F3 Stream Reach Summary

Study Reach: F3, Fraser River - This reach begins approximately ½ mile upstream of U.S. Highway 40 near the Winter Park Water and Sanitation District Wastewater Facility, and extends downstream to the Town of Winter Park, just upstream of Idlewild Road.

Reach Description: Approximate channel length: 2 ½ miles, approximate channel slope 1.9%.

The Fraser River crosses under U.S. Highway 40 in the upstream portion of this reach. Immediately downstream of U.S. Highway 40 is USGS Gage Station 09024000, which has some of the most extensive records in the County, dating back to 1911. By-pass flows for upstream diversions, set by the USFS, are measured at this gage.

Upstream of U.S. Highway 40 this reach is an open meadow and wetland environment. The stream appears somewhat sinuous. As the river approaches U.S. Highway 40 and on the downstream side of U.S. Highway 40 the floodplain becomes more confined with steeper side slopes and less sinuosity. Overbanks are dominated in the downstream reaches by pine forest. Some pockets of fine sediment deposition were observed that may be from traction sand generated during winter sanding operations on U.S. Highway 40. The Fraser River Trail parallels Reach F3 until it reaches the southern edge of the Town of Winter Park From here, the river valley widens and the river moves further east from the highway and town as it enters another meadow section.

Fraser River upstream of Highway 40 near Winter Park ski area

Fraser River downstream of USGS gage at Highway 40 near Winter Park

Fraser River downstream Highway 40 near USFS Idlewild Campground

Flow Recommendations:

Environmental Flow Methodology: Surveyed cross-section data collected by Ecological Resources Consultants (2006), and provided by the U.S. Army Corps of Engineers, were analyzed and combined with a PHABSIM site established in 2008 by Tetra Tech, located downstream of US Highway 40 and the USGS gage site. See Appendix A for methodology and Appendix E for PHABSIM survey information. CWCB instream flow recommendations are also available for this reach.

Water Users:

- Irrigators, municipalities and industry flow-related issues: Similar to Reach F2, flows in this reach are significantly controlled by transbasin diversions including Denver Water diversions on the Fraser River and Jim Creek. Base or minimal flows in F3 are mandated by the U.S. Forest Service, which requires a minimum of 10 cfs between May 15 and September 15 and 4 cfs between September 16 and May 14, measured at the Winter Park Gage, USGS 09024000, located in F3. These are referred to as by-pass flows and are imposed on Denver Water since they are being required to 'by-pass' diversions at a level that results in these minimum flows. When flows drop below the U.S. Forest Service requirements local diverters, including Winter Park Water and Sanitation District and Grand County have a difficult time extracting flows at their decreed amount (Wageck 2007).
- Recreational flows: Angling is the predominant recreational use.

Summary of Flows:

Environmental recommended target flow ranges

- 4 to 10 cfs, summer, based on adult brook trout habitat availability and the USFS recommendation.
- 4 to 10 cfs, winter, based on brook trout spawning habitat availability and the USFS recommendation.
- Flushing flow, at least 80 cfs for a 3-day duration with a frequency of 1 in 2 years during the late May to late June period.

CWCB Flows

- 8 cfs summer (05/15 – 09/15)
- 3.5 cfs winter (09/16 – 05/14)
- Wetted perimeter analysis of ERC data supports the CWCB flows

USFS Flows

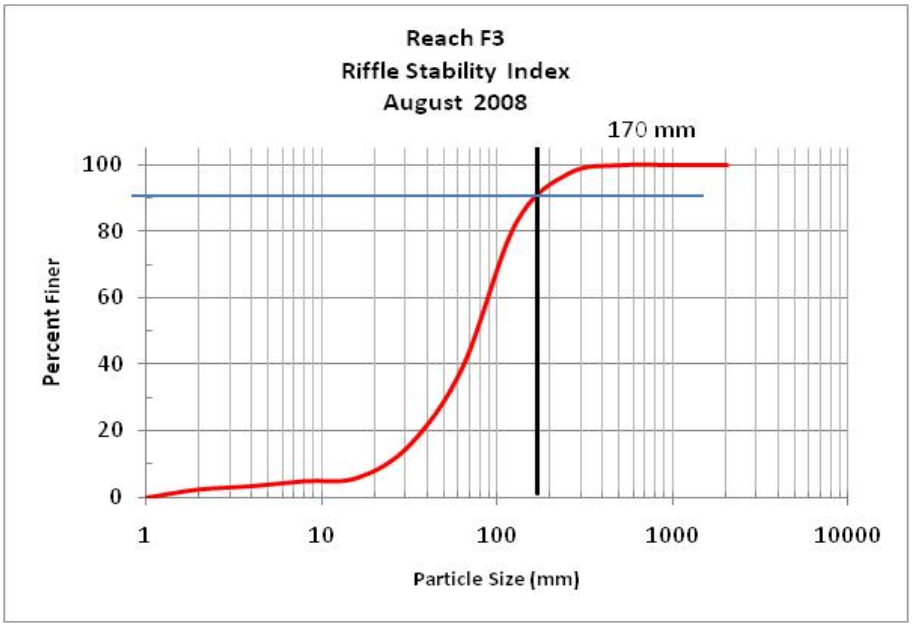
- 10 cfs summer (05/15 - 09/15)
- 4 cfs winter (09/16 - 05/14)

Water Users

- Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 8 cfs during the summer seasons and 4 cfs in the winter. Most of the summer diversions are for irrigation and will likely have some return flows.
- Angling: none reported.

Stream Assessments: In August 2008, Tetra Tech conducted three stream assessments in F3. 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" category, the EPA HQA evaluation scored in the "suboptimal" category and the RSI of 90 indicates the riffle substrate is quite unstable and had recently been mobilized by the flow regime. Relevant issues revealed in the stream assessments include excessive deposition and general lack of flow and diversity in velocity/depth regimes. Results of the assessments are summarized in the following tables and plot. Details and methodology are presented in Appendix A.

Reach F3 Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			**EPA Habitat Quality Assessment**		
Attribute			**Attribute**		**Score**
Upper Banks			**Channel**		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	18
2	Mass wasting hazard	3	2	Aquatic Structure as Cover	11
3	Debris Jam Potential	8	3	Velocity/ Depth Regimes	12
4	Vegetation Cover	6	4	Channel Flow Status	8
	Upper Bank Score:	**19**	5	Channel Alteration	14
Lower Banks			6	Frequency of Riffles	18
5	Channel Capacity	3	7	Channel Sinuosity	6
6	Bank Rock Content	4		**Channel Score**	**87**
7	Flow obstructors & Deflectors	4	**Banks**		
8	Cutting	4	8	Bank Stability	18
9	Deposition	12	9	Riparian Vegetation Cover and Disturbance	18
	Lower Bank Score:	**27**	10	Riparian Vegetation zone width	16
Channel Bottom				**Bank Score**	52
10	Rock Angularity	3		**Total Score**	**139**
11	Brightness	3	**Notes**		
12	Consolidation/Particle Packing	4			
13	Bottom size distribution	10			
14	Bed Scour and Deposition	15			
15	Clinging Aquatic Veg	2			
	Channel Bottom Score:	**37**			
	Total Score:	**83**			



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

Hydrologic Records: USGS Gage Station 09024000 has been in operation continuously since 1911 in this reach and provides sufficient record to characterize the flow regime alteration which has occurred. The accompanying IHA analyses describe the magnitude of these hydrologic changes by comparing the 1911 - 1935 period with the 1936 - 1970, 1971 - 2007, and the 1936 - 2007 periods. Both the IHA analyses and the daily streamflow exceedence plots indicate the CWCB flow recommendations have been commonly equaled or exceeded throughout the entire period-of-record. The environmental flow target ranges encompass 9 of 12 median monthly flows for the 1936 to 2007 period, with the remaining three monthly medians exceeding the target ranges. The flushing flow recommended is well supported by both the historic and the recent hydrologic record.

Water Temperature: F3 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 F3, indicate stream temperatures for the Fraser River in this area are generally well below the MWAT and DM standards.

Water Quality: Impacts from sanding operations on the west side of Berthoud Pass is a concern, although not to the same extent as upstream in F2. No other water quality concerns were noted from the available water quality data.

Water Supply Issues (UPCO): UPCO reports that water supply for this reach is generally adequate with occasional shortages and times with flows falling below the CWCB ISF. Under future conditions, shortages are predicted to increase significantly with flows dropping below CWCB ISF frequently, especially during the summer months.

Summary of Results and Additional Remarks:

1. Both the IHA analyses and the daily streamflow exceedence plots indicate the flow recommendations have been commonly equaled or exceeded throughout the entire period-of-record. The flow recommended for flushing is well supported by both the historic and the recent hydrologic record.
2. Temperatures and water quality appear supportive of a cold-water fishery.
3. Flows for water uses including recreation are generally adequate.
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.
5. 2007 electrofishing data collected by GEI Consultants indicate brook and rainbow trout occur within this reach, comprising 79 and 21 percent of the game fish collected, respectively (GEI 2007).

Restoration Opportunities: Restoration opportunities presented for F3 are aimed at reducing the impacts from excessive sedimentation and low flow conditions. Note that the proposed sediment basin(s), flushing flow recommendations and application of flow enhancements made for F2 will provide direct benefits in F3 as well. Additional restoration opportunities for F3 include the following:

- ✓ Practice and enforce effective Best Management Practices (BMPs) associated with local construction for the control of sediment runoff.

- ✓ Implement roadside BMPs along U.S Highway 40 to limit traction sand from entering the river directly along this reach.

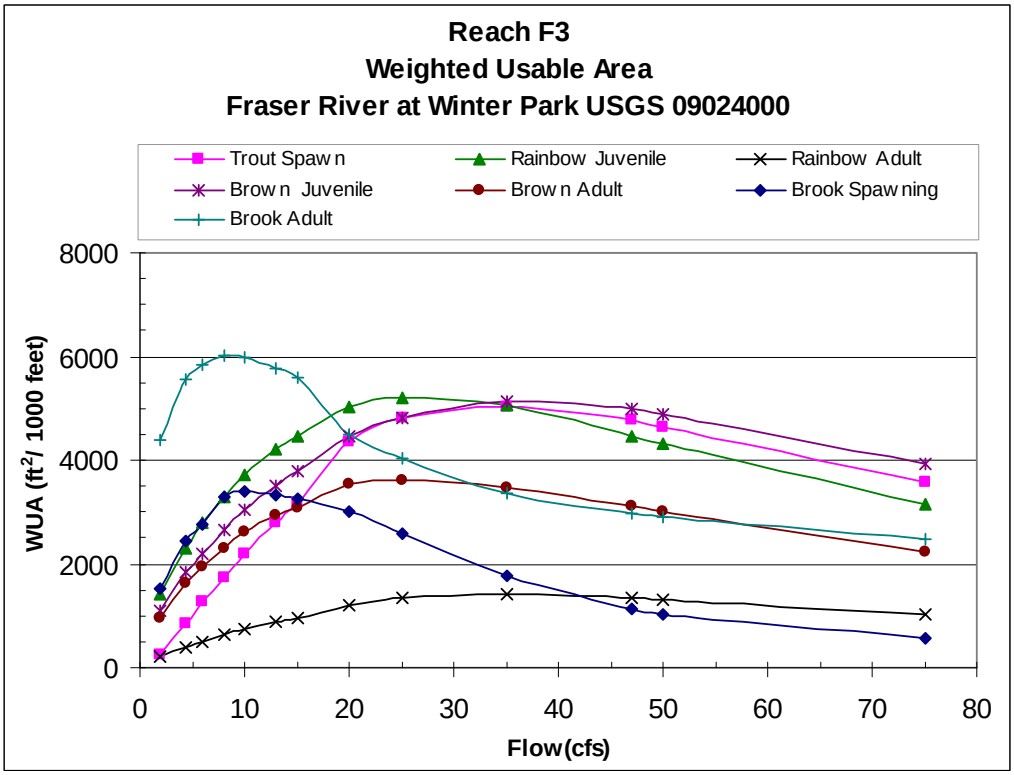
Monitoring: Establish and implement a monitoring program. Parameters should include intergravel fine sediments, and channel cross sections to monitor deposition and effectiveness of the sediment basin(s), both of which are recommendations for reach F2 and which are anticipated to provide benefits in F3. Continue to monitor flows at the USGS gage located in this reach.

