STREAM DATA STATISTICAL ANALYSIS

November 9, 2015

Prepared for:

MINNEHAHA CREEK WATERSHED DISTRICT
QUALITY OF WATER QUALITY OF LIFE

WSB Project No. 3195-00

WSB

701 Xenia Avenue South, Suite 300
Minneapolis, MN 55416
Tel: (763) 541-4800 · Fax: (763) 541-1700
wsbeng.com

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Prepared By:

WSB & Associates, Inc.
701 Xenia Avenue S., Suite 300
Minneapolis, MN 55416
(763) 541-4800
(763) 541-1700 (Fax)

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I. Introduction

Monitoring of streams has occurred in the Minnehaha Creek Watershed District (MCWD) since 1968, with significant expansions in monitoring intensity occurring since the late 1990s. One of the goals of the MCWD Water Quality Program (as noted in the MCWD 2013 5-Year Monitoring Plan) is to provide data to "maximize efficiencies in monitoring frequencies, locations, and events."

Monitored stream parameters of concern include temperature (TEMP), dissolved oxygen (DO), conductivity (COND), pH, soluble reactive phosphorus (SRP), total phosphorus (TP), and total suspended solids (TSS). These parameters are typical for stream sampling, and go back to 1968 for certain MCWD stations. MCWD stream sampling frequency is typically every week from March to early November.

The specific objective of this report is to assess the number of monitoring stations on the selected streams listed and make recommendations for anchor site(s) that best represent the health of the stream for Minnehaha Creek, Painter Creek, Long Lake Creek, and Classen Creek.

SPSS statistical software[1] was used for the analyses because of its ability to provide probability values (i.e. p-values) and the quality and acceptability of its analytical methods as compared to MS Excel programs.

II. Data Clean Up

Stream water quality data was received from MCWD staff in the form of an Excel spreadsheet. The data was organized and pre-screened to identify potential problems and limitations. Duplicate values were replaced with average values of the two duplicates. All data not corresponding to the April through October period was removed due to relatively small amounts of data available during those months.

The following comparisons were determined appropriate:

- Minnehaha Creek: 2005-2014 available data for LGB01 vs. CMH07, CMH07 vs. CMH19, CMH02 vs. CMH11, CMH03 vs. CMH04, CMH03 vs. CMH12/15, CMH04 vs. CMH12/15, CMH04 vs. CMH24; and, 2007-2014 available data for CMH24 vs. CMH18, CMH24 vs. CMH06, and CMH18 vs. CMH06.
- Painter Creek: 2005-2014 available data for CPA03 vs. CPA04, CPA04 vs. CPA06, CPA06 vs. CPA01, and CPA01 vs. CPA05;
- Long Lake Creek: 2005-2014 available data for CLO01 vs. CLO03; and
- Classen Creek: 2006-2014 available data for CCL01 vs. CCL04.

[1] http://www-01.ibm.com/software/analytics/spss/products/statistics/

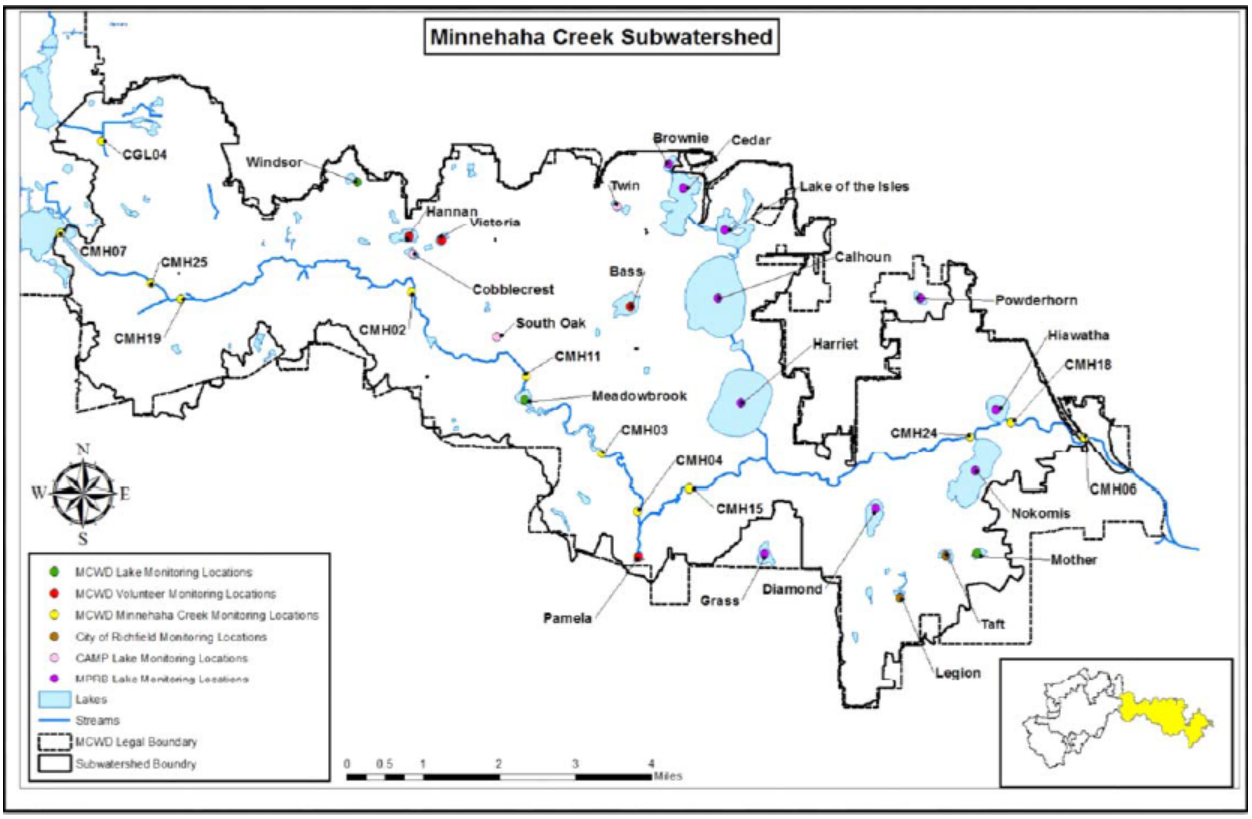
The data available for each individual site-to-site comparison was lined up and dates where both stream sites were not sampled were removed from further analysis. This ensured that one was always comparing data taken on the same day for both sites under analysis. Data was then uploaded to SPSS for statistical evaluation. Extreme outliers (greater than three standard deviations from the mean), where detected, were removed. If an outlier was detected for one station on a particular date, the data points were removed for both stations being compared. For example, if CPA01 had a TP outlier on 3/4/08 but CPA05 did not have an outlier on that date, both points were still removed prior to analysis. Plots of all comparisons can be found in Appendix A.

The next step was testing for normality for each of the proposed comparisons. The Shapiro-Wilk Test was utilized because it is highly robust. The normality testing results (0.05 level of significance) are shown in Appendix B (which also contains basic statistics); results indicate that many of the proposed comparisons do not have normal distributions for one or both of the stream locations. Typical data transformations (e.g. log, 1/X, square root) were performed on the raw data in an attempt to create normal distributions, but none of the transformations resulted in great improvement. Therefore non-parametric testing was applied to all site-to-site comparisons for consistency. The test chosen was the Kruskal-Wallis Test using a 0.05 level of significance. All comparisons had the same number of data points for the two sites being compared.

III. Minnehaha Creek

Minnehaha Creek flows 22 miles from Lake Minnetonka to the Mississippi River (Figure 1).

Figure 1. The Minnehaha Creek Subwatershed



Source: MCWD

Grays Bay (LGB01) and Grays Bay Dam (CMH07)

The headwaters of Minnehaha Creek begin at the Lake Minnetonka outlet at Grays Bay. Water passes over Grays Bay Dam, below which CMH07 is located. LGB01 is sampled bi-weekly (the location is immediately west of CMH07 in the center of the Bay; see Figure 1), while CMH07 is sampled weekly during the open-water season. As seen in Table1, there is only one statistically-significant difference between the two locations.

Table 1. LGB01 and CMH07 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP	
MONTH	LGB01	CMH07	LGB01	CMH07	LGB01	CMH07	LGB01	CMH07	LGB01	CMH07	LGB01	CMH07
APR	10.7	10.7	10.7	13.4	404	383	8.24	7.41	0	2	25	38
MAY	13.7	13.7	11.0	11.8	430	410	8.42	8.34	0	0	22	22
JUN	22.0	21.8	9.5	9.3	413	413	8.44	8.39	0	0	21	19
JUL	26.4	26.2	9.2	8.2	399	406	8.60	8.55	0	0	17	19
AUG	24.8	24.0	9.0	8.7	399	405	8.56	8.37	0	1	21	19
SEP	18.9	17.8	9.4	6.4	393	413	8.57	7.90	0	4	17	30
OCT	13.4	12.5	11.5	9.2	396	393	8.04	7.91	0	0	19	25

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

Grays Bay Dam (CMH07) and I-494 Interchange (CMH19)

From CMH07 Minnehaha Creek flows through a large wetland complex before it becomes confined to a narrower channel at the CMH19 location. Results indicate many statistically-significant differences between the two locations (Table 2). DO and pH decease downstream, while COND and TP increase in the downstream direction.

Table 2. CMH07 and CMH19 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH07	CMH19	CMH07	CMH19	CMH07	CMH19	CMH07	CMH19	CMH07	CMH19	CMH07	CMH19	CMH07	CMH19
APR	7.9	7.8	12.4	12.7	390	733	7.24	7.59	2	5	56	63	2	5
MAY	13.9	14.0	11.1	8.9	416	501	8.00	7.89	0	0	22	32	1	2
JUN	21.6	21.2	9.7	6.6	412	448	8.40	7.77	0	2	18	35	2	2
JUL	25.6	25.0	8.7	5.1	408	439	8.51	7.77	0	5	19	34	1	1
AUG	23.9	22.9	8.3	4.9	402	439	8.39	7.68	0	5	18	34	1	4
SEP	18.8	18.3	7.3	5.8	402	594	8.11	7.68	4	3	26	34	1	2
OCT	12.2	11.3	9.8	9.0	388	451	7.93	7.71	3	2	27	25	0	2

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

West 34th Street (CMH02) and Excelsior Blvd. (CMH11)

CMH02 is located on Minnehaha Creek soon after it passes underneath Highway 169. The creek continues to wind its way through St. Louis Park where CMH11 is located just before it enters a pond at Meadowbrook Golf Course. There are some statistically-significant differences between the two locations for pH, SRP, TP, and TSS (Table 3).

Table 3. CMH02 and CMH11 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH02	CMH11	CMH02	CMH11	CMH02	CMH11	CMH02	CMH11	CMH02	CMH11	CMH02	CMH11	CMH02	CMH11
APR	8.1	8.0	11.1	11.4	926	932	7.54	7.72	9	8	76	82	9	9
MAY	14.4	14.4	8.3	8.5	569	586	7.67	7.79	5	5	50	54	7	10
JUN	21.0	20.9	6.3	6.1	464	475	7.71	7.70	13	17	52	67	6	9
JUL	24.4	24.2	5.2	5.5	453	465	7.74	7.74	17	21	53	57	6	5
AUG	22.5	21.9	5.6	6.0	561	540	7.71	7.81	13	15	57	70	7	8
SEP	18.0	17.7	7.2	7.3	575	573	7.74	7.84	8	10	50	59	6	8
OCT	10.3	10.2	10.1	9.9	617	597	7.70	7.84	7	7	36	63	3	8

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

Browndale Dam (CMH03) and W. 56th Street (CMH04)

Located under the Browndale Avenue Bridge in Edina, CMH03 is roughly at the creek's midpoint between Lake Minnetonka and the Mississippi River. The small impoundment created by the dam is often referred to as the Mill Pond. The creek then flows a few miles through residential Edina to CMH04. Very few statistically-significant differences between the two locations are seen (Table 4), and these differences are likely not ecologically-significant. For example, mean TSS in June differs by only 2 ppm, which would not have an impact on the biota in the creek.

Table 4. CMH03 and CMH04 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH03	CMH04	CMH03	CMH04	CMH03	CMH04	CMH03	CMH04	CMH03	CMH04	CMH03	CMH04	CMH03	CMH04
APR	9.0	8.7	12.3	12.7	901	901	7.97	7.87	3	5	80	84	7	8
MAY	15.3	15.2	9.9	10.2	625	616	7.95	8.00	3	4	53	55	5	6
JUN	21.6	21.4	7.5	7.6	495	501	7.80	7.83	14	19	65	65	5	7
JUL	25.3	25.1	6.8	6.9	463	463	7.74	7.81	19	24	65	68	3	5
AUG	23.6	22.9	7.1	7.2	475	485	7.92	7.89	14	15	66	65	8	7
SEP	18.6	18.2	8.6	8.7	489	488	7.94	8.05	8	9	46	47	4	4
OCT	10.8	10.4	11.2	11.0	584	589	7.98	7.92	4	6	44	42	3	3

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

Browndale Dam (CMH03) and Upton/Xerxes Aves.(CMH12/15)

CMH12 and CMH15 are located downstream of CMH04, and located near the Edina/Minneapolis border. The two stations are less than 1000 feet from each other. CMH12 was discontinued in 2007 in favor of CMH15 because conditions were determined to be more favorable for accurate discharge measurement at CMH15.

Several statistically-significant differences between the two locations are seen (Table 5), but these differences are likely not ecologically-significant. For example, mean TSS in June differs by only 3 ppm, which would not have an impact on the biota in the creek. SRP is interesting because the concentration nearly doubles between the two locations, which is ecologically-significant.

Table 5. CMH03 and CMH12/15 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH03	CMH12&15	CMH03	CMH12&15	CMH03	CMH12&15	CMH03	CMH12&15	CMH03	CMH12&15	CMH03	CMH12&15	CMH03	CMH12&15
APR	9.0	8.6	12.4	12.4	911	912	8.08	7.98	3	7	85	94	8	7
MAY	15.4	15.1	9.7	9.6	603	613	7.96	7.94	3	6	55	58	6	8
JUN	21.7	21.4	7.6	7.3	485	493	7.80	7.75	12	20	61	75	5	8
JUL	25.4	24.7	6.9	6.7	467	470	7.76	7.79	17	24	64	66	4	7
AUG	23.4	22.3	7.4	7.3	477	486	7.87	7.85	13	19	67	66	8	6
SEP	18.7	17.9	8.4	8.4	500	515	7.89	7.88	8	14	54	56	5	4
OCT	11.2	10.7	11.0	10.3	562	573	7.94	7.84	6	12	51	55	4	4

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

W. 56th Street (CMH04) and Upton/Xerxes Aves. (CMH12/15)

These stations are described previously. No statistically-significant differences between the two locations are seen (Table 6).

Table 6. CMH04 and CMH12/15 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH04	CMH12&15	CMH04	CMH12&15	CMH04	CMH12&15	CMH04	CMH12&15	CMH04	CMH12&15	CMH04	CMH12&15	CMH04	CMH12&15
APR	8.7	8.5	12.7	12.2	901	898	7.87	7.85	7	9	84	88	8	7
MAY	15.2	14.9	9.9	9.4	616	636	8.00	7.88	5	7	57	61	6	6
JUN	21.4	21.3	7.6	7.2	502	504	7.83	7.72	20	25	65	**77**	7	8
JUL	25.1	24.8	6.9	6.8	463	462	7.81	7.80	24	27	65	66	5	7
AUG	22.9	22.5	7.2	6.9	485	485	7.89	7.85	15	20	65	67	7	7
SEP	18.2	18.0	8.8	8.9	478	490	7.99	7.94	9	12	45	48	4	5
OCT	10.4	10.3	11.0	10.6	589	597	7.95	7.92	7	9	42	44	3	3

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

W. 56th Street (CMH04) and 21st Ave./Minnehaha (CMH24)

CMH24 is located several miles downstream of CMH04, at a location just prior to the Lake Nokomis outfall. Very few statistically-significant differences between the two locations are seen (Table 7), and these differences are likely not ecologically-significant. For example, mean pH in July differs by only 0.13 units, which would not have an impact on the biota in the creek.

Table 7. CMH04 and CMH24 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH04	CMH24	CMH04	CMH24	CMH04	CMH24	CMH04	CMH24	CMH04	CMH24	CMH04	CMH24	CMH04	CMH24
APR	8.4	7.8	12.0	11.6	972	843	7.85	7.85	8	10	83	82	8	7
MAY	15.2	14.7	10.0	9.5	645	613	7.90	7.81	8	14	57	65	5	8
JUN	21.1	20.6	7.8	7.3	519	503	7.75	7.79	20	25	75	101	7	13
JUL	24.8	24.1	6.8	7.1	465	475	7.69	7.82	28	27	65	69	5	11
AUG	22.3	22.3	7.1	7.1	498	500	7.77	7.84	18	17	67	67	7	7
SEP	18.2	18.0	8.7	8.7	499	500	7.93	8.21	7	7	36	36	4	4
OCT	9.9	10.0	10.9	10.4	662	629	7.86	7.87	7	11	41	40	3	2

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

21st Ave./Minnehaha (CMH24) and 28th Ave. (CMH18)

After CMH24, the creek passes through Lake Hiawatha, then channelizes again prior to CMH18. Many statistically-significant differences between the two locations are seen (Table 8), which are likely ecologically-significant. The creek passes through a lake, so one sees sediments dropping out in the lake (TSS decreases), SRP decreases (dilution) and TEMP increases (warmer lake).

Table 8. CMH24 and CMH18 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH24	CMH18	CMH24	CMH18	CMH24	CMH18	CMH24	CMH18	CMH24	CMH18	CMH24	CMH18	CMH24	CMH18
APR	7.4	8.1	11.9	12.3	868	894	7.83	7.96	11	15	84	94	9	7
MAY	14.5	15.2	9.8	9.7	611	662	7.86	7.95	12	8	69	64	12	5
JUN	20.6	21.4	7.1	7.1	501	526	7.78	7.90	31	17	96	69	18	4
JUL	24.0	25.2	7.1	7.7	470	463	7.84	8.10	25	15	76	72	14	6
AUG	22.2	23.9	7.0	7.1	485	453	7.91	8.01	19	10	74	80	13	8
SEP	17.9	19.7	8.3	8.5	524	482	8.09	8.13	12	3	51	70	7	10
OCT	10.6	12.5	9.9	8.6	566	496	7.80	7.75	20	15	63	62	4	5

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

21st Ave./Minnehaha (CMH24) and Hiawatha Ave. (CMH06)

CMH06 is located immediately upstream of Minnehaha Falls, with a USGS-operated gauging station on location. Many statistically-significant differences between the two locations are seen (Table 9), which are likely ecologically-significant. The creek passes through a lake, so one sees sediments dropping out in the lake (TSS decreases) and TEMP increases.

Table 9. CMH24 and CMH06 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH24	CMH06	CMH24	CMH06	CMH24	CMH06	CMH24	CMH06	CMH24	CMH06	CMH24	CMH06	CMH24	CMH06
APR	7.4	8.2	11.9	11.8	854	886	7.92	7.97	7	6	78	84	9	7
MAY	14.5	15.3	9.8	9.7	611	658	7.86	7.94	12	10	63	69	9	7
JUN	20.6	21.7	7.4	8.0	501	521	7.77	7.91	23	21	96	75	14	4
JUL	24.0	25.2	7.1	7.4	476	465	7.84	8.03	25	21	69	76	11	7
AUG	22.2	23.3	7.2	7.3	495	454	7.88	7.93	19	15	70	84	9	8
SEP	17.9	19.3	8.3	8.1	524	486	8.06	7.96	10	9	45	55	3	5
OCT	10.6	11.6	9.9	10.0	566	505	7.82	7.75	14	15	48	60	4	5

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

28th (CMH18) and Hiawatha Ave. (CMH06)

These stations are described previously. Very few statistically-significant differences between the two locations are seen (Table 10), and these differences are likely not ecologically-significant. For example, mean TSS in September differs by only 3 ppm, which would not have an impact on the biota in the creek.

Table 10. CMH18 and CMH06 Mean Values and Statistical Results*

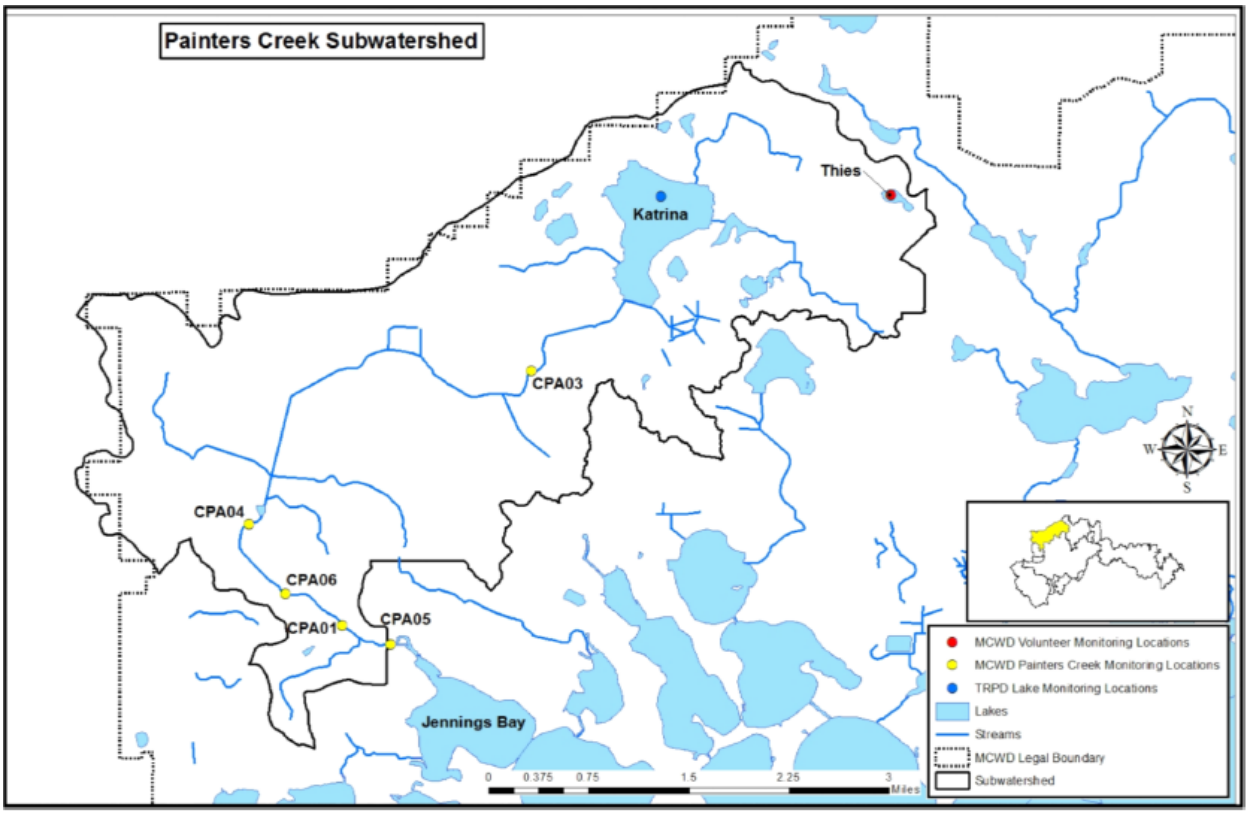
	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CMH18	CMH06	CMH18	CMH06	CMH18	CMH06	CMH18	CMH06	CMH18	CMH06	CMH18	CMH06	CMH18	CMH06
APR	8.1	8.4	11.9	11.9	862	862	7.97	8.00	6	5	85	85	7	8
MAY	15.5	15.6	9.5	9.6	637	634	7.95	7.95	7	8	64	71	5	7
JUN	21.6	21.9	7.2	8.0	521	517	7.97	7.96	15	21	69	75	5	6
JUL	25.2	25.2	7.7	7.4	463	465	8.10	8.03	15	21	72	80	6	7
AUG	23.9	23.3	7.1	7.1	453	451	7.98	7.93	9	15	77	84	8	8
SEP	19.7	19.3	8.3	8.0	482	486	8.10	7.96	2	10	60	57	7	4
OCT	12.5	11.6	8.6	10.0	496	505	7.75	7.73	15	15	62	61	5	5

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

IV. Painter Creek

Painter Creek begins northeast of the City of Maple Plain and flows through Lake Katrina (Figure 2). The creek then passes CPA03 and enters a series of large wetland complexes. At CPA04 the creek becomes more channelized again, then flows a few miles through wooded riparian areas to Lake Minnetonka.

