

Data Transmittal Report

CLEAR CREEK CONSULTANTS



To: Upper Clear Creek Watershed Association (UCCWA)

CC:

From: Mike Crouse

Date: 8-January-2018

Re: Stream Gaging Report Water Year 2017 – Clear Creek at Kermitts (Station CC-40)

Clear Creek Consultants (CCC) has been retained by UCCWA to operate and maintain the stream flow gaging station on Clear Creek above Johnson Gulch near Kermitts (Station CC-40). The UCCWA and others utilize streamflow 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 were published in annual reports. CCC has operated the CC-40 gage and published the flow data annually since 2006. This report presents data collected at the gage from October 2016 to October 2017.

Data Collection and Evaluation

A continuous recording Campbell Scientific data logger was used to measure a submersible pressure transducer to develop the water stage height record for CC-40. The 15-minute average stream stage height was recorded during ice-free periods extending from approximately March to November. The transducer was 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 as a stream stage height reference.

Continuous recording water quality probes were also operated at the CC-40 gage. A combination conductivity/temperature probe recorded in-stream temperature and conductivity (dissolved solids) conditions related to salt loading in Clear Creek (see attached specific conductance data plot). An in-stream turbidity probe was used to monitor stream turbidity conditions related to suspended sediment loading (see attached turbidity 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 was also operated at the CC-40 gage (see attached precipitation data plot).

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 (flow). Data collection methods and procedures used at the CC-40 streamgage follow standard USGS guidelines and protocols (USGS, 1982 – Measurement and Computation of Streamflow, Volumes 1 and 2).

Direct measurements of stream flow using a current meter are required each year to document this relationship at various seasonal flow rates. Three to six direct current meter discharge measurements are taken each season to maintain the discharge rating. Measurement results are available upon request. The discharge rating is evaluated annually to assess the accuracy of the rating in comparison to the direct measurements. The measurements are plotted on log-normal distribution using a computer program for comparison to the existing rating. If necessary, either shift adjustments are applied to the data before calculating discharge or the rating is revised to maintain accuracy.

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 (300-2,000 cfs). The streamflow rating table for CC-40 is attached.

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 Access database program for the computation of discharge and archiving. Water quality parameter data is also maintained in the Access database for CC-40. This data is available upon request.

The discharge rating equations were applied to the corrected stage height data for the computation of discharge. A stream flow computation program 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; and maximum and minimum instantaneous flow by month.

Results

The gage was audited approximately monthly during ice-free periods to check calibration against the gage reference points and make any necessary adjustments to maintain accuracy. Routine maintenance of the gage included removal of silt accumulated in the stilling well and instrument maintenance. The flow results are posted in real-time on the Clear Creek Watershed Foundation Web Site for rafters and other water users to obtain current stream flow conditions (clearcreekwater.org-flow.html and also at clearcr.com).

The CC-40 mean daily discharge results for October 2016 to October 2017 are presented in the attached table, along with the flow hydrograph. The gage is not operated over the winter months (November-March) because the gage is not accurate during heavy ice-cover conditions which occur each year at CC-40. Significant channel ice accumulation renders the flow rating useless during the winter. When possible, wintertime flows are estimated based on Clear Creek flows at the Golden USGS gage (CC-60) adjusted using the average flow ratio for the winter low-flow period.

