

Data Transmittal Report

CLEAR CREEK CONSULTANTS



To: Upper Clear Creek Watershed Association (UCCWA)

CC:

From: Mike Crouse

Date: 11-March-2019

Re: Stream Gaging Report Water Year 2018 – 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 2017 to October 2018.

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.

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.

Stream flow results during the operation season are available 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 this reporting period 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 rating 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.

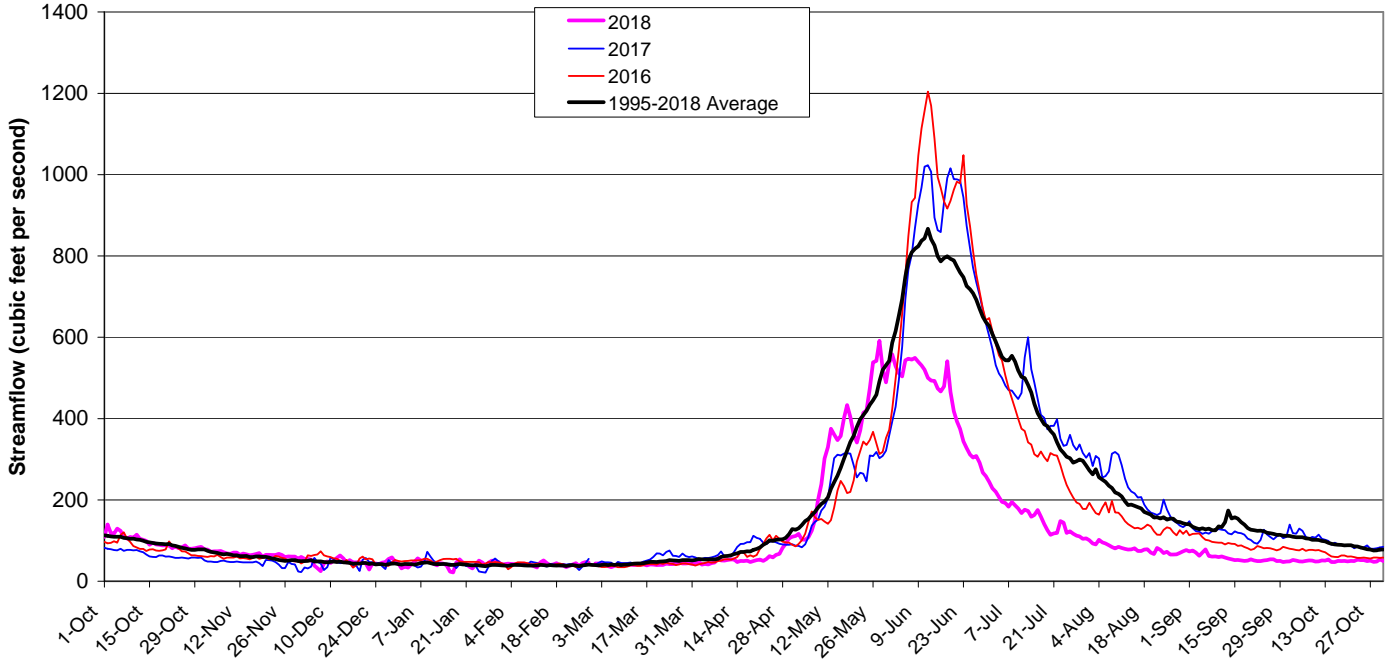
Minimum Clear Creek flows occur in winter, with maximum flows typically in June. Minimum flows typically range from 30 to 40 cfs at CC-40. Mean daily flows were near average in April and May, but were below average from June to October 2018. Peak snowmelt flows in 2018 were less than years 2017 and 2016.

Data graphs for specific conductance, temperature, and turbidity at CC-40 for this reporting period are also attached. Daily precipitation data summary for the 2016-2018 seasonal monitoring periods are also tabulated.

