TECHNICAL MEMORANDUM

To: Mr. Thomas Seal, M.S.
Watershed Monitoring Section
Florida Department of Environmental Protection

From: Dr. Tony Janicki
Janicki Environmental, Inc.

Subject: Suwanee River Water Quality Data

Last December I submitted a technical memorandum to Dr. Rick Copeland regarding water quality in the Suwannee River. The following summarizes that memo. On 23 September 1999, we received a series of data files in Excel format from Dr. Copeland. We converted these data files into SAS data sets in order to conduct some exploratory data analyses whose purpose was to ascertain if any differences in water quality have occurred between the two sampling periods in the data record: 1977-80 and 1989-98.

The water quality data analyzed included data from two locations on the Suwanee River: Branford and Wilcox. Several observations were made from these data:

- There was little difference in the water quality conditions at the two sampling sites visited in this study (Branford and Wilcox).

- There was little difference in water quality conditions between the two sampling periods (1977-80 and 1989-98) at either sampling site.

FDEP requested that these analyses be extended to examine potential changes in nitrogen loading since designation of the Suwannee River as an Outstanding Florida Water (OFW). It was requested that any additional data that may be available from the Suwannee River Water Management District (SRWMD) also be included.

Initially, we obtained two sets of data from the USGS. Daily flow data from two gage sites were obtained:

- Suwannee River at Branford - USGS station ID 023220500

- Suwannee River at Wilcox – USGS station ID 02323500.

We also obtained water quality from the USGS for these two stations. This essentially gave us a water quality data record that extended from the early 1970's through 1999.

We also contacted David Hornsby of SRWMD to determine if any further data may be available. He informed us that no further data were available to his knowledge.

All data used in the analyses described below have been converted into SAS format.

We also were put into contact with Eric Shaw of FDEP to confirm the date of OFW designation for the Suwannee River. He informed us that the river was designated
In March 1979.

DATA ANALYSES

The objective of the data analyses performed in this project was to examine potential changes in water quality, most notably nitrogen concentrations and/or loadings, in the Suwannee River since its designation as an OFW. To this end, we conducted a number of analyses that are summarized in a series of attachments to this document, as follows:

- Attachment 1. Concentration Time Series Plots
- Attachment 2. Daily Flow Statistics
- Attachment 3. Concentration-Flow Relationships
- Attachment 4. Loading Time Series Plots
- Attachment 5. Analyses of Variance Comparing Concentrations and Loadings in Pre- and Post-OFW Designation Periods
- Attachment 6. Seasonal Kendall τ Trend Tests for Concentrations and Loadings - Branford
- Attachment 7. Seasonal Kendall τ Trend Tests for Concentrations and Loadings - Wilcox

- Attachment 8. Analyses of Variance Comparing Concentrations and Loadings in Pre- and Post-OFW Designation Periods Segregated by Flow Regimes

- Attachment 9. Seasonal Kendall τ Trend Tests for Concentrations and Loadings Segregated by Flow Regimes - Branford

- Attachment 10. Seasonal Kendall τ Trend Tests for Concentrations and Loadings Segregated by Flow Regimes - Wilcox

Initially, time series of several water quality parameters and daily flows were produced to examine the general form of the data. These plots show that the data are typically quite variable, with the most notable potential trend being found in the NO_2NO_3 concentrations.

We then examined the daily flow statistics and these results are found in Attachment 2. We calculated cumulative frequency distributions for both stations for both the pre- and post-OFW periods. There was little difference between the flow distributions in the two periods at the Branford station. However, there appears to be somewhat lower flows in the Suwannee River at Wilcox during the post-OFW period.

Our next effort entailed examination of the relationships between several water quality parameters and river flow (Attachment 3). The relationships of specific conductance, and calcium, magnesium, and sulfate concentrations were particularly strong. The relationship between NO_2NO_3 concentrations and river flow was also significant but with a greater degree of uncertainty in that relationship.

Loadings for several water quality parameters were estimated from the flow and water quality data (Attachment 4). Time series plots of these loading estimates, similar to the observations made from the concentration data, exhibit a great deal of variability but with trends being most apparent for the NO_2NO_3 loadings at both stations.

We calculated analyses of variance (ANOVA) to test the hypothesis of no difference in concentrations or loadings between the pre- and post-OFW periods. The results from these analyses are presented in Attachment 5. Initially, the ANOVAs were performed on untransformed data. However, to improve the homogeneity of the variances and more closely approximate a normal distribution, natural log transformations of the concentration and loading data were calculated and the ANOVAs performed on these transformed data. The results of these analyses are summarized in Table 1.

TABLE 1. RESULTS OF ANOVAs COMPARING PRE- AND POST-OFW PERIODS * designates a significant ANOVA result at α=0.05.				
Variable	**Branford**		**Wilcox**	
	Pre-OFW Mean	Post-OFW Mean	Pre-OFW Mean	Post-OFW Mean
Daily Flow	7600	7747	10465	10198
Specific Conductance	215	192	218	236
Calcium Concentrations	27.5	29.8	35	34
Nitrite-Nitrate Concentrations	0.42	0.64*	0.42	0.58*
Calcium Loading	12662	13019	23898	23837
Nitrite-Nitrate Loading	187	275*	317	388*

The results indicate that there was a significant increase in NO_2NO_3 concentrations between the pre- and post-OFW periods. No other significant differences were detected.

To examine whether significant temporal trends in either the concentrations or loadings of NO_2NO_3 nitrogen have occurred since the OFW designation, a series of seasonal Kendall τ tests were performed. The results of these the analyses are presented in Attachment 6 (Branford) and 7 (Wilcox) and summarized in Table 2. Generally, no significant temporal trends were detected. A significant positive trend in NO_2NO_3 nitrogen concentrations was found at both sites. A significant negative trend in calcium loading was detected at the Wilcox site.