Figure 2. The Painter Creek Subwatershed



Source: MCWD

Deborah Dr. (CPA03) and CR26 (CPA04)

While the creek is channelized at CPA03, the creek then passes through a series of wetland complexes before becoming channelized again at CPA04. Many statistically-significant differences between the two locations are seen (Table 11), which are likely ecologically-significant. The creek passes through large wetlands, so one sees decreases in DO and increases in SRP and TP (due to decomposition processes).

Table 11. CPA03 and CPA04 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CPA03	CPA04	CPA03	CPA04	CPA03	CPA04	CPA03	CPA04	CPA03	CPA04	CPA03	CPA04	CPA03	CPA04
APR	6.6	6.3	8.1	6.6	432	490	7.27	7.18	66	77	177	159	3	2
MAY	12.7	12.5	3.7	3.4	464	519	7.20	7.16	119	122	191	224	3	4
JUN	19.0	18.8	2.2	1.6	456	528	7.20	7.19	177	226	278	383	4	7
JUL	22.0	22.0	1.2	1.1	429	505	7.14	7.10	159	250	259	424	5	9
AUG	20.6	20.7	2.4	1.6	475	516	7.35	7.22	147	193	255	397	7	14
SEP	15.7	15.8	3.8	2.0	484	535	7.42	7.38	106	150	204	271	10	4
OCT	10.5	10.6	4.0	2.9	509	535	7.27	7.26	143	128	236	241	8	6

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

CR26 (CPA04) and Painter Creek Dr. (CPA06)

Beyond CPA04, the creek passes through wooded areas before reaching CPA06. There are relatively few statistically-significant differences seen between the two locations, with the exception of DO which increases in the downstream direction (Table 12).

Table 12. CPA04 and CPA06 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CPA04	CPA06	CPA04	CPA06	CPA04	CPA06	CPA04	CPA06	CPA04	CPA06	CPA04	CPA06	CPA04	CPA06
APR	6.2	6.7	6.0	7.6	488	488	7.18	7.28	81	84	160	157	2	2
MAY	12.8	13.8	3.1	4.6	530	537	7.15	7.21	109	121	213	219	3	4
JUN	18.7	19.4	1.5	2.5	534	534	7.13	7.21	215	225	370	397	4	8
JUL	22.1	22.4	1.0	1.5	518	519	7.08	7.12	255	278	423	449	8	5
AUG	20.2	20.2	1.4	1.6	495	467	7.15	7.21	181	215	351	537	12	9
SEP	16.2	15.7	2.6	2.9	502	506	7.34	7.53	144	172	273	301	5	2
OCT	10.4	9.7	3.5	5.2	514	502	7.24	7.24	149	162	237	256	7	3

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

Painter Creek Dr. (CPA06) and West Branch Rd. (CPA01)

The creek continues to flow through wooded areas as it reaches CPA01. There are several statistically-significant differences seen between the two locations, with DO, pH, and TSS increasing in the downstream direction (Table 13).

Table 13. CPA06 and CPA01 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CPA06	CPA01	CPA06	CPA01	CPA06	CPA01	CPA06	CPA01	CPA06	CPA01	CPA06	CPA01	CPA06	CPA01
APR	6.4	6.2	8.1	9.6	499	506	7.29	7.42	84	84	164	168	2	5
MAY	13.8	13.7	4.7	6.0	544	544	7.23	7.38	124	128	213	225	4	10
JUN	19.2	18.8	2.6	4.1	545	546	7.16	7.36	227	235	386	385	8	13
JUL	22.7	22.6	1.4	3.3	520	521	7.09	7.31	277	287	468	448	5	12
AUG	20.8	20.8	1.7	4.6	480	494	7.18	7.40	214	230	503	417	9	19
SEP	16.5	16.4	2.7	5.2	508	522	7.25	7.53	195	199	333	329	2	6
OCT	9.0	9.0	4.8	7.4	540	554	7.16	7.37	152	160	263	238	3	6

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

West Branch Rd. (CPA01) and CR110 (CPA05)

The creek emerges from wooded riparian areas and reaches CPA05 prior to entering Lake Minnetonka at Jennings Bay. No statistically-significant differences are seen between the two locations (Figure 14).

Table 14. CPA01 and CPA05 Mean Values and Statistical Results*

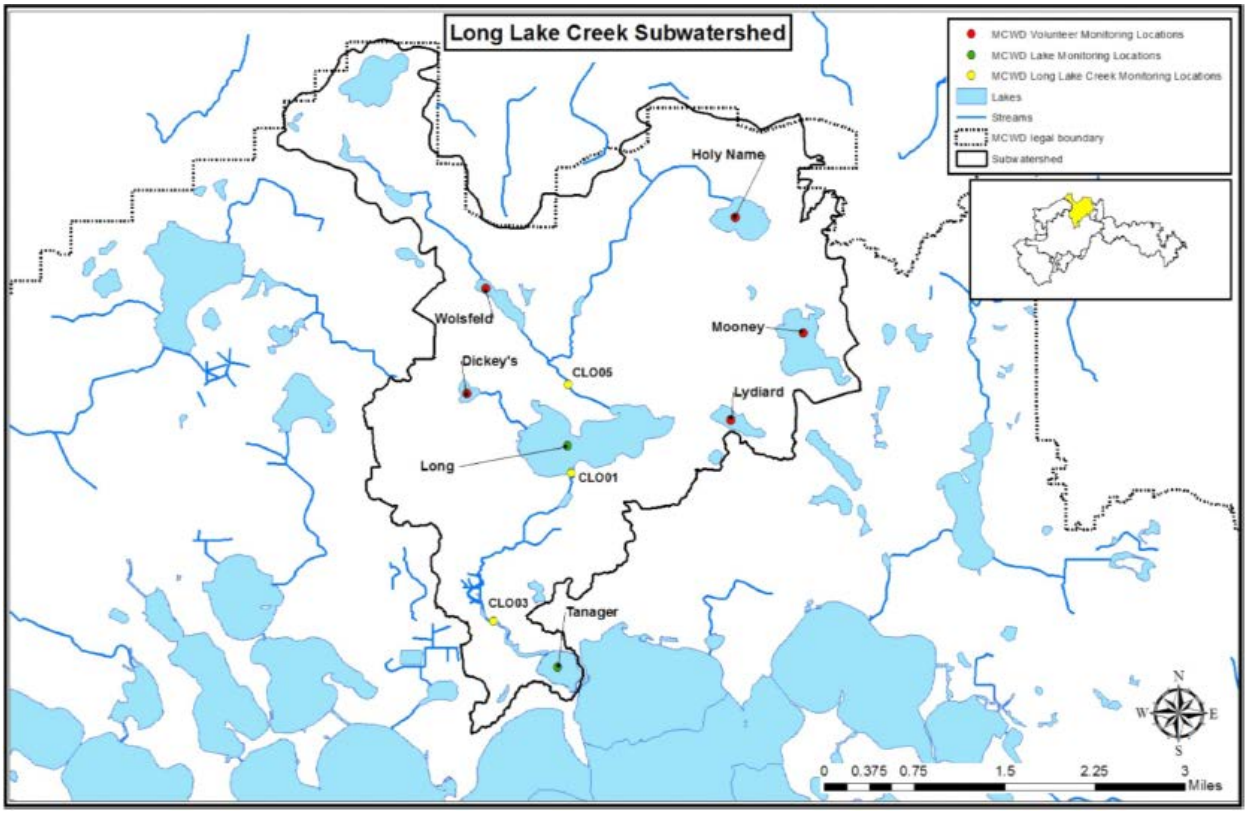
	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CPA01	CPA05	CPA01	CPA05	CPA01	CPA05	CPA01	CPA05	CPA01	CPA05	CPA01	CPA05	CPA01	CPA05
APR	6.2	6.2	9.6	10.2	506	509	7.39	7.35	84	85	168	172	5	7
MAY	13.7	13.5	6.0	6.5	544	547	7.38	7.43	127	129	227	223	12	1
JUN	18.9	18.4	4.0	4.4	545	547	7.43	7.47	234	236	390	394	13	12
JUL	22.3	21.8	3.5	3.9	536	539	7.40	7.46	279	286	429	435	11	8
AUG	20.7	20.2	4.7	4.8	498	515	7.41	7.52	232	236	413	412	11	6
SEP	16.1	15.6	5.3	5.9	522	524	7.60	7.52	193	196	325	308	6	6
OCT	9.1	8.8	7.2	8.0	556	562	7.42	7.52	155	159	239	234	6	4

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

V. Long Lake Creek

Long Lake Creek has two major upstream branches which come together prior to entering Long Lake (Figure 3). The lake outlets at CLO01, where the creek flows south towards Tanager Lake.

Figure 3. The Long Lake Creek Subwatershed



Source: MCWD

Long Lake Outlet (CLO01) and Brown/Fox Street (CLO03)

Long Lake discharges to Long Lake Creek at CLO01, flowing south towards Tanager Lake. CLO03 is located at the last bridge on the creek prior to entering the lake. There are many statistically-significant differences between the two locations (Table 15). In general one sees decreases in TEMP, DO, and pH between the two locations, while SRP and TP see large increases.

Table 15. CLO01 and CLO03 Mean Values and Statistical Results*

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CLO01	CLO03	CLO01	CLO03	CLO01	CLO03	CLO01	CLO03	CLO01	CLO03	CLO01	CLO03	CLO01	CLO03
APR	8.6	8.6	14.2	11.5	435	471	8.55	7.83	5	14	88	90	6	4
MAY	15.9	15.5	11.3	6.9	464	528	8.66	7.70	4	35	56	105	6	8
JUN	22.3	21.3	9.9	3.8	468	506	8.61	7.44	0	75	58	171	6	10
JUL	26.4	24.1	9.3	2.1	448	479	8.74	7.46	0	77	61	180	9	5
AUG	25.4	22.5	9.3	3.5	435	465	8.74	7.55	2	45	59	161	9	10
SEP	19.6	16.9	9.2	8.2	415	430	8.33	7.80	6	33	95	150	22	6
OCT	12.9	11.1	10.1	8.9	422	451	8.10	7.64	29	49	88	90	8	7

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

VI. Classen Creek

Classen Creek flows south from Lake Classen through wetland complexes before becoming more channelized just above station CCL04 (Figure 4). The creek then flows through an impoundment known locally as Swan Lake, eventually reaching Stubbs Bay just past CCL01.

Figure 4. The Classen Creek Subwatershed

Source: MCWD

Watertown Rd. (CCL04) and Bayside Rd. (CCL01)

There are many statistically-significant differences seen between the two locations (Table 16). In the downstream direction one sees increases in DO and pH. SRP and TP increase in the downstream direction in the spring and fall, but results are not so well defined during the summer months.

Table 16. CCL04 and CCL01 Mean Values and Statistical Results*.

	TEMP		DO		COND		pH		SRP		TP		TSS	
MONTH	CCL04	CCL01	CCL04	CCL01	CCL04	CCL01	CCL04	CCL01	CCL04	CCL01	CCL04	CCL01	CCL04	CCL01
APR	6.3	7.8	10.3	11.6	605	658	7.49	7.94	45	64	92	119	2	6
MAY	13.8	14.7	7.2	9.4	680	694	7.42	8.00	85	102	174	158	5	8
JUN	17.8	18.5	5.7	7.9	691	697	7.37	7.99	152	169	274	251	5	9
JUL	19.8	21.1	3.7	7.3	740	680	7.16	7.97	207	203	434	294	11	17
AUG	18.8	20.9	4.3	8.2	781	693	7.14	7.93	143	182	275	299	14	10
SEP	14.9	16.0	6.0	9.0	780	650	7.28	7.96	119	194	172	261	1	7
OCT	8.8	9.7	8.2	10.0	693	670	7.31	7.81	80	181	138	237	3	1

*white: not significant at 0.05 level; yellow: significant at 0.05 level. Kruskal-Wallis Test.

VII. Conclusions and Recommendations

It should also be noted here that the recommendations to follow are based purely on statistical analyses. There may be strong reasons to retain sampling locations (e.g. new projects on the landscape, TMDLs, regulatory reasons), so review of this report by others in the MCWD organization is highly recommended before any action is taken to drop sampling locations in the future.

Another factor in deciding whether or not to drop or decrease sampling frequency for a given location is the ability to predict water quality parameter values from a nearby location. For example, if one were to stop sampling CMH03 in the future but retain the CMH04 location, could one reasonably calculate CMH03 water quality values in the future using CMH04 values? Early results suggest that this may be possible, as indicated in Appendix A. The relatively high correlation coefficients for many locations/parameters are provided as evidence. However, TSS is often not strongly-correlated between two locations.

Minnehaha Creek

There is evidence that Grays Bay (LGB01) and Grays Bay Dam (CMH07) have highly similar water quality (Table 1). A 2013 HDR report found few statistically-significant differences between Wayzata Bay and Grays Bays with respect to TP. However, zebra mussel research is being conducted on Grays Bay so dropping LGB01 is not recommended.

CMH19 should be retained because it showed many statistically-significant differences with CMH07, and CMH19 represents the first upstream area where the creek is channelized.

While there are a relatively small number of statistically-significant differences between locations CMH02 and CMH11, these locations span a large stretch of the creek where development/redevelopment is occurring. It is recommended that both locations be retained.

There were relatively few statistically-significant differences between locations CMH03, CMH04, and CMH12/15, suggesting that one or two of these locations could be dropped from the sampling regime. If one were to drop locations CMH03 and CMH12/15, reasonable estimates of water quality parameter concentrations can be made in the future with CMH04 data and the relationships between CMH04 and CMH03, as well as between CMH04 and CMH12/15, as seen in Appendix A.

CMH24 should be retained given the long stretch of creek between its location and the next sampling locations upstream. It is recommended that CMH18 be dropped due to its strong similarities in water quality to location CMH06. Reasonable estimates of water quality parameter concentrations can be made in the future with CMH06 data using the relationships between CMH06 and CMH18 as seen in Appendix A.

Painter Creek

Given the many statistically-significant differences and the presence of large wetland complexes between CPA03 and CPA04 (Table 11), it is recommended that both locations be retained.

Given the strong similarities between locations CPA01 and CPA05, it is recommended that MCWD drop location CPA05. Because there are relatively few statistically-significant differences among locations CPA04, CPA06, and CPA01, MCWD might consider dropping CPA06 (because one would retain CPA01 due to dropping CPA05). Reasonable estimates of water quality parameter concentrations can be made in the future with CPA04 and CPA01 data using the relationships between these locations and CPA06 or CPA05 as seen in Appendix A.

Long Lake Creek

Because there are many statistically-significant differences between the two stations on Long Lake Creek, and the impact on water quality due to backwater effects of Tanager Lake on location CLO03, it is not recommended that either location be removed from the present sampling schedule.

Classen Creek

Because there are many statistically-significant differences between the two stations on Classen Creek, and the impact on water quality due to Swan Lake, it is not recommended that either location be removed from the present sampling schedule.

Future Directions

It is important to note that some sampling locations will dry up later in the year during dry years. Hence some late summer and fall results from this report might be biased towards wet years. Further analysis of locations and years where this might be a factor should be considered.

Additionally, it is recommended that the stream data be analyzed in such a way to compare weekly versus biweekly sampling schedules. This approach was taken by HDR in 2013 on Lake Minnetonka sampling data to show that significant time and cost saving could be achieved by reducing sampling frequencies.

Appendix A

X-Y Plots of Site-To-Site Water Quality Parameter Comparisons

All comparisons use available April through October data. Note that MS Excel was used to generate regression statistics in these figures, not SPSS software.

TEMP: Water Temperature (degrees C)

DO: Dissolved Oxygen (ppm)

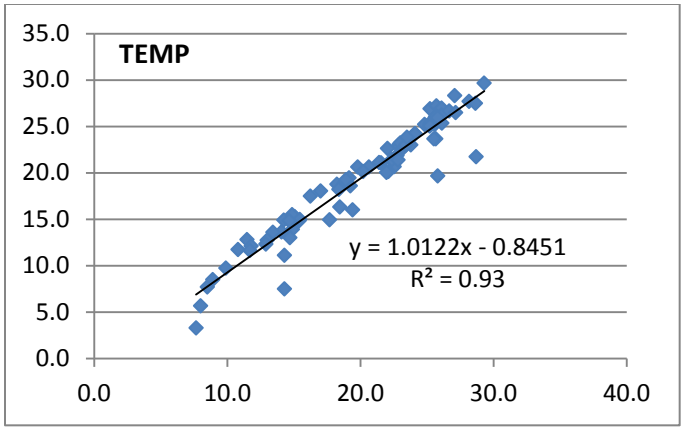
COND: Specific Conductivity (microS/cm^2)

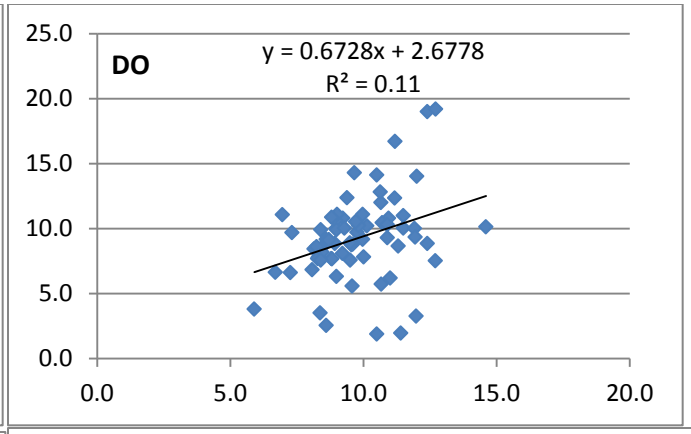
pH: pH

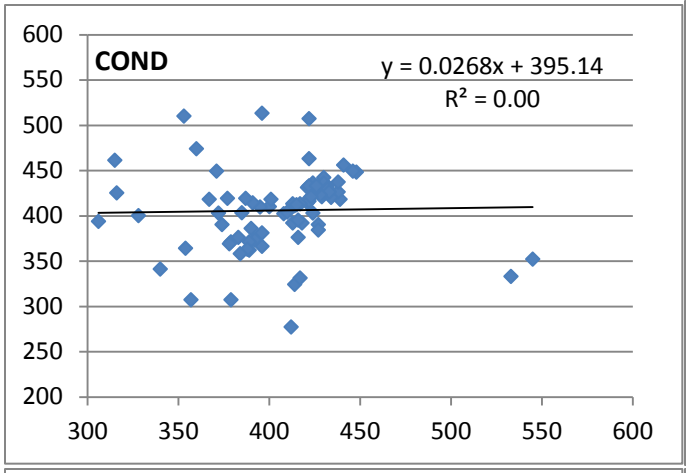
SRP: Soluble Reactive Phosphorus (ppb)

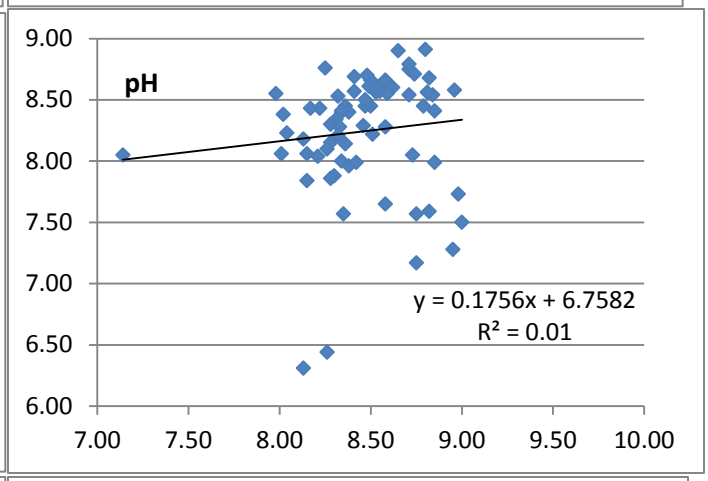
TP: Total Phosphorus (ppb)

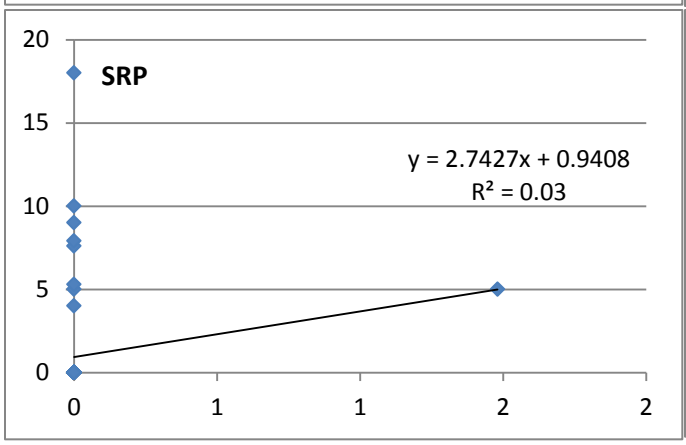
TSS: Total Suspended Solids (ppm)

