MC2 Stream Reach Summary

Study Reach: MC2, Muddy Creek **-** Wolford Mountain Reservoir downstream to the Colorado River.

Reach Description: Approximate channel length: 13.75 miles, approximate channel slope 0.1%.

Prior to the construction of Wolford Reservoir in 1995, Muddy Creek meandered through easily eroded shale that gave the stream its muddy appearance. With the completion of Wolford Mountain Reservoir, Muddy Creek became a cool, clear flowing stream below the dam. Fish sampling over the past few years indicate this stream is becoming viable trout habitat (Ewert 2008). The bank is lined with a narrow mixture of trees, and wetland vegetation and public access is available via several BLM sites along the river. The overbanks are relatively dry and sparsely vegetated by sagebrush.

Muddy Creek downstream of Highway 40

Muddy Creek at PHABSIM site

Restored banks of Muddy Creek at Grand River Ranch

Flow Recommendations:

Environmental Flow Methodology**:** A PHABSIM study site was established within this reach in summer 2007. See Appendix A for methodology and Appendix E for PHABSIM survey information. CWCB flows have been set.

Water Users:

- Irrigators, municipalities and industry flow-related issues: no flow-related issues reported, concerns noted about potential for algae blooms.
- Recreation: Angling is the predominant recreational use in this reach.

Summary of Flows:

Environmental, recommended target flow ranges

- 60 to 90 cfs for April through September
- 30 to 60 cfs for October through March
- Flushing flow of at least 350 cfs for a 3-day duration with a frequency of 1 in 2 years during the mid-May to mid-June period

CWCB flows

- 70 cfs (05/1 – 05/14)
- 105 cfs (05/15 – 06/30)
- 70 cfs (07/1 – 07/14)
- 20 cfs (07/15 – 04/30)

Water Users

- Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 90 cfs at anytime. Most of the diversions are made in the summer for irrigation and will likely have some return flows.
- Angling: 20 cfs

Stream Assessments: In August 2008 Tetra Tech conducted three assessments in MC2. These included Stream Reach Inventory/Channel Stability Evaluation (SRI/CSE), EPA Habitat Quality Assessment (HQA) and a Riffle Stability Index (RSI) evaluation. The SRI/CSE evaluation scored in the 'fair to almost poor' category, the EPA HQA evaluation scored in the 'marginal' category and the RSI of 87 indicates riffle substrate is highly unstable with up to 87% of particles mobilized during recent high flow events. Relevant issues revealed in the stream assessments indicate that this is a stream in transition as the constant and relatively high flows released out of Wolford Reservoir are influencing the morphology of the once highly sinuous creek. Bank erosion and signs of avulsion are common. Aquatic habitat structure is poor while velocity/depth regime lacks diversity. Riffles are infrequent and riparian vegetation cover and width are marginal. Also, fish passage barriers are present. The downstream end of Muddy Creek has also undergone anthropogenic alterations (channel realignment and floodplain manipulation) due primarily to agricultural-related land uses. Results of the assessments are summarized in the following tables and plot. Details and methodology are presented in Appendix A.

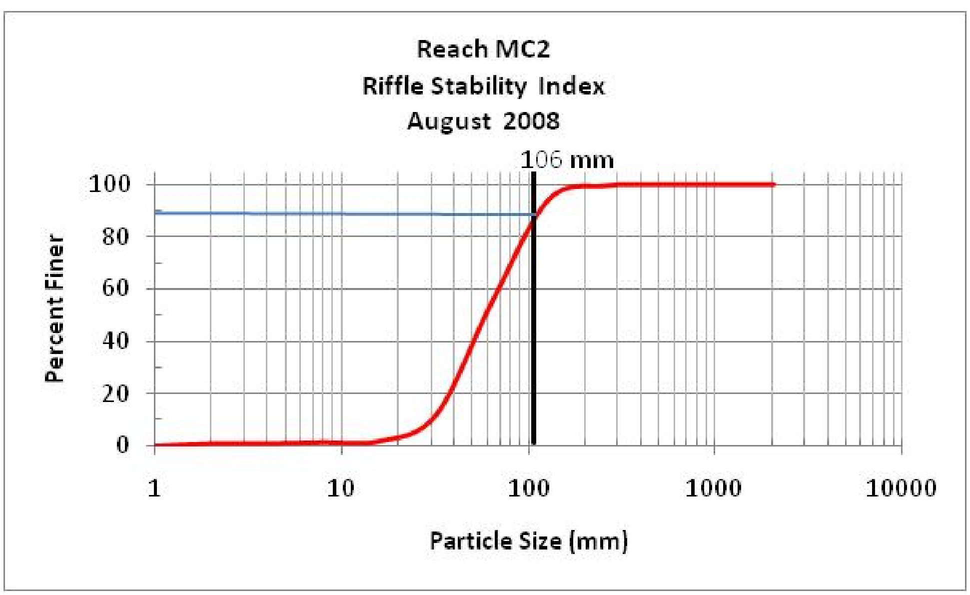
Reach MC2
Stream Assessments

Stream Reach Inventory/Channel Stability Evaluation

Attribute		
Upper Banks		
1	Landform Slope	2
2	Mass wasting hazard	6
3	Debris Jam Potential	3
4	Vegetation Cover	9
	Upper Bank Score:	**20**
Lower Banks		
5	Channel Capacity	3
6	Bank Rock Content	8
7	Flow obstructors & Deflectors	6
8	Cutting	12
9	Deposition	12
	Lower Bank Score:	**41**
Channel Bottom		
10	Rock Angularity	4
11	Brightness	4
12	Consolidation/Particle Packing	8
13	Bottom size distribution	12
14	Bed Scour and Deposition	18
15	Clinging Aquatic Veg	3
	Channel Bottom Score:	**49**
	Total Score:	**110**

EPA Habitat Quality Assessment

Attribute		**Score**
Channel		
1	Aquatic Habitat Barriers/ Diversion	9
2	Aquatic Structure as Cover	5
3	Velocity/ Depth Regimes	7
4	Channel Flow Status	18
5	Channel Alteration	10
6	Frequency of Riffles	7
7	Channel Sinuosity	14
	Channel Score	**70**
Banks		
8	Bank Stability	6
9	Riparian Vegetation Cover and Disturbance	10
10	Riparian Vegetation zone width	10
	Bank Score	26
	Total Score	**96**
Notes		



Spawning Observations: A spawning survey was conducted in the vicinity of the PHABSIM site on 27 October 2008. Eleven likely brown trout redds were identified and measured.

