Use of Hydrology in the Development of SB 3 Flow Recommendations

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Presentation to
Trinity - San Jacinto
Basin and Bay Area Stakeholders Committee

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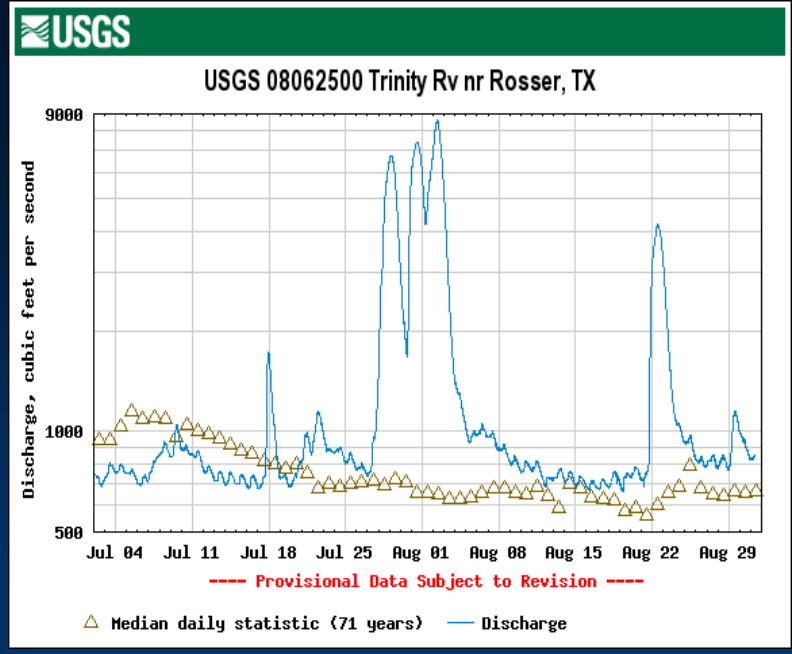
Rationale



- SB 3 timelines are aggressive and budgets are tight
- Hydrology has been considered the "master variable“ (Poff et al., 1997 as cited in NRC, 2005)
- Hydrologic data are
  - Widely available for a long period of time
  - Consistently measured
  - Fairly easy to work with

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SAC Hydrology Guidance

Use of Hydrologic Data in the Development of Instream Flow Recommendations for the Environmental Flows Allocation Process and the Hydrology-Based Environmental Flow Regime (HEFR) Methodology

- **First distributed to BBESTs on February 9, 2009**
- **Current revision dated April 20, 2009**
- **From the cover letter:**
  - *Hydrologic data analysis is an important first step in developing an environmental flow regime, but it provides only an initial estimate of flow requirements.*
  - *The SAC believes that the HEFR methodology might prove useful as a first step in developing instream flow recommendations, and we recommend that the BBESTs consider its utility…*

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SB 3 Definition of Environmental Flow Regime

Environmental Flow Regime:

11.002(16):

A schedule of flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are shown to be **adequate to support a sound ecological environment** and to maintain the productivity, extent, and persistence of key aquatic habitats in and along the affected water bodies.

From the SAC Hydrologic Methods Doc Conclusions:

The [HEFR] methodology…provides a relatively flexible computational approach for developing a flow regime matrix that is consistent with the [Texas Instream Flow Program] multi-tiered flow framework…

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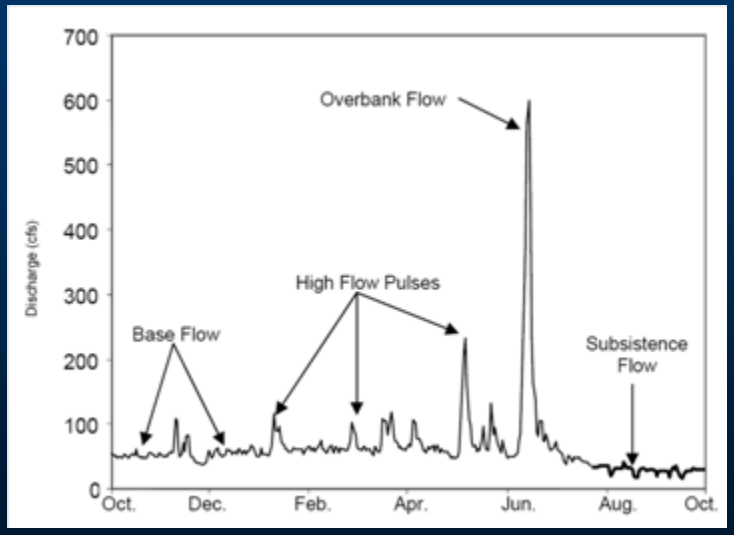
Generic Characteristics of a Flow Regime

