JANUARY 2020

TRAILER ESTATES
I&I Final Report

Prepared for:
Manatee County
1022 26th Avenue East
Bradenton, FL 34208

Prepared by:
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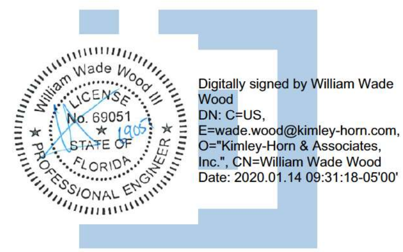

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Executive Summary

Kimley-Horn was assigned Trailer Estates Infiltration and Inflow (I&I) Study, due to findings during the "Trailer Estates Sanitary System Analysis" completed by Kimley-Horn in April 2019, which included the analysis of the sanitary sewer collection/transmission system within the Trailer Estates community. This I&I report will allow the County to quantify how much stormwater and/or groundwater is being treated within the sanitary sewer system and how much it costs to continue operating the system in its current condition. To quantify I&I Kimley-Horn subcontracted with ADS Environmental (ADS) to record flow data within 4 different manholes and rainfall data at one centralized and secure location. ADS uploads the collected data to Flowview, an online database, and Sliicer, an I&I analysis tool, after insuring the accuracy of the collected data. This Report encompasses data collected from May 10th, 2019 to October 30th, 2019.

From May 10th to October 30th, 2019 a total of 41.90 inches of rainfall was recorded from 25 identified rain events. These 25 rainfall events influenced flows within the Trailer Estates sewer system, indicating that I&I is an issue throughout Trailer Estates. Groundwater infiltration (GWI) was also observed, which is most obvious during night time flow observations when in theory minimal flows should be observed. For this system, GWI is expected to be attributed to the proximity to the bay causing high groundwater levels keeping the sewer pipes submerged throughout the wet season.

Data was collected from 4 flow meters placed in manholes throughout Trailer Estates. These 4 flow meters divide Trailer Estates into 4 sub-basins. **Table E-1**:Total **Inflow and Infiltration** below shows the volume of I&I recorded within each sub-basin during the collection period, May 10th to October 30th, and how much it is estimated to have cost treating that additional flow.

Table E-1:Total Inflow and Infiltration

Sub-Basin	Inflow and Infiltration Volume (MG)	Cost of Treatment* ($)
16539	6.001	$30,005.00
17795	7.886	$39,430.00
17797	12.652	$63,260.00
24364	3.677	$18,385.00
TOTAL	**30.216**	**$151,080.00**

**Treatment cost per million gallons is estimated from the EPA's Quick Guide For Estimating Infiltration and Inflow, and does not include O&M cost to deliver said flows to the wastewater treatment plant*

Analysis of the data during the reporting period revealed that Sub-Basin 17795 has the highest peaking factor correlating to a higher volume of rainfall derived I&I in the system. Whereas Sub-Basin 17797 has the highest amount of recorded I&I due to groundwater infiltration and Sub-Basin 16539 has significant I&I issues. Sub-Basin 24364 is affected by I&I, but serves a much smaller portion of Trailer Estates causing the area to be less impactful to the added flows to MLS 12A.

This I&I study aids as proof that Manatee County should implement sanitary sewer improvements to increase the reliability, reduce I&I, and eliminate the need for continuous rehabilitation efforts. Current rates of I&I will increase overtime due aging infrastructure, costing the County more in repairs and treatment than needed. Utilizing the cost for May through October, it can be projected that the County spends approximately **$321,446.80** annually due to the I&I occurring in Trailer Estates.

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Definitions

Drainage Basin – an area that is delineated by topography in which all stormwater drains to the same outfall

Sewer Basin – a section of a sewer system that flows to a common lift station

Sub-Basin – a section of a sewer system that flows to a common manhole

Dry-weather Flow – sanitary sewer flow that is uninfluenced by inflow and infiltration

GWI - groundwater infiltration; infiltration into a sewer system as a result of the water table level

Infiltration – entry of stormwater into a sewer system from saturated soil or high water table causing leaking underground through cracked pipes and laterals, pipe joints, or manhole chimneys

Inflow – the direct entry of stormwater into a sewer system through means such as broken manhole lids, combined systems, open clean outs, etc.

RDII – rainfall derived inflow and infiltration; defined as the difference between dry-weather flow and wet-weather flow

Rainfall Intensity – the amount of rainfall that occurs over a defined duration of time

Introduction and Background

Trailer Estates is a mobile/modular home community developed in the early 1930s to the west of US Highway 41 in the Southwest area of Manatee County. The sanitary sewer service area in this community is primarily serving residential homes, including some connections from the commercial properties along the US Highway 41 corridor. Trailer Estates sanitary sewer system includes approximately 51,790 linear feet (9.81 miles) of gravity sewer pipe, 242 manholes, 4 County owned lift stations and 3 private lift stations. This Report encompasses I&I data collected from May 10th, 2019 to October 30th, 2019.

To evaluate the amount of I&I within the Trailer Estates sewer system, flow monitoring and analysis of the collected data is required. The Trailer Estates Flow Monitoring Plan was submitted to the County on July 2nd, 2019 to establish how and where the data was collected within Trailer Estates. The County's GIS database in combination with as-builts, sewer sub-basins were established within Trailer Estates. From Kimley-Horn's evaluation, 4 manhole locations were selected for flow monitoring sites forming 4 sub-basins, see **Figure 1** below. All sanitary sewer flow from Trailer Estates flows to Master Lift Station 12A (MLS 12A) and is ultimately pumped to the Southwest Water Reclamation Facility (SWWRF) for treatment. Flow meters were positioned to capture as much of the Trailer Estates flow as possible based on the system's layout. The rain gauge and groundwater level monitoring device were positioned to be in a central and secure location, MLS 12A.

Flow monitoring took place for a period of 6 months, May 2019 through October 2019 . This time period allowed for the establishment of dry weather flow in both May and October and monitor the wet season June through September. The Trailer Estates I&I Interim Report was then prepared following the first 6 observed rainfall events to provide the County with an update of the findings and provide the County an opportunity to make any comments before the final report. No comments regarding the approach was made, monitoring continued through the end of October. This Final report captures the data results between May 10th and October 30th and discusses the County's next steps to repair the system.

Figure 1: Trailer Estates System Overview

Data Analysis

In this Report, flow, rainfall and groundwater data was analyzed from May 10th through October 30th, 2019 respectively from 4 flow meters, 1 rain gauge, and 1 piezometer. To analyze the collected groundwater, rainfall, and flow data, Kimley-Horn is utilizing Sliicer, a software tool developed by ADS to analyze the collected data and create graphs displaying I&I within Trailer Estates. The graphs included in this report are weekday and weekend dry weather flows (DWF) at each meter location, rain event hydrographs at each gauge in relation to rain, estimated I&I volumes during each event and groundwater levels in relation to rain.

Dry Weather Flow

To account for the different water use patterns between weekdays and weekend days, Kimley-Horn utilized Sliicer to divide the average DWF into two separate hydrographs. This ensures that flow variations between weekdays and weekends is accounted for in the flow component. DWF was calculated by selecting multiple weekday and weekend days within Sliicer, DWF days are defined as days without rain on that day or 72 hours before. These days were averaged together to produce a typical 24-hour DWF condition. Each sub-basin was calculated independently of one another within Sliicer, meaning that dry days selected will vary between each site depending on flow consistency. It should be noted that DWF in this community is similar on both weekdays and weekends.

Table 1 below identifies the established net minimum and peak DWF for each sub-basin in this collection period. The DWF shown in the sections below establish a base flow to compare how the sewer system flows differ in the Trailer Estates system during rainfall events.

Table 1:Net Minimum and Maximum DWF

Sub-Basin	Flow Meter ID	Net Minimum DWF (MGD)	Net Peak DWF (MGD)
16539	MH – 16539	0.026	0.050
17795	MH – 17795	0.028	0.059
17797	MH – 17797	0.046	0.065
24364	MH – 24364	0.017	0.030

Rainfall

During the collection period, twenty-five (25) rainfall events were recorded ranging from approximately 0.56 inches to 4.62 inches of rain. Each rain events exceeded 0.5 inches, and are considered significant enough to analyze I&I in the gravity sewer system. **Table 2** below demonstrates the total rainfall amount and maximum intensity during each recorded rain event.

Table 2: Recorded Rainfall Events

Gauge	Date of Event	Rainfall Amount (In)	Max Rainfall Intensity (In/hr)
RG - 01	05/10/2019	1.37	0.97
RG - 01	05/13/2019	0.70	0.65
RG - 01	06/09/2019	1.36	1.03
RG - 01	06/13/2019	1.84	1.66
RG - 01	06/15/2019	0.61	0.34
RG - 01	06/18/2019	0.76	0.20
RG - 01	6/28/2019	1.41	0.79
RG - 01	7/8/2019	1.12	0.62
RG - 01	7/9/2019	2.8	1.04
RG - 01	7/17/2019	1.21	0.9
RG - 01	7/20/2019	2.29	1.52
RG - 01	7/24/2019	3.64	1.36
RG - 01	7/31/2019	0.89	0.67
RG - 01	8/1/2019	1.69	1.22
RG - 01	8/6/2019	1.43	0.5
RG - 01	8/10/2019	0.91	0.3
RG - 01	8/12/2019	1.9	0.93
RG - 01	8/14/2019	2.38	0.99
RG - 01	8/16/2019	4.62	1.46
RG - 01	8/17/2019	1.72	0.85
RG - 01	8/20/2019	1.28	0.69
RG - 01	9/9/2019	0.83	0.82
RG - 01	9/18/2019	0.9	0.75
RG - 01	10/9/2019	0.56	0.39
RG - 01	10/18/2019	3.71	0.97

Groundwater

To analyze groundwater infiltration (GWI), groundwater levels are monitored with a piezometer in a centralized location (MLS 12A) throughout the study period. Due to Trailer Estates' proximity to the bay, nighttime flow rates are likely solely attributed to groundwater infiltration caused by the high groundwater elevations that keep the pipes completely submerged. GWI is calculated within Sliicer utilizing a method based on DWF occurring between 12am to 6am, about 12% of the overall DWF. This method is similar to EPA's Guide to Estimating I&I that takes the total DWF occurring between 12am and 6am. From May 10th to October 30th, 2019 the groundwater elevation increased until August and began decreasing into October when dry season is expected to return and less rainfall events are occurring, see **Figure 2** below for the increasing then decreasing trend.

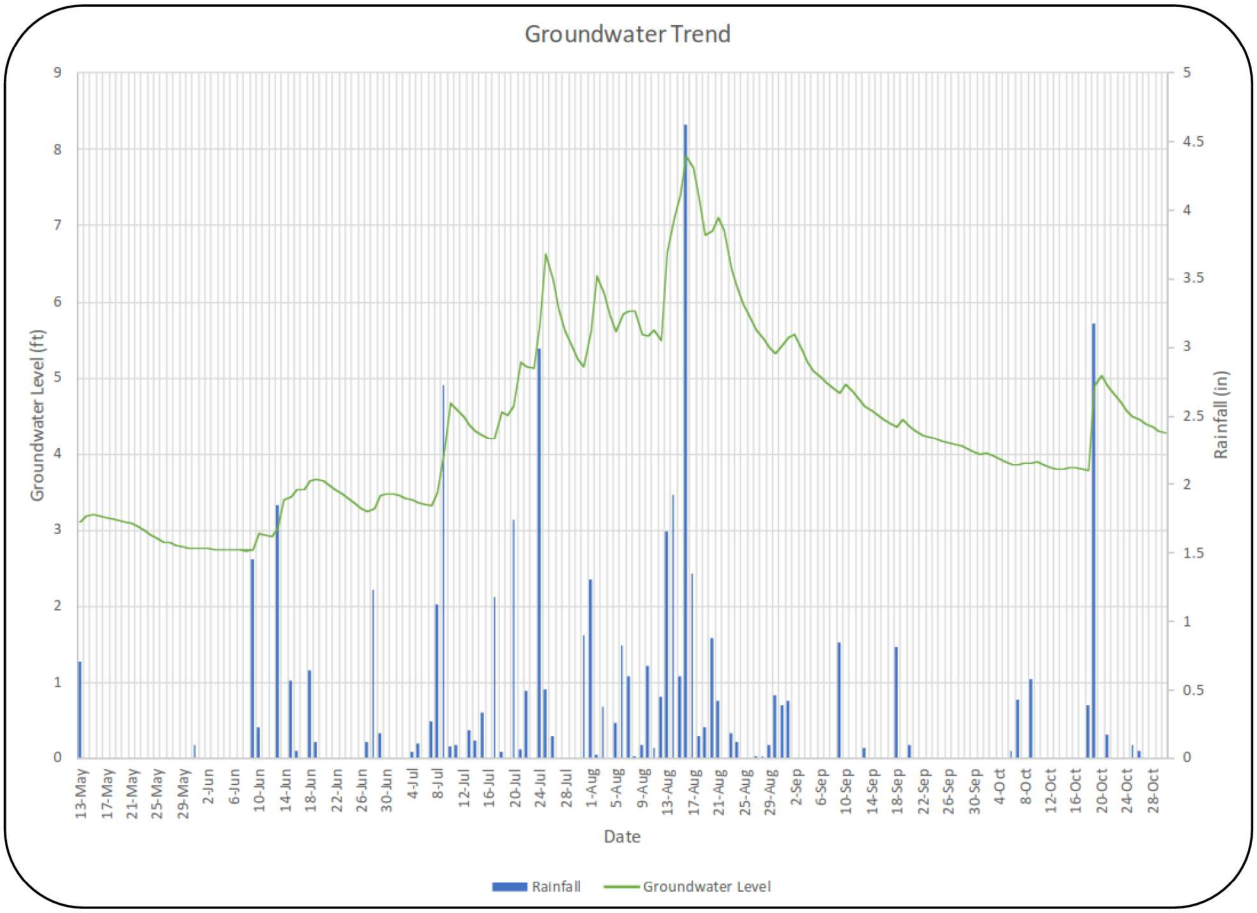

Figure 2: Groundwater Trend with Rainfall

Sub-Basin 16539

Flow Meter MH - 16539 is in the Trailer Estates Community Center parking lot, east of MLS 12A. Manhole 16539, where this flow meter is installed, receives all sanitary sewer flow from the southeast area of Trailer Estates. This sub-basin includes approximately 11,826 linear feet of gravity sewer that contributes to flows from Trailer Estates, that is ultimately pumped to the SWWRF for treatment. The flow meter's DWF and site statistics have been updated from the Interim Report and are shown in **Figure 4** and **Table 3** below.

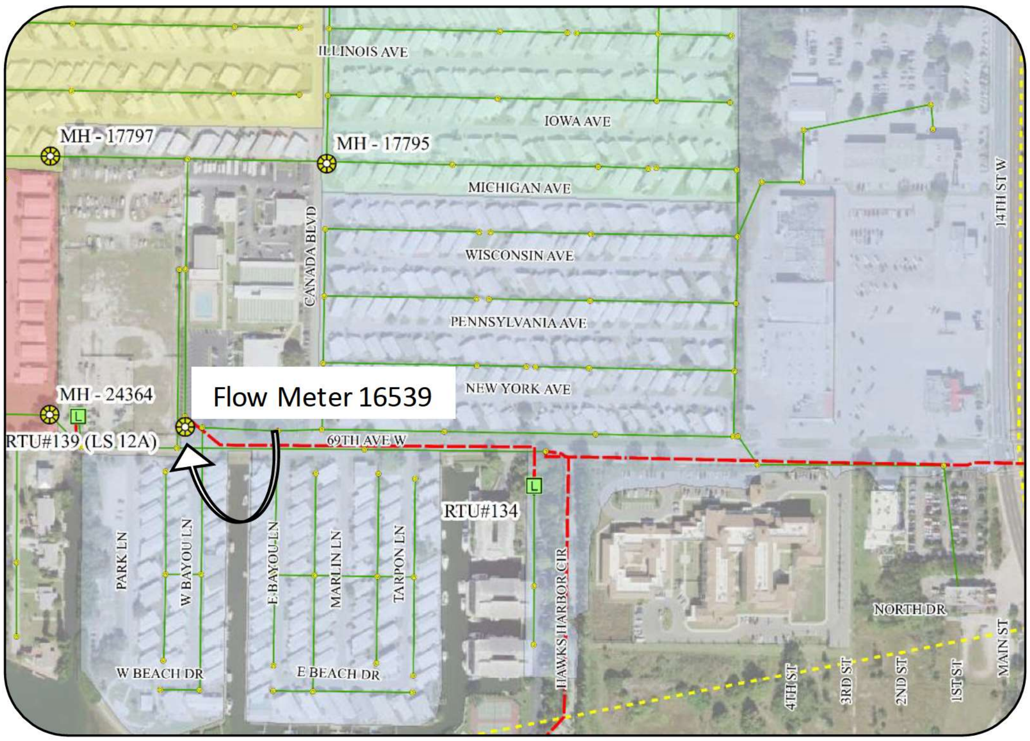

Figure 3: Sub-Basin 16539

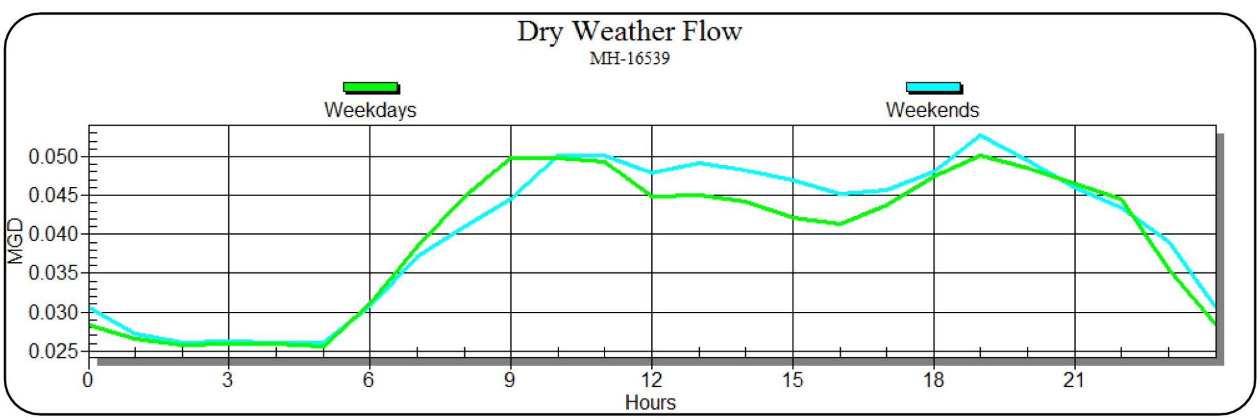

Figure 4: MH-16539 Dry Weather Flow

Table 3: MH-16539 Flow Meter Statistics

Average Dry Weather Flow Rate (MGD)	
Weekday	0.040
Weekend	0.041
Peak Hourly Dry Weather Flow Rate (MGD)	
Weekday	0.050
Weekend	0.053
Peak Hourly Wet Weather Flow Rate (MGD)	
Rain Event	0.532
Peak Values (15 Minute Intervals)	
Flow Depth (in)	41.95
Flow Velocity (fps)	3.01
Flow Meter Installation Pipe	
Pipe Size (in x in)	7.25 x 7.50

Sub-Basin 17795

Flow Meter MH – 17795 is located on Canada Boulevard, receives all sanitary sewer flow from the northeast area of Trailer Estates. This is the largest sub-basin within Trailer Estates serving 33% of the residents resulting in high flows. This sub-basin includes approximately 17,167 linear feet of gravity sewer that contributes flow to MLS 12A. The flow meter's DWF and site statistics have been updated from the Interim Report and are shown in **Figure 6** and **Table 4** below.

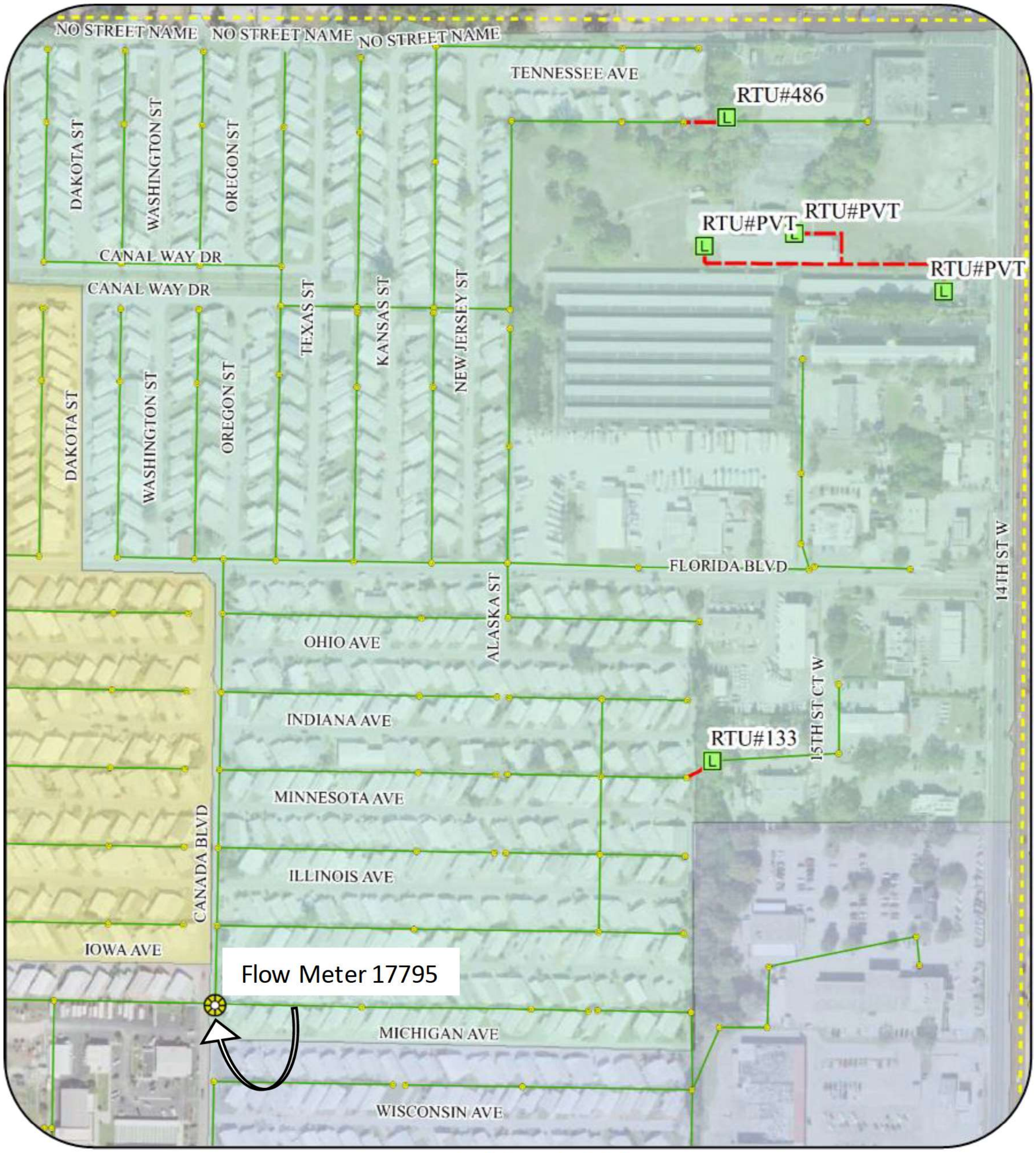

Figure 5: Sub-Basin 17795

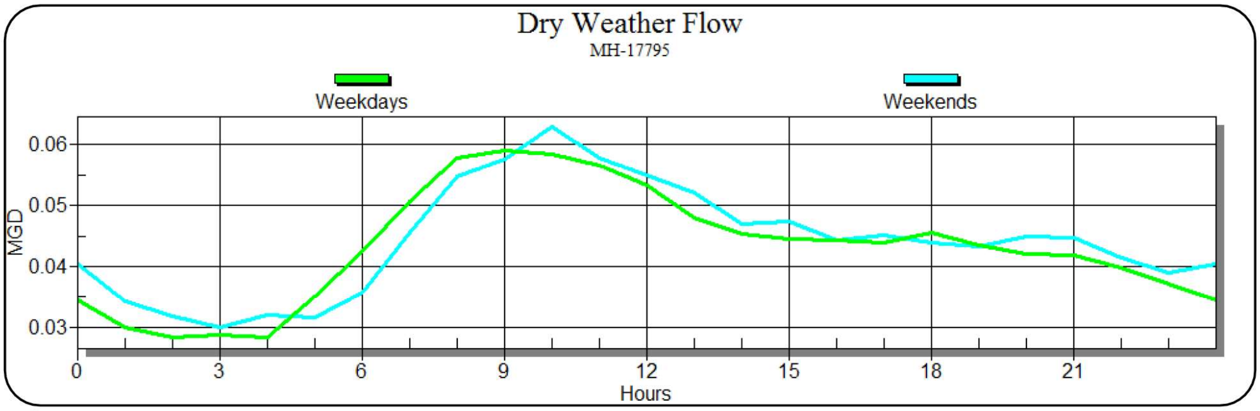

Figure 6: MH-17795 Dry Weather Flow

Table 4:MH-17795 Flow Meter Statistics

Average Dry Weather Flow Rate (MGD)	
Weekday	**0.043**
Weekend	**0.044**
Peak Hourly Dry Weather Flow Rate (MGD)	
Weekday	**0.059**
Weekend	**0.063**
Peak Hourly Wet Weather Flow Rate (MGD)	
Rain Event	**0.817**
Peak Values (15 Minute Intervals)	
Flow Depth (in)	**49.11**
Flow Velocity (fps)	**4.13**
Flow Meter Installation Pipe	
Pipe Size (in x in)	**7.75 x 7.50**

Sub-Basin 17797

Flow Meter MH - 17797 located south of Iowa Avenue behind a mobile home, north of MLS 12A. Manhole 17797, where Flow Meter 17797 is located, receives all sanitary flow from the northwest area of Trailer Estates and eventually discharges to MLS 12A. This sub-basin includes approximately 15,282 linear feet of gravity. It should be noted that the weekday and weekend trends vary more at this flow meter than others. The flow meter's DWF and site statistics have been updated from the Interim Report and are shown in **Figure 8** and **Table 5** below. Also, due to meter issues found by ADS during the fifth storm on June 15th, the storm was removed from analysis for Sub-Basin 17797.

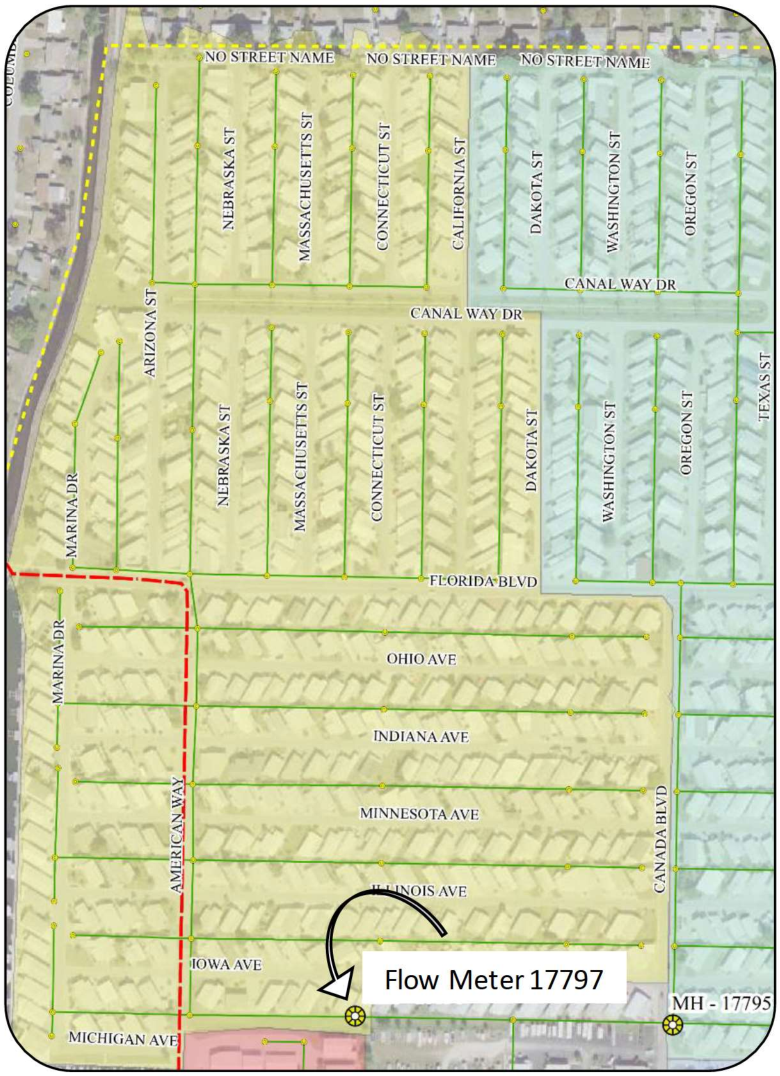

Figure 7: Sub-Basin 17797

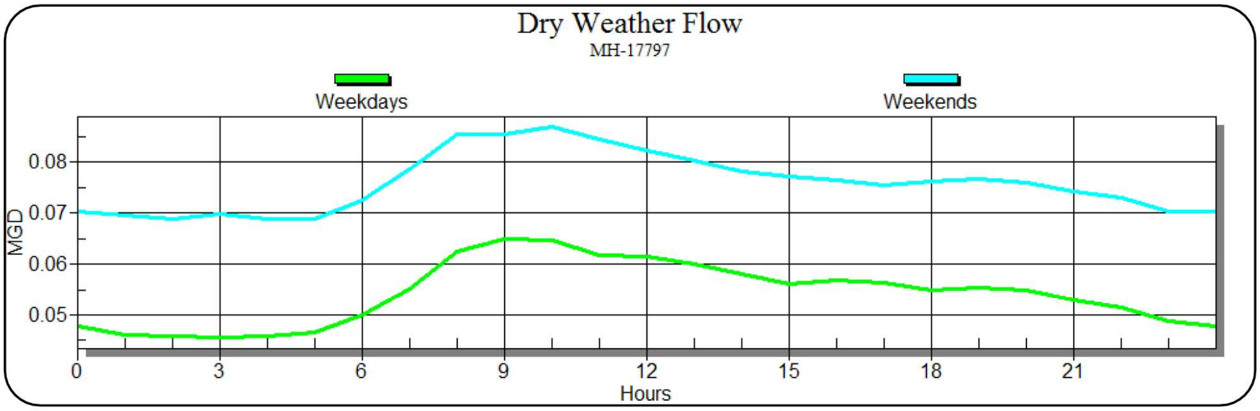

Figure 8: MH-17797 Dry Weather Flow

Table 5: MH-17797 Flow Meter Statistics

Average Dry Weather Flow Rate (MGD)	
Weekday	0.054
Weekend	0.076
Peak Hourly Dry Weather Flow Rate (MGD)	
Weekday	0.065
Weekend	0.087
Peak Hourly Wet Weather Flow Rate (MGD)	
Rain Event	0.542
Peak Values (15 Minute Intervals)	
Flow Depth (in)	52.81
Flow Velocity (fps)	3.16
Flow Meter Installation Pipe	
Pipe Size (in)	7.38

Sub-Basin 24364

Flow Meter MH - 24364 is located on MLS 12A's site and receives all sanitary sewer flow from the southwest area of Trailer Estates. Due to the low flows in this manhole, silt buildup occasionally caused readings to be skewed because the sensors would be obstructed. ADS made attempts to install a silt wedge, to prevent sediment from building up around the sensor. Any inconsistent flow data due to this issue has been omitted from the I&I calculations. Once consistent rain events occurred and the groundwater levels increased, flows increased passing the silt and this issue subsided. This sub-basin includes approximately 3,653 linear feet of gravity sewer. The flow meter's DWF and site statistics have been updated from the Interim Report and are shown in **Figure 10** and **Table 6** below.

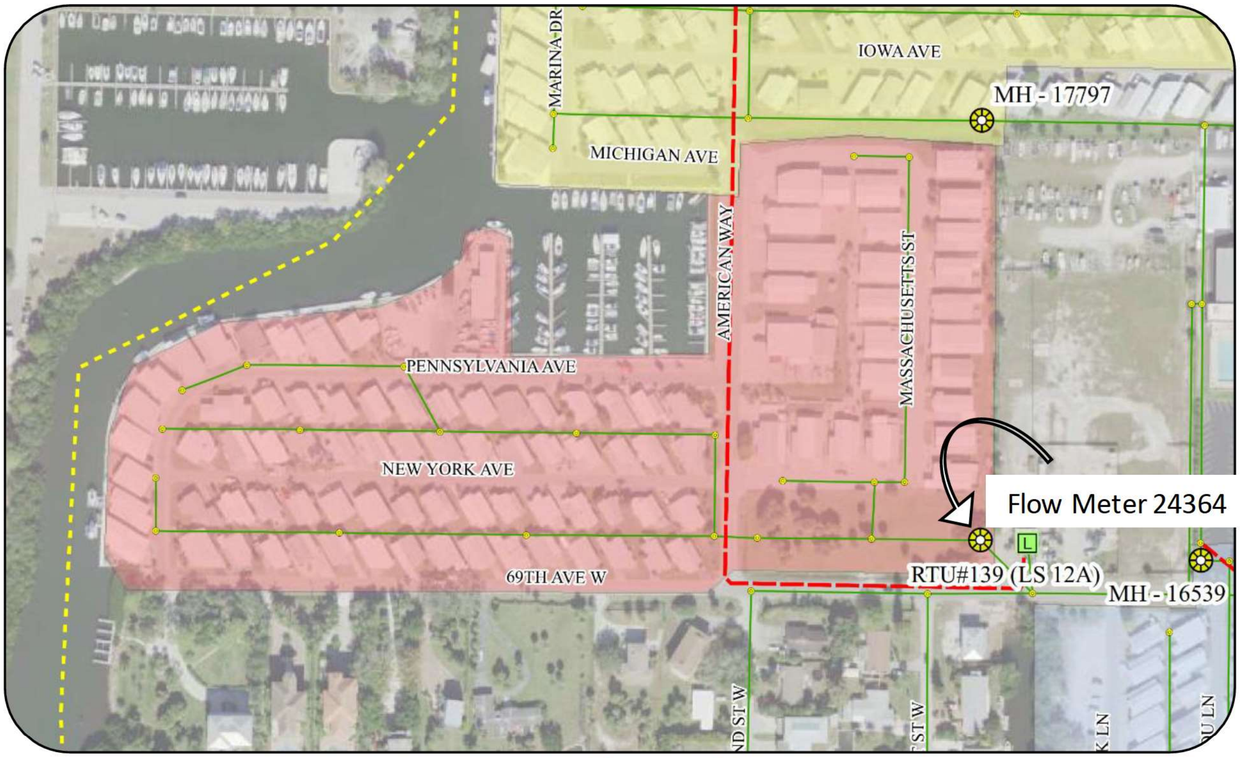

Figure 9: Sub-Basin 24364

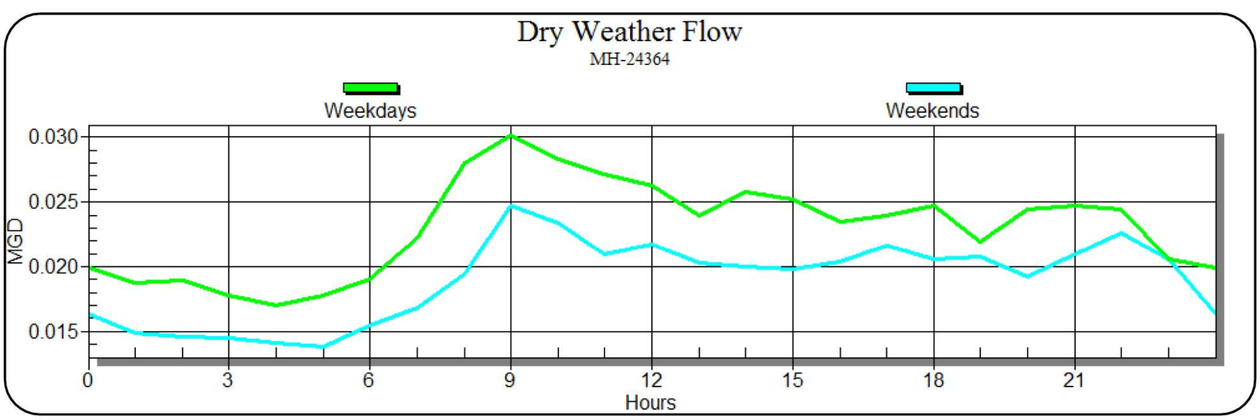

Figure 10: MH-24364 Dry Weather Flow

Table 6: MH-24364 Flow Meter Statistics

Average Dry Weather Flow Rate (MGD)	
Weekday	**0.023**
Weekend	**0.019**
Peak Hourly Dry Weather Flow Rate (MGD)	
Weekday	**0.030**
Weekend	**0.024**
Peak Hourly Wet Weather Flow Rate (MGD)	
Rain Event	**0.491**
Peak Values (15 Minute Intervals)	
Flow Depth (in)	**4.42**
Flow Velocity (fps)	**5.09**
Flow Meter Installation Pipe	
Pipe Size (in x in)	**7.38 x 7.25**

In addition to the information above, raw data including flow, rain, and groundwater can be found in **Appendix A**.

Data Analysis Results

To evaluate the data collected in Trailer Estates, Rainfall Derived Inflow and Infiltration (RDII) values were calculated in each sub-basin. RDII is the total volume of rainfall that enters the sewer system from a rainfall event. Typically, the sewer flow change is the highest during the rainfall event and slowly reverts back to DWF, sometimes days after the event occurs, a direct indication of infiltration. The initial spike or fast response in flow from a rainfall event is due to inflow, where stormwater has direct access into the system through manholes, broken cleanouts, direct connections, or combined sewers. The slow response that continues after the initial rainfall event is a sign of infiltration, which caused by groundwater in the saturated soil. During dry weather days, RDII should be minimal. RDII is calculated by taking the difference between wet weather flows and the derived DWF. Below in **Figure 11** is an example of RDII occurring in Sub-Basin 17795 on June 13th, 2019, all other sub-basin event hydrographs exported from Sliicer can be found in **Appendix B.**

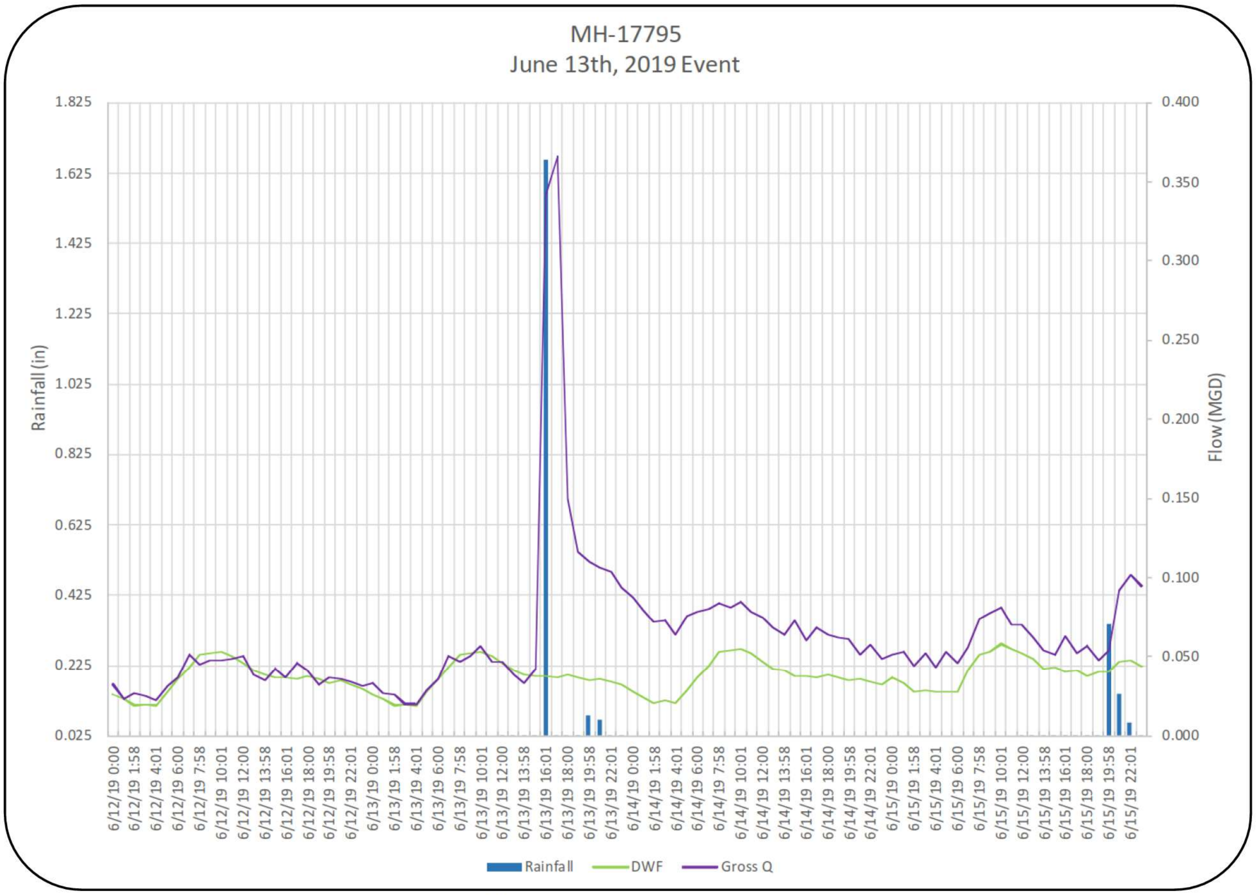

Figure 11: Sub-basin 17795 Event Hydrograph Example

The RDII in each sub-basin had similar patterns with immediate initial flow responses to a rainfall event, displaying that inflow is a major issue throughout Trailer Estates. Sub-Basin 17797 flows demonstrated slow response to the initial rain event than the other sub-basins, indicating RDII is a major factor in this sub-basin. Sub-Basins 17795 and 24364 also displayed evidence of RDII slightly less that Sub-Basin 17797, both ranging from 12 to 24 hours to return to average DWF patterns. Sub-Basin 16539 was the quickest to return to its average DWF pattern, displaying that inflow is the most pertinent issue in the sub-basin. **Table 7.** demonstrates the total amount of RDII that was treated from May 10th to October 30th. These totals are calculated in Sliicer utilizing a graph similar to the example above.

Table 7: Sub-Basin RDII Event Totals

Storm	Sub-Basin 16539 (MG)	Sub-Basin 17795 (MG)	Sub-Basin 17797 (MG)	Sub-Basin 24364 (MG)	Total (MG)
5/10/2019	0.022	0.035	0.027	0.024	0.108
5/13/2019	0.017	0.023	0.04	0.006	0.086
6/9/2019	0.022	0.032	0.094	0.017	0.165
6/13/2019	0.038	0.078	0.161	0.032	0.309
6/15/2019	0.01	0.014	0.037	0.005	0.066
6/18/2019	0.025	0.037	0.049	0.032	0.143
6/28/2019	0.031	0.057	0.102	0.019	0.209
7/8/2019	0.039	0.049	0.124	0.003	0.215
7/9/2019	0.073	0.132	0.258	0.071	0.534
7/17/2019	0.061	0.155	0.273	0.038	0.527
7/20/2019	0.092	0.215	0.335	0.088	0.73
7/24/2019	0.182	0.462	0.421	0.078	1.143
7/31/2019	0.025	0.058	0.073	0.02	0.176
8/1/2019	0.06	0.169	0.191	0.047	0.467
8/6/2019	0.059	0.159	0.222	0.032	0.472
8/10/2019	0.048	0.087	0.034	0.018	0.187
8/12/2019	0.066	0.141	0.341	0.038	0.586
8/14/2019	0.085	0.388	0.165	0.067	0.705
8/16/2019	0.151	0.274	0.058	0.059	0.542
8/17/2019	0.44	0.063	0.014	0.028	0.545
8/20/2019	0.092	0.164	0	0.176	0.432
9/9/2019	0.035	0.082	0.091	0.023	0.231
9/18/2019	0.043	0.076	0.088	0.007	0.214
10/9/2019	0.006	0.022	0.042	0.033	0.103
10/18/2019	0.127	0.308	0.504	0.11	1.049
Total:	**1.849**	**3.28**	**3.744**	**1.071**	**9.944**

To quantify the effects of the rainfall events on the Trailer Estates sewer system for each sub-basin, the peaking factor was compared at each metering location. The peaking factor is a ratio of the Peak Hourly Flow (PHF) to the DWF, indicating how significantly rainfall effects the sanitary flows. The peaking factor during a rainfall event can be an indicator that a specific sub-basin is affected by RDII. **Table 8** demonstrates the results of the calculated peak flows and peaking factors. Sub-Basin 17795 has the highest average peaking factor, indicating that Sub-Basin 17795 is most impacted by RDII.

Table 8: Rainfall Event Sub-Basin Peaking Factors

Rainfall Events	Sub-Basin 16539		Sub-Basin 17795		Sub-Basin 17797		Sub-Basin 24364	
	Peak Flow (MGD)	PHF/ DWF	Peak Flow (MGD)	PHF/ DWF	Peak Flow (MGD)	PHF/ DWF	Peak Flow (MGD)	PHF/ DWF
5/10/2019	0.26	5.18	0.17	2.93	0.17	2.63	0.07	2.27
5/13/2019	0.18	3.58	0.14	2.39	0.19	2.86	0.05	1.50
6/9/2019	0.26	4.87	0.21	3.32	0.30	3.40	0.07	2.83
6/13/2019	0.30	6.08	0.36	6.12	0.46	7.09	0.10	3.23
6/15/2019	0.09	1.68	0.10	1.62	Excluded	Excluded	0.04	1.50
6/18/2019	0.08	1.52	0.11	1.85	0.18	2.72	0.04	1.30
6/28/2019	0.16	3.22	0.14	2.37	0.23	3.48	0.05	1.70
7/8/2019	0.16	3.16	0.13	2.24	0.20	3.11	0.02	0.73
7/9/2019	0.39	7.78	0.58	9.80	0.54	8.29	0.18	5.90
7/17/2019	0.30	6.00	0.52	8.75	0.45	6.95	0.08	2.73
7/20/2019	0.38	7.19	0.61	9.65	0.47	5.40	0.15	6.17
7/24/2019	0.46	9.28	0.82	13.85	0.54	8.34	0.21	6.93
7/31/2019	0.16	3.26	0.21	3.61	0.30	4.57	0.05	1.70
8/1/2019	0.34	6.86	0.53	8.93	0.45	6.98	0.12	4.03
8/6/2019	0.29	5.86	0.43	7.25	0.39	5.94	0.08	2.57
8/10/2019	0.16	2.98	0.27	4.21	0.33	3.74	0.06	2.58
8/12/2019	0.40	7.98	0.65	10.98	0.45	6.92	0.19	6.33
8/14/2019	0.42	8.42	0.74	12.61	0.45	6.98	0.22	7.47
8/16/2019	0.53	10.64	0.75	12.78	0.47	7.25	0.28	9.33
8/17/2019	0.47	8.94	0.63	10.00	0.51	5.86	0.24	9.79
8/20/2019	0.37	7.46	0.50	8.46	0.00	0.00	0.49	16.37
9/9/2019	0.23	4.56	0.21	3.49	0.25	3.78	0.04	1.23
9/18/2019	0.17	3.40	0.16	2.69	0.27	4.08	0.03	1.00
10/9/2019	0.12	2.34	0.09	1.53	0.14	2.17	0.03	0.90
10/18/2019	0.36	7.16	0.52	8.88	0.50	7.72	0.16	5.40
Average	**0.28**	**5.58**	**0.38**	**6.41**	**0.34**	**5.01**	**0.12**	**4.22**

GWI also impacts Trailer Estates and can be identified by consistent presence of nighttime flows in the gravity sewer system that correlates with the groundwater elevation changes. The groundwater levels in Trailer Estates are high, causing the gravity sewer system to be submerged. GWI must be accounted for in this analysis because it is a constant addition of flow. Below in **Table 9** is the calculated average groundwater infiltration rate during dry days over this collection period.

Table 9: Groundwater Infiltration Rates

Sub-Basin	GWI Weekday Rate (MGD)	GWI Weekend Rate (MGD)
MH-16539	0.024	0.024
MH-17795	0.026	0.028
MH-17797	0.044	0.068
MH-24364	0.016	0.013

Cost of Treatment

The cost of treating I&I in Trailer Estates curing this collection period was established based on the United States Environmental Protection Agency's (EPA) Quick Guide for Estimating Infiltration and Inflow. In this guide, the total cost of treatment can be up to $5.00 per thousand gallons. Using this EPA Standard, the estimated I&I for the Trailer Estates system could potentially cost the County up to **$151,080** during this collection period, approximately 173 days.

Using the recorded RDII values calculated by Sliicer in each sub-basin, the estimated total volume of RDII that entered the sewer system from May 10th to October 30th is 9.944 MG. The RDII totals for each sub-basin in the collection period are listed below in **Table 10** along with the associated cost of treatment.

Table 10: Rainfall Derived Inflow and Infiltration Cost

Sub-Basin	RDII Volume (MG)	Cost of Treatment* ($)
MH-16539	1.849	$9,245.00
MH-17795	3.28	$16,400.00
MH-17797	3.744	$18,720.00
MH-24364	1.071	$5,355.00
TOTAL	**9.944**	**$49,720**

The cost above does not include the cost of treating GWI in the system. The volume of GWI in Trailer Estates was calculated by utilizing the GWI rates calculated in Sliicer during the collection period, May 10th to October 30th. Below in **Table 11** is the calculated GWI volume and cost associated based on the collection period.

Table 11: Groundwater Infiltration Treatment Cost

Sub-Basin	GWI Volume (MG)	Cost of Treatment ($)
MH-16539	4.152	$20,760.00
MH-17795	4.606	$23,030.00
MH-17797	8.908	$44,540.00
MH-24364	2.606	$13,030.00
TOTAL	**20.272**	**$101,360.00**

Conclusion

The data collected during this collection period shows that RDII and GWI are contributing factors to the sanitary sewer flows in Trailer Estates. Inflow occurring in Trailer Estates could be reduced with short term measures, such as installing inflow dishes in all manholes and repairing cleanouts and caps. A majority of manholes in the Trailer Estates system are behind homes in low lying areas causing the manholes to act as stormwater inlets during rainfall events. Replacing the entire system is a long-term measure that can save the County money, by reducing the need to pump and treat the additional flow attributed to I&I in the Trailer Estates system**.** A complete system replacement is recommended for Trailer Estates to effectively reduce I&I, see **Table 12** below for a summary of the recorded data.

Table 12: Trailer Estates Collection Period I&I Summary

Sub-Basin	Rainfall Amount (in)	RDII Volume (MG)	GWI Volume (MG)	Cost of Treatment ($)
MH-16539	41.90	1.849	4.152	$30,005.00
MH-17795	41.90	3.28	4.606	$39,430.00
MH-17797	41.90	3.744	8.908	$63,260.00
MH-24364	41.90	1.071	2.606	$18,385.00
TOTAL	**41.90**	**9.944**	**20.272**	**$151,080.00**

As discussed with staff, a complete replacement of the gravity sewer system is recommended. This system would involve the relocation of the existing infrastructure to the front of the mobile homes to allow easier access for County staff to perform maintenance such as pipe cleaning, inspection and any future rehabilitation. The construction will require open trench installation for the gravity collection and will require right-of-entry agreements and coordination with all property owners for lateral replacement. This project should be completed in multiple phases by constructing the main trunk lines of gravity sewer, then the subsequent sewer basins. As stated in the Trailer Estates Sewer Analysis, multiple public meetings should be held to inform the community of the planned improvements. Access discussions need to continuously take place, requiring public meetings during the highest occupancy season.

References

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APPENDIX A:
Trailer Estates – Raw Data

MANATEE CO.

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name:	MH 16539
Installing Team:	BP/TD
Field Manager:	BP
Project Manager	R. Cadet

Site Address /Location:	1903 BAY DR. IN PARKING LOT ON WEST SIDE OF BUILDING, NEAR FENCE ROW		
Site Access Details:	DRIVE	Latitude:	27.41852
		Longitude:	-82.58158

Monitor Series	Serial Number	I.P. Address
FS Triton	63002	166.213.158.140

Pipe Size (H x W)	Pipe Shape
7.25 x 7.50	Elliptical

MH ID:	System Characteristics
MH 16539	Residential
Pipe ID:	Duration
	Temp

Installation Information

Installation Date:	Installation Type:
4/23/2019	Standard Ring
Monitoring Location (Sensors):	RG Zone:
Upstream 0-5 FT	
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Silt (in):
4:00:00 PM	1
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
4.13	
Peak Velocity (fps)	Measurement Confidence (in)
1.15	0.25"
CS5 Offset (in)	CS4 Offset (in)
N/A	1.25
Hydraulics	A- Good

Hydraulic Comments:

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Type of Confined Space:
7' 10"	Sanitary
Manhole Material:	Manhole Condition:
Brick	Fair
US Input:	USMH:
DSMH:	Air Quality:
	Safe
Active Drops or Sidelines?	Surcharge Height (Ft)
No	
Pipe Material	Pipe Condition:
Vitrified Clay Pipe	Fair

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

If backup exists, distance?

Trunk:	N/A	Feet
L/S or P/S:	600	Feet
WWTP	N/A	Feet

ADS Project Name:	MANATEE CO
ADS Project Number:	

Daily Tabular Report

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
05/10/2019	05:15	3.31	21:50	21.89	4.45		02:20	0.34	21:45	2.45	0.74		02:20	0.022	21:45	0.415	0.071	0.071						1.36
05/11/2019	22:20	3.10	09:25	4.26	3.58		05:20	0.57	11:55	1.16	0.78		05:20	0.036	11:55	0.103	0.057	0.057						0.01
05/12/2019	02:25	3.14	17:55	5.68	4.32		16:50	0.27	13:15	0.77	0.53		16:50	0.025	13:15	0.093	0.050	0.050						
05/13/2019	05:15	3.82	15:55	16.27	4.70		05:50	0.23	16:00	1.67	0.51		05:50	0.019	16:00	0.284	0.056	0.056						0.70
05/14/2019	23:35	4.19	10:35	7.00	4.83		03:35	0.29	19:15	0.65	0.44		03:35	0.028	20:05	0.086	0.051	0.051						
05/15/2019	02:50	3.99	20:50	5.50	4.61		03:45	0.29	16:00	0.63	0.43		03:45	0.025	20:50	0.084	0.047	0.047						
05/16/2019	03:15	3.98	11:05	7.48	5.04		02:50	0.29	21:40	0.61	0.38		02:50	0.025	10:55	0.091	0.046	0.046						
05/17/2019	16:00	4.32	09:10	8.70	4.77		03:15	0.22	20:15	0.63	0.43		03:15	0.022	09:15	0.096	0.048	0.048						
05/18/2019	02:40	3.93	11:25	5.47	4.55		02:40	0.35	11:15	0.70	0.49		02:40	0.029	11:25	0.091	0.052	0.052						
05/19/2019	06:10	2.82	11:25	5.24	4.35		05:15	0.27	11:20	0.65	0.47		05:15	0.020	11:25	0.081	0.048	0.048						
05/20/2019	15:55	2.93	15:00	7.87	4.89		23:55	0.26	15:15	0.88	0.41		01:50	0.023	15:00	0.136	0.047	0.047						
05/21/2019	15:15	2.56	09:25	9.65	4.12		03:50	0.21	10:40	1.70	0.67		03:50	0.026	10:40	0.239	0.050	0.050						
05/22/2019	02:30	2.54	10:25	10.07	3.02		02:30	0.51	09:20	1.49	0.77		02:30	0.019	09:20	0.239	0.042	0.042						
05/23/2019	05:50	2.51	17:00	6.81	3.03		05:20	0.49	11:50	0.99	0.80		05:20	0.013	20:10	0.069	0.041	0.041						
05/24/2019	14:00	2.61	00:25	4.11	3.08		00:55	0.00	08:15	1.13	0.75		01:10	0.020	19:05	0.081	0.043	0.043						
05/25/2019	03:05	2.52	11:50	3.89	3.19		03:50	0.46	17:40	1.05	0.76		03:50	0.015	10:25	0.086	0.045	0.045						
05/26/2019	01:55	2.52	18:35	5.19	3.52		12:35	0.45	18:40	1.35	0.73		01:50	0.023	18:40	0.111	0.049	0.049						
05/27/2019	00:25	2.53	19:25	4.53	3.08		23:50	0.47	10:25	1.03	0.77		03:00	0.022	10:25	0.087	0.041	0.041						
05/28/2019	05:55	2.62	18:10	4.30	3.44		05:35	0.27	22:35	0.74	0.53		05:30	0.012	18:10	0.070	0.037	0.037						
05/29/2019	03:05	2.66	09:30	4.17	3.45		04:20	0.29	07:30	0.77	0.56		04:20	0.013	09:30	0.068	0.039	0.039						
05/30/2019	05:05	2.67	18:20	4.27	3.48		04:55	0.34	09:25	0.74	0.54		00:40	0.016	18:20	0.068	0.037	0.037						
05/31/2019	01:55	2.62	23:25	4.31	3.46		02:55	0.36	23:25	0.85	0.56		03:45	0.015	23:25	0.082	0.038	0.038						0.10
06/01/2019	04:20	2.58	10:05	4.59	3.39		05:10	0.26	10:05	0.87	0.56		04:45	0.016	10:05	0.092	0.038	0.038						
06/02/2019	19:30	2.60	12:35	4.45	3.33		01:10	0.33	20:05	1.02	0.64		02:15	0.016	12:35	0.089	0.040	0.040						
06/03/2019	00:25	2.54	10:10	4.16	2.98		07:20	0.36	15:55	1.36	0.77		06:10	0.020	21:40	0.081	0.040	0.040						
06/04/2019	00:45	2.54	08:50	4.44	2.91		04:55	0.64	08:50	1.08	0.82		04:55	0.026	08:50	0.110	0.041	0.041						
06/05/2019	06:15	2.42	21:50	3.80	2.85		19:50	0.62	21:50	1.03	0.84		23:50	0.022	21:50	0.082	0.039	0.039						
06/06/2019	03:40	2.54	14:20	4.66	2.92		14:15	0.49	08:45	1.10	0.78		03:30	0.018	14:20	0.099	0.039	0.039						
06/07/2019	02:15	2.54	15:25	4.82	3.12		15:25	0.39	10:25	1.07	0.71		05:40	0.017	22:55	0.084	0.039	0.039						
06/08/2019	21:55	2.72	10:00	4.47	3.24		16:25	0.37	09:55	1.22	0.62		03:40	0.021	09:55	0.099	0.039	0.039						
06/09/2019	00:25	2.51	23:15	16.38	3.35		03:50	0.37	23:15	2.19	0.79		00:20	0.019	23:15	0.372	0.051	0.051						1.45
06/10/2019	23:55	2.55	08:50	5.41	3.11		23:45	0.64	00:00	1.31	0.92		23:55	0.027	00:00	0.090	0.051	0.051						0.22
06/11/2019	04:50	2.52	21:20	4.21	3.41		23:30	0.46	00:10	0.91	0.62		04:50	0.020	10:25	0.071	0.041	0.041						
06/12/2019	05:45	2.68	15:00	4.25	3.48		04:35	0.34	12:05	0.83	0.56		05:45	0.015	12:05	0.078	0.038	0.038						
06/13/2019	02:15	2.79	17:00	26.34	4.44		04:00	0.35	17:00	2.40	0.75		04:00	0.018	17:00	0.407	0.066	0.066						1.84
06/14/2019	04:50	2.96	08:10	4.41	3.47		04:50	0.57	08:10	0.91	0.71		04:50	0.029	08:10	0.091	0.049	0.049						
06/15/2019	05:35	2.64	21:00	5.08	3.32		03:35	0.51	21:00	1.07	0.66		05:40	0.022	21:00	0.130	0.042	0.042						0.56
06/16/2019	05:20	2.74	11:25	4.23	3.41		06:00	0.51	11:25	0.88	0.69		04:30	0.025	11:25	0.083	0.046	0.046						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
06/17/2019	23:45	2.71	08:25	5.16	3.27		08:25	0.23	09:15	0.93	0.66		23:25	0.024	08:15	0.084	0.039	0.039						
06/18/2019	00:35	2.61	22:00	4.65	3.55		19:05	0.52	04:30	1.18	0.76		00:35	0.022	04:30	0.100	0.054	0.054						0.64
06/19/2019	08:20	3.04	06:35	4.95	3.48		00:20	0.47	06:40	0.99	0.66		00:50	0.027	06:35	0.108	0.046	0.046						0.12
06/20/2019	04:50	2.74	10:15	4.28	3.33		05:05	0.46	10:20	0.92	0.66		05:10	0.022	10:15	0.079	0.042	0.042						
06/21/2019	03:55	2.60	20:00	4.29	3.37		00:30	0.45	20:00	0.91	0.68		00:30	0.020	20:00	0.088	0.044	0.044						
06/22/2019	05:40	2.72	19:20	4.16	3.28		06:10	0.33	15:55	0.94	0.64		03:45	0.017	16:00	0.084	0.040	0.040						
06/23/2019	04:40	2.62	11:30	4.03	3.30		03:15	0.44	11:30	0.90	0.65		01:05	0.021	11:30	0.079	0.040	0.040						
06/24/2019	04:40	2.61	20:45	3.98	3.23		06:15	0.42	20:45	0.80	0.63		06:15	0.021	20:45	0.069	0.038	0.038						
06/25/2019	02:10	2.61	17:30	4.63	3.23		02:45	0.37	17:30	1.05	0.63		02:35	0.018	17:30	0.113	0.037	0.037						
06/26/2019	02:30	2.67	01:25	3.91	3.25		03:35	0.35	10:10	0.78	0.60		23:50	0.021	10:10	0.061	0.035	0.035						
06/27/2019	23:55	2.54	18:10	3.90	3.11		02:55	0.40	18:25	0.85	0.59		23:55	0.018	18:25	0.069	0.033	0.033						0.12
06/28/2019	04:40	2.52	17:30	8.19	3.31		02:10	0.39	17:40	1.62	0.71		05:25	0.015	17:40	0.275	0.049	0.049						1.23
06/29/2019	05:10	2.66	17:00	4.57	3.43		12:35	0.52	21:15	0.81	0.68		05:10	0.025	16:25	0.084	0.046	0.046						0.18
06/30/2019	05:15	2.68	15:15	4.23	3.36		04:40	0.42	17:30	0.85	0.66		05:20	0.022	19:20	0.073	0.042	0.042						
07/01/2019	03:10	2.62	12:10	4.04	3.24		23:30	0.48	07:20	1.01	0.67		23:25	0.022	08:25	0.069	0.040	0.040						0.00
07/02/2019	04:30	2.66	08:45	4.45	3.23		08:45	0.29	13:35	0.95	0.61		04:30	0.017	13:35	0.080	0.036	0.036						0.00
07/03/2019	02:50	2.54	12:30	3.77	3.00		01:10	0.39	14:05	0.83	0.58		02:20	0.016	12:30	0.065	0.031	0.031						0.00
07/04/2019	02:15	2.59	20:10	3.72	3.01		04:50	0.40	16:15	0.80	0.60		02:25	0.017	20:10	0.060	0.032	0.032						0.04
07/05/2019	05:35	2.55	09:15	3.95	3.05		02:10	0.37	18:45	0.84	0.62		02:10	0.016	09:15	0.068	0.034	0.034						0.11
07/06/2019	06:10	2.58	08:45	3.98	3.18		05:20	0.40	09:10	0.93	0.62		06:10	0.018	09:10	0.075	0.037	0.037						0.00
07/07/2019	02:30	2.50	19:35	4.34	3.07		02:20	0.40	12:00	1.05	0.63		02:30	0.015	19:35	0.097	0.036	0.036						0.27
07/08/2019	01:10	2.62	03:35	10.94	3.72		01:00	0.51	03:40	1.72	0.87		01:10	0.022	03:40	0.291	0.069	0.069						1.12
07/09/2019	02:35	2.75	14:00	31.61	5.85		02:10	0.59	13:45	2.47	1.09		02:10	0.027	13:45	0.419	0.112	0.112						2.72
07/10/2019	05:10	3.39	18:35	4.68	3.93		23:55	0.60	01:00	0.97	0.81		23:50	0.044	11:50	0.095	0.068	0.068						0.08
07/11/2019	04:15	3.30	21:35	4.68	3.90		22:55	0.52	11:45	0.83	0.67		03:00	0.035	11:45	0.087	0.056	0.056						0.09
07/12/2019	05:25	3.20	15:35	4.35	3.68		05:55	0.53	19:40	0.85	0.68		02:00	0.033	19:40	0.079	0.052	0.052						0.00
07/13/2019	02:30	2.85	19:55	4.42	3.43		03:10	0.56	20:55	1.09	0.71		03:20	0.027	20:55	0.093	0.049	0.049						0.20
07/14/2019	11:10	2.65	16:30	4.87	3.51		23:55	0.51	02:30	0.80	0.69		23:50	0.028	20:05	0.088	0.048	0.048						0.13
07/15/2019	05:20	2.88	16:25	4.46	3.48		03:50	0.46	16:25	1.23	0.69		03:50	0.024	16:25	0.125	0.049	0.049						0.33
07/16/2019	22:35	2.68	14:30	3.87	3.22		23:55	0.32	20:10	2.45	0.95		05:20	0.032	14:40	0.060	0.043	0.043						0.00
07/17/2019	08:10	2.65	22:30	20.84	4.10		01:50	0.25	22:30	1.93	0.57		01:50	0.025	22:30	0.327	0.058	0.058						1.17
07/18/2019	06:15	3.67	22:00	4.82	4.08		23:55	0.54	00:00	1.08	0.78		23:55	0.041	00:00	0.119	0.069	0.069						0.04
07/19/2019	05:15	3.62	20:55	4.85	4.05		00:00	0.55	20:55	0.77	0.64		05:20	0.042	20:55	0.087	0.056	0.056						0.00
07/20/2019	05:30	3.25	18:40	30.04	5.44		01:10	0.49	18:40	2.33	0.80		05:20	0.030	18:40	0.395	0.083	0.083						1.74
07/21/2019	23:55	3.43	18:30	4.90	3.91		16:05	0.72	10:20	1.18	0.88		23:55	0.051	10:25	0.130	0.073	0.073						0.06
07/22/2019	04:15	3.28	14:05	4.72	3.74		05:00	0.66	13:50	1.20	0.85		01:00	0.042	14:05	0.132	0.068	0.068						0.49
07/23/2019	23:55	3.34	07:55	7.75	3.78		07:10	0.65	08:00	1.33	0.77		23:50	0.043	07:55	0.219	0.061	0.061						0.00
07/24/2019	05:45	3.25	15:50	42.20	8.70		02:05	0.56	15:55	3.04	1.09		02:05	0.035	15:55	0.516	0.136	0.136						2.99
07/25/2019	23:55	4.17	10:40	6.53	4.70		01:30	0.88	11:20	1.44	1.08		23:25	0.084	10:35	0.227	0.120	0.120						0.50
07/26/2019	23:55	3.92	12:10	4.91	4.26		23:55	0.83	07:45	1.16	0.96		23:55	0.070	11:50	0.131	0.092	0.092						0.16
07/27/2019	04:00	3.70	20:45	4.71	4.12		22:35	0.69	09:55	1.07	0.79		12:20	0.058	09:40	0.104	0.071	0.071						0.00
07/28/2019	23:55	3.54	09:55	4.68	4.05		23:50	0.60	19:05	0.84	0.71		23:55	0.043	09:55	0.088	0.063	0.063						0.00
07/29/2019	05:55	3.44	22:30	4.55	3.87		23:35	0.50	09:40	0.81	0.67		23:35	0.036	09:30	0.082	0.055	0.055						0.00
07/30/2019	16:45	3.44	17:40	5.43	3.76		05:05	0.51	17:40	1.08	0.64		05:05	0.035	17:40	0.142	0.050	0.050						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
07/31/2019	03:30	3.33	17:45	10.59	3.96		05:10	0.54	17:45	1.64	0.76		05:10	0.035	17:45	0.279	0.067	0.067						0.89
08/01/2019	05:40	3.66	18:15	26.50	5.35		16:25	0.68	18:15	2.13	0.92		05:20	0.053	18:15	0.361	0.097	0.097						1.30
08/02/2019	23:55	3.85	12:20	4.71	4.20		23:55	0.77	08:55	0.99	0.88		23:55	0.063	08:55	0.107	0.082	0.082						0.02
08/03/2019	05:55	3.65	08:55	5.23	4.16		06:00	0.65	08:50	1.20	0.85		05:55	0.048	08:50	0.152	0.080	0.080						0.37
08/04/2019	06:10	3.66	19:15	4.68	3.98		13:00	0.59	12:25	0.88	0.74		23:55	0.050	10:55	0.086	0.064	0.064						0.00
08/05/2019	03:55	3.53	06:40	5.20	4.03		03:35	0.54	07:00	1.16	0.77		03:35	0.038	07:00	0.143	0.068	0.068						0.26
08/06/2019	05:40	3.47	08:35	15.16	4.62		05:25	0.62	08:35	1.81	0.93		05:40	0.042	08:35	0.307	0.095	0.095						0.82
08/07/2019	05:00	3.73	17:40	14.43	4.42		06:10	0.74	17:40	1.71	0.91		05:50	0.057	17:40	0.290	0.091	0.091						0.60
08/08/2019	23:35	3.70	11:25	4.47	4.10		23:55	0.69	09:10	0.96	0.84		23:35	0.053	11:25	0.098	0.075	0.075						0.01
08/09/2019	06:10	3.54	19:05	4.65	3.89		05:25	0.64	08:35	0.91	0.74		06:10	0.045	08:35	0.091	0.062	0.062						0.10
08/10/2019	09:35	2.64	13:55	6.75	4.91		23:15	0.50	08:55	2.59	0.74		06:20	0.040	13:45	0.201	0.081	0.081						0.67
08/11/2019	03:05	6.00	17:05	7.90	6.96		23:45	0.36	09:50	0.62	0.48		23:45	0.054	09:50	0.100	0.075	0.075						0.07
08/12/2019	15:10	3.64	14:45	8.09	6.29		14:50	0.31	21:45	1.00	0.61		00:40	0.051	21:45	0.120	0.080	0.080						0.45
08/13/2019	02:45	4.11	03:50	34.06	6.87		02:45	0.69	03:50	2.50	1.10		02:45	0.062	03:50	0.425	0.136	0.136						1.65
08/14/2019	04:35	4.28	09:35	32.06	5.49		02:45	0.73	09:35	2.38	0.91		04:30	0.071	10:30	0.429	0.157	0.157						1.92
08/15/2019													23:50	0.112	14:10	0.235	0.165	0.165						0.60
08/16/2019	23:55	5.71	18:15	35.86	16.82		22:45	1.18	18:20	2.61	1.73		02:45	0.104	03:45	0.553	0.301	0.301						4.62
08/17/2019	09:45	4.48	20:55	39.47	16.86		10:00	1.17	20:55	2.81	1.78		10:00	0.120	20:55	0.477	0.272	0.272						1.34
08/18/2019	22:35	5.60	04:20	23.67	15.85		22:55	1.46	04:15	2.29	1.90		22:55	0.232	04:15	0.388	0.322	0.322						0.16
08/19/2019	05:05	5.76	18:40	27.60	9.93		03:55	1.39	18:50	2.46	1.65		03:50	0.198	18:50	0.417	0.268	0.268						0.22
08/20/2019	14:40	3.86	16:20	28.54	6.74		13:45	0.95	16:15	2.33	1.35		13:45	0.079	16:15	0.395	0.181	0.181						0.87
08/21/2019	17:55	4.01	22:40	18.11	4.93		20:35	1.04	22:40	1.86	1.19		17:55	0.091	22:40	0.315	0.127	0.127						0.42
08/22/2019	23:50	3.68	00:00	5.01	4.24		23:50	0.91	00:00	1.32	1.08		23:50	0.069	00:00	0.158	0.102	0.102						0.00
08/23/2019	01:25	3.58	16:15	4.86	4.07		05:10	0.77	16:40	1.12	0.93		05:10	0.060	16:40	0.128	0.083	0.083						0.18
08/24/2019	12:10	2.60	10:00	4.86	3.39		13:00	0.68	18:55	0.96	0.79		03:10	0.055	18:55	0.127	0.077	0.077						0.12
08/25/2019	13:45	2.52	15:25	4.99	3.34		04:40	0.68	22:55	0.84	0.76		04:40	0.057	15:25	0.097	0.073	0.073						0.00
08/26/2019	23:15	3.50	12:20	4.57	3.99		01:45	0.65	09:25	0.83	0.75		23:15	0.049	09:20	0.084	0.064	0.064						0.00
08/27/2019	23:45	3.22	09:55	5.05	3.65		01:00	0.65	09:55	0.94	0.75		01:00	0.040	09:55	0.095	0.057	0.057						0.01
08/28/2019	05:05	3.01	18:20	4.33	3.54		00:00	0.56	18:20	0.87	0.75		05:05	0.034	18:20	0.085	0.054	0.054						0.01
08/29/2019	23:45	3.11	19:40	4.59	3.55		05:05	0.66	19:40	0.92	0.75		23:45	0.038	19:40	0.097	0.054	0.054						0.10
08/30/2019	04:50	2.89	19:35	4.75	3.65		02:40	0.57	19:20	0.96	0.77		04:50	0.031	19:35	0.106	0.059	0.059						0.46
08/31/2019	05:10	3.41	17:05	7.45	3.97		03:00	0.71	17:10	1.61	0.86		03:00	0.048	17:10	0.273	0.075	0.075						0.38
09/01/2019	05:20	3.94	17:05	7.97	4.47		05:15	0.61	18:00	0.93	0.73		05:15	0.052	17:05	0.148	0.075	0.075						0.41
09/02/2019	23:55	3.45	09:05	5.17	4.13		23:55	0.64	09:05	0.88	0.74		23:55	0.044	09:05	0.109	0.068	0.068						0.00
09/03/2019	23:45	3.28	11:45	4.69	3.78		02:40	0.59	13:40	0.81	0.71		04:45	0.038	11:45	0.085	0.056	0.056						0.00
09/04/2019	23:55	2.99	21:50	4.61	3.59		03:55	0.56	13:25	0.89	0.68		23:55	0.031	21:50	0.090	0.050	0.050						0.00
09/05/2019	21:10	2.63	13:20	4.59	3.21		01:05	0.58	22:30	0.87	0.69		04:50	0.029	22:30	0.090	0.047	0.047						0.00
09/06/2019	01:40	2.70	05:45	4.29	3.43		23:55	0.00	05:45	0.81	0.63		04:40	0.024	05:45	0.078	0.043	0.043						0.00
09/07/2019	01:50	2.71	12:55	4.10	3.43		00:00	0.00	12:50	0.80	0.57		01:55	0.020	12:55	0.071	0.042	0.042						0.00
09/08/2019	22:10	2.52	18:05	4.43	3.42		02:00	0.00	18:15	0.88	0.64		02:15	0.020	18:15	0.087	0.043	0.043						0.00
09/09/2019	20:10	2.50	22:10	15.64	3.47		02:00	0.33	22:10	1.76	0.69		01:15	0.019	22:10	0.298	0.052	0.052						0.84
09/10/2019	05:40	3.10	09:20	4.33	3.54		09:35	0.60	00:00	0.94	0.77		23:35	0.038	13:45	0.078	0.055	0.055						0.00
09/11/2019	23:30	2.80	11:55	4.31	3.30		03:00	0.64	11:55	0.99	0.73		23:30	0.031	11:55	0.095	0.046	0.046						0.00
09/12/2019	03:15	2.77	16:35	4.12	3.31		05:15	0.59	09:15	0.93	0.73		04:55	0.027	16:35	0.080	0.046	0.046						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
09/13/2019	04:30	2.70	12:25	4.30	3.28		02:20	0.61	20:15	0.84	0.72		04:35	0.028	12:25	0.079	0.043	0.043						0.07
09/14/2019	06:05	2.62	19:45	4.01	3.17		23:50	0.44	14:20	0.89	0.70		23:50	0.020	19:45	0.076	0.040	0.040						0.00
09/15/2019	02:10	2.62	22:15	4.16	3.20		05:45	0.49	13:25	0.90	0.71		00:40	0.023	19:00	0.078	0.041	0.041						0.00
09/16/2019	04:45	2.56	11:45	3.87	3.15		04:50	0.46	12:35	0.92	0.71		04:55	0.022	11:45	0.069	0.041	0.041						0.00
09/17/2019	05:15	2.50	21:25	4.07	3.11		01:55	0.49	11:40	0.91	0.71		01:55	0.019	19:55	0.079	0.039	0.039						0.00
09/18/2019	06:05	2.62	20:50	12.61	3.33		03:30	0.48	20:50	1.77	0.77		02:15	0.021	20:50	0.301	0.051	0.051						0.81
09/19/2019	05:50	2.83	10:15	4.44	3.40		23:15	0.54	10:20	1.08	0.78		05:50	0.034	10:20	0.088	0.052	0.052						0.00
09/20/2019	23:55	2.81	20:05	4.15	3.37		02:05	0.57	20:05	0.97	0.76		23:55	0.030	20:05	0.088	0.050	0.050						0.09
09/21/2019	05:00	2.69	13:45	4.00	3.32		00:25	0.61	16:55	0.92	0.75		05:00	0.028	16:55	0.080	0.047	0.047						0.00
09/22/2019	23:25	2.56	22:35	4.27	3.26		05:50	0.38	15:15	0.87	0.66		04:45	0.019	12:10	0.072	0.038	0.038						0.00
09/23/2019	21:10	2.52	10:20	3.86	3.13		05:55	0.00	10:20	0.88	0.60		05:05	0.016	23:20	0.074	0.035	0.035						0.00
09/24/2019	06:15	2.67	11:15	5.59	3.07		01:40	0.00	11:15	0.87	0.53		03:20	0.017	11:15	0.073	0.032	0.032						0.00
09/25/2019	23:05	2.66	10:05	7.23	3.11		00:30	0.00	10:50	0.92	0.56		00:55	0.018	17:25	0.070	0.035	0.035						0.00
09/26/2019	00:25	2.59	16:00	3.71	3.05		23:55	0.54	14:05	0.84	0.68		23:55	0.021	11:45	0.060	0.036	0.036						0.00
09/27/2019	05:45	2.46	18:40	4.09	3.04		02:10	0.49	18:40	0.95	0.67		03:05	0.020	18:40	0.085	0.037	0.037						0.00
09/28/2019	05:45	2.49	10:40	3.87	3.00		03:00	0.50	13:55	0.86	0.70		03:00	0.020	10:40	0.070	0.037	0.037						0.00
09/29/2019	01:55	2.52	19:35	7.25	3.15		05:10	0.53	17:45	0.98	0.71		05:10	0.020	19:45	0.072	0.041	0.041						0.00
09/30/2019	05:30	2.71	18:40	4.02	3.16		02:20	0.60	10:20	0.97	0.71		04:10	0.027	10:25	0.075	0.042	0.042						0.00
10/01/2019	06:15	2.76	10:25	3.81	3.06		05:40	0.49	10:25	0.87	0.67		05:45	0.020	10:25	0.070	0.036	0.036						0.00
10/02/2019	07:50	2.55	17:30	3.91	3.12		07:35	0.51	08:05	0.91	0.68		05:15	0.020	08:05	0.072	0.037	0.037						0.00
10/03/2019	17:35	2.58	08:30	4.49	3.16		17:20	0.39	08:30	1.19	0.68		23:25	0.021	08:30	0.123	0.037	0.037						0.00
10/04/2019	00:15	2.54	08:55	3.90	3.06		03:30	0.51	17:50	0.85	0.65		05:05	0.019	08:55	0.066	0.036	0.036						0.00
10/05/2019	02:25	2.62	23:55	4.44	3.09		03:10	0.49	12:20	0.88	0.65		03:10	0.021	12:20	0.072	0.036	0.036						0.00
10/06/2019	04:50	2.54	09:35	6.94	3.22		04:45	0.32	12:15	0.83	0.63		04:45	0.015	22:05	0.069	0.037	0.037						0.05
10/07/2019	02:15	2.66	20:40	4.58	3.31		01:20	0.44	20:40	1.27	0.67		01:40	0.022	20:40	0.134	0.042	0.042						0.43
10/08/2019	00:00	2.95	07:50	4.63	3.69		00:05	0.54	07:50	0.89	0.74		00:05	0.028	07:50	0.096	0.057	0.057						0.00
10/09/2019	22:30	2.62	16:25	5.16	3.56		03:50	0.57	16:25	1.14	0.75		03:55	0.035	16:25	0.141	0.057	0.057						0.58
10/10/2019	08:45	2.61	19:00	4.09	3.26		04:20	0.58	20:45	1.08	0.72		02:35	0.030	20:45	0.088	0.049	0.049						0.00
10/11/2019	05:15	2.70	21:05	4.07	3.26		02:30	0.56	21:00	1.01	0.74		05:15	0.025	21:05	0.089	0.045	0.045						0.00
10/12/2019	05:10	2.66	19:30	4.09	3.28		02:40	0.56	21:35	0.99	0.75		02:40	0.025	21:35	0.084	0.046	0.046						0.00
10/13/2019	23:40	2.55	13:35	3.98	3.23		23:20	0.54	21:00	0.96	0.72		23:40	0.023	13:35	0.079	0.042	0.042						0.00
10/14/2019	01:50	2.53	09:50	4.03	3.12		00:55	0.55	09:50	0.98	0.71		05:45	0.022	09:50	0.086	0.040	0.040						0.00
10/15/2019	04:30	2.52	13:15	4.09	3.15		01:10	0.48	13:15	1.07	0.73		03:15	0.019	13:15	0.095	0.043	0.043						0.00
10/16/2019	05:00	2.54	20:35	4.13	3.14		01:15	0.49	20:35	1.08	0.76		05:00	0.020	20:35	0.098	0.043	0.043						0.00
10/17/2019	03:35	2.50	12:35	3.80	3.06		06:40	0.60	16:05	1.08	0.81		06:40	0.024	12:35	0.085	0.045	0.045						0.00
10/18/2019	04:55	2.54	22:50	4.13	3.13		00:20	0.55	20:50	1.33	0.87		00:20	0.022	20:50	0.118	0.050	0.050						0.38
10/19/2019	00:30	3.08	08:30	31.34	7.24		00:30	0.70	08:20	2.18	1.21		00:30	0.039	08:20	0.371	0.138	0.138						3.17
10/20/2019	05:00	3.35	21:50	4.87	3.89		23:40	0.70	08:45	1.11	0.84		05:55	0.050	08:45	0.114	0.069	0.069						0.00
10/21/2019	02:00	3.46	08:45	4.84	4.01		04:25	0.66	08:55	0.84	0.75		02:00	0.045	08:45	0.096	0.066	0.066						0.17
10/22/2019	23:55	3.03	12:20	4.49	3.68		01:30	0.61	19:40	0.90	0.72		23:55	0.034	10:05	0.083	0.055	0.055						0.00
10/23/2019	01:40	2.92	09:10	4.35	3.52		03:20	0.58	09:15	0.82	0.69		03:20	0.030	09:10	0.081	0.049	0.049						0.00
10/24/2019	05:20	2.64	18:00	4.34	3.47		04:50	0.54	17:05	0.79	0.67		04:50	0.025	11:35	0.077	0.046	0.046						0.00
10/25/2019	03:55	2.70	10:45	4.56	3.54		05:05	0.44	10:50	0.84	0.68		05:05	0.024	10:45	0.088	0.047	0.047						0.10
10/26/2019	02:10	2.72	08:45	4.21	3.45		05:20	0.51	08:45	0.78	0.67		02:10	0.024	08:45	0.073	0.045	0.045						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
10/27/2019	04:55	2.62	11:35	4.45	3.38		05:25	0.39	11:35	0.83	0.65		03:15	0.022	11:35	0.084	0.042	0.042						0.00
10/28/2019	05:05	2.62	19:30	4.40	3.29		03:05	0.40	19:35	0.85	0.65		01:10	0.020	19:35	0.085	0.041	0.041						0.00
10/29/2019	05:15	2.59	18:30	4.08	3.22		01:50	0.50	19:35	0.87	0.66		05:15	0.020	18:30	0.074	0.040	0.040						0.00
10/30/2019	04:15	2.57	07:30	3.95	3.06		02:55	0.51	10:05	0.86	0.61		05:50	0.021	11:40	0.071	0.040	0.040						0.00

Report Summary For The Period 05/10/2019 - 10/30/2019

	UniDepth (in)	Vel (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			10.626	46.59
Avg	3.94	0.74	0.061	

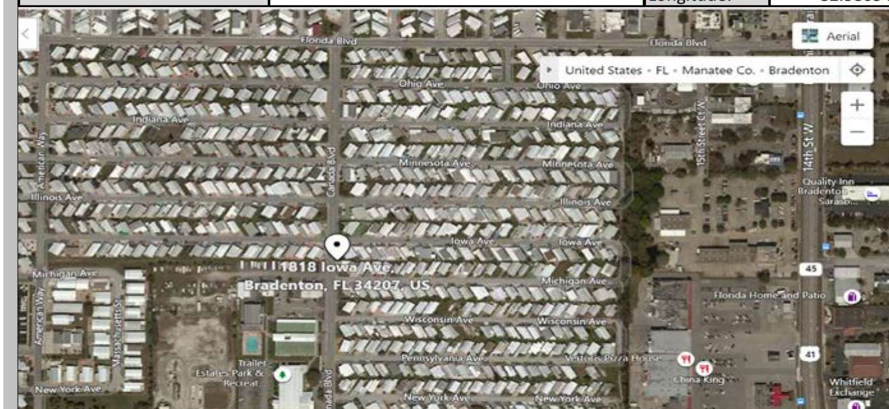
MANATEE CO

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name:	**MH 17795**
Installing Team:	**BP/TD**
Field Manager:	**BP**
Project Manager	**R. Cadet**

Site Address /Location:	IN DRIVEWAY OF 1817 MICHIGAN AVE, NEXT TO CANADA BLVD			Monitor Series: TRITON+	Serial Number: 41728	I.P. Address: 107.80.30.237
Site Access Details:	DRIVE	Latitude: 27.42027	Longitude: -82.58054	Pipe Size (H x W): 7.75" x 7.50"		Pipe Shape: Elliptical



MH ID:	System Characteristics
17795	Residential
Pipe ID:	Duration
	Temp

Installation Information

Installation Date:	Installation Type:
4/24/2019	Standard Ring
Monitoring Location (Sensors):	RG Zone:
Upstream 0-5 FT	
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Silt (in):
12:17:00 PM	0
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
2.50	
Peak Velocity (fps)	Measurement Confidence (in)
1.17	0.25"
CS5 Offset (in)	CS4 Offset (in)
N/A	0
Hydraulics	A- Good

Hydraulic Comments:

THIS FLOW IS STRONGER THAN THE OTHER LINE AND NOT AFFECTED BY IT

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Type of Confined Space:
6' 9"	Sanitary
Manhole Material:	Manhole Condition:
Liner	Good
US Input:	USMH:
	Possible Output Install
DSMH:	Air Quality:
	Safe
Active Drops or Sidelines?	Surcharge Height (Ft)
No	4'
Pipe Material	Pipe Condition:
Liner	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Grass (buried)

ADS Project Name:	MANATEE CO.
ADS Project Number:	

Additional Site Info. / Comments:

If backup exists, distance?

Trunk:	N/A	Feet
L/S or P/S:	N/A	Feet
WWTP	N/A	Feet

Daily Tabular Report

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
05/10/2019	03:45	1.60	21:30	6.05	2.20		03:35	0.69	21:30	1.93	0.98		03:55	0.021	21:30	0.332	0.051	0.051						1.36
05/11/2019	22:55	2.00	08:30	3.26	2.43		23:30	0.93	08:30	1.47	1.12		22:55	0.040	08:30	0.120	0.062	0.062						0.01
05/12/2019	02:55	1.85	09:05	2.93	2.16		21:00	0.84	10:50	1.37	1.01		03:20	0.032	09:05	0.096	0.048	0.048						
05/13/2019	03:50	1.73	15:55	4.53	2.36		03:15	0.62	15:55	1.77	1.08		03:55	0.026	15:55	0.220	0.060	0.060						0.70
05/14/2019	22:55	2.00	11:15	3.21	2.32		21:20	0.92	10:15	1.40	1.08		22:55	0.039	10:15	0.101	0.056	0.056						
05/15/2019	03:55	1.87	09:45	3.15	2.24		03:30	0.86	09:45	1.47	1.04		03:30	0.033	09:45	0.115	0.052	0.052						
05/16/2019	05:10	1.79	12:45	2.88	2.17		03:00	0.79	08:40	1.33	1.01		05:10	0.028	08:40	0.089	0.048	0.048						
05/17/2019	03:50	1.65	08:00	2.89	2.07		04:05	0.72	10:10	1.32	0.96		04:10	0.023	10:10	0.089	0.044	0.044						
05/18/2019	05:45	1.69	11:45	2.78	2.06		22:00	0.72	10:50	1.40	0.97		04:35	0.026	10:50	0.088	0.043	0.043						
05/19/2019	04:30	1.63	07:55	2.74	2.01		02:00	0.67	12:20	1.23	0.93		04:15	0.022	07:55	0.080	0.040	0.040						
05/20/2019	02:15	1.52	10:40	2.91	2.02		04:10	0.66	10:40	1.32	0.93		02:15	0.019	10:40	0.093	0.041	0.041						
05/21/2019	05:10	1.47	10:15	2.86	1.97		02:45	0.54	09:35	1.30	0.91		02:45	0.015	10:10	0.087	0.039	0.039						
05/22/2019	03:55	1.49	08:25	2.93	1.97		04:00	0.62	08:25	1.38	0.92		04:00	0.017	08:25	0.098	0.039	0.039						
05/23/2019	04:20	1.48	07:35	2.90	1.93		02:10	0.64	09:20	1.33	0.89		01:50	0.018	09:20	0.089	0.037	0.037						
05/24/2019	04:25	1.42	11:45	2.70	1.92		04:25	0.60	11:45	1.26	0.88		04:25	0.016	11:45	0.080	0.036	0.036						
05/25/2019	04:05	1.48	20:25	2.65	1.97		04:00	0.62	11:05	1.25	0.90		04:00	0.017	11:05	0.077	0.038	0.038						
05/26/2019	03:55	1.44	11:45	2.74	1.94		03:55	0.61	10:25	1.28	0.88		03:55	0.016	11:45	0.082	0.037	0.037						
05/27/2019	05:50	1.41	11:45	2.67	1.90		06:00	0.57	11:45	1.21	0.86		06:00	0.015	11:45	0.076	0.035	0.035						
05/28/2019	03:45	1.43	11:05	2.61	1.87		03:45	0.60	11:05	1.20	0.83		03:45	0.016	11:05	0.072	0.033	0.033						
05/29/2019	02:40	1.32	11:45	2.83	1.91		02:40	0.55	11:40	1.33	0.86		02:40	0.013	11:45	0.090	0.036	0.036						
05/30/2019	03:05	1.28	10:50	2.72	1.83		02:20	0.54	10:50	1.27	0.83		02:20	0.012	10:50	0.081	0.032	0.032						
05/31/2019	02:40	1.27	14:25	2.58	1.83		02:20	0.56	10:00	1.23	0.84		02:45	0.012	10:00	0.071	0.032	0.032						0.10
06/01/2019	04:20	1.26	10:30	2.60	1.82		04:20	0.55	13:00	1.27	0.84		04:20	0.012	13:00	0.075	0.032	0.032						
06/02/2019	00:40	1.39	11:05	2.71	1.88		06:30	0.61	11:05	1.26	0.88		06:30	0.015	11:05	0.080	0.035	0.035						
06/03/2019	03:10	1.43	09:45	2.82	1.93		02:30	0.64	09:45	1.35	0.91		03:10	0.017	09:45	0.091	0.037	0.037						
06/04/2019	03:30	1.29	09:50	2.70	1.81		03:50	0.25	09:50	1.25	0.83		02:15	0.012	09:50	0.080	0.032	0.032						
06/05/2019	04:50	1.26	09:40	2.64	1.81		04:40	0.51	11:00	1.24	0.83		04:40	0.011	11:00	0.076	0.032	0.032						
06/06/2019	04:10	1.32	08:15	2.54	1.85		02:35	0.54	08:15	1.25	0.86		02:40	0.013	08:15	0.073	0.034	0.034						
06/07/2019	01:10	1.43	07:05	2.60	1.93		01:55	0.59	08:40	1.21	0.89		01:55	0.016	07:05	0.072	0.036	0.036						
06/08/2019	04:00	1.46	17:05	2.60	1.91		05:40	0.58	17:05	1.24	0.86		05:40	0.016	17:05	0.075	0.035	0.035						
06/09/2019	04:25	1.38	23:00	6.16	1.96		04:25	0.60	23:10	1.92	0.88		04:25	0.016	23:05	0.332	0.041	0.041						1.45
06/10/2019	22:55	1.88	00:55	3.06	2.33		22:55	0.92	08:55	1.31	1.08		22:55	0.035	00:55	0.097	0.057	0.057						0.22
06/11/2019	03:00	1.71	11:00	2.68	2.04		02:35	0.76	08:05	1.29	0.95		02:35	0.026	08:05	0.078	0.042	0.042						
06/12/2019	04:35	1.56	07:25	2.62	1.98		04:30	0.66	12:40	1.23	0.88		04:35	0.020	12:40	0.075	0.038	0.038						
06/13/2019	03:55	1.49	16:35	22.84	2.92		04:15	0.56	16:50	2.83	1.10		03:55	0.018	16:50	0.579	0.083	0.083						1.84
06/14/2019	21:35	2.41	11:00	3.34	2.71		23:50	0.77	00:05	1.41	1.09		23:30	0.047	00:05	0.114	0.070	0.070						
06/15/2019	20:00	2.19	22:20	3.51	2.61		04:50	0.79	22:20	1.46	1.01		04:00	0.041	22:20	0.131	0.063	0.063						0.56
06/16/2019	23:40	2.30	11:35	3.34	2.63		15:45	0.92	11:35	1.38	1.07		23:40	0.049	11:35	0.116	0.066	0.066						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
06/17/2019	22:50	2.11	08:10	3.17	2.42		03:30	0.85	11:25	1.32	1.00		03:30	0.040	11:25	0.103	0.055	0.055						
06/18/2019	00:05	2.13	04:40	3.79	2.82		00:05	0.86	08:40	1.49	1.14		00:05	0.039	04:40	0.145	0.078	0.078						0.64
06/19/2019	03:45	2.33	07:50	3.66	2.63		20:30	0.89	07:50	1.46	1.04		03:30	0.047	07:50	0.140	0.064	0.064						0.12
06/20/2019	23:45	2.22	10:45	3.18	2.51		03:35	0.90	07:45	1.28	1.03		23:45	0.044	07:45	0.100	0.060	0.060						
06/21/2019	04:00	2.05	12:30	3.03	2.36		23:30	0.83	08:00	1.28	0.98		23:30	0.036	08:00	0.094	0.053	0.053						
06/22/2019	03:30	1.94	09:55	3.19	2.30		02:40	0.81	09:55	1.32	0.98		02:40	0.033	09:55	0.105	0.051	0.051						
06/23/2019	03:55	1.84	11:50	3.03	2.21		20:35	0.73	11:50	1.24	0.93		03:45	0.029	11:50	0.092	0.045	0.045						
06/24/2019	03:55	1.80	17:55	3.16	2.22		03:50	0.69	17:55	1.35	0.92		03:50	0.025	17:55	0.106	0.045	0.045						
06/25/2019	04:25	1.90	09:00	2.96	2.26		22:45	0.72	09:00	1.30	0.94		03:20	0.029	09:00	0.094	0.048	0.048						
06/26/2019	04:10	1.73	08:30	2.85	2.18		01:55	0.64	08:30	1.32	0.92		02:30	0.023	08:30	0.090	0.044	0.044						
06/27/2019	03:10	1.66	20:10	2.78	2.12		05:05	0.67	09:05	1.25	0.90		03:10	0.022	09:05	0.082	0.042	0.042						0.12
06/28/2019	03:15	1.65	17:30	4.97	2.41		03:20	0.68	17:45	1.69	1.01		03:20	0.022	17:30	0.233	0.059	0.059						1.23
06/29/2019	15:55	2.39	10:00	3.36	2.71		13:35	0.87	17:05	1.39	1.11		15:50	0.051	10:00	0.115	0.071	0.071						0.18
06/30/2019	23:25	2.22	10:40	3.26	2.56		02:50	0.92	09:55	1.35	1.06		23:25	0.046	10:40	0.110	0.063	0.063						
07/01/2019	04:30	2.08	07:50	3.17	2.48		20:15	0.84	07:50	1.35	1.05		23:45	0.039	07:50	0.106	0.060	0.060						0.00
07/02/2019	04:00	1.98	08:10	3.11	2.37		05:05	0.79	08:05	1.37	1.01		05:05	0.033	08:05	0.105	0.055	0.055						0.00
07/03/2019	04:00	1.90	08:20	3.22	2.32		02:50	0.82	08:20	1.37	0.98		04:00	0.032	08:20	0.111	0.051	0.051						0.00
07/04/2019	04:20	1.81	12:15	2.88	2.26		04:15	0.75	15:25	1.23	0.95		04:20	0.027	15:25	0.085	0.048	0.048						0.04
07/05/2019	04:15	1.98	10:45	2.95	2.30		04:20	0.84	09:35	1.25	0.99		04:15	0.035	09:35	0.087	0.051	0.051						0.11
07/06/2019	23:40	1.93	10:50	3.04	2.28		23:30	0.83	10:05	1.27	1.00		23:40	0.033	10:00	0.093	0.051	0.051						0.00
07/07/2019	02:55	1.77	14:25	3.04	2.26		02:50	0.72	10:55	1.28	0.99		02:50	0.025	14:25	0.094	0.050	0.050						0.27
07/08/2019	01:35	1.89	03:25	5.31	2.95		03:15	0.68	03:35	1.70	1.20		01:35	0.033	03:25	0.252	0.089	0.089						1.12
07/09/2019	04:10	2.41	13:40	21.71	4.69		04:40	0.99	13:45	3.26	1.45		02:45	0.055	13:45	0.667	0.170	0.170						2.72
07/10/2019	23:50	3.26	09:30	4.12	3.57		22:35	1.04	09:30	1.44	1.26		22:35	0.088	09:30	0.160	0.117	0.117						0.08
07/11/2019	23:30	3.08	12:40	3.99	3.39		04:10	1.07	13:15	1.45	1.24		04:10	0.086	12:40	0.155	0.107	0.107						0.09
07/12/2019	23:40	2.82	07:10	3.88	3.18		12:00	1.03	09:45	1.47	1.23		23:40	0.075	09:45	0.148	0.098	0.098						0.00
07/13/2019	03:35	2.72	10:25	3.78	3.00		01:05	0.91	10:25	1.36	1.16		03:25	0.063	10:25	0.135	0.085	0.085						0.20
07/14/2019	14:40	2.67	11:05	3.68	2.96		17:30	0.92	11:05	1.27	1.13		23:35	0.061	11:05	0.122	0.082	0.082						0.13
07/15/2019	02:55	2.54	16:40	4.23	3.01		05:05	0.90	16:40	1.46	1.12		05:05	0.053	16:40	0.167	0.083	0.083						0.33
07/16/2019	21:35	2.70	08:45	3.83	3.06		21:35	1.01	08:45	1.34	1.13		21:35	0.064	08:45	0.135	0.085	0.085						0.00
07/17/2019	14:45	2.54	22:10	17.74	3.65		12:10	0.95	22:30	2.68	1.23		05:00	0.059	22:30	0.549	0.112	0.112						1.17
07/18/2019	23:45	3.40	00:35	5.18	3.90		22:10	1.25	00:35	1.79	1.48		23:45	0.112	00:35	0.260	0.154	0.154						0.04
07/19/2019	22:35	3.09	08:45	3.97	3.40		15:20	1.15	00:15	1.52	1.29		23:55	0.090	12:40	0.156	0.112	0.112						0.00
07/20/2019	15:55	2.91	18:20	24.16	4.89		15:55	1.10	18:25	3.11	1.44		15:55	0.077	18:25	0.637	0.165	0.165						1.74
07/21/2019	23:55	3.60	00:20	4.80	3.93		21:40	1.31	00:20	1.64	1.47		21:40	0.124	00:20	0.219	0.154	0.154						0.06
07/22/2019	04:10	3.45	14:10	4.61	3.79		01:45	1.35	14:40	1.70	1.48		03:55	0.121	14:40	0.212	0.148	0.148						0.49
07/23/2019	23:45	3.33	10:10	4.32	3.61		23:05	1.34	10:10	1.66	1.46		23:05	0.115	10:10	0.195	0.137	0.137						0.00
07/24/2019	03:45	3.25	15:50	41.58	9.06		01:55	1.32	15:55	4.15	2.01		03:50	0.109	15:55	0.850	0.305	0.305						2.99
07/25/2019	08:15	4.53	11:30	7.65	5.36		07:30	1.61	10:40	2.11	1.82		08:25	0.204	11:30	0.422	0.275	0.275						0.50
07/26/2019	23:00	4.68	09:35	6.11	5.07		22:50	1.54	01:30	1.86	1.69		22:50	0.200	09:35	0.306	0.240	0.240						0.16
07/27/2019	23:55	3.94	10:45	5.45	4.50		15:30	1.37	07:45	1.59	1.48		23:55	0.147	10:45	0.237	0.183	0.183						0.00
07/28/2019	23:55	3.53	10:15	4.75	3.87		13:15	1.29	07:00	1.49	1.41		23:55	0.123	10:15	0.196	0.144	0.144						0.00
07/29/2019	23:55	3.15	09:00	4.39	3.51		03:35	1.23	17:50	1.44	1.34		23:55	0.098	09:00	0.170	0.121	0.121						0.00
07/30/2019	23:15	2.98	08:15	3.79	3.22		23:05	1.20	14:35	1.45	1.28		23:05	0.087	08:15	0.140	0.104	0.104						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
07/31/2019	03:10	2.88	17:50	6.09	3.47		01:40	1.14	17:50	1.77	1.35		01:40	0.081	17:50	0.307	0.124	0.124						0.89
08/01/2019	17:10	3.45	18:00	22.60	5.32		17:05	1.30	18:50	2.62	1.61		17:05	0.114	18:50	0.536	0.202	0.202						1.30
08/02/2019	23:55	3.84	00:10	5.17	4.29		16:10	1.37	00:10	1.77	1.59		23:55	0.151	00:10	0.256	0.186	0.186						0.02
08/03/2019	06:15	3.68	08:55	7.99	4.70		17:05	1.44	09:55	1.71	1.54		05:20	0.140	09:15	0.346	0.200	0.200						0.37
08/04/2019	23:40	3.38	07:25	4.76	3.86		04:35	1.28	00:45	1.55	1.42		23:35	0.114	00:45	0.198	0.145	0.145						0.00
08/05/2019	03:20	3.26	07:00	6.22	3.87		02:15	1.28	07:40	1.65	1.45		02:15	0.106	07:00	0.278	0.150	0.150						0.26
08/06/2019	05:00	3.29	08:20	13.52	4.77		04:50	1.33	08:50	2.15	1.61		04:50	0.111	08:50	0.441	0.202	0.202						0.82
08/07/2019	04:20	3.77	17:40	7.96	4.50		04:55	1.44	21:00	1.78	1.59		04:55	0.143	18:00	0.361	0.196	0.196						0.60
08/08/2019	22:15	3.50	00:55	4.98	4.09		22:20	1.44	00:55	1.70	1.56		22:15	0.130	00:55	0.237	0.172	0.172						0.01
08/09/2019	20:30	3.18	00:10	4.06	3.46		14:45	0.55	11:15	1.63	1.46		20:30	0.109	00:10	0.174	0.130	0.130						0.10
08/10/2019	06:10	3.08	13:50	5.41	3.86		06:10	1.31	14:50	1.93	1.54		06:10	0.099	14:50	0.285	0.159	0.159						0.67
08/11/2019	23:55	3.35	13:55	4.29	3.75		21:40	1.40	00:45	1.66	1.50		23:50	0.121	06:50	0.190	0.148	0.148						0.07
08/12/2019	00:25	3.34	01:05	4.82	3.91		10:50	1.34	22:20	1.81	1.56		00:00	0.119	22:20	0.241	0.163	0.163						0.45
08/13/2019	02:50	3.87	03:30	33.30	6.88		00:25	1.45	04:05	3.29	1.87		02:55	0.157	04:05	0.675	0.278	0.278						1.65
08/14/2019	04:10	4.01	09:45	43.80	10.75		03:50	1.46	09:55	3.65	2.19		03:50	0.158	09:55	0.748	0.376	0.376						1.92
08/15/2019	12:00	6.33	17:15	15.09	9.90		23:35	1.48	01:20	2.31	1.96		23:35	0.301	01:20	0.474	0.399	0.399						0.60
08/16/2019	02:45	6.17	04:15	49.87	31.29		03:00	1.38	05:15	3.73	3.01		01:20	0.276	05:15	0.764	0.612	0.612						4.62
08/17/2019	22:50	5.92	11:15	45.51	21.17		10:10	1.87	18:20	3.34	2.60		10:10	0.384	18:20	0.685	0.517	0.517						1.34
08/18/2019	22:35	5.40	22:25	7.38	6.35		18:55	1.23	00:00	2.38	1.76		23:25	0.205	00:35	0.430	0.316	0.316						0.16
08/19/2019	01:55	5.35	18:00	7.72	6.10		01:25	1.16	18:00	2.17	1.46		04:45	0.193	18:00	0.445	0.254	0.254						0.22
08/20/2019	13:30	4.17	15:40	16.66	6.68		04:40	1.28	17:05	2.55	1.75		15:00	0.182	17:05	0.522	0.293	0.293						0.87
08/21/2019	22:00	4.36	22:25	15.12	5.79		22:05	1.52	22:40	2.23	1.76		22:00	0.180	22:40	0.457	0.269	0.269						0.42
08/22/2019	23:55	4.47	00:10	12.03	5.69		21:55	1.39	00:35	2.17	1.63		23:55	0.170	00:35	0.444	0.254	0.254						0.00
08/23/2019	13:50	4.29	16:20	7.38	4.83		13:35	1.23	16:25	1.53	1.36		13:40	0.147	16:25	0.304	0.183	0.183						0.18
08/24/2019	23:35	4.00	18:55	5.33	4.38		15:10	1.20	18:55	1.43	1.31		15:25	0.135	18:55	0.215	0.156	0.156						0.12
08/25/2019	23:45	3.52	10:45	4.55	3.86		13:50	1.21	21:30	1.37	1.28		23:40	0.111	10:45	0.168	0.130	0.130						0.00
08/26/2019	23:55	3.32	10:40	4.14	3.56		03:10	1.13	10:45	1.43	1.28		23:55	0.102	10:40	0.159	0.118	0.118						0.00
08/27/2019	22:40	3.14	11:15	3.91	3.41		16:15	1.15	13:30	1.39	1.25		22:40	0.091	05:40	0.143	0.109	0.109						0.01
08/28/2019	23:50	2.98	08:00	4.04	3.27		19:55	1.06	09:25	1.40	1.21		23:55	0.082	08:00	0.149	0.100	0.100						0.01
08/29/2019	04:10	2.89	09:20	4.07	3.18		04:55	1.12	18:50	1.46	1.21		04:10	0.079	09:20	0.155	0.096	0.096						0.10
08/30/2019	02:30	2.89	16:05	5.21	3.64		03:50	1.11	19:50	1.76	1.36		03:50	0.078	16:05	0.257	0.134	0.134						0.46
08/31/2019	15:15	3.60	17:20	5.90	4.13		14:20	1.24	17:25	1.85	1.47		14:20	0.121	17:25	0.309	0.165	0.165						0.38
09/01/2019	16:05	3.71	17:00	5.82	4.22		06:10	1.25	17:00	1.78	1.44		15:50	0.125	17:00	0.293	0.166	0.166						0.41
09/02/2019	22:30	3.63	00:05	4.66	3.97		23:20	1.10	00:05	1.60	1.37		23:20	0.114	00:05	0.206	0.145	0.145						0.00
09/03/2019	23:55	3.37	08:45	4.58	3.67		00:50	1.03	08:45	1.48	1.18		23:55	0.088	08:45	0.187	0.114	0.114						0.00
09/04/2019	22:50	3.13	07:35	4.51	3.45		22:50	0.99	07:35	1.46	1.09		22:50	0.077	07:35	0.181	0.096	0.096						0.00
09/05/2019	23:40	3.05	07:45	3.83	3.28		05:45	0.91	11:20	1.29	1.07		02:25	0.073	11:20	0.129	0.089	0.089						0.00
09/06/2019	22:40	2.77	10:30	3.74	3.13		02:40	0.98	10:30	1.30	1.07		22:40	0.066	10:30	0.127	0.083	0.083						0.00
09/07/2019	22:55	2.71	09:45	3.68	2.95		03:15	0.95	09:45	1.38	1.08		03:15	0.062	09:45	0.132	0.078	0.078						0.00
09/08/2019	23:55	2.55	10:30	3.54	2.83		02:45	0.93	14:05	1.32	1.06		23:55	0.057	10:30	0.120	0.072	0.072						0.00
09/09/2019	00:55	2.52	22:10	5.14	2.90		00:55	0.92	22:10	1.68	1.09		00:55	0.053	22:10	0.242	0.079	0.079						0.84
09/10/2019	15:45	3.11	00:00	3.99	3.38		04:20	1.15	00:00	1.47	1.26		15:45	0.091	00:00	0.157	0.108	0.108						0.00
09/11/2019	23:45	2.89	07:25	3.94	3.21		04:00	0.98	07:25	1.38	1.13		23:50	0.070	07:25	0.144	0.091	0.091						0.00
09/12/2019	21:05	2.73	08:10	3.67	2.95		11:30	0.88	08:10	1.26	1.03		11:30	0.059	08:10	0.120	0.074	0.074						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
09/13/2019	13:40	2.51	07:45	3.55	2.82		04:55	0.88	16:15	1.37	1.06		03:20	0.053	16:15	0.121	0.072	0.072						0.07
09/14/2019	23:45	2.38	14:30	3.41	2.71		02:45	0.90	14:30	1.32	1.05		23:45	0.050	14:30	0.114	0.068	0.068						0.00
09/15/2019	03:50	2.39	09:20	3.32	2.60		02:40	0.90	10:45	1.24	1.01		02:40	0.049	10:45	0.103	0.061	0.061						0.00
09/16/2019	23:05	2.30	08:20	3.46	2.57		03:00	0.89	11:05	1.36	1.03		02:55	0.046	08:20	0.120	0.062	0.062						0.00
09/17/2019	02:50	2.21	09:50	3.32	2.51		02:30	0.87	16:15	1.31	1.00		02:35	0.042	16:15	0.109	0.058	0.058						0.00
09/18/2019	03:55	2.17	20:45	5.88	2.70		05:35	0.85	20:45	1.87	1.05		04:15	0.041	20:45	0.313	0.071	0.071						0.81
09/19/2019	23:40	2.75	00:25	3.74	3.06		19:20	1.00	10:20	1.42	1.19		23:40	0.067	10:20	0.137	0.090	0.090						0.00
09/20/2019	23:20	2.63	12:45	3.60	2.87		04:20	0.94	11:10	1.32	1.07		04:20	0.059	12:45	0.118	0.074	0.074						0.09
09/21/2019	21:55	2.54	10:55	3.39	2.76		00:50	0.91	10:55	1.26	1.02		04:05	0.054	10:55	0.108	0.067	0.067						0.00
09/22/2019	23:55	2.34	10:50	3.47	2.65		16:35	0.81	10:50	1.34	0.97		23:55	0.045	10:50	0.119	0.061	0.061						0.00
09/23/2019	03:05	2.27	08:30	3.34	2.54		04:10	0.78	12:25	1.21	0.94		03:00	0.040	08:30	0.101	0.055	0.055						0.00
09/24/2019	04:05	2.21	08:05	3.26	2.50		01:55	0.74	08:05	1.20	0.93		01:55	0.037	08:05	0.099	0.054	0.054						0.00
09/25/2019	16:40	2.15	10:00	3.32	2.43		02:40	0.78	10:00	1.29	0.93		02:40	0.036	10:00	0.108	0.052	0.052						0.00
09/26/2019	03:30	2.05	09:40	3.18	2.37		00:50	0.78	10:40	1.20	0.94		03:30	0.035	09:40	0.090	0.051	0.051						0.00
09/27/2019	04:50	2.11	08:35	3.14	2.39		22:40	0.78	11:25	1.21	0.94		04:50	0.036	08:35	0.091	0.051	0.051						0.00
09/28/2019	04:00	2.06	10:10	3.22	2.38		03:50	0.78	11:15	1.30	0.95		03:50	0.035	10:10	0.100	0.051	0.051						0.00
09/29/2019	23:40	1.99	09:50	3.26	2.37		21:10	0.75	09:50	1.30	0.96		21:10	0.033	09:50	0.107	0.051	0.051						0.00
09/30/2019	03:15	1.91	08:35	3.10	2.24		02:30	0.73	08:35	1.29	0.92		02:30	0.029	08:35	0.099	0.046	0.046						0.00
10/01/2019	03:30	1.89	11:00	3.12	2.26		04:50	0.69	11:00	1.29	0.92		04:50	0.027	11:00	0.100	0.047	0.047						0.00
10/02/2019	04:25	1.86	08:25	3.09	2.25		05:05	0.70	08:25	1.21	0.89		05:05	0.027	08:25	0.092	0.045	0.045						0.00
10/03/2019	02:55	1.83	10:20	3.10	2.25		02:25	0.69	10:20	1.23	0.88		02:25	0.026	10:20	0.094	0.044	0.044						0.00
10/04/2019	02:45	1.85	10:00	3.11	2.23		03:30	0.69	10:00	1.25	0.87		03:30	0.026	10:00	0.096	0.044	0.044						0.00
10/05/2019	04:00	1.80	10:45	3.02	2.20		04:00	0.71	10:45	1.28	0.88		04:00	0.025	10:45	0.095	0.043	0.043						0.00
10/06/2019	05:45	1.75	12:10	2.99	2.16		05:40	0.66	10:45	1.20	0.87		05:40	0.023	11:45	0.085	0.042	0.042						0.05
10/07/2019	03:25	1.76	10:20	3.08	2.23		03:15	0.71	12:55	1.23	0.89		03:25	0.025	12:55	0.091	0.044	0.044						0.43
10/08/2019	04:15	1.95	11:00	3.22	2.32		15:50	0.76	11:00	1.21	0.90		04:15	0.031	11:00	0.098	0.047	0.047						0.00
10/09/2019	02:15	1.88	17:25	3.50	2.45		01:40	0.73	17:25	1.36	0.97		01:40	0.029	17:25	0.122	0.056	0.056						0.58
10/10/2019	21:45	2.18	09:10	3.07	2.49		20:35	0.80	09:10	1.24	1.00		21:40	0.042	09:10	0.094	0.057	0.057						0.00
10/11/2019	04:20	2.01	09:55	3.05	2.35		02:50	0.77	11:25	1.26	0.96		02:50	0.033	11:25	0.094	0.051	0.051						0.00
10/12/2019	04:30	1.92	10:35	2.99	2.27		04:30	0.77	10:35	1.26	0.95		04:30	0.031	10:35	0.092	0.049	0.049						0.00
10/13/2019	03:45	1.86	11:30	2.91	2.23		03:45	0.76	11:30	1.19	0.93		03:45	0.029	11:30	0.084	0.046	0.046						0.00
10/14/2019	05:05	1.87	14:50	2.85	2.22		04:40	0.74	10:05	1.20	0.91		05:05	0.029	14:50	0.081	0.045	0.045						0.00
10/15/2019	04:05	1.75	09:10	2.99	2.19		01:35	0.71	09:10	1.24	0.90		04:05	0.026	09:10	0.091	0.044	0.044						0.00
10/16/2019	03:30	1.76	09:55	2.95	2.16		03:25	0.68	09:55	1.25	0.87		03:30	0.024	09:55	0.090	0.042	0.042						0.00
10/17/2019	01:45	1.74	08:50	2.91	2.15		01:15	0.68	12:30	1.16	0.86		01:50	0.024	08:50	0.080	0.041	0.041						0.00
10/18/2019	04:15	1.69	11:00	3.02	2.17		01:45	0.68	09:45	1.27	0.88		04:20	0.022	11:00	0.092	0.042	0.042						0.38
10/19/2019	00:20	2.15	07:40	16.23	4.84		00:20	0.83	07:55	2.58	1.57		00:20	0.038	07:55	0.529	0.204	0.204						3.17
10/20/2019	23:25	3.22	10:50	4.26	3.51		14:30	1.20	11:20	1.57	1.34		22:25	0.100	10:50	0.181	0.122	0.122						0.00
10/21/2019	03:35	3.18	09:05	4.36	3.55		03:40	1.19	07:10	1.61	1.39		03:40	0.095	09:05	0.191	0.127	0.127						0.17
10/22/2019	23:15	3.02	09:00	4.09	3.33		15:55	1.22	09:00	1.63	1.36		23:15	0.094	09:00	0.179	0.115	0.115						0.00
10/23/2019	23:25	2.83	12:05	3.81	3.15		23:10	1.15	08:30	1.47	1.28		23:10	0.078	12:05	0.147	0.100	0.100						0.00
10/24/2019	23:55	2.60	11:05	3.89	2.98		05:10	1.09	11:05	1.51	1.22		23:50	0.068	11:05	0.156	0.089	0.089						0.00
10/25/2019	03:10	2.56	18:00	4.17	2.99		01:30	0.98	17:55	1.66	1.24		01:30	0.064	17:55	0.186	0.092	0.092						0.10
10/26/2019	23:45	2.76	13:15	4.01	3.07		22:00	1.19	16:50	1.54	1.29		23:45	0.081	13:15	0.159	0.098	0.098						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
10/27/2019	23:40	2.51	09:00	3.61	2.82		16:45	1.12	09:00	1.51	1.25		23:40	0.067	09:00	0.141	0.085	0.085						0.00
10/28/2019	03:20	2.43	09:05	3.31	2.71		17:05	1.14	08:50	1.44	1.24		03:30	0.063	08:50	0.120	0.079	0.079						0.00
10/29/2019	02:35	2.35	10:35	3.41	2.66		21:20	1.09	10:35	1.50	1.21		03:30	0.059	10:35	0.131	0.076	0.076						0.00
10/30/2019	03:20	2.25	07:15	3.15	2.51		02:00	1.06	07:15	1.37	1.15		03:05	0.053	12:10	0.110	0.069	0.069						0.00

Report Summary For The Period 05/10/2019 - 10/30/2019

	UniDepth (in)	Vel (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			17.394	46.59
Avg	3.36	1.17	0.100	

MANATEE CO.

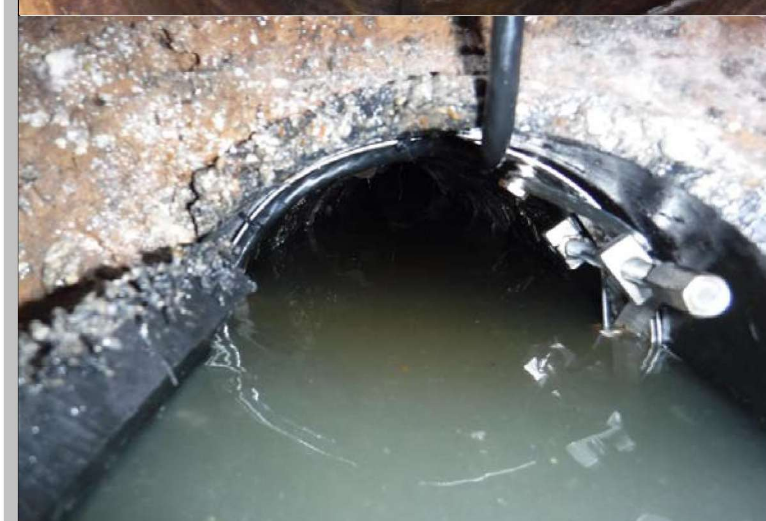
Flow Monitoring Site Report

Site Name:	MH 17797
Installing Team:	BP/TD
Field Manager:	BP/TD
Project Manager	R. Cadet

Site Address /Location:	BEHIND 2016 IOWA AVE. ACCESS VIA EASEMENT BETWEET MICHIGAN AND IOWA		
Site Access Details:	DRIVE	Latitude: 27.4203	Longitude: -82.58257

Monitor Series	Serial Number	I.P. Address
TRITON+	63065	107.80.31.55

Pipe Size (H x W)	Pipe Shape
7.38" x 7.38"	Circular
MH ID:	**System Characteristics**
MH 17797	Residential
Pipe ID:	**Duration**
	Temp



Installation Information

Installation Date:	Installation Type:
4/24/2019	Standard Ring
Monitoring Location (Sensors):	**RG Zone:**
Upstream 0-5 FT	
Sensors / Devices:	**Pressure Sensor Range (psi)**
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Silt (in):
11:21:00 AM	0.25
Depth of Flow (Wet DOF) (in)	**Range (Air DOF) (in)**
4.75	
Peak Velocity (fps)	**Measurement Confidence (in)**
0.87	0.25"
CS5 Offset (in)	**CS4 Offset (in)**
N/A	0.5
Hydraulics	A- Good

Hydraulic Comments:

SMOOTH SLOW FLOW

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Type of Confined Space:
7' 5"	Sanitary
Manhole Material:	**Manhole Condition:**
Liner	Good
US Input:	**USMH:**
	DNL- Did Not Look
DSMH:	**Air Quality:**
DNL- Did Not Look	Safe
Active Drops or Sidelines?	**Surcharge Height (Ft)**
	7'
Pipe Material	**Pipe Condition:**
Liner	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Grass (buried)

Additional Site Info. / Comments:

If backup exists, distance?

