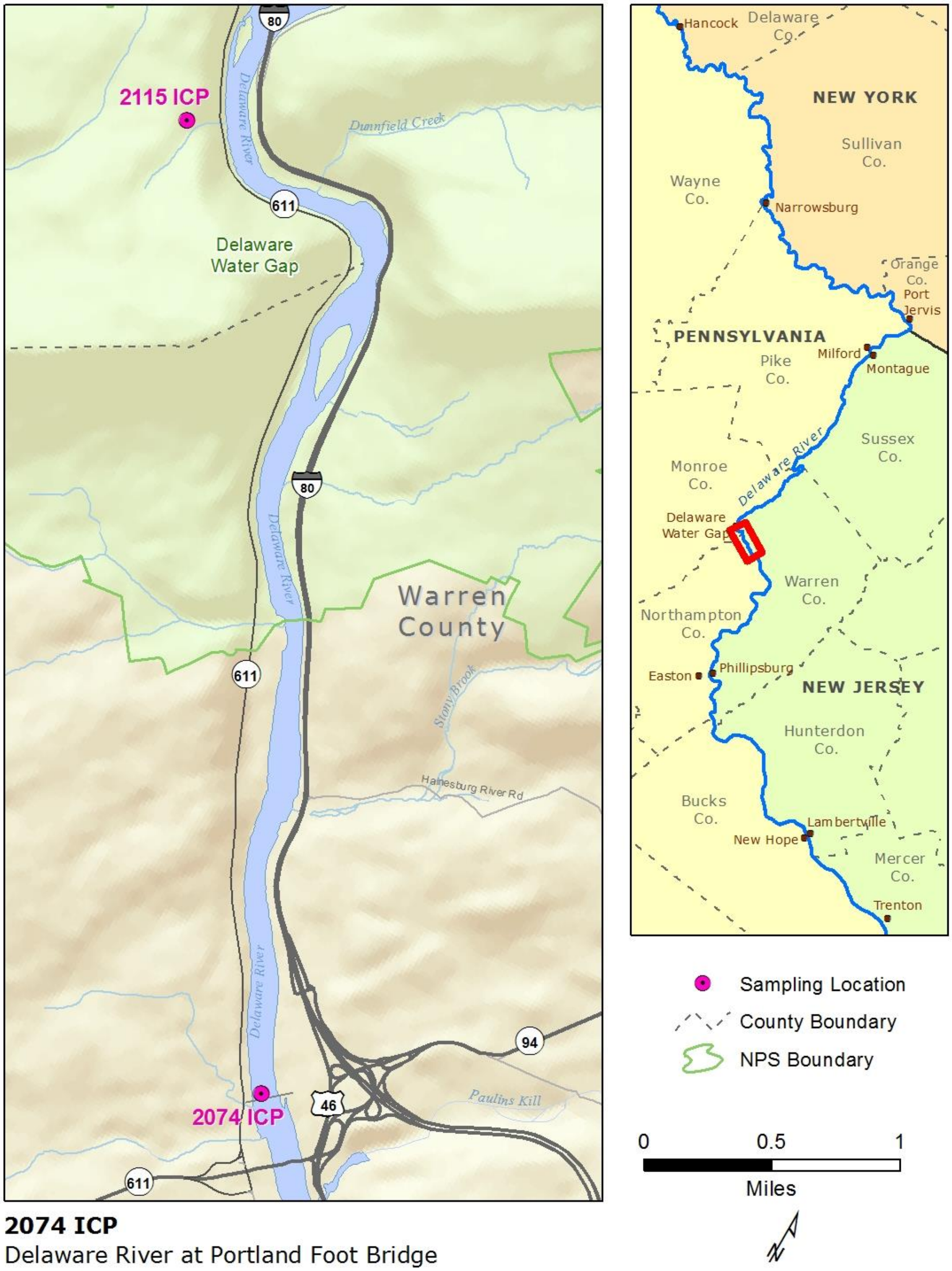
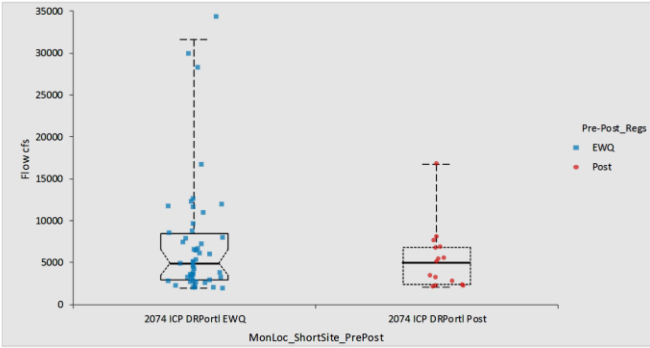
## Chapter 24:  2074 ICP Delaware River at Portland




**2074 ICP**
Delaware River at Portland Foot Bridge

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




N | 65

| Flow cfs by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 1896 | 2920 | 4907 | 8463 | 34245 | 5543 |
| 2074 ICP DRPortl Post | 2039 | 2409 | 5015 | 6813 | 16715 | 4404 |

Flow was roughly the same between the EWQ and post-EWQ periods, with a median difference of about 100 cfs. Too few samples were collected in the post-EWQ period (n=15). Considering the under-representation of the flow regime in post-EWQ data, it is possible that water quality differences can falsely be interpreted as significant when they really are not. This point is considered in each analysis to follow.

Kruskal-Wallis test

| Flow cfs by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 40.5 | 0.81 |
| 2074 ICP DRPortl Post | 15 | 135.0 | 9.00 |

| | |
|---|---|
| H statistic | 0.49 |
| $X^2$ approximation | 0.49 |
| DF | 1 |
| p-value | 0.4835[1] |

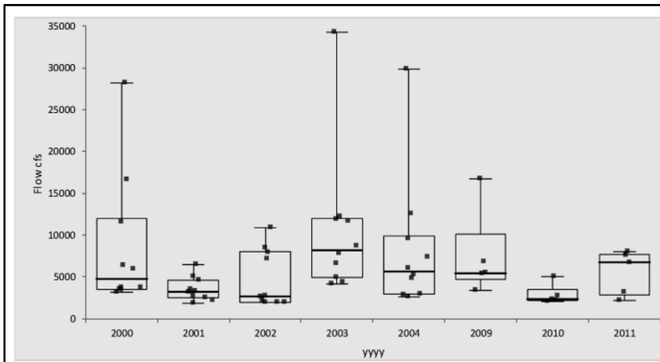
H0: $\theta_1 = \theta_2 = \theta$...
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

Upstream ICP: Del. River at Kittatinny Visitor Center 2115 ICP
Downstream ICP: Del. River at Belvidere 1978 ICP

Tributary BCP Watersheds in Upstream Reach:

Slateford Creek, PA – 2095 BCP (new, see Appendix A)
Dunnfield Creek, NJ – 2114 BCP (Middle Delaware)

Both are small tributaries that do not have a major effect on the Delaware River.




N | 65

| Flow cfs by yyyy | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2000 | 3173 | 3524 | 4819 | 11993 | 28181 | 8469 |
| 2001 | 1896 | 2526 | 3207 | 4606 | 6534 | 2080 |
| 2002 | 1944 | 2011 | 2654 | 7977 | 10861 | 5966 |
| 2003 | 4136 | 4916 | 8232 | 11968 | 34245 | 7052 |
| 2004 | 2660 | 2920 | 5679 | 9852 | 29907 | 6932 |
| 2009 | 3416 | 4696 | 5446 | 10127 | 16715 | 5431 |
| 2010 | 2039 | 2168 | 2342 | 3502 | 5015 | 1335 |
| 2011 | 2190 | 2830 | 6714 | 7724 | 7999 | 4894 |

Annual May to September flow statistics associated with water quality measurements are plotted above. These are flow measurements or sometimes estimates associated with the time of each water quality sample. Mean annual flow at this location is about 7,410 cfs; harmonic mean flow is about 6,850 cfs; and average May to September flow is about 5,300 cfs, which is most typical of summer flow conditions. Though a wide range of flows were sampled by DRBC, these data are most representative of summer flow conditions. Flows corresponding to each water quality sample were taken directly from instantaneous water discharge data from the USGS gage No. 01446500 on the Delaware River at Belvidere then estimated at Portland by applying a drainage area weighting factor.

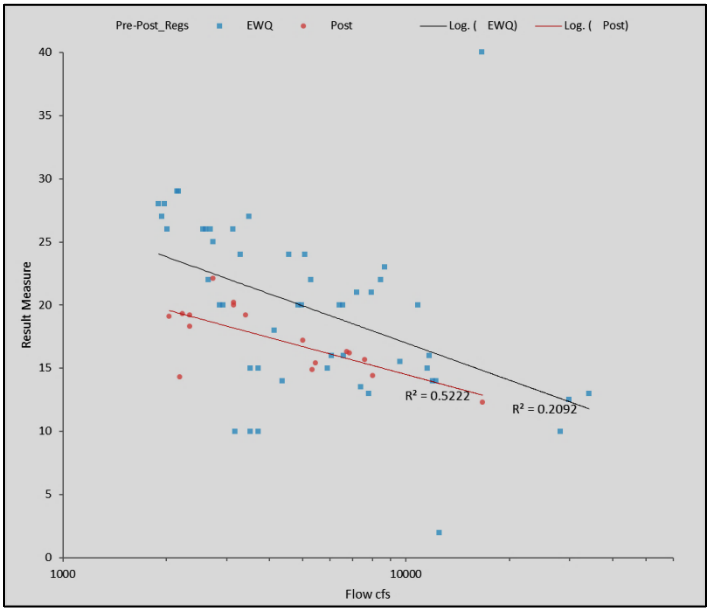
USGS and NJDEP have also monitored water quality monitoring at this site. They sample once per quarter every year, whereas DRBC samples twice per month from May through September for selected multi-year study periods. DRBC uses the NJDEP/USGS data to check its own results and to supplement the long-term monitoring of NJDEP/USGS with more intensive sampling during selected study periods.

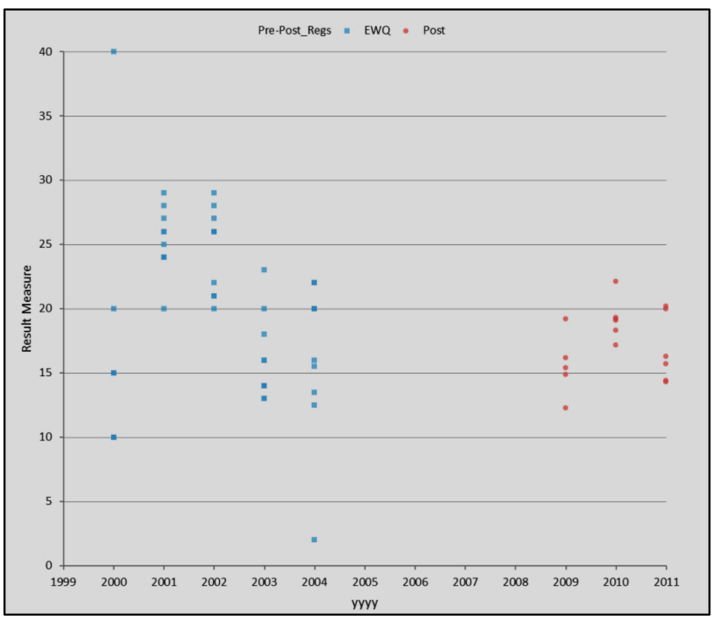
Chapter 24: 2074 ICP Delaware River at Portland

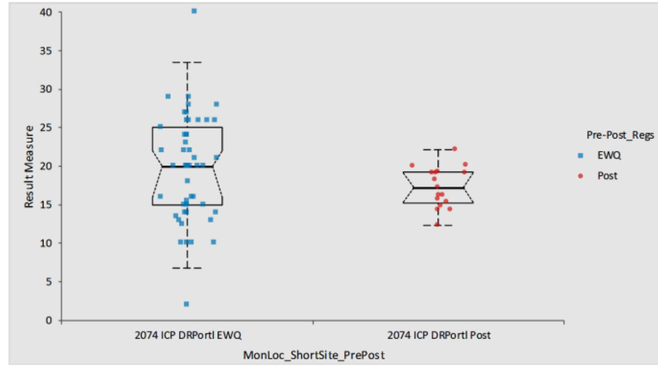
Alkalinity as CaCO3, Total mg/l

Existing Water Quality (Table 2C):

Median 20 mg/l
Lower 95% Confidence Interval 16 mg/l
Upper 95% Confidence Interval 22 mg/l
Defined in regulations as a flow-related parameter

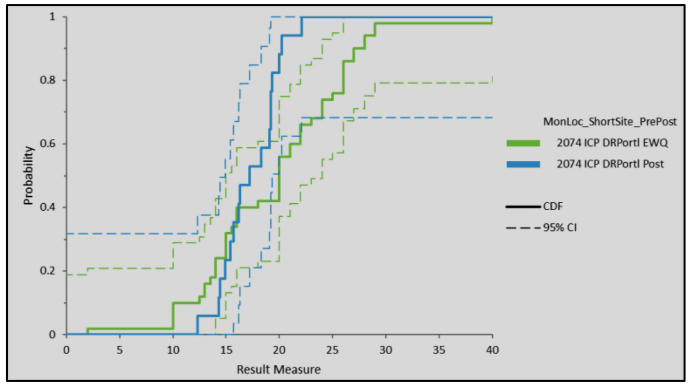



| N | 67 |
|---|---|

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 2 | 15 | 20 | 25 | 40 | 10 |
| 2074 ICP DRPortl Post | 12 | 15 | 17 | 19 | 22 | 4 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 202.0 | 4.04 |
| 2074 ICP DRPortl Post | 17 | 594.1 | 34.95 |

| | |
|---|---|
| H statistic | 2.10 |
| $X^2$ approximation | 2.10 |
| DF | 1 |
| p-value | 0.1470[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.

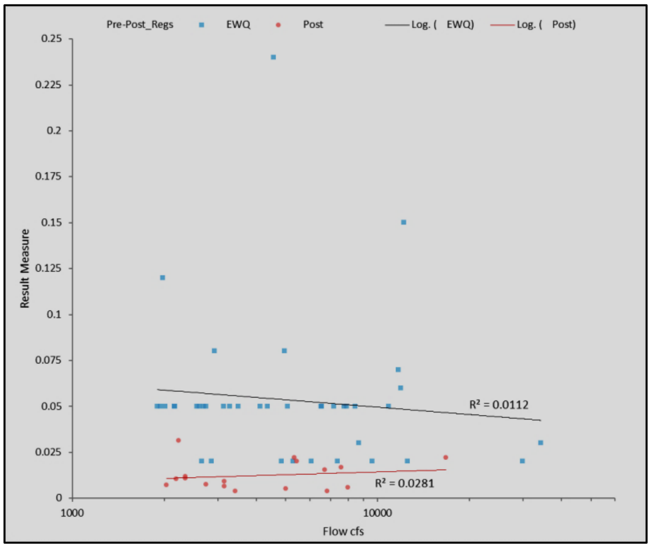
No water quality degradation is evident here. Alkalinity apparently did not measurably change between the EWQ and post-EWQ periods. However, sources of analytical uncertainty include potential laboratory artifacts, insufficient post-EWQ sampling frequency (n=17), and possible under-representation of flow conditions. 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 scale. NJDEP/USGS data were comparable with DRBC results.

