# Pilot Analysis of Maryland Phase I MS4 Permit Water Quality Data

## Figures.

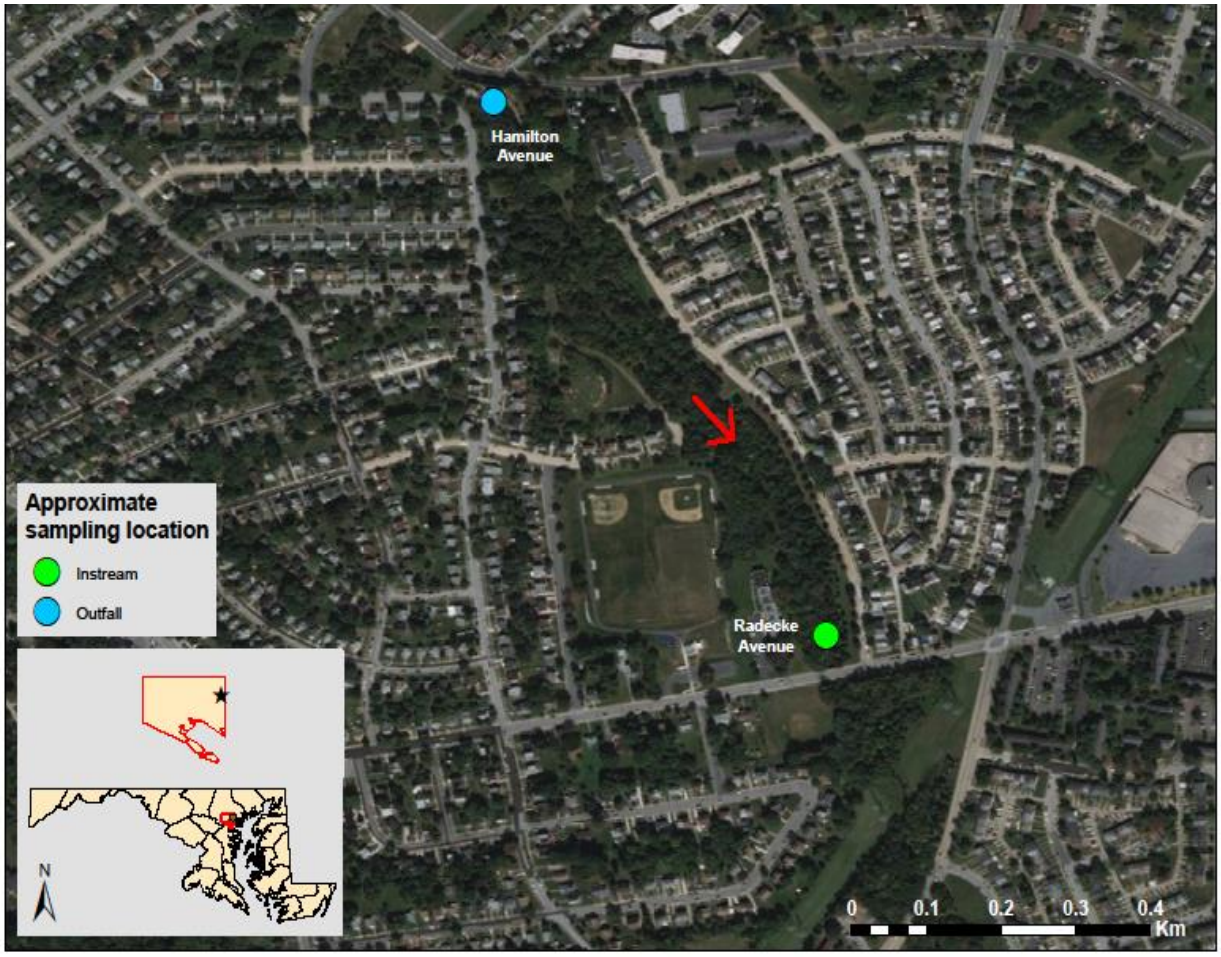
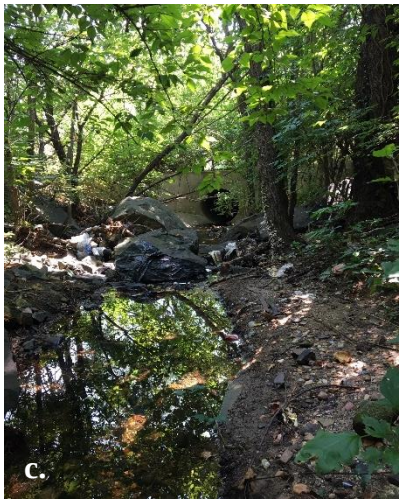
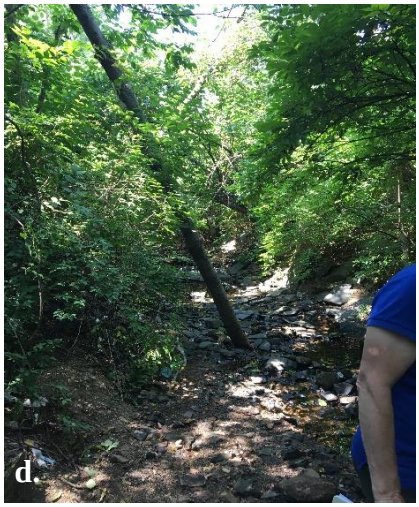
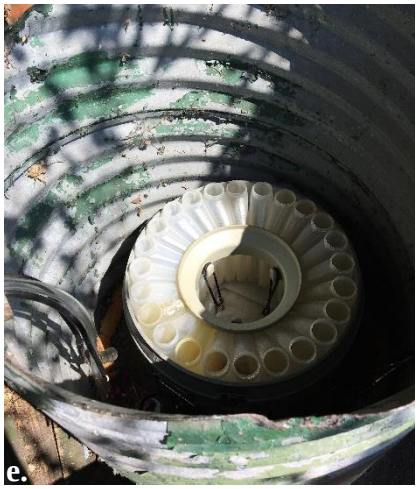



**Figure 1.** Moores Run, Baltimore City monitoring locations. Red arrow indicates the direction of flow.







**Figures 2a-2f.** Pictures from the Moores Run, BACI site visit. (a) instream site, looking downstream; (b) instream site, looking upstream; (c) outfall site, looking downstream; (d) outfall site, looking upstream; (e) instream sampler; (f) refrigerated outfall sampler.

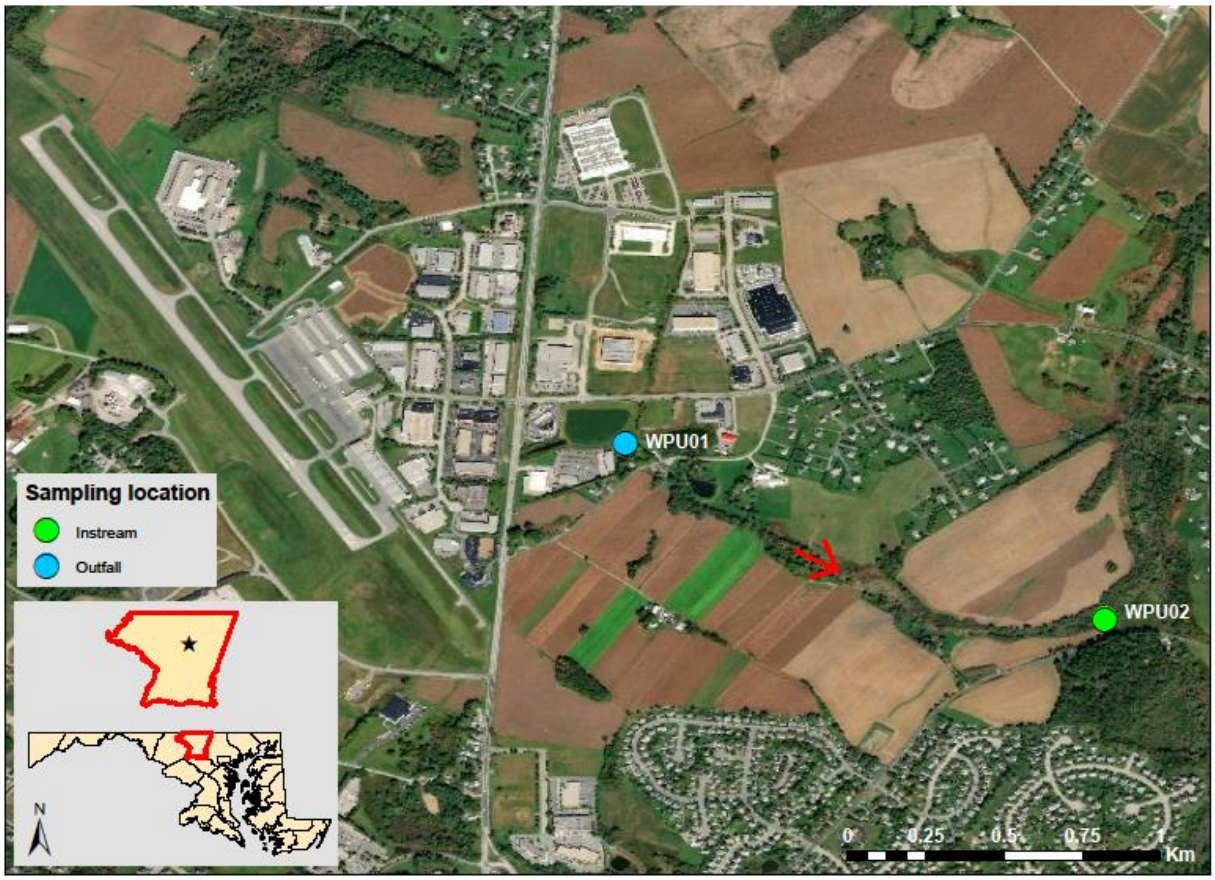


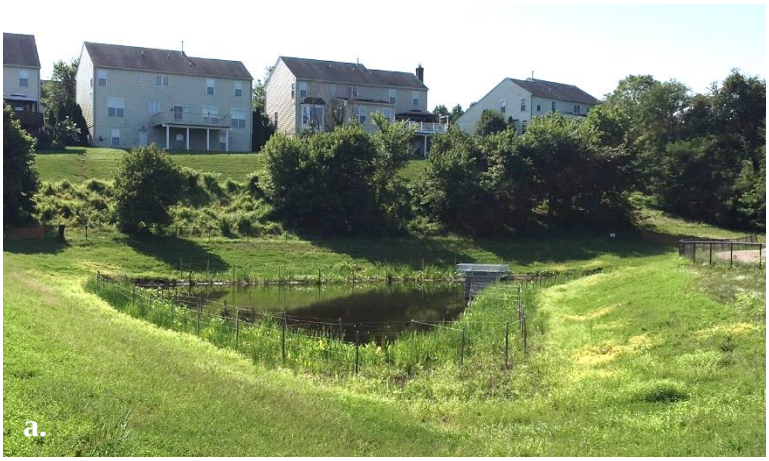

**Figure 3.** Airpark Business Center, Carroll County monitoring locations. Red arrow indicates the direction of flow.





**Figures 4a-4d.** Pictures from the Airpark Business Center, CACO site visit. Figure a. is the detention pond; b. is the instream site with a weir, looking upstream; c. is the outfall from the detention pond; d. is the water sampler.


**Figure 5.** Urbana, Frederick County monitoring locations. Red arrow indicates the direction of flow.







**Figures 6a-6d.** Pictures from the FRCO site visit. Figure a. outfall detention basin, Pond-R; b. outfall sampler; c. instream sampling station; d. bank condition at instream site.

