

# DHMH-PA DEP laboratory comparison

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The workgroup formerly known as AMQAW

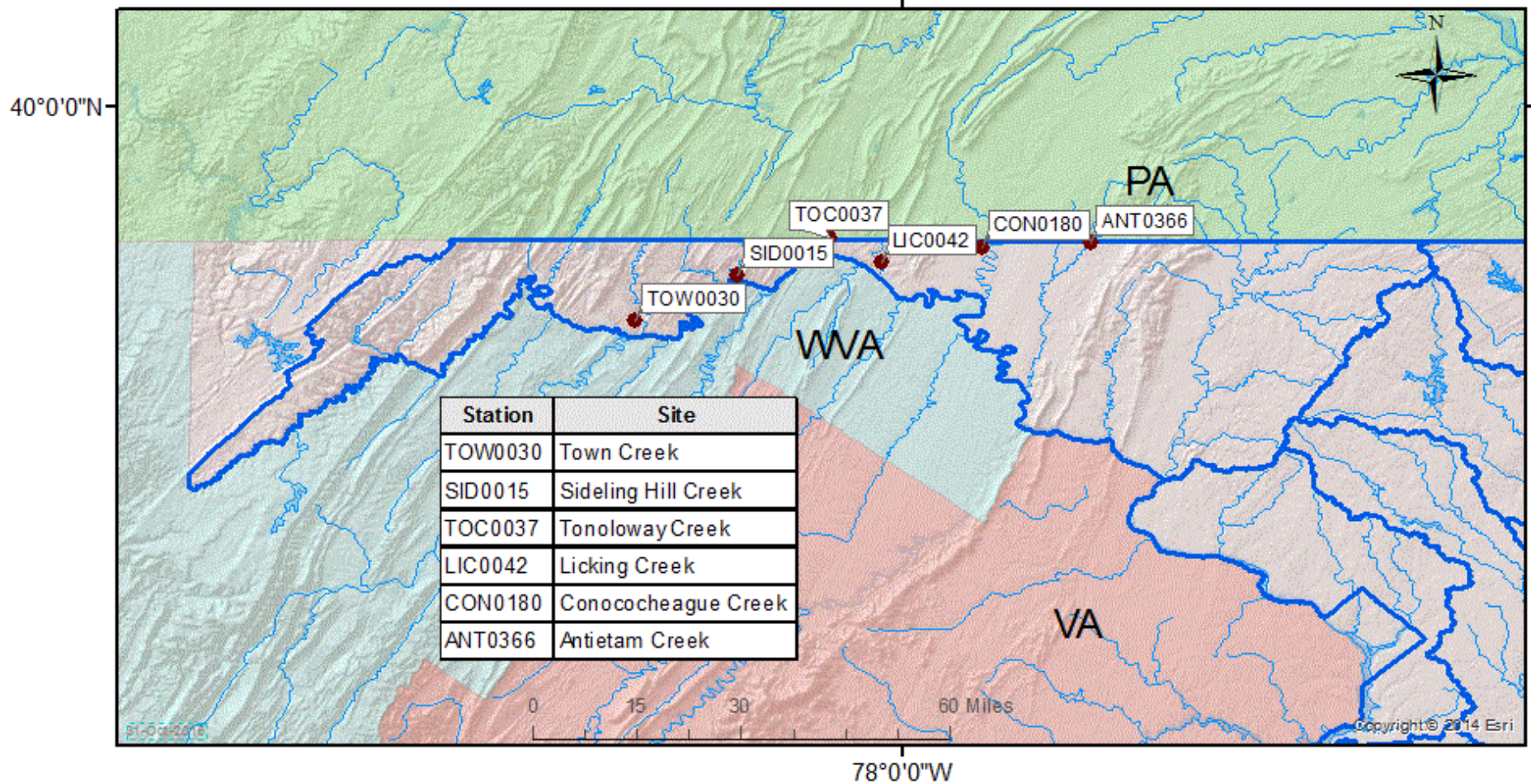


3 November 2016

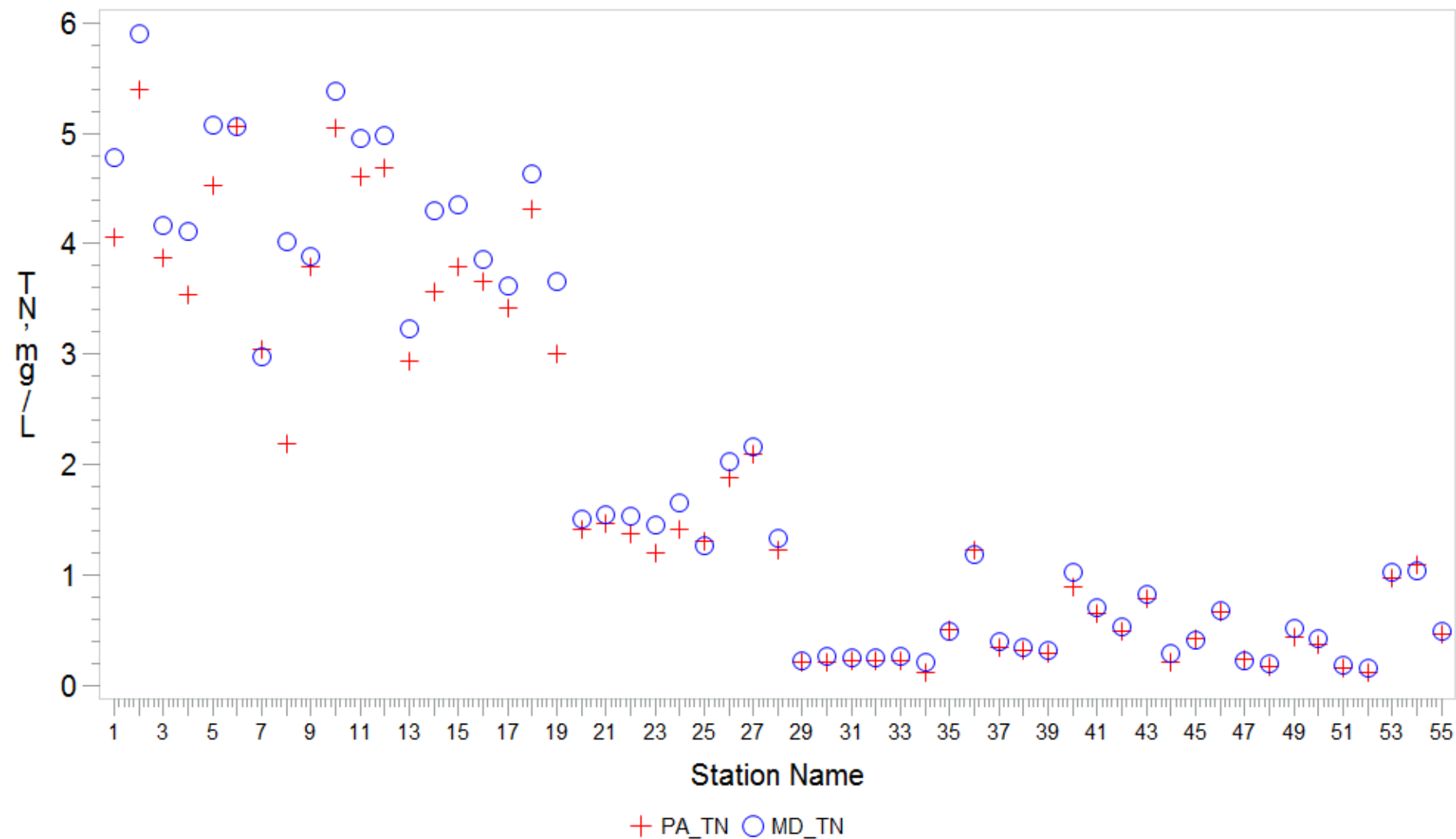
# A little background

- PA DEP started sampling six stations in MD when the non-tidal network was initiated in 2005
- PA DEP decided to turn over sampling those stations to MD DNR in October 2014
- A comparison study between the labs was devised to test for a possible “lab effect”
- 42 samples were collected (by DNR) under the study and 13 samples were collected prior, between July and September 2014

