	2125	2100
Average flow rate for entire storm (cfs)	0.076	0.086	0.043	0.025	1.548	2.065	3.063
Duration of flow (hr)	15.5	35.9	15.8	37.0	25.1	31.5	31.4
Runoff first 24 hrs of event (start at time of first sample) (cf)	4001	8822	2442	2689	137390	157659	297222 (b)
Runoff volume sampled (cf)	3900	6339	2369	1845	115010	102049	71715
% of runoff volume sampled	97.48	71.85	97.01	68.61	83.71	64.73	24.13
Average flow rate during sampling interval (cfs)	0.085	0.122	0.049	0.035	2.173	2.283	3.622
Peak of hydrograph captured?	yes	yes	yes	yes	yes	yes	no
Number of aliquots collected	21	30	24	20	29	30	34
Peak flow rate (cfs)	0.24	0.19	0.12	0.04	5.37	3.19	4.5
Peak hydrograph (date, time)	10/31/2016 10:45:00 PM	11/1/2016 1:00:00 AM	10/31/2016 10:45:00 PM	11/1/2016 4:15:00 AM	10/31/2016 9:55:00 PM	11/1/2016 4:50:00 AM	10/31/2016 11:45:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	1:30	3:45	1:30	7:00	0:40	7:35	2:30

(a) Flow high initially from the previous storm. Flow values begin when the first sample was triggered by rising flow in pipe.

(b) Sampler did not start at the beginning of storm; sampler turned on manually morning after. Sampler set to flow pace sample every 2000 cf starting at 0700 on 11/1/2016.

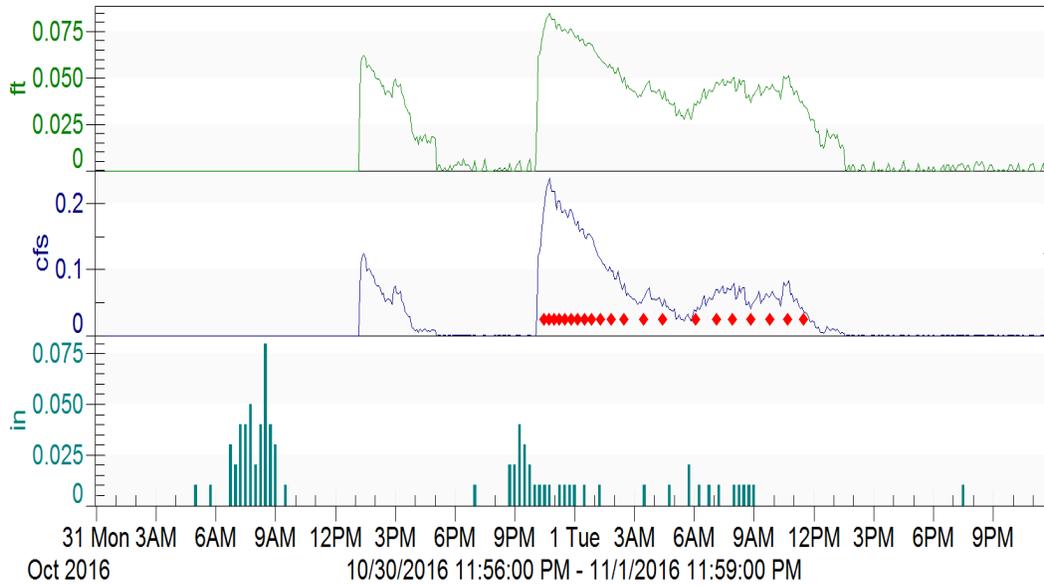


Figure 29. EBI, Storm 5.

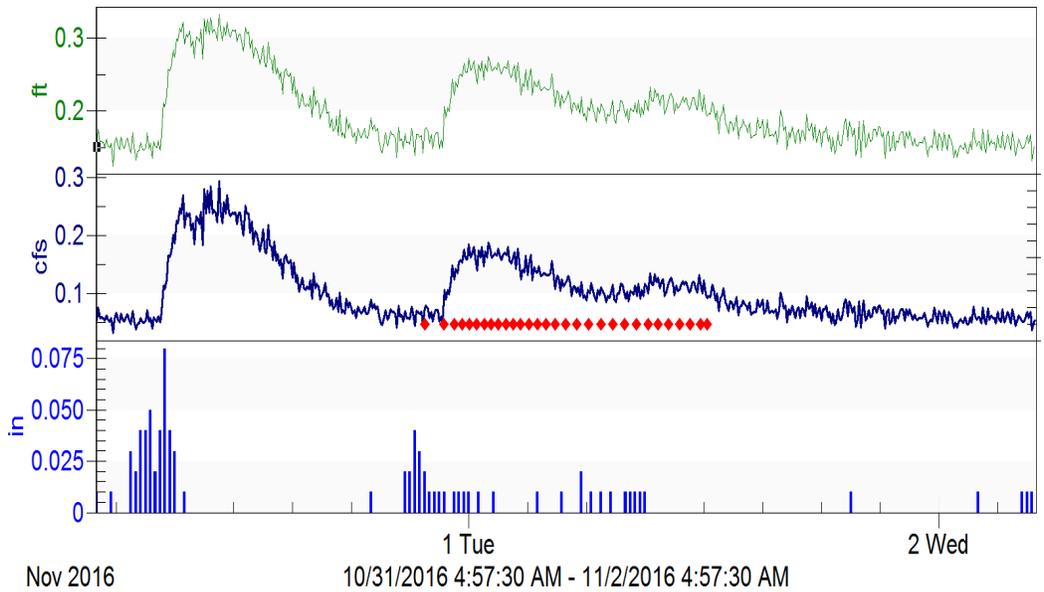


Figure 30. EBO, Storm 5.

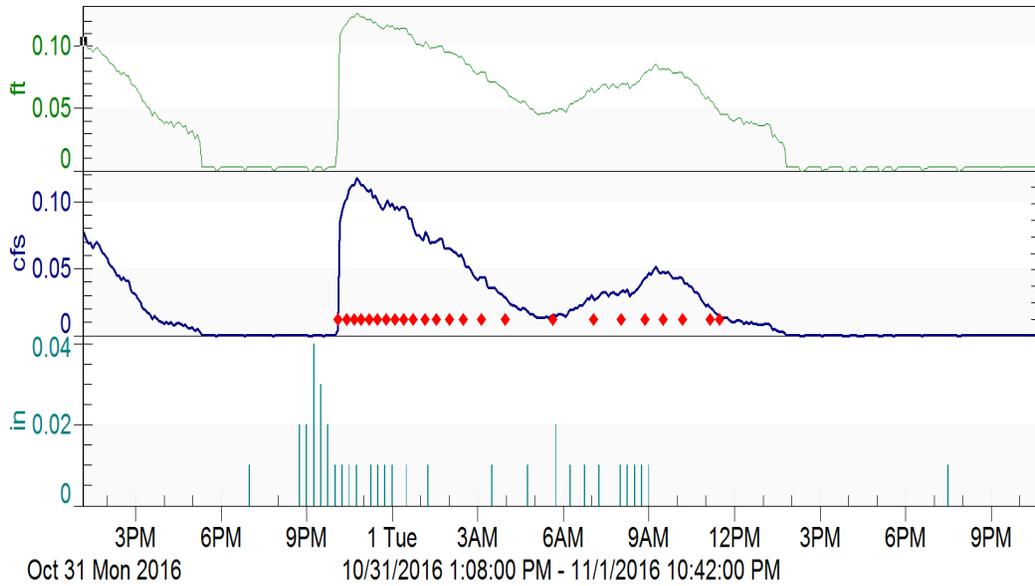


Figure 31. WBI, Storm 5.

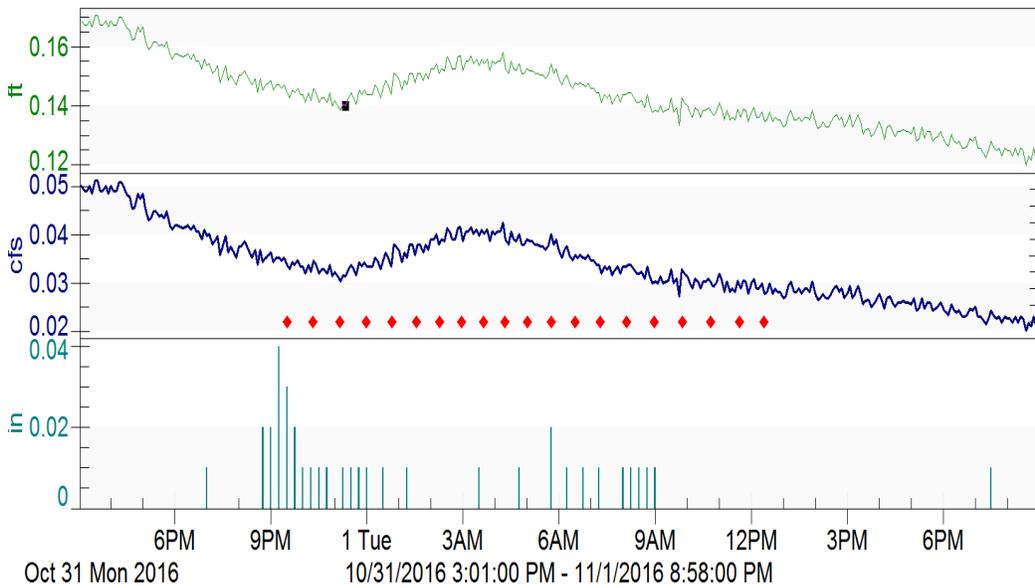


Figure 32. WBO, Storm 5.

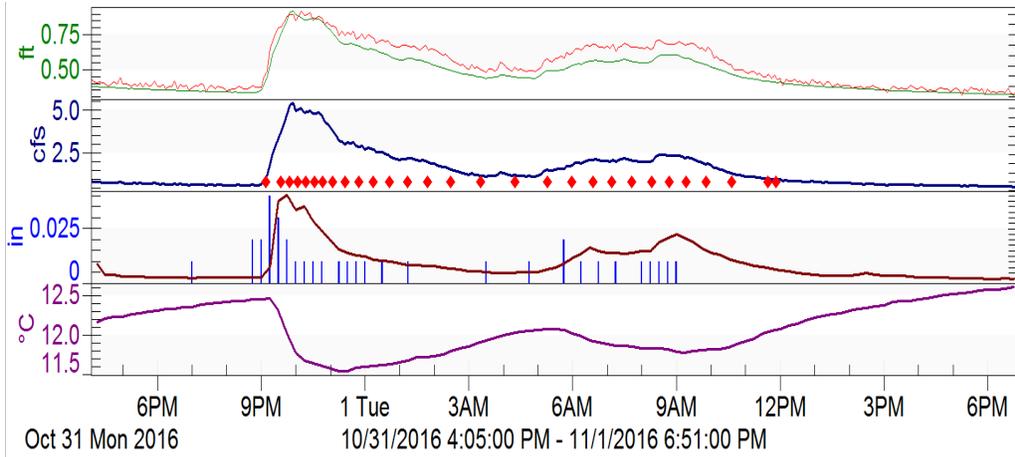


Figure 33. WCI, Storm 5.

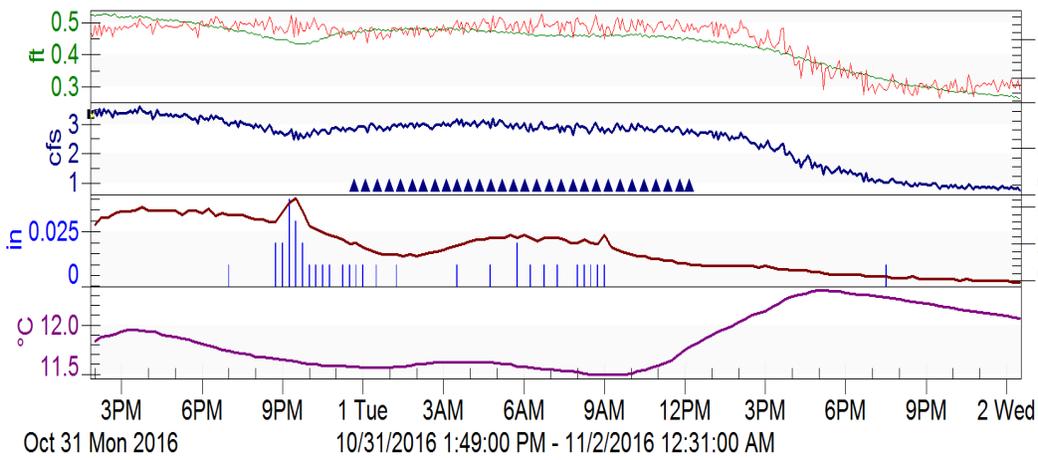


Figure 34. WCEBO, Storm 5.

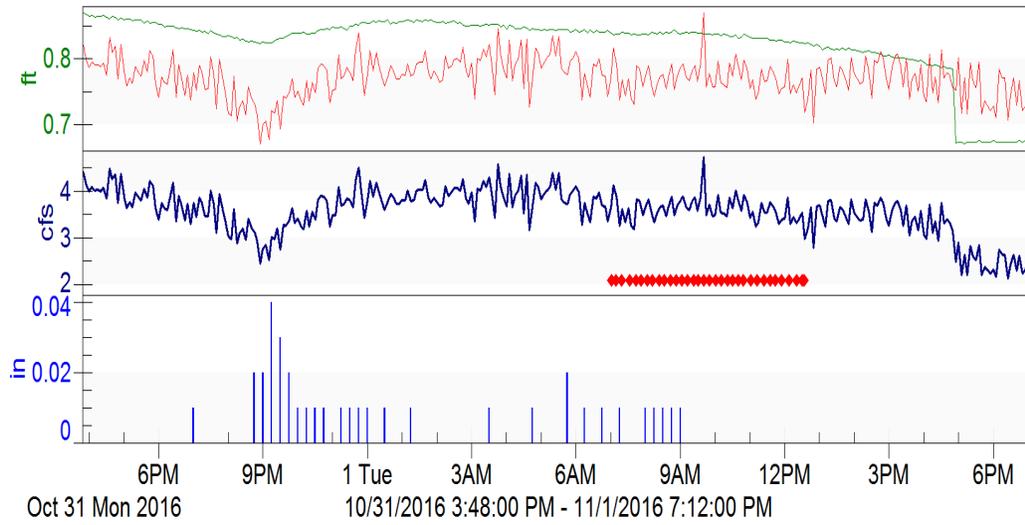


Figure 35. NFWHC, Storm 5.

Precipitation Information	Storm 6
	12/19/2016
Dry antecedent period (hr)	10
Rainfall in 4 days before storm (in)	0.37
Rainfall in 48 hours before storm (in)	0.37
Rainfall in 24 hours before storm (in)	0.37
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.31
Peak rainfall (date, time)	12/19/16 8:30 PM
Rainfall volume in bioretention basin (cf)	25432
Rainfall volume in wetland complex basin (cf)	220109

Sampling Information	Storm 6 - 12/19/2016						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	3587	6606 (a)	2267	(b)	106249	144624	285526
Start of flow (hhmm)	2130	2150	2145	(b)	1942	2055	2015
Average flow rate for entire storm (cfs)	0.098	0.07	0.062	(b)	0.938	0.954	1.624
Duration of flow (hr)	10.2	26.2	10.2	(b)	31.5	42.1	48.8
Runoff first 24 hrs of event (start at time of first sample) (cf)	3592	6134	2267	(b)	96797	117028	202140
Runoff volume sampled (cf)	3131	5468	1955	(b)	79352	77649	136812
% of runoff volume sampled	87.17	89.14	86.24	(b)	81.98	66.35	67.68
Average flow rate during sampling interval (cfs)	0.104	0.126	0.073	(b)	1.656	1.743	2.759
Peak of hydrograph captured?	yes	yes	yes	no	yes	yes	yes
Number of aliquots collected	8	12	9	36	14	11	13
Peak flow rate (cfs)	0.29	0.31 (a)	0.13	(b)	4.25	2.24	3.51
Peak hydrograph (date, time)	12/19/2016 11:45:00 PM	12/20/2016 1:20:00 AM	12/19/2016 11:40:00 PM	12/20/2016 4:40:00 AM	12/19/2016 10:20:00 PM	12/20/2016 5:25:00 AM	12/20/2016 3:55:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	3:15	4:50	3:10	8:10	1:50	8:55	7:25

(a) Flow meter likely clogged, cleared at 0300. Spike is likely not accurate; peak flow rate estimated.

(b) Flow meter clogged and reading abnormally high; flow data from this site for this storm are unreliable. Because meter was reading high, aliquots were all collected in a short period of time (~2 hrs).

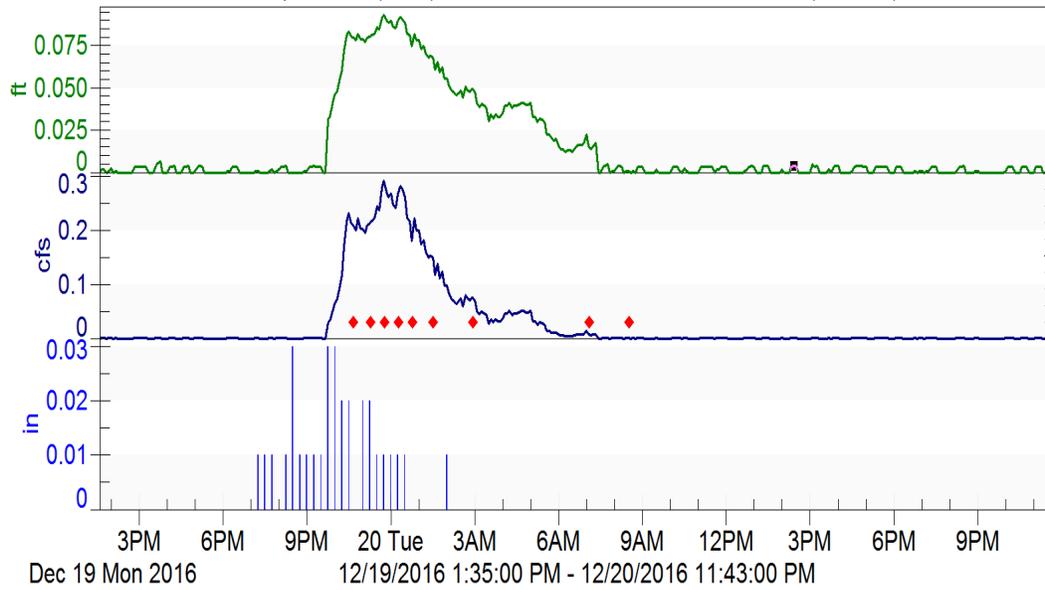


Figure 36. EBI, Storm 6.

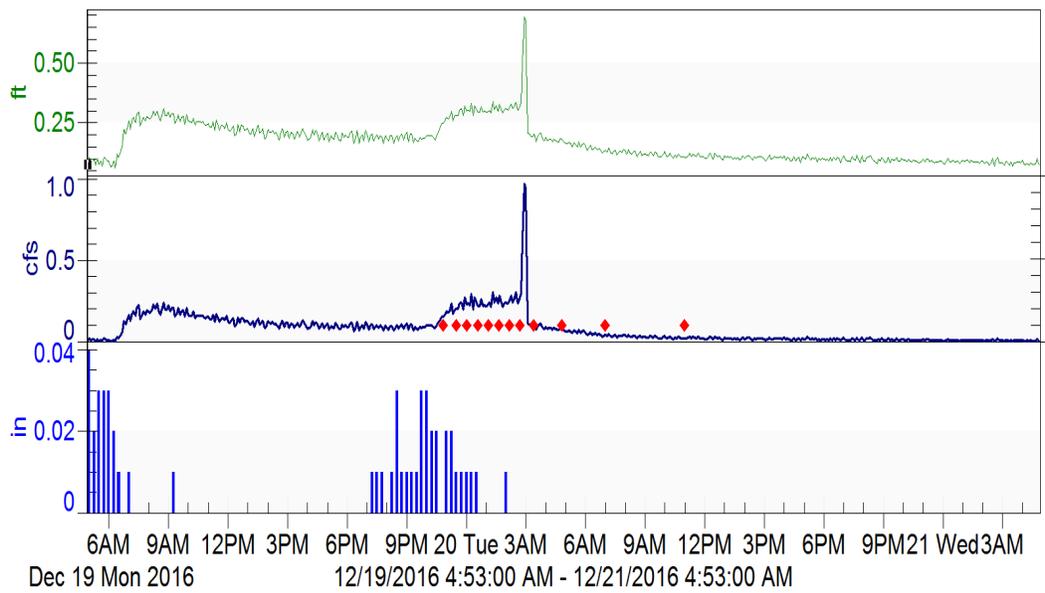


Figure 37. EBO, Storm 6.

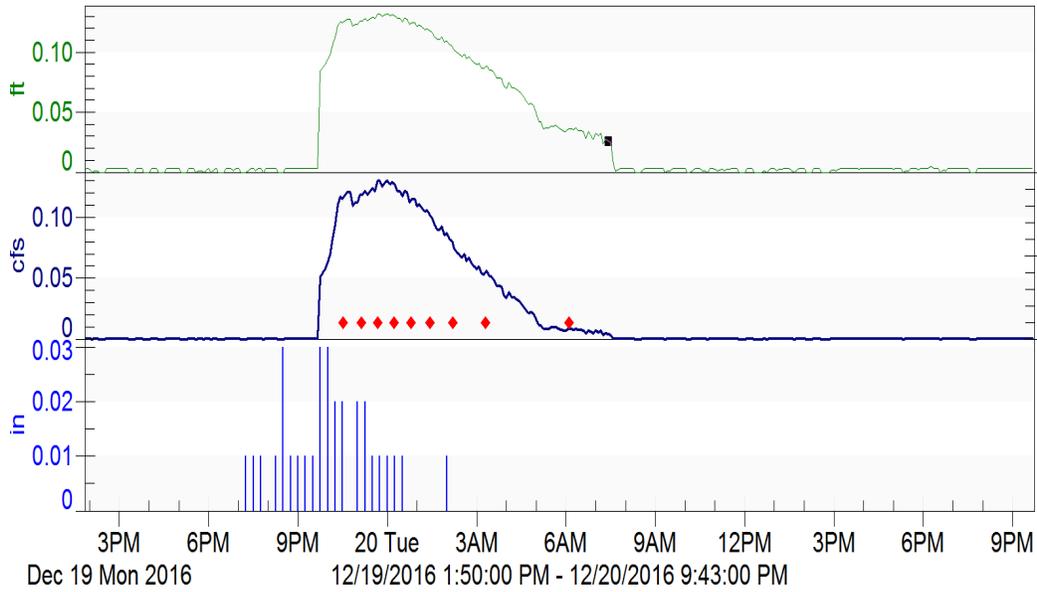


Figure 38. WBI, Storm 6.

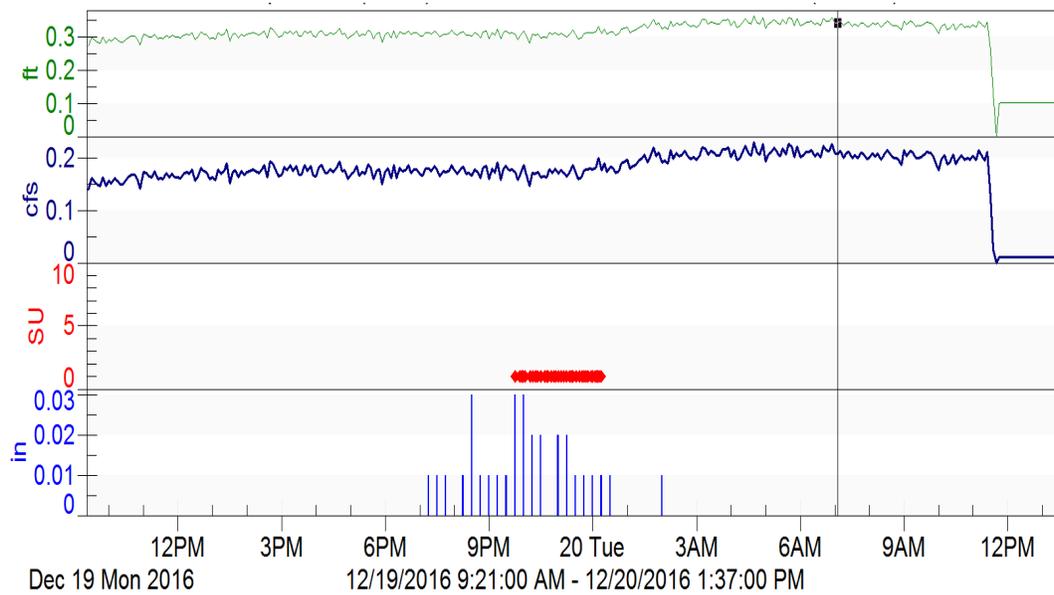


Figure 39. WBO, Storm 6.

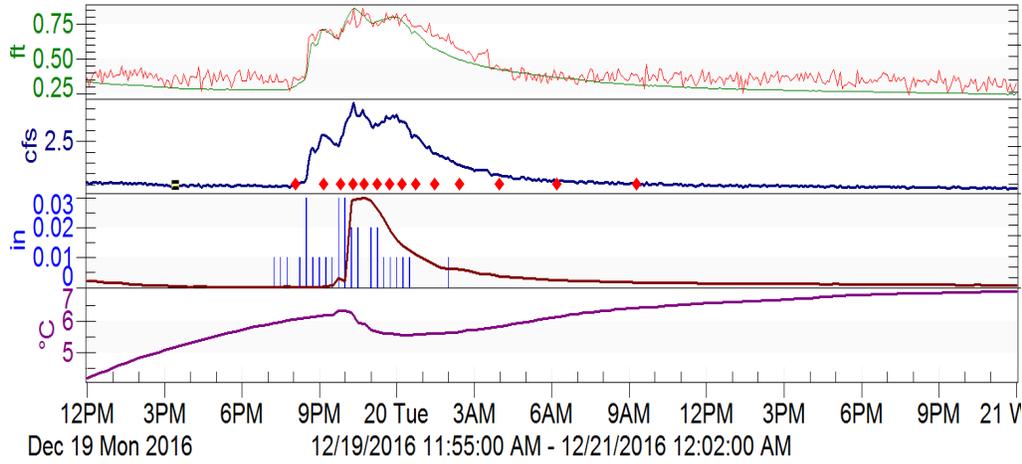


Figure 40. WCI, Storm 6.

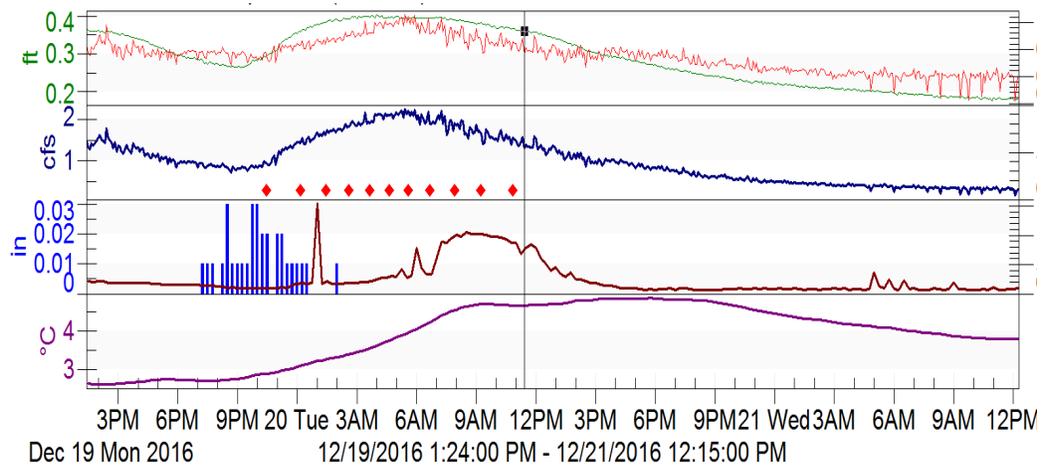


Figure 41. WCEBO, Storm 6.

