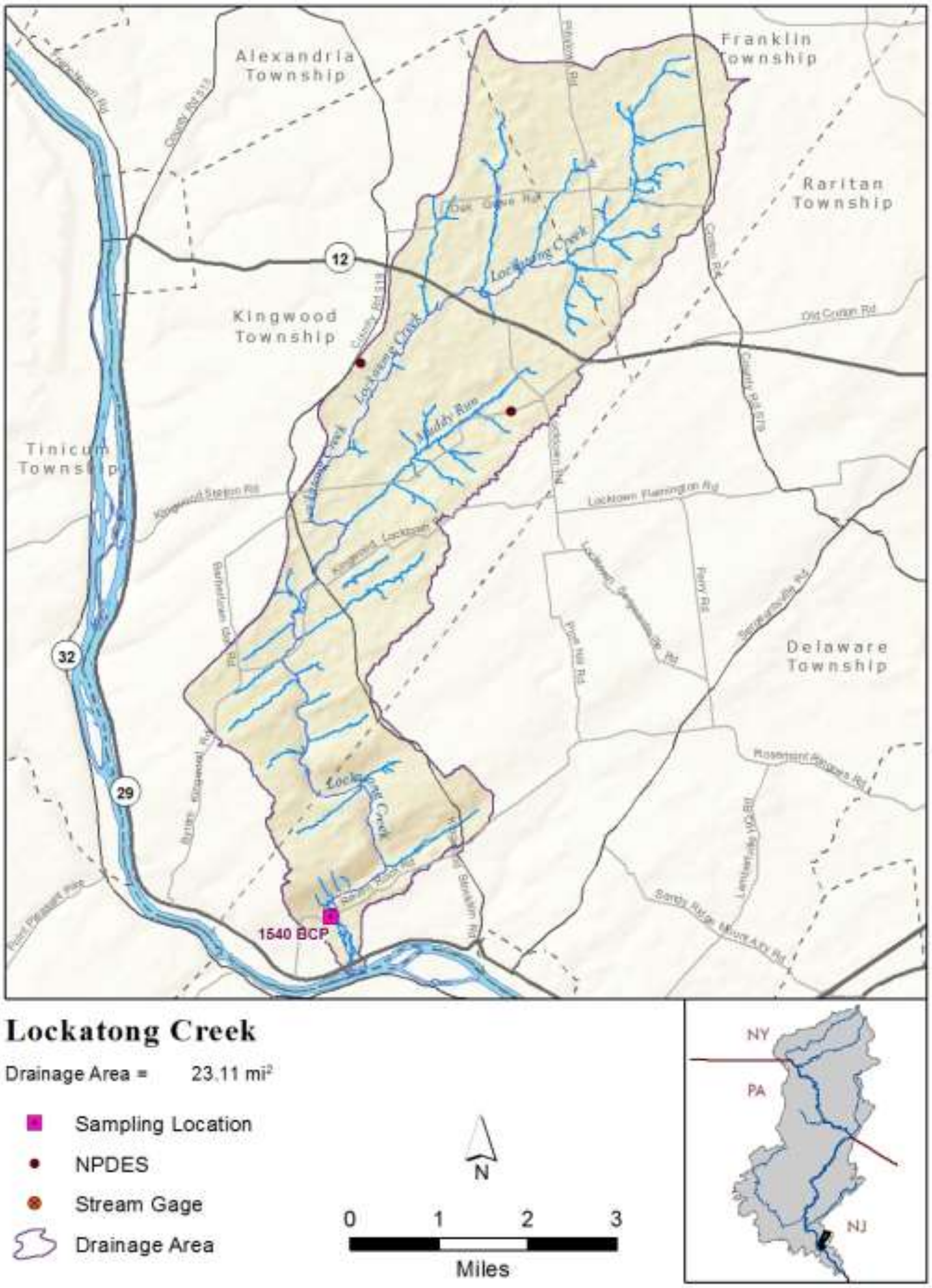
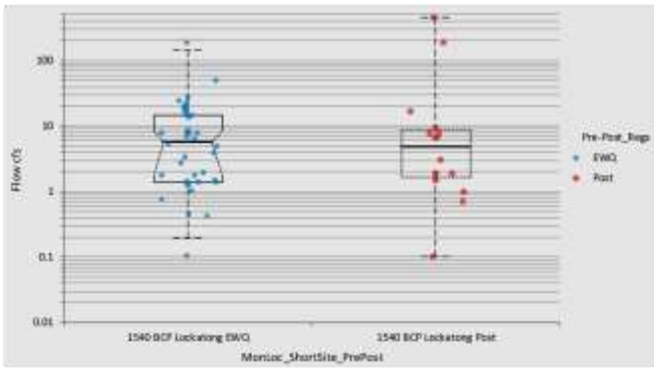
Chapter 6: 1540 BCP Lockatong Creek, Hunterdon County, NJ



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



N | 54

Flow cfs by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.10	1.39	5.72	14.57	180.30	13.19
1540 BCP Lockatong Post	0.10	1.67	4.90	8.65	451.90	6.98

Kruskal-Wallis test

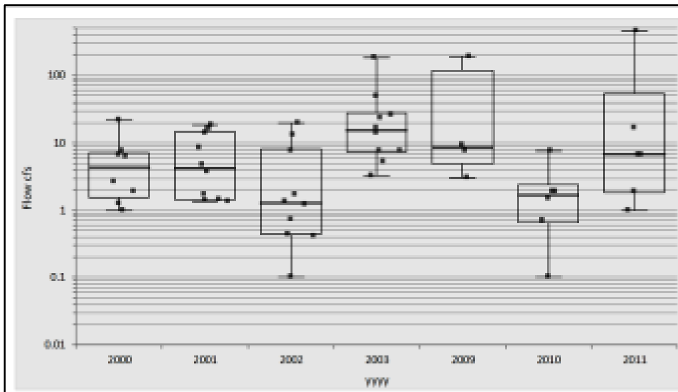
Flow cfs by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	4.8	0.13
1540 BCP Lockatong Post	16	11.4	0.71

H statistic	0.07
X^2 approximation	0.07
DF	1
p-value	0.7981 [1]

H0: $\theta_1 = \theta_2 = \theta \ldots$
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.

Flow was roughly the same between the EWQ and post-EWQ periods. Fewer samples were collected in the post-EWQ period, but the range of flow conditions sampled was wider. Both data sets contain samples taken at minimum flow, when only standing pools were present and much of the channel was dry. Flow is plotted on a logarithmic scale.

The 23.1 square mile Lockatong Creek watershed is about 41% forested, with less than 1% urban land cover. There is no carbonate bedrock in the watershed. Lockatong Creek is captured by the Delaware and Raritan Canal and provides public water supply via the New Jersey Water Supply Authority. Its influence upon the Delaware River is minimal except during high-flow conditions.



N | 54

Flow cfs by yyyy	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
2000	0.99	1.52	4.41	7.24	22.21	5.72
2001	1.33	1.44	4.29	14.57	18.75	13.14
2002	0.10	0.44	1.28	8.14	19.72	7.71
2003	3.32	7.46	15.62	28.36	180.30	20.90
2009	3.10	4.98	8.50	115.92	192.00	110.94
2010	0.10	0.65	1.70	2.38	7.60	1.73
2011	1.00	1.83	6.70	53.24	451.90	51.42

Annual May to September flow statistics are plotted above. Flow is plotted on a logarithmic scale. These are flow measurements or sometimes estimates associated with the time of each water quality sample. "Normal" annual median flow is about 47 cfs at this location, but the summer seasonal flow is around 29 cfs (USGS gage 01460880, 2006-2012 data). Though a wide range of flows were sampled by DRBC, these data sets appear to be most representative of low flow conditions. EWQ samples were taken when there was no USGS gage on the Lockatong Creek, and flows were estimated based upon a DRBC rating curve built at the same location where the USGS gage now resides. When available, USGS continuous flow records were used to match flow with DRBC water quality samples in the post-EWQ period of 2009-2011.

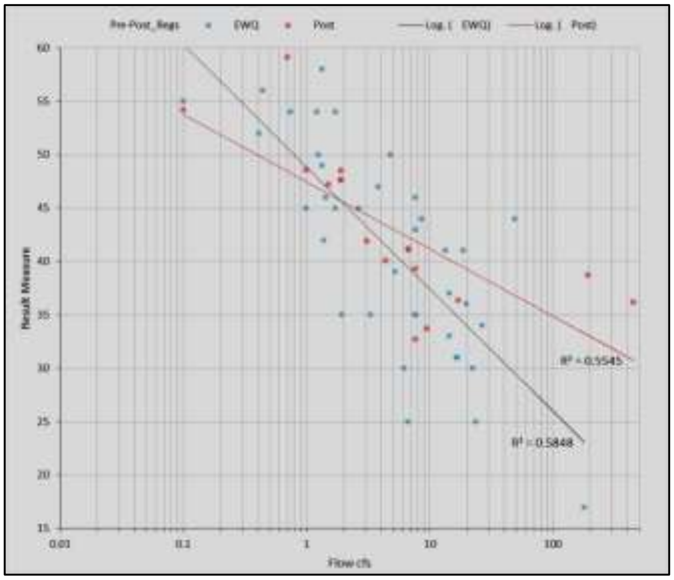
Upstream ICP: Delaware River at Bulls Island
Downstream ICP: Delaware River at Lambertville

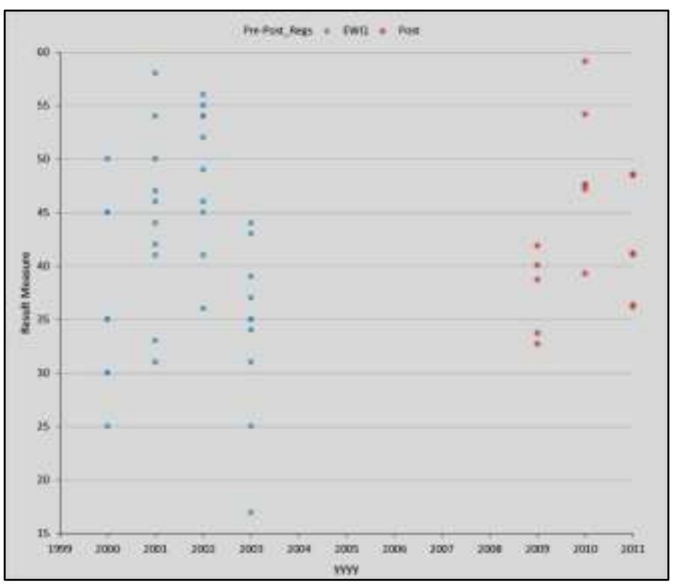
Chapter 6: 1540 BCP Lockatong Creek, NJ

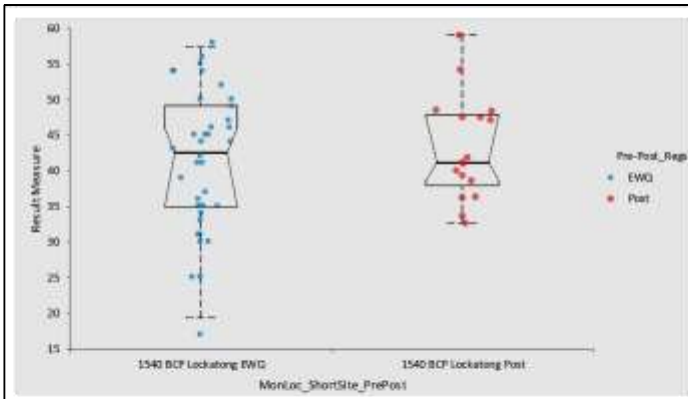
Alkalinity as CaCO3, Total mg/l

Existing Water Quality (Table 2U):

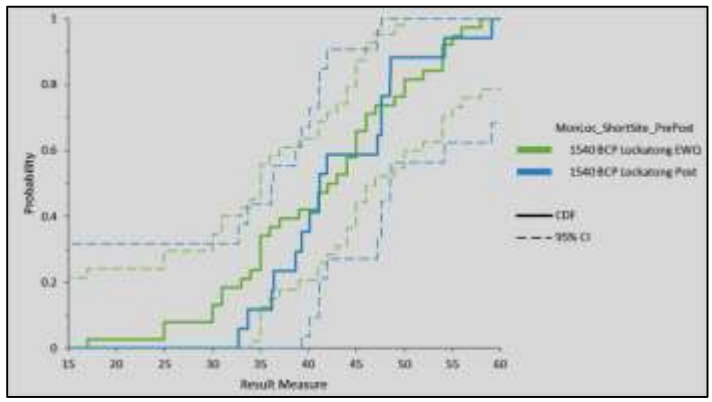
Median 43 mg/l
Lower 95% Confidence Interval 35 mg/l
Upper 95% Confidence Interval 46 mg/l
Defined in regulations as a flow-related parameter







N	55					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	17.0	34.9	42.5	49.1	58.0	14.2
1540 BCP Lockatong Post	32.7	37.9	41.2	47.9	59.1	10.0



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	30.4	0.80
1540 BCP Lockatong Post	17	68.0	4.00

H statistic	0.38
X^2 approximation	0.38
DF	1
p-value	0.5356[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.

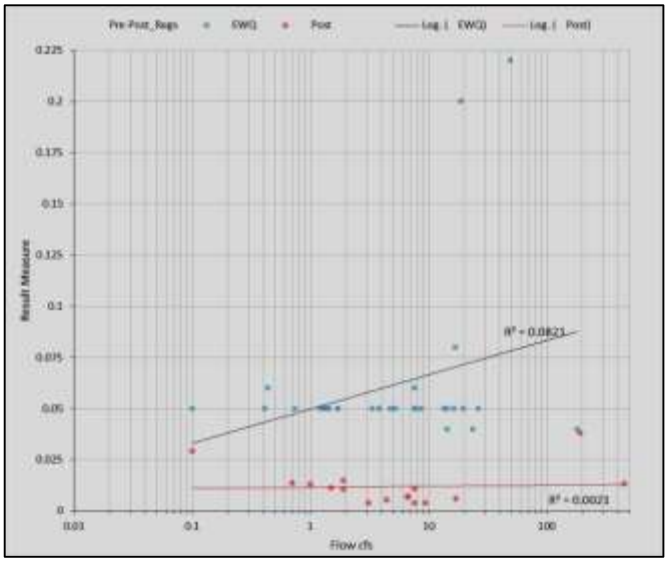
No water quality degradation is evident. Alkalinity did not measurably change between the EWQ and post-EWQ periods. Alkalinity is inversely related to flow in both data sets. Post-EWQ median alkalinity fell within EWQ 95% confidence intervals. Flow is plotted on a logarithmic axis.