Hydrologic Records: The streamflow exceedence plots for Muddy Creek below Wolford Reservoir (USGS Gage 9041400, 1996 - 2007) suggests that flows are typically available over much of the April to September period to meet the recommended environmental target flow range. However, during the winter period, flow releases from Wolford Reservoir tend to be less than the recommended range, especially during the November to February period. The same holds true when comparing the preferred winter flow range to the daily exceedence plots for the pre-Wolford Reservoir period (USGS Gage 9041500, 1983 - 1995). Both sets of exceedence plots indicate the recommended flushing flow range has been present with regularity over the periods-of-record. The median 1-, 3- and 7-day maximum flows reported on the IHA Scorecard also lend support for the magnitude and duration of the flush.

Water Temperature: MC2 is a Tier I stream reach as designated by CDPHE with a chronic temperature standard of 17^{o}C MWAT and an acute temperature standard of 21.2^{o}C DM. Temperature data reviewed in reach MC2 indicate stream temperatures for Muddy Creek in this area exceed both the MWAT and DM standard in late July/early August. Temperatures remain within both standards otherwise. This reach has been identified by the State of Colorado for monitoring and evaluation for temperatures as defined by the Clean Water Act, Section 303(d).

Water Quality: Water quality data indicate several exceedences of phosphorus. Out of the 126 samples reviewed for phosphorus, 3 samples equaled or exceeded the 0.1 mg/l guidance. Increase in algae blooms is a concern of the local diverters and irrigators (Thompson 2007).

Water Quality: No water quality data were available for this reach.

Water Supply Issues (UPCO): No water supply issues are reported for this reach.

Results and Remarks:

1. Recommended flows are typically available over much of the April to September period. However, during the winter period, flow releases from Wolford Reservoir have tended to be less than the recommended range.
2. The stream assessments indicate that this is a stream in transition as the constant and relatively high flows released out of Wolford Reservoir are influencing the morphology of the once highly sinuous creek. Bank erosion and signs of avulsion are common, and aquatic habitat quality is marginal to poor.
3. The downstream end of Muddy Creek has undergone anthropogenic alterations (channel realignment and floodplain manipulation) due primarily to agricultural and municipal related land uses.
4. Some temperature exceedences have occurred, however, overall temperatures are likely supportive of a cold-water fishery.
5. Several water quality readings have indicated exceedence of phosphorus, however, water quality is likely supportive of a cold-water fishery.
6. Flows for recreation are generally adequate.
7. A fish passage barrier is present on the Grand River Ranch near the mouth of MC2 at its confluence with the Colorado River.
8. This site has been identified in the CNHP as a Potential Conservation Area due to outstanding biodiversity with the presence of the federally listed plant species. Immediate protection is recommended by CNHP.

9. The relative abundance of trout spawning habitat suggests the implementation of flushing flows could be especially beneficial in MC2. Enhancement of the winter flow regime would likely require some modification of the existing reservoir-operating plan.
10. Some restoration work has been implemented on Grand River Ranch property including bank protection, and installation of instream structures such as j-hooks.

Restoration Opportunities: It is anticipated that channel responses to changes in flow regimes will continue to occur for many years. Thus, some recommendations and opportunities should not be implemented until the stream stabilizes. Specific opportunities may include the following:

- ✓ Apply enhancement flows to increase low flows, and/or to increase flushing flows during spring runoff. Alternate application of enhancement and flushing flows as needed.
- ✓ Explore opportunities to enhance low flows, typically in August and September.
- ✓ Work with private property owners to develop land use BMP guidelines related to erosion control
- ✓ Restore and protect banks and channel after stream has stabilized. Monitor existing restoration.
- ✓ Consider fish by-pass at existing diversions.
- ✓ Further analysis and monitoring should be conducted to evaluate ramping rates from releases out of Wolford Reservoir.

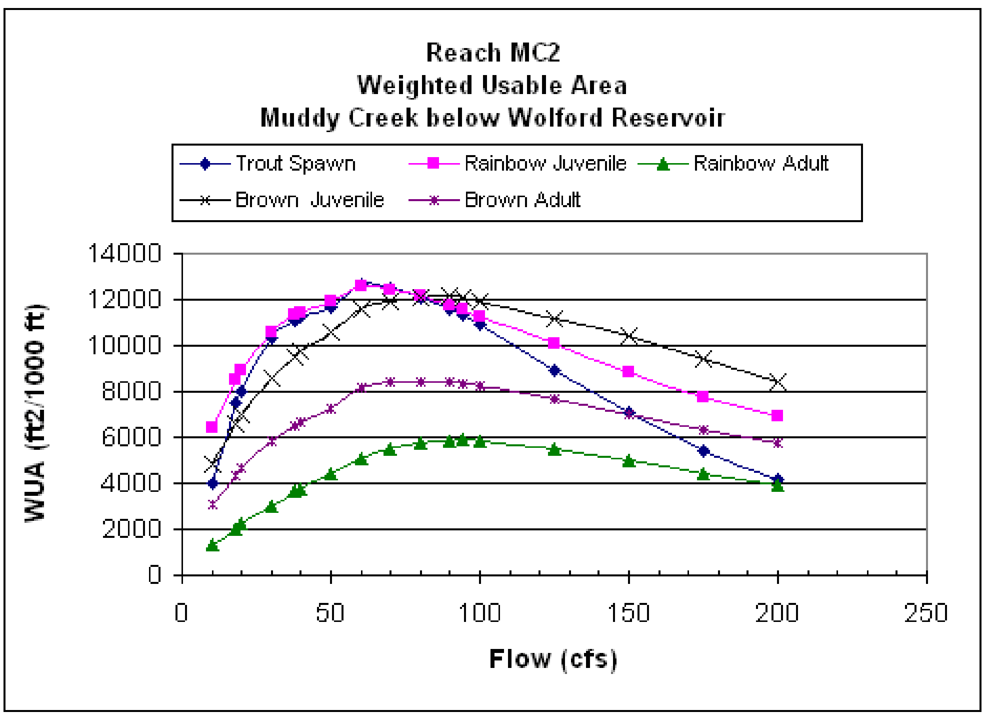
Monitoring: Establish and implement a monitoring program. Parameters should include water quality monitoring; air temperature; intergravel fine sediments; fish population and diversity, and benthic macro invertebrates. Continue to monitor surface water temperatures and flows. Monitor channel morphology.