Trunk:	N/A	Feet
L/S or P/S:	600	Feet
WWTP	N/A	Feet

ADS Project Name:	MANATEE CO
ADS Project Number:	

ADS ENVIRONMENTAL SERVICES

Daily Tabular Report

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
05/10/2019	03:05	2.50	21:45	16.77	3.47		21:20	0.75	21:55	1.49	0.89		03:05	0.033	21:55	0.264	0.058	0.058						1.36
05/11/2019	05:40	3.81	10:20	6.38	4.81		10:00	0.51	01:40	1.15	0.81		05:35	0.064	10:20	0.109	0.081	0.081						0.01
05/12/2019	23:55	4.08	08:05	6.43	4.77		15:35	0.34	03:15	0.72	0.56		15:35	0.043	12:15	0.089	0.065	0.065						
05/13/2019	02:05	3.86	16:10	14.70	5.70		09:30	0.49	16:10	1.15	0.63		02:30	0.047	16:10	0.202	0.083	0.083						0.70
05/14/2019	22:20	2.24	12:45	7.89	4.58		09:30	0.00	01:50	0.70	0.25		13:50	0.045	01:50	0.103	0.065	0.065						
05/15/2019	03:15	2.24	11:25	6.75	3.36		00:00	0.00	09:10	0.42	0.15		22:00	0.023	08:20	0.063	0.051	0.051						
05/16/2019	00:15	2.22	01:15	5.48	2.76		00:10	0.00	23:35	0.62	0.28		01:25	0.033	10:10	0.065	0.049	0.049						
05/17/2019	19:35	2.29	09:45	6.11	3.12		00:15	0.00	13:55	0.66	0.35		18:55	0.027	10:25	0.068	0.049	0.049						
05/18/2019	20:20	2.26	08:45	5.61	2.59		00:00	0.00	07:15	0.57	0.01		00:40	0.026	01:10	0.056	0.052	0.052						
05/19/2019	16:50	2.29	08:30	5.04	2.79		00:00	0.00	06:50	0.54	0.02		16:05	0.028	02:40	0.056	0.051	0.051						
05/20/2019	01:20	2.40	08:55	5.15	3.63		00:00	0.00	23:55	0.97	0.54		06:10	0.029	10:10	0.105	0.059	0.059						
05/21/2019	11:50	2.72	10:10	7.92	3.52		08:50	0.54	00:05	1.01	0.77		11:50	0.035	10:10	0.108	0.057	0.057						
05/22/2019	08:35	2.43	07:15	4.26	3.00		07:35	0.00	13:35	1.98	0.69		04:45	0.029	12:55	0.076	0.052	0.042						
05/23/2019	00:55	2.56	03:10	3.79	2.97		02:40	0.52	08:30	1.42	0.84		03:55	0.025	09:00	0.086	0.048	0.048						
05/24/2019	23:15	2.39	08:00	3.33	2.95		05:20	0.50	14:45	1.16	0.79		05:20	0.025	09:00	0.072	0.045	0.045						
05/25/2019	00:40	2.28	08:00	3.57	2.91		22:20	0.51	12:45	1.39	0.71		23:30	0.024	09:10	0.077	0.039	0.039						
05/26/2019	03:15	2.68	11:10	3.36	2.91		02:45	0.49	11:30	0.98	0.65		02:50	0.024	11:30	0.065	0.036	0.036						
05/27/2019	02:20	2.69	08:55	3.52	2.88		04:55	0.46	18:45	2.15	0.85		02:20	0.022	12:45	0.079	0.044	0.044						
05/28/2019	05:30	2.64	10:35	4.87	2.86		03:20	0.00	07:20	2.13	1.09		01:35	0.031	10:35	0.134	0.052	0.052						
05/29/2019	04:35	2.57	09:35	4.14	2.85		04:15	0.49	07:20	1.93	0.85		04:15	0.023	09:35	0.102	0.045	0.045						
05/30/2019	04:55	2.45	08:30	3.30	2.85		05:40	0.41	09:15	2.07	0.86		05:00	0.019	09:15	0.081	0.045	0.045						
05/31/2019	05:20	2.51	15:05	3.14	2.79		23:55	0.46	15:10	1.79	0.96		23:55	0.022	07:55	0.078	0.049	0.049						0.10
06/01/2019	01:35	2.36	10:15	3.23	2.78		06:25	0.47	10:45	1.80	0.96		06:35	0.022	12:00	0.092	0.049	0.049						
06/02/2019	04:50	2.50	23:05	3.43	2.82		00:15	0.49	12:15	1.86	1.04		00:45	0.023	12:55	0.090	0.053	0.053						
06/03/2019	15:10	2.58	08:15	3.35	2.80		15:35	0.00	17:20	1.84	0.98		06:50	0.024	12:10	0.081	0.048	0.048						
06/04/2019	03:35	2.42	05:25	3.69	2.80		23:10	0.45	07:30	1.87	0.80		17:40	0.021	09:55	0.087	0.040	0.040						
06/05/2019	05:15	2.38	10:40	3.31	2.78		05:00	0.41	12:55	2.01	0.64		05:00	0.018	13:05	0.069	0.033	0.033						
06/06/2019	04:40	2.29	21:50	3.27	2.78		06:35	0.44	12:25	1.99	0.88		06:35	0.021	16:40	0.094	0.046	0.046						
06/07/2019	03:25	2.41	11:00	3.43	2.67		08:25	0.69	08:00	1.98	1.17		05:30	0.034	09:05	0.091	0.058	0.058						
06/08/2019	20:50	2.38	14:30	4.15	2.73		06:10	0.45	00:15	1.29	0.68		06:10	0.019	09:45	0.062	0.034	0.034						
06/09/2019	07:00	2.31	23:20	21.22	3.44		02:55	0.36	23:30	1.84	0.72		02:55	0.017	23:30	0.325	0.048	0.048						1.45
06/10/2019	23:55	3.04	00:05	5.21	3.58		23:35	0.96	20:10	2.22	1.29		23:35	0.062	00:00	0.244	0.100	0.100						0.22
06/11/2019	04:30	2.93	09:25	3.56	3.18		21:10	0.72	08:05	2.05	1.00		21:10	0.045	09:25	0.104	0.064	0.064						
06/12/2019	12:20	2.58	08:10	3.47	3.16		11:20	0.66	19:30	1.40	0.80		05:40	0.038	15:00	0.075	0.050	0.050						
06/13/2019	04:50	2.89	17:15	39.31	6.21		05:25	0.68	17:45	2.84	1.19		05:30	0.037	17:45	0.500	0.129	0.129						1.84
06/14/2019	23:50	3.93	00:00	5.00	4.32		22:05	1.09	00:20	1.73	1.35		22:05	0.101	00:20	0.203	0.138	0.138						
06/15/2019	05:35	3.86	23:20	5.09	4.20		18:40	0.92	00:00	1.52	1.12		18:40	0.085	23:25	0.181	0.109	0.109						0.56
06/16/2019	23:55	4.27	00:00	4.93	4.58		23:55	0.96	08:25	1.41	1.15		23:55	0.096	00:35	0.166	0.127	0.127						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
06/17/2019	22:05	3.84	10:10	4.85	4.11		04:15	0.90	10:10	1.26	1.03		22:20	0.082	10:10	0.150	0.097	0.097						
06/18/2019	01:05	3.77	04:50	5.37	4.61		00:30	0.92	06:30	1.64	1.16		00:30	0.077	04:50	0.206	0.130	0.130						0.64
06/19/2019	23:55	3.89	09:45	5.49	4.25		09:40	0.93	11:00	2.07	1.15		23:50	0.086	13:00	0.147	0.112	0.112						0.12
06/20/2019	23:45	3.71	07:50	4.46	3.92		21:05	0.87	08:05	1.33	1.04		21:05	0.076	08:05	0.131	0.091	0.091						
06/21/2019	23:55	3.41	07:55	4.11	3.68		03:25	0.86	13:35	2.07	1.09		03:25	0.068	07:50	0.113	0.086	0.086						
06/22/2019	18:55	3.33	12:00	3.87	3.48		05:35	0.92	13:15	2.04	1.22		05:35	0.064	11:40	0.121	0.089	0.089						
06/23/2019	05:30	3.22	08:20	3.83	3.38		04:30	0.87	06:40	2.20	1.22		04:30	0.057	10:55	0.131	0.085	0.085						
06/24/2019	23:30	3.03	08:05	3.75	3.27		01:20	0.88	12:40	2.15	1.18		23:55	0.054	09:05	0.107	0.078	0.078						
06/25/2019	03:15	2.92	11:50	3.46	3.11		01:45	0.88	19:05	2.17	1.18		01:45	0.050	08:05	0.100	0.072	0.072						
06/26/2019	04:45	2.85	09:25	3.41	3.03		04:55	0.83	08:05	1.74	1.18		04:55	0.044	09:45	0.096	0.070	0.070						
06/27/2019	04:50	2.81	08:25	3.47	2.98		04:00	0.84	11:55	1.57	1.18		04:00	0.044	09:40	0.093	0.067	0.067						0.12
06/28/2019	03:55	2.74	17:45	9.67	3.52		02:30	0.91	18:00	1.84	1.29		03:20	0.046	17:45	0.290	0.101	0.101						1.23
06/29/2019	15:45	3.72	09:20	4.42	4.03		15:05	1.09	09:00	1.83	1.53		15:05	0.092	09:00	0.173	0.140	0.140						0.18
06/30/2019	04:00	3.74	07:40	4.21	3.95		17:35	0.91	00:35	1.60	1.20		23:50	0.081	10:45	0.143	0.106	0.106						
07/01/2019	11:25	3.32	08:50	4.30	3.82		18:30	0.75	08:05	1.42	0.92		18:30	0.061	08:05	0.140	0.078	0.078						0.00
07/02/2019	23:50	3.35	07:55	4.19	3.59		08:05	0.72	08:35	2.12	1.09		08:05	0.061	10:55	0.108	0.084	0.084						0.00
07/03/2019	23:55	3.15	09:30	3.72	3.32		08:00	0.91	11:20	1.81	1.16		02:50	0.062	11:30	0.120	0.079	0.079						0.00
07/04/2019	21:35	3.05	09:05	3.68	3.22		15:50	0.89	10:00	1.44	1.17		15:50	0.056	10:00	0.114	0.076	0.076						0.04
07/05/2019	23:55	2.92	10:15	3.56	3.10		11:50	0.97	08:50	1.53	1.25		05:50	0.059	08:50	0.105	0.076	0.076						0.11
07/06/2019	23:40	2.83	10:25	3.69	3.07		08:35	1.04	16:45	1.61	1.30		23:25	0.060	10:30	0.111	0.078	0.078						0.00
07/07/2019	05:20	2.77	10:55	3.47	3.01		01:20	0.96	20:15	1.53	1.24		01:20	0.049	10:00	0.100	0.072	0.072						0.27
07/08/2019	02:15	2.86	03:35	5.39	4.26		02:15	0.86	14:30	1.84	1.53		02:10	0.060	03:40	0.228	0.154	0.154						1.12
07/09/2019	02:35	3.88	14:00	39.80	10.96		08:40	1.07	14:40	3.35	1.84		11:30	0.097	14:40	0.591	0.262	0.262						2.72
07/10/2019	23:35	5.61	00:05	6.73	6.01		21:05	1.42	11:40	1.95	1.71		21:05	0.208	00:30	0.310	0.260	0.260						0.08
07/11/2019	23:55	5.34	10:40	5.81	5.54		07:15	1.15	06:50	1.60	1.41		19:25	0.164	07:55	0.229	0.196	0.196						0.09
07/12/2019	23:50	4.84	08:45	5.97	5.24		22:35	1.14	08:45	1.63	1.30		22:35	0.139	08:45	0.245	0.170	0.170						0.00
07/13/2019	15:40	4.62	09:20	5.15	4.82		02:30	1.05	18:35	1.57	1.27		02:30	0.122	11:30	0.178	0.148	0.148						0.20
07/14/2019	23:30	4.40	08:50	5.11	4.66		12:40	1.09	19:55	1.69	1.41		16:05	0.129	19:55	0.191	0.158	0.158						0.13
07/15/2019	05:00	4.25	16:55	5.33	4.59		10:30	1.12	23:00	1.73	1.35		04:10	0.115	23:00	0.203	0.149	0.149						0.33
07/16/2019	23:10	4.11	08:55	4.96	4.45		17:35	1.04	08:00	1.59	1.24		23:50	0.101	09:00	0.192	0.132	0.132						0.00
07/17/2019	15:50	3.89	23:10	30.43	6.03		18:55	0.99	23:40	2.65	1.27		19:15	0.091	23:40	0.468	0.137	0.137						1.17
07/18/2019	03:25	5.34	00:00	19.01	6.31		19:50	1.51	00:00	2.57	1.83		23:25	0.210	00:00	0.453	0.271	0.271						0.04
07/19/2019	22:40	5.15	07:50	5.56	5.29		14:25	1.19	03:15	1.74	1.38		22:55	0.153	07:50	0.228	0.181	0.181						0.00
07/20/2019	15:15	4.82	19:00	37.65	10.21		08:35	1.05	20:45	2.78	1.52		16:40	0.131	20:45	0.490	0.223	0.223						1.74
07/21/2019	12:20	5.42	00:00	9.44	6.40		17:30	1.31	06:05	2.33	1.77		23:10	0.216	03:55	0.331	0.280	0.280						0.06
07/22/2019	10:40	5.41	14:25	11.27	6.97		22:35	1.24	00:25	1.67	1.42		05:45	0.186	14:30	0.271	0.230	0.230						0.49
07/23/2019	23:50	4.89	15:35	20.67	6.66		15:05	1.20	17:35	2.01	1.47		23:00	0.175	17:35	0.354	0.220	0.220						0.00
07/24/2019	04:10	4.83	15:55	45.88	16.24		14:00	1.31	17:15	4.02	2.05		03:35	0.167	16:40	0.563	0.315	0.315						2.99
07/25/2019	06:35	8.91	11:35	25.24	14.19		08:20	1.84	12:55	2.47	2.08		08:20	0.324	12:55	0.436	0.367	0.367						0.50
07/26/2019	23:55	10.97	10:50	15.60	13.39		23:15	1.63	00:55	1.96	1.82		23:15	0.287	00:55	0.346	0.320	0.320						0.16
07/27/2019	23:55	8.10	00:05	10.96	9.73		06:50	1.39	01:50	1.69	1.57		20:40	0.255	01:50	0.297	0.277	0.277						0.00
07/28/2019	04:45	6.51	18:45	8.81	7.43		17:10	1.24	05:50	1.56	1.38		17:10	0.219	05:50	0.263	0.242	0.242						0.00
07/29/2019	23:55	5.44	08:40	9.77	6.57		11:50	1.08	21:50	1.49	1.29		23:55	0.172	08:50	0.238	0.207	0.207						0.00
07/30/2019	23:55	5.05	11:40	6.29	5.36		21:50	1.10	12:10	1.61	1.30		21:50	0.138	07:45	0.221	0.174	0.174						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
07/31/2019	16:50	4.62	18:00	10.66	5.56		09:05	1.13	19:25	1.95	1.39		04:40	0.144	18:10	0.320	0.192	0.192						0.89
08/01/2019	12:00	5.49	19:25	33.39	10.85		07:45	1.30	20:35	2.66	1.79		16:45	0.184	20:35	0.469	0.281	0.281						1.30
08/02/2019	23:55	7.70	00:00	17.22	11.31		19:40	1.43	00:00	2.24	1.74		23:55	0.262	00:00	0.395	0.306	0.306						0.02
08/03/2019	06:50	6.21	09:25	17.12	10.60		00:30	1.31	10:10	2.19	1.70		04:25	0.233	10:10	0.386	0.295	0.295						0.37
08/04/2019	23:55	6.93	09:50	10.04	8.48		23:50	1.23	01:25	1.49	1.40		23:50	0.211	01:25	0.263	0.247	0.247						0.00
08/05/2019	23:00	5.97	08:15	14.57	8.36		02:45	1.13	08:50	1.75	1.39		23:10	0.192	08:50	0.309	0.237	0.237						0.26
08/06/2019	04:35	5.65	08:50	26.62	11.62		06:40	1.17	10:30	2.27	1.61		02:50	0.175	10:30	0.401	0.273	0.273						0.82
08/07/2019	05:25	6.95	19:05	20.79	11.14		09:55	1.36	19:50	2.08	1.61		09:55	0.241	19:50	0.367	0.283	0.283						0.60
08/08/2019	23:40	7.26	00:00	15.78	11.04		23:35	1.30	00:25	1.84	1.56		23:35	0.229	00:25	0.324	0.275	0.275						0.01
08/09/2019	15:15	5.85	11:00	8.05	6.85		18:20	1.06	14:25	1.50	1.30		15:15	0.186	03:25	0.237	0.221	0.221						0.10
08/10/2019	04:05	1.25	09:00	7.38	3.83		04:05	0.00	15:30	1.90	1.41		07:20	0.190	15:30	0.335	0.248	0.248						0.67
08/11/2019	07:50	0.00	08:35	7.38	6.17		00:25	0.00	11:20	1.59	1.36		23:45	0.194	10:05	0.262	0.230	0.230						0.07
08/12/2019	17:55	5.77	22:00	10.24	7.45		00:25	-8.99	22:20	1.40	0.40		17:35	0.183	22:20	0.247	0.212	0.074						0.45
08/13/2019	02:40	7.20	04:20	40.01	20.59		03:55	0.99	04:55	2.60	2.04		03:55	0.175	04:55	0.458	0.361	0.361						1.65
08/14/2019	04:45	11.55	10:15	45.86	26.25		05:05	1.60	11:10	2.60	2.16		05:05	0.283	11:10	0.458	0.381	0.381						1.92
08/15/2019	23:55	25.48	01:30	36.22	30.34		21:35	2.10	03:45	2.45	2.30		21:35	0.371	03:45	0.432	0.405	0.405						0.60
08/16/2019	02:50	23.67	17:45	52.84	44.49		02:55	2.17	13:15	2.76	2.57		02:55	0.383	13:15	0.487	0.453	0.453						4.62
08/17/2019	23:55	31.73	11:05	51.32	40.86		18:15	2.30	20:45	2.92	2.67		18:15	0.405	20:45	0.516	0.472	0.472						1.34
08/18/2019	23:55	24.78	03:55	31.87	28.07		23:30	2.39	05:40	2.83	2.62		23:30	0.422	05:40	0.499	0.462	0.462						0.16
08/19/2019	15:40	20.79	19:55	26.38	23.27		12:25	2.14	21:05	2.46	2.31		16:10	0.379	21:05	0.433	0.407	0.407						0.22
08/20/2019	07:20	20.70	00:00	24.68	21.93		09:35	0.00	00:25	2.35	0.89		06:45	0.371	00:25	0.415	0.392	0.155						0.87
08/21/2019							00:00	0.00	00:00	0.00	0.00													0.42
08/22/2019	17:20	7.61	17:30	8.83	8.50		00:00	0.00	12:30	2.36	0.52		23:45	0.299	18:25	0.359	0.325	0.090						0.00
08/23/2019	00:05	8.13	17:30	14.15	10.40		12:55	1.56	17:30	2.00	1.79		12:55	0.274	17:30	0.353	0.315	0.315						0.18
08/24/2019	05:35	11.05	20:30	12.31	11.63		23:50	1.46	00:10	1.78	1.65		23:50	0.258	00:10	0.314	0.292	0.292						0.12
08/25/2019	23:55	9.40	10:15	11.68	10.71		21:05	1.29	12:40	1.63	1.54		20:50	0.248	12:40	0.288	0.272	0.272						0.00
08/26/2019	23:35	7.69	09:05	10.54	9.02		20:35	1.24	09:30	1.55	1.44		20:35	0.219	09:30	0.273	0.254	0.254						0.00
08/27/2019	23:55	6.02	08:00	9.07	7.26		11:45	1.19	17:00	1.58	1.34		17:20	0.198	00:15	0.249	0.230	0.230						0.01
08/28/2019	23:55	5.54	11:15	6.43	5.77		23:50	1.22	15:55	1.66	1.40		23:50	0.169	11:15	0.228	0.203	0.203						0.01
08/29/2019	17:45	5.44	19:30	5.86	5.57		02:30	1.21	08:10	1.60	1.34		02:30	0.166	08:10	0.233	0.188	0.188						0.10
08/30/2019	15:20	5.32	16:15	8.76	5.90		00:25	1.20	21:20	1.68	1.40		00:25	0.163	16:20	0.287	0.207	0.207						0.46
08/31/2019	16:05	5.92	17:45	11.86	6.96		15:00	1.21	18:10	1.76	1.53		15:00	0.185	18:10	0.310	0.246	0.246						0.38
09/01/2019	05:30	6.28	18:20	13.60	8.09		14:50	1.28	18:10	1.87	1.54		16:30	0.216	18:10	0.331	0.262	0.262						0.41
09/02/2019	23:50	5.98	09:30	8.74	7.06		17:25	1.28	16:10	1.66	1.47		21:55	0.206	12:40	0.291	0.248	0.248						0.00
09/03/2019	23:55	5.54	10:25	6.38	5.79		14:10	1.25	08:50	1.49	1.38		18:55	0.180	10:25	0.232	0.201	0.201						0.00
09/04/2019	23:50	5.35	12:10	6.05	5.55		22:30	1.10	11:40	1.48	1.29		22:30	0.154	11:40	0.208	0.180	0.180						0.00
09/05/2019	22:20	5.18	09:10	5.79	5.33		12:05	1.03	11:35	1.36	1.17		23:35	0.140	09:10	0.188	0.156	0.156						0.00
09/06/2019	23:55	4.87	08:45	5.45	5.11		19:45	1.03	12:45	1.26	1.10		23:45	0.126	08:45	0.159	0.139	0.139						0.00
09/07/2019	23:45	4.66	09:10	5.13	4.84		02:05	0.98	13:05	1.27	1.11		02:05	0.115	12:55	0.153	0.131	0.131						0.00
09/08/2019	22:10	4.45	11:20	5.04	4.65		09:30	1.01	08:45	1.33	1.12		23:55	0.109	11:10	0.148	0.125	0.125						0.00
09/09/2019	15:30	4.36	22:15	6.45	4.63		01:10	1.00	22:45	1.65	1.15		01:10	0.105	22:15	0.261	0.130	0.130						0.84
09/10/2019	23:40	4.82	00:00	5.37	5.00		21:20	1.15	01:50	1.67	1.38		21:20	0.138	01:50	0.213	0.170	0.170						0.00
09/11/2019	22:45	4.41	09:25	5.08	4.71		05:15	1.01	10:55	1.39	1.21		23:35	0.114	09:00	0.171	0.138	0.138						0.00
09/12/2019	23:05	4.34	06:55	4.92	4.53		22:55	0.92	02:40	1.36	1.11		22:55	0.094	06:55	0.143	0.120	0.120						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
09/13/2019	23:55	4.27	06:50	4.78	4.43		03:45	0.89	13:45	1.22	1.03		03:45	0.090	08:45	0.140	0.108	0.108						0.07
09/14/2019	23:10	4.24	10:00	4.77	4.41		04:45	0.83	20:05	1.33	1.06		04:45	0.082	10:00	0.150	0.110	0.110						0.00
09/15/2019	14:00	4.11	08:25	4.76	4.28		01:35	0.86	08:30	1.22	1.02		01:35	0.085	08:25	0.139	0.102	0.102						0.00
09/16/2019	22:15	4.05	09:40	4.71	4.23		15:50	0.79	08:25	1.19	0.94		15:50	0.077	08:40	0.131	0.092	0.092						0.00
09/17/2019	23:45	3.87	09:05	4.49	4.07		00:35	0.86	09:35	1.27	1.09		02:20	0.079	09:05	0.127	0.101	0.101						0.00
09/18/2019	02:50	3.83	20:50	9.15	4.27		14:30	0.91	21:55	1.92	1.17		14:30	0.081	21:05	0.288	0.117	0.117						0.81
09/19/2019	03:50	2.47	11:35	5.38	4.95		17:50	0.94	00:10	1.55	1.22		17:50	0.115	11:35	0.194	0.149	0.149						0.00
09/20/2019	23:15	4.68	10:35	5.24	4.87		21:40	0.87	07:55	1.17	1.04		21:40	0.098	07:55	0.146	0.124	0.124						0.09
09/21/2019	23:15	4.34	11:05	5.30	4.65		00:55	0.80	23:30	1.15	1.00		21:45	0.090	11:00	0.143	0.112	0.112						0.00
09/22/2019	04:45	4.25	08:15	4.99	4.47		19:20	0.68	10:55	1.20	0.98		23:30	0.077	10:45	0.135	0.105	0.105						0.00
09/23/2019	15:20	2.46	08:35	5.30	4.35		02:40	0.60	13:20	1.14	0.95		00:55	0.068	08:35	0.132	0.098	0.098						0.00
09/24/2019	13:35	4.05	08:35	5.27	4.29		18:40	0.67	10:00	1.11	0.94		04:40	0.075	08:35	0.133	0.094	0.094						0.00
09/25/2019	16:20	3.80	08:30	4.98	4.13		01:30	0.85	15:20	1.22	1.06		01:30	0.079	08:30	0.134	0.101	0.101						0.00
09/26/2019	08:15	2.99	08:00	4.83	4.05		22:15	0.82	08:25	1.19	0.97		23:05	0.075	08:35	0.121	0.090	0.090						0.00
09/27/2019	23:55	3.68	12:40	4.77	4.02		00:30	0.89	16:30	1.20	0.97		23:55	0.077	12:40	0.121	0.088	0.088						0.00
09/28/2019	04:10	3.61	17:25	4.45	3.88		08:35	0.88	13:30	1.17	1.01		03:55	0.071	17:25	0.111	0.088	0.088						0.00
09/29/2019	23:30	3.48	08:30	4.56	3.80		08:55	0.99	12:40	1.22	1.05		23:35	0.075	08:30	0.117	0.089	0.089						0.00
09/30/2019	03:55	3.38	08:35	4.61	3.68		23:45	0.80	08:20	1.16	0.94		23:45	0.060	08:35	0.113	0.075	0.075						0.00
10/01/2019	16:10	3.40	09:45	4.14	3.64		04:30	0.78	16:15	0.99	0.87		04:35	0.057	09:45	0.091	0.068	0.068						0.00
10/02/2019	01:25	3.39	09:00	4.07	3.61		02:45	0.81	11:20	0.95	0.88		01:25	0.058	09:00	0.088	0.069	0.069						0.00
10/03/2019	17:55	3.36	09:55	4.18	3.57		01:00	0.79	09:55	1.02	0.90		01:00	0.057	09:55	0.099	0.069	0.069						0.00
10/04/2019	23:55	3.33	09:10	4.40	3.58		01:50	0.88	12:05	1.24	0.97		23:55	0.063	09:10	0.101	0.074	0.074						0.00
10/05/2019	03:50	3.27	09:15	4.14	3.50		15:40	0.72	12:35	1.14	0.91		04:40	0.058	10:20	0.096	0.067	0.067						0.00
10/06/2019	23:55	3.27	12:05	3.99	3.48		00:35	0.79	16:55	1.08	0.91		00:35	0.054	12:05	0.084	0.067	0.067						0.05
10/07/2019	04:55	3.22	09:25	3.89	3.44		04:45	0.86	15:30	1.09	0.95		04:45	0.056	09:25	0.089	0.069	0.069						0.43
10/08/2019	23:10	3.32	08:05	3.97	3.54		05:40	0.93	12:45	1.23	1.02		23:55	0.065	10:10	0.100	0.077	0.077						0.00
10/09/2019	05:40	3.20	16:40	5.12	3.76		04:55	0.83	18:15	1.31	1.05		05:10	0.057	17:35	0.154	0.088	0.088						0.58
10/10/2019	04:45	3.80	09:30	4.62	4.05		11:00	0.89	12:55	1.28	1.09		15:50	0.086	12:55	0.132	0.100	0.100						0.00
10/11/2019	02:50	3.61	09:30	4.56	3.90		22:30	0.91	04:20	1.24	1.00		15:05	0.076	09:30	0.125	0.088	0.088						0.00
10/12/2019	23:55	3.54	09:05	4.55	3.84		23:35	0.85	11:10	1.21	0.93		23:55	0.066	08:45	0.116	0.080	0.080						0.00
10/13/2019	21:40	3.39	09:35	4.35	3.67		02:15	0.82	19:05	1.15	0.92		02:15	0.060	09:35	0.100	0.073	0.073						0.00
10/14/2019	05:00	3.28	08:45	4.34	3.60		07:20	0.80	12:25	1.14	0.94		05:05	0.057	08:30	0.113	0.072	0.072						0.00
10/15/2019	22:35	3.25	17:30	4.16	3.47		09:10	0.84	13:10	1.26	0.97		05:20	0.058	17:30	0.113	0.071	0.071						0.00
10/16/2019	23:55	3.09	09:05	4.14	3.37		04:50	0.84	17:00	1.18	0.99		03:20	0.055	09:00	0.097	0.069	0.069						0.00
10/17/2019	02:50	3.04	09:20	4.11	3.37		19:45	0.80	04:40	1.12	0.92		03:25	0.054	09:20	0.095	0.064	0.064						0.00
10/18/2019	18:40	3.18	16:45	4.02	3.41		04:55	0.76	16:45	1.06	0.87		04:55	0.049	16:45	0.096	0.062	0.062						0.38
10/19/2019	00:40	3.39	09:05	32.62	10.30		00:45	0.89	09:05	3.02	1.94		00:45	0.063	09:05	0.534	0.318	0.318						3.17
10/20/2019	20:15	5.43	09:15	6.03	5.66		15:50	1.48	11:20	1.92	1.71		22:10	0.203	11:20	0.279	0.244	0.244						0.00
10/21/2019	05:25	5.32	08:05	6.33	5.67		22:00	1.17	11:30	1.91	1.41		22:00	0.167	07:50	0.265	0.200	0.200						0.17
10/22/2019	21:35	5.27	09:55	5.95	5.48		23:10	1.08	07:40	1.44	1.23		23:10	0.142	09:05	0.204	0.168	0.168						0.00
10/23/2019	21:55	4.96	09:00	5.93	5.28		20:20	0.92	11:00	1.43	1.15		23:15	0.117	11:00	0.206	0.151	0.151						0.00
10/24/2019	23:35	4.54	08:10	5.36	4.91		04:10	0.92	14:35	1.40	1.14		04:10	0.110	08:30	0.172	0.137	0.137						0.00
10/25/2019	05:00	4.42	18:10	5.20	4.67		06:00	1.02	10:05	1.53	1.15		06:00	0.107	18:45	0.183	0.130	0.130						0.10
10/26/2019	23:55	4.41	10:10	5.19	4.70		20:35	0.97	08:15	1.40	1.12		20:35	0.103	08:15	0.172	0.128	0.128						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
10/27/2019	23:05	4.20	08:15	5.11	4.43		20:55	0.92	11:30	1.23	1.03		20:55	0.093	11:30	0.144	0.108	0.108						0.00
10/28/2019	23:35	3.87	08:20	4.67	4.22		13:05	0.88	13:10	1.64	1.10		04:25	0.087	12:45	0.137	0.107	0.107						0.00
10/29/2019	02:50	3.76	09:50	4.77	4.03		23:25	0.90	12:45	1.54	1.09		04:05	0.079	09:40	0.144	0.100	0.100						0.00
10/30/2019	02:00	3.81	10:15	4.45	4.02		05:55	0.85	01:10	2.26	0.99		02:00	0.072	10:45	0.119	0.090	0.090						0.00

Report Summary For The Period 05/10/2019 - 10/30/2019

	UniDepth (in)	Vel (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			24.839	46.59
Avg	6.15	1.18	0.145	

MANATEE CO

Flow Monitoring Site Report

Site Name:	**MH 24364**
Installing Team:	**BP/TD**
Field Manager:	**BP/TD**
Project Manager	**R. Cadet**

Site Address /Location:	2003 Bay Dr. Bradenton. Inside fenced pump station. If locked contact Steve Nail for access. (941-737-5854)			Monitor Series	FS Triton	Serial Number	64333
				I.P. Address	107.80.18.123		
Site Access Details:	DRIVE	Latitude:	27.41854	Pipe Size (H x W)	7.38" x 7.25"	Pipe Shape	Elliptical
		Longitude:	-82.58258				

MH ID:	System Characteristics
MH ID:MH24364	Residential
Pipe ID:	Duration
	Temp

Installation Information

Installation Date:	Installation Type:
4/23/2019	Standard Ring
Monitoring Location (Sensors):	RG Zone:
Upstream 0-5 FT	
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Silt (in):
3:53:00 PM	0.13
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
1.25	
Peak Velocity (fps)	Measurement Confidence (in)
1.04	0.25"
CS5 Offset (in)	CS4 Offset (in)
N/A	0
Hydraulics	A- Good
Hydraulic Comments:	
SHALLOW SMOOTH FLOW	

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Type of Confined Space:
7.0'	Sanitary
Manhole Material:	Manhole Condition:
Concrete	Fair
US Input:	USMH:
	DNL- Did Not Look
DSMH:	Air Quality:
Unacceptable Hydraulics	Safe
Active Drops or Sidelines?	Surcharge Height (Ft)
No	1'
Pipe Material	Pipe Condition:
Lined	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Grass (buried)

Additional Site Info. / Comments:	If backup exists, distance?		
If locked contact Steve Nail for access. (941-737-5854)	Trunk:	N/A	Feet
	L/S or P/S:	150	Feet
	WWTP	N/A	Feet

ADS Project Name:	MANATEE CO.
ADS Project Number:	

Daily Tabular Report

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
05/10/2019	04:25	1.17	10:30	2.49	1.65		18:10	0.00	21:35	2.64	1.30		04:15	0.005	21:35	0.122	0.026	0.026						1.36
05/11/2019	23:50	1.15	23:30	1.87	1.27		05:35	0.00	18:45	2.49	1.48		00:35	0.013	12:50	0.060	0.029	0.029						0.01
05/12/2019	00:30	1.16	11:50	1.93	1.38		11:35	0.00	16:45	2.46	1.39		19:50	0.010	13:05	0.055	0.025	0.025						
05/13/2019	01:00	1.14	05:45	2.12	1.33		00:45	0.00	22:55	2.38	1.30		05:40	0.007	15:55	0.063	0.031	0.031						0.70
05/14/2019	05:00	1.21	19:25	1.73	1.29		11:50	0.00	23:15	2.34	1.28		18:35	0.008	04:45	0.037	0.020	0.020						
05/15/2019	04:20	1.15	16:25	2.19	1.36		19:15	0.00	20:40	2.42	1.00		23:25	0.006	19:20	0.042	0.015	0.015						
05/16/2019	04:10	1.12	00:45	1.95	1.36		11:10	0.00	14:35	2.27	1.18		04:20	0.004	10:00	0.045	0.021	0.021						
05/17/2019	09:55	1.11	23:00	1.83	1.35		00:00	0.00	20:15	2.18	0.84		01:30	0.004	10:35	0.045	0.018	0.018						
05/18/2019	14:10	1.20	08:05	2.38	1.44		08:40	0.00	21:35	2.18	1.20		06:50	0.012	21:35	0.051	0.026	0.026						
05/19/2019	22:35	1.08	21:15	2.01	1.32		07:25	0.00	22:05	2.41	0.98		11:55	0.006	22:05	0.056	0.020	0.020						
05/20/2019	06:50	1.08	23:55	2.12	1.26		18:35	0.00	06:50	2.24	1.09		14:55	0.008	06:50	0.046	0.022	0.022						
05/21/2019	02:00	1.08	00:15	2.31	1.30		09:45	0.00	09:10	2.40	1.20		03:40	0.007	09:10	0.056	0.024	0.024						
05/22/2019	11:55	1.06	18:25	2.15	1.26		03:05	0.32	18:40	2.35	1.07		03:05	0.005	09:55	0.061	0.022	0.022						
05/23/2019	06:40	1.13	13:15	2.13	1.40		07:10	0.00	10:45	2.36	1.16		21:00	0.009	10:45	0.063	0.024	0.024						
05/24/2019	23:50	1.16	11:20	2.91	1.49		04:25	0.24	02:20	2.04	0.68		04:25	0.004	02:20	0.048	0.014	0.014						
05/25/2019	03:55	1.12	09:55	2.04	1.39		20:25	0.32	09:20	0.74	0.47		23:55	0.007	09:55	0.027	0.011	0.011						
05/26/2019	02:35	1.11	03:55	2.43	1.38		05:25	0.30	15:15	1.10	0.45		05:25	0.006	15:15	0.024	0.011	0.011						
05/27/2019	05:50	0.72	03:50	2.00	1.41		13:25	0.28	23:25	2.13	0.60		13:55	0.006	19:30	0.039	0.012	0.012						
05/28/2019	23:45	1.16	20:00	2.07	1.53		19:10	0.00	09:20	2.43	1.10		21:10	0.005	09:20	0.089	0.026	0.026						
05/29/2019	05:50	1.14	07:20	3.78	1.37		15:15	0.00	12:20	2.43	0.85		04:10	0.005	08:45	0.063	0.017	0.017						
05/30/2019	01:45	1.15	01:05	2.18	1.40		11:15	0.00	18:15	2.43	0.97		04:05	0.004	18:15	0.063	0.019	0.019						
05/31/2019	10:50	1.21	18:10	2.17	1.50		04:50	0.00	10:20	2.37	0.91		02:05	0.003	10:20	0.062	0.017	0.017						0.10
06/01/2019	22:20	1.10	21:45	2.96	1.59		05:45	0.00	08:15	2.20	0.62		04:20	0.002	08:15	0.051	0.010	0.010						
06/02/2019	00:25	1.10	14:35	3.20	1.28		19:55	0.00	07:35	2.26	0.70		06:15	0.004	09:50	0.050	0.012	0.012						
06/03/2019	19:15	1.08	22:10	2.15	1.45		05:15	0.19	18:15	2.20	0.64		02:45	0.004	18:15	0.043	0.011	0.011						
06/04/2019	13:25	0.56	09:10	2.08	1.33		02:15	0.00	17:30	2.24	0.52		02:25	0.003	17:30	0.049	0.009	0.009						
06/05/2019	13:05	0.92	08:00	2.03	1.37		21:30	0.00	09:45	2.23	0.62		07:05	0.004	13:10	0.056	0.012	0.012						
06/06/2019	21:10	0.67	21:15	3.31	1.40		02:50	0.00	12:45	2.25	0.48		03:20	0.003	12:45	0.047	0.008	0.008						
06/07/2019	06:45	0.57	06:40	2.34	1.38		21:55	0.28	12:40	2.27	0.84		23:15	0.003	10:00	0.046	0.013	0.013						
06/08/2019	20:45	1.08	08:25	2.11	1.47		09:15	0.00	15:10	2.25	0.86		05:55	0.002	11:10	0.045	0.014	0.014						
06/09/2019	05:10	1.07	09:20	2.69	1.35		10:35	0.00	23:15	2.37	0.88		12:35	0.004	23:00	0.087	0.015	0.015						1.45
06/10/2019	23:05	1.17	19:40	2.01	1.33		05:55	0.00	08:50	2.42	1.76		20:25	0.010	10:15	0.054	0.031	0.031						0.22
06/11/2019	19:40	1.16	07:45	2.03	1.35		07:30	0.00	09:20	2.31	1.40		02:10	0.006	12:55	0.053	0.024	0.024						
06/12/2019	01:30	1.12	10:05	2.08	1.33		22:20	0.00	10:10	2.26	0.94		03:30	0.006	10:10	0.051	0.015	0.015						
06/13/2019	00:50	1.10	16:30	2.77	1.48		00:40	0.30	16:30	3.87	1.33		02:20	0.004	16:30	0.228	0.030	0.030						1.84
06/14/2019	23:55	1.26	16:20	2.25	1.45		19:35	0.65	22:00	2.34	1.73		19:35	0.014	22:00	0.056	0.035	0.035						
06/15/2019	09:20	0.97	09:25	2.48	1.35		09:00	0.00	20:40	2.36	1.32		18:20	0.010	09:20	0.043	0.022	0.022						0.56
06/16/2019	06:35	1.25	10:15	1.70	1.36		12:50	0.00	10:55	2.26	1.44		14:40	0.008	10:20	0.049	0.025	0.025						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
06/17/2019	04:05	1.19	15:50	1.65	1.31		14:10	0.00	15:50	2.44	0.99		16:35	0.007	15:50	0.051	0.018	0.018						
06/18/2019	00:10	1.22	11:00	1.76	1.43		01:30	0.00	09:00	2.41	1.51		00:20	0.008	04:40	0.056	0.031	0.031						0.64
06/19/2019	03:20	1.25	10:00	1.66	1.34		03:45	0.00	22:50	2.26	1.49		06:25	0.008	19:15	0.050	0.028	0.028						0.12
06/20/2019	13:15	1.23	18:20	1.78	1.36		07:35	0.00	11:40	2.44	1.70		17:55	0.008	08:55	0.054	0.032	0.032						
06/21/2019	05:40	1.20	20:35	1.87	1.28		02:25	0.00	21:40	2.43	1.52		13:00	0.007	21:15	0.059	0.024	0.024						
06/22/2019	16:00	1.17	21:15	3.16	1.30		01:40	0.00	18:00	2.46	1.47		22:20	0.007	10:55	0.053	0.026	0.026						
06/23/2019	19:00	1.12	22:45	2.12	1.29		10:15	0.00	20:40	2.48	1.44		10:15	0.006	20:25	0.047	0.022	0.022						
06/24/2019	05:55	1.15	03:30	2.05	1.36		23:25	0.00	09:20	2.50	1.44		23:25	0.007	14:50	0.053	0.024	0.024						
06/25/2019	16:25	1.13	05:15	2.18	1.31		00:30	0.00	10:45	2.35	1.56		10:15	0.006	18:35	0.058	0.024	0.024						
06/26/2019	01:25	0.61	23:35	2.94	1.34		11:40	0.00	17:40	2.42	1.47		13:50	0.008	17:25	0.049	0.024	0.024						
06/27/2019	20:50	1.11	13:00	2.25	1.37		11:15	0.00	18:20	2.52	1.53		01:20	0.010	18:15	0.064	0.026	0.026						0.12
06/28/2019	11:40	1.03	17:25	2.05	1.34		13:40	0.48	09:00	2.52	1.44		14:05	0.007	17:25	0.085	0.026	0.026						1.23
06/29/2019	05:40	1.24	09:30	1.59	1.31		16:30	0.58	09:30	2.58	1.73		16:30	0.010	09:30	0.056	0.028	0.028						0.18
06/30/2019	21:15	1.21	21:40	2.04	1.31		13:00	0.00	13:15	2.50	1.66		13:00	0.008	12:20	0.048	0.027	0.027						
07/01/2019	02:55	1.12	20:30	2.67	1.38		06:20	0.00	21:20	2.48	1.59		14:40	0.010	21:50	0.049	0.025	0.025						0.00
07/02/2019	12:35	1.17	23:00	1.91	1.40		01:05	0.00	09:50	2.51	1.56		16:15	0.010	16:40	0.054	0.024	0.024						0.00
07/03/2019	14:30	1.18	22:15	1.88	1.39		10:50	0.00	09:45	2.51	1.62		23:50	0.013	09:45	0.048	0.025	0.025						0.00
07/04/2019	23:05	1.13	22:50	2.17	1.61		16:45	0.00	09:00	2.48	1.08		16:05	0.006	10:15	0.044	0.018	0.018						0.04
07/05/2019	10:15	1.08	21:00	3.01	1.56		00:00	0.00	00:00	0.00	0.00		14:30	0.009	22:05	0.026	0.015	0.015						0.11
07/06/2019	23:05	1.06	00:55	3.49	1.60		00:00	0.00	22:45	2.35	0.71		19:30	0.011	09:45	0.034	0.016	0.016						0.00
07/07/2019	13:05	0.23	02:30	2.16	1.62		06:05	0.00	10:40	1.05	0.46		05:00	0.008	19:10	0.021	0.013	0.013						0.27
07/08/2019	00:25	0.38	03:20	3.27	1.25		03:15	0.00	03:30	0.72	0.36		01:40	0.011	03:25	0.040	0.016	0.016						1.12
07/09/2019	04:15	1.21	13:10	2.61	1.63		00:15	0.00	13:10	4.32	1.35		05:20	0.010	13:05	0.209	0.054	0.054						2.72
07/10/2019	22:55	1.56	07:50	1.92	1.68		13:55	1.22	07:40	2.23	1.82		13:55	0.033	09:15	0.068	0.049	0.049						0.08
07/11/2019	03:00	1.53	10:15	1.78	1.61		08:35	0.00	10:20	2.06	1.62		19:25	0.027	10:20	0.060	0.041	0.041						0.09
07/12/2019	23:35	1.45	09:10	1.84	1.57		12:00	1.00	09:00	1.94	1.39		22:20	0.024	09:10	0.055	0.033	0.033						0.00
07/13/2019	14:30	1.41	09:45	1.75	1.51		05:20	1.00	19:20	1.74	1.28		05:20	0.021	09:45	0.041	0.029	0.029						0.20
07/14/2019	14:30	1.48	17:00	1.91	1.57		14:35	0.73	18:10	1.68	1.33		04:50	0.023	17:00	0.051	0.032	0.032						0.13
07/15/2019	01:30	1.46	09:15	1.84	1.61		23:20	0.74	09:25	1.62	1.30		23:20	0.018	09:25	0.048	0.033	0.033						0.33
07/16/2019	23:55	1.39	08:20	1.90	1.55		06:55	0.48	08:15	1.72	1.04		23:45	0.011	08:20	0.056	0.024	0.024						0.00
07/17/2019	21:30	1.14	22:15	2.10	1.42		04:15	0.34	21:55	2.48	1.13		04:15	0.006	22:15	0.095	0.024	0.024						1.17
07/18/2019	23:55	1.47	00:00	1.92	1.62		14:20	0.82	19:25	2.33	1.72		18:50	0.029	00:35	0.064	0.044	0.044						0.04
07/19/2019	14:45	1.42	09:25	1.81	1.52		17:25	0.69	07:45	1.96	1.27		17:25	0.014	07:45	0.050	0.029	0.029						0.00
07/20/2019	01:00	1.42	18:15	2.96	1.72		04:20	0.54	18:10	3.43	1.21		04:20	0.011	18:15	0.215	0.040	0.040						1.74
07/21/2019	23:35	1.64	11:20	2.02	1.80		10:25	0.90	09:05	2.30	1.76		23:00	0.034	11:20	0.071	0.054	0.054						0.06
07/22/2019	12:05	1.54	14:20	1.94	1.72		01:00	0.69	21:00	2.31	1.70		11:40	0.030	16:40	0.071	0.047	0.047						0.49
07/23/2019	20:40	1.47	08:30	1.83	1.61		18:05	0.73	11:55	2.28	1.68		04:10	0.021	11:55	0.062	0.042	0.042						0.00
07/24/2019	05:15	1.42	14:50	2.92	1.79		08:30	0.66	14:50	4.48	1.91		05:50	0.020	14:50	0.286	0.064	0.064						2.99
07/25/2019	06:00	1.76	10:45	2.42	1.97		23:05	1.04	10:35	2.50	1.95		06:15	0.047	10:35	0.112	0.068	0.068						0.50
07/26/2019	23:40	1.66	09:25	2.00	1.81		16:45	1.01	18:35	2.11	1.76		22:00	0.039	09:40	0.073	0.054	0.054						0.16
07/27/2019	23:55	1.49	10:35	1.94	1.64		22:30	0.81	15:00	1.99	1.55		22:30	0.019	10:35	0.054	0.040	0.040						0.00
07/28/2019	23:55	1.39	07:55	1.69	1.51		22:00	0.65	12:55	2.06	1.40		22:00	0.014	10:05	0.052	0.031	0.031						0.00
07/29/2019	10:00	1.26	09:25	4.77	1.52		10:20	0.28	21:55	2.29	1.13		19:35	0.010	14:40	0.079	0.024	0.024						0.00
07/30/2019	07:30	1.07	12:00	1.58	1.32		11:35	0.00	07:30	2.20	1.06		01:20	0.009	07:35	0.048	0.019	0.019						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
07/31/2019	01:50	1.21	18:45	5.71	1.40		09:45	0.00	18:35	2.13	1.03		05:45	0.007	18:45	0.113	0.020	0.020						0.89
08/01/2019	16:05	1.34	18:15	2.58	1.84		11:40	0.47	17:50	2.96	1.64		13:45	0.013	17:50	0.151	0.055	0.055						1.30
08/02/2019	23:55	1.59	12:50	1.99	1.73		20:20	1.01	17:55	2.37	1.79		20:20	0.026	17:55	0.067	0.050	0.050						0.02
08/03/2019	06:15	1.55	08:45	1.98	1.70		21:25	0.85	11:35	2.37	1.70		05:35	0.024	11:35	0.077	0.047	0.047						0.37
08/04/2019	23:55	1.47	08:05	1.81	1.60		05:10	0.90	12:25	2.05	1.52		05:10	0.021	08:05	0.054	0.038	0.038						0.00
08/05/2019	04:40	1.43	12:50	2.01	1.55		05:05	0.81	12:50	2.33	1.47		04:45	0.017	12:50	0.084	0.035	0.035						0.26
08/06/2019	04:05	1.41	07:50	2.23	1.70		05:15	0.88	08:15	2.29	1.68		05:15	0.018	08:40	0.091	0.048	0.048						0.82
08/07/2019	04:10	1.56	17:30	2.12	1.70		08:50	0.75	22:15	2.14	1.62		15:30	0.023	18:40	0.071	0.045	0.045						0.60
08/08/2019	17:45	1.55	13:40	1.85	1.66		00:50	0.88	09:35	2.28	1.63		15:45	0.024	09:35	0.068	0.043	0.043						0.01
08/09/2019	23:35	1.38	08:25	1.79	1.52		08:50	0.70	10:30	2.18	1.50		13:00	0.016	12:45	0.056	0.034	0.034						0.10
08/10/2019	02:00	1.33	13:45	1.90	1.53		09:55	0.00	14:40	2.24	1.46		05:30	0.012	14:40	0.067	0.035	0.035						0.67
08/11/2019	23:20	1.36	10:25	1.87	1.49		19:30	0.77	12:10	2.29	1.63		16:55	0.017	10:25	0.065	0.035	0.035						0.07
08/12/2019	18:20	1.32	12:50	1.70	1.44		20:20	0.71	09:30	2.16	1.51		20:20	0.013	13:05	0.052	0.031	0.031						0.45
08/13/2019	01:10	1.38	03:10	2.90	1.87		01:40	0.83	03:20	4.44	2.00		02:35	0.021	03:20	0.271	0.068	0.068						1.65
08/14/2019	03:40	1.62	09:30	3.96	2.10		00:40	1.30	09:25	4.16	1.97		00:40	0.034	09:25	0.404	0.081	0.081						1.92
08/15/2019	23:50	2.07	03:05	2.52	2.28		22:05	1.57	02:45	2.39	2.04		12:10	0.068	02:45	0.117	0.090	0.090						0.60
08/16/2019	02:55	2.01	03:15	3.85	2.66		01:10	1.36	03:35	4.08	2.44		01:20	0.060	03:20	0.357	0.142	0.142						4.62
08/17/2019	08:00	2.05	17:20	4.14	2.45		10:15	1.73	17:20	4.66	2.27		10:00	0.069	17:20	0.481	0.117	0.117						1.34
08/18/2019	23:45	1.77	04:15	2.37	2.01		02:00	1.73	09:15	2.40	2.05		23:00	0.052	04:15	0.111	0.074	0.074						0.16
08/19/2019	11:55	1.67	20:45	1.92	1.76		18:20	1.11	11:15	2.47	1.78		16:20	0.039	18:05	0.067	0.051	0.051						0.22
08/20/2019	14:00	1.55	15:55	3.81	2.03		10:10	0.97	15:55	4.73	2.06		02:15	0.030	15:55	0.437	0.088	0.088						0.87
08/21/2019	17:10	1.54	10:05	4.16	2.11		17:50	1.34	10:15	4.90	2.34		19:25	0.035	10:05	0.508	0.120	0.120						0.42
08/22/2019	23:55	1.52	12:05	4.76	2.03		19:20	1.13	12:05	5.14	2.33		18:55	0.033	12:05	0.633	0.109	0.109						0.00
08/23/2019	01:50	1.46	16:55	1.93	1.63		21:25	1.13	16:20	1.87	1.52		04:00	0.027	16:55	0.062	0.039	0.039						0.18
08/24/2019	23:55	1.67	09:45	2.09	1.75		23:35	0.91	08:50	1.58	1.21		23:35	0.024	09:45	0.054	0.035	0.035						0.12
08/25/2019	23:45	1.57	10:05	1.85	1.70		14:45	0.86	17:45	1.74	1.27		23:45	0.026	17:45	0.051	0.035	0.035						0.00
08/26/2019	18:35	1.49	08:20	1.86	1.59		22:20	0.73	17:05	2.02	1.19		14:25	0.017	15:15	0.043	0.029	0.029						0.00
08/27/2019	17:35	1.30	17:50	1.83	1.47		18:05	0.50	10:40	2.38	1.28		23:35	0.014	14:35	0.058	0.027	0.027						0.01
08/28/2019	23:05	1.25	16:15	1.70	1.36		15:45	0.00	08:55	2.31	1.29		23:45	0.009	08:55	0.056	0.024	0.024						0.01
08/29/2019	02:45	1.23	07:30	2.11	1.36		02:30	0.00	17:00	2.28	1.37		02:30	0.007	07:30	0.076	0.026	0.026						0.10
08/30/2019	12:55	1.24	10:40	1.64	1.36		10:55	0.00	10:40	2.47	1.25		04:15	0.007	10:40	0.064	0.023	0.023						0.46
08/31/2019	05:35	1.25	17:15	1.77	1.37		10:55	0.00	08:45	2.39	1.31		04:40	0.009	17:05	0.057	0.025	0.025						0.38
09/01/2019	14:40	1.29	18:05	1.62	1.41		01:00	0.00	18:10	2.36	1.41		12:30	0.010	18:10	0.058	0.029	0.029						0.41
09/02/2019	23:55	1.29	11:50	1.66	1.39		04:50	0.00	11:05	2.23	1.47		23:35	0.011	11:05	0.049	0.028	0.028						0.00
09/03/2019	21:35	1.23	08:05	2.01	1.33		01:20	0.00	10:40	2.31	1.21		23:25	0.007	10:40	0.055	0.022	0.022						0.00
09/04/2019	05:25	1.21	08:40	1.58	1.30		01:30	0.39	09:25	1.97	0.82		19:45	0.006	10:35	0.045	0.014	0.014						0.00
09/05/2019	12:10	1.18	04:35	2.19	1.33		03:30	0.30	07:50	2.07	0.75		03:30	0.005	07:05	0.054	0.013	0.013						0.00
09/06/2019	00:40	1.20	00:25	2.19	1.39		05:00	0.34	22:05	2.16	0.70		02:00	0.006	11:35	0.046	0.012	0.012						0.00
09/07/2019	14:40	1.21	20:40	2.28	1.43		20:40	0.00	17:35	2.29	0.91		04:05	0.006	17:35	0.053	0.017	0.017						0.00
09/08/2019	21:25	1.22	17:45	2.23	1.65		08:00	0.00	09:40	2.35	1.16		21:30	0.008	11:15	0.080	0.031	0.031						0.00
09/09/2019	17:35	1.18	05:00	2.14	1.32		08:40	0.00	22:25	2.46	1.07		06:15	0.007	22:25	0.062	0.019	0.019						0.84
09/10/2019	17:20	1.23	09:40	1.55	1.32		06:55	0.00	14:45	2.48	1.34		06:15	0.010	09:55	0.056	0.024	0.024						0.00
09/11/2019	06:00	1.21	20:25	1.80	1.36		09:35	0.00	10:55	2.51	1.33		13:35	0.009	20:35	0.061	0.026	0.026						0.00
09/12/2019	19:20	1.22	08:40	1.70	1.30		05:55	0.00	14:45	2.47	1.17		19:10	0.009	08:50	0.060	0.020	0.020						0.00

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
09/13/2019	19:35	1.17	06:55	2.28	1.38		06:30	0.00	08:40	2.33	1.16		19:50	0.007	13:45	0.053	0.021	0.021						0.07
09/14/2019	03:20	1.10	09:10	1.73	1.29		14:45	0.00	08:15	2.32	1.12		02:15	0.007	09:45	0.040	0.019	0.019						0.00
09/15/2019	10:35	1.16	10:25	1.79	1.34		05:35	0.65	12:25	2.52	1.26		05:35	0.010	12:25	0.054	0.023	0.023						0.00
09/16/2019	04:55	1.13	08:40	2.43	1.29		10:10	0.00	10:40	2.49	1.11		06:25	0.007	08:30	0.091	0.019	0.019						0.00
09/17/2019	04:10	1.13	09:55	3.72	1.33		11:05	0.00	09:35	2.30	1.23		04:55	0.006	07:55	0.073	0.022	0.022						0.00
09/18/2019	12:20	1.12	08:50	2.36	1.37		03:35	0.00	11:50	2.36	1.08		03:55	0.006	11:15	0.050	0.019	0.019						0.81
09/19/2019	06:35	1.18	12:45	3.55	1.39		19:50	0.54	15:30	2.24	1.17		19:40	0.009	15:30	0.045	0.021	0.021						0.00
09/20/2019	06:35	1.14	18:00	2.01	1.36		11:10	0.00	08:15	2.38	1.18		05:55	0.009	17:55	0.055	0.022	0.022						0.09
09/21/2019	22:35	1.19	15:20	1.68	1.31		16:10	0.50	07:25	2.06	1.06		16:10	0.008	09:55	0.042	0.018	0.018						0.00
09/22/2019	03:40	1.19	10:55	2.16	1.28		19:45	0.42	10:05	1.30	0.82		19:45	0.006	08:50	0.037	0.014	0.014						0.00
09/23/2019	01:55	1.13	10:50	3.43	1.32		18:20	0.00	20:10	2.21	0.86		05:30	0.005	16:35	0.038	0.014	0.014						0.00
09/24/2019	04:40	1.14	04:55	2.10	1.36		12:05	0.00	16:10	2.31	1.25		05:00	0.008	08:40	0.049	0.023	0.023						0.00
09/25/2019	01:30	1.20	01:45	2.19	1.36		06:40	0.00	08:25	2.39	1.38		13:25	0.010	00:10	0.049	0.025	0.025						0.00
09/26/2019	21:50	1.17	22:45	2.05	1.29		01:45	0.00	07:30	2.39	1.21		21:50	0.008	21:25	0.055	0.020	0.020						0.00
09/27/2019	17:40	1.12	17:55	1.93	1.34		08:35	0.78	20:55	2.29	1.41		17:15	0.013	17:45	0.043	0.025	0.025						0.00
09/28/2019	23:50	1.14	05:20	2.23	1.36		06:50	0.00	09:50	2.29	1.24		13:30	0.007	19:30	0.062	0.023	0.023						0.00
09/29/2019	06:40	1.13	23:50	2.10	1.37		10:10	0.00	11:05	2.39	1.33		08:35	0.009	21:10	0.063	0.024	0.024						0.00
09/30/2019	06:05	1.30	04:15	2.56	1.57		23:15	0.36	07:45	2.24	1.16		23:15	0.007	07:25	0.056	0.027	0.027						0.00
10/01/2019	10:10	1.24	07:15	1.94	1.39		01:10	0.00	11:45	2.38	1.03		06:20	0.004	08:45	0.049	0.020	0.020						0.00
10/02/2019	07:20	1.15	00:55	3.20	1.53		15:15	0.00	08:40	2.31	1.15		23:50	0.007	17:25	0.073	0.026	0.026						0.00
10/03/2019	12:25	1.12	02:50	2.81	1.38		00:15	0.00	11:45	2.60	0.98		04:25	0.003	13:35	0.066	0.019	0.019						0.00
10/04/2019	14:50	1.11	23:50	2.38	1.47		09:00	0.00	07:45	2.42	1.46		05:30	0.013	17:00	0.066	0.031	0.031						0.00
10/05/2019	12:45	1.13	02:15	3.63	1.51		17:15	0.00	15:10	2.47	1.29		05:40	0.007	14:05	0.064	0.028	0.028						0.00
10/06/2019	08:55	1.18	10:45	2.74	1.43		00:50	0.00	21:50	2.18	0.93		05:15	0.005	19:25	0.042	0.018	0.018						0.05
10/07/2019	20:25	1.17	15:30	2.03	1.40		13:55	0.00	08:55	2.52	1.44		04:25	0.011	15:30	0.063	0.029	0.029						0.43
10/08/2019	01:55	-9.99	00:05	1.26	-9.12		01:15	0.00	00:30	1.41	0.07		01:10	0.014	00:30	0.021	0.019	0.001						0.00
10/09/2019	00:00	-9.99	20:50	1.41	-5.90		00:00	0.00	21:10	2.23	0.55		19:25	0.020	22:15	0.032	0.025	0.006						0.58
10/10/2019	02:00	1.18	05:30	1.79	1.37		11:05	0.72	20:40	2.42	1.52		14:45	0.017	08:10	0.062	0.028	0.028						0.00
10/11/2019	22:45	1.22	15:00	2.04	1.37		22:50	0.56	10:40	2.45	1.41		19:30	0.015	11:00	0.068	0.026	0.026						0.00
10/12/2019	00:50	1.19	06:45	2.07	1.38		17:05	0.35	10:35	1.60	0.73		02:00	0.010	10:15	0.043	0.017	0.017						0.00
10/13/2019	23:00	1.18	02:40	2.16	1.34		02:15	0.00	18:05	2.52	0.97		05:50	0.008	18:10	0.048	0.019	0.019						0.00
10/14/2019	06:25	1.12	06:40	2.05	1.31		22:45	0.40	08:00	2.57	0.92		06:15	0.010	08:05	0.055	0.018	0.018						0.00
10/15/2019	11:45	1.22	11:50	2.08	1.36		01:30	0.00	10:40	0.90	0.51		07:00	0.010	10:40	0.027	0.015	0.015						0.00
10/16/2019	22:05	1.22	03:20	2.01	1.38		02:10	0.00	12:50	0.85	0.50		22:05	0.011	16:30	0.027	0.016	0.016						0.00
10/17/2019	04:50	1.14	06:10	1.99	1.37		00:00	0.00	16:05	0.84	0.47		03:50	0.009	16:05	0.031	0.015	0.015						0.00
10/18/2019	03:20	1.09	23:15	2.77	1.39		02:55	0.00	08:25	1.14	0.45		04:15	0.007	08:25	0.037	0.015	0.015						0.38
10/19/2019	02:30	1.09	08:10	2.60	2.02		01:05	0.00	08:00	3.46	1.92		00:40	0.016	08:15	0.187	0.072	0.072						3.17
10/20/2019	23:55	1.52	09:20	1.83	1.64		22:35	1.28	09:45	2.25	1.76		23:55	0.031	09:45	0.067	0.045	0.045						0.00
10/21/2019	03:45	1.45	09:45	1.81	1.59		18:55	0.97	05:15	1.96	1.57		00:50	0.024	10:05	0.056	0.038	0.038						0.17
10/22/2019	21:00	1.44	11:25	1.89	1.57		20:50	0.81	12:20	2.04	1.50		20:50	0.024	11:25	0.052	0.036	0.036						0.00
10/23/2019	23:50	1.34	09:40	1.92	1.50		18:55	0.00	19:45	2.14	1.48		17:40	0.017	09:40	0.058	0.033	0.033						0.00
10/24/2019	03:50	1.29	08:25	1.82	1.46		12:10	0.00	08:55	2.55	1.49		05:10	0.018	08:20	0.054	0.032	0.032						0.00
10/25/2019	23:15	1.33	20:00	1.79	1.48		21:50	0.50	13:20	2.57	1.52		14:20	0.017	20:40	0.061	0.033	0.033						0.10
10/26/2019	03:45	1.29	11:00	2.03	1.49		10:50	0.00	16:05	2.62	1.42		22:10	0.009	11:05	0.073	0.032	0.032						0.05

Date	UniDepth (in)						Vel (ft/s)						Quantity (MGD - Total MG)						Rain (in)					
	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total	Time	Min	Time	Max	Avg	Total
10/27/2019	04:10	1.26	12:20	1.97	1.43		04:25	0.46	08:50	2.40	1.05		04:25	0.007	13:05	0.056	0.021	0.021						0.00
10/28/2019	03:00	1.21	02:55	2.07	1.39		08:00	0.00	14:50	2.32	0.94		16:40	0.008	14:00	0.040	0.018	0.018						0.00
10/29/2019	01:30	1.23	23:45	2.15	1.42		13:10	0.00	09:35	2.66	1.17		19:35	0.005	09:25	0.074	0.023	0.023						0.00
10/30/2019	07:05	1.25	07:00	2.06	1.45		07:55	0.00	08:10	2.44	1.25		10:20	0.006	08:50	0.058	0.020	0.020						0.00

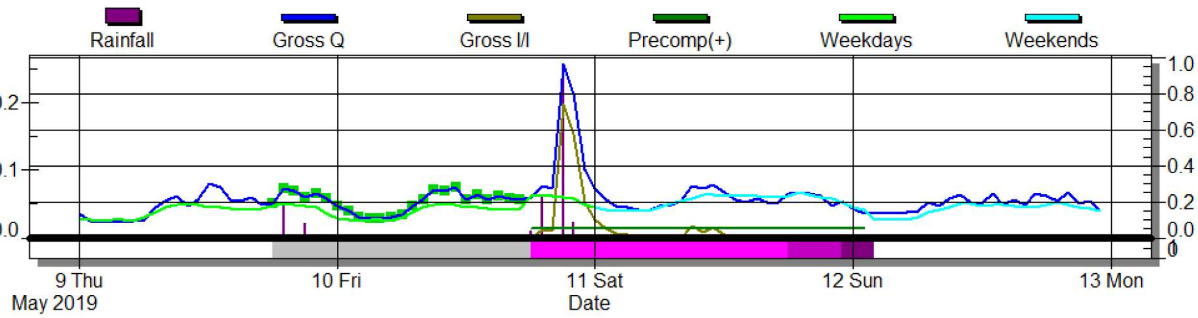
Report Summary For The Period 05/10/2019 - 10/30/2019

	UniDepth (in)	Vel (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			5.226	46.59
Avg	1.40	1.27	0.030	

APPENDIX B: Trailer Estates – Sliicer Rainfall Event Hydrographs

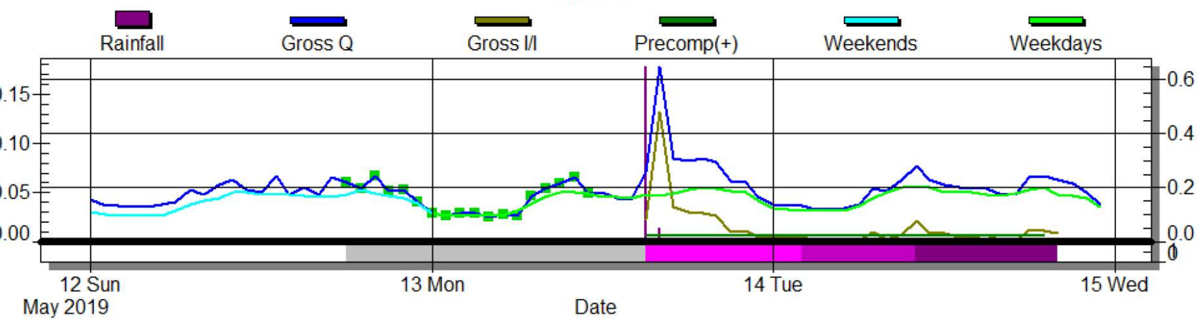
Storm Event - 5/10/2019 6:00:00 PM

MH-16539



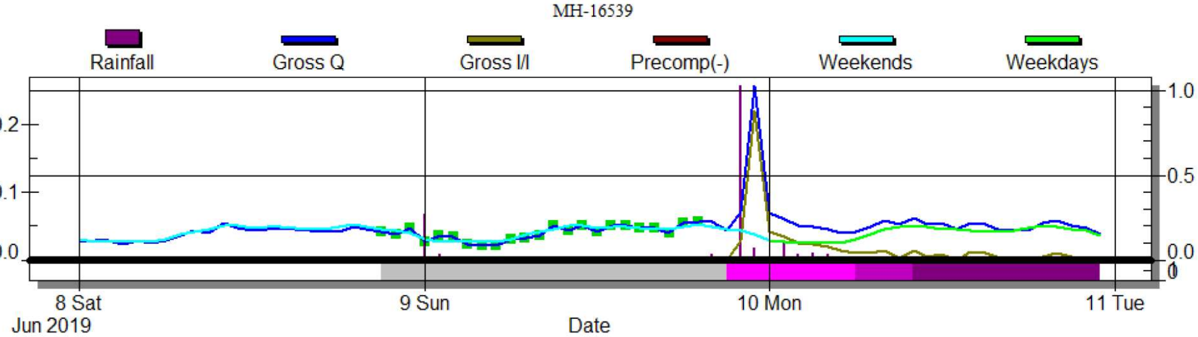
Storm Event - 5/13/2019 3:00:00 PM

MH-16539



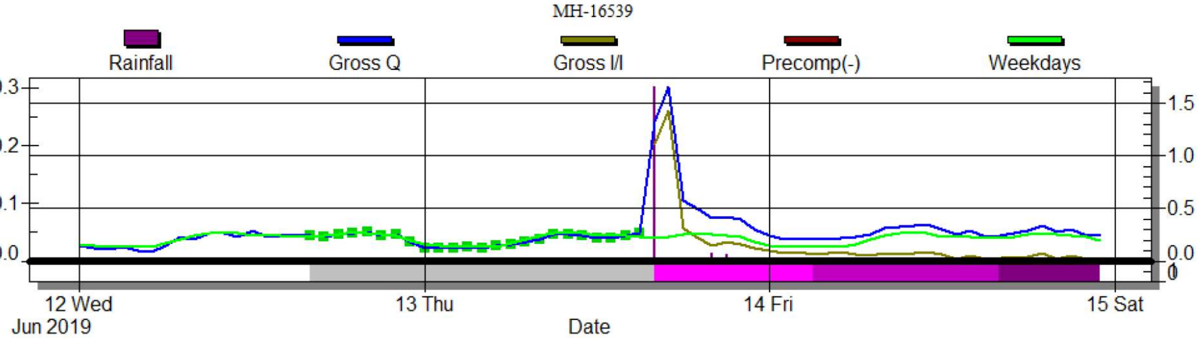
Storm Event - 6/9/2019 9:00:00 PM

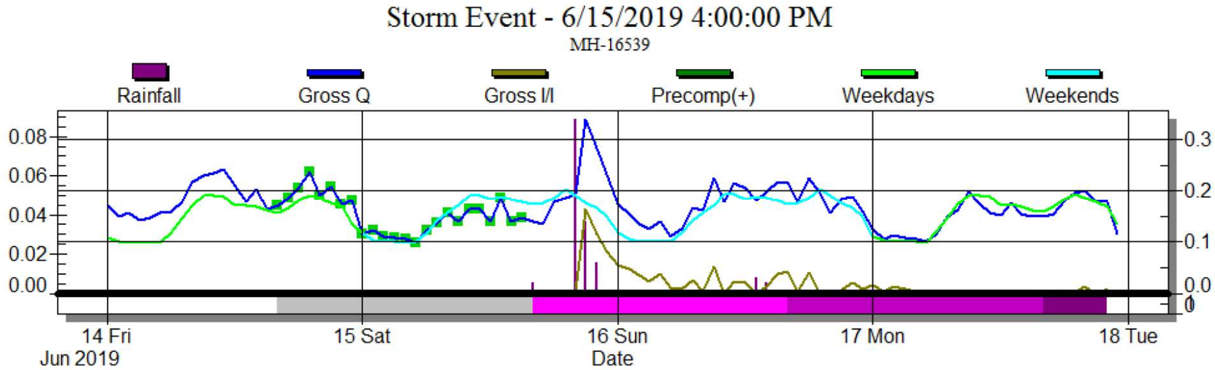
MH-16539

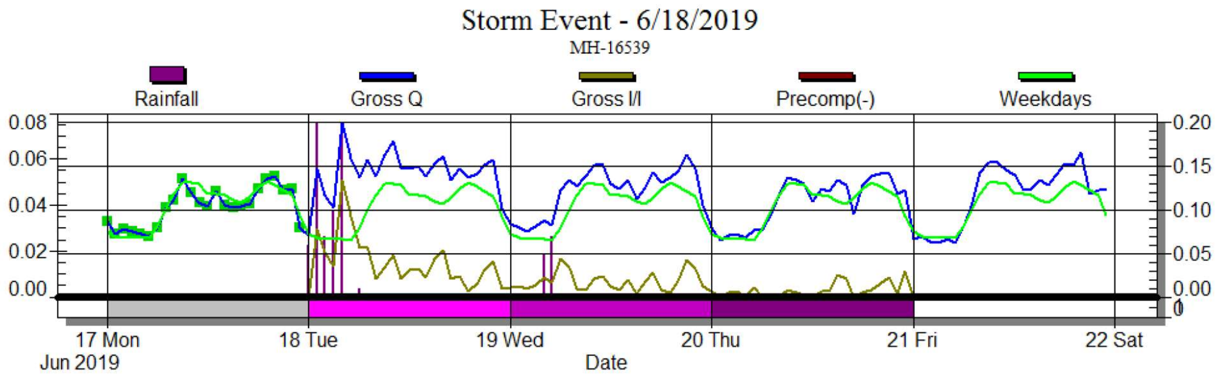


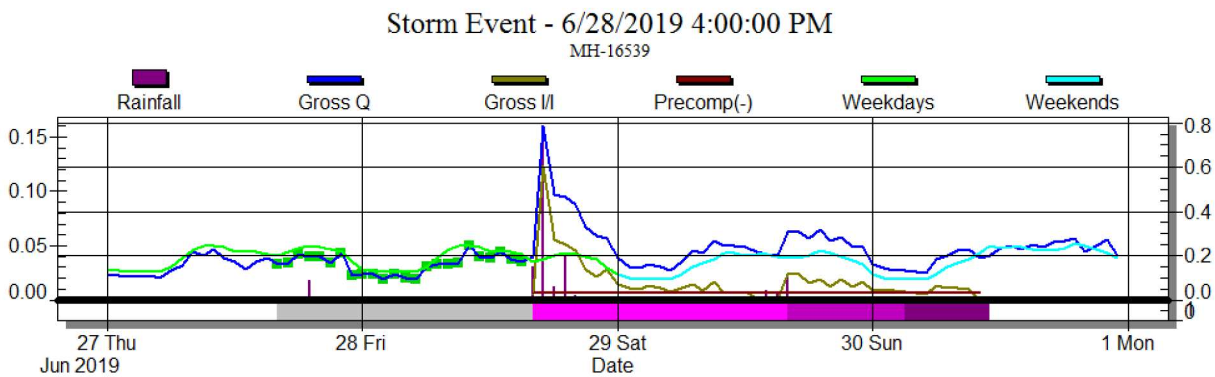
Storm Event - 6/13/2019 4:00:00 PM

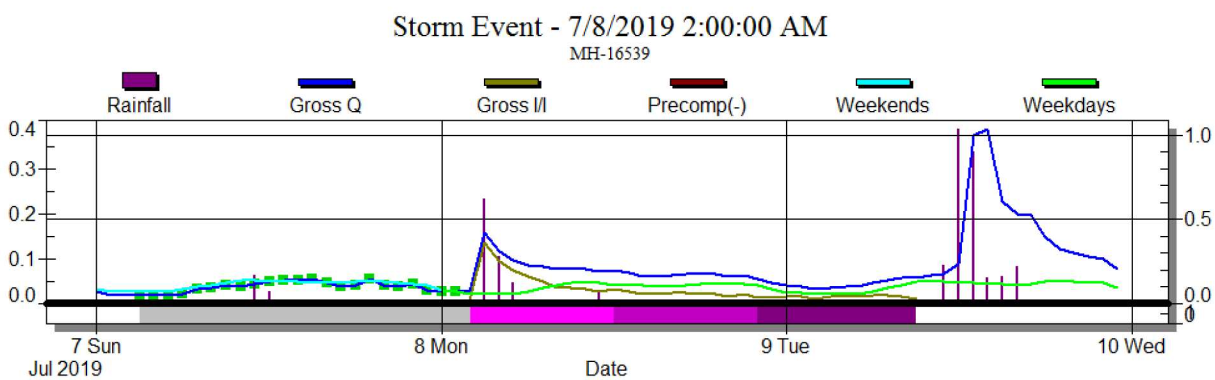
MH-16539




Storm Event - 6/15/2019 4:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.08
0.06
0.04
0.02
0.00
0.3
0.2
0.1
0.0
0
14 Fri
Jun 2019
15 Sat
16 Sun
17 Mon
18 Tue
Date

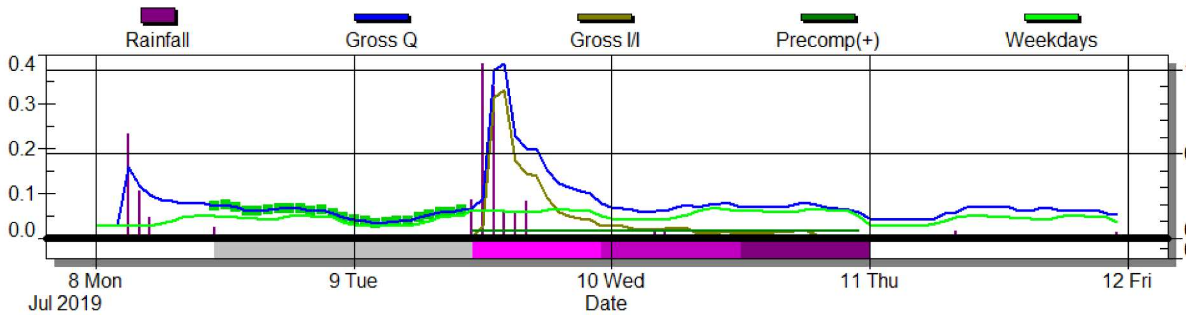

Storm Event - 6/18/2019
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
0.08
0.06
0.04
0.02
0.00
0.20
0.15
0.10
0.05
0.00
0
17 Mon
Jun 2019
18 Tue
19 Wed
20 Thu
21 Fri
22 Sat
Date


Storm Event - 6/28/2019 4:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
0.15
0.10
0.05
0.00
0.8
0.6
0.4
0.2
0.0
0
27 Thu
Jun 2019
28 Fri
29 Sat
30 Sun
1 Mon
Date


Storm Event - 7/8/2019 2:00:00 AM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekends
Weekdays
0.4
0.3
0.2
0.1
0.0
1.0
0.5
0.0
0
7 Sun
Jul 2019
8 Mon
9 Tue
10 Wed
Date

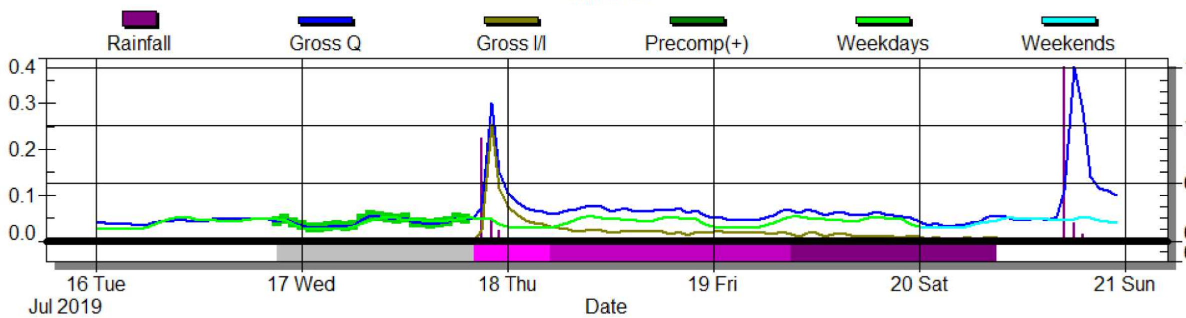
Storm Event - 7/9/2019 11:00:00 AM

MH-16539



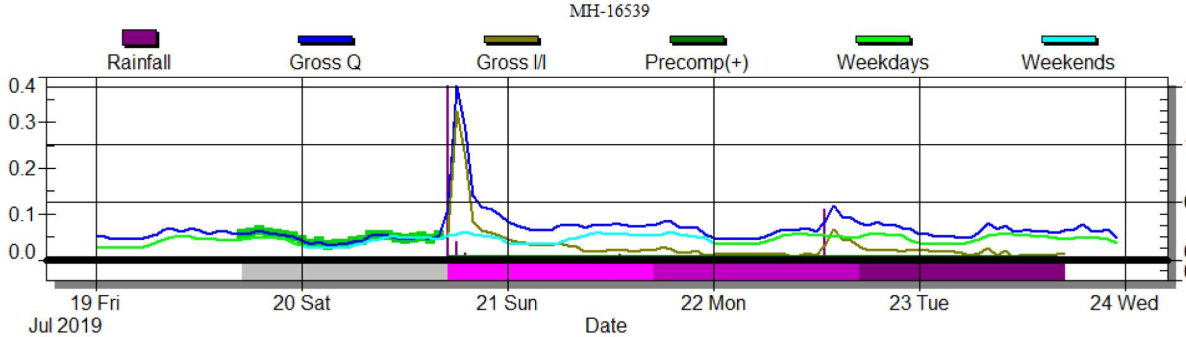
Storm Event - 7/17/2019 8:00:00 PM

MH-16539



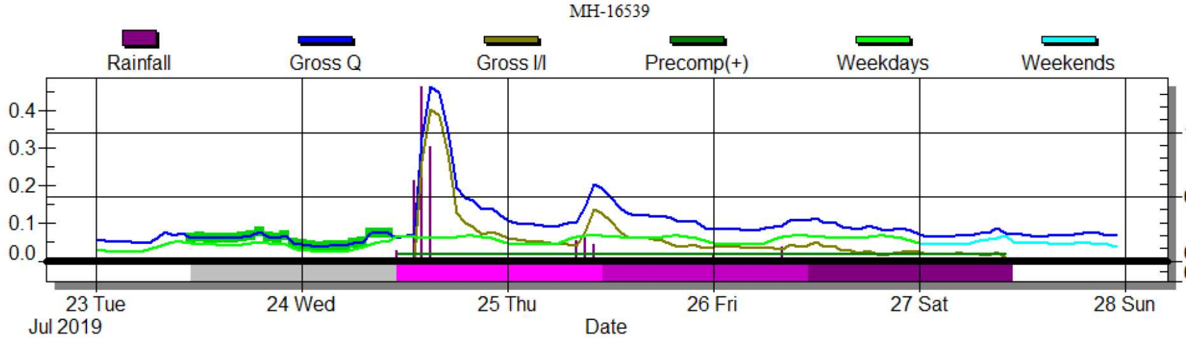
Storm Event - 7/20/2019 5:00:00 PM

MH-16539



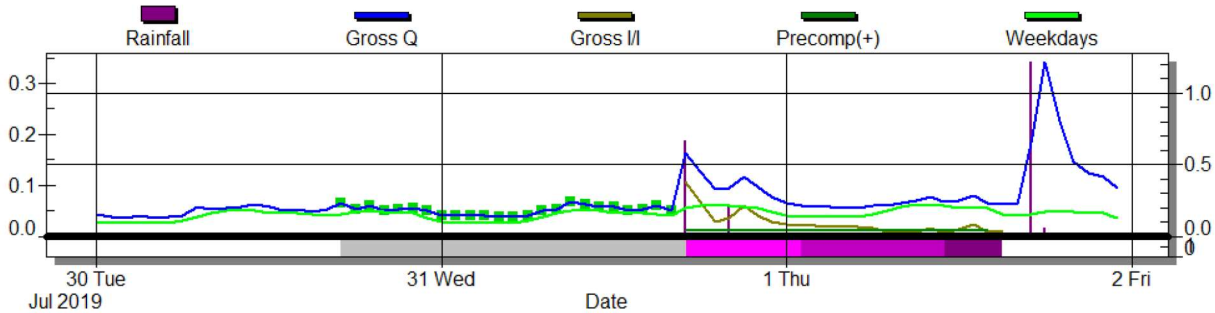
Storm Event - 7/24/2019 11:00:00 AM

MH-16539



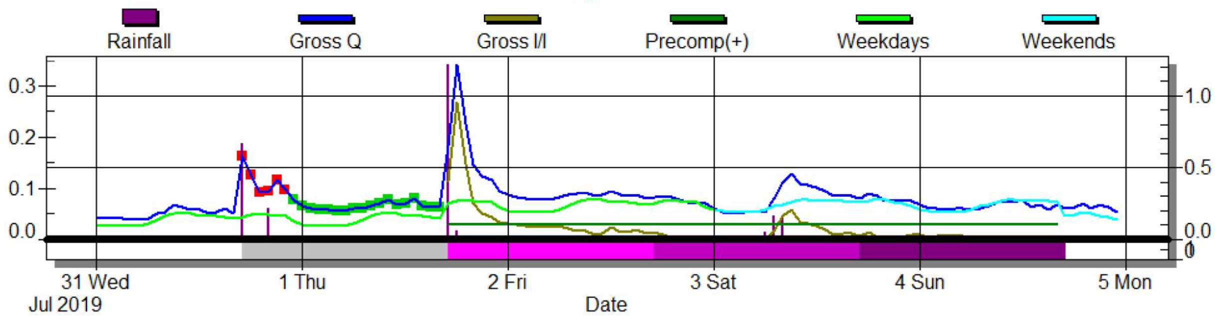
Storm Event - 7/31/2019 5:00:00 PM

MH-16539



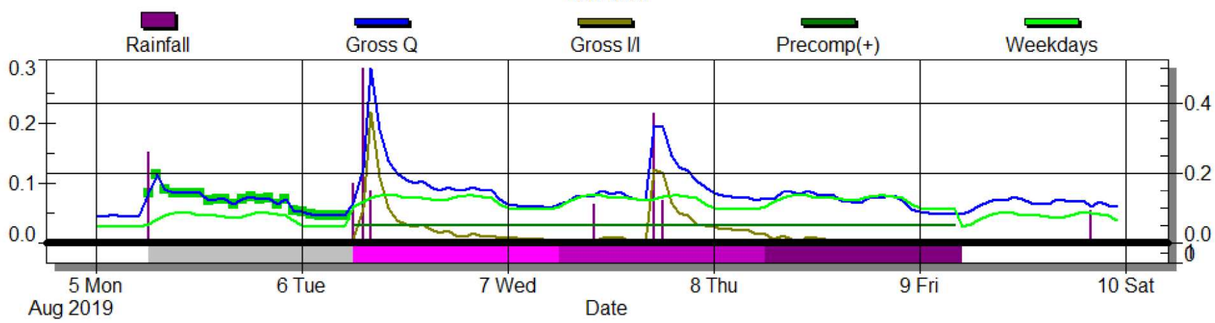
Storm Event - 8/1/2019 5:00:00 PM

MH-16539



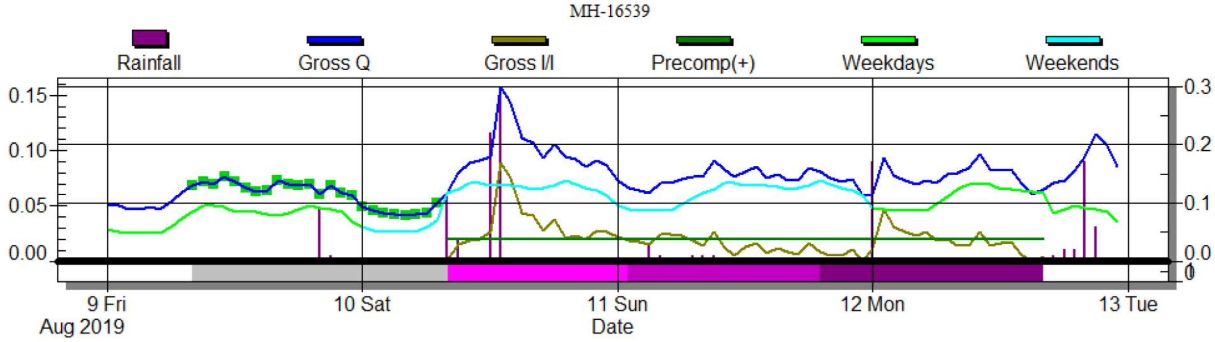
Storm Event - 8/6/2019 6:00:00 AM

MH-16539



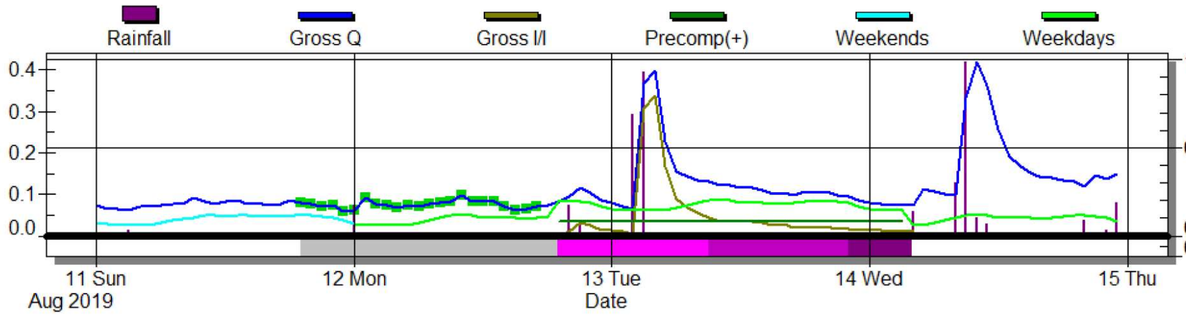
Storm Event - 8/10/2019 8:00:00 AM

MH-16539



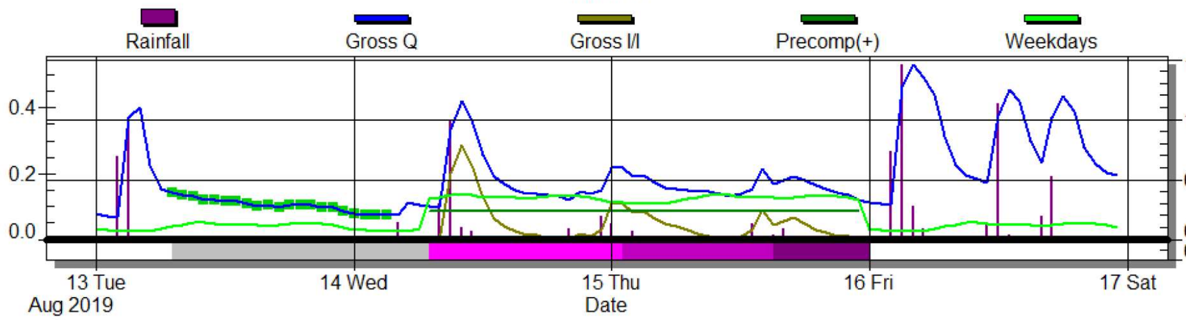
Storm Event - 8/12/2019 7:00:00 PM

MH-16539



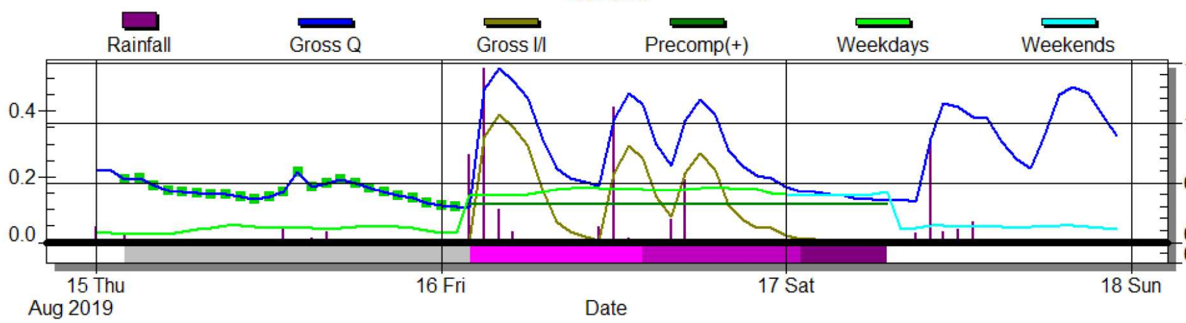
Storm Event - 8/14/2019 7:00:00 AM

MH-16539



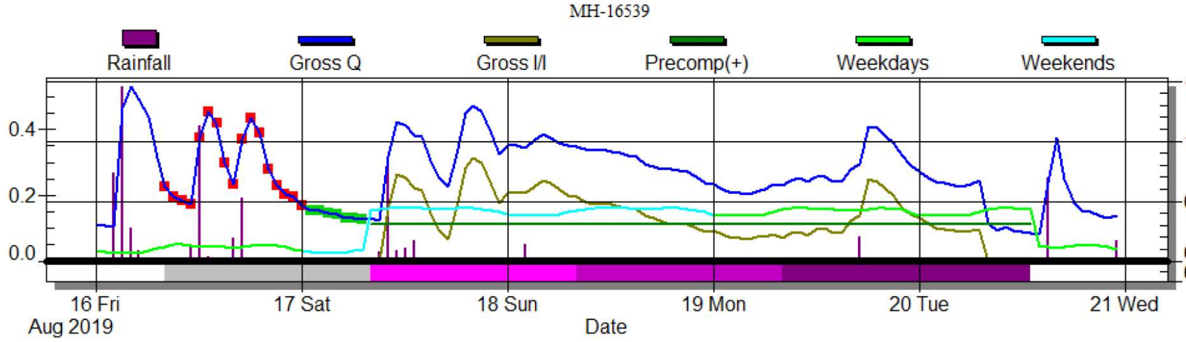
Storm Event - 8/16/2019 2:00:00 AM

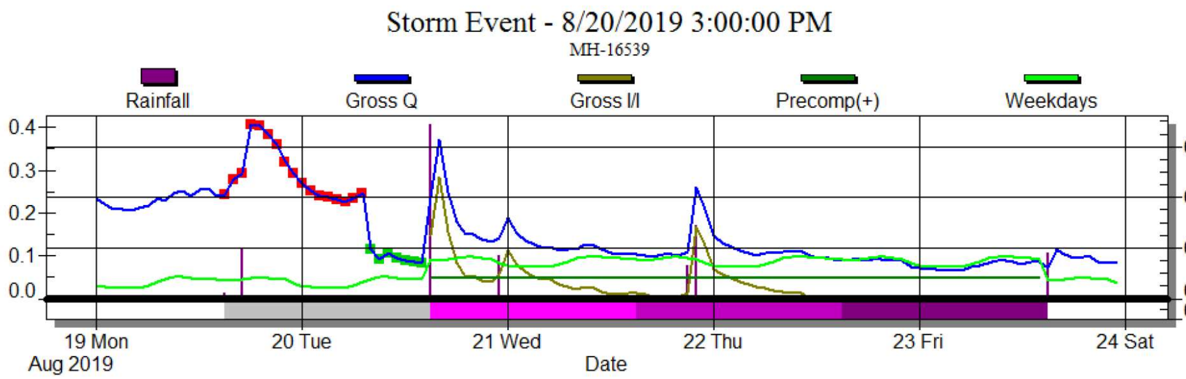
MH-16539

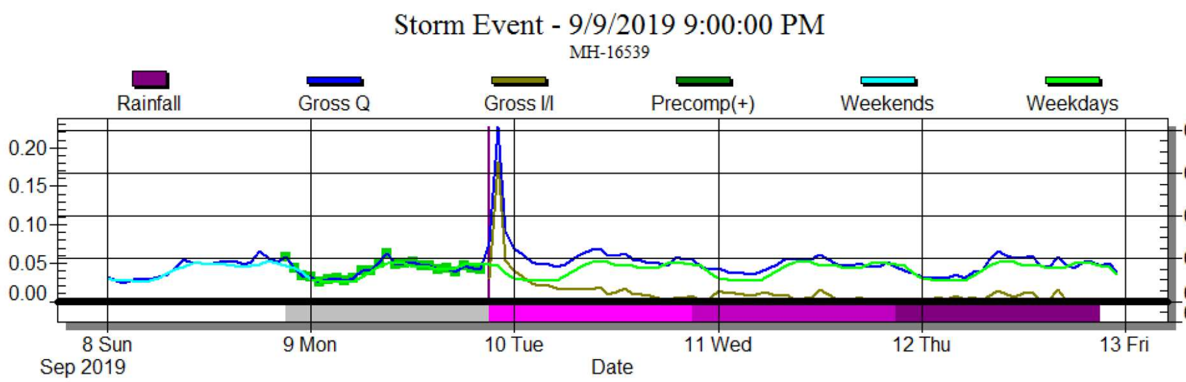


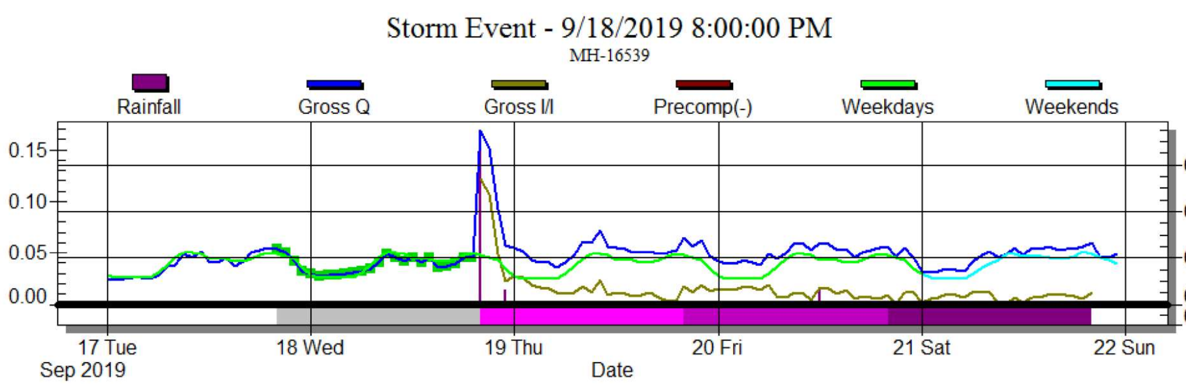
Storm Event - 8/17/2019 8:00:00 AM

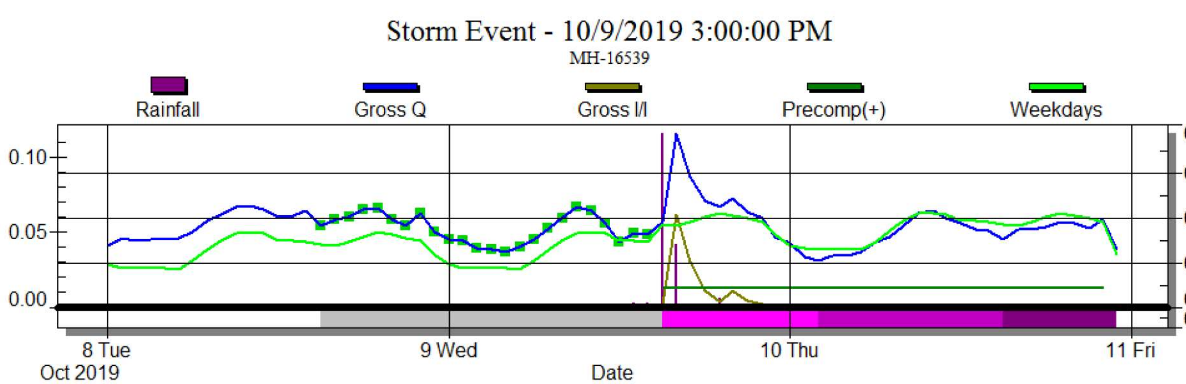
MH-16539




Storm Event - 8/20/2019 3:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.4
0.3
0.2
0.1
0.0
0.6
0.4
0.2
0.0
0
19 Mon
Aug 2019
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Date

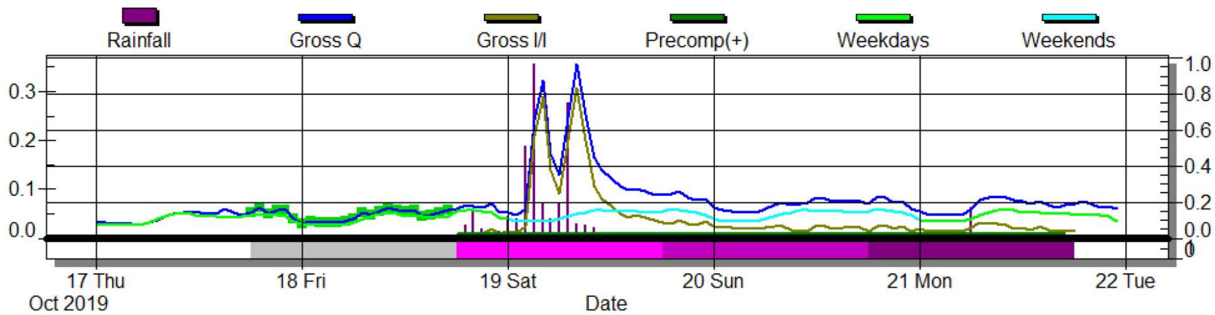

Storm Event - 9/9/2019 9:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekends
Weekdays
0.20
0.15
0.10
0.05
0.00
0.8
0.6
0.4
0.2
0.0
0
8 Sun
Sep 2019
9 Mon
10 Tue
11 Wed
12 Thu
13 Fri
Date


Storm Event - 9/18/2019 8:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
0.15
0.10
0.05
0.00
0.6
0.4
0.2
0.0
0
17 Tue
Sep 2019
18 Wed
19 Thu
20 Fri
21 Sat
22 Sun
Date


Storm Event - 10/9/2019 3:00:00 PM
MH-16539
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.10
0.05
0.00
0.4
0.3
0.2
0.1
0.0
0
8 Tue
Oct 2019
9 Wed
10 Thu
11 Fri
Date

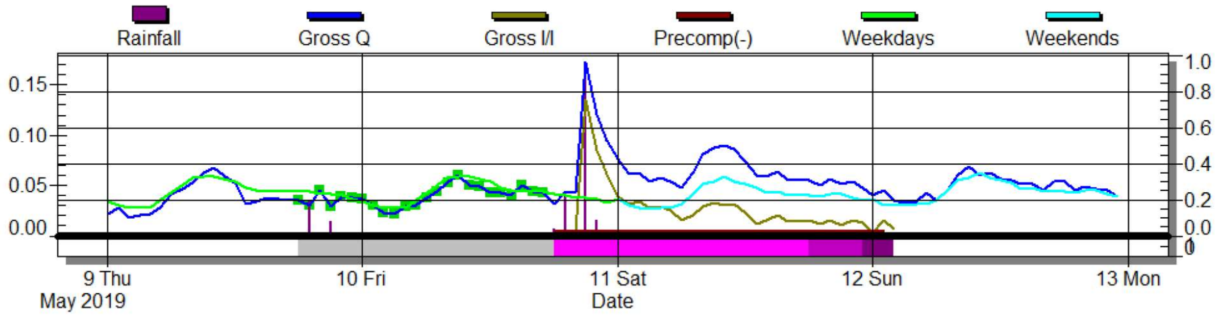
Storm Event - 10/18/2019 6:00:00 PM

MH-16539



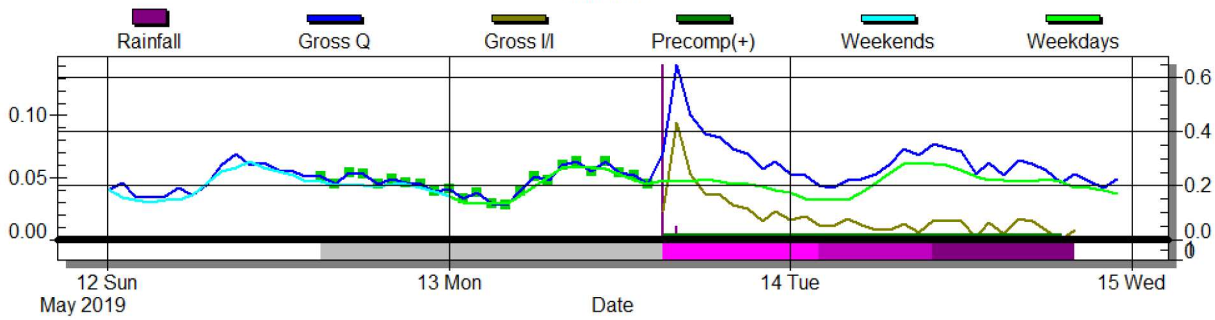
Storm Event - 5/10/2019 6:00:00 PM

MH-17795



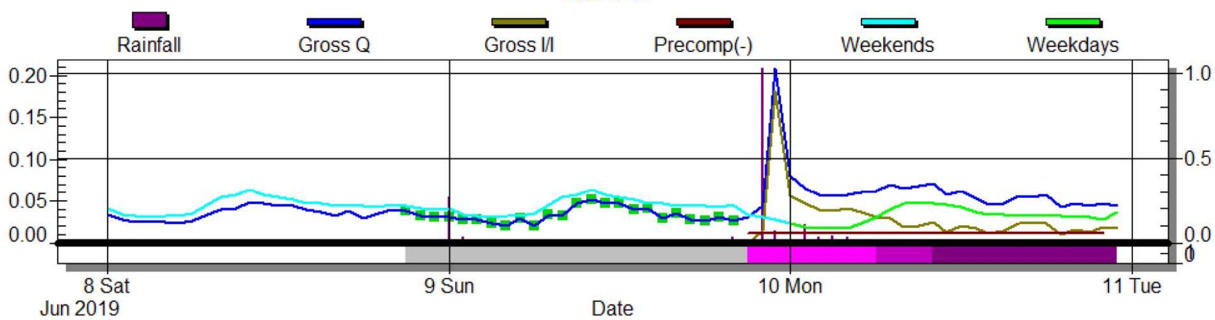
Storm Event - 5/13/2019 3:00:00 PM

MH-17795



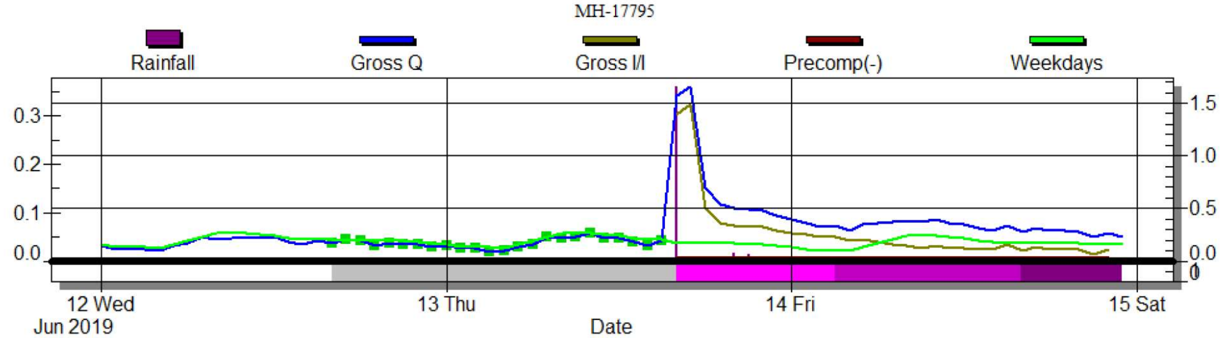
Storm Event - 6/9/2019 9:00:00 PM

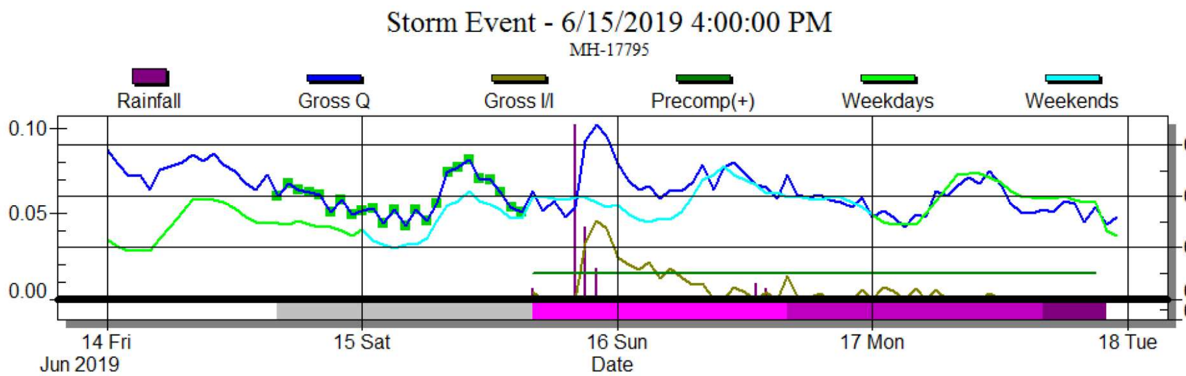
MH-17795



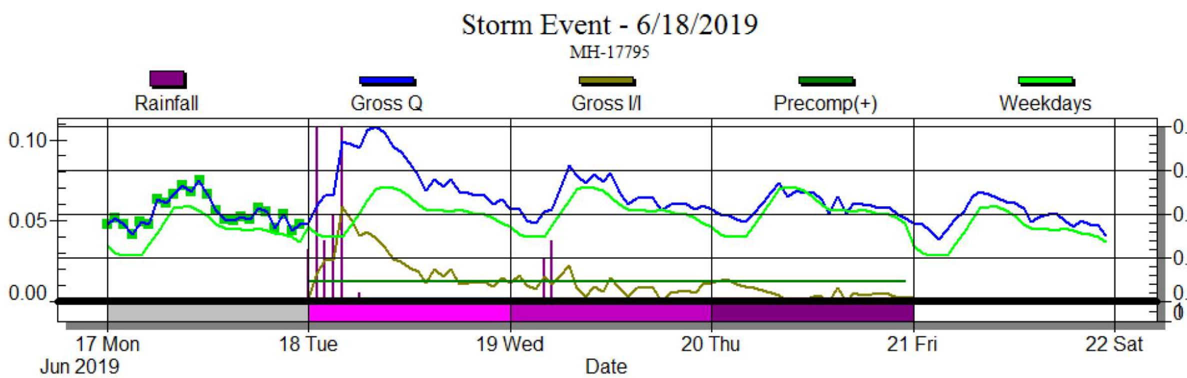
Storm Event - 6/13/2019 4:00:00 PM

MH-17795

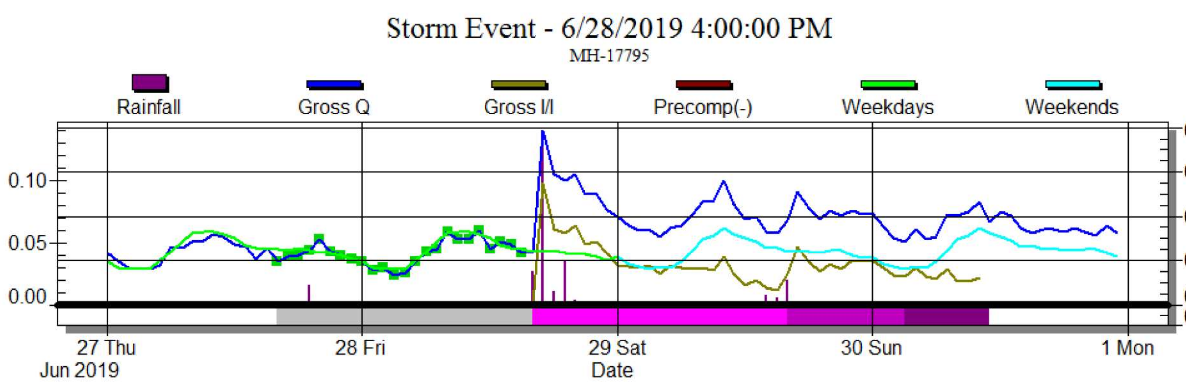




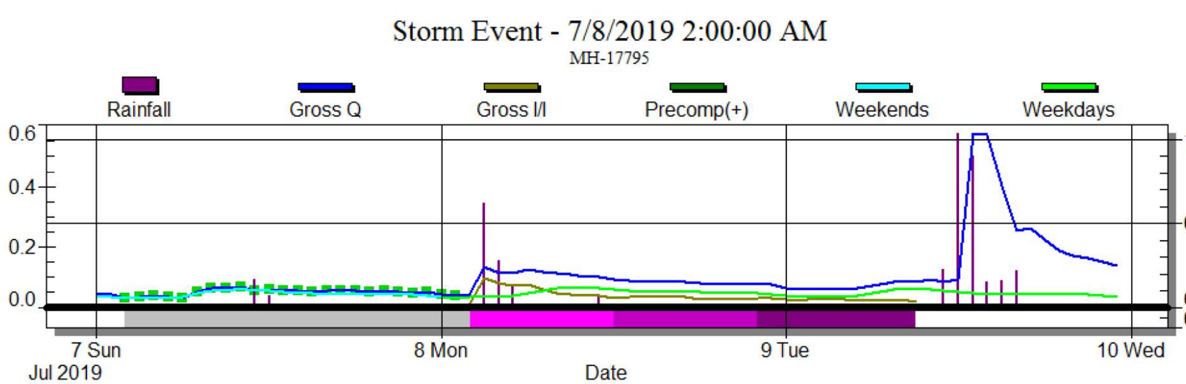
Storm Event - 6/15/2019 4:00:00 PM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.10
0.05
0.00
0.3
0.2
0.1
0.0
0
14 Fri
Jun 2019
15 Sat
16 Sun
17 Mon
18 Tue
Date



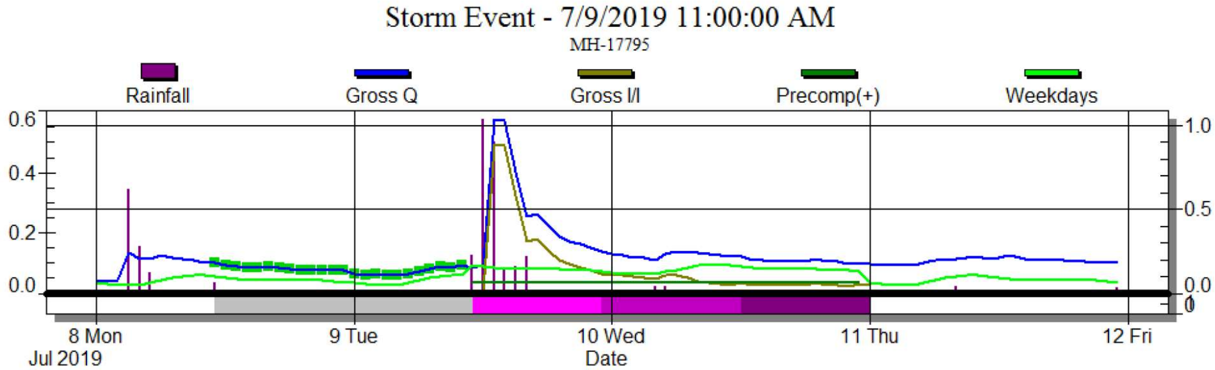
Storm Event - 6/18/2019
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.10
0.05
0.00
0.20
0.15
0.10
0.05
0.00
0
17 Mon
Jun 2019
18 Tue
19 Wed
20 Thu
21 Fri
22 Sat
Date

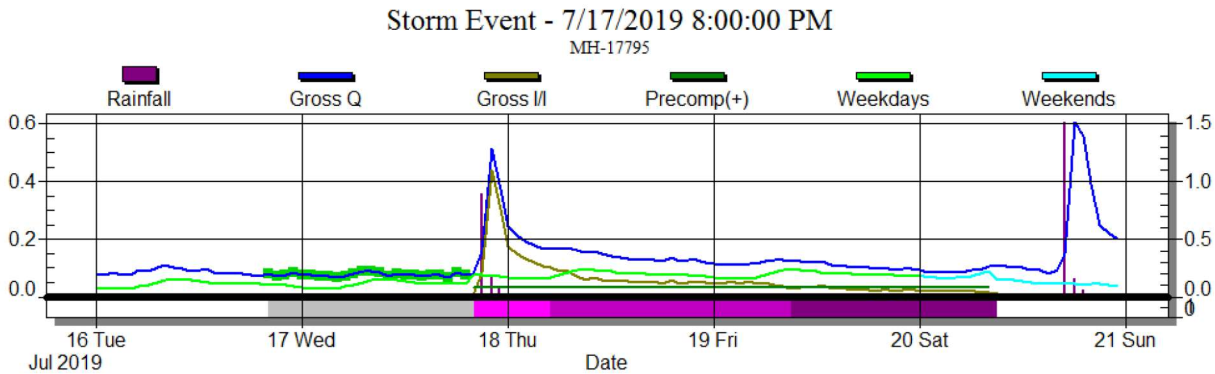


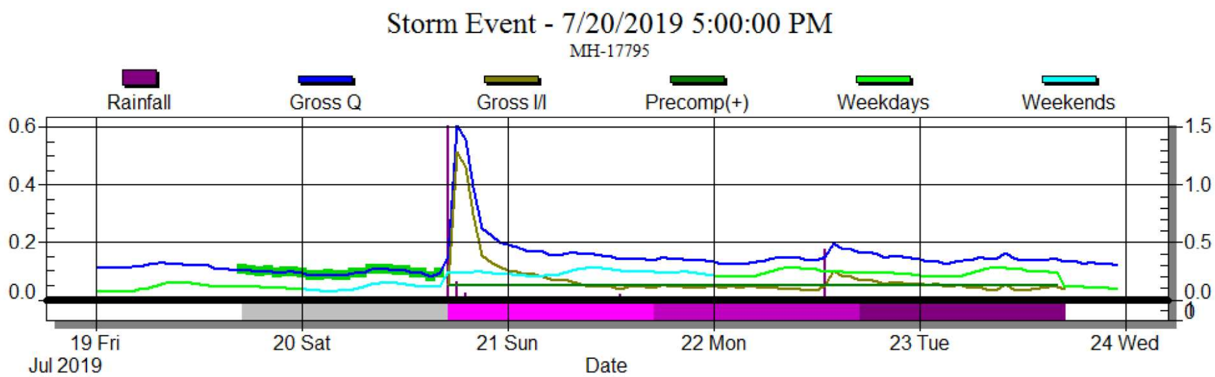
Storm Event - 6/28/2019 4:00:00 PM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
0.10
0.05
0.00
0.8
0.6
0.4
0.2
0.0
0
27 Thu
Jun 2019
28 Fri
29 Sat
30 Sun
1 Mon
Date

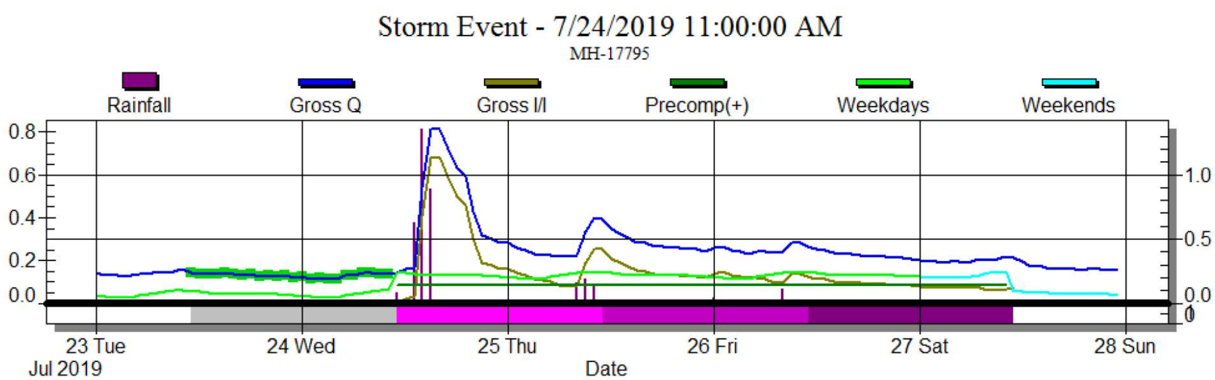


Storm Event - 7/8/2019 2:00:00 AM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekends
Weekdays
0.6
0.4
0.2
0.0
1.0
0.5
0.0
0
7 Sun
Jul 2019
8 Mon
9 Tue
10 Wed
Date

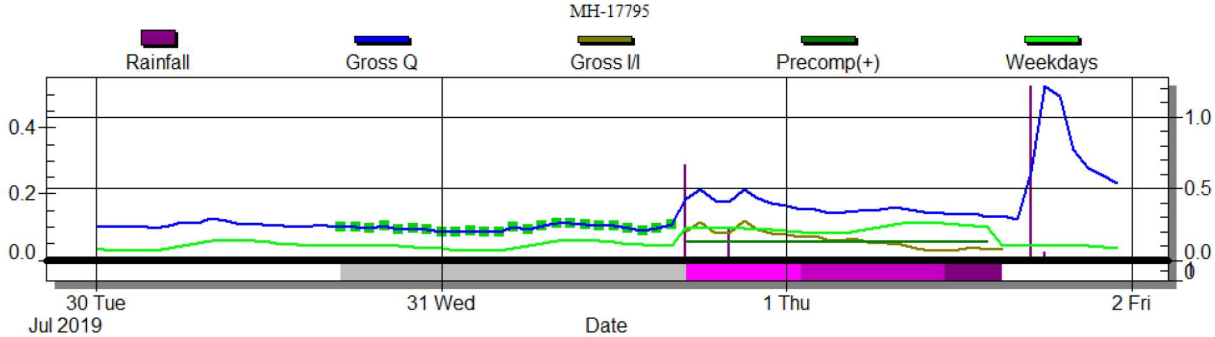

Storm Event - 7/9/2019 11:00:00 AM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.6
0.4
0.2
0.0
1.0
0.5
0.0
0
8 Mon
Jul 2019
9 Tue
10 Wed
11 Thu
12 Fri
Date


Storm Event - 7/17/2019 8:00:00 PM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.6
0.4
0.2
0.0
1.5
1.0
0.5
0.0
0
16 Tue
Jul 2019
17 Wed
18 Thu
19 Fri
20 Sat
21 Sun
Date

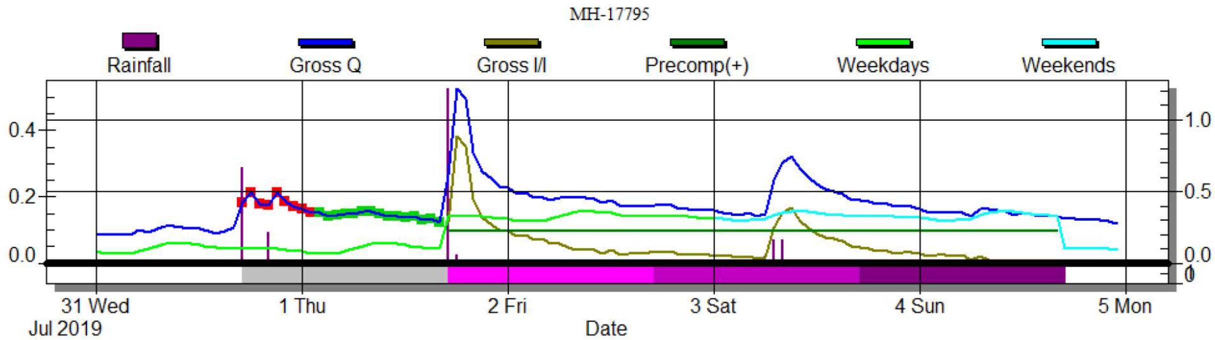

Storm Event - 7/20/2019 5:00:00 PM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.6
0.4
0.2
0.0
1.5
1.0
0.5
0.0
0
19 Fri
Jul 2019
20 Sat
21 Sun
22 Mon
23 Tue
24 Wed
Date


Storm Event - 7/24/2019 11:00:00 AM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.8
0.6
0.4
0.2
0.0
1.0
0.5
0.0
0
23 Tue
Jul 2019
24 Wed
25 Thu
26 Fri
27 Sat
28 Sun
Date

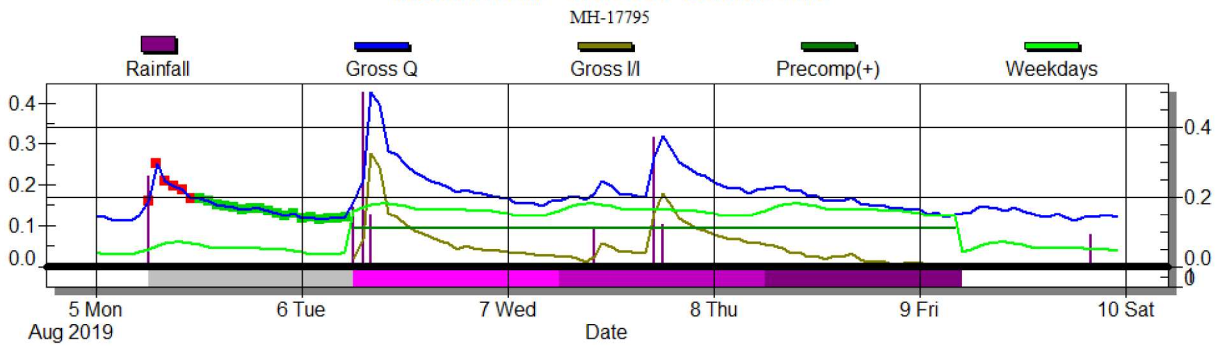
Storm Event - 7/31/2019 5:00:00 PM



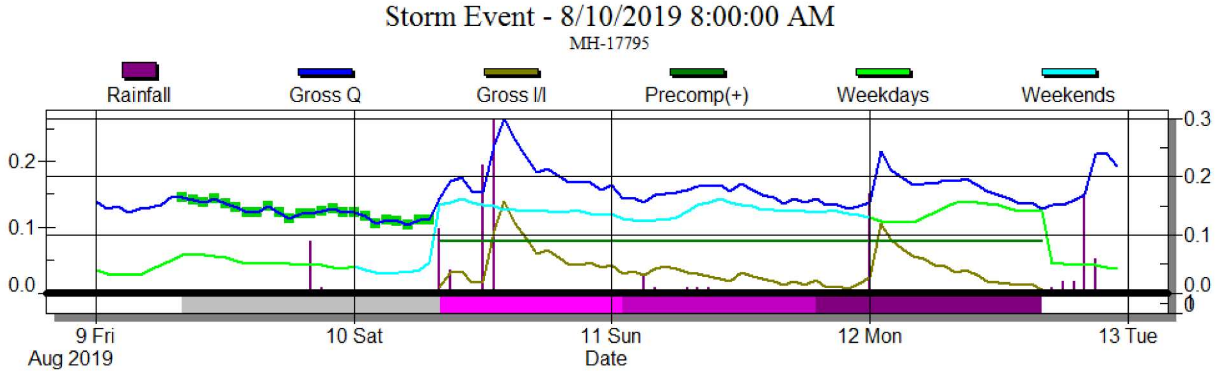
Storm Event - 8/1/2019 5:00:00 PM



Storm Event - 8/6/2019 6:00:00 AM

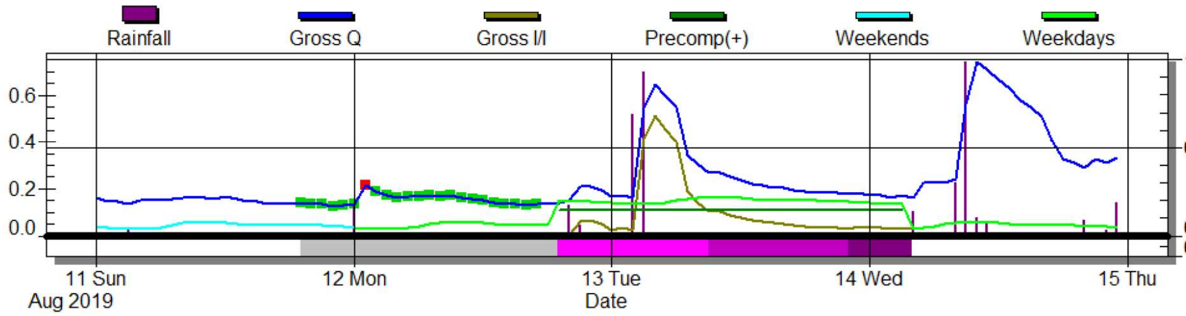


Storm Event - 8/10/2019 8:00:00 AM



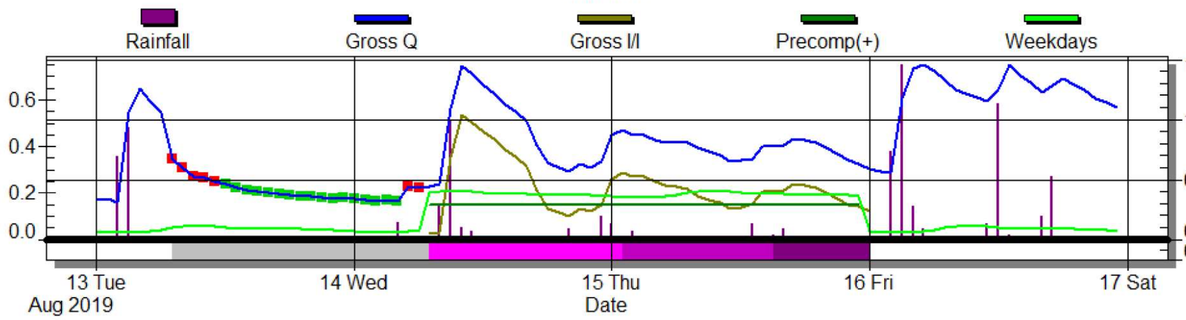
Storm Event - 8/12/2019 7:00:00 PM

MH-17795



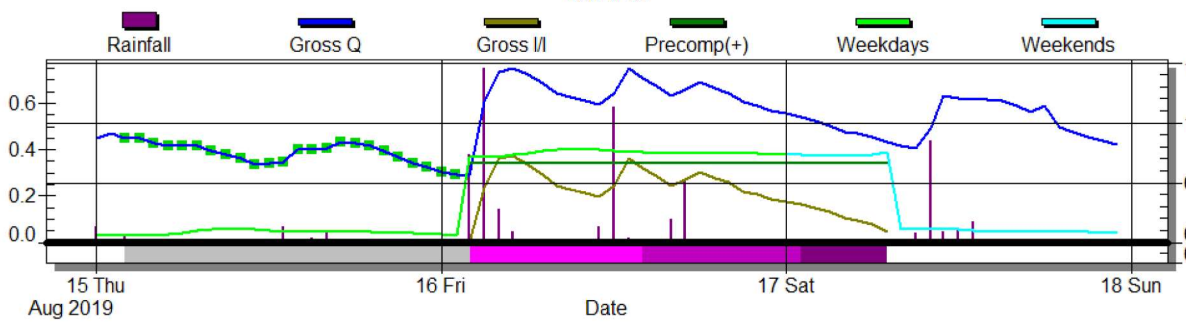
Storm Event - 8/14/2019 7:00:00 AM

MH-17795



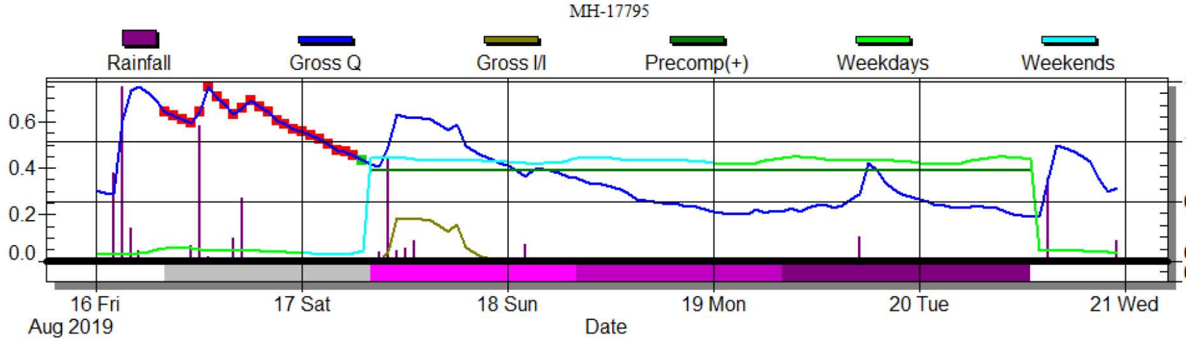
Storm Event - 8/16/2019 2:00:00 AM

MH-17795



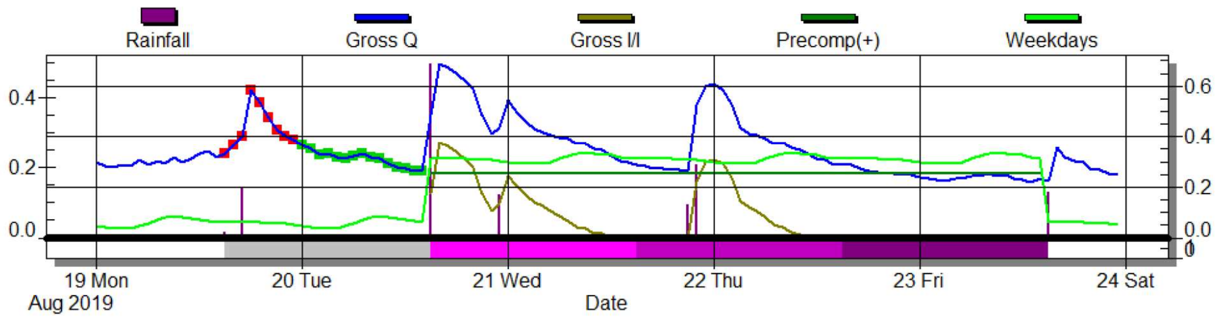
Storm Event - 8/17/2019 8:00:00 AM

MH-17795



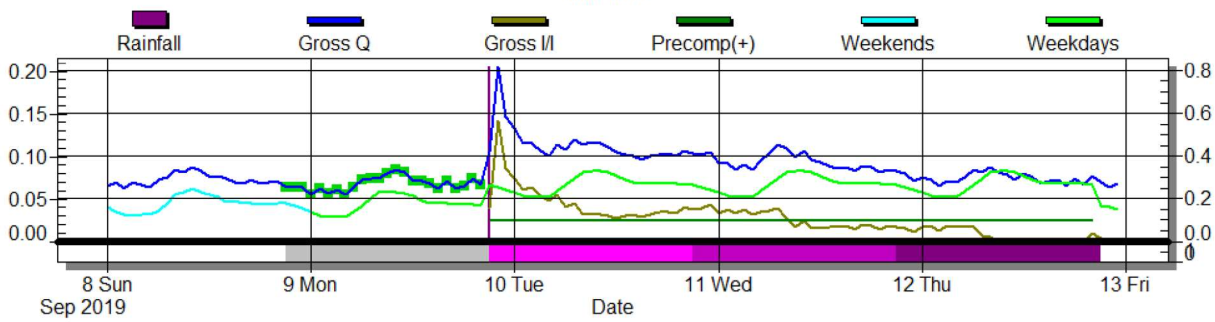
Storm Event - 8/20/2019 3:00:00 PM

MH-17795



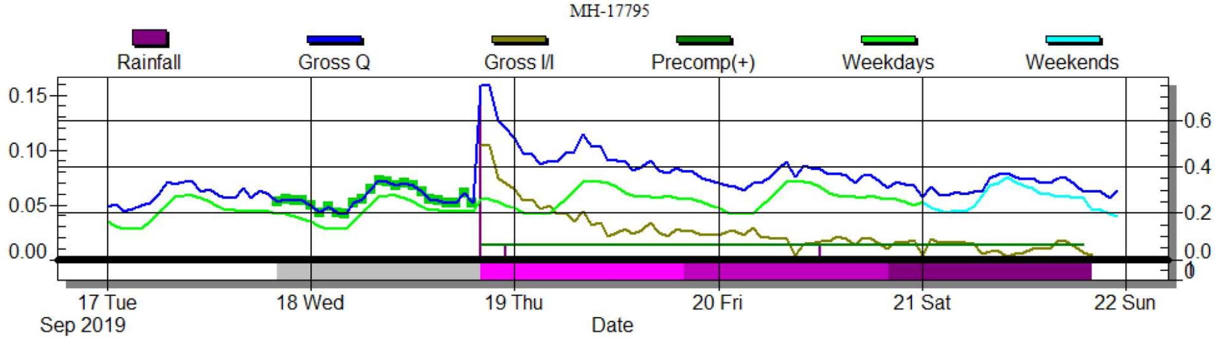
Storm Event - 9/9/2019 9:00:00 PM

MH-17795



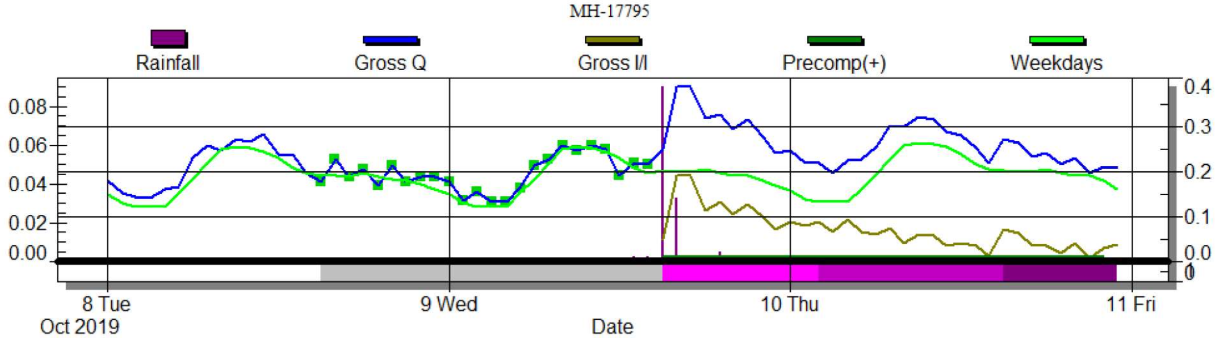
Storm Event - 9/18/2019 8:00:00 PM

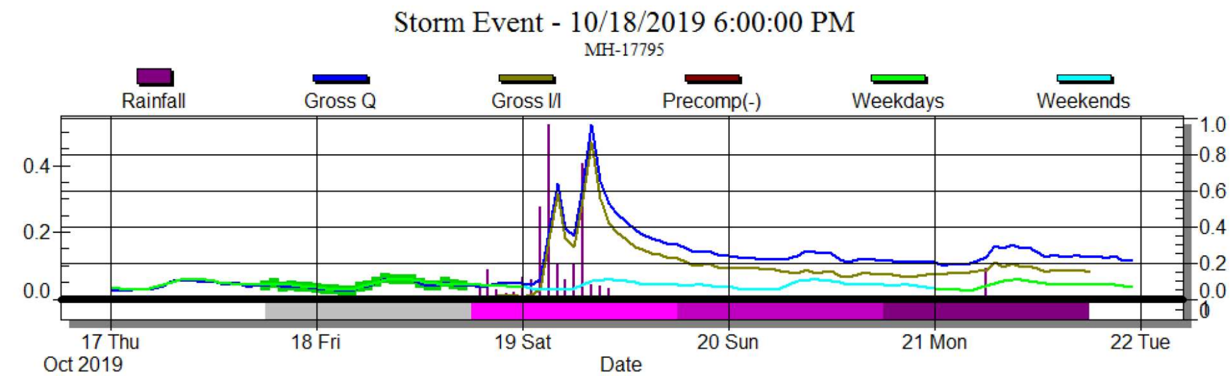
MH-17795



Storm Event - 10/9/2019 3:00:00 PM

MH-17795

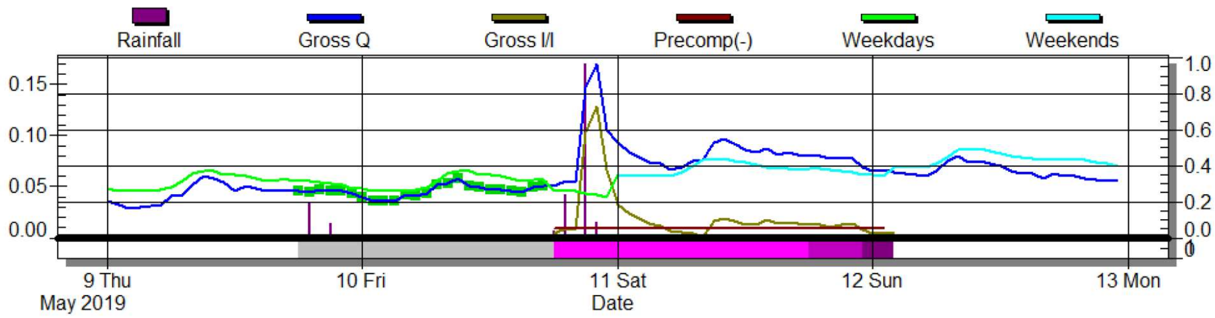




Storm Event - 10/18/2019 6:00:00 PM
MH-17795
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
0.4
0.2
0.0
1.0
0.8
0.6
0.4
0.2
0.0
0
17 Thu
Oct 2019
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
Date

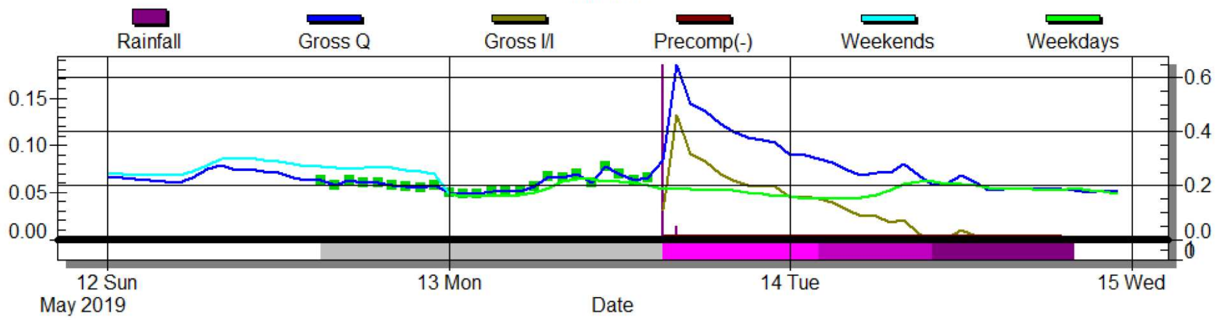
Storm Event - 5/10/2019 6:00:00 PM

MH-17797



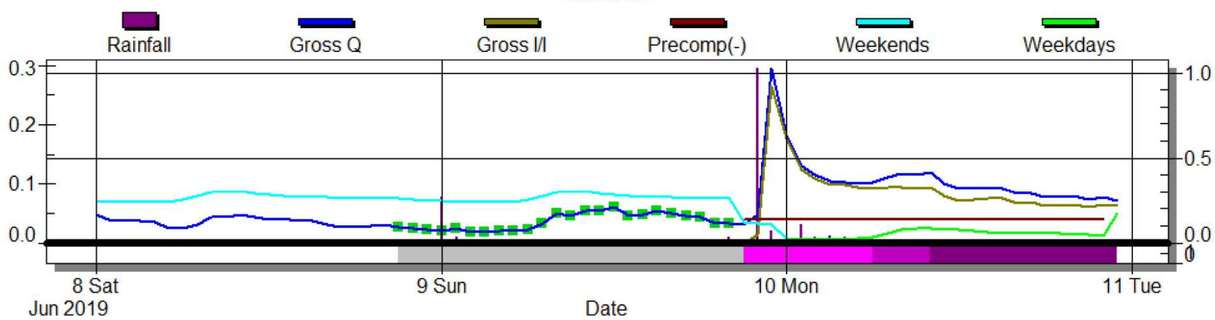
Storm Event - 5/13/2019 3:00:00 PM

MH-17797



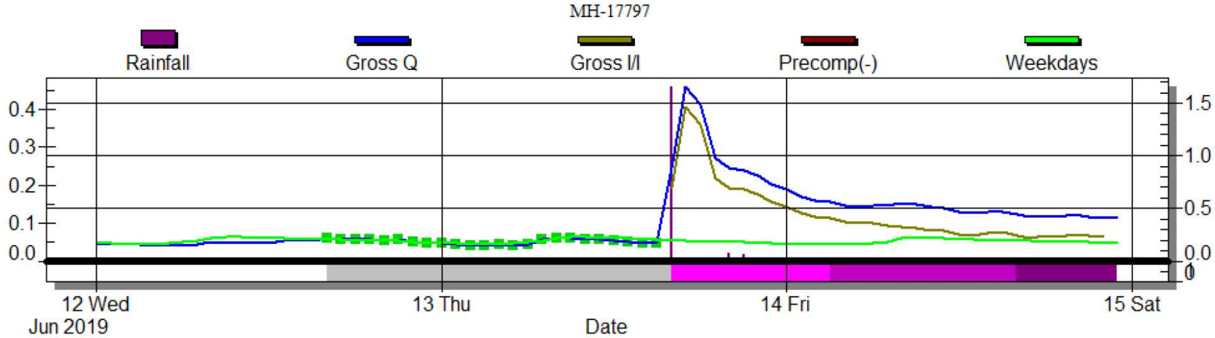
Storm Event - 6/9/2019 9:00:00 PM

MH-17797

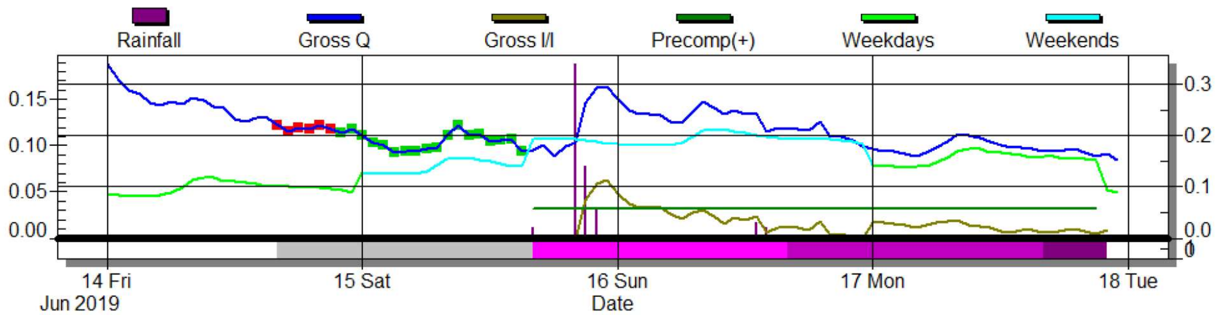


Storm Event - 6/13/2019 4:00:00 PM

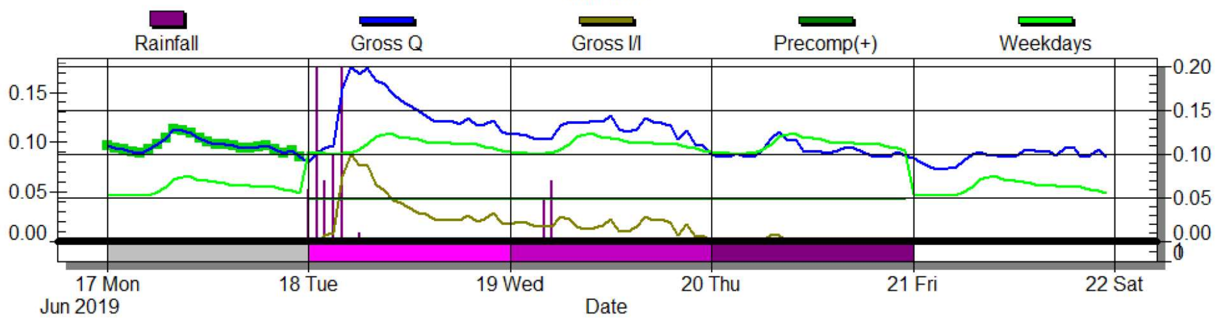
MH-17797



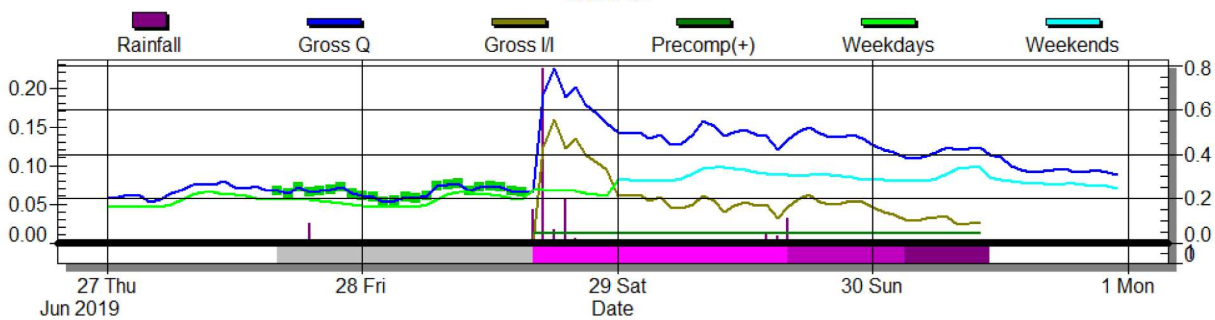
Storm Event - 6/15/2019 4:00:00 PM
MH-17797



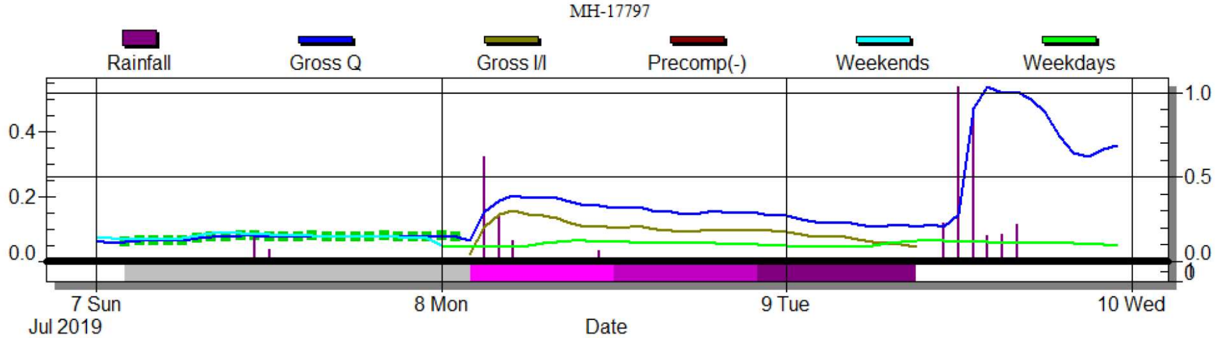
Storm Event - 6/18/2019
MH-17797



Storm Event - 6/28/2019 4:00:00 PM
MH-17797

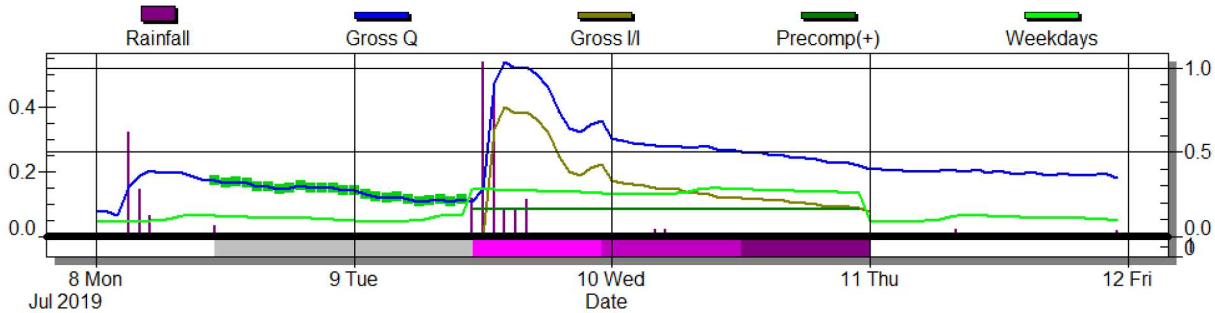


Storm Event - 7/8/2019 2:00:00 AM
MH-17797



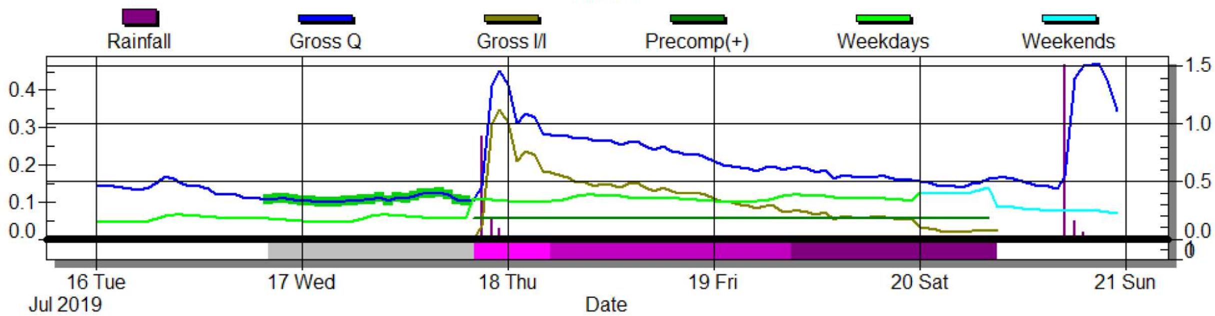
Storm Event - 7/9/2019 11:00:00 AM

MH-17797



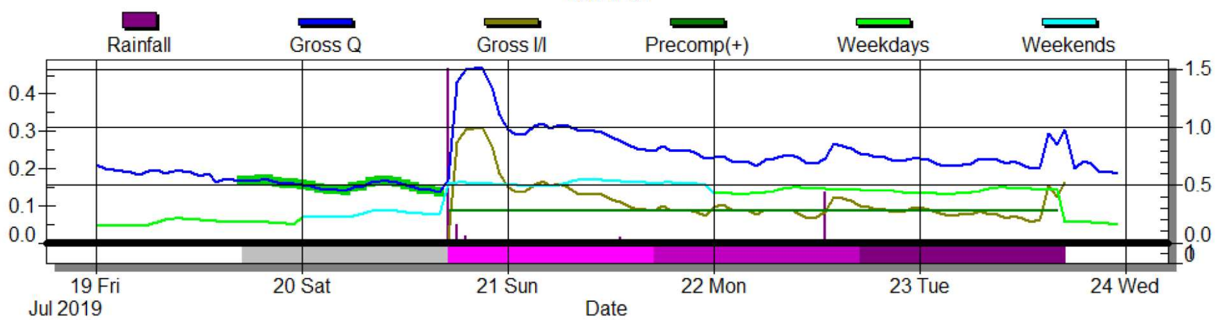
Storm Event - 7/17/2019 8:00:00 PM

MH-17797



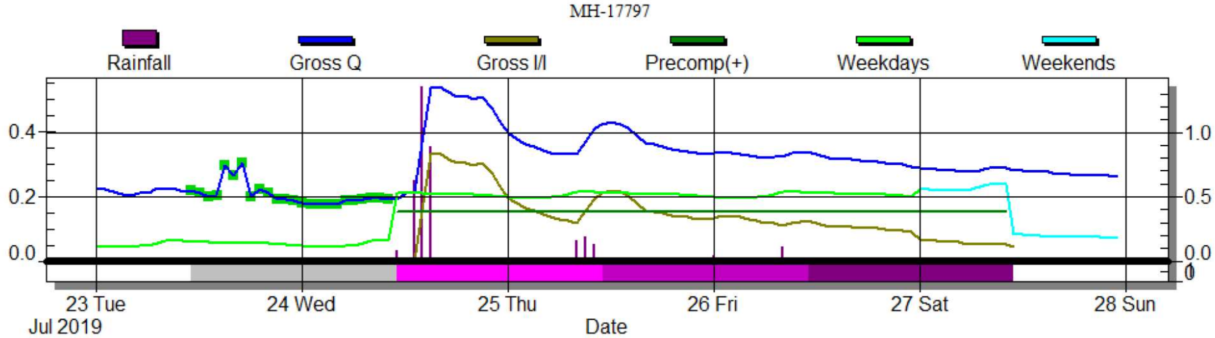
Storm Event - 7/20/2019 5:00:00 PM

MH-17797



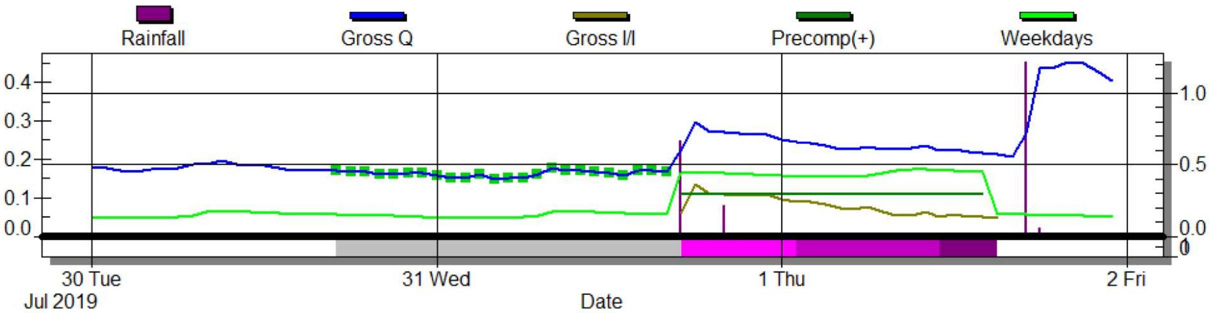
Storm Event - 7/24/2019 11:00:00 AM

MH-17797



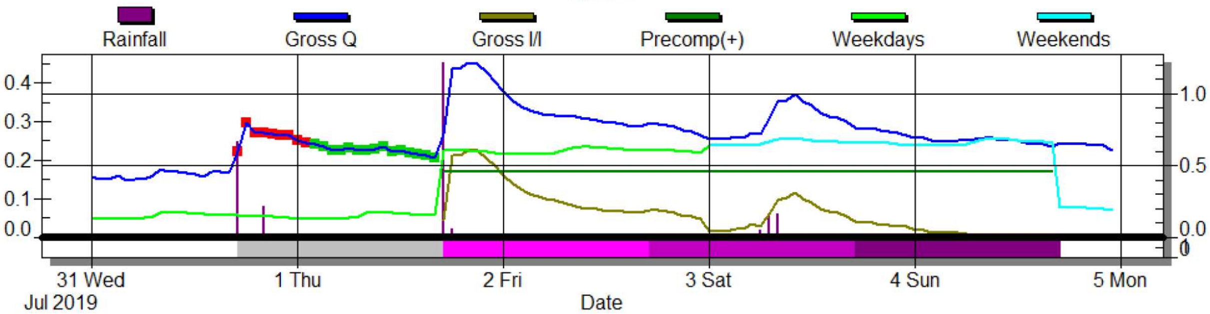
Storm Event - 7/31/2019 5:00:00 PM

MH-17797



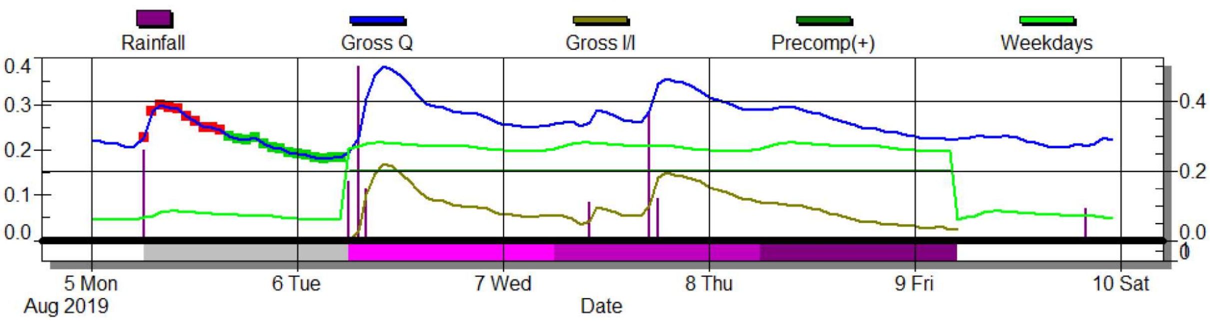
Storm Event - 8/1/2019 5:00:00 PM

MH-17797



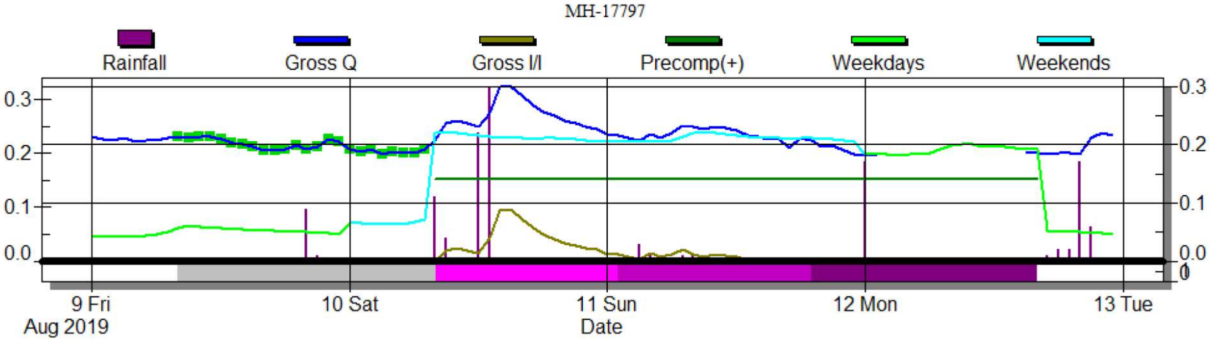
Storm Event - 8/6/2019 6:00:00 AM

MH-17797

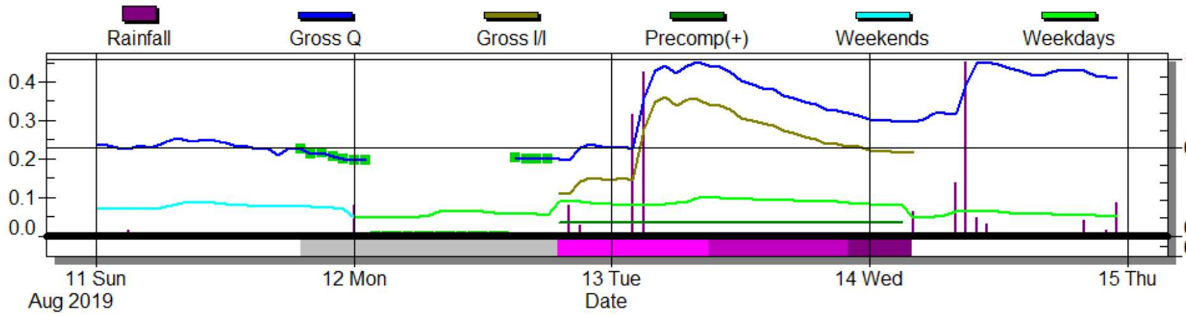


Storm Event - 8/10/2019 8:00:00 AM

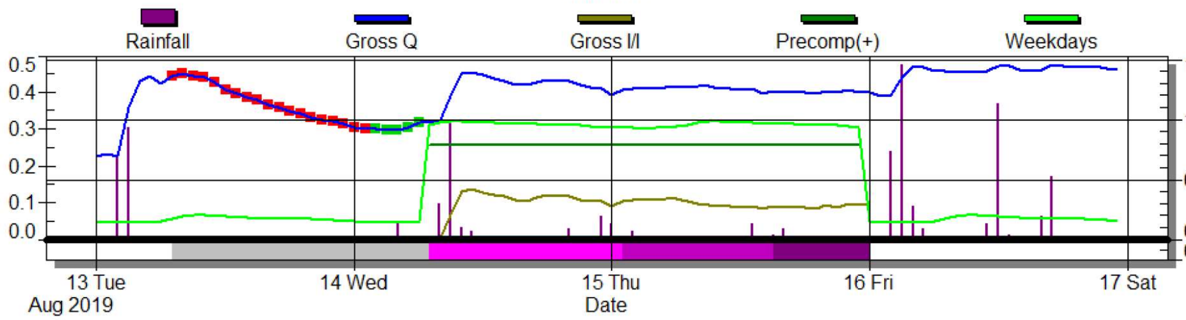
MH-17797



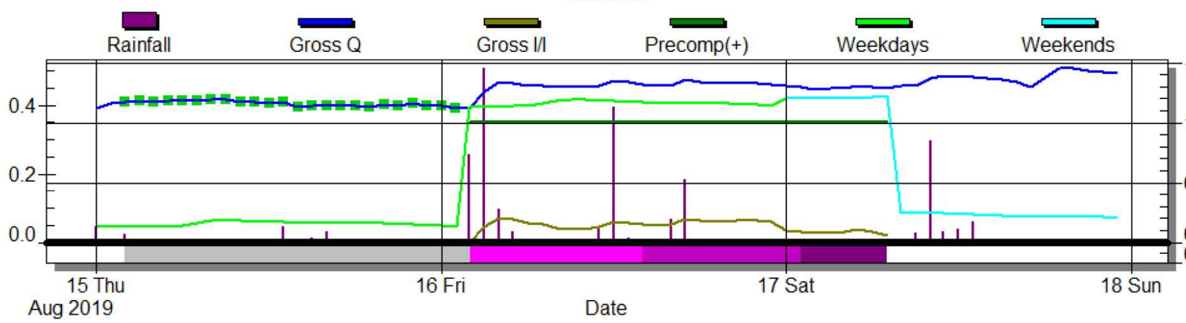
Storm Event - 8/12/2019 7:00:00 PM
MH-17797