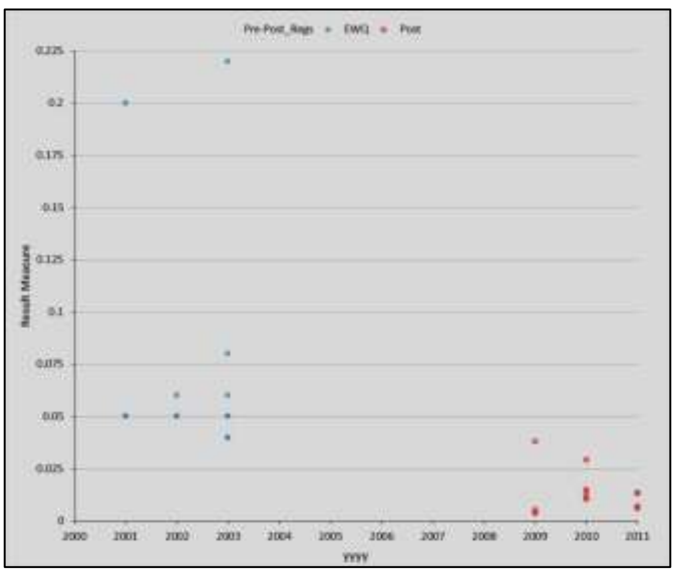
Chapter 6: 1540 BCP Lockatong Creek, NJ

Ammonia Nitrogen as N, Total mg/l

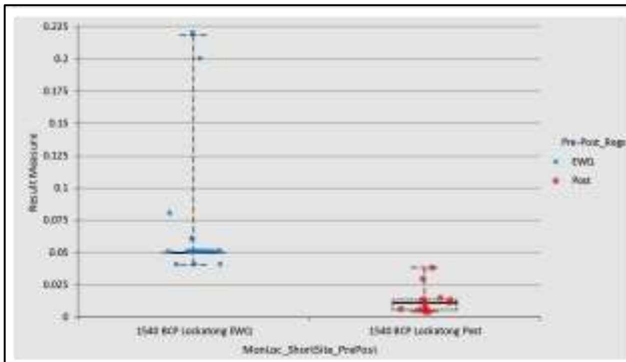
Existing Water Quality (Table 2U):

Median <0.05 mg/l
Lower 95% Confidence Interval <0.05 mg/l
Upper 95% Confidence Interval <0.05 mg/l



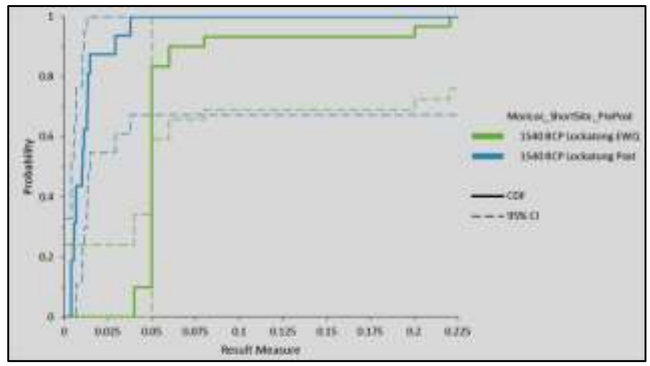


No water quality degradation is evident. Ammonia concentrations apparently declined between the two periods. However, differences in detection limits, potential laboratory artifacts, and too few post-EWQ samples introduced uncertainty in conclusions. Post-EWQ median ammonia concentration was below the EWQ lower 95% confidence interval.



N 46

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.040	0.050	0.050	0.050	0.220	0.000
1540 BCP Lockatong Post	0.004	0.006	0.011	0.014	0.038	0.008



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	30	1920.0	64.00
1540 BCP Lockatong Post	16	3600.0	225.00

H statistic	34.42
X^2 approximation	34.42
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 independent data were readily available to validate results. EWQ data possessed 25/30 undetected results, interfering with calculation of the median. Thus EWQ was established as <0.05 mg/l; the detection limit at the time. At lower detection limits there were still 5 undetected results in post-EWQ data. We are now able to measure ambient Lockatong Creek concentrations (median 0.011 mg/l), which are certainly less than 0.05 mg/l. Some improvement possibly took place, as the post-EWQ data contained no concentrations higher than 0.004 mg/l.

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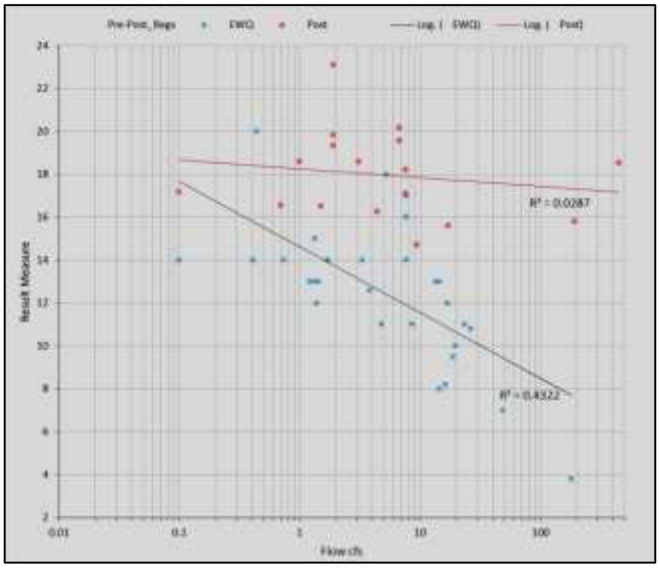
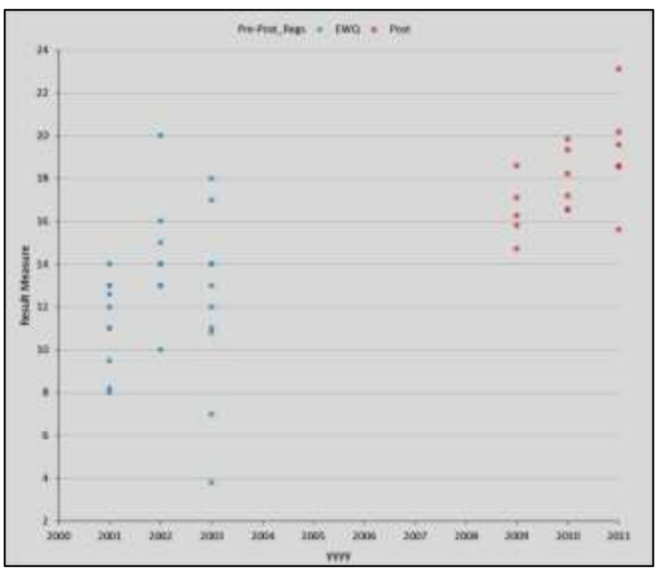
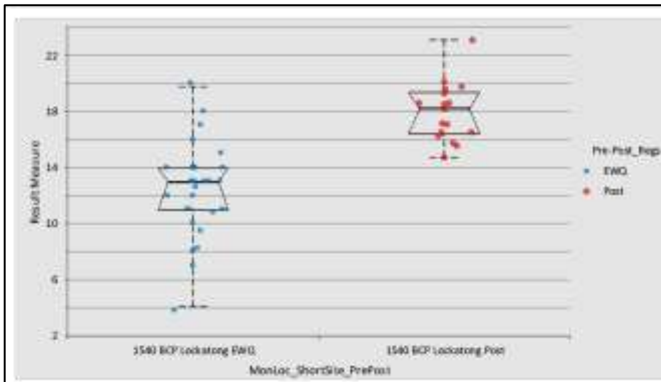
Chloride, Total mg/l

Existing Water Quality (Table 2U):

Median 13 mg/l
Lower 95% Confidence Interval 11 mg/l
Upper 95% Confidence Interval 14 mg/l
Defined in regulations as a flow-related parameter

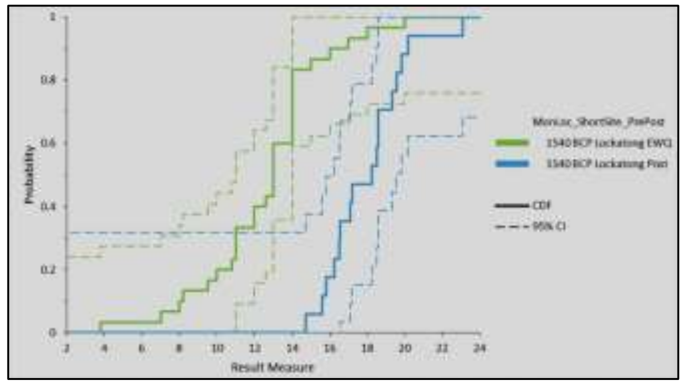






N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	3.8	11.0	13.0	14.0	20.0	3.0
1540 BCP Lockatong Post	14.7	16.4	18.2	19.4	23.1	3.0



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	30	1642.8	54.76
1540 BCP Lockatong Post	17	2899.1	170.53

H statistic	24.27
X^2 approximation	24.27
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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.

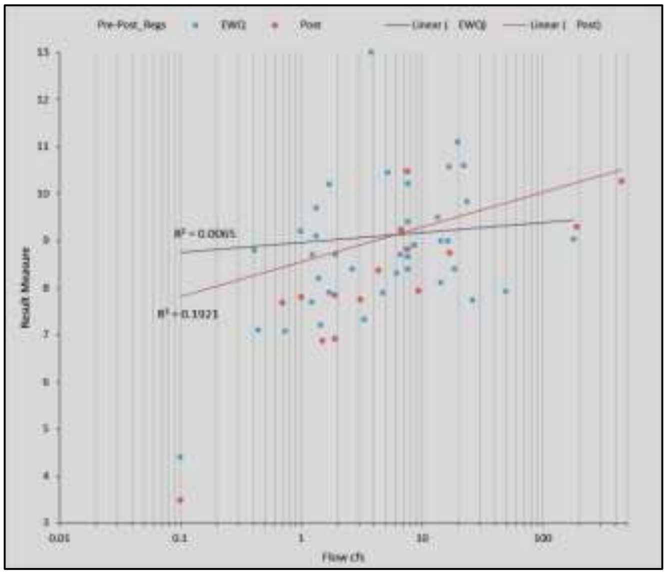
Water quality degradation is evident. Chloride concentrations apparently increased between the two periods. However, analytical uncertainty included potential laboratory artifacts and insufficient post-EWQ sampling (n=17). Post-EWQ median concentration rose above the EWQ upper 95% confidence interval. EWQ chloride was inversely related to flow, but post-EWQ chloride was not flow-related, probably due to insufficient post-EWQ sampling.

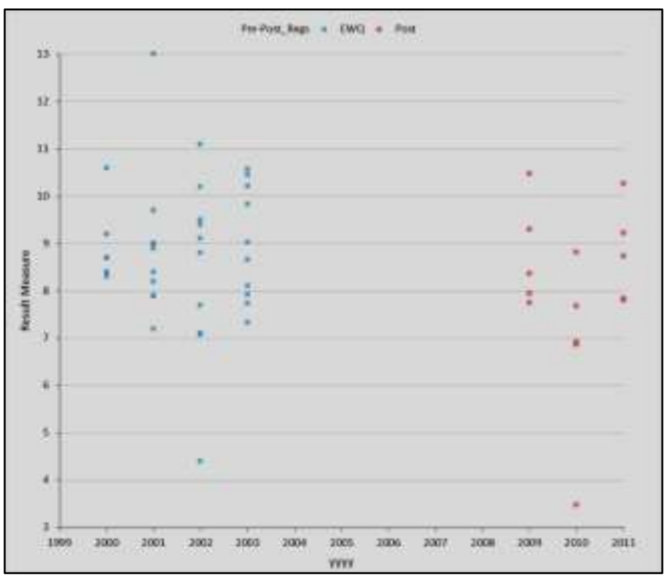
Chapter 6: 1540 BCP Lockatong Creek, NJ

Dissolved Oxygen (DO) mg/l

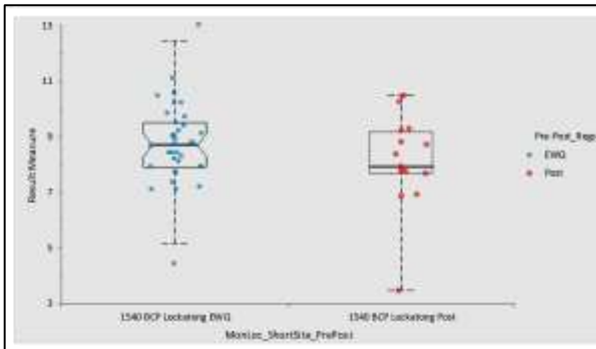
Existing Water Quality (Table 2U):

Median 8.70 mg/l
Lower 95% Confidence Interval 8.30 mg/l
Upper 95% Confidence Interval 9.10 mg/l

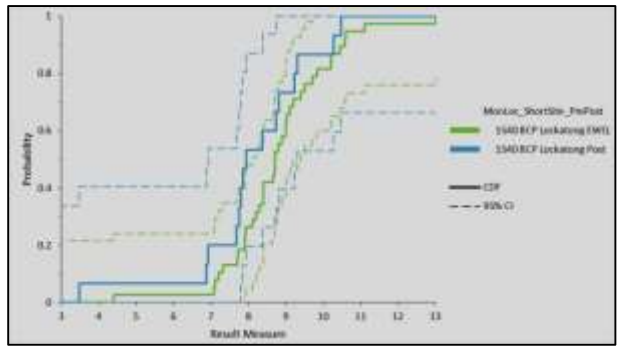




No water quality degradation is evident. No measurable change took place between the EWQ and Post-EWQ periods. Post-EWQ median DO concentration fell below the EWQ lower 95% confidence interval, but there were too few post-EWQ samples for a significant comparison.



