

## Appendix 2.9. Model Archive Summary for Sodium Concentration at U.S. Geological Survey site 07144100; Little Arkansas River near Sedgwick, Kansas, during May 1998 through December 2019

This model archive summary summarizes the sodium model developed to compute hourly or daily sodium. Model development methods follow U.S. Geological Survey (USGS) guidance from Office of Surface Water/Office of Water Quality Technical Memoranda and USGS Techniques and Methods, book 3, chap. C4 (Rasmussen and others, 2009).

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### Site and Model Information

Site Number: 07144100

Site Name: Little Arkansas River near Sedgwick, Kansas

Location: Latitude 37°52'59", longitude 97°25'27" referenced to North American Datum of 1927, in NE 1/4 NW 1/4 NW 1/4 sec.15, T.25 S., R.1 W., Sedgwick County, Kansas; hydrologic unit 11030012.

Equipment: A Sutron Satlink II High Data Rate Collection Platform and a Design Analysis Water Log H350/355 nonsubmersible pressure transducer transfers real-time stage and water-quality data via satellite. The primary reference gage is a Type-A wire-weight gage located on the downstream bridge handrail. Check-bar elevation is 33.614 feet. The orifice is enclosed in a well-screen and attached to a concrete pier on the left downstream side of the bridge. Gage height was measured during May 1998 through December 2019. A YSI 6600 water-quality monitor equipped with water temperature, specific conductance, pH, dissolved oxygen, and turbidity (a YSI Model 6026 [September 1998 through December 2006] and YSI Model 6136 [July 2004 through March 2015]) sensors collected data during April 1998 through March 2015. A YSI EXO2 water-quality monitor equipped with water temperature, specific conductance, pH, dissolved oxygen, turbidity, and fluorescent dissolved organic matter sensors collected data during September 2014 through December 2019. A Hach Nitratax monitor collected nitrate data during March 2012 through December 2019.

Date model was developed: June 1, 2020

Model calibration data period: May 1, 1998 through December 11, 2019

### Model Data

All data were collected using USGS protocols (U.S. Geological Survey, variously dated; Wagner and others, 2006; Sauer and Turnipseed, 2010; Turnipseed and Sauer, 2010) and are stored in the National Water Information System (NWIS) database (U.S. Geological Survey, 2021). Explanatory variables were evaluated individually and in combination. Potential explanatory variables included streamflow, water temperature, specific conductance, pH, dissolved oxygen, YSI EXO2 turbidity, nitrate, and fluorescent dissolved organic matter. Seasonal components (sine and cosine variables) also were evaluated as explanatory variables.

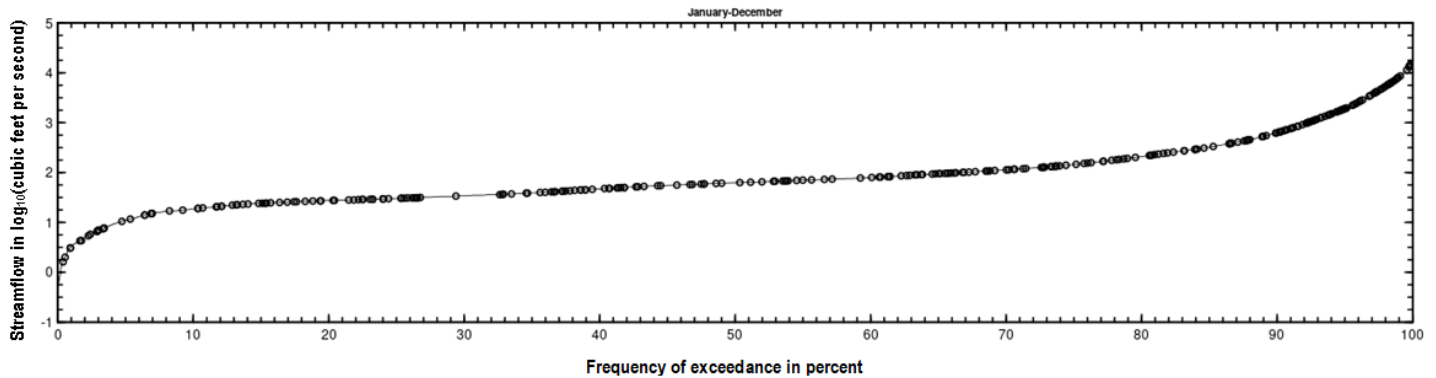
The regression model is based on 320 concomitant values of discretely collected sodium and continuously measured specific conductance during May 1998 through December 2019. Discrete samples were collected over a range of streamflow and specific conductance conditions. No samples had concentrations that were below laboratory detection limits. Summary statistics and the complete model-calibration dataset are provided below. Outliers and influential points were identified using studentized residuals, DFITS, Cook's D (Cook, 1977), and leverage. Outliers in previously published versions of this model (Christensen and others, 2003; Rasmussen and others, 2016) were examined and retained in the dataset if there were no clear issues, explanations, or conditions that would cause a result to be invalid for model calibration. All samples were retained in the dataset.

### Sodium

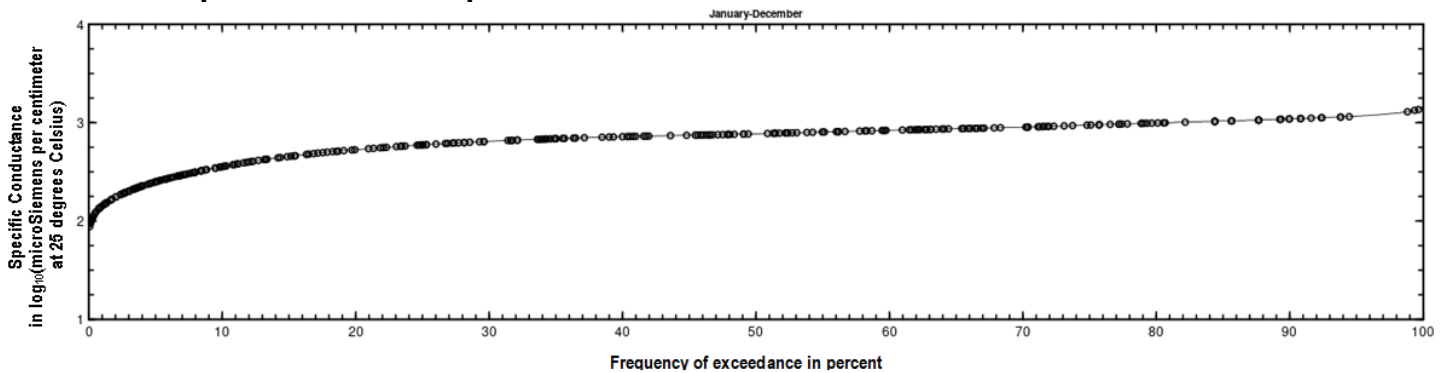
Discrete samples were collected from the downstream side of the bridge or instream within 50 feet of the bridge using equal-width-increment, multi-vertical, single vertical or grab-dip methods following U.S. Geological Survey (variously dated) and Rasmussen and others (2014). Discrete samples were collected on a semifixed to event-based schedule ranging

from 4 to 24 samples per year with a FISP US DH-95 or D-95 with a Teflon bottle, cap, and nozzle depth-integrating sampler, a DH-81 with a Teflon bottle, cap, and nozzle hand sampler or a grab sample with a Teflon bottle depending on sample location. Samples were analyzed for sodium by the Wichita Municipal Water and Wastewater Laboratory in Wichita, Kansas, or the USGS National Water Quality Laboratory according to standard methods (American Public Health Association and others, 1995).

## Sodium Samples Plotted on Streamflow Duration Curve



## Sodium Samples Plotted on Specific Conductance Duration Curve



## Continuous Data

Concomitant specific conductance values were time interpolated. If no concomitant continuous data were available within 2 hours of sample collection, the sample was not included in the dataset.

## Model Development

Ordinary least squares regression analysis was done using R (version 4.0.0) programming language (R Core Team, 2020) to relate discretely collected sodium to specific conductance and other continuously measured data. The distribution of residuals was examined for normality and plots of residuals (the difference between the measured and model-calculated values) compared to model-computed sodium were examined for homoscedasticity (departures from zero did not change substantially over the range of model-calculated values). Previously published explanatory variables were also strongly considered for continuity; however, the best explanatory variable(s) was ultimately selected.