TABLE 2. RESULTS OF SEASONAL KENDALL τ TESTS OF TEMPORAL TRENDS		
Variable	**Branford**	**Wilcox**
Daily Flow	No Significant Trend	No Significant Trend
Specific Conductance	No Significant Trend	No Significant Trend
Calcium Concentrations	No Significant Trend	No Significant Trend
Nitrite-Nitrate Concentrations	Significant Positive Trend	Significant Positive Trend
Calcium Loading	No Significant Trend	Significant Negative Trend
Nitrite-Nitrate Loading	No Significant Trend	No Significant Trend

Discussions with David Hornsby led to a further set of data analyses, similar in form to those summarized above, but conducted on data stratified according to flow. The logic is based on the knowledge that at flows less than 6000 cfs at Wilcox that the Suwannee River flow is predominantly baseflow dominated by groundwater. At high flows (> 10,000 cfs) the aquifers are being recharged.

The ANOVAs described above were repeated for each of three flow regimes:

- Low – flow < 6,00 cfs at Wilcox, < 3,297 cfs at Branford (based on relationship between flows at Wilcox and Branford);
- Medium – flow > 6,000 cfs and < 10,000 cfs at Wilcox, > 3,297 cfs and < 6,957 cfs at Branford; and
- High – flow > 10,000 cfs at Wilcox, > 6,957 cfs at Branford.

The results from the analyses are presented in Attachment 8. Tables 3 and 4 summarize these results. Significant increases in NO_2NO_3 nitrogen concentrations were observed at both sites under the moderate flow regime. There was also a significant increase at Branford under the low flow regime. Significantly higher NO_2NO_3 nitrogen loadings were found at both sites under the moderate and high flow regimes.

TABLE 3. RESULTS OF ANOVAs COMPARING PRE- AND POST-OFW PERIODS AT BRANFORD ACCORDING TO FLOW REGIME.
* designates a significant ANOVA result at α=0.05.

Variable	Low Flow Regime		Moderate Flow Regime		High Flow Regime	
	Pre-OFW Period	Post-OFW Period	Pre-OFW Period	Post-OFW Period	Pre-OFW Period	Post-OFW Period
Specific Conductance	318	308	220	250*	109	118
Calcium Concentrations	46.3	43.1	31.3	35.2	15.9	15.6
Nitrite-Nitrate Concentrations	0.69	0.85*	0.47	0.84*	0.24	0.32
Calcium Loading	10457	9265	12510	13227*	13666	15369
Nitrite-Nitrate Loading	153	180	188	317*	201	300*

TABLE 4. RESULTS OF ANOVAs COMPARING PRE- AND POST-OFW PERIODS AT WILCOX ACCORDING TO FLOW REGIME.
* designates a significant ANOVA result at α=0.05.

Variable	Low Flow Regime		Moderate Flow Regime		High Flow Regime	
	Pre-OFW Period	Post-OFW Period	Pre-OFW Period	Post-OFW Period	Pre-OFW Period	Post-OFW Period
Specific Conductance	298	300	251	263	147	152
Calcium Concentrations	48.9	41.3	40.1	39.7	20.8	21.9
Nitrite-Nitrate Concentrations	0.60	0.72	0.51	0.69*	0.27	0.35
Calcium Loading	20184	19051	25517	24643	23075	26309
Nitrite-Nitrate Loading	257	308	327	427*	327	420*

The final set of data analyses entailed calculation of the seasonal Kendall τ tests by flow regime at both Branford and Wilcox. The results from these analyses are presented in Attachments 9 (Branford) and 10 (Wilcox). Table 5 summarizes these results.

TABLE 5. RESULTS OF SEASONAL KENDALL τ TESTS OF TEMPORAL TRENDS AT BRANFORD.

Variable	Low Flow Regime	Moderate Flow Regime	High Flow Regime
Specific Conductance	No Significant Trend	No Significant Trend	No Significant Trend
Calcium Concentrations	No Significant Trend	No Significant Trend	No Significant Trend
Nitrite-Nitrate Concentrations	No Significant Trend	Significant Positive Trend	No Significant Trend
Calcium Loading	Significant Negative Trend	Significant Negative Trend	No Significant Trend
Nitrite-Nitrate Loading	No Significant Trend	Significant Positive Trend	No Significant Trend

TABLE 5. RESULTS OF SEASONAL KENDALL τ TESTS OF TEMPORAL TRENDS AT WILCOX.