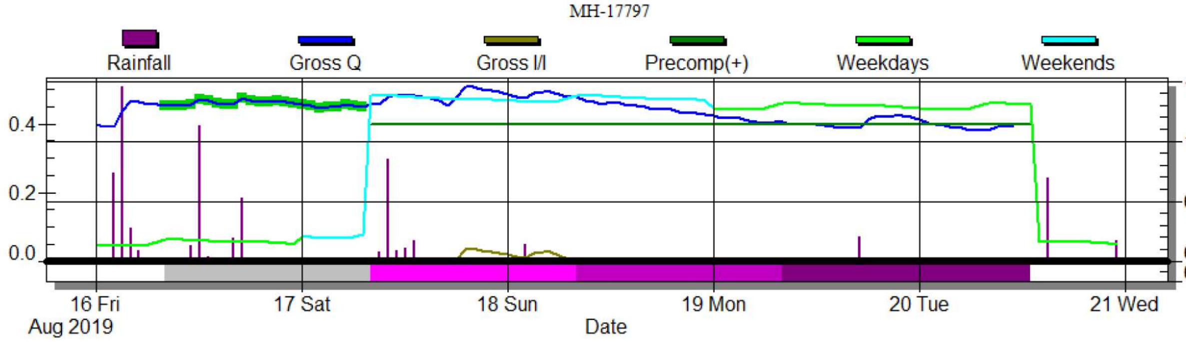
Storm Event - 8/14/2019 7:00:00 AM
MH-17797

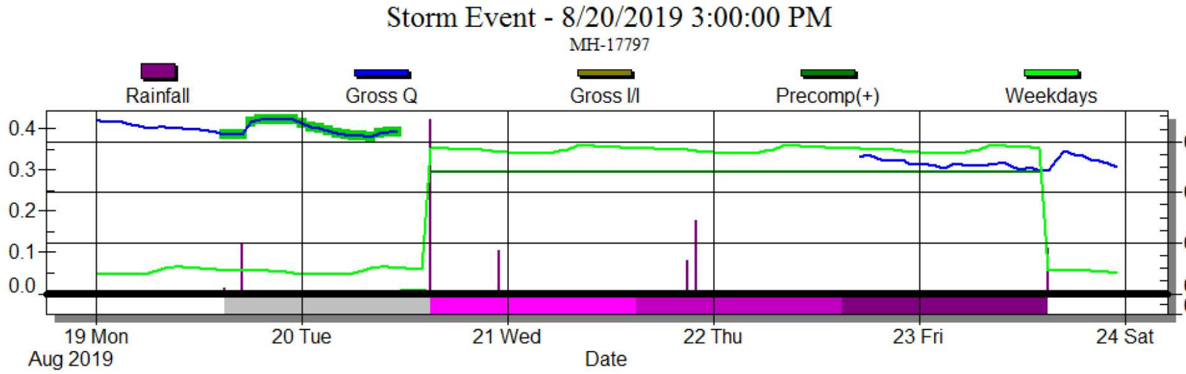


Storm Event - 8/16/2019 2:00:00 AM
MH-17797

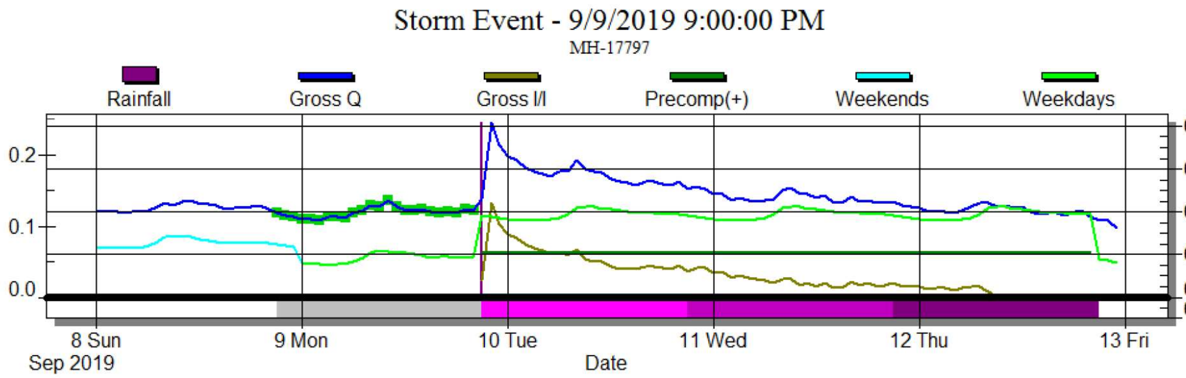


Storm Event - 8/17/2019 8:00:00 AM
MH-17797

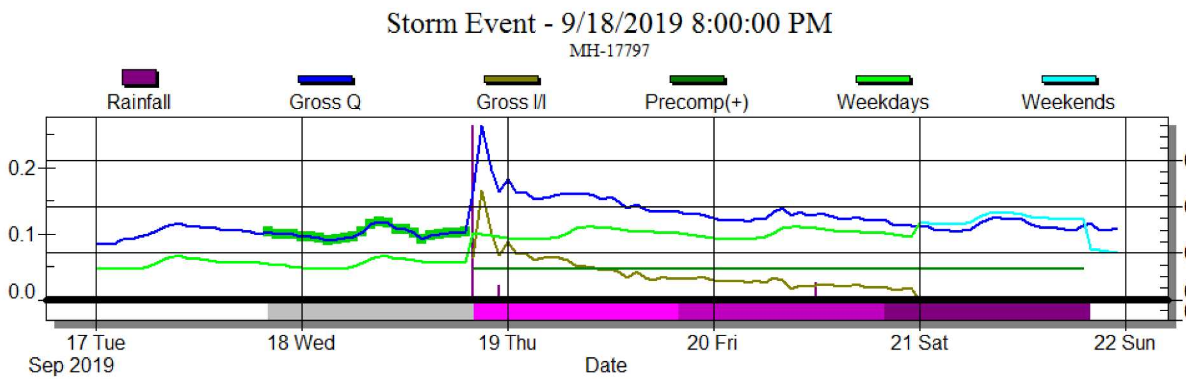




Storm Event - 8/20/2019 3:00:00 PM
MH-17797
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.4
0.3
0.2
0.1
0.0
0.6
0.4
0.2
0.0
0
19 Mon
Aug 2019
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Date



Storm Event - 9/9/2019 9:00:00 PM
MH-17797
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekends
Weekdays
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
0
8 Sun
Sep 2019
9 Mon
10 Tue
11 Wed
12 Thu
13 Fri
Date



Storm Event - 9/18/2019 8:00:00 PM
MH-17797
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.2
0.1
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0.4
0.2
0.0
0
17 Tue
Sep 2019
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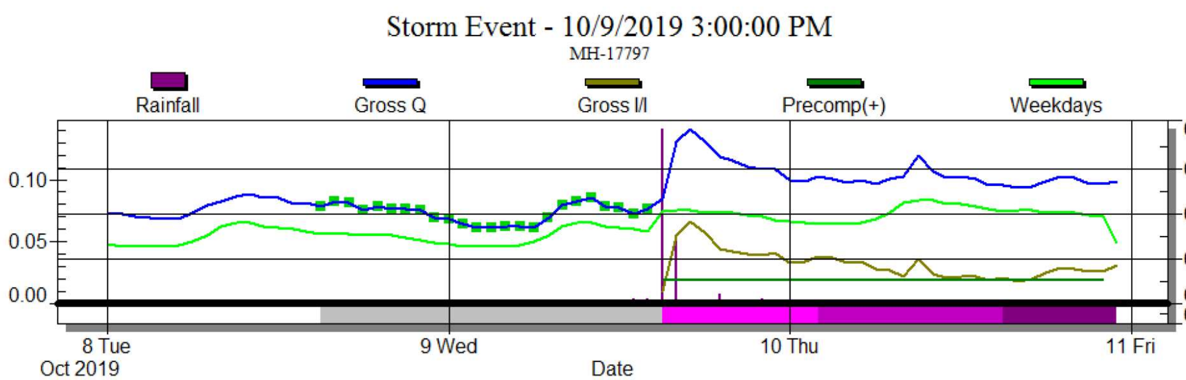
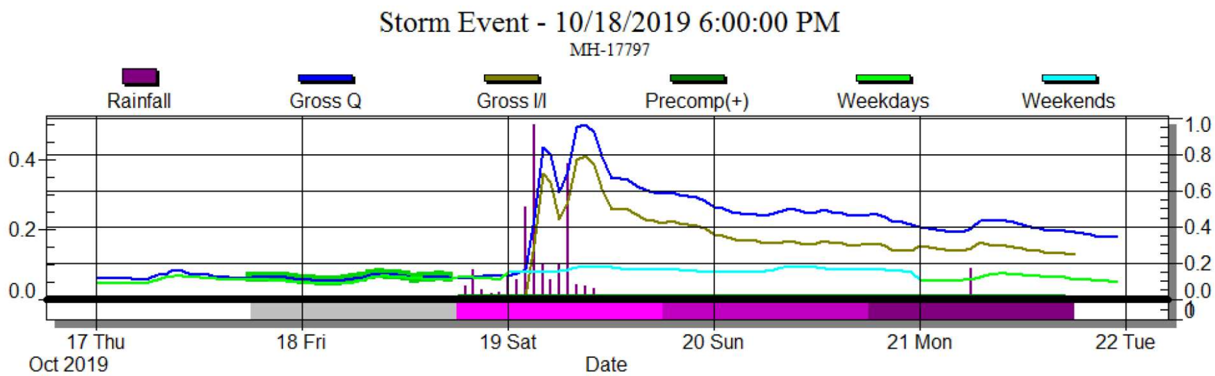
19 Thu
20 Fri
21 Sat
22 Sun
Date



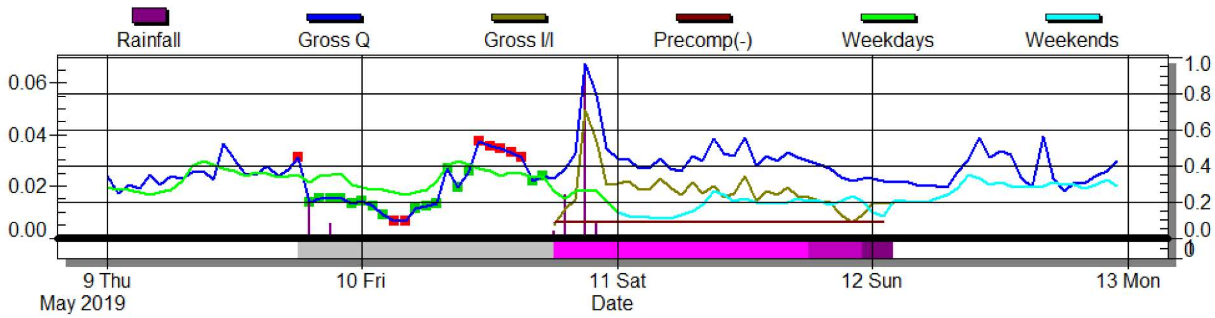
Storm Event - 10/9/2019 3:00:00 PM
MH-17797
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
0.10
0.05
0.00
0.4
0.3
0.2
0.1
0.0
0
8 Tue
Oct 2019
9 Wed
10 Thu
11 Fri
Date



Storm Event - 10/18/2019 6:00:00 PM
MH-17797
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
0.4
0.2
0.0
1.0
0.8
0.6
0.4
0.2
0.0
0
17 Thu
Oct 2019
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
Date

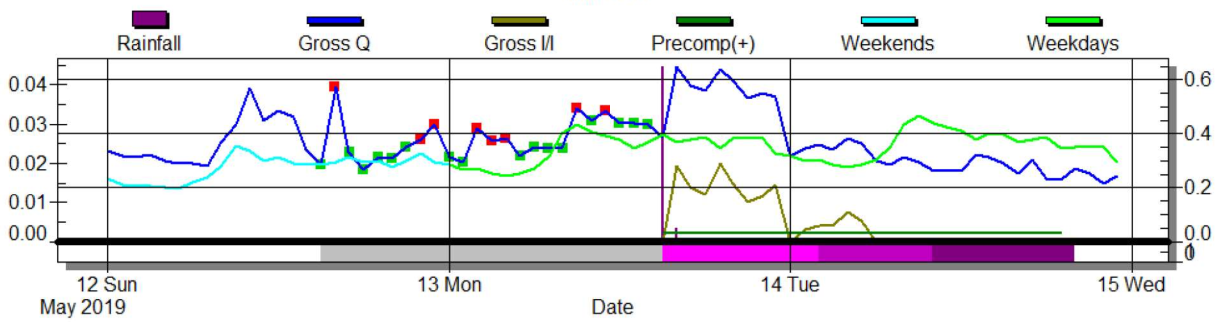
Storm Event - 5/10/2019 6:00:00 PM

MH-24364



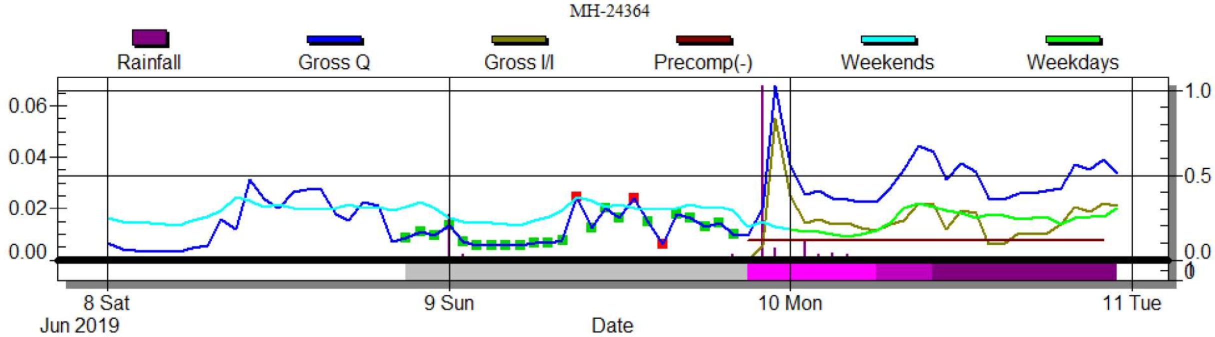
Storm Event - 5/13/2019 3:00:00 PM

MH-24364



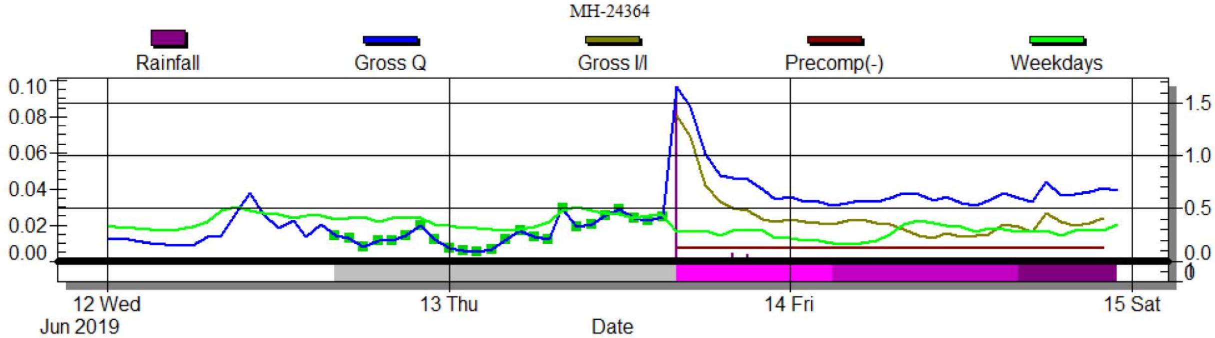
Storm Event - 6/9/2019 9:00:00 PM

MH-24364



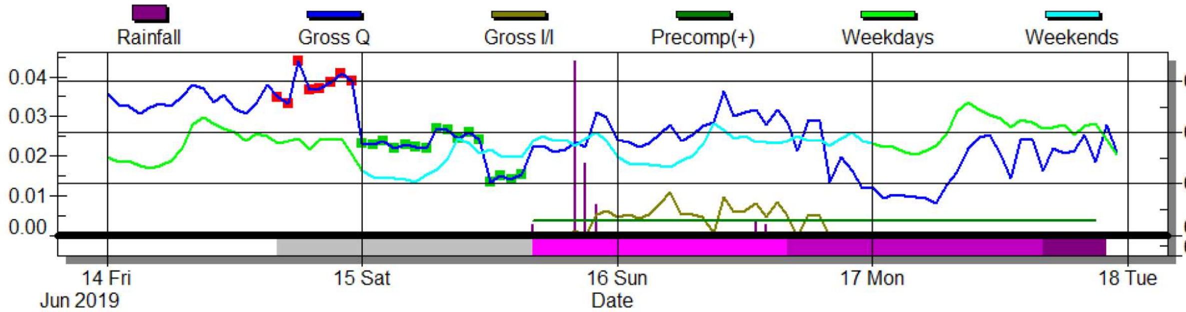
Storm Event - 6/13/2019 4:00:00 PM

MH-24364



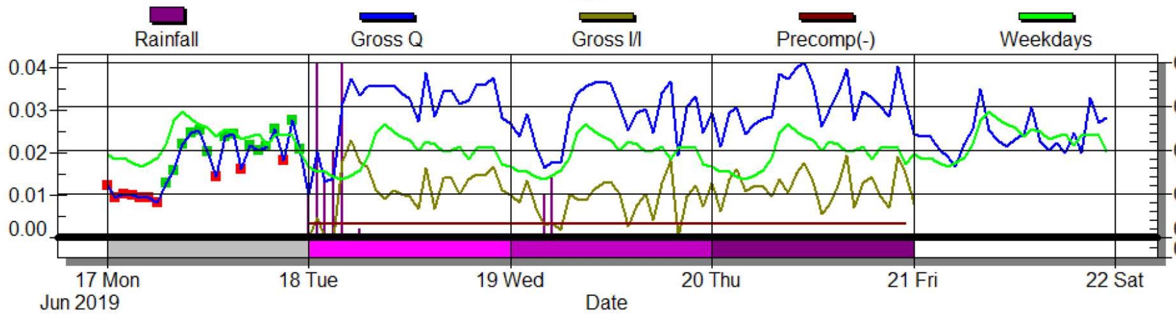
Storm Event - 6/15/2019 4:00:00 PM

MH-24364



Storm Event - 6/18/2019

MH-24364



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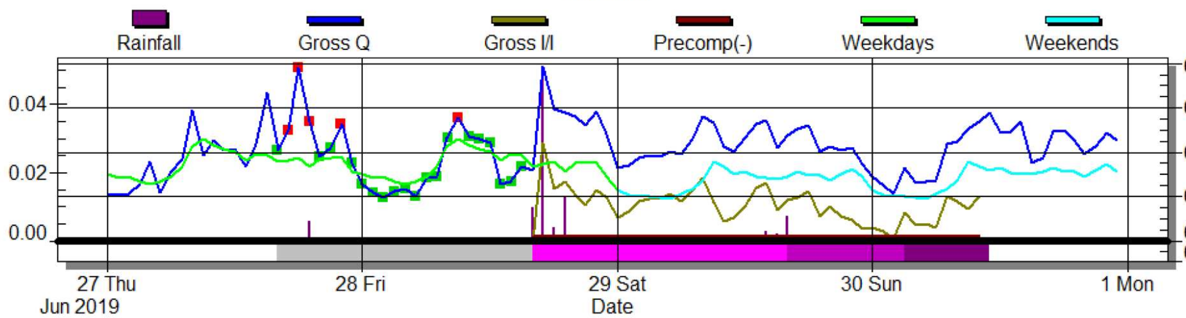
MH-24364



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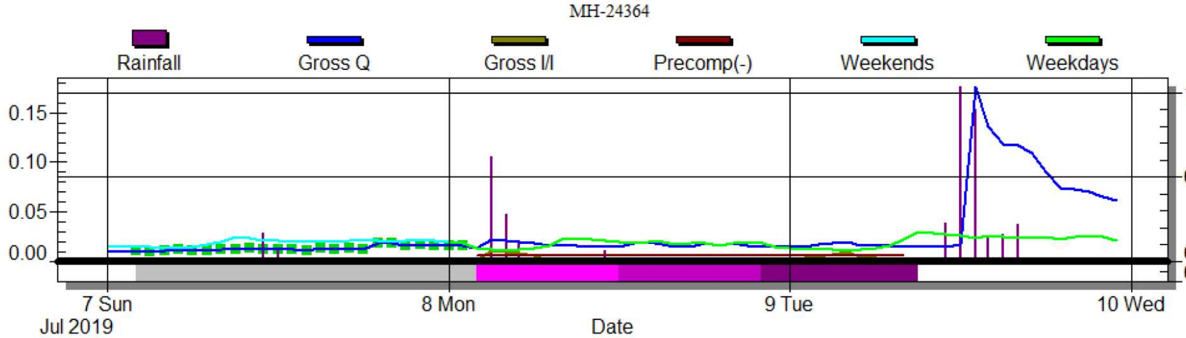

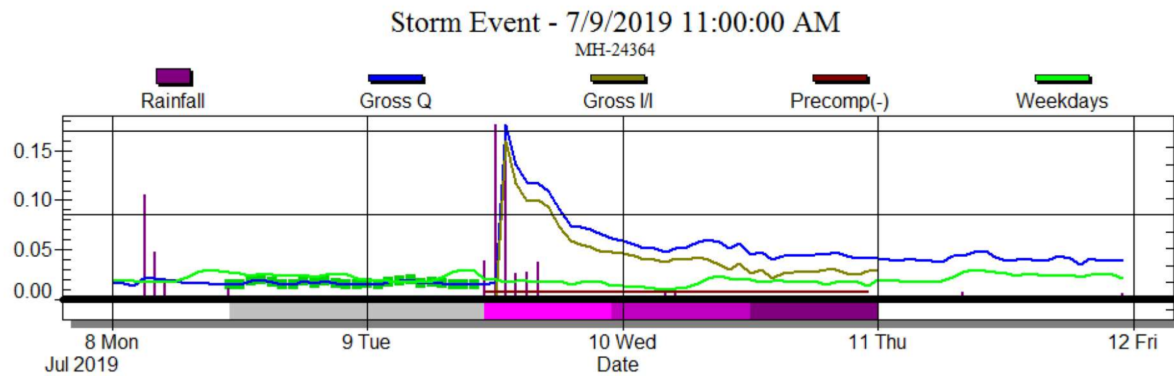

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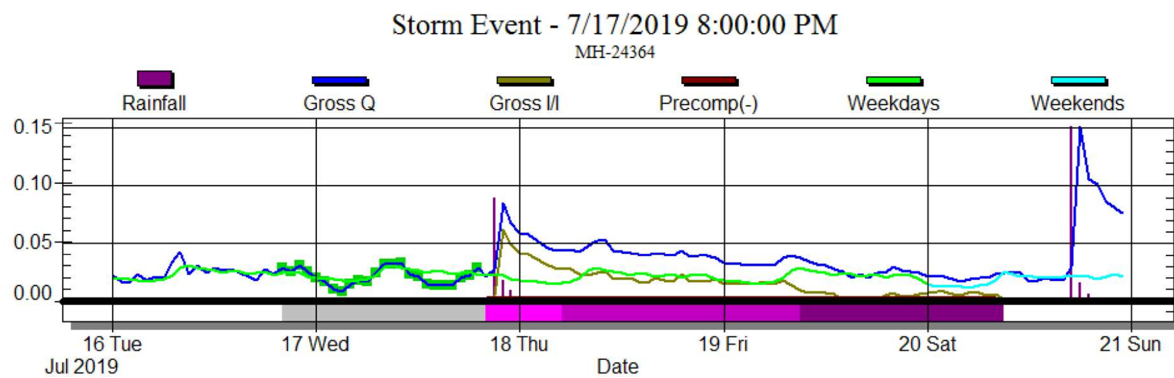

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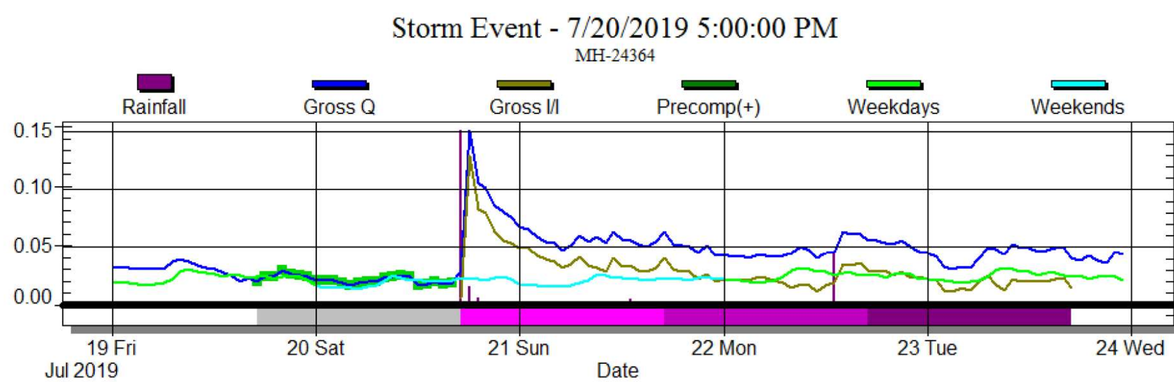

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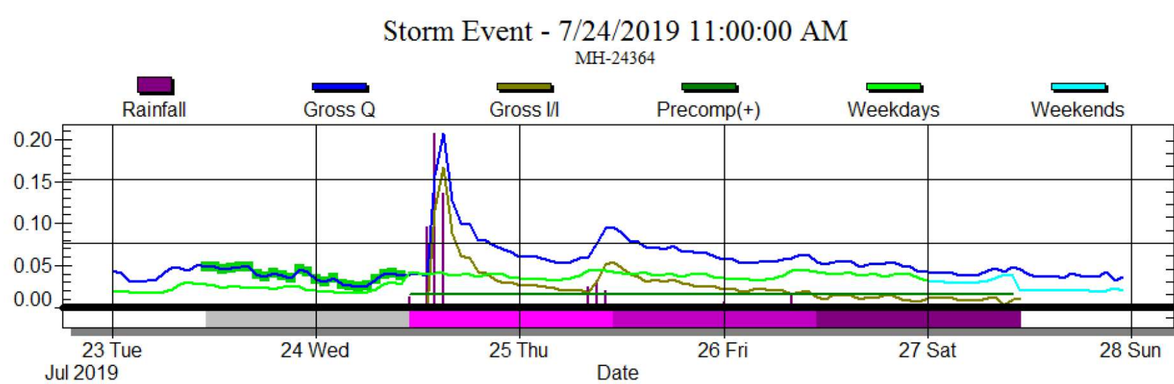

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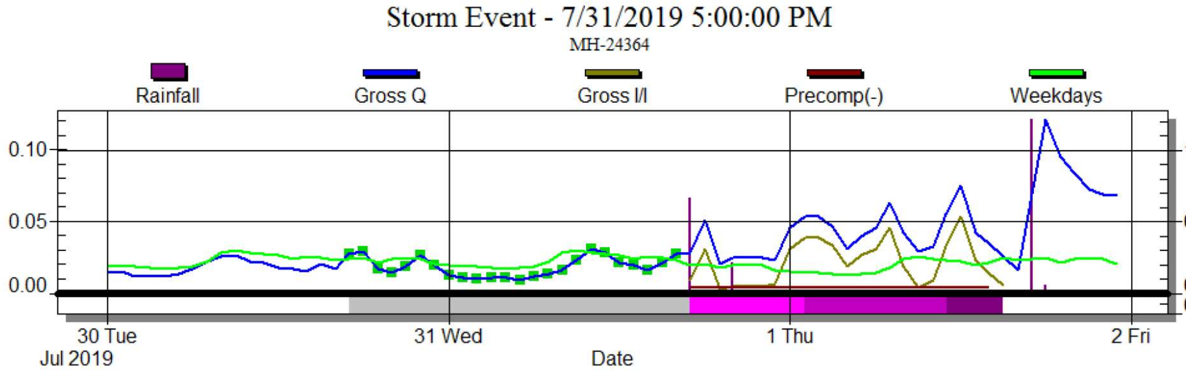
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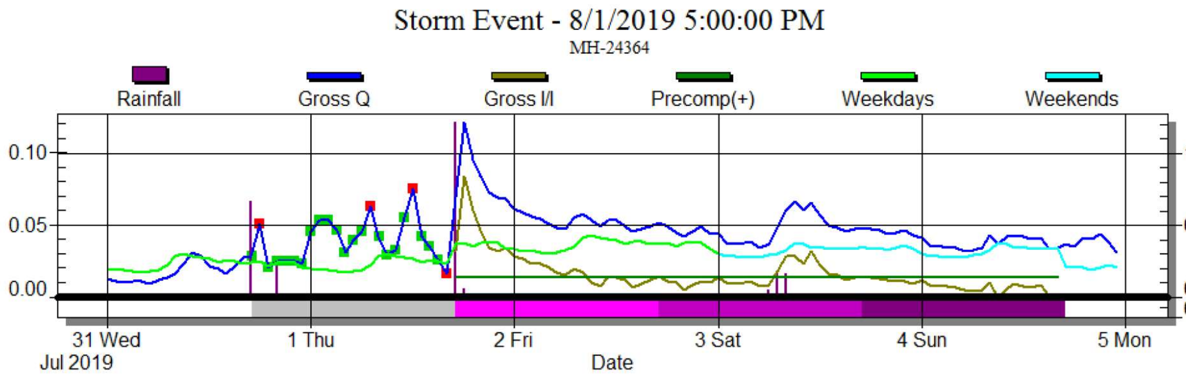
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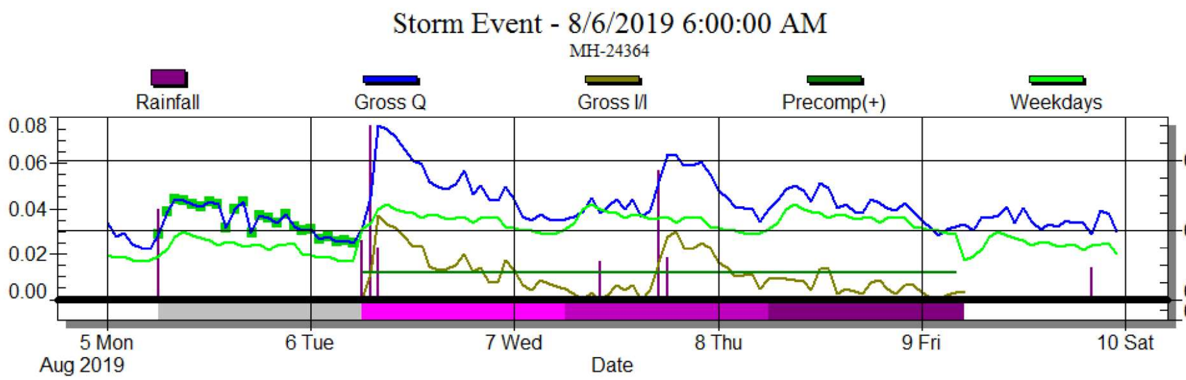
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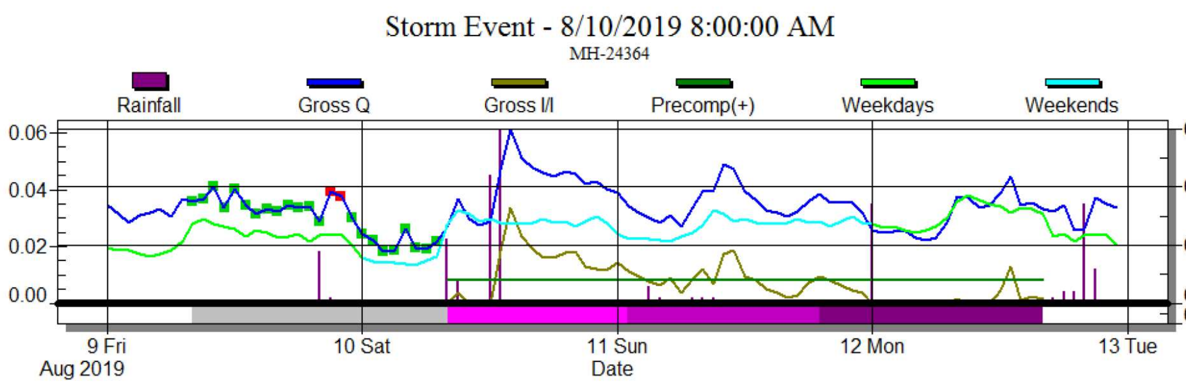
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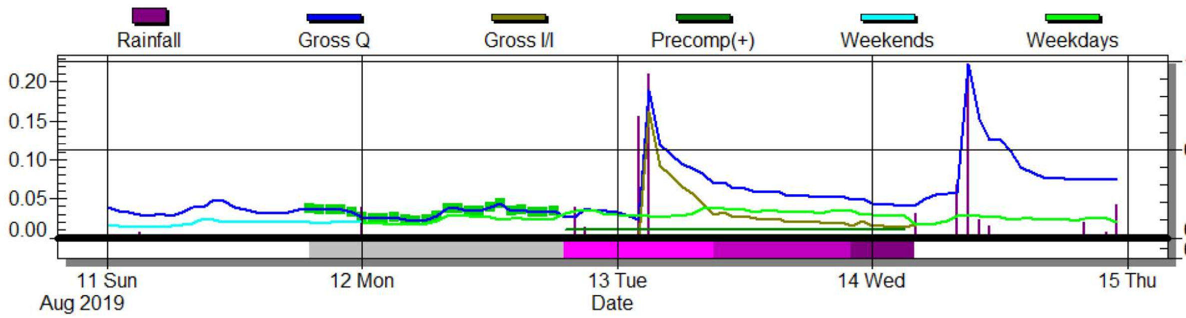

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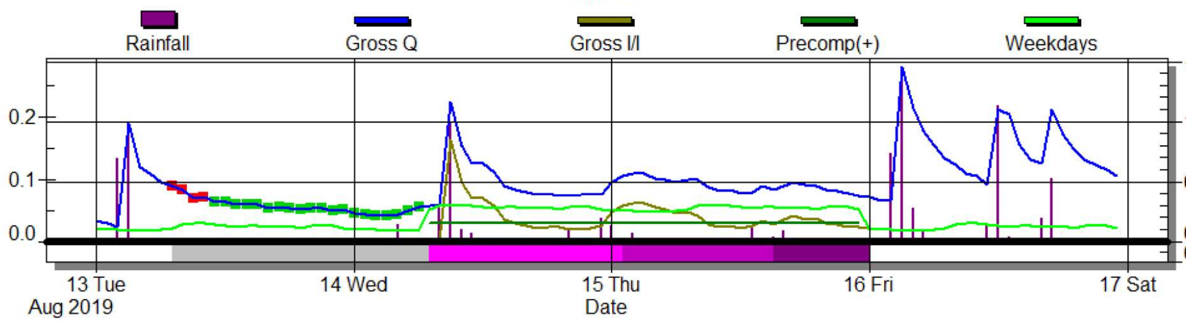

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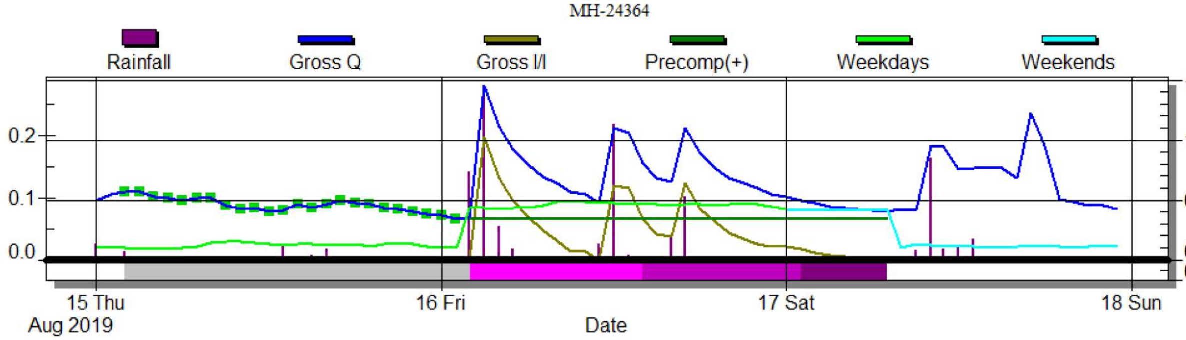

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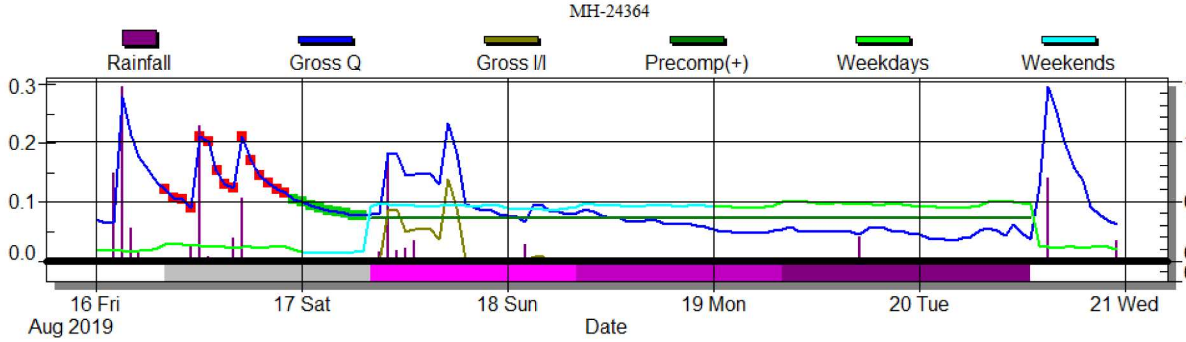

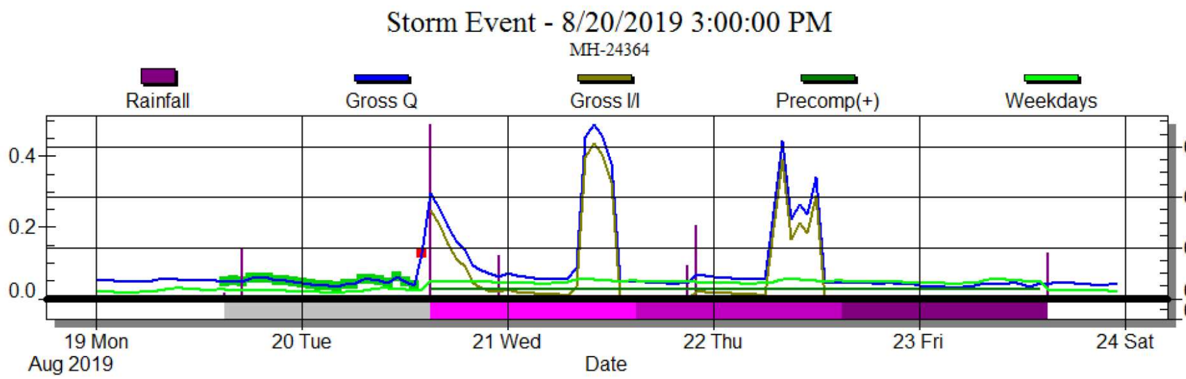
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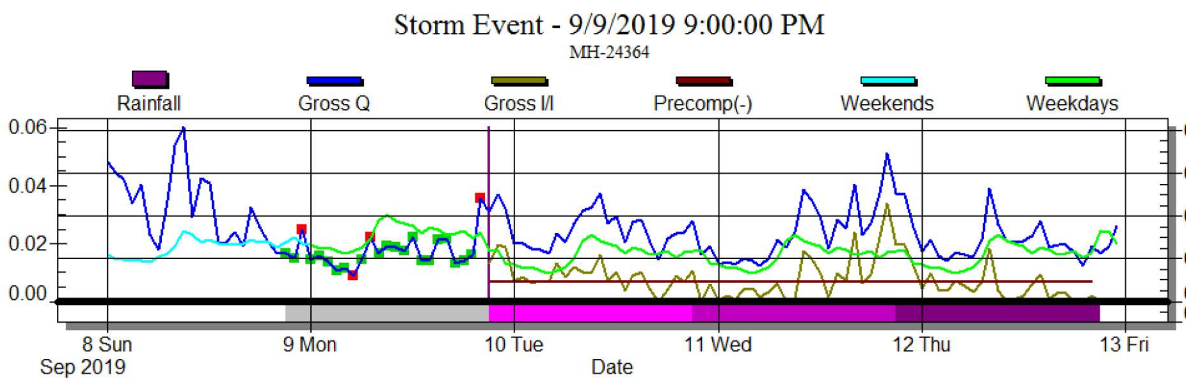
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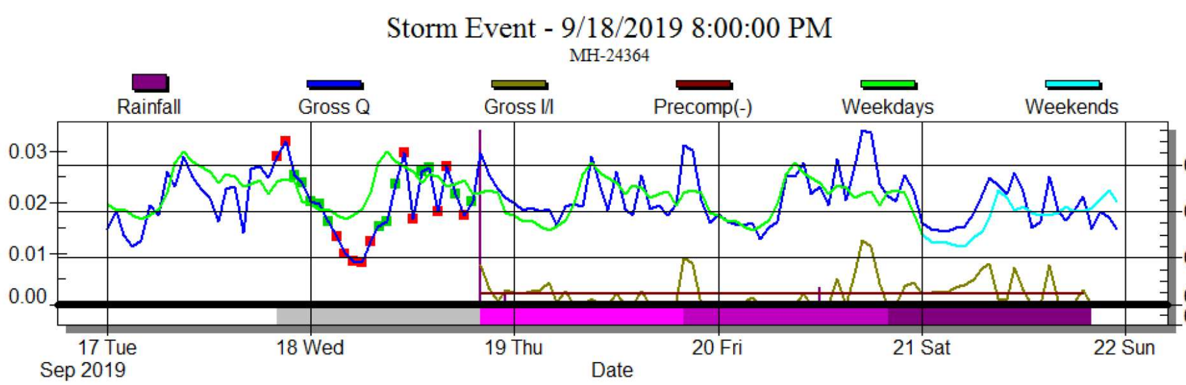
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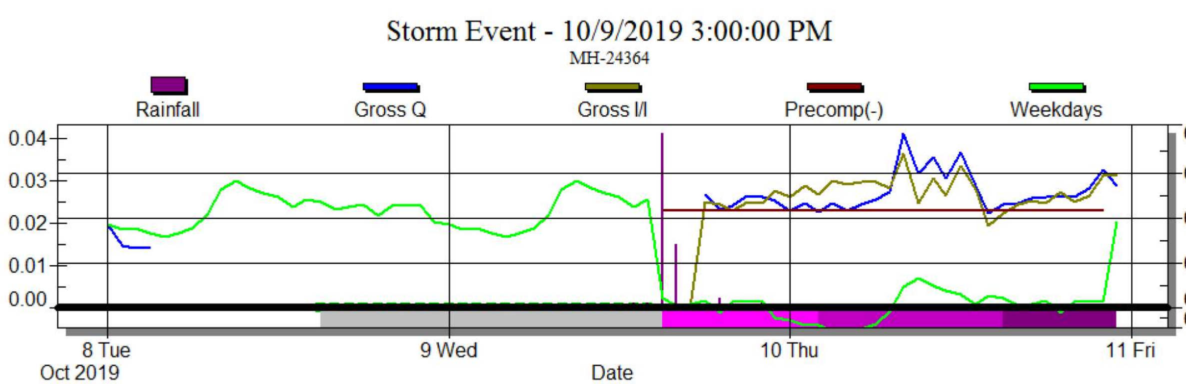
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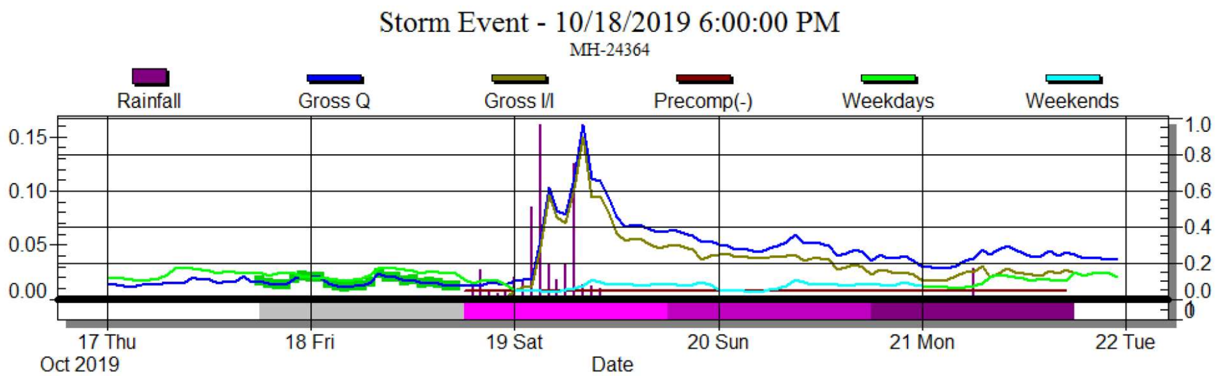

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APPENDIX C:
Trailer Estates Sewer System Analysis

NOVEMBER 2018

TRAILER ESTATES
Sewer System Analysis

Manatee County FLORIDA

Prepared for:
Manatee County
1022 26th Avenue East
Bradenton, FL 34208

Kimley»Horn

Prepared by:
Kimley-Horn and Associates, Inc.
100 Second Avenue South
St. Petersburg, FL 33701

Manatee County
Trailer Estates Sewer System Analysis

Prepared for:
Manatee County
1022 26th Avenue East
Bradenton, FL 34208

Prepared By:
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St. Petersburg, FL 33701

W. Wade Wood, P.E.
FL #69051

CA 00000696
April 2019
Tampa, Florida
148400024

Executive Summary

The Trailer Estates sewer system owned and operated by Manatee County is reaching the end of its effective useful life and is continuously requiring rehabilitation. The Trailer Estates Sewer System Analysis is intended to determine the most economical sewer system that will reduce operational issues and effectively reduce inflow and infiltration (I&I) contribution into the system. Additionally, this analysis will evaluate the feasibility of continued rehabilitation compared to a replacement alternative to ensure the allocation of County resources is the most effective. The following five alternatives for the Trailer Estates Sewer System will be evaluated as part of this analysis:

1. Full Repair of Existing Gravity Sewer System
2. Replacement of Existing Gravity Sewer System
3. Vacuum Sewer System
4. Low Pressure System
5. Package Pump Station System

Each alternative will be scored based on the established criteria to determine the best suited option for the Trailer Estates community. Alternative infrastructure was sized based on estimated flows within the system and a peaking factor established based on population. The alternatives will be assigned a ranking (1 through 5, 1 being the best and 5 being the worst) for five categories and will be summed to produce an overall ranking. Assumptions for each category vary per alternative. The evaluation criteria include the following categories: Capital Cost, Operations, Life Cycle, Maintenance/Accessibility, and Public Inconvenience.

As part of the sewer analysis for Trailer Estates, I&I was evaluated using the County's gravity sewer flow meter, rain gauge at Master Lift Station 12A, and a piezometer installed to record the fluctuations in ground water. Based on the data gathered as part of the study period, the Trailer Estates sewer system is susceptible to I&I. Large spikes in flow after rain events were observed, which is indicative of inflow. Additionally, the lag in response time to revert to normalized flows are evidence of rainfall derived infiltration.

The ranking of each alternative in addition to the comparison of capital costs are shown in **Table E-1** below. Based on the evaluation criteria, Alterative 5 – Package Pump Station System is recommended. This alternative would allow the County to phase the project to complete one package pump station and corresponding gravity basin at a time. Additionally, a new system would increase accessibility and effectively eliminate I&I and the continuous need for rehabilitation efforts within Trailer Estates.

Table E-1: Alternative Comparison

Alternative	Overall Ranking	Capital Cost
1: Rehabilitation	31	$22,191,332.00
2: Replacement	30	$22,940,310.00
3: Vacuum Sewer	34	$21,790,720.00
4: Low Pressure	29	$21,097,342.00
5: Package Pump Stations	27	$21,882,060.00

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Definitions

Drainage Basin: An area that is delineated by topography in which all stormwater drains to the same outfall

Dry-weather Flow: Sanitary sewer flow that is uninfluenced by inflow and infiltration

Fast Response: The immediate effect on flow in a sewer system caused by inflow

GIS: Geographic Information System

GWI: Groundwater Infiltration; infiltration into a sewer system as a result of the water table level

Infiltration: Entry of stormwater into a sewer system from saturated soil or high-water table causing leaking underground through cracked pipes and laterals, pipe joints, or manhole chimneys

Inflow: The direct entry of stormwater into a sewer system through means such as broken manhole lids, combined systems, open clean outs, etc.

Sewershed: A section of a sewer system that flows to a common lift station

Slow Response: The effect on flow in a sewer system caused by infiltration

Wet-weather Flow: Sanitary sewer flow during a rain event that deviates from typical dry-weather flow

Introduction

On August 28, 2018, Manatee County authorized Kimley-Horn to provide general engineering services to complete a Sewer System Analysis for the Trailer Estates Sewer System. The County has historically contributed funds on an annual basis to perform repairs and maintenance on the gravity sewer system. The repairs and maintenance performed over time have not addressed all the deficiencies in the system, thus the need for continued funding. In lieu of budgeting for future repairs and replacement (R&R), the County wants to evaluate whether ongoing R&R or complete replacement of the system will be a more practical solution. The following five alternatives will be evaluated as part of this analysis:

1. Full Repair of Existing Gravity Sewer System
2. Replacement of Existing Gravity Sewer System
3. Vacuum Sewer System
4. Low Pressure System
5. Package Pump Station System

The intent of this work assignment is to determine the most economical solution that will reduce operational issues and reduce inflow and infiltration (I&I) contribution. Each alternative listed above will be scored based on the established criteria to determine the best suited option for the Trailer Estates community. The existing gravity system is suspected to be a contributor of I&I to the County's sanitary sewer collection/transmission system for this basin. This analysis will try to determine evidence of I&I in the existing Trailer Estates gravity sewer system.

Trailer Estates Background

Trailer Estates is a mobile/modular home community developed in the early 1930s to the west of US 41 in the Southwest area of Manatee County, FL as shown in **Figure 1** below.

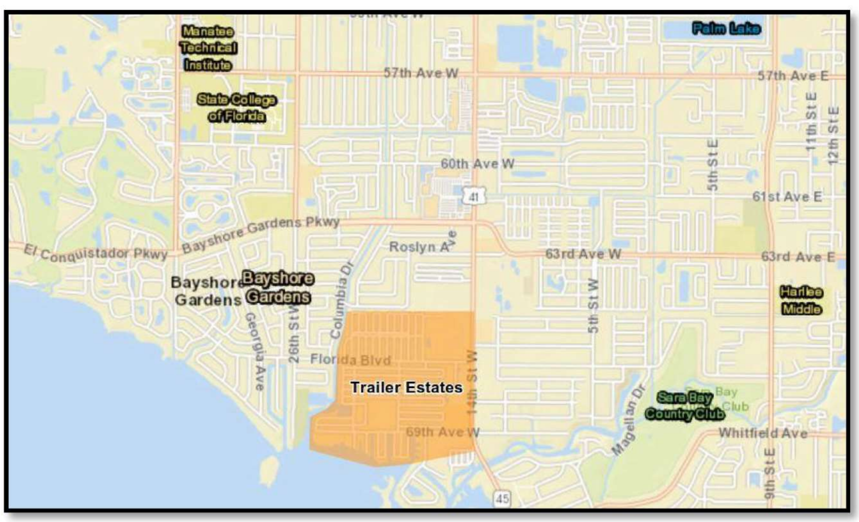


Figure 1: Trailer Estates Location Map

The current gravity collection system is comprised primarily of vitrified clay pipe that is located in easements behind residences of the Trailer Estates community. Commercial connections, along the US 41 corridor have been added since the community's original development. In these areas, gravity main is mostly PVC and HDPE pipe, based on the County's Global Information System (GIS). A total of 1,436 parcels are served by the Trailer Estates gravity collection system. A summary of the existing collection system infrastructure is shown in **Table 1** below.

Table 1: Trailer Estates Existing Infrastructure

Attribute	Overall Count
6-inch Gravity Main	10,950 LF
8-inch Gravity Main	38,900 LF
10-inch Gravity Main	310 LF
15-inch Gravity Main	430 LF
24-inch Gravity Main	1,200 LF
Manhole	242
Service Laterals	1,407

Flow from outside of Trailer Estates is pumped into the 24-inch gravity main along 69th Avenue West from Lift Station RTU 134 (Sarabay Apts 134SC), RTU 135 (1A 135SC), RTU 439 (2A 439SC), and RTU 440 (16-A 440 SC). The Trailer Estates gravity collection system currently discharges to the County's Master Lift Station 12A (MLS 12A). The existing sanitary sewer configuration for Trailer Estates is shown in **Figure 2** below.

The County has made improvements to the existing sanitary system through the six phase CIP project titled Trailer Estates Water and Sewer Line Improvements. This project's construction occurred from 2002-2010 and included rehabilitation to the sanitary sewer system in conjunction with the potable water main replacement to the front of the properties. The sanitary sewer system improvements in this CIP project included manhole lining, ring and cover replacement and adjustment, inflow dish installation, pipe lining, pipe bursting, point repairs, lateral replacement, and grouting lateral connections. The following list describes the area of each phase of the project and the year of completion.

- **Phase 1** (2003): Homes along Pennsylvania, Wisconsin and Michigan Ave.
- **Phase 2** (2006): North of Florida Blvd. from Dakota St. to New Jersey St. and Tennessee Ave.
- **Phase 3** (2009): South of Florida Blvd. including Ohio, Indiana, Minnesota, Illinois, and Iowa Ave. between Marina Dr. and Canada Blvd.
- **Phase 4** (2009): South of Florida Blvd. including Ohio, Indiana, Minnesota, Illinois, and Iowa Ave. east of Canada Blvd.
- **Phase 5** (2009): North of Florida Blvd including all the streets east of the canal to California St.
- **Phase 6** (2010): Homes in the vicinity of 69th Ave. W that were not previously included in an earlier phase

Based on the information provided by the County including maintenance logs, work orders, and as-builts of CIP projects, the Trailer Estates existing system map was updated to show pipes and manholes that have received rehabilitation through lining or replacement in **Figure 3** below. A detailed report of maintenance activities made to the system is shown in **Appendix A.** As illustrated, the County has rehabilitated much of the Trailer Estates system by repairing and lining the gravity sewer and manholes, to try and reduce any contribution of I&I.

Figure 2: Trailer Estates Existing Sewer System Exhibit

Figure 3: Trailer Estates Existing Sewer System – Previously Completed CIP Projects

Wastewater Flow Calculations

The total wastewater flow contribution from the Trailer Estates community was calculated to determine the adequacy of the existing infrastructure and to size all proposed infrastructure. Wastewater flow pumped by MLS 12A is measured by a flow meter connected to the County's SCADA system. The satellite lift stations do not have a flow meter; however, the County has instrumentation in place that allows their SCADA system to estimate the average daily inflow and average pumping rates. The measured and estimated flow data was provided by the County from October 2017 to October 2018. A summary of the flow data per station is shown in **Table 2** below.

Table 2: Wastewater Flow per Lift Station SCADA Data

Lift Station RTU	Lift Station Name	Average Daily Inflow (GPD)	Average Daily Inflow (GPM)	Pump Type	Design Operating Point of Pumps
139	MLS 12A	784,511	544.8	FLYGT 3231.665	2500 GPM @ 135 FT TDH
134	SARABAY APTS 134SC	12,333	8.6	HOMA AMX434-155	100 GPM @ 18 FT TDH
135	1A 135SC	163,037	113.2	HOMA AMX646-330	650 GPM @ 44 FT TDH
439	2A 439SC	225,145	156.4	BARNES	1400 GPM @ 48 FT TDH
440	16-A 440 SC	57,487	39.9	HYDROMATIC	350 GPM @ 25 FT TDH

Pump type and operating points are shown for reference purposes.

To determine the average daily flow (ADF) contributing from only the Trailer Estates gravity system, the flow from the contributing lift stations was subtracted out of the estimated average daily flow to MLS 12A as shown in **Table 3** below.

Table 3: Estimated Flow in Trailer Estates Gravity System

Scenario	Flow
MLS 12A ADF	784,511 GPD
ADF from Contributing Lift Stations	458,003 GPD
Trailer Estates Gravity System ADF	326,508 GPD (227 GPM)

The peak hour flow (PHF) contributing to the Trailer Estates sewer system was calculated using a peaking factor established based on population data of the project area. The peaking factor is representative of the entire wastewater system. It does not represent the recommended peaking factor for individual commercial or residential users.

Peak Hour Flow Calculation (PHF):

- Peak Hour Flow is based on the population calculation from the Ten State Standards ("Recommended Standards for Wastewater Facilities", 2014)
- The 2018 population within the City Limits is 1,555 (See **Appendix C** for a ESRI Community Profile Report)
- Using the equation shown in **Figure 4** below, the peaking factor is **3.67** for PHF

$$\text{Q Peak Hourly/Q Design Ave} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}} \quad \text{--- (P = population in thousands)}$$

Figure 4: Ten State Standards Peaking Factor Equation (Population = 1,555)
("Recommended Standards for Wastewater Facilities", 2014)

A summary of the calculated ADF and PHF of the Trailer Estates sewer system per SCADA operating data is shown in **Table 4** below.

Table 4: Wastewater Flow Summary per Land Use Code

Scenario	SCADA Flow Data
ADF (GPD)	326,508
ADF (GPM)	227
Peaking Factor	3.67
PHF (GPD)	1,198,284
PHF (GPM)	**832.1**

To verify the ADF calculated from the County's historic SCADA data, flows were also calculated per land use code to compare to the operating data above. This approach will identify the flow allocation variations throughout the Trailer Estates system. Applied wastewater flows are based on the *Manatee County 2017 Utility Flow Contribution Table* and the corresponding *Potable and Wastewater Service Areas Map*, both included in **Appendix B.** The wastewater flows in this table take into account contribution from I&I as shown by the higher sewer demand versus the potable water demand. The total flow contribution is broken down by land use type in the designated County service area. Trailer Estates is in the Southwest service area and is primarily zoned as a Mobile Home land use type. Commercial properties located along US 41 and condos along Sarasota Bay also discharge into the Trailer Estates sewer system. A map showing the land use type by parcel is shown in **Figure 5** below. Parcel information is included in the County's GIS parcel file and is consistent with the County property appraiser information available. In some instances, corrections were made to building square footage or quantity of units when data was incorrectly shown in the parcel data information in GIS.

Figure 5: Trailer Estates Land Use Map

The ADF calculations per land use type are shown in **Table 5** below. All square footage values were calculated using the total 'under roof' square footage attribute for each property.

Table 5: Wastewater Flow Calculations per Land Use

Land Use Code Description	No. of Parcels	Total Units for Flow Calculation	Wastewater Rate - ADF (GPD)	Estimated Total ADF per Land Use (GPD)
Mobile Home	1291	1291 Units	230 per residence	296,930
Single Family Residence	26	26 Units	345 per residence	8,970
Condominium	6	6 Units	230 per condo	1,380
Commercial, Warehouse, Convenience Store	29	214,529 SF	0.1 per SF	21,453
Office	7	25,078 SF	0.2 per SF	5,016
Marina	1	125 Berths	100 per berth	12,500
Recreation	4	255 Spaces	5 per parking space	1,275
Hotel	1	50 Rooms	120 per room	6,000
Restaurant	3	18,457 SF	5 per SF	92,285
Fast Food Restaurant	1	3,862 SF	0.85 per SF	3,283
Assisted Living Facility	1	126 Beds	125 per bed	15,750
Church	1	75 Seats	3 per seat	225
			Total ADF (GPD)	**465,067**
			Total ADF (GPM)	**323**

Comparing the flows from the County's historic SCADA data (326,508 GPD) to the flows developed from the land use codes (465,067 GPD), the flows are within 30% of each other.

- 465,067 GPD – 326,508 GPD/465,067 GPD x 100 = 29.8%

This flow calculation comparison helps validify the flow rates used for design. It ensures that the land use estimate isn't grossly overestimating the gravity system's anticipated flow and that the County's lift station SCADA systems are quantifying flow into the stations reliably. Flows based off land use codes will typically be more conservative and, in this case, the applied wastewater flows include an additional allowance for I&I.

Inflow and Infiltration Analysis

The County has expressed concerns regarding I&I within the Trailer Estates sewer system. As part of the overall analysis of the Trailer Estates sewer system, I&I was identified using a sanitary sewer flow meter. Throughout the duration of the analysis, the flow meter was installed at two (2) locations within the system. In addition to the flow meter, a 2-inch piezometer with a LevelTroll was installed to monitor groundwater levels. The location of the equipment used in this analysis is shown in **Figure 6** below.

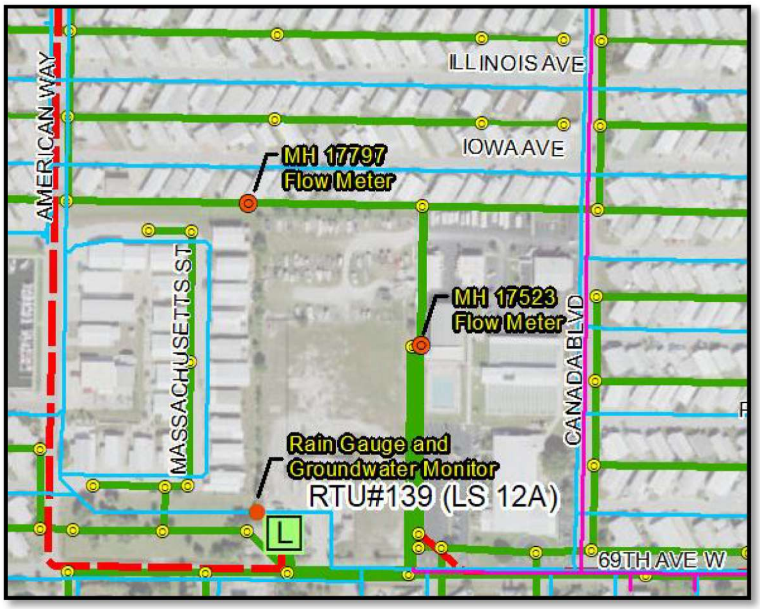


Figure 6: Flow Monitoring Equipment Location Exhibit

The Trailer Estates area is a coastal community, located on the Intercoastal, thus groundwater can play a major role in infiltration. Rainfall data was also obtained from a monitoring station located at MLS 12A. The data from the rain gauge is recorded in inches of rain per day. Using this data, flow trends were analyzed to determine if there is a presence of I&I within the system.

Flow Monitoring Results

I&I can be identified through flow monitoring when an increase in sewer flow rates correspond with rainfall or elevated groundwater levels (rainfall derived infiltration) in the sewershed. These system responses are typically characterized by an initial peak in sewer flow corresponding with the start of a rain event followed by a gradual return to normal dry weather flow as the rain infiltrates into the ground and the soil becomes less saturated.

In July 2018, the County's flow meter was installed in Manhole 17523, which captures the majority of the flow to MLS 12A from Trailer Estates, excluding the small portions of the system directly to the east and south of MLS 12A. This manhole also receives flow from the Sarabay Coves Condos.

Figure 7 below shows the sewer flow in Manhole 17523 versus rainfall during the collection period.

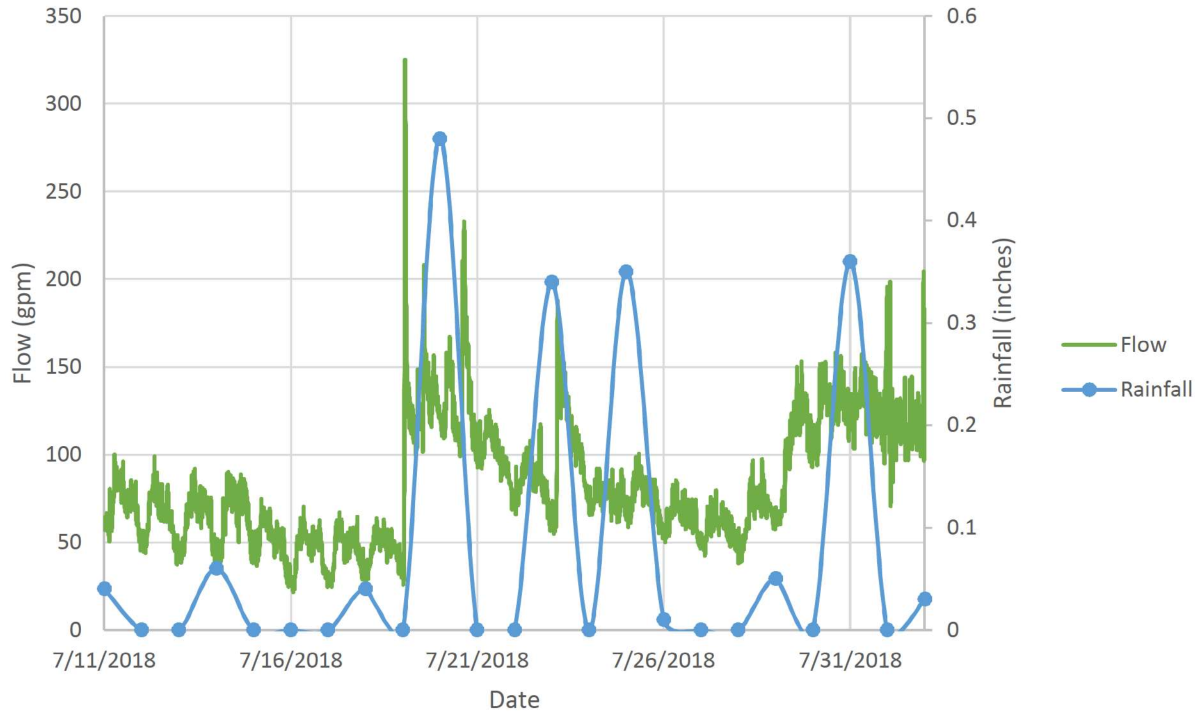


Figure 7: Manhole 17523 Sewer Flow vs Rainfall

Due to the differences in data collection frequency of rainfall (daily total) versus flow rate (recorded every 5 minutes), the rainfall appears to occur subsequent to the initial spike in sewer flow. Although the level of detail of the rainfall data does not allow for identification of the beginning and end of a particular rain event, daily rainfall totals of greater than 0.3 inches correlate with increased sewer flow rate at this flow meter location. Therefore, it can be reasonably assumed that the spike in sewer flow on July 20th, 2018 correlated with the rainfall depicted on the graph as occurring afterwards. A sudden peak in sewer flow during a rain event is indicative of stormwater entering the sanitary system as inflow. Consecutive rain events in the days following this initial spike in sewer flow kept the ground saturated which influenced the rainfall derived infiltration into the gravity system. This is shown by the gradual decrease in the average sewer flow each day after July 20th, until the next rain event on July 31st caused another spike in sewer flow.

The flow meter was relocated to Manhole 17797 after high flow conditions in Manhole 17523 caused frequent issues with data collection. Manhole 17797 receives flow from the northwest quadrant of Trailer Estates. **Figure 8** below shows the sewer flow versus rainfall during the collection period.

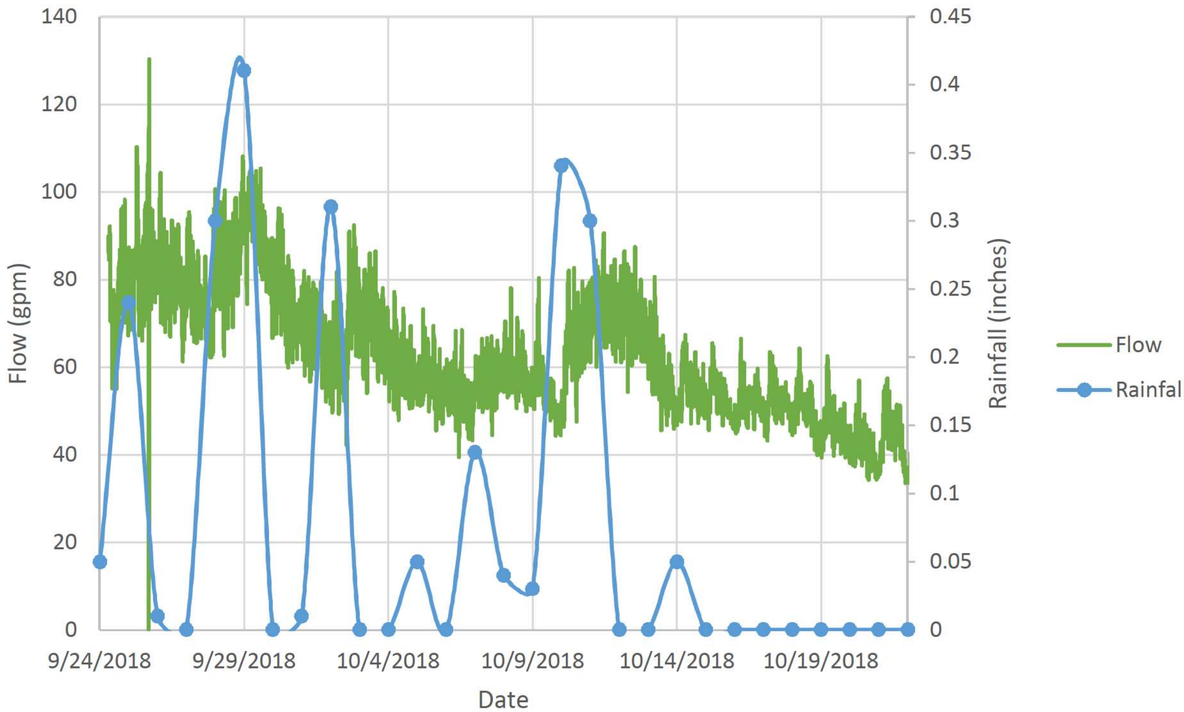


Figure 8: Manhole 17797 Sewer Flow Vs Rainfall

A similar trend is identifiable at this meter location. The days with rainfall also have an increased sewer flow rate. In addition to rainfall, groundwater elevations can influence sewer flow, especially in coastal communities where groundwater elevations are high and seasonally submerge gravity systems. **Figure 9** shows the correlation between sewer flow rate at Manhole 17797 and the depth of groundwater above the installed sensor.

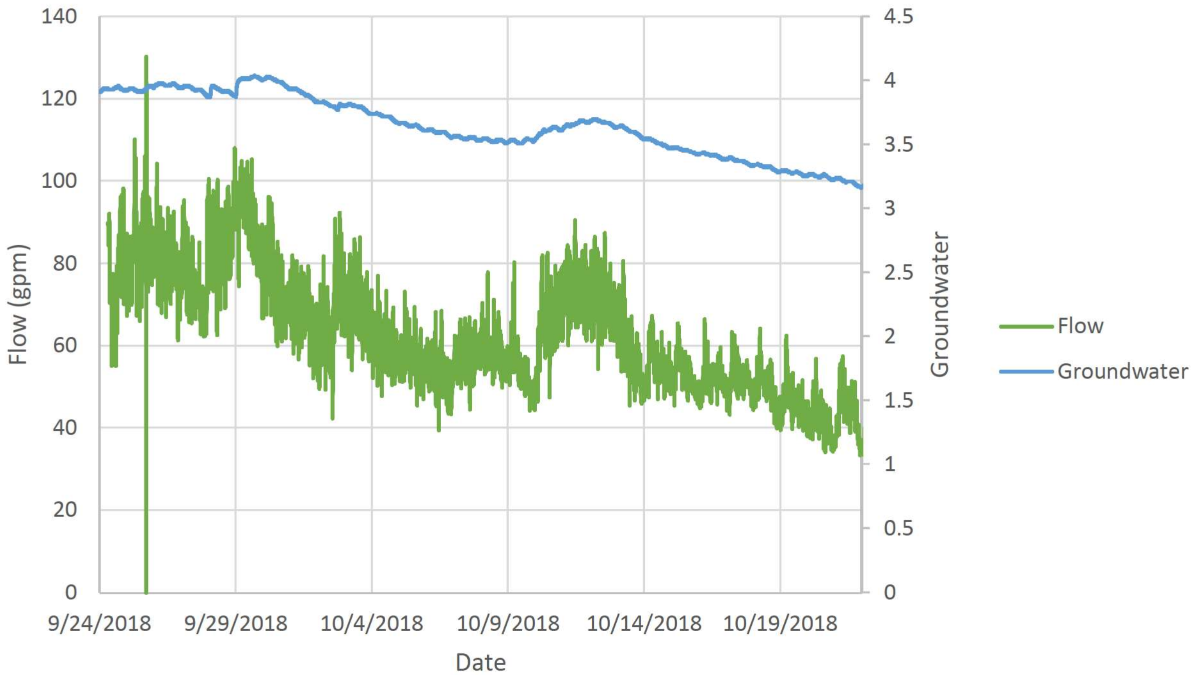


Figure 9: Manhole 17797 Sewer Flow Vs Groundwater

During the collection period at Manhole 17797, the sewer flow rate trends downward as the groundwater levels decrease. The effects of groundwater on sewer flow is most evident at night, during low flow times when residents are sleeping. Night time flow rates are expected to be similar on daily basis, regardless of groundwater elevation. As shown in **Figure 9**, the minimum flows each day fluctuate with the groundwater level. This is evidence that the minimum flows are influenced by infiltration of groundwater into the Trailer Estates system.

Based on the data collected from Flow Meter 17523, the minimum flow rate experienced in the system is approximately 20 GPM. This flow rate was recorded at 1:30AM when there is minimal sewer use, therefore it is likely that the flow mainly consisted of groundwater infiltration. Assuming that 20 GPM of baseline infiltration enters the system year-round, over 10 million addition gallons of flow require treatment each year. As represented in the figures above, especially during wet weather, the night time flow rates are often higher than 20 GPM as the system flows increase during rain events. Therefore, it is expected that the actual annual volume of I&I is much higher.

The analysis described above was performed to determine whether I&I is present in the system, not to quantify or differentiate between inflow, infiltration, or rainfall derived infiltration. If the County prefers to differentiate and quantify the types of I&I, it would be recommended to perform a flow monitoring study on the basin. However, if the system is ultimately rehabilitated or replaced, a flow monitoring study would not be warranted.

Evaluation of Gravity Sewer Alternatives

Ranking Methodology

To adequately evaluate the alternatives for the Trailer Estates system, a criterion was established for analyzing each alternative. The alternatives will be assigned a ranking for five categories that will be summed to produce an overall ranking to determine the best suited option for the Trailer Estates community. The evaluation criteria include the following categories:

- Capital Cost
- Operations
- Life Cycle
- Maintenance/Accessibility
- Public Inconvenience

Capital Cost:

The ranking per capital cost of each rehabilitation alternative will be based on the opinion of probable cost (OPC) for construction. The OPCs utilize cost data provided by vendors in addition to recent bid-data for similar projects in the Manatee County area. The alternatives will be ranked 1 through 5, 5 being the most expensive initial capital cost. The capital cost ranking does not include operational or maintenance costs.

Operations:

The ranking for operational considerations will evaluate three sub-criteria:

1. Change in operating expense of each system, as compared to existing condition
2. I&I reduction
3. Additional operator training

Each of the three sub-criteria will receive a ranking 1 through 5, 5 being the worst condition i.e. most expensive to operate, least amount of I&I reduction, and the most training required. Operating costs will be based on cost information from equipment vendors using average power consumption rates. The overall reduction in I&I will be estimated based on current flow monitoring results and if the proposed rehabilitation will replace all infrastructure.

Life Cycle:

The ranking for life cycle will evaluate the service life of the system over a 50-year period. This includes identifying the components of the system that can be expected to require repair or replacement over 50 years. Systems that require the most infrastructure replacement will receive a ranking of 5, indicating a shorter life cycle, while system infrastructure that outlasts the 50-year period will receive a ranking of 1.

Maintenance/Accessibility:

The ranking for maintenance and accessibility will evaluate three sub-criteria:

1. Location of infrastructure and accessibility to County staff
2. Level of maintenance required per system
3. Frequency and cost of replacement or rehabilitation

Each of the three sub-criteria will receive a ranking 1 through 5, 5 being the worst condition i.e. more difficult location, increased required maintenance, high frequency, or expense of system component replacement. Location of infrastructure will be based on preliminary conceptual design of each system. Maintenance efforts and replacement schedule for each system will be based on information provided by equipment vendors.

Public Inconvenience:

The ranking for public inconvenience will evaluate three sub-criteria:

1. Length of construction
2. Restoration required
3. Detours and traffic pattern impact

Each of the three sub-criteria will receive a ranking 1 through 5, 5 being the worst condition i.e. longest length of construction, most amount of restoration required, and most severe impact to current traffic patterns. Public inconvenience will be based on preliminary conceptual design of each system.

Alternative 1: System Rehabilitation

Manatee County implemented a 6-phase system-wide rehabilitation project in Trailer Estates from 2002-2010. The sanitary sewer system improvements in this CIP project included manhole lining, ring and cover replacement and adjustment, inflow dish installation, pipe lining, pipe bursting, point repairs, lateral replacement, and grouting lateral connections. As discussed in the Inflow and Infiltration Analysis Section, the system continues to show evidence of I&I. Inspection videos from 2014 show root intrusion in pipe joints in some areas, specifically along American Way. These types of operation and maintenance (O&M) defects are a source of I&I. These projects were meant to address most of the pipes in the existing gravity sewer system and rehabilitated/replaced sewer laterals as needed throughout the CIP project; however, they did not include complete lateral replacement.

As typical of gravity systems of this age, defects in the manholes, gravity sewer, and laterals are expected to be the main source of I&I. According to the County's GIS information, 573 of the 1407 service laterals within the project area are documented as VCP or unknown pipe material, which equals 41 percent of the laterals in the system. County staff has mentioned that they have encountered "Orangeburg" pipe when performing repairs. Orangeburg pipe is bituminized fiber pipe constructed from layers of wood pulp and pressed together, which will deteriorate over time. This pipe was commonly used from the late 1800s up through the 1970s, and was primarily used for sanitary sewer laterals. It can be assumed that these laterals have not been rehabilitated since the original construction and are a contributor of the system's I&I.

Alternative 1 would continue rehabilitation efforts in Trailer Estates by completing the following:

- Schedule remaining VCP pipes for CIPP lining
- Clean and inspect newer gravity pipes serving commercial properties along U.S. 41 to evaluate condition and rehabilitation if necessary
- Manhole inspections and rehabilitation including lining and inflow dishes
- Complete lateral replacement and cleanout installation
- Smoke detection to identify outstanding defects
- Rehabilitate previously lined or pipe burst pipes with failures

The challenges for this alternative relates to accessibility of the system. The existing gravity system is located in narrow easements behind the properties. These easements are congested with other utilities including, but not limited to, abandoned water main, buried cable, telephone poles, and pull boxes. Landscaping and fencing from surrounding property owner have also encroached on this easement over time.

Figure 10 shows examples of these easements that include the gravity system infrastructure within Trailer Estates.

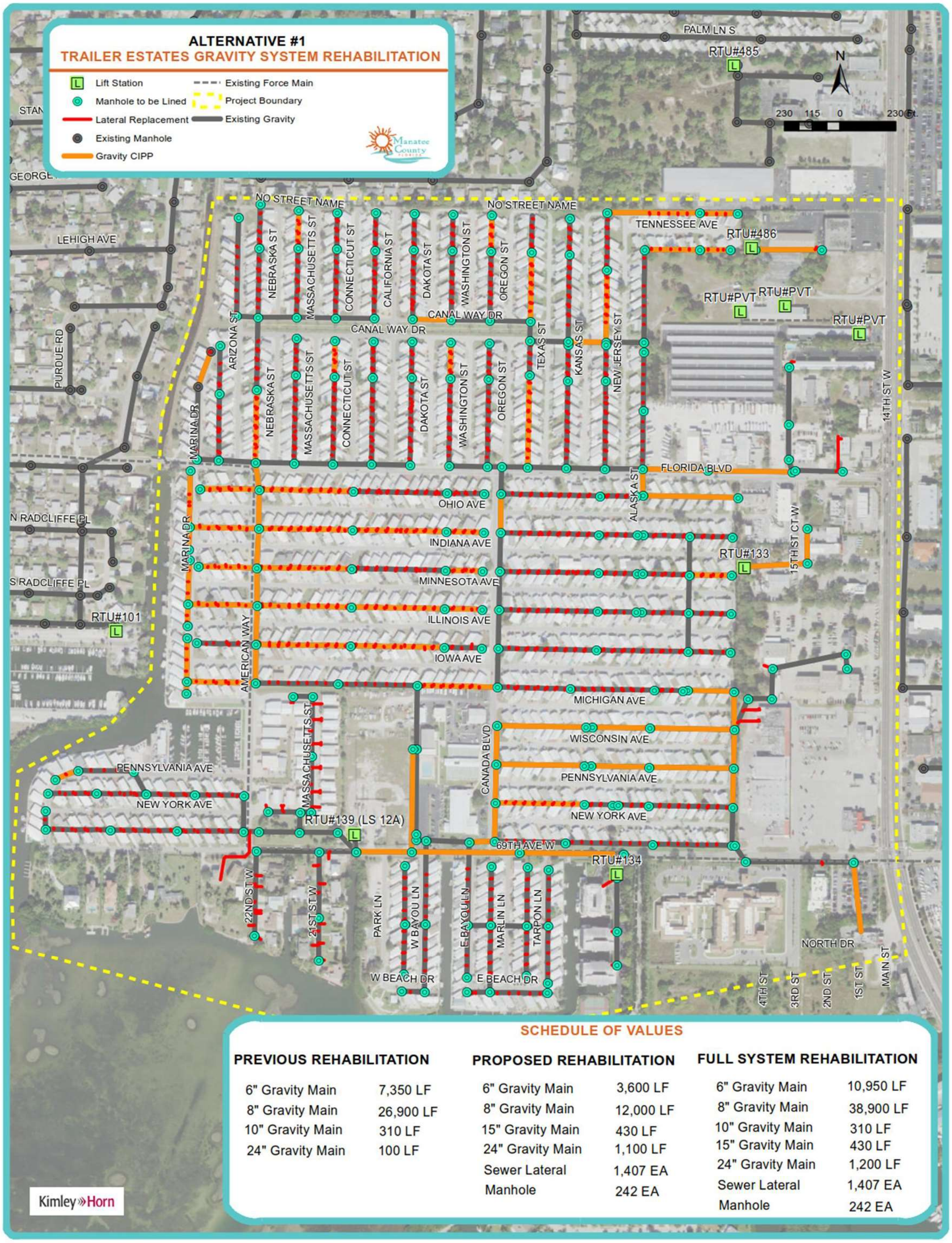
Figure 10: Existing Utility Easements

These narrow and congested utility easements make it difficult to access manholes, and therefore maintain the system. To clean, inspect, and rehabilitate gravity main, the contractor needs to have access to manholes with large equipment and trucks. Although there are provisions available for completing work on easements such as these, it is more expensive and takes longer to complete. Rehabilitation options are limited to trenchless methods, as excavating the pipe for repairs is infeasible due to inaccessibility to complete the work.

Another challenge of Alternative 1 is lateral replacement. The sanitary sewer laterals are owned both by the County and the homeowner. Typically, the demarcation line for sewer laterals is the right-of-way line or easement line. The County owns and maintains the segment from the demarcation line to the main run of gravity sewer, and the homeowner is responsible for the portion from the demarcation line to the house. Many municipalities are struggling with the same challenges, since a portion of the problem is on private property.

As demonstrated in previous sections, I&I is a concern for the Trailer Estates sewer system. Being a coastal community with high groundwater levels, not addressing the sewer laterals does not fully resolve the concerns with the sewer system. For this option to be affective, it would require extensive public involvement and public notification, to get buy-in from the residents. Prior to entering private property, the contractor/plumber would be required to get a right-of-entry agreement signed by each homeowner. Remaining infrastructure requiring lining or replacement is shown in **Figure 11** below.

Figure 11: Alternative 1: Gravity System Rehabilitation Exhibit



Capital Cost:

The OPC for the rehabilitation of the system is shown in **Table 6** below. Standard liner thicknesses were assumed. All gravity mains and manholes within the system were assumed to require rehabilitation once over the life of the system, regardless if they have been rehabilitated in previously completed CIP projects or work orders. All sewer laterals were assumed to be replaced from the home/business to the sewer pipe connection. As mentioned above, to fully fix the system the laterals will be required to be replaced, which will require the right-of-entry agreement.

Table 6: Alternative 1 OPC

OPINION OF PROBABLE CONSTRUCTION COSTS MANATEE COUNTY TRAILER ESTATES ALTERNATIVE #1: SYSTEM REHABILITATION					
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**	**AMOUNT**
I. MISCELLANEOUS					
1	Mobilization (10% Proposed Improvements)	1	LS	1,115,530.00	1,115,530.00
2	Maintenance of Traffic	1	LS	200,000.00	200,000.00
				SUBTOTAL	**$ 1,315,530**
II. PROPOSED IMPROVEMENTS					
3	CIPP Main Liner 6" Diameter - 6 mm thickness	10,950	LF	45.00	492,750.00
4	CIPP Main Liner 8" Diameter- 6 mm thickness	38,900	LF	50.00	1,945,000.00
5	CIPP Main Liner 10" Diameter- 6 mm thickness	310	LF	52.00	16,120.00
6	CIPP Main Liner 15" Diameter- 7.5 mm thickness	430	LF	55.00	23,650.00
7	CIPP Main Liner 24" Diameter- 10.5 mm thickness	1,200	LF	80.00	96,000.00
8	Pipeline Inspection and Cleaning	51,790	LF	5.00	258,950.00
9	Manhole Inspection and Lining	242	EA	2,000.00	484,000.00
10	Seal Manhole Chimneys and Insert Inflow Dishes	242	EA	330.00	79,860.00
11	Sewer Lateral (Will Require ROW Entry Agreements)	1,407	EA	5,500.00	7,738,500.00
12	Smoke Detection	50,990	LF	0.40	20,396.00
				SUBTOTAL	**$ 11,155,226**
I. MISCELLANEOUS					**$ 1,315,530**
II. PROPOSED IMPROVEMENTS					**$ 11,155,226**
				SUBTOTAL	**$ 12,470,756**
				CONTINGENCY (20%)	**$ 2,494,160**
				INITIAL CONSTRUCTION TOTAL	**$ 14,964,916**
				ADDITIONAL CAPITAL INVESTMENT THROUGH LIFE CYCLE	**$ 7,226,416**
				OVERALL CAPITAL COST	**$ 22,191,332**
Costs taken from Bid Tabulations and Existing Projects in Construction					
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.					

The cost described in the table above is representative of the initial capital cost for a full system rehabilitation. It should be noted that the rehabilitation components, gravity sewer and manhole lining, will more than likely be required to be rehabilitated twice over the 50-year life cycle. Based on this assumption, the overall capital cost over this timeframe is estimated to be $29,929,832.00. This overall capital cost is assuming today's dollars. Rehabilitation efforts 30-years from now could be much higher.

Operations:

Operation of the system should not vary greatly from what operational procedures are currently in place and no additional training is necessary. Operating costs should not increase, as the gravity system will remain the main source of collection system up to the MLS 12A. Reducing I&I in the existing system will be difficult because of the private laterals. The responsibility of the County ends at the property line. All maintenance and replacement of the private lateral is the responsibility of the homeowner. Currently, the County does not have language in the code of ordinances requiring homeowners to repair broken laterals or allowing the County to enforce this effort. As a result, rehabilitation to the system as outlined in this section cannot guarantee a significant reduction or elimination of I&I in the system without complete cooperation of the property owners. To encourage cooperation, the County can send out right-of-entry forms to each resident for permission to allow contractors to repair these private laterals or issue notices to the residents recommending a certified plumber to be hired to inspect and repair their laterals. Although lateral replacement is recommended and would reduce the impacts of I&I, it is unlikely that all property owners will comply with these efforts, decreasing the anticipated effectiveness of I&I reduction for this alternative.

Life Cycle:

Based on information provided by manufacturers and field information, the service life of the rehabilitation, i.e. manholes and gravity sewer mains are estimated at 30-years to 50-years. Assuming a 50-year life cycle period, the chances that the gravity sewer system will have to be fully rehabilitated twice, is highly likely. This alternative would essentially be a revolving "band-aid" of repairs and is considered to have the lowest life cycle ranking. However, it should be noted that the life cycle of the rehabilitation efforts will vary based on precision of installation and varying conditions.

Maintenance/Accessibility:

By upholding the existing configuration of the system, the accessibility of gravity mains by maintenance staff will not be improved. Currently, most gravity mains are in utility easements located behind homes, making cleaning and inspection more problematic. Ideally the entire system will be cleaned and inspected every 5 years. As structural or O&M defects develop, efforts to correct the defects should be made as they are identified. Based on the annual maintenance and additional rehabilitation required within the 50-year evaluation period, the annual maintenance cost for Alternative 1 is shown in **Table 7** below.

Table 7: Alternative 1 Annual Cost Over 50 Year Period

Cost Component	Cost
Maintenance Required (During 50-year period) [1]	$51,790.00
Annual Cost[2]	$51,790.00

[1] Includes cleaning and inspection of 20% of the gravity system per year

[2] Costs do not include County labor, engineering fees, appreciation, depreciation or interest. All costs are based on present-day information.

Public Inconvenience:

The public inconvenience incurred from construction of these types of rehabilitation is minimal. In the locations where the gravity system runs parallel to the road, maintenance of traffic (MOT) at the manholes where the pipes need to be lined would consist of a single lane block or simple detour. In the cases where the pipe runs through the utility easement behind the mobile homes, extra provisions may have to be taken to ensure that the lining equipment can extend to the manhole. Lateral replacement would include direct impacts to homeowners, as right-of-entry agreements for complete lateral replacement would be required. If only partial laterals can be replaced, construction would include minor excavation confined to the County owned utility easements and public right-of-way.

Based on the evaluation criteria and sub-criteria, a matrix showing the rankings of Alternative 1 is shown in **Table 8** below.

Table 8: Alternative 1: System Rehabilitation Criteria Matrix

Evaluation Criteria		Evaluation Sub-Criteria	Sub-Criteria Ranking	Evaluation Criteria Ranking
Capital Cost	$22,191,332.00	N/A		4
Operations		Operating Expense	1	7
		I&I Reduction	5	
		Additional Operator Training	1	
Life Cycle		N/A		5
Maintenance and Accessibility		Accessibility	5	12
		Required Maintenance	2	
		Frequency of Rehab/Replacement	5	
Public Inconvenience		Length of Construction	1	3
		Required Restoration	1	
		Traffic Impacts	1	
			Summation	32

Alternative 2: Gravity System Replacement

The current design of the Trailer Estates gravity system poses access and maintenance problems due to the location of many of the gravity mains in the utility easement behind the homes. Complete replacement and redesign of the gravity system including moving the gravity sewer from the rear easements to the public right-of-way would improve accessibility. New infrastructure would significantly reduce the volume of I&I entering the system, as constructing a new gravity sewer system would require the construction of new sewer laterals. Right-of-entry agreements will still be required to make this alternative successful. See **Figure 12** for the conceptual design of the gravity system replacement.

This conceptual design assumes that only old infrastructure will be replaced. More recently installed PVC gravity main serving the commercial properties are in satisfactory condition and will be connected to the new infrastructure. Additional assumptions for the gravity main design are listed below:

- Minimum slope requirements for scouring velocity of 2 fps per Ten State Standards

Table 9: Minimum Slopes per Ten State Standards

Pipe Diameter	Min. Slope (feet per 100 feet)
8-inch	0.40
12-inch	0.28
18-inch	0.12

- Contributing flow based on flow per parcel calculated using historic data. Pipes were sized per Pipe Capacity Requirements - ASCE recommendation for gravity sewer design

Table 10: ASCE Capacity Recommendation per Pipe Diameter

Pipe Diameter	Percentage of Pipe Flowing Full
8-inch	50%
12-inch	50%
18-inch	75%

If this alternative is selected for construction, the design will require survey and utility locates to identify the topographic characteristics of the area and any conflicts that may require modifications to the layout. The approximate depth of cover of the gravity main for the constructed system using this layout ranges from 3 to 13 feet of cover.

Construction of the proposed system should be completed in a number phases depending on budget and constructability in terms maintaining service to residents with minimal disruption. As illustrated in **Figure 12**, a possible construction phasing plan for the conceptual system layout consists of 5 phases. Construction of the system replacement would begin at the most upstream portions of the system in the initial phases, progressing to the portions closest to MLS 12A in the final phases. Since the proposed system will be located in front of the properties, it is important to ensure that all homes are connected to an operating portion of the system before the existing gravity main in the rear of the properties is abandoned. It is assumed that one phase of construction would be completed per fiscal year, resulting in a total construction time of 5 years.

Figure 12: Alternative 2: Gravity System Replacement Exhibit

Capital Cost:

The OPC for the recommended rehabilitation of the system are shown in **Table 11.** The OPC assumes that the gravity main will be installed via open cut and will require significant roadway restoration. Additionally, all sewer laterals will require complete replacement.

Table 11: Alternative 2 OPC

OPINION OF PROBABLE CONSTRUCTION COSTS MANATEE COUNTY TRAILER ESTATES ALTERNATIVE #2: SYSTEM REPLACEMENT					
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**	**AMOUNT**
I. MISCELLANEOUS					
1	Mobilization (10% Proposed Improvements)	1	LS	1,709,720.00	1,709,720.00
2	Maintenance of Traffic	1	LS	200,000.00	200,000.00
3	Erosion and Sediment Control	1	LS	100,000.00	100,000.00
4	Record Drawings	1	LS	10,000.00	10,000.00
				SUBTOTAL	**$ 2,019,720**
II. PROPOSED IMPROVEMENTS					
5	18" PVC Pipe (Including Excavation, Backfill, Sodding, Landscaping)	4,400	LF	175.00	770,000.00
6	8" PVC Pipe (Including Excavation, Backfill, Sodding, Landscaping)	37,500	LF	125.00	4,687,500.00
7	2" PVC/HDPE Force Main	230	LF	40.00	9,200.00
8	Precast Concrete Manhole	156	EA	5,000.00	780,000.00
9	Connect to Existing Manhole	5	EA	2,000.00	10,000.00
10	Sewer Lateral (Will Require ROW Entry Agreements)	1,407	EA	5,500.00	7,738,500.00
11	Manhole Abandonment	207	EA	1,000.00	207,000.00
12	Grout Fill Abandoned Existing Pipelines	750	CY	500.00	375,000.00
13	Roadway Restoration	36,000	SY	70.00	2,520,000.00
				SUBTOTAL	**$ 17,097,200**
I. MISCELLANEOUS					**$ 2,019,720**
II. PROPOSED IMPROVEMENTS					**$ 17,097,200**
				SUBTOTAL	**$ 19,116,920**
				CONTINGENCY (20%)	**$ 3,823,390**
				CONSTRUCTION TOTAL	**$ 22,940,310**
Costs taken from Bid Tabulations and Existing Projects in Construction					
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.					

Operations:

Operation of a new gravity system would not warrant any significant changes for County staff. The relocation of the infrastructure to the front of the mobile homes would allow easier access for County staff to preform maintenance such as pipe cleaning and inspection and any future rehabilitation that is required for the system. I&I contributing to the system would be significantly reduced with the installation of new infrastructure. I&I reduction will not occur with same success without the replacement of laterals.

Life Cycle:

Based on information provided by manufacturers, the service life of the system components proposed are shown in **Table 12** below. The estimated life span of new PVC pipe and prefabricated concrete manholes is 100 years and 50 years, respectively. Assuming a 50-year evaluation period, no additional rehabilitation or replacement will be required. The service life of infrastructure will vary based on precision of installation and varying sewer conditions. Routine maintenance is recommended to preserve the service life of the system components.

Table 12: Service Life of System Replacement Components

System Component	Service Life (years)	Varying Factors
PVC Gravity Main	100	Material degradation; inadequate maintenance
PVC/HDPE Force Main	100	Material degradation; inadequate maintenance
Precast Concrete Manhole	50	Material degradation; inadequate maintenance; corrosion
PVC Sewer Lateral	100	Material degradation; inadequate maintenance

Maintenance/Accessibility:

The current design of the Trailer Estates gravity system poses access and maintenance problems due to the location of many of the gravity mains in the utility easement behind the homes. Complete replacement and redesign of the gravity system including moving the gravity piping out to the front of the mobile homes would improve accessibility for maintenance activities such as cleaning and inspection. Ideally the entire system will be cleaned and inspected every 5 years. In terms of point repairs or replacement, the depth of the system in portions of the proposed system reduce ease of access compared with shallower systems. As structural or O&M defects develop, efforts to correct the defects should be made as they are identified. Based on the annual maintenance costs required within a 50-year evaluation period, the annual maintenance cost for Alternative 2 is shown in **Table 13** below.

Table 13: Alternative 2 Annual Cost Over 50 Year Period

Cost Component	Cost
Maintenance Required (During 50-year period) [1]	$42,130.00
Annual Cost[2]	**$42,130.00**

[1] Includes cleaning and inspection of 20% of the gravity system per year

[2] Costs do not include County labor, engineering fees, appreciation, depreciation or interest. All costs are based on present-day information.

Public Inconvenience:

Construction of the replacement of the entire gravity system would require multiple years of phased construction to complete. Open trench installation is required for gravity sewer to ensure the accuracy of required pipe slopes. The grid layout of the streets in Trailer Estates would allow for simple detours around construction, however the residents of Trailer Estates should expect a lengthy and visible construction project if a complete system replacement is pursued. Additionally, right-of-entry agreements will be required to re-route and replace each sewer lateral. If the County has planned roadway surface (pavement) improvements in these areas, it would be recommended to phase the gravity sewer installation with these planned improvements. There would also be a level of cost share between the road restoration and the road resurfacing.

Based on the evaluation criteria and sub-criteria, a matrix showing the rankings of Alternative 2 is shown in **Table 14** below.

Table 14: Alternative 2: Gravity System Replacement Criteria Matrix

Evaluation Criteria		Evaluation Sub-Criteria	Sub-Criteria Ranking	Evaluation Criteria Ranking
Capital Cost	$22,940,310.00	N/A		5
Operations		Operating Expense	1	4
		I&I Reduction	2	
		Additional Operator Training	1	
Life Cycle		N/A		1
Maintenance and Accessibility		Accessibility	3	5
		Required Maintenance	1	
		Frequency of Rehab/Replacement	1	
Public Inconvenience		Length of Construction	5	15
		Required Restoration	5	
		Traffic Impacts	5	
			Summation	29

Alternative 3: Vacuum Sewer System

Vacuum sewer systems have been used in Europe for over 100 years and were introduced in the United States in the 1970s. These systems use differential air pressures to transport wastewater instead of gravity. Vacuum sewer systems are typically implemented into areas that are trying to convert from septic to a centralized sewer system. However, vacuum sewer systems are recommended for areas with flat terrain and high-water table levels, both of which are characteristics of the Trailer Estates area.

The main components of a typical vacuum sewer are as follows:

- **Collection pit:** fiberglass sump and valve pit that collects waste from a gravity line from up to four buildings and houses a vacuum valve.
- **Vacuum valve:** pneumatically controlled valve that allows waste into the vacuum main when a specified volume of waste has accumulated in the collection pit.
- **Vacuum main:** consisting of small diameter PVC piping, the network of pipe that connects the collection pits to the vacuum pump station.
- **Vacuum pump station:** central collection point for the waste in the system, consisting of a vacuum tank, vacuum pumps, discharge pumps, and all electrical and instrumentation panels to control the system. The vacuum pump station connects the flow from the vacuum sewer to the conveyance system or directly to the treatment plant.

Figure 13 shows a preliminary layout of a vacuum sewer system in Trailer Estates.

The following assumptions were made in the preliminary design of the vacuum sewer system:

- Commercial properties along U.S. 41 remain connected to conventional system and are routed along 69th Ave. W. to MLS 12A
- Each collection pit serves four manufactured homes

Figure 13: Alternative 3: Vacuum Sewer System Exhibit

Capital Costs:

An OPC for the preliminary layout of the vacuum sewer is outlined in **Table 15.**

Table 15: Alternative 3 OPC

OPINION OF PROBABLE CONSTRUCTION COSTS MANATEE COUNTY TRAILER ESTATES ALTERNATIVE #3: VACUUM SEWER SYSTEM					
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**	**AMOUNT**
I. MISCELLANEOUS					
1	Mobilization (10% Proposed Improvements)	1	LS	1,622,630.00	1,622,630.00
2	Maintenance of Traffic	1	LS	200,000.00	200,000.00
3	Erosion and Sediment Control	1	LS	100,000.00	100,000.00
4	Record Drawings	1	LS	10,000.00	10,000.00
				SUBTOTAL	**$ 1,932,630**
II. PROPOSED IMPROVEMENTS					
5	Vacuum Sewer Lateral (Will Require ROW Entry Agreements)	1,407	EA	5,500.00	7,738,500.00
6	4" PE/PVC Vacuum Main Pipe	27,200	LF	50.00	1,360,000.00
7	6" PE/PVC Vacuum Main Pipe	5,280	LF	60.00	316,800.00
8	8" PE/PVC Vacuum Main Pipe	7,100	LF	70.00	497,000.00
9	10" PE/PVC Vacuum Main Pipe	3,000	LF	100.00	300,000.00
10	6" PVC/HDPE Force Main	200	LF	60.00	12,000.00
11	6" Force Main Tap and Valve	1	EA	5,000.00	5,000.00
12	4" Division Valve	50	EA	1,250.00	62,500.00
13	6" Division Valve	3	EA	1,500.00	4,500.00
14	Trailer Mounted Vacuum Pump	1	EA	25,000.00	25,000.00
15	Collection Pit and Vacuum Valve	350	EA	4,600.00	1,610,000.00
16	Dedicated Air Vent	350	EA	500.00	175,000.00
17	Vacuum Pump Station 860 GPM (Including Vacuum Tank, 4 Vacuum Pumps, 2 Discharge Pumps, Electrical and Instrumentation)	1	EA	420,000.00	420,000.00
18	Vacuum Pump Station Building	1	EA	320,000.00	320,000.00
19	Odor Control Bio-Filter	1	EA	65,000.00	65,000.00
20	Generator	1	EA	60,000.00	60,000.00
21	Monitoring System (Including Vacuum Valves/Pits Monitoring Package, Installation)	1	LS	210,000.00	210,000.00
22	Spare Parts	1	LS	10,000.00	10,000.00
23	Grout Fill Abandoned Existing Pipelines	750	CY	500.00	375,000.00
24	Roadway Restoration	38,000	SY	70.00	2,660,000.00
				SUBTOTAL	**$ 16,226,300**
I. MISCELLANEOUS					**$ 1,932,630**
II. PROPOSED IMPROVEMENTS					**$ 16,226,300**
				SUBTOTAL	**$ 18,158,930**
				CONTINGENCY (20%)	**$ 3,631,790**
				CONSTRUCTION TOTAL	**$ 21,790,720**
Costs taken from Bid Tabulations and Existing Projects in Construction					
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.					

Operations:

Successful operation of a vacuum sewer system requires trained operators that are familiar with the layout of the system. It is recommended that operators are involved during the construction of the vacuum sewer system and troubleshoot any issues that arise in the start-up of the system. Once the system is up and running, the day-to-day operation requirements are minimal. In an Operator Survey completed in 2003, operators reported that labor associated with the vacuum pump station was relatively minor and predicable, similar to that required for a conventional lift station (*Alternative Sewer Systems*, 2008). Some vacuum sewer companies offer monitoring systems that can communicate alarms for high water levels in the collection pits or malfunctioning vacuum valves with the SCADA system, which aides in proficient operation of the system.

The vacuum sewer system runs almost entirely pneumatically; only the vacuum pump station requires electrical power. Power is required for the vacuum pumps and discharge pumps as well as lighting and ventilation in the vacuum pump station. According to *Alternative Sewer Systems* published by the Water Environment Federation in 2008, an average sized vacuum sewer system's pump station consumes 300 kWh/connection of power per year, resulting in increased operating costs.

Vacuum sewer mains are completely sealed, as they operate under a vacuum, essentially eliminating infiltration in this portion of the system. Due to the existing laterals' orientation behind the homes, the lateral connections to the collection pits routed to the front of the properties will be of new construction, potentially removing the I&I source that is evident in the existing system. The construction of the new laterals will require right-of-entry agreements. Once the laterals are installed, they will be the responsibility of the homeowners to maintain. Overall, construction of a vacuum sewer system would greatly decrease I&I within Trailer Estates.

Life Cycle:

Guideline: Vacuum sewer systems, 2016, outlines the durability of vacuum sewer systems and was used as a resource in determine the service life of the individual components shown in **Table 16** below. Assuming a 50-year evaluation period, the vacuum main will not require replacement. However, it is estimated that the system pumps will require replacement four times while the vacuum tanks will need to be replaced once within the 50-year period. Collection pits, vacuum valves, and controllers will also need to be replaced once within the evaluation period. The service life of equipment is highly dependent on preventative maintenance or lack thereof of the system components and environmental conditions.

Table 16: Service Life of Vacuum Sewer Components

System Component	Service Life (years)	Varying Factors
PVC Vacuum Main	100	Damage from other excavations; material degradation
Vacuum Pumps	12.5 - 20	Inadequate maintenance; high run times
Sewage Pumps	12.5 - 15	Inadequate maintenance; high run times; clogging
Vacuum Tank	25 - 40	Material; maintenance; corrosion
Collection Pit	30 - 55	Potential for I&I
Vacuum Valve	30	Maintenance; opening frequency
Controller	25	Maintenance; power supply

Maintenance/Accessibility:

Vacuum sewer systems include minimal maintenance. The vacuum pump station should be visited daily to check pump run times and oil and block temperature. A quick visual check of these items should be enough to ensure the system is running properly and there are no signs of issues. Throughout the year, other preventative maintenance checks should be performed on the system. Examples of preventative maintenance tasks and their associated frequency are shown in **Table 17**.

Table 17: Vacuum Sewer System Maintenance Tasks

Task Frequency	Task
Daily	• Visually inspect operation gauges and charts at vacuum pump station
Weekly	• Test sump valve in vacuum pump station • Exercise on site generator
Monthly	• Change oil and filters on vacuum pumps • Check motor couplings • Exercise shut off valves at vacuum pump station
Semiannually	• Exercise isolation valves along vacuum mains • Conduct external leak tests on all vacuum valves • Check valve timing

*Table adapted from *Alternative Sewer Systems* 2008.

Most maintenance activities throughout the year are limited to the vacuum pump station. Maintenance requirements of the vacuum mains are limited.

Maintenance activities that occur in less frequent intervals include rebuild tasks. Most valve controllers need to be rebuilt every five years. This includes removing the controller and replacing with a spare so the shaft seals can be replaced and the components can be cleaned. Every 10 years, the vacuum valves should be removed and checked for wear. All worn components should be replaced and the valve seat and shaft seals should be replaced. These rebuilds require only 1-2 hours to complete by a single maintenance staff member.

All system components of the vacuum sewer system are easy to access. The vacuum pump station will be located on County property and accessed like a conventional lift station. All vacuum main and collection pits will be located in front of the mobile homes in the right-of-way. The collection pits have hinged framed and covers so they can be easily opened by maintenance staff to access the valves. **Table 18** below outlines the annual maintenance cost based on anticipated replacement of system components (assuming recommended maintenance activities are followed) and operating cost over the 50-year evaluation period for Alternative 3.

Table 18: Alternative 3 Annual Cost Over 50 Year Period

Cost Component	Cost
Maintenance Required (During 50-year period) [1]	$87,266.67
Additional Operating Cost [2]	$29,805.60
Annual Cost[3]	**$117,072.27**

[1] Vacuum pump oil change once per year, collection tank inspection every two years, odor bed mulch changed every 3-4 years, generator oil change and inspection every 6 months, vacuum valves rebuilt every 10 years, and controller rebuilt every 5 years
[2] Additional operating cost for system assumes 22,000 kWhr/month @11.29 cents per kWh
[3] Costs do not include County labor, engineering fees, appreciation, depreciation or interest. All costs are based on present day information.

Public Inconvenience:
The construction of a vacuum sewer requires open trench installation. Vacuum sewer main is typically installed with 3 to 5 feet of cover with minimum slope of 0.20%, which cannot be met with other installation methods such as horizontal directional drilling (HDD). This open excavation would require road closures and detours throughout construction. Unlike conventional gravity sewers, vacuum sewer main design can easily adapt to change in alignment in the field due to unknown conflicting utilities by using bends.

In terms of odor and odor control, there are few issues when it comes to vacuum sewers. This is due to the input of air into the system at the collection pits as a part of the vacuum mechanism instead of output. In addition, the system is sealed throughout all steps of wastewater conveyance. At the vacuum pump station, the vacuum pump exhaust is run through a manufactured biomass filter, which may produce an earthy odor.

Based on the evaluation criteria and sub-criteria, a matrix showing the rankings of Alternative 3 is shown in **Table 19** below.

Table 19: Alternative 3: Vacuum Sewer Criteria Matrix

Evaluation Criteria		Evaluation Sub-Criteria	Sub-Criteria Ranking	Evaluation Criteria Ranking
Capital Cost	$21,790,720.00	N/A		2
Operations		Operating Expense	3	9
		I&I Reduction	1	
		Additional Operator Training	5	
Life Cycle		N/A		4
Maintenance and Accessibility		Accessibility	1	9
		Required Maintenance	4	
		Frequency of Rehab/Replacement	4	
Public Inconvenience		Length of Construction	3	10
		Required Restoration	4	
		Traffic Impacts	3	
			Summation	34

Alternative 4: Low Pressure Sewer System

Low pressure sewer systems are favorable for areas with high water table levels where the construction of deep gravity mains would be costly. Based on the layout and estimated flows from the Trailer Estates community, there are two low pressure system design alternatives that could be implemented.

1. Duplex grinder pump stations designed in a cluster arrangement to serve an average of ten manufactured homes, single family residences, and/or condominium lots.
2. Installation of an individual simplex grinder pump station at each manufactured home and single family residence. Duplex or Quadplex stations would be required to serve the commercial properties.

The low pressure system design consisting of duplex grinder pump stations serving an average of ten properties is recommended due to the lower overall cost of installation and construction, ease of maintenance due to fewer pump stations, and less impact to the community. Duplex grinder pump stations would be used to serve manufactured homes, single family residence, condominiums, and commercial parcels. Quadplex grinder pump stations would be used to serve hotels, restaurants, and assisted living facilities. These grinder pump stations connect to a system of small diameter pipe, valves, air release valves, cleanouts and fittings. This is the design option analyzed in this alternative.

The main components of a typical low pressure sewer system are as follows:

- **Low pressure main:** consisting of small diameter HDPE piping, the network of pipe that runs from the duplex pump stations to MLS 12A.
- **Lateral kit:** consisting of small diameter stainless steel piping, check valve, curb stop, and fittings located after the pump station.
- **Grinder pump station:** central collection point for the waste in the system, consisting of an HDPE tank, cover, grinder pumps, alarm panel, and precast ballast anchors.
- **Terminal flushing connection:** located at the end of the low pressure main run, these connections are used to flush the pipeline.
- **In-line flushing connection:** located along the low pressure main run, these connections are used to flush the pipeline.

See **Figure 14** for a preliminary layout of a low pressure sewer system in Trailer Estates.

Figure 14: Alternative 4: Low Pressure Sewer System Exhibit

Capital Costs:

The OPC for a low pressure sewer system is outlined in **Table 20.** Significant electrical improvements will be required throughout the Trailer Estates community to provide electrical service to the lift stations.

Table 20: Alternative 4 OPC

OPINION OF PROBABLE CONSTRUCTION COSTS MANATEE COUNTY TRAILER ESTATES ALTERNATIVE #4: LOW PRESSURE SEWER SYSTEM					
ITEM	DESCRIPTION	QUANTITY		UNIT PRICE	AMOUNT
I. MISCELLANEOUS					
1	Mobilization (10% Proposed Improvements)	1	LS	1,570,110.00	1,570,110.00
2	Maintenance of Traffic	1	LS	200,000.00	200,000.00
3	Erosion and Sediment Control	1	LS	100,000.00	100,000.00
4	Record Drawings	1	LS	10,000.00	10,000.00
				SUBTOTAL	$ 1,880,110
II. PROPOSED IMPROVEMENTS					
5	1.25" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	10,950	LF	14.00	153,300.00
6	2" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	9,080	LF	20.00	181,600.00
7	3" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	21,579	LF	24.00	517,896.00
8	4" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	2,465	LF	29.00	71,485.00
9	6" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	2,003	LF	37.00	74,111.00
10	8" HDPE Pipe (Including Fittings, Valves, Excavation, Backfill, Sodding, Landscaping)	1,540	LF	44.00	67,760.00
11	Simplex Grinder Pump Station (Including Alarm Panel, Precast Ballast, Pumps, Vent, Valves, Tank, and 4" PVC Gravity Line to the Station)	103	EA	8,750.00	901,250.00
12	Duplex Grinder Pump Station (Including Alarm Panel, Precast Ballast, Pumps, Vent, Valves, Tank and 4" and 6" PVC Gravity Lines to the Station)	116	EA	26,600.00	3,085,600.00
13	Commercial Duplex Grinder Pump Station (Including Alarm Panel, Precast Ballast, Pumps, Vent, Valves, Tank and 4" and 6" PVC Gravity Lines to the Station)	51	EA	26,000.00	1,326,000.00
14	Quadplex Grinder Pump Station (Including Alarm Panel, Precast Ballast, Pumps, Vent, Valves, Tank and 4" and 6" PVC Gravity Lines to the Station)	3	EA	34,300.00	102,900.00
15	Terminal Flushing Connections	24	EA	2,000.00	48,000.00
16	In-Line Flushing Connections	13	EA	1,200.00	15,600.00
17	Electrical Power Supply Upgrades	1	LS	300,000.00	300,000.00
18	Sewer Lateral (Will Require ROW Entry Agreements)	1,407	EA	5,500.00	7,738,500.00
19	Grout Fill Abandoned Existing Pipelines	750	CY	500.00	375,000.00
20	Roadway Restoration	10,600	SY	70.00	742,000.00
				SUBTOTAL	$ 15,701,002
I. MISCELLANEOUS					$ 1,880,110
II. PROPOSED IMPROVEMENTS					$ 15,701,002
				SUBTOTAL	$ 17,581,112
				CONTINGENCY (20%)	$ 3,516,230
				CONSTRUCTION TOTAL	$ 21,097,342
Costs taken from Bid Tabulations and Existing Projects in Construction					
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.					

Operations:

In a properly functioning low pressure system, there is minimal daily operation required. Operators that are working on the low-pressure system should be trained in the following areas:

- **Electrical:** the grinder pump stations have electrical components that need to be troubleshot and maintained.
- **Plumbing:** knowledge of basic plumbing and how it pertains to pumping is required

In older communities, such as Trailer Estates, it is likely that electrical power supply will require updating to serve the grinder pump stations. The grinder pumps require a large electrical draw during start up, and a certified electrician should assess the power supply pre-installation. According to Environment One Corporation, a manufacturer of grinder pump stations, the typical grinder pump station serving a single-family home of 250 GPD sewer demand, uses 7.76 kWhr of power a month. Using the average price of electricity per kWhr for Florida as reported by the U.S. Energy Information Administration for July 2018 of 11.29 cents per kWhr, the estimated operation cost for these pumps can be calculated. See **Table 21** for the operation costs the grinder pump stations.

Table 21: Operation Costs of Grinder Pump Stations

Number of Grinder Pump Stations	Number of Grinder Pumps	Electrical Demand per Pump (kWhr/month)	Cost per kWhr (cents)	Annual Operation Cost per Pump ($)	Total Annual Operation Cost ($)
167	354	7.76	11.29	$ 10.51	$ 3,722

The construction of a low pressure system will likely eliminate the majority of the existing issues of I&I in the system. The locations of the duplex pump stations should be selected to most efficiently serve each cluster of properties and be easily accessible by maintenance staff. As with Alternatives 2 and 3, the low pressure system will be installed in the front of the properties, requiring all laterals to be replaced and connected to the grinder pump stations. A right-of-entry form would be required to be completed by each property owner, allowing the contractor access to construct the new laterals. These new laterals on the homeowner's property would be the responsibility of the homeowners maintain. In addition, all low pressure main leaving the grinder pump station is completely sealed, preventing infiltration. Overall, construction of a low pressure sewer system would greatly decrease I&I within Trailer Estates.

Life Cycle:

Based on information provided by Environment One Corporation, a low pressure manufacturer, the service life of the proposed system components were outlined and are shown in **Table 22** below. Assuming a 50-year evaluation period, the HDPE low pressure sewer main, flushing connections, and service laterals will not require replacement. Other system components such as pumps and electrical panels are estimated to need replacement twice within the 50-year period. Each pump has a stator, a composite rubber housing for the pump's rotor, which requires replacement every 10 years, resulting in replacement five times per pump over 50 years. The life cycle of equipment is highly dependent on preventative maintenance or lack thereof of the system components and environmental conditions.

Table 22: Service Life of Low Pressure Sewer Components

System Component	Service Life (years)	Varying Factors
HDPE Low Pressure Main	100	Material degradation; inadequate maintenance
Flushing Connections	100	Material degradation; inadequate maintenance
Grinder Pumps	20	Inadequate maintenance; high run times; clogging
Pump Stator	10	Material degradation, high pump run times
Electrical Panel	20	Maintenance; power supply
PVC Sewer Lateral	100	Material degradation; inadequate maintenance

Maintenance/Accessibility:

Maintenance for low pressure sewer systems mainly consist of service calls from residents. The most common issues are electrical issues associated with the grinder pumps. The electrical problems can be a diversity of things ranging from the failure of components of the grinder station such as switches and/or sensors to faulty wiring. Pump related issues caused when flushed material jams the grinder pumps are another common cause of service calls. Environmental One Corporation states that low pressure systems have one tenth the maintenance of vacuum systems and one third the maintenance of gravity systems. The maintenance tasks for low pressure systems are shown in **Table 23** below. Routine daily preventative maintenance for every station is not practical to complete because of the quantity of stations in the system.

Table 23: Low Pressure Sewer System Maintenance Tasks

Task Frequency	Task
Daily	• Visually inspect grinder pump stations
Monthly	• Wash down grinder pump vaults • Run pumps and controllers through their cycles • Clean motor starter contacts • Inspect air release stations for proper operation
Annually	• Exercise main line isolation • Exercise and service of guide rail systems, pump breakaway fittings, and shut valves • Conduct pump draw-down tests and record voltage and amperage readings

The preliminary design of the low pressure sewer system includes all new infrastructure to be located in the front of the properties, allowing easy accessibility to all system components that require maintenance by the County. The grinder pump stations would be located in the right-of-way in front of the property, where maintenance staff could access them without the need of MOT. **Table 24** below outlines the annual maintenance cost based on anticipated replacement of system components (assuming recommended maintenance activities are followed) and operating cost over the 50-year evaluation period for Alternative 4.

Table 24: Alternative 4 Annual Cost Over 50 Year Period

Cost Component	Cost
Maintenance Required (During 50 year period)[1]	$208,338.20
Additional Operating Cost[2]	$3,721.69
Annual Cost[3]	**$212,059.89**

[1] Assumes pump and panel replacement every 20 years and pump stator replacement every 10 years
[2] Additional operating cost for system assumes 7.76 kWhr/month per pump @11.29 cents per kWh
[3] Costs do not include County labor, engineering fees, appreciation, depreciation or interest. All costs are based on present-day information.

Public Inconvenience:

The majority of the low pressure sewer system mainlines can be installed via HDD. Therefore, minimal disturbance and restoration will be required to the roads. MOT will have to be used only during the short period when the drills are in operation. On the other hand, the installation of the grinder pump stations and laterals will require excavation on and in front of the homeowner's property. The visible lid of an installed grinder pump station is typically 36-inches in diameter.

Odor is a concern with the grinder pump stations located in the front of the property. It is important that roof vents are clear to avoid the odors of the raw wastewater returning through drains into the house. If sewage is retained in the grinder pump station basin for a long period of time, the sewage will become septic. This condition produces an odorous, toxic gas. Since Trailer Estates is a transient community, with residents only occupying the property seasonally, it is more likely that the stations could become septic from inactivity. If this alternative were to be selected, provisions to avoid these conditions should be considered in the system design.

Power outages are a threat to low pressure sewer systems because each grinder pump station requires electricity to run. Wide spread power outages due to hurricanes are a possibility and inevitability in Trailer Estates. If a power outage occurs, there is potential that the pump station basins could fill up causing wastewater to back up into homes and overflow at the station. While the stations are designed with extra storage capacity for these situations, they are not equipped to handle extended power outages and typically require immediate response from maintenance staff. For Trailer Estates, pump stations with higher holding capacities, back up storage, and emergency generators should be on hand. Due to the proximity of Trailer Estates to Sarasota Bay, it is likely a hurricane or tropical storm would cause power outages and flooding that would severely damage the system and cause maintenance difficulties.

Based on the evaluation criteria and sub-criteria, a matrix showing the rankings of Alternative 4 is shown in **Table 25** below.

Table 25: Alternative 4: Low Pressure Sewer Criteria Matrix

Evaluation Criteria		Evaluation Sub-Criteria	Sub-Criteria Ranking	Evaluation Criteria Ranking
Capital Cost	$21,097,342.00	N/A		1
Operations		Operating Expense	2	7
		I&I Reduction	1	
		Additional Operator Training	4	
Life Cycle		N/A		3
Maintenance and Accessibility		Accessibility	4	12
		Required Maintenance	5	
		Frequency of Rehab/Replacement	3	
Public Inconvenience		Length of Construction	2	6
		Required Restoration	2	
		Traffic Impacts	2	
			Summation	29

Alternative 5: Package Pump Station

Package pump stations are prefabricated stations with fiberglass wet wells, used for a range a flow and head conditions. These systems can be used to reduce the overall depth and size of a gravity sewer system by providing a transmission system. The main components of the proposed package pump station system are as follows:

Package Pump Station

- **Wet Well and hatch cover:** prefabricated fiberglass wet well five feet in diameter with hinged hatch cover to provide access to the wet well.
- **Pump and Rail System:** dual submersible pumps (assumed 10 HP motors) mounted on a rail system
- **Floats, Leve Transducer, and Controls:** wet well level monitoring equipment and control panel with main circuit breaker, generator receptacle, high level alarm light and horn, elapsed time meters
- **Valves and Valve Vault:** swing check valves with clean out ports located within fiberglass valve box with aluminum cover

Collection and Transmission System

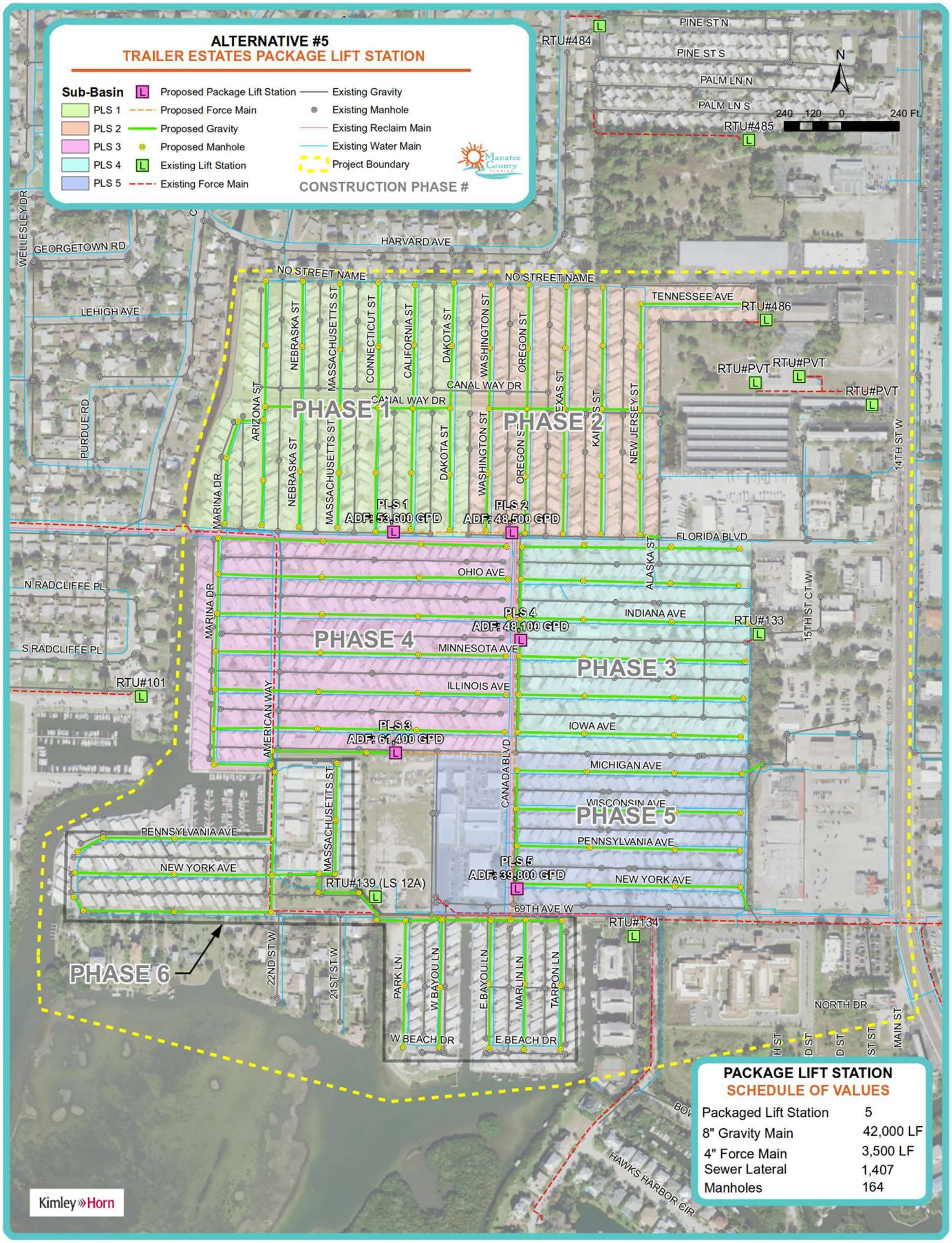
- **Gravity Main and Manholes:** Gravity main replacement for collection areas defined for each package pump station
- **Laterals:** Lateral replacement and connection to gravity main system. Complete lateral replacement will require right-of-entry agreements.
- **Force Main:** force main transmission system discharging to MLS 12A.

The proposed layout of the package pump station system is shown in **Figure 15** below. The following assumptions were made in the preliminary design of the package pump station system:

- Gravity collection system, including pipes, manholes, and laterals will be replaced and relocated to the front right-of-way. Gravity systems designed to standards outlined in Alternative 2. The approximate depth of cover of the gravity main for the constructed system using this layout ranges from 3 to 15 feet of cover.
- Package pump stations will be used to serve sub-basins of Trailer Estates. Sub-basins were broken up based on equivalent contributing flows per area. Station locations were identified where property is owned by the County or where space is available in utility easements or right-of-way.

Construction of the proposed system can be completed in phases by constructing one package pump station and its corresponding collection system each fiscal year. The design and construction of each force main would include a designated valve for connection of force mains from the following phases. One phase would only include gravity main construction to MLS 12A from the properties south and west of MLS 12A, as a package pump station is not necessary to keep construction depths shallow in this area. Since the proposed system will be located in front of the properties, it is important to ensure that all homes are connected to an operating portion of the system before the existing gravity main in the rear of the properties is abandoned. It is assumed that one phase of construction would be completed per fiscal year, resulting in a total construction time of 6 years for 6 phases.

Figure 15: Alternative 5: Package Pump Station System Exhibit



Capital Costs:

An OPC for the preliminary design of the package pump station system is outlined in **Table 26.**

Table 26: Alternative 5 OPC

OPINION OF PROBABLE CONSTRUCTION COSTS MANATEE COUNTY TRAILER ESTATES ALTERNATIVE #5: PACKAGE PUMP STATION					
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**	**AMOUNT**
I. MISCELLANEOUS					
1	Mobilization (10% Proposed Improvements)	1	LS	1,629,550.00	1,629,550.00
2	Maintenance of Traffic	1	LS	200,000.00	200,000.00
3	Erosion and Sediment Control	1	LS	100,000.00	100,000.00
4	Record Drawings	1	LS	10,000.00	10,000.00
				SUBTOTAL	**$ 1,939,550**
II. PROPOSED IMPROVEMENTS					
5	Package Pump Station (Including 4' x 10' Wet Well, Pumps, Piping, Valves, Fiberglass Valvebox, Panel)	5	EA	50,000.00	250,000.00
6	8" PVC Pipe (Including Excavation, Backfill, Sodding, Landscaping)	42,000	LF	100.00	4,200,000.00
7	4" PVC/HDPE Force Main	3,500	LF	50.00	175,000.00
8	Precast Concrete Manhole	164	EA	5,000.00	820,000.00
9	Connect to Existing Manhole	5	EA	2,000.00	10,000.00
10	Sewer Lateral (Will Require ROW Entry Agreements)	1,407	EA	5,500.00	7,738,500.00
11	Manhole Abandonment	207	EA	1,000.00	207,000.00
12	Grout Fill Abandoned Existing Pipelines	750	CY	500.00	375,000.00
13	Restoration	36,000	SY	70.00	2,520,000.00
				SUBTOTAL	**$ 16,295,500**
I. MISCELLANEOUS					**$ 1,939,550**
II. PROPOSED IMPROVEMENTS					**$ 16,295,500**
				SUBTOTAL	**$ 18,235,050**
				CONTINGENCY (20%)	**$ 3,647,010**
				CONSTRUCTION TOTAL	**$ 21,882,060**
Costs taken from Bid Tabulations and Existing Projects in Construction					
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.					

Operations:

Successful operation of the package pump station system will require connectivity of each pump station to the County's SCADA system. County operators will not require any additional training to operate this system. The addition of five package pump stations will increase operating costs due to power consumption of each station. According to Barney's Pumps Inc., a manufacturer of package pump stations, a typical 10 HP station uses 1800 kWhr of power a month. Using the average price of electricity of 11.29 cents/kWhr, the estimated operation cost for these pumps can be calculated. See **Table 27** for the operation costs of the grinder pump stations.

Table 27: Operation Costs of Package Pump Stations

Number of Package Pump Stations	Electrical Demand per Station (kWhr/month)	Cost per kWhr (cents)	Total Annual Operation Cost ($)
5	1800	11.29	$ 12,193.20

By using package pump stations, the gravity systems will be shallower in most areas, reducing the initial cost of gravity main construction and the limits of restoration. I&I will be significantly reduced by replacing the infrastructure.

Life Cycle:

Based on information provided by manufacturers such as Barneys Pumps Inc., a package pump station manufacturer, the service life of package pump station system components are shown in **Table 28** below. Assuming a 50-year evaluation period, it is estimated that the five proposed packaged pump stations will require replacement once within the 50-year period. The proposed force main, gravity main, manholes, and sewer laterals will not require replacement during this evaluation period. The life cycle of the infrastructure will vary based on precision of installation and varying sewer conditions. The pumps within each station should be serviced every 5 to 10 years. Pump services are assumed to be required every 10 years for this analysis. The service life of equipment is highly dependent on preventative maintenance or lack thereof of the system components and environmental conditions.

Table 28: Service Life of Package Pump Station System Components

System Component	Service Life (years)	Varying Factors
Packaged Pump Station	30 - 50	Inadequate maintenance; corrosion; high run times; clogging
PVC Gravity Pipe	100	Material degradation; inadequate maintenance
PVC/HDPE Force Main	100	Material degradation; inadequate maintenance
Precast Concrete Manhole	50	Material degradation; inadequate maintenance; corrosion
PVC Sewer Lateral	100	Material degradation; inadequate maintenance

Maintenance/Accessibility:

The relocation of the infrastructure to the front of the mobile homes would allow easier access for County staff to preform maintenance such as pipe cleaning and inspection and any future rehabilitation that is required for the system. Package pump stations and gravity systems require routine maintenance. It is recommended that the gravity system be cleaned and inspected every five years. Preventative maintenance required for package pump stations is shown in **Table 29.**

Table 29: Package Pump Station Maintenance Tasks

Task Frequency	Task
Monthly	• Pump down station to remove any buildup of grease • Clean station floats and transducer • Spray down wet well • Actuate valves
Annually	• Perform station draw down test to verify pump operating point and check for vibration or unusual noise • Inspect Impeller • Check oil chamber, wear ring, power cables, discharge flange, guide rails • Lubricate locks, hatches, latches and hinges

Every 10 years, pumps should be removed and overhauled by manufacturer. All worn components should be replaced as they are identified during annual inspection. **Table 30** below outlines the annual maintenance cost based on anticipated replacement of system components (assuming recommended maintenance activities are followed) and operating cost over the 50-year evaluation period for Alternative 5.