Specific conductance was selected as the best predictor of sodium based on residual plots, high coefficient of determination ( $R^2$ ), and low model standard percentage error (MSPE). Specific conductance was positively related to sodium because it measures water's capacity to conduct an electrical current and is related to the concentration of ionized substances in water (Hem, 1992).

## Model Summary

Summary of final sodium regression analysis at USGS site number 07144100:

Sodium-based model:

$$\log_{10}(NA) = 1.36 \times \log_{10}(SC) - 2.16$$

where,

$\log_{10}$  = logarithm base 10;

$NA$  = sodium, in milligrams per liter (mg/L); and

$SC$  = specific conductance, in microsiemens per centimeter at 25 degrees Celsius ( $\mu\text{S}/\text{cm}$ )

The log-transformed model may be retransformed to original units so that  $NA$  can be calculated directly. The retransformation introduces a bias in the calculated constituent. This bias may be corrected using Duan's bias correction factor (BCF; Duan, 1983). For this model, the calculated BCF is 1.01. The retransformed model, accounting for BCF is:

$$NA = 0.007 \times SC^{1.36}$$

## Model Statistics, Data, and Plots

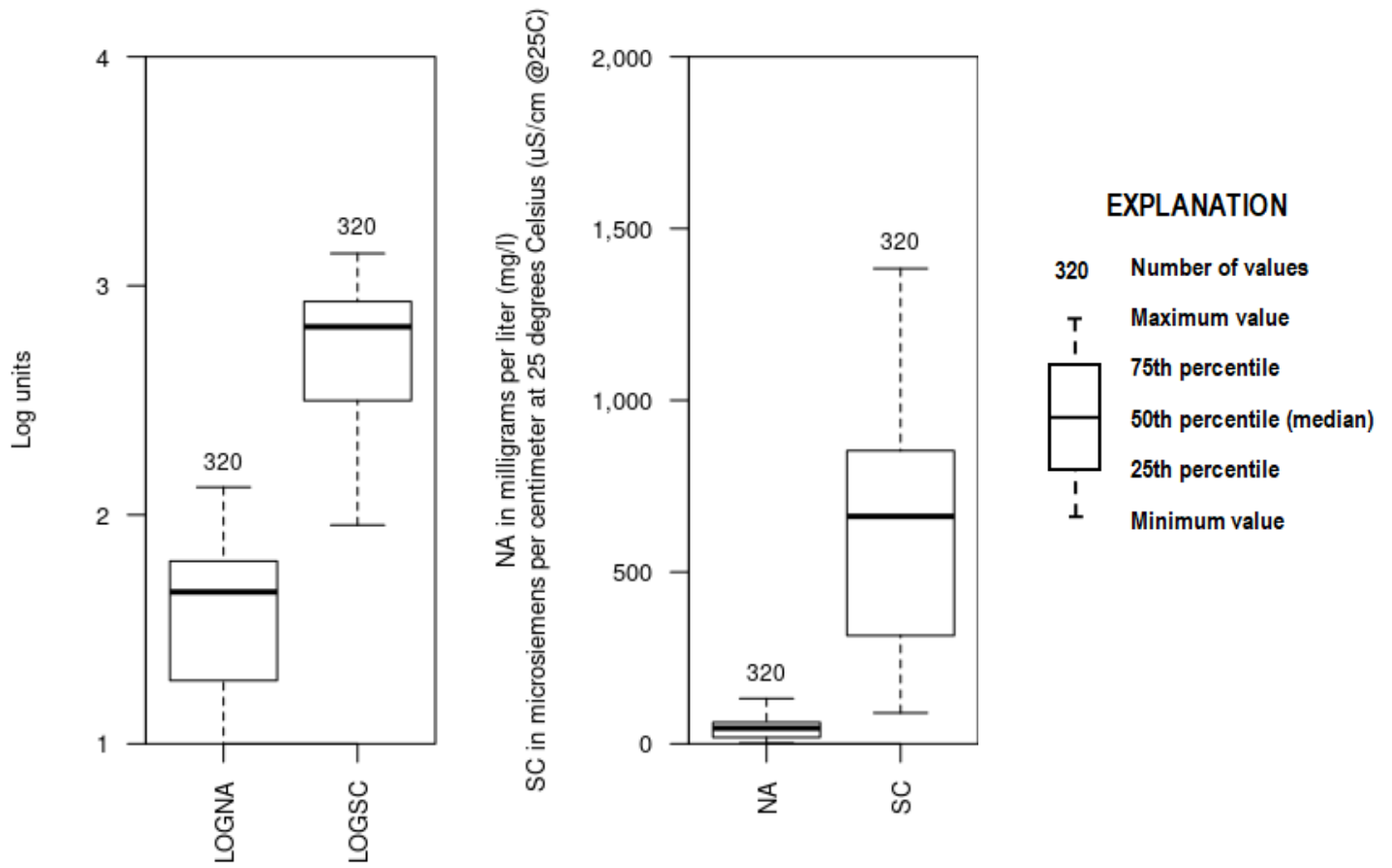
### Model

$$\text{LOGNA} = + 1.36 * \text{LOGSC} - 2.16$$

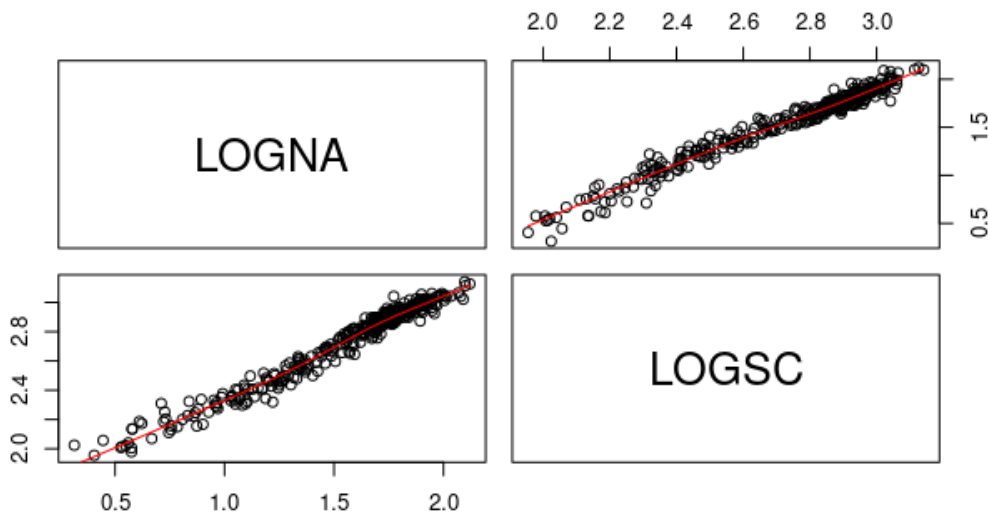
### Variable Summary Statistics

	LOGNA	NA.	LOGSC	SC
Minimum	0.314	2.06	1.96	90.2
1st Quartile	1.280	18.90	2.50	315.0
Median	1.660	46.00	2.82	662.0
Mean	1.520	44.60	2.71	610.0
3rd Quartile	1.800	62.80	2.93	853.0
Maximum	2.120	132.00	3.14	1380.0

## Box Plots



## Exploratory Plots



## Basic Model Statistics

Number of Observations	320
Standard error (RMSE)	0.0696
Average Model standard percentage error (MSPE)	16.1
Coefficient of determination (R <sup>2</sup> )	0.968
Adjusted Coefficient of Determination (Adj. R <sup>2</sup> )	0.968
Bias Correction Factor (BCF)	1.01

## Explanatory Variables

	Coefficients	Standard Error	t value	Pr(> t )
(Intercept)	-2.16	0.0378	-57.2	1.93e-169
LOGSC	1.36	0.0139	98.0	1.28e-239