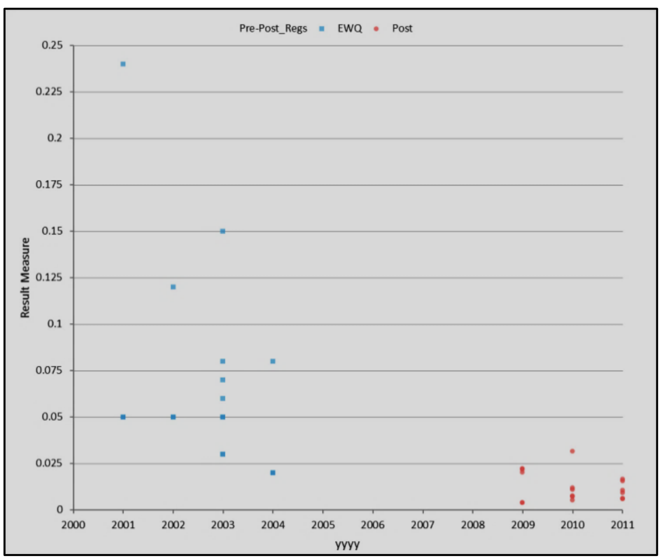
Chapter 24: 2074 ICP Delaware River at Portland

Ammonia Nitrogen as N, Total mg/l

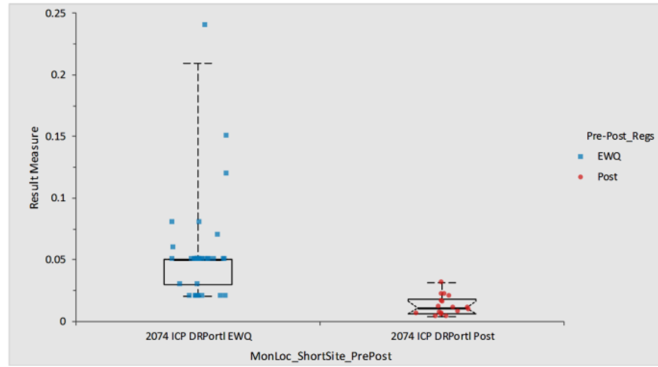
Existing Water Quality (Table 2C):

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



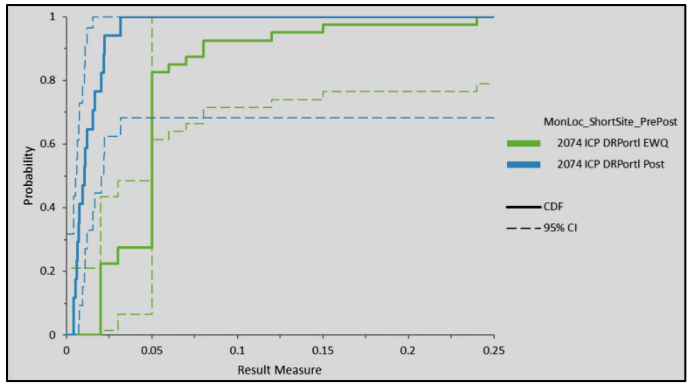




No water quality degradation is evident here. Ammonia concentrations apparently declined; or at least we now know what ammonia concentrations are at Portland. Sources of analytical uncertainty include potential laboratory artifacts, detection limit differences, and insufficient post-EWQ sampling frequency (n=17).




N 57

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.020 | 0.030 | 0.050 | 0.050 | 0.240 | 0.020 |
| 2074 ICP DRPortl Post | 0.004 | 0.006 | 0.011 | 0.018 | 0.032 | 0.012 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 40 | 2280.1 | 57.00 |
| 2074 ICP DRPortl Post | 17 | 5364.9 | 315.58 |

| | |
|---|---|
| H statistic | 29.56 |
| X² approximation | 29.56 |
| 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.

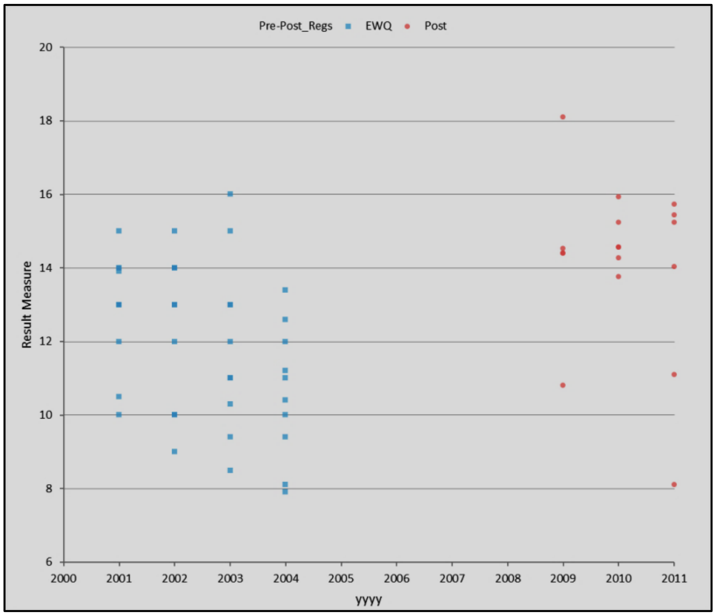
Post-EWQ median ammonia concentration was below the EWQ lower 95% confidence interval. Ammonia is unrelated to flow in both data sets. EWQ data contained 33/40 undetected results that interfered with calculation of the median (thus EWQ <0.05 mg/l). Under 2009-2011 lower detection levels there were 3/17 undetected results and it was possible to see the true median. Perhaps some water quality improvement took place, as post-EWQ data contained concentrations no greater than 0.032 mg/l. NJDEP/USGS data were comparable to DRBC results, with high non-detect frequency and similar concentrations.

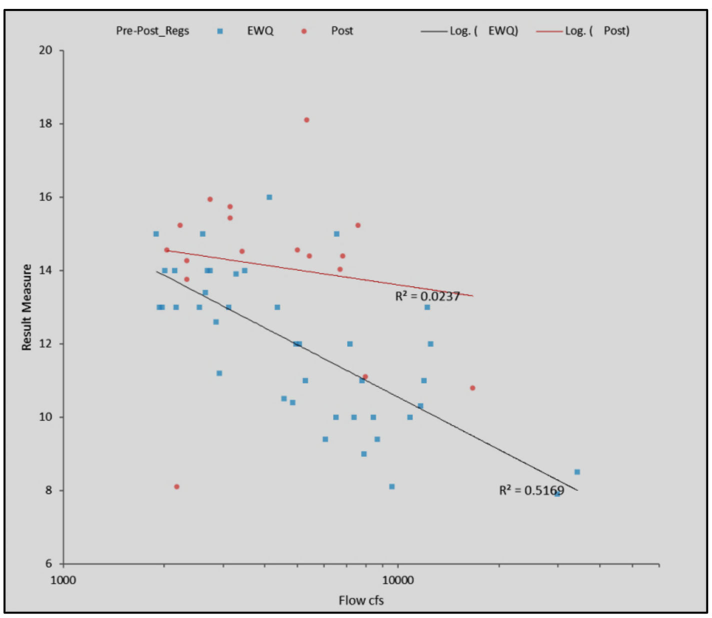
Chapter 24: 2074 ICP Delaware River at Portland

Chloride, Total mg/l

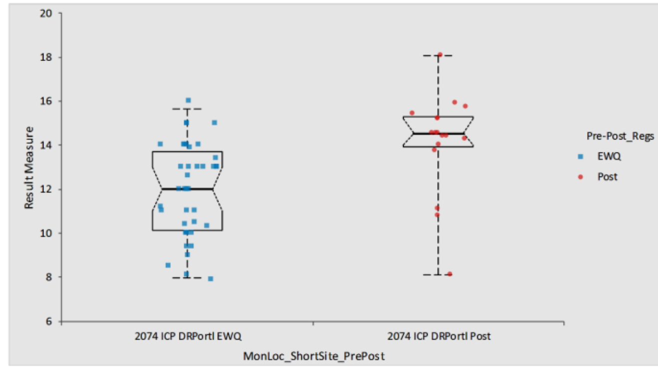
Existing Water Quality (Table 2C):

Median 12 mg/l
Lower 95% Confidence Interval 11 mg/l
Upper 95% Confidence Interval 13 mg/l
Defined in regulations as a flow-related parameter

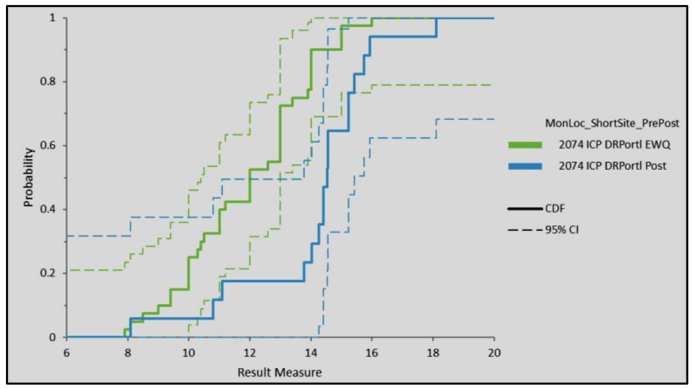



Water quality degradation is evident here. Median chloride concentrations apparently rose by 3 mg/l between the two periods.




| N | 57 | | | | | |
|---|---|---|---|---|---|---|
| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
| 2074 ICP DRPortl EWQ | 8 | 10 | 12 | 14 | 16 | 4 |
| 2074 ICP DRPortl Post | 8 | 14 | 15 | 15 | 18 | 1 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 40 | 1076.4 | 26.91 |
| 2074 ICP DRPortl Post | 17 | 2532.7 | 148.98 |

| | |
|---|---|
| H statistic | 13.15 |
| $X^2$ approximation | 13.15 |
| DF | 1 |
| p-value | 0.0003 [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.

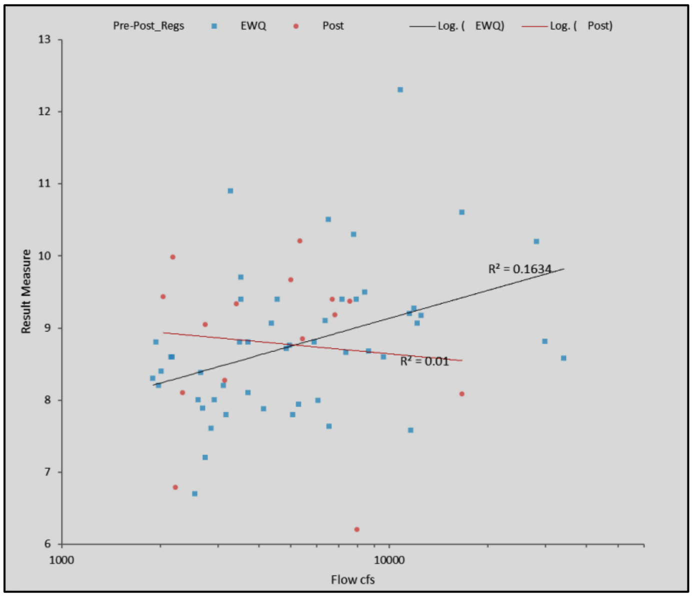
Sources of analytical uncertainty include potential laboratory artifacts, insufficient post-EWQ sampling frequency (n=17), and under-representation of flow conditions. Post-EWQ median concentration rose above the EWQ upper 95% confidence interval. Chloride concentration is inversely related to flow in EWQ data, but unrelated in post-EWQ data. NJDEP and USGS data were similar to DRBC results; displayed a slight increase in chloride concentrations (sampling dissolved rather than DRBC's total chlorides).

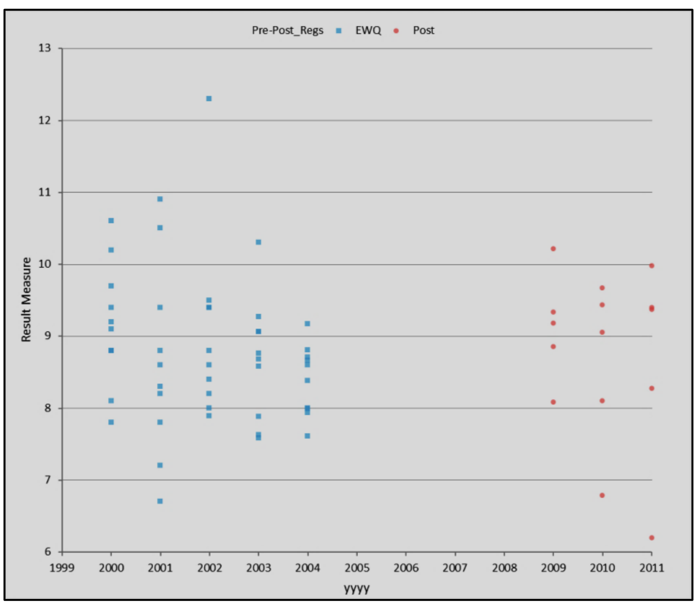
Chapter 24: 2074 ICP Delaware River at Portland

Dissolved Oxygen (DO) mg/l

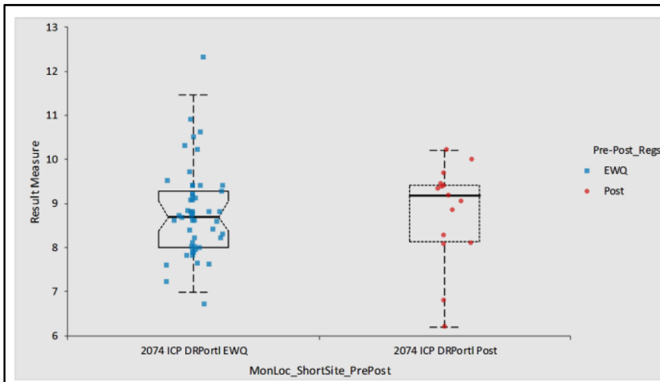
Existing Water Quality (Table 2C):

Median 8.70 mg/l
Lower 95% Confidence Interval 8.38 mg/l
Upper 95% Confidence Interval 9.06 mg/l

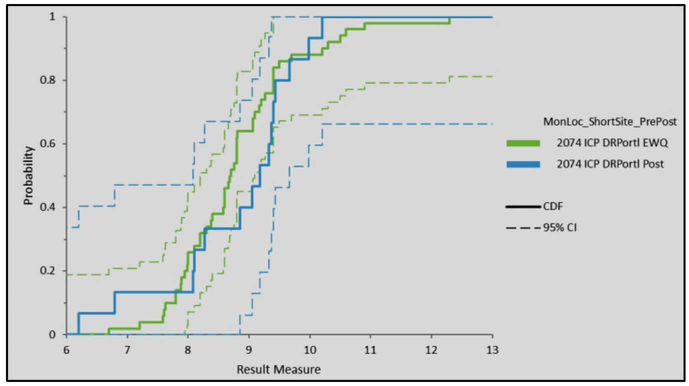



No water quality degradation is evident here. No measurable change took place between the EWQ and Post-EWQ periods. Sources of analytical uncertainty include insufficient post-EWQ sampling frequency (n=15) and under-representation of flow conditions.




| N | 65 | | | | | |
|---|---|---|---|---|---|---|
| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
| 2074 ICP DRPortl EWQ | 6.70 | 8.00 | 8.70 | 9.28 | 12.30 | 1.28 |
| 2074 ICP DRPortl Post | 6.20 | 8.13 | 9.18 | 9.43 | 10.21 | 1.30 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 68.4 | 1.37 |
| 2074 ICP DRPortl Post | 15 | 228.2 | 15.21 |

| | |
|---|---|
| H statistic | 0.83 |
| $X^2$ approximation | 0.83 |
| DF | 1 |
| p-value | 0.3622 [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.

