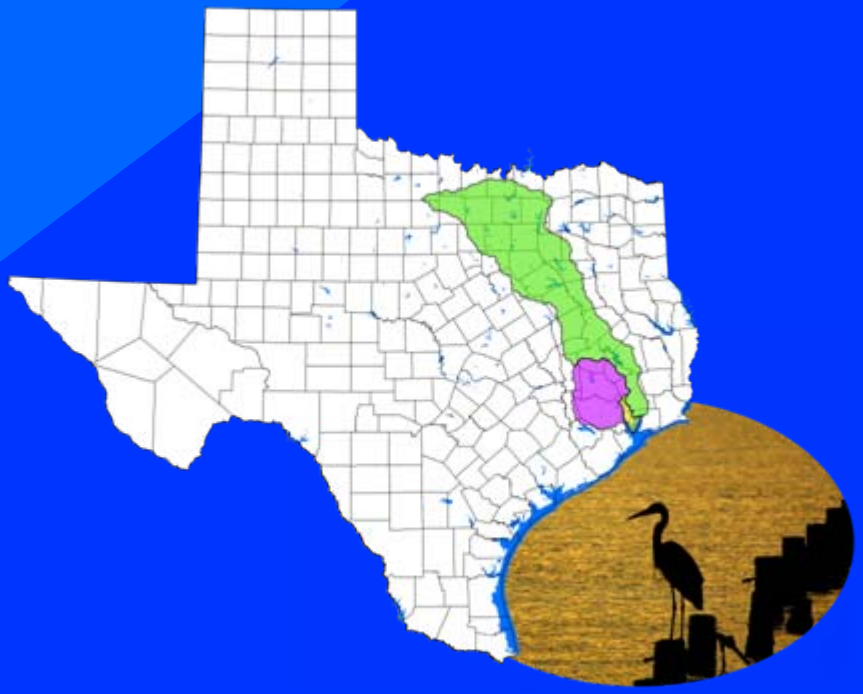
Trinity-San Jacinto BBEST

Trinity and San Jacinto River Basins Instream Flow Recommendation

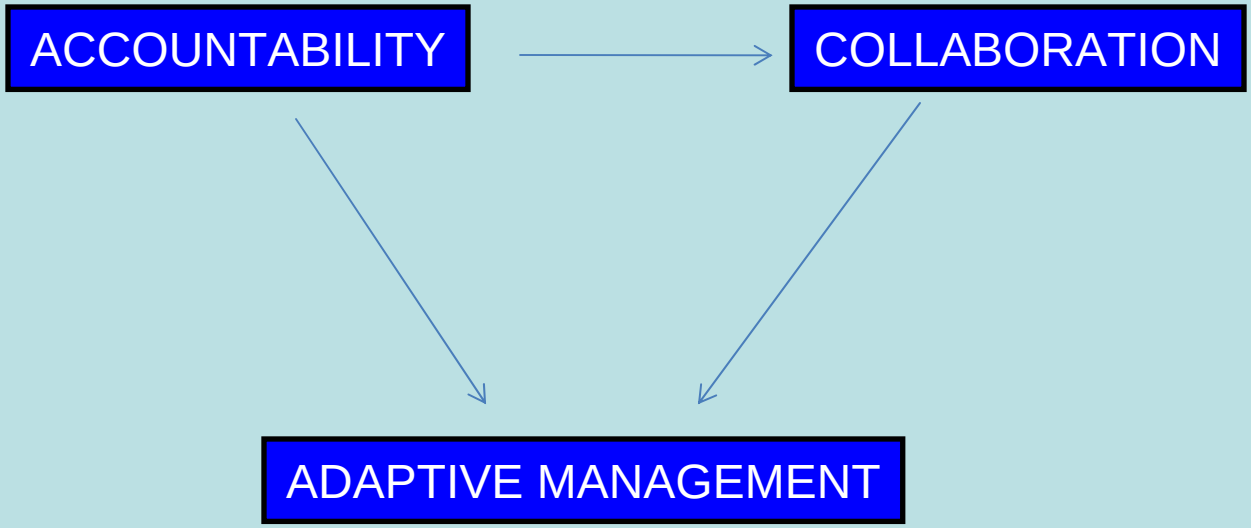


DRAFT

COLLABORATION

November 12, 2009

PATH FORWARD COMPONENTS



ACCOUNTABILITY

Base Recommendations on Accurate Information

Define the Degree of Accuracy (Availability of Science)