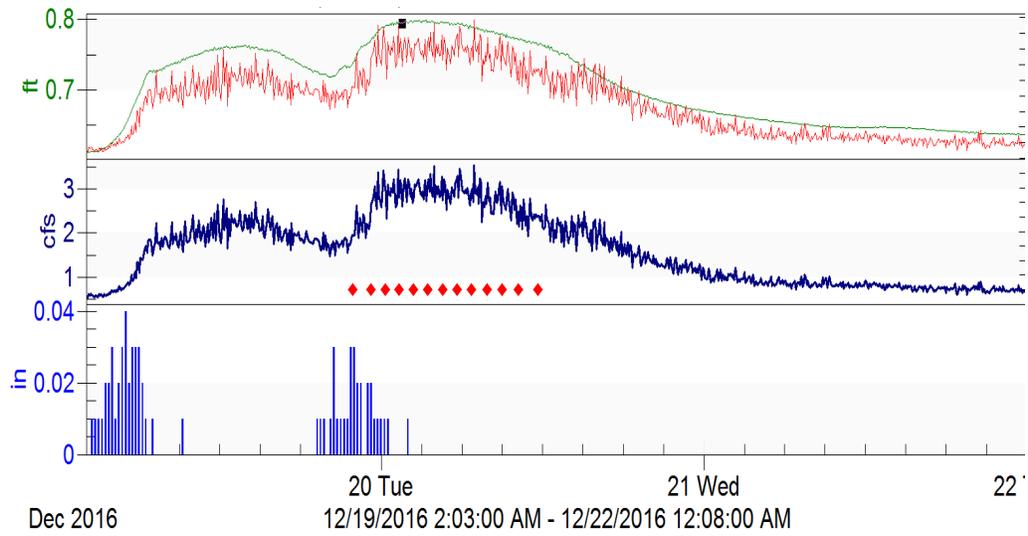


Figure 42. NFWHC, Storm 6.

Precipitation Information	Storm 7
	1/17/2017
Dry antecedent period (hr)	161.5
Rainfall in 4 days before storm (in)	0
Rainfall in 48 hours before storm (in)	0
Rainfall in 24 hours before storm (in)	0
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	2.08
Peak rainfall (date, time)	12/19/16 8:30 PM
Rainfall volume in bioretention basin (cf)	170639
Rainfall volume in wetland complex basin (cf)	1476858

Sampling Information	Storm 7 - 1/17/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	(a)	27124	21386	14100	628598	882707	1411030
Start of flow (hhmm)	(a)	1525	1425	1605	414	1430	1130
Average flow rate for entire storm (cfs)	(a)	0.23	0.212	0.022	2.697	3.528	5.096
Duration of flow (hr)	(a)	32.8	28.0	178.0	64.7	69.5	76.9
Runoff first 24 hrs of event (start at time of first sample) (cf)	19160 (a)	25639	21215	4635	484854	475048	788049
Runoff volume sampled (cf)	13636 (a)	22820	13932	3245	301152	370453	593546
% of runoff volume sampled	>50% (b)	89.01	65.67	70.01	62.11	77.98	75.32
Average flow rate during sampling interval (cfs)	0.823	0.343	0.3	0.048	6.594	5.167	8.462
Peak of hydrograph captured?	yes	yes	yes	no	yes	yes	no
Number of aliquots collected	20	28	36	34	36	36	36
Peak flow rate (cfs)	1.1 (c)	0.53	0.45	0.06	10.8	7.46	14.18
Peak hydrograph (date, time)	see WBI (c)	1/17/2017 9:35:00 PM	1/17/2017 8:40:00 PM	1/18/2017 12:35:00 PM	1/17/2017 8:45:00 PM	1/18/2017 12:00:00 PM	1/18/2017 11:50:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	~5:55 (c)	6:50	5:55	21:50	6:00	21:15	21:05

(a) Flow meter malfunctioned at 21:35 and stopped sampling. No flow data after 21:35.

(b) Based on flow at WBI, it appears samples were collected over an interval that included the peak flow and more than 50% of the storm volume.

(c) Assumed peaks at WBI and EBI were at similar times; if so, peak at EBI was recorded before meter malfunctioned.

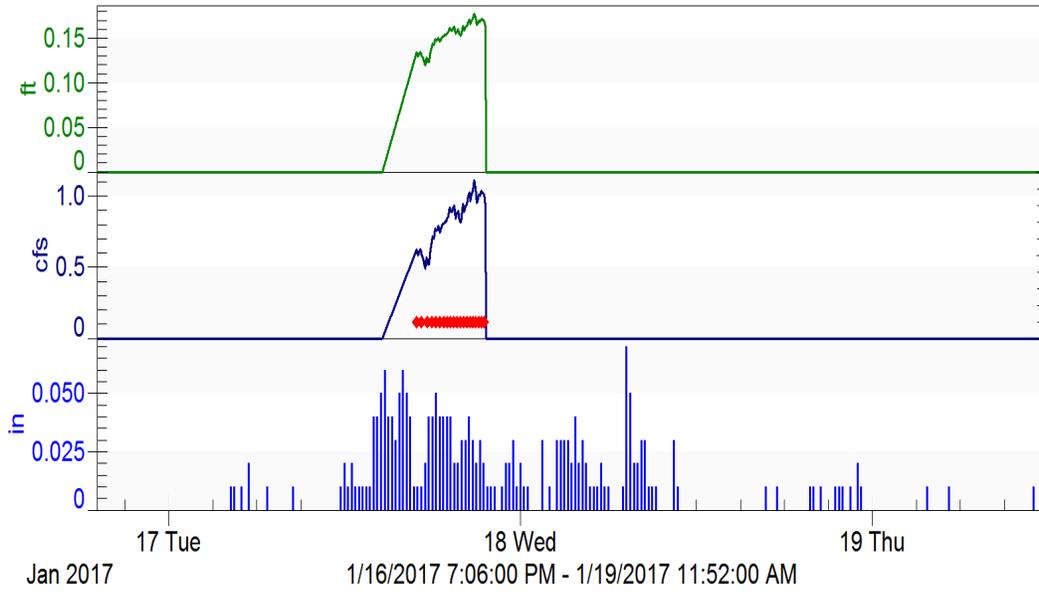


Figure 43. EBI, Storm 7.

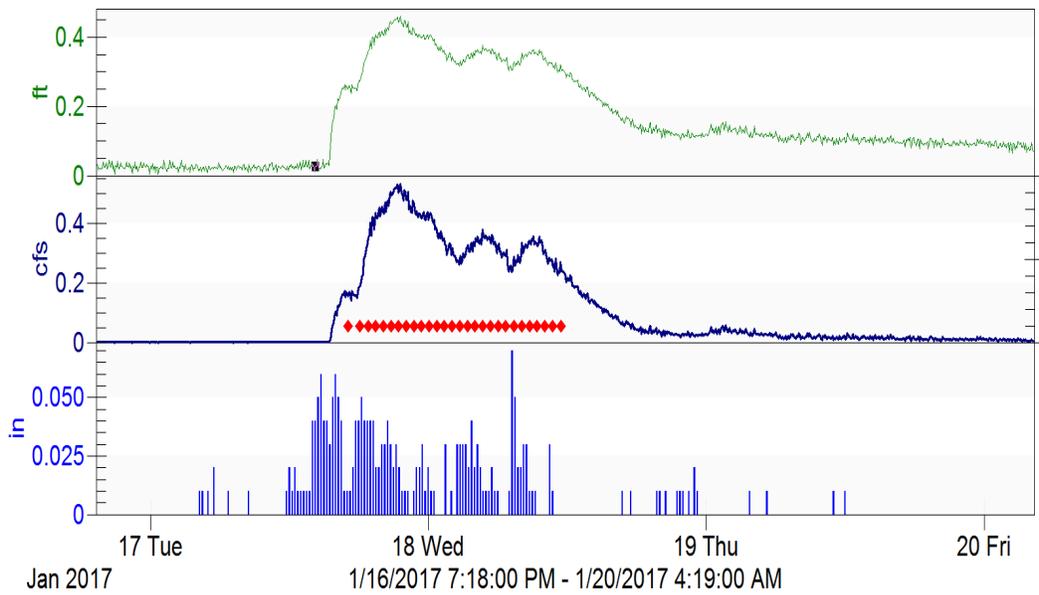


Figure 44. EBO, Storm 7.

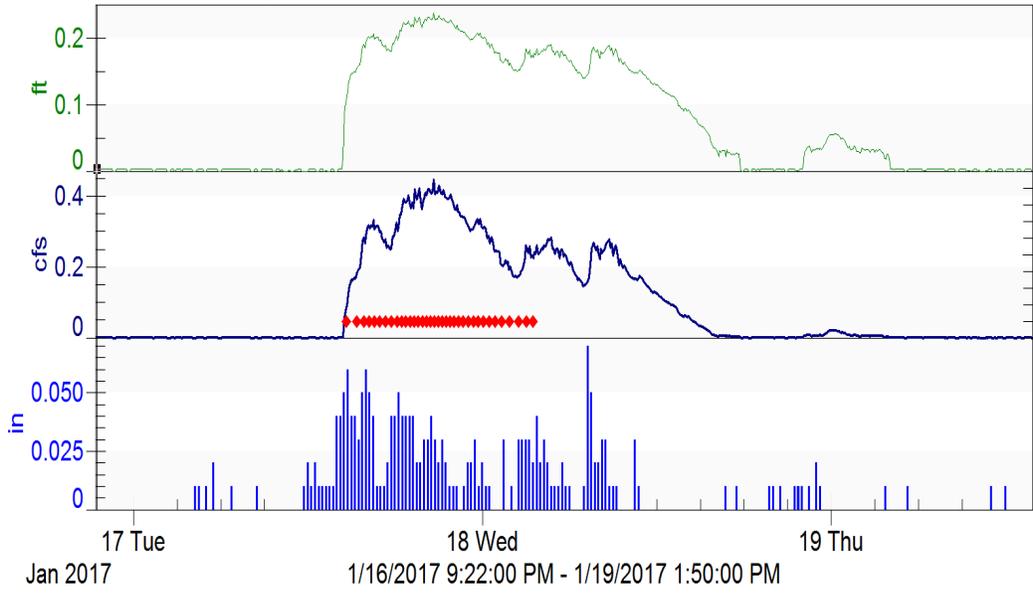


Figure 45. WBI, Storm 7.

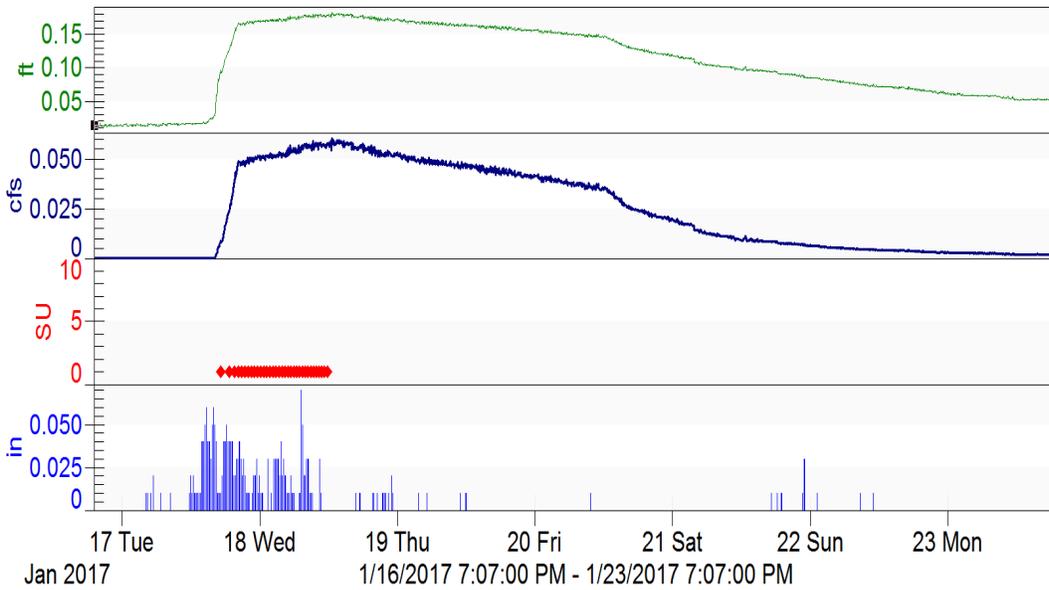


Figure 46. WBO, Storm 7.

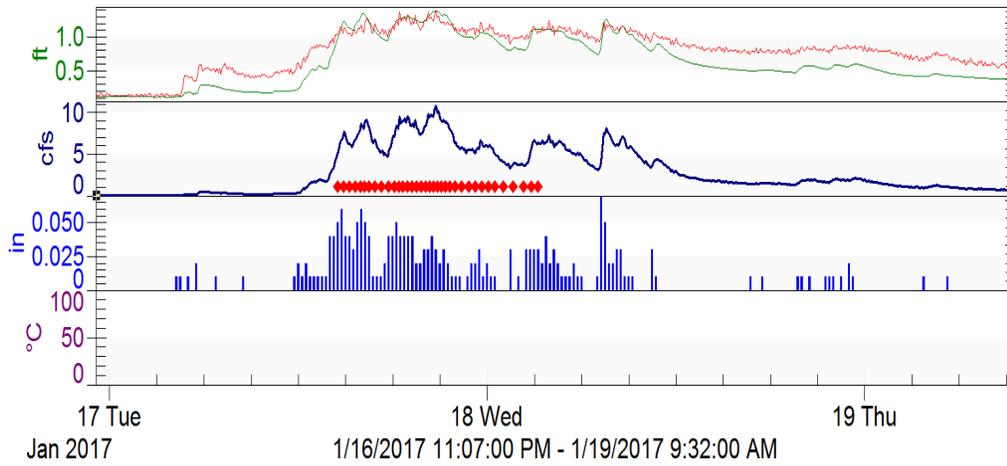


Figure 47. WCI, Storm 7.

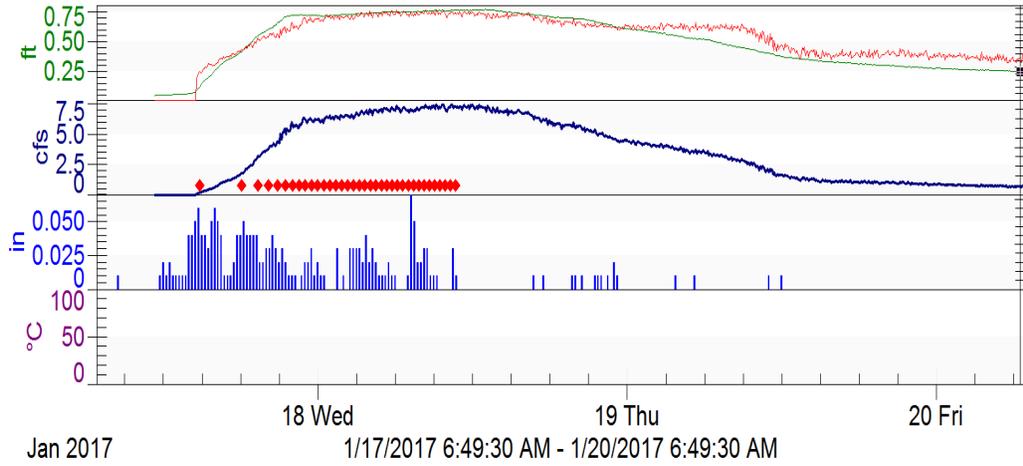


Figure 48. WCEBO, Storm 7.

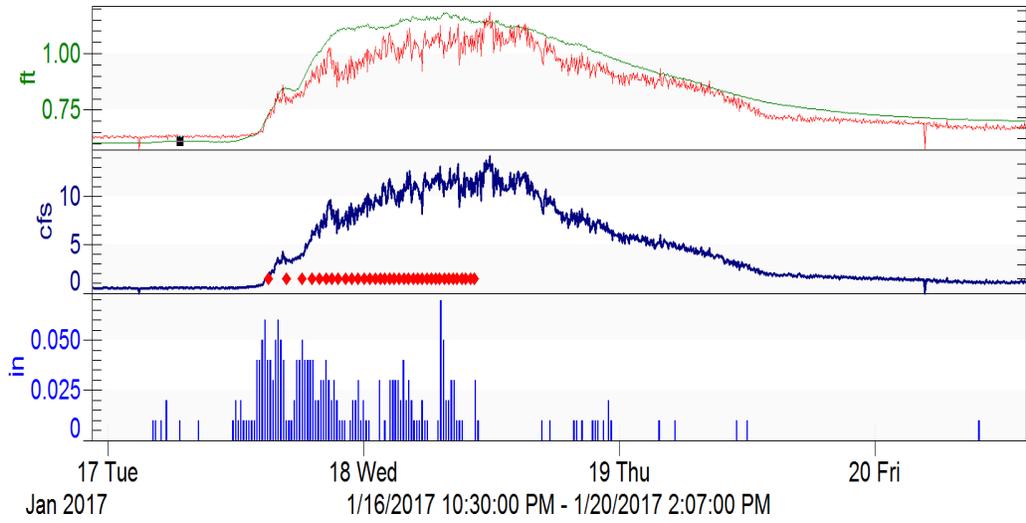


Figure 49. NFWHC, Storm 7.

Precipitation Information	Storm 8
	2/8/2017
Dry antecedent period (hr)	12
Rainfall in 4 days before storm (in)	2.22
Rainfall in 48 hours before storm (in)	0.87
Rainfall in 24 hours before storm (in)	0.4
Rainfall in 6 hours before storm (in)	0.01
Rainfall during storm (in)	1.68
Peak rainfall (date, time)	2/9/17 8:15 AM
Rainfall volume in bioretention basin (cf)	137824
Rainfall volume in wetland complex basin (cf)	1192847

Sampling Information	Storm 8 - 2/8/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	47779	26000~	21404	17791	584197	983970	(b)
Start of flow (hhmm)	1140	(a)	1245	1335	740	1000	(b)
Average flow rate for entire storm (cfs)	0.387	(a)	0.177	0.032	2.929	3.582	(b)
Duration of flow (hr)	34.3	(a)	33.6	154.4	55.4	76.3	(b)
Runoff first 24 hrs of event (start at time of first sample) (cf)	47778	22151	19362	4372	417244	399415	452202
Runoff volume sampled (cf)	40464	18392	17567	3398	372560	312789	385972
% of runoff volume sampled	84.69	83.03	90.73	77.72	89.29	78.31	85.35
Average flow rate during sampling interval (cfs)	0.529	0.285	0.23	0.048	4.984	4.145	6.057
Peak of hydrograph captured?	yes	yes	yes	yes	yes	no	yes
Number of aliquots collected	33	20	26	24	27	19	15
Peak flow rate (cfs)	1.37	0.54	0.47	0.06	13.53	8.09	12.86
Peak hydrograph (date, time)	2/9/2017 8:20:00 AM	2/9/2017 10:20:00 AM	2/9/2017 9:05:00 AM	2/9/2017 12:45:00 PM	2/9/2017 8:35:00 AM	2/9/2017 3:35:00 PM	2/9/2017 8:55:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	0:05	2:05	0:50	4:30	0:20	7:20	0:40

(a) Flow meter started shortly after rain event had started.

(b) Flow meter became buried by cobble at ~930 and we lost velocity measurements.

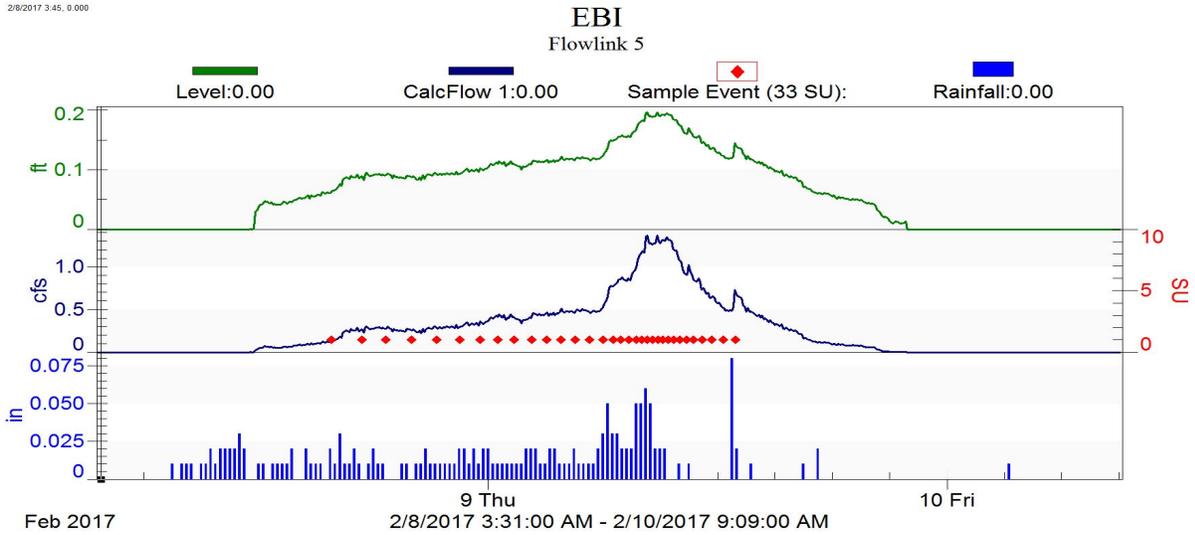


Figure 50. EBI, Storm 8.

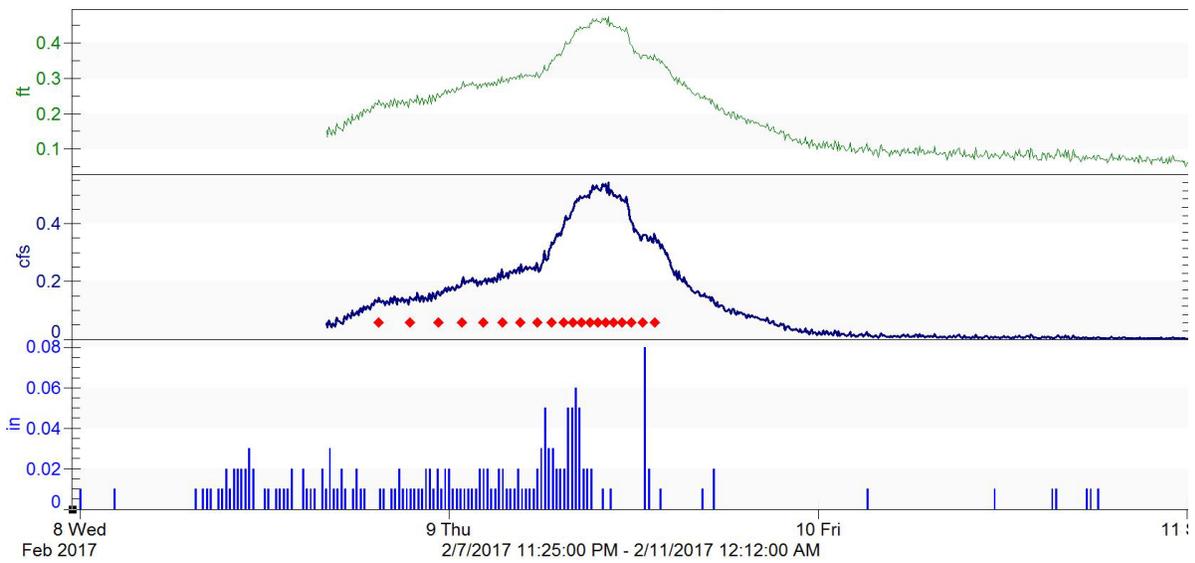


Figure 51. EBO, Storm 8.

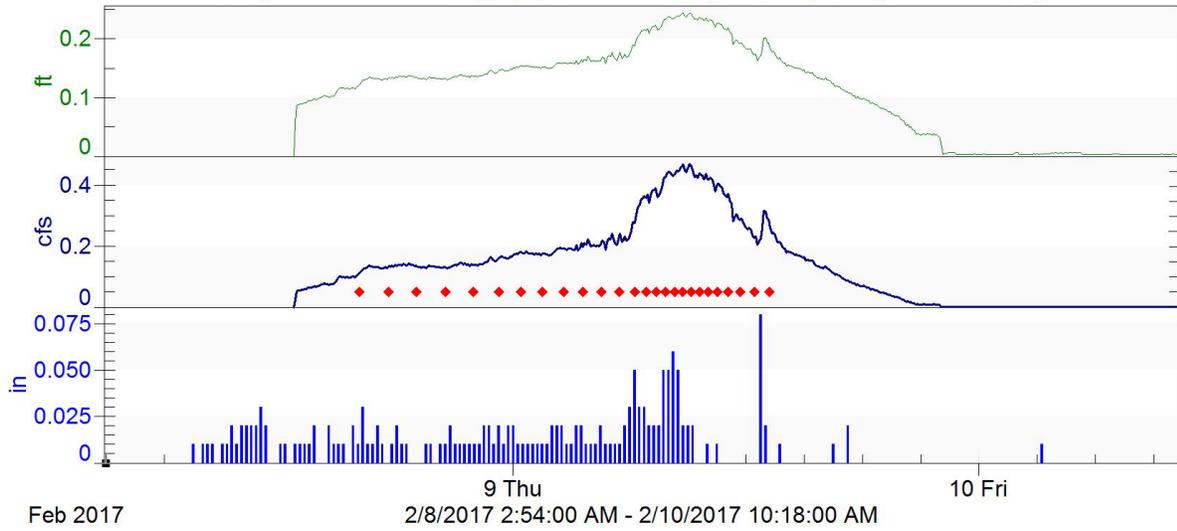


Figure 52. WBI, Storm 8.

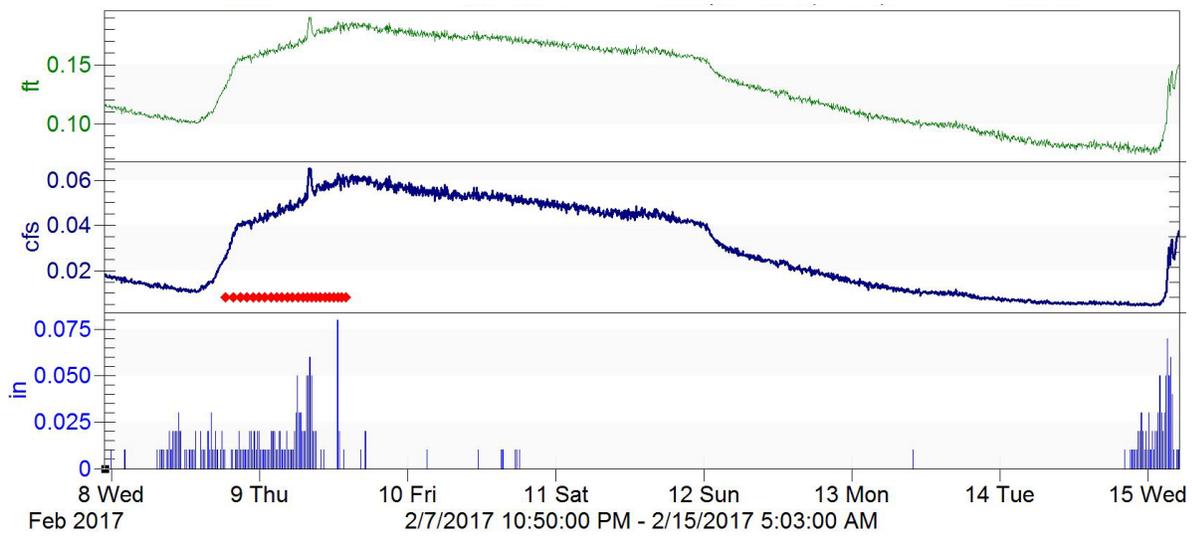


Figure 53. WBO, Storm 8.

