

F-VC Stream Reach Summary

Study Reach: F-VC, Vasquez Creek - Denver Water Diversion downstream to confluence of Fraser River.

Reach Description: Approximate channel length: 5 ½ miles with an average channel slope of 2.4%.

Vasquez Creek is a steep, rocky stream, typical of the high mountain environment. The upper 2 ¼ miles, located between the Denver Water diversion and Tunnel No. 2 intake is flatter than the lower reach, sinuous and an open meadow/wetlands environment. Below Tunnel No. 2, to the Fraser River confluence the channel becomes steeper, more confined with the presence of large boulders and woody material typical of this type of environment. Vegetation is relatively dense along the channel banks throughout this reach with a pine forest overbank. On the downstream end where the reach flows through the Town of Winter Park, the overbank areas are developed (primarily residential and commercial buildings). The upstream portion of the reach, however, is undeveloped with the exception of recreational trails, which appear to be extensively used. Algae were observed in July 2007 at the water diversion located in the Town of Winter Park upstream of the Lions Gate Drive Bridge. This creek is valued for water supply and the fishery.



Vasquez Creek Upstream of the Winter Park Town Boundary



Vasquez at private diversion structure in the town of Winter Park

Flow Recommendations:

Environmental Flow Methodology: A PHABSIM site was established within this reach in summer 2007, located between the Denver Water diversion and the Grand County Water and Sanitation building. See Appendix A for methodology and Appendix E for PHABSIM survey information. Also reviewed was a PHABSIM study reported by Chadwick (1985) that was conducted immediately downstream of the Grand County diversion. Based upon these brook trout habitat - flow relations, environmental flow recommendations were developed for this location. CWCB instream flow and Forest Service by-pass flow recommendations have also been established for this reach.

Water Users:

- Irrigators, municipalities and industry flow-related issues: Grand County Water and Sanitation District divert in this reach. Generally, diversions are manageable under current conditions, although there is concern about water supply shortages under future conditions.
- Recreational: Above the Town of Winter Park, the river is valued for angling. The over bank areas include a recreational trail network that is accessed and used frequently, especially given its proximity to the Town of Winter Park.

Summary of Flows:

Environmental, recommended target flow ranges

- 5 to 8 cfs, April through September
- 5 to 8 cfs, October through March
- Flushing flow, at least 50 cfs for a 3-day duration with a frequency of 1 in 2 years during the late May to late June period.

Environmental Flows (based on Chadwick 1985)

- 4 to 10 cfs, summer
- 4 to 8 cfs winter

CWCB Flows

- 6 cfs, summer (05/15 – 09/15)
- 3 cfs, winter (09/16 – 05/14)

Forest Service Bypass Flows

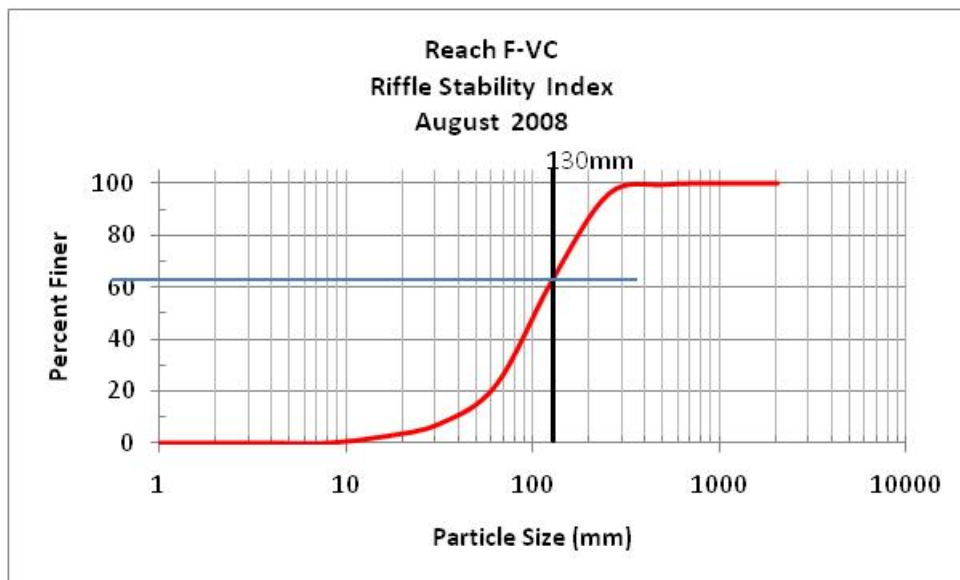
- 8 cfs, summer (05/15 – 09/15)
- 3 cfs, winter (09/16 – 05/14)

Water Users

- Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 9 cfs.
- Recreation: none reported

Stream Assessments: In August 2008 Tetra Tech conducted three stream assessments in F-VC. 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, the EPA HQA evaluation scored in the ‘suboptimal’ range, and the RSI of 64 indicates this reach tends to be quite stable and in dynamic equilibrium. Overall, the stream assessments did not reveal any issues of significant concern, with the exception of possible fish passage impediments due to diversion structures. Results of the assessments are summarized in the following tables and plot. Details and methodology are presented in Appendix A.

Reach F-VC Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			EPA Habitat Quality Assessment		
Attribute			Attribute	Score	
Upper Banks			Channel		
1	Landform Slope	4	1	Aquatic Habitat Barriers/ Diversion	8
2	Mass wasting hazard	3	2	Aquatic Structure as Cover	16
3	Debris Jam Potential	7	3	Velocity/ Depth Regimes	16
4	Vegetation Cover	6	4	Channel Flow Status	15
		Upper Bank Score:	5	Channel Alteration	15
Lower Banks			6	Frequency of Riffles	19
5	Channel Capacity	2	7	Channel Sinuosity	6
6	Bank Rock Content	2	Channel Score		95
7	Flow obstructors & Deflectors	2	Banks		
8	Cutting	5	8	Bank Stability	18
9	Deposition	8	9	Riparian Vegetation Cover and Disturbance	18
		Lower Bank Score:	10	Riparian Vegetation zone width	18
Channel Bottom			Bank Score		54
10	Rock Angularity	2	Total Score		149
11	Brightness	2	Notes		
12	Consolidation/Particle Packing	2			
13	Bottom size distribution	4			
14	Bed Scour and Deposition	6			
15	Clinging Aquatic Veg	2			
		Channel Bottom Score:			18
		Total Score:			57



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

Hydrologic Records: USGS Gage Station 09025000 is located downstream of the PHABSIM sites in the Town of Winter Park and has been operated continuously since 1933. Daily streamflow exceedence plots, IHA analyses, and flood frequency analysis are presented for the post-Denver Water period-of-record, 1936 to 2007. These data indicate the environmental target flow ranges recommended have been commonly available in the lower portions of the reach and the flushing flow is exceeded by the 1.25 and the 2.0-year return period flood events. The IHA analysis comparing 1936 - 1970 with 1971 - 2007 records indicates that during the more recent period, median flows during June through October have tended to be higher, while winter flows have been lower than in the early period.

Water Temperature: F-VC 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-VC indicate stream temperatures for Vasquez Creek in this area are well below the MWAT and DM standards.

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

Water Supply Issues (UPCO): No water supply issues are reported in the UPCO report for this reach, because tributaries were not included in the study. However, water users have indicated under current conditions the 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. The UPCO report indicates that the Grand County Water and Sanitation District will experience the most severe shortages, as compared to other local water users, under the future conditions scenario.

Results and Remarks:

1. Recommended environmental target flow ranges have been commonly available in the lower portions of the reach. The flow recommended for flushing is well supported by both the historic and the recent hydrologic record.
2. Temperatures and water quality are supportive of a cold-water fishery.
3. Based on electrofishing data collected by Chadwick (1985), brook trout were the predominant game fish within the Vasquez Creek study reach, comprising over 98 percent of the trout captured. Small numbers of rainbow and cutthroat trout were also collected. CDOW sampling in 1993 found only brook trout. Thus, the environmental flow recommendations are based on adult and spawning habitat for brook trout.
4. CDOW and the Forest Service may be undertaking efforts to restore the native cutthroat trout. Should acceptable habitat suitability information for this species become available, it may be beneficial to re-run the PHABSIM analysis.
5. A reconnaissance-level study was completed by GEI in June 2005 addressing several alternatives and associated costs for a pump-back plan along the Fraser River. This plan would relocate the Grand County Water and Sanitation District diversions to the Fraser. Preliminary indications show the pump-back plan could compensate for flow shortages, but the environmental impacts are yet unknown.