Instream Flow Components (IFCs)

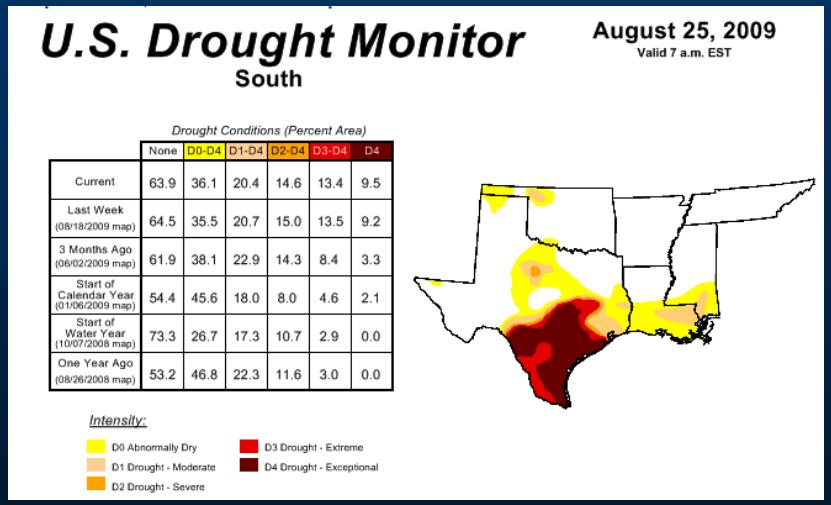
- Base flow, pulses, etc.

Hydrologic/Climatic Conditions

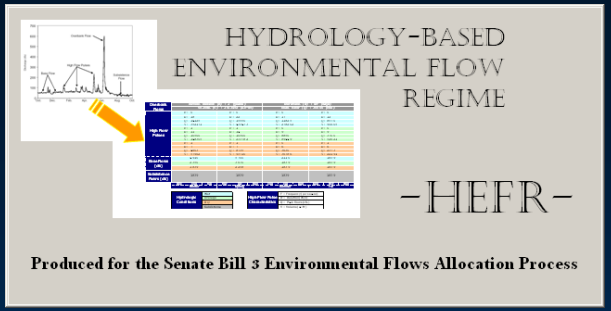
- Dry, average, wet, etc.



NAS (2005)



HEFR Basics



- Uses hydrologic data
- Computations are rapid
- Develops numbers for a flow regime matrix

A hydrological tool for an ecological purpose

1. (1) Select Flow Gage
2. (2) Select Period of Record
3. (3) Separate (parse) Hydrograph into Flow Components
4. (4) Generate Statistical Summaries in Excel