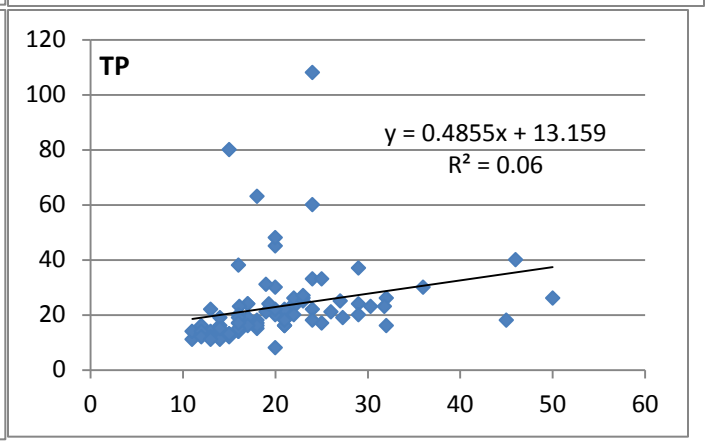




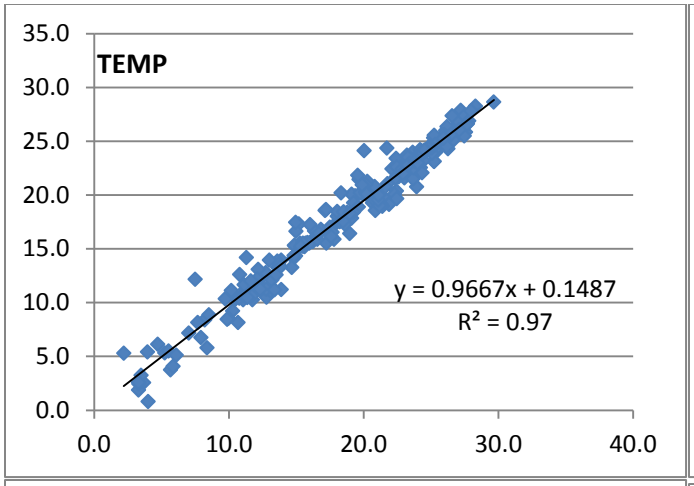


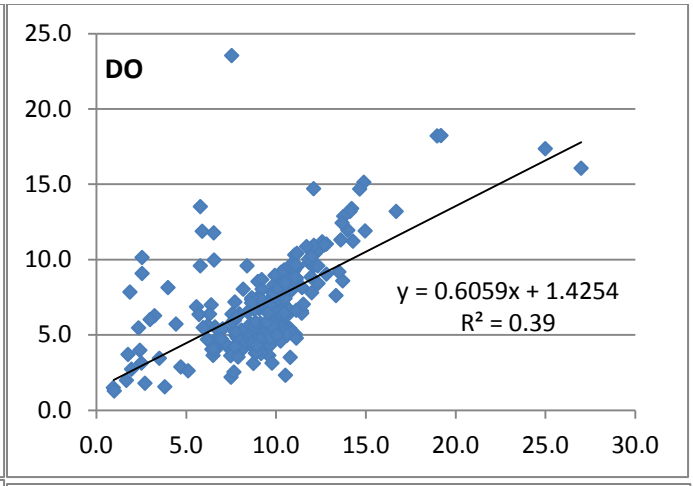


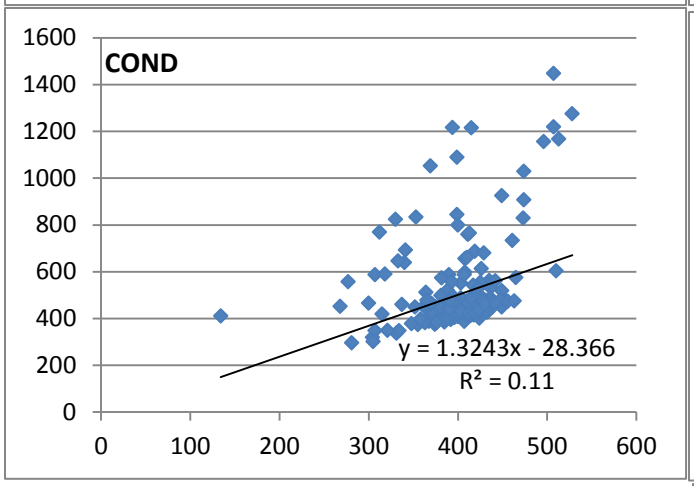


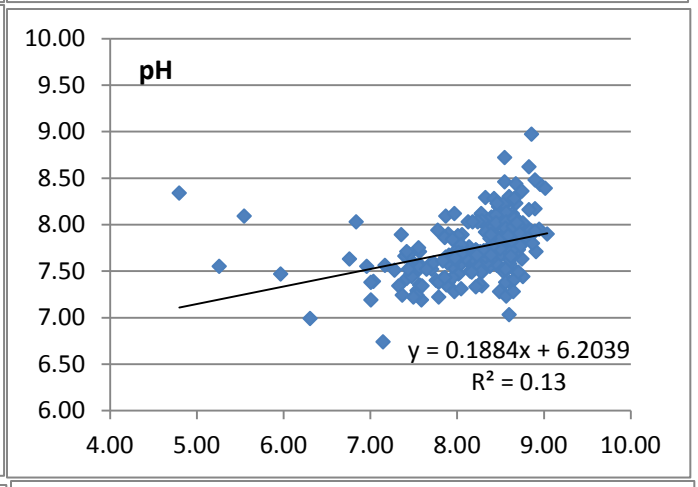


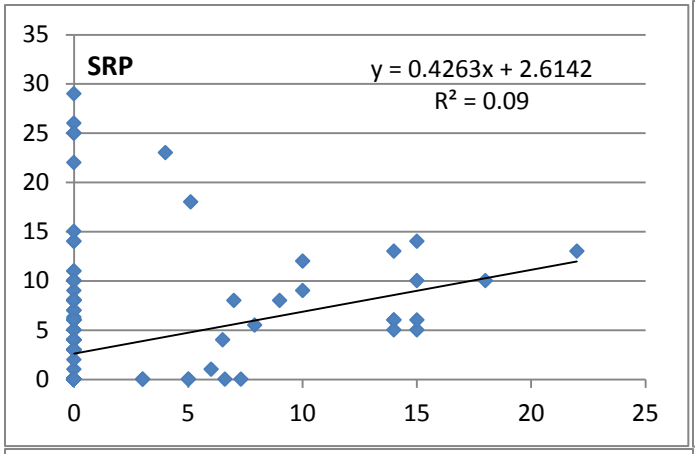
LGB01 vs. CMH07

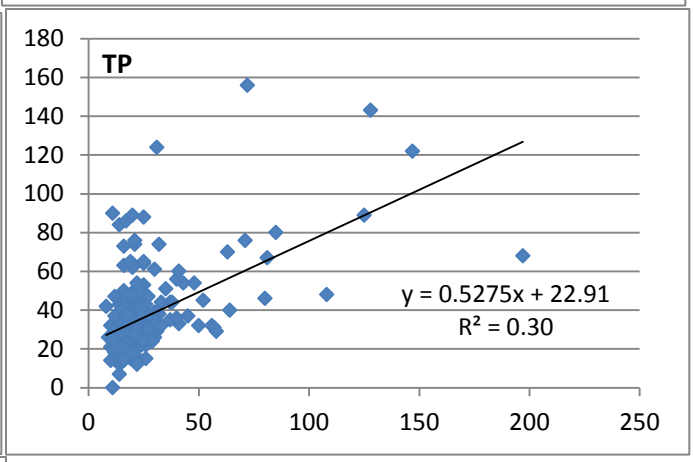


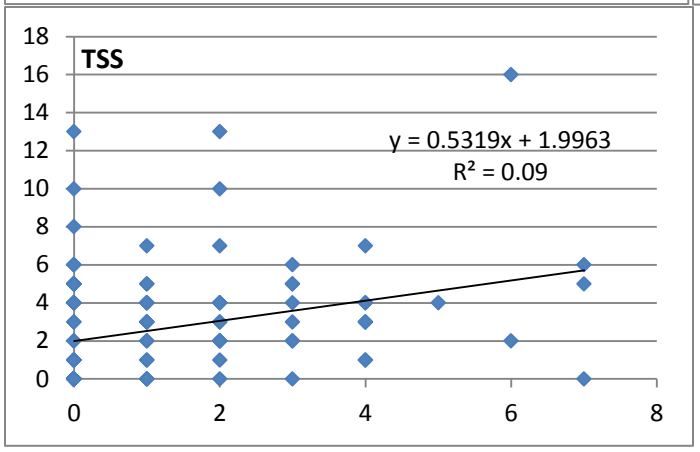




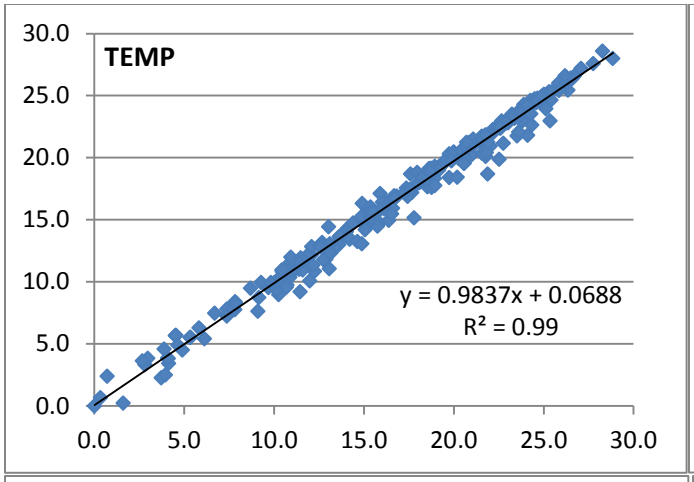


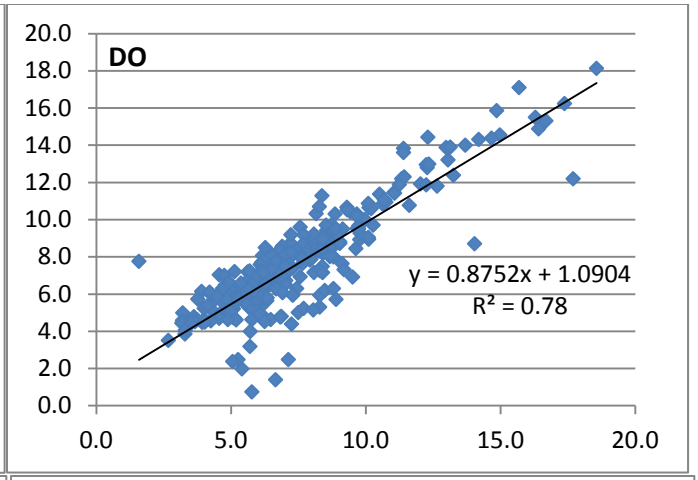


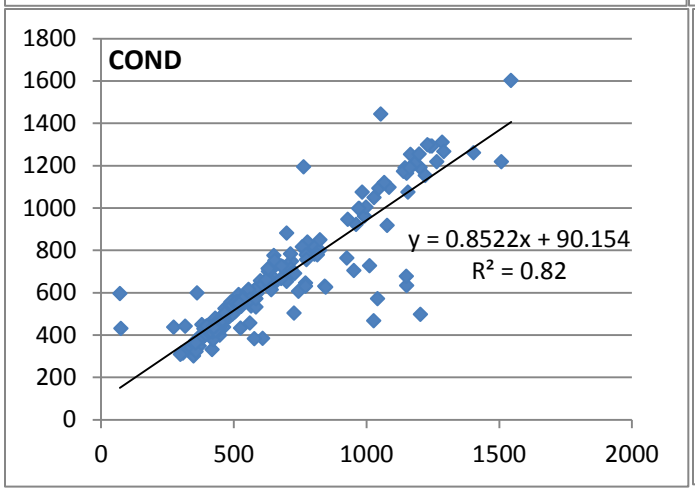


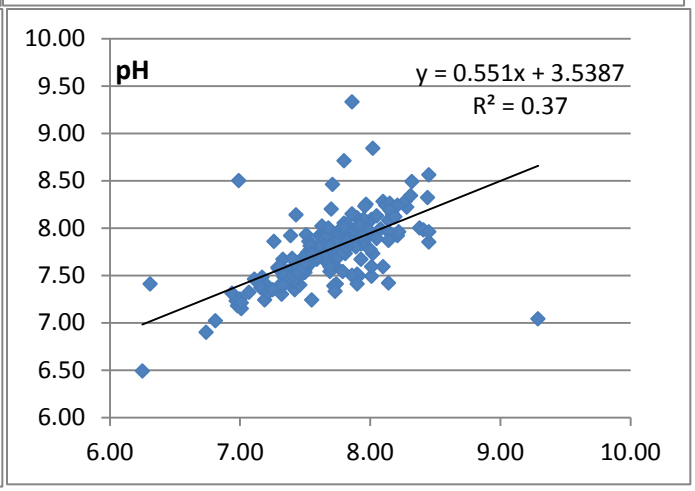


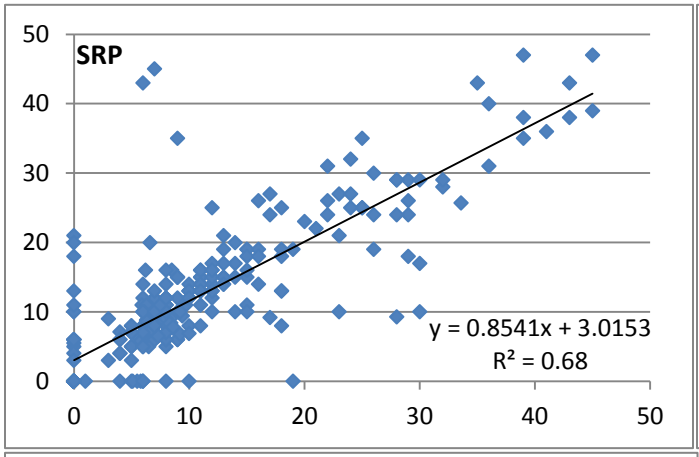
CMH07 vs. CMH19

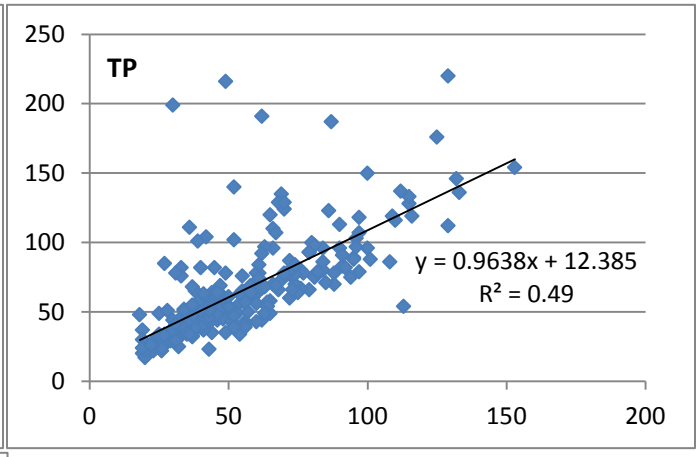


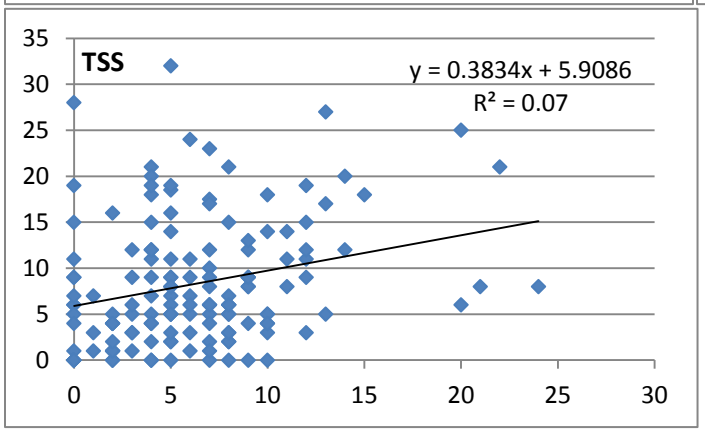




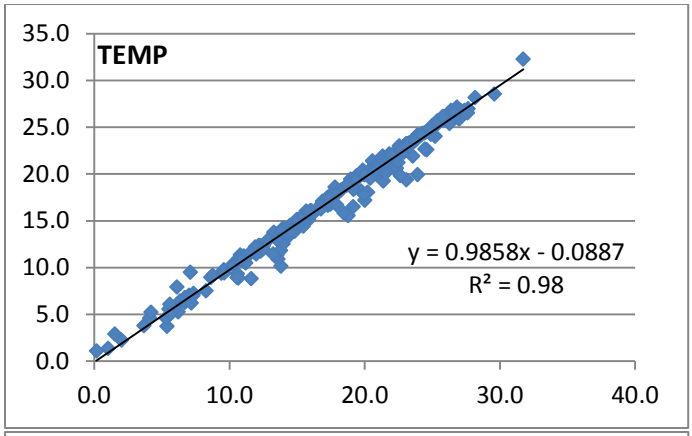


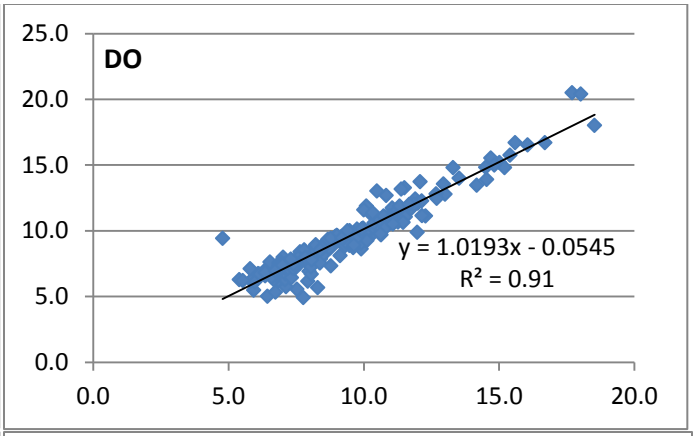


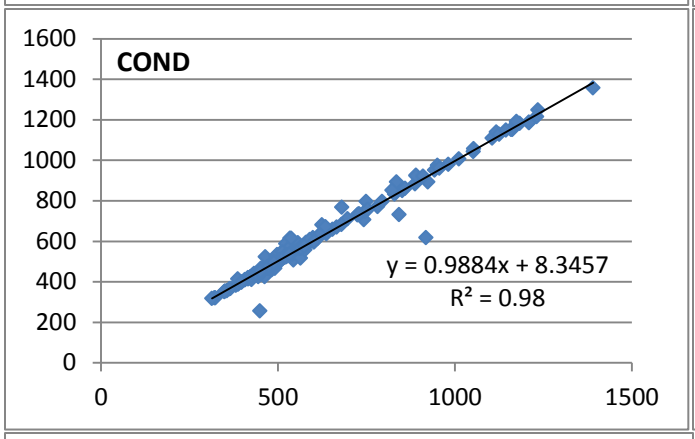


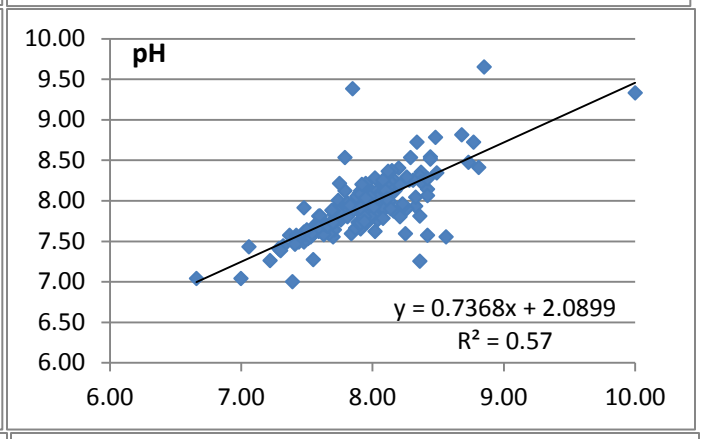


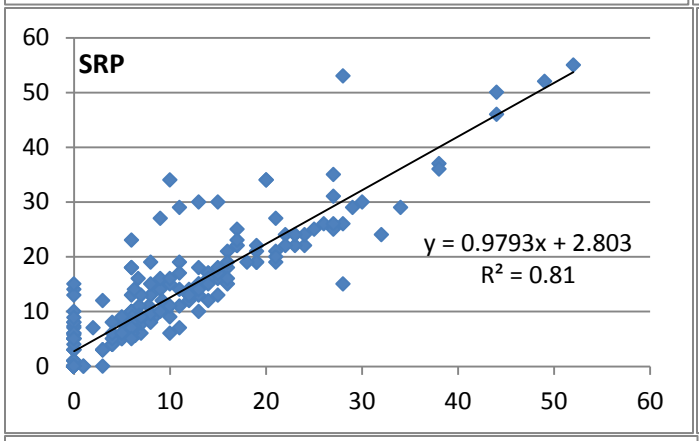
CMH02 vs. CMH11

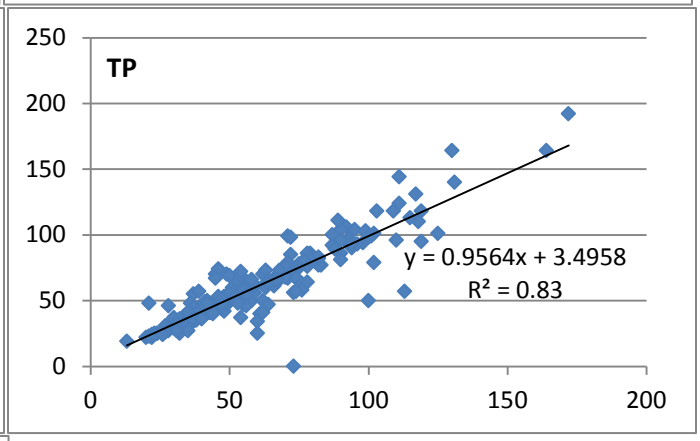


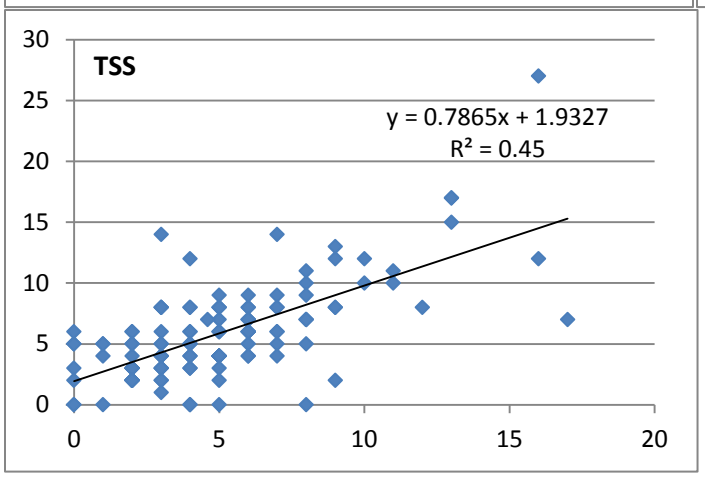




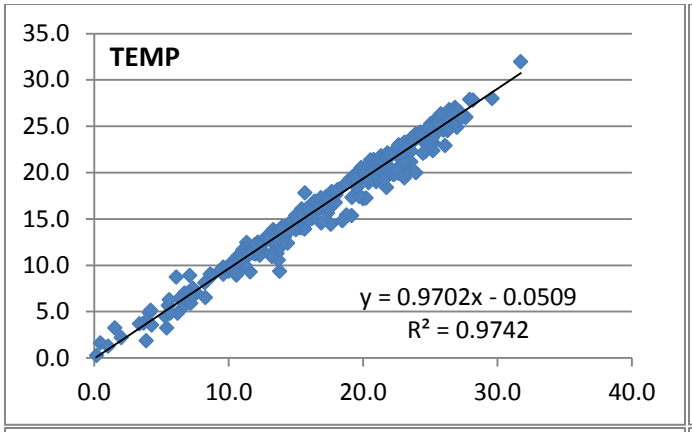


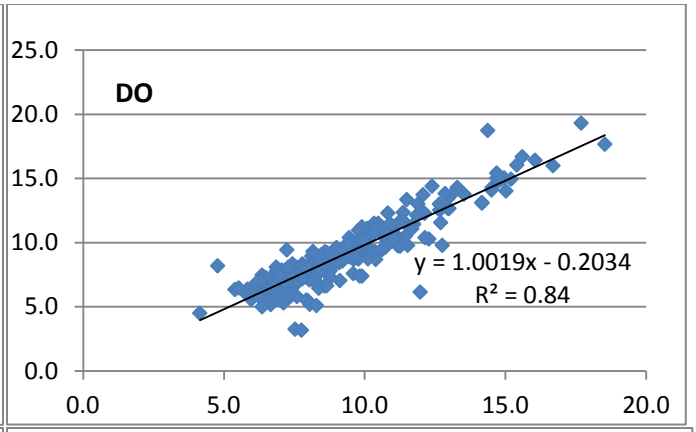


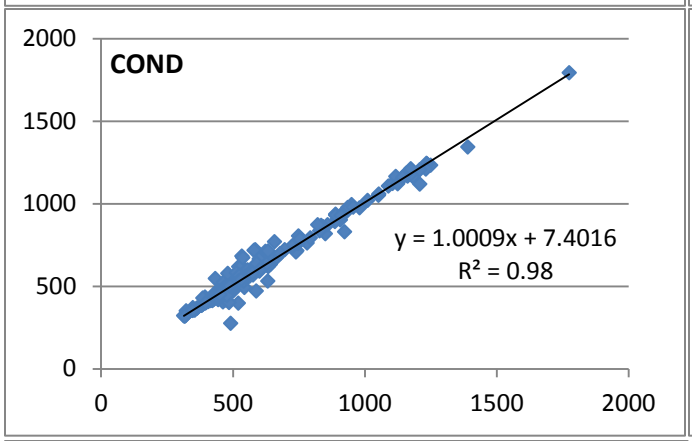


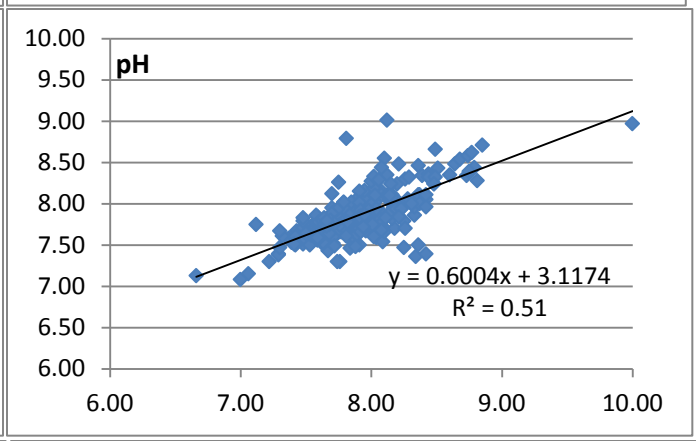


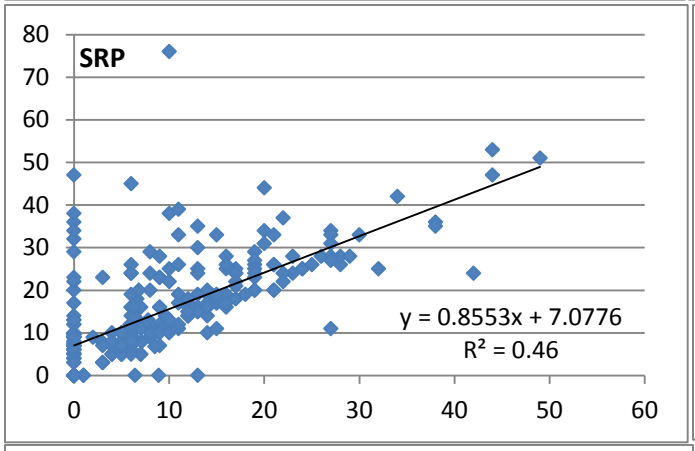
CMH03 vs. CMH04

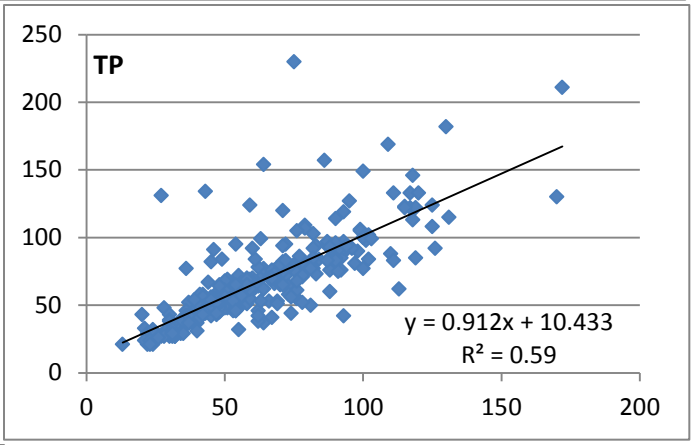


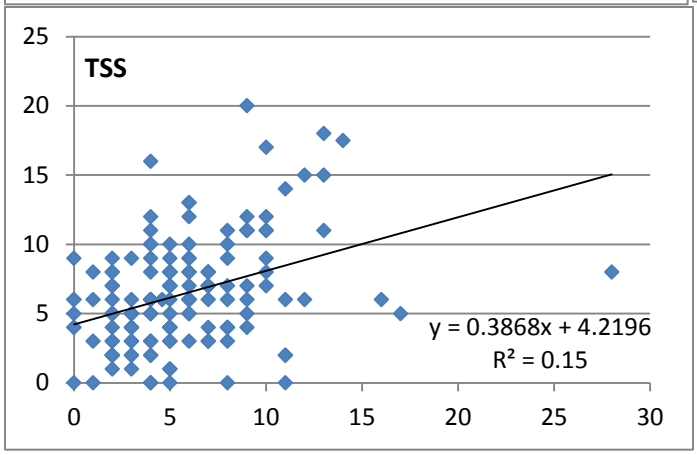




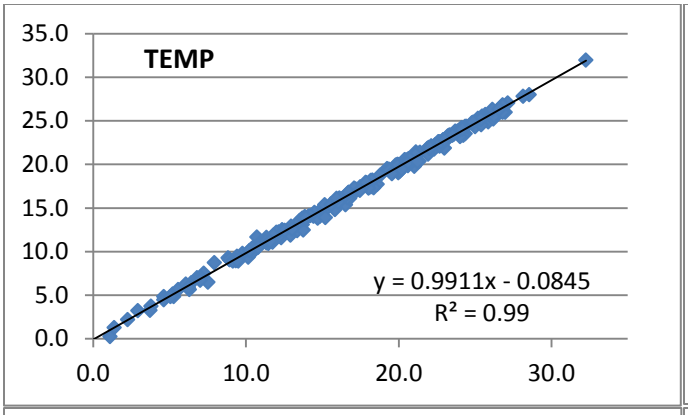


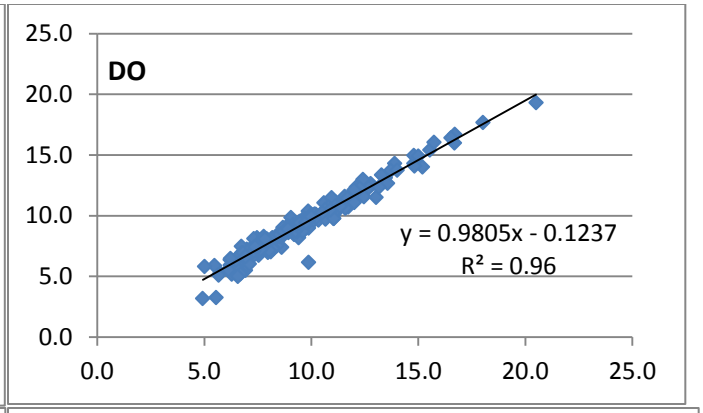


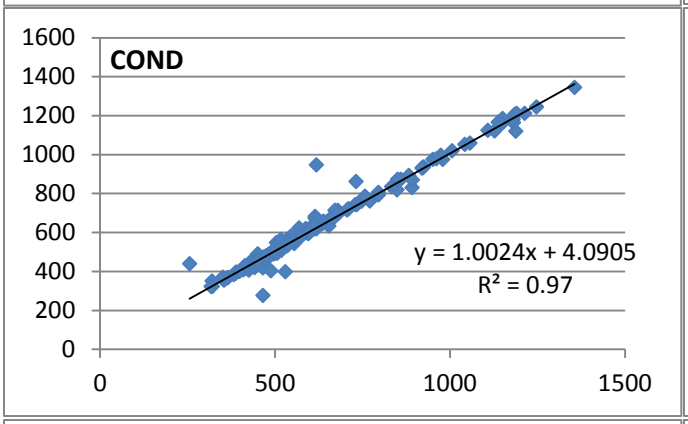


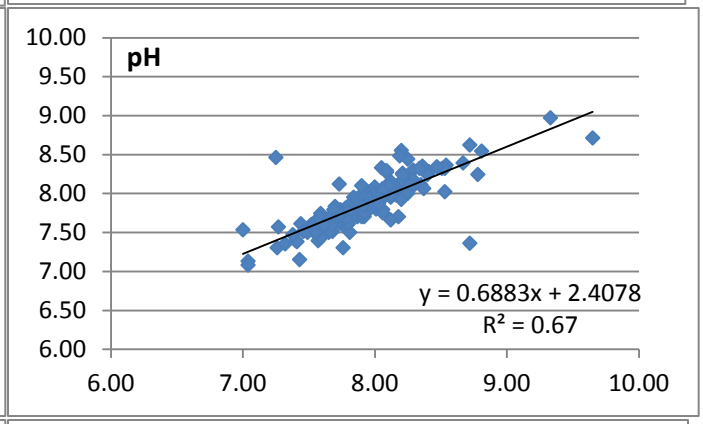


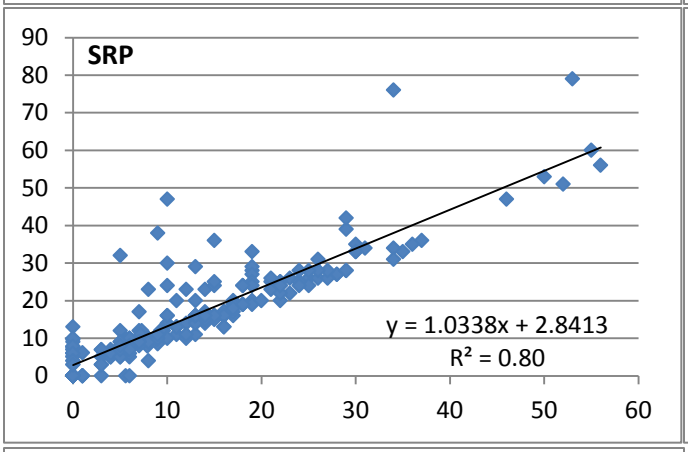
CMH03 vs. CMH12/15

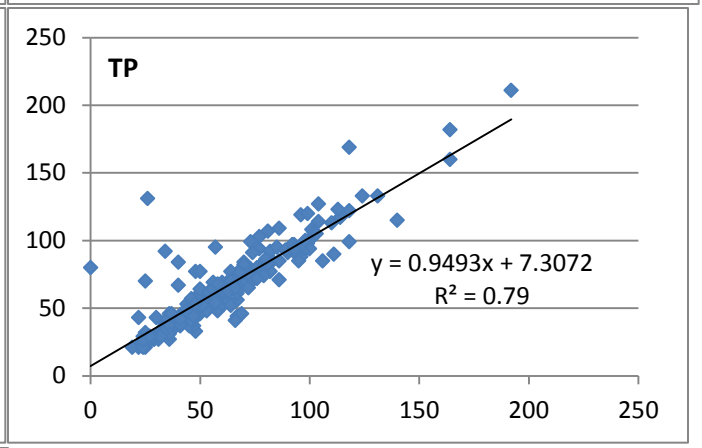


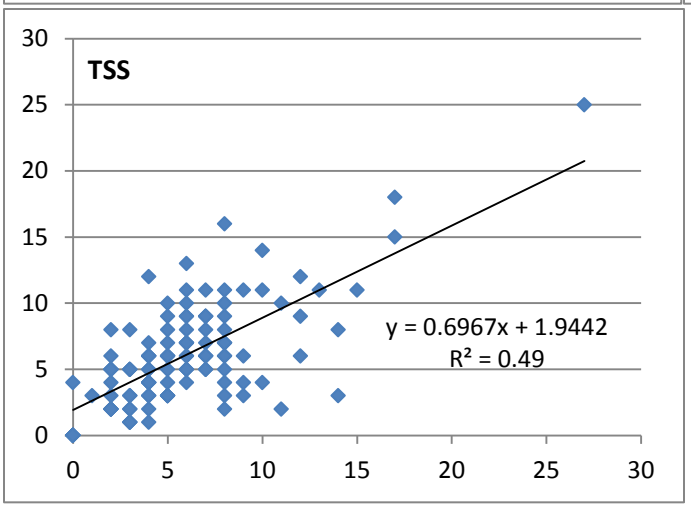




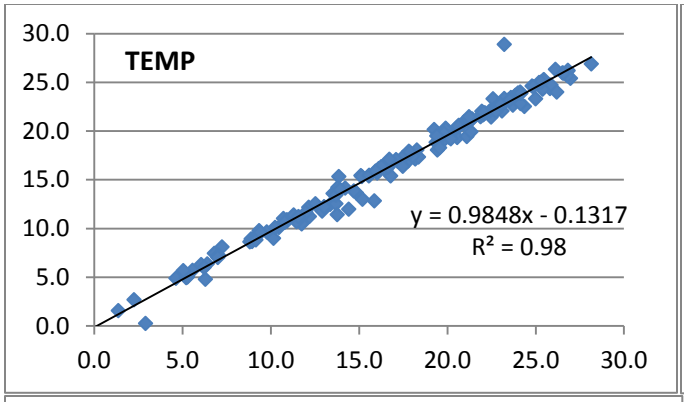


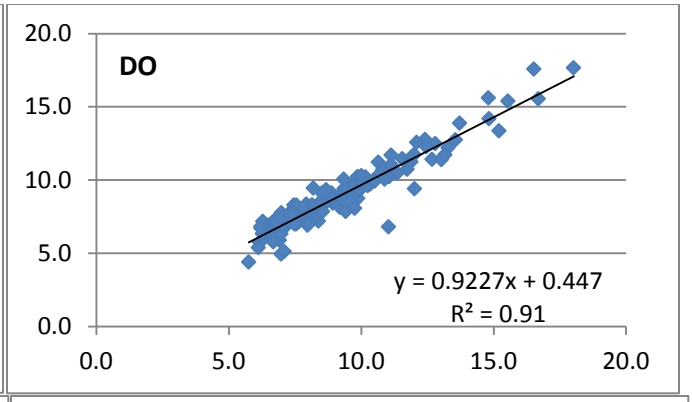


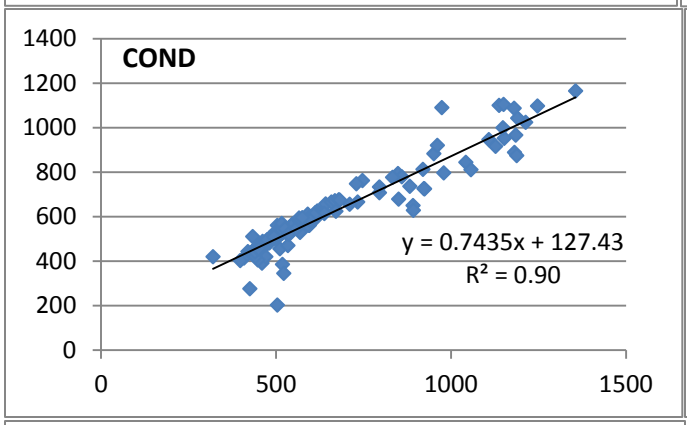


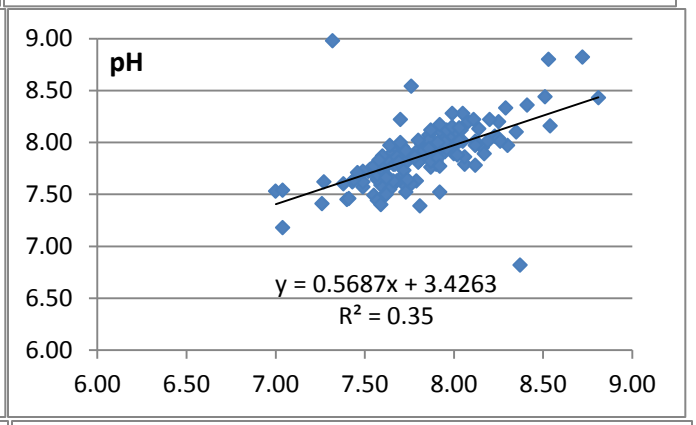


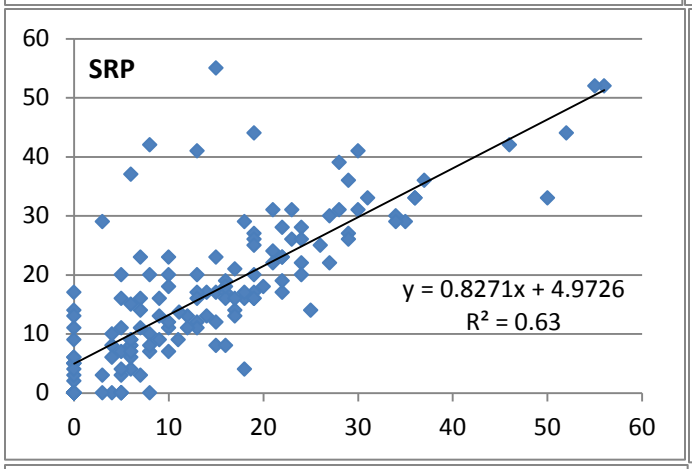
CMH04 vs. CMH12/15

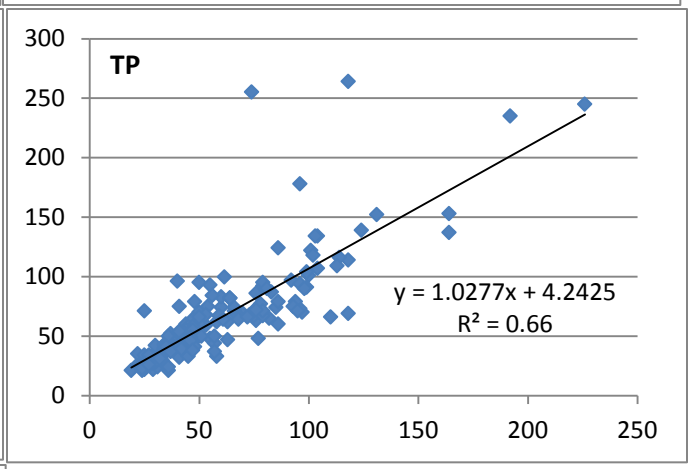


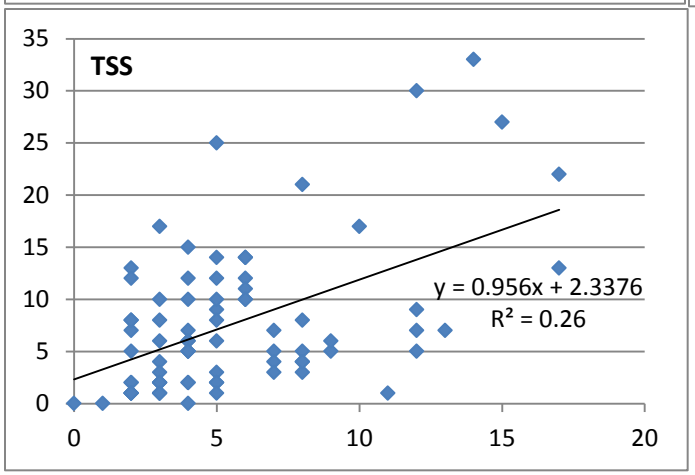




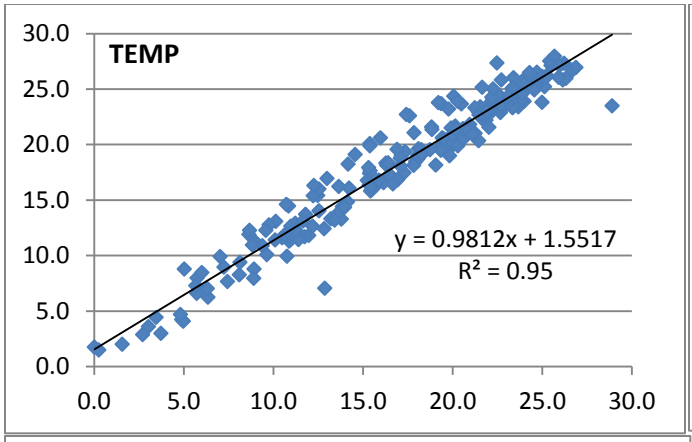


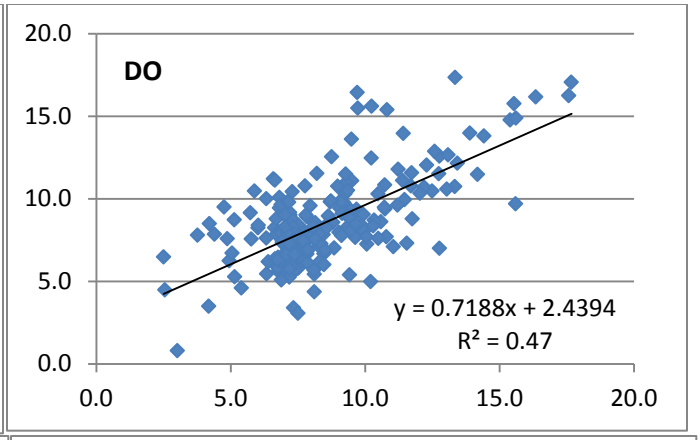


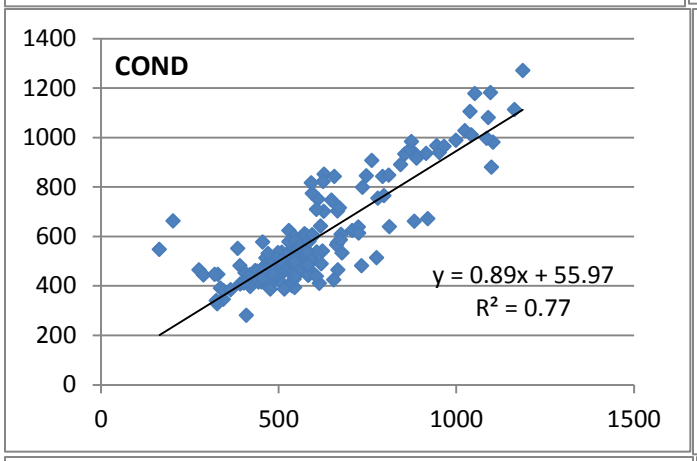


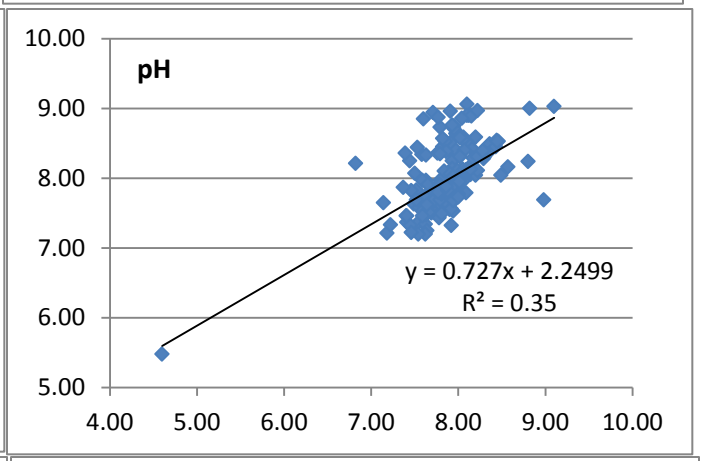


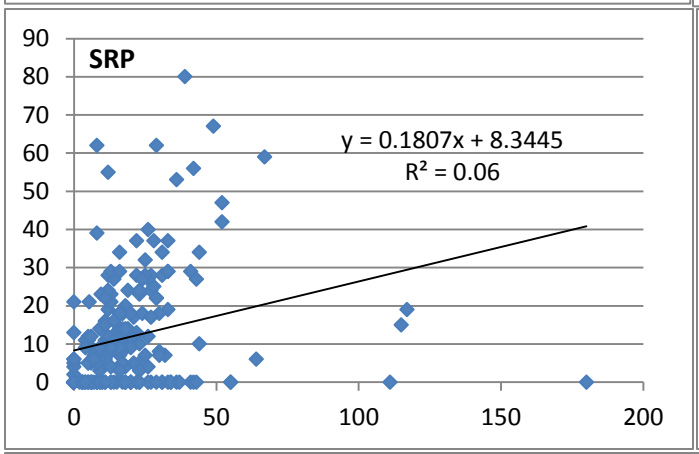
CMH04 vs. CMH24

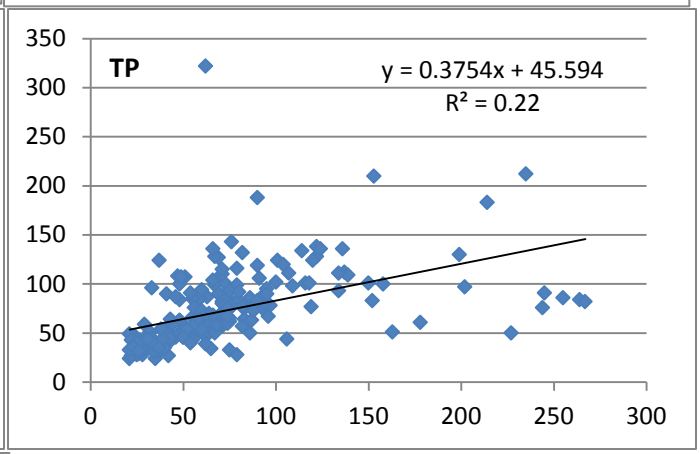


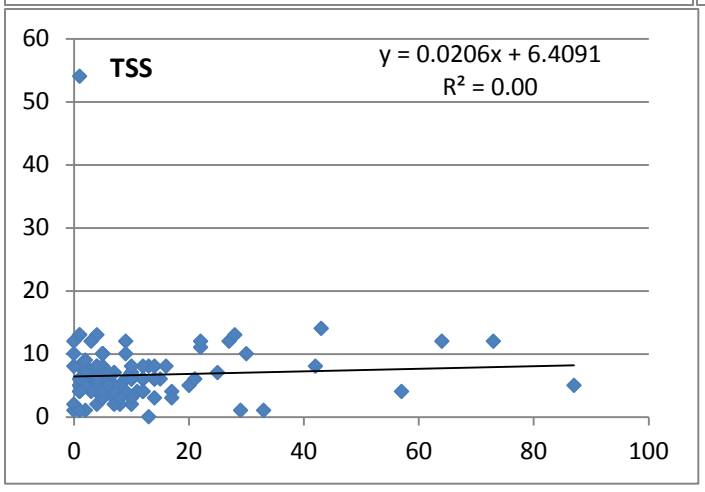




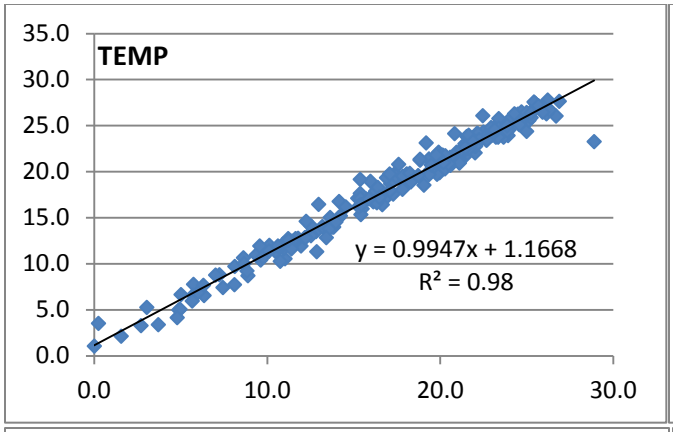


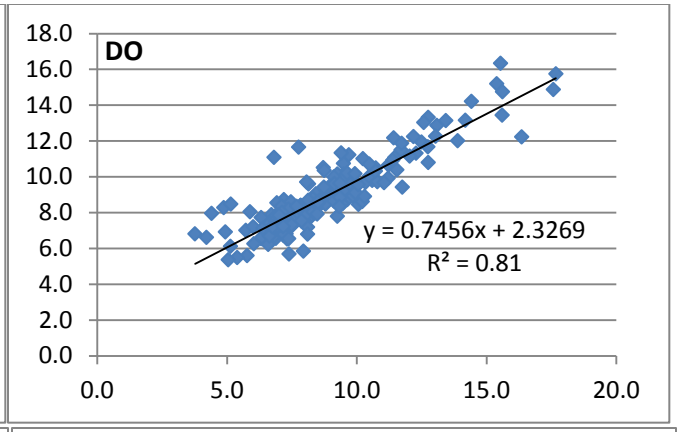


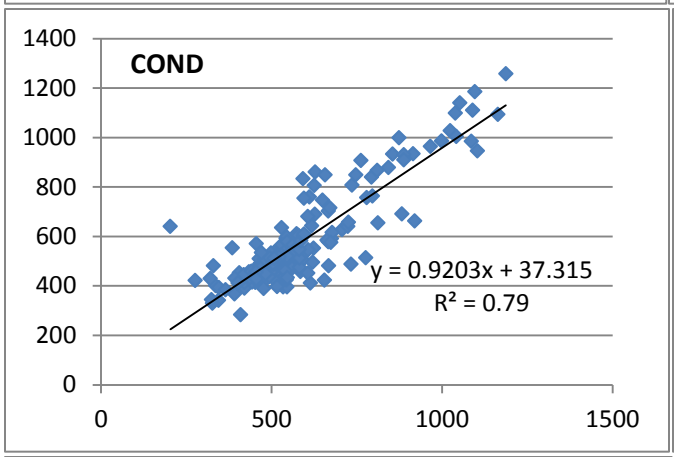


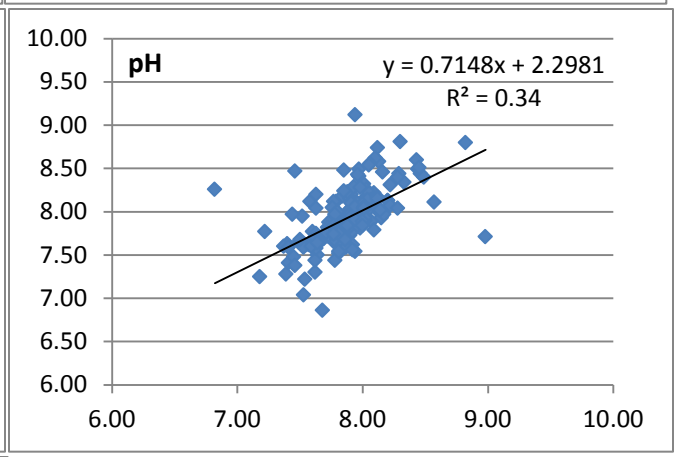


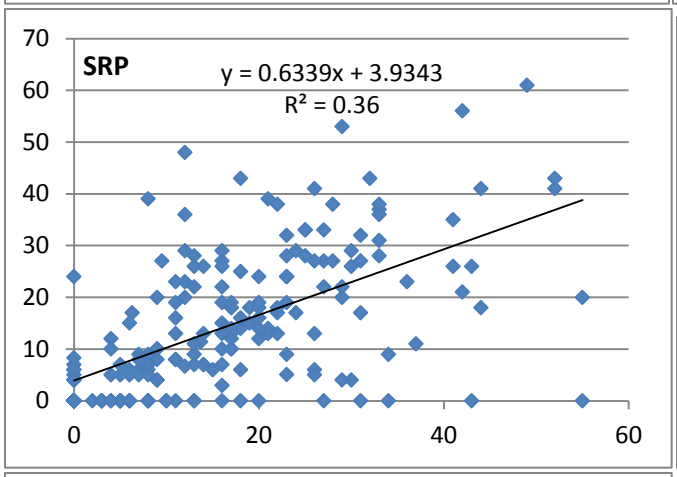
CMH24 vs. CMH18

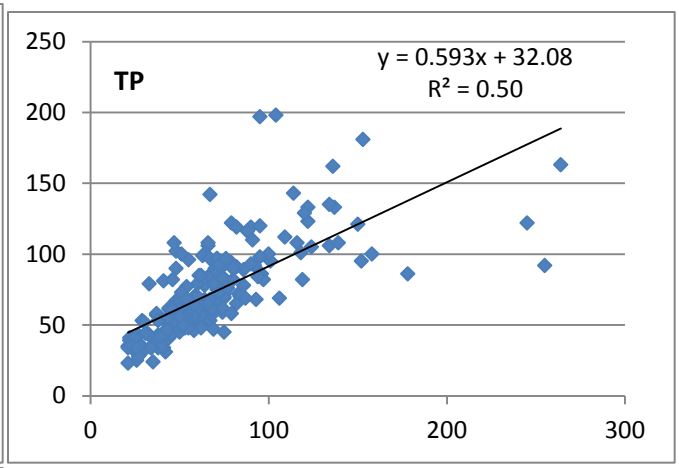


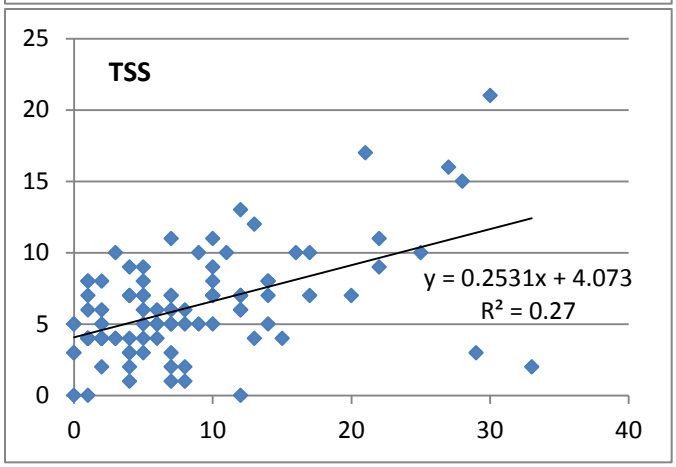




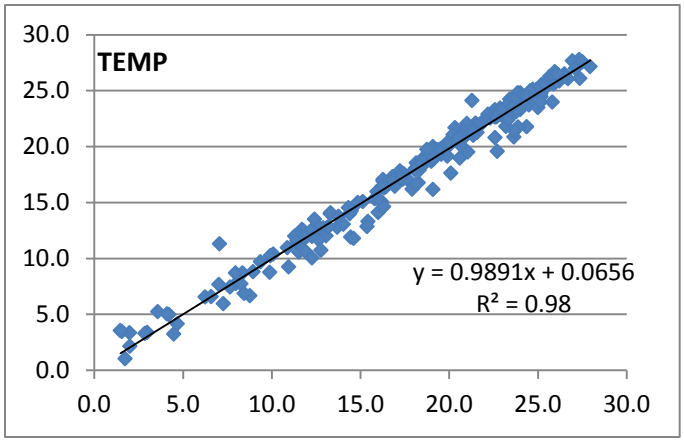


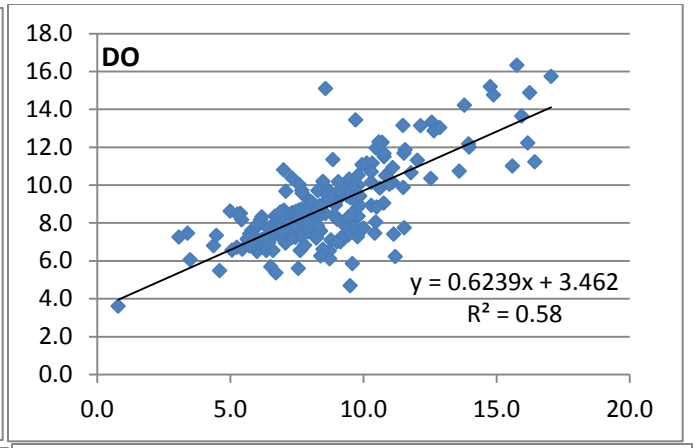


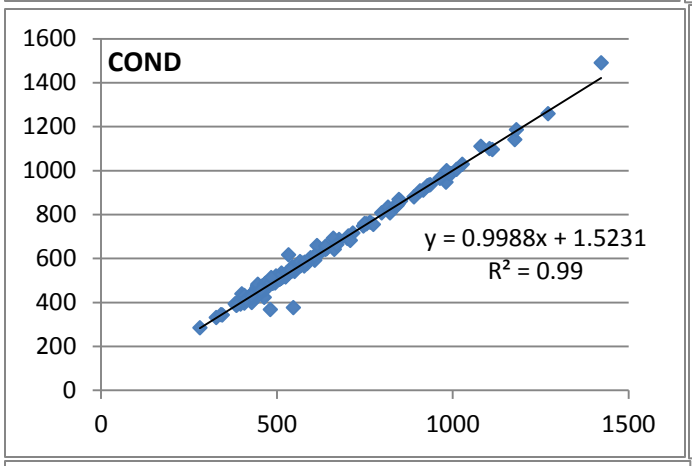


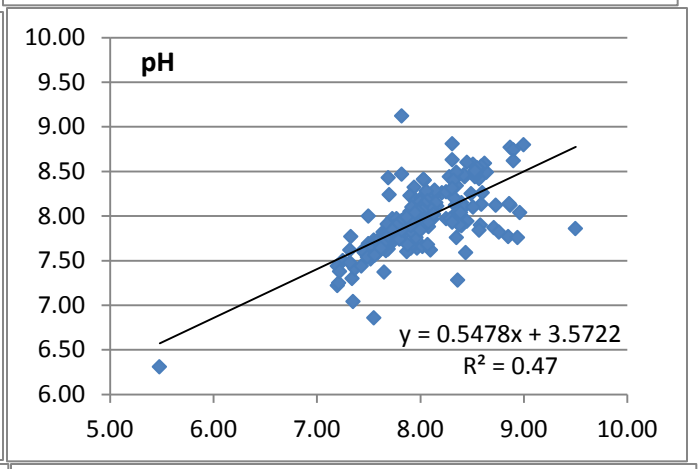


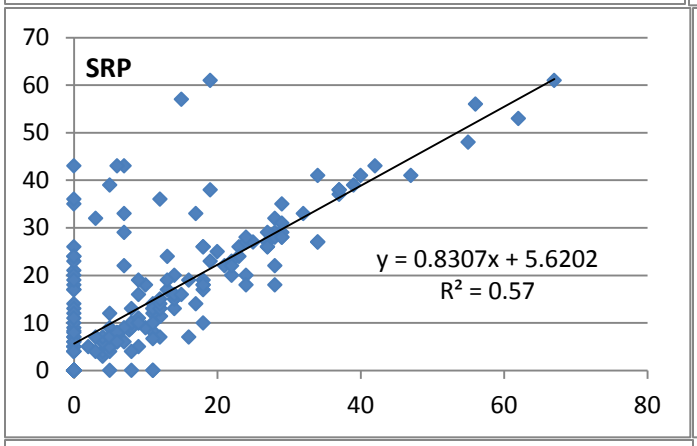
CMH24 vs. CHH06

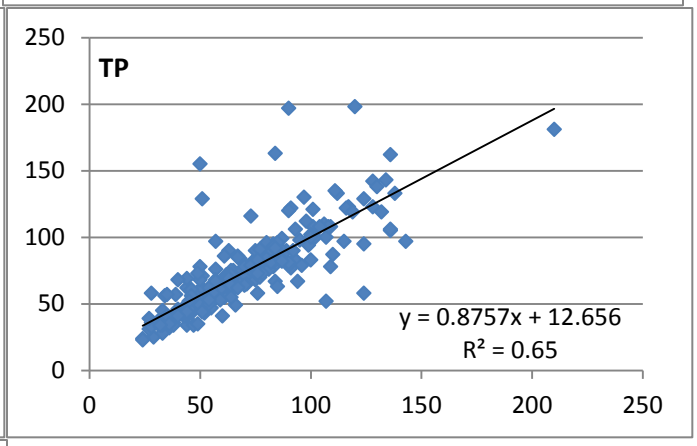


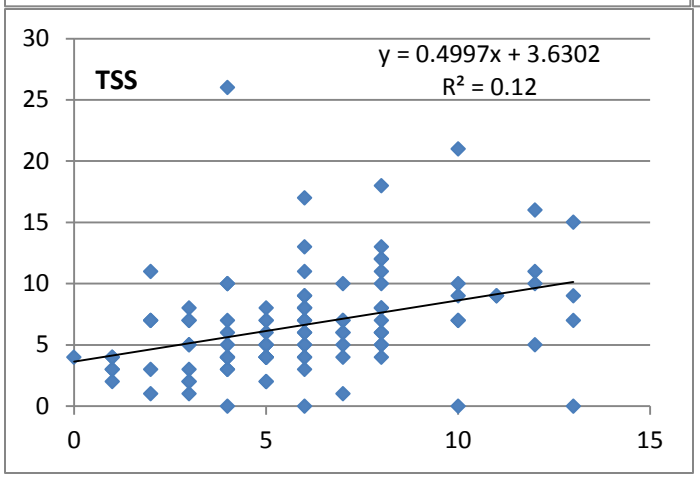




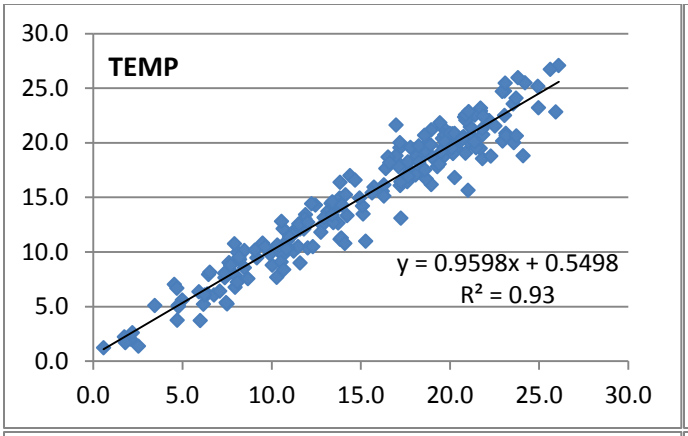


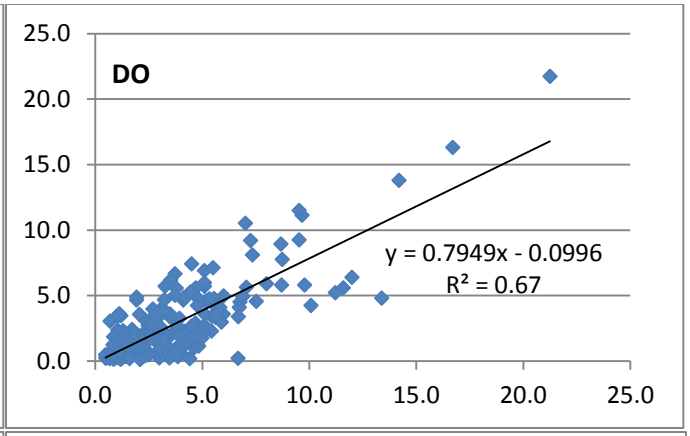


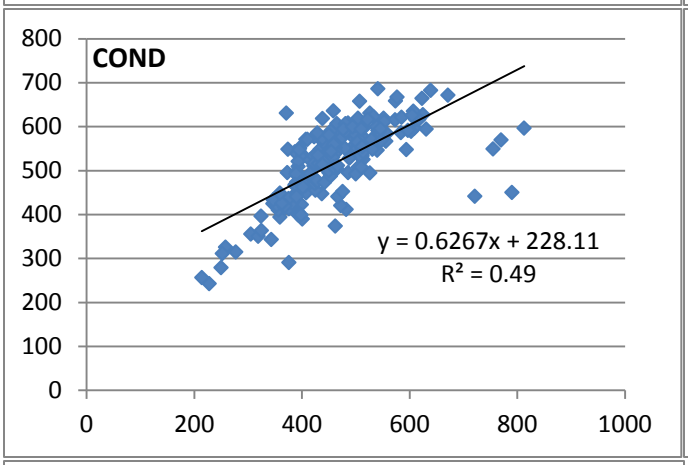


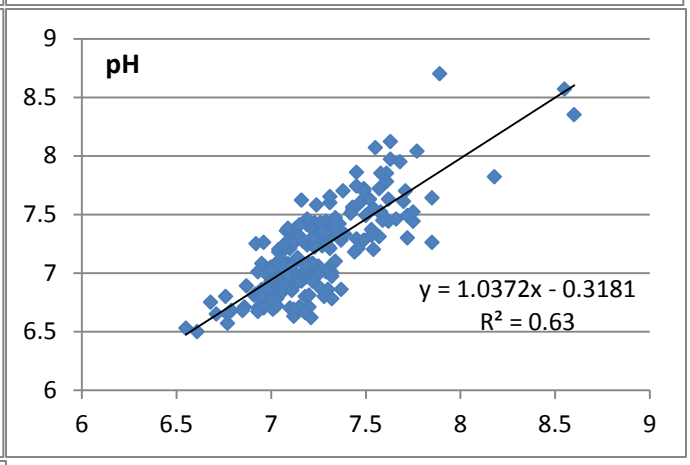


