# Model Archive Summary for Suspended Sediment Concentration at Station 01478245; White Clay Creek near Strickersville, Pennsylvania [2020 Version]

This model archive summary describes the regression model developed to estimate continuous instantaneous (15-minute) suspended sediment concentrations starting in 2011. The model was updated in June 2020, using all available calibration data. The new model is used to compute suspended sediment concentrations for entire period of record, beginning November 15, 2011.

## Site and Model Information

U.S. Geological Survey (USGS) station number: 01478245

Station name: White clay Creek near Strickersville, Pennsylvania

Lat 39°44'51", long 75°46'15" referenced to North American Datum of 1927, Chester County, PA, Hydrologic Unit 02040205, on right bank, 0.1 mi downstream from West Branch White Clay Creek, in the White Clay Creek State Preserve, and 1.5 mi northeast of Strickersville.

Date regression model was created: June 2020.

Period of data for model calibration: January 12, 2012 – November 1, 2019.

Model application date: October 2019 onward.

Database Reviewed by: Elizabeth A. Hittle, May 2020

Computed by: Matthew C. Gyves, June 2020.

Approved by: Joseph W. Duris, Water-Quality Specialist, June 2020.

## Equipment

A Yellow Spring Instrument (YSI) 600OMS monitor equipped with sensors for temperature, specific conductance, and turbidity (6136 sensor) is deployed at this site. The monitor is housed in a 3-inch perforated plastic pipe placed in the stream about 2 ft from the right bank. Readings from the sensors are recorded every 15 minutes and transmitted hourly by way of GOES satellite.

## Model Calibration Dataset

All data were collected using standard USGS protocols and are stored in the National Water Information System (NWIS) database. Linear regression models were developed using RStudio Version 1.2.1335. Primary packages included (dataRetrieval, v2.7.5; dplyr, v0.8.3; plotly v4.9.0, and the Model Archive Summary Shiny App (available at https://github.com/PatrickEslick/ModelArchiveSummary). Explanatory variables evaluated as inputs to linear regression were turbidity and streamflow.

The final regression model is based on 80 concurrent measurements of suspended sediment and turbidity concentrations. Suspended sediment concentrations were determined from analysis of discrete samples, and turbidity concentrations were determined from continuous record of 15-minute values, interpolated when necessary to correspond with collection time of the discrete sample for sediment analysis. Suspended sediment samples were collected over a range of hydrologic conditions throughout each year during sampling period. Studentized residuals for final model were inspected and considered for potential removal as outliers if residual values were greater than 3 or less than -3. Several samples met these criteria; and other regression diagnostics show their influence on model performance significant. Sand is being transported under certain flow conditions, which has a significant effect on total mass within a suspended sediment sample. Additional modeling looking at sand/fine splits is warranted. Because sand is considered part of the total sediment load, these samples are included in this model.

## Data Collection

Discrete samples for suspended sediment analysis were collected using an ISCO automatic sampler which was set to sample based on stage and turbidity thresholds to provide data for a broad range of turbidity values. Over time, these thresholds were changed to collect samples under different conditions, covering the range of measured values. Water was pulled by the sampler peristaltic pump through 0.5-inch tubing from an intake located near the turbidity probe and stored in 1-liter polypropylene bottles. Once collected, sample times were recorded in the field during bottle retrieval as reported by the ISCO. Samples were analyzed for suspended sediment concentration (SSC) in the laboratory at the USGS office in Exton, Pennsylvania and the USGS Kentucky Sediment Laboratory in Louisville, Kentucky using standard USGS methods. Suspended sediment concentrations ranged from 19 to 9,530 mg/L in the 80 analyzed samples.

Turbidity data were collected according to USGS Techniques and Methods 1-D3 (Wagner and Others, 2006). Turbidity concentrations ranged from 12 to 1,420 formazin nephelometric units (FNU) during collection of concurrent discrete suspended sediment samples used for model calibration.

Streamflow data were collected according to USGS Water-Supply Paper 2175 (Rantz and others, 1982). Streamflow ranged from 153 to 7,640 cubic feet per second (cfs) during the collection of concurrent discrete suspended sediment and turbidity samples used for model calibration.

## Model Development

Regression analysis was done using R by examining turbidity (*Turb*) and streamflow ($Q$) as explanatory variables for SSC. A variety of linear regression models that predict *SSC* and $\log_{10}(SSC)$ were evaluated and computed using methods described by Rasmussen and others, 2011.

The model with $\log_{10}(Turb)$ and $\log_{10}(Q)$ as explanatory variables was selected as the best predictor of $\log_{10}(SSC)$ on the basis of residual plots, maximizing adjusted coefficient of determination (adjusted $R^2$), and minimizing model residual standard error (or root mean square error, *RMSE*) and standard percentage error (*MSPE*). The addition of discharge as an explanatory variable significantly improved model performance.

## Prior Model

This model supersedes the previous equation used to compute suspended sediment that was never published. All data in NWIS have been revised based on this model.

Note 80155 (SS discharge ton/d) is present in QWDATA through 2019??? This shouldn't be in the database unless it's from the new model. We don't have to reject the old data in this case, but we do need to publish the model that derived the values.

## Model Summary

Final regression model for suspended sediment concentration (SSC) at site number 01478245:

$$\text{Log}_{10}\, SSC = .9 \log_{10} Turb + .582 \log_{10} Q - 1$$

where

*SSC* = suspended sediment concentration, in milligrams per liter (mg/L) (parameter 80154);
*Turb* = turbidity, in formazin nephelometric units (FNU) (parameter 63680);
$Q$ = discharge, in cubic feet per second ($ft^3/s$) (parameter 00060)

*Turb* and $Q$ makes physical and statistical sense as explanatory variables for *SSC* because previous studies showed suspended sediment concentrations were directly related to turbidity concentrations and streamflow. The transformed model may be retransformed to the original units so that SSC concentrations can be calculated

directly. A potential bias that is introduced because of retransformation can be corrected using Duan's bias correction factor (BCF). For this model the BCF is 1.26. The retransformed model, using the BCF, is:

$$SSC = .1\ Turb^{.9} \times Q^{.582} \times 1.26$$

### References


Rasmussen, P.P., Gray, J.R., Glysson, G.D., and Ziegler, A.C., 2009, revised 2011, Guidelines and procedures for computing time-series suspended-sediment concentrations and loads from in-stream turbidity-sensor and streamflow data: U.S. Geological Survey Techniques and Methods, book 3, chap. C4, 52 p.

Rantz, S.E., and others, 1982, Measurement and computation of streamflow, v. 2: U.S. Geological Survey Water-Supply Paper 2175, v. 2, 631 p. (Also available at http://pubs.usgs.gov/wsp/wsp2175/pdf/WSP2175_vol2a.pdf).