	N	53				
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	4.40	7.92	8.70	9.52	13.00	1.60
1540 BCP Lockatong Post	3.48	7.69	7.94	9.16	10.48	1.47



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	136.4	3.59
1540 BCP Lockatong Post	15	345.6	23.04

H statistic	2.02
X^2 approximation	2.02
DF	1
p-value	0.1550 [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.

Sampling time of day may have slightly biased the post-EWQ data; average sample time was 10:00 AM for post-EWQ samples compared with 11:00 AM for EWQ samples. DO concentrations typically increase during the day; an hour in time difference can be meaningful. Flow is plotted on a logarithmic scale. DO is unrelated to flow in both data sets. There are extreme low DO values in both data sets. Those measurements were taken from standing pools during dry conditions in 2002 and 2010 when there was no observable flow in Lockatong Creek. The pools were full of decomposing leaves that drove DO concentrations below 5 mg/l.

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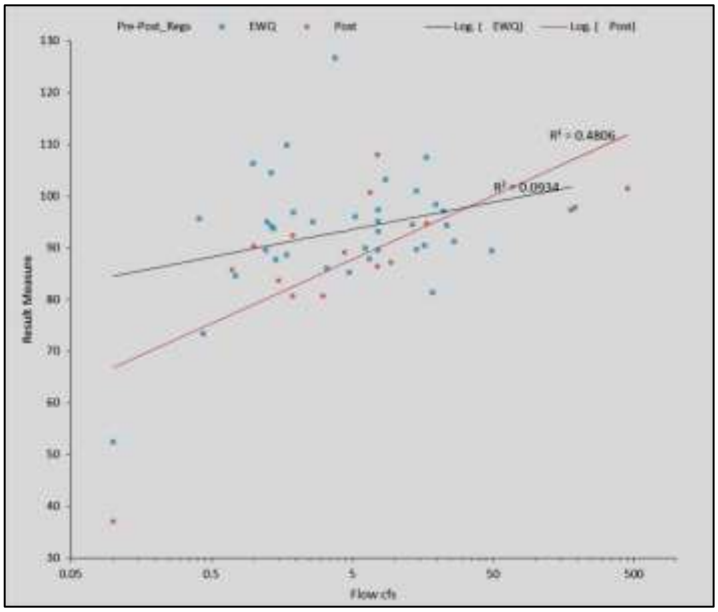
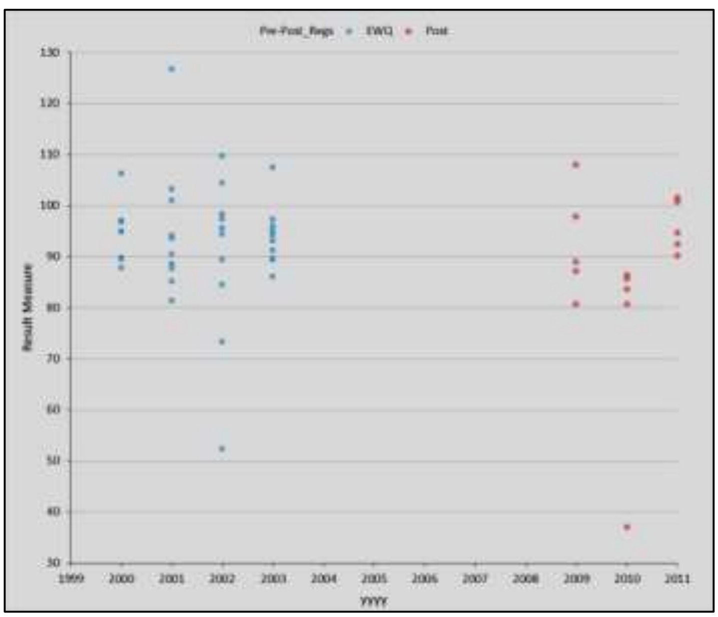
Dissolved Oxygen Saturation %

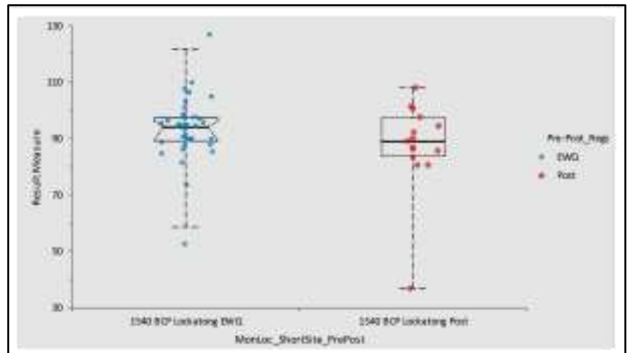
Existing Water Quality (Table 2U):

Median 94%
Lower 95% Confidence Interval 90%
Upper 95% Confidence Interval 96%



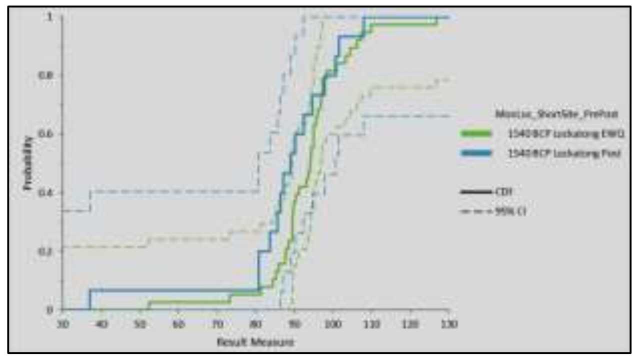


No water quality degradation is evident. Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. The apparent post-EWQ flow relationship is skewed by a single low outlier value.



N 53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	52	89	94	97	127	8
1540 BCP Lockatong Post	37	84	89	97	108	13



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	136.4	3.59
1540 BCP Lockatong Post	15	345.6	23.04

H statistic	2.02
X^2 approximation	2.02
DF	1
p-value	0.1551 [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.

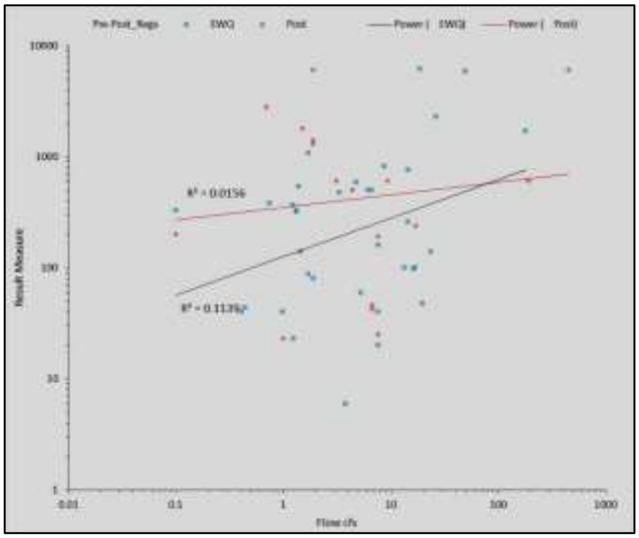
Post-EWQ median DO saturation fell below the EWQ lower 95% confidence interval, but not significantly. Dissolved oxygen saturation is slightly imbalanced in Lockatong Creek, tending between 80% and 110%. One algae bloom was detected in 2001 as indicated by the highest saturation level near 130%. There is some oxygen demand that suppresses DO saturation but it rarely drops below 80% except for on two occasions when the stream dried up and left standing pools in 2002 and 2010. Decomposing leaves and organic matter in the pools suppressed concentrations below 5 mg/l and saturation levels near or below 50%.

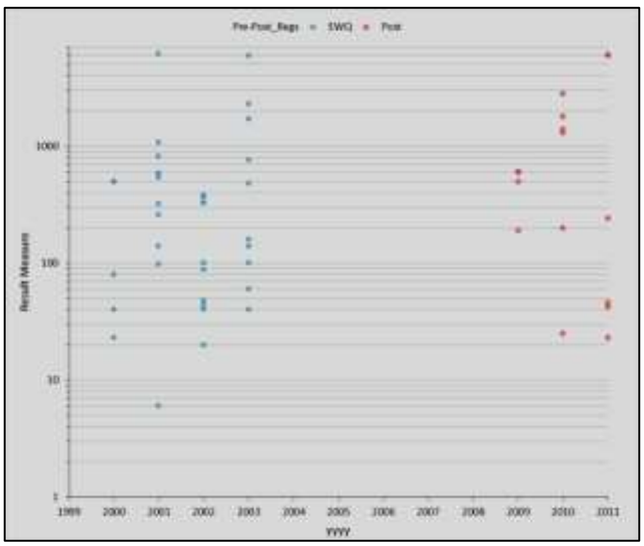
Chapter 6: 1540 BCP Lockatong Creek, NJ

Enterococcus colonies/100 ml

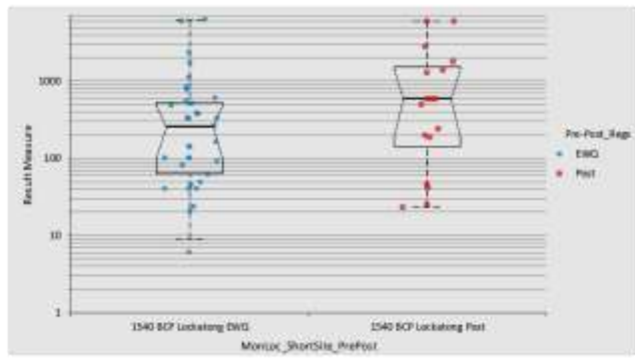
Existing Water Quality (Table 2U):

Median 260/100 ml
Lower 95% Confidence Interval 98/100 ml
Upper 95% Confidence Interval 480/100 ml



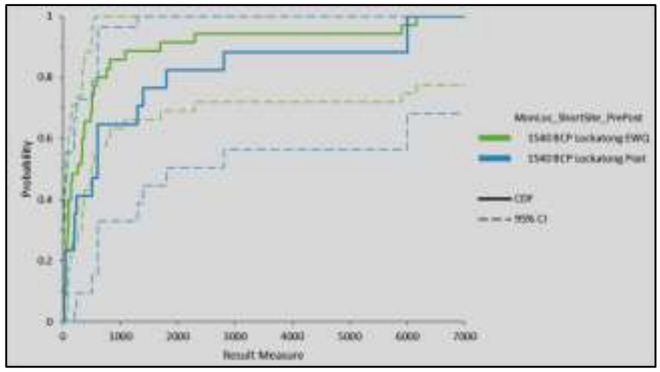


No water quality degradation is indicated. Enterococci did not measurably change between the EWQ and Post-EWQ periods. Enterococcus concentrations are unrelated related to flow in both data sets. Note that concentrations and flows are plotted on a logarithmic scale.



N	52

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	6	63	260	533	6,164	470
1540 BCP Lockatong Post	23	142	600	1,533	6,000	1,391



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	35	165.0	4.72
1540 BCP Lockatong Post	17	339.8	19.99

H statistic	2.20
X^2 approximation	2.20
DF	1
p-value	0.1381 [1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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.

Sources of analytical uncertainty included potential laboratory artifacts and insufficient post-EWQ sampling (n=17). Post-EWQ median enterococcus concentrations were above the EWQ upper 95% confidence interval, but variability is so high and post-EWQ N so low that the rise is meaningless.

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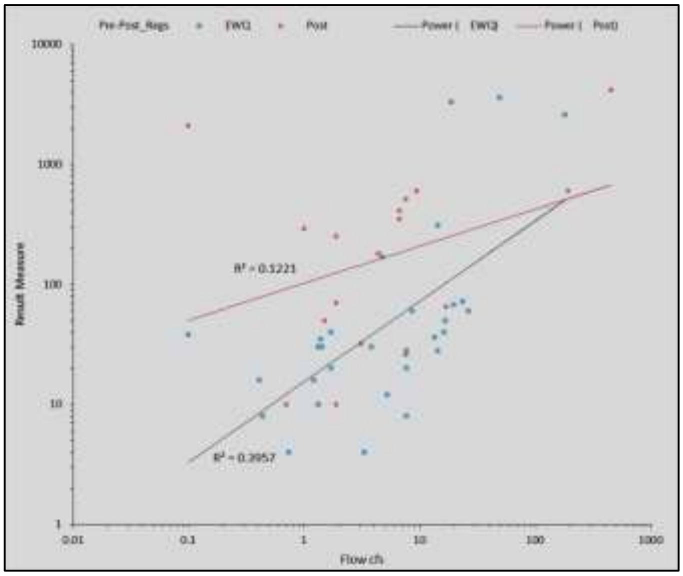
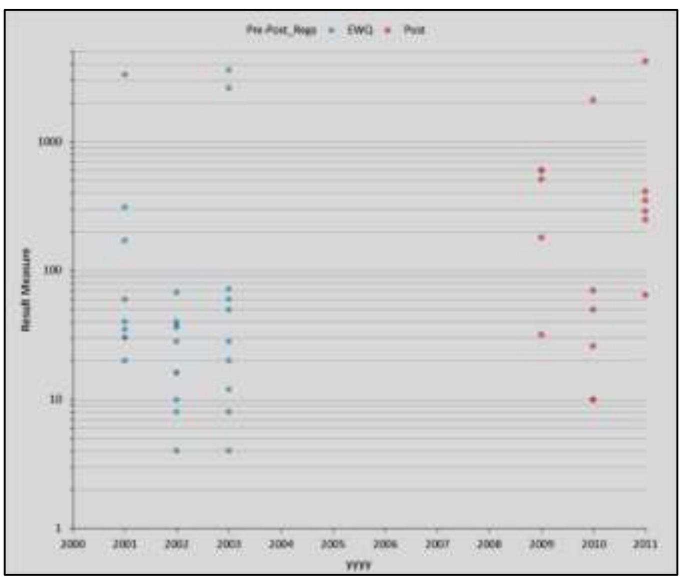
Escherichia coli colonies/100 ml

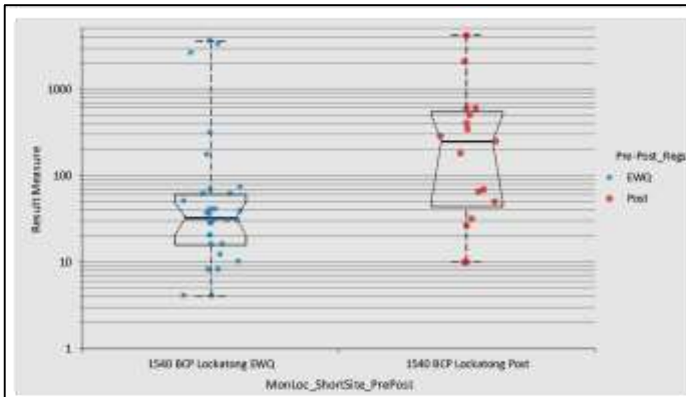
Existing Water Quality (Table 2U):

Median 33/100 ml
Lower 95% Confidence Interval 20/100 ml
Upper 95% Confidence Interval 50/100 ml
Defined in regulations as a flow-related parameter



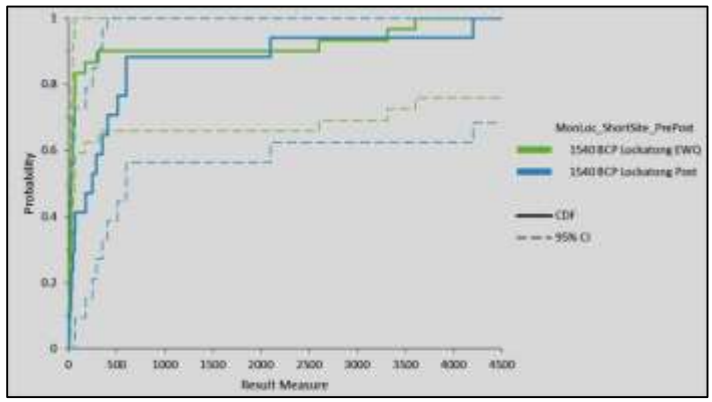


Water quality degradation is evident. E. coli concentrations apparently rose between the EWQ and Post-EWQ periods. Post-EWQ median E. coli rose above the EWQ upper 95% confidence interval.