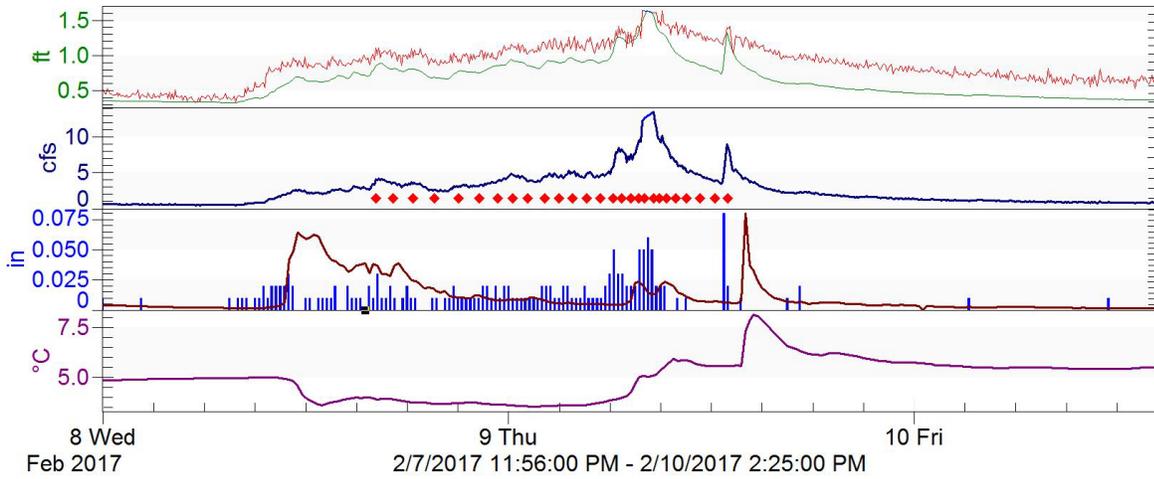


Figure 54. WCI, Storm 8.

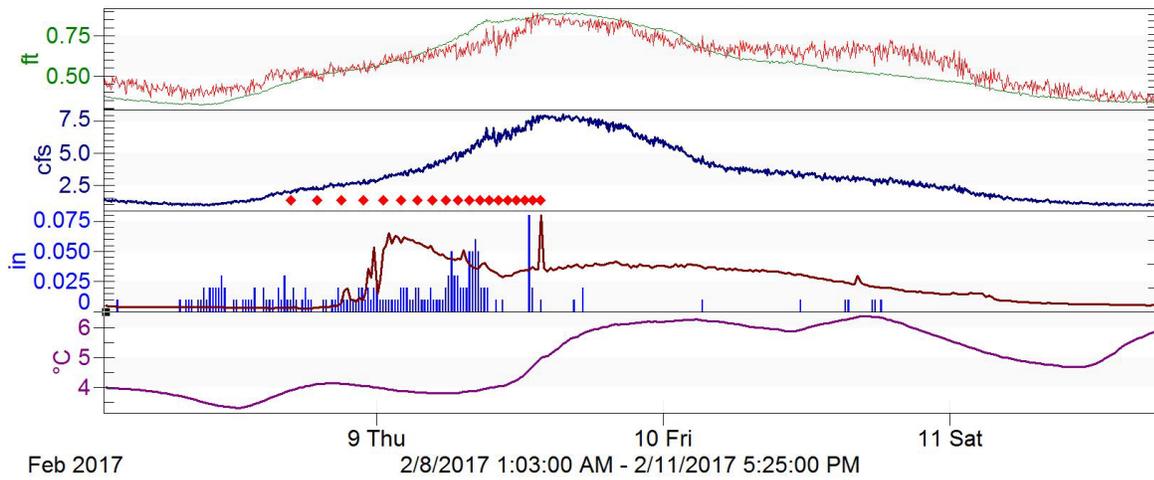


Figure 55. WCEBO, Storm 8.

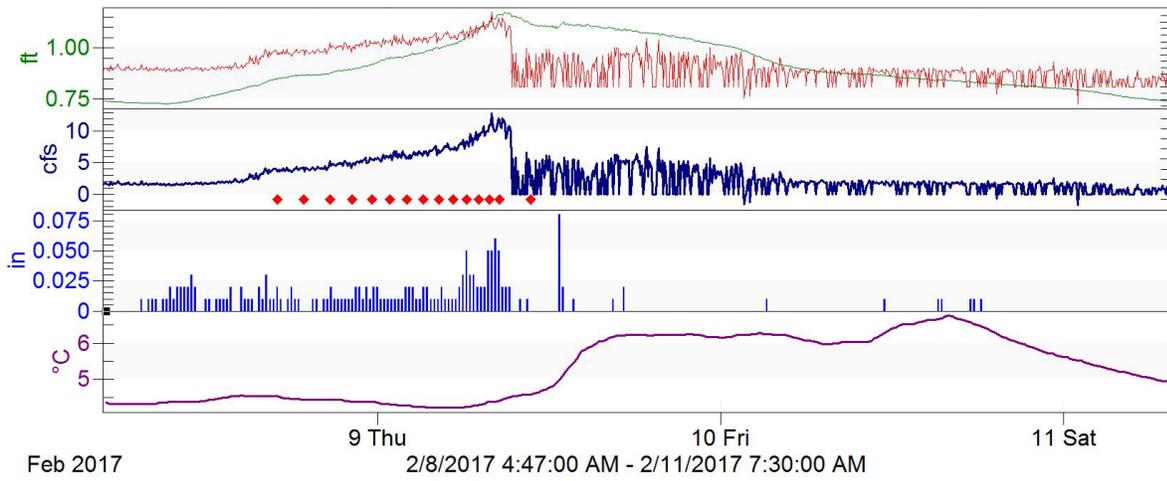


Figure 56. NFWHC, Storm 8.

Precipitation Information	Storm 9
	2/15/2017
Dry antecedent period (hr)	98
Rainfall in 4 days before storm (in)	0.01
Rainfall in 48 hours before storm (in)	0.01
Rainfall in 24 hours before storm (in)	0
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	2.38
Peak rainfall (date, time)	2/16/17 5:00 AM
Rainfall volume in bioretention basin (cf)	195250
Rainfall volume in wetland complex basin (cf)	1689867

Sampling Information	Storm 9 - 2/15/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	62077	32689	29678	26109 (a)	(b)	1136490	1740240
Start of flow (hhmm)	2345	110	2355	130 (a)	(b)	2300	2100
Average flow rate for entire storm (cfs)	0.43	0.198	0.206	0.055 (a)	(b)	5.374	6.866
Duration of flow (hr)	40.1	45.9	40.0	131.9 (a)	(b)	58.7	70.4
Runoff first 24 hrs of event (start at time of first sample) (cf)	41627	20489	19536	5771	392030	493341	869002
Runoff volume sampled (cf)	27946	19980	15458	4472	329300	402278	654610
% of runoff volume sampled	67.13	97.52	79.13	77.49	84.00	81.54	75.33
Average flow rate during sampling interval (cfs)	0.369	0.235	0.195	0.063	4.675	5.191	8.54
Peak of hydrograph captured?	no	yes	no	no	no	no	no
Number of aliquots collected	36	31	36	36	36	36	36
Peak flow rate (cfs)	2.23	0.64	0.98	0.07	19.85	11.54	27.61
Peak hydrograph (date, time)	2/16/2017 5:05:00 AM	2/16/2017 6:40:00 AM	2/16/2017 5:05:00 AM	2/16/2017 6:45:00 AM	2/16/2017 5:00:00 AM	2/16/2017 8:20:00 AM	2/16/2017 5:20:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	0:05	1:40	0:05	1:45	0:00	3:20	0:20

(a) Flow rates questionable; spikes likely due to backflow in catch basin and high levels after storm may be due to bubbler line clogging. Confirmatory sample collected on 2/16/17 to assess if back flow may have affected chemical concentrations in composite sample.

(b) Flow meter malfunctioned during high flow @ 0450. Later discovered large chunk of concrete was blocking velocity meter sensor. All samples had been collected prior to malfunction.

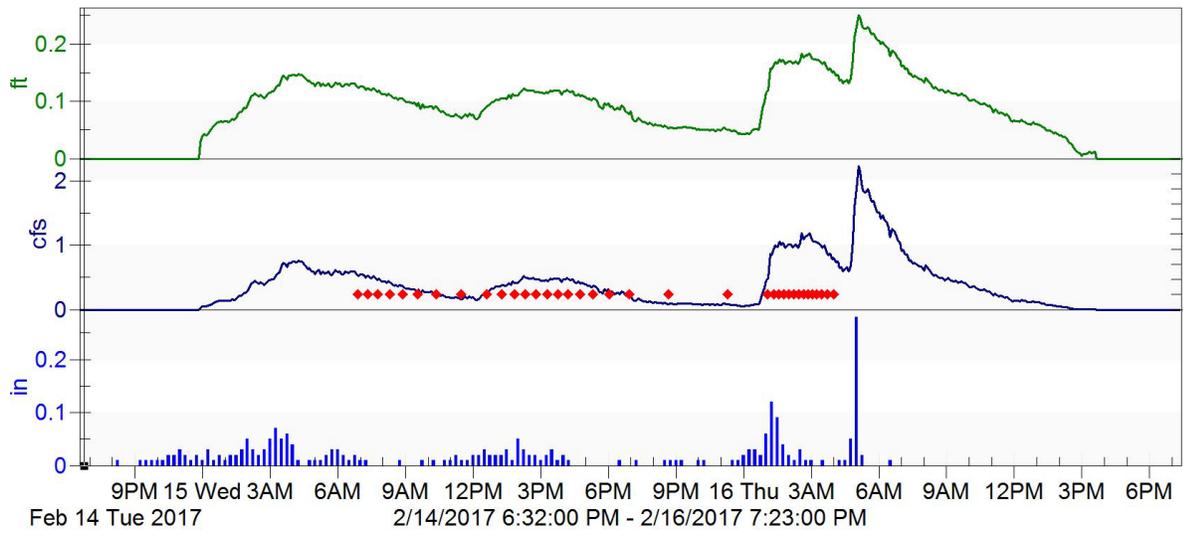


Figure 57. EBI, Storm 9.

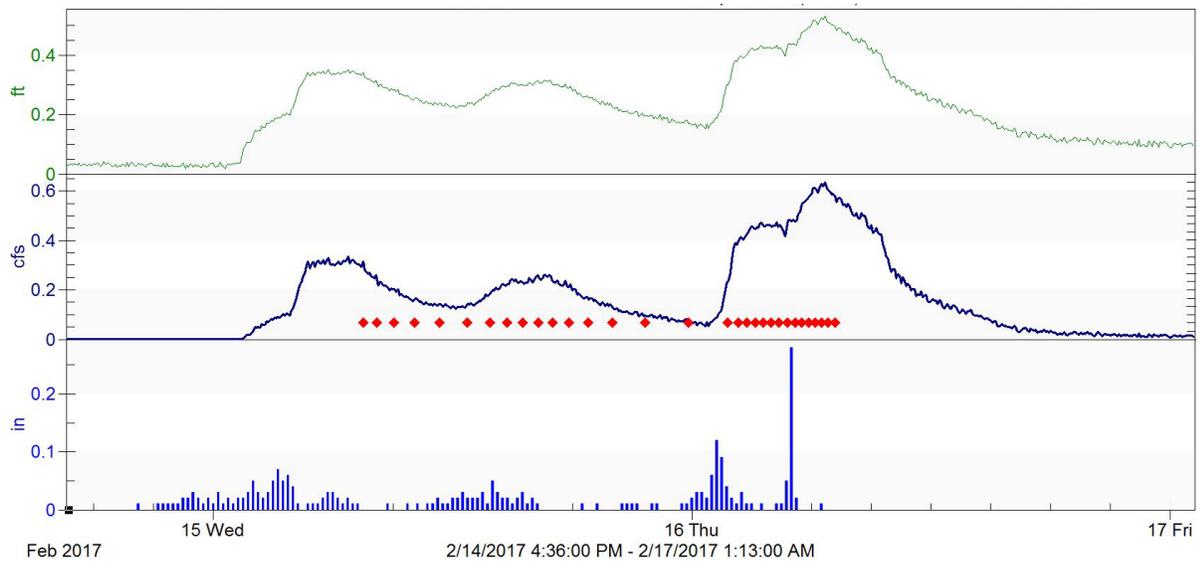


Figure 58. EBO, Storm 9.

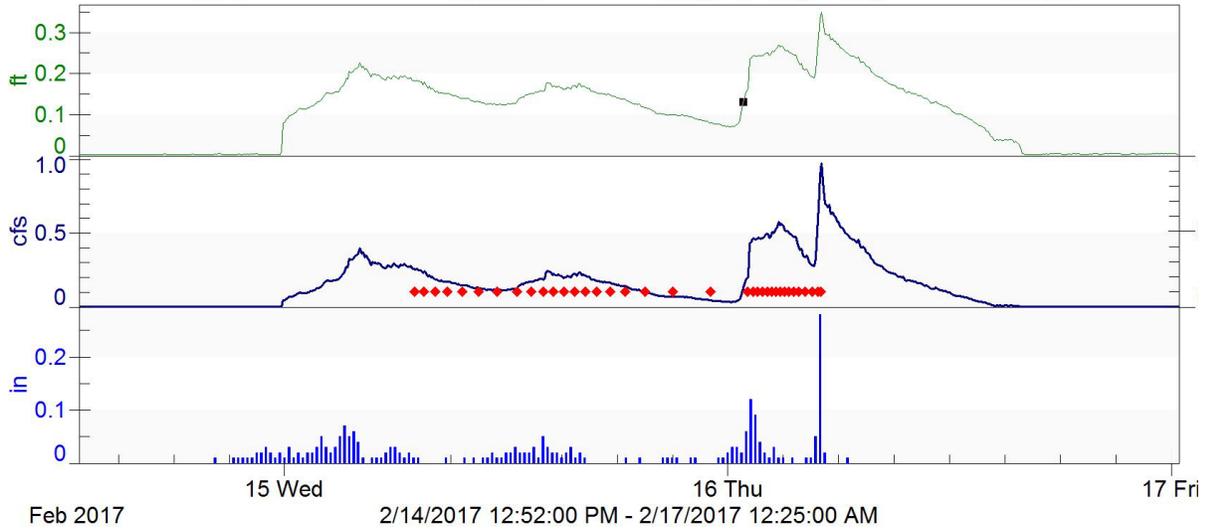


Figure 59. WBI, Storm 9.

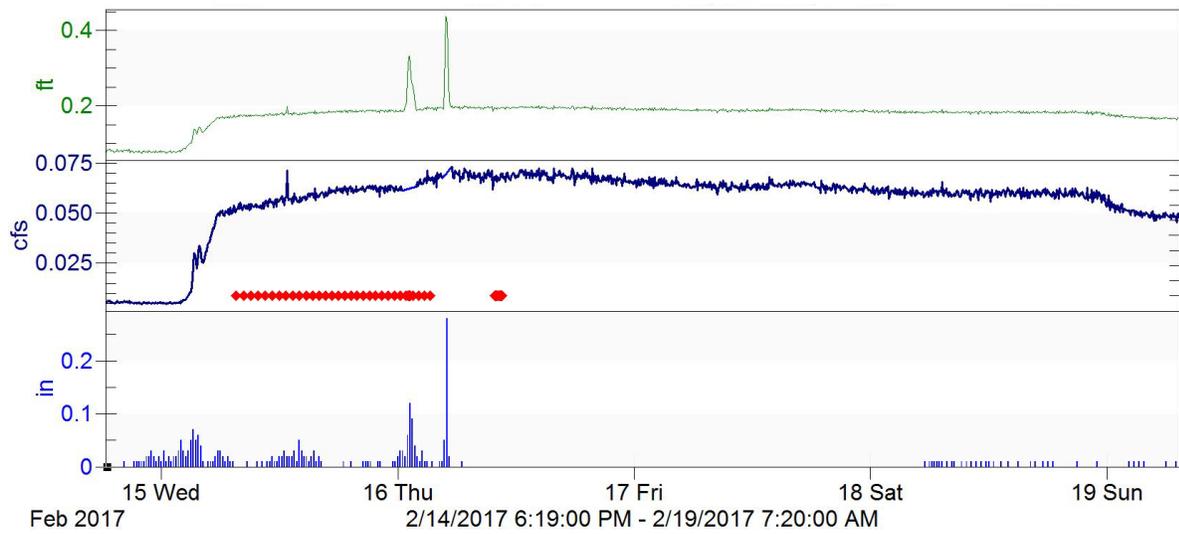


Figure 60. WBO, Storm 9.

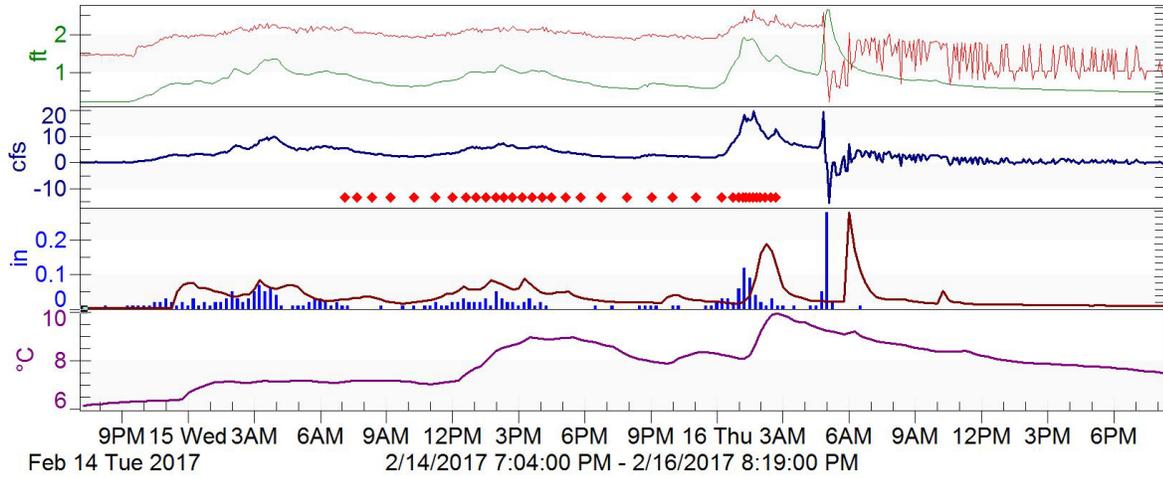


Figure 61. WCI, Storm 9.

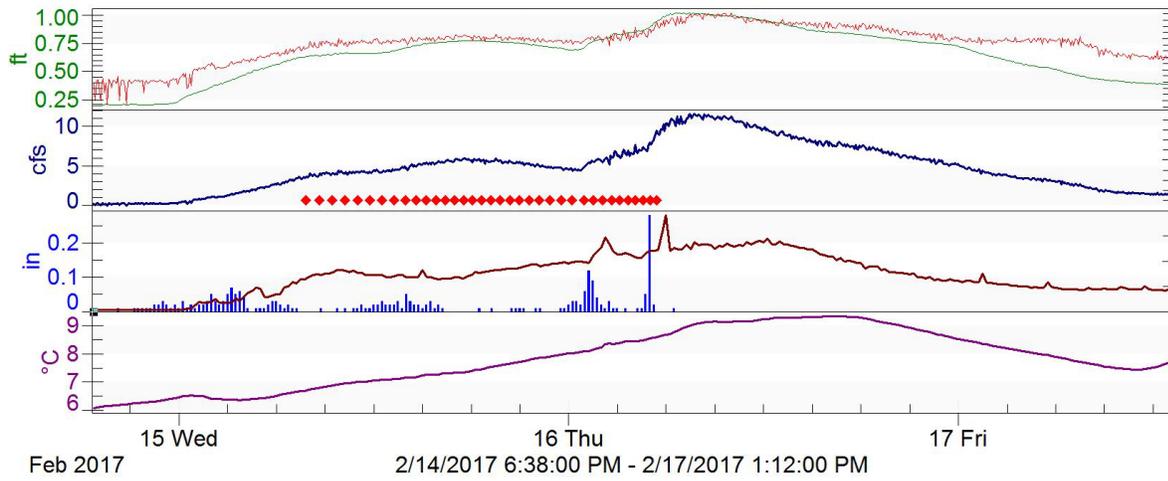


Figure 62. WCEBO, Storm 9.

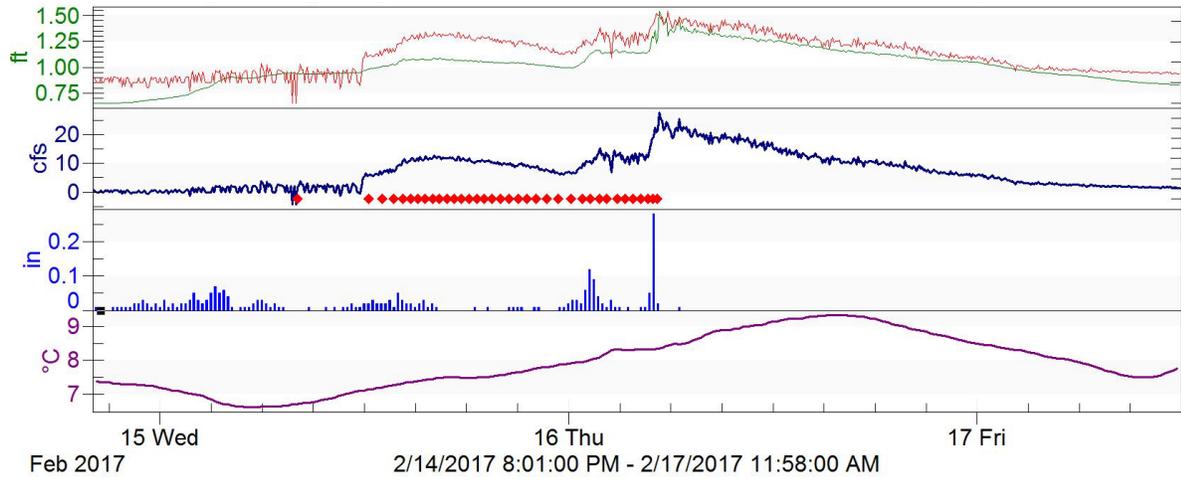


Figure 63. NFWHC, Storm 9.

Precipitation Information	Storm 10
	3/7/2017
Dry antecedent period (hr)	10.75
Rainfall in 4 days before storm (in)	0.58
Rainfall in 48 hours before storm (in)	0.24
Rainfall in 24 hours before storm (in)	0.22
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.72
Peak rainfall (date, time)	3/7/17 4:15 PM
Rainfall volume in bioretention basin (cf)	59067
Rainfall volume in wetland complex basin (cf)	511220

Sampling Information	Storm 10 - 3/7/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	12197	8278	6492	(a)	199635	284633	303841
Start of flow (hhmm)	625	647	630	(a)	110	630	435
Average flow rate for entire storm (cfs)	0.16	0.063	0.084	(a)	1.473	1.762	1.829
Duration of flow (hr)	21.2	36.5	21.5	(a)	37.6	44.9	46.1
Runoff first 24 hrs of event (start at time of first sample) (cf)	12197	7513	6295	(a)	170594	186477	185229
Runoff volume sampled (cf)	10299	7353	5637	(a)	156980	168959	168972
% of runoff volume sampled	84.44	97.87	89.55	(a)	92.02	90.61	91.22
Average flow rate during sampling interval (cfs)	0.229	0.096	0.118	(a)	2.374	2.161	2.172
Peak of hydrograph captured?	yes	yes	yes	no	yes	yes	yes
Number of aliquots collected	36	24	36	36	36	33	20
Peak flow rate (cfs)	0.45	0.2	0.18	(a)	5.16	2.89	3.21
Peak hydrograph (date, time)	3/7/2017 5:05:00 PM	3/7/2017 5:50:00 PM	3/7/2017 5:00:00 PM	3/7/2017 7:45:00 PM	3/7/2017 4:50:00 PM	3/7/2017 8:00:00 PM	3/7/2017 6:40:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	0:50	1:35	0:45	3:30	0:35	3:45	2:25

(a) Flow meter clogged and reading high; flow data not usable.

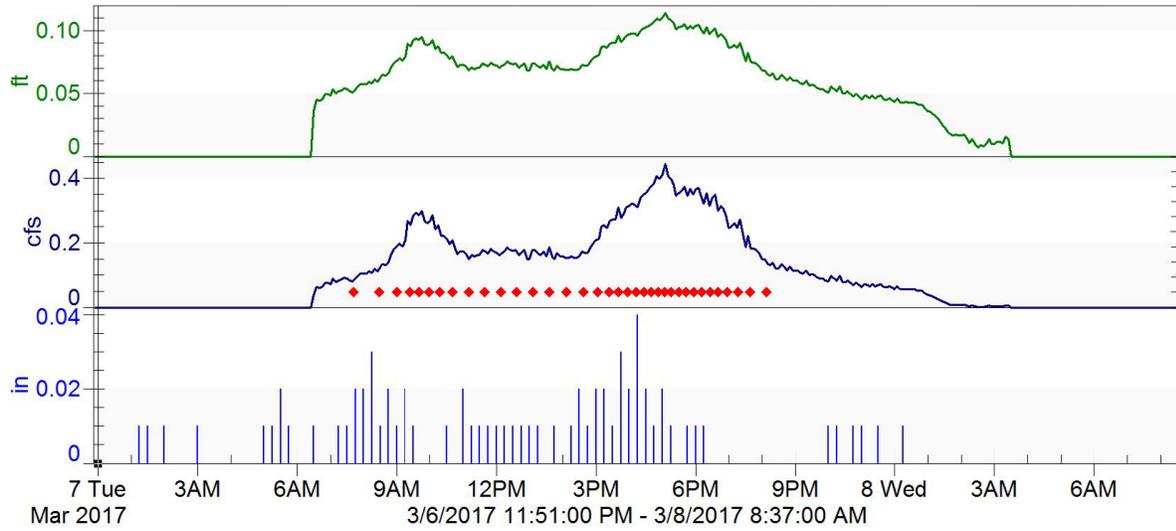


Figure 64. EBI, Storm 10.

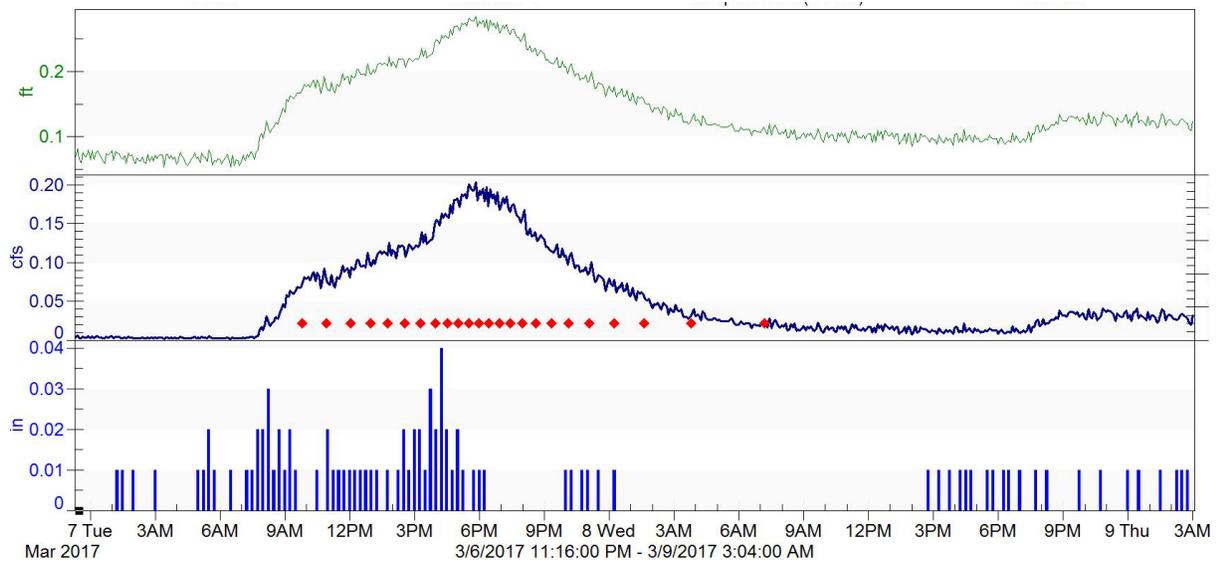


Figure 65. EBO, Storm 10.