Support Data

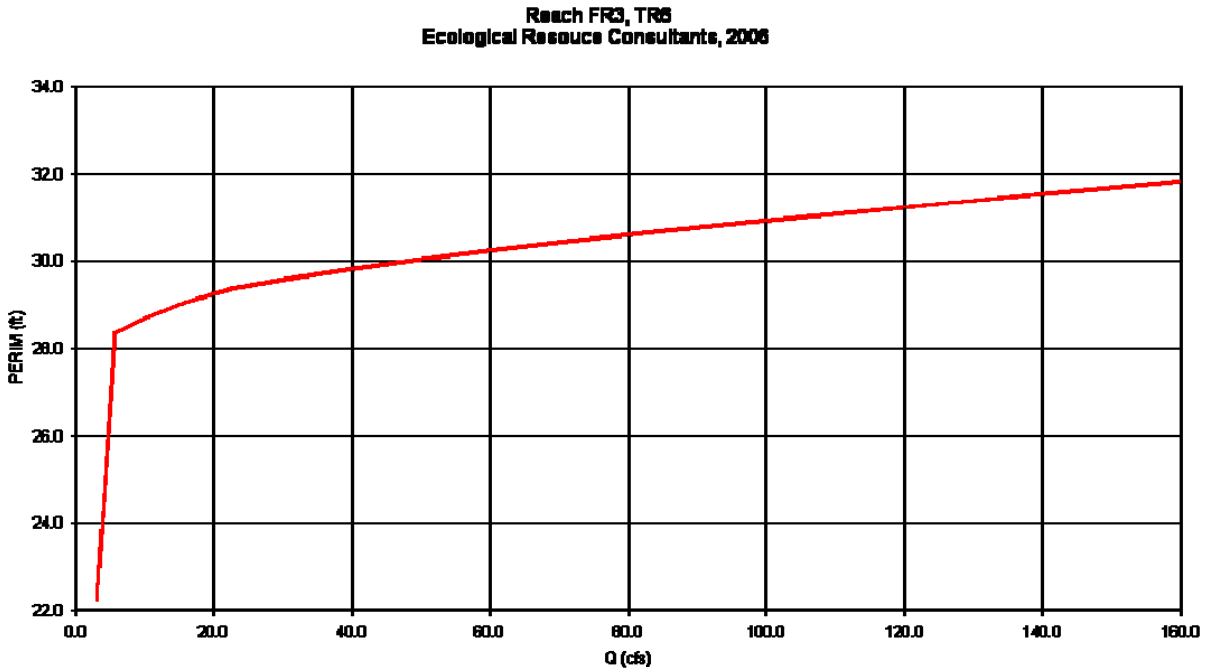
Weighted Usable Area Plots and Tables:

Habitat-flow relations for the target species and life stages for Reach F3, Tetra Tech site 2008.

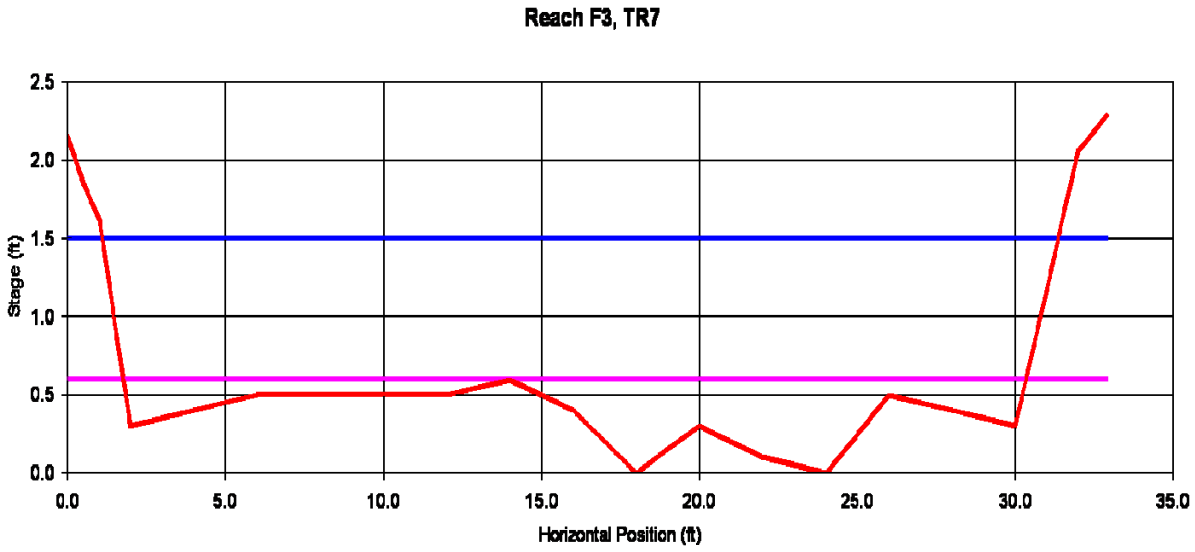
F3								
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult	Brook Spawning	Brook Adult
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)						
2.0	16917.8	257.3	1423.0	219.0	1111.1	963.1	1538.4	4381.4
4.4	20283.2	861.2	2311.3	394.2	1831.7	1620.1	2441.2	5549.6
6.0	21299.7	1267.9	2778.8	497.3	2209.2	1949.5	2753.5	5845.2
8.0	21938.1	1742.8	3295.6	621.3	2653.8	2304.9	3285.2	6019.1
10.0	22419.7	2188.4	3724.2	736.5	3042.3	2607.1	3396.8	5982.3
13.0	22704.3	2803.9	4220.6	885.3	3520.0	2921.7	3343.1	5780.0
15.0	22836.1	3172.6	4466.0	967.1	3788.9	3076.5	3253.7	5604.7
20.0	23091.7	4370.6	5030.1	1204.2	4451.7	3531.1	3001.8	4511.3
25.0	23294.9	4799.0	5217.4	1334.9	4824.5	3619.6	2596.2	4020.4
35.0	23624.9	5038.7	5076.3	1425.3	5137.4	3481.9	1759.3	3357.9
47.0	23939.4	4763.2	4475.0	1341.4	4998.9	3099.6	1138.2	2970.3
50.0	24008.6	4646.4	4316.5	1307.6	4883.3	2996.3	1040.4	2897.7
75.0	24491.7	3570.9	3139.4	1011.0	3922.0	2246.5	557.3	2476.4



Wetted Perimeter-Flow Relationship



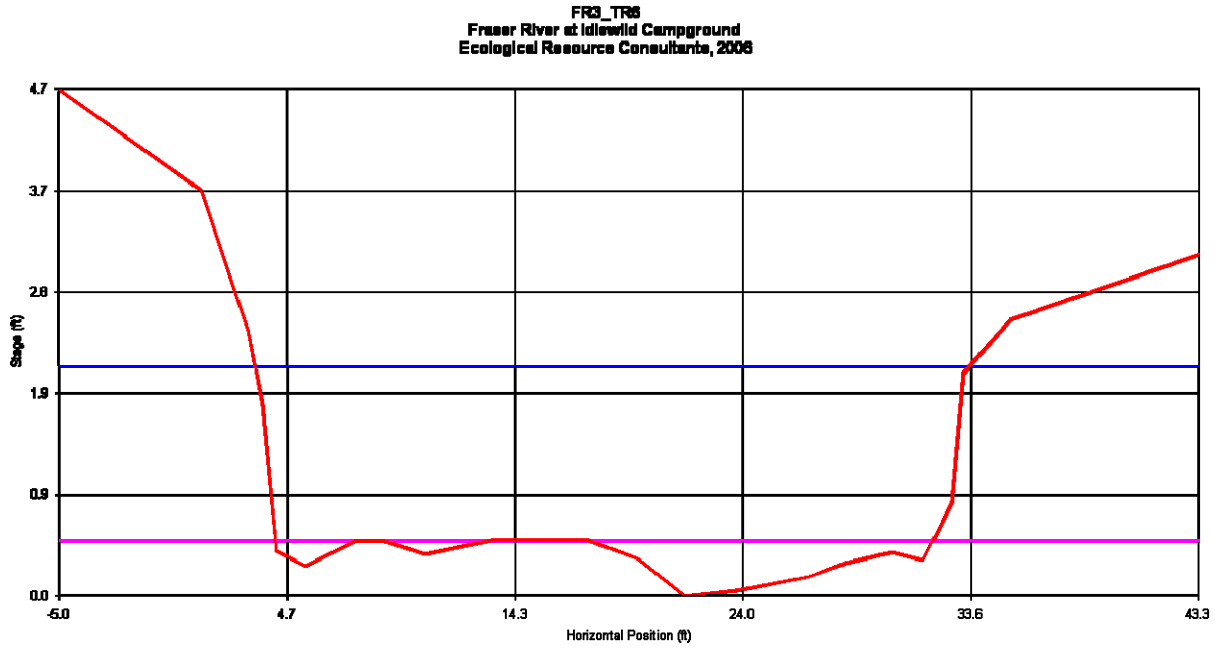
Transect and Bedload Threshold Plots and Tables



Reach F3 TR7
TT2008 site

Resistance Method: Jarrett's Equation

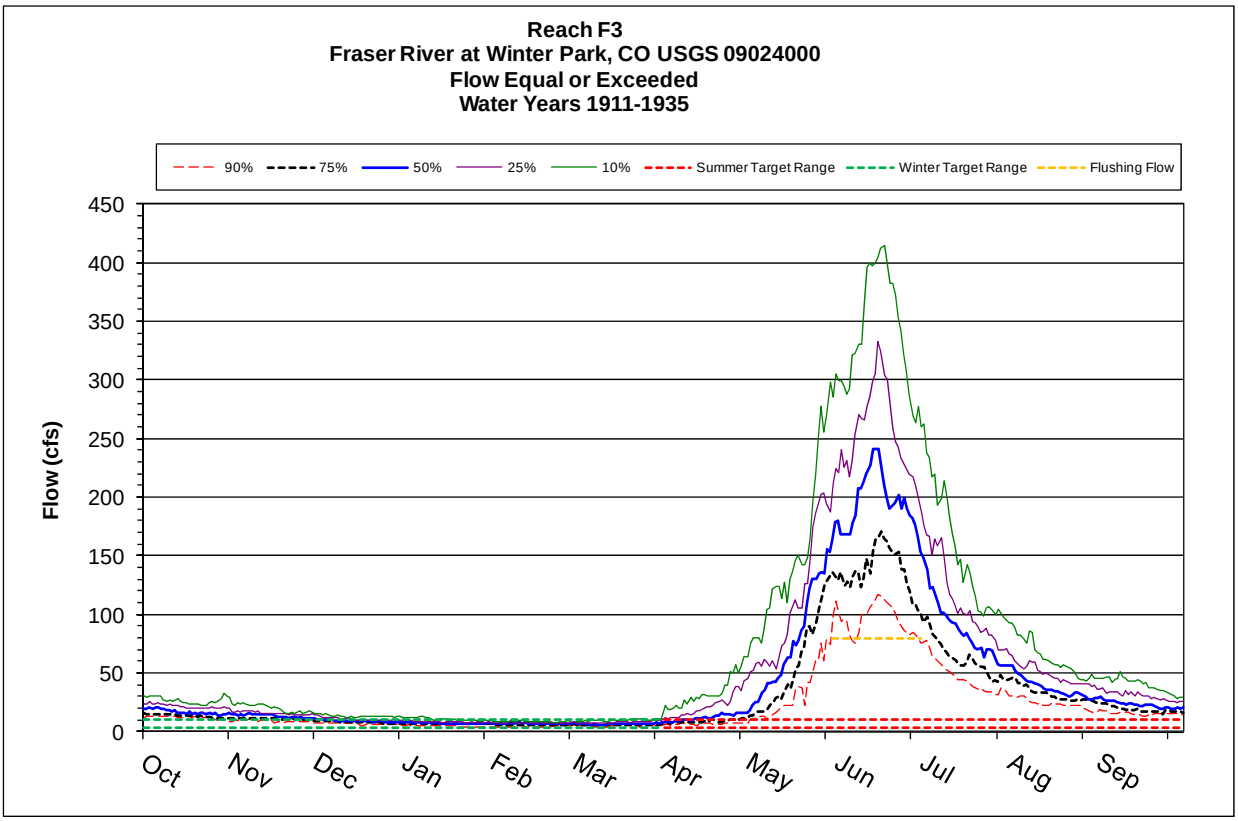
STAGE (ft)	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.50	4.2	19.73	19.4	0.21	0.22	0.018	0.109	0.65	2.74	0.24
0.60	6.90	28.99	28.57	0.24	0.24	0.018	0.107	0.72	4.94	0.27
0.70	9.77	29.26	28.76	0.33	0.34	0.018	0.101	0.95	9.24	0.37
0.80	12.66	29.54	28.95	0.43	0.44	0.018	0.096	1.16	14.71	0.47
0.90	15.56	29.82	29.14	0.52	0.53	0.018	0.093	1.37	21.28	0.57
1.00	18.48	30.09	29.33	0.61	0.63	0.017	0.090	1.56	28.90	0.67
1.10	21.43	30.37	29.51	0.71	0.73	0.017	0.088	1.75	37.55	0.76
1.20	24.39	30.65	29.70	0.80	0.82	0.017	0.086	1.93	47.18	0.85
1.30	27.37	30.92	29.89	0.88	0.92	0.017	0.085	2.11	57.77	0.94
1.40	30.36	31.20	30.08	0.97	1.01	0.017	0.083	2.28	69.30	1.02
1.50	33.38	31.48	30.27	1.06	1.10	0.017	0.082	2.45	81.73	1.11
1.60	36.42	31.75	30.46	1.15	1.20	0.017	0.080	2.61	95.06	1.19
1.70	39.48	32.12	30.76	1.23	1.28	0.016	0.079	2.76	109.03	1.26
1.80	42.57	32.50	31.09	1.31	1.37	0.016	0.078	2.91	123.81	1.33
1.90	45.70	32.87	31.39	1.39	1.46	0.016	0.077	3.05	139.49	1.40
2.00	48.85	33.21	31.67	1.47	1.54	0.016	0.076	3.20	156.07	1.47

