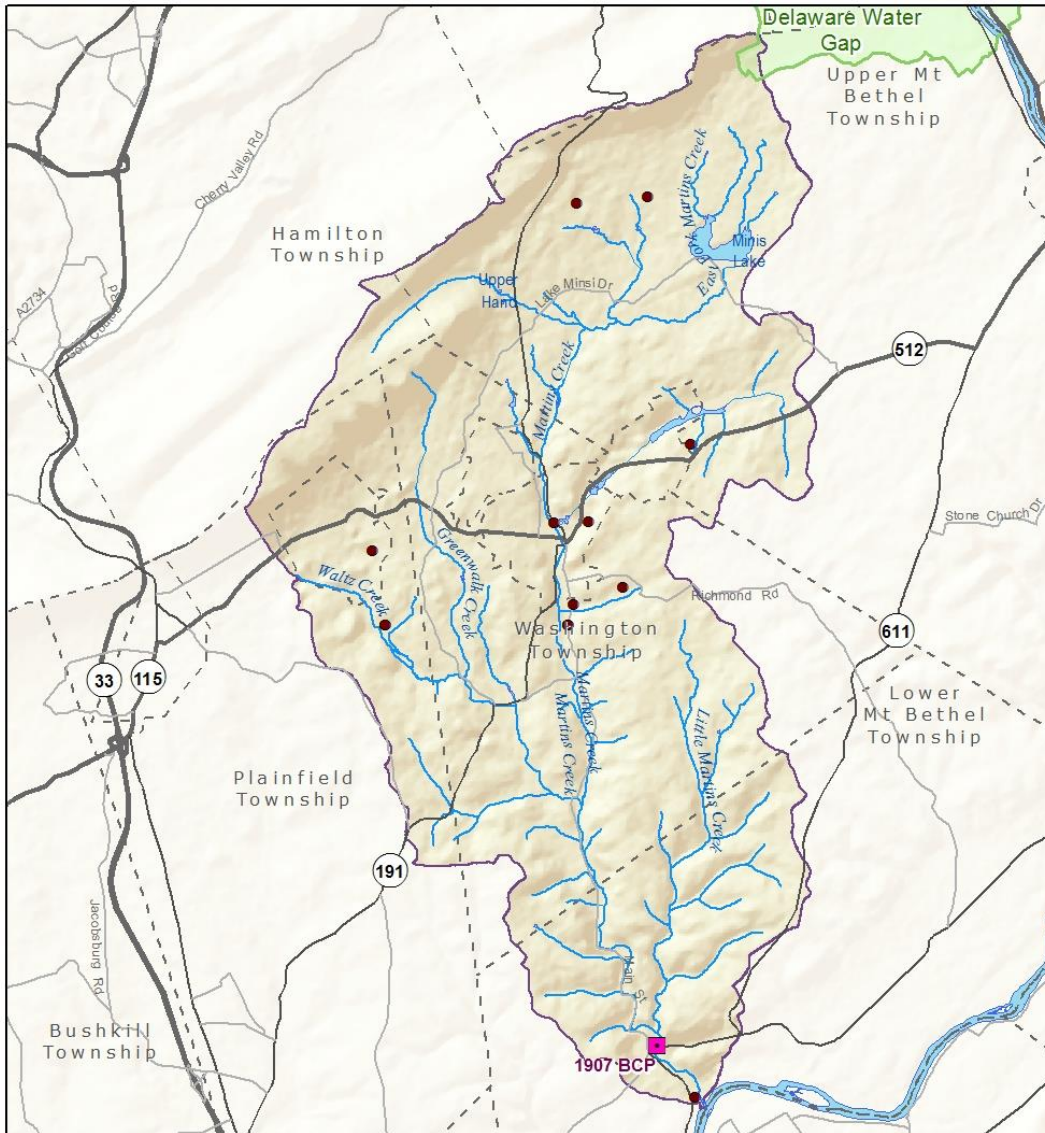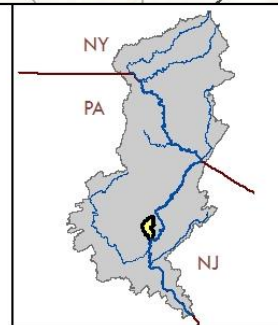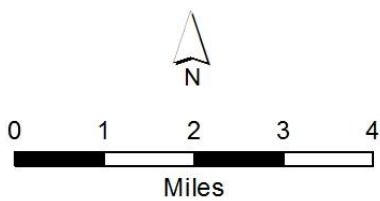# Chapter 20: 1907 BCP Martins Creek, Northampton County, PA
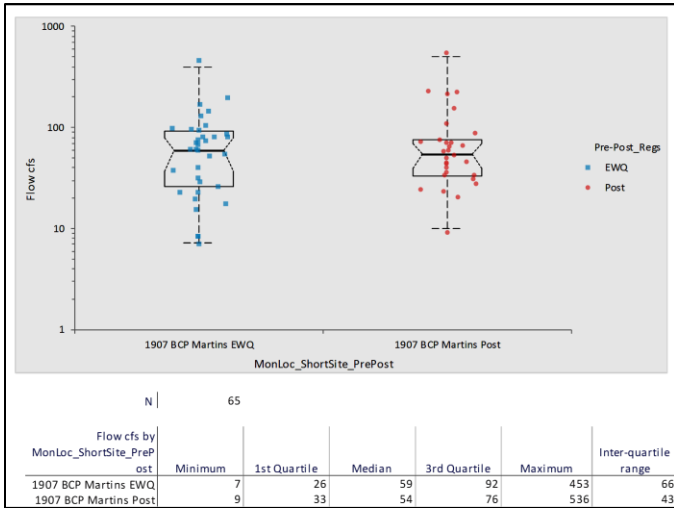

Martins Creek

Drainage Area =   44.56 mi²

- ▣ Sampling Location
- ● NPDES
- Drainage Area
- NPS Boundary

0   1   2   3   4
Miles

Analysis of flow differences between the EWQ and post-EWQ periods:

Flow cfs by MonLoc_ShortSite_PreP ost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
N	65					
1907 BCP Martins EWQ	7	26	59	92	453	66
1907 BCP Martins Post	9	33	54	76	536	43

Flow conditions associated with the EWQ and post-EWQ sampling periods were similar. The range of flow conditions sampled was also roughly equal, so water quality comparisons should not be affected by unequal flow conditions.
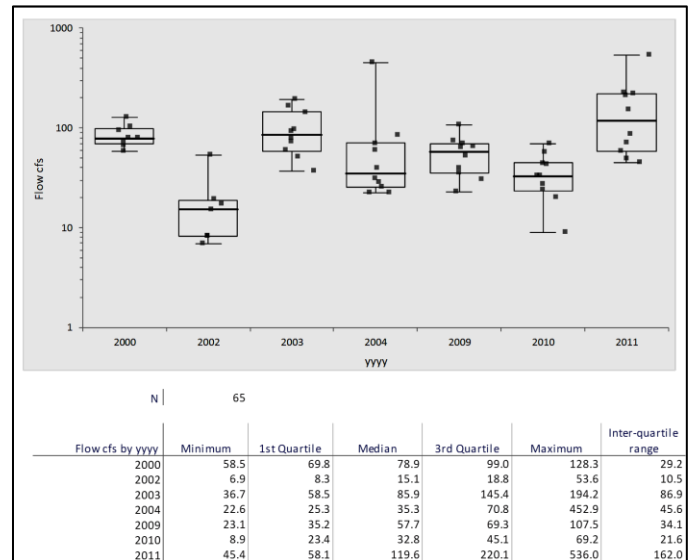
Kruskal-Wallis test

Flow cfs by MonLoc_ShortSite_PreP ost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	0.1	0.00
1907 BCP Martins Post	30	0.1	0.00
H statistic	0.00		
X² approximation	0.00		
DF	1		
p-value	0.9790[1]		

H0: $\theta_1 = \theta_2 = \theta$...
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

Martins Creek is a good-quality cold-water creek possessing naturally reproducing trout populations. The watershed was about 38% glaciated, 8% urban, and contains significant agricultural lands. Overall watershed area is about 44.5 square miles, and it is about 55% forested. Only 1.5% of the watershed is covered by carbonate bedrock. In comparison, the neighboring Bushkill Creek watershed is 38% carbonate bedrock, and the Lehigh River watershed contains 16%. So limestone is not a major determinant of water quality here compared with the Bushkill and Lehigh.

Upstream ICP: Delaware River at Belvidere 1978 ICP
Downstream ICP: Delaware River at Easton 1838 ICP

Flow cfs by yyyy	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
N	65					
2000	58.5	69.8	78.9	99.0	128.3	29.2
2002	6.9	8.3	15.1	18.8	53.6	10.5
2003	36.7	58.5	85.9	145.4	194.2	86.9
2004	22.6	25.3	35.3	70.8	452.9	45.6
2009	23.1	35.2	57.7	69.3	107.5	34.1
2010	8.9	23.4	32.8	45.1	69.2	21.6
2011	45.4	58.1	119.6	220.1	536.0	162.0

There are few dischargers in the Martins Creek watershed. There are no independent data sources available to compare with DRBC results at this site. There is a USGS gage in the watershed, but it is located in the upper portion of the watershed and is too far from the Little Creek Road monitoring site to be of use for flow estimation.

Annual May to September flow statistics associated with water quality measurements are plotted above. These are measurements or estimates associated with the time of each water quality sample. Mean annual flow is about 76 cfs; and harmonic mean flow is about 24 cfs (USGS Stream Stats retrieval, Feb. 2014) which is more typical of summer flow conditions. Among the wide range of flows sampled by DRBC, these data appear to be most representative of harmonic mean to mean annual flow conditions. In the EWQ period, flows were measured using a DRBC-constructed benchmark gage and gage-discharge rating. Because of shifting gravel bars near the Little Creek Road site, it proved too expensive to continue maintenance of the rating curve. Post-EWQ flows corresponding to each water quality sample were estimated using the USGS BaSE model, but still compared with DRBC benchmark gage height measurements. BaSE estimates and rating curve measurements were comparable. DRBC intends to use the BaSE program for future flow estimates.

*Stuckey, M.H., Koerkle, E.H., and Ulrich, J.E., 2012, Estimation of baseline daily mean streamflows for ungaged locations on Pennsylvania streams, water years 1960–2008: U.S. Geological Survey Scientific Investigations Report 2012–5142, 61 p.)

Chapter 20: 1907 BCP Martins Creek, PA
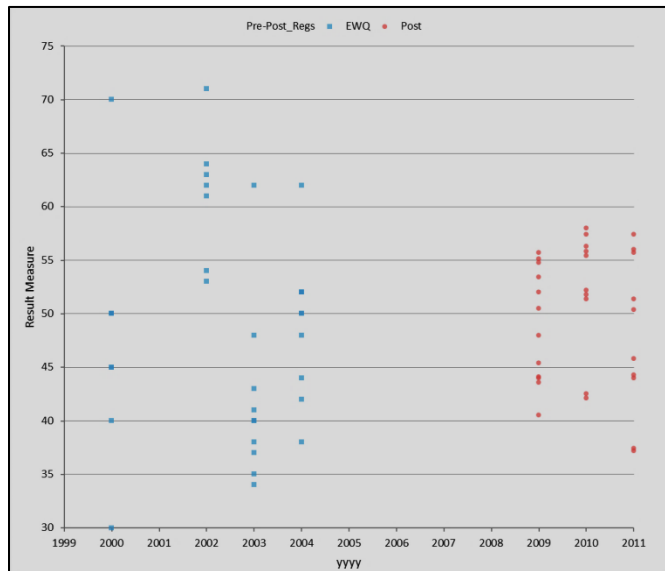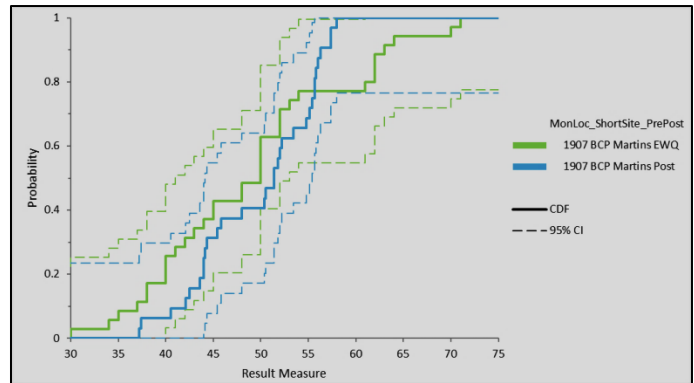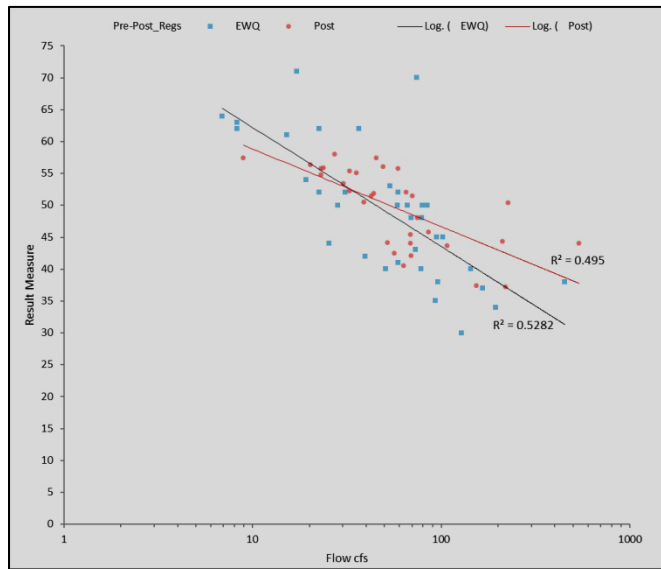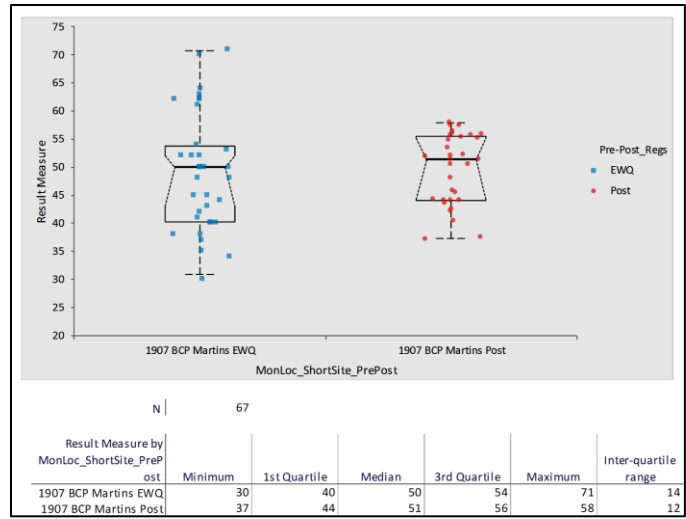
Alkalinity as CaCO3, Total mg/l

Existing Water Quality (Table 2G):

Median 50 mg/l
Lower 95% Confidence Interval 43 mg/l
Upper 95% Confidence Interval 52 mg/l
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	30	40	50	54	71	14
1907 BCP Martins Post	37	44	51	56	58	12

N | 67

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	138.0	3.94
1907 BCP Martins Post	32	150.9	4.72

H statistic	0.76
X² approximation	0.76
DF	1
p-value	0.3828 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. Alkalinity apparently did not measurably change between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. Alkalinity is inversely related to flow in both data sets. Post-EWQ median alkalinity was within the EWQ 95% confidence intervals. Flow is plotted on a logarithmic scale.