Support Data

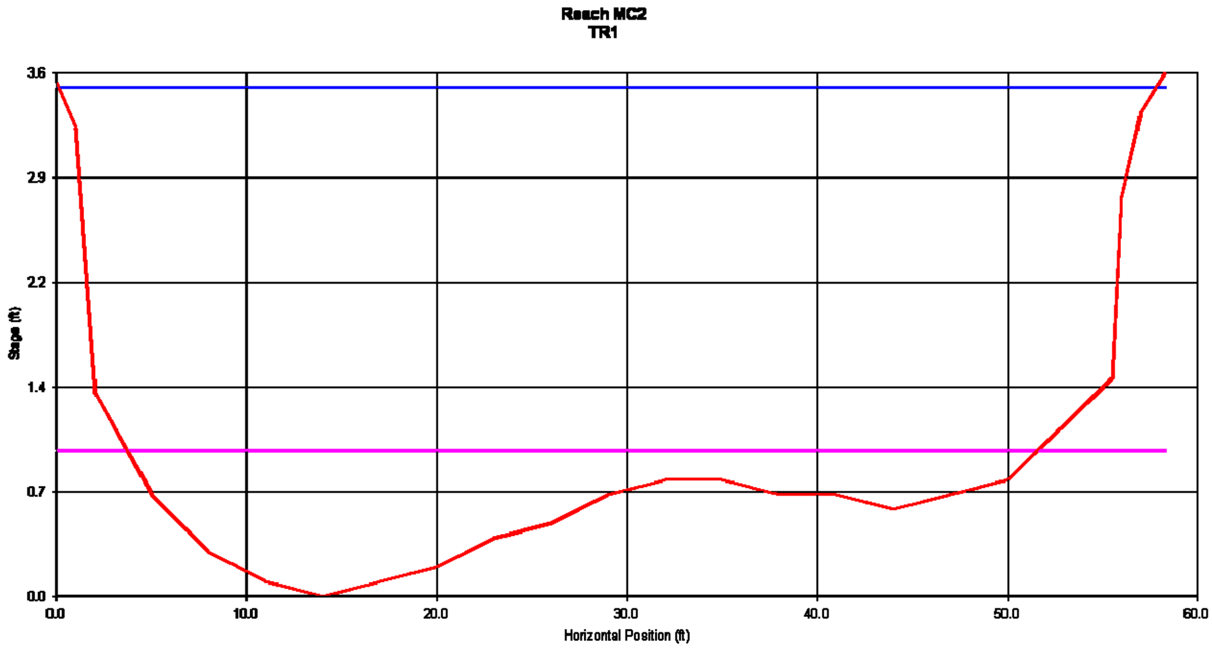
Weighted Useable Area Plots and Tables

Habitat-flow relations for the target species and life stages for Reach MC2, Tetra Tech site.

Reach MC2						
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)				
10.0	36055.6	3986.4	6415.7	1291.7	4834.0	3061.4
18.0	38136.4	7483.0	8507.6	2027.5	6611.2	4365.8
20.0	38483.8	7967.7	8906.4	2209.4	6982.1	4637.7
30.0	40890.9	10330.9	10557.9	3034.9	8589.0	5824.0
38.0	42399.7	11087.9	11303.6	3644.9	9537.1	6531.2
40.0	42596.1	11235.4	11437.1	3782.2	9735.7	6679.8
50.0	43038.6	11670.8	11904.6	4382.2	10569.4	7274.0
60.0	43381.2	12699.0	12552.3	5106.8	11559.2	8176.8
70.0	43723.9	12515.4	12449.8	5512.6	11929.2	8404.7
80.0	44036.7	12108.2	12143.9	5759.8	12110.6	8457.5
90.0	44296.0	11549.4	11749.8	5867.2	12143.9	8393.5
94.0	44393.8	11297.7	11576.8	5882.2	12098.4	8341.7
100.0	44524.6	10902.1	11290.0	5868.1	11907.6	8243.0
125.0	45040.3	8921.4	10065.1	5538.0	11192.6	7656.7
150.0	45368.4	7078.3	8849.6	5001.0	10382.6	6993.1
175.0	45629.7	5455.1	7767.9	4442.6	9455.2	6357.0
200.0	45864.2	4141.8	6934.9	3945.2	8413.5	5779.0



