SITE NUMBER—07144100

SITE NAME—Little Arkansas River near Sedgwick

DATE CREATED—3/15/2013

MODEL DEVELOPMENT DATA PERIOD—5/1/1998 – 9/22/2011

MODEL-CALIBRATION DATASET—All data were collected using U.S. Geological Survey (USGS) protocols and are stored in National Water Information System (NWIS) database. The regression model is based on 158 concurrent measurements of specific conductance, streamflow, and alkalinity samples collected from 05-01-1998 through 09-22-2011. Samples were collected throughout the range of continuously observed hydrologic flow rate and specific conductance conditions. Specific conductance and streamflow values are time-averaged, approved unit values corresponding with the duration of sample collection. Summary statistics and complete model-calibration dataset are provided. A single alkalinity value was deemed an outlier.

Outlier removed from the dataset.

Date	Specific conductance, in microsiemens per centimeter at 25 degrees Celsius	Streamflow, in cubic feet per second	Alkalinity, in milligrams per liter as calcium carbonate
7/10/1998	211	1,360	18

The documentation to review the alkalinity analysis was unavailable. However, the alkalinity value was 10 times less than the minimum alkalinity at similar specific conductance and streamflow values. For this reason, the sample was removed from the dataset.

MODEL DEVELOPMENT— Regression analysis was done using S-PLUS, R, and a spreadsheet macro that examined specific conductance and streamflow together as explanatory variables for estimating alkalinity. Different combinations of untransformed and $\log_{10}$-transformed data were evaluated. Alkalinity, specific conductance and streamflow were selected as the best model based on residual plots, model standard percentage error (*MSPE*), adjusted R^2, prediction error sum of squares (PRESS), and Mallow's C_p. Model spreadsheet is archived and can be found at http://nrtwq.usgs.gov/ks for review, and contains all relevant sample data and more in-depth statistical information.

MODEL SUMMARY—Summary of final regression analysis for alkalinity concentration at site number 07144100.

Specific conductance and streamflow-based model:

$$\mathbf{\log_{10}(Alk) = 0.731 \times \log_{10}(SC) - 0.1 \times \log_{10}(Q) + 0.381}\ ,$$

where

Alk = alkalinity, in milligrams per liter as calcium carbonate;

SC = specific conductance, in microsiemens per centimeter at 25 degrees Celsius; and

Q = streamflow, in cubic feet per second.

The use of specific conductance and streamflow as explanatory variables makes sense both physically and statistically. Physically because alkalinity is composed of major ions that affect the conductivity of water and results in a clear correlation between alkalinity and specific conductance. Alkalinity correlates well with streamflow because high streamflow values tend to dilute concentrations of dissolved constituents associated with alkalinity. Specific conductance and streamflow make statistical sense as explanatory variables because they resulted in a model with low Mallow's C_p and PRESS values, and high adjusted R^2 values.

ALKALINITY RECORD— The record is computed using the regression model in the National Real-Time Water Quality (NRTWQ) website. Data are computed at hourly intervals. The record is complete for the year except as noted. The specific conductance monitor was removed during winter months because of below freezing conditions. A more in-depth description of the water quality record can be found at – http://nrtwq.usgs.gov/ks.

REMARKS—

- Site location, equipment, and other stream-gaging station information can be found in the Site Information Management System (SIMS).

Computed: Aaron King

Reviewed: Pat Rasmussen

07144100 - Little Ark near Sedgwick - Alkalinity

Model Form

log(Alk) = 0.731 * log(SC) - 0.1 * log(Q) + 0.381

Explanatory variable summary statistics

	log(SC)	SC	log(Q)	Q
Minimum	1.732	54.0	0.4940	3.12
1st Quartile	2.441	276	1.698	49.9
Median	2.765	582	2.225	168
Mean	2.675	585	2.409	1460
3rd Quartile	2.941	871	3.144	1400
Maximum	3.126	1340	4.181	15200

Notes:

Dependent variable summary statistics

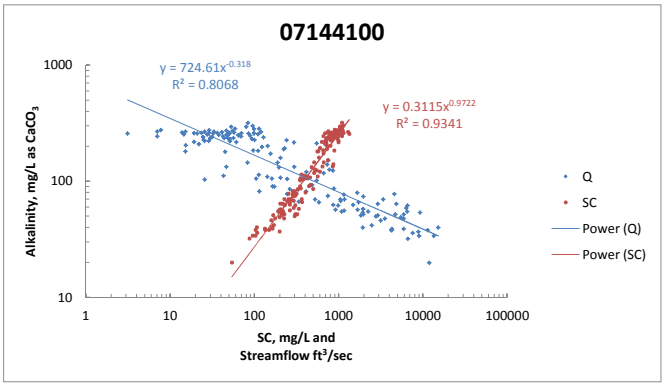
	log(Alk)	Alk
Minimum	1.301	20.0
1st Quartile	1.810	64.5
Median	2.137	137
Mean	2.094	155
3rd Quartile	2.396	249
Maximum	2.502	318

Notes:

Model Calibration

Basic Data

Number of Measurements:	158
Standard Error:	0.0646
MSPE (Upper)	+16.05
MSPE (Lower)	-13.83
R^2	0.96
Adj R^2	0.96
Duan BCF:	1.01
VIF	3.51



Explanatory Variables

Variable	Value	Standard Error
Intercept	0.381	0.1075
log(SC)	0.731	0.0314
log(Q)	-0.1	0.0110

Notes:

Covariance Matrix

	Intercept	log(SC)	log(Q)
Intercept	1	-0.99	-0.908
log(SC)	-0.99	1	0.846
log(Q)	-0.908	0.846	1

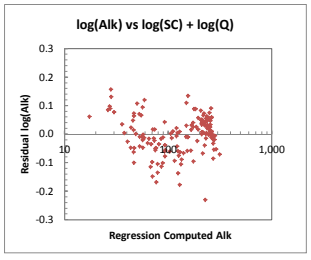
Test Criteria

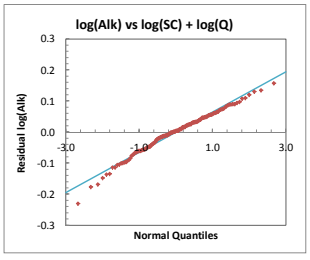
Leverage	Cook's D	DFITS
0.0570	0.843	0.276

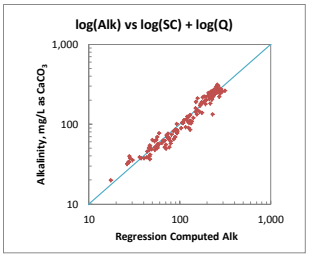
Observations exceeding at least one test criterion

Observation	Observed log(Alk)	Predicted log(Alk)	Residuals	Standardized Residuals	Studentized Residuals	Leverage	Cook's D	DFITS
1	2.15	2.24	-0.0950	-1.50	-1.50	0.0455	0.0356	-0.328
4	1.72	1.88	-0.169	-2.62	-2.67	0.0149	0.0346	-0.328
13	1.51	1.42	0.0892	1.41	1.41	0.0464	0.0321	0.311
19	1.72	1.83	-0.115	-1.80	-1.82	0.0280	0.0312	-0.308
35	1.89	1.77	0.118	1.83	1.85	0.0220	0.0251	0.277
51	1.53	1.43	0.0995	1.56	1.57	0.0393	0.0333	0.318
93	1.30	1.24	0.0637	1.02	1.02	0.0771	0.0291	0.296
99	2.41	2.41	0.00416	0.0666	0.0664	0.0754	0.000121	0.0190
113	1.70	1.85	-0.149	-2.31	-2.34	0.0180	0.0326	-0.317
134	2.33	2.19	0.138	2.15	2.18	0.0246	0.0390	0.346
140	1.58	1.45	0.130	2.03	2.05	0.0353	0.0505	0.393
141	1.60	1.44	0.157	2.47	2.51	0.0357	0.0752	0.483
156	2.13	2.35	-0.228	-3.53	-3.67	0.0112	0.0470	-0.391
157	2.02	2.13	-0.109	-1.72	-1.74	0.0511	0.0534	-0.403

