

F9 Stream Reach Summary

Study Reach: F9, Fraser River - River Camp at Granby Ranch Golf Course downstream to the Town of Granby, downstream of Highway 40.

Reach Description: Approximate channel length: 3 ¾ miles, approximate channel slope 0.5%.

As the river leaves Fraser Canyon, the valley opens and flattens and the channel planform becomes increasing sinuous except where confined by development on the overbanks. The river is located along the north and east side of the valley with Granby Ranch golf course development along the west overbanks. Below the golf course, the river is less confined and overbanks are dominated by wetlands-type vegetation with some scattered trees. This reach is very popular with anglers on the privately owned Granby Ranch.



Fraser River at downstream end of the canyon



Fraser River between the Town of Granby and the Granby Golf Course

Flow Recommendations:

Environmental Flow Methodology: A PHABSIM study site was established within this reach in summer 2007. In addition, CWCB flows have been set. The recommended winter target flow range has been revised in 2010 based upon re-evaluation of habitat-flow relations and historic flow availability. See Appendix A for methodology and Appendix E for PHABSIM survey information.

Water Users:

- Irrigators, municipalities and industry flow-related issues: The primary water supplier in this reach is Silvercreek Water Wastewater Authority with alluvial wells along the Fraser. No flow-related issues are reported.
- Recreational Flows: Angling is the predominant use.

Summary of Flows:

Environmental, recommended target flow ranges

- 80 to 120 cfs for April through September
- 40 to 100 cfs for October through March
- Flushing flow of at least 400 cfs for a 3-day duration with a frequency of 1 in 2 years during the late May to late June period.

CWCB flows

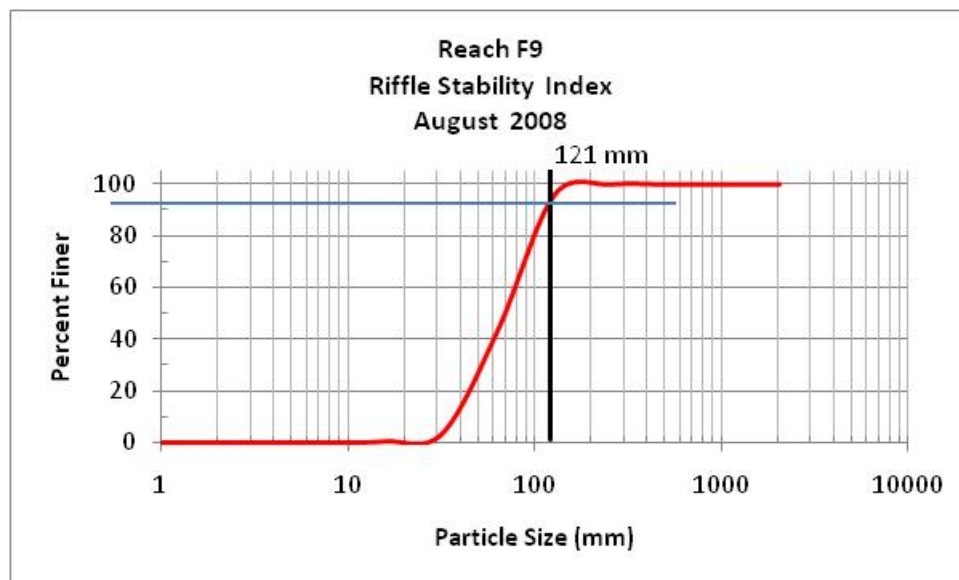
- 30 cfs summer (05/15 – 09/30)
- 19 cfs for winter (09/16 – 05/14)

Water Users:

- Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 67 cfs. 16.6 cfs is Granby water supply, while the remainder of the diversions is made in the summer for irrigation and will likely have some return flows.
- Recreation: Results from private and commercial users are presented below along with minimum, or tolerable flow ranges from American Whitewater for floatboating.
 - Kayaking: 350-900 cfs
 - Rafting: 500-1000 cfs
 - American Whitewater:
 - Fraser Canyon: minimum 700-1300 cfs, optimum 1300 cfs
 - Angling: 60 -200 cfs

Stream Assessments: In August 2008 Tetra Tech conducted three stream assessments in F9. 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’ range, and the RSI of 93 indicates riffle substrate is highly unstable with up to 93% of particles mobilized during recent high flow events. Relevant issues revealed in the stream assessments include excessive fine sediment deposition, lack of aquatic cover, numerous channel alterations, and frequent anthropogenic impacts to overbank areas. Results of all three assessments are summarized in the following table and plot. Details and methodology are presented in Appendix A.

| Reach F9 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 15 |
| 2 | Mass wasting hazard | 6 | 2 | Aquatic Structure as Cover 8 |
| 3 | Debris Jam Potential | 4 | 3 | Velocity/ Depth Regimes 16 |
| 4 | Vegetation Cover | 8 | 4 | Channel Flow Status 16 |
| | | Upper Bank Score: 20 | 5 | Channel Alteration 10 |
| Lower Banks | | | 6 | Frequency of Riffles 16 |
| 5 | Channel Capacity | 4 | 7 | Channel Sinuosity 8 |
| 6 | Bank Rock Content | 6 | Channel Score 89 | |
| 7 | Flow obstructors & Deflectors | 4 | Banks | |
| 8 | Cutting | 10 | 8 | Bank Stability 14 |
| 9 | Deposition | 12 | 9 | Riparian Vegetation Cover and Disturbance 12 |
| | | Lower Bank Score: 36 | 10 | Riparian Vegetation zone width 10 |
| Channel Bottom | | | Bank Score 36 | |
| 10 | Rock Angularity | 3 | Total Score 125 | |
| 11 | Brightness | 3 | Notes | |
| 12 | Consolidation/Particle Packing | 6 | | |
| 13 | Bottom size distribution | 10 | | |
| 14 | Bed Scour and Deposition | 15 | | |
| 15 | Clinging Aquatic Veg | 3 | | |
| | | Channel Bottom Score: 40 | | |
| | | Total Score: 96 | | |



Spawning Observations: A spawning survey was conducted in the vicinity of the F9 PHABSIM site on 28 October 2008. Ten likely brown trout redds were identified and measured.

Hydrologic Records: Two streamflow gaging stations provide records applicable to reach F9. USGS Gage Station 09034000 operated continually from 1904 to 1909 and from 1938 to 1955, while the NCWCD has operated a seasonal gage (April to September) near the mouth of the Fraser River from 1988 to the present. Inspection of the daily streamflow exceedence plots and IHA analyses indicates the recommended environmental target flow ranges are commonly available through much of the water year. The recommended flushing flow is commonly present during the spring runoff period and is supported by the flood frequency analysis provided for the USGS station at Granby.