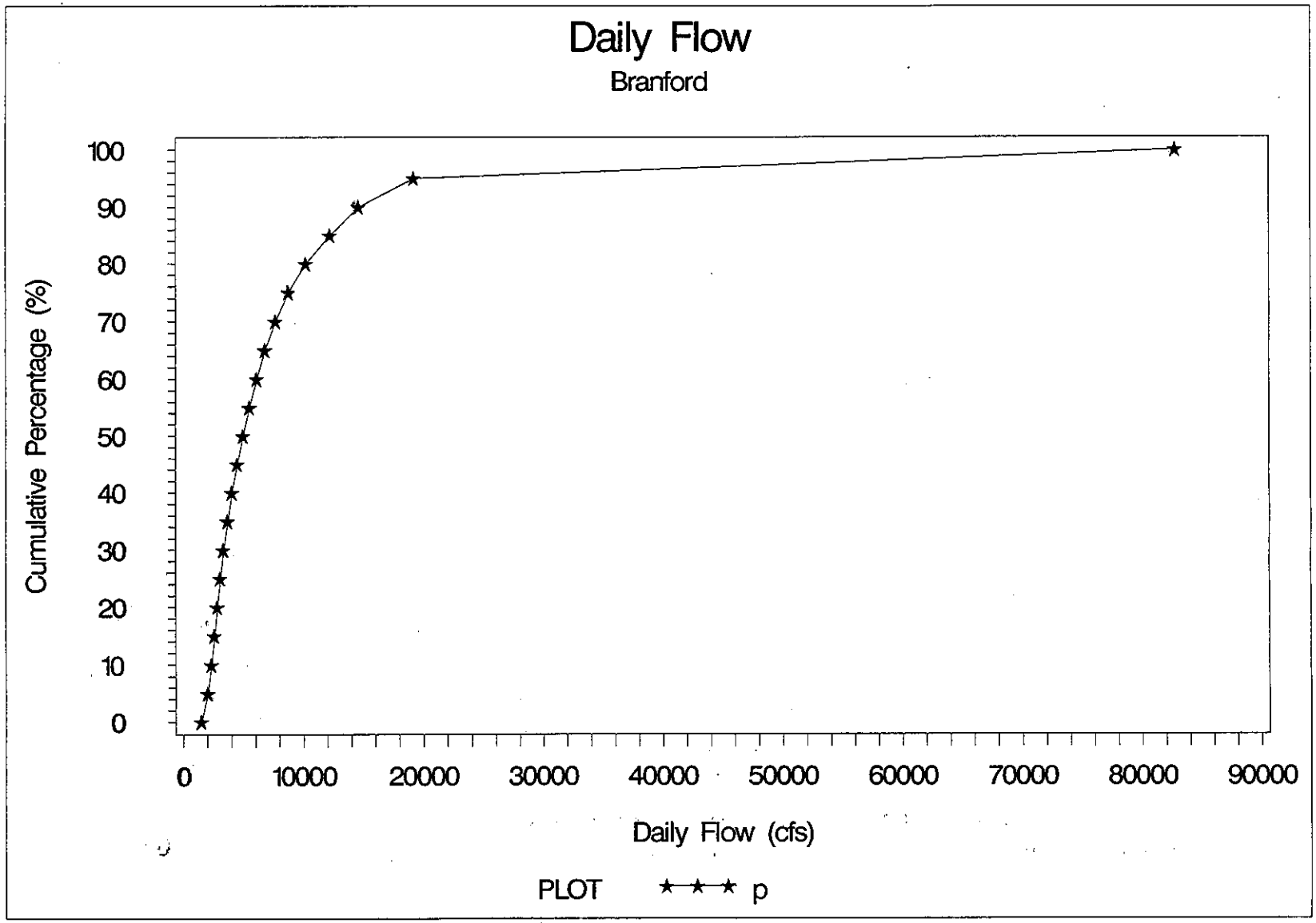
Variable	Low Flow Regime	Moderate Flow Regime	High Flow Regime
Specific Conductance	No Significant Trend	No Significant Trend	No Significant Trend
Calcium Concentrations	Significant Negative Trend	No Significant Trend	No Significant Trend
Nitrite-Nitrate Concentrations	Significant Positive Trend	No Significant Trend	No Significant Trend
Calcium Loading	No Significant Trend	No Significant Trend	No Significant Trend
Nitrite-Nitrate Loading	Significant Positive Trend	No Significant Trend	No Significant Trend

The trend test results show that the significant temporal trends in either NO_2NO_3 nitrogen concentrations or loadings were most likely to be found under the low flow regimes.

CONCLUSIONS

These new analyses suggest that there has been a statistically significant increase in NO_2NO_3 nitrogen concentrations and loadings since the OFW designation in 1979. It also appears that these changes were most likely

observed under low flow conditions when groundwater predominates the flows in the lower Suwannee River.


Daily Flow
Branford
Cumulative Percentage (%)
100
90
80
70
60
50
40
30
20
10
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Daily Flow (cfs)
PLOT
p

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis
WILCOX
The UNIVARIATE Procedure
Variable: FLOW (Flow (cfs))

Moments

N	21184	Sum Weights	21184
Mean	10361.3321	Sum Observations	219494460
Std Deviation	6484.45257	Variance	42048125.1
Skewness	2.33979178	Kurtosis	10.1025477
Uncorrected SS	3.16496E12	Corrected SS	8.90705E11
Coeff Variation	62.5831937	Std Error Mean	44.5522184

Basic Statistical Measures

Location		Variability	
Mean	10361.33	Std Deviation	6484
Median	8290.00	Variance	42048125
Mode	10800.00	Range	81740
		Interquartile Range	6900

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	232.566	Pr > |t|	<.0001
Sign	M	10592	Pr >= |M|	<.0001
Signed Rank	S	1.122E8	Pr >= |S|	<.0001

Quantiles (Definition 5)

