Data Transmittal Report

CLEAR CREEK CONSULTANTS

To: Upper Clear Creek Watershed Association

CC:

From: Mike Crouse

Date: 29-January-2010

Re: Stream Gaging Report 2009 – Clear Creek at Kermitts (Station CC-40)

Clear Creek Consultants (CCC) has been retained by UCCWA to operate and maintain the stream gaging station on Clear Creek above Johnson Gulch near Kermitts (Station CC-40). The UCCWA and others utilize stream flow data from this gage to assess water quality conditions in Clear Creek. From October 1994 to October 2005, the gage was operated by the U.S. Geological Survey and records are published in annual reports. CCC has operated the gage and published CC-40 data since 2006. This report presents data collected from October 2008 to October 2009.

Data Collection Activities

Operation of the CC-40 streamgage requires the development and maintenance of a discharge rating to define the relationship between stream stage height and discharge. Direct measurements of streamflow using a current meter are required to document changes in this relationship at various seasonal flow rates. These measurements are compared to the discharge rating and, if necessary, shift adjustments are applied to maintain accuracy. All methods and procedures utilized for the CC-40 streamgage follow standard USGS protocols (USGS, 1982 – Measurement and Computation of Streamflow, Volumes 1 and 2).

Seven direct current meter discharge measurements were taken in 2009 to support the discharge rating. Measurement results are shown in the attached table which summarizes the stream width, cross-sectional area, mean velocity, and discharge for each measurement. These measurements are plotted on log-normal distribution using a computer program for comparison to the existing rating. Each year the discharge rating is evaluated to assess the accuracy of the rating in comparison to the direct measurements. Shifts are applied when appropriate to maintain accuracy.

For 2009, new rating curves were developed for CC-40 designated as Rating No. 5. Three separate rating curves were developed and utilized for the CC-40 gage representing low flow (20-70 cfs), medium flow (70-300 cfs), and high flow (300-3,000 cfs). The medium flow Rating No. 5 is attached as an example.

A continuous recording Campbell Scientific data logger is used to measure a submersible pressure transducer to develop the stage height record at CC-40. The 15-minute average stream stage height is recorded during ice-free periods from approximately March to November. The transducer readings are calibrated using an electronic tape gage referenced to the base of the gage enclosure box. An outside

staff gage mounted in the stream is also utilized for this purpose. The gage was audited approximately monthly to check calibration against the gage reference points and make any necessary adjustments to maintain accuracy. The gage reference and benchmark elevations are measured with a laser level (to an accuracy of +/- 0.01-ft) periodically to document any vertical movement in the gage and make any necessary adjustments.

A continuous recording conductivity/temperature probe is operated as part of the CC-40 gage to monitor in-stream temperature and dissolved solids conditions related to salt loading in Clear Creek (see attached data plot). An in-stream turbidity probe was installed in August 2008 to monitor stream turbidity conditions related to suspended sediment loading (see attached data plot). These water quality parameters are recorded by the data logger as 15-minute average and daily maximum values. A tipping bucket rainfall intensity gauge is also operated at CC-40.

Results

The stage height record was compiled for review, plotted, and any necessary corrections were made based on field calibration measurements. The final stage height record was then imported into an MSAccess database program for archiving and computation of discharge. Water quality parameter data is also maintained in the MSAccess database for CC-40. This data is available upon request.

The updated discharge rating equations described above were applied to the corrected stage height data for the computation of discharge. A streamflow calculator was used within the Access database framework to compute the 15-minute discharge. Statistical output summaries from the database program include mean daily flow; mean hourly flow; maximum and minimum instantaneous flow by month.

The CC-40 mean daily discharge results for October 2008 to October 2009 are presented in the attached table, along with the flow hydrograph of these data. The gage is not operated and the rating is not accurate during ice-cover conditions which occur every winter at CC-40. Therefore, winter (December-February) flows are estimated based on Clear Creek flows at the Golden USGS gage (CC-60) adjusted with an average gage ratio of 0.88.

Minimum flows occur in winter, with maximum flows typically in June in Clear Creek. The peak instantaneous flow was 1,013 cfs on June 27, 2009. Mean daily flows were slightly above average in May and early June 2009. Maximum June flows were near the long-term average. Flows were below normal from July through October 2009.