Water Temperature: F9 is a Tier II stream reach as designated by CDPHE with a chronic temperature standard of 18.2°C MWAT and an acute temperature standard of 23.8°C DM. Temperature data reviewed in reach F9 indicate stream temperatures for the Fraser River in this area are generally below the MWAT and DM standards. However, some exceedences have occurred and resulted in placement of F9 on the 303(d) list of impaired waters for temperature, with a low priority.

Water Quality: Available data shows phosphorus above the guidelines established for this study several times over the past fifteen years at the gage on the Fraser River in Granby. As of April 2010 this reach of the Fraser River has been placed by the State of Colorado on the 303(D) list for monitoring and evaluation for copper. All other available data shows compliance with water quality criteria.

Water Supply Issues (UPCO): UPCO reports that flows in this reach are generally adequate under current conditions, with occasional shortages under future conditions.

Summary of Results and Additional Remarks:

1. Recommended target flow ranges are commonly available through much of the water year. The recommended flushing flow is commonly present during the spring runoff.
2. The stream assessments indicate lack of aquatic cover, channel alterations, and anthropogenic impacts on the overbanks. There is some evidence that this reach is aggradational, most likely the result of gradient changes as the Fraser River emerges from the canyon.
3. Temperatures and water quality appear supportive of a cold-water fishery, although some exceedences of temperature standards have been observed.
4. Flows for water uses including recreation are generally adequate.
5. Colorado Division of Wildlife electrofishing records from 1993 indicate about equal numbers of brown and rainbow trout occurred within this reach. CDOW fish collections in Granby during 2009 found brown trout to be about 5 times more abundant than rainbow trout, although a large number of naturally spawned young-of-year rainbows were also collected. In recent years, CDOW has been stocking numerous rainbow trout into the Fraser to supplement the populations depleted by whirling disease.
6. The relative abundance of trout spawning habitat within F9 and other reaches of the Fraser River system, in comparison to that found within the Colorado River above the Fraser River confluence site (CR3), suggests the Fraser may have been an important spawning tributary. The influence of Windy Gap dam and several other downstream barriers on trout passage is unknown and may be an issue deserving of further study.
7. Granby Ranch is located upstream of Granby within the Town limits. This is a private development and includes a new golf course and home sites. Granby Ranch is currently planning 3 miles of river restoration through the ranch. No specific design information including flow regimes is available for inclusion in this report. Impacts of the golf course on water flows, water quality and temperature are unknown. Monitoring of the river and coordination with the landowners is recommended as future phases of the Stream Management Plan progress.

8. 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, may occasionally be lower than target ranges in this reach.

Restoration Opportunities: Fish passage improvements recommended in F10 and CR4 would provide access to existing spawning habitat observed in F9 and would help restore connectivity between the Fraser and Colorado Rivers. Other restoration opportunities are noted below.

- ✓ Follow-up on the existing restoration efforts at the Granby Ranch and explore opportunities to expand onto public property. Specific restoration components might include bank stabilization, tree plantings, channel narrowing with pool-cover feature and bar construction.

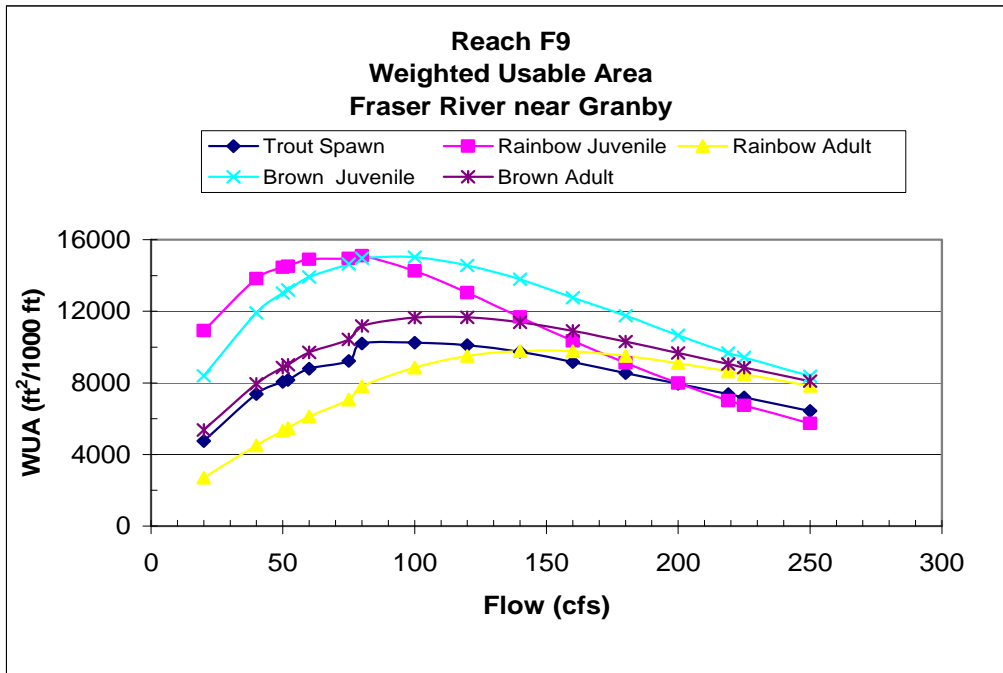
Monitoring: Establish and implement a monitoring program. Parameters should include intergravel fine sediments; pH and phosphorus. Continue monitoring surface water temperature. Consider the addition of air temperature monitoring. Should fish passage enhancements be implemented in F10 include monitoring of fish populations and diversity.