# Station locations



# PA DEP and MD DHMH spit sample data for total nitrogen



# Wilcoxon Signed Rank Test comparison of log ratios for total nitrogen calculated as MD DHMH minus PA DEP

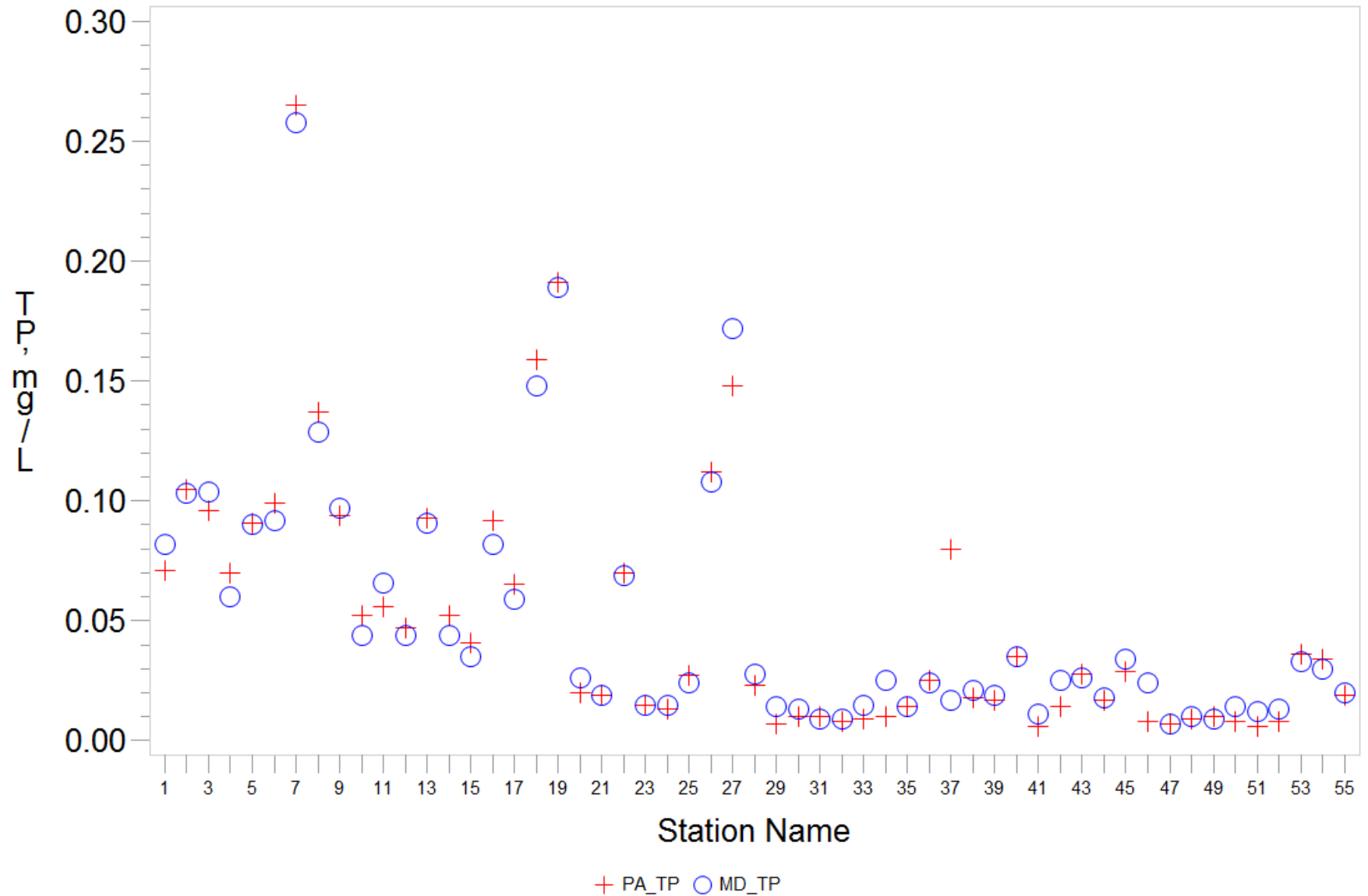
| Moments         |            |                  |            |
|-----------------|------------|------------------|------------|
| N               | 55         | Sum Weights      | 55         |
| Mean            | 0.04740874 | Sum Observations | 2.60748053 |
| Std Deviation   | 0.05408134 | Variance         | 0.00292479 |
| Skewness        | 2.22234642 | Kurtosis         | 6.76429306 |
| Uncorrected SS  | 0.28155608 | Corrected SS     | 0.15793872 |
| Coeff Variation | 114.074623 | Std Error Mean   | 0.00729233 |

| Tests for Location: Mu0=0 |           |          |          |        |
|---------------------------|-----------|----------|----------|--------|
| Test                      | Statistic |          | p Value  |        |
| Student's t               | t         | 6.501182 | Pr >  t  | <.0001 |
| Sign                      | M         | 20.5     | Pr >=  M | <.0001 |
| Signed Rank               | S         | 712      | Pr >=  S | <.0001 |

| Basic Statistical Measures |          |                     |         |
|----------------------------|----------|---------------------|---------|
| Location                   |          | Variability         |         |
| Mean                       | 0.047409 | Std Deviation       | 0.05408 |
| Median                     | 0.035733 | Variance            | 0.00292 |
| Mode                       | 0.041393 | Range               | 0.28569 |
|                            |          | Interquartile Range | 0.04383 |

| Quantiles (Definition 5) |            |
|--------------------------|------------|
| Quantile                 | Estimate   |
| 100% Max                 | 0.2632054  |
| 99%                      | 0.2632054  |
| 95%                      | 0.1472151  |
| 90%                      | 0.0860444  |
| 75% Q3                   | 0.0648896  |
| 50% Median               | 0.0357331  |
| 25% Q1                   | 0.0210608  |
| 10%                      | -0.0104573 |
| 5%                       | -0.0156363 |
| 1%                       | -0.0224861 |
| 0% Min                   | -0.0224861 |

# PA DEP and MD DHMH spit sample data for total phosphorus





# Wilcoxon Signed Rank Test comparison of log ratios for total phosphorus calculated as MD DHMH minus PA DEP

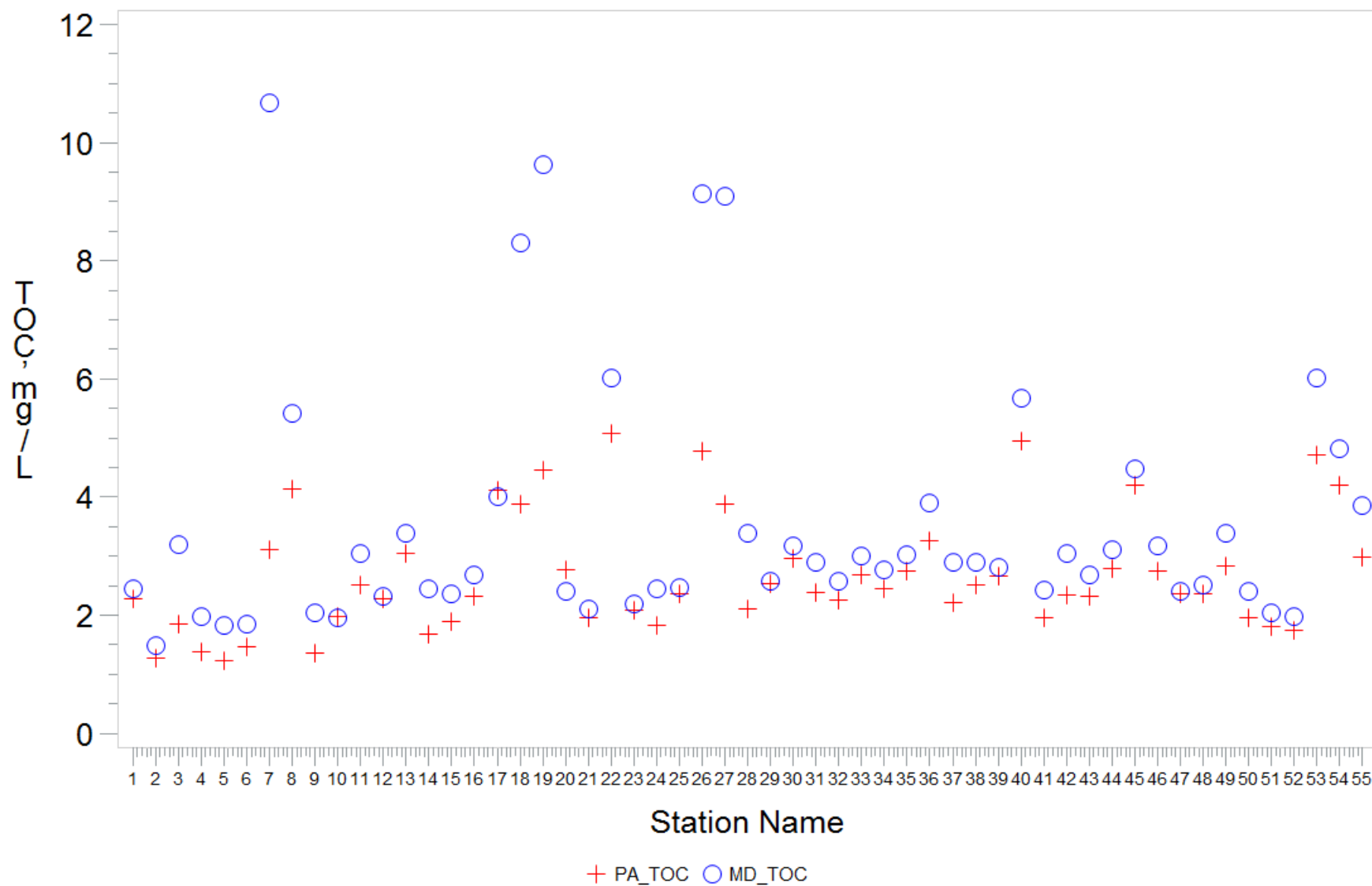
| Moments         |            |                  |            |
|-----------------|------------|------------------|------------|
| N               | 55         | Sum Weights      | 55         |
| Mean            | 0.03837357 | Sum Observations | 2.11054637 |
| Std Deviation   | 0.15717346 | Variance         | 0.0247035  |
| Skewness        | -0.8042415 | Kurtosis         | 7.96411299 |
| Uncorrected SS  | 1.41497807 | Corrected SS     | 1.33398887 |
| Coeff Variation | 409.587802 | Std Error Mean   | 0.02119327 |