## Correlation Matrix

	Intercept	E.vars
Intercept	1.000	-0.995
E.vars	-0.995	1.000

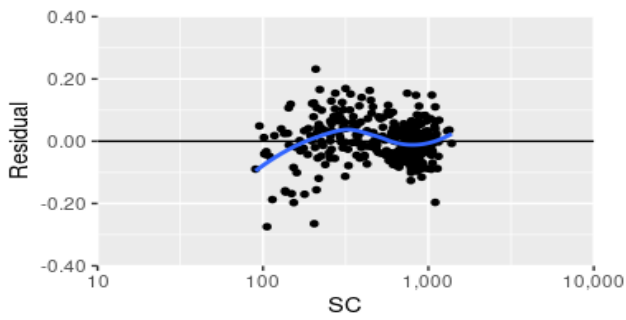
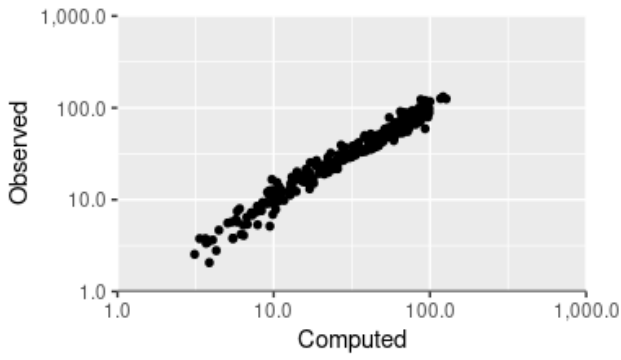
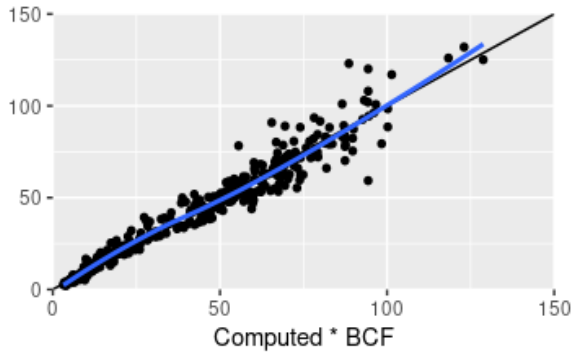
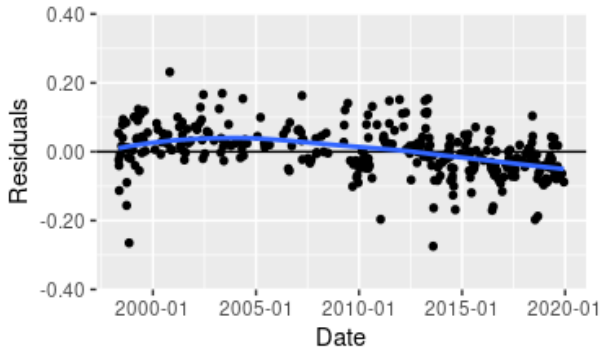
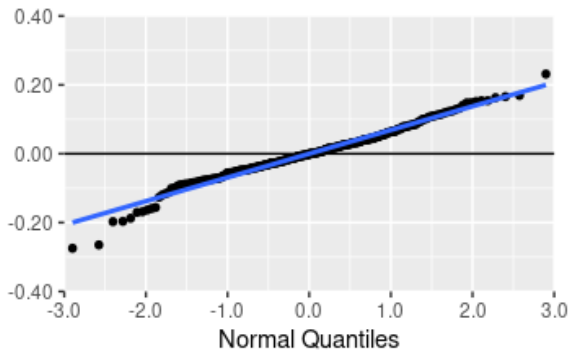
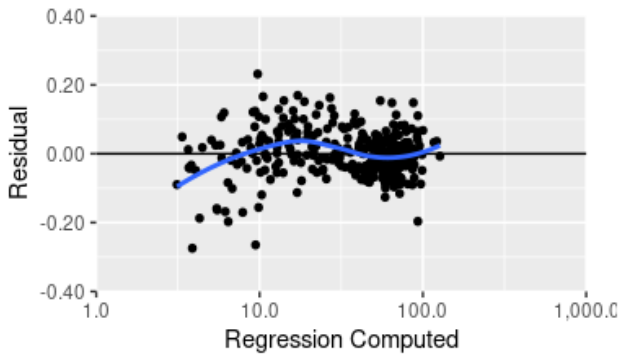
## Outlier Test Criteria

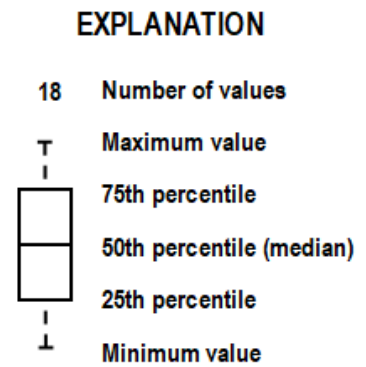
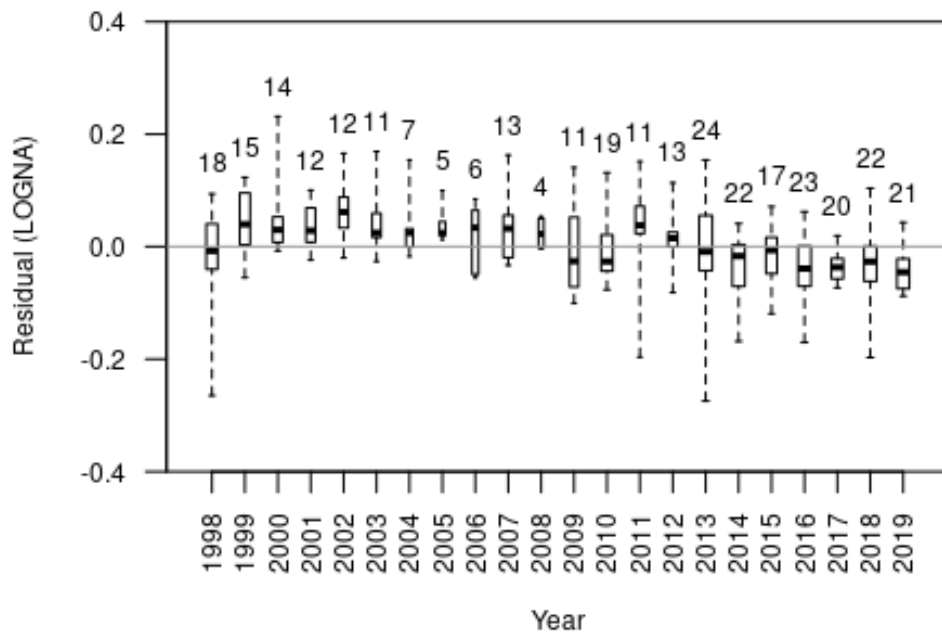
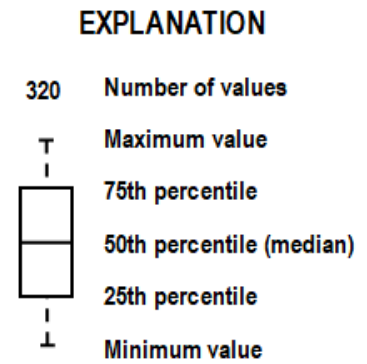
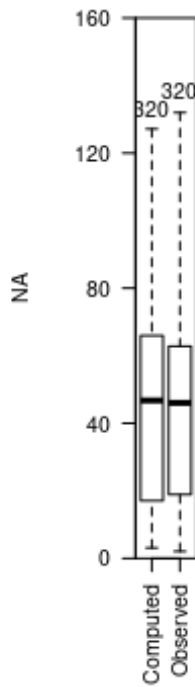
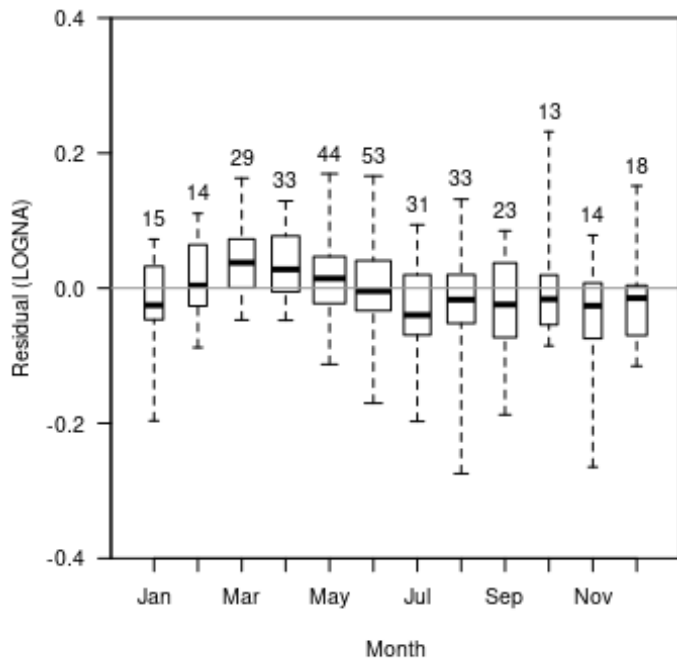
Leverage	Cook's D	DFFITS
0.0187	0.1947	0.1581