COLLABORATION

- Embrace a spirit of cooperation
- Recognize each others contributions
- Consider availability of science
- Define areas of agreement

ADAPTIVE MANAGEMENT

- Adopt action oriented approach in the face of uncertainty when dealing with complex ecological problems
- Define the area of disagreement and of needed science improvement
- Develop action plan and recommend implementation program
- Provide input into Accountability and Collaboration components to advance decision making process

PATH FORWARD

SCIENCE ENHANCMENT ADAPTIVE MANAGEMENT PROCESS

- Define available science and assumptions that served as basis for SB3 analysis
- Develop and / or gather relatively easy to obtain information (cross-sections, velocities, wetted perimeters, sediment grain size, etc.)
- Monitoring for Adaptive Management Purposes

SCIENCE ENHANCMENT ADAPTIVE MANAGEMENT PROCESS

- Perform focused research and studies for developing science needed for the Trinity and San Jacinto basins
- Provide input into refining initial decisions based on improved science

ACCOUNTABILITY BASED PATH FORWARD PROCESS

- Document state of available science and availability of Trinity and San Jacinto basins flow and ecological relationships information
- Develop perspectives regarding the level of confidence associated with the proposed flow regimes
- Develop perspectives regarding the initially selected stations at which flow regimes should be established

ACCOUNTABILITY BASED PATH FORWARD PROCESS

- Present proposed stations and associated flow regimes in two tables (Table 1- Recommended Flows and Table 2 – Provisional Flows)
- Table 1 presents Recommended Flows that require less development of enhanced science and that could be used for permitting purposes.
- Table 2 presents Provisional Flows and additional stations that require more development of supporting science prior to being used for permitting purposes

BBEST Mandates

- Finalize environmental flow regime recommendations and submit them to the basin and bay area stakeholders committee, the advisory group, and the commission not later than November 1, 2009, except that at the request of the basin and bay area stakeholders committee for good cause shown, the advisory group may extend the deadline provided by this subdivision [§Sec. 11.02362(c-3)].

- Develop environmental flow analyses and a recommended environmental flow regime for the river basin and bay system for which the team is established through a collaborative process designed to achieve a consensus. In developing the analyses and recommendations, the science team must consider all reasonably available science, without regard to the need for the water for other uses, and the science team's recommendations must be based solely on the best science available [§Sec. 11.02362(m)].

BBEST Mandates

- An "Environmental flow regime" is defined by SB3 as:

  “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.”

- Senate Bill 3 defines an “environmental flow analysis” as the:

  “application of a scientifically derived process for predicting the response of an ecosystem to changes in instream flows or freshwater inflows.”

- Senate Bill 3 contains provisions for:

  A continuing adaptive management process that can be applied to refine initially identified flow regimes as information (science) that confirms ecological – flow relationships required to support a sound ecological condition becomes available.

NRC Ordination of Some Basic Biological Assessment Methodologies from Holistic to Specific (NRC 2005)

	Holistic Higher Uncertainty	→	→	→	→	Specific Lower Uncertainty
	Ecosystem Indicator	→	→	→	→	Metrics with Direct Response to Flow
Approach	Course Ecological Indicators	Assemblage Structure	Habitat Guilds	Species HSC	Population Models	Individual-based Models
Key Characteristics	Integrates many components/ processes; correlational	Integrates many components; correlational	Integrates many components; correlational	Individual or species; correlational	Dynamic simulation of aggregate response variable	Dynamic simulation of ecological mechanisms
Strengths (Benefits)	Rapid, cheap, Repeatable	→	→	→	→	Predictive with high resolution
Weaknesses (Limitations	Ecological responses and mechanisms not specified	→	→	→	→	System site specific; expensive; time consuming
Settings where appropria	Any	→	→	→	→	Those for which much information is available
Appropriate spatial scale	Intermediate to large	Intermediate to large	Intermediate	Small	Large	Small to large
Outputs	A single target value and correlations with flow	A set of values and correlation with flow	A set of values and correlation with flow	A series of values and correlation with flow	A series of simulated values at variable flows	A series of simulated values at variable flows
Examples/Applications	Multiple applications: water quality, watersheds, etc.	Channel-floodplain connectivity	Leonard and Orth, 1988	Many ISF programs	Long history but few formal applications to ISF	Jager et al., 1997, 2001; Railsback et al., 1999, 2002, others

