Please Note that Content of Agenda Items May Require Meeting to Extend to 4:00pm

Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin and Bay Area Stakeholder Committee (BBASC)

Thursday, May 19th, 2011 at 10:00 am
Guadalupe-Blanco River Authority, River Annex
905 Nolan
Seguin, TX 78155

AGENDA

I. Introductions

II. Public Comment

III. Discussion and Agreement on Agenda

IV. Approval of Minutes from May 4, 2011 Meeting

V. Review of TPWD and SAC Comments on BBEST Recommendations – Dr. Dan Opdyke, Dr. George Ward and Ed Oborny

VI. BBASC Questions Regarding BBEST Recommendations and SAC and TPWD Comments – Sam Vaugh
   a. Instream BBEST Subcommittee – Dr. Thomas Hardy and Ed Oborny
   b. Estuary BBEST Subcommittee – Dr. Norman Johns and Dr. George Ward

VII. Progress Report on Bay and Estuary Time Series Analysis, Ecological Impacts – Dr. Norman Johns

VIII. Technical Evaluations of Application of BBEST Flow Recommendations on New Run-of-River Permits – Sam Vaugh, HDR

IX. Follow-Up on BBASC Balancing Analysis Requests Regarding Flow Recommendations Relating to Water Supply Projects – Sam Vaugh, HDR

X. Discussion Regarding Work Plan Development
   a. List of Work Plan Elements

b. Discussion Regarding Creation of a Work Plan Workgroup

XI. Discussion Regarding West Warren's Resignation from BBASC

XII. Set Next Meeting Date, Time and Location (June 1, 2011)

XIII. Public Comment

XIV. Adjourn

AGENDA ITEM I

Introductions

AGENDA ITEM II

Public Comment

AGENDA ITEM III

Discussion and Agreement on Agenda

AGENDA ITEM IV

Approval of Minutes from May 4, 2011 Meeting

AGENDA ITEM V

Review of TPWD and SAC Comments on BBEST Recommendations –

Dr. Dan Opdyke, Dr. George Ward and Ed Oborny

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Carter P. Smith
Executive Director

Date: April 21, 2011

To: The Honorable Karen J. Hixon
Executive Director Carter Smith
Deputy Executive Director Ross Melinchuk

From: Ms. Cindy Loeffler, Water Resources Branch
Ms. Colette Barron Bradsby, Legal Division
Mr. Norman Boyd, Coastal Fisheries Division
Mr. David Bradsby, Water Resources Branch
Ms. Lynne Hamlin, Water Resources Branch
Mr. Nathan Kuhn, Coastal Fisheries Division
Dr. Wen Lee, Coastal Fisheries Division
Mr. Kevin Mayes, Inland Fisheries Division
Dr. Dan Opdyke, Water Resources Branch
Mr. Clint Robertson, Inland Fisheries Division
Ms. Angela Schrift, Coastal Fisheries Division

Re: Texas Parks and Wildlife Department Staff Perspectives on the Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin and Bay Expert Science Team Report

Senate Bill 3, Article 1 (SB 3), as passed by the 80th Texas Legislature in 2007, created a statewide process for identifying and protecting environmental flow needs. As part of this process, a Basin and Bay Expert Science Team (BBEST) was formed for the Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays (GSA BBEST). The GSA BBEST submitted its final report on March 1, 2011 documenting science-based recommendations for an environmental flow regime for the applicable rivers and bay systems. SB 3 directs each BBEST to develop an environmental flow regime recommendation:

> *...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.*

The BBEST engaged resource agency staff and others throughout the process. Texas Parks and Wildlife Department (TPWD) staff assisted and supported the BBEST by providing data, maps, and information related to riparian habitats; assisting with cross-sectional work for the Comparative Cross Section Methodology (CCM); developing lists of instream focal species/guild criteria, habitat suitability envelope curves, and analyses; statistically evaluating blue crab abundance data; enhancing and improving the Hydrology-based

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Environmental Flow Regime (HEFR) methodology; and refining and improving the Flow Regime Application Tool (FRAT). The BBEST fostered participation by TPWD and others that resulted in the use of best available science to generate environmental flow regime recommendations that TPWD generally supports.

Having worked on numerous instream flow and freshwater inflow recommendations over many years, TPWD staff is familiar with the uncertainty embedded in such efforts, cognizant of the challenges faced by the BBEST, appreciative of the efforts expended by the members, and grateful for the many opportunities to provide input throughout the process. Each BBEST had approximately twelve months and a limited budget for outside services to meet the SB 3 charge. The difficulty of the challenge cannot be overstated and the progress of the BBEST is commendable. The GSA BBEST clearly learned and benefitted from the experiences of previous BBESTs and extended the state of the science in many respects. Furthermore, the GSA BBEST had the additional advantage of contemporary, if still incomplete, instream flow studies on the lower San Antonio River, as well as relevant information at selected sites on the lower Guadalupe River. That said, it is widely recognized that the science of environmental flows is not an exact one, and the GSA BBEST did not have the time, data, directive, or budget to perform a definitive analysis.

This memorandum contains general comments regarding the GSA BBEST report and the SB 3 charge to develop an environmental flow regime, and it contains specific comments addressing instream flows and freshwater inflows. More detailed technical comments are provided as an appendix. These comments are intended to assist the Environmental Flows Advisory Group, the Texas Commission on Environmental Quality, and the GSA Basin and Bay Area Stakeholder Committee (GSA BBASC) in reviewing the BBEST recommendations.

General Comments

TPWD staff commends the GSA BBEST for its efforts to address the requirements set forth by SB 3. In general, the BBEST followed guidance provided by the Texas Environmental Flows Science Advisory Committee (SAC) and addressed the requirements set forth by SB 3.

Section 1 contains a thorough explanation of the SB 3 process and the BBEST charge. TPWD staff appreciates the efforts of the BBEST in Section 1.3 to define a sound ecological environment and supports the BBEST's definition, with the mutual understanding that the phrase "to a reasonable extent" is both broad and subjective. TPWD staff understands that it is impossible to provide a precise definition of a sound ecological environment given the scope of the SB 3

tasks. Subsequently, the BBEST concludes that the current conditions "are, broadly speaking, 'sound' today with few exceptions." Several such exceptions are listed on page 1.8 and include declines in the numbers of tarpon, blue crab, southern flounder, and episodic declines in whooping cranes. TPWD staff agrees that additional studies would be required to fully ascertain the influence of freshwater inflows on these observed effects.

Section 2 provides a highly useful overview of the basins and ecosystems, including relevant information on hydrology, water quality, biology, and physical processes.

Instream Flow Analyses

TPWD staff supports the GSA BBEST instream flow recommendations with one exception and a few qualifications described below. TPWD staff commends the GSA BBEST members for their use of the best available science (such as preliminary Senate Bill 2 instream flow study data collected on the lower San Antonio and lower Cibolo Creek) to make instream flow regime recommendations. The GSA BBEST recommendations provide an appropriate degree of flow variability required to support a sound ecological environment by incorporating seasonal subsistence, a range of base flow conditions, and a suite of high flow pulses.

Section 3 presents details on the BBEST's instream flow analyses. The BBEST generated flow recommendations at 16 gaged locations. TPWD staff believes that this is a reasonable suite of locations, both in number and spatial distribution. On Page 3.8 the BBEST recommends that TCEQ develop methods to identify environmental flow requirements at intermediate locations on an as-needed basis using drainage area adjustments and/or other reasonable approaches. TPWD staff agrees with this recommendation and encourages the BBEST to give this issue additional attention when assisting the BBASC in developing its work plan if TCEQ does not adopt specific rules in the interim. In particular, the BBEST should make clear if it is their intent for all instream flow recommendations to be extended to the salt water barrier.

The BBEST used the full period of record at all locations except those downstream of the City of San Antonio, where the early period of record was used. TPWD staff agrees with this decision.

For subsistence flow recommendations, the BBEST used the default HEFR flow calculation which results in an extremely low flow at many of the locations. Similar to the approach taken by the Colorado-Lavaca BBEST, TPWD staff recommends the greatest of Q95, TCEQ's critical low flow (generally 7Q2) , or

the default HEFR subsistence flow calculation to support critical water quality and habitat needs during very dry times. As one example, at the Mission River at Refugio location, the BBEST recommended subsistence flow values range from 1.0 to 1.3 cfs. Based on Figure 3.3-24, these flows only protect from 1 to 7% of the maximum habitat for each guild. Comparatively, Q95 for this location is 1.5 cfs and the critical low flow is 4.7 cfs which would protect from 15-35% of each guild's maximum habitat. While recognizing that subsistence flows are not intended to provide optimal habitat at all times, TPWD staff believes that the protection of only 1% of the maximum habitat of deep runs is inadequate. Many of the other tributary and upstream locations exhibit similar results. In addition, use of Q95 or the critical low flow value would enhance the ability to meet the standards for important water quality parameters such as dissolved oxygen and temperature. HEFR provides the options to calculate Q95 and manually enter flow values to address water quality protection.

A series of habitat-flow relationships, one at each location, are provided on pages 3.53 – 3.72. Four locations (lower San Antonio River and Cibolo Creek) are based on preliminary TIFP study results and two locations (Guadalupe River at Gonzales and Victoria) are based on PHABSIM outputs using existing cross-section data. The remaining locations are based on the CCM method, which uses limited site-specific data and hydraulic model outputs. A comparison of CCM results to PHABSIM and preliminary TIFP output would have helped to illustrate the utility and uncertainty of the CCM method. TPWD staff recommends that the BBEST perform such a comparison to help guide the BBASC in setting priorities in their work plan. TPWD staff also supports an analysis of habitat time series for sites with PHABSIM or preliminary TIFP habitat output to assist in evaluating how changes in instream flow recommendations could potentially affect instream habitat.

Freshwater Inflow Analyses

TPWD staff appreciates the significant effort expended by the BBEST to extend the state of the science with regard to the salinity zone approach. While recognizing that the BBEST report is a final report, TPWD submits the following comments (and detailed comments in the appendix to this letter) in the interest of further expanding understanding and communication of the overall approach.

The habitat-based salinity zone approach employed by the BBEST to develop quantitative freshwater inflow recommendations relies heavily upon salinity preferences of two species: *Rangia* and oysters. As a result, the recommendation lacks explicit freshwater inflow recommendations for certain months. In addition, the beneficial effects of freshwater inflows other than salinity, e.g., nutrient and sediment delivery, are not considered. Nutrients and

sediments are largely delivered during high flow pulses ("Very High Inflows" and "Med-High Sustained Inflows w. Pulse(s)", in the lexicon of Figure 4.1-2). Since nutrients and sediments are not considered in this method, no recommendations are provided for such events. As a result, high flow pulses receive no quantitative discussion or specification. For the "missing months" those months which have no freshwater inflow recommendations, the BBEST has explicitly specified that instream flow requirements are to be extended to the bay. TPWD staff is unclear if this extension of instream flow recommendations to the bay is a recommendation of the BBEST for all months. The section "3.1.2.6 Geographic Interpolation" does not specifically state the intent of the BBEST in this regard. TPWD staff believes that that it is important to extend the instream flow recommendations to the bay in all months, in light of the limitations of the habitat-based salinity zone approach. TPWD staff encourages the BBEST to follow this approach when assessing impacts of future water development scenarios.

The BBEST recommendation allows for a 25% reduction in the frequency of G2-A and G2-B conditions (Table 4.5-2). Support for this decision is provided by a Heinz Center report and an EPA report with sediment contaminant breakpoints, but TPWD staff is uncertain of the EPA report's relevance. TPWD staff notes that the BBEST recommendation allows greater than a 25% reduction in other flows. For example, any flows in the G2-A range could be diverted down to the floor of the G2-A category, with 25% of such events diverted down to the G2-B floor, and still be in compliance with the recommendation. Thus, in this context, the BBEST recommendation of a 25% reduction is effectively a minimum allowed reduction in flows. This does not appear to be consistent with the maximum 25% reduction in key flow characteristics (with unknown reductions in other flows) used by the Heinz Center to classify minimally impacted sites, assuming that the 25% Heinz number is a relevant and appropriate precedent for the BBEST to adopt. Furthermore, in the 69 year historical record, 28 years exceeded the maximum of the G2-A flow range and thus provide sub-optimal (i.e., too fresh) habitat. These years are afforded no protection by the habitat-based methodology and essentially unlimited diversions would be allowed in these years except as potentially limited by instream flow requirements. TPWD staff understands the difficulty in judgment calls related to acceptable reductions in flows. TPWD staff also understands that such calls must be made by the BBEST. However, TPWD staff questions whether a minimum 25% reduction in flows is appropriate or supported by the literature.

TPWD staff agrees that freshwater inflows in the summer months may be most critical for oysters because of the proliferation of parasites during hot months. However, appropriate salinity conditions are beneficial to oysters throughout the year, and TPWD staff believes that an annual schedule of beneficial inflows

should have been recommended for oysters, as was done by the Colorado-Lavaca BBEST.

The BBEST makes the case that while salinity may not significantly influence white shrimp, other effects of freshwater inflows may (page 4.115). The BBEST then provides a series of statistical analyses to relate freshwater inflows to white shrimp abundance, most notably Figure 4.5-26, which is a regression between these two variates (using freshwater inflows from June-Sept). This regression has a modest R^2 value, but it does appear to demonstrate increases in abundance as inflow increases. Ultimately, the BBEST concluded that "below 250,000 ac-ft, [total for July-Sept] there would appear to be a significant limiting effect on abundance..." TPWD staff believes freshwater inflow does influence white shrimp abundance and recommends further evaluation of the relationship between white shrimp abundance and freshwater inflows be considered in the work plan.

Integration of Instream Flow and Estuary Inflow Regimes

TPWD staff questions whether it is appropriate to simply add the HEFR tables for Goliad and Victoria (plus downstream ungaged flows) to facilitate a comparison to the recommended freshwater inflow regime. Appendix B of the SAC guidance document (Methodologies for Establishing a Freshwater Inflow Regime for Texas Estuaries Within the Context of the Senate Bill 3 Environmental Flows Process) takes a different approach, wherein daily flow data from various locations (Goliad, Victoria, TxRR) are summed to create a total inflow hydrology which is then entered into HEFR as an input and then a single new flow matrix is generated. Without a more detailed analysis, it is difficult to compare the advantages and disadvantages of the BBEST and SAC approaches. As long as the results are simply used semi-quantitatively to compare to freshwater inflow requirements, perhaps both approaches are acceptable.

Environmental Flow Regime Recommendations

As noted above, TPWD staff does not support the subsistence flow recommendations. This concern is somewhat ameliorated by the 50% diversion rule spelled out in Section 6.1.1. This implementation rule provides significantly increased protection, as compared to the BBEST's initial strawman recommendation of allowing all water to be diverted down to the subsistence flow value (when flows are below base under dry hydrologic conditions). However, if the implementation rule is not carried forward into the GSA

BBASC recommendation or is not adopted in TCEQ rulemaking, TPWD staff believes that the subsistence flow recommendations should be re-evaluated.

Concluding Comments

TPWD plans to remain involved with the important work of SB 3 and the Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays by offering technical and professional assistance and guidance to the GSA BBASC as requested. TPWD staff looks forward to assisting the BBASC and BBEST with the development of a focused and prioritized work plan that addresses many of the issues raised in the BBEST report and this letter.

Attachment

Appendix of Detailed Comments (listed by page number)

Page 4.10: Figure 4.1-2 illustrates various "inflow regime levels" with associated seasonality and ecosystem functions. These four flow levels are very similar to the four flow components commonly used in instream flow efforts (overbank events, high flow pulses, base flows, and subsistence flows). It's unclear whether there is a compelling reason to maintain different terminology, for essentially the same ideas, in the estuarine section as compared to the instream section.

Page 4.30: *Rangia* and oysters were chosen as focal species. However, since TPWD does not use sampling gear and methodologies designed to quantitatively sample *Rangia*, there is significant uncertainty related to this species' distribution, abundance, and trends.

Page 4.64 describes the occurrence of a few varieties of "low salinity-sensitive plant species." Given that the freshwater inflow recommendations are based on only two species (*Rangia* and oysters) and cover only 6-8 months (depending on flow level), the use of additional species, particularly ones with different life cycles, would have been beneficial. The limited data regarding these species is essentially the same as the (also limited) data that was available to the Trinity-San Jacinto BBEST in its salinity zone analysis of *Vallisneria*. TPWD staff recommends that additional species, particularly those with different life cycles, be further considered in the work plan.

Page 4.66: The report states that "for oysters the time window was chosen to cover the high temperature time of year July – September when the 'dermo' parasite can be problematic at high salinities". According to page 4.33, dermo "proliferates at temperatures above 68F and at salinities above 20psu suggesting a focus on non-winter months". A review of the TPWD Coastal Fisheries database suggests that the months of April – October have average temperatures above 68 °F. TPWD staff suggests that the BBEST revisit the temperature data and consider expanding the suite of months associated with oyster health in the work plan.

Page 4.84: Table 4.4-2 has a value of 0.73 for 2008. The chart on page 4.84 shows this at approximately 0.65 instead of 0.73. One of these is incorrect.

Page 4.94: TPWD staff recommends that the BBEST evaluate the expected frequency of *Rangia* spawning in their work plan. The inflow recommendations may vary if *Rangia* need to spawn every year to maintain viable populations.