Restoration Opportunities:

- ✓ Support efforts by the CDOW and the Forest Service to restore the native cutthroat trout.
- ✓ Consider enhancement of fish passage from the Fraser upstream into F-VC if supported by relevant fisheries data.

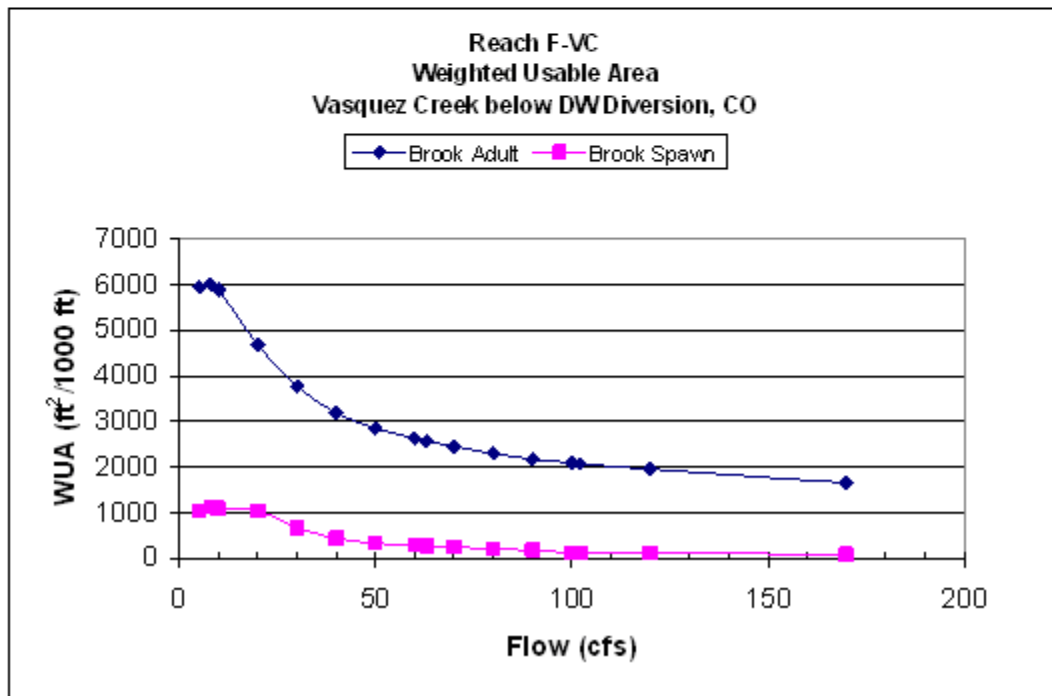
Monitoring: Continue to monitor flows for compliance with Forest Service by-pass and CWCB ISF requirements.

Support Data

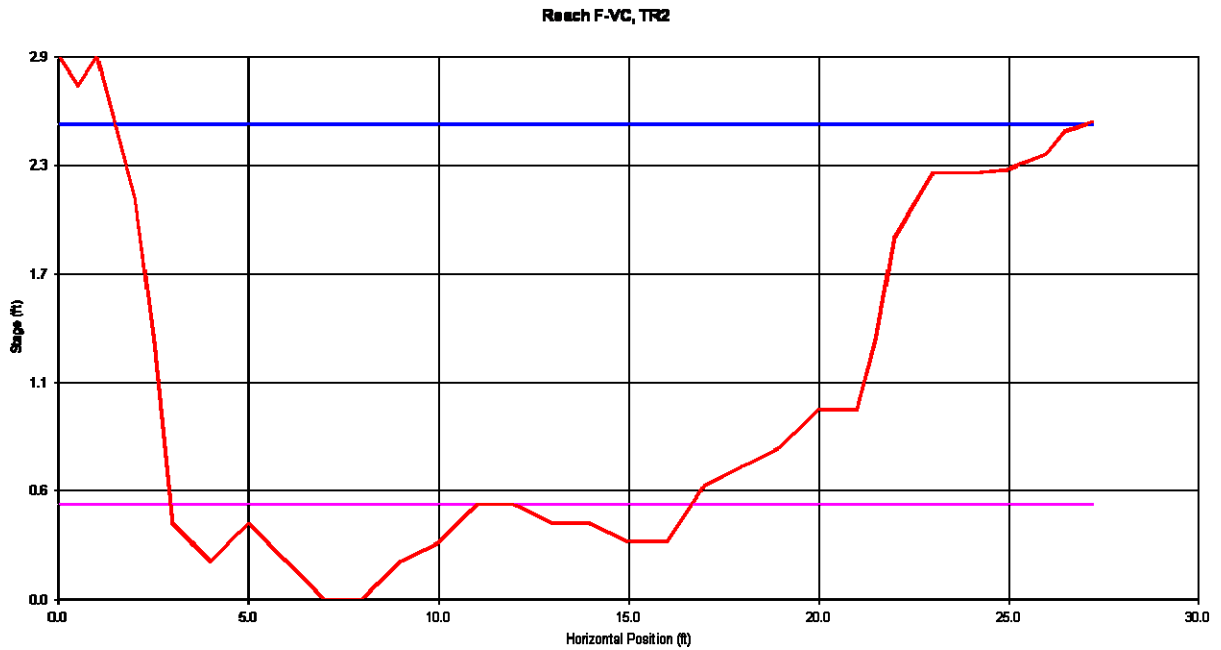
Weighted Useable Area Plots and Tables

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

Reach F-VC			
Discharge	Total Area	Brook Spawn	Brook Adult
(cfs)	(ft ²)	Weighted Usable Area (ft ² /1000 ft stream length)	
5	15314.9	1045.9	5944.8
8	16233.0	1117.8	6000.6
10	16412.5	1090.7	5884.3
20	17138.0	1045.7	4674.6
30	17844.9	663.0	3766.3
40	18816.7	443.1	3185.5
50	19536.0	329.9	2851.1
60	20096.2	286.9	2624.1
63	20222.3	276.4	2569.4
70	20490.2	243.5	2447.7
80	20836.0	203.3	2297.2
90	21244.7	172.7	2171.2
100	21582.7	126.0	2090.3
102	21751.0	124.7	2074.9
120	22938.3	114.8	1955.4
170	24967.1	85.3	1653.7