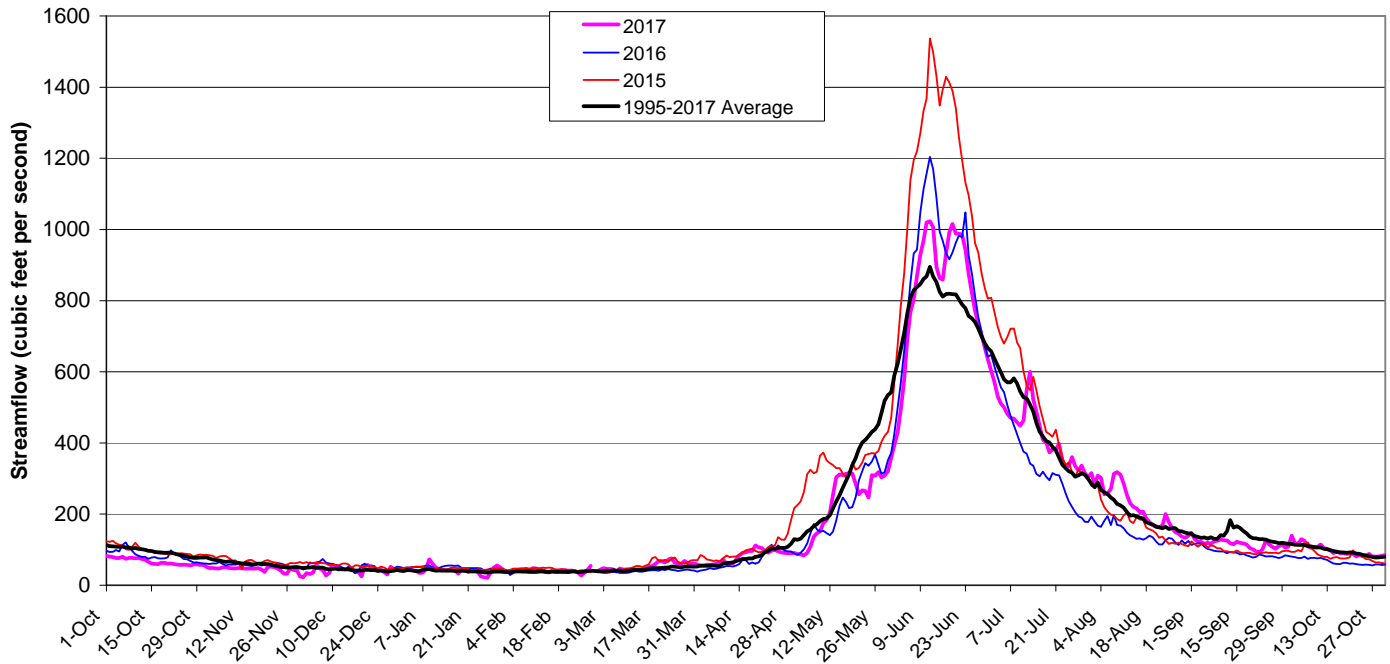
Minimum Clear Creek flows occur in winter with maximum flows typically in June. Minimum flows typically range from 30 to 40 cfs at CC-40. Mean daily flows were near average in April and below average in May 2017. Peak snowmelt flows were above average in June but were less than years 2016 and 2015. Flow was near average from July through October 2017.

Data graphs for 2017 specific conductance, temperature, and turbidity at CC-40 are also attached. Daily precipitation data summary for the 2014-2017 seasonal monitoring period is also tabulated.

