Model Archive Summary for Arsenic Concentration at Station 07144100; Little Arkansas River near Sedgwick, Kansas

This model archive summary (MAS) summarizes the arsenic concentration (As) model developed to compute hourly As from January 1, 2007 onward. This model supersedes all models used from 1999 to 2007.

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, on left bank at downstream side from county highway bridge, 2.1 miles (mi) south of Sedgwick, and at mile marker 23.7.
Equipment: A YSI 6600 water-quality monitor equipped with sensors for water temperature, specific conductance (SC), dissolved oxygen, and pH, and a YSI Model 6136 turbidity sensor for turbidity. The monitor is housed in a 4-inch plastic pipe. Readings from the YSI 6600 are recorded every 30 minutes and transmitted by way of satellite, hourly.
Date model was created: April 6, 2015
Model calibration data period: May 11, 1998 to August 7, 2014
Model application date: January 1, 2007 onward

Model Data

All data were collected using U.S. Geological Survey (USGS) protocols and are stored in the National Water Information System (NWIS) database. The regression model is based on 189 concurrent measurements of arsenic concentration, streamflow, and water temperature collected from May 11, 1998 through August 7, 2014. Samples were collected throughout the range of continuously observed hydrologic and specific conductance conditions. No samples were below laboratory reporting levels. Summary statistics and complete model-calibration dataset are provided below. Studentized residuals from the final model were inspected for values greater than 3 or less than negative 3. Values outside of that range are considered potential outliers and are investigated. A sample collected June 9, 2005 was deemed an outlier and was removed from the dataset.

Sampling Details

Cross-section samples are collected either from the downstream side of the bridge or instream upstream near the bridge. The equal-width-increment or multi-vertical method is used, and samples typically are composited for analysis. Cross-section samples are obtained during all discrete sample collections every month and also during selected runoff events. A FISP US D-95 with a teflon bottle, cap, and nozzle depth integrating sampler is used from the bridge; and DH-81 with a teflon bottle, cap, and nozzle hand sampler or a grab sample with a teflon bottle for wading samples. Samples are analyzed at the USGS National Water Quality Laboratory in Lakewood, Colorado; the Wichita Municipal Water and Wastewater Laboratory, Wichita, Kansas; the USGS Ohio Microbiology Lab in Columbus, Ohio; the USGS Organic Lab in Lawrence, Kansas; and ALS Environmental at various locations in the U.S.

Model Development

Regression analysis was done using R by examining SC, streamflow, and other continuously measured data as explanatory variables for estimating arsenic concentration. A variety of models that predict As and models that predict $\log_{10}$(As) were evaluated. The distribution of residuals was examined for normality, and plots of residuals (the difference between the measured and predicted values) as compared to predicted As were examined for homoscedasticity (meaning that their departures from zero did not change substantially over the

range of predicted values). This comparison led to the conclusion that the most appropriate and reliable model would be one that estimated $\log_{10}$(As).

Streamflow and water temperature were selected as the best predictors of As based on residual plots, relatively high adjusted coefficient of determination (adjusted R^2) and relatively low model standard percentage error (*MSPE*), prediction error sum of squares (PRESS), and Mallow's C_p. Values for all of the aforementioned statistics and metrics were computed for various models and are included below along with all relevant sample data and more in-depth statistical information.

Model Summary

Summary of final regression analysis for arsenic concentration at site number 07144100.
Arsenic concentration-based model:

$$\log_{10}(As) = -0.183 \times \log_{10}(Q) + 0.014 \times TEMP + 0.880 ,$$

where

As = arsenic concentration, in milligrams per liter (mg/L); and
Q = streamflow in cubic feet per second (ft^3/s); and
TEMP = water temperature in degrees Celsius.

Streamflow is a good explanatory variable for modeling arsenic because it can be a good indicator of the source of the arsenic. When concentrations of arsenic are diluted by higher in-stream water volumes, there is potential that the source may be an underlying aquifer instead of being directly associated with rainfall and runoff. However, when higher streamflows increase the arsenic concentration, this potentially indicates that sources are directly related to rainfall and runoff. The physical significance of the correlation between water temperature and arsenic is less certain; however, the statistical correlation is strong once the variability for streamflow is accounted for. The model created using water temperature and streamflow had the highest R^2 value and the lowest values for standard error, Mallow's C_p, and PRESS.

The log-transformed model may be retransformed to the original units so that As 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). For this model, the calculated BCF is 1.03. The retransformed model, accounting for BCF is:

$$As = \frac{7.81 \times 10^{0.014 \times \mathrm{TEMP}}}{Q^{0.183}}.$$

Previous Models

Model	Start year	End year	Model
1.0	1999	2006	$\log_{10}(As) = -0.25 \times \log_{10}(Q) + 1.30$
2.0	2007	--	$\log_{10}(As) = -0.183 \times \log_{10}(Q) + 0.014 \times TEMP + 0.880$

Arsenic Concentration Record

The As record is computed using this regression model and stored at the National Real-Time Water Quality (NRTWQ) Web site. Data are computed at hourly intervals. The complete water-quality record can be found at http://nrtwq.usgs.gov/ks.