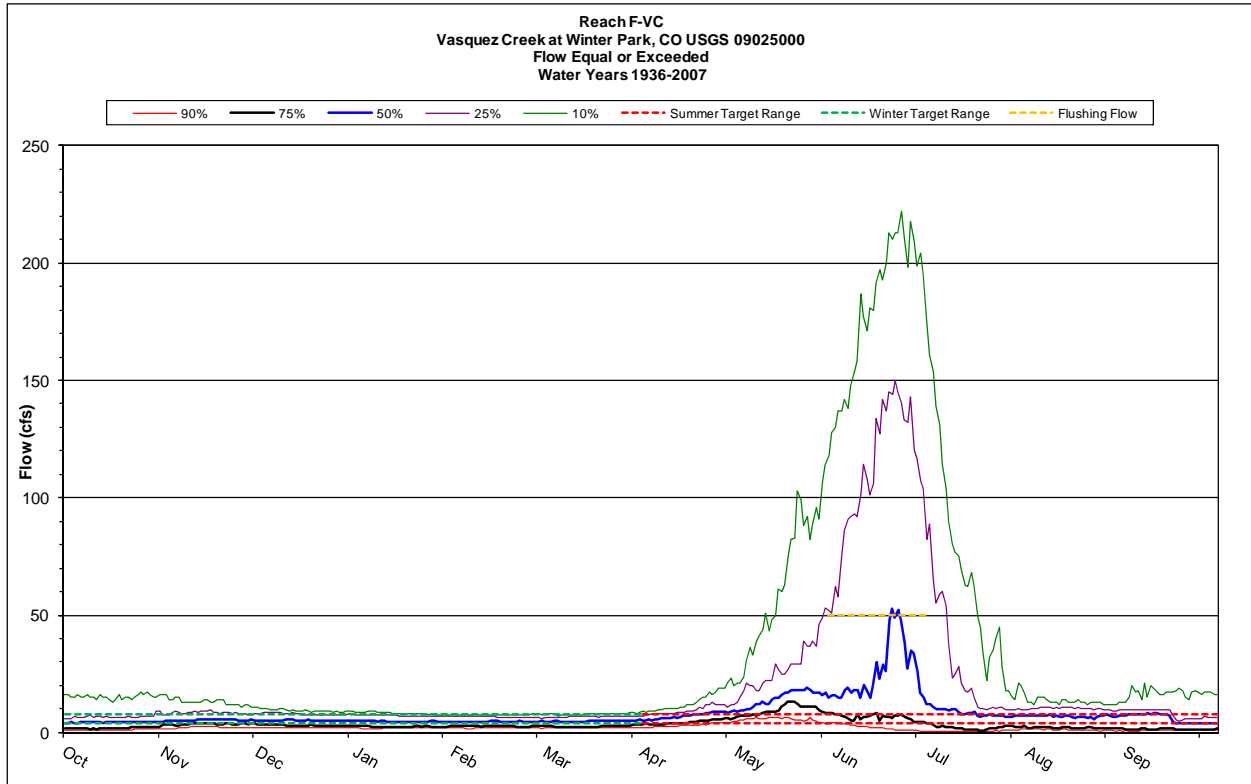
Transect and Bedload Threshold Plots and Tables



Reach F-VC
 Vasquez Creek TR 2
 TT2007 site
 Resistance Method: Jarrett's Equation

STAGE (ft)	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.5	2.82	12.93	12.71	0.22	0.22	0.006	0.071	0.58	1.6	0.08
0.6	4.11	13.39	13.10	0.31	0.31	0.006	0.067	0.77	3.2	0.11
0.7	5.47	14.51	14.15	0.38	0.39	0.006	0.065	0.92	5.0	0.14
0.8	6.94	15.63	15.20	0.44	0.46	0.006	0.064	1.05	7.3	0.17
0.9	8.48	16.25	15.75	0.52	0.54	0.006	0.062	1.20	10.2	0.20
1.0	10.09	16.87	16.30	0.60	0.62	0.006	0.061	1.35	13.6	0.22
1.1	11.83	18.16	17.49	0.65	0.68	0.006	0.060	1.44	17.1	0.24
1.2	13.59	18.44	17.68	0.74	0.77	0.006	0.059	1.60	21.7	0.28
1.3	15.36	18.72	17.87	0.82	0.86	0.006	0.058	1.75	26.9	0.31
1.4	17.16	18.99	18.05	0.90	0.95	0.006	0.057	1.90	32.5	0.34
1.5	18.97	19.25	18.21	0.99	1.04	0.006	0.056	2.04	38.7	0.37
1.6	20.80	19.51	18.37	1.07	1.13	0.006	0.055	2.18	45.2	0.40
1.7	22.65	19.76	18.52	1.15	1.22	0.006	0.055	2.31	52.3	0.43
1.8	24.51	20.02	18.68	1.22	1.31	0.006	0.054	2.44	59.8	0.46
1.9	26.38	20.27	18.84	1.30	1.40	0.006	0.054	2.57	67.7	0.49
2.0	28.28	20.70	19.19	1.37	1.47	0.006	0.053	2.67	75.6	0.51
2.1	30.22	21.13	19.55	1.43	1.55	0.006	0.053	2.78	83.9	0.54
2.2	32.20	21.60	19.97	1.49	1.61	0.006	0.052	2.87	92.5	0.56
2.3	34.32	24.34	22.67	1.41	1.51	0.006	0.053	2.74	94.1	0.53
2.4	36.64	25.31	23.60	1.45	1.55	0.006	0.053	2.80	102.7	0.54
2.5	39.03	26.25	24.49	1.49	1.59	0.006	0.052	2.87	111.9	0.56

Hydrographs and Exceedence Plots and Tables



Return Period T (year)	Probability P (percent)	Flood Discharge Q (ft ³ /sec)
1.05	95.2	23
1.11	90.1	37
1.25	80	63
2	50	148
5	20	294
10	10	394
25	4	514

Flood frequency analysis for USGS gage 09025000, Vazquez Creek at Winter Park, CO, for 70 years of record (Water years 1936-2006).

IHA Results

Reach F-VC
Non-Parametric IHA Scorecard
Vasquez Creek at Winter Park 1936-2007
USGS 09025000

Period of Analysis: 1936-2007 (72 years)

Mean annual flow (cfs)	1
Mean flow/area (dimensionless)	13.95
Annual C. V.	13.95
Flow predictability (%)	2.31
Constancy/predictability	0.39
% of floods in 60d period	0.66
Flood-free season (days)	0.33
	4

Parameter Group #1

	Medians	Coeff. of Disp.
October (cfs)		
November (cfs)	4.45	1.006
December (cfs)	5.4	0.6991
January (cfs)	5.3	0.8443
February (cfs)	4.75	1
March (cfs)	4.55	0.8681
April (cfs)	4.95	0.8384
May (cfs)	7	0.6964
June (cfs)	15.5	0.7581
July (cfs)	17	6.335
August (cfs)	7.7	1.123
September (cfs)	6.75	1.296
	5.625	1.291

Parameter Group #2

1-day minimum (cfs)		
3-day minimum (cfs)	1.5	1.917
7-day minimum (cfs)	1.55	1.855
30-day minimum (cfs)	1.614	1.861
90-day minimum (cfs)	1.857	1.464
1-day maximum (cfs)	3.133	0.9984
3-day maximum (cfs)	139	1.196
7-day maximum (cfs)	120.2	1.388
30-day maximum (cfs)	103.5	1.551
90-day maximum (cfs)	49.98	1.969
Number of zero days (count)	25.78	1.841
Base flow index (7day minimum in cfs/median in cfs)	0	0
	0.112	2.255

Parameter Group #3

Date of minimum (Julian day)		
Date of maximum (Julian day)	199	0.4699
	169	0.05601

Parameter Group #4

Low pulse count (#)		
Low pulse duration (days)	3	1.667
High pulse count (#)	11.25	2.578
High pulse duration (days)	5	0.75
The low pulse threshold is (cfs)	5	1.8
The high pulse threshold is (cfs)	3.1	
	9.7	

Parameter Group #5

Rise rate (cfs difference between consecutive days)		
Fall rate (cfs difference between consecutive days)	0.5	0.8
Number of reversals	-0.4	-1.187

Reach F-VC
IHA Percentile Data
Vasquez Creek at Winter Park 1936-2007
USGS 09025000