CLEAR CREEK ABOVE JOHNSON GULCH NEAR KERMITTS
WY 2009
Provisional Data - Subject to Revision

LOCATION -- 0.5 mi upstream Johnson Gulch LATITUDE 39 44'47" LONGITUDE 105 26'08"
GAGE DRAINAGE AREA -- 267 sq-mi GAGE ELEVATION -- 7210 ft-msl
PERIOD OF RECORD -- October 1994 to Current Year

DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2008 TO SEPTEMBER 2009
MEAN DAILY VALUES

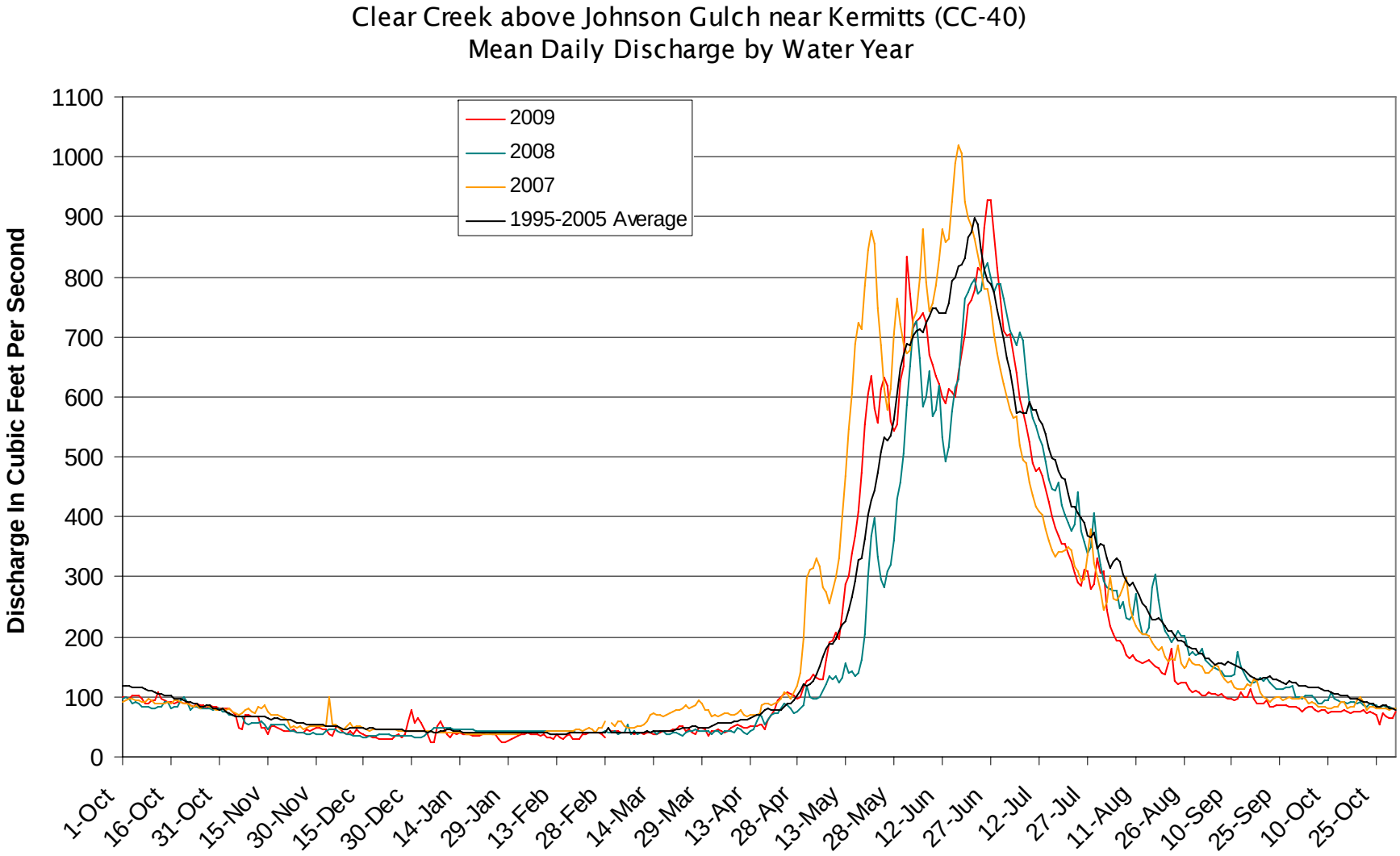
DAY	2008 OCT	2008 NOV	2008 DEC	2009 JAN	2009 FEB	2009 MAR	2009 APR	2009 MAY	2009 JUN	2009 JUL	2009 AUG	2009 SEP
1	99.9	80.7	48 e	64 e	36 e	42.0	43.4	126	834	710	309	102
2	98.2	80.2	46 e	56 e	39 e	41.9	42.7	129	772	702	245	103
3	96.6	80.1	45 e	45 e	37 e	42.0	44.9	137	715	704	219	109
4	101	74.8	39 e	38 e	40 e	41.4	43.8	132	726	673	205	106
5	101	71.1	36 e	26 e	37 e	40.7	40.6	128	733	639	195	105
6	102	48.6	49 e	26 e	37 e	40.1	42.1	128	741	596	194	102
7	97.4	45.4	50 e	50 e	37 e	41.0	48.2	160	722	575	187	104
8	89.8	70.8	46 e	60 e	36 e	37.8	50.7	192	669	551	170	100
9	89.2	69.5	41 e	49 e	37 e	41.2	53.7	195	654	525	164	97.6
10	94.4	68.6	39 e	37 e	33 e	39.7	49.8	207	635	490	168	96.2
11	94.7	67.6	43 e	32 e	32 e	37.2	48.6	196	622	476	162	93.0
12	109	66.6	39 e	40 e	29 e	41.6	49.5	241	600	481	160	96.5
13	95.5	48 e	45 e	39 e	37 e	41.7	49.8	288	590	468	155	108
14	94.6	49 e	40 e	40 e	33 e	37.7	50.3	302	615	447	158	98.2