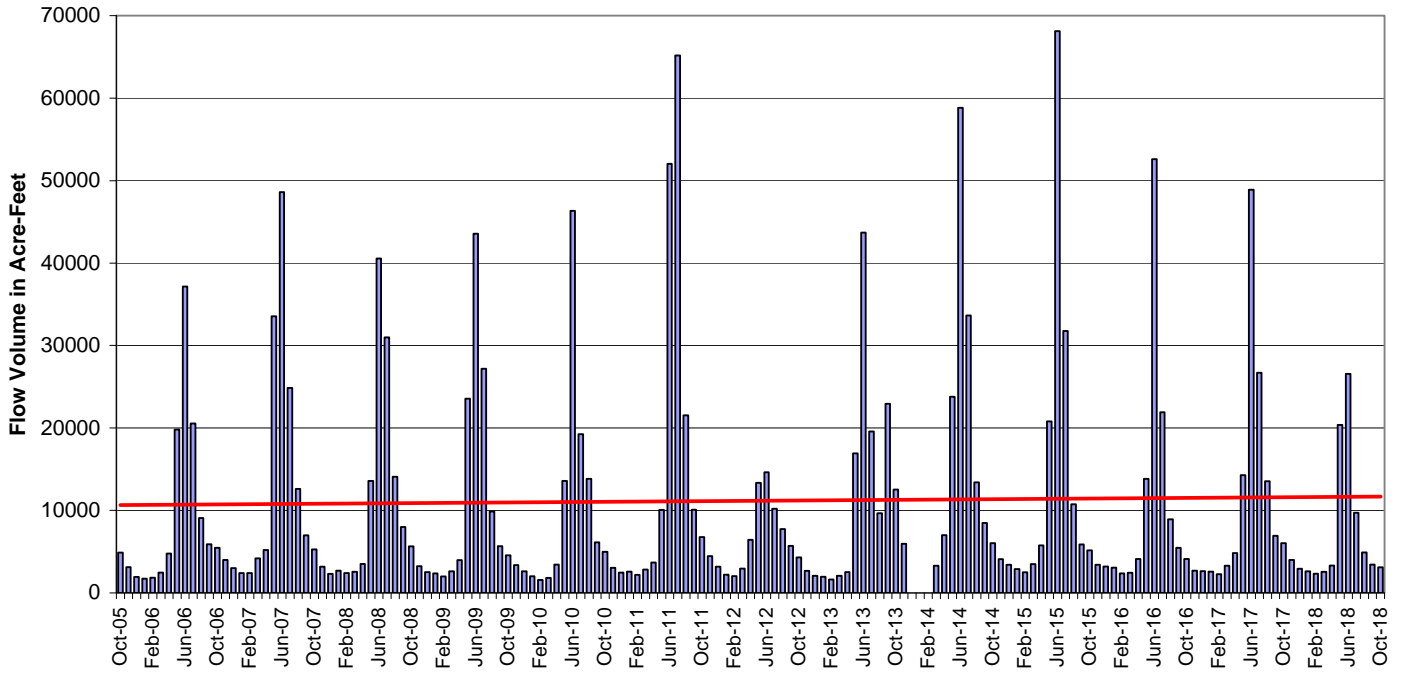
CLEAR CREEK ABOVE JOHNSON GULCH NEAR KERMITTS														
WY 2018														
Provisional Data - Subject to Revision														
LOCATION -- 0.5 mi upstream Johnson Gulch				LATITUDE 39 44'47" LONGITUDE 105 26'08"										
GAGE DRAINAGE AREA -- 267 sq-mi				GAGE ELEVATION -- 7210 ft-msl										
PERIOD OF RECORD -- October 1994 to Current Year														
DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2017 TO OCTOBER 2018														
MEAN DAILY VALUES														
DAY	2017 OCT	2017 NOV	2017 DEC	2018 JAN	2018 FEB	2018 MAR	2018 APR	2018 MAY	2018 JUN	2018 JUL	2018 AUG	2018 SEP	2018 OCT	
1	109	78.2	60 e	32 e	41 e	44 e	44.3	109	558	244	101	73.3	48.3	
2	139	77.6	55 e	37 e	42 e	44 e	48.3	111	529	229	92.9	75.3	49.3	
3	118	72.7	55 e	33 e	43 e	43 e	41.2	117	512	220	90.4	70.3	52.6	
4	117	73.6	53 e	42 e	42 e	41 e	42.7	102	504	207	102	62.7	50.8	
5	130	73.8	39 e	47 e	42 e	37 e	41.3	102	544	195	95.9	70.8	49.0	
6	124	74.103	32 e	56 e	41 e	35 e	44.3	108	547	193	92.8	78.3	48.4	
7	109	72 e	25 e	51 e	43 e	38 e	46.2	125	545	183	89.0	62.1	50.2	
8	105	69 e	44 e	47 e	43 e	43 e	57.8	149	549	195	84.4	60.5	51.3	
9	109	67 e	49 e	47 e	42 e	41.0	51.4	200	540	187	80.5	61.3	50.9	
10	107	70 e	45 e	47 e	41 e	40.9	50.7	239	531	179	84.8	59.6	48.3	
11	115	71 e	49 e	43 e	37 e	40.0	52.5	302	521	168	81.9	61.1	49.2	
12	104	65 e	58 e	39 e	34 e	40.8	53.5	330	500	176	79.7	58.5	51.5	
13	102	68 e	63 e	44 e	47 e	39.9	53.8	375	494	173	78.0	56.0	50.9	
14	99.2	66 e	56 e	43 e	52 e	40.7	47.5	361	493	159	78.2	54.0	53.6	
15	90.0	64 e	46 e	39 e	44 e	41.3	49.9	347	474	163	81.3	51.8	47.2	
16	95.0	65 e	52 e	24 e	40 e	41.5	49.6	357	467	175	74.4	52.7	47.3	