## Flagged Observations

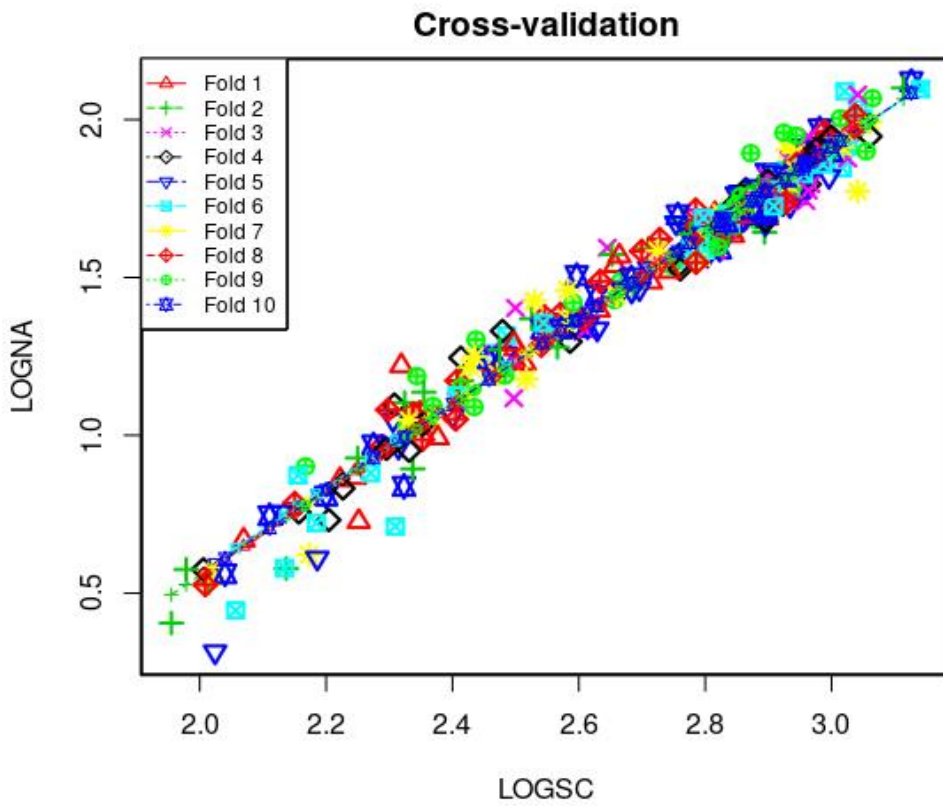
	LOGNA	Estimate	Residual	Standard Residual	Studentized Residual	Leverage	Cook's D	DFFITS
9/22/1998 10:15	0.838	0.994	-0.156	-2.25	-2.27	0.00908	0.0232	-0.217
9/25/1998 10:10	0.405	0.494	-0.0895	-1.3	-1.31	0.0258	0.0225	-0.212
10/5/1998 10:20	0.575	0.563	0.012	0.175	0.174	0.0228	0.000357	0.0267
11/5/1998 13:40	0.711	0.976	-0.265	-3.82	-3.91	0.0095	0.0702	-0.383
4/16/1999 11:15	1.1	0.974	0.123	1.78	1.79	0.00955	0.0153	0.176
8/3/1999 11:45	0.901	0.783	0.119	1.72	1.73	0.0148	0.0223	0.212
10/26/2000 11:35	1.22	0.989	0.232	3.34	3.4	0.00921	0.052	0.328
6/6/2001 10:10	0.575	0.526	0.049	0.714	0.713	0.0244	0.00637	0.113
6/13/2002 9:30	1.19	1.02	0.166	2.4	2.41	0.00847	0.0245	0.223
5/14/2003 10:00	1.4	1.23	0.169	2.44	2.46	0.00489	0.0146	0.172
5/13/2004 12:40	1.3	1.15	0.154	2.22	2.24	0.00609	0.0152	0.175
4/28/2009 10:05	1.08	0.96	0.121	1.75	1.75	0.00988	0.0153	0.175
9/9/2009 12:00	0.732	0.832	-0.101	-1.46	-1.46	0.0133	0.0144	-0.17
6/9/2010 9:45	0.873	0.766	0.107	1.55	1.55	0.0154	0.0188	0.194
6/13/2010 15:20	0.533	0.575	-0.0419	-0.61	-0.609	0.0224	0.00425	-0.0921
6/13/2010 19:20	0.549	0.582	-0.0333	-0.483	-0.483	0.0221	0.00264	-0.0725
6/14/2010 9:40	0.561	0.61	-0.0487	-0.707	-0.707	0.021	0.00535	-0.103
7/6/2010 9:00	0.526	0.567	-0.0407	-0.592	-0.591	0.0227	0.00406	-0.0901
1/19/2011 11:40	1.77	1.97	-0.196	-2.83	-2.86	0.00747	0.0302	-0.249
3/13/2013 9:15	2.09	1.94	0.148	2.14	2.15	0.00696	0.016	0.18
8/7/2013 9:45	0.314	0.588	-0.274	-3.99	-4.09	0.0218	0.177	-0.61
8/15/2013 9:10	0.578	0.741	-0.163	-2.37	-2.38	0.0162	0.0461	-0.306
9/3/2014 12:00	0.622	0.79	-0.168	-2.44	-2.46	0.0146	0.0439	-0.299
6/17/2015 10:40	0.894	1.01	-0.119	-1.72	-1.73	0.00866	0.013	-0.161
6/17/2016 12:10	0.727	0.897	-0.17	-2.46	-2.48	0.0115	0.0352	-0.267
7/6/2016 11:15	0.579	0.738	-0.159	-2.31	-2.32	0.0163	0.0441	-0.299
7/19/2018 11:30	0.611	0.808	-0.197	-2.85	-2.89	0.014	0.058	-0.345
9/6/2018 12:00	0.445	0.633	-0.187	-2.72	-2.75	0.0201	0.0758	-0.393
5/23/2019 12:20	0.668	0.65	0.018	0.262	0.261	0.0194	0.000679	0.0368

# Statistical Plots

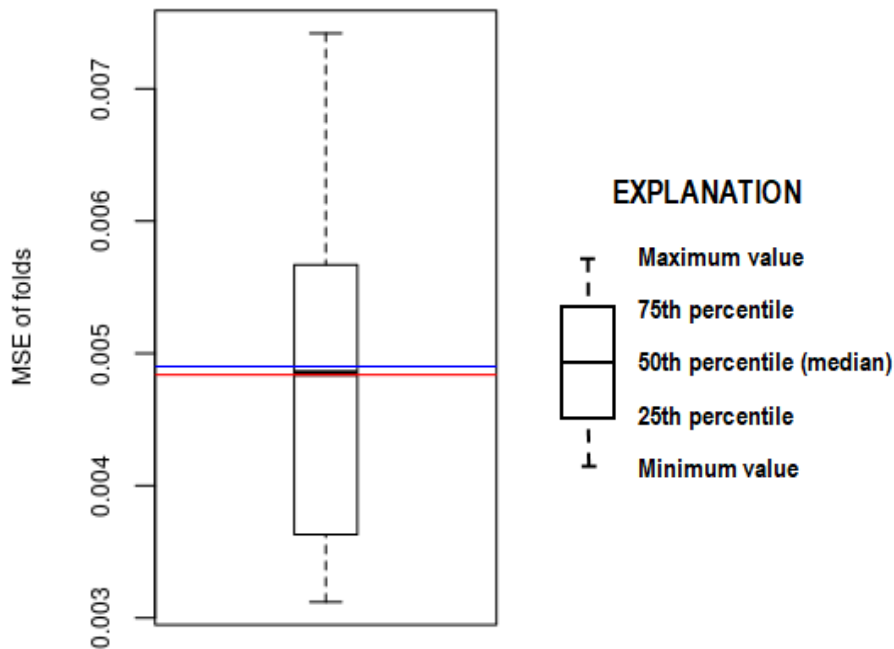




# Cross Validation



Minimum MSE of folds: 0.00312  
Mean MSE of folds: 0.00490  
Median MSE of folds: 0.00485  
Maximum MSE of folds: 0.00742  
(Mean MSE of folds) / (Model MSE): 1.01000