Page 4.66 states "the salinity zone approach needs salinity data thoroughly covering the entire habitat extent, reflecting variations therein." TWPD staff questions the degree to which data "thoroughly covering…" are actually needed. As shown in Figure 4.2-7, isohalines (i.e., lines of equal salinity) are fairly smooth across both the oyster and *Rangia* habitat areas. Given the uncertainty in salinity suitability curves, it appears that the effort associated with the BBEST's approach could be reduced, with limited impact on the results, if simply two locations associated with each habitat area (one on the upstream end and one on the downstream end) were carried forward in the analysis.

Page 4.82: If TPWD staff understands the method correctly, 15 individual linear regressions between TXBLEND modeled salinity and Guadalupe River inflows were developed, one for each of the Thiessen polygons shown on Figure 4.4-9. Two correction factors were then added to each regression, one for low flows and one for high flows. Because the objective here is to fit modeled salinity data with a regression, it appears that a non-linear regression (e.g., quadratic) have been both simpler and more accurate than a linear regression with two correction factors.

Page 4.91: Figure 4.5-1 shows that the suite of freshwater inflow recommendations includes 6 tiers (A, B, C, CC, D, and DD). Some of these categories represent multiple years in the 69 year period of record. However, category CC represents only a single year and D represents only 2. Additionally, category CC is the only category where antecedent flows are part of the recommendation. Finally, category CC is recommended to occur no more than 1/6 of the total of categories C (as stated in Table 4.5-2, or 1/4, as stated in footnote #5 to Table 4.5-2) and CC combined, which have an unspecified combined recommended occurrence but only a 10% combined historical occurrence. TPWD staff wonders if the clearly rare category CC is so necessary that it warrants the inclusion of such complexity. If category CC could be dropped or modified, the complicated analyses and rules associated with the June antecedent flow could be avoided.

Page 4.102: The regression analysis of both Guadalupe and Mission-Aransas inflows concludes that "most of the behavior of salinity in this area, as related to inflow, is dominated by the influence of Guadalupe River inflows." This is based on the very modest improvement in R^2 values when the Mission-Aransas inflows are added to the regression (Figure 4.5-7). However, there could be an alternative explanation. If Mission-Aransas inflows are highly correlated to Guadalupe inflows, then it is possible that Mission-Aransas inflows actually have a substantial impact on salinities but this impact is masked by the statistical approach employed by the BBEST (i.e., running statistics using Guadalupe inflows, then adding Mission-Aransas). TPWD staff understands that the BBEST also performed the statistics with Mission-Aransas inflows first and then adding Guadalupe inflows, with the conclusion remaining that Guadalupe inflows are much more important to salinities than Mission-Aransas inflows. TPWD staff recommends that the BBEST and BBASC explore the dependence of Mission-Aransas salinities on Mission-Aransas inflows further in the work plan.

Page 4.134: To maintain *Rangia* habitat in Copano Bay, page 4.113 notes that the G1-Aprime category includes both a Guadalupe Estuary inflow value as well as a Mission-Aransas inflow value (50-125k ac-ft/yr). This latter Mission-Aransas inflow value does not appear in the synthesis inflow regimes on page 4.134. TPWD staff recommends that the BBEST clarify their intent with regards to the Mission-Aransas inflow requirements under the G1-Aprime criteria level.

Page 4.135: The attainment frequencies specified in the attainment goal tables (e.g., Table 4.6-3) are somewhat ambiguous. For example, G1-Aprime is recommended "at least 12% of years" and G1-A is recommended at least "12% of years." Consider the scenario where a model

simulation predicts that G1-Aprime will be met in 14% of years and G1-A in only 10% of years. Seemingly, this would be satisfactory from an ecological perspective, but this is clearly not allowed under the written recommendations. It may be helpful for the BBEST, in its deliberations with the BBASC, to recast these frequencies as "this category or a higher category." For example, G1-A could be recommended to be equaled or exceeded (up to the ceiling of the G1-Aprime category) at least 24% of the time.

Page 6.25: TPWD staff questions the value of Section 6.2 (Comparisons to Water Rights Permits) in the BBEST report. A comparison to special conditions in existing permits may not be useful in that such conditions were developed using a more limited technical analysis than that employed by the BBEST under its charge to use the best science available. It does not appear that these comparisons influenced the BBEST's recommendations.

Page 6.30: Clause 6.4.2(2) suggests that only 50% of the flows above subsistence must be passed, whereas the example clearly shows that this 50% is in addition to the subsistence flow itself. TPWD staff believes that the intent is clear, but the language ("...then 50% of the difference between inflow and the seasonal subsistence value must be passed, and the balance may be impounded...") could be misinterpreted. TPWD staff recommends that the BBEST closely coordinate with the BBASC and TCEQ to ensure that the correct intent is carried forward.

Memorandum

To: **Environmental Flows Advisory Group (EFAG)**
From: **Texas Environmental Flows Science Advisory Committee (SAC)**
Date: **May 3, 2011**
Re: **Review comments on Guadalupe and San Antonio Rivers, San Antonio Bay and Aransas-Copano Bay Basin and Bay Expert Science Team (BBEST) Environmental Flows Recommendations Report dated March 1, 2011**

Introduction

The Guadalupe and San Antonio Rivers, San Antonio and Aransas-Copano Bays BBEST submitted its environmental flow analyses and environmental flow regime recommendations to its Stakeholder Committee, the EFAG and the Texas Commission on Environmental Quality (TCEQ) on 2 March 2011. Texas Water Code Sec. 11.02362 (q), as added by Senate Bill 3 in the 80th Texas Legislature, 2007 (SB 3), provides that "In accordance with the applicable schedule…the advisory group, with input from the science advisory committee, shall review the environmental flow analyses and environmental flow regime recommendations submitted by each basin and bay expert science team. If appropriate the advisory group shall submit comments on the analyses and recommendations to the commission for use by the commission in adopting rules under Section 11.1471. Comments must be submitted not later than six months after the date of receipt of the analyses and recommendations." This memorandum represents the SAC's input to the EFAG based on our review of the BBEST report.

The timeframe dictated by SB 3 presents a challenge to the BBEST. They have only 12 months from their appointment to organize themselves, develop their agenda for addressing the requirements placed on them under the statute, conduct their analyses and report their results. In many respects, the Guadalupe/San Antonio BBEST was the best-prepared of all to undertake this assignment. A high proportion of its members had previous experience addressing the nuances of environmental flow analyses, including some with prior BBEST experience; the information bases for both the basin and bay are especially rich, members of the BBEST being among the principal contributors; and SB2 studies were underway within the basin to provide a source for detailed field observations. In addition, the BBEST was provided substantial staff support from TWDB, TPWD, TCEQ, SARA, SAWS and GBRA.

SAC Review and Comments

These comments are organized following the *Framework for SAC review of BBEST work products (2nd ed. 12/17/2010)*, and conclude with a summary. The SAC also had the opportunity to visit with BBEST leadership and ask for further explanation of their work at our meeting on April 13 as we prepared these comments.

1. Do the environmental flow analyses conducted by the BBEST appear to be based on a consideration of all reasonably available science, without regard to the need for water for other uses?

1.1 Has the BBEST identified and considered available literature and data? Were relevant scientific data and/or analyses discounted by the BBEST?

The literature reviews are excellent. The organization and presentation of the physical and biological systems encompassed in this basin are very well done. The reviews of the riparian environment and the candidate estuarine organisms are particularly good. It is noteworthy that SB2 results from San Antonio were made available to the BBEST and were considered in its work. Moreover, several state agencies (notably TWDB and TPWD) assisted in performing analyses and modeling runs, and in conducting field surveys of river cross sections to improve the hydraulic data base.

1.2 Are the data sources and methods adequately documented?

Data sources are very well described, and much of the data are provided in various appendices. The extent to which the methods are described is variable. Figure 1 and 2 diagram the apparent logical sequence by which the recommendations are formulated, for Instream Flows and Estuary Inflows, respectively.

The methods for determination of instream flow recommendations are especially disappointing, given the importance of these recommendations and the substantial data resources available to this BBEST. While an impressive body of work is presented in the determination of physical-habitat requirements as a function of flow, as schematized in the right side of Fig. 1, the only justification for adopting (or defaulting to) the historical HEFR base flows is the sentence:

> Results of habitat modeling for both the SB2/LSAR and GSA guild sets at two locations on the San Antonio River (Elmendorf and Goliad) and two locations on the Guadalupe River (Gonzales and Victoria) indicate that the statistically derived base flows will maintain suitable habitat for all of the habitat guilds considered. (p. 6.19)

How exactly the detailed depictions of WUA curves for the various guilds resulted in (or "indicated") the recommendation of maintenance of the historical HEFR flows is the crux, and the above sentence is quite inadequate. Members of the BBEST have informed the SAC that these recommendations were based upon consideration of the WUA results together with professional judgment, but that these were insufficiently documented due to the press of time.

In the case of the estuary, a novel analysis was carried out by the BBEST using an estuary equivalent of weighted usable area, defined in terms of the proportion of salinity coverage of species-dependent fixed-habitat zones, in which the weight is based upon a salinity preference diagram for the species. Documentation of the data sources (salinity model results from the TWDB hydrodynamic/salinity model, literature reviews of salinity dependence of the species, and data-based

INSTREAM FLOW DETERMINATION

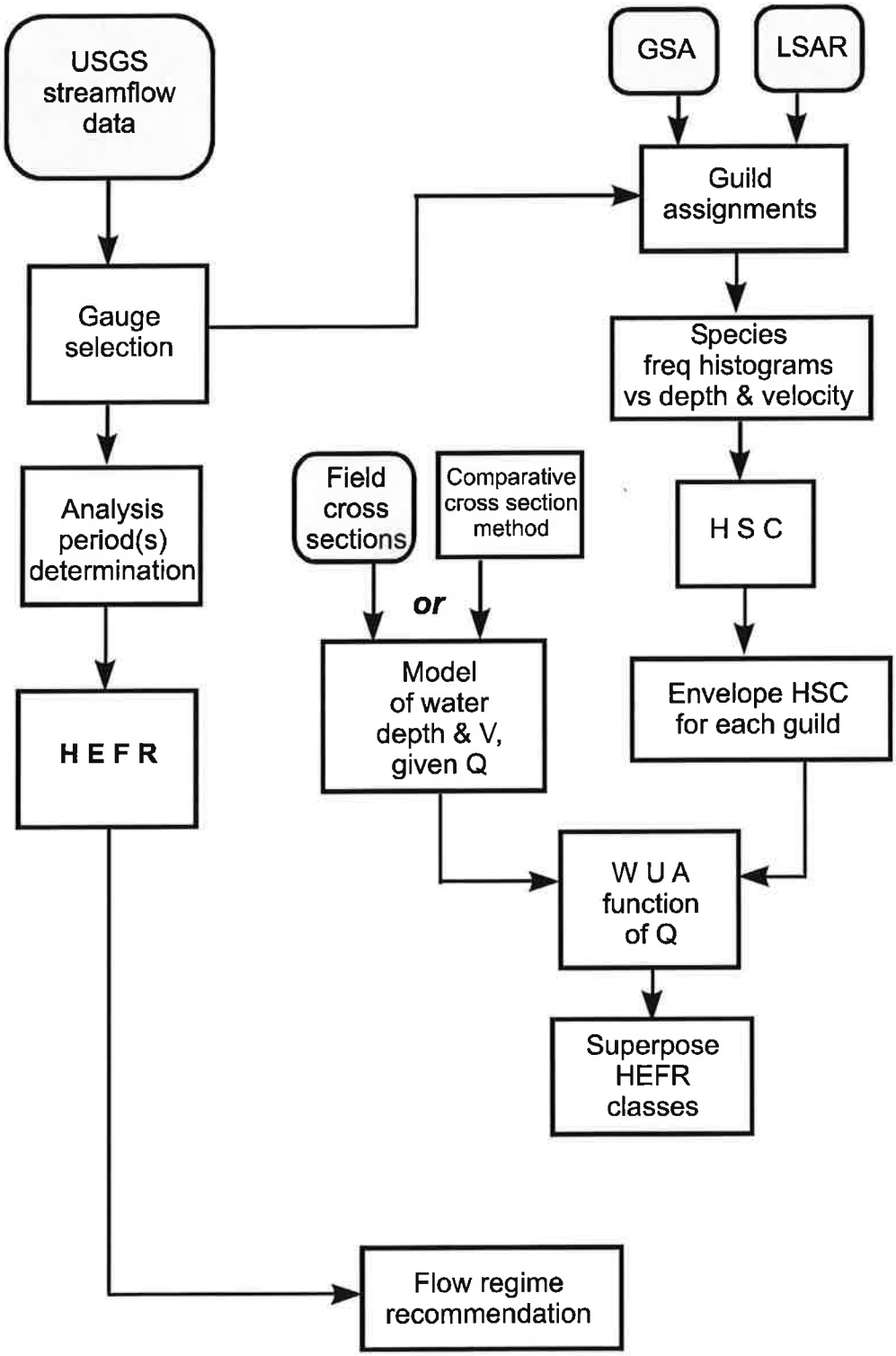


Figure 1 - Decision path for instream flow recommendations

ESTUARY INFLOW DETERMINATION

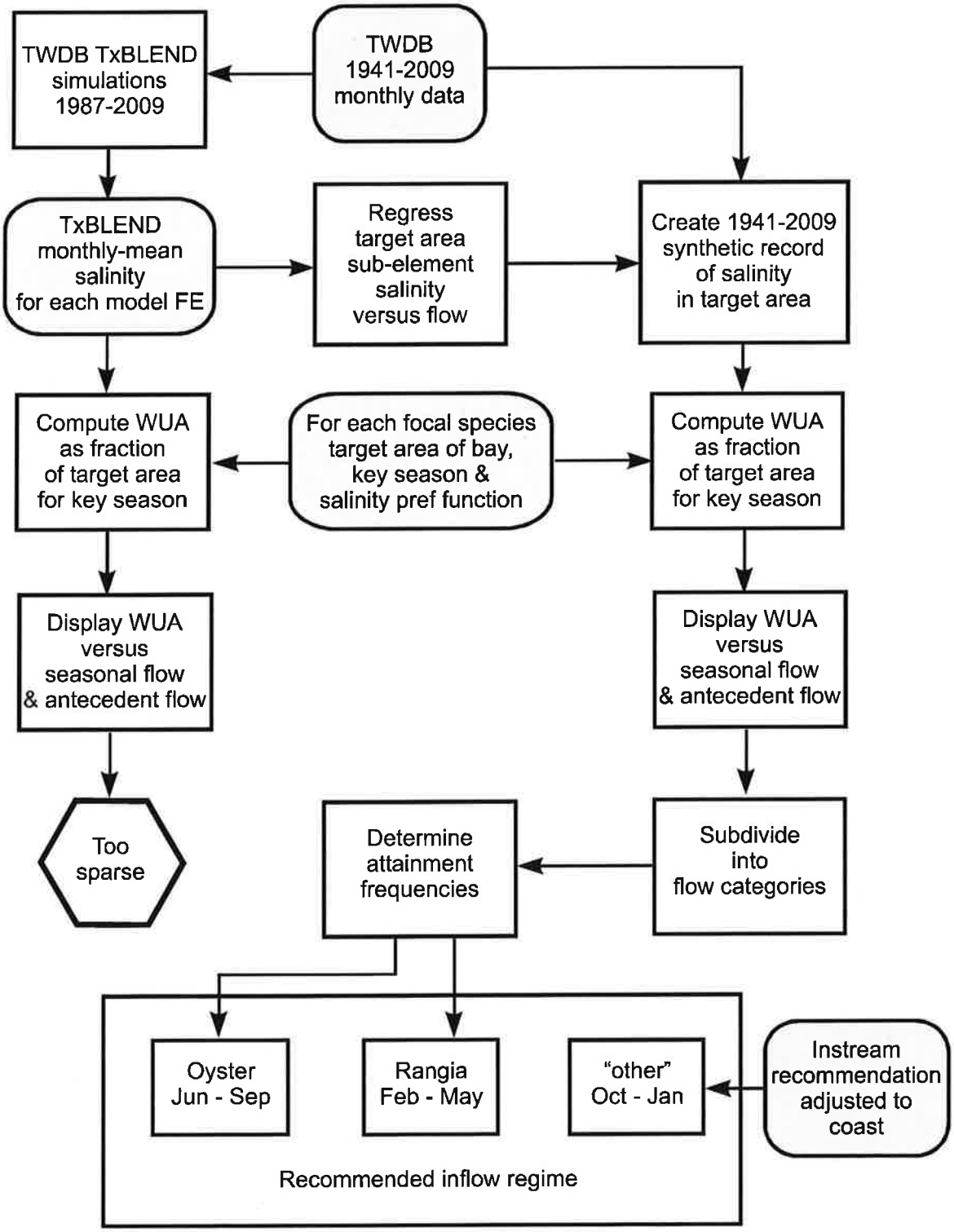


Figure 2 - Decision path for estuary inflow recommendations

identification of the zones of greatest abundance in the estuaries) and the analytical methodology is generally thorough.

1.3 To what extent has the BBEST considered factors extraneous to the ecosystem, especially societal constraints, such as other water needs?

External societal factors did not play any role in the scientific issues addressed or in the methodologies. Several scenarios of alternative recommendations and/or hypothetical projects were evaluated, but only as a detailed demonstration of how the recommendations could be applied.

2. Did the BBEST perform an environmental flow analysis that resulted in a recommended environmental flow regime 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?

2.1 How is a sound environment defined and assessed for both riverine (lotic) and estuarine systems? What metrics of ecosystem health were used?