17	90.4	67 e	47 e	22 e	41 e	39.3	51.0	402	479	159	74.4	51.3	49.9	
18	90.0	69 e	47 e	46 e	44 e	41.3	47.1	434	541	141	78.1	50.0	49.6	
19	88.3	60 e	47 e	54 e	39 e	40.7	49.3	404	466	126	79.0	51.0	50.2	
20	89.0	65 e	46 e	46 e	39 e	40.0	51.8	361	418	114	70.3	54.4	48.9	
21	88.4	65 e	44 e	43 e	35 e	40.1	53.0	341	393	117	66.7	51.1	49.9	
22	81.3	65 e	29 e	36 e	38 e	40.5	50.3	371	374	119	82.0	49.7	49.8	
23	85.9	64 e	43 e	31 e	41 e	43.1	55.0	414	344	148	77.5	49.7	53.0	
24	81.4	68 e	44 e	42 e	44 e	42.2	61.4	420	328	144	69.4	51.2	52.1	
25	83.3	64 e	42 e	51 e	37 e	42.1	58.7	475	312	119	72.6	52.1	52.0	
26	88.2	59 e	45 e	46 e	44 e	43.7	65.1	538	304	123	65.4	54.3	49.5	
27	80.3	61 e	48 e	39 e	47 e	45.6	67.4	542	308	117	65.7	54.4	51.0	
28	80.0	61 e	55 e	45 e	46 e	44.0	82.5	591	292	112	66.1	49.8	47.9	
29	81.3	60 e	59 e	51 e		43.7	91.6	523	267	110	69.8	50.3	48.1	
30	83.2	55 e	49 e	49 e		44.2	106	489	259	104	73.7	47.5	54.3	
31	84.7		44 e	47 e		42.9		537		105	76.6		49.5	
TOTAL	3048	2009 e	1470 e	1321 e	1171 e	1283	1665	10278	13394	4902	2474	1725	1554	
MEAN	98.3	67 e	47 e	43 e	42 e	41.4	55.5	332	446	158	79.8	57.5	50.1	
MAX	139.4	78 e	63 e	56 e	52 e	45.6	106	591	558	244	102	78.3	54.3	
MIN	80.0	55 e	25 e	22 e	34 e	34.8	41.2	102	259	104	65.4	47.5	47.2	
AC-FT	6,046	3,985 e	2,916 e	2,620 e	2,323 e	2,546	3,302	20,387	26,567	9,723	4,907	3,422	3,083	
INSTANTANEOUS MEASUREMENTS														
MAX FLOW	153						48.3	117	662	627	272	115	127	58.8
DATE	2-Oct						27-Mar	30-Apr	28-May	1-Jun	12-Jul	4-Aug	5-Sep	27-Oct
MIN FLOW	74.4						35.8	37.3	94.2	244	100	58.0	45.1	42.8
DATE	27-Oct						17-Mar	3-Apr	4-May	30-Jun	31-Jul	27-Aug	30-Sep	15-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: 2006-2018**