15	92.5	39 e	38 e	39 e	29 e	38.7	51.3	338	608	424	160	100
16	91.1	50 e	35 e	37 e	35 e	40.2	54.5	369	601	402	155	112
17	89.7	50 e	35 e	37 e	38 e	42.3	53.1	407	639	382	151	96.0
18	90.2	48 e	33 e	35 e	31 e	41.8	44.4	474	673	369	148	90.0
19	91.1	46 e	32 e	35 e	31 e	43.3	62.2	554	704	356	141	88.9
20	89.2	43 e	31 e	34 e	30 e	46.1	70.5	604	752	356	138	88.8
21	91.0	44 e	30 e	38 e	39 e	46.5	78.8	635	761	338	155	94.5
22	85.6	44 e	29 e	41 e	37 e	49.9	93.6	581	778	325	179	84.4
23	83.3	45 e	31 e	40 e	41 e	50.6	98.8	556	815	307	126	82.5
24	87.5	40 e	30 e	38 e	41 e	42.7	106	613	810	290	122	85.1
25	86.1	40 e	35 e	37 e	40.2	45.1	108	632	883	284	123	86.6
26	85.7	41 e	38 e	30 e	39.1	41.3	104	620	928	313	124	87.1
27	81.7	46 e	33 e	26 e	37.3	38.2	101	559	929	309	123	87.3
28	85.0	43 e	39 e	26 e	32.8	47.8	96.7	542	871	281	113	84.4
29	84.6	46 e	59 e	27 e		49.3	100	554	815	287	108	83.4
30	84.6	48 e	77 e	29 e		44.8	116	625	764	330	109	82.8
31	80.5		57 e	33 e		34.2		650		306	108	
TOTAL	2843	1635 e	1266 e	1183 e	1000 e	1309	1996	11875	21958	13697	4970	2853
MEAN	91.7	54 e	41 e	38 e	36 e	42.2	66.5	383	732	442	160	95.1
MAX	109	81 e	77 e	64 e	41 e	50.6	116	650	929	710	309	112
MIN	80.5	39 e	29 e	26 e	29 e	34.2	40.6	126	590	281	108	82.5
AC-FT	5,640	3,242 e	2,512 e	2,346 e	1,984 e	2,596	3,960	23,553	43,554	27,167	9,859	5,660