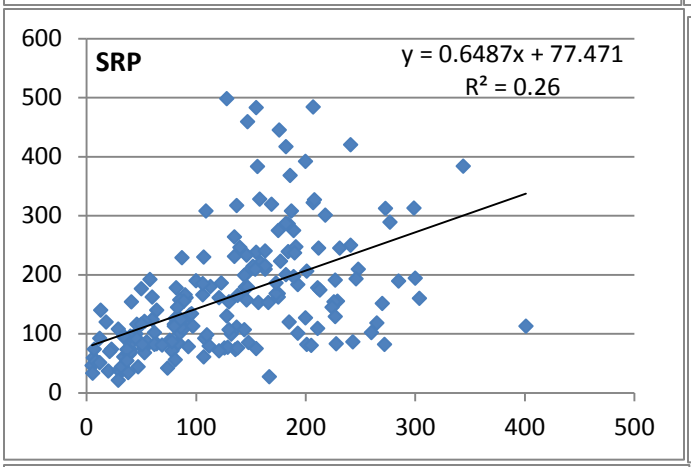
CMH18 vs. CMH06

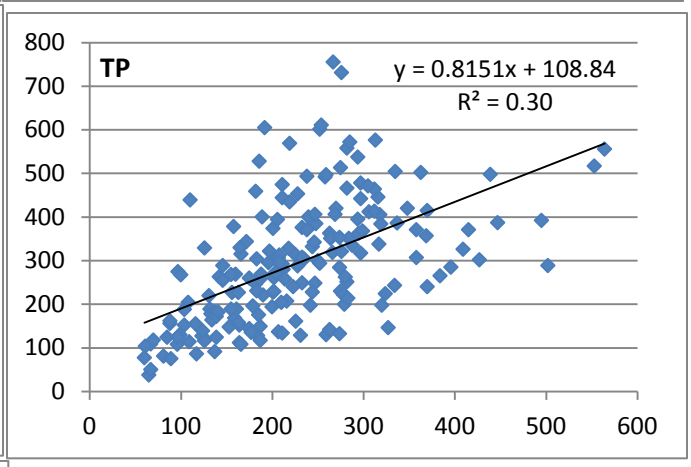


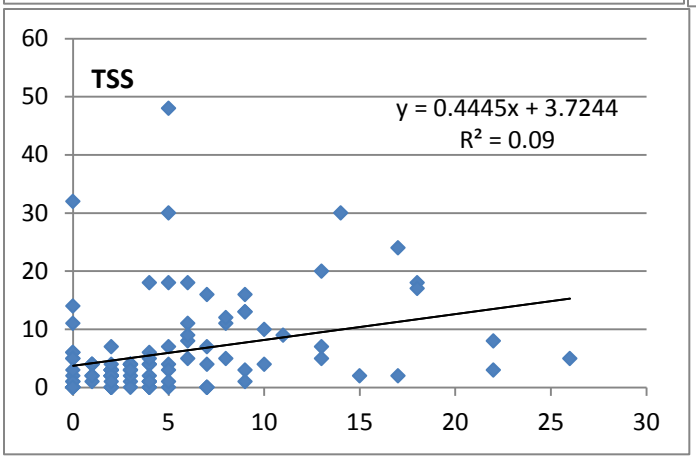




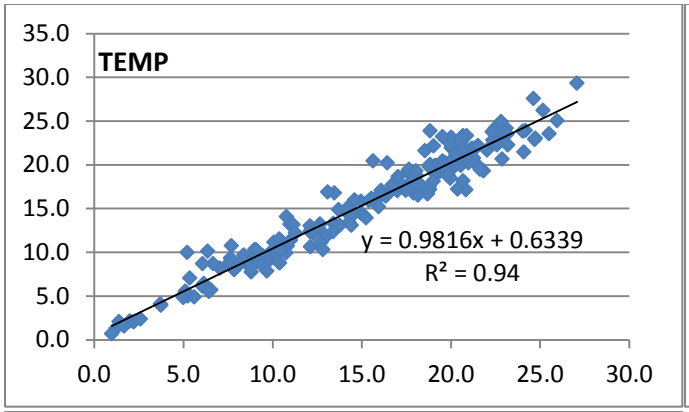


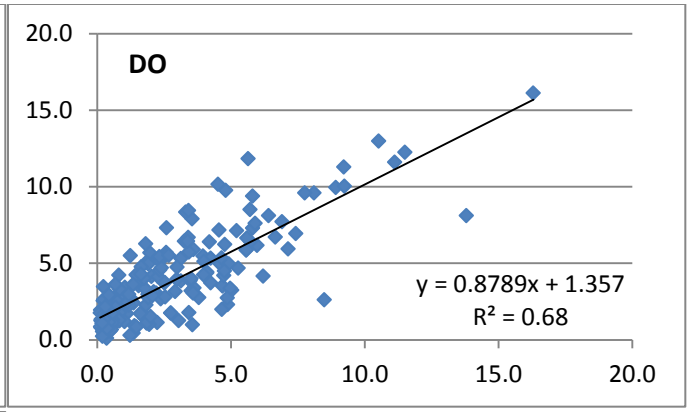


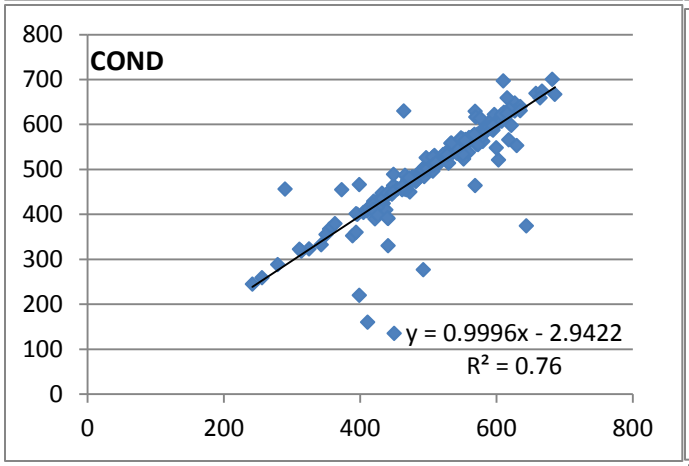


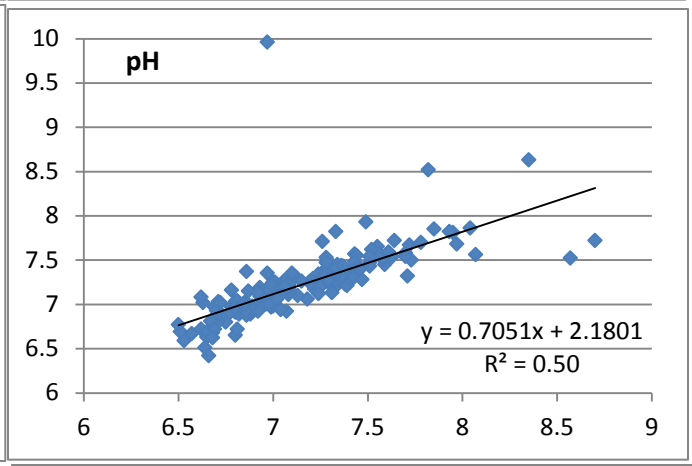


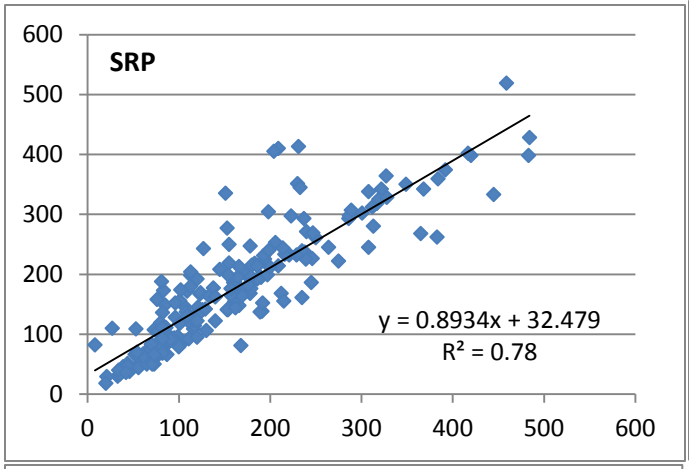
CPA03 vs. CPA04

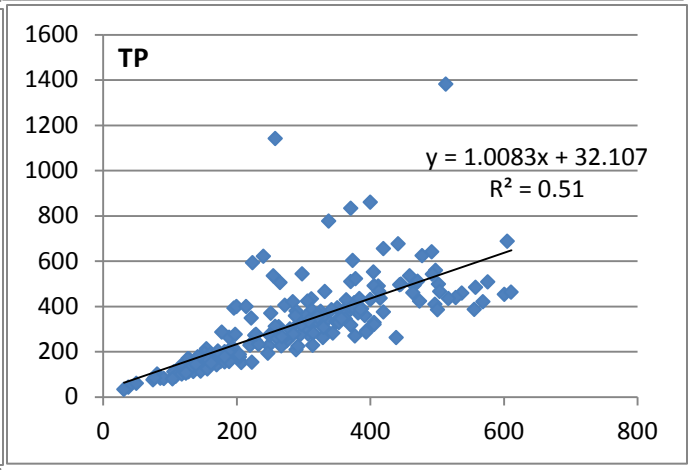


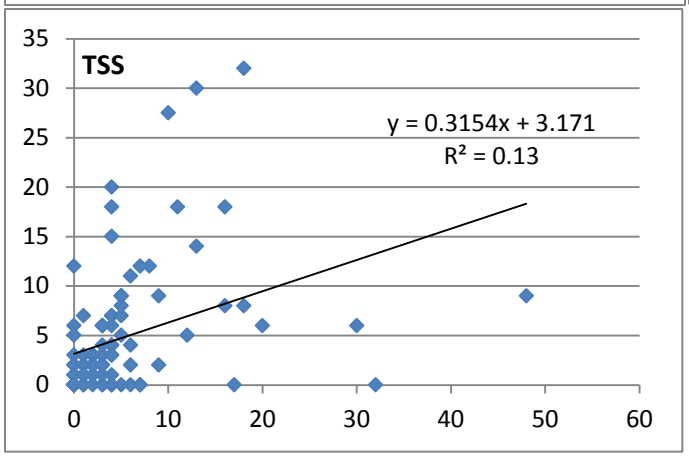




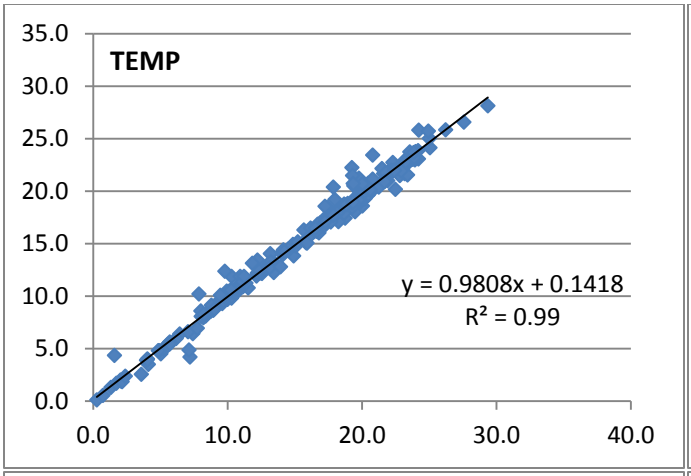


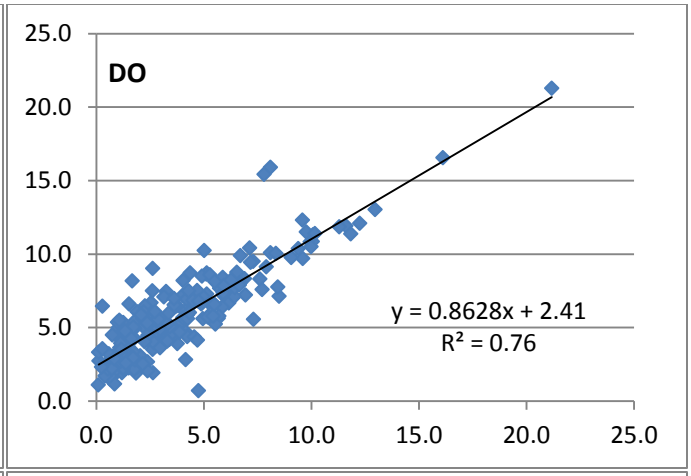


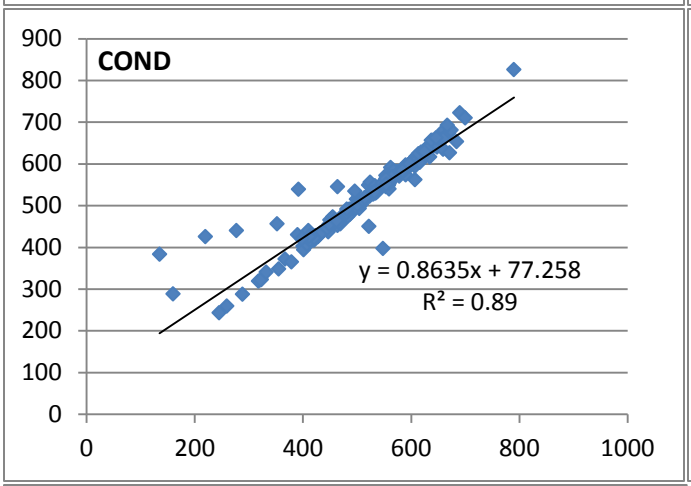


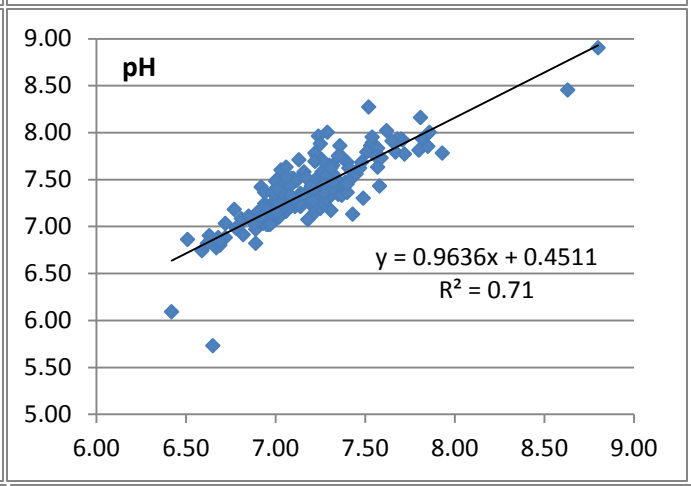


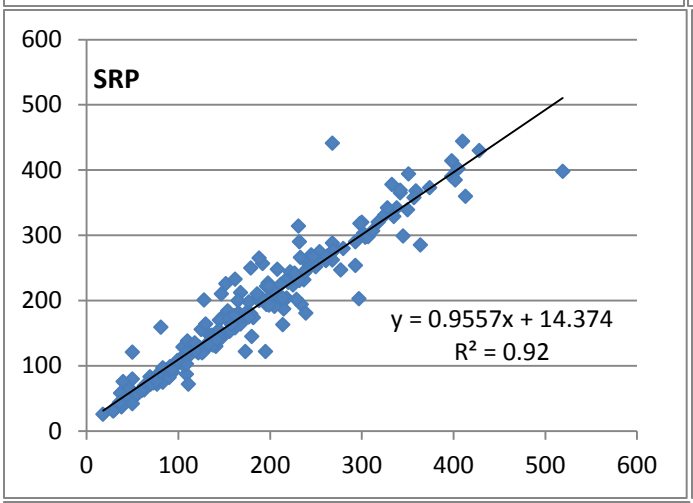
CPA04 vs. CPA06

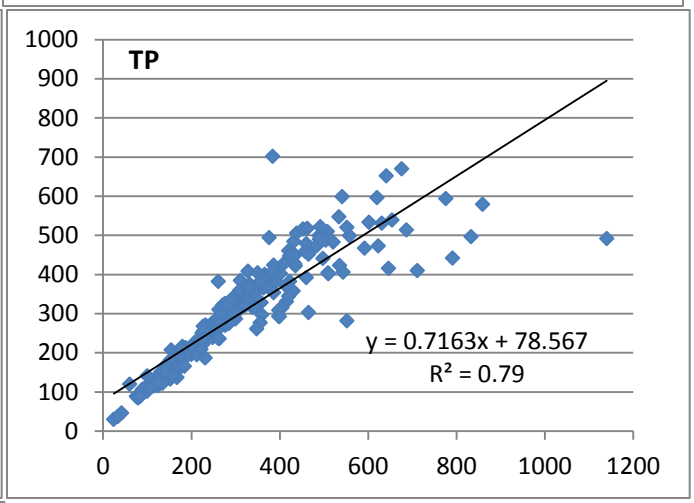


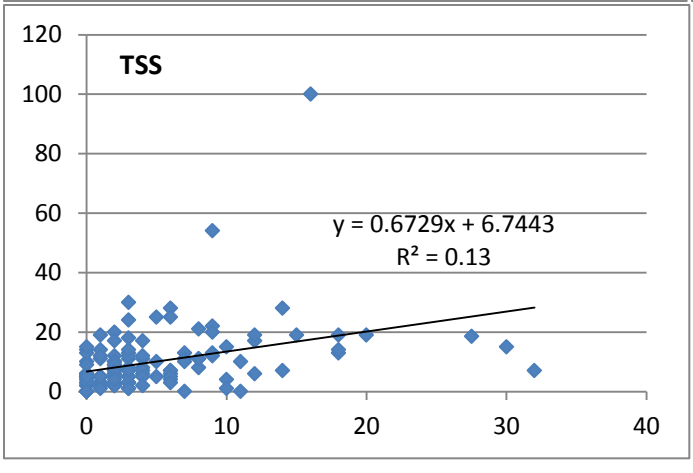




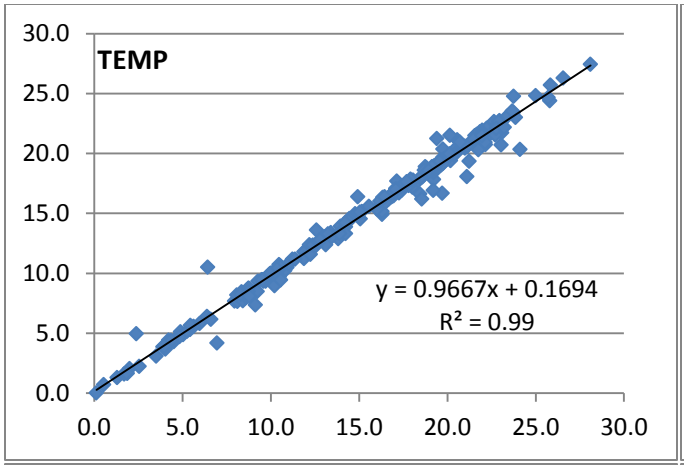


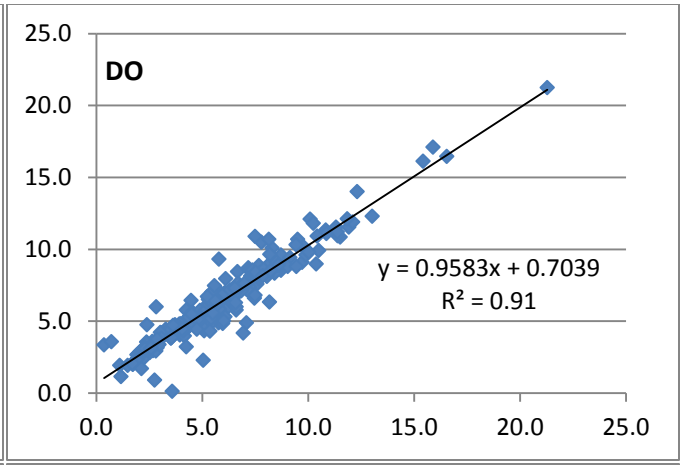


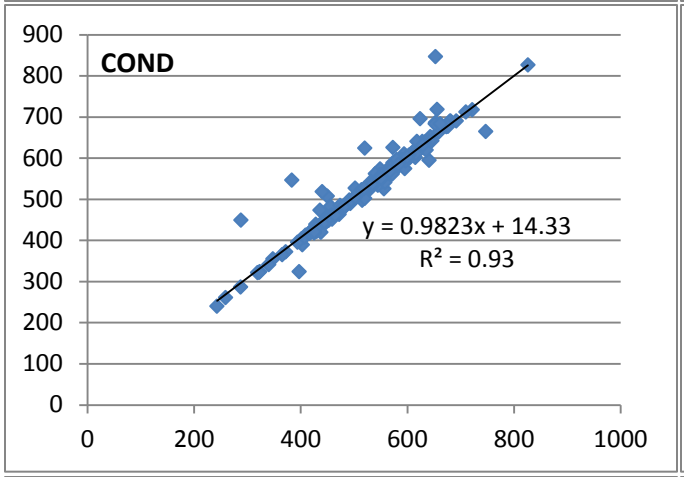


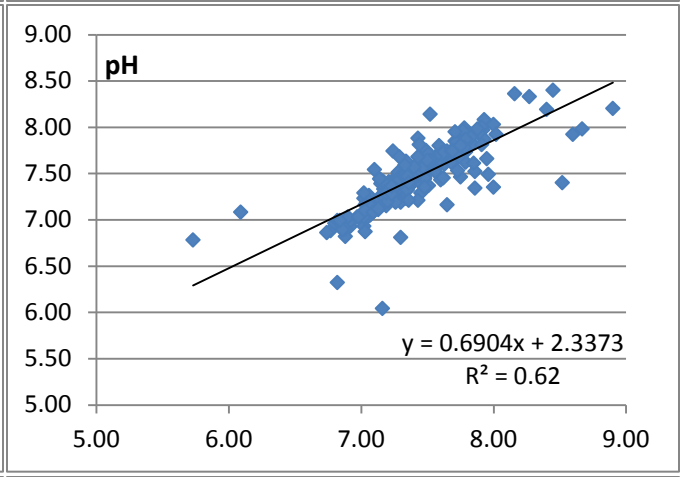


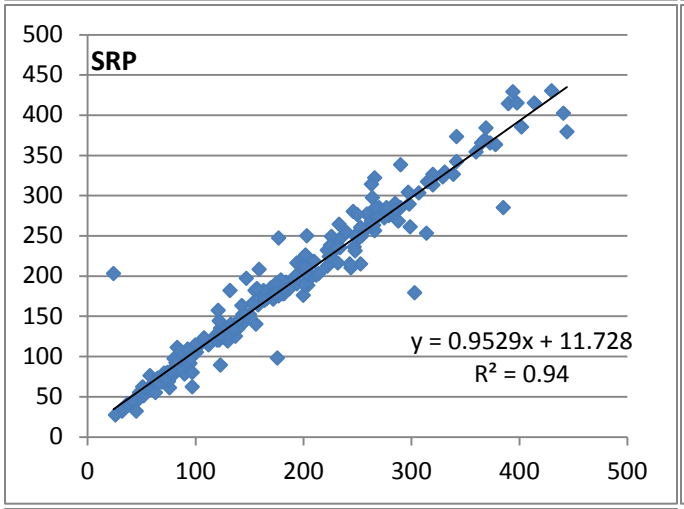
CPA06 vs. CPA01

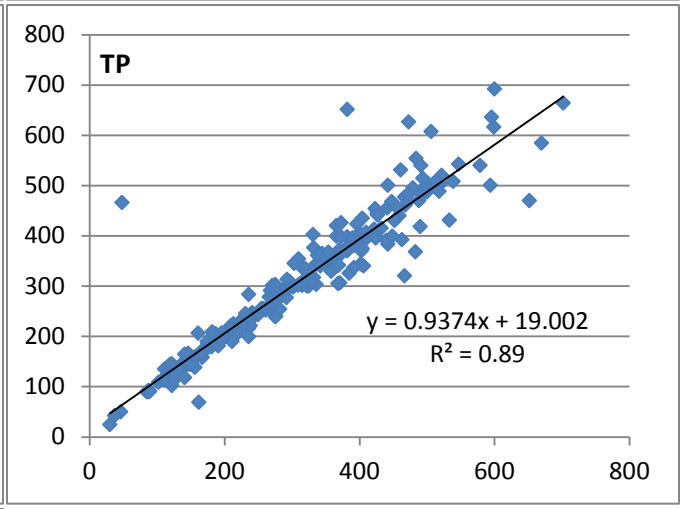


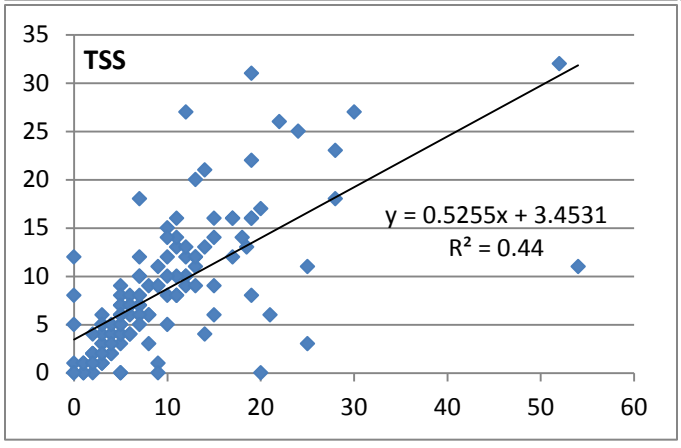




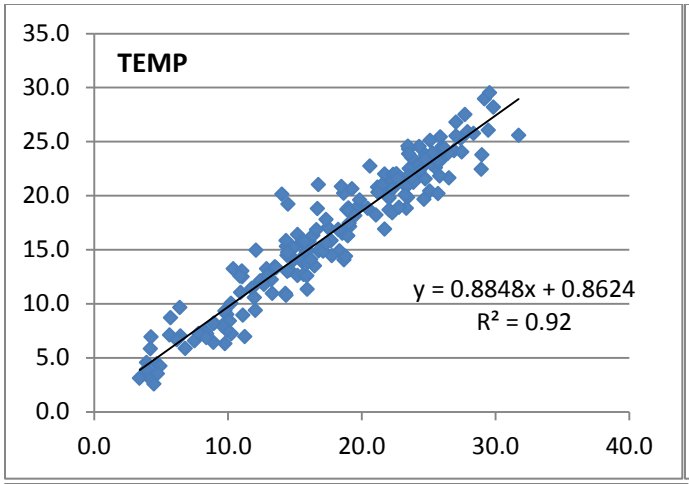


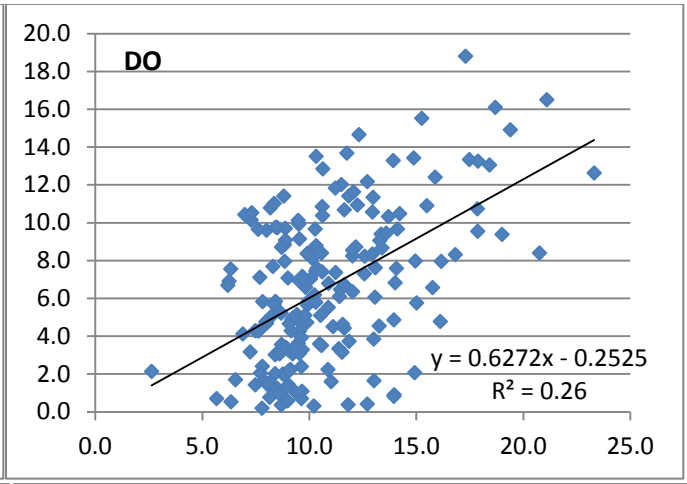


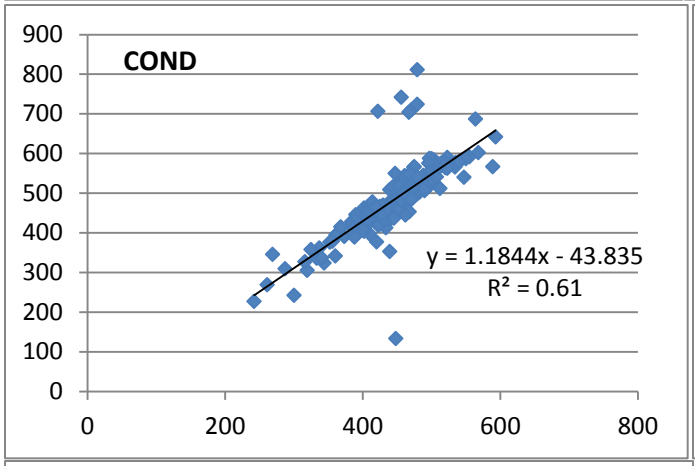


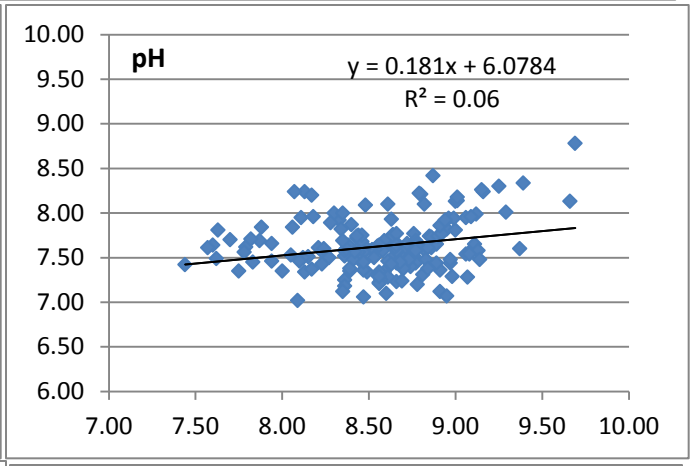


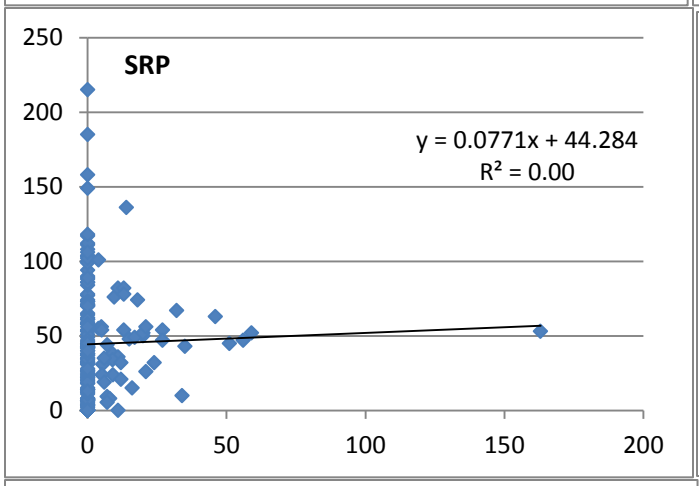
CPA01 vs. CPA05

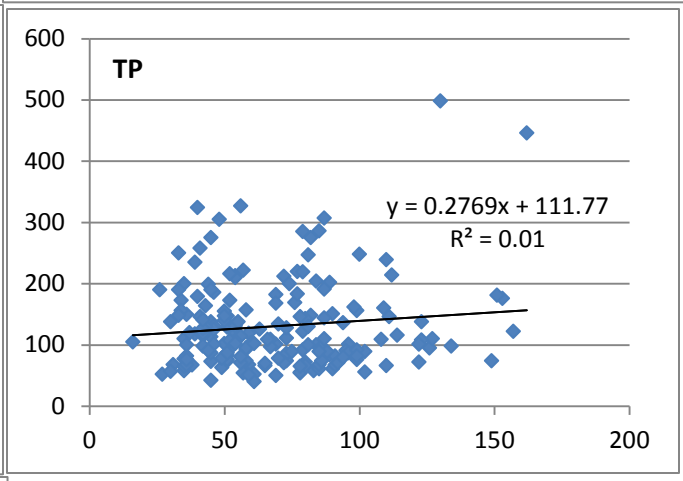


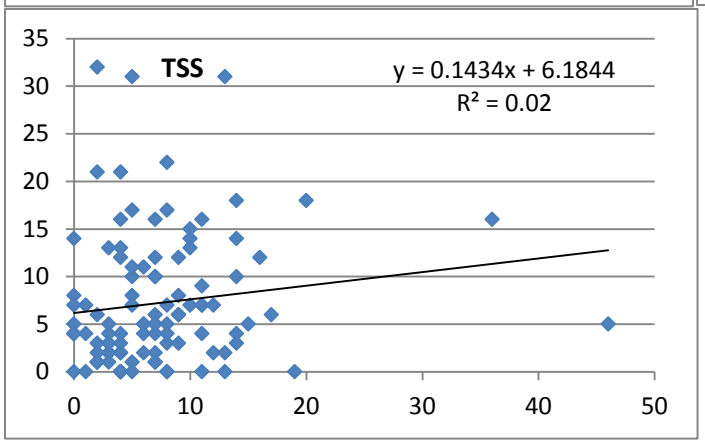




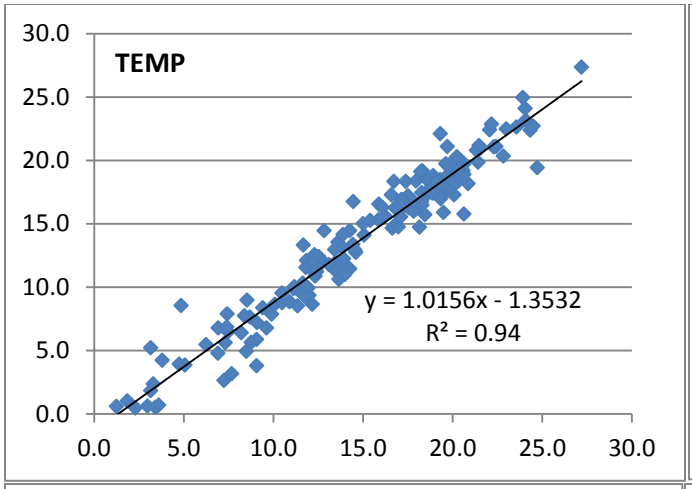


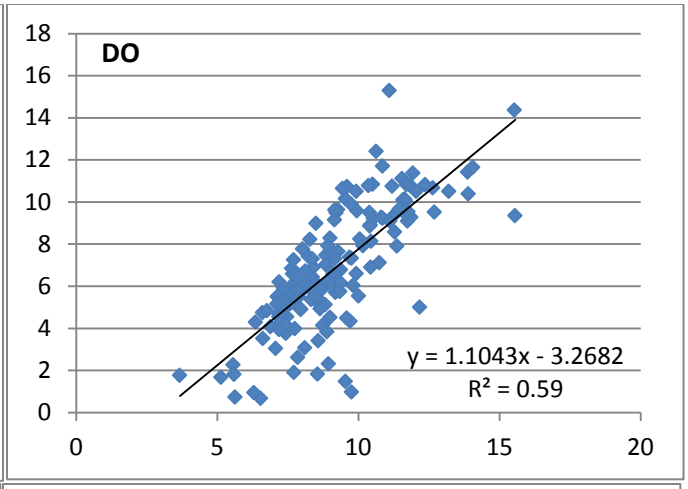


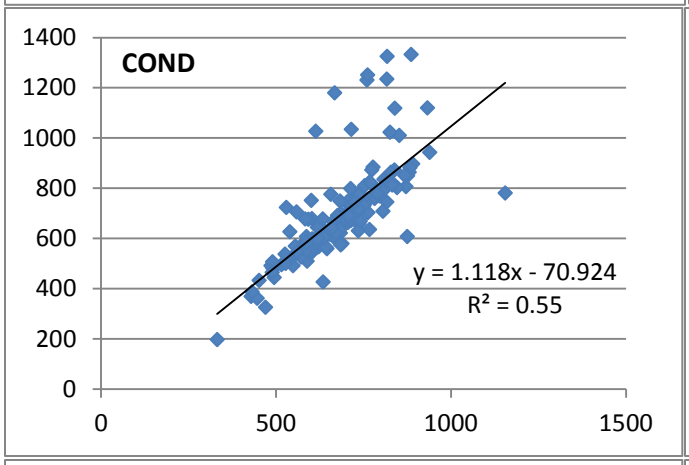


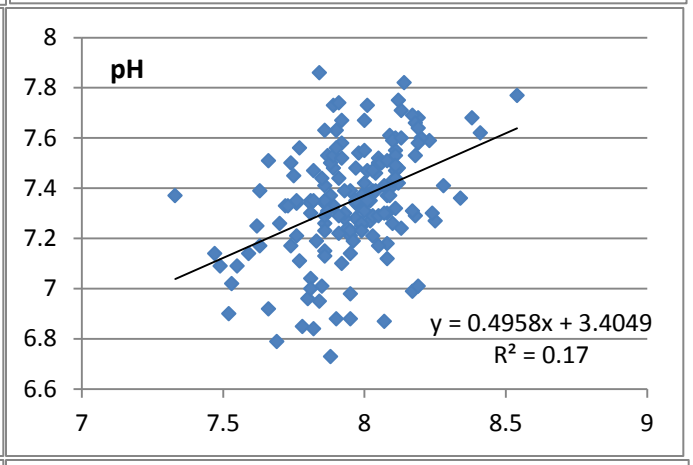


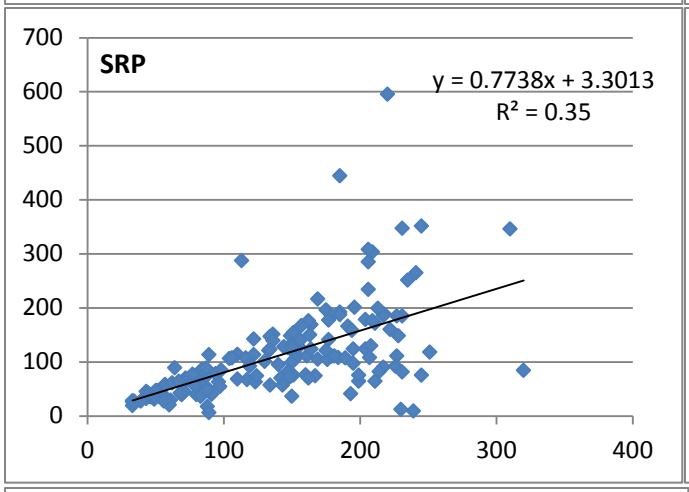
CLO01 vs. CLO03

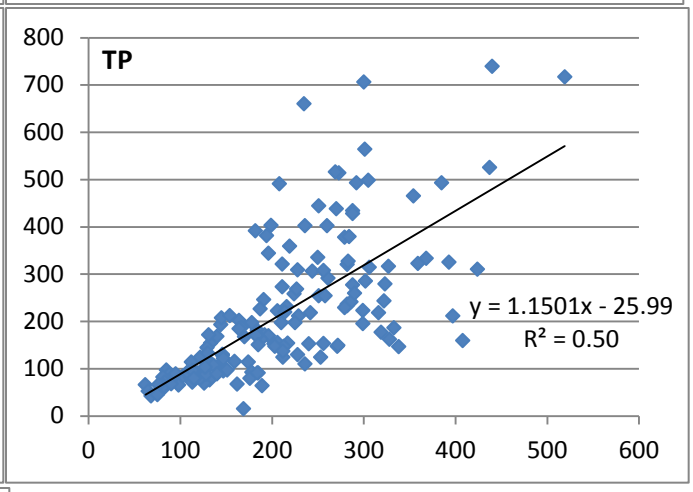


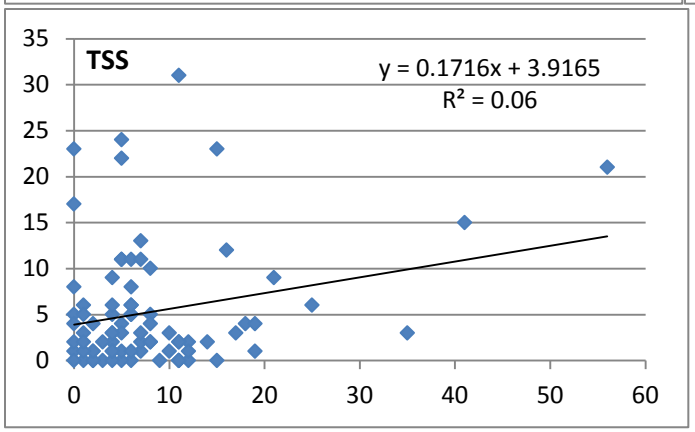












CCL01 vs CCL04

Appendix B

Descriptive Statistics of Stream Water Quality Data

NOTE: Shaded cells represent data sets that are not normally-distributed based on results of Shapiro-Wilk Tests (0.05 level of significance) using SPSS statistical software.

GRAYS BAY vs. CMH07

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP
APR	Grays Bay	Mean	10.7	10.7	404	8.24	0	25
		St Dev	2.8	1.9	36	0.11	1	6
		Count	7	7	7	5	7	8
	CMH07	Mean	8.9	13.4	383	7.41	2	38
		St Dev	3.9	6.0	82	0.95	3	31
		Count	7	7	7	5	7	8
MAY	Grays Bay	Mean	13.7	11.0	430	8.42	0	22
		St Dev	2.4	0.7	10	0.24	0	5
		Count	12	8	12	11	11	13
	CMH07	Mean	13.7	11.8	410	8.34	0	22
		St Dev	2.6	1.9	43	0.20	0	5
		Count	12	8	12	11	11	13
JUN	Grays Bay	Mean	22.0	9.5	413	8.44	0	21
		St Dev	2.2	1.2	17	0.25	0	9
		Count	17	16	17	17	16	18
	CMH07	Mean	21.8	9.3	413	8.39	0	19
		St Dev	1.9	1.5	35	0.28	0	5
		Count	17	16	17	17	16	18
JUL	Grays Bay	Mean	26.4	9.2	399	8.60	0	17
		St Dev	1.5	1.8	26	0.23	0	5
		Count	14	14	14	12	13	14
	CMH07	Mean	26.2	8.2	406	8.55	0	19
		St Dev	2.0	1.8	22	0.21	0	8
		Count	14	14	14	12	13	14
AUG	Grays Bay	Mean	24.8	9.0	399	8.56	0	21
		St Dev	1.8	1.3	58	0.21	0	11
		Count	14	11	14	14	12	15
	CMH07	Mean	24.0	8.7	405	8.37	1	19
		St Dev	2.4	1.2	45	0.47	3	7
		Count	14	11	14	14	12	15
SEP	Grays Bay	Mean	18.9	9.4	393	8.57	0	17
		St Dev	2.2	1.3	58	0.33	0	2