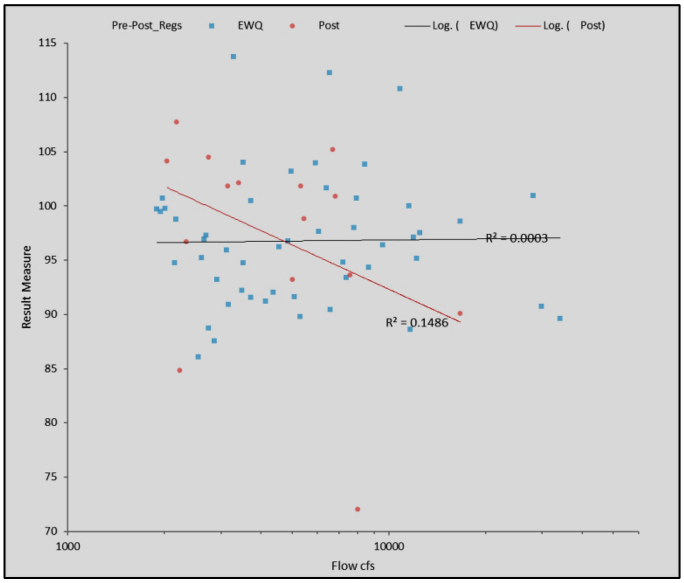
Post-EWQ median DO concentration was above the upper EWQ 95% confidence interval, but the increase was not significant due to an insufficient number of post-EWQ samples (n=15). DO concentration is unrelated to flow in both data sets. The low reading below 7 mg/l in 2010 was probably a probe malfunction. The low reading near 6 mg/l in 2011 could also have been a probe malfunction or may have been real, as other meter readings that day were within expected ranges. NJDEP/USGS data were comparable to DRBC results.

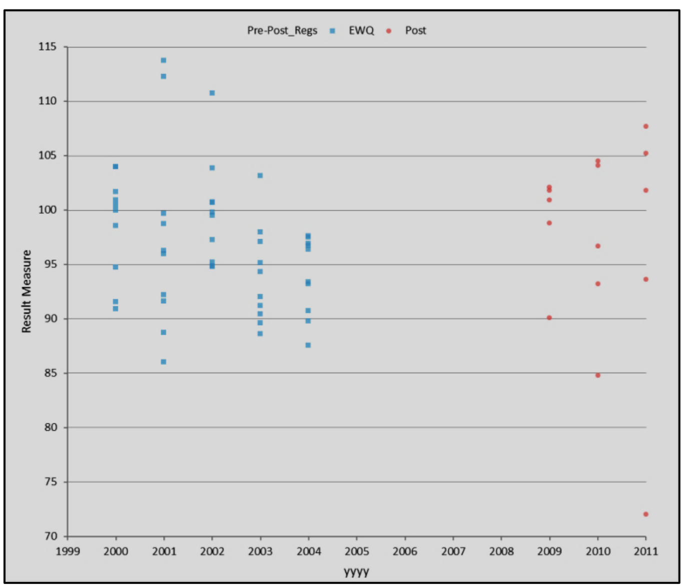
Chapter 24: 2074 ICP Delaware River at Portland

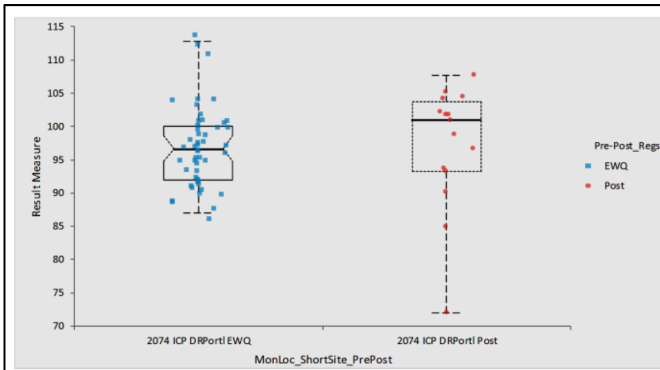
Dissolved Oxygen Saturation %

Existing Water Quality (Table 2C):

Median 97%
Lower 95% Confidence Interval 95%
Upper 95% Confidence Interval 99%

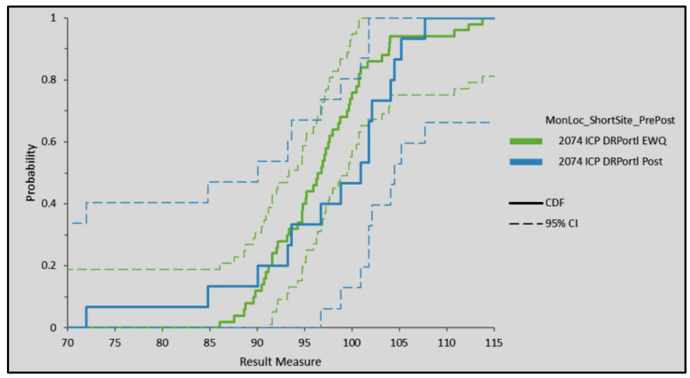



| N | 65 |
|---|---|

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 86 | 92 | 97 | 100 | 114 | 8 |
| 2074 ICP DRPortl Post | 72 | 93 | 101 | 104 | 108 | 11 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 124.8 | 2.50 |
| 2074 ICP DRPortl Post | 15 | 416.1 | 27.74 |

| | |
|---|---|
| H statistic | 1.51 |
| $X^2$ approximation | 1.51 |
| DF | 1 |
| p-value | 0.2187[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.

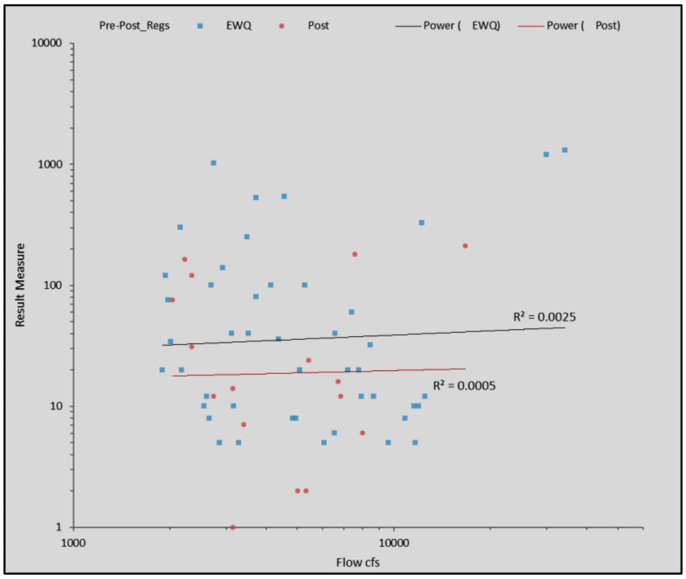
No water quality degradation is evident here. Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. Sources of analytical uncertainty include insufficient post-EWQ sampling frequency (n=15) and under-representation of flow conditions. Post-EWQ median DO saturation was above the upper EWQ 95% confidence interval, but the difference was not significant due to an insufficient number of post-EWQ samples (n=15). There was a low saturation values of 72% measured in July 2011, which was possibly a probe malfunction. Biweekly instead of monthly sampling is recommended for this location. NJDEP/USGS data were similar to DRBC results.

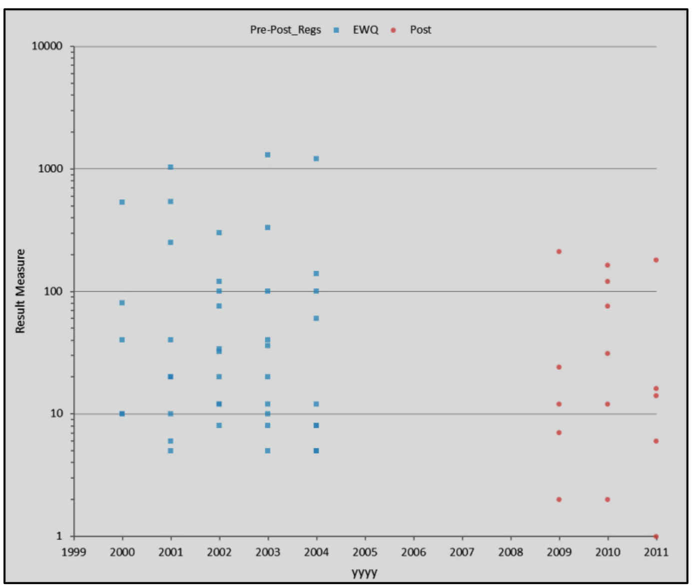
Chapter 24: 2074 ICP Delaware River at Portland

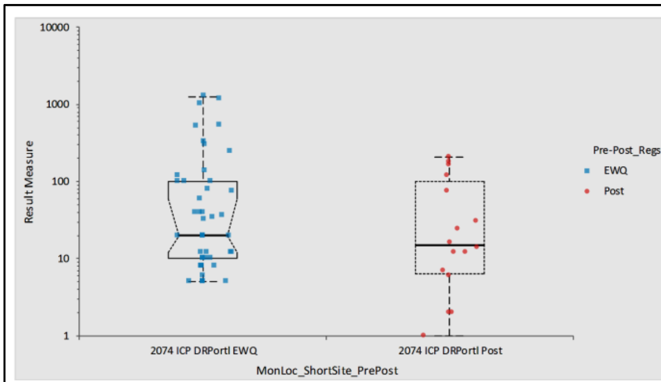
Enterococcus colonies/100 ml

Existing Water Quality (Table 2C):

Median 20/100 ml
Lower 95% Confidence Interval 12/100 ml
Upper 95% Confidence Interval 60/100 ml

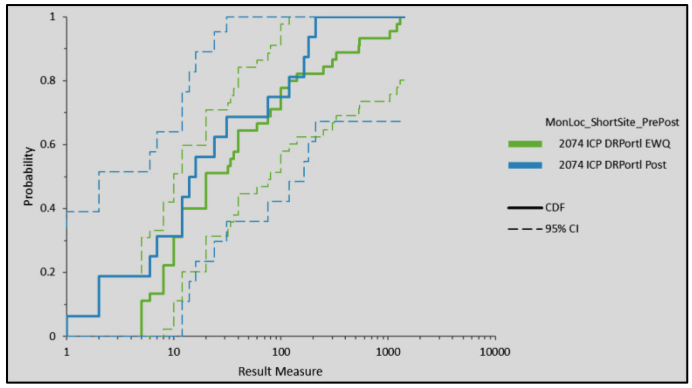



N 61

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 5 | 10 | 20 | 100 | 1300 | 90 |
| 2074 ICP DRPortl Post | 1 | 6 | 15 | 102 | 210 | 95 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 45 | 73.5 | 1.63 |
| 2074 ICP DRPortl Post | 16 | 206.6 | 12.92 |

| | |
|---|---|
| H statistic | 0.89 |
| X² approximation | 0.89 |
| DF | 1 |
| p-value | 0.3451 [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.

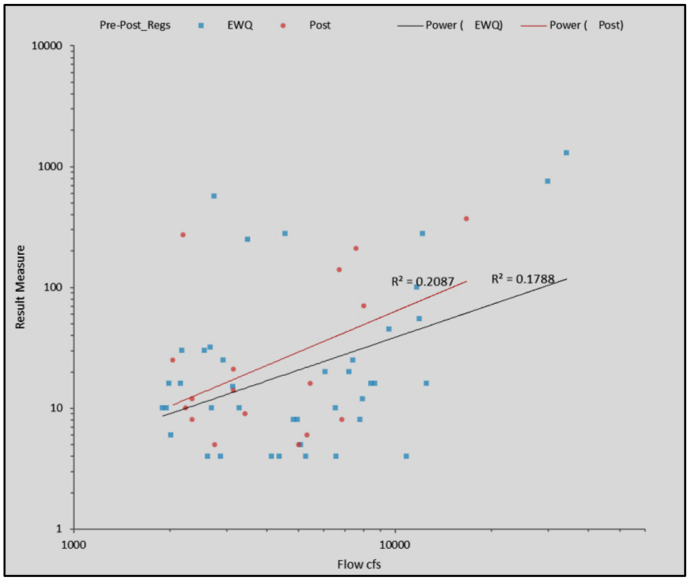
No water quality degradation is evident here. Enterococci apparently did not measurably change between the EWQ and Post-EWQ periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). Biweekly instead of monthly sampling is recommended. Enterococcus concentrations are unrelated to flow in both data sets. Post-EWQ median enterococcus concentrations fell slightly but remained within the EWQ 95% confidence intervals. NJDEP/USGS data were slightly higher than DRBC results, but displayed a similar slight decline in concentration.

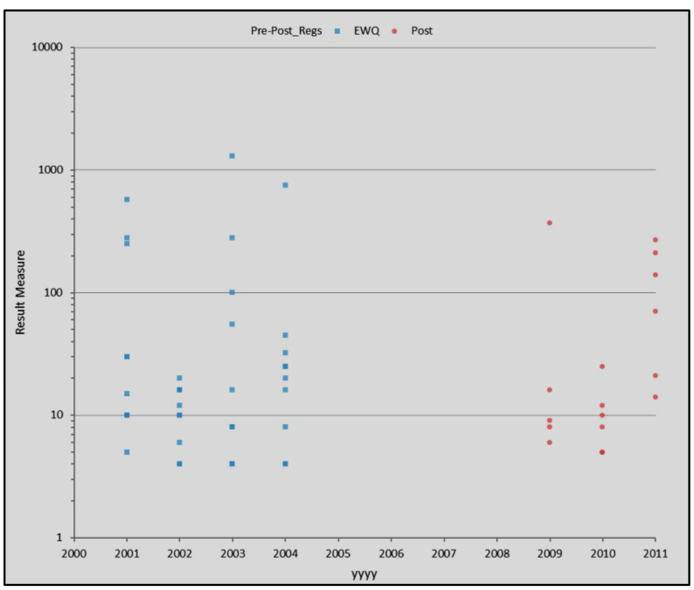
Chapter 24: 2074 ICP Delaware River at Portland

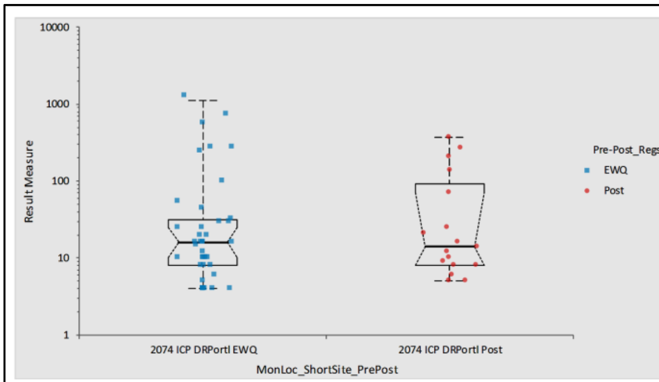
Escherichia coli colonies/100 ml

Existing Water Quality (Table 2C):

Median 16/100 ml
Lower 95% Confidence Interval 8/100 ml
Upper 95% Confidence Interval 25/100 ml
This was defined in rules as a flow-related parameter

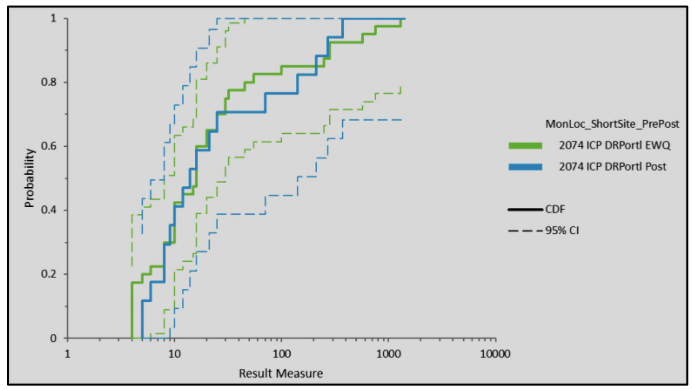



N 57

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 4 | 8 | 16 | 31 | 1300 | 23 |
| 2074 ICP DRPortl Post | 5 | 8 | 14 | 93 | 370 | 85 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 40 | 4.9 | 0.12 |
| 2074 ICP DRPortl Post | 17 | 11.5 | 0.68 |

| | |
|---|---|
| H statistic | 0.06 |
| $X^2$ approximation | 0.06 |
| DF | 1 |
| p-value | 0.8066 [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.