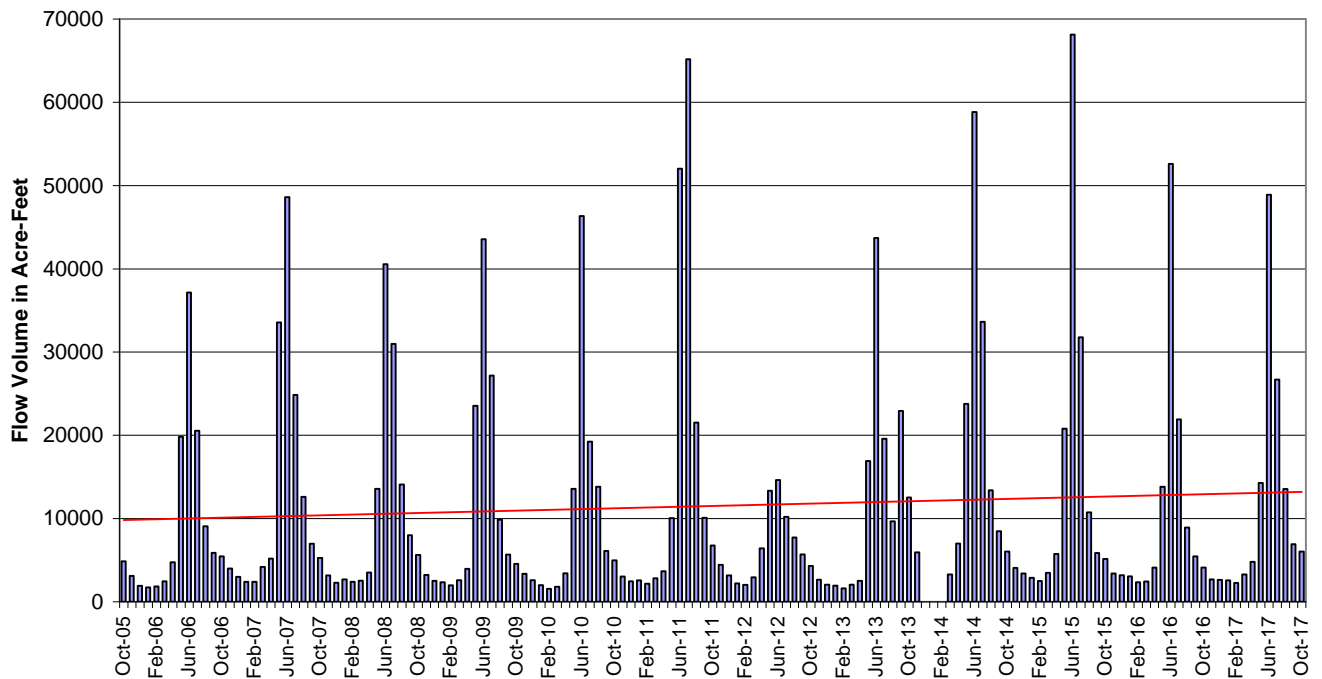
CLEAR CREEK ABOVE JOHNSON GULCH NEAR KERMITTS													
WY 2017													
Provisional Data - Subject to Revision													
LOCATION -- 0.5 mi upstream Johnson Gulch				LATITUDE 39 44'47" LONGITUDE 105 26'08"									
GAGE DRAINAGE AREA -- 267 sq-mi				GAGE ELEVATION -- 7210 ft-msl									
PERIOD OF RECORD -- October 1994 to Current Year													
DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2016 TO SEPTEMBER 2017													
MEAN DAILY VALUES													
DAY	2016 OCT	2016 NOV	2016 DEC	2017 JAN	2017 FEB	2017 MAR	2017 APR	2017 MAY	2017 JUN	2017 JUL	2017 AUG	2017 SEP	2017 OCT
1	82.6	51.6	22 e	42 e	43 e	39 e	58.6	91.2	393	603	315	148	109
2	80.1	48.2	34 e	43 e	38 e	44 e	54.7	87.4	429	572	283	130	139
3	78.8	48.5	32 e	44 e	38 e	48 e	54.5	87.1	494	531	308	123	118
4	76.6	47.4	36 e	42 e	41 e	46 e	57.8	83.8	576	510	302	122	117
5	76.2	47.3	58 e	39 e	40 e	46 e	57.0	90.8	694	500	256	116	130
6	80.3	50.2	48 e	34 e	39 e	45 e	58.9	109	767	481	259	120	124
7	74.7	50.8	44 e	36 e	40 e	38 e	60.9	136	804	470	271	117	109
8	77.1	48.5	28 e	48 e	42 e	47 e	64.6	146	869	469	313	123	105
9	77.2	47.2	34 e	73 e	42 e	44 e	73.3	152	929	458	318	125	109
10	76.0	47.4	58 e	61 e	48 e	44.5	60.8	174	968	448	311	128	107
11	76.8	48.6	55 e	50 e	47 e	45.2	63.3	183	1019	463	286	127	115
12	73.9	47.2	47 e	46 e	45 e	46.1	60.9	204	1023	550	253	126	104
13	71.2	46.6	44 e	43 e	42 e	42.8	72.6	253	1007	600	231	118	102
14	65.7	46.7	45 e	41 e	38 e	43.7	84.0	303	894	522	221	115	99.2
15	60.9	46.9	48 e	42 e	36 e	45.0	91.7	311	863	489	216	123	90.0
16	60.2	46.7	48 e	43 e	42 e	48.7	92.4	310	859	448	206	119	95.0
17	59.1	48 e	37 e	41 e	41 e	51.0	96.4	314	934	409	207	118	90.4