Best Available Science for Support of Recommendations

- Insufficient amount of information regarding the geomorphology of the system, as well as the behavior of flows within the Trinity related to habitat at varying flow levels, at locations within the system to establish biological-flow relationships

- Utility of information from studies external to the Trinity watershed
  - Variations in various habitat areas are significantly diverse at different locations

- No information exists within the Trinity nor San Jacinto basins to ascribe varying flow magnitudes to different habitat areas at specific locations within the Trinity watershed

Scientific Method

"principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses."

-Merriam-Webster Dictionary

- An estimate based upon professional judgment is merely a single step in the formulation of "science", i.e. the formulation of a hypothesis.
- No data are presently available for observation and experimentation to validate such estimates to arrive at a scientifically sound conclusion

Scientific Method

- Amounts based upon professional judgment of what is necessary should be used solely as a means of validation through comparison with scientifically derived data that can be shown to support a sound ecological environment in the future.

- SAC acknowledges that hydrologic analyses “constitute the first, and perhaps the easiest, step in the process of developing instream flow recommendations” (Instream Flow Guidance Document, 2009)

- Hydrologic analyses, are a “step in the process” (only one overlay), and without any additional supporting ecological analyses are insufficient to develop an instream flow recommendation.
- More than one overlay (Hydrology, Water Quality, Geomorphology, etc.) is necessary to define a reliable instream flow recommendation. These data sets need to be developed by site location or by similar reaches in order to be relevant to the recommendation.

Approach

- Achieving the BBEST mandate to develop a recommendation on a flow regime involves:
  - Application of what science is available to reach a sound conclusion,
  - Identification of where more study is necessary through adaptive management.
- It is also the responsibility of the BBEST to convey the level of confidence associated with the decisions employed in the development of these recommendations in order to inform upon their utility to users impacted by the recommendations.

Approach

- Due to insufficient information being available for the two river basins, Recommended Flow Amounts for a limited number of flow conditions at a limited number of stations (Recommended Flow Stations) are proffered.
    - The process of selecting these stations gave consideration to the information available at the stations and to providing initial geographic coverage that would be beneficial to TCEQ in the permitting process.
- Identified Additional Stations that may be of value for establishing flow regimes if determined to be needed in the future.
- Provisional Flow Amounts for additional flow conditions (i.e. base wet flow, pulse flows, etc.) have been identified as candidate flows for the Recommended Flow Stations and Additional Stations
- These additional stations and the Provisional Flow Amounts may be of utility in an adaptive management context.

Approach

Basin	USGS Gage Site	Recommended Flows	Provisional Flows
Trinity	Trinity River near Oakwood	X	X
	Trinity River at Romayor	X	X
	West Fork Trinity River at Grand Prairie		X
	Trinity River at Dallas		X
San Jacinto	West Fork San Jacinto River near Conroe	X	X
	East Fork San Jacinto River near Cleveland	X	X

Approach

- Utilize four seasons
- Overbank flows identified through NWS.
- Utilized MBFIT method to parse hydrograph
  - Subsistence – median of lowest 10 percent of historical base flows by season using HEFR, then averaged with Trungale amounts based on IHA and HEFR
  - Base Flow – 25th percentile of historical base flows by season using HEFR, then averaged with Trungale amounts based on IHA and HEFR.
- High Flow Pulses – basis of historical seasonal frequency as assessed by application of the frequency-based method in HEFR utilizing a 2 per season magnitude,
  - Recognizes and accepts that the ultimate attainment frequency associated with each seasonal pulse event within the flow regime will certainly be less than that based on the historical frequency of occurrence derived by HEFR.
  - Similar approach has been adopted by the Sabine-Neches BBEST.