Chapter 20: 1907 BCP Martins Creek, PA
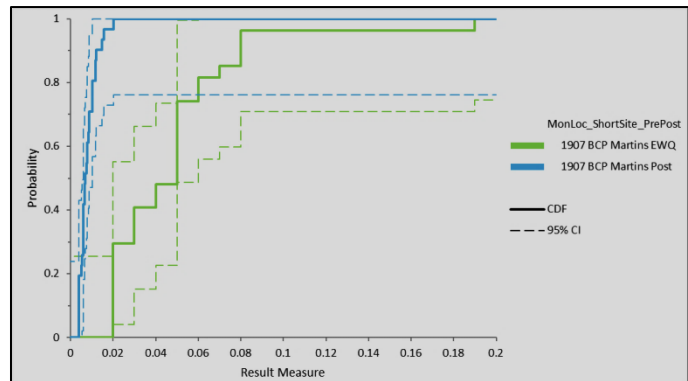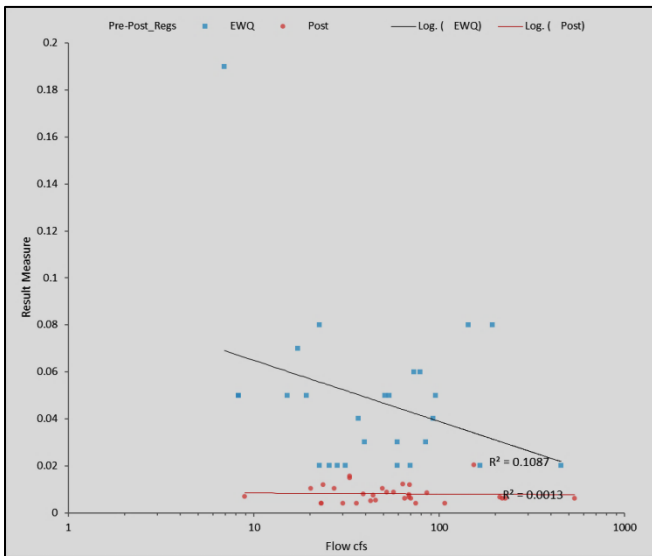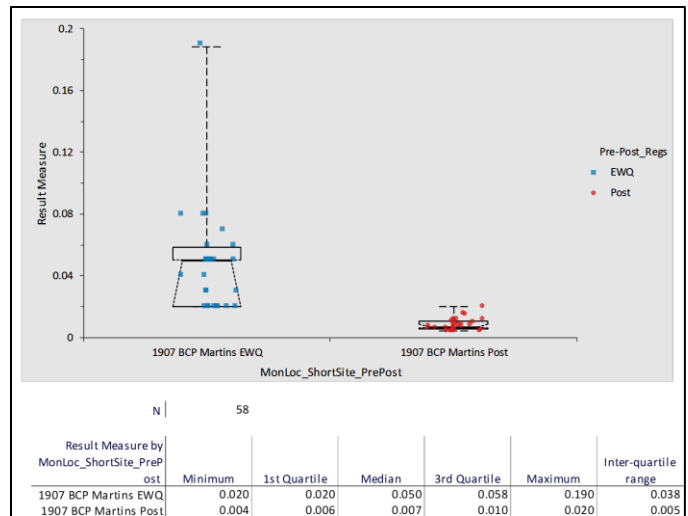
Ammonia Nitrogen as N, Total mg/l

Existing Water Quality (Table 2G):

Median <0.05 mg/l
Lower 95% Confidence Interval 0.02* mg/l
Upper 95% Confidence Interval 0.05 mg/l
*based on estimated values below detection limit

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.020	0.020	0.050	0.058	0.190	0.038
1907 BCP Martins Post	0.004	0.006	0.007	0.010	0.020	0.005

N | 58

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	27	6241.1	231.15
1907 BCP Martins Post	31	5435.8	175.35

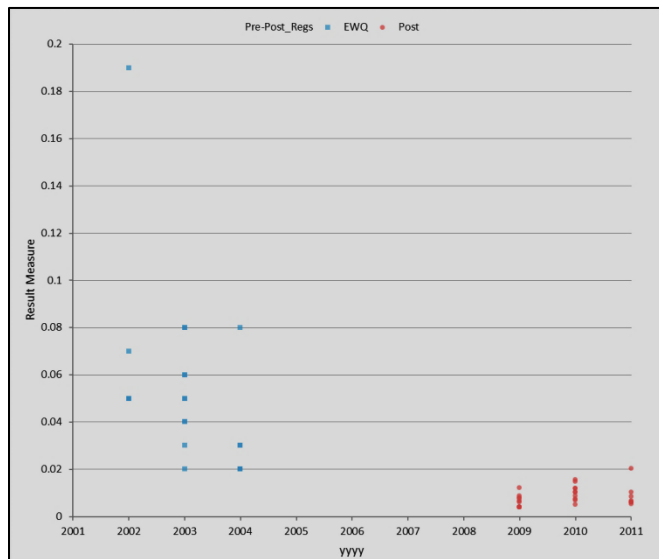|	
H statistic	41.20
X² approximation	41.20
DF	1
p-value	<0.0001[1]

H0: $\theta_1 = \theta_2 = \theta_{...}$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Ammonia concentrations appear to have declined significantly. However, analytical uncertainty was introduced by potential laboratory artifacts and detection limit differences.

Post-EWQ median ammonia concentration was below the EWQ lower 95% confidence interval. There were no independent data available for comparison with DRBC results. Ammonia is unrelated to flow in both data sets. Flow is plotted on a logarithmic scale. EWQ data contained 18 undetected results out of 27 tests. EWQ results above the detection limit were highly variable. Under 2009-2011 lower detection levels there were still 12/31 undetected results. Post-EWQ results above detection levels were less variable – no result was higher than 0.02 mg/l. True ammonia concentrations are now measurable in this high-quality stream.

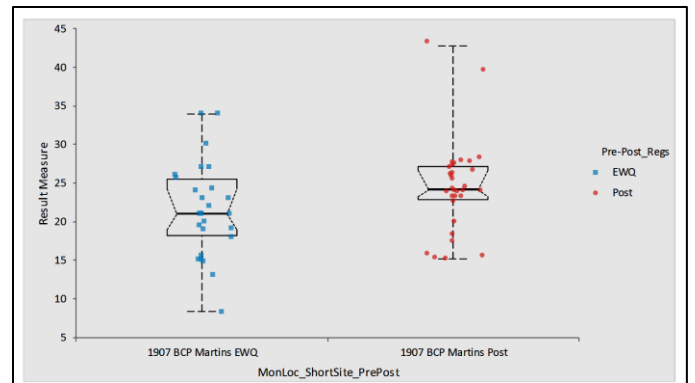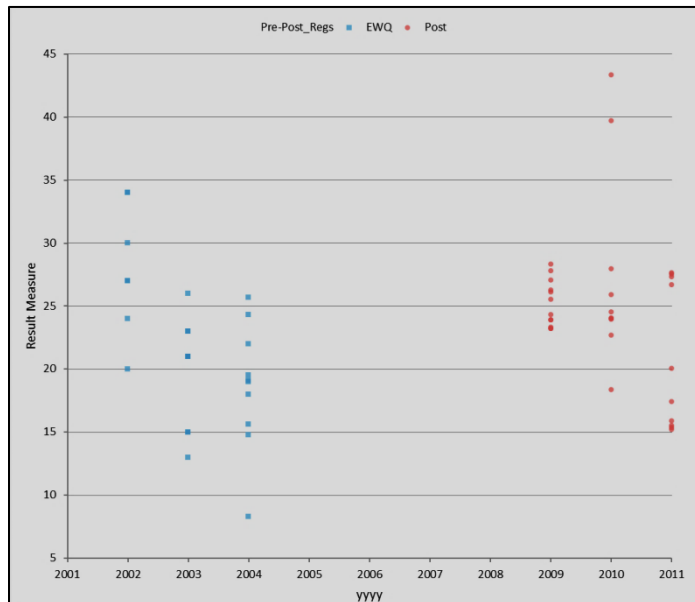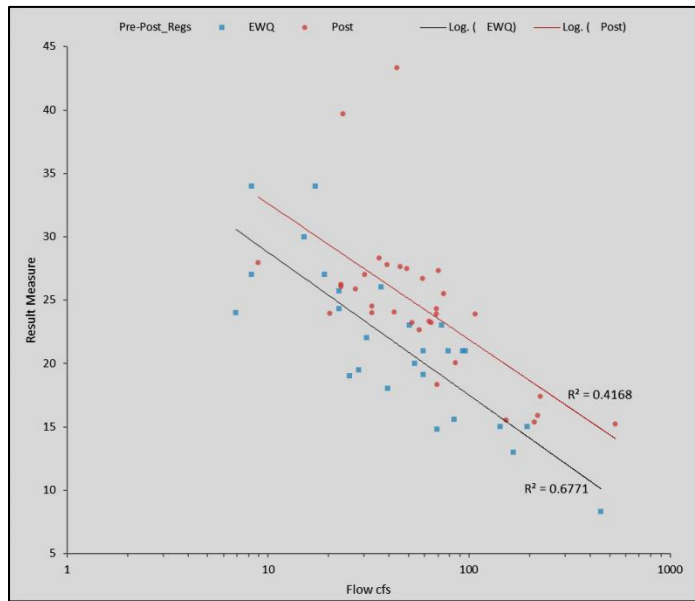Chapter 20: 1907 BCP Martins Creek, PA

Chloride, Total mg/l

Existing Water Quality (Table 2G):

Median 21.0 mg/l
Lower 95% Confidence Interval 19.0 mg/l
Upper 95% Confidence Interval 24.3 mg/l
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	8.3	18.2	21.0	25.5	34.0	7.3
1907 BCP Martins Post	15.2	22.9	24.2	27.2	43.3	4.3
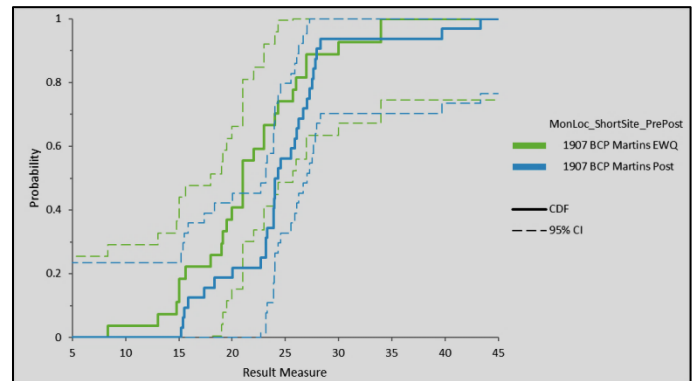
N = 59

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	27	757.4	28.05
1907 BCP Martins Post	32	639.0	19.97

H statistic	4.74
X² approximation	4.74
DF	1
p-value	0.0295 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

There is evidence of water quality degradation here. Chloride concentrations apparently rose by about 3 mg/l between the two periods. However, analytical uncertainty was introduced by potential laboratory artifacts. Post-EWQ median concentration rose to the EWQ upper 95% confidence interval. Chloride concentration is inversely related to flow in both data sets. Note that flow is plotted on a logarithmic scale. No independent data were available for comparison with DRBC results.

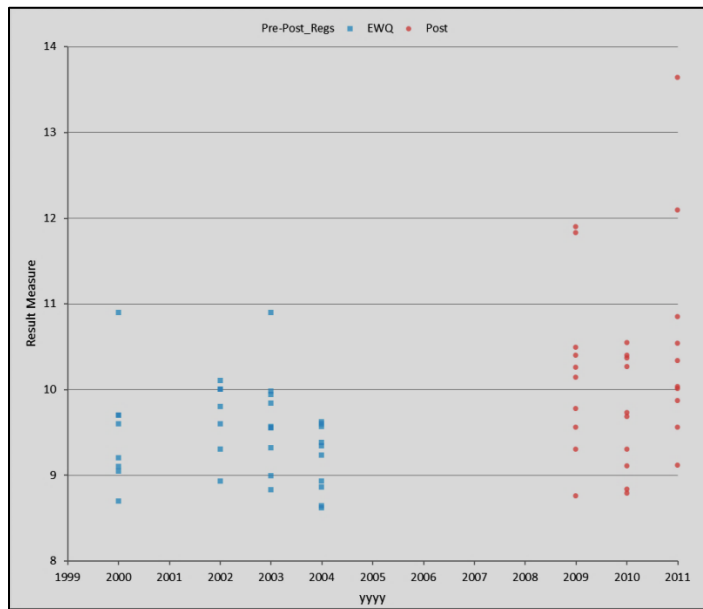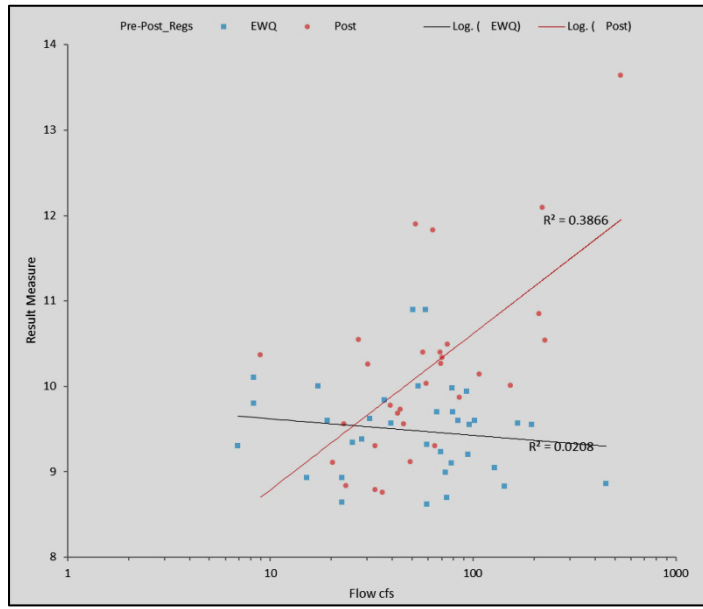Chapter 20: 1907 BCP Martins Creek, PA

Dissolved Oxygen (DO) mg/l

Existing Water Quality (Table 2G):
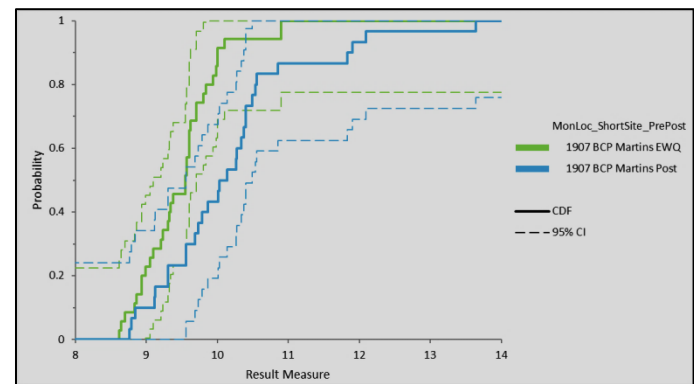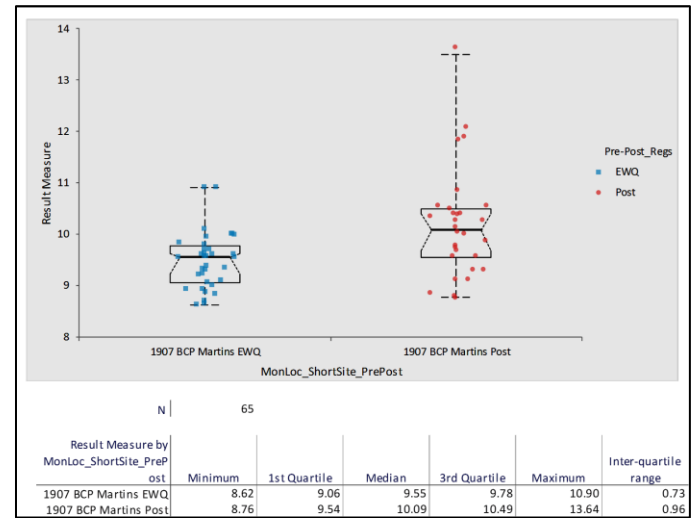
Median 9.55 mg/l
Lower 95% Confidence Interval 9.23 mg/l
Upper 95% Confidence Interval 9.62 mg/l

No water quality degradation is evident here. Dissolved oxygen concentrations increased between the EWQ and Post-EWQ periods. There were no known sources of

analytical uncertainty in these data.