The report contains thorough discussions of the definition(s) and metrics for a sound environment. A thoughtful overview of the concept and its definition(s) is presented at the outset of the report (Section 1.3). Instream flows are based on the Physical Habitat Simulation System (PHABSIM) approach, using physical requirements, mainly depth and velocity, of several guilds of fish. Flows to estuaries are based on salinity versus inflow relations, together with literature results for salinity preference mainly for sessile or limited-motility focal organisms, *viz.* oyster (*Crassostrea virginica*) and the clam *Rangia*. Other species are considered in overlay sections.

2.2 How were locations selected for environmental flow analysis? Are these shown to be representative of and adequate to protect the basin? Was the process and rationale for selection adequately described? Were environmental flow regimes recommended for each selected site? Was a procedure presented by which the flow regime at other locations could be estimated?

For instream flows, the assessment of gauge locations was based upon distribution, period of record and the representativeness of the gauge, and the presentation was very well done, including a good survey of available gauge records. HEFR-type regimes are defined and the initial HEFR analyses presented in Appendix 3.2-1. A procedure for flow regime determination at other locations is not stated. However, a brief paragraph (Section 3.1.2.6) recommends that the TCEQ develop "appropriate methods for interpolation of flow conditions ..." (p. 3.8).

In the estuary, flow determination was linked to habitat zones in which the focal species are typically present in greatest abundance. There are two estuaries within the geographical responsibility of this BBEST, San Antonio Bay and Aransas-Copano Bay. For the latter, flow determination posed a complex problem due to influence of San Antonio Bay river inflows, which enter Aransas

Bay from San Antonio Bay, as well as the direct inflows into the Aransas-Copano system. This was well-handled by the BBEST.

2.3 How were the historical flow periods defined and evaluated? How was a particular period selected as the basis for determining the flow regime?

A transition date was established demarcating the beginning of substantial anthropogenic effects on the flow, namely (1) date of reservoir construction in the Guadalupe (1965), (2) approximate date of urban expansion in San Antonio (1970). Generally, the full period of record was selected for analysis, except on the San Antonio River where the pre-development period (up to 1970) was used because of lower municipal return flows.

One feature of the hydroclimatology of the two river basins is that there has been an upward trend in inflow over the past seven decades, due to increased rainfall and associated runoff. The mean flow has nearly doubled in the Guadalupe (as measured at Victoria) and has increased about a factor of 2.4 in the San Antonio (as measured at Goliad). In the latter, part of the increase is doubtless driven by the accelerated urbanization in the San Antonio area and the associated increase in return flows, but the majority of the increase is hydroclimatological (see Appendix 5.1-1).

2.4 Was a sound ecological environment determined to exist at each selected site during the selected period? If not, were the underlying causes and/or modifications needed identified?

This conclusion is forwarded at the outset of the report in Section 1.3, in which the scientific basis is presented for both the riverine and estuarine environments. In the body of the report, notably in the "overlay" sections, additional supporting information is presented.

In the case of the riverine environment, the concept of community "intactness" is invoked in the opening chapter and repeatedly in Chapter 3. Nowhere is this concept defined nor a procedure for its determination cited. In Section 3.3.5.1, it is stated that "relative intactness" was assessed (p. 3.49), but no results of this assessment are shown. The "intactness" of the Guadalupe aquatic ecosystem was offered as justification for employing the entire period of record (along with the "best representation of the natural hydrograph"), despite the above-noted increasing trends in inflow.

2.5 Was a functional relationship between flow regimes and ecological health developed? Or, were proxy or intermediate variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlay considerations (sediment transport, water quality, nutrients, etc.) addressed?

For instream flows, a version of PHABSIM was used, in which the measure of ecological health was, in effect, abundance of guilds of fish and associated habitat requirements, namely depth and current speed. The report itself does not contain a discussion of how the WUA curves were evaluated or otherwise considered by

the BBEST nor does it explain the logic by which the BBEST defaulted to HEFR-based recommendations.

An example of the WUA results of the analysis is shown in Figure 3. The blue rectangle plots the full range of historical baseflows over all seasons and hydroclimate classes. This would seem to allow the interpretation that baseflows are generally higher than they need to be, considering their relationship with the flows necessary to achieve maximum habitat for most guilds. The BBEST advises that such an interpretation based strictly on maximizing habitat for most guilds would be wrong. Indeed, there is a variety of displacements of WUA's and the corresponding baseflow range shown in the report (pp 3.53-73), none of which, the SAC is advised, was deemed sufficient to modify the hydrology-based results. Rather, it seems that the WUA results were viewed as simply not contradicting the adequacy of the HEFR flows.

For this reason, our schematic of the decision path shown in Fig. 1 indicates no logic path from the WUA analyses to the flow recommendations, which are entirely the default HEFR results. The BBEST has acknowledged that its discussion of the use of the WUA's in the report was incomplete due to press of

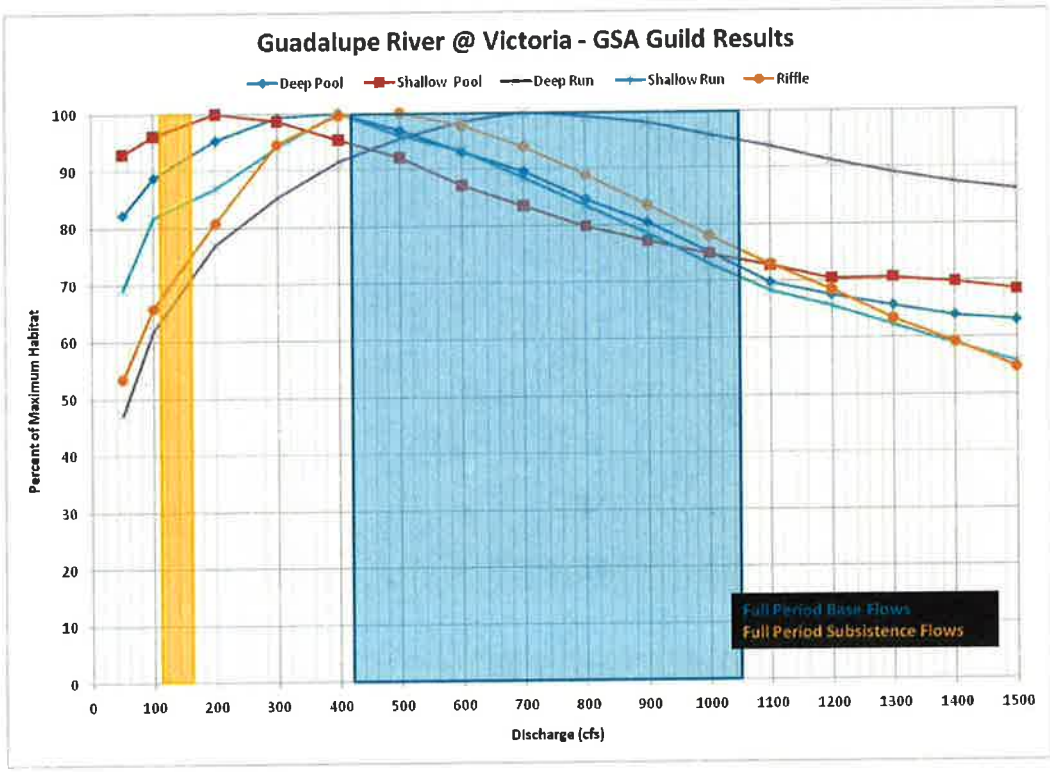


Figure 3 - Weighted Usable Area curves for a station on the Guadalupe (p 3.56 in the BBEST report). Guilds are named for the physio-graphic area in which the fish are generally found. The two rectangles show the range of subsistence flows (yellow) and base flows (blue) from the HEFR analysis.

time, and that it intends to work with the BBASC as necessary to clarify its recommendations.

The SAC believes that the WUA methodology and its use should be clearly delineated in the Workplan, its deficiencies noted, and any necessary data collection and methodological revisions, as well as further analysis, should be high-lighted as an important part of future adaptive management strategy.

The overlays for instream flows are generally well done. The water quality analysis is thorough, its presentation succinct, and demonstrates the general high quality of river water in the basin, even under low-flow conditions. The riparian overlay (Section 3.6) is a well-written discourse on the vegetation of the riparian community and its dependence upon river flow. Its greatest weakness is the much greater proportion of text of a general and tutorial nature compared to information specific to the basin. The BBEST notes (p 3.123) that field data from the basin are still in the process of analysis. In its present state, this section is inconclusive and did not affect the decision path for flow recommendations. However, information such as Figs. 3.6-14 and 3.6-15, and Table 3.6-6 beg to be populated with real data specific to the basin including topography and associated inundation stages.

The geomorphology overlay (Section 3.5) contains the results of a number of hydrological scenarios, including two HEFR cases with 2 and 5 tiers of flood pulses and several WAM simulations for hypothetical river developments. These results would have general value in other contexts, and it is puzzling why they were not presented in their own section, then referenced as necessary. The geomorphology analysis is a sediment transport modeling exercise, in which the historical sediment-versus-discharge relations are used to compute sediment load under the various hydrological scenarios. As one would expect, sediment transport diminishes with increased impact on flood pulses. The BBEST concludes that the channel will remain stable (i.e., not change) so long as sediment load does not change more than 10%. A single literature source is cited for this judgment (which is based on channel-forming flows, a concept which its authors acknowledge "is not universally accepted").

The report appears ambiguous on whether the geomorphology overlay is incorporated into the environmental flow recommendations. In Section 6.1, only the HEFR-based regime tables are presented, with no additional conditions. Yet in the discussions of Section 6.4 addressing hypothetical projects, suggestions are proffered as to how the hypothetical project might be constrained to reduce its effect on sediment load to within the 10% range. The SAC feels that the BBEST should clarify for the stakeholders and TCEQ whether this and any other additional conditions are to be applied to the flow recommendations.

If, indeed, it is the intention of the BBEST to apply this condition, the SAC observes that the basis for the rather stringent constraint of being within 10% of

historical sediment load is limited, being based upon one didactic reference, in which the 10% limit is suggested without observational basis or literature citation, hardly the "preponderance of literature within the published scientific literature *[sic]*" that is claimed in the BBEST report (page 7.5).

For the estuary, an extensive and detailed analysis was carried out for occurrence of salinity preference as a function of (bivariate) inflows. The focal organisms oyster and *Rangia* primarily defined the regime, though other organisms were used as overlays. Oyster and *Rangia* have different seasonal requirements, and together define the recommendations for February – September. The recommendations are presented as seasonal flows with associated attainment-frequency goals. These will not be directly applicable to operational use, but would be employed in long term simulations to determine the effect (e.g. achievement of recommended attainment frequencies) of a proposed diversion or impoundment. There were also detailed analyses of a number of species or parameters which ultimately did not play a role in the inflow recommendations. This is not a criticism of the work as a comprehensive approach is clearly valuable and much good information is presented. In particular, a lot of effort was expended on blue crab because of its important role in San Antonio Bay foodwebs, and while it is clear that salinity plays a role in disease, growth, and reproduction, there was insufficient data available to use blue crab as an indicator species.

2.6 Was a sound ecological environment demonstrated to be achieved at each selected site under conditions of the recommended flow regime?

No. However, to a certain extent, this was moot, since the systems were determined to be presently healthy, and the recommendation was to revert to historical-data-based flows (HEFR statistics for the instream flows and historical frequencies of flows that achieve target salinity zones for the estuary), even though strict adherence to the HEFR-based flows and associated attainment frequencies does not specifically preserve the historical statistics of all flows. On the other hand, it also has not been demonstrated that all of the flow components of the recommended instream flow regimes, including three levels of base flow and up to five levels of high-flow pulses, are necessary to protect a sound ecological environment.

2.7 Is uncertainty in the analyses described or quantified? Where models were employed, was the extent of validation and associated predictive errors described and quantified?

We acknowledge the attempt by the BBEST to address the issue of uncertainty at various places in the report, albeit largely qualitative. Uncertainty in these analyses is important, and we appreciate the suggestions for future studies, etc. which might ameliorate some of the inherent uncertainty. It would have been helpful if known uncertainty had been presented as a quantified qualifier to the recommended regime.

As there is no relation between the WUA results and the instream flow recommendation values, a quantitative expression of uncertainty would be difficult. Members of the BBEST have indicated that the number of cross sections available for the WUA calculations in the instream flow regime substantially affects the uncertainty of the results, and that the one or two cross sections for many of the stations rendered the results imprecise.

The salinity-flow relations in the estuary were based on modeled salinities, not data. (Reliance on data alone would have not have allowed the BBEST the specificity of geographic salinity zones needed for its analysis.) While the accuracy of the model is quantified in an appendix (as variance of the data about the predicted values), and the accuracy of the regressions of modeled salinity on flows was determined (again, as a variance), the two were not combined and translated into the effective confidence of the inflows.

Summary and Conclusions

The general philosophy of the BBEST in its approach to environmental flow determination is characterized by statements throughout the report, e.g.:

- Adoption of the natural flow paradigm, in which the dynamic variation exhibited in the natural hydrograph is used to identify key regime components, also qualitatively consistent with the conceptual treatment of streamflow dynamics in the Texas Instream Flow Program, considered necessary to maintain natural habitats. [pp 3.25-3.28]

- Selection of the entire period of record upon which to base flow recommendations, because "...longer periods of record likely capture the natural variation in precipitation and discharge." [p 3.49]

- For the estuary, "historical flow patterns of magnitude, timing, frequency, and duration should be passed through to the estuary, but they should not be artificially modified or exacerbated by water management operation." [p 4.9]

Given this philosophy, it is perhaps not surprising that the BBEST chose to recommend environmental flows based on historical values.

It is sobering, however, that the best-equipped BBEST thus far could not make a quantifiable recommendation founded upon a clear connection between levels of flow and metrics of ecosystem health that could be defended as adequate, which is the goal of Senate Bill 3 with regard to the BBEST charge, and instead recommended little, if anything, more than default HEFR flow regimes based on historical hydrology.

It is the SAC's opinion that the BBEST has achieved excellence in its report, except for the following items that are of concern to the SAC:

- While an impressive body of technical work on WUA's of important guilds has been developed, there is no logical connection presented between these results and the (default) HEFR flows ultimately recommended.

- The variety of relationships displayed between the WUA's and the range of baseflows raises the question: what kind of relationship would be necessary to yield a flow recommendation different from HEFR?

- In the estuary, a convincing presentation of the dependence of preferable salinities within key habitat zones on the inflows (more precisely, the time history of inflows) was made for each of the focal species oyster and *Rangia*. However, the attainment frequency for each of these was essentially the historical statistics, which is equivalent to specifying the historical occurrence of the corresponding flow classes.

In closing, we observe that much new analysis was developed by this BBEST of potentially great value in future environmental flow studies in this basin, and we particularly appreciate the inclusion of Chapter 7 which introduces potential content of a work plan for the basin as required by SB3. It is also possible, even probable, that the work of the BBEST was more complete than its report would suggest. This should be communicated directly to the BBASC by the BBEST membership, and we encourage a robust interaction with the stakeholders as they undertake development of recommended Standards and Strategies. (We do note the *faux pas* that the BBEST fails to acknowledge in the introduction to Section 6 that the BBASC is a primary recipient of the BBEST recommendations). Finally, that the BBEST report falls short of the potential is an indication of the difficulty of the SB3 task, the complexity of the present state of the science, and the limitations of resources and time within which the BBEST must work.

Review comments on

Guadalupe and San Antonio Rivers, San Antonio Bay and Aransas-Copano Bay

Basin and Bay Expert Science Team (BBEST)

Environmental Flows Recommendations Report

(March 1, 2011)

1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.1 Has the BBEST identified and considered available literature and data?

1.2 Are the data sources and methods adequately documented?

1.3 To what extent has the BBEST considered factors extraneous to the ecosystem?

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.1 How is a sound environment defined and assessed? What metrics were used?

2.2 How were locations selected for e-flow analysis? Are these shown to be representative of and adequate to protect the basin? Were e-flow regimes recommended for each selected site? Was a procedure presented by which the flow regime at other locations could be estimated?

2.3 How were the historical flow periods defined and evaluated? How was a particular period selected as the basis for determining the flow regime?

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.4 Was a sound ecological environment determined to exist at each site during the selected period?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

2.6 Was a sound ecological environment demonstrated to be achieved under the recommended flow regime?

2.7 Is uncertainty in the analyses described/quantified? Was the extent of model validation and associated predictive errors described and quantified ?

1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.1 Has the BBEST identified and considered available literature and data?

The literature reviews are excellent.

The organization and presentation of the physical and biological systems encompassed in this basin are very well done.

The reviews of the riparian environment and the candidate estuarine organisms are particularly good.

