

F-RC1 Stream Reach Summary

Study Reach: F-RC1, Ranch Creek - A tributary to the Fraser River, from Denver Water diversion downstream to F-RC2.

Reach Description: Approximate channel length: 3.25 mile, approximate channel slope 5.8%. subdivided as follows:

- Denver Water diversion to County Road 8: Approximately channel length 1.75 miles, approximate channel slope 5.8%.
- County Road 8 to Devils Thumb: Approximate channel length: 1.5 miles, approximate channel slope 0.6%.

Upstream of County Road 8 this reach of Ranch Creek is a confined, steep and mountainous reach dominated by cobbles and boulders. Vegetation, consisting of pine forest, is relatively thick along the channel overbanks. Within this short reach the North, South and Middle Forks all confluence with the mainstem. Downstream of County Road 8 the channel begins to flatten and sinuosity increases. The creek floodplain widens and the overbanks are primarily open meadows dominated by willows and shrubs. This creek is valued for fisheries and aesthetics, but heavily impacted by flow alteration from upstream diversions.



Ranch Creek at County Road 8



Ranch Creek upstream of County Road 8

Flow Recommendations:

Environmental Flow Methodology: A study site was established within F-RC1 in 2008, located upstream of County Road 8. See Appendix A for methodology and Appendix E for PHABSIM survey information. CWCB instream flow recommendations are available for this reach.

Water Users:

- Irrigators, municipalities and industry flow-related issues: none reported
- Recreational flows: There are concerns about degraded conditions for angling due to low flows, especially over the past several years due (Pers. Comm. C. Klancke 2008).

Summary of Flows:

Environmental, recommended target flow ranges

- 6 to 10 cfs, April through September
- 6 to 10 cfs, October through March
- Flushing flow, 40 cfs for a 3-day duration with a frequency of 1 in 2 years during the late May to late June period.

CWCB flows

- 4 cfs summer (05/15 – 09/15)
- 1.5 cfs for winter (09/16 – 05/14)

Forest Service By-pass Flows

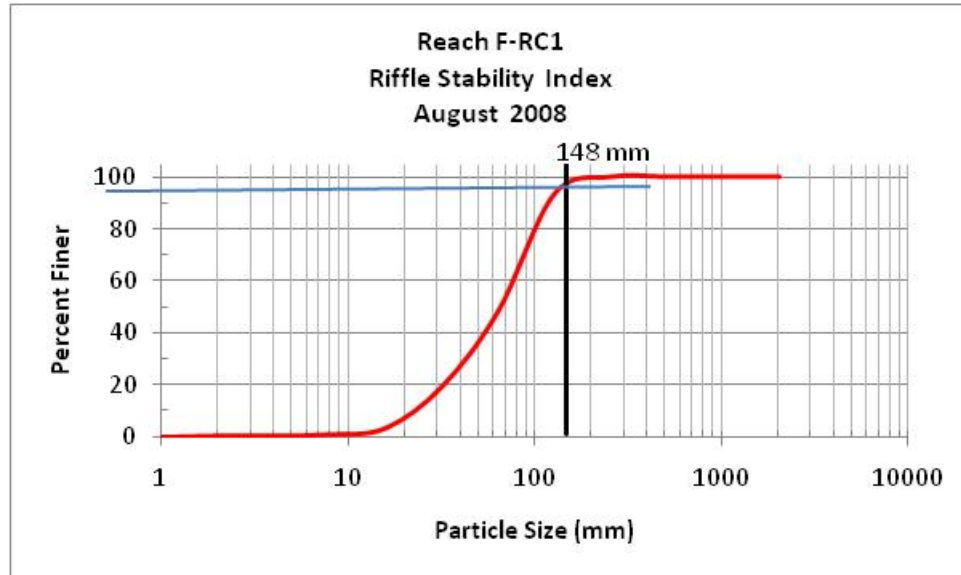
- 4 cfs summer
- 2 cfs winter

Water Users

- Irrigators, municipalities and industry: There are no local diversions in this reach.
- Recreation: none reported

Stream Assessments: In August 2008 Tetra Tech conducted three stream assessments in F-RC1. 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 'good' category and the EPA HQA evaluation rating was 'suboptimal'. The RSI was performed at a riffle approximately 1.5 miles downstream of County Road 8 just upstream of the Devil's Thumb Lodge due to the lack of a suitable point bar within the PHABSIM site. The score of 96 indicates the riffle substrate was highly unstable with up to 96% of the particles mobilized during recent high water events. Relevant issues revealed in the stream assessments included a general lack of diversity in the water velocity/depth regime due to low flow and excessive fine sediment deposition in areas of low to moderate water velocity particularly downstream of County Road 8. Results of the assessments are summarized in the following table and plot. Details and methodology are presented in Appendix A.

Reach F-RC1 Stream Assessments			
Stream Reach Inventory/Channel Stability Evaluation		EPA Habitat Quality Assessment	
Attribute		Attribute	Score
Upper Banks		Channel	
1	Landform Slope	2	
2	Mass wasting hazard	3	
3	Debris Jam Potential	5	
4	Vegetation Cover	4	
Upper Bank Score:		14	
Lower Banks		5	
5	Channel Capacity	2	
6	Bank Rock Content	2	
7	Flow obstructors & Deflectors	2	
8	Cutting	4	
9	Deposition	4	
Lower Bank Score:		14	
Channel Bottom		Bank Score	
10	Rock Angularity	2	
11	Brightness	2	
12	Consolidation/Particle Packing	4	
13	Bottom size distribution	4	
14	Bed Scour and Deposition	8	
15	Clinging Aquatic Veg	3	
Channel Bottom Score:		23	
Total Score:		51	
		Channel Score	
		18	
		8	Bank Stability
		9	Riparian Vegetation Cover and Disturbance
		10	Riparian Vegetation zone width
			Bank Score
			44
			Total Score
			129
		Notes	



Spawning Observations: A trout spawning survey was not conducted in this reach.

Hydrologic Records: USGS Gage Station 09032000 has been in operation on Ranch Creek near Fraser from 1934 until the present. The daily streamflow exceedence plots indicate the CWCB flows are commonly available during both the summer and winter periods. The median (50 percentile) daily peak flow occurs in early June and approaches 70 cfs.

Water Temperature: F-RC1 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 F-RC1 indicate stream temperatures for Ranch Creek in this area are generally well below the MWAT and DM standards although this reach has been identified by the State of Colorado for having temperature impairment as defined by the Clean Water Act, Section 303(d).

Water Quality: No water quality issues were noted from the available data.

Water Supply Issues (UPCO): Water supply issues in this reach were not presented in the UPCO report.

Results and Remarks:

1. CWCB flows are commonly available during both the summer and winter periods but recommended environmental flows are not.
2. The stream assessments indicate a general lack of habitat diversity due to low flow and a large amount of fine sediment accumulation in areas of lower water velocity.
3. Temperatures and water quality are likely adequate for support of a cold-water fishery above County Road 8.
4. Review of future flow conditions as depicted by Denver Water's PACSM model indicate that the late summer flows, flushing flows and winter base flows, without flow enhancements or restoration, will be typically lower than target ranges in this reach.