| Tests for Location: Mu0=0 |           |          |          |        |
|---------------------------|-----------|----------|----------|--------|
| Test                      | Statistic |          | p Value  |        |
| Student's t               | t         | 1.810649 | Pr >  t  | 0.0758 |
| Sign                      | M         | 0        | Pr >=  M | 1.0000 |
| Signed Rank               | S         | 186.5    | Pr >=  S | 0.0714 |

| Basic Statistical Measures |          |                     |         |
|----------------------------|----------|---------------------|---------|
| Location                   |          | Variability         |         |
| Mean                       | 0.038374 | Std Deviation       | 0.15717 |
| Median                     | 0.000000 | Variance            | 0.02470 |
| Mode                       | 0.000000 | Range               | 1.14976 |
|                            |          | Interquartile Range | 0.10093 |

| Quantiles (Definition 5) |            |
|--------------------------|------------|
| Quantile                 | Estimate   |
| 100% Max                 | 0.4771213  |
| 99%                      | 0.4771213  |
| 95%                      | 0.3010300  |
| 90%                      | 0.2518120  |
| 75% Q3                   | 0.0690809  |
| 50% Median               | 0.0000000  |
| 25% Q1                   | -0.0318474 |
| 10%                      | -0.0543577 |
| 5%                       | -0.0725507 |
| 1%                       | -0.6726411 |
| 0% Min                   | -0.6726411 |

# PA DEP and MD DHMH spit sample data for total organic carbon





# Wilcoxon Signed Rank Test comparison of log ratios for total organic carbon calculated as MD DHMH minus PA DEP

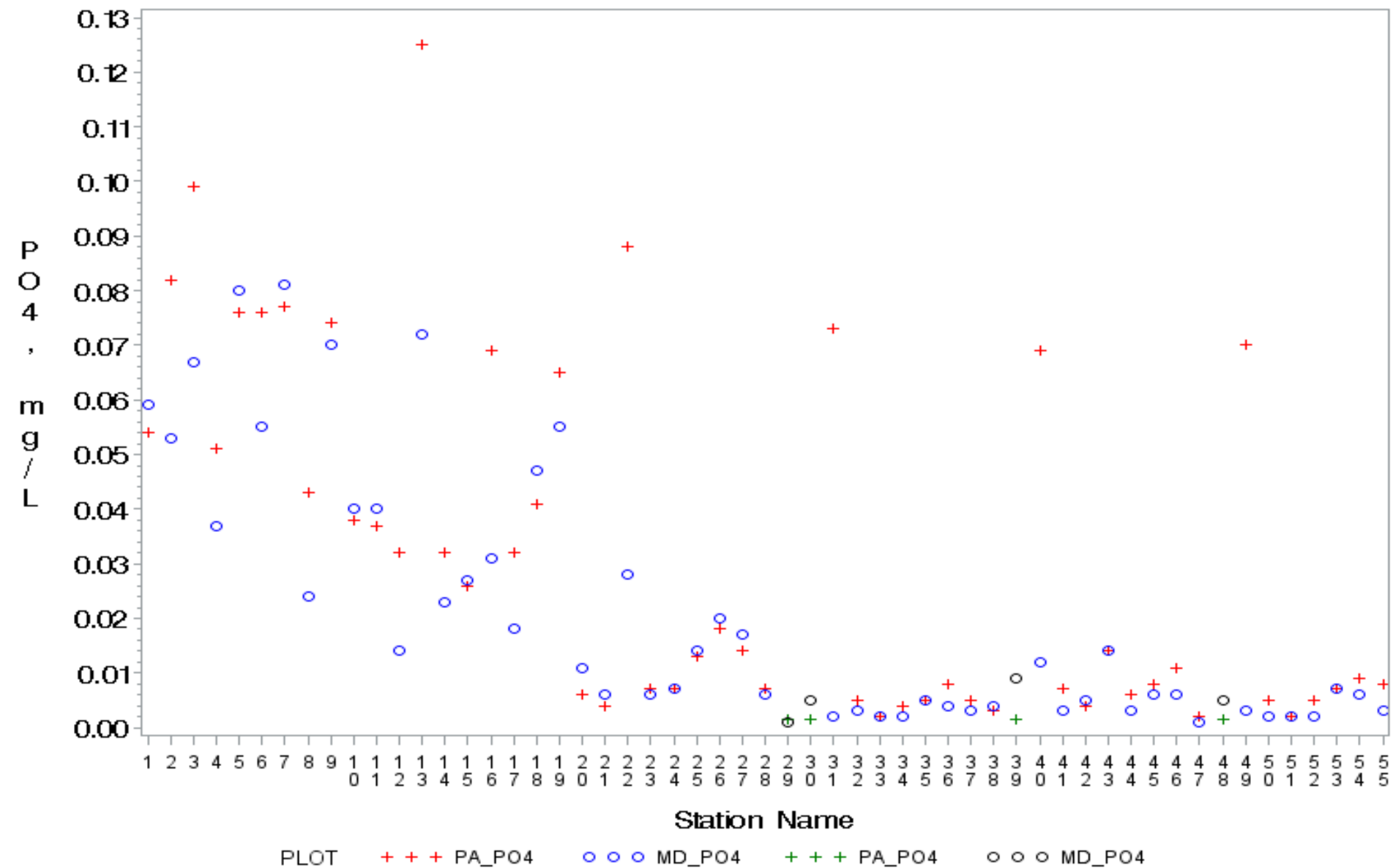
| Moments         |            |                  |            |
|-----------------|------------|------------------|------------|
| N               | 55         | Sum Weights      | 55         |
| Mean            | 0.09889965 | Sum Observations | 5.43948058 |
| Std Deviation   | 0.10581006 | Variance         | 0.01119577 |
| Skewness        | 2.06797677 | Kurtosis         | 5.26723837 |
| Uncorrected SS  | 1.14253418 | Corrected SS     | 0.60457147 |
| Coeff Variation | 106.987294 | Std Error Mean   | 0.01426743 |

| Tests for Location: Mu0=0 |           |         |          |        |
|---------------------------|-----------|---------|----------|--------|
| Test                      | Statistic |         | p Value  |        |
| Student's t               | t         | 6.93185 | Pr >  t  | <.0001 |
| Sign                      | M         | 24.5    | Pr >=  M | <.0001 |
| Signed Rank               | S         | 741     | Pr >=  S | <.0001 |

| Basic Statistical Measures |          |                     |         |
|----------------------------|----------|---------------------|---------|
| Location                   |          | Variability         |         |
| Mean                       | 0.098900 | Std Deviation       | 0.10581 |
| Median                     | 0.065524 | Variance            | 0.01120 |
| Mode                       | .        | Range               | 0.59536 |
|                            |          | Interquartile Range | 0.08330 |

| Quantiles (Definition 5) |             |
|--------------------------|-------------|
| Quantile                 | Estimate    |
| 100% Max                 | 0.53664954  |
| 99%                      | 0.53664954  |
| 95%                      | 0.33492849  |
| 90%                      | 0.23700304  |
| 75% Q3                   | 0.11648252  |
| 50% Median               | 0.06552406  |
| 25% Q1                   | 0.03318472  |
| 10%                      | 0.00999289  |
| 5%                       | -0.00553531 |
| 1%                       | -0.05871187 |
| 0% Min                   | -0.05871187 |