Remarks

None

Computed: Patrick Eslick
Reviewed: Patrick Rasmussen

Model Statistics, Data, and Plots

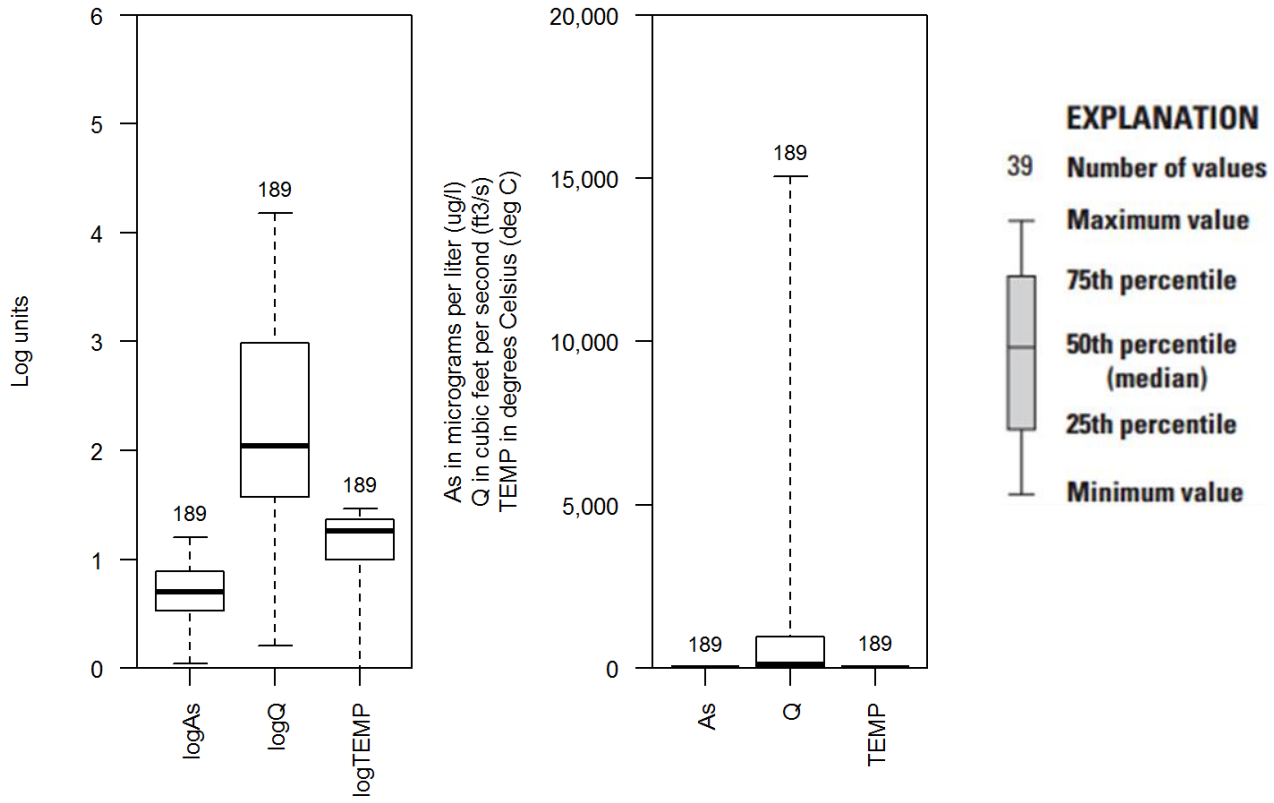
Model

logAs = + 0.014 * TEMP + -0.183 * logQ + 0.88

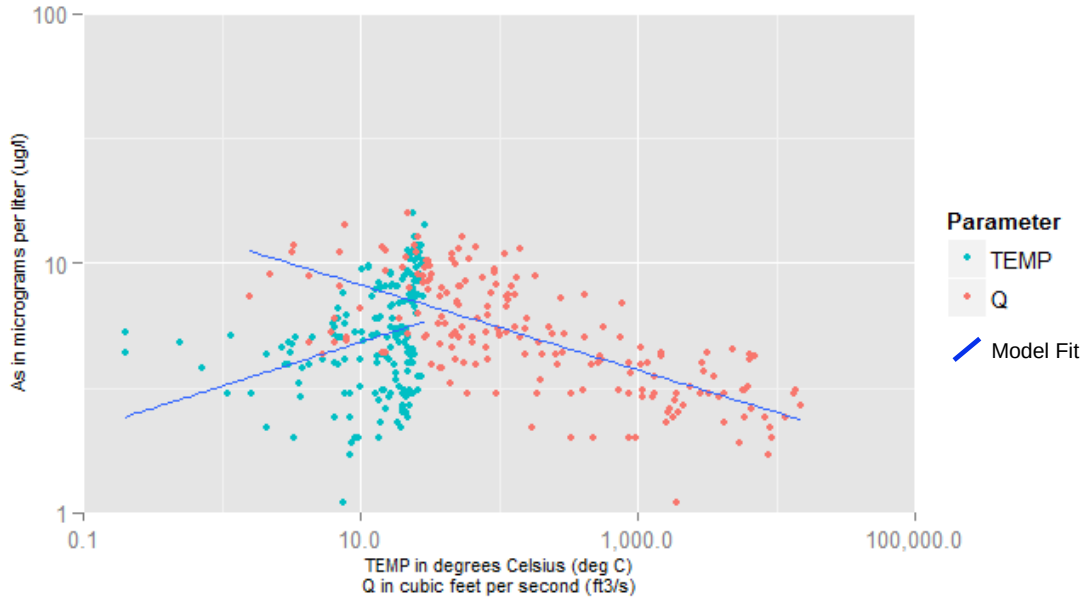
Variable Summary Statistics

	logAs	TEMP	logQ	As	Q
Minimum	0.0414	0.20	0.204	1.10	1.6
1st Quartile	0.5310	9.85	1.570	3.40	37.5
Median	0.6990	18.10	2.040	5.00	110.0
Mean	0.7040	16.50	2.230	5.75	1230.0
3rd Quartile	0.8920	23.20	2.990	7.80	978.0
Maximum	1.2000	29.00	4.180	15.90	15100.0

Box Plots



Exploratory Plot



Basic Model Statistics

```
Number of Observations                              189
Standard error (RMSE)                             0.114
Upper Model standard percentage error (MSPE)       30.1
Lower Model standard percentage error (MSPE)       23.1
Coefficient of determination (R²)                 0.741
Adjusted Coefficient of Determination (Adj. R²) 0.738
Bias Correction Factor (BCF)                       1.03
Variance Inflation Factors (VIF)
    TEMP     logQ
1.010864 1.010864
```