Transect and Bedload Threshold Plots and Tables

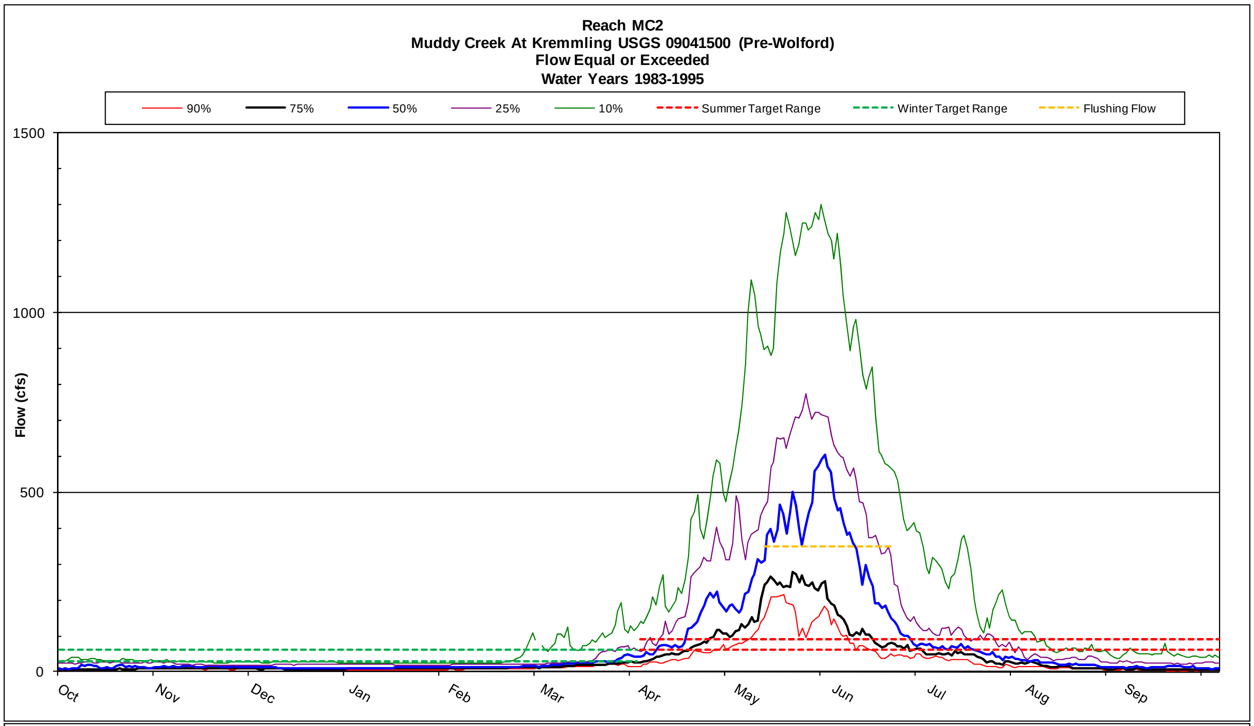


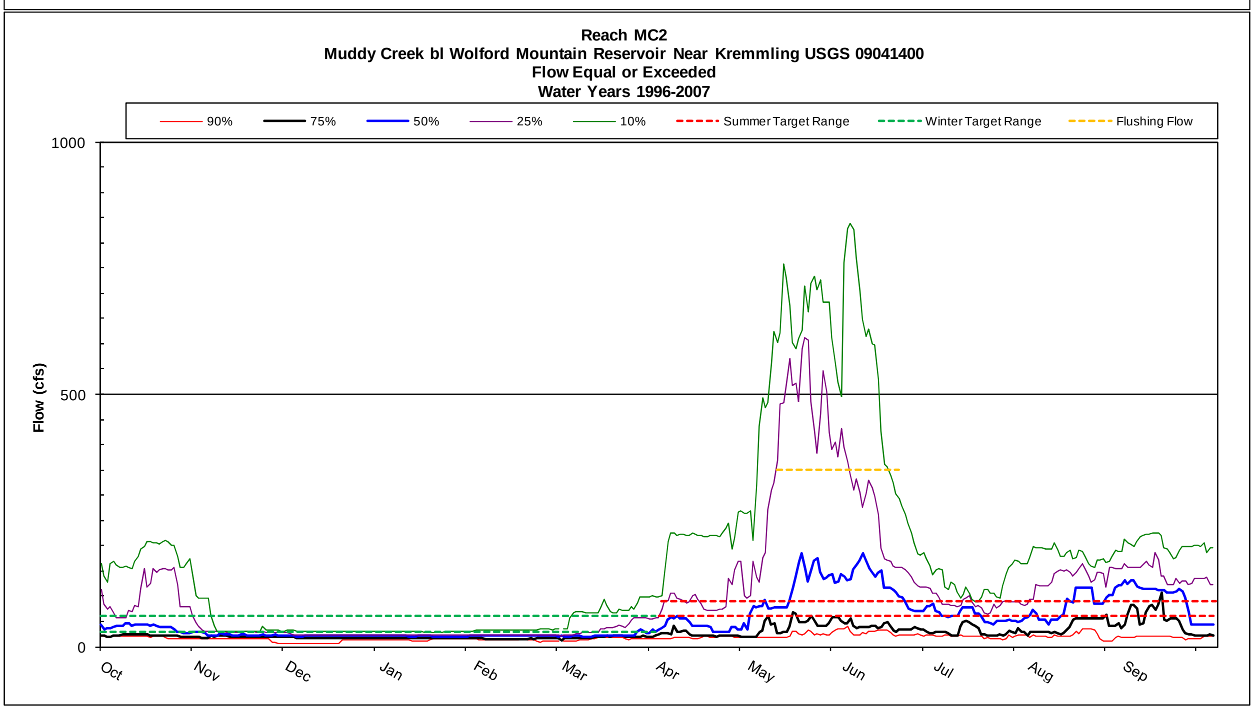
Reach MC2, TR1
Tt2007 site

Resistance Method: Jarrett's Equation

STAGE (ft)	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
1.0	22.70	44.97	44.86	0.50	0.51	0.002	0.041	1.02	23.3	0.06
1.1	27.25	46.20	46.07	0.59	0.59	0.002	0.040	1.17	31.8	0.07
1.2	31.91	47.43	47.29	0.67	0.67	0.002	0.039	1.30	41.5	0.08
1.3	36.70	48.66	48.50	0.75	0.76	0.002	0.038	1.43	52.5	0.09
1.4	41.61	49.89	49.71	0.83	0.84	0.002	0.038	1.55	64.7	0.10
1.5	46.63	50.80	50.55	0.92	0.92	0.002	0.037	1.68	78.5	0.11
1.6	51.69	51.02	50.65	1.01	1.02	0.002	0.037	1.83	94.4	0.13
1.7	56.76	51.24	50.74	1.11	1.12	0.002	0.036	1.97	111.7	0.14
1.8	61.84	51.47	50.84	1.20	1.22	0.002	0.036	2.10	130.2	0.15
1.9	66.93	51.69	50.93	1.29	1.31	0.002	0.035	2.24	149.9	0.16
2.0	72.02	51.91	51.03	1.39	1.41	0.002	0.035	2.37	170.8	0.17
2.1	77.13	52.13	51.12	1.48	1.51	0.002	0.035	2.50	193.0	0.18
2.2	82.25	52.35	51.22	1.57	1.61	0.002	0.034	2.63	216.3	0.20
2.3	87.37	52.57	51.31	1.66	1.70	0.002	0.034	2.76	240.7	0.21
2.4	92.51	52.80	51.41	1.75	1.80	0.002	0.034	2.88	266.3	0.22
2.5	97.66	53.02	51.50	1.84	1.90	0.002	0.033	3.00	293.0	0.23
2.6	102.81	53.24	51.60	1.93	1.99	0.002	0.033	3.12	320.9	0.24
2.7	107.98	53.46	51.69	2.02	2.09	0.002	0.033	3.24	349.8	0.25
2.8	113.15	53.73	51.86	2.11	2.18	0.002	0.033	3.35	379.5	0.26
2.9	118.35	54.04	52.08	2.19	2.27	0.002	0.032	3.46	410.0	0.27
3.0	123.57	54.36	52.31	2.27	2.36	0.002	0.032	3.57	441.6	0.28
3.1	128.81	54.67	52.54	2.36	2.45	0.002	0.032	3.68	474.2	0.29
3.2	134.08	54.98	52.76	2.44	2.54	0.002	0.032	3.79	507.8	0.30
3.3	139.37	55.48	53.21	2.51	2.62	0.002	0.032	3.88	541.1	0.31
3.4	144.72	56.22	53.92	2.57	2.68	0.002	0.032	3.96	573.4	0.32
3.5	150.16	57.05	54.72	2.63	2.74	0.002	0.031	4.04	606.0	0.33