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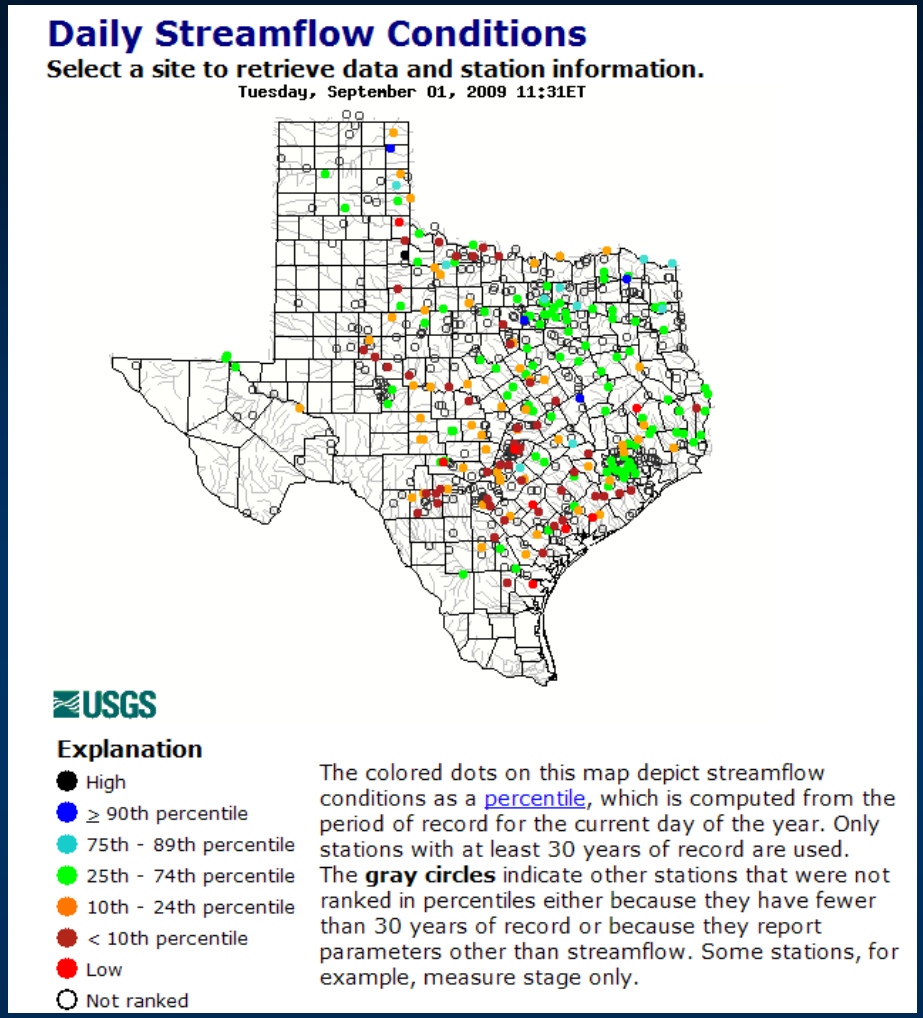
(1) Select Flow Gage

- **SAC Guidance:**
  - "Geographic Scope of Instream Flow Recommendations"



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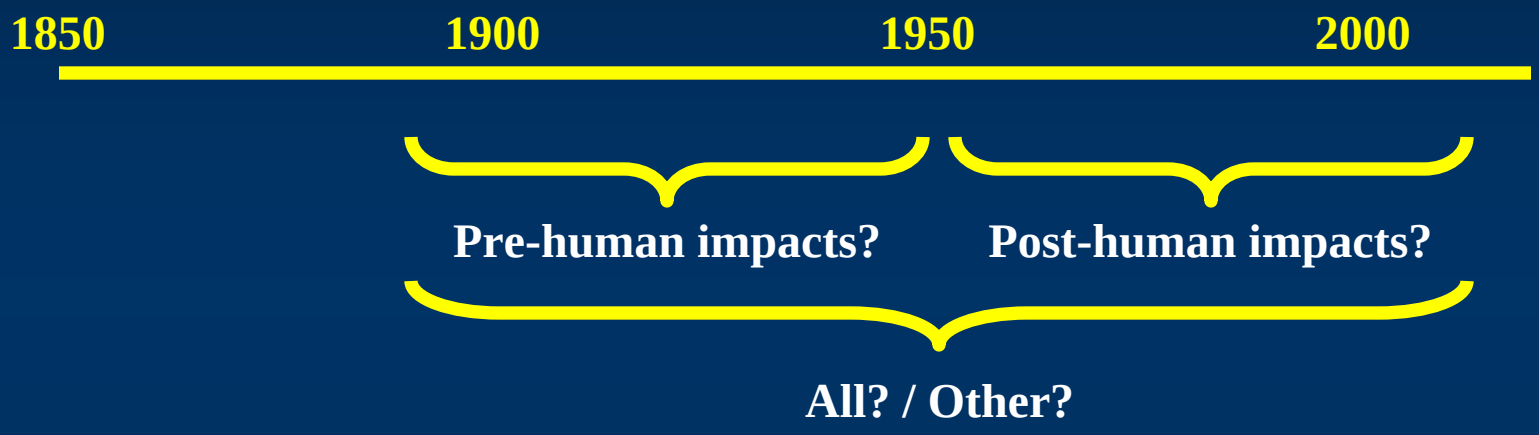
(2) Select Period of Record