Explanatory Variables

```
            Coefficients Standard Error t value Pr(>|t|)
(Intercept)        0.880        0.02660    33.1 8.65e-80
TEMP               0.014        0.00106    13.2 1.65e-28
logQ              -0.183        0.00905   -20.2 1.07e-48
```

Correlation Matrix

```
          Intercept   TEMP   logQ
Intercept     1.000 -0.579 -0.689
TEMP         -0.579  1.000 -0.104
logQ         -0.689 -0.104  1.000
```

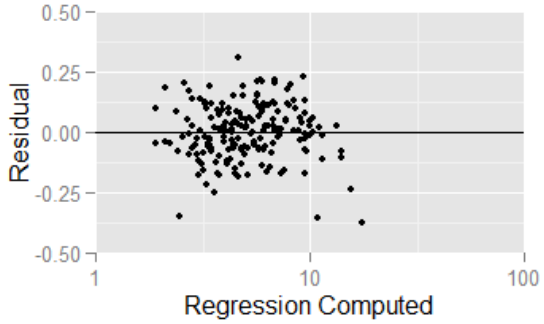
Outlier Test Criteria

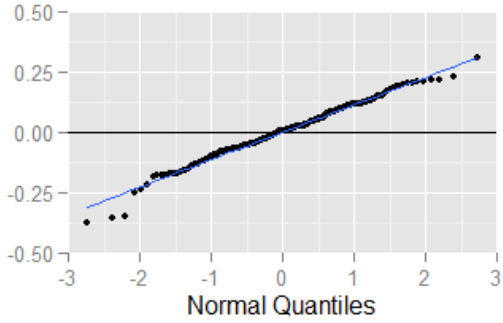
```
  Leverage   Cook's D     DFFITS
0.03174603 0.19457636 0.20573780
```

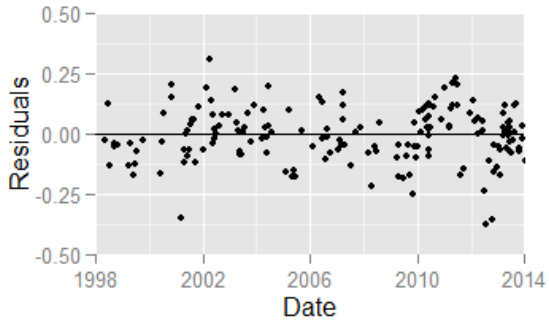
Flagged Observations

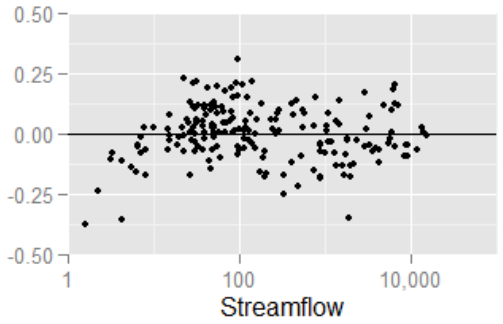
	logAs	Estimate	Residual	Standard Residual	Studentized Residual	Leverage	Cook's D	DFFITS
10/26/2000 11:36	0.61280	0.4124	0.200400	1.77400	1.78400	0.021040	2.254e-02	0.261500
3/14/2001 10:41	0.04139	0.3883	-0.346900	-3.06900	-3.14100	0.020450	6.554e-02	-0.453800
4/9/2002 10:06	0.97310	0.6657	0.307500	2.70400	2.75100	0.008704	2.140e-02	0.257800
3/20/2003 10:21	0.50510	0.3251	0.180000	1.59700	1.60400	0.026140	2.283e-02	0.262800
7/30/2003 12:21	1.14900	1.1260	0.023530	0.20950	0.20890	0.032840	4.965e-04	0.038490
1/27/2005 11:21	0.34240	0.5019	-0.159500	-1.41300	-1.41700	0.023180	1.579e-02	-0.218200
7/27/2006 11:16	1.04100	1.1450	-0.103800	-0.92450	-0.92420	0.033310	9.817e-03	-0.171500
2/5/2007 9:31	0.64350	0.6683	-0.024900	-0.22160	-0.22110	0.032560	5.509e-04	-0.040550
4/14/2008 12:11	0.30100	0.5193	-0.218300	-1.92300	-1.93700	0.011660	1.454e-02	-0.210400
11/3/2009 9:21	0.30100	0.5510	-0.250000	-2.20100	-2.22400	0.010610	1.731e-02	-0.230300
1/19/2011 11:41	0.72430	0.5349	0.189400	1.68200	1.69100	0.028060	2.724e-02	0.287300
6/7/2011 8:31	1.20100	0.9722	0.229200	2.02300	2.04100	0.016180	2.244e-02	0.261700
7/12/2012 10:16	0.95420	1.1920	-0.237600	-2.12300	-2.14300	0.039580	6.191e-02	-0.435100
7/19/2012 10:16	0.86330	1.2400	-0.376600	-3.37800	-3.47700	0.046800	1.867e-01	-0.770400
10/24/2012 9:30	0.68120	1.0360	-0.354300	-3.13800	-3.21600	0.022670	7.614e-02	-0.489800
12/12/2012 10:00	0.63350	0.7760	-0.142600	-1.27000	-1.27200	0.033950	1.889e-02	-0.238500
1/16/2013 9:30	0.68120	0.7377	-0.056420	-0.50330	-0.50230	0.036410	3.190e-03	-0.097630
1/29/2013 10:06	0.69020	0.8637	-0.173500	-1.53300	-1.53900	0.018290	1.460e-02	-0.210000
7/9/2013 9:31	1.06800	1.1500	-0.081900	-0.72960	-0.72870	0.033970	6.241e-03	-0.136700
8/7/2013 9:46	0.49140	0.4859	0.005414	0.04821	0.04808	0.033010	2.644e-05	0.008883
6/5/2014 10:40	1.05300	0.8367	0.216400	1.90500	1.91900	0.011510	1.409e-02	0.207100