18	63.2	45 e	39 e	32 e	41 e	53.7	96.0	315	992	402	189	115	90.0
19	63.2	38 e	25 e	42 e	41 e	59.8	112	314	1015	374	177	105	88.3
20	60.5	52 e	53 e	45 e	42 e	68.5	107	285	989	382	169	101	89.0
21	60.9	52 e	57 e	37 e	41 e	68.0	104	255	988	382	166	95.0	88.4
22	59.2	51 e	47 e	41 e	41 e	64.1	95.0	267	986	398	163	92.4	81.3
23	57.9	47 e	47 e	41 e	40 e	72.2	91.4	265	943	350	167	101	85.9
24	57.5	41 e	44 e	38 e	35 e	75.7	97.5	246	875	333	201	127	81.4
25	58.2	32 e	45 e	24 e	27 e	63.0	98.6	310	820	335	176	115	83.3
26	57.2	32 e	37 e	22 e	35 e	62.1	95.5	308	771	360	160	109	88.2
27	55.9	48 e	30 e	21 e	44 e	60.1	92.0	318	736	335	149	103	80.3
28	58.3	43 e	52 e	36 e	55 e	68.2	90.6	303	704	323	145	110	80.0
29	58.4	41 e	45 e	50 e		61.9	90.2	308	668	336	137	114	81.3
30	57.6	24 e	43 e	56 e		59.6	90.0	321	635	316	133	106	83.2
31	58.0		43 e	49 e		61.0		358		304	139		84.7
TOTAL	2073	1364 e	1326 e	1303 e	1146 e	1663 e	2422	7208	24644	13453	6826	3491	3048
MEAN	66.9	45 e	43 e	42 e	41 e	54 e	80.7	233	821	434	220	116	98.3
MAX	82.6	52 e	58 e	73 e	55 e	76 e	112	358	1023	603	318	148	139
MIN	55.9	24 e	22 e	21 e	27 e	38 e	54.5	83.8	393	304	133	92.4	80.0
AC-FT	4,112	2,705 e	2,630 e	2,584 e	2,274 e	3,299 e	4,804	14,297	48,881	26,684	13,539	6,925	6,046
INSTANTANEOUS MEASUREMENTS													
MAX FLOW	89.4					79.3 p	121	390	1103	739	357	160	153
DATE	3-Oct					24-Mar	19-Apr	1-Jun	12-Jun	13-Jul	9-Aug	1-Sep	2-Oct
MIN FLOW	51.1					40.4 p	51.7	80.1	371	292	128	90.1	74.4
DATE	31-Oct					13-Mar	2-Apr	4-May	1-Jun	31-Jul	30-Aug	22-Sep	27-Oct
e = estimated during ice affected period using average ratio of CC-60 flow													
p = partial data NA = not available													