Red line - Model MSE

Blue line - Mean MSE of folds



## Model-Calibration Dataset

	Date	LOGNA	LOGSC	NA	SC	Computed LOGNA	Computed NA	Residual	Normal Quantiles
1	5/1/1998	1.91	2.96	80.7	903	1.85	72.1	0.0543	0.892
2	5/6/1998	1.77	2.91	58.3	811	1.79	62.4	-0.0237	-0.356
3	5/11/1998	1.82	2.96	66	914	1.86	73.3	-0.0401	-0.669
4	5/14/1998	1.12	2.5	13.1	314	1.23	17.2	-0.113	-1.72
5	5/27/1998	1.8	2.93	63.5	843	1.81	65.7	-0.00937	-0.153
6	6/16/1998	1.83	2.94	67.6	877	1.84	69.4	-0.00568	-0.0901
7	6/24/1998	1.66	2.8	45.9	634	1.64	44.7	0.017	0.265
8	7/10/1998	1.05	2.31	11.2	202	0.971	9.47	0.0786	1.17
9	7/13/1998	1.27	2.5	18.8	316	1.23	17.3	0.0404	0.699
10	7/20/1998	1.67	2.75	47.1	568	1.58	38.4	0.0939	1.36
11	8/6/1998	1.8	2.91	63.7	817	1.79	63	0.0105	0.193
12	9/15/1998	1.9	2.93	80.2	853	1.82	66.8	0.0848	1.29
13	9/22/1998	0.838	2.32	6.89	210	0.994	9.99	-0.156	-1.88
14	9/25/1998	0.405	1.96	2.54	90.2	0.494	3.16	-0.0895	-1.54
15	10/5/1998	0.575	2.01	3.76	101	0.563	3.7	0.012	0.201
16	10/22/1998	1.4	2.63	24.9	428	1.41	26.2	-0.0162	-0.249
17	11/5/1998	0.711	2.31	5.14	204	0.976	9.58	-0.265	-2.58
18	12/4/1998	1.71	2.86	50.8	728	1.73	53.9	-0.0202	-0.323
19	1/12/1999	1.97	3.04	94.4	1100	1.97	94.5	0.00495	0.114
20	2/1/1999	1.32	2.49	20.7	306	1.21	16.6	0.101	1.43
21	2/19/1999	1.9	3.02	78.9	1040	1.94	87.6	-0.0398	-0.65
22	3/16/1999	2.12	3.13	132	1340	2.08	123	0.036	0.621
23	3/23/1999	2.01	3.04	102	1100	1.97	94.3	0.0396	0.669
24	4/7/1999	1.54	2.66	34.5	454	1.45	28.4	0.0902	1.33
25	4/16/1999	1.1	2.31	12.5	203	0.974	9.53	0.123	1.72
26	5/5/1999	1.73	2.91	53.8	806	1.79	61.8	-0.0551	-0.965
27	5/24/1999	1.1	2.32	12.7	211	0.996	10	0.108	1.49
28	6/18/1999	1.23	2.5	17	316	1.23	17.3	-0.00332	-0.0352
29	6/21/1999	1.07	2.35	11.8	223	1.03	10.8	0.0436	0.76
30	7/20/1999	0.928	2.25	8.47	178	0.895	7.94	0.0334	0.593
31	8/3/1999	0.901	2.17	7.97	147	0.783	6.14	0.119	1.66
32	8/19/1999	1.86	2.96	72.8	914	1.86	73.4	0.00214	0.0666
33	9/28/1999	1.17	2.41	14.9	259	1.12	13.3	0.0556	0.916
34	2/9/2000	1.98	3.05	96.3	1120	1.98	96.1	0.00629	0.145
35	3/7/2000	1.26	2.46	18.2	287	1.18	15.2	0.0824	1.24
36	3/28/2000	1.17	2.41	14.9	255	1.11	13	0.0647	1.03
37	5/19/2000	1.94	3.03	87.3	1060	1.95	90	-0.00761	-0.13
38	5/31/2000	1.49	2.67	30.8	464	1.46	29.2	0.0283	0.493
39	6/28/2000	1.38	2.57	24.2	372	1.33	21.7	0.0532	0.869
40	7/20/2000	1.75	2.86	56.5	725	1.72	53.6	0.0287	0.511
41	7/28/2000	1.35	2.55	22.3	356	1.3	20.4	0.0435	0.75
42	8/16/2000	1.77	2.87	59	745	1.74	55.6	0.0314	0.538
43	9/8/2000	1.84	2.93	69.4	849	1.82	66.4	0.0246	0.415
44	9/25/2000	1.87	2.93	74.4	857	1.82	67.2	0.0495	0.835
45	10/26/2000	1.22	2.32	16.6	208	0.989	9.86	0.232	2.9
46	11/8/2000	1.53	2.71	33.8	515	1.52	33.6	0.00764	0.169
47	12/4/2000	1.97	3.04	92.6	1090	1.96	92.7	0.00504	0.122
48	3/14/2001	1.37	2.53	23.4	335	1.27	18.8	0.1	1.41
49	4/13/2001	1.59	2.71	39	513	1.52	33.4	0.0722	1.1
50	4/26/2001	1.92	3	83.1	989	1.91	81.6	0.0133	0.225
51	5/8/2001	1.69	2.82	49.5	666	1.67	47.8	0.021	0.364
52	6/4/2001	1.26	2.46	18.4	288	1.18	15.3	0.0858	1.31
53	6/6/2001	0.575	1.98	3.76	95.2	0.526	3.4	0.049	0.824