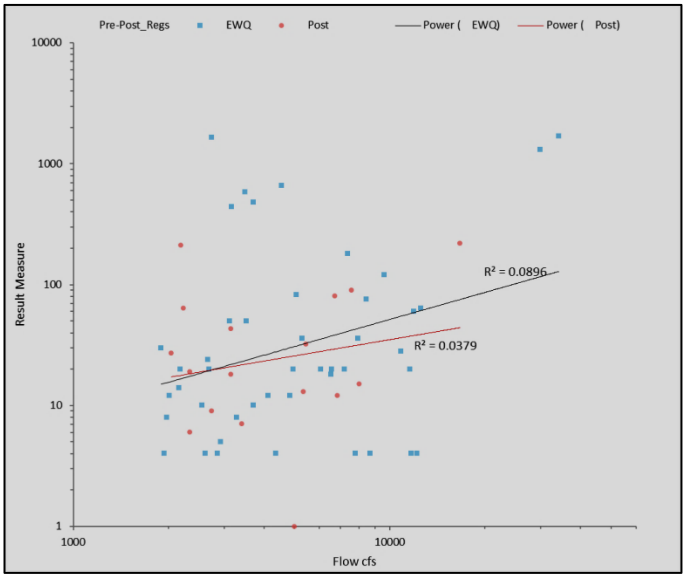
No water quality degradation is evident here. E. coli concentrations apparently did not measurably change between the two periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). Post-EWQ median E. coli fell within the EWQ 95% confidence intervals. Biweekly instead of monthly sampling is recommended. E. coli concentrations are weakly related to flow in both data sets. NJDEP/USGS data were similar to DRBC results at this location.

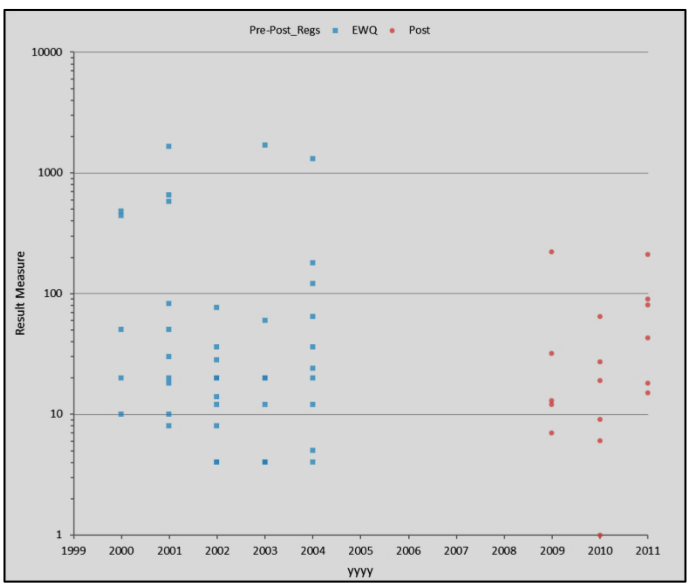
Chapter 24: 2074 ICP Delaware River at Portland

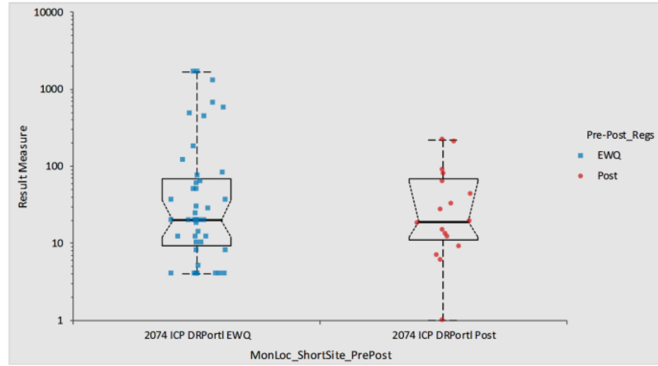
Fecal coliform colonies/100 ml

Existing Water Quality (Table 2C):

Median 20/100 ml
Lower 95% Confidence Interval 12/100 ml
Upper 95% Confidence Interval 36/100 ml
*Erroneously defined in regulations as a flow-related

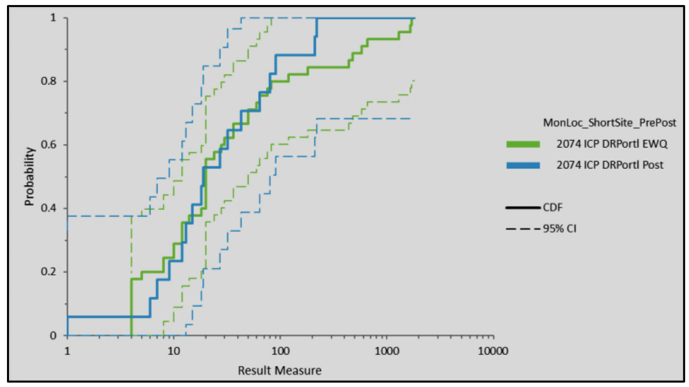



N 62

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 4 | 9 | 20 | 68 | 1700 | 59 |
| 2074 ICP DRPortl Post | 1 | 11 | 19 | 69 | 220 | 58 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 45 | 0.8 | 0.02 |
| 2074 ICP DRPortl Post | 17 | 2.1 | 0.12 |

| | |
|---|---|
| H statistic | 0.01 |
| X² approximation | 0.01 |
| DF | 1 |
| p-value | 0.9244 [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.

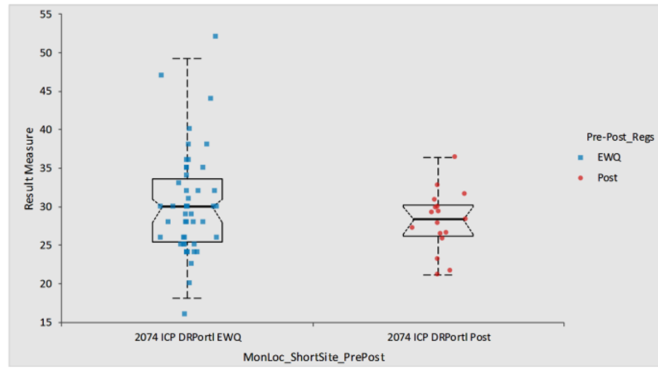
No water quality degradation is evident here. Fecal coliform concentrations apparently did not measurably change between the EWQ and post-EWQ periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). There were fewer high results in the post-EWQ data set, but insufficient data to indicate a significant change. Fecal coliform concentrations are unrelated to flow in both data sets. Biweekly instead of monthly sampling is recommended. NJDEP/USGS data were similar to DRBC results, but possessed a high frequency of undetected results.

Chapter 24: 2074 ICP Delaware River at Portland

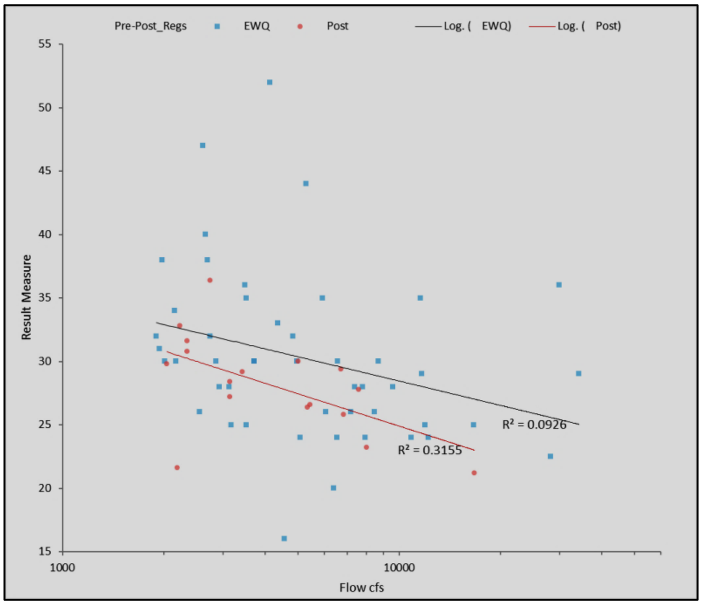
Hardness as CaCO3, Total mg/l

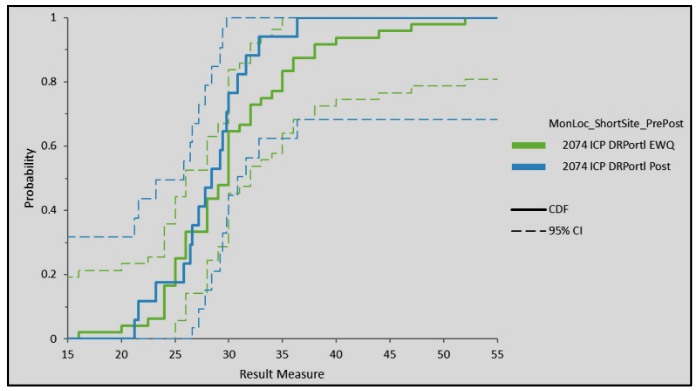
Existing Water Quality (Table 2C):

Median 30 mg/l
Lower 95% Confidence Interval 28 mg/l
Upper 95% Confidence Interval 31 mg/l




| N | 65 | | | | | |
|---|---|---|---|---|---|---|
| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
| 2074 ICP DRPortl EWQ | 16 | 25 | 30 | 34 | 52 | 8 |
| 2074 ICP DRPortl Post | 21 | 26 | 28 | 30 | 36 | 4 |



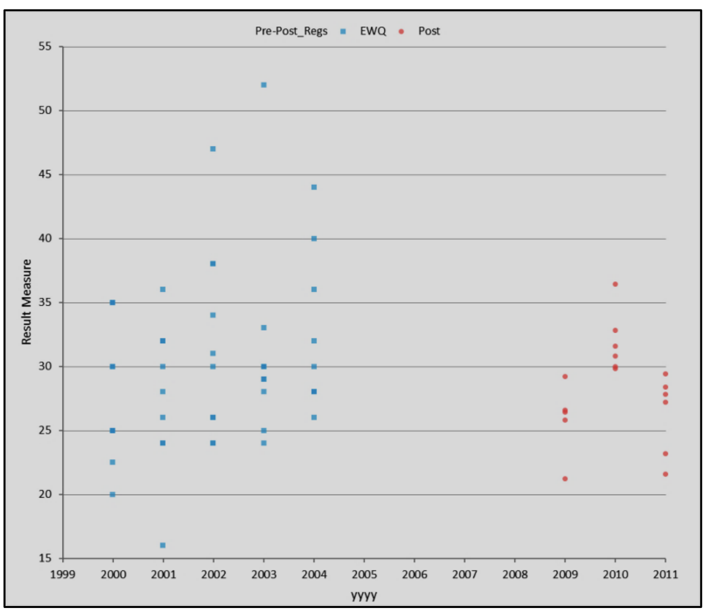




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 48 | 96.3 | 2.01 |
| 2074 ICP DRPortl Post | 17 | 272.0 | 16.00 |

| | |
|---|---|
| H statistic | 1.03 |
| X² approximation | 1.03 |
| DF | 1 |
| p-value | 0.3091 [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.



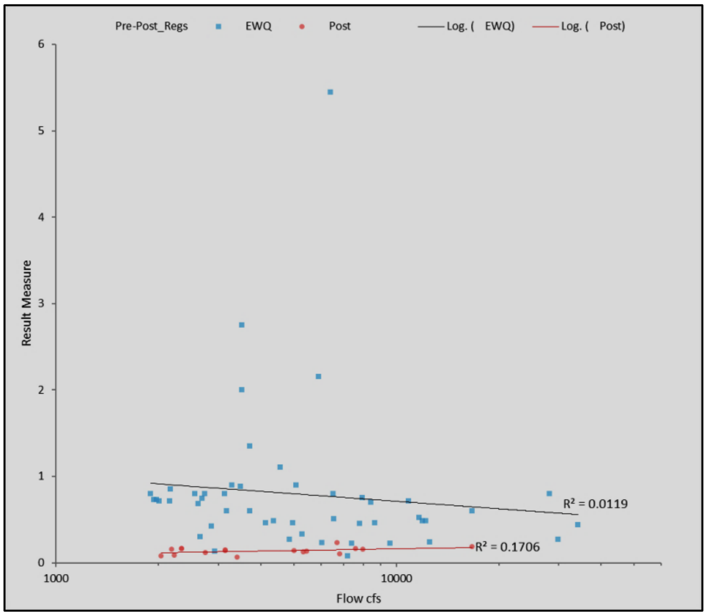

No water quality degradation is evident here. Hardness apparently did not measurably change between the EWQ and post-EWQ periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). Hardness is unrelated to flow in the EWQ data set, but weakly and inversely related to flow in the post-EWQ data set. Post-EWQ median hardness fell within the EWQ 95% confidence intervals. USGS/NJDEP data were comparable with DRBC results.