**Clear Creek Mean Daily Streamflow by Water Year
above Johnson Gulch near Kermitts (CC-40)
Drainage Area = 267 square miles**




**Clear Creek above Johnson Gulch near Kermitts (Station CC-40)
Monthly Flow Volume: 2006-2017**



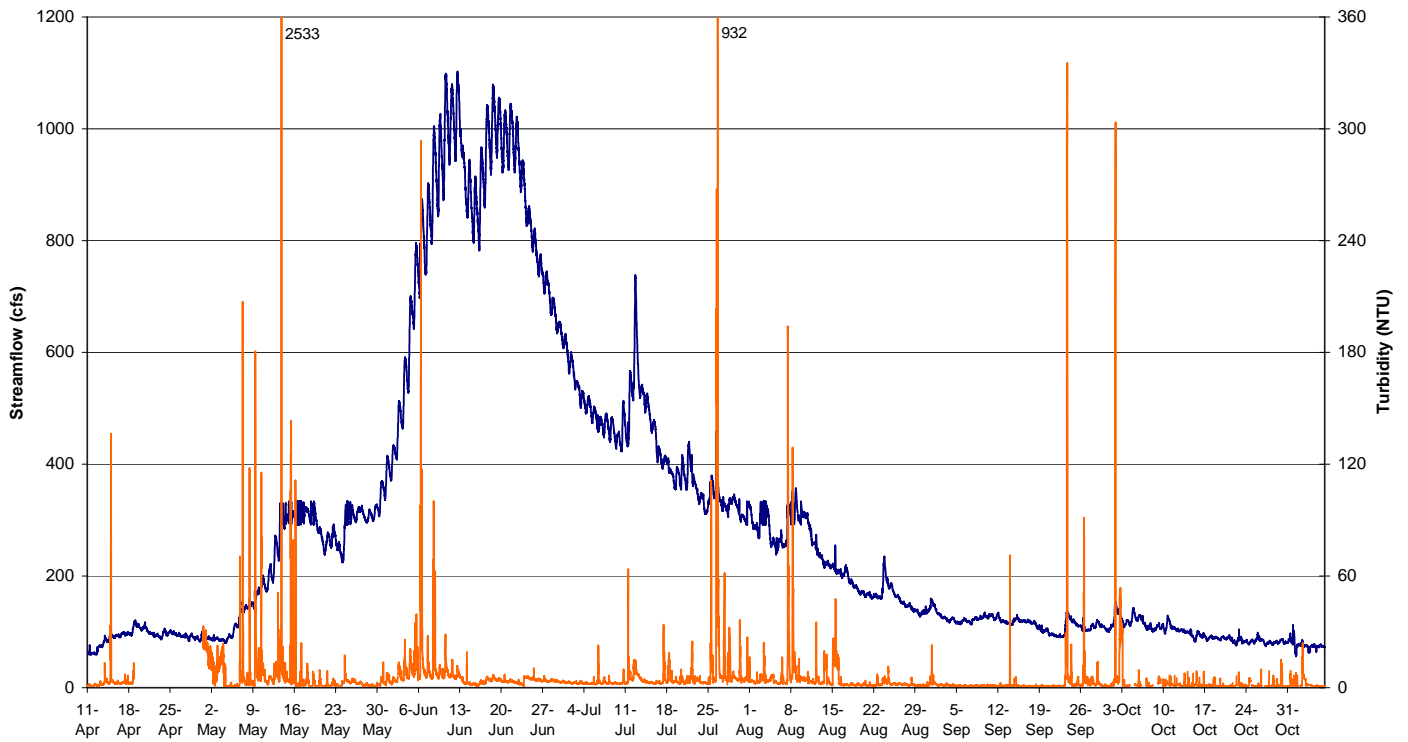
CLEAR CREEK NEAR KERMITTS	
PROVISIONAL STREAMFLOW RATING TABLE	
GAGE HEIGHT	STREAMFLOW
(feet)	(cubic feet per second)
3.3	34
3.4	41
3.5	50
3.6	59
3.7	78
3.8	93
3.9	109
4.0	128
4.1	150
4.2	175
4.3	203
4.4	235
4.5	271
4.6	312
4.7	304
4.8	327
4.9	352
5.0	379
5.1	406
5.2	435
5.3	466
5.4	498
5.5	532
5.6	567
5.7	604
5.8	643
5.9	683
6.0	726
6.1	770
6.2	816
6.3	864
6.4	914
6.5	966
6.6	1020
6.7	1076
6.8	1135
6.9	1195
7.0	1258
7.1	1324
7.2	1391
7.3	1462
7.4	1534
7.5	1610