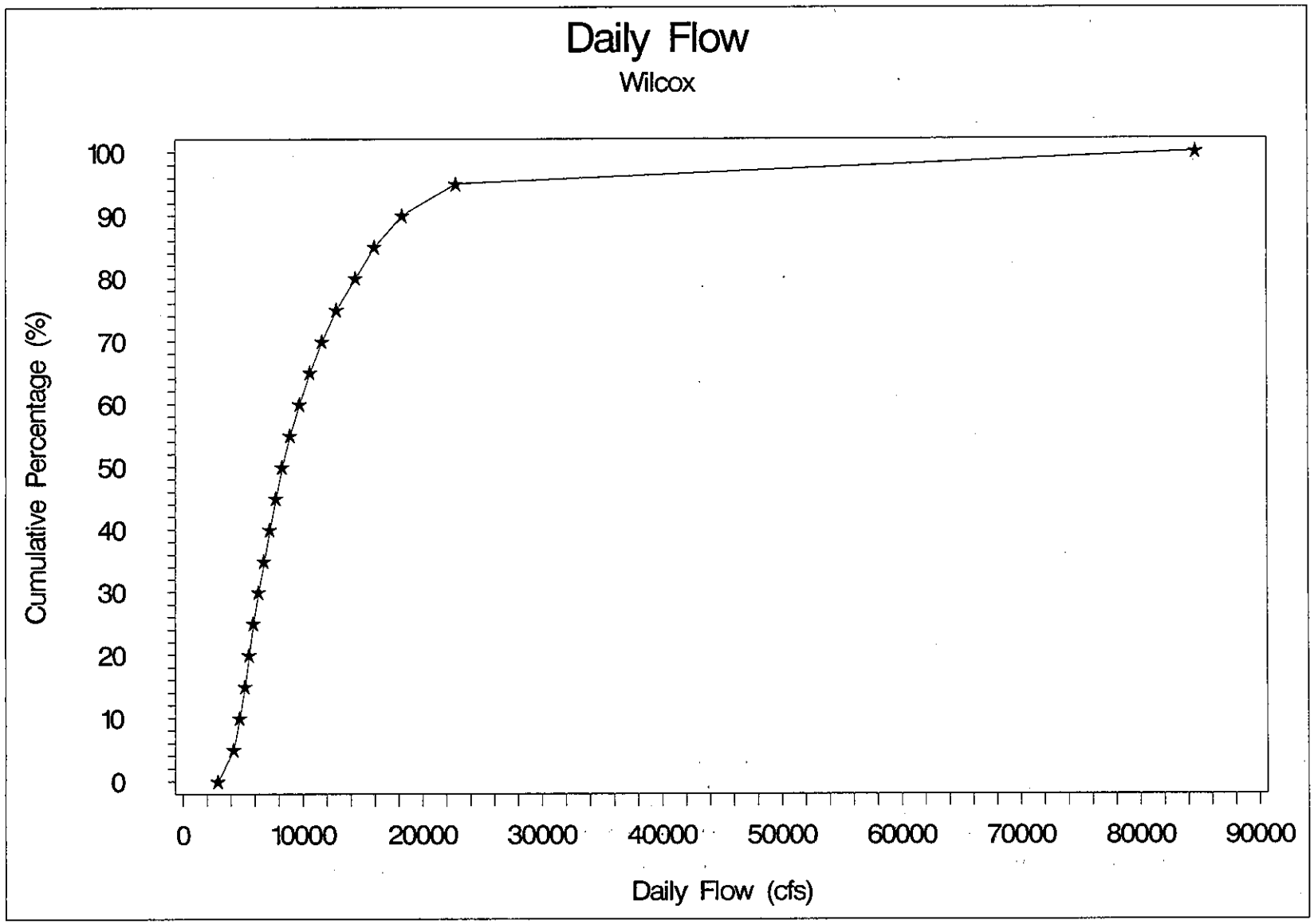
Quantile	Estimate
100% Max	84700
99%	33500
95%	22800
90%	18300
75% Q3	12800
50% Median	8290
25% Q1	5900
10%	4740
5%	4250
1%	3630
0% Min	2960

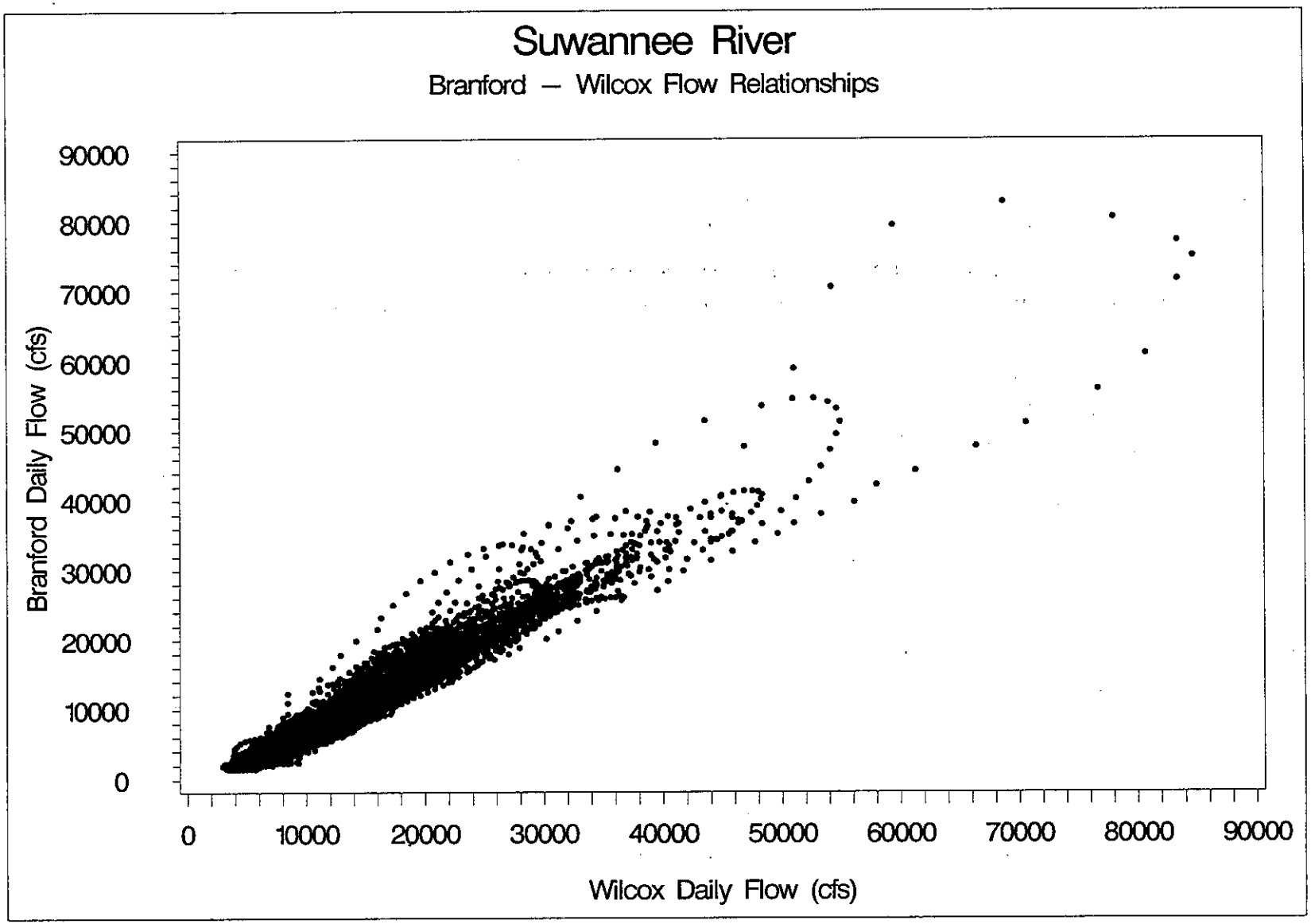
Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
2960	15002	78000	2753
3100	15003	80700	2757
3110	14944	83400	2754
3260	21171	83400	2756
3270	5993	84700	2755

