Baseline Characterization of Little Bear Creek near Brightwater Treatment Plant Site

Phase I - 2004

Objectives

- Phase I - Characterize Little Bear Creek Existing Stream Conditions prior to construction and future operations of the Brightwater Treatment Plant

- *Phase II (in Planning) – Broaden Analytes to include Metals, Organics, Hydrocarbons, and nutrients*.

Monitoring Design

- 1-year* duration (12/2003 – 12/2004)
- 10 Storms, 6 Base Flows
- 8* samples per storm, 4-hrs increments
- 3* samples per base, 8-hrs increments
- Parameters: Alkalinity, Total Dissolved Solids, Turbidity, and Total Suspended Solids

Monitoring Design

- Establish Upstream Boundary Conditions
- Establish Discharge Conditions from TP Site
- Establish Downstream Conditions after all discharges from TP site have entered the Stream System
- Use Sequenced Synoptic Sampling

Sequenced Synoptic Sampling

- Typical stream flow velocities range between 1 ~ 3 fps
- Estimated Travel-time 20 ~ 40 mins between AD478 and AE478
- Auto-sample Collections sequenced in 5-minute increments (30-min lag between AD478 & AE478

Monitoring Locations

- Started with 8 sampling locations
  1 Upstream / 1 Downstream Boundary
  6 water courses exiting TP site
  2 streams (Howell, “Unnamed”), 4 others
- After 1st Storm event, discontinued AF478

Monitoring Locations

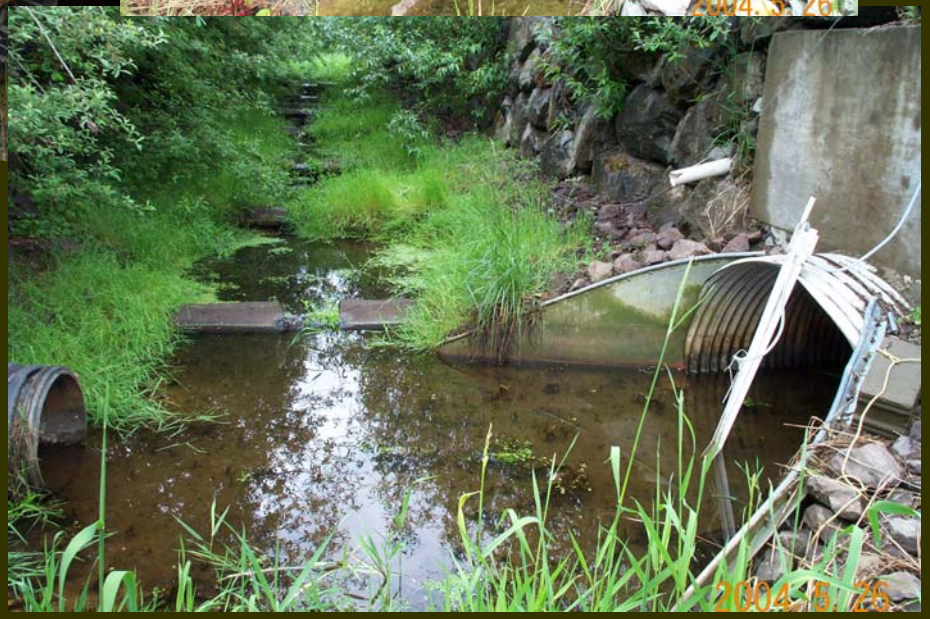
AD478

Salamander at D478B

D478B

AC478

Site AB478



E478B

Site AA478

Equipment Setup

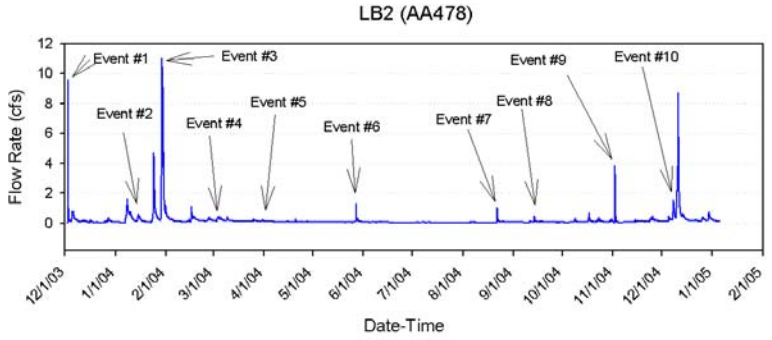
Sample Collection

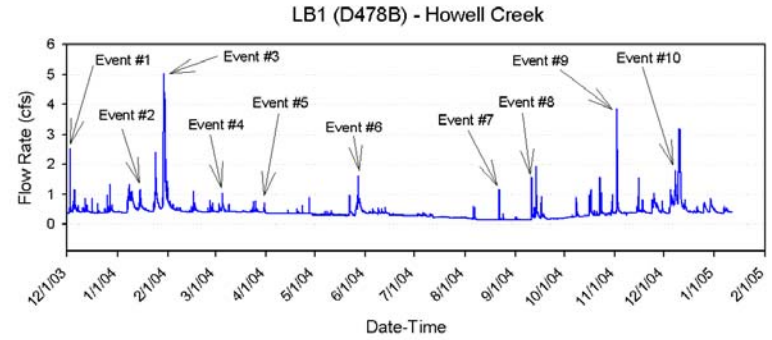
Event Narrations

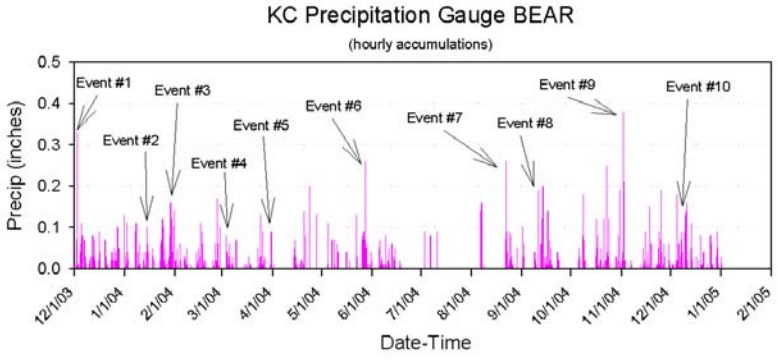
Event Date	24-hr (inches)*	Comment
12/2/03	0.72	
1/14/04	0.62	
1/29/04	1.88	
2/11/04	0.01	Precipitation occurred during sampling of base event.
3/5/04	0.09	.31-inches occurred < 24-hrs after
3/22/04	0.07	Precipitation occurred during sampling of base event.
3/30/04	0.31	
5/6/04	0.00	Base flow event
5/25/04	0.44	1.16 inches feel within 36-hours
7/13/04	0.00	Base flow event
8/22/04	1.34	Sampling started after precipitation occurred.
9/10/04	0.55	
9/28/04	0.00	Base flow event
11/2/04	1.79	
12/4/04	0.63	
12/16/04	0.04	Precipitation occurred during sampling of base event.

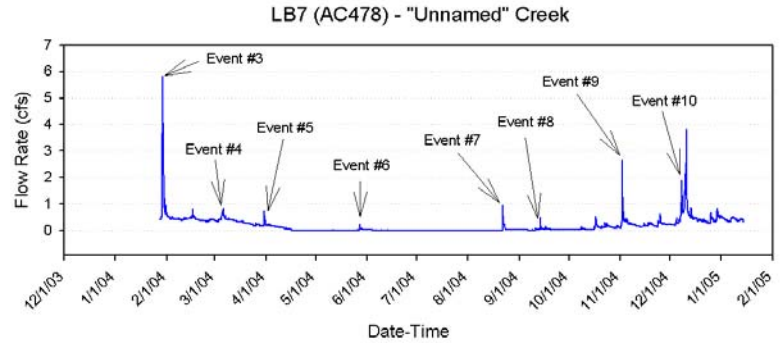
*Totals are approximate given spatial and temporal variability

