LOXAHATCHEE RIVER WATER QUALITY EVENT SAMPLING

TASK 2: FINAL REPORT

In Partial Fulfillment of PC P601800

For the Period

October 2005 through September 2006

Respectfully Submitted by

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Introduction

Since 1971 the Loxahatchee River District (LRD) has been fulfilling its mission to preserve and protect the Loxahatchee River through an innovative wastewater treatment and reuse program and an active research and monitoring program within the Loxahatchee River. For more than 15 years, the Loxahatchee River District has carefully documented water quality in the Loxahatchee River through a bi-monthly (i.e., every other month) water quality sampling program termed Project RiverKeeper. More recently, efforts to develop a water quality model for the Loxahatchee River have resulted in the need to better understand short-term nutrient dynamics in the system. In particular, it has been suggested that nutrient dynamics and nutrient loading in the Loxahatchee River may be strongly affected by runoff derived from rainfall events. Such short-term effects may be missed by the bi-monthly sampling of Project RiverKeeper. Therefore, in addition to the bi-monthly water quality monitoring program (i.e., RiverKeeper) the Loxahatchee River District partnered with the South Florida Water Management District to conduct high-frequency water quality sampling in response to rainfall events in the Loxahatchee River watershed. This event-based project was designed to determine the effect of rainfall events and associated increased discharge on various water quality parameters by conducting high-frequency (every 4 hours) short duration (3–5 days) water quality monitoring. The project was conducted in Cypress Creek, one of the major tributaries flowing into the wild and scenic (i.e., freshwater) portion of the Loxahatchee River.

The purpose of this report is to summarize the results from the water quality event sampling conducted during the period September 2005 – September 2006. Rainfall and discharge data are summarized. Physical and chemical water quality data are compared to the bi-monthly RiverKeeper data (Figure 3). Water quality event sampling data are then used to explore potential relationships between various water quality parameters and surface water discharge rates (Appendix A). Finally, water quality event sampling data are used to understand the temporal effect of rainfall on various water quality parameters (Appendix B). All raw data used to generate this report are provided in electronic format (MS Excel) in an associated CD.

Figure 1. Loxahatchee River District's water quality event sampling station #105 is located in the Cypress Creek basin west of Interstate 95. Water flowing past this site discharges into the wild and scenic Loxahatchee River just downstream of Trapper Nelson's historic site.

Study Area

The Loxahatchee River estuary encompasses approximately 400 ha and drains a watershed of approximately 700 km^2 located in northeastern Palm Beach County and southeastern Martin County, Florida, USA. Freshwater discharges into the estuary from the North Fork, the Northwest Fork, and the Southwest Fork of the Loxahatchee River. The hydrology of the basin has been substantially altered by flood control efforts since the 1950s. Historically (pre-1950), most surface water runoff reaching the estuary originated in the Loxahatchee and Hungryland Sloughs and flowed gradually to the Northwest Fork. In the 1930s the Lainhart Dam, a small fixed-weir dam, was constructed in the Northwest Fork at river mile 14.5 to reduce "over" drainage of upstream reaches of the Northwest Fork during the dry season. In 1958 a major canal (C-18) and flood control structure (S-46) were constructed to divert flows from the Northwest Fork to the Southwest Fork, which increased the intensity and decreased the duration of storm-related discharge to the estuary.

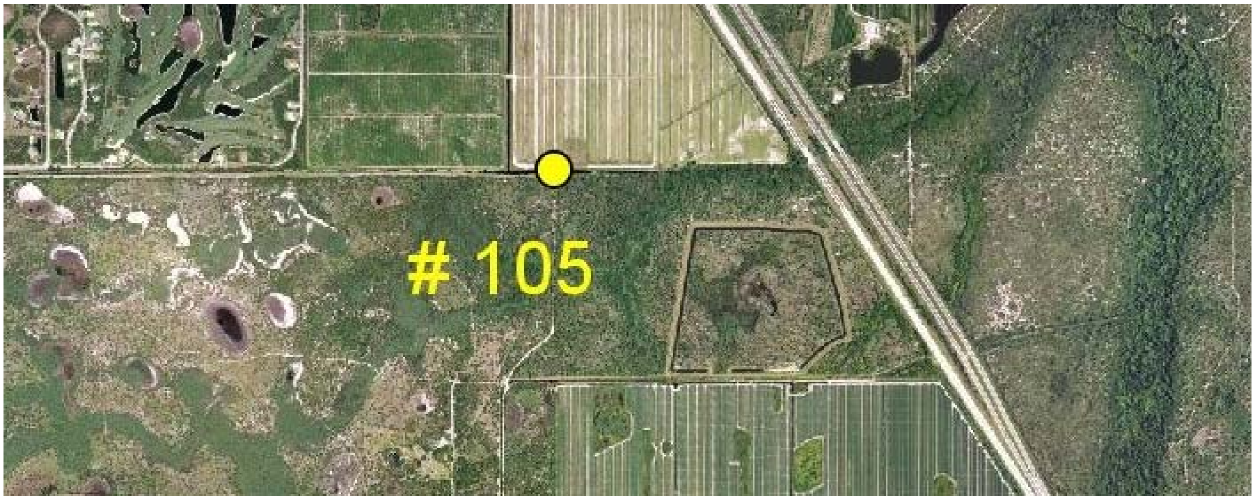


Figure 2. Close up detail showing the location of sampling station #105 with respect to Cypress Creek Canal that drains Pal-Mar, Groves West, and Cypress Creek sub-basins to the west and discharges to the east into Cypress Creek and ultimately into the wild and scenic Loxahatchee River

The Northwest Fork of the Loxahatchee River was the first federally designated wild and scenic river in the state of Florida, and is the southern most wild and scenic river in the nation. Cypress Creek, Kitching Creek, and Moonshine Creek / Hobe Grove Ditch are the three major tributaries that discharge into the wild and scenic reach of the Loxahatchee River. Currently, surface waters from three sub-basins (Cypress Creek, Pal-Mar, and Grove West) are discharged into Cypress Creek Canal, which discharges into Cypress Creek. These sub-basins influence water quality at station #105 (Figure 1), which is the sampling location for the present study. Cypress Creek contributes approximately 26-32% of the surface water discharged to the Northwest Fork of the Loxahatchee River (SFWMD 2006), and as such has the potential to significantly influence water quality in the Loxahatchee River.

Materials and Methods

Water quality was monitored following five rainfall events during the period September 2005 – September 2006. LRD staff collected water quality samples at RiverKeeper monitoring station #105 (Figure 1), which is located in Cypress Creek Canal at 26.971485286 North and -80.188653132 West (coordinates are in decimal degrees using WGS 84 Datum). Sampling events typically were initiated when rainfall exceeded a 0.25” in a one hour period. During the wet season (June – November), these rainfall events resulted in canal discharge exceeding 200 cfs; however, during the dry season (December – May) rainfall events did not result in appreciable increases in canal discharge (see Figure 1). During each sampling event, duplicate samples (i.e., one raw sample and one acidified sample) were collected every four hours using a battery-powered ISCO Avalanche refrigerated auto-sampler. Samples were generally collected for 3–5 days following each rainfall event. The auto-sampler recorded the date and time of each discrete sampling event as well as the temperature of the refrigerated samples. During each sampling event, LRD personnel collected samples and replaced empty sample bottles every 24 hours. Samples were returned to LRD's Wildpine Laboratory for analysis.

Table 1. Characterization of the five rainfall events that triggered water quality event sampling during the period September 2005 through September 2006.

Event Number	1	2	3	4	5
Sampling dates	9/22–26/05	2/4–6/06	4/9–12/06	8/30/06 – 9/2/06	9/19–22/06
Season	wet	dry	dry	wet	wet
Peak discharge (cfs)	324 cfs	39 cfs	57 cfs	309 cfs	227 cfs
Cumulative rainfall during previous month	11.35”	0.42”	0.53”	6.52”	9.99”
Sample initiation rule (rainfall per hour)	0.25” / hr	0.5” / hr	0.25” / hr	0.25” / hr	0.25” / hr
Total Rainfall during event (at sample site)	1.04”	N/A	0.82”	1.8”	0.66”
Total Rainfall during event (at Jupiter Farms)	2.25”	2.85”	1.22”	3.44”	2.16”

In the laboratory, samples were analyzed for turbidity (ntu); total suspended solids (mg/l); color (pcu); orthophosphorus (mg-P/L); total phosphorus (mg-P/L); alkalinity (mg/L); total kjeldahl nitrogen (mg-N/L); ammonia (mg-N/L); nitrate + nitrite (mg-N/L); and total nitrogen (mg-N/L). Furthermore, during each sampling event a HydroTech Data Sonde 3 or Data Sonde 4 was installed near the auto-sampler sample intake and recorded temperature, pH, conductivity, and dissolved oxygen concentration in the surface water. Discharge and stage (water elevation) data were obtained from the USGS station #265818080111900 located in the Cypress Creek canal below Gulfstream Bridge, FL, which corresponds to water quality sampling station #105.

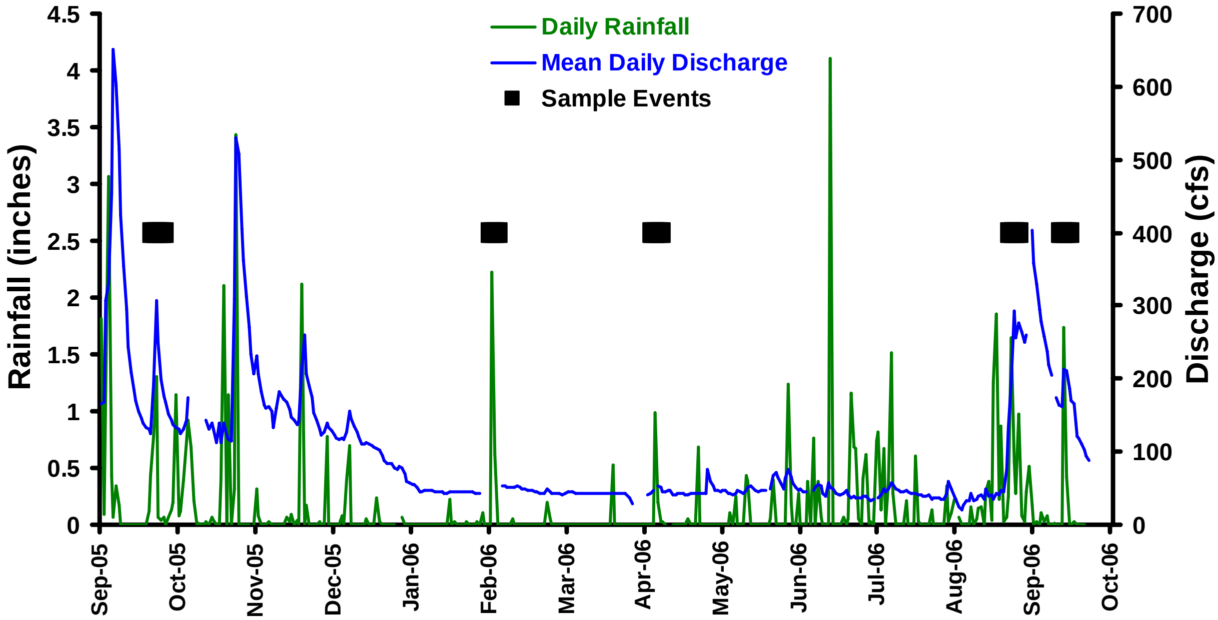


Figure 2. Water quality event samples were collected during and immediately following rainfall events (i.e., storms). Mean daily discharge data are from the USGS station #265818080111900 Cypress Creek canal below Gulfstream Bridge, FL, which corresponds to the water quality sampling station. Rainfall was measured in Jupiter Farms by LRD staff.

Results & Discussion

During the monitoring period (September 2005 – September 2006) 65.28 inches of rain fell in the vicinity of Cypress Creek (i.e., Jupiter Farms rainfall station). The most rainfall observed in any one day occurred in June 2006 when 4.1” of rain fell. Between September 2005 and September 2006 more than 3” of rain fell on 3 days, more than 2” of rain fell on 6 days, and more than 1” of rain fell on 18 days. Freshwater discharge at the water quality sampling station #105 is presented in Figure 3 and summarized by season in Table 2. In particular, it should be noted that median wet season discharge (128 cfs) was nearly three times higher than median dry season discharge (46 cfs). Similarly, 74% of the water discharged through Cypress Creek canal passed during the wet season (28,163 cfs), while only 26% was discharged during the dry season (9,683 cfs). Water quality was monitored during three wet season and two dry season events (Figure 2).

Table 2. Freshwater discharge near station #105 in Cypress Creek canal (USGS station #265818080111900) during the period September 1, 2005 through September 30, 2006.

	Discharge (cfs)			
	Mean	Median	Max	Sum
Dry Season	58	46	155	9,683
Wet Season	139	128	651	28,163

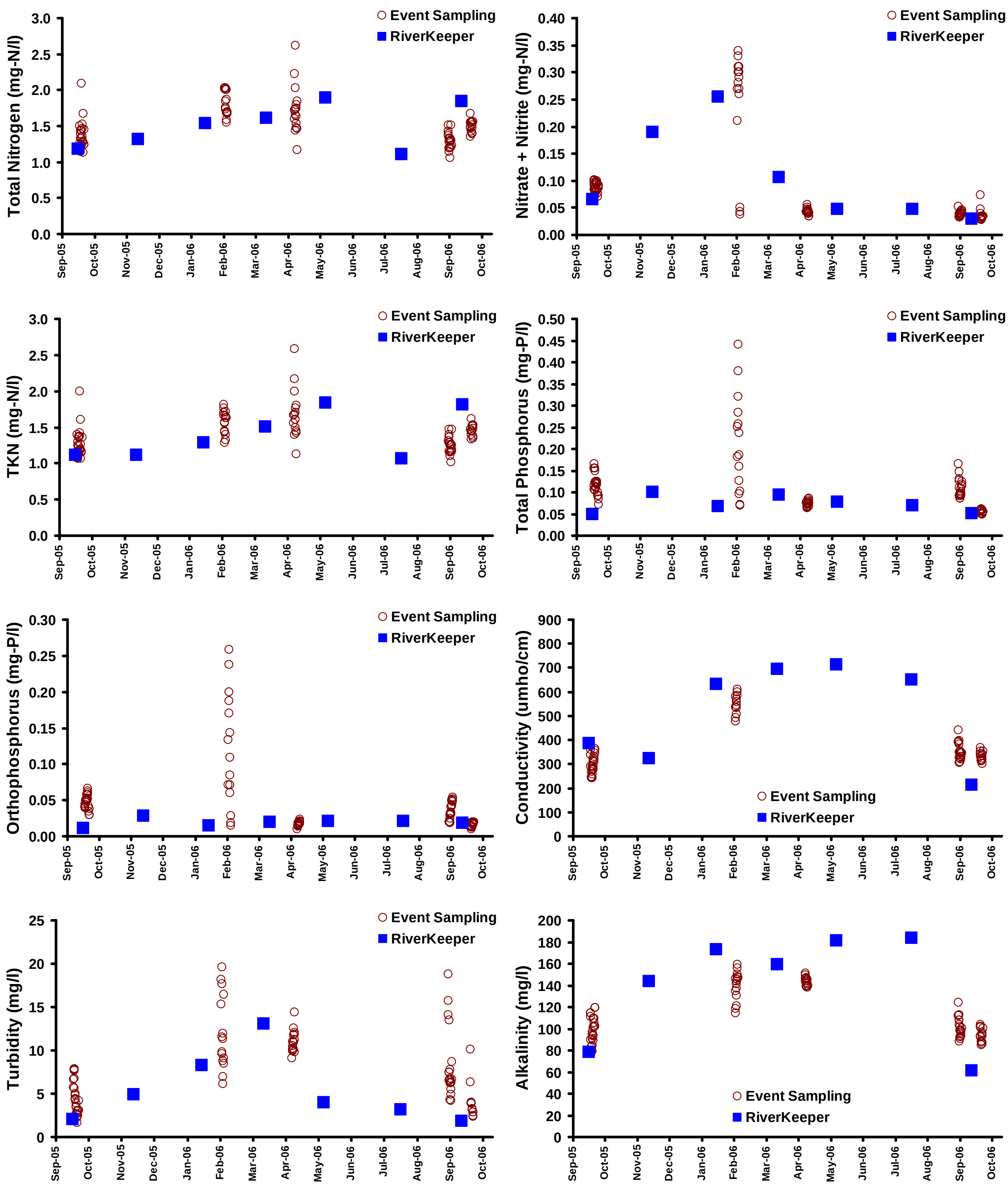


Figure 3. Comparison of Station 105 (Cypress Creek) water quality using samples taken every 4 hours during storm events and bi-monthly samples (RiverKeeper Data). All samples were collected at the exact same location. Bi-monthly samples do not capture the spikes associated with storm events, they appear to provide a reliable picture of average water quality conditions at the site over the year.