INSTANTANEOUS MEASUREMENTS

PEAK STAG	4.09									
PEAK FLOW	115		57.3	127	901	1,013	753	348	132	
DATE	12-Oct		27-Mar	30-Apr	31-May	27-Jun	1-Jul	1-Aug	16-Sep	
MIN STAGE	3.79									
MIN FLOW	75.1		23.4	30.2	121	564	266	103	78.6	
DATE	23-Oct		31-Mar	6-Apr	1-May	13-Jun	29-Jul	29-Aug	30-Sep	

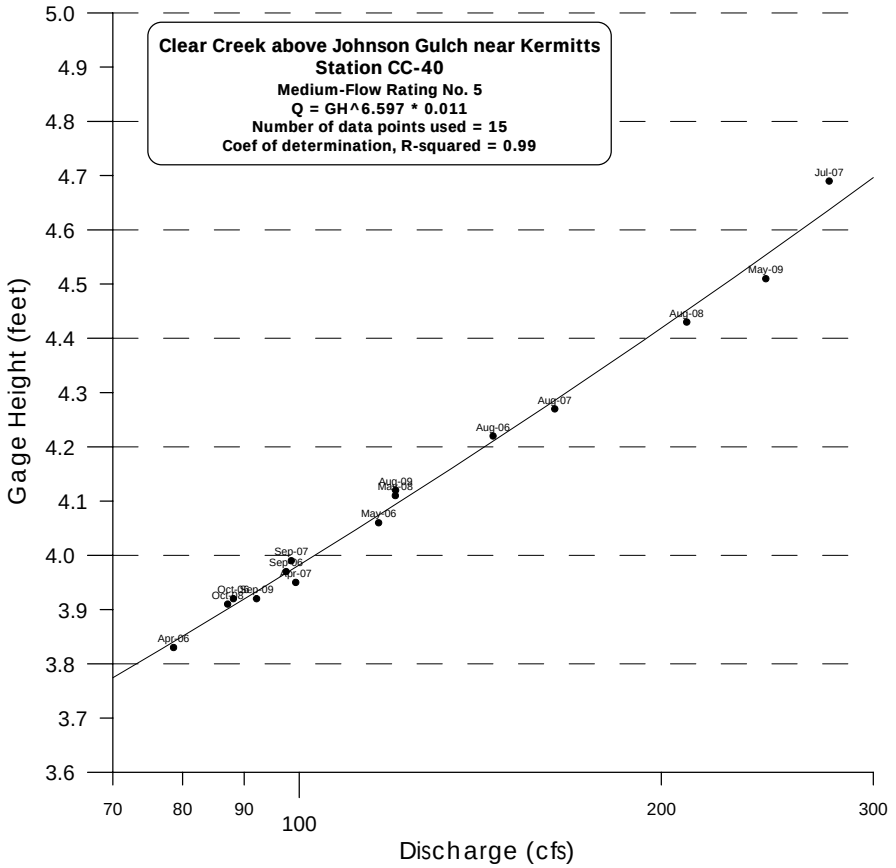
e = estimated during ice affected period using average ratio 0.88 of CC-60 flow