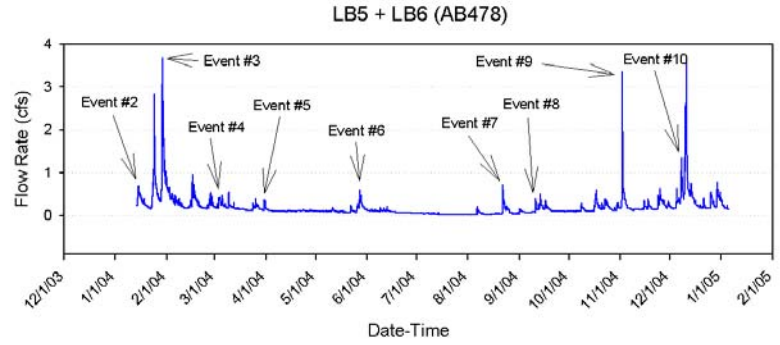
Continuous Flow Observations

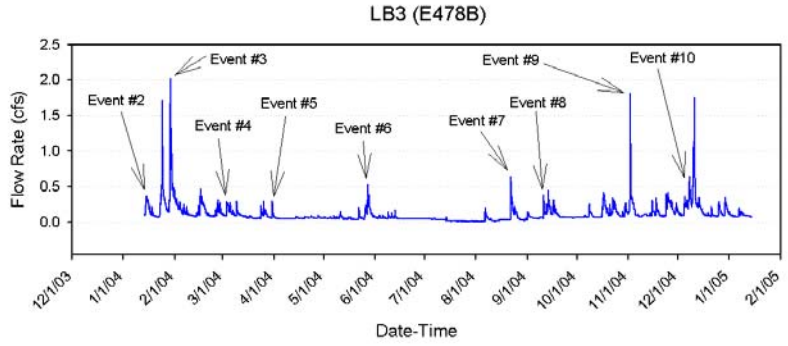


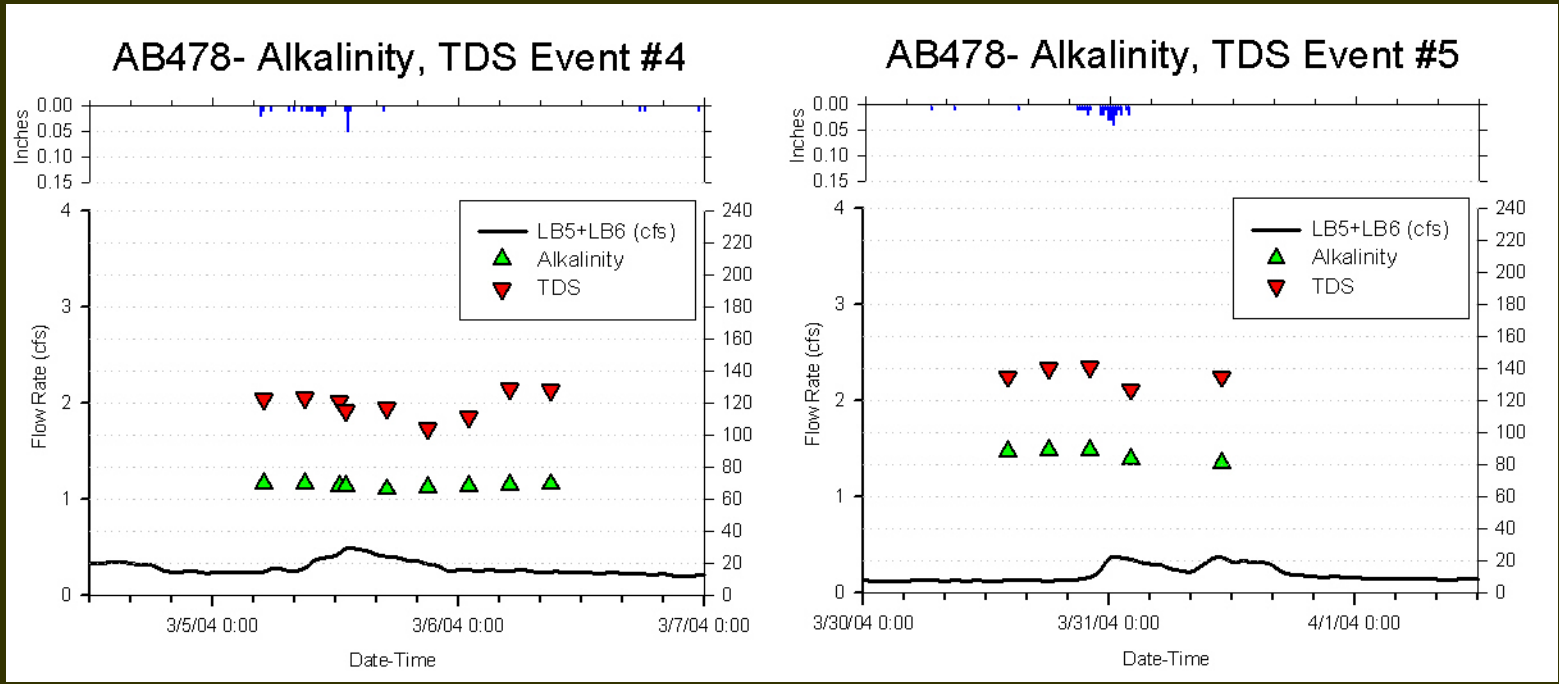




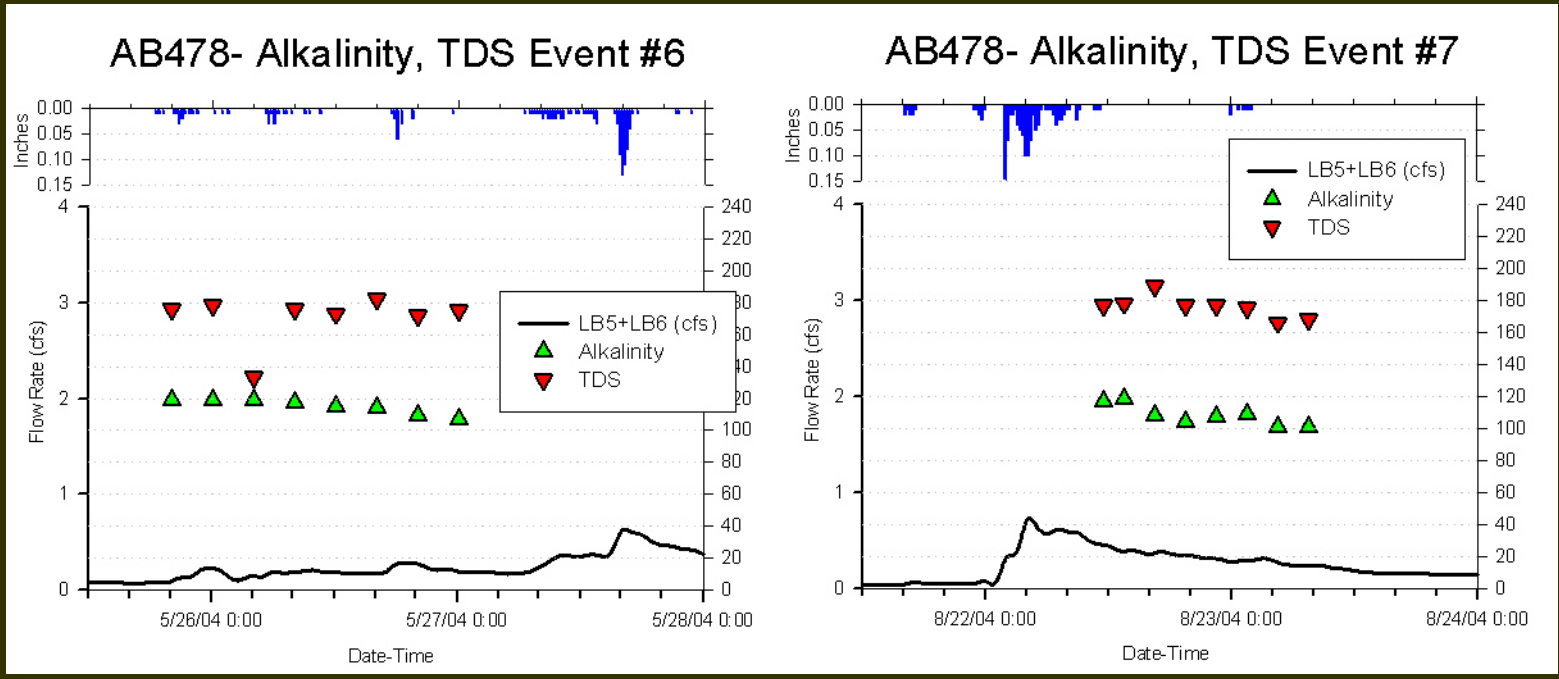




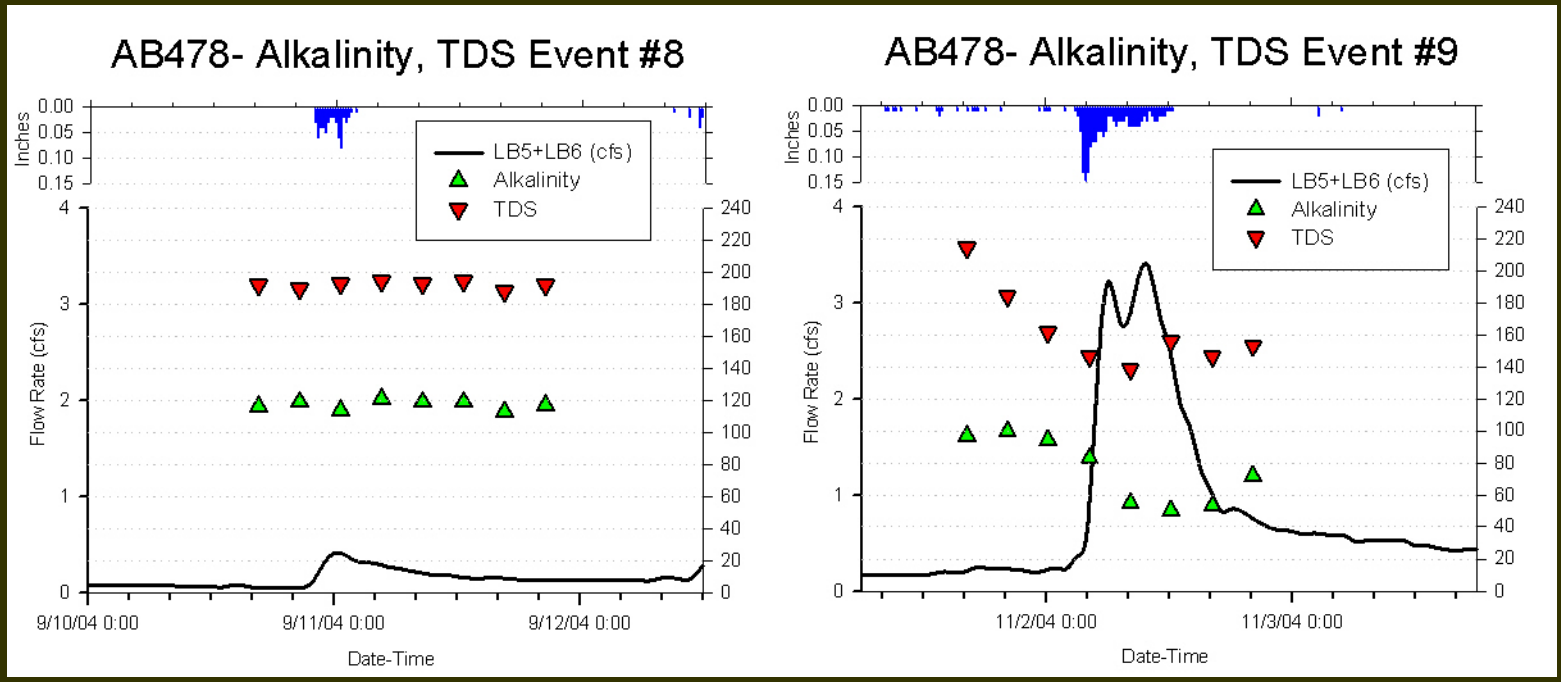



AB478- Alkalinity, TDS Event #4
Inches
0.00
0.05
0.10
0.15
Flow Rate (cfs)
0
1
2
3
4
0
20
40
60
80
100
120
140
160
180
200
220
240
LB5+LB6 (cfs)
Alkalinity
TDS
3/5/04 0:00
3/6/04 0:00
3/7/04 0:00
Date-Time
AB478- Alkalinity, TDS Event #5
Inches
0.00
0.05
0.10
0.15
Flow Rate (cfs)
0
1
2
3
4
0
20
40
60
80
100
120
140
160
180
200
220
240
LB5+LB6 (cfs)
Alkalinity
TDS
3/30/04 0:00
3/31/04 0:00
4/1/04 0:00
Date-Time

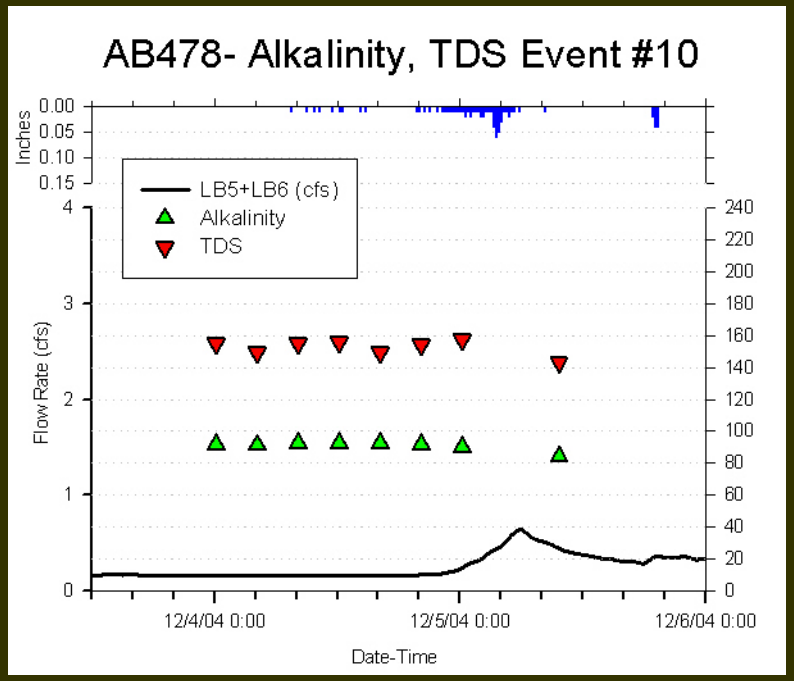
Results


AB478- Alkalinity, TDS Event #6
Inches
0.00
0.05
0.10
0.15
Flow Rate (cfs)
0
1
2
3
4
0
20
40
60
80
100
120
140
160
180
200
220
240
LB5+LB6 (cfs)
Alkalinity
TDS
5/26/04 0:00
5/27/04 0:00
5/28/04 0:00
Date-Time
AB478- Alkalinity, TDS Event #7
Inches
0.00
0.05
0.10
0.15
Flow Rate (cfs)
0
1
2
3
4
0
20
40
60
80
100
120
140
160
180
200
220
240
LB5+LB6 (cfs)
Alkalinity
TDS
8/22/04 0:00
8/23/04 0:00
8/24/04 0:00
Date-Time