Sloto, R.A., and Olson, L.E., Estimated suspended-sediment loads and yields in the French and Brandywine Creek Basins, Chester County, Pennsylvania, water years 2008–09: U.S. Geological Survey Scientific Investigations Report 2011–5109, 31 p.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at http://pubs.water.usgs.gov/tm1d3


# Model Statistics, Data, and Plots

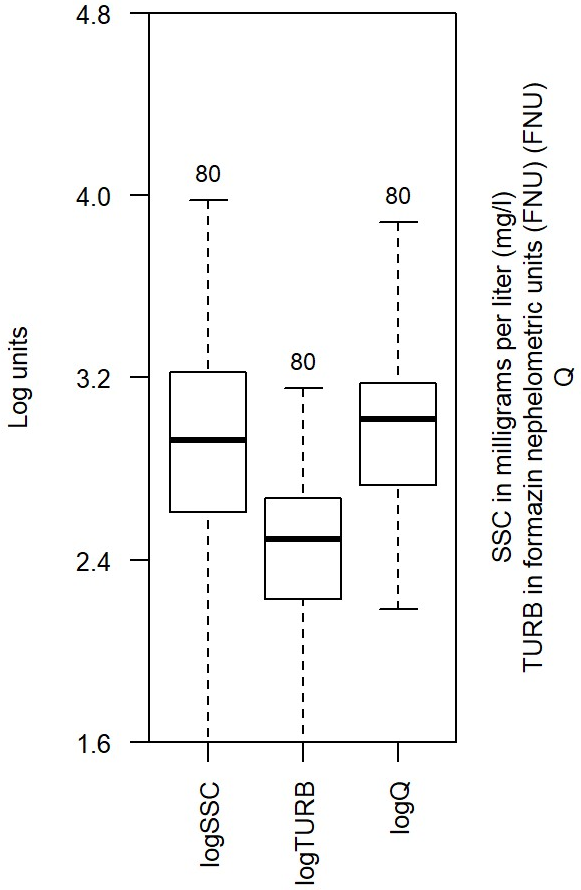
## Model

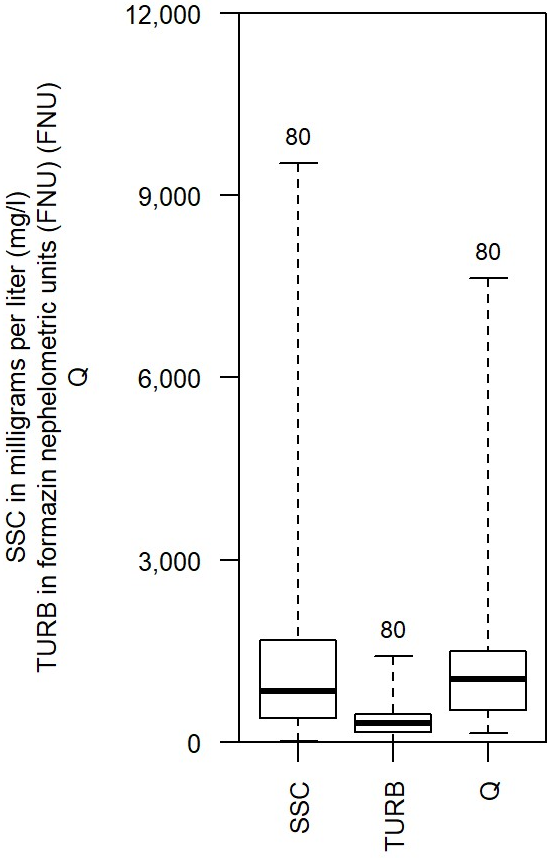
logSSC = + 0.9 * logTURB + 0.582 * logQ - 1

## Variable Summary Statistics

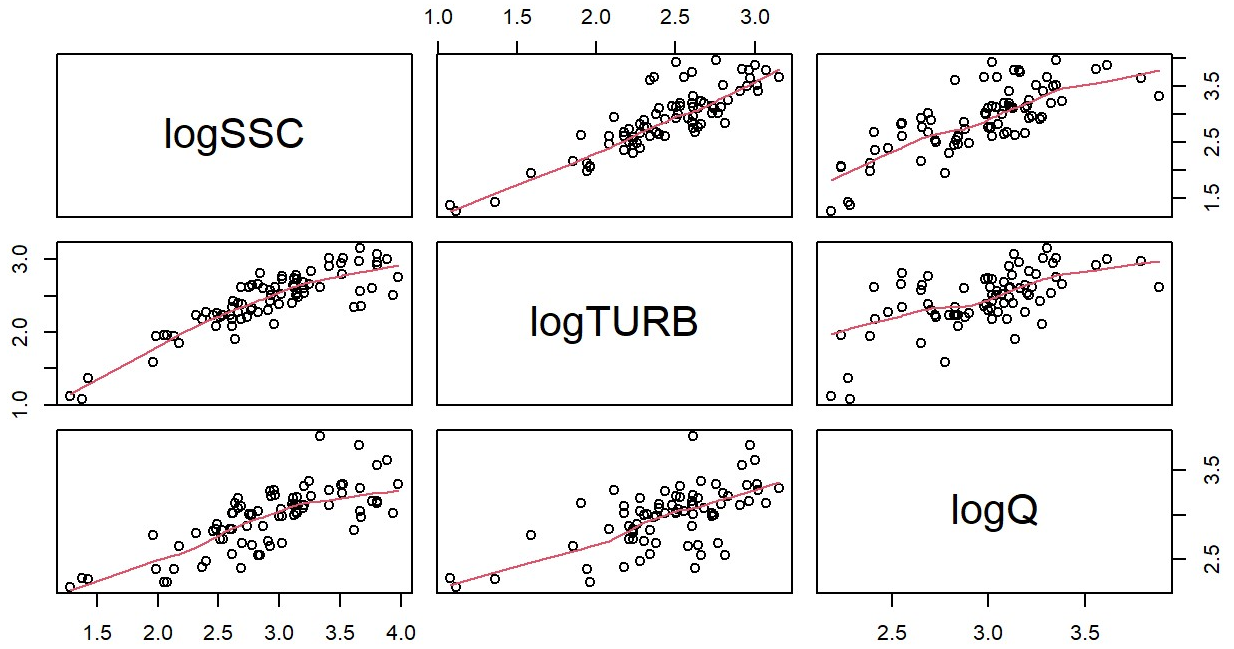
| | logSSC | SSC | logTURB | logQ | TURB | Q |
|---|---|---|---|---|---|---|
| Minimum | 1.28 | 19 | 1.08 | 2.18 | 12 | 153 |
| 1st Quartile | 2.61 | 406 | 2.23 | 2.73 | 170 | 535 |
| Median | 2.92 | 840 | 2.49 | 3.02 | 310 | 1050 |
| Mean | 2.91 | 1670 | 2.43 | 2.96 | 376 | 1240 |
| 3rd Quartile | 3.22 | 1670 | 2.67 | 3.17 | 470 | 1490 |
| Maximum | 3.98 | 9530 | 3.15 | 3.88 | 1420 | 7640 |