Restoration Opportunities: Restoration opportunities presented for F-RC1 are aimed at reducing the impacts from excessive sedimentation, high water temperatures and low flow conditions. Specific restoration opportunities include the following:

- ✓ Apply flow enhancements to supplement low flow conditions and/or generate flushing flows.
- ✓ Inventory downstream culverts, bridges and other stream crossings for capacity-related issues as they relate to flushing flow implementation.

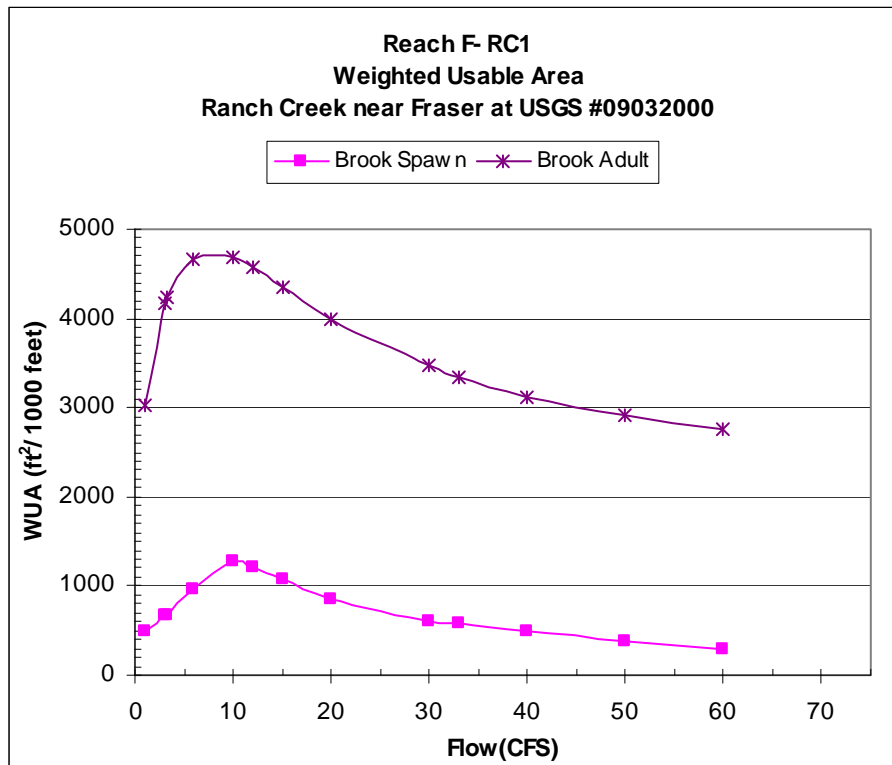
Monitoring: Establish and implement a monitoring program. Parameters should include surface water temperature and streamflow.

Support Data

Weighted Useable Area Plots and Tables:

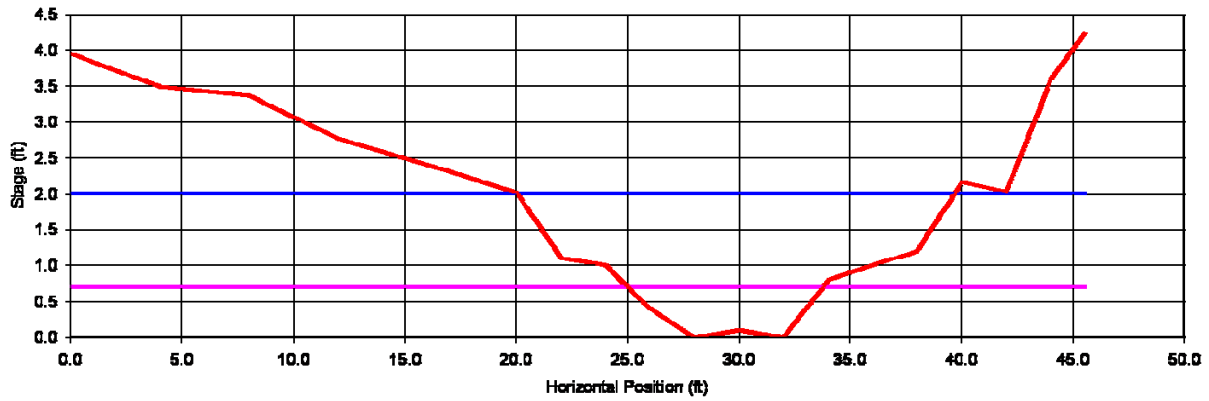
Habitat-flow relations for the target species and life stages for Reach RC1, Tetra Tech site, 2008.

Reach F-RC1			
Flow	Total Area	Brook Spawn	Brook Adult
(cfs)	(ft ²)	Weighted Usable Area (ft ² /1000 ft stream length)	
1.0	11102.7	483.1	3021.4
3.0	13897.7	667.1	4179.5
3.2	14080.9	672.5	4246.8
6.0	15960.9	966.4	4669.8
10.0	18427.2	1289.1	4682.3
12.0	19009.2	1201.8	4563.3
15.0	19501.3	1072.3	4338.6
20.0	20046.8	860.7	3998.4
30.0	20774.1	613.4	3471.8
33.0	20958.8	579.5	3347.1
40.0	21350.4	486.2	3126.0
50.0	22061.9	372.8	2913.8
60.0	22603.1	286.0	2768.6



Transect and Bedload Threshold Plots and Tables:

Reach F-RC1, TR6

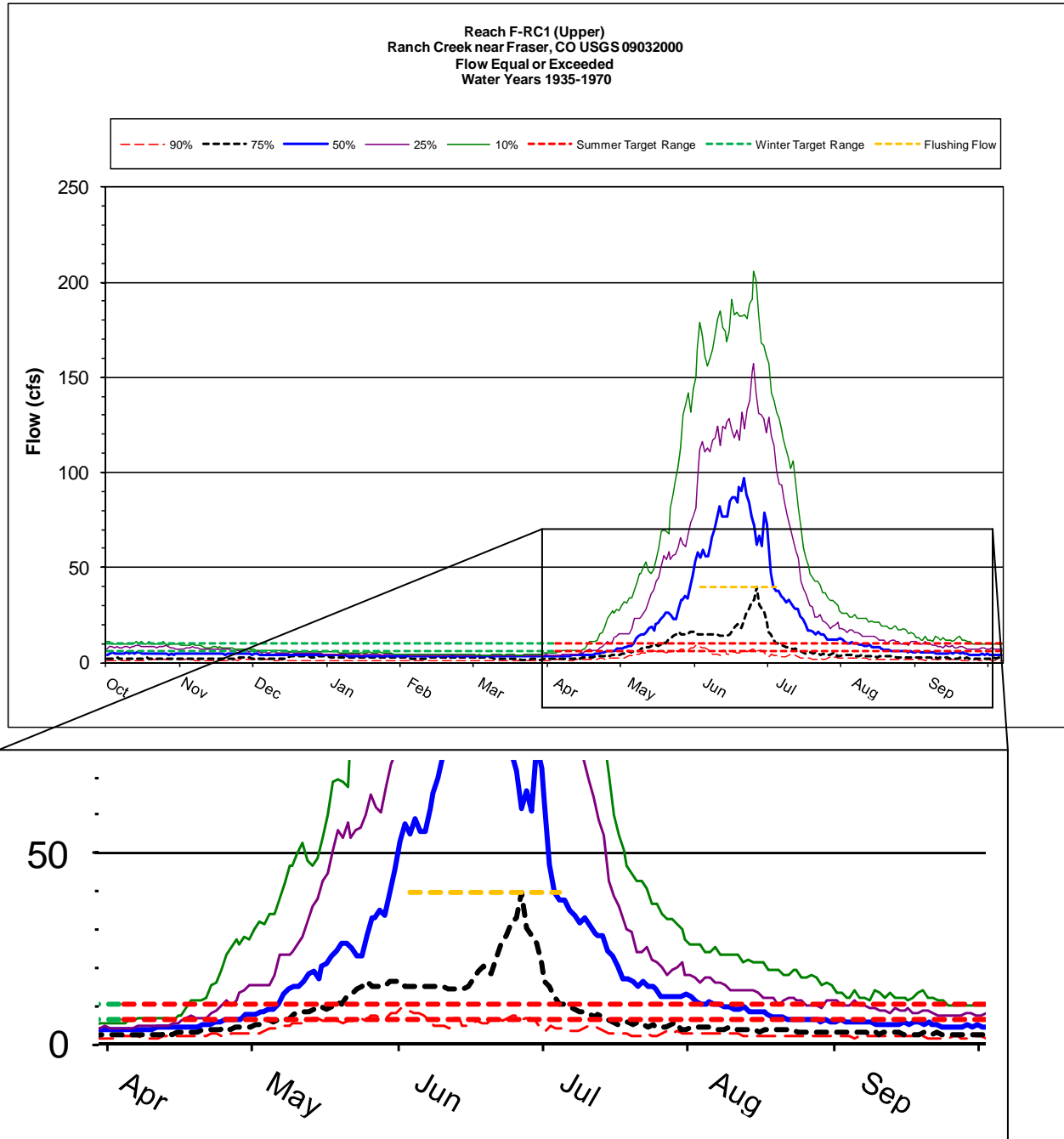


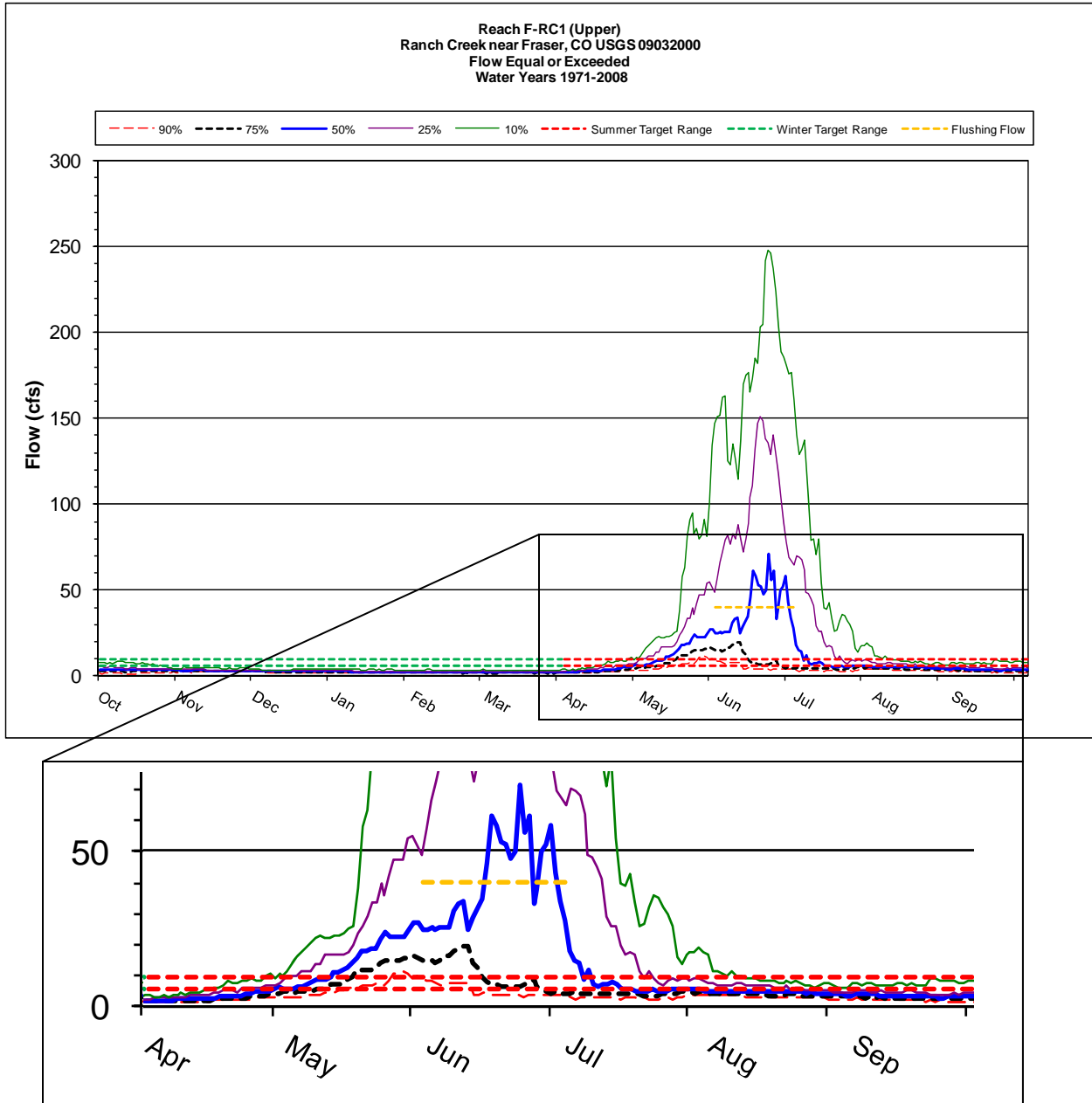
Reach F-RC1 TR6
TT2008 site

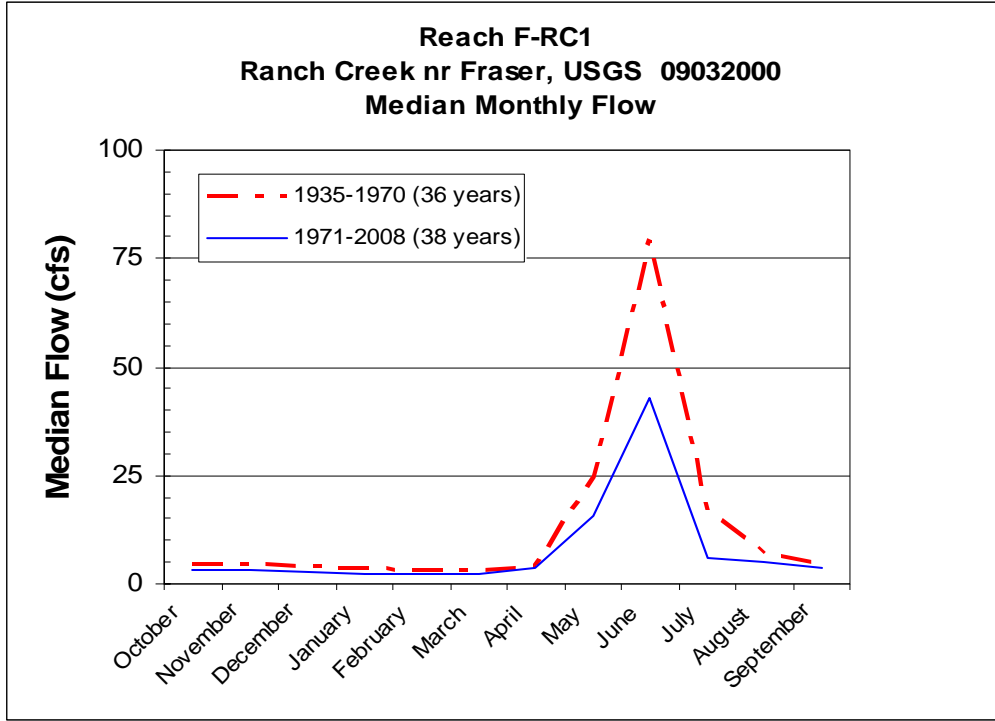
Resistance Method: Jarrett's Equation

STAGE	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.70	4.36	8.97	8.75	0.49	0.50	0.010	0.076	1.20	5.26	0.30
0.80	5.27	9.59	9.33	0.55	0.56	0.011	0.078	1.35	7.13	0.39
0.90	6.27	10.94	10.66	0.57	0.59	0.013	0.081	1.42	8.90	0.46
1.00	7.40	12.29	12.00	0.60	0.62	0.014	0.084	1.50	11.09	0.53
1.10	8.75	15.30	15.00	0.57	0.58	0.016	0.088	1.45	12.71	0.55
1.20	10.31	16.55	16.21	0.62	0.64	0.017	0.089	1.58	16.25	0.66
1.30	11.95	17.02	16.64	0.70	0.72	0.018	0.090	1.76	21.01	0.80
1.40	13.64	17.49	17.07	0.78	0.80	0.020	0.091	1.93	26.38	0.96
1.50	15.36	17.96	17.49	0.86	0.88	0.021	0.092	2.11	32.37	1.13
1.60	17.13	18.43	17.92	0.93	0.96	0.022	0.093	2.27	38.97	1.30
1.70	18.95	18.90	18.34	1.00	1.03	0.024	0.094	2.44	46.21	1.49
1.80	20.80	19.37	18.77	1.07	1.11	0.025	0.095	2.60	54.08	1.69
1.90	22.70	19.84	19.19	1.14	1.18	0.027	0.096	2.76	62.60	1.90
2.00	24.64	20.31	19.62	1.21	1.26	0.028	0.097	2.91	71.78	2.12

Hydrographs and Exceedence Plots and Tables:







Flood frequency analysis for USGS gage 09032000, Ranch Creek near Fraser, CO, for 73 years of record (Water years 1935-2008).

Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft ³ /sec)
1.05	95.2	24
1.11	90.1	41
1.25	80	73
2	50	168
5	20	293
10	10	355
25	4	411

Flood frequency analysis for USGS gage 09032000, Ranch Creek near Fraser, CO, for 36 years of record (Water years 1935 -1970).

Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft³/sec)
1.05	95.2	24
1.11	90.1	40
1.25	80	70
2	50	161
5	20	277
10	10	335
25	4	388

Flood frequency analysis for USGS gage 09032000, Ranch Creek near Fraser, CO, for 36 years of record (Water years 1971 - 2007).

Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft³/sec)
1.05	95.2	24
1.11	90.1	42
1.25	80	76
2	50	179
5	20	310
10	10	373
25	4	428

IHA Results:

Reach F-RC1
 IHA Non-Parametric RVA Scorecard
 Ranch Creek near Fraser 1935-1970 versus 1971-2008
 USGS 09032000