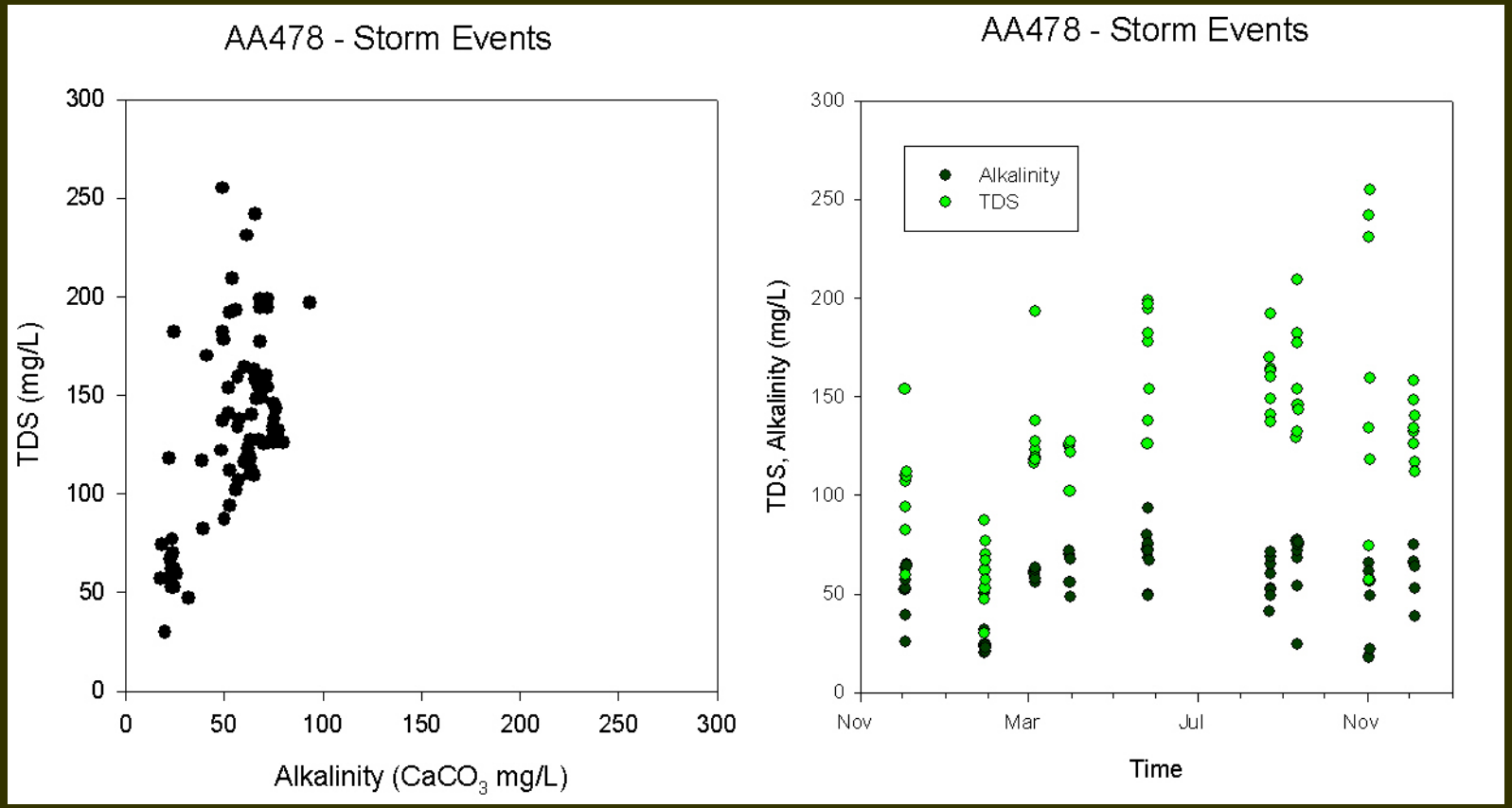
Results


AB478- Alkalinity, TDS Event #8
Inches
0.00
0.05
0.10
0.15
LB5+LB6 (cfs)
Alkalinity
TDS
Flow Rate (cfs)
4
3
2
1
0
240
220
200
180
160
140
120
100
80
60
40
20
0
9/10/04 0:00
9/11/04 0:00
9/12/04 0:00
Date-Time
AB478- Alkalinity, TDS Event #9
Inches
0.00
0.05
0.10
0.15
LB5+LB6 (cfs)
Alkalinity
TDS
Flow Rate (cfs)
4
3
2
1
0
240
220
200
180
160
140
120
100
80
60
40
20
0
11/2/04 0:00
11/3/04 0:00
Date-Time

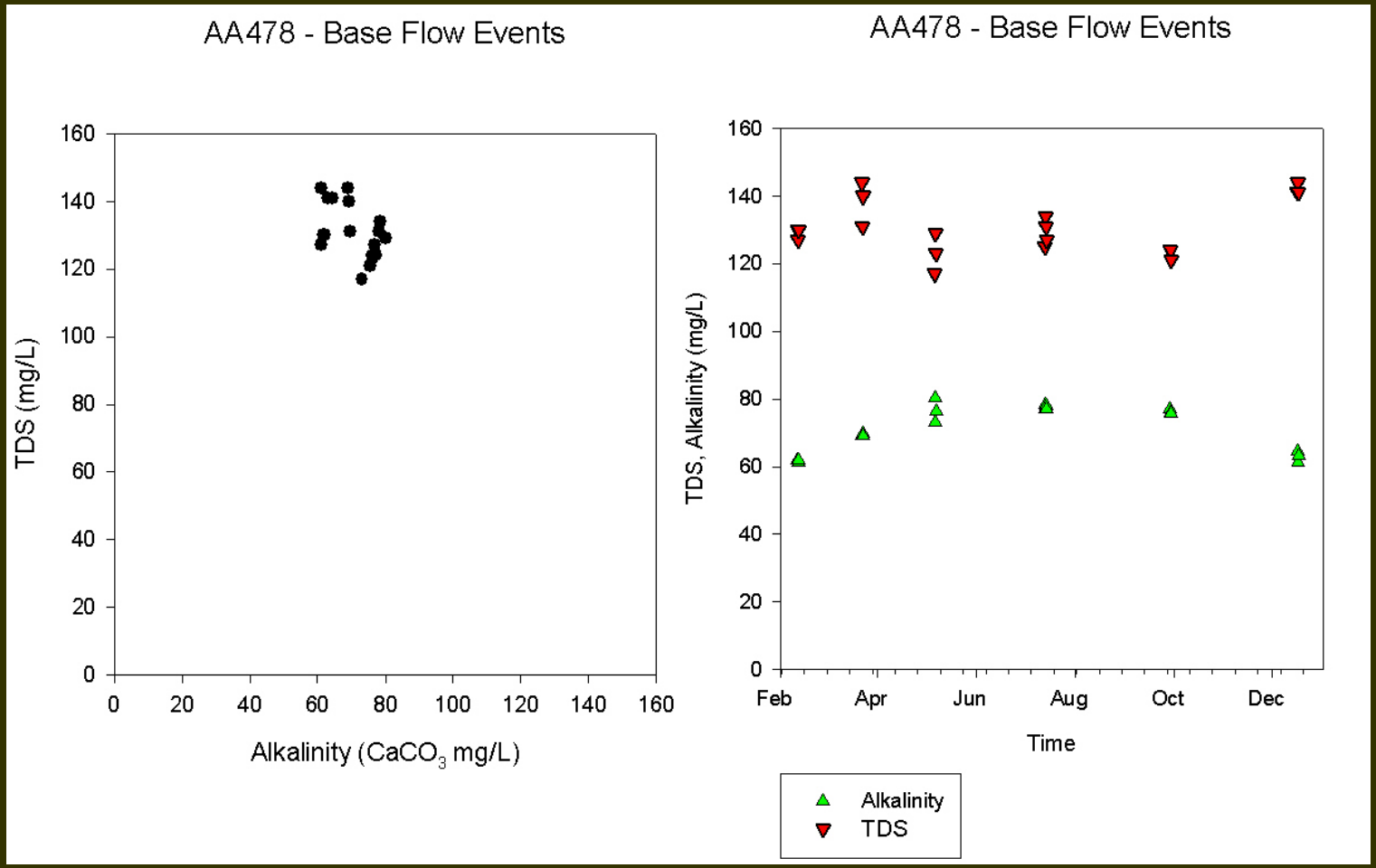
Results


AB478- Alkalinity, TDS Event #10
Inches
0.00
0.05
0.10
0.15
LB5+LB6 (cfs)
Alkalinity
TDS
Flow Rate (cfs)
4
3
2
1
0
240
220
200
180
160
140
120
100
80
60
40
20
0
12/4/04 0:00
12/5/04 0:00
12/6/04 0:00
Date-Time