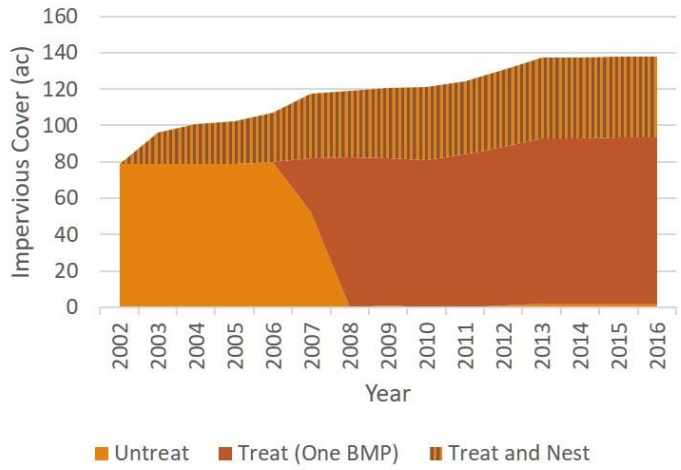



**Figure 7a.** Impervious cover and BMPs at CACO's outfall

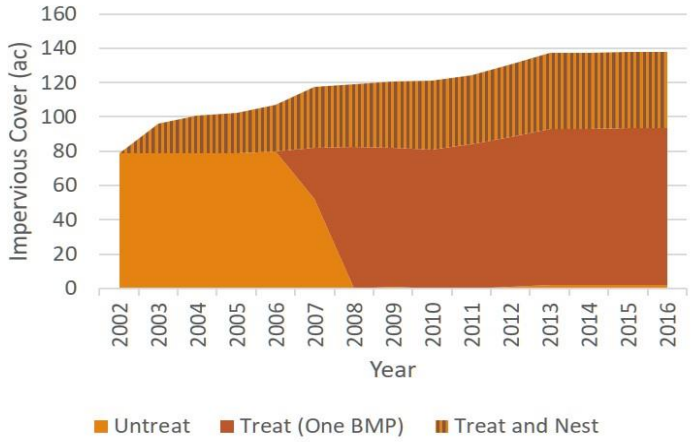



**Figure 7b.** Impervious cover and BMPs at CACO's instream

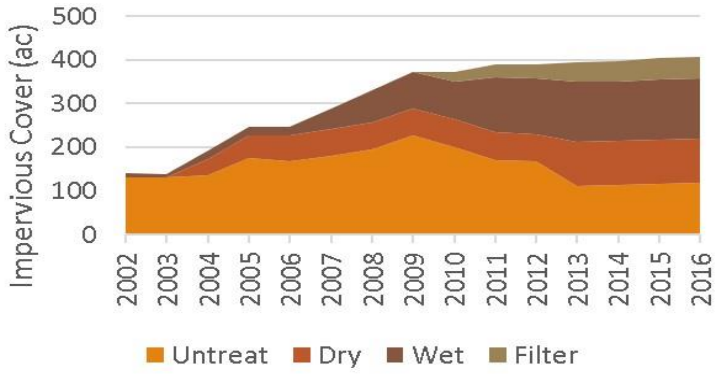
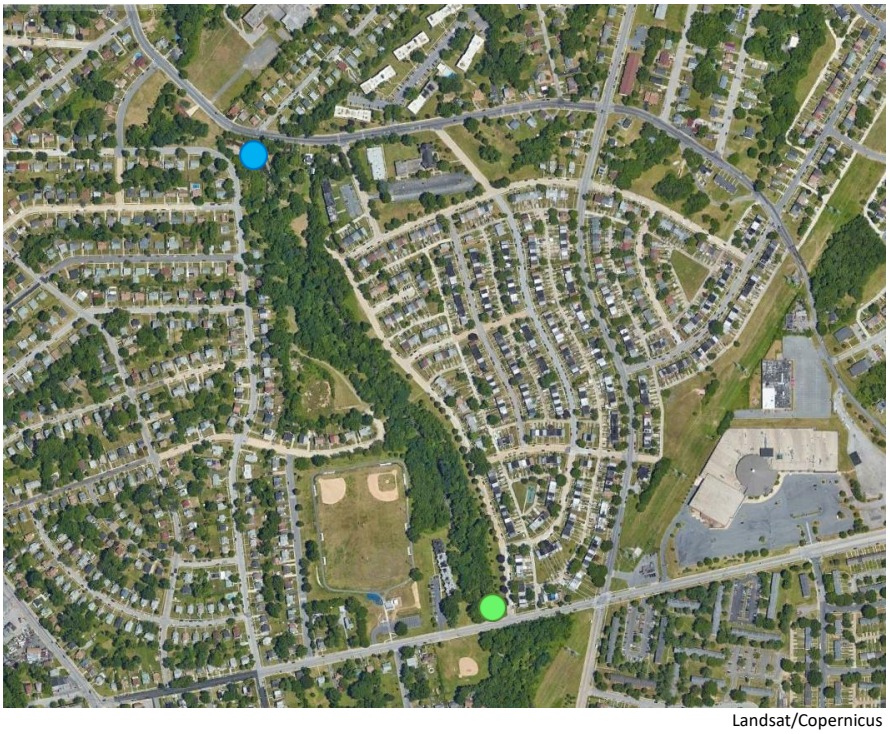



**Figure 7c.** Impervious cover and BMPs at FRCO's instream

**a.**

U.S. Geological Survey

**b.**



Landsat/Copernicus

**Figures 8a-8b.** Aerial imagery of the BACI watershed in April 1994 (a) and June 2017 (b). Blue circle is the outfall station, green circle is the instream station.

**Figure 9a.** FRCO's outfall, Pond-R, in December 2002. Storm box containing monitoring and sampling equipment is located in left-center of photo.