Obs	cp0	cp5	cp10	cp15	cp20	cp25	cp30	cp35	cp40	cp45	cp50	cp55
1	2960	4250	4740	5190	5540	5900	6330	6790	7270	7780	8290	8960

Obs	cp60	cp65	cp70	cp75	cp80	cp85	cp90	cp95	cp100
1	9750	10600	11600	12800	14400	16000	18300	22800	84700


Daily Flow
Wilcox
Cumulative Percentage (%)
100
90
80
70
60
50
40
30
20
10
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Daily Flow (cfs)


Suwannee River
Branford – Wilcox Flow Relationships
Branford Daily Flow (cfs)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Wilcox Daily Flow (cfs)

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis

The CONTENTS Procedure

Data Set Name:	C.SUWANNEE	Observations:	72659
Member Type:	DATA	Variables:	6
Engine:	V6	Indexes:	0
Created:	10:59 Monday, October 30, 2000	Observation Length:	48
Last Modified:	10:59 Monday, October 30, 2000	Deleted Observations:	0
Protection:		Compressed:	NO
Data Set Type:		Sorted:	YES
Label:			

-----Engine/Host Dependent Information-----

Data Set Page Size:	4096
Number of Data Set Pages:	866
First Data Page:	1
Max Obs per Page:	84
Obs in First Data Page:	62
Number of Data Set Repairs:	0
File Name:	c:\FDEP\SUWANNEE\suwannee.sd2
Release Created:	6.08.00
Host Created:	WIN

-----Alphabetic List of Variables and Attributes-----

#	Variable	Type	Len	Pos	Format	Label
6	DATE	Num	8	40	DATE7.	
3	DAY	Num	8	16		
4	FLOW	Num	8	24		Flow (cfs)
5	GAGE	Char	8	32		USGS Gage Number
2	MONTH	Num	8	8		
1	YEAR	Num	8	0		

-----Sort Information-----

Sortedby: GAGE DATE
Validated: YES
Character Set: ANSI

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis

The FREQ Procedure

USGS Gage Number

GAGE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
02319500	26542	36.53	26542	36.53
02320500	24931	34.31	51473	70.84
02323500	21186	29.16	72659	100.00

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis
WILCOX

---------- period=1 ----------

The UNIVARIATE Procedure
Variable: FLOW (Flow (cfs))

Moments

N	14336	Sum Weights	14336
Mean	10540.0872	Sum Observations	151102690
Std Deviation	6460.35488	Variance	41736185.2
Skewness	2.52431403	Kurtosis	12.7540315
Uncorrected SS	2.19092E12	Corrected SS	5.98288E11
Coeff Variation	61.2931825	Std Error Mean	53.9563272

Basic Statistical Measures

Location		Variability	
Mean	10540.09	Std Deviation	6460
Median	8600.00	Variance	41736185
Mode	8000.00	Range	81430
		Interquartile Range	7020

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	195.3448	Pr > |t|	<.0001
Sign	M	7168	Pr >= |M|	<.0001
Signed Rank	S	51383808	Pr >= |S|	<.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	84700
99%	33500
95%	22500
90%	18300
75% Q3	13100
50% Median	8600
25% Q1	6080
10%	4810
5%	4280
1%	3720
0% Min	3270

Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
3270	5993	78000	2753
3280	6021	80700	2757
3340	5578	83400	2754
3340	5548	83400	2756
3370	5992	84700	2755

Missing Values

Missing Value	Count	-----Percent Of----- All Obs	Missing Obs
.	2	0.01	100.00

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis
WILCOX

---------- period=2 ----------

The UNIVARIATE Procedure
Variable: FLOW (Flow (cfs))

Moments

N	6848	Sum Weights	6848
Mean	9987.11595	Sum Observations	68391770
Std Deviation	6519.23216	Variance	42500388
Skewness	1.98433166	Kurtosis	4.74059219
Uncorrected SS	9.74037E11	Corrected SS	2.91E11
Coeff Variation	65.2764241	Std Error Mean	78.7797451

Basic Statistical Measures

Location		Variability	
Mean	9987.12	Std Deviation	6519
Median	7560.00	Variance	42500388
Mode	10700.00	Range	45340
		Interquartile Range	6670

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	126.7726	Pr > |t|	<.0001
Sign	M	3424	Pr >= |M|	<.0001
Signed Rank	S	11725488	Pr >= |S|	<.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	48300
99%	33600
95%	23600
90%	18500
75% Q3	12300
50% Median	7560
25% Q1	5630
10%	4630
5%	4110
1%	3530
0% Min	2960

Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
2960	664	47500	1566
3100	665	47900	1570
3110	606	48000	1567
3260	6833	48200	1569
3300	6837	48300	1568

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis
WILCOX

Obs	period	cp0	cp5	cp10	cp15	cp20	cp25	cp30	cp35	cp40	cp45	cp50
1	1	3270	4280	4810	5320	5670	6080	6590	7100	7600	8050	8600
2	2	2960	4110	4630	5010	5340	5630	5980	6310	6650	7070	7560

Obs	cp55	cp60	cp65	cp70	cp75	cp80	cp85	cp90	cp95	cp100
1	9320	10100	10900	11800	13100	14500	16100	18300	22500	84700
2	8160	8970	9790	10900	12300	13900	15900	18500	23600	48300

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Suwannee River Data Analysis
BRANFORD
The UNIVARIATE Procedure
Variable: FLOW (Flow (cfs))

Moments

N	24929	Sum Weights	24929
Mean	7039.41394	Sum Observations	175485550
Std Deviation	5989.5232	Variance	35874388.2
Skewness	2.59779372	Kurtosis	11.8705488
Uncorrected SS	2.12959E12	Corrected SS	8.94277E11
Coeff Variation	85.0855378	Std Error Mean	37.9349768

Basic Statistical Measures

Location		Variability	
Mean	7039.414	Std Deviation	5990
Median	4980.000	Variance	35874388
Mode	2640.000	Range	81270
		Interquartile Range	5660