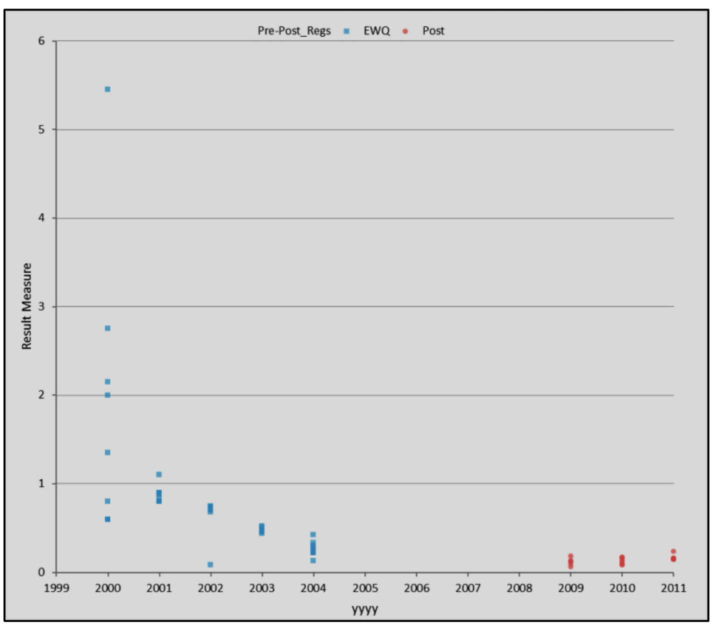
Chapter 24: 2074 ICP Delaware River at Portland

Nitrate + Nitrite as N, Total mg/l

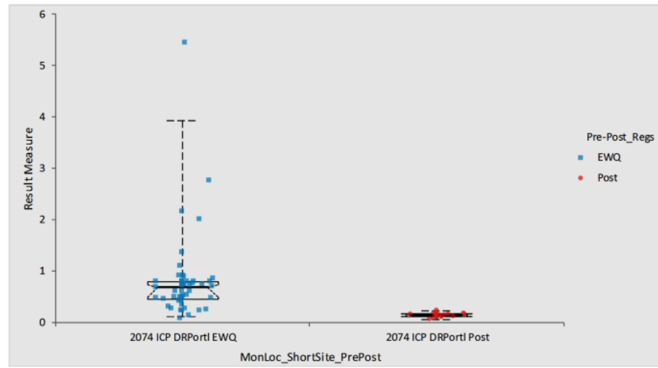
Existing Water Quality (Table 2C, as Nitrate only):

Median 0.68 mg/l
Lower 95% Confidence Interval 0.48 mg/l
Upper 95% Confidence Interval 0.74 mg/l



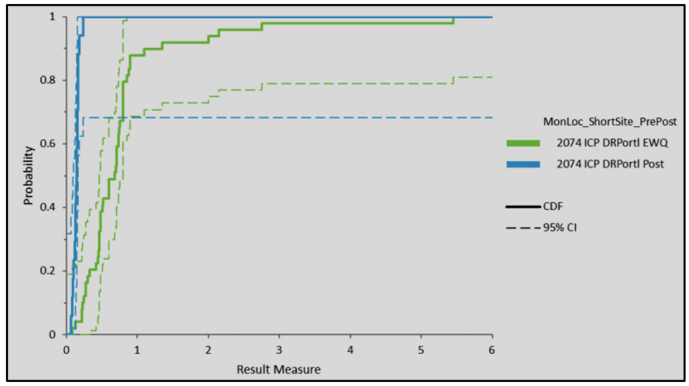




No water quality degradation is evident here. Nitrate concentrations apparently declined between the two periods.




| N | 66 |
|---|---|

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.080 | 0.447 | 0.680 | 0.800 | 5.450 | 0.353 |
| 2074 ICP DRPortl Post | 0.060 | 0.111 | 0.142 | 0.163 | 0.231 | 0.052 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 49 | 3064.4 | 62.54 |
| 2074 ICP DRPortl Post | 17 | 8832.7 | 519.57 |

| | |
|---|---|
| H statistic | 32.32 |
| $X^2$ approximation | 32.32 |
| 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.

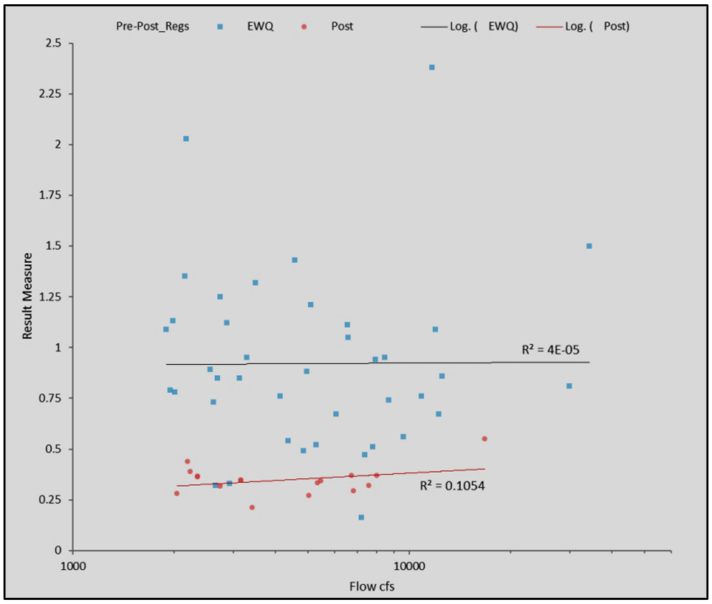
Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). Nitrate is unrelated to flow in either data set. The entire concentration scale is thrown off by the extremely variable results in 2000. Post-EWQ nitrate concentrations fell below the lower EWQ 95% confidence interval, and were less variable than EWQ nitrate. Post-EWQ nitrate + nitrite samples were assumed equivalent with EWQ nitrate samples since EWQ nitrite results were never detected. USGS/NJDEP data were most similar to DRBC 2003-2011 data, and did not display such a precipitous decline in concentrations.

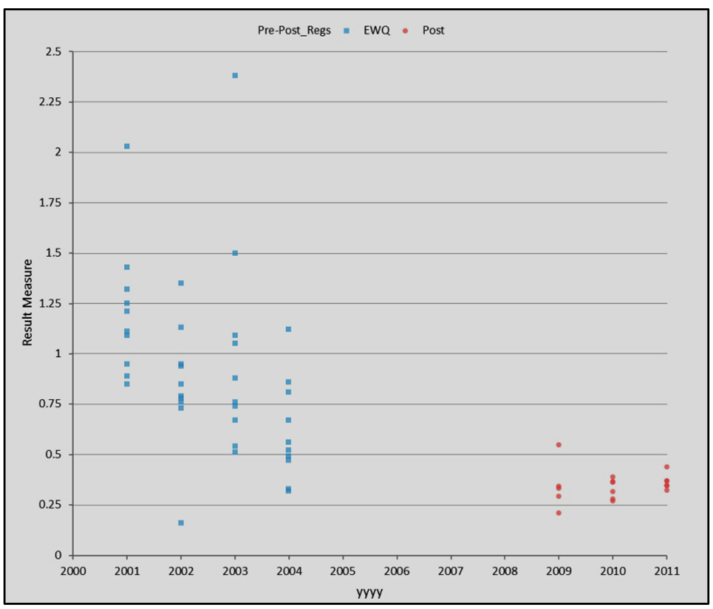
Chapter 24: 2074 ICP Delaware River at Portland

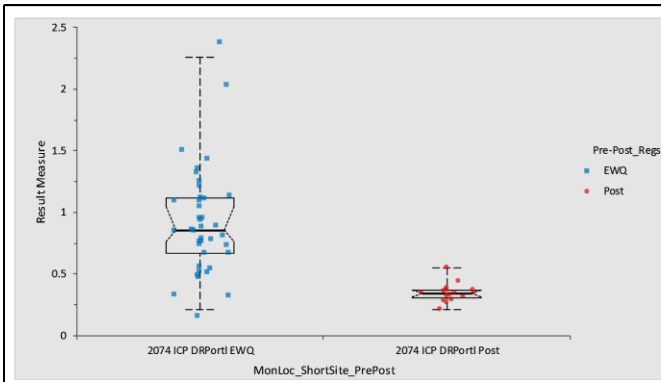
Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 2C):

Median 0.86 mg/l
Lower 95% Confidence Interval 0.74 mg/l
Upper 95% Confidence Interval 1.05 mg/l

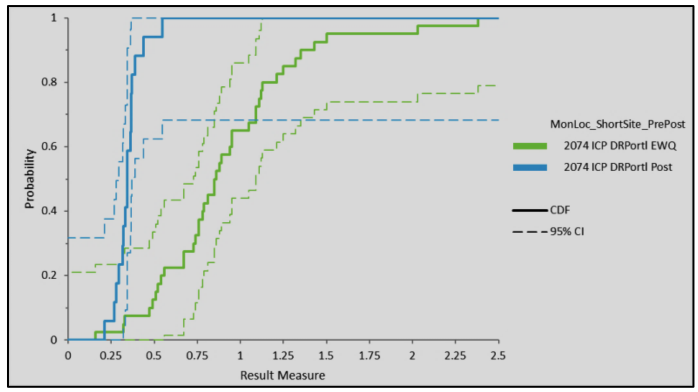



N 57

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.160 | 0.670 | 0.855 | 1.116 | 2.380 | 0.446 |
| 2074 ICP DRPortl Post | 0.210 | 0.308 | 0.344 | 0.368 | 0.548 | 0.060 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 40 | 2175.6 | 54.39 |
| 2074 ICP DRPortl Post | 17 | 5119.1 | 301.12 |

| | |
|---|---|
| H statistic | 26.48 |
| $X^2$ approximation | 26.48 |
| 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.

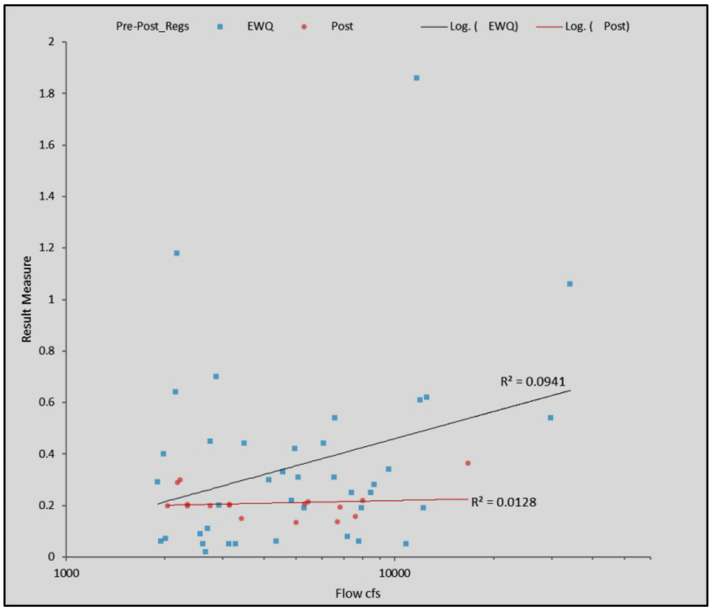
No water quality degradation is evident here. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). TN is unrelated to flow in both data sets. Post-EWQ median TN concentrations fell below the EWQ lower 95% confidence intervals. USGS/NJDEP data were similar to DRBC 2003-2011 results, showing a significant decline in concentrations but not as drastic as DRBC results indicate.

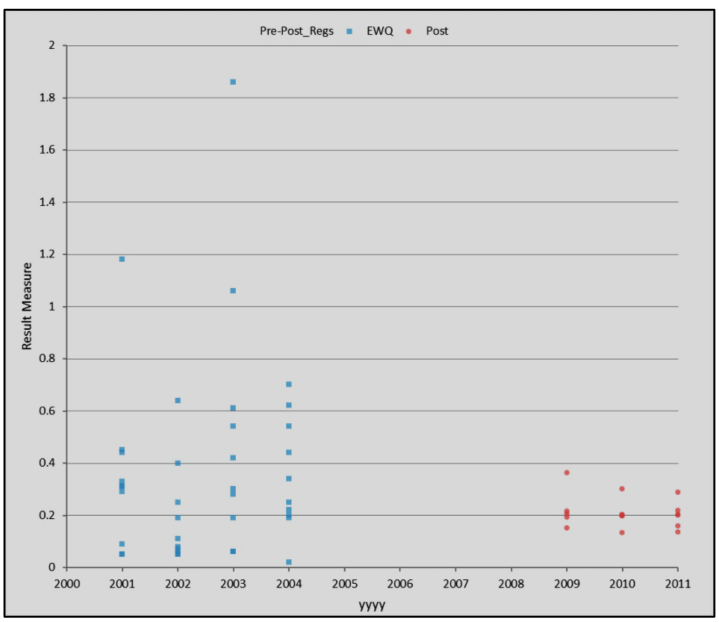
Chapter 24: 2074 ICP Delaware River at Portland

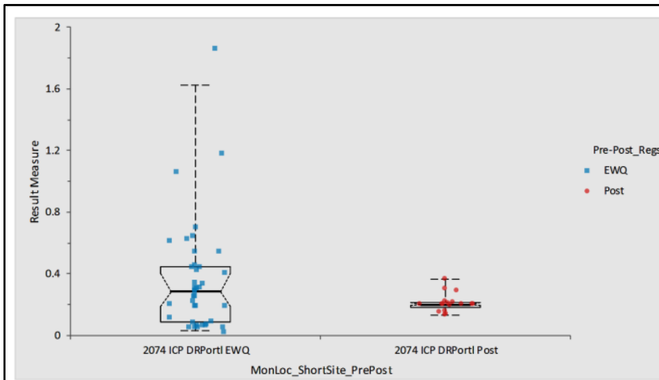
Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality (Table 2C):

Median 0.29 mg/l
Lower 95% Confidence Interval 0.19 mg/l
Upper 95% Confidence Interval 0.40 mg/l

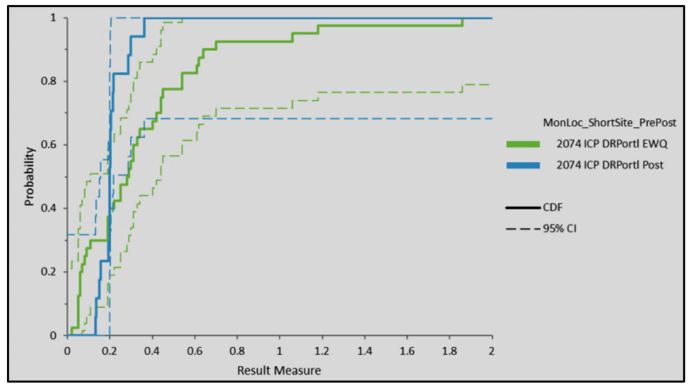



| N | 57 |
|---|---|

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.020 | 0.084 | 0.285 | 0.446 | 1.860 | 0.362 |
| 2074 ICP DRPortl Post | 0.133 | 0.181 | 0.200 | 0.216 | 0.363 | 0.035 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 40 | 115.6 | 2.89 |
| 2074 ICP DRPortl Post | 17 | 272.0 | 16.00 |

| | |
|---|---|
| H statistic | 1.41 |
| $X^2$ approximation | 1.41 |
| DF | 1 |
| p-value | 0.2354[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.

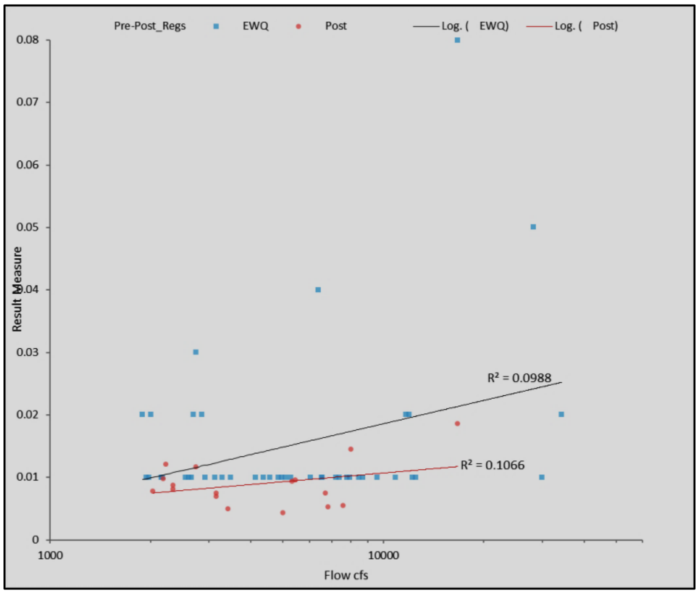
No water quality degradation is evident here. TKN concentrations apparently did not measurably decline between the EWQ and post-EWQ periods. Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=17). The post-EWQ range was far narrower and all concentrations were less than 0.36 mg/l. TKN concentration is unrelated to flow in both data sets. Post-EWQ median TKN fell below the lower EWQ 95% confidence interval, but there were insufficient post-EWQ samples (n=17) to detect significant change. USGS/NJDEP values were similar to DRBC results.