Source: Frederick County Division of Public Works, 2003

**Figure 9b.** FRCO's outfall monitoring storm box in December 2004.

Source: Frederick County Division of Public Works, 2004

**Figure 9c.** FRCO's outfall monitoring storm box in August 2019.

**Figure 10a.** FRCO's instream monitoring station at Peter Pan Run in December 2004.

Source: Frederick County Division of Public Works, 2004

**Figure 10b.** FRCO's instream monitoring station at Peter Pan Run in August 2019.

**Figure 10c.** FRCO's instream monitoring station with newly formed sand bar at Peter Pan Run in August 2019.

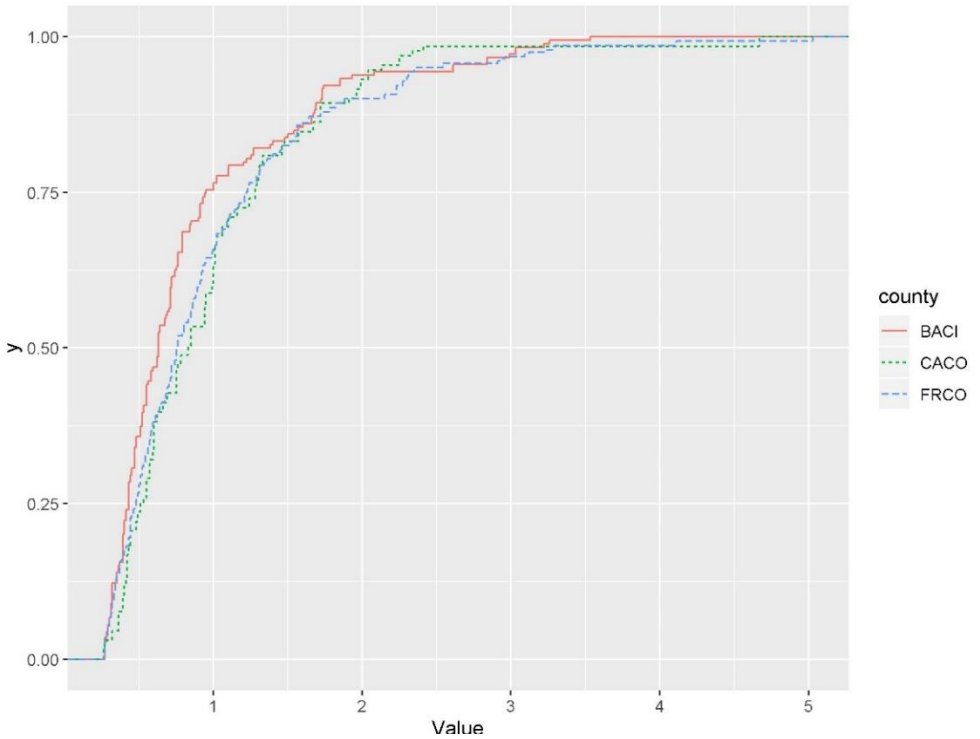



**Figure 11a.** Rainfall frequency spectrum.

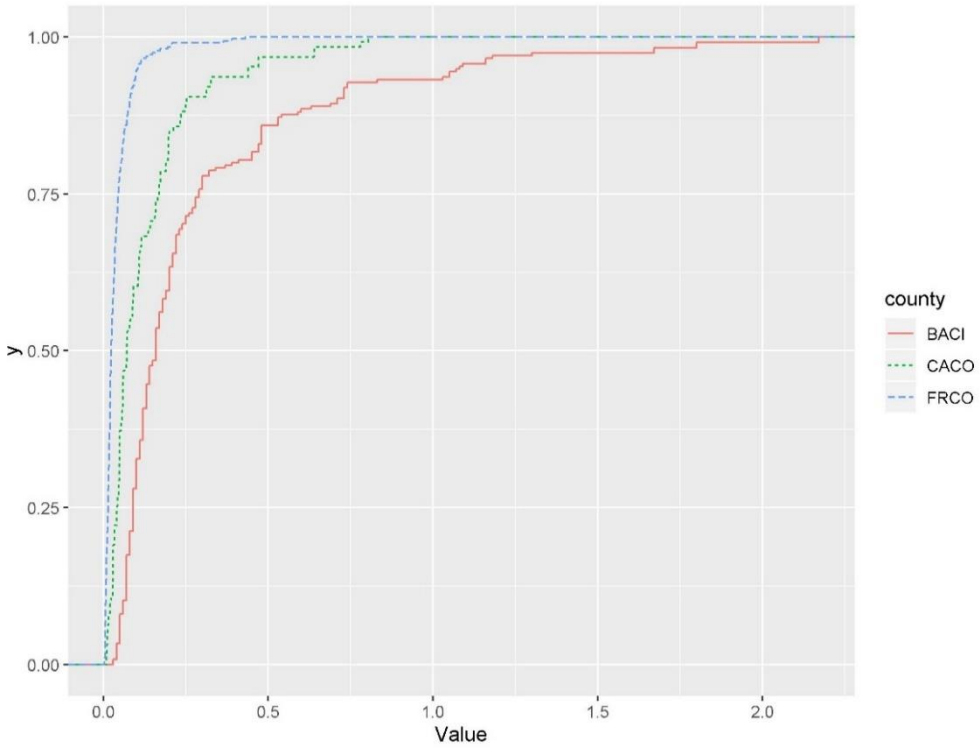



**Figure 11b.** Rainfall intensity frequency spectrum.

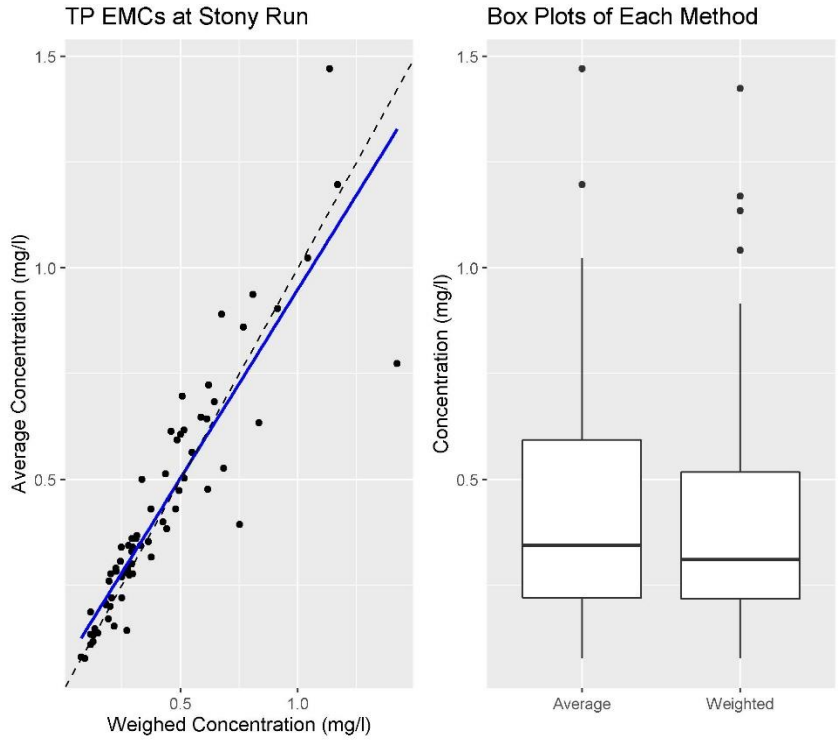



**Figure 12a**. EMC calculations of TP.

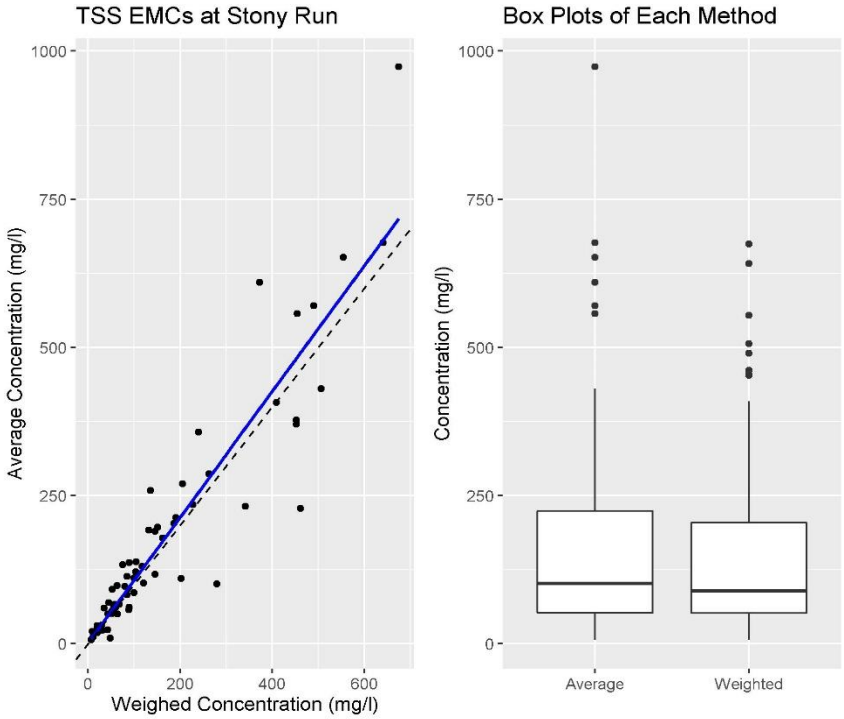



**Figure 12b.** EMC calculations of TSS.

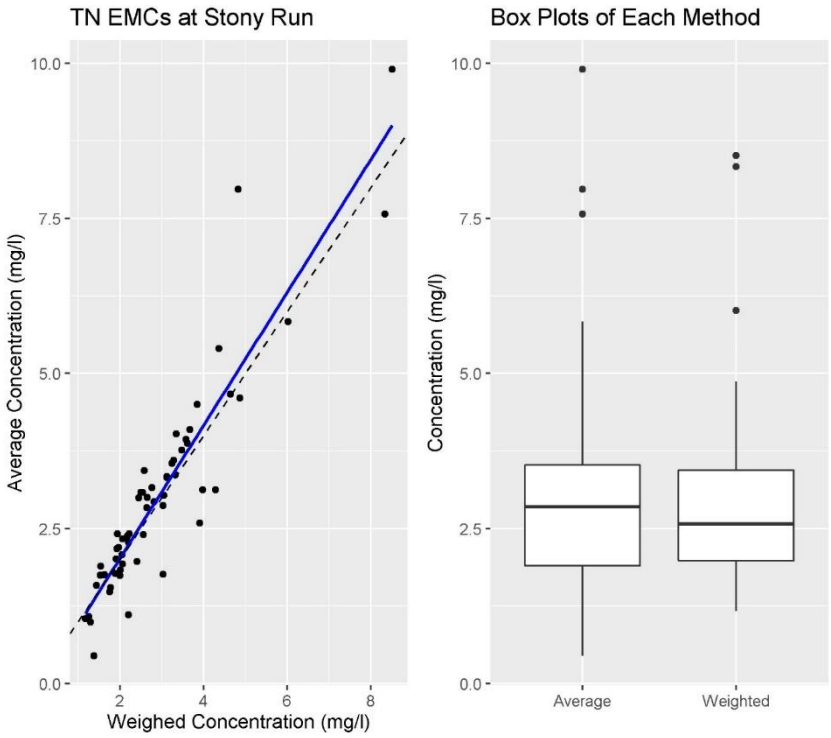



**Figure 12c.** EMC calculations of TN.

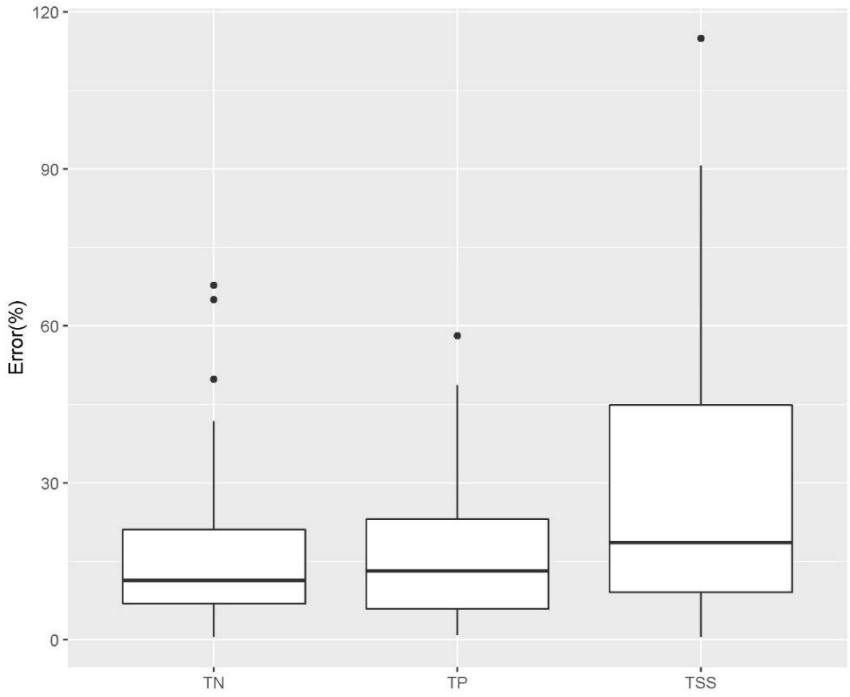



**Figure 13.** Error of each parameter.

# Tables.

**Tables 1a-1c.** Data coverage of the water quality parameters. Each site and flow combination are divided into periods (W = winter, Sp = spring, Su = summer, Au = Autumn, and A = annual) and colored depending on the data coverage. Pink = poor data coverage (< 75%), yellow = moderate coverage (between 75% and 80%), and green = good coverage (> 80%). A check mark (✓) indicates which time period a time series was created for.

| 1a. BACI | Instream | | | | | | | | | | Outfall | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stormflow | | | | | Baseflow | | | | | Stormflow | | | | | Baseflow | | | | |
| | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A |
| **BOD** | | | | | ✓ | | | | | | | ✓ | ✓ | | | | | | | |
| **TSS** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| ***E. coli*** | | | | | | | | | | | | | | | | | | | | |
| **$NO_{23}$** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| **TP** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| **TKN** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| **TCU** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| **TZN** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |
| **TPB** | | | | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | | | ✓ |

| 1b. CACO | Instream | | | | | | | | | | Outfall | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stormflow | | | | | Baseflow | | | | | Stormflow | | | | | Baseflow | | | | |
| | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A |
| **BOD** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| **TSS** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| ***E. coli*** | | | | | | | | | | | | | | | | | | | | |
| **$NO_{23}$** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| **TP** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| **TKN** | | | | ✓ | | | ✓ | ✓ | | | | | | | | | ✓ | ✓ | | |
| **TCU** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| **TZN** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |
| **TPB** | | | | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | ✓ | | |

| 1c. FRCO | Instream | | | | | | | | | | Outfall | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stormflow | | | | | Baseflow | | | | | Stormflow | | | | | Baseflow | | | | |
| | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A | W | Sp | Su | Au | A |
| **BOD** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TSS** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| ***E. coli*** | | | | | | | | | | | | | | | | | | | | |
| **$NO_{23}$** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TP** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TKN** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TCU** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TZN** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |
| **TPB** | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | |

**Tables 2a-2c.** Percent censoring indicated by colored cells of *culled* datasets. Percentage is colored to indicate the level of censoring: pink = heavy censoring (>50%), yellow = moderate censoring (between 5% and 50%), and green = little to no censoring (<5%). Standardized detection limit given in moderate cells.

| 2a. BACI | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | 0% | | 0% | |
| **TSS** | 0% | 1 mg/L<br>7.1% | 0% | 1 mg/L<br>17.2% |
| ***E. coli*** | 0% | 0% | 0% | 0% |
| **$NO_{23}$** | 0% | 0% | 0% | 0% |
| **TP** | 0% | 2.1% | 0% | 0% |
| **TKN** | 0.8% | 0.5 mg/L<br>12.3% | 1% | 0.5 mg/L<br>14.6% |
| **TCU** | 3.0% | 2 ug/L<br>21.1% | 3.9% | 2 ug/L<br>21.0% |
| **TZN** | 3.0% | 22 ug/L<br>21.7% | 3.9% | 22 ug/L<br>15.4% |
| **TPB** | 4.5% | | 3.9% | |

| 2b. CACO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | 1 mg/L<br>6.0% | | 3.2% | 4 mg/L<br>41.9% |
| **TSS** | 0% | 1 mg/L<br>16.9% | 0% | 3.4% |
| ***E. coli*** | 0% | 0% | 0% | 2 MPN/100<br>5.2% |
| **$NO_{23}$** | 0% | 0% | 0.05 mg/L<br>6.3% | 0.05 mg/L<br>11.5% |
| **TP** | 0% | 0.01 mg/L<br>19.1% | 0% | 0% |
| **TKN** | 0.5 mg/L<br>5.8% | | 0.5 mg/L<br>7.9% | 0.5 mg/L<br>31.0% |
| **TCU** | 2 ug/L<br>5.8% | | 2 ug/L<br>6.3% | 2 ug/L<br>42.5% |
| **TZN** | 20 ug/L<br>8.7% | | 3.1% | 20 ug/L<br>32.2% |
| **TPB** | 5 ug/L<br>35.7% | | | |

| 2c. FRCO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | 4 mg/L<br>35.0% | | 4 mg/L<br>24.8% | 4 mg/L<br>28.9% |
| **TSS** | 2.2% | 1 mg/L<br>33.2% | 2.9% | 1 mg/L<br>7.9% |
| ***E. coli*** | 0% | 0% | 0% | 0% |
| **$NO_{23}$** | 0% | 0% | 0% | 0.05 mg/L<br>10.5% |
| **TP** | 2.2% | 0.02 mg/L<br>20.0% | 0% | 2.6% |
| **TKN** | 0.5 mg/L<br>32.8% | | 0.5 mg/L<br>18.1% | 0.5 mg/L<br>34.2% |
| **TCU** | 2 ug/L<br>21.1% | | 1.8% | 2 ug/L<br>7.9% |
| **TZN** | 20 ug/L<br>16.7% | | 2.9% | 20 ug/L<br>5.3% |
| **TPB** | 2 ug/L<br>36.1% | | | |