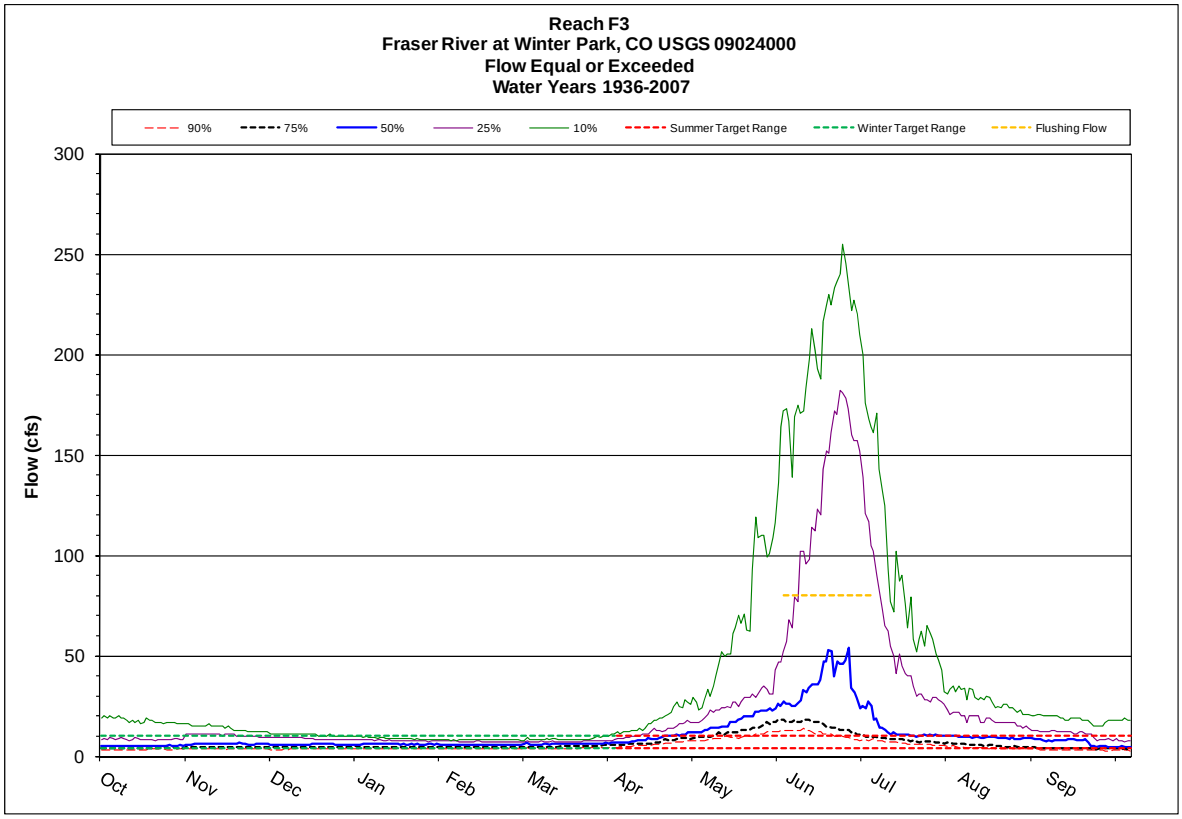


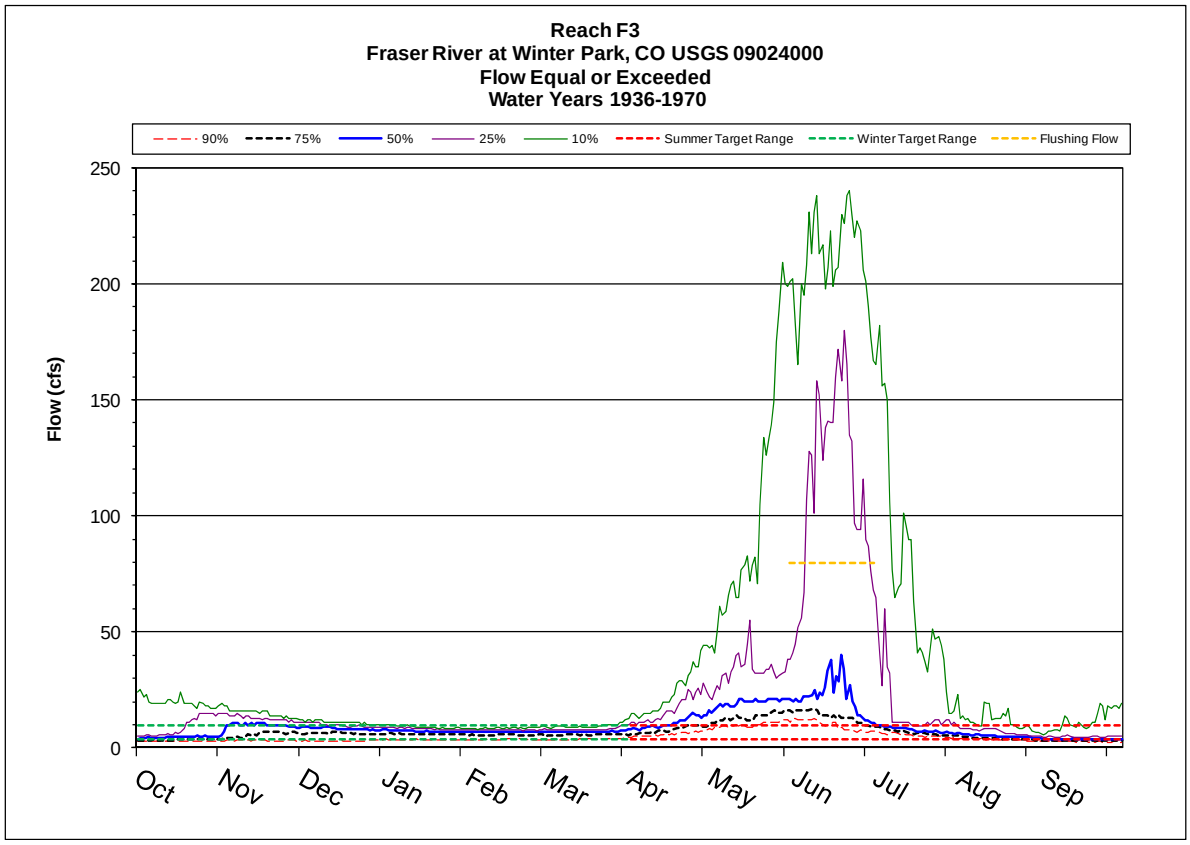
**Data from Corps, by Ecological Resouce Consultants, 2006 for Denver Water
Fraser River at Idlewild Campground **
FR3_TR6
Resistance Method: Jarrett's Equation

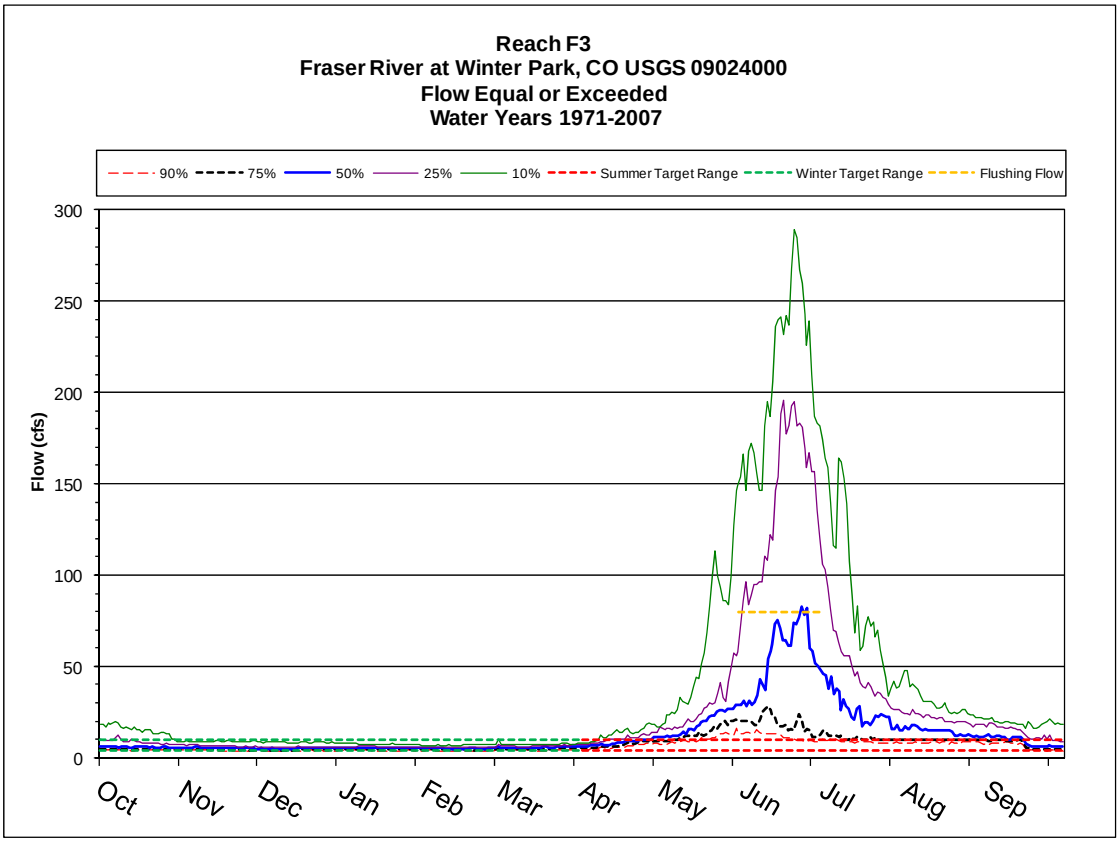
STAGE #SEC (ft)	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.50 T	4.65	22.24	22.07	0.21	0.21	0.017	0.107	0.64	3.0	0.22
0.60 T	7.37	28.35	28.10	0.26	0.26	0.017	0.103	0.76	5.6	0.28
0.70 T	10.20	28.71	28.37	0.36	0.36	0.017	0.098	0.99	10.1	0.38
0.80 T	13.05	29.07	28.64	0.45	0.46	0.017	0.094	1.20	15.7	0.48
0.90 T	15.92	29.37	28.83	0.54	0.55	0.017	0.091	1.41	22.4	0.58
1.00 T	18.81	29.59	28.92	0.64	0.65	0.017	0.089	1.60	30.2	0.67
1.10 T	21.71	29.80	29.01	0.73	0.75	0.017	0.087	1.80	39.0	0.77
1.20 T	24.61	30.02	29.09	0.82	0.85	0.017	0.086	1.98	48.8	0.87
1.30 T	27.52	30.24	29.18	0.91	0.94	0.017	0.084	2.16	59.5	0.97
1.40 T	30.45	30.46	29.27	1.00	1.04	0.017	0.083	2.34	71.1	1.06
1.50 T	33.38	30.68	29.35	1.09	1.14	0.017	0.082	2.51	83.7	1.15
1.60 T	36.32	30.89	29.44	1.18	1.23	0.017	0.081	2.67	97.1	1.25
1.70 T	39.27	31.11	29.53	1.26	1.33	0.017	0.080	2.83	111.3	1.34
1.80 T	42.22	31.34	29.63	1.35	1.43	0.017	0.079	2.99	126.4	1.43
1.90 T	45.19	31.58	29.76	1.43	1.52	0.017	0.078	3.15	142.2	1.52
2.00 T	48.17	31.82	29.89	1.51	1.61	0.017	0.078	3.30	158.8	1.61
2.10 T	51.17	32.22	30.20	1.59	1.69	0.017	0.077	3.43	175.6	1.68

Hydrographs and Exceedence Plots and Tables






Reach F3
Fraser River at Winter Park, CO USGS 09024000
Flow Equal or Exceeded
Water Years 1936-1970
90%
75%
50%
25%
10%
Summer Target Range
Winter Target Range
Flushing Flow
Flow (cfs)
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep


