CR 1 Stream Reach Summary

Study Reach: CR1, North Fork Colorado River – From Red Top diversion downstream to Shadow Mountain Reservoir.

Reach Description: Approximate channel length: 3 miles, approximate channel slope 1.7%.

The North Fork of the Colorado River originates in Rocky Mountain National Park along the Continental divide, flowing southerly to its confluence with Shadow Mountain Lake. Over 90% of the basin is on federally owned lands, including Arapahoe National Forest and Rocky Mountain National Park. Shadow Mountain Reservoir is one of three significant water bodies in the east central portion of Grand County; the other two being Grand Lake and Granby Reservoir. Shadow Mountain Reservoir and Granby Reservoir were constructed as part of the Colorado-Big Thompson (C-BT) Project during the 1940's. Today the lake and two reservoirs are operated in an integrated manner as part of the C-BT project (HRC 2003).

Approximately three miles upstream of Shadow Mountain Lake is the Redtop Valley Ditch, supplying irrigation water to four ranches located west of Granby Reservoir. The cessation of irrigation on two of these ranches is proposed in the 10825 Water Supply Study for support of the Upper Colorado River Endangered Fish (Grand River). Under current conditions, the existing Redtop Valley Ditch is decreed over 160 cubic feet per second (cfs) of water, which reportedly dries up the three mile reach between the headgate and Shadow Mountain Lake during irrigation season. Implementation of the preferred alternative would reduce the diversions to approximately half by volume, thereby increasing flows down the Colorado mainstem.

Colorado River North Fork upstream of Shadow MountainReservior

Flow Recommendations:

Environmental Flow Methodology: A study site has not yet been established within this reach

Water Users:

- Irrigators, municipalities and industry flow-related issues: The Grand Ditch and Redtop Valley Ditch are the major diversion in this reach. Under current conditions, the existing Redtop Valley Ditch is decreed over 160 cubic feet per second (cfs) of water, which reportedly dries up the three mile reach between the headgate and Shadow Mountain Lake during irrigation season. Implementation of the preferred alternative would reduce the diversions to approximately half by volume. There are no reported problems diverting flows, however, local residents report that the downstream 3 miles of the North Fork is often dewatered during irrigation season.

- The Grand Ditch, which diverts flows high in the watershed, within the Park boundaries, had a bank failure several years ago reportedly resulting in large volumes of sediment deposition in and near the mouth of the North Fork at its confluence with Shadow Mountain Lake.

- Recreational flows: Angling is popular in this reach.

Summary of Flows:

Environmental, recommended flow ranges

- Environmental flow recommendations have not yet been made for this reach, however, given the potential for diversion alterations at the Redtop Valley Ditch, this reach is recommended for further study.
- The proposed Redtop Valley Ditch modifications for the 10825 water will increase flows in portions of the river that, under current conditions, are often dewatered. Thus, conditions for fisheries will likely improve.

CWCB flows

- No ISF are available for this reach.

Water Users

Irrigators, municipalities and industry: Between the Redtop Valley Ditch and Shadow Mountain Reservoir there are no local diversions.

Stream Assessments: No stream assessments were conducted in CR1.

Spawning Observations: No spawning observations have yet been made in CR1.

Hydrologic Records: USGS Gage Station 09011000 located immediately upstream of the high water line for Shadow Mountain Reservoir was operated from 1904 - 1918 and 1936 - 1986. Daily streamflow exceedence plots and IHA analysis compare the early period with the post-transbasin construction period (1957 - 1986). Median monthly flows for the early period ranged from 20 cfs in January up to 834 cfs in June, while for the more recent period, the January median declined to 15 cfs and the June median declined to 403 cfs. Since 1990, seasonal records have been collected by the Northern Colorado Water Conservancy District.

USGS Gage 9010500 is located approximately 8 miles upstream of Shadow Mountain Lake and has been in operation since 1953. Daily streamflow exceedence plots compared with the flow records below the Redtop Valley diversion indicate diversions occur typically from early June through early August. Diversion records reviewed from 1975 to 2008 for the Red Top Valley Ditch indicate typical diversions of 86 to 186 cfs during the months of May, June, July and August.

Water Temperature: CR1 is a Tier I stream reach as designated by CDPHE with a chronic temperature standard of 17°C MWAT and an acute temperature standard of 21.2°C DM. Temperature data reviewed in reach CR1 indicate stream temperatures for the Colorado River in this area are generally below the MWAT and DM standards except when diversions are in-place and CR1 becomes highly dewatered.