Figure 3 shows the gross characterization of water quality in Cypress Creek canal at station #105 using bi-monthly (RiverKeeper) samples, and the fine-scale variability in water quality following discrete rainfall events. First, it should be noted that, as expected, the event-based sampling documented substantial variability in water quality. For example, see the variability in total phosphorus concentrations following the February 2005 rainfall event (Event #2). It appears that rainfall events and the resulting freshwater runoff result in appreciable short-term changes in several physical (e.g., turbidity) and most chemical (total nitrogen) water quality parameters. Nutrient dynamics and nutrient loading in the Loxahatchee River may well be affected by runoff following rainfall events. Though these short-term effects may be missed by the bi-monthly sampling of Project RiverKeeper, it is important to note in Figure 3 that Project RiverKeeper sampling provides a sound understanding of typical water quality conditions at station #105. In fact, there is a surprising degree of concordance between the data collected as part of Project RiverKeeper and the water quality event samples. Therefore, we suggest the Project RiverKeeper be maintained as an excellent approach to characterizing the general water quality conditions within the surface waters of the Loxahatchee River and estuary.

A large and ongoing challenge is the creation of a water quality model that adequately characterizes nutrient inputs and water quality in the Loxahatchee River. In an effort to facilitate the calibration and validation of such a model, we explored potential relationships between each of the monitored water quality parameters and surface water discharge (flow) rates (Appendix A). First, it should be noted that there were meaningful differences in average surface water discharge and water quality conditions between wet and dry seasons. On average, rainfall events during the dry season result in small increases in surface water discharge (see Figure 2), while similar amounts of rain in the wet season result in large increases in discharge. Similarly, there were significant differences in average water quality conditions (e.g., NH_3 concentrations) between the wet and dry seasons (note red and blue horizontal lines in Appendices A and B). Therefore, it may be somewhat inappropriate to generate gross relationships for each water quality parameter as an overall function of discharge. For example, the alkalinity graph in Appendix A shows surface water alkalinity decreases (on average) as flow increases. In fact, the global coefficient of determination (R^2) value for this relationship (for all events combined) is 0.794 (i.e., 79.4% of the variability in alkalinity can be accounted for by changes in flow). However, when we analyze the independent rainfall events (i.e., events 1, 2, 3, 4, and 5) separately, the coefficient of determination varies greatly among events (event 1, R^2=0.887; event 2, R^2=0.059; event 3, R^2=0.187; event 4, R^2=0.001; event 5, R^2=0.179). It appears that increases in discharge resulting from a single, isolated event may be quite variable with respect to the observed increase in surface water discharge as well as the observed change in alkalinity concentration. Similar, event-specific affects were observed for nearly all measured parameters; see especially turbidity, orthophosphorus, and total phosphorus. Second, the degree to which nutrients were transported across the landscape and into surface waters appears to have differed significantly between the wet and dry season. For example, orthophosphorus, total phosphorus, and total nitrogen values observed in post-storm surface water discharge were substantially higher during the dry season than during the wet season.

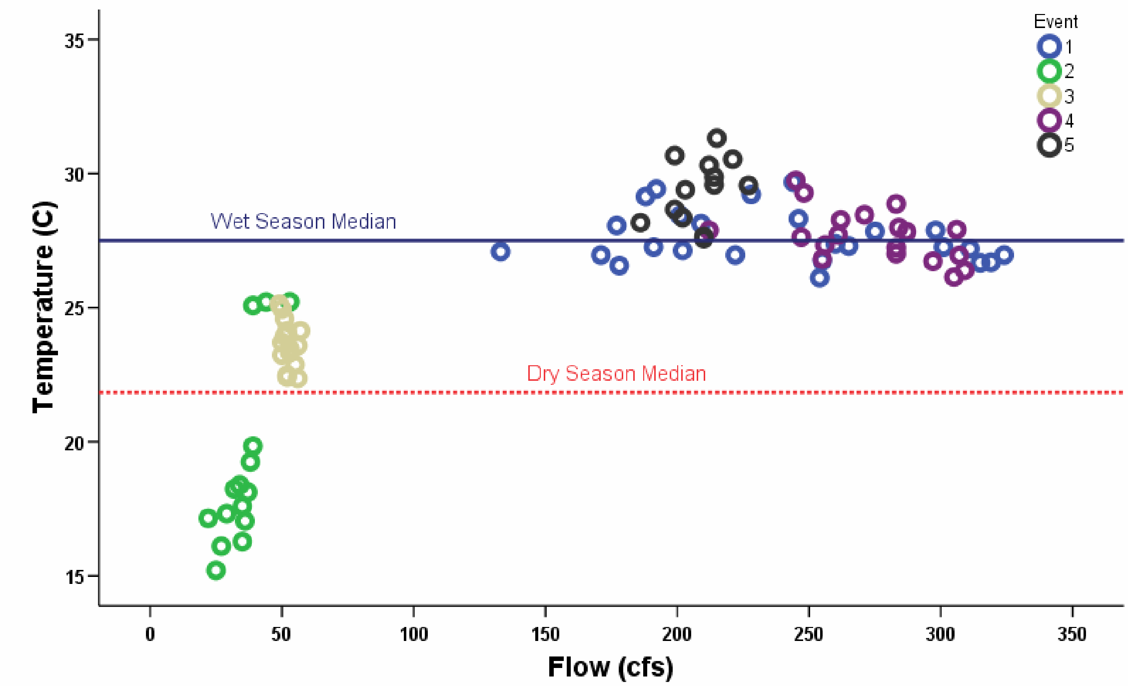
Finally, water quality event sampling data were organized showing the temporal succession in water quality conditions following each event (Appendix B). The data organized in this manner illustrate a number of interesting findings. For example, event #1 in the dissolved oxygen graph clearly shows the 24 hour diurnal cycle of dissolved oxygen increasing through the day (photosynthesis) and decreasing through the night (respiration). More importantly, these graphics clearly illustrate the rapid, short-term increase in orthophosphorus and total phosphorus concentrations following event #2 (the first substantial dry season rainfall event). Also, the nitrate+nitrite graph shows the large and relatively persistent (48 hour) increase in NO_2+NO_3 concentrations following event #2; a similar increase was not observed during any of the other events. Based on the present sampling protocol, we were unable to determine the relative effect of antecedent rainfall events on water quality aspects of surface water runoff; however, it seems that the duration between rainfall events may serve to influence the magnitude of the response by different water quality parameters such as orthophosphorus, total phosphorus, and nitrate+nitrite. Such questions deserve further attention during the development of a water quality model for the Loxahatchee River.

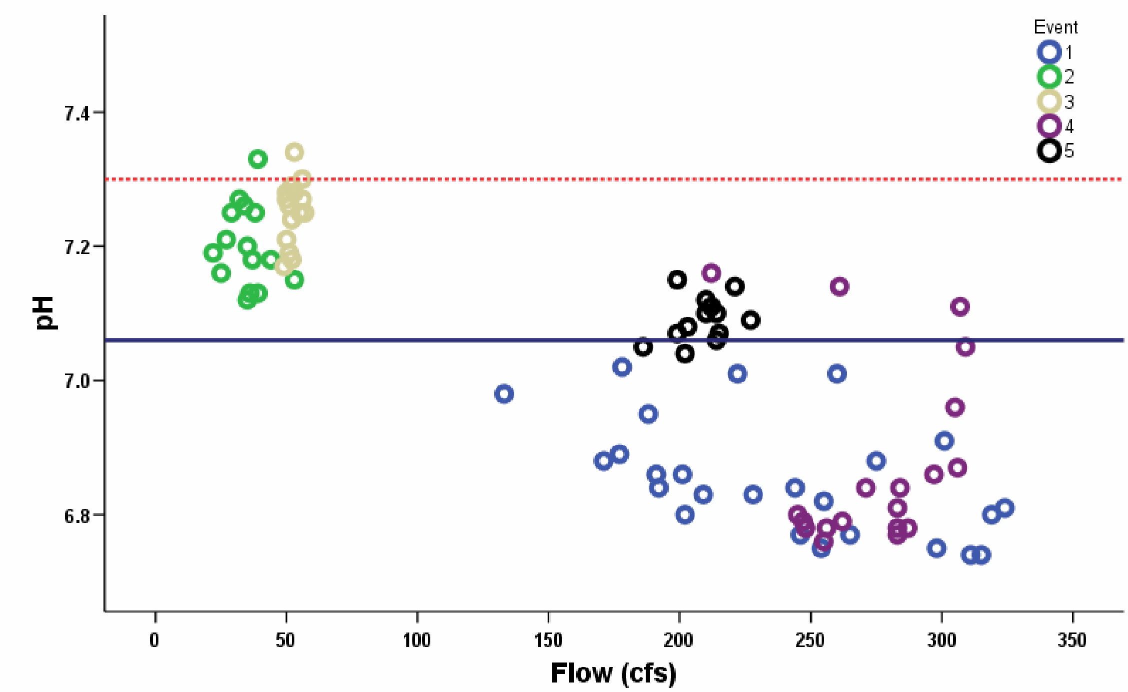
In conclusion, we would like to acknowledge that the effect of each independent rainfall event on measured water quality parameters appeared somewhat unique. The first event monitored (event #1) appeared to present the most textbook-like response. Surface water runoff following the dry season events (events #2 and #3) had the highest observed nutrient concentrations, which suggests antecedent conditions may significantly influence the observed effect of rainfall on surface water quality. In addition, it should be noted that other tributaries drain to the Loxahatchee River, and the water quality in these tributaries should be evaluated following rainfall events. Nonetheless, the presented data also suggest the RiverKeeper water quality monitoring program has been successfully used to characterize typical water quality conditions, and should be continued as a cost-effective approach to document water quality conditions in the Loxahatchee River watershed. We look forward to working with SFWMD personnel to conduct water quality monitoring that furthers our understanding of short-term nutrient dynamics in the Loxahatchee River watershed, and to offer such data for the creation, calibration, and validation of a water quality model for the Loxahatchee River.