Support Data

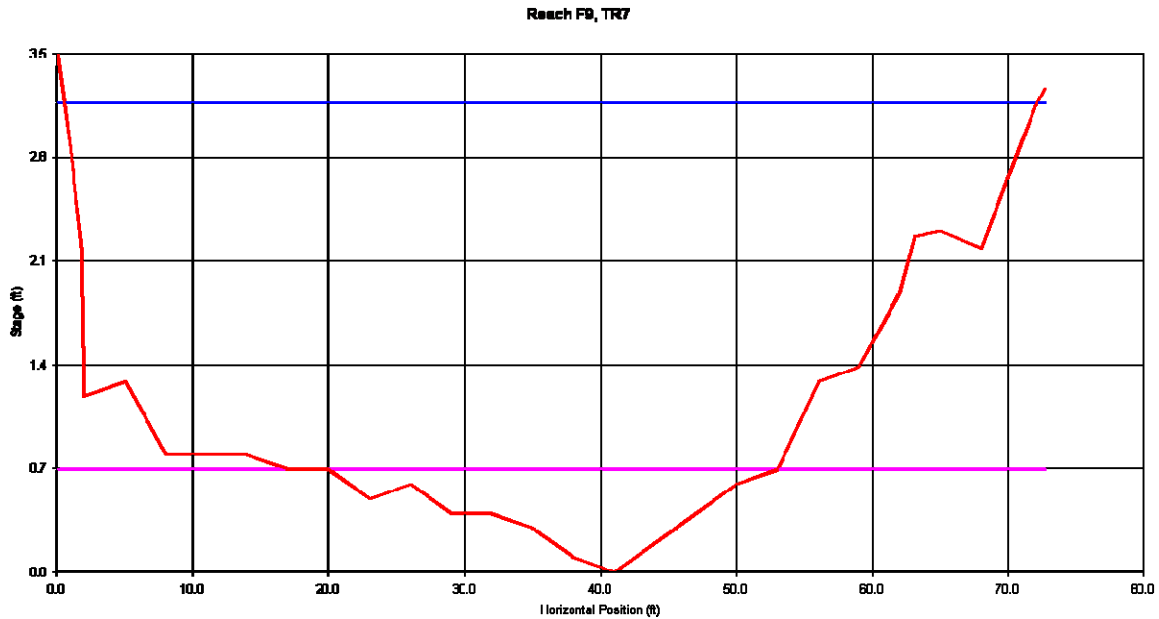
Weighted Useable Area Charts and Tables

Table F9-1 Habitat-flow relations for the target species and life stages for Reach F9, Tetra Tech site .

| Reach F9 | | | | | | |
|---|-------------------------------|-------------|------------------|---------------|----------------|-------------|
| Discharge (cfs) | Total Area (ft ²) | Trout Spawn | Rainbow Juvenile | Rainbow Adult | Brown Juvenile | Brown Adult |
| Weighted Usable Area (ft ² /1000 ft stream length) | | | | | | |
| 20 | 38680.8 | 4751.3 | 10918.8 | 2700.6 | 8398.2 | 5368.1 |
| 40 | 42362.0 | 7378.4 | 13830.8 | 4499.4 | 11918.1 | 7949.9 |
| 50 | 43394.0 | 8057.3 | 14450.4 | 5330.6 | 13016.9 | 8851.4 |
| 52 | 43589.4 | 8169.2 | 14522.8 | 5483.7 | 13191.1 | 9009.9 |
| 60 | 44328.1 | 8791.1 | 14903.8 | 6124.3 | 13923.9 | 9709.0 |
| 75 | 46186.1 | 9221.6 | 14946.7 | 7070.0 | 14641.8 | 10430.7 |
| 80 | 46846.5 | 10198.1 | 15109.0 | 7804.8 | 14965.7 | 11180.7 |
| 100 | 47769.6 | 10248.9 | 14260.3 | 8855.7 | 15026.9 | 11642.4 |
| 120 | 48481.7 | 10106.4 | 13033.3 | 9510.0 | 14566.2 | 11661.7 |
| 140 | 49128.3 | 9735.6 | 11686.5 | 9778.7 | 13792.6 | 11382.5 |
| 160 | 49850.3 | 9159.3 | 10353.4 | 9759.5 | 12764.6 | 10901.4 |
| 180 | 50273.2 | 8548.8 | 9120.7 | 9508.8 | 11761.4 | 10307.7 |
| 200 | 50673.0 | 7947.1 | 7998.4 | 9100.6 | 10660.5 | 9671.5 |
| 219 | 51183.8 | 7379.3 | 7009.6 | 8636.2 | 9677.2 | 9053.8 |
| 225 | 51337.1 | 7194.3 | 6737.0 | 8480.8 | 9432.4 | 8862.7 |
| 250 | 51931.9 | 6433.4 | 5736.0 | 7831.1 | 8372.3 | 8103.9 |