Hydrographs and Exceedence Plots and Tables





Return Period T (year)	**Probability P (percent)**	**Flood Discharge Q (ft^3/sec)**
1.05	95.2	146
1.11	90.1	187
1.25	80	252
2	50	448
5	20	795
10	10	1073
25	4	1477

Flood frequency analysis for USGS gage 09041400, Muddy Creek below Wolford Mountain Reservoir near Kremmling, CO, for eleven-year period of record (Water years 1996-2006).

IHA Results

Reach MC2
Non-Parametric IHA Scorecard
USGS 09041500, Muddy Creek At Kremmling (Pre-Wolford)

Period of Analysis: 1982-1995 (14 years)

Mean annual flow	94.45	
Mean flow/area	94.45	
Annual C. V.	1.95	
Flow predictability	0.49	
Constancy/predictability	0.43	
% of floods in 60d period	0.45	
Flood-free season	164	
	Medians	**Coeff. of Disp.**
Parameter Group #1		
October (cfs)	14.5	1.324
November (cfs)	14.75	0.7017
December (cfs)	12.5	1.23
January (cfs)	13.5	0.9815
February (cfs)	13.75	0.8327
March (cfs)	26	0.5577
April (cfs)	88.25	1.381
May (cfs)	402	0.972
June (cfs)	174	1.886
July (cfs)	57	0.9035
August (cfs)	21	0.9643
September (cfs)	12.75	1.344
Parameter Group #2		
1-day minimum (cfs)	5.2	1.611
3-day minimum (cfs)	5.517	1.402
7-day minimum (cfs)	6.15	1.384
30-day minimum (cfs)	7.475	1.121
90-day minimum (cfs)	12.43	1.012
1-day maximum (cfs)	766.5	0.758
3-day maximum (cfs)	752.3	0.7273
7-day maximum (cfs)	721.4	0.7283
30-day maximum (cfs)	548.7	0.8063
90-day maximum (cfs)	299.3	0.8552
Number of zero days (count)	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.07963	0.651
Parameter Group #3		
Date of minimum (Julian day)	273.5	0.05123
Date of maximum (Julian day)	138	0.05464
Parameter Group #4		
Low pulse count (#)	5	1.45
Low pulse duration (days)	6.5	1.462
High pulse count (#)	3	1.667
High pulse duration (days)	16.75	2.657
The low pulse threshold is (cfs)	12	
The high pulse threshold is (cfs)	70	
Parameter Group #5		
Rise rate (cfs difference between consecutive days)	4.175	0.8683
Fall rate (cfs difference between consecutive days)	-3	-1.542
Number of reversals	81.5	0.3252

Reach MC2
IHA Percentile Data (non-parametric)
USGS 09041500, Muddy Creek At Kremmling (Pre-Wolford)

Period of Analysis: 1982-1995 (14 years)