Parameter Group #1	Period of Analysis: 1936-2007 (72 years)					
	10%	25%	50%	75%	90%	(75-25)/50
October (cfs)	1.3	1.8	4.45	6.275	13	1.006
November (cfs)	2.215	3.725	5.4	7.5	13	0.6991
December (cfs)	2.06	3.075	5.3	7.55	9	0.8443
January (cfs)	1.8	2.525	4.75	7.275	8	1
February (cfs)	2	2.625	4.55	6.575	7.4	0.8681
March (cfs)	2	2.6	4.95	6.75	7.77	0.8384
April (cfs)	3.3	4.225	7	9.1	11.35	0.6964
May (cfs)	6.63	11	15.5	22.75	47.1	0.7581
June (cfs)	1.6	6.688	17	114.4	166.1	6.335
July (cfs)	0.8	2.1	7.7	10.75	44.8	1.123
August (cfs)	1.13	2	6.75	10.75	12.7	1.296
September (cfs)	0.93	1.513	5.625	8.775	13.8	1.291
Parameter Group #2						
1-day minimum (cfs)	0.1	0.225	1.5	3.1	3.91	1.917
3-day minimum (cfs)	0.1	0.3417	1.55	3.217	4.057	1.855
7-day minimum (cfs)	0.1186	0.4179	1.614	3.421	4.164	1.861
30-day minimum (cfs)	0.4203	0.9342	1.857	3.652	4.717	1.464
90-day minimum (cfs)	1.064	1.867	3.133	4.995	5.996	0.9984
1-day maximum (cfs)	17.3	48.75	139	215	271	1.196
3-day maximum (cfs)	15.87	36.42	120.2	203.3	257.7	1.388
7-day maximum (cfs)	14.4	25.89	103.5	186.4	234.6	1.551
30-day maximum (cfs)	10.29	18.98	49.98	117.4	186.4	1.969
90-day maximum (cfs)	7.129	13.43	25.78	60.9	91.43	1.841
Number of zero days (count)	0	0	0	0	0	0
Base flow index (7day minimum in cfs/median in cfs)	0.01952	0.04032	0.112	0.2929	0.4175	2.255
Parameter Group #3						
Date of minimum (Julian day)	30.1	81	199	275	317.7	0.4699
Date of maximum (Julian day)	137.3	156.3	169	176.8	198.3	0.05601
Parameter Group #4						
Low pulse count (#)	0	0	3	5	7	1.667
Low pulse duration (days)	2.3	5	11.25	34	78.7	2.578
High pulse count (#)	1.3	3.25	5	7	10.7	0.75
High pulse duration (days)	2	3	5	12	29.6	1.8
Parameter Group #5						
Rise rate (cfs difference between consecutive days)	0.3	0.4	0.5	0.8	1	0.8
Fall rate (cfs difference between consecutive days)	-1	-0.775	-0.4	-0.3	-0.23	-1.187
Number of reversals	67.3	77.25	88	98	108.4	0.2358
EFC Monthly Low Flows						
October Low Flow (cfs)	1.5	1.8	4.1	4.85	6.16	0.7439
November Low Flow (cfs)	2.06	3.1	4.9	6	7.915	0.5918
December Low Flow (cfs)	2	2.95	4.75	7.2	8.5	0.8947
January Low Flow (cfs)	1.8	2.4	4.4	6.95	7.82	1.034
February Low Flow (cfs)	2	3	4.55	6.45	7.4	0.7582
March Low Flow (cfs)	2.02	2.6	5.1	6.6	7.76	0.7843
April Low Flow (cfs)	2.595	4	6	7.575	8.62	0.5958
May Low Flow (cfs)	4.05	5.675	7	8.275	8.8	0.3714
June Low Flow (cfs)	2.03	3.15	4.6	7.675	9.3	0.9837
July Low Flow (cfs)	2.1	2.7	4	8.3	9.3	1.4
August Low Flow (cfs)	1.66	1.975	3.45	8.225	9.14	1.812
September Low Flow (cfs)	1.52	2.05	4.1	6.175	7.745	1.006
EFC Parameters						
Extreme low peak (cfs)	0.3	0.5	0.9	1.1	1.3	0.6667
Extreme low duration (days)	1.8	3	7	11.5	22.6	1.214
Extreme low timing (Julian date)	192.6	203	242	270	306.3	0.1831
Extreme low freq. (#/year)	0	0	0	4	7.4	0
High flow peak (cfs)	9.2	11	13	19.5	29.5	0.6538
High flow duration (days)	3.6	5	7	21	33.8	2.286
High flow timing (Julian date)	101.2	135	191	232	327.4	0.265
High flow frequency (#/year)	2	3	5	6	8	0.6
High flow rise rate (cfs difference between consecutive days)	0.8013	1.433	2.133	3.284	5.333	0.8674
High flow fall rate (cfs difference between consecutive days)	-6.207	-2.15	-1.3	-0.8	-0.5679	-1.038
Small Flood peak (cfs)	148	174.5	196	231.5	251	0.2908
Small Flood duration (days)	12	36.5	68	86.5	109	0.7353
Small Flood timing (Julian date)	151	162.5	169	175	177	0.03415
Small Flood freq. (#/year)	0	0	0	1	1	0
Small Flood riserate (cfs difference between consecutive days)	2.626	3.563	5.018	11.31	44.58	1.543
Small Flood fallrate (cfs difference between consecutive days)	-28.23	-14.4	-10.31	-4.936	-3.286	-0.9183
Large flood peak (cfs)	274	276	287	380	417	0.3624
Large flood duration (days)	18	61	78	138	201	0.9872
Large flood timing (Julian date)	162	165	172	177	179	0.03279
Large flood freq. (#/year)	0	0	0	0	0.7	0
Large flood riserate (cfs difference between consecutive days)	4.602	5.798	7.731	10.24	69	0.5746
Large flood fallrate (cfs difference between consecutive days)	-24.94	-18.57	-8.227	-3.314	-1.671	-1.854

Reach F-VC

Non-Parametric IHA Scorecard

Vasquez Creek at Winter Park 1936-1970 vs 1971-2007
USGS 09025000

	Pre-impact period: 1936-1970 (35 years)	Post-impact period: 1971-2007 (37 years)
Mean annual flow (cfs)	13.48	14.39
Mean flow/area (dimensionless)	13.48	14.39
Annual C. V.	2.43	2.2
Flow predictability (%)	0.4	0.57
Constancy/predictability	0.5	0.66
% of floods in 60d period	0.39	0.39
Flood-free season (days)	14	58