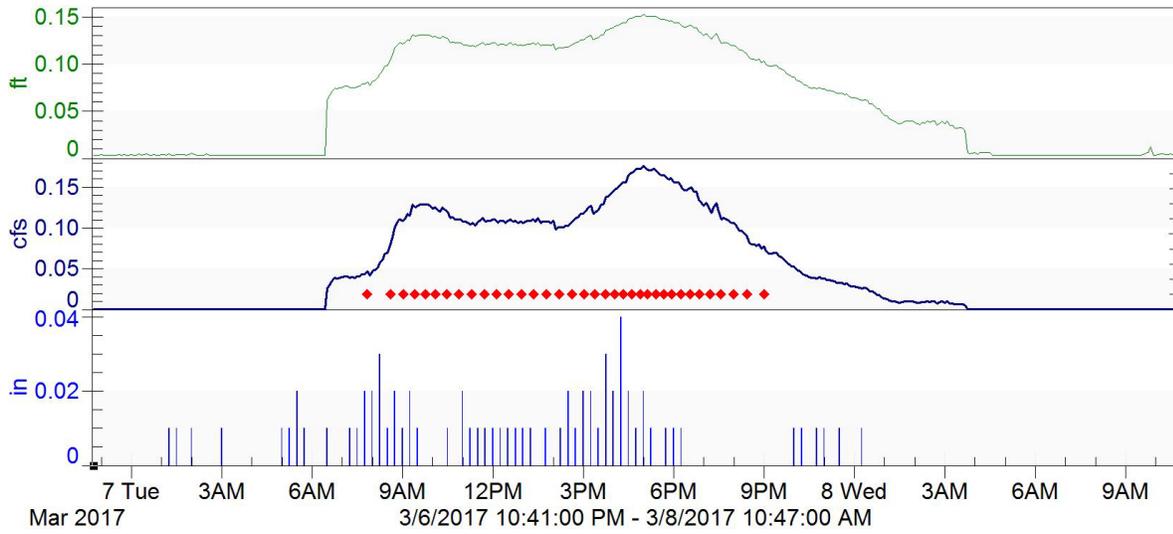


Figure 66. WBI, Storm 10.

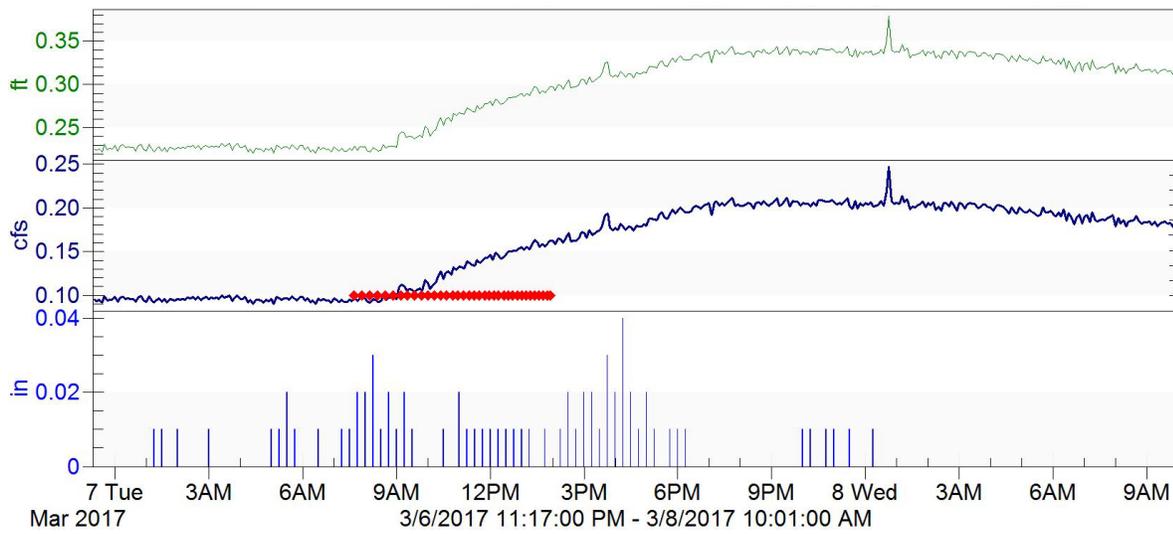


Figure 67. WBO, Storm 10.

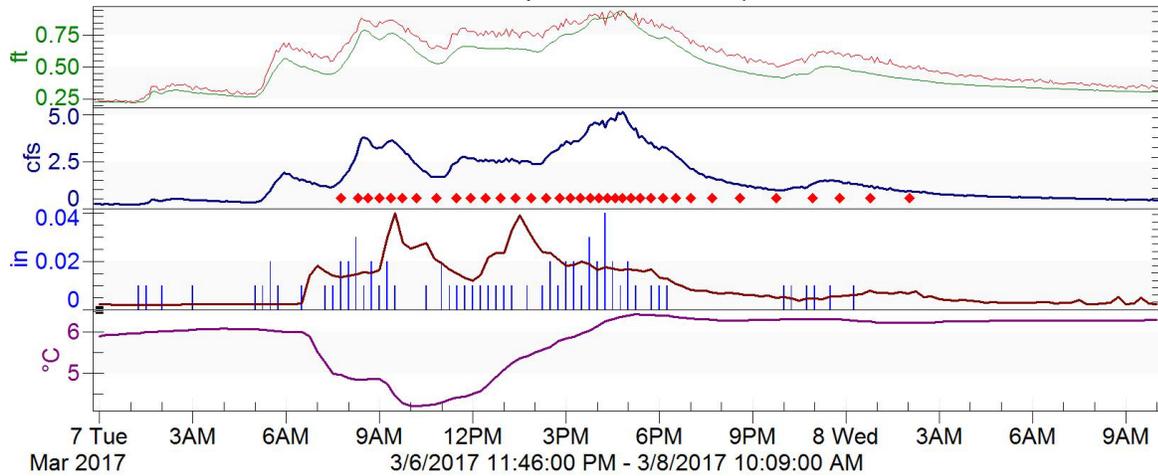


Figure 68. WCI, Storm 10.

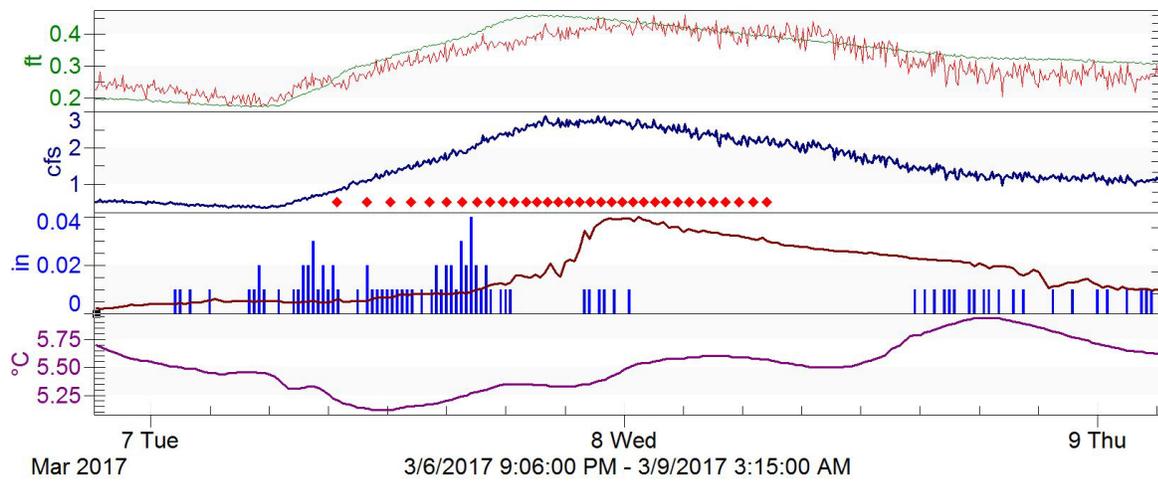


Figure 69. WCEBO, Storm 10.

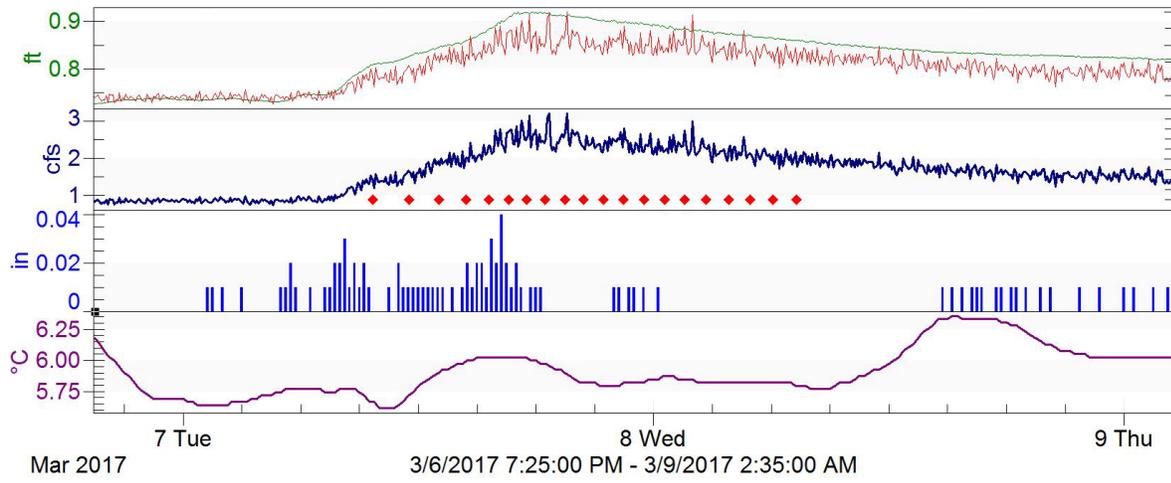


Figure 70. NFWHC, Storm 10.

Precipitation Information	Storm 11
	3/9/2017
Dry antecedent period (hr)	14.5
Rainfall in 4 days before storm (in)	0.98
Rainfall in 48 hours before storm (in)	0.84
Rainfall in 24 hours before storm (in)	0.3
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	1.01
Peak rainfall (date, time)	3/9/17 6:00 PM
Rainfall volume in bioretention basin (cf)	82858
Rainfall volume in wetland complex basin (cf)	717128

Sampling Information	Storm 11 - 3/9/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	19162	13010	9017	5388 (a)	255706	380238	377637
Start of flow (hhmm)	1735	1900	1745	555	925	1000	1000
Average flow rate for entire storm (cfs)	0.137	0.066	0.064	0.028	1.486	2.214	2.247
Duration of flow (hr)	38.9	54.8	39.1	53.5	47.8	47.7	46.7
Runoff first 24 hrs of event (start at time of first sample) (cf)	14476	9526	6594	2988	198178	238399	231754
Runoff volume sampled (cf)	14393	9145	6551	2751	190796	215225	212000
% of runoff volume sampled	99.43	96.00	99.35	92.07	96.28	90.28	91.48
Average flow rate during sampling interval (cfs)	0.237	0.132	0.099	0.035	2.513	2.809	2.76
Peak of hydrograph captured?	yes	yes	yes	yes	yes	yes	yes
Number of aliquots collected	36	24	30	26	35	33	20
Peak flow rate (cfs)	0.57	0.31	0.24	0.04	6.84	3.54	4.31
Peak hydrograph (date, time)	3/9/2017 6:35:00 PM	3/9/2017 7:35:00 PM	3/9/2017 6:40:00 PM	3/9/2017 10:05:00 PM	3/9/2017 6:25:00 PM	3/10/2017 12:30:00 AM	3/9/2017 7:35:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	0:35	1:35	0:40	4:05	0:25	6:30	1:35

(a) Tail of this stormflow runs in to another storm, so reported volume is likely underestimate of actual volume.

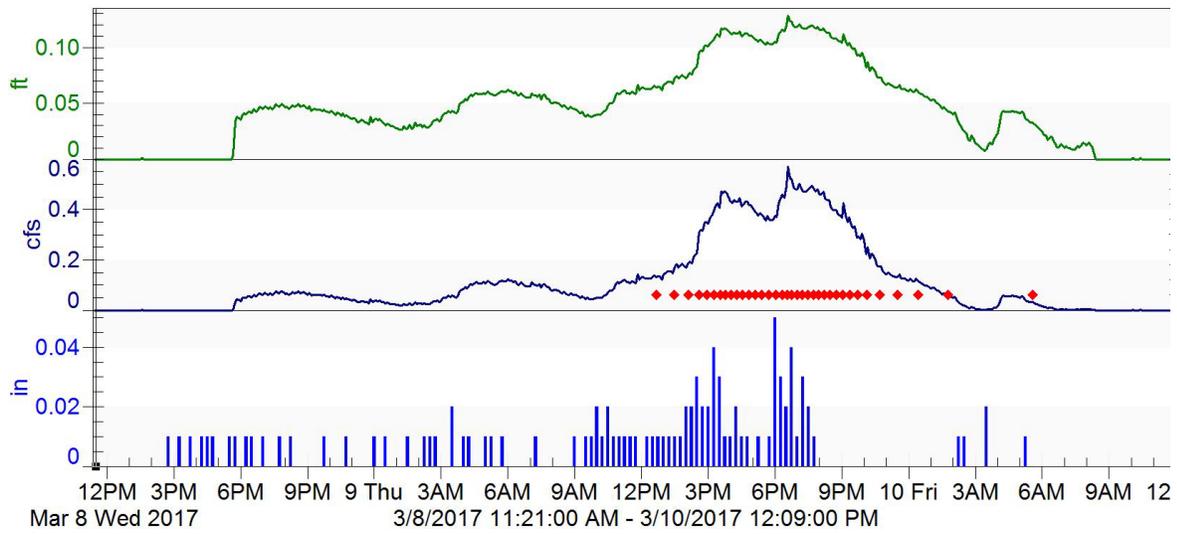


Figure 71. EBI, Storm 11.

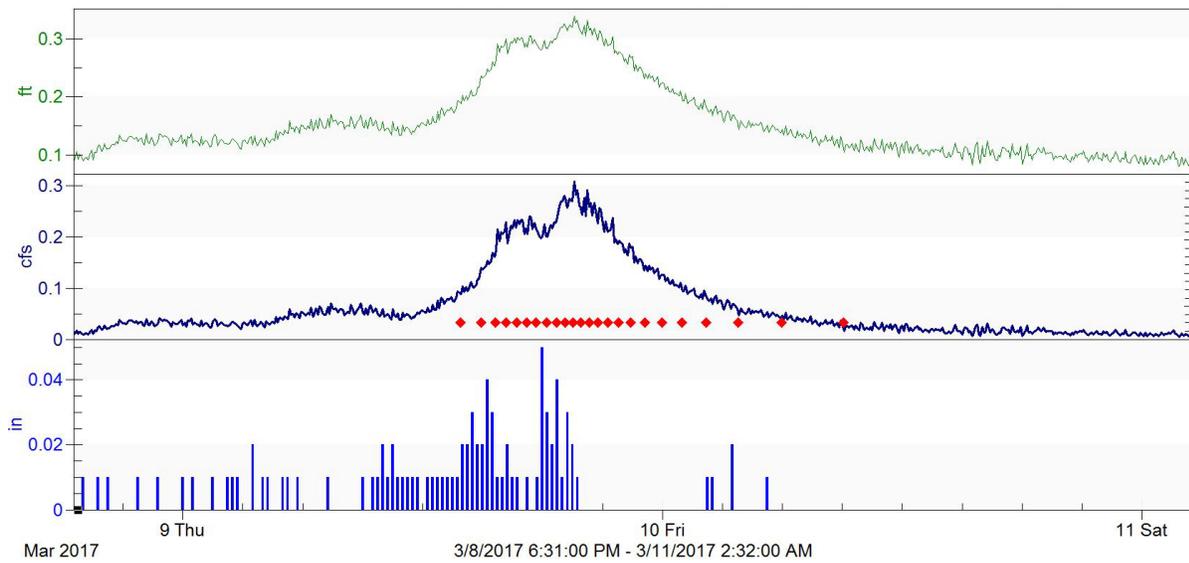


Figure 72. EBO, Storm 11.

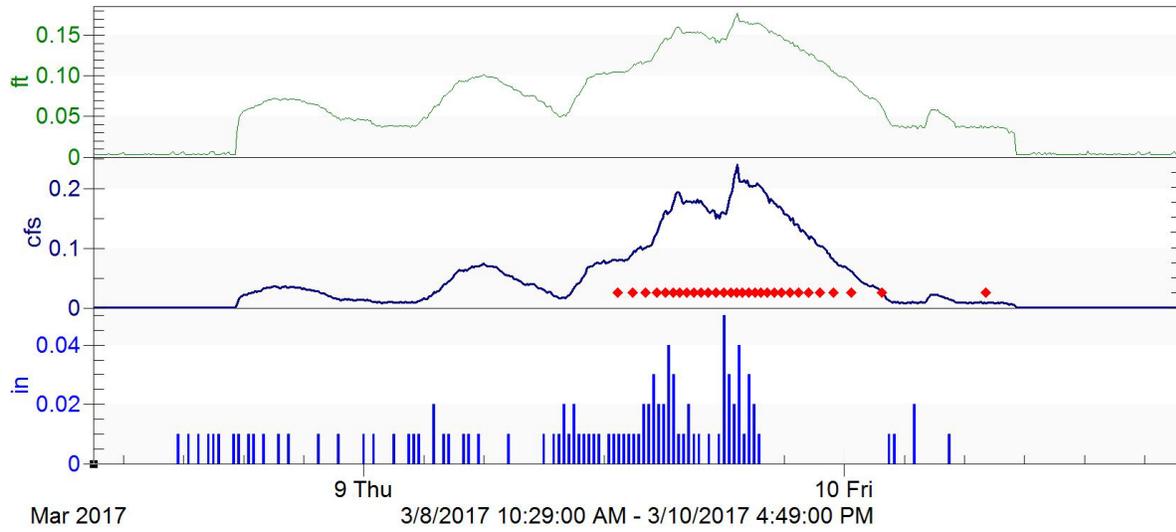


Figure 73. WBI, Storm 11.

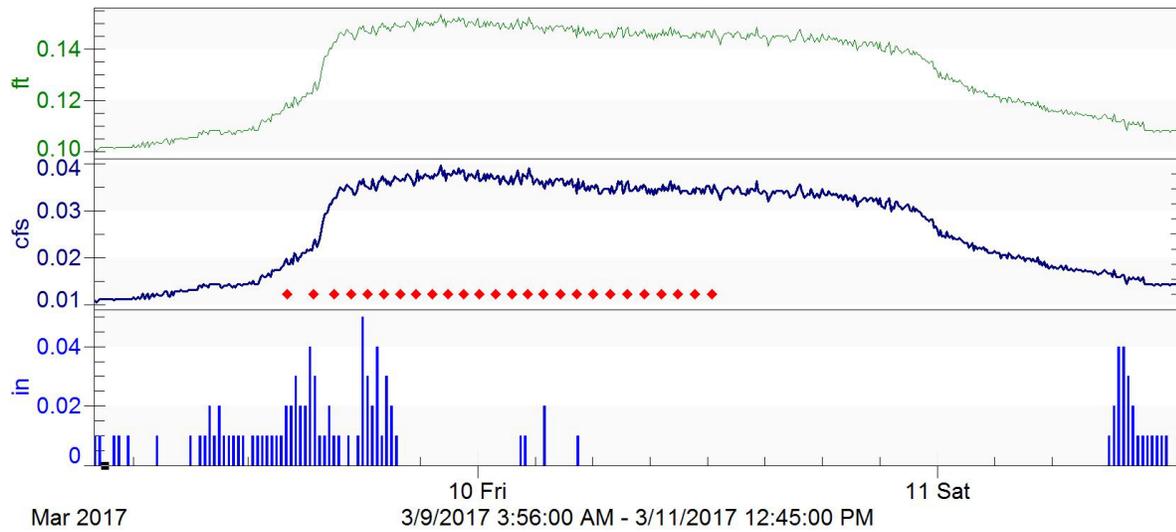


Figure 74. WBO, Storm 11.

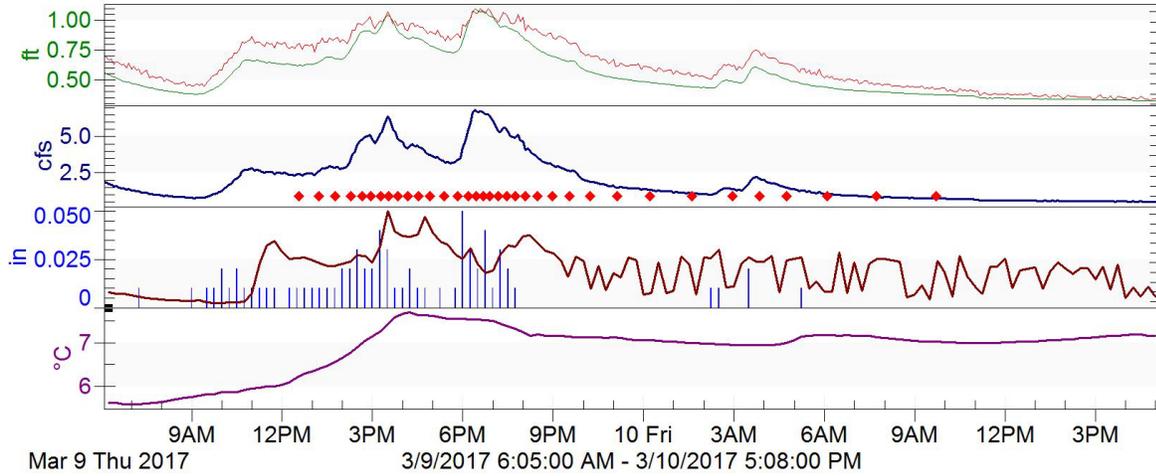


Figure 75. WCI, Storm 11.

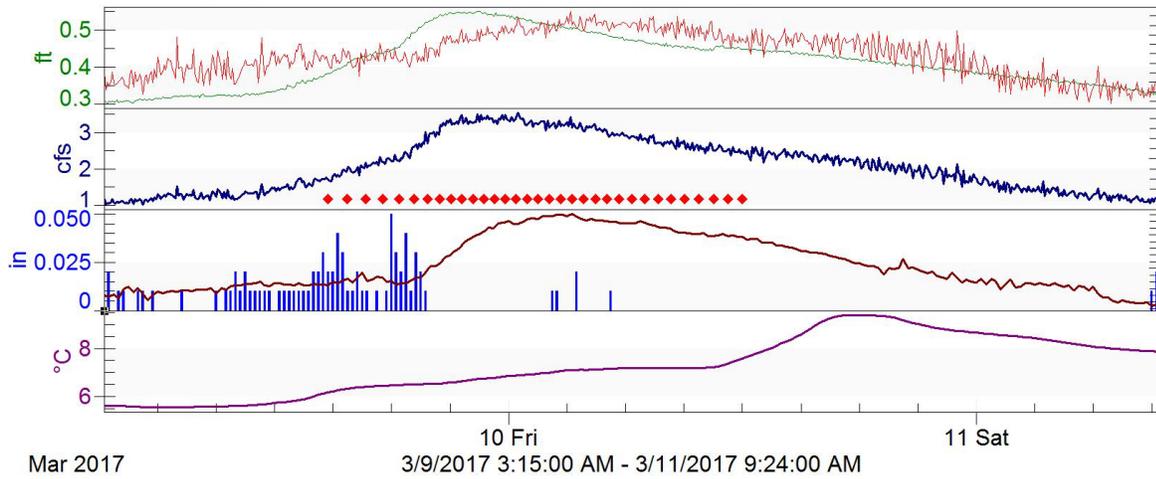


Figure 76. WCEBO, Storm 11.

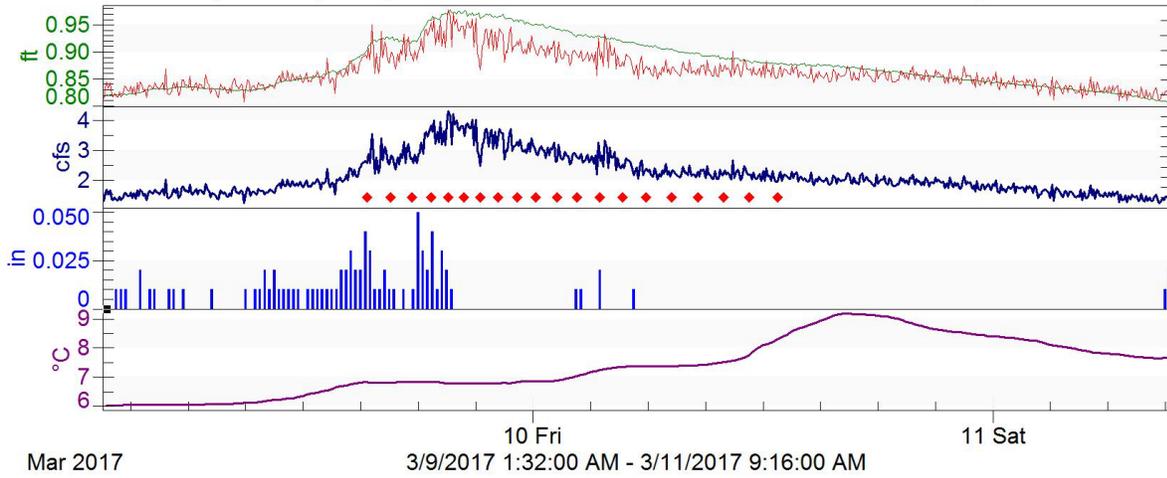


Figure 77. NFWHC, Storm 11.

Precipitation Information	Storm 12
	3/13/2017
Dry antecedent period (hr)	39
Rainfall in 4 days before storm (in)	1.03
Rainfall in 48 hours before storm (in)	0.25
Rainfall in 24 hours before storm (in)	0.01
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.99
Peak rainfall (date, time)	3/13/17 10:00 AM
Rainfall volume in bioretention basin (cf)	81218
Rainfall volume in wetland complex basin (cf)	702928

Sampling Information	Storm 12 - 3/13/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	(a)	12065	8319	4347 (b)	272237	294196	288554
Start of flow (hhmm)	(a)	830	805	950	505	650	545
Average flow rate for entire storm (cfs)	(a)	0.088	0.071	0.031	2.08	2.137	2.071
Duration of flow (hr)	(a)	38.1	32.5	39.0 (b)	36.4	38.2	38.7
Runoff first 24 hrs of event (start at time of first sample) (cf)	(a)	9827	7292	2869	224823	204119	201414
Runoff volume sampled (cf)	(a)	8994	7157	2439	224823	169791	201414
% of runoff volume sampled	(a)	91.52	98.15	85.01	100.00	83.18	100.00
Average flow rate during sampling interval (cfs)	(a)	0.123	0.087	0.033	2.456	2.334	2.288
Peak of hydrograph captured?	(a)	yes	yes	yes	yes	yes	yes
Number of aliquots collected	8	16	19	17	27 (c)	17	17 (d)
Peak flow rate (cfs)	(a)	0.31	0.22	0.04	5.78	2.92	3.24
Peak hydrograph (date, time)	(a)	3/13/2017 4:30:00 PM	3/13/2017 3:40:00 PM	3/13/2017 8:15:00 PM	3/13/2017 3:05:00 PM	3/13/2017 9:25:00 PM	3/13/2017 5:10:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	(a)	6:30	5:40	10:15	5:05	11:25	7:10

(a) Flow meter malfunctioned halfway through sampling event; flow data missing from 1610 through 2400.

(b) Flow is still quite high when the next storm starts; therefore, volume is underestimate of actual runoff from sampled event.

(c) Sampler ran for 25.5 hours.

(d) Sampler ran for 24.5 hours.