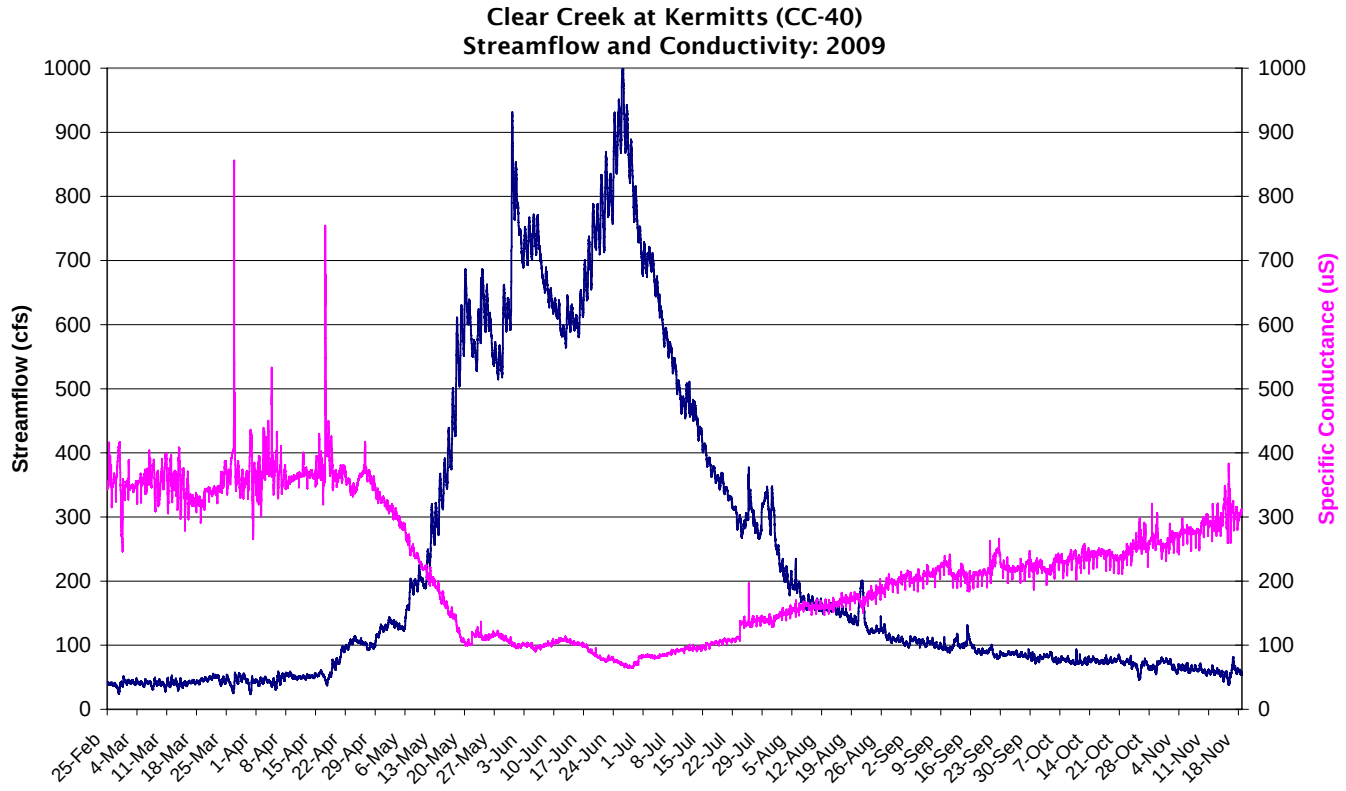

Clear Creek Consultants

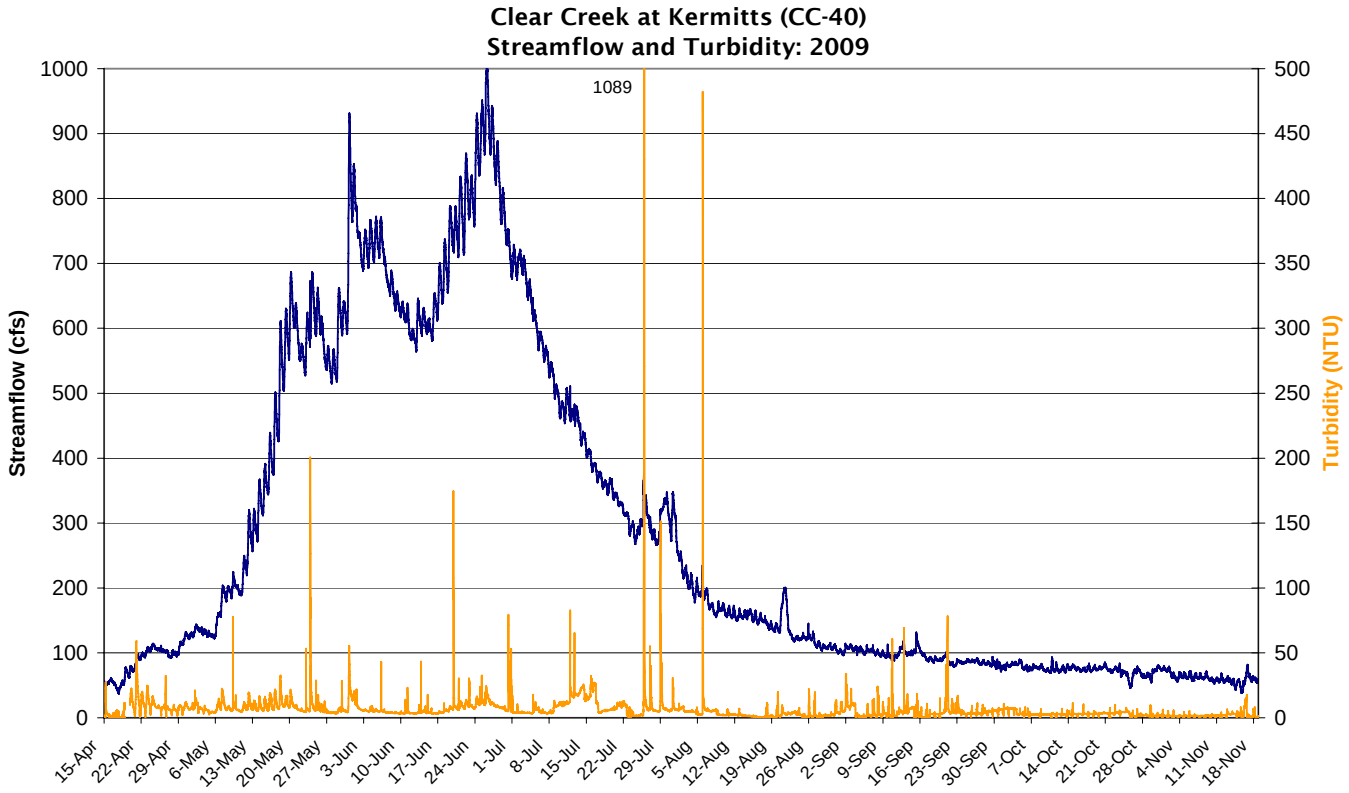

Clear Creek above Johnson Gulch near Kermitts (CC-40)
Mean Daily Discharge by Water Year
Discharge In Cubic Feet Per Second
2009
2008
2007
1995-2005 Average
1100
1000
900
800
700
600
500
400
300
200
100
0
1-Oct
16-Oct
31-Oct
15-Nov
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
14-Mar
29-Mar
13-Apr
28-Apr
13-May
28-May
12-Jun
27-Jun
12-Jul
27-Jul
11-Aug
26-Aug
10-Sep
25-Sep
10-Oct
25-Oct

Clear Creek above Johnson Gulch near Kermitts (Station CC-40)
Discharge Measurement Summary

Meas. No.	Date	Time	Observer	No. Sections	Width (ft)	Area (ft^2)	Mean Velocity (ft/s)	Gage Height (ft)	Discharge (cfs)
1	12-Jan-06	14:15	MWC	22	40.0	28.2	1.72	ICE	48.6
2	6-Mar-06	14:30	MWC	22	41.0	41.1	1.18	3.63	48.6
3	13-Apr-06	10:00	MWC	24	44.5	53.1	1.48	3.83	78.6
4	2-May-06	15:45	MWC	24	47.0	55.9	2.08	4.06	116.4
5	24-Jul-06	19:15	MWC	25	45.0	80.1	2.74	4.53	219.1
6	22-Aug-06	12:30	MWC	26	46.0	63.7	2.28	4.22	144.9
7	19-Sep-06	17:00	MWC	25	46.5	51.4	1.90	3.97	97.5
8	20-Oct-06	15:30	MWC	25	45.5	50.0	1.76	3.92	88.2