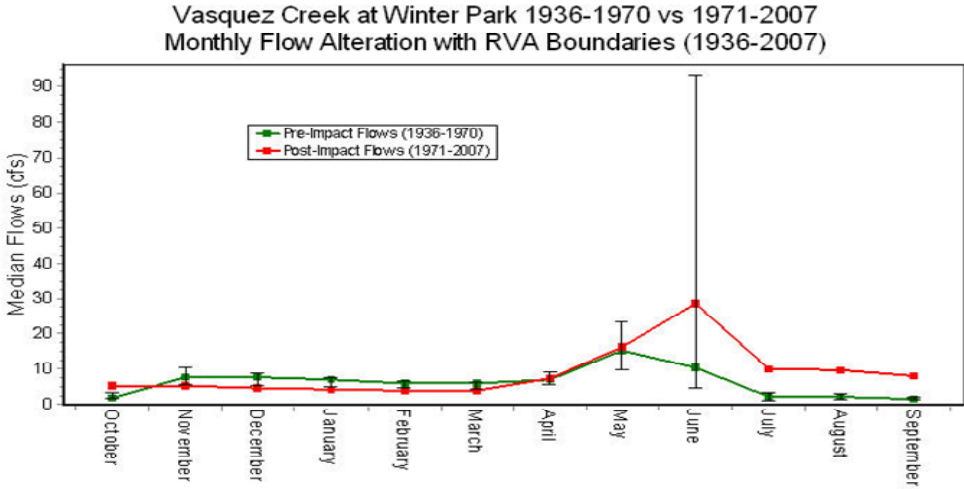
	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
October (cfs)	1.8	5.1	3.667	0.3824	1.833	0.8957	0.00	0.01502
November (cfs)	7.5	5	1.253	0.275	0.3333	0.7806	0.004004	0.08509
December (cfs)	7.6	4.5	0.8026	0.6889	0.4079	0.1417	0.04705	0.6887
January (cfs)	7	4	0.8	0.825	0.4286	0.03125	0.1121	0.951
February (cfs)	5.8	3.9	0.7414	0.9103	0.3276	0.2278	0.1111	0.5325
March (cfs)	5.7	3.7	0.7193	1.176	0.3509	0.6345	0.2182	0.05205
April (cfs)	7	7.1	0.7286	0.5951	0.01429	0.1832	0.8028	0.4284
May (cfs)	15	16	1.22	0.4375	0.06667	0.6414	0.6857	0.08008
June (cfs)	10.35	28.5	11.06	3.079	1.754	0.7217	0.07207	0.1662
July (cfs)	2.1	10	1.238	0.335	3.762	0.7294	0.00	0.1041
August (cfs)	2	9.7	1.05	0.268	3.85	0.7447	0.00	0.1221
September (cfs)	1.45	7.8	1.034	0.4519	4.379	0.5631	0.00	0.1502
Parameter Group #2								
1-day minimum (cfs)	0.2	3.1	2	0.4194	14.5	0.7903	0.00	0.1411
3-day minimum (cfs)	0.3333	3.1	1.76	0.4409	8.3	0.7495	0.00	0.09109
7-day minimum (cfs)	0.4	3.186	1.821	0.4753	6.964	0.739	0.00	0.08208
30-day minimum (cfs)	0.9267	3.487	0.8957	0.5315	2.763	0.4065	0.00	0.1331
90-day minimum (cfs)	2.066	3.924	1.309	0.6421	0.8999	0.5096	0.00	0.1041
1-day maximum (cfs)	148	123	1.345	1.159	0.1689	0.1384	0.5295	0.6316
3-day maximum (cfs)	132	116.3	1.495	1.277	0.1187	0.1461	0.7087	0.6066
7-day maximum (cfs)	113	102.3	1.526	1.439	0.09482	0.05726	0.7387	0.8228
30-day maximum (cfs)	54.23	48.47	1.886	1.943	0.1063	0.03014	0.6657	0.9189
90-day maximum (cfs)	32.5	24.54	1.783	1.893	0.2449	0.06152	0.5135	0.8468
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimum in cfs/median in cfs)	0.03915	0.2823	1.478	0.7611	6.212	0.4851	0.00	0.2042
Parameter Group #3								
Date of minimum (Julian day)	201	35	0.1639	0.2773	0.9071	0.6917	0.001001	0.05806
Date of maximum (Julian day)	168	172	0.07377	0.04098	0.02186	0.4444	0.2092	0.1512
Parameter Group #4								
Low pulse count (#)	6	0	0.8333	0	1	1	0.08609	0.05305
Low pulse duration (days)	5.75	2	2	11	0.6522	4.5	0.1842	0.00
High pulse count (#)	4	7	0.75	0.6429	0.75	0.1429	0.00	0.6456
High pulse duration (days)	5	5	2.575	1.45	0	0.4369	0.7658	0.3744
The low pulse threshold is (cfs)	1.9							
The high pulse threshold is (cfs)	9							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	0.5	0.5	1.2	0.85	0	0.2917	0.4925	0.4565
Fall rate (cfs difference between consecutive days)	-0.4	-0.5	-0.75	-1	0.25	0.3333	0.07307	0.5986
Number of reversals	89	87	0.2247	0.2586	0.02247	0.1509	0.4344	0.6286

Reach F-VC

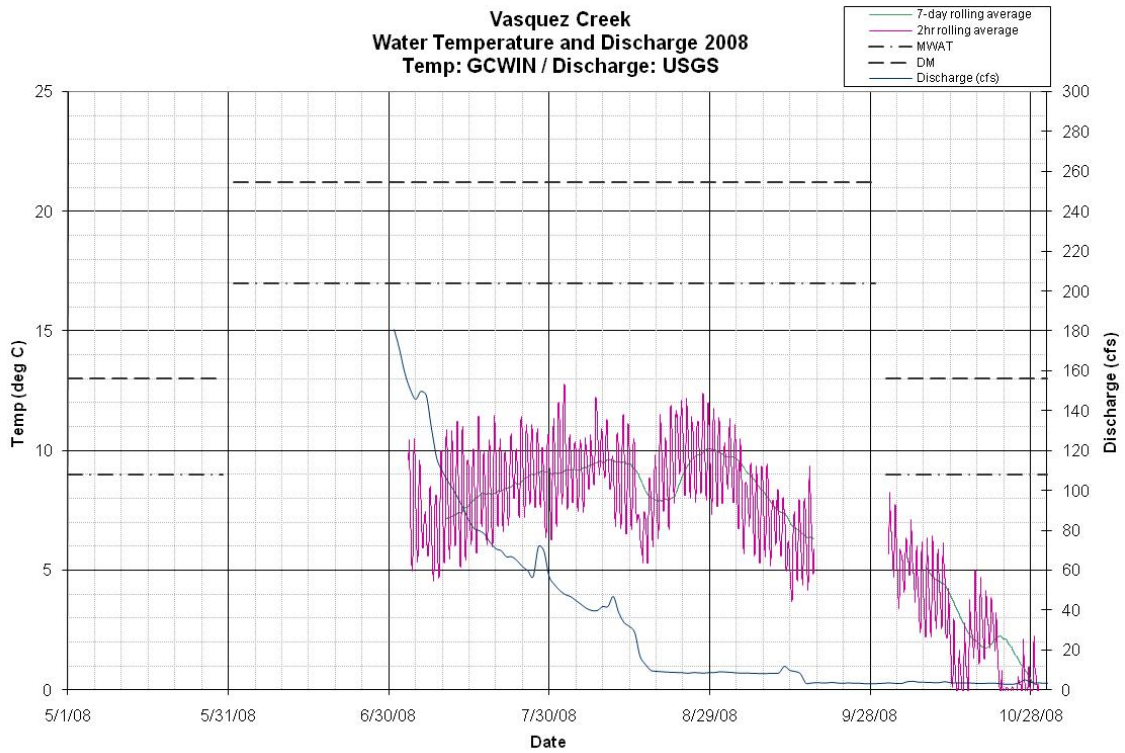
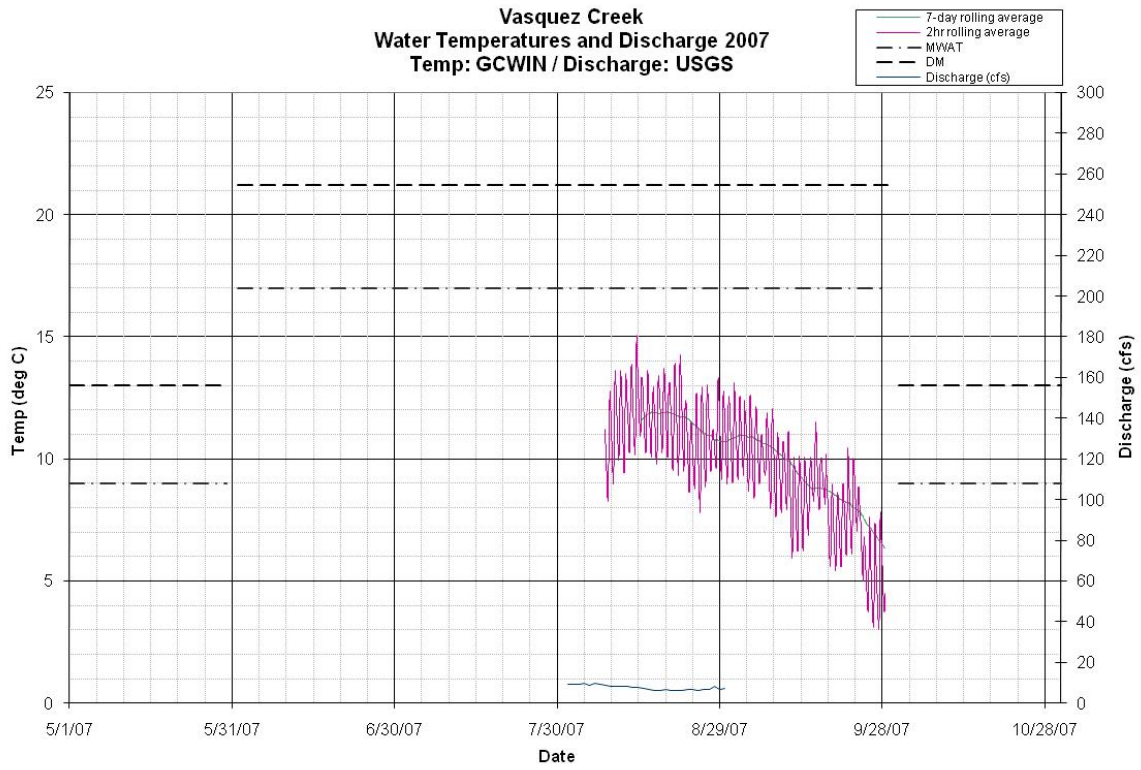
IHA Percentile Data