Reach F3
Fraser River at Winter Park, CO USGS 09024000
Flow Equal or Exceeded
Water Years 1971-2007
90%
75%
50%
25%
10%
Summer Target Range
Winter Target Range
Flushing Flow
Flow (cfs)
300
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
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Jul
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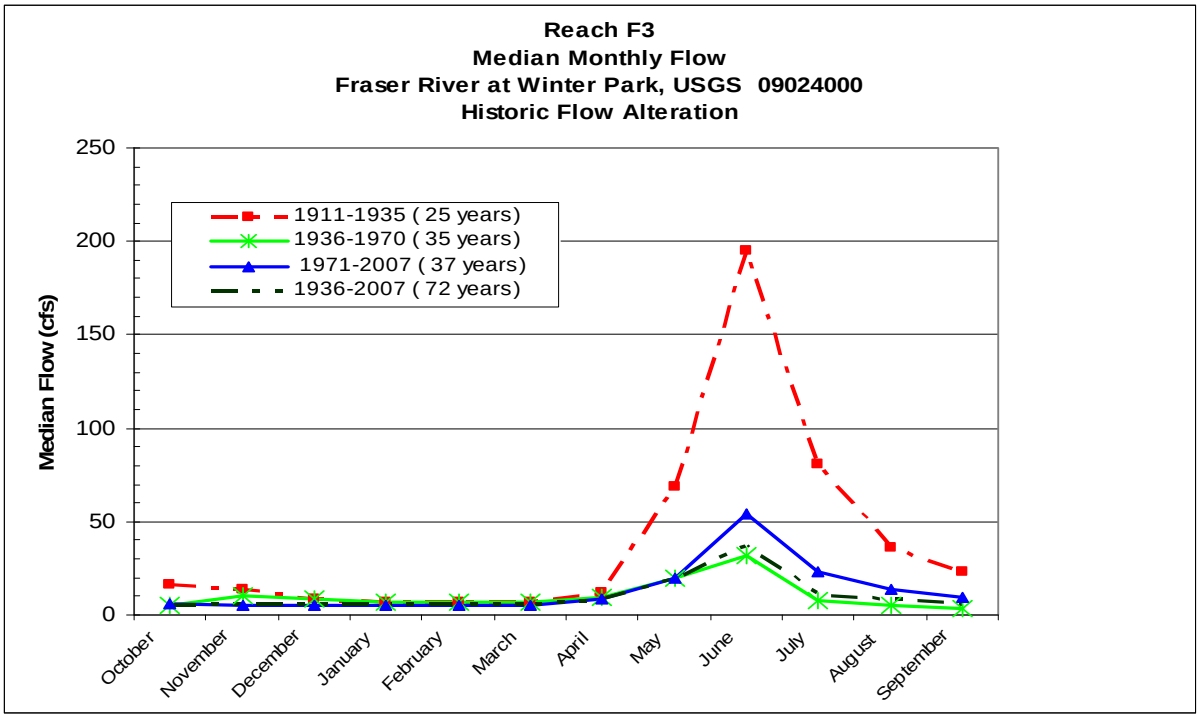
Sep



Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft^3/sec)
1.05	95.2	176
1.11	90.1	200
1.25	80	233
2	50	320
5	20	446
10	10	536
25	4	655

Flood frequency analysis for USGS gage 09024000, Fraser River at Winter Park, CO, for 22 years of record (Water years 1911-1935).

Return Period T (year)	**Probability P (percent)**	**Flood Discharge Q (ft^3/sec)**
1.05	95.2	32
1.11	90.1	50
1.25	80	81
2	50	179
5	20	336
10	10	440
25	4	562

Flood frequency analysis for USGS gage 09024000, Fraser River at Winter Park, CO, for 70 years of record (Water years 1936-2006).

IHA Results

Reach F3
Non-Parametric IHA Scorecard
Fraser River at Winter Park 1911-1935 versus 1936-2007
USGS 09024000

	Pre-impact period: 1911-1935 (25 years)	Post-impact period: 1936-2007 (72 years)
Mean annual flow (cfs)	44.28	17.79
Mean flow/area (dimensionless)	44.28	17.79
Annual C. V.	1.52	2.08
Flow predictability (%)	0.68	0.54
Constancy/predictability	0.44	0.72
% of floods in 60d period	0.55	0.63
Flood-free season (days)	168	224

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
October (cfs)	16	5.1	0.4063	0.7108	0.6813	0.7496	0.002002	0.07808
November (cfs)	14	6.275	0.2679	0.9124	0.5518	2.406	0.03604	0.00
December (cfs)	9	5.95	0.2778	0.6555	0.3389	1.36	0.03704	0.001001
January (cfs)	7	6	0.2714	0.4625	0.1429	0.7039	0.1291	0.02202
February (cfs)	7	5.6	0.2857	0.4487	0.2	0.5703	0.05706	0.02102
March (cfs)	7	6.1	0.3	0.3852	0.1286	0.2842	0.05405	0.2753
April (cfs)	12	8.6	0.8458	0.5581	0.2833	0.3401	0.004004	0.2432
May (cfs)	69	20	0.8043	0.5	0.7101	0.3784	0.00	0.3153
June (cfs)	195	37	0.5321	2.919	0.8103	4.486	0.1451	0.00
July (cfs)	81	11	0.4691	1.725	0.8642	2.677	0.2052	0.00
August (cfs)	36	8.85	0.4028	1.353	0.7542	2.359	0.03904	0.00
September (cfs)	23	5.975	0.4891	1.163	0.7402	1.378	0.03203	0.00
Parameter Group #2								
1-day minimum (cfs)	6	3.4	0.3417	0.3162	0.4333	0.07461	0.00	0.8739
3-day minimum (cfs)	6	3.483	0.2306	0.3038	0.4194	0.3178	0.00	0.3433
7-day minimum (cfs)	6	3.564	0.2464	0.3367	0.406	0.3662	0.00	0.2533
30-day minimum (cfs)	6.167	3.985	0.1676	0.3279	0.3538	0.9568	0.00	0.01301
90-day minimum (cfs)	7.248	4.947	0.1525	0.3914	0.3174	1.566	0.001001	0.00
1-day maximum (cfs)	291	162.5	0.543	1.102	0.4416	1.029	0.04304	0.01702
3-day maximum (cfs)	272.7	145	0.5691	1.245	0.4682	1.187	0.05405	0.009009
7-day maximum (cfs)	256.4	120.6	0.5735	1.464	0.5295	1.552	0.04204	0.006006
30-day maximum (cfs)	204.5	67.68	0.469	1.592	0.6691	2.395	0.07708	0.001001
90-day maximum (cfs)	125.8	36.1	0.4993	1.651	0.713	2.306	0.09309	0.00
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimun in cfs/median in cfs)	0.1422	0.2316	0.3884	0.7207	0.6281	0.8559	0.00	0.009009
Parameter Group #3								
Date of minimum (Julian day)	33	265.5	0.1557	0.4624	0.7295	1.969	0.7758	0.001001
Date of maximum (Julian day)	164	168.5	0.04098	0.05191	0.02459	0.2667	0.2332	0.2593
Parameter Group #4								
Low pulse count (#)	4	6	1.375	1	0.5	0.2727	0.06106	0.4414
Low pulse duration (days)	6.75	5.75	5.019	4.174	0.1481	0.1683	0.5556	0.7988
High pulse count (#)	3	2	0.8333	1	0.3333	0.2	0.08509	0.3393
High pulse duration (days)	14	9.75	4.018	2.09	0.3036	0.4799	0.5245	0.2242
The low pulse threshold is (cfs)	8							
The high pulse threshold is (cfs)	44							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	3	0.775	0.8333	0.6452	0.7417	0.2258	0.00	0.7057
Fall rate (cfs difference between consecutive days)	-2	-0.65	-0.5	-0.7692	0.675	0.5385	0.008008	0.8569
Number of reversals	71	93	0.3169	0.207	0.3099	0.3468	0.00	0.2382

Reach F3
IHA Non-Parametric RVA Scorecard
Fraser River at Winter Park 1911-1935 versus 1936-2007
USGS 09024000

	Pre-impact period: 1911-1935				Post-impact period: 1936-2007				RVA Boundaries		Hydrologic Alteration
Hydrologic Parameters	**Medians**	**Coeff. of Dispersion**	**Minimum**	**Maximum**	**Medians**	**Coeff. of Dispersion**	**Minimum**	**Maximum**	**Low**	**High**	**(Middle Category)**
Parameter Group #1											
October (cfs)	16	0.4063	11	28	5.1	0.7108	2.6	32	15	20	-0.7596
November (cfs)	14	0.2679	7	20	6.275	0.9124	2.7	16	11.79	15	-0.7272
December (cfs)	9	0.2778	4	21	5.95	0.6555	2.8	15	8	9.71	-0.5949
January (cfs)	7	0.2714	4	12	6	0.4625	2.9	10	7	8	-0.6261
February (cfs)	7	0.2857	3	10	5.6	0.4487	3.2	9.9	6	8	-0.5139
March (cfs)	7	0.3	5	11	6.1	0.3852	3.4	10	6	8	-0.4406
April (cfs)	12	0.8458	7	38.5	8.6	0.5581	4.6	21	10.58	14	-0.6181
May (cfs)	69	0.8043	15	138	20	0.5	7.5	122	59.58	84.42	-0.9228
June (cfs)	195	0.5321	77.5	339	37	2.919	5.6	262	165	225	-0.8071
July (cfs)	81	0.4691	25	161	11	1.725	4.6	209	64.58	94.84	-0.9228
August (cfs)	36	0.4028	18	64	8.85	1.353	3.2	40	32	43.42	-0.9684
September (cfs)	23	0.4891	11	39.5	5.975	1.163	2.5	29.5	20	25.84	-0.9653
Parameter Group #2											
1-day minimum (cfs)	6	0.3417	2	8	3.4	0.3162	2.1	7.2	4.874	6	-0.8958
3-day minimum (cfs)	6	0.2306	2.333	8	3.483	0.3038	2.1	7.3	5.279	6.084	-0.9614
7-day minimum (cfs)	6	0.2464	3	8	3.564	0.3367	2.1	7.614	5.509	6.126	-0.9614
30-day minimum (cfs)	6.167	0.1676	3.1	8	3.985	0.3279	2.57	8.183	6.004	6.765	-0.8071
90-day minimum (cfs)	7.248	0.1525	4	9.026	4.947	0.3914	2.83	9.842	6.841	7.564	-0.7685
1-day maximum (cfs)	291	0.543	147	622	162.5	1.102	11	440	264.1	333.3	-0.7299
3-day maximum (cfs)	272.7	0.5691	140.3	592.3	145	1.245	11	425	241.9	324.6	-0.6528
7-day maximum (cfs)	256.4	0.5735	136.7	549.6	120.6	1.464	10.57	385.7	224.4	312.4	-0.5756
30-day maximum (cfs)	204.5	0.469	112.7	358	67.68	1.592	9.4	297.4	175	245	-0.7299
90-day maximum (cfs)	125.8	0.4993	77.37	194.1	36.1	1.651	7.582	159.4	116	145.9	-1
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.1422	0.3884	0.06559	0.2455	0.2316	0.7207	0.04806	0.6083	0.1115	0.1548	-0.537
Parameter Group #3											
Date of minimum (Julian day)	33	0.1557	2	336	265.5	0.4624	1	356	33	67.84	-0.5486
Date of maximum (Julian day)	164	0.04098	131	183	168.5	0.05191	7	305	157.3	166.4	-0.537
Parameter Group #4											
Low pulse count (#)	4	1.375	0	10	6	1	1	13	2	5.42	0.006944
Low pulse duration (days)	6.75	5.019	2	141	5.75	4.174	1	212	4.125	26.25	0.1719
High pulse count (#)	3	0.8333	1	6	2	1	0	5	2	4	-0.2622
High pulse duration (days)	14	4.018	1	110	9.75	2.09	1	62	6.29	39.31	0.04167
The low pulse threshold is (cfs)			8								
The high pulse threshold is (cfs)			44								
Parameter Group #5											
Rise rate (cfs/day)	3	0.8333	1	10	0.775	0.6452	0.2	3	2	3.42	-0.9537
Fall rate (cfs/day)	-2	-0.5	-12	-1	-0.65	-0.7692	-2	-0.2	-2	-2	-0.9783
Number of reversals (count)	71	0.3169	40	103	93	0.207	56	126	62.32	80	-0.7222