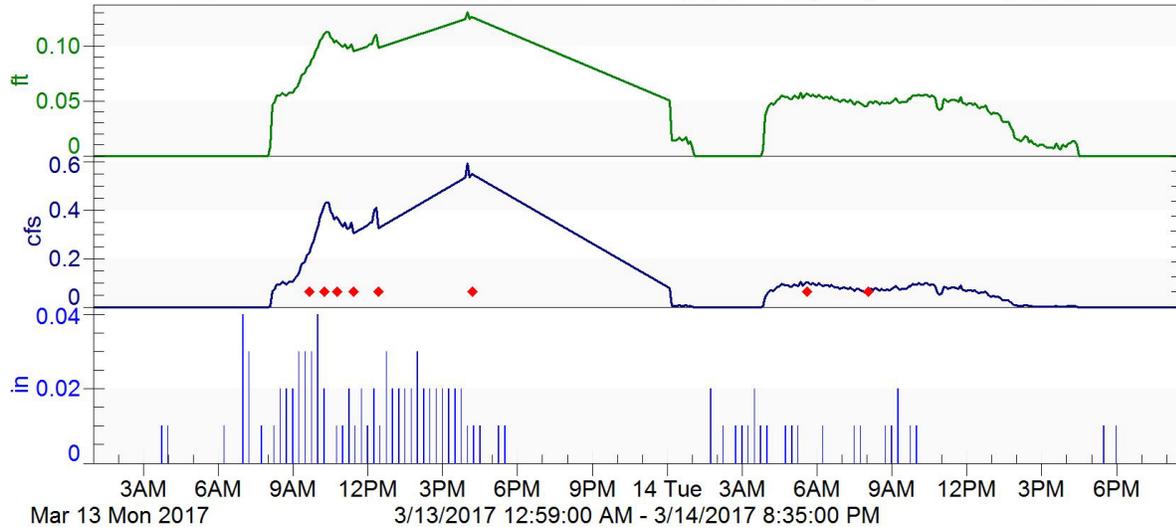


Figure 78. EBI, Storm 12.

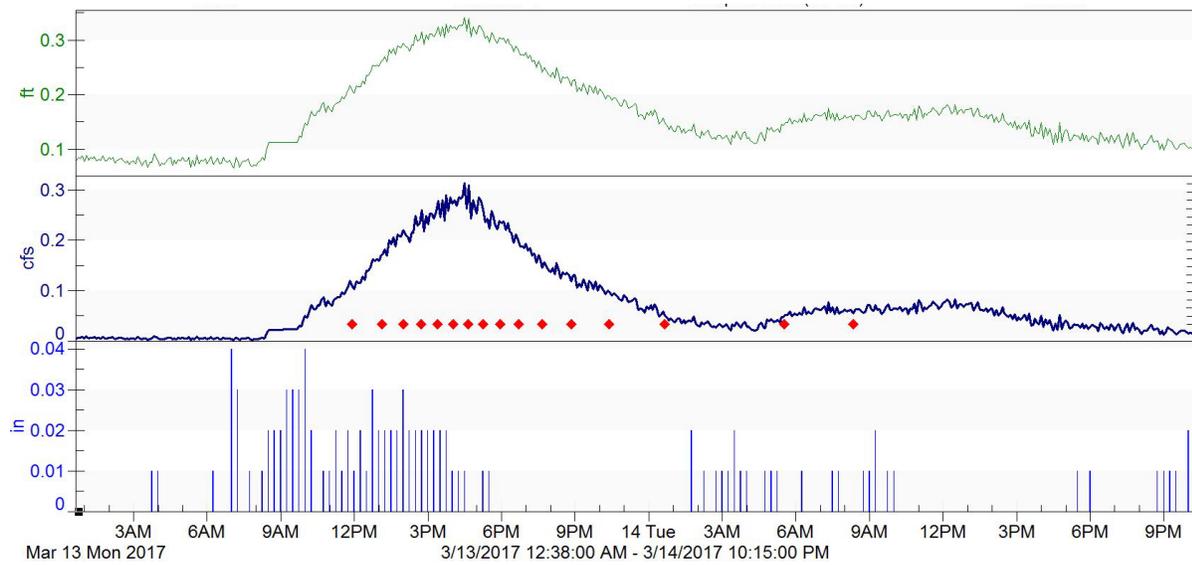


Figure 79. EBO, Storm 12.

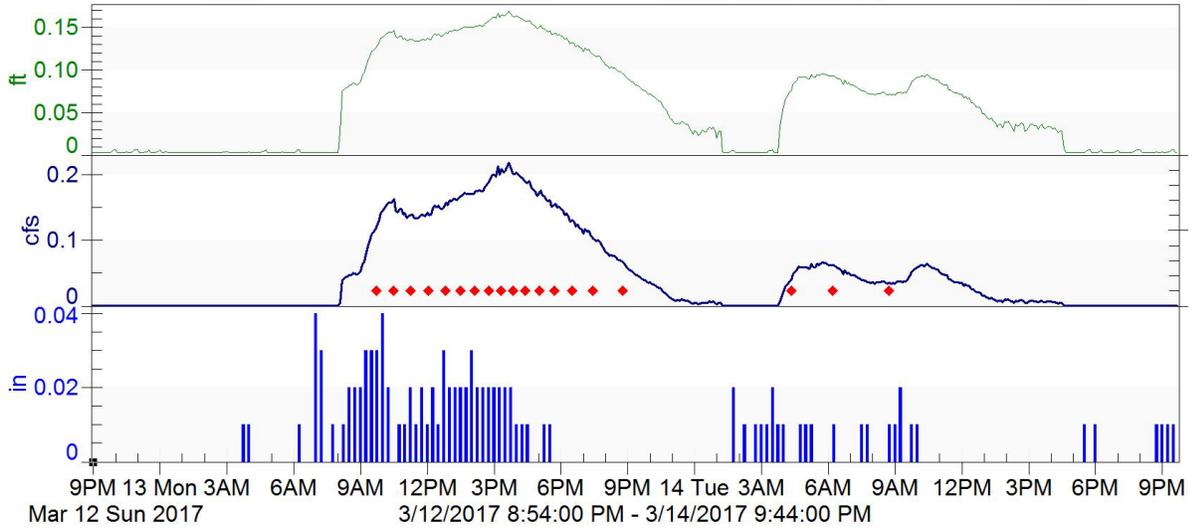


Figure 80. WBI, Storm 12.

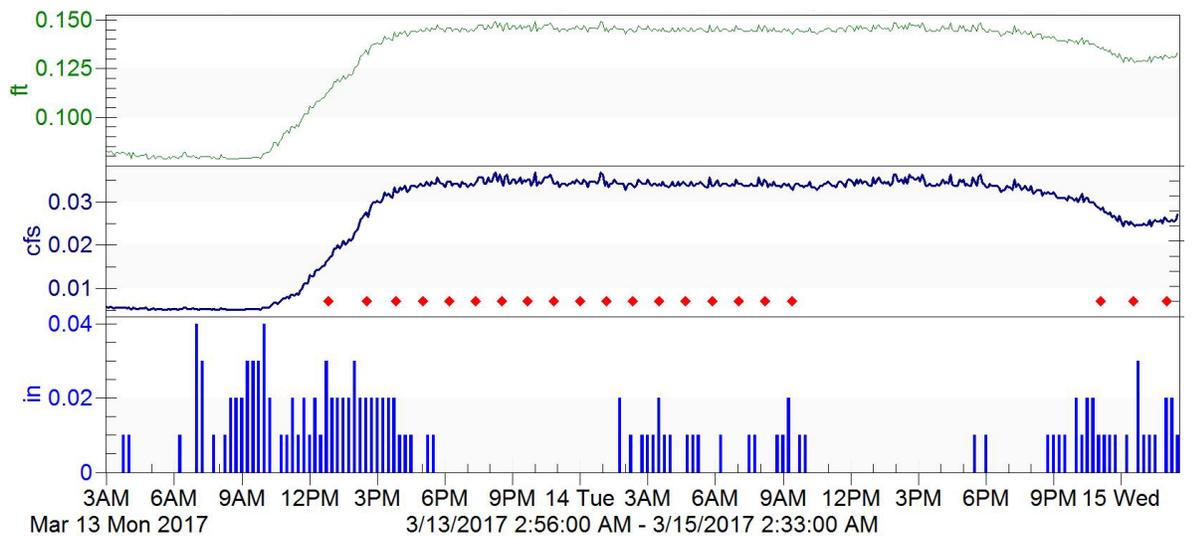


Figure 81. WBO, Storm 12.

Note: The last three samples included in the WBO figure were collected as part of Storm 13, and were not included in the Storm 12 sample.

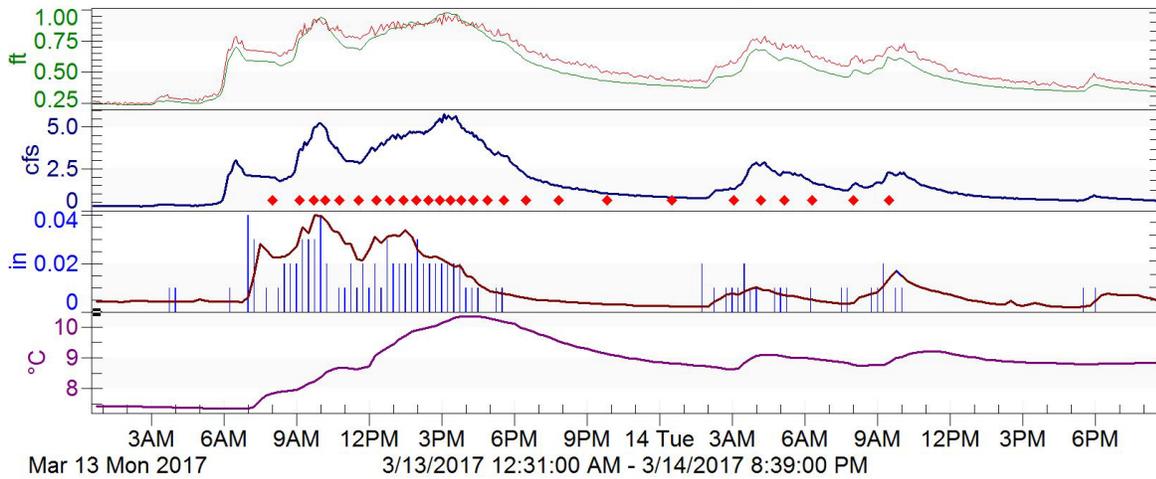


Figure 82. WCI, Storm 12.

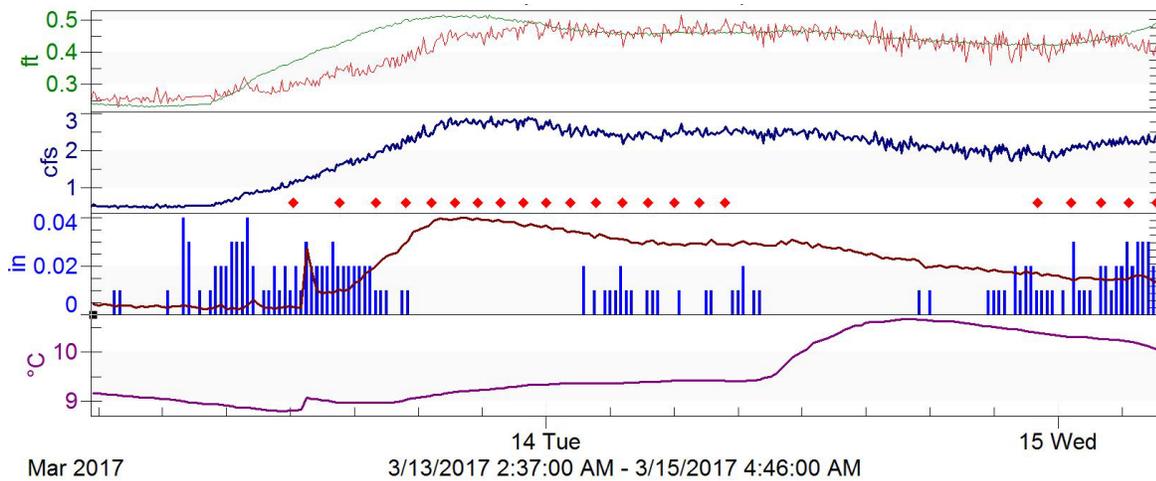


Figure 83. WCEBO, Storm 12.

Note: The last five samples included in the WCEBO figure were collected as part of Storm 13, and were not included in the Storm 12 sample.

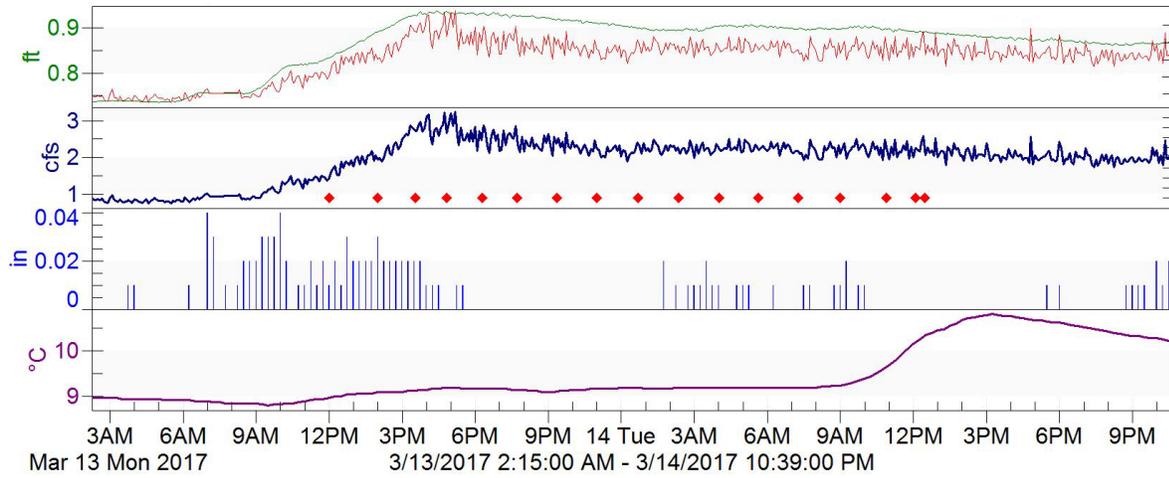


Figure 84. NFWHC, Storm 12.

Precipitation Information	Storm 13
	3/14/2017
Dry antecedent period (hr)	7.5
Rainfall in 4 days before storm (in)	1.24
Rainfall in 48 hours before storm (in)	0.99
Rainfall in 24 hours before storm (in)	0.22
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	1.17
Peak rainfall (date, time)	3/15/17 3:15 AM
Rainfall volume in bioretention basin (cf)	95984
Rainfall volume in wetland complex basin (cf)	830733

Sampling Information	Storm 13 - 3/14/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	28602	18874	12918	9097 (a)	421871	605799	760488
Start of flow (hhmm)	2230	2255	2235	15	2040	2150	2150
Average flow rate for entire storm (cfs)	0.31	0.142	0.137	0.038	1.829	2.769	3.317
Duration of flow (hr)	25.6	36.9	26.2	66.5	64.1	60.8	63.7
Runoff first 24 hrs of event (start at time of first sample) (cf)	28586	17669	12877	3163	329631	335536	486449
Runoff volume sampled (cf)	25235	17478	12762	3124	302687	328408	427512
% of runoff volume sampled	88.28	98.92	99.11	98.77	91.83	97.88	87.88
Average flow rate during sampling interval (cfs)	0.408	0.206	0.161	0.037	4.377	3.875	5.685
Peak of hydrograph captured?	yes	yes	yes	yes	yes	yes	yes
Number of aliquots collected	36	30	33	23	36	32	36
Peak flow rate (cfs)	0.68	0.41	0.3	0.05	7.34	5.53	9.88
Peak hydrograph (date, time)	3/15/2017 9:40:00 AM	3/15/2017 10:40:00 AM	3/15/2017 9:45:00 AM	3/15/2017 5:30:00 PM	3/15/2017 7:55:00 AM	3/15/2017 2:35:00 PM	3/15/2017 11:25:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	6:25	7:25	6:30	14:15	4:40	11:20	8:10

(a) Flow high initially, when sampled storm starts, and flow remains high as next storm starts. Flow volume is an estimate.

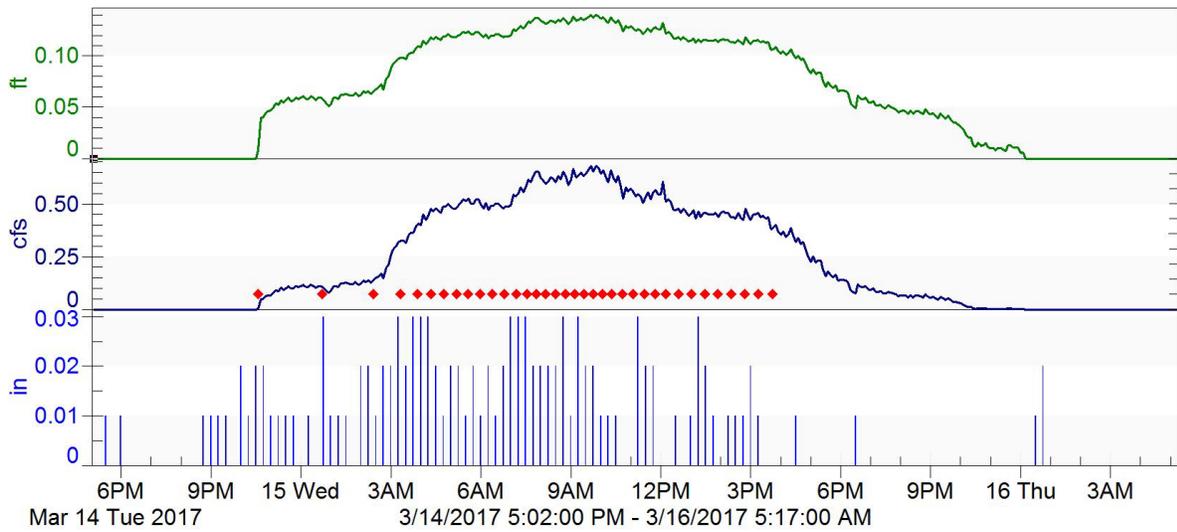


Figure 85. EBI, Storm 13.

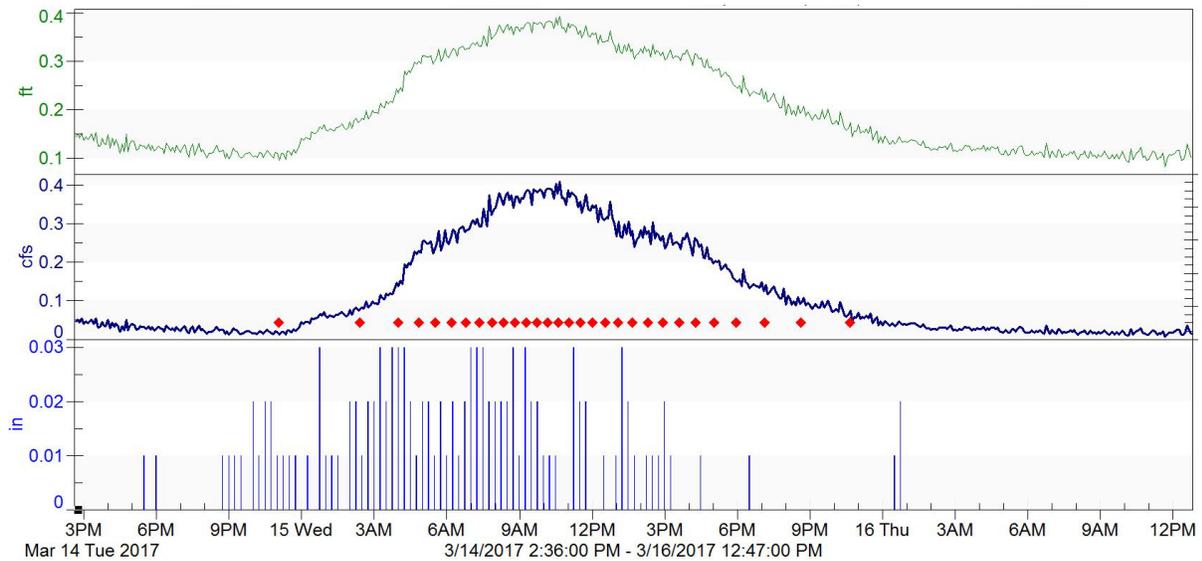


Figure 86. EBO, Storm 13.

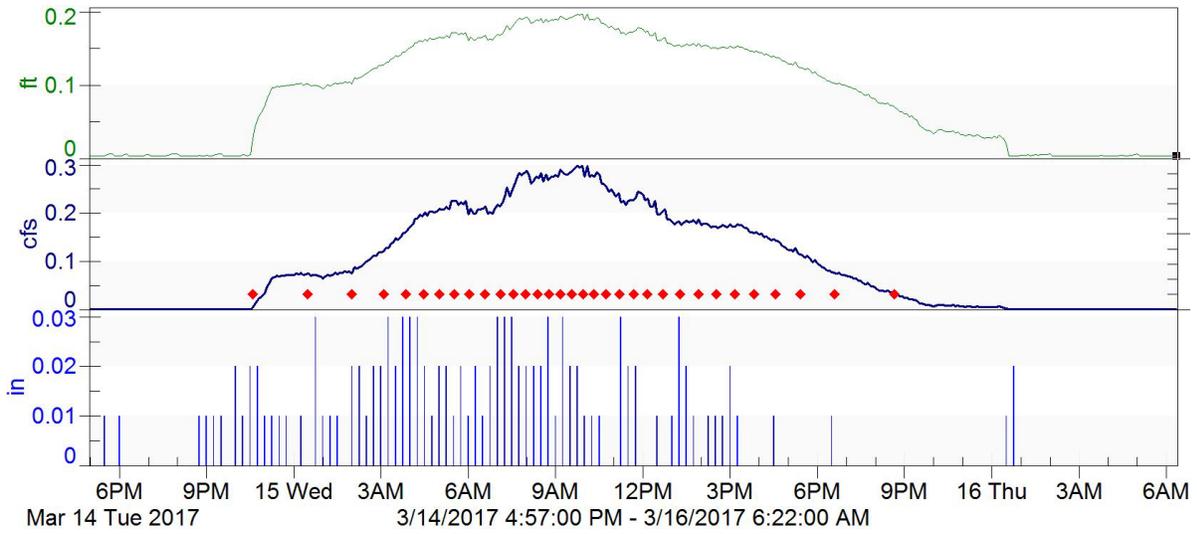


Figure 87. WBI, Storm 13.

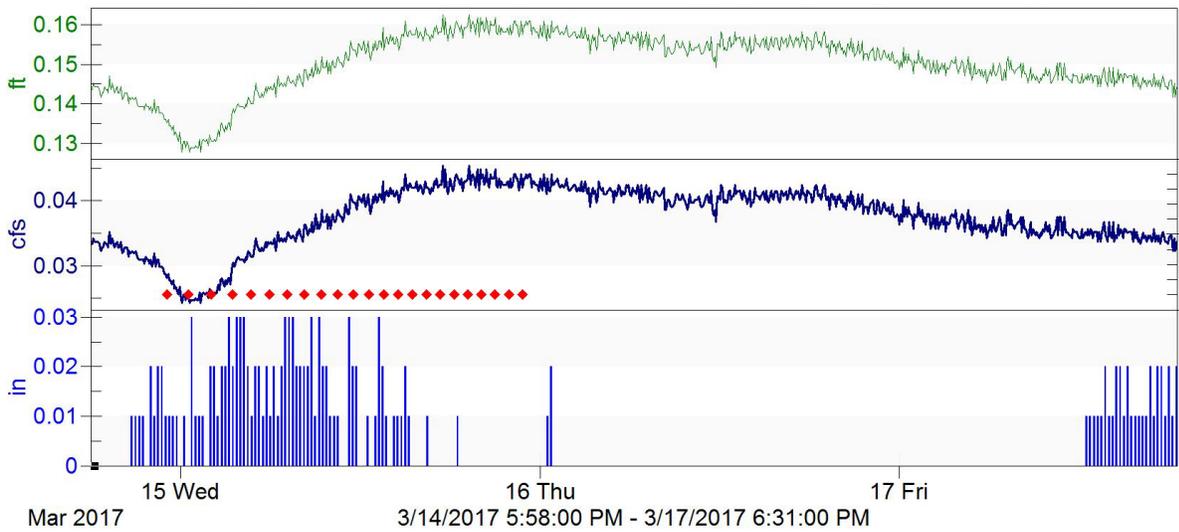


Figure 88. WBO, Storm 13.

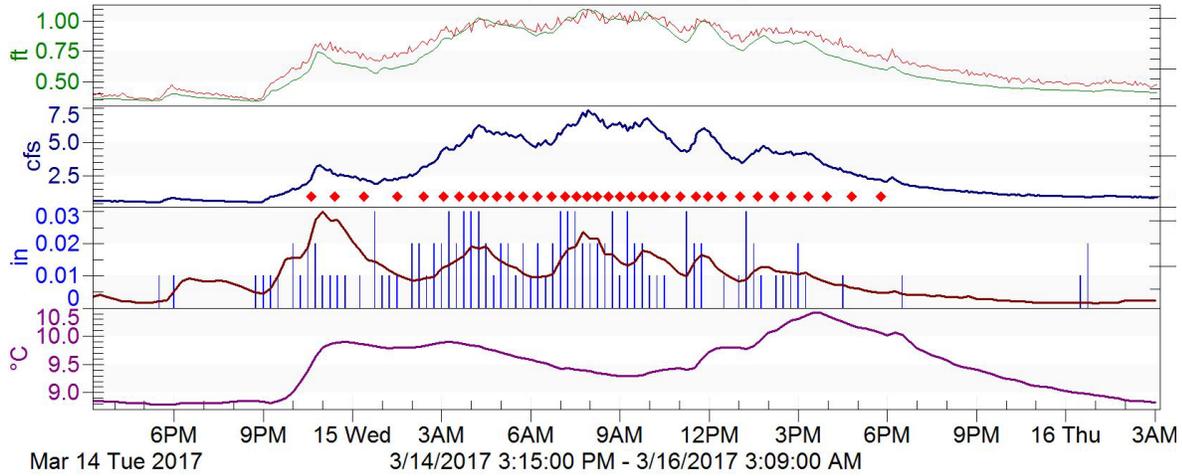


Figure 89. WCI, Storm 13.

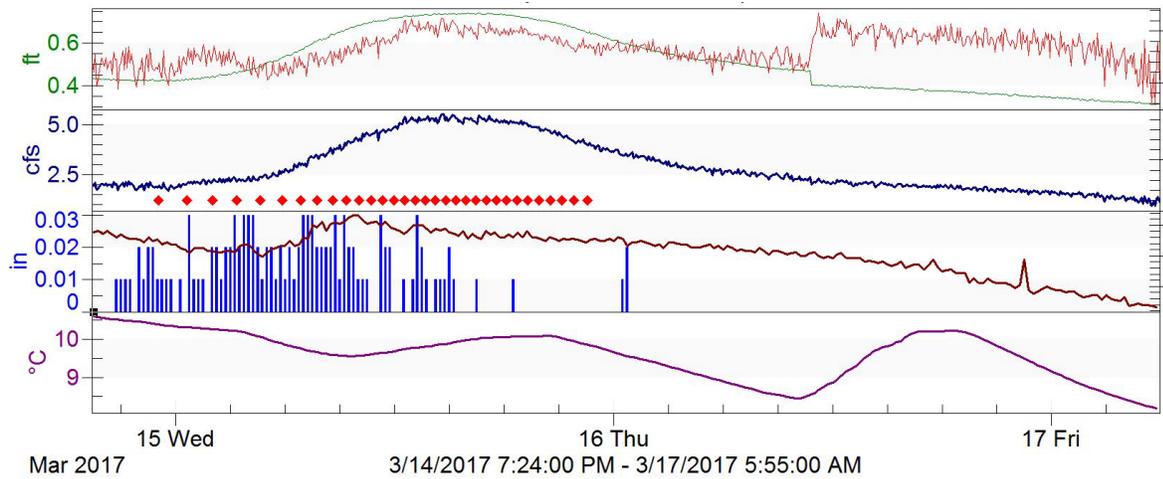


Figure 90. WCEBO, Storm 13.