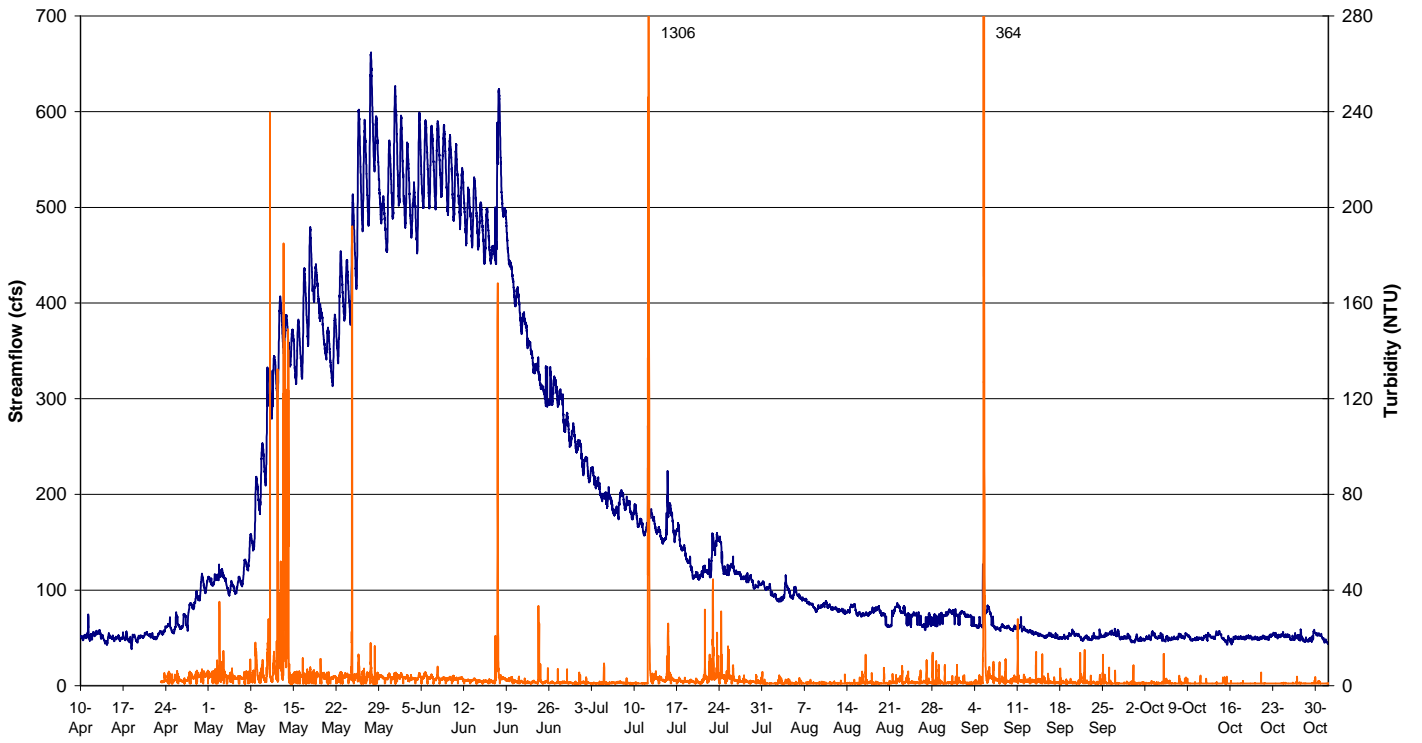
CLEAR CREEK NEAR KERMITTS (Station CC-40)	
PROVISIONAL STREAMFLOW RATING TABLE	
GAGE HEIGHT	STREAMFLOW
(feet)	(cubic feet per second)
3.3	36
3.4	44
3.5	52
3.6	62
3.7	82
3.8	97
3.9	115
4.0	134
4.1	157
4.2	183
4.3	212
4.4	245
4.5	283
4.6	325
4.7	310
4.8	335
4.9	360
5.0	387
5.1	415
5.2	444
5.3	476
5.4	508
5.5	542
5.6	578
5.7	616
5.8	655
5.9	696
6.0	739
6.1	783
6.2	830
6.3	879
6.4	929
6.5	982
6.6	1037
6.7	1093
6.8	1153
6.9	1214
7.0	1278
7.1	1344
7.2	1412
7.3	1483
7.4	1557
7.5	1633