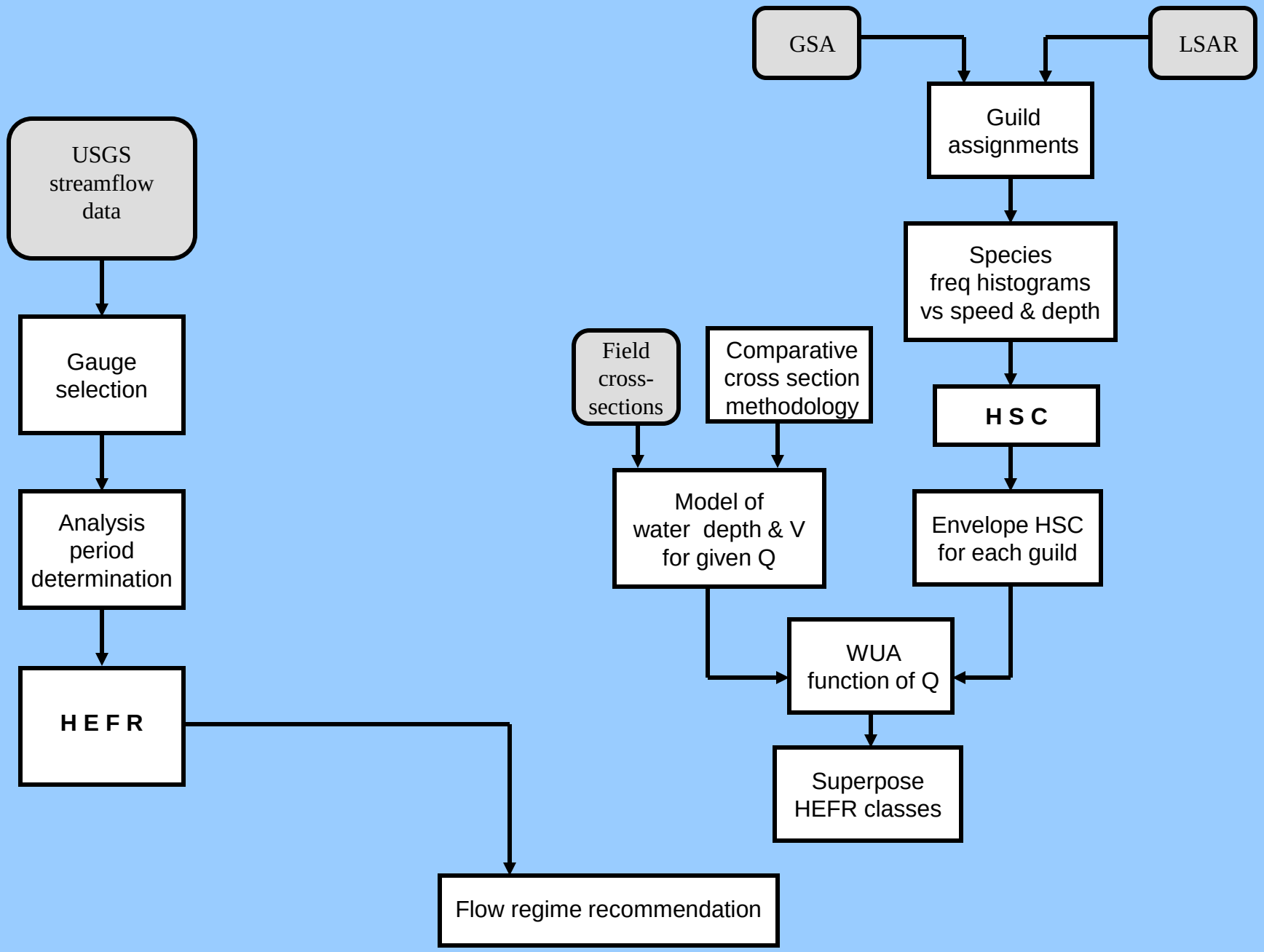
1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.2 Are the data sources and methods adequately documented?

Data sources are very well described, and much of the data are provided in various appendices. The extent to which the methods are described is, however, variable.

Critical path through the analysis showing how the final answer, the e-flow regime, is achieved for the instream environment :

INSTREAM FLOW DETERMINATION



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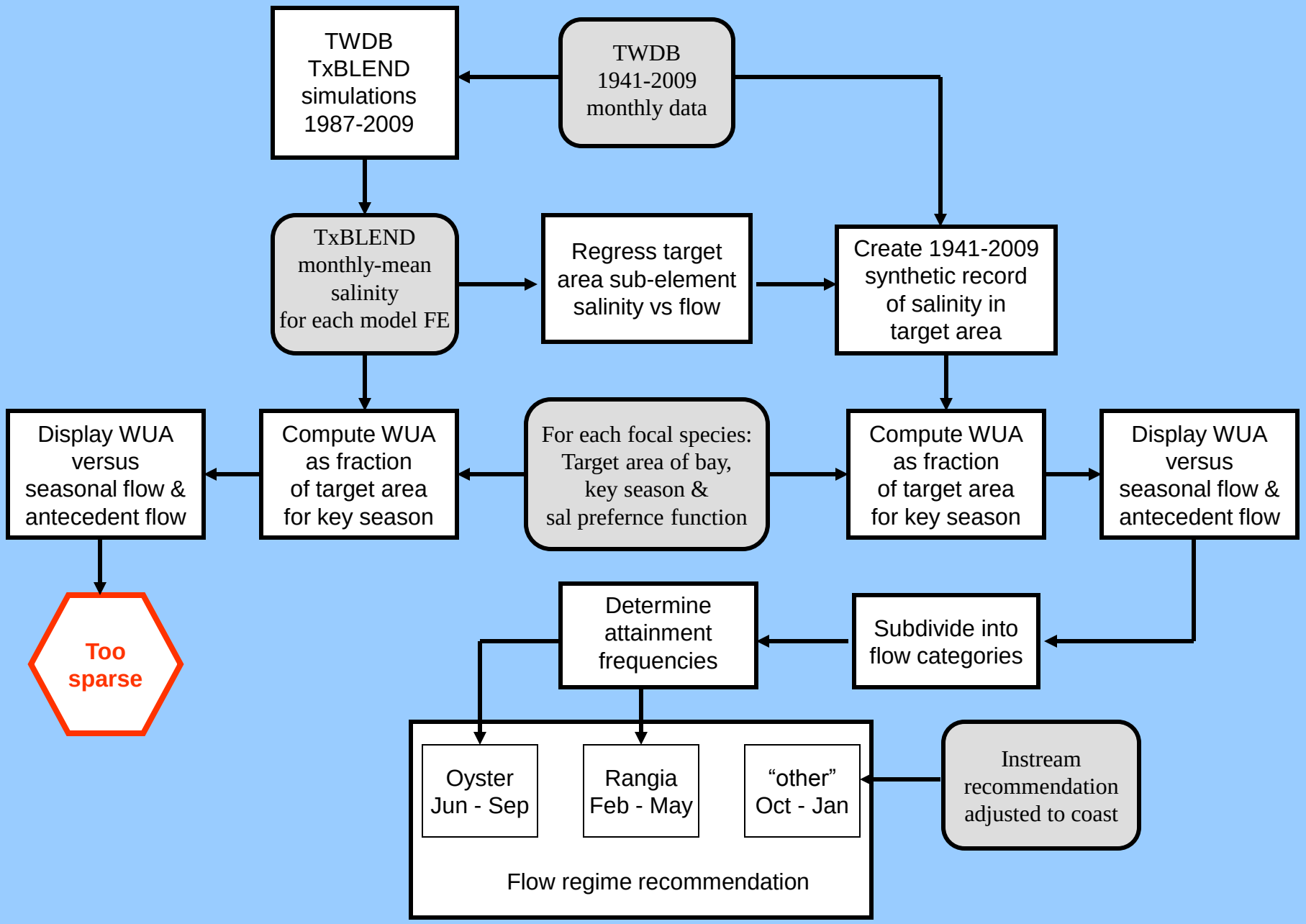
Critical path through the analysis showing how the final answer, the e-flow regime, is achieved for the estuarine environment :

ESTUARY INFLOW DETERMINATION



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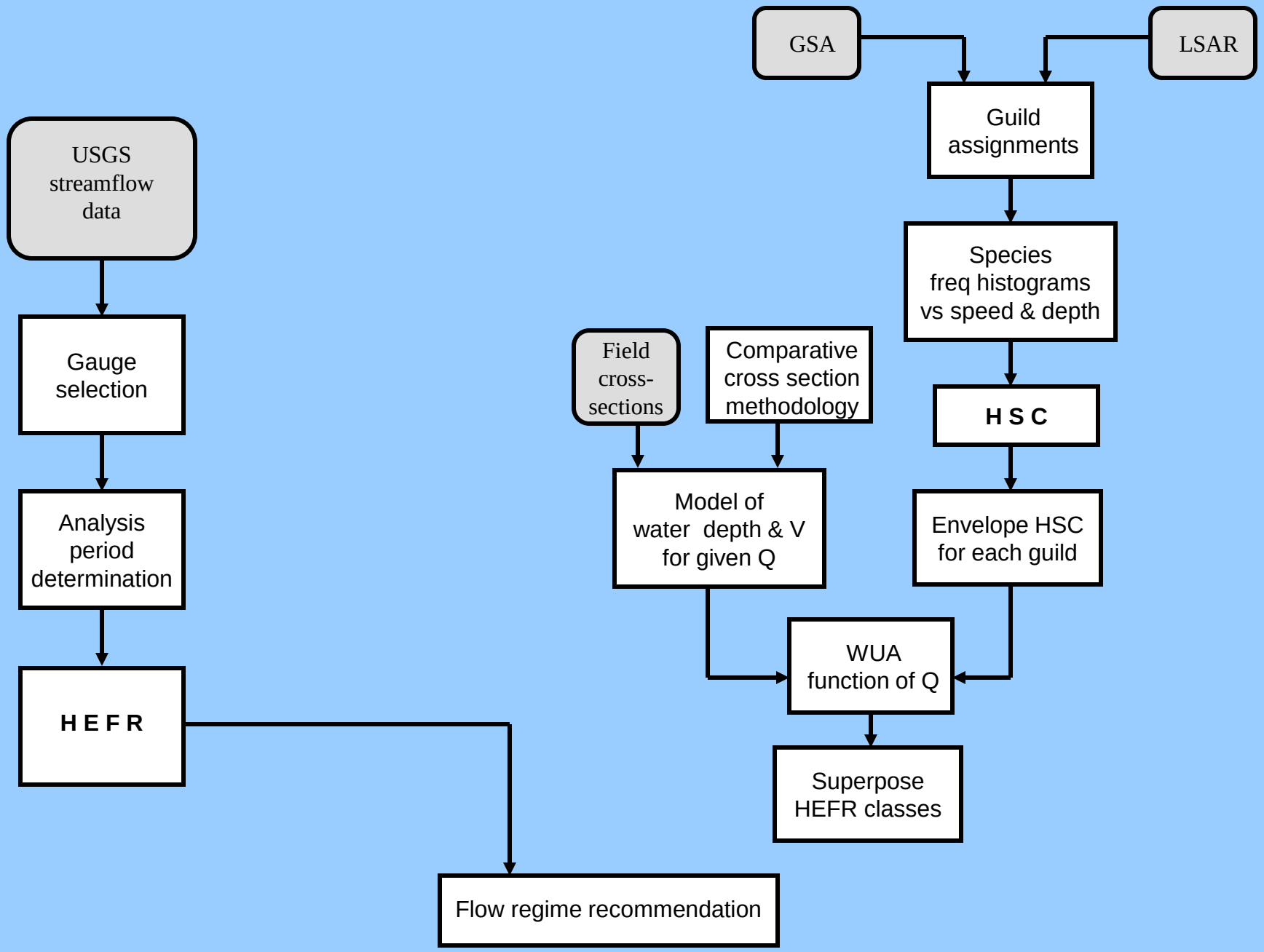
1.2 Are the data sources and methods adequately documented?

INSTREAM FLOW DETERMINATION



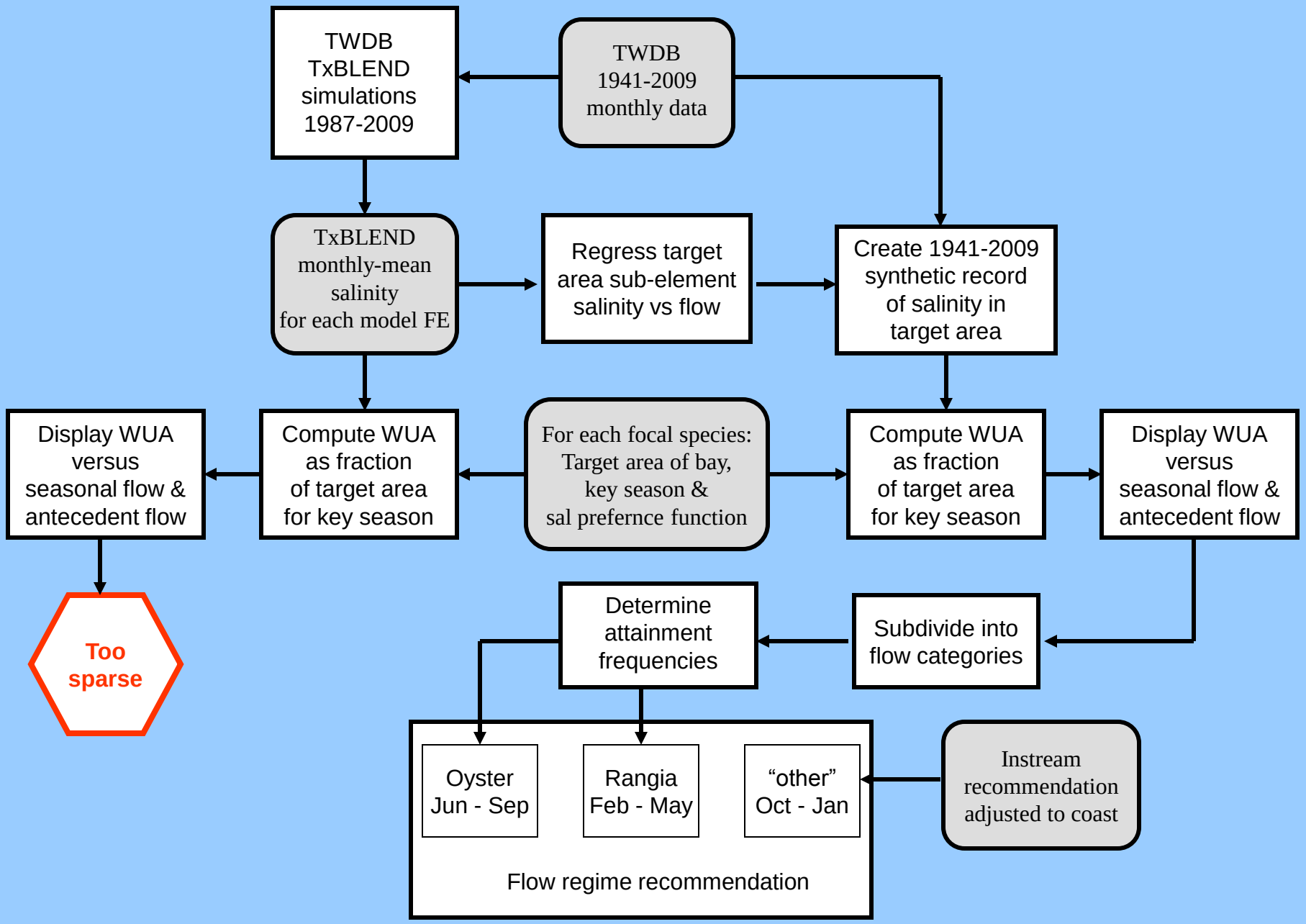
1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.2 Are the data sources and methods adequately documented?

While an impressive body of work is presented in the determination of physical-habitat requirements as a function of flow, as schematized in the right side of Fig. 1, the only justification for adopting (or defaulting to) the historical HEFR base flows is the sentence:

> Results of habitat modeling for both the SB2/LSAR and GSA guild sets at two locations on the San Antonio River (Elmendorf and Goliad) and two locations on the Guadalupe River (Gonzales and Victoria) indicate that the statistically derived base flows will maintain suitable habitat for all of the habitat guilds considered. (p. 6.19)

ESTUARY INFLOW DETERMINATION



1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.2 Are the data sources and methods adequately documented?

In the case of the estuary, a novel analysis was carried out by the BBEST using estuary equivalent of weighted usable area, defined in terms of the proportion of salinity coverage of species-dependent fixed-habitat zones, the weighting based upon a salinity preference function for the species.

Documentation of the data sources (salinity model results from TWDB TxBLEND, literature reviews of species' salinity dependence, and data-based identification of the zones of greatest abundance) and the analytical methodology is generally thorough.

1. Are the environmental flow analyses based on consideration of all reasonably available science?

1.3 To what extent has the BBEST considered factors extraneous to the ecosystem?

External societal factors did not play any role in the scientific issues addressed or in the methodologies.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.1 How is a sound environment defined and assessed? What metrics were used?

The report contains thorough discussions of definition(s) and metrics for a sound environment. A thoughtful overview of the concept is presented at the outset of the report (Section 1.3).

Instream flows are based on the Physical Habitat Simulation System (PHABSIM) approach, using physical requirements, mainly depth and velocity, of several guilds of fish.

Flows to estuaries are based on salinity versus inflow relations, together with literature results for salinity preference mainly for sessile or limited-motility focal organisms

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.2 How were locations selected for e-flow analysis? Are these shown to be representative of and adequate to protect the basin? Were e-flow regimes recommended for each selected site? Was a procedure presented by which the flow regime at other locations could be estimated?

For instream flows, the assessment of gauge locations was based upon distribution, period of record and the representativeness of the gauge, and the presentation was very well done, including a good survey of available gauge records. HEFR-type regimes are defined and the initial HEFR analyses presented in Appendix 3.2-1.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.2 How were locations selected for e-flow analysis? Are these shown to be representative of and adequate to protect the basin? Were e-flow regimes recommended for each selected site? Was a procedure presented by which the flow regime at other locations could be estimated?