**Table 3.** Breakdown of trend methods applied based on degree of censoring and data coverage.

| | **Trend Test** |
|---|---|
| **Minimal censoring (< 5 %)** | Seasonal Kendall on seasonally-culled data (annual time series) OR Mann-Kendall on seasonally-culled data (one-season time series) |
| **Moderate censoring (between 5% and 50%)** | Mann-Kendall on median-adjusted, seasonally-culled data (annual or one-season time series) |
| **Heavy censoring (> 50 %)** | Too censored for trend analysis. Plot the detection limits and measured values over time. |

**Tables 4a-4c.** Top row in each cell is the data type and degree of censoring. Bottom row, bolded, is the analysis method. An asterisk (*) indicates that the modified flow correcting (MFC) procedure was done. NAs indicate that trend analysis could not be completed due to inadequate sampling frequency.

| 4a. BACI | **Instream** | | **Outfall** | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | Annual; little censoring<br>**Seasonal Kendall * on Culled Data** | NA | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Season-Adjusted Culled Data** | NA |
| **TSS** | Annual; little censoring<br>**Seasonal Kendall * on Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | Annual; little censoring<br>**Seasonal Kendall * on Culled Data** | Annual; little censoring<br>**Seasonal Kendall on Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Annual; little censoring<br>**Seasonal Kendall on Culled Data** |
| **TP** | Annual; little censoring<br>**Seasonal Kendall * on Culled Data** | Annual; little censoring<br>**Seasonal Kendall on Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Annual; little censoring<br>**Seasonal Kendall on Culled Data** |
| **TKN** | Annual; little censoring<br>**Seasonal Kendall * on Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** |
| **TCU** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** |
| **TZN** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** |
| **TPB** | Annual; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring<br>**Plot** | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring<br>**Plot** |

| 4b. CACO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; high censoring<br>Summer; high censoring<br>**Plot** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** |
| **TSS** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data**<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data**<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Autumn; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** | Spring; little censoring<br>**Mann-Kendall on Culled Data**<br>Summer; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** |
| **TP** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data**<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; little censoring<br>Summer; little censoring<br>**Mann-Kendall on Culled Data** |
| **TKN** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; high censoring<br>Summer; high censoring<br>**Plot** | NA | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** |
| **TCU** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; high censoring<br>Summer; high censoring<br>**Plot** | Autumn; little censoring<br>**Mann-Kendall on Culled Data** | Spring; mod. censored<br>**Mann-Kendall on Median-Adjusted Culled Data**<br>Summer; high censoring<br>**Plot** |
| **TZN** | Autumn; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** | Spring; high censoring<br>Summer; high censoring<br>**Plot** | Autumn; mod. censoring<br>**Mann-Kendall on Median Adjusted Culled Data** | Spring; mod. censoring<br>Summer; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** |
| **TPB** | Autumn; mod. censoring<br>**Mann-Kendall on Median-Adjusted Culled Data** | Spring; high censoring<br>Summer; high censoring<br>**Plot** | Autumn; heavy censoring<br>**Plot** | Spring; high censoring<br>Summer; high censoring<br>**Plot** |

| 4c. FRCO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow | Baseflow | Stormflow | Baseflow |
| **BOD** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring **Plot** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | NA |
| **TSS** | Annual; little censoring **Seasonal Kendall * on Culled Data** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; little censoring **Seasonal Kendall * on Culled Data** | NA |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | Annual; little censoring **Seasonal Kendall * on Culled Data** | Annual; little censoring **Seasonal Kendall on Culled Data** | Annual; little censoring **Seasonal Kendall * on Culled Data** | NA |
| **TP** | Annual; little censoring **Seasonal Kendall * on Culled Data** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; little censoring **Seasonal Kendall * on Culled Data** | NA |
| **TKN** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring **Plot** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | NA |
| **TCU** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring **Plot** | Annual; little censoring **Seasonal Kendall * on Culled Data** | NA |
| **TZN** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring **Plot** | Annual; little censoring **Seasonal Kendall * on Culled Data** | NA |
| **TPB** | Annual; mod. censoring **Mann-Kendall on Median Adjusted Culled Data** | Annual; high censoring **Plot** | Annual; high censoring **Plot** | NA |

**Tables 5a-5c.** Eigenvectors and eigenvalues from the Principal Components analyses.

**Table 5a. Carroll County Outfall**

| | PC1 | PC2 | PC3 |
|---|---|---|---|
| *Eigen Vectors* | | | |
| Untreat | 0.395 | 0.919 | 0.00 |
| Dry | -0.650 | 0.279 | -0.707 |
| Nest | -0.650 | 0.279 | 0.707 |
| | | | |
| *Eigen Values* | 3,845 | 27.49 | 0.00 |
| *Proportion of Variance Accounted For* | 0.993 | 0.007 | 0.00 |

**Table 5b. Carroll County Instream**

| | PC1 | PC2 | PC3 |
|---|---|---|---|
| *Eigen Vectors* | | | |
| Untreat | 0.534 | 0.634 | 0.559 |
| Dry | -0.815 | 0.212 | 0.539 |
| Nest | -0.223 | 0.744 | -0.630 |
| | | | |
| *Eigen Values* | 5,242 | 66.83 | 3.854 |
| *Proportion of Variance Accounted For* | 0.987 | 0.013 | 0.00 |

**Table 5c. Frederick County Instream**

| | PC1 | PC2 | PC3 | PC4 |
|---|---|---|---|---|
| *Eigen Vectors* | | | | |
| Untreat | 0.594 | 0.107 | 0.798 | 0.00 |
| Dry | 0.533 | -0.795 | -0.290 | 0.00 |
| Wet | 0.603 | 0.597 | -0.529 | 0.00 |
| Filter | 0.00 | 0.00 | 0.000 | 1.00 |
| | | | | |
| *Eigen Values* | 2,339 | 114.5 | 17.99 | 0.00 |
| *Proportion of Variance Accounted For* | 0.946 | 0.046 | 0.007 | 0.00 |

**Tables 6a-6c.** Results of the Wilcoxon signed-rank test to compare median concentrations at outfall and instream sites. Green cells indicate significant differences ($p \leq 0.05$) between the outfall and instream concentrations. The bolded number indicates the larger median value. NS indicates a nonsignificant result.

| 6a. BACI | Stormflow | | | Baseflow | | |
|---|---|---|---|---|---|---|
| | Outfall median | Instream median | p-value | Outfall median | Instream median | p-value |
| **BOD (mg/L)** | **10.00** | 9.00 | NS | 1.00 | 1.00 | NS |
| **TSS (mg/L)** | 78.00 | **84.50** | 0.046 | 2.00 | **2.40** | NS |
| ***E. coli* (MPN/100)** | 24000 | **25000** | NS | **2300** | 1300 | NS |
| **$NO_{23}$ (mg/L)** | 0.69 | **0.76** | 0.009 | **2.65** | 1.56 | < 0.001 |
| **TP (mg/L)** | **0.30** | 0.28 | NS | **0.12** | 0.10 | < 0.001 |
| **TKN (mg/L)** | **1.40** | 1.26 | 0.005 | 0.66 | **0.70** | NS |
| **TCU (µg/L)** | **22.00 µg/L** | 19.00 µg/L | < 0.001 | **4.20 µg/L** | 3.80 µg/L | NS |
| **TZN (µg/L)** | **90.00 µg/L** | 82.00 µg/L | 0.04 | **36.00 µg/L** | 21.00 µg/L | < 0.001 |
| **TPB (µg/L)** | **19.00 µg/L** | 15.00 µg/L | < 0.001 | **1.01 µg/L** | 1.00 µg/L | 0.005 |

| 6b. CACO | Stormflow | | | Baseflow | | |
|---|---|---|---|---|---|---|
| | Outfall median | Instream median | p-value | Outfall median | Instream median | p-value |
| **BOD (mg/L)** | **4.67** | 4.59 | 0.034 | **3.00** | 1.00 | < 0.001 |
| **TSS (mg/L)** | 28.6 | **82.72** | < 0.001 | **10.00** | 4.00 | < 0.001 |
| ***E. coli* (MPN/100)** | 49 | **261** | < 0.001 | 151 | **558** | < 0.001 |
| **$NO_{23}$ (mg/L)** | 0.38 | **2.49** | < 0.001 | 0.33 | **6.8** | < 0.001 |
| **TP (mg/L)** | 0.14 | **0.23** | < 0.001 | **0.08** | 0.06 | < 0.001 |
| **TKN (mg/L)** | 0.94 | **1.14** | NS | **0.80** | 0.25 | < 0.001 |
| **TCU (µg/L)** | 4.70 | **5.71** | NS | **2.21** | 1.00 | < 0.001 |
| **TZN (µg/L)** | **28.21** | 22.00 | < 0.001 | **16.00** | 11.00 | < 0.001 |
| **TPB (µg/L)** | 1.50 | **2.50** | < 0.001 | 1.00 | 1.00 | NS |

| 6c. FRCO | Stormflow | | | Baseflow | | |
|---|---|---|---|---|---|---|
| | Outfall median | Instream median | p-value | Outfall median | Instream median | p-value |
| **BOD (mg/L)** | **3.00** | 2.41 | NS (0.054) | **3.00** | 1.00 | < 0.001 |
| **TSS (mg/L)** | 8.67 | **44.71** | < 0.001 | **7.00** | 2.00 | < 0.001 |
| ***E. coli* (MPN/100)** | **1517** | 495 | NS | **133** | 84 | NS |
| **$NO_{23}$ (mg/L)** | 0.31 | **1.78** | < 0.001 | 0.28 | **3.00** | < 0.001 |
| **TP (mg/L)** | 0.17 | 0.17 | NS | **0.19** | 0.08 | < 0.001 |
| **TKN (mg/L)** | 0.86 | 0.86 | NS | **0.90** | 0.25 | < 0.001 |
| **TCU (µg/L)** | **4.44** | 3.74 | NS | **5.00** | 1.00 | < 0.001 |
| **TZN (µg/L)** | **26.40** | 21.48 | NS | **38.10** | 12.50 | < 0.001 |
| **TPB (µg/L)** | 1.00 | **2.40** | < 0.001 | 1.00 | 1.00 | NS |