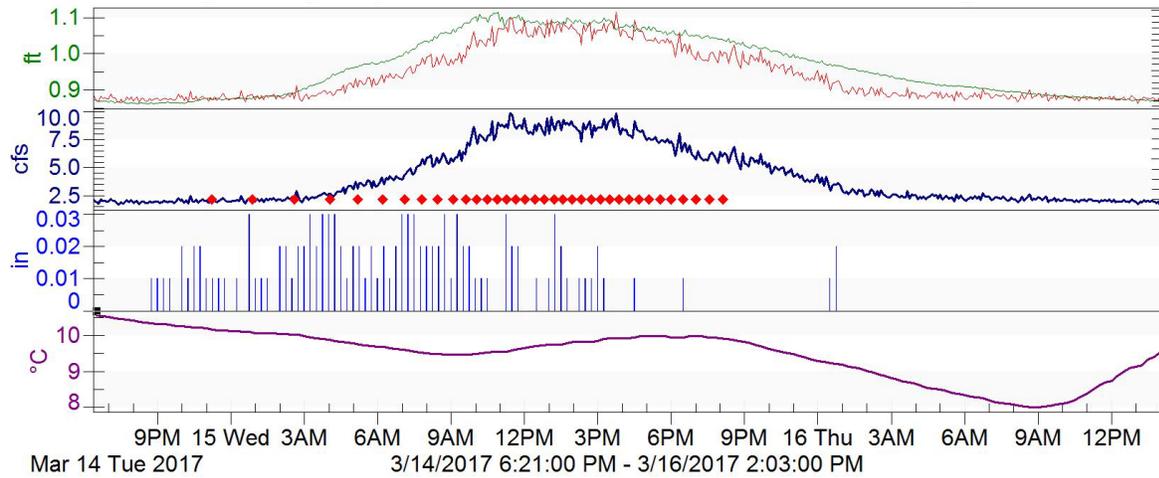


Figure 91. NFWHC, Storm 13.

Precipitation Information	Storm 14
	3/26/2017
Dry antecedent period (hr)	27.45
Rainfall in 4 days before storm (in)	0.44
Rainfall in 48 hours before storm (in)	0.12
Rainfall in 24 hours before storm (in)	0.01
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.38
Peak rainfall (date, time)	3/26/17 1:30 PM
Rainfall volume in bioretention basin (cf)	31174
Rainfall volume in wetland complex basin (cf)	269811

Sampling Information	Storm 14 - 3/26/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	3465	3562	2315	(a)	96073	184604 (b)	239039
Start of flow (hhmm)	1130	1255	1130	(a)	900	1140	940
Average flow rate for entire storm (cfs)	0.053	0.039	0.035	(a)	0.913	0.897	1.096
Duration of flow (hr)	18.2	25.4	18.4	(a)	29.2	57.2	60.6
Runoff first 24 hrs of event (start at time of first sample) (cf)	3356	3448	2259	(a)	82480	98238	101331
Runoff volume sampled (cf)	3279	3053	1849	(a)	79528	88766	89695
% of runoff volume sampled	97.71	88.54	81.85	(a)	96.42	90.36	88.52
Average flow rate during sampling interval (cfs)	0.065	0.048	0.046	(a)	1.018	1.181	1.18
Peak of hydrograph captured?	yes	yes	yes	yes	yes	yes	yes
Number of aliquots collected	34	17	36	26	32	32	18
Peak flow rate (cfs)	0.12	0.09	0.08	(a)	3.01	1.49	1.56
Peak hydrograph (date, time)	3/26/2017 3:35:00 PM	3/27/2017 12:45:00 AM	3/26/2017 4:50:00 PM	3/27/2017 3:30:00 AM	3/26/2017 3:30:00 PM	3/27/2017 12:15:00 AM	3/27/2017 4:05:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	2:05	11:15	3:20	14:00	2:00	10:45	14:35

(a) Flow meter reading high because of clogged bubbler tube.

(b) Grass caught on flow meter may have elevated flow readings.

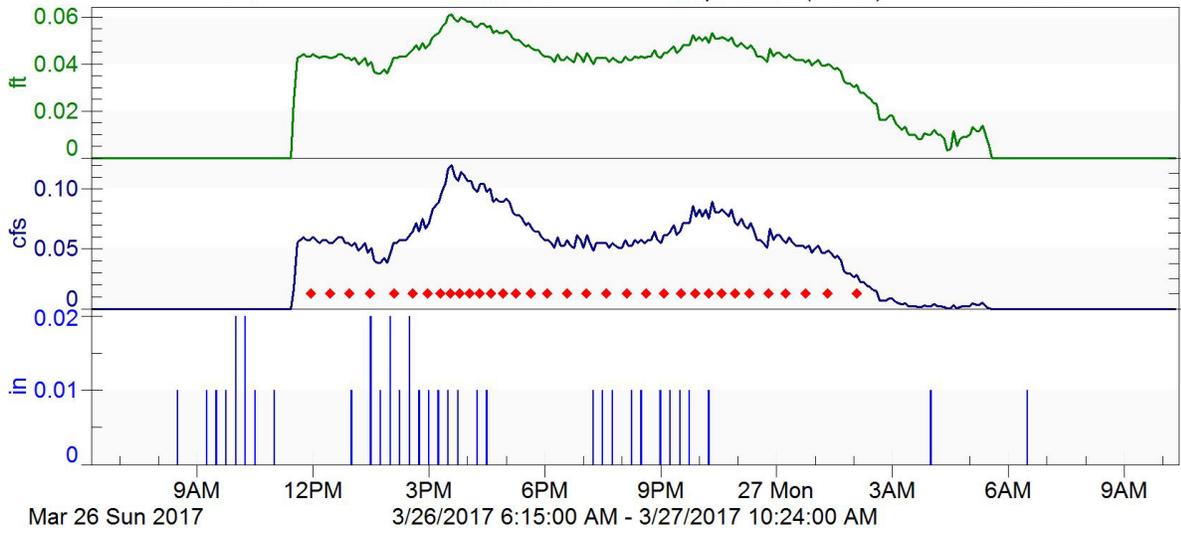


Figure 92. EBI, Storm 14.

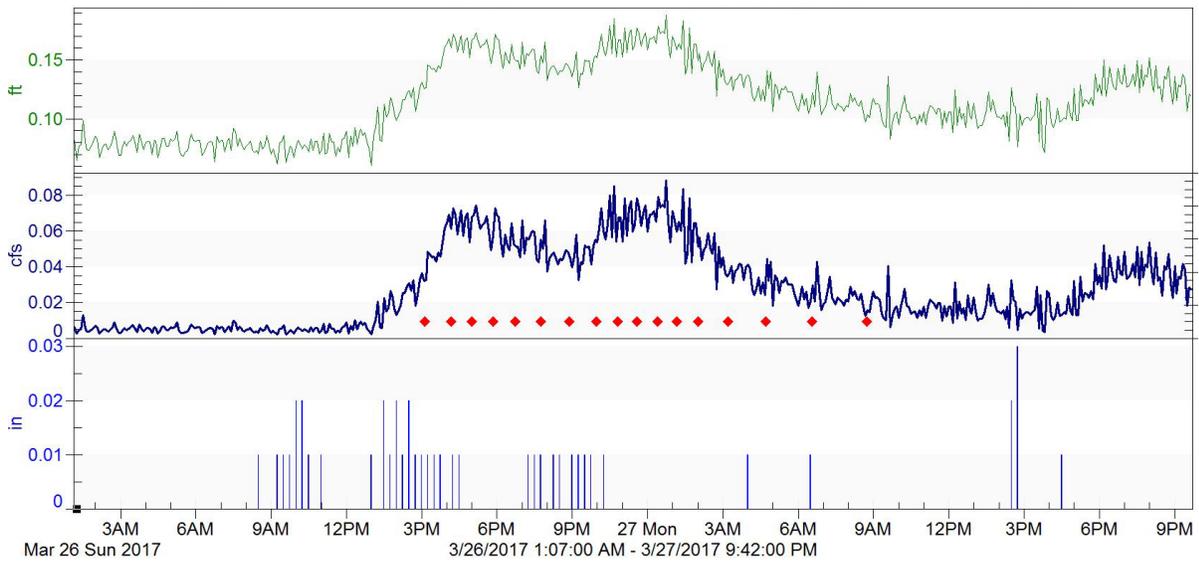


Figure 93. EBO, Storm 14.

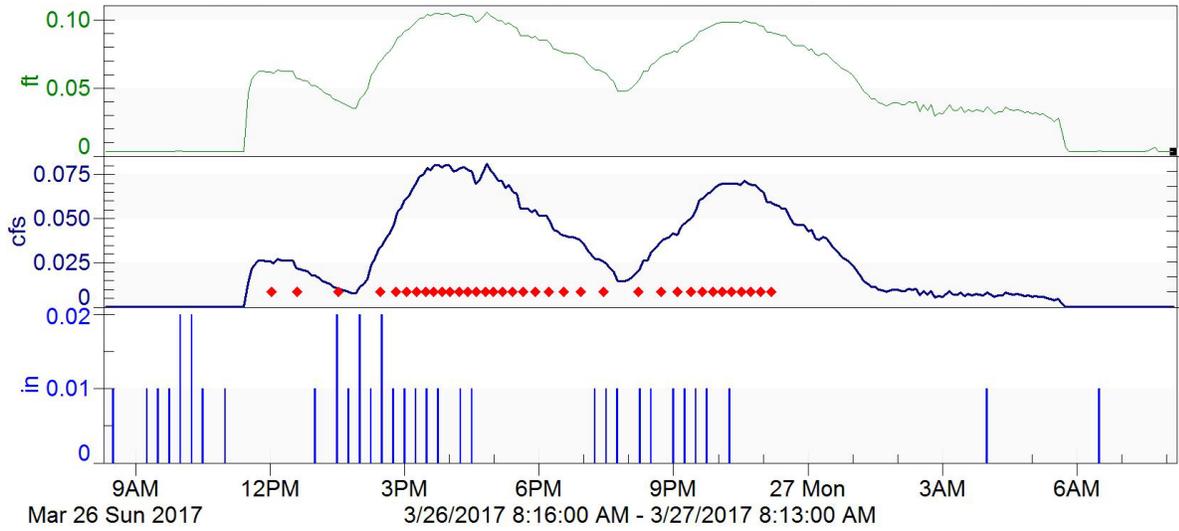


Figure 94. WBI, Storm 14.

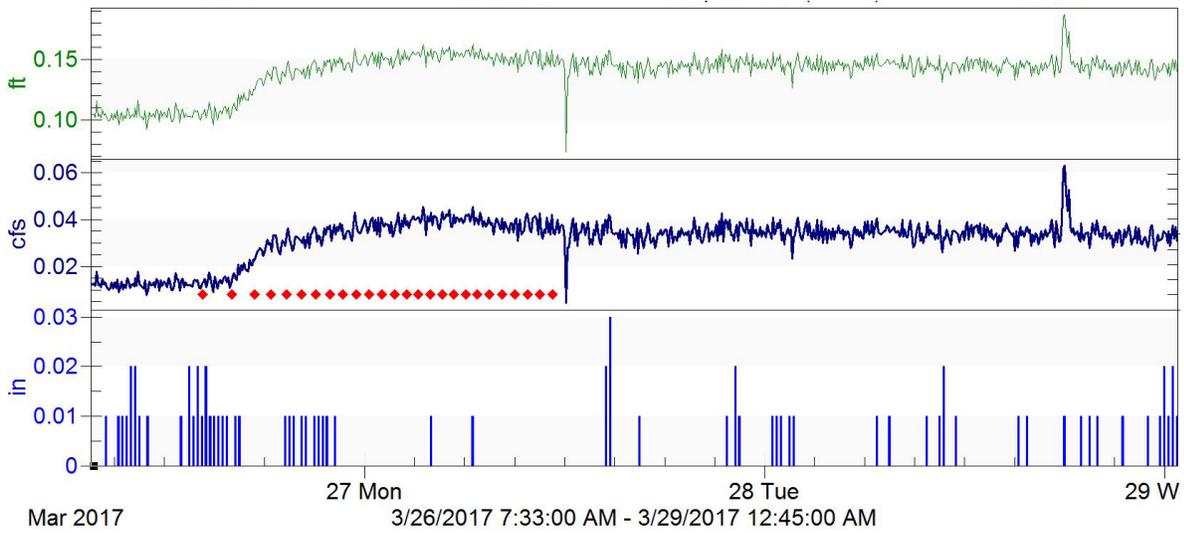


Figure 95. WBO, Storm 14.

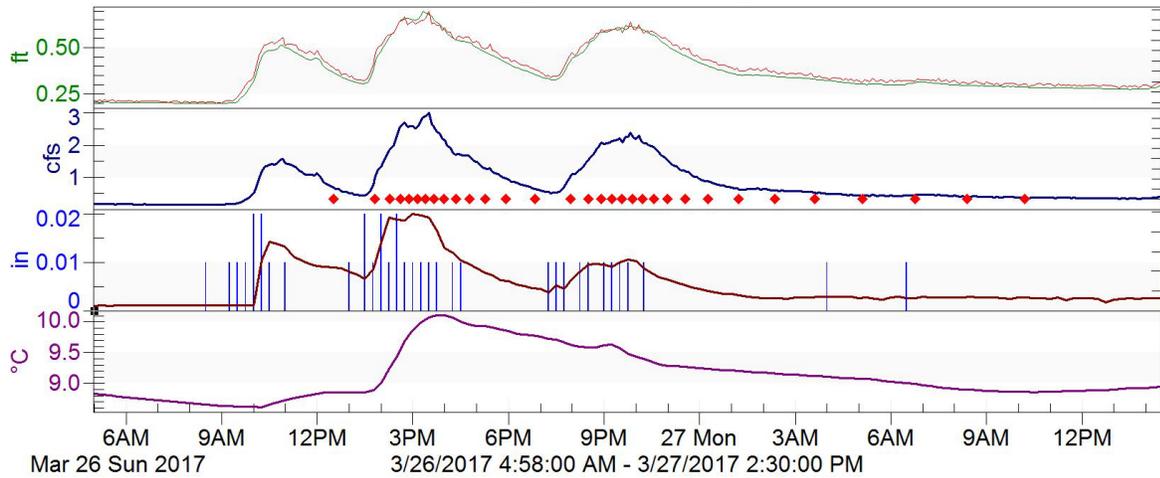


Figure 96. WCI, Storm 14.

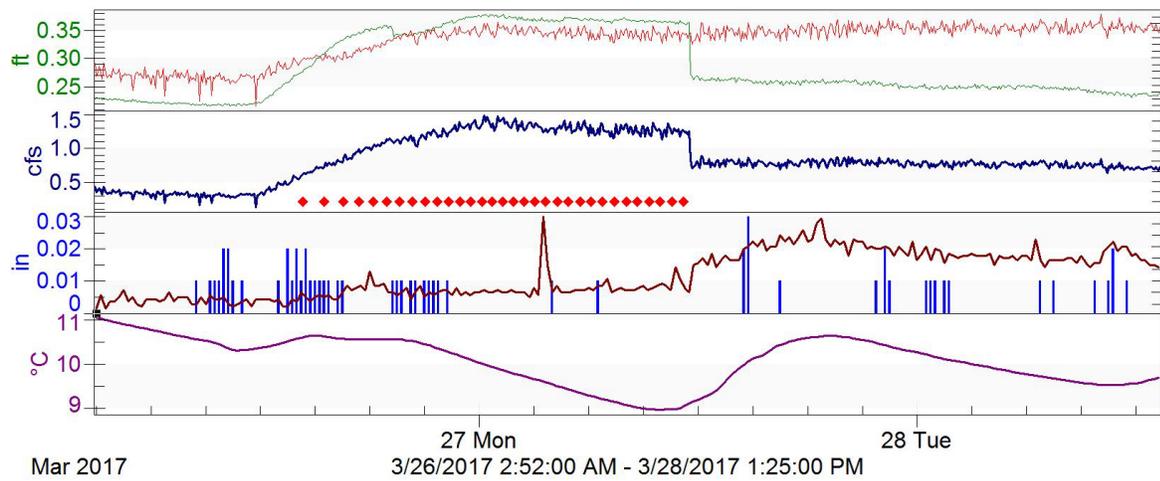


Figure 97. WCEBO, Storm 14.

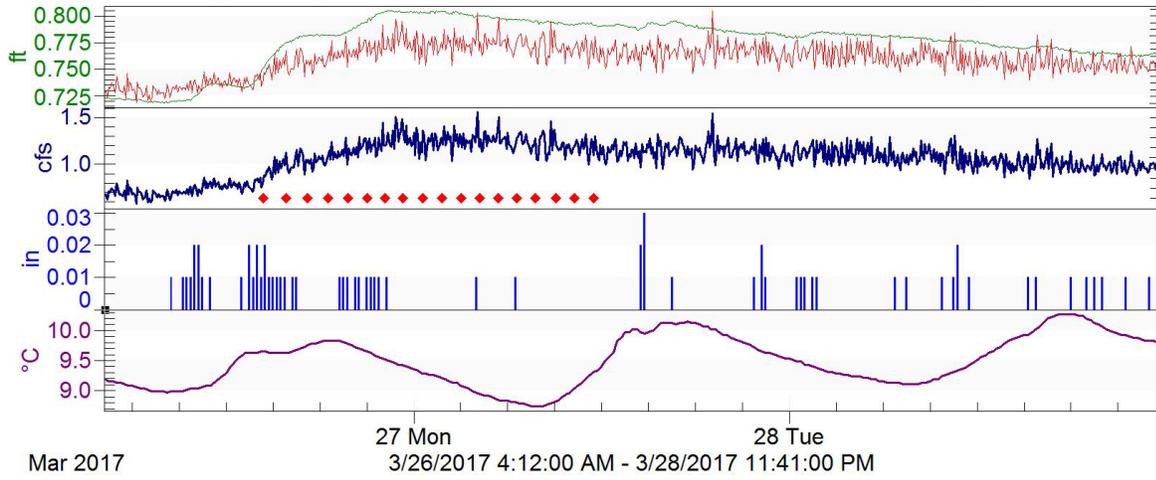


Figure 98. NFWHC, Storm 14.

Precipitation Information	Storm 15
	3/29/2017
Dry antecedent period (hr)	6.5
Rainfall in 4 days before storm (in)	0.72
Rainfall in 48 hours before storm (in)	0.36
Rainfall in 24 hours before storm (in)	0.18
Rainfall in 6 hours before storm (in)	0.02
Rainfall during storm (in)	0.6
Peak rainfall (date, time)	3/29/17 4:15 AM
Rainfall volume in bioretention basin (cf)	49222.8
Rainfall volume in wetland complex basin (cf)	426016.8

Sampling Information	Storm 15 - 3/29/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	14190	10380	6398	(a)	(b)	279216	381724
Start of flow (hhmm)	25	2340	30	(a)	(b)	100	2340
Average flow rate for entire storm (cfs)	0.237	0.061	0.106	(a)	(b)	0.933	1.258
Duration of flow (hr)	16.6	47.3	16.8	(a)	(b)	83.1	84.3
Runoff first 24 hrs of event (start at time of first sample) (cf)	14002	8924	6364	(a)	(b)	135587	157171
Runoff volume sampled (cf)	13601	8763	6325	(a)	(b)	116416	139248
% of runoff volume sampled	97.14	98.20	99.39	(a)	(b)	85.86	88.60
Average flow rate during sampling interval (cfs)	0.332	0.111	0.124	(a)	(b)	1.614	1.862
Peak of hydrograph captured?	yes	yes	yes	no	(b)	yes	yes
Number of aliquots collected	34	24	29	36	(b)	18	13
Peak flow rate (cfs)	0.6	0.33	0.24	(a)	7.17	2.08	2.48
Peak hydrograph (date, time)	3/29/2017 6:35:00 AM	3/29/2017 7:10:00 AM	3/29/2017 4:40:00 AM	3/29/2017 5:15:00 PM	3/29/2017 4:30:00 AM	3/29/2017 1:15:00 PM	3/29/2017 8:15:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	2:20	2:55	0:25	13:00	0:15	9:00	4:00

(a) Flow meter reading incorrectly high because of clogged bubbler tube.

(b) Autosampler malfunctioned after sampling event; data missing data from the end of event.

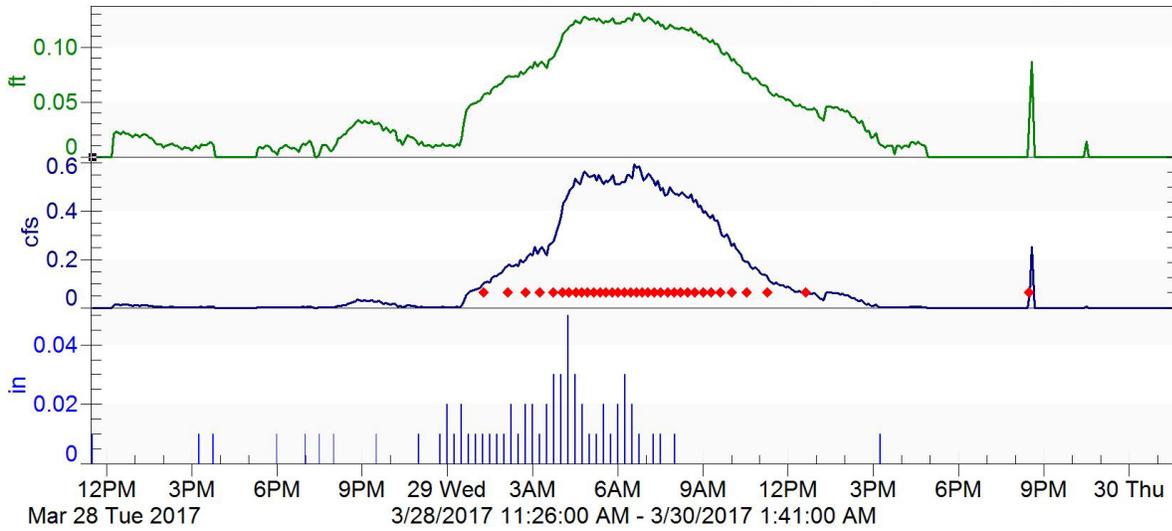


Figure 99. EBI, Storm 15.

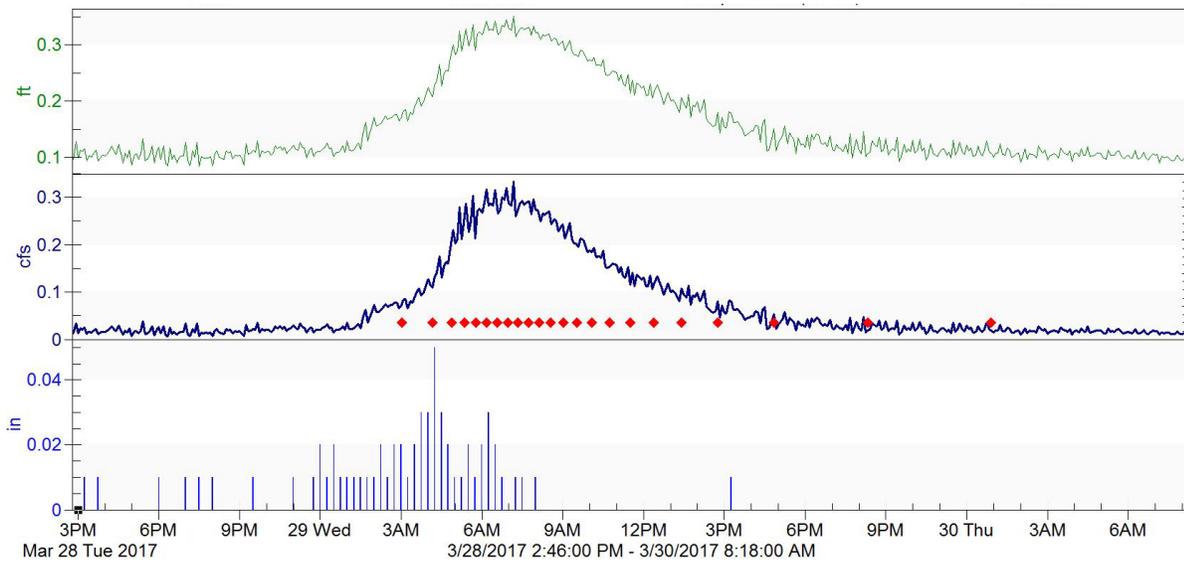


Figure 100. EBO, Storm 15.

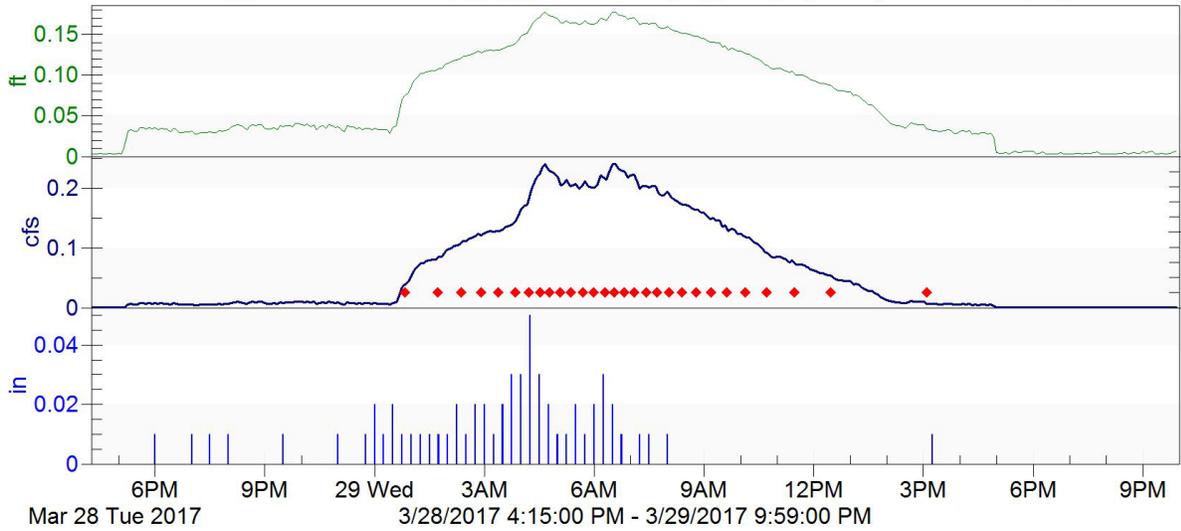


Figure 101. WBI, Storm 15.

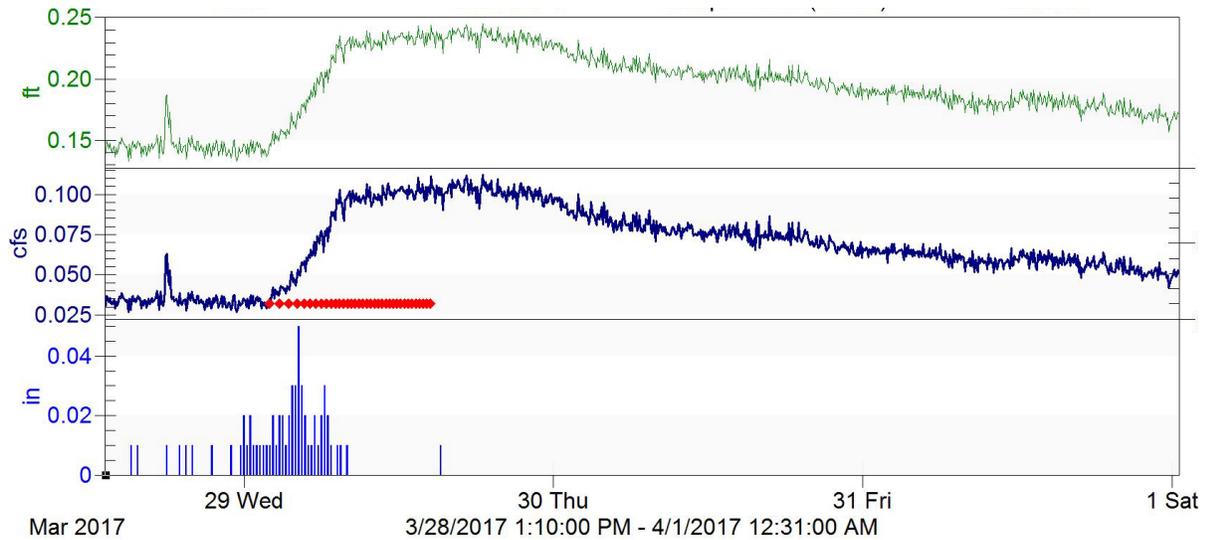


Figure 102. WBO, Storm 15.