# PA DEP and MD DHMH spit sample data for orthophosphate (PA censored data)



# Wilcoxon Signed Rank Test comparison of log ratios for orthophosphate calculated as MD DHMH minus PA DEP

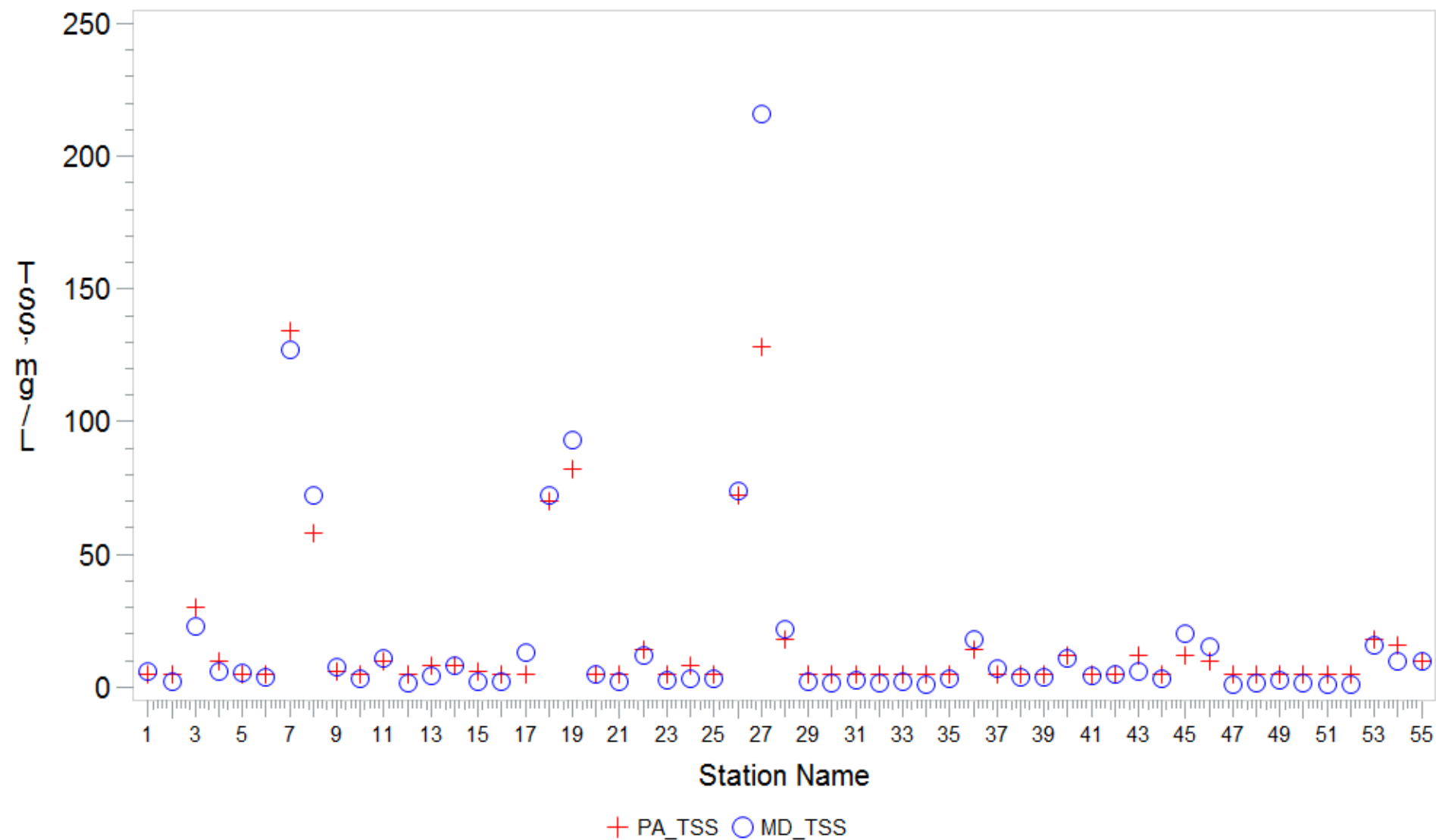
| Moments         |            |                  |            |
|-----------------|------------|------------------|------------|
| N               | 55         | Sum Weights      | 55         |
| Mean            | -0.1411907 | Sum Observations | -7.7654859 |
| Std Deviation   | 0.36388122 | Variance         | 0.13240954 |
| Skewness        | -1.4105867 | Kurtosis         | 5.90728925 |
| Uncorrected SS  | 8.24652916 | Corrected SS     | 7.15011513 |
| Coeff Variation | -257.7233  | Std Error Mean   | 0.04906573 |

| Tests for Location: Mu0=0 |           |          |          |        |
|---------------------------|-----------|----------|----------|--------|
| Test                      | Statistic |          | p Value  |        |
| Student's t               | t         | -2.87758 | Pr >  t  | 0.0057 |
| Sign                      | M         | -7.5     | Pr >=  M | 0.0444 |
| Signed Rank               | S         | -327     | Pr >=  S | 0.0007 |

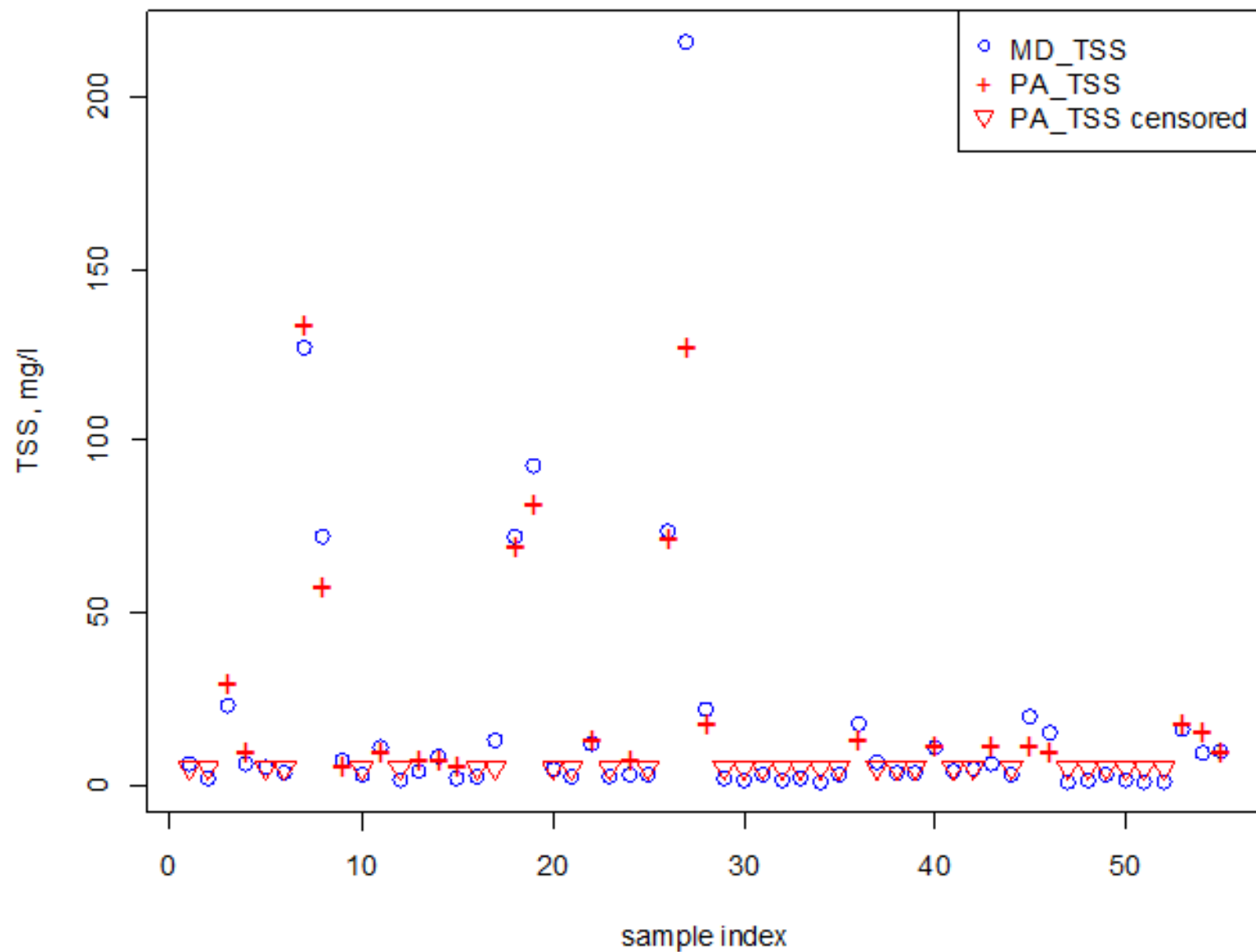
| Basic Statistical Measures |          |                     |         |
|----------------------------|----------|---------------------|---------|
| Location                   |          | Variability         |         |
| Mean                       | -0.14119 | Std Deviation       | 0.36388 |
| Median                     | -0.12494 | Variance            | 0.13241 |
| Mode                       | 0.00000  | Range               | 2.34044 |
|                            |          | Interquartile Range | 0.32331 |