**Tables 7a-7c.** Results of the permutation and t-test methods to compare mean concentrations at outfall and instream sites. Green cells indicate significant differences ($p \leq 0.05$) between the outfall and instream concentrations. The bolded number indicates the larger median value. NS indicates a nonsignificant result.

| 7a. BACI | Stormflow | | | | Baseflow | | | |
|---|---|---|---|---|---|---|---|---|
| | Outfall mean | Instream mean | t-test p-value | Perm. p-value | Outfall mean | Instream mean | t-test p-value | Perm. p-value |
| **BOD (mg/L)** | **13.98** | 12.52 | 0.10 | 0.10 | **2.07** | 1.84 | 0.22 | 0.22 |
| **TSS (mg/L)** | 111.5 | **126.8** | 0.03 | 0.03 | 3.86 | **4.03** | 0.79 | 0.81 |
| ***E. coli* (MPN/100)** | **84888** | 74297 | 0.52 | 0.57 | **4324.8** | 2952.4 | 0.13 | 0.13 |
| **$NO_{23}$ (mg/L)** | 0.75 | **0.82** | 0.01 | 0.01 | **2.63** | 1.60 | <0.01 | <0.01 |
| **TP (mg/L)** | **0.36** | 0.34 | 0.15 | 0.15 | **0.18** | 0.14 | 0.03 | 0.02 |
| **TKN (mg/L)** | **2.00** | 1.66 | 0.01 | <0.01 | **1.19** | 0.93 | 0.13 | 0.13 |
| **TCU (µg/L)** | **26.49** | 22.10 | <0.01 | <0.01 | **5.51** | 4.74 | 0.10 | 0.11 |
| **TZN (µg/L)** | **117.2** | 106.1 | 0.14 | 0.15 | **37.7** | 29.0 | <0.01 | <0.01 |
| **TPB (µg/L)** | **26.93** | 21.33 | 0.01 | 0.01 | **2.01** | 1.62 | 0.02 | 0.01 |

| 7b. CACO | Stormflow | | | | Baseflow | | | |
|---|---|---|---|---|---|---|---|---|
| | Outfall mean | Instream mean | t-test p-value | Perm. p-value | Outfall mean | Instream mean | t-test p-value | Perm. p-value |
| **BOD (mg/L)** | **7.98** | 6.09 | 0.01 | 0.01 | **4.16** | 1.96 | <0.01 | <0.01 |
| **TSS (mg/L)** | 66.6 | **119.5** | <0.01 | <0.01 | **13.27** | 6.49 | <0.01 | <0.01 |
| ***E. coli* (MPN/100)** | 3446 | **6851** | 0.22 | 0.01 | 1481 | **3769** | 0.02 | <0.01 |
| **$NO_{23}$ (mg/L)** | 0.45 | **2.49** | <0.01 | <0.01 | 0.65 | **6.48** | <0.01 | <0.01 |
| **TP (mg/L)** | 0.21 | **0.33** | 0.01 | <0.01 | 0.09 | 0.09 | 0.91 | 0.92 |
| **TKN (mg/L)** | 1.11 | **1.28** | 0.20 | 0.20 | **1.00** | 0.43 | <0.01 | <0.01 |
| **TCU (µg/L)** | **8.59** | 6.87 | 0.06 | 0.06 | **3.83** | 1.86 | 0.01 | <0.01 |
| **TZN (µg/L)** | **38.2** | 26.5 | <0.01 | <0.01 | **31.4** | 14.8 | 0.08 | <0.01 |
| **TPB (µg/L)** | 2.47 | **3.52** | <0.01 | <0.01 | 2.25 | **2.27** | 0.55 | 0.75 |

| 7c. FRCO | Stormflow | | | | Baseflow | | | |
|---|---|---|---|---|---|---|---|---|
| | Outfall mean | Instream mean | t-test p-value | Perm. p-value | Outfall mean | Instream mean | t-test p-value | Perm. p-value |
| **BOD (mg/L)** | **3.91** | 3.52 | 0.27 | 0.27 | **3.38** | 1.22 | <0.01 | <0.01 |
| **TSS (mg/L)** | 19.8 | **168.3** | <0.01 | <0.01 | **16.2** | 2.92 | <0.01 | <0.01 |
| ***E. coli* (MPN/100)** | **1350** | 876 | 0.03 | 0.03 | 122 | **144** | 0.75 | 0.79 |
| **$NO_{23}$ (mg/L)** | 0.41 | **1.87** | <0.01 | <0.01 | 0.58 | **3.09** | <0.01 | <0.01 |
| **TP (mg/L)** | 0.21 | **0.33** | 0.01 | 0.01 | **0.23** | 0.11 | <0.01 | <0.01 |
| **TKN (mg/L)** | 1.02 | **1.06** | 0.65 | 0.66 | **0.81** | 0.39 | <0.01 | <0.01 |
| **TCU (µg/L)** | 5.40 | **6.05** | 0.37 | 0.38 | **4.90** | 1.93 | <0.01 | <0.01 |
| **TZN (µg/L)** | 31.88 | **36.27** | 0.33 | 0.36 | **40.3** | 19.9 | <0.01 | <0.01 |
| **TPB (µg/L)** | 2.29 | **5.35** | <0.01 | <0.01 | **1.91** | 1.73 | 0.36 | 0.38 |

**Tables 8a-8c.** Results of all methods used for trend analysis. Parameters that were non-significant for each method were left as blanks. A dash indicates that no tests could be done due to issues with the data.

Direction = The direction of trend; either Positive or Negative.

Significant (Signif)? = How many methods found the trend to be significant? If all methods resulted in significant negative trends, cell colored dark blue; if only some methods resulted in significant negative trends, cell colored light blue. If all methods resulted in significant positive trends, cell colored dark gold; if only some methods resulted in significant positive trends, cell colored light gold. Step trend method results excluded from the count because it does not test for increasing or decreasing through entire time period. Also, only tests performed on annual data were included in the count, so seasonal time series were excluded.

| 8a. BACI | Instream | | | | Outfall | | | |
|---|---|---|---|---|---|---|---|---|
| | Stormflow | | Baseflow | | Stormflow | | Baseflow | |
| | Direction | Signif? | Direction | Signif? | Direction | Signif? | Direction | Signif? |
| **BOD** | Pos. | 1/4 | - | - | Pos. | 2/3 | | |
| **TSS** | | | | | Pos. | 3/3 | Neg. | 1/4 |
| ***E. coli*** | Neg. | 3/3 | | | Neg. | 3/3 | | |
| **$NO_{23}$** | Neg. | 5/5 | | | | | | |
| **TP** | | | | | | | | |
| **TKN** | | | | | Pos. | 1/3 | Neg. | 1/4 |
| **TCU** | | | Neg. | 1/1 | | | Neg. | 1/1 |
| **TZN** | Neg. | 3/4 | Neg. | 1/1 | | | Neg. | 1/1 |
| **TPB** | Neg. | 2/4 | | | | | - | - |

| 8b. CACO | Instream | | | | Outfall | | | |
|---|---|---|---|---|---|---|---|---|
| | Stormflow | | Baseflow | | Stormflow | | Baseflow | |
| | Direction | Signif? | Direction | Signif? | Direction | Signif? | Direction | Signif? |
| **BOD** | | | - | - | Pos. | 2/3 | | |
| **TSS** | | | | | Neg. | 1/3 | | |
| ***E. coli*** | | | | | | | | |
| **$NO_{23}$** | | | Neg. | 3/3 | | | Neg. | 3/3 |
| **TP** | | | Neg. | 1/3 | Neg. | 3/3 | Neg. | 3/3 |
| **TKN** | | | | | | | | |
| **TCU** | Neg. | 3/3 | - | - | Neg. | 3/3 | | |
| **TZN** | | | - | - | Neg. | 3/3 | | |
| **TPB** | | | - | - | Neg. | 3/3 | - | - |

| 8c. FRCO | Instream | | | | Outfall | | | |
|---|---|---|---|---|---|---|---|---|
| | Stormflow | | Baseflow | | Stormflow | | Baseflow | |
| | Direction | Signif? | Direction | Signif? | Direction | Signif? | Direction | Signif? |
| **BOD** | | | - | - | Neg. | 1/4 | - | - |
| **TSS** | | | Neg. | 4/4 | Neg. | 2/5 | | |
| ***E. coli*** | | | | | | | | |
| **$NO_{23}$** | Neg. | 5/5 | Neg. | 2/4 | Neg. | 3/5 | Neg. | 2/3 |
| **TP** | | | Neg. | 1/4 | Neg. | 5/5 | | |
| **TKN** | Pos. | 4/4 | | | Neg. | 2/4 | | |
| **TCU** | Neg. | 4/4 | - | - | Neg. | 5/5 | - | - |
| **TZN** | | | - | - | | | - | - |
| **TPB** | Neg. | 2/4 | - | - | Neg. | 1/3 | - | - |

**Tables 9a-9b.** Permutation trend results for (a) stormflow and (b) baseflow concentrations. P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue.

| 9a. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value |
| **BOD** | 0.16 | 0.08 | 0.22 | 0.03 | 0.23 | 0.06 | 0.28 | 0.03 | 0.04 | 0.61 | -0.16 | 0.06 |
| **TSS** | 0.06 | 0.51 | 0.20 | 0.05 | -0.01 | 0.94 | -0.32 | 0.01 | -0.06 | 0.46 | -0.29 | < 0.01 |
| ***E. coli*** | -0.43 | < 0.01 | -0.42 | 0.01 | 0.22 | 0.20 | 0.19 | 0.27 | -0.11 | 0.71 | -0.27 | 0.38 |
| **$NO_{23}$** | -0.26 | < 0.01 | -0.11 | 0.27 | 0.04 | 0.77 | -0.10 | 0.42 | -0.37 | < 0.01 | -0.26 | < 0.01 |
| **TP** | 0.07 | 0.42 | 0.14 | 0.18 | -0.06 | 0.63 | -0.34 | 0.01 | -0.06 | 0.44 | -0.29 | < 0.01 |
| **TKN** | 0.14 | 0.12 | 0.19 | 0.06 | 0.23 | 0.06 | 0.16 | 0.21 | 0.22 | < 0.01 | -0.18 | 0.03 |
| **TCU** | -0.06 | 0.52 | -0.10 | 0.32 | -0.40 | < 0.01 | -0.61 | < 0.01 | -0.29 | < 0.01 | -0.22 | 0.01 |
| **TZN** | -0.19 | 0.03 | -0.02 | 0.88 | 0.01 | 0.96 | -0.40 | < 0.01 | 0.02 | 0.81 | -0.07 | 0.42 |
| **TPB** | -0.15 | 0.09 | 0.03 | 0.74 | -0.16 | 0.19 | -0.53 | < 0.01 | -0.16 | 0.03 | -0.14 | 0.09 |

| 9b. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value |
| **TSS** | -0.03 | 0.69 | -0.14 | 0.08 | -0.06 | 0.58 | 0.20 | 0.06 | -0.22 | < 0.01 | 0.12 | 0.47 |
| ***E. coli*** | -0.21 | 0.09 | -0.18 | 0.16 | 0.19 | 0.14 | 0.09 | 0.47 | -0.10 | 0.49 | 0.10 | 0.80 |
| **$NO_{23}$** | 0.13 | 0.10 | -0.06 | 0.45 | -0.33 | < 0.01 | -0.27 | 0.01 | -0.18 | 0.01 | -0.34 | 0.04 |
| **TP** | -0.02 | 0.85 | -0.09 | 0.28 | -0.13 | 0.21 | -0.44 | < 0.01 | -0.04 | 0.55 | -0.12 | 0.48 |
| **TKN** | -0.11 | 0.17 | -0.16 | 0.04 | -0.05 | 0.65 | 0.20 | 0.06 | -0.02 | 0.76 | 0.08 | 0.63 |