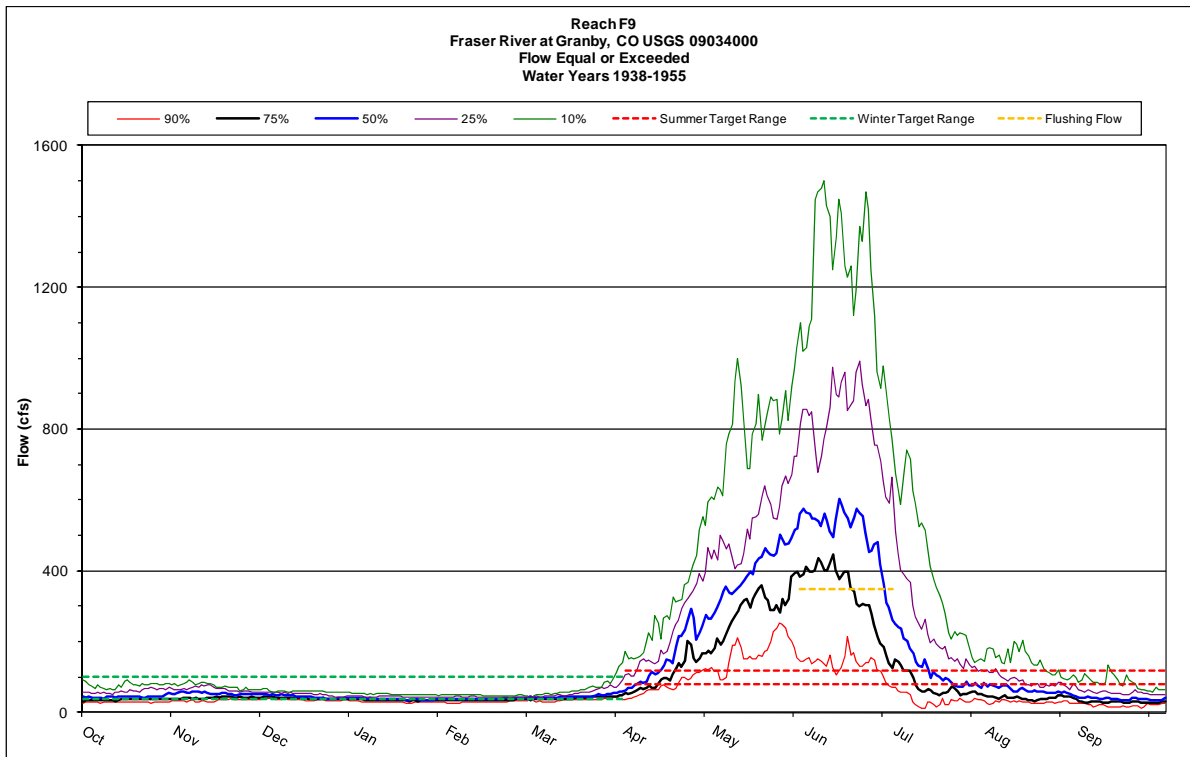
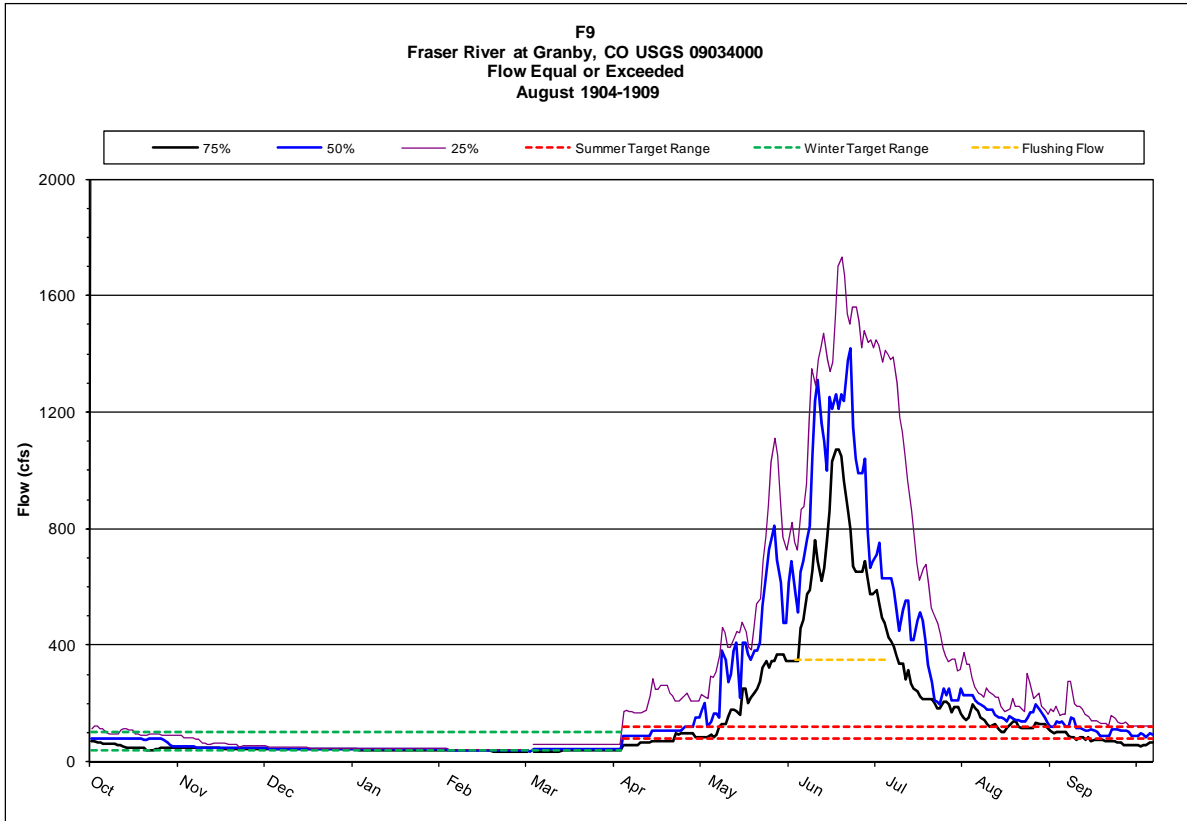
Transect and Bedload Threshold