	Pre-impact period: 1935-1970				Post-impact period: 1971-2008				RVA Boundaries		Hydrologic Alteration (Middle Category)
	Coeff. of				Coeff. of				Low	High	
	Medians	Dispersion	Minimum	Maximum	Medians	Dispersion	Minimum	Maximum			
Parameter Group #1											
October (cfs)	4.6	1.315	0.9	24	3.4	0.375	0.62	7.8	2.663	7.416	1.132
November (cfs)	4.8	0.9375	0.97	13	3.2	0.2305	1.9	5.2	4.05	5.737	-0.7085
December (cfs)	4.05	0.358	0.9	7.7	2.8	0.2232	1.7	5.6	3.721	4.4	-0.8543
January (cfs)	3.65	0.3151	0.9	5.6	2.5	0.25	1.9	4.9	3.3	4	-0.7474
February (cfs)	3.3	0.4318	0.7	4.8	2.2	0.2841	1.55	4.2	2.8	3.779	-0.7085
March (cfs)	3.35	0.6269	0.6	5.4	2.2	0.2727	1.3	4.2	2.521	3.6	-0.594
April (cfs)	4.3	0.686	1.4	12	3.625	0.4862	2	7.3	3.521	5.582	0.3421
May (cfs)	24.5	1.408	3	102	15.5	0.7742	5	49	15.21	40.37	0.4211
June (cfs)	79.25	1.224	2.6	186	43	1.952	3.5	206.5	51.74	111.1	-0.2895
July (cfs)	16.5	1.162	2.3	50	5.9	1.419	1.9	153	7.063	20	-0.5263
August (cfs)	6.75	1.163	1.5	27	5.05	0.3366	1.3	9.9	3.963	8.979	1.526
September (cfs)	4.425	1.226	0.85	14	3.6	0.4722	1.45	9	2.782	6.074	1.368
Parameter Group #2											
1-day minimum (cfs)	2.1	1.071	0.4	4.1	1.6	0.5	0.4	2.8	1.2	2.879	1.259
3-day minimum (cfs)	2.117	1.094	0.4667	4.1	1.667	0.47	0.4	2.867	1.214	3.093	1.526
7-day minimum (cfs)	2.157	1.093	0.5	4.143	1.807	0.4407	0.4214	2.986	1.244	3.097	1.526
30-day minimum (cfs)	2.583	0.9258	0.6467	4.41	2.033	0.2893	1.119	3.243	1.456	3.195	1.368
90-day minimum (cfs)	3.126	0.6047	0.7367	4.693	2.202	0.279	1.511	3.808	2.786	3.69	-0.6842
1-day maximum (cfs)	142.5	0.7632	12	345	139.5	1.094	6.2	402	110.1	193	-0.05263
3-day maximum (cfs)	131	0.7538	9.033	338.7	131.5	1.115	6.133	367.7	109.8	178.7	-0.05263
7-day maximum (cfs)	124.7	0.7191	7.357	317.9	119.1	1.251	5.9	346.4	101.4	155.1	-0.2105
30-day maximum (cfs)	99.18	0.7725	5.16	204.4	59.17	1.659	5.267	248	64.85	122.3	-0.1316
90-day maximum (cfs)	56.65	0.8052	4.274	98.47	31.54	1.407	4.319	116.5	36.65	62.27	-0.4474
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimum in cfs/median in cfs)	0.1396	0.9799	0.0315	0.4658	0.1766	0.9378	0.04893	0.6713	0.1233	0.1995	0.02632
Parameter Group #3											
Date of minimum (Julian day)	30	0.3545	4	342	73	0.2725	6	343	70.42	277.4	0.8158
Date of maximum (Julian day)	167.5	0.05123	141	278	164	0.04986	139	291	158.2	170.6	0.02632
Parameter Group #4											
Low pulse count (#)	2	3	0	18	5	0.65	1	12	1	4	0.07368
Low pulse duration (days)	5.75	2.152	1	107	6.25	1.8	2	186	4.455	8.675	0.2316
High pulse count (#)	3	1	10	2	1	0	7	2	5	0.1121	
High pulse duration (days)	8	3.672	1	160	12.5	2.46	1	87	2.605	15.95	0.1053
The low pulse threshold is (cfs)			3.1								
The high pulse threshold is (cfs)			9.8								
Parameter Group #5											
Rise rate (cfs/day)	0.5	1.2	0.2	1.8	0.4	0.75	0.1	1	0.421	0.8975	0.1842
Fall rate (cfs/day)	-0.55	-1.159	-1	-0.2	-0.275	-0.4091	-0.55	-0.1	-0.6895	-0.3	0.1053
Number of reversals (count)	85	0.1824	64	113	86	0.2209	53	119	81	89.79	-0.1984
Assessment of Hydrologic Alteration											
	Middle RVA Category		High RVA Category		Low RVA Category						
	Expected	Observed	Alter.	Expected	Observed	Alter.	Expected	Observed	Alter.		
Parameter Group #1											
October (cfs)	12.67	27	1.132	12.67	2	-0.8421	12.67	9	-0.2895		
November (cfs)	13.72	4	-0.7085	12.67	0	-1	11.61	34	1.928		
December (cfs)	13.72	2	-0.8543	11.61	2	-0.8278	12.67	34	1.684		
January (cfs)	15.83	4	-0.7474	10.56	2	-0.8105	11.61	32	1.756		
February (cfs)	13.72	4	-0.7085	12.67	3	-0.7632	11.61	31	1.67		
March (cfs)	14.78	6	-0.594	10.56	2	-0.8105	12.67	30	1.368		
April (cfs)	12.67	17	0.3421	12.67	4	-0.6842	12.67	17	0.3421		
May (cfs)	12.67	18	0.4211	12.67	1	-0.9211	12.67	19	0.5		
June (cfs)	12.67	9	-0.2895	12.67	8	-0.3684	12.67	21	0.6579		
July (cfs)	14.78	7	-0.5263	10.56	6	-0.4316	12.67	25	0.9737		
August (cfs)	12.67	32	1.526	12.67	1	-0.9211	12.67	5	-0.6053		
September (cfs)	12.67	30	1.368	12.67	5	-0.6053	12.67	3	-0.7632		
Parameter Group #2											
1-day minimum (cfs)	13.72	31	1.259	12.67	0	-1	11.61	7	-0.3971		
3-day minimum (cfs)	12.67	32	1.526	12.67	0	-1	12.67	6	-0.5263		
7-day minimum (cfs)	12.67	32	1.526	12.67	0	-1	12.67	6	-0.5263		
30-day minimum (cfs)	12.67	30	1.368	12.67	2	-0.8421	12.67	6	-0.5263		
90-day minimum (cfs)	12.67	4	-0.6842	12.67	2	-0.8421	12.67	32	1.526		
1-day maximum (cfs)	12.67	12	-0.05263	12.67	13	0.02632	12.67	13	0.02632		
3-day maximum (cfs)	12.67	12	-0.05263	12.67	11	-0.1316	12.67	15	0.1842		
7-day maximum (cfs)	12.67	10	-0.2105	12.67	12	-0.05263	12.67	16	0.2632		
30-day maximum (cfs)	12.67	11	-0.1316	12.67	7	-0.4474	12.67	20	0.5789		
90-day maximum (cfs)	12.67	7	-0.4474	12.67	7	-0.4474	12.67	24	0.8947		
Number of zero days (count)	38	38	0	0	0	0	0	0	0		
Base flow index (7day minimum in cfs/median in cfs)	12.67	13	0.02632	12.67	14	0.1053	12.67	11	-0.1316		
Parameter Group #3											
Date of minimum (Julian day)	12.67	23	0.8158	12.67	8	-0.3684	12.67	7	-0.4474		
Date of maximum (Julian day)	12.67	13	0.02632	12.67	12	-0.05263	12.67	13	0.02632		
Parameter Group #4											
Low pulse count (#)	15.83	17	0.07368	11.61	21	0.8086	10.56	0	-1		
Low pulse duration (days)	10.56	13	0.2316	8.444	12	0.4211	8.444	13	0.5395		
High pulse count (#)	24.28	27	0.1121	6.333	5	-0.2105	7.389	6	-0.188		
High pulse duration (days)	12.67	14	0.1053	12.67	16	0.2632	12.67	7	-0.4474		
Parameter Group #5											
Rise rate (cfs/day)	12.67	15	0.1842	12.67	1	-0.9211	12.67	22	0.7368		
Fall rate (cfs/day)	12.67	14	0.1053	12.67	24	0.8947	12.67	0	-1		
Number of reversals (count)	13.72	11	-0.1984	12.67	16	0.2632	11.61	11	-0.05263		