Recommended Flows

Trinity at Oakwood

Overbank Flows	Qp: 24,600 cfs Duration is 18 to 61 (33) DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows			
Base Flows (cfs)	265 at (91% over 41 yrs)	322 at (95% over 41 yrs)	186 at (85% over 41 yrs)	162 at (82% over 41 yrs)
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days			
Subsistence Flows (cfs)	98 at (100% over 41 yrs)	80 at (100% over 41 yrs)	75 at (97% over 41 yrs)	85 at (96% over 41 yrs)
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions			

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Winter			Spring			Summer			Fall		

Trinity at Romayor

Overbank Flows	Qp: 44,600 cfs Duration is 34 DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows			
Base Flows (cfs)	744 at (91% over 44 yrs)	923 at (93% over 44 yrs)	510 at (83% over 44 yrs)	515 at (74% over 44 yrs)
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days			
Subsistence Flows (cfs)	295 at (100% over 44 yrs)	290 at (100% over 44 yrs)	223 at (97% over 44 yrs)	240 at (95% over 44 yrs)
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions			

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Winter			Spring			Summer			Fall		

East Fork San Jacinto near Cleveland

Overbank Flows	Qp: 16,000 cfs Duration is 20 to 64 (36) DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows.			
Base Flows (cfs)	27 at (86% over 30 yrs)	28 at (90% over 30 yrs)	16 at (69% over 30 yrs)	16 at (66% over 30 yrs)
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days			
Subsistence Flows (cfs)	10 at (100% over 30 yrs)	10 at (100% over 30 yrs)	9 at (91% over 30 yrs)	9 at (89% over 30 yrs)
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions			

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Winter			Spring			Summer			Fall		

West Fork San Jacinto near Conroe

Overbank Flows	Qp: 16,800 cfs Duration is 18 to 61 (33) DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows.											
Base Flows (cfs)	38 at (90% over 30 yrs)			47 at (90% over 30 yrs)			17 at (81% over 30 yrs)			16 at (77% over 30 yrs)		
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days											
Subsistence Flows (cfs)	10 at (100% over 30 yrs)			12 at (100% over 30 yrs)			10 at (95% over 30 yrs)			10 at (92% over 30 yrs)		
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	Winter			Spring			Summer			Fall		

Provisional Flows

- Initial Stations
- Additional Stations

Trinity near Oakwood

High Flow Pulses	Qp: 3,200 cfs at (34% over 41 yrs) Volume is 18,931 Duration is 5			Qp: 7,840 cfs at (31% over 41 yrs) Volume is 141,705 Duration is 11			Qp: 1,180 cfs at (40% over 41 yrs) Volume is #N/A Duration is 2			No recommendation		
Base Flows - Wet (cfs)	980			1080			470			370		
	Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
	Winter			**Spring**			**Summer**			**Fall**		

These are a reasonable representation of the hydrology, but the relationship between the ecological health of the system and these magnitudes and frequencies of flow has not yet been defined.
Defer to adaptive management to identify what is necessary for future science to support the utilization of these amounts in developing an instream flow recommendation or in a water permitting context.

Trinity at Romayor

High Flow Pulses	Qp: 10,100 cfs at (28% over 44 yrs) Volume is 83,087 to 281,058 (152,814) Duration is 7 to 25 (13)			Qp: 10,900 cfs at (36% over 44 yrs) Volume is 106,220 to 319,381 (184,186) Duration is 8 to 29 (15)			Qp: 1,870 cfs at (46% over 44 yrs) Volume is 9,538 to 35,559 (18,417) Duration is 3 to 13 (7)			Qp: 2,560 cfs at (26% over 44 yrs) Volume is 15,903 to 51,774 (28,695) Duration is 4 to 15 (8)		
Base Flows - Wet (cfs)	1753			1900			910			720		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	Winter			Spring			Summer			Fall		

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East Fork San Jacinto near Cleveland

High Flow Pulses	Qp: 475 cfs at (14% over 30 yrs) Volume is 5,055 Duration is 8			Qp: 687 cfs at (9% over 30 yrs) Volume is 6,769 Duration is 8				Qp: 94 cfs at (12% over 30 yrs) Volume is 288 Duration is 2			Qp: 56 cfs at (17% over 30 yrs) Volume is #N/A Duration is 2		
Base Flows - Wet (cfs)	80			64				34			38		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
	Winter			Spring			Summer			Fall			

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Defer to adaptive management to identify what is necessary for future science to support the utilization of these amounts in developing an instream flow recommendation or in a water permitting context.