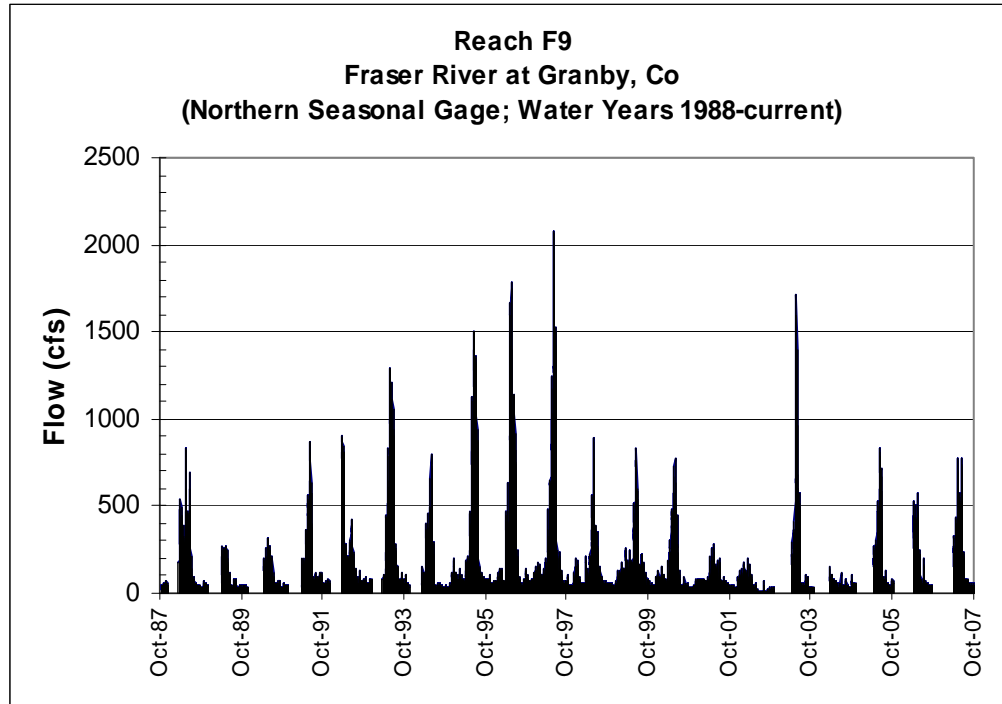


Reach FR9, TR 7
 TT2007 site
 Resistance Method: Jarrett's Equation

| STAGE (ft) | AREA (sq ft) | PERIM (ft) | WIDTH (ft) | R (ft) | DHYD (ft) | SLOPE (ft/ft) | n | VAVG (ft/s) | Q (cfs) | SHEAR (psf) |
|------------|--------------|------------|------------|--------|-----------|---------------|-------|-------------|---------|-------------|
| 0.7 | 10.50 | 33.04 | 33.00 | 0.32 | 0.32 | 0.006 | 0.067 | 0.80 | 8.4 | 0.12 |
| 0.8 | 14.27 | 39.55 | 39.50 | 0.36 | 0.36 | 0.006 | 0.066 | 0.88 | 12.6 | 0.14 |
| 0.9 | 18.88 | 46.67 | 46.60 | 0.40 | 0.41 | 0.006 | 0.065 | 0.97 | 18.4 | 0.15 |
| 1.0 | 23.59 | 47.79 | 47.70 | 0.49 | 0.49 | 0.006 | 0.062 | 1.15 | 27.1 | 0.18 |
| 1.1 | 28.42 | 48.91 | 48.80 | 0.58 | 0.58 | 0.006 | 0.061 | 1.31 | 37.3 | 0.22 |
| 1.2 | 33.35 | 50.03 | 49.90 | 0.67 | 0.67 | 0.006 | 0.060 | 1.47 | 49.1 | 0.25 |
| 1.3 | 38.55 | 54.25 | 54.01 | 0.71 | 0.71 | 0.006 | 0.059 | 1.55 | 59.9 | 0.27 |
| 1.4 | 44.10 | 57.35 | 57.03 | 0.77 | 0.77 | 0.006 | 0.058 | 1.66 | 73.1 | 0.29 |
| 1.5 | 49.83 | 58.06 | 57.65 | 0.86 | 0.86 | 0.006 | 0.057 | 1.82 | 90.5 | 0.32 |
| 1.6 | 55.63 | 58.77 | 58.27 | 0.95 | 0.95 | 0.006 | 0.056 | 1.97 | 109.6 | 0.35 |
| 1.7 | 61.49 | 59.48 | 58.89 | 1.03 | 1.04 | 0.006 | 0.056 | 2.12 | 130.3 | 0.39 |
| 1.8 | 67.41 | 60.19 | 59.51 | 1.12 | 1.13 | 0.006 | 0.055 | 2.27 | 152.7 | 0.42 |
| 1.9 | 73.39 | 60.90 | 60.13 | 1.21 | 1.22 | 0.006 | 0.054 | 2.41 | 176.7 | 0.45 |
| 2.0 | 79.42 | 61.30 | 60.43 | 1.30 | 1.31 | 0.006 | 0.054 | 2.56 | 203.0 | 0.49 |
| 2.1 | 85.48 | 61.70 | 60.73 | 1.39 | 1.41 | 0.006 | 0.053 | 2.70 | 231.0 | 0.52 |
| 2.2 | 91.56 | 62.10 | 61.04 | 1.47 | 1.50 | 0.006 | 0.052 | 2.85 | 260.6 | 0.55 |
| 2.3 | 97.81 | 65.63 | 64.49 | 1.49 | 1.52 | 0.006 | 0.052 | 2.87 | 280.9 | 0.56 |
| 2.4 | 104.47 | 68.39 | 67.20 | 1.53 | 1.55 | 0.006 | 0.052 | 2.93 | 306.2 | 0.57 |
| 2.5 | 111.21 | 68.97 | 67.74 | 1.61 | 1.64 | 0.006 | 0.052 | 3.07 | 340.9 | 0.60 |
| 2.6 | 118.01 | 69.55 | 68.27 | 1.70 | 1.73 | 0.006 | 0.051 | 3.20 | 377.4 | 0.64 |
| 2.7 | 124.87 | 70.14 | 68.81 | 1.78 | 1.81 | 0.006 | 0.051 | 3.33 | 415.6 | 0.67 |
| 2.8 | 131.78 | 70.72 | 69.34 | 1.86 | 1.90 | 0.006 | 0.051 | 3.46 | 455.5 | 0.70 |
| 2.9 | 138.74 | 71.31 | 69.88 | 1.95 | 1.99 | 0.006 | 0.050 | 3.58 | 497.1 | 0.73 |
| 3.0 | 145.75 | 71.90 | 70.43 | 2.03 | 2.07 | 0.006 | 0.050 | 3.71 | 540.3 | 0.76 |
| 3.1 | 152.82 | 72.50 | 70.98 | 2.11 | 2.15 | 0.006 | 0.050 | 3.83 | 585.2 | 0.79 |
| 3.2 | 159.95 | 73.13 | 71.57 | 2.19 | 2.23 | 0.006 | 0.049 | 3.95 | 631.6 | 0.82 |

Hydrographs and Exceedence Plots





| Return Period T (year) | Probability P (percent) | Flood Discharge Q (ft³/sec) |
|-----------------------------------|------------------------------------|---|
| 1.05 | 95.2 | 350 |
| 1.11 | 90.1 | 467 |
| 1.25 | 80 | 643 |
| 2 | 50 | 1086 |
| 5 | 20 | 1647 |
| 10 | 10 | 1969 |
| 25 | 4 | 2315 |

Flood frequency analysis for USGS gage 09034000, Fraser River at Granby, CO, for 18 years of record (Water years 1938-1955).

IHA Results**Reach F9****Non-Parametric IHA Scorecard****Fraser River At Granby USGS 09034000 1938-1955****Period of Analysis: 1938-1955 (18 years)**

| | |
|--------------------------------|-------|
| Mean annual flow (cfs) | 148.1 |
| Mean flow/area (dimensionless) | 148.1 |
| Annual C. V. | 1.53 |
| Flow predictability (%) | 0.64 |
| Constancy/predictability | 0.58 |
| % of floods in 60d period | 0.6 |
| Flood-free season (days) | 196 |

| | Medians | Coeff. of Disp. |
|--|----------------|------------------------|
| Parameter Group #1 | | |
| October (cfs) | 43.5 | 0.6034 |
| November (cfs) | 53.5 | 0.3715 |
| December (cfs) | 44 | 0.2784 |
| January (cfs) | 37.5 | 0.28 |
| February (cfs) | 38.5 | 0.2338 |
| March (cfs) | 46.5 | 0.2419 |
| April (cfs) | 151 | 0.4114 |
| May (cfs) | 416 | 0.4579 |
| June (cfs) | 486 | 0.9334 |
| July (cfs) | 100 | 1.223 |
| August (cfs) | 59.5 | 0.6891 |
| September (cfs) | 37.25 | 0.5671 |
| Parameter Group #2 | | |
| 1-day minimum (cfs) | 26.5 | 0.2736 |
| 3-day minimum (cfs) | 27.5 | 0.2758 |
| 7-day minimum (cfs) | 27.71 | 0.3003 |
| 30-day minimum (cfs) | 33.4 | 0.279 |
| 90-day minimum (cfs) | 39.42 | 0.1963 |
| 1-day maximum (cfs) | 1045 | 0.7584 |
| 3-day maximum (cfs) | 850.3 | 0.9345 |
| 7-day maximum (cfs) | 771.7 | 0.9299 |
| 30-day maximum (cfs) | 633.3 | 0.6984 |
| 90-day maximum (cfs) | 396.9 | 0.7038 |
| Number of zero days (count) | 0 | 0 |
| Base flow index (7day minimum in cfs/median in cfs) | 0.1677 | 0.3722 |
| Parameter Group #3 | | |
| Date of minimum (Julian day) | 267.5 | 0.06216 |
| Date of maximum (Julian day) | 158 | 0.06284 |
| Parameter Group #4 | | |
| Low pulse count (#) | 5.5 | 1.136 |
| Low pulse duration (days) | 4 | 2.094 |
| High pulse count (#) | 3 | 0.8333 |
| High pulse duration (days) | 9.5 | 3.961 |
| The low pulse threshold is (cfs) | 40 | |
| The high pulse threshold is (cfs) | 129 | |
| Parameter Group #5 | | |
| Rise rate (cfs difference between consecutive days) | 4 | 0.3125 |
| Fall rate (cfs difference between consecutive days) | -5 | -0.4 |
| Number of reversals | 109 | 0.1491 |