**Tables 10a-10c.** Results of Mann-Kendall and Seasonal Kendall trend analysis, including modified flow correcting (MFC) results. P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue. Plus or minus signs indicate the trend direction: increasing (+) or decreasing (-). NA indicates issues with data that prevented analysis, either inadequate data coverage or heavy censoring. NS indicates a nonsignificant result.

| 10a. BACI | **Instream** | | **Outfall** | |
|---|---|---|---|---|
| | Stormflow (ANNUAL) | Baseflow (ANNUAL) | Stormflow (SPRING, SUMMER) | Baseflow (ANNUAL) |
| **BOD** | NS (+)<br>MFC: NS (+) | NA | Spring: NA (+)<br>Summer: NA (+) | NA |
| **TSS** | NS (-)<br>MFC: NS (-) | NS (-) | Spring: < 0.001 (+)<br>Summer: NS (-) | NS (-) |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | 0.045 (-)<br>MFC: 0.033 (-) | NS (+) | Spring: NS (-)<br>Summer: NS (-) | NS (-) |
| **TP** | NS (-)<br>MFC: NS (-) | NS (-) | Spring: NS (+)<br>Summer: 0.021 (-) | NS (-) |
| **TKN** | NS (+)<br>MFC: NS (+) | NS (-) | Spring: NS (+)<br>Summer: NS (+) | NS (-) |
| **TCU** | NS (-) | < 0.001 (-) | Spring: NS (-)<br>Summer: 0.019 (-) | < 0.001 (-) |
| **TZN** | 0.010 (-) | 0.013 (-) | Spring: NS (+)<br>Summer: < 0.001 (-) | < 0.001 (-) |
| **TPB** | 0.035 (-) | NA | Spring: NS (+)<br>Summer: NS (-) | NA |

| 10b. CACO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow (AUTUMN) | Baseflow (SPRING, SUMMER) | Stormflow (AUTUMN) | Baseflow (SPRING, SUMMER) |
| **BOD** | NS (+) | NA | 0.017 (+) | Spring: NS (+)<br>Summer: NS (+) |
| **TSS** | NS (-) | Spring: NS (-)<br>Summer: NS (-) | NS (+) | Spring: NS (+)<br>Summer: 0.011 (+) |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | NS (+) | Spring: < 0.001 (-)<br>Summer: NS (-) | < 0.001 (-) | Spring: NS (+)<br>Summer: NS (+) |
| **TP** | NS (+) | Spring: NS (-)<br>Summer: < 0.001 (-) | NS (+) | Spring: 0.027 (-)<br>Summer: NS (-) |
| **TKN** | NS (+) | NA | NA | Spring: NS (+)<br>Summer: NS (+) |
| **TCU** | NS (-) | NA | < 0.001 (-) | Spring: 0.014 (-)<br>Summer: NA |
| **TZN** | NS (-) | NA | NS (-) | Spring: NS (+)<br>Summer: NS (+) |
| **TPB** | NS (-) | NA | NA | NA |

| 10c. FRCO | Instream | | Outfall | |
|---|---|---|---|---|
| | **Stormflow (ANNUAL)** | **Baseflow (ANNUAL)** | **Stormflow (ANNUAL)** | **Baseflow (ANNUAL)** |
| **BOD** | NS (+) | NA | NS (-) | NA |
| **TSS** | NS (+)<br>MFC: NS (-) | < 0.001 (-) | NS (+)<br>MFC: NS (+) | NA |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | < 0.001 (-)<br>MFC: < 0.001 (-) | NS (-) | NS (-)<br>MFC: NS (-) | NA |
| **TP** | NS (-)<br>MFC: NS (-) | NS (-) | < 0.001 (-)<br>MFC: < 0.001 (-) | NA |
| **TKN** | < 0.001 (+) | NA | NS (-) | NA |
| **TCU** | 0.0086 (-) | NA | 0.050 (-)<br>MFC: 0.050 (-) | NA |
| **TZN** | NS (-) | NA | NS (-)<br>MFC: NS (-) | NA |
| **TPB** | NS (-) | NA | NA | NA |

**Tables 11a-11b.** Log-link least squares regression results for stormflow (a) and baseflow (b) concentrations. Values represent the multiplicative change over each year (e.g., 1.2 implies 20% increase). P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends (a > 1.00) are highlighted gold, and significantly decreasing trends (a < 1.00) are highlighted blue.

| 11a. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **BOD** | 1.02 | 0.07 | 1.03 | 0.10 | 1.04 | 0.08 | 1.06 | 0.03 | 1.01 | 0.48 | 0.97 | 0.02 |
| **TSS** | 1.01 | 0.75 | 1.05 | 0.05 | 0.99 | 0.76 | 0.92 | 0.05 | 0.97 | 0.09 | 0.14 | < 0.01 |
| ***E. coli*** | 0.65 | 0.01 | 0.53 | 0.04 | 1.16 | 0.48 | 1.11 | 0.59 | 0.83 | 0.75 | 0.78 | 0.53 |
| **$NO_{23}$** | 0.98 | < 0.01 | 0.99 | 0.32 | 1.00 | 0.95 | 0.98 | 0.39 | 0.97 | < 0.01 | 0.93 | < 0.01 |
| **TP** | 1.01 | 0.46 | 1.02 | 0.21 | 0.99 | 0.57 | 0.94 | 0.02 | 0.99 | 0.43 | 0.93 | < 0.01 |
| **TKN** | 1.02 | 0.08 | 1.04 | 0.04 | 1.03 | 0.08 | 1.02 | 0.22 | 1.05 | < 0.01 | 0.96 | 0.03 |
| **TCU** | 0.99 | 0.58 | 0.99 | 0.36 | 0.93 | < 0.01 | 0.87 | < 0.01 | 0.93 | < 0.01 | 0.95 | 0.01 |
| **TZN** | 0.97 | 0.05 | 1.00 | 0.97 | 1.00 | 0.93 | 0.93 | < 0.01 | 1.00 | 0.81 | 0.99 | 0.44 |
| **TPB** | 0.97 | 0.10 | 1.01 | 0.73 | 0.98 | 0.20 | 0.91 | < 0.01 | 0.94 | < 0.01 | 0.91 | 0.17 |

| 11b. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **TSS** | 0.98 | 0.59 | 0.96 | 0.09 | 0.99 | 0.62 | 1.03 | 0.08 | 0.89 | < 0.01 | 1.06 | 0.28 |
| ***E. coli*** | 0.87 | 0.06 | 0.92 | 0.26 | 1.13 | 0.39 | 1.09 | 0.69 | 0.87 | 0.55 | 1.39 | 0.69 |
| **$NO_{23}$** | 1.01 | 0.11 | 1.00 | 0.44 | 0.98 | < 0.01 | 0.92 | 0.02 | 0.99 | 0.01 | 0.73 | 0.07 |
| **TP** | 1.00 | 0.89 | 0.98 | 0.40 | 0.96 | 0.20 | 0.95 | < 0.01 | 0.98 | 0.68 | 0.98 | 0.55 |
| **TKN** | 0.98 | 0.30 | 0.95 | 0.13 | 0.99 | 0.68 | 1.03 | 0.10 | 0.99 | 0.78 | 1.01 | 0.62 |

**Tables 12a-12b.** Logistic regression results for stormflow (a) and baseflow (b) concentrations. Values represent the multiplicative change in odds of a high concentration greater than the median (e.g., 1.2 implies 20% increase in odds over one year). P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends (a > 1.00) are highlighted gold, and significantly decreasing trends (a < 1.00) are highlighted blue.

| 12a. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **BOD** | 1.10 | 0.02 | 1.17 | < 0.01 | 1.07 | 0.24 | 1.09 | 0.14 | 0.99 | 0.86 | 0.96 | 0.44 |
| **TSS** | 1.01 | 0.84 | 1.10 | 0.02 | 1.01 | 0.86 | 0.94 | 0.24 | 0.97 | 0.39 | 1.02 | 0.74 |
| ***E. coli*** | 0.45 | < 0.01 | 0.69 | 0.02 | 1.09 | 0.52 | 0.99 | 0.91 | 0.35 | 0.37 | 0.29 | 0.26 |
| **$NO_{23}$** | 0.91 | 0.02 | 0.96 | 0.35 | 0.99 | 0.85 | 1.01 | 0.84 | 0.83 | < 0.01 | 0.91 | 0.04 |
| **TP** | 1.03 | 0.38 | 1.07 | 0.13 | 0.97 | 0.58 | 0.77 | < 0.01 | 1.00 | 0.91 | 0.90 | 0.04 |
| **TKN** | 1.02 | 0.59 | 1.06 | 0.13 | 1.05 | 0.33 | 1.10 | 0.11 | 1.12 | < 0.01 | 0.96 | 0.39 |
| **TCU** | 0.95 | 0.21 | 0.93 | 0.07 | 0.79 | < 0.01 | 0.67 | < 0.01 | 0.86 | < 0.01 | 0.90 | 0.02 |
| **TZN** | 0.94 | 0.10 | 0.99 | 0.79 | 0.97 | 0.63 | 0.87 | 0.02 | 1.02 | 0.50 | 1.02 | 0.60 |
| **TPB** | 0.91 | 0.02 | 1.04 | 0.35 | 0.98 | 0.66 | 0.67 | < 0.01 | 0.95 | 0.16 | 0.84 | < 0.01 |

| 12b. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **TSS** | 0.97 | 0.40 | 0.92 | 0.02 | 0.98 | 0.67 | 1.08 | 0.08 | 0.90 | < 0.01 | 0.99 | 0.95 |
| ***E. coli*** | 0.92 | 0.40 | 0.84 | 0.08 | 1.17 | 0.08 | 1.00 | 0.97 | 1.09 | 0.75 | NA | NA |
| **$NO_{23}$** | 1.02 | 0.64 | 0.98 | 0.49 | 0.86 | < 0.01 | 0.92 | 0.05 | 0.97 | 0.32 | 0.71 | 0.01 |
| **TP** | 1.02 | 0.50 | 0.98 | 0.58 | 0.87 | < 0.01 | 0.84 | < 0.01 | 0.89 | < 0.01 | 0.94 | 0.44 |
| **TKN** | 0.97 | 0.28 | 0.97 | 0.32 | 1.00 | 0.93 | 1.08 | 0.06 | 1.00 | 0.92 | 1.19 | 0.06 |

**Tables 13a-13c.** Results of step trend analysis. P-values are given for the Kruskal-Wallis (KW) test and the individual Mann-Whitney tests by period if the KW test was significant. Green cells represent significant differences between periods. NS indicates a non-significant p-value. NA indicates issues with data that prevented analysis, either inadequate data coverage or heavy censoring. NS indicates a nonsignificant result.