		Count	11	10	11	10	12	11
	CMH07	Mean	17.8	6.4	413	7.90	4	30
		St Dev	2.6	3.4	40	0.45	6	24
		Count	11	10	11	10	10	11
OCT	Grays Bay	Mean	13.4	11.5	396	8.04	0	19
		St Dev	1.4	2.2	31	0.62	0	5
		Count	4	4	4	4	3	5
	CMH07	Mean	12.5	9.2	393	7.91	0	25
		St Dev	1.6	2.3	58	0.19	0	15
		Count	4	4	4	4	3	5

CMH07 vs. CMH19

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH07	Mean	7.9	12.4	390	7.24	2	56	2
		St Dev	4.0	6.4	92	1.05	4	52	3
		Count	24	21	24	18	24	24	15
	CMH19	Mean	7.8	12.7	733	7.59	5	63	5
		St Dev	4.4	4.3	323	0.33	8	41	4
		Count	24	21	24	18	24	24	15
MAY	CMH07	Mean	13.9	11.1	416	8.00	0	22	1
		St Dev	3.8	1.7	32	0.62	0	7	2
		Count	34	31	31	35	29	34	20
	CMH19	Mean	14.0	8.9	501	7.89	0	32	2
		St Dev	3.8	2.1	105	0.37	0	15	3
		Count	34	31	31	35	29	34	20
JUN	CMH07	Mean	21.6	9.7	412	8.40	0	18	2
		St Dev	2.3	1.5	22	0.28	0	5	2
		Count	38	38	36	38	32	38	22
	CMH19	Mean	21.2	6.6	448	7.77	2	35	2
		St Dev	2.3	1.4	31	0.34	5	18	2
		Count	38	38	36	38	32	38	22
JUL	CMH07	Mean	25.6	8.7	408	8.51	0	19	1
		St Dev	1.9	1.7	20	0.27	0	8	1
		Count	40	40	38	38	34	40	21
	CMH19	Mean	25.0	5.1	439	7.77	5	34	1
		St Dev	1.7	1.5	31	0.34	5	12	1
		Count	40	40	38	38	34	40	21
AUG	CMH07	Mean	23.9	8.3	402	8.39	0	18	1
		St Dev	2.5	2.7	32	0.47	0	6	1
		Count	37	37	33	36	27	34	19
	CMH19	Mean	22.9	4.9	439	7.68	5	34	4
		St Dev	2.5	1.9	50	0.30	7	15	3
		Count	37	37	33	36	27	34	19
SEP	CMH07	Mean	18.8	7.3	402	8.11	4	26	1
		St Dev	2.8	3.2	39	0.52	6	19	1
		Count	34	34	34	33	29	30	15
	CMH19	Mean	18.3	5.8	594	7.68	3	34	2
		St Dev	2.7	1.9	257	0.22	5	18	3
		Count	34	34	34	33	29	30	15
OCT	CMH07	Mean	12.2	9.8	388	7.93	3	27	0
		St Dev	3.2	3.5	56	0.35	6	14	0
		Count	28	28	25	28	25	26	13
	CMH19	Mean	11.3	9.0	451	7.71	2	25	2
		St Dev	3.6	2.5	84	0.24	4	10	2
		Count	28	28	25	28	25	26	13

CMH02 vs. CMH11

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH02	Mean	8.1	11.1	926	7.54	9	76	9
		St Dev	4.7	3.6	335	0.56	11	31	6
		Count	43	40	43	37	42	42	24
	CMH11	Mean	8.0	11.4	932	7.72	8	82	9
		St Dev	4.5	2.9	342	0.49	10	39	6
		Count	43	40	43	37	42	42	24
MAY	CMH02	Mean	14.4	8.3	569	7.67	5	50	7
		St Dev	3.6	2.4	185	0.36	7	24	4
		Count	40	38	39	40	40	39	23
	CMH11	Mean	14.4	8.5	586	7.79	5	54	10
		St Dev	3.7	2.6	193	0.34	6	26	7
		Count	40	38	39	40	40	39	23
JUN	CMH02	Mean	21.0	6.3	464	7.71	13	52	6
		St Dev	2.5	1.2	57	0.29	11	22	3
		Count	45	45	41	44	45	42	23
	CMH11	Mean	20.9	6.1	475	7.70	17	67	9
		St Dev	2.5	1.5	57	0.22	11	36	5
		Count	45	45	41	44	45	42	23
JUL	CMH02	Mean	24.4	5.2	453	7.74	17	53	6
		St Dev	1.8	1.2	49	0.31	11	20	5
		Count	40	40	35	36	40	39	20
	CMH11	Mean	24.2	5.5	465	7.74	21	57	5
		St Dev	1.8	1.1	65	0.23	10	20	4
		Count	40	40	35	36	40	39	20
AUG	CMH02	Mean	22.5	5.6	561	7.71	13	57	7
		St Dev	2.5	1.4	188	0.25	9	20	4
		Count	38	37	37	38	37	38	21
	CMH11	Mean	21.9	6.0	540	7.81	15	70	8
		St Dev	2.8	2.0	129	0.33	8	37	8
		Count	38	37	37	38	37	38	21
SEP	CMH02	Mean	18.0	7.2	575	7.74	8	50	6
		St Dev	2.8	1.4	278	0.21	8	26	5
		Count	34	34	33	32	33	34	18
	CMH11	Mean	17.7	7.3	573	7.84	10	59	8
		St Dev	2.9	1.4	183	0.21	7	31	9
		Count	34	34	33	32	33	34	18
OCT	CMH02	Mean	10.3	10.1	617	7.70	7	36	3