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)	37.44	9	-0.7596	20.16	1	-0.9504	14.4	62	3.306
November (cfs)	40.32	11	-0.7272	8.64	3	-0.6528	23.04	58	1.517
December (cfs)	34.56	14	-0.5949	23.04	10	-0.566	14.4	48	2.333
January (cfs)	37.44	14	-0.6261	17.28	11	-0.3634	17.28	47	1.72
February (cfs)	57.6	28	-0.5139	5.76	6	0.04167	8.64	38	3.398
March (cfs)	51.84	29	-0.4406	17.28	11	-0.3634	2.88	32	10.11
April (cfs)	28.8	11	-0.6181	20.16	11	-0.4544	23.04	50	1.17
May (cfs)	25.92	2	-0.9228	23.04	3	-0.8698	23.04	67	1.908
June (cfs)	25.92	5	-0.8071	23.04	5	-0.783	23.04	62	1.691
July (cfs)	25.92	2	-0.9228	23.04	4	-0.8264	23.04	66	1.865
August (cfs)	31.68	1	-0.9684	23.04	0	-1	17.28	71	3.109
September (cfs)	28.8	1	-0.9653	23.04	1	-0.9566	20.16	70	2.472
Parameter Group #2									
1-day minimum (cfs)	28.8	3	-0.8958	20.16	2	-0.9008	23.04	67	1.908
3-day minimum (cfs)	25.92	1	-0.9614	23.04	2	-0.9132	23.04	69	1.995
7-day minimum (cfs)	25.92	1	-0.9614	23.04	2	-0.9132	23.04	69	1.995
30-day minimum (cfs)	25.92	5	-0.8071	23.04	1	-0.9566	23.04	66	1.865
90-day minimum (cfs)	25.92	6	-0.7685	23.04	5	-0.783	23.04	61	1.648
1-day maximum (cfs)	25.92	7	-0.7299	23.04	6	-0.7396	23.04	59	1.561
3-day maximum (cfs)	25.92	9	-0.6528	23.04	6	-0.7396	23.04	57	1.474
7-day maximum (cfs)	25.92	11	-0.5756	23.04	5	-0.783	23.04	56	1.431
30-day maximum (cfs)	25.92	7	-0.7299	23.04	4	-0.8264	23.04	61	1.648
90-day maximum (cfs)	25.92	0	-1	23.04	4	-0.8264	23.04	68	1.951
Number of zero days (count)	72	72	0	0	0		0	0	
Base flow index (7day minimun in cfs/median in cfs)	25.92	12	-0.537	23.04	55	1.387	23.04	5	-0.783
Parameter Group #3									
Date of minimum (Julian day)	28.8	13	-0.5486	23.04	55	1.387	20.16	4	-0.8016
Date of maximum (Julian day)	25.92	12	-0.537	23.04	39	0.6927	23.04	21	-0.08854
Parameter Group #4									
Low pulse count (#)	28.8	29	0.006944	23.04	37	0.6059	20.16	6	-0.7024
Low pulse duration (days)	23.04	27	0.1719	23.04	18	-0.2188	23.04	27	0.1719
High pulse count (#)	46.08	34	-0.2622	8.64	5	-0.4213	17.28	33	0.9097
High pulse duration (days)	25.92	27	0.04167	23.04	6	-0.7396	23.04	23	-0.001736
Parameter Group #5									
Rise rate (cfs/day)	43.2	2	-0.9537	23.04	0	-1	5.76	70	11.15
Fall rate (cfs/day)	46.08	1	-0.9783	5.76	71	11.33	20.16	0	-1
Number of reversals (count)	28.8	8	-0.7222	20.16	63	2.125	23.04	1	-0.9566

Reach F3
IHA Percentile Data
Fraser River at Winter Park1911-1935 versus 1936-2007
USGS 09024000

	Pre-impact period: 1911-1935 (25 years)						Post-impact period: 1936-2007 (72 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)	12.6	15	16	21.5	25.4	0.4063	3.35	4.325	5.1	7.95	15.7	0.7108
November (cfs)	9.2	11.25	14	15	18.8	0.2679	3.665	4.65	6.275	10.38	13.35	0.9124
December (cfs)	7	8	9	10.5	12.8	0.2778	3.53	4.7	5.95	8.6	10.7	0.6555
January (cfs)	5.2	6.5	7	8.4	11	0.2714	3.83	4.8	6	7.575	8.74	0.4625
February (cfs)	4.6	6	7	8	8.4	0.2857	3.56	4.662	5.6	7.175	8	0.4487
March (cfs)	6	6	7	8.1	10.4	0.3	4	5	6.1	7.35	8.54	0.3852
April (cfs)	7	8.1	12	18.25	30.1	0.8458	6.2	7.075	8.6	11.88	16	0.5581
May (cfs)	23.8	45.5	69	101	129.4	0.8043	11	14	20	24	53.1	0.5
June (cfs)	100.8	154	195	257.8	315.7	0.5321	11.3	14.5	37	122.5	169.6	2.919
July (cfs)	42.6	60.5	81	98.5	131.4	0.4691	6.53	8.025	11	27	58.2	1.725
August (cfs)	26.4	31	36	45.5	55.6	0.4028	3.93	5.025	8.85	17	23.7	1.353
September (cfs)	15.4	17.75	23	29	36.6	0.4891	3.1	3.8	5.975	10.75	15.85	1.163
Parameter Group #2												
1-day minimum (cfs)	3	4.2	6	6.25	7	0.3417	2.33	2.825	3.4	3.9	4.65	0.3162
3-day minimum (cfs)	3	5	6	6.383	7	0.2306	2.433	2.9	3.483	3.958	4.72	0.3038
7-day minimum (cfs)	3.8	5.214	6	6.693	7	0.2464	2.547	2.964	3.564	4.164	4.86	0.3367
30-day minimum (cfs)	4.58	6	6.167	7.033	7.589	0.1676	2.946	3.336	3.985	4.643	5.525	0.3279
90-day minimum (cfs)	5.238	6.511	7.248	7.617	8.687	0.1525	3.647	4.282	4.947	6.218	7.532	0.3914
1-day maximum (cfs)	169.2	215	291	373	547.8	0.543	20.3	58.75	162.5	237.8	296.1	1.102
3-day maximum (cfs)	160.2	205.5	272.7	360.7	518.3	0.5691	19.5	49.5	145	230	284.2	1.245
7-day maximum (cfs)	153.9	186.4	256.4	333.4	484.8	0.5735	19.03	37.57	120.6	214.1	260.8	1.464
30-day maximum (cfs)	132.7	156.9	204.5	252.8	354.7	0.469	16.15	25.52	67.68	133.3	209.9	1.592
90-day maximum (cfs)	79.26	103.7	125.8	166.5	185.1	0.4993	12.69	17.91	36.1	77.49	99.69	1.651
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)	0.07002	0.1069	0.1422	0.1621	0.1918	0.3884	0.1201	0.1624	0.2316	0.3293	0.4515	0.7207
Parameter Group #3												
Date of minimum (Julian day)	325	7	33	64	94.6	0.1557	45.3	79.75	265.5	276.5	316.7	0.4624
Date of maximum (Julian day)	148.2	153	164	168	176.2	0.04098	140.3	155	168.5	174	187.1	0.05191
Parameter Group #4												
Low pulse count (#)	1	1	4	6.5	9.4	1.375	2	3	6	9	11	1
Low pulse duration (days)	2	3.5	6.75	37.38	73.5	5.019	2	3.625	5.75	27.63	101.8	4.174
High pulse count (#)	1	1.5	3	4	5	0.8333	0	1	2	3	4	1
High pulse duration (days)	1.8	3.25	14	59.5	97.4	4.018	1	3.625	9.75	24	44	2.09
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	1.76	2	3	4.5	7.2	0.8333	0.3	0.5	0.775	1	1	0.6452
Fall rate (cfs difference between consecutive days)	-6.4	-3	-2	-2	-1.6	-0.5	-1	-1	-0.65	-0.5	-0.4	-0.7692
Number of reversals	48.6	58.5	71	81	92.4	0.3169	78	84	93	103.3	111	0.207
EFC Monthly Low Flows												
October Low Flow (cfs)	12.6	14.25	16	21	24.8	0.4219	6.405	6.738	9.35	14	17.9	0.7767
November Low Flow (cfs)	10	11	13	15	18.5	0.3077	6.205	6.4	8.8	12	14.9	0.6364
December Low Flow (cfs)	7.35	8	9	10.75	13	0.3056	6.2	7.2	8.4	9.7	11	0.2976
January Low Flow (cfs)	7	7	8	8.8	11	0.225	6.2	6.425	7.3	8.375	9.36	0.2671
February Low Flow (cfs)	6.9	7	8	8	9	0.125	6.28	6.55	7.1	7.8	8.72	0.1761
March Low Flow (cfs)	6.38	7	7.8	8.3	9.6	0.1667	6.3	6.5	7	7.8	9.08	0.1857
April Low Flow (cfs)	7.85	8.05	11.5	12.75	14.5	0.4087	7.315	8.013	9.1	11	15	0.3283
May Low Flow (cfs)	8	13.38	19.5	33.5	43.1	1.032	10.2	12	16	21	25.5	0.5625
June Low Flow (cfs)	38	38	40	42	42	0.1	9.555	12	16	25.63	33	0.8516
July Low Flow (cfs)	25	36	40	43	43	0.175	7.22	8	9.575	13.75	28	0.6005
August Low Flow (cfs)	20.6	28.5	31	37	42.8	0.2742	6.4	7.75	10	17	23.25	0.925
September Low Flow (cfs)	15	17.25	23.25	27.63	34.5	0.4462	6.62	8.25	10	14	17.6	0.575
EFC Parameters												
Extreme low peak (cfs)	3.8	4.475	5.025	6	6	0.3035	3.665	4.413	4.9	5.413	5.7	0.2041
Extreme low duration (days)	1.9	3	5.75	28	47	4.348	3.1	5	7	19.63	71.6	2.089
Extreme low timing (Julian date)	309.4	28	48.75	78.13	95.25	0.137	65.4	111.8	239	270.3	304.9	0.4331
Extreme low freq. (#/year)	0	0	2	3	7.2	1.5	2	3	5	6	8	0.6
High flow peak (cfs)	22.4	31.5	42	52.5	74	0.5	23	29	37.75	58.88	133.2	0.7914
High flow duration (days)	2	3.5	4.5	10	13.8	1.444	2	3.25	4.75	9.75	28	1.368
High flow timing (Julian date)	118.9	135	172	283	319	0.4044	118.6	143.9	167.8	188	220.6	0.1206
High flow frequency (#/year)	0.6	2.5	4	5.5	7	0.75	1	2	3	4.75	6.7	0.9167
High flow rise rate (cfs differnenc between consecutive days)	4	5.25	6.333	8	11.44	0.4342	4.744	6.135	9.188	13.78	18.55	0.8315
High flow fall rate (cfs difference between consecutive days)	-6.473	-4.417	-3	-2	-1.778	-0.8056	-11.6	-8.875	-5.635	-3.347	-2.834	-0.981
Small Flood peak (cfs)	292.4	300	349	423	500.2	0.3524	300	358	384	424	440	0.1719
Small Flood duration (days)	69.4	72	86	98	118.4	0.3023	16	53	59	71	77	0.3051
Small Flood timing (Julian date)	152.4	155	164	168	181.4	0.03552	159	165	174	185	191	0.05464
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	0	0.7	0
Small Flood riserate (cfs difference between consecutive days)	5.531	9.091	11.5	13.41	21.25	0.3757	7.818	8.323	9.917	17.73	71.2	0.9484
Small Flood fallrate (cfs difference between consecutive days)	-8.592	-8.132	-5.75	-4.296	-4.09	-0.6672	-53	-29.17	-12.07	-10.47	-8.286	-1.549
Large flood peak (cfs)	609	609	615.5	622	622	0.02112						
Large flood duration (days)	88	88	116	144	144	0.4828						
Large flood timing (Julian date)	166	166	168.5	171	171	0.01366						
Large flood freq. (#/year)	0	0	0	0	0.4	0	0	0	0	0	0	0
Large flood riserate (cfs difference between consecutive days)	6.789	6.789	10.38	13.98	13.98	0.6923						
Large flood fallrate (cfs difference between consecutive days)	-12.33	-12.33	-11.48	-10.64	-10.64	-0.1472						

Reach F3
Non-Parametric IHA Scorecard
Fraser River at Winter Park 1936-70 versus 1971 - 2007
USGS 09024000

	Pre-impact period: 1936-1970 (35 years)	**Post-impact period: 1971-2007 (37 years)**
Mean annual flow (cfs)	16.62	18.89
Mean flow/area (dimensionless)	16.62	18.89
Annual C. V.	2.13	2.03
Flow predictability (%)	0.56	0.59
Constancy/predictability	0.69	0.64
% of floods in 60d period	0.32	0.32
Flood-free season (days)	97	78