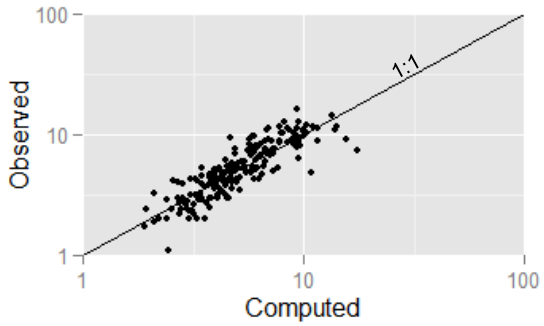
Statistical Plots

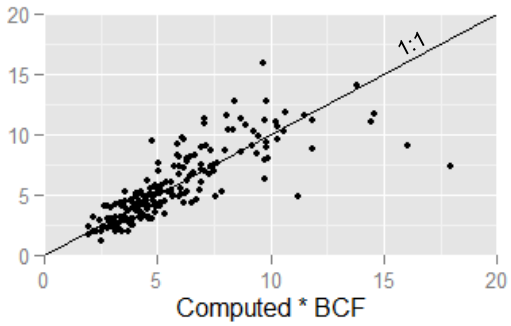


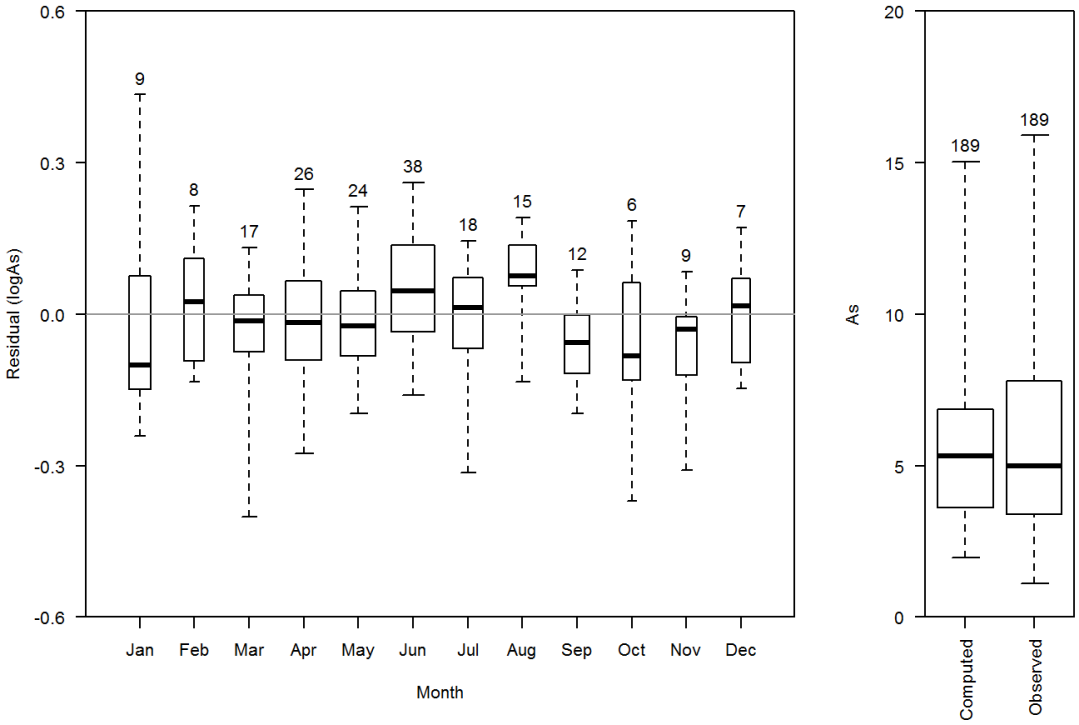












Models Considered

Model Formula	Number of Variables	Standard Error	R2	Adjusted R2	Cp	PRESS	VIF	MSPE
logAs ~ logQ	1	0.1585	49.8	49.53	251.4	4.796	1	± 37
logAs ~ logSC	1	0.1765	37.79	37.45	355.8	5.926	1	± 42
logAs ~ SC	1	0.185	31.61	31.24	409.5	6.53	1	± 44
logAs ~ TEMP + logSC	2	0.1123	74.96	74.69	34.7	2.411	1.082	± 26
logAs ~ TEMP + logQ	2	0.1142	74.08	73.8	42.3	2.514	1.011	± 27
logAs ~ logQ + cos(2piD/365)	2	0.1207	71.05	70.74	68.68	2.807	1.058	± 28
logAs ~ TEMP + logQ + logSC	3	0.1031	78.98	78.64	1.704	2.057	1.156	± 24
logAs ~ TEMP + logQ + SC	3	0.104	78.6	78.26	4.98	2.102	1.176	± 24
logAs ~ TEMP + logSC + cos(2piD/365)	3	0.1114	75.49	75.09	32.05	2.389	5.738	± 26
logAs ~ Q + TEMP + logQ + logSC	4	0.1028	79.22	78.76	1.677	2.048	2.424	± 24
logAs ~ TEMP + logQ + logSC + SC	4	0.103	79.15	78.69	2.278	2.068	1.179	± 24
logAs ~ TEMP + logQ + logSC + cos(4piD/365)	4	0.1031	79.11	78.65	2.628	2.066	1.264	± 24
logAs ~ Q + TEMP + logQ + logSC + cos(4piD/365)	5	0.1027	79.38	78.82	2.204	2.053	2.458	± 24
logAs ~ TEMP + logQ + logSC + SC + cos(4piD/365)	5	0.1028	79.33	78.76	2.698	2.071	1.308	± 24
logAs ~ Q + TEMP + logQ + logSC + SC	5	0.103	79.24	78.67	3.455	2.074	3.563	± 24
logAs ~ Q + TEMP + logQ + logTEMP + logSC + cos(4piD/365)	6	0.1027	79.48	78.8	3.398	2.061	2.47	± 24
logAs ~ Q + TEMP + logQ + logSC + SC + cos(4piD/365)	6	0.1029	79.43	78.75	3.809	2.075	3.565	± 24
logAs ~ TEMP + logQ + logTEMP + logSC + SC + cos(4piD/365)	6	0.1029	79.41	78.73	3.982	2.079	7.944	± 24