	Period of Analysis					
	10%	**25%**	**50%**	**75%**	**90%**	**(75-25)/50**
Parameter Group #1						
October (cfs)	7.1	7.8	14.5	27	42	1.324
November (cfs)	8.175	9.15	14.75	19.5	41	0.7017
December (cfs)	6.95	7.375	12.5	22.75	41	1.23
January (cfs)	6.2	9	13.5	22.25	38	0.9815
February (cfs)	7.5	10.55	13.75	22	38	0.8327
March (cfs)	17	21	26	35.5	83	0.5577
April (cfs)	46.25	54.63	88.25	176.5	240	1.381
May (cfs)	175.5	250.5	402	641.3	1005	0.972
June (cfs)	61.75	87.88	174	416.1	626.3	1.886
July (cfs)	30	41.5	57	93	204.5	0.9035
August (cfs)	9.7	12.75	21	33	55.5	0.9643
September (cfs)	4.125	6.863	12.75	24	42.75	1.344
Parameter Group #2						
1-day minimum (cfs)	1.655	3.875	5.2	12.25	17	1.611
3-day minimum (cfs)	2.118	4.517	5.517	12.25	17.17	1.402
7-day minimum (cfs)	2.829	5.021	6.15	13.54	17.36	1.384
30-day minimum (cfs)	4.67	6.839	7.475	15.22	24.15	1.121
90-day minimum (cfs)	6.947	7.843	12.43	20.42	38.48	1.012
1-day maximum (cfs)	327	460.3	766.5	1041	1400	0.758
3-day maximum (cfs)	312	447.5	752.3	994.7	1383	0.7273
7-day maximum (cfs)	292.9	401.4	721.4	926.8	1319	0.7283
30-day maximum (cfs)	216.1	302.8	548.7	745.2	1062	0.8063
90-day maximum (cfs)	138.6	184.2	299.3	440.1	531.7	0.8552
Number of zero days (count)	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.03673	0.06122	0.07963	0.1131	0.1803	0.651
Parameter Group #3						
Date of minimum (Julian day)	249.5	259.8	273.5	278.5	341.5	0.05123
Date of maximum (Julian day)	118	125.3	138	145.3	151	0.05464
Parameter Group #4						
Low pulse count (#)	0	0	5	7.25	9	1.45
Low pulse duration (days)	1	2.875	6.5	12.38	22.05	1.462
High pulse count (#)	2	2	3	7	8	1.667
High pulse duration (days)	1.5	3	16.75	47.5	63.25	2.657
Parameter Group #5						
Rise rate (cfs difference between consecutive days)	1	2	4.175	5.625	12.5	0.8683
Fall rate (cfs difference between consecutive days)	-9	-6.625	-3	-2	-1.825	-1.542
Number of reversals	41	64.5	81.5	91	108	0.3252
EFC Monthly Low Flows						
October Low Flow (cfs)	7.74	8.775	12	23.5	31.2	1.227
November Low Flow (cfs)	8.41	9.1	13.5	18.5	26.4	0.6963
December Low Flow (cfs)	7.48	8.125	10	19.5	28	1.138
January Low Flow (cfs)	7.95	9.2	13.5	20.5	23.7	0.837
February Low Flow (cfs)	8	10.1	13	20.5	23.2	0.8
March Low Flow (cfs)	13.7	16.25	22	27	45	0.4886
April Low Flow (cfs)	24.8	33	47	57	63.6	0.5106
May Low Flow (cfs)			67.5			
June Low Flow (cfs)	41	43	57.5	59	68	0.2783
July Low Flow (cfs)	18.6	33.5	41	52	55.8	0.4512
August Low Flow (cfs)	10	13	20.25	30.63	46.5	0.8704
September Low Flow (cfs)	7.9	9.65	13.25	24	39.5	1.083
EFC Parameters						
Extreme low peak (cfs)	4.25	5.15	5.85	6.275	6.77	0.1923
Extreme low duration (days)	1.2	3.75	4.75	6	6.9	0.4737
Extreme low timing (Julian date)	246	256.1	268	294.3	314.2	0.1042
Extreme low freq. (#/year)	0	0	2.5	5.25	8.5	2.1
High flow peak (cfs)	42	46.75	72	80.75	93.25	0.4722
High flow duration (days)	3.5	4	5	5.125	6.75	0.225
High flow timing (Julian date)	119.8	173.6	195.5	221	258.5	0.1294
High flow frequency (#/year)	2	3	5	6	8	0.6
High flow rise rate (cfs differnenc between consecutive days)	8.5	10.56	13.39	19.5	22.57	0.6674
High flow fall rate (cfs difference between consecutive days)	-15.13	-9.375	-7.508	-6.527	-2.675	-0.3793
Small Flood peak (cfs)	721	789.3	923.5	1188	1210	0.4312
Small Flood duration (days)	56	74.75	92	118.3	131	0.4728
Small Flood timing (Julian date)	126	126.8	140.5	146.3	150	0.05328
Small Flood freq. (#/year)	0	0	0	1	1	0
Small Flood riserate (cfs difference between consecutive days)	16.78	20	27.24	30.39	32.77	0.3815
Small Flood fallrate (cfs difference between consecutive days)	-18.8	-18.68	-16.03	-13.88	-10.97	-0.2992
Large flood peak (cfs)			1590			
Large flood duration (days)			111			
Large flood timing (Julian date)			138			
Large flood freq. (#/year)	0	0	0	0	0.5	0
Large flood riserate (cfs difference between consecutive days)			47.5			
Large flood fallrate (cfs difference between consecutive days)			-19.15			

Reach Mc2
Non-Parametric IHA Scorecard
USGS gage 09041400, Muddy Creek below Wolford Mountain Reservoir near Kremmling, CO

Muddy Creek Period of Record
Period of Analysis: 1996-2007 (12 years)

Mean annual flow	73.82
Mean flow/area	73.82
Annual C. V.	1.43
Flow predictability	0.57
Constancy/predictability	0.65
% of floods in 60d period	0.43
Flood-free season	129