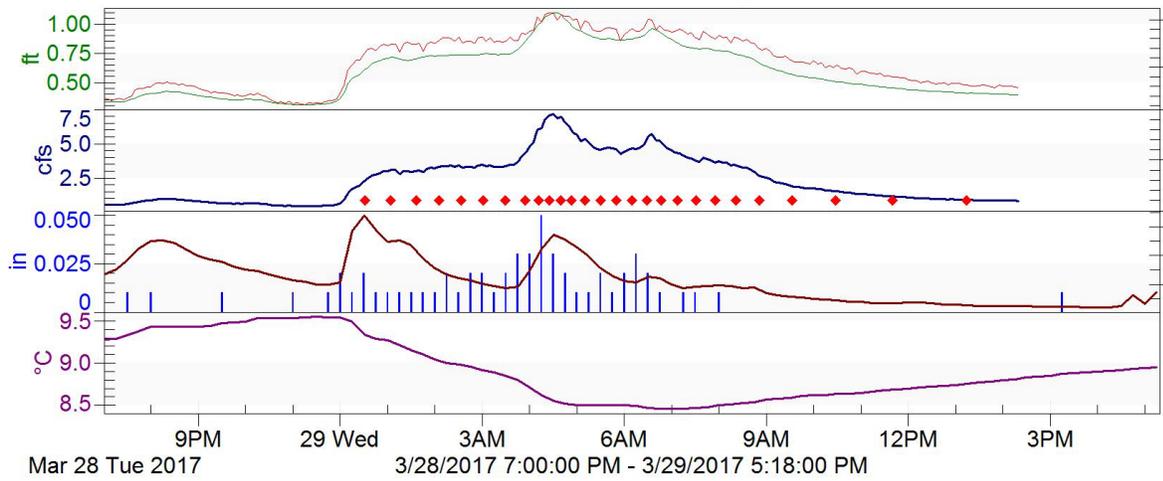


Figure 103. WCI, Storm 15.

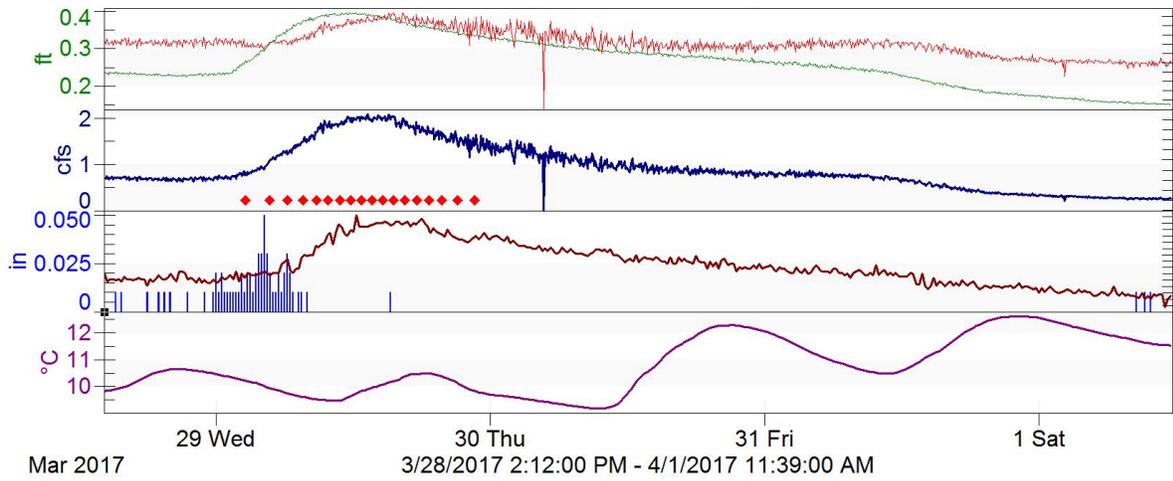


Figure 104. WCEBO, Storm 15.

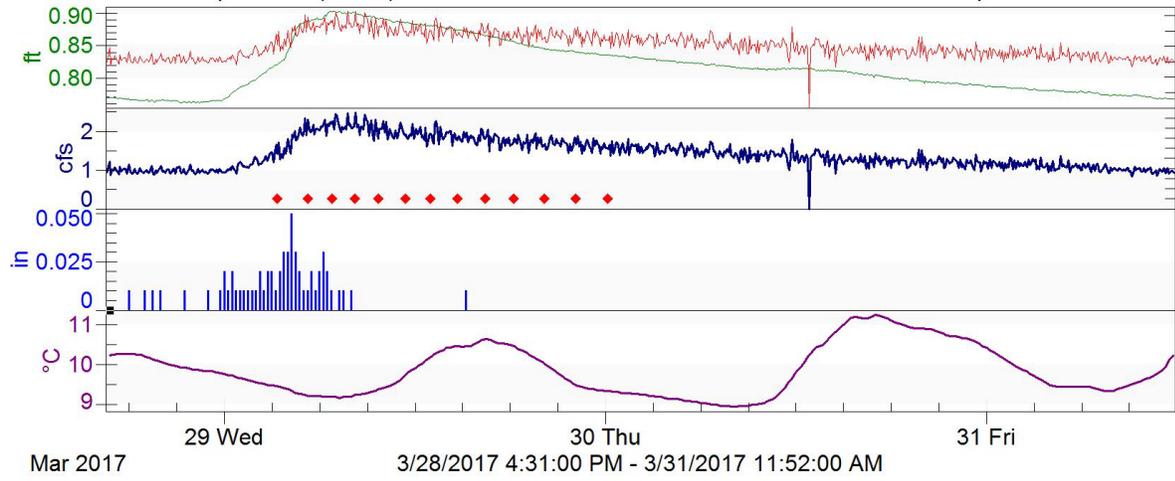


Figure 105. NFWHC, Storm 15.

Precipitation Information	Storm 16
	4/5/2017
Dry antecedent period (hr)	71.25
Rainfall in 4 days before storm (in)	0.17
Rainfall in 48 hours before storm (in)	0
Rainfall in 24 hours before storm (in)	0
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.64
Peak rainfall (date, time)	4/5/17 6:00 AM
Rainfall volume in bioretention basin (cf)	52504.32
Rainfall volume in wetland complex basin (cf)	454417.92

Sampling Information	Storm 16 - 4/5/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	5238	5799	4034	(a)	(b)	267937 (c)	374593 (c)
Start of flow (hhmm)	2245	110	2240	(a)	(b)	2050	1940
Average flow rate for entire storm (cfs)	0.064	0.051	0.048	(a)	(b)	0.751	1.069
Duration of flow (hr)	22.7	31.6	23.3	(a)	(b)	99.1	97.3
Runoff first 24 hrs of event (start at time of first sample) (cf)	4220	4896	3341	(a)	92290	92694	117402
Runoff volume sampled (cf)	3507	4696	1859	(a)	62177	84612	101809
% of runoff volume sampled	83.10	95.92	55.64	(a)	>50% (b)	91.28	86.72
Average flow rate during sampling interval (cfs)	0.105	0.061	0.09	(a)	2.096	1.092	1.363
Peak of hydrograph captured?	yes	yes	yes	yes	unclear	yes	yes
Number of aliquots collected	36	29	36	36	36	34	18
Peak flow rate (cfs)	0.14	0.13	0.1	(a)	(b)	1.43	1.74
Peak hydrograph (date, time)	4/5/2017 11:40:00 AM	4/5/2017 1:25:00 PM	4/5/2017 11:50:00 AM	4/5/2017 7:30:00 PM	(b)	4/5/2017 5:30:00 PM	4/5/2017 3:35:00 PM
Time difference: peak rain to peak hydrograph (hr:min)	5:40	7:25	5:50	13:30	(b)	11:30	9:35

(a) Flow meter reading incorrectly high because of clogged bubbler tube.

(b) Sampler malfunctioned prior to sampling event; missing flow data.

(c) Flow values include a second storm that occurred very soon after the first storm.

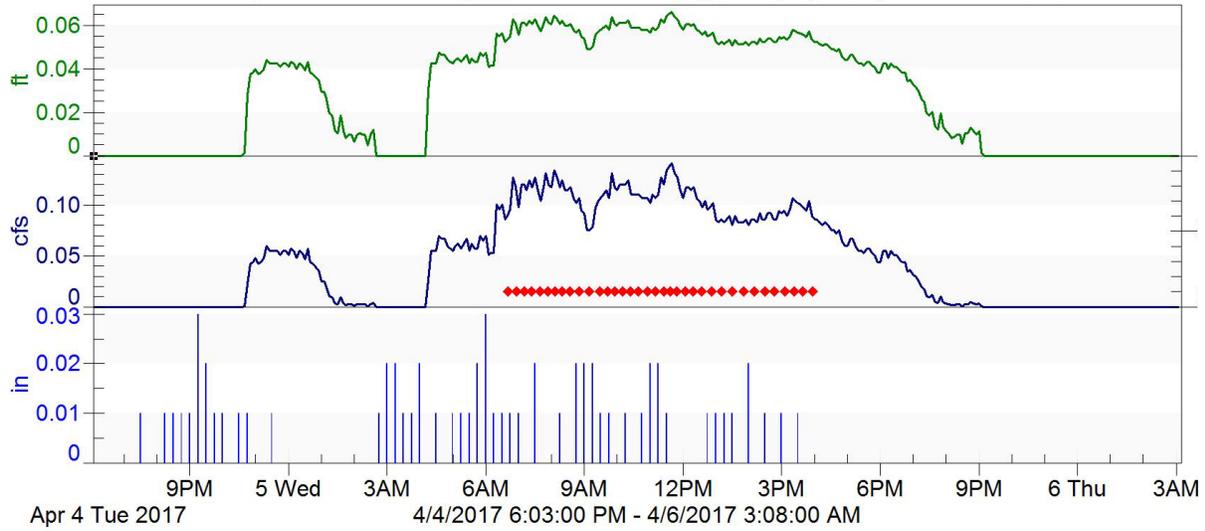


Figure 106. EBI, Storm 16.

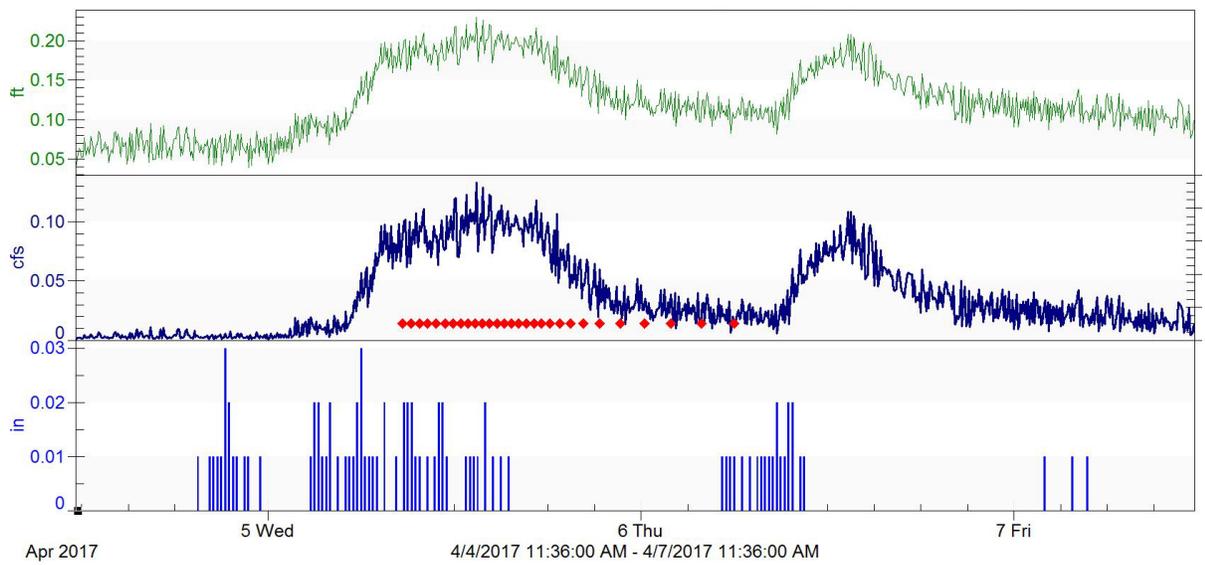


Figure 107. EBO, Storm 16.

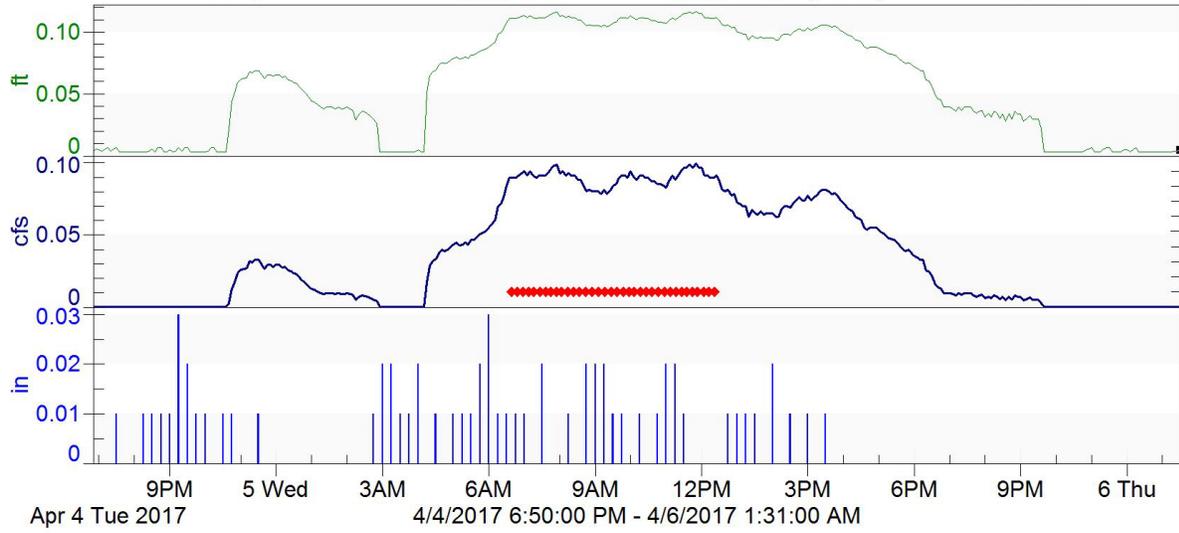


Figure 108. WBI, Storm 16.

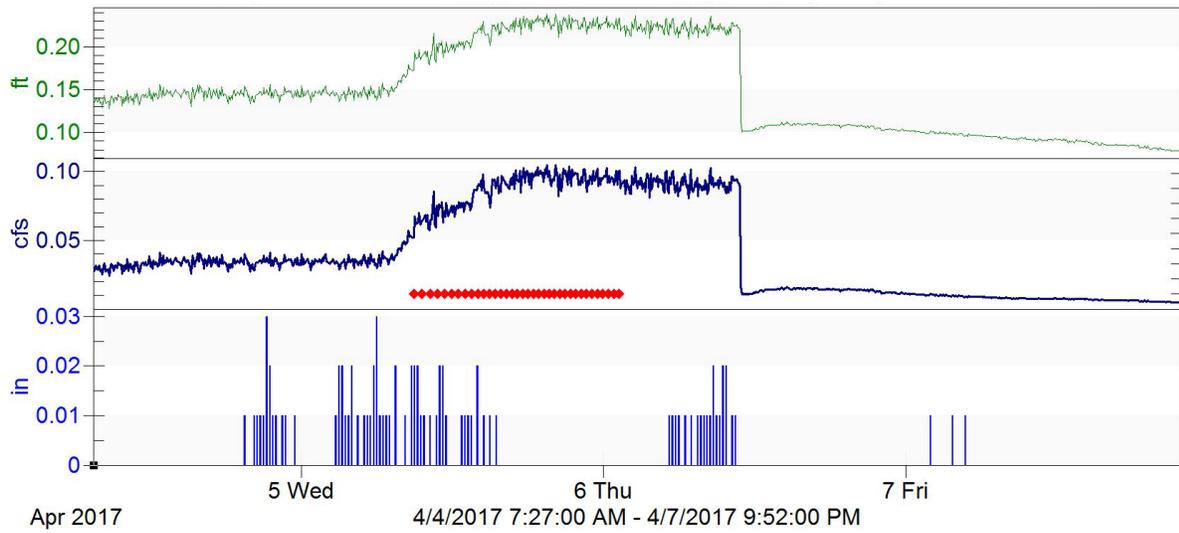


Figure 109. WBO, Storm 16.

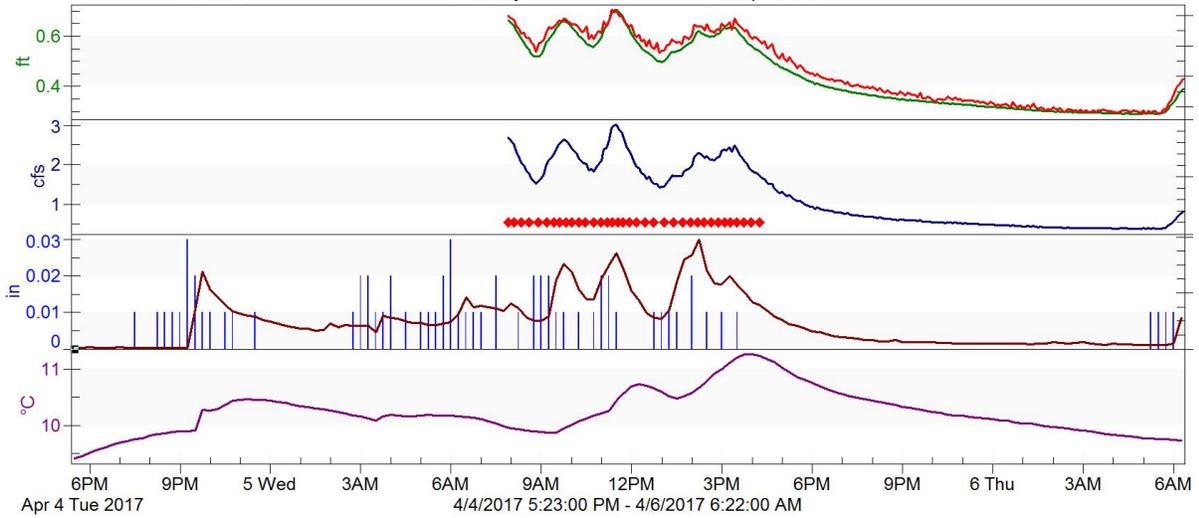


Figure 110. WCI, Storm 16.

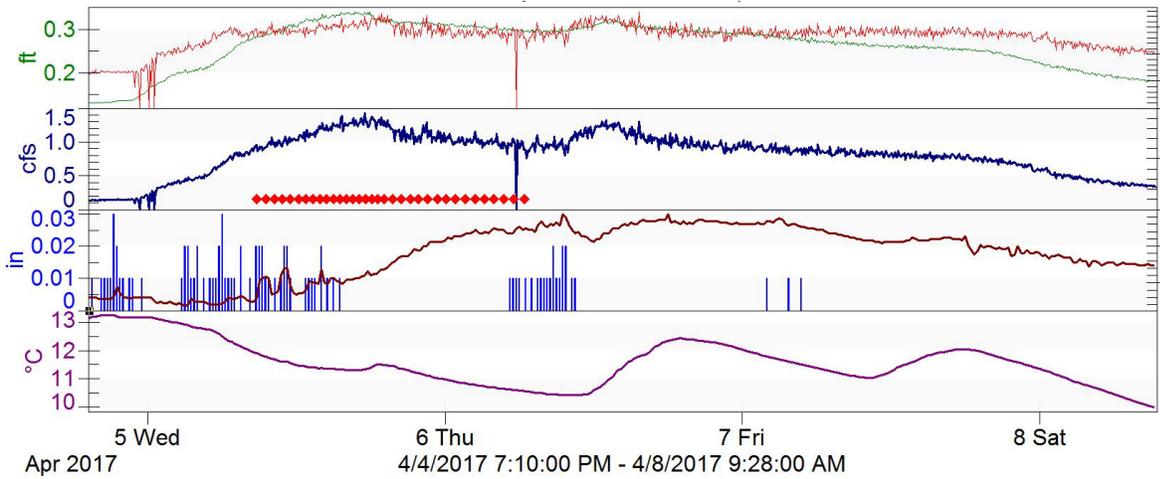


Figure 111. WCEBO, Storm 16.

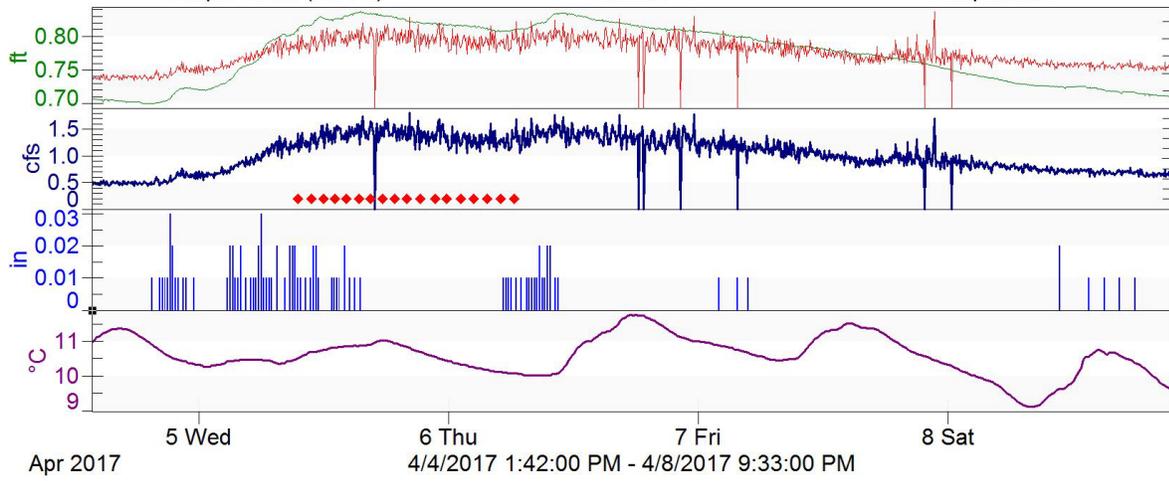


Figure 112. NFWHC, Storm 16.

Precipitation Information	Storm 17
	4/19/2017
Dry antecedent period (hr)	13.75
Rainfall in 4 days before storm (in)	0.4
Rainfall in 48 hours before storm (in)	0.4
Rainfall in 24 hours before storm (in)	0.15
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.4
Peak rainfall (date, time)	4/19/17 9:00 PM
Rainfall volume in bioretention basin (cf)	32815.2
Rainfall volume in wetland complex basin (cf)	284011.2

Sampling Information	Storm 17 - 4/19/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	7160	7896	4242	6450	139194	188477	300870
Start of flow (hhmm)	1240	1300	1240	2200	1025	1150	1130
Average flow rate for entire storm (cfs)	0.103	0.071	0.059	0.029	0.951	0.786	1.115
Duration of flow (hr)	19.3	30.9	20.0	61.8	40.7	66.6	75.0
Runoff first 24 hrs of event (start at time of first sample) (cf)	7024	7057	4160	2709	115425	94940	126451
Runoff volume sampled (cf)	4818	5677	2594	1380	103128	53139	72052
% of runoff volume sampled	68.59	80.44	62.36	50.94	89.35	55.97	56.98
Average flow rate during sampling interval (cfs)	0.115	0.106	0.061	0.026	1.638	1.029	1.378
Peak of hydrograph captured?	yes	yes	yes	yes	yes	yes	yes
Number of aliquots collected	36	27	36	33	36	17	21
Peak flow rate (cfs)	0.42	0.27	0.19	0.05	5.33	1.56	2.53
Peak hydrograph (date, time)	4/19/2017 11:50:00 PM	4/20/2017 12:40:00 AM	4/19/2017 11:50:00 PM	4/20/2017 6:15:00 AM	4/19/2017 10:15:00 PM	4/20/2017 5:20:00 AM	4/20/2017 12:40:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	2:50	3:40	2:50	9:15	1:15	8:20	3:40

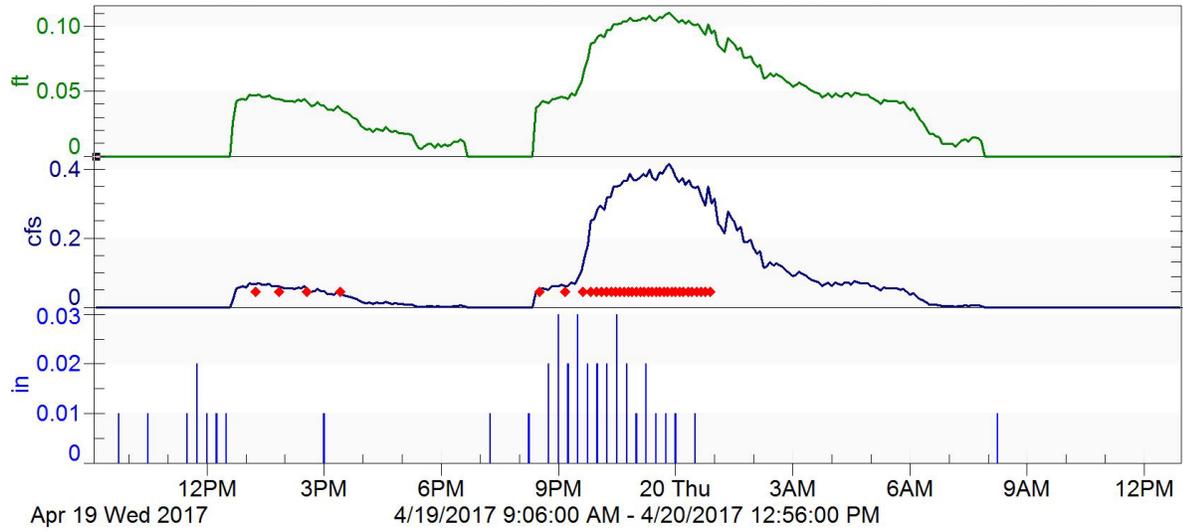


Figure 113. EBI, Storm 17.