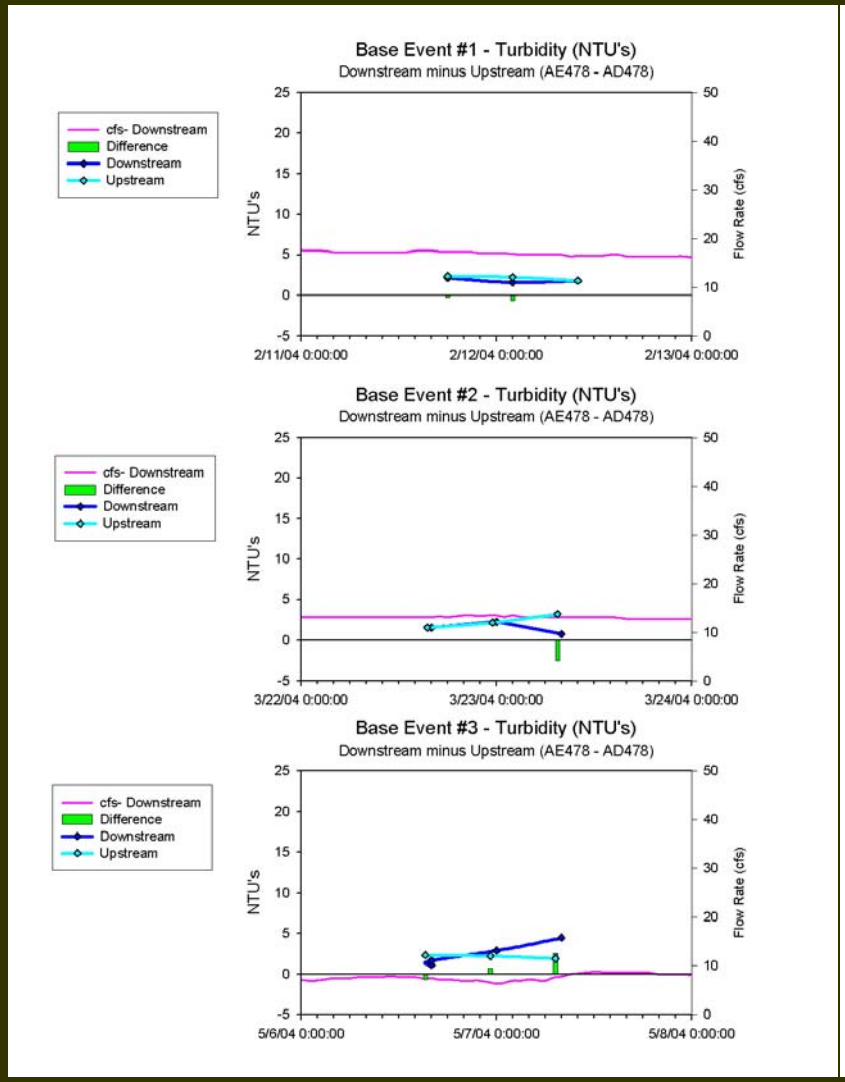
Example: AA478 Storm

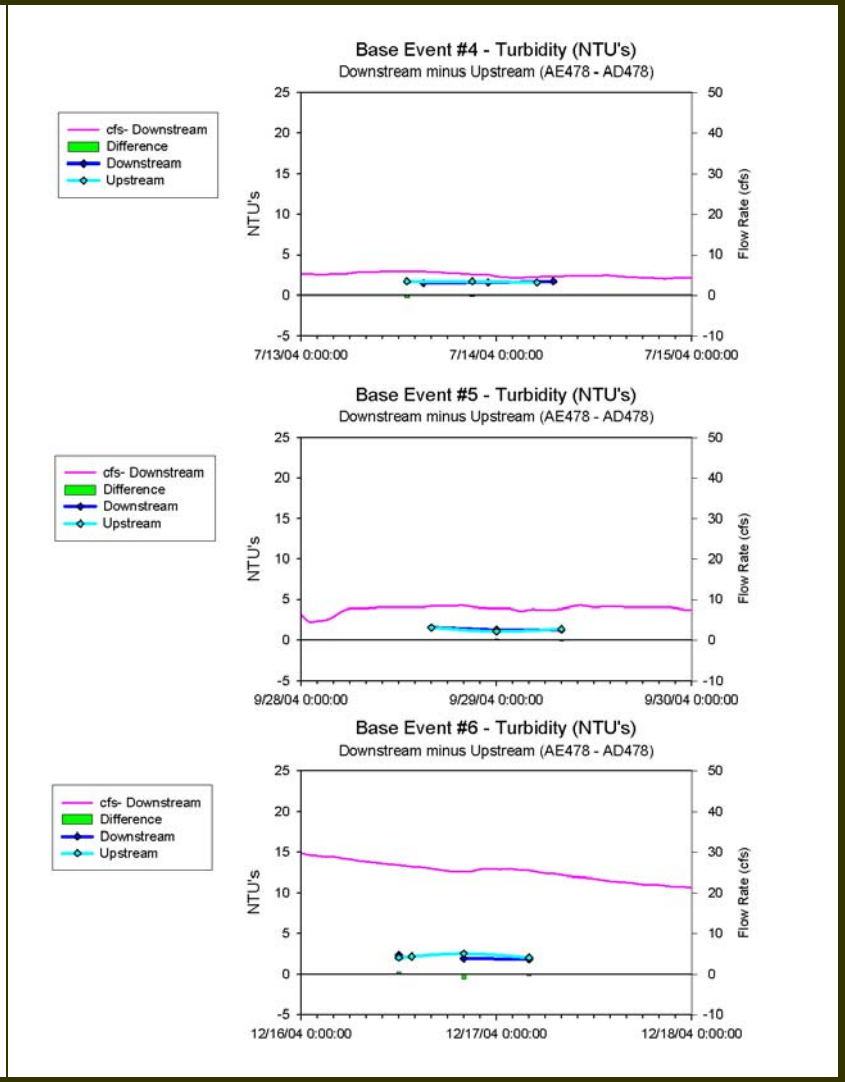


Example: AA478 Base

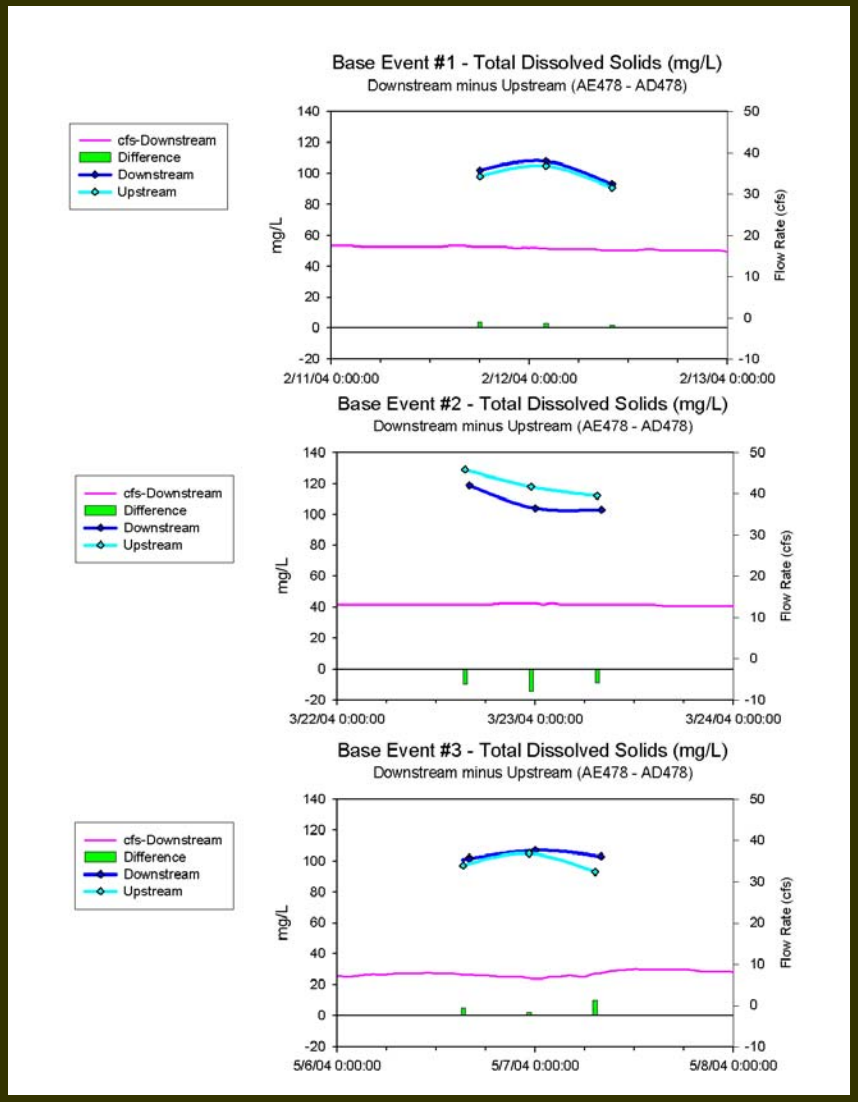


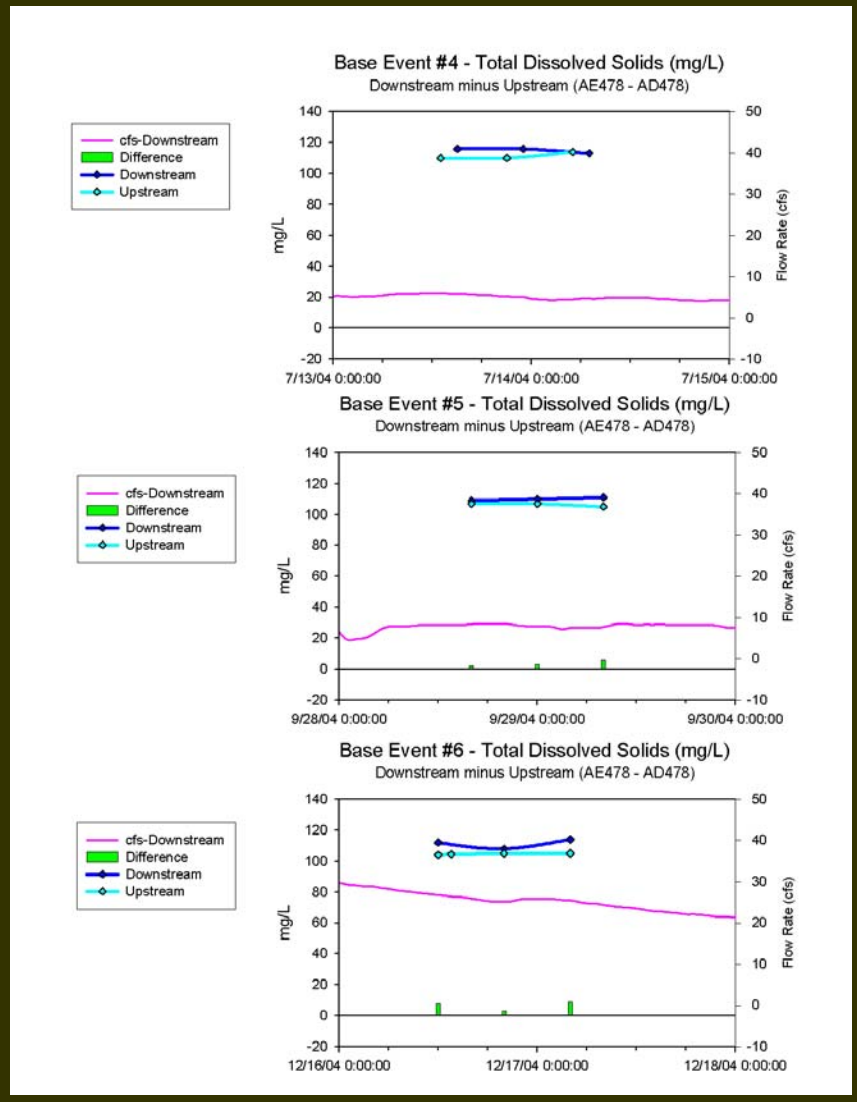
Base Flow Changes in Little Bear Creek (Turbidity)