Table 30: Alternative 5 Annual Cost Over 50 Year Period

Cost Component	Cost
Maintenance Cost of System[1] (During 50 year period)	$58,333.33
Additional Operating Cost[2]	$12,193.20
Annual Cost[3]	**$71,026.53**

[1] Maintenance cost assumed cleaning and inspection of 20% of the system annually and pump overhaul every 10 years; additional replacement assumes package pump stations be replaced after 30 years
[2] Additional operating cost for system assumes 18,000 kWhr/month @11.29 cents per kWh
[3] Costs do not include County labor, engineering fees, appreciation, depreciation or interest. All costs are based on present-day information.

Public Inconvenience:

The construction of the gravity collection system will require open trench installation; however, the system will be much shallower in most areas. The replacement of the laterals will require right-of-entry agreements and coordination with all property owners. The open excavation would require road closures and detours throughout construction. The force main can be installed using trenchless methods such as HDD, limiting restoration where possible.

Based on the evaluation criteria and sub-criteria, a matrix showing the rankings of Alternative 5 is shown in **Table 31** below.

Table 31: Alternative 5: Package Pump Station Criteria Matrix

Evaluation Criteria		Evaluation Sub-Criteria	Sub-Criteria Ranking	Evaluation Criteria Ranking
Capital Cost	$21,882,060.00	N/A		3
Operations		Operating Expense	2	4
		I&I Reduction	1	
		Additional Operator Training	1	
Life Cycle		N/A		2
Maintenance and Accessibility		Accessibility	2	7
		Required Maintenance	3	
		Frequency of Rehab/Replacement	2	
Public Inconvenience		Length of Construction	4	11
		Required Restoration	3	
		Traffic Impacts	4	
			Summation	27

Recommendations

Based on the individual alternative rankings per the established criterion and the assumptions outlined within each alternative, Alternative 5 – Package Pump Station System is the most favorable alternative. A summary comparison matrix is shown in **Table 32** below, utilizing the established ranking methodology.

Alternative 5 would relocate the gravity sewer infrastructure to the front right-of-way and shallow the system, increasing accessibility for future maintenance. The County will be able to phase the project and complete one package pump station and corresponding gravity sewer basin at a time. By replacing the system, I&I will be effectively reduced. Preventative maintenance of the proposed system is recommended to prevent I&I from occurring in the future.

Additionally, it is recommended the County hold multiple public meetings to inform the community of the planned improvements. Discussions regarding access to the private sanitary sewer laterals should be held on a frequent basis. Experience in working in these types of communities have shown that the residents are oftentimes seasonal, thus requiring public meetings during the highest occupancy times.

Table 32: Alternative Comparison Matrix

Alternative	Criteria		Ranking	Overall Alternative Rank
Alternative 1: System Rehabilitation	Capital Cost	$22,191,332.00	4	31
	Operations		7	
	Life Cycle		5	
	Maintenance/Accessibility		12	
	Public Inconvenience		3	
Alternative 2: System Replacement	Capital Cost	$22,940,310.00	5	30
	Operations		4	
	Life Cycle		1	
	Maintenance/Accessibility		5	
	Public Inconvenience		15	
Alternative 3: Vacuum Sewer System	Capital Cost	$21,790,720.00	2	34
	Operations		9	
	Life Cycle		4	
	Maintenance/Accessibility		9	
	Public Inconvenience		10	
Alternative 4: Low Pressure System	Capital Cost	$21,097,342.00	1	29
	Operations		7	
	Life Cycle		7	
	Maintenance/Accessibility		12	
	Public Inconvenience		6	
Alternative 5: Package Pump Station System	Capital Cost	$21,882,060.00	3	27
	Operations		4	
	Life Cycle		2	
	Maintenance/Accessibility		7	
	Public Inconvenience		11	

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APPENDIX A:
System Maintenance Completed to Date
(Provided by Manatee County)

Total of work orders for Trailer Estates - System 12A
01/01/2006 - 05/08/2017

Order#	Order Date	LaborTotal	PartsTotal	EquipTotal	Job Total	System	ActivityCode	REQUIREMENT	UWOW ID	ADDRESS
214400	11/19/2010	$10,288.28	$1,975.98	$6862.66	$19,126.92	12A	623	REPAIR FORCE MAIN	23E13	2003 BAY DRBRADENTON
232827	05/24/2011	$84.60	$0.00	$90.00	$174.60	12A	411	REPAIR MAIN LINE	282TEC4A	1803 NEW YORK AVEBRADENTON
246882	10/03/2011	$109.52	$0.00	$100.00	$209.52	12A	411	REPAIR MAIN LINE	282TE323	1903 MINNESOTA AVEBRADENTON
251137	11/03/2011	$68.46	$0.00	$62.50	$130.96	12A	411	REPAIR MAIN LINE	282TE315	1911 ILLINOIS AVEBRADENTON
251329	11/04/2011	$171.50	$4.65	$225.00	$401.15	12A	411	REPAIR MAIN LINE	282TE330	2013 OHIO AVEBRADENTON
251589	11/08/2011	$765.39	$0.00	$2040.00	$2,805.39	12A	411	REPAIR MAIN LINE	282TEBD2	1414 69TH AVE WBRADENTON
283216	10/18/2012	$63.95	$9.30	$62.50	$135.75	12A	411	REPAIR MAIN LINE	282TE322	1907 MINNESOTA AVE
287155	12/04/2012	$159.04	$27.31	$200.00	$386.35	12A	411	REPAIR MAIN LINE	282TE321	2013 MINNESOTA AVEBRADENTON
300398	04/24/2013	$134.88	$216.90	$75.00	$426.78	12A	411	REPAIR MAIN LINE	282TE334	1909 INDIANA AVEBRADENTON
303003	05/20/2013	$96.52	$501.30	$87.75	$685.57	12A	411	REPAIR MAIN LINE	282TE315	1911 ILLINOIS AVEBRADENTON
312442	08/27/2013	$112.41	$27.31	$125.00	$264.72	12A	411	REPAIR MAIN LINE	282TE333	2011 INDIANA AVEBRADENTON
312441	08/27/2013	$114.11	$27.31	$62.50	$203.92	12A	411	REPAIR MAIN LINE	282TEC4A	1803 NEW YORK AVEBRADENTON
316524	10/02/2013	$216.76	$26.24	$295.00	$538.00	12A	411	REPAIR MAIN LINE	282TEC4A	1818 PENNSYLVANIA AVE
343218	07/22/2014	$95.14	$81.93	$112.50	$289.57	12A	411	REPAIR MAIN LINE	282TE314	2015 ILLINOIS AVEBRADENTON
378524	07/21/2015	$270.33	$9.00	$300.00	$579.33	12A	411	REPAIR MAIN LINE	282TE3342005	2005 INDIANA AVEBRADENTON
381387	08/18/2015	$139.28	$0.00	$118.75	$258.03	12A	411	REPAIR MAIN LINE	282TE314	2015 ILLINOIS AVEBRADENTON
393517	01/06/2016	$39.63	$244.67	$50.00	$334.30	12A	528	REPLACE MH RIM & COVER	282TE157	1707 ILLINOIS AVEBRADENTON
393518	01/06/2016	$69.36	$244.67	$87.50	$401.53	12A	528	REPLACE MH RIM & COVER	282TE156	1715 ILLINOIS AVEBRADENTON
395467	01/26/2016	$262.08	$9.00	$385.00	$656.08	12A	411	REPAIR MAIN LINE	282TE316	1903 ILLINOIS AVEBRADENTON
418304	09/28/2016	$266.98	$0.00	$192.50	$459.48	12A	411	REPAIR MAIN LINE	282TE322	2005 MINNESOTA AVEBRADENTON
423456	12/01/2016	$441.29	$0.00	$315.00	$756.29	12A	411	REPAIR MAIN LINE	282TE27	6504 NEW JERSEY STBRADENTON
434570	04/17/2017	$96.28	$203.57	$105.00	$404.85	12A	528	REPLACE MH RIM & COVER	282TE2A16	6506 ARIZONA STBRADENTON
434566	04/17/2017	$96.28	$192.63	$105.00	$393.91	12A	528	REPLACE MH RIM & COVER	282TE2A15A	6504 MASSACHUSETTS STBRADENTON
434565	04/17/2017	$102.10	$211.07	$122.50	$435.67	12A	528	REPLACE MH RIM & COVER	282TE27	6504 NEW JERSEY STBRADENTON
435152	04/25/2017	$6.84	$0.00	$17.50	$24.34	12A	528	REPLACE MH RIM & COVER	282TEC5A	1711 NEW YORK AVEBRADENTON
435138	04/25/2017	$7.29	$0.00	$8.75	$16.04	12A	528	REPLACE MH RIM & COVER	282TE2C11	- BAY DRBRADENTON
435134	04/25/2017	$7.29	$0.00	$8.75	$16.04	12A	528	REPLACE MH RIM & COVER	282TE6C	1806 NEW YORKBRADENTON
435136	04/25/2017	$7.29	$0.00	$8.75	$16.04	12A	528	REPLACE MH RIM & COVER	282TEC4A	1717 NEW YORK AVEBRADENTON
435147	04/25/2017	$14.59	$0.00	$17.50	$32.09	12A	528	REPLACE MH RIM & COVER	282TEC1A2	2303 NEW YORK AVEBRADENTON
435137	04/25/2017	$7.29	$0.00	$8.75	$16.04	12A	528	REPLACE MH RIM & COVER	282TEC1A1	2209 NEW YORK AVEBRADENTON
435143	04/25/2017	$7.29	$0.00	$8.75	$16.04	12A	528	REPLACE MH RIM & COVER	282TE2C4	2311 NEW YORK AVEBRADENTON
435339	04/26/2017	$119.49	$302.34	$122.50	$544.33	12A	528	REPLACE MH RIM & COVER	282TE2C11	- BAY DRBRADENTON
435342	04/26/2017	$95.88	$203.57	$105.00	$404.45	12A	528	REPLACE MH RIM & COVER	282TE6C	1806 NEW YORKBRADENTON
435343	04/26/2017	$159.79	$203.57	$175.00	$538.36	12A	528	REPLACE MH RIM & COVER	282TEC1A1	2209 NEW YORK AVEBRADENTON
435433	04/27/2017	$93.26	$302.34	$122.50	$518.10	12A	510	REPAIR MANHOLE	282TE36	6604 KANSAS STBRADENTON
436039	05/03/2017	$159.79	$0.00	$175.00	$334.79	12A	528	REPLACE MH RIM & COVER	282TE7C	1704 NEW YORKBRADENTON

TRAILER ESTATES

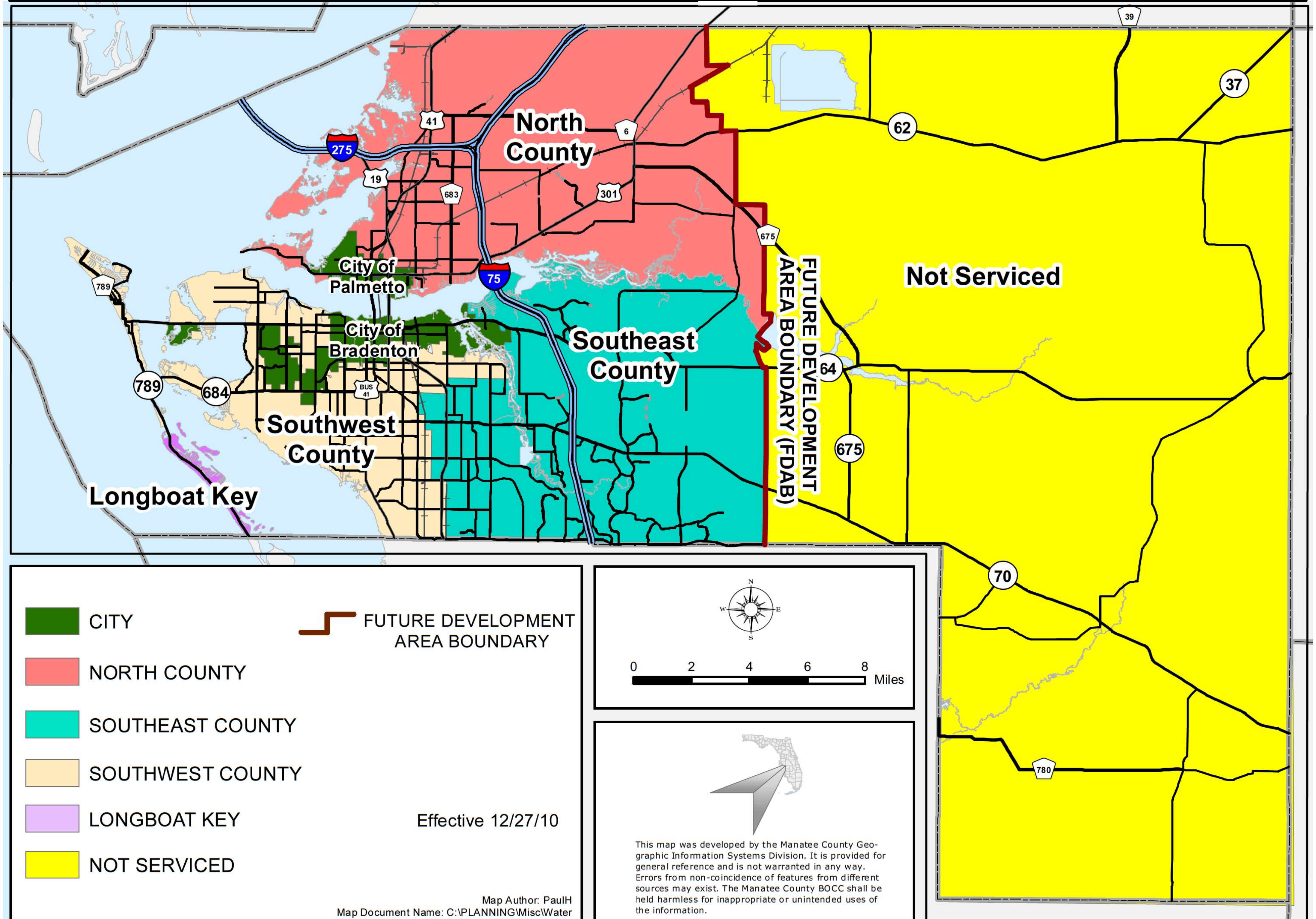
APPENDIX B: 2017 Utility Flow Contributions Table; Potable and Wastewater Service Areas Map

2017 UTILITY FLOW CONTRIBUTION TABLE

Average Daily Flow

USE CODE	LAND USE TYPE	POTABLE WATER (GPD)			WASTE WATER (GPD)			SOLID WASTE - (CY/DAY)		
		QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL
	NORTH COUNTY									
SFD	SINGLE FAMILY DETACHED	3 PERSONS	80	240	3 PERSONS	80	240	2.7 PERSONS	7.9	21.3
SFA	SINGLE FAMILY ATTACHED	3 PERSONS	80	240	3 PERSONS	80	240	2.5 PERSONS	7.9	19.8
DUP	DUPLEX	2 PERSONS	80	160	2 PERSONS	80	160	2.5 PERSONS	7.9	19.8
MFA	MULTI-FAMILY APARTMENTS	2 PERSONS	80	160	2 PERSONS	80	160	1.8 PERSONS	7.9	14.2
MFH	MULTI-FAMILY CONDOMINIUMS	2 PERSONS	80	160	2 PERSONS	80	160	1.8 PERSONS	7.9	14.2
MHU	MOBILE HOME	2 PERSONS	80	160	2 PERSONS	80	160	1.7 PERSONS	7.9	13.4
	SOUTHEAST COUNTY									
SFD	SINGLE FAMILY DETACHED	3 PERSONS	80	240	3 PERSONS	85	255	2.7 PERSONS	7.9	21.3
SFA	SINGLE FAMILY ATTACHED	3 PERSONS	80	240	3 PERSONS	85	255	2.5 PERSONS	7.9	19.8
DUP	DUPLEX	2 PERSONS	80	160	2 PERSONS	85	170	2.5 PERSONS	7.9	19.8
MFA	MULTI-FAMILY APARTMENTS	2 PERSONS	80	160	2 PERSONS	85	170	1.8 PERSONS	7.9	14.2
MFH	MULTI-FAMILY CONDOMINIUMS	2 PERSONS	80	160	2 PERSONS	85	170	1.8 PERSONS	7.9	14.2
MHU	MOBILE HOME	2 PERSONS	80	160	2 PERSONS	85	170	1.7 PERSONS	7.9	13.4
	SOUTHWEST COUNTY									
SFD	SINGLE FAMILY DETACHED	3 PERSONS	80	240	3 PERSONS	115	345	2.7 PERSONS	7.9	21.3
SFA	SINGLE FAMILY ATTACHED	3 PERSONS	80	240	3 PERSONS	115	345	2.5 PERSONS	7.9	19.8
DUP	DUPLEX	2 PERSONS	80	160	2 PERSONS	115	230	2.5 PERSONS	7.9	19.8
MFA	MULTI-FAMILY APARTMENTS	2 PERSONS	80	160	2 PERSONS	115	230	1.8 PERSONS	7.9	14.2
MFH	MULTI-FAMILY CONDOMINIUMS	2 PERSONS	80	160	2 PERSONS	115	230	1.8 PERSONS	7.9	14.2
MHU	MOBILE HOME	2 PERSONS	80	160	2 PERSONS	115	230	1.7 PERSONS	7.9	13.4
HTL	HOTEL	ROOMS	150		ROOMS	120		ROOMS	2.5	
OFF	GENERAL OFFICE	SQ. FT.	0.24		SQ. FT.	0.2		SQ. FT.	1	
MOF	MEDICAL OFFICE	SQ. FT.	0.6		SQ. FT.	0.5		SQ. FT.	1	
OFFPK	RESEARCH PARK	SQ. FT.	0.24		SQ. FT.	0.2		SQ. FT.	1	
COM	CONVENIENCE STORE	SQ. FT.	0.24		SQ. FT.	0.2		SQ. FT.	9	
COM	SUPERMARKET	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	9	
COM	SMALL SHOPPING CENTER (20,000 - 83,000 SQ. FT.)	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	5	
COM	LARGE SHOPPING CENTER (OVER 83,000 SQ. FT.)	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	4	
RST	GENERAL RESTAURANT	SQ. FT.	6		SQ. FT.	5		SQ. FT.	3.5	
FFR	FAST FOOD RESTAURANNT	SQ. FT.	0.97		SQ. FT.	0.85		SQ. FT.	3.5	
MAR	MARINA	BERTHS	120		BERTHS	100		BERTHS	4	
REC	GOLF COURSE & OTHER RECREATIONAL USES	PARKING SPACES	10		PARKING SPACES	5		PARKING SPACES	2.15	
COM	WHOLESALE	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	2	
OFF	DRIVE-IN BANK	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	1	
COM	GENERAL COMMERCIAL	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	1	
RVP	"RV" PARK	PADS	120		PADS	100		PADS	8	
WHS	WAREHOUSE	SQ. FT.	0.12		SQ. FT.	0.1		SQ. FT.	2	
MFG	MANUFACTURING	SQ. FT.	0.5		SQ. FT.	0.4		EMPLOYEES	SEE IMPACT FEE RATES	
ALF	ASSISTED LIVING FACILITY	BEDS	150		BEDS	125		BEDS	5	
HOS	HOSPITAL	BEDS	300		BEDS	250		BEDS	125	
SCH	ELEMENTARY SCHOOL	STUDENTS	25		STUDENTS	20		STUDENTS	0.5	
								ROOMS	10	
SCH	MIDDLE SCHOOL	STUDENTS	30		STUDENTS	25		STUDENTS	0.5	
								ROOMS	10	
SCH	HIGH SCHOOL	STUDENTS	30		STUDENTS	25		STUDENTS	0.5	
								ROOMS	10	
CHU	CHURCH	SEATS	3.6		SEATS	3		SQ.FT. OFFICE/100	1	

Potable Water / Wastewater Service Areas



APPENDIX C: ESRI Community Profile Report

Community Profile

Polygon
Area: 0.38 square miles

Trailer Estates - GIS Reports

Population Summary	
2000 Total Population	1,274
2010 Total Population	1,320
2018 Total Population	1,555
2018 Group Quarters	0
2023 Total Population	1,743
2018-2023 Annual Rate	2.31%
2018 Total Daytime Population	1,466
Workers	287
Residents	1,179
Household Summary	
2000 Households	824
2000 Average Household Size	1.55
2010 Households	826
2010 Average Household Size	1.60
2018 Households	967
2018 Average Household Size	1.61
2023 Households	1,081
2023 Average Household Size	1.61
2018-2023 Annual Rate	2.25%
2010 Families	428
2010 Average Family Size	2.07
2018 Families	488
2018 Average Family Size	2.08
2023 Families	541
2023 Average Family Size	2.09
2018-2023 Annual Rate	2.08%
Housing Unit Summary	
2000 Housing Units	1,438
Owner Occupied Housing Units	51.3%
Renter Occupied Housing Units	6.1%
Vacant Housing Units	42.7%
2010 Housing Units	1,386
Owner Occupied Housing Units	51.3%
Renter Occupied Housing Units	8.3%
Vacant Housing Units	40.4%
2018 Housing Units	1,613
Owner Occupied Housing Units	49.9%
Renter Occupied Housing Units	10.0%
Vacant Housing Units	40.0%
2023 Housing Units	1,799
Owner Occupied Housing Units	50.9%
Renter Occupied Housing Units	9.2%
Vacant Housing Units	39.9%
Median Household Income	
2018	$65,618
2023	$81,437
Median Home Value	
2018	$86,560
2023	$96,064
Per Capita Income	
2018	$53,531
2023	$63,181
Median Age	
2010	70.9
2018	73.1
2023	74.2

Data Note: Household population includes persons not residing in group quarters. Average Household Size is the household population divided by total households. Persons in families include the householder and persons related to the householder by birth, marriage, or adoption. Per Capita Income represents the income received by all persons aged 15 years and over divided by the total population.
Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

October 05, 2018

2018 Households by Income	
Household Income Base	967
<$15,000	5.7%
$15,000 - $24,999	6.9%
$25,000 - $34,999	13.7%
$35,000 - $49,999	13.4%
$50,000 - $74,999	14.7%
$75,000 - $99,999	13.2%
$100,000 - $149,999	22.4%
$150,000 - $199,999	3.4%
$200,000+	6.5%
Average Household Income	$89,274
2023 Households by Income	
Household Income Base	1,081
<$15,000	4.3%
$15,000 - $24,999	5.3%
$25,000 - $34,999	10.7%
$35,000 - $49,999	11.1%
$50,000 - $74,999	14.0%
$75,000 - $99,999	14.5%
$100,000 - $149,999	27.8%
$150,000 - $199,999	4.3%
$200,000+	8.0%
Average Household Income	$105,727
2018 Owner Occupied Housing Units by Value	
Total	805
<$50,000	17.4%
$50,000 - $99,999	44.6%
$100,000 - $149,999	9.6%
$150,000 - $199,999	6.1%
$200,000 - $249,999	3.2%
$250,000 - $299,999	0.9%
$300,000 - $399,999	7.3%
$400,000 - $499,999	2.6%
$500,000 - $749,999	0.1%
$750,000 - $999,999	0.7%
$1,000,000 - $1,499,999	7.5%
$1,500,000 - $1,999,999	0.0%
$2,000,000 +	0.0%
Average Home Value	$207,919
2023 Owner Occupied Housing Units by Value	
Total	915
<$50,000	13.6%
$50,000 - $99,999	39.6%
$100,000 - $149,999	8.9%
$150,000 - $199,999	6.7%
$200,000 - $249,999	4.0%
$250,000 - $299,999	1.2%
$300,000 - $399,999	14.1%
$400,000 - $499,999	2.7%
$500,000 - $749,999	0.1%
$750,000 - $999,999	0.8%
$1,000,000 - $1,499,999	8.4%
$1,500,000 - $1,999,999	0.0%
$2,000,000 +	0.0%
Average Home Value	$242,404

Data Note: Income represents the preceding year, expressed in current dollars. Household income includes wage and salary earnings, interest dividends, net rents, pensions, SSI and welfare payments, child support, and alimony.
Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

October 05, 2018

2010 Population by Age	
Total	1,321
0 - 4	0.8%
5 - 9	1.0%
10 - 14	0.7%
15 - 24	1.7%
25 - 34	2.0%
35 - 44	2.6%
45 - 54	5.8%
55 - 64	16.8%
65 - 74	31.2%
75 - 84	28.8%
85 +	8.6%
18 +	96.7%
2018 Population by Age	
Total	1,554
0 - 4	1.0%
5 - 9	0.9%
10 - 14	0.8%
15 - 24	1.5%
25 - 34	1.5%
35 - 44	2.1%
45 - 54	4.1%
55 - 64	13.1%
65 - 74	31.3%
75 - 84	29.2%
85 +	14.4%
18 +	97.0%
2023 Population by Age	
Total	1,745
0 - 4	0.7%
5 - 9	0.7%
10 - 14	0.7%
15 - 24	1.2%
25 - 34	1.5%
35 - 44	1.8%
45 - 54	3.0%
55 - 64	11.3%
65 - 74	31.8%
75 - 84	32.7%
85 +	14.5%
18 +	97.4%
2010 Population by Sex	
Males	607
Females	713
2018 Population by Sex	
Males	732
Females	822
2023 Population by Sex	
Males	826
Females	918

Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

2010 Population by Race/Ethnicity	
Total	1,321
White Alone	98.1%
Black Alone	0.5%
American Indian Alone	0.0%
Asian Alone	0.5%
Pacific Islander Alone	0.0%
Some Other Race Alone	0.5%
Two or More Races	0.5%
Hispanic Origin	2.1%
Diversity Index	7.6
2018 Population by Race/Ethnicity	
Total	1,555
White Alone	97.4%
Black Alone	0.6%
American Indian Alone	0.0%
Asian Alone	0.6%
Pacific Islander Alone	0.0%
Some Other Race Alone	0.8%
Two or More Races	0.6%
Hispanic Origin	2.8%
Diversity Index	10.3
2023 Population by Race/Ethnicity	
Total	1,743
White Alone	96.8%
Black Alone	0.7%
American Indian Alone	0.0%
Asian Alone	0.7%
Pacific Islander Alone	0.0%
Some Other Race Alone	1.0%
Two or More Races	0.7%
Hispanic Origin	3.5%
Diversity Index	12.5
2010 Population by Relationship and Household Type	
Total	1,320
In Households	100.0%
In Family Households	67.2%
Householder	31.1%
Spouse	29.1%
Child	5.2%
Other relative	1.6%
Nonrelative	0.2%
In Nonfamily Households	32.8%
In Group Quarters	0.0%
Institutionalized Population	0.0%
Noninstitutionalized Population	0.0%

Data Note: Persons of Hispanic Origin may be of any race. The Diversity Index measures the probability that two people from the same area will be from different race/ethnic groups.
Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

October 05, 2018

2018 Population 25+ by Educational Attainment	
Total	1,489
Less than 9th Grade	2.6%
9th - 12th Grade, No Diploma	17.5%
High School Graduate	34.3%
GED/Alternative Credential	2.1%
Some College, No Degree	26.1%
Associate Degree	0.1%
Bachelor's Degree	11.1%
Graduate/Professional Degree	6.2%
2018 Population 15+ by Marital Status	
Total	1,513
Never Married	10.9%
Married	66.2%
Widowed	9.1%
Divorced	13.9%
2018 Civilian Population 16+ in Labor Force	
Civilian Employed	99.5%
Civilian Unemployed (Unemployment Rate)	0.5%
2018 Employed Population 16+ by Industry	
Total	377
Agriculture/Mining	0.0%
Construction	1.9%
Manufacturing	1.1%
Wholesale Trade	2.7%
Retail Trade	3.2%
Transportation/Utilities	1.1%
Information	0.0%
Finance/Insurance/Real Estate	11.4%
Services	79.0%
Public Administration	0.0%
2018 Employed Population 16+ by Occupation	
Total	378
White Collar	74.0%
Management/Business/Financial	25.2%
Professional	29.2%
Sales	18.3%
Administrative Support	1.3%
Services	23.1%
Blue Collar	3.2%
Farming/Forestry/Fishing	0.3%
Construction/Extraction	1.3%
Installation/Maintenance/Repair	0.5%
Production	0.8%
Transportation/Material Moving	0.3%
2010 Population By Urban/ Rural Status	
Total Population	1,320
Population Inside Urbanized Area	100.0%
Population Inside Urbanized Cluster	0.0%
Rural Population	0.0%

Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

October 05, 2018

2010 Households by Type	
Total	825
Households with 1 Person	42.9%
Households with 2+ People	57.1%
Family Households	51.9%
Husband-wife Families	48.4%
With Related Children	3.2%
Other Family (No Spouse Present)	3.5%
Other Family with Male Householder	0.7%
With Related Children	0.1%
Other Family with Female Householder	2.8%
With Related Children	0.5%
Nonfamily Households	5.2%
All Households with Children	3.8%
Multigenerational Households	1.0%
Unmarried Partner Households	2.9%
Male-female	2.5%
Same-sex	0.4%
2010 Households by Size	
Total	824
1 Person Household	43.0%
2 Person Household	50.7%
3 Person Household	3.9%
4 Person Household	1.9%
5 Person Household	0.2%
6 Person Household	0.1%
7 + Person Household	0.1%
2010 Households by Tenure and Mortgage Status	
Total	826
Owner Occupied	86.1%
Owned with a Mortgage/Loan	21.5%
Owned Free and Clear	64.5%
Renter Occupied	13.9%
2010 Housing Units By Urban/ Rural Status	
Total Housing Units	1,386
Housing Units Inside Urbanized Area	100.0%
Housing Units Inside Urbanized Cluster	0.0%
Rural Housing Units	0.0%

Data Note: Households with children include any households with people under age 18, related or not. Multigenerational households are families with 3 or more parent-child relationships. Unmarried partner households are usually classified as nonfamily households unless there is another member of the household related to the householder. Multigenerational and unmarried partner households are reported only to the tract level. Esri estimated block group data, which is used to estimate polygons or non-standard geography.

Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

October 05, 2018

Top 3 Tapestry Segments		
	1.	The Elders (9C)
	2.	Down the Road (10D)
	3.	The Great Outdoors (6C)
2018 Consumer Spending		
Apparel & Services: Total $		$2,044,682
Average Spent		$2,114.46
Spending Potential Index		97
Education: Total $		$1,149,113
Average Spent		$1,188.33
Spending Potential Index		82
Entertainment/Recreation: Total $		$3,434,606
Average Spent		$3,551.82
Spending Potential Index		110
Food at Home: Total $		$5,228,704
Average Spent		$5,407.14
Spending Potential Index		108
Food Away from Home: Total $		$3,550,573
Average Spent		$3,671.74
Spending Potential Index		105
Health Care: Total $		$7,075,841
Average Spent		$7,317.31
Spending Potential Index		128
HH Furnishings & Equipment: Total $		$2,251,577
Average Spent		$2,328.41
Spending Potential Index		111
Personal Care Products & Services: Total $		$928,822
Average Spent		$960.52
Spending Potential Index		116
Shelter: Total $		$17,566,171
Average Spent		$18,165.64
Spending Potential Index		108
Support Payments/Cash Contributions/Gifts in Kind: Total $		$3,092,922
Average Spent		$3,198.47
Spending Potential Index		129
Travel: Total $		$2,389,296
Average Spent		$2,470.83
Spending Potential Index		115
Vehicle Maintenance & Repairs: Total $		$1,176,293
Average Spent		$1,216.44
Spending Potential Index		113

Data Note: Consumer spending shows the amount spent on a variety of goods and services by households that reside in the area. Expenditures are shown by broad budget categories that are not mutually exclusive. Consumer spending does not equal business revenue. Total and Average Amount Spent Per Household represent annual figures. The Spending Potential Index represents the amount spent in the area relative to a national average of 100.
Source: Consumer Spending data are derived from the 2015 and 2016 Consumer Expenditure Surveys, Bureau of Labor Statistics. Esri.
Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2018 and 2023 Esri converted Census 2000 data into 2010 geography.

APPENDIX D:
Trailer Estates – Sliicer User Guide

User's Guide

ADS Engineering Tools

Sliicer

Version 2.3

ADS Environmental Services

Contents

INTRODUCTION

Introduction Introducing ADS Sliicer

Welcome to ADS Sliicer. This section introduces you to Sliicer, tells you how Sliicer is organized, and explains how to use this guide. It also explains the kind of computer you will need to run Sliicer, and tells you how to install Sliicer on your computer. Finally, it gives you information on Sliicer project license files and product support.

What is Sliicer

Sliicer is a tool developed by ADS Environmental Services, Inc. to help you use rainfall and flow data to find the locations of the worst inflow/infiltration problems in your sanitary sewer collection system. By itself in its raw form, flow data can difficult and interpret. The purpose of Sliicer is to make interpreting your flow data easier, so you can draw conclusions about what to do to enhance the performance of your collection system. Sliicer also allows you to integrate your flow data with physical inspection data to find the best approach to fixing your collection system. Finally, Sliicer helps you use the results of your flow study to calibrate your hydraulic model so you can study the hydraulic impact of design storms and proposed rehabilitation programs.

How is Sliicer Organized

The Sliicer screen is divided into several windows. The main control window is called the ADS Engineering Wizard. The Engineering Wizard has a number of different modes, which are organized into a tab system. There are six main tabs: Rain, Basin, Meter, RDII, Rehab, and Model. The tabs are presented in the order that you will normally use when you do your flow study.

One of the main purposes of Sliicer is to help you visualize what is happening in your collection system. To do this, Sliicer displays visual presentations of rainfall and flow data in various graphical windows. Which graphical windows are displayed is controlled by the current tab of the Engineering Wizard. For example, when the rain tab is current, the rain data is displayed in the graphical window.

How to Use This Guide

This manual is organized into 9 chapters. Chapters 1 and 2 explain general topics that you will need to know to get started using Sliicer. Chapters 3 - 6 explain each of the four basic tabs (Rain, Basin, Meter, and RDII) that you will use to complete a flow study. Chapter 7 explains how to customize the settings for you flow study, and Chapter 8 explains how to print your Sliicer results. Chapter 9 deals with the advanced topic of Modeling.

Sliicer.exe vs. Sliicer.com

Sliicer functionality is available in two forms, Sliicer.exe for PC, desktop installation, and through an internet browser as Sliicer.com. Most of the functions for these two platforms are identical, however, there are a few differences, mainly in the way Sliicer is started, and in how the data files accessed.

The remainder of the introduction applies only to Sliicer.exe desktop users, so Sliicer.com users should skip directly to chapter 1. Some of the topics in chapter 1, notably the section on “Creating a Database” also pertain only to Sliicer.exe, so Sliicer.com users should read only the sections of chapter 1 that pertain to Sliicer.com. Sliicer.com users may wish to refer to the **Sliicer Quick Start Guide** before reading this manual in order to more quickly get an overview all Sliicer features.

Hardware Requirements

Before you install Sliicer.exe on your desktop, you should make sure your computer meets or exceeds the following hardware requirements:

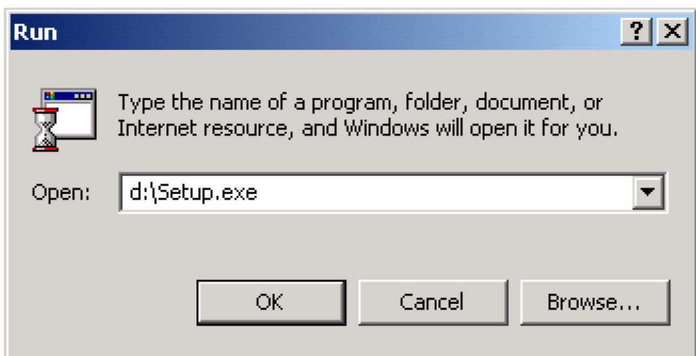
- Laptop or Desktop PC with at least a 486 processor, Pentium processor recommended.
- Windows 2000 or Windows XP operating system.
- At least 16 MB of RAM, 32 MB recommended.
- Sliicer will run with an SVGA (600x800 resolution) monitor, However XVGA (768x1024 resolution) or higher is recommended.

Installing Sliicer

You use the Sliicer setup program to install Sliicer.exe on your computer. The setup program is on the first Sliicer setup disk.

➔ **To install Sliicer.exe**

1. Insert the Setup disk in drive.
2. From the Windows Start button, choose Run.



The Windows Run dialog appears.

3. In the Run dialog box, type <drive letter>:\setup.exe in the Open field.
4. Click the OK button.
5. When Setup starts, follow the instructions on your screen.

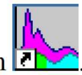
Hardware Specific License Key

In order to run Sliicer.exe on your computer, you must first obtain a machine specific license key. In order to get this key you need to give ADS the serial number of your computer's hard disk.

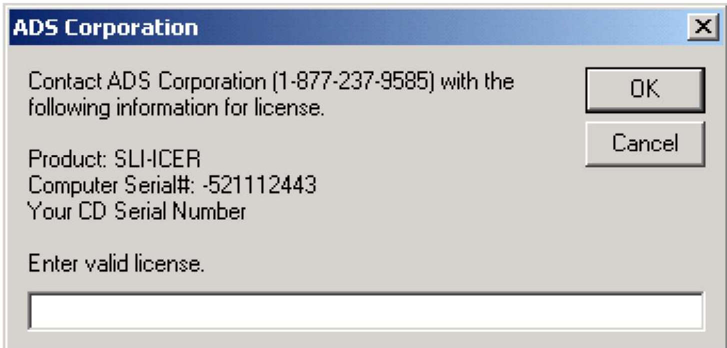
Obtaining Your License Key

The first time you run Sliicer.exe on your desktop, after the introduction screen, you will be presented with a dialog requesting a license key number. The dialog also shows you your hard disk serial number so you can report that number to ADS. The dialog also displays the phone number you need to call in order to get your serial number. When you call ADS to get your machine specific key code, you will be asked to provide the hard disk serial number displayed in this dialog box. You can either call with the dialog visible (recommended), or write the number down and have it available when you call. If you do write it down, remember to include the negative sign if shown, and double check the number.

➔ **To obtain your machine specific License Key Code**

1. Start Sliicer.exe by double clicking the Sliicer Icon .

   After the opening screen, Sliicer will show the License Key Dialog box.



2. With this Dialog box displayed, call ADS support at the number shown.
3. Tell them that you need a license key code for Sliicer, and give the Computer Serial# when asked (remember to include the negative sign if applicable)
4. Enter the License Key Code in the entry field labeled Enter valid license.
5. Click OK.

   If you entered the correct License Key Code, Sliicer will start.

➔ **If Sliicer doesn't open**

If you do not enter the correct key code, Sliicer will display the following dialog box.

1. Click OK.

   Sliicer will terminate.

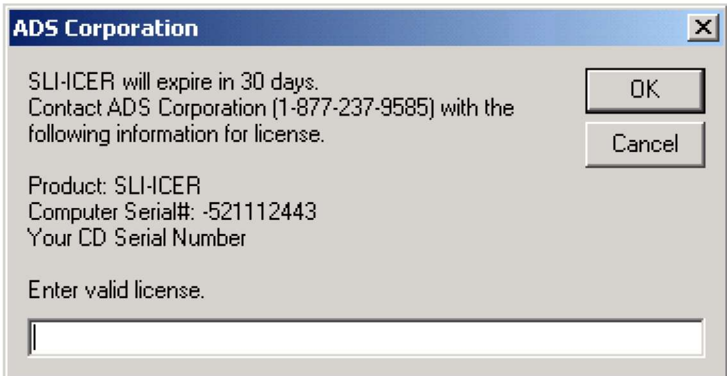
2. Repeat the process outlined above "To obtain your machine specific License Key Code", and make sure you enter the correct License Key Code.
3. If Sliicer still doesn't work, call ADS back for assistance.

Renewing Your License Key

The License Key Codes assigned by ADS are valid for a specified period of time. After that time period expires, Sliicer.exe will not run without a new License Key Code. As a reminder to you that you need a new License Key Code, thirty days before your License Key Code expires, Sliicer will prompt you with a dialog box requesting a new License Key Code. Until the actual expiration date, entry of the new License Key Code is optional, but it is recommended that you call ADS to get a new License Key Code as soon as possible to avoid a disruption in your use of Sliicer.

➔ Renewing your License Key Code

Beginning thirty days before your License Key Code expires, Sliicer.exe will display the following dialog box at startup.



- Call ADS and get a new License Key Code following the procedure listed under "To obtain your machine specific License Key Code".

CHAPTER 1

Chapter 1 Getting Started with Sliicer

This section introduces you to the basics of running Sliicer.

In this chapter you will learn to:

- Start Sliicer
- Understand the Sliicer Menu
- Understand the Sliicer database
- Create and Open a Sliicer database
- Understand the Sliicer Tab system

Starting Sliicer

How you start Sliicer depends on whether you are using Sliicer.exe on your desktop, or accessing Sliicer.com through the internet. In either case, you use the Sliicer icon to start Sliicer.

➔ **To start Sliicer.exe installed on your desktop**

- Double click the Sliicer icon in the Sliicer group or on the desktop.

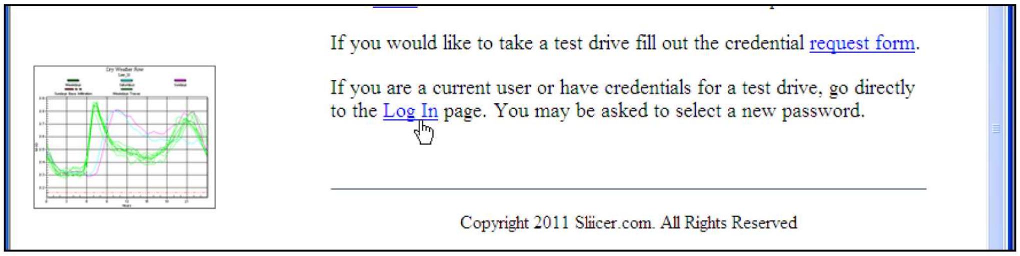
  The Sliicer main screen appears.

➔ **To start Sliicer.com from a web browser**

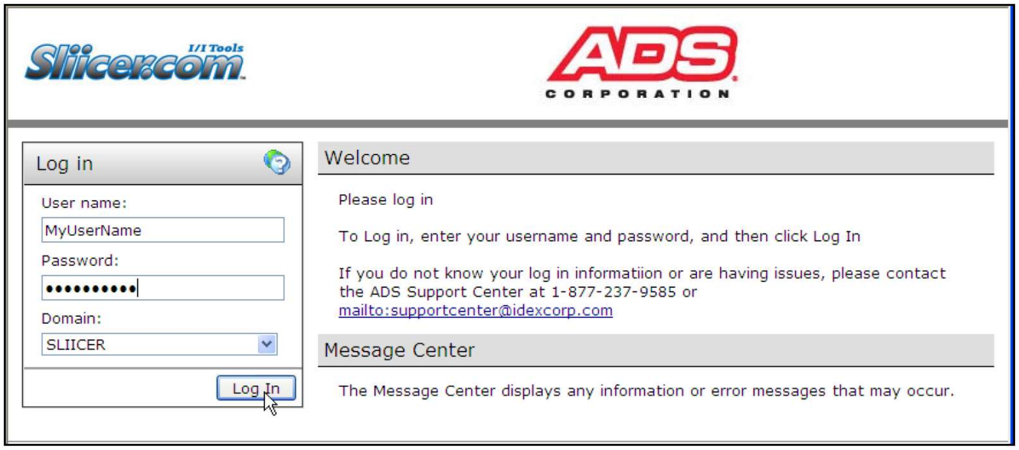
1. In your internet browser, go to the URL http://www.sliicer.com.

   The Sliicer.com introductory web page appears.

2. Scroll to the bottom of the web page, and click the Log In Hyperlink.

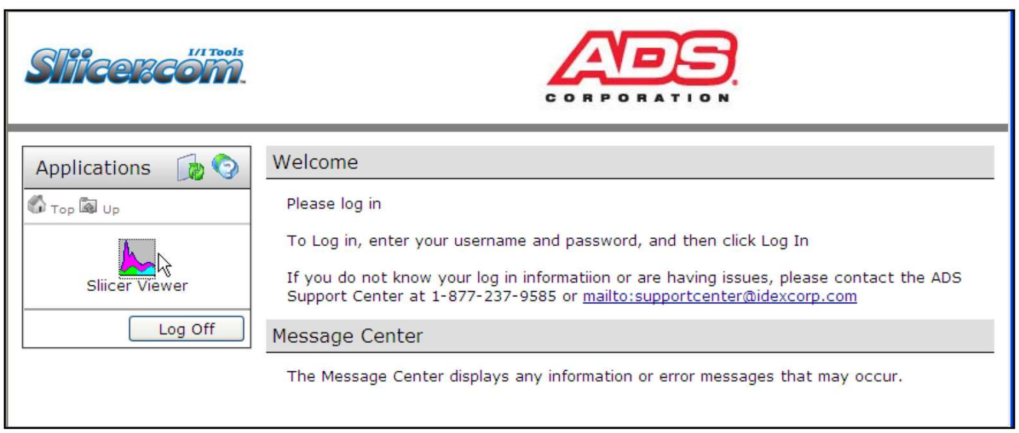


3. Scroll to the bottom of the web page, and click the <u>Log In</u> Hyperlink.



The Sliicer.com log in screen appears.

4. Type in your User Name and Password, and click Log In.



The Applications group page appears.

5. Double click the Sliicer Viewer icon.

The Sliicer main screen appears.

Understanding the Sliicer Menu

The Sliicer main menu allows access to the **File**, **Options**, **Window**, and **Help** items. When you first start Sliicer, only the File and Help items appear. The Options and Window items are added when you create or open a Sliicer database.

File

The file menu allows you to Create, Open and Close the Sliicer database file. It also allows you to print reports and exit the program.

For more information on creating and opening files, see the next section: Understanding the Sliicer Database. For more information on printing reports, see Chapter 8, Output.

Options

The options menu is available after you open a Sliicer database. The items in the Options menu allow you to customize the way Sliicer works.

The options menu is different depending on what window is current. When the Engineering Wizard is current, you can use the items in the Options menu to change Global Options, and Day Group Settings. When a graphical window is current, the Options menu allows you to change the scale and line type.

To learn more about the Options menu, see Chapter 7, Customizing Sliicer.

Format

The Format menu allows you to save and recall display styles for dry day graphs, Q vs. i graphs, and scatter graphs. For more information about Sliicer styles, see Chapter 7, Customizing Sliicer.

Tools

The Tools menu allows access advanced Sliicer features, such as the Multiple Linear Regression flow model.

Window

The Window menu allows you to reposition the currently displayed windows. From time to time, you will want to resize Sliicer's windows. When you want to return to the original window layout, you use the Window Tile menu item.

➔ **To reposition Sliicer's windows**

- From the Windows menu, choose Tile

  Sliicer adjusts the size and position of all current windows.

Help

The Sliicer software includes online help. You can use online help to search for answers to specific topics. You can access online help two ways: Using the Help menu, or using the F1 key.

➔ **To access help using the menu**

- From the Help menu choose Contents.

  Sliicer opens help and displays the Help Contents screen.

➔ **To access help using the F1 key**

1. Select the control you want help on.
2. Press the F1 key.

   Sliicer opens help on the topic you selected.

Understanding the Sliicer Database

By itself in its raw form, flow data can difficult and interpret. The purpose of Sliicer is to make interpreting your flow data easier, so you can draw conclusions about what to do to enhance the performance of your collection system. Sliicer does this by extracting information from the flow data, and processing it into an information database.

Sliicer uses standard ADS Profile database files for its input. As Sliicer processes, it leaves the results of its calculations in a Microsoft Access database called FLOWLOAD.MDB.

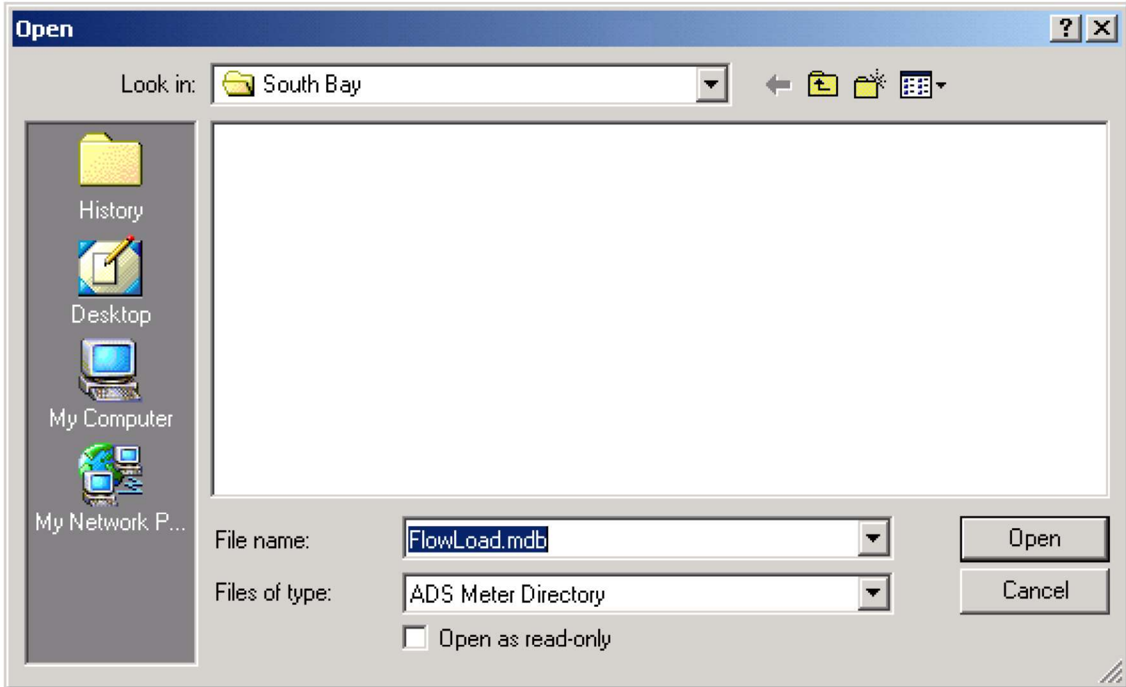
Creating a New Database

When you start a new job with Sliicer.exe, you must create a new FLOWLOAD.MDB database. Sliicer keeps the results of your work in this file. You create a Sliicer database in the project folder for your job. The project folder is the folder that contains the ADS Profile database.

Note **Sliicer.com users** do not ever need to create databases because ADS creates a flowload.mdb database for you. Sliicer.com users should skip this section and go directly to the next section titled "Opening an Existing Database."

➔ **To create a new Sliicer database**

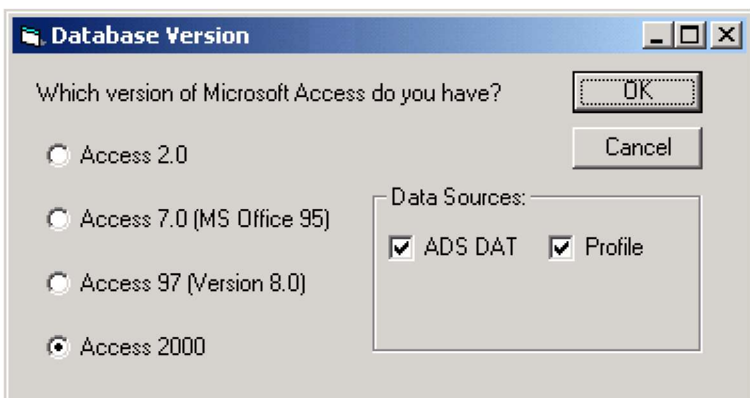
1. From the File menu, choose New.



The New file dialog appears.

2. In the Look in: list, move to the project folder for the new job.

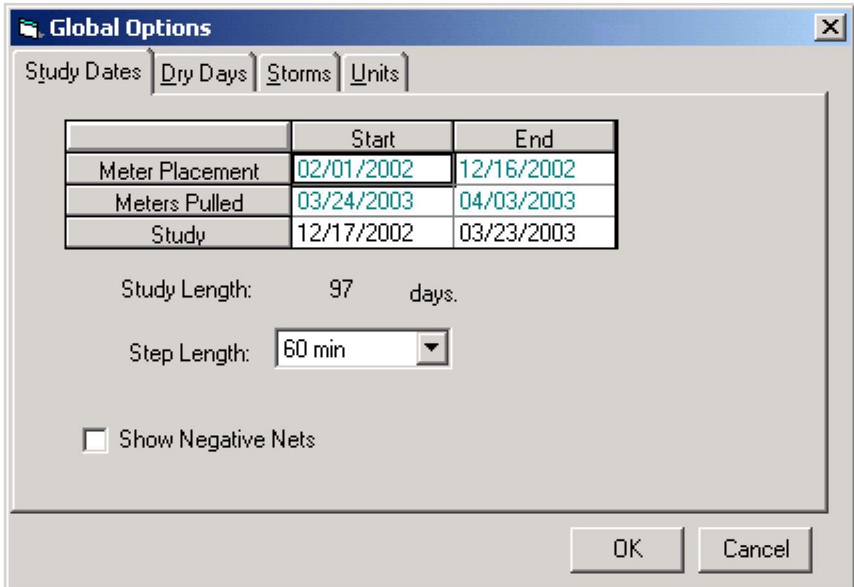
3. Click Open.



The Database Version dialog appears.

4. Select the version of Microsoft Access you want, and check the types of ADS data sources for your project.

5. Click OK.

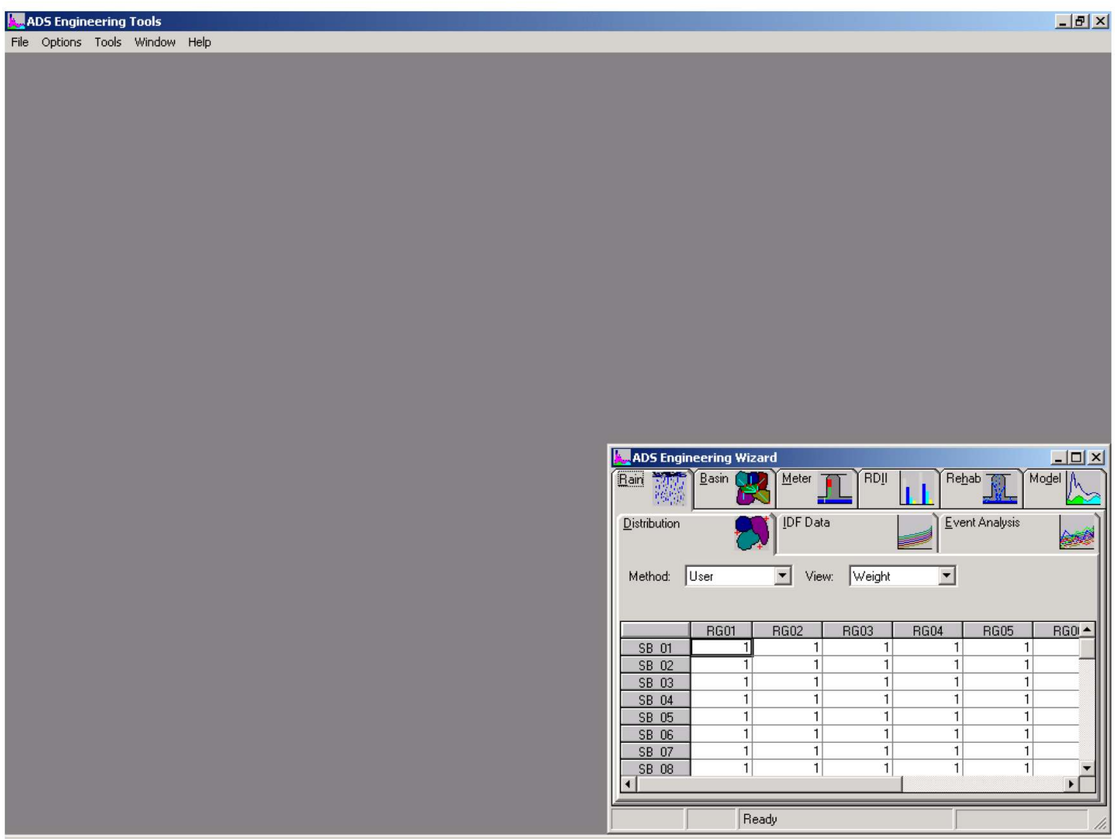


The Global Options dialog appears.

Note In this example, you will be accepting the default global options for the Sliicer database. You can change these global options later if needed. To learn more about changing global options, see Chapter 7, Customizing Sliicer.

---

6. Click OK.



Sliicer creates and opens a new database (FLOWLOAD.MDB) in the project folder and displays the ADS Engineering Wizard window.

Saving the Sliicer Database

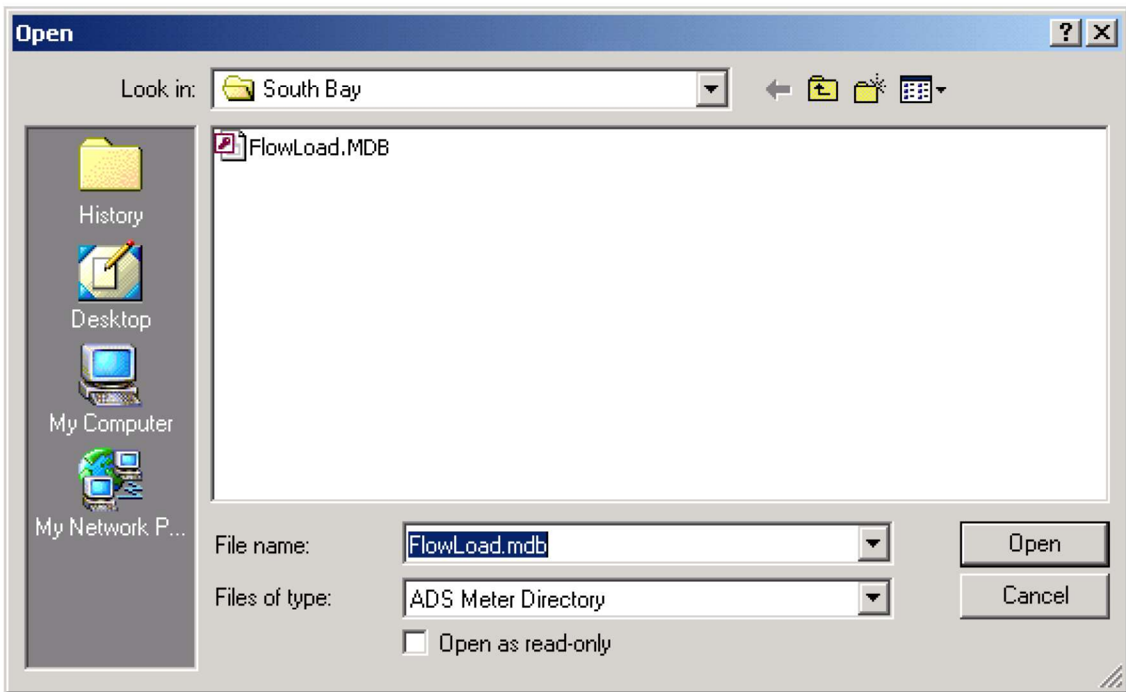
Whenever you perform an operation in Sliicer, the results are immediately stored in the database. This means that when you quit Sliicer, the work you have done is already saved. Sliicer doesn't have a save function, because there is never a need to save.

Opening an Existing Database

Once you create a Sliicer database for a job, or ADS has created a Sliicer database for you, you can open it again at any time. For Sliicer.com users, ADS always creates the Sliicer database for you. Further, Sliicer.com users need to navigate to their specific database, as it is the only database they will be able to access, even if they can see other folders.

➔ **To open an existing Sliicer database**

1. From the File menu, choose Open.



The Open file dialog appears.

2. In the Look in list, move to the project folder for the job.

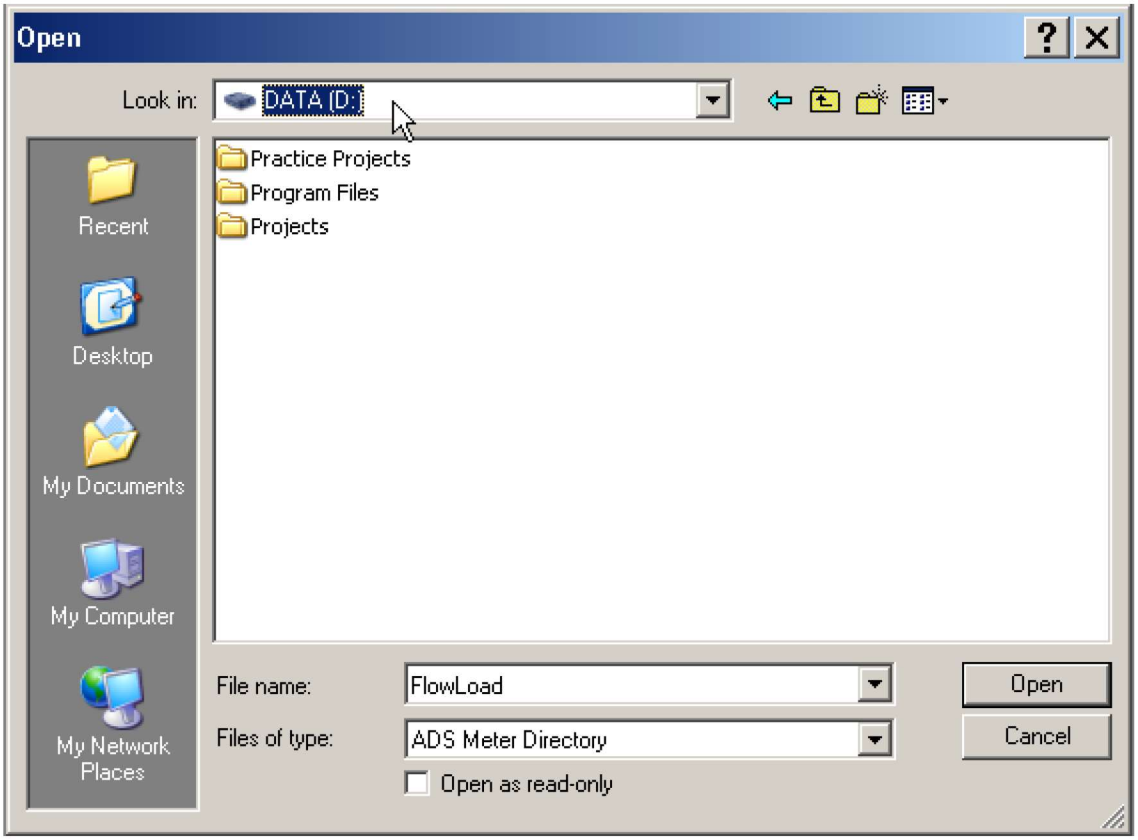
If there is an existing database present in the folder, it will be listed in the files box.

3. Double click FLOWLOAD.MDB in the files list box.

Sliicer opens the database and displays the ADS Engineering Wizard window.

➔ **To open an Sliicer database through Sliicer.com**

1. From the File menu, choose Open.



The Open file dialog appears.

2. Navigate to the D drive.

   If you are a Free Trial User, you will only have access to jobs under the Practice Projects folder. If you are a Registered User, your flowload database will be found under the Projects folder.

3. Navigate to the folder you want, and double click FLOWLOAD.MDB in the files list box.

   Sliicer opens the database and displays the ADS Engineering Wizard window.

Closing a Database

You can close an open Sliicer database at any time. Since any calculations Sliicer makes are immediately saved to the database, you don't have to worry about saving before you close.

➔ **To close a Sliicer database**

- From the File menu, choose Close.

  Sliicer closes the current database and the ADS Engineering Wizard window.

Understanding the ADS Engineering Wizard Window

Sliicer presents all of its text and numerical information in the ADS Engineering Wizard Window, which displays every time you create or open a Sliicer database.

The Sliicer Engineering Wizard uses a lot more controls (buttons, text boxes, tables, etc.) than it can show on the screen at one time. In order to make the controls more manageable for viewing, Sliicer uses a tab system. In the tab system, controls that work together are grouped in the same tab.

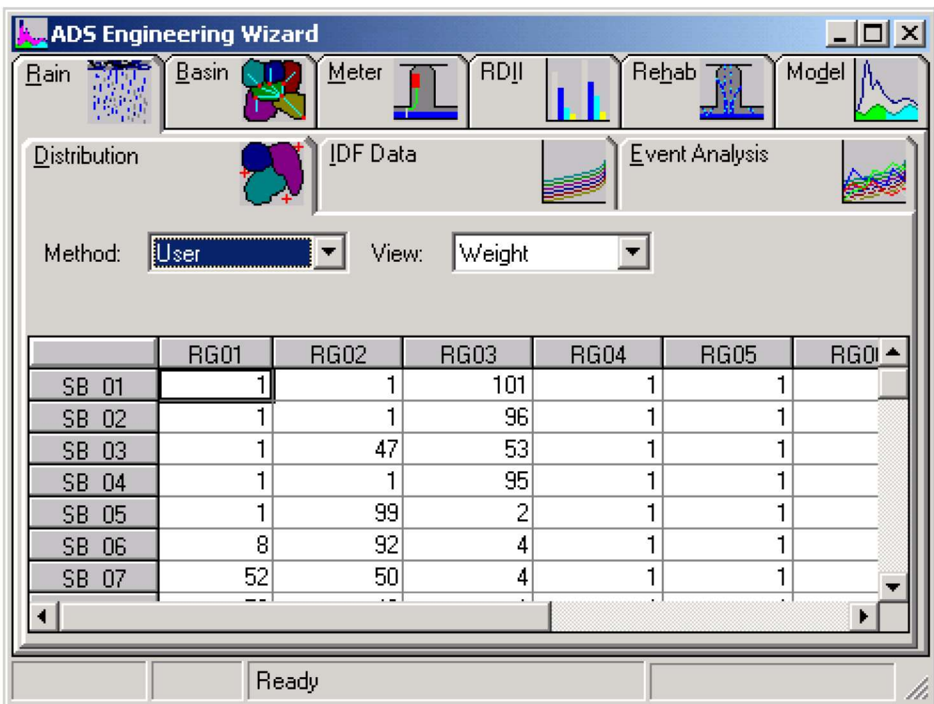
You may be wondering why this window is called a “wizard”. A wizard is a software tool that walks you through a complex process in the right order. Usually, wizards only present one screen at a time to keep you focused on the next step.

The problem is that the process of doing a flow study is somewhat iterative. What you do at the beginning sometimes depends on how things look at the end. Although there is an order to the steps you follow, you frequently have to loop part way back once you see how things turn out.

The Sliicer ADS Engineering Wizard was designed to accommodate this process with the best of both worlds. The tabs are organized in the sequence that you will normally use to do your flow studies. By starting with the left most tab, and working your way toward the right, Sliicer helps you accomplish each part of your analysis in the right order. In this way, the tabs work like a wizard.

However, you don’t ***have to*** walk though each step in exact order. You can jump forward, or loop back at any time by just clicking the tab you want. All the steps in the process are always available as tabs. The Sliicer tab system suggests an order for your analysis, but it doesn’t force you to do your work in just one way.

The Sliicer main tab system has six tabs: **Rain**, **Basin**, **Meter**, **RDII**, **Rehab**, and **Model**. A summary of each tab is shown below:



- **Rain** - The Rain tab allows you to review the rain gauge data you are using for the your flow study. It also allows you to choose a rainfall distribution method to assign one or more rain gauges to each meter basin. For more information on the Rain tab, see Chapter 3.
- **Basin** - The Basin tab allows you to set the basin size for each meter basin in either acres, lineal feet, or inch miles. These values are then used to normalize your results to help you make better comparisons of your basins. For more information on the Basin tab, see Chapter 4.
- **Meter** - The Meter tab allows you to view the rainfall and flow traces for each meter, one site at a time. You also use the meter tab to set dry days and storm events, and to calculate the dry and wet weather information you use to complete your study. For more information on the Meter tab, see Chapter 5.

- **RDII** (Rainfall Dependent Inflow/Infiltration) - The RDII allows you to compare the severity of I/I problems of your basins. The comparisons can be normalized by rainfall and basin size if you entered values in the Basin tab. For more information on the Results tab, see Chapter 6.
- **Rehab – This tab is no longer active.**
- **Model** - The Model tab allows you to prepare the results of your flow study for export to various hydraulic modeling programs. For more information on the Model tab, see Chapter 9.

CHAPTER 2

Chapter 2 Common Functions

As you have already seen, Sliicer displays information in two types of screens. Sliicer presents text information in the form of the Engineering Wizard window, which includes a tab system, scrollable lists, drop down lists, and tables, etc. Sliicer presents graphical information in a number of different graphical windows.

At first, learning to manipulating these different windows may seem overwhelming. However, there are a number of common functions for both the Engineering Wizard and the graphical windows.

In this chapter you will learn the common functions for:

Engineering Wizard:

- Tab systems
- Scrollable lists
- Drop down lists
- Tables

Graphical windows:

- Zooming in
- Zooming out
- Panning
- Customizing

ADS Engineering Wizard Functions

Sliicer presents all of its text and numerical information in the Engineering Wizard using a number of different controls, including tabs, scrollable lists, drop down lists and tables. Each of these controls has many things in common with the other controls of its type. The following section explains the common functions of these controls.

Tab Systems

The Sliicer Engineering Wizard uses a lot more controls than it can show on the screen at one time. In order to make the controls more manageable for viewing, Sliicer uses a tab system. In the tab system, controls that work together are grouped into one tab.

The tabs in Sliicer are very simple to operate. You change tabs by simply clicking the mouse on the tab you want.

➔ **To change tabs**

- Click the mouse on the tab you want.

  Sliicer changes to the tab you selected.

Note Several of the tabs have prerequisites. If you have not accomplished the necessary prerequisites before you try to enter a tab, Sliicer will stop you from entering the tab and tell you what to do first.

Scrollable Lists

Sliicer uses Scrollable lists when it doesn't have enough room on the screen to show the whole list. You use the scroll bar to scroll the list.

➔ **To scroll a list**

- Click the up or down arrows in the scroll bar.

  -OR-

  To scroll a list page at a time, click the scroll bar just below the up arrow, or just above the down arrow.

  Sliicer scrolls the list.

Drop-Down Lists

Sliicer uses drop down lists when it wants you to choose just one option from a list, and it isn't important that you see the rest of the list once you have made your choice. Drop down lists look like text boxes with a small down arrow at the right.

➔ **To change the value of a drop down list**

1. Click the down arrow at the right of the drop down list.

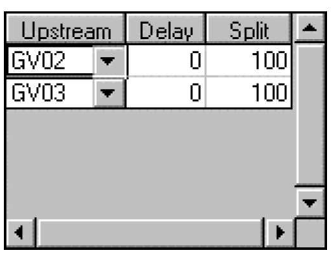
   Sliicer displays more of the list elements. If there isn't room for all the list elements, it also displays a scroll bar.

2. Scroll the list to find the element you want.
3. Double-click the element you want.

   Sliicer closes the drop down list and sets it to the element you selected.

Tables

Sliicer uses a number of tables to display text and numerical information. Some of the tables support data entry in all fields, some support data entry in several fields and some are for information reporting only. Tables that support data entry use the common functions shown below.



Adding and Deleting Rows

➔ **To add the first new row to data entry tables**

- Double click the table header.

  Sliicer adds the first new row to the table.

➔ **To add subsequent rows to data entry tables**

1. Select a cell in the last row of the table.
2. Press the down arrow ↓ key.

   Sliicer adds a new row to the table.

➔ **To delete rows from data entry tables**

1. Select any cell in the row you want to delete.
2. Press the Del key on the keyboard.

   Sliicer deletes the row in the table.

Entering Data

➔ **To update information in data entry tables**

1. Double click the cell you want to change.
2. Enter the new value.
3. Press the **Enter** key on the keyboard.

   -OR-

   Change cells.

   Sliicer updates the table with the new information.

Date Fields

A number of Sliicer tables contain date fields. You can edit date fields using edit mode or calendar mode.

Note If a date field does not support these functions, it is not editable.

➔ **To edit date fields using edit mode**

1. Double click the date field to put it in edit mode.

   Up and down arrows appear at the right side of the date cell.

2. Click on the month, day or year you want to change.
3. Type the new value.

   -OR-

   Use the up and down arrows to change the value.

➔ **To edit date fields using calendar mode**

1. Double click the date field to put it in edit mode.

   Up and down arrows appear at the right side of the date cell.

2. Double click the date field again to display the calendar.

   The calendar appears.

3. Select the date you want from the calendar.

   Sliicer updates the date field with the date you selected.

Column Width

You can increase or decrease the width of table columns using the mouse.

➔ **To change a table column width**

1. Place the mouse cursor between the column headers you want to change.

   Sliicer displays the →| |← symbol.

2. Click and drag the mouse to the new column.

   Sliicer updates the column width

Graphical Window Functions

One of the main purposes of Sliicer is to allow you to visualize your flow and rain data. Sliicer does this by presenting the flow and rain data in graphical windows that correspond to the current tab of the Engineering Wizard. For example, when the Rain tab is current, you can display rain data in a graphical window. When the Meter tab is current, you can display flow data.

Common Graph Functions

Although the content of the various graphical windows is different, many of the functions are the same. Zooming in and out are a primary example. In addition to zooming, panning, customizing and printing are also the same for all graphical windows.

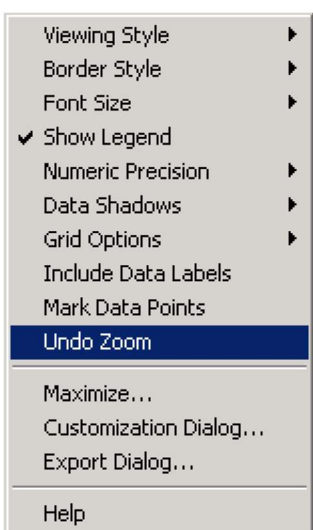
➔ **To zoom in**

1. Make sure the graphical window you want to zoom is current.
2. Hold the shift key down.
3. Drag a rectangle with the mouse over the region you want to zoom.

   The graph is updated to the zoomed region.

➔ **To zoom out**

1. Make sure the graphical window you want to zoom is current.
2. Right click the mouse.



   The graph pop-up menu appears.

3. Choose Undo Zoom in the menu.

   The graph returns to its un-zoomed state.

➔ To pan a graphical window

1. Zoom in on a graphical window.

   A scroll bar appears at the bottom of the graphical window.

2. Click the right and left scroll arrows to pan the direction you want.

   -OR-

   If you want to scroll a page at a time, click in the scroll bar just to the right of the left scroll arrow, or just to the left of the right scroll arrow.

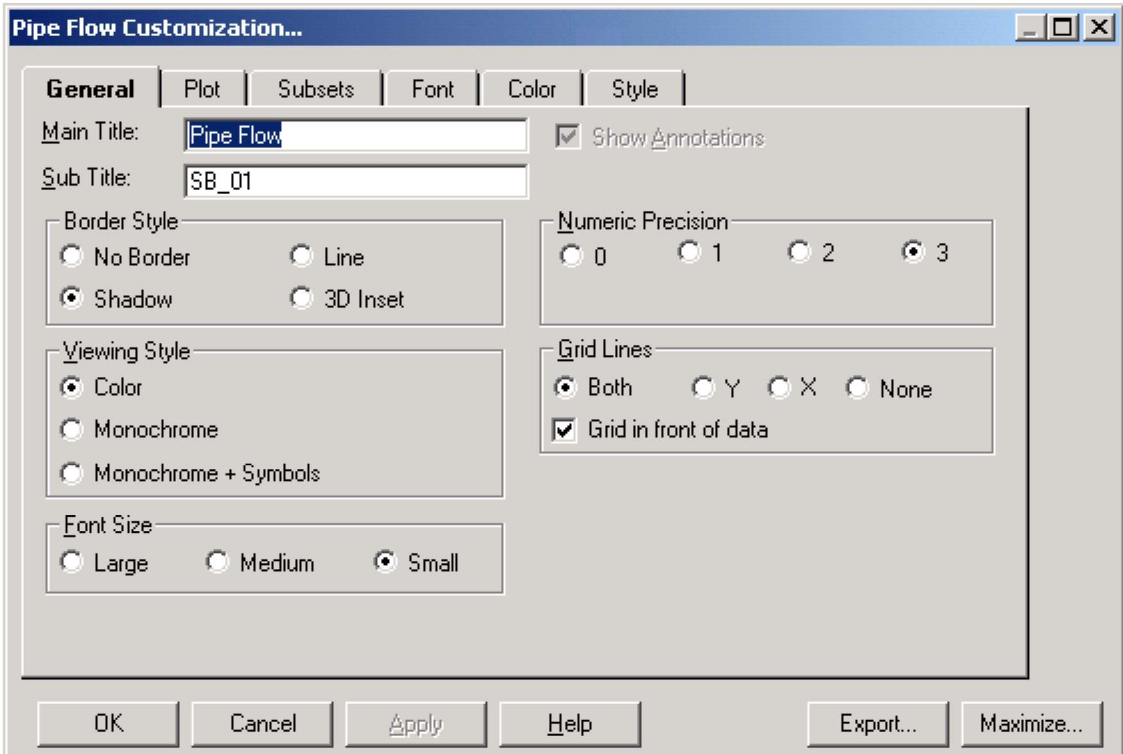
   Sliicer scrolls the graph in the direction you selected.

➔ To customize a graphical window

1. Click the right mouse button on the graphical window you want to customize.

   The graph menu appears.

2. Select Customize Dialog.



The Graph Customize dialog appears.

3. Modify the settings you want to change.
4. Click the OK button.
5. Sliicer applies the changes to the graph.

Note The Customization dialog includes its own help system. Use customization help to find out more about the settings in the customization dialog.

C H A P T E R 3

Chapter 3 Rainfall

Rainfall is the engine that drives or creates all I/I. Because of this, understanding rainfall patterns is critical to analyzing the consequent distribution of I/I. ADS recommends rain gauge density of at least one rain gauge per two square miles. ADS also recommends a minimum of two rain gauges, even for very small basins, in case one fails. Rain gauges should be set to record rainfall accumulation at least once every five minutes, or perhaps even more frequently. Without good rainfall data, you can’t properly interpret wet weather basin performance.

The Rain tab allows you to view the data from the rain gauges you plan to use in your study. The Rain tab also calculates composite rain traces for each meter.

This section explains how to use the Rain tab. In this chapter you will learn how to:

- View rain data
- Clear rain data
- Block any rain data that appears to be invalid and that you don't want to include in the study
- Choose a rain distribution method to develop a composite rain trace for each meter

Understanding the Rain Table

When you enter the Rain tab, Sliicer displays the rainfall distribution information in the Rain Table. The rows of the Rain Table represent the meters. The columns of the Rain Table represent the rain gauges. Each cell in the table displays an aspect of the weight relationship between a meter and a rain gauge for the current rainfall distribution method.

Viewing Rain Data

Sliicer allows you to view data from one or more rain gauges. You can display the data from each gauge in a different color so you can compare rain gauge response for a particular rain event.

Plotting Rain Gauge Data

You can plot any of the rain gauges listed across the top row of the Rain Table. You use the color buttons and the clear button in the top right part of the Rain tab to plot rain gauges.

➔ **To plot rain gauge data:**

1. Right click the mouse on any cell in the column of the rain gauge you want to plot

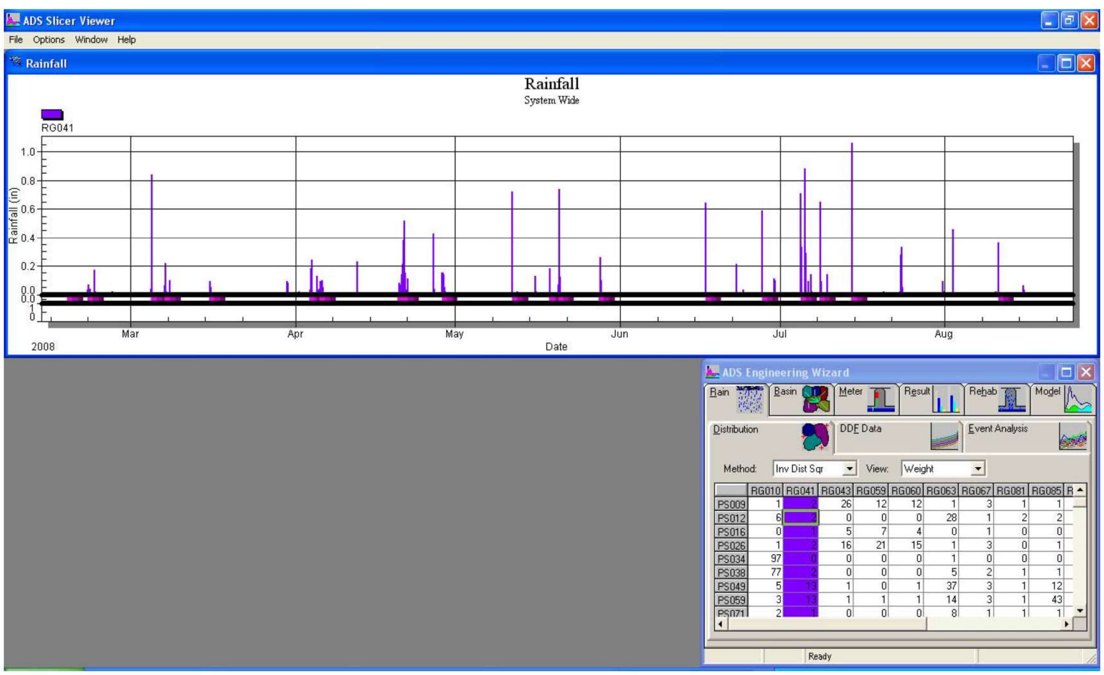
   

   The Rainfall Plot menu appears.

2. Click Plot.

The Sliicer Color dialog appears

3. Select the color you want to use to plot the rain gauge.
4. Click OK.



The Rainfall window appears at the top of the screen with the rain data plotted in the color you selected. The background of the rain gauge column in the spread sheet also changes to the same color.

Clearing a Rain Gauge

You can clear specific gauges from the Rainfall Window, either one at a time, or in groups.

➔ **To clear a rain gauge:**

1. Right click the mouse on any cell in the column of the rain gauge you want to clear.

The Rainfall Plot menu appears.

2. Click Clear.

   Sliicer clears the selected rain gauge from the Rainfall graph.

Ignoring Rainfall Data

The main reason that the rain tab allows you to compare rain gauges is to determine if there are any problems with the rain data. One of the best ways to find problems with rain gauges is to compare their data with other rain gauges. If you notice problems, you can ignore the bad days of rain data without throwing the whole rain gauge out of the study.

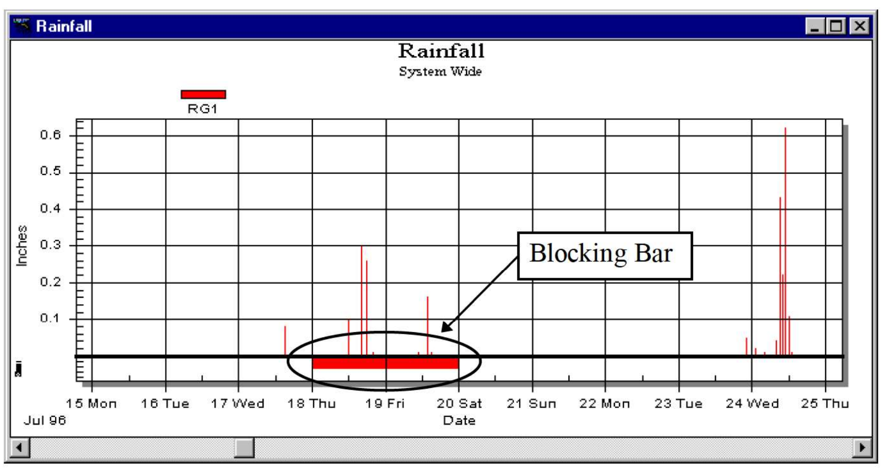
There are two ways to block rainfall data: by selecting the column and dragging the mouse in the graph area, and by dragging the mouse in the blocking bar area.

Blocking Rainfall by Selecting the Rain Gauge Column

Blocking rainfall by selecting the rain gauge column, and dragging the mouse in the graph area is the easiest way to make sure you are blocking rain for the rain gauge you specify.

➔ **To block rainfall data by selecting the rain gauge column:**

1. In the Rain Table, select any cell in the column of the gauge you want to block.
2. Drag the days you want to block with the mouse in the plot (upper) region of the Rainfall window.
3. Release the mouse button.



The blocked days will be shown by a blocking bar below the rainfall trace.

➔ **To undo blocked rainfall data:**

1. Select any cell in the spread sheet in the column of the rain gauge for which you want to undo the rainfall block.
2. Starting with a blocked day, drag the days you want to undo with the mouse in the plot (upper) region of the Rainfall window.
3. Release the mouse button.

   The blocked range in the status region of the rainfall window will be modified.

Blocking Rainfall by Dragging the Mouse in the Blocking Bar Area

You can also block rainfall by dragging the mouse in the blocking bar area. When you block rainfall by dragging the mouse in the blocking bar area, Sliicer figures out which rain gauge to block by the location of the mouse pointer when you first clicked in the blocking bar area. Blocking rainfall by dragging the mouse in the blocking bar area is a more direct way of blocking rainfall, because you don't have to select the rain gauge column first, and you can adjust which

➔ **To block rainfall dragging the mouse in the blocking bar area:**

1. Click and hold down the left mouse button on the day you want to start blocking at the same level in the blocking bar as other blocked days for the rain gauge you want to block.
2. Drag the days you want to block and release the mouse.

   Sliicer will mark the days as blocked in the blocking bar.

➔ **To undo blocked rainfall dragging the mouse in the blocking bar area:**

1. Click and hold down the left mouse button on the day you want to remove from blocking with the tip of the mouse pointer in the blocking bar.
2. Drag the days you want to remove from blocking and release the mouse.

   Sliicer will unmark the days as blocked in the blocking bar.

Distributing Rainfall

Another important function of the rain tab is to allow you to choose a rainfall distribution method. A rainfall distribution method is the way you weight the data from each rain gauge for a particular basin. Each meter basin is closer to some rain gauges than to others. The closer a rain gauge is to a meter basin, the more weight it should be given. Different weights can be assigned to the same rain gauge for different meters, because the rain gauge is closer to some meters than others.

Sliicer supports several different ways to weight rain gauges. The Inverse Distance and Inverse Distance Squared methods require the presence of a table of distances between the centroid of each sewer shed to each rain gauge. A project of 12 meters and 4 rain gauges would require at table of 48 distances. The table should be in the following format and should be submitted to ADS for importing into the Sliicer.com Flowload.

BASIN	RAINGAUGE	DISTANC E
SITE01	RG01	13316
SITE02	RG01	3873
SITE03	RG01	9256
SITE04	RG01	10338
SITE05	RG01	5783
SITE01	RG02	20966
SITE02	RG02	18077
SITE03	RG02	15120
SITE04	RG02	7588

Understanding Composite Rain Traces

Sliicer uses the weights shown in the rain table to calculate a composite rain trace for each meter. A composite rain trace is a rain trace that is derived from more than one rain gauge. The composite rain trace combines the data from the component rain gauges according to their weights to develop a custom rain trace for each basin.

Different rainfall distribution methods use different approaches to assign weights to the rain gauges. However, when it comes to calculating the composite rain trace, only the weights are considered, regardless of the method used to derive them. This means that Sliicer can use the results of any approach to distribute rainfall, because you can enter rainfall weights that represent the results of any rainfall distribution method you choose.

Selecting a Rainfall Distribution Method

You use the Method drop down list to select the rainfall distribution method. Sliicer supports three different rainfall distribution methods: User Defined Weights, Inverse Distance, and Inverse Distance Squared.

Note Much of the analysis work that Sliicer does in the Meter tab is based on the rainfall information. Each change you make to the rainfall distribution method affects the I/I analysis, and requires re-calculation for all meter sites. Therefore, to avoid wasted work, you should make every effort to settle on a rainfall distribution method before you invest much time in adjusting your I/I calculations in the Meter tab.

User Defined Weights

User Defined Weights allows you to specify any weight relationship between the meters and rain gauges you want. You can use this method to approximate direct assignment or any other distribution method.

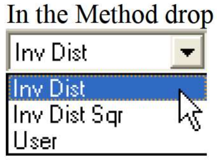
Inverse Distance

The Inverse Distance method assigns weights to the rain gauges for each meter basin based on the distance from the centroid of a meter basin to each of the system rain gauges. In this method, all rain gauges are used for each meter, but the closest rain gauges are given the most weight.

The Inverse Distance Method requires the calculation of the distance between every rain gauge and every meter basin centroid.

➔ **To select a rainfall distribution method**

1. Make the Rain tab current
2. In the Method drop down list, select the method you want.



Sliicer updates the cells in the Rain Table to reflect the method you selected.

Selecting a Rainfall View

When you use the Inverse Distance or Inverse Distance Squared rainfall distribution methods, Sliicer can display several different views of the relationship between each rain gauge and meter. You use the View drop down list to change the rainfall view. The view options are different for each rainfall distribution method.

The User Defined View

There is only one view supported for the User Defined distribution method. This is the weights themselves. In the user defined view, you can enter any weight values you want into the Rain Table cells.

Inverse Distance Views

When you use the Inverse Distance method, Sliicer allows you to look at three points in this derivation process:

Distance Displays the actual distance between each rain gauge and the centroid of each meter basin (in feet)

1/Dist Displays the inverse of this **Distance** (actually displays 1000/Dist to reduce the number of leading zeros for easier viewing).

Weight The percentage of influence each rain gauge has for a meter basin.

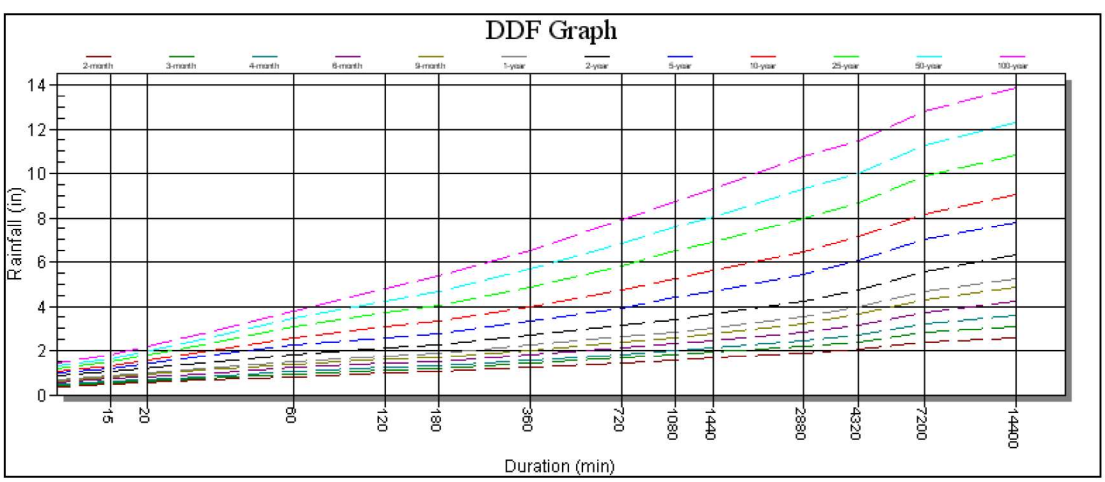
DDF Data

Sliicer allows you to input depth-duration-frequency (DDF) data so you can plot DDF curves. After you input DDF data, Sliicer can also use the DDF data to evaluate your rain events and give you feedback on the statistical frequency for each of your actual rain events. One of the main uses for this analysis is to determine if you have encountered enough significant rainfall events to satisfy the requirements for the purpose of your flow monitoring project. The DDF data, combined with Sliicer's rain event analysis feature helps you determine when enough significant rain events have been encountered to satisfy the requirements of your study.

Understanding DDF Data

DDF data is a compilation of the statistical analysis of the long term history of rainfall events for a given geographical location. The DDF compilation is represented as a set of intensity-duration numbers for a given statistical return period known as the frequency. For example for the five year return period, or frequency, the intensity for a storm of one hour in duration might be 2.0 inches of rainfall. What this means is that, on average, a storm with greater than 2.0 inches of rainfall in one hour occurs only once every five years. Again at the five year frequency, the intensity for a storm with a 30 minute duration might be 1.2 inches of rainfall. This would mean that a storm with more than 1.2 inches of rainfall in 30 minutes occurs on average only once every 5 years. The set of order pairs composed of intensity-duration numbers can be graphed to form an intensity-duration curve.

Usually, however, in a complete set of DDF data, sets of intensity-duration numbers are provided for a number of different return periods or frequencies. Often, values for return periods varying from 2 months to 100 years may be provided. The data for these three variable, intensity, duration and frequency therefore form a three dimensional space. Since it is difficult to represent three dimensional data graphically in two dimensions, DDF data is usually displayed as a family of two dimensional curves. Duration is plotted on the x-axis, intensity on the y-axis, and a different curve is plotted for each frequency, as shown below.

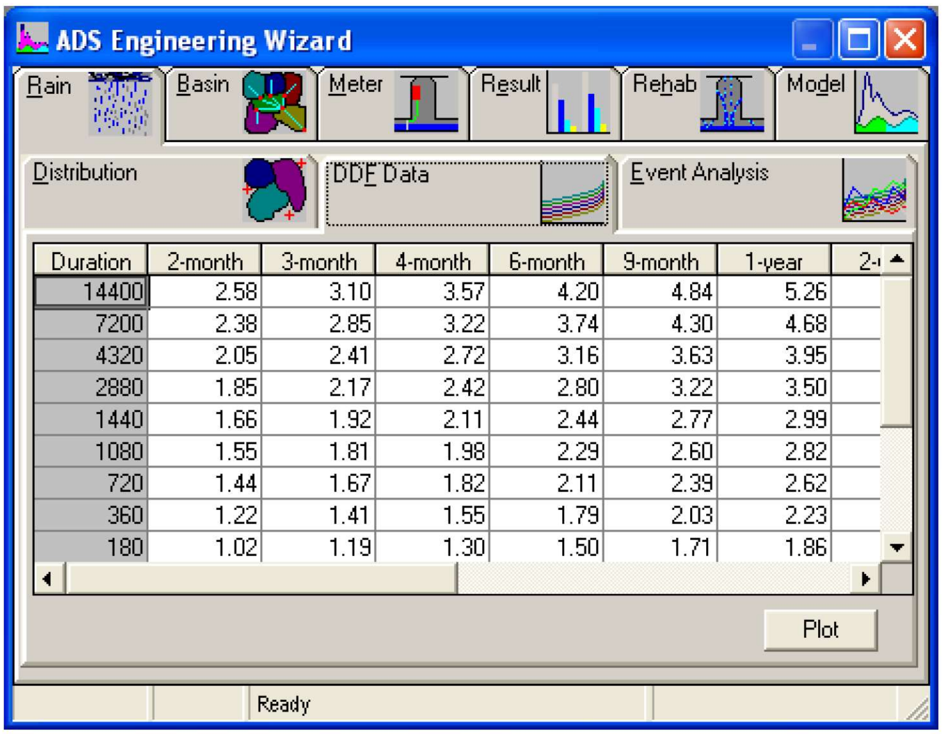


Entering DDF Data

Sliicer allows you to enter DDF data for the geographical area of your flow study. Before you can enter DDF data, you must locate DDF data for you area. Organizations such as the Midwestern Regional Climate Center in Illinois have published DDF data for some areas of the country. If publications such as these are not available for your area, you may be able to obtain DDF data from local city or county government. Check with the department that handles storm water design issues to see what DDF data they recommend for the area.

➔ **To enter DDF data**

1. Find DDF curves or tables for the geographical area of your study.
2. Make sure the Rain Tab is current.
3. Select the DDF data sub tab.



The DDF data entry spread sheet appears.

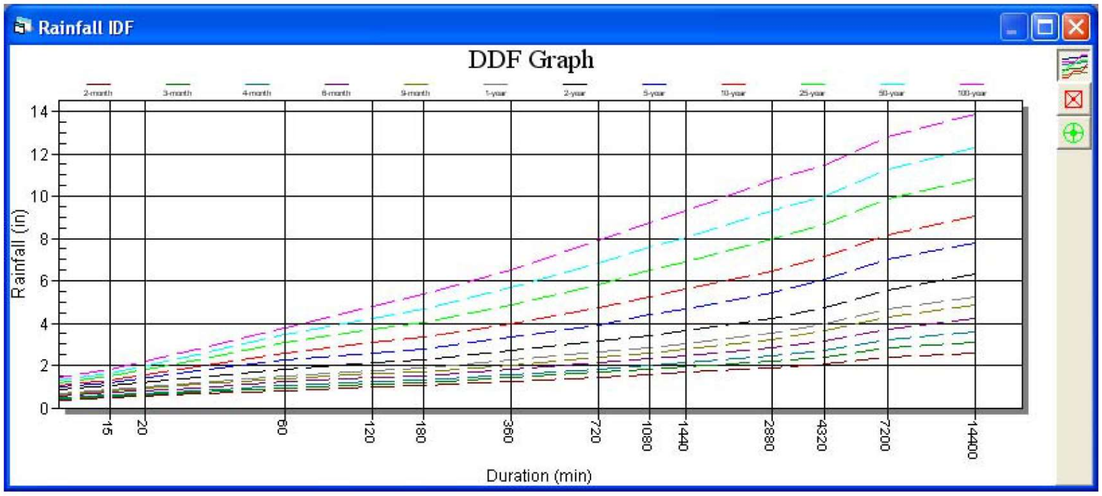
4. Enter the intensity values for each duration and frequency for which you have obtained data.

Plotting DDF Data

Once you have entered DDF intensity values into the DDF spread sheet, you can plot the family of intensity-duration curves. Plotting DDF data gives you a visual display of you data, and allows you to quickly find any data entry errors. It also becomes the background for the event analysis features described in the next section.

➔ **To plot DDF data**

1. Make sure the rain tab and DDF Data sub tab are current
2. Make sure you have entered DDF data in the DDF spread sheet
3. Click the Plot button



The DDF graph appears in the Rainfall DDF window.

Rainfall Event Analysis

Once you have entered DDF data for the geographical location of your flow study, you can use this data to analyze the actual rainfall events that occurred within the study period. The analysis of your rainfall events gives you a frequency for each storm event for each duration, up to the maximum duration of the storm event, or the maximum duration entered in the DDF data spread sheet, whichever is smaller. By reviewing this information, you can determine if the rainfall events encountered in your study period are large enough to satisfy the requirements of your study, or if you should leave the monitors in the ground longer to collect data for additional storms. You can even perform this analysis on preliminary flow data to enable you to analyze the rainfall events and make necessary decisions before the monitors and rain gauges are pulled.

Understanding Rainfall Event Analysis

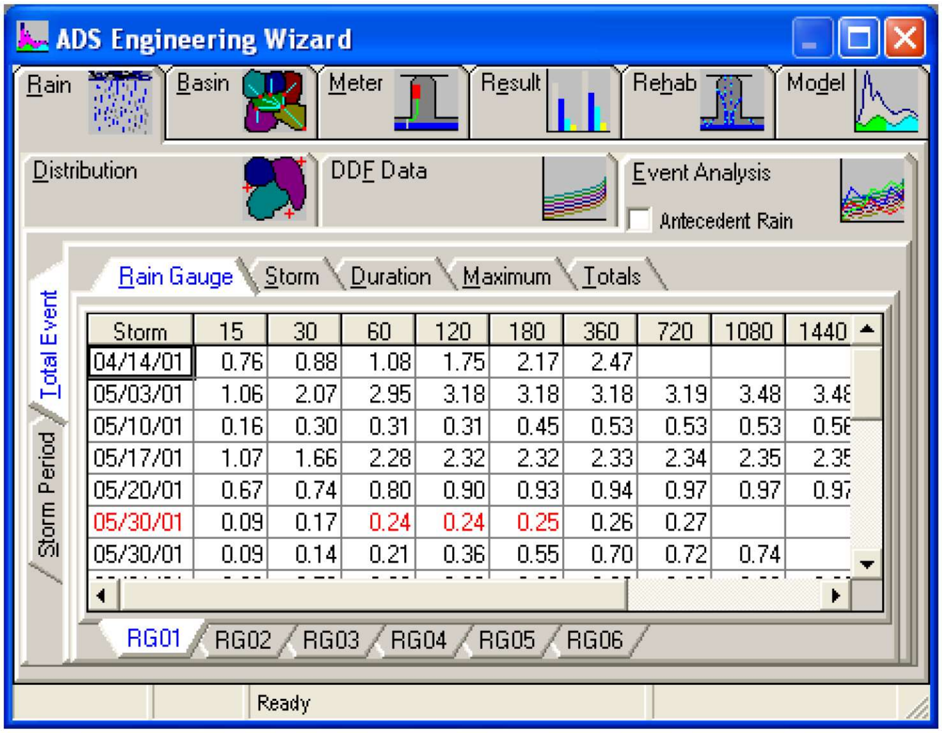
The Sliicer Rainfall Event analysis feature analyzes each rainfall event to determine the maximum intensity for each duration listed in the DDF data tab up to the maximum duration of the event. It does this by sliding a duration window through the event one rain tick at a time, and summing all the rainfall that falls within that window. When Sliicer is done sliding the window through the rain event, it then records the maximum intensity for the duration window as the intensity for that particular duration. Sliicer then increases the duration window and repeats the process until a maximum intensity had been determined for each duration up to the maximum duration of the rain event.

Viewing Rainfall Event Analysis Results

Sliicer accomplishes rainfall event analysis automatically whenever you start the program. You can view the results of this analysis in the Event Analysis tab. The Event Analysis tab lets you look at the results of the analysis in a number of different ways. Because there are so many different options in the Event Analysis tab, it will be helpful to use a model to guide to knowing what you are looking at.

First remember that DDF values map to a three dimensional space. Also note that a normal spread sheet, such as the one shown in the DDF Data tab is adequate to display three dimensional data. But, although the frequency dimension drops out of the rainfall event analysis, an additional two dimensions are added because intensity values for each duration are calculated for each storm for each rain gauge. This brings the total number of dimensions for the rainfall event analysis results to four: (1) intensity, (2) duration, (3) rain gauge, and (4) storm. In addition, these values are calculated for both the storm period, and for the total event period, which includes the storm period, and the R1 and R2 recovery periods. Therefore, it is impossible to display all the rainfall event analysis results on a single spread sheet, because a normal spread sheet is limited to three dimensions.

In order to view the event analysis results in a spread sheet, it will be necessary to fix two of the variables, so the other three can be displayed in a single spread sheet. In order to accomplish this, three tab systems have been added to the event analysis results spread sheet, one above, one on the left, and one below. The top tab allows you to select the variable you want to fix so you can view the other three in the table. The left tab allows you to choose between analysis values for the storm period only, or for the whole event. The bottom tab allows you to select and change the value of the variable you want to hold constant.



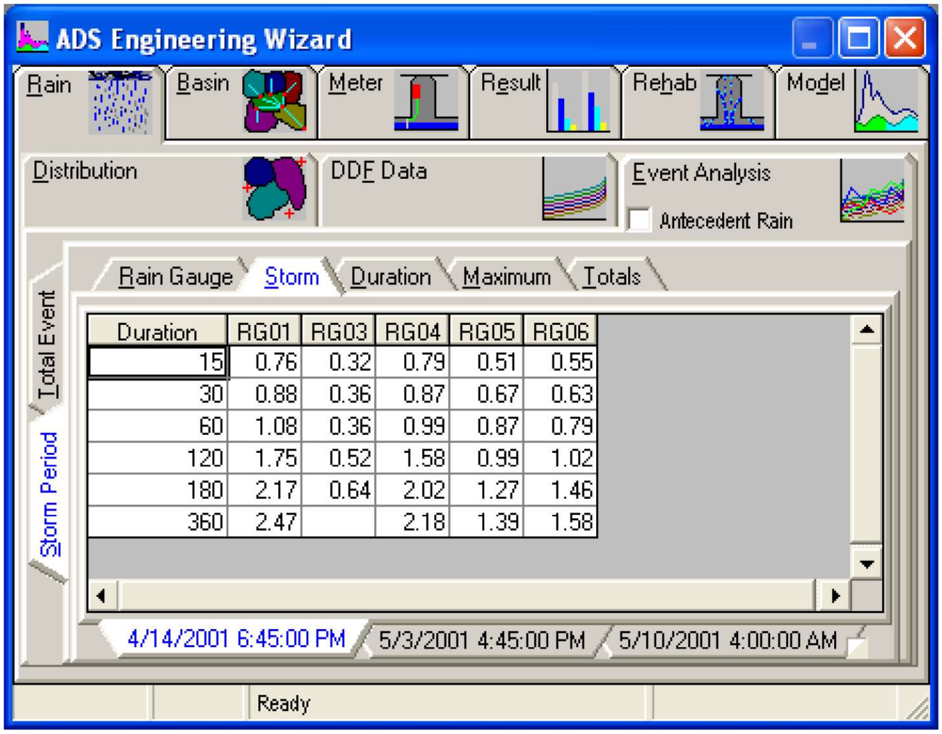
As shown above, the top tab can be set to fix either the rain gauge, the storm or the duration (the Maximum setting will be discussed later). For each of the first three settings of the top tab, (Rain Gauge, Storm or Duration) various arrangements of intensity values will be displayed.

Viewing Results for Each Rain Gauge

If the top tab is set to Rain Gauge, then the bottom tab will list all the available rain gauges. When you select a rain gauge on the bottom tab, you will see a spread sheet of the intensity values for each storm for each duration for the rain gauge you selected. You can view a different intensity, duration, storm spread sheet for each rain gauge.

Viewing Results for Each Storm

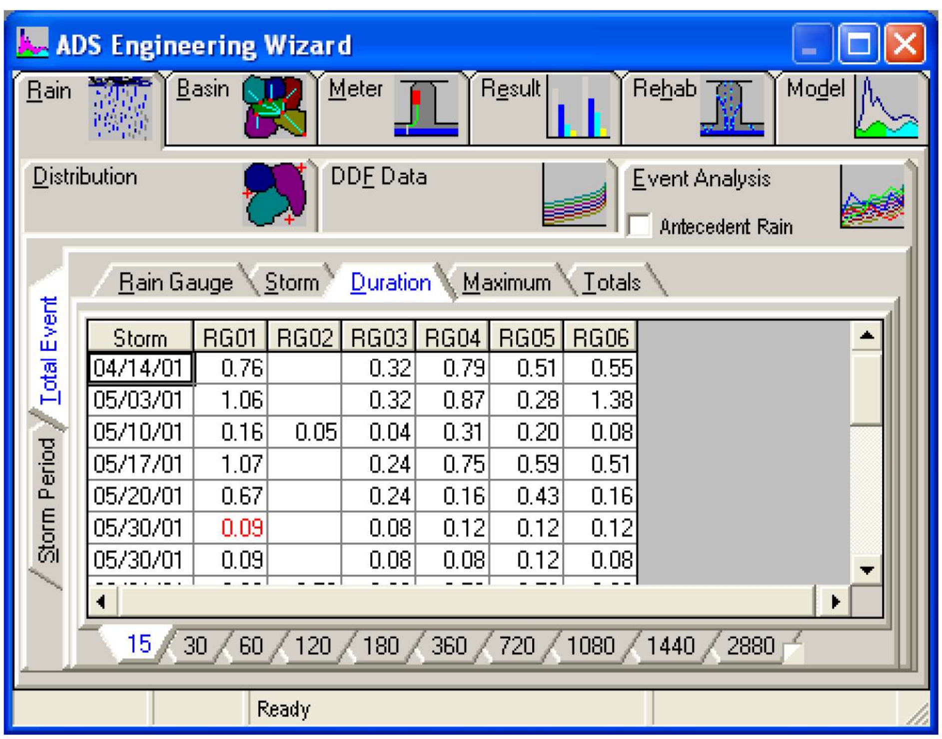
When you set the top tab to Storm, the bottom tab will display each of the storm events. When you select a storm from the bottom tab, you will see a spread sheet of intensities for each rain gauge for each duration for the storm you selected, as shown below:



When you select a different storm you will see a different intensity, duration, rain gauge spread sheet for the storm you selected.

Viewing Results for Each Duration

In the same way, when you select the duration variable in the top tab, the bottom tab will be loaded with all the different duration values. When you select a duration value, you will see a spread sheet of intensities for each storm and each rain gauge for the duration you selected on the bottom tab as shown below:



When you change the duration on the bottom tab, you will see the intensities for each rain gauge and storm for the duration you selected.

Viewing Results for Maximum Frequency

When you set the top tab to the Maximum setting, Sliicer shows you different attributes of the maximum frequency for all durations for each storm for each rain gauge. When you use the maximum setting, the bottom tab allows you to select the attribute of the maximum intensity you wish to see. You have four choices: (1) intensity, (2) duration, (3) frequency, and (4) summary, which shows a combination of intensity - duration and frequency.

Viewing Results for the Duration of Total Rainfall

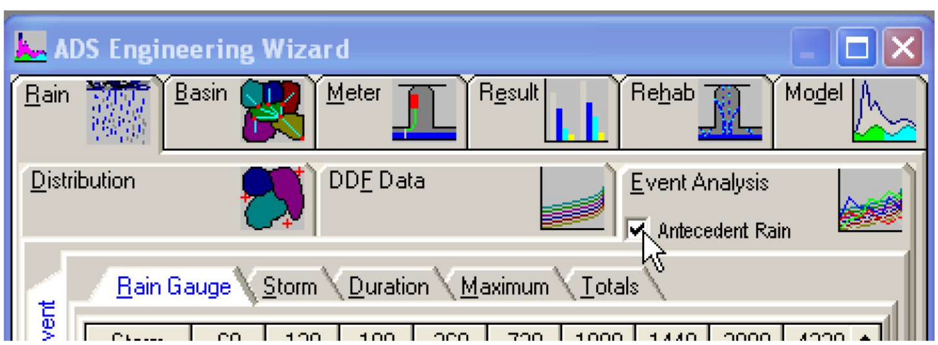
When you set the top tab to the Total setting, Sliicer shows you the calculation of all rainfall within the specified period (storm period only or total event, including the R1 & R2 recovery periods), and the duration of time from the first rain tick to the last rain tick within the specified period. When you view the total calculation, the bottom tab allows you to select the attribute of the total you wish to see. You have three choices: (1) total rain depth, (2) exact duration of rainfall, and (3) summary, which shows a combination of total rain depth and exact duration of rainfall.

Antecedent Rainfall

Sliicer allows you to optionally include 10 day of ancecedent rainfall in the rainfall analysis calculations.

➔ **To include antecedent rainfall in rainfall analysis results**

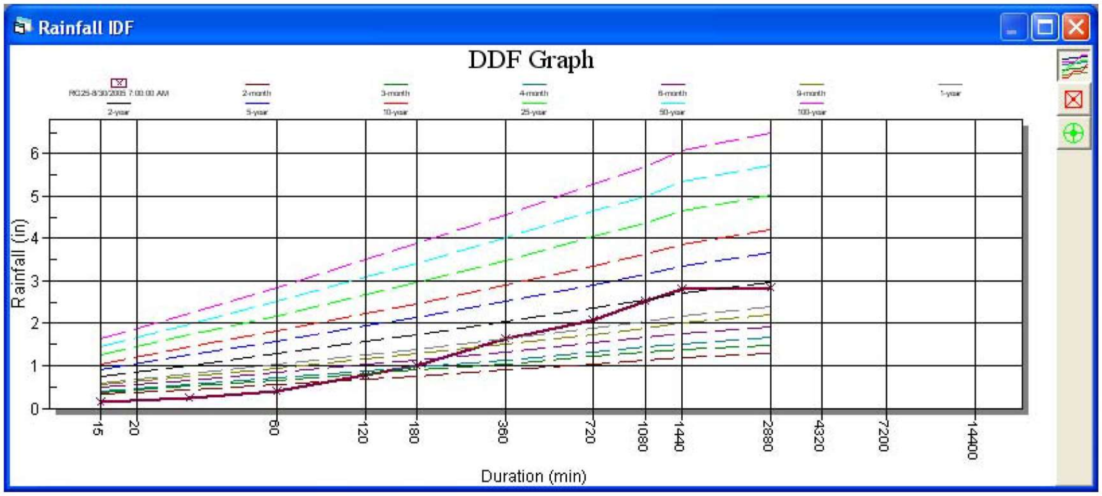
1. Make sure the Rain tab and the Event Analysis sub-tab is selected.
2. Check the Antcedent Rain checkbox in the Event Analysis sub-tab.



Sliicer recalculates the rainfall analysis including 10 days prior to the start of the storm, and refreshes the rainfall analysis tables, and graphs.

Plotting Rainfall Event Analysis Results

In addition to displaying the numeric results of the rainfall event analysis in spread sheet form, Sliicer can also plot these results on the DDF graph. When Sliicer plots the rainfall event analysis results on the DDF graph, it plots the maximum intensity values for each duration for each storm event. Sliicer marks the intensity points, and connects all the intensity values for one storm with a line. The line helps you quickly visualize which intensity points belong to the same storm. The line will usually cross some of the intensity duration curves, making it easy to see which intensity value has the greatest frequency, as shown below:



In the above graph, the intensity values for the storm at 8/30/05 7:00 am for RG25 are plotted as bright pink X's with a connecting thick bright pink line. From this graph it is easy to see that the durations with intensity values of the greatest frequency are the 1440, 2880 and 4320 min durations. When the storm was analyzed at the 1440 and 2880 min durations, the frequencies nearly reached the two year level. When the storm was analyzed at the 4320 min duration, the frequencies reached the ten year level. Thus, we could conclude that this storm exceeded two year frequency level for both the one to two day durations and reached the ten year frequency for the three day duration.

You can plot rain event analysis results from any one of the rain event analysis spread sheet views. When you plot a rain event, the background color for the cell or cells for that particular rain event will be changed to the color you select for plotting the rain event.

➔ **To plot rainfall analysis results**

1. Make sure the Rain tab and the Event Analysis sub-tab is selected.
2. Right click a cell in the rain event analysis spread sheet for the storm and rain gauge you want to plot with the mouse.

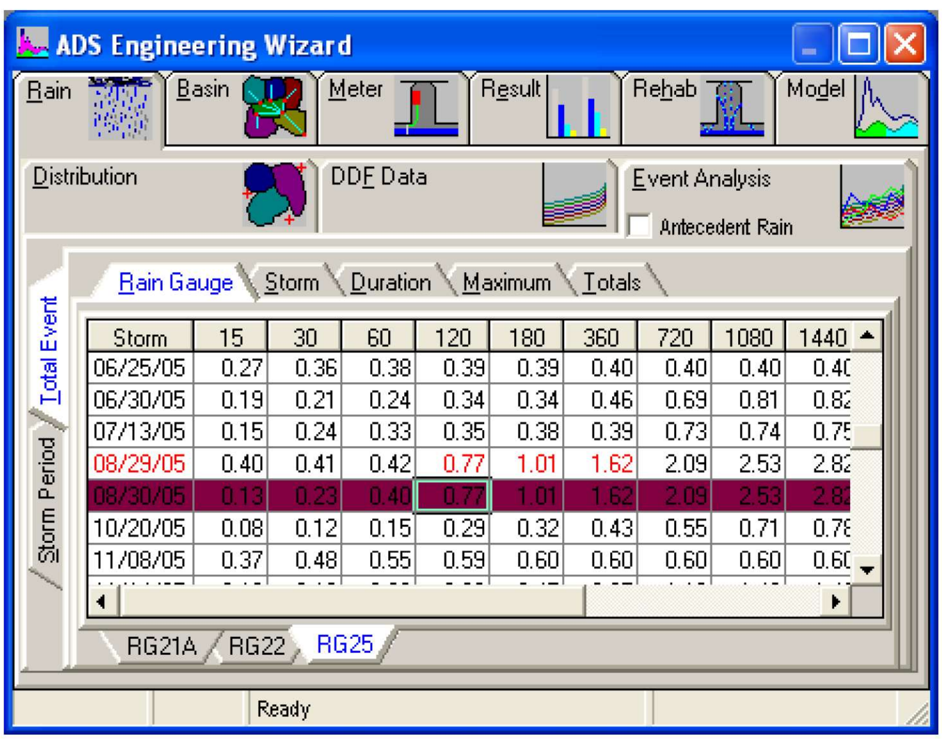
   

   The Rain Analysis menu appears.
3. Click Plot.

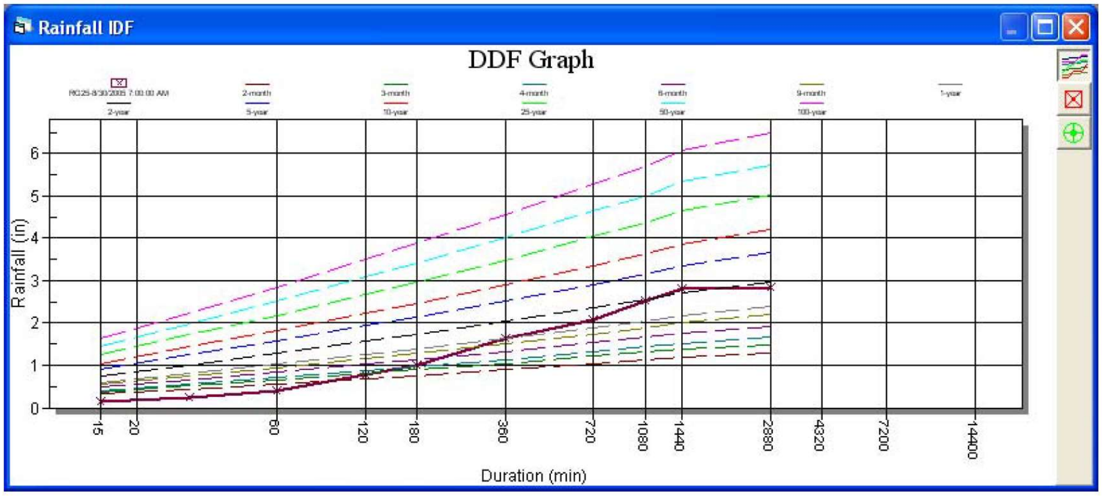
The Color dialog appears.

4. Select the color you want, and click the OK button.

   Sliicer changes the cell background color to the color you selected.



Sliicer also plots the intensity values for the storm and rain gauge on the DDF graph.



As shown above, Sliicer connects each intensity-duration point for a single storm and rain gauge with a line.

➔ **To clear rainfall analysis results**

1. Make sure the Rain tab and the Event Analysis sub-tab are selected.
2. Right click a cell in the rain event analysis spread sheet for the storm and rain gauge you want to clear with the mouse.

The Rain Analysis menu appears.

3. Click clear.

Sliicer clears the background color of the cell, and deletes the intensity values from the DDF graph.

➔ **To clear all rainfall analysis results**

1. Make sure the Rain tab and the Event Analysis sub-tab are selected.
2. Right click the mouse on any cell in the event analysis spread sheet.

The Rain Analysis menu appears.

3. Click clear.

Sliicer clears the background color of the cells and deletes the intensity values from the DDF graph for all rainfall analysis events that are currently plotted.

Plotting the Rain Total and Actual Duration on the Graph

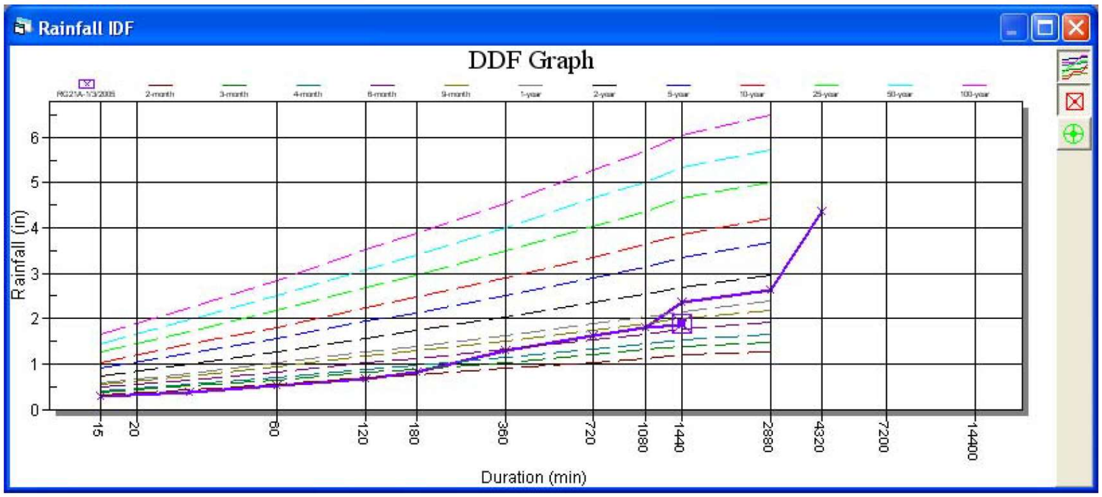
Sliicer allows you to view the Rain Total and the Actual Duration for each storm for both the storm period and for the total event.

➔ **To plot the rain total and actual duration for the storm period.**

1. First, plot the rainfall analysis results as described above.

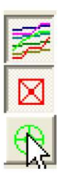
2. At the right side of the rain analysis graph, click the button with the red box. The tool tip text says "Rain total and max duration for Storm Period."

A box with an "x" inside appears on the graph at the point of the total rain and max duration within the storm period for each storm plotted in the same color used to plot the storms.

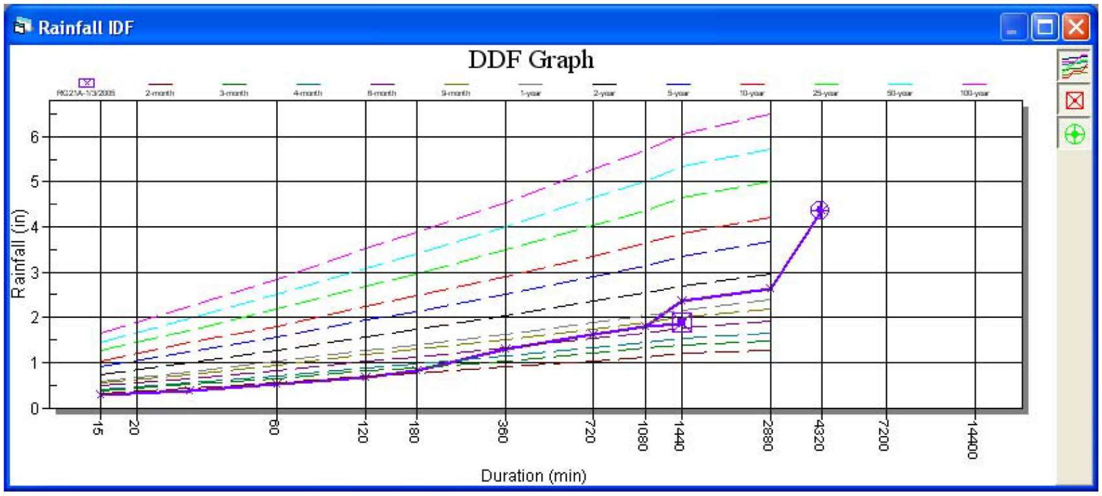


➔ **To plot the rain total and actual duration for the total event.**

1. First, plot the rainfall analysis results as described above.
2. At the right side of the rain analysis graph, click the button with the red box. The tool tip text says "Rain total and max duration for Total Event."



A circle with a cross inside appears on the graph at the point of the total rain and max duration within the storm period for each storm plotted in the same color used to plot the storms.



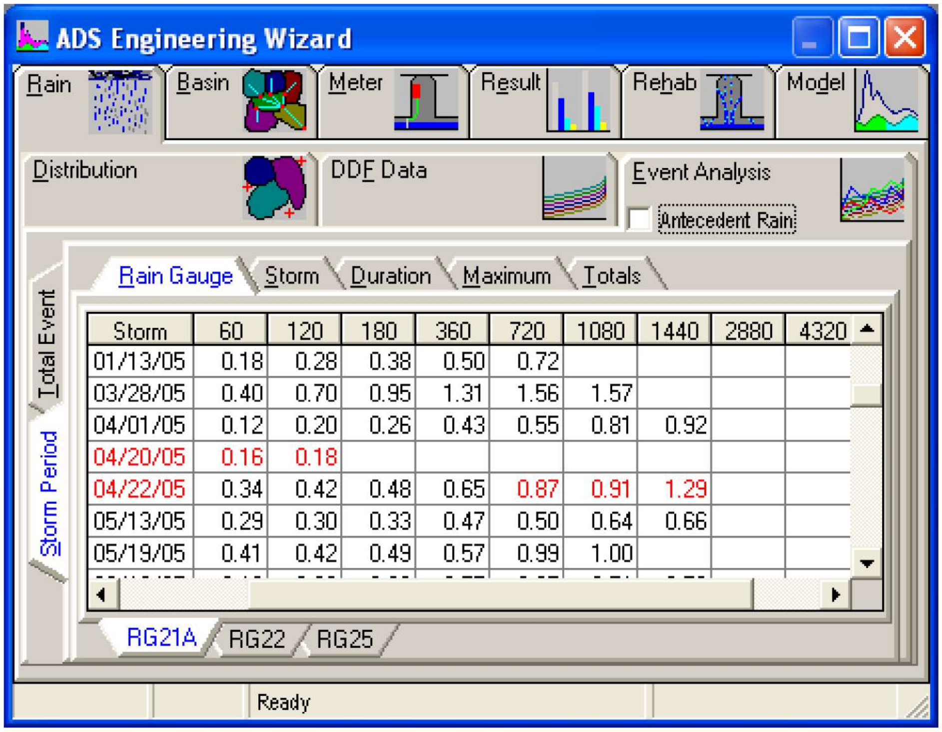
Viewing Differences between the Storm Period and Total Event

Sliicer flags values in the rain analysis that are different for the storm period and the total event by displaying these values in red. Sliicer markes a rain analysis value in red whenever the difference between the rain analysis calculations for the storm period and the total event are greater than 0.1 inch. For most analysis purposes, the rain analysis values should be the same for the storm period and the total event. When they are different, they indicate that a significant amounts of rainfall occurs within the recovery periods after the storm period. This means that the user should consider changing the length of the storm period so that all the significant rainfall occurs within the storm period. To view the differences for rain analysis values between the storm period and the total event, select the value of the tab at the left margin to the value you want to see.

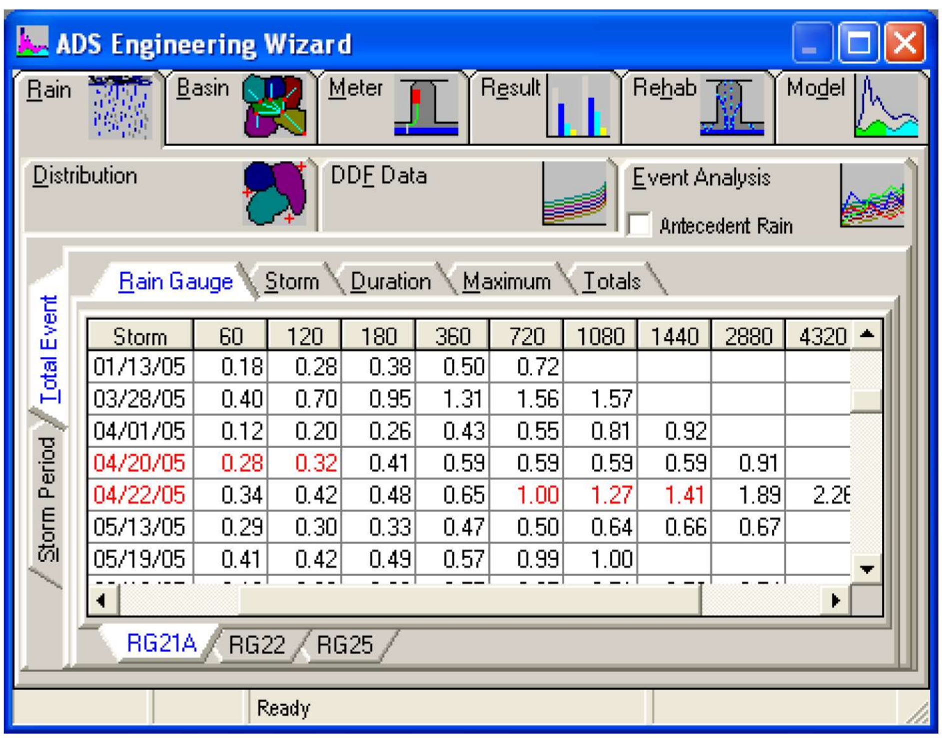
➔ **To view the differences for rain analysis values between the storm period and the total event.**

1. Make sure the rain analysis tab is current.
2. Select the value of the tab at the left margin to the value you want to see, either “Storm Period,” or “Total Event.”

Storm Events:



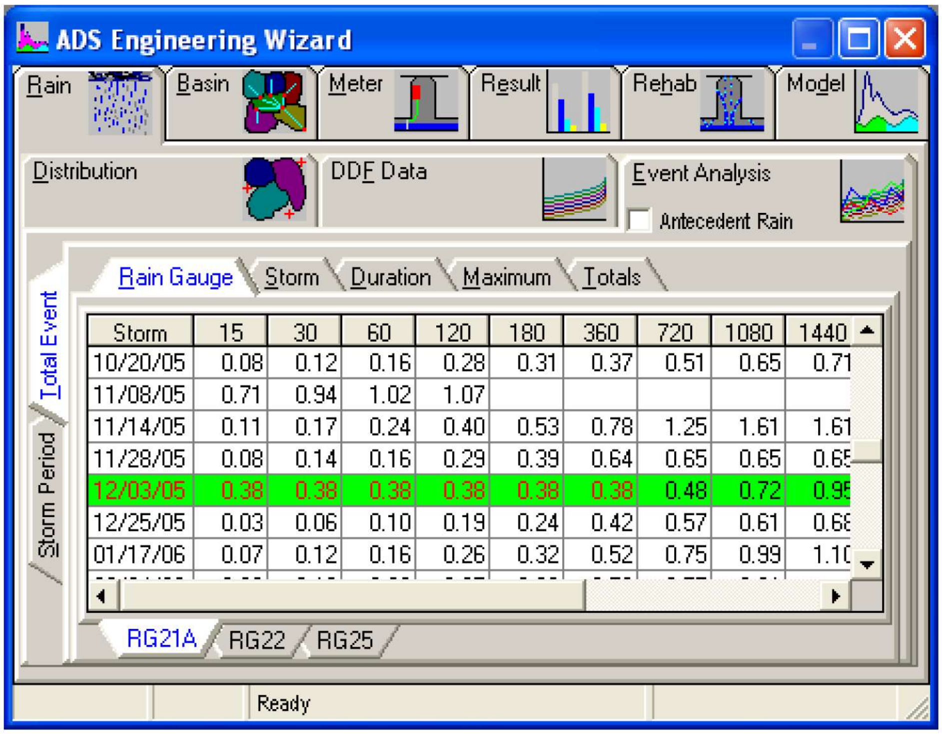
Total Event:

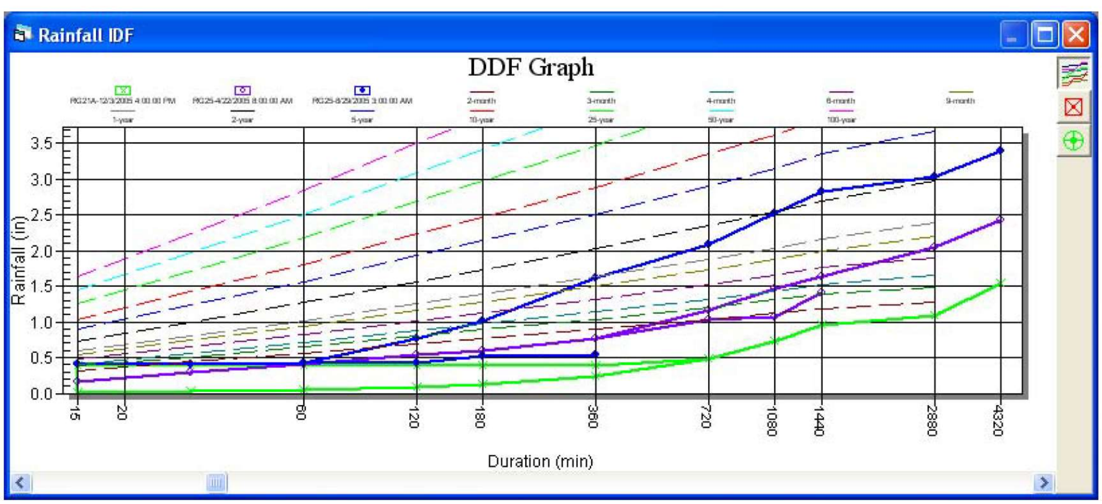


Notice that the values in red are different in the two figures shown above, whereas those shown in black remain the same between the two views.

Viewing Rain Analysis Differences on the Graph

When Sliicer plots the rain analysis graph, it plots the values for both the rain event and the total event. When these value are the same, the values appear on the rain analysis graph as a line, as shown above. However, when the values are different, they appear on the graph as a fork or a loop. When Sliicer flags values in the rain analysis that are different for the storm period and the total event, the user can graph the storm to evaluate the magnitude of the discrepancy of rain analysis values between the storm period and the total event.





CHAPTER 4

Chapter 4 Basins

The Basin tab allows you to enter basin size information for each meter basin. Basin size values are used to normalize the results of your I/I analysis for better basin comparisons.

Basin size is one of the most important variables an engineer can control. For reasons which will become apparent the more you use hydraulic tools like Sliicer, it makes a great deal of sense to place a flow monitor in any location where you think you might need to size a relief sewer or storage basin. For I/I work on sanitary sewers, this generally works out to one monitor every 8,000 to 12,000 linear feet of mainline sewer. For combined sewers that are normally sized to transport rain water, there are no similar rules-of-thumb. However, the same general rule still applies - place a monitor everywhere you think you may need to size a relief sewer or re-size a regulator.

In this chapter you will learn to:

- Understand basin size normalization
- Enter basin size parameters

Understanding Basin Size Normalization

In order to determine where the worst inflow/infiltration problems are in your system, it is not enough to know where the most flow came in. Although this information is part of the picture, it needs to be correlated with the size of the basin before it becomes really useful. Consider the following table:

Basin	A	B
RDII	500000 gal	600000 gal
Size	10000 lf	20000 lf
Normalized Inflow	50 gal/lf	30 gal/lf

Although basin B has more total RDII, basin A has almost twice an much RDII per foot of sewer. The normalized inflow value gives a different view of where the worst problems are. Therefore, it is important to normalize RDII information by basin size whenever possible.

Entering Basin Size Parameters

Sliicer supports three different measures of basin size for normalization purposes: area, mainline sewer length and footprint. There are two ways to enter basin size parameters: directly into the Basin Size table, and by using the Basin Pipe Diameter table to calculate the length and footprint values for you.

Note Normalization will only be enabled for a basin size measure if you enter values for all basins. For example, if you enter values for area for all basins and length for all but one basin, only area normalization will be enabled. If you want normalization enabled for length as well, you must enter length values for all basins.

➔ **To enter parameters directly into the Basin Size table**

1. Make sure the Basin tab is current.
2. In the Basin Size table, select the cell for the basin and size parameter you want to enter.
3. Enter the size parameter.

Using the Inch Miles Table

You can use the Basin Pipe Diameter table to calculate the total length and footprint for you. To use the Basin Pipe Diameters table, you must know the total length of each pipe size for your basins. You enter the diameters and the total length of pipe for each diameter, and Sliicer updates the Basin Size table with the total length and footprint for the basin.

Tip Did you know that inch-miles represents a sewer's footprint in plan view? Also, did you know that one inch-mile = 440 square feet?

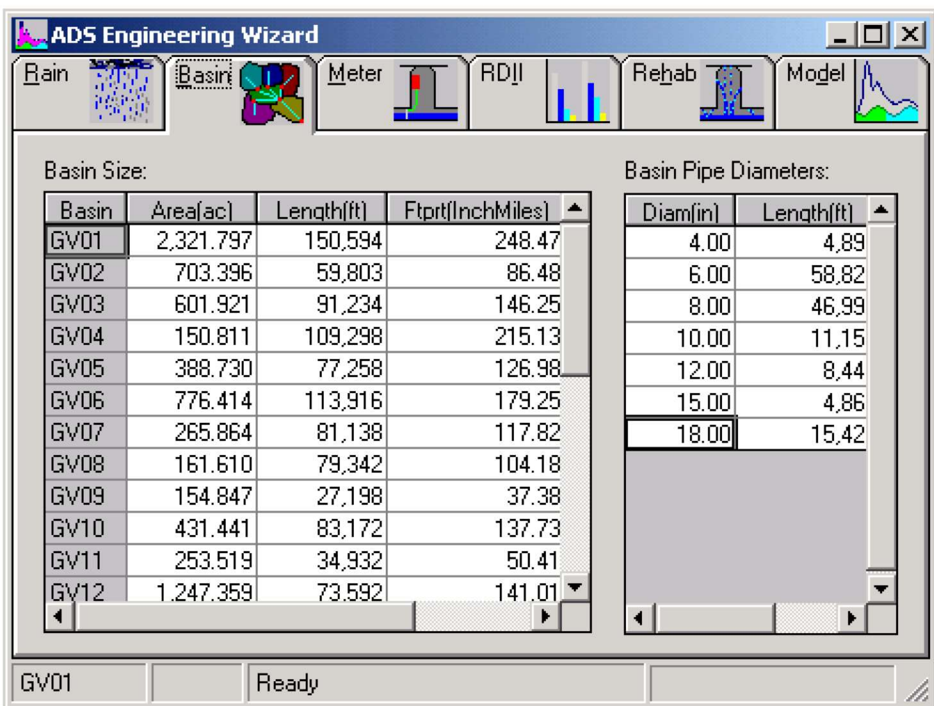
➔ **To use the Inch Miles table to calculate length and inch miles**

1. In the Basin Size table, select the basin you want to work with.
2. Double click the Basin Pipe Diameters table header to add the first new row.

   -OR-

   Move to the last row of the Basin Pipe Diameters table and hit the down arrow on the keyboard.

   A new row is added to the Basin Pipe Diameters table.
3. In the Diam column, enter the diameter.
4. In the Length column, enter the length of pipe at that diameter for the selected basin.
5. Change cells.



Basin	Area(ac)	Length(ft)	Ftprt(InchMiles)
GV01	2,321.797	150,594	248.47
GV02	703.396	59,803	86.48
GV03	601.921	91,234	146.25
GV04	150.811	109,298	215.13
GV05	388.730	77,258	126.98
GV06	776.414	113,916	179.25
GV07	265.864	81,138	117.82
GV08	161.610	79,342	104.18
GV09	154.847	27,198	37.38
GV10	431.441	83,172	137.73
GV11	253.519	34,932	50.41
GV12	1,247.359	73,592	141.01

Diam(in)	Length(ft)
4.00	4,89
6.00	58,82
8.00	46,99
10.00	11,15
12.00	8,44
15.00	4,86
18.00	15,42

The Length and Footprint values in the Basin Size table for the current meter will update to the sum of the values shown in the Basin Pipe Diameters table.

Note You can override the calculated values by entering Length and/or Footprint directly into the Basin Size table, even after you have entered rows in the Basin Pipe Diameter table. However, if you make any changes to the Basin Pipe Diameter table, it will update the Length and InchMile cells in the Basin Size table for the current site, deleting the values you entered manually.

CHAPTER 5

Chapter 5 Meters

The meter tab is the heart of the Sliicer program. It is here that all the “slicing” of the data in to dry days, storm days, recovery days, etc. takes place. In fact, the Meter tab is so large, that it has been divided into its own sub-tab system.

The meter tab contains all the processes that pertain to each individual meter. All of the other tabs look at the whole system. In the meter tab, you will take a detailed look each meter site. Sliicer will help you derive inflow/infiltration information from the flow data one site at a time.

In this chapter you will learn to:

- Understand the Meter Tab system
- Use the Site tab to plot a site
- Use the Dry Days tab to calculate dry weather information
- Use the Storms tab to calculate wet weather information
- Use the Graphs tab to plot scatter graphs

Understanding the Meter Tab System

The meter sub-tab system automates the calculations necessary to complete a flow study. The four sub-tabs are: Site, DryDays, Storms, Graphs. The Site tab allows you to choose a site, select data traces to view, and set the upstream meters. The Dry Days tab helps you calculate the average dry day diurnal curve(s) for the site. The Storms tab uses the dry day and rainfall information to help you figure out how much rainfall dependent inflow/infiltration (RDII) entered the collection system during storm events. The Graphs tab allows you to plot a scatter graph of the sites data.