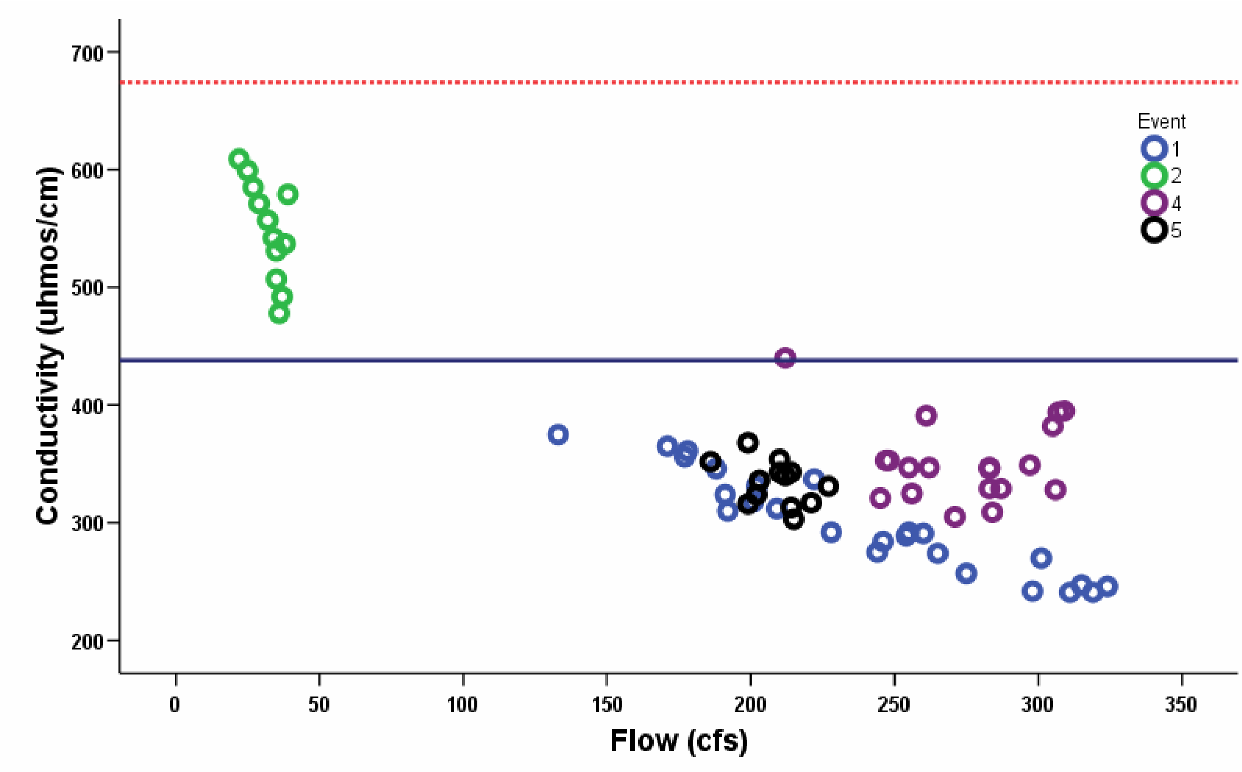
Literature Cited

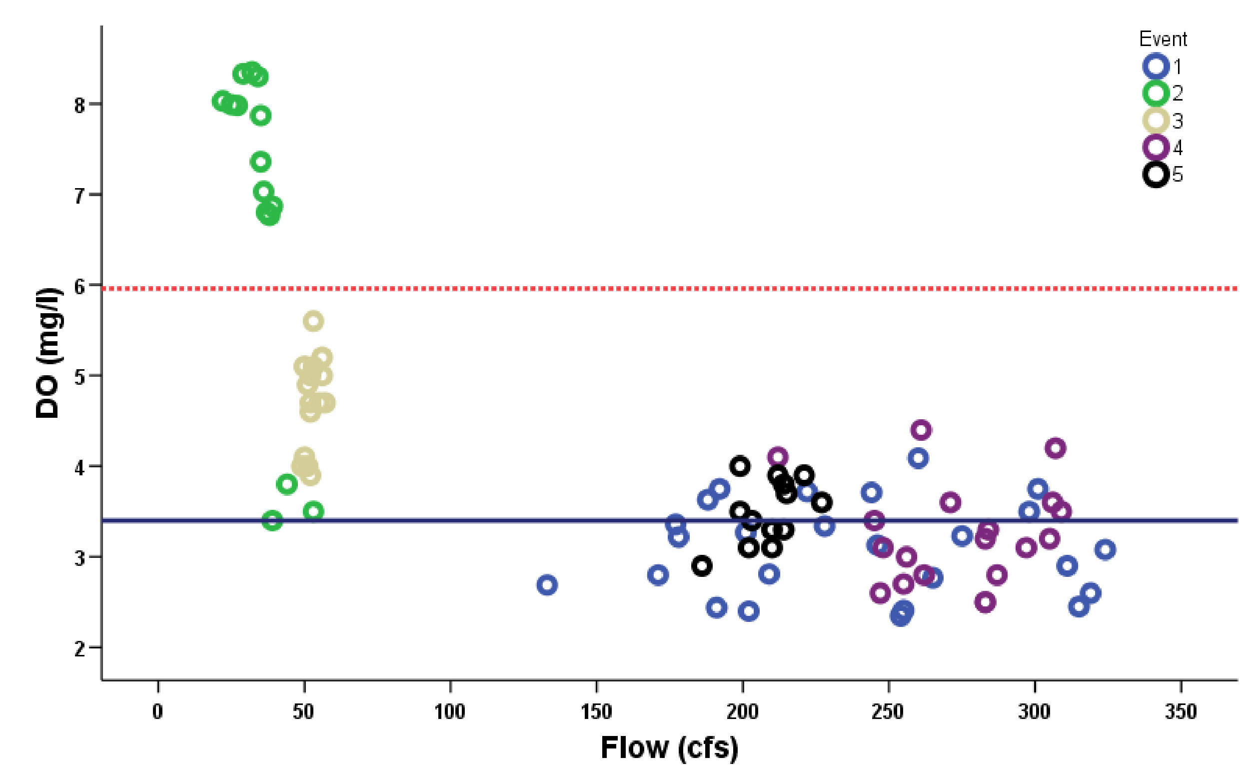
SFWMD. 2006. Restoration Plan for the Northwest Fork of the Loxahatchee River. South Florida Water Management District, West Palm Beach, Florida.

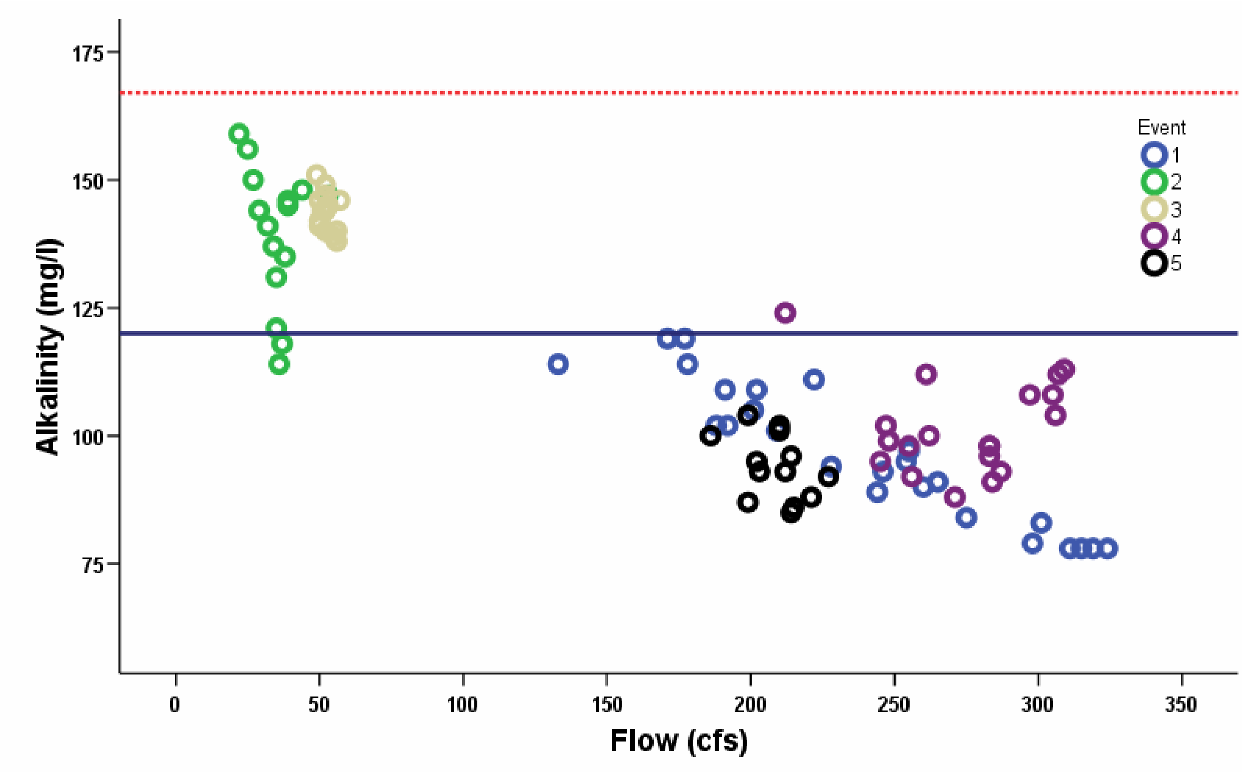
Appendix A. Scatter plots showing the relationship (or lack thereof) between flow, measured in cfs, and physical and chemical water quality parameters. Data were collected every four hours at station #105 during the period September 2005 through September 2006. Five independent rainfall events were monitored. Events 1, 4, and 5 occurred during the wet season, while events 2 and 3 occurred during the dry season. In each graph, the horizontal blue line represents the wet season median value for that site during the period September 2005 through July 2006, while the dashed horizontal red line represents the dry season median value for that site during the period September 2005 through July 2006.

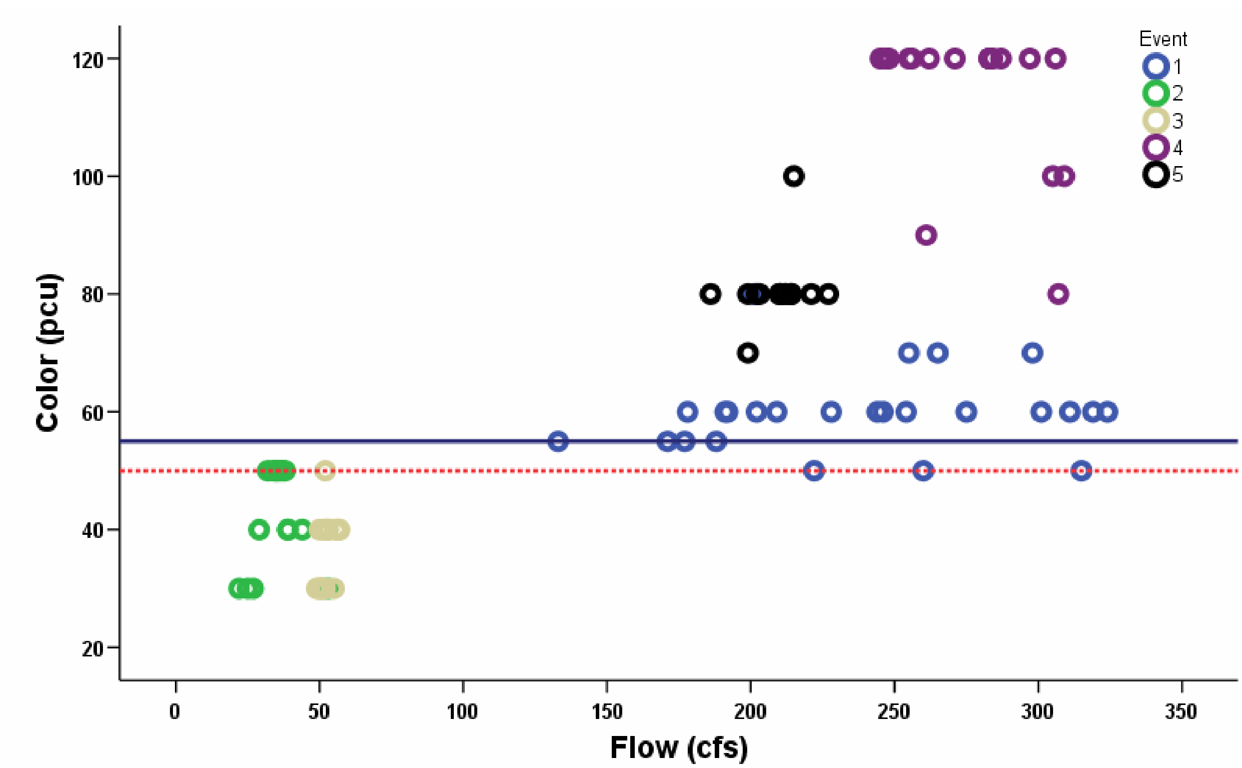


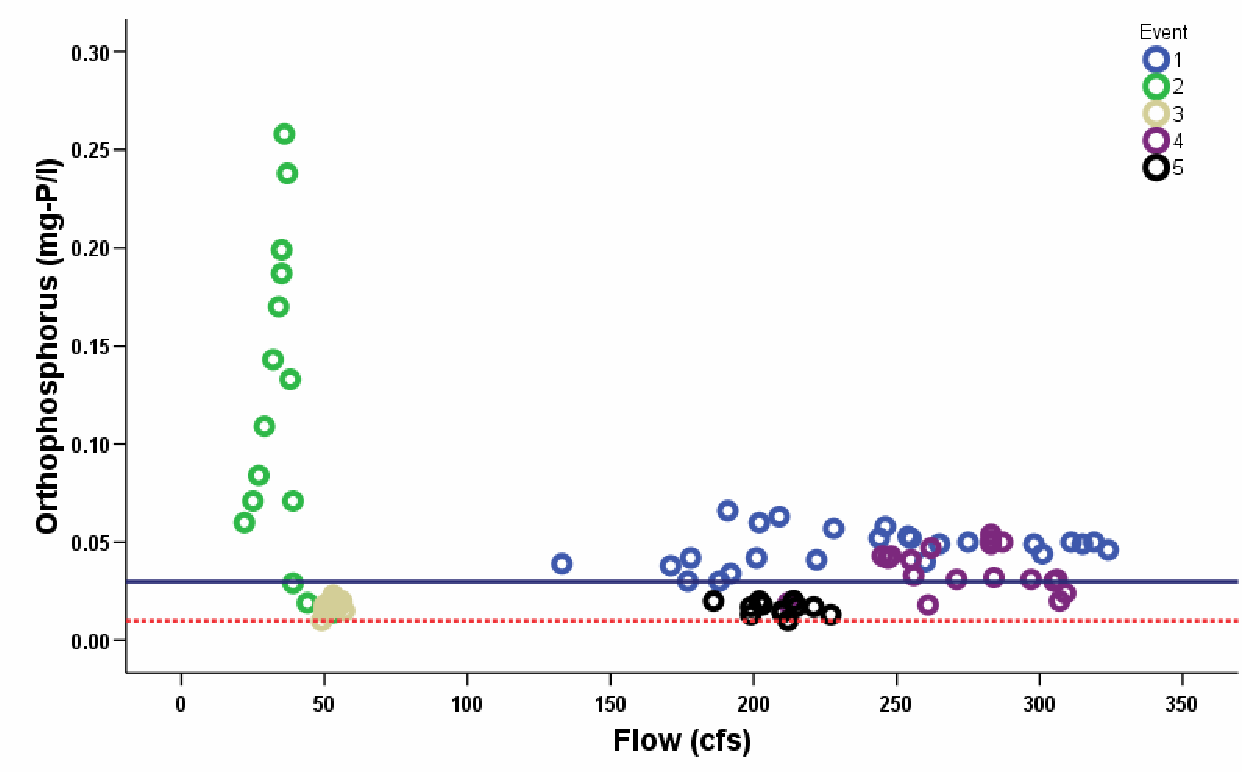


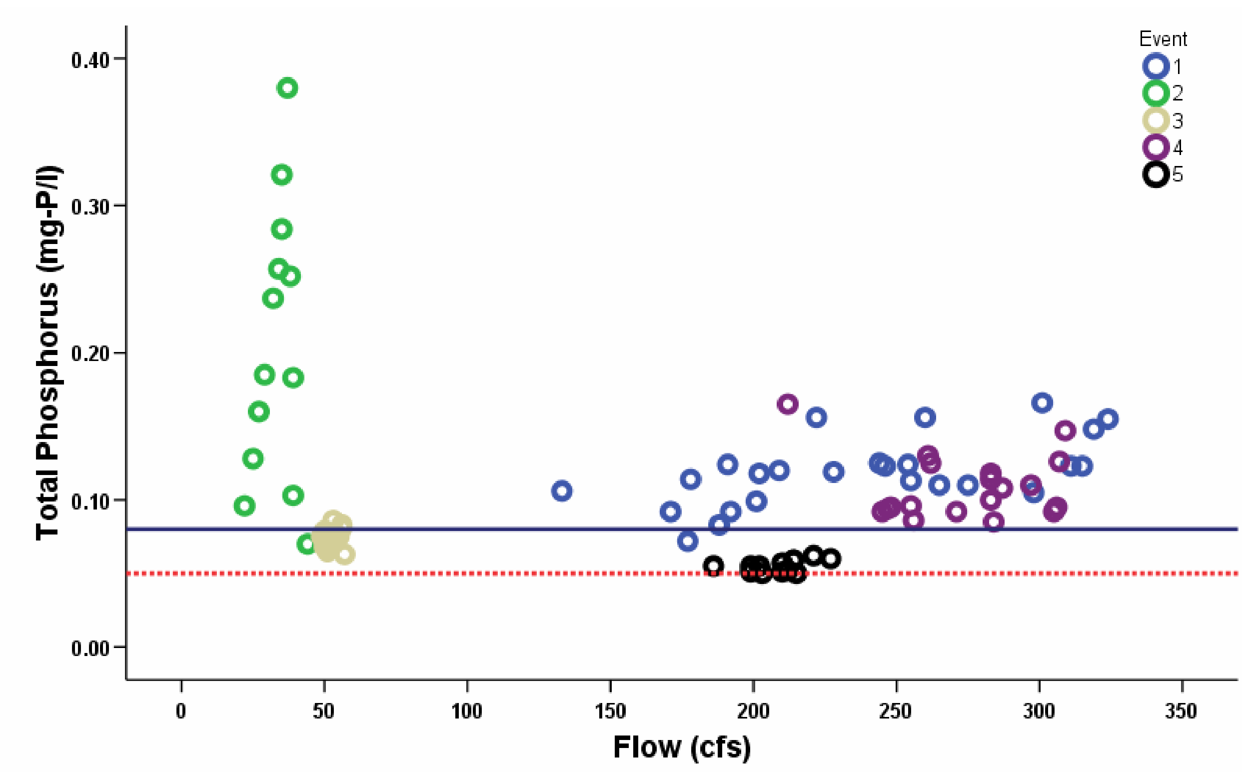

Conductivity (uhmos/cm)
700
600
500
400
300
200
0
50
100
150
200
250
300
350
Flow (cfs)
Event
1
2
4
5