Model-Calibration Data Set

	Date	logAs	TEMP	logQ	As	Q	Computed logAs	Computed As	Residual	Normal Quantiles	Censored Values
1	1998-05-11	0.7404	19.43	2.111	5.5	129	0.7677	6.054	-0.0273	-0.241	--
2	1998-06-24	0.8692	24.42	2.615	7.4	412.1	0.7456	5.754	0.124	1.15	--
3	1998-07-10	0.5441	26.13	3.125	3.5	1334	0.6764	4.907	-0.132	-1.2	--
4	1998-09-22	0.5563	18.17	2.947	3.6	884.6	0.5974	4.091	-0.0411	-0.338	--
5	1998-09-25	0.415	20.32	3.818	2.6	6575	0.4685	3.04	-0.0535	-0.482	--
6	1998-11-05	0.2304	8.4	3.938	1.7	8663	0.2792	1.966	-0.0488	-0.452	--
7	1999-04-07	0.3617	14.09	3.202	2.3	1594	0.4933	3.219	-0.132	-1.18	--
8	1999-04-16	0.2788	8.753	3.733	1.9	5405	0.3216	2.168	-0.0428	-0.366	--

9	1999-05-24	0.3979	19.92	3.219	2.5	1656	0.5722	3.86	-0.174	-1.59	--
10	1999-06-21	0.4314	20.4	3.334	2.7	2158	0.558	3.736	-0.127	-1.15	--
11	1999-07-20	0.5441	27.55	3.547	3.5	3528	0.6193	4.303	-0.0753	-0.737	--
12	1999-09-28	0.4472	13.6	3.264	2.8	1835	0.4753	3.088	-0.0281	-0.254	--
13	2000-05-31	0.6335	24.31	2.312	4.3	205.1	0.7994	6.513	-0.166	-1.42	--
14	2000-06-28	0.6021	22.62	3.067	4	1168	0.6377	4.489	-0.0357	-0.31	--
15	2000-07-20	0.9395	25.85	2.132	8.7	135.4	0.8539	7.384	0.0856	0.737	--
16	2000-10-26	0.6128	16.2	3.808	4.1	6430	0.4124	2.672	0.2	1.75	--
17	2000-11-08	0.7924	8.04	1.914	6.2	82	0.6437	4.551	0.149	1.32	--
18	2001-03-14	0.04139	7.605	3.279	1.1	1903	0.3883	2.527	-0.347	-2.2	--
19	2001-04-13	0.4914	14.7	2.602	3.1	400	0.6115	4.226	-0.12	-1.13	--
20	2001-04-26	0.716	19.19	2.001	5.2	100.3	0.7843	6.291	-0.0683	-0.686	--
21	2001-05-08	0.7324	18.07	2.186	5.4	153.3	0.7349	5.615	-0.00251	-0.0663	--
22	2001-06-04	0.5911	17.7	3.021	3.9	1049	0.5772	3.905	0.0138	0.106	--
23	2001-06-06	0.3424	19.82	3.952	2.2	8956	0.4369	2.827	-0.0944	-0.966	--
24	2001-06-23	0.4771	23.08	3.628	3	4250	0.5418	3.599	-0.0647	-0.605	--
25	2001-07-11	0.9956	27.7	1.69	9.9	49	0.9606	9.441	0.035	0.366	--
26	2001-08-02	1.072	27.52	1.394	11.8	24.76	1.012	10.63	0.0597	0.542	--
27	2001-08-28	1.009	24.5	1.491	10.2	31	0.952	9.255	0.0566	0.527	--
28	2001-09-20	0.3617	18.67	3.62	2.3	4166	0.4814	3.132	-0.12	-1.1	--
29	2001-10-31	0.9191	13.67	1.453	8.3	28.35	0.8069	6.628	0.112	0.925	--
30	2002-01-10	0.5798	3.777	1.574	3.8	37.52	0.6458	4.574	-0.0661	-0.637	--
31	2002-02-21	0.8808	7.485	1.623	7.6	42	0.689	5.051	0.192	1.64	--
32	2002-04-09	0.9731	10.35	1.971	9.4	93.59	0.6657	4.787	0.307	2.73	--
33	2002-04-22	0.6232	13.3	3.171	4.2	1481	0.4881	3.181	0.135	1.26	--
34	2002-05-13	0.699	15.82	2.621	5	417.9	0.6238	4.347	0.0752	0.621	--
35	2002-05-22	0.699	18.1	2.152	5	141.9	0.7415	5.701	-0.0425	-0.352	--
36	2002-06-06	0.716	18.1	2.387	5.2	243.9	0.6986	5.164	0.0174	0.16	--
37	2002-06-13	0.4914	22.7	3.758	3.1	5729	0.5128	3.366	-0.0214	-0.2	--
38	2002-07-09	1.009	28.52	1.477	10.2	30	1.011	10.6	-0.00244	-0.053	--
39	2002-08-15	0.699	22.1	2.875	5	750	0.6656	4.786	0.0334	0.338	--
40	2002-09-19	1.049	21.9	1.176	11.2	15	0.973	9.714	0.0762	0.637	--
41	2002-12-18	0.7559	6.42	1.613	5.7	41	0.6759	4.902	0.0799	0.653	--
42	2003-03-20	0.5051	9.865	3.799	3.2	6294	0.3251	2.185	0.18	1.54	--
43	2003-04-17	0.7782	13.65	1.843	6	69.73	0.7354	5.621	0.0428	0.394	--
44	2003-04-23	0.6435	14.5	2.464	4.4	290.9	0.634	4.45	0.00947	0.0663	--
45	2003-05-14	0.415	15.1	3.233	2.6	1710	0.502	3.284	-0.087	-0.885	--
46	2003-05-29	0.6812	21.01	2.286	4.8	193	0.7579	5.92	-0.0766	-0.791	--
47	2003-06-11	0.7324	21.6	1.987	5.4	97	0.8208	6.842	-0.0884	-0.904	--
48	2003-06-24	0.9294	25.88	1.756	8.5	57	0.923	8.658	0.00642	0.0398	--
49	2003-07-30	1.149	29.01	0.8865	14.1	7.7	1.126	13.81	0.0235	0.214	--
50	2003-09-03	0.7404	20.09	2.757	5.5	571.5	0.6589	4.713	0.0815	0.686	--
51	2003-10-14	0.4914	14.4	3.033	3.1	1079	0.5287	3.492	-0.0373	-0.324	--
52	2003-12-11	0.7076	1.155	1.658	5.1	45.48	0.5938	4.057	0.114	0.987	--
53	2004-03-09	0.3802	8.285	3.254	2.4	1794	0.4024	2.611	-0.0222	-0.214	--
54	2004-03-30	0.716	13.37	2.465	5.2	292	0.6178	4.288	0.0982	0.827	--
55	2004-04-26	0.8325	16.86	1.708	6.8	51	0.8052	6.601	0.0273	0.268	--
56	2004-05-13	0.4624	16.1	3.104	2.9	1270	0.5396	3.581	-0.0772	-0.809	--
57	2004-05-26	0.8451	20.57	1.699	7	50	0.8588	7.468	-0.0137	-0.133	--
58	2004-06-16	1.104	24.7	1.736	12.7	54.5	0.91	8.403	0.194	1.69	--
59	2004-06-22	0.6628	21.72	3.017	4.6	1040	0.6343	4.454	0.0285	0.31	--
60	2004-07-27	0.4914	20.95	3.767	3.1	5845	0.4867	3.17	0.00471	-0.0132	--
61	2005-01-27	0.3424	2.1	2.234	2.2	171.3	0.5019	3.283	-0.159	-1.39	--
62	2005-03-23	0.3802	6.466	3.766	2.4	5836	0.2834	1.985	0.0968	0.809	--
63	2005-05-10	0.5315	17.9	2.294	3.4	197	0.7126	5.334	-0.181	-1.75	--
64	2005-05-27	0.4914	20.6	2.862	3.1	727.9	0.6469	4.585	-0.156	-1.32	--
65	2005-06-06	0.3979	21.17	3.288	2.5	1943	0.577	3.903	-0.179	-1.64	--