	MEDIANS		**COEFF. of DISP.**		**DEVIATION FACTOR**		**SIGNIFICANCE COUNT**	
	Pre	**Post**	**Pre**	**Post**	**Medians**	**C.D.**	**Medians**	**C.D.**
Parameter Group #1								
October (cfs)	4.8	5.7	0.4375	0.6316	0.1875	0.4436	0.02503	0.5075
November (cfs)	10	5.2	0.615	0.351	0.48	0.4293	0.01502	0.1071
December (cfs)	8.4	5	0.3571	0.3	0.4048	0.16	0.01101	0.4494
January (cfs)	7.1	5.1	0.3239	0.3039	0.2817	0.06181	0.006006	0.8068
February (cfs)	7.05	4.9	0.305	0.2347	0.305	0.2304	0.01001	0.2222
March (cfs)	7.1	5.4	0.3662	0.2315	0.2394	0.3679	0.001001	0.1301
April (cfs)	9.5	8.2	0.7684	0.3232	0.1368	0.5794	0.02803	0.2002
May (cfs)	20	20	0.9	0.475	0	0.4722	0.951	0.1902
June (cfs)	32	54.5	2.313	2.266	0.7031	0.02008	0.07007	0.959
July (cfs)	8.1	23	0.5309	1.261	1.84	1.375	0.00	0.08509
August (cfs)	5.1	14	0.5882	0.7571	1.745	0.2871	0.00	0.3904
September (cfs)	3.8	9.4	0.4211	0.6303	1.474	0.497	0.00	0.1221
Parameter Group #2								
1-day minimum (cfs)	3	3.7	0.3333	0.2568	0.2333	0.2297	0.00	0.3323
3-day minimum (cfs)	3	3.767	0.3222	0.2434	0.2556	0.2447	0.00	0.3884
7-day minimum (cfs)	3	3.929	0.2905	0.2509	0.3095	0.1362	0.00	0.6817
30-day minimum (cfs)	3.447	4.463	0.3066	0.258	0.295	0.1584	0.00	0.4194
90-day minimum (cfs)	5.274	4.782	0.3876	0.2214	0.09332	0.4288	0.04204	0.1401
1-day maximum (cfs)	143	189	1.441	0.8413	0.3217	0.416	0.1682	0.2843
3-day maximum (cfs)	122.3	172	1.684	0.8779	0.406	0.4787	0.1592	0.2032
7-day maximum (cfs)	93	145.7	2.089	0.9936	0.5668	0.5244	0.08509	0.1411
30-day maximum (cfs)	47.8	77.07	2.266	1.347	0.6123	0.4058	0.07007	0.1882
90-day maximum (cfs)	29.17	39.16	1.567	1.403	0.3425	0.1048	0.1341	0.7628
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimun in cfs/median in cfs)	0.2248	0.2509	0.818	0.6678	0.1161	0.1836	0.5275	0.4625
Parameter Group #3								
Date of minimum (Julian day)	269	50	0.06557	0.2896	0.8033	3.417	0.01502	0.04805
Date of maximum (Julian day)	168	170	0.06011	0.04235	0.01093	0.2955	0.6657	0.2653
Parameter Group #4								
Low pulse count (#)	4	5	1	1	0.25	0	0.1702	0.8959
Low pulse duration (days)	7.5	5.5	1.367	2	0.2667	0.4634	0.1572	0.1051
High pulse count (#)	5	4	0.6	1	0.2	0.6667	0.4054	0.05205
High pulse duration (days)	3.25	5	1.808	7.5	0.5385	3.149	0.06707	0.09109
The low pulse threshold is (cfs)	5.1							
The high pulse threshold is (cfs)	12							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	0.8	0.7	0.5	0.8571	0.125	0.7143	0.4655	0.06507
Fall rate (cfs difference between consecutive days)	-0.6	-1	-0.9167	-0.5	0.6667	0.4545	0.02002	0.2753
Number of reversals	88	98	0.1364	0.2143	0.1136	0.5714	0.006006	0.02503

Reach F3
IHA Non-Parametric RVA Scorecard
Fraser River at Winter Park 1936-70 versus 1971 - 2007
USGS 09024000

	Pre-impact period: 1936-1970				Post-impact period: 1971-2007				RVA Boundaries		Hydrologic Alteration
Hydrologic Parameters	**Medians**	**Coeff. of Dispersion**	**Minimum**	**Maximum**	**Medians**	**Coeff. of Dispersion**	**Minimum**	**Maximum**	**Low**	**High**	**(Middle Category)**
Parameter Group #1											
October (cfs)	4.8	0.4375	2.6	32	5.7	0.6316	3.9	19	4	5.112	-0.3497
November (cfs)	10	0.615	2.7	16	5.2	0.351	3.4	15	7.788	12	-0.6622
December (cfs)	8.4	0.3571	2.8	12	5	0.3	3.3	15	7.176	9.148	-0.7089
January (cfs)	7.1	0.3239	2.9	10	5.1	0.3039	3.7	10	6.488	8	-0.8108
February (cfs)	7.05	0.305	3.2	9.9	4.9	0.2347	3.2	9.1	6.5	7.5	-0.8108
March (cfs)	7.1	0.3662	3.6	10	5.4	0.2315	3.4	9.9	6.552	7.624	-0.7817
April (cfs)	9.5	0.7684	4.6	21	8.2	0.3232	4.8	15.5	8.6	13.12	-0.2568
May (cfs)	20	0.9	7.5	122	20	0.475	9.2	106	15.76	26.36	0.5281
June (cfs)	32	2.313	5.6	244	54.5	2.266	7.4	262	14.5	52.54	-0.2568
July (cfs)	8.1	0.5309	4.6	185	23	1.261	8	209	7.2	9.448	-0.6622
August (cfs)	5.1	0.5882	3.2	22	14	0.7571	3.3	40	4.4	5.912	-0.9369
September (cfs)	3.8	0.4211	2.5	29.5	9.4	0.6303	3.8	20	3.476	4.312	-0.9272
Parameter Group #2											
1-day minimum (cfs)	3	0.3333	2.1	5.2	3.7	0.2568	2.1	7.2	2.776	3.4	-0.3919
3-day minimum (cfs)	3	0.3222	2.1	5.2	3.767	0.2434	2.133	7.3	2.792	3.441	-0.3451
7-day minimum (cfs)	3	0.2905	2.1	5.471	3.929	0.2509	2.386	7.614	2.838	3.509	-0.3451
30-day minimum (cfs)	3.447	0.3066	2.57	6.49	4.463	0.258	3.17	8.183	3.104	3.897	-0.1996
90-day minimum (cfs)	5.274	0.3876	2.83	9.842	4.782	0.2214	3.631	9.552	4.793	6.251	-0.05405
1-day maximum (cfs)	143	1.441	12	421	189	0.8413	11	440	90.6	225.6	0.01871
3-day maximum (cfs)	122.3	1.684	11.33	395	172	0.8779	11	425	58.17	209.5	0.1642
7-day maximum (cfs)	93	2.089	10.57	355.4	145.7	0.9936	11	385.7	47.58	189.2	0.3098
30-day maximum (cfs)	47.8	2.266	9.4	287.9	77.07	1.347	10.21	297.4	26.54	99.8	0.237
90-day maximum (cfs)	29.17	1.567	7.582	154.3	39.16	1.403	9.683	159.4	17.99	53.4	0.237
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.2248	0.818	0.04806	0.4824	0.2509	0.6678	0.07203	0.6083	0.1709	0.2919	0.01871
Parameter Group #3											
Date of minimum (Julian day)	269	0.06557	5	297	50	0.2896	1	356	253	273.1	-0.5946
Date of maximum (Julian day)	168	0.06011	109	305	170	0.04235	7	192	156.8	173	0.07207
Parameter Group #4											
Low pulse count (#)	4	1	0	9	5	1	0	12	3	5.12	-0.3694
Low pulse duration (days)	7.5	1.367	1	141	5.5	2	1	133	5.775	12.9	-0.4482
High pulse count (#)	5	0.6	0	9	4	1	0	14	3	6	-0.2186
High pulse duration (days)	3.25	1.808	1	49	5	7.5	1	132	3	5.9	-0.2568
The low pulse threshold is (cfs)			5.1								
The high pulse threshold is (cfs)			12								
Parameter Group #5											
Rise rate (cfs/day)	0.8	0.5	0.35	1.65	0.7	0.8571	0.2	3	0.6	1	-0.2511
Fall rate (cfs/day)	-0.6	-0.9167	-1	-0.3	-1	-0.5	-2	-0.2	-0.8	-0.5	-0.4679
Number of reversals (count)	88	0.1364	56	119	98	0.2143	67	126	84	93.12	-0.4679