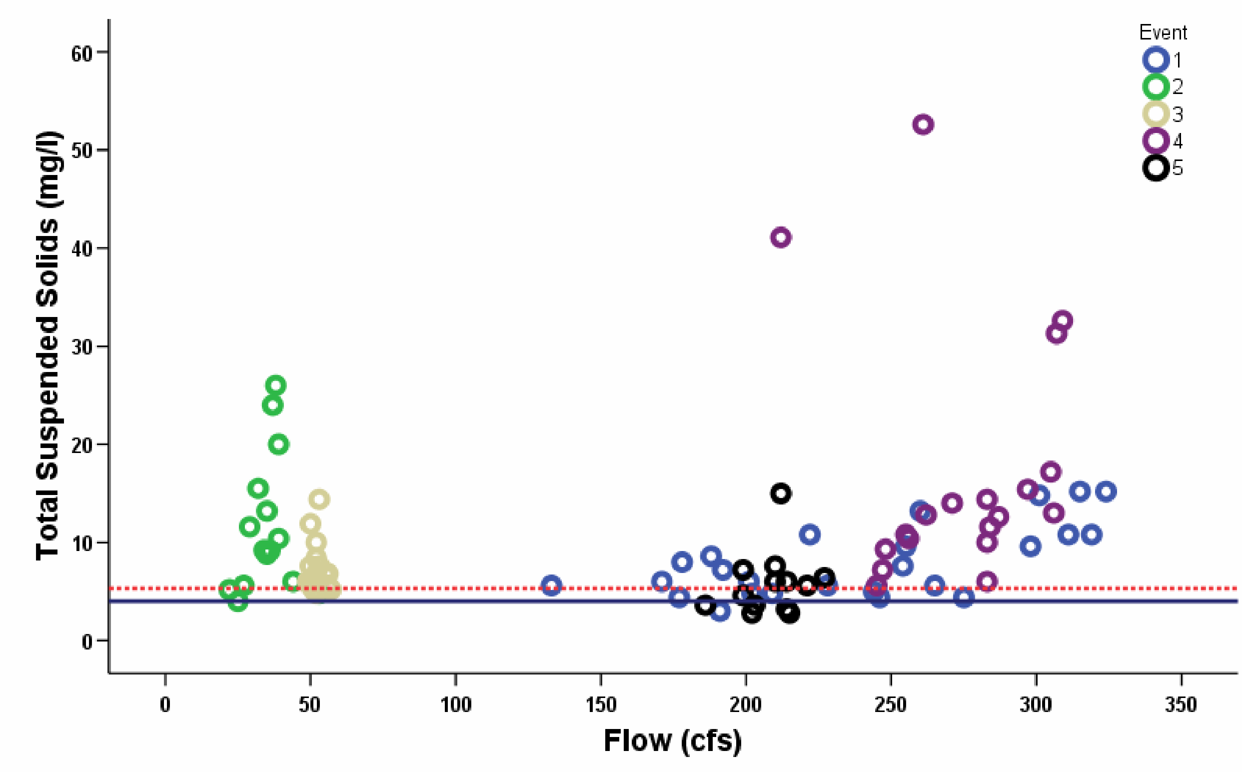

DO (mg/l)
8
7
6
5
4
3
2
0
50
100
150
200
250
300
350
Flow (cfs)
Event
1
2
3
4
5

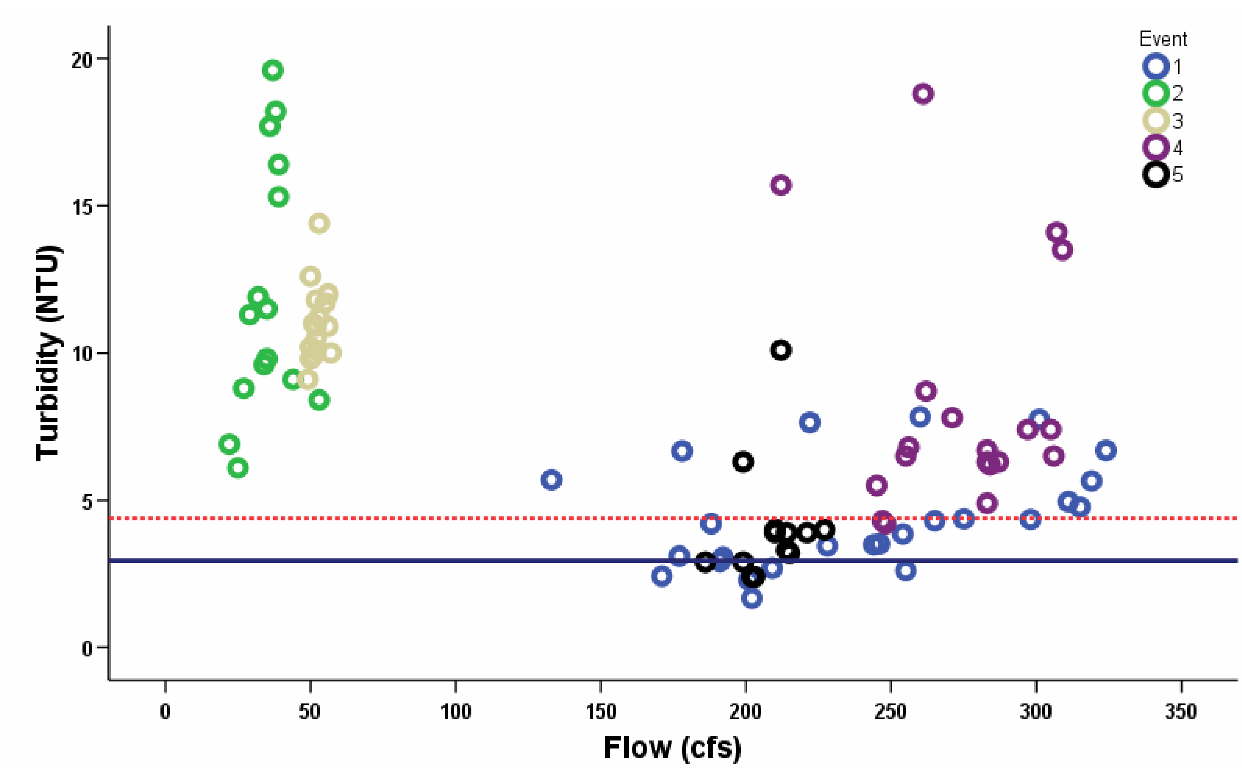

175
150
125
100
75
Alkalinity (mg/l)
0
50
100
150
200
250
300
350
Flow (cfs)
Event
1
2
3
4
5

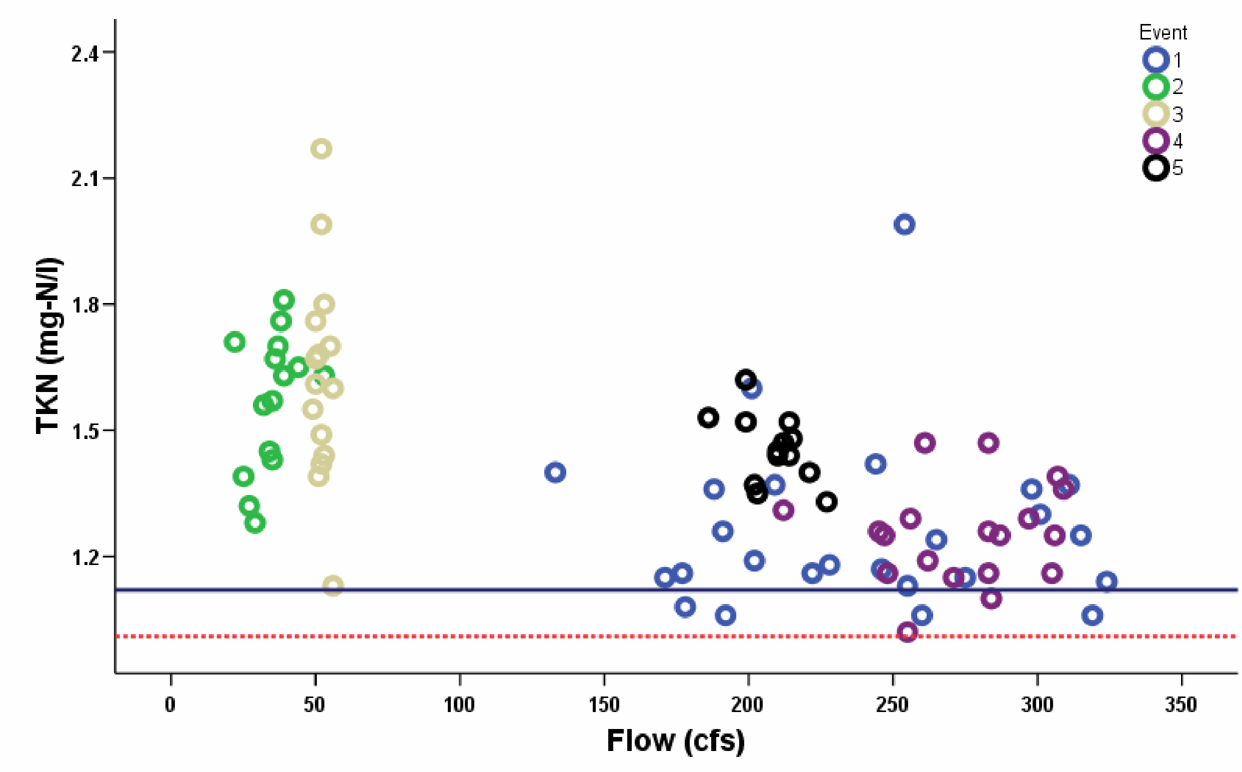

120
100
80
60
40
20
Color (pcu)
0
50
100
150
200
250
300
350
Flow (cfs)
Event
1
2
3
4
5

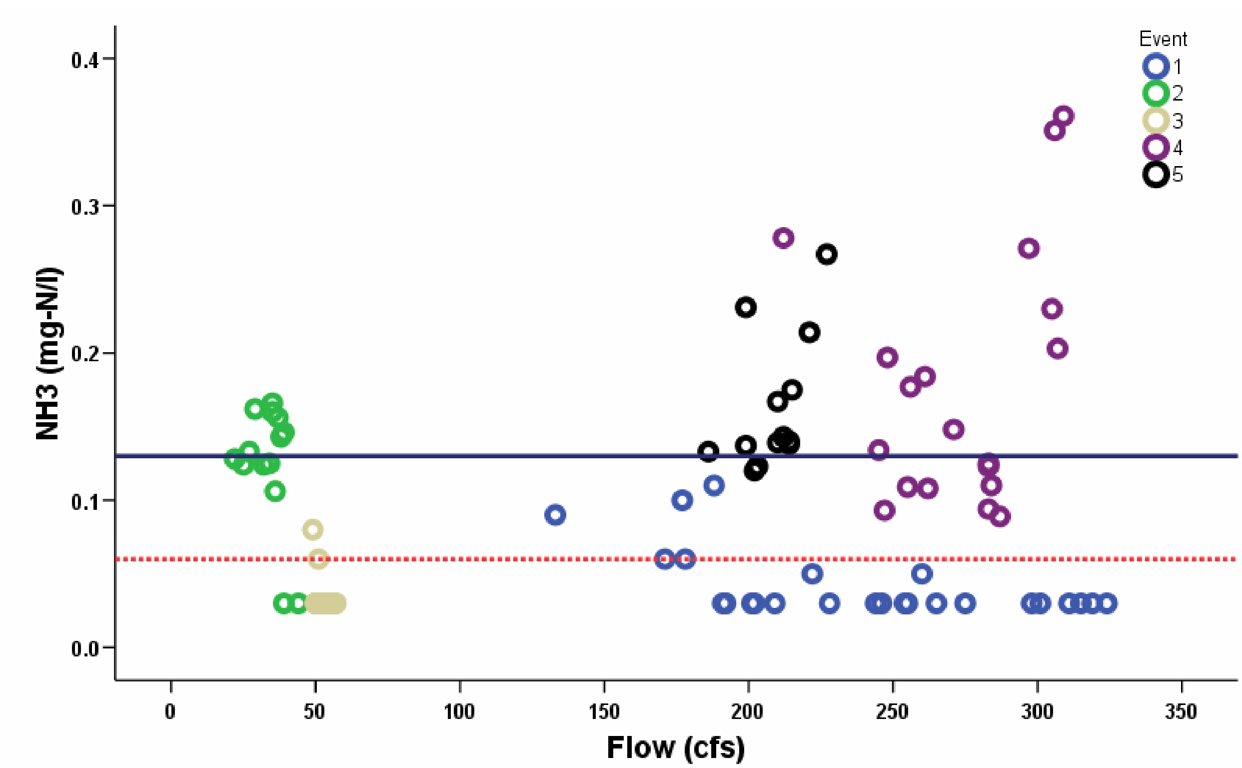

Event
1
2
3
4
5
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Orthophosphorus (mg-P/l)
0
50
100
150
200
250
300
350
Flow (cfs)


Event
1
2
3
4
5
0.40
0.30
0.20
0.10
0.00
Total Phosphorus (mg-P/l)
0
50
100
150
200
250
300
350
Flow (cfs)


Total Suspended Solids (mg/l)
Flow (cfs)
Event
1
2
3
4
5
0
10
20
30
40
50
60
0
50
100
150
200
250
300
350


Turbidity (NTU)
Flow (cfs)
Event
1
2
3
4
5
0
5
10
15
20
0
50
100
150
200
250
300
350