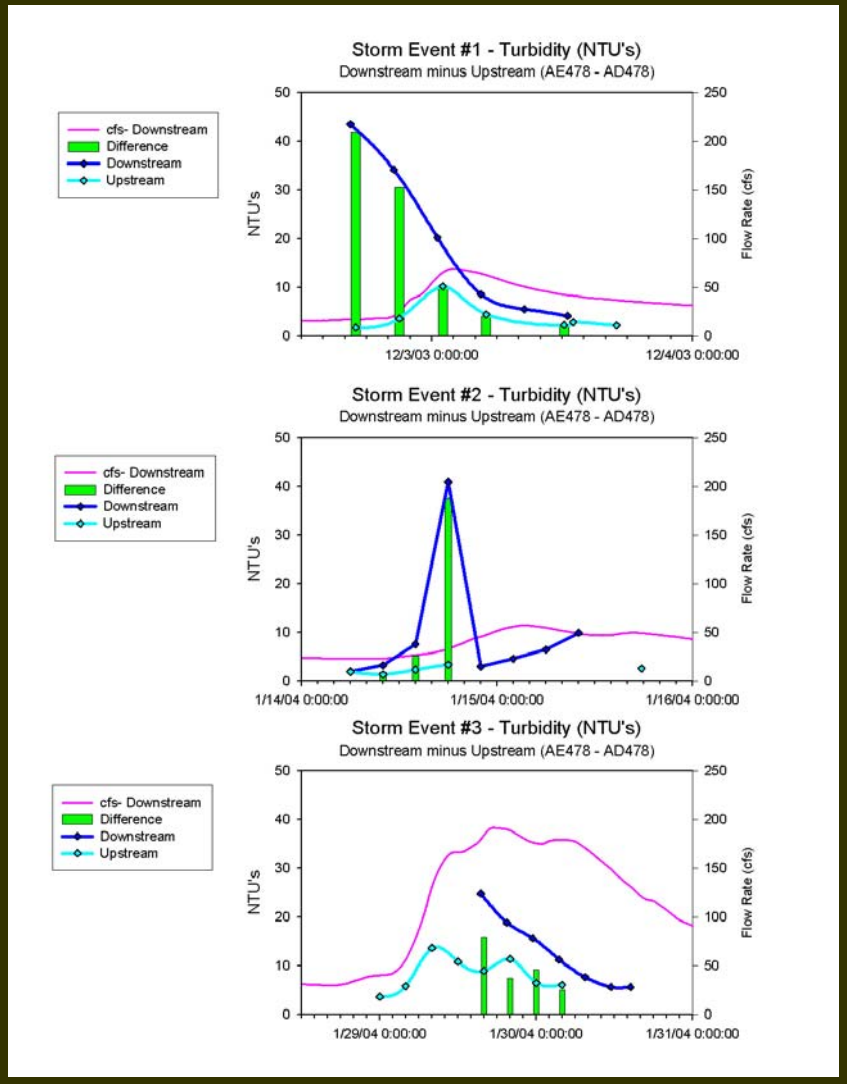


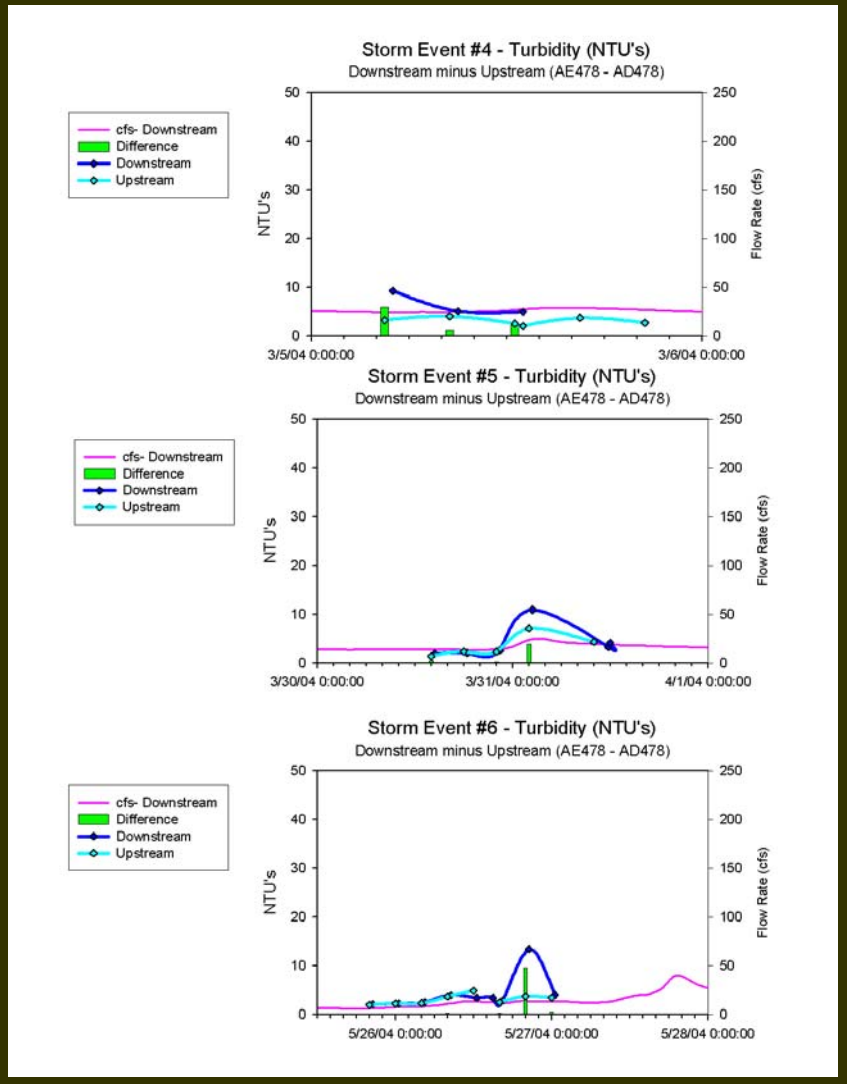
Base Flow Changes in Little Bear Creek (TDS)



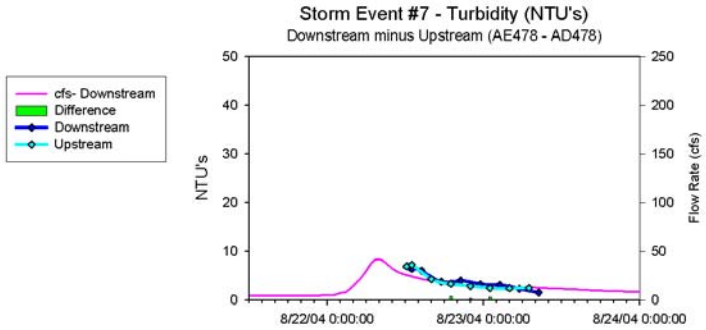


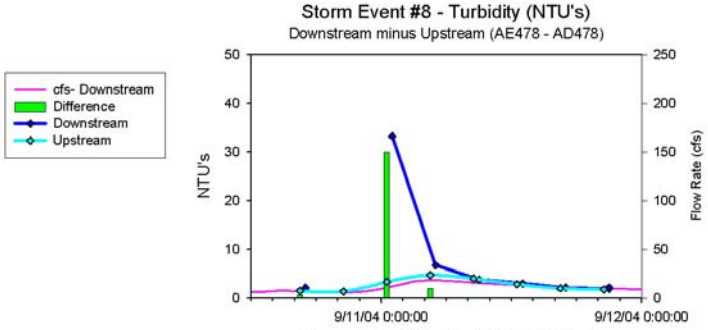
Storm Flow Changes in Little Bear Creek (Turbidity)

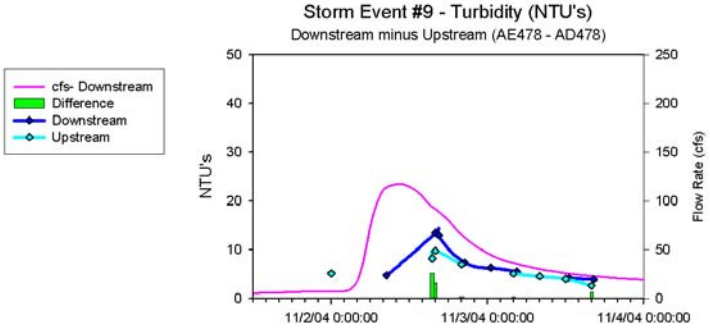


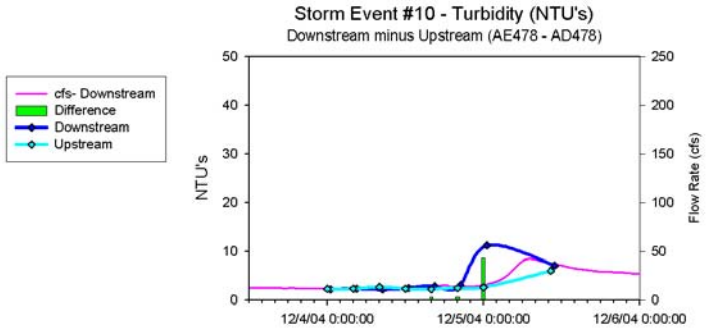


Storm Flow Changes in Little Bear Creek (Turbidity)