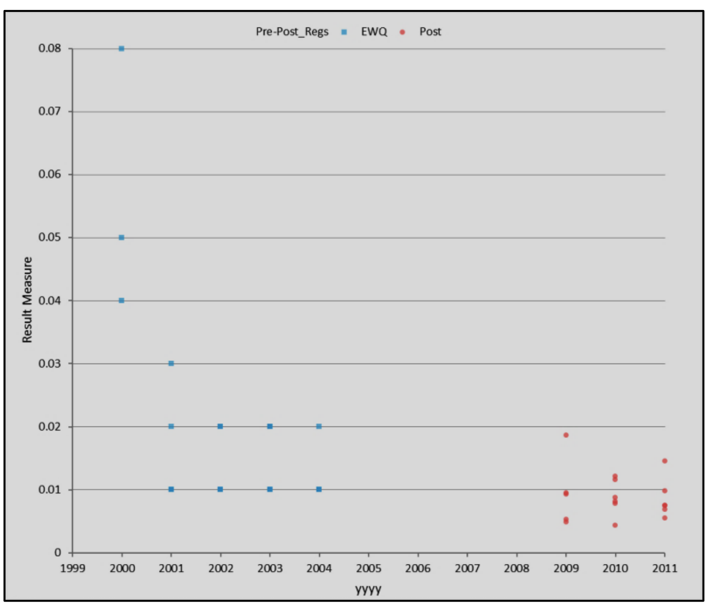
Chapter 24: 2074 ICP Delaware River at Portland

Orthophosphate as P, Total mg/l (OP)

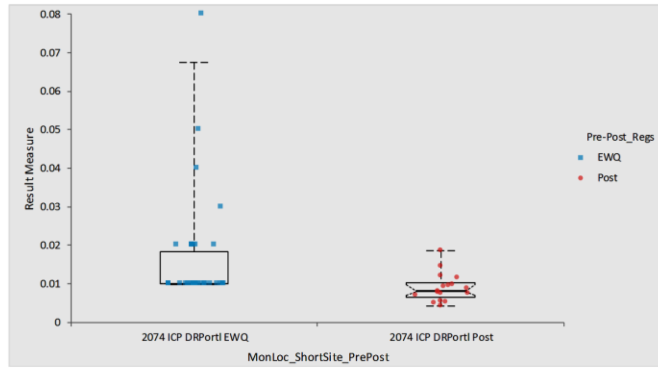
Existing Water Quality (Table 2C):

Median 0.01 mg/l
Lower 95% Confidence Interval 0.005 (<0.01) mg/l*
Upper 95% Confidence Interval 0.01 mg/l
*Used ½ the detection limit as estimate; actually <0.01



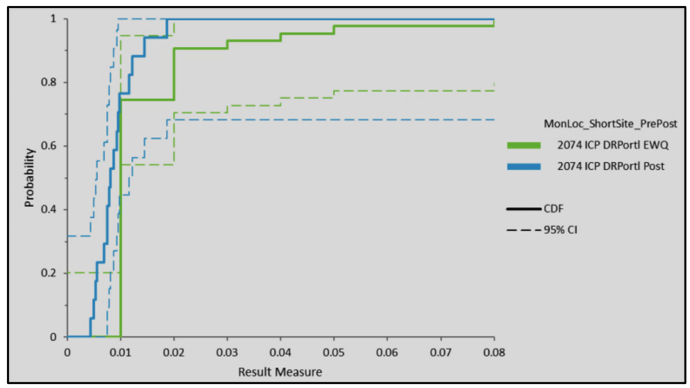




No water quality degradation is evident here. OP concentrations apparently declined between the EWQ and post-EWQ periods.




| | |
|---|---|
| N | 60 |

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.010 | 0.010 | 0.010 | 0.018 | 0.080 | 0.008 |
| 2074 ICP DRPortl Post | 0.004 | 0.006 | 0.008 | 0.010 | 0.019 | 0.004 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 43 | 1311.8 | 30.51 |
| 2074 ICP DRPortl Post | 17 | 3318.0 | 195.18 |

| | |
|---|---|
| H statistic | 17.93 |
| X² approximation | 17.93 |
| 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.

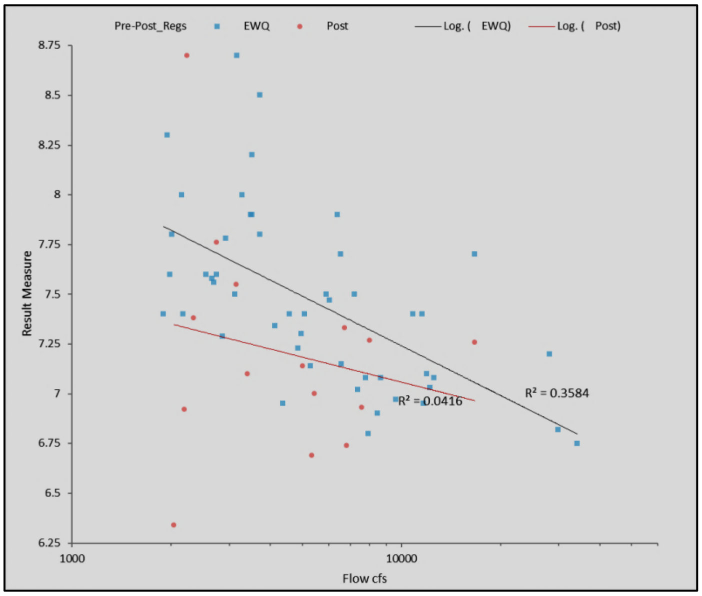
Sources of analytical uncertainty include potential laboratory artifacts, detection limit differences and insufficient post-EWQ sampling (n=17). OP is unrelated to flow in both data sets. Post-EWQ median OP fell below the EWQ lower 95% confidence interval. No post-EWQ concentrations were higher than 0.019 mg/l. The EWQ non-detection rate was 32/43 samples, interfering with estimation of the median. There were no post-EWQ undetected results, and a narrower range. USGS/NJDEP analyzes dissolved rather than total OP, but their results were similar to DRBC, with a high rate of undetected results in the EWQ period and gradually improving method sensitivity.

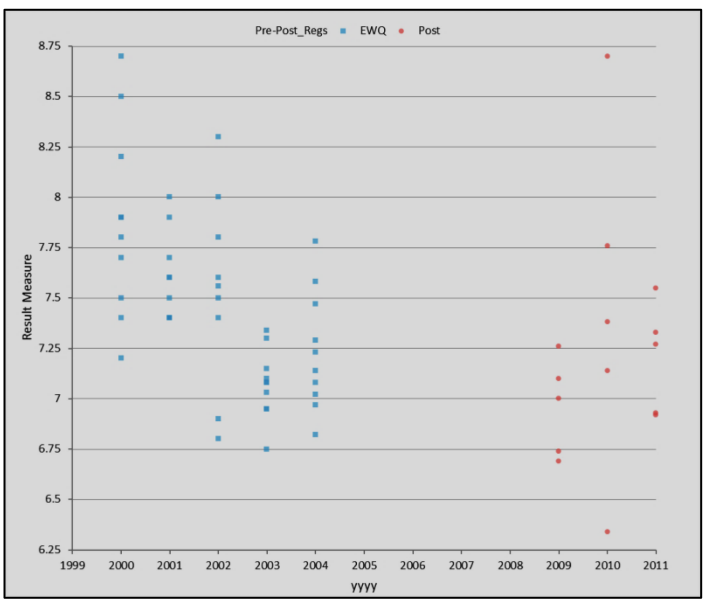
Chapter 24: 2074 ICP Delaware River at Portland

pH

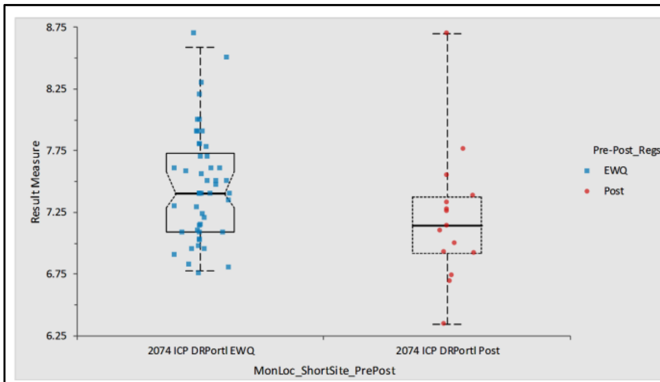
Existing Water Quality (Table 2C):

Median 7.40 standard units
Lower 95% Confidence Interval 7.29 standard units
Upper 95% Confidence Interval 7.58 standard units



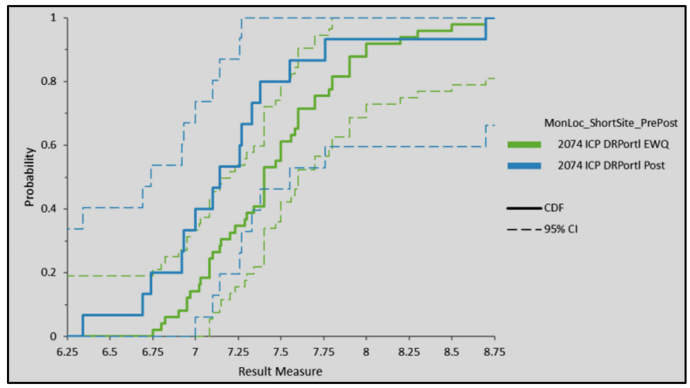




No water quality degradation is evident here. pH apparently declined between the two periods. Sources of analytical uncertainty include insufficient post-EWQ sampling (n=15). pH is inversely related to flow in EWQ data but unrelated in post-EWQ data.




N | 64

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 6.75 | 7.09 | 7.40 | 7.73 | 8.70 | 0.63 |
| 2074 ICP DRPortl Post | 6.34 | 6.92 | 7.14 | 7.37 | 8.70 | 0.45 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 49 | 388.7 | 7.93 |
| 2074 ICP DRPortl Post | 15 | 1269.6 | 84.64 |

| | |
|---|---|
| H statistic | 4.79 |
| $X^2$ approximation | 4.79 |
| DF | 1 |
| p-value | 0.0286[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.

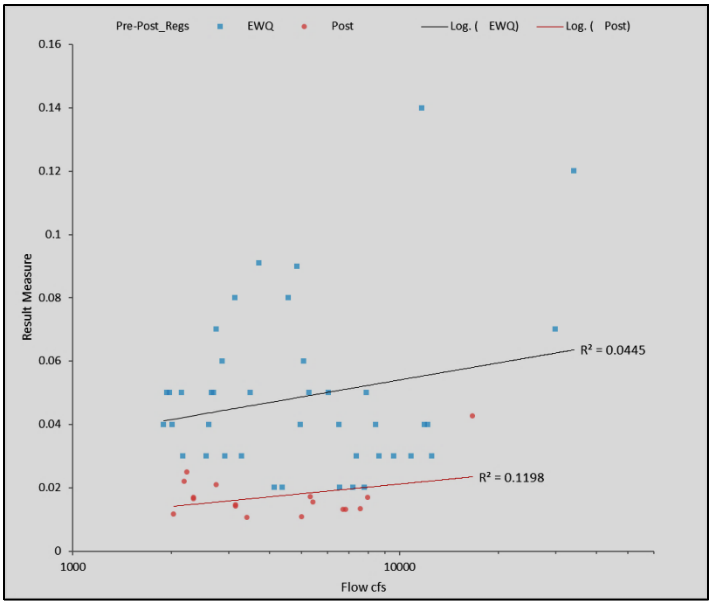
Post-EWQ median pH was below the lower EWQ 95% confidence interval. USGS/NJDEP data also showed a slight decline, mainly because post-EWQ pH was less wide-ranging and stayed nearer pH 7 during wet years. In dry, low-flow years, algae and aquatic plant growth in the Delaware River at Portland is much greater than during wet years when plants cannot grow thickly without being occasionally scoured away. If post-EWQ DRBC sampling were more representative of the entire range of flow conditions, there probably would not have been a significant difference in pH values. Biweekly instead of monthly sampling is recommended.

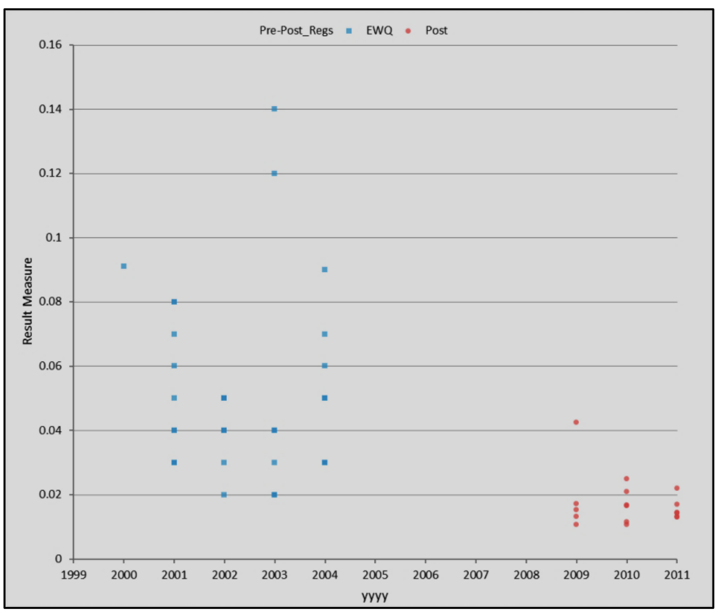
Chapter 24: 2074 ICP Delaware River at Portland

Phosphorus as P, Total (TP) mg/l

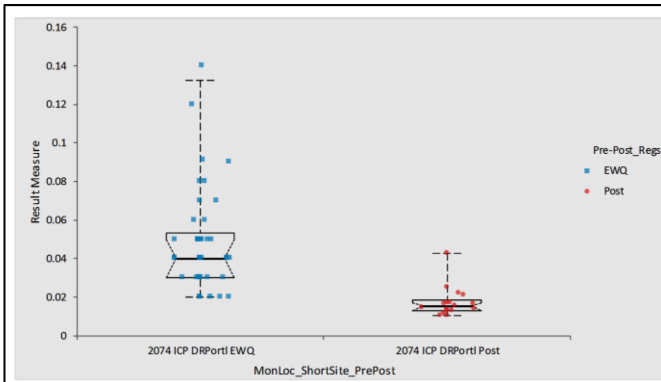
Existing Water Quality (Table 2C):

Median 0.04 mg/l
Lower 95% Confidence Interval 0.03 mg/l
Upper 95% Confidence Interval 0.05 mg/l



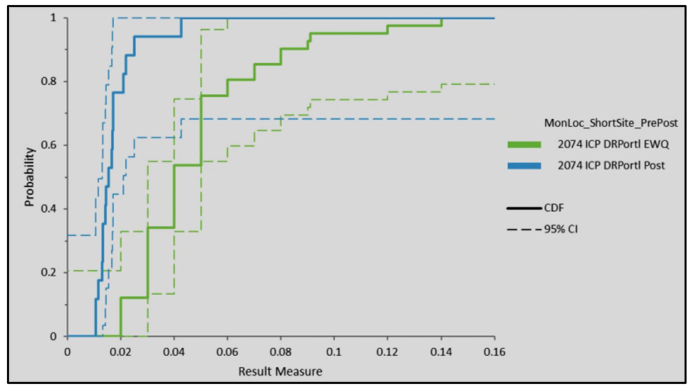




No water quality degradation is evident here. Total Phosphorus (TP) concentrations apparently declined between the EWQ and post-EWQ periods.