Streamgauge sponsored by the Upper Clear Creek Watershed Association

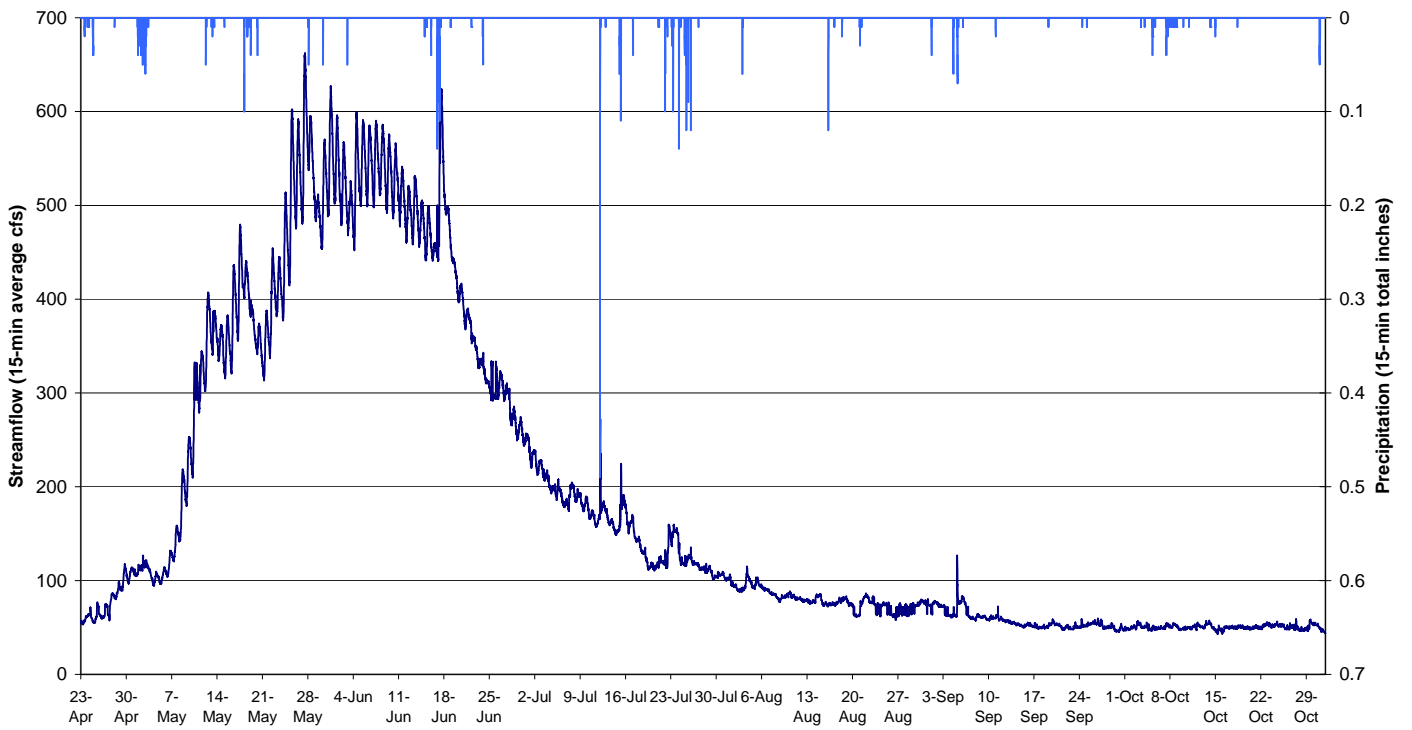
Operated by:  *Clear Creek Consultants*