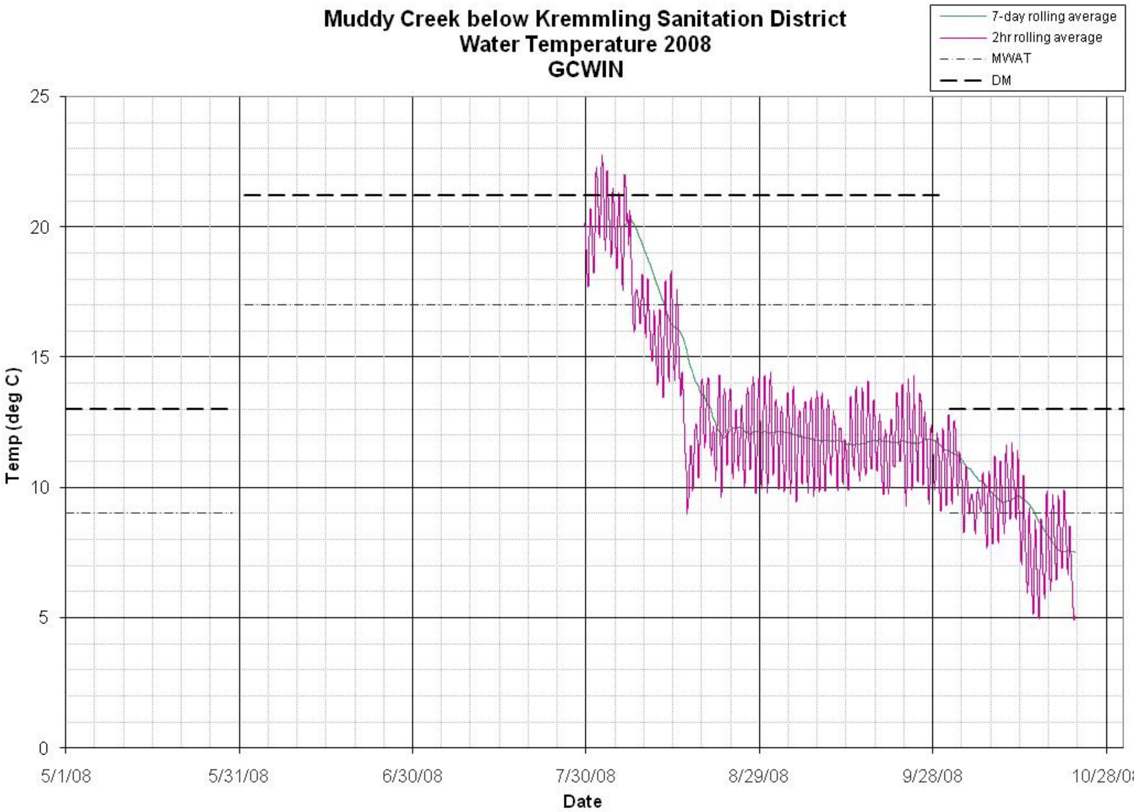
	Medians	Coeff. of Disp.
Parameter Group #1		
October (cfs)	43.5	1.374
November (cfs)	23.5	0.383
December (cfs)	21.5	0.2907
January (cfs)	20.5	0.2805
February (cfs)	21	0.3452
March (cfs)	22	0.4318
April (cfs)	42	1.089
May (cfs)	132.5	2.642
June (cfs)	116.3	1.092
July (cfs)	59.5	0.7269
August (cfs)	113.5	0.8436
September (cfs)	108.3	0.4065
Parameter Group #2		
1-day minimum (cfs)	15	0.5
3-day minimum (cfs)	15	0.4833
7-day minimum (cfs)	15	0.5
30-day minimum (cfs)	19.75	0.3886
90-day minimum (cfs)	20.43	0.3258
1-day maximum (cfs)	382.5	1.446
3-day maximum (cfs)	371.2	1.342
7-day maximum (cfs)	356.4	1.229
30-day maximum (cfs)	239.1	1.331
90-day maximum (cfs)	141.4	1.186
Number of zero days (count)	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.2826	0.4686
Parameter Group #3		
Date of minimum (Julian day)	325	0.3115
Date of maximum (Julian day)	154	0.3531
Parameter Group #4		
Low pulse count (#)	5	1.35
Low pulse duration (days)	5	2
High pulse count (#)	3.5	0.7857
High pulse duration (days)	22.5	1.406
The low pulse threshold is (cfs)	21	
The high pulse threshold is (cfs)	85	
Parameter Group #5		
Rise rate (cfs difference between consecutive days)	3	0.6667
Fall rate (cfs difference between consecutive days)	-3	-0.3333
Number of reversals	64	0.1445

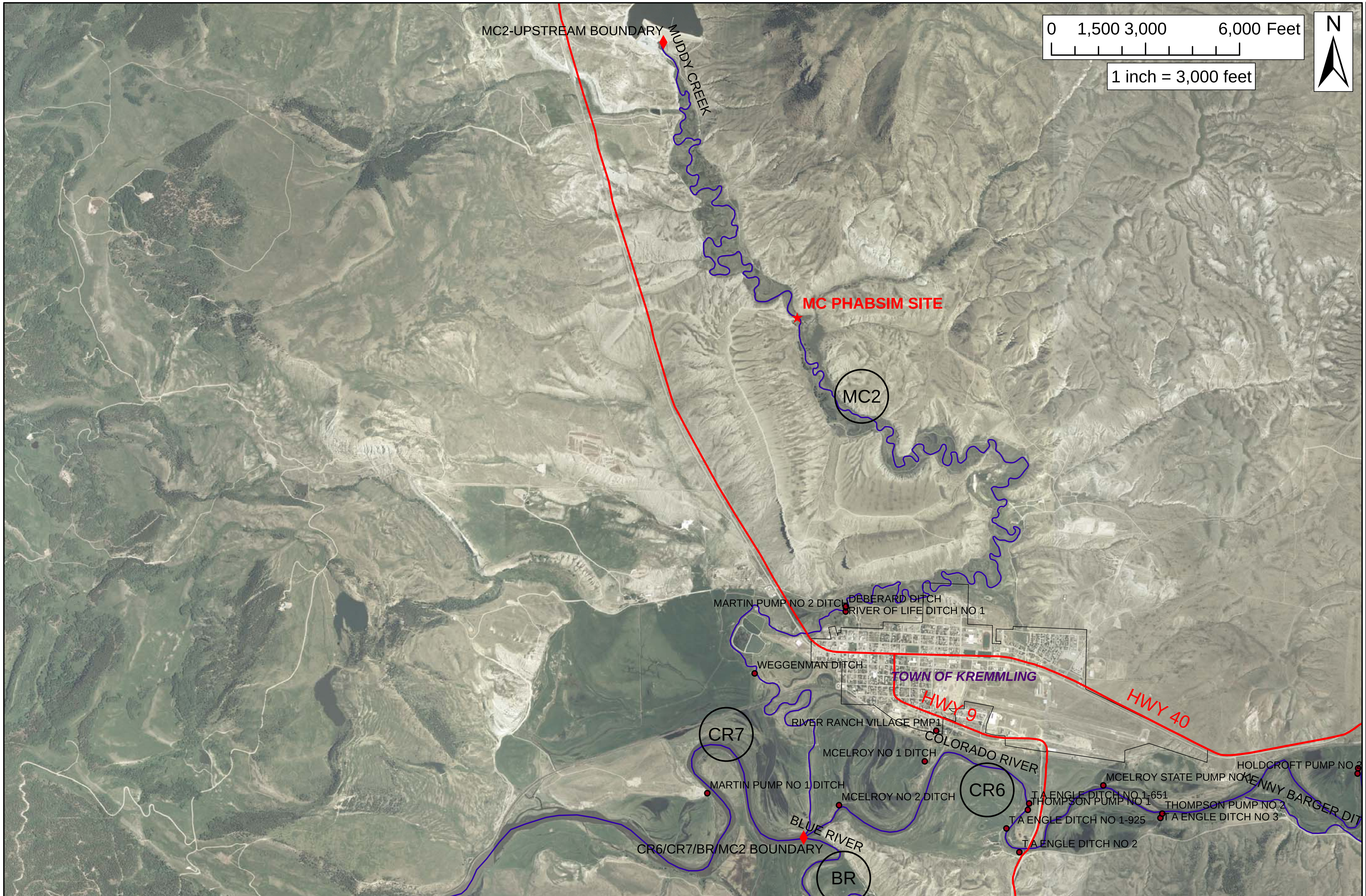
Reach MC2
IHA Percentile Data (non-parametric)
USGS gage 09041400, Muddy Creek below Wolford Mountain Reservoir near Kremmling, CO,