66	2005-08-31	0.8633	24.61	2.047	7.3	111.5	0.8519	7.351	0.0114	0.0796	--
67	2006-02-09	0.5911	3	1.519	3.9	33	0.6451	4.566	-0.0541	-0.497	--
68	2006-05-02	0.9085	18.39	2.086	8.1	121.8	0.7576	5.916	0.151	1.35	--
69	2006-06-08	1.104	25.3	1.415	12.7	26	0.9771	9.807	0.127	1.2	--
70	2006-06-26	0.8261	24.31	2.049	6.7	111.9	0.8474	7.275	-0.0214	-0.187	--
71	2006-07-27	1.041	25.4	0.5021	11	3.177	1.145	14.44	-0.104	-1.03	--
72	2006-08-15	1.045	23.78	0.8451	11.1	7	1.06	11.86	-0.0145	-0.146	--
73	2006-08-23	1.064	26.85	1.163	11.6	14.56	1.045	11.46	0.0196	0.173	--
74	2006-09-27	0.9031	18.2	0.8451	8	7	0.9815	9.906	-0.0784	-0.827	--
75	2007-01-10	0.6435	3.1	1.159	4.4	14.42	0.7122	5.329	-0.0688	-0.703	--
76	2007-02-05	0.6435	0.2	1.176	4.4	15	0.6683	4.817	-0.0249	-0.227	--
77	2007-03-12	0.7782	12.7	1.279	6	19	0.8251	6.91	-0.0469	-0.409	--
78	2007-03-21	0.9031	15.3	1.708	8	51	0.7833	6.276	0.12	1.1	--
79	2007-03-27	0.7782	17	2.198	6	157.9	0.7176	5.395	0.0606	0.573	--
80	2007-04-02	0.6021	13.1	3.46	4	2882	0.4325	2.798	0.17	1.46	--
81	2007-04-18	0.4771	12.9	2.935	3	861	0.5255	3.466	-0.0483	-0.423	--
82	2007-07-11	0.4771	23.66	3.284	3	1924	0.6127	4.237	-0.136	-1.23	--
83	2007-09-06	0.9542	23.2	1.415	9	26	0.9476	9.163	0.00662	0.053	--
84	2007-11-26	0.699	4.5	1.462	5	29	0.6764	4.907	0.0225	0.2	--
85	2008-03-06	0.301	3.303	2.99	2	977.7	0.3807	2.484	-0.0796	-0.846	--
86	2008-04-14	0.301	9.21	2.685	2	484	0.5193	3.418	-0.218	-1.89	--
87	2008-05-29	0.4771	20.28	3.454	3	2846	0.5342	3.537	-0.0571	-0.542	--
88	2008-06-30	0.6021	23.83	2.942	4	874.4	0.6777	4.922	-0.0756	-0.773	--
89	2008-08-05	1.041	26.6	1.407	11	25.5	0.9969	10.26	0.0445	0.409	--
90	2009-04-06	0.4771	7.76	2.272	3	187	0.5744	3.88	-0.0973	-0.987	--
91	2009-04-13	0.301	9.7	2.933	2	856.8	0.4809	3.129	-0.18	-1.69	--
92	2009-04-28	0.301	13.58	3.963	2	9190	0.3472	2.3	-0.0462	-0.394	--
93	2009-06-16	0.4771	22.67	2.939	3	868.3	0.662	4.747	-0.185	-1.81	--
94	2009-07-30	0.6021	22.12	2.712	4	515.4	0.6956	5.129	-0.0935	-0.945	--
95	2009-09-09	0.4771	20.1	3.509	3	3227	0.5218	3.437	-0.0447	-0.38	--
96	2009-09-24	0.4771	16.41	2.522	3	333	0.65	4.618	-0.173	-1.46	--
97	2009-11-03	0.301	9.27	2.516	2	328	0.551	3.677	-0.25	-2.07	--
98	2009-11-19	0.699	7.273	1.813	5	65	0.6514	4.632	0.0476	0.438	--
99	2009-12-01	0.6021	6.473	1.74	4	55	0.6534	4.654	-0.0513	-0.467	--
100	2009-12-17	0.4771	1.61	1.771	3	59	0.5795	3.926	-0.102	-1.01	--
101	2010-01-06	0.4771	1.1	1.982	3	96	0.5338	3.533	-0.0567	-0.527	--
102	2010-01-19	0.6628	2.703	1.903	4.6	80	0.5707	3.847	0.092	0.773	--
103	2010-02-04	0.6812	3	1.806	4.8	64	0.5926	4.046	0.0886	0.755	--
104	2010-02-23	0.5911	2.847	1.833	3.9	68.13	0.5855	3.98	0.00558	0.0132	--
105	2010-03-10	0.6128	9.85	2.74	4.1	550	0.5182	3.409	0.0946	0.791	--
106	2010-04-14	0.9085	16.4	1.724	8.1	53	0.7957	6.458	0.113	0.945	--
107	2010-04-23	0.7404	16.41	2.357	5.5	227.7	0.6802	4.95	0.0602	0.558	--
108	2010-05-13	0.6232	15.25	2.733	4.2	541.2	0.5953	4.071	0.0279	0.296	--
109	2010-06-09	0.5682	21.75	3.471	3.7	2959	0.5518	3.683	0.0164	0.146	--
110	2010-06-10	0.6435	23.8	3.505	4.4	3200	0.5744	3.88	0.0691	0.605	--
111	2010-06-13	0.3802	21.9	3.915	2.4	8227	0.4728	3.071	-0.0926	-0.925	--
112	2010-06-14	0.3802	22.07	4.063	2.4	11570	0.4481	2.901	-0.0679	-0.67	--
113	2010-06-14	0.4314	22.9	4.178	2.7	15060	0.4389	2.84	-0.00754	-0.106	--
114	2010-06-15	0.6335	23	3.809	4.3	6438	0.5077	3.328	0.126	1.18	--
115	2010-06-16	0.6532	23.62	3.682	4.5	4808	0.5395	3.581	0.114	0.966	--
116	2010-07-06	0.4771	23.2	4.127	3	13400	0.4524	2.929	0.0247	0.227	--
117	2010-08-19	1.013	24.99	1.785	10.3	61	0.9051	8.308	0.108	0.904	--
118	2010-08-25	0.8388	23.7	2.887	6.9	770	0.6859	5.016	0.153	1.39	--
119	2010-11-16	0.5911	6.973	2.418	3.9	262	0.5366	3.557	0.0545	0.512	--
120	2011-01-19	0.7243	0.2	1.907	5.3	80.75	0.5349	3.542	0.189	1.59	--
121	2011-03-07	0.699	6.937	1.708	5	51	0.6659	4.79	0.0331	0.324	--
122	2011-03-16	0.7243	9.18	1.681	5.3	48	0.7022	5.207	0.0221	0.187	--