Water Quality: The Three Lakes Watershed Assessment (HRC 2003) indicates that all the lakes are in a mesotrophic or moderately nourished tropic state and that the water quality of each of the Three Lakes is very similar due to the manner in which the CB-T system operates. The study also indicates that the more developed sub-watersheds contribute a disproportionate amount of nutrients to the system. These more developed watersheds include Stillwater, Windy Gap and Willow Creek. However, the Three Lakes Clean Lakes Watershed Assessment report recommends that the North Fork of the Colorado River be considered for pollutant reduction. No detailed recommendations are included as to sources or pollutants. A comprehensive study of the Three Lakes area is being under taken as part of the Windy Gap EIS (HRC 2003b) which, when available, may provide better insights as to the possible pollutants within this largely undeveloped watershed.

Water Supply Issues: No reported water supply issues.

Summary of Results and Additional Remarks:

1. Under current conditions the diversion into Redtop Valley Ditch significantly reduces flows into CR1. Local residents report that downstream of the diversion (essentially CR1) is often dewatered during irrigation season.
2. Implementation of the preferred alternative for 10825water would reduce the existing diversions by approximately half, thereby increasing flows into the Colorado River. This provides an opportunity to re-establish flows during the critical months of July, August and September for the support of fisheries and associated habitat in CR1. Thus, further studies are recommended for the development of environmental flows.

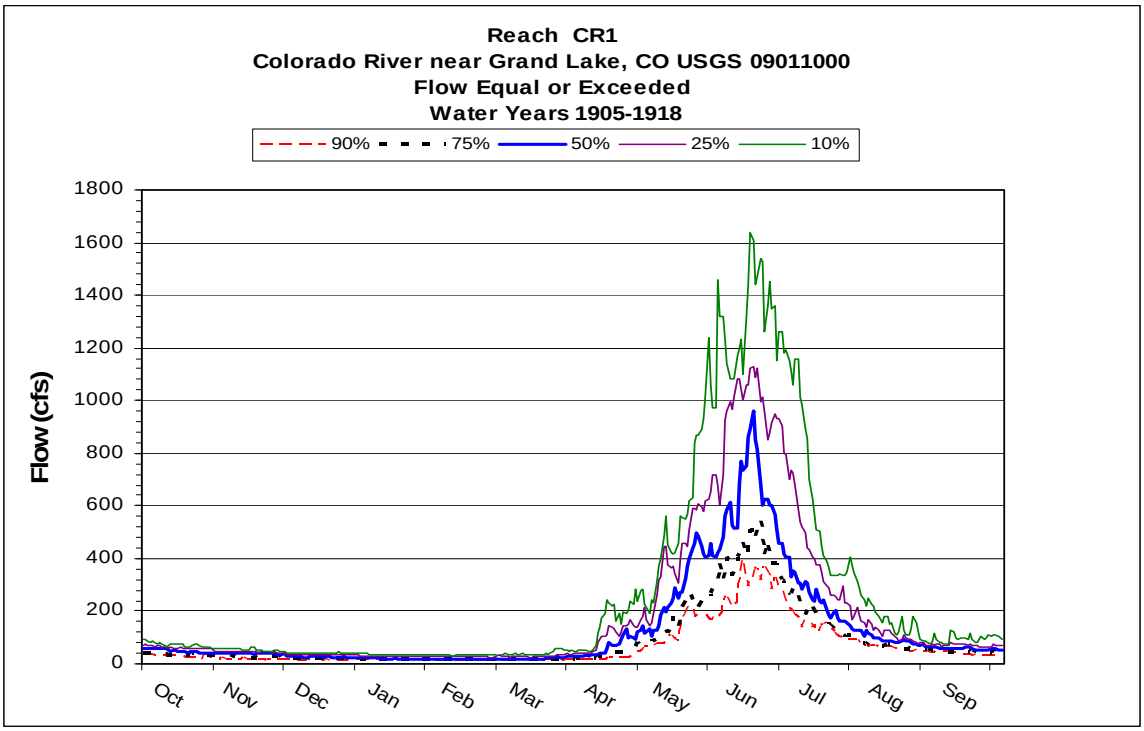
Restoration Opportunities:

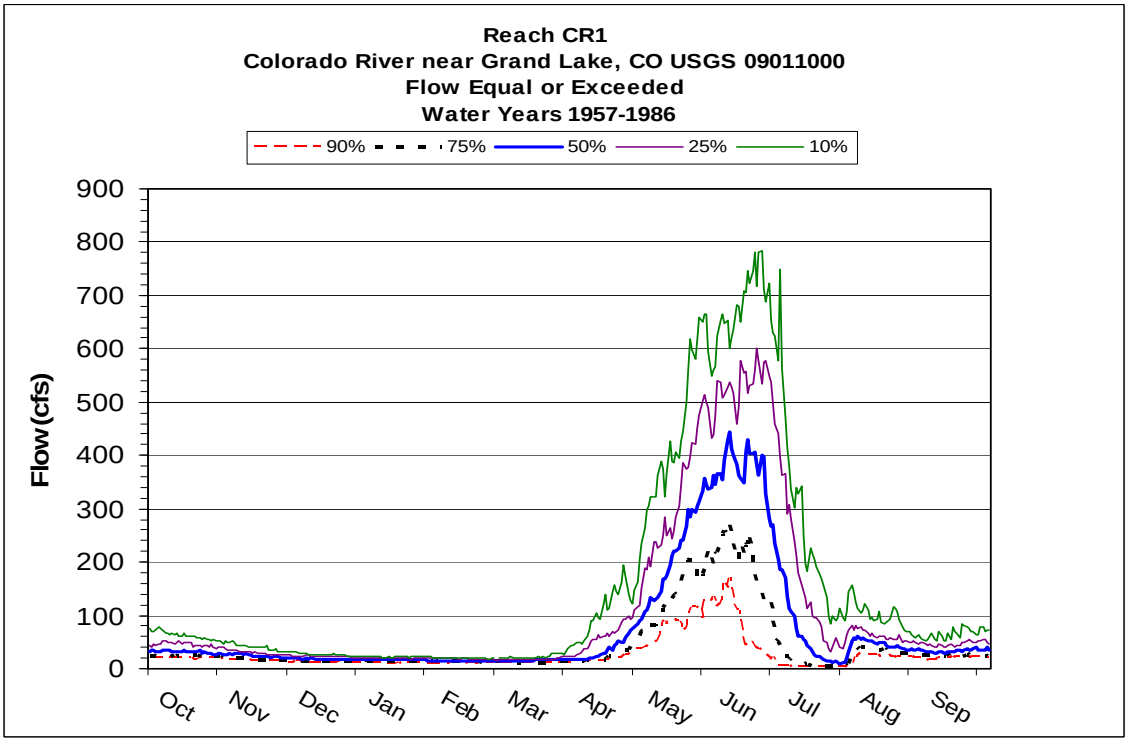
- ✓ To facilitate the implementation of the 10825 Water Supply preferred alternative it is recommended that a study site be established and evaluated for developing environmental flow recommendations.

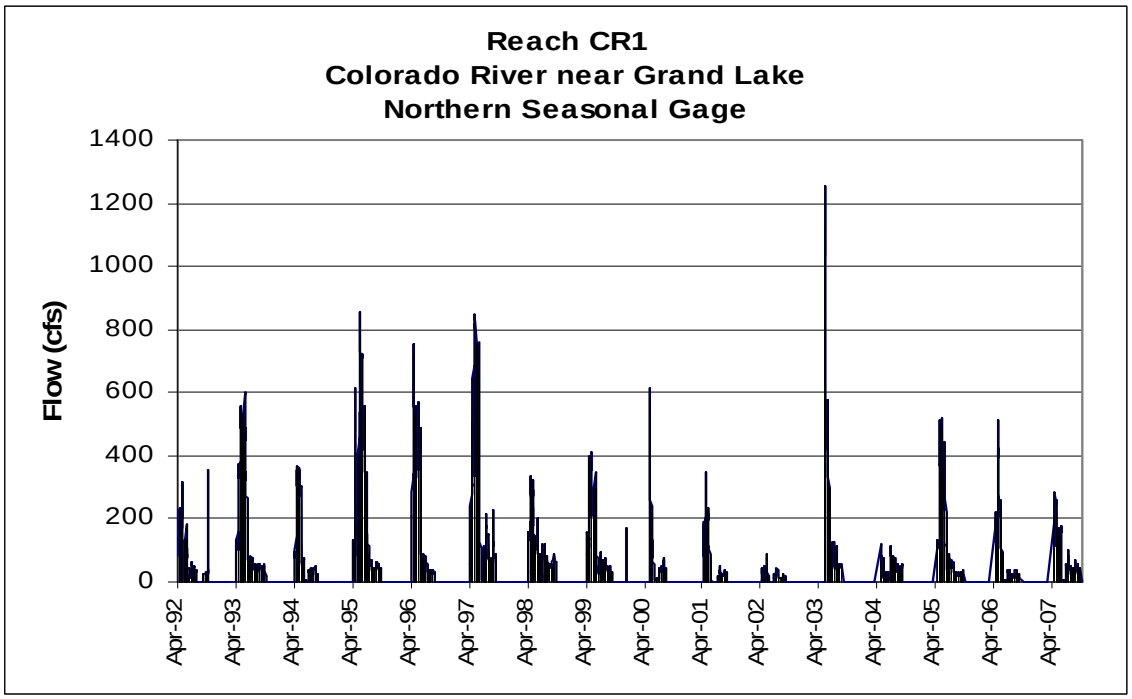
Monitoring: Monitor streamflows and surface water temperature until additional studies and assessments are complete. Following assessments and evaluation, additional monitoring may be recommended.