Using the Site Tab

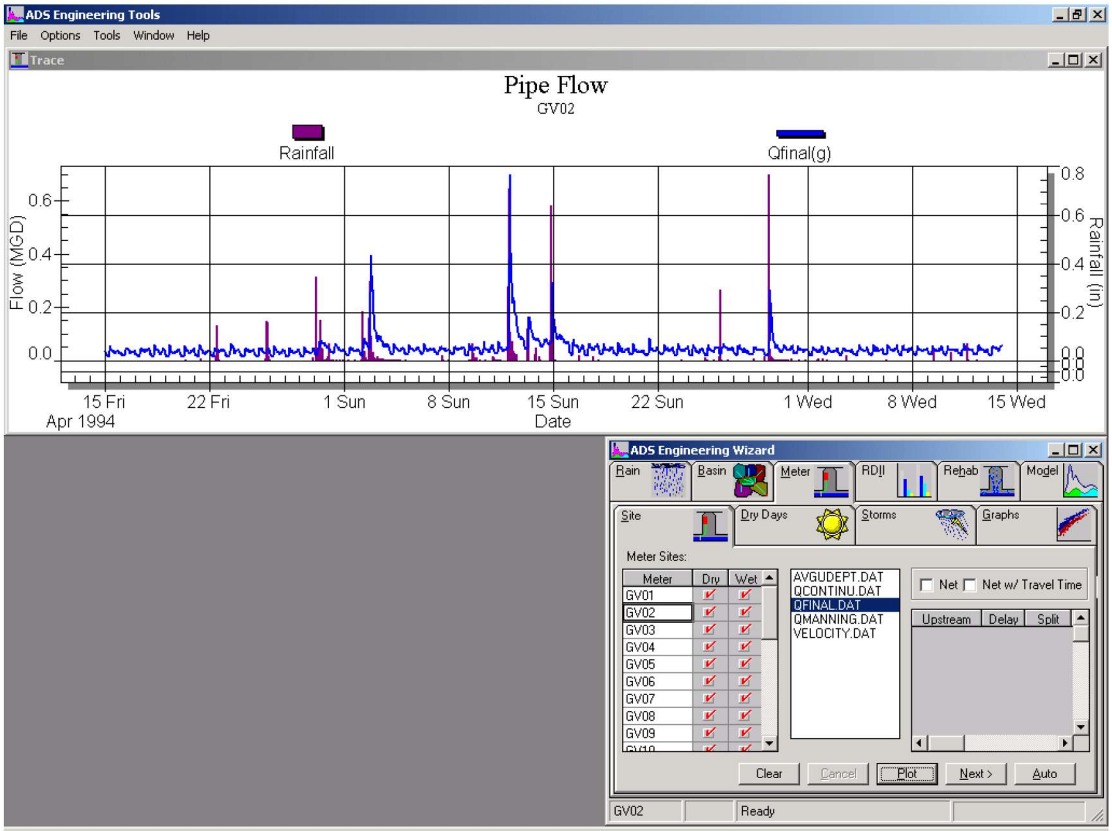
The Site tab allows you to choose a site, select data traces to view, and set the upstream meters. Whenever you want to look at a different site, you start with the Site tab.

Plotting a Site

One of the main functions of the Site tab is to allow you to choose a site to plot.

➔ **To plot a site**

1. In the Meter Sites table, select the meter you want to plot.
2. In the Traces box, make sure Q trace (normally QFINAL) is selected. This is the default setting.
3. Click the Plot button.



Sliicer plots the rainfall and flow for the selected site.

Selecting Other Traces

Sometimes you will want to see more than just QFINAL. Sliicer allows you to plot any Flow, Depth or Velocity trace as well.

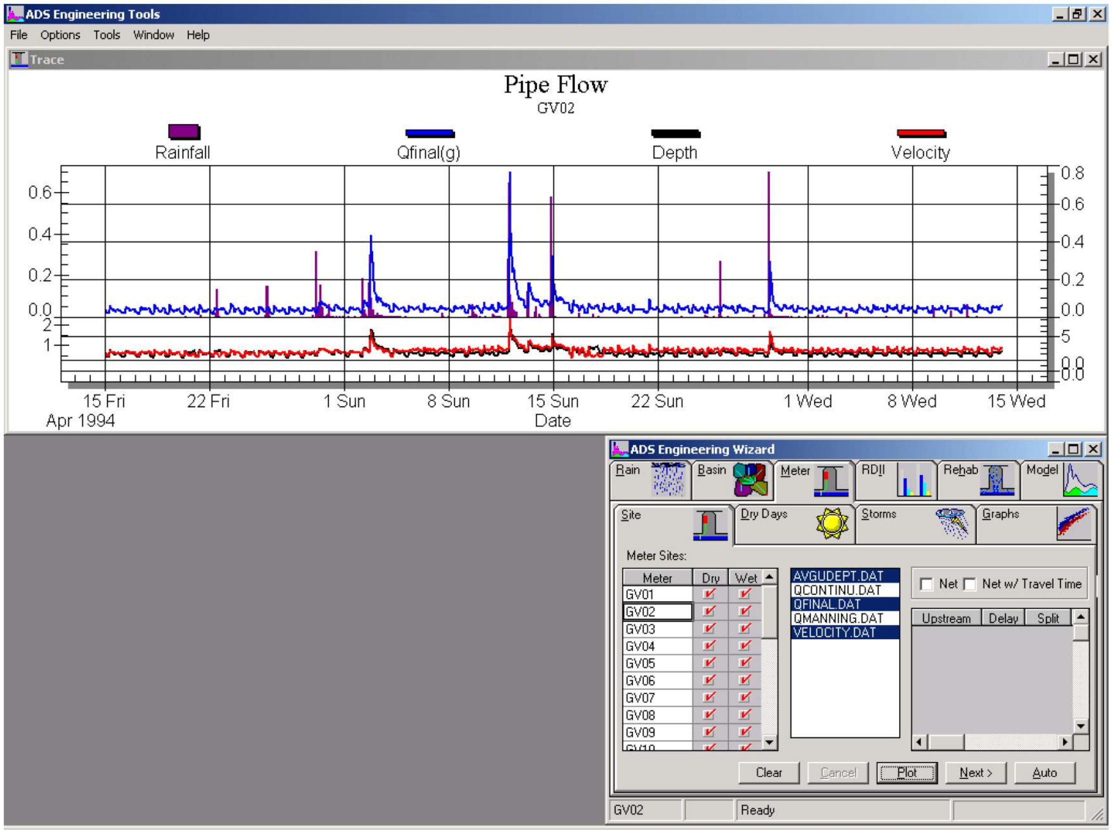
Note Although you can look at other traces, such as depth and velocity, at least one Qfinal trace must be selected for Sliicer to work.

➔ **To plot more than one trace**

1. In the Meter Sites table, select the meter you want to plot.
2. In the Traces box, select the traces you want to plot. Make sure at least one of the traces is a Q (Flow) trace.

Note The Traces box supports Windows extended select functionality. Select additional traces by holding the Ctrl key down and clicking the mouse. Select a group of traces by holding the Shift key down and clicking the mouse.

3. Click the Plot button.



Sliicer plots the rainfall, flow, and other selected traces for the selected site.

Setting Upstream Meters

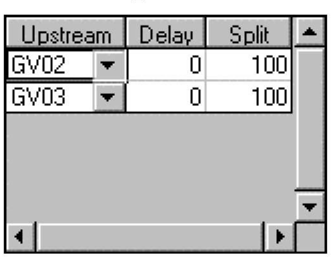
Many of the meters you work with will have other meters upstream. In order for Sliicer to derive accurate information from the flow data, you must tell it about the upstream meters. You do this by listing the upstream meters for each site in the Upstream table. The Upstream table is located in the lower right portion of the Meter Sites tab. You should set the upstream meters for each site before you do any further processing with Sliicer.

➔ **To set upstream meters**

1. In the Meter Sites table, select the downstream meter.
2. If the Upstream table doesn't have any rows, double click the Upstream table header.

   -OR-

   If the Upstream table already has rows, move to a cell in the last row and press the down-arrow key on the keyboard.
3. A new row is added to the Upstream table.
4. Select the Upstream column for the new row.



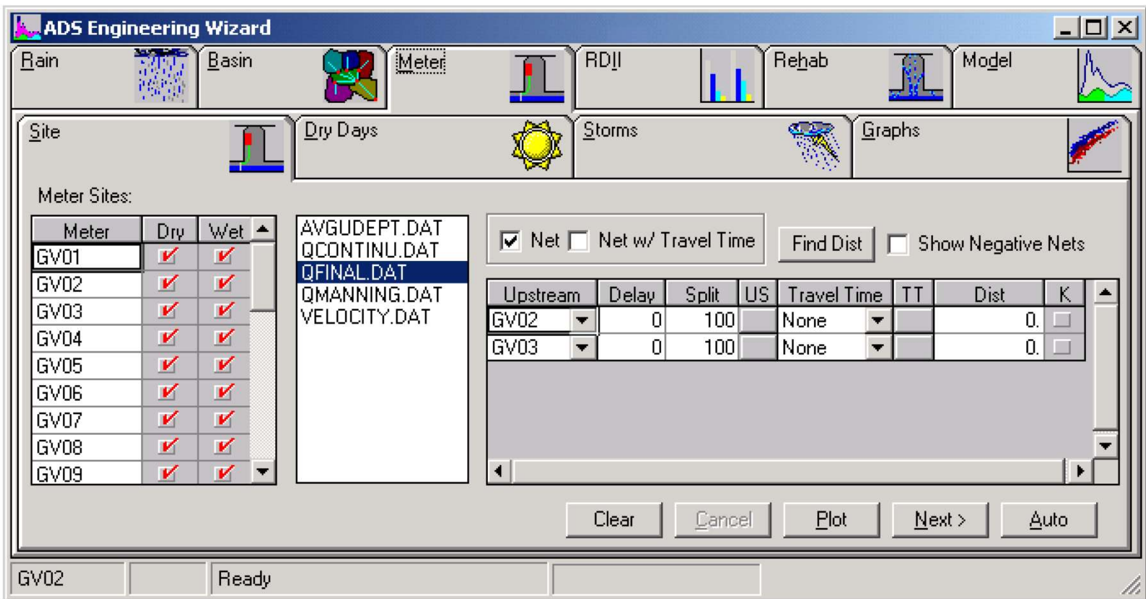
5. Select the upstream meter from the drop down list.

Viewing Upstream Flow

In addition to viewing other traces, you can also view the flow from the upstream meters.

➔ **To view upstream flow**

1. Set the upstream meters.
2. Enlarge the Engineering Wizard window so that the additional columns for the upstream table are visible.



3. Click the button in the US (Upstream) column for the upstream site you want to display.

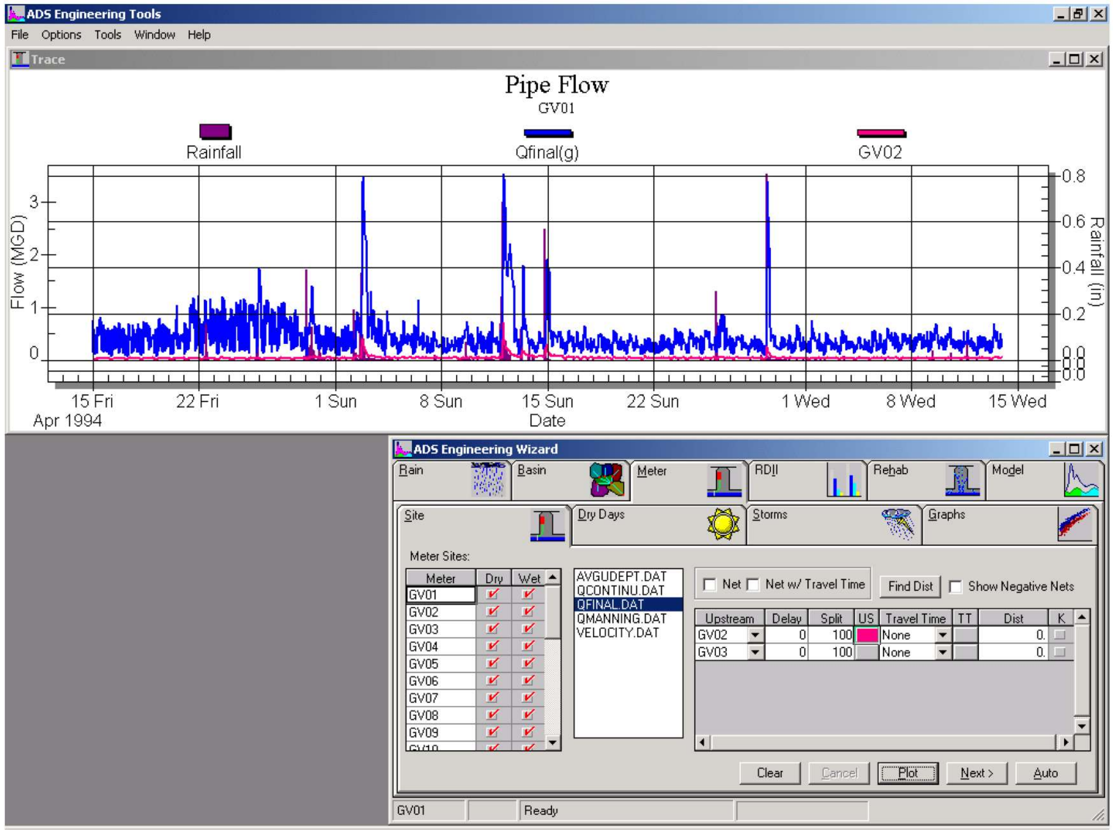
The Plot popup menu appears.

4. Select Plot from the popup menu.

The Color dialog appears.

5. Select the color you want and click OK.

6. Click the Plot Button in the Engineering Wizard



Sliicer plots the flow for the selected upstream site.

Viewing Net Flow

In addition to viewing the upstream meters, you can also view the net flow for the selected site. Net flow is the difference between the flow going out of a basin and the sum of all the flows coming into the basin from upstream basins. The net flow represents the component of the metered flow that originated in the basin being monitored as opposed to originating in upstream basins.

➔ **To view net flow**

1. Set the upstream meters.

2. Check the Upstream check box in the View group.

3. Click the Plot button.

   Sliicer plots the flow for the current site and the net flow.

Upstream Travel Time

The flow from upstream sites takes time to reach the downstream site. When the distance between the upstream site and the downstream site is large, and or when the flow velocity is very slow, this travel time can become significant enough that it should be taken into account in the Sliicer analysis.

Sliicer has two methods of taking travel time into account: a constant Delay, and a Variable Travel Time approach.

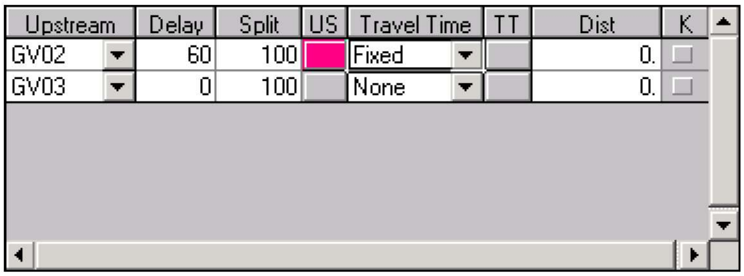
Setting a Fixed Delay

One way to take upstream travel times into account is to use a fixed time delay. When you set a fixed delay for an upstream site, Sliicer will adjust the calculation of the net flow by the amount of the delay.

Note The delay can only be set in multiples of the step length. If you are doing your work on an hourly basis, only delays of 60, 120, 180 min, etc. will be accepted for the delay. If you are using 30 min step lengths, delays of 30, 60, 90 min will be acceptable.

➔ **To set the delay**

1. Select the delay cell for the upstream meter you want to delay.



2. Enter the delay value.
3. Set the Travel Time column to Fixed.
4. If you want to see the effect the delay has the calculation of the net flow, check Upstream and/or Net in the View group, and click the Plot button.

   Sliicer replots the Upstream and/or Net traces adjusted by the delay value.

Viewing the Travel Time

Sliicer allows you to effect that the travel time you set has on the upstream flow.

➔ **To view the upstream Travel Time**

1. Click the button in the TT (Travel Time) column for the upstream site for which you want to display the time traveled upstream flows.

   The Plot popup menu appears.

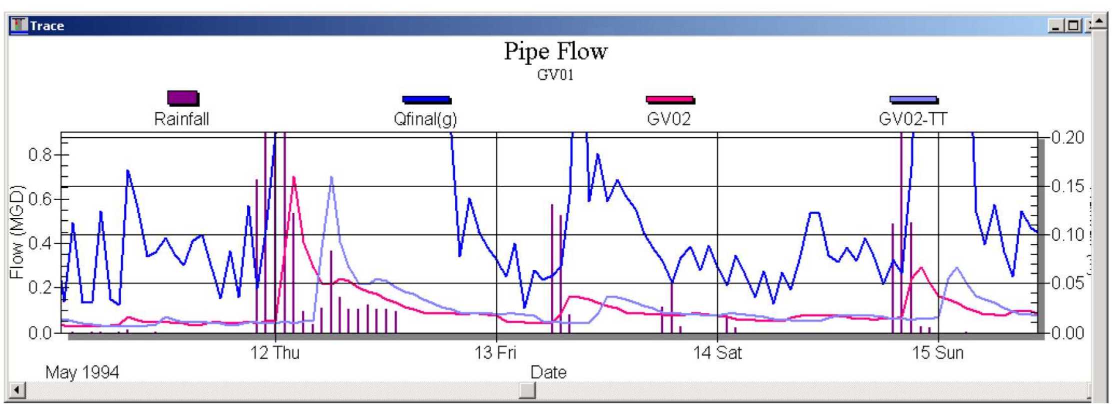
2. Select Plot from the popup menu.

The Color dialog appears.

3. Select the color you want and click OK.

Upstream	Delay	Split	US	Travel Time	TT	Dist	K
GV02	240	100		Fixed		0.	
GV03	0	100		None		0.	

4. Click the Plot Button in the Engineering Wizard.



Sliicer plots both the upstream trace (GV02), and the time traveled upstream trace (GV02-TT).

Variable Travel Time

In addition to supporting a fixed travel time, Sliicer also supports a variable travel time. When Sliicer uses a variable travel time, it modulates the upstream flow trace based on the average velocity and distance between the upstream and downstream sites. Of course, between any two sites, the velocity may change many times according to changes in the hydraulic conditions, particularly the slope of the conduit.

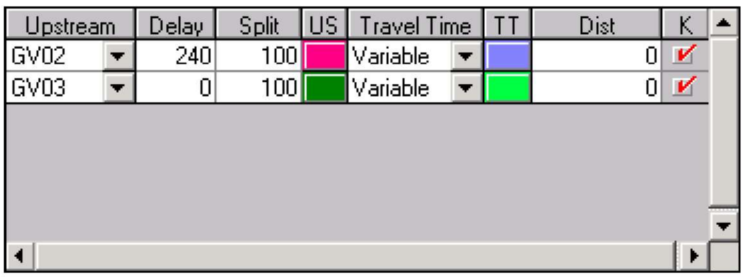
However, ADS engineers have found that many times effective results for a variable travel time can be approached by using a simple average velocity between the upstream and down stream sites. In order to make this approach work, however, it is frequently necessary to make adjustments to the actual distance between the sites to compensate for the changes in slope. The distance used by Sliicer to modulate the upstream trace by a variable travel time is referred to as the Conceptual Distance (K). The conceptual distance has the same units as actual distance, but may be different from the actual flow distance between the two sites.

The conceptual distance is a single distance that complements the average velocity between the upstream and downstream sites such that the modulation of the upstream flow fits the changes in shape between the upstream and downstream flow traces.

Sliicer contains an algorithm to estimate the conceptual distance that can be used to a starting point in setting this value. Sliicer users can then modify the conceptual distance and evaluate the results of their changes by visual inspection.

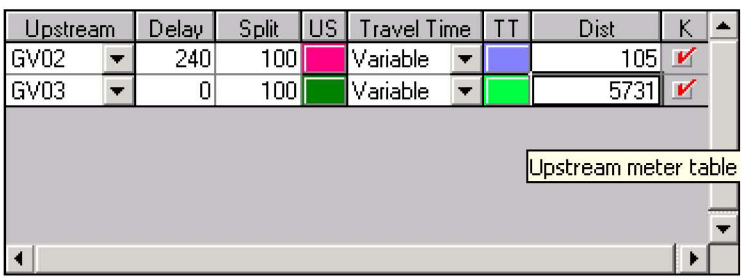
➔ To have Sliicer determine the conceptual distance (K)

1. Check the k column for the upstream sites for which you want Sliicer to determine the conceptual distance (K)



2. Click the Find Dist button.

Sliicer determines the conceptual distance for each upstream site for which the k column was checked.



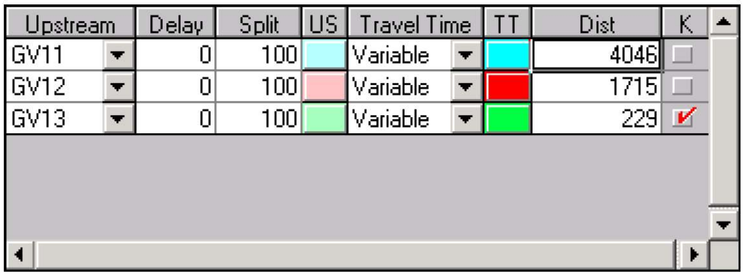
➔ To adjust the conceptual distance manually

- Enter the value you want into the Dist column of the upstream table.

Tip If you want to keep the distance you entered in the Dist column of the upstream table, uncheck the K column. Sliicer will replace the existing value of the Dist column with the value it calculates each time you click the Find Dist button.

➔ To view the variable travel time

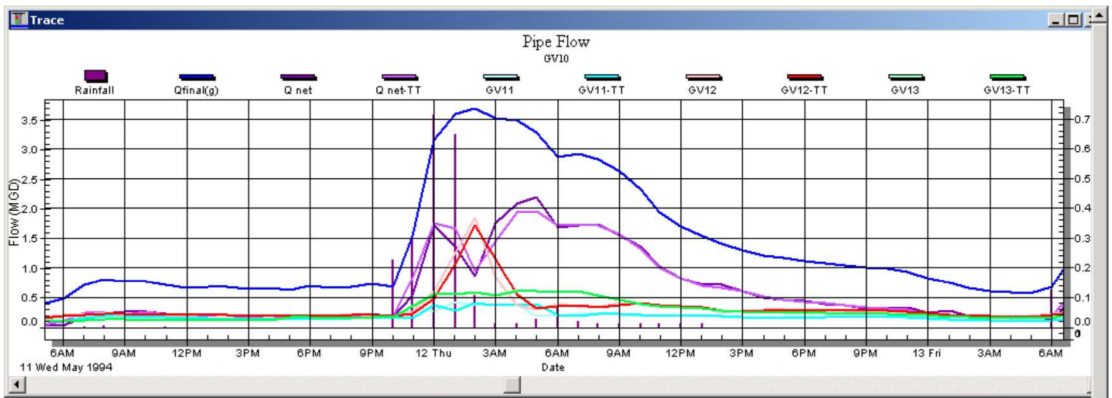
1. Set the value of the Travel Time to Variable for each upstream site where you want to use Variable Travel Time.
2. Set the color for the TT column for each upstream site you want to plot.
3. If you want to compare the Time Traveled upstream trace with the unaltered upstream trace, also set the color on the US column.



Upstream	Delay	Split	US	Travel Time	TT	Dist	K
GV11	0	100		Variable		4046	☐
GV12	0	100		Variable		1715	☐
GV13	0	100		Variable		229	☑

4. If you want to see the effect that the variable travel time has on the net flow, also check the Net w/ Travel Time check box.

5. Click the Plot button.



Sliicer displays the upstream sites flows in both unaltered and variable time traveled format, along with the Gross downstream flow, and the unaltered and altered net flows.

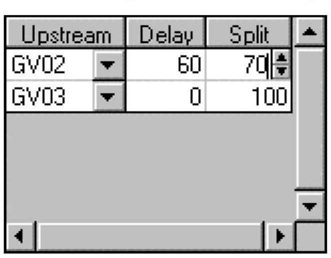
Setting the Split

Diversions and cross connections in the collection system can split the flow from an upstream meter to more than one downstream site. Sliicer allows you to account for this by setting the split for upstream meters. The split is the percentage of flow from an upstream site that actually flows into the selected downstream site.

When you enter a new row in the Upstream table, the split defaults to 100, meaning that all the flow from the upstream site is assumed to flow into the this downstream site. If all the flow from the upstream meter doesn't flow to the selected site, you can reduce the split value to reflect this. When you do reduce the split value to less than 100, you should also enter this upstream meter as upstream to the other sites where the rest of its flow goes. The total of all split values for all entries of one upstream meter should equal 100%.

➔ **To set the split**

1. Select the split cell for the upstream meter you want to split.



Upstream	Delay	Split
GV02	60	70
GV03	0	100

2. Enter the split value.
3. If you want to see the effect the new split value has the calculation of the net flow, check Upstream and/or Net in the View group, and click the Plot button.

   Sliicer replots the Upstream and/or Net traces adjusted by the delay value.

Understanding Site Status

In order for Sliicer to present you with complete Rainfall Dependent Inflow/Infiltration information in the Results tab, you must first process all sites for both dry and wet weather. The Sliicer Meter Sites table on the Meter Site tab tells you about the status of this processing. A check in the dry and wet columns of the Meter Sites table means that the dry and wet weather calculations have been completed for that site.

Sliicer has to process upstream sites before it processes downstream sites because downstream calculations depend on upstream results. Therefore, Sliicer will not let you process downstream sites until the upstream sites have been processed.

The site status checks in the Meter Sites table let you know which downstream meters you can process. If all the upstream meters have checks in both their dry and wet columns, Sliicer will let you process the downstream site.

Clearing Site Status

Whenever you perform operations in Sliicer that invalidate prerequisite information, Sliicer clears the site status to force recalculation. In some cases, the changes you make only clear the downstream sites. In other cases, such as when you add a new storm event, Sliicer clears the status of all sites, because they must all be recalculated.

Sliicer also allows you to clear the status information yourself. You might want to clear the status information when you make changes to the .DAT files, or FLOWLOAD.MDB yourself. In such a case, Sliicer would not know that recalculation was needed. You also might want to clear site status so you can use the Auto button to recalculate all sites, even though only a few are needed.

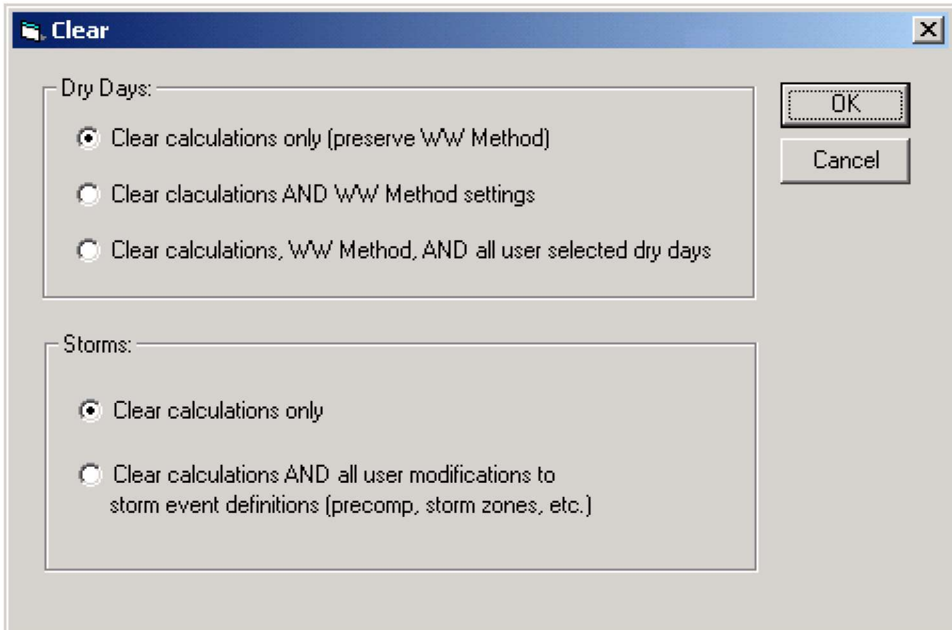
When you clear site status, you can choose the degree of clearing for both dry and wet weather calculations. The consequences of each degree of clearing are shown in the following table:

Degree	Dry Days	Storms
Standard	**Clear calculations only -** Clears all dry day calculations, but preserves the changes you made to the selection of dry days for each site.	**Clear calculations only -** Clears all storm calculations, but preserves the changes you made to storm events, such as start date, precomp, storm period lengths, etc.
Medium	**Clear calculations and WW settings** – Clears all dry day calculations and Waste Water method settings, but preserves the selection of the dry days for each site.	
Extensive	**Clear calculations AND all user selected dry days -** In addition to clearing dry day calculations, also clears any work you did customizing dry day selections for each site.	**Clear calculations AND all user modifications to storm event definitions (precomp, storm periods, etc.) -** In addition to clearing storm calculations, also clears any changes to storm event definitions.

Note In most cases that you clear site status, you will want to clear only calculations. You should be very careful clearing anything else, particularly if you have invested a lot of time in customizing either dry day selections or storm event parameters.

➔ **To clear site status**

1. In the Meter Site tab, click the Clear button.



   The clear dialog appears.

2. Select the type of clear you want to perform for both dry and wet weather.
3. Click the OK button.

   Sliicer clears the site status to the degree you specified.

Automating Calculations

The Meter sub-tab is organized in the order you must follow when processing data with Sliicer.

1. Plot the site.
2. Calculate dry information.
3. Calculate storm information.

Further, you must process upstream sites before downstream sites.

Sliicer has two automation features to help you move through the calculations in the right order: the Next> button and the Auto button.

Using the Next> Button

The Next> button helps you move to the next valid calculation step in processing your meters. Next> moves you through the calculation process one step at a time to give you time to digest the visual displays and interact with the analysis parameters.

The Next> button is available on all three of the Meter sub-tabs in the calculation process: Site, Dry Days, and Storms. When you press the next, button, Sliicer moves to the next logical step in the calculation process.

When you press Next> in the …	Sliicer moves to...
Site tab	…the Dry Days tab for the selected meter.
Dry Days tab	…the Storms tab for the selected meter.
Storms tab	…the Site tab and plots the next unprocessed meter that has all upstream sites processed.

➔ **To use the Next> button**

1. If the Site tab is current, in the Meter Sites table, select the site where you want Sliicer to start calculating.
2. Click the Next> button.

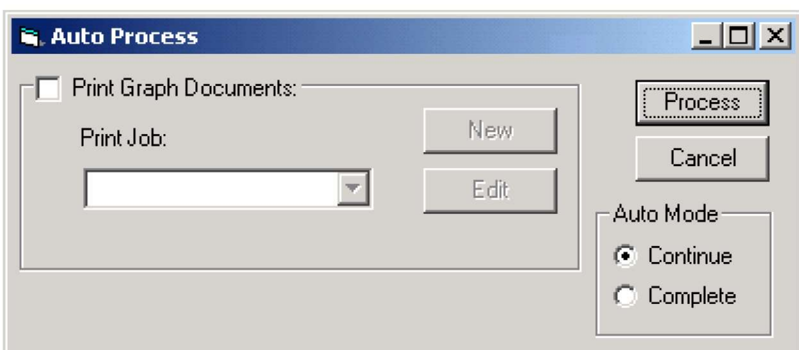
   Sliicer moves to the next logical calculation step.

Using the Auto Button

The Auto button follows the same processing sequence as the Next> button, but moves automatically from one step to the next without stopping for your review. The Auto button is useful for getting an initial quick overview of the data by watching Sliicer move through calculations for all sites. It is also useful for recalculating downstream sites when changes are made to upstream parameters, and for recalculating all sites when global system changes are made.

➔ **To use the Auto button**

1. If the Site tab is current, in the Meter Sites table select the site where you want Sliicer to start calculating.
2. Click the Auto> button.



   The Auto Process dialog box appears.

3. Click Process.

   Sliicer moves through the calculations in logical order without stopping.

➔ **To stop auto calculation**

- Press the cancel button on the current meter sub-tab.

  The automatic calculation process is stopped after the calculations for the current sub-tab are complete.

Using Radar Rainfall

Sliicer allows you to use Radar Rainfall if you have it, and it allows you to use it in conjunction with Rain Gauges if you have both, or of you only have Radar Rainfall data for selected time periods.

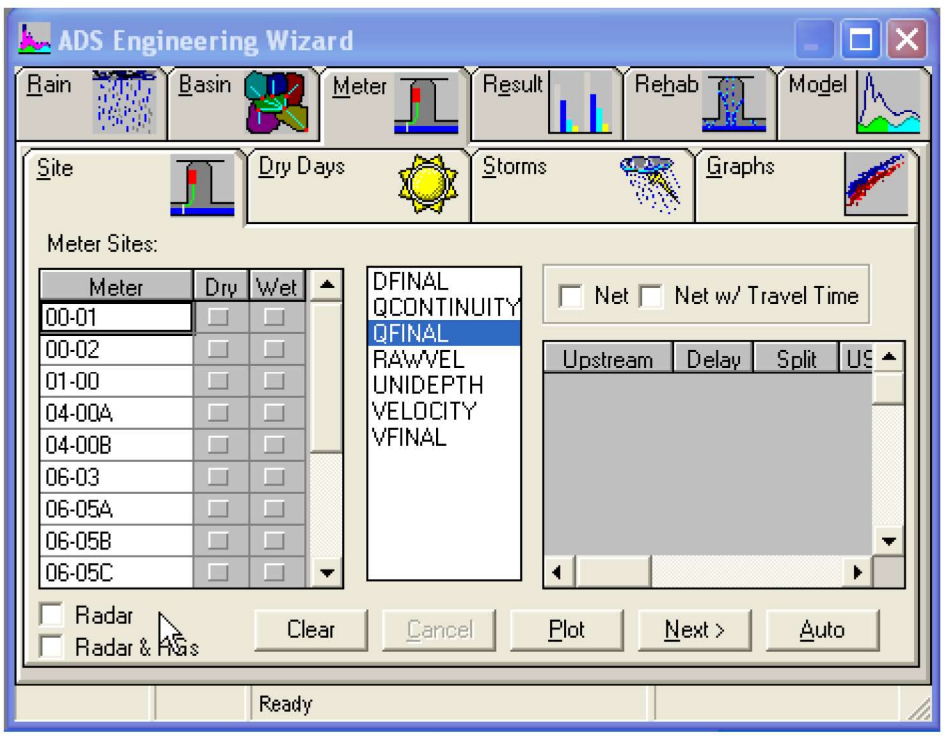
Setting up the Radar Data Files

In order for Sliicer to recognize your Radar Rainfall data, you must use Sliicer's predefined formats for file names, the data files and the folder location of the data files. The Radar Rainfall files are placed in a folder under the project folder which must be named "CALAMAR." The Radar Rainfall files are named according to the following convention: "RainGauge_[MeterSiteName].csv, where [MeterSiteName] is the name of a flow meter site in Sliicer. Finally, the Radar Rainfall data files must have a csv (comma separated values) file format as shown below:

3/28/2010 17:30,0.005
3/28/2010 17:35,0.004
3/28/2010 17:40,0.002
3/28/2010 17:45,0.004
3/28/2010 17:50,0.001

Note The two fields in the file are DateTime and RainValue, but the file does not include a column header row.

Once you have set up the Sliicer data files, you must also enable the Radar permissions in the Permissions table in the Sliicer flowload. Once all these preconditions are complete, when you move to the Sliicer Site tab, Sliicer will display two check boxes that pertain to viewing and using Radar Rainfall data.



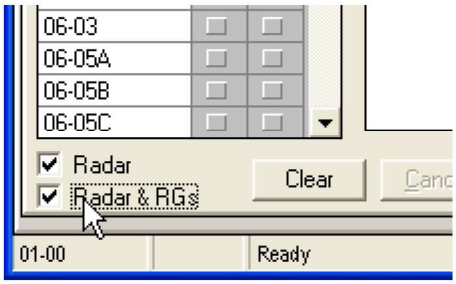
Displaying the Rain Gauge Data Alongside the Radar Data for Comparison

Sliicer uses Radar Rainfall data for the periods for which it exists, and it uses the Rain Gauge rainfall data in time steps where there is no Radar data. When you check the "Radar" check box, Sliicer plots the Radar data in olive green where it is exists, and the rain gauge data in dark purple where no radar data exists. It does not plot the rain gauge data during the time periods where radar data exists.

You can plot the rainfall data alongside the radar data for comparison purposes. When you show the rain gauge data during the time periods that radar data exists, Sliicer still uses the radar data for calculations. The display of the rain gauge data is simply for comparison purposes. When Sliicer plots both the radar data and the rain gauge data during the same time period, it offsets the radar data by a partial time step for easier viewing. The user should keep in mind that this time offset is for display purposes only, and that the values really occur at the same time.

➔ **To show the Rain Gauge data alongside the Radar data for comparison**

1. In the lower left of the Site tab, in addition to checking the "Radar" check box, also check the "Radar & RG" check box.



Note The acceptable setting combinations for the Radar check boxes are: None checked, only "Radar", both "Radar" and "Radar & RG's".

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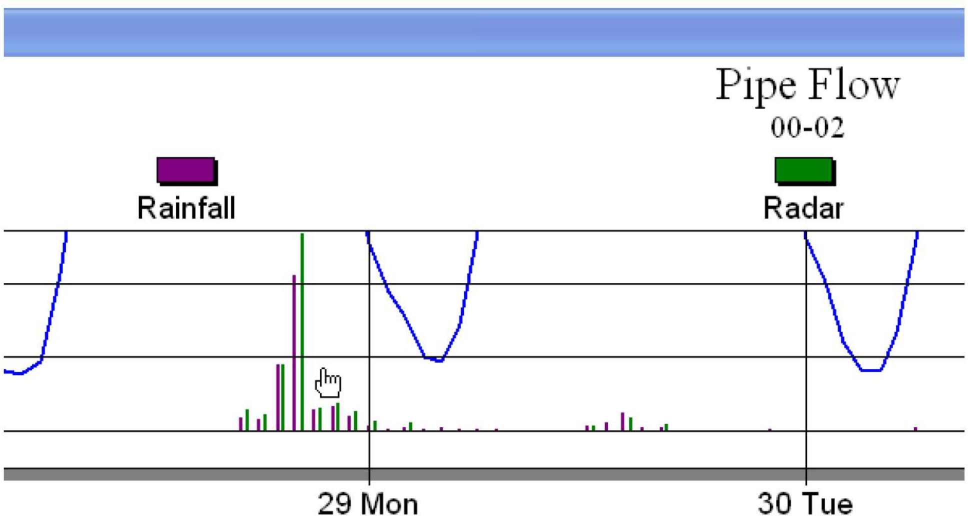
2. Click the Plot button.



Sliicer plots both the radar data and the rain gauge data during the time periods where radar data exists.

Using the Dry Days Tab

Once you have plotted a site, you are ready to calculate dry day information. The dry day information that Sliicer derives from the flow data has several uses. First, collection system owners are frequently interested in the dry weather performance of their collection system. Second, Sliicer uses the dry day information as a basis for calculating wet weather flows in the Storms tab.

Understanding the Dry Day Table

When you enter the Dry Days tab, Sliicer presents the results of the Dry Day calculations in the Dry Days table. The meaning of each of the field names is shown below.

Gr (Gross) Click the buttons under the **Gr** column and set the color to display the gross average dry day diurnal curve for the day group.

Nt (Net) Click the buttons under the **Nt** column and set the color to display the net dry day diurnal curve for the day group.

Tr (Trace) Click the buttons under the **Tr** column and set the color to display dry day traces for the day group.

BI (Base Infiltration) Click the buttons under the **BI** column and set the color to display the net base infiltration for the day group

Regime Displays the **Regime** of the current row. Only visible if Regimes are being used.

Year Displays the **Year** of the current row. Only visible if Years are being used.

Season Displays the **Season** of the current row. Only visible if Seasons are being used.

Day Group Displays the **Day Group** of the current row.

Tr (Trace) Select the **Tr** checkbox and the **Plot** button to display dry day traces for the day group.

Av (Average) Select the **Av** checkbox and the **Plot** button to display the average dry day diurnal curve for the day group.

Nt (Net) Select the **Nt** checkbox and the **Plot** button to display the net dry day diurnal curve for the day group.

BI (Base Infiltration) Select the **BI** checkbox and the **Plot** button to display the net base infiltration for the day group.

Num (Number of Days) Displays the total number of qualified dry days used to calculate the averages for the day group.

Alt (Use Alternate Day Group) Select the **Alt** checkbox to use an alternate day group.

AltRegime (Alternate Regime) Drop-down list which allows alternate **Regime** selection when no dry days are available for the associated **Regime**.

AltYear (Alternate Year) Drop-down list which allows alternate **Year** selection when no dry days are available for the associated **Year**.

AltSeason (Alternate Season) Drop-down list which allows alternate **Season** selection when no dry days are available for the associated **Season**.

AltDayGroup (Alternate Day Group) Drop-down list which allows alternate **Day Group** selection when no dry days are available for the associated **Day Group**.

TrPkDate (Trace Peak Date) Displays the date of the dry day with the highest peak flow.

TracePk (Trace Peak) Displays the peak flow rate (mgd) for the dry day with the peak flow.

GrossPeak (Gross Peak) Displays the peak flow rate (mgd) of the gross average diurnal curve for the specified day group.

GrossMin (Gross Minimum) Displays the minimum flow rate (mgd) of the gross average diurnal curve for the specified day group.

GrossAvg (Gross Average) Displays the average flow rate (mgd) of the gross average diurnal curve for the specified day group.

NetPeak (Net Peak) The peak flow rate (mgd) of the net average diurnal curve for the specified day group .

NetMin (Net Minimum) The minimum flow rate (mgd) of the net average diurnal curve for the specified day group.

NetAvg (Net Average) The average flow rate (mgd) of the net average diurnal curve for the specified day group.

GroWWP (Gross Wastewater Production) Displays the total cumulative wastewater production at this site for the specified day group.

GroBInfil (Gross Base Infiltration) Displays the total cumulative base infiltration at this site for the specified day group.

NetWWP (Net Wastewater Production) Displays the discrete wastewater production for the specified day group.

NetBInfil (Net Base Infiltration) Displays the discrete base infiltration for this site for the specified day group.

WW/L (Wastewater per length) Displays the Wastewater quantity per length of pipe for the basin when the length of pipe has been entered in the Basin tab.

WWMethod (Wastewater Method) Select the appropriate wastewater method to calculate wastewater production and base infiltration for the specified day group. Acceptable values are:

- BI= x% * Min
- WW= (A - M)/x%
- WW = x% * Avg
- Stevens/Schutzbach

Factor(%) Enter the wastewater factor to be used in the selected WWMethod formula. The default is 88%. For more information, see the section titled Calculating Base Infiltration.

Using Day Groups

In order to understand the way Sliicer calculates dry day information, you must first understand the concept of day groups. Sliicer allows you to divide the days of the week up into groups based on similar flow patterns. These groups are called day groups.

For example, the most common setting is two day groups: Weekdays and Weekends. In this configuration, flows from Mondays through Fridays are grouped to form one day group. Saturdays and Sundays are grouped together to form another day group. This is a reasonable day group configuration for many studies because the days composing the Weekday day group have similar water usage patterns, and the days composing the Weekend day group also have similar water usage patterns. However, Saturday-Sunday flows are significantly different than Monday-Friday flows, and so two day groups are needed.

When Sliicer calculates dry day information, it produces one set of results for each day group. In the above example, Sliicer would produce two sets of calculations and average dry day diurnal curves; one for Weekdays and one for Weekends.

Sliicer allows you to customize day group settings for your study. Customization of day groups can take the form of classifying days differently, or implementing seasons or regimes to help classify dry days. For more information on customizing day groups, see Chapter 7, Customizing Sliicer.

Alternate Day Groups

Sometimes, because of limited data, or the way the rainfall events occurred, there may not be any dry days that qualify for a day group. For example, suppose you are using three day groups: Weekdays, Saturdays, and Sundays on a 30 day study. Further suppose that significant rainfall occurred every Sunday. This would eliminate any Sundays from qualifying as dry days.

When this happens, Sliicer will choose an alternate day group to use for wet weather calculations. In the above example, Sliicer might choose Weekdays, or Saturdays. This means that when Sliicer does the wet weather calculations in the Storms tab for the events that occurred on Sundays, it will use the dry weather diurnal curves from the alternate day group to subtract to find the wet weather flow component.

Sliicer does not apply a great deal of intelligence in selecting the Alternate Day Group. When a day group has no qualified dry days, Sliicer simply choose the next viable day group as the Alternate Day Group.

However, you can change the Alternate Day Group yourself in the Dry Days table. You should check and/or set the Alternate Day Group whenever Sliicer reports that no dry days qualified to form an average for a particular day group. Sliicer reports the number of days used to make the average in the NumDays column of the Dry Days table.

➔ **To change the Alternate Day Group**

- In the AltDayGroup column of the Dry Days table, select the new Alternate Day Group.

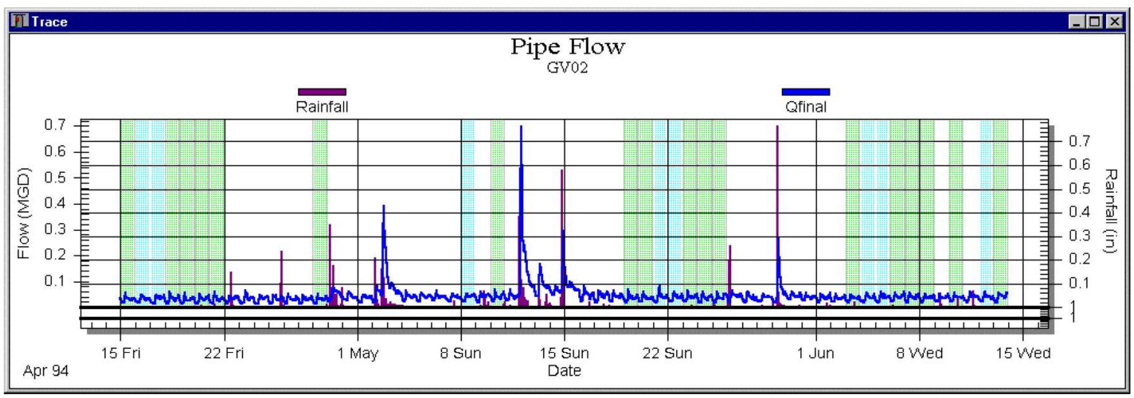
  Sliicer will use the new AltDayGroup setting when performing wet weather calculations.

Changing Dry Days

When you first enter the dry day tab, Sliicer highlights the dry days in the Trace window. Sliicer marks all the days that passed the global dry day tests. You can change the dry day selection visually from the dry day tab. You change the dry day test if you feel that the days that Sliicer selected are not right.

➔ **To change selected dry days**

1. Plot a site and move to the Dry Days tab.



   Sliicer highlights the dry days that passed the global dry day tests.

2. In the Trace window, click the day you want to change.

   Sliicer changes the status of the day you clicked. If it was dry, it is cleared. If it was not marked, it is highlighted and added to the dry day set.

Tip You can also change the tests that Sliicer uses to determine the dry days. To change the dry day tests, see chapter 8, Customizing Sliicer.

Plotting Diurnal Curves

In addition to highlighting the selected dry days, Sliicer also displays the Dry window when you enter the Dry Days tab. In the default setting, Sliicer plots the gross dry day average diurnal curve for each day group in the Dry window. You can also tell Sliicer to plot Net diurnal curves, Individual day traces, and Base Infiltration in the Dry window.

Which diurnal curves are plotted in the Dry window is controlled by the first four button columns in the Dry Days table. The meaning of these button column headers is shown below.

Column Header	Plot Type
Av	Gross Average Diurnal Curve
Nt	Net Average Diurnal Curve
Tr	Daily Traces Used to Derive Average
BI	Base Infiltration

By setting a color for these columns, you can tell Sliicer what to plot in the Dry Day window.

➔ **To plot net diurnal curves**

1. In the Dry Days table, click the button in the "Nt" column on the row for which you want to plot net diurnal curves.

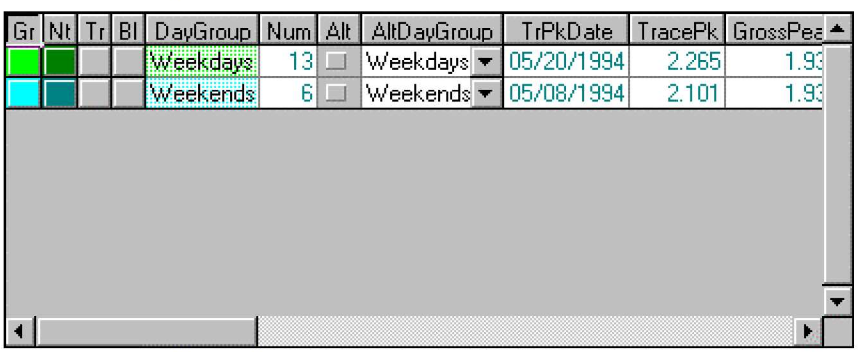
   The plot menu appears.

2. Click Plot.

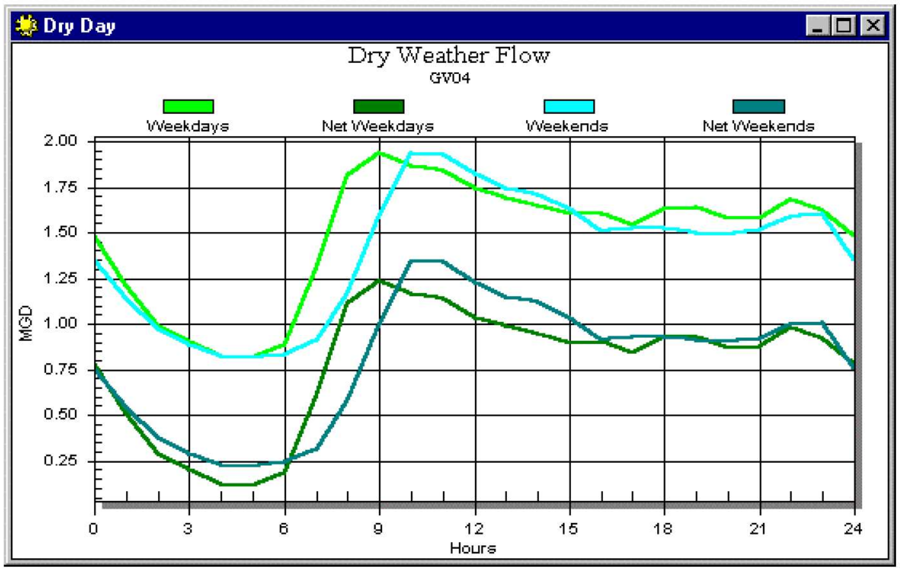
   

   The color dialog appears.

3. Click the color you want and click the OK button.

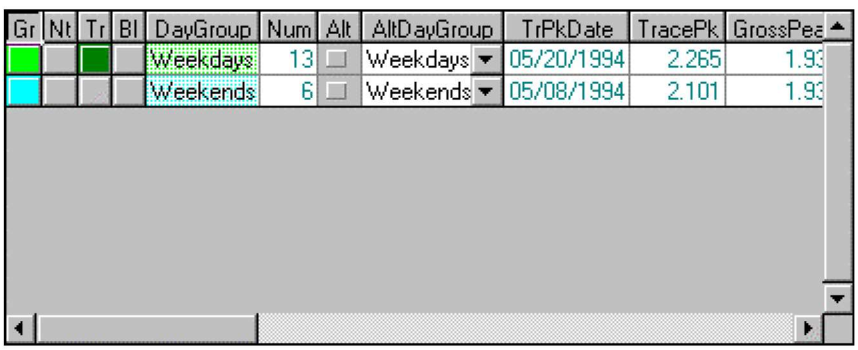
   Sliicer changes the button color to the color you selected…



…and re-plots the Dry window showing the net diurnal curves for the day groups you selected in the same color you selected in the Dry Day Table.

➔ **To plot daily traces**

1. In the Dry Days table, click the button in the “Tr” column on the row for which you want to plot daily traces.

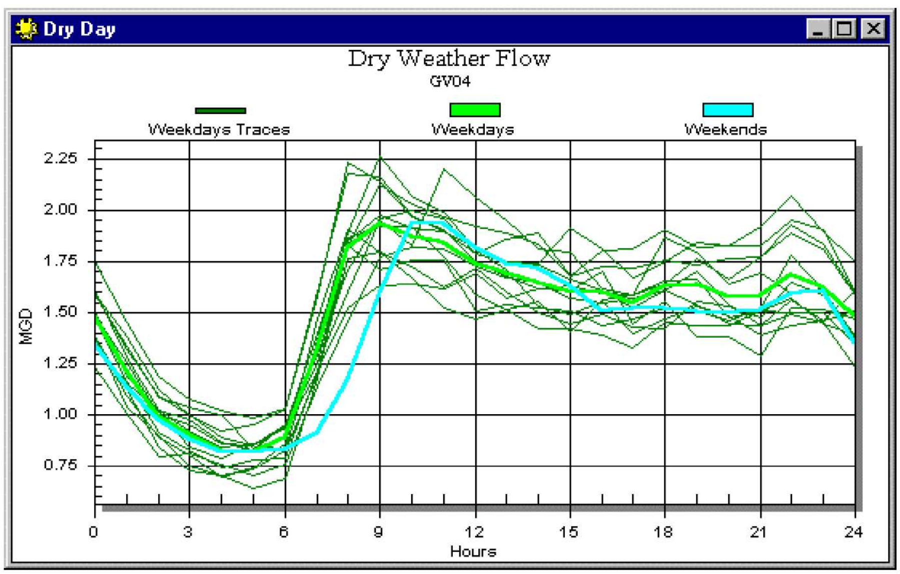


The plot menu appears.

2. Click Plot.

The color dialog appears.

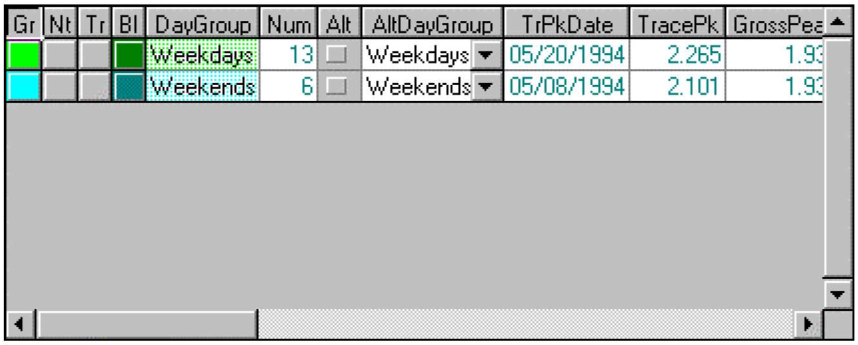
3. Click the color you want and click the OK button.

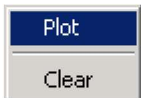


Sliicer re-plots the Dry window with showing the daily diurnal curves for the day groups you selected.

➔ **To plot base infiltration**

1. In the Dry Days table, click the button in the "BI" column on the row for which you want to base infiltration.



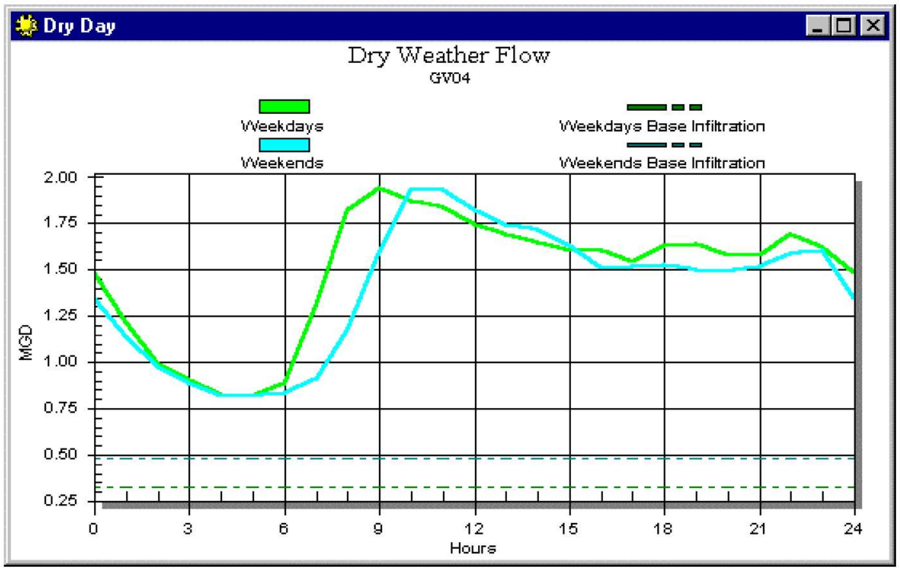


The plot menu appears.

2. Click Plot.

The color dialog appears.

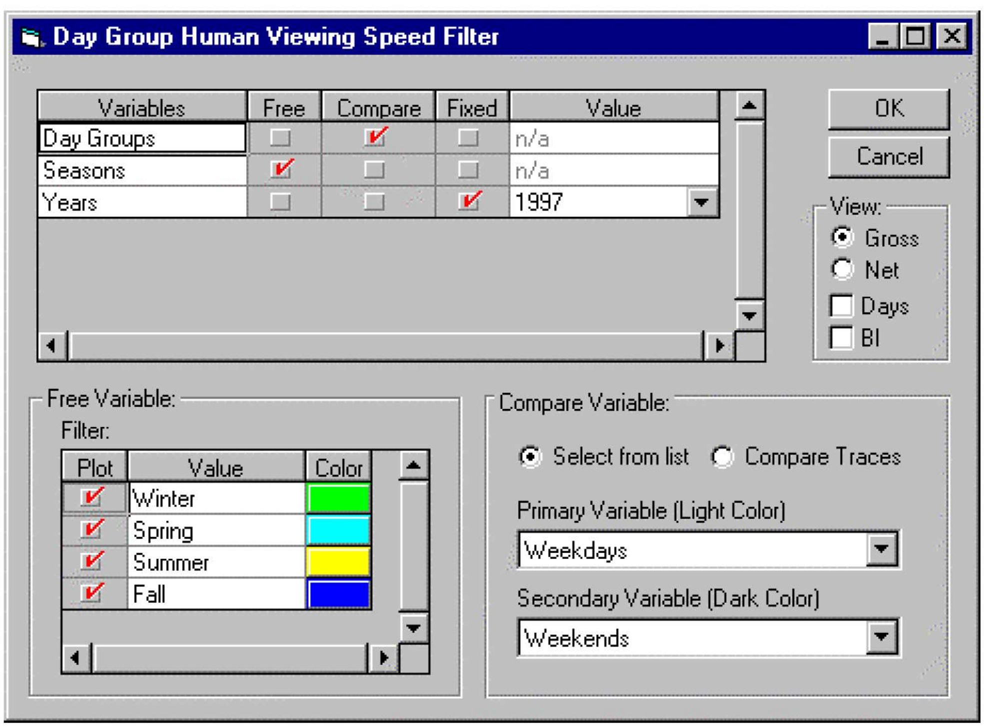
3. Click the color you want and click the OK button.



Sliicer re-plots the Dry window showing the base infiltration for the day groups you selected.

Understanding the Day Group HVS Filter

For most short term flow studies, selecting the traces to plot and setting their colors is easily accomplished using the color buttons in the first four columns of the dry day table. However, on some long term studies, when advanced day group features, i.e. seasons, regimes and years have been implemented to deal with the dry day flow patterns, the number of rows in the dry day table can increase dramatically. When this situation develops, setting the plotting traces and their colors manually from the color button columns can become tedious. In order to help with this situation, Sliicer provides the Day Group Human Viewing Speed (HVS) Filter, shown below.



The Day Group HVS Filter helps you select the traces to plot and set the colors easily, without having to select a color for each trace you want to plot. Further, the Day Group HVS Filter helps you set up comparison scenarios so you can plot more meaningful configurations of data. This feature is particularly helpful in setting up plots on large numbers of dry day traces.

The Sliicer plotting mechanism has three modes of distinguishing between traces: color, shade and line type. The dry day plots reserve line type for distinguishing between the type of trace: Gross, Net, Days and Base Infiltration. This leaves only two modes for handling the remaining plotting issues: color and shade. The basic purpose of the Dry Day HVS filter is to allow you to choose how these two plotting modes are used to create the type of plots you want.

How these two modes are used is determined by the settings of the free, compare and fixed variables. In this context, the term variable is reserved for day group features that can have different values. There are four possible variables: day type, season, year, and regime. Only the day group features that have been actually implemented in the study will appear as variables in the HVS Filter dialog.

Sliicer can plot up to seven different colors, each in two shades. Basically, the free variable uses color to distinguish between its values. This means that Sliicer can plot up to seven different values without duplication. For example, if you select seasons as the free variable, Sliicer can plot Spring, Summer, Winter and Fall each in a different color. If you select day group as the free variable, and are using seven different day groups, one for each day of the week, Sliicer would be able to plot each one in a different color.

The compare variable uses shade. Since the Sliicer plotting tools only support two shades, the compare variable can display only two values, thus its name “compare”. Even if the compare variable has more than two possible values, such as seven days of the week, or four seasons, it can only display two of them. This is actually to your advantage, in that limiting the number of traces you view keeps the graph intelligible, and directs the theme of your plot. The point of the day group HVS Filter is that you have the control to select which variable is set to free and which is set to compare depending on what you want to see.

Remember at this point that Sliicer can have up to four day group variables: day type, season, year and regime. If more than two of there variables are implemented, then the variables other than those you select as free and compare must be fixed to one value. This means that Sliicer will only plot traces for one of the fixed variables values. For example if you set the free variable to seasons, and the compare variable to years and select the values as 1996 and 1997, you would have to fix the day type to one value, such as “Weekends”. Sliicer would plot each season in a different color for both 1996 and 1997, with the curves for each year being plotted in a different shade, but, for only one day type: Weekends. At first blush, having to set the third and forth variables to fixed values may seem limiting. However, because the day group HVS Filter gives you the option to change which variables are free and compare, you are still able to view the data from many different angles.

Using the HVS Filter

The HVS Filter has four components: the variable type table, the free variable table, the compare variable lists and the view selectors. The variable type table, located in the upper left of the day group HVS Filter dialog, allows you to select the free and compare variables. When you select these variables, all other variables will automatically be set to fixed. The variable type table also allows you to select the values of the fixed variables.

Once you select the free variable, Sliicer will change the contents of the free variable table (located in the lower left section of the day group HVS filter dialog) to list the values of the free variable you select. Sliicer assumes that all values are to be plotted, and makes a default color assignment for each value. In the free variable table, you can choose which values to plot, and adjust the colors for each value manually.

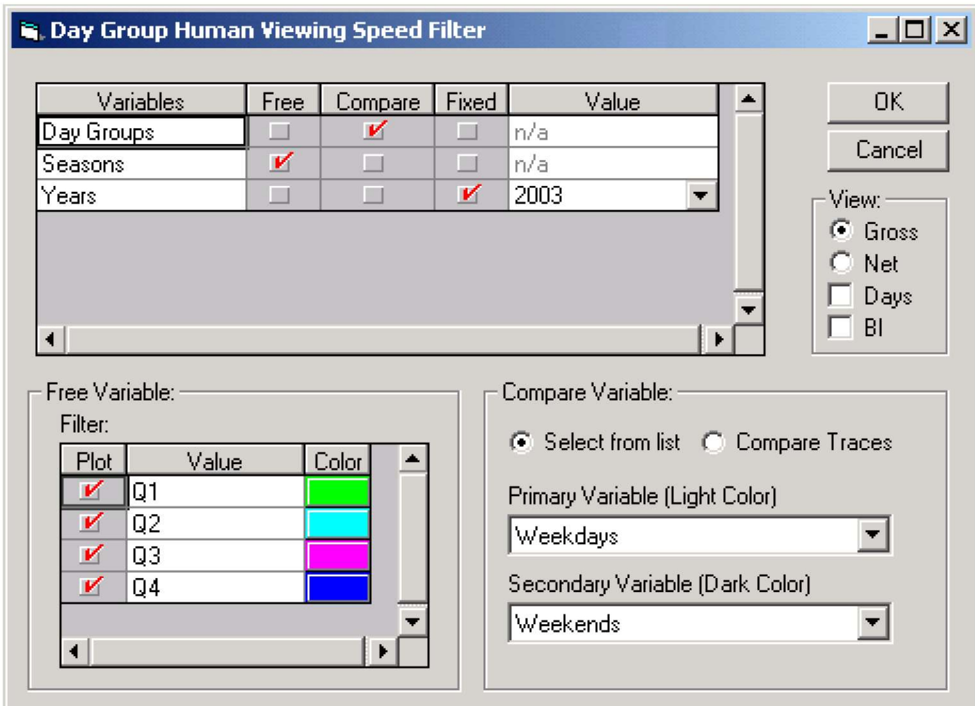
When you select a compare variable in the variable type table, Sliicer loads the two list boxes in the compare variable section (lower right of HVS Filter dialog) with the first two values of the compare variable. The first list box selects the value of the compare variable that will be plotted using light colors, and the second sets the value that will be plotted in dark colors.

If you are using more than two day group features in your study, the variables which are not set to free and compare will be forced to fixed in the free variable table. When the fixed column is checked for a variable in the free column table, a list box with the variables values will appear in the Value column. (When a variable is marked as either free or compare, "n/a" appears in the Value column. When a variable is set to fixed, you can select the fixed value you want in the value list box.

Finally, the view selector, located below the HVS Filter dialog buttons allows you to set which traces you want to view. You can choose between gross and net diurnal curves. You can also choose to add either day traces or base infiltration to the plot using the view selector check boxes.

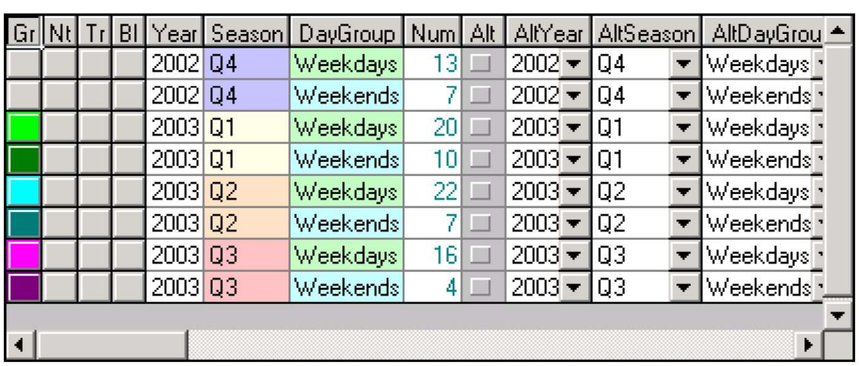
➔ **To select traces to plot using the Day Group HVS Filter**

1. In the Meter tab, select the site you want to plot, and move to the dry day tab.
2. In the dry day tab, click the filter button.

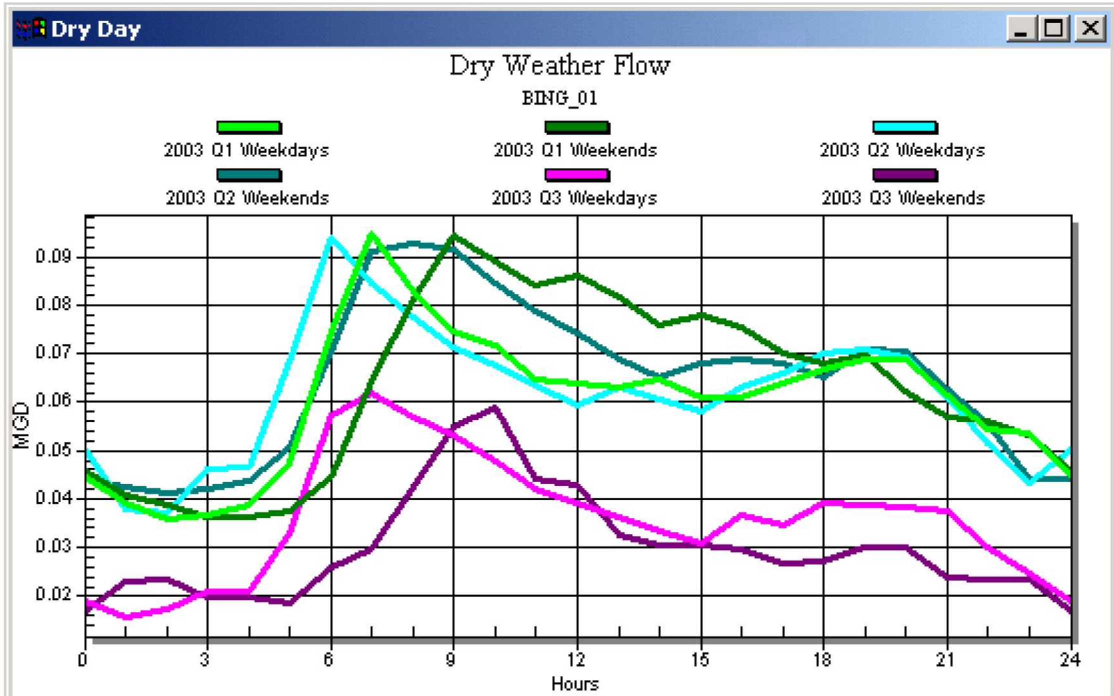


The Day Group HVS Filter dialog appears

3. In the variable type table (upper left) check the Free column of the variable for which you want to see all values.
4. Also, in the variable type table, check the compare column for the variable for which you want to compare two values
5. Still in the variable type table, set the value of the remaining fixed variables, if any.
6. In the view selector area, select the values you want to plot.
7. Click the OK button.



Sliicer sets the plot color buttons of the traces you selected in the HVS Filter.



Sliicer also plots the selected traces in the Day Group graph window.

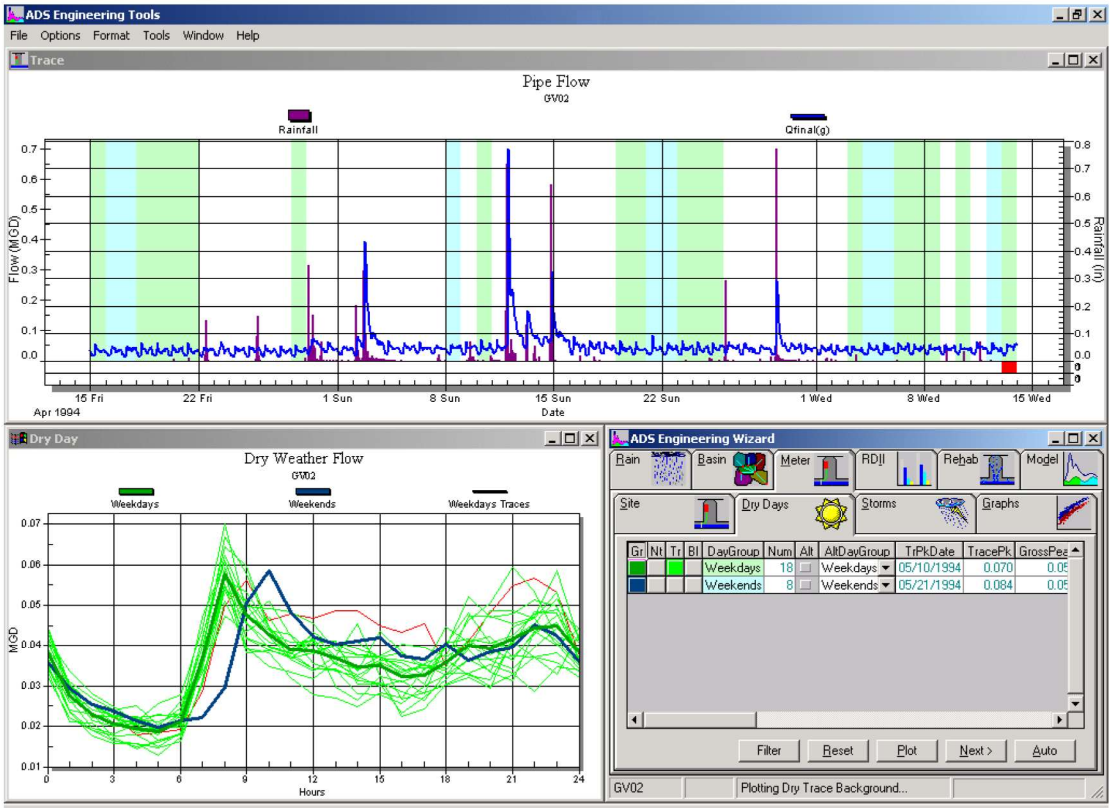
Finding a Trace

One of the best ways to evaluate the quality of the dry day selections it to view the traces that make up the dry day. When you do this, you will sometimes notice one or two traces that simply do not fit with the rest of the dry days. They passed the global rainfall test, because they were not preceded by rainfall, and they passed the global average test, because they had normal averages. However, the shapes of their diurnal curves do not fit with the other dry days.

Although it is easy to see the problem in the when you plot traces in Dry Day window, it can be difficult to find the date of the problem day using the Trace window alone. Sliicer has a function that helps you find the date of a bad trace. You use the Ctrl key with the mouse to click on and highlight the bad day in the Dry Day window. Sliicer also highlights the day in the trace window so you can easily find the date. Then you can eliminate it from the dry day set by clicking on it in the Trace window and replotting.

➔ **To find a trace in the dry day window**

1. Plot the traces for the day group you want to inspect
2. Place the mouse near a unique point on the trace you want.
3. Hold the Ctrl key down, and click the ***left*** mouse button.



Sliicer highlights the closest trace in red. It also marks the day in the trace window with a red band below the day.

➔ **To un-highlight a trace**

1. Place the mouse near a unique point on the highlighted trace.
2. Hold the Ctrl key down, and click the ***right*** mouse button.

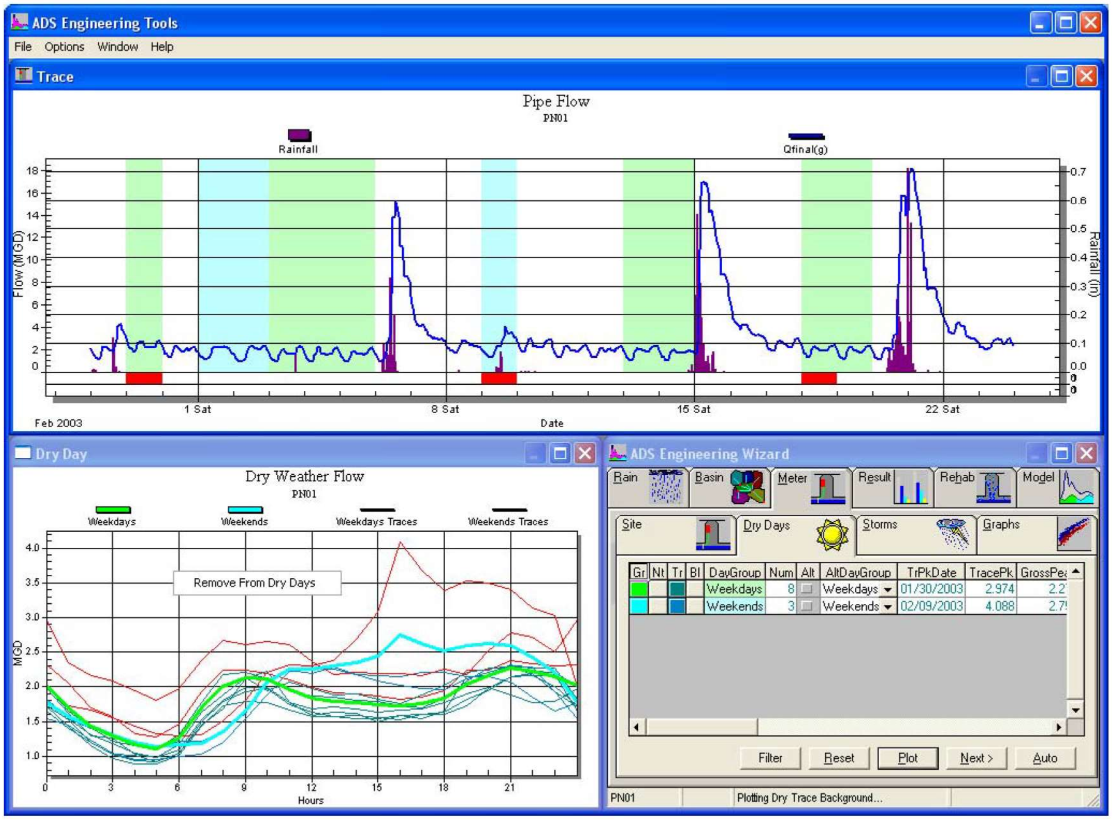
Removing Selected Traces from Dry Day Designation

Once you have selected day traces in the dry day graph window, you can remove the selected days from dry day designation.

Although it is easy to see the problem in the when you plot traces in Dry Day window, it can be difficult to find the date of the problem day using the Trace window alone. Sliicer has a function that helps you find the date of a bad trace. You use the Ctrl key with the mouse to click on and highlight the bad day in the Dry Day window. Sliicer also highlights the day in the trace window so you can easily find the date. Then you can eliminate it from the dry day set by clicking on it in the Trace window and replotting.

➔ **To remove selected days from dry day designation**

1. Plot the traces for the day group you want to inspect
2. Select the traces for the days you want to remove.
3. Single left click the mouse in the dry day graph window.



A popup menu appears in the dry day graph window with the single option "Remove From Dry Days"

4. Select the option "Remove From Dry Days".

A confirmation message box appears.

5. Click Yes to remove the selected traces from dry day designation.

Calculating Base Infiltration

Sliicer gives you a number of ways to control the base infiltration calculation. First you can select from four different equations to calculate base infiltration. You set the base infiltration calculation method in the WWMethod column of the Dry Days table. The four methods Sliicer supports are shown below.

WWMethod Setting	Expanded Formula
WW=(A-M)/x%	Waste Water = (Average - Minimum)/Factor
BI = x% * Min	Base Infiltration = Factor * Minimum
WW = x% * Avg	Waste Water = Factor * Average
Stevens/Schutzbach	$BaseInfiltration = \dfrac{0.4 \times MDF}{\left(1 - \left(0.6 \times \left(MDF/ADF\right)^{(MDF)^{0.7}}\right)\right)}$

All four of these methods can be used to calculate Base Infiltration and Waste Water Production. Waste Water Production and Base Infiltration are related by the following equation:

Total daily flow = Waste Water Production + Base Infiltration

In addition to setting the Base Infiltration calculation method, you can also set the factor used by the first three of the WWMethod equations. (The Stevens/Schutzbach method doesn't use a factor.) You set the factor in the Factor (x%) column of the Dry Days table.

➔ **To change the base infiltration method**

1. In the WWMethod column of the Dry Days table, choose the method you want to use.
2. In the Factor (x%) column set the factor.
3. If you want to see the Base Infiltration in the Dry Day window, click the "BI" button for the row you want to see and set the color.
4. Click the Plot button.

   Sliicer updates the Dry Days table with the new base infiltration and waste water production values, and displays a new base infiltration line if you selected a color using the "BI" button in the Dry Day Table.

Using the Storms Tab

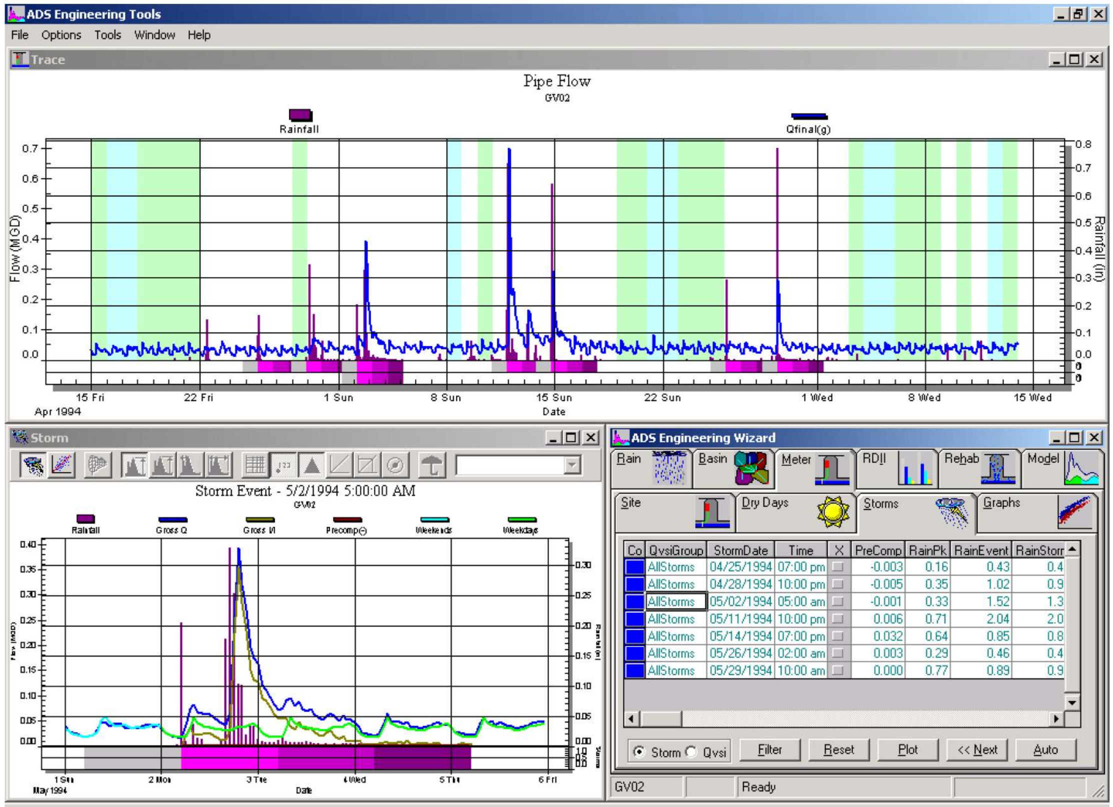
After you have completed your work in the Dry Days tab, you are ready to move to the Storms tab. Sliicer will not let you move to the Storms tab before you have completed work in the Dry Days tab because it needs the dry weather information to complete the wet weather calculations. Sliicer subtracts the dry weather average diurnal curves from the measured flow during storm events to determine the wet weather flow component.

➔ **To enter the Storms tab**

1. Make sure you have processed the dry weather calculations for a site.
2. Click the Storms tab.

   -OR-

   From the Dry Days tab, click the Next> button.



Sliicer moves to the Storms tab, and displays the Storm window.

Understanding the Storm Table

When you enter the Storms tab, Sliicer presents the results of the wet weather calculations in the Storm table. The meaning of the fields in the Storm table is shown below.

Co (Qvsi Group Color) Contains the color of the QvsiGroups to which the storm belongs.

QvsiGroup (Qvsi Group) Contains the name of the QvsiGroup to which the storm belongs.

StormDate (Storm Date) Contains the date a particular storm event start. All other information in this row of the Storm Table pertains to this storm event.

Time (Storm Start Time) Indicates the storm event start time associated with the current storm event.

X (Exclude) Select this checkbox to exclude this storm event from the RDI/I analysis. When an event is excluded, its flow values will not be subtracted from the downstream site when that site is netted, and RDI/I calculations for the downstream site will include both the flow and basin size parameters for this meter for this particular event.

PreComp (Pre-compensation) Displays the calculated pre-compensation value total for each storm event. The precomp is an arbitrary amount of time (usually 24 hours) preceding the storm start time that is used adjust the average dry flow to the current flow context.

RainPk (Rain Peak) Displays the maximum rainfall intensity for each storm event. This value is the hourly peak (assuming you are using 60 min steps), and does not include rolling rainfall intensity calculations.

RollRnPk (Rolling Rain Peak) Displays the peak hourly (assuming you are using 60 min steps) rainfall intensity calculated using the rolling rainfall technique. It is only displayed if you have activated the rolling rainfall calculations using the global options dialog.

RainEvent (Rain in Rain Event) Displays the rainfall total for the rainfall event that triggered the storm.

RainStrom (Rain Storm) Displays the rainfall total for the storm period only.

RainTotal (Rain Total) Displays the total rainfall for the entire storm event, including the storm period, and both recovery periods.

GroQPKEvt (Gross Quantity Peak) Displays the peak flow rate (mgd) for the complete event.

GroQVolEvt (Gross Quantity Volume) Displays the total flow volume (mg) for the complete event.

GroQPkSt (Gross Quantity Peak Storm) Displays the peak gross flow rate (mgd) for the storm period.

GroQVolSt (Gross Quantity Volume Storm) Displays the total volume (mg) for the storm period.

GroQPkR1 (Gross Quantity Peak Recovery 1) Displays the peak flow rate (mgd) for the first recovery period.

GroQVolR1 (Gross Quantity Volume Recovery 1) Displays the total volume (mg) for the first recovery period.

GroQPkR2 (Gross Quantity Peak Recovery 2) Displays the peak flow rate (mgd) for the second recovery period.

GroQVolR2 (Gross Quantity Volume Recovery 2) Displays the total volume (mg) for the second recovery period.

GroIIPkEvt (Gross Inflow/Infiltration Peak) Displays the peak I/I (mgd) for the complete event.

GroIIVolEvt (Gross Inflow/Infiltration Volume) Displays the I/I volume (mg) for the complete event.

GroIIPkSt (Gross Inflow/Infiltration Peak Storm) Displays the peak I/I (mgd) for the storm period.

GroIIVolSt (Gross Inflow/Infiltration Volume Storm) Displays the I/I volume (mg) for the storm period.

GroIIPkR1 (Gross Inflow/Infiltration Peak Recovery 1) Displays the peak I/I (mgd) for the first recovery period.

GroIIVolR1 (Gross Inflow/Infiltration Volume Recovery 1) Displays the I/I volume (mg) for the first recovery period.

GroIIPkR2 (Gross Inflow/Infiltration Peak Recovery 2) Displays the peak I/I (mgd) for the second recovery period.

GroIIVolR2 (Gross Inflow/Infiltration Volume Recovery 2) Displays the I/I volume (mg) for the second recovery period.

NetIIPkEvt (Net Inflow/Infiltration Peak) Displays the discrete I/I peak (mgd) for the current site for the complete event.

NetIIVolEvt (Net Inflow/Infiltration Volume) Displays the discrete I/I volume (mg) for the current site for the complete event.

NetIIPkSt (Net Inflow/Infiltration Peak Storm) Displays the discrete I/I peak (mgd) for the current site for the storm period.

NetIIVolSt (Net Inflow/Infiltration Volume Storm) Displays the discrete I/I volume (mg) for the current site for the storm period.

NetIIPkR1 (Net Inflow/Infiltration Peak Recovery 1) Displays the discrete I/I peak (mgd) for the current site for the first recovery period.

NetIIVolR1 (Net Inflow/Infiltration Volume Recovery 1) Displays the discrete I/I volume (mg) for the current site for the first recovery period.

NetIIPkR2 (Net Inflow/Infiltration Peak Recovery 2) Displays the discrete I/I peak (mgd) for the current site for the second recovery period.

NetIIVolR2 (Net Inflow/Infiltration Volume Recovery 2) Displays the discrete I/I volume (mg) for the current site for the second recovery period.

Viewing Different Storm Events

When you enter the Storms tab, Sliicer highlights the storm events in the trace window, displays a row of calculations for each storm event, and displays a detailed graph of the storm event in the Storm window. Only one storm at a time is displayed in the Storm Window. You can view other events in the Storm window in two ways.

➔ **To view different Storm Events using the Storm Table**

- In the Storm table, click the row of the storm event you want to view.

  The Storm window is updated with graphical information on the storm you selected.

➔ **To view different Storm Events using the Trace window**

- In the Trace window, single click the mouse above the x-axis in the date range of a storm event (any of the purple periods, not the gray period).

  The Storm window is updated with graphical information on the storm you selected.

Understanding Storm Events

Before you do any more work with the Storms tab, you should understand how Sliicer determines storm events. Sliicer uses the Global Storm Parameters to find storm events. These parameters are: Rainfall Threshold, Time Lapse, and Dribble. In order for Sliicer to identify a storm event, the Rainfall Threshold must be exceeded in continuous steps without a break longer than the Time Lapse. Sliicer starts checking for a storm event whenever the rainfall in a single step exceeds the Dribble. Rainfall in a single step less than the Dribble is ignored for the purposes of triggering a potential storm event.

When Sliicer first creates a storm event, it divides it into three periods called the Storm Period, Recovery 1, and Recovery 2. The default length of each period is 24 hours. Sliicer also assumes a 24 hour precomp zone immediately prior to the start of the storm event.

If you do not like the storm events that Sliicer selects, you have several options. You can change the global storm selection parameters and ask Sliicer to find new storm events. For more information on changing the global storm selection parameters, see Chapter 7, Customizing Sliicer.

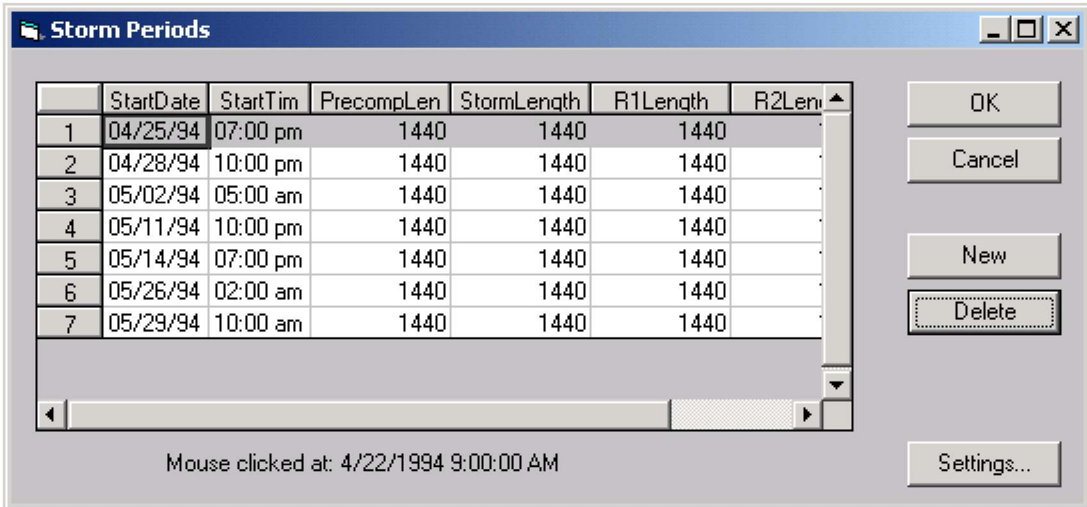
You can also change the individual storm events yourself. You can move the storm event start times, change the period lengths, add new storm events, or delete storm events.

Adding and Deleting Storm Events

You can add and delete storm events from the Meter Storms tab. You add and/or delete storm events manually when the storm events that Sliicer selects aren't what you want.

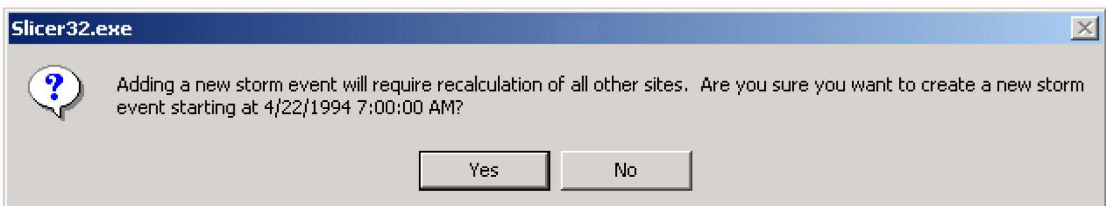
➔ **To add a new storm event**

1. Move to the Meter Storms tab.
2. In the Trace window, double click the mouse where you want to new storm event to start. (Don't worry if you don't get the start time exactly right in this step, you can always change it later)



The Storm Periods dialog appears with the time the mouse was clicked at the bottom.

3. To create a new storm event starting at that time, click the New button.



Sliicer will ask you to confirm erasing storm calculations for all sites.

4. Click the OK button.

Sliicer creates a new storm event starting at the time the mouse was clicked.

➔ **To delete an existing storm event**

1. In the trace window, double click the storm event you want to delete.

   The Storm Periods dialog appears.

2. Select the event you want to delete.

3. Click the delete button.

   Sliicer removes the event from the system for all sites.

Modifying Storm Events

Sliicer allows you to make changes to existing storm events. You can change storm event parameters that affect all sites, or parameters that affect only the current site.

Changing Global Storm Event Parameters

Several of the storm event parameters that Sliicer allows you to change have a global effect. These are the Storm Start Time and the Storm Event Period Lengths. If you change these parameters for one site, the change will apply to all sites. Sliicer keeps the start time and period lengths synchronized for all sites so that the you can make valid comparisons of different sites for the same storm event.

Note Global Event Parameters are different than the Global Storm Selection Parameters. Global Storm Selection Parameters tell Sliicer how to find storm events and determine the start time. In contrast, you set the Global Event Parameters the way you want. For more information on Global Storm Selection Parameters, see Changing Global Storm Parameters in Chapter 7, Customizing Sliicer.

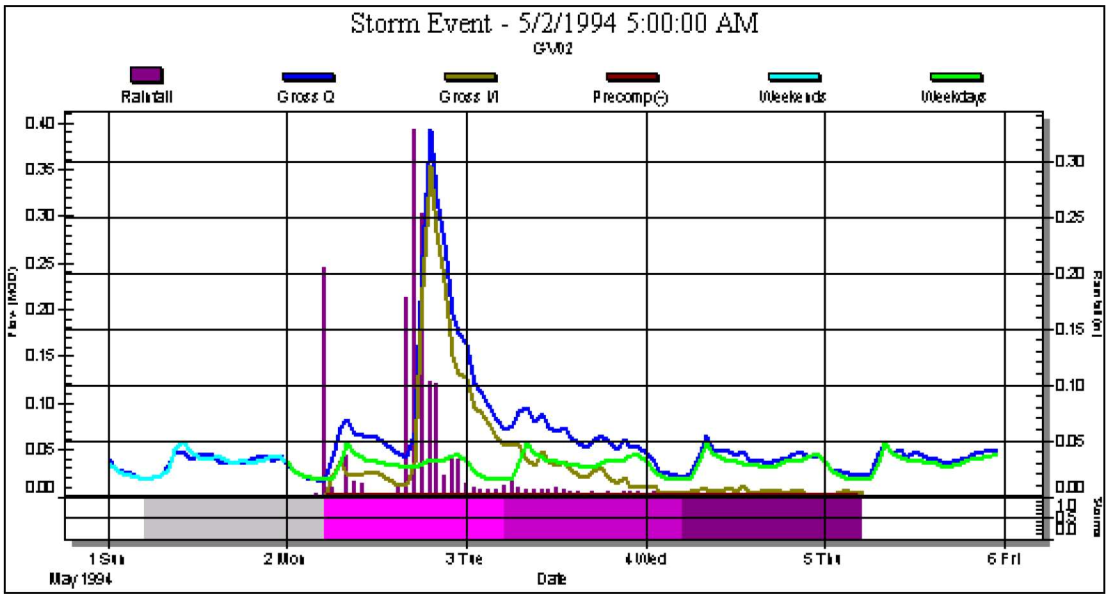
Changing the Storm Start Time

Sliicer allows you to change the Storm Start Time for any storm event. The Storm Start Time is a global parameter. Changing the Storm Start Time for any event causes Sliicer to recalculate storm events for all sites.

You can change the storm start time with the mouse, or by using the Storm Settings dialog.

➔ **To change the storm start time with the mouse**

1. In the Storm window, place the mouse on the left edge of the first purple band below the x-axis.

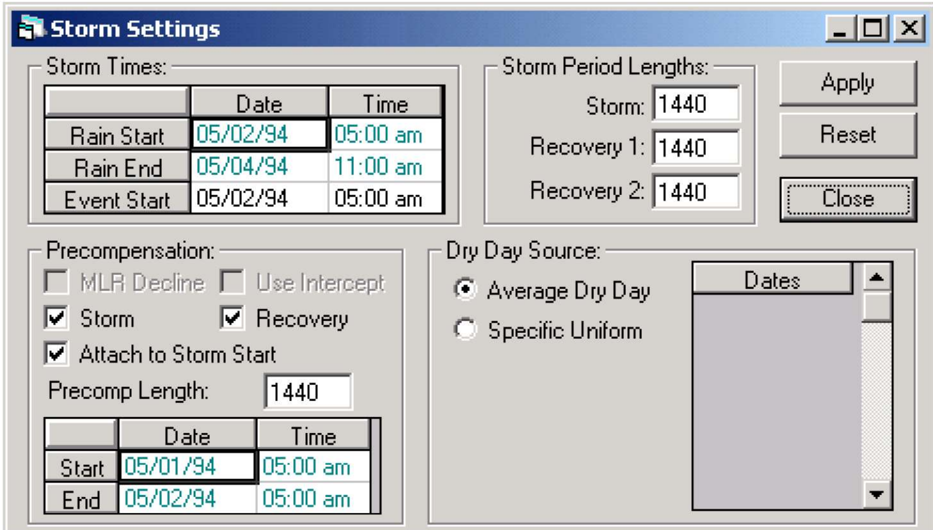


2. Click and hold down the mouse and drag it to the new start time.
3. Release the mouse.

   The Storm window will update the storm start time, and calculations will be changed for this event.

➔ **To change the storm start time with the Storm Settings dialog**

1. In the Storm window, double click the mouse above the x-axis.



The storm settings box appears.

2. In the Event Start row of the Storm Times table, change the date and/or time.
3. Click the Apply button.

   The Storm window will update the storm start time, and calculations will be changed for this event.

Period Lengths

Sliicer allows you to change one or more of the period lengths for any storm event. As in the case of the storm start time, the period lengths are global parameters. Changing the period lengths for any site changes the event for all sites. This in turn causes Sliicer to recalculate all wet weather events.

You can change the storm event period lengths either by dragging the mouse in the Storm window, or by using the Storm Settings dialog.

➔ **To change the period lengths with the mouse**

1. In the Storm window, place the mouse on the right edge of the any of the three purple bands below the x-axis.
2. Click and hold down the mouse and drag it to the new period end time.
3. Release the mouse.

   The Storm window will update the storm period length, and calculations will be changed for this event.

➔ **To change the period lengths with the Storm Settings dialog**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. Change the value in one or more Storm Period Lengths.
3. Click the Apply button.

   The Storm window will update the storm period lengths, and calculations will be changed for this event.

Changing Local Storm Event Parameters

Sliicer also allows you to change two storm event parameters that are local to a specific site: Precomp, and Dry Day Source. Changing these parameters only affects the current site, and therefore does not require recalculation of storm flows for all sites.

Precomp

Precomp is short for Pre-Compensation. Precomp is a way of moving the dry day diurnal curve shape up or down to compensate for flow conditions immediately preceding the storm event. The precomp period is an arbitrary amount of time (usually 24 hours) preceding the storm start time that is used adjust the average dry flow to the current flow context. The average flow of the precomp period is compared with the average flow of the dry day diurnal curve for the correct day group. The dry flows used to calculate the wet weather flow are then either boosted or dropped to reflect the difference between diurnal curve and the local flow context.

Sliicer gives you several options to control the precomp. You can change the length of the precomp period, attach or detach it from the storm start time. You can also remove outlier points within the procomp period for use in calculating the precomp one at a time. In addition, you can choose to precomp just the storm period, the whole event, or nothing at all. Several of these parameters can also be changed using the Mouse.

Using the Storm Settings Dialog...

➔ **To detach the precomp period from the storm start**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. In the Precompensation group, Un-check the Attach to Storm Start check box.
3. Click the Apply button.

   The precomp is detached from the storm start, and may be moved with the mouse, or with the start and end times in the Storm Settings dialog.

➔ **To change the precomp period length**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. In the Precompensation group, change Precomp Length field.
3. Click the Apply button.

   The Storm window will update the precomp length, and display the changes in the precomp, dry day, and I/I curves.

Note The way you change the precomp period length depends on whether the precomp is attached to the storm start or not. When the precomp is attached to the storm start, you use the Precomp Length field to change the precomp period length. When the precomp is not attached to the storm start, you use the precomp Start and End times to change the precomp period length.

➔ **To change the precomp period start and end times**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. In the Precompensation group, change the start time and/or end time.
3. Click the Apply button.

   The Storm window will update the precomp times, and display the changes in the precomp, dry day, and I/I curves.

➔ **To adjust the application of precomp**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. In the Precompensation group, check the Storm and/or Recovery check boxes.
3. Click the Apply button.

   The Storm window will update the precomp application, and display the changes in the precomp, dry day, and I/I curves.

Using the Mouse in the Storm Window...

➔ **To move the precomp period away from the storm start time**

1. In the Storm window, place the mouse in the center of the gray precomp zone.
2. Click and hold down the mouse and drag it to the new time.
3. Release the mouse.

   The Storm window will update the precomp times, and display the changes in the precomp, dry day, and I/I curves.

➔ **To change the precomp period start and end times**

1. In the Storm window, place the mouse on the edge of the gray precomp time (start or end) you want to change.
2. Click and hold down the mouse and drag it to the new time.
3. Release the mouse.

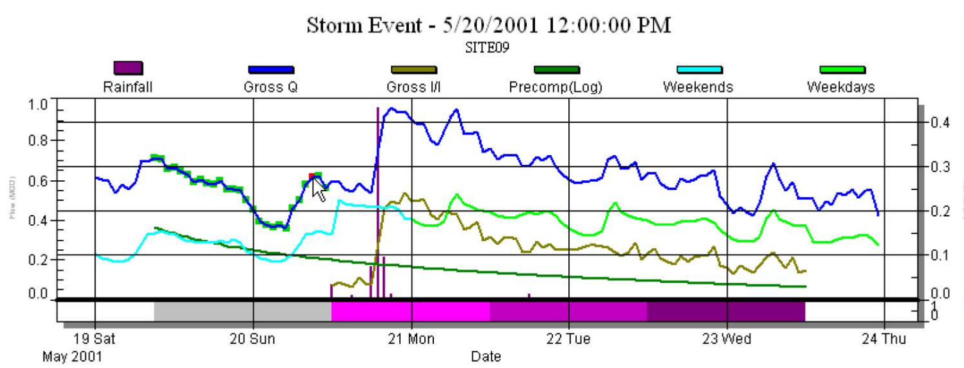
   The Storm window will update the precomp times, and display the changes in the precomp, dry day, and I/I curves.

Removing Outlier Precomp Calculation points

The points within the precomp period are marked with small solid boxes. The boxes for points used in the precomp calculations are colored green, and points that are not used in the precomp calculation are colored red. You can toggle points in an out of use in the precomp calculation by clicking the mouse on the box for the time step you want to change. When you change the calculation status of a point in the precomp period, Sliicer immediately updates the precomp and I/I curves in the storm graph.

➔ **To remove outlier points in the precomp period from use in the precomp calculation**

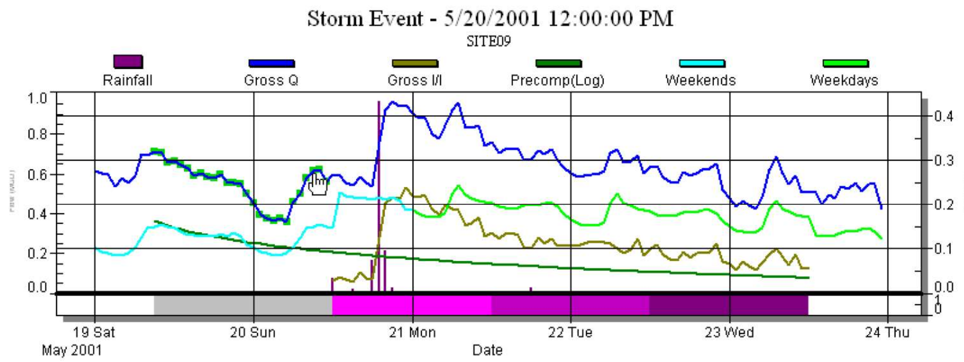
1. To remove a point outlier time step from use in the precomp calculation, click the green box for that time step.



   The box for the selected time step will turn red, indicating that it has been excluded from the precomp calculation, and the precomp line and the I/I curves will update.

➔ **To reinstate outlier points in the precomp period for use in the precomp calculation**

1. To remove a point outlier time step from use in the precomp calculation, click the green box for that time step.



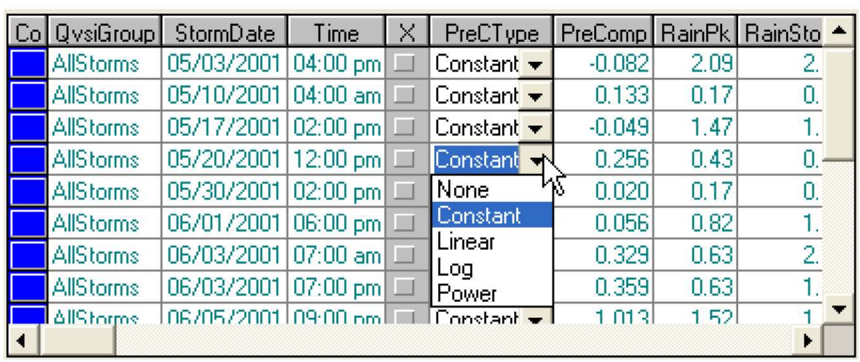
The box for the selected time step will turn red, indicating that it has been excluded from the precomp calculation, and the precomp line and the I/I curves will update.

Precomp Calculation types (fixed vs. declining)

In addition to controlling the precomp period, Sliicer also offers several calculation methods for applying the precomp value to the dry day curve. The default is a constant precomp, meaning that the precomp value is applied at a constant rate to the dry day curve through the whole storm period. In addition to the constant rate, Sliicer also offers three declining precomp methods, by curve fitting either a linear, log or power regression to the variation in the difference between the actual flow and the dry day average flow during the precomp period.

➔ **To change the precomp calculation type**

1. In the Storm table, click the drop down arrow in the column labled "PreCType" in the row of the storm for which you want to change the precomp calculation type.

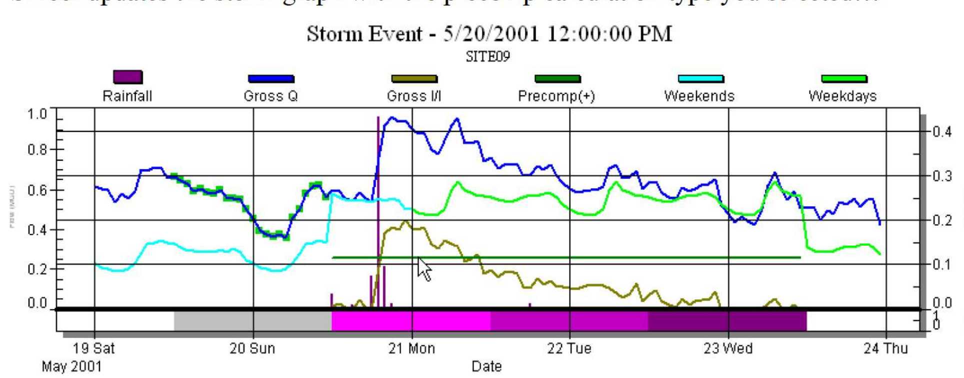


Co	QvsiGroup	StormDate	Time	X	PreCType	PreComp	RainPk	RainSto
	AllStorms	05/03/2001	04:00 pm		Constant	-0.082	2.09	2.
	AllStorms	05/10/2001	04:00 am		Constant	0.133	0.17	0.
	AllStorms	05/17/2001	02:00 pm		Constant	-0.049	1.47	1.
	AllStorms	05/20/2001	12:00 pm		Constant	0.256	0.43	0.
	AllStorms	05/30/2001	02:00 pm		None	0.020	0.17	0.
	AllStorms	06/01/2001	06:00 pm		Constant	0.056	0.82	1.
	AllStorms	06/03/2001	07:00 am		Linear	0.329	0.63	2.
	AllStorms	06/03/2001	07:00 pm		Log	0.359	0.63	1.
					Power			
	AllStorms	06/05/2001	09:00 pm		Constant	1.013	1.52	1.

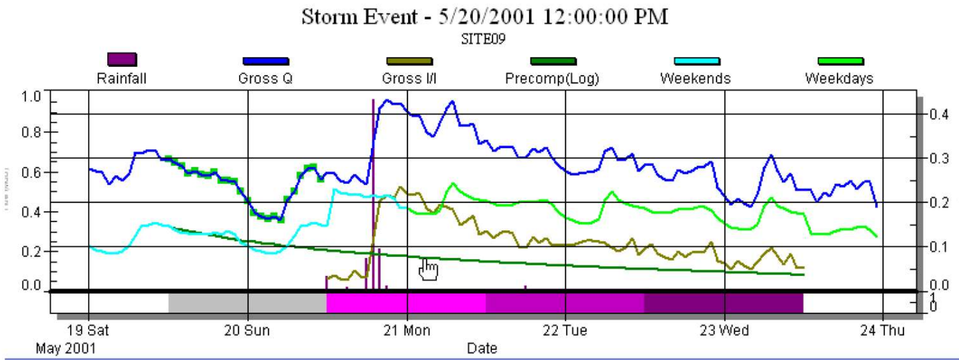
The list of precomp calculation options appears.

2. Click the precomp calculation method you want.

Sliicer updates the storm graph with the precomp calculation type you selected…



Storm before change with "Constant" precomp calculation type



Storm after change with "Log" precomp calculation type

…and updates calculations in the storm table based on the new precomp calculation type.

Dry Day Source

Sliicer allows you to choose from two types of dry day curves to estimate the dry weather flow during storm events. You can use the average diurnal curves for each day group derived in the Dry Days tab, or you can use an average of diurnal curves from one or more specific dry days that you select.

Sliicer defaults to using the average diurnal curves from the Dry Days tab. In almost all circumstances, this is the best setting. However, under some circumstances, such as when a diurnal anomaly precedes a storm event, and likely continued through the event, it may be preferable to use one or more of the anomalous dry days proceeding the storm event to determine the wet weather flow component.

➔ **To use specific dry days**

1. In the Storm window, double click the mouse above the x-axis.

   The storm settings box appears.

2. In the dry day source group, select Specific Uniform.

   The specific dry day table in enabled.

3. Add the first new row to the specific dry day table by double clicking the table header.

   -OR-

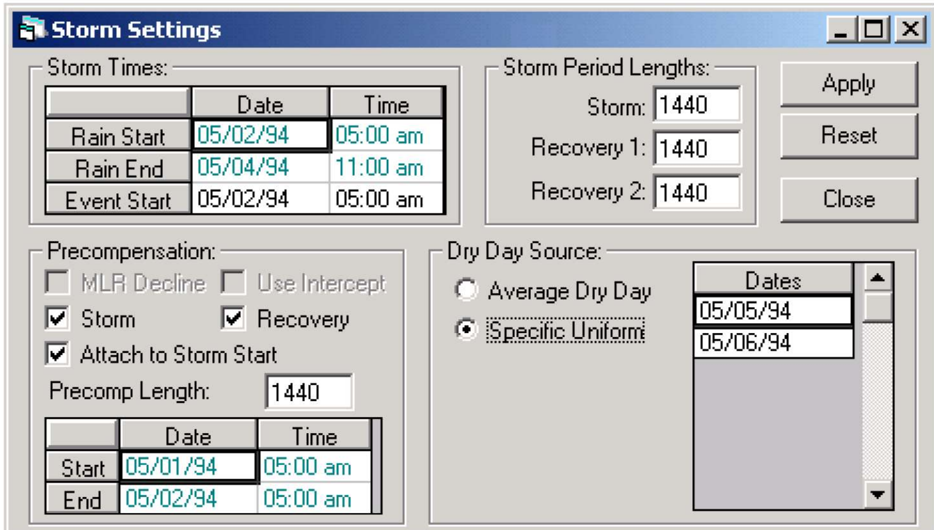
   Add a subsequent new row to the table by making a cell in the last row current, and then pressing the down arrow key on the keyboard.

4. Select the date cell of the new row.

5. Enter the date of the dry day you want to use.

   -OR-

   Click the day you want to use as the dry day in the trace window.



6. In the Storm Settings dialog, click the Apply button.

   Sliicer adjusts the dry day curve shown in the Storm window, and recalculates the I/I for the current storm.

Ignoring Storm Events

Sometimes, a monitor may not perform well on a specific storm due to sensor failure, or other factors. When the failure is of a nature that it would be better not to use the data from the site to calculate net values downstream, Sliicer allows you to ignore the site data for one or more storm events.

When you ignore a site's data for a specific storm event, Sliicer will not use the data for downstream nets. Instead, it uses the ignored meter's upstream sites. This increases the effective basin size of the downstream site, and has the effect of adding both the flow and basin size of the ignored meter into the downstream site. Both the extra flow and additional basin size will be used when normalized results are presented in the Results tab.

➔ **To ignore a site's data for a storm event**

- In the Storm Table, check the X column for the storm event you want to ignore.

  Sliicer will not use the values from the current site for net calculations on the downstream site.

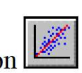
Using Q vs. i

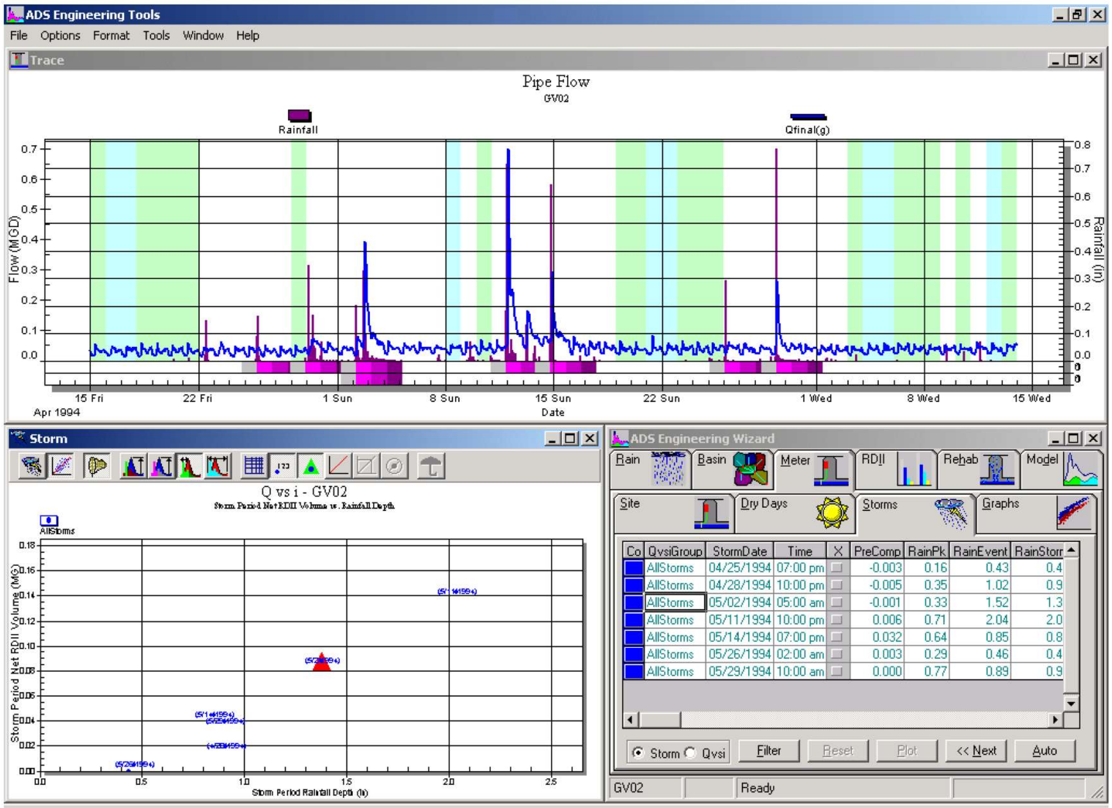
Once the Storm calculations have been performed for a site, Sliicer will give you information about the correlation between the wet flow component and the rainfall that caused the response. This correlation is known as Q vs. i.

Viewing Q vs. i

There are two modes of viewing the Q vs. i results: The Q vs. i table and the Q vs. i graph. When you are in the Storms tab, you can toggle between viewing either one or both of these Q vs. i displays.

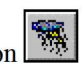
➔ **To view Q vs. i graph**

- In the Storms graph window, select the Q vs. i tool button  in the upper left.



Sliicer displays the Q vs. i window instead of the Storm window.

➔ To view the storm graph

- In the Storms graph window, select the Q vs. i tool button  in the upper left.

  Sliicer returns the display of the Storm window the storm events.

➔ To view the Q vs. i table.

- In the Storm tab, select the Qvsi radio button in the lower left of the Engineering Wizard screen.

Sliicer displays the Q vs. i table in place of the storm events table.

Co	Show	QvsiGroup	n	r2	t	UseAl	Equation
	✔	AllStorms	7	0.96	11.39		-0.04 + (0.09* Rain)

➔ To view the storm events table

- In the Storm tab, select the Storm radio button in the lower left of the Engineering Wizard screen.

Sliicer returns the display of the Storm window the storm events.

Co	QvsiGroup	StormDate	Time	X	PreComp	RainPk	RainEvent	RainStorr
	AllStorms	04/25/1994	07:00 pm		-0.003	0.16	0.43	0.4
	AllStorms	04/28/1994	10:00 pm		-0.005	0.35	1.02	0.9
	AllStorms	05/02/1994	05:00 am		-0.001	0.33	1.52	1.3
	AllStorms	05/11/1994	10:00 pm		0.006	0.71	2.04	2.0
	AllStorms	05/14/1994	07:00 pm		0.032	0.64	0.85	0.8
	AllStorms	05/26/1994	02:00 am		0.003	0.29	0.46	0.4
	AllStorms	05/29/1994	10:00 am		0.000	0.77	0.89	0.9

Types of Q vs. i

Sliicer supports several different types of Q vs. i. All forms of Q vs. i are correlations of the wet weather flow component and rainfall, but they each measure different aspects of the issue.

You can change between different Q vs. i types using the Q vs. i tool bar.

Viewing Gross and Net Q vs. i

You can view either the gross or the net Q vs. i in the Sliicer Q vs. i graph. Both net and gross Q vs. i use the same values for rainfall, but the Gross Q vs. i only mitigates the flow by dry day and precomp settings. The net Q vs. i values are mitigated by upstream wet weather flows, and give readings that better pertain solely to the current site.

➔ **To view net Q vs. i**

- Click the net button  in the Q vs. i toolbar to make sure it is down.

  Sliicer displays the net Q vs. i in the Q vs. i graph window.

➔ **To view gross Q vs. i**

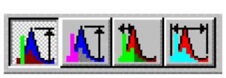
- Click the net button  in the Q vs. i toolbar to make sure it is up.

  Sliicer displays the gross Q vs. i in the Q vs. i graph window.

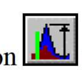
Viewing Peak vs. Peak Q vs. i

The Peak vs. Peak Q vs. i correlates the peak rainfall with the peak net I/I. If rolling peak rainfall has been enabled, the rain peak is a rolling peak. If it has not been enabled, Sliicer uses the peak hourly rainfall. For information on enabling the rolling peak rainfall, see Chapter 7, Customizing Sliicer.

The type of Q vs. i is controlled by Q vs. i type selection buttons in the Storm graph toolbar, shown below:



➔ **To view Peak vs. Peak Q vs. i**

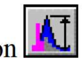
- Click the left most Q vs. i control button  in the Q vs. i toolbar.

  Sliicer displays Peak vs. Peak Q vs. i in the Q vs. i window.

Viewing Rain Total to Peak vs. Peak Q vs. i

The Rain Total to Peak vs. Peak Q vs. i correlates the rain total to the time of the peak net I/I with the peak net I/I.

➔ **To view Rain Total to Peak vs. Peak Q vs. i**

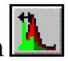
- Click the second Q vs. i control button  in the Q vs. i toolbar.

  Sliicer displays Rain Total to Peak vs. Peak Q vs. i in the Q vs. i window.

Viewing Rain Total vs. Volume (Storm Period) Q vs. i

The Rain Total vs. Volume (Storm Period) Q vs. i correlates the total rainfall with the net I/I volume for only the Storm period (usually the first 24 hours) of the event.

➔ **To view Rain Total vs. Volume (Storm Period) Q vs. i**

- Click the third Q vs. i control button  in the Q vs. i toolbar.

  Sliicer displays Total vs. Volume (Storm Period) Q vs. i in the Q vs. i window.

Viewing Rain Total vs. Volume (Total Event) Q vs. i

The Rain Total vs. Volume (Total Event) Q vs. i correlates the total rainfall with the net I/I volume for the complete storm event (usually 72 hours).

➔ **To view Rain Total vs. Volume (Total Event) Q vs. i**

- Click the fourth Q vs. i control button  in the Q vs. i toolbar.

  Sliicer displays Rain Total vs. Volume (Total Event) Q vs. i in the Q vs. i window.

Removing Storms From Q vs. i

From time to time, you may find that particular storms distort the Q vs. i analysis. There may have been a problem with a rain gauge or the monitor, or some other anomalous hydraulic phenomena taking place at the time of the storm that caused the meter to record an uncharacteristic response during a storm event.

In such a case you may want to remove a storm from the Q vs. i analysis. You do this by using the "P" (Peak) and "V" (Volume) check box fields in the Storm table. All the checked storms will be used in the Q vs. i analysis. If you don't want to use a storm in the Q vs. i analysis, you uncheck the "P" column for the first two types of Q vs. i, and "V" for second two types of Q vs. i.

➔ **To remove a storm from Q vs. i analysis**

1. In the Storm table, uncheck the storm you want to remove. Uncheck the "P" column for the first two types of Q vs. i, and the "V" column for the second two types of Q vs. i.
2. Change rows.

   Sliicer deletes the unchecked storm from the Q vs. i analysis.

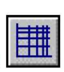
Customizing the Q vs. i Graph

Sliicer gives you a number of display options in the Q vs. i window. You can set the axis type to either linear or log scale. You can also hide or display any of the following: a regression line; date annotations on each point; highlighting of the current storm point; projection lines; and projection lines annotations.

Controlling the Scale (Linear vs. Log)

You can change the Q vs. i scale using the Q vs. i tool bar.

➔ **To change the Q vs. i scale**

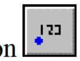
- Click the Scale button  on the Q vs. i toolbar.

Sliicer toggles the scale between linear and log scale. When the scale button is down, log scale is current.

Displaying Date Labels

Sliicer allows you to label each of the Q vs. i points with the storm date. This helps you know which point on the graph corresponds to each storm.

➔ **To display date labels**

- Click the Date Labels button  on the Q vs. i tool bar.

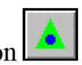
  Sliicer toggles the date labels on and off. When the Date Labels button is down, the date labels are displayed.

Highlighting the Current Storm

In default mode Sliicer highlights the current storm in the Q vs. i window. This makes it easier for you to see which storm in the Storm table and Trace window correspond to a point on the Q vs. i graph.

However, when you want to print the Q vs. i graph, the highlight is out of context and doesn't look good on the plot. To remedy this, Sliicer allows you to turn the current storm highlighting off.

➔ **To turn off the current storm highlighting**

- Click the Highlight Current Storm button  on the Q vs. i tool bar.

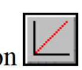
  Sliicer toggles the current storm highlighting on and off. When the Highlight Current Storm button is down, the current storm is highlighted.

Displaying a Regression Line

Sliicer allows you to display a regression line on the Q vs. i graph. You can use this line for projecting the wet flow component for an arbitrary rain event.

Warning The reliability of projecting flow from rainfall is affected by many things, such as the number of storms evaluated, and the hydraulics at the monitor site and downstream sites, etc. Although Sliicer allows you to create and use a regression line, you must use sound engineering judgment in determining the reliability of any projections you make using this line.

➔ **To display a regression line**

- Click the Regression Line button  in the Q vs. i tool bar..

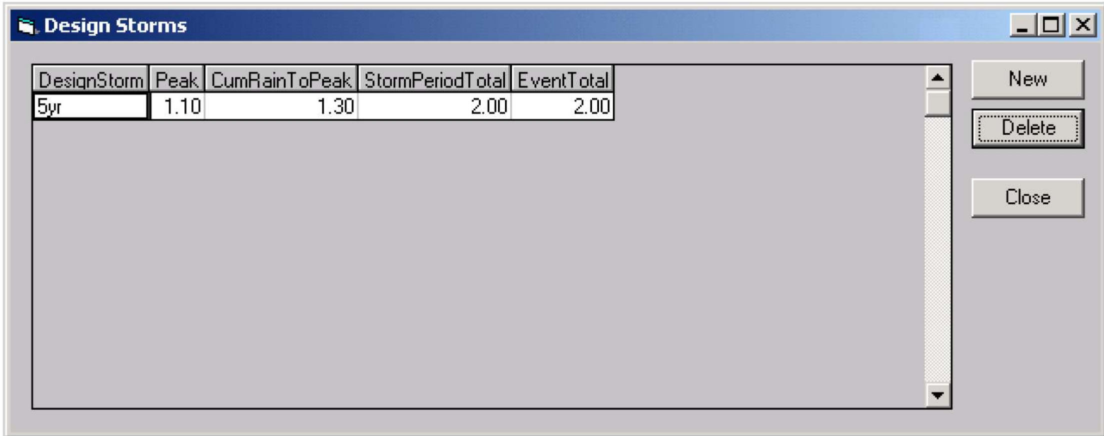
  Sliicer toggles the regression line on and off. When the Regression Line button is down, the regression line is displayed.

Displaying Projection Lines

When the regression line is displayed, Sliicer also allows you to plot projection lines that show the projected net I/I for a hypothetical rainfall. In order to plot projection lines, you must first create a design storm. Sliicer then allows you to project the net I/I from any of the design storm you created.

➔ **To create a design storm**

1. Click the Projection button .



The Design Storms dialog appears.

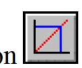
2. Click the New button to add a new row.
3. Enter a name (e.g. "5year") in the DesignStorm column.
4. Enter rainfall amounts for each of the Q vs. i types (Peak, CumRainToPeak, RainTotalStorm, RainTotalEvent).

Note The four rainfall values correspond to each of the four types of Q vs. i.

5. Click the Close button.

   Sliicer adds a design storm to the information database.

➔ **To display projection lines**

1. Make sure you have created at least one design storm.
2. Select the design storm you want to project in the design storm drop down list to the right of the Project button.
3. Click the Projection Line button  in the Q vs. i tool bar.

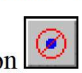
   Sliicer toggles the projection line on and off. When the Regression Line button is down, the regression line is displayed.

Note The Projection line button will only work if the regression line is displayed.

Hiding Q vs. i points

There are times when you may only want to view the regression line, and not the associated points for a Q vs. i display. This is especially helpful on long term data, when you clear the graph of noise so you can see the difference between the regression line for different Q vs. i groups (a topic yet to be discussed). In order to hide points, you must already be displaying the regression line. Hiding points without displaying the regression line is not allowed, because it would simply produce a blank graph.

➔ **To hide Q vs. i points**

1. Display either the regression line and/or the projection lines.
2. Click the Hide Points button  in the Q vs. i tool bar

   Sliicer hides the points and only displays the regression and/or projection lines.

Understanding Q vs. i groups

Sliicer allows you to divide your storms into different Q vs. i groups. This feature allows you to accomplish several different objectives in analyzing large quantities of flow data. Generally speaking, you can divide the storm events into different groups for Q vs. i analysis purposes, and Sliicer will do a different Q vs. i regression analysis on each group of storms. This enables you to compare the projected flow for different sets of storms. You might want to group storms by season, regime, year, storm duration, frequency or some other custom grouping.

Understanding Q vs. i Group Configurations

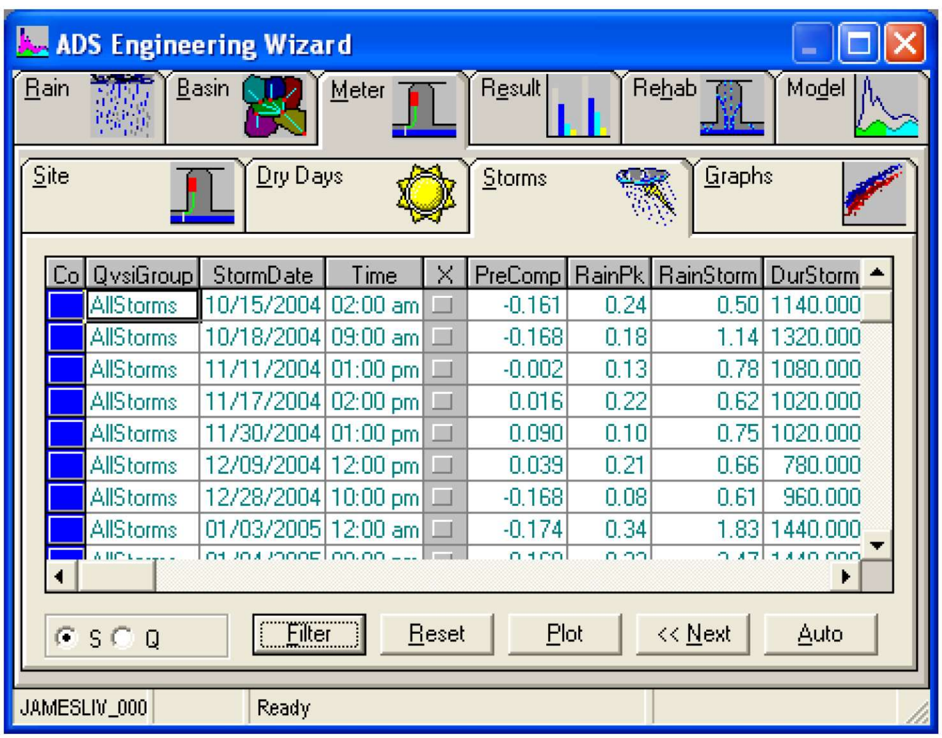
In addition to classifying storms into Q vs. i groups, Sliicer also allows you to assemble sets of Q vs. i groups into Q vs. i configurartions. Q vs. i configurations are a powerful tool for analyzing patterns in storm response. Using Q vs. i configurations allows you to group your storms by a number of different criteria, and to study which criteria best explain the variations in rainfall response.

Frequently, the rainfall response at a particular flow monitoring site will not fit a linear correlation. In these cases, there are other factors effecting the correlation. These factors can include the time of year, the amount of rainfall, the duration of the rainfall, the return period of the rainfall (frequency), the season of the year, before and after a rehab project, and changes from year to year in the collection system. It is the job of the engineer to determine which of these factors are in play effecting a particular correlation.

Sliicer allows you to create multiple Q vs. i group configurations to help you understand how your system is responding to rainfall. A Q vs i configuration is a container for a collection of Q vs. i groups. By using multiple Q vs. i configurations, you can quickly compare different theories on what is driving the response patterns to determine which parameters give the best explanation for to your collection system.

The AllStorms Q vs. i Configuration and Q vs. i Group

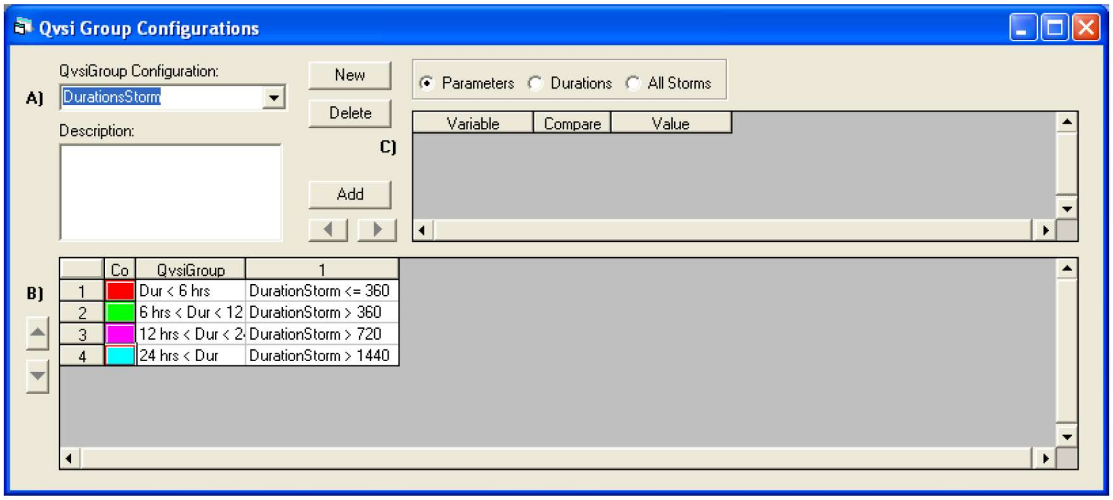
The first time Sliicer analyzes storms for a site, it will group all the storms into one Q vs. i group called "AllStorms" as shown below:



In some cases, the Q vs i correlation with all storms in one group is adequate, however, particularly when the flow monitoring period covers multiple seasons or years, a better Q vs. i correlation can be achieved by classifying the storms by common characteristics into the same Q vs. i group.

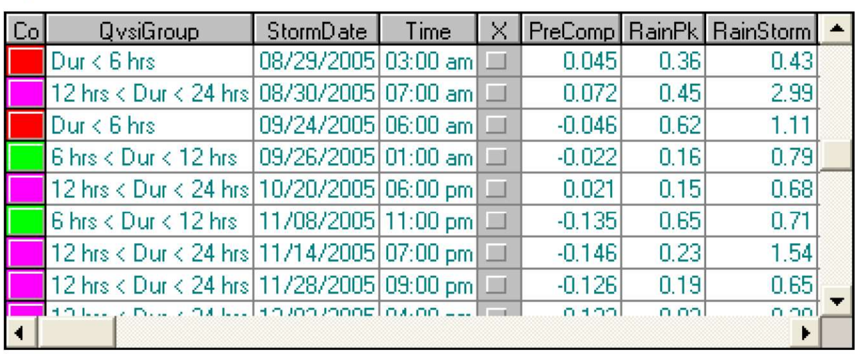
Understanding the Q vs. i Group Configurations dialog

In order to group storms together into Q vs. i groups by common features feature, you must first create the Q vs. i groups, and a Q vs. i configuration to hold them. To do this, you use the Q vs. i Group Configuration, shown below:



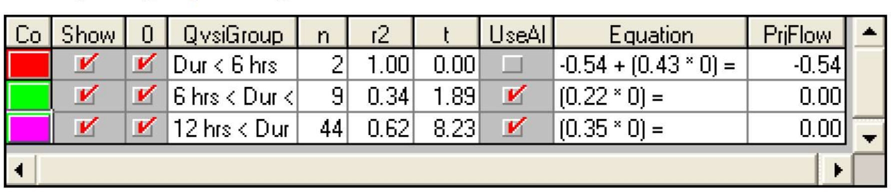
The Q vs. i Group Configuration dialog is a type of Human Viewing Speed (HVS) filter is similar to the day group HVS filter in concept. In both cases the purpose of the HVS filter is to provide a tool to quickly and easily classify large amounts of data into viewing categories to help you answer questions about your collection system. However, the function of each of the HVS filters, day group and Q vs. i are quite different. In the case of dry days, the point of the HVS filter is to help you group dry days according to day of week, season, regime and year to develop more accurate dry day averages. In the case of the Q vs. i Group Configuration HSV filter, the point is to group storm events into classes by common characteristics, such as seasons, regimes, years, rainfall amount or duration, etc.

When Sliicer does the Q vs. i analysis, it includes all the storms classified into one Q vs. i group in a separate regression set.



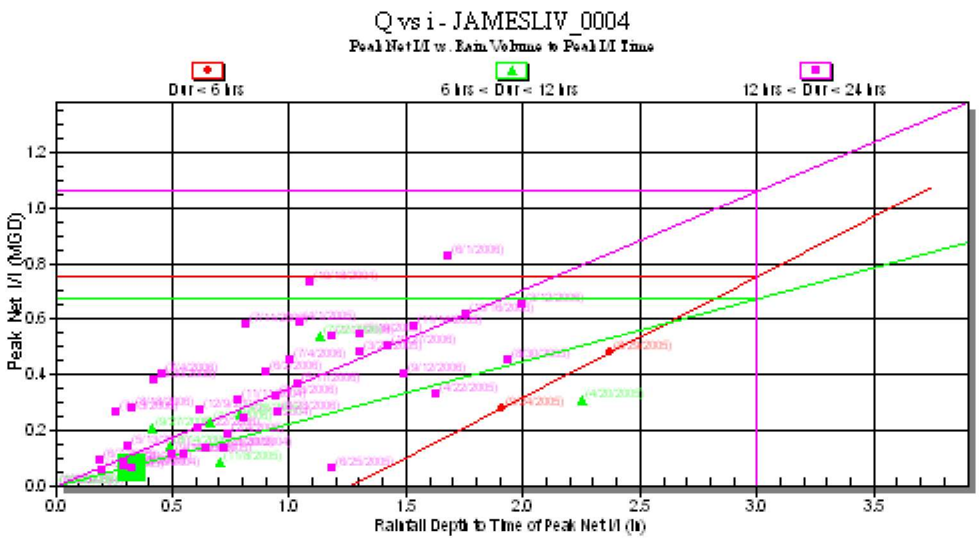
Co	QvsiGroup	StormDate	Time	X	PreComp	RainPk	RainStorm
	Dur < 6 hrs	08/29/2005	03:00 am		0.045	0.36	0.43
	12 hrs < Dur < 24 hrs	08/30/2005	07:00 am		0.072	0.45	2.99
	Dur < 6 hrs	09/24/2005	06:00 am		-0.046	0.62	1.11
	6 hrs < Dur < 12 hrs	09/26/2005	01:00 am		-0.022	0.16	0.79
	12 hrs < Dur < 24 hrs	10/20/2005	06:00 pm		0.021	0.15	0.68
	6 hrs < Dur < 12 hrs	11/08/2005	11:00 pm		-0.135	0.65	0.71
	12 hrs < Dur < 24 hrs	11/14/2005	07:00 pm		-0.146	0.23	1.54
	12 hrs < Dur < 24 hrs	11/28/2005	09:00 pm		-0.126	0.19	0.65

Each Q vs. i group is assigned a color…



Co	Show	0	QvsiGroup	n	r2	t	UseAl	Equation	PriFlow
	✓	✓	Dur < 6 hrs	2	1.00	0.00		-0.54 + (0.43 * 0) =	-0.54
	✓	✓	6 hrs < Dur <	9	0.34	1.89	✓	(0.22 * 0) =	0.00
	✓	✓	12 hrs < Dur	44	0.62	8.23	✓	(0.35 * 0) =	0.00

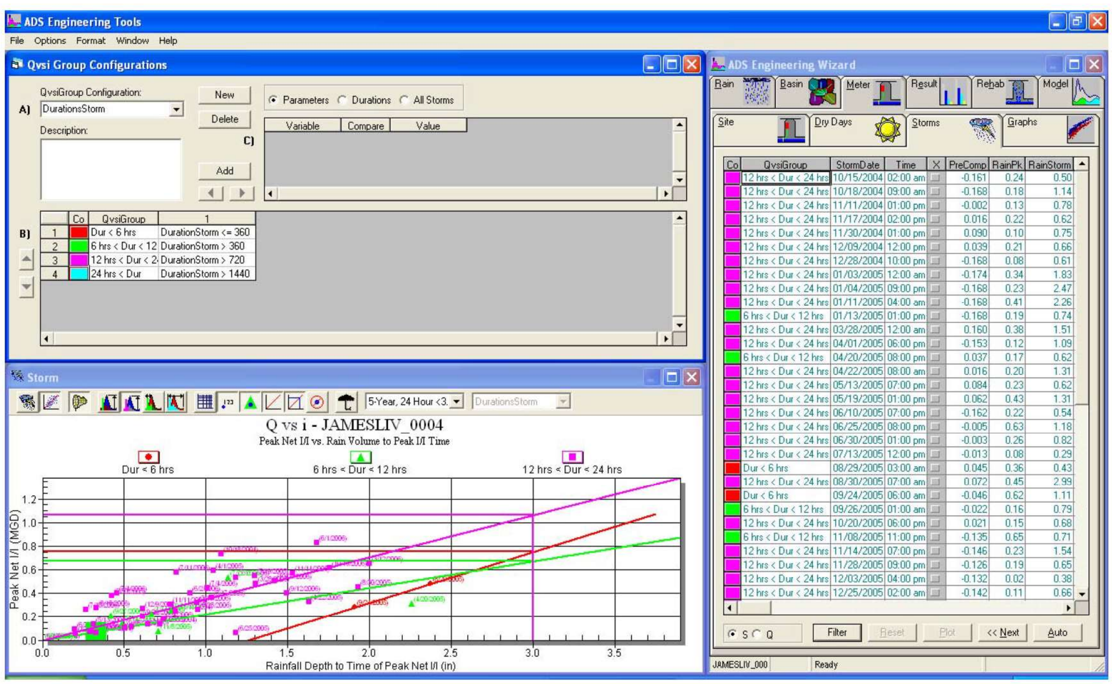
and the Q vs. i points for each storm in the Q vs. i group are plotted in that color…



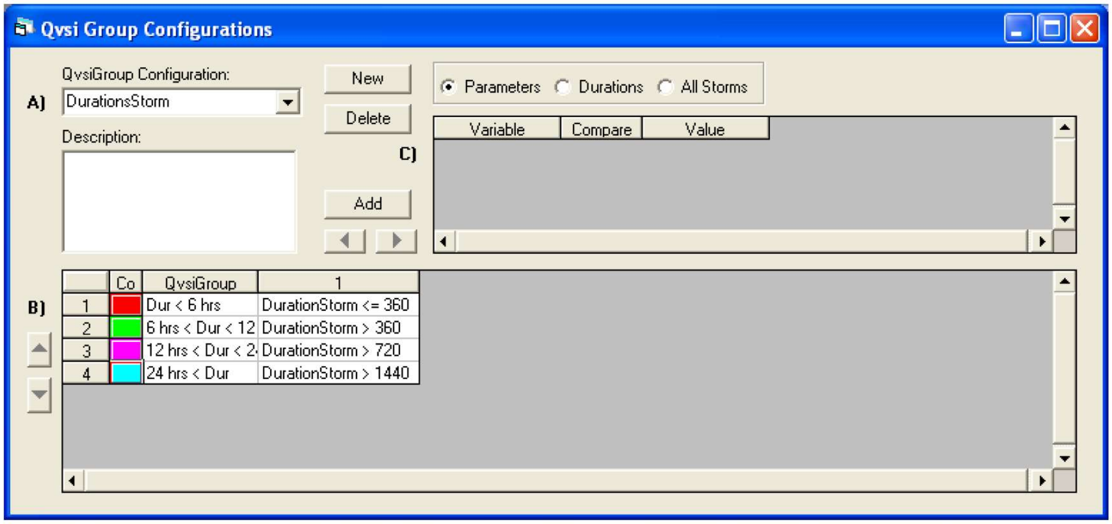
along with their accompanying regression line are plotted in that color.