| Quantiles (Definition 5) |            |
|--------------------------|------------|
| Quantile                 | Estimate   |
| 100% Max                 | 0.7781513  |
| 99%                      | 0.7781513  |
| 95%                      | 0.5228787  |
| 90%                      | 0.1249387  |
| 75% Q3                   | 0.0222764  |
| 50% Median               | -0.1249387 |
| 25% Q1                   | -0.3010300 |
| 10%                      | -0.3979400 |
| 5%                       | -0.7596678 |
| 1%                       | -1.5622929 |
| 0% Min                   | -1.5622929 |

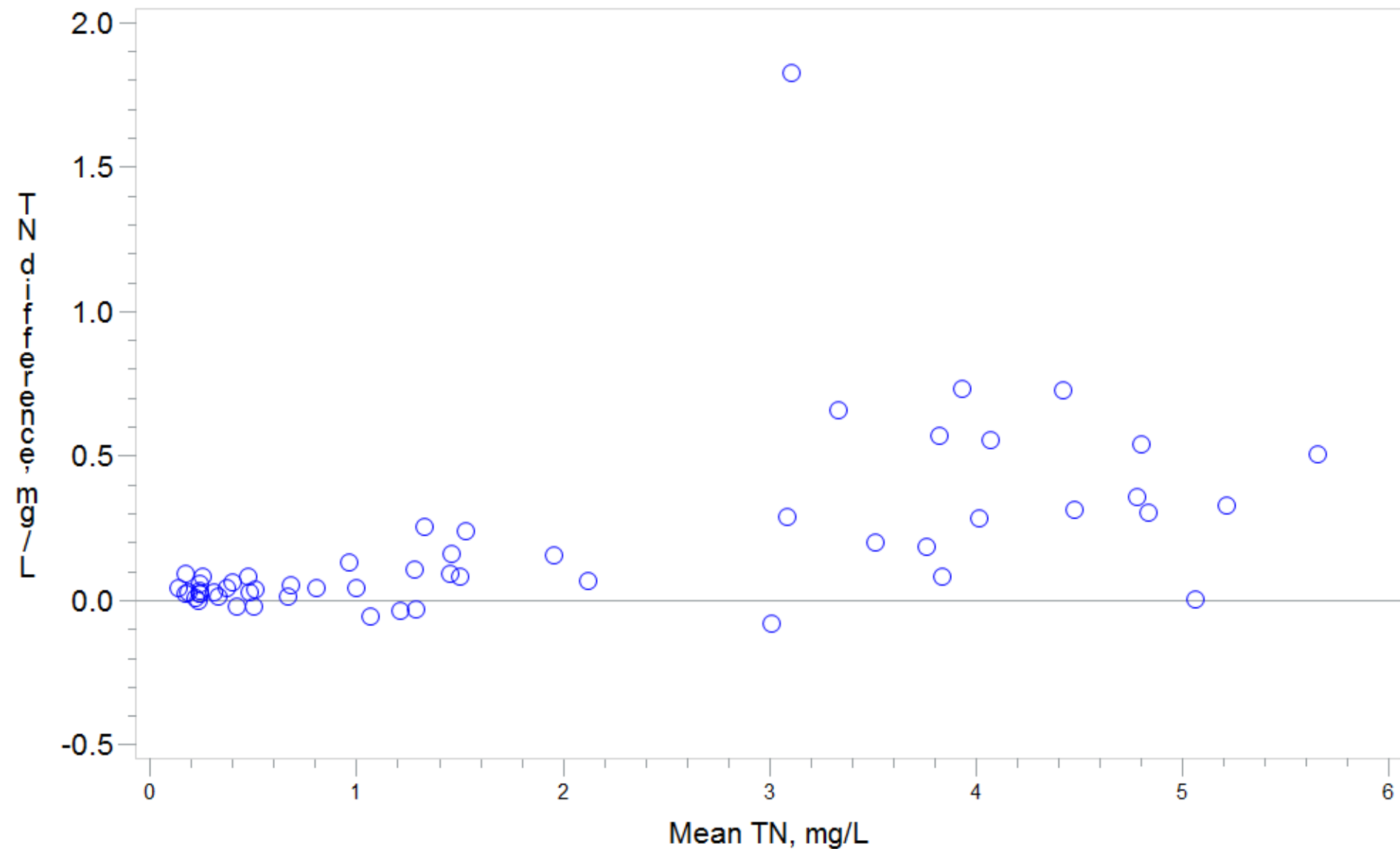
# PA DEP and MD DHMH spit sample data for total suspended solids



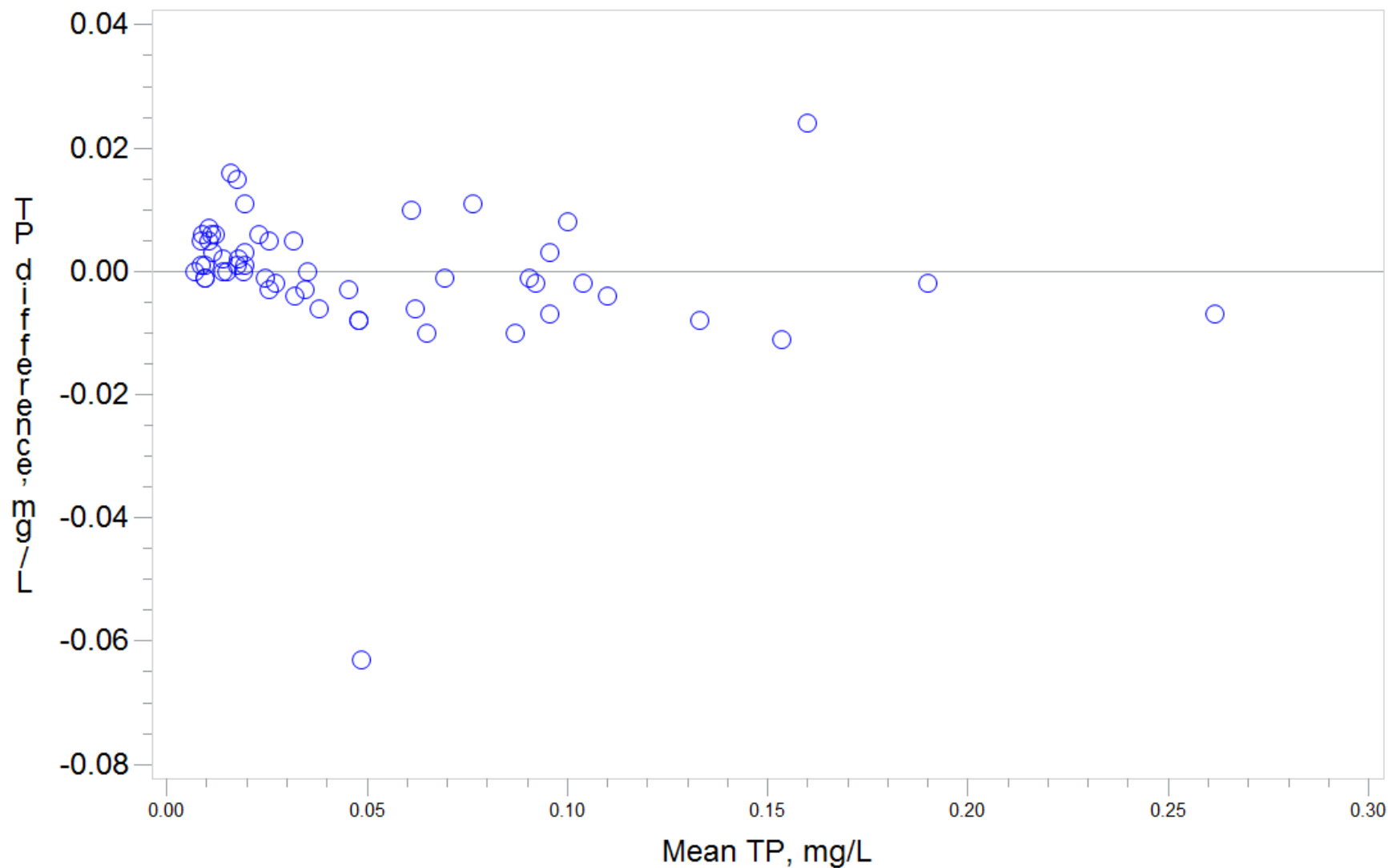
# PA DEP and MD DHM H spit sample data for total suspended solids