Support Data

Hydrographs and Exceedence Plots and Tables







Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft^3/sec)
1.05	95.2	273
1.11	90.1	341
1.25	80	437
2	50	665
5	20	942
10	10	1102
25	4	1277

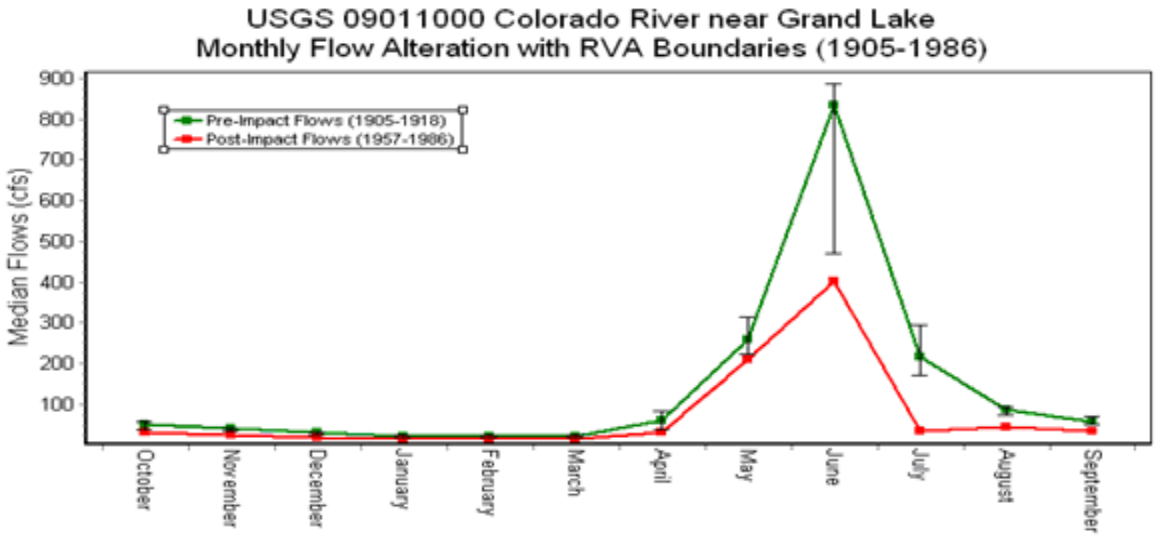
Flood frequency analysis for USGS 09011000 Colorado River near Grand Lake, CO, for 30 years of record (Water years 1957-1986)