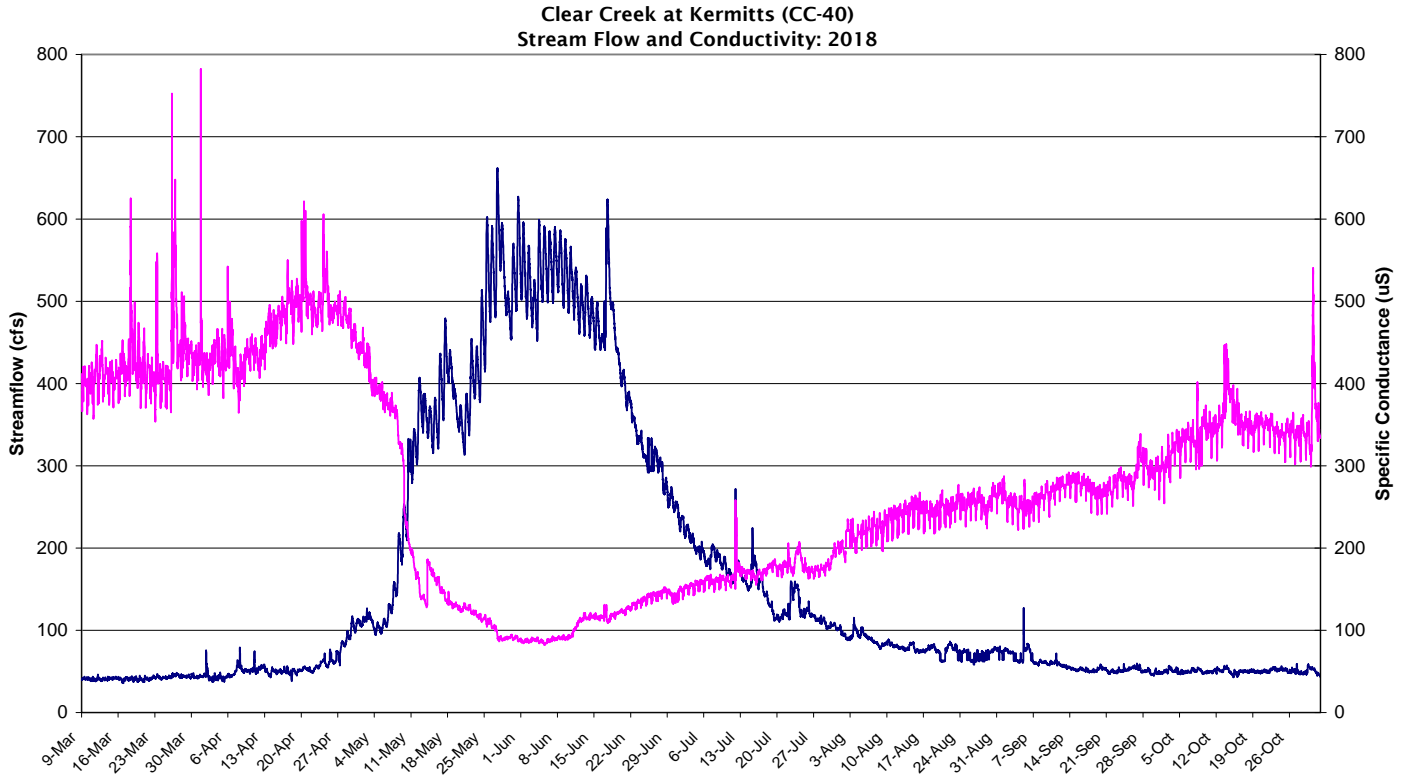
Based on Rating No. 10

Clear Creek at Kermitts (CC-40)
Stream Flow and Turbidity: 2018

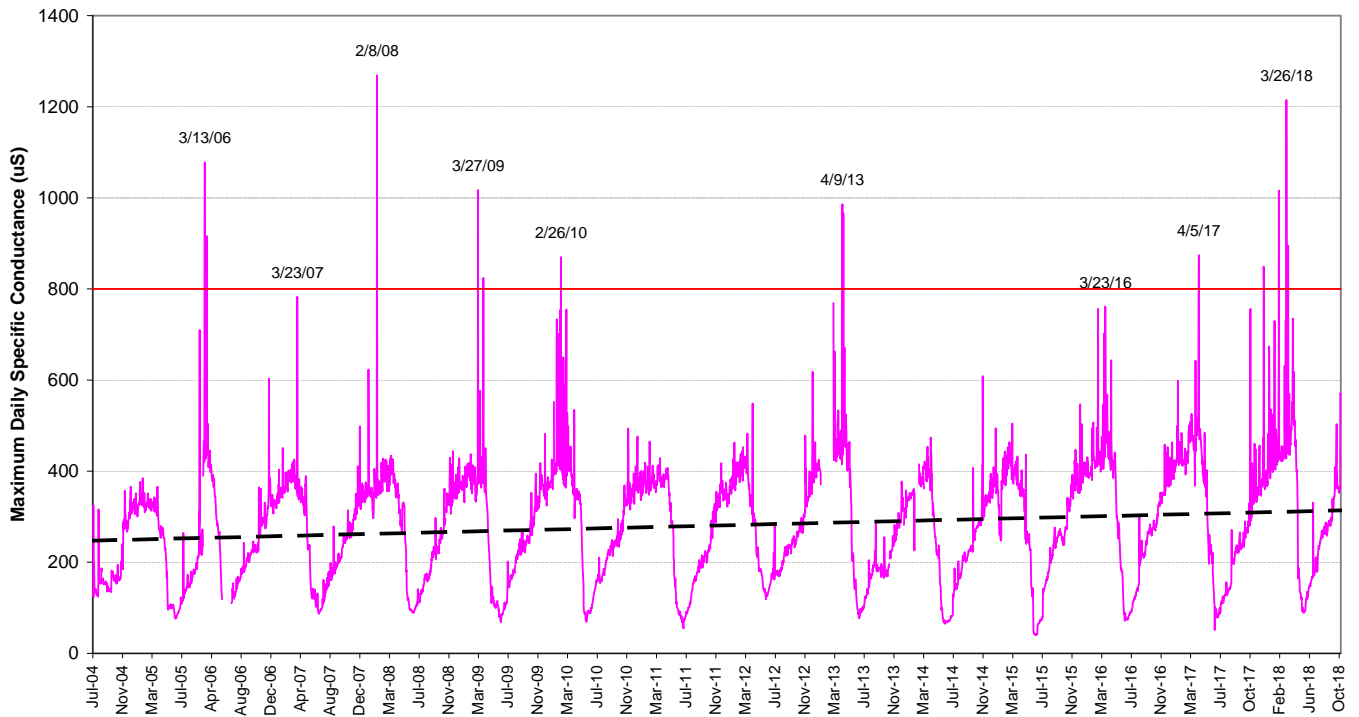


Clear Creek at Kermitts (CC-40)
Stream Flow and Precipitation: 2018





Clear Creek at Kermitts (CC-4) Maximum Specific Conductance July 2004 to October 2018