In the estuary, flow determination was linked to habitat zones in which the focal species are typically present in greatest abundance.

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2.3 How were the historical flow periods defined and evaluated? How was a particular period selected as the basis for determining the flow regime?

A transition date was established demarcating the beginning of substantial anthropogenic effects on the flow, namely

(1) date of reservoir construction in the Guadalupe (1965),

(2) approximate date of urban expansion in San Antonio (1970).

Generally, the full period of record was selected for analysis, except on the San Antonio where the pre-development period (up to 1970) was used because of lower municipal return flows.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.4 Was a sound ecological environment determined to exist at each site during the selected period?

Yes. See especially Section 1.3, in which the scientific basis is presented for both the riverine and estuarine environments.

In the case of the riverine environment, the concept of community "intactness" is invoked in the opening chapter and repeatedly in Chapter 3. Nowhere is this concept defined nor a procedure for its determination cited. In Section 3.3.5.1, it is stated that "relative intactness" was assessed (p. 3.49), but no results of this assessment are shown.

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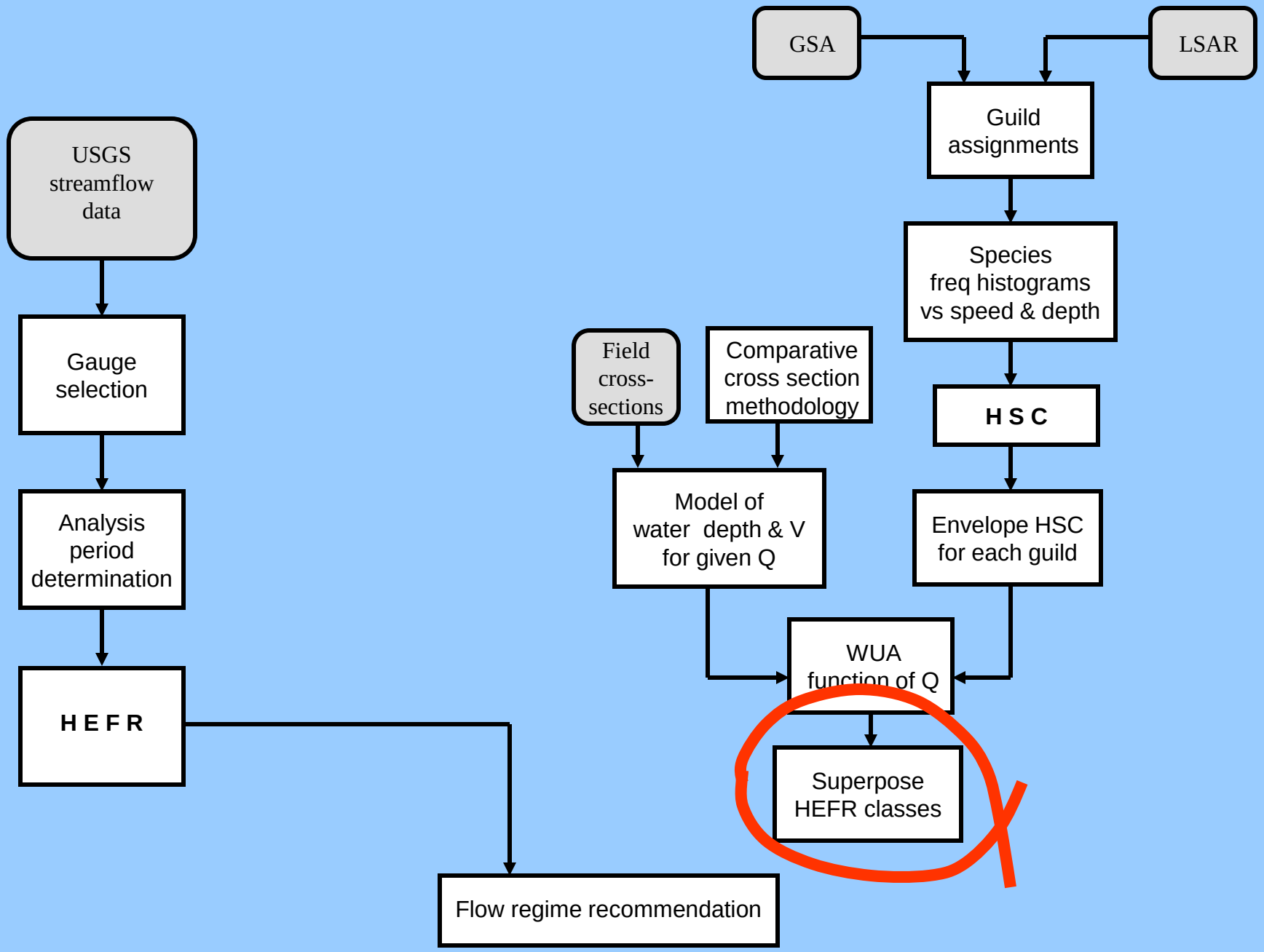
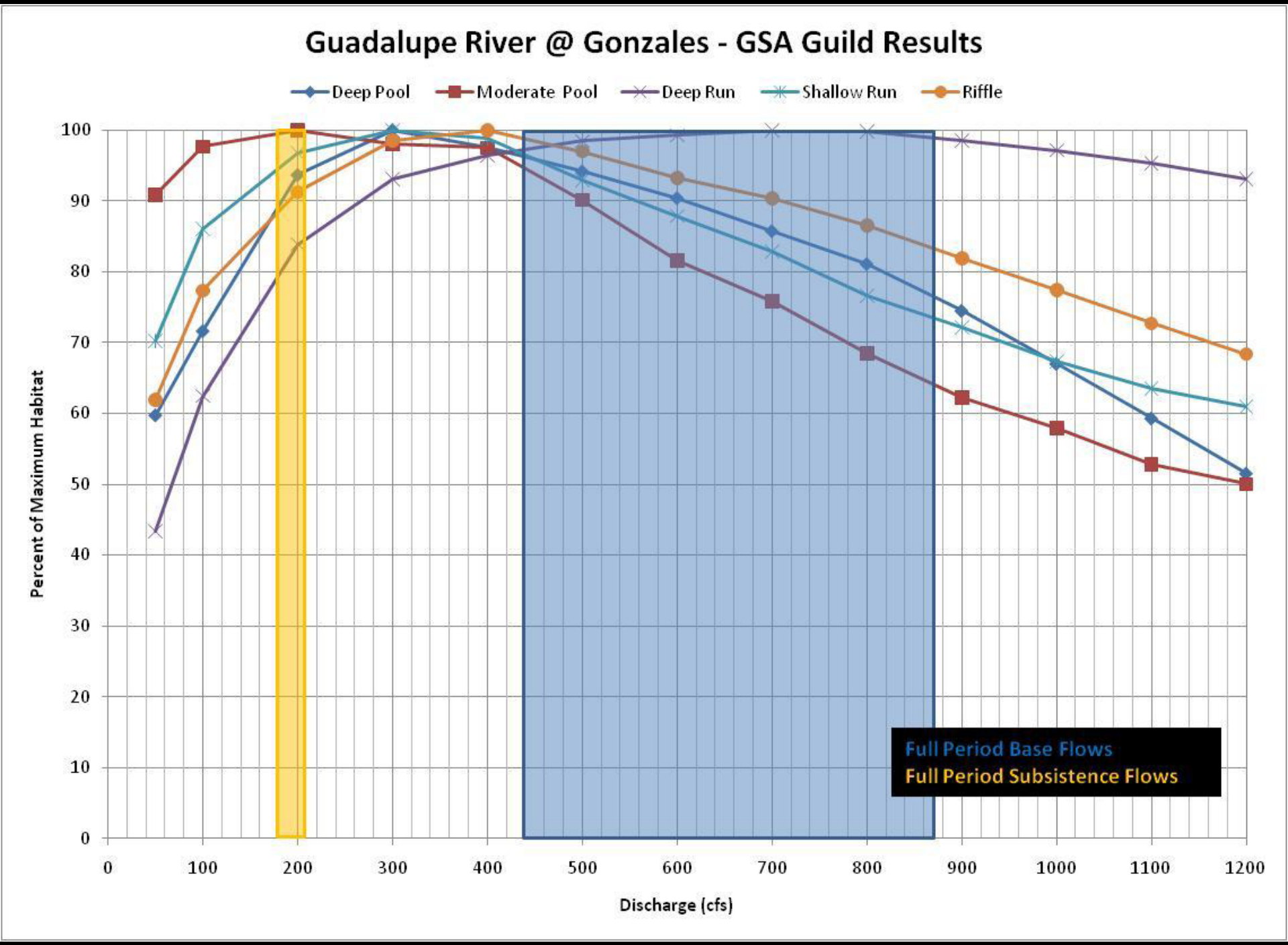
2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

For instream flows, PHABSIM was used, in which the measure of ecological health was, in effect, abundance of guilds of fish and associated habitat requirements, namely depth and current speed.

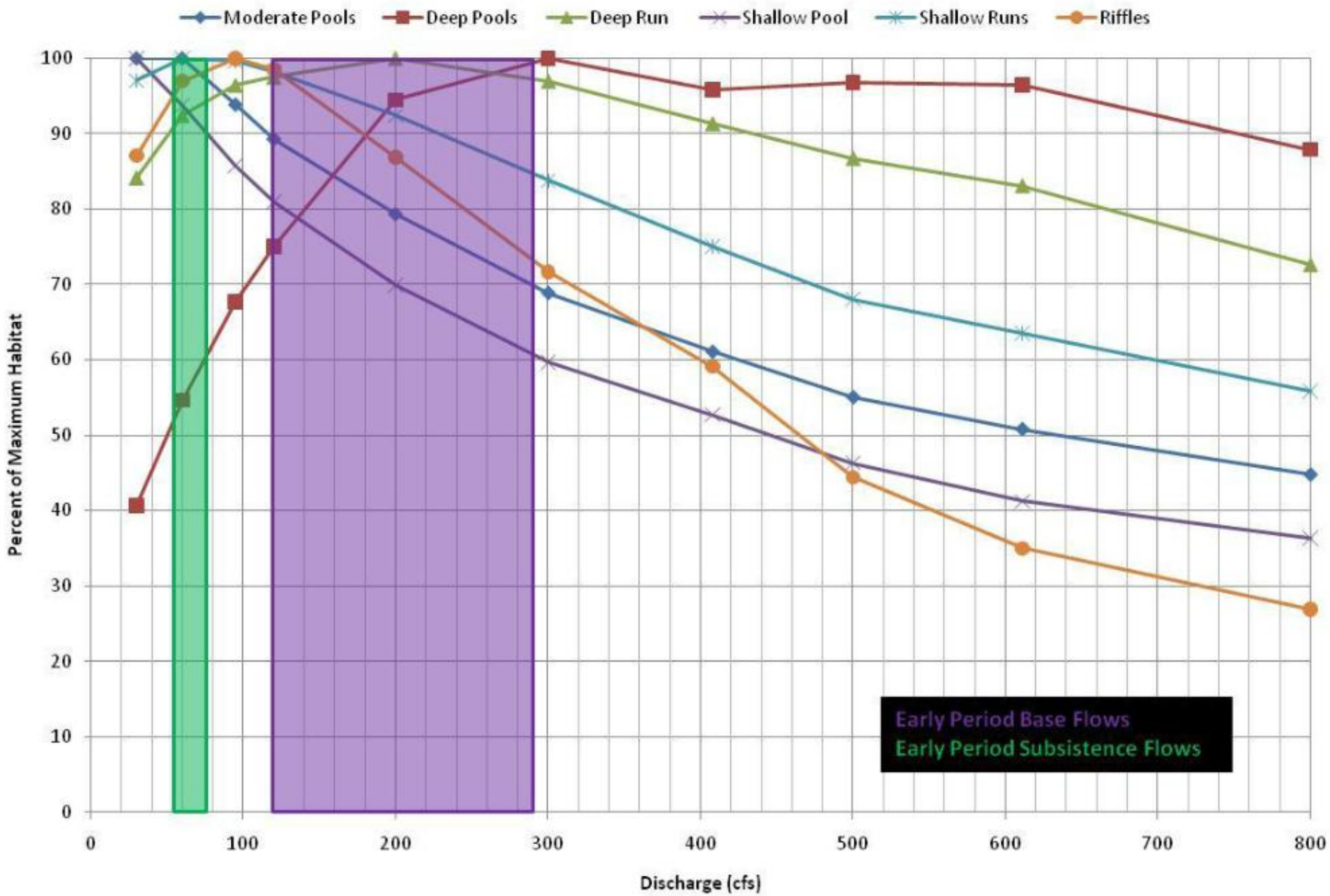
The report does not contain a discussion of how the WUA curves were evaluated or otherwise considered by the BBEST, nor does it explain the logic by which the BBEST defaulted to HEFR-based recommendations.

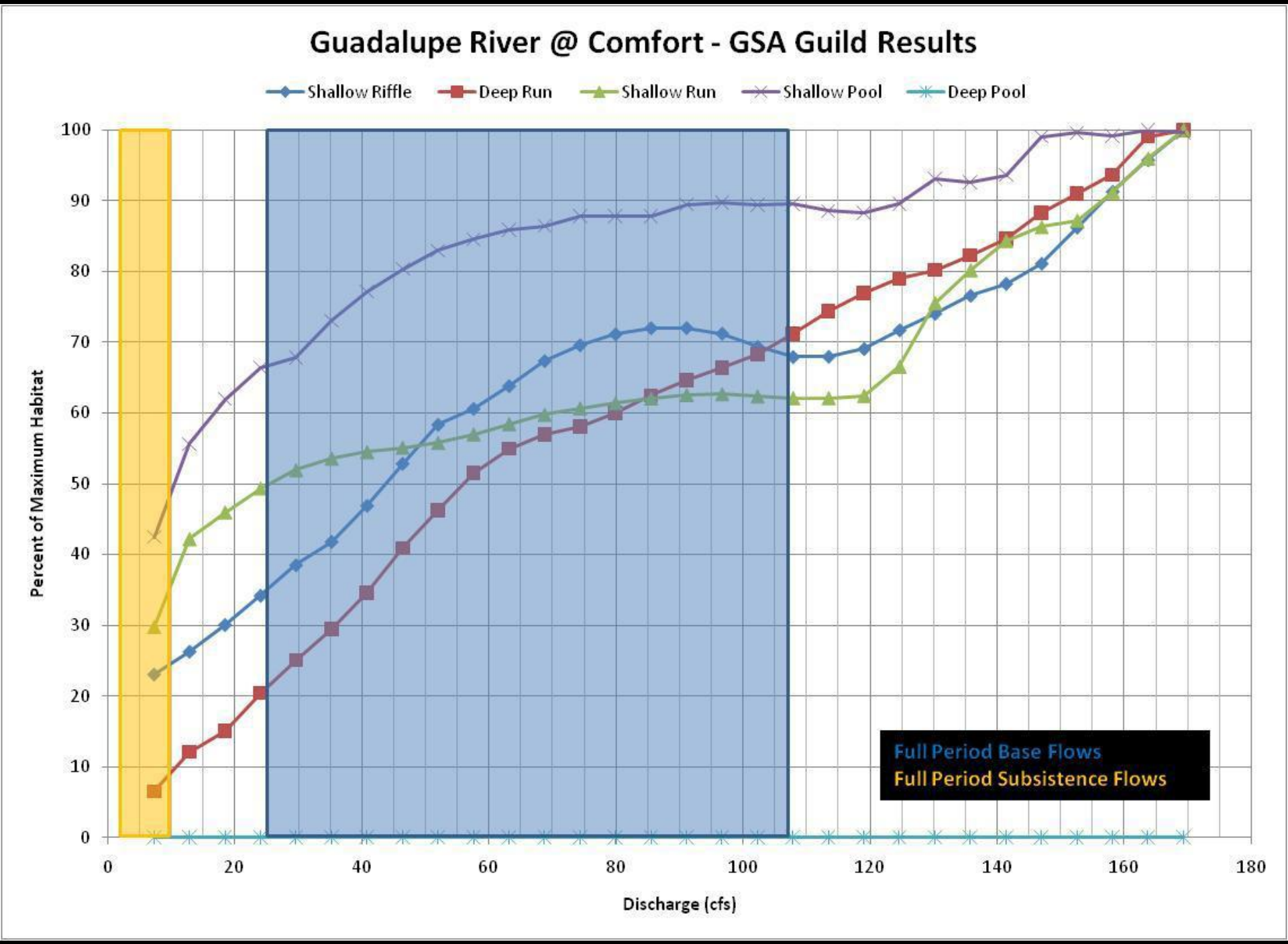
INSTREAM FLOW DETERMINATION




Guadalupe River @ Gonzales - GSA Guild Results
Deep Pool
Moderate Pool
Deep Run
Shallow Run
Riffle
Percent of Maximum Habitat
Discharge (cfs)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Full Period Base Flows
Full Period Subsistence Flows

San Antonio @ Goliad - LSAR Guild Results




Guadalupe River @ Comfort - GSA Guild Results
Shallow Riffle
Deep Run
Shallow Run
Shallow Pool
Deep Pool
Percent of Maximum Habitat
Discharge (cfs)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
Full Period Base Flows
Full Period Subsistence Flows

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

The SAC believes that the WUA methodology and its use should be clearly delineated in the Workplan, its deficiencies noted, and any necessary data collection and methodological revisions, as well as further analysis, should be high-lighted as an important part of future adaptive management strategy.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

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The overlays for instream flows are generally well done.