		St Dev	3.6	2.1	238	0.24	9	15	4
		Count	29	29	29	29	28	26	17
	CMH11	Mean	10.2	9.9	597	7.84	7	63	8
		St Dev	3.7	2.4	213	0.23	8	47	7
		Count	29	29	29	29	28	26	17

CMH03 vs. CMH04

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH03	Mean	9.0	12.3	901	7.97	3	80	7
		St Dev	4.9	2.6	285	0.64	4	36	3
		Count	33	31	33	27	29	33	18
	CMH04	Mean	8.7	12.7	901	7.87	5	84	8
		St Dev	4.4	2.8	282	0.53	5	39	4
		Count	33	31	33	27	29	33	18
MAY	CMH03	Mean	15.3	9.9	625	7.95	3	53	5
		St Dev	4.0	2.5	207	0.41	5	25	2
		Count	32	31	32	31	31	32	20
	CMH04	Mean	15.2	10.2	616	8.00	4	55	6
		St Dev	3.9	3.0	200	0.47	6	25	3
		Count	32	31	32	31	31	32	20
JUN	CMH03	Mean	21.6	7.5	495	7.80	14	65	5
		St Dev	2.4	0.9	69	0.27	8	30	3
		Count	36	36	36	33	34	34	20
	CMH04	Mean	21.4	7.6	501	7.83	19	65	7
		St Dev	2.5	1.1	79	0.28	10	31	4
		Count	36	36	36	33	34	34	20
JUL	CMH03	Mean	25.3	6.8	463	7.74	19	65	3
		St Dev	2.1	0.7	26	0.25	13	20	2
		Count	30	29	30	26	30	30	16
	CMH04	Mean	25.1	6.9	463	7.81	24	68	5
		St Dev	2.0	0.8	27	0.24	12	22	2
		Count	30	29	30	26	30	30	16
AUG	CMH03	Mean	23.6	7.1	475	7.92	14	66	8
		St Dev	2.4	0.9	64	0.32	11	23	5
		Count	30	26	29	29	30	30	18
	CMH04	Mean	22.9	7.2	485	7.89	15	65	7
		St Dev	3.2	0.7	72	0.26	11	22	6
		Count	30	26	29	29	30	30	18
SEP	CMH03	Mean	18.6	8.6	489	7.94	8	46	4
		St Dev	2.8	1.1	89	0.34	8	20	2
		Count	28	28	28	25	28	28	14
	CMH04	Mean	18.2	8.7	488	8.05	9	47	4
		St Dev	2.9	1.1	109	0.42	7	21	3
		Count	28	28	28	25	28	28	14
OCT	CMH03	Mean	10.8	11.2	584	7.98	4	44	3
		St Dev	3.7	1.7	188	0.17	5	16	2
		Count	30	30	30	28	28	29	18
	CMH04	Mean	10.4	11.0	589	7.92	6	42	3
		St Dev	3.6	2.1	191	0.17	7	14	2
		Count	30	30	30	28	28	29	18

CMH03 vs. CMH12&15

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH03	Mean	9.0	12.4	911	8.08	3	85	8
		St Dev	5.1	2.5	314	0.60	5	36	3
		Count	43	40	43	36	38	42	23
	CMH12&15	Mean	8.6	12.4	912	7.98	7	94	7
		St Dev	4.8	2.7	311	0.43	10	44	4
		Count	43	40	43	36	38	42	23
MAY	CMH03	Mean	15.4	9.7	603	7.96	3	55	6
		St Dev	3.7	2.1	203	0.36	4	24	3
		Count	40	38	40	39	39	40	23
	CMH12&15	Mean	15.1	9.6	613	7.94	6	58	8
		St Dev	3.7	2.6	211	0.36	7	24	4
		Count	40	38	40	39	39	40	23
JUN	CMH03	Mean	21.7	7.6	485	7.80	12	61	5
		St Dev	2.4	0.9	53	0.28	8	22	3
		Count	45	45	43	42	42	44	25
	CMH12&15	Mean	21.4	7.3	493	7.75	20	75	8
		St Dev	2.5	1.3	81	0.22	13	32	4
		Count	45	45	43	42	42	44	25
JUL	CMH03	Mean	25.4	6.9	467	7.76	17	64	4
		St Dev	1.9	0.9	29	0.24	11	17	2
		Count	41	41	41	37	40	40	21
	CMH12&15	Mean	24.7	6.7	470	7.79	24	66	7
		St Dev	1.8	0.9	34	0.19	11	14	2
		Count	41	41	41	37	40	40	21
AUG	CMH03	Mean	23.4	7.4	477	7.87	13	67	8
		St Dev	2.4	1.1	62	0.34	11	25	6
		Count	42	41	41	42	42	42	23
	CMH12&15	Mean	22.3	7.3	486	7.85	19	66	6
		St Dev	3.0	1.4	73	0.30	10	24	4
		Count	42	41	41	42	42	42	23
SEP	CMH03	Mean	18.7	8.4	500	7.89	8	54	5
		St Dev	2.8	1.2	86	0.29	7	25	2
		Count	36	36	36	33	36	35	16
	CMH12&15	Mean	17.9	8.4	515	7.88	14	56	4
		St Dev	2.9	1.3	105	0.24	10	30	3
		Count	36	36	36	33	36	35	16
OCT	CMH03	Mean	11.2	11.0	562	7.94	6	51	4
		St Dev	3.8	1.7	183	0.23	9	21	3
		Count	38	38	38	37	36	37	21