Notes:







Date	SC, µS/cm at 25°C	Streamflow, ft³/sec	Alkalinity, mg/L as $CaCO_3$	log(Alk)	log(SC)	log(Q)	Regression Computed Alk	Residual log(Alk)	Normal Quantiles
5/1/1998	868	729	140	2.15	2.94	2.86	174	-0.095	-1.37
5/6/1998	803	143	202	2.31	2.91	2.16	194	0.018	0.248
5/11/1998	911	128	240	2.38	2.96	2.11	215	0.048	0.734
5/14/1998	322	1947	52.0	1.72	2.51	3.29	76.5	-0.168	-2.13
5/27/1998	844	100	228	2.36	2.93	2.00	208	0.039	0.634
6/16/1998	877	43.5	236	2.37	2.94	1.64	233	0.005	0.055
6/24/1998	598	413	121	2.08	2.78	2.62	141	-0.065	-1.10
7/13/1998	316	243	78.0	1.89	2.50	2.39	93.0	-0.076	-1.22
7/20/1998	558	44.8	180	2.26	2.75	1.65	167	0.033	0.468
8/6/1998	819	28.7	224	2.35	2.91	1.46	231	-0.014	-0.381
9/15/1998	877	14.5	254	2.41	2.94	1.16	260	-0.010	-0.281
9/22/1998	201	913	57.0	1.76	2.30	2.96	58.5	-0.011	-0.331
9/25/1998	88.0	6590	32.0	1.51	1.94	3.82	26.2	0.086	1.41
10/5/1998	108	7490	36.0	1.56	2.03	3.87	30.1	0.078	1.33
10/22/1998	425	104	106	2.03	2.63	2.02	126	-0.074	-1.19
11/5/1998	200	8776	37.0	1.57	2.30	3.94	46.4	-0.099	-1.45
12/4/1998	729	222	190	2.28	2.86	2.35	173	0.041	0.654
1/12/1999	1101	113	284	2.45	3.04	2.05	250	0.055	0.889
2/1/1999	306	4676	52.0	1.72	2.49	3.67	67.5	-0.113	-1.73
2/19/1999	1041	119	267	2.43	3.02	2.08	239	0.049	0.777
3/16/1999	1337	110	256	2.41	3.13	2.04	289	-0.052	-0.820