Result Measure by MonLoc_ShortSite_PreP ost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	8.62	9.06	9.55	9.78	10.90	0.73
1907 BCP Martins Post	8.76	9.54	10.09	10.49	13.64	0.96

N = 65

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PreP ost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	1604.8	45.85
1907 BCP Martins Post	30	1872.3	62.41
H statistic	9.73		
X² approximation	9.73		
DF	1		
p-value	0.0018 [1]		

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Post-EWQ median DO concentration was above the upper EWQ 95% confidence interval. Such an increase constitutes a water quality improvement. DO concentration is unrelated to flow in the EWQ data set. DO is positively related to flow in the post-EWQ data, apparently driven by a few high measurements taken in 2009 and 2011. Unless there was a change in water temperatures (none) or increased algal activity (possible), the relationship may not be real. Flow is plotted on a logarithmic scale. No independent data were available for comparison with DRBC results.

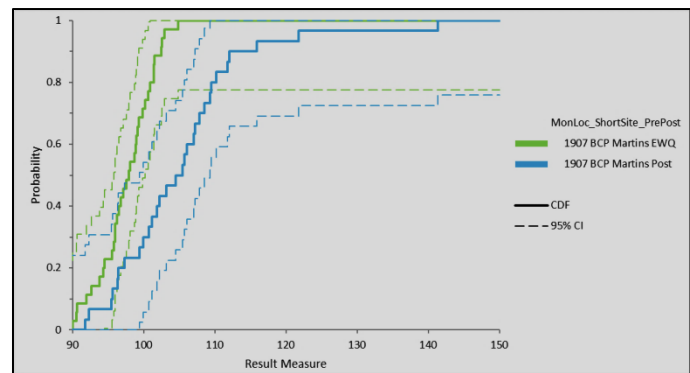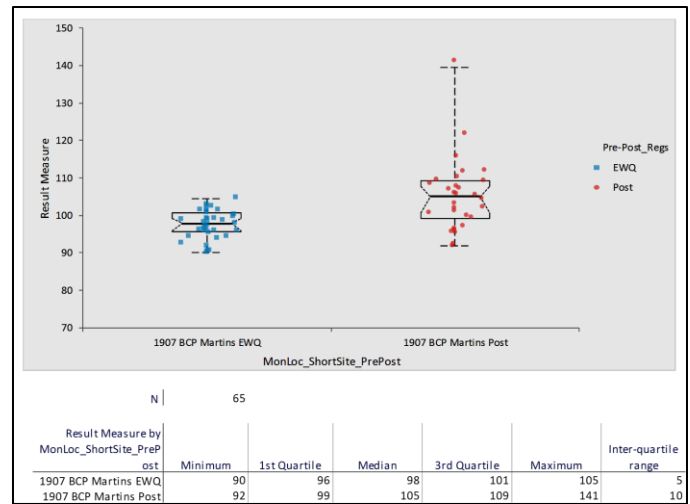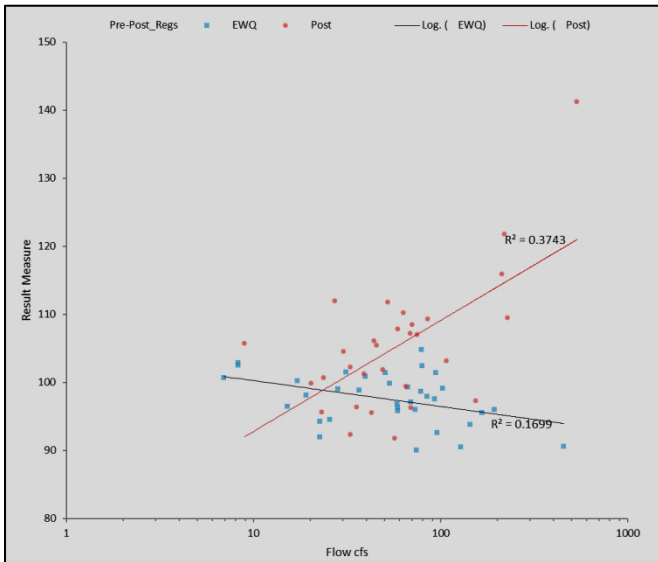Chapter 20: 1907 BCP Martins Creek, PA

Dissolved Oxygen Saturation %

Existing Water Quality (Table 2G):

Median 98%
Lower 95% Confidence Interval 96%
Upper 95% Confidence Interval 99%

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
N	65					
1907 BCP Martins EWQ	90	96	98	101	105	5
1907 BCP Martins Post	92	99	105	109	141	10

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	2571.4	73.47
1907 BCP Martins Post	30	3000.0	100.00

H statistic	15.58
X² approximation	15.58
DF	1
p-value	<0.0001[1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.
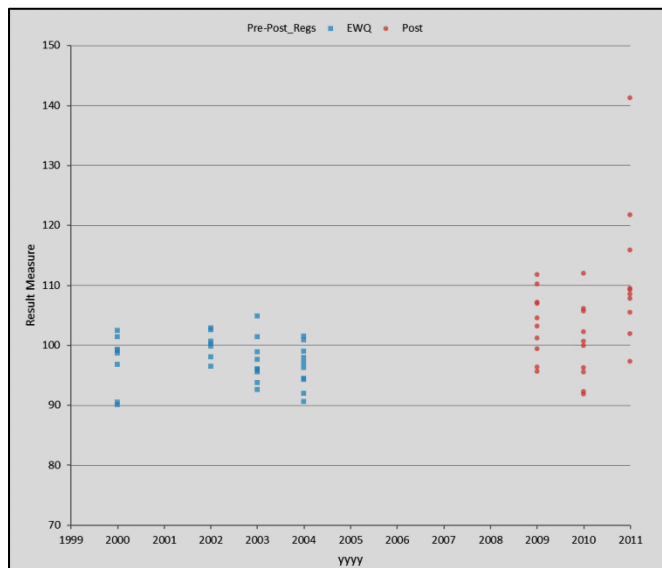
No water quality degradation is evident here. Dissolved oxygen saturation increased between the EWQ and post-EWQ periods. There were no known sources of analytical uncertainty in these data. Post-EWQ median DO saturation rose above the upper EWQ 95% confidence interval.

Flow is plotted on a logarithmic scale. DO saturation is not usually flow-related, but there is a weakly positively relationship in the post-EWQ data that was not shown in the baseline EWQ data (see DO discussion above). There were no measurements below 80%, so there is no concern about an excess of oxygen-reducing material. However, there are two values over 120% which indicated super-saturation conditions that are often associated with high algal production. As a rule of thumb, 80-120% is considered "normal"; in that range a balance exists between oxygen demand and supply. No independent data were available to confirm results.
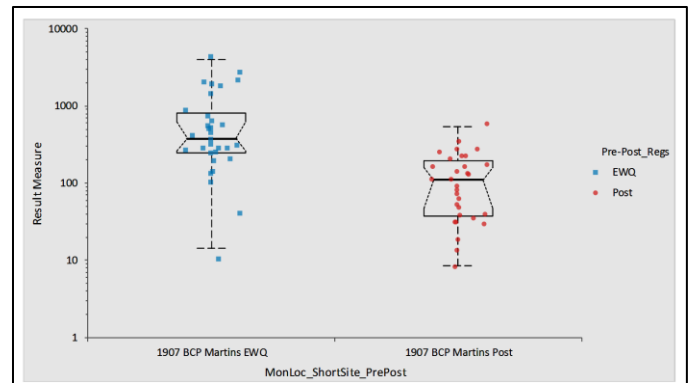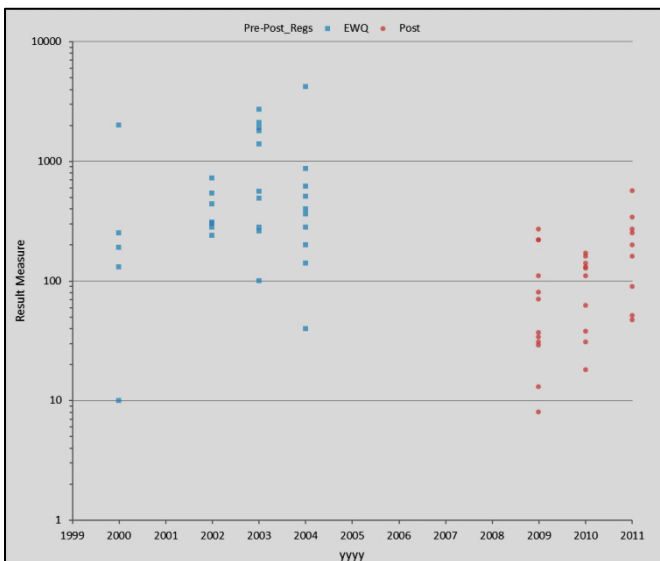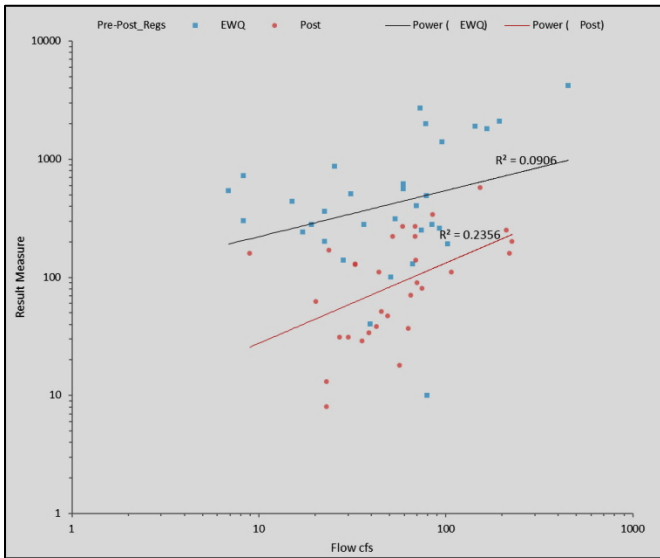
Chapter 20: 1907 BCP Martins Creek, PA

Enterococcus colonies/100 ml
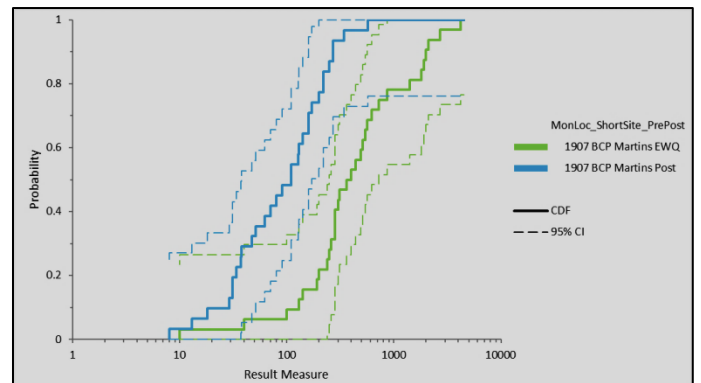
Existing Water Quality (Table 2G):

Median 380/100 ml
Lower 95% Confidence Interval 260/100 ml
Upper 95% Confidence Interval 620/100 ml

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	10	244	380	808	4200	563
1907 BCP Martins Post	8	37	110	195	570	158

N = 63

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	32	4005.1	125.16
1907 BCP Martins Post	31	4134.3	133.37