Event
1
2
3
4
5
TKN (mg-N/l)
2.4
2.1
1.8
1.5
1.2
Flow (cfs)
0
50
100
150
200
250
300
350


Event
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2
3
4
5
NH3 (mg-N/l)
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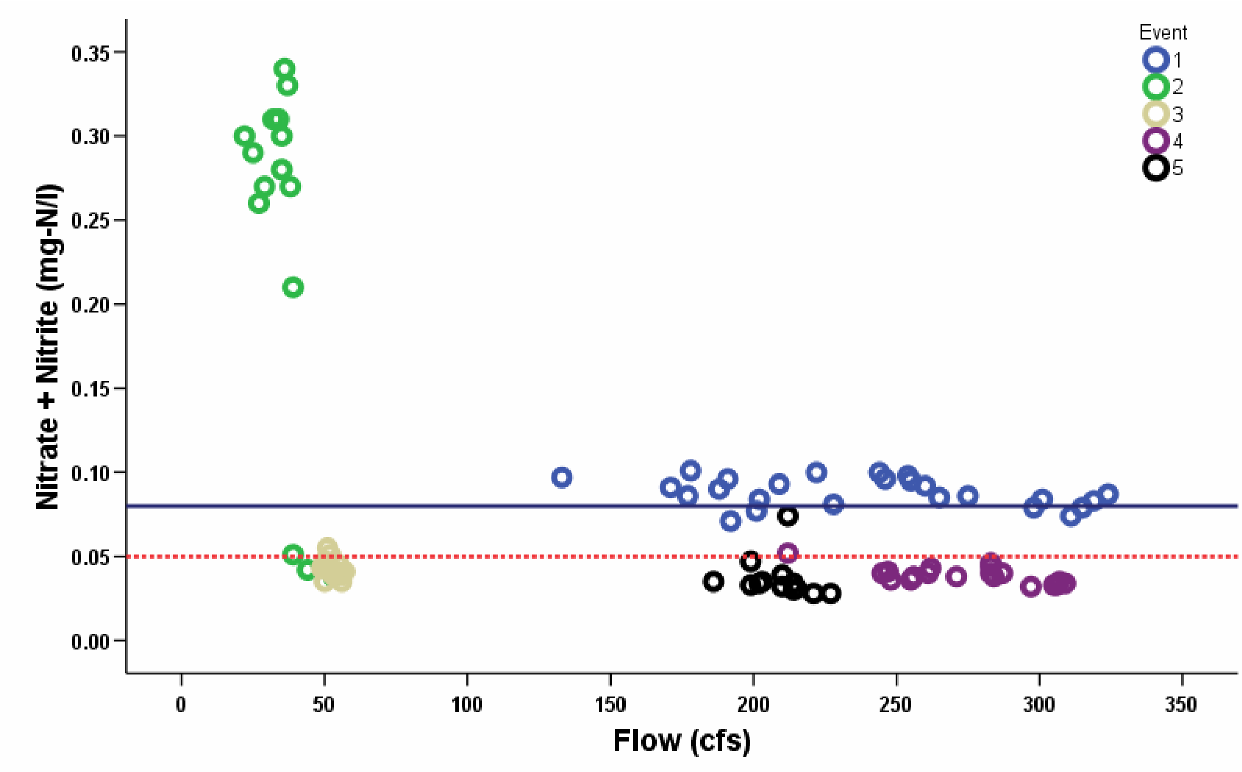
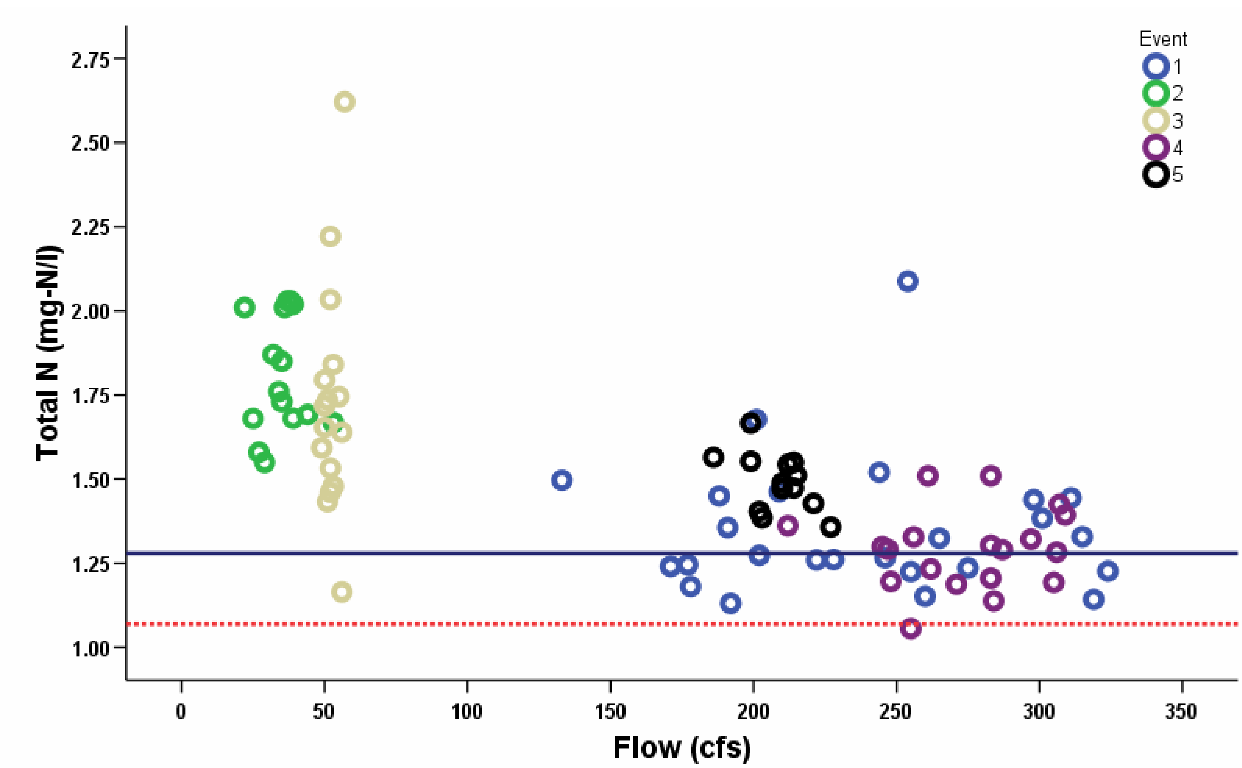
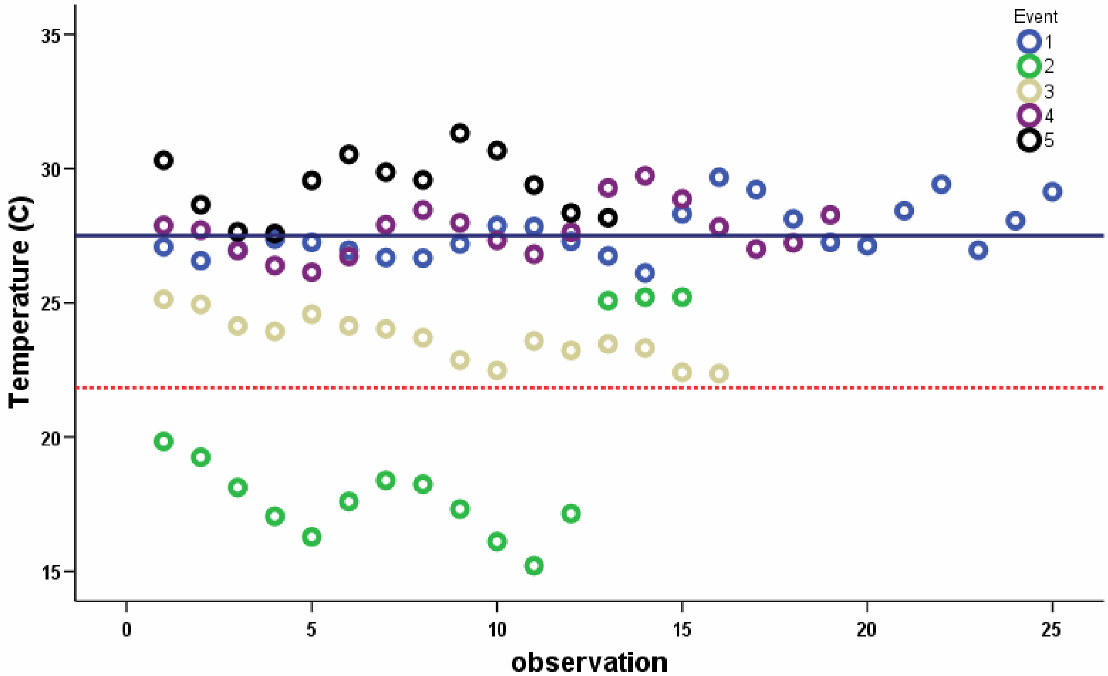
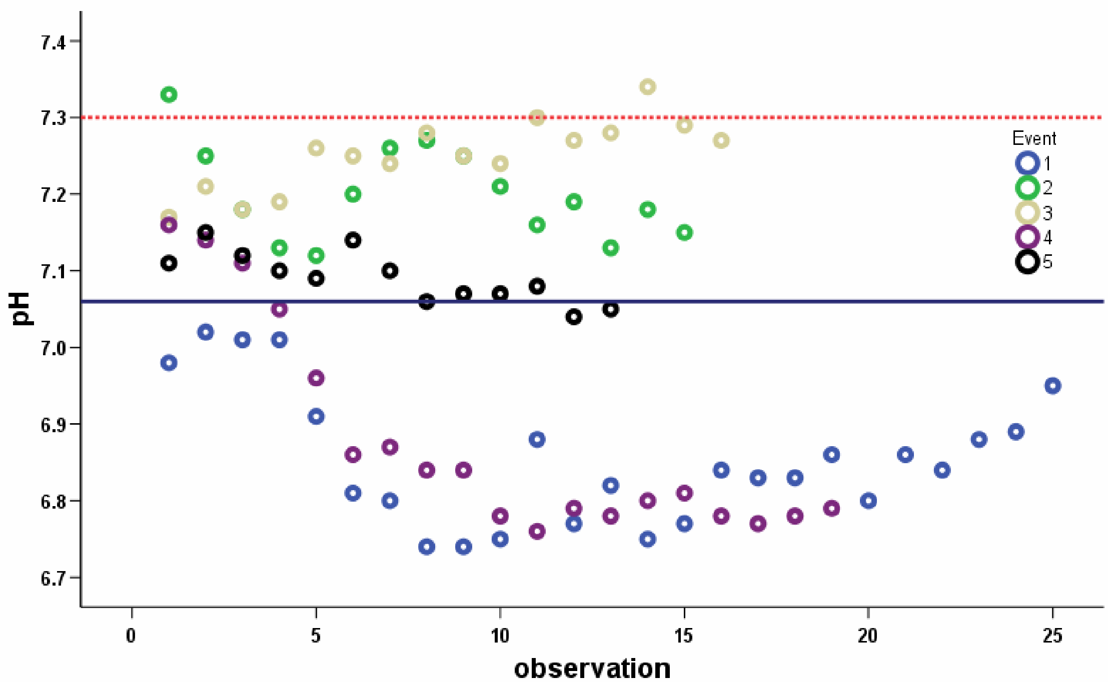
0.1
0.0
Flow (cfs)
0
50
100
150
200
250
300
350

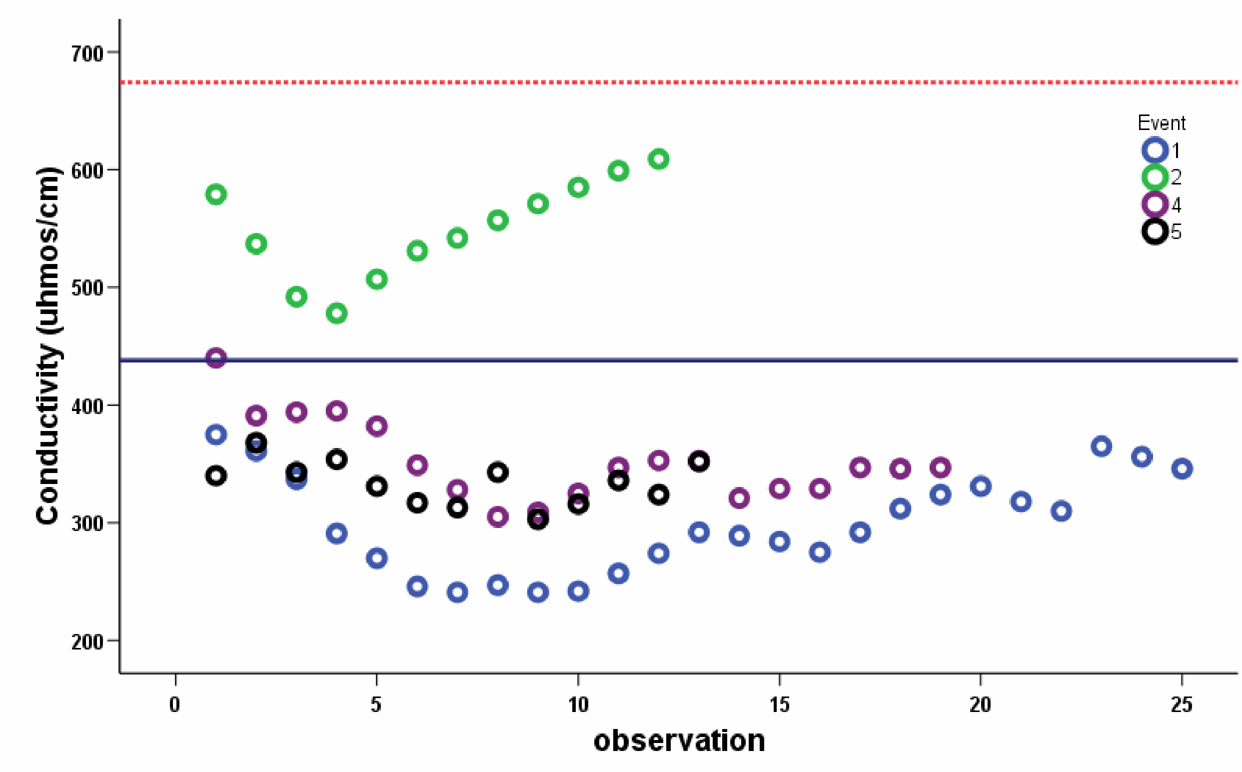

Event
1
2
3
4
5
Nitrate + Nitrite (mg-N/l)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
50
100
150
200
250
300
350
Flow (cfs)