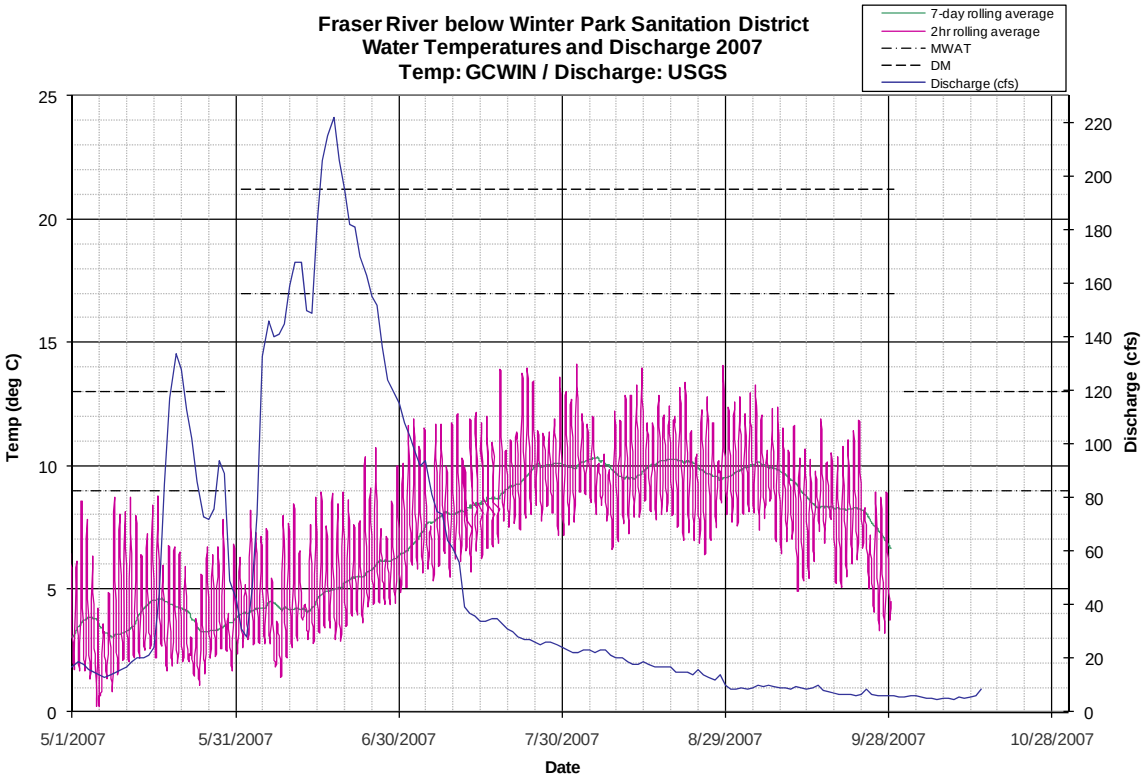
Assessment of Hydrologic Alteration

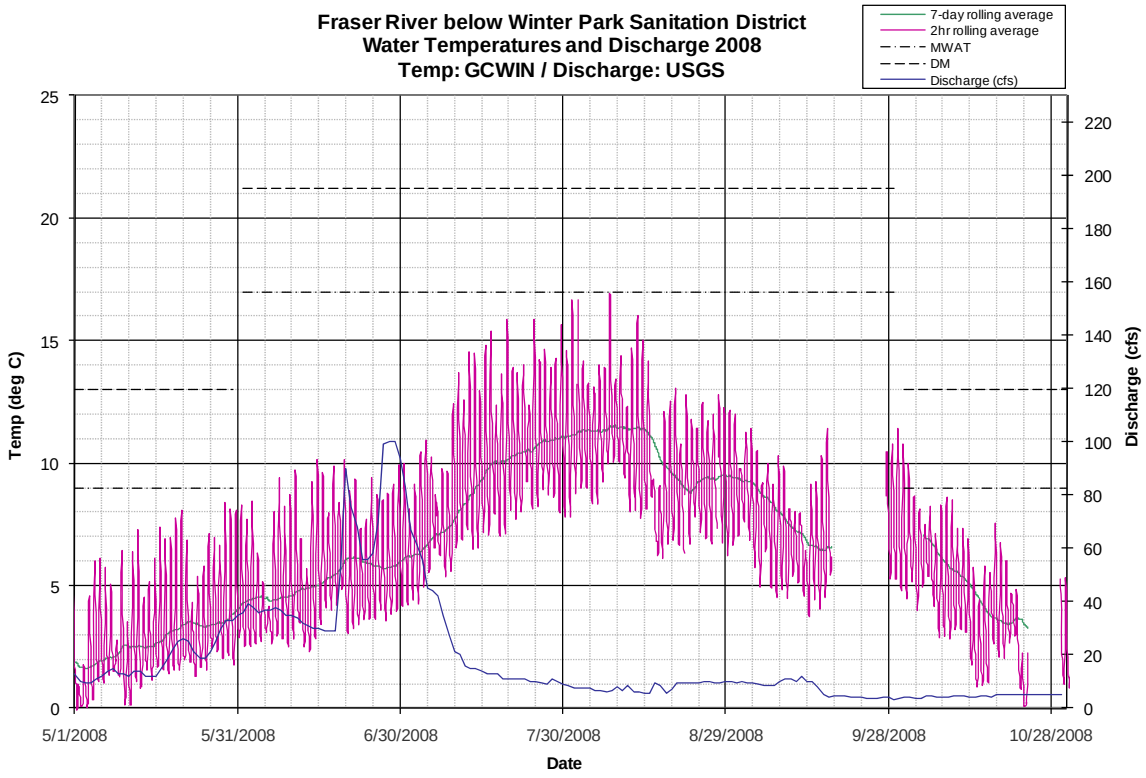
	Middle RVA Category			High RVA Category			Low RVA Category		
	Expected	**Observed**	**Alter.**	**Expected**	**Observed**	**Alter.**	**Expected**	**Observed**	**Alter.**
Parameter Group #1									
October (cfs)	16.91	11	-0.3497	11.63	24	1.064	8.457	2	-0.7635
November (cfs)	14.8	5	-0.6622	10.57	1	-0.9054	11.63	31	1.666
December (cfs)	13.74	4	-0.7089	11.63	2	-0.828	11.63	31	1.666
January (cfs)	15.86	3	-0.8108	9.514	2	-0.7898	11.63	32	1.752
February (cfs)	15.86	3	-0.8108	10.57	2	-0.8108	10.57	32	2.027
March (cfs)	13.74	3	-0.7817	11.63	2	-0.828	11.63	32	1.752
April (cfs)	14.8	11	-0.2568	11.63	3	-0.742	10.57	23	1.176
May (cfs)	13.74	21	0.5281	11.63	5	-0.57	11.63	11	-0.05405
June (cfs)	14.8	11	-0.2568	11.63	19	0.6339	10.57	7	-0.3378
July (cfs)	14.8	5	-0.6622	11.63	32	1.752	10.57	0	-1
August (cfs)	15.86	1	-0.9369	11.63	35	2.01	9.514	1	-0.8949
September (cfs)	13.74	1	-0.9272	11.63	36	2.096	11.63	0	-1
Parameter Group #2									
1-day minimum (cfs)	14.8	9	-0.3919	10.57	25	1.365	11.63	3	-0.742
3-day minimum (cfs)	13.74	9	-0.3451	11.63	27	1.322	11.63	1	-0.914
7-day minimum (cfs)	13.74	9	-0.3451	11.63	27	1.322	11.63	1	-0.914
30-day minimum (cfs)	13.74	11	-0.1996	11.63	26	1.236	11.63	0	-1
90-day minimum (cfs)	13.74	13	-0.05405	11.63	5	-0.57	11.63	19	0.6339
1-day maximum (cfs)	13.74	14	0.01871	11.63	12	0.03194	11.63	11	-0.05405
3-day maximum (cfs)	13.74	16	0.1642	11.63	13	0.1179	11.63	8	-0.312
7-day maximum (cfs)	13.74	18	0.3098	11.63	11	-0.05405	11.63	8	-0.312
30-day maximum (cfs)	13.74	17	0.237	11.63	13	0.1179	11.63	7	-0.398
90-day maximum (cfs)	13.74	17	0.237	11.63	13	0.1179	11.63	7	-0.398
Number of zero days (count)	37	37	0	0	0		0	0	
Base flow index (7day minimun in cfs/median in cfs)	13.74	14	0.01871	11.63	14	0.2039	11.63	9	-0.226
Parameter Group #3									
Date of minimum (Julian day)	14.8	6	-0.5946	11.63	12	0.03194	10.57	19	0.7973
Date of maximum (Julian day)	15.86	17	0.07207	9.514	12	0.2613	11.63	8	-0.312
Parameter Group #4									
Low pulse count (#)	15.86	10	-0.3694	11.63	15	0.2899	9.514	12	0.2613
Low pulse duration (days)	12.69	7	-0.4482	11.63	9	-0.226	11.63	18	0.5479
High pulse count (#)	24.31	19	-0.2186	8.457	7	-0.1723	4.229	11	1.601
High pulse duration (days)	14.8	11	-0.2568	11.63	17	0.4619	9.514	8	-0.1592
Parameter Group #5									
Rise rate (cfs/day)	25.37	19	-0.2511	1.057	3	1.838	10.57	15	0.4189
Fall rate (cfs/day)	16.91	9	-0.4679	9.514	8	-0.1592	10.57	20	0.8919
Number of reversals (count)	16.91	9	-0.4679	11.63	22	0.8919	8.457	6	-0.2905

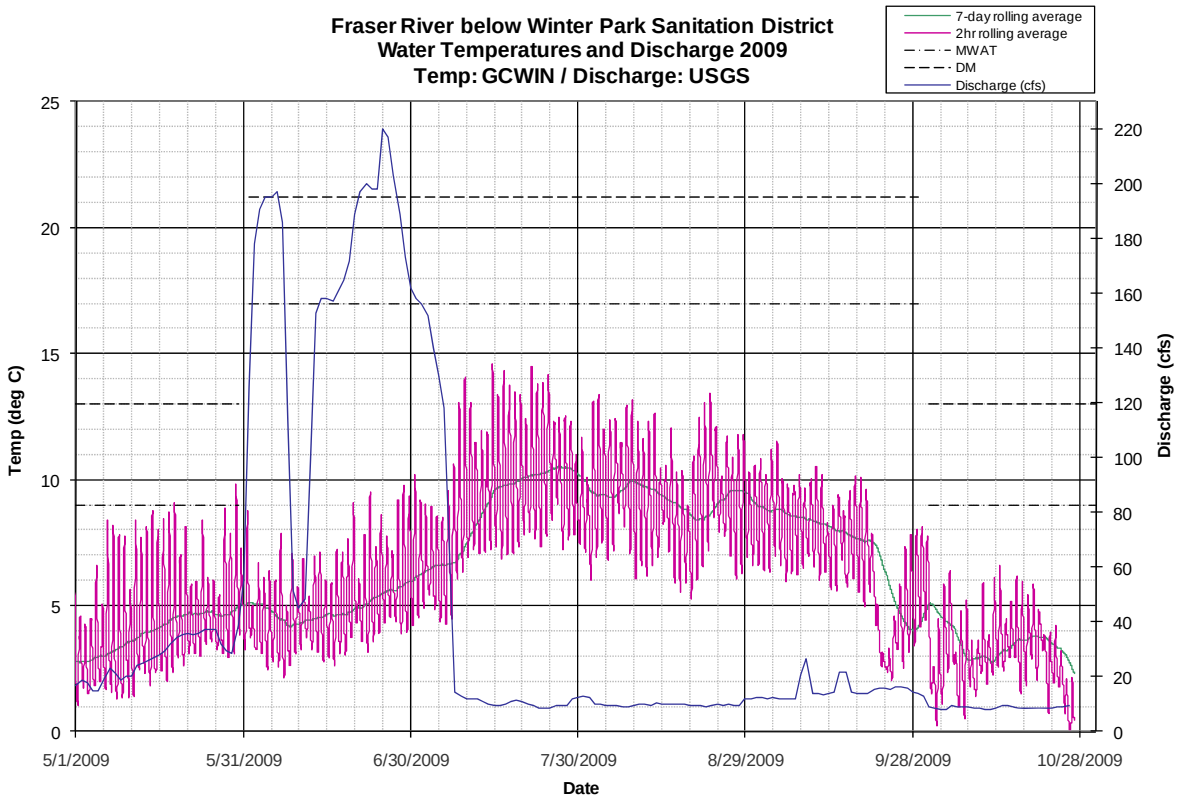
Reach F3
IHA Non-Parametric RVA Scorecard
Fraser River at Winter Park 1936-70 versus 1971 - 2007
USGS 09024000