Reach F9

IHA Percentile Data

Fraser River At Granby USGS 09034000 1938-1955

Period of Analysis: 1938-1955 (18 years)

| | 10% | 25% | 50% | 75% | 90% | (75-25)/50 |
|--|--------|--------|--------|--------|--------|------------|
| Parameter Group #1 | | | | | | |
| October (cfs) | 29 | 36.75 | 43.5 | 63 | 76.3 | 0.6034 |
| November (cfs) | 37.7 | 44.38 | 53.5 | 64.25 | 68.4 | 0.3715 |
| December (cfs) | 37 | 40.75 | 44 | 53 | 60 | 0.2784 |
| January (cfs) | 29.5 | 34 | 37.5 | 44.5 | 50.2 | 0.28 |
| February (cfs) | 29.8 | 35.5 | 38.5 | 44.5 | 48.15 | 0.2338 |
| March (cfs) | 37.9 | 42.75 | 46.5 | 54 | 62.2 | 0.2419 |
| April (cfs) | 78.4 | 115.1 | 151 | 177.3 | 196.8 | 0.4114 |
| May (cfs) | 180.3 | 335.5 | 416 | 526 | 744.6 | 0.4579 |
| June (cfs) | 137.9 | 401 | 486 | 854.6 | 1007 | 0.9334 |
| July (cfs) | 39.8 | 70.25 | 100 | 192.5 | 330 | 1.223 |
| August (cfs) | 32.9 | 39.25 | 59.5 | 80.25 | 139.3 | 0.6891 |
| September (cfs) | 22.1 | 30.88 | 37.25 | 52 | 71.15 | 0.5671 |
| Parameter Group #2 | | | | | | |
| 1-day minimum (cfs) | 8.68 | 21.75 | 26.5 | 29 | 31 | 0.2736 |
| 3-day minimum (cfs) | 9.213 | 22 | 27.5 | 29.58 | 34.93 | 0.2758 |
| 7-day minimum (cfs) | 11.53 | 23.89 | 27.71 | 32.21 | 36.87 | 0.3003 |
| 30-day minimum (cfs) | 20.85 | 28.31 | 33.4 | 37.63 | 40.18 | 0.279 |
| 90-day minimum (cfs) | 27.02 | 36.26 | 39.42 | 43.99 | 47.58 | 0.1963 |
| 1-day maximum (cfs) | 348.6 | 635 | 1045 | 1428 | 1684 | 0.7584 |
| 3-day maximum (cfs) | 327.9 | 593.7 | 850.3 | 1388 | 1597 | 0.9345 |
| 7-day maximum (cfs) | 283.9 | 534.5 | 771.7 | 1252 | 1454 | 0.9299 |
| 30-day maximum (cfs) | 240.9 | 461.8 | 633.3 | 904.1 | 1229 | 0.6984 |
| 90-day maximum (cfs) | 185.5 | 325.2 | 396.9 | 604.6 | 672.9 | 0.7038 |
| Number of zero days (count) | 0 | 0 | 0 | 0 | 0 | 0 |
| Base flow index (7day minimum in cfs/median in cfs) | 0.137 | 0.1556 | 0.1677 | 0.218 | 0.2695 | 0.3722 |
| Parameter Group #3 | | | | | | |
| Date of minimum (Julian day) | 209 | 252.3 | 267.5 | 275 | 308.1 | 0.06216 |
| Date of maximum (Julian day) | 132.2 | 147 | 158 | 170 | 174.4 | 0.06284 |
| Parameter Group #4 | | | | | | |
| Low pulse count (#) | 1.9 | 3.75 | 5.5 | 10 | 16.1 | 1.136 |
| Low pulse duration (days) | 1.9 | 2 | 4 | 10.38 | 15.05 | 2.094 |
| High pulse count (#) | 1 | 2 | 3 | 4.5 | 7 | 0.8333 |
| High pulse duration (days) | 1.9 | 2.375 | 9.5 | 40 | 90.8 | 3.961 |
| Parameter Group #5 | | | | | | |
| Rise rate (cfs difference between consecutive days) | 3 | 4 | 4 | 5.25 | 7.2 | 0.3125 |
| Fall rate (cfs difference between consecutive days) | -7.6 | -6 | -5 | -4 | -2.9 | -0.4 |
| Number of reversals | 98.6 | 101 | 109 | 117.3 | 121.1 | 0.1491 |
| EFC Monthly Low Flows | | | | | | |
| October Low Flow (cfs) | 34.9 | 38 | 44.5 | 59.25 | 67.3 | 0.4775 |
| November Low Flow (cfs) | 38.3 | 44.75 | 53 | 61.25 | 65.7 | 0.3113 |
| December Low Flow (cfs) | 37.3 | 40.75 | 44 | 53 | 60 | 0.2784 |
| January Low Flow (cfs) | 33.7 | 34.75 | 37.5 | 44.5 | 50.2 | 0.26 |
| February Low Flow (cfs) | 34 | 36 | 39 | 45 | 48.3 | 0.2308 |
| March Low Flow (cfs) | 41.4 | 43.5 | 47 | 54 | 60.8 | 0.2234 |
| April Low Flow (cfs) | 40.45 | 66 | 80 | 104.9 | 122.7 | 0.4859 |
| May Low Flow (cfs) | 80 | 86.5 | 108 | 116 | 118 | 0.2731 |
| June Low Flow (cfs) | 46.5 | 54.13 | 96.25 | 117.8 | 118.5 | 0.661 |
| July Low Flow (cfs) | 38.6 | 51.5 | 79 | 89 | 114 | 0.4747 |
| August Low Flow (cfs) | 36.7 | 40 | 56 | 74.25 | 104.2 | 0.6116 |
| September Low Flow (cfs) | 32 | 35 | 38 | 55 | 70.6 | 0.5263 |
| EFC Parameters | | | | | | |
| Extreme low peak (cfs) | 20.8 | 25.5 | 27.5 | 29 | 30 | 0.1273 |
| Extreme low duration (days) | 1 | 2 | 4 | 7 | 15.6 | 1.25 |
| Extreme low timing (Julian date) | 147.6 | 242.5 | 254 | 291 | 311.4 | 0.1325 |
| Extreme low freq. (#/year) | 0 | 1 | 2 | 4.5 | 9.3 | 1.75 |
| High flow peak (cfs) | 73.4 | 84.5 | 115.8 | 154.9 | 175.6 | 0.608 |
| High flow duration (days) | 2.5 | 3 | 4 | 6.25 | 10.1 | 0.8125 |
| High flow timing (Julian date) | 142.5 | 181.5 | 218.3 | 232.3 | 271.1 | 0.1387 |
| High flow frequency (#/year) | 3.9 | 4 | 5.5 | 7.25 | 11.1 | 0.5909 |
| High flow rise rate (cfs difference between consecutive days) | 15.88 | 18.09 | 20.44 | 25 | 35.53 | 0.3379 |
| High flow fall rate (cfs difference between consecutive days) | -18.43 | -14.31 | -10.33 | -8.5 | -7.12 | -0.5625 |
| Small Flood peak (cfs) | 1050 | 1078 | 1275 | 1465 | 1640 | 0.3039 |
| Small Flood duration (days) | 60 | 71.25 | 97.5 | 108.3 | 115 | 0.3795 |
| Small Flood timing (Julian date) | 143 | 148.8 | 164 | 172.3 | 174 | 0.06421 |
| Small Flood freq. (#/year) | 0 | 0 | 0 | 1 | 1 | 0 |
| Small Flood riserate (cfs difference between consecutive days) | 19.83 | 20.67 | 23.08 | 26.35 | 27.31 | 0.246 |
| Small Flood fallrate (cfs difference between consecutive days) | -44.24 | -40.61 | -29.2 | -21.85 | -19.85 | -0.6424 |
| Large flood peak (cfs) | | | 2080 | | | |
| Large flood duration (days) | | | 91 | | | |
| Large flood timing (Julian date) | | | 161 | | | |
| Large flood freq. (#/year) | 0 | 0 | 0 | 0 | 0.1 | 0 |
| Large flood riserate (cfs difference between consecutive days) | | | 34.42 | | | |
| Large flood fallrate (cfs difference between consecutive days) | | | -56.06 | | | |