IHA Results

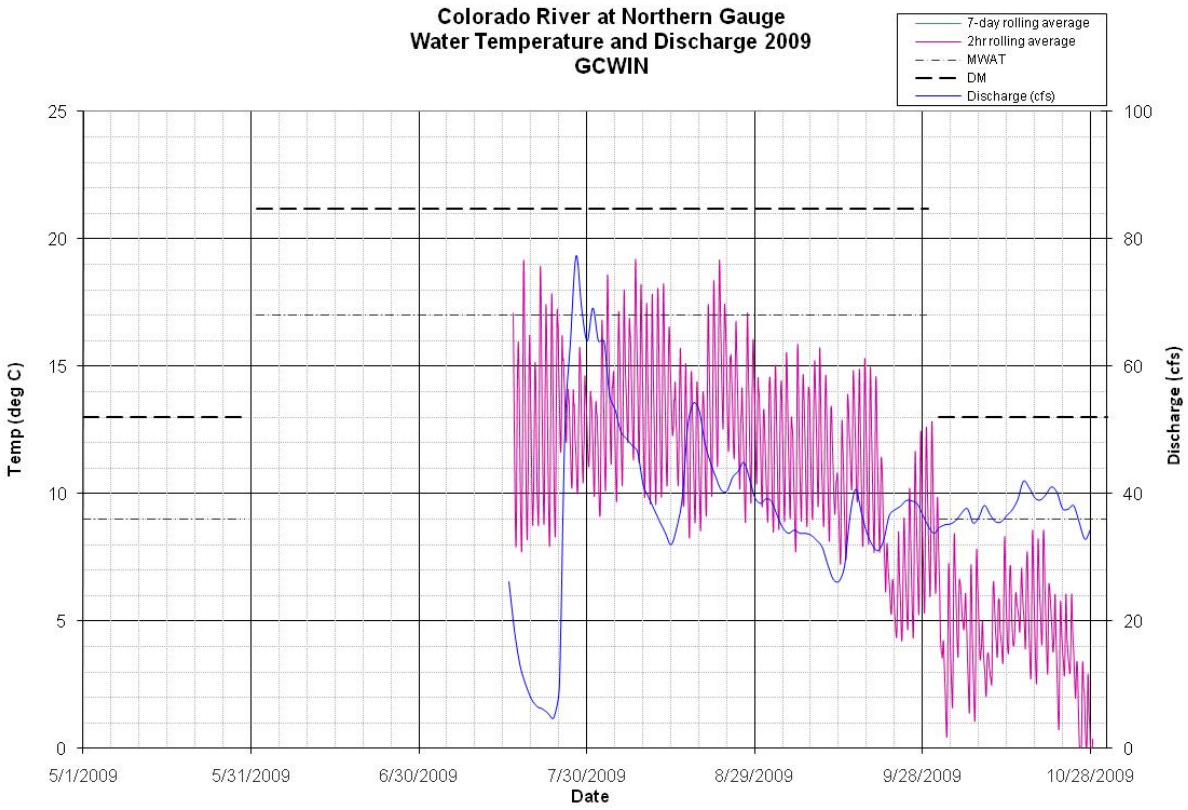
Reach CR1								
Non-Parametric IHA Scorecard								
USGS 09011000 Colorado River near Grand Lake								
Pre-impact period: 1905-1918 (13 years)			**Post-impact period: 1957-1986 (30 years)**					
Mean annual flow	143.1			81.91				
Mean flow/area	143.1			81.91				
Annual C. V.	1.65			1.74				
Flow predictability	0.66			0.55				
Constancy/predictability	0.43			0.48				
% of floods in 60d period	0.64			0.69				
Flood-free season	215			168				
	MEDIANS		**COEFF. of DISP.**		**DEVIATION FACTOR**		**SIGNIFICANCE COUNT**	
	Pre	**Post**	**Pre**	**Post**	**Medians**	**C.D.**	**Medians**	**C.D.**
Parameter Group #1								
October (cfs)	50	31	0.49	0.6129	0.38	0.2508	0.01802	0.4885
November (cfs)	40	24.25	0.4375	0.4691	0.3938	0.07216	0.002002	0.8438
December (cfs)	30	18	0.3333	0.5139	0.4	0.5417	0.01702	0.1221
January (cfs)	20	16	0.525	0.3438	0.2	0.3452	0.01502	0.3153
February (cfs)	20	15	0.475	0.325	0.25	0.3158	0.005005	0.2513
March (cfs)	20	15	0.425	0.2167	0.25	0.4902	0.002002	0.1381
April (cfs)	61	29.75	0.9385	1.298	0.5123	0.3834	0.2112	0.3083
May (cfs)	260	211	0.7038	0.6197	0.1885	0.1196	0.1502	0.7628
June (cfs)	834.5	403.3	0.6411	0.677	0.5168	0.05599	0.03203	0.8859
July (cfs)	218	35	0.6399	2.844	0.8394	3.444	0.2382	0.002002
August (cfs)	85	44	0.3471	0.4659	0.4824	0.3424	0.009009	0.3764
September (cfs)	58	35	0.3707	0.5107	0.3966	0.3777	0.04905	0.2492
Parameter Group #2								
1-day minimum (cfs)	20	8.1	0.55	1	0.595	0.8182	0.04404	0.04905
3-day minimum (cfs)	20	8.683	0.55	0.9463	0.5658	0.7205	0.03504	0.07207
7-day minimum (cfs)	20	9.607	0.5357	0.9439	0.5196	0.7619	0.04204	0.06006
30-day minimum (cfs)	20	13.83	0.4583	0.382	0.3083	0.1664	0.003003	0.7107
90-day minimum (cfs)	20	15.19	0.4083	0.2699	0.2408	0.339	0.00	0.3654
1-day maximum (cfs)	1110	623.5	0.8324	0.4707	0.4383	0.4345	0.001001	0.2092
3-day maximum (cfs)	1110	592	0.7565	0.4658	0.4667	0.3842	0.002002	0.2322
7-day maximum (cfs)	1051	547.6	0.6912	0.5083	0.4788	0.2647	0.002002	0.4785
30-day maximum (cfs)	816.2	425.2	0.7092	0.5681	0.4791	0.199	0.002002	0.7157
90-day maximum (cfs)	498.5	244.3	0.5006	0.6237	0.51	0.2457	0.003003	0.5315
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimun in cfs/median in cfs)	0.1371	0.1174	0.4515	0.6206	0.1434	0.3745	0.2723	0.2753
Parameter Group #3								
Date of minimum (Julian day)	1	202	0.2664	0.3477	0.9016	0.3051	0.00	0.1291
Date of maximum (Julian day)	167	161	0.03279	0.06079	0.03279	0.8542	0.1932	0.04004
Parameter Group #4								
Low pulse count (#)	1	4.5	2	0.8889	3.5	0.5556	0.001001	0.1602
Low pulse duration (days)	74	6.5	1.223	1.673	0.9122	0.368	0.02402	0.5746
High pulse count (#)	3	3	0.6667	0.3333	0	0.5	0.3684	0.2192
High pulse duration (days)	5	9.5	5.05	3.329	0.9	0.3408	0.0961	0.5986
The low pulse threshold is (cfs)	25							
The high pulse threshold is (cfs	130							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	14	5	0.6786	0.6	0.6429	0.1158	0.001001	0.9039
Fall rate (cfs difference between consecutive days)	-9	-3	-0.5	-0.6667	0.6667	0.3333	0.002002	0.6136
Number of reversals	70	91.5	0.4286	0.2322	0.3071	0.4581	0.00	0.1512