H statistic	24.23
X² approximation	24.23
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta$...
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Enterococci apparently declined between the EWQ and Post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. There was no truncation of high values in post-EWQ data. Enterococcus concentrations are unrelated to flow in both data sets. Concentrations and flows are plotted on logarithmic scale, and regressions are power relationships. Post-EWQ median enterococcus concentrations fell below the lower EWQ 95% confidence interval.
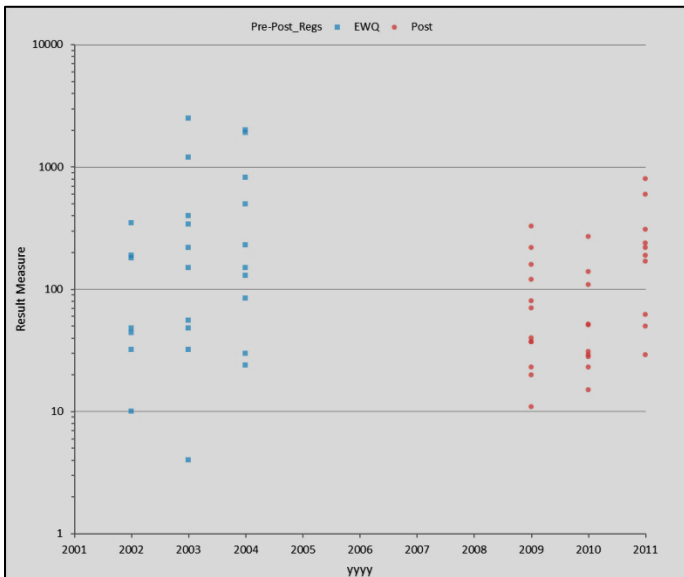
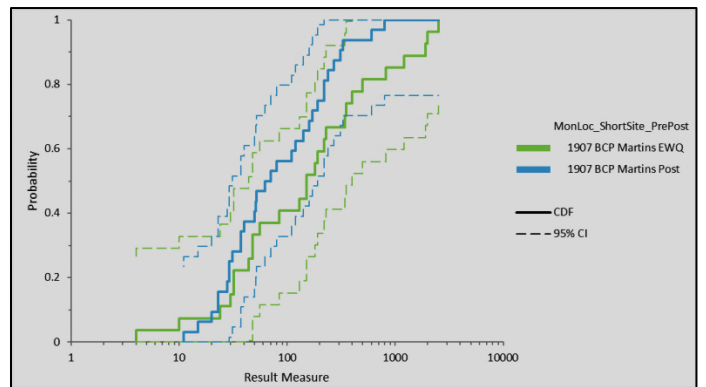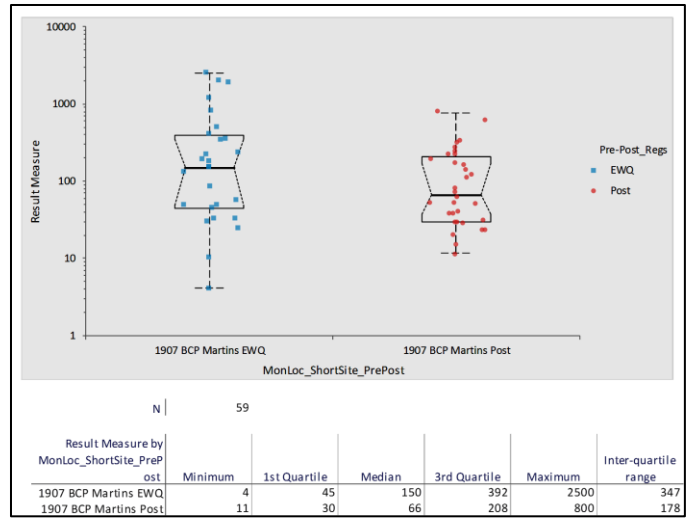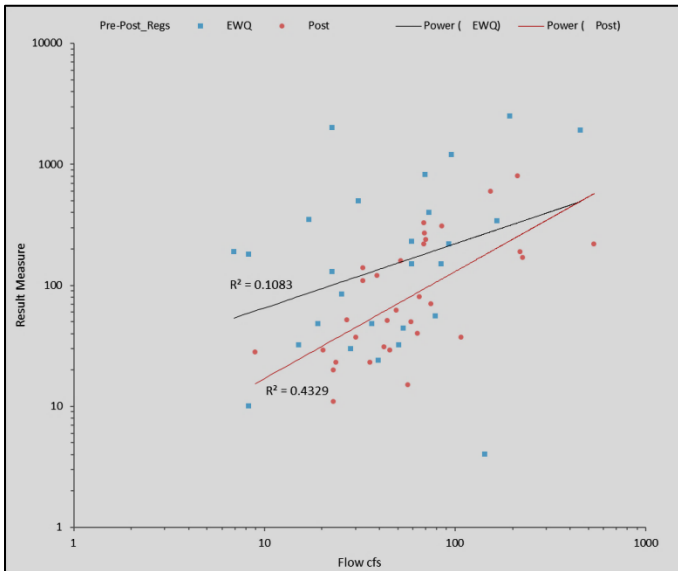Chapter 20: 1907 BCP Martins Creek, PA

Escherichia coli colonies/100 ml

Existing Water Quality (Table 2G):

Median 150/100 ml
Lower 95% Confidence Interval 48/100 ml
Upper 95% Confidence Interval 350/100 ml

Result Measure by MonLoc_ShortSite_PrePost	N	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
	59						
1907 BCP Martins EWQ		4	45	150	392	2500	347
1907 BCP Martins Post		11	30	66	208	800	178

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	27	428.0	15.85
1907 BCP Martins Post	32	361.1	11.29

H statistic	2.68
X² approximation	2.68
DF	1
p-value	0.1019[1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. E. coli concentrations apparently did not measurably change between the two periods. However, analytical uncertainty was introduced by potential laboratory artifacts, though there was no truncation of high values in post-EWQ data. Post-EWQ median E. coli fell within EWQ 95% confidence intervals. Flows and concentrations are plotted on logarithmic scale, and regressions are power relationships. E. coli was unrelated to flow in EWQ data, but positively related to flow in post-EWQ data. No independent data were available to validate DRBC results.
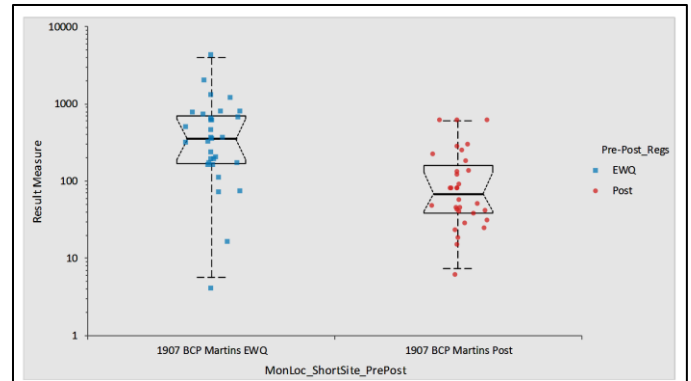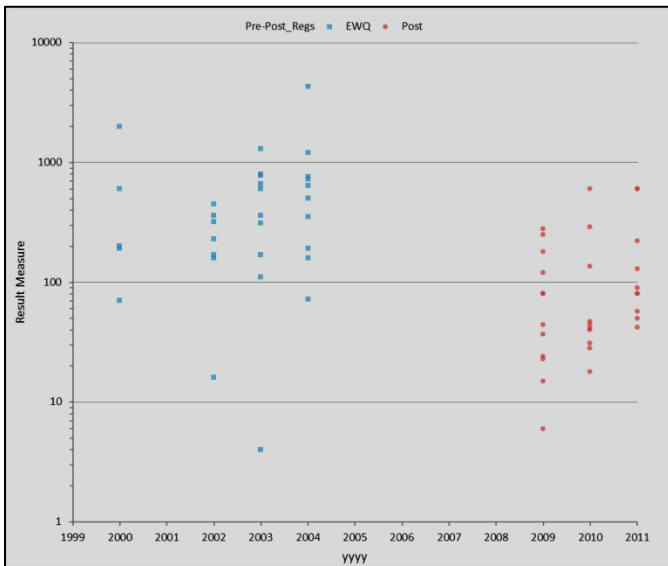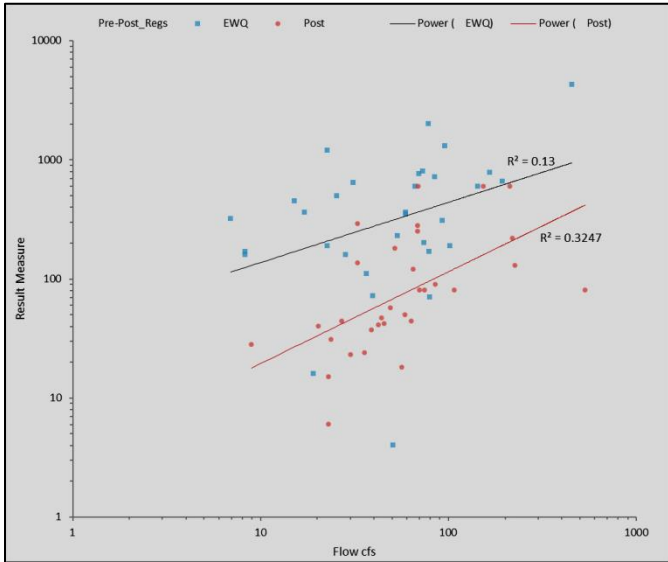
Chapter 20: 1907 BCP Martins Creek, PA

Fecal coliform colonies/100 ml
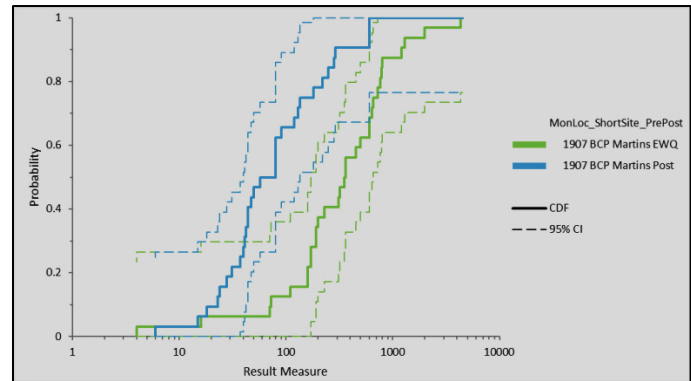
Existing Water Quality (Table 2G):

Median 355/100 ml
Lower 95% Confidence Interval 190/100 ml
Upper 95% Confidence Interval 640/100 ml

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
N					64	
1907 BCP Martins EWQ	4	170	355	695	4300	525
1907 BCP Martins Post	6	38	69	162	600	123

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	32	3280.5	102.52
1907 BCP Martins Post	32	3280.5	102.52

H statistic	18.94
X² approximation	18.94
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Fecal coliform concentrations apparently declined between the two periods. However, analytical uncertainty was introduced by laboratory artifacts. Fecal coliform concentrations are unrelated to flow in EWQ data, but weakly related in post-EWQ data. Post-EWQ median concentrations fell below the lower EWQ 95% confidence interval. Concentrations and flows are plotted on logarithmic scale, and regressions are power relationships. There were no independent data to confirm results.

Chapter 20: 1907 BCP Martins Creek, PA
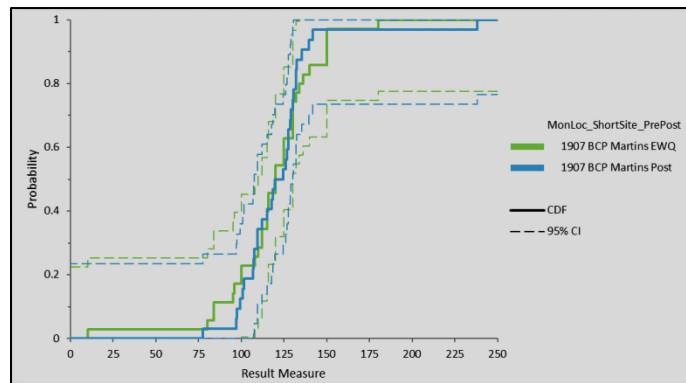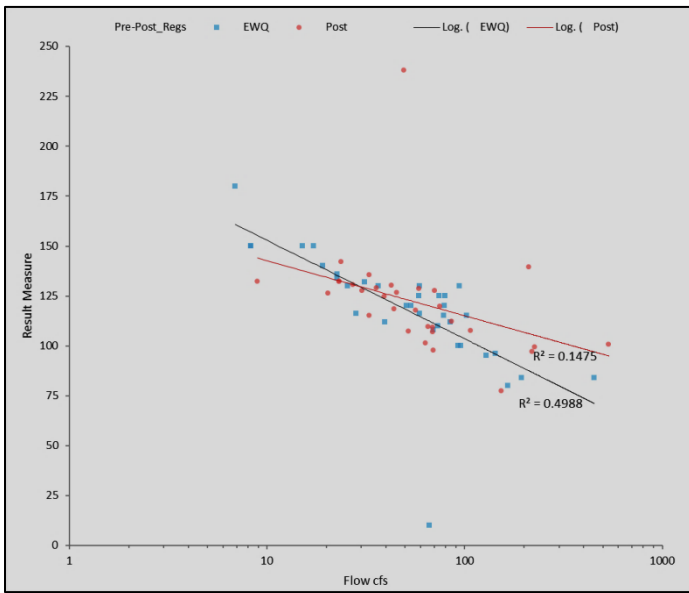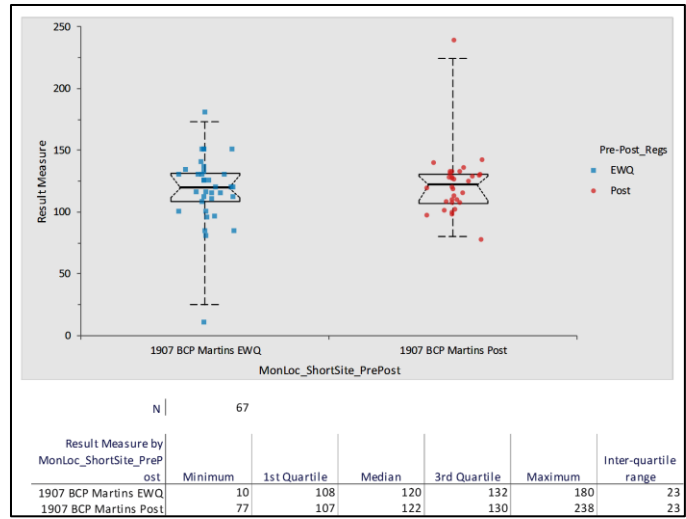
Hardness as CaCO3, Total mg/l

Existing Water Quality (Table 2G):

Median 120 mg/l
Lower 95% Confidence Interval 112 mg/l
Upper 95% Confidence Interval 130 mg/l
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	N	67				
	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	10	108	120	132	180	23
1907 BCP Martins Post	77	107	122	130	238	23

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	0.3	0.01
1907 BCP Martins Post	32	0.3	0.01

H statistic	0.00
X² approximation	0.00
DF	1
p-value	0.9700 [1]