123	2011-04-06	0.8633	12	1.58	7.3	38	0.7603	5.953	0.103	0.865	--
124	2011-04-18	0.9542	16.7	1.509	9	32.3	0.8392	7.138	0.115	1.03	--
125	2011-05-02	0.9823	11.61	1.462	9.6	29	0.7763	6.176	0.206	1.89	--
126	2011-06-07	1.201	24	1.342	15.9	21.97	0.9722	9.696	0.229	2.39	--
127	2011-06-21	1.037	23.4	2.041	10.9	109.9	0.8362	7.089	0.201	1.81	--
128	2011-06-22	1.013	22.78	1.659	10.3	45.65	0.897	8.155	0.116	1.05	--
129	2011-08-15	0.7993	25.03	1.415	6.3	26	0.9733	9.722	-0.174	-1.54	--
130	2011-09-22	0.6628	16.7	1.66	4.6	45.68	0.8117	6.7	-0.149	-1.29	--
131	2011-12-20	0.4624	3.7	3.037	2.9	1090	0.3776	2.466	0.0848	0.72	--
132	2012-02-06	0.5911	4.3	2.667	3.9	464	0.4538	2.939	0.137	1.29	--
133	2012-03-01	0.4771	8.407	3.117	3	1310	0.4291	2.777	0.048	0.452	--
134	2012-04-07	0.6335	14.14	2.414	4.3	259.4	0.6381	4.492	-0.0046	-0.0796	--
135	2012-04-17	0.8261	16.41	1.917	6.7	82.69	0.7605	5.956	0.0656	0.589	--
136	2012-06-18	0.8751	26.09	2.114	7.5	130	0.8605	7.498	0.0145	0.12	--
137	2012-06-19	0.9395	25.2	1.886	8.7	76.95	0.8897	8.019	0.0498	0.467	--
138	2012-07-12	0.9542	26.65	0.3424	9	2.2	1.192	16.08	-0.238	-1.97	--
139	2012-07-19	0.8633	28.27	0.2041	7.3	1.6	1.24	17.96	-0.377	-2.73	--
140	2012-09-11	0.9445	21.01	0.6335	8.8	4.3	1.06	11.86	-0.115	-1.08	--
141	2012-10-24	0.6812	19.3	0.6335	4.8	4.3	1.036	11.22	-0.354	-2.39	--
142	2012-11-07	0.7243	10.36	0.7924	5.3	6.2	0.8811	7.862	-0.157	-1.35	--
143	2012-11-14	0.7782	6.833	0.8195	6	6.6	0.8266	6.934	-0.0484	-0.438	--
144	2012-12-12	0.6335	2.1	0.7324	4.3	5.4	0.776	6.172	-0.143	-1.26	--
145	2013-01-16	0.6812	0.5	0.8195	4.8	6.6	0.7377	5.65	-0.0564	-0.512	--
146	2013-01-29	0.6902	10.49	0.8976	4.9	7.9	0.8637	7.552	-0.173	-1.5	--
147	2013-02-13	0.699	3.4	0.8976	5	7.9	0.7641	6.005	-0.0652	-0.621	--
148	2013-03-12	0.716	6.4	1.342	5.2	22	0.725	5.488	-0.00901	-0.12	--
149	2013-03-13	0.7404	6.573	1.73	5.5	53.73	0.6566	4.689	0.0837	0.703	--
150	2013-03-27	0.8195	6.86	1	6.6	10	0.794	6.433	0.0255	0.241	--
151	2013-04-15	0.7853	13.8	1.591	6.1	39	0.7835	6.279	0.00182	-0.0398	--
152	2013-04-15	0.8976	13.8	1.591	7.9	39	0.7835	6.279	0.114	1.01	--
153	2013-04-24	0.6128	5.407	1.913	4.1	81.85	0.6069	4.181	0.0059	0.0265	--
154	2013-05-06	0.7076	12.6	2.004	5.1	101	0.6912	5.077	0.0164	0.133	--
155	2013-05-09	0.7243	20.1	2.054	5.3	113.3	0.7874	6.335	-0.0631	-0.589	--
156	2013-05-15	0.9345	20.25	1.505	8.6	32	0.8897	8.02	0.0448	0.423	--
157	2013-05-21	0.8388	18.9	1.699	6.9	49.97	0.8355	7.079	0.00332	-0.0265	--
158	2013-05-28	0.9685	22.15	1.181	9.3	15.16	0.9757	9.774	-0.00717	-0.0929	--
159	2013-06-05	0.8751	22.9	2.064	7.5	116	0.8248	6.906	0.0502	0.482	--
160	2013-06-05	0.8513	22.9	2.063	7.1	115.7	0.825	6.91	0.0262	0.254	--
161	2013-06-13	0.9243	24.77	1.487	8.4	30.66	0.9565	9.353	-0.0323	-0.296	--
162	2013-06-24	0.8976	24.23	1.355	7.9	22.66	0.973	9.715	-0.0754	-0.755	--
163	2013-07-09	1.068	25.96	0.5185	11.7	3.3	1.15	14.61	-0.0819	-0.865	--
164	2013-07-29	0.5051	19.23	3.375	3.2	2370	0.5341	3.536	-0.0289	-0.282	--
165	2013-08-07	0.4914	25.75	4.14	3.1	13790	0.4859	3.165	0.00541	0	--
166	2013-08-15	0.6232	23.5	3.849	4.2	7070	0.5073	3.325	0.116	1.08	--
167	2013-08-29	0.9494	25.6	2.262	8.9	183	0.8266	6.934	0.123	1.13	--
168	2013-10-24	0.7076	12.07	1.477	5.1	30	0.78	6.229	-0.0724	-0.72	--
169	2013-10-30	0.6335	15.14	2.19	4.3	154.8	0.6929	5.097	-0.0595	-0.558	--
170	2013-11-25	0.6721	3.2	1.572	4.7	37.33	0.6382	4.494	0.0339	0.352	--
171	2013-12-11	0.5798	0.7167	1.591	3.8	39	0.5998	4.114	-0.02	-0.173	--
172	2014-01-14	0.5185	3.6	1.653	3.3	45	0.629	4.399	-0.11	-1.05	--
173	2014-02-20	0.6128	7.683	1.69	4.1	49	0.6795	4.943	-0.0667	-0.653	--
174	2014-03-17	0.7559	7.7	1.568	5.7	37	0.702	5.205	0.0538	0.497	--
175	2014-04-09	0.8921	12.66	1.484	7.8	30.51	0.7869	6.329	0.105	0.885	--
176	2014-04-14	0.9868	11.47	1.496	9.7	31.33	0.7681	6.061	0.219	2.2	--
177	2014-05-14	0.9138	16.88	1.98	8.2	95.58	0.7556	5.889	0.158	1.42	--
178	2014-05-15	0.9638	16.65	1.961	9.2	91.5	0.7559	5.893	0.208	1.97	--
179	2014-05-29	1.064	24.67	1.837	11.6	68.67	0.8912	8.047	0.173	1.5	--