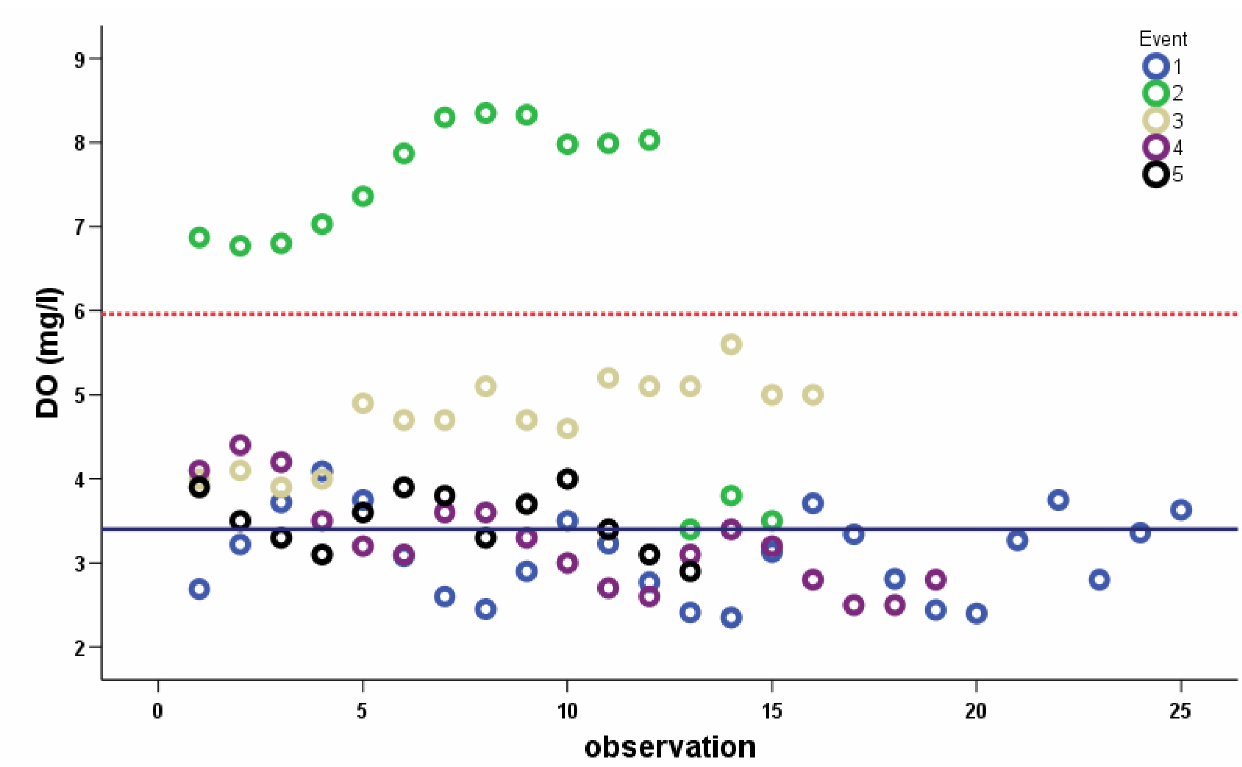

Event
1
2
3
4
5
Total N (mg-N/l)
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0
50
100
150
200
250
300
350
Flow (cfs)

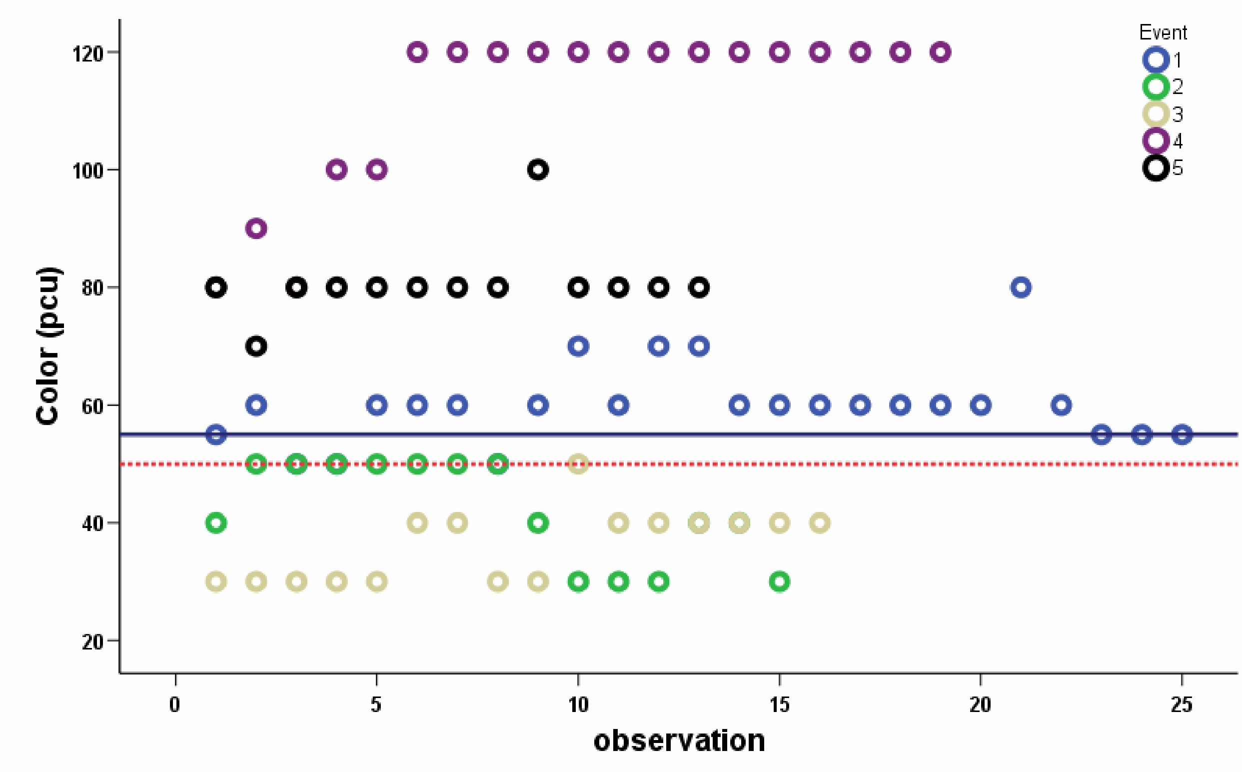
Appendix B. Scatter plots show the temporal response of various water quality parameters following five discrete rainfall events. Data were collected every four hours at station #105 during the period September 2005 through September 2006. See Figure 1 and Table 1 for a characterization of the five independent rainfall events that were monitored. Events 1, 4, and 5 occurred during the wet season, while events 2 and 3 occurred during the dry season. In each graph, the horizontal blue line represents the wet season median value for that site during the period September 2005 through July 2006, while the dashed horizontal red line represents the dry season median value for that site during the period September 2005 through July 2006.






Conductivity (uhmos/cm)
700
600
500
400
300
200
0
5
10
15
20
25
observation
Event
1
2
4
5


DO (mg/l)
9
8
7
6
5
4
3
2
0
5
10
15
20
25
observation
Event
1
2
3
4
5


Event
1
2
3
4
5
Color (pcu)
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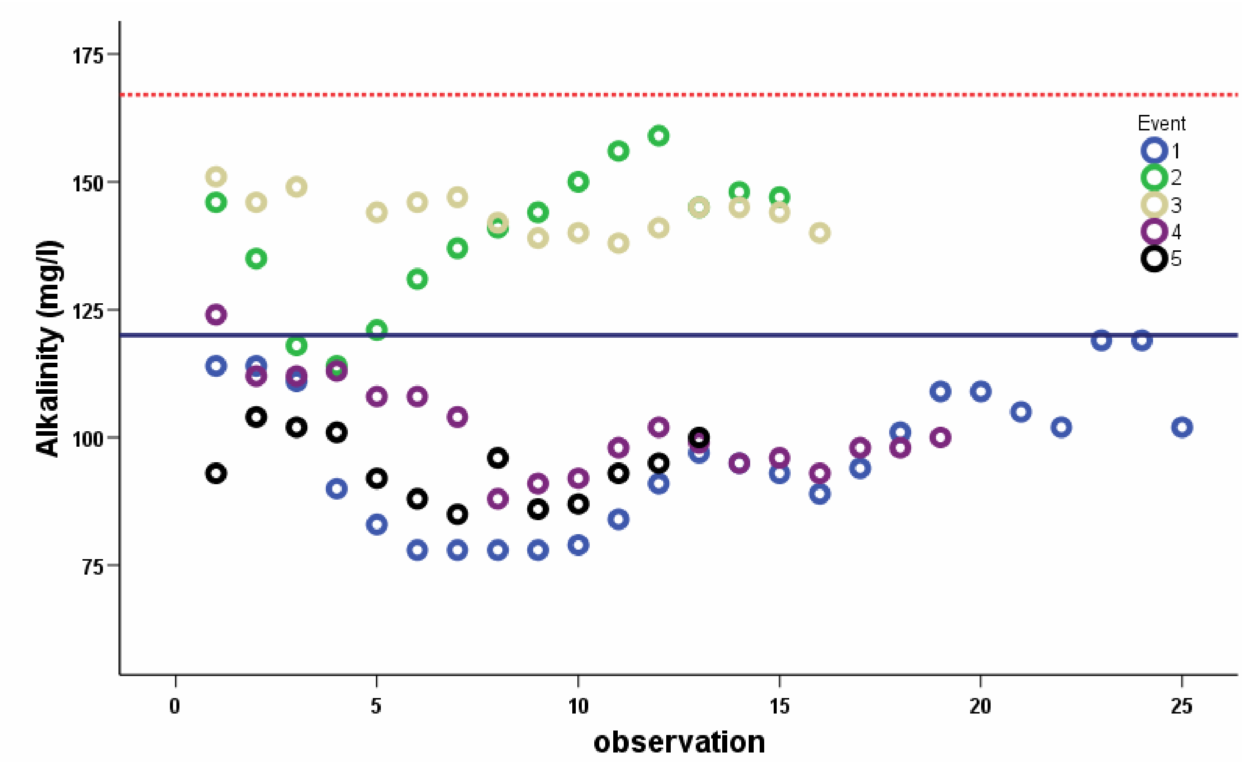
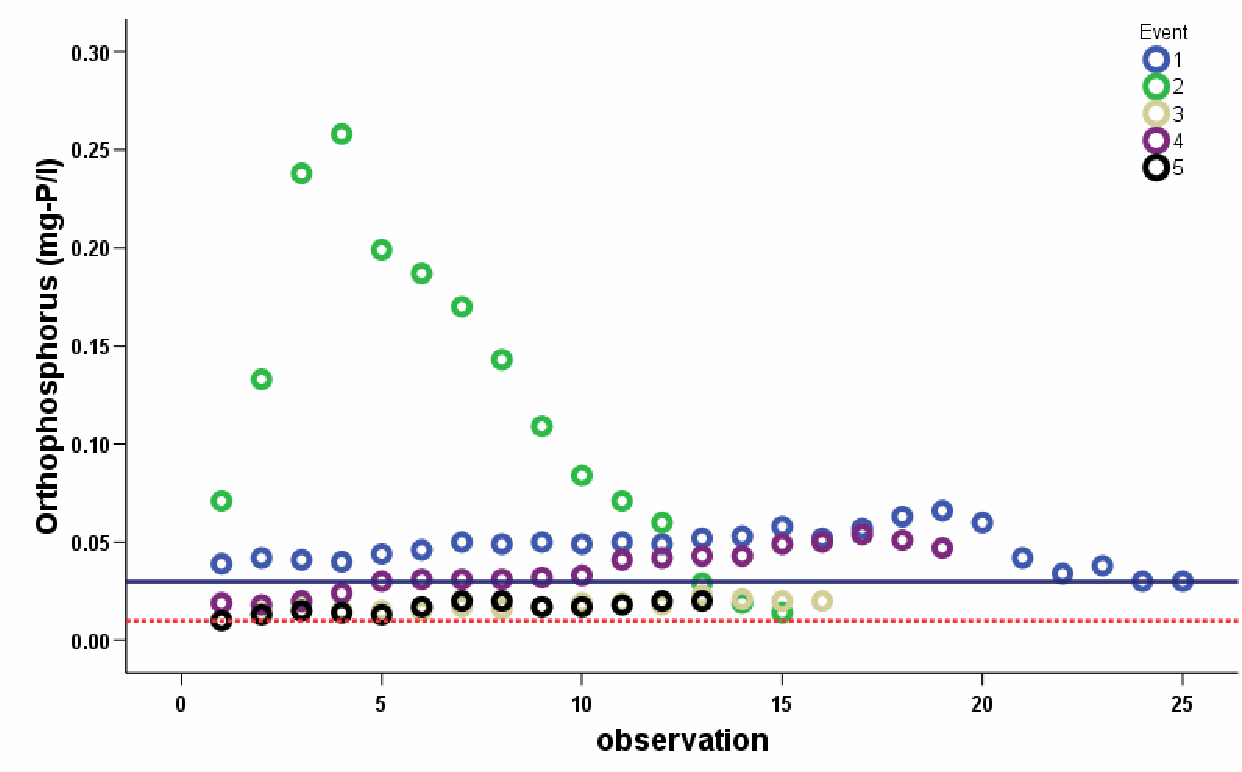
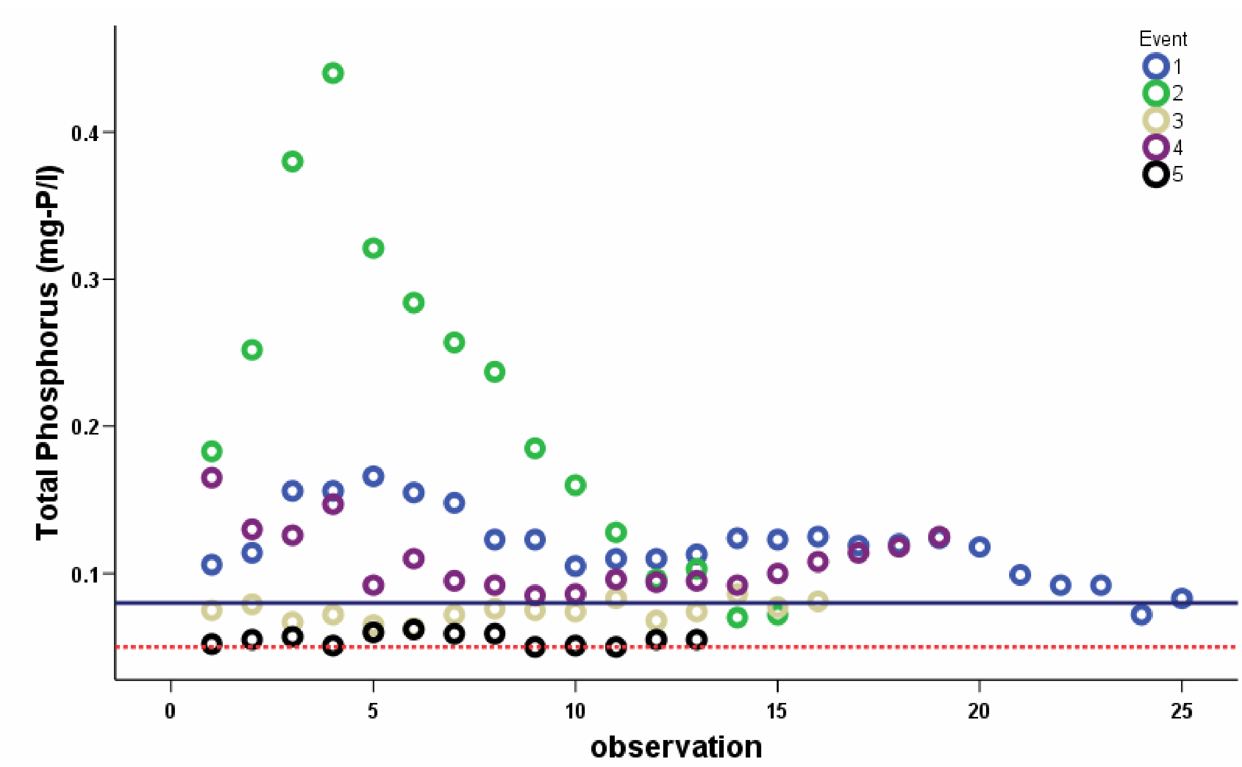
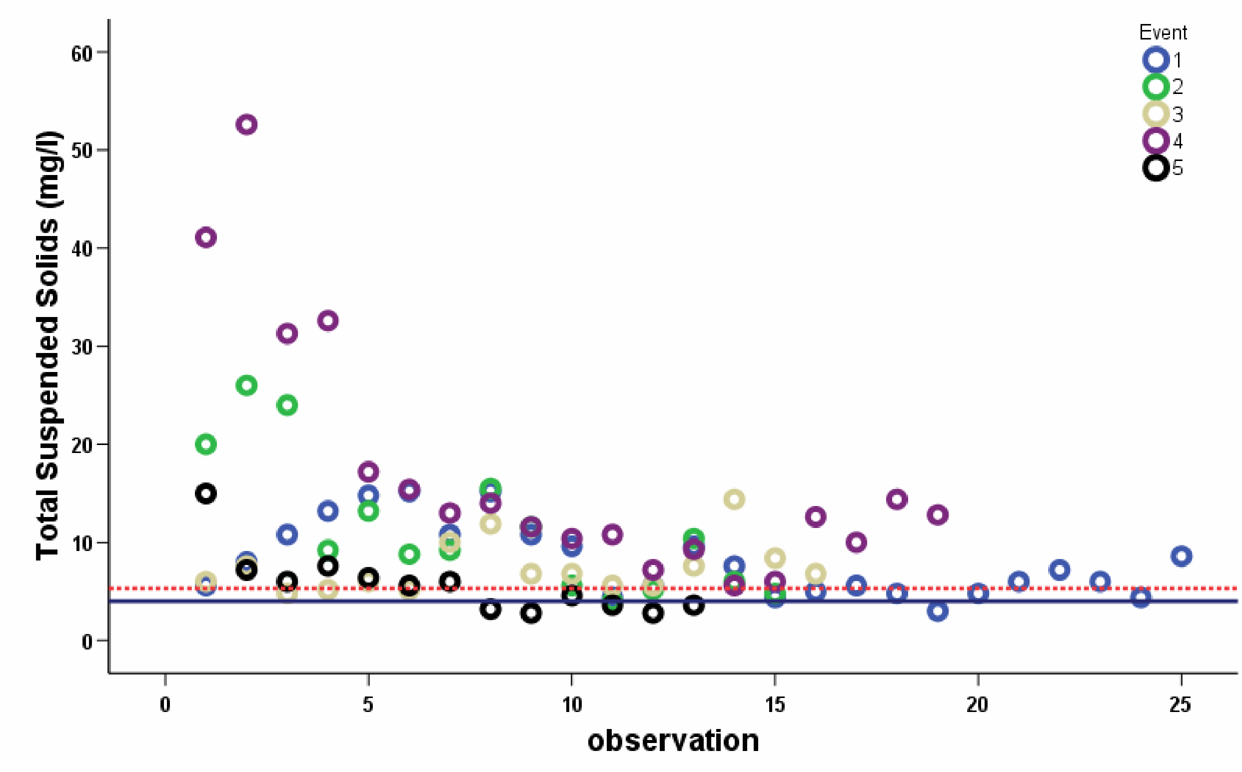
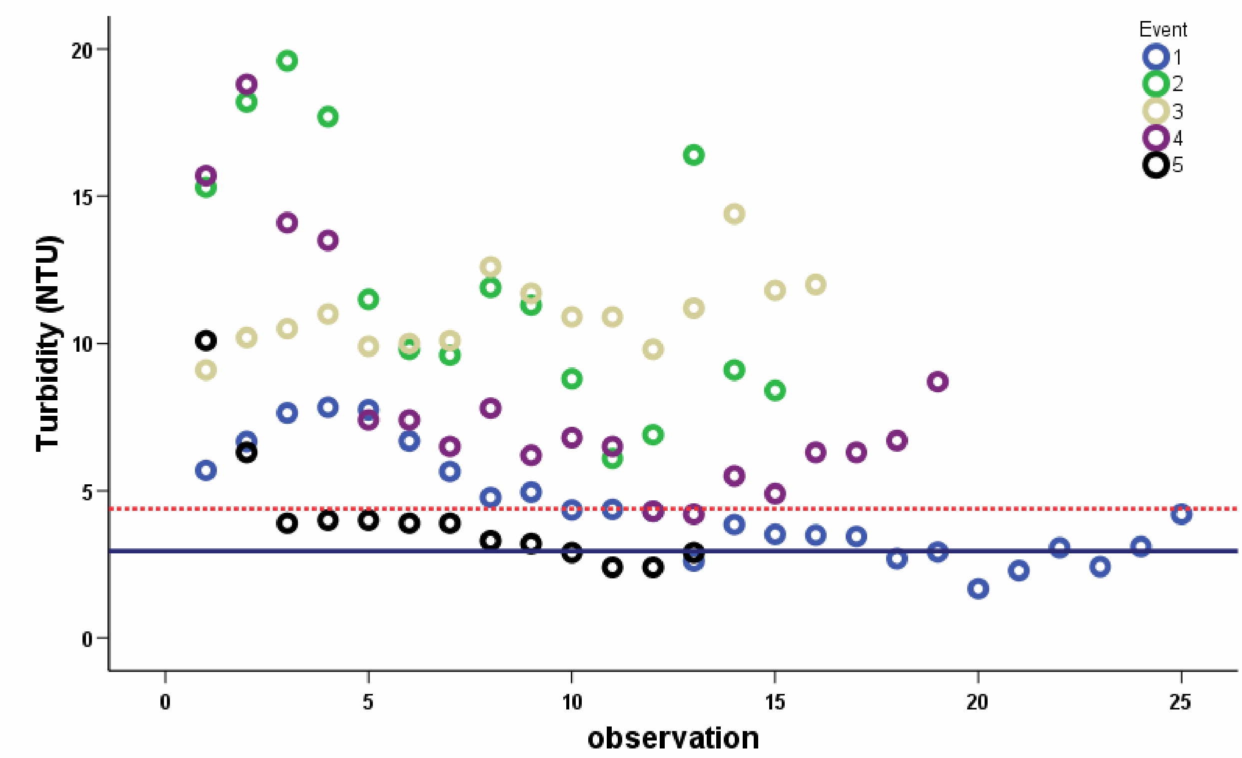
100
80
60
40
20
0
5
10
15
20
25
observation