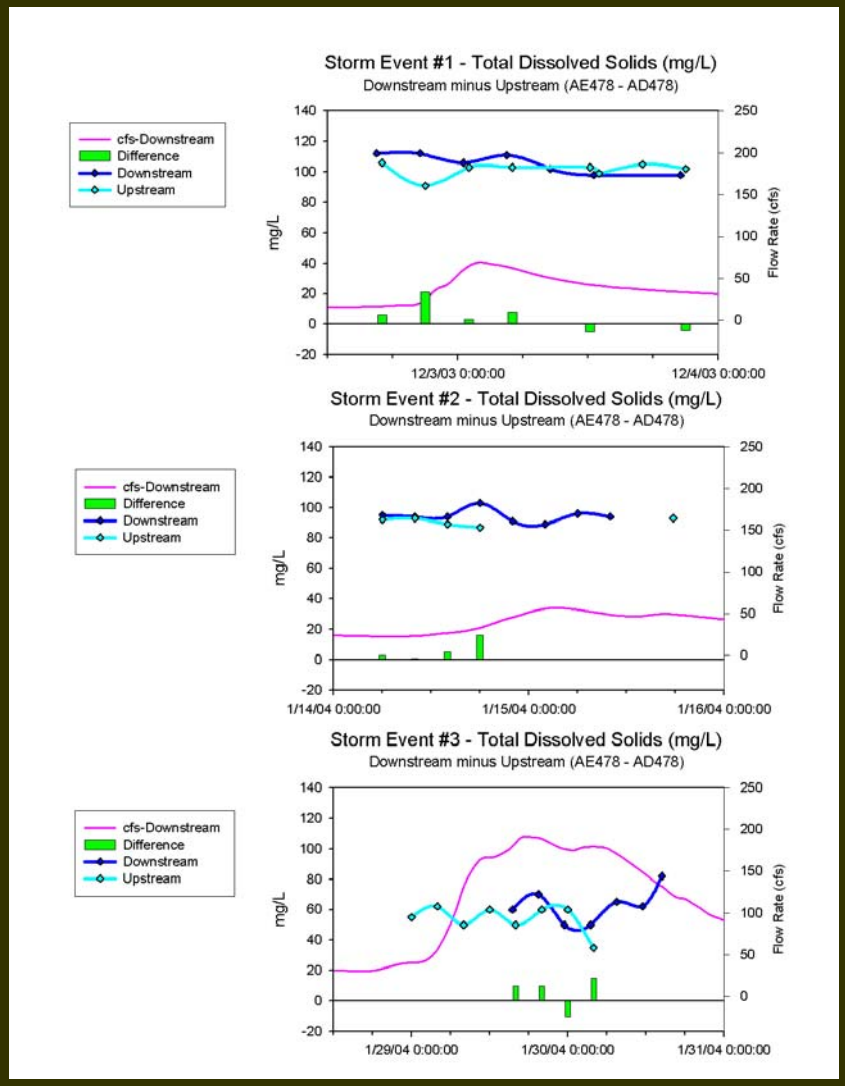


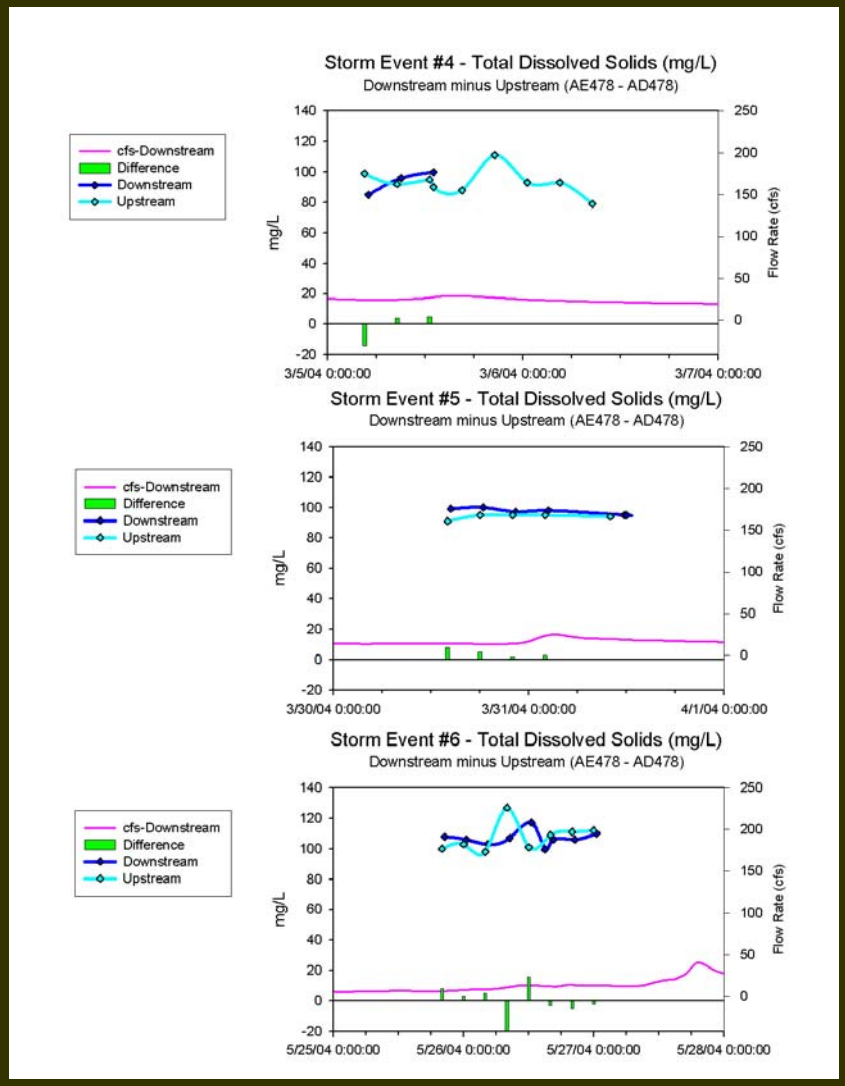




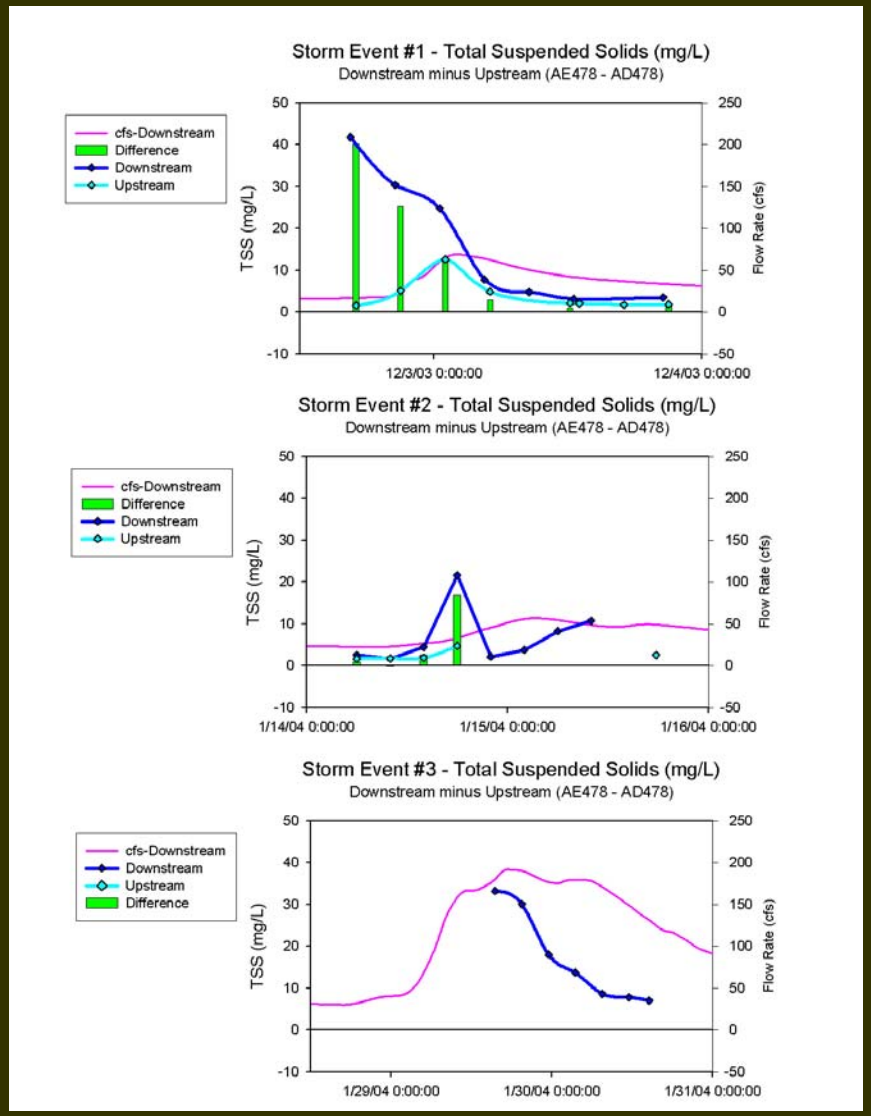


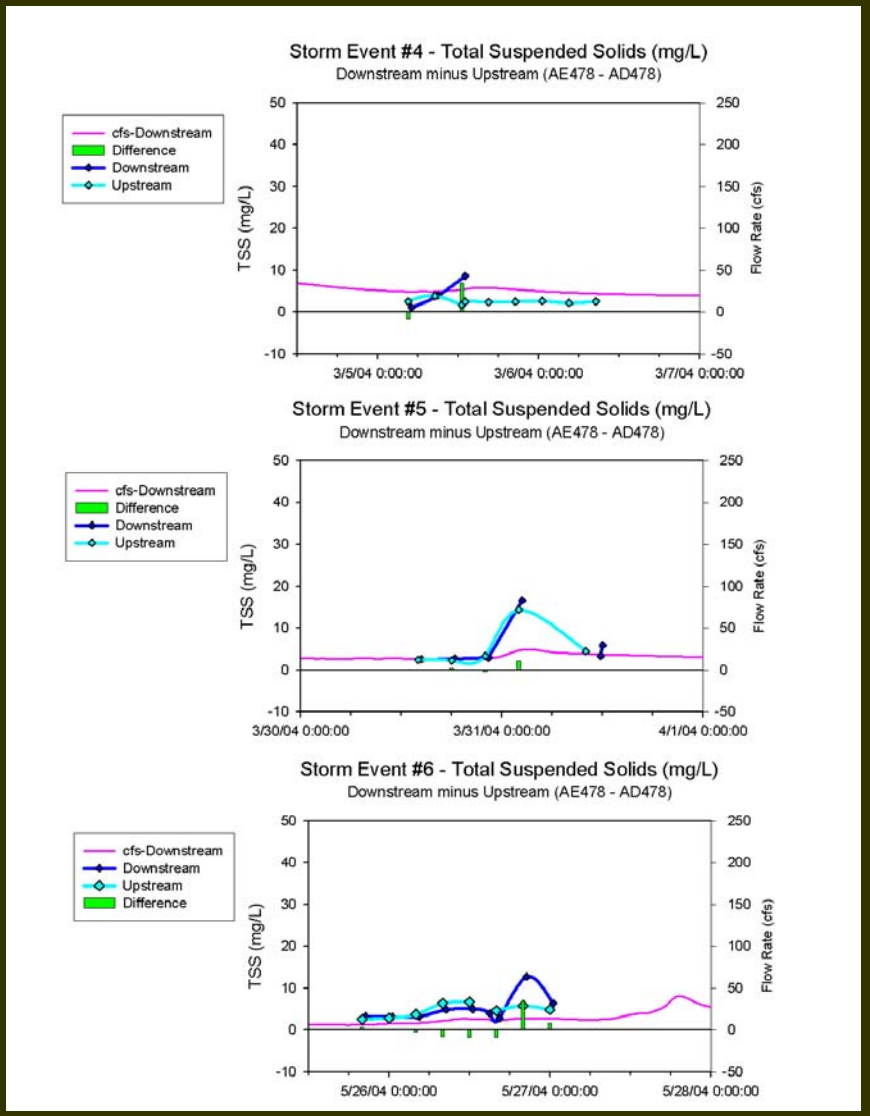
Storm Flow Changes in Little Bear Creek (TDS)



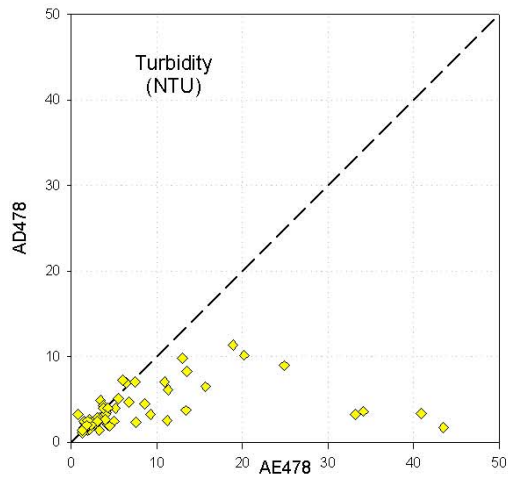


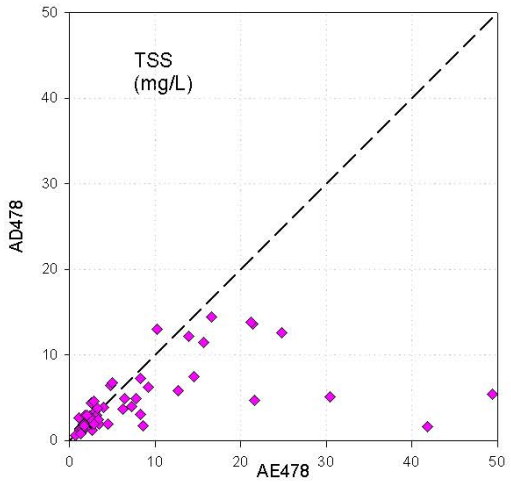
Storm Flow Changes in Little Bear Creek (TSS)