	CMH12&15	Mean	10.7	10.3	573	7.84	12	55	4
		St Dev	3.7	2.3	192	0.28	11	29	3
		Count	38	38	38	37	36	37	21

CMH04 vs. CMH12&15

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH04	Mean	8.7	12.7	901	7.87	7	84	8
		St Dev	4.4	2.8	282	0.53	9	39	4
		Count	33	31	33	27	31	32	19
	CMH12&15	Mean	8.5	12.2	898	7.85	9	88	7
		St Dev	4.3	2.9	282	0.42	12	41	4
		Count	33	31	33	27	31	32	19
MAY	CMH04	Mean	15.2	9.9	616	8.00	5	57	6
		St Dev	3.9	2.3	200	0.47	6	26	3
		Count	32	30	32	31	32	33	18
	CMH12&15	Mean	14.9	9.4	636	7.88	7	61	6
		St Dev	3.9	2.4	216	0.34	8	27	3
		Count	32	30	32	31	32	33	18
JUN	CMH04	Mean	21.4	7.6	502	7.83	20	65	7
		St Dev	2.5	1.1	79	0.28	12	31	4
		Count	36	36	35	33	35	34	20
	CMH12&15	Mean	21.3	7.2	504	7.72	25	77	8
		St Dev	2.5	1.3	98	0.24	17	33	5
		Count	36	36	35	33	35	34	20
JUL	CMH04	Mean	25.1	6.9	463	7.81	24	65	5
		St Dev	2.0	0.8	27	0.24	12	16	2
		Count	30	30	30	26	30	29	16
	CMH12&15	Mean	24.8	6.8	462	7.80	27	66	7
		St Dev	1.9	0.9	29	0.22	11	15	2
		Count	30	30	30	26	30	29	16
AUG	CMH04	Mean	22.9	7.2	485	7.89	15	65	7
		St Dev	3.2	0.7	72	0.26	11	22	6
		Count	30	26	29	29	30	30	18
	CMH12&15	Mean	22.5	6.9	485	7.85	20	67	7
		St Dev	3.2	0.9	79	0.26	11	22	6
		Count	30	26	29	29	30	30	18
SEP	CMH04	Mean	18.2	8.8	478	7.99	9	45	4
		St Dev	2.9	0.9	96	0.34	7	19	3
		Count	27	27	27	24	27	27	14
	CMH12&15	Mean	18.0	8.9	490	7.94	12	48	5
		St Dev	2.9	1.0	97	0.26	8	27	3
		Count	27	27	27	24	27	27	14
OCT	CMH04	Mean	10.4	11.0	589	7.95	7	42	3
		St Dev	3.6	2.1	191	0.22	8	14	2
		Count	30	30	30	30	29	28	17
	CMH12&15	Mean	10.3	10.6	597	7.92	9	44	3
		St Dev	3.6	2.3	194	0.27	8	16	2
		Count	30	30	30	30	29	28	17

CMH04 vs CMH24

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH04	Mean	8.4	12.0	972	7.85	8	83	8
		St Dev	4.5	2.4	257	0.45	9	41	5
		Count	26	25	26	24	24	25	14
	CMH24	Mean	7.8	11.6	843	7.85	10	82	7
		St Dev	4.2	2.4	212	0.28	12	47	7
		Count	26	25	26	24	24	25	14
MAY	CMH04	Mean	15.2	10.0	645	7.90	8	57	5
		St Dev	3.6	2.5	204	0.38	9	28	3
		Count	24	24	24	24	24	23	12
	CMH24	Mean	14.7	9.5	613	7.81	14	65	8
		St Dev	3.5	2.7	161	0.37	12	27	8
		Count	24	24	24	24	24	23	12
JUN	CMH04	Mean	21.1	7.8	519	7.75	20	75	7
		St Dev	2.5	1.0	79	0.19	11	44	5
		Count	27	25	27	26	24	27	13
	CMH24	Mean	20.6	7.3	503	7.79	25	101	13
		St Dev	2.6	1.2	99	0.24	13	65	8
		Count	27	25	27	26	24	27	13
JUL	CMH04	Mean	24.8	6.8	465	7.69	28	65	5
		St Dev	2.0	0.5	21	0.17	12	19	2
		Count	21	21	20	18	21	20	10
	CMH24	Mean	24.1	7.1	475	7.82	27	69	11
		St Dev	1.7	0.6	34	0.13	11	14	6
		Count	21	21	20	18	21	20	10
AUG	CMH04	Mean	22.3	7.1	498	7.77	18	67	7
		St Dev	2.9	0.5	77	0.16	11	25	4
		Count	21	20	20	20	19	21	10
	CMH24	Mean	22.3	7.1	500	7.84	17	67	7
		St Dev	3.2	0.8	66	0.19	7	25	6
		Count	21	20	20	20	19	21	10
SEP	CMH04	Mean	18.2	8.7	499	7.93	7	36	4
		St Dev	2.9	0.9	60	0.33	6	10	2
		Count	19	19	18	18	19	19	8
	CMH24	Mean	18.0	8.7	500	8.21	7	36	4
		St Dev	2.7	0.9	60	0.33	8	15	3
		Count	19	19	18	18	19	19	8
OCT	CMH04	Mean	9.9	10.9	662	7.86	7	41	3
		St Dev	3.3	1.4	185	0.15	8	15	1
		Count	21	19	21	20	20	21	11
	CMH24	Mean	10.0	10.4	629	7.87	11	40	2
		St Dev	3.2	1.3	143	0.15	10	17	2
		Count	21	19	21	20	20	21	11