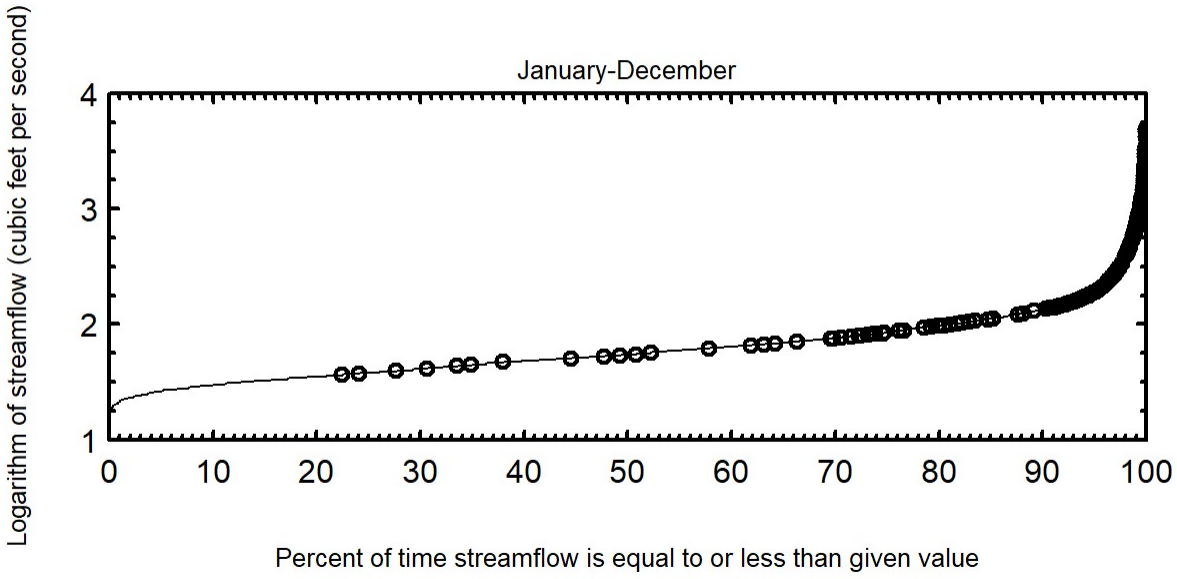
## Box Plots

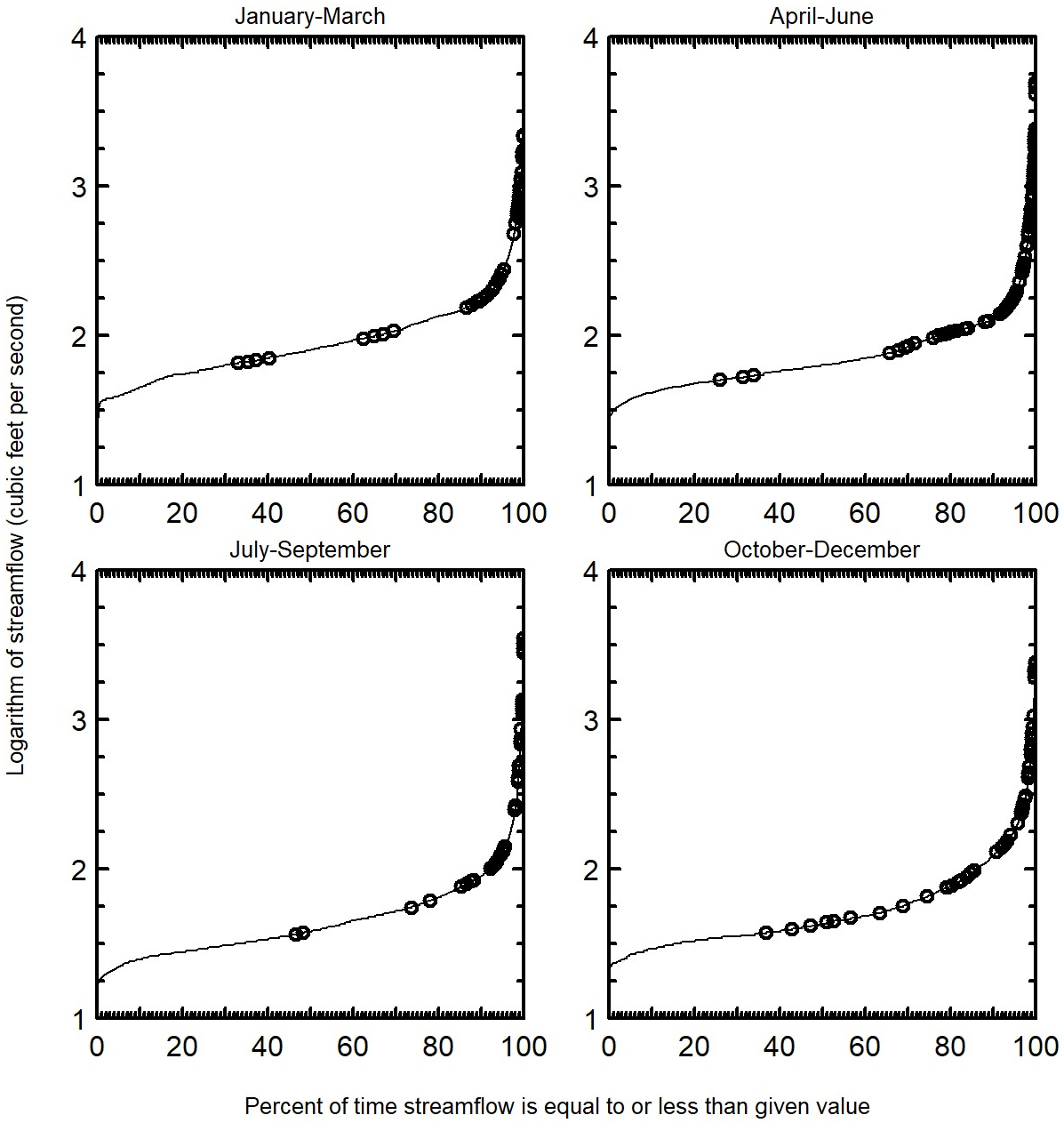



# Exploratory Plots


logSSC
logTURB
logQ
1.0
1.5
2.0
2.5
3.0
3.5
4.0


January-December
Logarithm of streamflow (cubic feet per second)
Percent of time streamflow is equal to or less than given value
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4




# Basic Model Statistics

| | |
|---|---|
| Number of Observations | 80 |
| Standard error (RMSE) | 0.25 |
| Average Model standard percentage error (MSPE) | 60.7 |
| Coefficient of determination ($R^2$) | 0.816 |
| Adjusted Coefficient of Determination (Adj. $R^2$) | 0.811 |
| Bias Correction Factor (BCF) | 1.26 |

Variance Inflation Factors (VIF)

logTURB logQ

| | |
|---|---|
| 1.74 | 1.74 |

## Explanatory Variables

| | Coefficients | Standard Error | t value | Pr(>\|t\|) |
|---|---|---|---|---|
| (Intercept) | -1.000 | 0.2400 | -4.17 | 8.04e-05 |
| logTURB | 0.900 | 0.0917 | 9.82 | 3.18e-15 |
| logQ | 0.582 | 0.1060 | 5.49 | 4.93e-07 |

## Correlation Matrix

| | Intercept | logTURB | logQ |
|---|---|---|---|
| Intercept | 1.0000 | -0.0766 | -0.702 |
| logTURB | -0.0766 | 1.0000 | -0.651 |
| logQ | -0.7020 | -0.6510 | 1.000 |