54	6/23/2001	0.859	2.22	7.23	167	0.857	7.28	0.00229	0.0744
55	7/11/2001	1.77	2.91	58.7	815	1.79	62.8	-0.0238	-0.364
56	8/2/2001	1.76	2.89	57	769	1.76	58.1	-0.00265	-0.0274
57	8/28/2001	1.84	2.9	69.1	790	1.77	60.2	0.0657	1.06
58	9/20/2001	0.785	2.15	6.09	141	0.759	5.82	0.0253	0.44
59	10/31/2001	1.85	2.93	70.9	853	1.82	66.8	0.0314	0.529
60	1/10/2002	2	3.01	101	1030	1.93	86.6	0.0724	1.11
61	2/21/2002	2.03	3.04	108	1100	1.97	94.3	0.0642	1
62	4/9/2002	1.97	2.98	93.5	958	1.89	78.2	0.0831	1.25
63	4/22/2002	1.25	2.41	17.6	259	1.12	13.2	0.129	1.8
64	5/13/2002	1.71	2.78	51.8	610	1.62	42.3	0.0932	1.34
65	5/22/2002	1.44	2.63	27.7	425	1.41	25.9	0.034	0.602
66	6/6/2002	1.34	2.59	22	393	1.36	23.3	-0.0199	-0.306
67	6/13/2002	1.19	2.34	15.4	221	1.02	10.6	0.166	2.4
68	7/9/2002	1.71	2.86	51.4	717	1.72	52.7	-0.00562	-0.0823
69	8/15/2002	1.69	2.79	48.8	618	1.63	43.1	0.059	0.94
70	9/19/2002	1.77	2.86	58.9	717	1.72	52.7	0.0537	0.881
71	12/18/2002	2.1	3.11	126	1300	2.07	118	0.0327	0.565
72	3/20/2003	1.33	2.48	21.4	301	1.21	16.3	0.125	1.76
73	4/17/2003	1.99	3.06	98.4	1150	2	100	-0.00243	-0.0196
74	4/23/2003	1.7	2.82	50.3	654	1.66	46.5	0.0393	0.659
75	5/14/2003	1.4	2.5	25.3	316	1.23	17.3	0.169	2.58
76	5/29/2003	1.5	2.68	31.5	482	1.48	30.8	0.0156	0.241
77	6/11/2003	1.65	2.83	45	673	1.68	48.4	-0.0262	-0.423
78	6/24/2003	1.93	2.99	84.4	967	1.89	79.2	0.033	0.583
79	7/30/2003	1.87	2.95	73.8	889	1.84	70.6	0.0246	0.423
80	9/3/2003	1.21	2.43	16.4	267	1.14	13.8	0.0795	1.2
81	10/14/2003	0.964	2.29	9.2	194	0.946	8.95	0.0177	0.29
82	12/11/2003	2	3.05	101	1120	1.98	96.7	0.0232	0.389
83	3/9/2004	1.03	2.33	10.7	213	1	10.1	0.0287	0.502
84	3/30/2004	1.9	3	79.3	1010	1.92	83.6	-0.0175	-0.265
85	4/26/2004	1.92	3	82.5	989	1.91	81.7	0.00996	0.185
86	5/13/2004	1.3	2.44	20.1	274	1.15	14.3	0.154	2.19
87	5/26/2004	1.92	3.01	83.3	1030	1.93	86.6	-0.0112	-0.169
88	6/22/2004	1.15	2.41	14.2	259	1.12	13.3	0.035	0.611
89	7/27/2004	0.756	2.13	5.7	135	0.731	5.45	0.0247	0.432
90	1/27/2005	1.34	2.54	21.7	349	1.29	19.8	0.0447	0.771
91	3/23/2005	1.14	2.35	13.7	226	1.04	11	0.0997	1.38
92	5/27/2005	1.2	2.46	16	288	1.18	15.3	0.0244	0.406
93	6/6/2005	1.2	2.47	15.9	293	1.19	15.6	0.0127	0.209
94	8/31/2005	1.34	2.56	21.9	366	1.32	21.2	0.0201	0.356
95	5/2/2006	1.78	2.86	60.2	732	1.73	54.3	0.0504	0.847
96	6/26/2006	1.24	2.46	17.4	287	1.18	15.2	0.0648	1.04
97	7/27/2006	1.65	2.84	44.3	692	1.7	50.3	-0.0493	-0.858
98	8/15/2006	1.61	2.82	40.8	658	1.67	47	-0.0554	-1
99	8/23/2006	1.68	2.77	47.7	582	1.59	39.8	0.0848	1.27
100	9/27/2006	1.76	2.88	57.6	750	1.74	56.1	0.017	0.273
101	1/10/2007	1.9	2.94	78.6	873	1.83	68.9	0.0626	0.99
102	2/5/2007	1.96	2.99	91.6	974	1.9	80	0.0645	1.02
103	3/12/2007	1.77	2.85	58.3	708	1.71	51.9	0.0561	0.928
104	3/21/2007	1.76	2.86	57.3	728	1.73	53.9	0.0323	0.556
105	3/27/2007	1.59	2.65	39.3	442	1.43	27.3	0.163	2.28
106	4/2/2007	0.866	2.25	7.35	176	0.889	7.84	-0.0227	-0.339
107	4/18/2007	1.09	2.37	12.4	234	1.06	11.5	0.0362	0.63
108	7/11/2007	0.808	2.2	6.42	159	0.827	6.8	-0.0194	-0.29
109	8/16/2007	1.66	2.83	45.3	684	1.69	49.5	-0.0331	-0.538

110	9/6/2007	1.86	2.98	72.6	954	1.89	77.8	-0.0242	-0.381
111	11/26/2007	1.83	2.91	67.7	815	1.79	62.8	0.0385	0.65
112	12/6/2007	1.85	2.96	70.6	906	1.85	72.4	-0.00589	-0.098
113	12/13/2007	1.19	2.47	15.6	296	1.2	15.9	-0.00206	-0.0117
114	3/6/2008	1.26	2.48	18.1	305	1.21	16.5	0.0455	0.792
115	4/14/2008	1.46	2.67	29.1	467	1.46	29.5	-0.00035	0.0117
116	5/29/2008	1.07	2.34	11.7	218	1.01	10.5	0.0544	0.904
117	6/30/2008	1.28	2.54	19.3	347	1.29	19.7	-0.0042	-0.0509
118	4/6/2009	1.7	2.83	50.6	670	1.68	48.1	0.0275	0.475
119	4/13/2009	1.62	2.73	41.8	535	1.54	35.4	0.0773	1.14
120	4/28/2009	1.08	2.3	12	198	0.96	9.23	0.121	1.69
121	6/16/2009	1.51	2.6	32.1	395	1.37	23.5	0.141	1.88
122	7/30/2009	1.09	2.41	12.4	259	1.12	13.3	-0.026	-0.415
123	9/9/2009	0.732	2.2	5.39	160	0.832	6.89	-0.101	-1.69
124	9/24/2009	1.06	2.4	11.5	251	1.1	12.7	-0.0369	-0.602
125	11/3/2009	1.23	2.51	16.9	327	1.25	18.1	-0.0257	-0.398
126	11/19/2009	1.69	2.89	49.2	780	1.77	59.2	-0.0746	-1.2
127	12/1/2009	1.8	2.96	62.4	921	1.86	74.1	-0.0689	-1.08
128	12/17/2009	1.85	3.02	70.2	1040	1.94	87.4	-0.09	-1.57
129	1/6/2010	1.95	3.06	88.5	1150	2	100	-0.0484	-0.835
130	1/19/2010	1.89	3.02	77.9	1040	1.94	87.4	-0.0448	-0.729
131	2/4/2010	1.86	2.98	71.7	949	1.88	77.2	-0.0264	-0.44
132	2/23/2010	1.91	3	81.8	997	1.91	82.6	0.00135	0.0509
133	3/10/2010	1.68	2.85	47.7	713	1.71	52.4	-0.035	-0.565
134	3/11/2010	1.63	2.79	42.8	619	1.63	43.2	0.00135	0.0587
135	4/14/2010	1.92	3.02	83.6	1040	1.94	87.4	-0.0137	-0.241
136	4/23/2010	1.55	2.77	35.8	590	1.6	40.5	-0.0475	-0.803
137	5/13/2010	1.38	2.55	23.8	351	1.3	20	0.0791	1.19
138	6/9/2010	0.873	2.16	7.47	143	0.766	5.91	0.107	1.47
139	6/13/2010	0.533	2.01	3.41	103	0.575	3.8	-0.0419	-0.699
140	6/14/2010	0.549	2.02	3.54	105	0.582	3.87	-0.0333	-0.547
141	6/14/2010	0.561	2.04	3.64	110	0.61	4.12	-0.0487	-0.847
142	6/15/2010	0.969	2.27	9.32	188	0.929	8.59	0.0408	0.709
143	6/16/2010	0.962	2.31	9.17	206	0.982	9.73	-0.0201	-0.314
144	7/6/2010	0.526	2.01	3.36	102	0.567	3.74	-0.0407	-0.689
145	8/19/2010	1.57	2.8	37.2	637	1.65	44.9	-0.0766	-1.25
146	8/25/2010	1.57	2.65	37.4	449	1.44	27.9	0.132	1.84
147	11/16/2010	1.58	2.7	38.3	501	1.51	32.4	0.0784	1.16
148	1/19/2011	1.77	3.04	59.3	1100	1.97	94.3	-0.196	-2.28
149	3/7/2011	1.79	2.88	61.4	759	1.75	57	0.0378	0.64
150	3/16/2011	1.83	2.91	68.1	808	1.79	62.1	0.0461	0.803
151	4/6/2011	1.91	2.98	82.1	956	1.89	78	0.0279	0.484
152	5/2/2011	1.89	2.97	77.1	936	1.87	75.8	0.0131	0.217
153	6/7/2011	1.72	2.84	52.5	692	1.7	50.3	0.0242	0.398
154	6/21/2011	1.95	2.96	88.3	920	1.86	74	0.0821	1.22
155	6/22/2011	1.96	2.92	90.9	841	1.81	65.5	0.148	1.93
156	8/15/2011	1.37	2.58	23.3	382	1.35	22.4	0.0221	0.381
157	9/22/2011	1.42	2.59	26.3	390	1.36	23.1	0.0618	0.965
158	12/20/2011	1.43	2.53	26.7	338	1.27	19	0.152	2.04
159	2/6/2012	1.57	2.66	37	461	1.46	29	0.111	1.54
160	3/1/2012	1.49	2.63	30.8	430	1.42	26.4	0.0726	1.13
161	4/7/2012	1.46	2.58	28.8	382	1.35	22.5	0.114	1.6
162	4/17/2012	1.73	2.86	53.8	725	1.72	53.6	0.00714	0.153
163	6/18/2012	1.32	2.57	21.1	372	1.33	21.6	-0.00487	-0.0587
164	6/19/2012	1.55	2.72	35.8	529	1.54	34.9	0.0167	0.257
165	7/12/2012	1.69	2.89	48.5	781	1.77	59.3	-0.0817	-1.36