The water quality analysis is thorough, its presentation succinct, and demonstrates the general high quality of river water in the basin, even under low-flow conditions.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

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The riparian overlay is a well-written discourse on the vegetation of the riparian community and its dependence upon river flow. Its greatest weakness is the much greater proportion of text of a general and tutorial nature compared to information specific to the basin.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

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The BBEST notes (p 3.123) that riparian field data from the basin are still in the process of analysis. In its present state, this section is inconclusive and did not affect the decision path for flow recommendations. However, information such as Figs. 3.6-14 and 3.6-15, and Table 3.6-6 beg to be populated with real data specific to the basin including topography and associated inundation stages.

Table 3.6.6. Documented woody vegetation species within riparian surveys in Guadalupe/San Antonio/Mission river systems. National Wetland Indicator abbreviations and associated probability of being located in a wetland: OBL – obligate (>99%), FACW (99<66%), FAC (66<33%), FACU (33<1%), UPL <1%), + (usually at higher end of range), - (usually at lower end of range) (Reed 1988). Color spectrum refers to Figure 14; G – Guadalupe River surveys (TWDB, unpubl. data), S – San Antonio River Surveys (TIFP and TPW, unpubl. data), M - Mission River (Davis, unpubl. data).

OBL	FACW+	FACW	FACW-	FAC+	FAC	FAC-	FACU+	FACU	FACU-	UPL
G S	G S M	M	G S M	G S M	G S	G S	G S M	M	G S M	G S M
Bald Cypress	Black Willow	Dwarf Palmetto	Box Elder	Pecan	American Elm	Bur Oak	Chinese Tallow	Huisache	Western Soapberry	Acacia
G S M			G M	G S	G S M	G M	S M	G M		G M
Buttonbush			Deciduous Holly	Red Oak	Cedar Elm	Yaupon	Live Oak	Red Mulberry		Anaqua
			G S M	G S	G S M			G S		G
			Green Ash	Sycamore	Cottonwood			Red Oak		Ashe Juniper
			M		M			G		M
			Retama		Mexican Ash			White Mulberry		Brasil
					G					G S M
					Roughleaf Dogwood					Chinaberry
					G					M
					Roosevelt Weed					Colima
					G S M					G M
					Sugar Hackberry					Desert Hackberry
					G M					G
					Texas Hawthorn					Flameleaf Sumac
					G M					G M

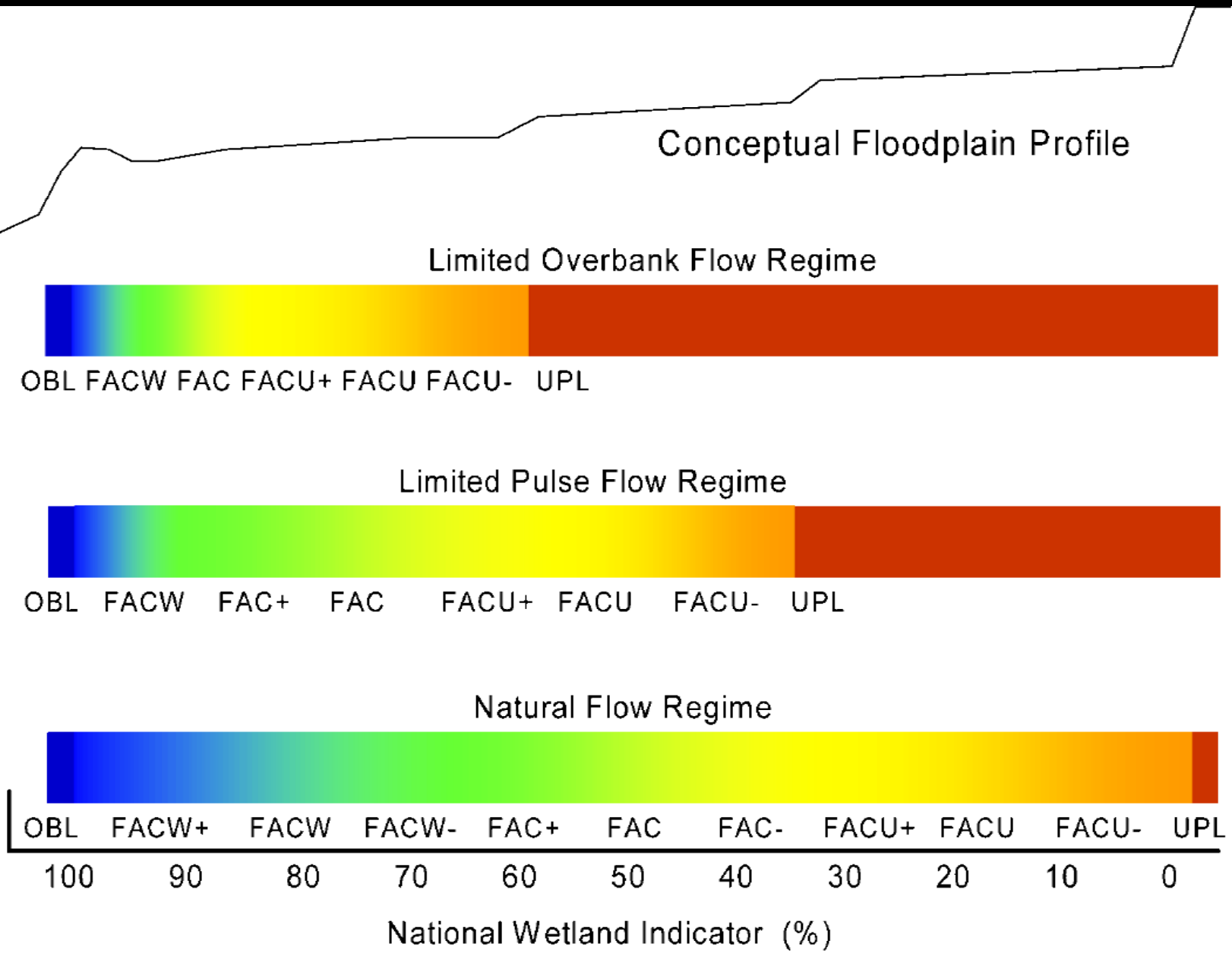


Figure 3.6.13. Conceptual diagram of distribution of vegetation arranged by National Wetland Indicator designation across the floodplain profile (see Table 6 for definitions) for natural, limited pulse, and limited overbank flow regimes.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

The geomorphology analysis is a sediment transport modeling exercise. The BBEST concludes that the channel will remain stable (i.e., not change) so long as sediment load does not change more than 10%. This is based on one didactic reference, in which the 10% limit is suggested without observational basis or literature citation, hardly the "preponderance of … published scientific literature" claimed.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

The report appears ambiguous on whether the geomorphology overlay is incorporated into the environmental flow recommendations. In Section 6.1, only the HEFR-based regime tables are presented, with no additional conditions. Yet in Section 6.4, addressing hypothetical projects, there are discussions as to how the project might be modified to bring the change in sediment load to within the 10% range.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

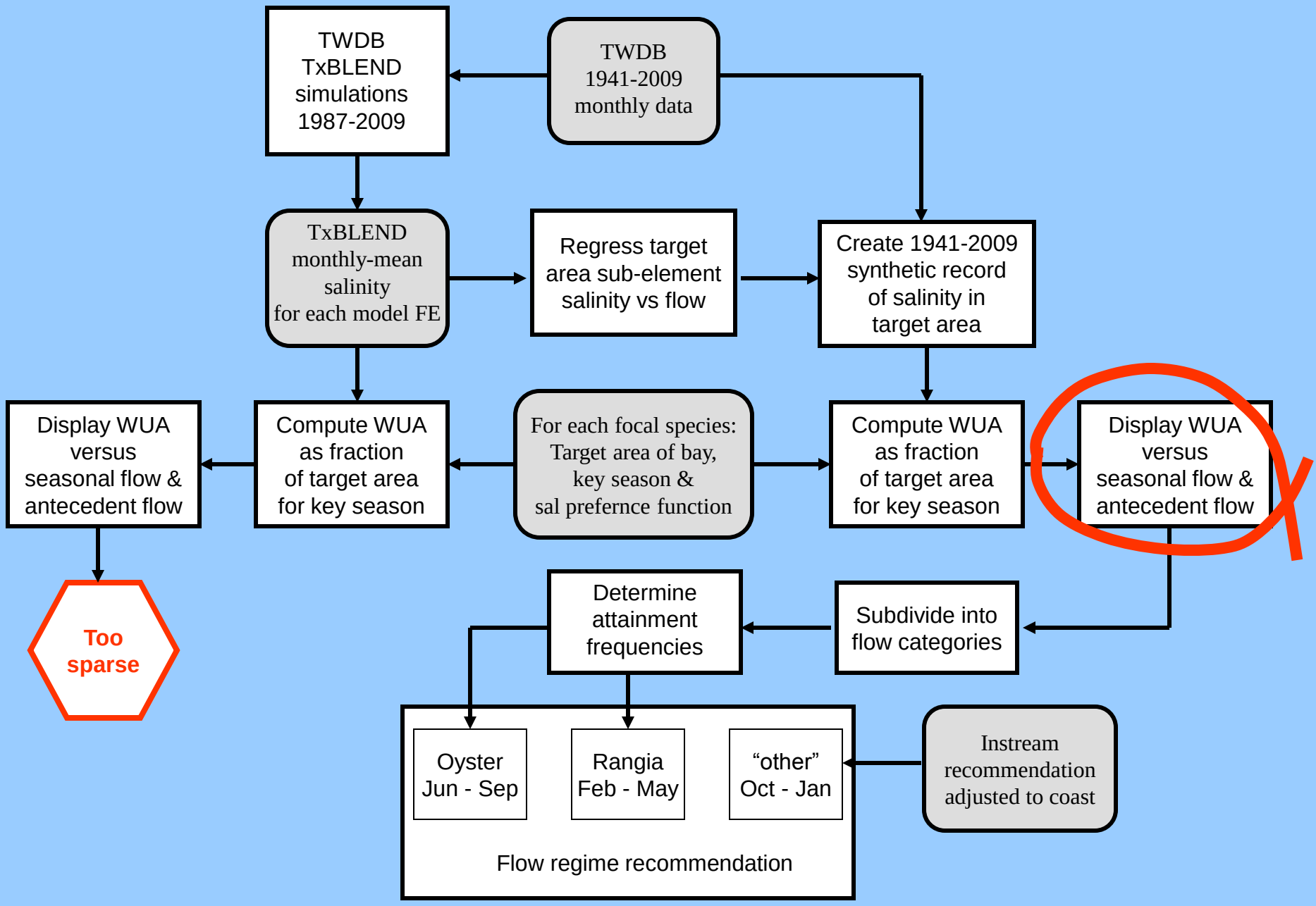
The SAC feels that the BBEST should clarify for the stakeholders and TCEQ whether this and any other additional conditions are to be applied to the flow recommendations.

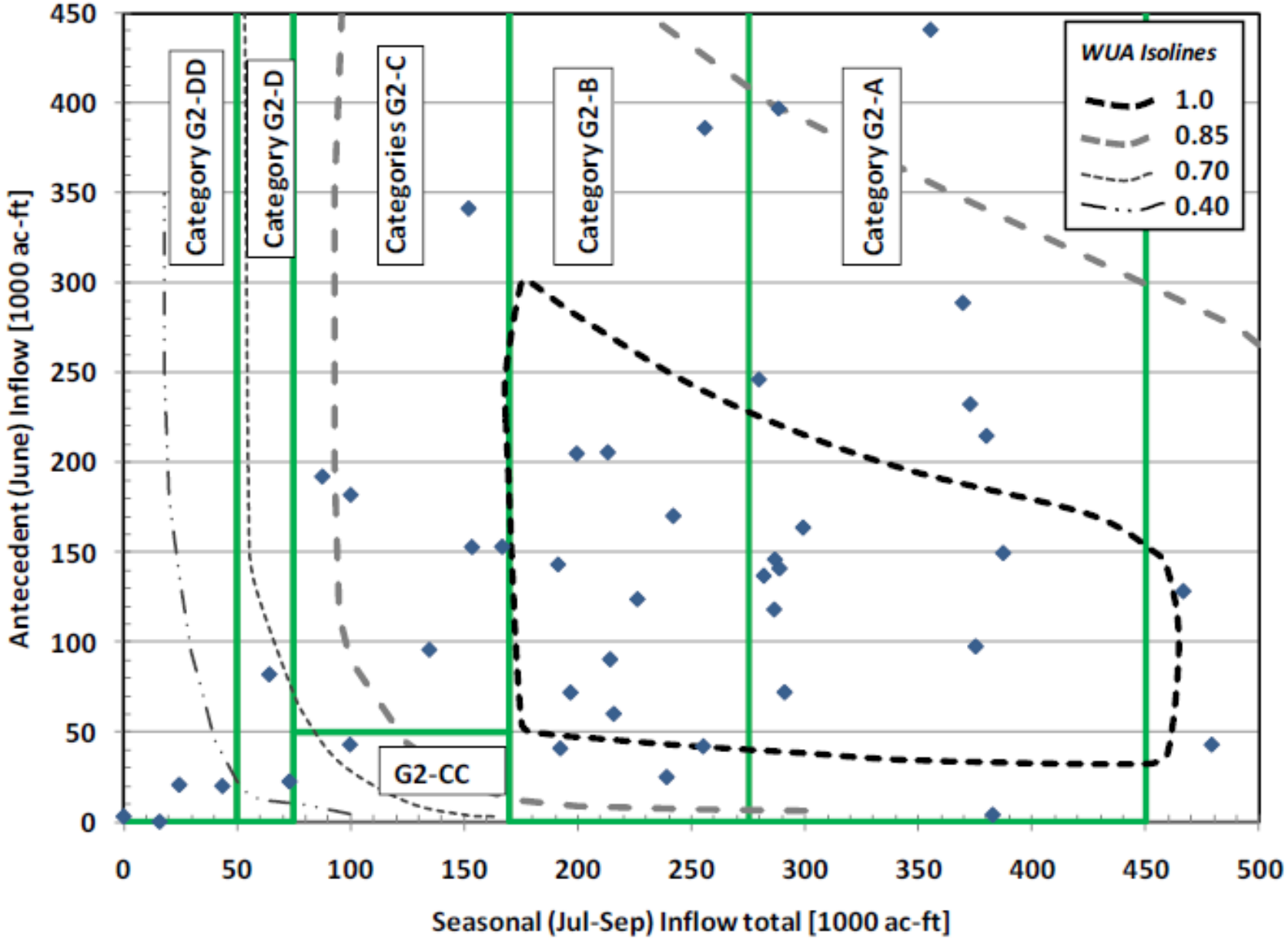
2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

For the estuary, an extensive analysis was carried out for occurrence of salinity preference as a function of inflows. The focal organisms oyster and *Rangia* primarily defined the regime, though other organisms were used as overlays.

ESTUARY INFLOW DETERMINATION




Category G2-DD
Category G2-D
Categories G2-C
Category G2-B
Category G2-A
G2-CC
WUA Isolines
1.0
0.85
0.70
0.40
Antecedent (June) Inflow [1000 ac-ft]
Seasonal (Jul-Sep) Inflow total [1000 ac-ft]
0
50
100
150
200
250
300
350
400
450
500

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.5 Was a functional relationship between flow regimes and ecological health developed, or were proxy variables used? Are assumptions underlying the methodology clearly stated? To what extent were overlays addressed?

The recommendations are presented as seasonal flows with associated attainment-frequency goals. These will not be directly applicable to operational use, but would be employed in long term simulations to determine the effect (e.g. achievement of recommended attainment frequencies) of a proposed diversion or impoundment.

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.6 Was a sound ecological environment demonstrated to be achieved under the recommended flow regime?

No. However, to a certain extent, this was moot, since the systems were determined to be presently healthy, and the recommendation was to revert to historical-data-based flows (HEFR statistics for the instream flows and historical frequencies of flows that achieve target salinity zones for the estuary).

2. Did BBEST perform an analysis resulting in an e-flow regime adequate to support a sound ecological environment and to maintain productivity, extent and persistence of key aquatic habitats in and along the affected water bodies?

2.7 Is uncertainty in the analyses described/quantified? Was the extent of model validation and associated predictive errors described and quantified ?

We acknowledge the attempt by the BBEST to address the issue of uncertainty at various places in the report, albeit largely qualitative. Uncertainty in these analyses is important, and we appreciate the suggestions for future studies, etc. which might ameliorate some of the inherent uncertainty. It would have been helpful if known uncertainty had been presented as a quantified qualifier to the recommended regime.

Summary and Conclusions

In many respects, the Guadalupe/San Antonio BBEST was the best-prepared of all to undertake this assignment.

A high proportion of its members had previous experience addressing the nuances of environmental flow analyses, including some with prior BBEST experience; the information bases for both the basin and bay are especially rich, members of the BBEST being among the principal contributors; and SB2 studies were underway within the basin to provide a source for detailed field observations.

In addition, the BBEST was provided substantial staff support from TWDB, TPWD, TCEQ, SARA, SAWS and GBRA.

It is sobering that the best-equipped BBEST thus far could not make a quantifiable recommendation founded upon a clear connection between levels of flow and metrics of ecosystem health that could be defended as adequate, which is the goal of Senate Bill 3 with regard to the BBEST charge, and instead recommended little, if anything, more than default HEFR flow regimes based on historical hydrology.