| 13a. BACI | **Instream** | | **Outfall** | |
|---|---|---|---|---|
| | Stormflow (ANNUAL) | Baseflow (ANNUAL) | Stormflow (SPRING, SUMMER) (PERIODS II, III) | Baseflow (ANNUAL) |
| **BOD** | NS | NA | Spring: NS<br>Summer: NS | NA |
| **TSS** | NS | NS | Spring: NS<br>Summer: NS | NS |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | KW: 0.014<br>I ~ II: 0.024<br>I ~ III: 0.0070<br>II ~ III: NS | NS | Spring: NS<br>Summer: NS | NS |
| **TP** | NS | NS | Spring: NS<br>Summer: NS | NS |
| **TKN** | NS | KW: < 0.001<br>I ~ II : < 0.001<br>I ~ III: 0.049<br>II ~ III: < 0.001 | Spring: NS<br>Summer: NS | KW: < 0.001<br>I ~ II : 0.008<br>I ~ III: NS<br>II ~ III: < 0.001 |
| **TCU** | NS | KW: < 0.001<br>I ~ II : NS<br>I ~ III: < 0.001<br>II ~ III: < 0.001 | Spring: NS<br>Summer: NS | KW: < 0.001<br>I ~ II : NS<br>I ~ III: < 0.001<br>II ~ III: < 0.001 |
| **TZN** | NS | NS | Spring: NS<br>Summer: NS | KW: < 0.001<br>I ~ II : NS<br>I ~ III: < 0.001<br>II ~ III: < 0.001 |
| **TPB** | NS | NA | Spring: NS<br>Summer: NS | NA |

| 13b. CACO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow (AUTUMN) (PERIODS II, III) | Baseflow (SPRING,SUMMER) (PERIODS II, III) | Stormflow (AUTUMN) (PERIODS II, III) | Baseflow (SPRING,SUMMER) (PERIODS II, III) |
| **BOD** | NS | NA | NS | Spring: NS<br>Summer: NS |
| **TSS** | NS | Spring: NS<br>Summer: NS | NS | Spring: NS<br>Summer: 0.0042 |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | NS | Spring: NS<br>Summer: NS | NS | Spring: NS<br>Summer: NS |
| **TP** | NS | Spring: NS<br>Summer: NS | NS | Spring: NS<br>Summer: NS |
| **TKN** | NS | NA | NA | Spring: NS<br>Summer: NS |
| **TCU** | NS | NA | 0.032 | Spring: 0.0055<br>Summer: NA |
| **TZN** | NS | NA | NS | Spring: NS<br>Summer: NS |
| **TPB** | NS | NA | NA | NA |

| 13c. FRCO | Instream | | Outfall | |
|---|---|---|---|---|
| | Stormflow (ANNUAL) | Baseflow (ANNUAL) | Stormflow (ANNUAL) | Baseflow (ANNUAL) |
| **BOD** | NS | NA | NS | NA |
| **TSS** | NS | KW: < 0.001<br>I ~ II: 0.0095<br>I ~ III: 0.0095<br>II ~ III: < 0.001 | NS | NA |
| ***E. coli*** | NA | NA | NA | NA |
| **$NO_{23}$** | NS | NS | NS | NA |
| **TP** | NS | KW: 0.0015<br>I ~ II: NS<br>I ~ III: NS<br>II ~ III: < 0.001 | NS | NA |
| **TKN** | NS | NA | NS | NA |
| **TCU** | KW: 0.036<br>I ~ II: NS<br>I ~ III: 0.015<br>II ~ III: NS | NA | NS | NA |
| **TZN** | NS | NA | NS | NA |
| **TPB** | NS | NA | NA | NA |

**Table 14.** Trends observed in runoff coefficient over time. P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue.

| | Permutation Method | | Log-Transformed Least Square Regression | |
|---|---|---|---|---|
| | Correlation | p-value | Coefficient | p-value |
| **Outfall** | | | | |
| **BACI** | 0.35 | < 0.01 | 0.40 | < 0.01 |
| **CACO** | -0.49 | < 0.01 | -0.58 | < 0.01 |
| **FRCO** | -0.03 | 0.68 | 0.13 | 0.13 |
| **Instream** | | | | |
| **BACI** | 0.06 | 0.49 | 0.06 | 0.49 |
| **CACO** | -0.12 | 0.30 | -0.33 | 0.01 |
| **FRCO** | -0.06 | 0.45 | 0.04 | 0.60 |

**Table 15a.** Permutation trend results for unit loads during stormflow. P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue.

| 15a. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value | C | p-value |
| **TSS** | 0.05 | 0.57 | 0.34 | <0.01 | -0.12 | 0.32 | -0.34 | 0.01 | 0.02 | 0.81 | -0.07 | 0.39 |
| **$NO_{23}$** | -0.11 | 0.22 | 0.27 | 0.01 | -0.16 | 0.19 | -0.31 | 0.01 | -0.09 | 0.24 | -0.08 | 0.33 |
| **TP** | 0.05 | 0.61 | 0.36 | <0.01 | -0.12 | 0.35 | -0.40 | 0.00 | -0.02 | 0.82 | -0.08 | 0.38 |
| **TKN** | 0.13 | 0.16 | 0.38 | <0.01 | -0.09 | 0.44 | -0.38 | 0.00 | 0.05 | 0.51 | -0.11 | 0.21 |

**Table 15b.** Log-link results for unit loads during stormflow. Values represent the multiplicative change over each year (e.g., 1.2 implies 20% increase). P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue.

| 15b. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **TSS** | 1.01 | 0.62 | 1.08 | 0.00 | 0.94 | 0.52 | 0.89 | 0.08 | 1.01 | 0.84 | 0.91 | 0.38 |
| **$NO_{23}$** | 0.98 | 0.21 | 1.04 | 0.01 | 0.94 | 0.32 | 0.29 | 0.00 | 0.97 | 0.43 | 0.96 | 0.35 |
| **TP** | 1.01 | 0.65 | 1.07 | 0.00 | 0.95 | 0.51 | 0.88 | 0.02 | 0.99 | 0.89 | 0.93 | 0.50 |
| **TKN** | 1.02 | 0.17 | 1.08 | 0.00 | 0.94 | 0.63 | 0.87 | 0.01 | 1.02 | 0.59 | 0.93 | 0.21 |

**Table 15c.** Logistic regression results for unit loads during stormflow. Values represent the multiplicative change in odds of a high concentration greater than the median (e.g., 1.2 implies 20% increase in odds over one year). P-values less than or equal to 0.05 are considered to be statistically significant. Significantly increasing trends are highlighted gold, and significantly decreasing trends are highlighted blue.

| 15c. | BACI | | | | CACO | | | | FRCO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instream | | Outfall | | Instream | | Outfall | | Instream | | Outfall | |
| | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value | a | p-value |
| **TSS** | 0.99 | 0.74 | 1.20 | <0.01 | 0.93 | 0.18 | 0.73 | <0.01 | 1.01 | 0.87 | 1.02 | 0.69 |
| **$NO_{23}$** | 0.98 | 0.49 | 1.13 | <0.01 | 0.94 | 0.21 | 0.86 | 0.01 | 0.95 | 0.13 | 1.01 | 0.87 |
| **TP** | 0.99 | 0.75 | 1.13 | 0.01 | 0.91 | 0.07 | 0.72 | <0.01 | 0.96 | 0.17 | 0.99 | 0.84 |
| **TKN** | 1.03 | 0.46 | 1.18 | <0.01 | 0.96 | 0.47 | 0.77 | <0.01 | 1.05 | 0.14 | 1.05 | 0.29 |

**Table 16.** Land cover and BMP Capture at the Carroll County outfall.

| Year | Untreated[1] Impervious Cover (acres) | Treated[2] Impervious Cover (acres) | Nested[3] Treatment (acres) |
|---|---|---|---|
| **2000-2002** | 49.7 | 0 | 0 |
| **2003** | 49.7 | 16.9 | 16.9 |
| **2004** | 49.7 | 22.0 | 22.0 |
| **2005** | 49.6 | 23.3 | 23.3 |
| **2006** | 46.6 | 27.2 | 27.2 |
| **2007** | 53.7 | 27.2 | 27.2 |
| **2008** | 0.0 | 80.9 | 28.1 |
| **2009** | 0.0 | 81.0 | 29.5 |
| **2010** | 0.0 | 82.5 | 29.5 |
| **2011** | 0.0 | 84.0 | 29.5 |
| **2012** | 0.0 | 89.7 | 31.7 |
| **2013** | 0.1 | 95.3 | 33.9 |
| **2014** | 0.0 | 95.4 | 33.9 |
| **2015** | 0.0 | 95.6 | 33.9 |
| **2016** | 0.0 | 95.8 | 34.1 |

1. **Untreated:** Impervious Cover not treated by any BMP
2. **Treated:** Impervious Cover treated by any "modern" (post 2000) BMP. Includes both small BMPs within a larger BMP drainage area and large BMPs.
3. **Nested :** Impervious Cover treated in a small BMP within the drainage are of a larger practice

**Table 17.** Land cover and BMP capture at Carroll County instream.

| Year | Untreated[1] Impervious Cover (acres) | Treated[2] Impervious Cover (acres) | Nested[3] Treatment (acres) |
|---|---|---|---|
| **2000-2002** | 79.0 | 0 | 0 |
| **2003** | 79.0 | 16.9 | 16.9 |
| **2004** | 79.0 | 22.0 | 22.0 |
| **2005** | 79.0 | 23.3 | 23.3 |
| **2006** | 79.7 | 27.2 | 27.2 |
| **2007** | 52.3 | 65.1 | 35.6 |
| **2008** | 0.0 | 118.8 | 36.5 |
| **2009** | 1.1 | 119.7 | 38.7 |
| **2010** | 0.0 | 121.1 | 40.1 |
| **2011** | 0.0 | 124.1 | 40.1 |
| **2012** | 0.8 | 129.8 | 42.3 |
| **2013** | 2.1 | 135.4 | 44.5 |
| **2014** | 2.0 | 135.5 | 44.5 |
| **2015** | 2.0 | 135.7 | 44.5 |
| **2016** | 2.0 | 135.9 | 44.7 |

1. **Untreated:** Impervious Cover not treated by any BMP
2. **Treated:** Impervious Cover treated by any "modern" (post 2000) BMP. Includes both small BMPs within a larger BMP drainage area and large BMPs.
3. **Nested:** Impervious Cover treated in a small BMP within the drainage are of a larger practice

**Table 18.** Land cover and BMP capture at Frederick County instream.

| Year | Untreated[1] Impervious Cover (acres) | Dry Pond[2] Impervious Cover (acres) | Wet Practice[3] Impervious Cover (acres) | Filters and Other[4] Impervious Cover (acres) |
|---|---|---|---|---|
| **1999-2002** | 130.5 | 0 | 8.2 | 0.0 |
| **2003** | 130.5 | 0.0 | 8.2 | 0.0 |
| **2004** | 135.9 | 37.8 | 18.8 | 0.0 |
| **2005** | 176.5 | 51.6 | 18.8 | 0.0 |
| **2006** | 167.7 | 60.4 | 18.8 | 0.0 |
| **2007** | 180.8 | 61.35 | 46.3 | 0.0 |
| **2008** | 193.9 | 62.3 | 73.8 | 0.0 |
| **2009** | 226.1 | 62.3 | 82.9 | 1.3 |
| **2010** | 200.7 | 62.3 | 87.6 | 22.0 |
| **2011** | 171.6 | 62.3 | 127.2 | 29.3 |
| **2012** | 167.4 | 62.3 | 127.2 | 33.5 |
| **2013** | 110.6 | 102 | 136.8 | 46.3 |
| **2014** | 112.6 | 102 | 136.8 | 46.5 |
| **2015** | 116.2 | 102 | 136.8 | 49.8 |
| **2016** | 118.4 | 102 | 136.8 | 49.9 |