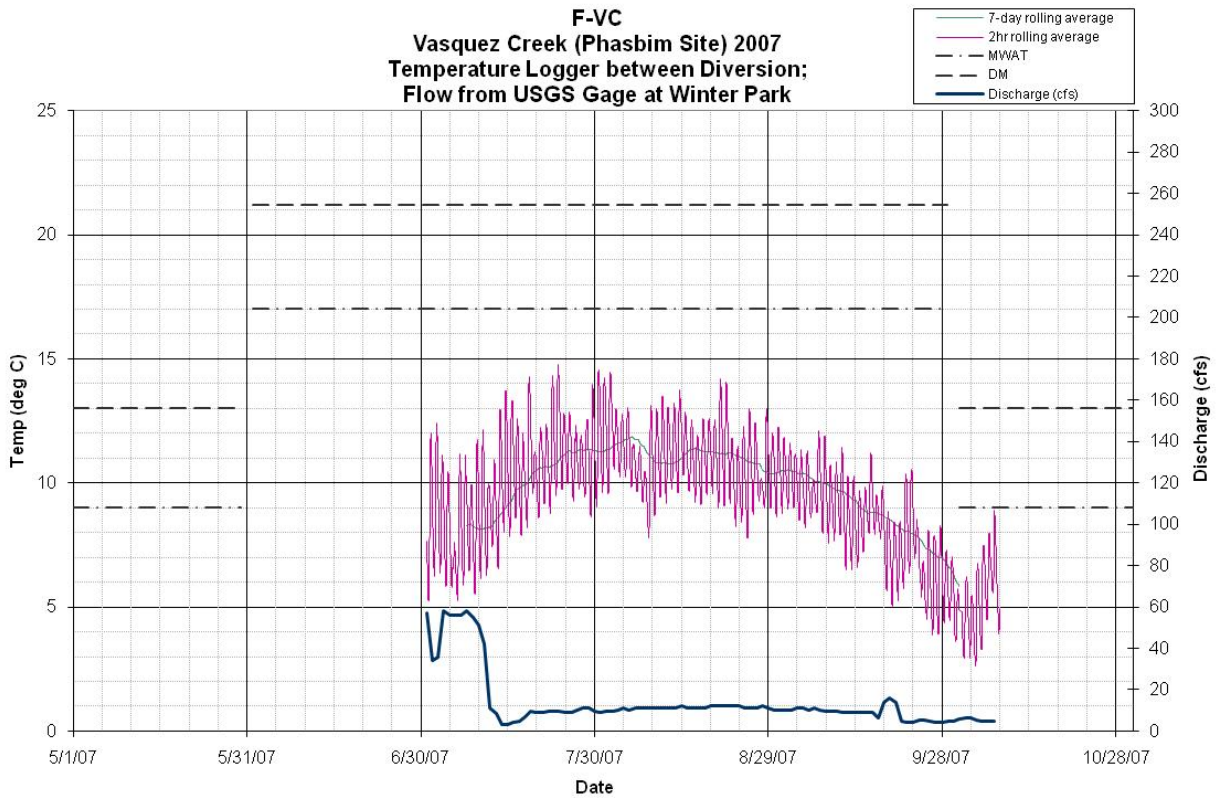
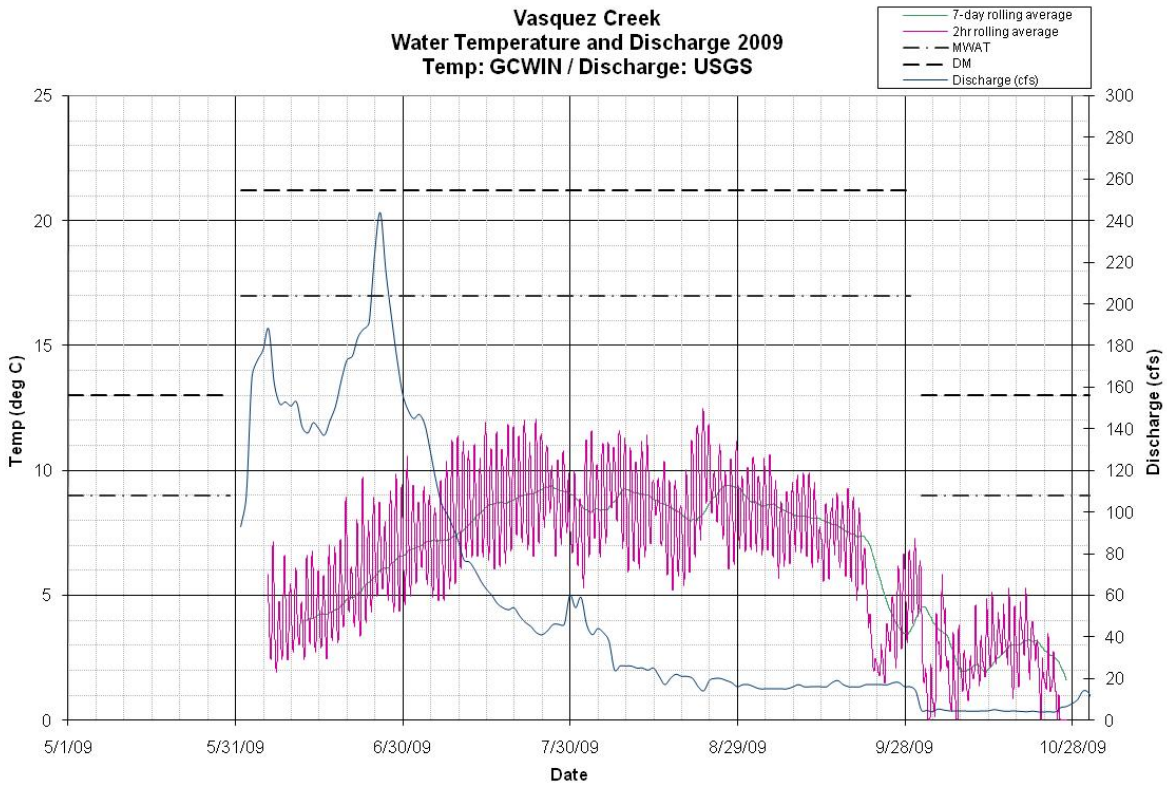
Vasquez Creek at Winter Park 1936-1970 vs 1971-2007
USGS 09025000