Streamgauge sponsored by the Upper Clear Creek Watershed Association

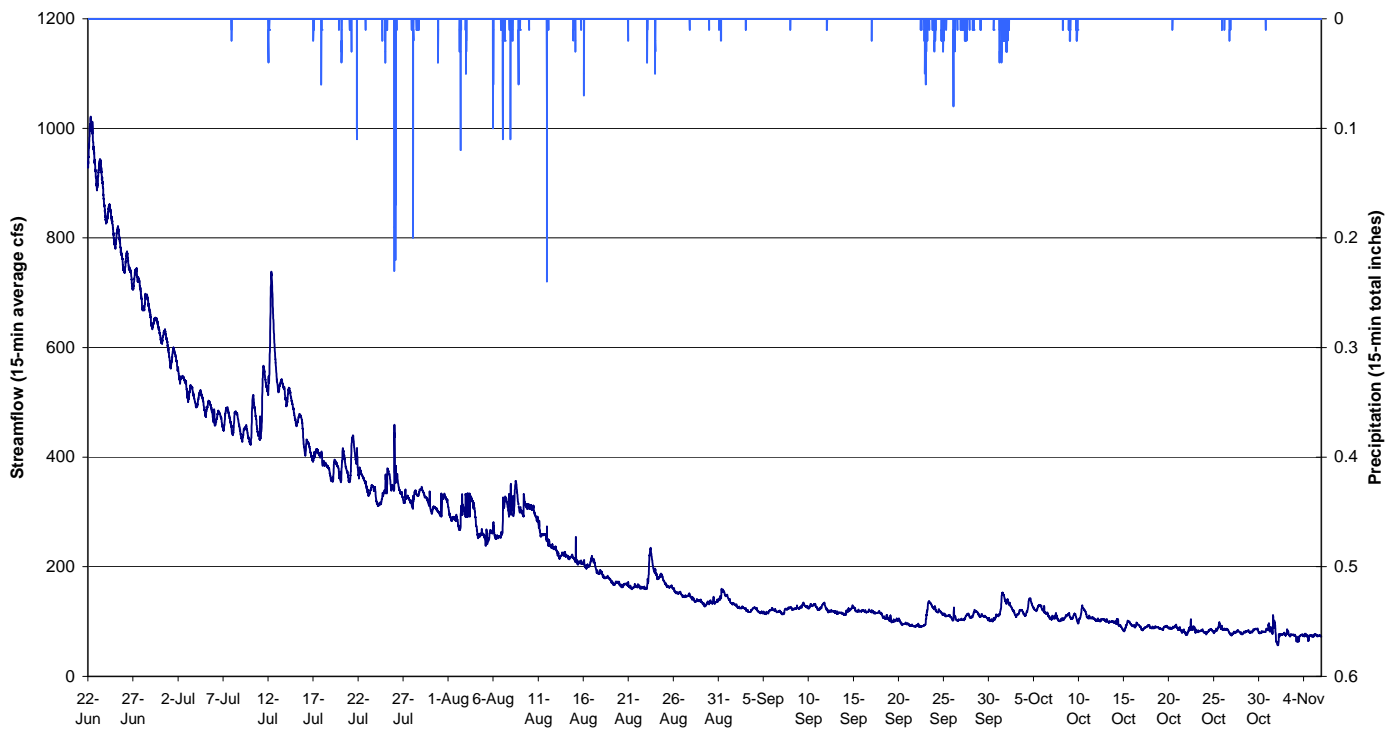
Operated by:  Clear Creek Consultants

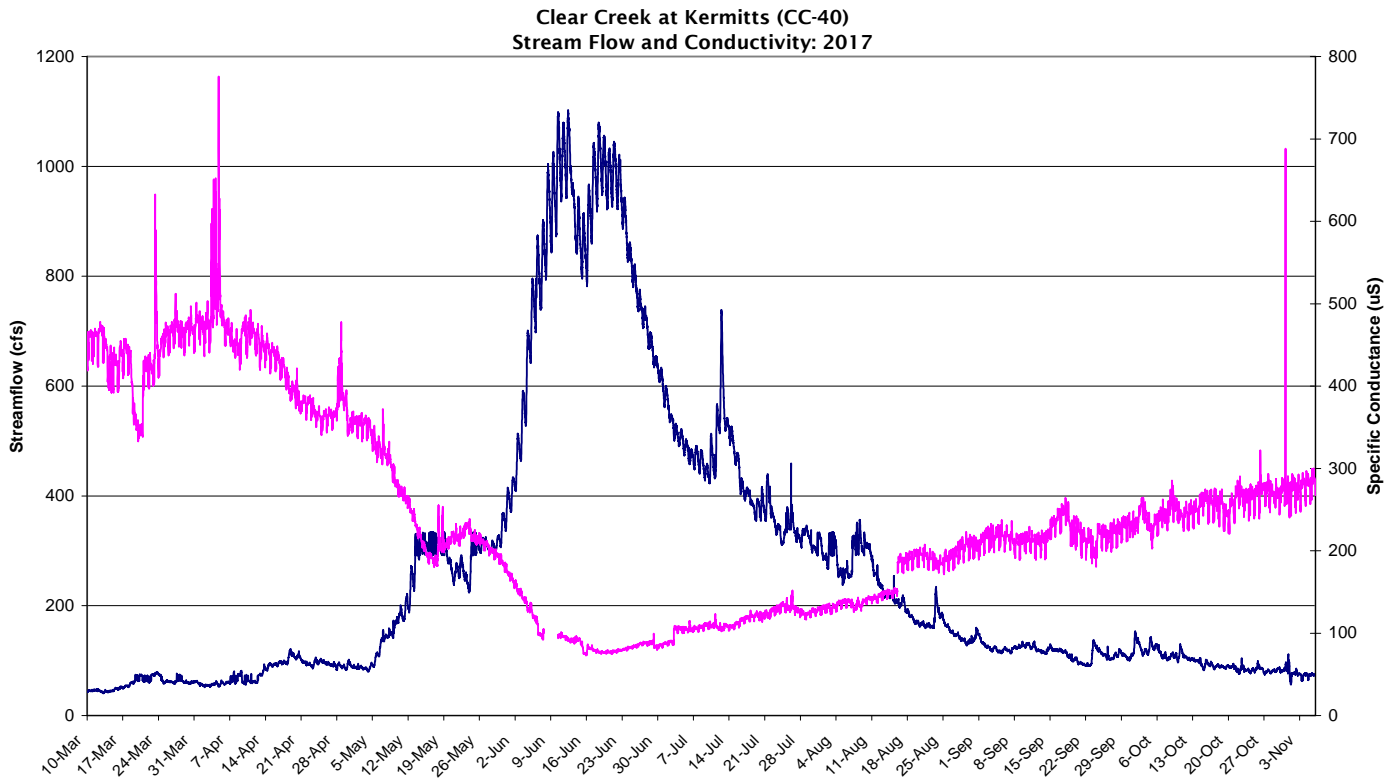
Based on Rating No. 10

Clear Creek at Kermitts (CC-40)
Stream Flow and Turbidity: 2017

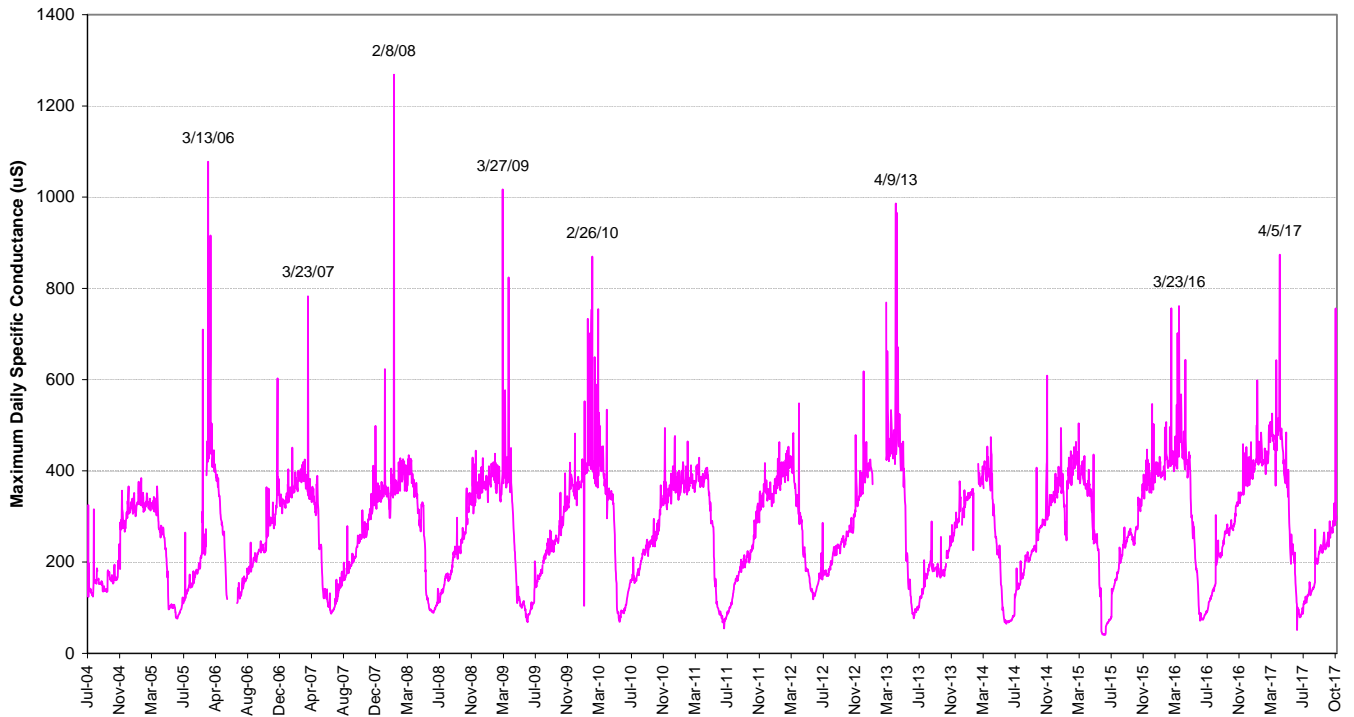


Clear Creek at Kermitts (CC-40)
Stream Flow and Precipitation: 2017





**Clear Creek at Kermitts (CC-4) Maximum Specific Conductance and Temperature
July 2004 to November 2017**



DAILY RAINFALL RECORDS (inches) CLEAR CREEK STATION CC-4 (above Johnson Gulch) Lat 39 44' 46.27" N Long 105 26' 9.19" W Elev. 7220 ft-MSL YEARS: 2016, 2017, 2018																		
DATE	2016						2017						2018					
	MAY	JUN	JUL	AUG	SEP	OCT	MAY	JUN	JUL	AUG	SEP	OCT	MAY	JUN	JUL	AUG	SEP	OCT
1	0.06	0.02	0.05	0	0.17	0	NA	NA	0	0	0	0.13						
2	0	0	0.21	0.06	0.01	0	NA	NA	0	0.04	0	1.03						
3	0	0	0.05	0.01	0.01	0	NA	NA	0	0.37	0.01	0						