1. **Untreated:** Impervious Cover not treated by any BMP
2. **Dry Pond:** Impervious Cover treated by any "modern" (post 2000) dry ED practice
3. **Wet Practice:** Area treated by ewt ED ponds and shallow marsh
4. **Filters and Other:** Includes area treated by Combined ED Pond and Sand Filter and small filtering BMPs

**Table 19a.** Relationship between the Treatment Index and stormflow concentrations (mg/l). Blue shading indicates an anticipated result (negative relationship), and gold shading indicates a counterintuitive result (positive relationship).

| | Variable | Results for Development Index | |
|---|---|---|---|
| | | Coefficient | p-value |
| **CACO Outfall** | TSS | -0.56 | 0.01 |
| | TP | -0.0013 | < 0.01 |
| | $NO_{23}$ | -0.0007 | 0.29 |
| | TKN | 0.0021 | 0.11 |
| **CACO Instream** | TSS | -0.052 | 1.00 |
| | TP | >-0.0001 | 0.96 |
| | $NO_{23}$ | 0.0005 | 0.58 |
| | TKN | 0.0025 | 0.06 |
| **FRCO Instream** | TSS | 0.58 | 0.12 |
| | TP | -0.0003 | 0.71 |
| | $NO_{23}$ | 0.0065 | < 0.01 |
| | TKN | -0.0033 | 0.01 |

**Table 19b.** Relationship between the Treatment Index and baseflow concentrations (mg/l). Blue shading indicates an anticipated result (negative relationship), yellow shading indicates a counterintuitive result (positive relationship).

| | Variable | Results for Development Index | |
|---|---|---|---|
| | | Coefficient | p-value |
| **CACO Outfall** | TSS | 0.035 | 0.10 |
| | TP | -0.0004 | < 0.01 |
| | $NO_{23}$ | -0.0041 | < 0.01 |
| | TKN | 0.0029 | 0.02 |
| **CACO Instream** | TSS | -0.0103 | 0.40 |
| | TP | -0.0003 | 0.17 |
| | $NO_{23}$ | -0.0078 | 0.01 |
| | TKN | -0.0000 | 1.00 |
| **FRCO Instream** | TSS | 0.219 | 1.00 |
| | TP | -0.0002 | 0.98 |
| | $NO_{23}$ | 0.0068 | < 0.01 |
| | TKN | -0.0020 | 0.03 |

**Table 20.** Relationship between the Treatment Index and runoff coefficient (cf/inch of rainfall). Blue shading indicates an anticipated result (negative relationship), gold shading indicates a counterintuitive result (positive relationship).

| | Coefficient | p-value |
|---|---|---|
| **CACO Outfall** | -4,038 | < 0.01 |
| **CACO Instream** | -5,658 | 0.86 |
| **FRCO Instream** | -7,188 | 0.73 |

**Table 21.** Relationship between the Treatment Index and unit pollutant loads (cf/inch of rainfall). Blue shading indicates an anticipated result (negative relationship), gold shading indicates a counterintuitive result (positive relationship).

| | Variable | Results for Development Index | |
|---|---|---|---|
| | | Coefficient | p-value |
| **CACO Outfall** | TSS | -30.0 | < 0.01 |
| | TP | -0.085 | < 0.01 |
| | $NO_{23}$ | -0.175 | < 0.01 |
| | TKN | -0.254 | < 0.01 |
| **CACO Instream** | TSS | -69.8 | 0.06 |
| | TP | -0.103 | 0.38 |
| | $NO_{23}$ | -0.616 | 0.03 |
| | TKN | -1.013 | 0.21 |
| **FRCO Instream** | TSS | -136 | 0.64 |
| | TP | -1.079 | 1.00 |
| | $NO_{23}$ | 2.375 | 0.75 |
| | TKN | -1.766 | 0.16 |

**Tables 22a-22c.** Number of Samples to Detect a Change in 1 Permit Cycle (5 years). Results of the power analysis calculate the number of samples per year needed to detect a change of a given percentage per year. Dark shading indicates that 12 samples per year are sufficient to detect the change, and light shading indicates that between 13 and 24 samples could detect the change.

| 22a. BACI | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | >48 | 35 | >48 | >48 | >48 | | | | | | |
| **TSS** | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 |
| ***E. coli*** | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 |
| **$NO_{23}$** | >48 | 37 | 9 | >48 | >48 | 14 | >48 | 35 | 9 | >48 | 21 | 6 |
| **TP** | >48 | >48 | 18 | >48 | >48 | 26 | >48 | >48 | >48 | >48 | >48 | >48 |
| **TKN** | >48 | >48 | 19 | >48 | >48 | 40 | >48 | >48 | >48 | >48 | >48 | >48 |
| **TCU** | >48 | >48 | 14 | >48 | >48 | 21 | | | | | | |
| **TZN** | >48 | >48 | 23 | >48 | >48 | 30 | | | | | | |
| **TPB** | >48 | >48 | 41 | >48 | >48 | 45 | | | | | | |

| 22b. CACO | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | >48 | 30 | >48 | >48 | 35 | | | | | | |
| **TSS** | >48 | >48 | 35 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | 30 |
| ***E. coli*** | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 |
| **$NO_{23}$** | >48 | >48 | 25 | >48 | >48 | 25 | >48 | 14 | 4 | >48 | >48 | >48 |
| **TP** | >48 | >48 | 21 | >48 | >48 | 30 | >48 | >48 | >48 | >48 | >48 | 15 |
| **TKN** | >48 | >48 | 18 | >48 | >48 | 16 | >48 | >48 | 26 | >48 | >48 | 32 |
| **TCU** | >48 | >48 | 21 | >48 | >48 | 21 | | | | | | |
| **TZN** | >48 | 46 | 12 | >48 | >48 | 19 | | | | | | |
| **TPB** | >48 | >48 | 15 | >48 | >48 | 19 | | | | | | |

| 22c. FRCO | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | >48 | 30 | >48 | >48 | 16 | | | | | | |
| **TSS** | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 | >48 |
| ***E. coli*** | >48 | >48 | 38 | >48 | >48 | 25 | >48 | >48 | >48 | >48 | >48 | 48 |
| **$NO_{23}$** | >48 | 23 | 6 | >48 | >48 | 26 | >48 | 25 | 7 | >48 | >48 | >48 |
| **TP** | >48 | >48 | >48 | >48 | >48 | 17 | >48 | >48 | >48 | >48 | >48 | 35 |
| **TKN** | >48 | >48 | 33 | >48 | >48 | 21 | >48 | >48 | >48 | >48 | >48 | 18 |
| **TCU** | >48 | >48 | 38 | >48 | >48 | 35 | | | | | | |
| **TZN** | >48 | >48 | >48 | >48 | >48 | 21 | | | | | | |
| **TPB** | >48 | >48 | >48 | >48 | >48 | >48 | | | | | | |

**Tables 23a-23c.** Number of Samples to Detect a Change in 2 Permit Cycles (10 years). Results of the power analysis calculate the number of samples per year needed to detect a change of a given percentage per year. Dark shading indicates that 12 samples per year are sufficient to detect the change, and light shading indicates that between 13 and 24 samples could detect the change.

| 23a. BACI | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | 23 | 6 | >48 | >48 | 16 | | | | | | |
| **TSS** | >48 | 35 | 8 | >48 | 38 | 9 | >48 | >48 | 22 | >48 | >48 | 13 |
| ***E. coli*** | >48 | >48 | 15 | >48 | >48 | >48 | >48 | >48 | 13 | >48 | >48 | 13 |
| **$NO_{23}$** | 38 | 6 | 2 | >48 | 9 | 3 | 33 | 6 | 2 | 21 | 4 | 2 |
| **TP** | >48 | 12 | 3 | >48 | 18 | 5 | >48 | 35 | 9 | >48 | 44 | 11 |
| **TKN** | >48 | 12 | 3 | >48 | 25 | 7 | >48 | 42 | 11 | >48 | >48 | 18 |
| **TCU** | >48 | 9 | 3 | >48 | 13 | 4 | | | | | | |
| **TZN** | >48 | 15 | 4 | >48 | 19 | 5 | | | | | | |
| **TPB** | >48 | 27 | 7 | >48 | 30 | 8 | | | | | | |

| 23b. CACO | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | 19 | 5 | >48 | 23 | 6 | | | | | | |
| **TSS** | >48 | 24 | 6 | >48 | 38 | 9 | >48 | 38 | 9 | >48 | 19 | 5 |
| ***E. coli*** | >48 | >48 | 44 | >48 | >48 | 41 | >48 | >48 | 31 | >48 | >48 | >48 |
| **$NO_{23}$** | >48 | 18 | 5 | >48 | 17 | 5 | 13 | 3 | 2 | >48 | >48 | 13 |
| **TP** | >48 | 13 | 4 | >48 | 19 | 5 | >48 | >48 | 21 | >48 | 10 | 3 |
| **TKN** | >48 | 12 | 3 | >48 | 11 | 3 | >48 | 18 | 5 | >48 | 22 | 5 |
| **TCU** | >48 | 13 | 4 | >48 | 13 | 4 | | | | | | |
| **TZN** | 45 | 8 | 2 | >48 | 13 | 4 | | | | | | |
| **TPB** | >48 | 9 | 3 | >48 | 12 | 3 | | | | | | |

| 23c. FRCO | Instream, Stormflow | | | Outfall, Stormflow | | | Instream, Baseflow | | | Outfall, Baseflow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Trend (% Change) | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% | 2% | 5% | 10% |
| **BOD** | >48 | 20 | 5 | >48 | 11 | 3 | | | | | | |
| **TSS** | >48 | 47 | 11 | >48 | >48 | >48 | >48 | >48 | 47 | >48 | >48 | 21 |
| ***E. coli*** | >48 | 25 | 7 | >48 | 17 | 5 | >48 | >48 | 17 | >48 | 31 | 8 |
| **$NO_{23}$** | 23 | 4 | 2 | >48 | 18 | 5 | 25 | 5 | 2 | >48 | >48 | >48 |
| **TP** | >48 | 41 | 11 | >48 | 11 | 3 | >48 | >48 | >48 | >48 | 23 | 6 |
| **TKN** | >48 | 22 | 6 | >48 | 13 | 4 | >48 | >48 | 13 | >48 | 12 | 3 |
| **TCU** | >48 | 25 | 7 | >48 | 23 | 6 | | | | | | |
| **TZN** | >48 | 44 | 11 | >48 | 13 | 4 | | | | | | |
| **TPB** | >48 | 44 | 11 | >48 | >48 | 35 | | | | | | |

**Table 24.** Comparison of methods for trend detection when results disagreed. A 5% statistical significance was used to identify significant trends.

| | Found a Trend [1] | Did Not Find a Trend [1] | In the Minority [2] |
|---|---|---|---|
| **Mann-Kendall [3]** | 2 | 8 | 1 (did not find) |
| **Modified Flow Corrected Mann-Kendall** | 0 | 3 | 1 (did not find) |
| **Log-Link Regression** | 11 | 8 | 5 (4 found, 1 did not) |
| **Logistic Regression** | 8 | 11 | 6 (4 found, 2 did not) |
| **Permutation Method** | 12 | 7 | 3 (found) |

1: These columns represent instances where there was some disagreement among methods, and this method either found or did not find a statistically significant trend.

2: Represents cases where a method was either a single outlier or, in two cases, a minority of 2 out of 5.

3: In addition to the data above, there were four points where Mann-Kendall found a trend but was the only analysis conducted.