3/23/1999	1095	98.1	259	2.41	3.04	1.99	253	0.011	0.135
4/7/1999	404	1651	80.0	1.90	2.61	3.22	91.8	-0.060	-0.987
4/16/1999	200	5410	49.0	1.69	2.30	3.73	48.8	0.002	-0.071
5/5/1999	802	239	226	2.35	2.90	2.38	184	0.089	1.45
5/24/1999	211	1664	57.0	1.76	2.32	3.22	57.1	0.000	-0.135
6/18/1999	300	410	82.0	1.91	2.48	2.61	84.9	-0.015	-0.416
6/21/1999	220	2223	55.0	1.74	2.34	3.35	57.2	-0.017	-0.433
7/20/1999	176	3521	48.0	1.68	2.25	3.55	46.4	0.015	0.167
8/3/1999	149	4238	38.0	1.58	2.17	3.63	40.3	-0.025	-0.540
8/19/1999	924	88.8	248	2.39	2.97	1.95	225	0.042	0.674
9/28/1999	212	1915	54.0	1.73	2.33	3.28	56.5	-0.019	-0.486
2/9/2000	1113	84.4	259	2.41	3.05	1.93	260	-0.001	-0.151
3/7/2000	286	1151	77.0	1.89	2.46	3.06	74.0	0.018	0.216
3/28/2000	254	4559	78.0	1.89	2.41	3.66	59.1	0.121	2.00
5/19/2000	1064	98.6	282	2.45	3.03	1.99	247	0.057	0.962
5/31/2000	456	203	108	2.03	2.66	2.31	124	-0.059	-0.962
6/28/2000	364	1165	70.0	1.85	2.56	3.07	88.1	-0.100	-1.50
7/28/2000	353	160	106	2.03	2.55	2.21	105	0.004	-0.024
8/16/2000	749	23.5	262	2.42	2.87	1.37	221	0.074	1.25
9/8/2000	846	19.1	261	2.42	2.93	1.28	247	0.025	0.348
9/25/2000	855	20.9	258	2.41	2.93	1.32	246	0.020	0.265
10/26/2000	228	6524	62.0	1.79	2.36	3.81	52.7	0.071	1.19
11/8/2000	514	82.5	145	2.16	2.71	1.92	148	-0.009	-0.232
12/4/2000	1086	46.2	252	2.40	3.04	1.67	271	-0.031	-0.577
3/14/2001	336	1932	58.0	1.76	2.53	3.29	79.0	-0.134	-1.81
4/13/2001	565	415	110	2.04	2.75	2.62	135	-0.088	-1.29
4/26/2001	982	98.2	260	2.42	2.99	1.99	233	0.047	0.714
5/8/2001	660	155	173	2.24	2.82	2.19	167	0.016	0.183
6/4/2001	292	1050	68.0	1.83	2.47	3.02	75.8	-0.047	-0.755
6/6/2001	96.0	8962	34.0	1.53	1.98	3.95	27.1	0.098	1.73
6/23/2001	165	4251	39.0	1.59	2.22	3.63	43.4	-0.046	-0.714
7/11/2001	811	49.1	254	2.41	2.91	1.69	217	0.068	1.16
8/2/2001	765	24.4	241	2.38	2.88	1.39	224	0.033	0.486
8/28/2001	788	31.2	241	2.38	2.90	1.50	223	0.034	0.559
9/20/2001	135	4178	38.0	1.58	2.13	3.62	37.5	0.005	0.024
10/31/2001	853	27.3	254	2.41	2.93	1.44	239	0.026	0.381
1/10/2002	1040	36.4	262	2.42	3.02	1.56	269	-0.011	-0.314
2/21/2002	1100	42.0	244	2.39	3.04	1.62	276	-0.053	-0.843
4/9/2002	961	93.5	232	2.37	2.98	1.97	231	0.002	-0.055
4/22/2002	265	1480	63.0	1.80	2.42	3.17	68.2	-0.034	-0.615
5/22/2002	422	142	110	2.04	2.63	2.15	121	-0.042	-0.694
6/6/2002	388	244	105	2.02	2.59	2.39	108	-0.012	-0.348
6/13/2002	226	5868	48.0	1.68	2.35	3.77	52.9	-0.042	-0.674
7/9/2002	720	29.6	235	2.37	2.86	1.47	210	0.050	0.820
8/15/2002	744	750	152	2.18	2.87	2.88	155	-0.009	-0.265
9/19/2002	720	15.2	205	2.31	2.86	1.18	224	-0.039	-0.654
12/18/2002	1300	41.1	266	2.43	3.11	1.61	313	-0.070	-1.16
3/20/2003	292	6285	59.0	1.77	2.47	3.80	63.3	-0.031	-0.559
4/17/2003	1150	69.9	260	2.42	3.06	1.84	271	-0.018	-0.451
4/23/2003	642	296	134	2.13	2.81	2.47	153	-0.058	-0.937
5/14/2003	369	1709	66.0	1.82	2.57	3.23	85.6	-0.113	-1.66