H0: $\theta_1 = \theta_2 = \theta$...
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.
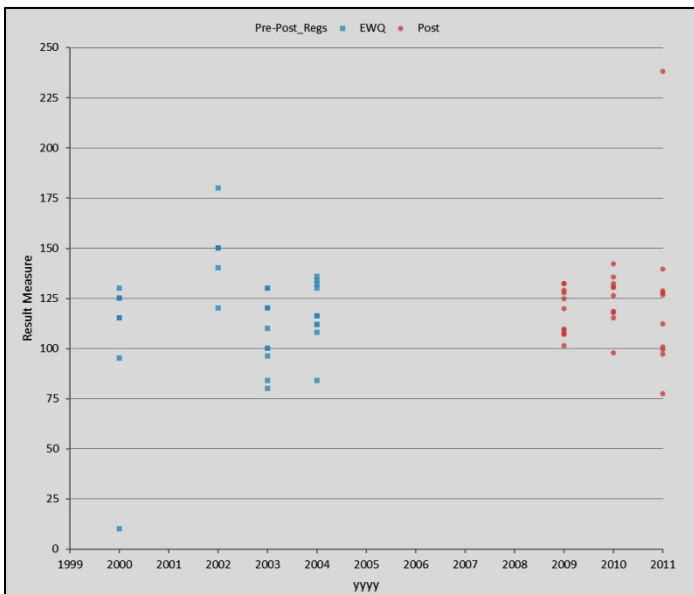
No water quality degradation is evident here. Hardness apparently did not measurably change between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. Hardness is inversely related to flow in the EWQ data set, but unrelated to flow in the post-EWQ data set. Post-EWQ median hardness was within the EWQ 95% confidence intervals. Flow is plotted on a logarithmic scale. No independent data were available for comparison with DRBC results.
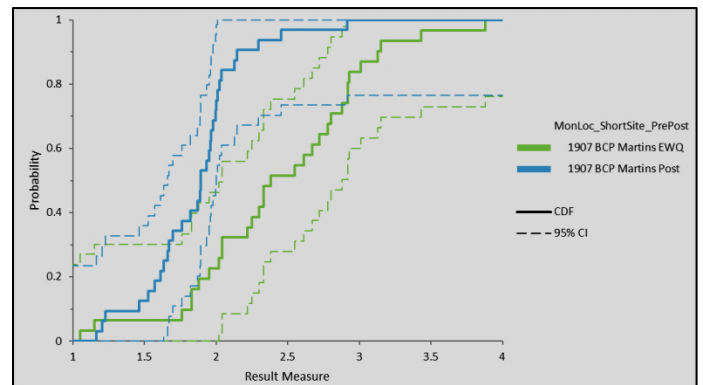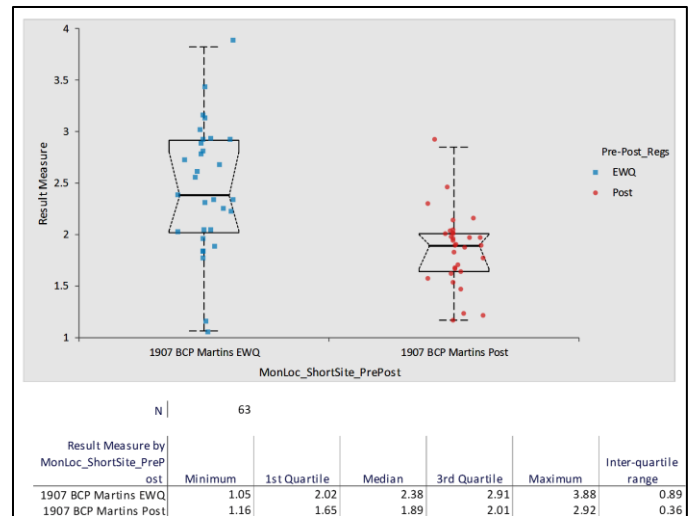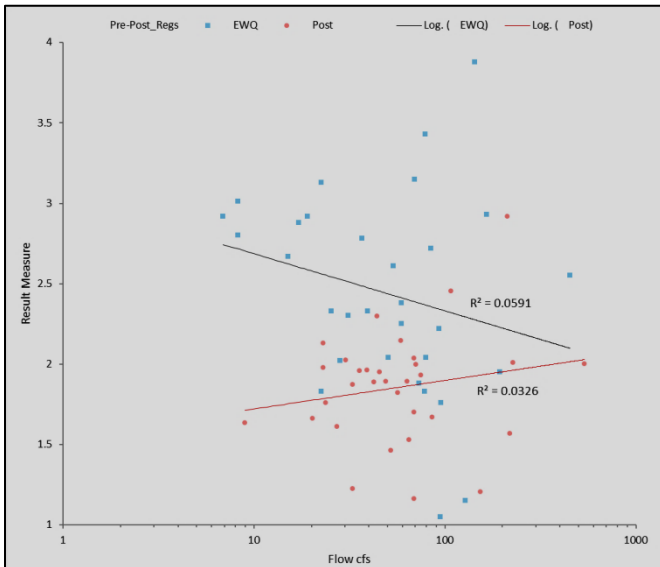
Chapter 20: 1907 BCP Martins Creek, PA

Nitrate + Nitrite as N, Total mg/l

Existing Water Quality (Table 2G, as Nitrate only):

Median 2.38 mg/l
Lower 95% Confidence Interval 2.04 mg/l
Upper 95% Confidence Interval 2.80 mg/l

| N | 63 | | | | | |

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	1.05	2.02	2.38	2.91	3.88	0.89
1907 BCP Martins Post	1.16	1.65	1.89	2.01	2.92	0.36

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	31	2961.6	95.53
1907 BCP Martins Post	32	2869.0	89.66

H statistic	17.35
X² approximation	17.35
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.
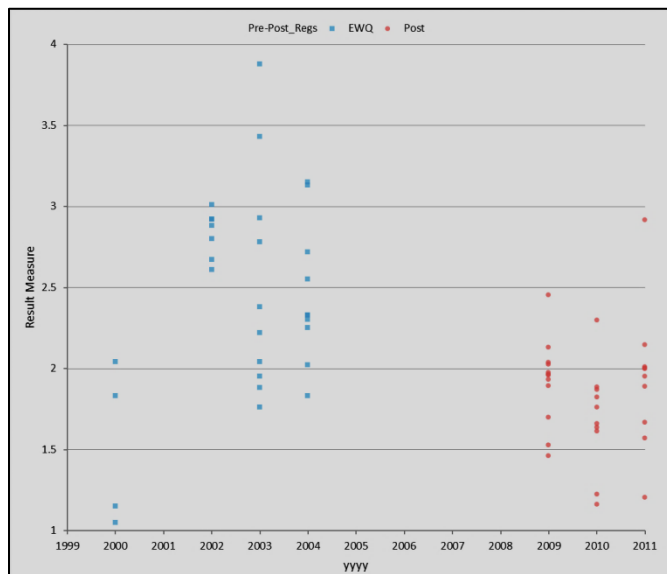
No water quality degradation is evident here. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. Nitrate is unrelated to flow in both data sets.

Post-EWQ median concentrations fell below the lower EWQ 95% confidence interval. Post-EWQ nitrate + nitrite results were assumed equivalent with EWQ nitrate results since EWQ nitrite results were never detected. No independent data were available to compare with DRBC results. At other sites where concentrations are lower, there was a problem interpreting the data due to changing detection limits. Concentrations are sufficiently high in Martins Creek that problems with interpretation did not arise. There were no undetected results in either data set.
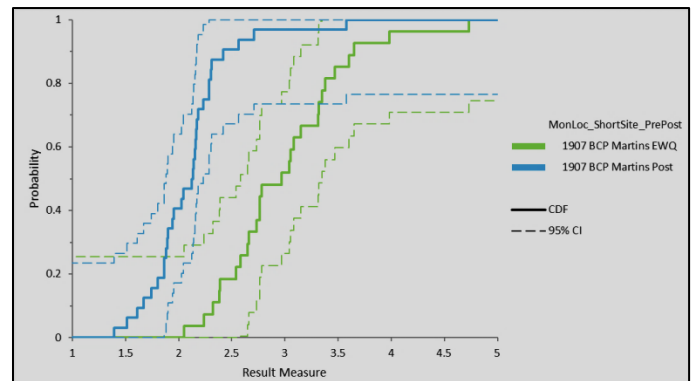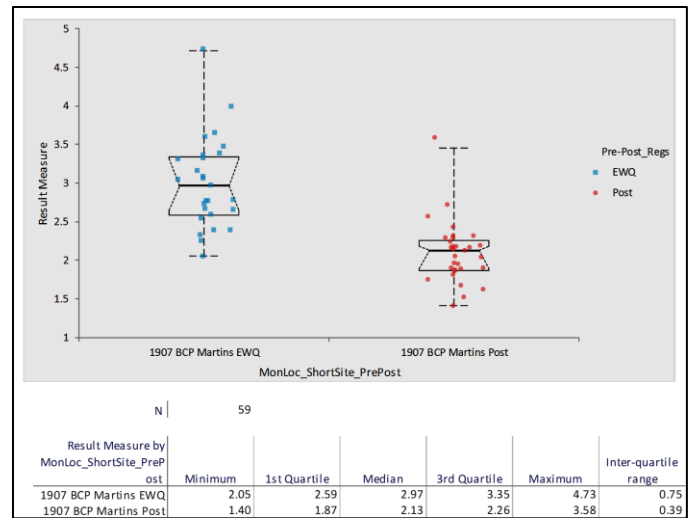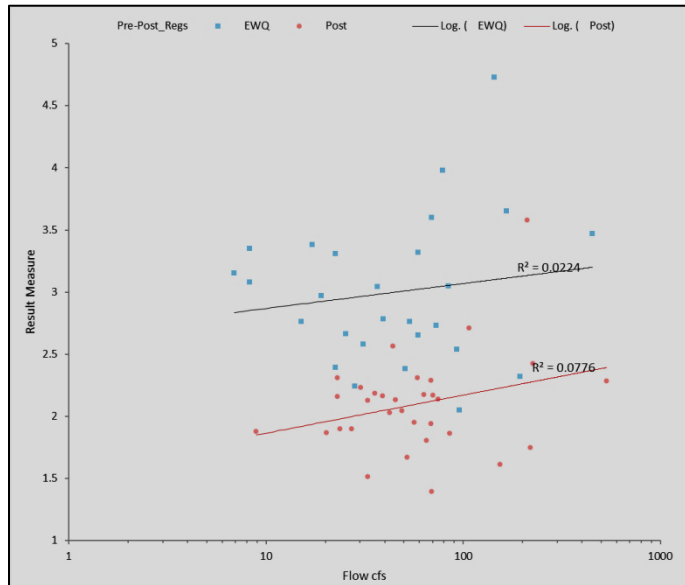
Chapter 20: 1907 BCP Martins Creek, PA

Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 2G):

Median 2.95 mg/l
Lower 95% Confidence Interval 2.65 mg/l
Upper 95% Confidence Interval 3.32 mg/l

N	59					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	2.05	2.59	2.97	3.35	4.73	0.75
1907 BCP Martins Post	1.40	1.87	2.13	2.26	3.58	0.39

Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	27	5125.3	189.83
1907 BCP Martins Post	32	4324.5	135.14
H statistic	32.03		
X² approximation	32.03		
DF	1		
p-value	<0.0001 [1]		

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.
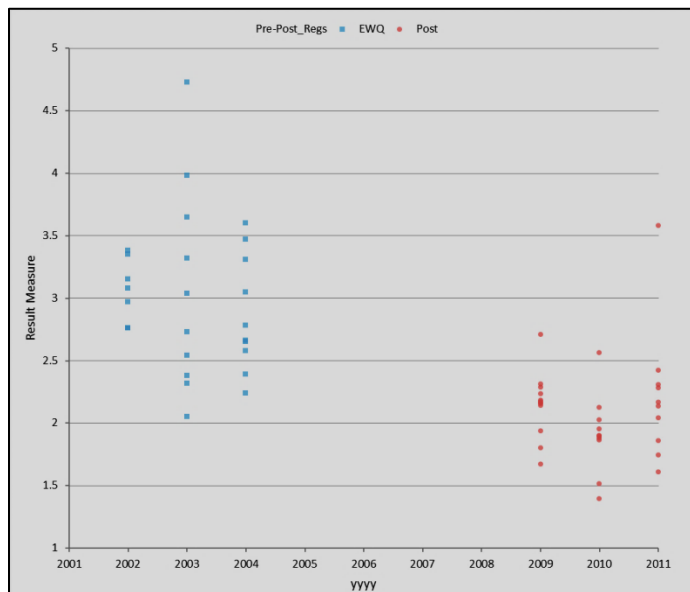
No water quality degradation is evident here. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. TN is unrelated to flow in both data sets. No independent data were available to compare with DRBC results. Post-EWQ median TN concentration fell below the lower EWQ 95% confidence interval. Even though TN apparently declined (unless the decline is actually a laboratory artifact), concentrations are still fairly high.

Chapter 20: 1907 BCP Martins Creek, PA
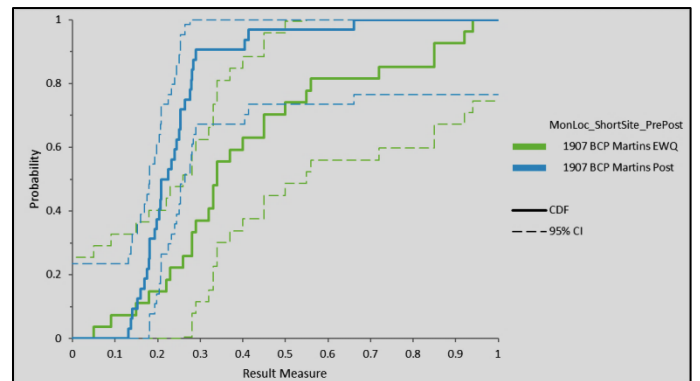
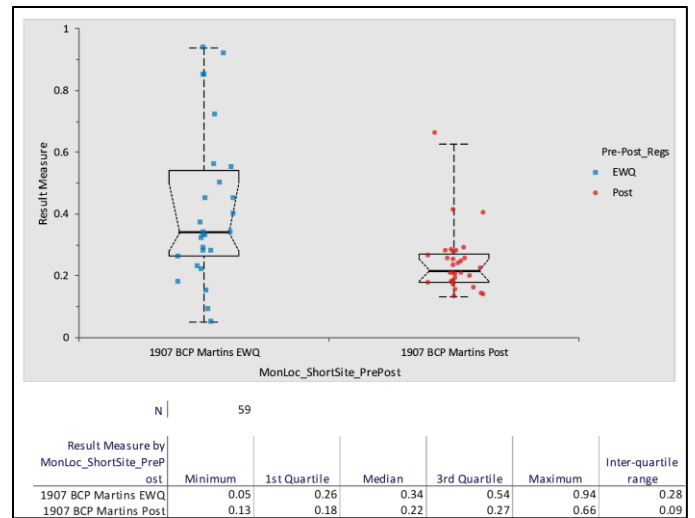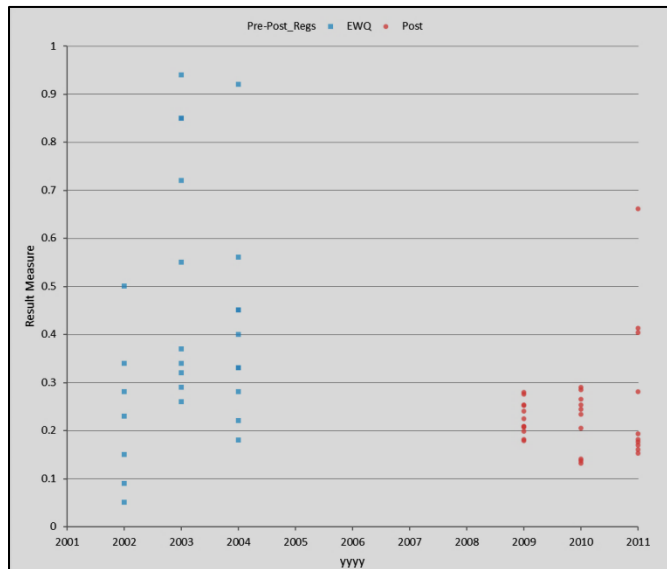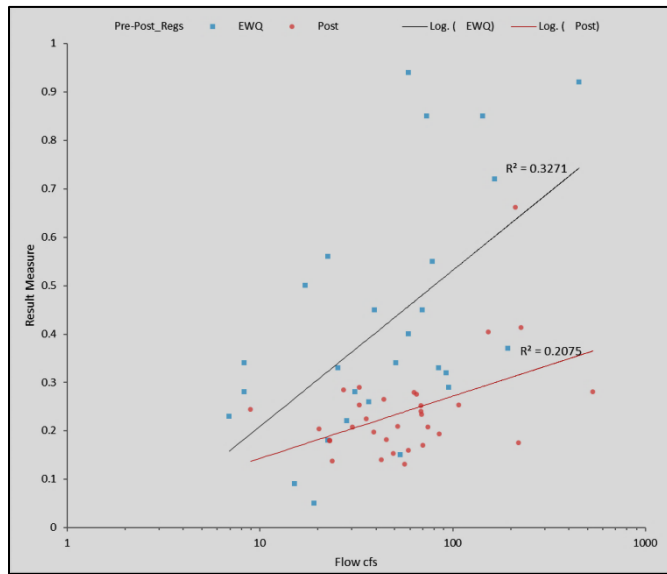Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality (Table 2G):

Median 0.34 mg/l
Lower 95% Confidence Interval 0.28 mg/l
Upper 95% Confidence Interval 0.50 mg/l
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.05	0.26	0.34	0.54	0.94	0.28
1907 BCP Martins Post	0.13	0.18	0.22	0.27	0.66	0.09

N | 59

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	27	2028.0	75.11
1907 BCP Martins Post	32	1711.1	53.47

H statistic	12.68
X² approximation	12.68
DF	1
p-value	0.0004 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. TKN concentrations apparently declined between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. The post-EWQ range was far narrower and all concentrations except one were less than 0.42 mg/l. TKN concentration is weakly related to flow in both data sets. Post-EWQ median TKN fell below the lower EWQ 95% confidence interval. The TKN decline contributed to the apparent improvement in total nitrogen concentrations. There were no additional data to confirm DRBC results.