N 58

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.020 | 0.030 | 0.040 | 0.053 | 0.140 | 0.023 |
| 2074 ICP DRPortl Post | 0.011 | 0.013 | 0.015 | 0.018 | 0.043 | 0.005 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 41 | 2366.6 | 57.72 |
| 2074 ICP DRPortl Post | 17 | 5707.8 | 335.75 |

| | |
|---|---|
| H statistic | 28.62 |
| $X^2$ approximation | 28.62 |
| 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.

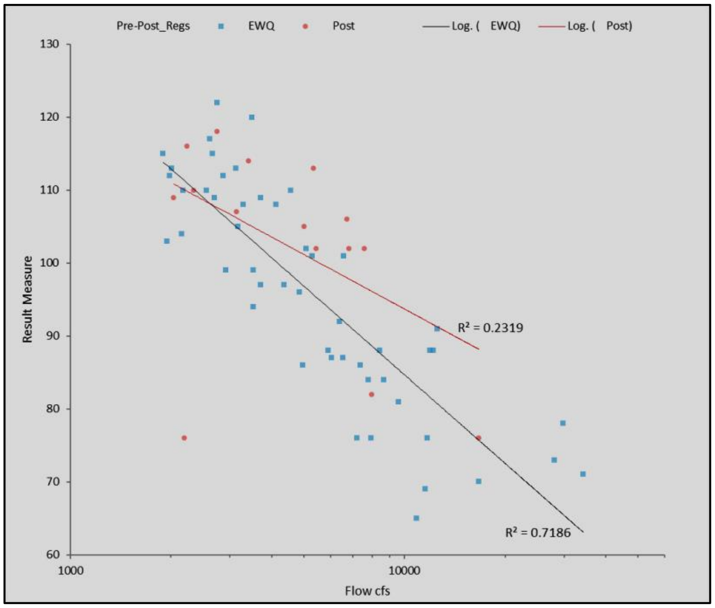
Sources of analytical uncertainty include potential laboratory artifacts, detection limit differences and insufficient post-EWQ sampling (n=17). Post-EWQ median total phosphorus fell below the EWQ lower 95% confidence interval. TP is unrelated to flow in both data sets. USGS/NJDEP data were comparable with DRBC post-EWQ results, though no decline in concentrations was apparent. USGS/NJDEP data during the EWQ period ranged from 0.01 to 0.06 mg/l. This was not very different from DRBC results, but DRBC EWQ data varied more widely.

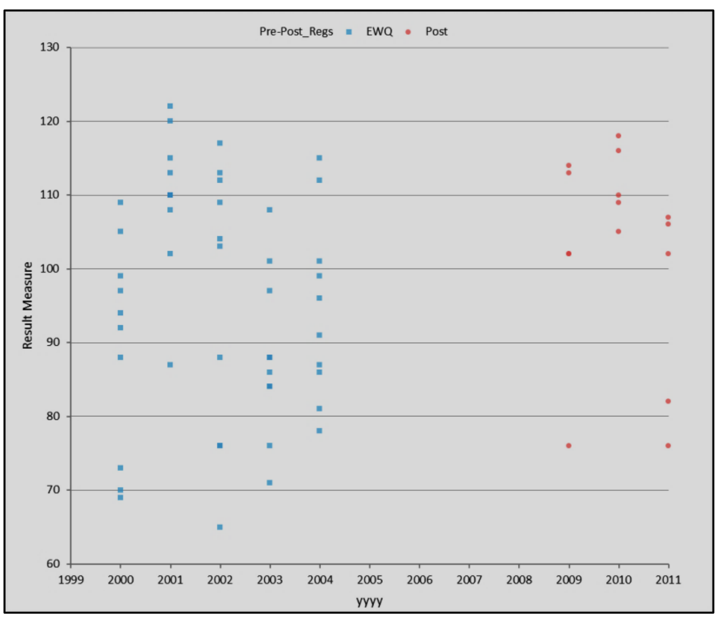
Chapter 24: 2074 ICP Delaware River at Portland

Specific Conductance µmho/cm

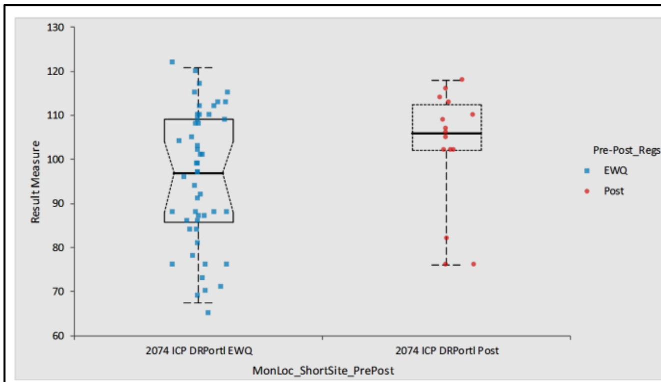
Existing Water Quality (Table 2C):

Median 97 µmho/cm
Lower 95% Confidence Interval 88 µmho/cm
Upper 95% Confidence Interval 104 µmho/cm
Defined in regulations as a flow-related parameter



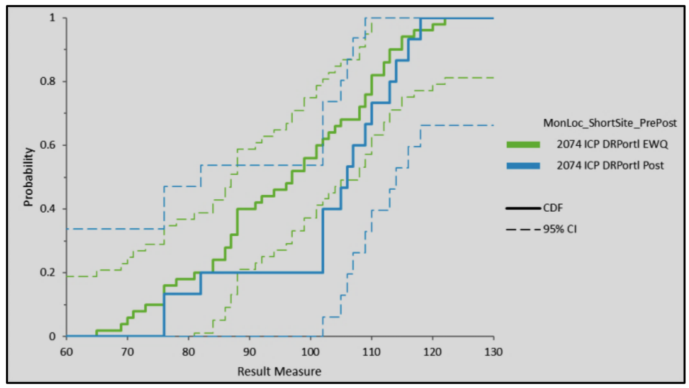




No water quality degradation is evident here. Specific conductance increased by 9 µmho/cm between the EWQ and post-EWQ periods, but the increase was not significant.




| N | 65 |
|---|---|

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 65 | 86 | 97 | 109 | 122 | 23 |
| 2074 ICP DRPortl Post | 76 | 102 | 106 | 113 | 118 | 11 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 206.0 | 4.12 |
| 2074 ICP DRPortl Post | 15 | 686.8 | 45.79 |

| | |
|---|---|
| H statistic | 2.50 |
| $X^2$ approximation | 2.50 |
| DF | 1 |
| p-value | 0.1138[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.

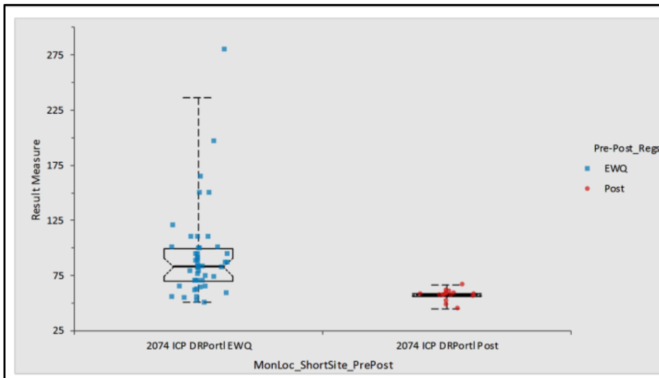
Analytical uncertainty included insufficient post-EWQ sampling (n=15) and possible flow differences. Post-EWQ median specific conductance increased near the upper EWQ 95% confidence interval. Biweekly instead of monthly sampling is recommended. Specific conductance is inversely related to flow in both data sets. Post-EWQ data were not representative of the full range of flow conditions, rendering a weak flow relationship. It is probable that, if more samples were taken under higher flow conditions, there might not have been any increase in specific conductance. USGS/NJDEP data were similar to DRBC results, also showing a slight increase in concentration.

Chapter 24: 2074 ICP Delaware River at Portland

Total Dissolved Solids (TDS) mg/l

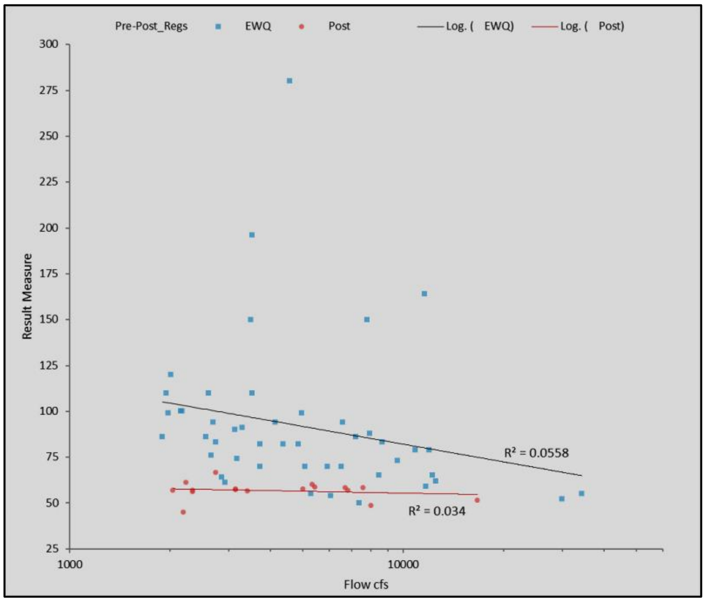
Existing Water Quality (Table 2C):

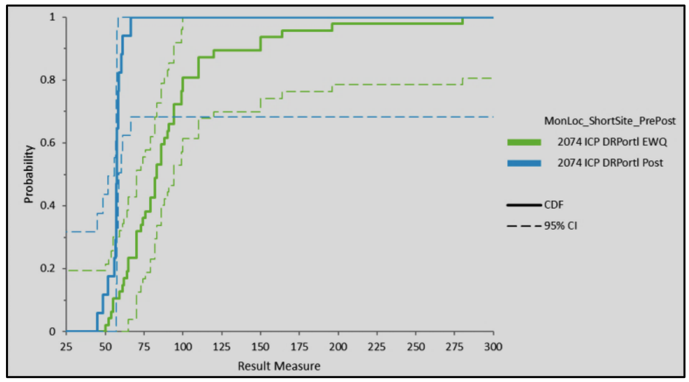
Median 83 mg/l
Lower 95% Confidence Interval 74 mg/l
Upper 95% Confidence Interval 91 mg/l




N 64

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 70 | 83 | 99 | 280 | 29 |
| 2074 ICP DRPortl Post | 45 | 56 | 57 | 58 | 66 | 2 |



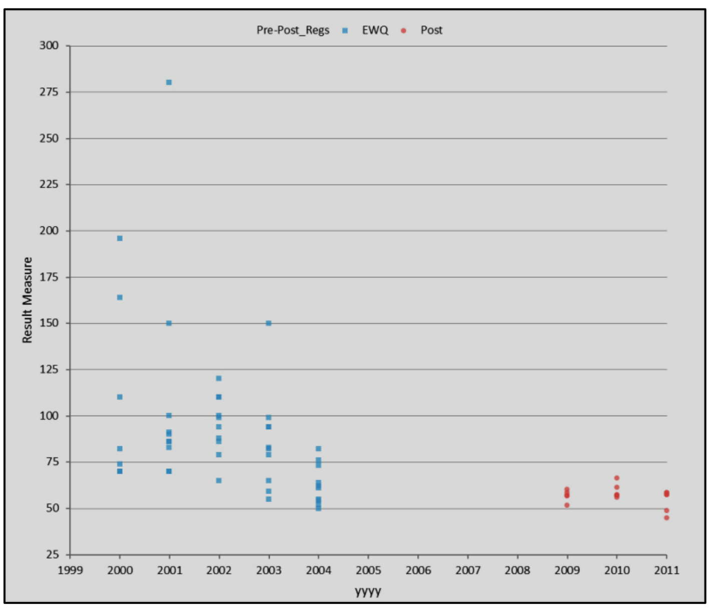




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 47 | 2171.9 | 46.21 |
| 2074 ICP DRPortl Post | 17 | 6004.7 | 353.22 |

| | |
|---|---|
| H statistic | 23.60 |
| $X^2$ approximation | 23.60 |
| 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 declined between the two periods. Sources of analytical uncertainty include potential laboratory artifacts, detection limit differences and insufficient post-EWQ sampling (n=17).

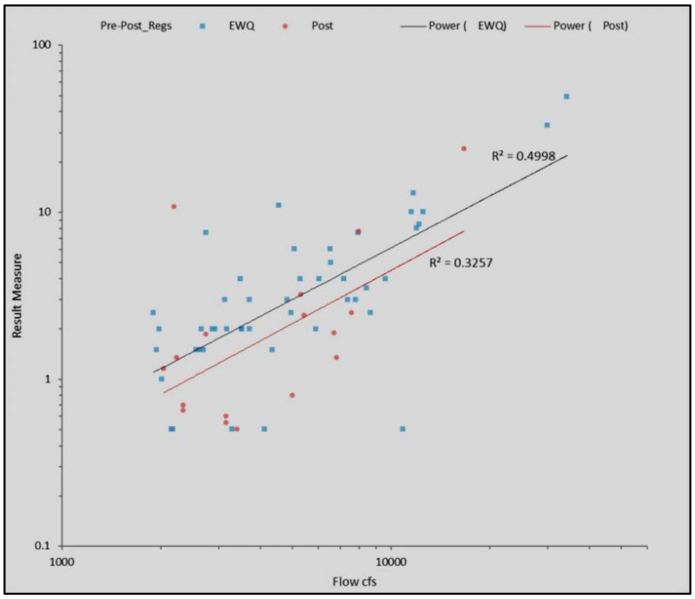
TDS is unrelated to flow in either data set. Post-EWQ median TDS fell below the EWQ lower 95% lower confidence interval, and was less variable than the baseline samples as well. Post-EWQ detection limits were lower than EWQ detection limits, though there were no undetected results at any time. Perhaps this decline is not real but an artifact of using different laboratories. EWQ 2003-2004 data are most similar to post-EWQ 2009-2011 data. USGS/NJDEP data are comparable to DRBC 2003-2011 results but do not show a declining trend. The USGS/NJDEP data actually show a slight but insignificant increase.