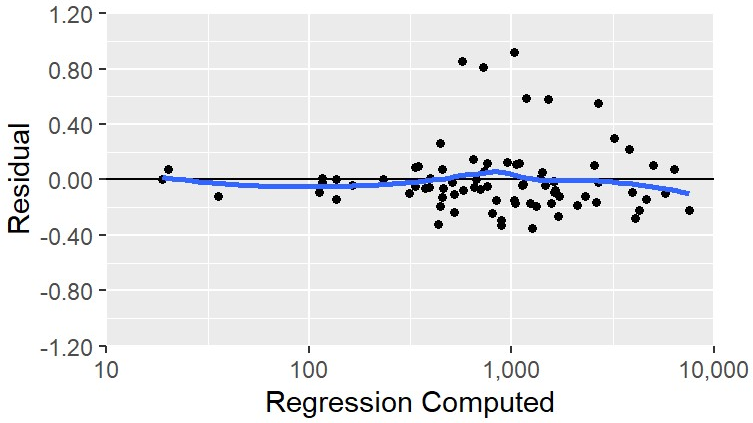
## Outlier Test Criteria

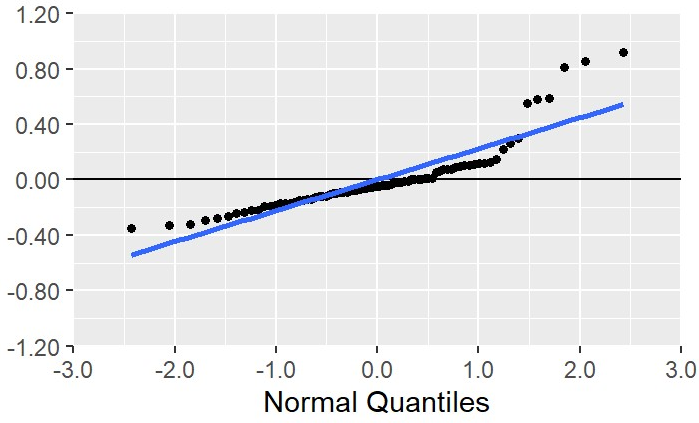
| Leverage | Cook's D | DFFITS |
|---|---|---|
| 0.112 | 0.264 | 0.387 |

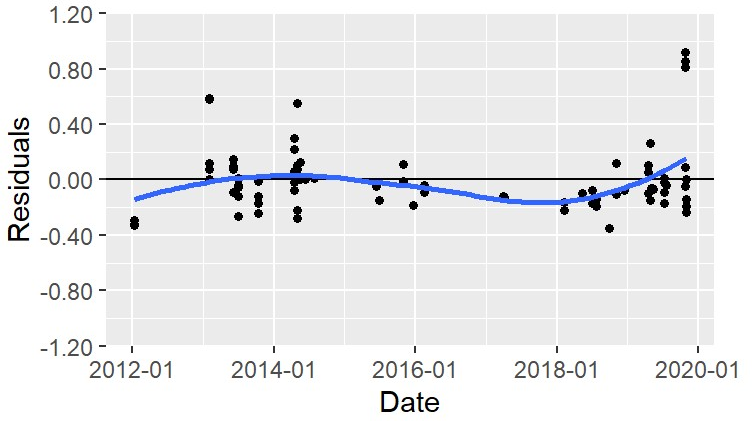
## Flagged Observations

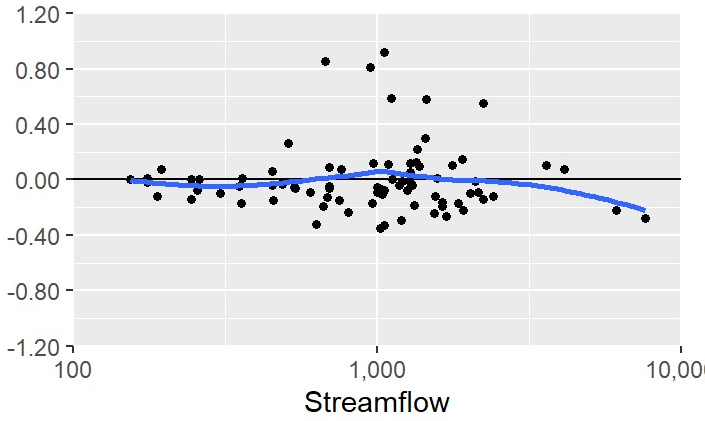
| | logSSC | Estimate | Residual | Standard Residual | Studentized Residual | Leverage | Cook's D | DFFITS |
|---|---|---|---|---|---|---|---|---|
| 2013-01-30 23:00 | 1.28 | 1.27 | 0.00511 | 0.0222 | 0.022 | 0.1470 | 2.82e-05 | 0.00914 |
| 2013-06-08 13:45 | 1.38 | 1.30 | 0.07780 | 0.3390 | 0.337 | 0.1550 | 7.04e-03 | 0.14500 |
| 2014-04-30 14:30 | 3.98 | 3.43 | 0.54900 | 2.2300 | 2.290 | 0.0286 | 4.86e-02 | 0.39200 |
| 2014-04-30 21:00 | 3.33 | 3.61 | -0.28000 | -1.2000 | -1.210 | 0.1370 | 7.66e-02 | -0.48100 |
| 2019-10-27 13:30 | 3.61 | 2.75 | 0.85800 | 3.4600 | 3.740 | 0.0143 | 5.78e-02 | 0.45000 |
| 2019-10-27 14:30 | 3.93 | 3.01 | 0.91800 | 3.7000 | 4.050 | 0.0130 | 6.02e-02 | 0.46600 |
| 2019-10-27 15:30 | 3.67 | 2.86 | 0.80900 | 3.2600 | 3.490 | 0.0135 | 4.84e-02 | 0.40800 |

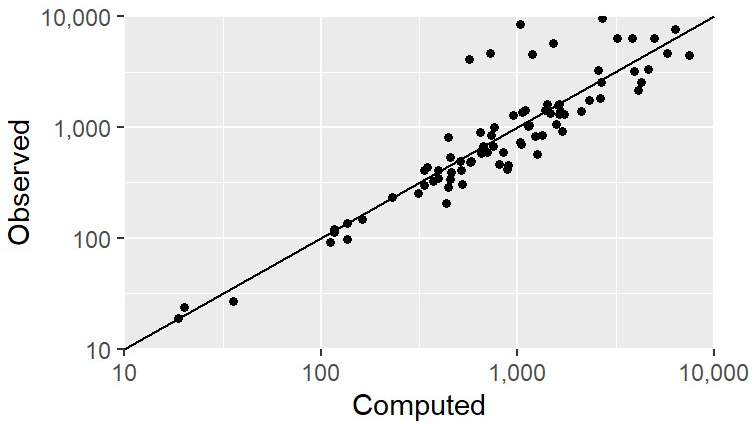
## Statistical Plots

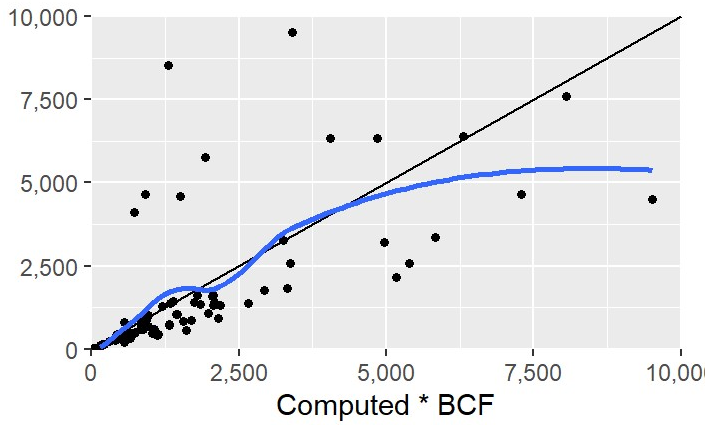

Residual
1.20
0.80
0.40
0.00
-0.40
-0.80
-1.20
10
100
1,000
10,000
Regression Computed