CMH24 vs. CMH18

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH24	Mean	7.4	11.9	868	7.83	11	84	9
		St Dev	4.2	2.3	208	0.71	15	44	7
		Count	31	30	31	28	30	30	16
	CMH18	Mean	8.1	12.3	894	7.96	15	94	7
		St Dev	4.4	2.8	197	0.73	21	49	3
		Count	31	30	31	28	30	30	16
MAY	CMH24	Mean	14.5	9.8	611	7.86	12	69	12
		St Dev	3.3	2.8	162	0.36	12	40	16
		Count	28	28	28	28	28	28	15
	CMH18	Mean	15.2	9.7	662	7.95	8	64	5
		St Dev	3.3	2.7	168	0.40	12	25	3
		Count	28	28	28	28	28	28	15
JUN	CMH24	Mean	20.6	7.1	501	7.78	31	96	18
		St Dev	2.4	1.6	92	0.19	30	61	20
		Count	32	32	32	30	32	32	16
	CMH18	Mean	21.4	7.1	526	7.90	17	69	4
		St Dev	2.0	1.3	83	0.37	12	22	3
		Count	32	32	32	30	32	32	16
JUL	CMH24	Mean	24.0	7.1	470	7.84	25	76	14
		St Dev	1.6	0.8	53	0.18	11	31	16
		Count	32	32	32	30	32	32	16
	CMH18	Mean	25.2	7.7	463	8.10	15	72	6
		St Dev	1.7	1.8	29	0.44	15	23	3
		Count	32	32	32	30	32	32	16
AUG	CMH24	Mean	22.2	7.0	485	7.91	19	74	13
		St Dev	2.9	1.2	86	0.29	11	39	13
		Count	34	34	34	34	34	34	17
	CMH18	Mean	23.9	7.1	453	8.01	10	80	8
		St Dev	1.9	2.2	57	0.44	9	36	3
		Count	34	34	34	34	34	34	17
SEP	CMH24	Mean	17.9	8.3	524	8.09	12	51	7
		St Dev	2.8	1.4	68	0.33	14	36	15
		Count	28	28	28	28	28	28	13
	CMH18	Mean	19.7	8.5	482	8.13	3	70	10
		St Dev	2.6	1.9	46	0.36	6	57	13
		Count	28	28	28	28	28	28	13
OCT	CMH24	Mean	10.6	9.9	566	7.80	20	63	4
		St Dev	3.4	2.5	170	0.22	34	61	3
		Count	29	29	29	28	28	28	15
	CMH18	Mean	12.5	8.6	496	7.75	15	62	5
		St Dev	3.3	1.7	94	0.21	20	31	3
		Count	29	29	29	28	28	28	15

CMH24 vs. CMH06

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH24	Mean	7.4	11.9	854	7.92	7	78	9
		St Dev	4.3	2.4	218	0.34	8	36	8
		Count	27	26	27	25	23	25	14
	CMH06	Mean	8.2	11.8	886	7.97	6	84	7
		St Dev	4.1	2.1	208	0.50	8	37	4
		Count	27	26	27	25	23	25	14
MAY	CMH24	Mean	14.5	9.8	611	7.86	12	63	9
		St Dev	3.3	2.8	162	0.37	12	25	8
		Count	28	28	28	27	28	27	14
	CMH06	Mean	15.3	9.7	658	7.94	10	69	7
		St Dev	3.3	1.9	174	0.40	12	28	5
		Count	28	28	28	27	28	27	14
JUN	CMH24	Mean	20.6	7.4	501	7.77	23	96	14
		St Dev	2.4	1.1	92	0.18	13	61	9
		Count	32	30	32	28	29	32	14
	CMH06	Mean	21.7	8.0	521	7.91	21	75	4
		St Dev	2.2	0.7	78	0.23	10	28	3
		Count	32	30	32	28	29	32	14
JUL	CMH24	Mean	24.0	7.1	476	7.84	25	69	11
		St Dev	1.6	0.6	43	0.18	11	15	5
		Count	32	30	31	30	32	30	14
	CMH06	Mean	25.2	7.4	465	8.03	21	76	7
		St Dev	1.7	0.5	28	0.26	14	29	2
		Count	32	30	31	30	32	30	14
AUG	CMH24	Mean	22.2	7.2	495	7.88	19	70	9
		St Dev	2.9	0.9	65	0.20	11	31	8
		Count	34	32	33	33	33	33	15
	CMH06	Mean	23.3	7.3	454	7.93	15	84	8
		St Dev	2.3	0.8	56	0.35	12	38	4
		Count	34	32	33	33	33	33	15
SEP	CMH24	Mean	17.9	8.3	524	8.06	10	45	3
		St Dev	2.8	1.4	68	0.30	10	20	3
		Count	28	28	28	26	27	27	11
	CMH06	Mean	19.3	8.1	486	7.96	9	55	5
		St Dev	2.8	1.2	48	0.27	12	24	2
		Count	28	28	28	26	27	27	11
OCT	CMH24	Mean	10.6	9.9	566	7.82	14	48	4
		St Dev	3.4	2.5	170	0.19	14	29	4
		Count	29	29	29	27	27	26	14
	CMH06	Mean	11.6	10.0	505	7.75	15	60	5
		St Dev	3.4	1.5	100	0.16	17	25	1
		Count	29	29	29	27	27	26	14

CMH18 vs. CMH06

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CMH18	Mean	8.1	11.9	862	7.97	6	85	7
		St Dev	4.8	2.8	249	0.71	8	39	3
		Count	32	30	32	29	28	30	17
	CMH06	Mean	8.4	11.9	862	8.00	5	85	8
		St Dev	4.4	2.1	254	0.60	7	34	4
		Count	32	30	32	29	28	30	17
MAY	CMH18	Mean	15.5	9.5	637	7.95	7	64	5
		St Dev	3.3	2.7	171	0.38	12	24	2
		Count	32	32	32	31	32	32	16
	CMH06	Mean	15.6	9.6	634	7.95	8	71	7
		St Dev	3.3	1.9	175	0.38	12	30	5
		Count	32	32	32	31	32	32	16
JUN	CMH18	Mean	21.6	7.2	521	7.97	15	69	5
		St Dev	2.1	1.3	80	0.43	12	22	3
		Count	36	35	36	33	36	36	18
	CMH06	Mean	21.9	8.0	517	7.96	21	75	6
		St Dev	2.2	0.7	75	0.27	14	27	6
		Count	36	35	36	33	36	36	18
JUL	CMH18	Mean	25.2	7.7	463	8.10	15	72	6
		St Dev	1.7	1.8	29	0.44	15	23	3
		Count	32	32	31	30	32	32	14
	CMH06	Mean	25.2	7.4	465	8.03	21	80	7
		St Dev	1.7	0.8	28	0.26	14	32	2
		Count	32	32	31	30	32	32	14
AUG	CMH18	Mean	23.9	7.1	453	7.98	9	77	8
		St Dev	1.9	2.2	57	0.41	9	31	3
		Count	34	34	34	33	33	33	15
	CMH06	Mean	23.3	7.1	451	7.93	15	84	8
		St Dev	2.3	1.0	57	0.35	12	38	4
		Count	34	34	34	33	33	33	15
SEP	CMH18	Mean	19.7	8.3	482	8.10	2	60	7
		St Dev	2.6	1.3	46	0.33	4	30	3
		Count	28	27	28	26	27	27	11
	CMH06	Mean	19.3	8.0	486	7.96	10	57	4
		St Dev	2.8	1.2	48	0.27	13	28	2
		Count	28	27	28	26	27	27	11
OCT	CMH18	Mean	12.5	8.6	496	7.75	15	62	5
		St Dev	3.3	1.7	94	0.21	20	31	3
		Count	29	29	29	28	28	28	14
	CMH06	Mean	11.6	10.0	505	7.73	15	61	5
		St Dev	3.4	1.5	100	0.18	17	24	1
		Count	29	29	29	28	28	28	14

CPA03 vs. CPA04

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CPA03	Mean	6.6	8.1	432	7.27	66	177	3
		St Dev	3.5	4.1	121	0.25	46	74	2
		Count	31	31	31	27	34	35	19
	CPA04	Mean	6.3	6.6	490	7.18	77	159	2
		St Dev	3.0	4.5	128	0.23	37	69	2
		Count	31	31	31	27	34	35	19
MAY	CPA03	Mean	12.7	3.7	464	7.20	119	191	3
		St Dev	4.1	1.8	82	0.17	82	88	2
		Count	35	35	35	34	35	36	21
	CPA04	Mean	12.5	3.4	519	7.16	122	224	4
		St Dev	3.9	2.2	77	0.18	57	91	4
		Count	35	35	35	34	35	36	21
JUN	CPA03	Mean	19.0	2.2	456	7.20	177	278	4
		St Dev	2.4	1.1	72	0.30	85	92	4
		Count	34	34	34	31	33	34	21
	CPA04	Mean	18.8	1.6	528	7.19	226	383	7
		St Dev	2.5	1.3	76	0.40	111	96	8
		Count	34	34	34	31	33	34	21
JUL	CPA03	Mean	22.0	1.2	429	7.14	159	259	5
		St Dev	1.7	0.6	59	0.30	53	61	4
		Count	29	29	29	26	27	27	15
	CPA04	Mean	22.0	1.1	505	7.10	250	424	9
		St Dev	2.3	1.1	70	0.50	112	109	8
		Count	29	29	29	26	27	27	15
AUG	CPA03	Mean	20.6	2.4	475	7.35	147	255	7
		St Dev	2.6	1.4	120	0.39	53	91	6
		Count	26	26	24	26	20	21	10
	CPA04	Mean	20.7	1.6	516	7.22	193	397	14
		St Dev	2.2	1.6	77	0.51	96	154	14
		Count	26	26	24	26	20	21	10
SEP	CPA03	Mean	15.7	3.8	484	7.42	106	204	10
		St Dev	3.0	1.5	66	0.38	60	65	7
		Count	25	24	25	20	17	17	10
	CPA04	Mean	15.8	2.0	535	7.38	150	271	4
		St Dev	2.5	1.4	70	0.50	36	65	2
		Count	25	24	25	20	17	17	10
OCT	CPA03	Mean	10.5	4.0	509	7.27	143	236	8
		St Dev	2.0	2.4	112	0.20	92	128	9
		Count	26	25	25	24	20	21	13
	CPA04	Mean	10.6	2.9	535	7.26	128	241	6
		St Dev	2.4	2.2	75	0.27	70	109	9
		Count	25	25	25	24	20	21	13

CPA04 vs. CPA06

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CPA04	Mean	6.2	6.0	488	7.18	81	160	2
		St Dev	3.1	3.5	124	0.23	42	68	2
		Count	33	32	33	29	36	36	20
	CPA06	Mean	6.7	7.6	488	7.28	84	157	2
		St Dev	3.4	3.0	125	0.28	43	70	2
		Count	33	32	33	29	36	36	20
MAY	CPA04	Mean	12.8	3.1	530	7.15	109	213	3
		St Dev	3.8	2.2	78	0.20	55	94	3
		Count	39	39	39	39	38	40	22
	CPA06	Mean	13.8	4.6	537	7.21	121	219	4
		St Dev	3.8	2.6	73	0.16	59	94	6
		Count	39	39	39	39	38	40	22
JUN	CPA04	Mean	18.7	1.5	534	7.13	215	370	4
		St Dev	2.3	1.3	74	0.33	108	98	3
		Count	37	37	37	33	37	37	19
	CPA06	Mean	19.4	2.5	534	7.21	225	397	8
		St Dev	2.5	1.6	74	0.34	100	129	9
		Count	37	37	37	33	37	37	19
JUL	CPA04	Mean	22.1	1.0	518	7.08	255	423	8
		St Dev	2.3	1.1	75	0.47	103	105	8
		Count	32	31	32	29	30	30	17
	CPA06	Mean	22.4	1.5	519	7.12	278	449	5
		St Dev	2.5	0.8	87	0.31	86	109	4
		Count	32	31	32	29	30	30	17
AUG	CPA04	Mean	20.2	1.4	495	7.15	181	351	12
		St Dev	1.6	1.5	67	0.52	62	89	15
		Count	28	29	29	29	22	22	9
	CPA06	Mean	20.2	1.6	467	7.21	215	537	9
		St Dev	2.3	0.8	123	0.49	78	289	9
		Count	28	29	29	29	22	22	9
SEP	CPA04	Mean	16.2	2.6	502	7.34	144	273	5
		St Dev	2.4	2.1	67	0.63	37	75	2
		Count	16	16	16	11	13	12	8
	CPA06	Mean	15.7	2.9	506	7.53	172	301	2
		St Dev	2.3	1.5	73	0.88	37	98	3
		Count	16	16	16	11	13	12	8
OCT	CPA04	Mean	10.4	3.5	514	7.24	149	237	7
		St Dev	2.2	2.3	81	0.26	93	125	11
		Count	17	17	17	16	16	16	10
	CPA06	Mean	9.7	5.2	502	7.24	162	256	3
		St Dev	1.8	1.7	99	0.19	90	127	5
		Count	17	17	17	16	16	16	10

CPA06 vs. CPA01

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CPA06	Mean	6.4	8.1	499	7.29	84	164	2
		St Dev	3.4	3.6	127	0.38	43	76	2
		Count	38	38	38	34	41	41	23
	CPA01	Mean	6.2	9.6	506	7.42	84	168	5
		St Dev	3.4	3.5	130	0.50	36	74	3
		Count	38	38	38	34	41	41	23
MAY	CPA06	Mean	13.8	4.7	544	7.23	124	213	4
		St Dev	3.7	2.5	73	0.14	63	96	6
		Count	43	43	43	41	43	44	26
	CPA01	Mean	13.7	6.0	544	7.38	128	225	10
		St Dev	3.5	2.5	74	0.19	62	97	8
		Count	43	43	43	41	43	44	26
JUN	CPA06	Mean	19.2	2.6	545	7.16	227	386	8
		St Dev	2.7	1.6	77	0.24	95	126	8
		Count	42	42	42	37	42	42	23
	CPA01	Mean	18.8	4.1	546	7.36	235	385	13
		St Dev	2.4	1.8	79	0.27	94	110	7
		Count	42	42	42	37	42	42	23
JUL	CPA06	Mean	22.7	1.4	520	7.09	277	468	5
		St Dev	2.4	0.9	77	0.30	84	130	4
		Count	32	31	32	28	32	32	18
	CPA01	Mean	22.6	3.3	521	7.31	287	448	12
		St Dev	2.1	1.3	75	0.33	73	80	7
		Count	32	31	32	28	32	32	18
AUG	CPA06	Mean	20.8	1.7	480	7.18	214	503	9
		St Dev	2.3	0.8	132	0.49	76	217	8
		Count	25	26	26	27	23	22	12
	CPA01	Mean	20.8	4.6	494	7.40	230	417	19
		St Dev	2.3	1.9	88	0.52	66	112	29
		Count	25	26	26	27	23	22	12
SEP	CPA06	Mean	16.5	2.7	508	7.25	195	333	2
		St Dev	2.8	1.5	69	0.35	61	128	3
		Count	18	18	18	12	15	15	9
	CPA01	Mean	16.4	5.2	522	7.53	199	329	6
		St Dev	2.7	1.7	53	0.40	59	108	3
		Count	18	18	18	12	15	15	9
OCT	CPA06	Mean	9.0	4.8	540	7.16	152	263	3
		St Dev	2.8	1.9	101	0.17	78	143	4
		Count	24	23	24	24	24	23	14
	CPA01	Mean	9.0	7.4	554	7.37	160	238	6
		St Dev	2.8	1.8	85	0.16	77	107	8
		Count	24	23	24	24	24	23	14

CPA01 vs. CPA05

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CPA01	Mean	6.2	9.6	506	7.39	84	168	5
		St Dev	3.4	3.5	130	0.50	36	74	3
		Count	38	38	38	34	41	41	22
	CPA05	Mean	6.2	10.2	509	7.35	85	172	7
		St Dev	3.4	3.2	131	0.44	34	73	5
		Count	38	38	38	34	41	41	22
MAY	CPA01	Mean	13.7	6.0	544	7.38	127	227	12
		St Dev	3.5	2.5	74	0.18	62	96	11
		Count	43	43	43	40	44	45	27
	CPA05	Mean	13.5	6.5	547	7.43	129	223	11
		St Dev	3.4	2.2	73	0.18	63	95	9
		Count	43	43	43	40	44	45	27
JUN	CPA01	Mean	18.9	4.0	545	7.43	234	390	13
		St Dev	2.5	1.7	81	0.36	98	112	7
		Count	44	44	44	41	44	44	24
	CPA05	Mean	18.4	4.4	547	7.47	236	394	12
		St Dev	2.3	1.7	83	0.32	87	111	6
		Count	44	44	44	41	44	44	24
JUL	CPA01	Mean	22.3	3.5	536	7.40	279	429	11
		St Dev	2.2	1.5	85	0.39	77	107	7
		Count	35	35	35	33	34	34	18
	CPA05	Mean	21.8	3.9	539	7.46	286	435	8
		St Dev	2.3	1.3	95	0.34	74	93	6
		Count	35	35	35	33	34	34	18
AUG	CPA01	Mean	20.7	4.7	498	7.41	232	413	11
		St Dev	2.2	1.9	89	0.51	65	109	15
		Count	26	27	27	28	25	25	11
	CPA05	Mean	20.2	4.8	515	7.52	236	412	6
		St Dev	2.1	1.7	84	0.42	58	111	3
		Count	26	27	27	28	25	25	11
SEP	CPA01	Mean	16.1	5.3	522	7.60	193	325	6
		St Dev	2.5	1.7	53	0.49	44	100	4
		Count	18	18	18	12	15	15	8
	CPA05	Mean	15.6	5.9	524	7.52	196	308	6
		St Dev	2.4	1.3	51	0.33	53	106	4
		Count	18	18	18	12	15	15	8
OCT	CPA01	Mean	9.1	7.2	556	7.42	155	239	6
		St Dev	2.9	2.2	86	0.18	74	107	8
		Count	26	25	26	26	24	24	13
	CPA05	Mean	8.8	8.0	562	7.52	159	234	4
		St Dev	2.9	2.8	91	0.23	70	100	6
		Count	26	25	26	26	24	24	13

CLO01 vs. CLO003

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CLO01	Mean	8.6	14.2	435	8.55	5	88	6
		St Dev	3.7	3.9	87	0.53	9	32	5
		Count	37	37	37	32	37	40	23
	CLO03	Mean	8.6	11.5	471	7.83	14	90	4
		St Dev	4.1	2.8	105	0.31	15	33	4
		Count	37	37	37	33	37	40	23
MAY	CLO01	Mean	15.9	11.3	464	8.66	4	56	6
		St Dev	3.7	2.8	47	0.30	7	19	5
		Count	43	43	40	40	41	43	26
	CLO03	Mean	15.5	6.9	528	7.70	35	105	8
		St Dev	3.9	2.5	91	0.22	30	46	7
		Count	43	43	40	40	41	43	26
JUN	CLO01	Mean	22.3	9.9	468	8.61	0	58	6
		St Dev	2.6	2.5	48	0.35	0	26	4
		Count	38	37	38	33	29	35	19
	CLO03	Mean	21.3	3.8	506	7.44	75	171	10
		St Dev	2.3	2.2	101	0.18	43	78	9
		Count	38	37	38	33	29	35	19
JUL	CLO01	Mean	26.4	9.3	448	8.74	0	61	9
		St Dev	2.3	1.9	46	0.27	0	23	4
		Count	26	25	24	24	22	26	14
	CLO03	Mean	24.1	2.1	479	7.46	77	180	5
		St Dev	2.5	1.7	53	0.33	28	52	4
		Count	26	25	24	24	22	26	14
AUG	CLO01	Mean	25.4	9.3	435	8.74	2	59	9
		St Dev	2.2	1.4	33	0.27	4	19	5
		Count	16	16	16	16	16	16	8
	CLO03	Mean	22.5	3.5	465	7.55	45	161	10
		St Dev	2.4	2.3	51	0.21	42	80	10
		Count	14	14	14	14	16	16	8
SEP	CLO01	Mean	19.6	9.2	415	8.33	6	95	22
		St Dev	3.0	2.0	46	0.46	9	31	18
		Count	16	16	16	13	11	10	5
	CLO03	Mean	16.9	8.2	430	7.80	33	150	6
		St Dev	3.7	2.5	57	0.35	19	135	6
		Count	16	16	16	13	11	10	5
OCT	CLO01	Mean	12.9	10.1	422	8.10	29	88	8
		St Dev	2.9	2.1	57	0.29	42	20	5
		Count	16	15	14	14	16	15	9
	CLO03	Mean	11.1	8.9	451	7.64	49	90	7
		St Dev	2.8	2.1	73	0.23	30	25	9
		Count	16	15	14	15	16	15	9

CCL01 vs. CCL04

MONTH	SITE	STAT	TEMP	DO	COND	pH	SRP	TP	TSS
APR	CCL01	Mean	7.8	11.6	658	7.94	64	119	6
		St Dev	5.0	1.8	122	0.16	39	53	7
		Count	33	29	33	29	32	33	18
	CCL04	Mean	6.3	10.3	605	7.49	45	92	2
		St Dev	4.3	0.8	137	0.22	23	29	3
		Count	33	29	33	29	32	33	18
MAY	CCL01	Mean	14.7	9.4	694	8.00	102	158	8
		St Dev	3.3	1.3	95	0.14	39	59	8
		Count	40	40	40	40	37	40	22
	CCL04	Mean	13.8	7.2	680	7.42	85	174	5
		St Dev	4.0	1.7	128	0.16	40	120	7
		Count	40	40	40	40	37	40	22
JUN	CCL01	Mean	18.5	7.9	697	7.99	169	251	9
		St Dev	2.3	0.5	113	0.15	42	63	6
		Count	34	33	34	33	33	32	17
	CCL04	Mean	17.8	5.7	691	7.37	152	274	5
		St Dev	2.8	1.2	137	0.20	69	90	3
		Count	34	33	34	33	33	32	17
JUL	CCL01	Mean	21.1	7.3	680	7.97	203	294	17
		St Dev	2.5	1.5	116	0.19	32	85	19
		Count	21	21	21	19	20	21	9
	CCL04	Mean	19.8	3.7	740	7.16	207	434	11
		St Dev	3.0	1.6	239	0.21	140	175	8
		Count	21	21	21	19	20	21	9
AUG	CCL01	Mean	20.9	8.2	693	7.93	182	299	10
		St Dev	2.1	1.8	110	0.21	41	68	4
		Count	13	13	13	13	13	11	5
	CCL04	Mean	18.8	4.3	781	7.14	143	275	14
		St Dev	2.2	2.4	263	0.20	87	96	13
		Count	13	13	13	13	13	11	5
SEP	CCL01	Mean	16.0	9.0	650	7.96	194	261	7
		St Dev	3.5	1.2	78	0.31	27	69	5
		Count	10	10	10	10	7	7	3
	CCL04	Mean	14.9	6.0	780	7.28	119	172	1
		St Dev	3.5	3.8	143	0.26	20	46	2
		Count	10	10	10	10	7	7	3
OCT	CCL01	Mean	9.7	10.0	670	7.81	181	237	1
		St Dev	2.8	1.8	150	0.21	62	67	1
		Count	17	17	17	17	17	17	7
	CCL04	Mean	8.8	8.2	693	7.31	80	138	3
		St Dev	2.8	2.7	233	0.14	21	49	3
		Count	17	17	17	17	17	17	7