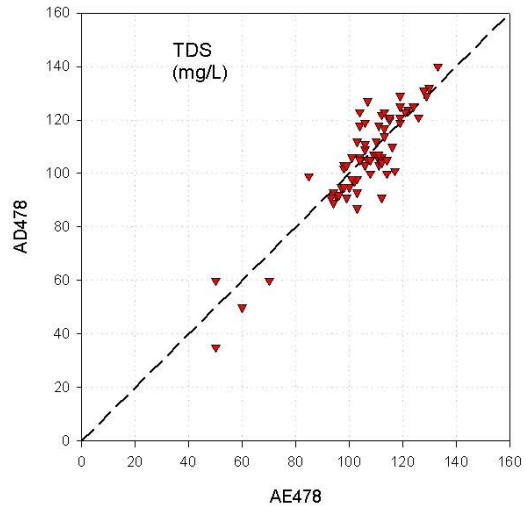


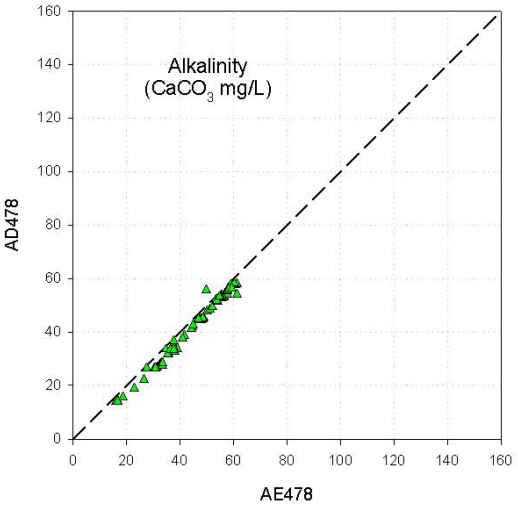


Boundary Conditions

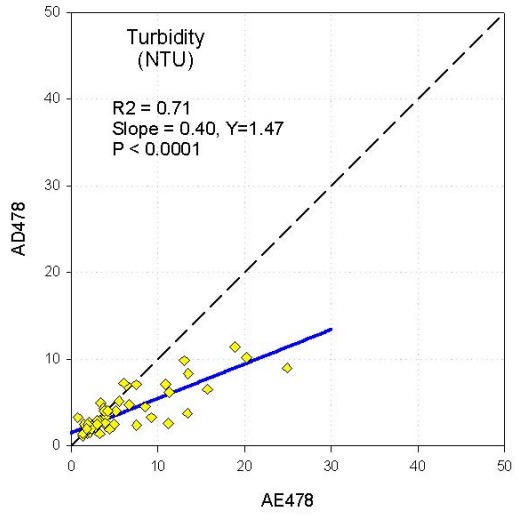


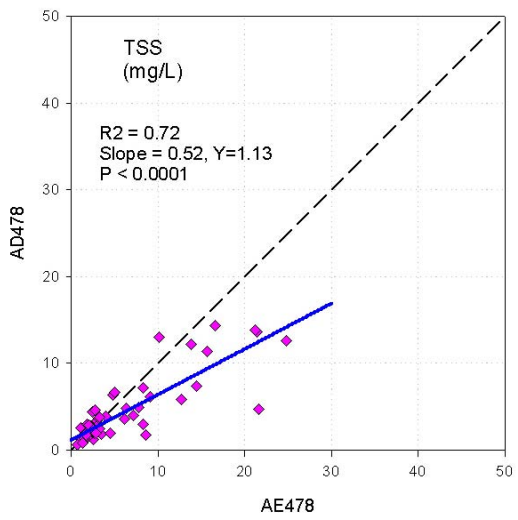


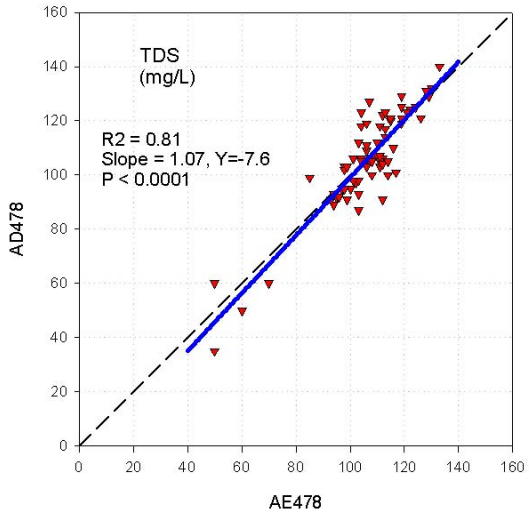


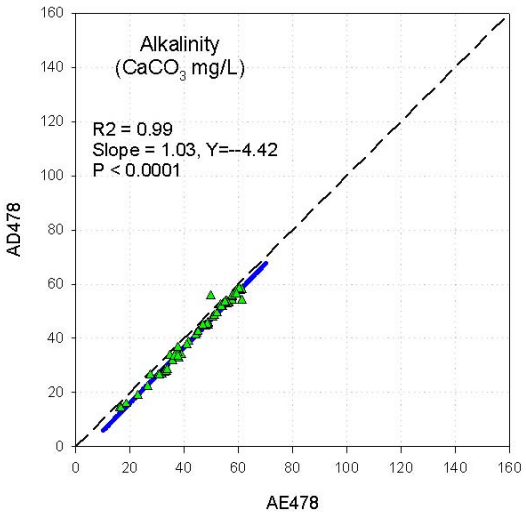


Boundary Conditions









Outliers Removed

Analyses

Storm Flow		Event RPD			
Event #	Event Date	Turbidity	TSS	TDS	Alkalinity
1	12/2/2003	373%	294%	5%	15%
2	1/14/2004	494%	201%	7%	17%
3	1/29/2004	114%	n/a	12%	17%
4	3/5/2004	98%	68%	-2%	13%
5	3/30/2004	32%	10%	5%	7%
6	5/25/2004	39%	10%	0%	4%
7	8/22/2004	n/a	n/a	n/a	n/a
8	9/10/2004	162%	139%	-5%	3%
9	11/2/2004	29%	52%	-6%	19%
10	12/4/2004	56%	28%	1%	7%

Base Flow		Event RPD			
Event #	Event Date	Turbidity	TSS	TDS	Alkalinity
1	2/11/2004	-13%	17%	3%	9%
2	3/22/2004	-34%	0%	-9%	8%
3	5/6/2004	40%	-20%	6%	6%
4	7/13/2004	-4%	-17%	3%	5%
5	9/28/2004	2%	32%	3%	4%
6	12/16/2004	-7%	30%	6%	8%

RPD = Relative Percent Difference

Paired Samples Test

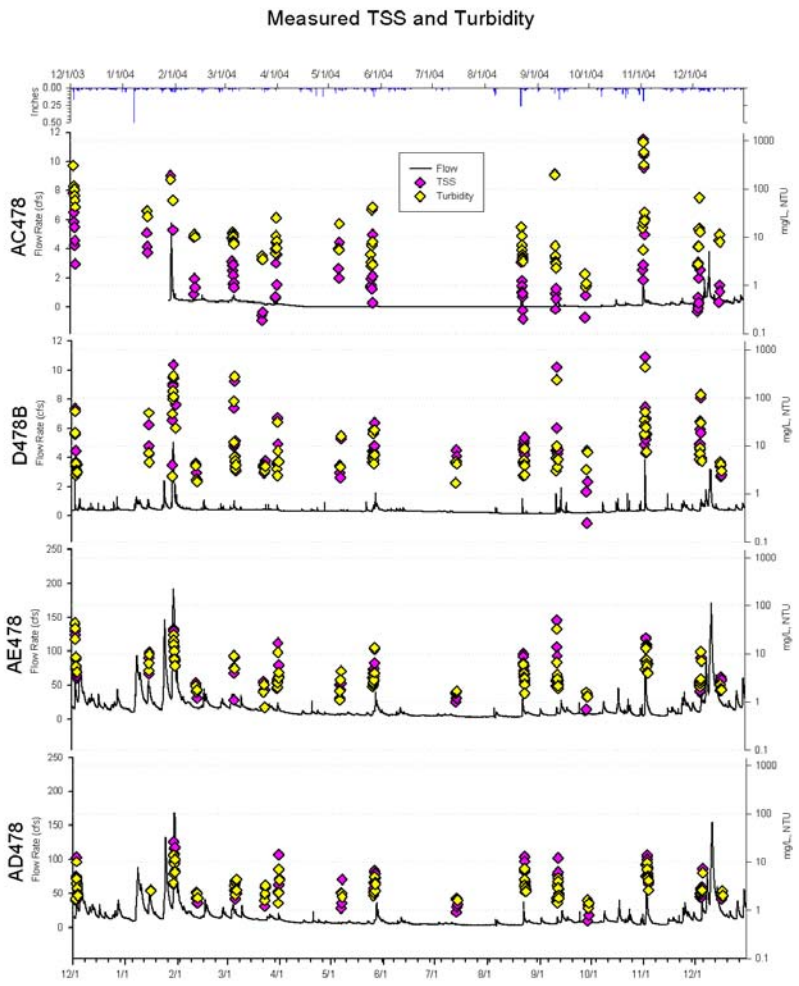
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	NTU_AE - NTU_AD	3.2841	8.25068	.95271	1.3858	5.1824	3.447	74	.001
Pair 2	TSS_AE - TSS_AD	3.1444	8.34803	1.04350	1.0591	5.2297	3.013	63	.004
Pair 3	TDS_AE - TDS_AD	.5135	7.95922	.92524	-1.3305	2.3575	.555	73	.581
Pair 4	ALK_AE - ALK_AD	3.1593	1.54425	.17831	2.8040	3.5146	17.718	74	.000

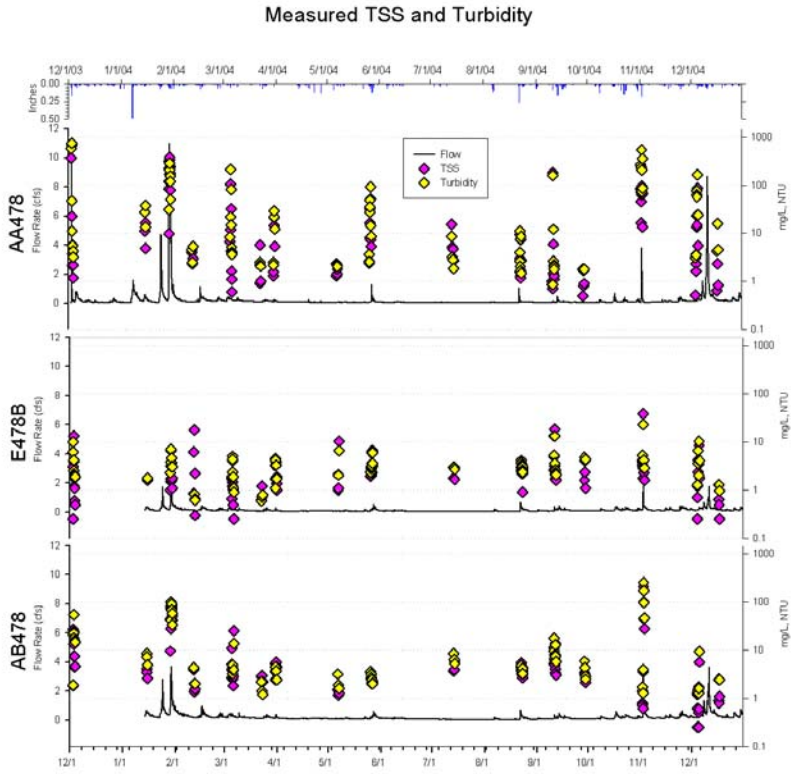
My Unreadable Table

Locator	AA478									
Event Type	Storm					Base				
Parameter	Flow	Alk	Turb	TDS	TSS	Flow	Alk	Turb	TDS	TSS
Count	74	74	74	71	74	19	19	19	19	19
Missing	0	0	0	3	0	0	0	0	0	0
Mean	1.1	55.2	81.0	132.5	61.1	0.1	71.1	3.8	130.7	2.9
Minimum	0.1	17.8	0.9	30.0	0.5	0.1	61.1	1.7	117.0	0.5
Maximum	11.0	93.2	750.0	255.0	672.0	0.2	80.2	15.7	144.0	15.2
Range	11.0	75.4	749.2	225.0	671.5	0.2	19.1	14.0	27.0	14.7
Variance	5.6	324.2	19533.6	2157.3	15962.8	0.0	47.3	11.3	64.3	11.5
CoeffOfVariance	2.1	0.3	1.7	0.4	2.1	0.6	0.1	0.9	0.1	1.2
StdDeviation	2.4	18.0	139.8	46.4	126.3	0.1	6.9	3.4	8.0	3.4
StdError	0.3	2.1	16.2	5.5	14.7	0.0	1.6	0.8	1.8	0.8
GeometricMean	0.3	51.3	19.9	123.3	10.9	0.1	70.8	3.1	130.5	1.9
HarmonicMean	0.2	46.4	5.8	112.2	3.3	0.1	70.4	2.7	130.2	1.4
RMS	2.6	58.0	160.7	140.3	139.6	0.1	71.4	5.0	130.9	4.4
Skewness	2.7	-0.7	2.8	0.2	3.0	1.7	-0.3	2.8	0.4	2.9
SE_Skewness	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5
Kurtosis	6.5	-0.3	9.2	0.2	9.7	1.6	-1.6	9.0	-0.8	10.0
SE_Kurtosis	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0
10_Percentile	0.1	23.6	2.2	67.0	1.2	0.1	61.8	1.8	122.6	0.8
20_Percentile	0.1	40.2	3.2	102.0	1.6	0.1	62.7	2.0	124.0	0.9
30_Percentile	0.1	50.0	4.2	117.0	2.5	0.1	66.3	2.1	125.8	0.9
40_Percentile	0.1	54.5	9.2	125.0	5.3	0.1	69.3	2.2	127.4	1.3
50_Percentile	0.2	58.8	18.5	129.0	7.8	0.1	73.1	2.5	130.0	1.8
60_Percentile	0.3	63.3	34.8	138.0	14.3	0.1	76.0	2.8	130.8	2.3
70_Percentile	0.4	65.9	71.4	153.9	24.1	0.1	76.7	3.8	132.8	2.9
80_Percentile	0.6	70.4	134.0	164.0	80.9	0.1	77.0	4.6	140.4	4.3
90_Percentile	3.1	74.8	224.7	193.0	179.1	0.2	78.2	6.0	141.6	5.3