Reach F-RC 1

IHA Percentile Data

Ranch Creek near Fraser 1935-1970 versus 1971-2008

USGS 09032000

Parameter Group #1	Pre-impact period: 1935-1970 (36 years)						Post-impact period: 1971-2008 (38 years)					
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
October (cfs)	1.34	2.25	4.6	8.3	9.86	1.315	1.67	2.825	3.4	4.1	6.05	0.375
November (cfs)	1.27	2.5	4.8	7	7.59	0.9375	2.18	2.888	3.2	3.625	4.65	0.2305
December (cfs)	1.2	3.525	4.05	4.975	5.73	0.358	2.1	2.475	2.8	3.1	4.31	0.2232
January (cfs)	1.07	2.95	3.65	4.1	5.19	0.3151	2	2.175	2.5	2.8	3.73	0.25
February (cfs)	1.07	2.55	3.3	3.975	4.33	0.4318	1.8	2	2.2	2.625	3.37	0.2841
March (cfs)	1.1	1.675	3.35	3.775	4	0.6269	1.6	1.9	2.2	2.5	3.31	0.2727
April (cfs)	1.635	3.3	4.3	6.25	10.45	0.686	2.345	2.738	3.625	4.5	5.705	0.4862
May (cfs)	5.45	11.25	24.5	45.75	65.6	1.408	6.65	11	15.5	23	30.5	0.7742
June (cfs)	6.365	18.5	79.25	115.5	156.9	1.224	5.305	7.688	43	91.63	157	1.952
July (cfs)	2.71	5.575	16.5	24.75	43.5	1.162	3.38	4.875	5.9	13.25	37.1	1.419
August (cfs)	1.57	2.9	6.75	10.75	18	1.163	3.65	4.3	5.05	6	7.3	0.3366
September (cfs)	1.335	2.325	4.425	7.75	11.15	1.226	2.86	3.2	3.6	4.9	6.83	0.4722
Parameter Group #2												
1-day minimum (cfs)	0.67	1	2.1	3.25	3.8	1.071	0.576	1.3	1.6	2.1	2.51	0.5
3-day minimum (cfs)	0.7167	1.008	2.117	3.325	3.82	1.094	0.583	1.392	1.667	2.175	2.61	0.47
7-day minimum (cfs)	0.74	1.029	2.157	3.386	3.826	1.093	0.8167	1.464	1.807	2.261	2.674	0.4407
30-day minimum (cfs)	0.9608	1.148	2.583	3.539	3.893	0.9258	1.378	1.749	2.033	2.338	2.854	0.2893
90-day minimum (cfs)	1.069	1.988	3.126	3.877	4.15	0.6047	1.776	1.983	2.202	2.597	3.475	0.279
1-day maximum (cfs)	16.7	89	142.5	197.8	238.9	0.7632	18.5	59.75	139.5	204	271.9	1.034
3-day maximum (cfs)	15.8	84.67	131	183.4	230.4	0.7538	17.27	52.33	131.5	199	263.9	1.115
7-day maximum (cfs)	14.97	81.86	124.7	171.5	213.6	0.7191	15.71	37	119.1	186.1	251.7	1.251
30-day maximum (cfs)	11.46	55.17	99.18	131.8	172.4	0.7725	12.04	19.71	59.17	117.9	180.8	1.659
90-day maximum (cfs)	7.558	25.6	56.65	71.22	82.1	0.8052	8.017	12.31	31.54	56.69	90.98	1.407
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimum in cfs/median in cfs)	0.06237	0.1043	0.1396	0.241	0.3028	0.9799	0.05482	0.09366	0.1766	0.2593	0.4535	0.9378
Parameter Group #3												
Date of minimum (Julian day)	283.8	312.8	30	76.5	258	0.3545	285.4	334.3	73	234.5	268.2	0.2725
Date of maximum (Julian day)	149	154.3	167.5	173	178.2	0.05123	141.9	153.8	164	172	181.4	0.04986
Parameter Group #4												
Low pulse count (#)	0	0	2	6	8	3	2	3	5	6.25	8.1	0.65
Low pulse duration (days)	1	3.875	5.75	16.25	60.9	2.152	2.45	3.375	6.25	14.63	45.35	1.8
High pulse count (#)	1	2	3	5	6.3	1	1	2	2	4	6	1
High pulse duration (days)	1	2	8	31.38	74.6	3.672	1.9	3.25	12.5	34	66	2.46
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	0.2	0.4	0.5	1	1	1.2	0.2	0.3	0.4	0.6	0.755	0.75
Fall rate (cfs difference between consecutive days)	-1	-0.9375	-0.55	-0.3	-0.2	-1.159	-0.4	-0.3125	-0.275	-0.2	-0.2	-0.4091
Number of reversals	68.4	76.75	85	92.25	98	0.1824	64.4	78.75	86	97.75	104.2	0.2209
EFC Monthly Low Flows												
October Low Flow (cfs)	1.49	2.3	4	6.7	8.66	1.1	1.78	2.9	3.4	4	5.26	0.3235
November Low Flow (cfs)	1.45	2.475	4.675	5.8	7.5	0.7112	2.18	2.888	3.2	3.525	4.11	0.1992
December Low Flow (cfs)	1.4	3.575	4	4.925	5.75	0.3375	2.1	2.475	2.8	3.025	3.41	0.1964
January Low Flow (cfs)	2.9	3.35	3.8	4.15	5.1	0.2105	2	2.175	2.5	2.8	3.73	0.25
February Low Flow (cfs)	2.52	2.95	3.55	4	4.39	0.2958	1.8	2	2.2	2.625	3.37	0.2841
March Low Flow (cfs)	1.4	2.3	3.4	3.8	4	0.4412	1.6	1.9	2.2	2.5	3.31	0.2727
April Low Flow (cfs)	1.76	2.35	3.7	4.4	6	0.5541	2	2.575	3.375	4.025	4.665	0.4296
May Low Flow (cfs)	3.1	4.6	7.1	8.55	9	0.5563	3.2	4.45	6.2	7.275	8.2	0.4556
June Low Flow (cfs)	2.6	2.85	4.1	5.7	6.5	0.6951	3.7	4	5.1	7.5	8.35	0.6863
July Low Flow (cfs)	2.25	2.775	4.15	6.5	8.36	0.8976	3.16	3.925	5.1	5.6	7.48	0.3284
August Low Flow (cfs)	1.75	2.65	4.2	7.05	9.1	1.048	3.56	4.188	4.975	5.725	7.12	0.309
September Low Flow (cfs)	1.46	2.3	4.4	7.4	9.04	1.159	2.81	3.175	3.525	4.463	6.3	0.3652
EFC Parameters												
Extreme low peak (cfs)	0.85	0.985	1.1	1.2	1.2	0.1955	0.4	0.615	0.825	0.9975	1.2	0.4636
Extreme low duration (days)	1.4	4	6	10.5	28.3	1.083	1	1.25	7.25	12.63	32	1.569
Extreme low timing (Julian date)	143.1	235.5	276	351	46.2	0.3156	219.5	255.3	288.5	302	71	0.1277
Extreme low freq. (#/year)	0	0	0	3	5.3	0	0	0	0	0	2	0
High flow peak (cfs)	5.85	7.5	9.5	11	12.75	0.3684	6.35	7	9	10.38	13.2	0.375
High flow duration (days)	3	3	4.75	6.375	15.2	0.7105	2.35	3	4	6.875	9.3	0.9688
High flow timing (Julian date)	75.25	135.9	213	261.3	304.6	0.3426	144	184.9	209.5	233.6	252.6	0.1332
High flow frequency (#/year)	2	3	5	7	8	0.8	1	3	5	6	8.2	0.6
High flow rise rate (cfs difference between consecutive days)	0.6924	1.109	1.65	2.117	2.745	0.6105	1.051	1.35	1.7	2.275	2.742	0.5438
High flow fall rate (cfs difference between consecutive days)	-2.151	-1.236	-0.9367	-0.5542	-0.3746	-0.7284	-2.424	-1.381	-1.075	-0.8575	-0.7683	-0.4872
Small Flood peak (cfs)	151.8	163	186	207	232	0.2366	143.6	156	184.5	199.5	212.8	0.2358
Small Flood duration (days)	57.2	77	97	137	160.8	0.6186	40.6	51.5	62.5	85	91.7	0.536
Small Flood timing (Julian date)	146.6	152	166	173	175.8	0.05738	140.3	152.8	162.5	170.8	174.4	0.04918
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	1	1	0
Small Flood riser rate (cfs difference between consecutive days)	2.636	3.555	4.741	5.681	6.661	0.4485	3.328	3.95	4.426	5.972	9.377	0.4568
Small Flood fall rate (cfs difference between consecutive days)	-9.79	-4.595	-2.71	-1.963	-1.482	-0.9712	-12.48	-8.435	-6.755	-4.688	-3.057	-0.5547
Large flood peak (cfs)	248	248	321	345	345	0.3022	245	250	271	342	402	0.3395
Large flood duration (days)	51	51	122	131	131	0.6557	53	68	72	87	93	0.2639
Large flood timing (Julian date)	162	162	167	181	181	0.05191	150	159	169	174	177	0.04098
Large flood freq. (#/year)	0	0	0	0	0.3	0	0	0	0	0	1	0
Large flood riser rate (cfs difference between consecutive days)	5.698	5.698	6.504	9.594	9.594	0.5991	5.687	6.025	7.328	11.68	16.14	0.7712
Large flood fall rate (cfs difference between consecutive days)	-19.74	-19.74	-3.708	-2.943	-2.943	-4.528	-10.83	-10.71	-7.203	-5.26	-4.383	-0.7571