Difference between PA DEP and MD DHMH total nitrogen versus the mean  
(difference calculated as MD\_TN minus PA\_TN)

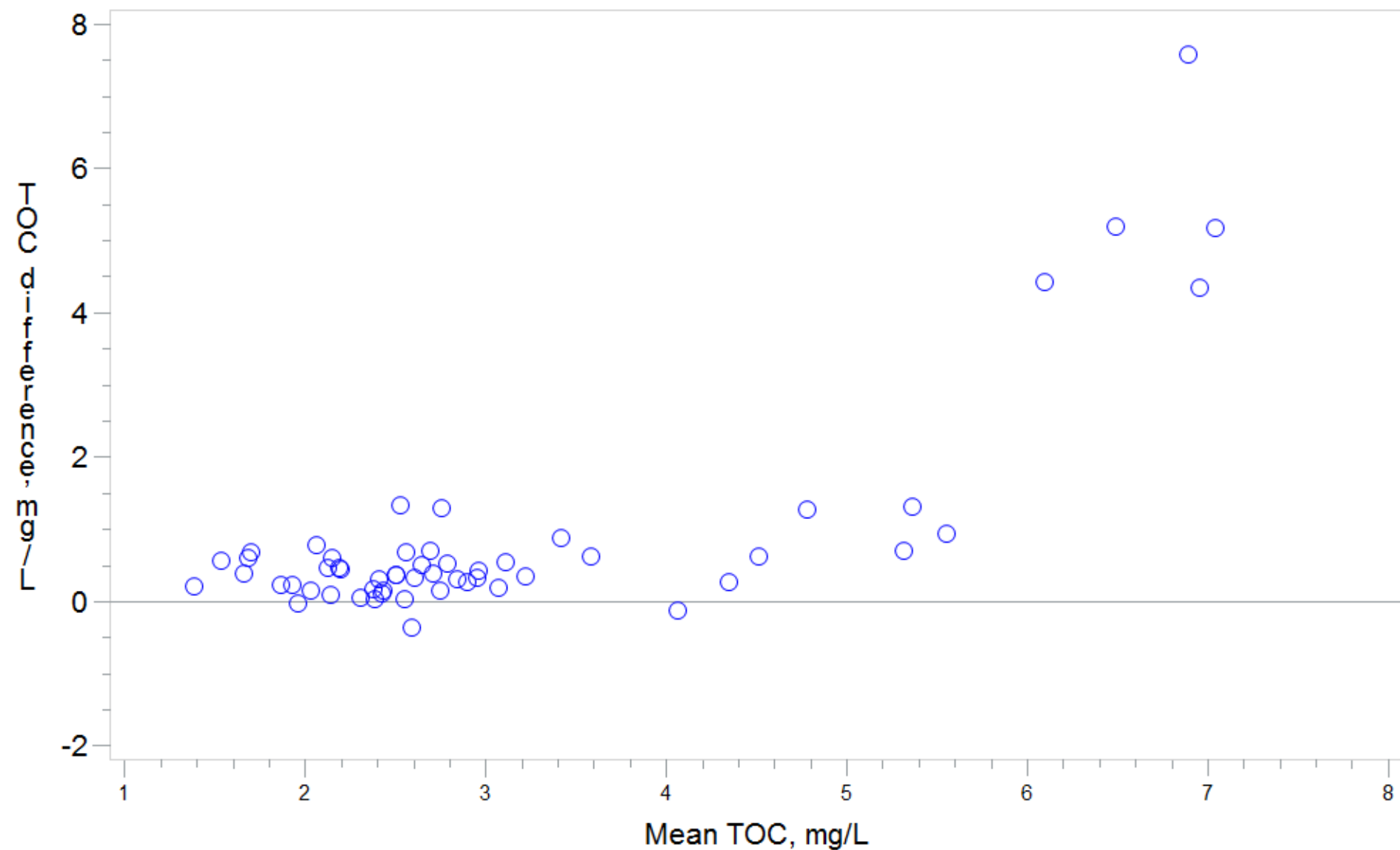


Difference between PA DEP and MD DHMH total phosphorus versus the mean  
(difference calculated as MD\_TP minus PA\_TP)