N 47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	4	16	33	61	3,600	45
1540 BCP Lockatong Post	10	44	250	540	4,200	496



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	30	452.4	15.08
1540 BCP Lockatong Post	17	798.4	46.96

H statistic	6.66
X^2 approximation	6.66
DF	1
p-value	0.0099 [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.

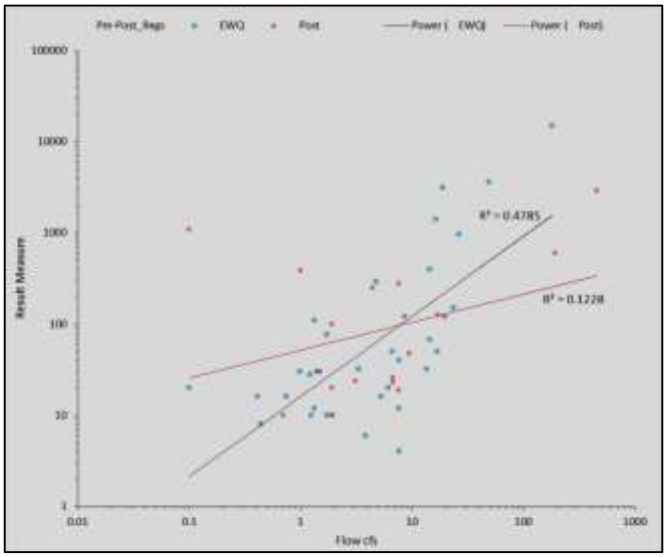
Analytical uncertainty included potential laboratory artifacts and insufficient post-EWQ sampling (n=17). No independent data were available at this site to validate DRBC's conclusion. The increase is reported as such in the summary matrix, but confidence in the conclusion is low because of low N and high variability.

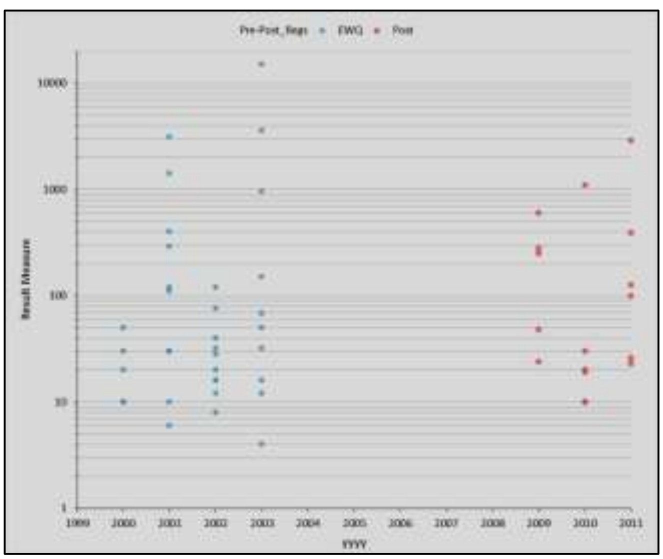
Chapter 6: 1540 BCP Lockatong Creek, NJ

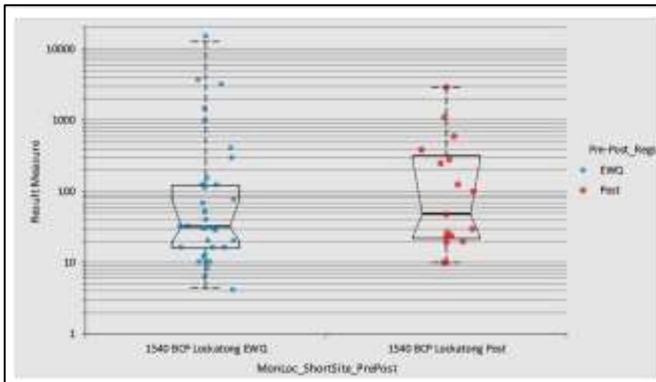
Fecal coliform colonies/100 ml

Existing Water Quality (Table 2U):

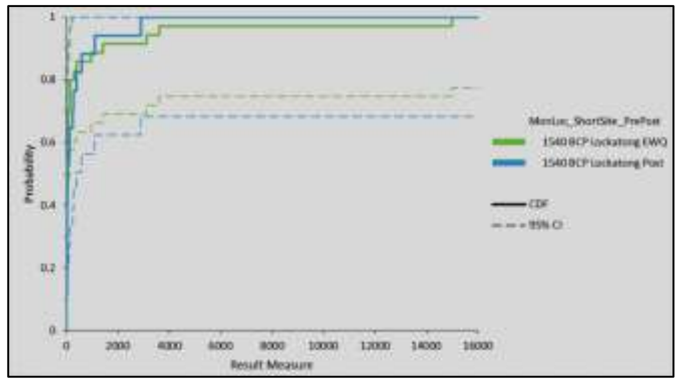
Median 32/100 ml
Lower 95% Confidence Interval 20/100 ml
Upper 95% Confidence Interval 76/100 ml
Defined in regulations as a flow-related parameter







N	52					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	4	16	32	120	15,000	104
1540 BCP Lockatong Post	10	22	48	317	2,900	295



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	35	41.3	1.18
1540 BCP Lockatong Post	17	84.9	5.00

H statistic	0.55
X^2 approximation	0.55
DF	1
p-value	0.4581 [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.

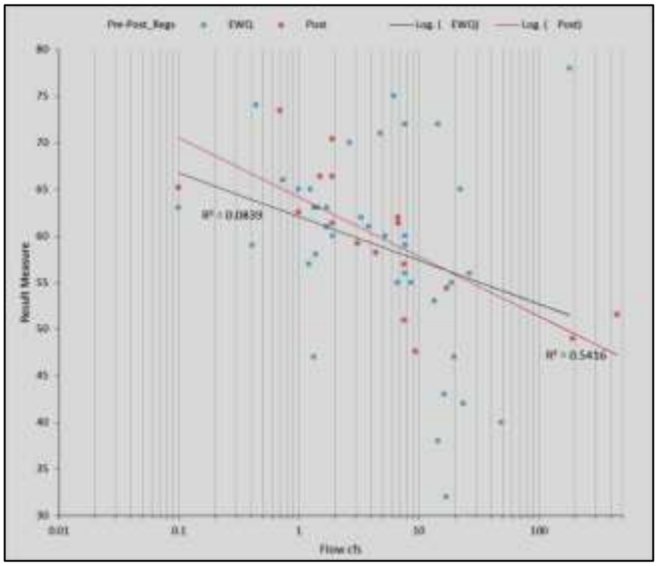
No water quality degradation is evident. Fecal coliform concentrations did not measurably change between the EWQ and post-EWQ periods. Fecal coliform concentrations are positively related to flow in both data sets, but weakly so in the post-EWQ data. Post-EWQ median concentrations fell within the EWQ 95% confidence intervals, but the data were naturally variable and post-EWQ N was low. Note that concentrations and flows are plotted on a logarithmic scale.

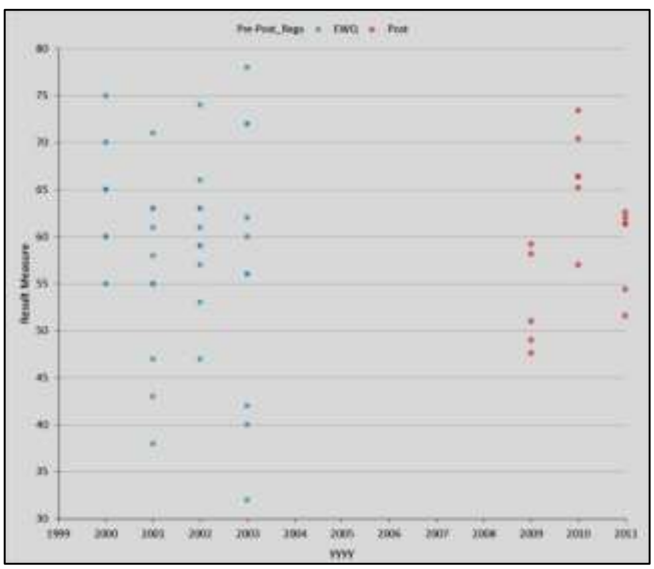
Chapter 6: 1540 BCP Lockatong Creek, NJ

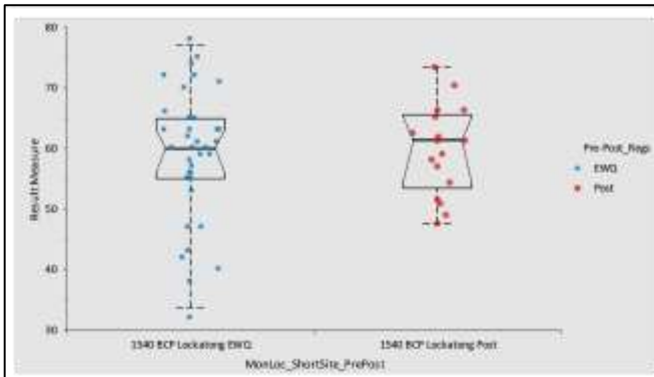
Hardness as CaCO3, Total mg/l

Existing Water Quality (Table 2U):

Median 60 mg/l
Lower 95% Confidence Interval 56 mg/l
Upper 95% Confidence Interval 63 mg/l

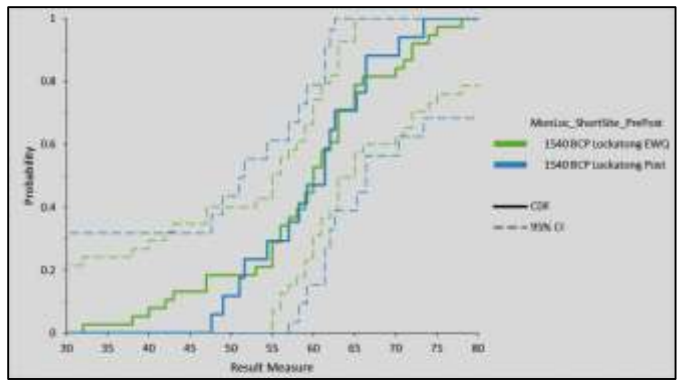






N 55

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	32	55	60	65	78	10
1540 BCP Lockatong Post	48	53	61	66	73	12



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	1.3	0.03
1540 BCP Lockatong Post	17	2.9	0.17

H statistic	0.02
X² approximation	0.02
DF	1
p-value	0.8985 [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.

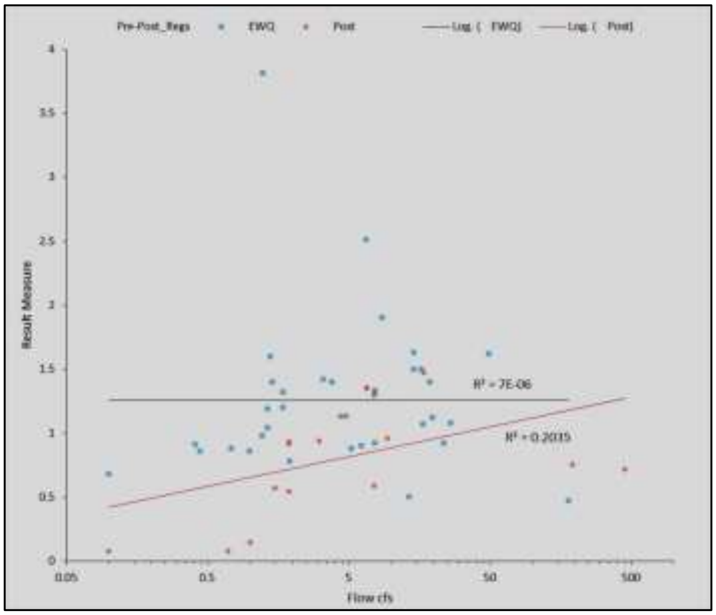
We found no evidence of water quality degradation. Hardness did not measurably change between the EWQ and post-EWQ periods. Hardness is inversely related to flow in the post-EWQ data, but unrelated to flow in the EWQ data. Post-EWQ median hardness fell within the EWQ 95% confidence intervals. Note that flows are plotted on a logarithmic scale.