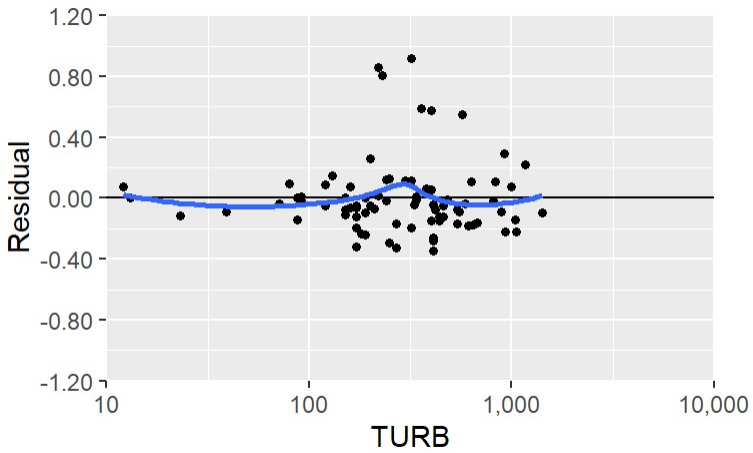

1.20
0.80
0.40
0.00
-0.40
-0.80
-1.20
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
Normal Quantiles

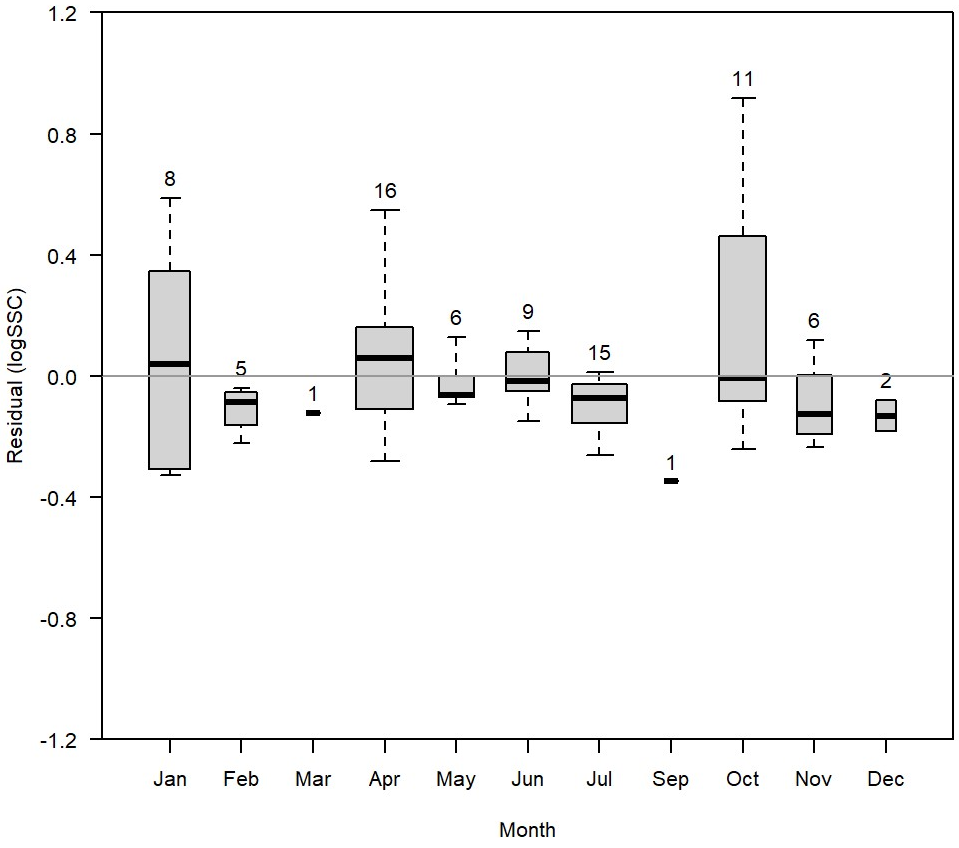

Residuals
1.20
0.80
0.40
0.00
-0.40
-0.80
-1.20
2012-01
2014-01
2016-01
2018-01
2020-01
Date