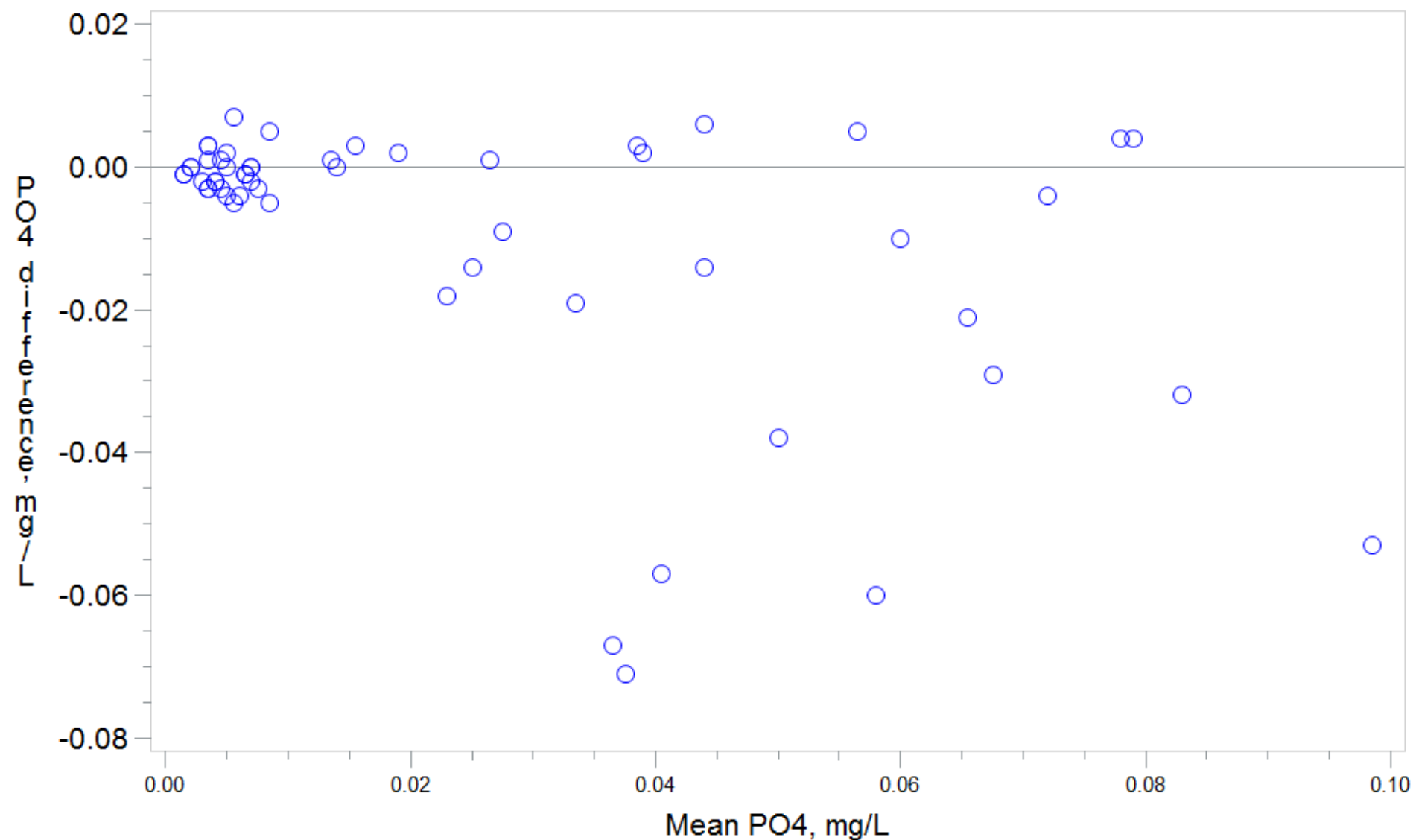




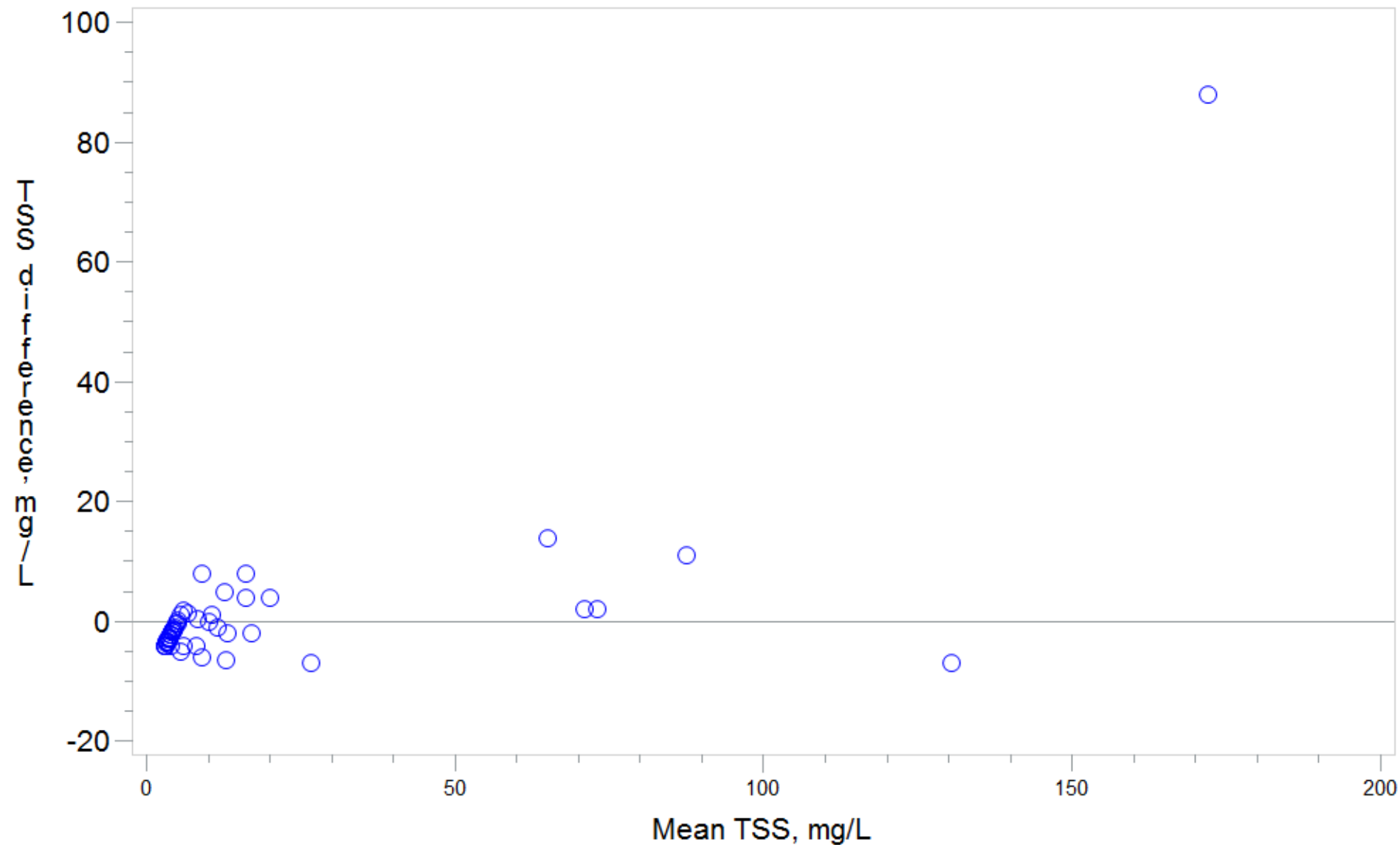
Difference between PA DEP and MD DHMH total organic carbon versus the mean  
(difference calculated as MD\_TOC minus PA\_TOC)



Difference between PA DEP and MD DHMH orthophosphate versus the mean  
(difference calculated as MD\_PO4 minus PA\_PO4 - uncensored)



Difference between PA DEP and MD DHMH total suspended solids versus the mean  
(difference calculated as MD\_TSS minus PA\_TSS - uncensored)



Test of differences among stations for total nitrogen  
(difference calculated as MD\_TN minus PA\_TN)

Analysis of Variance for Variable TNDiff  
Classified by Variable StationName

| StationName | N  | Mean     |
|-------------|----|----------|
| ANT0366     | 9  | 0.497000 |
| CON0180     | 10 | 0.393700 |
| LIC0042     | 9  | 0.126111 |
| SID0015     | 9  | 0.025889 |
| TOC0037     | 9  | 0.043444 |
| TOW0030     | 9  | 0.029111 |

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|--------|----|----------------|-------------|---------|--------|
| Among  | 5  | 1.968573       | 0.393715    | 6.3393  | 0.0001 |
| Within | 49 | 3.043223       | 0.062107    |         |        |

Average scores were used for ties.

Test for differences among stations for total nitrogen  
(difference calculated as MD\_TN minus PA\_TN)

Wilcoxon Scores (Rank Sums) for Variable TNDiff  
Classified by Variable StationName