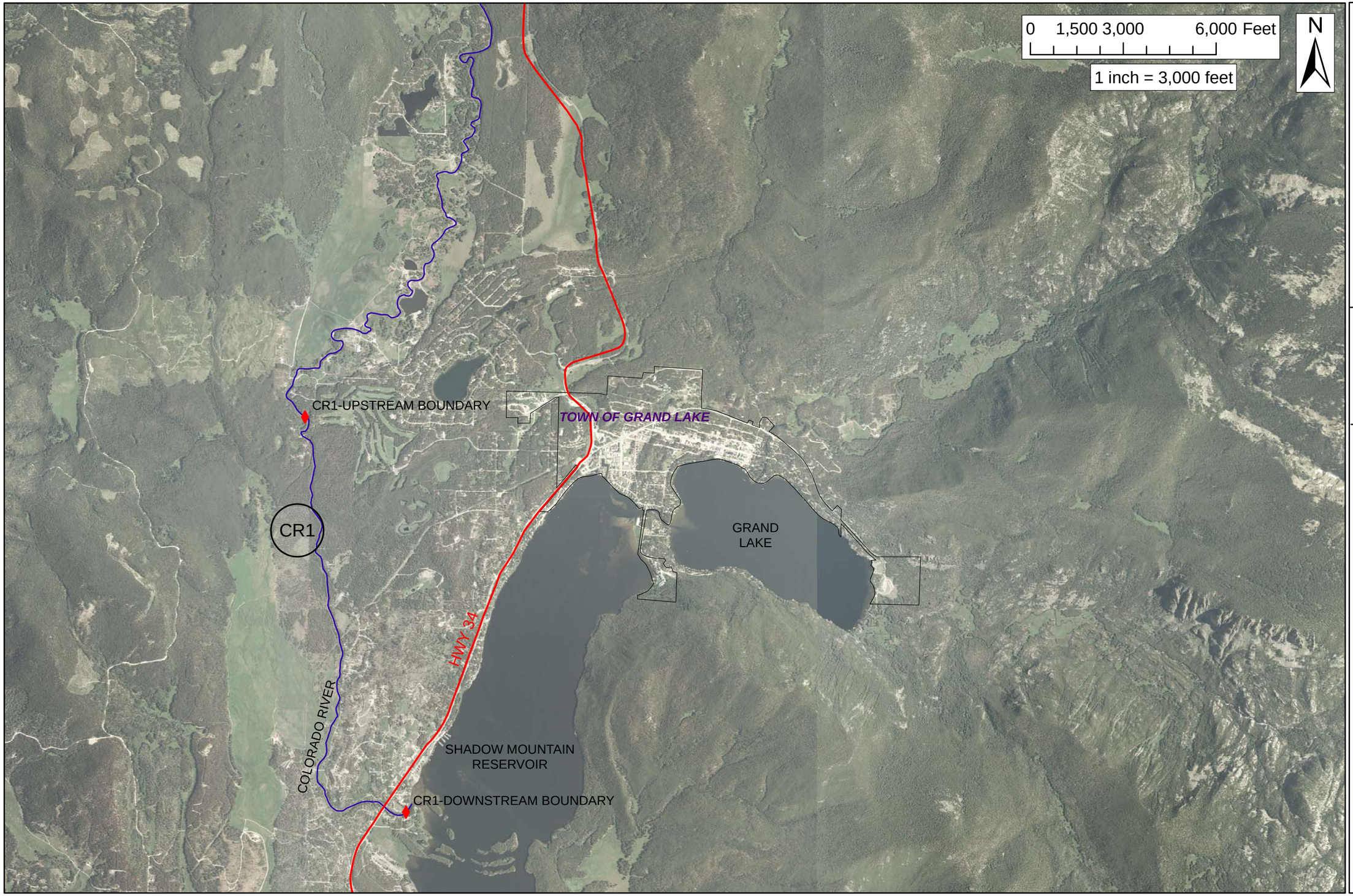
CR1
IHA Percentile Data
USGS 09011000 Colorado River near Grand Lake