- Varies by gage
- Some discussion in Section 4 of Hydrologic Methods document

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(3) Separate (parse) Hydrograph

Two Options

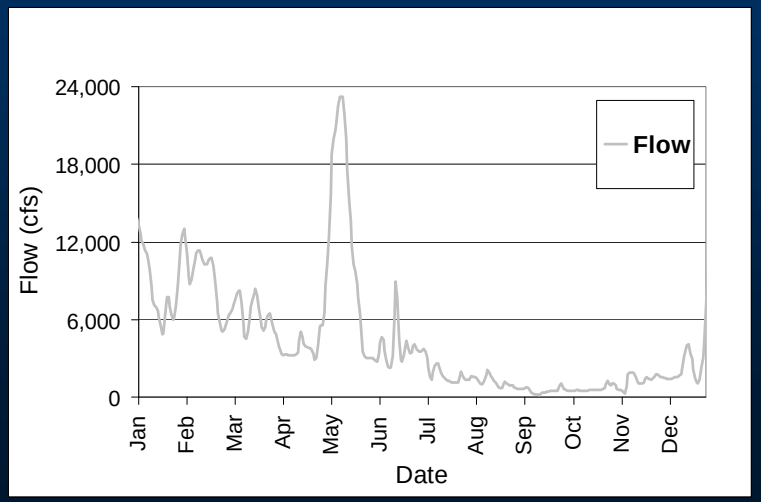
1. Indicators of Hydrologic Alteration (IHA)

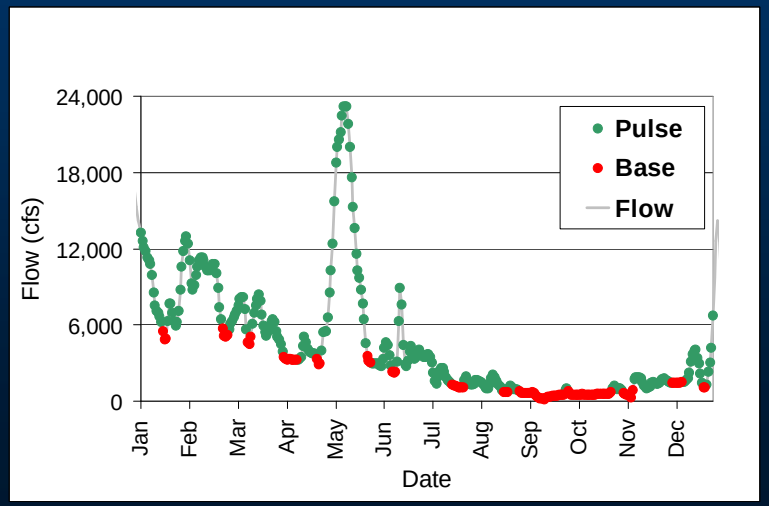
- Environmental Flow Components function

2. Modified Base Flow Index with Threshold (MBFIT)

- Bureau of Reclamation method with modifications for SB 3

Both split the hydrograph into IFCs





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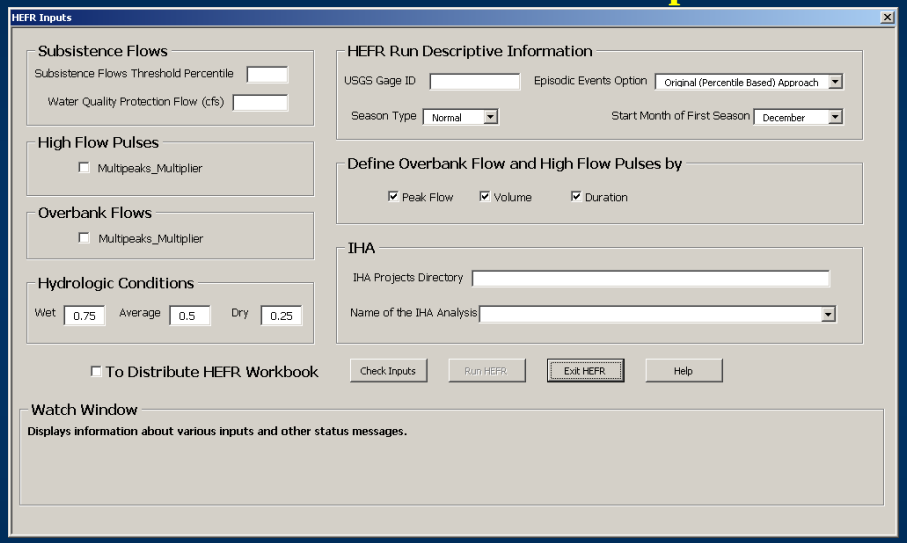
(4) Generate Statistical Summaries in Excel