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	185.5653	Pr > |t|	<.0001
Sign	M	12464.5	Pr >= |M|	<.0001
Signed Rank	S	1.5537E8	Pr >= |S|	<.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	82800
99%	29200
95%	19200
90%	14600
75% Q3	8750
50% Median	4980
25% Q1	3090
10%	2350
5%	2030
1%	1680
0% Min	1530

Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
1530	8770	75100	6135
1530	8769	77300	6134
1540	8969	79500	6131
1540	8966	80600	6133
1540	8963	82800	6132

Obs	cp0	cp5	cp10	cp15	cp20	cp25	cp30	cp35	cp40	cp45	cp50
1	1530	2030	2350	2600	2840	3090	3370	3710	4070	4520	4980

Obs	cp55	cp60	cp65	cp70	cp75	cp80	cp85	cp90	cp95	cp100
1	5520	6110	6800	7680	8750	10200	12200	14600	19200	82800

Suwannee River
Branford - Wilcox Flow Relationships

The REG Procedure
Model: MODEL1
Dependent Variable: Br_flow

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7.4466999E11	7.4466999E11	420670	<.0001
Error	20909	37013086559	1770199		
Corrected Total	20910	7.81683E11			

Root MSE	1330.48818	R-Square	0.9526
Dependent Mean	7298.25116	Adj R-Sq	0.9526
Coeff Var	18.23023		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2193.25116	17.28609	-126.88	<.0001
Wx_flow	1	0.91502	0.00141	648.59	<.0001

Brflow = -2193 + 0.91502 WXFLOW

WX flow	BR FLOW
6000	3297
10000	6957

POR

Suwannee.sdz - daily flow record

02320500	Branford	1927 - 9/99
02323500	Wilcox	1930 - 9/99

year
month
day
flow (cfs)
gage
date

6000 - GW
10000 -

Branford Pre

FIELDID	SITEID	STATID	DATSAMP	NO3NTOT	NO3NDISS	NO2NTOT	NO2NDISS
770392	61420001	SUW140C1	18-Jul-77	0	0.69	0	0.01
770465	61420001	SUW140C1	16-Aug-77	0	0.43	0	0.01
770539	61420001	SUW140C1	19-Sep-77	0	0.58	0	0.25
770579	61420001	SUW140C1	17-Oct-77	0	0.73	0	0.02
770674	61420001	SUW140C1	14-Nov-77	0	0.24	0	0.02
770713	61420001	SUW140C1	12-Dec-77	0	0.22	0	0.01
780018	61420001	SUW140C1	17-Jan-78	0	0.17	0	0
780108	61420001	SUW140C1	14-Feb-78	0	0.1	0	0
780187	61420001	SUW140C1	23-Mar-78	0	0.1	0	0
780239	61420001	SUW140C1	11-Apr-78	0	0.51	0	0
780324	61420001	SUW140C1	16-May-78	0	0.33	0	0
780430	61420001	SUW140C1	20-Jun-78	0	0.62	0	0
780482	61420001	SUW140C1	20-Jul-78	0	0.4	0	0
780559	61420001	SUW140C1	16-Aug-78	0	0.56	0	0
780650	61420001	SUW140C1	18-Sep-78	0	0.82	0	0
780743	61420001	SUW140C1	18-Oct-78	0	1.07	0	0
780816	61420001	SUW140C1	13-Nov-78	0	0.92	0	0
780907	61420001	SUW140C1	19-Dec-78	0	0.92	0	0
790030	61420001	SUW140C1	16-Jan-79	0	0.5	0	0
790128	61420001	SUW140C1	20-Feb-79	0	0.13	0	0
790190	61420001	SUW140C1	13-Mar-79	0	0.16	0	0.01
790278	61420001	SUW140C1	17-Apr-79	0	0.59	0	0
790319	61420001	SUW140C1	09-May-79	0	0.63	0	0
790418	61420001	SUW140C1	05-Jun-79	0	0.54	0	0
790488	61420001	SUW140C1	18-Jul-79	0	0.46	0	0
790655	61420001	SUW140C1	21-Aug-79	0	1.08	0	0
790754	61420001	SUW140C1	22-Oct-79	0		0	
790923	61420001	SUW140C1	20-Nov-79	0		0	
790942	61420001	SUW140C1	12-Dec-79	0	0.36	0	0
800008	61420001	SUW140C1	14-Jan-80	0	0.88	0	0
800069	61420001	SUW140C1	20-Feb-80	0	0.33	0	0
800136	61420001	SUW140C1	12-Mar-80	0	0.02	0	0
800196	61420001	SUW140C1	15-Apr-80	0	0.06	0	0
800261	61420001	SUW140C1	07-May-80	0	0.97	0	0
800353	61420001	SUW140C1	11-Jun-80	0	1.04	0	0
800394	61420001	SUW140C1	07-Jul-80	0	0.74	0	0
800494	61420001	SUW140C1	07-Aug-80	0	0.9	0	0
800572	61420001	SUW140C1	04-Sep-80	0	2.28	0	0