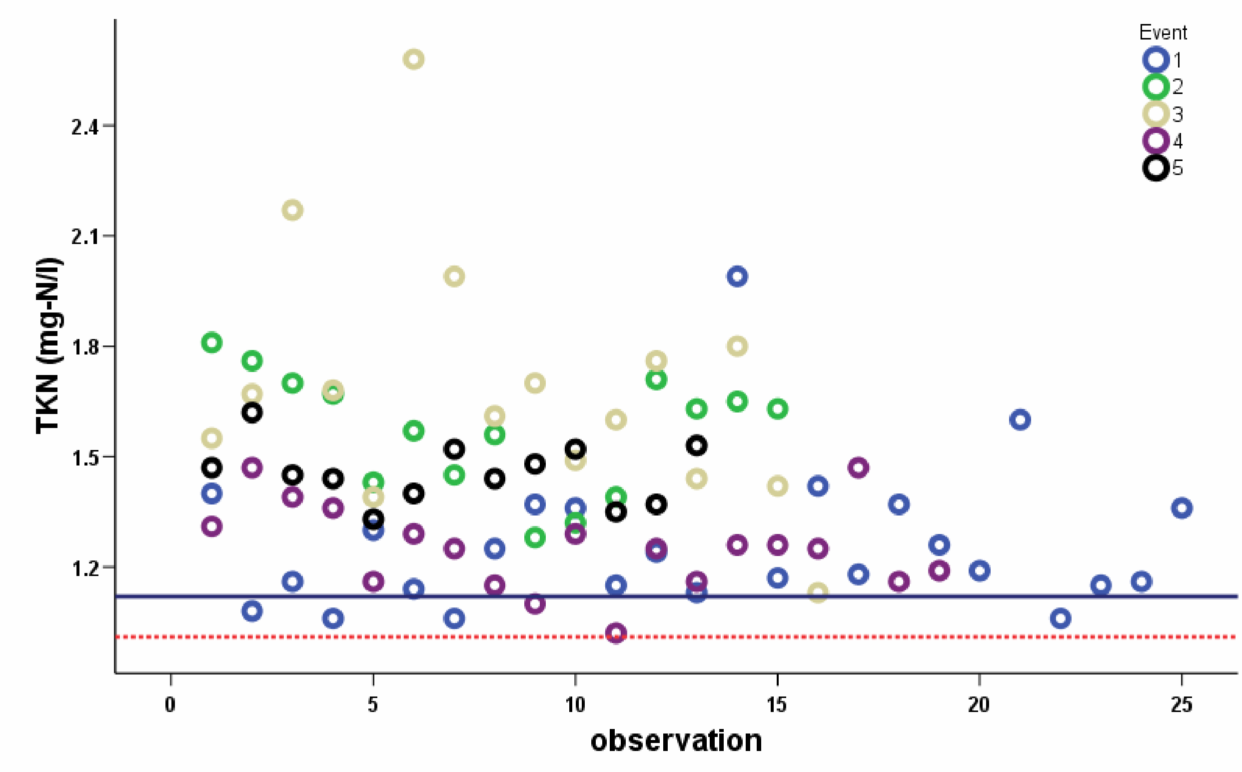

Event
1
2
3
4
5
Alkalinity (mg/l)
175
150
125
100
75
0
5
10
15
20
25
observation

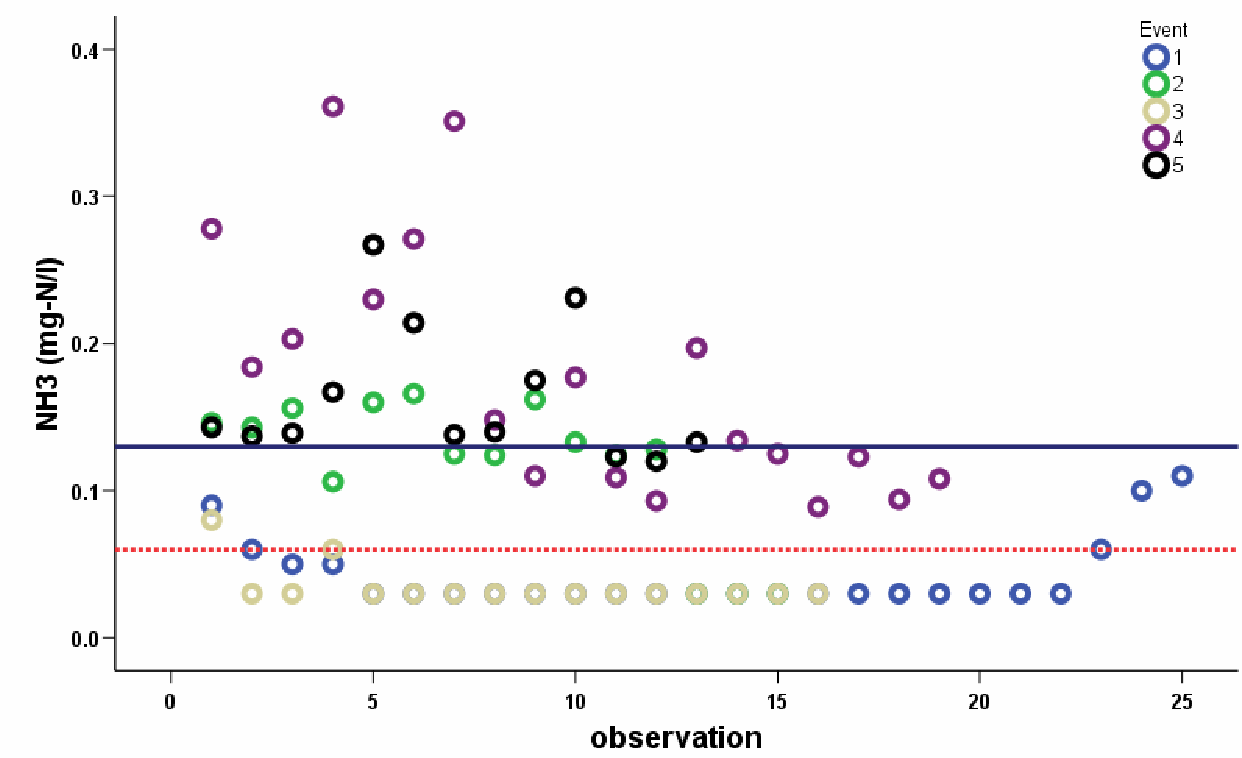

Event
1
2
3
4
5
Orthophosphorus (mg-P/l)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25
observation