- **HEFR uses Excel to generate summary statistics of each IFC**
  - Subsistence
  - Base Flow
  - High Flow Pulses
  - Overbank Events
- **Outputs may include: flow, volume, duration, frequency**

HEFR Input Window



Subsistence Flows

Ecological Roles

- Protect water quality and critical habitat during very dry times

HEFR can calculate a statistic based on historically observed dry periods

~or~

User can input a recommendation based on other information

- For example, flow expected to protect water quality or maintain necessary habitat

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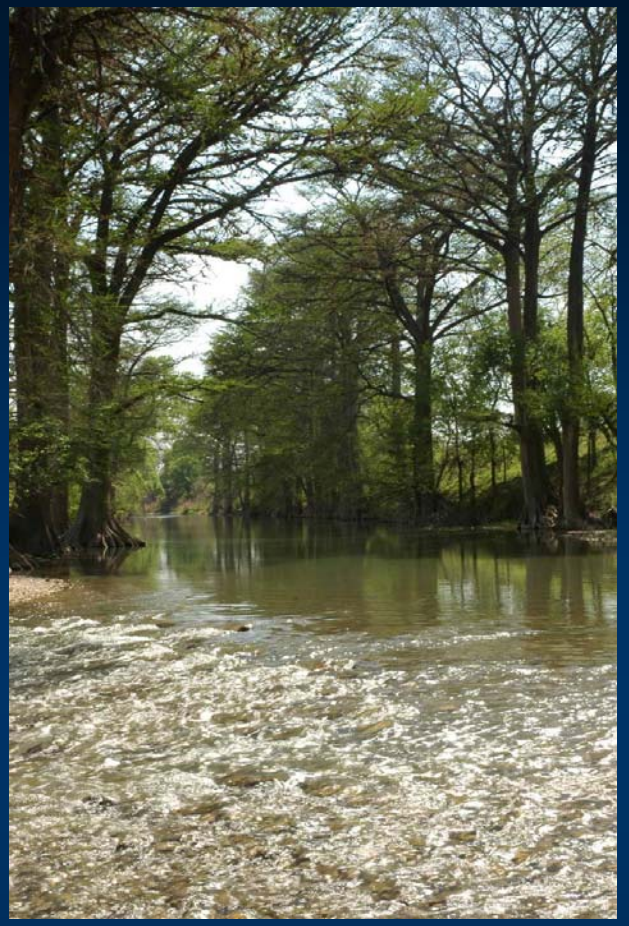
Base Flows



Ecological Roles

- Provide suitable habitat
- Maintain diversity
- Maintain water table for riparian vegetation
- Provide connectivity along channel

HEFR calculates statistics seasonally and monthly, at three user-specified percentiles (often termed dry, average, and wet)