West Fork San Jacinto near Conroe

High Flow Pulses	Qp: 420 cfs at (30% over 30 yrs) Volume is 3,679 Duration is 7			Qp: 1,100 cfs at (13% over 30 yrs) Volume is 12,377 Duration is 9				Qp: 74 cfs at (25% over 30 yrs) Volume is 380 Duration is 2			No recommendation		
Base Flows - Wet (cfs)	111			88				38			47		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
	Winter			Spring				Summer			Fall		

These are a reasonable representation of the hydrology, but the relationship between the ecological health of the system and these magnitudes and frequencies of flow has not yet been defined.
Defer to adaptive management to identify what is necessary for future science to support the utilization of these amounts in developing an instream flow recommendation or in a water permitting context.

West Fork Trinity River at Grand Prairie

Overbank Flows	10,700 cfs Duration is 13 to 49 (25) DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows.				
High Flow Pulses	Qp: 392 cfs at (89% over 30 yrs) Volume is 3,830 Duration is 4	Qp: 1,280 cfs at (19% over 30 yrs) Volume is 8,345 Duration is 8	Qp: 293 cfs at (32% over 30 yrs) Volume is 1,899 Duration is 3	No recommendation	
Base Flows - Wet (cfs)	118	138	82	79	
Base Flows (cfs)	45 at (85% over 30 yrs)	45 at (89% over 30 yrs)	35 at (82% over 30 yrs)	35 at (75% over 30 yrs)	
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days				
Subsistence Flows (cfs)	19 at (99% over 30 yrs)	17 at (99% over 30 yrs)	16 at (97% over 30 yrs)	15 at (95% over 30 yrs)	
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions				
	Dec | Jan | Feb | Mar | Apr | May		Jun | Jul | Aug | Sep | Oct | Nov		
	Winter		Spring		

These are a reasonable representation of the hydrology, but the relationship between the ecological health of the system and these magnitudes and frequencies of flow has not yet been defined. Defer to adaptive management to identify what is necessary for future science to support the utilization of these amounts in developing an instream flow recommendation or in a water permitting context.