Timeseries Summary

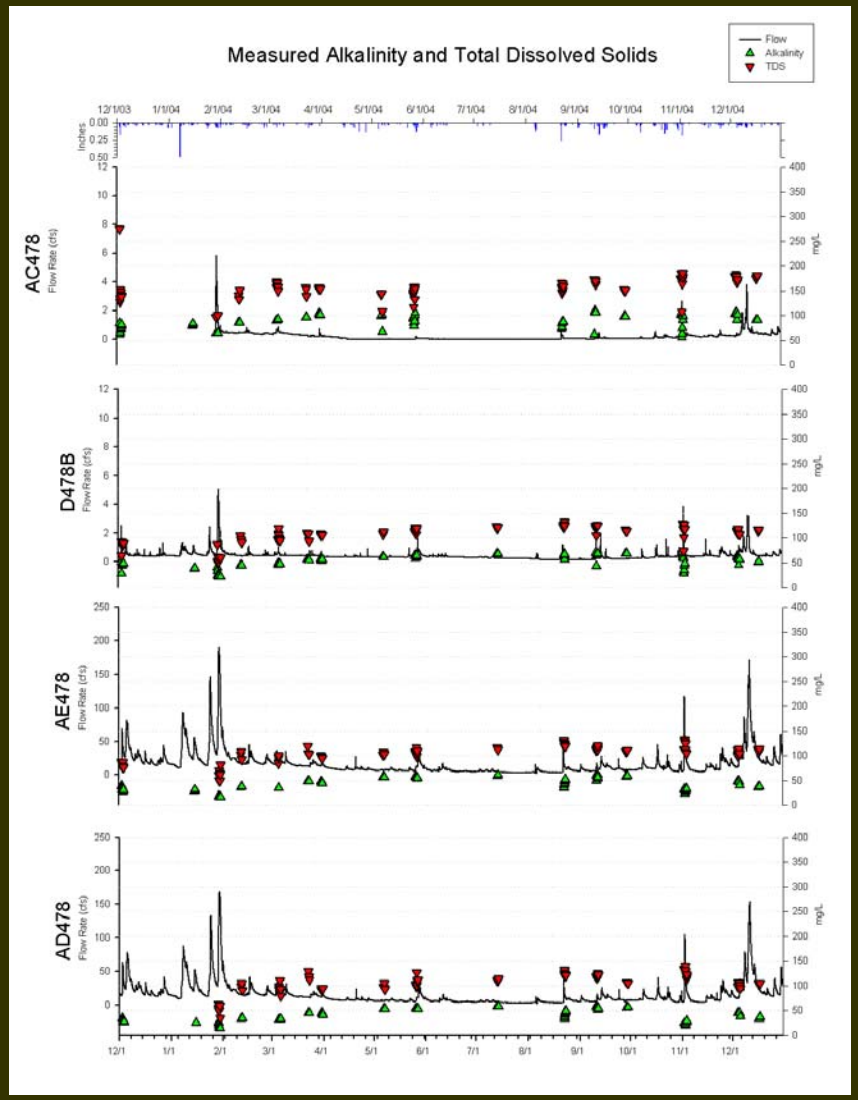
TSS & Turbidity

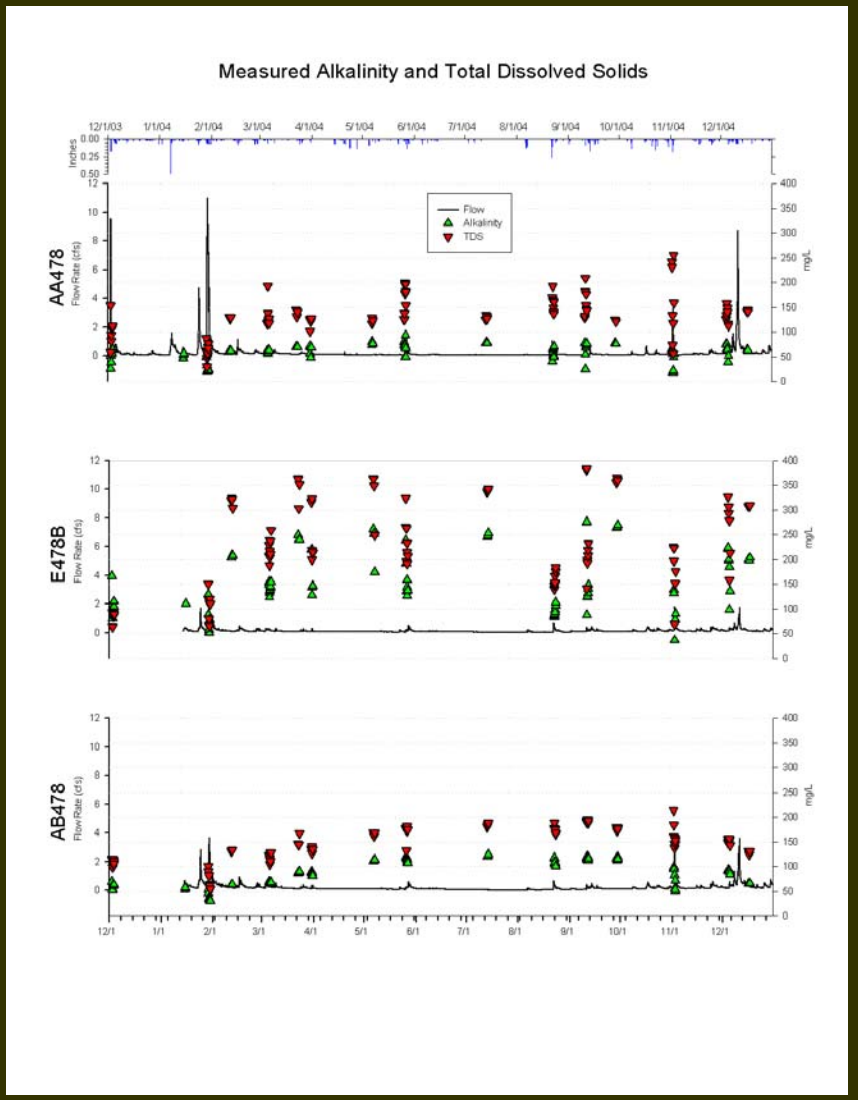




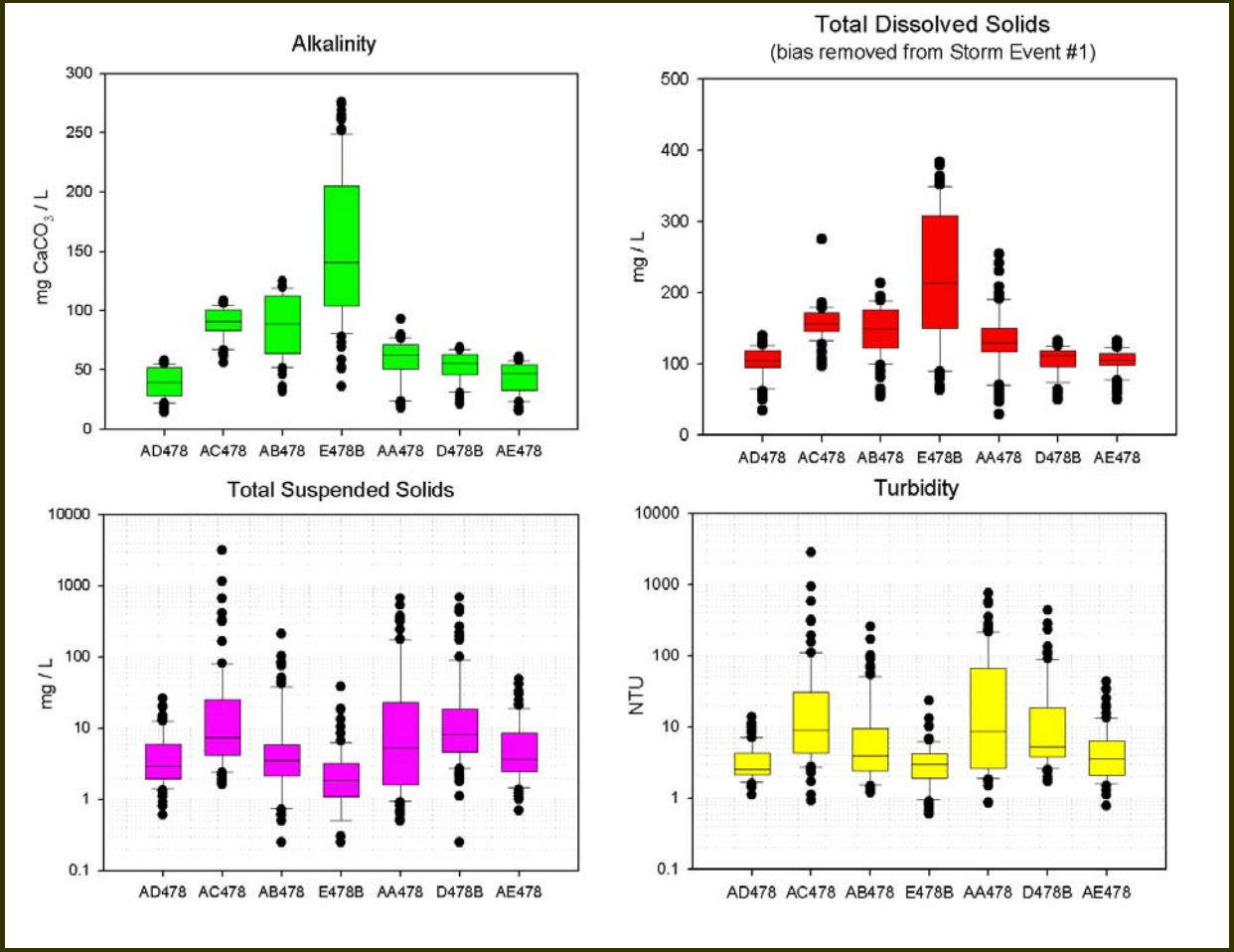
Timeseries Summary

Alkalinity & TDS





All* Data Collected



Other Analyses to be Completed

- Estimate loadings
- Characterize Significance of discharges into Little Bear Creek
- Characterize Relationships between comparable analytes (e.g. TSS-Turbidity, Alkalinity-TDS)

Acknowledgements

- WTD (Brightwater TP) – Funding, Procuring easements (11-yrs)
- KCEL – Equipment Preparation, Analyses, Significant Contributor to SAP
- WLR (Science) – Oversight, Installation and Operation of Auto-Samplers and Flow Monitoring