5/29/2003	479	193	132	2.12	2.68	2.29	129	0.010	0.103
6/11/2003	656	96.5	185	2.27	2.82	1.99	174	0.027	0.399
6/24/2003	1000	57.0	264	2.42	3.00	1.76	250	0.024	0.331
7/30/2003	894	7.73	278	2.44	2.95	0.888	281	-0.005	-0.183
9/3/2003	265	578	66.0	1.82	2.42	2.76	75.0	-0.055	-0.865
10/14/2003	193	1077	55.0	1.74	2.29	3.03	55.9	-0.007	-0.216
12/11/2003	1120	46.2	274	2.44	3.05	1.66	277	-0.005	-0.167
3/9/2004	212	1819	51.0	1.71	2.33	3.26	56.8	-0.046	-0.734
3/30/2004	999	292	216	2.33	3.00	2.47	212	0.009	0.087
4/26/2004	986	50.6	260	2.42	2.99	1.70	250	0.017	0.199
5/13/2004	265	1153	56.0	1.75	2.42	3.06	69.9	-0.096	-1.41
5/26/2004	1040	49.7	262	2.42	3.02	1.70	261	0.003	-0.040
6/16/2004	788	56.1	237	2.38	2.90	1.75	210	0.052	0.865
6/22/2004	273	1042	70.0	1.85	2.44	3.02	72.2	-0.013	-0.364
7/27/2004	133	5855	39.0	1.59	2.12	3.77	35.9	0.036	0.596
1/27/2005	348	172	90.0	1.95	2.54	2.24	103	-0.060	-1.01
3/23/2005	227	5855	52.0	1.72	2.36	3.77	53.1	-0.009	-0.248
5/10/2005	587	203	160	2.20	2.77	2.31	149	0.031	0.451
5/27/2005	305	743	75.0	1.88	2.48	2.87	81.0	-0.033	-0.596
6/6/2005	291	1957	74.0	1.87	2.46	3.29	71.0	0.018	0.232
6/9/2005	54.0	11797	20.0	1.30	1.73	4.07	17.3	0.063	1.04
8/31/2005	363	112	114	2.06	2.56	2.05	111	0.011	0.119
2/9/2006	872	32.5	258	2.41	2.94	1.51	239	0.033	0.522
5/2/2006	743	122	198	2.30	2.87	2.09	186	0.027	0.416
6/8/2006	1000	25.5	223	2.35	3.00	1.41	271	-0.084	-1.25
6/26/2006	286	114	82.0	1.91	2.46	2.06	93.3	-0.056	-0.889
7/27/2006	693	3.12	258	2.41	2.84	0.494	256	0.004	-0.008
8/15/2006	658	6.99	245	2.39	2.82	0.845	227	0.033	0.504
8/23/2006	576	15.2	181	2.26	2.76	1.18	191	-0.022	-0.522
9/27/2006	751	6.99	268	2.43	2.88	0.845	250	0.030	0.433
1/10/2007	873	13.8	264	2.42	2.94	1.14	261	0.005	0.040
2/5/2007	974	15.2	268	2.43	2.99	1.18	280	-0.019	-0.468
3/12/2007	708	19.1	220	2.34	2.85	1.28	216	0.007	0.071
3/21/2007	698	51.0	222	2.35	2.84	1.71	194	0.058	0.987
3/27/2007	446	164	91.0	1.96	2.65	2.21	125	-0.136	-1.90
4/2/2007	167	2886	51.0	1.71	2.22	3.46	45.5	0.049	0.798
4/18/2007	231	861	63.0	1.80	2.36	2.94	65.1	-0.015	-0.399
7/11/2007	161	1927	40.0	1.60	2.21	3.29	46.2	-0.062	-1.04
9/6/2007	952	25.5	268	2.43	2.98	1.41	261	0.011	0.151
11/26/2007	815	28.9	262	2.42	2.91	1.46	230	0.056	0.912
12/13/2007	300	2740	50.0	1.70	2.48	3.44	70.2	-0.147	-2.00
3/6/2008	305	979	62.0	1.79	2.48	2.99	78.8	-0.104	-1.55
4/14/2008	465	484	93.0	1.97	2.67	2.69	115	-0.093	-1.33
5/29/2008	216	2895	64.0	1.81	2.33	3.46	54.9	0.067	1.13
6/30/2008	356	877	87.0	1.94	2.55	2.94	89.2	-0.011	-0.298
8/5/2008	708	24.9	228	2.36	2.85	1.40	211	0.034	0.540
4/6/2009	669	187	145	2.16	2.83	2.27	165	-0.056	-0.912
4/13/2009	548	851	124	2.09	2.74	2.93	123	0.005	0.008
4/28/2009	202	9190	54.0	1.73	2.31	3.96	46.6	0.064	1.10
6/16/2009	511	661	118	2.07	2.71	2.82	120	-0.005	-0.199
7/30/2009	255	523	70.0	1.85	2.41	2.72	73.6	-0.022	-0.504
9/9/2009	159	3141	46.0	1.66	2.20	3.50	43.5	0.024	0.314