Reach F9**Non-Parametric IHA Scorecard**

Fraser River nr Granby (Northern Gage)

Season from Julian date 92.to 274.

April through September

Period of Analysis: 1988-2007 (20 years)

| | |
|--------------------------------|-------|
| Mean annual flow (cfs) | 210.6 |
| Mean flow/area (dimensionless) | 210.6 |
| Annual C. V. | 1.29 |
| Flow predictability (%) | 0.48 |
| Constancy/predictability | 0.55 |
| % of floods in 60d period | 0.78 |
| Flood-free season (days) | 91 |

| | Medians | Coeff. of Disp. |
|--|----------------|------------------------|
|--|----------------|------------------------|

Parameter Group #1

| | | |
|-----------------|-------|--------|
| October (cfs) | | |
| November (cfs) | | |
| December (cfs) | | |
| January (cfs) | | |
| February (cfs) | | |
| March (cfs) | | |
| April (cfs) | 173.7 | 0.7139 |
| May (cfs) | 339.4 | 0.6919 |
| June (cfs) | 365.1 | 1.054 |
| July (cfs) | 71.05 | 0.8476 |
| August (cfs) | 54.3 | 0.5681 |
| September (cfs) | 40.88 | 0.4523 |

Parameter Group #2

| | | |
|--|--------|--------|
| 1-day minimum (cfs) | 28.5 | 0.6544 |
| 3-day minimum (cfs) | 31.22 | 0.6062 |
| 7-day minimum (cfs) | 34.04 | 0.5121 |
| 30-day minimum (cfs) | 42.49 | 0.5222 |
| 90-day minimum (cfs) | 64.3 | 0.6972 |
| 1-day maximum (cfs) | 829.4 | 0.9693 |
| 3-day maximum (cfs) | 774.6 | 1.05 |
| 7-day maximum (cfs) | 727.2 | 1.135 |
| 30-day maximum (cfs) | 491.1 | 0.8823 |
| 90-day maximum (cfs) | 309.8 | 0.7663 |
| Number of zero days (count) | 0 | 0 |
| Base flow index (7day minimum in cfs/median in cfs) | 0.1766 | 0.6701 |

Parameter Group #3

| | | |
|------------------------------|-----|---------|
| Date of minimum (Julian day) | 263 | 0.08265 |
| Date of maximum (Julian day) | 153 | 0.07719 |

Parameter Group #4

| | | |
|-----------------------------------|-------|--------|
| Low pulse count (#) | 4 | 0.9375 |
| Low pulse duration (days) | 8.5 | 1.676 |
| High pulse count (#) | 3 | 0.9167 |
| High pulse duration (days) | 10.25 | 3.366 |
| The low pulse threshold is (cfs) | 50.1 | |
| The high pulse threshold is (cfs) | 259 | |

Parameter Group #5

| | | |
|--|-------|---------|
| Rise rate (cfs difference between consecutive days) | 10.95 | 0.9349 |
| Fall rate (cfs difference between consecutive days) | -8.25 | -0.6939 |
| Number of reversals | 63 | 0.2024 |

Reach F9
IHA Percentile Data
Fraser River nr Granby (Northern Gage)
Season from Julian date 92 to 274.