DAILY RAINFALL RECORDS (inches)																		
CLEAR CREEK STATION CC-40 (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	0	0	0	0	0.08	0
2	0	0	0.21	0.06	0.01	0	NA	NA	0	0.04	0	1.03	0.51	0	0	0	0	0
3	0	0	0.05	0.01	0.01	0	NA	NA	0	0.37	0.01	0	1.1	0.07	0	0.08	0	0.01
4	0	0	0.05	0.05	0	0	NA	NA	0	0	0	0	0	0	0	0	0	0.01
5	0	0	0	0.03	0	0	NA	NA	0	0	0	0	0	0	0	0	0.63	0.19
6	0.02	0.12	0	0.01	0	0.23	NA	NA	0	0.28	0	0	0	0	0	0	0.01	0.01
7	0.04	0.03	0	0.01	0	0	NA	NA	0	0.5	0	0	0	0	0	0	0	0.11
8	0.03	0	0	0	0	0	NA	NA	0.03	0.32	0.01	0.02	0	0	0	0	0	0.12
9	0.02	0.02	0	0	0	0	NA	NA	0	0.11	0	0.14	0	0	0	0	0	0.07
10	0	0	0	0.02	0	0	NA	NA	0	0.01	0	0.16	0	0	0	0	0	0.01
11	0	0.02	0	0	0	0	NA	NA	0	0	0	0	0	0	0	0	0.03	0.01
12	0	0.36	0	0	0.02	0.01	NA	NA	0.13	0.34	0.03	0	0.1	0	0.73	0	0	0
13	0	0.33	0	0	0.19	0	NA	NA	0	0	0	0	0.09	0	0.01	0	0	0
14	0	0	0	0	0.03	0	NA	NA	0	0	0	0	0.01	0	0	0	0	0.06
15	0.25	0	0.06	0.01	0	0	NA	NA	0	0.1	0	0	0.01	0.03	0.64	0	0	0.06
16	0.61	0	0	0.07	0	0	NA	NA	0	0.13	0	0	0	0.05	0	0.18	0	0
17	0.07	0	0	0.05	0	0	NA	NA	0.05	0	0.02	0	0	1.2	0.04	0.01	0	0
18	0.02	0	0.04	0.2	0	0	NA	NA	0.08	0	0	0	0.18	0.01	0	0.03	0	0.01
19	0	0	0.28	0.16	0	0	NA	NA	0	0	0	0	0.24	0.02	0	0	0.01	0
20	0	0.03	0.07	0	0	0	NA	NA	0.13	0	0	0	0.13	0	0	0	0	0
21	0	0.01	0	0	0	0	NA	NA	0.07	0.02	0	0.01	0	0	0.04	0.08	0	0
22	0	0.18	0.47	0	0	0	NA	0	0.22	0	0	0	0	0.02	0.32	0	0	0
23	0	0	0.1	0.01	0	0	NA	0	0.01	0.08	0.58	0	0	0	0.18	0	0	0
24	0.01	0.01	0	0.2	0	0	NA	0	0	0.16	0.31	0	0	0.09	0.19	0	0.01	0
25	0	0.14	0	0.16	0	0	NA	0	0.23	0	0.18	0	0	0	0.28	0	0.01	0
26	0.05	0.01	0	0	0	0	NA	0	1.03	0	0.3	0.02	0	0	0.22	0	0	0
27	0.2	0.01	0	0	0	0	NA	0	0	0	0.16	0.06	0	0	0.01	0	0	0
28	0	0	0	0	0	0	NA	0	0.37	0.01	0.28	0	0.11	0	0	0	0	0
29	0.01	0	0	0	0	0	NA	0	0.08	0	0.03	0	0	0	0	0	0	0
30	0	0.15	0	0.12	0	0	NA	0	0	0.01	0	0	0.06	0	0	0	0	0
31	0.01		0.1	0		0	NA		0.05	0.07		0.01	0		0			0.33
TOTAL	1.40	1.44	1.48	1.17	0.43	0.24	NA	NA	2.48	2.55	1.91	1.58	2.54	1.49	2.66	0.38	0.78	1.00
RainDays	14	15	11	16	6	2			13	16	11	9	11	8	11	5	7	13
MAX	0.61	0.36	0.47	0.20	0.19	0.23	NA	NA	1.03	0.50	0.58	1.03	1.10	1.20	0.73	0.18	0.63	0.33
X-2D	0.86	0.69	0.57	0.36	0.22	0.23	NA	NA	1.26	0.82	0.89	1.16	1.61	1.25	0.74	0.19	0.64	0.33
X-3D	0.93	0.71	0.57	0.41	0.24	0.23	NA	NA	1.40	1.10	1.07	1.16	1.61	1.28	0.74	0.22	0.64	0.33
DryDays	17	15	20	15	24	29			18	15	19	22	20	22	20	26	23	18
NA No data collected at raingauge / Not available																		
* Rain gauge not present, P partial data																		