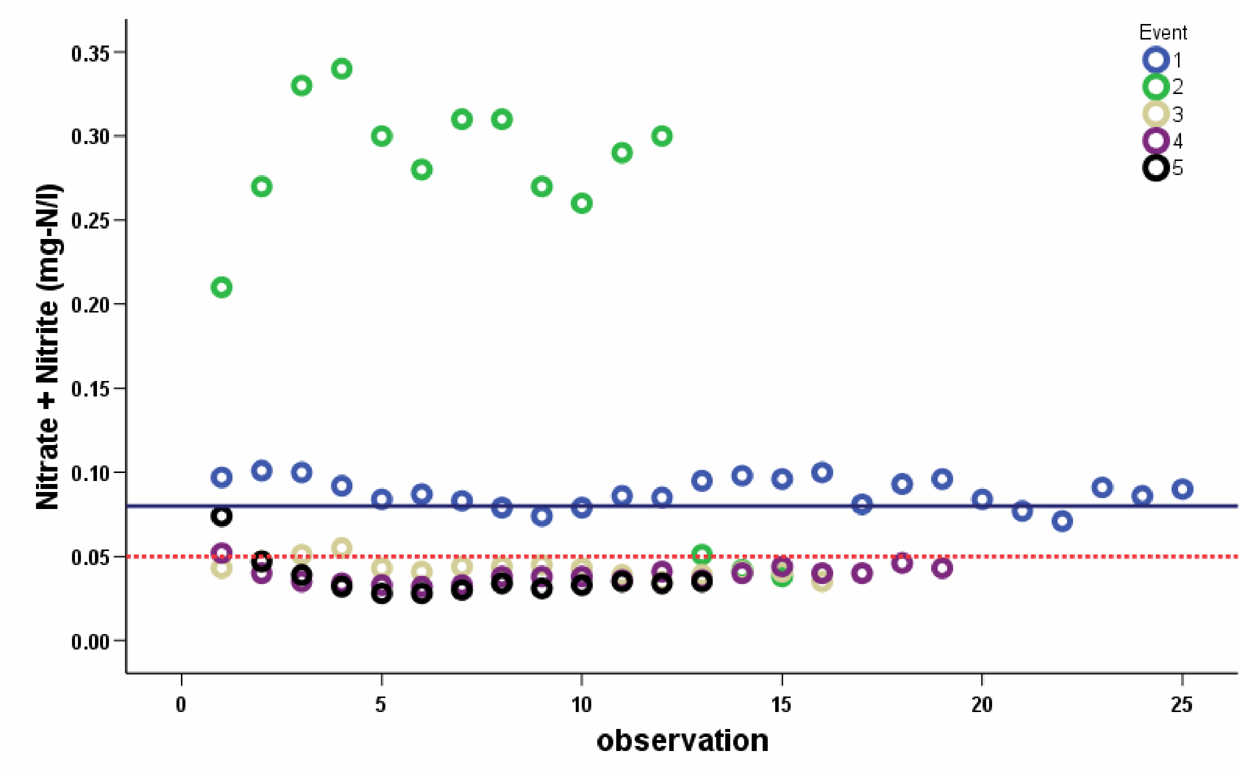

Event
1
2
3
4
5
Total Phosphorus (mg-P/l)
0.4
0.3
0.2
0.1
0
5
10
15
20
25
observation

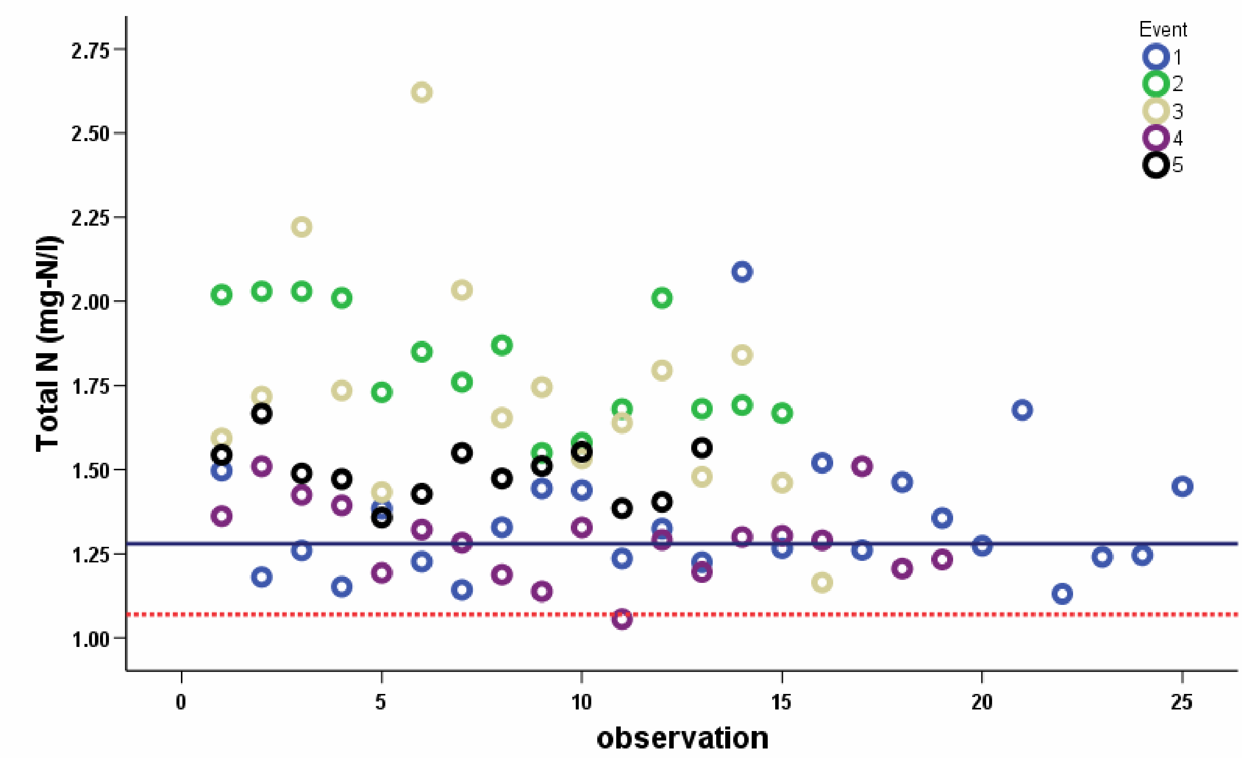

Event
1
2
3
4
5
Total Suspended Solids (mg/l)
observation
0
10
20
30
40
50
60
0
5
10
15
20
25


Event
1
2
3
4
5
Turbidity (NTU)
observation
0
5
10
15
20
0
5
10
15
20
25


Event
1
2
3
4
5
2.4
2.1
1.8
1.5
1.2
TKN (mg-N/l)
0
5
10
15
20
25
observation


Event
1
2
3
4
5
0.4
0.3
0.2
0.1
0.0
NH3 (mg-N/l)
0
5
10
15
20
25
observation


Event
1
2
3
4
5
Nitrate + Nitrite (mg-N/l)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25
observation


Event
1
2
3
4
5
Total N (mg-N/l)
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0
5
10
15
20
25
observation

Appendix C. Description of probe calibration and Q/A & Q/C procedures.

TABLE OF CALIBRATION ACCEPTANCE CRITERIA

Effective Date: 4/24/03 Rev. 4 on 10/1/05

PARAMETER/ METHOD	BLANK (mg/L)	MDL (mg/L)	# OF INITIAL STDS	INITIAL CALIB CORR COEF OR % R	2ND STD % R	CONTINUING CALIB STD % R	[HISTORICAL VALUES] PRECISION OF DUPS % RPD	ACCURACY OF SPIKES % R	SAMPLE HOLD TIMES
Fecal Coliform SM9222D MF	1 pre-1 post + every 10 samples less than MDL	1 cfu/ 100 mLs	N/A	N/A	N/A	N/A	[0 - 50] every 10 samples or matrix set	N/A	6 hours
Total Coliform SM9222B MF	1 pre-1 post + every 10 samples less than MDL	1 cfu/ 100 mLs	N/A	N/A	N/A	N/A	[0 - 50] every 10 samples or matrix set	N/A	6 hours
Ammonia-N EPA 350.2 low-Color, Nessler's	1 pre- + every 10 samples less than MDL	0.05	6 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	80 - 120 every 10 samples at varied conc + end	[0 - 25] every 10 samples or matrix set	[85 - 115] every 10 samples or matrix set	28 days
Ammonia-N EPA 350.2 high-Titrimetric	1 pre- + every10 samples less than MDL	0.2	4 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	80 - 120 every 10 samples at varied conc + end	[0 - 8] every 10 samples or matrix set	[85-115] every 10 samples or matrix set	28 days
TKN EPA 351.2 Block, AA	1 pre- + every 10 samples less than MDL	0.2	4 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	90 -110 every 10 samples at varied conc + end	[0 - 29] every 10 samples or matrix set	90 - 110 every 10 samples or matrix set	28 days
Nitrate+Nitrate-N EPA 353.2 low-Cd Reduc, AA	1 pre- + every 10 samples less than MDL	0.006	5 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	90 -110 every 10 samples at varied conc + end	[0 - 25] every 10 samples or matrix set	90 -110 every 10 samples or matrix set	48 hours

PARAMETER/ METHOD	BLANK (mg/L)	MDL (mg/L)	# OF INITIAL STDS	INITIAL CALIB CORR COEF OR % R	2ND STD % R	CONTINUING CALIB STD % R	PRECISION OF DUPS % RPD	ACCURACY OF SPIKES % R	SAMPLE HOLD TIMES
Nitrate+Nitrate-N EPA 353.2 high-Cd Reduc, AA	1 pre- + every 10 samples less than MDL	0.06	4 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	90 -110 every 10 samples at varied conc + end	[0 - 17] every 10 samples or matrix set	90 -110 every 10 samples or matrix set	28 days
Ortho-Phosphate EPA 365.2 Color, Ascorbic	1 pre- + every 10 samples less than MDL	0.002	6 to bracket samples	>/= 0.995 98 -102 published	90 - 110 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 30] every 10 samples or matrix set	[90 - 110] every 10 samples or matrix set	48 hours
Total Phosphorus EPA 365.2 low-Color, Ascorbic	1 pre- + every 10 samples less than MDL	0.002	6 to bracket samples	>/= 0.995 98 -102 published	90 - 110 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 30] every 10 samples or matrix set	[85 - 115] every 10 samples or matrix set	28 days
Total Phosphorus EPA 365.2 high-Color, Ascorbic	1 pre- + every 10 samples less than MDL	0.004	6 to bracket samples	>/= 0.995 98 -102 published	90 - 110 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 12] every 10 samples or matrix set	[85 - 115] every 10 samples or matrix set	28 days
BOD EPA 405.1 5 day, 20 C	1 dil. H20- 1 seed Bk every 10 samples </= 0.2	2.0 published	1 GGA	85 - 115	85 - 115 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 30] every 10 samples or matrix set	[75 - 125] every 10 samples or matrix set	48 hours
NOTE: Must meet 2.0 mg/L minimum DO depletion (initial minus final) and 1.0 mg/L residual (final) DO for each test bottle.									
CBOD SM5210B 5 day, 20 C	1 dil. H20- 1 seed Bk every 10 samples </= 0.2	2.0 published	1 GGA	85 - 115 published in method	85 - 115 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 30] every 10 samples or matrix set	[75 - 125] every 10 samples or matrix set	48 hours
NOTE: Must meet 2.0 mg/L minimum DO depletion (initial minus final) and 1.0 mg/L residual (final) DO for each test bottle.									

PARAMETER/ METHOD	BLANK (mg/L)	MDL (mg/L)	# OF INITIAL STDS	INITIAL CALIB CORR COEF OR % R	2ND STD % R	CONTINUING CALIB STD % R	PRECISION OF DUPS % RPD	ACCURACY OF SPIKES % R	SAMPLE HOLD TIMES
Alkalinity EPA 310.1 Titrimetric, pH 4.5	1 pre- + every 10 samples less than MDL	1	min of 2 bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 5] every 10 samples or matrix set	[85 - 115] every 10 samples or matrix set	14 days
Chloride SM4500Cl- B Argentometric	1 pre- + every 10 samples less than MDL	0.5	min of 2 bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	80 -120 every 10 samples at varied conc + end	[0 - 3] every 10 samples or matrix set	[80 - 120] every 10 samples or matrix set	28 days
Conductivity EPA 120.1 Meter	1 pre- + every 10 samples less than MDL	1 umhos/cm	min of 2 to bracket samples	95-105	95-105 one varied prior to sample analysis	95-105 every 10 samples at varied conc + end	[0 - 2] every 10 samples or matrix set	N/A	28 days
TDS (filterable) EPA 160.1 Gravimetric, 180 C	1 pre- + every 10 samples less than MDL	10	1	90 - 110	90 - 110	N/A	[0 - 6] every 10 samples or matrix set	N/A	7 days
TSS (non-filterable) EPA 160.2 Gravimetric, 104 C	1 pre- + every 10 samples less than MDL	1	1	80 - 120	80 - 120	N/A	[0 - 50] every 10 samples or matrix set	N/A	7 days
NOTE: Choose sample size to yield between 2.5 & 200 mg residue and complete filtration time within 10 min.									
Sulfate EPA 375.2 Color, MTB, AA	1 pre- + every 10 samples less than MDL	10	6 to bracket samples	>/= 0.995	90 - 110 one varied prior to sample analysis	90 -110 every 10 samples at varied conc + end	[0 - 15] every 10 samples or matrix set	90 -110 every 10 samples or matrix set	28 days
Turbidity EPA 180.1	1 DI H2O every 20 samples less than MDL	0.1 NTU	4 formazin quarterly	95 - 105	95 - 105 2 gelex stds to bracket analysis	95 - 105 1 gelex every 10 samples or at end	[0 - 11] every 10 samples or matrix set	N/A	48 hours

PARAMETER/ METHOD	BLANK (mg/L)	MDL (mg/L)	# OF INITIAL STDS	INITIAL CALIB CORR COEF OR % R	2ND STD % R	CONTINUING CALIB STD % R	PRECISION OF DUPS % RPD	ACCURACY OF SPIKES % R	SAMPLE HOLD TIMES
pH EPA 150.1	N/A	N/A	2 or 3 to bracket samples	90 - 105 % efficiency of electrode	+/- 0.2 units	+/- 0.2 units	0 - 5	N/A	analyze immediatel y
Chlorophyll a	1 pre	1	none	N/A	none	N/A	0 - 30	N/A	21 days
Color	1 pre	5	none	N/A	none	N/A	0 - 5	N/A	48 hours

Appendix C. Discussion of data accuracy

Loxahatchee River District

WildPine Ecological Laboratory
NELAP Certification # E56025
2500 Jupiter Park, Jupiter, Florida 33458-8964
Telephone (561) 747-5709 Fax (561) 743-3027
wildpine@loxahatcheeriver.org

October 1, 2006

Client: SFWMD

Re: WATER QUALITY EVENT SAMPLING FINAL REPORT FOR 2006

To Client:

Analytical results reported by the WildPine Lab in this report have been reviewed for compliance with the Loxahatchee River District's Quality Systems Manual and meet applicable Standard Operating Procedures and Lab Methods as required by the July 2003 National Environmental Laboratory Accreditation Program (NELAP). The analytical results in this report represent the samples as they were collected according to the DEP Standard Operating Procedures for Field Activities (DEP-SOP-001/01) unless otherwise noted.

FDOH has certified the Loxahatchee River District (E56026) in compliance with FAC 64E-1 for the examination of environmental samples in the following categories:

NON-POTABLE WATER – General Chemistry, Microbiology

Please direct any quality assurance or quality control questions resulting from this report to the Lab Manager or Assistant Lab Manager at (561) 747-5709.

Respectfully submitted,

Lorene Bachman, Lab Manager Susan Noel, Asst. Lab Manager

Appendix D. Raw data and associated files.

Raw data are provided in electronic format on the attached CD. Also, formulas for parameter conversion and calculation, taken from the Hydrolab manual, are included as a separate pdf file on the attached CD.