Using the Q vs. i Group Configurations HVS Filter

When you start the Q vs. i Group Configurations HVS filter, Sliicer reconfigures the display to devote more screen area to the task of creating and organizing Q vs. i groups and configurations.



As can be seen above, more screen space is devoted to the table of storms, and the Q vs. i Configurations form completely replaces the hydrograph window.



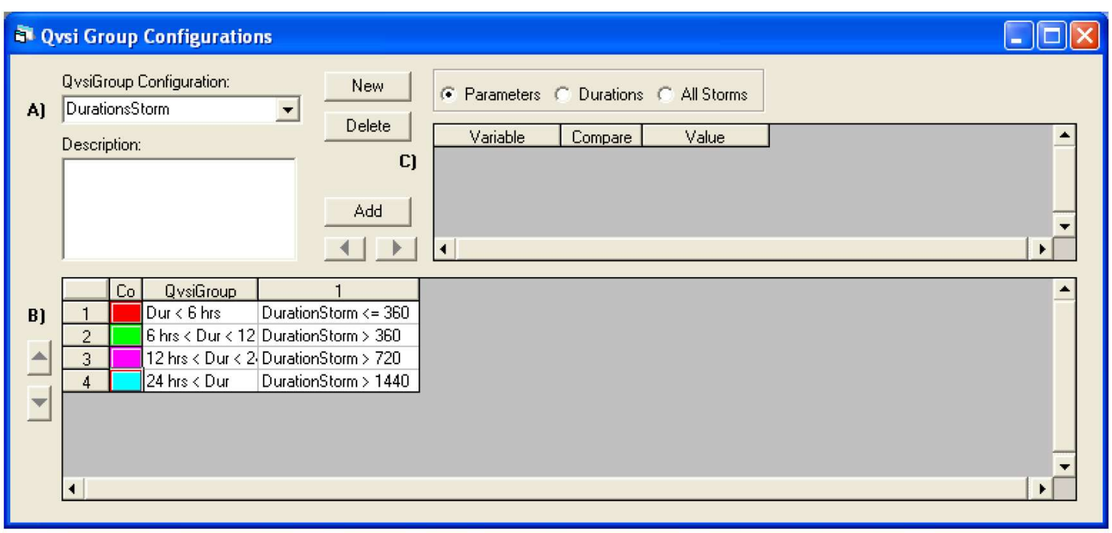
The Q vs. i Configuration dialog has three main parts, labeled on the form as A), B), and C). Part A) is the name of the Q vs. i configuration, which is the container for the Q vs. i groups. Along with the name, the Q vs. i configuration can also contain a description. The New and Delete buttons on this form pertain to creating and deleting Q vs. i configurations.

Part B) is the list of the Q vs. i groups for the configuration in focus. Each Q vs. i group has a name, a color, and one or more query conditions. The arrow buttons allow you to change the application order of both the Q vs. i groups and the queries within each group.

Part C) is the query creation table that allows you to create the queries that you associate with each Q vs. i group. The Parameters, Durations, All Storms radio buttons allow you to select the types of conditions you want to use to define the queries for the Q vs. i groups, and the Add button allows you to add the query you have constructed to the currently selected Q vs. i group.

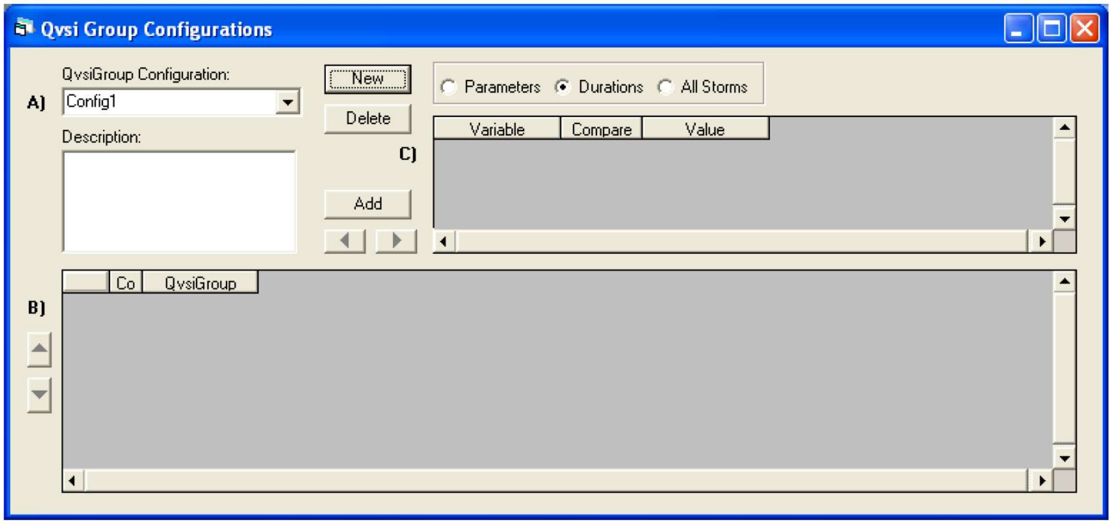
➔ **Step A) To create a new Q vs. i configuration, give it a name and a description**

1. From the Storm tab, click the Filter button.



The Q vs. i Group Configuration dialog appears.

2. Click the New button.

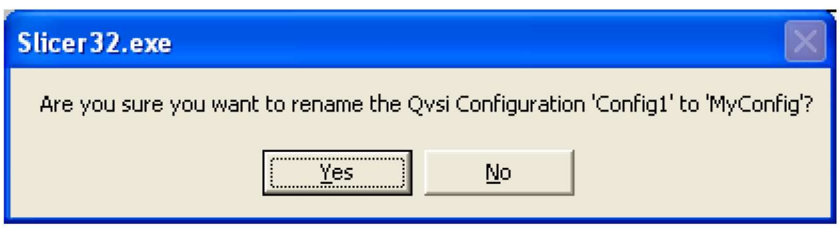


Sliicer adds a new Q vs. i configuration with an automatically assigned name.

3. Click on then QvsiGroup Configuration combo box.

4. Type the name you want for the new Q vs i. configuration

5. Press the enter key on the keyboard.



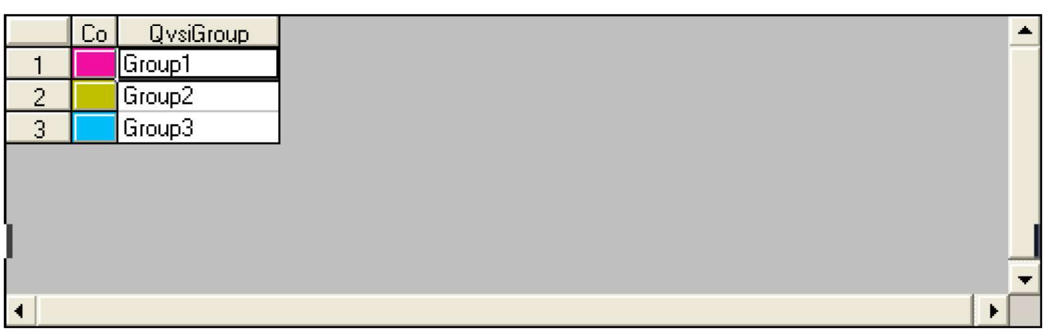
6. Click Yes to Change the name.

   Sliicer changes the name of the new Q vs. i configuration to the name you typed.

7. In the description text box, you may type a description of the Q vs. i configuration.

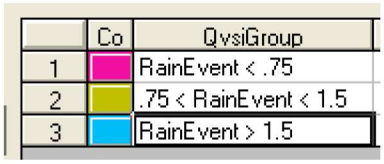
➔ **Step B) To add Q vs. i Groups to the configuration, and give them names**

1. Click the Q vs. i groups table to make it current, and press the down arrow on the keyboard once for each group you want to add.



   Sliicer adds a Q vs. i group to the table.

2. Select the automatic group name, and type a new name, that describes the Q vs. i Group.

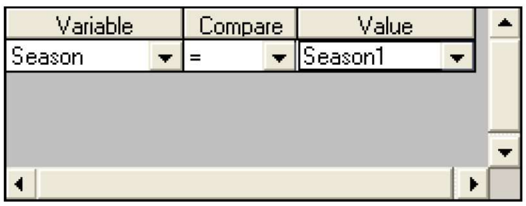


Sliicer changes the name of the Q vs. i groups to the name you type.

Note The Q vs. i group names are used for legend headers in the Q vs. i graph. Therefore it is important to use Q vs. i group names that describe the query conditions used to define the group in order to make the Q vs. i graph more readable.

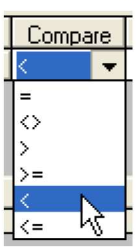
➔ **Step C) To add queries to the Q vs. i groups**

1. Click the query component table to make it current, and press the down arrow on the keyboard once for each query condition you want to add.



2. In the variable column, click the drop down arrow, and select the parameter you want to use for the query criterion.

3. In the compare column, select the type of comparison you want for the query component.



4. In the value column, type the value to which you wish to compare.

5. Click on the Q vs. i group in the Q vs. i group table to which you want to add the query condition to make it current.

6. Click the Add button.

Sliicer adds the query condition to the currently selected Q vs. i group.

5. Repeat the process of building and adding query components to each Q vs. i group in the configuration.

	Co	QvsiGroup	1
1		RainEvent < .75	(RainEvent < 0.75)
2		.75 < RainEvent < 1.5	(RainEvent > 0.75)
3		RainEvent > 1.5	(RainEvent > 1.5)

Working with Q vs. i Group Queries

Sliicer gives you a great deal of power and flexibility to assemble query conditions for your Q vs. i groups. You can combine query conditions with both logical AND and OR operators, delete conditions that you don't want, and sort the query conditions, all to give you the desired subset of storm events for each Q vs. i group.

Combining Query Conditions with a Logical AND Operator

In order to combine query conditions with a logical AND operator, you add multiple rows to the query component table before you add them to the Q vs. i group using the Add button.

➔ **To combine query conditions with a logical AND operator**

1. Click the query component table to make it current, and press the down arrow on the keyboard until you have two or more rows in the table.

Variable	Compare	Value
Season	=	Season1
Season	=	Season1

Note You must use the down arrow key on the computer keyboard, not the down arrow that appears in the first two columns of the query component table in order to add new rows to the table. Also, you must not be in edit mode of any of the cells in the table for the down arrow key on the keyboard to add a new row. If you are in edit mode in any cell in the table, the keyboard down arrow key will not add a new row, but will perform a function relative to the type of cell that is currently in edit mode. If the down arrow key on the keyboard doesn't add a new row, SINGLE click to another cell in the same row, and then press the down arrow key on the keyboard again. Sliicer will add a new row to the table.

2. Set the Variable, Compare and Value for each row in the query component table.

Variable	Compare	Value
RainEvent	>	0.750
RainEvent	<	1.500

3. In the Q vs. i composition table, click the Q vs. i group to which you want to add the new query condition.

4. Click the Add button.

	Co	QvsiGroup	1
1		RainEvent < 0.75	(RainEvent < 0.75)
2		0.75 < RainEvent < 1.5	(RainEvent > 0.75) AND (RainEvent < 1.5)
3		RainEvent > 1.5	(RainEvent > 1.5)

Sliicer adds the combined query condition to a single query cell for the selected Q vs. i group, joining the conditions with a logical AND operator.

Combining Query Conditions with a Logical OR Operator

In order to combine query conditions with a logical OR operator, you add query conditions from the query component table to the Q vs. i group using the Add button multiple times. These may be single or multiple line queries

➔ **To combine query conditions with a logical OR operator**

1. Set up the first query condition in the query condition table.

Variable	Compare	Value
Season	=	Winter

2. In the Q vs. i composition table, click the Q vs. i group to which you want to add the new query condition.

	Co	QvsiGroup
1		WinterFall
2		SpringSummer

3. Click the Add button.

	Co	QvsiGroup	1
1		WinterFall	(Season = 'Winter')
2		SpringSummer	

4. Set up the second query condition in the query condition table.

Variable	Compare	Value
Season	=	Fall

5. In the Q vs. i composition table, click the Q vs. i group to which you want to add the new query condition.

	Co	QvsiGroup	1
1		WinterFall	(Season = 'Winter')
2		SpringSummer	

6. Click the Add button.

	Co	QvsiGroup	1	2
1		WinterFall	(Season = 'Winter')	(Season = 'Fall')
2		SpringSummer		

Sliicer adds the combined second query condition to a new column for the selected Q vs. i group.

Note Although the logical operator is not explicitly stated for this configuration, the logical operator joining multiple query condition columns in the Q vs. i query composition table is always a logical OR operator.

Deleting a Query Condition from the Q vs. i Composition

You can delete query conditions from the composition of a Q vs. i group at any time. You may want to delete a query condition if you add the condition to the wrong Q vs. i group, make a mistake in the definition of the query condition, or if you change your mind about the composition of the Q vs. i group.

➔ **To delete a query condition**

1. Click the cell of the query component you want to delete in the Q vs. i composition table.

	Co	QvsiGroup	1	2
1		WinterFall	(Season = 'Winter')	(Season = 'Summer')
2		SpringSummer		

2. Press the delete key on the computer keyboard.

	Co	QvsiGroup	1
1		WinterFall	(Season = 'Winter')
2		SpringSummer	

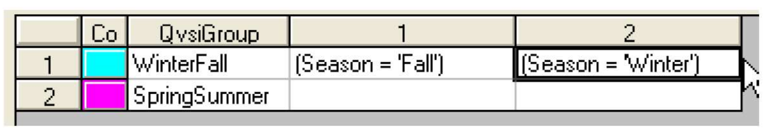
Sliicer deletes the query condition you selected from the Q vs. i group.

Sorting Query Conditions in Q vs. i Groups

You can sort query conditions from the composition of a Q vs. i group in the most logical order by using the query sort arrow buttons above the Q vs. i composition table.

➔ **To sort query conditions**

1. Click the cell of the query component you want to sort in the Q vs. i composition table.

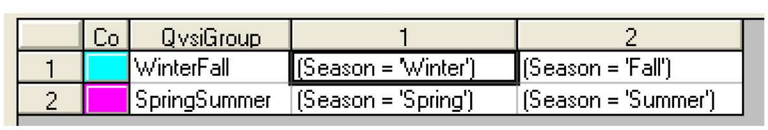


	Co	QvsiGroup	1	2
1		WinterFall	(Season = 'Fall')	(Season = 'Winter')
2		SpringSummer		

2. Click the query condition sort arrow to move the query condition to the location you want.

	Co	QvsiGroup	1	2
1		WinterFall	(Season = 'Fall')	(Season = 'Winter')
2		SpringSummer		

Sliicer moves the query condition in the direction you selected.



	Co	QvsiGroup	1	2
1		WinterFall	(Season = 'Winter')	(Season = 'Fall')
2		SpringSummer	(Season = 'Spring')	(Season = 'Summer')

Understanding the Parameters, Durations and AllStorms Radio Buttons

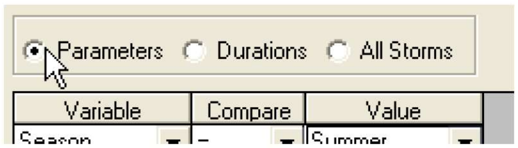
There are three types of query conditions that you can add to your Q vs. i groups: parameters from the storm table, return frequency values for various storm durations, and all the storms in the storm table. The parameters and duration fields are available for selection in the drop down list of the Variable column of the query component table. Storm table parameters are listed by their field name. Return frequency fields are listed by their duration in minutes, and are found in the bottom half of this list.

Parameters and Durations

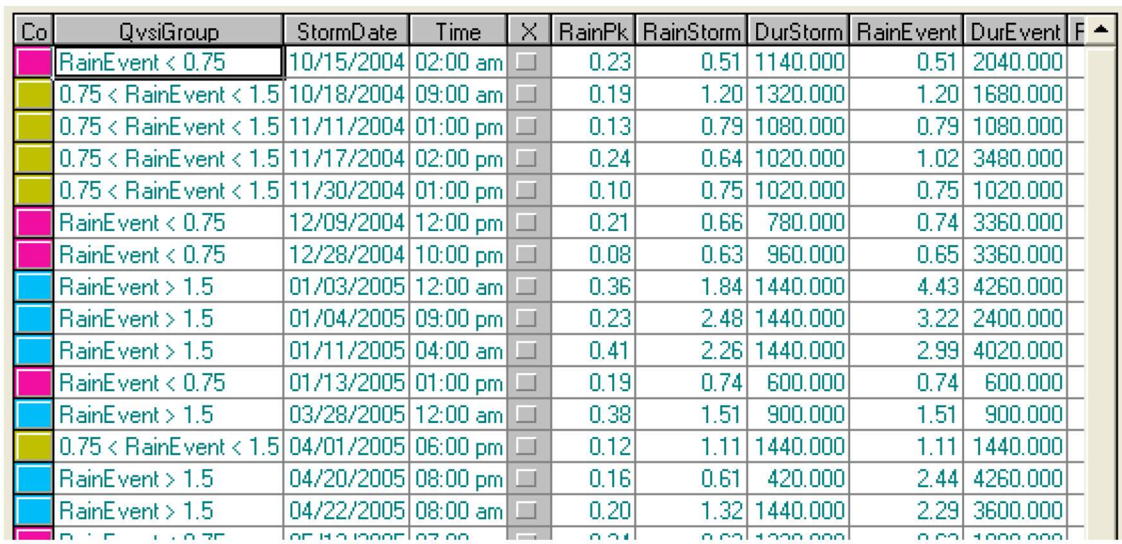
Frequently, it is helpful to see the values of the criteria variable for the storms in order to know how to set the value for the query condition. You can view the values of the criteria variable for any of the parameters in the storm table by using the parameters radio button. By using the durations radio button, you can view the values of the return frequency for a number of different durations.

➔ **To view the storm table parameters**

1. Select the Parameters radio button.



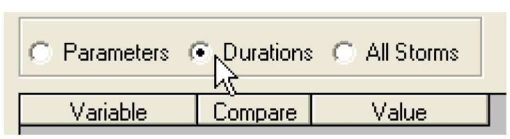
Sliicer displays storm table parameters in the Engineering Wizard table.



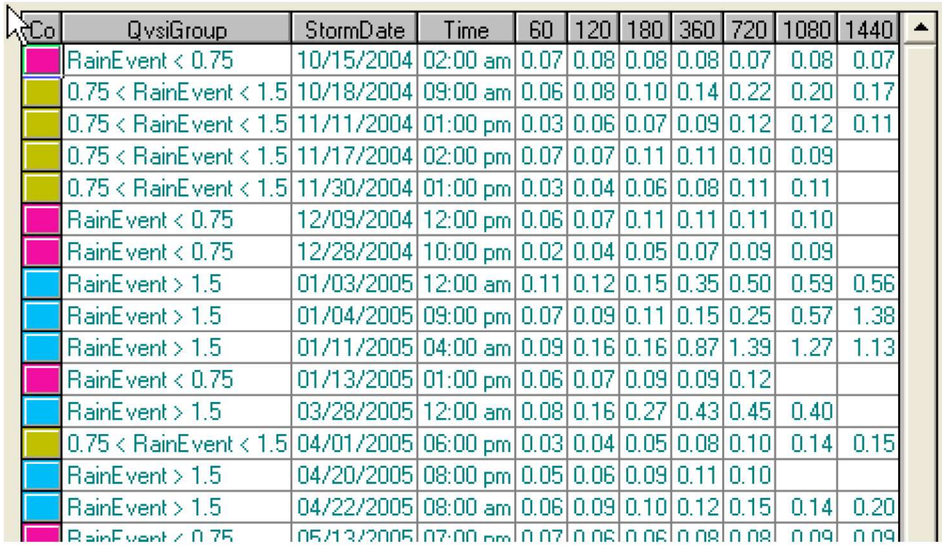
Co	QvsiGroup	StormDate	Time	X	RainPk	RainStorm	DurStorm	RainEvent	DurEvent
	RainEvent < 0.75	10/15/2004	02:00 am		0.23	0.51	1140.000	0.51	2040.000
	0.75 < RainEvent < 1.5	10/18/2004	09:00 am		0.19	1.20	1320.000	1.20	1680.000
	0.75 < RainEvent < 1.5	11/11/2004	01:00 pm		0.13	0.79	1080.000	0.79	1080.000
	0.75 < RainEvent < 1.5	11/17/2004	02:00 pm		0.24	0.64	1020.000	1.02	3480.000
	0.75 < RainEvent < 1.5	11/30/2004	01:00 pm		0.10	0.75	1020.000	0.75	1020.000
	RainEvent < 0.75	12/09/2004	12:00 pm		0.21	0.66	780.000	0.74	3360.000
	RainEvent < 0.75	12/28/2004	10:00 pm		0.08	0.63	960.000	0.65	3360.000
	RainEvent > 1.5	01/03/2005	12:00 am		0.36	1.84	1440.000	4.43	4260.000
	RainEvent > 1.5	01/04/2005	09:00 pm		0.23	2.48	1440.000	3.22	2400.000
	RainEvent > 1.5	01/11/2005	04:00 am		0.41	2.26	1440.000	2.99	4020.000
	RainEvent < 0.75	01/13/2005	01:00 pm		0.19	0.74	600.000	0.74	600.000
	RainEvent > 1.5	03/28/2005	12:00 am		0.38	1.51	900.000	1.51	900.000
	0.75 < RainEvent < 1.5	04/01/2005	06:00 pm		0.12	1.11	1440.000	1.11	1440.000
	RainEvent > 1.5	04/20/2005	08:00 pm		0.16	0.61	420.000	2.44	4260.000
	RainEvent > 1.5	04/22/2005	08:00 am		0.20	1.32	1440.000	2.29	3600.000

➔ **To view the return frequency of various durations**

2. Select the Durations radio button.



Sliicer displays return frequencies for various durations in the Engineering Wizard table.



Co	QvsiGroup	StormDate	Time	60	120	180	360	720	1080	1440
	RainEvent < 0.75	10/15/2004	02:00 am	0.07	0.08	0.08	0.08	0.07	0.08	0.07
	0.75 < RainEvent < 1.5	10/18/2004	09:00 am	0.06	0.08	0.10	0.14	0.22	0.20	0.17
	0.75 < RainEvent < 1.5	11/11/2004	01:00 pm	0.03	0.06	0.07	0.09	0.12	0.12	0.11
	0.75 < RainEvent < 1.5	11/17/2004	02:00 pm	0.07	0.07	0.11	0.11	0.10	0.09	
	0.75 < RainEvent < 1.5	11/30/2004	01:00 pm	0.03	0.04	0.06	0.08	0.11	0.11	
	RainEvent < 0.75	12/09/2004	12:00 pm	0.06	0.07	0.11	0.11	0.11	0.10	
	RainEvent < 0.75	12/28/2004	10:00 pm	0.02	0.04	0.05	0.07	0.09	0.09	
	RainEvent > 1.5	01/03/2005	12:00 am	0.11	0.12	0.15	0.35	0.50	0.59	0.56
	RainEvent > 1.5	01/04/2005	09:00 pm	0.07	0.09	0.11	0.15	0.25	0.57	1.38
	RainEvent > 1.5	01/11/2005	04:00 am	0.09	0.16	0.16	0.87	1.39	1.27	1.13
	RainEvent < 0.75	01/13/2005	01:00 pm	0.06	0.07	0.09	0.09	0.12		
	RainEvent > 1.5	03/28/2005	12:00 am	0.08	0.16	0.27	0.43	0.45	0.40	
	0.75 < RainEvent < 1.5	04/01/2005	06:00 pm	0.03	0.04	0.05	0.08	0.10	0.14	0.15
	RainEvent > 1.5	04/20/2005	08:00 pm	0.05	0.06	0.09	0.11	0.10		
	RainEvent > 1.5	04/22/2005	08:00 am	0.06	0.09	0.10	0.12	0.15	0.14	0.20
	RainEvent < 0.75	05/13/2005	07:00 pm	0.07	0.06	0.06	0.08	0.08	0.09	0.09

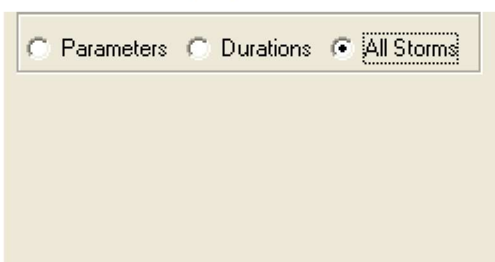
Using the AllStorms Query Condition

There are times when you may want to add all storms to one of your Q vs. i groups. You do this by adding the AllStorms query condition. When Sliicer applies query conditions for each Q vs. i group to the storm table, it does so in the order that the queries are listed in the Q vs. i group composition table. This means that, if a storm qualifies for membership in two Q vs. i groups, its final membership will be with the last Q vs. i group for which is qualified. You may leverage this feature as a short cut in the construction of a Q vs. i configuration. The most common use would be to add all storms to the first Q vs. i group of the configuration, and then use subsequent Q vs. i groups to select storms that qualify for a specific condition from that group to compare to the rest of the storms.

➔ **To use the AllStorms Query Condition**

1. Select the All Storms radio button.

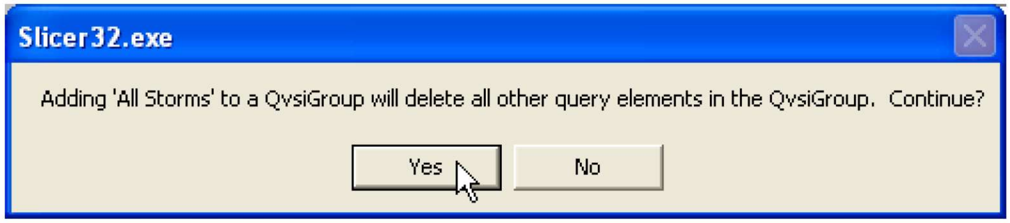
Sliicer hides the query condition table.



2. In the Q vs. i composition table, select the Q vs. i group you want to include all storms (usually the first.)

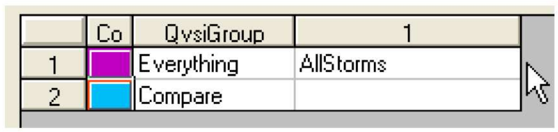
	Co	QvsiGroup
1		Everything
2		Compare

3. Click the Add button.



Sliicer notifies you that adding the All Storms query to a Q vs. i group will delete all other query components of that Q vs. i group.

4. Click the Yes button.



Sliicer adds the All Storms query condition to the Q vs. i group you selected.

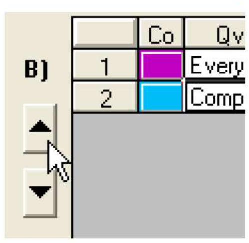
Q vs. i Group Order

You can adjust the order of the query conditions you add to your Q vs. i group by using the Query Sort buttons. Sliicer applies the query conditions of the Q vs. i groups to storms in the order they are listed in the Q vs. i composition table. Therefore, if a storm qualifies for more than one Q vs. i group, it will be assigned to the Q vs. i group furthest down the list in the Q vs. i composition table. You can change the assignment of storms that qualify for more than one Q vs. i group by changing the order of the Q vs. i groups in the Q vs. i composition table.

➔ **To change the Q vs. i Group Order**

1. In the Q vs. i group composition table, select the came of the Q vs. i group you want to change in the QvsiGroup column.

2. Click the Q vs. i group promotion or demotion button to move the Q vs. i group up or down in the list.



Sliicer promotes or demotes the Q vs. i group in the Q vs. i group composition table.

Deleting Q vs. i Configurations

You can delete query conditions from your Q vs. i groups at any time.

➔ **To delete a Q vs. i configuration**

1. Click the Delete button.

Sliicer asks you to confirm deletion of the Q vs. i Configuration.

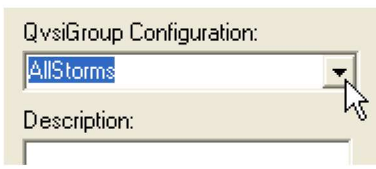
2. Click Yes to delete the Q vs. i configuration.

Changing the Current Q vs. i Configurations

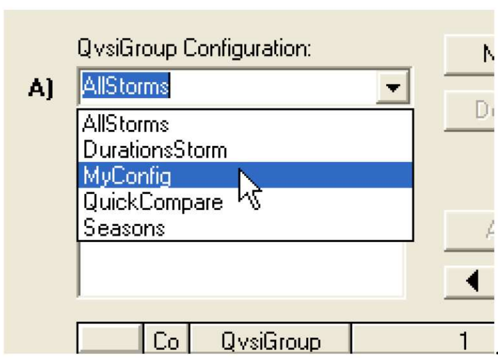
You can change the current Q vs. i configuration at any time, both from the Q vs. i Configuration dialog when you are building Q vs. i configurations, and from the Storm graph window when you are not.

➔ **To change the current Q vs. i configuration in the Q vs. i Configuration dialog**

1. Click the down arrow on the QvsiGroup Configuration combo box.



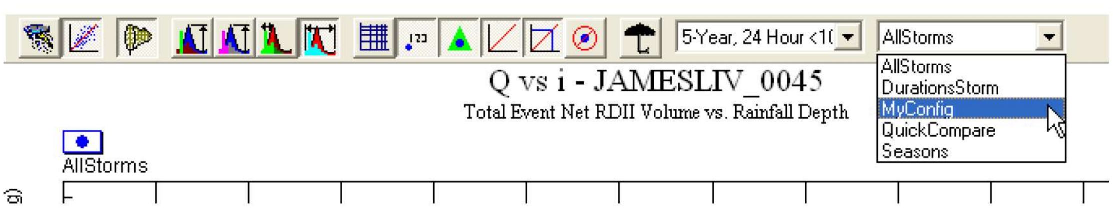
Sliicer shows a list of the available Q vs. i configurations.



2. Click the Q vs. i configuration you want to make current.

➔ **To change the current Q vs. i configuration from the storm graph window**

1. Click the down arrow of the Q vs. i configuration combo box on the storm graph window toolbar.



Sliicer shows a list of the available Q vs. i configurations.

2. Click the Q vs. i configuration you want to make current.

Note The Q vs. i configuration combo box in the storm graph window is disabled when the Q vs. i Configuration form is open. When the Q vs. i Configuration dialog box is open, use the Q vs. i configuration combo box in the Q vs. i Configuration form to change the current Q vs. i Configuration.

Understanding Q vs. i Exceptions

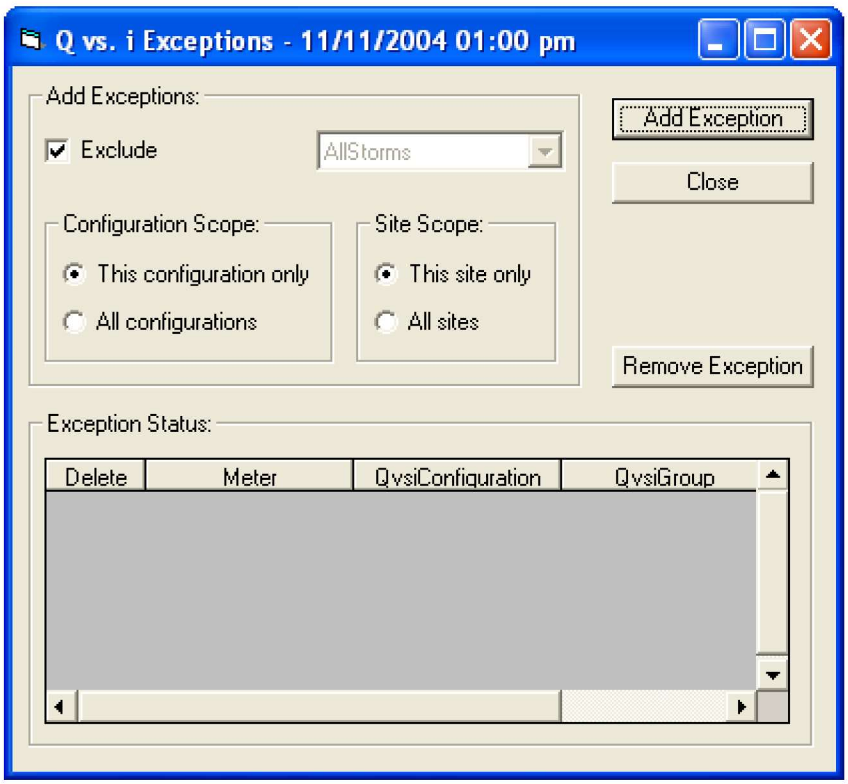
There are times when you may want exclude a particular storm from all Q vs. i group, or assign a storm to a specific Q vs. i group on an individual basis, apart from query conditions. When you do this, you create a Q vs. i group exception. You make this individual assignment from the storm table, not the Q vs. i Configuration form. You may also define the scope of the exception. When you define the scope of the exception, you set two parameters. First you set the exception to apply to either one specific Q vs. i configuration or to all configurations, and second, you set the exception to apply to just the current meter site, or to all sites. By setting these two parameters, you have four options regarding the scope of a Q vs. i exception: (1) limit it just to the current meter, and one Q vs. i configuration, (2) to the current meter for all Q vs. i configurations, (3) to all sites for the current Q vs. i Configuration, and (4) to all sites for all Q vs. i configurations.

Using Q vs. i Exceptions to Exclude Storms

The most common use of Q vs. i Exceptions is to exclude storms from all Q vs. i groups.

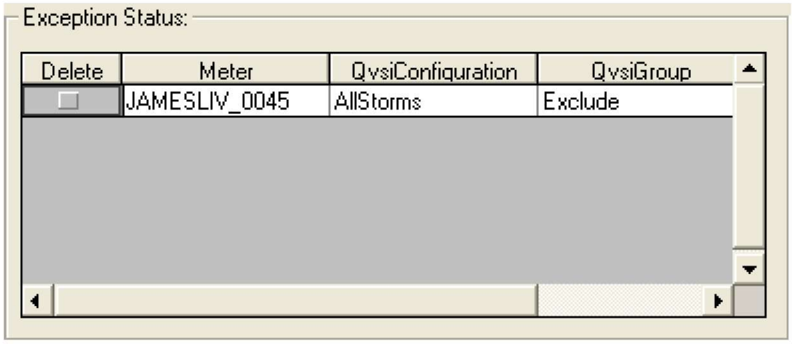
➔ **To Exclude a storm from Q vs. i group assignment**

1. In the storm table, click the Co (color) column for the storm for which you want to exclude from the Q vs. i groups.



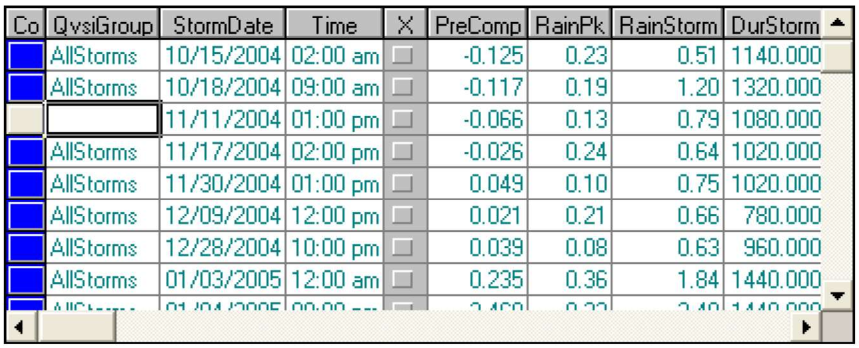
The Q vs. i Exceptions dialog appears.

3. Leave the Exclude checkbox checked.
4. Set the Configuration Scope and Site Scope to the values you want.
5. Click the Add Exceptions button.



Sliicer adds the exception to the Exception status list.

6. Click the Close button.



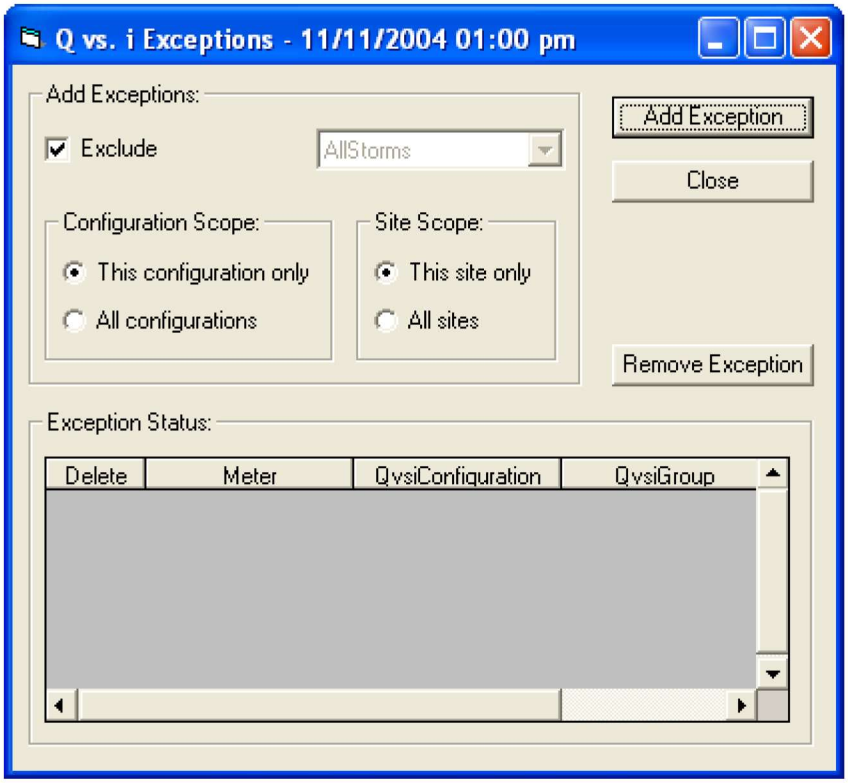
Sliicer removes the storm from Q vs. i groups.

Using Q vs. i Exceptions to Assign a Storm to a Q vs. i Group Manually

There are times when you may want to assign the Q vs. i group to storm on an individual basis. When you do this, you create a Q vs. i group exception. You make this individual assignment in the storm table, not the Q vs. i HVS filter.

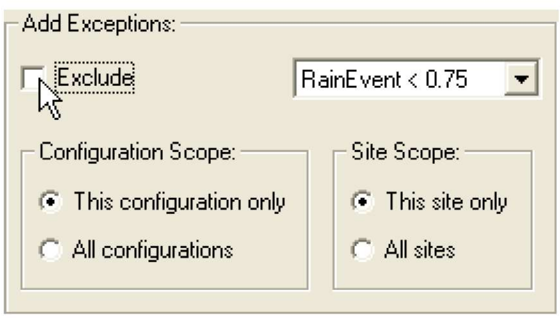
➔ **To assign a storm to a Q vs. i group manually**

1. In the storm table, click the Co (color) column for the storm for which you want to set the Q vs. i group manually.



The Q vs. i Exceptions dialog appears.

2. Uncheck the Exclude checkbox.



The Q vs. i group combo box is enabled.

3. Select the Q vs. i group to which you want to add the storm.

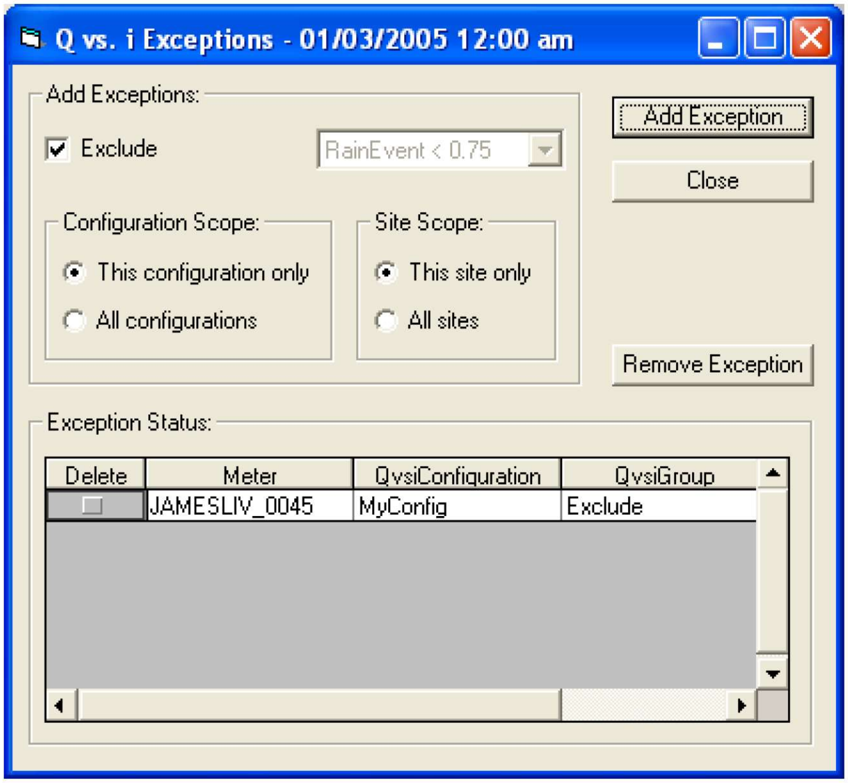
4. Set the Configuration Scope and Site Scope to the values you want.
5. Click the Add Exception button.
6. Sliicer changes the color button color for the storm you selected, and changes the name of the Q vs. i group to the name associated with that color.

Removing Q vs. i Exceptions

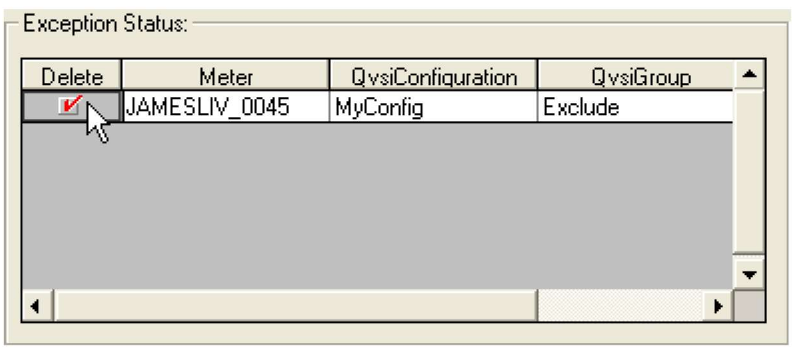
You can remove Q vs. i Group exceptions at any time.

➔ **To remove Q vs. i group exceptions**

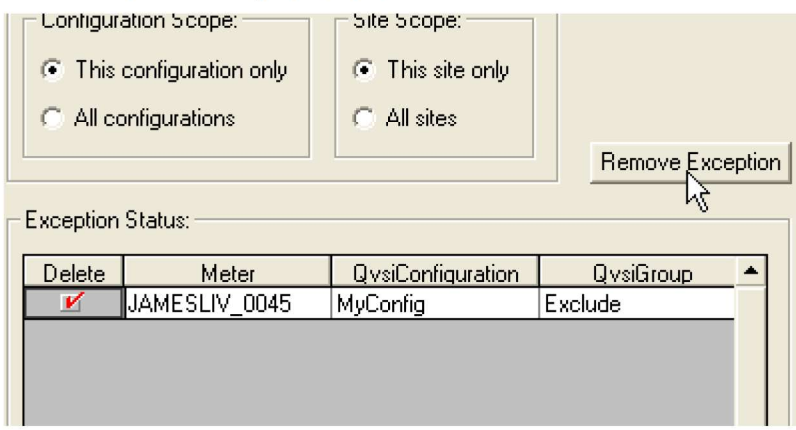
1. In the storm table, click the Co (color) column for the storm for which you want to remove the Q vs. i exception.



2. In the Exception Status table, click the Delete check box for the exception item you want to remove.



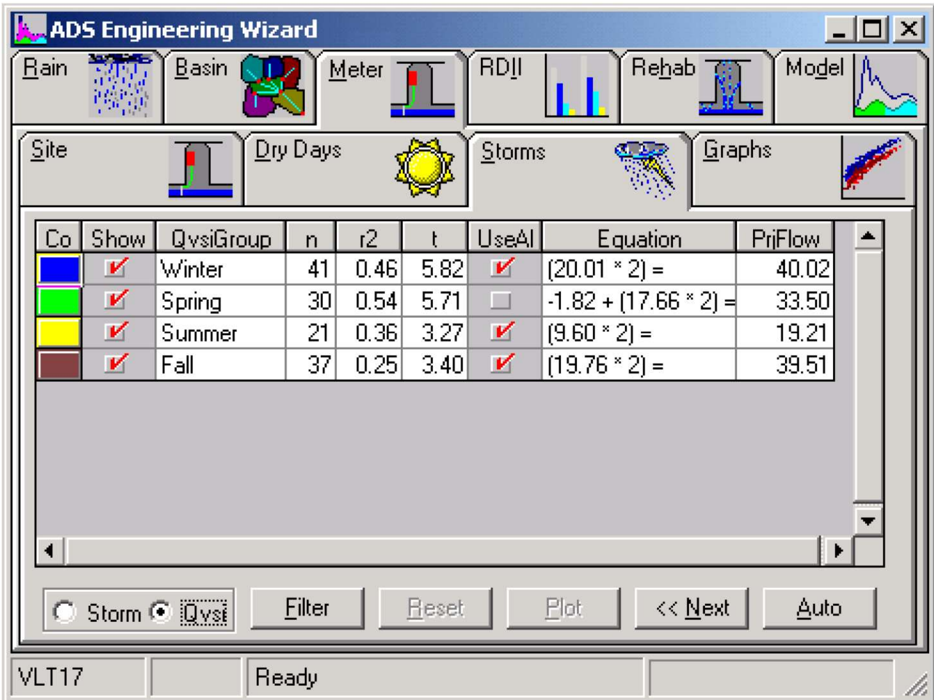
3. Click the Remove Exception button.



Sliicer removes the Q vs. i exception you selected and returns the storm to the Q vs. i group for which qualified by query conditions.

Viewing the Q vs. i Table

Once you have created your Q vs. i groups, you can view summary information on the regression analysis of each Q vs. i group in the Q vs. i table. You access the Q vs. i table from the storm tab.

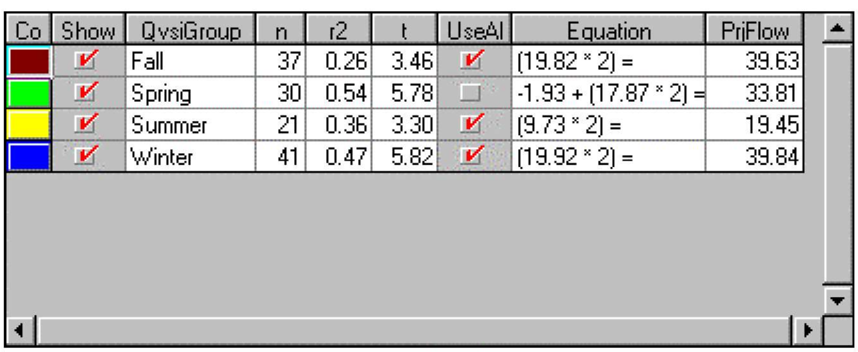


Co	Show	QvsiGroup	n	r2	t	UseAl	Equation	PriFlow
	✔	Winter	41	0.46	5.82	✔	(20.01 * 2) =	40.02
	✔	Spring	30	0.54	5.71		-1.82 + (17.66 * 2) =	33.50
	✔	Summer	21	0.36	3.27	✔	(9.60 * 2) =	19.21
	✔	Fall	37	0.25	3.40	✔	(19.76 * 2) =	39.51

➔ **To view the Q vs. i table**

- In the Storm tab, select the Q vs. i radio button in the lower left of the Engineering Wizard screen.

Sliicer displays the Q vs. i table in place of the storm events table.



Co	Show	QvsiGroup	n	r2	t	UseAl	Equation	PriFlow
	✔	Fall	37	0.26	3.46	✔	(19.82 * 2) =	39.63
	✔	Spring	30	0.54	5.78		-1.93 + (17.87 * 2) =	33.81
	✔	Summer	21	0.36	3.30	✔	(9.73 * 2) =	19.45
	✔	Winter	41	0.47	5.82	✔	(19.92 * 2) =	39.84

Sliicer presents the results of the regression analysis of each Q vs. i group in the Q vs. i table. The meaning of the fields in the Q vs. i table is shown below.

Co (Q vs. i Group Color) Contains the color of the QvsiGroup.

Show (Show) Determines if the Q vs. i points and regression line are to be displayed on the Q vs. i graph. You can turn the display of each Q vs. i group on and off using this check box.

QvsiGroup (Q vs. i Group) Contains the name of the QvsiGroup.

n (Number of points) Number of storms that were analyzed in the regression analysis for a Q vs. i group.

r2 (Correlation Coefficient) Correlation coefficient derived from the regression analysis for the Q vs. i group. The correlation coefficient is a measure of the tendency of the points to correlate to the regression line. The maximum value of the correlation coefficient is 1.0, representing perfect linear correlation. A value of zero indicates that there is no linear correlation.

t (Students T) The students t value helps you determine the statistical significance of the correlation coefficient. The lower the number of points, the higher the correlation coefficient must be in order to be statistically significant. The exact statistical significance of a correlation coefficient can be determined from a statistics table using n, t and r^2.

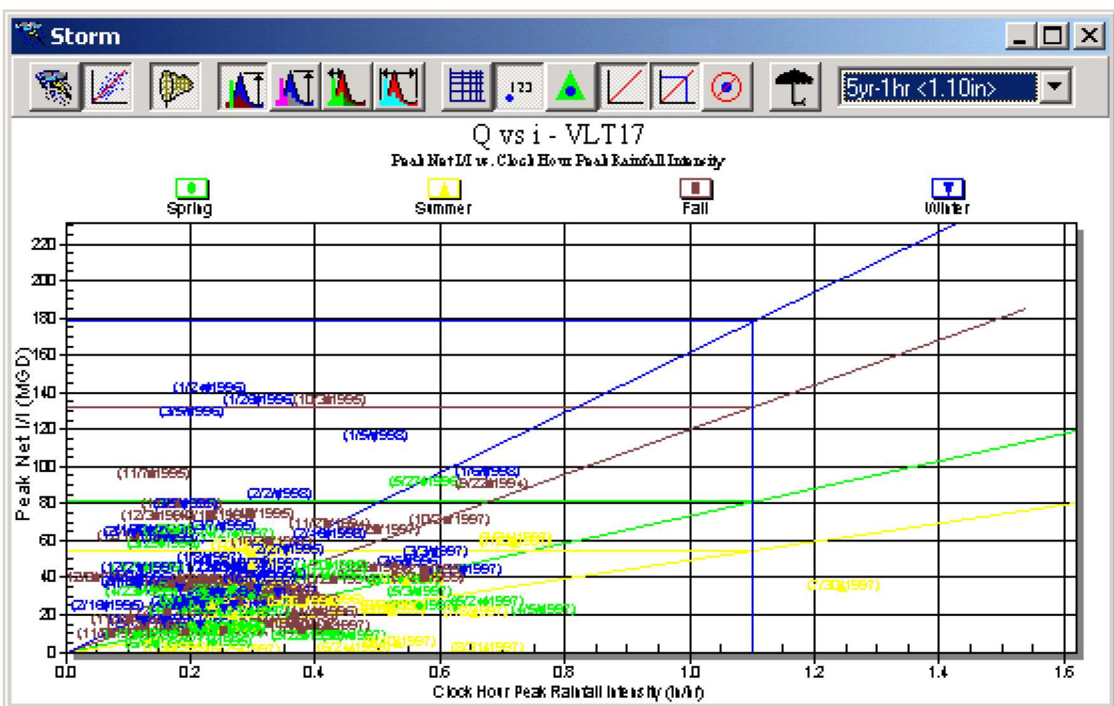
UseAlt (Use Alternate Regression Equation) If this box is checked, then Sliicer will use an alternate regression equation, forcing the y intercept of the line through the graph origin. This feature is implemented automatically when the initial regression calculation yields a positive y-intercept. Since a positive y-intercept implies that there is a response in the sewer with zero rainfall, many engineers would rather see the regression line tied to the origin in such cases. However, if there are ample Q vs. i points near the area projection, it may be acceptable to allow a positive y-intercept because such a line would be a better fit in the area where a projection is being sought. In any case, you can dictate that Sliicer force the regression line through the origin by using the check box column titled UseAlt.

Equation (Regression Line Equation) This column contains the regression equation. If a design storm has been selected in the Q vs. i graph, then the equation includes the rainfall value in the equation. If no design storm is current, the equation will have the word "Rain" in place of a numeric value.

PrjFlow (Projected Flow) Displays the projected flow value when regression equation is evaluated with the rainfall value of the currently selected design storm. If no design storm is current, the column will not be displayed.

Viewing Multiple Q vs. i groups

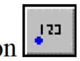
If you have more than one Q vs. i group, you can compare the Q vs. i points and regression lines on the Q vs. i graph. For the most part, comparing Q vs. i groups is automatic. When you view the Q vs. i graph, all the Q vs. i groups will be displays in their respective colors.

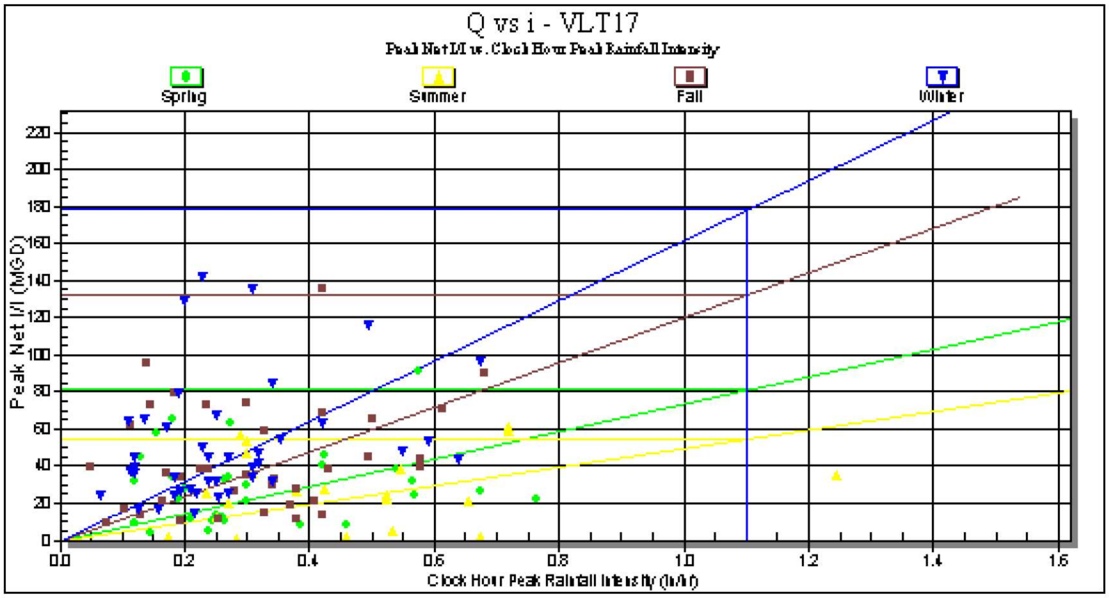


As we would expect, we see that the projected flow for a given rainfall is greatest in the winter, followed by the fall, then the spring and finally the summer.

When viewing a Q vs. i graph of a large number of points, the graph can become extremely crowed making it difficult to read. Sliicer provides a number of was for you to reduce the noise on the graph and make it easier to read. You can hide the point annotations, hide the points themselves, and hide Q vs. i groups you aren't interested in.

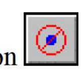
➔ **To hide Q vs. i point annotations**

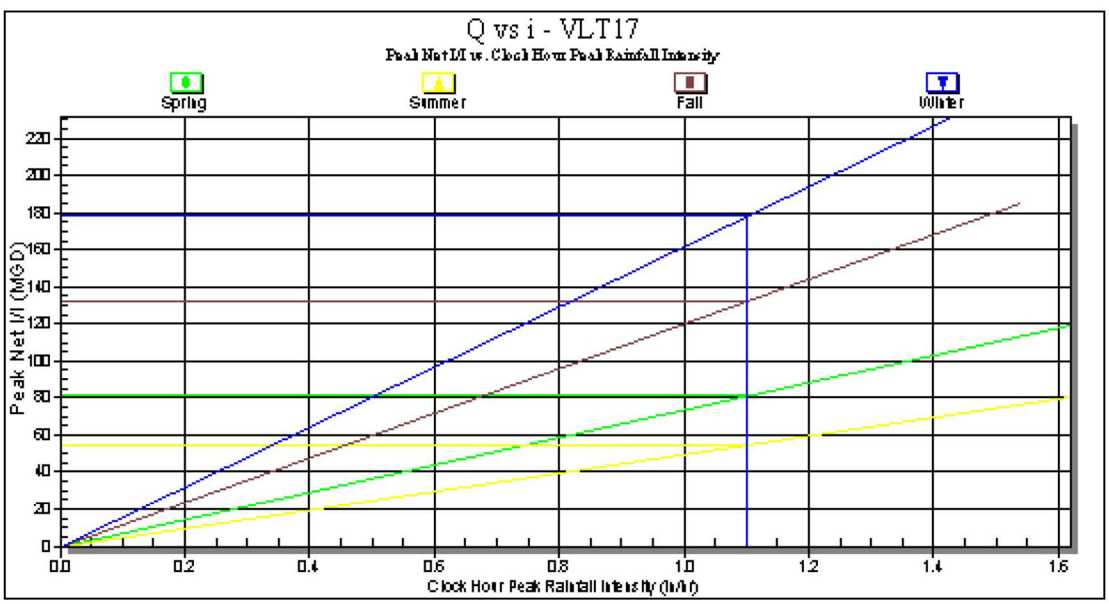
- Click the Date Labels button  on the Q vs. i tool bar.



Sliicer toggles the date labels on and off. When the Date Labels button is down, the date labels are displayed, and when the Date Label button is up the dates are not shown.

➔ **To hide Q vs. i points**

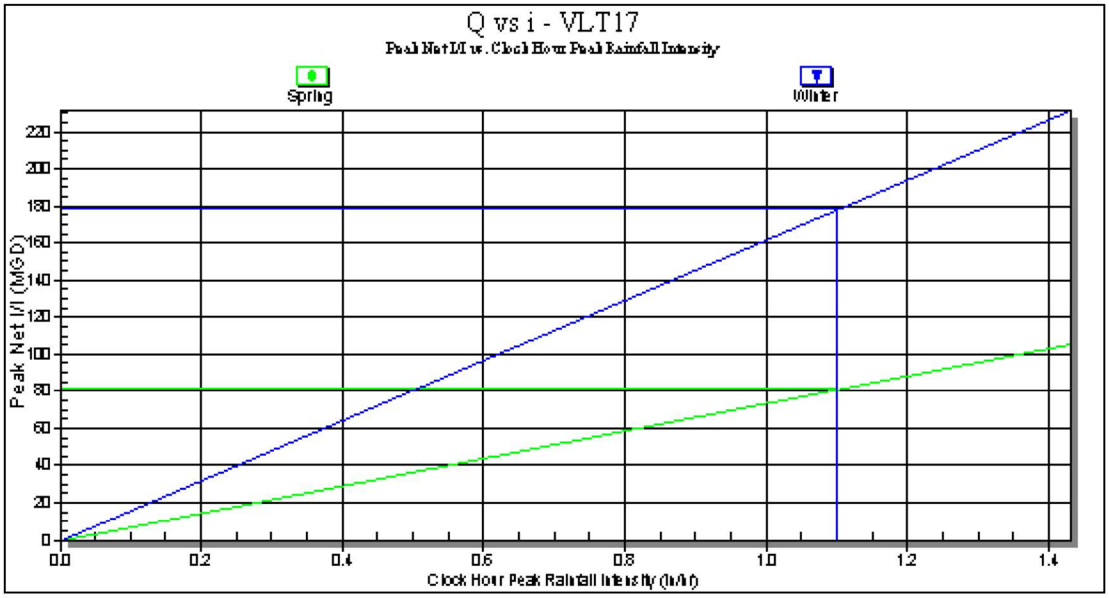
1. Display either the regression line and/or the projection lines.
2. Click the Hide Points button  in the Q vs. i tool bar



Sliicer hides the points and only displays the regression and/or projection lines.

➔ **To hide a Q vs. i group**

1. In the Q vs. i table, un-check the check box in the Show column for the row of the Q vs. i group you want to hide.



Sliicer hides the Q vs. i group you specified.

Using RTK

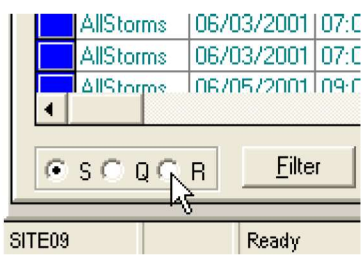
Sliicer's storm tab has an RTK mode, which assists the user in graphically finding the three R's, T's, and K's of the RTK unit hydrograph method which fit the response of each storm. Sliicer has the further capacity to aggregate these R's, T's, and K's according by the QvsiGroups of any QvsiConfiguration. These values can then be exported for use in loading hydraulic models. Sliicer has the capability of calculating these values automatically, and also allows the user to set or modify these parameters manually. The RTK feature is permission-based and an ADS Engineer or Hosted System Support person may activate it for you.

Using RTK Mode

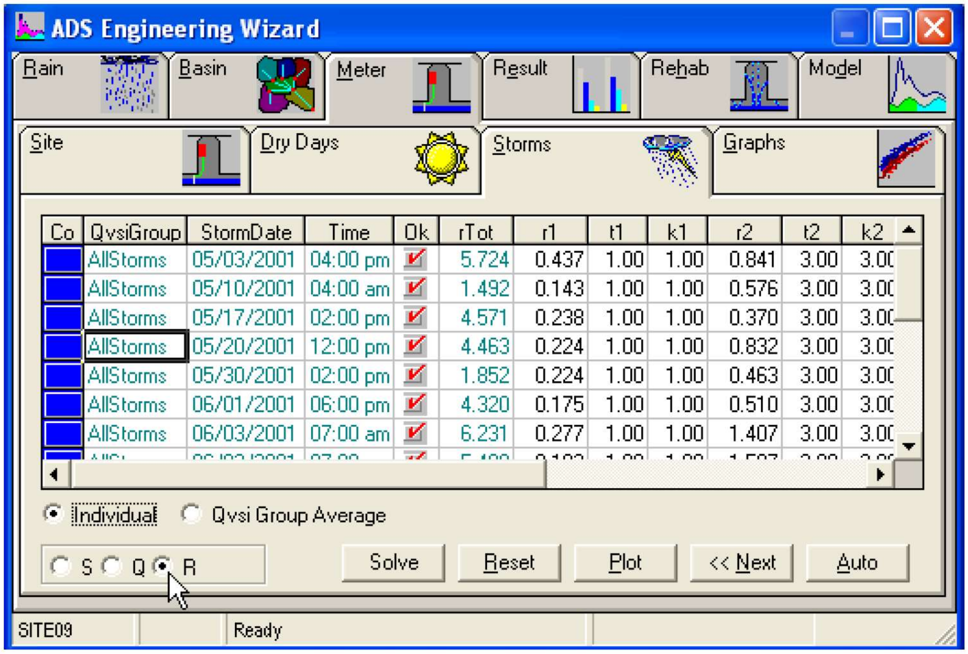
Before you can view the RTK parameters, you must put Sliicer in RTK mode. You put Sliicer in RTK mode by selecting the R radio button in the Storm tab, select the Q vs. i radio button in the lower left of the Engineering Wizard screen.

➔ **To put Sliicer in RTK mode**

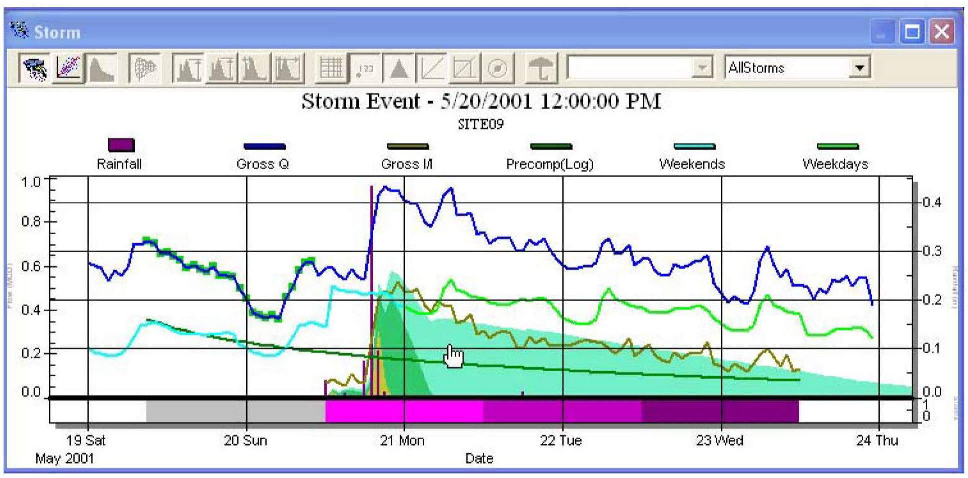
1. In the Meter, Storm tab, select the "R" (RTK) radio button.



Sliicer moves to RTK mode, and displays the RTK table in place of the storm table…



And shows the RTK Hydrographs in the Storm Graph.

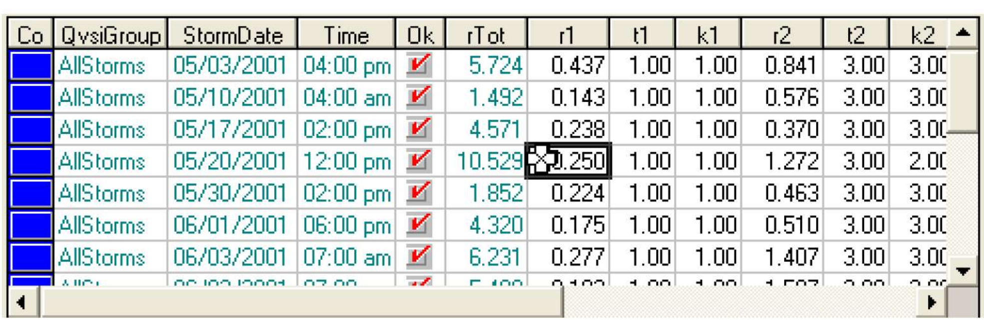


Manually Solving RTK Parameters

You can adjust the RTK parameters manually by simply entering a new number into the cell for parameter and storm you want to change.

➔ **To change an RTK parameter manually**

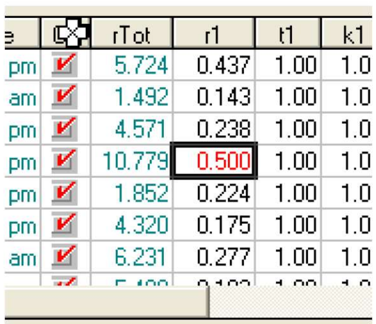
1. In the Storm tab, in the RTK table, select the cell of the parameter you want to change in the row of the storm it applies to.



2. Once the cell has been selected, double click the same cell to put in into edit mode.

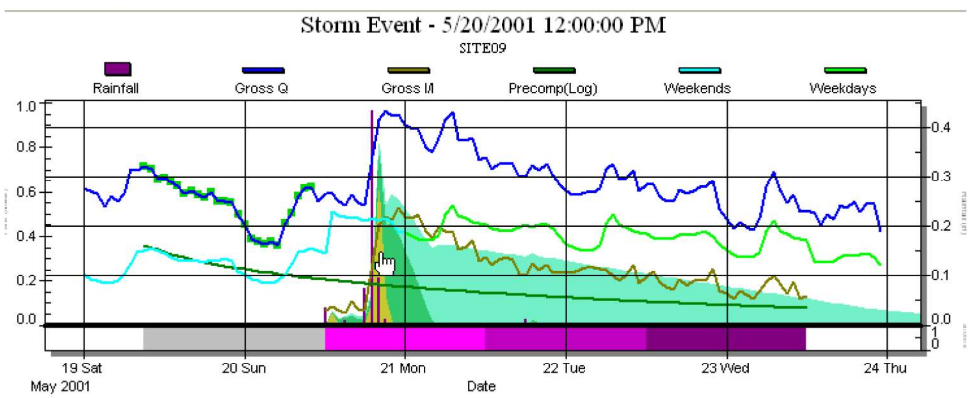
Time	Ok	rTot	r1	t1	k1
4:00 pm	✓	5.724	0.437	1.00	1.00
4:00 am	✓	1.492	0.143	1.00	1.00
2:00 pm	✓	4.571	0.238	1.00	1.00
2:00 pm	✓	10.529	0.250	1.00	1.00
2:00 pm	✓	1.852	0.224	1.00	1.00
5:00 pm	✓	4.320	0.175	1.00	1.00
7:00 am	✓	6.231	0.277	1.00	1.00

3. Type the new value and hit the enter key.



e		rTot	r1	t1	k1
pm	✓	5.724	0.437	1.00	1.0
am	✓	1.492	0.143	1.00	1.0
pm	✓	4.571	0.238	1.00	1.0
pm	✓	10.779	0.500	1.00	1.0
pm	✓	1.852	0.224	1.00	1.0
pm	✓	4.320	0.175	1.00	1.0
am	✓	6.231	0.277	1.00	1.0

4. Sliicer changes the color of the edited value to red, and updates the RTK hydrograph display in the Storm Graph window.



Automatically Solving for RTK Parameters

Sliicer can automatically calculate RTK parameters. Sliicer does this by solving for the three R's for a user range of specified settings for the three T's and K's, and then selecting the best fit from all the candidate permutations. You can set the ranges and intervals for the T's and K's, and Sliicer will find the set of three R's, T's and K's that best fit the I/I hydrograph.

In order for Sliicer to automatically calculate the RTK parameters, you must first set the ranges for the T's and K's using the RTK Solver dialog. The RTK Solver is started automatically whenever you move to RTK mode. The RTK Solver can also be opened when closed in RTK mode by clicking the "Solve" button in the Engineering Wizard. Once you set the solution parameters, you can choose to solve for the RTK parameters of just the current storm, or all storms for the current site.

Starting the RTK Solver Dialog

The RTK Solver dialog is started whenever you enter RTK mode. You can also start the RTK Solver dialog by clicking the "Solve" button from the Engineering Wizard when in RTK mode.

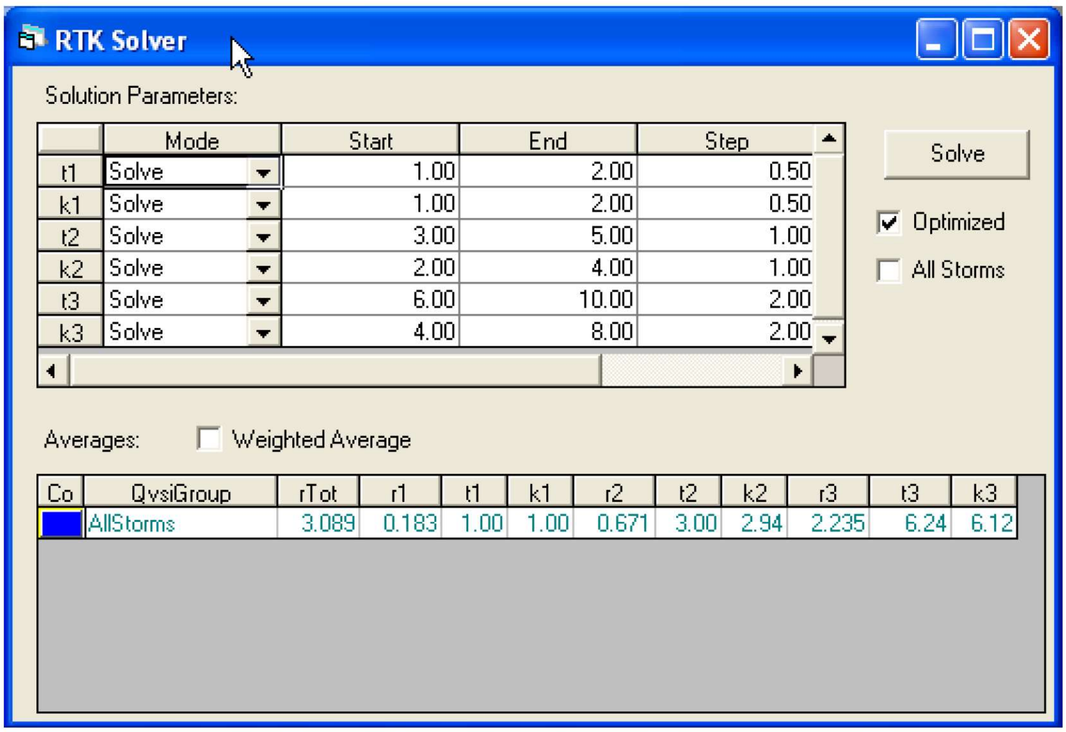
➔ **To start the RTK Solver dialog**

1. From the Meter, Storm tab, in the lower left of the Engineering Wizard screen, click the "R" radio button.

   -OR-

   Once in RTK Mode, Click the 

button.



The RTK Solver dialog appears.

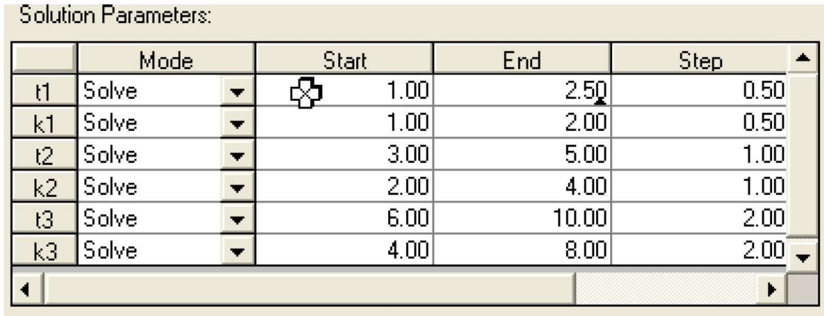
Setting the RTK Solutions Parameters

You can set the RTK solution parameters in the RTK Solver dialog. The solution parameters you set are the T's and K's for each of the three RTK unit hydrograph triangles. You set a "Start", and "End", and a "Step" for each parameter for which you wish Sliicer to try alternative solutions. Sliicer then moves through the range from the "Start" value, to the "End" value at the interval set in the "Step" parameter. Sliicer does a regression analysis to find the three R's for each permutation of the three T's and K's specified in the Solution Parameters table. Sliicer then does a Least Squares analysis of all the permutations to select the set of R's,. T's and K's with best fit.

Although you can set and change the RTK solution parameters, you don't have to. Sliicer comes pre-loaded with a reasonable default values.

➔ **To change the RTK Solution parameters**

1. In the Solutions Parameters table of the RTK Solver dialog, click the parameter you want to change to make it current.
2. Double click the cell to put it in edit mode, and enter the new value.
3. Click enter.


Solution Parameters:

	Mode	Start	End	Step
t1	Solve	1.00	2.50	0.50
k1	Solve	1.00	2.00	0.50
t2	Solve	3.00	5.00	1.00
k2	Solve	2.00	4.00	1.00
t3	Solve	6.00	10.00	2.00
k3	Solve	4.00	8.00	2.00

Controling the Number of Permutations

Since Sliicer solves for the RTK parameters by doing a regression on every permutation of the T's and K's specified in the Solution Parameters table, the time it takes to calculate the solution is directly proportional to the number of permutations you specify. Care must be taken to ensure that the solution parameters do not specify a number of permutations that overwhelms the processor.

Consider the following solutions parameter scenarios.

Parameter	Start	End	Step	Num Steps
T1	1.00	2.00	0.50	3
K1	1.00	2.00	0.50	3
T2	3.00	5.00	1.00	3
K2	2.00	4.00	1.00	3
T3	6.00	10.00	2.00	3
K3	4.00	8.00	2.00	3

3 x 3 x 3 x 3 x 3 x 3 = 729 calculation permutations

Parameter	Start	End	Step	Num Steps
T1	1.00	2.00	0.25	5
K1	1.00	2.00	0.25	5
T2	3.00	5.00	0.50	5
K2	2.00	4.00	0.50	5
T3	6.00	10.00	1.00	5
K3	4.00	8.00	1.00	5

5 x 5 x 5 x5 x 5 x 5 = 15,625 calculation permutations

Note that by simply cutting the step in half for all six parameters, the compute time increases by 21 times (15,625 / 729 =21). There may be occasions where such increases are justified, but it warrants careful consideration.

Using the RTK Solver Modes for Limited Solutions

In addition to solving for all RTK parameters, you can use the Sliicer RTK Solver to find a limited solution by setting the Mode to values other than "Solve" for various T's and K's. The mode setting allows you fix the value of a particular parameter to a specific value, or to limit it to the average of a previous calculation. When you set the mode to "Fixed", you specify the value for the parameter you want. When you set the mode to "Average", Sliicer will use the value in the Averages table for the QvsiGroup that applies to each storm according the currently set QvsiConfiguration.

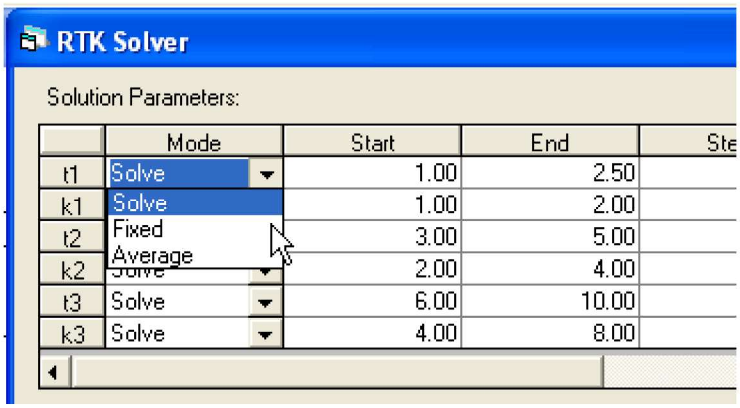
You may want to make use of the Mode capability to solve for RTK parameters in an iterative process. By fixing some of the parameters for an initial solution, you can increase the number of solution permutations allocated to other parameters, hence increasing the resolution of the solutions for the parameters of interest.

Once this is accomplished, you can set the mode for the parameters just solved to the average of the previous iteration, and increase the permutations allocated to other parameters in subsequent iterations.

This accommodates the technique, implemented by some proponents of RTK, in which the 3rd unit hydrograph is solved first, matching the trailing edge of the hydrograph, for which it is completely responsible, then moving to the first unit hydrograph, and finishing up with the middle unit hydrograph.

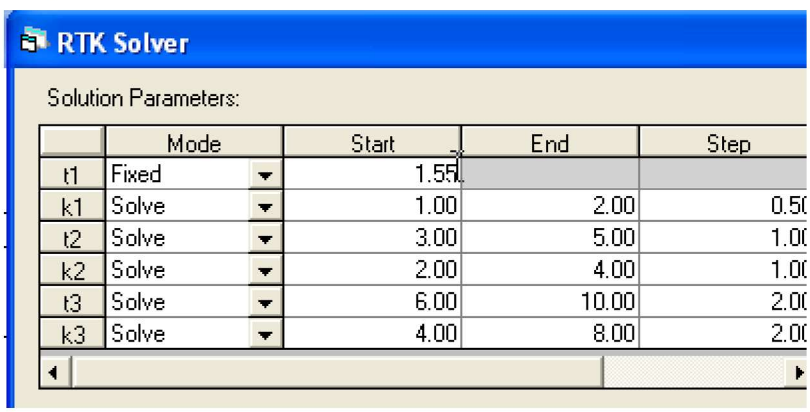
➔ **To set an RTK solution parameter to fixed**

1. In the RTK Solver dialog, in the Solution Parameters table, click the drop down arrow in the Mode column for the parameter you want to fix, and select Fixed.



   Sliicer changes the mode for the solution parameter you indicated.

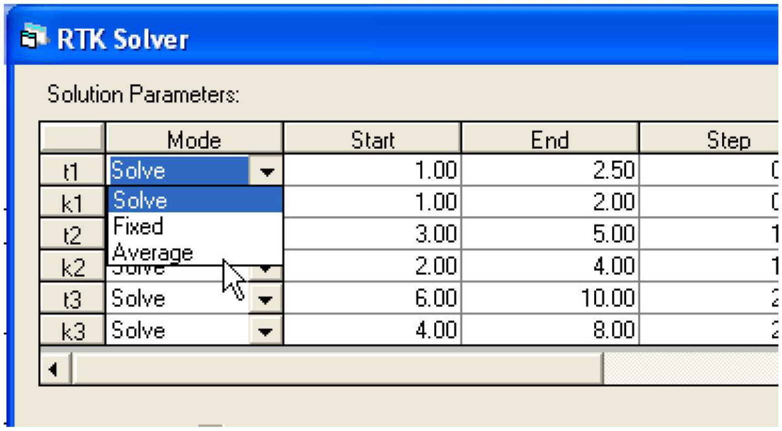
2. Type the fixed value you want to use into the start column. This is the value that Sliicer will use for this parameter for all solutions generated while the fixed setting is in effect.



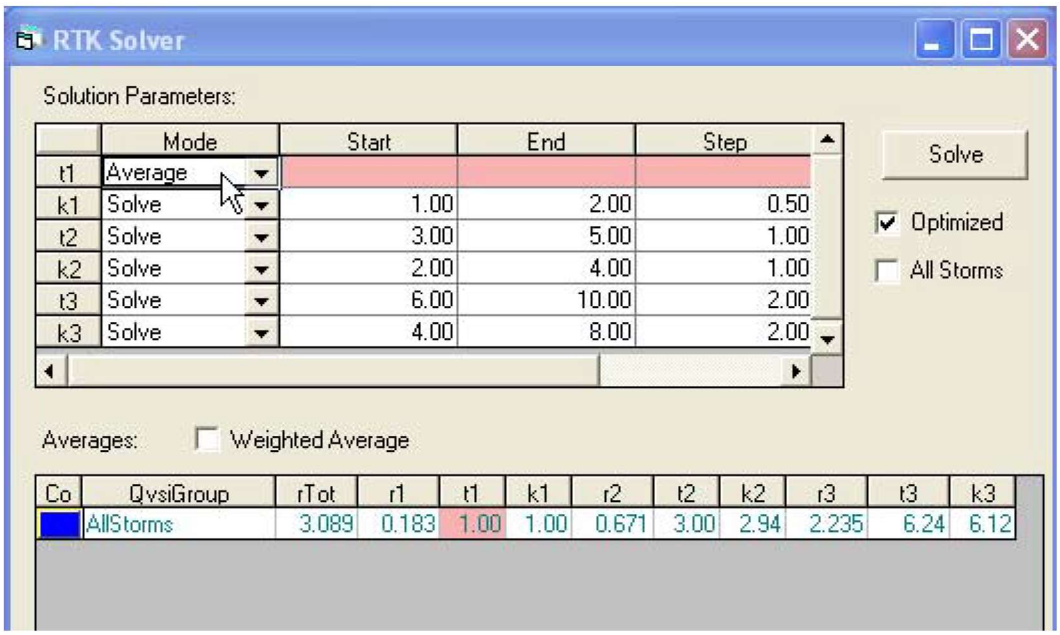
   Note that Sliicer greys out the End and Step cells for the parameter set to fixed, because they are not applicable.

➔ **To set an RTK solution use the Average of the applicable QvsiGroup**

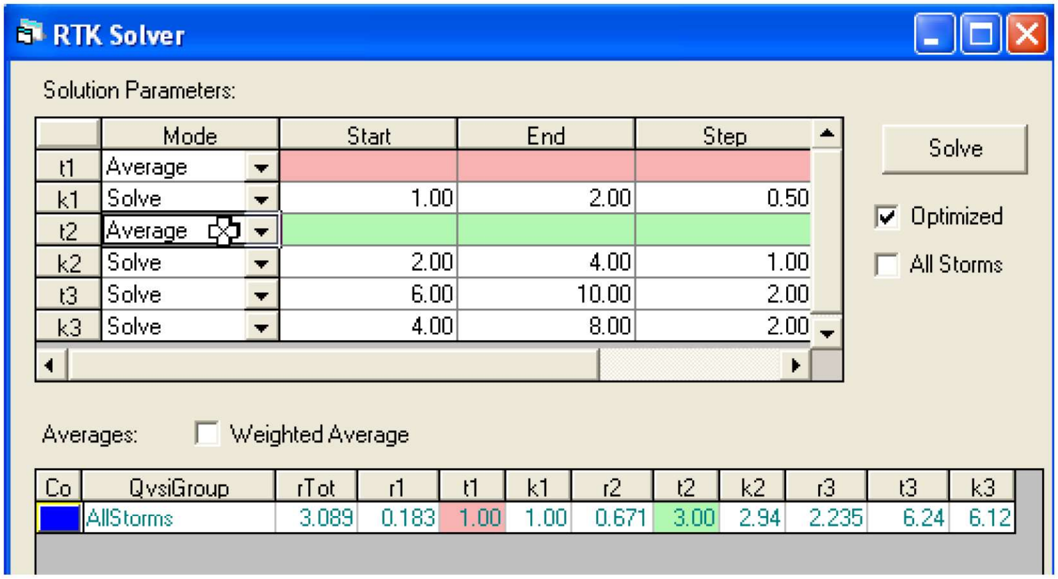
1. In the RTK Solver dialog, in the Solution Parameters table, click the drop down arrow in the Mode column for the parameter for which you want to use the average, and select Average.



Sliicer changes the mode for the solution parameter you indicated.



Note that Sliicer colors out the Start, End and Step cells for the parameter set to average, and also colors the column of the same parameter in the Averages table, to indicate what value will be used for the parameter in all solutions generated with this solution parameter setting.



If you set more than one column to Average, Sliicer uses a different color for each parameter set to average, and colors the corresponding column in the Averages table to the same color used in the Solution Parameters table.

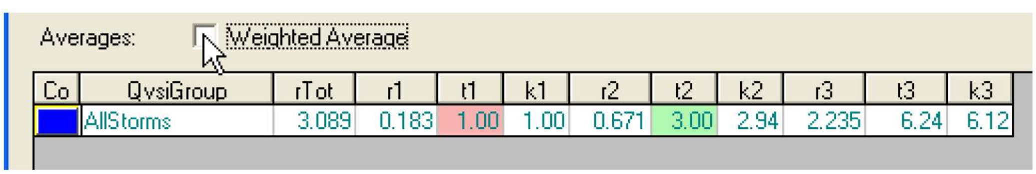
Aggregating RTK Parameters by QvsiGroup

When you calculate the RTK parameters for multiple storms, Sliicer aggregates the values for the parameters in the Averages table in the RTK Solver dialog. Sliicer aggregates the parameters according to Q vs. i groups based on the current Q vs. i Configuration. When you change Q vs. i Configuration, Sliicer automatically re-aggregates the RTK parameters for each of the Q vs. i Groups of the newly selected Q vs. i Configuration without needing to recalculate the RTK parameters for each storm.

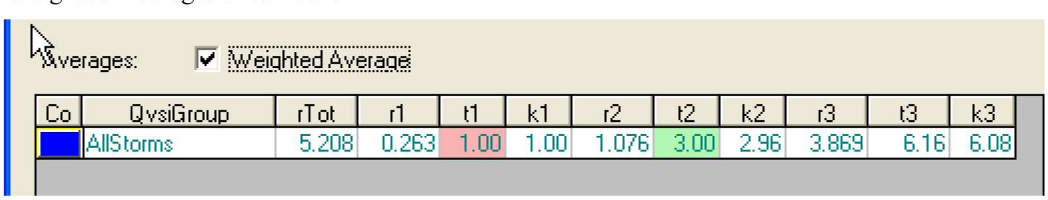
There are two types of aggregation, simple average and weighted average by storm size. The default value is a simple average.

➔ **To change the aggregation type**

1. In the RTK Solver dialog, click the Weighted Average check box.

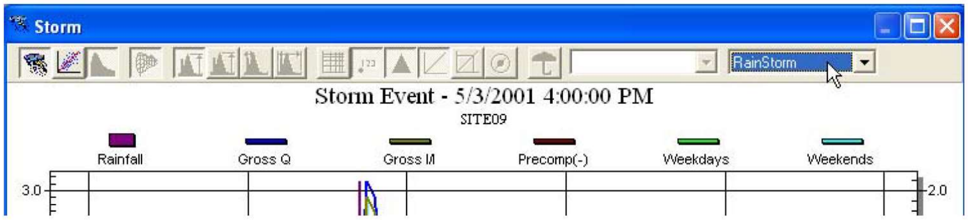


Sliicer changes the aggregation values shown in the Averages table to reflect the setting of the Weighted Averages check box.

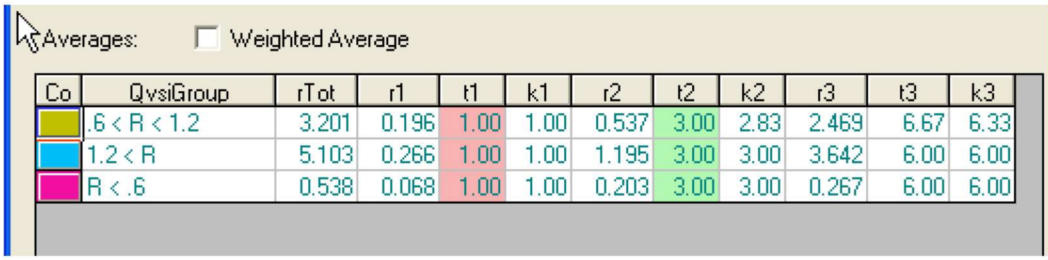


➔ **To change the aggregation Q vs. i groups**

1. In the Storm Graph window, select the Q vs. i configuration you want.



Sliicer re-aggregates the parameters for the new Q vs. i groups according to the new Q vs. i configuration you selected.



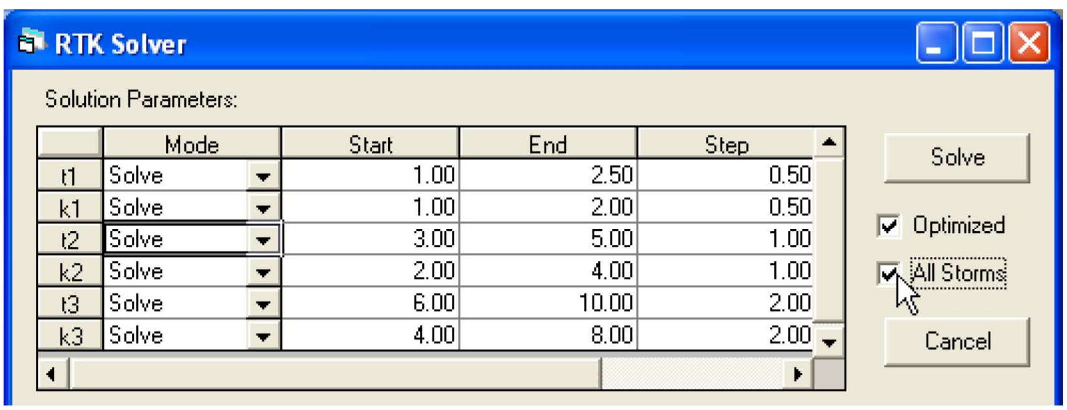
Co	QvsiGroup	rTot	r1	t1	k1	r2	t2	k2	r3	t3	k3
	.6 < R < 1.2	3.201	0.196	1.00	1.00	0.537	3.00	2.83	2.469	6.67	6.33
	1.2 < R	5.103	0.266	1.00	1.00	1.195	3.00	3.00	3.642	6.00	6.00
	R < .6	0.538	0.068	1.00	1.00	0.203	3.00	3.00	0.267	6.00	6.00

Automating RTK Calculations

You can automate RTK calculations. When you automate calculations, Sliicer uses the RTK solution parameters you set to solve all storms for the current site.

➔ **To automate RTK calculations**

1. In the RTK Solver dialog, check the “All Storms” checkbox.



2. Click the Solve button.

   Sliicer Solves the RTK parameters for all storms for the current site.

Plotting Scatter Graphs

Sliicer allows you to view scatter graphs for each site to check the quality of the data, and to gain insight into the hydraulic phenomena that took place during the monitoring period. The scatter graphs are viewed in the Meter Graphs tab. Although the Meter Graphs tab is not included in the automatic work flow sequence for deriving I/I information (Site > Dry > Storm), it is included in the Meter tab because scatter graphs are viewed one site at a time.

Plotting a Scatter Graph

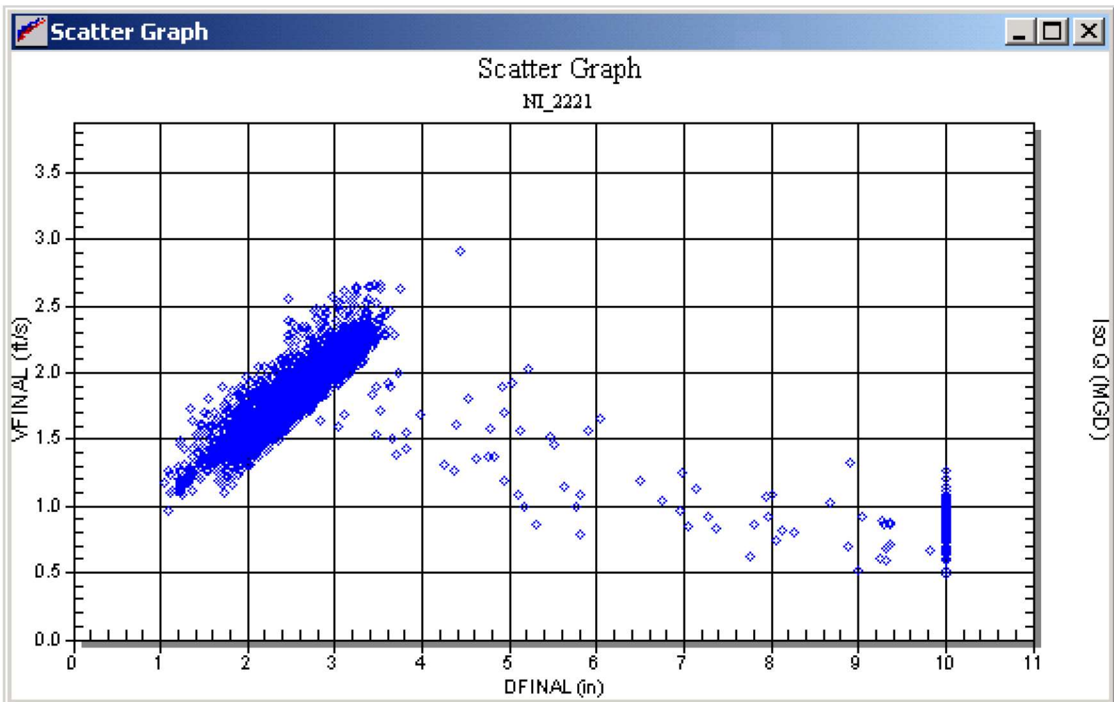
Before you view a scatter graph, you must plot the traces you want to use in the Meter Site tab. Further, since the purpose of a scatter graph is to plot one data set against another, Sliicer will not let you enter the Meter Graphs tab until you have plotted at least two traces, one of which must be a Q trace. Although you must plot at least two traces, you may plot more. For example, if you want to view a scatter graph of velocity vs. depth, you would need to plot AVGDEPT, VELOCITY, and QFINAL, because you must plot at least one Q trace.

You can create a scatter graph of any two traces that are supported by Sliicer. The most commonly viewed scatter graph is depth vs. velocity.

➔ **To plot a scatter graph**

1. In the Meter Site tab, select at least two traces. (One must be a Q trace.)
2. Click the Meter Graphs tab.

   The Graphs tab becomes current.
3. In the x-axis and y-axis drop down lists, select the traces you want to plot on the x and y-axes.
4. Click the Plot button.



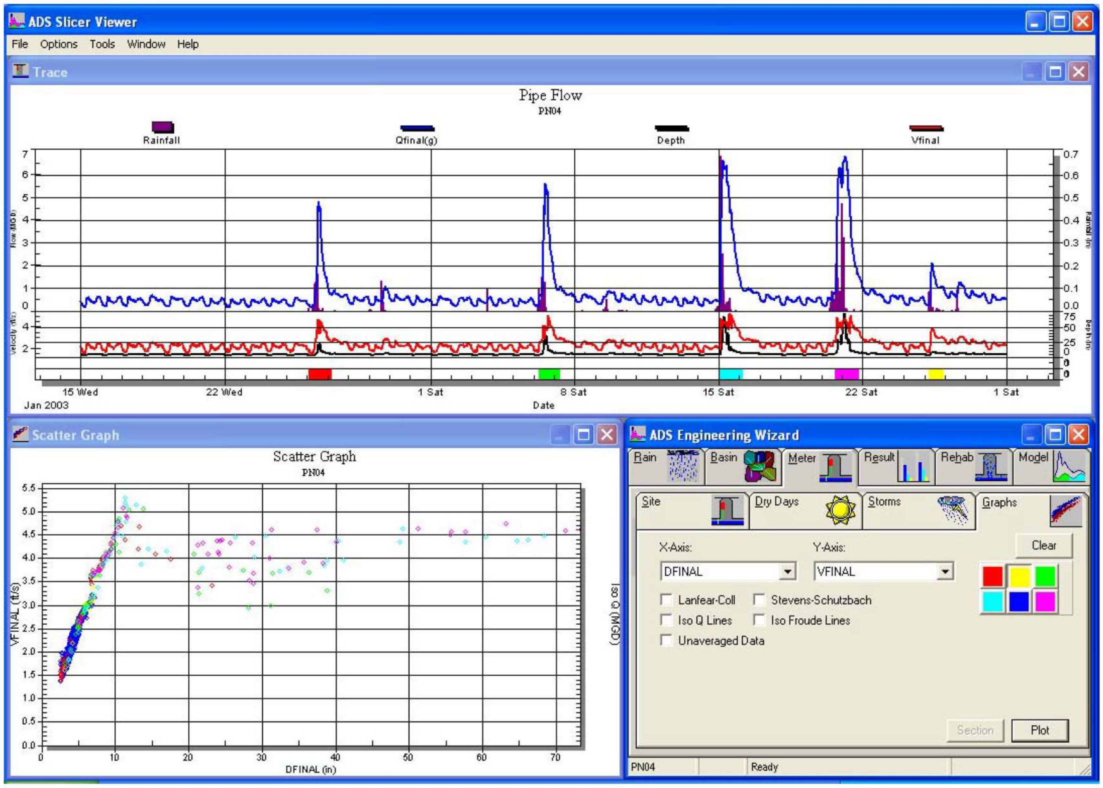
Sliicer plots a scatter graph of the traces you selected.

Color Coding a Time Interval

Sliicer allows you to "drill down" on the scatter graph by color coding time intervals in the Trace window. You color code a time interval in the Trace window by dragging the mouse. When you color code a time interval in the Trace window, Sliicer also color codes the same points in the Scatter Graph window. You can color code as many intervals as you want in up to five different colors.

➔ **To color code a time interval**

1. Plot a scatter graph.
2. Select a color by clicking one of the color buttons in the Meter Graph tab (Blue sets the time interval back to the default color in the scatter graph).
3. In the Trace window, drag the mouse through the time interval you want to color code.



Sliicer color codes the corresponding points in the scatter graph in the color you selected. Sliicer also plots a band of the selected color in the Trace window to mark the interval.

Plotting a Section of the Scatter Graph

Many times you may want to study a time interval of the scatter graph more closely. Sliicer allows you to do this by plotting just a section of the scatter graph. You do this by using the Section button. The section button is enabled any time you zoom a time interval in the trace window.

➔ **To plot a section of the scatter graph**

1. Plot a scatter graph.

   In the Trace window, zoom a section.

2. The Section button appears on the Meter Graph tab.
3. Click the Section button.

   Sliicer plots the scatter graph of the zoomed section.

Plotting Pipe Curves on the Scattergraph

Sliicer allows you to plot pipe curves on the Scattergraph to help you interpret it. Four types of pipe curves can be plotted. They are: Lanfear-Coll pipe curve, the Stevens-Schutzbach pipe curve, Iso Q lines and Iso Froude lines. The Lanfear-Coll curve gives you an idea what the flow would be in a laboratory situation. The Stevens-Schutzbach pipe curve, which is developed from actual flow monitor data in a particular pipe, is usually a more accurate reflection of the flow characteristics given the actual condition of the pipe, and gives important information regarding the hydraulic effect of obstructions in the pipe, such as offset joints. The Iso Q lines show constant values of Q. These are particularly useful in evaluating surcharge situation. Finally Iso Froude lines show various energy states, including Critical Flow on the scattergraph.

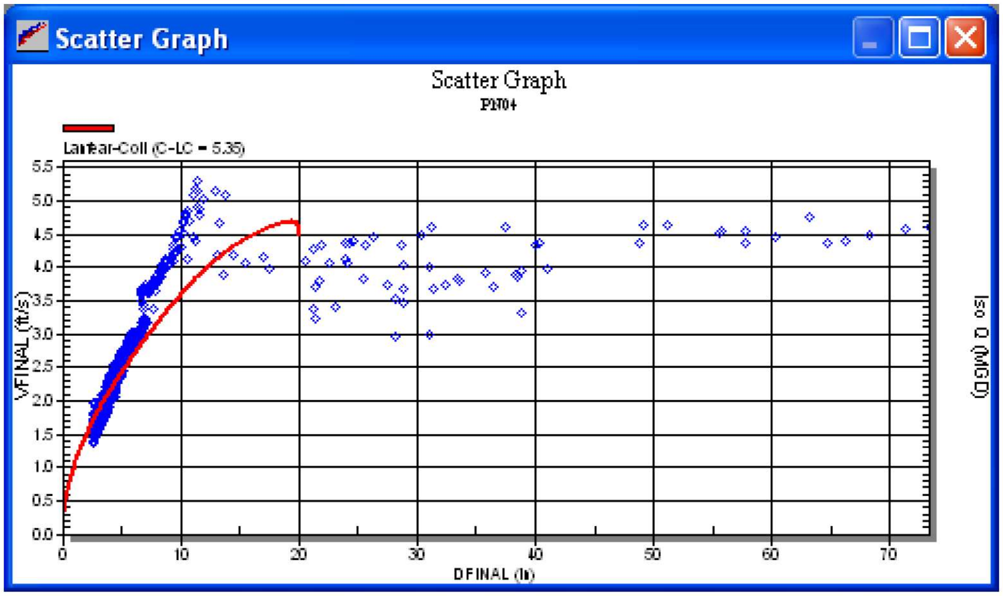
Plotting the Lanfear-Coll Pipe Curve on the Scattergraph

Sliicer allows you to plot the Lanfear-Coll pipe curve on the Scattergraph

➔ **To add the Lanfear-Coll curve to the scattergraph**

1. Check the Lanfear-Coll check box.

2. Click the plot button.



Sliicer adds the Lanfear-Coll pipe curve to the scattergraph plot, and annotates the Lanfear-Coll hydraulic coefficient (C_{LC}) in the graph legend.

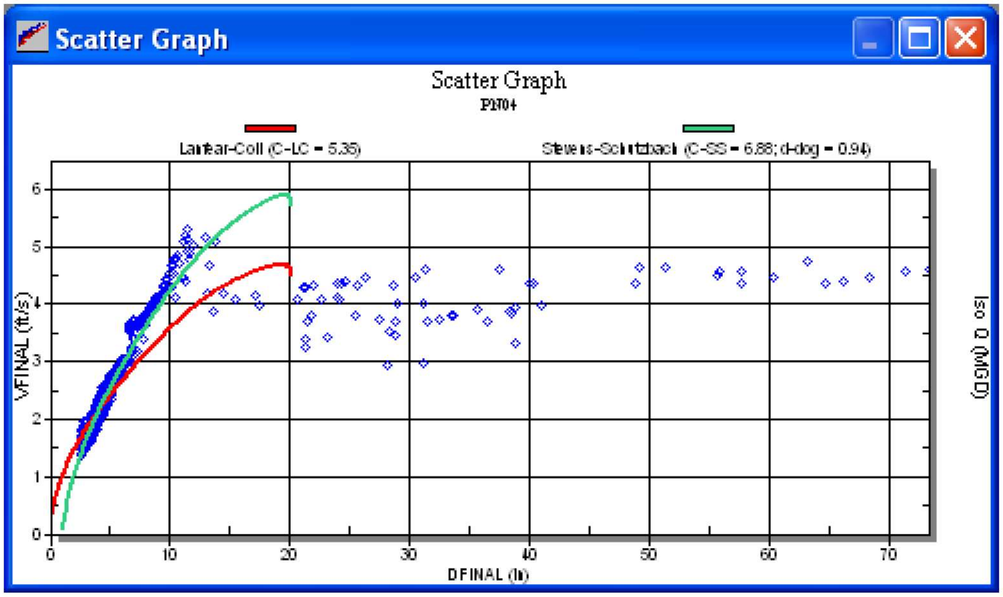
Plotting the Stevens-Schutzbach Pipe Curve on the Scattergraph

Sliicer allows you to plot the Stevens-Schutzbach pipe curve on the Scattergraph. The Stevens-Schutzbach pipe curve was developed from actual flow monitor data in a particular pipe, is usually a more accurate reflection of the flow characteristics given the actual condition of the pipe, and gives important information regarding the hydraulic effect of obstructions, such as offset joints.

➔ **To add the Stevens-Schutzbach curve to the scattergraph**

1. Check the Stevens-Schutzbach check box.

2. Click the plot button.



Sliicer adds the Stevens-Schutzbach pipe curve to the scattergraph plot, and annotates the Stevens-Schutzbach hydraulic coefficient (C_{SS}) and the depth of the theoretical obstruction in the bottom of the pipe (d_{dog}) in the graph legend.

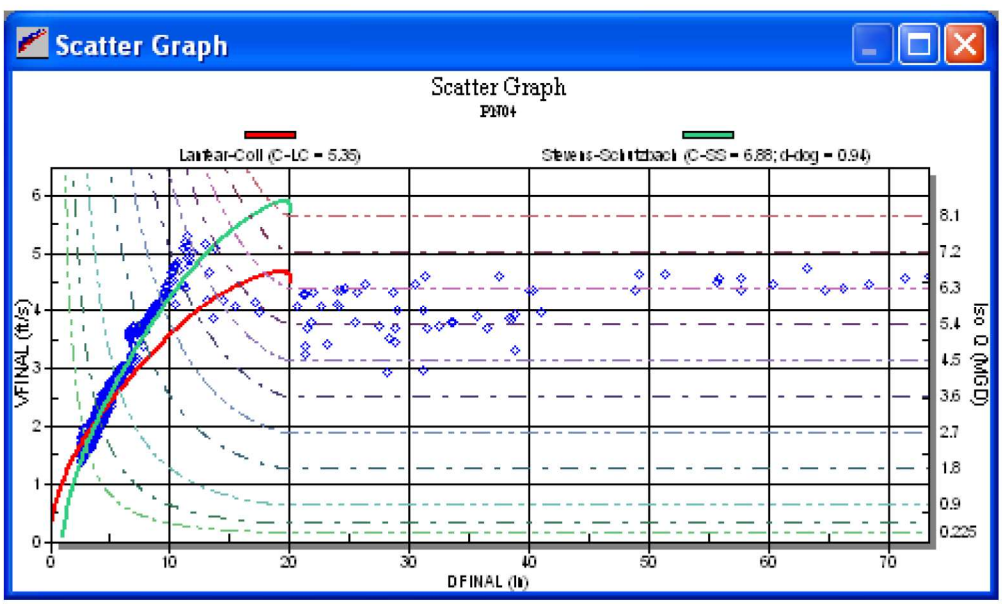
Plotting Iso-Q lines on the Scattergraph

Sliicer allows you to plot Iso-Q lines on the Scattergraph. The Iso Q lines show constant values of Q. These are particularly useful in evaluating surcharge situation.

➔ **To add the Iso-Q lines on the scattergraph**

1. Check the Plot Iso Q Lines check box.

2. Click the plot button.



Sliicer plots the scattergraph which includes 11 Iso Q lines.

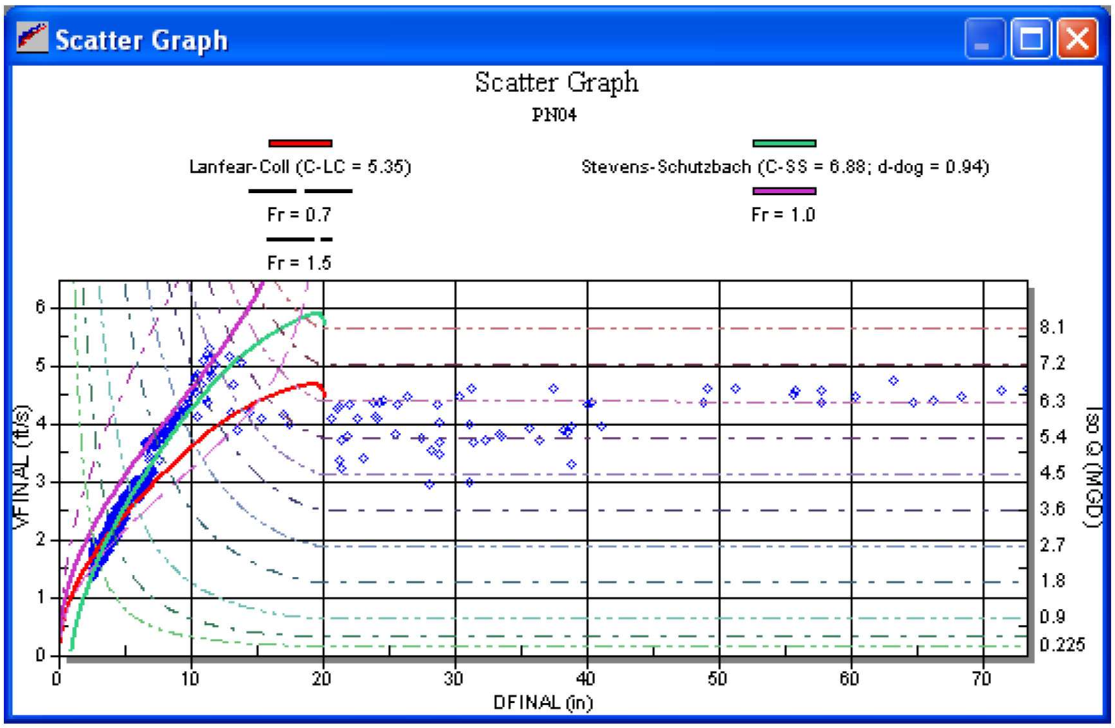
Plotting Iso-Froude lines on the Scattergraph

Sliicer also allows you to plot Iso-Froude lines on the Scattergraph. Iso Froude lines show various energy states, including Critical Flow on the scattergraph, and are useful for identifying hydraulic phenomena such as hydraulic jumps.

➔ **To add Iso-Froude lines to the scattergraph**

1. Check the Critical Flow (Fr=1) check box.

2. Click the plot button.



Sliicer plots the scatter graph of and includes plots of Iso-Froude lines for Fr = 0.7, Fr = 1.0 and Fr = 1.5.

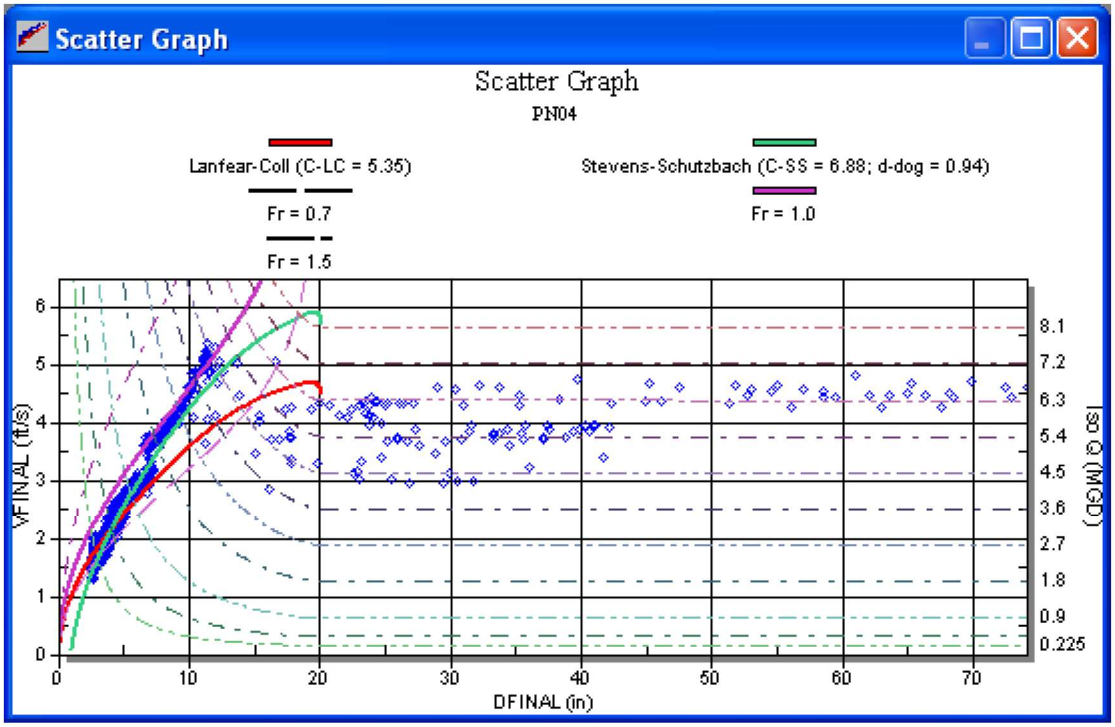
Plotting Unaveraged Data

In default mode, Sliicer plots one point on the scatter graph for each averaged data point corresponding to the step length selected in the Gobal study options dialog. However, you can view the unaveraged data points in the scatter graph window without changing the step length for the study.

➔ **To plot unaveraged data**

1. Check the Unaveraged Data check box.

2. Click the plot button.



Sliicer plots the scatter graph of the unaveraged data.

Note When viewing unavaraged data, the one to one correspondence between the points plotted in the hydrograph window and the scatter graph window is temporarily suspended. Because of this, when viewing unaveraged data, you can not color code sections of the hydrograph. Also note that although you can can run the scatter graph in video mode while showing unaveraged data, the actual points shown in the video will not correspond directly to the unaveraged points because the points shown by the video mode are the averaged points.

Comparing a Section of the Scatter Graph

When you study a time interval, you will frequently want to compare it with the scatter graph of the entire period for context. Sliicer allows you to do this quickly, without having to zoom out in the Trace window, and risk loosing track of the interval you selected.

➔ **To plot the complete scatter graph without loosing the zoomed interval**

1. Plot a scatter graph section.
2. Click the plot button.

   Sliicer plots the scatter graph of all points without changing the zoom in the Trace window.

Viewing Scatter Graphs in Video Mode

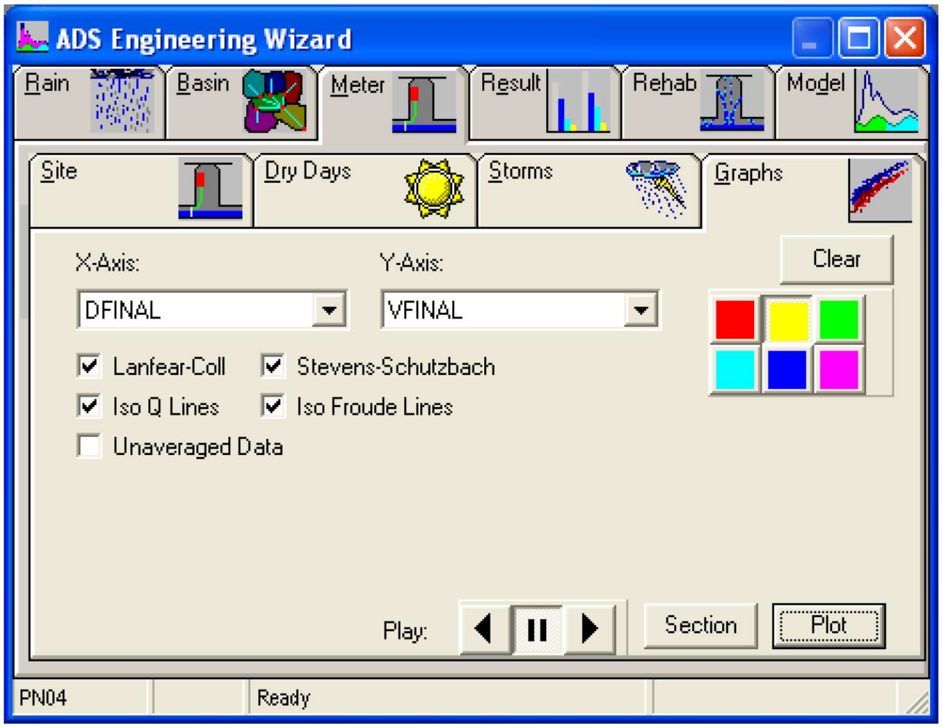
Another tool that Sliicer gives you to study the scatter graph is video mode. Video mode automatically moves through the data points in the trace window sequentially, updating the scatter graph window as it moves. This allows you to discover the sequence of events in the scatter graph.

Video mode becomes available when you zoom an interval of less than 7 days. When video mode is enabled, you can move forward, backward, and pause the action at any time.

➔ **To view scatter graphs in video mode**

1. Plot a scatter graph.

2. In the Trace window, zoom an time interval less than 7 days.

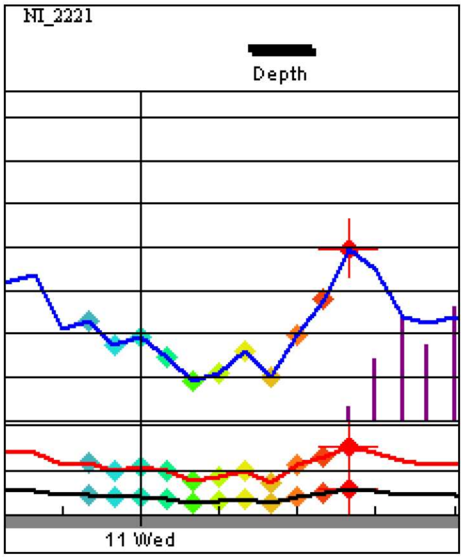


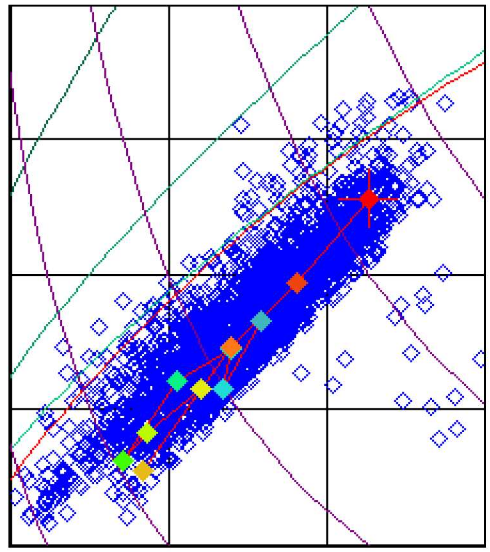
The Scatter Graph Video Controls appear in the lower left corner of the Meter Graphs tab.

3. Click the button with the arrow indicating the direction you want the plot to move.

Sliicer begins moving through the data points, updating the scatter graph as it goes.

As Sliicer moves through the datapoints, it shows a series of rainbow colored diamond shaped points on each Trace in the upper window.





The corresponding points are shown in the same color in the scattergraph window as well.

➔ **To pause scatter graphs in video mode**

- Click the pause button.

  Sliicer pauses the video mode at the next data point.

CHAPTER 6

Chapter 6 Results

Once you have processed some or all of the meter sites in the project for dry and wet weather flow, you can compare the response of different sites using the Results tab.

In this chapter you will learn how to use the Results tab to perform a number of different comparisons:

Dry Days:

- Compare a single dry day parameter for different day groups.
- Compare multiple dry day parameters for a single day type.

Storms:

- Compare a single parameter for multiple storms.
- Compare multiple parameters for a single storm.

Q vs. i:

- Compare multiple Q vs. i parameters for a single design storm.
- Compare a single Q vs. i parameters for multiple design storms.

In addition, Sliicer allows you to normalize your results. You can normalize by rainfall, and/or three measures of basin size: Area, Length and Footprint.

Note The Results tab only displays sites that have been processed for dry and wet weather calculations. If you enter the Results tab before you complete the processing of all sites, be aware that the basin ranking results that you see do not include information from unprocessed sites.

Dry Day Results

When you compare dry day results with the Results tab, you can compare a single dry day parameter for multiple day groups or multiple dry day parameters for one day type.

Comparing a Single Dry Day Parameter for Multiple Day Groups

You can use the results tab to compare a single dry day parameter for various day groups. When you compare day groups, you must first decide which day group to compare. Although you can change the comparison parameter at any time, which you compare multiple day groups, you can only compare on parameter at a time.

➔ **To compare day groups**

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.

Sliicer makes the Results tab current.

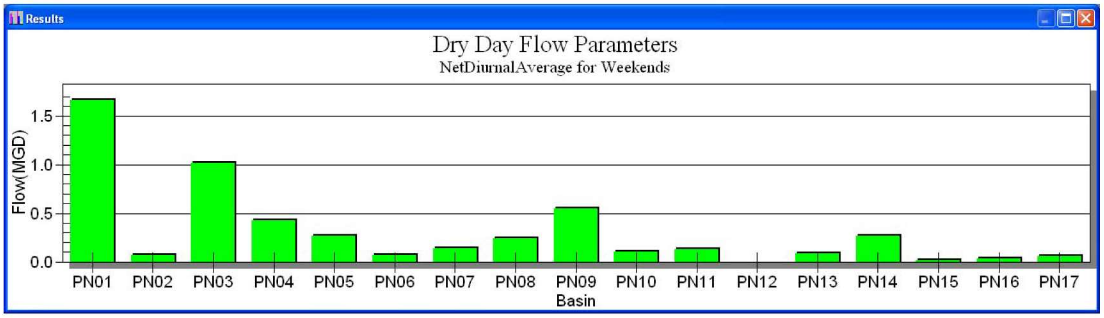
3. In the Result Type, choose Dry Days.
4. In the Compare group, choose Day Groups.
5. In the Dry Day Parameters list box, select the parameter you want to compare.
6. In the Results table, right click the mouse on any cell in the column you want to compare.

The plot menu appears.

7. Click plot.

The color dialog appears.

8. Click the color you want and click OK.



Sliicer plots a bar graph of the current parameter for the day group you selected. To compare additional day groups, repeat steps 6 through 8. To clear a day group, repeat steps 6 and 7, but click the clear menu selection in step 7 instead of plot.

Comparing Dry Day Parameters

You can also use the Results tab to compare multiple parameters for a single day group. When you compare multiple parameters, you must first decide which day group you want to compare. Although you can change the day group at any time, when you compare multiple parameters, you can only compare one day group at a time.

➔ **To compare parameters**

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.

   Sliicer makes the Results tab current.
3. In the Result Type, choose Dry Days.
4. In the Compare group, choose Params.
5. In the Day Type list box, select the parameter you want to compare.
6. In the Results Table, select the column header of the parameter you want to compare. For a definition of the parameter names, see Understanding the Dry Day Table in Chapter 5.
7. Click a color button.

   Sliicer plots a bar graph of the current storm for the parameter you selected. To compare additional parameters, repeat steps 5 and 6. To clear a parameter from the graph, repeat steps 5 and 6, but click the clear menu selection in step 6 instead of a color.

Rainfall Derived Inflow and Infiltration (RDII) Results

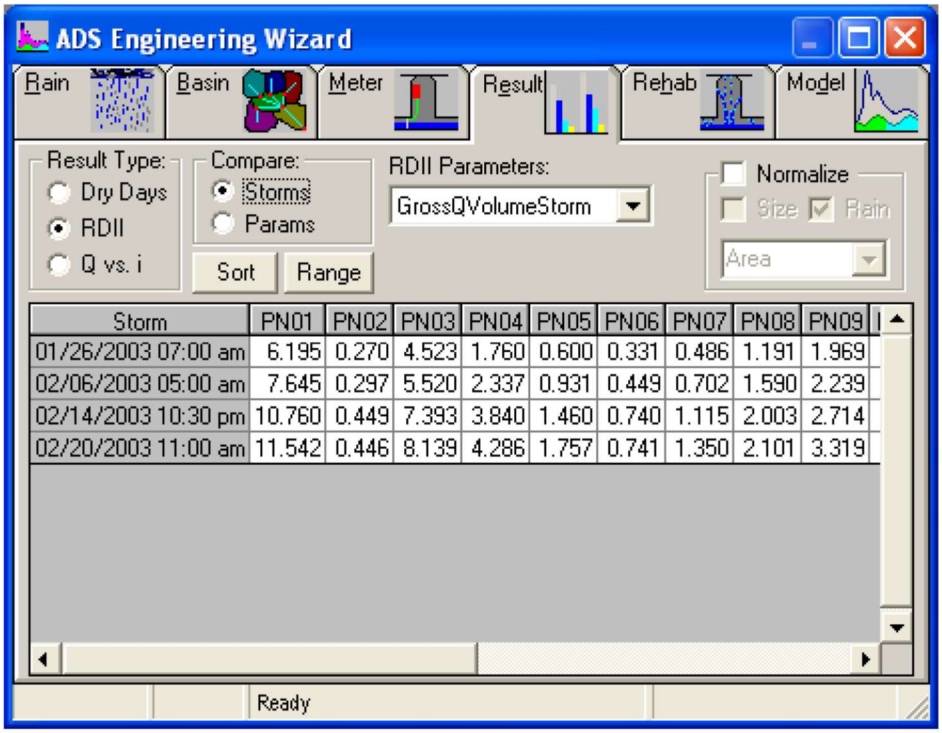
When you use the Results tab to view storm results, you choose between comparing a single RDII parameter for multiple storms, or comparing multiple parameters for a single storm.

Comparing Storms

You can use the Results tab to compare a single parameter for various storms. When you compare storms, you must first decide on what parameter to compare. Although you can change the comparison parameter at any time, when you compare multiple storms, you can only compare one parameter at a time.

➔ To compare storms

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.



Sliicer makes the Results tab current.

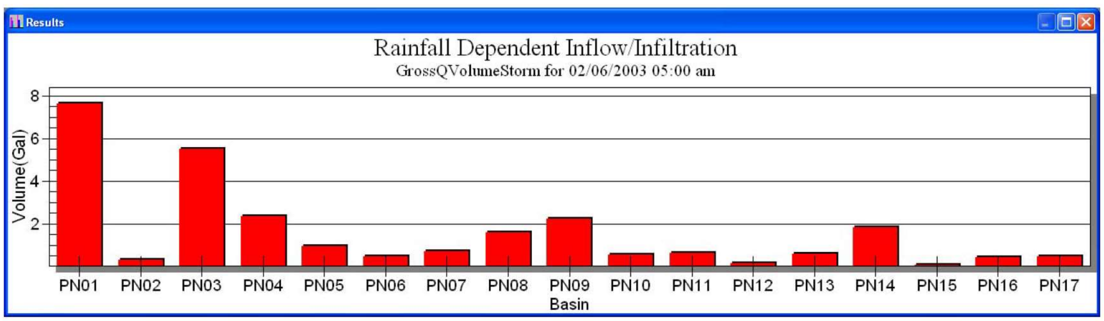
3. In the Results Type, choose RDII.
4. In the Compare group, choose Storms.
5. In the I/I Parameters list box, select the parameter you want to compare.
6. In the Results table, right click the mouse on any cell in the column you want to compare.

The plot menu appears.

7. Click plot.

The color dialog appears.

8. Click the color you want and click OK.



Sliicer plots a bar graph of the current parameter for the storm you selected. To compare additional storms, repeat steps 5 through 7. To clear a storm, repeat steps 5 and 6, but click the clear menu selection in step 6 instead of plot.

Comparing Storm Parameters

You can also use the Results tab to compare multiple parameters for a single storm. When you compare multiple parameters, you must first decide which storm you want to compare. Although you can change the storm at any time, when you compare multiple parameters, you can only compare one storm at a time.

➔ **To compare parameters**

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.

   Sliicer makes the Results tab current.
3. In the Results Type, choose RDII.
4. In the Compare group, choose I/I Params.
5. In the Storms list box, select the parameter you want to compare.
6. In the Results table, Select the column header of the parameter you want to compare. For an definition of the parameter names, see Understanding the Storm Table in Chapter 5.
7. Click a color button.

Sliicer plots a bar graph of the current storm for the parameter you selected. To compare additional parameters, repeat steps 5 and 6. To clear a parameter from the graph, repeat steps 5 and 6, but click the clear button in step 6 instead of a color.

Q vs. i Results

When you use the Results tab to Q vs. i results, you choose between comparing multiple Q vs. i regression parameters, including design storm predictions, for a single Q vs. i group, or comparing a single regression parameter or design storm prediction for a multiple Q vs. i groups.

Comparing Q vs. i Parameters

You can use the Results tab to compare multiple parameters for a single Q vs. i group. When you compare Q vs. i parameters, you must first decide on what Q vs. i group to compare. Although you can change the comparison Q vs. i group at any time, when you compare multiple parameters, you can only compare one Q vs. i group at a time.

➔ **To compare storms**

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.

Sliicer makes the Results tab current.

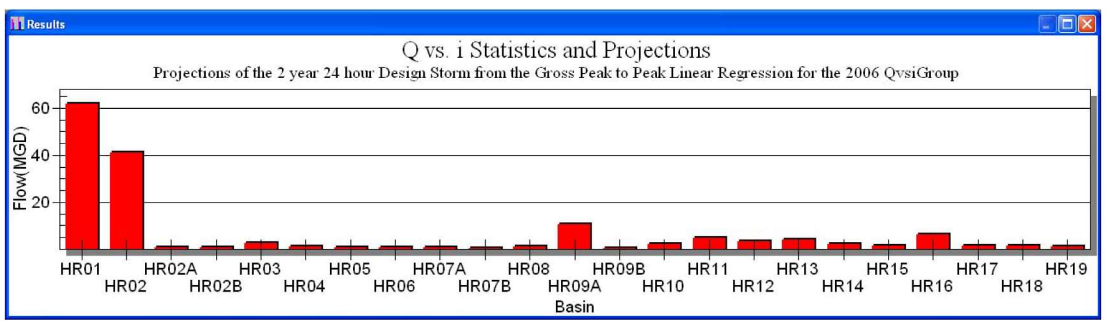
3. In the Results Type, choose Q vs. i.
4. In the Compare group, choose Design St.
5. In the Q vs. i Parameters list boxes, select the parameters of the Q vs. i regression and the Q vs. i group you want to view, you want to compare.
6. In the Results table, right click the mouse on any cell in the column you want to compare.

The plot menu appears.

7. Click plot.

The color dialog appears.

8. Click the color you want and click OK.



Sliicer plots a bar graph of the parameter you selected. To compare additional parameters, repeat steps 6 through 8. To clear a storm, repeat steps 6 and 7, but click the clear menu selection in step 7 instead of plot.

Comparing Q vs. i Groups

You can also use the Results tab to compare a single regression parameter or design storm prediction for a multiple Q vs. i groups. When you compare multiple Q vs. i groups, you must first decide which regression parameter or design storm prediction you want to compare. Although you can change which regression parameter or design storm prediction you use at any time, when you compare multiple Q vs. i groups, you can only compare one regression parameter or design storm prediction at a time.

➔ **To compare parameters**

1. Make sure you have processed more than one, and preferably all sites for dry and wet weather flow using the Meter tab.
2. In the Engineering Wizard, click the Results tab.

Sliicer makes the Results tab current.

3. In the Results Type, choose Q vs. i.
4. In the Compare group, choose Q vs. i Groups.
5. In the Q vs. i Parameters list boxes, select the parameters of the Q vs. i regression and the Q vs. i group you want to view, you want to compare.
6. In the Results table, right click the mouse on any cell in the column you want to compare.

   The plot menu appears.
7. Click plot.

   The color dialog appears.
8. Click the color you want and click OK.

   Sliicer plots a bar graph of the parameter you selected. To compare additional parameters, repeat steps 6 through 8. To clear a storm, repeat steps 6 and 7, but click the clear menu selection in step 7 instead of plot.

Normalizing the Results

Sliicer gives you a number of normalization options when you compare sites in the Results tab. You can normalize both by rainfall and/or basin size. When you normalize by basin size, you can do it three different ways, by area, by length, or by inch-miles. In order to normalize by basin size, you must first enter values for the basin size measure(s) you want to use in the Basin tab.

Normalizing your I/I results is extremely important when you want to compare results to find the worst basins. Simply looking for the most raw wet weather flow does not always lead to the right conclusion about the location of the worst I/I problems in the collection system. Although raw I/I information is part of the picture, it needs to be correlated with basin size and rainfall information before it becomes really useful. Consider the following table:

Basin	**A**	**B**	**C**
Inflow	500000 gal	600000 gal	400000 gal
Size	10000 lf	20000 lf	10000 lf
Normalized by Size	50 gal/lf	30 gal/lf	40 gal/lf
Rainfall	1 in	1 in	.5 in
Normalized by Size and Rain	50 gal/lf/in	30 gal/lf/in	80 gal/lf/in

When considering only raw inflow, it appears that basin B is in the worst condition, because it has the most inflow. However, when we look at basin size, we discover that Basin B also has twice as much sewer. After normalizing by basin size, Basin A has almost twice as much inflow/lf as Basin B, and Basin B turns out to be the least leaky basin.

Further, when we add rainfall to the picture, we discover that it didn't rain as hard in Basin C. Normalizing by rainfall changes the basin severity ranking yet again. Now basin C takes the lead by almost double.

As we can see in this simple example, normalization of I/I response can lead to very different, and hopefully much more informed conclusions. Therefore, it is important to normalize Inflow/Infiltration information by basin size ***and*** rainfall whenever possible.

Normalizing by Rainfall

Sliicer allows you to normalize your I/I results by rainfall. When you normalize your I/I results, Sliicer reduces the number of parameters you can use to compare sites to the Net I/I Volume parameters. Sliicer does this because normalization of other I/I parameters is not meaningful.

Note should also be made that normalizing by rainfall is only applicable to RDII, and not to dry day or Q vs. i results.

➔ **To normalize by rainfall**

1. Process more than one, and preferably all sites for dry and wet weather using the Meter tab.
2. Move to the Results tab.
3. Check the checkbox for the Normalize group.

Sliicer enables normalization.

4. In the Normalize group, check the Rain checkbox.

Sliicer adjusts the values in the Results table to reflect the normalization by rainfall.

Normalizing by Basin Size

In addition to rainfall, Sliicer allows you to normalize by three different measures of basin size: Area, Lineal Feet, and Inch-Miles.

Note If you want to normalize by basin size, you must first enter values for all basins for the measures you want to use in the Basin tab. For more information on entering basin size parameters, see Chapter 4, Basins.

➔ **To normalize by basin size**

1. Make sure you have entered values for all sites for the basin size parameter(s) you want to use for normalization.
2. Process more than one, and preferably all sites for dry and wet weather using the Meter tab.
3. Move to the Results tab.
4. Check the checkbox for the Normalize group.

Sliicer enables normalization.

5. In the Normalize group, check the Size checkbox.

6. In the Basin Size Parameter drop down list, select the type of basin size normalization you want to use.

Sliicer adjusts the values in the Results table to reflect the normalization by the basin size measure you selected.

Customizing the Display

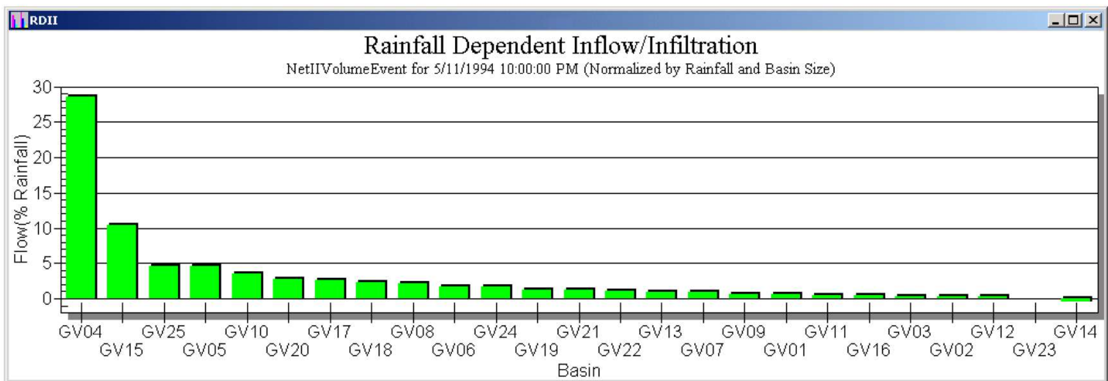
Sliicer gives you several options when you plot RDII graphs. You can sort the table and the corresponding graph on any parameter, and you can limit the sites that are displayed in the table and the graph.

Sorting the Sites

You can sort the Results table on any column. Since the RDII graph appears in the same order as the Results table, sorting the table also sorts the graph.

➔ **To sort the sites**

1. In the Results table, select the column header you want to sort.
2. Click the  button.



Sliicer sorts the table and the graph on the column you selected.

Tip To return the order of the table to meters names, sort the table on the Meter column.