Chapter 20: 1907 BCP Martins Creek, PA
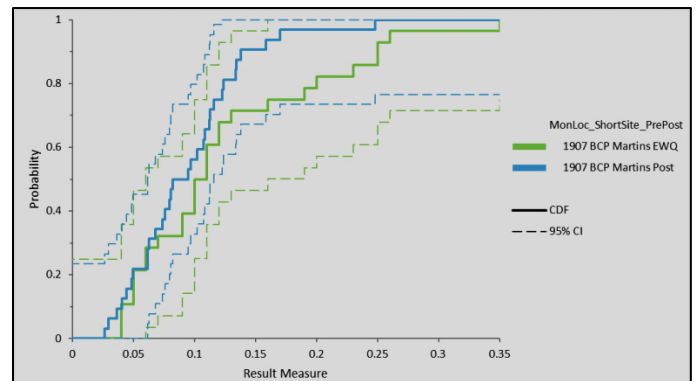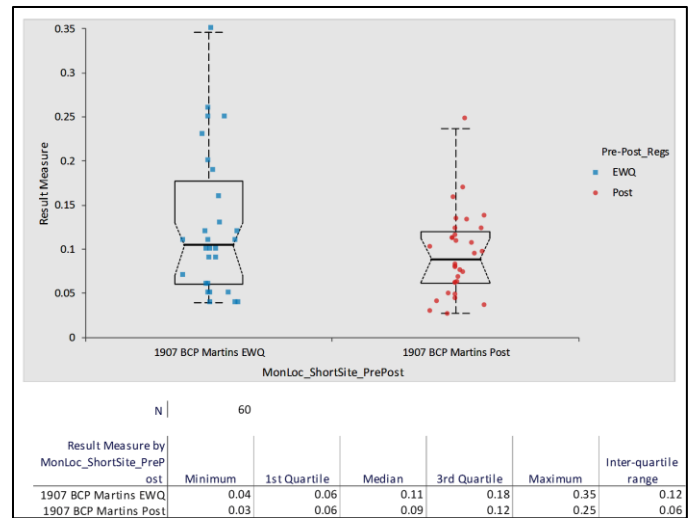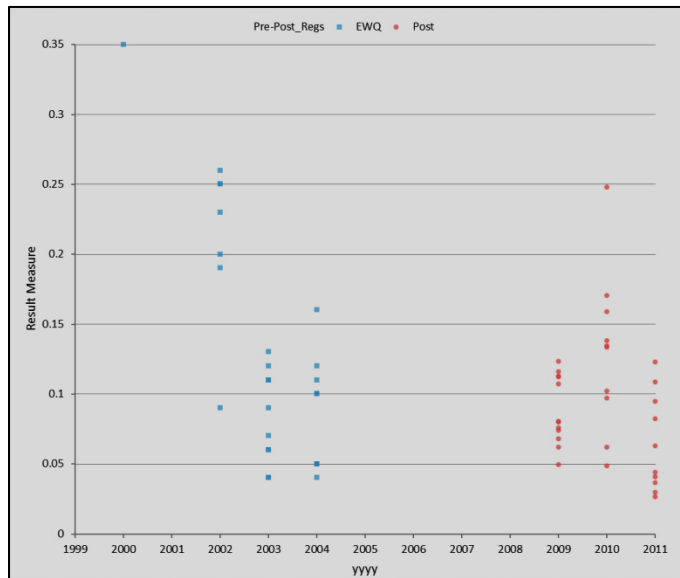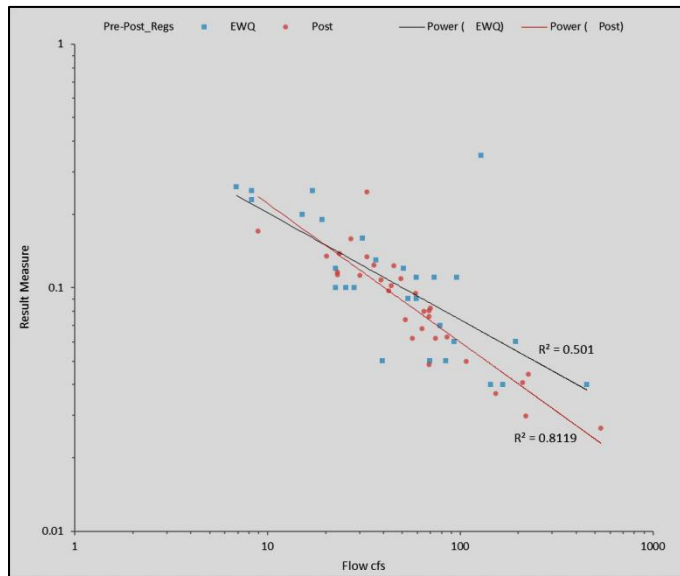
Orthophosphate as P, Total mg/l (OP)

Existing Water Quality (Table 2G):

Median 0.11 mg/l
Lower 95% Confidence Interval 0.07 mg/l
Upper 95% Confidence Interval 0.13 mg/l
Should have been designated in rules as flow-related

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.04	0.06	0.11	0.18	0.35	0.12
1907 BCP Martins Post	0.03	0.06	0.09	0.12	0.25	0.06

N | 60

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	28	234.3	8.37
1907 BCP Martins Post	32	205.0	6.41

H statistic	1.44
X² approximation	1.44
DF	1
p-value	0.2299 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. OP concentrations apparently did not measurably change between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. OP is inversely related to flow in both data sets, and should have been designated as such in DRBC water quality rules. Post-EWQ median orthophosphate fell within the EWQ 95% confidence intervals. There was no interference by detection limits in either data set, as concentrations are well-above detection levels. There were no independent data available for comparison with DRBC results.
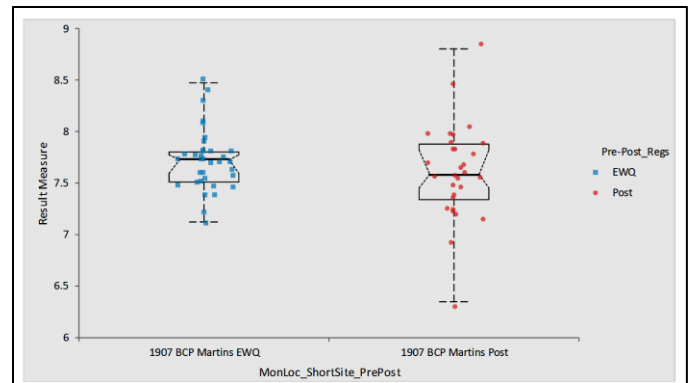
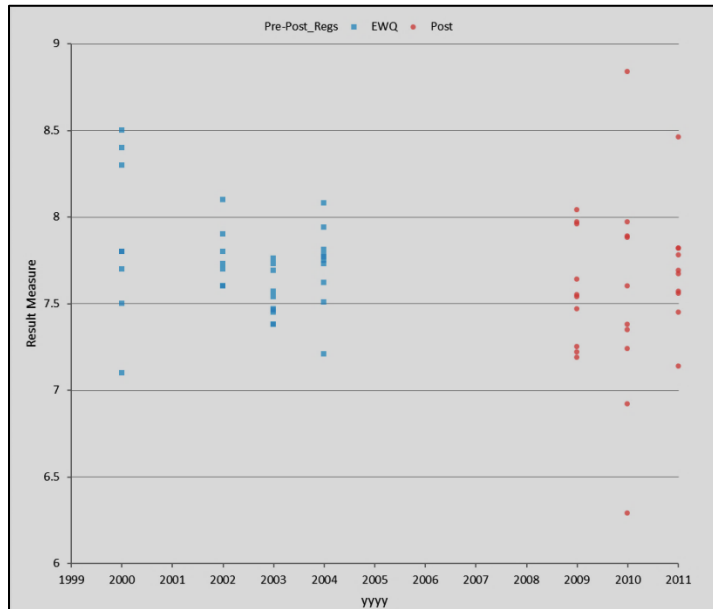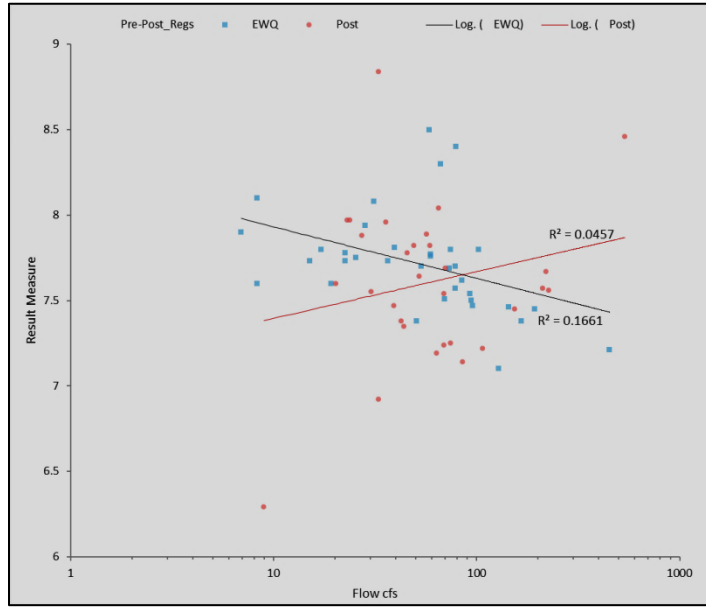Chapter 20: 1907 BCP Martins Creek, PA

pH

Existing Water Quality (Table 2G):

Median 7.73 standard units
Lower 95% Confidence Interval 7.60 standard units
Upper 95% Confidence Interval 7.78 standard units

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
N		65				
1907 BCP Martins EWQ	7.10	7.52	7.73	7.80	8.50	0.29
1907 BCP Martins Post	6.29	7.34	7.59	7.88	8.84	0.54
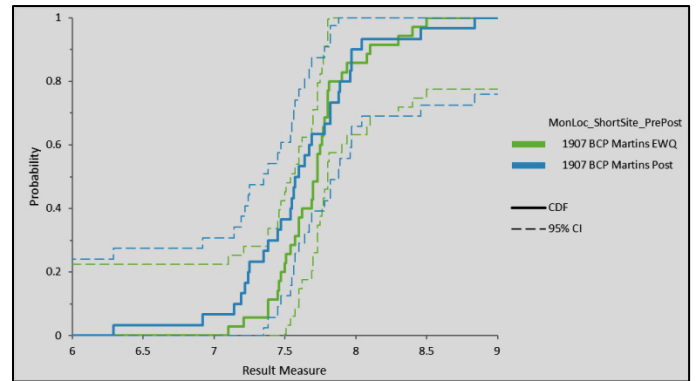
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	192.1	5.49
1907 BCP Martins Post	30	224.1	7.47
H statistic	1.16		
X² approximation	1.16		
DF	1		
p-value	0.2804 [1]		

H0: θ₁ = θ₂ = θ...
The median of the populations are all equal.
H1: θᵢ ≠ θⱼ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. pH did not measurably change between the EWQ and post-EWQ periods. There were no known sources of analytical uncertainty in these data. pH is unrelated to flow in both data sets. Post-EWQ median pH was just below the lower EWQ 95% confidence interval, but the decline was not significant. The result below pH 6.5 taken in 2010 was probably a probe malfunction. There are no independent data available for comparison with DRBC results.

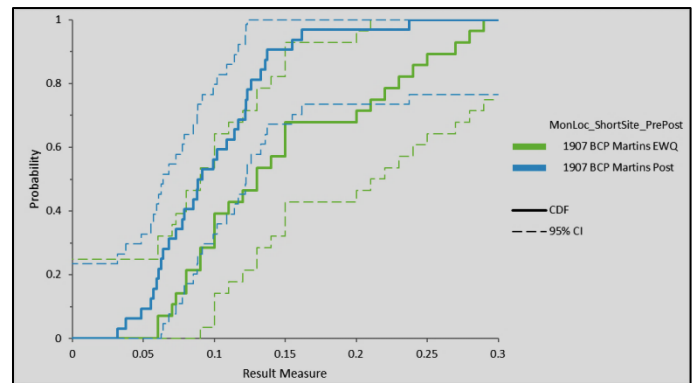Chapter 20: 1907 BCP Martins Creek, PA
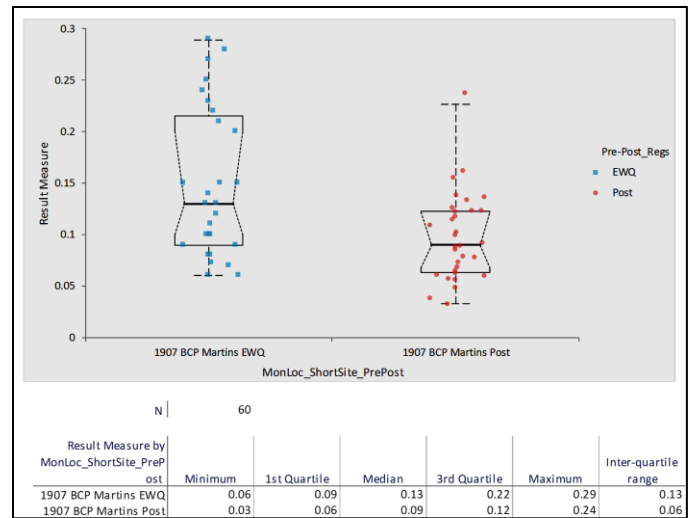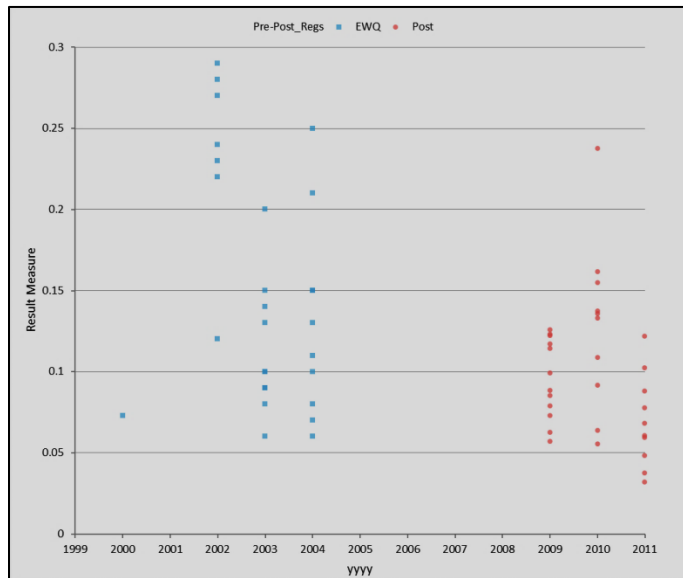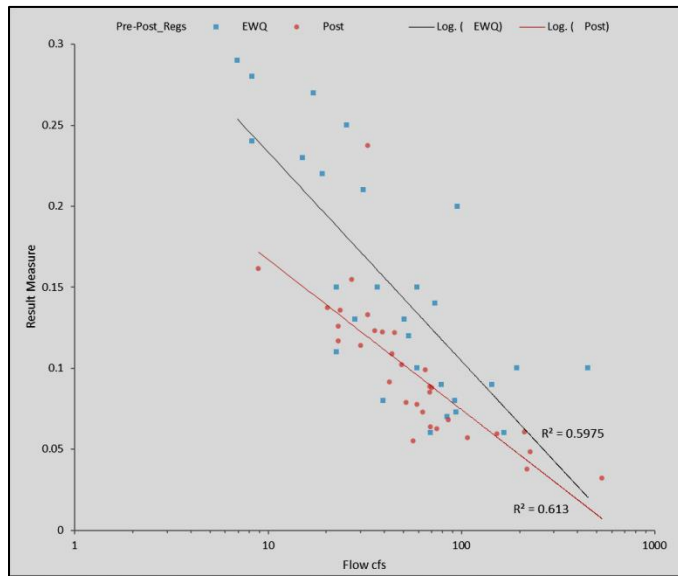
Phosphorus as P, Total (TP) mg/l