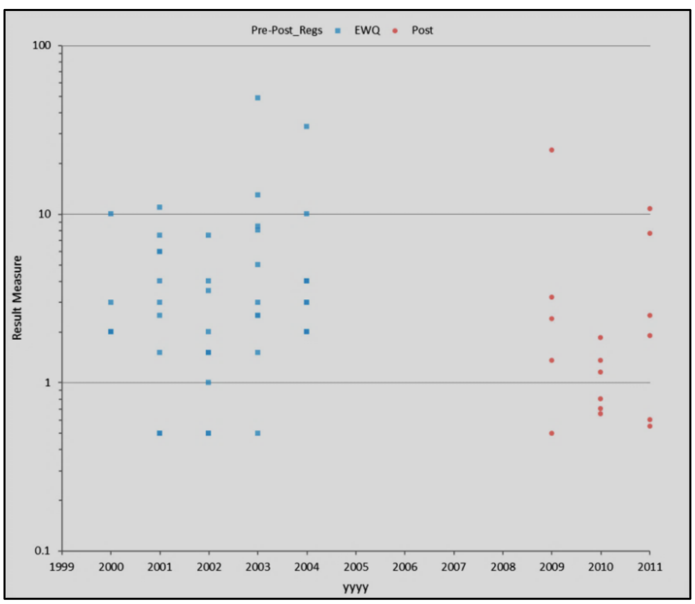
Chapter 24: 2074 ICP Delaware River at Portland

Total Suspended Solids (TSS) mg/l

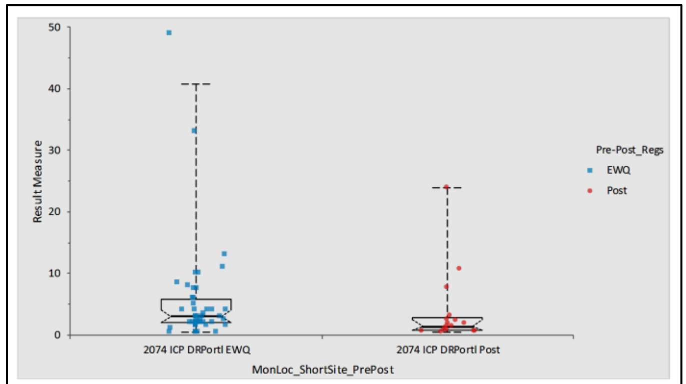
Existing Water Quality (Table 2C):

Median 3.0 mg/l
Lower 95% Confidence Interval 2.0 mg/l
Upper 95% Confidence Interval 4.0 mg/l
Defined in regulations as a flow-related parameter



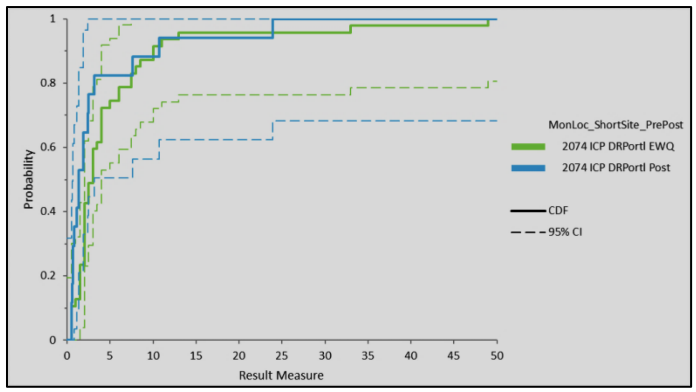




No water quality degradation is evident here. TSS apparently declined between the EWQ and post-EWQ periods, but the decline appears due to insufficient post-EWQ sampling of the full range of flow conditions.




N 64

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 0.5 | 2.0 | 3.0 | 5.8 | 49.0 | 3.8 |
| 2074 ICP DRPortl Post | 0.5 | 0.7 | 1.3 | 2.7 | 23.9 | 2.0 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 47 | 414.0 | 8.81 |
| 2074 ICP DRPortl Post | 17 | 1144.7 | 67.34 |

| | |
|---|---|
| H statistic | 4.52 |
| $X^2$ approximation | 4.52 |
| DF | 1 |
| p-value | 0.0335 [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.

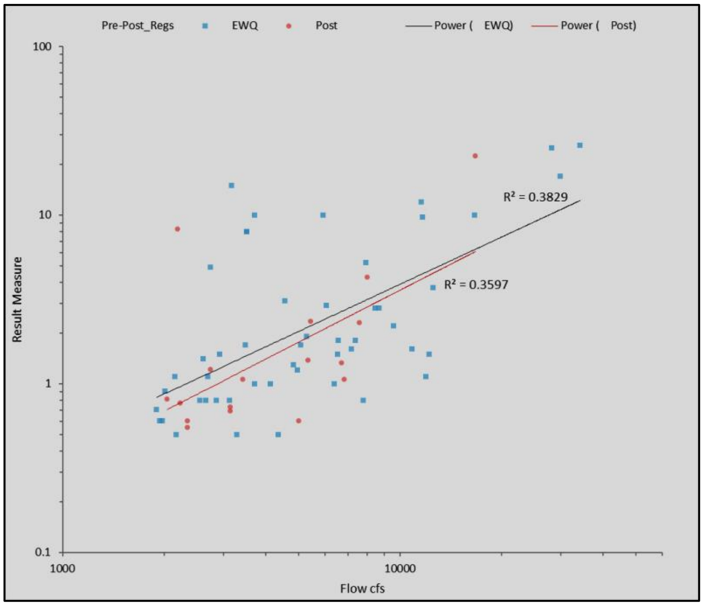
Sources of analytical uncertainty include potential laboratory artifacts and insufficient post-EWQ sampling (n=17). TSS is positively related to flow in both data sets. Post-EWQ median TSS fell below the lower EWQ 95% confidence interval, though higher flow conditions are not represented in the comparison. Biweekly instead of monthly sampling is recommended. USGS/NJDEP data also displayed a significant decline in TSS for the same reason as the DRBC results. If the full range of flow conditions were better represented, there might have been much less concentration difference between the two periods.

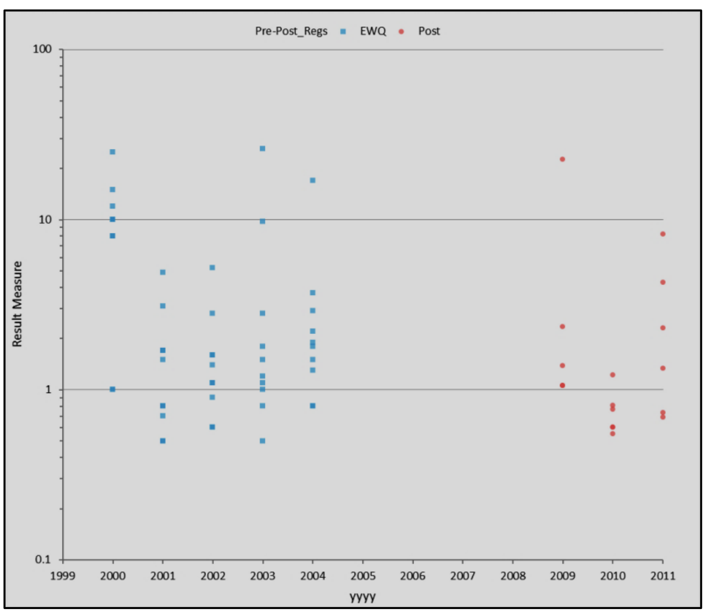
Chapter 24: 2074 ICP Delaware River at Portland

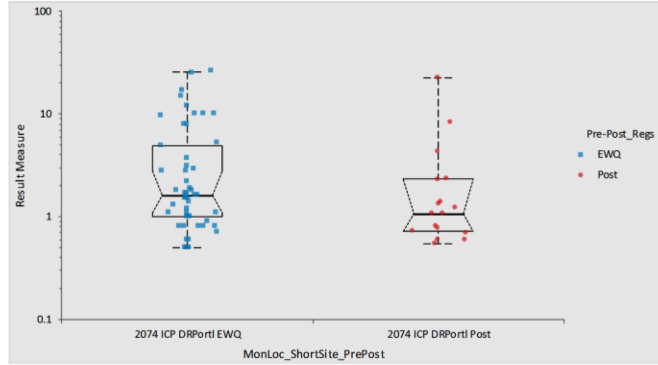
Turbidity NTU

Existing Water Quality (Table 2C):

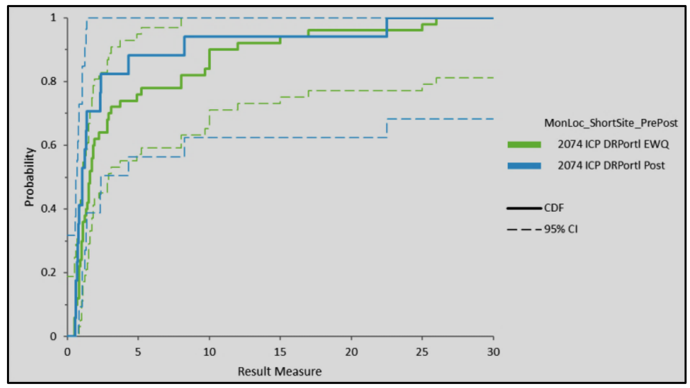
Median 1.6 NTU
Lower 95% Confidence Interval 1.1 NTU
Upper 95% Confidence Interval 2.8 NTU
Defined in regulations as a flow-related parameter




| N | 67 | | | | | |
|---|---|---|---|---|---|---|
| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
| 2074 ICP DRPortl EWQ | 0.5 | 1.0 | 1.6 | 4.9 | 26.0 | 3.9 |
| 2074 ICP DRPortl Post | 0.6 | 0.7 | 1.1 | 2.3 | 22.5 | 1.6 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 229.0 | 4.58 |
| 2074 ICP DRPortl Post | 17 | 673.5 | 39.62 |

| | |
|---|---|
| H statistic | 2.38 |
| $X^2$ approximation | 2.38 |
| DF | 1 |
| p-value | 0.1229 [1] |

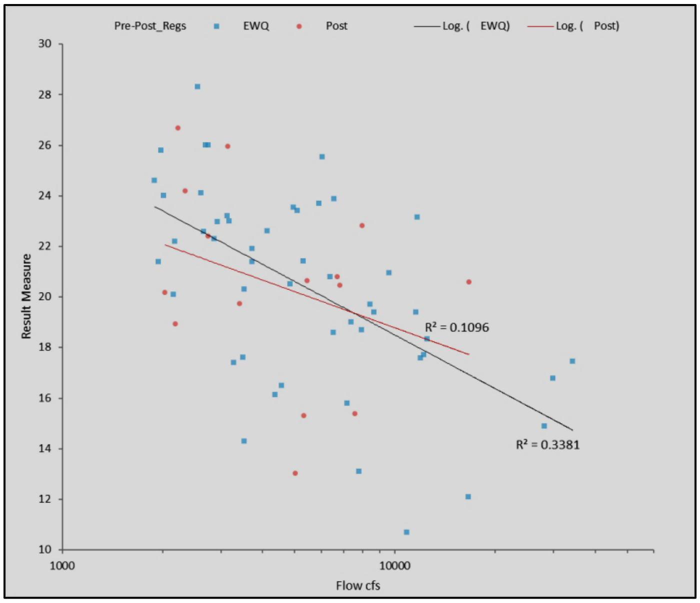
H0: $\theta_1 = \theta_2 = \theta_{...}$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

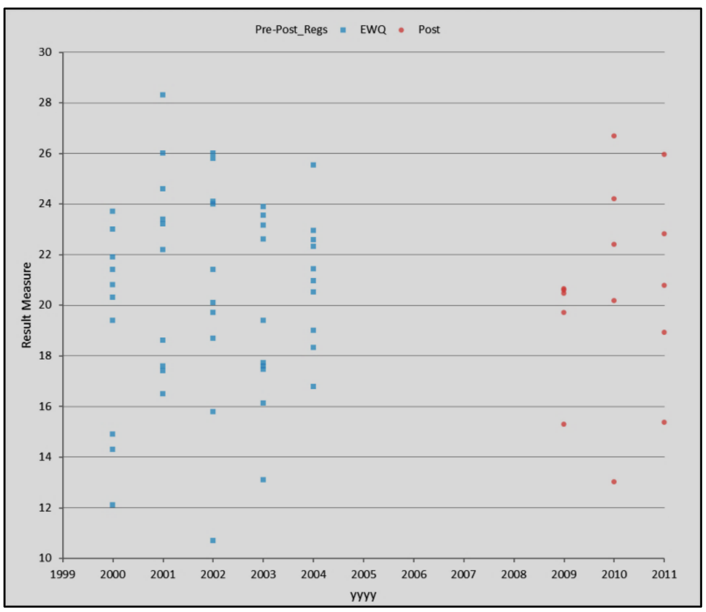
No water quality degradation is evident here. Turbidity apparently did not measurably change between the EWQ and post-EWQ periods. However, an insufficient number of post-EWQ samples (n=17) were taken and the full range of flow conditions was not represented. The post-EWQ median turbidity fell to the lower EWQ 95% confidence interval of the median but only because of too few samples at higher flow. Turbidity is positively related to flow in both data sets, power regression lines are shown. There were very few USGS/NJDEP data available for comparison with DRBC results, but results were similar. Biweekly instead of monthly sampling is recommended at this location.

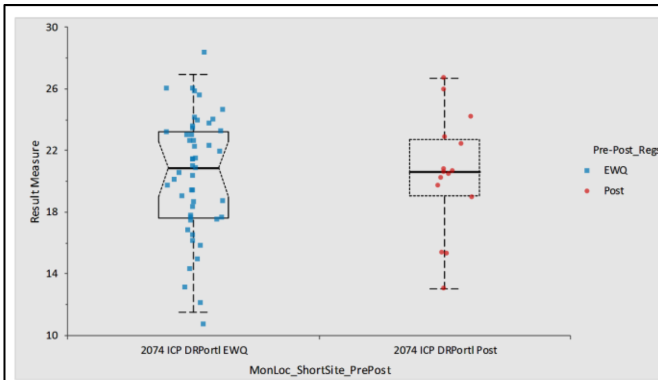
Chapter 24: 2074 ICP Delaware River at Portland

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules

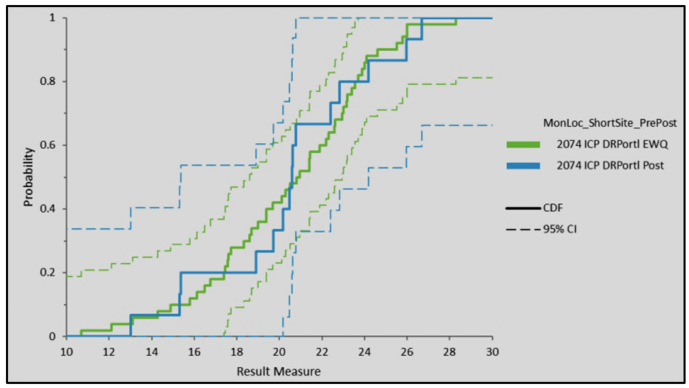



N 65

| Result Measure by MonLoc_ShortSite_PrePost | Minimum | 1st Quartile | Median | 3rd Quartile | Maximum | Inter-quartile range |
|---|---|---|---|---|---|---|
| 2074 ICP DRPortl EWQ | 10.7 | 17.6 | 20.9 | 23.2 | 28.3 | 5.6 |
| 2074 ICP DRPortl Post | 13.0 | 19.1 | 20.6 | 22.8 | 26.7 | 3.7 |




Kruskal-Wallis test

| Result Measure by MonLoc_ShortSite_PrePost | n | Rank sum | Mean rank |
|---|---|---|---|
| 2074 ICP DRPortl EWQ | 50 | 0.1 | 0.00 |
| 2074 ICP DRPortl Post | 15 | 0.3 | 0.02 |

| | |
|---|---|
| H statistic | 0.00 |
| X² approximation | 0.00 |
| DF | 1 |
| p-value | 0.9752 [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 apparently did not measurably change between the EWQ and post-EWQ periods. However, an insufficient number of post-EWQ samples (n=15) were taken and the full range of flow conditions was not represented. Water temperature is weakly and inversely related to flow. USGS/NJDEP data were comparable with DRBC results.