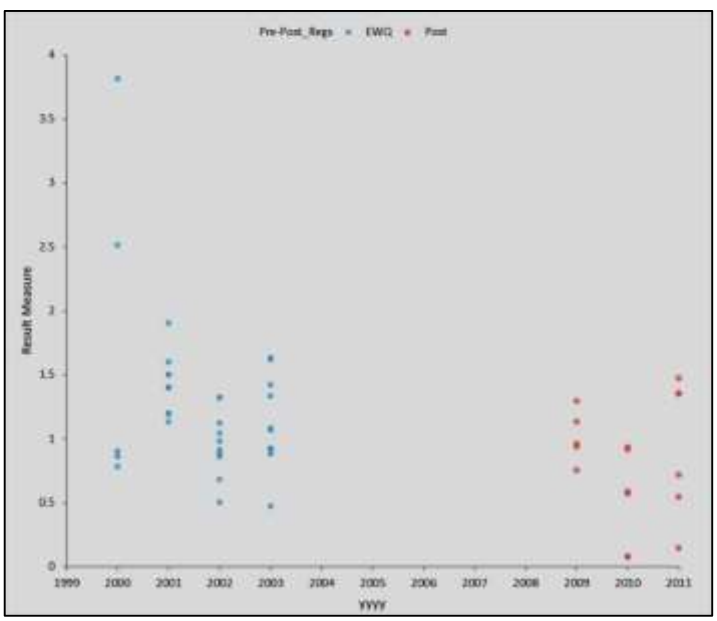
Chapter 6: 1540 BCP Lockatong Creek, NJ

Nitrate + Nitrite as N, Total mg/l

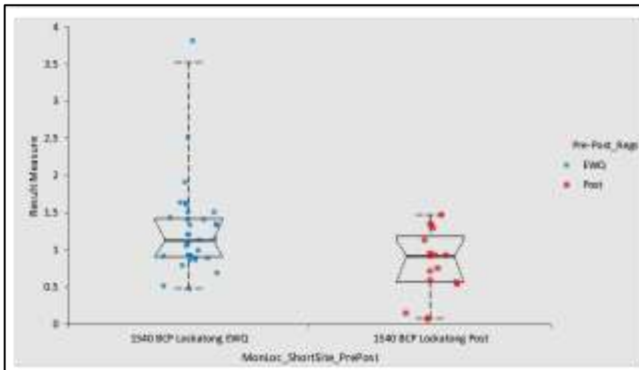
Existing Water Quality (Table 2U, as Nitrate only):

Median 1.13 mg/l
Lower 95% Confidence Interval 0.92 mg/l
Upper 95% Confidence Interval 1.40 mg/l



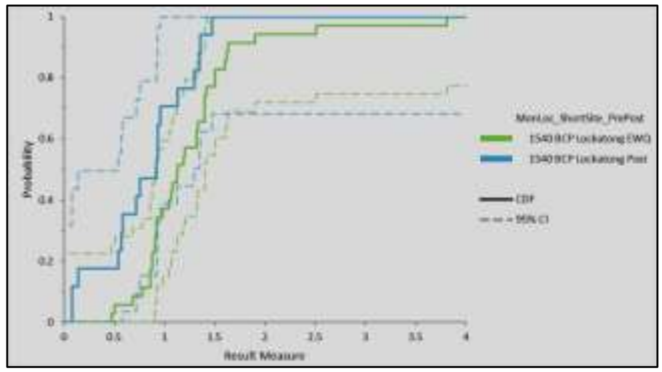


No water quality degradation is evident. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods. However, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty in conclusions.



N 52

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.47	0.90	1.13	1.42	3.81	0.52
1540 BCP Lockatong Post	0.08	0.56	0.92	1.19	1.47	0.63



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	35	475.5	13.58
1540 BCP Lockatong Post	17	978.9	57.58

H statistic	6.34
X^2 approximation	6.34
DF	1
p-value	0.0118 [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.

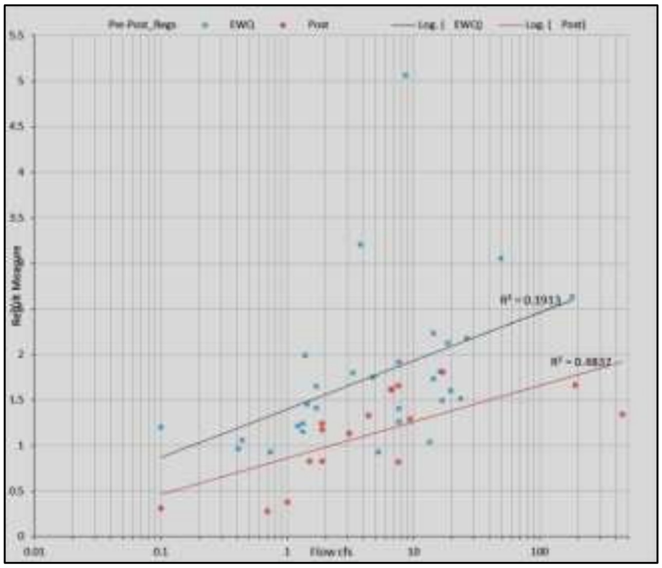
In both data sets, nitrate is unrelated to flow. On the annual plot, 2002-2003 EWQ nitrates appear to match well with post-EWQ nitrate + nitrite for 2009-2011. Post-EWQ Nitrate + Nitrite concentrations are assumed equivalent with EWQ nitrate concentrations, since EWQ nitrite concentrations were never detected. Independent data were not available for validation of results. Post-EWQ median nitrate + nitrite concentrations fell to the EWQ lower 95% confidence interval. Water quality may have improved, as there were no non-detect results to cloud a statistical comparison.

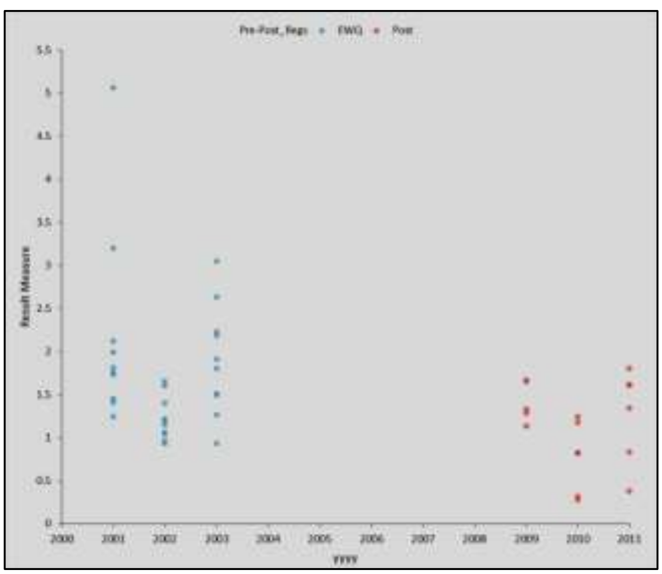
Chapter 6: 1540 BCP Lockatong Creek, NJ

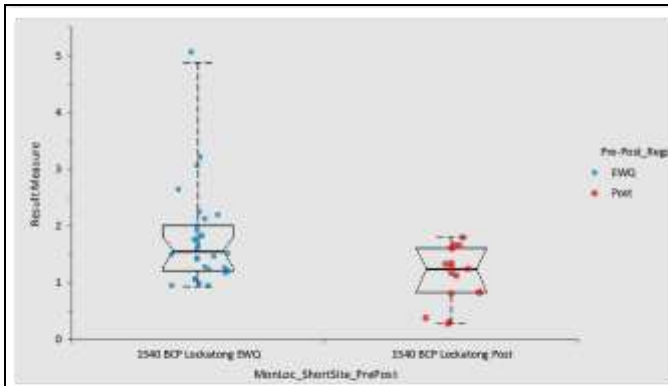
Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 2U):

Median 1.56 mg/l
Lower 95% Confidence Interval 1.26 mg/l
Upper 95% Confidence Interval 1.81 mg/l

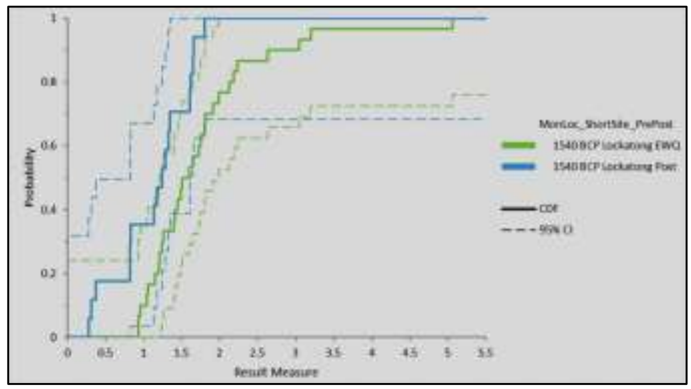






N 47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.93	1.21	1.56	2.00	5.06	0.79
1540 BCP Lockatong Post	0.28	0.82	1.24	1.61	1.80	0.79



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	30	472.0	15.73
1540 BCP Lockatong Post	17	833.0	49.00

H statistic	6.94
X^2 approximation	6.94
DF	1
p-value	0.0084[1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods. However, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty in conclusions.

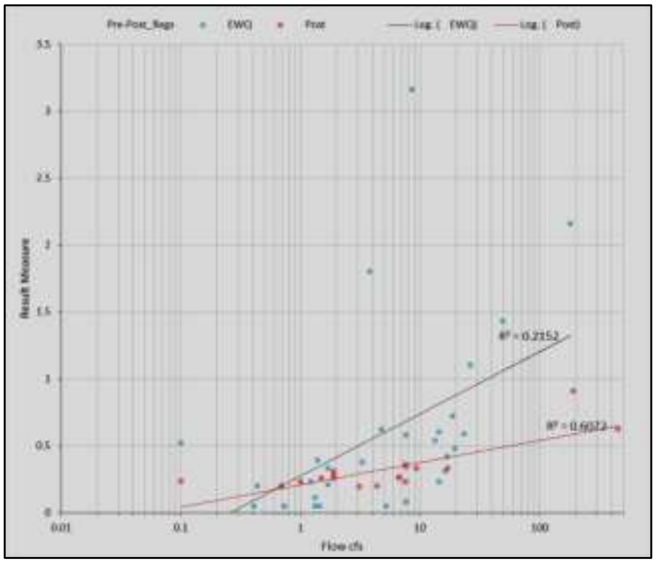
TN is strongly related to flow in the post-EWQ period, but weakly related to flow in the EWQ period due to skewing of the regression by some outlier samples. Note that flows are plotted on a logarithmic scale. DRBC results could not be independently validated. Post-EWQ median TN concentrations fell just below the EWQ lower 95% confidence interval.

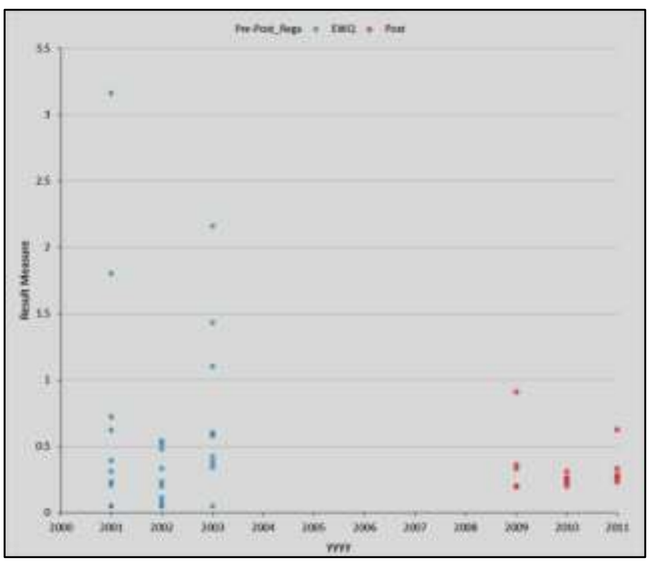
Chapter 6: 1540 BCP Lockatong Creek, NJ

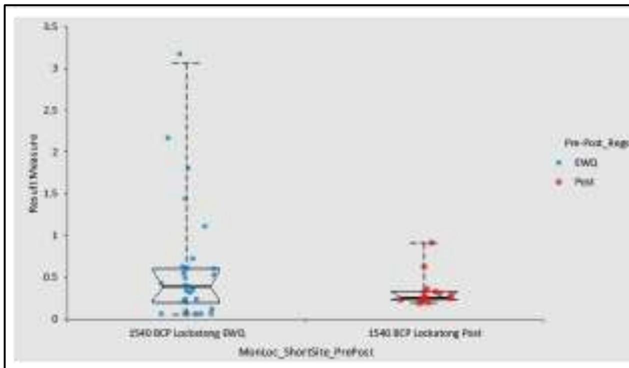
Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality (Table 2U):

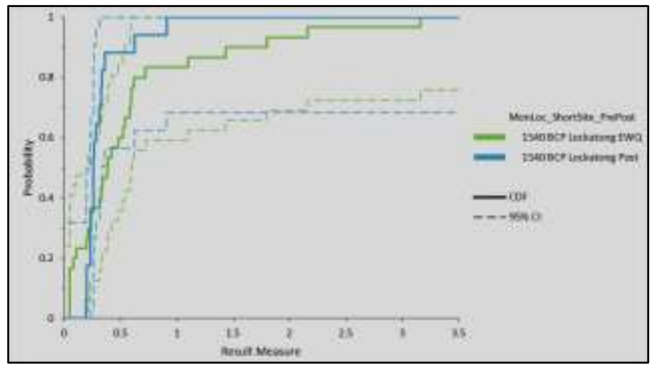
Median 0.39 mg/l
Lower 95% Confidence Interval 0.23 mg/l
Upper 95% Confidence Interval 0.58 mg/l







N	47					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.05	0.19	0.39	0.60	3.16	0.41
1540 BCP Lockatong Post	0.20	0.23	0.26	0.33	0.91	0.10



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	30	67.5	2.25
1540 BCP Lockatong Post	17	119.1	7.01

H statistic	0.99
X^2 approximation	0.99
DF	1
p-value	0.3188 [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. TKN concentrations apparently declined between the two periods. However, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty in conclusions. TKN concentration is related to flow in both data sets, though weakly so in the EWQ data because of some high values that skew the regression.