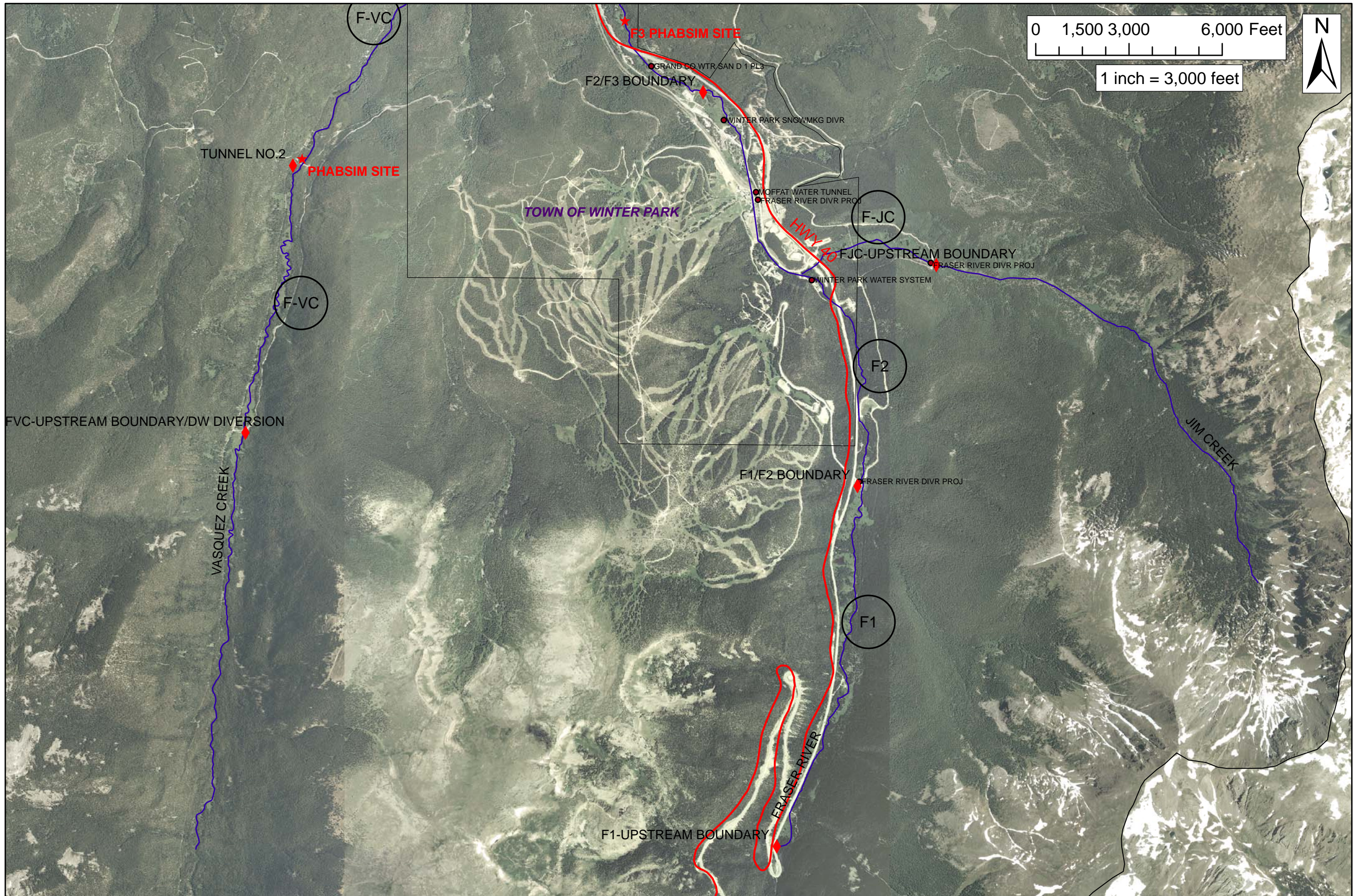
Parameter	Pre-impact period: 1936-1970 (35 years)				Post-impact period: 1971-2007 (37 years)				Post-impact			
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #1												
October (cfs)	0.96	1.3	1.8	7.9	16.6	3.667	3.54	4.3	5.1	6.25	7.88	0.3824
November (cfs)	1.96	2.6	7.5	12	14.4	1.253	2.74	4.1	5	5.475	6.6	0.275
December (cfs)	1.8	2.5	7.6	8.6	10	0.8026	2.44	3.15	4.5	6.25	7.04	0.6889
January (cfs)	1.76	2	7	7.6	8.4	0.8	1.98	2.95	4	6.25	7.44	0.825
February (cfs)	1.56	2.5	5.8	6.8	7.48	0.7414	2	2.75	3.9	6.3	7.46	0.9103
March (cfs)	1.7	2.5	5.7	6.6	7.64	0.7193	2.18	2.65	3.7	7	8.12	1.176
April (cfs)	2.53	4.9	7	10	12.3	0.7286	3.6	4.125	7.1	8.35	9.92	0.5951
May (cfs)	3.68	7.7	15	26	58.6	1.22	9.18	13	16	20	40	0.4375
June (cfs)	0.64	3	10.35	117.5	167.8	11.06	7.7	11.25	28.5	99	167.4	3.079
July (cfs)	0.38	0.9	2.1	3.5	31.8	1.238	7.08	8.65	10	12	48.6	0.335
August (cfs)	0.76	1.2	2	3.3	5.48	1.05	7.14	8.4	9.7	11	14.2	0.268
September (cfs)	0.38	1	1.45	2.5	9.08	1.034	5.46	6.475	7.8	10	15.8	0.4519
Parameter Group #2												
1-day minimum (cfs)	0	0.1	0.2	0.5	1	2	1.58	2.35	3.1	3.65	4.24	0.4194
3-day minimum (cfs)	0.02	0.1	0.3333	0.6867	1.28	1.76	1.62	2.4	3.1	3.767	4.313	0.4409
7-day minimum (cfs)	0.08286	0.1286	0.4	0.8571	1.369	1.821	1.723	2.436	3.186	3.95	4.543	0.4753
30-day minimum (cfs)	0.186	0.5667	0.9267	1.397	1.809	0.8957	1.835	2.547	3.487	4.4	4.961	0.5315
90-day minimum (cfs)	0.9976	1.09	2.066	3.794	6.64	1.309	2.004	2.872	3.924	5.392	5.688	0.6421
1-day maximum (cfs)	16	31	148	230	261	1.345	17.8	57.5	123	200	276.6	1.159
3-day maximum (cfs)	15.4	28.67	132	226	243.4	1.495	15.93	42.5	116.3	191	262.4	1.277
7-day maximum (cfs)	14.49	24.29	113	196.7	226.5	1.526	13.89	26.64	102.3	173.8	247.9	1.439
30-day maximum (cfs)	9.8	16.96	54.23	119.3	186.2	1.886	10.24	20.33	48.47	114.5	200.7	1.943
90-day maximum (cfs)	6.012	9.501	32.5	67.45	90.64	1.783	7.78	13.97	24.54	60.42	96.72	1.893
Number of zero days (count)	0	0	0	0	3.4	0	0	0	0	0	0	0
Base flow index (7day minimum in cfs/median in cfs)	0.006392	0.02017	0.03915	0.07803	0.1177	1.478	0.09303	0.1774	0.2823	0.3922	0.4622	0.7611
Parameter Group #3												
Date of minimum (Julian day)	176.4	193	201	253	286.6	0.1639	311.2	345.5	35	81	261.6	0.2773
Date of maximum (Julian day)	114	150	168	177	190.8	0.07377	153.6	161.5	172	176.5	256.6	0.04098
Parameter Group #4												
Low pulse count (#)	2	3	6	8	11.4	0.8333	0	0	0	2	0	0
Low pulse duration (days)	3	4	5.75	15.5	31.5	2	1	1.5	2	23.5	50.5	11
High pulse count (#)	2	3	4	6	9.8	0.75	2.8	4	7	8.5	11	0.6429
High pulse duration (days)	2	3	5	15.88	28.5	2.575	2	2.5	5	9.75	31.6	1.45
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	0.3	0.4	0.5	1	1	1.2	0.2	0.325	0.5	0.75	1.05	0.85
Fall rate (cfs difference between consecutive days)	-1	-0.6	-0.4	-0.3	-0.3	-0.75	-1	-0.8	-0.5	-0.3	-0.2	-1
Number of reversals	72.4	79	89	99	106.6	0.2247	64.6	72.5	87	95	110.6	0.2586
EFC Monthly Low Flows												
October Low Flow (cfs)	1.005	1.3	1.7	2.225	3.08	0.5441	3.48	4.2	4.6	5.3	6.4	0.2391
November Low Flow (cfs)	1.5	2.05	2.775	7.375	8.05	1.919	2.71	4.025	4.9	5.4	6.12	0.2806
December Low Flow (cfs)	1.8	2.275	7.3	8.25	8.77	0.8185	2.44	3.15	4.5	6.25	7.04	0.6889
January Low Flow (cfs)	1.71	1.95	5.4	7.125	7.78	0.9583	1.98	2.95	4	6.25	7.44	0.825
February Low Flow (cfs)	1.64	2.4	5.5	6.8	7.29	0.8	2	2.625	3.85	5.975	7.33	0.8701
March Low Flow (cfs)	1.7	2.425	5.55	6.6	7.4	0.7523	2.18	2.65	3.7	7	8	1.176
April Low Flow (cfs)	2.43	3.175	6	7.375	8.185	0.7	3.55	4	6	7.5	8.38	0.5333
May Low Flow (cfs)	3.425	3.963	6.15	7.863	8.59	0.6341	5.19	6.25	7.1	8.05	8.5	0.2535
June Low Flow (cfs)	1.51	1.975	3.1	4	4.7	0.6532	4.8	6.763	8.325	8.925	9	0.2598
July Low Flow (cfs)	1.15	1.6	2.1	3.125	3.75	0.7262	4.27	7.288	8.3	8.7	8.91	0.1702
August Low Flow (cfs)	1.05	1.375	2	2.9	3.8	0.7625	5.6	7.313	8.05	8.438	8.65	0.1398
September Low Flow (cfs)	1	1.15	1.45	2.25	3.42	0.7586	3.9	4.2	4.725	6.125	7.75	0.4074
EFC Parameters												
Extreme low peak (cfs)	0.1	0.3	0.5	0.6625	0.8	0.725						
Extreme low duration (days)	2	3	6	12	17.5	1.5						
Extreme low timing (Julian date)	183	192.5	215	244.3	249	0.1414						
Extreme low freq. (#/year)	0	1	2	4	7	1.5	0	0	0	0	0	0
High flow peak (cfs)	9	9.75	12.75	19.63	25	0.7745	9	11	12	16	22.2	0.4167
High flow duration (days)	2.75	4	7.5	17.75	37	1.833	4	5	8	14	31.8	1.125
High flow timing (Julian date)	32.5	110.8	148.8	214.3	340.5	0.2828	119.1	156.5	198.5	239	284.9	0.2254
High flow frequency (#/year)	1	3	5	7	8.4	0.8	1.8	3	5	7	8	0.8
High flow rise rate (cfs difference between consecutive days)	0.4733	1.613	2.325	3.488	5.308	0.8065	0.4106	1.043	1.416	1.963	3.097	0.6491
High flow fall rate (cfs difference between consecutive days)	-8.706	-1.924	-1.329	-0.7086	-0.2226	-0.9146	-3.206	-1.458	-1	-0.75	-0.5067	-0.7083
Small Flood peak (cfs)	148	175	218	232	245.6	0.2615	160.2	175	194	206	254	0.1598
Small Flood duration (days)	9.4	28	56	70	164.6	0.75	36.2	69	80	117	133.4	0.6
Small Flood timing (Julian date)	150.6	154	168	177	179.8	0.06284	156.2	165	172	174	175.8	0.02459
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	1	1	0
Small Flood rise rate (cfs difference between consecutive days)	2.918	3.6	4.916	16.21	112.7	2.565	2.563	3.126	4.217	5.596	13.44	0.5856
Small Flood fallrate (cfs difference between consecutive days)	-37.09	-18.86	-12.97	-6.56	-2.843	-0.9479	-9.07	-7.428	-6.319	-3.286	-2.549	-0.6555
Large flood peak (cfs)	276	276	280	380	380	0.3714	264	269	287	355	417	0.2997
Large flood duration (days)	18	18	63	79	79	0.9683	68	73.5	103	172	205	0.9563
Large flood timing (Julian date)	162	162	165	173	173	0.03005	164	167	172	178	179	0.03005
Large flood freq. (#/year)	0	0	0	0	0.4	0	0	0	0	0	1	0
Large flood rise rate (cfs difference between consecutive days)	5.683	5.683	7.731	69	69	8.19	4.602	5.391	6.403	8.987	10.24	0.5616
Large flood fallrate (cfs difference between consecutive days)	-23.48	-23.48	-18.57	-8.227	-8.227	-0.8216	-12.37	-9.382	-6.375	-2.457	-1.635	-1.086