9	22-Nov-06	15:30	MWC	21	33.7	45.4	1.36	3.73	62.0
10	25-Jan-07	15:30	MWC	22	37.0	28.5	1.29	ICE	36.7
11	16-Mar-07	18:00	MWC	22	42.0	44.2	1.44	3.67	63.5
12	23-Apr-07	13:45	MWC	25	46.0	52.5	1.89	3.95	99.3
13	26-Jul-07	9:15	MWC	25	47.0	85.2	3.24	4.69	275.7
14	27-Aug-07	16:30	MWC	25	46.5	65.3	2.50	4.27	163.1
15	25-Sep-07	15:00	MWC	23	42.5	49.8	1.98	3.99	98.5
16	8-Nov-07	17:00	MWC	20	33.5	40.9	1.41	3.72	57.6
17	11-Mar-08	12:30	MWC	19	29.5	37.5	1.07	3.61	40.6
18	22-Apr-08	16:30	MWC	21	34.0	43.0	1.59	3.78	68.2
19	10-May-08	17:00	MWC	24	44.5	53.5	2.25	4.11	120.2
20	13-Aug-08	9:15	MWC	25	46.0	73.5	2.86	4.43	209.9
21	16-Sep-08	15:00	MWC	25	41.0	53.3	2.39	4.06	127.2
22	17-Oct-08	16:30	MWC	27	46.0	47.6	1.83	3.91	87.2
23	17-Nov-08	14:00	MWC	20	33.5	36.8	1.48	3.70	55.2
24	25-Feb-09	15:30	MWC	20	31.5	34.8	1.28	3.62	44.5
25	15-Apr-09	17:15	MWC	19	31.0	38.9	1.45	3.68	57.4
26	12-May-09	17:15	MWC	26	46.0	76.0	3.21	4.51	244.2
27	25-Aug-09	14:15	MWC	28	46.5	58.1	2.07	4.12	120.3
28	25-Sep-09	15:45	MWC	27	46.0	50.1	1.84	3.92	92.2
29	26-Oct-09	15:45	MWC	20	30.5	40.8	1.23	3.68	50.7
30	19-Nov-09	15:30	MWC	20	31.0	42.6	1.46	3.71	62.6