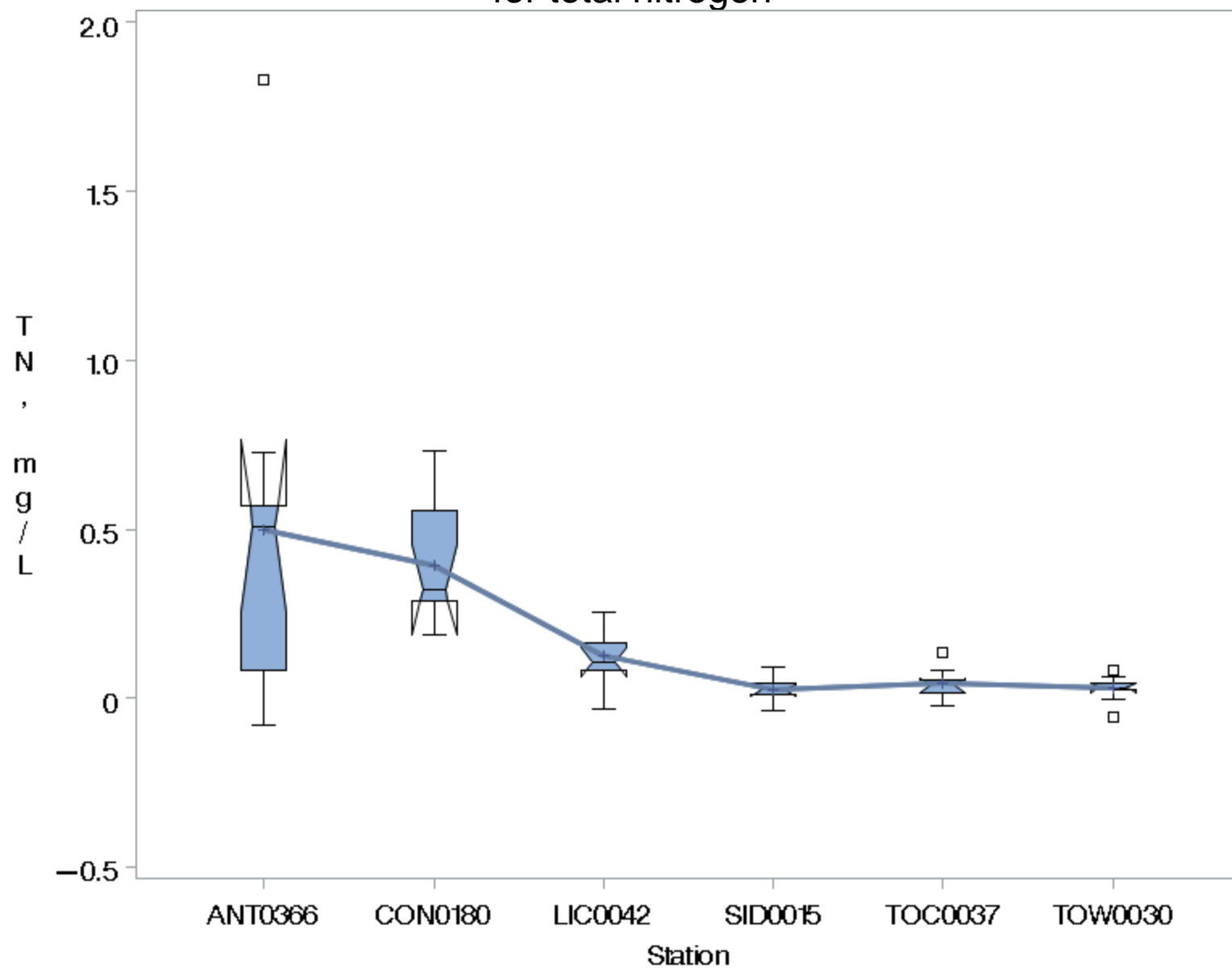
| StationName | N  | Sum of<br>Scores | Expected<br>Under H0 | Std Dev<br>Under H0 | Mean<br>Score |
|-------------|----|------------------|----------------------|---------------------|---------------|
| ANT0366     | 9  | 338.00           | 252.0                | 43.953729           | 37.555556     |
| CON0180     | 10 | 458.00           | 280.0                | 45.824930           | 45.800000     |
| LIC0042     | 9  | 280.00           | 252.0                | 43.953729           | 31.111111     |
| SID0015     | 9  | 140.50           | 252.0                | 43.953729           | 15.611111     |
| TOC0037     | 9  | 168.00           | 252.0                | 43.953729           | 18.666667     |
| TOW0030     | 9  | 155.50           | 252.0                | 43.953729           | 17.277778     |

Average scores were used for ties.

Kruskal-Wallis Test

|                 |         |
|-----------------|---------|
| Chi-Square      | 28.3543 |
| DF              | 5       |
| Pr > Chi-Square | <.0001  |

Notched box and whisker plots showing differences among stations  
for total nitrogen



Test for differences among stations for total phosphorus  
(difference calculated as MD\_TP minus PA\_TP)

Wilcoxon Scores (Rank Sums) for Variable TPDiff  
Classified by Variable StationName

| StationName | N  | Sum of<br>Scores | Expected<br>Under H0 | Std Dev<br>Under H0 | Mean<br>Score |
|-------------|----|------------------|----------------------|---------------------|---------------|
| ANT0366     | 9  | 209.50           | 252.0                | 43.944214           | 23.277778     |
| CON0180     | 10 | 142.00           | 280.0                | 45.815010           | 14.200000     |
| LIC0042     | 9  | 285.00           | 252.0                | 43.944214           | 31.666667     |
| SID0015     | 9  | 291.50           | 252.0                | 43.944214           | 32.388889     |
| TOC0037     | 9  | 334.50           | 252.0                | 43.944214           | 37.166667     |
| TOW0030     | 9  | 277.50           | 252.0                | 43.944214           | 30.833333     |

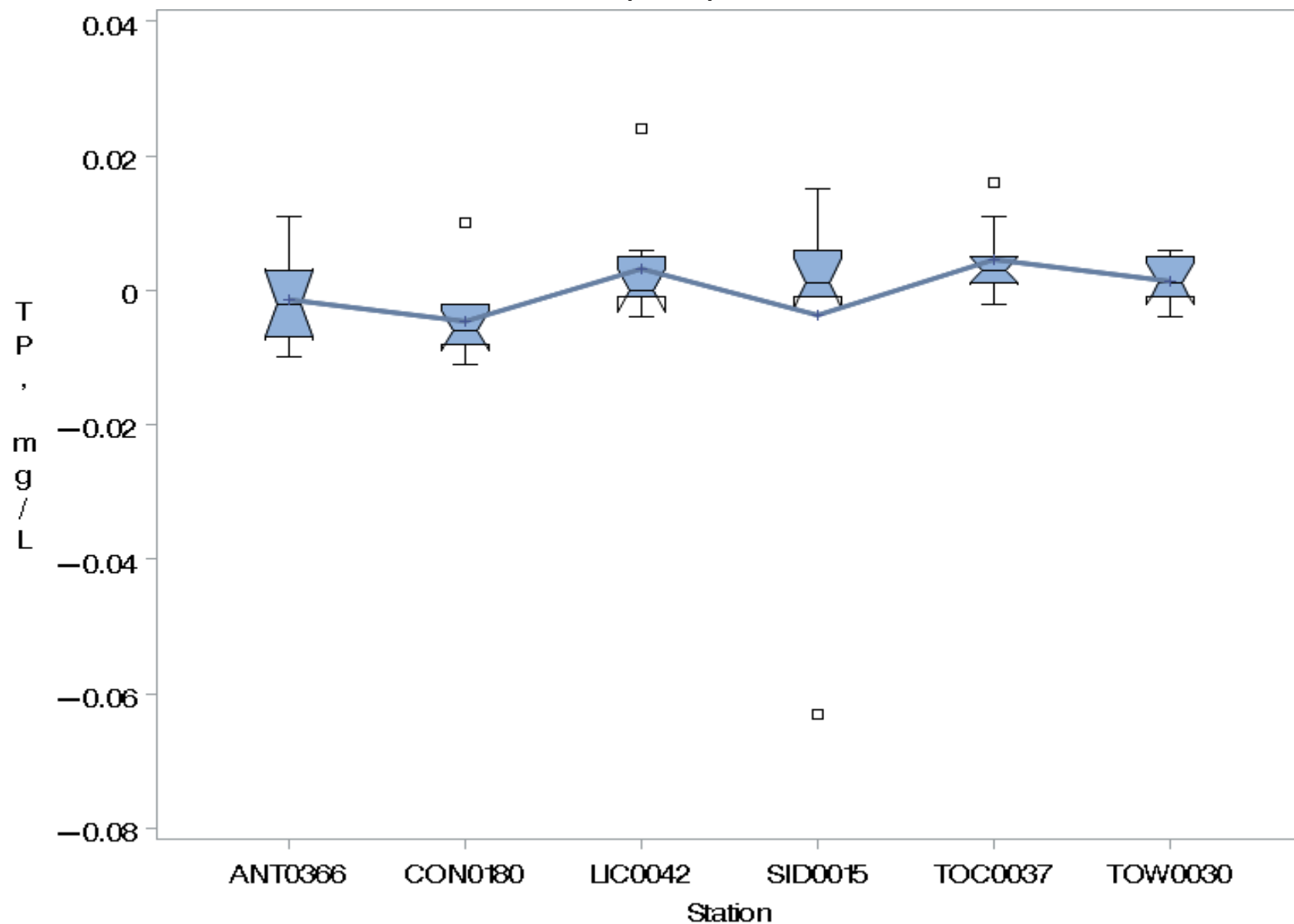
Average scores were used for ties.

Kruskal-Wallis Test

|                 |         |
|-----------------|---------|
| Chi-Square      | 12.5824 |
| DF              | 5       |
| Pr > Chi-Square | 0.0276  |



Notched box and whisker plots showing differences among stations  
for total phosphorus



# Any questions or comments?