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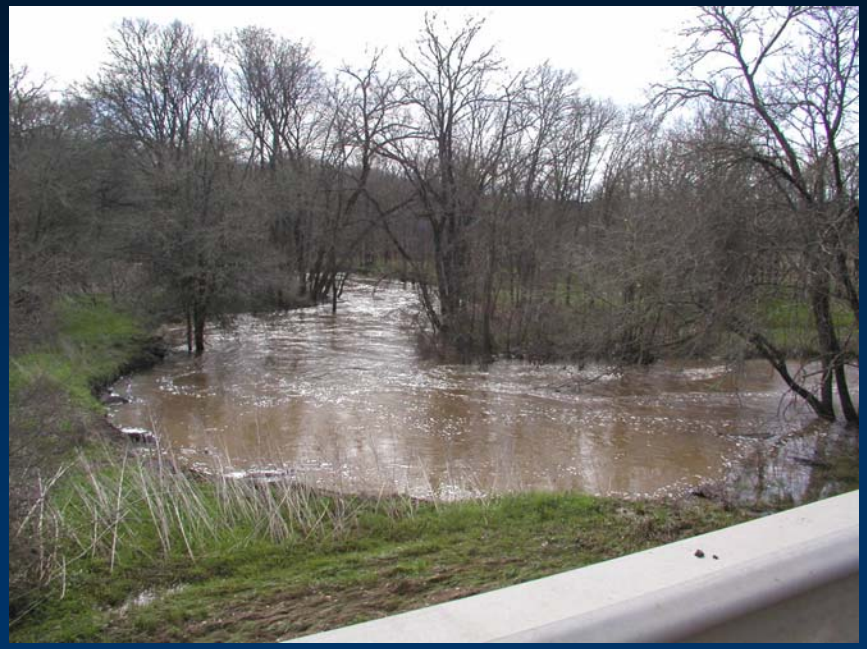
High Flow Pulses



Ecological Roles

- Provide spawning cues
- Prevent riparian vegetation from encroaching into channel
- Restore water quality following drought

HEFR has two options

- “Original, percentile-based approach”
  - More prescriptive, seasonal basis only
- “Alternate, frequency-based approach”
  - More flexible, can handle multi-year intervals

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Overbank Flows

Ecological Roles

- Shape physical habitats
- Provide migration and spawning cues
- Facilitate exchange of nutrients, sediments, woody debris

HEFR has two options

- “Original, percentile-based approach”
  - Median of historical overbank flows
- “Alternate, frequency-based approach”
  - More flexible

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Illustrative HEFR Output

Overbank Flows	Qp: 56,000 cfs with Frequency one per 5 years Volume is 2,849,465 to 4,136,063 (3,492,764) Duration is 33 to 96 (57)			
High Flow Pulses	Qp: 27,000 cfs with Frequency 3 per 5 years Volume is 953,028 to 2,221,427 (1,587,227) Duration is 19 to 55 (32)			
	Qp: 16,600 cfs with Frequency 2 per 3 years Volume is 202,268 to 1,468,901 (835,584) Duration is 13 to 37 (22)			
	Qp: 14,100 cfs with Frequency 2 per year Volume is 16,234 to 1,282,821 (649,527) Duration is 11 to 33 (19)			
	Qp: 13,200 cfs with Frequency 1 per season Volume is #N/A to 1,113,691 (539,522) Duration is 11 to 32 (19)	Qp: 10,600 cfs with Frequency 1 per season Volume is #N/A to 897,743 (287,809) Duration is 9 to 25 (15)		
	Qp: 8,700 cfs with Frequency 2 per 3 seasons Volume is #N/A to 704,824 (129,499) Duration is 7 to 21 (12)	Qp: 4,380 cfs with Frequency 2 per 3 seasons Volume is #N/A to 445,753 (#N/A) Duration is 4 to 12 (7)		
Base Flows (cfs)	6220	4890	1540	1650
	3800	3000	925	870
	2300	1560	558	492
Subsistence Flows (cfs)	134	280	249	217
	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec
	Winter	Spring	Summer	Fall

Hydrologic Conditions	
	Wet (75th %ile)
	Average (50th %ile)
	Dry (25th %ile)
	Subsistence

Bottom Line

- **Flexibility = Decisions Required**
- **Need to keep ecological goals front and center**
- **HEFR can efficiently populate a flow matrix to generate a "first cut"**
- **Other disciplines are necessary before reaching a "final" instream recommendation**
  - Biology – SAC guidance released September 1
  - Geomorphology – SAC guidance released May 29
  - Water Quality – SAC guidance forthcoming
- **These disciplines can be used to guide HEFR parameter selection ("pre-processing") or as direct overlays that replace HEFR-generated flow recommendations ("post-processing").**

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