Trinity River at Dallas

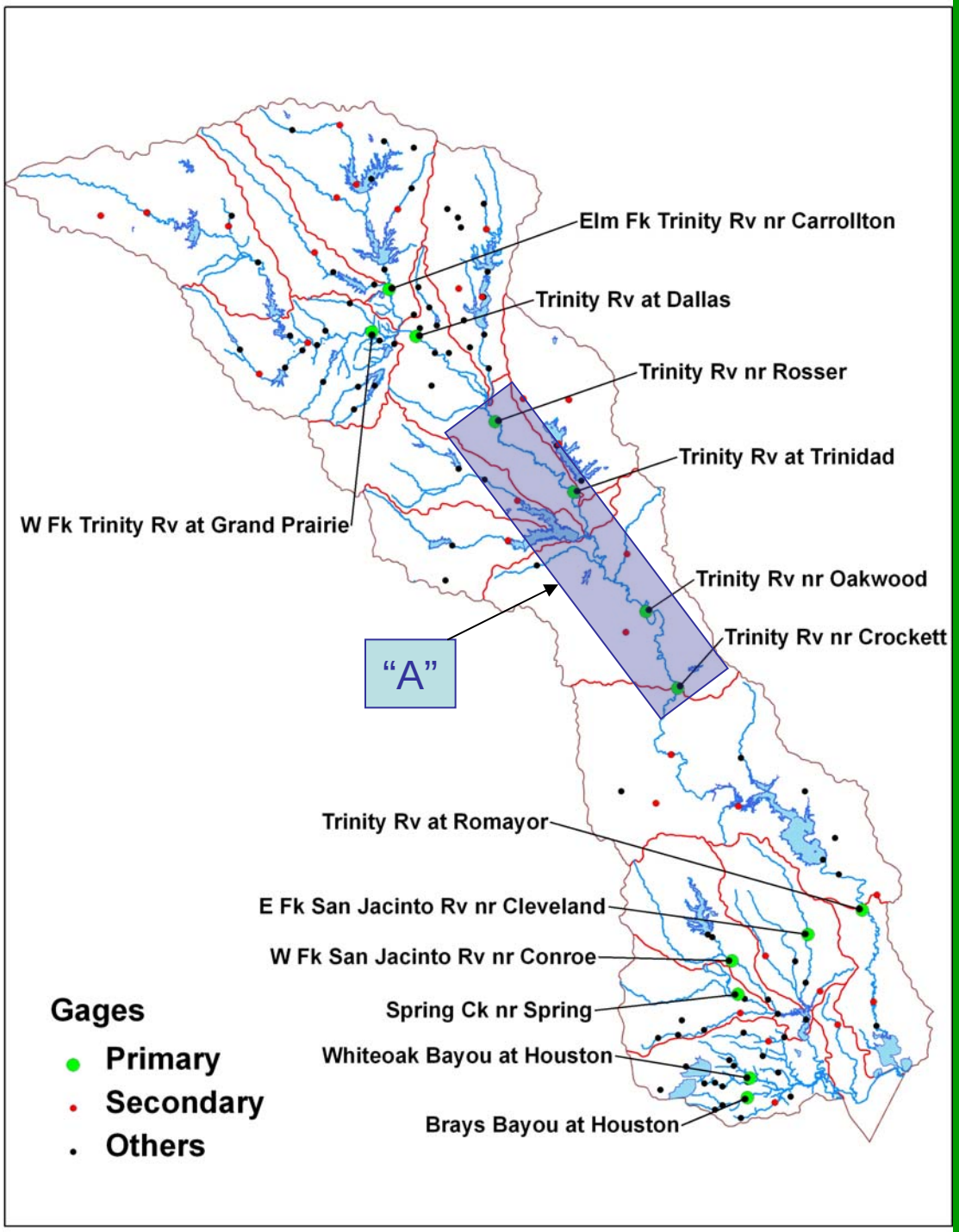
Overbank Flows	Qp: 11,100 cfs Duration is 10 to 41 (21) DEFINITION: Overbank flows are naturally driven, infrequent, high magnitude flow events that produce water levels that exceed channel banks and result in water entering the floodplain. BBEST does not recommend action be taken to produce such flows.				
High Flow Pulses	Qp: 758 cfs at (28% over 50 yrs) Volume is #N/A Duration is 3	Qp: 4,120 cfs at (16% over 50 yrs) Volume is 41,998 Duration is 9	Qp: 660 cfs at (29% over 50 yrs) Volume is 685 Duration is 3	No recommendation	
Base Flows - Wet (cfs)	272	304	225	198	
Base Flows (cfs)	31 at (87% over 50 yrs)	37 at (90% over 50 yrs)	32 at (86% over 50 yrs)	26 at (82% over 50 yrs)	
	DEFINITION: Base flows represent the range of "average" or "normal" flow conditions in the absense of significant precipitation or runoff events. PURPOSE: Maintain typical occurrence and persistence of consecutive base flow days				
Subsistence Flows (cfs)	15 at (93% over 50 yrs)				
	DEFINITION: An atypical, short-duration (days to weeks) low flow event PURPOSE: Maintain historical occurrence and persistence, prevent development of poor water quality conditions				

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Winter						Spring					

These are a reasonable representation of the hydrology, but the relationship between the ecological health of the system and these magnitudes and frequencies of flow has not yet been defined. Defer to adaptive management to identify what is necessary for future science to support the utilization of these amounts in developing an instream flow recommendation or in a water permitting context.

Spare Slides

Gage Locations



BBEST Mandate - SB 3

Sec. 11.02362. DEVELOPMENT OF ENVIRONMENTAL FLOW REGIME RECOMMENDATIONS.

(m) Each basin and bay expert science team shall develop environmental flow analyses and a recommended environmental flow regime for the river basin and bay system for which the team is established through a collaborative process designed to achieve a consensus. In developing the analyses and recommendations, the science team must consider **all reasonably available science, without regard to the need for the water for other uses**, and the **science team's recommendations must be based solely on the best science available**.

Sec. 11.002. DEFINITIONS.

(15) "Environmental flow analysis" means the **application of a scientifically derived** process for predicting the response of an ecosystem to changes in instream flows or freshwater inflows.

(16) "Environmental flow regime" means 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.

While “Sound Ecological Environment” is not defined in SB3 it is defined in the National Academy of Science reviewed Texas Instream Flow Studies: Technical Overview “A resilient, functioning ecosystem characterized by intact, natural processes, and a balanced, integrated, and adaptive community of organisms comparable to that of the natural habitat of a region.”