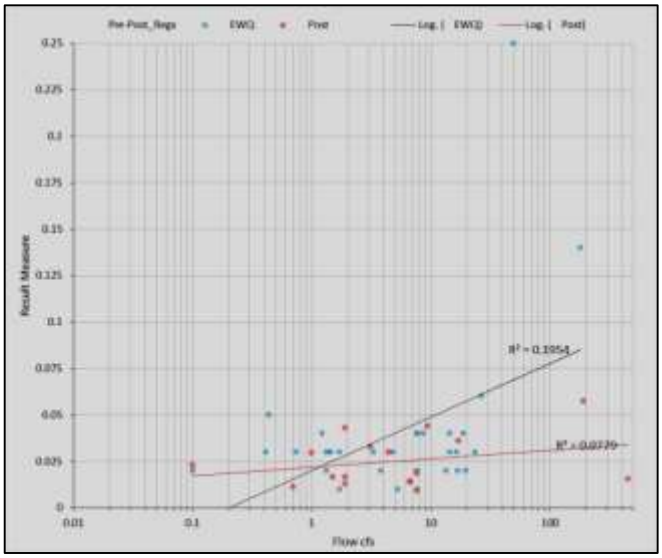
TKN ranges less widely and is less variable in the post-EWQ data set. Post-EWQ median TKN fell to just above the EWQ lower 95% confidence interval. There are no discrepancies in detection limits between the two data sets. Although results may indicate a water quality improvement, there still could be differences attributable to separate laboratories, which is unaccounted because no split sampling was conducted upon laboratory changes.

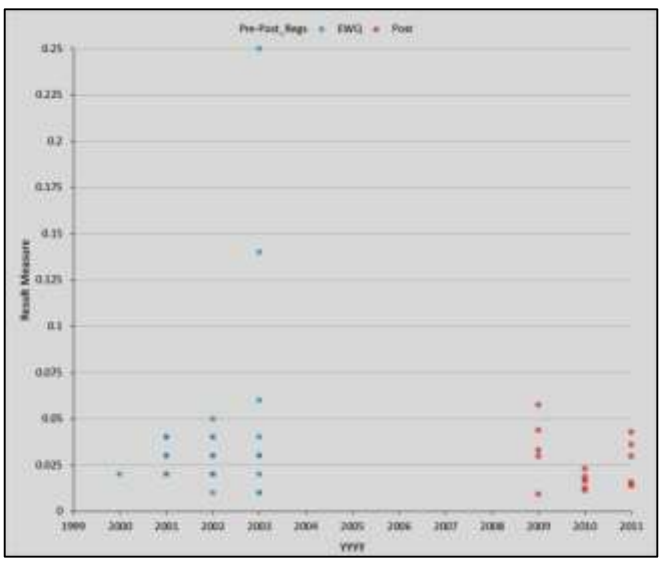
Chapter 6: 1540 BCP Lockatong Creek, NJ

Orthophosphate as P, Total mg/l (OP)

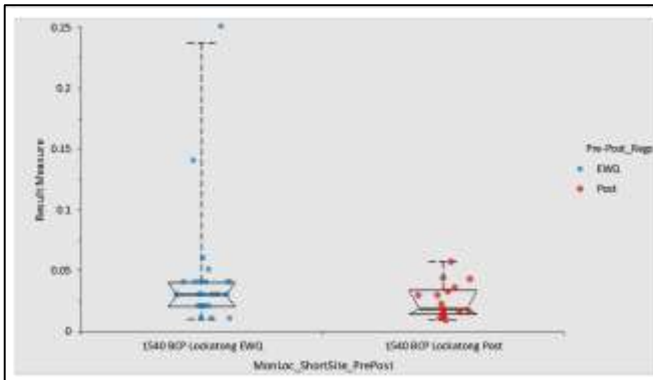
Existing Water Quality (Table 2U):

Median 0.03 mg/l
Lower 95% Confidence Interval 0.02 mg/l
Upper 95% Confidence Interval 0.04 mg/l



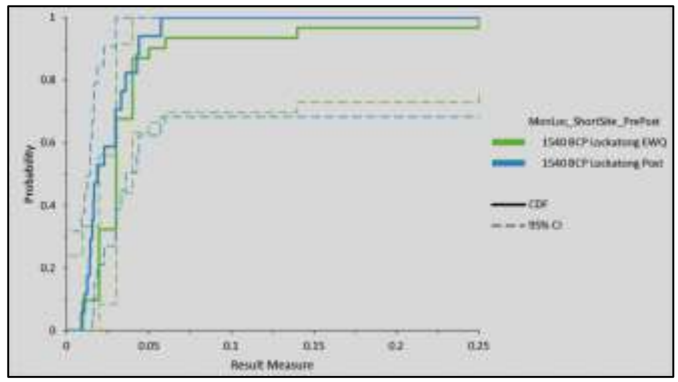


No water quality degradation is evident. OP apparently did not change between the two periods. Analytical uncertainty included potential laboratory artifacts, insufficient post-EWQ sampling (n=17), and detection limit differences. Orthophosphate is weakly related to flow in EWQ data, but unrelated to flow in post-EWQ data.



N 48

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.01	0.02	0.03	0.04	0.25	0.02
1540 BCP Lockatong Post	0.01	0.01	0.02	0.03	0.06	0.02



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	31	235.8	7.61
1540 BCP Lockatong Post	17	430.0	25.29

H statistic	3.46
X^2 approximation	3.46
DF	1
p-value	0.0630 [1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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.

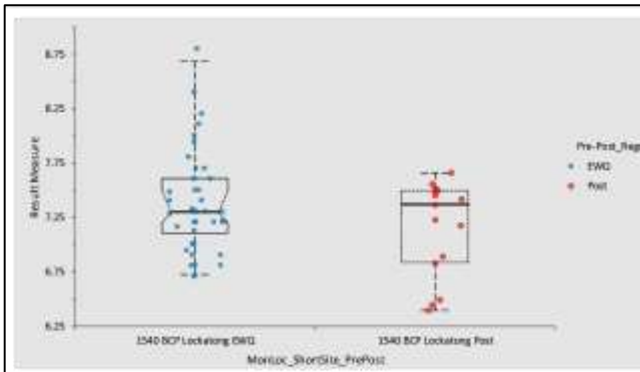
Post-EWQ median orthophosphate was within the EWQ 95% confidence intervals. There were no independent data to confirm DRBC results. DRBC detection limits improved between the two periods, but there were only three non-detect results in EWQ data and there were no non-detect results in post-EWQ data. Thus there was no interference in estimation of the median in either data set. Some improvement in water quality may be evident in that there are no values above 0.05 mg/l in the post-EWQ data set, but there was insufficient post-EWQ data (n=17) to conclusively document such an improvement.

Chapter 6: 1540 BCP Lockatong Creek, NJ

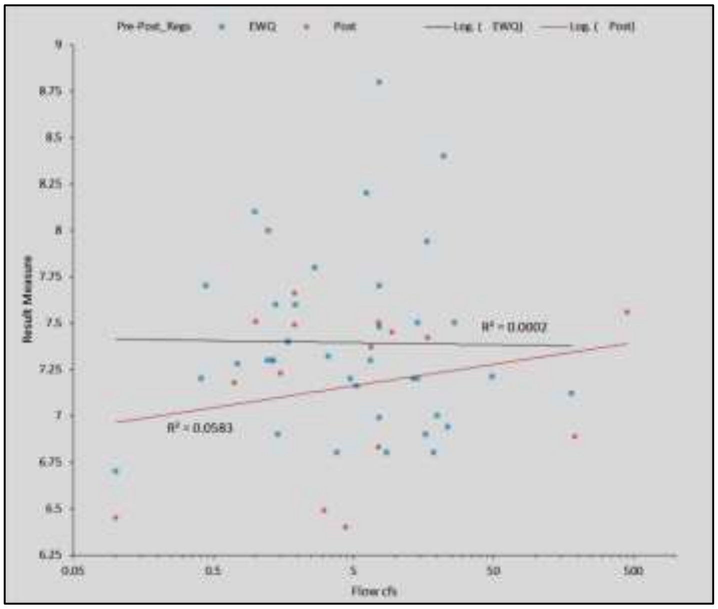
pH, units

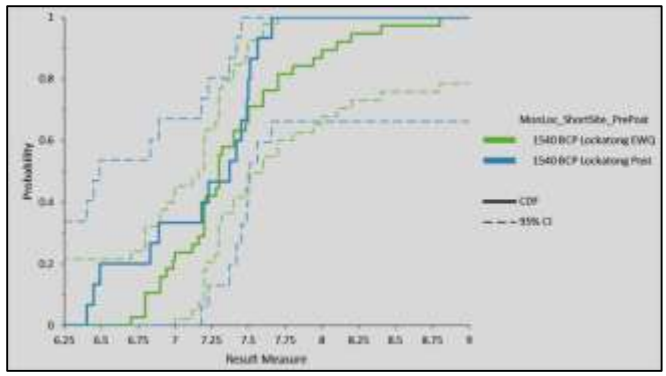
Existing Water Quality (Table 2U):

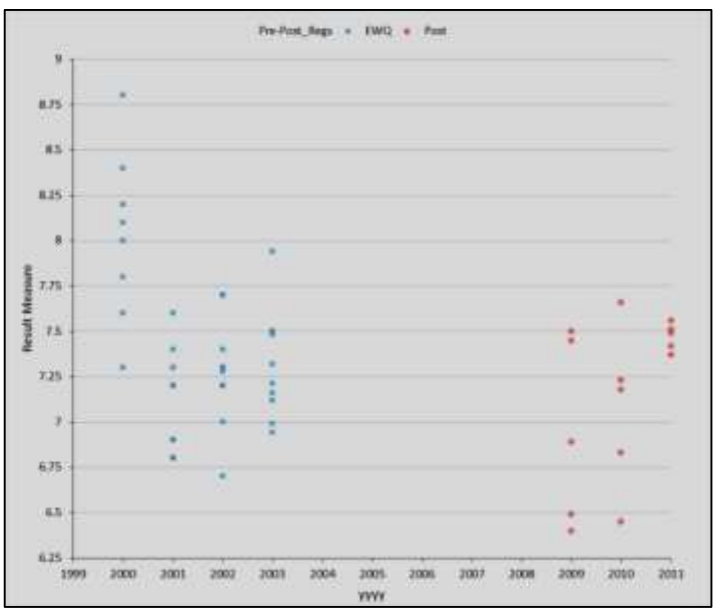
Median 7.30 standard units
Lower 95% Confidence Interval 7.20 standard units
Upper 95% Confidence Interval 7.50 standard units



N	53					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	6.70	7.11	7.30	7.61	8.80	0.50
1540 BCP Lockatong Post	6.40	6.84	7.37	7.50	7.66	0.66







Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	55.7	1.47
1540 BCP Lockatong Post	15	141.1	9.40

H statistic	0.83
X^2 approximation	0.83
DF	1
p-value	0.3634 [1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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.

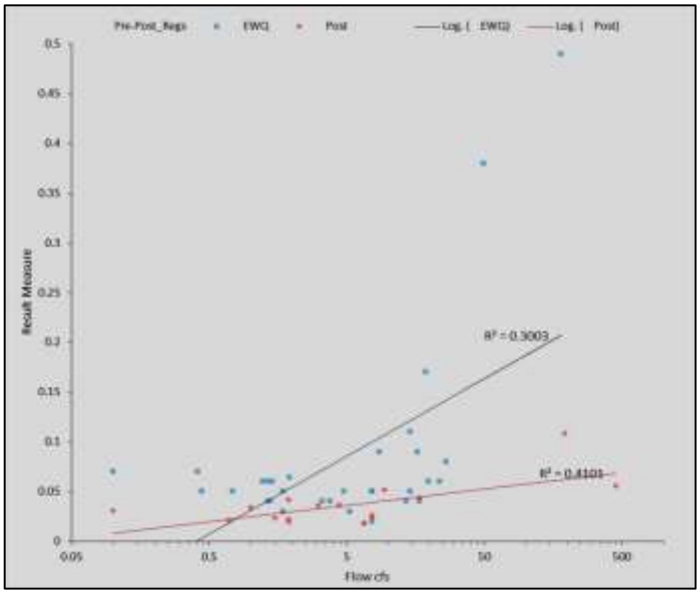
No water quality degradation is evident. pH did not measurably change between the EWQ and post-EWQ periods. pH is unrelated to flow in both data sets. Post-EWQ median pH was within the EWQ 95% confidence intervals. Note that flows are plotted on a logarithmic scale.

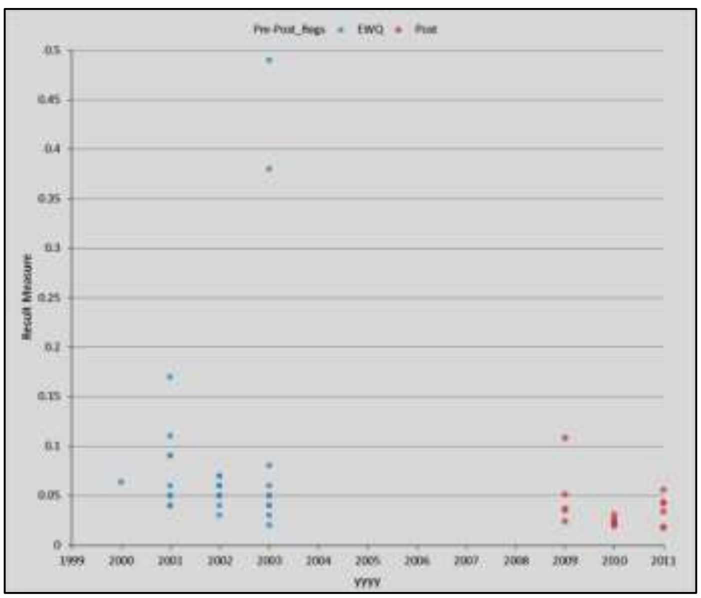
Chapter 6: 1540 BCP Lockatong Creek, NJ

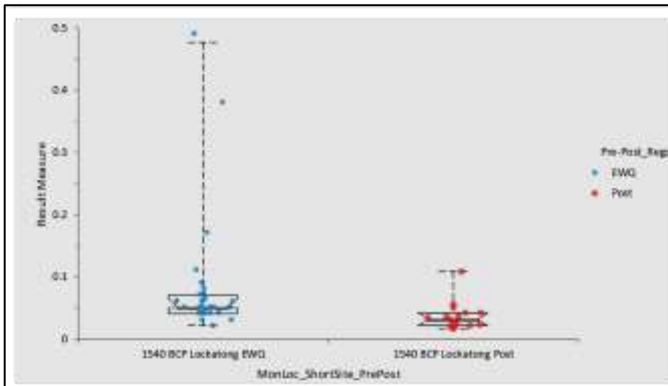
Phosphorus as P, Total (TP) mg/l

Existing Water Quality (Table 2U):

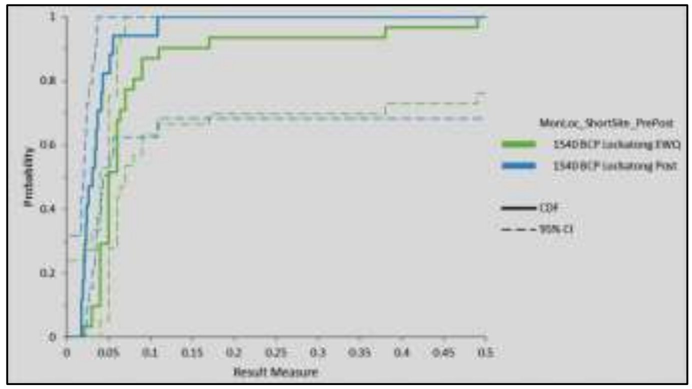
Median 0.05 mg/l
Lower 95% Confidence Interval 0.05 mg/l
Upper 95% Confidence Interval 0.06 mg/l







N	48					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.020	0.040	0.050	0.070	0.490	0.030
1540 BCP Lockatong Post	0.018	0.021	0.031	0.042	0.108	0.021



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	31	926.8	29.90
1540 BCP Lockatong Post	17	1690.0	99.41

H statistic	13.43
X^2 approximation	13.43
DF	1
p-value	0.0002 [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. Total Phosphorus (TP) concentrations apparently declined between the EWQ and post-EWQ periods. However, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty in conclusions.