Period of Analysis: 1996-2007 (12 years)

	Period of Analysis					
	10%	**25%**	**50%**	**75%**	**90%**	**(75-25)/50**
Parameter Group #1						
October (cfs)	20	24	43.5	83.75	158.7	1.374
November (cfs)	16.5	20	23.5	29	31	0.383
December (cfs)	6.65	16.75	21.5	23	30.9	0.2907
January (cfs)	13.6	16.25	20.5	22	29.3	0.2805
February (cfs)	14.3	15.5	21	22.75	33.4	0.3452
March (cfs)	14.9	20	22	29.5	67.3	0.4318
April (cfs)	19.6	22.13	42	67.88	219.3	1.089
May (cfs)	23.1	47.25	132.5	397.3	524.2	2.642
June (cfs)	30.15	40.38	116.3	167.4	343.4	1.092
July (cfs)	21.6	33.25	59.5	76.5	88.6	0.7269
August (cfs)	24.3	54.25	113.5	150	167.5	0.8436
September (cfs)	20	83.75	108.3	127.8	181.4	0.4065
Parameter Group #2						
1-day minimum (cfs)	4.09	10.25	15	17.75	24.6	0.5
3-day minimum (cfs)	5.267	12.42	15	19.67	25.43	0.4833
7-day minimum (cfs)	5.543	13.25	15	20.75	25.79	0.5
30-day minimum (cfs)	7.759	14.08	19.75	21.75	28.69	0.3886
90-day minimum (cfs)	13.66	15.92	20.43	22.57	29.49	0.3258
1-day maximum (cfs)	180.7	222.3	382.5	775.5	940.1	1.446
3-day maximum (cfs)	170.2	215.3	371.2	713.3	931.9	1.342
7-day maximum (cfs)	150.2	211.8	356.4	649.9	856.4	1.229
30-day maximum (cfs)	97.61	165.2	239.1	483.3	587.1	1.331
90-day maximum (cfs)	46.23	86.88	141.4	254.6	320.7	1.186
Number of zero days (count)	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.06836	0.1765	0.2826	0.3089	0.4272	0.4686
Parameter Group #3						
Date of minimum (Julian day)	131.1	271.5	325	19.5	73.3	0.3115
Date of maximum (Julian day)	133.3	140	154	269.3	289.7	0.3531
Parameter Group #4						
Low pulse count (#)	0.3	2	5	8.75	10.7	1.35
Low pulse duration (days)	1.1	1.5	5	11.5	26.8	2
High pulse count (#)	2	2.25	3.5	5	6	0.7857
High pulse duration (days)	2.6	6.125	22.5	37.75	90.45	1.406
Parameter Group #5						
Rise rate (cfs difference between consecutive days)	1.3	2	3	4	7.1	0.6667
Fall rate (cfs difference between consecutive days)	-6	-4	-3	-3	-1.3	-0.3333
Number of reversals	50	59	64	68.25	73.4	0.1445
EFC Monthly Low Flows						
October Low Flow (cfs)	20.1	22	30	46	69.9	0.8
November Low Flow (cfs)	20	20	24	29	31	0.375
December Low Flow (cfs)	17.2	19.75	22	23.75	32.3	0.1818
January Low Flow (cfs)	17.2	18	21	22	30.2	0.1905
February Low Flow (cfs)	16.2	20	21	23	33.6	0.1429
March Low Flow (cfs)	17.9	20.25	21.5	29.5	36.6	0.4302
April Low Flow (cfs)	20	20	24.5	29	62.6	0.3673
May Low Flow (cfs)	18	20	22	33.5	35	0.6136
June Low Flow (cfs)	22	22.75	30.25	58	76	1.165
July Low Flow (cfs)	20.6	23	38	63	79.4	1.053
August Low Flow (cfs)	18.1	20.5	31	62.5	84.1	1.355
September Low Flow (cfs)	20	21	26.75	44.13	69.5	0.8645
EFC Parameters						
Extreme low peak (cfs)	2.8	10	13	15	15	0.3846
Extreme low duration (days)	3	5	17	25	53	1.176
Extreme low timing (Julian date)	338	358	36.5	202	265	0.4262
Extreme low freq. (#/year)	0	0	1	2	3.7	2
High flow peak (cfs)	65.5	74	108	128.5	190.8	0.5046
High flow duration (days)	5	6	8	11	36.7	0.625
High flow timing (Julian date)	101.4	167	191.5	237	264.8	0.1913
High flow frequency (#/year)	0.9	3	5.5	8.5	10	1
High flow rise rate (cfs differnenc between consecutive days)	6.017	9.28	13.33	16	21.47	0.504
High flow fall rate (cfs difference between consecutive days)	-14.16	-12.83	-10.15	-7.333	-3.96	-0.542
Small Flood peak (cfs)	496	561.5	756	800.5	819	0.3161
Small Flood duration (days)	62	63.5	66	92	97	0.4318
Small Flood timing (Julian date)	133	133.5	140	148	153	0.03962
Small Flood freq. (#/year)	0	0	0	1	1	0
Small Flood riserate (cfs difference between consecutive days)	9.508	11.88	17	54.21	62.92	2.49
Small Flood fallrate (cfs difference between consecutive days)	-18.46	-17.09	-13.8	-12.92	-12.45	-0.3018
Large flood peak (cfs)			992			
Large flood duration (days)			173			
Large flood timing (Julian date)			155			
Large flood freq. (#/year)	0	0	0	0	0.7	0
Large flood riserate (cfs difference between consecutive days)			10.34			
Large flood fallrate (cfs difference between consecutive days)			-11.2			

Surface Water Temperature Plots





GRAND COUNTY
STREAM MANAGEMENT PLAN
REACHES

Legend

- REACH BOUNDARY
- PHABSIM SITES
- DIVERSIONS

REACH: MC2

SHEET # :
1 OF 1

TETRA TECH