4	0	0	0.05	0.05	0	0	NA	NA	0	0	0	0						
5	0	0	0	0.03	0	0	NA	NA	0	0	0	0						
6	0.02	0.12	0	0.01	0	0.23	NA	NA	0	0.28	0	0						
7	0.04	0.03	0	0.01	0	0	NA	NA	0	0.5	0	0						
8	0.03	0	0	0	0	0	NA	NA	0.03	0.32	0.01	0.02						
9	0.02	0.02	0	0	0	0	NA	NA	0	0.11	0	0.14						
10	0	0	0	0.02	0	0	NA	NA	0	0.01	0	0.16						
11	0	0.02	0	0	0	0	NA	NA	0	0	0	0						
12	0	0.36	0	0	0.02	0.01	NA	NA	0.13	0.34	0.03	0						
13	0	0.33	0	0	0.19	0	NA	NA	0	0	0	0						
14	0	0	0	0	0.03	0	NA	NA	0	0	0	0						
15	0.25	0	0.06	0.01	0	0	NA	NA	0	0.1	0	0						
16	0.61	0	0	0.07	0	0	NA	NA	0	0.13	0	0						
17	0.07	0	0	0.05	0	0	NA	NA	0.05	0	0.02	0						
18	0.02	0	0.04	0.2	0	0	NA	NA	0.08	0	0	0						
19	0	0	0.28	0.16	0	0	NA	NA	0	0	0	0						
20	0	0.03	0.07	0	0	0	NA	NA	0.13	0	0	0						
21	0	0.01	0	0	0	0	NA	NA	0.07	0.02	0	0.01						
22	0	0.18	0.47	0	0	0	NA	0	0.22	0	0	0						
23	0	0	0.1	0.01	0	0	NA	0	0.01	0.08	0.58	0						
24	0.01	0.01	0	0.2	0	0	NA	0	0	0.16	0.31	0						