It is the SAC's opinion that the BBEST has achieved excellence in its report, except for the following items that are of concern:

- While an impressive body of technical work on WUA's of important guilds has been developed, there is no logical connection presented between these results and the (default) HEFR flows ultimately recommended

- The variety of relationships displayed between the WUA's and the range of baseflows raises the question: **what kind of relationship would be necessary to yield a flow recommendation different from HEFR** ?

- In the estuary, a convincing presentation of the dependence of preferable salinities on the inflows was made for each of the focal species. However, the attainment frequency for each of these was essentially the historical statistics, equivalent to the historical occurrence of the corresponding flow classes

Much new analysis was developed by this BBEST of potentially great value in future environmental flow studies in this basin.

Inclusion of Chapter 7 introducing potential content of a work plan for the basin is appreciated.

It is probable that the work of the BBEST was more complete than its report would suggest.

That the BBEST report falls short of the potential is an indication of the difficulty of the SB3 task, the complexity of the present state of the science, and the limitations of resources and time within which the BBEST must work.

AGENDA ITEM VI

BBASC Questions Regarding BBEST Recommendations and SAC and TPWD Comments – Sam Vaugh

a. Instream BBEST Subcommittee – Dr. Thomas Hardy and Ed Oborny
b. Estuary BBEST Subcommittee – Dr. Norman Johns and Dr. George Ward

AGENDA ITEM VII

Progress Report on Bay and Estuary Time Series Analysis, Ecological Impacts –

Dr. Norman Johns

AGENDA ITEM VIII

Technical Evaluations of Application of BBEST Flow Recommendations on New Run-of-River Permits – Sam Vaugh, HDR

Guadalupe, San Antonio, Mission, & Aransas Rivers and Mission, Copano, Aransas, & San Antonio Bays Basin and Bay Area Stakeholder Committee (GSA BBASC)

Technical Analyses of GSA BBEST Recommendations – Part 3: Run-Of-River Diversions

Brian Perkins, PE
Ed Oborny

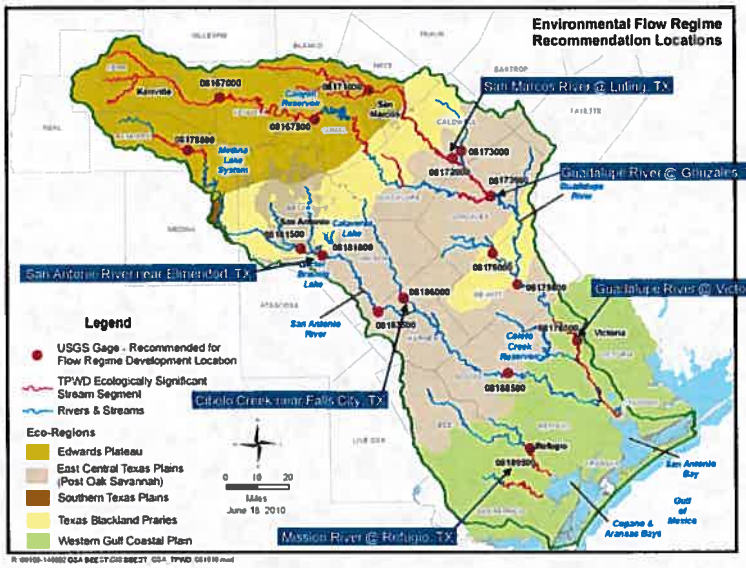
May 4, 2011

Presentation Format

1) Project Description
2) Project Hydrology: Availability for Diversion
3) Instream Ecology
4) Questions / Clarifications
5) Discussion by the BBASC

2

Run-Of-River Diversion Locations



3

Descriptions

- Desired Run-Of-River Diversions of 10,000 acft/yr
- Uniform Diversion of Streamflow When Available, Subject to Downstream Senior Water Rights and Environmental Flow Criteria

- Scenarios:
  - No Environmental Flow
  - Lyons Method
  - BBEST Recommendations (Subsistence and Baseflow Only)

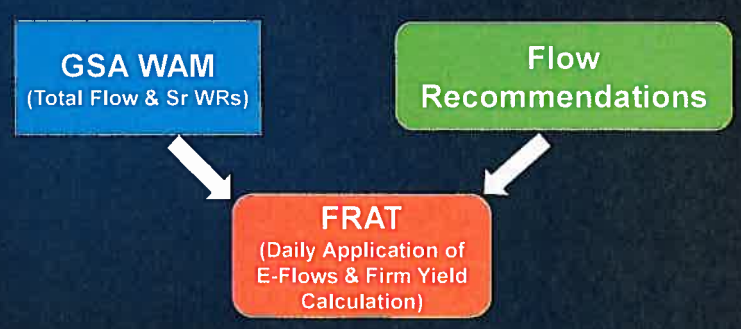
4

Run-Of-River Diversions

- No Environmental Flow
  - Theoretical maximum diversion subject to downstream senior water rights only.
- Lyons Method
  - TCEQ desktop environmental flow used in permitting. Uses 40% (Oct – Feb) and 60% (Mar – Sept) of monthly medians as flow criteria.
- BBEST Recommendations (Subsistence and Baseflow Only)
  - Subsistence and Baseflow components from the recommended flow regime from the GSA BBEST Recommendation.

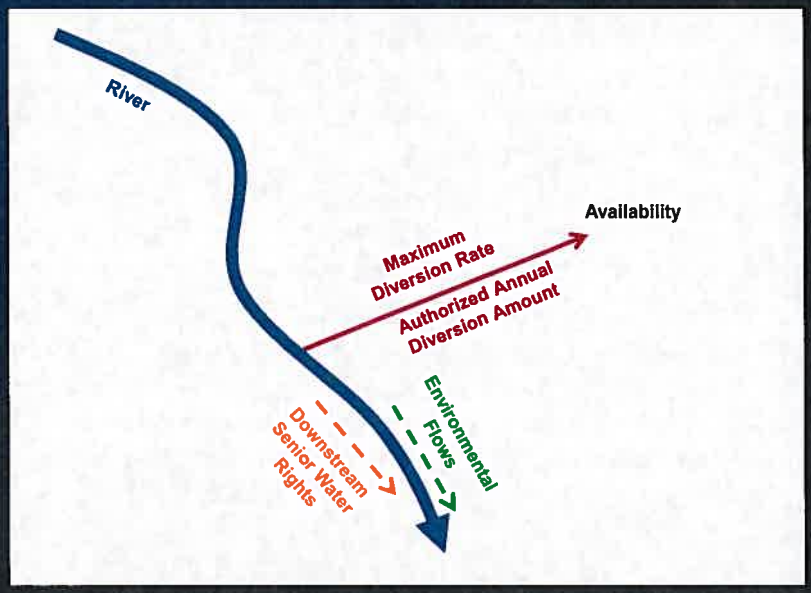
5

Run-Of-River Diversions



6

Run-Of-River Diversions



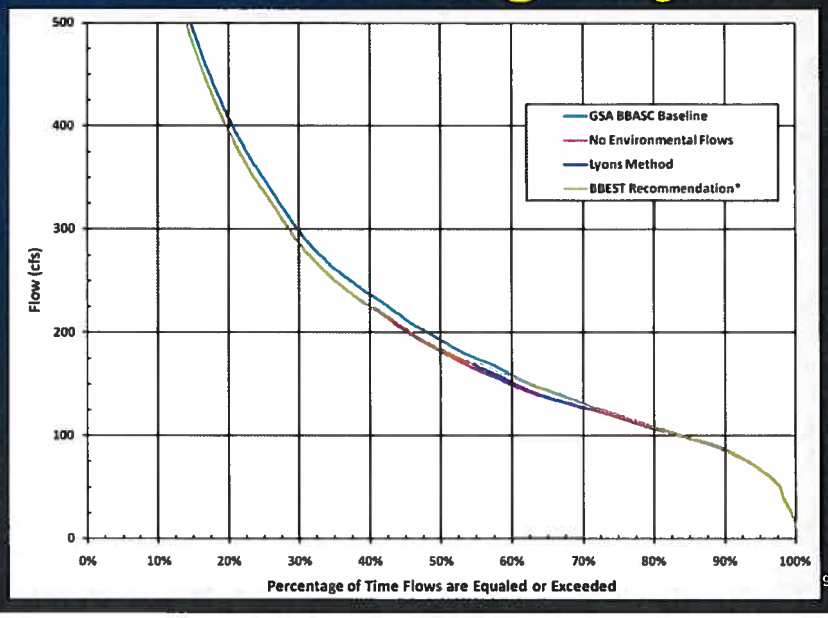
7

Run-Of-River Diversions – San Marcos River @ Luling

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	10,000	10,000	10,000
Average Annual Diversion (acft/yr)	6,161	5,542	5,015
Minimum Annual Diversion (acft/yr)	0	0	0
Monthly Reliability	56.6%	45.8%	37.0%
Daily Reliability	57.9%	52.8%	46.1%

8

Run-Of-River Diversions – San Marcos River @ Luling



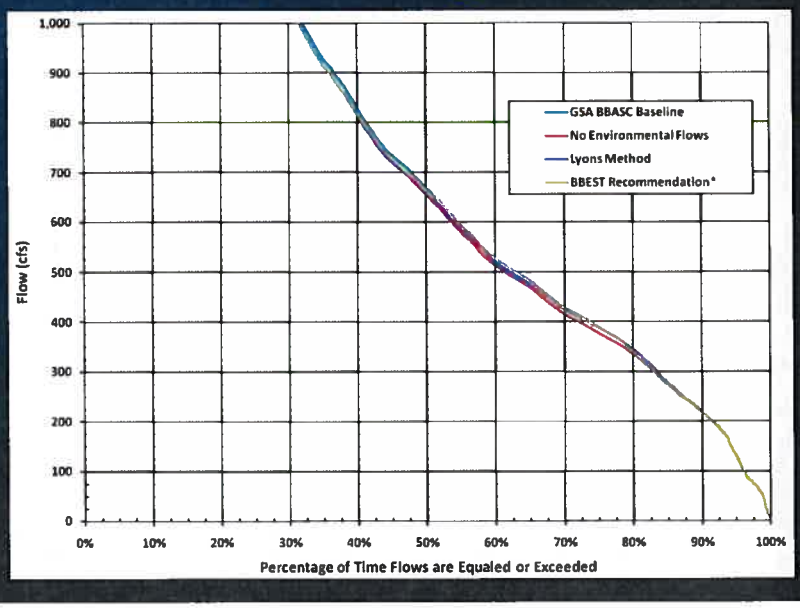
9

Run-Of-River Diversions – Guadalupe River @ Gonzales

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	10,000	10,000	10,000
Average Annual Diversion (acft/yr)	8,130	5,997	5,128
Minimum Annual Diversion (acft/yr)	54	10	22
Monthly Reliability	80.1%	49.5%	38.1%
Daily Reliability	80.4%	58.5%	49.8%

10

Run-Of-River Diversions – Guadalupe River @ Gonzales



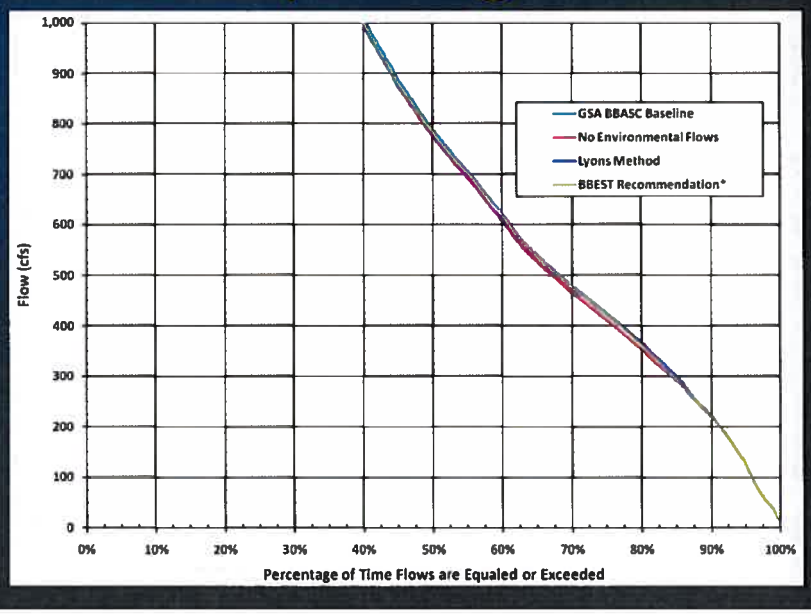
11

Run-Of-River Diversions – Guadalupe River @ Victoria

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	10,000	10,000	10,000
Average Annual Diversion (acft/yr)	8,547	6,273	5,831
Minimum Annual Diversion (acft/yr)	584	82	311
Monthly Reliability	85.0%	48.3%	42.0%
Daily Reliability	85.3%	62.2%	57.0%

12

Run-Of-River Diversions – Guadalupe River @ Victoria



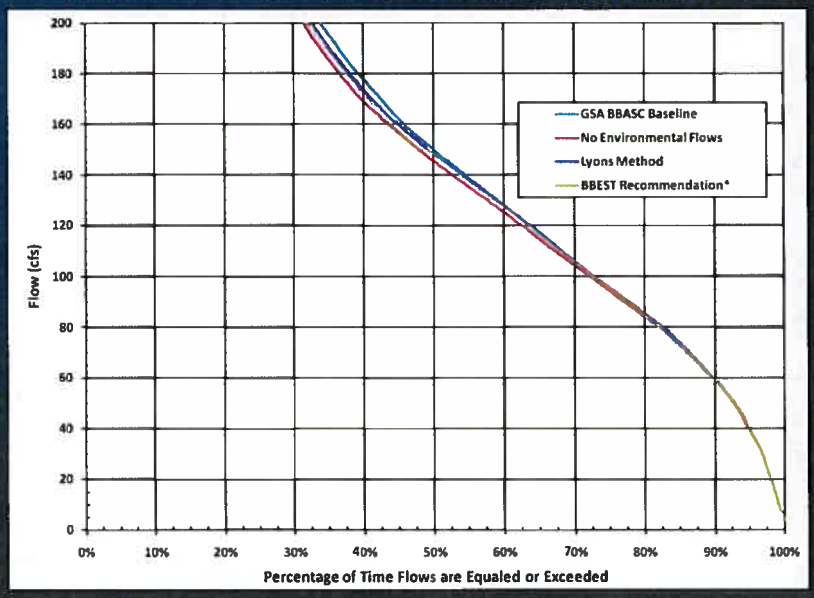
13

Run-Of-River Diversions – San Antonio River near Elmendorf

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	10,000	10,000	9,368
Average Annual Diversion (acft/yr)	4,437	3,066	3,797
Minimum Annual Diversion (acft/yr)	0	0	0
Monthly Reliability	41.2%	18.7%	24.7%
Daily Reliability	42.4%	29.2%	35.2%

14

Run-Of-River Diversions – San Antonio River near Elmendorf



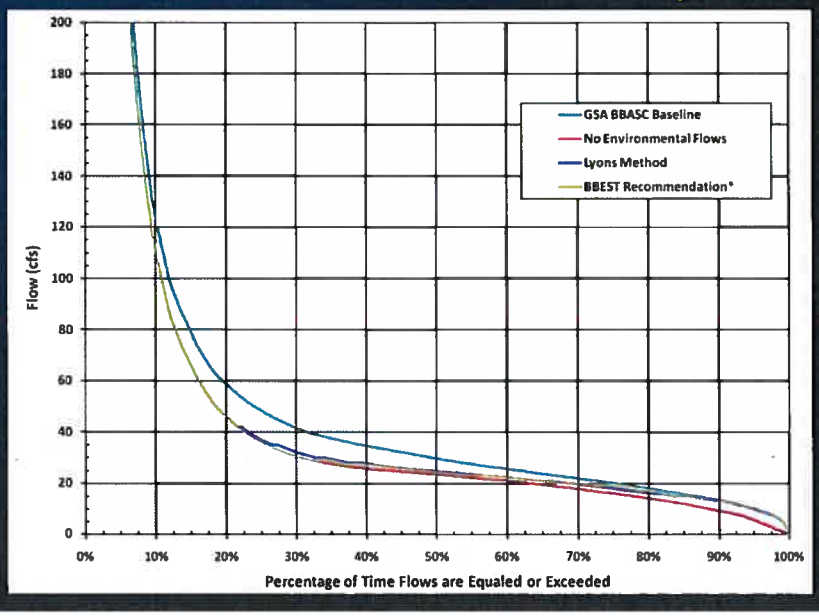
15

Run-Of-River Diversions – Cibolo Creek near Falls City

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	9,598	9,559	9,509
Average Annual Diversion (acft/yr)	5,575	4,440	4,676
Minimum Annual Diversion (acft/yr)	204	82	133
Monthly Reliability	32.7%	16.2%	15.0%
Daily Reliability	42.6%	32.9%	33.2%