Clear Creek at Kermitts (CC-40)
Streamflow and Conductivity: 2009
Streamflow (cfs)
Specific Conductance (uS)
0
100
200
300
400
500
600
700
800
900
1000
25-Feb
4-Mar
11-Mar
18-Mar
25-Mar
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep
7-Oct
14-Oct
21-Oct
28-Oct
4-Nov
11-Nov
18-Nov


Clear Creek at Kermitts (CC-40)
Streamflow and Turbidity: 2009
1089
Streamflow (cfs)
Turbidity (NTU)
0
100
200
300
400
500
600
700
800
900
1000
0
50
100
150
200
250
300
350
400
450
500
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
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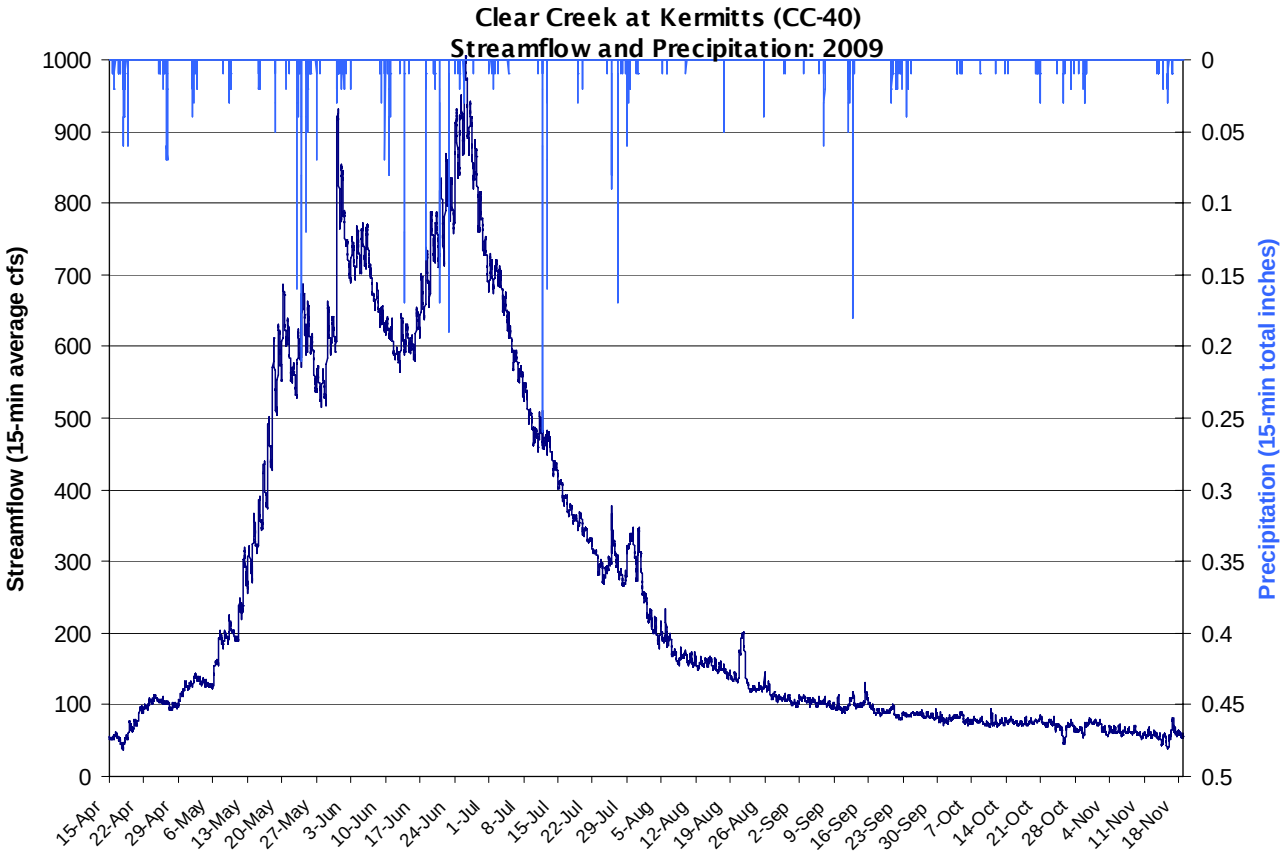
14-Oct
21-Oct
28-Oct
4-Nov
11-Nov
18-Nov