Live Oak
(904) 362 0001

WILCOX

FIELDID	SITEID	STATID	DATSAMP	NO3NTOT	NO3NDISS	NO2NTOT	NO2NDISS
770594	01429002	SUW160C1	18-Oct-77	0	0.63	0	0.01
770669	01429002	SUW160C1	15-Nov-77	0	0.19	0	0.01
770721	01429002	SUW160C1	12-Dec-77	0	0.2	0	0.01
780034	01429002	SUW160C1	17-Jan-78	0	0.12	0	0
780096	01429002	SUW160C1	13-Feb-78	0	0.08	0	0
780183	01429002	SUW160C1	22-Mar-78	0	0.71	0	0
780234	01429002	SUW160C1	10-Apr-78	0	0.4	0	0
780326	01429002	SUW160C1	16-May-78	0	0.41	0	0
780416	01429002	SUW160C1	19-Jun-78	0	0.52	0	0
780485	01429002	SUW160C1	21-Jul-78	0	0.37	0	0
780554	01429002	SUW160C1	14-Aug-78	0	0.41	0	0
780656	01429002	SUW160C1	18-Sep-78	0	0.69	0	0
780728	01429002	SUW160C1	18-Oct-78	0	0.76	0	0
780822	01429002	SUW160C1	14-Nov-78	0	0.66	0	0
780913	01429002	SUW160C1	20-Dec-78	0	1.03	0	0
790029	01429002	SUW160C1	16-Jan-79	0	0.5	0	0
790136	01429002	SUW160C1	22-Feb-79	0	0.2	0	0
790184	01429002	SUW160C1	13-Mar-79	0	0.14	0	0
790284	01429002	SUW160C1	18-Apr-79	0	0.43	0	0
790325	01429002	SUW160C1	10-May-79	0	0.83	0	0
790425	01429002	SUW160C1	06-Jun-79	0	0.73	0	0
790478	01429002	SUW160C1	17-Jul-79	0	0.47	0	0
790652	01429002	SUW160C1	21-Aug-79	0	0.92	0	0
790760	01429002	SUW160C1	23-Oct-79	0		0	
790870	01429002	SUW160C1	21-Nov-79	0		0	
790940	01429002	SUW160C1	11-Dec-79	0	0.6	0	0
800015	01429002	SUW160C1	15-Jan-80	0	0.74	0	0
800082	01429002	SUW160C1	21-Feb-80	0	0.37	0	0
800132	01429002	SUW160C1	11-Mar-80	0	0.37	0	0
800203	01429002	SUW160C1	16-Apr-80	0	0.07	0	0
800251	01429002	SUW160C1	06-May-80	0	0.41	0	0
800357	01429002	SUW160C1	11-Jun-80	0	0.77	0	0
800403	01429002	SUW160C1	08-Jul-80	0	0.68	0	0
800490	01429002	SUW160C1	06-Aug-80	0	0.64	0	0
800559	01429002	SUW160C1	03-Sep-80	0	0.89	0	0

WILCOX

FIELDID	DATSAMP	TKN	TKNREM	NOXNTOT	NOXNTREM	NO3NTOT	NO3NTREM	NO2NTOT	NO2NTREM
89020050	13-Feb-89	0.18		0.8		0.8		0.05	K
89040335	10-Apr-89	1		0.44		0.44		0.05	K
89060596	12-Jun-89	0.1	K	0.49		0.45		0.05	K
89080683	13-Aug-89			0.76		0.76		0.05	K
89100958	09-Oct-89	0.1	K	0.57		0.57		0.05	K
89111291	11-Dec-89	0.35		0.88		0.88		0.05	K
90020112	14-Feb-90	0.59		0.28		0.28		0.05	K
90030350	13-Mar-90	0.81		0.82		0.82		0.05	K
90040541	17-Apr-90	0.3		0.59		0.59		0.05	K
90040728	15-May-90	0.1	K	0.83		0.83		0.05	K
90050904	13-Jun-90	0.23		0.57		0.57		0.05	K
90071226	16-Jul-90	0.13		0.52		0.52		0.05	K
90071474	15-Aug-90	0.11		0.55		0.55		0.05	K
90081859	13-Sep-90	0.16		0.37		0.37		0.05	K
90102114	18-Oct-90	0.35		0.45		0.45		0.05	K
90102393	14-Nov-90	0.1	K	0.69		0.66		0.05	K
90122726	13-Dec-90	0.2		0.73		0.73		0.05	K
91010037	15-Jan-91	0.22		0.76		0.76		0.05	K
91010194	20-Feb-91	0.87		0.13		0.13		0.05	K
91020569	21-Mar-91	0.86		0.05	K	0.05	K	0.05	K
91040990	18-Apr-91	0.7		0.38		0.38		0.05	K
91051337	16-May-91	1.3		1		0.54		0.46	
91051667	13-Jun-91	0.91		0.36		0.31		0.052	
91072023	16-Jul-91	0.62		0.31		0.31		0.05	K
91072398	12-Aug-91	0.94		0.1		0.98		0.05	K
91082621	09-Sep-91	0.47		0.52		0.52		0.05	K
91093027	14-Oct-91	0.16		0.82					
91103332	12-Nov-91	0.2		0.99					
91113574	10-Dec-91	0.13		0.96					
91124184	13-Jan-92	0.19		0.91					
92010215	10-Feb-92	0.59		0.14					
92020604	09-Mar-92	0.68		0.1					
92030945	13-Apr-92	0.83		0.36					
92041183	07-May-92	0.6		0.61					
92051397	04-Jun-92	0.17		0.86					
92061938	08-Jul-92	0.67		0.55					
92072276	06-Aug-92	0.5		0.67					
92082537	03-Sep-92	0.81		0.33					
92093130	15-Oct-92	0.7		0.23					
92103557	05-Nov-92	0.39		0.64					
92113801	03-Dec-92	0.64		0.33					
92124227	07-Jan-93	0.35		0.56					
93010256	04-Feb-93	0.55		0.17					
93020388	04-Mar-93	0.45		0.33					
93031035	08-Apr-93	0.78		0.09					
93041284	06-May-93	0.28		0.65					
93051769	03-Jun-93	0.18		0.8					