	Pre-impact period: 1905-1918 (13 years)						Post-impact period: 1957-1986 (30 years)					
	Pre-Impact						Post-Impact					
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #1												
October (cfs)	28.8	37	50	61.5	66.8	0.49	20.1	25	31	44	58.9	0.6129
November (cfs)	18	28	40	45.5	52.6	0.4375	16	17.88	24.25	29.25	41.05	0.4691
December (cfs)	13.8	23.5	30	33.5	39.4	0.3333	12.2	14	18	23.25	26	0.5139
January (cfs)	15.4	17	20	27.5	34	0.525	11	13.75	16	19.25	21.9	0.3438
February (cfs)	14	17	20	26.5	31.8	0.475	11	13.75	15	18.63	19.9	0.325
March (cfs)	14.4	19	20	27.5	32.4	0.425	13	13.75	15	17	21	0.2167
April (cfs)	18.6	30.5	61	87.75	110	0.9385	16	17.88	29.75	56.5	80.25	1.298
May (cfs)	147.2	205	260	388	524	0.7038	95.1	147.3	211	278	356.3	0.6197
June (cfs)	324.4	395	834.5	930	1086	0.6411	55.75	232.9	403.3	505.9	593.6	0.677
July (cfs)	148.4	162.5	218	302	410.8	0.6399	4.02	5.475	35	105	141.4	2.844
August (cfs)	60	65.5	85	95	111.6	0.3471	25	35.5	44	56	87.9	0.4659
September (cfs)	35	49	58	70.5	76.1	0.3707	23.5	25.38	35	43.25	51.7	0.5107
Parameter Group #2												
1-day minimum (cfs)	10.4	14	20	25	30.6	0.55	3.02	3.9	8.1	12	14.9	1
3-day minimum (cfs)	10.67	14	20	25	30.8	0.55	3.203	4.033	8.683	12.25	14.93	0.9463
7-day minimum (cfs)	11.29	14.29	20	25	31.11	0.5357	3.48	4.611	9.607	13.68	15	0.9439
30-day minimum (cfs)	13.3	15.83	20	25	31.4	0.4583	5.947	10.24	13.83	15.53	18.43	0.382
90-day minimum (cfs)	15.16	17.96	20	26.13	32.36	0.4083	10.97	13.62	15.19	17.72	19.33	0.2699
1-day maximum (cfs)	481	696	1110	1620	1784	0.8324	267.7	475.3	623.5	768.8	1181	0.4707
3-day maximum (cfs)	455.7	645.3	1110	1485	1679	0.7565	250.4	456	592	731.8	999.1	0.4658
7-day maximum (cfs)	415.1	600.9	1051	1327	1506	0.6912	216.3	422.3	547.6	700.7	886	0.5083
30-day maximum (cfs)	335.9	454	816.2	1033	1072	0.7092	170	311.5	425.2	553	681.7	0.5681
90-day maximum (cfs)	228.6	305.7	498.5	555.2	573	0.5006	98.71	181.2	244.3	333.5	420	0.6237
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.07664	0.1081	0.1371	0.17	0.2598	0.4515	0.06063	0.07453	0.1174	0.1474	0.1748	0.6206
Parameter Group #3												
Date of minimum (Julian day)	301.2	326	1	57.5	79.6	0.2664	52.2	84	202	211.3	215.9	0.3477
Date of maximum (Julian day)	153	159.5	167	171.5	179.2	0.03279	133.1	150	161	172.3	177.8	0.06079
Parameter Group #4												
Low pulse count (#)	0	0	1	2	7.2	2	1	3	4.5	7	10.9	0.8889
Low pulse duration (days)	2.5	4.5	74	95	106	1.223	2.1	4.875	6.5	15.75	159.1	1.673
High pulse count (#)	1.4	2.5	3	4.5	6.6	0.6667	1	2	3	3	4	0.3333
High pulse duration (days)	1.4	3.25	5	28.5	67.6	5.05	2.05	4	9.5	35.63	50	3.329
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	4	6	14	15.5	18.8	0.6786	2.775	3	5	6	7.45	0.6
Fall rate (cfs difference between consecutive days)	-16.8	-11	-9	-6.5	-3	-0.5	-5	-4	-3	-2	-2	-0.6667
Number of reversals	24	50	70	80	100.6	0.4286	74	81	91.5	102.3	106.8	0.2322
EFC Monthly Low Flows												
October Low Flow (cfs)	28.8	37	50	61.5	66.8	0.49	21.1	25	31	42.25	58.55	0.5565
November Low Flow (cfs)	22	33	40	45.5	51.4	0.3125	20	21.5	24.5	30	41.5	0.3469