Temperature Plots







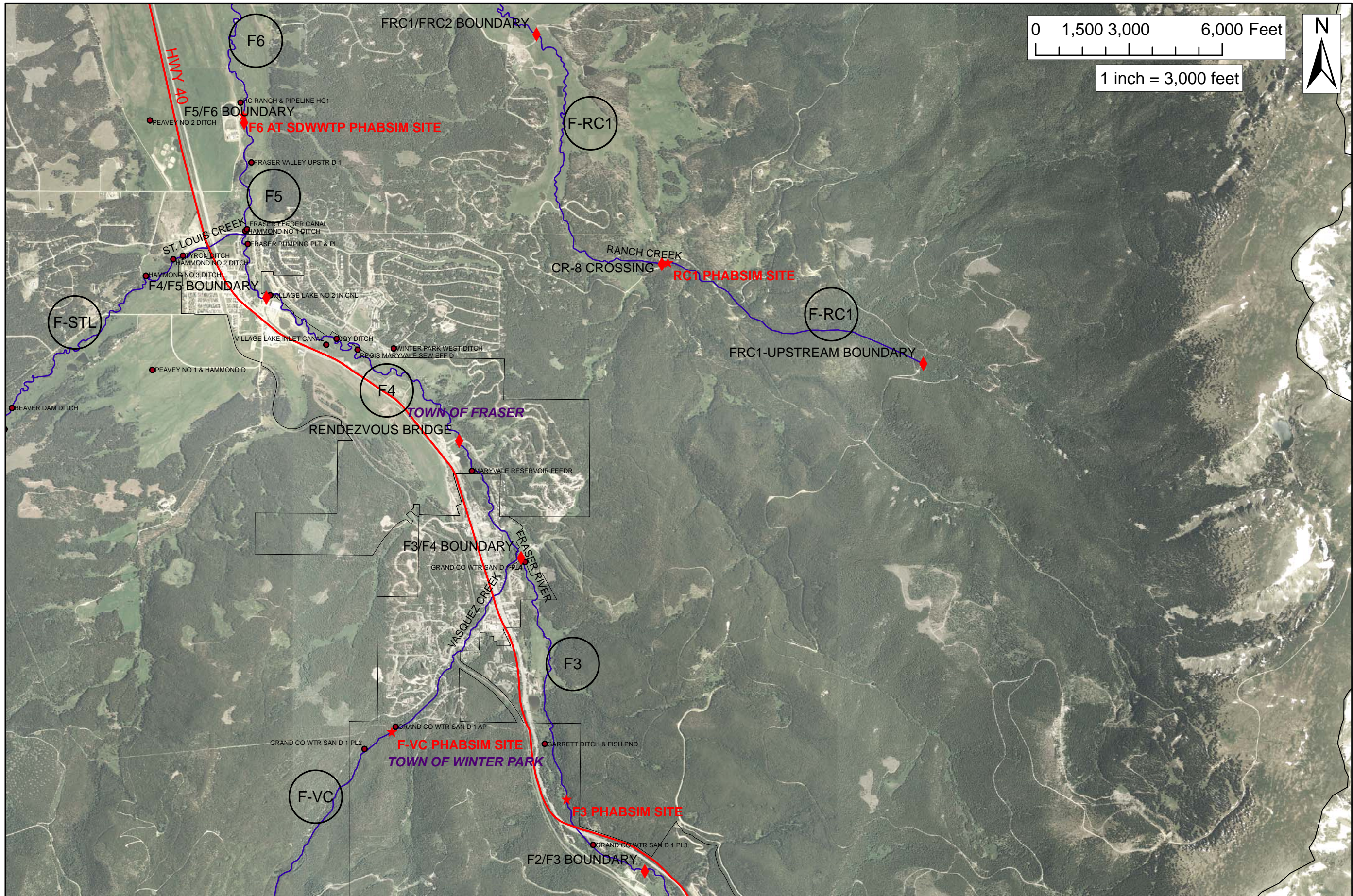
GRAND COUNTY
STREAM MANAGEMENT PLAN
REACHES

Legend

- ◆ REACH BOUNDARY
- ★ PHABSIM SITES
- DIVERSIONS

REACH: F-VC
SHEET # :
1 OF 2





0 1,500 3,000 6,000 Feet

1 inch = 3,000 feet



GRAND COUNTY
 STREAM MANAGEMENT PLAN
 REACHES

Legend

- ◆ REACH BOUNDARY
- ★ PHABSIM SITES
- DIVERSIONS

REACH: F-VC
 SHEET # :
 2 OF 2