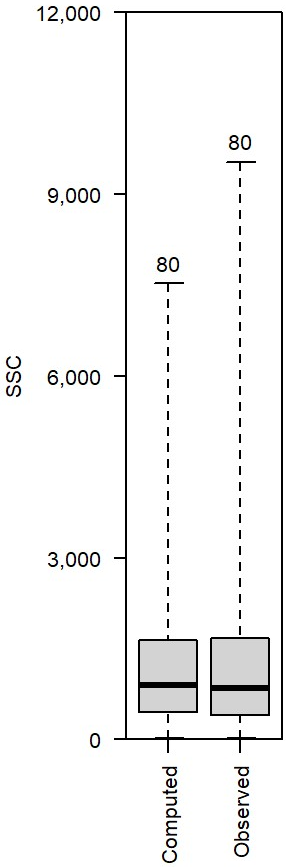

1.20
0.80
0.40
0.00
-0.40
-0.80
-1.20
100
1,000
10,000
Streamflow

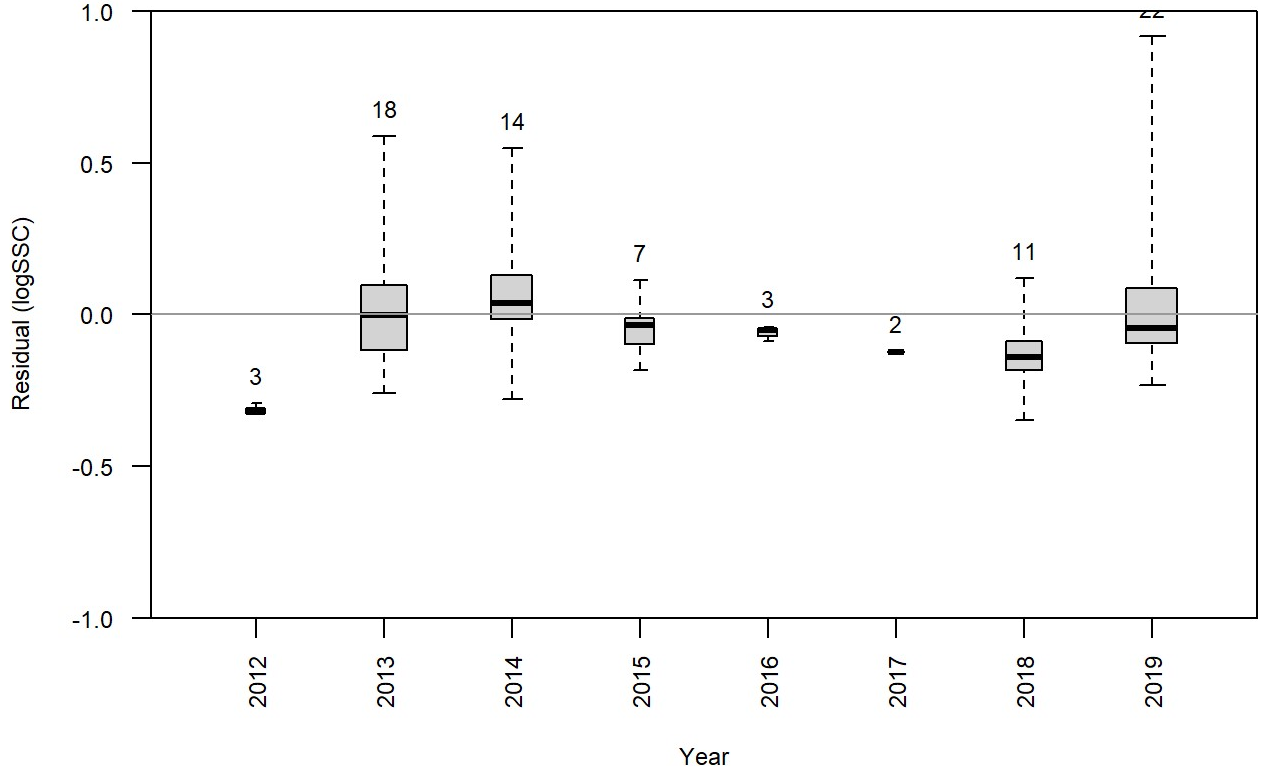

Observed
10,000
1,000
100
10
10
100
1,000
10,000
Computed


10,000
7,500
5,000
2,500
0
0
2,500
5,000
7,500
10,000
Computed * BCF

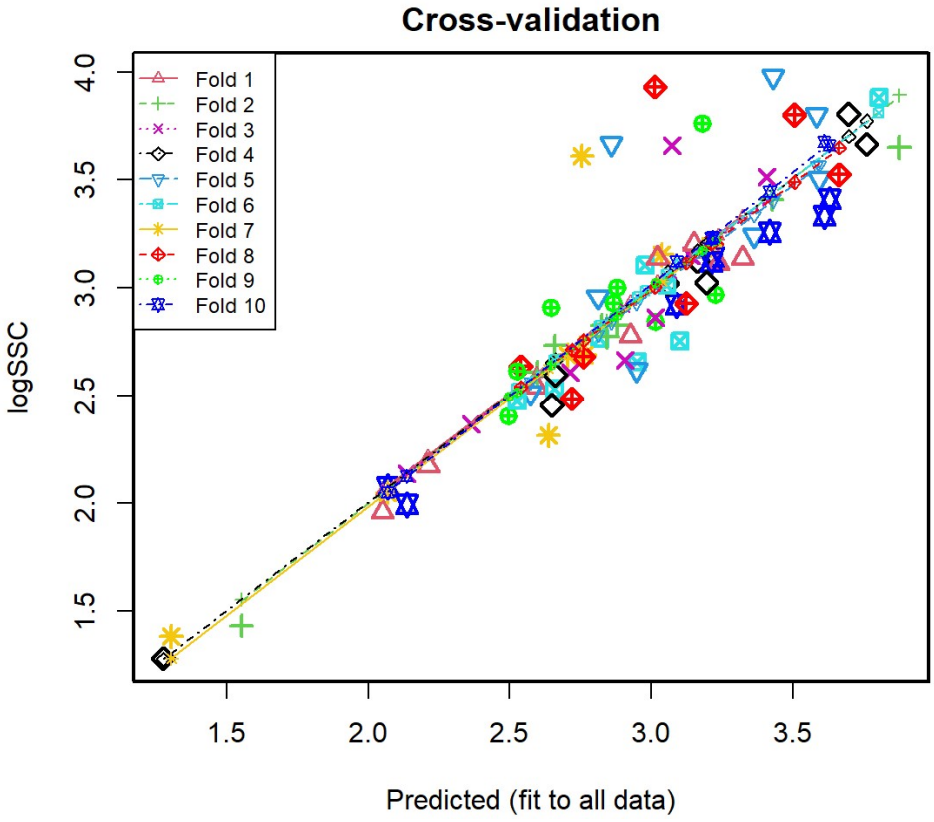

Residual
1.20
0.80
0.40
0.00
-0.40
-0.80
-1.20
10
100
1,000
10,000
TURB


1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
Residual (logSSC)
8
5
1
16
6
9
15
1
11
6
2
Jan
Feb
Mar
Apr
May
Jun
Jul
Sep
Oct
Nov
Dec
Month

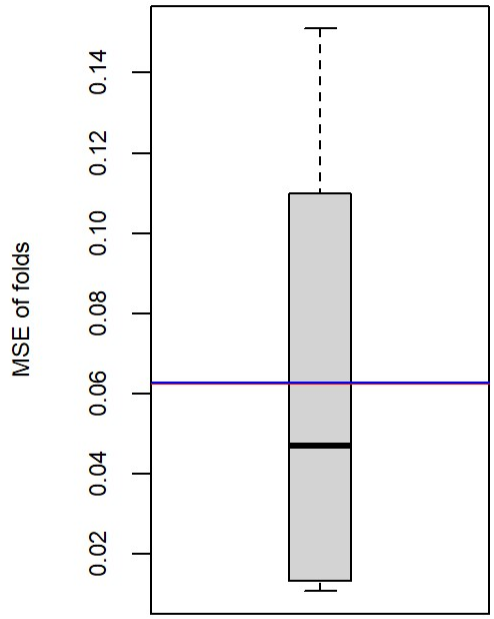

12,000
9,000
6,000
3,000
0
SSC
80
80
Computed
Observed




# Cross Validation



```
              Minimum MSE of folds:  0.0107
                 Mean MSE of folds:  0.0628
               Median MSE of folds:  0.0469
              Maximum MSE of folds:  0.1510
(Mean MSE of folds) / (Model MSE):  1.0100
```




```
Red line - Model MSE
Blue line - Mean MSE of folds
```