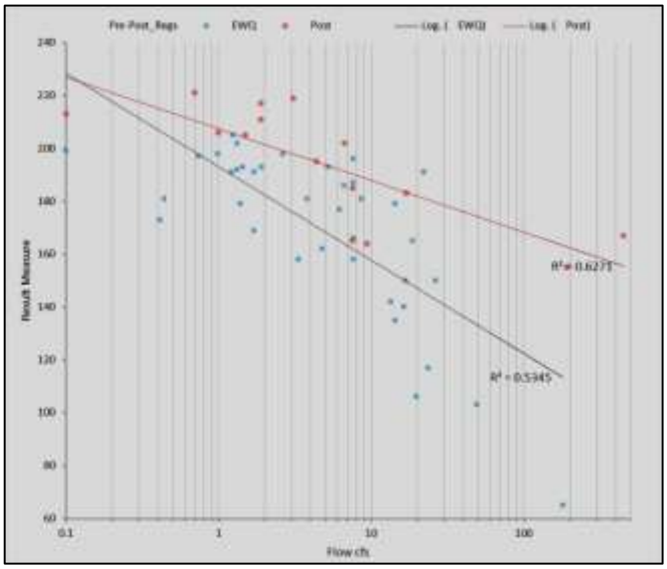
Post-EWQ median total phosphorus fell below the EWQ lower 95% confidence interval. TP is positively related to flow in both data sets, though TP was not designated as such in DRBC water quality regulations. The EWQ flow relationship is skewed by two high outlier values from samples taken in July and September 2003. Note that flows are plotted on a logarithmic scale. No independent data were available to confirm these results.

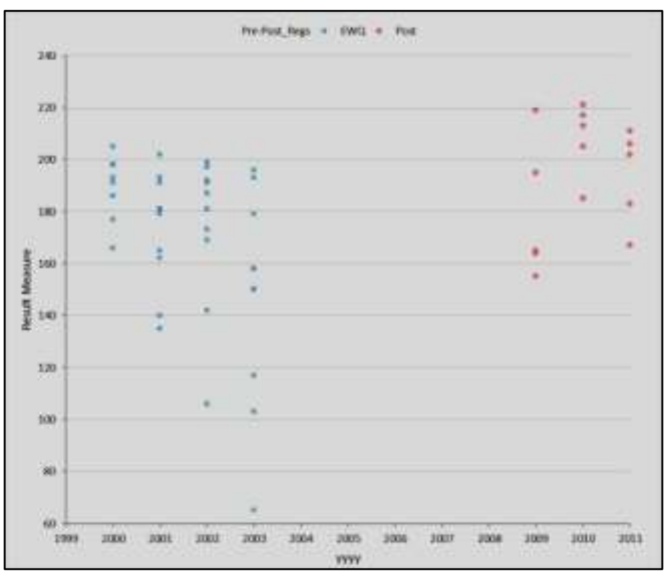
Chapter 6: 1540 BCP Lockatong Creek, NJ

Specific Conductance µmho/cm

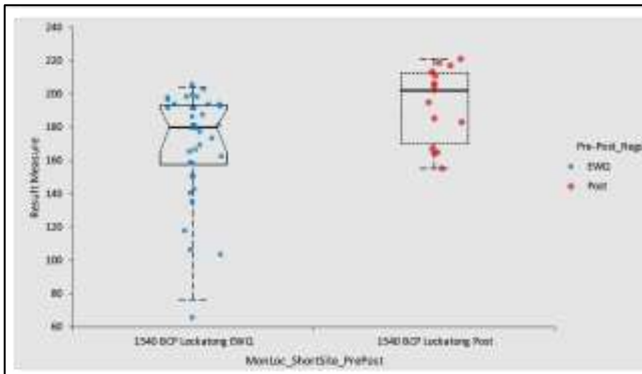
Existing Water Quality (Table 2U):

Median 180 µmho/cm
Lower 95% Confidence Interval 165 µmho/cm
Upper 95% Confidence Interval 191 µmho/cm
Defined in regulations as a flow-related parameter



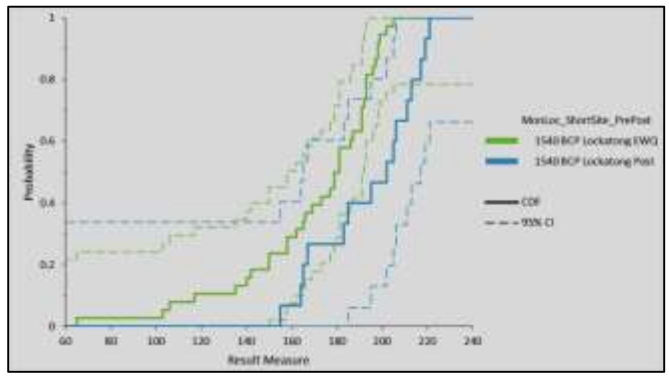


Water quality degradation is evident. Specific conductance rose above the EWQ upper 95% confidence interval between the EWQ and post-EWQ periods. In both data sets, specific conductance is inversely related to flow.



N 53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	65	157	180	193	205	36
1540 BCP Lockatong Post	155	170	202	213	221	43



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	512.1	13.48
1540 BCP Lockatong Post	15	1297.4	86.49

H statistic	7.59
X^2 approximation	7.59
DF	1
p-value	0.0059 [1]

H0: $\theta_1 = \theta_2 = \theta\ldots$
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.

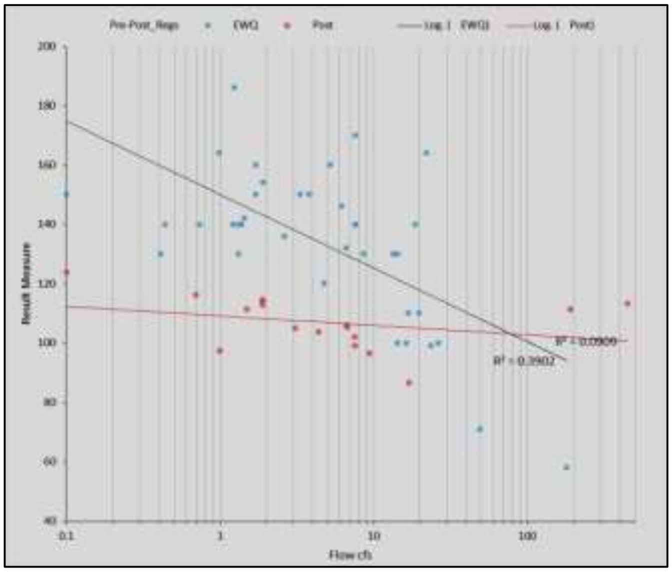
Note that flow is plotted on a logarithmic scale. The rise in specific conductance may be attributable to the concurrent rise in chloride concentrations. No new dischargers are present in the watershed. Median specific conductance rose from 180 to 202 µmho/cm, a 12% increase.

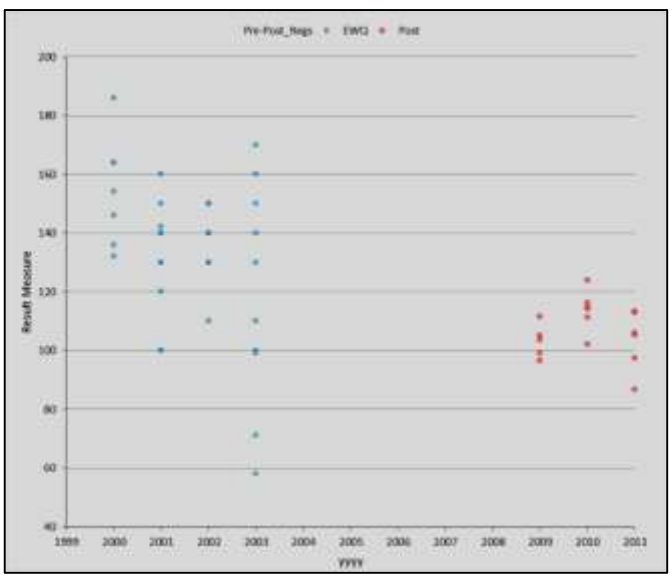
Chapter 6: 1540 BCP Lockatong Creek, NJ

Total Dissolved Solids (TDS) mg/l

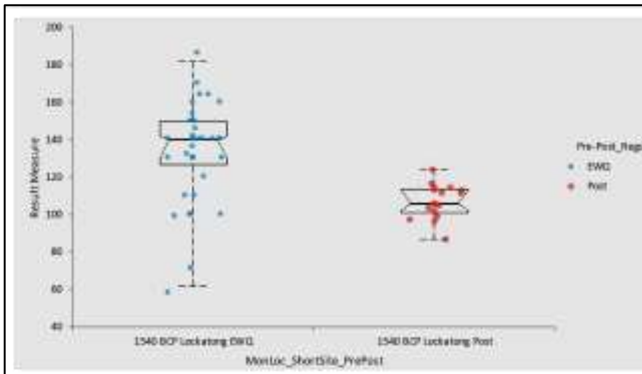
Existing Water Quality (Table 2U):

Median 140 mg/l
Lower 95% Confidence Interval 130 mg/l
Upper 95% Confidence Interval 142 mg/l
Defined in regulations as a flow-related parameter

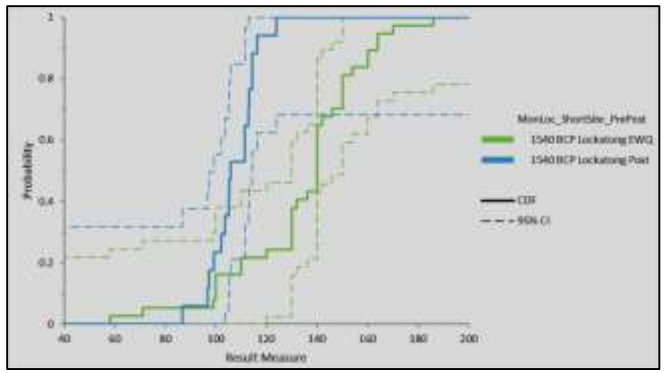




No water quality degradation is evident. TDS apparently declined between the EWQ and post-EWQ periods. However, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty in conclusions.



	N	54				
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	58	127	140	150	186	23
1540 BCP Lockatong Post	87	101	106	114	124	13



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	37	1197.6	32.37
1540 BCP Lockatong Post	17	2606.5	153.32

H statistic	15.44
X^2 approximation	15.44
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.

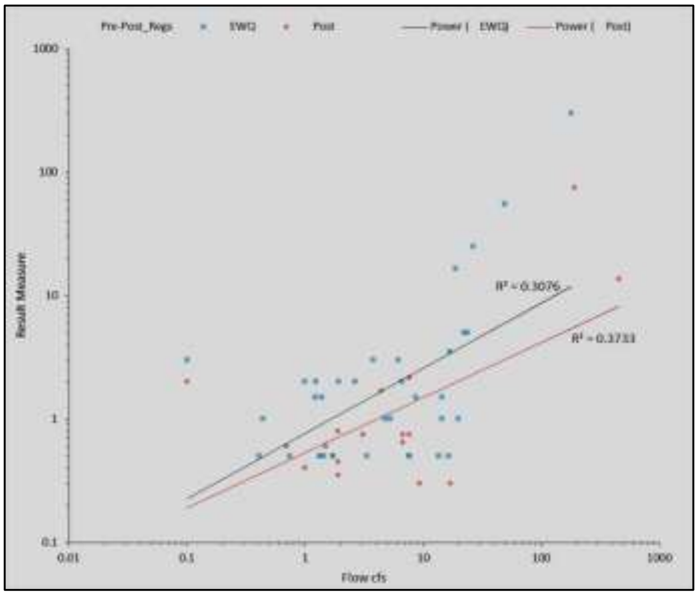
TDS is inversely and strongly related to flow in the EWQ data set, but unrelated to flow in the post-EWQ data set. Post-EWQ TDS varied very little because both high and low flow conditions were not well-represented – there were too few post-EWQ samples taken to cover the flow regime (n=17). Post-EWQ median TDS was well below the EWQ 95% lower confidence interval. Detection limit differences did not influence the data, and there were no non-detect results at any time. Note that flows are plotted on a logarithmic scale.