166	7/19/2012	1.7	2.83	50.5	683	1.69	49.4	0.0152	0.233
167	9/11/2012	1.71	2.84	51.2	685	1.69	49.6	0.0186	0.323
168	10/24/2012	1.64	2.82	43.5	663	1.67	47.4	-0.0317	-0.511
169	11/7/2012	1.8	2.92	63.1	826	1.8	63.9	-0.00043	-0.00391
170	11/14/2012	1.85	2.93	70.7	860	1.82	67.5	0.0258	0.449
171	12/12/2012	1.82	2.93	66.7	854	1.82	66.9	0.00404	0.106
172	1/16/2013	1.86	2.94	72.3	880	1.84	69.7	0.0213	0.372
173	1/29/2013	1.82	2.9	65.8	791	1.77	60.3	0.0433	0.739
174	2/13/2013	1.81	2.93	64.6	860	1.82	67.5	-0.0135	-0.225
175	3/12/2013	1.95	2.94	88.9	878	1.84	69.5	0.113	1.57
176	3/13/2013	2.09	3.02	123	1050	1.94	88.6	0.148	1.98
177	3/27/2013	2.07	3.06	117	1160	2	101	0.0677	1.07
178	4/15/2013	2.08	3.04	120	1100	1.97	94.3	0.11	1.52
179	4/24/2013	1.7	2.76	49.9	571	1.58	38.7	0.116	1.63
180	5/6/2013	1.89	2.87	78.3	745	1.74	55.6	0.154	2.11
181	5/15/2013	1.62	2.78	41.5	599	1.61	41.4	0.00736	0.161
182	5/21/2013	1.43	2.66	26.8	453	1.45	28.3	-0.0175	-0.273
183	5/28/2013	1.76	2.86	57.3	718	1.72	52.9	0.0401	0.689
184	6/5/2013	1.48	2.69	30.3	489	1.49	31.4	-0.0105	-0.161
185	6/13/2013	1.87	2.96	74.9	907	1.86	72.6	0.0191	0.331
186	6/24/2013	2.1	3.14	125	1380	2.1	129	-0.00709	-0.122
187	7/9/2013	1.68	2.86	47.9	721	1.72	53.2	-0.0399	-0.659
188	7/29/2013	0.756	2.16	5.7	143	0.768	5.94	-0.0124	-0.201
189	8/7/2013	0.314	2.02	2.06	106	0.588	3.92	-0.274	-2.9
190	8/15/2013	0.578	2.14	3.78	137	0.741	5.58	-0.163	-1.98
191	8/29/2013	1.59	2.82	38.9	665	1.67	47.7	-0.083	-1.38
192	10/24/2013	1.75	2.94	56.5	878	1.84	69.4	-0.0836	-1.41
193	10/30/2013	1.34	2.61	22.1	411	1.39	24.8	-0.0451	-0.75
194	11/25/2013	1.79	2.94	62.1	863	1.83	67.9	-0.0333	-0.556
195	12/11/2013	1.88	3.03	75.4	1060	1.95	89.7	-0.0698	-1.1
196	1/14/2014	1.92	3.03	82.3	1060	1.95	89.7	-0.0318	-0.52
197	2/20/2014	1.91	3.02	81.7	1040	1.94	87.4	-0.024	-0.372
198	3/17/2014	1.9	3	79.1	998	1.91	82.7	-0.0137	-0.233
199	4/9/2014	1.9	2.99	79.6	989	1.91	81.6	-0.00523	-0.0744
200	4/14/2014	1.87	2.99	74.7	967	1.89	79.2	-0.0197	-0.298
201	5/14/2014	1.63	2.78	42.3	597	1.61	41.1	0.0172	0.282
202	5/15/2014	1.78	2.9	60.1	791	1.77	60.3	0.00374	0.098
203	5/29/2014	1.85	2.94	70.5	869	1.83	68.5	0.0183	0.314
204	6/3/2014	1.66	2.79	46.2	612	1.62	42.5	0.0411	0.719
205	6/5/2014	1.73	2.85	53.5	707	1.71	51.8	0.02	0.347
206	6/9/2014	1.03	2.36	10.8	231	1.05	11.3	-0.0135	-0.217
207	6/12/2014	0.722	2.18	5.27	153	0.806	6.48	-0.0841	-1.43
208	6/24/2014	1.54	2.76	34.6	573	1.58	38.9	-0.0462	-0.771
209	7/10/2014	1.58	2.82	38.4	657	1.67	46.9	-0.0811	-1.34
210	7/15/2014	1.68	2.88	47.9	760	1.75	57.1	-0.0705	-1.11
211	7/24/2014	1.64	2.89	43.9	783	1.77	59.5	-0.126	-1.84
212	8/4/2014	1.75	2.92	56.2	823	1.8	63.6	-0.0483	-0.824
213	8/7/2014	1.67	2.9	46.8	786	1.77	59.8	-0.1	-1.66
214	9/3/2014	0.622	2.17	4.19	149	0.79	6.25	-0.168	-2.04
215	10/16/2014	1.64	2.78	43.4	598	1.61	41.2	0.0274	0.467
216	12/9/2014	1.8	2.92	62.7	829	1.8	64.2	-0.00514	-0.0666
217	12/15/2014	1.86	2.96	71.7	921	1.86	74.1	-0.00891	-0.145
218	2/11/2015	2.01	3.04	103	1090	1.96	93.2	0.049	0.813
219	2/25/2015	1.95	3.02	89.3	1040	1.93	87	0.0165	0.249
220	4/6/2015	1.95	3	88.2	999	1.91	82.8	0.0329	0.574
221	4/16/2015	1.89	2.98	76.8	960	1.89	78.5	-0.00362	-0.0431