Existing Water Quality (Table 2G):

Median 0.13 mg/l
Lower 95% Confidence Interval 0.10 mg/l
Upper 95% Confidence Interval 0.20 mg/l
TP should have been designated in rules as flow-related

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.06	0.09	0.13	0.22	0.29	0.13
1907 BCP Martins Post	0.03	0.06	0.09	0.12	0.24	0.06

N | 60

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	28	1302.9	46.53
1907 BCP Martins Post	32	1140.0	35.63

H statistic	8.01
X² approximation	8.01
DF	1
p-value	0.0046 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Total Phosphorus (TP) concentrations apparently declined between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. Post-EWQ median total phosphorus fell below the EWQ lower 95% confidence interval. TP is inversely related to flow in both data sets. No additional data were available to confirm DRBC results. There were no undetected results in either data set.

Chapter 20: 1907 BCP Martins Creek, PA

Specific Conductance μmho/cm

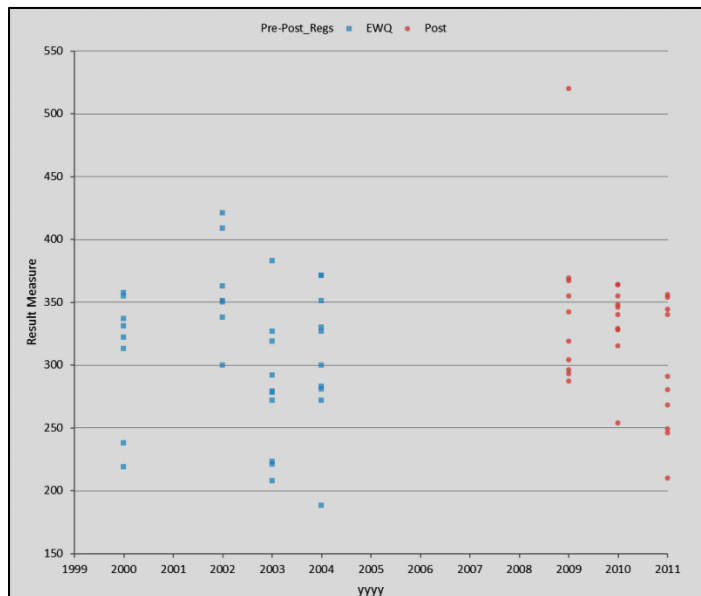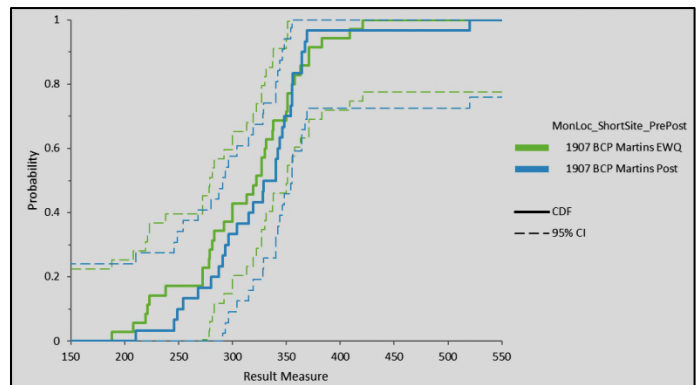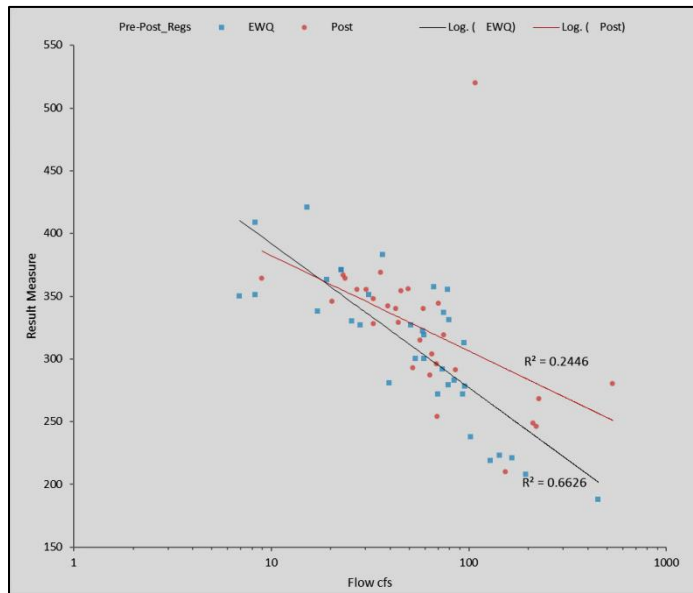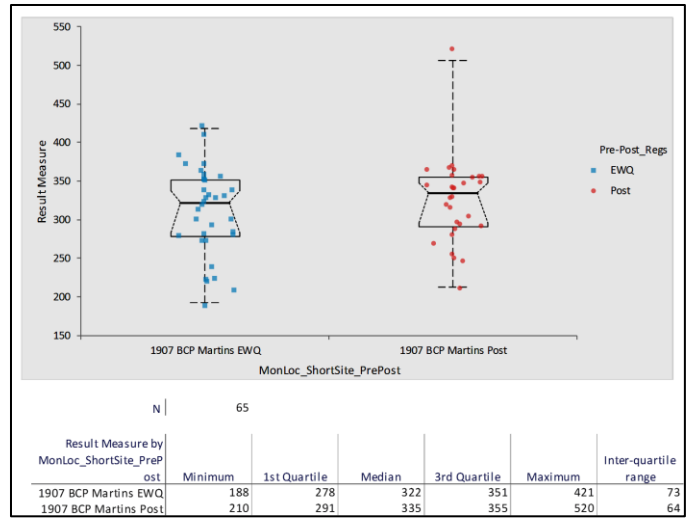Existing Water Quality (Table 2G):

Median 322 μmho/cm
Lower 95% Confidence Interval 283 μmho/cm
Upper 95% Confidence Interval 338 μmho/cm
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	188	278	322	351	421	73
1907 BCP Martins Post	210	291	335	355	520	64

N | 65

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	94.5	2.70
1907 BCP Martins Post	30	110.2	3.67

H statistic	0.57
X² approximation	0.57
DF	1
p-value	0.4492 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

Some evidence of water quality degradation was found here. Specific conductance increased, but not above the EWQ upper 95% confidence interval. Specific conductance is inversely related to flow in both data sets. The rise in specific conductance may be partially attributable to the concurrent rise in chloride concentrations.   Median specific conductance increased from 322 to 335 μmho/cm; a 4% rise that was not as severe as other Lower Delaware watersheds. No data were available to confirm DRBC results.

Chapter 20: 1907 BCP Martins Creek, PA

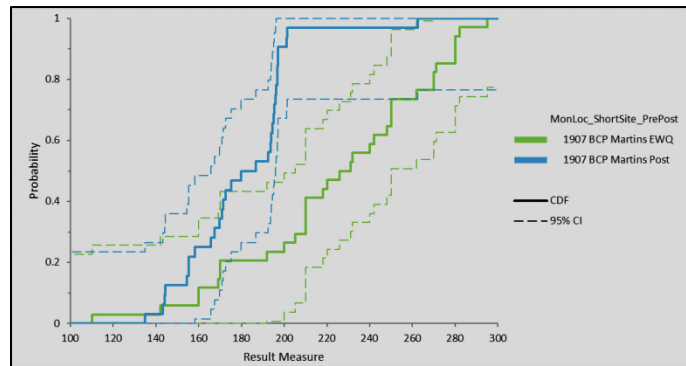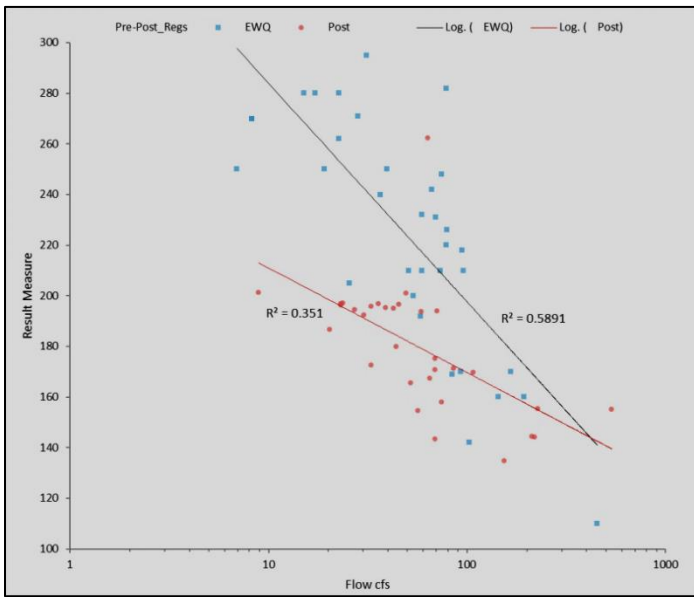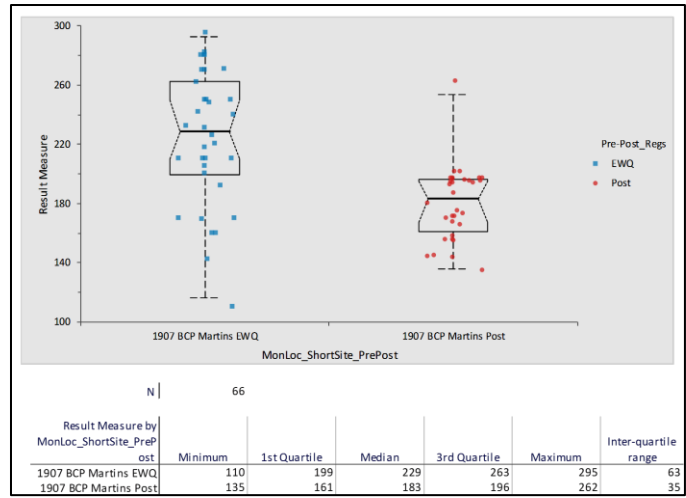Total Dissolved Solids (TDS) mg/l

Existing Water Quality (Table 2G):

Median 229 mg/l
Lower 95% Confidence Interval 210 mg/l
Upper 95% Confidence Interval 250 mg/l
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	110	199	229	263	295	63
1907 BCP Martins Post	135	161	183	196	262	35

N = 66

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	34	3281.1	96.50
1907 BCP Martins Post	32	3486.1	108.94

H statistic	18.37
X² approximation	18.37
DF	1
p-value	<0.0001[1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.
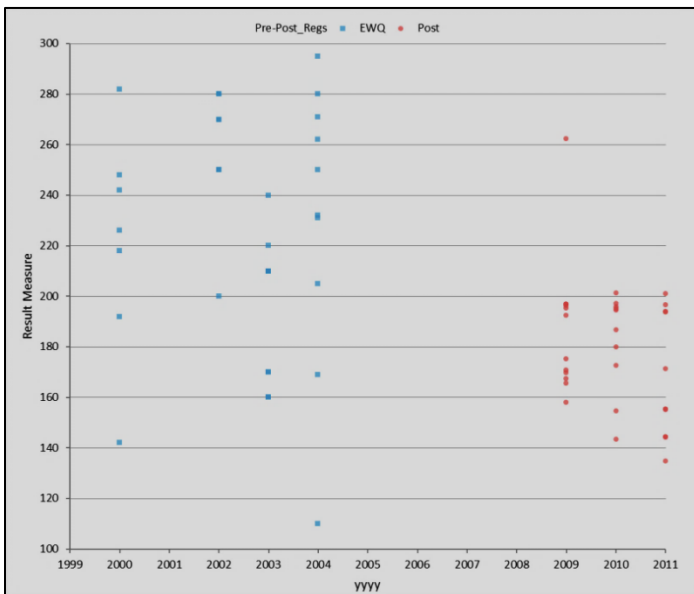
No water quality degradation is evident here. TDS apparently declined between the two periods. However, analytical uncertainty was introduced by potential laboratory artifacts. TDS is inversely related to flow in both data sets. Post-EWQ median TDS fell below the EWQ lower 95% lower confidence interval, and was less variable than the baseline samples as well. Post-EWQ detection limits were lower than EWQ detection limits, though there were no non-detect results at any time.