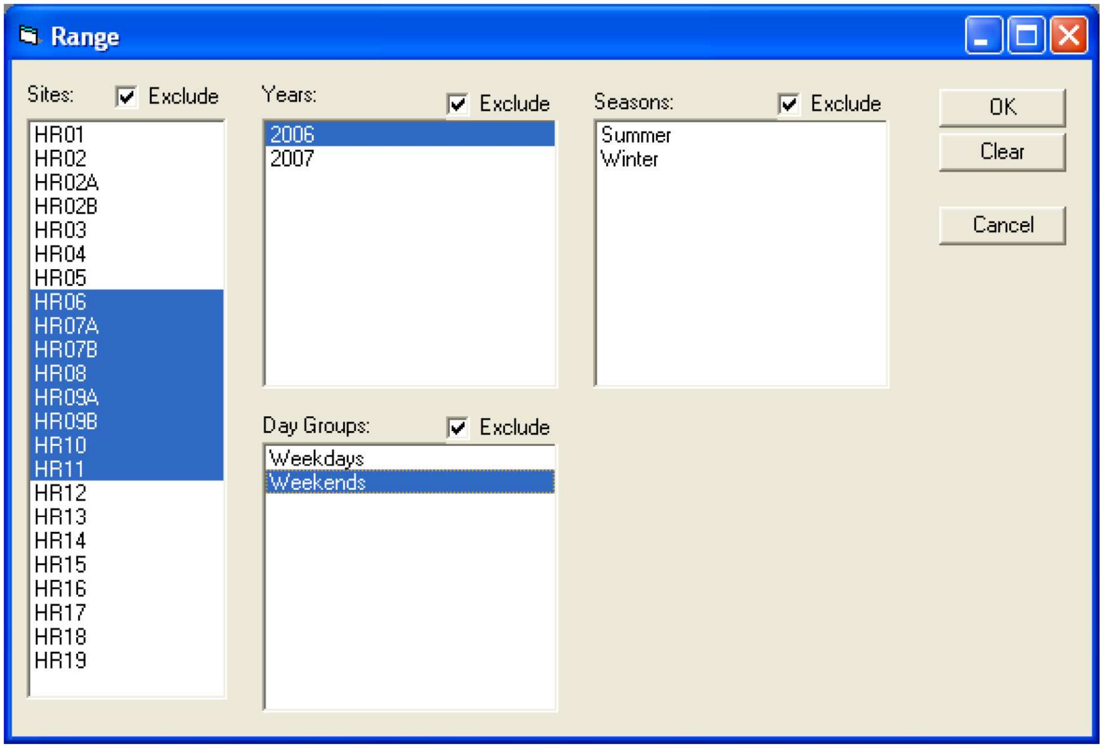
Limiting the Display Range

Sliicer allows you to limit the number of sites displayed in the results table. It also allows you to limit the number of day group for dry day results and the number of storm events for RDII results that are shown in the Results table and graph. You limit the displayed sites, day groups and storms using the Range button.

➔ **To limit the dry day display range**

1. In the Result Type group, select Dry Days.

2. In the Results tab, click the Range button.



The Range dialog appears.

3. Select the sites you want to limit.
4. To exclude the selected sites, check the Exclude Sites check box.

   -OR-

   To display only the selected sites, uncheck the Exclude Sites check box.
5. If you want to limit the day groups displayed, select the storm events you want to limit.
6. To exclude the selected day groups, check the check box for the day group parameter you want to exclude.

   -OR-

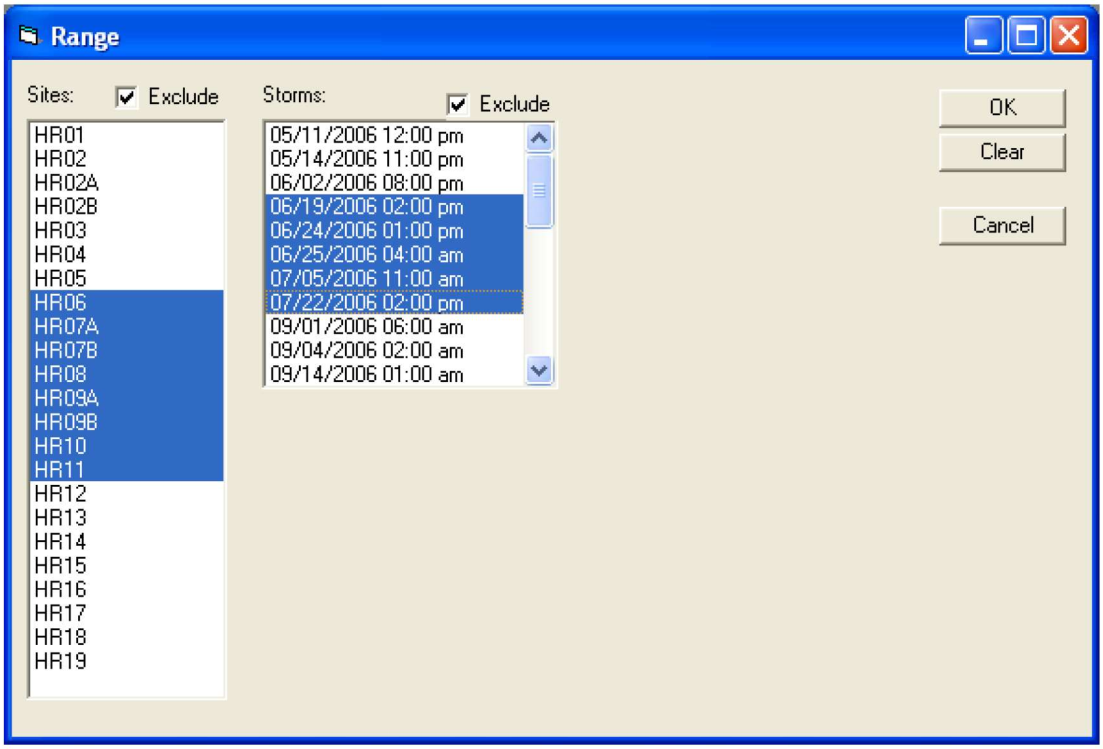
   To display only the selected day groups, uncheck the Exclude check box for the day group parameters you want include.
7. Click the OK button.

   Sliicer limits the display of the Results table and graph to the sites and day groups you selected.

➔ To limit the RDII display range

1. In the Result Type group, select RDII.

2. In the Results tab, click the Range button.



The Range dialog appears.

3. Select the sites you want to limit.
4. To exclude the selected sites, check the Exclude Sites check box.

   -OR-

   To display only the selected sites, uncheck the Exclude Sites check box.
5. If you want to limit the storm events displayed, select the storm events you want to limit.
6. To exclude the selected storm events, check the Exclude Storms check box.

   -OR-

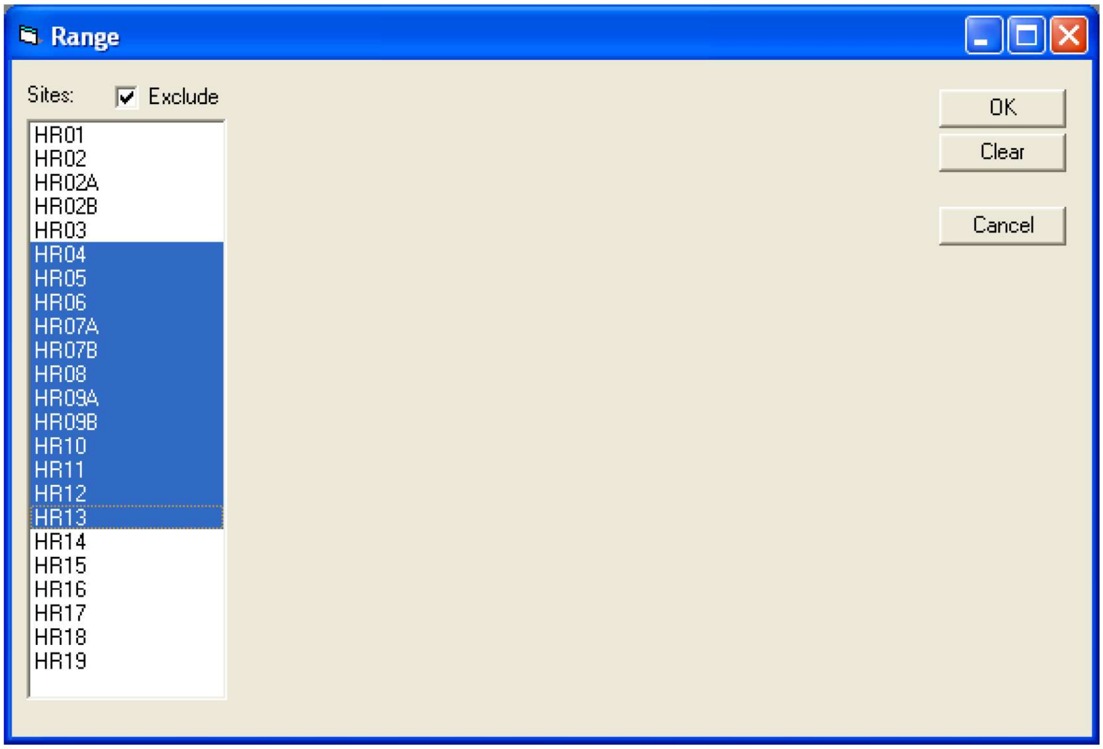
   To display only the selected storm events, uncheck the Exclude Storms check box.
7. Click the OK button.

   Sliicer limits the display of the Results table and graph to the sites and storm events you selected.

➔ To limit the Q vs. i display range

1. In the Result Type group, select Q vs. i.

2. In the Results tab, click the Range button.



The Range dialog appears.

3. Select the sites you want to limit.
4. To exclude the selected sites, check the Exclude Sites check box.

   -OR-

   To display only the selected sites, uncheck the Exclude Sites check box.
5. Click the OK button.

   Sliicer limits the display of the Results table and graph to the sites and storm events you selected.

CHAPTER 7

Chapter 7 Customizing Sliicer

Sliicer allows you to customize a number of different features to suit the demands of your flow study. You can customize the amount of data that will be included in the study, and the way Sliicer determines dry days and storms events. You can also customize the number and types of day groups Sliicer will use. In addition, you can customize the scale and line type of the graphical windows.

You use the Options menu to customize Sliicer. The options menu changes depending on the current window in Sliicer. When the Engineering Wizard window is current, the Option menu allows you to change Global options and Day Group options. When a graphical window is current, Sliicer allows you to change the scale and line type for the graphical window.

In this chapter, you will learn to:

- Change Sliicer's global options for study length, dry days and storm events
- Change Sliicer's day group configuration
- Change the scale and line type settings for Sliicer's graphical windows

Changing Global Options

When the Engineering Wizard is the current window, you can access the Global Options dialog from the Options menu. The Global Options dialog contains a tab system that allows you to adjust three types of parameters. The Study tab allows you to change parameters that effect the amount of data Sliicer uses for calculations and display. The Dry Days tab allows you to change the tests that Sliicer uses to determine dry days. The Storms tab allows you to change parameters that Sliicer uses to determine storm events.

Changing Study Parameters

You use the Global Options Dialog Study tab to change the amount of data Sliicer will use for calculation and display. The Global Options Dialog Study tab allows you to change the study start and end dates, and the study step length.

Changing Study Dates

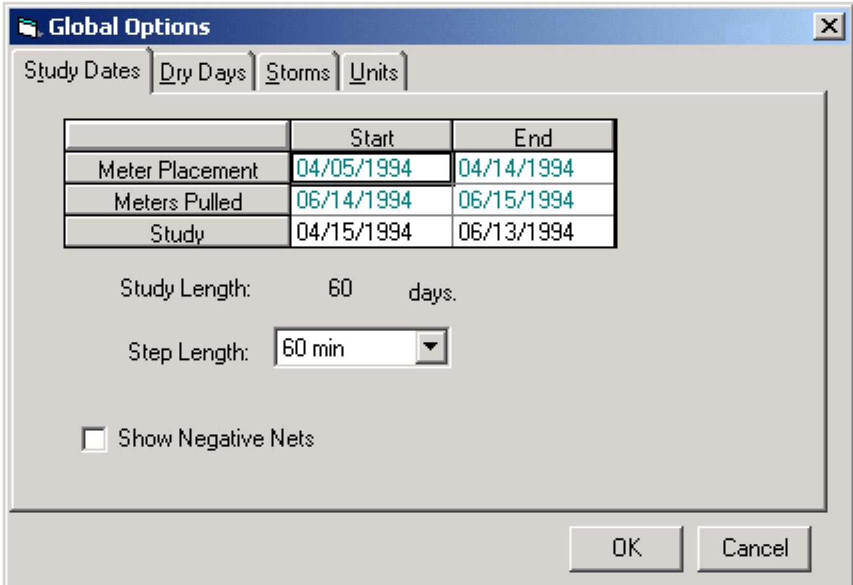
The Study tab allows you to change both the start and end date that Sliicer will use. Sliicer also displays the dates that the first and last meters were placed and pulled to help you decide what the best date range for your study should be.

When you create a Sliicer database for a new flow study, Sliicer presents the Global Options dialog set to the Study tab. In most cases, Sliicer defaults the study start date to the day after the last meter was placed, and defaults the study end date to the day before the first meter is pulled.

You can change the Study Start and End dates when you create a new Sliicer database, or any time thereafter. However, since much of the information derivation process depends on how much data Sliicer uses, you should finalize your study date decisions early on in the study.

➔ **To change study parameters**

1. From the Options menu, choose Global.



The global options dialog appears.

2. Change the date(s) in the Study Start Date and/or End Date cell.
3. Click the OK button.

   Sliicer resets the study start and end dates, and clears all derived information.

Note You may find that the study start and end dates are limited by the Sliicer License File (Sliicer.Lic) that was supplied by ADS for use with your project. If you are unable to set the study start and end dates the way you want, contact ADS to see about obtaining a revised license file.

Changing the Study Step Length

You can also change the step length that Sliicer uses for the study. Depending on the length of the study, values from 5 min up to 1440 may be allowed. Shorter step lengths give more detailed graphs, and take longer to do calculations. Longer step lengths give less graph resolution, but calculate quicker.

The Sliicer step length also controls how much data Sliicer can view. When the step length is set to 60 minutes, Sliicer can view about 100 days worth of data. If you want to use a shorter step length, Sliicer will not be able to look at as much data. In order to look at more than 100 days worth of data, you must use a longer step length.

Note The default step length is 60 min. This is the normal value used by most engineers for flow studies. Unless you have a good reason to do otherwise, you should use the 60 min default for the step length.

➔ **To change the study step length**

1. From the Options menu, choose Global.

   The global options dialog appears.
2. In the Step Length drop down list, select the step length you want.
3. Click the OK button.

   Sliicer changes the step length, and clears all derived information.

Showing Negative Nets

When Sliicer subtracts downstream flow from upstream to develop a net flow trace, occasionally, the total upstream flow exceeds the downstream flow. Although, theoretically this implies a flow loss in the system, negative nets can also develop in Sliicer for other reasons, such as data analysis issues, flow balancing issues and travel time issues, to name a few.

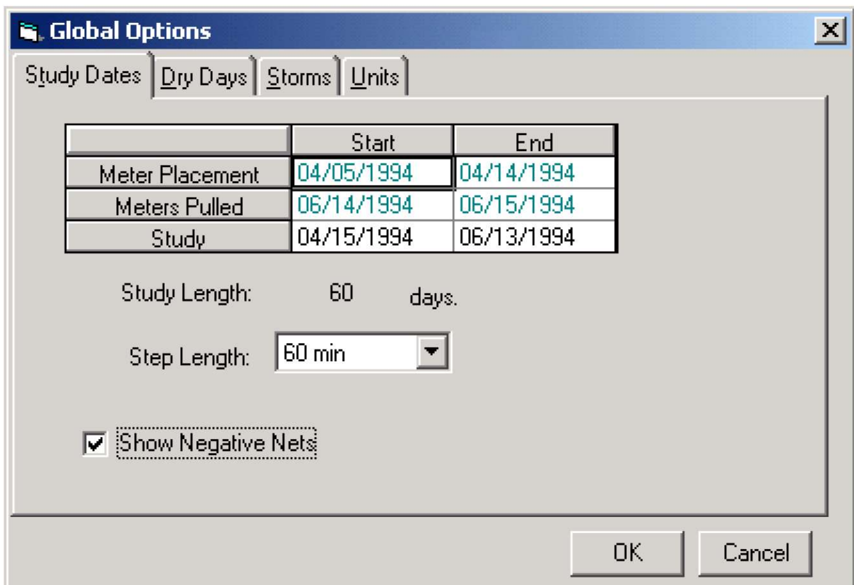
Most of the time the nets occur only occasionally and are negligible when they occur. Therefore, in default mode, Sliicer will not display any negative values in the net trace. However, occasions do occur when the negative values of the net trace are of interest. When you want to see these values, use the Show Negative Nets check box on the Global Options Study Dates tab.

➔ **To show negative nets**

1. From the Options menu, choose Global.

   The global options dialog appears.

2. Check the Show Negative Nets check box.



3. Click the OK button.

   Sliicer will show negative net values in the trace window.

Changing Dry Day Parameters

There are a number of global settings which effect how Sliicer calculates dry day information. These fall into two categories, Dry Day Selection parameters and Waste Water Production /Base Infiltration parameters.

Changing Dry Day Selection Parameters

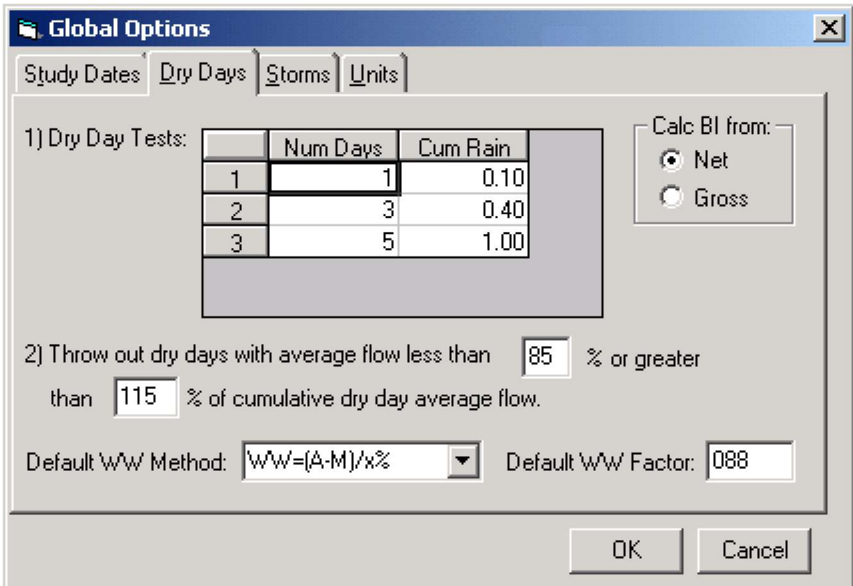
When determining which days will be considered dry days, Sliicer uses two tests. The first test checks to make sure a rainfall threshold within a specified number of days preceding the day being tested has not been exceeded. This test can have multiple threshold levels. Sliicer will only mark a day as dry when it passes all the rainfall thresholds set in the Global Options Dry Days tab.

The second test considers the average daily flow. It verifies that the average daily flow for the day being tested falls within specified percentages of the average of all currently marked dry days.

You can use the Global Options Dry Days tab to set the parameters for both dry day tests. You can set the number of days and the rain threshold for as many rainfall tests as you want. You can also set the upper and lower boundaries for the average test.

➔ **To change the dry day parameters**

1. From the Options menu, choose Global.
2. Click the Dry Days tab.



The Global Options Dry Days tab becomes current.

3. If you want to change the rainfall test, change the values in the rainfall test table. You can add rows, delete rows, and change values.
4. If you want to change the average test, enter new percentages for the average boundaries under test 2.
5. Click the OK button.

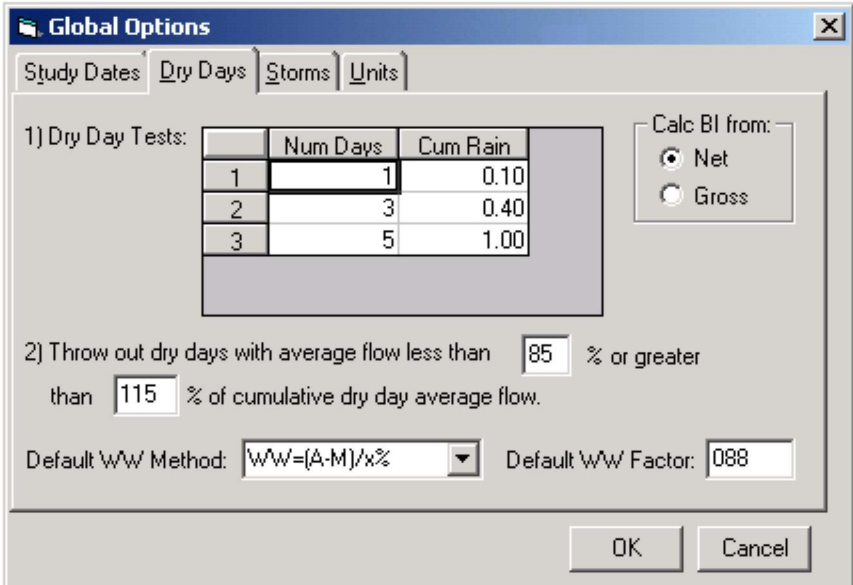
   Sliicer changes the Dry Day test, and erases all derived information.

Changing Waste Water Production/Base Infiltration Settings

In the section on dry days in Chapter 5, you learned how to change the settings Sliicer uses to calculate Waste Water Production (WWP) and Base Infiltration (BI). You can also control the default settings Sliicer uses to calculate Waste Water Production and Base Infiltration, so that you don't have change the Waste Water Method or factor on each site. By changing these parameters globally, Sliicer will use the values you select as a starting point, saving you time later.

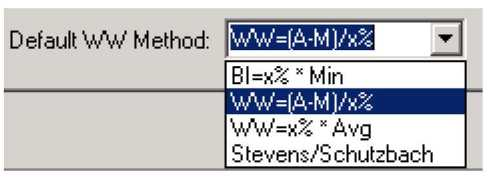
➔ **To change the waste water production/base infiltration settings**

1. From the Options menu, choose Global.
2. Click the Dry Days tab.



The Global Options Dry Days tab becomes current.

3. If you want to change the Default WW Method, you can select a new method in the Default WW Method combo box.



4. If you want to change the Default WW factor, enter a new value in the Default WW Factor field.

5. If you want to change the basis of Base Infiltration calculation from the net to the gross diurnal curve, click the Gross option button in the Calc BI from: group.

6. Click the OK button.

   Sliicer changes the default waste water production and base infiltration, and erases all derived information.

Changing Global Storm Parameters

Sliicer allows you to set three types of global storm parameters that effect storm event creation, allowance of negative I/I values, and the way Sliicer determines rainfall peaks for Q vs. i.

Changing Event Creation Parameters

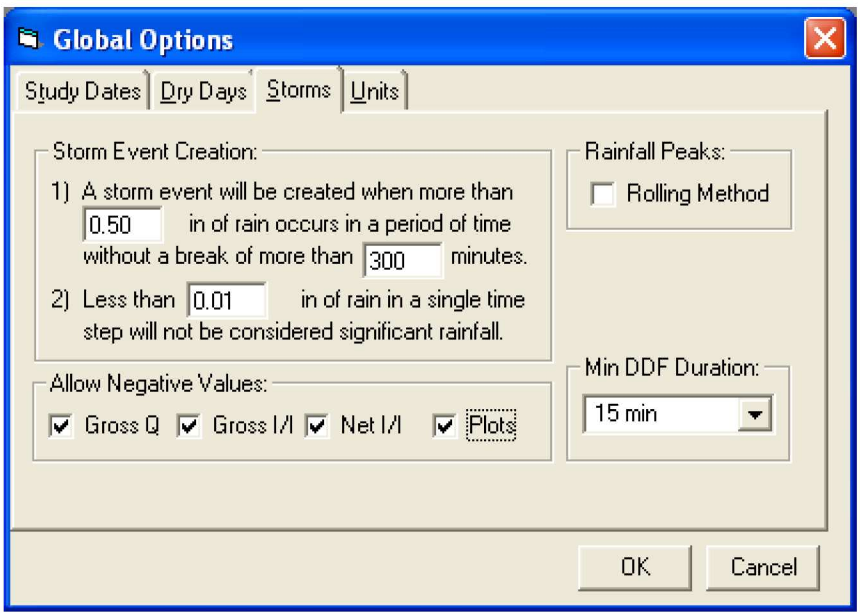
Sliicer allows you to adjust three parameters that control how storm events are created: the Rain Threshold, the Time Lapse, and the Dribble. The Rain Threshold is the amount of rain that must fall for Sliicer to identify a storm event. The Time Lapse is the amount of time without rain for Sliicer to stop attributing rainfall to a potential event. The Dribble is the amount of rainfall that must be exceeded in a step to be considered significant rainfall.

Sliicer moves through all the rainfall traces simultaneously in chronological order. When it encounters rainfall exceeding the Dribble at any of the gauges, it triggers a potential storm event. Sliicer then accumulates all rainfall for every system rain gauge (including rainfall less than the Dribble) until a break in the rainfall for all gauges is encountered that exceeds the Time Lapse. When this happens, Sliicer compares the total rainfall each rain gauge encountered during the potential event with the Rain Threshold. If the cumulative rainfall for any of the rain gauges exceeded the Rain Threshold, Sliicer marks and saves the start time as a Storm Event.

You can control how Sliicer selects Storm Events by changing the Storm Event Creation parameters.

➔ **To change storm parameters**

1. From the Options menu, choose Global.
2. Click the Storms tab.



The Global Options Storms tab becomes current.

3. In the Storm Event Creation group, adjust the values you want to change.
4. Click the OK button.

Sliicer changes the Storm Event Creation parameters, and erases all derived information.

Allowing Negative Values

You can tell Sliicer to allow negative I/I values for GrossQ, Gross I/I, Net I/I, and Plots. You may want to allow negative I/I values if you are using large precomp values that are causing some points on your I/I hydrograph to go to zero, or if you have flow reversals in your system.

Note Negative value in the traces and/or I/I values could represent errors in the flow data, or errors in the data processing. They could also represent real phenomena that actually occurred in the sewer. For instance, an SSO or CSO could create a large negative I/I value at the next monitor downstream. Similarly, although not very common in wet climates, exfiltration could cause negative I/I values.

➔ **To allow negative I/I values**

1. From the Options menu, choose Global.
2. Click the Storms tab.

   The Global Options Storms tab becomes current.
3. Check the type of negative I/I values you want.
4. Click the OK button.

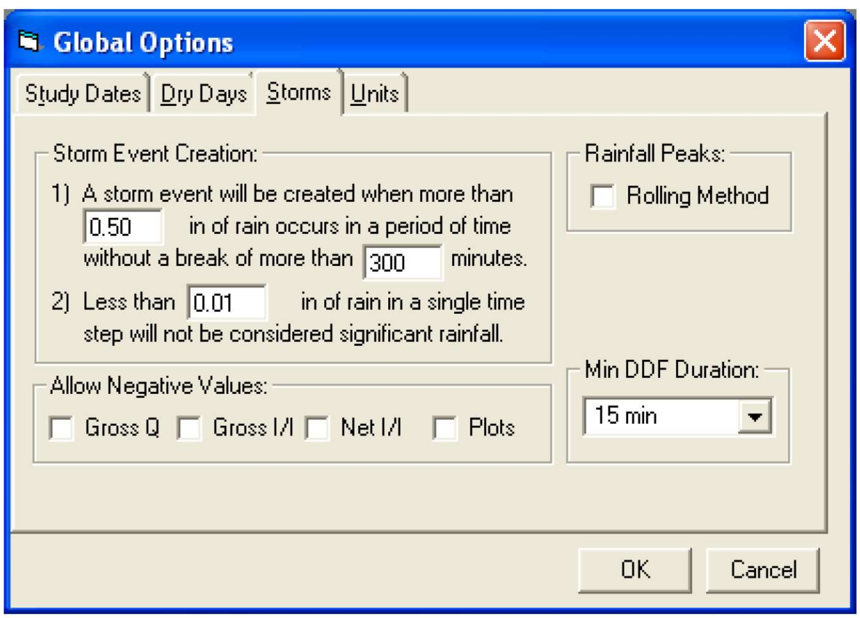
   Sliicer changes the way storm calculations are done to allow negatives in the hydrographs you selected.

Enabling Rolling Rainfall Peaks

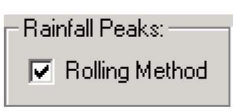
You can tell Sliicer to calculate Rolling Step Rainfall Peaks instead of clock step rainfall peaks for storm events. When Sliicer uses Rolling Step Rainfall Peaks, it looks for the peak rainfall amount across step boundaries. Using this method sometimes increases the rainfall peak by as much as 100%. When you tell Sliicer to calculate Rolling Step Rainfall Peaks, Sliicer uses the rolling peaks instead of fixed step peaks in the Q vs. i analysis. You use the Rolling Step check box to tell Sliicer to calculate Rolling Step Rainfall Peaks.

➔ **To enable rolling rainfall peaks**

1. From the Options menu, choose Global.
2. Click the Storms tab.



   The Global Options Storms tab becomes current.
3. In the Rainfall Peaks group, Check the Rolling Step check box.



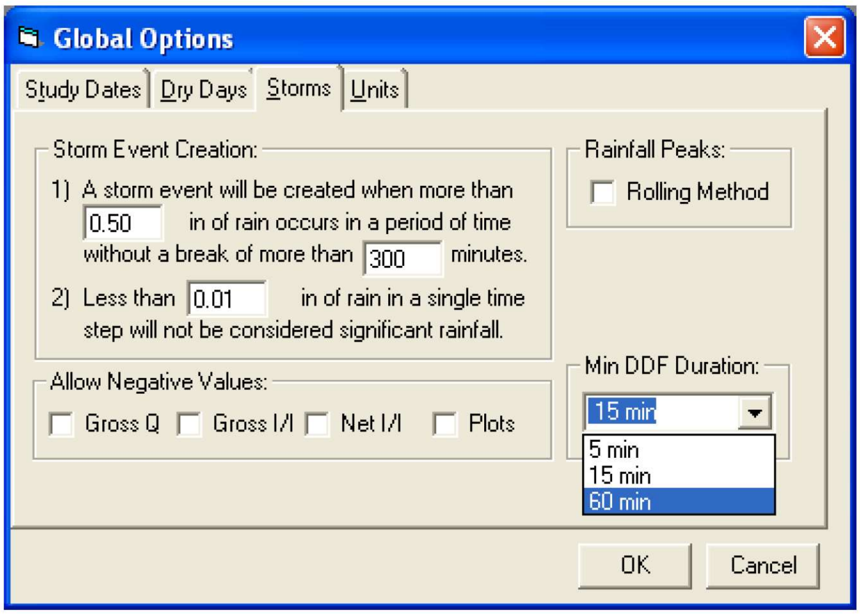
   Sliicer changes the way rainfall peaks are calculated for storm events.

Changing the Minimum DDF

You can tell Sliicer to calculate Rolling Step Rainfall Peaks instead of clock step rainfall peaks for storm events. When Sliicer uses Rolling Step Rainfall Peaks, it looks for the peak rainfall amount across step boundaries. Using this method sometimes increases the rainfall peak by as much as 100%. When you tell Sliicer to calculate Rolling Step Rainfall Peaks, Sliicer uses the rolling peaks instead of fixed step peaks in the Q vs. i analysis. You use the Rolling Step check box to tell Sliicer to calculate Rolling Step Rainfall Peaks.

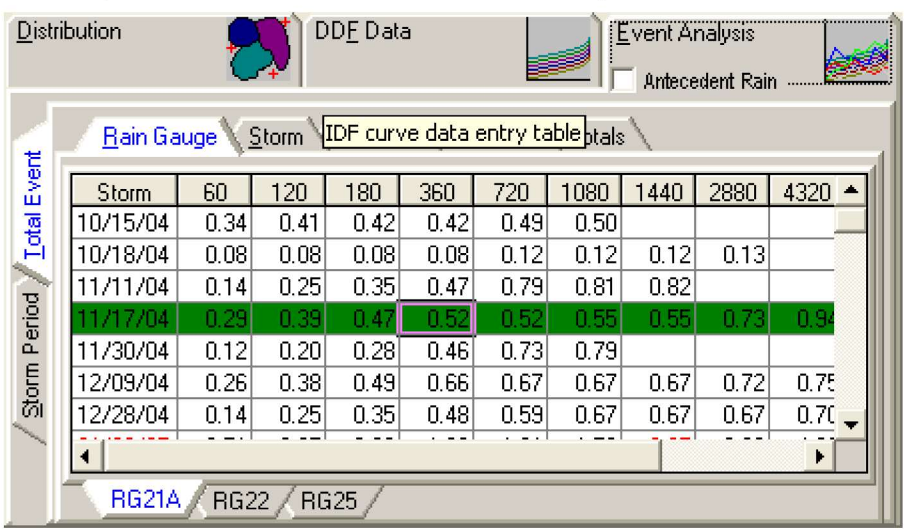
➔ **To enable rolling rainfall peaks**

1. From the Options menu, choose Global.
2. Click the Storms tab.



3. In the Min DDF Duration combo box, select the value you want.

   Sliicer adjusts the minimum DDF duration to the value you selected.



The figure above shows the effect in the rain analysis table of setting the Min DDF duration to 60 min.

Changing the Units Settings

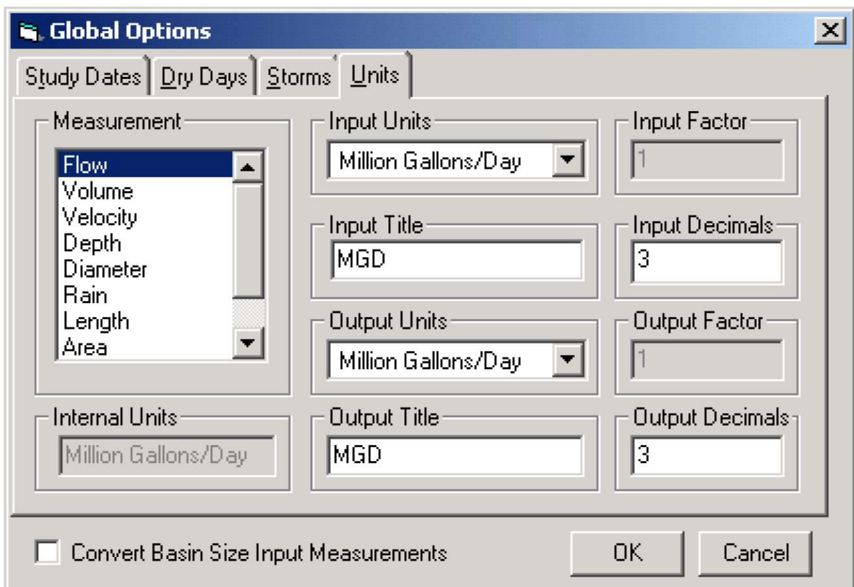
Sliicer allows you to select from a number of different units for each type of measurement. Sliicer allows you to control the settings of both the input units and the output units. The input units are the units of the data that Sliicer reads in, and the output units are the units that Sliicer displays in its graphs and tables. Whenever you change any of the units settings, Sliicer updates the results calculations throughout the program to reflect your change.

Changing the Units

You change the units from the Global Units dialog Units tab.

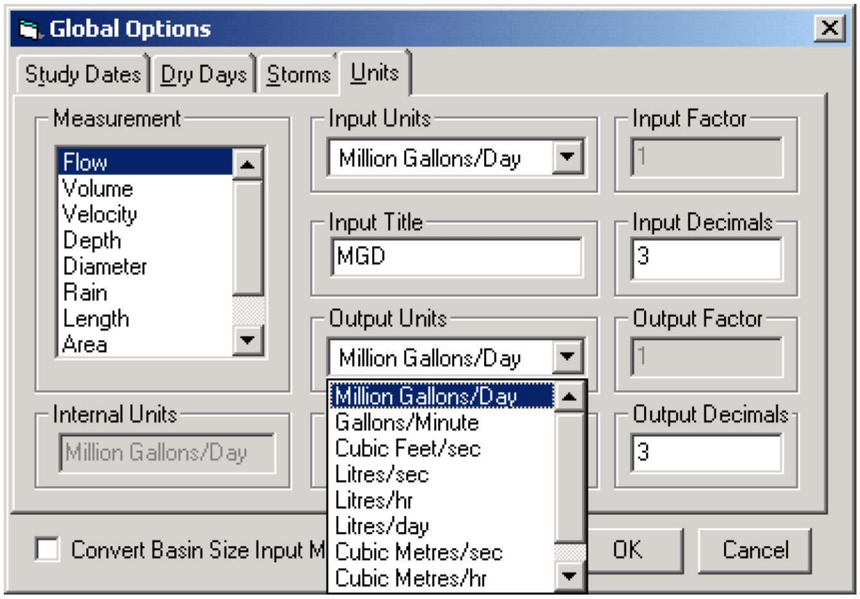
➔ **To change the units settings**

1. From the Options menu, choose Global.
2. Click the Units tab.



The Global Options Units tab becomes current.

3. In the Measurement list, select the measurement for which you want to change units.
4. In the Input Units and Output Units drop down lists, select the units you want.



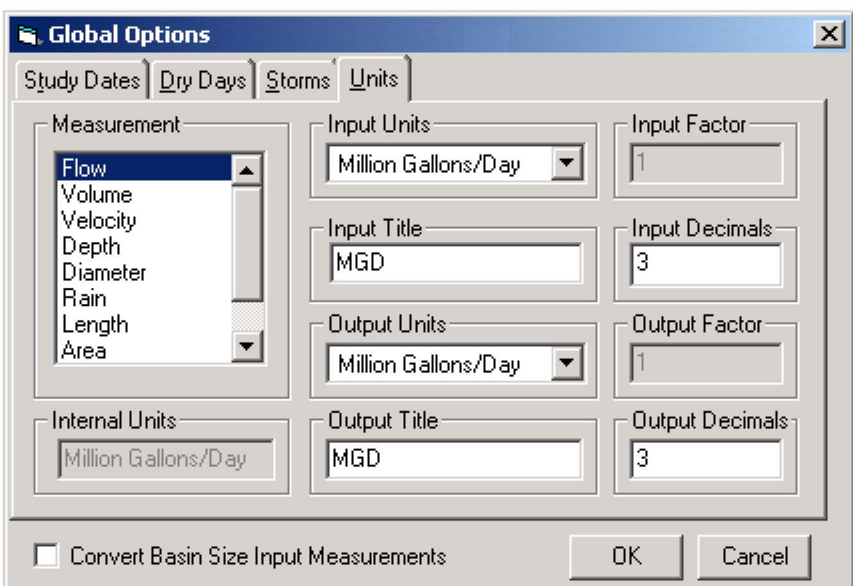
5. Click the OK button.
6. Sliicer changes the units settings, and converts all existing units to the units you specified.

Customizing the Units Settings

Sliicer also allows you to set both the units description string and the number of decimal places for each measurement type.

➔ **To customize the units settings**

1. Start the Global Options dialog.



2. Change the Title and Decimals to the values you want.
3. Click the OK button.
4. Sliicer changes the graph and table displays to reflect your customized settings.

Understanding Input Units

Sliicer looks to external files for most of its input of most measurement types, including Flow, Velocity, Depth and Rain. Setting the input units in these cases is simply a matter of determining the units of the raw data, and setting the units accordingly.

However, in the cases of Length, Area and Footprint, the input is actually entered into the Sliicer Basin Size table in the Basins tab. Because of this, you must coordinate the units you use to enter the basin size measurements (i.e. Length, Area and Footprint), with the input units settings for these measurements in the Global Options Units tab.

Because it may be difficult to remember to set these units correctly before you enter your basin size data, Sliicer has two modes of changing these units. In the default mode, Sliicer will assume you knew what you were doing when you entered your basin size values, and convert basin size input measurements when you click the OK button. In the other mode, Sliicer allows you to compensate for forgetting to set the basin size units correctly when you started. In this mode, you can change the basin size input units without Sliicer making any changes to your basin size values. You might want to use this feature if you entered the basin area in Hectares, but had left the units setting for Area set to Acres. This mode would allow to change the area units to Hectares without changing the values of the numbers you entered for the area in the basin size tab. Sliicer would simply interpret these numbers differently after you changed the units.

➔ **To control the conversion of Basin Size Input measurements**

- In the Global Options Units tab, check the Convert Basin Size Input Measurements if you want Sliicer to covert the basin size values you have entered into the Basin size tab.

  -OR-

  Un-check the Convert Basin Size Input Measurements if you don't want Sliicer to do this conversion, and leave the values as they are.

Changing Day Group Options

Sliicer allows you to change the way day groups are defined. You change the day group settings using the Day Groups item in the Options menu. The Day Groups item is available in the Options menu when the Engineering Wizard is the current window.

Understanding Day Groups

In order to understand the way Sliicer calculates dry day information, you must first understand the concept of day groups. Sliicer allows you to divide the days of your flow study up into groups based on similar flow patterns. Sliicer allows you to classify days in four different ways, day of week, exception days, seasons and regimes. These classifications are called day groups.

For example, the most common day of week setting is two day groups: Weekdays and Weekends. In this configuration, flows from Mondays through Fridays are grouped to form one day group. Saturdays and Sundays are grouped together to form another day group. This is a reasonable day group configuration for many studies because the days composing the Weekday day group have similar water usage patterns, and the days composing the Weekend day group also have similar water usage patterns. However, Saturday-Sunday flows are significantly different than Monday-Friday flows, and so two day groups are needed.

When Sliicer calculates dry day information, it produces one set of results for each day group. In the above example, Sliicer would produce two sets of calculations and average dry day diurnal curves; one for Weekdays and one for Weekends.

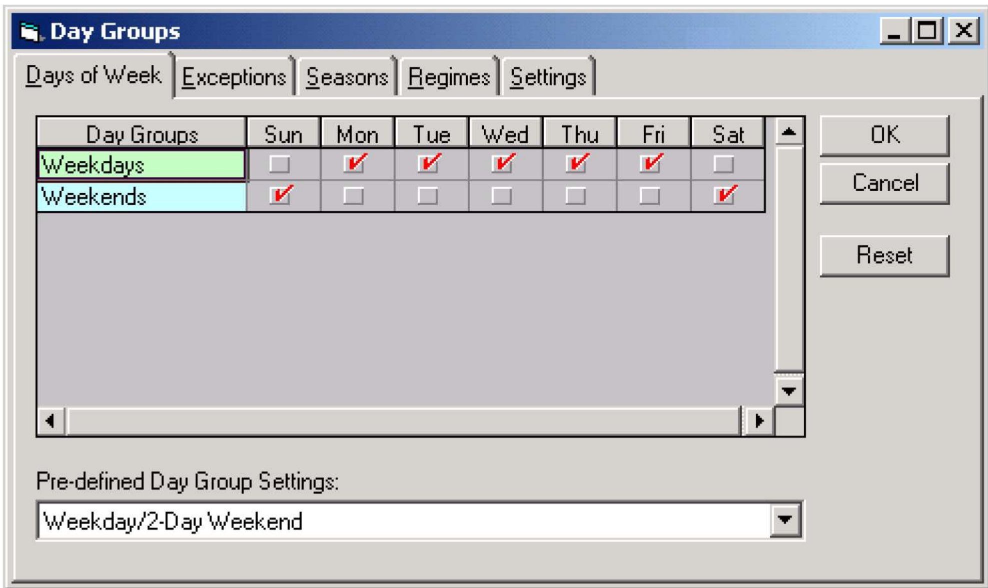
Changing the Day Group Settings

The default day group configuration is Weekdays and Weekends. Although you can change this setting at any time, doing so clears all previous calculations. Therefore, it is best to make any changes to the day group configuration early on in the study, before you do any final calculations.

There are two ways to change the day group settings: Use a different pre-defined day group set, and create a custom day group set.

➔ **To select a different pre-defined day group set**

1. From the options menu, choose Day Groups.



   The Day Groups dialog appears.

2. Make sure the Days of Week tab is current
3. In the Pre-Defined Day Group Settings list, select a new configuration.

   The day group table displays a check for the day groups composing each day group.

4. To save the change, click the OK button.

   The day groups will be reconfigured, and all calculations will be cleared.

➔ **To create a custom day group set**

1. In the Day Groups table, create a row for each day group you want to use.
2. Type the name you want for each day group in the Day Group column.
3. Check the boxes for the day groups you want to include in each day group.

Note A day type can only be a member of one day group. Also be careful not to leave any day groups unassigned to a day group.

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4. Click the OK button.

   The day groups will be reconfigured, and all calculations will be cleared.

Using Exception Day Groups

Sometimes, setting up day groups strictly by day of week is not adequate to describe all the cyclical patterns of water usage for your study. You may have regular events such as football games, or concerts that drastically effect water usage that occur on a calendar basis, but are not tied exactly to any one day of the week. Sliicer allows you to set up exception day groups to handle situations like these.

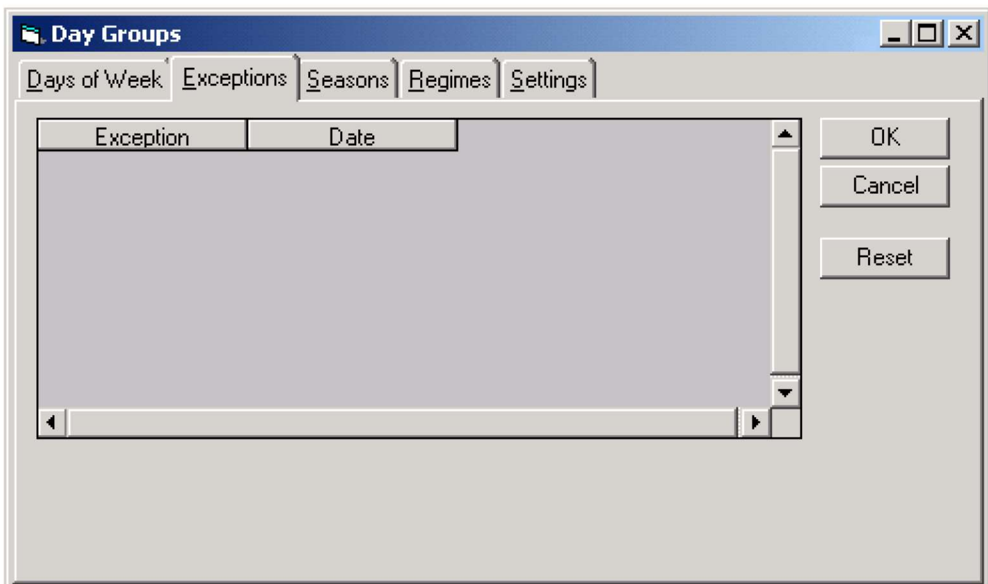
Defining Exception Day Groups

In addition to creating day groups by day type, you can also create exception day groups by specific dates. You might use this feature to create a day group for home football games by listing the dates the home games occur. Sliicer would then calculate dry day information for home football games as well as for other normal day groups.

This might be particularly useful if a significant storm event occurred on a home football game day. In order to make an accurate determination of the wet weather flow component, it would be better to use an average of other dry home football game days rather than use normal weekends.

➔ **To define an exception day group by date**

1. Open the Day Groups dialog
2. Click the Exceptions tab.



Sliicer shows the Exceptions tab with the Exception Date table.

3. Double click the Exception table header to add the first row.

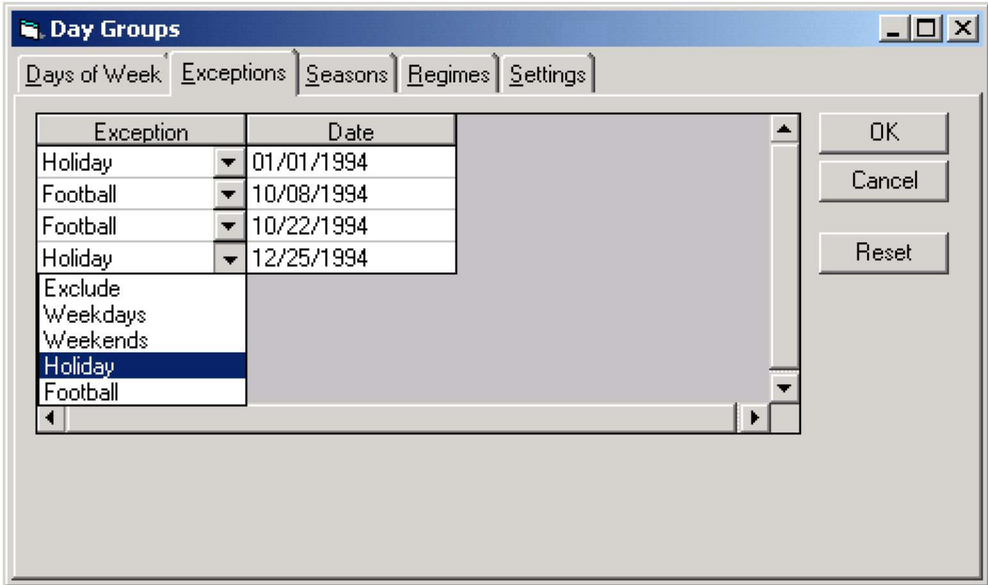
   -OR-

   Move to the last row in the Exception table and press the down-arrow on the keyboard.

4. In the Exception column, type the name for the exception day group.

   -OR-

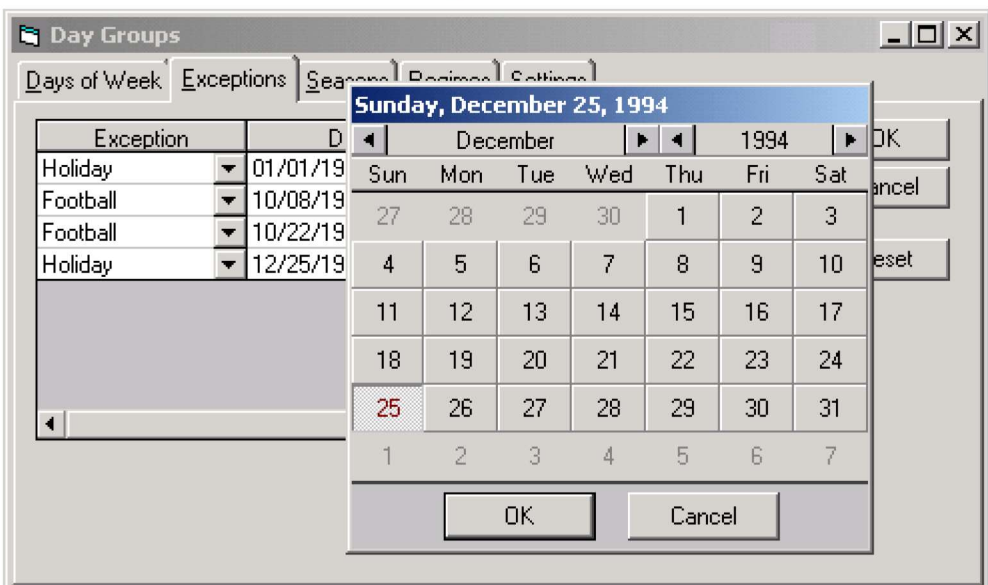
   If you are entering an additional date for an exception day group you already defined, select the name from the drop down list.



5. In the Date column of the new row, enter the date you want.

   -OR-

   Double click the date cell twice to bring up the Calendar dialog and select the date you want.



6. Click the OK button.

   Sliicer creates exception day groups for the dates you entered, and clears all calculations.

Using the Exclude Day Group

You can also use the Exception day group feature to exclude specific dates from other day groups. You do this by adding dates to a special day group called "Exclude". Dates added to the Exclude day group will not be considered part of the day group to which their day type is assigned.

➔ **To create an Exclude day group**

1. Open the Day Groups dialog and click the exclude tab.

2. Double click the Exception table header to add the first row.

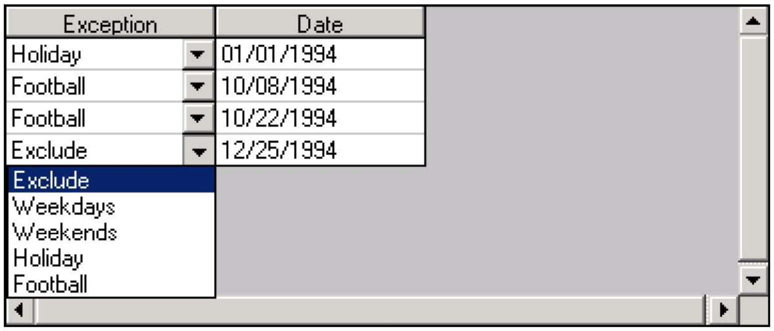
   -OR-

   Move to the last row in the Exception table and press the down-arrow on the keyboard.

3. In the Exception column, type or select the name “Exclude” (case sensitive).

   -OR-

   Select “Exclude” from the drop down list.



4. In the Exception column of the new row, enter the date you want.

   The specified date(s) will be excluded from dry day calculations.

Handling Larger Cyclical Patterns

Day of week settings are usually all that are needed for short term studies, but for long term data (more than 4 months), other larger cyclical patterns come into play that require the use of more advanced handling of day classification. Sliicer allows you to handle these patterns by setting up seasons and regimes.

Using Seasons

When you study long term data, particularly when you are trying to study dry day patterns, it is not acceptable to lump a dry February day in with a dry day in August to find the average dry day. Seasonal variation in rainfall, growth patterns of plants, and other annually varying factors often cause wide variation in average dry day flow through out the year.

The Sliicer season feature was developed to address this issue. The Season feature helps you manage cyclical patterns that vary on an annual basis to develop more accurate analysis of dry day flow patterns. When you set up seasons, Sliicer analyzes the dry days for each season separately so that more accurate dry day averages are developed for each season.

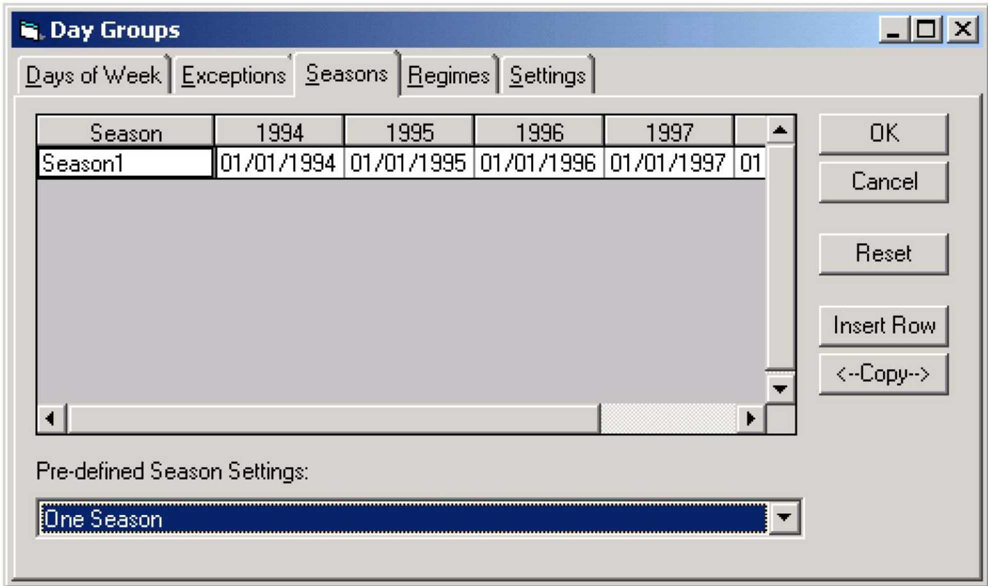
Sliicer has a number of pre-configured season settings available, such as the traditional calendar seasons, quarters, etc. You can also create your own seasons to suit your specific needs. However you create your seasons, Sliicer allows you to adjust the start dates of each season to fit the climatological issues of your area. If your study spans multiple years, Sliicer even allows you to set different start dates for the same season for different years to reflect the difference in the start time of the same season from year to year.

Setting up Seasons

You can set up seasons on any study, but it make the most sense on studies with 6 months or more of data. Using seasons is particularly useful when your study spans multiple years.

➔ **To set up seasons**

1. From the day group dialog, select the Seasons tab.



Initially the Season tab shows one season, called "Season1", with a start date for each year of the study.

Note Sliicer always operates with at least one season. The default name for this season is "Season1". When only one season is shown in the Seasons table, Sliicer will not present season options elsewhere in the program. To have the season features activated, you must have more than one season.

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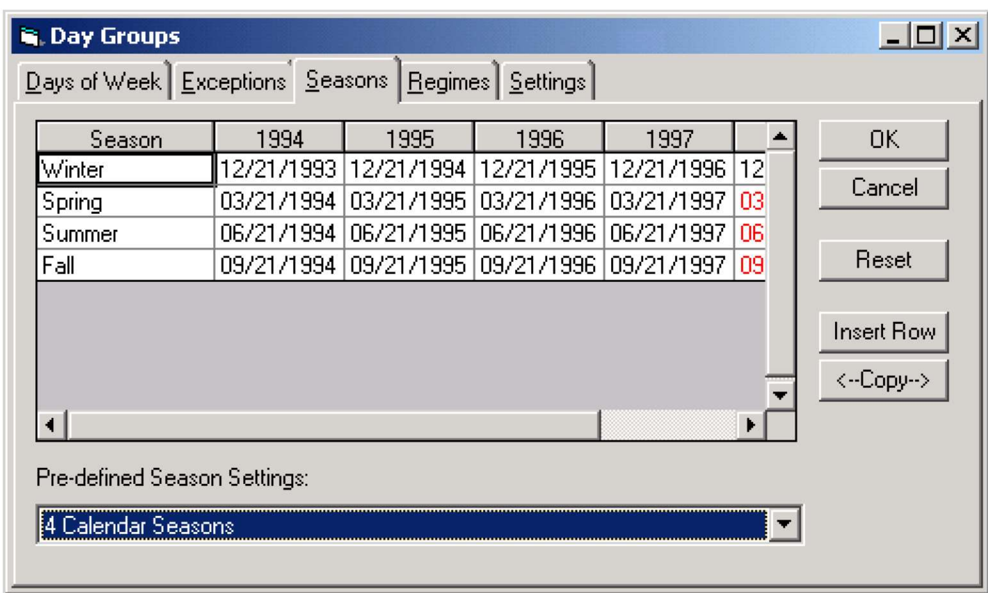
2. Select a season setting from the Pre-defined Season Settings list box.



Sliicer loads the seasons table with the seasons you selected. Sliicer also shows a start date for each season for each year of the study.

3. Select the OK button.

Sliicer will warn you that changing seasons will delete all analysis results and require a recalculation of all analysis results.

4. If you want to go ahead with the change to the season configuration, click the OK button.

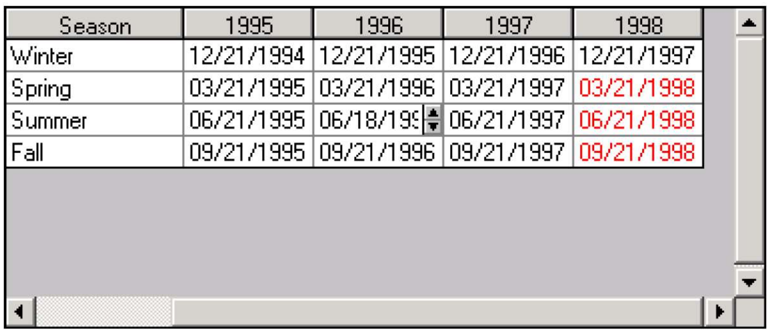
Note When you use Seasons, Sliicer calculates different dry day results sets for each day group in each season. As you can see, this adds complexity to the results, so you should not use Seasons unless the added complexity is justified by analysis requirements.

Changing Season Start Dates

You can change the start dates for any of the seasons. You can even have different start dates for the same season for different years. This might be useful if you have a very late spring one year and an early spring in another.

➔ **To change season start dates**

1. Double click the cell for the season and year for which you want to change the start date.



Spin button arrows appear in the cell you select.

2. Type a new date.

   -OR-

   Position the cursor on either the month, day or year, and use the spin buttons to change the date.

   -OR-

   Double click the selected cell again, and the calendar dialog appears.

   Click the date you want on the calendar.

   Sliicer changes the start date for the season and year to the date you selected.

Adding and Deleting Seasons

To add or additional season, you simply add rows to the seasons table. You can also remove existing seasons by deleting rows from the season table.

➔ **To add a season**

1. Select a cell in the last row in the Season table.
2. Press the down arrow on the keyboard.

Season	1995	1996	1997	1998
Winter	12/21/1994	12/21/1995	12/21/1996	12/21/1997
Spring	03/21/1995	03/21/1996	03/21/1997	03/21/1998
Summer	06/21/1995	06/18/1996	06/21/1997	06/21/1998
Fall	09/21/1995	09/21/1996	09/21/1997	09/21/1998
Season1	09/22/1995	09/22/1996	09/22/1997	09/22/1998

   A new row is added to the Season table with the season name "Season1".

3. In the Season column, type the name of the new season.
4. In the Year columns, adjust the start dates for the new season for each year if necessary.
5. Click the OK button.

   A new season is created, and all calculations are cleared.

➔ **To delete a season**

1. Click any cell on the row you want to delete to make it current.
2. Press the delete key on the keyboard.

   Sliicer will prompt you for confirmation before deleting the season.

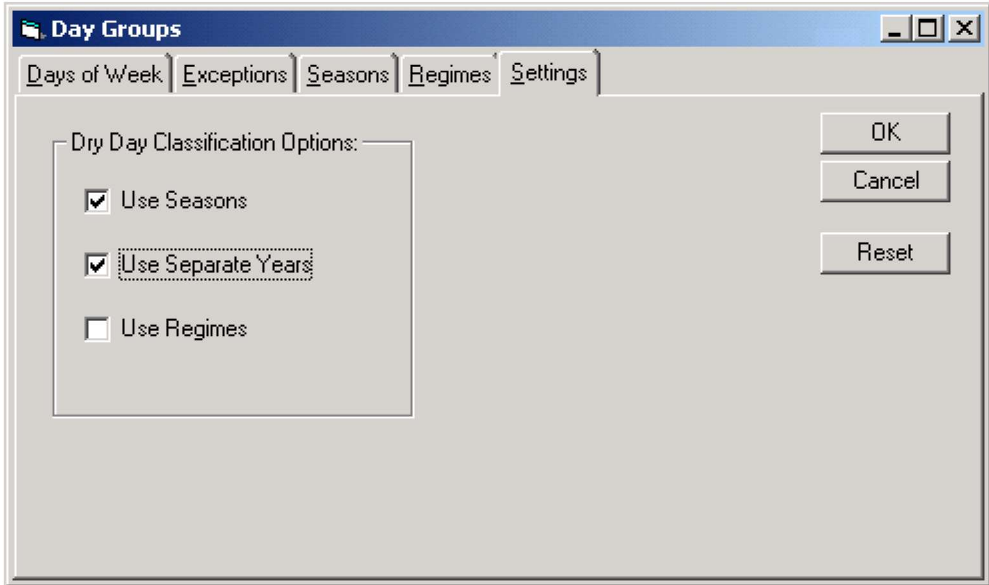
Using Years

Whenever your study spans multiple years, Sliicer allows gives you a choice of how the analysis is done. If you wish, the Sliicer season feature can give you averages across different years for the same season. This, for example would help you to develop a Spring Dry Day Average spanning several years. This is the default setting for how Sliicer handles years.

On the other hand, you might wish to compare the average spring dry day from one year with the average for the same season from other years. This would allow you to find trends progressing from one year to next. Sliicer allows you to do this type of analysis by enabling the years function.

➔ **To use years**

1. In the Day Groups dialog, select the Settings tab.



2. Make sure the “Use Separate Years” check box is checked.
3. Click the OK button.

   Sliicer will use separate years when developing dry day averages.

Understanding Regimes

Not all changes in the mode of long term flow data are cyclical. Some changes are caused one time events such as a plant going on line, relief sewer construction, a change in the valve settings at a pump station or a rehabilitation program. In order to accommodate the analysis of changes like these, Sliicer has a regime feature. For example, if the maintenance crew changed the operating parameters of a pump half way through the monitoring period, you could use the regime feature to treat the periods before and after the change differently.

The Sliicer regime feature allows you to create as many different regimes as you need to describe changes in your collection system. Like seasons, each regime has a start date. But, in contrast to Seasons, Regimes are one time events, and do not automatically cycle on an annual basis. Once a regime is started, it remains in effect until the start time of the next regime, if any. However, you may cause your regimes to cycle manually, by entering more than one instance of a particular regime name. When you do this, Sliicer will group all the dry days for the same regime together for analysis purposes, even if the time segments for a particular regime name are discontiguous.

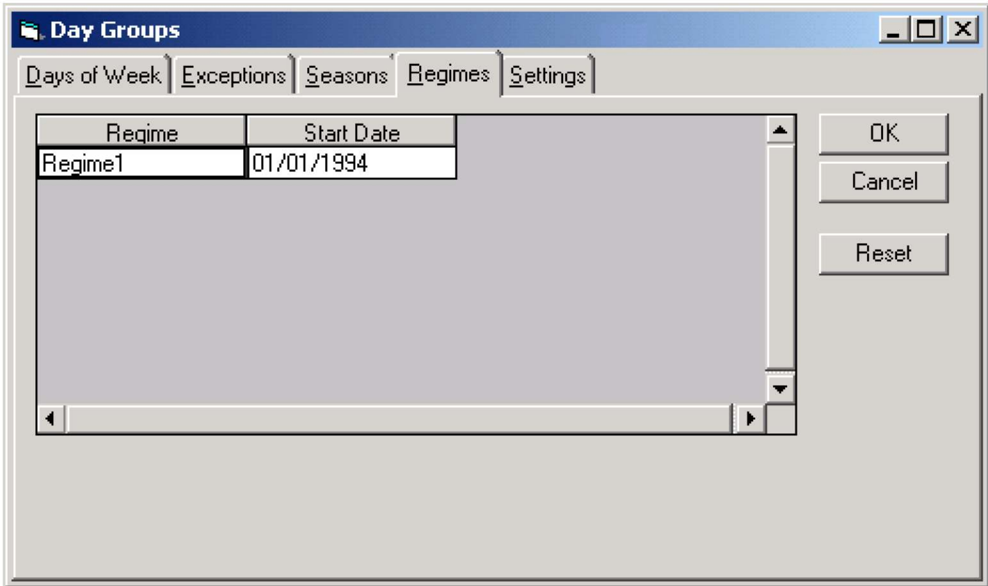
Note should be made that you can use both seasons and years in the same analysis. When you do this, invariably, the regime changes will take place within a season. This means that some seasons will have values for two different regimes, e.g. Regime1 Fall Weekdays vs. Regime2 Fall Weekdays. Sliicer can handle this level of complexity in the analysis, just make sure you are ready for this level of hair splitting before you set your study up to use both seasons and regimes.

Using Regimes

You can set up regimes at any time from the Day Group dialog box. As in the case of seasons, Sliicer always operates with at least one regime which starts on the first day any monitors are in the ground. The default regime name is “Regime1”. If there is only one regime for the study, the regime features will not be activated. If you want the regime features active, you must have at least two regimes.

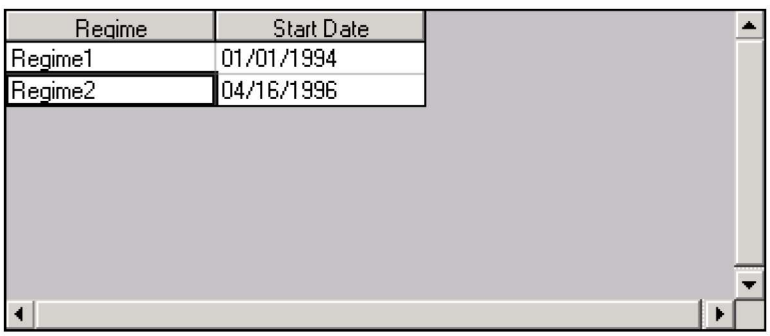
➔ **To add regimes**

1. In the Day Group dialog, select the Regime tab.



The regime table appears.

2. Click the regime cell for the last row in the table to make it current.
3. Press the down arrow key on your keyboard.



A new row appears in the regime table with a name like "Regime2".

4. Change the name in the Regime cell to the name you want.
5. Change the start date for the regime to the date you want.
6. Click the OK button

   Sliicer sets up the regimes you requested, and deletes the analysis results.

➔ **To delete a regime**

1. Click any cell on the row you want to delete to make it current.
2. Press the delete key on the keyboard.

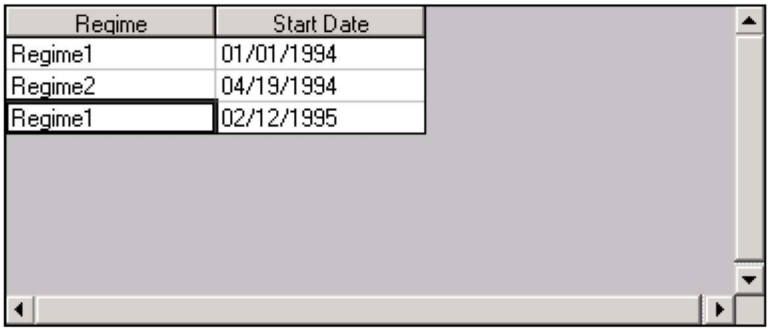
   Sliicer will prompt you for confirmation before deleting the regime.

Cycling Regimes

Although regimes do not cycle automatically like seasons, you may cause your seasons to cycle manually. You do this by adding a row to the regime table with a regime name equal to the name of the preceding season you want to cycle. Sliicer will then lump the dry days from two or more regimes with the same name together for the purpose of dry day analysis.

➔ **To cause a regime to cycle**

1. Add a new regime.
2. Set the start date for the new regime.
3. Name the regime the same as a preceding regime.



Sliicer will lump dry days from two or more regimes with the same name together for analysis purposes.

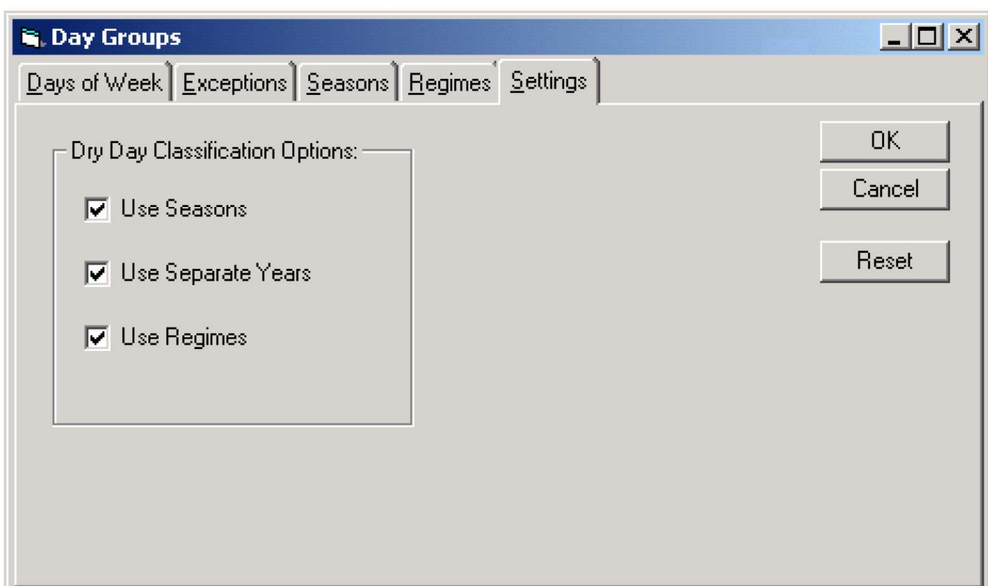
Controlling Day Group Settings

There are times when you may want to turn your advanced day group settings on and off. You may want to do this in order to compare analysis results using the setting with those without the setting. Sliicer allows you to do this easily without clearing your advanced day group settings. This is important, because the setup of your seasons and regimes can be quite involved, especially on studies spanning several years.

The Sliicer Day Group settings tab allows you compare the analysis with and without the seasons or regimes enabled. You can do this without deleting all the season and day group information you entered in the season and regime tabs.

➔ **To enable the use of seasons, years or regimes**

1. In the Day Group dialog, select the Settings tab.



2. Make sure the advanced day group setting you want to use is checked.
3. Click the OK button.

➔ **To disable the use of seasons, years or regimes**

1. In the Day Group dialog, select the Settings tab.
2. Make sure the advanced day group setting you want to use is not checked.
3. Click the OK button.

Changing Graphical Window Options

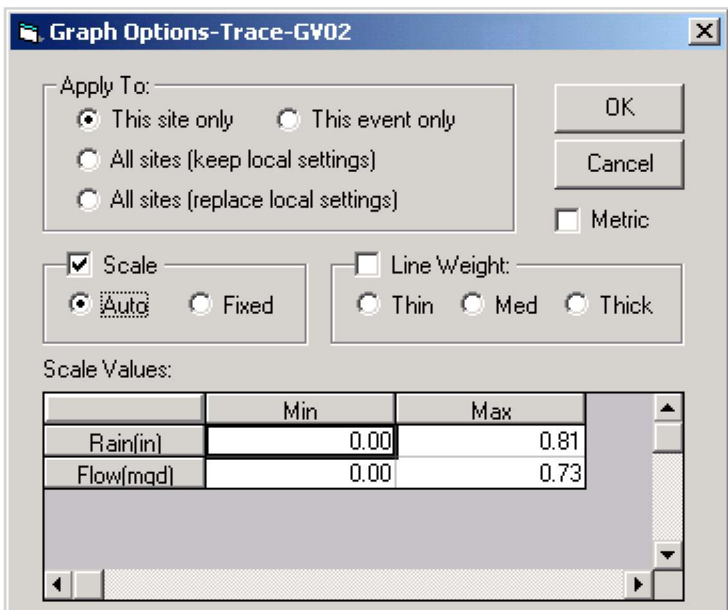
You can change both the scale and line type for most of the graphical windows in Sliicer. You make these changes from the Graph item in the Options menu. The Graph item is available from the Options menu when a graphical window is current.

Changing Graph Scale

Sliicer allows you to change the scale of many of the graphs. If the graph has more than one data set, such as the trace window, you can set a different scale for every data set.

➔ **To set the scale**

1. Make sure a graphical window is current (e.g. Rain, Trace, Dry Day, Storm, Scatter Graph)
2. From the Options menu, choose Graph.



The Graph Options dialog appears.

3. To change the scale check the Scale box and set it to Fixed.
4. Enter the minimum and maximum scale values you want for each data set into the Scale Values table.
5. Set the application range in the Apply To group.
6. Click the OK button.

Sliicer replots the graphical window with the scale you specified.

Tip You can remove any scales you apply by setting the scale back to Auto. Click the Scale check box, and select Auto in the Scale group.

Changing Graph Line Type

Sliicer also allows you to change the line type for graph windows. Thicker line types show up better on the screen, and thinner line types work better for printing.

➔ **To change the line type**

1. Make sure a graphical window is current (e.g. Rain, Trace, Dry Day, Storm, Scatter Graph)
2. From the Options menu, choose Graph.

   The Graph Options dialog appears.
3. Check the Line Weight check box.
4. Select the Line Weight you want.
5. If you don't want to change the scale, uncheck the Scale check box.
6. Set the application range in the Apply To group.

7. Click the OK button.

   Sliicer replots the graphical window with the line type you specified.

Styles

Sliicer allows you to save the format changes you make to several of its graph types: Dry Day graphs, Q vs. i graphs and Scattergraphs. Sliicer allows you to do this by saving styles. When you configure one of these Sliicer graphs they way you want it, you can save it to a named style. Then, when you want to apply the style to a different site, you can recall the style from a list.

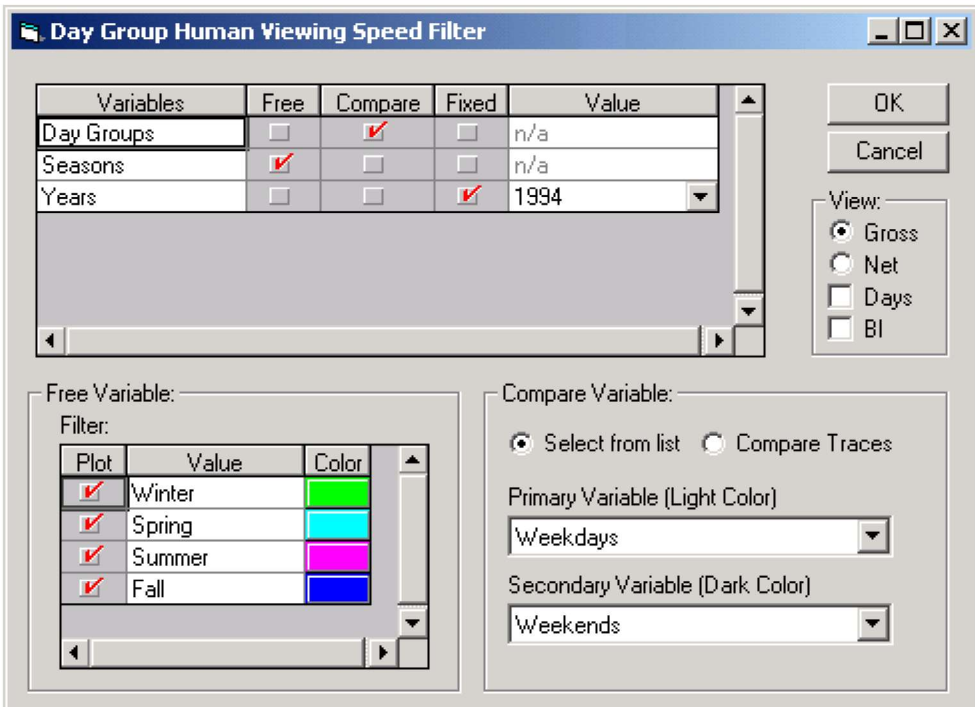
Saving Dry Day Styles

Sliicer allows many options to customize your dry day graphs. You can add various diurnal curves, including net, and daily traces. You can also add base infiltration. Finally you can use the Day Group Human Viewing Speed Filter to compare diurnal curves from different seasons, regimes, years and day groups. You can also compare these diurnal curve by setting the colors manually.

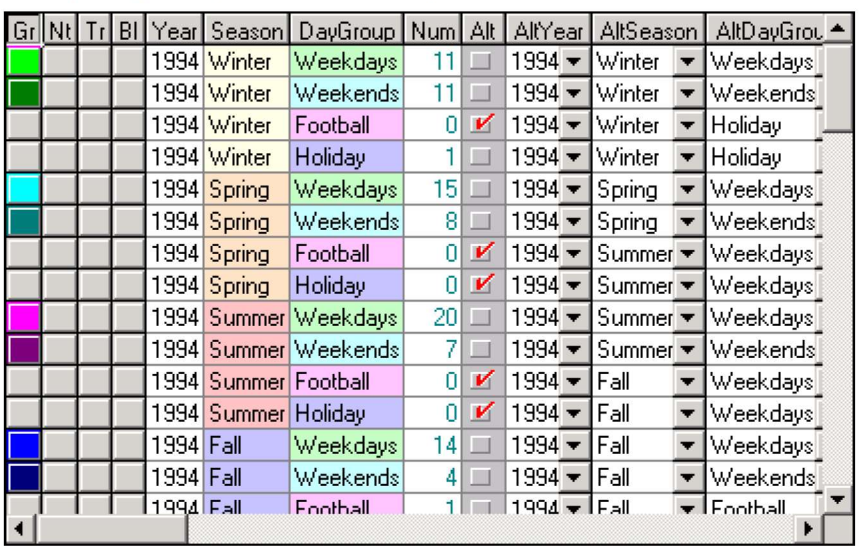
When you finally arrive at the combination of settings for your dry day graph, you may want to re-apply these settings to other meter sites. Sliicer allows you to do this in one simple operation by using dry day styles. When you have the dry day settings configured the way you want, you save them to a dry day style. When you want to re-apply these settings to another site, you load the style you previously saved to the new site.

➔ To save a Dry Day Style

1. Configure the dry day graph the way you want using the color buttons in the dry day table and the Day Group Human Viewing Speed Filter, which you access from the Filter button on the Engineering Wizard Dry Day tab.

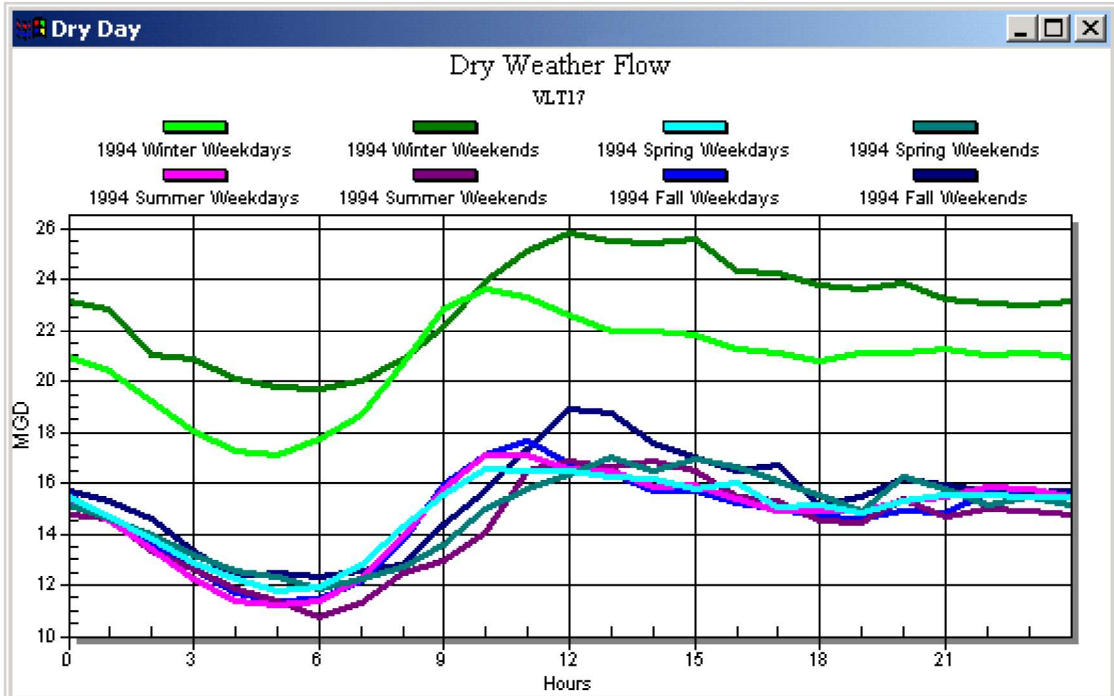


Example Day Group Human Viewing Speed Filter configuration.



Gr	Nt	Tr	BI	Year	Season	DayGroup	Num	Alt	AltYear	AltSeason	AltDayGrou
				1994	Winter	Weekdays	11	☐	1994	Winter	Weekdays
				1994	Winter	Weekends	11	☐	1994	Winter	Weekends
				1994	Winter	Football	0	✔	1994	Winter	Holiday
				1994	Winter	Holiday	1	☐	1994	Winter	Holiday
				1994	Spring	Weekdays	15	☐	1994	Spring	Weekdays
				1994	Spring	Weekends	8	☐	1994	Spring	Weekends
				1994	Spring	Football	0	✔	1994	Summer	Weekdays
				1994	Spring	Holiday	0	✔	1994	Summer	Weekdays
				1994	Summer	Weekdays	20	☐	1994	Summer	Weekdays
				1994	Summer	Weekends	7	☐	1994	Summer	Weekends
				1994	Summer	Football	0	✔	1994	Fall	Weekdays
				1994	Summer	Holiday	0	✔	1994	Fall	Weekdays
				1994	Fall	Weekdays	14	☐	1994	Fall	Weekdays
				1994	Fall	Weekends	4	☐	1994	Fall	Weekends
				1994	Fall	Football	1	☐	1994	Fall	Football

Results of application of HVS filter configuration shown above on Dry Day table.



Results of application of HVS filter configuration shown above on Dry Day graph.

2. From the Format menu, choose Save Style.

The Save Style dialog appears and offers a generic name for the style.

3. Give the style a name that will help you remember what it is.

4. Click the OK button.

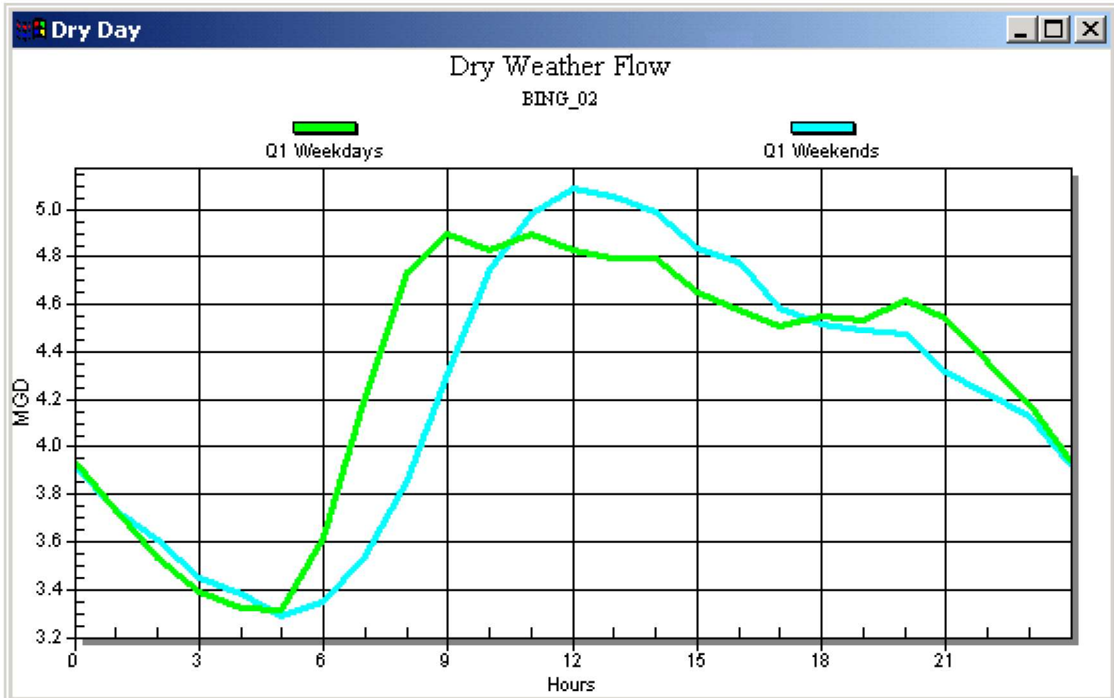
Sliicer saves the style for later recall or application to other sites.

Loading Dry Day Styles

Once you have saved a dry day style, you can apply it to other sites.

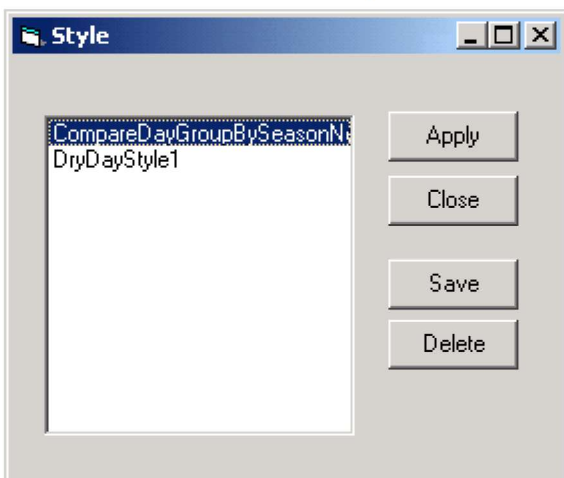
➔ **To load a Dry Day Style**

1. Select the site to which you want to apply the dry day style, and move to the dry day tab.



Sliicer displays the default diurnal curve configuration.

2. From the Format menu, choose Styles.



The style dialog appears.

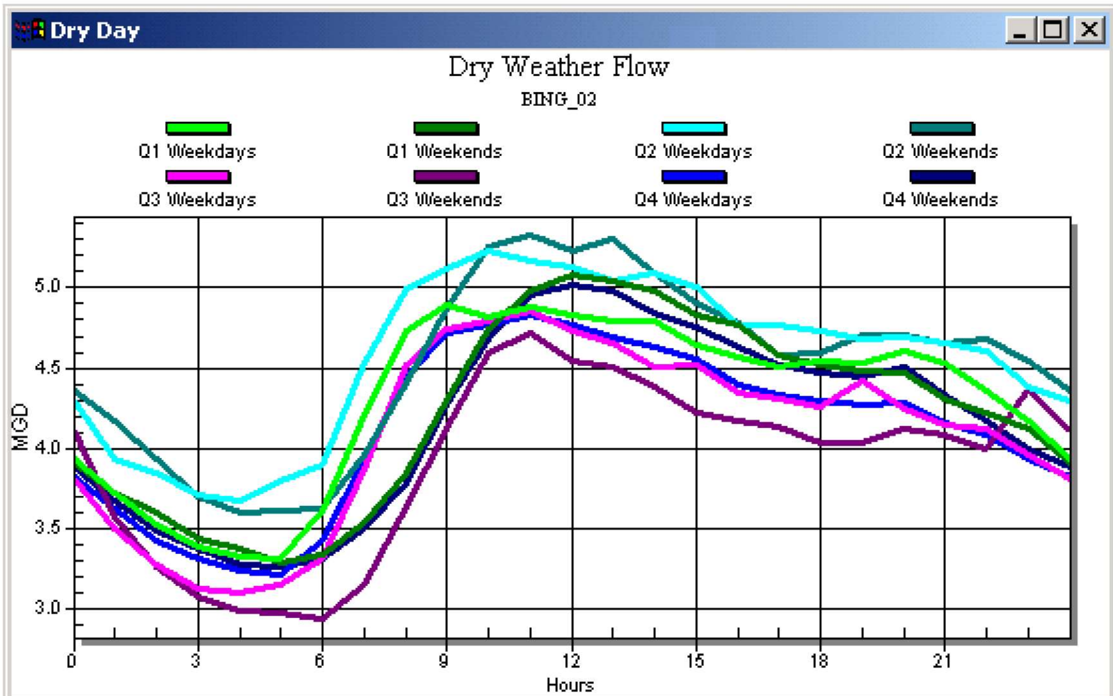
3. Select the style you want to apply, and click the Apply button.

   -OR-

   Double click the style you want to apply.

Gr	Nt	Tr	Bl	Season	DayGroup	Num	Alt	AltSeason	AltDayGroup	TrPkDate
				Q1	Weekdays	34		Q1	Weekdays	02/03/2003
				Q1	Weekends	13		Q1	Weekends	01/12/2003
				Q2	Weekdays	31		Q2	Weekdays	04/21/2003
				Q2	Weekends	9		Q2	Weekends	06/28/2003
				Q3	Weekdays	34		Q3	Weekdays	07/04/2003
				Q3	Weekends	9		Q3	Weekends	07/05/2003
				Q4	Weekdays	21		Q4	Weekdays	11/27/2002
				Q4	Weekends	9		Q4	Weekends	12/21/2002

Sliicer applies the style you selected to the current day groups configuration.



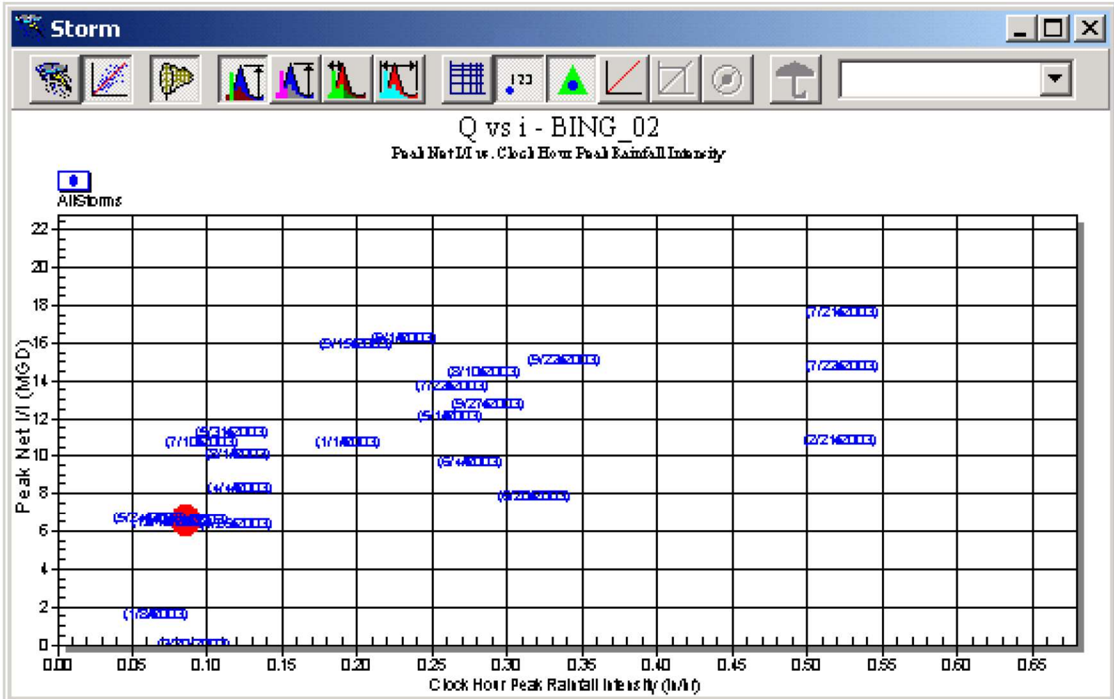
Sliicer also plots the changes in the Dry Day Graph.

Saving Q vs. i Styles

Sliicer also allows you to save the configuration of your Q vs i graphs as a Q vs. i style.

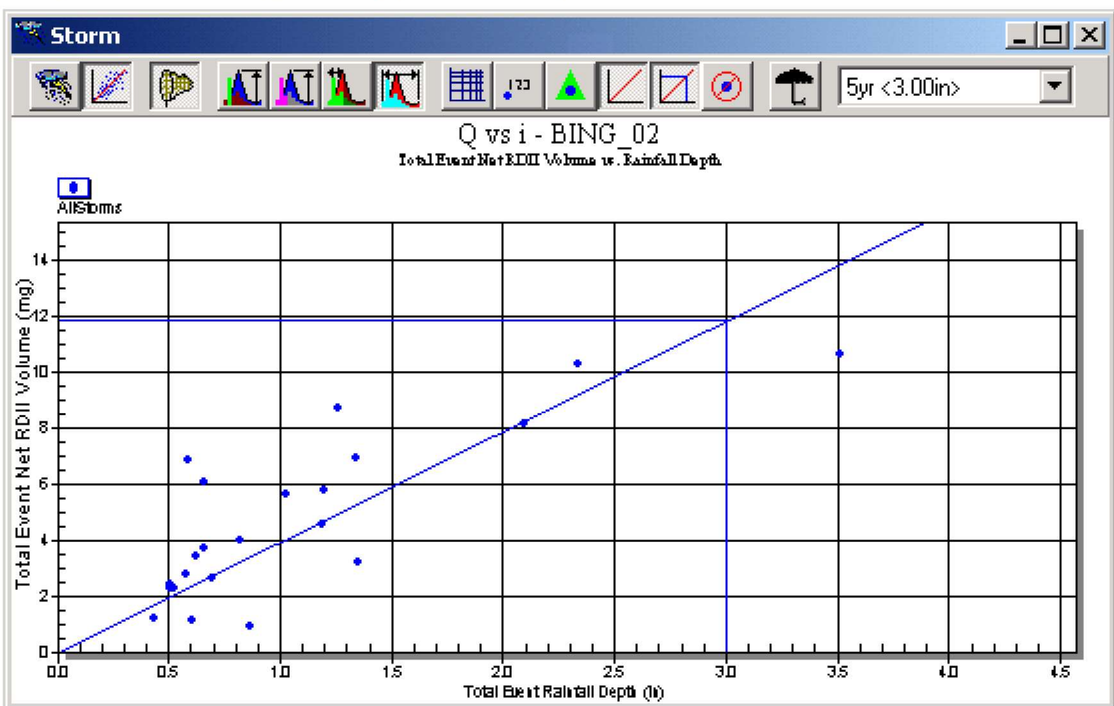
➔ **To save a Q vs. i Style**

1. Move to the storm tab for any site, and change the storm graph type to Q vs i.

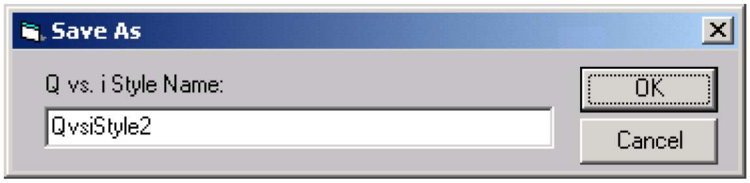


Sliicer displays the Q vs. i graph in default configuration.

2. Configure the Q vs i graph the way you want it for your style.



3. From the Format menu, choose Save Style.



The Save Style dialog appears and offers a generic name for the style.

4. Give the style a name that will help you remember what it is.

5. Click the OK button.

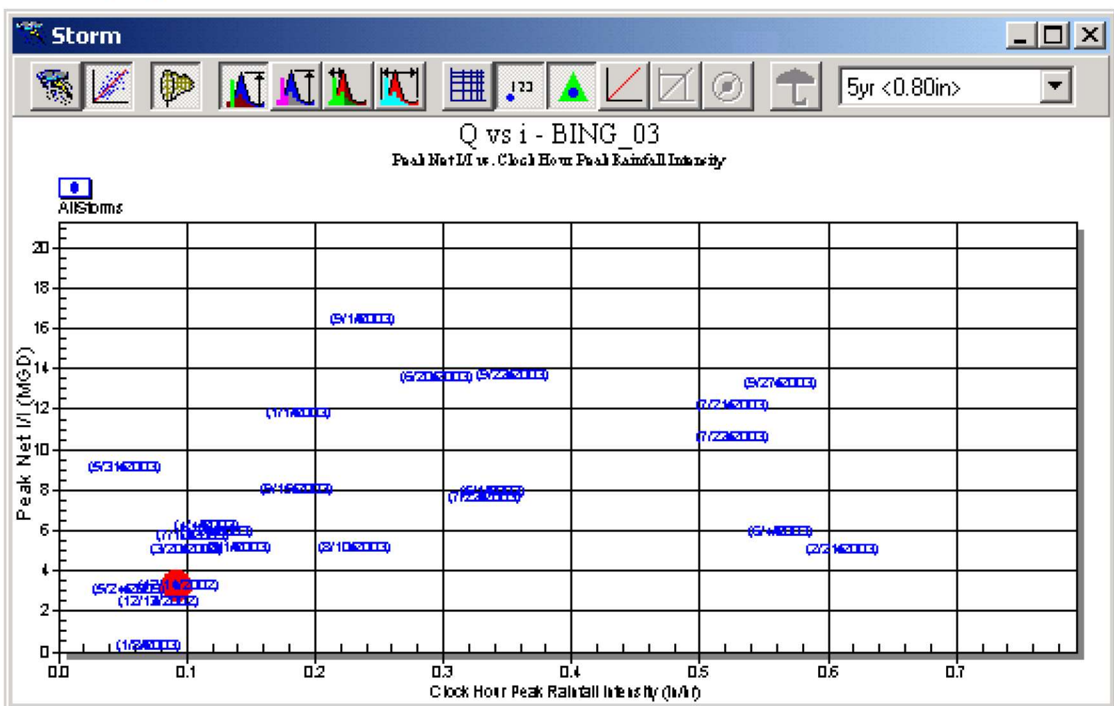
   Sliicer saves the style for later recall or application to other sites.

Loading Q vs. i Styles

Once you have saved a Q vs i style, you can load it to other sites.

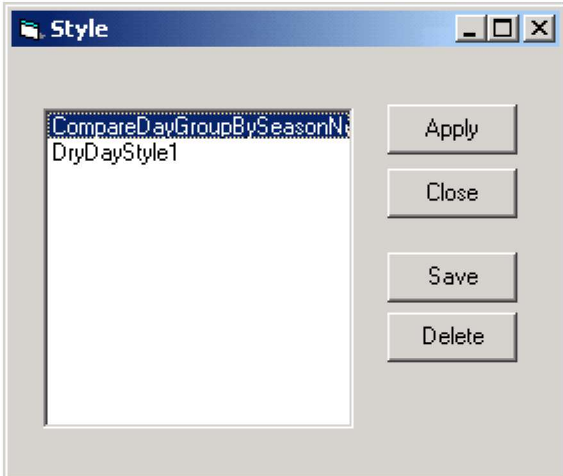
➔ **To Load a Q vs. i Style**

1. Select the site to which you want to apply the Q vs. i style, move to the storm tab, and change the storm graph type to Q vs i.



   Sliicer displays the default Q vs. i configuration.

2. From the Format menu, choose Styles.

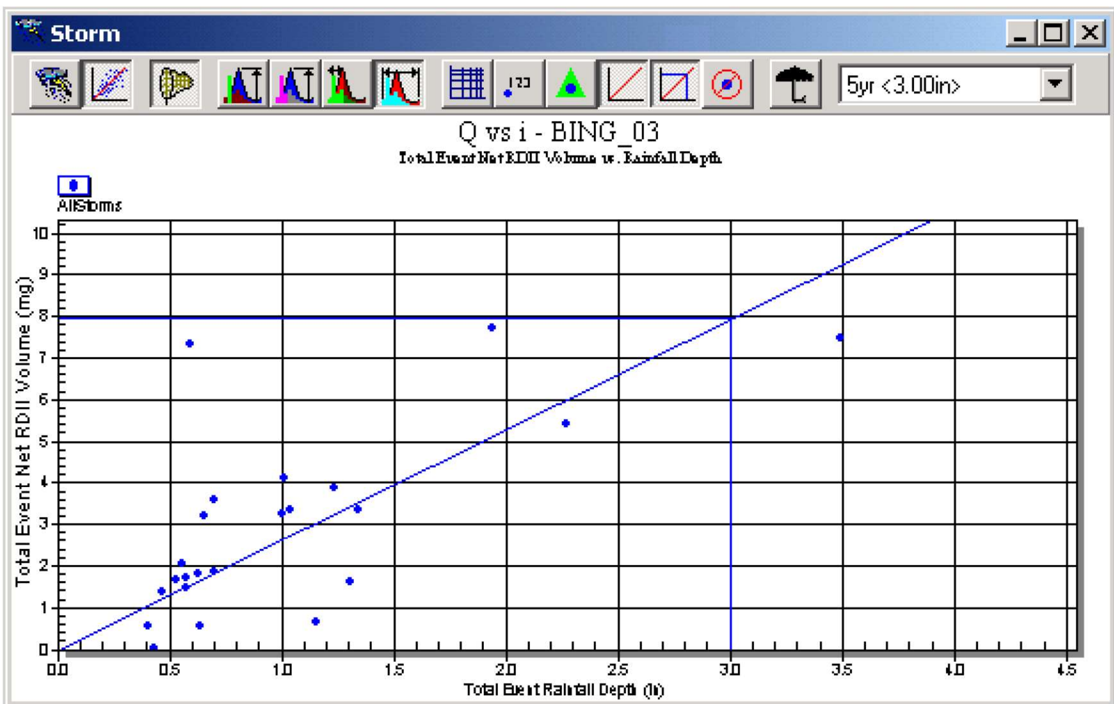


The style dialog appears.

3. Select the style you want to apply, and click the Apply button.

   -OR-

   Double click the style you want to apply.



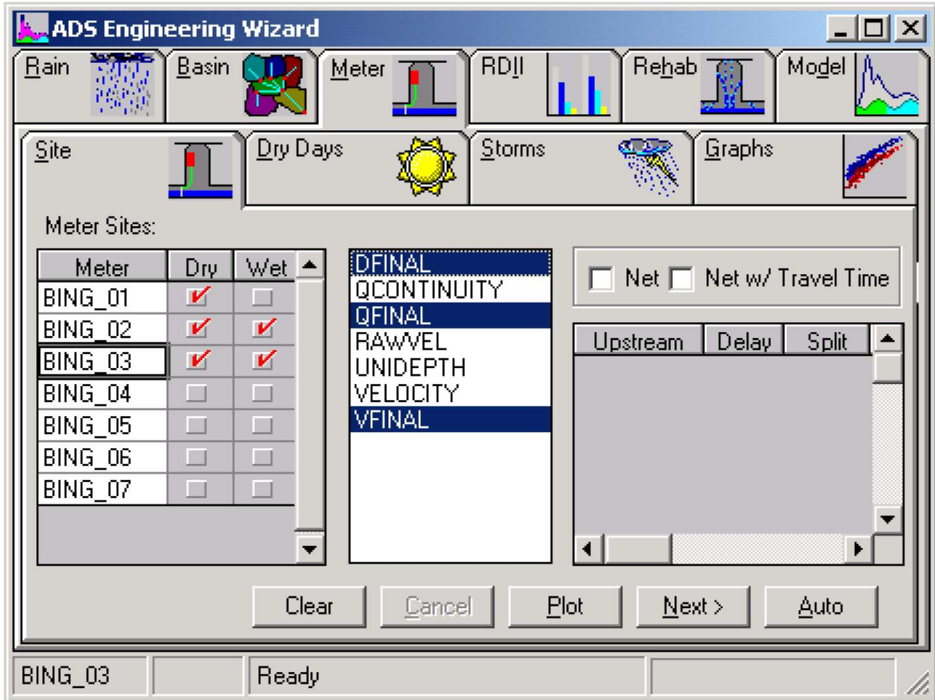
Sliicer applies the style you selected to the Q vs i graph.

Saving Scattergraph Styles

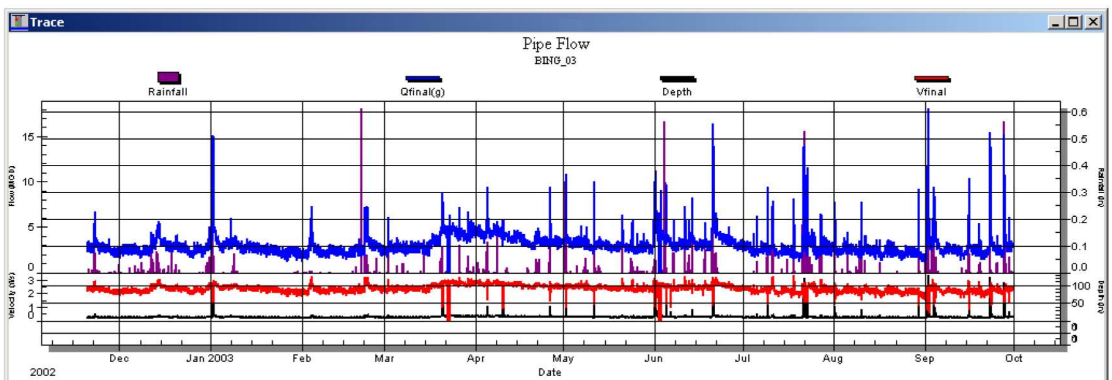
Sliicer also allows you to save the configuration of your Scattergraphs as a Scattergraph style.

➔ **To save a Scattergraph Style**

1. In the Meter tab, select the additional traces you want to plot in the scattergraph in addition to Qfinal, and click Plot.

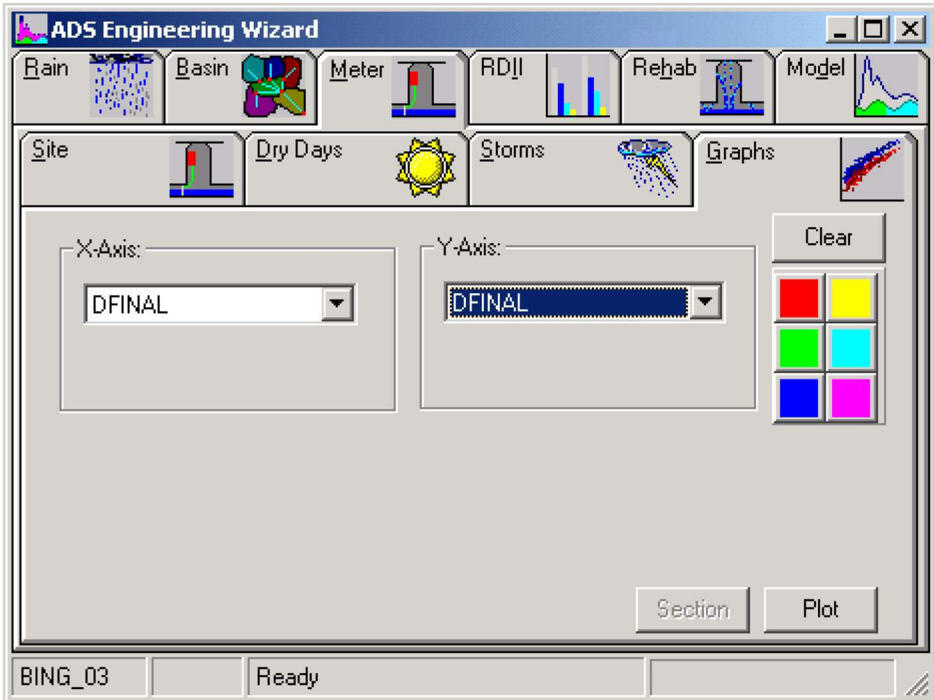


Most often the traces you want to use for the scattergraph are Dfinal and Vfinal.



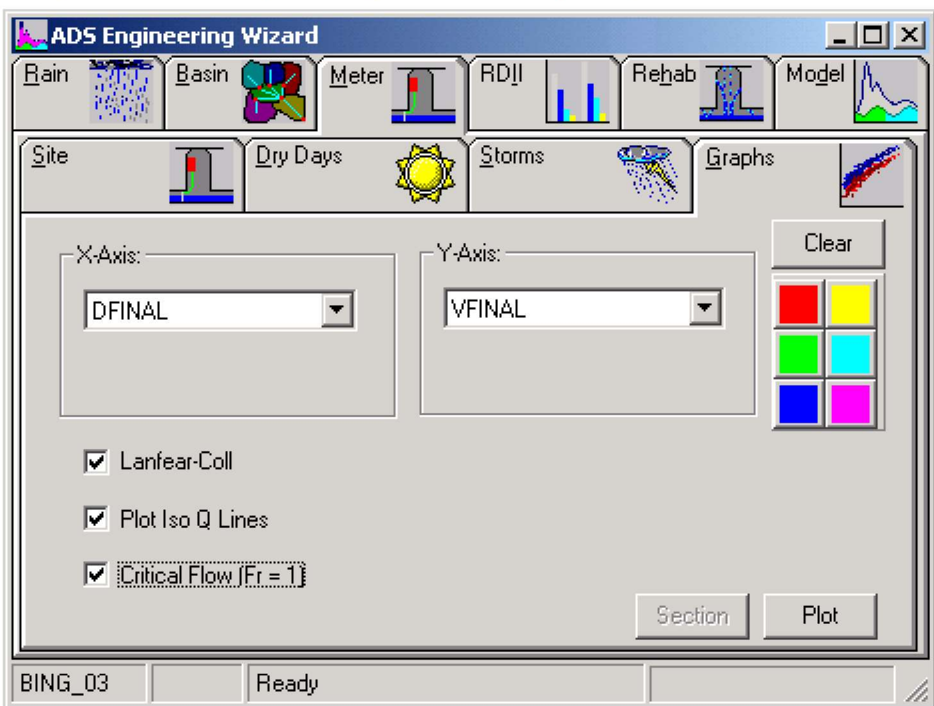
Sliicer displays Qfinal, Vfinal and Dfinal.

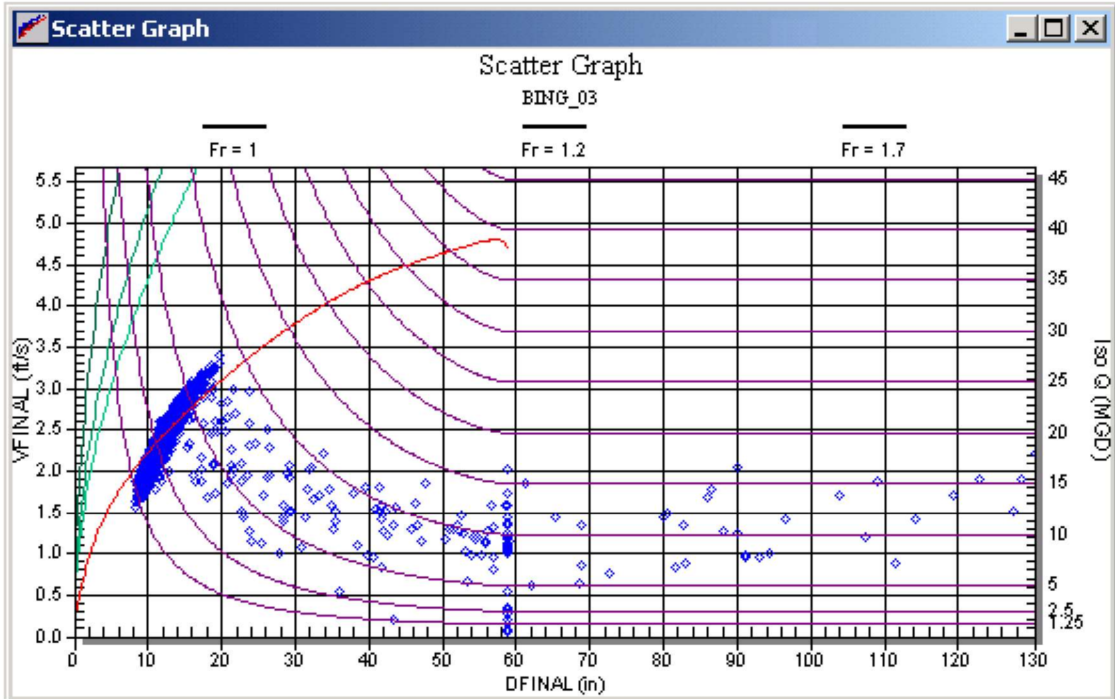
2. Move to the Graphs tab.



Sliicer displays the default Scattergraph settings.

3. Configure the Scattergraph the way you want it for your style, and click the Plot button.





Sliicer plots the Scattergraph.

4. From the Format menu, choose Save Style.

The Save Style dialog appears and offers a generic name for the style.

5. Give the style a name that will help you remember what it is.

6. Click the OK button.

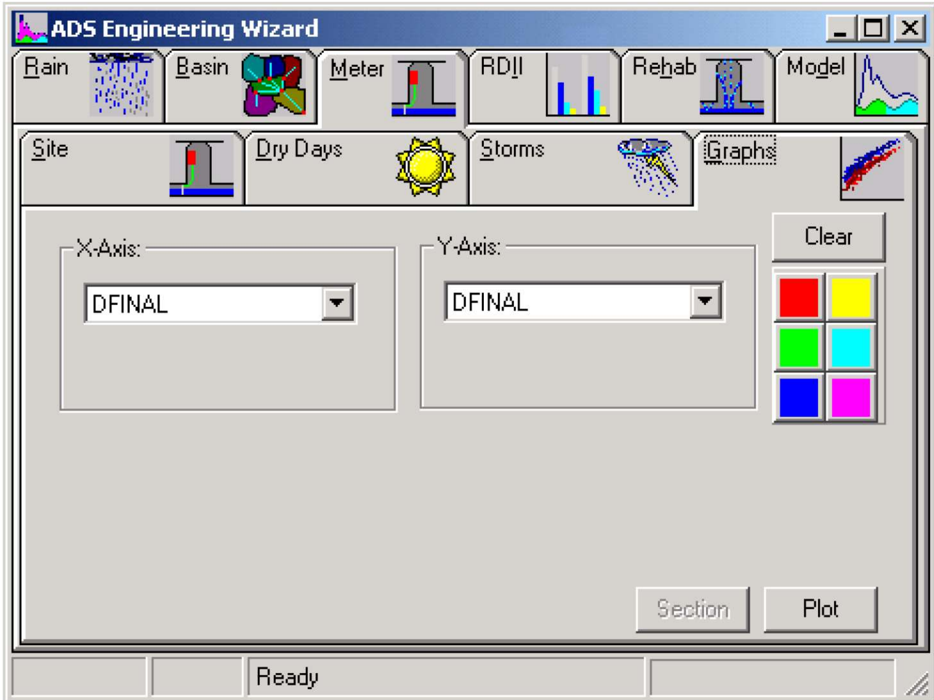
Sliicer saves the style for later recall or application to other sites.

Loading Scattergraph Styles

Once you have saved a Scattergraph style, you can load it to other sites.

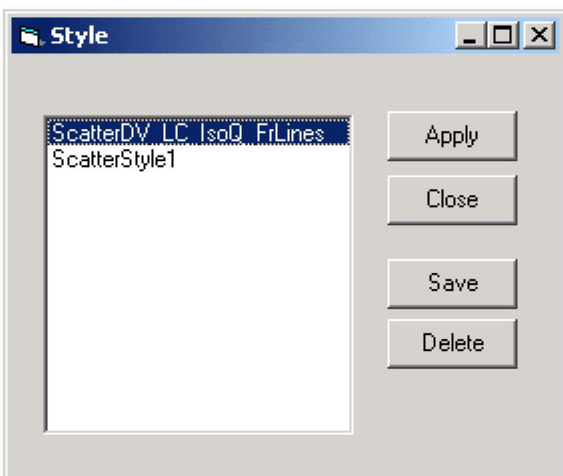
➔ **To Load a Scattergraph Style**

1. Select the site to which you want to apply the Scattergraph style, move to the storm tab, and change the storm graph type to Scattergraph.



Sliicer displays the default Scattergraph configuration.

2. From the Format menu, choose Styles.

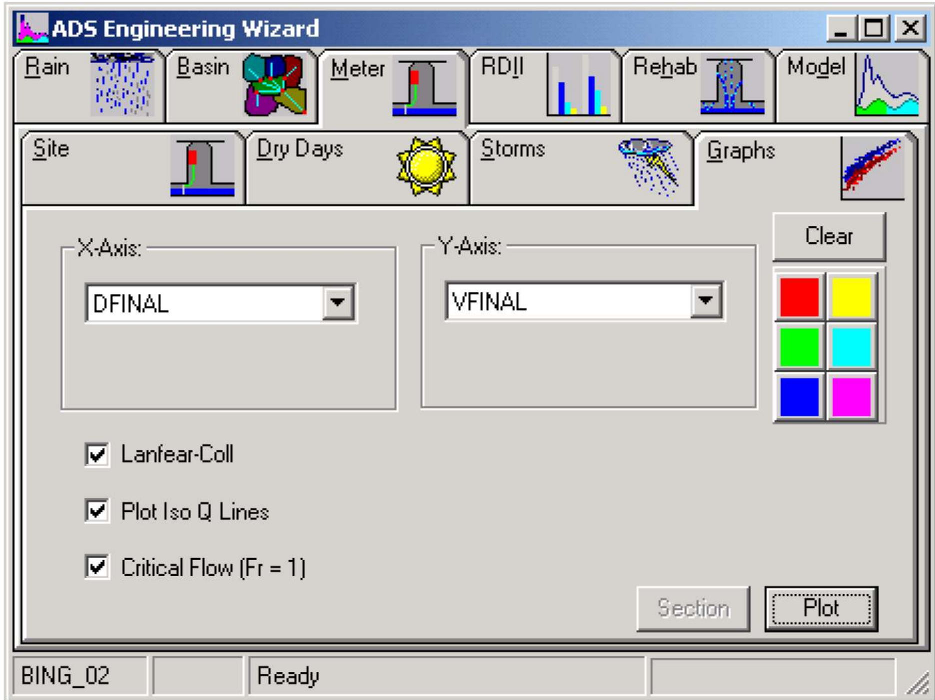


The style dialog appears.

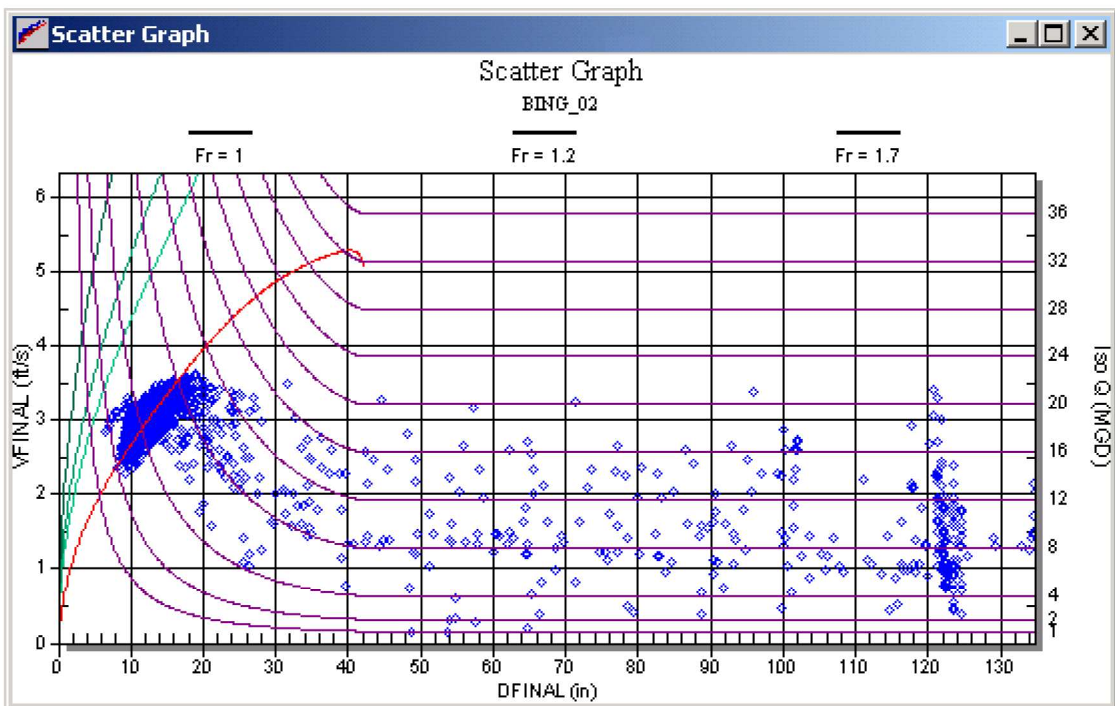
3. Select the style you want to apply, and click the Apply button.

   -OR-

   Double click the style you want to apply.



Sliicer applies the style you selected to the Graphs Tab...



…and plots the scattergraph according to the style settings you selected.

CHAPTER 8

Chapter 8 Output

Sliicer offers you a number of types of output, including printing and exporting your results. You can print tabular summary reports of both your dry and wet weather flow calculations. You can also print out a number of ranked table reports. Finally, you can print any of the graphical windows to the printer, to a file, or to the clipboard.

In this chapter, you will learn how to print the following tabular reports:

- Dry Weather Summary
- Wet Weather Summary
- Ranked Table Reports

You will also learn how to print Sliicer's graphical windows.

In addition, if you are running Sliicer on a server through sliicer.com, you will not have direct access to your files, such as your flowload database and the graphical document files that you create. However, Sliicer has export features that allow you to transfer tables from the sliicer database and graphical document output files to your computer.

Printing Tabular Reports

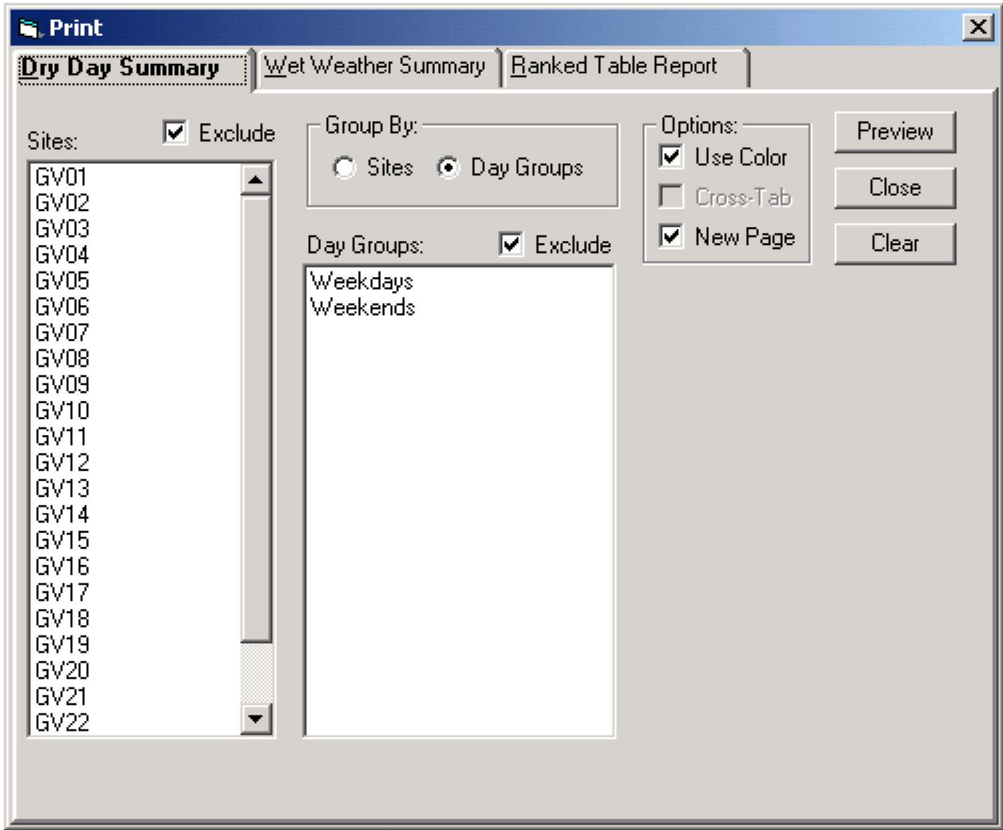
You can print three types of tabular reports with Sliicer: Dry Flow Summaries, Wet Flow Summaries, and Ranked Table Reports. You print tabular reports in Sliicer using the File Print menu. Sliicer will only report on sites that have been processed. If you print reports before you process all sites, you may not see all the information you want in the report. Sliicer.com may not allow you to access your local printer, but you can capture the report information by selecting the report in the Preview view and pasting in a spreadsheet on your local computer.

Printing Dry Flow Summary Reports

You can print Dry Flow Summary reports. Dry Flow Summary reports give you a good overview of how the system performs under dry weather conditions.

➔ **To print a Dry Flow Summary report**

1. Make sure you have processed at least some of the sites (preferably all) for dry weather.
2. From the File menu, choose Print.



The Print dialog appears.

3. Make sure the Dry Flow Summary tab is current.
4. In the Group By box select Sites or Day Groups.
5. If you want to exclude sites, select the sites you want to exclude in the Sites list.

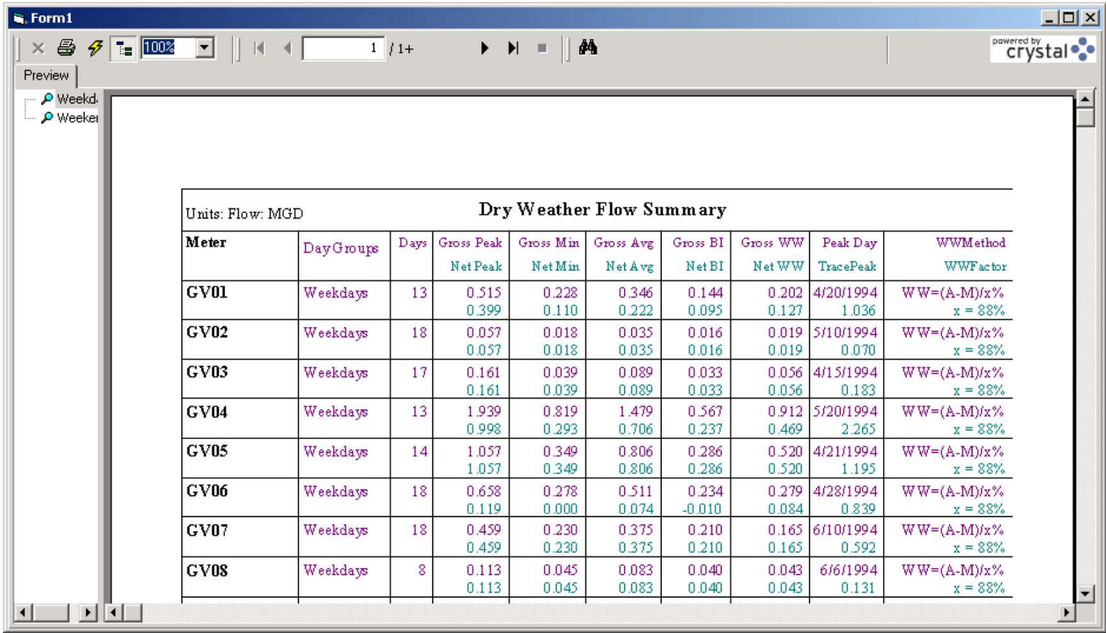
   -OR-

   If you only want to print specific sites, uncheck the Exclude Sites check box and select the sites you want to print.
6. If you want to exclude Day Groups, select the Day Groups you want to exclude in the Day Group list.

   -OR-

   If you only want to print specific Day Groups, uncheck the Exclude Day Groups check box and select the Day Groups you want to print.
7. If you want to print the report in color, check the Use Color check box.
8. Click the Preview button.

Note You can clear either one of the lists using the Clear button. Make the list you want to clear current, and click the Clear button. Sliicer clears the current list.



Units: Flow: MGD

Dry Weather Flow Summary

Meter	DayGroups	Days	Gross Peak / Net Peak	Gross Min / Net Min	Gross Avg / Net Avg	Gross BI / Net BI	Gross WW / Net WW	Peak Day / TracePeak	WWMethod / WWFactor
GV01	Weekdays	13	0.515	0.228	0.346	0.144	0.202	4/20/1994	WW=(A-M)/x%
			0.399	0.110	0.222	0.095	0.127	1.036	x = 88%
GV02	Weekdays	18	0.057	0.018	0.035	0.016	0.019	5/10/1994	WW=(A-M)/x%
			0.057	0.018	0.035	0.016	0.019	0.070	x = 88%
GV03	Weekdays	17	0.161	0.039	0.089	0.033	0.056	4/15/1994	WW=(A-M)/x%
			0.161	0.039	0.089	0.033	0.056	0.183	x = 88%
GV04	Weekdays	13	1.939	0.819	1.479	0.567	0.912	5/20/1994	WW=(A-M)/x%
			0.998	0.293	0.706	0.237	0.469	2.265	x = 88%
GV05	Weekdays	14	1.057	0.349	0.806	0.286	0.520	4/21/1994	WW=(A-M)/x%
			1.057	0.349	0.806	0.286	0.520	1.195	x = 88%
GV06	Weekdays	18	0.658	0.278	0.511	0.234	0.279	4/28/1994	WW=(A-M)/x%
			0.119	0.000	0.074	-0.010	0.084	0.839	x = 88%
GV07	Weekdays	18	0.459	0.230	0.375	0.210	0.165	6/10/1994	WW=(A-M)/x%
			0.459	0.230	0.375	0.210	0.165	0.592	x = 88%
GV08	Weekdays	8	0.113	0.045	0.083	0.040	0.043	6/6/1994	WW=(A-M)/x%
			0.113	0.045	0.083	0.040	0.043	0.131	x = 88%

Sliicer displays a preview of the report.

9. In the Report Preview window, select the print button to print.

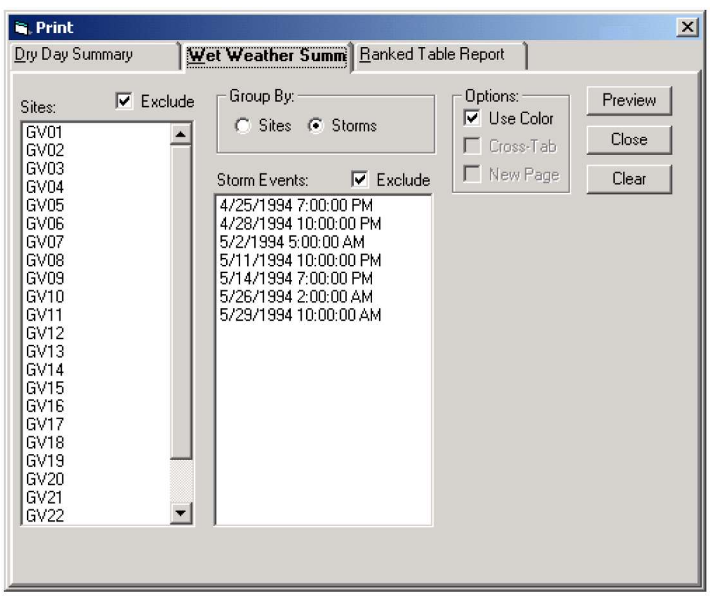
   Sliicer prints the report.

Printing Wet Flow Summary Reports

You can print Wet Flow Summary reports. Wet Flow Summary reports give you an overview of how the system performs under wet weather conditions.

➔ **To print a Wet Flow Summary report**

1. Make sure you have processed at least some of the sites (preferably all) for dry and wet weather.
2. From the File menu, choose Print.



The Print dialog appears

3. Click the Wet Flow Summary tab to make it current.
4. In the Group By box select Sites or Storms.
5. If you want to exclude sites, select the sites you want to exclude in the Sites list.

   -OR-

   If you only want to print specific sites, uncheck the Exclude Sites check box and select the sites you want to print.
6. If you want to exclude Storm Events, select the Events you want to exclude in the Events list.

   -OR-

   If you only want to print specific Storm Events, uncheck the Exclude Events check box and select the Events you want to print.

Note You can clear either one of the lists using the Clear button. Make the list you want to clear current, and click the Clear button. Sliicer clears the current list.

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7. If you want to print the report in color, check the Use Color check box.
8. Click the Preview button.

   Sliicer displays a preview of the report.
9. In the Report Preview window, select the print button  to print.

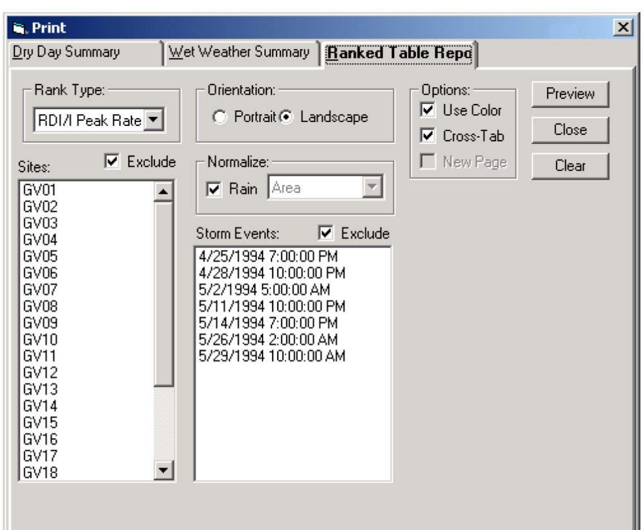
   Sliicer prints the report.

Printing Ranked Table Reports

Sliicer also allows you to print Ranked Table reports. You can print ranked table reports of Peak I/I, I/I Volume for the three storm periods (Storm, Recovery 1, and Recovery 2), and Base Infiltration. Each of the ranked table reports supports different types of normalization.

➔ **To print a Ranked Table report**

1. Make sure you have processed at least some of the sites (preferably all) for dry and wet weather.
2. From the File menu, choose Print.



The Print dialog appears

3. Click the Ranked Tables tab to make it current.
4. In the Rank Type list, select the type of ranked table you want to print.
5. In the Normalize box, select the type of normalization you want.

Note The RDI/I Peak Rate report is not normalized. The RDI/I Volume, Recovery 1 Infil, and Recovery 2 Infil reports are always normalized by basin size, and you can add Rainfall normalization if you wish. The Base Infiltration report is normalized only by basin size.

6. If you want to exclude sites, select the sites you want to exclude in the Sites list.

   -OR-

   If you only want to print specific sites, uncheck the Exclude Sites check box and select the sites you want to print.
7. If you want to exclude Storm Events (or in the case of Base Infiltration, Day Groups), select the Events (or Day Groups) you want to exclude in the Events (or Day Groups) list.

   -OR-

   If you only want to print specific Events (or Day Groups), uncheck the Exclude Events (or Day Groups) check box and select the Events (or Day Groups) you want to print.

Note You can clear either one of the lists using the Clear button. Make the list you want to clear current, and click the Clear button. Sliicer clears the current list.

8. If you want to print the report in color, check the Use Color check box.
9. If you want the report presented as a Cross-Tab, check the Cross-Tab check box (recommended).
10. Click the Preview button.

    Sliicer displays a preview of the report.
11. In the Report Preview window, select the print button to print.

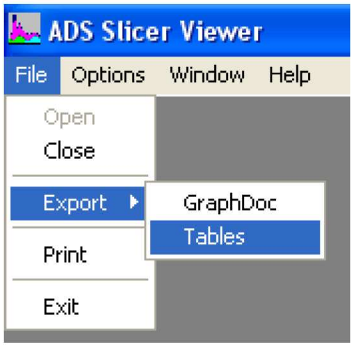
    Sliicer prints the report.

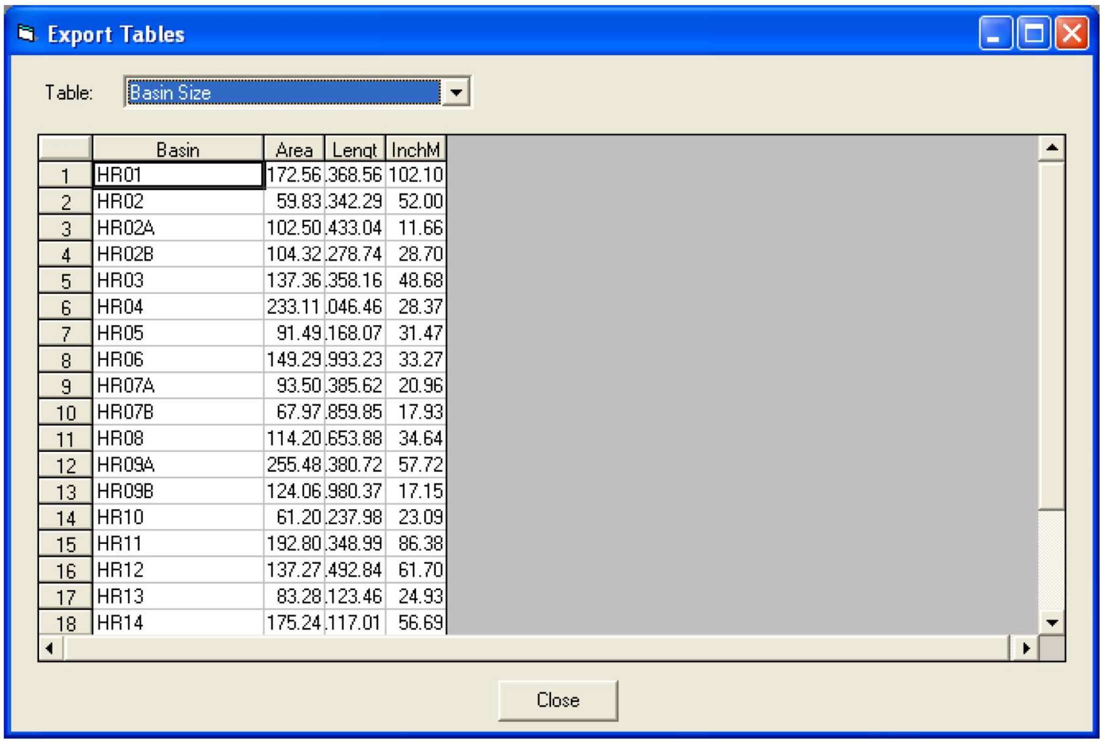
Exporting Sliicer Tables

Sliicer allows you to export a number of different tables through the Windows clipboard. You export these tables through the File, Export, Tables feature. This feature is particularly useful if you are running Sliicer on a remote server, such as Sliicer.com, because you don't have access to the Sliicer database. Although you can export any of the Sliicer tables throughout the program, many of the tables only display results for one site at a time. Using the Export Tables feature, you can export the data for all sites in one operation.