222	4/22/2015	1.69	2.8	48.8	627	1.64	44	0.0504	0.858
223	5/5/2015	1.7	2.88	49.9	763	1.75	57.4	-0.0552	-0.977
224	5/20/2015	1.03	2.35	10.7	226	1.04	11	-0.00617	-0.106
225	5/27/2015	0.992	2.38	9.81	238	1.07	11.8	-0.075	-1.24
226	6/10/2015	1.64	2.8	43.4	627	1.64	44	-0.00038	0.00391
227	6/17/2015	0.894	2.34	7.83	217	1.01	10.4	-0.119	-1.8
228	6/29/2015	1.7	2.87	50.2	735	1.73	54.5	-0.0303	-0.493
229	7/13/2015	1.3	2.59	19.8	385	1.35	22.7	-0.0543	-0.94
230	8/3/2015	1.71	2.88	50.8	763	1.75	57.5	-0.048	-0.813
231	8/17/2015	1.57	2.77	37.2	596	1.61	41	-0.0372	-0.611
232	8/27/2015	1.27	2.47	18.7	298	1.2	16	0.0713	1.08
233	9/8/2015	1.56	2.74	36.3	546	1.56	36.5	0.00369	0.0901
234	11/17/2015	1.68	2.84	47.7	687	1.69	49.8	-0.0132	-0.209
235	1/19/2016	1.72	2.88	52.7	755	1.75	56.6	-0.0253	-0.389
236	3/16/2016	1.84	2.94	69.1	878	1.84	69.5	0.0033	0.0823
237	4/20/2016	1.81	2.9	64.2	793	1.78	60.5	0.0316	0.547
238	4/21/2016	1.79	2.88	61.3	767	1.76	57.8	0.0309	0.52
239	5/3/2016	1.36	2.54	22.7	350	1.29	19.9	0.0622	0.977
240	5/18/2016	1.63	2.82	42.6	654	1.66	46.5	-0.0331	-0.529
241	5/26/2016	1.29	2.5	19.5	314	1.23	17.2	0.0601	0.952
242	5/31/2016	0.986	2.35	9.68	225	1.03	10.9	-0.0475	-0.792
243	6/7/2016	1.54	2.75	34.5	558	1.57	37.5	-0.0302	-0.484
244	6/17/2016	0.727	2.25	5.33	178	0.897	7.99	-0.17	-2.11
245	6/21/2016	1.05	2.41	11.2	254	1.11	12.9	-0.055	-0.952
246	6/28/2016	1.49	2.71	30.6	518	1.52	33.9	-0.0389	-0.63
247	7/6/2016	0.579	2.13	3.79	136	0.738	5.54	-0.159	-1.93
248	7/13/2016	1.34	2.61	21.6	409	1.39	24.6	-0.0506	-0.881
249	7/25/2016	1.63	2.84	43	698	1.7	50.9	-0.068	-1.07
250	8/11/2016	1.11	2.41	12.8	255	1.11	12.9	0.00116	0.0431
251	8/16/2016	1.46	2.7	29.1	497	1.5	32	-0.0357	-0.574
252	8/29/2016	0.958	2.3	9.07	198	0.957	9.16	0.000919	0.0352
253	9/7/2016	1.34	2.63	21.7	426	1.41	26	-0.073	-1.17
254	9/13/2016	1.09	2.43	12.3	272	1.14	14.1	-0.0553	-0.99
255	10/24/2016	1.69	2.9	48.7	789	1.77	60.1	-0.0853	-1.45
256	11/15/2016	1.68	2.9	47.8	787	1.77	59.9	-0.0919	-1.6
257	12/14/2016	1.74	2.96	55.3	911	1.86	73	-0.115	-1.76
258	1/10/2017	1.8	2.97	62.5	928	1.87	74.9	-0.0731	-1.19
259	2/14/2017	1.8	2.94	62.9	878	1.84	69.4	-0.0372	-0.621
260	3/14/2017	1.8	2.95	62.7	890	1.84	70.8	-0.0471	-0.781
261	3/30/2017	1.03	2.35	10.8	225	1.03	10.9	-8.12E-05	0.0196
262	4/11/2017	1.47	2.69	29.4	485	1.49	31.1	-0.0183	-0.282
263	5/1/2017	1.34	2.57	21.7	373	1.33	21.7	0.00551	0.13
264	5/15/2017	1.61	2.8	40.8	637	1.65	44.9	-0.0359	-0.593
265	5/31/2017	1.7	2.9	50.1	786	1.77	59.8	-0.0712	-1.13
266	6/5/2017	1.64	2.84	43.8	687	1.69	49.8	-0.0503	-0.869
267	6/13/2017	1.78	2.95	60.2	886	1.84	70.3	-0.0623	-1.03
268	6/28/2017	1.76	2.94	57.6	862	1.83	67.7	-0.0647	-1.06
269	7/13/2017	1.68	2.86	48.3	725	1.72	53.6	-0.0397	-0.64
270	7/31/2017	1.56	2.79	36.5	623	1.63	43.6	-0.0721	-1.14
271	8/2/2017	1.59	2.8	38.8	630	1.64	44.3	-0.052	-0.892
272	8/16/2017	1.67	2.84	47	692	1.7	50.3	-0.0236	-0.347
273	8/30/2017	1.73	2.87	53.1	748	1.74	55.9	-0.0171	-0.257
274	9/6/2017	1.72	2.87	52	749	1.74	56	-0.0269	-0.467
275	10/17/2017	1.76	2.87	56.9	740	1.74	55.1	0.0195	0.339
276	11/15/2017	1.69	2.86	49.5	722	1.72	53.3	-0.0264	-0.449
277	12/12/2017	1.72	2.87	52	749	1.74	56	-0.0266	-0.458

278	1/18/2018	1.78	2.94	60.9	866	1.83	68.2	-0.0437	-0.719
279	1/31/2018	1.75	2.88	56	765	1.76	57.7	-0.00691	-0.114
280	3/6/2018	1.75	2.88	55.9	754	1.75	56.5	0.000622	0.0274
281	3/22/2018	1.76	2.88	57	753	1.75	56.4	0.00964	0.177
282	4/18/2018	1.79	2.93	62.2	856	1.82	67.1	-0.0277	-0.475
283	5/2/2018	1.82	2.93	65.9	844	1.81	65.8	0.00561	0.137
284	5/9/2018	1.83	2.96	67.2	904	1.85	72.2	-0.0257	-0.406
285	5/23/2018	1.91	2.98	80.6	945	1.88	76.8	0.0267	0.458
286	6/1/2018	1.25	2.43	17.8	272	1.15	14.2	0.104	1.45
287	6/6/2018	1.58	2.73	38.4	531	1.54	35.1	0.0451	0.781
288	6/20/2018	1.68	2.83	47.4	681	1.69	49.2	-0.0115	-0.177
289	6/26/2018	1.37	2.61	23.2	404	1.38	24.2	-0.0122	-0.185
290	7/19/2018	0.611	2.19	4.08	154	0.808	6.51	-0.197	-2.4
291	7/31/2018	0.832	2.23	6.79	168	0.863	7.39	-0.0312	-0.502
292	8/16/2018	1.44	2.66	27.8	457	1.45	28.7	-0.00831	-0.137
293	8/28/2018	1.18	2.52	15.1	329	1.26	18.3	-0.0782	-1.31
294	9/6/2018	0.445	2.06	2.79	114	0.633	4.35	-0.187	-2.19
295	9/18/2018	1.53	2.76	33.6	576	1.59	39.2	-0.0617	-1.02
296	10/16/2018	0.951	2.33	8.94	215	1.01	10.3	-0.0541	-0.928
297	11/19/2018	1.82	3	66	991	1.91	81.9	-0.0879	-1.49
298	12/4/2018	1.73	2.89	53.1	779	1.77	59.1	-0.0406	-0.679
299	12/17/2018	1.73	2.93	53.4	859	1.82	67.5	-0.0964	-1.63
300	1/29/2019	1.73	2.92	53.8	837	1.81	65.1	-0.0776	-1.29
301	2/19/2019	1.9	3.05	79.4	1130	1.99	98.4	-0.0878	-1.47
302	3/14/2019	1.46	2.68	28.6	483	1.48	30.8	-0.0263	-0.432
303	3/19/2019	1.52	2.74	33.1	554	1.56	37.2	-0.0455	-0.76
304	4/11/2019	1.74	2.88	54.8	760	1.75	57.1	-0.0122	-0.193
305	4/16/2019	1.86	2.99	72.1	968	1.89	79.3	-0.0358	-0.583
306	5/1/2019	1.05	2.33	11.2	214	1	10.2	0.0432	0.729
307	5/15/2019	1.19	2.48	15.5	304	1.21	16.5	-0.0214	-0.331
308	5/23/2019	0.668	2.07	4.65	117	0.65	4.52	0.018	0.306
309	6/5/2019	1.55	2.79	35.3	610	1.62	42.4	-0.0748	-1.22
310	6/12/2019	1.73	2.9	53.3	799	1.78	61.1	-0.0536	-0.916
311	6/24/2019	0.745	2.11	5.56	129	0.706	5.14	0.0398	0.679
312	7/10/2019	1.28	2.57	19	368	1.32	21.3	-0.0448	-0.739
313	7/30/2019	1.74	2.93	55	853	1.82	66.8	-0.0791	-1.33
314	8/7/2019	1.72	2.9	52.4	787	1.77	59.9	-0.0528	-0.904
315	8/20/2019	0.88	2.27	7.59	186	0.923	8.48	-0.0425	-0.709
316	8/26/2019	1.13	2.41	13.4	255	1.11	13	0.018	0.298
317	9/11/2019	1.6	2.82	39.5	662	1.67	47.3	-0.0729	-1.16
318	10/9/2019	1.74	2.93	54.8	847	1.82	66.2	-0.0767	-1.27
319	11/6/2019	1.73	2.91	53.2	810	1.79	62.3	-0.0632	-1.04
320	12/11/2019	1.78	2.96	59.6	919	1.86	73.9	-0.0879	-1.52

## Definitions

NA: Sodium in mg/L (00930)

SC: Specific conductance in  $\mu\text{S}/\text{cm}$  @25C (00095)

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