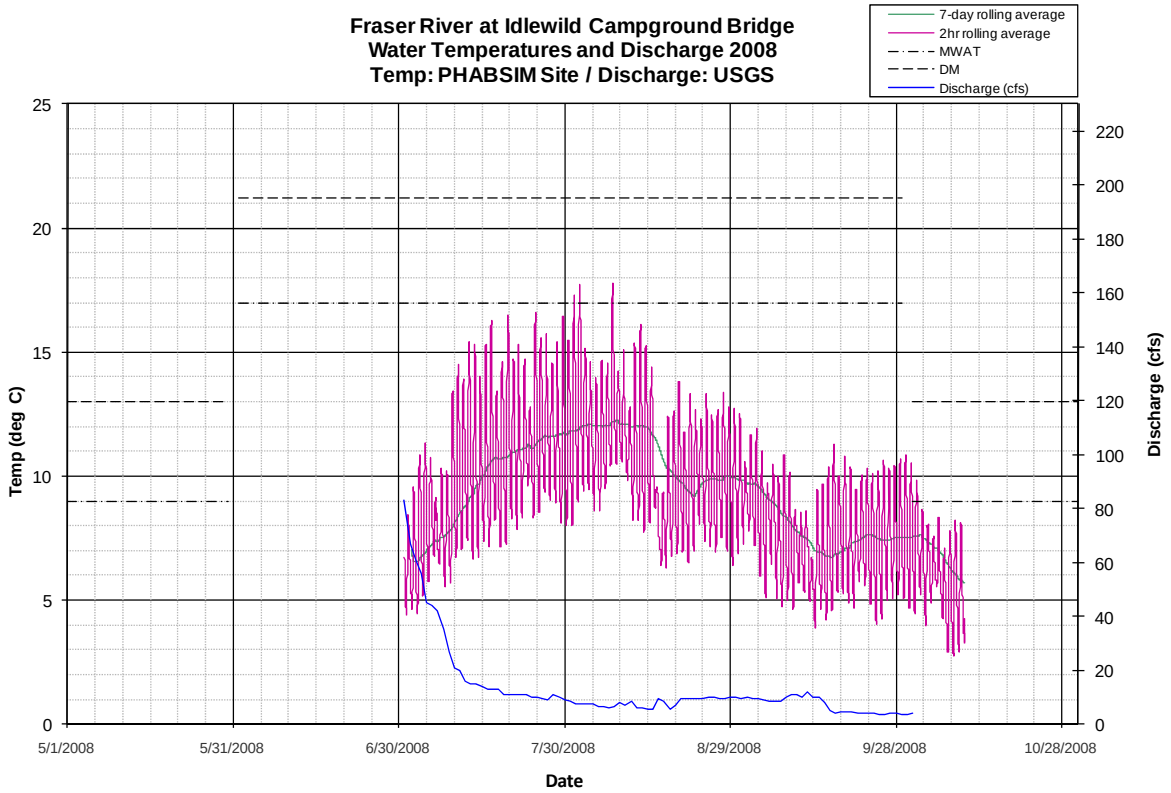
	Pre-impact period: 1936-1970 (35 years)						Post-impact period: 1971-2007 (37 years)					
			Pre-Impact						Post-Impact			
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #1												
October (cfs)	2.96	4	4.8	6.1	19	0.4375	4.24	4.7	5.7	8.3	15	0.6316
November (cfs)	3.16	6.85	10	13	15.2	0.615	3.78	4.45	5.2	6.275	9.04	0.351
December (cfs)	3.18	6.6	8.4	9.6	11	0.3571	3.76	4.45	5	5.95	8.04	0.3
January (cfs)	3.74	6	7.1	8.3	8.94	0.3239	3.8	4.4	5.1	5.95	7.44	0.3039
February (cfs)	3.74	5.6	7.05	7.75	8.36	0.305	3.5	4.5	4.9	5.65	6.56	0.2347
March (cfs)	3.84	5.6	7.1	8.2	9.16	0.3662	3.98	4.95	5.4	6.2	7	0.2315
April (cfs)	6.16	7.7	9.5	15	18.4	0.7684	6.14	6.975	8.2	9.625	12.4	0.3232
May (cfs)	11	14	20	32	67.4	0.9	10.8	14	20	23.5	44.4	0.475
June (cfs)	9.06	14	32	88	168.2	2.313	12.2	22.25	54.5	145.8	189	2.266
July (cfs)	6.1	6.7	8.1	11	34.2	0.5309	8.72	11	23	40	76.2	1.261
August (cfs)	3.66	4.1	5.1	7.1	10.28	0.5882	8.14	9.9	14	20.5	27.6	0.7571
September (cfs)	2.8	3.1	3.8	4.7	5.93	0.4211	5.87	7.575	9.4	13.5	16.6	0.6303
Parameter Group #2												
1-day minimum (cfs)	2.2	2.5	3	3.5	3.98	0.3333	2.86	3.3	3.7	4.25	5.02	0.2568
3-day minimum (cfs)	2.24	2.633	3	3.6	4.22	0.3222	3.007	3.4	3.767	4.317	5.14	0.2434
7-day minimum (cfs)	2.369	2.8	3	3.671	4.323	0.2905	3.063	3.45	3.929	4.436	5.3	0.2509
30-day minimum (cfs)	2.64	2.987	3.447	4.043	5.11	0.3066	3.342	3.665	4.463	4.817	6.184	0.258
90-day minimum (cfs)	3.136	4.642	5.274	6.687	7.749	0.3876	3.728	4.217	4.782	5.276	6.865	0.2214
1-day maximum (cfs)	19.6	42	143	248	285.8	1.441	20.4	75.5	189	234.5	360.4	0.8413
3-day maximum (cfs)	18.6	35.67	122.3	241.7	276.4	1.684	19.27	70.17	172	221.2	342.4	0.8779
7-day maximum (cfs)	18.03	31.14	93	225.4	260.5	2.089	18.97	59	145.7	203.8	302.7	0.9936
30-day maximum (cfs)	15.65	21.8	47.8	130.1	206.9	2.266	15.5	41.25	77.07	145	225.5	1.347
90-day maximum (cfs)	12.88	17.56	29.17	63.28	96.5	1.567	11.27	26.3	39.16	81.24	111.5	1.403
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)	0.1088	0.1413	0.2248	0.3252	0.4436	0.818	0.1401	0.1784	0.2509	0.3459	0.4686	0.6678
Parameter Group #3												
Date of minimum (Julian day)	233	251	269	275	279.4	0.06557	312.8	343.5	50	83.5	270.6	0.2896
Date of maximum (Julian day)	116.2	152	168	174	194.4	0.06011	144	159	170	174.5	185	0.04235
Parameter Group #4												
Low pulse count (#)	2	2	4	6	8	1	0.8	2	5	7	10	1
Low pulse duration (days)	2.25	4.875	7.5	15.13	34.75	1.367	2	3.5	5.5	14.5	39	2
High pulse count (#)	2	3	5	6	8.4	0.6	1	2	4	6	7.2	1
High pulse duration (days)	2	2.375	3.25	8.25	32.5	1.808	2	3	5	40.5	70.2	7.5
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	0.46	0.6	0.8	1	1	0.5	0.3	0.4	0.7	1	1.02	0.8571
Fall rate (cfs difference between consecutive days)	-1	-1	-0.6	-0.45	-0.4	-0.9167	-1	-1	-1	-0.5	-0.39	-0.5
Number of reversals	75	84	88	96	104.2	0.1364	80.8	87	98	108	115.2	0.2143
EFC Monthly Low Flows												
October Low Flow (cfs)	3.45	3.675	4.4	5	5.6	0.3011	3.97	4.525	5.55	7.15	8.22	0.473
November Low Flow (cfs)	3.43	4.425	8.15	11	12	0.8067	3.87	4.45	5.2	6.163	8.15	0.3293
December Low Flow (cfs)	4.14	6.7	8.3	9.4	11	0.3253	3.88	4.45	5	5.8	7.88	0.27
January Low Flow (cfs)	3.94	6.1	7.1	8	8.6	0.2676	3.89	4.4	5.1	5.95	7.44	0.3039
February Low Flow (cfs)	3.7	5.575	7.025	7.713	8.1	0.3043	3.74	4.5	4.9	5.65	6.56	0.2347
March Low Flow (cfs)	3.85	5.575	7.05	7.863	8.8	0.3245	3.98	4.95	5.4	6.2	7	0.2315
April Low Flow (cfs)	5.84	6.6	8.6	10.5	11.5	0.4535	5.475	6.213	7.4	8.537	9.815	0.3142
May Low Flow (cfs)	6.72	8.8	10	11	12	0.22	8.26	9.4	10	11.13	12	0.1725
June Low Flow (cfs)	7.06	9.1	10.5	11.5	12	0.2286	5.8	7.8	10	11	12	0.32
July Low Flow (cfs)	5.1	6.175	7.15	8.075	9.55	0.2657	5.75	8.1	8.9	11	11	0.3258
August Low Flow (cfs)	3.82	4.1	4.9	5.6	7.22	0.3061	5.56	9.1	10	11	11.8	0.19
September Low Flow (cfs)	3.5	3.625	3.9	4.7	5.07	0.2756	4.6	5.1	6.5	9.2	10	0.6308
EFC Parameters												
Extreme low peak (cfs)	2.5	2.8	3	3.2	3.2	0.1333	2.66	3	3.2	3.3	3.3	0.09375
Extreme low duration (days)	2	3	5	10	34	1.4	1	1	3	5	16.7	1.333
Extreme low timing (Julian date)	232	247	253	277	317	0.08197	254.4	316	338	45	53.8	0.2596
Extreme low freq. (#/year)	0	0	1	4	8.4	4	0	0	0	1	3	0
High flow peak (cfs)	10.9	13	14.5	21	29.6	0.5517	9.3	12.5	14	17	33.4	0.3214
High flow duration (days)	2.5	4	7	14.5	32.8	1.5	2	3	5	9.5	58.4	1.3
High flow timing (Julian date)	33.8	117	190	230	303.8	0.3087	118.9	184	211	245	278	0.1667
High flow frequency (#/year)	2	3	4	6	8.4	0.75	1	2	4	6	7.2	1
High flow rise rate (cfs differnenc between consecutive days)	1.575	1.792	2.5	4	13.66	0.883	1.043	1.8	2.3	3	4.601	0.5217
High flow fall rate (cfs difference between consecutive days)	-7.82	-1.9	-1.281	-0.7059	-0.476	-0.932	-2.696	-1.883	-1.5	-0.95	-0.5398	-0.6222
Small Flood peak (cfs)	144.8	178	230	262	282	0.3652	150.8	186.5	211	231	244	0.2109
Small Flood duration (days)	49.6	50	64	80	88.8	0.4688	51	65	76	120	149.6	0.7237
Small Flood timing (Julian date)	151.2	157	168	170	177.4	0.03552	154.6	163	170	174.5	182.6	0.03142
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	1	1	0
Small Flood riserate (cfs difference between consecutive days)	2.348	3.295	4.314	5.325	8.546	0.4705	2.359	3.534	4.415	5.611	6.619	0.4704
Small Flood fallrate (cfs difference between consecutive days)	-25.18	-16.6	-13.5	-7.755	-5.285	-0.6552	-13.83	-9.597	-6.083	-2.976	-1.726	-1.088
Large flood peak (cfs)	287	287	384	421	421	0.349	286	296.5	364	428	440	0.3613
Large flood duration (days)	70	70	75	102	102	0.4267	117	128.3	134	142.3	161	0.1045
Large flood timing (Julian date)	159	159	169	185	185	0.07104	165	170.3	173	178.3	191	0.02186
Large flood freq. (#/year)	0	0	0	0	0.4	0	0	0	0	0	1	0
Large flood riserate (cfs difference between consecutive days)	4.525	4.525	7.314	10.51	10.51	0.8188	4.074	5.486	8.07	8.925	8.95	0.4262
Large flood fallrate (cfs difference between consecutive days)	-14.88	-14.88	-12.9	-6.645	-6.645	-0.6385	-6.129	-5.106	-3.851	-3.201	-3.114	-0.4947

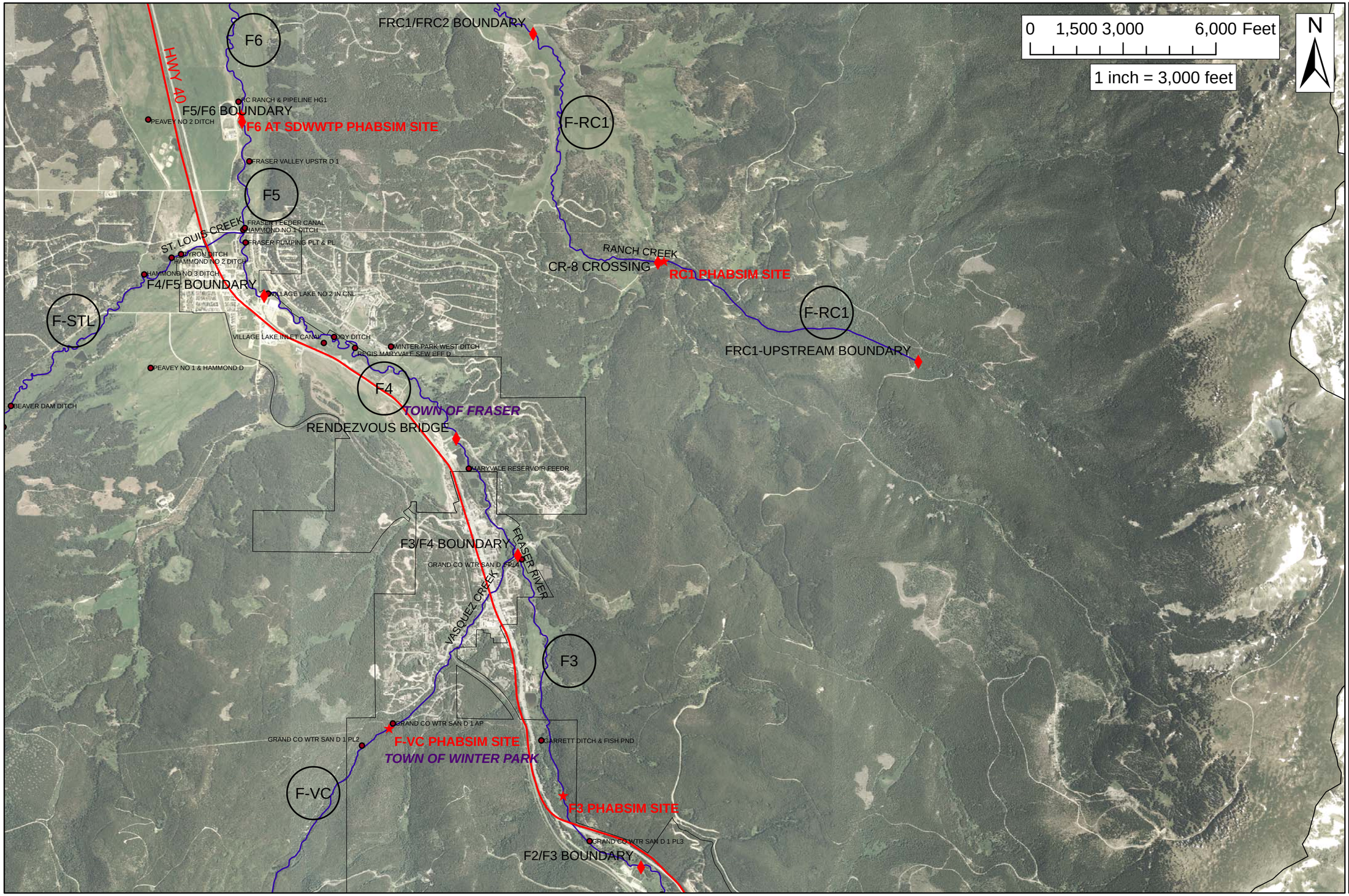
Surface Water Temperature Plots






Fraser River below Winter Park Sanitation District
Water Temperatures and Discharge 2009
Temp: GCWIN / Discharge: USGS
7-day rolling average
2hr rolling average
MWAT
DM
Discharge (cfs)
Temp (deg C)
Discharge (cfs)
Date
5/1/2009
5/31/2009
6/30/2009
7/30/2009
8/29/2009
9/28/2009
10/28/2009


Fraser River at Idlewild Campground Bridge
Water Temperatures and Discharge 2008
Temp: PHABSIM Site / Discharge: USGS
7-day rolling average
2hr rolling average
MWAT
DM
Discharge (cfs)
Temp (deg C)
Discharge (cfs)
Date
5/1/2008
5/31/2008
6/30/2008
7/30/2008
8/29/2008
9/28/2008
10/28/2008



GRAND COUNTY STREAM MANAGEMENT PLAN REACHES

Legend

- REACH BOUNDARY
- PHABSIM SITES
- DIVERSIONS

REACH: F3

SHEET # :
1 OF 1

GRAND COUNTY Colorado · Est 1874

TETRA TECH