Reach F-RC1

Non-Parametric IHA Scorecard

Ranch Creek near Fraser 1935-1970 versus 1971-2008

USGS 09032000

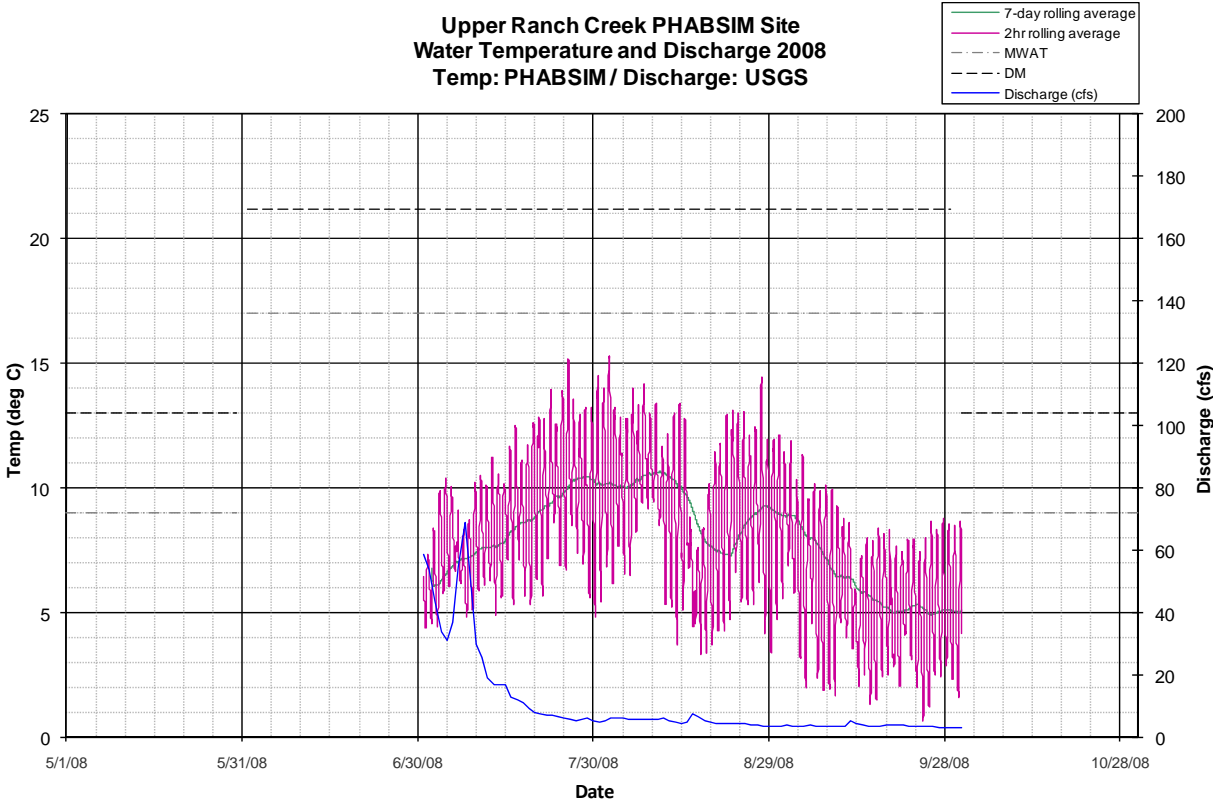
Pre-impact period: 1935-1970 (36 years)