180	2014-06-03	1.053	25.24	1.706	11.3	50.82	0.9231	8.66	0.13	1.23	--
181	2014-06-05	1.053	24.83	2.148	11.3	140.6	0.8367	7.098	0.216	2.07	--
182	2014-06-09	0.6435	21.65	3.168	4.4	1474	0.6057	4.17	0.0378	0.38	--
183	2014-06-12	0.4624	21.3	3.589	2.9	3880	0.524	3.455	-0.0616	-0.573	--
184	2014-06-24	0.8573	24.4	2.444	7.2	278	0.7766	6.18	0.0808	0.67	--
185	2014-07-10	0.8808	24.4	1.946	7.6	88.33	0.8675	7.619	0.0133	0.0929	--
186	2014-07-15	1.033	25.48	1.663	10.8	46	0.9344	8.888	0.0991	0.846	--
187	2014-07-24	0.9494	25.78	1.447	8.9	28	0.978	9.827	-0.0286	-0.268	--
188	2014-08-04	1.025	25.67	1.329	10.6	21.33	0.998	10.29	0.0273	0.282	--
189	2014-08-07	0.9823	25.33	1.301	9.6	20	0.9984	10.3	-0.0161	-0.16	--

Definitions

As: Arsenic in ug/l (01000)
TEMP: Temperature, water in deg C (00010)
Q: Stream flow in ft3/s (00060)