# Model-Calibration Data Set

| | Date | logSSC | logTURB | logQ | SSC | TURB | Q | Computed logSSC | Computed SSC | Residual | Normal Quantiles | Censored Values |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2012-01-12 | 2.66 | 2.4 | 3.08 | 454 | 250 | 1200 | 2.95 | 1130 | -0.293 | -1.7 | -- |
| 2 | 2012-01-12 | 2.62 | 2.43 | 3.02 | 417 | 270 | 1050 | 2.95 | 1120 | -0.327 | -2.05 | -- |
| 3 | 2012-01-12 | 2.31 | 2.23 | 2.8 | 206 | 170 | 628 | 2.64 | 546 | -0.322 | -1.85 | -- |
| 4 | 2013-01-31 | 1.28 | 1.11 | 2.18 | 19 | 13 | 153 | 1.27 | 23.7 | 0.00511 | 0.435 | -- |
| 5 | 2013-01-31 | 2.73 | 2.2 | 2.88 | 541 | 160 | 758 | 2.66 | 577 | 0.0734 | 0.653 | -- |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 2013-01-31 | 3.16 | 2.48 | 3.11 | 1430 | 300 | 1280 | 3.04 | 1380 | 0.117 | 1.01 | -- |
| 7 | 2013-01-31 | 3.76 | 2.6 | 3.16 | 5760 | 400 | 1450 | 3.18 | 1920 | 0.578 | 1.58 | -- |
| 8 | 2013-01-31 | 3.66 | 2.56 | 3.05 | 4580 | 360 | 1110 | 3.07 | 1500 | 0.588 | 1.7 | -- |
| 9 | 2013-06-08 | 2.96 | 2.11 | 3.28 | 909 | 130 | 1900 | 2.81 | 818 | 0.148 | 1.18 | -- |
| 10 | 2013-06-08 | 2.64 | 1.9 | 3.14 | 432 | 80 | 1370 | 2.54 | 437 | 0.097 | 0.817 | -- |
| 11 | 2013-06-08 | 1.96 | 1.59 | 2.78 | 91 | 39 | 599 | 2.05 | 141 | -0.0893 | -0.334 | -- |
| 12 | 2013-06-08 | 1.38 | 1.08 | 2.29 | 24 | 12 | 194 | 1.3 | 25.4 | 0.0778 | 0.733 | -- |
| 13 | 2013-07-01 | 2.97 | 2.61 | 3.23 | 929 | 410 | 1680 | 3.23 | 2140 | -0.261 | -1.48 | -- |
| 14 | 2013-07-01 | 3.15 | 2.53 | 3.2 | 1410 | 340 | 1580 | 3.14 | 1750 | 0.00892 | 0.505 | -- |
| 15 | 2013-07-01 | 2.76 | 2.3 | 3 | 582 | 200 | 1000 | 2.82 | 829 | -0.0522 | -0.0469 | -- |
| 16 | 2013-07-01 | 2.17 | 1.85 | 2.65 | 149 | 71 | 451 | 2.21 | 205 | -0.0376 | 0.11 | -- |
| 17 | 2013-07-02 | 1.43 | 1.36 | 2.28 | 27 | 23 | 189 | 1.55 | 44.9 | -0.119 | -0.505 | -- |
| 18 | 2013-10-11 | 3.2 | 2.53 | 3.32 | 1600 | 340 | 2100 | 3.21 | 2060 | -0.00814 | 0.301 | -- |
| 19 | 2013-10-11 | 3.24 | 2.66 | 3.38 | 1750 | 460 | 2400 | 3.36 | 2920 | -0.121 | -0.541 | -- |
| 20 | 2013-10-11 | 2.92 | 2.43 | 3.27 | 833 | 270 | 1850 | 3.09 | 1550 | -0.169 | -0.861 | -- |
| 21 | 2013-10-11 | 2.66 | 2.28 | 3.19 | 461 | 190 | 1540 | 2.91 | 1020 | -0.243 | -1.39 | -- |
| 22 | 2014-04-15 | 2.93 | 2.58 | 2.65 | 847 | 380 | 451 | 2.87 | 930 | 0.0612 | 0.615 | -- |
| 23 | 2014-04-15 | 3.41 | 2.91 | 3.11 | 2570 | 810 | 1280 | 3.43 | 3370 | -0.0165 | 0.205 | -- |
| 24 | 2014-04-15 | 3.14 | 2.73 | 3.02 | 1390 | 540 | 1050 | 3.22 | 2090 | -0.0748 | -0.237 | -- |
| 25 | 2014-04-15 | 3.8 | 2.96 | 3.16 | 6330 | 920 | 1440 | 3.51 | 4050 | 0.295 | 1.39 | -- |
| 26 | 2014-04-15 | 3.8 | 3.07 | 3.13 | 6330 | 1170 | 1350 | 3.58 | 4850 | 0.218 | 1.24 | -- |
| 27 | 2014-04-30 | 3.98 | 2.76 | 3.35 | 9530 | 570 | 2240 | 3.43 | 3410 | 0.549 | 1.48 | -- |
| 28 | 2014-04-30 | 3.81 | 2.92 | 3.56 | 6390 | 830 | 3610 | 3.7 | 6310 | 0.107 | 0.908 | -- |
| 29 | 2014-04-30 | 3.88 | 3 | 3.61 | 7610 | 1000 | 4120 | 3.8 | 8060 | 0.0769 | 0.692 | -- |
| 30 | 2014-04-30 | 3.65 | 2.97 | 3.79 | 4490 | 930 | 6130 | 3.88 | 9510 | -0.224 | -1.24 | -- |
| 31 | 2014-05-01 | 3.33 | 2.61 | 3.88 | 2150 | 410 | 7640 | 3.61 | 5170 | -0.28 | -1.58 | -- |
| 32 | 2014-05-16 | 3.11 | 2.4 | 3.13 | 1280 | 250 | 1340 | 2.98 | 1200 | 0.129 | 1.12 | -- |
| 33 | 2014-05-16 | 2.83 | 2.28 | 3.05 | 671 | 190 | 1120 | 2.83 | 846 | 0.000974 | 0.334 | -- |
| 34 | 2014-06-10 | 2.37 | 2.18 | 2.41 | 232 | 150 | 260 | 2.36 | 292 | 0.00154 | 0.368 | -- |
| 35 | 2014-07-28 | 2.61 | 2.34 | 2.56 | 407 | 220 | 360 | 2.6 | 498 | 0.0136 | 0.541 | -- |
| 36 | 2015-06-15 | 3.02 | 2.77 | 2.69 | 1050 | 590 | 486 | 3.06 | 1440 | -0.0364 | 0.141 | -- |
| 37 | 2015-06-15 | 2.83 | 2.66 | 2.55 | 674 | 460 | 352 | 2.88 | 956 | -0.05 | -0.0156 | -- |
| 38 | 2015-06-21 | 2.69 | 2.38 | 2.69 | 490 | 240 | 486 | 2.71 | 642 | -0.0157 | 0.237 | -- |
| 39 | 2015-06-28 | 2.78 | 2.64 | 2.66 | 599 | 440 | 455 | 2.93 | 1070 | -0.149 | -0.733 | -- |
| 40 | 2015-10-29 | 3.2 | 2.68 | 3.08 | 1570 | 480 | 1210 | 3.21 | 2040 | -0.0117 | 0.269 | -- |