9/24/2009	246	333	67.0	1.83	2.39	2.52	75.0	-0.049	-0.798
11/3/2009	327	328	85.0	1.93	2.52	2.52	92.5	-0.037	-0.634
11/19/2009	780	65.0	249	2.40	2.89	1.81	206	0.083	1.37
12/1/2009	921	54.7	273	2.44	2.96	1.74	236	0.063	1.07
12/17/2009	1030	58.7	284	2.45	3.01	1.77	254	0.048	0.755
1/6/2010	1150	94.5	302	2.48	3.06	1.98	263	0.060	1.01
1/19/2010	1040	79.7	296	2.47	3.02	1.90	248	0.076	1.29
2/4/2010	949	63.9	250	2.40	2.98	1.81	238	0.022	0.298
2/23/2010	997	69.3	244	2.39	3.00	1.84	244	0.000	-0.119
3/10/2010	712	547	212	2.33	2.85	2.74	155	0.135	2.32
4/14/2010	1040	52.7	295	2.47	3.02	1.72	259	0.057	0.937
4/23/2010	601	228	193	2.29	2.78	2.36	150	0.110	1.90
5/13/2010	349	544	102	2.01	2.54	2.74	92.2	0.044	0.694
6/9/2010	170	2448	42.0	1.62	2.23	3.39	46.9	-0.048	-0.777
6/10/2010	228	3345	70.0	1.85	2.36	3.52	56.3	0.095	1.66
6/13/2010	104	11316	38.0	1.58	2.02	4.05	28.1	0.132	2.13
6/14/2010	107	15162	40.0	1.60	2.03	4.18	27.8	0.158	2.67
6/15/2010	192	6480	55.0	1.74	2.28	3.81	46.5	0.073	1.22
6/16/2010	203	4806	64.0	1.81	2.31	3.68	49.9	0.108	1.81
7/6/2010	104	13387	34.0	1.53	2.02	4.13	27.6	0.091	1.55
8/19/2010	632	60.8	218	2.34	2.80	1.78	177	0.090	1.50
8/25/2010	524	770	126	2.10	2.72	2.89	120	0.022	0.281
11/16/2010	500	262	86.0	1.93	2.70	2.42	129	-0.176	-2.32
1/19/2011	1100	83.3	318	2.50	3.04	1.92	258	0.091	1.60
3/7/2011	759	50.8	232	2.37	2.88	1.71	206	0.051	0.843
3/16/2011	806	48.0	237	2.38	2.91	1.68	217	0.038	0.615
4/6/2011	957	37.6	252	2.40	2.98	1.58	252	0.000	-0.103
4/18/2011	942	32.8	268	2.43	2.97	1.52	253	0.026	0.364
5/2/2011	937	28.8	276	2.44	2.97	1.46	255	0.035	0.577
6/7/2011	691	21.9	210	2.32	2.84	1.34	210	0.000	-0.087
6/21/2011	890	110	184	2.27	2.95	2.04	215	-0.067	-1.13
6/22/2011	854	46.2	134	2.13	2.93	1.66	227	-0.229	-2.67
8/15/2011	376	25.5	104	2.02	2.58	1.41	132	-0.105	-1.60
9/22/2011	391	42.9	112	2.05	2.59	1.63	129	-0.062	-1.07