25	0	0.14	0	0.16	0	0	NA	0	0.23	0	0.18	0						
26	0.05	0.01	0	0	0	0	NA	0	1.03	0	0.3	0.02						
27	0.2	0.01	0	0	0	0	NA	0	0	0	0.16	0.06						
28	0	0	0	0	0	0	NA	0	0.37	0.01	0.28	0						
29	0.01	0	0	0	0	0	NA	0	0.08	0	0.03	0						
30	0	0.15	0	0.12	0	0	NA	0	0	0.01	0	0						
31	0.01		0.1	0		0	NA		0.05	0.07		0.01						
TOTAL	1.40	1.44	1.48	1.17	0.43	0.24	NA	NA	2.48	2.55	1.91	1.58	0.00	0.00	0.00	0.00	0.00	0.00
RainDays	14	15	11	16	6	2			13	16	11	9	0	0	0	0	0	0
MAX	0.61	0.36	0.47	0.20	0.19	0.23	NA	NA	1.03	0.50	0.58	1.03	0.00	0.00	0.00	0.00	0.00	0.00
X-2D	0.86	0.69	0.57	0.36	0.22	0.23	NA	NA	1.26	0.82	0.89	1.16	0.00	0.00	0.00	0.00	0.00	0.00
X-3D	0.93	0.71	0.57	0.41	0.24	0.23	NA	NA	1.40	1.10	1.07	1.16	0.00	0.00	0.00	0.00	0.00	0.00
DryDays	17	15	20	15	24	29			18	15	19	22	0	0	0	0	0	0
NA No data collected at raingauge / Not available																		
* Rain gauge not present, P partial data																		