Clear Creek at Kermitts (CC-40)
Streamflow and Precipitation: 2009
Streamflow (15-min average cfs)
Precipitation (15-min total inches)
1000
900
800
700
600
500
400
300
200
100
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
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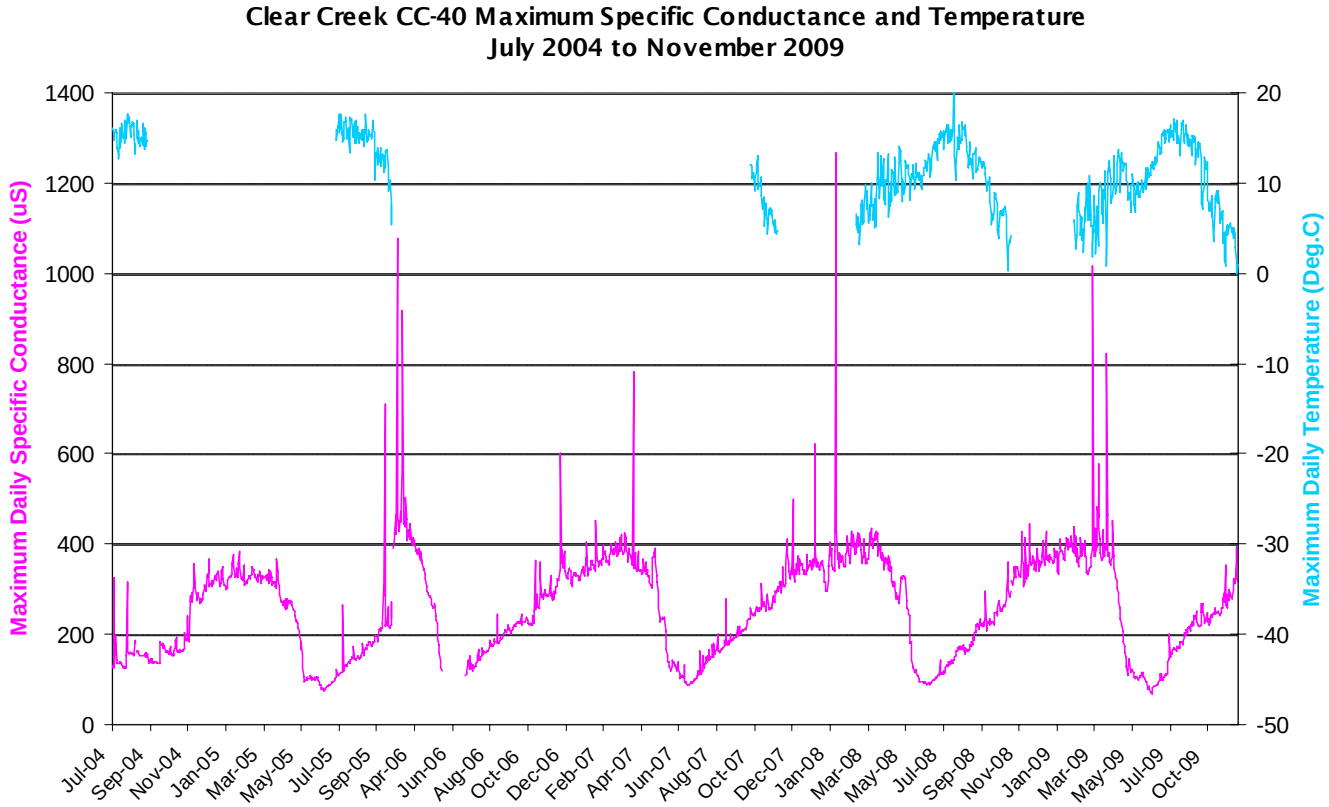
14-Oct
21-Oct
28-Oct
4-Nov
11-Nov
18-Nov


Clear Creek CC-40 Maximum Specific Conductance and Temperature
July 2004 to November 2009
Maximum Daily Specific Conductance (uS)
Maximum Daily Temperature (Deg.C)
1400
1200
1000
800
600
400
200
0
20
10
0
-10
-20
-30
-40
-50
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07
Apr-07
Jun-07
Aug-07
Oct-07
Dec-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Oct-09