December Low Flow (cfs)	21.3	25	30	34.25	39.8	0.3083	19	19.75	21.5	25.25	28.5	0.2558
January Low Flow (cfs)	19.3	20	24.5	29.25	34.5	0.3776	19	19	20	21.25	22	0.1125
February Low Flow (cfs)	19.1	20	22.5	28.13	33.45	0.3611	19	19	19.5	20.25	21.9	0.0641
March Low Flow (cfs)	20	20	26	30.38	35.4	0.399	19	19	21	23.5	29	0.2143
April Low Flow (cfs)	21	28.5	37	49	81.2	0.5541	22	27.38	35.5	45.75	60.6	0.5176
May Low Flow (cfs)	71	73	94	110	130	0.3936	37.4	71	89	105	125.8	0.382
June Low Flow (cfs)							35.3	42.5	70.75	108.8	119.1	0.9364
July Low Flow (cfs)	90	99.25	103	118	124	0.182	24.75	29	38.25	51	65.05	0.5752
August Low Flow (cfs)	57	62.5	77	85	91.4	0.2922	25.55	32.63	41.75	51.25	68.6	0.4461
September Low Flow (cfs)	34.4	48	56	70	71.6	0.3929	23.55	26.5	33.25	40	45.95	0.406
EFC Parameters												
Extreme low peak (cfs)	11	11.75	16	17.25	18	0.3438	6.705	12.63	15	17.13	18	0.3
Extreme low duration (days)	2	2.75	10	61.5	69	5.875	2.1	4.375	12	21.38	75.15	1.417
Extreme low timing (Julian date)	1	25.75	38.75	68.75	98	0.1175	296.4	324.6	77.5	148.9	212.7	0.4802
Extreme low freq. (#/year)	0	0	0	2	14.4	0	2	2	3.5	6	8.8	1.143
High flow peak (cfs)	82.8	98	165	202.5	730	0.6333	64.7	81.38	93.5	120.8	151.2	0.4211
High flow duration (days)	3	3.5	5	6	64.6	0.5	3	3	4	5	9.6	0.5
High flow timing (Julian date)	122.2	146	217	236	281.4	0.2459	124.9	159	207.3	220.3	226	0.1673
High flow frequency (#/year)	1	1.5	5	6.5	8.6	1	3.1	5	6	8.25	10	0.5417
High flow rise rate (cfs differnenc between consecutive days)	14.2	17.99	26	31.11	92.1	0.5046	13.03	15	18.75	21.95	29.71	0.3707
High flow fall rate (cfs difference between consecutive days)	-33.2	-18	-12.98	-10.67	-6.6	-0.5652	-15.39	-13.04	-10.83	-8.875	-7.738	-0.3842
Small Flood peak (cfs)	1110	1193	1480	1640	1700	0.3024	1200	1200	1220	1220	1220	0.01639
Small Flood duration (days)	75	82.5	92.5	98.5	103	0.173	64	64	70	82	82	0.2571
Small Flood timing (Julian date)	153	159	169.5	176.8	182	0.0485	146	146	173	182	182	0.09836
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	0	0.9	0
Small Flood riserate (cfs difference between consecutive days)	21.78	22.19	32.95	40.43	43.6	0.5535	28.71	28.71	36.97	72.5	72.5	1.185
Small Flood fallrate (cfs difference between consecutive days)	-35.12	-33.81	-27.21	-21.76	-21.37	-0.443	-40.52	-40.52	-21.12	-21.04	-21.04	-0.9227
Large flood peak (cfs)			1840									
Large flood duration (days)			83									
Large flood timing (Julian date)			167									
Large flood freq. (#/year)	0	0	0	0	0.6	0	0	0	0	0	0	0
Large flood riserate (cfs difference between consecutive days)			39.09									
Large flood fallrate (cfs difference between consecutive days)			-43.2									


USGS 09011000 Colorado River near Grand Lake
Monthly Flow Alteration with RVA Boundaries (1905-1986)
Pre-Impact Flows (1905-1918)
Post-Impact Flows (1957-1986)
Median Flows (cfs)
900
800
700
600
500
400
300
200
100
October
November
December
January
February
March
April
May
June
July
August
September

Surface Water Temperature Plots





GRAND COUNTY
STREAM MANAGEMENT PLAN
REACHES

Legend

- REACH BOUNDARY
- PHABSIM SITES
- DIVERSIONS

REACH: CR1

SHEET # :
1 OF 1

TETRA TECH