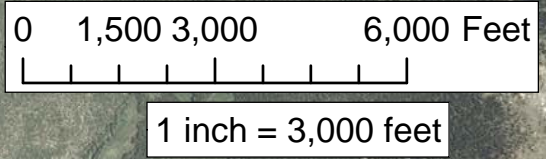
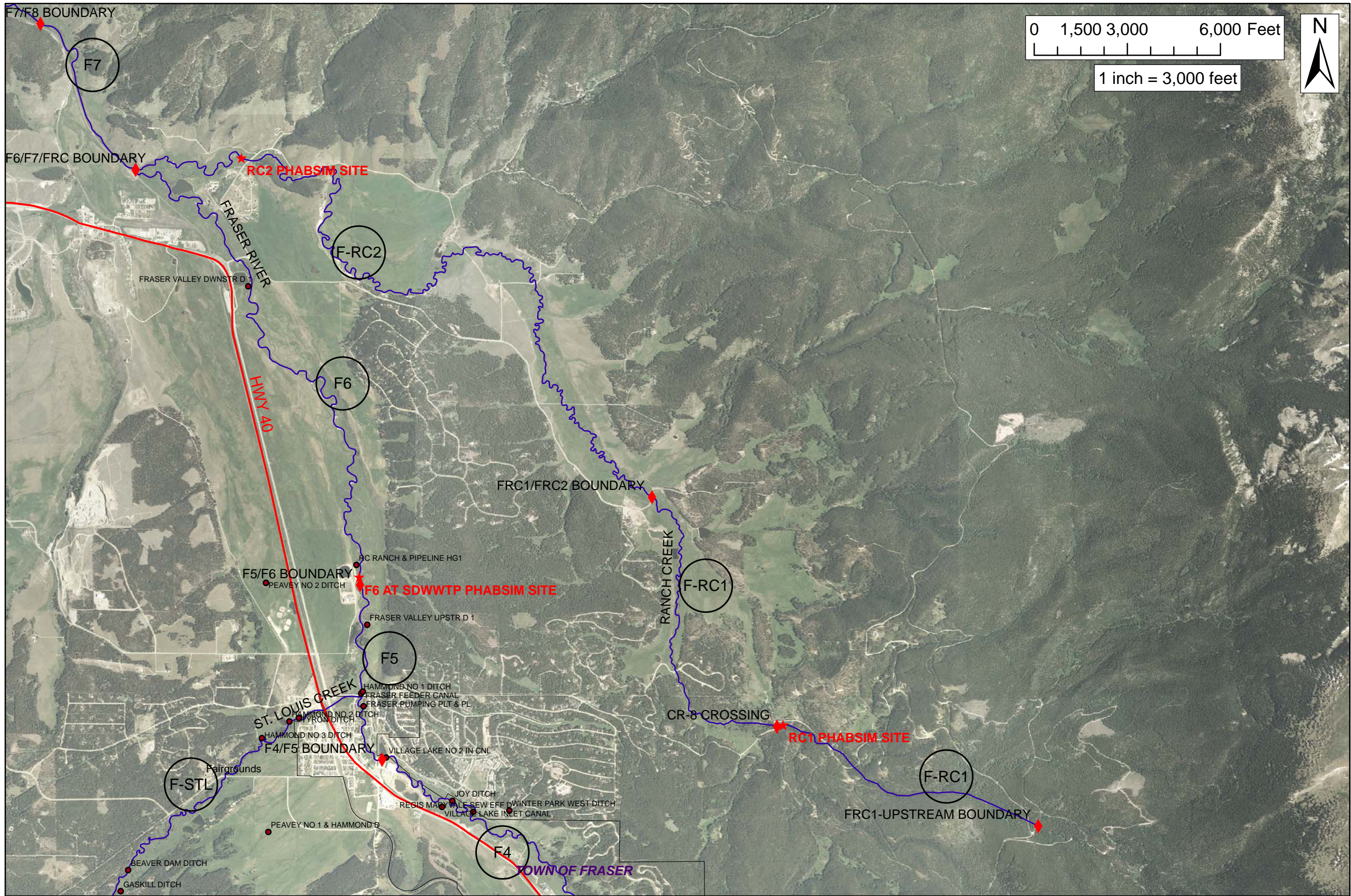
Post-impact period: 1971-2008 (38 years)

Mean annual flow (cfs)	15.58	12.1
Mean flow/area (dimensionless)	15.58	12.1
Annual C. V.	2.08	2.6
Flow predictability (%)	0.45	0.61
Constancy/predictability	0.56	0.62
% of floods in 60d period	0.44	0.45
Flood-free season (days)	125	182

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
October (cfs)	4.6	3.4	1.315	0.375	0.2609	0.7149	0.01301	0.1612
November (cfs)	4.8	3.2	0.9375	0.2305	0.3333	0.7542	0.003003	0.02102
December (cfs)	4.05	2.8	0.358	0.2232	0.3086	0.3765	0.02402	0.1171
January (cfs)	3.65	2.5	0.3151	0.25	0.3151	0.2065	0.01301	0.2773
February (cfs)	3.3	2.2	0.4318	0.2841	0.3333	0.3421	0.01201	0.1992
March (cfs)	3.35	2.2	0.6269	0.2727	0.3433	0.5649	0.007007	0.01602
April (cfs)	4.3	3.625	0.686	0.4862	0.157	0.2913	0.1391	0.3904
May (cfs)	24.5	15.5	1.408	0.7742	0.3673	0.4502	0.07207	0.1752
June (cfs)	79.25	43	1.224	1.952	0.4574	0.5948	0.1071	0.1181
July (cfs)	16.5	5.9	1.162	1.419	0.6424	0.2215	0.1361	0.5405
August (cfs)	6.75	5.05	1.163	0.3366	0.2519	0.7105	0.006006	0.05506
September (cfs)	4.425	3.6	1.226	0.4722	0.1864	0.6148	0.3343	0.1532
Parameter Group #2								
1-day minimum (cfs)	2.1	1.6	1.071	0.5	0.2381	0.5333	0.1251	0.08909
3-day minimum (cfs)	2.117	1.667	1.094	0.47	0.2126	0.5706	0.1251	0.07007
7-day minimum (cfs)	2.157	1.807	1.093	0.4407	0.1623	0.5967	0.1101	0.08609
30-day minimum (cfs)	2.583	2.033	0.9258	0.2893	0.2129	0.6875	0.04404	0.03904
90-day minimum (cfs)	3.126	2.202	0.6047	0.279	0.2956	0.5387	0.01502	0.04505
1-day maximum (cfs)	142.5	139.5	0.7632	1.034	0.02105	0.355	0.9379	0.5375
3-day maximum (cfs)	131	131.5	0.7538	1.115	0.003817	0.4796	1	0.3634
7-day maximum (cfs)	124.7	119.1	0.7191	1.251	0.04467	0.74	0.7948	0.1401
30-day maximum (cfs)	99.18	59.17	0.7725	1.659	0.4035	1.148	0.07107	0.02302
90-day maximum (cfs)	56.65	31.54	0.8052	1.407	0.4432	0.7472	0.08308	0.1291
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimum in cfs/median in cfs)	0.1396	0.1766	0.9799	0.9378	0.2655	0.04288	0.1882	0.9029
Parameter Group #3								
Date of minimum (Julian day)	30	73	0.3545	0.2725	0.235	0.2312	0.2392	0.4735
Date of maximum (Julian day)	167.5	164	0.05123	0.04986	0.01913	0.02667	0.5796	0.8939
Parameter Group #4								
Low pulse count (#)	2	5	3	0.65	1.5	0.7833	0	0.07107
Low pulse duration (days)	5.75	6.25	2.152	1.8	0.08696	0.1636	0.7417	0.8138
High pulse count (#)	3	2	1	1	0.3333	0	0.2262	0.8298
High pulse duration (days)	8	12.5	3.672	2.46	0.5625	0.33	0.4204	0.6156
The low pulse threshold is (cfs)	3.1							
The high pulse threshold is (cfs)	9.8							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	0.5	0.4	1.2	0.75	0.2	0.375	0.2853	0.2042
Fall rate (cfs difference between consecutive days)	-0.55	-0.275	-1.159	-0.4091	0.5	0.6471	0	0.1572
Number of reversals	85	86	0.1824	0.2209	0.01176	0.2116	0.5205	0.4535

Temperature Plots





GRAND COUNTY
 STREAM MANAGEMENT PLAN
 REACHES

- Legend**
- ◆ REACH BOUNDARY
 - ★ PHABSIM SITES
 - DIVERSIONS

REACH: F-RC1
 SHEET # :
 1 OF 1