93063058	13-Jul-93	0.35		0.88					
93073274	05-Aug-93	0.12		0.87					
93083672	02-Sep-93	0.17		0.86					
93094076	07-Oct-93	0.18		0.71					
93104425	11-Nov-93	0.27		0.75					
93114670	09-Dec-93	0.36		0.75					
93124830	06-Jan-94	0.46		0.6					
94010097	10-Feb-94	0.85		0.08					
94020239	10-Mar-94	0.76		0.05	K				
94030422	07-Apr-94	0.8		0.18					
94040511	10-May-94	0.36		0.72					
94050643	07-Jun-94	0.1	K	0.87					
94060947	12-Jul-94	0.64		0.39					
94071037	11-Aug-94	0.72		0.35					
94081149	08-Sep-94	0.34		0.51					
94091292	11-Oct-94	0.86		0.07					
94101421	10-Nov-94	0.43		0.36					
94111614	14-Dec-94	0.46		0.38					
94121725	05-Jan-95	0.34		0.67					
95010030	09-Feb-95	0.49		0.26					
95020193	09-Mar-95	0.5		0.25					
95030623	04-Apr-95	0.5		0.41					
95040764	11-May-95	0.19		0.88					
95050887	08-Jun-95	0.15		0.93					
95061072	13-Jul-95	0.35		0.81					
95071199	14-Aug-95	0.45		0.65					
95081357	11-Sep-95	0.57		0.65					
95091417	10-Oct-95	0.38		0.64					
95091677	14-Nov-95	0.12		0.61					
95111800	12-Dec-95	0.16		0.86					
95121965	16-Jan-96	0.27		0.72					
96010072	13-Feb-96	0.39		0.56					
96020192	12-Mar-96	0.43		0.29					
96030349	09-Apr-96	0.9		0.08					
96040471	15-May-96	0.54		0.33					
96050627	11-Jun-96	0.13		0.77					
96060907	23-Jul-96	0.38		0.79					
96071084	15-Aug-96	0.26		0.88					
96081226	11-Sep-96	0.19		0.81					
96101575	13-Nov-96	0.34		0.84					
96111774	10-Dec-96	0.28		0.8					
96121935	22-Jan-97	0.69		0.32					
97010386	18-Feb-97	0.66		0.28					
97020513	18-Mar-97	0.64		0.3					
97030702	09-Apr-97	0.45		0.5					
97040853	14-May-97	0.43		0.66					
97040855	14-May-97	0.46		0.68	Q				
97051095	16-Jun-97	0.46		0.59					

97061309	17-Jul-97	0.44	0.67				
97071476	15-Aug-97	0.84	0.36				
97081618	12-Sep-97	0.18	0.79				
97091843	13-Oct-97	0.17	0.93				
97102039	18-Nov-97	0.74	0.24				
97112118	17-Dec-97	0.5	0.22				
97122441	14-Jan-98	0.58	0.15				
98010152	12-Feb-98	0.61	0.13				
98020371	17-Mar-98	0.67	0.1				
98030795	14-Apr-98	0.48	0.42				
98040970	12-May-98	0.42	0.88				
98051156	09-Jun-98	0.09	1.13				
98061461	14-Jul-98	0.12	1.07				
98071670	12-Aug-98	0.2	1.12				
98081856	09-Sep-98	0.25	0.9				
98102182	22-Oct-98	0.53	0.42				
98102288	11-Nov-98	0.25	1.08				
98112488	09-Dec-98	0.15	1.13				
98122828	07-Jan-99	0.15	1.14				
99012963	10-Feb-99	0.64	0.45				
99023394	03-Mar-99	0.34	0.72				
99033494	14-Apr-99	0.22	0.83				
99043646	05-May-99	0.64	0.94				

DRAFT - CLARIFICATION ON QUESTIONS FROM JANICKI ENV.

Scope of Work

Regression analyses of salinity-streamflow relationships in the Lower Peace River/Upper Charlotte Harbor Estuary

Background

The Hydrobiological Monitoring Program (HBMP) for the Lower Peace River/Upper Charlotte Harbor Estuary conducted by the Peace River Manasota Regional Water Supply Authority (PRMRWSA) specifies that regressions of salinity with streamflow will be periodically re-evaluated as new data for the estuary becomes available. These regressions include salinity at fixed-location stations as a function of streamflow and the locations of surface isohalines as a function of streamflow. The District encumbered funds to perform these analyses and issued a purchase order to the PRMRWSA to conduct this work. A previous scope of work was prepared by Coastal Environmental. The scope of work included below is revised from the previous scope and is intended to support activities of the scientific review panel and presentation of the HBMP findings in the Year Three report. Presentation of the regression analyses in a separate report will assist reviewers in evaluating the salinity regime of the estuary, the relative effect of withdrawals, and the HBMP study design.

Task I Salinity at fixed location stations

The contractor will develop statistically rigorous models of salinity at each of seven fixed-location stations monitored as part of the HBMP (EQL stations 9, 10, 11, 12 13, 14, and 15). Regressions will be developed for salinity at surface, 1 meter, 2 meters and bottom depths as a function of gaged freshwater inflows. The contractor will investigate as the independent variable the total gaged flow at the water treatment plant (Peace at Arcadia + Horse and Joshua Creeks) and the total gaged flow to the lower river (gaged flow at treatment plant plus Shell Creek). The flow term that produces the best regression will be presented for each station. The contractor will similarly evaluate different lagged flow terms (average flows over preceding periods) and select the lagged flow term that produces the best regression. Appropriate plots and statistical results will be presented to support the final regressions developed for each station and depth.

- ***How is "best regression" defined?***
  Regression that produces high r-square value (not necessarily the highest), plus has a distribution of residuals that is homoscedastic, or nearly so.

- ***Are we looking for the "best regression" for all stations and depths, considered individually or overall?***
  Lets assume the form of the equation could be same for all stations and depths, unless results show otherwise (regression shows poor residuals). Then another

GENERAL QUESTIONS

What are the project deliverables?

Report that presents results (regression equations, diagnostic plots and predictions), text can be very limited. Just the results, no ecological interpretation necessary.

What is the project schedule?

Would like to have it done before year three report goes to scientific review panel, Hey, do it in by end of Jan. 2001 to pay off those holiday bills. Could be done a little later if necessary.

The time to complete the project will include the time to prepare the draft deliverables. It would seem reasonable that a thirty-day review by the District followed by a thirty-day period to respond to the comments.

Given the limited, straight-forward nature of this project, I would say that the District review can be shortened to 10 working days. Would like to receive the draft by end of January. If you want thirty days to respond that's okay, but hope that revisions can be minor or avoided entirely. I would hope a good kickoff meeting should avoid need for revisions.

Project budget estimate will depend upon the answers to the above questions.

Please keep it within the original cost estimated by Coastal.