Chapter 20: 1907 BCP Martins Creek, PA
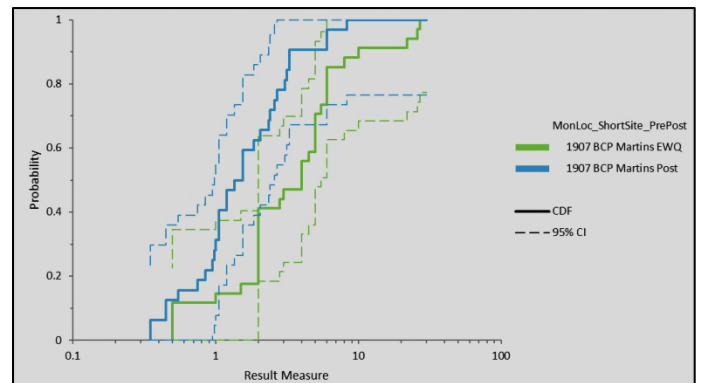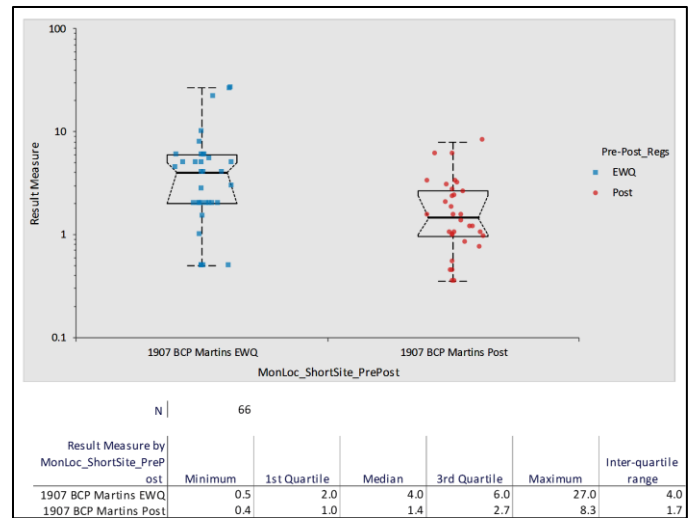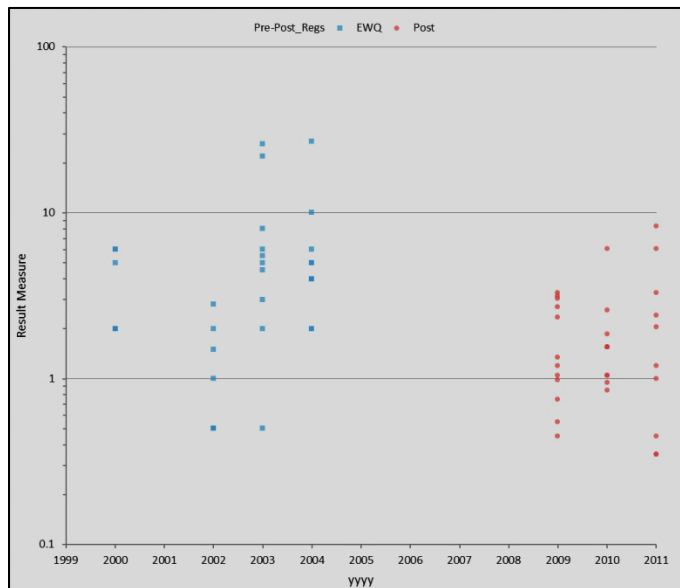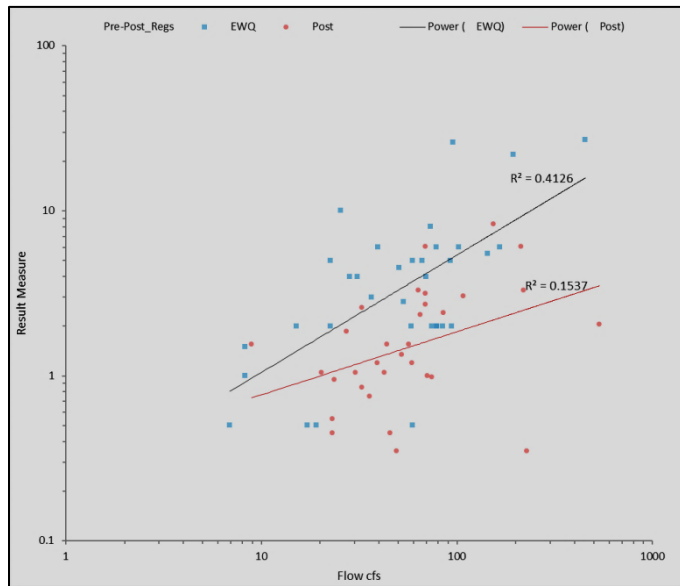
Total Suspended Solids (TSS) mg/l

Existing Water Quality (Table 2G):

Median 4.0 mg/l
Lower 95% Confidence Interval 2.0 mg/l
Upper 95% Confidence Interval 5.0 mg/l
Should have been designated in rules as flow-related

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.5	2.0	4.0	6.0	27.0	4.0
1907 BCP Martins Post	0.4	1.0	1.4	2.7	8.3	1.7

N = 66

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	34	1751.1	51.50
1907 BCP Martins Post	32	1860.5	58.14

H statistic	9.83
X² approximation	9.83
DF	1
p-value	0.0017 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. TSS concentrations apparently declined between the EWQ and post-EWQ periods. However, analytical uncertainty was introduced by potential laboratory artifacts. TSS is positively but weakly related to flow in both data sets, and should have been designated as flow-related in DRBC water quality rules. Post-EWQ median TSS fell below the EWQ lower 95% confidence interval. Flows and concentrations are plotted on logarithmic scale, and regressions are power relationships. There were no independent data available to confirm DRBC results.
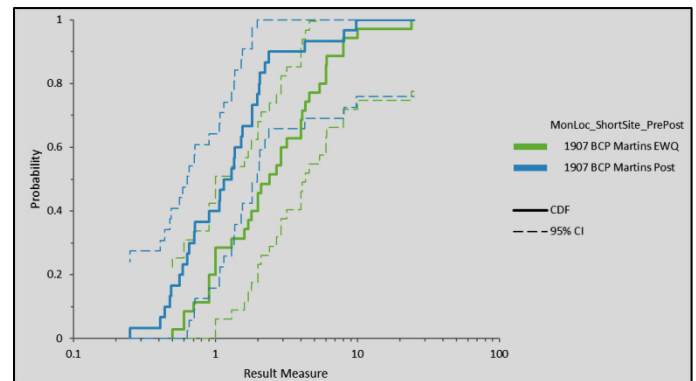
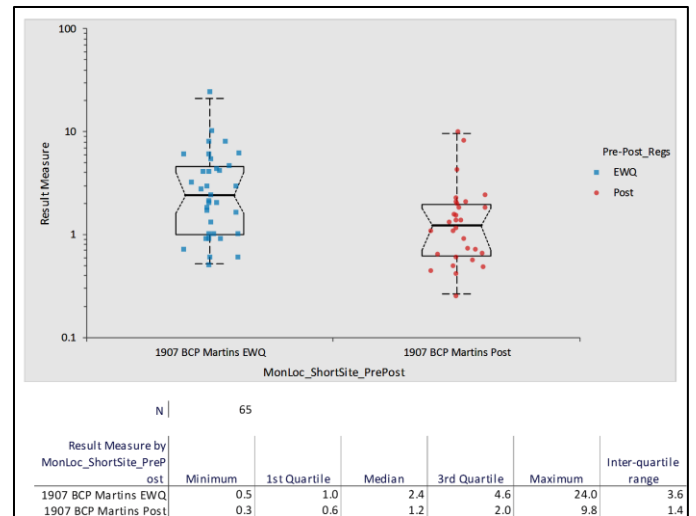Chapter 20: 1907 BCP Martins Creek, PA
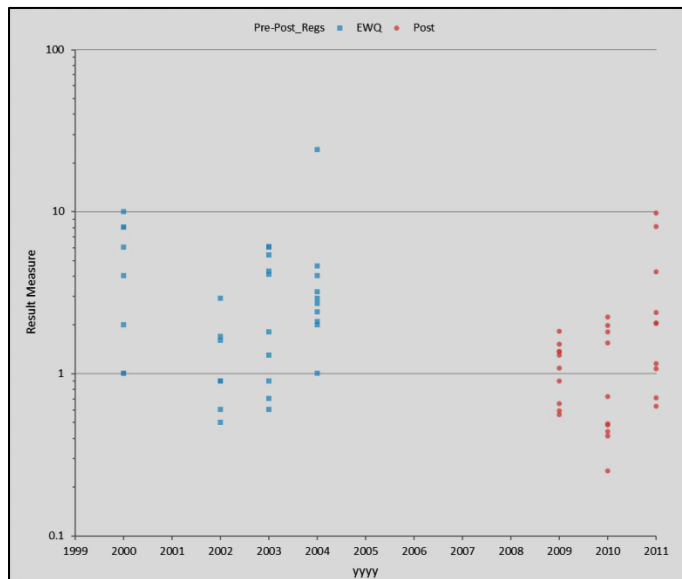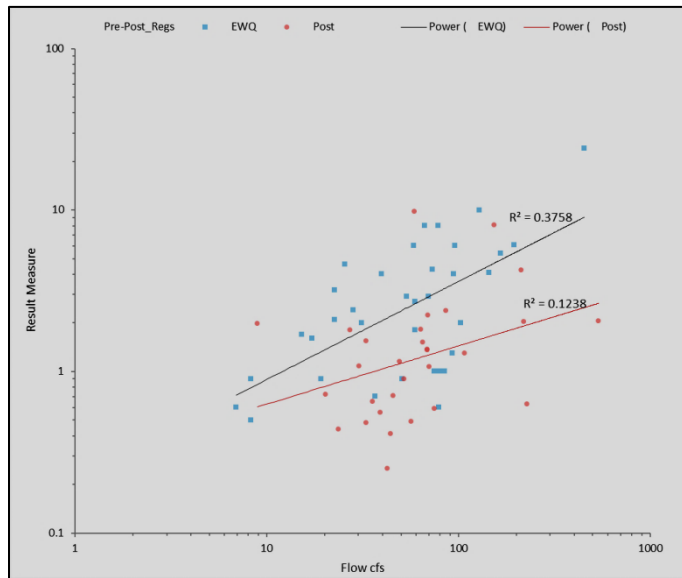
Turbidity NTU

Existing Water Quality (Table 2G):

Median 2.4 NTU
Lower 95% Confidence Interval 1.6 NTU
Upper 95% Confidence Interval 4.0 NTU
Defined in regulations as a flow-related parameter

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	0.5	1.0	2.4	4.6	24.0	3.6
1907 BCP Martins Post	0.3	0.6	1.2	2.0	9.8	1.4

N | 65

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	1382.9	39.51
1907 BCP Martins Post	30	1613.3	53.78

|	
H statistic	8.38
X² approximation	8.38
DF	1
p-value	0.0038 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Turbidity measurably declined between the EWQ and post-EWQ periods. There were no known sources of analytical uncertainty in these results. The post-EWQ median turbidity fell below the lower EWQ 95% confidence interval. Turbidity is positively but weakly related to flow in both data sets. Concentrations and flows are represented on logarithmic scale, and regressions are power relationships. There were no additional data available for comparison with DRBC results.
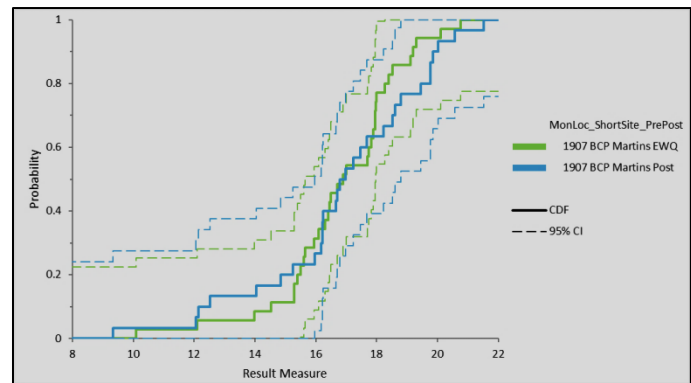
Chapter 20: 1907 BCP Martins Creek, PA

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules
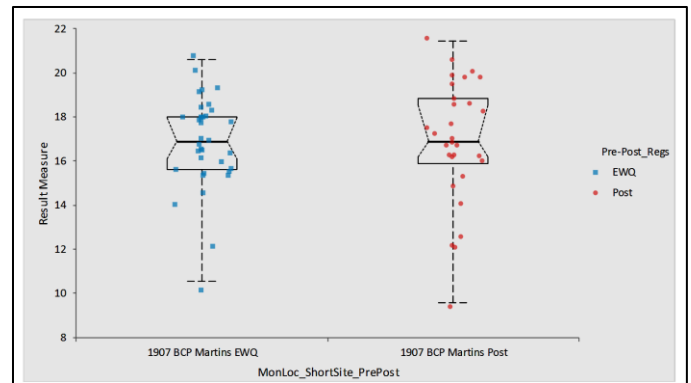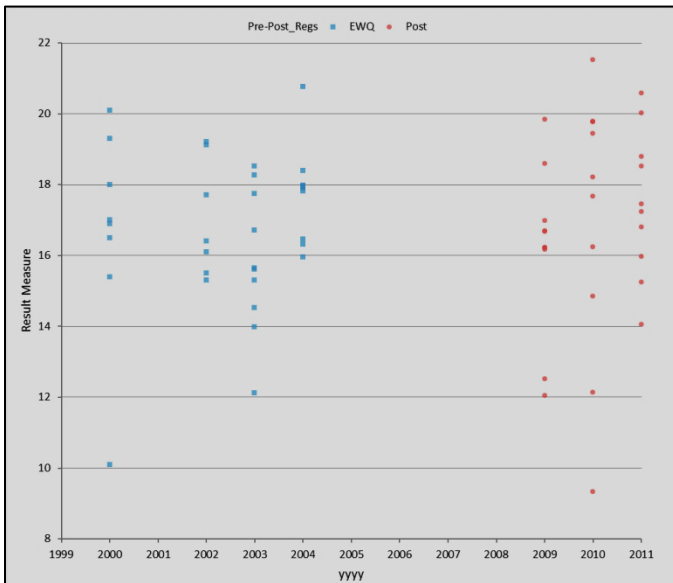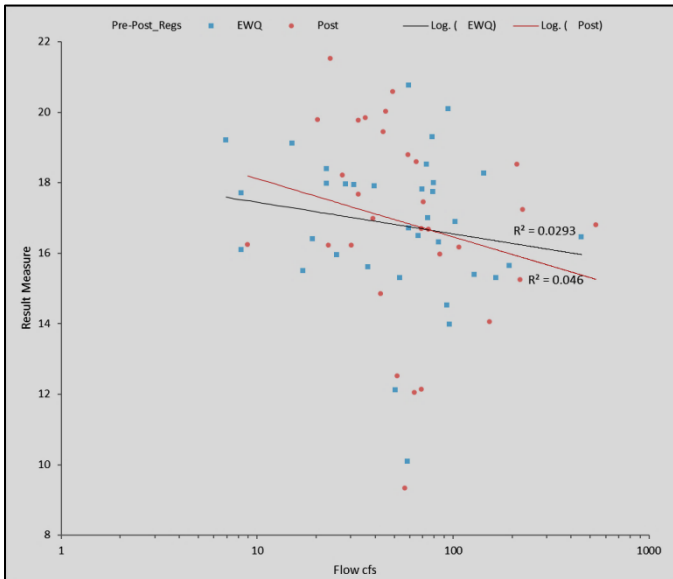
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1907 BCP Martins EWQ	10.1	15.6	16.9	18.0	20.8	2.4
1907 BCP Martins Post	9.3	15.9	16.9	18.8	21.5	2.9

N = 65

Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1907 BCP Martins EWQ	35	17.9	0.51
1907 BCP Martins Post	30	20.8	0.69

H statistic	0.11
X² approximation	0.11
DF	1
p-value	0.7422 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. Water temperature was nearly identical between the EWQ and post-EWQ periods. There were no known sources of analytical uncertainty in these results. Water temperature is unrelated to flow in both data sets. Note that flows are plotted on a logarithmic scale. No independent data were available to confirm DRBC results.