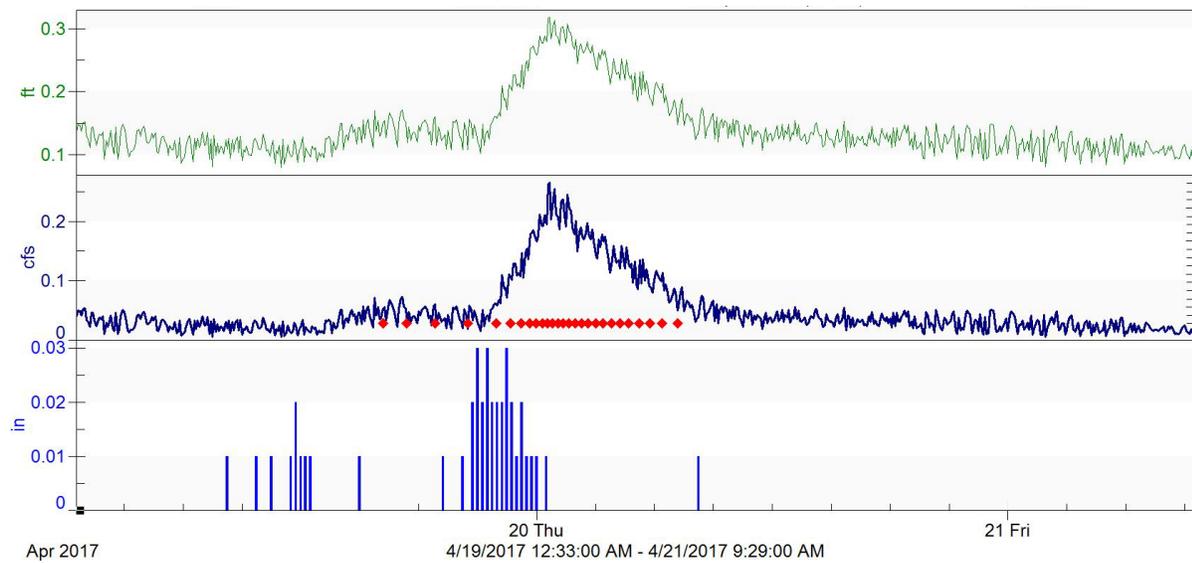


Figure 114. EBO, Storm 17.

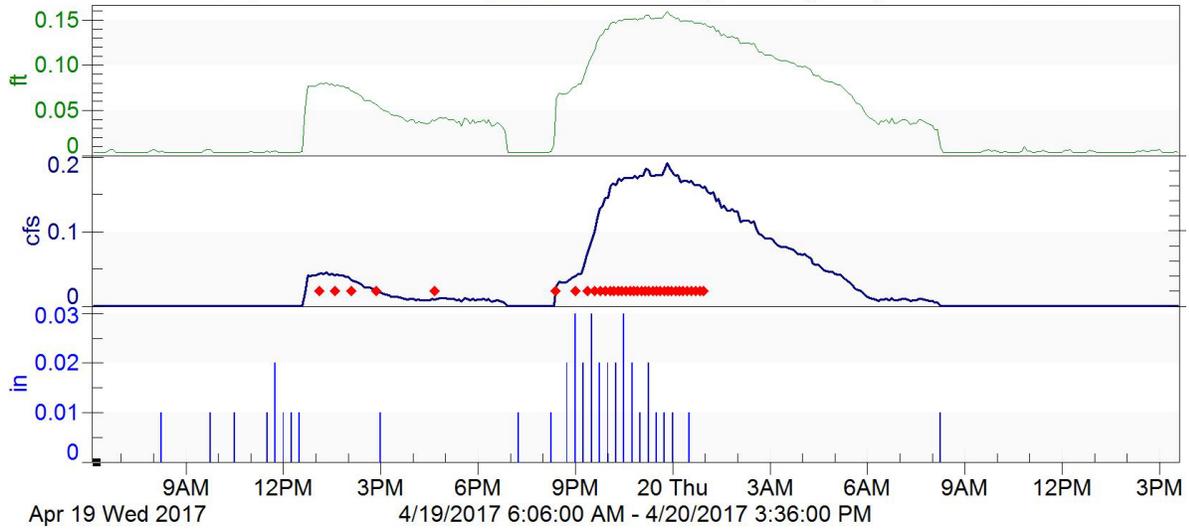


Figure 115. WBI, Storm 17.

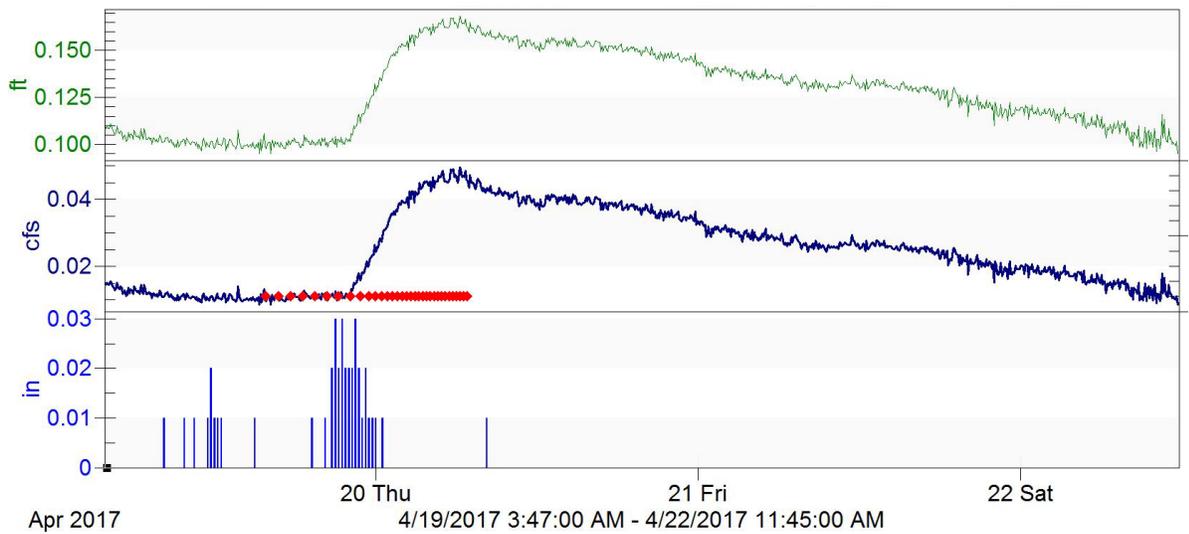


Figure 116. WBO, Storm 17.

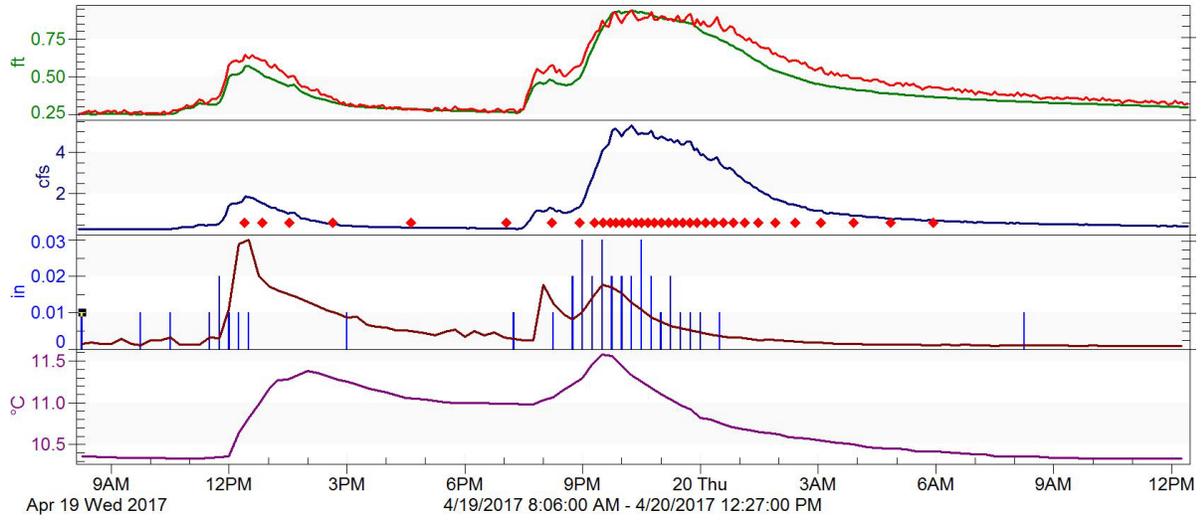


Figure 117. WCI, Storm 17.

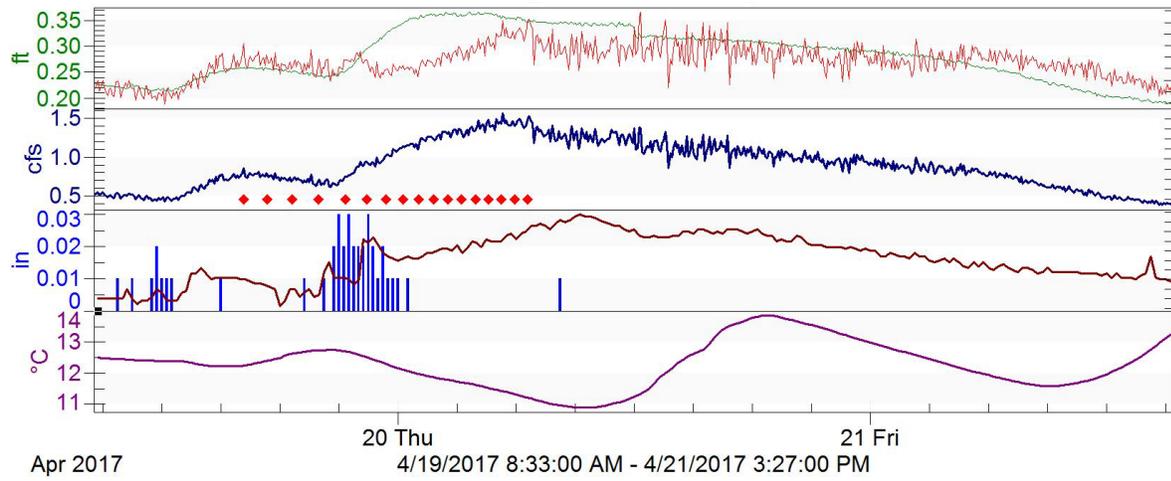


Figure 118. WCEBO, Storm 17.

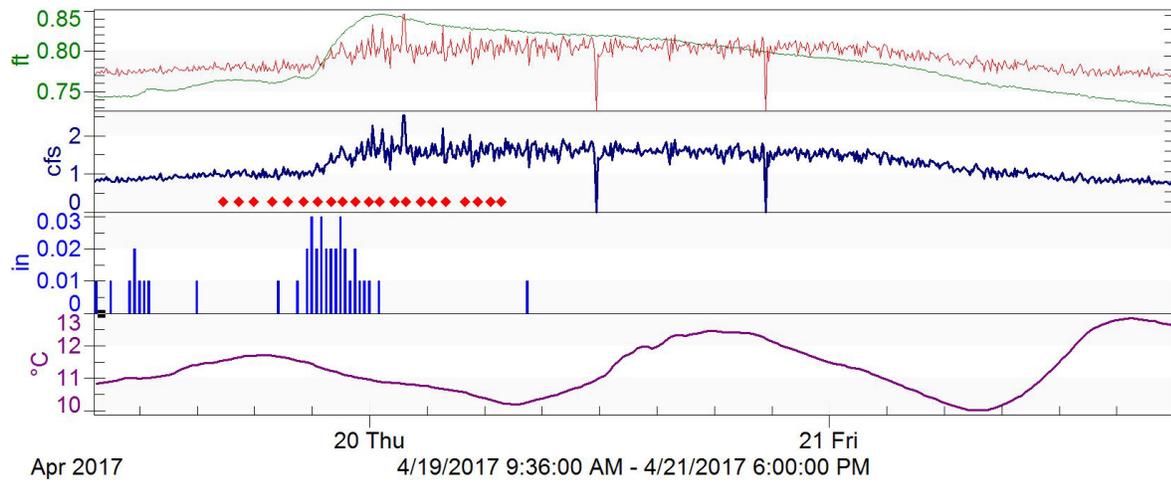


Figure 119. NFWHC, Storm 17.

Precipitation Information	Storm 18
	4/23/2017
Dry antecedent period (hr)	17.75
Rainfall in 4 days before storm (in)	0.46
Rainfall in 48 hours before storm (in)	0.08
Rainfall in 24 hours before storm (in)	0.08
Rainfall in 6 hours before storm (in)	0
Rainfall during storm (in)	0.5
Peak rainfall (date, time)	4/23/17 6:00 PM
Rainfall volume in bioretention basin (cf)	41019
Rainfall volume in wetland complex basin (cf)	355014

Sampling Information	Storm 18 - 4/23/2017						
	EBI	EBO	WBI	WBO	WCI	WCEBO	NFWHC
Total runoff volume for storm (cf)	4365	5047	2834	4756	113487	111810	199780
Start of flow (hhmm)	1550	1620	1550	1855	1310	1620	1400
Average flow rate for entire storm (cfs)	0.07	0.047	0.044	0.035	0.978	1.036	1.248
Duration of flow (hr)	17.3	29.8	17.9	37.7	32.2	30.0	44.5
Runoff first 24 hrs of event (start at time of first sample) (cf)	4138	4432	2711	3226	102154	100177	131859
Runoff volume sampled (cf)	4081	3714	2695	2287	96861	81701	99388
% of runoff volume sampled	98.62	83.80	99.41	70.89	94.82	81.56	75.37
Average flow rate during sampling interval (cfs)	0.082	0.061	0.048	0.038	1.333	1.289	1.607
Peak of hydrograph captured?	yes						
Number of aliquots collected	20	15	24	16	27	23	17
Peak flow rate (cfs)	0.32	0.13	0.161	0.04	8.15	1.77	2.17
Peak hydrograph (date, time)	4/23/2017 6:10:00 PM	4/23/2018 8:45:00 PM	4/23/2017 6:10:00 PM	4/24/2017 3:45:00 AM	4/23/2017 6:00:00 PM	4/24/2017 8:10:00 AM	4/24/2017 6:50:00 AM
Time difference: peak rain to peak hydrograph (hr:min)	0:10	2:45	0:10	9:45	0:00	14:10	12:50

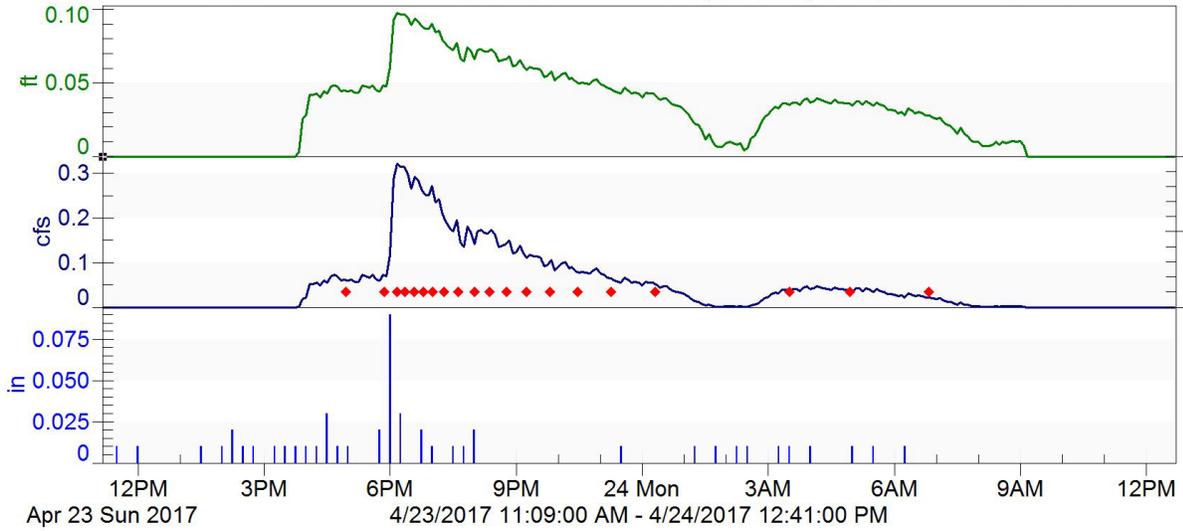


Figure 120. EBI, Storm 18.

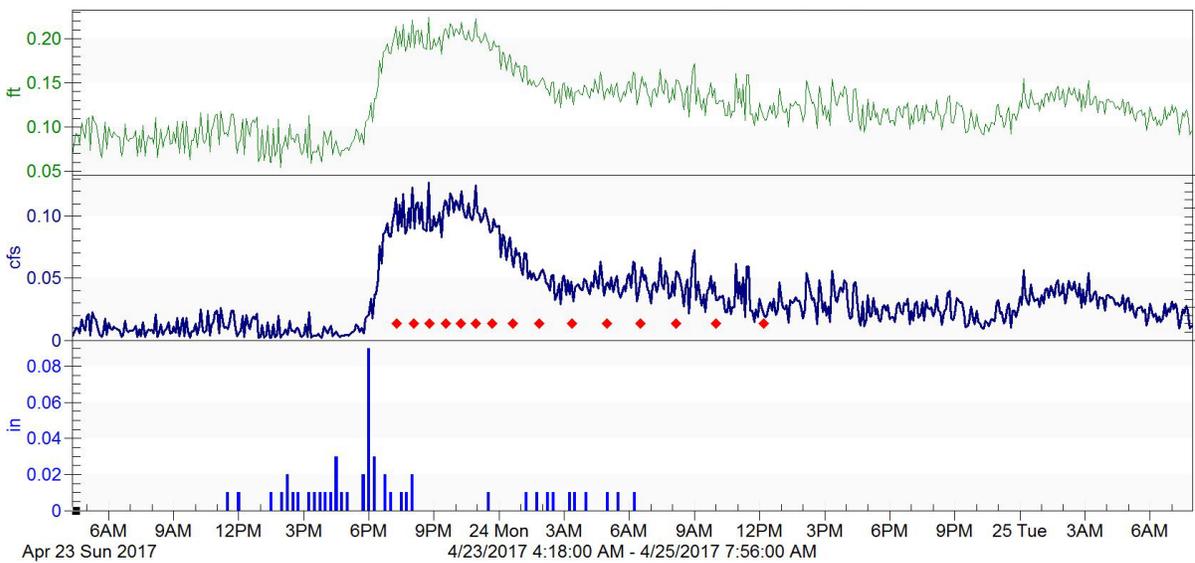


Figure 121. EBO, Storm 18.

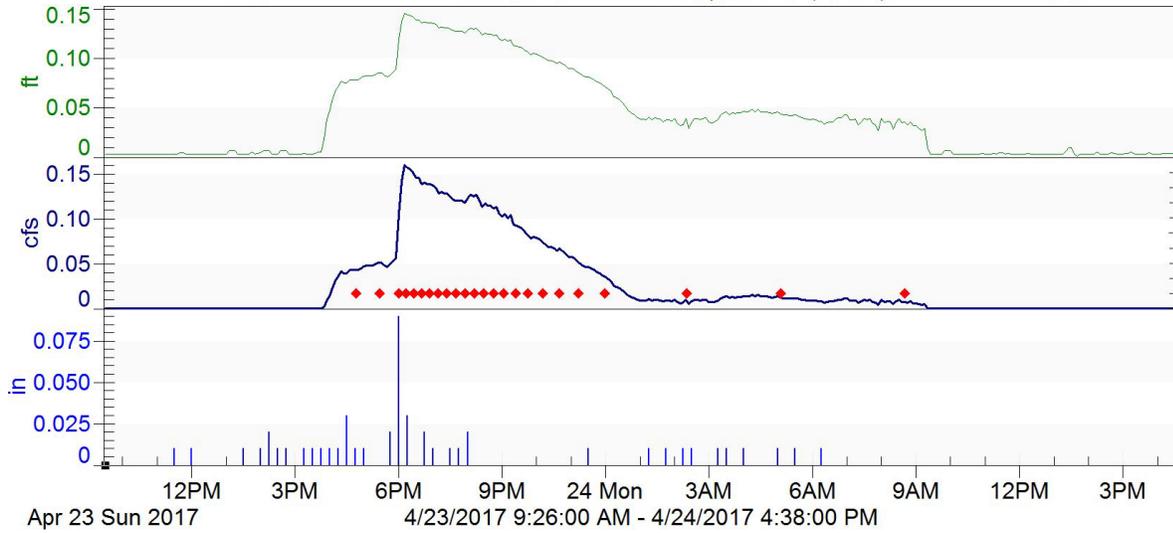


Figure 122. WBI, Storm 18.

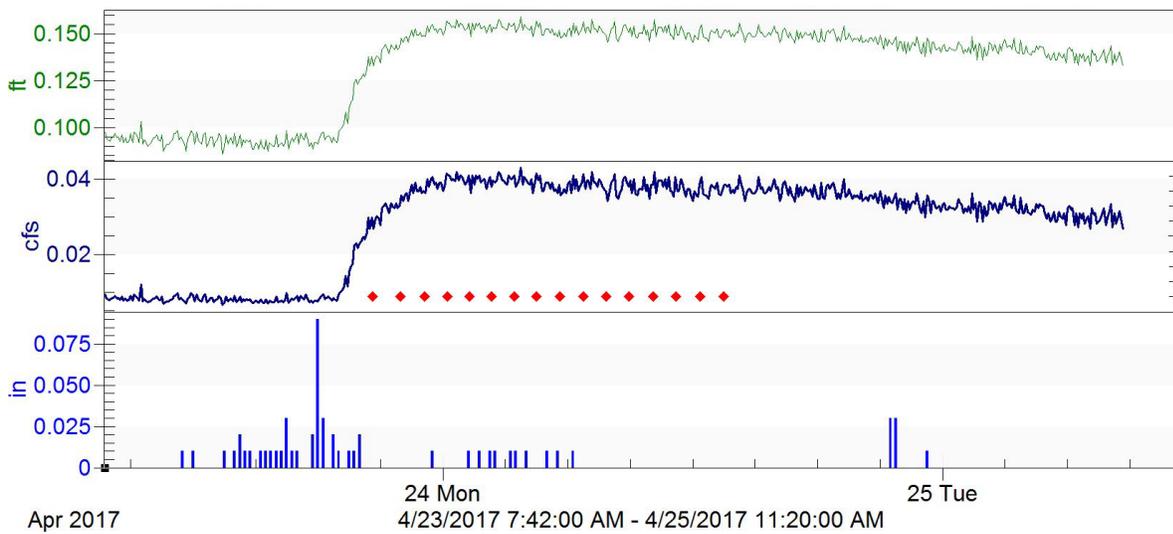


Figure 123. WBO, Storm 18.

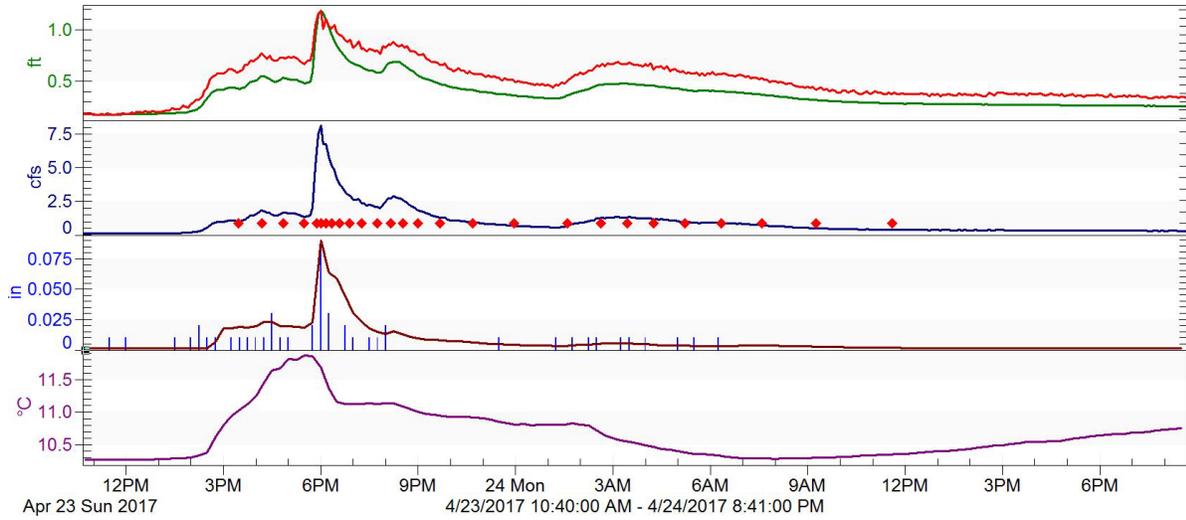


Figure 124. WCI, Storm 18.

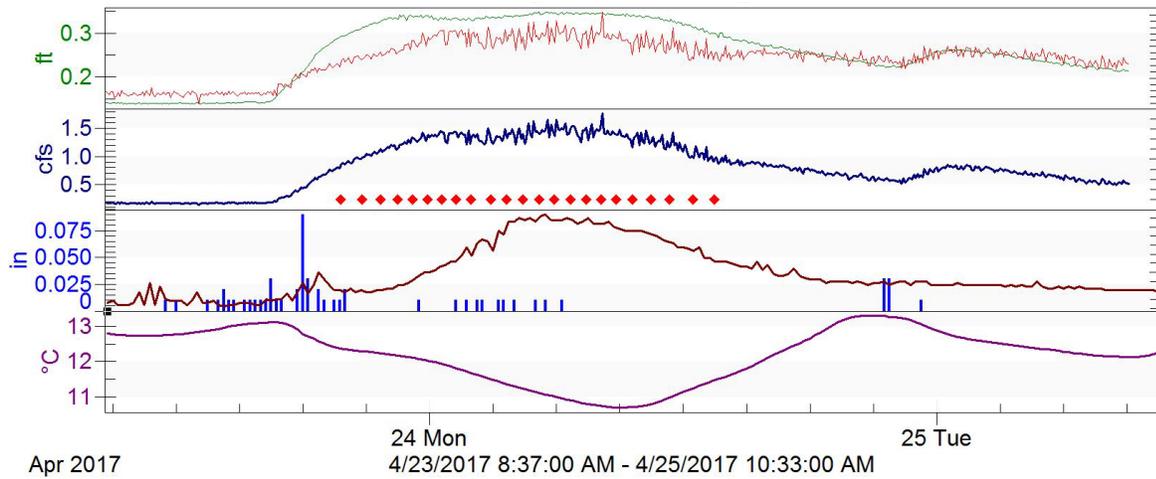


Figure 125. WCEBO, Storm 18.

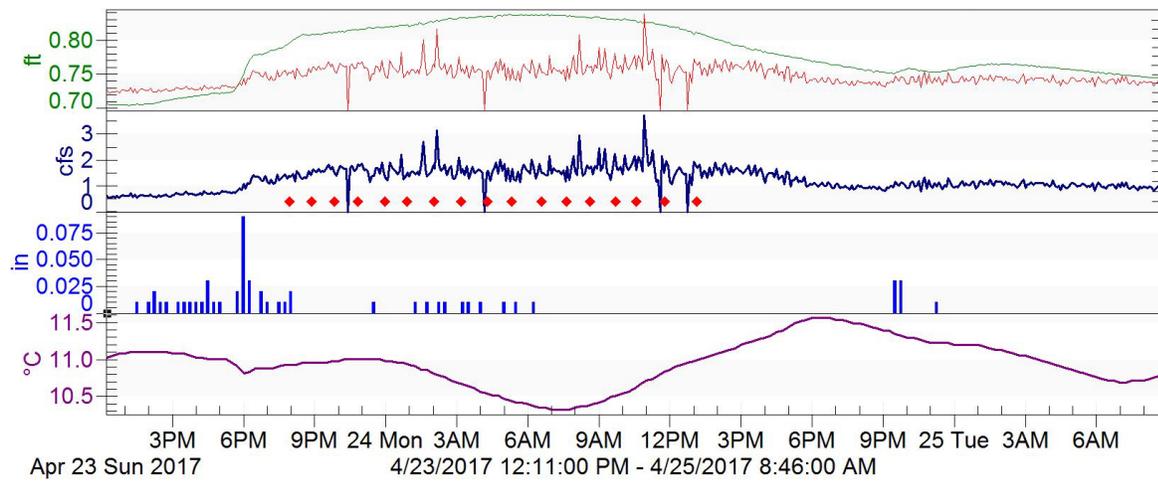


Figure 126. NFWHC, Storm 18.

Appendix I References

King County. 2016. Quality Assurance Project Plan Effectiveness Monitoring of the South 356th Street Retrofit and Expansion Project, Federal Way, WA. Prepared by Kate Macneale, Water and Land Resources Division. Seattle, Washington.