| 41 | 2015-10-29 | 3.14 | 2.51 | 3.04 | 1370 | 320 | 1090 | 3.02 | 1330 | 0.114 | 0.956 | -- |
| 42 | 2015-12-24 | 3.14 | 2.79 | 3.12 | 1380 | 610 | 1320 | 3.32 | 2660 | -0.183 | -1.01 | -- |
| 43 | 2016-02-16 | 3.51 | 2.95 | 3.33 | 3210 | 890 | 2150 | 3.59 | 4970 | -0.0879 | -0.301 | -- |
| 44 | 2016-02-17 | 3.12 | 2.61 | 3.11 | 1330 | 410 | 1300 | 3.16 | 1840 | -0.0403 | 0.0782 | -- |
| 45 | 2016-02-17 | 2.54 | 2.23 | 2.73 | 348 | 170 | 532 | 2.59 | 496 | -0.0524 | -0.0782 | -- |
| 46 | 2017-04-01 | 3.11 | 2.64 | 3.19 | 1300 | 440 | 1550 | 3.24 | 2180 | -0.122 | -0.578 | -- |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | 2017-04-06 | 2.53 | 2.23 | 2.84 | 341 | 170 | 684 | 2.66 | 574 | -0.125 | -0.615 | -- |
| 48 | 2018-02-11 | 3.41 | 3.02 | 3.28 | 2570 | 1050 | 1920 | 3.63 | 5400 | -0.221 | -1.18 | -- |
| 49 | 2018-02-11 | 3.26 | 2.83 | 3.21 | 1810 | 680 | 1630 | 3.42 | 3320 | -0.161 | -0.817 | -- |
| 50 | 2018-05-14 | 2.4 | 2.28 | 2.48 | 252 | 190 | 304 | 2.5 | 396 | -0.0945 | -0.401 | -- |
| 51 | 2018-07-04 | 2.84 | 2.81 | 2.55 | 699 | 650 | 356 | 3.02 | 1310 | -0.172 | -0.956 | -- |
| 52 | 2018-07-04 | 2.69 | 2.62 | 2.41 | 489 | 420 | 256 | 2.76 | 732 | -0.0733 | -0.205 | -- |
| 53 | 2018-07-23 | 3.53 | 3.02 | 3.35 | 3350 | 1040 | 2230 | 3.66 | 5840 | -0.14 | -0.653 | -- |
| 54 | 2018-07-23 | 2.93 | 2.51 | 3.21 | 850 | 320 | 1630 | 3.12 | 1680 | -0.195 | -1.12 | -- |
| 55 | 2018-09-28 | 2.75 | 2.61 | 3.01 | 568 | 410 | 1020 | 3.1 | 1600 | -0.348 | -2.43 | -- |
| 56 | 2018-11-03 | 3 | 2.38 | 2.99 | 1000 | 240 | 970 | 2.88 | 960 | 0.119 | 1.06 | -- |
| 57 | 2018-11-06 | 2.61 | 2.18 | 3.02 | 406 | 150 | 1040 | 2.71 | 655 | -0.106 | -0.47 | -- |
| 58 | 2018-12-16 | 2.68 | 2.18 | 3.1 | 481 | 150 | 1250 | 2.76 | 729 | -0.079 | -0.269 | -- |
| 59 | 2019-04-20 | 3.67 | 3.15 | 3.31 | 4640 | 1420 | 2020 | 3.76 | 7290 | -0.0948 | -0.435 | -- |
| 60 | 2019-04-20 | 3.52 | 2.8 | 3.25 | 3280 | 630 | 1770 | 3.41 | 3250 | 0.106 | 0.861 | -- |
| 61 | 2019-04-20 | 3.2 | 2.6 | 3.11 | 1600 | 400 | 1280 | 3.15 | 1790 | 0.0535 | 0.578 | -- |
| 62 | 2019-04-27 | 2.87 | 2.6 | 2.87 | 733 | 400 | 749 | 3.02 | 1310 | -0.15 | -0.774 | -- |
| 63 | 2019-04-27 | 2.91 | 2.3 | 2.71 | 807 | 200 | 508 | 2.65 | 559 | 0.261 | 1.31 | -- |
| 64 | 2019-05-05 | 2.6 | 2.23 | 2.84 | 395 | 170 | 695 | 2.66 | 580 | -0.065 | -0.141 | -- |
| 65 | 2019-05-08 | 2.51 | 2.2 | 2.73 | 324 | 160 | 537 | 2.57 | 472 | -0.0621 | -0.11 | -- |
| 66 | 2019-05-12 | 2.78 | 2.32 | 3.01 | 596 | 210 | 1030 | 2.84 | 882 | -0.0684 | -0.173 | -- |
| 67 | 2019-07-12 | 3.12 | 2.74 | 3 | 1320 | 550 | 1000 | 3.21 | 2060 | -0.0921 | -0.368 | -- |
| 68 | 2019-07-12 | 3.03 | 2.73 | 2.98 | 1060 | 540 | 961 | 3.2 | 1980 | -0.17 | -0.908 | -- |
| 69 | 2019-07-12 | 2.05 | 1.96 | 2.24 | 112 | 91 | 174 | 2.07 | 147 | -0.0177 | 0.173 | -- |
| 70 | 2019-07-12 | 2.08 | 1.96 | 2.24 | 119 | 91 | 174 | 2.07 | 147 | 0.00858 | 0.47 | -- |
| 71 | 2019-07-18 | 3.01 | 2.52 | 3.07 | 1030 | 330 | 1180 | 3.05 | 1430 | -0.042 | 0.0469 | -- |
| 72 | 2019-10-27 | 3.61 | 2.34 | 2.83 | 4100 | 220 | 674 | 2.75 | 718 | 0.858 | 2.05 | -- |
| 73 | 2019-10-27 | 3.93 | 2.51 | 3.02 | 8540 | 320 | 1050 | 3.01 | 1300 | 0.918 | 2.43 | -- |
| 74 | 2019-10-27 | 3.67 | 2.36 | 2.98 | 4660 | 230 | 951 | 2.86 | 914 | 0.809 | 1.85 | -- |
| 75 | 2019-10-27 | 2.61 | 2.08 | 2.84 | 410 | 120 | 695 | 2.53 | 424 | 0.0874 | 0.774 | -- |
| 76 | 2019-10-27 | 2.48 | 2.08 | 2.84 | 300 | 120 | 695 | 2.53 | 424 | -0.0483 | 0.0156 | -- |
| 77 | 2019-11-01 | 2.49 | 2.26 | 2.9 | 306 | 180 | 799 | 2.72 | 662 | -0.233 | -1.31 | -- |
| 78 | 2019-11-01 | 2.46 | 2.23 | 2.82 | 286 | 170 | 661 | 2.65 | 563 | -0.193 | -1.06 | -- |
| 79 | 2019-11-01 | 1.99 | 1.94 | 2.39 | 98 | 87 | 244 | 2.13 | 172 | -0.144 | -0.692 | -- |
| 80 | 2019-11-01 | 2.14 | 1.94 | 2.39 | 137 | 87 | 244 | 2.13 | 172 | 0.00181 | 0.401 | -- |

# Definitions

SSC: Suspended sediment concentration (SSC), in mg/l (80154)

TURB: Turbidity, in FNU (63680)

Q: Discharge, in $ft^3/s$ (00060)