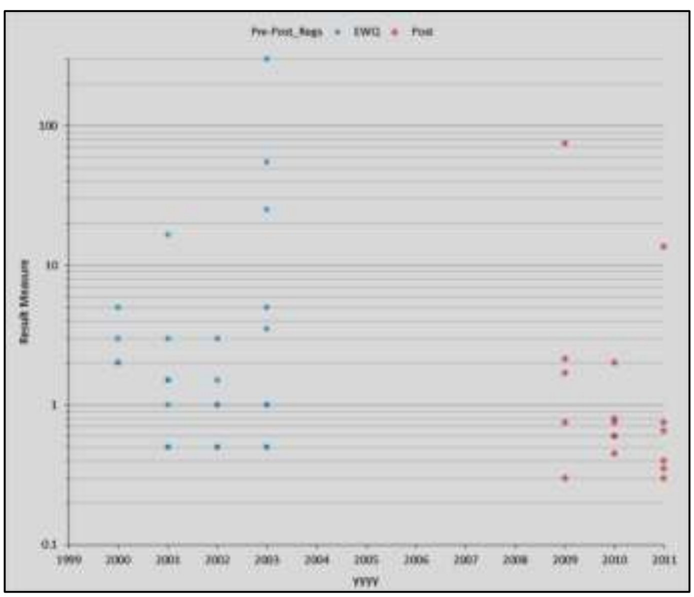
Chapter 6: 1540 BCP Lockatong Creek, NJ

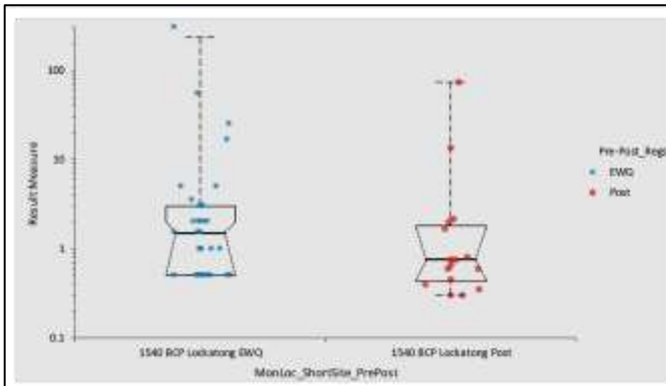
Total Suspended Solids (TSS) mg/l

Existing Water Quality (Table 2U):

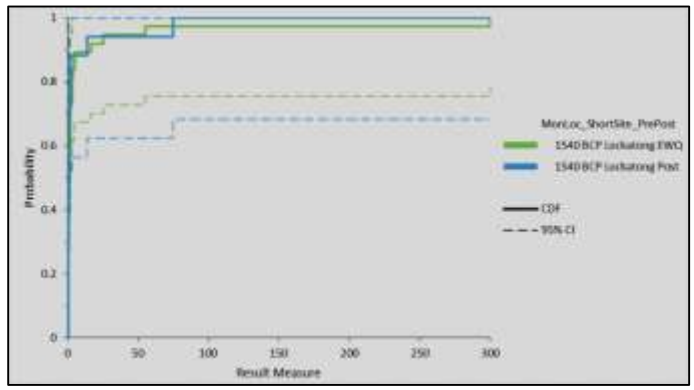
Median 1.0 mg/l
Lower 95% Confidence Interval 0.5 mg/l
Upper 95% Confidence Interval 2.0 mg/l
Defined in regulations as a flow-related parameter







N	54					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.50	0.50	1.50	3.00	300.00	2.50
1540 BCP Lockatong Post	0.30	0.43	0.75	1.80	74.55	1.37



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	37	166.5	4.50
1540 BCP Lockatong Post	17	362.5	21.32

H statistic	2.17
X^2 approximation	2.17
DF	1
p-value	0.1405 [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.

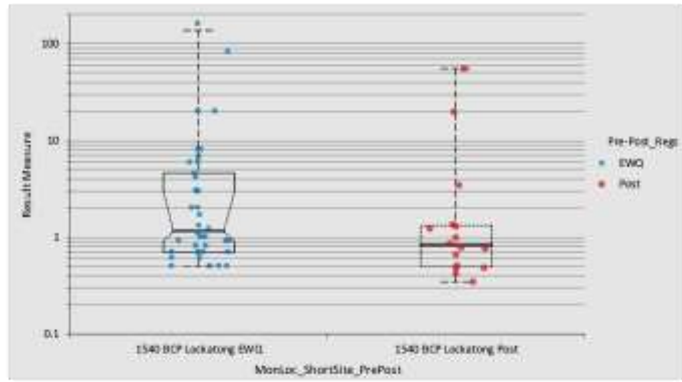
No water quality degradation is evident. TSS did not measurably change between the EWQ and post-EWQ periods. TSS is positively related to flow in both data sets. Post-EWQ median TSS was within the EWQ 95% confidence intervals. Note that both flow and concentration are plotted on a logarithmic scale.

Chapter 6: 1540 BCP Lockatong Creek, NJ

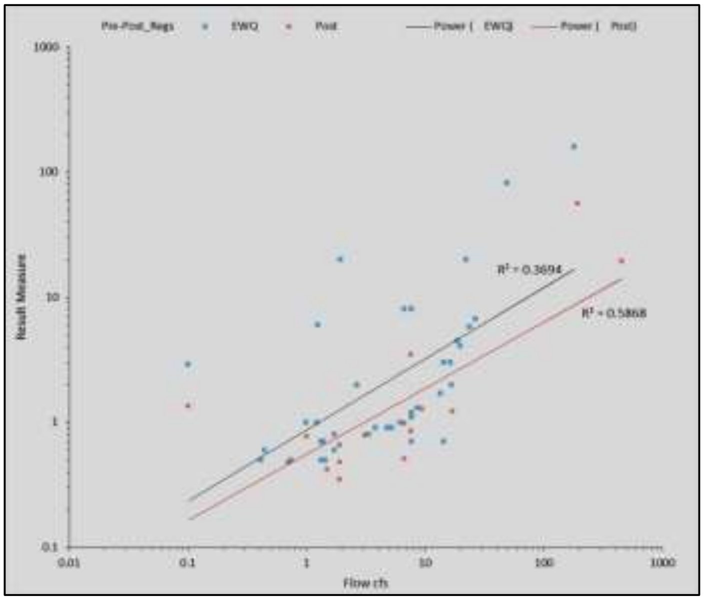
Turbidity NTU

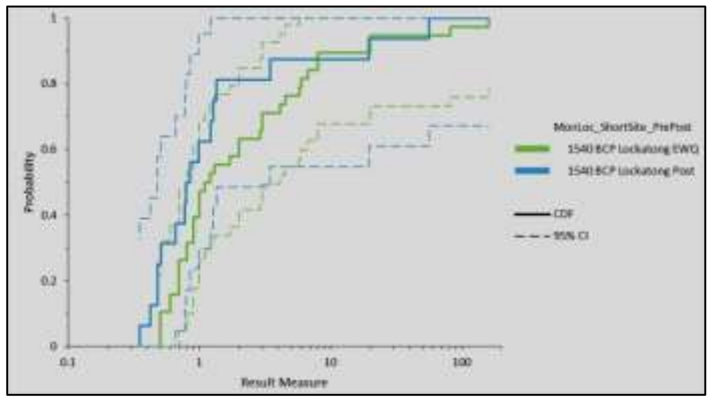
Existing Water Quality (Table 2U):

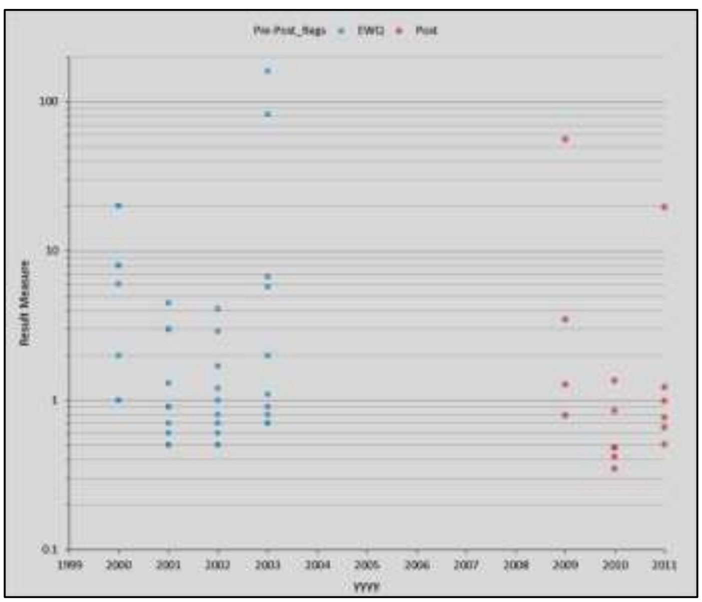
Median 1.2 NTU
Lower 95% Confidence Interval 0.8 NTU
Upper 95% Confidence Interval 3.0 NTU
Defined in regulations as a flow-related parameter



N	54					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	0.5	0.7	1.2	4.6	160.0	3.9
1540 BCP Lockatong Post	0.4	0.5	0.8	1.3	56.1	0.8







Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	208.4	5.49
1540 BCP Lockatong Post	16	495.1	30.94

H statistic	2.85
X^2 approximation	2.85
DF	1
p-value	0.0916 [1]

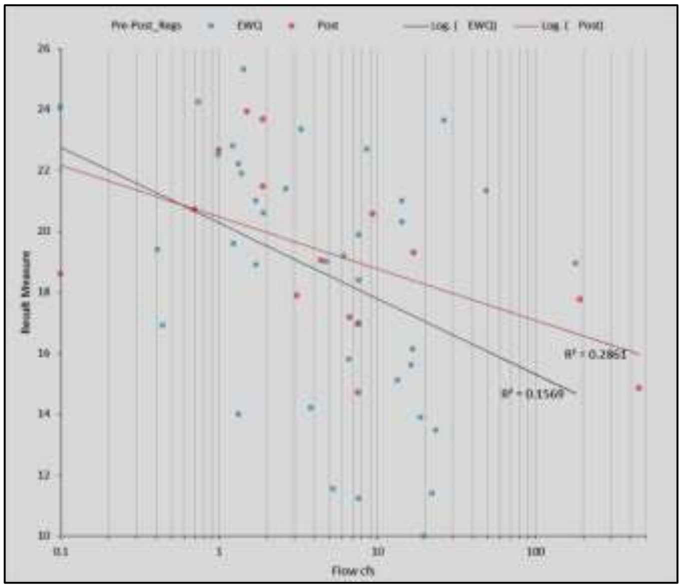
H0: $\theta_1 = \theta_2 = \theta_{...}$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

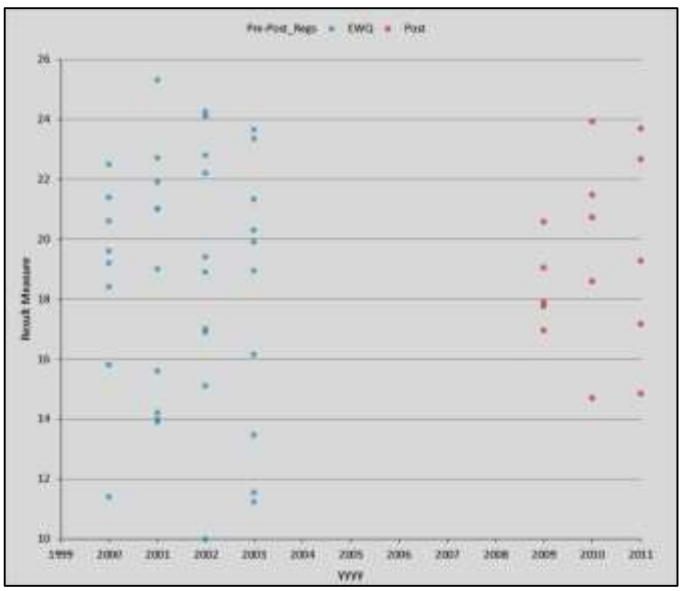
No water quality degradation is evident. Turbidity did not measurably change between the EWQ and post-EWQ periods. The post-EWQ median turbidity fell within the EWQ 95% confidence intervals of the median. In both data sets, the turbidity vs. flow relationship is positive. Note that both concentration and flow is represented on logarithmic scales in all charts.

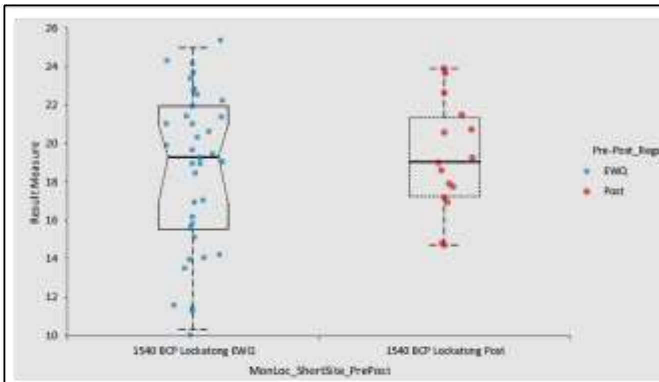
Chapter 6: 1540 BCP Lockatong Creek, NJ

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules

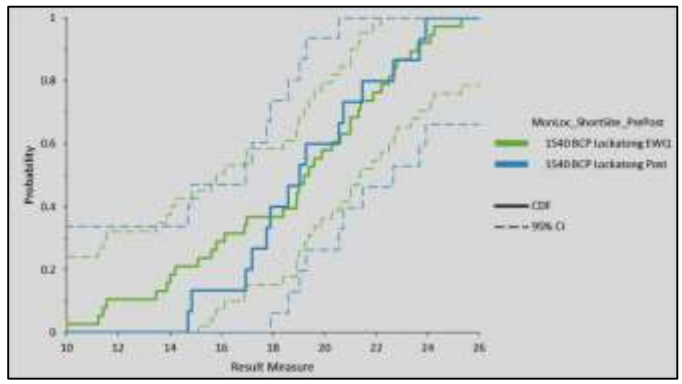






N | 53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1540 BCP Lockatong EWQ	10.0	15.6	19.3	21.9	25.3	6.4
1540 BCP Lockatong Post	14.7	17.3	19.0	21.4	23.9	4.1



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1540 BCP Lockatong EWQ	38	5.2	0.14
1540 BCP Lockatong Post	15	13.1	0.87

H statistic	0.08
X^2 approximation	0.08
DF	1
p-value	0.7822 [1]

H0: $\theta_1 = \theta_2 = \theta \ldots$
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. Water temperature did not measurably change between the EWQ and post-EWQ periods. Water temperature is inversely but weakly related to flow in both data sets. Note that flows are plotted on a logarithmic scale.