April through September

| Period of Analysis: 1988-2007 (20 years) | | | | | | |
|--|--------|--------|--------|--------|--------|------------|
| Parameter Group #1 | 10% | 25% | 50% | 75% | 90% | (75-25)/50 |
| October (cfs) | | | | | | |
| November (cfs) | | | | | | |
| December (cfs) | | | | | | |
| January (cfs) | | | | | | |
| February (cfs) | | | | | | |
| March (cfs) | | | | | | |
| April (cfs) | 91.76 | 107.9 | 173.7 | 231.9 | 309.9 | 0.7139 |
| May (cfs) | 65.15 | 182.3 | 339.4 | 417.1 | 670 | 0.6919 |
| June (cfs) | 32.6 | 149.4 | 365.1 | 534.1 | 1158 | 1.054 |
| July (cfs) | 31.96 | 48.7 | 71.05 | 108.9 | 218.6 | 0.8476 |
| August (cfs) | 37.34 | 44.6 | 54.3 | 75.45 | 93.35 | 0.5681 |
| September (cfs) | 27.36 | 36.73 | 40.88 | 55.21 | 68.49 | 0.4523 |
| Parameter Group #2 | | | | | | |
| 1-day minimum (cfs) | 13.7 | 21.8 | 28.5 | 40.45 | 47.11 | 0.6544 |
| 3-day minimum (cfs) | 14.51 | 23.22 | 31.22 | 42.14 | 52.61 | 0.6052 |
| 7-day minimum (cfs) | 16.47 | 26.12 | 34.04 | 43.55 | 56.7 | 0.5121 |
| 30-day minimum (cfs) | 28.6 | 33.55 | 42.49 | 55.74 | 69.17 | 0.5222 |
| 90-day minimum (cfs) | 34.28 | 47.96 | 64.3 | 92.79 | 144.8 | 0.6972 |
| 1-day maximum (cfs) | 179.3 | 383.3 | 829.4 | 1187 | 1772 | 0.9693 |
| 3-day maximum (cfs) | 165.1 | 365.4 | 774.6 | 1179 | 1703 | 1.05 |
| 7-day maximum (cfs) | 143.2 | 319.2 | 727.2 | 1145 | 1557 | 1.135 |
| 30-day maximum (cfs) | 98.24 | 268.1 | 491.1 | 701.4 | 1287 | 0.8823 |
| 90-day maximum (cfs) | 63.9 | 195.6 | 309.8 | 433 | 796.7 | 0.7663 |
| Number of zero days (count) | 0 | 0 | 0 | 0 | 0 | 0 |
| Base flow index (7day minimum in cfs/median in cfs) | 0.1098 | 0.1301 | 0.1766 | 0.2485 | 0.3256 | 0.6701 |
| Parameter Group #3 | | | | | | |
| Date of minimum (Julian day) | 165.7 | 240.5 | 263 | 270.8 | 274 | 0.08265 |
| Date of maximum (Julian day) | 94.6 | 140.3 | 153 | 168.5 | 175.6 | 0.07719 |
| Parameter Group #4 | | | | | | |
| Low pulse count (#) | 0.1 | 2 | 4 | 5.75 | 8 | 0.9375 |
| Low pulse duration (days) | 1.9 | 5.25 | 8.5 | 19.5 | 34.35 | 1.676 |
| High pulse count (#) | 0.1 | 1 | 3 | 3.75 | 4 | 0.9167 |
| High pulse duration (days) | 1 | 4.375 | 10.25 | 38.88 | 50.1 | 3.366 |
| Parameter Group #5 | | | | | | |
| Rise rate (cfs difference between consecutive days) | 2.76 | 7.025 | 10.95 | 17.26 | 26.58 | 0.9349 |
| Fall rate (cfs difference between consecutive days) | -17.16 | -12.27 | -8.25 | -6.55 | -3.2 | -0.6939 |
| Number of reversals | 52.1 | 55.25 | 63 | 68 | 69.9 | 0.2024 |
| EFC Monthly Low Flows | | | | | | |
| October Low Flow (cfs) | | | | | | |
| November Low Flow (cfs) | | | | | | |
| December Low Flow (cfs) | | | | | | |
| January Low Flow (cfs) | | | | | | |
| February Low Flow (cfs) | | | | | | |
| March Low Flow (cfs) | | | | | | |
| April Low Flow (cfs) | 60.09 | 69.15 | 81.4 | 127.3 | 150.5 | 0.7141 |
| May Low Flow (cfs) | 40.01 | 111.4 | 144 | 158.9 | 161.1 | 0.3297 |
| June Low Flow (cfs) | 48.25 | 50.9 | 62.4 | 101.9 | 120.2 | 0.8165 |
| July Low Flow (cfs) | 39.11 | 53.95 | 64.88 | 83.46 | 95.01 | 0.4549 |
| August Low Flow (cfs) | 39.52 | 44.74 | 54.2 | 70.21 | 80.18 | 0.47 |
| September Low Flow (cfs) | 36.77 | 37.73 | 42.55 | 53.76 | 65.5 | 0.3769 |
| EFC Parameters | | | | | | |
| Extreme low peak (cfs) | 22.18 | 25.3 | 26.6 | 29.55 | 30.9 | 0.1598 |
| Extreme low duration (days) | 1.5 | 2 | 4 | 6 | 10.6 | 1 |
| Extreme low timing (Julian date) | 239.6 | 263.5 | 286.5 | 318.3 | 335 | 0.1496 |
| Extreme low freq. (#/year) | 0 | 1.25 | 2.5 | 7.5 | 8.9 | 2.5 |
| High flow peak (cfs) | 98.5 | 118 | 142 | 190 | 240 | 0.507 |
| High flow duration (days) | 1 | 2.5 | 4 | 5.5 | 10.5 | 0.75 |
| High flow timing (Julian date) | 73.5 | 118.5 | 167 | 205 | 258 | 0.2363 |
| High flow frequency (#/year) | 2 | 4.25 | 6 | 9 | 12 | 0.7917 |
| High flow rise rate (cfs difference between consecutive days) | 18.6 | 24.18 | 27.3 | 31.45 | 45.8 | 0.2665 |
| High flow fall rate (cfs difference between consecutive days) | -25.55 | -20.64 | -17.75 | -14.03 | -12.64 | -0.3722 |
| Small Flood peak (cfs) | 830 | 845.5 | 896.5 | 1447 | 1717 | 0.6704 |
| Small Flood duration (days) | 52 | 67.5 | 97.5 | 123 | 129 | 0.5692 |
| Small Flood timing (Julian date) | 89 | 143.3 | 155 | 168.5 | 172 | 0.06899 |
| Small Flood freq. (#/year) | 0 | 0 | 0 | 1 | 1 | 0 |
| Small Flood riserate (cfs difference between consecutive days) | 7.131 | 10.4 | 18.39 | 25.7 | 31.2 | 0.8316 |
| Small Flood fallrate (cfs difference between consecutive days) | -59.14 | -46.27 | -28.02 | -20.26 | -14.28 | -0.9282 |
| Large flood peak (cfs) | 1778 | 1778 | 1930 | 2081 | 2081 | 0.157 |
| Large flood duration (days) | 84 | 84 | 86.5 | 89 | 89 | 0.0578 |
| Large flood timing (Julian date) | 141 | 141 | 150.5 | 160 | 160 | 0.05191 |
| Large flood freq. (#/year) | 0 | 0 | 0 | 0 | 0.9 | 0 |
| Large flood riserate (cfs difference between consecutive days) | 36.79 | 36.79 | 48.59 | 60.39 | 60.39 | 0.4858 |
| Large flood fallrate (cfs difference between consecutive days) | -55.04 | -55.04 | -41.8 | -28.56 | -28.56 | -0.6336 |

Surface Water Temperature Plots