➔ **To export a Sliicer table throught the Windows clipboard**

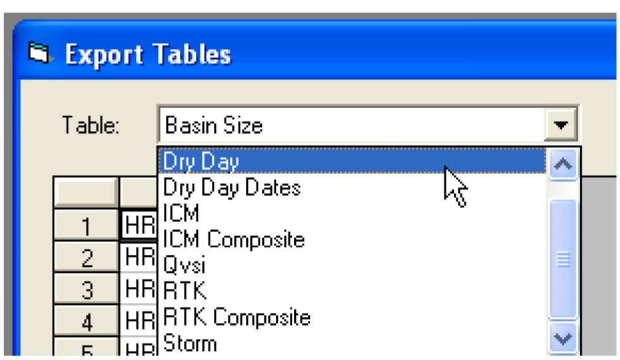
1. 1. From the file menu, click Export, Tables.





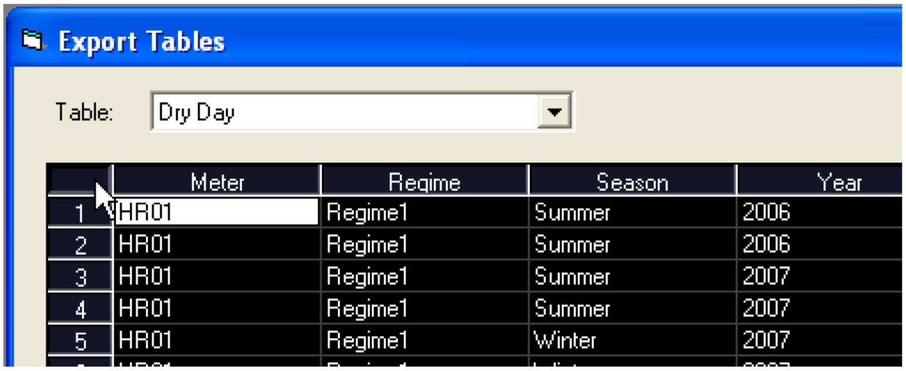
The Export Tables window appears.

2. 2. In the table drop down, select the table you want to export.



Sliicer displays the table you selected.

3. 3. Click the mouse on the box at the upper left corner of the table.



Sliicer highlights the entire table.

4. Type Ctrl-C on the keyboard to copy the select cells to the clipboard.
5. Open you spreadsheet program on you local computer.
6. Type ctrl-V or select Edit, Paste from the spreadsheet menu to paste the coppied cells into your spreadsheet.

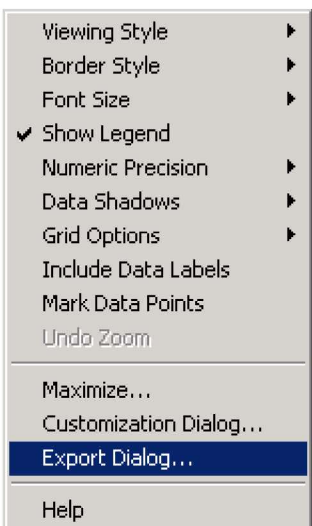
   Once in your spreadsheet, you can delete rows and columns, and format, print and save on your local computer.

Printing Graphical Windows

You can print any of the graphical windows in Sliicer to a printer, a file, or to the clipboard for insertion into other programs, such as your word processor.

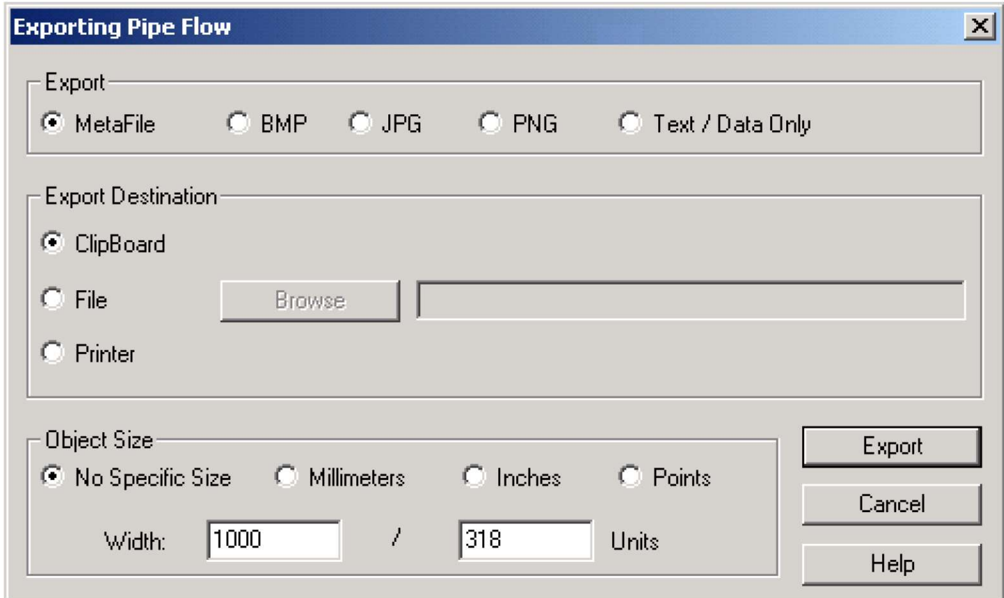
➔ **To print a graphical window**

1. Click the right mouse button on the graphical window you want to print.



   The graph menu appears.

2. Select Export Dialog.



The Graph Export dialog appears.

3. In the Export group, select the type of image you want to export.
4. In the Export Destination group, select the destination of the export.
5. Click the Export button.

   Sliicer exports the graph image to the destination you selected.

Graphical Documents

In addition to being able to print individual graphs, Sliicer also allows you to print any combination of the graphs that Sliicer generates as it runs on Auto and save them to a Word document file. This feature can save countless hours generating a graphical data appendix for your study.

Understanding Graphical Document Templates

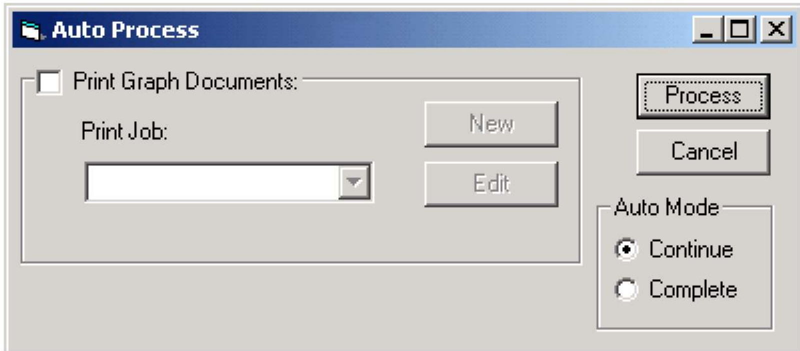
In order to automatically generate graphical Word documents for you, Sliicer needs to know which graphs you want and how you want to configure those graphs on a page. You give Sliicer this information through the use of Graphical Document Templates. These templates contain the information on which graphs you want Sliicer to print, as well as how you want each graph formatted.

Creating a Graphical Document Template

You create a Sliicer Graphical Template through the Auto Dialog.

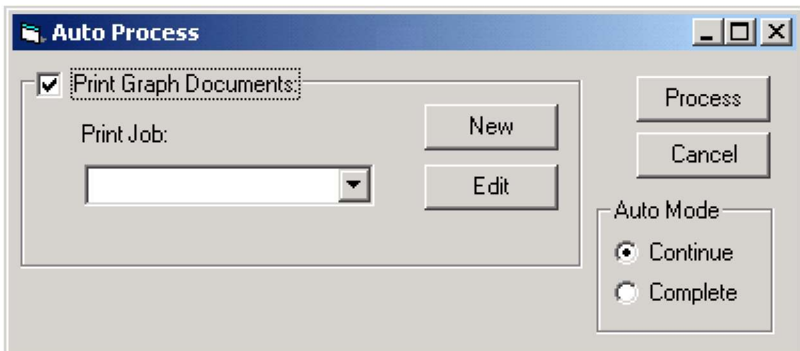
➔ **To create a Graphical Document Template**

1. From the Meter Site tab, click the Auto Button



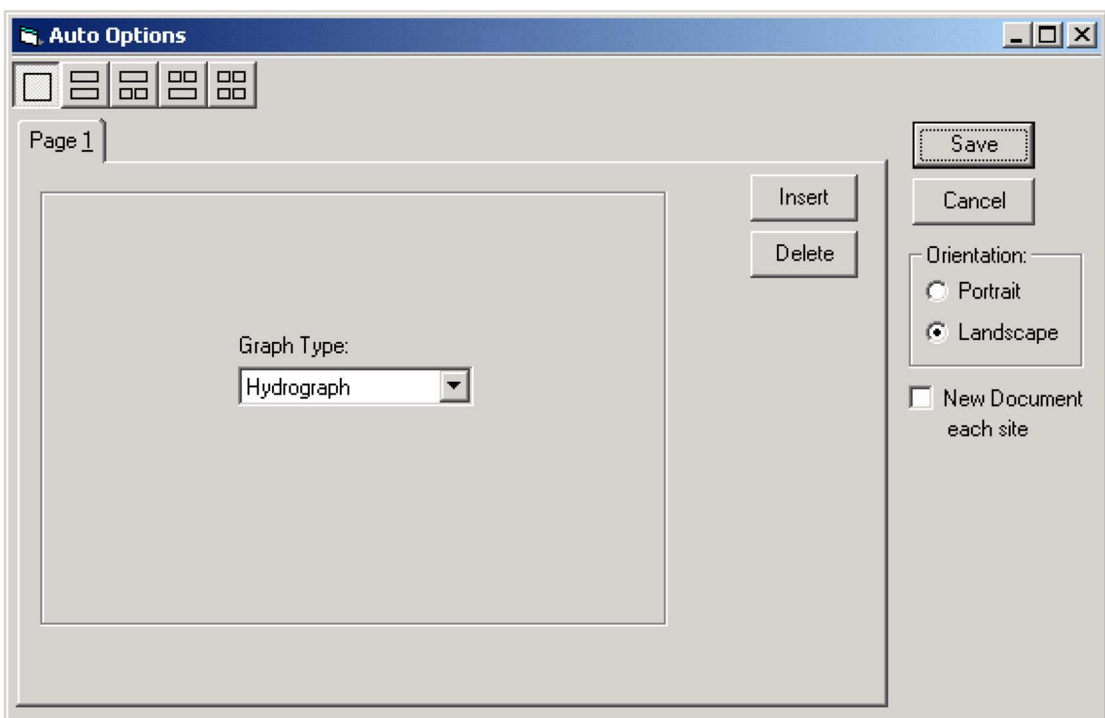
The Auto Dialog appears.

2. Check the Print Graph Documents checkbox.



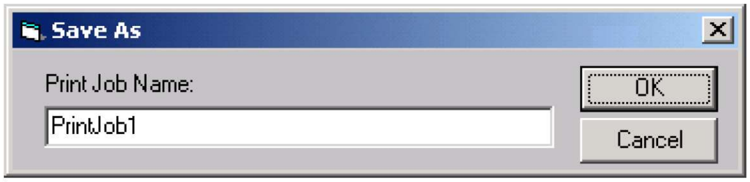
The New and Edit buttons are enabled.

3. Click New



The Auto Options Dialog appears.

4. Click Save.



The Sliicer Print Job Name Save As dialog appears.

5. Type a name to label the print job (optional).

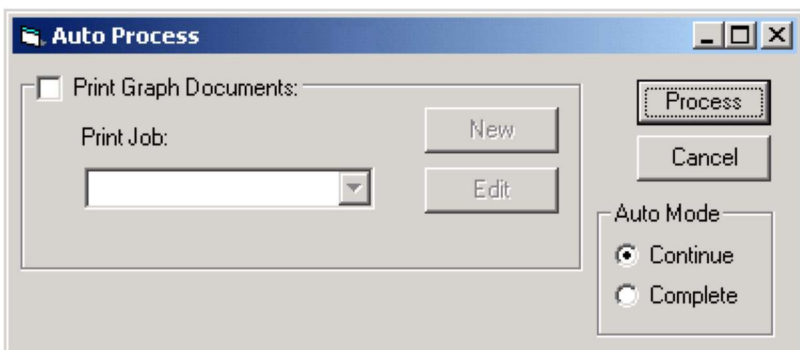
Sliicer Saves the Print Job to the name you specified.

Editing a Graphical Document Template

Once you have created a Graphical Document Template, you can edit it to change the graphs it includes and the page layout of each graph.

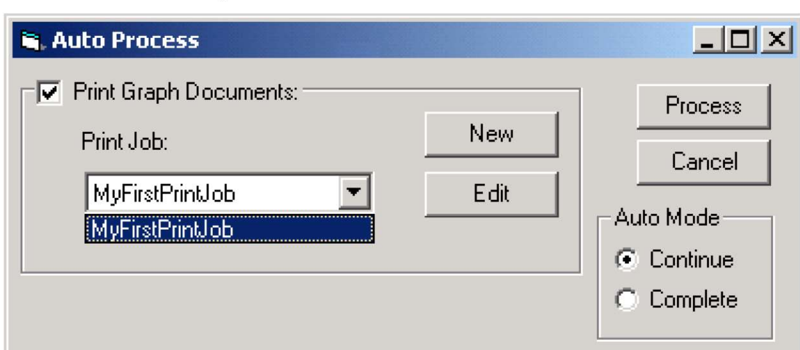
➔ **To edit a Graphical Document Template**

1. From the Meter Site tab, click the Auto Button.



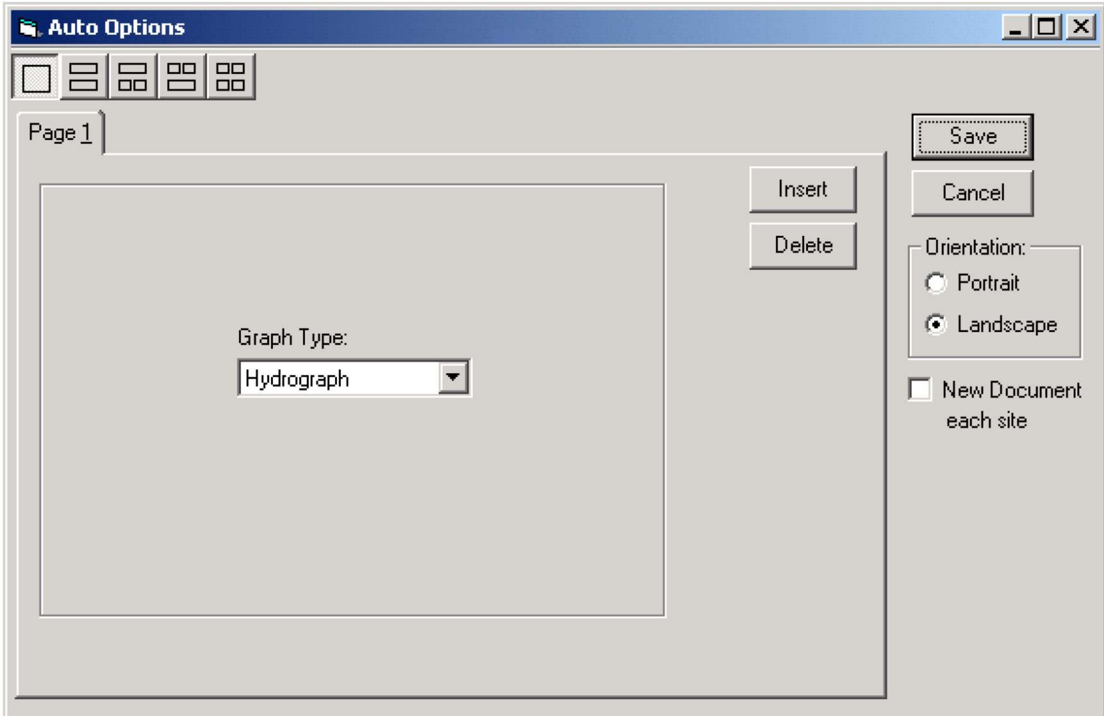
The Auto Dialog appears.

2. Check the Print Graph Documents checkbox.



The New and Edit buttons are enabled.

3. Select the Print Job you want to edit, and click the Edit button.



The Auto Options dialog appears, and you can now edit both the composition and the layout of your graphical print job.

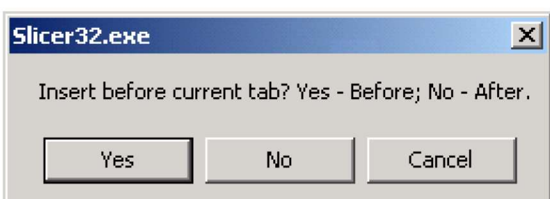
Adding Pages to the Print Job

You can add and delete pages to any Sliicer Print Job.

➔ **To add a page to a Print Job**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.

2. In the Auto Options dialog, click the Insert button .

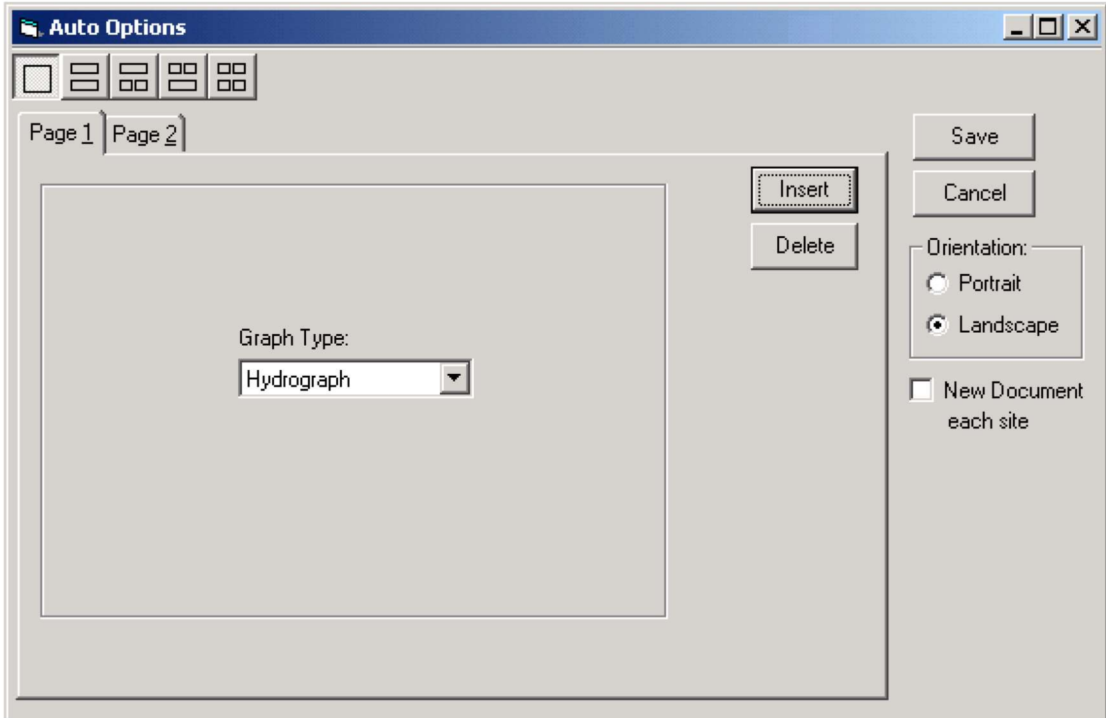


If you are inserting the new page from the first page of the template, Sliicer asks if you want to insert the new page before the current page, or after the current page.

3. If you want the new page to be the first page in the template, click the Yes button.

   -OR-

   If you want the new page to be the second page in the template, click the No button.



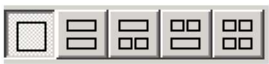
Sliicer inserts the new page into the template.

Modifying the page layout

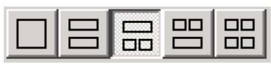
Sliicer allows you to select from five different layouts for each page in your Graphical Document Template.

➔ **To change the layout of a page**

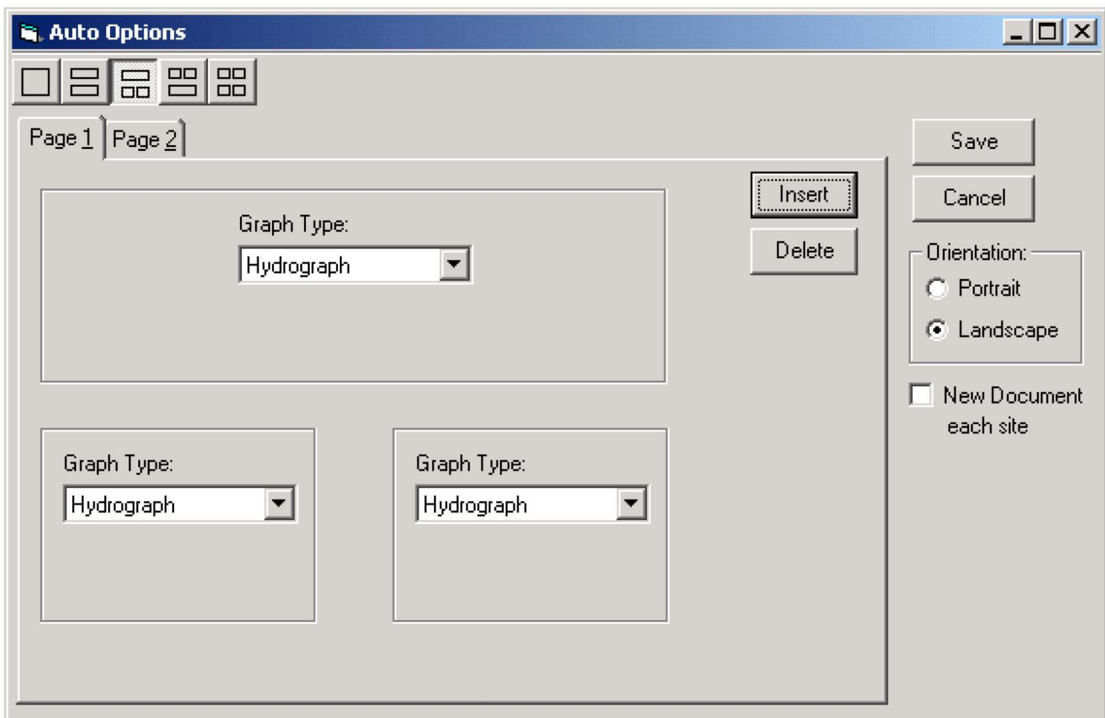
1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the page layout toolbar, select the layout style you want.



Default setting.



New setting.



Sliicer changes the layout of the current template page.

Changing the Graph Type

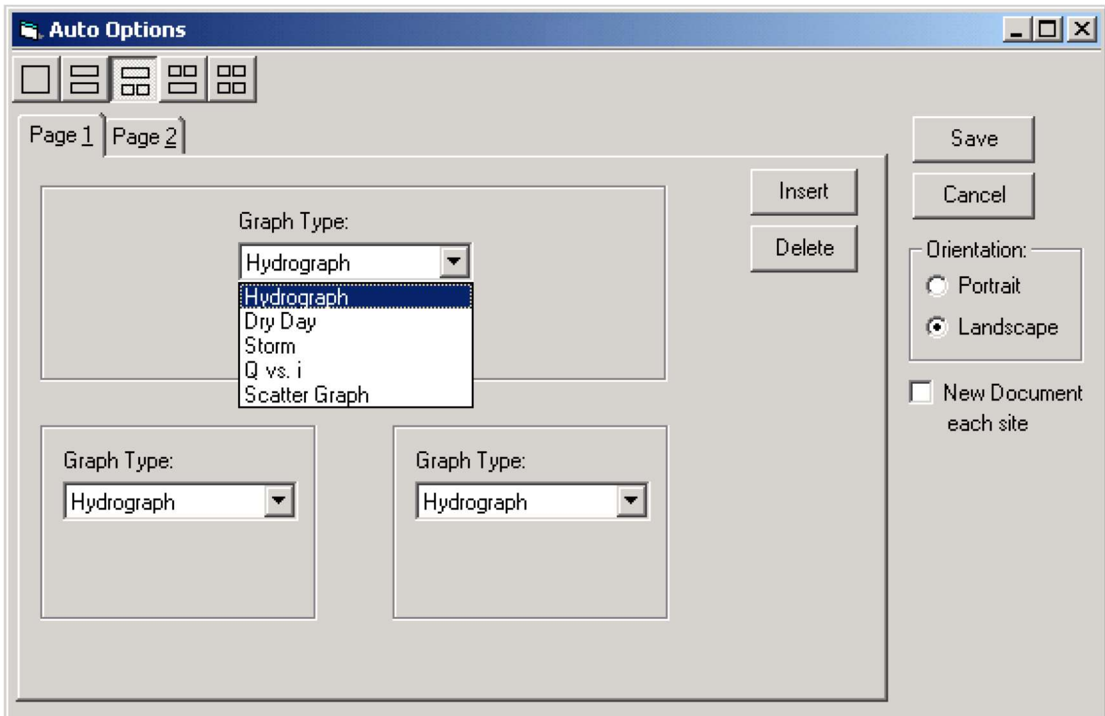
Sliicer allows you to select from five different types of graphs: Hydrographs, Dry Day Graphs, Storm, Q vs. i and Scattergraph. Each graph type except the hydrograph takes parameter to specify the format of the graph. The Dry Day, Q vs. ii and Scattergraph each take a graph style for their parameter. The style tells Sliicer the format to use when exporting the graph to the document. Therefore, it is important to have saved at least one style for each of these types before you try to generate a graphical document using these types of graphs. The Storm graph talks the storm start date as its parameter.

Changing the Graph Type to a Hydrograph

The most common graph type is the Hydrograph. The Hydrograph displays the flow and rainfall for the entire study period.

➔ **To change the graph type to a hydrograph**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the frame for the graph you want to be a hydrograph, select hydrograh from the Graph Type combo box.



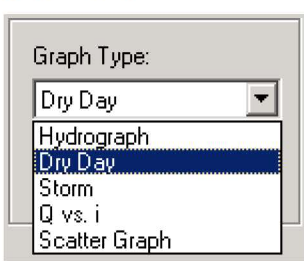
Sliicer configures the graph as a hydrograph.

Changing the Graph Type to Dry Day

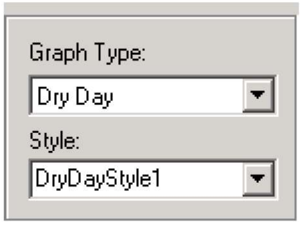
The Dry Day graph displays the average diurnal curves for dry days for each day group for either gross or net or both. It can also contain daily traces and base infiltration.

➔ **To change the graph type to Dry Day**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the frame for the graph you want to be a Dry Day graph, select Dry Day from the Graph Type combo box.

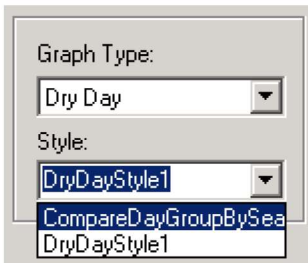


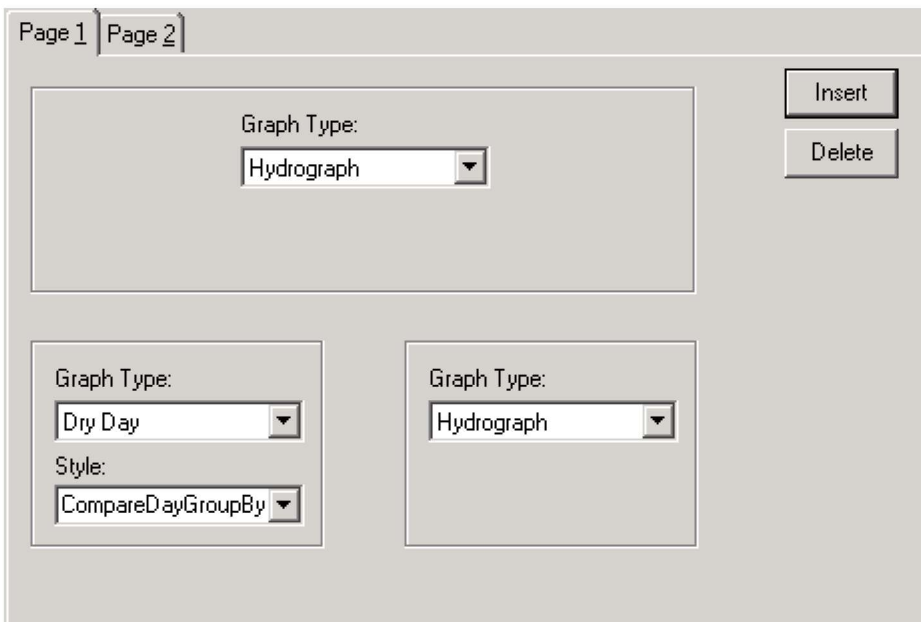
Sliicer changes the graph type to Dry Day...



…and adds the Style combo box.

3. Select the Dry Day style you want to use for the graphical document from the Style combo box.





Sliicer will use the Dry Day Style you select for to configure the Dry Day Graph for each site it exports to the graphical document.

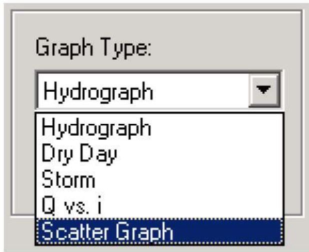
Changing the Graph Type to a Scattergraph

The scattergraph is a display of two traces plotted against each other. Most commonly, these two traces are Depth and Velocity. This type of scattergraph is useful in diagnosing the hydraulic characteristics of a meter site.

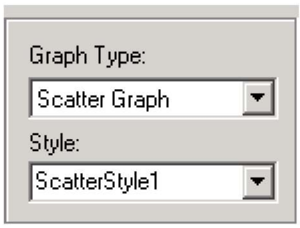
➔ **To change the graph type to a Scattergraph**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.

2. In the frame for the graph you want to be a Scattergraph, select Scatter Graph from the Graph Type combo box.

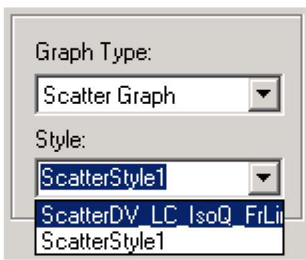


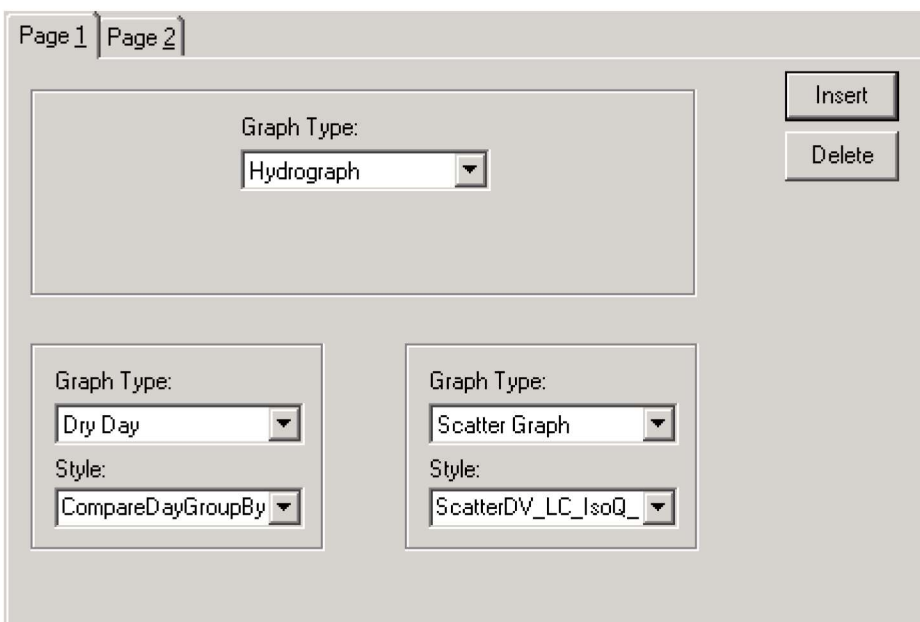
Sliicer changes the graph type to Scattergraph...



…and adds the Style combo box.

3. Select the Scattergraph style you want to use for the graphical document from the Style combo box.





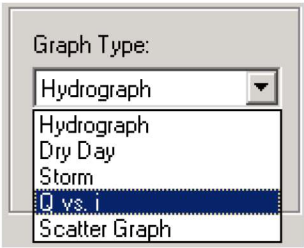
Sliicer will use the Scattergraph Style you select for to configure the Scattergraph for each site it exports to the graphical document.

Changing the Graph Type to Q vs. i

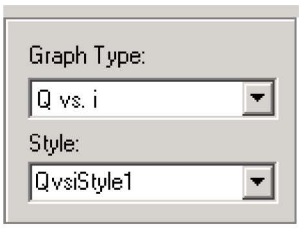
The Q vs. ii graph inflow and infiltration as a function of rainfall. This graph is useful in determining the response each site has to rainfall.

➔ **To change the graph type to Q vs. i**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the frame for the graph you want to be a Scattergraph, select Scatter Graph from the Graph Type combo box.

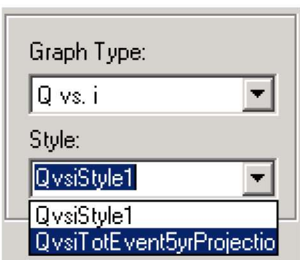


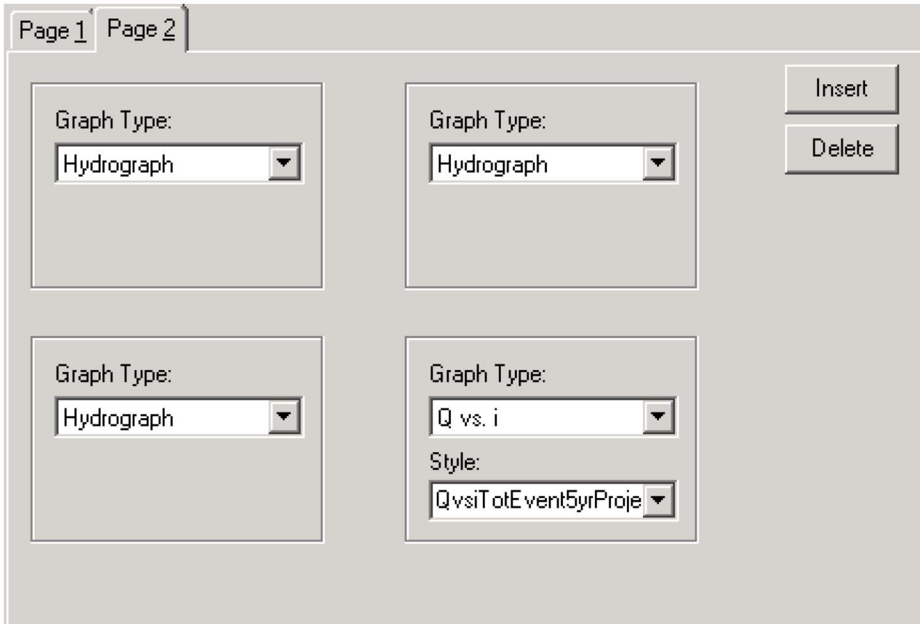
Sliicer changes the graph type to Q vs. i...



…and adds the Style combo box.

3. Select the Q vs. i style you want to use for the graphical document from the Style combo box.





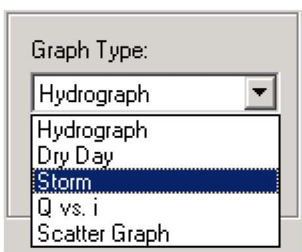
Sliicer will use the Scattergraph Style you select for to configure the Scattergraph for each site it exports to the graphical document.

Changing the Graph Type to Storm

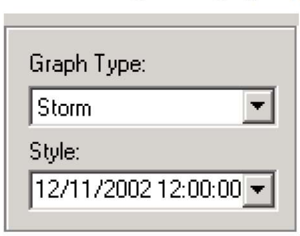
In creating a data appendix it is frequently to include the graphs of a number of individual storms. Much can be learned about the characteristics of a site by viewing the graphs of several storm events.

➔ **To change the graph type to Storm**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the frame for the graph you want to be a Storm, select Storm from the Graph Type combo box.

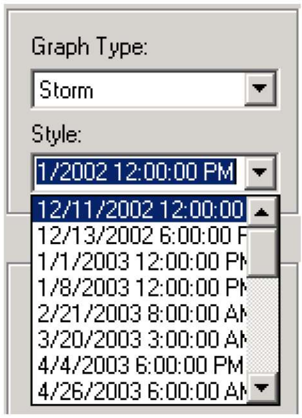


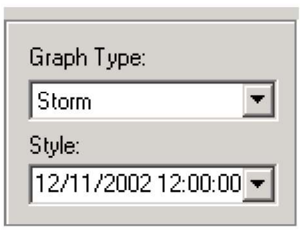
Sliicer changes the graph type to Storm...



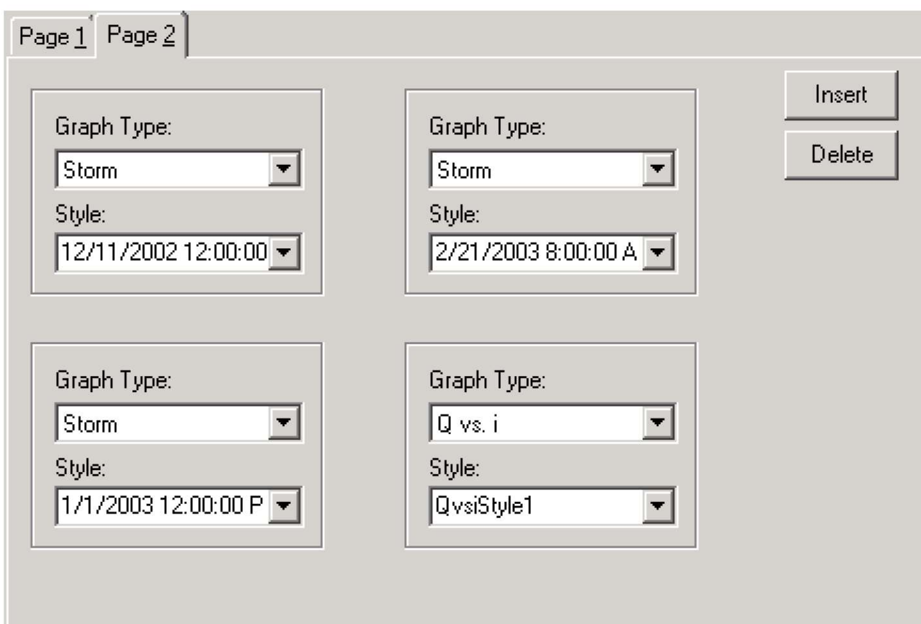
…and adds the Style combo box.

3. Select the Storm date you want to use for the graphical document from the Style combo box.





Sliicer will use the Scattergraph Style you select for to configure the Scattergraph for each site it exports to the graphical document.



Frequently, you will want to show multiple storms on one graphical document page You can accomplish this by configuring the Graph Type for several of the graph cells on a page to Storm, and then selecting different Storm Start Dates in the Style combo box for each Storm, as shown above.

Setting the Graphical Template options

You have several options of how Sliicer will format the pages of the Graphical Document. You can set the page layout orientation to either Portrait or Landscape, and you can have Sliicer add the graphs for all sites to one Word document, or have Sliicer create a separate document for the graphs for each meter site.

➔ **To set the page layout**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. In the orientation frame, select the orientation you want.

➔ **To get separate documents for each site**

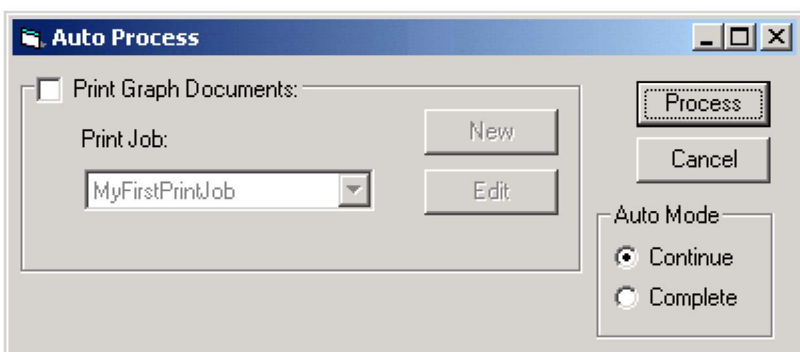
1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. If you want separate documents for each site, check the New Document each site checkbox.

Creating the Graphical Document

Once you have created and configured a Graphical Document Template the way you want, you are ready to create the Graphical Document itself. Sliicer creates the Graphical Document for you when you run the Auto command. When you run the Sliicer Auto command with Graphical Document generation enabled, Sliicer creates a Word document and appends the graphs you referenced in your template to the document as it processes. When Sliicer runs Auto in this mode, the appearance of the screens in the Auto process will be different than when running with the Graphical Document generation turned off. When generating a Graphical Document, Sliicer will cycle through each graph that you specified to be included in your template.

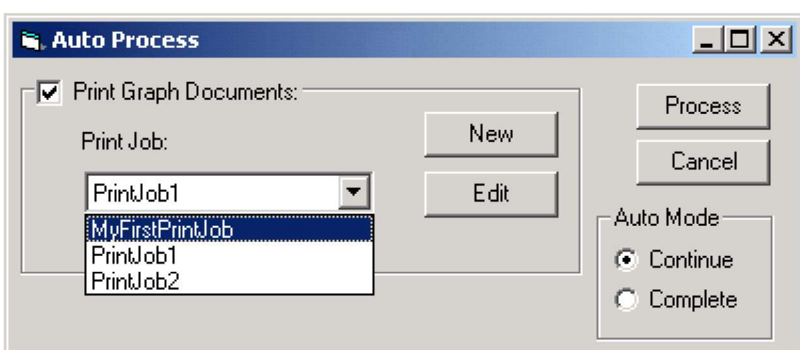
➔ **To create a Graphical Document**

1. Follow the procedures for Creating a Graphical Document Template, or Editing a Graphical Document Template outlined above.
2. From the Meter Sites tab, click the Auto button.



The Auto Process dialog appears.

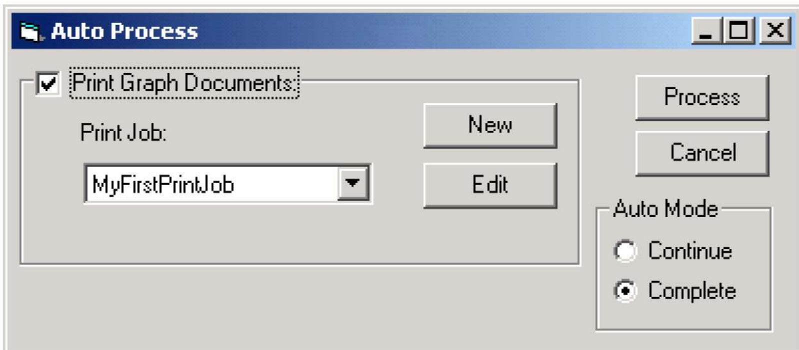
3. Check the Print Graph Documents check box, and select the Graphical Document Template you want from the Print Job combo box.



4. In the Auto Mode frame, choose complete if you want Sliicer to include graphs from all sites in your Graphical Document.

   -OR-

   Choose continue if you only want Sliicer to include the sites it has not yet processed as indicated in the Meter Status table on the sites tab in the Graphical Document.



5. Click the Process button.

   Sliicer cycles through the sites you specified, adding the graphs specified by your template to the Graphical Document. The Document is stored in the GraphDoc folder under the project directory with a file name that matches the Print Job name and a .doc extension, e.g. MyFirstPrintJob.doc.

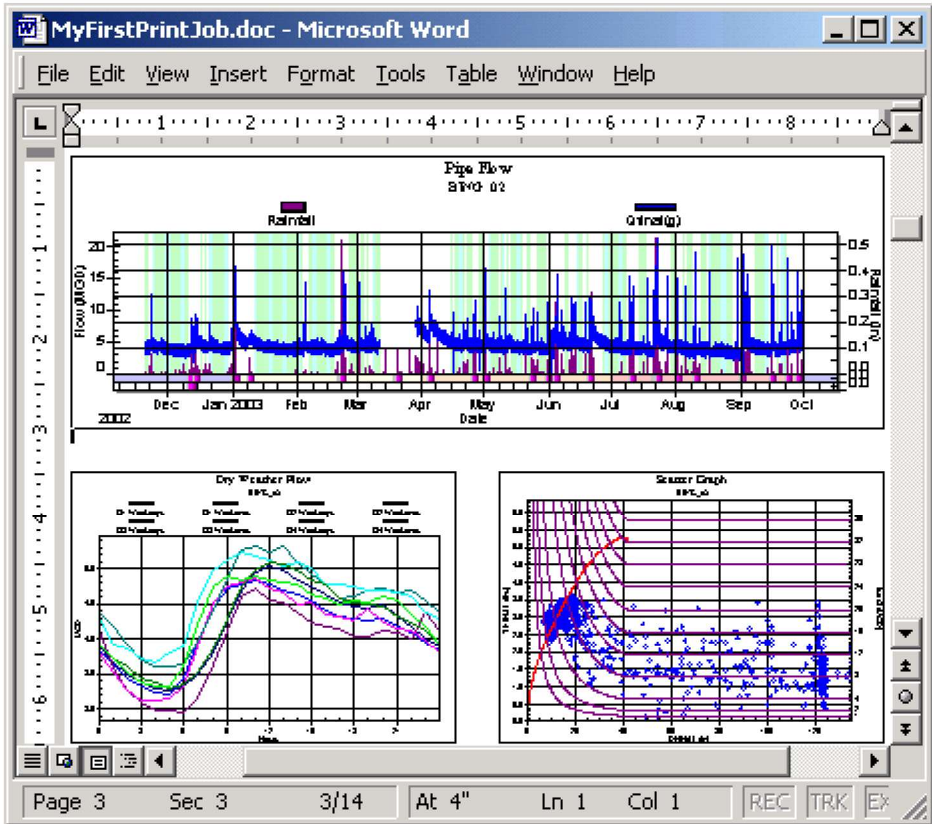
Printing the Graphical Document

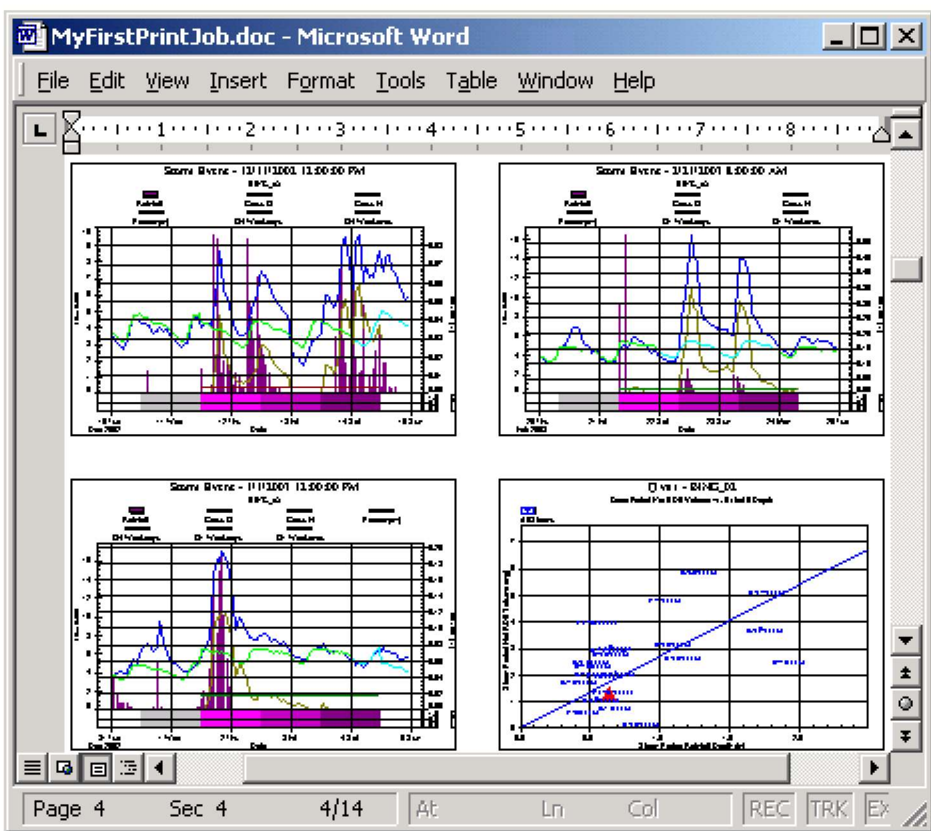
Once you have created a Graphical document, you are ready to print. You print your graphical document by opening it in Microsoft Word, and using Word's Print command.

➔ **To print a Graphical Document**

1. Start Microsoft Word, and open the Graphical Document you want to print.
2. Review the Graphical Document in Word to make sure it is correct.
3. From the Word File menu, choose Print.

   Sliicer prints the Graphical Document to your printer.





Example of a Graphical Document generated by Sliicer.

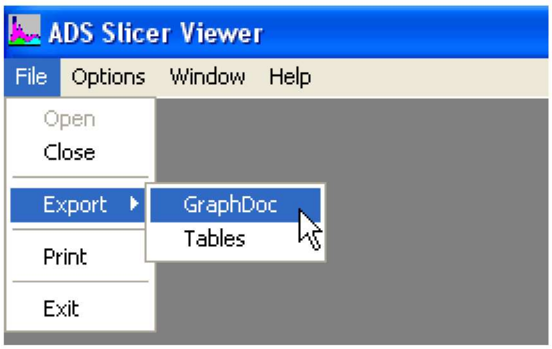
Exporting the Graphical Document

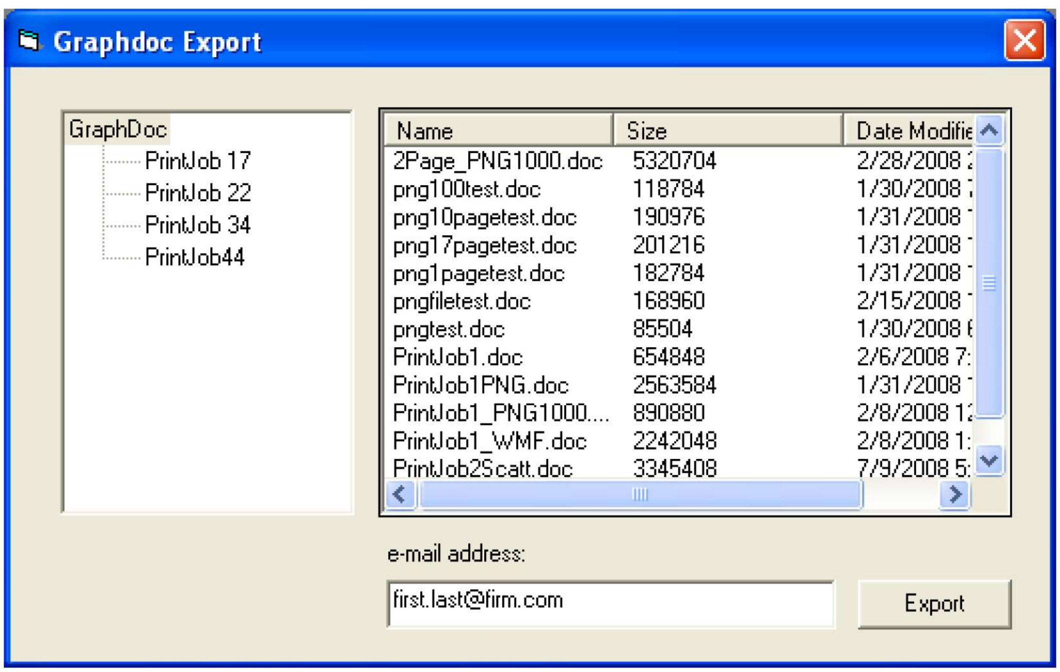
When you create a Graphical document running Sliicer on a server, such as through Sliicer.com, you are unable to print the file directly, because it resides on the server drive, not on your local computer. However, Sliicer allows you to export this file to your local machine by e-mailing a link to the file on the Sliicer file server (ftp).

You can export graphical document files whether you have created one graphical document with all sites, or a different graphical document for each site.

➔ **To export a Graphical Document (All Sites in One Graph Doc File)**

1. From the Sliicer File menu, select Export, GraphDoc





The Graphdoc Export dialog appears.

2. Make sure the GraphDoc folder is selected in the left hand folder tree box, and select the graphical document you want to export from the file list on the right.

3. In the e-mail address text box, type your e-mail address.

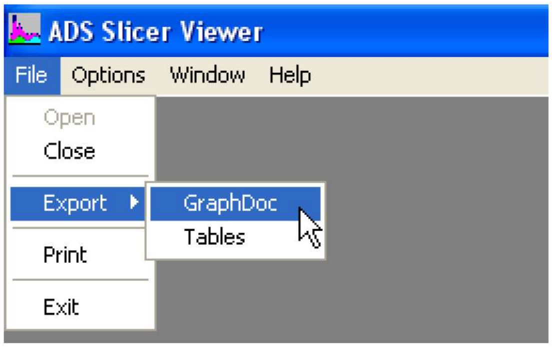
4. Click the Export Button.

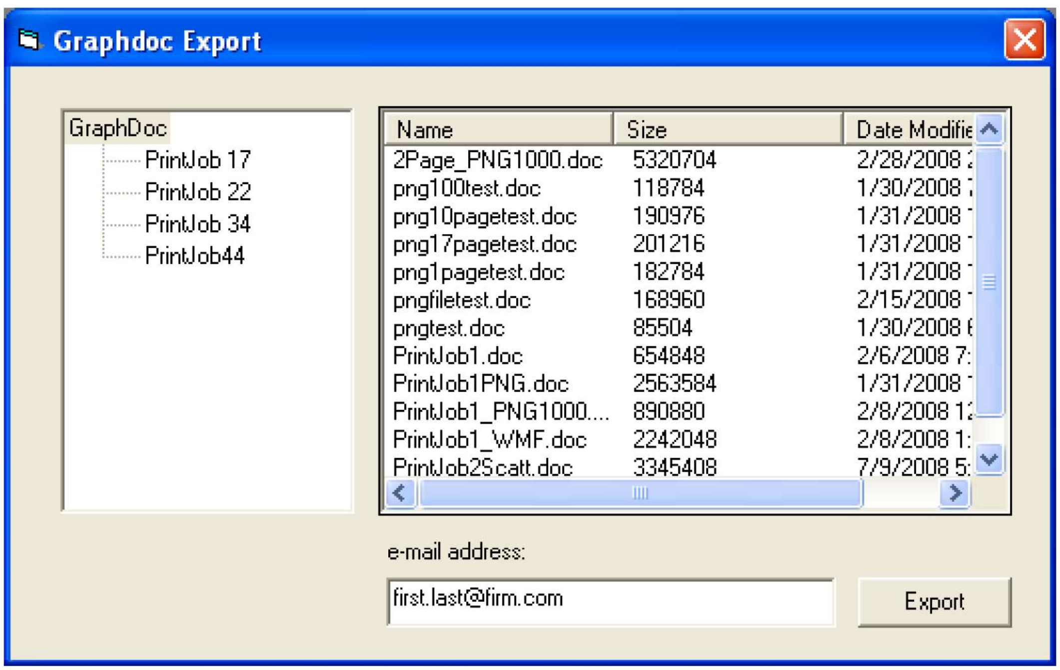
Sliicer will move the file you selected to the ftp:\\Sliicer.com file server, and e-mail a link to download the file to the e-mail address you specified.

Note The first time you export a graphical document, your e-mail filter may place the e-mail in your junk e-mail folder. If you don't receive the e-mail shortly after you click the export button, check your junk e-mail folder for an e-mail from downloadrequest@hiwaay.com with a subject heading reading: Sliicer Download – YourGraphDocFileName.doc.

➔ **To export a Graphical Document (Separate Files for Each Site)**

1. From the Sliicer File menu, select Export, GraphDoc

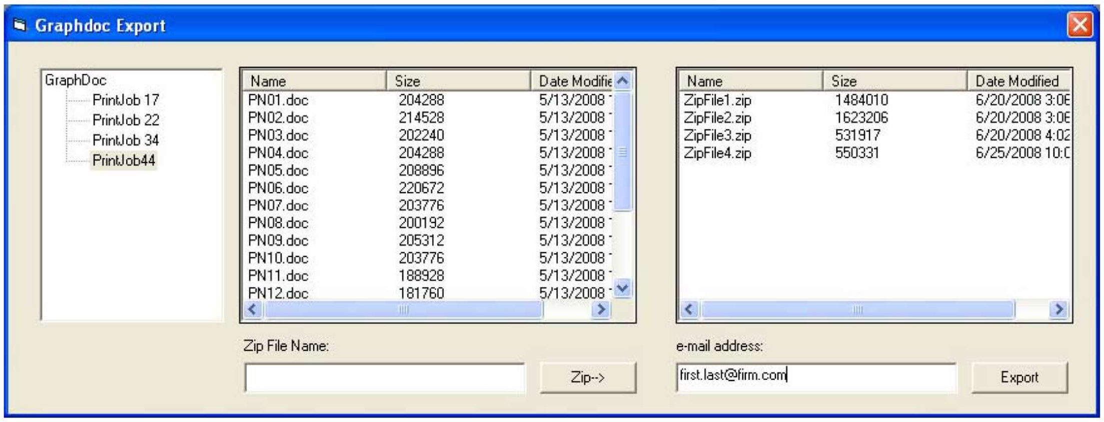




The Graphdoc Export dialog appears.

Note that in the left hand folder tree, each graphical document job name is listed under the GraphDoc folder for each print job that created a separate graph doc file for each site.

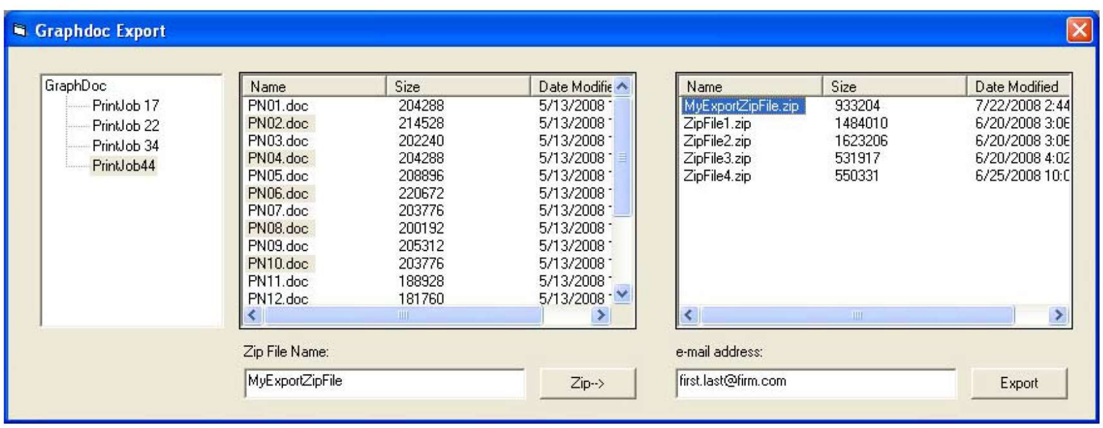
2. Select the print job from which you want to export site by site graphical document files.

3. 

4. The Graphdoc Export dialog expands to include a new window for zip files, the e-mail address text box moves to the right, and in its place, a Zip File Name box appears, along with a Zip→ button.
5. In the center box with .doc files, select the files you want to export. You may select more than one file by holding down the shift key as you click the mouse to select a range, or by holding the ctrl key down as you click the mouse to add and remove files from the selection.
6. When you have selected all the files you want to export, type a name for the zip file in the Zip File Name: text box, and click the Zip→ button.

   Sliicer will zip the individual site graphical document files you selected into one zip file, and add the zip file name to the zip file list on the right.
7. In the zip file list on the right, select the zip files containing the site by site graph doc files you want to export.

Note You can view which single site graph doc files are contained in each zip file by simply selecting the zip file. When you select the zip file, the graph doc files it contains are highlighted in the .doc file list box.



8. In the e-mail address text box, type your e-mail address.
9. Click the Export Button.

   Sliicer will move the zip file you selected to the ftp:\\Sliicer.com file server, and e-mail a link to download the file to the e-mail address you specified.

Note The first time you export a graphical document, your e-mail filter may place the e-mail in your junk e-mail folder. If you don't receive the e-mail shortly after you click the export button, check your junk e-mail folder for an e-mail from downloadrequest@hiwaay.com with a subject heading reading: Sliicer Download – YourGraphDocZipFileName.zip.

Backing Up and Restoring Sliicer Databases

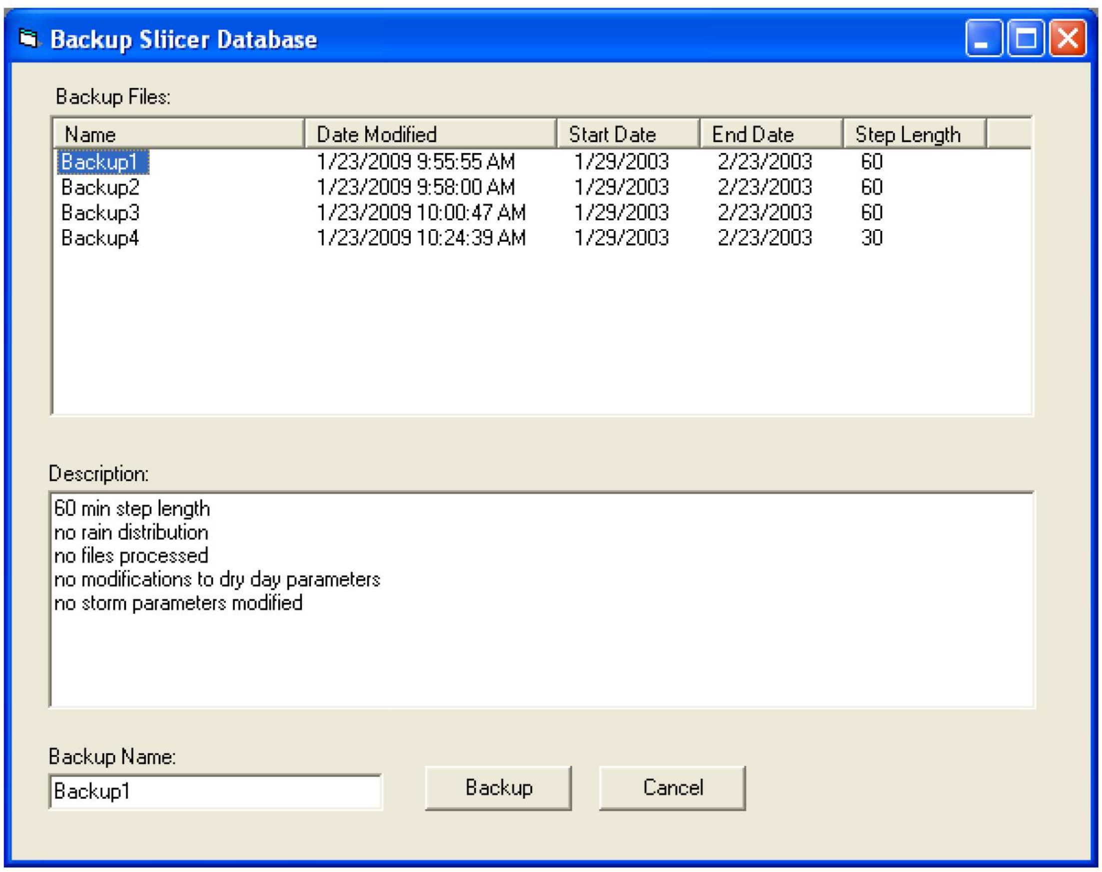
Sliicer allows you to backup its database at any time in your work process. You can make as many backup files as you want. (Sliicer.com users are subject to a backup file limit which is initially set at 5 backup files. If you need more backup files for your job, contact ADS for an increase in the number of backup files.) You can also restore the database to any state you previously backed up at any time. Backing up Sliicer databases allows you to easily look at your flow data from multiple perspectives, such as different step lengths, different day group configurations and different storm event definitions or settings. Whcn you backup a Sliicer database, you are free to completely change the study settings to answer new questions, and you can return to your previous analysis at any time without having to redo your settings and reruning the analysis.

Backing Up Sliicer Databases

You can backup your Sliicer database at any time in your work flow process. Once you backup your database, you can return to that analysis state at any time.

➔ **To backup a Sliicer database**

1. From the File menu, select Backup.



The Backup dialog appears.

2. In the File Name text box, enter the name for the backup file.
3. In the Description text box, enter a description of the state of the Sliicer database that you are backing up.

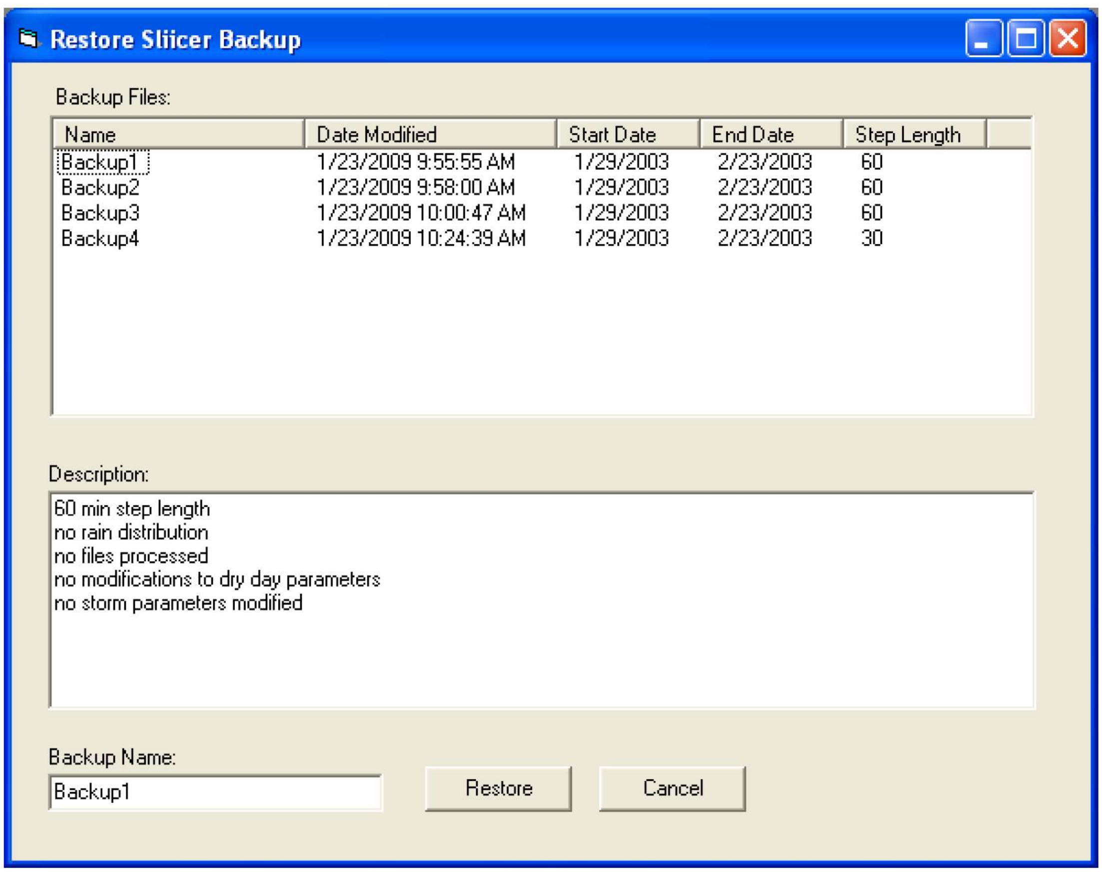
Note It is important to enter as many relevant descriptive parameters regarding the state of the Sliicer database that you are backing up to help you find the file later when you want to restore it to the current database state.

Restoring a Sliicer Database

Once you have backed up the state of a Sliicer database, you can restore the Sliicer database to the previous state at any time in the future, even after you have made many changes to the database. Further, since Sliicer allows you to backup multiple copies of the databases, you can move easily between dramatically different analysis scenarios. You can use this feature to manage separate analyses with different step lengths, different rainfall distributions, different day group configurations, different storm settings and parameters, or difference in any other Sliicer setting.

➔ **To restore a Sliicer database**

1. From the File menu, select Restore.



The Restore dialog appears.

2. In the Backup Files list box, select the name of the Sliicer backup file you want to restore.

Note You can examine the descriptions of the backup files before you restore in order to help you select the backup file you want. Click the file name in the Backup file list box to review the description before you restore. You can also use the keyboard up and down arrows when the backup list box is in current focus to toggle quickly through the file descriptions.

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4. Click the Restore button.

   Sliicer asks if you want to backup the current state of the database before you restore. If you want to backup your current database state before restoring, click Yes. Sliicer will show the backup form. Follow the instructions under the previous section “To Backup a Sliicer Database”, and return to these instructions when you have finished the backup. If you do not want to backup the current Sliicer database state before you restore, click “No”.

5. Click the Restore button.

   Sliicer restores the state to the backup you selected.

CHAPTER 9

Chapter 9 Model

Sliicer allows you to use the results of your flow study to load several different Hydraulic Models. You can create three different types of model flow loadings:

- Dry Weather
- Actual Storm Events
- Design Storm Events

In this chapter you will learn to:

- Understand the Sliicer flow file types
- Select a basis for your flow files
- Create Sliicer flow files
- Export Sliicer flows to several model formats
- Calibrate Sliicer model flows

Understanding the Model Tab

Hydraulic models allow you to run alternative analyses in the form of “what if” scenarios, and understand more fully how your collection system reacts to rainfall. The model tab allows you to use the results of your flow study to load your hydraulic model. By using Sliicer flows to load you model, you can study hydraulic issues that occur between your flow monitors.

Sliicer supports export into two different hydraulic models: HydraPIPE and XP-Extran. In addition, Sliicer allows you to make three different types of flow loading to each of these models: Dry Weather, Actual Storms, and Design Storms.

Dry Weather

Sliicer allows you to use the results of your dry weather analysis to load your model for dry weather. You use dry weather flow files to calibrate your model for dry weather, and to study capacity issues in your collection system under dry weather conditions. You can use any of the day groups you defined in your flow study to create dry weather flow files.

Actual Storms

Sliicer also allows you to use actual storm event flows to load your model. You can use the Net I/I for any storm event you analyzed. Normally, you will combine your storm flows with one of your dry weather flow files. You can use the combined loading of dry weather flows and actual storm event flows to calibrate your model for wet weather and study capacity issues in your collection system during storm events.

Design Storms

In addition to actual storms, Sliicer also allows you to use design storms to load your model. As in the case of actual storm flows, you will usually combine design storm flows with dry weather flows to simulate a complete flow loading. By using design storm flows, you can run “what if” analyses on your collection system for hypothetical storm events.

Creating Model Flows

One of the most time consuming tasks in setting up a model is determining what flows to use. The Sliicer Model tab is designed to make this task much easier. Sliicer allows you to visualize flow alternatives so you can more quickly make an informed choice about what flows to use.

Selecting a Basis

Before you create a flow file of any type (dry, storm or design), you must choose a model basis. The model basis is the flow issue you want to model. Each of the four different flow file types has a different basis, as shown below:

Flow Type	Model Basis	Example of Model Basis
Dry Weather	Day Group	Weekdays
Actual Storms	Storm Event	04/12/94 10:00
Design Storms	Actual Storm Flow File	Storm1

Viewing Alternatives

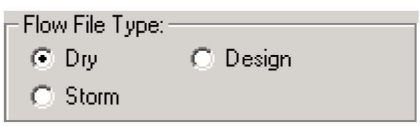
Before you create a Sliicer flow file, the first thing you need to do is select a basis. In order to select a basis, you will need to view the alternatives. One of the main functions of the Sliicer Model tab is to help you select a basis by allowing you to easily view the alternatives.

You view alternatives for a particular flow file type (dry, storm or design) by color coding one or more model basis alternatives and one or more meter sites. When at least one basis alternative and one meter site are color coded, Sliicer will display a graph of the selected alternatives for your review.

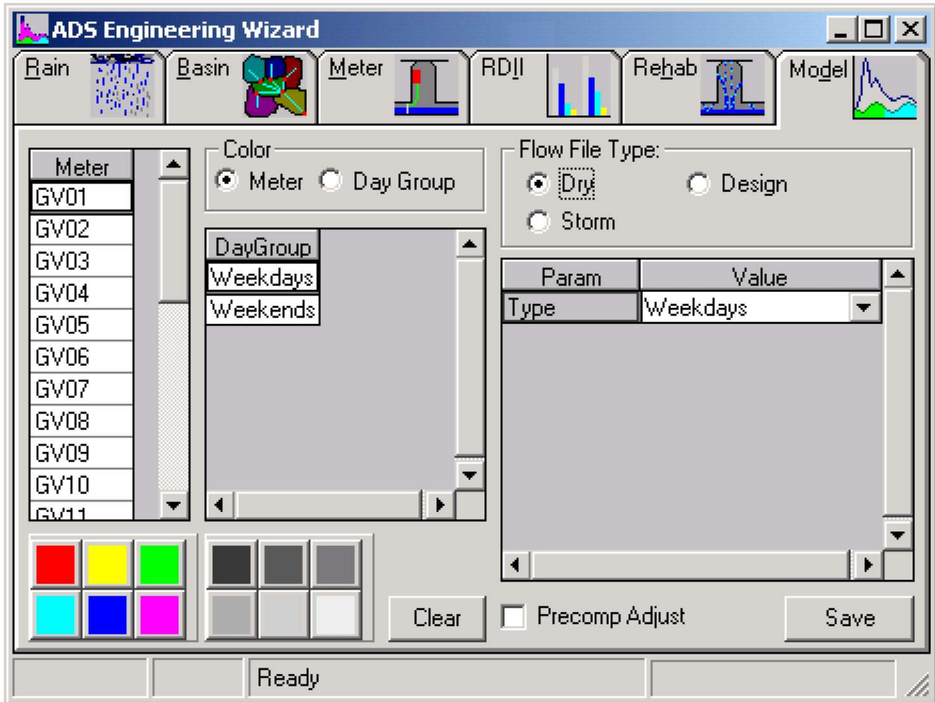
Viewing Dry Weather Alternatives

Suppose you want to create a dry weather flow file. Also suppose you used three day groups in your flow study: Weekdays, Saturdays, and Sundays. In order to create a model flow file, you must choose between the three day groups to load the model. Sliicer helps you by allowing you to view and compare the different day group diurnal curves for multiple monitor sites. By reviewing these alternatives, you can more easily choose the day group to use for your dry weather model basis.

➔ **To view dry weather basis alternatives**

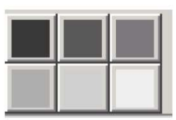


1. In the Flow File Type box, select Dry

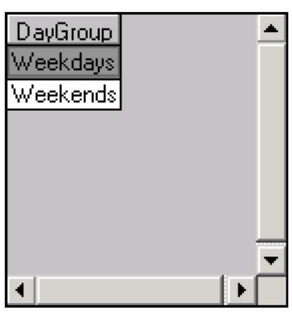


Sliicer displays the Meter and Day Group tables on the left side of the Engineering Wizard window.

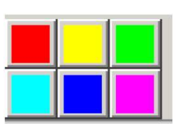
2. Select the Day Group basis you want to view.
3. Click one of the shading buttons (directly below the Day Group table).



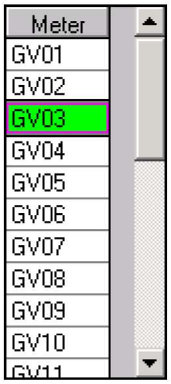
Sliicer shades the background of the daygroup you selected with the shade you selected.



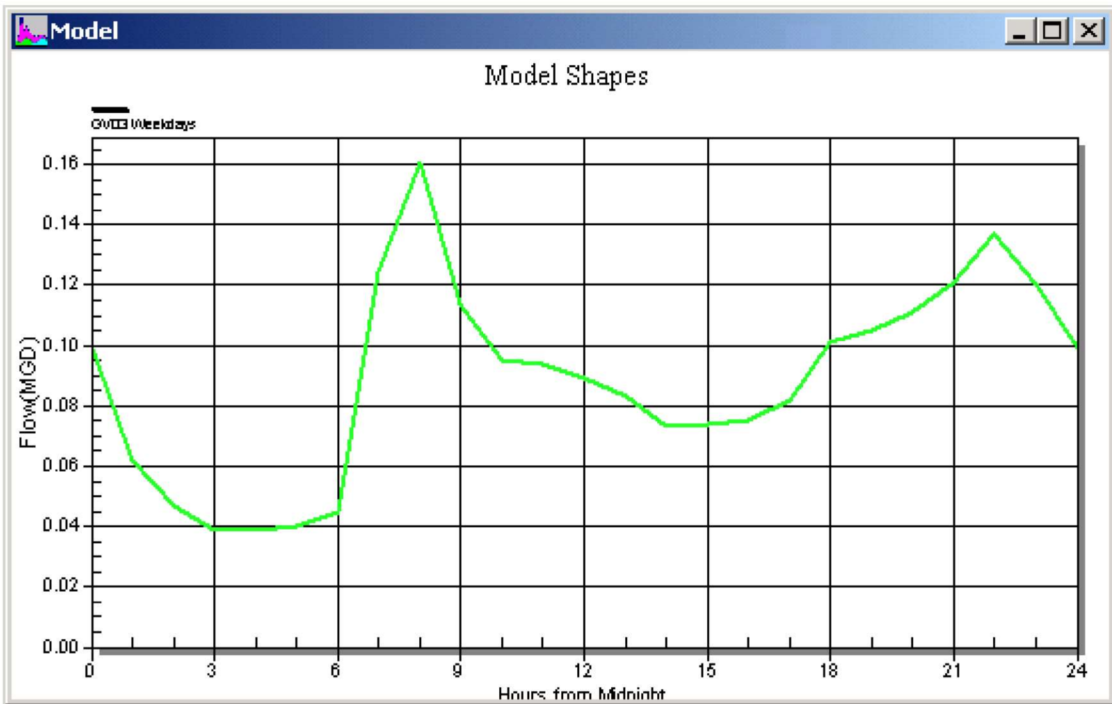
4. Select the meter site you want to view.
5. Click one of the meter color buttons (directly below the Meter table)



Sliicer changes the background of the site you selected to the color you selected.

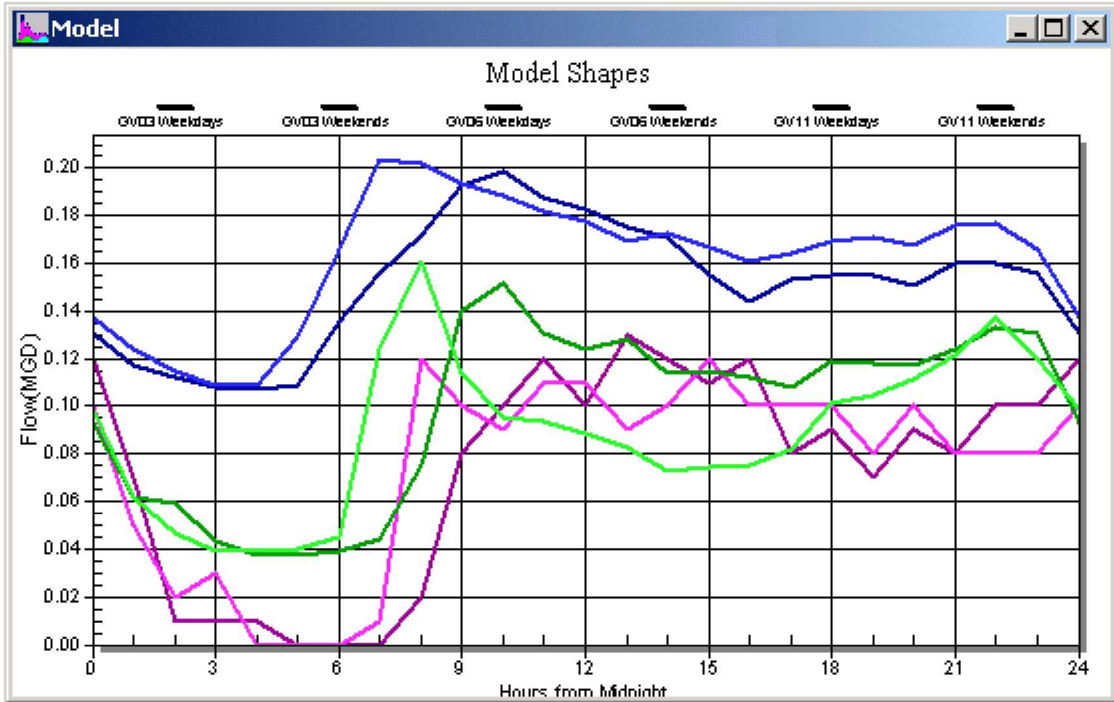


…and plots the dry day hydrograph for the selected site in the color and shade you selected.



Sliicer displays a graph of the Day Group for the site you selected.

6. Repeat steps 2 -3 or 4-5 or both until you have displayed all the alternatives and sites and or day groups you want to see.



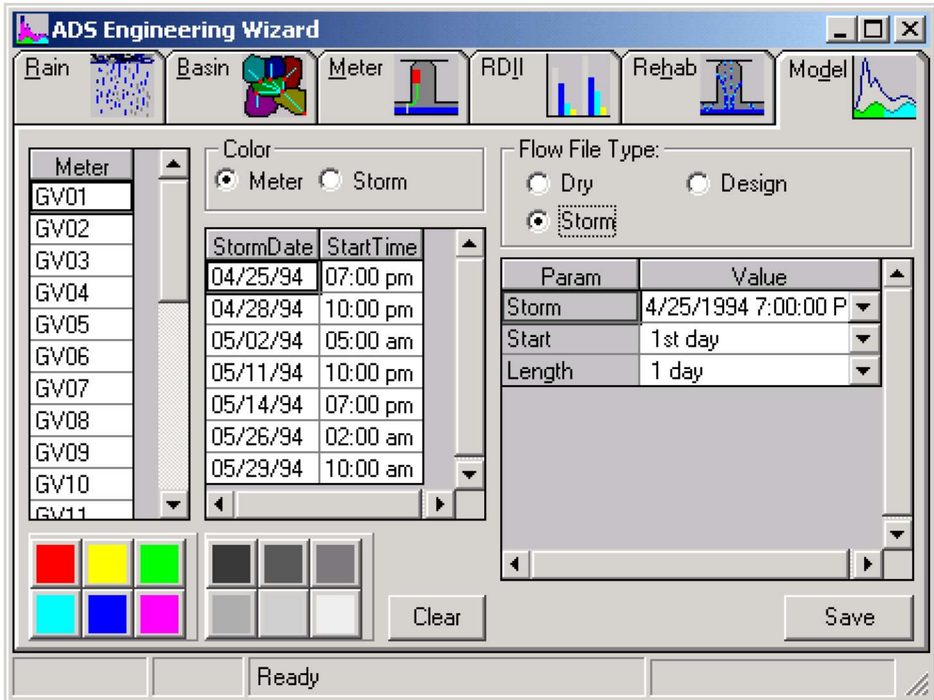
Note Use the Clear button instead of the color buttons to clear either Day Groups or Meter Sites

Viewing Actual Storm Alternatives

To select an actual storm basis, you will need to choose between different storm events. Sliicer helps do this by allowing you to view and compare different storm events for multiple monitor sites. By reviewing alternative storm events at different locations in the system, you can more easily select the right storm for the model basis.

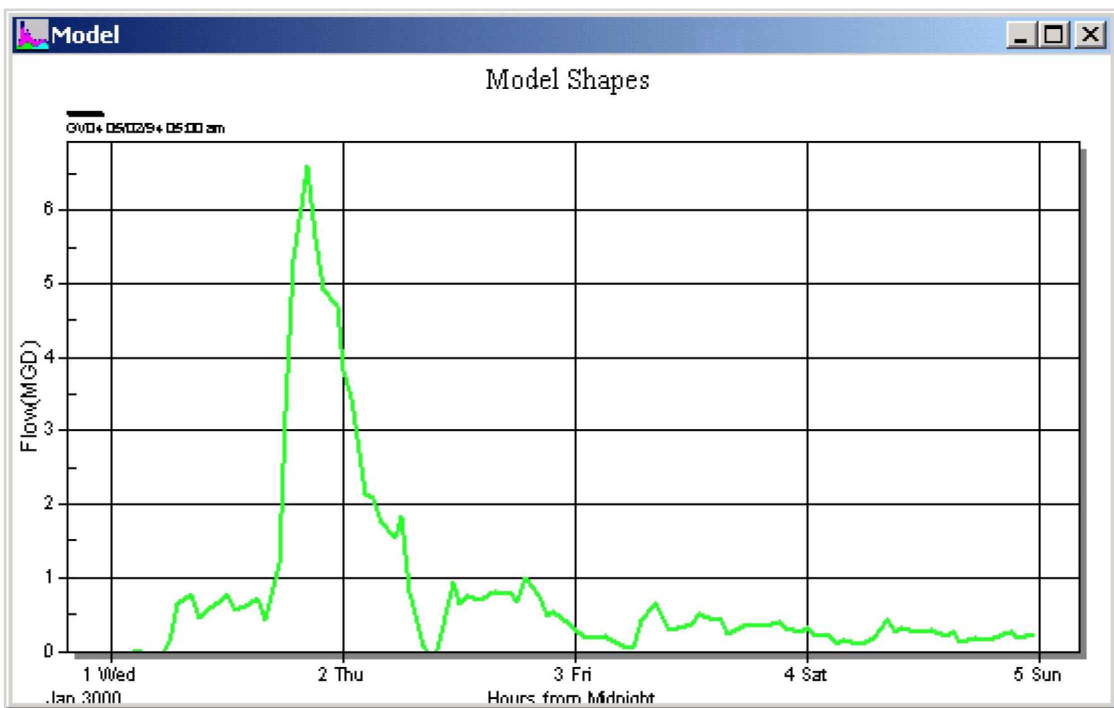
➔ **To view actual storm alternatives**

1. In the Flow File Type box, select Storm.



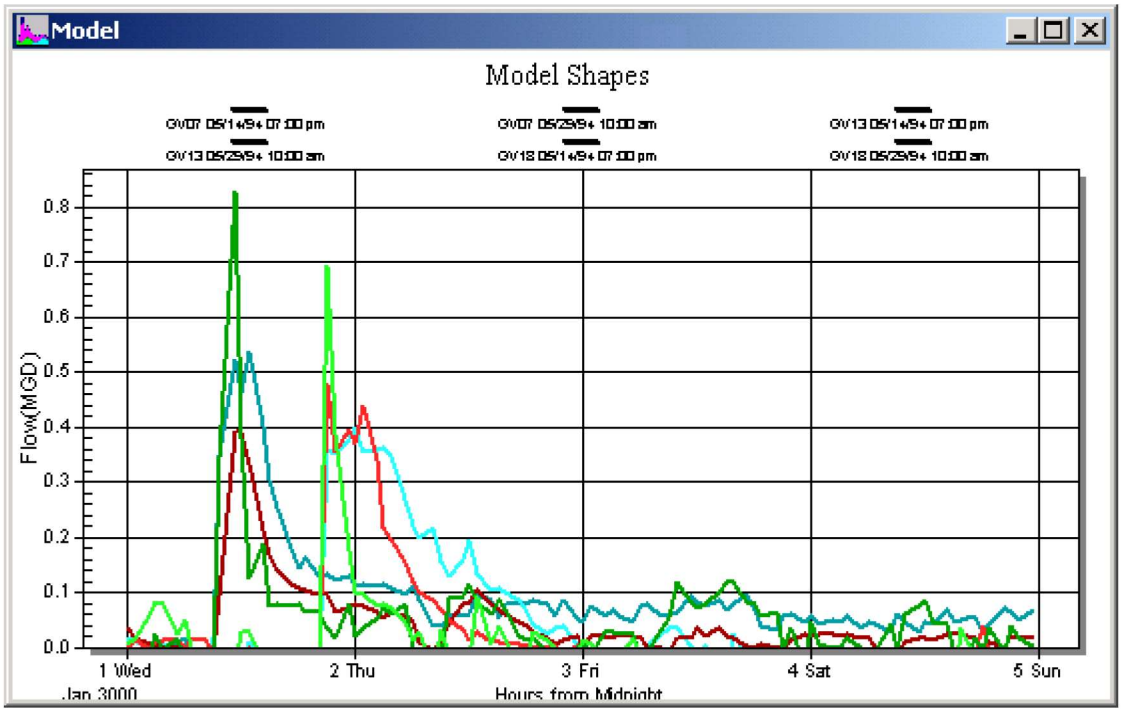
Sliicer displays the Meter and Storm tables on the left side of the Engineering Wizard window.

2. In the Storm table, select the Storm basis you want to view.
3. Click one of the basis color buttons (directly below the Storm table).
4. Select the meter site you want to view.
5. Click one of the meter color buttons (directly below the Meter table)



Sliicer displays a graph of the Storm for the site you selected.

6. Repeat steps 2 -3 or 4-5 or both until you have displayed all the alternatives and sites you want to see.



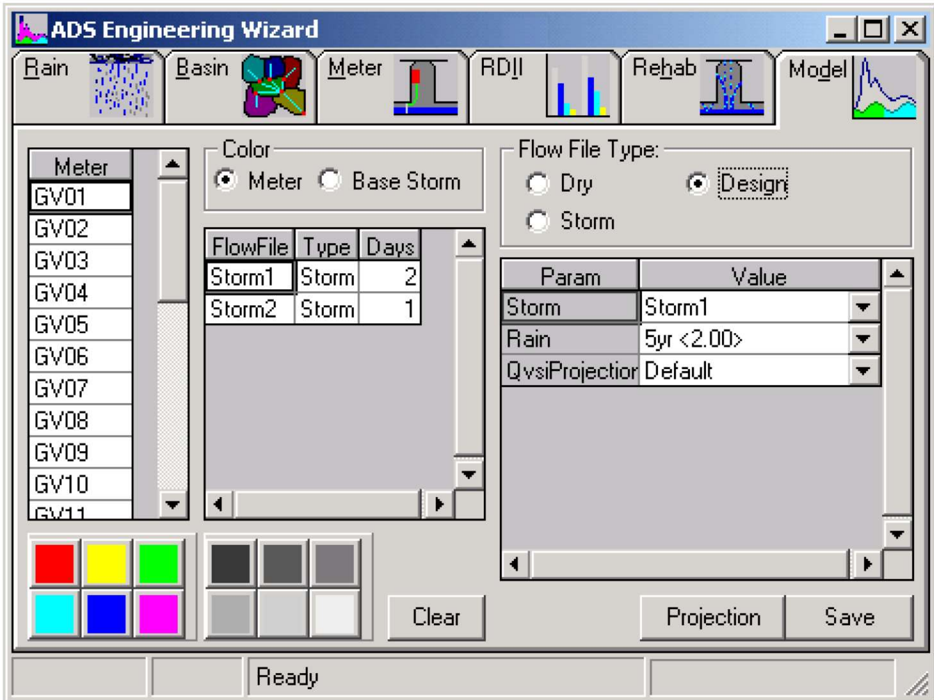
Viewing Design Storm Alternatives

Sliicer also helps you review alternative design storms for multiple meter sites to assist you in selecting a design storm to model. However, the display for the design storm viewing mode is different than for dry weather or for actual storm events. In design storm mode, the Sliicer Model tab displays the actual storm flow file basis in one color, and the projected event in the other color. Therefore, when you view design storms, Sliicer will allow you to view multiple sites for one storm basis, or one site for multiple storms, but not both at the same time.

➔ **To view design storm alternatives**

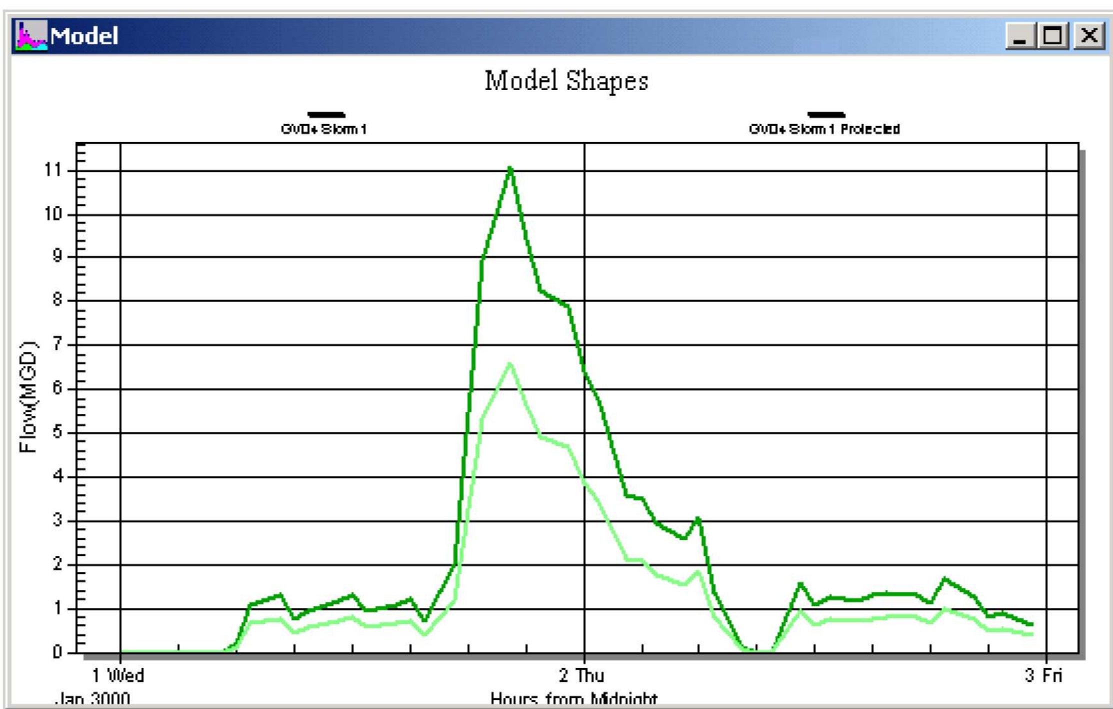
1. In the Flow File Type box, select Design

Note If you have not yet saved a storm flow file, Sliicer will not let you set the Flow File Type to Design mode. For information on saving flow files see Saving Flows later in this chapter.



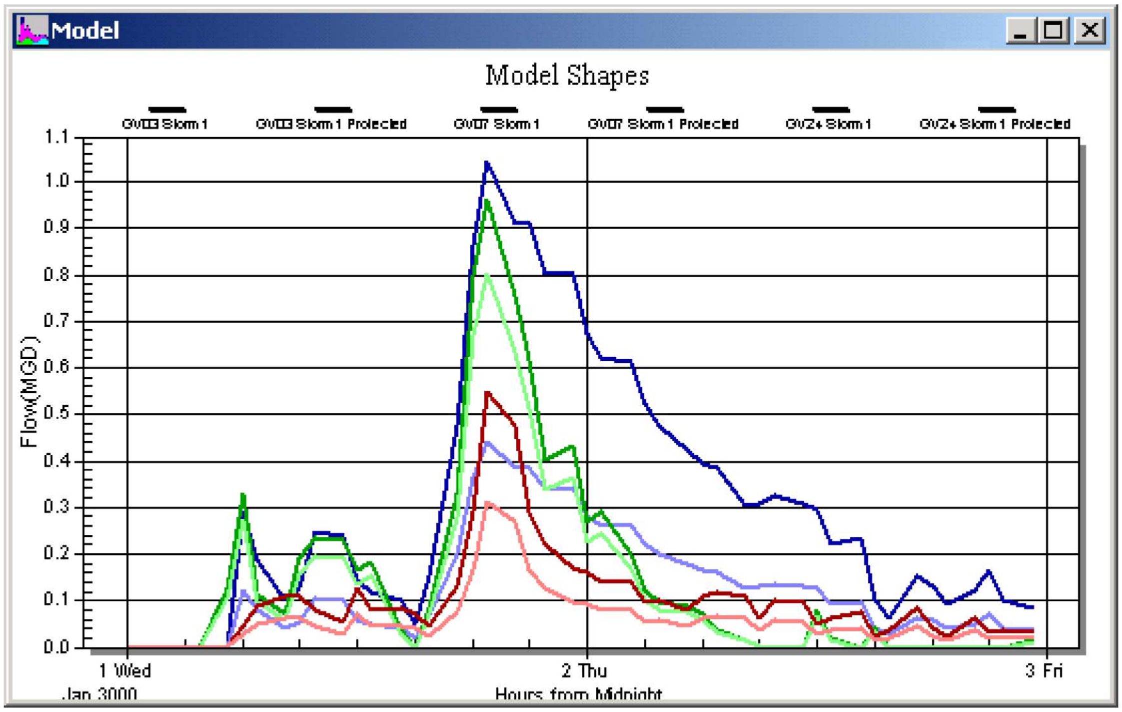
Sliicer displays the Meter and FlowFile tables on the left side of the Engineering Wizard window.

2. Select the Actual Storm FlowFile basis you want to view.
3. Click the basis color button (directly below the FlowFile table).
4. Select the meter site you want to view.
5. Click one of the meter color buttons (directly below the Meter table)



Sliicer displays a graph of the Storm flow and projected Design Storm flow for the site you selected.

6. Repeat steps 2 -3 or 4-5 until you have displayed all the alternatives and sites you want to see.



Note Use the Clear button instead of the color buttons to clear either Day Groups or Meter Sites

Choosing the Model Basis

Once you have viewed the model basis alternatives for the type of flow file you want to create, the next step is to choose the model basis to use. You use the model basis table for the type of flow file you want to create to select a model basis.

➔ **To choose a model basis**

- In the model basis table, double click the model basis you want to use for the model flow file.

  Sliicer loads the model basis you selected into the flow file Parameters (Param) table.

Setting the Parameters

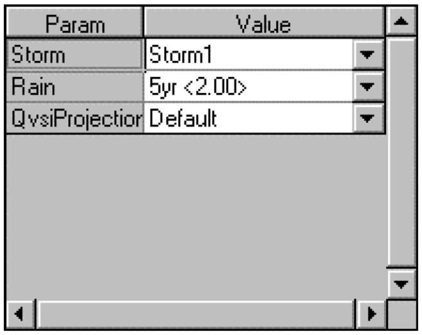
Each type of flow file has a different set of parameters that you must specify before you save your flows. All flow file types have at least one parameter, the model basis. The following table shows the parameters for each type of flow file.

Dry	**Storm**	**Design**
Day Group	Storm Start Time	Storm Flow File
	Start Day	Rainfall
	Model Length	Q vs. i Projection Set

When you choose a model basis, you have filled out the first parameter Sliicer needs to create a flow file. Depending on the type of flow file you are creating, you may need to specify up to two additional parameters.

➔ To set the flow file parameters

- In the Parameters (Param) table, select the values you want from the drop down lists.



Parameters table shown for Design mode.

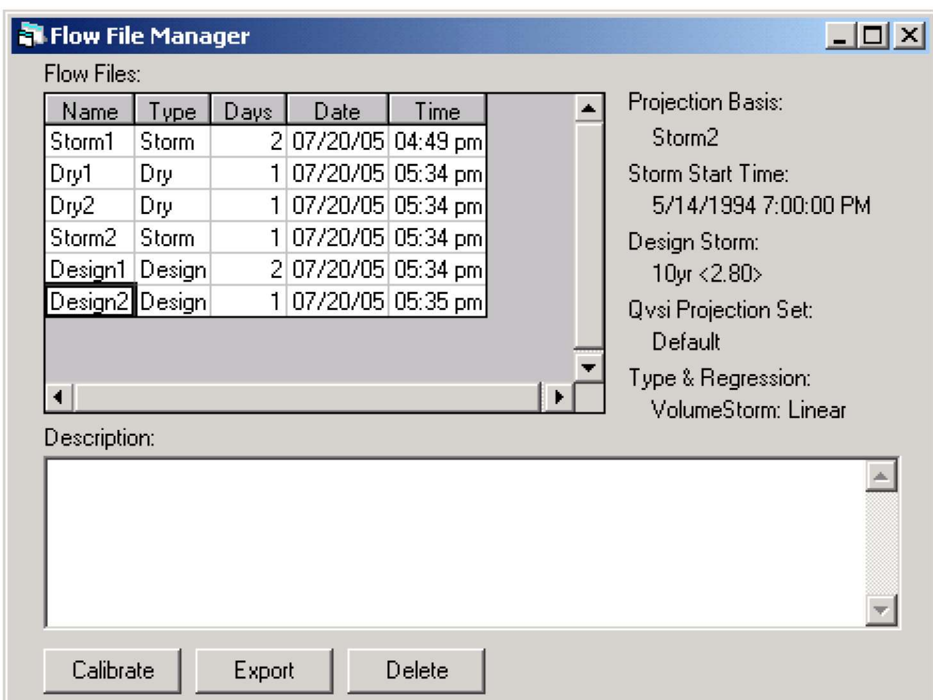
Saving Flows

Once you have selected the flow basis and set the parameters for the type of flow file you are trying to create, you are ready to save the flow file.

➔ To save the flows

1. Make sure you have set all the parameters in the Parameters (Param) table.
2. Click the 

button.



Sliicer saves the flow file to the Flow File Manager window.

Annotating Flows

Once you have saved a flow file to the Flow File Manager form, you can annotate the flow file with a description so you can remember the details of why you created it, and what it should be used for. In even medium sized modeling projects, it is frequently necessary to create a large number of model runs to complete calibration and "what if" analysis. As time goes by, it is easy to loose track of the unique aspects of each model loading. Therefore, we strongly recommend that you annotate saved model runs in detail, to help you remember the reason you created each flow file.

➔ **To annotate a flow file**

1. In the Flow Files table, select a cell for the flow file you want to annotate.
2. Type the annotation in the Description text box.
3. Change rows in the Flow Files table.

   Sliicer saves the annotation you entered.

Deleting Flows

You can delete a flow file at any time.

➔ **To delete a flow file**

1. Select a cell in the row of the Flow File table for the flow file you want to delete
2. Press the Del key on the keyboard.

   Sliicer deletes the flow file.

Loading Your Model

Once you have saved your flow files to the Flow File Manager, you are ready to export your flows to your hydraulic model. Sliicer keeps your flows in its own database, so you don't have to choose which model you want to use until the very last step in the Model tab. This also makes it possible for you to compare the results from different modeling programs by exporting the same Sliicer flow file to different model formats.

Understanding Model Correlation

In order to set up your model to work with Sliicer, you must select a method of model correlation. Model correlation is the way you tell Sliicer how to distribute flows from the monitor basins to the pipes and manholes in your model. Sliicer keeps track of flows on a per basin basis. In order to get the best results out of your model, you should distribute a portion of the basin flow to each of the pipes and manholes within that basin. By doing this, you develop a more realistic flow load for each pipe or manhole.

Understanding Weight Based Flow Distribution

You tell Sliicer how to distribute flow among your model pipes and manholes by using a correlation table. The correlation table tells Sliicer the name of each pipe or manhole you want to model, the basin it belongs to, and the flow distribution weighting factor relative to the other pipes in its basin. Most often, you will want to use pipe length as the flow distribution weighting factor, but you are not limited to using length. You can use modified length weights, or any other technique that is justified by the information you have about the pipes and manholes in your collection system.

For example, if you only wanted to model 15 pipes in a basin that contained 40 pipes, you may not want to use simple pipe length to distribute flow. Suppose the 25 unmodeled pipes were all grouped upstream of just one of the modeled pipes. In this case you might still want to use the length of the modeled pipes as the basis for flow distribution weights, but increase the weight on the one pipe that receives flow from the 25 unmodeled pipes by the sum of the length of these unmodeled pipes. This would correct the model flow distribution and heighten accuracy of the capacity analysis that the model produced.

Using Model Correlation Approaches

Sliicer supports three methods of approaching model correlation:

- HydraPIPE SY_*.DBF (g_fignum = sy_fignum)
- Correlation Table (ASCII Text Comma Separated Format (*.csv))
- Direct Entry into CollectionSystem Table in Flowload.MDB

Regardless of the model you select, you can use any of these three methods to specify model correlation. In all three approaches, the completed correlation process results in a population of the CollectionSystem table in FlowLoad.MDB. In the first two approaches, Sliicer reads external files, and loads the CollectionSystem table itself. In the third approach, you load the CollectionSystem directly using MS Access.

Using HydraPIPE Model Correlation

When you use the HydraPIPE SY_*.DBF approach, you use fields in the SY_*.DBF table to specify the correlation of pipes to their basins, and the flow distribution weights on each pipe. Sliicer uses three fields in the SY_*.DBF table to make the correlation: SYS_NAME, SYS_LENGTH, and BASIN. You must ensure that these fields are filled out for every pipe you want to model before you use the table to correlate in Sliicer. Also, in this approach, you are limited to using the length specified in the SYS_LENGTH field of the SY_*.DBF table for the flow distribution weights on each pipe.

To specify the injection pipe for each defect, you use the SY_FIGNUM field in the LNDFCT.DBF and MHDFCT.DBF tables. You enter G_FIGNUM from the SY_*.DBF table for the injection pipe into the SY_FIGNUM field for each defect in the MHDFCT.DBF and LNDFCT.DBF tables. If the pipe on which the a defect occurs is modeled, you enter the G_FIGNUM value for that pipe from the SY_*.DBF table into the SY_FIGNUM field of the defect table. If it is not modeled, you enter the G_FIGNUM of the first modeled pipe downstream where the flow for defect will enter the modeled portion of the collection system.

Using ASCII Text File Model Correlation

In the second approach, you specify the model correlation values for each pipe using an Comma Separated Format ASCII Text file (*.CSV). The four fields for the ASCII Model Correlation table are: Basin, Manhole, Unique Model Injection Name, Flow Proportion Weight. An example of a section of an ASCII model correlation table is show below.

```
"GV01","01001","LINK-01001",940
"GV01","01002","LINK-01002",717
"GV01","01003","LINK-01003",641
"GV01","01004","LINK-01004",570
"GV01","01005","LINK-01005",698
"GV01","01006","LINK-01006",212
"GV01","01008","LINK-01007",140
"GV01","01009","LINK-01007",140
```

The Basin and Manhole fields must be exact matches with the MINI and MANHOLE fields in the MHDFCT.DBF and LNDFCT.DBF tables. The Injection field must be an exact match with the unique model pipe or manhole name. The first three fields are enclosed in double quotes (") because they are strings. The fourth field, the Flow Proportion Weight is not enclosed in double quotes because it is a number. This method allows complete flexibility in specifying the Flow Proportion Weight.

Using Direct Entry Model Correlation

The third method of specifying model correlation is Direct Entry. In this method you use MS Access to fill out the fields in the CollectionSystem table in FlowLoad.MDB. You can use either queries or data entry techniques to populate the CollectionSystem table, but if you use this method, you must complete the population of the CollectionSystem table before you use Sliicer to export any flows.

The fields for the CollectionSystem table are the following:

Basin - Exact match on the basin name used in Sliicer and in the defects tables.

Name - Exact match on the upstream manhole name used in the defects tables.

Inject - Exact match on the unique model manhole or pipe name.

Weight - Number representing the flow proportion weight.

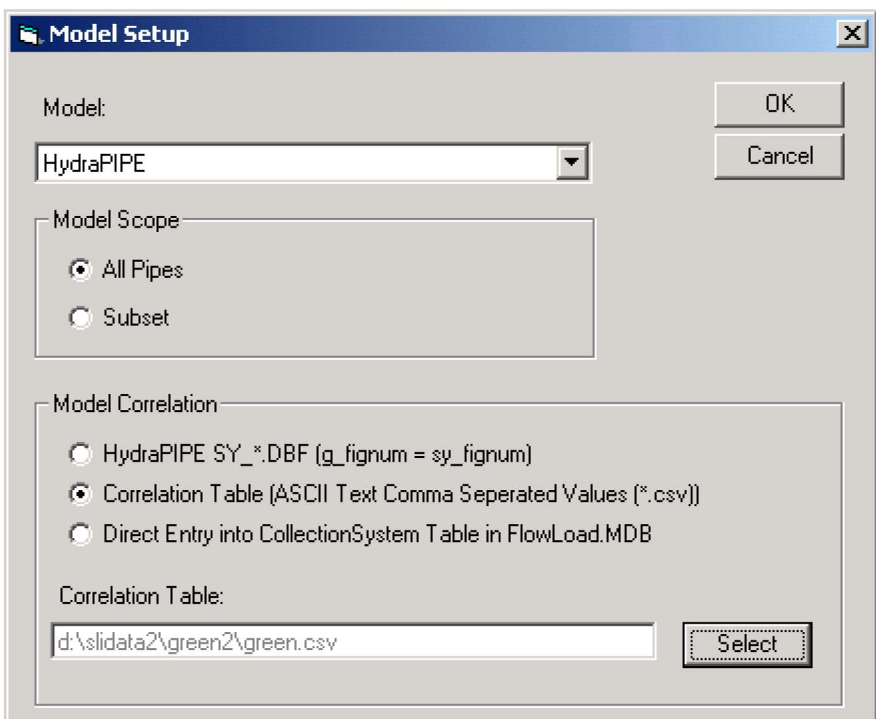
Warning After you use the Direct Entry method to load the CollectionSystem table in FlowLoad.MDB, you should not select another Model Correlation method in the Model Setup dialog, because doing so will replace the values you entered into the CollectionSystem table with values imported from the external tables used by the other methods. Further, if you use the Direct Entry Model Correlation method, you should back up the CollectionSystem table to another table name (e.g. CollectionSystemBack) in case you inadvertently overwrite it by selecting another Model Correlation method.

Choosing a Model

The first time you try to export a flow file, Sliicer will ask you to tell it which model you want to use. You also need to give Sliicer some information about your collection system so Sliicer knows how to correlate the flows it exports with the names of the collection system pipes and manholes.

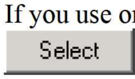
➔ **To choose a model**

1. In the Flow File Manager window, select the flow file you want to export in the Flow File table.
2. Click the Export button.

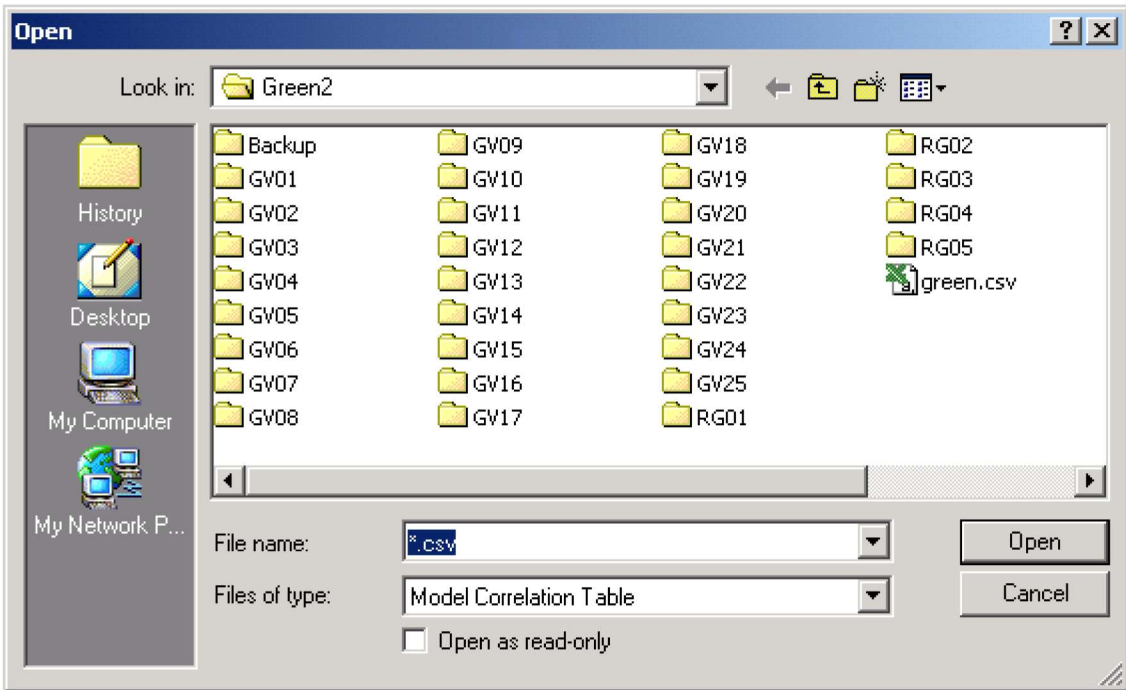


The first time you export a flow file, Sliicer automatically displays the Model Setup dialog first.

Note You can also access the Model Setup dialog from the Model Export dialog by clicking the Setup button (shown in step 8 of this procedure).

3. In the Model drop down list, select the model you want to use.
4. In the Model Scope box, choose between modeling All Pipes, or a Subset.
5. In the Model Correlation box, select the Model Correlation method you want to use.
6. If you use one of the first two methods (HydraPIPE SY_*.DBF, or Correlation Table), click the 

button.

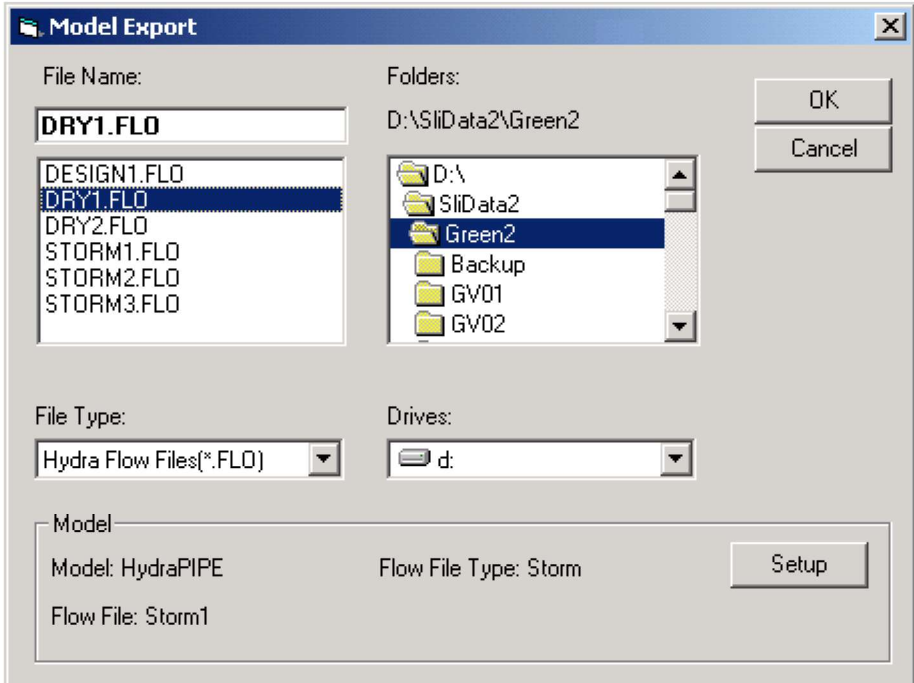


The open correlation table dialog appears.

Caution If you have previously used the Direct Entry method to populate the CollectionSystem table in FlowLoad.MDB, clicking the OK button in the next step will overwrite the values you entered manually. If you don't want to do this, click the Cancel button in the Open dialog, and change the Model Correlation method back to Direct Entry.

7. Select the correlation table you want, and click the OK button.

   Sliicer clears the CollectionSystem table, and loads the CollectionSystem with the information from the external table you selected.
8. In the Model Setup dialog, click the OK button.



Sliicer loads the collection system information into the database, and displays the Model Export dialog.

Exporting Flows

Once you have specified which model you are going to use, you are ready to export your flows. The process of exporting flows is slightly different depending on what model you export to.

For export to HydraPIPE, you do not have to specify any additional parameters when you export. This is because each type of flow file can be added inside the HydraPIPE interface. This means that you can combine any of the wet file types (Storm or Design) with dry flow files using HydraPIPE.

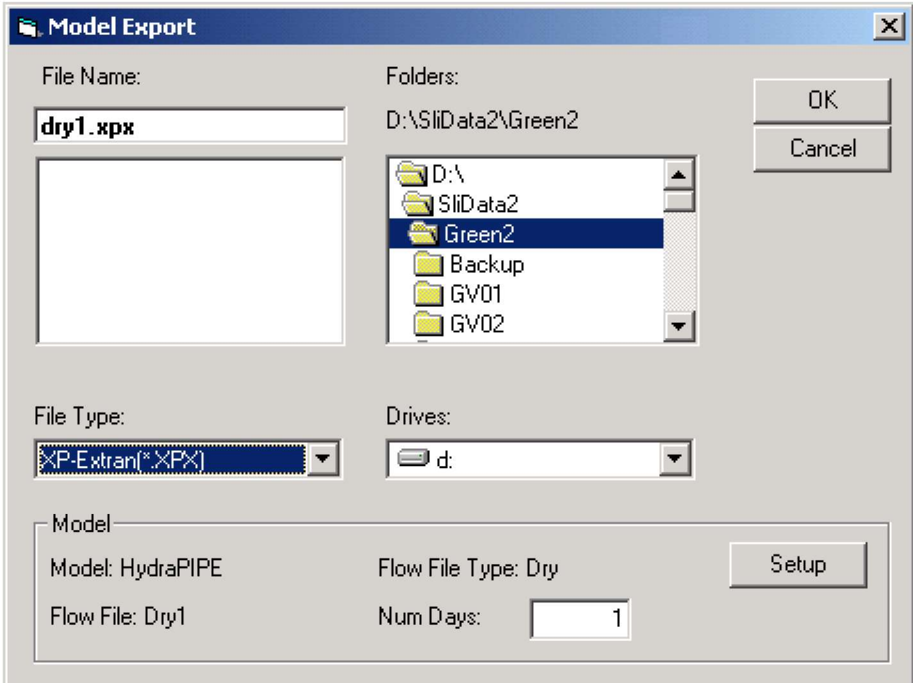
Also, Dry flow files in HydraPIPE are handled as diurnal hydrographs. This means that it is only necessary to input one days worth of dry flows no mater now many days are modeled. The Hydra engine treats dry flows diurnally, and continues cycling the flows for each day of the model.

However, XP-Extran does not have the same flexibility either in combining flow files or in diurnalization. Because of this, it is necessary to specify the number of days you want to model when you export dry flows to XP-Extran. It is also necessary to specify which dry flow file you want to use whenever you export a wet flow file (Storm or Design). Since the XP-Extran interface is not able to combine dry and wet flow files, Sliicer must combine the dry and wet flows as the flows are exported.

➔ **To export flows**

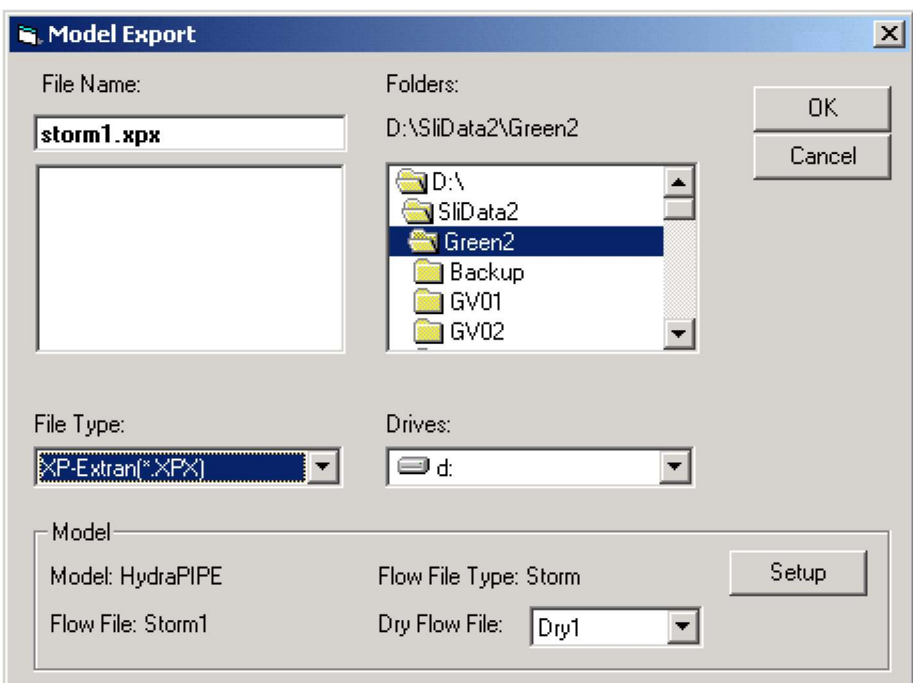
1. In the Flow File Manager window, select the flow file you want to export in the Flow File table.
2. Click the 

button.



The Model Export dialog appears.

3. In the File Type drop down list, select the flow file export format you want to use.
4. In the File Name box, type the file name of the flow file.
5. If you are exporting a dry flow file to XP-Extran format, enter the number of days you want to model.



6. If you are exporting a wet flow file (Storm or Design) to XP-Extran format, Select the Dry flow file you want to use for the dry flow component.
7. Click the OK button.

Sliicer exports the flows to the file name you specified in the format you selected.

Calibrating Flows

After you run your model on flows you exported from Sliicer, you may want to calibrate your flow files. Sliicer allows you to calibrate both the shape and volume of your model hydrographs numerically. It also allows you to use the mouse to calibrate the shape.

Once you have calibrated your flow file, you save it back to the flow file manager under a new name. You can then export your calibrated flow file and re-run your model.

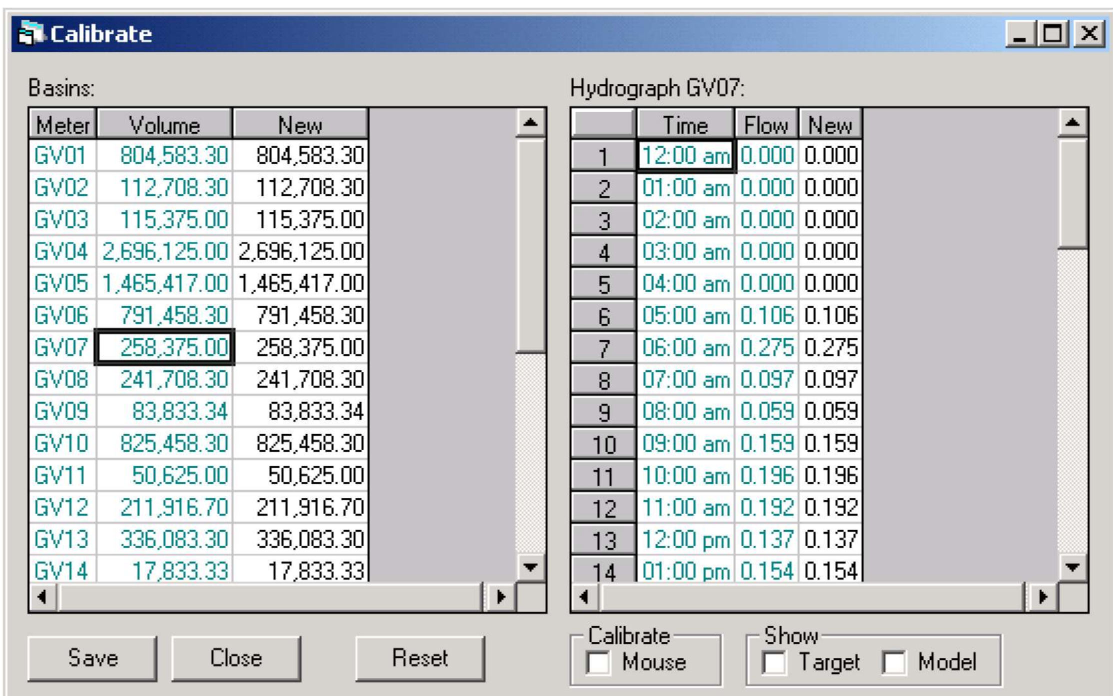
Adjusting Hydrograph Volume

Sliicer allows you to change the volume of your model hydrographs on a per basin basis. When you change the hydrograph volume, Sliicer distributes the new volume over each step of the hydrograph proportionally.

➔ **To adjust the hydrograph volume**

1. In the Flow File Manager window, select the flow file you want to calibrate.
2. Click the 

button.

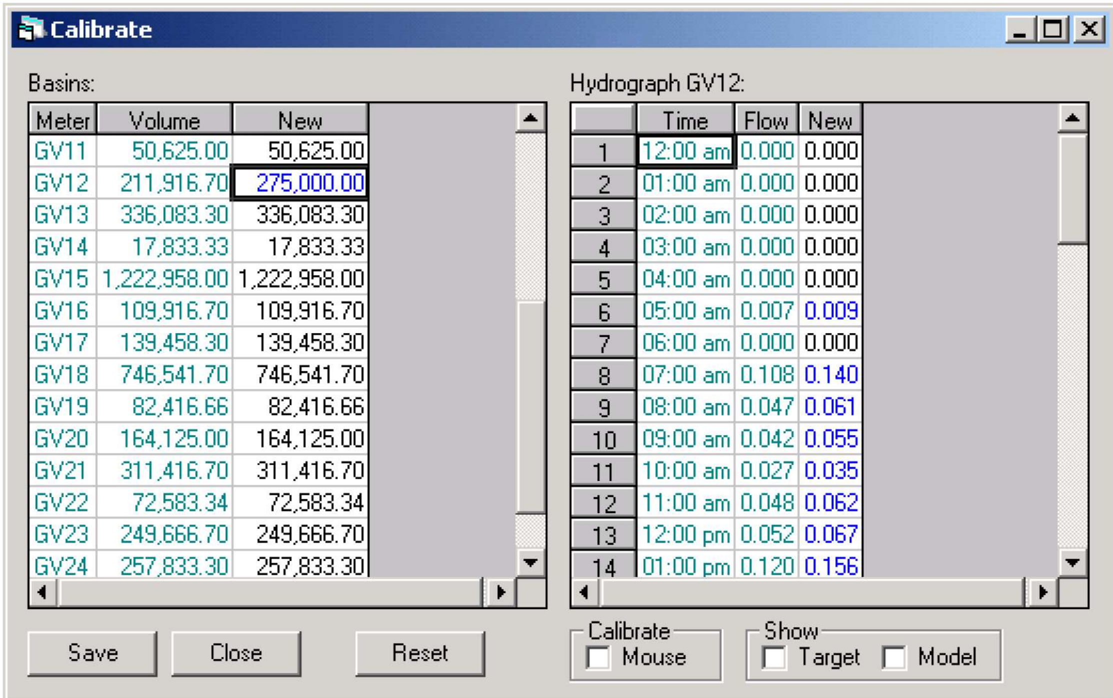


   Sliicer opens the Calibrate window.

3. In the Basins table, double click the cell in the New column for the basin you want to change.
4. Enter the new volume.
5. Press the Enter key.

   -OR-

   Change rows in the Basins table.



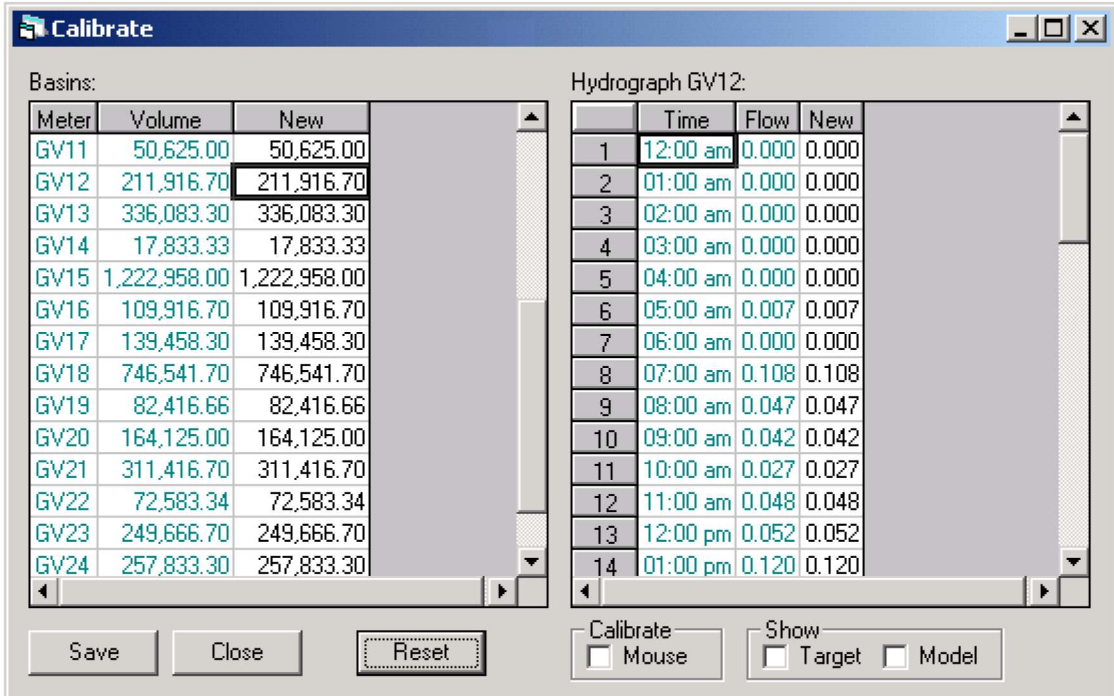
Sliicer changes the flow, and adjusts the values in the hydrograph to reflect the changes in volume. Sliicer also color codes the changes, blue for increases, and red for decreases.

Adjusting the Hydrograph Shape

You can also change the individual steps in the hydrograph for each basin.

➔ **To adjust the hydrograph shape**

1. In the Flow File Manager window, select the flow file you want to calibrate.
2. Click the Calibrate button.

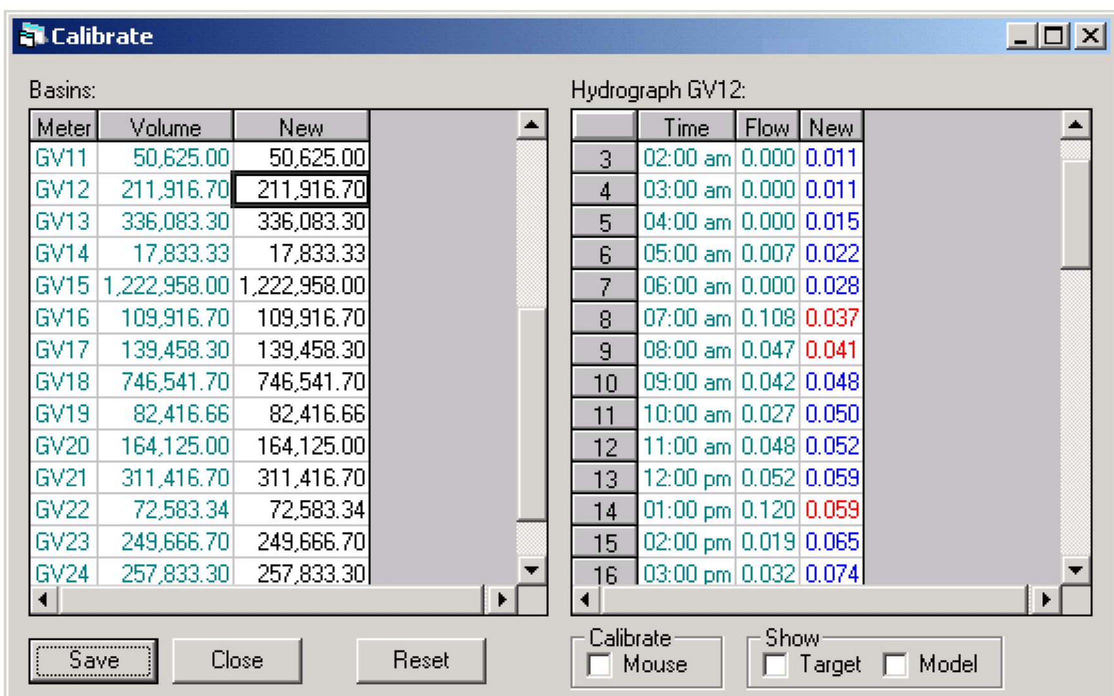


Sliicer opens the Calibrate window.

3. In the Basins table, select the basin you want to calibrate.
4. In the Hydrograph table, edit the steps you want to change in the New column.
5. After editing each value you want to change, press the enter key.

   -OR-

   Change rows in the Hydrograph table.



Sliicer changes the values of the hydrograph. Sliicer also color codes the changes, blue for increases, and red for decreases.

Resetting Values

If you make a mistake, you can reset any of the volume or hydrograph values that you changed.

➔ **To reset volume or hydrograph values**

1. Select the row(s) in the Basin or Hydrograph table you want to reset.
2. Click the 

button.

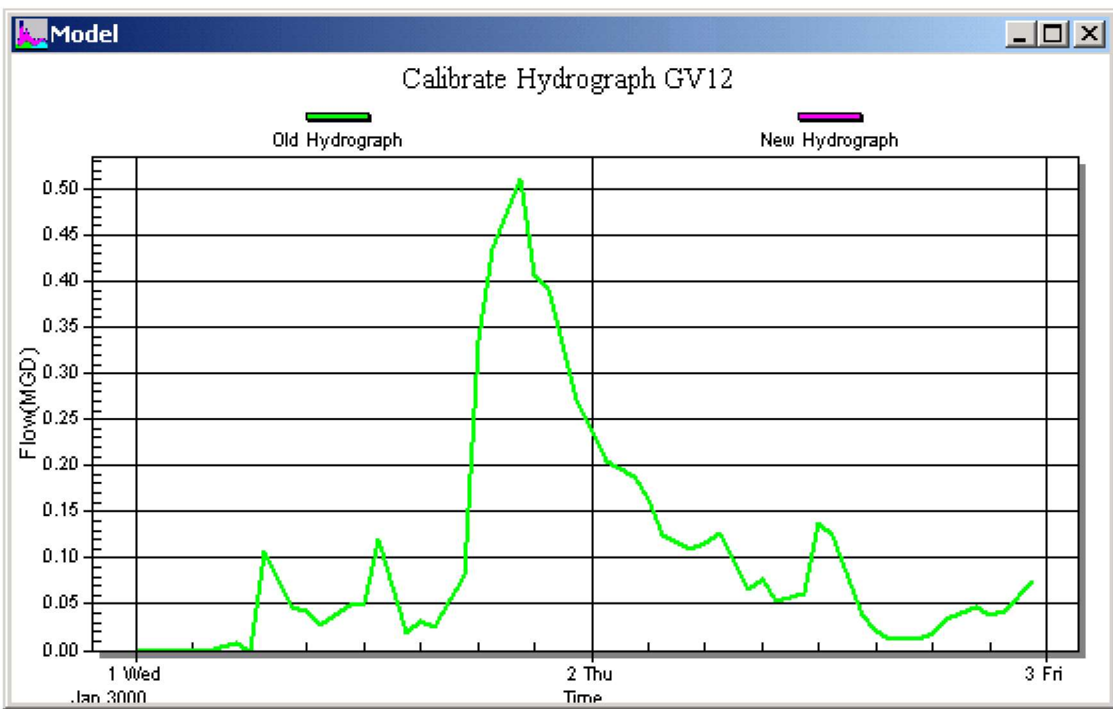
   Sliicer resets the basin volume and/or hydrograph values you selected.

Using Mouse Calibration

In addition to calibrating by entering the numeric values into the Basin and Hydrograph tables, you can also use Mouse Calibration. You use mouse calibration to adjust the shape of the hydrograph visually. For example, you might want to use mouse calibration to inject a slightly steeper hydrograph into your model so that the downstream model attenuated hydrograph will match your monitor flows.

➔ **To use mouse calibration**

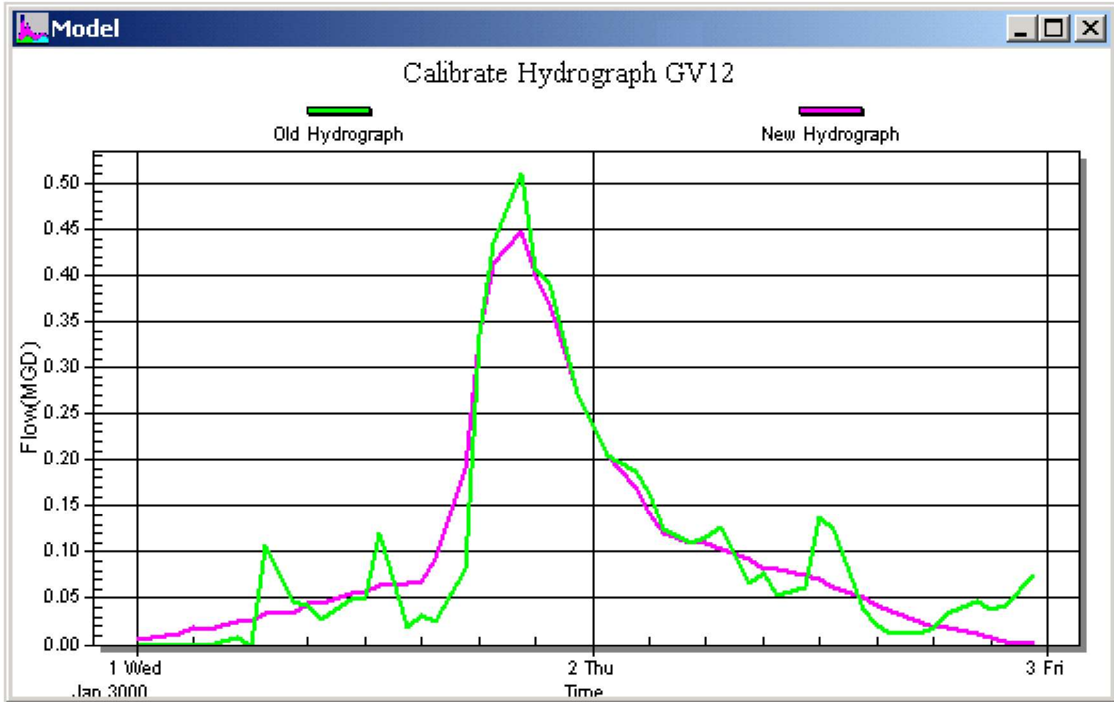
1. Open the calibrate window on the flow file you want to calibrate.
2. In the Basins table, select the basin you want to calibrate.



   Sliicer displays a graph of the hydrograph for the basin you selected in the Model window.

3. In the Calibrate window, check the 

check box.
4. In the Model window, click the mouse where you want the new values of the hydrograph to be.



Sliicer displays the new hydrograph as well as the old hydrograph in the model window, and updates the values in the Hydrograph table, color coding the changed values blue for increases and red for decreases.

Implementing Fixed Volume Calibration

Many times when you change the shape of the hydrograph, you will want to preserve the original volume. This is easy to accomplish with the Sliicer calibration system. First you change the hydrograph to the shape you want. Then you set the volume you want for the basin. Sliicer adjusts all the steps in the hydrograph proportionally, preserving the relative shape of your hydrograph while adjusting the values of each step to conform to the volume you specified.

➔ **To implement fixed volume calibration**

1. Open the Calibrate window on the flow file you want to calibrate.
2. Edit the hydrograph shape using the Hydrograph table, or mouse calibration.
3. If you want to preserve the original volume, select the a cell in the basin table for the basin you are calibrating, and click the Reset button

   -OR-

   Enter the volume you want into the New column for the basin you are calibrating.
4. Press the Enter key on the keyboard.

   -OR-

   Change rows in the Basin table.

   Sliicer fits the volume you entered under the hydrograph shape, and adjusts the value of each hydrograph step proportionally.

Saving a Calibrated Flow File

Once you have calibrated you flow file, you must save it before you can export it to load your model. When you save a calibrated flow file, Sliicer adds it to the flow file manager just like the original flow files you created from the Engineering Wizard Model tab. Once you have saved your calibrated flow file, you can export it to your model or re-calibrate it just like the flow files you created from the Model tab.

➔ **To save a calibrated flow file**

1. Open the flow file you want to calibrate and make the calibration changes.
2. In the Calibrate window, click the Save button.

Sliicer displays the Save As dialog.

3. Enter the name for the calibrated flow file.
4. Click the OK button.

Sliicer saves the calibrated flow file to a new name and displays the new flow file in the Flow File Manager window.

Note Sliicer adds a comment to the new calibrated flow file description indicating its source. You should add additional comments to the calibrated flow file's description to help you remember why you made the calibration changes.

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