16

Run-Of-River Diversions – Cibolo Creek near Falls City



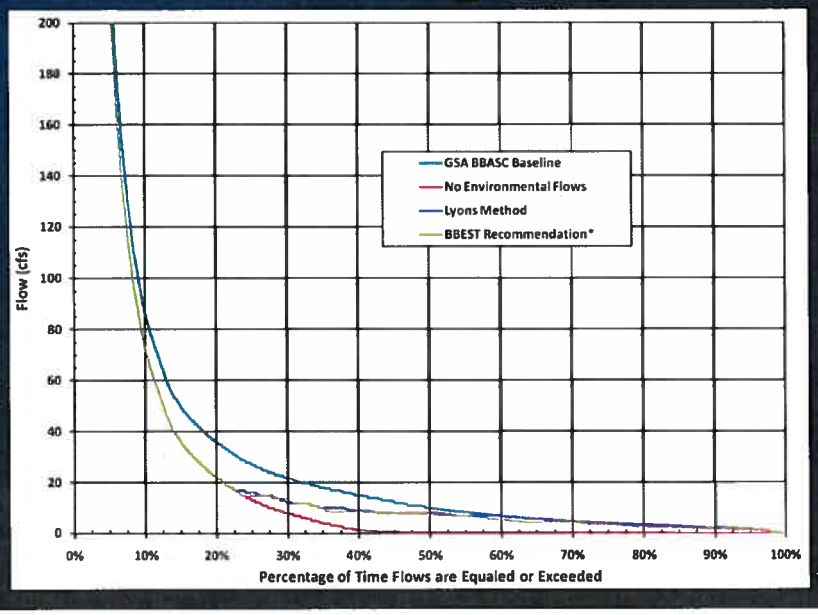
17

Run-Of-River Diversions – Mission River @ Refugio

	No Environmental Flow	Lyons Method	BBEST Recommendation
Maximum Annual Diversion (acft/yr)	10,000	9,699	9,896
Average Annual Diversion (acft/yr)	6,039	3,605	3,852
Minimum Annual Diversion (acft/yr)	0	0	0
Monthly Reliability	25.1%	11.7%	11.3%
Daily Reliability	44.6%	29.6%	30.2%

18

Run-Of-River Diversions – Mission River @ Refugio



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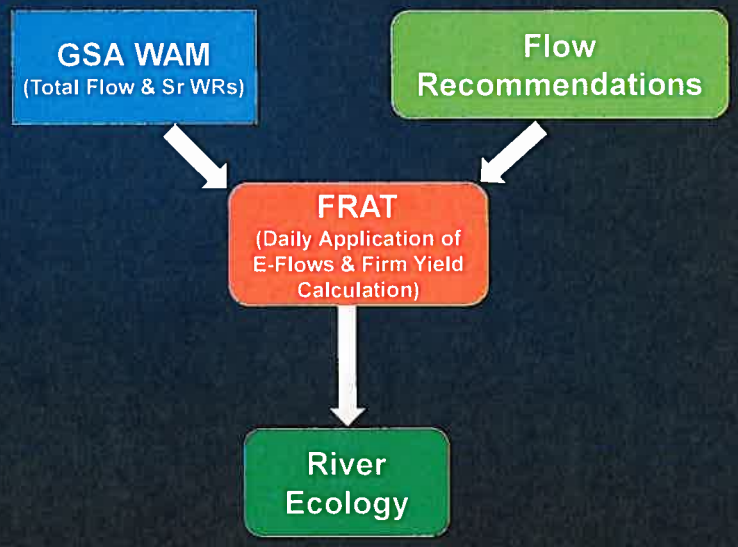
Run-Of-River Diversions



20

Run-Of-River Diversions

BIO-WEST
Presentation

21

Questions, Comments, & Discussion

22

AGENDA ITEM IX

Follow-Up on BBASC Balancing Analysis Requests Regarding Flow Recommendations Relating to Water Supply Projects – Sam Vaugh, HDR

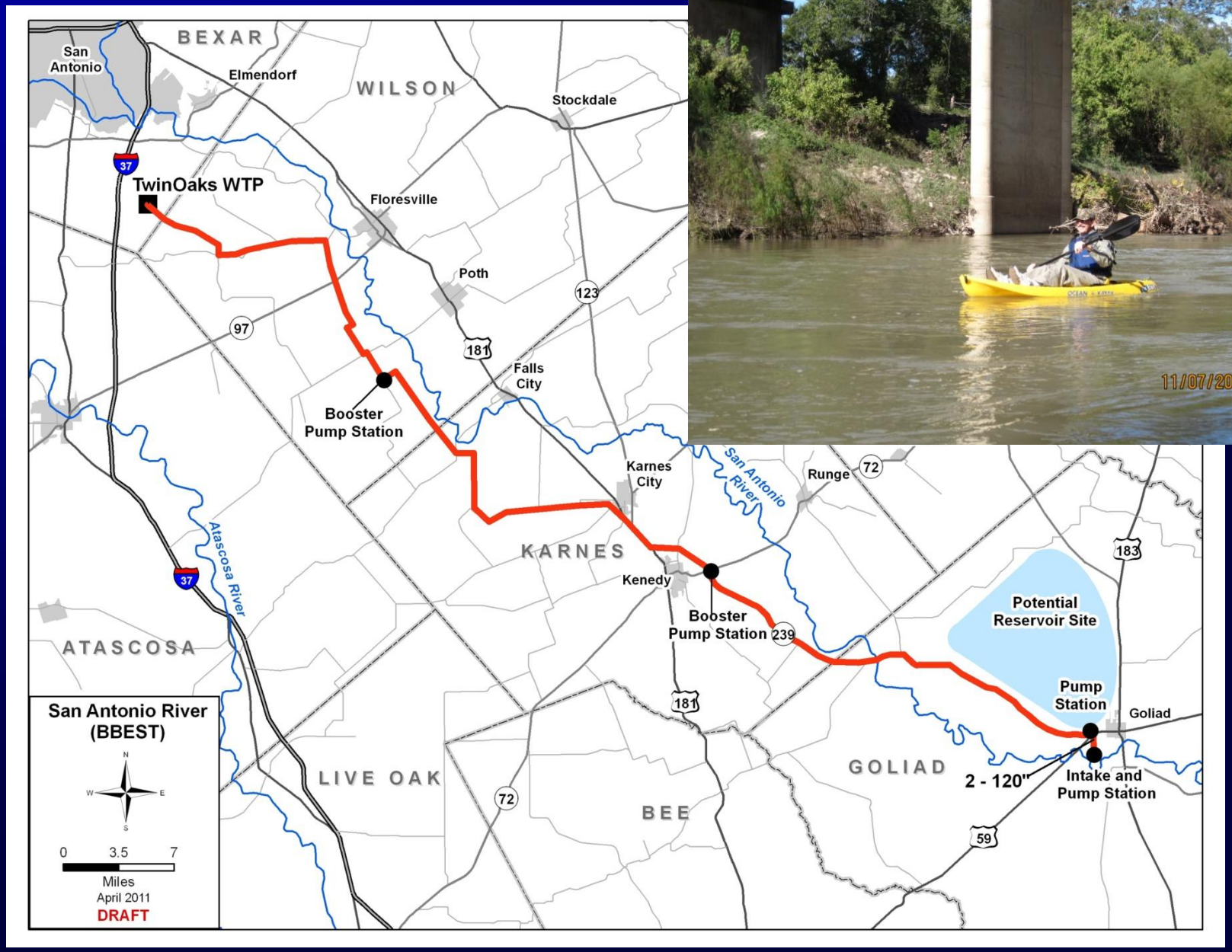
Guadalupe, San Antonio, Mission, & Aransas Rivers and Mission, Copano, Aransas, & San Antonio Bays Basin and Bay Area Stakeholder Committee (GSA BBASC)

Technical Analyses of GSA BBEST Recommendations: Two Firm Yield Projects

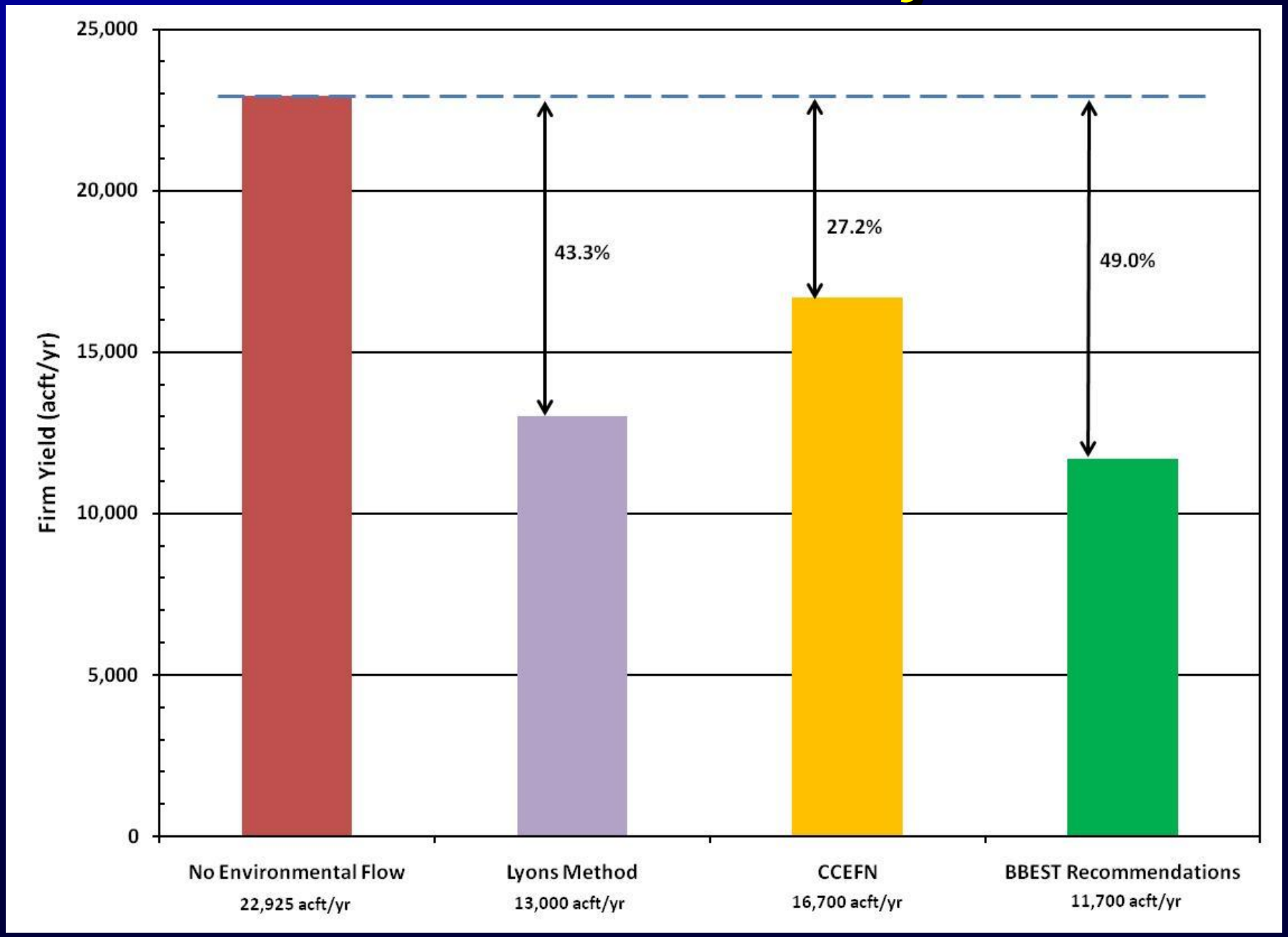
Sam Vaugh, PE

May 19, 2011

San Antonio River Project



San Antonio River Project



San Antonio River Project

	No Environmental Flow	Lyons Method	CCEFN	BBEST Recommendation
Available Project Yield (acft/yr)	22,925	13,000	16,700	11,700
Raw Water at Reservoir				
Total Project Cost	$273,450,000	$273,450,000	$273,450,000	$273,450,000
Total Annual Cost	$24,560,000	$24,378,000	$24,396,000	$24,232,000
Annual Cost of Raw Water ($ per acft)	$1,071	$1,875	$1,461	$2,071
Annual Cost of Raw Water ($ per 1,000 gallons)	$3.29	$5.75	$4.48	$6.36
Treated Water Delivered				
Total Project Cost	$523,535,000	$440,614,000	$471,271,000	$432,205,000
Total Annual Cost	$54,793,000	$44,634,000	$48,586,000	$43,006,000
Annual Cost of Water ($ per acft)	$2,390	$3,433	$2,909	$3,676
Annual Cost of Water ($ per 1,000 gallons)	$7.33	$10.54	$8.93	$11.28

Note: Costs corrected since May 4 Meeting

San Antonio River Project

Full BBEST Recommendation = 11,720 acft/yr

Overbank Flows	Qp: 23,600 cfs with Average Frequency 1 per 5 years Duration Bound is 69											
	Qp: 10,600 cfs with Average Frequency 1 per 2 years Regressed Volume is 107,000 Duration Bound is 45											
	Qp: 7,680 cfs with Average Frequency 1 per year Duration Bound is 38											
High Flow Pulses	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19			Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24			Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16			Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19		
	Qp: 550 cfs with Average Regressed Volume is 3,940 Duration Bound is 11			Qp: 1,570 cfs with Average Regressed Volume is 11,300 Duration Bound is 16			Qp: 750 cfs with Average Regressed Volume is 4,450 Duration Bound is 10			Qp: 780 cfs with Average Regressed Volume is 5,070 Duration Bound is 11		
Base Flows (cfs)	[illegible]			[illegible]			[illegible]			[illegible]		
Subsistence Flows (cfs)	[illegible]			[illegible]			[illegible]			[illegible]		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

Flow Levels
High (75th %ile)
Medium (50th %ile)
Low (25th %ile)
Subsistence

Notes:

1. Period of Record used: 1/1/1940 to 12/31/1969.
2. Volumes are in acre-feet and durations are in days.

11,720 acft/yr

11,720 acft/yr

12,532 acft/yr

15,120 acft/yr

17,120 acft/yr

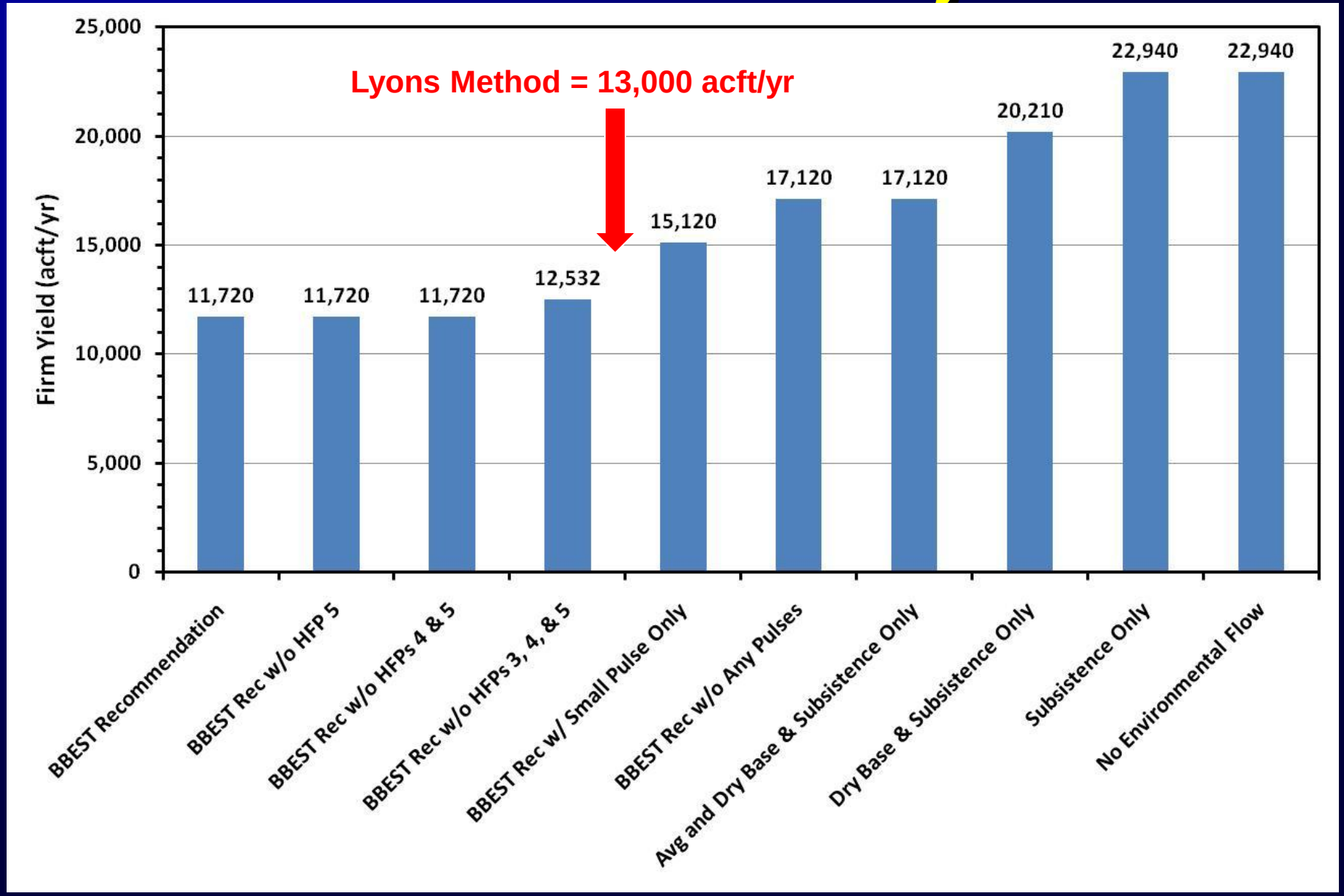
17,120 acft/yr

20,210 acft/yr

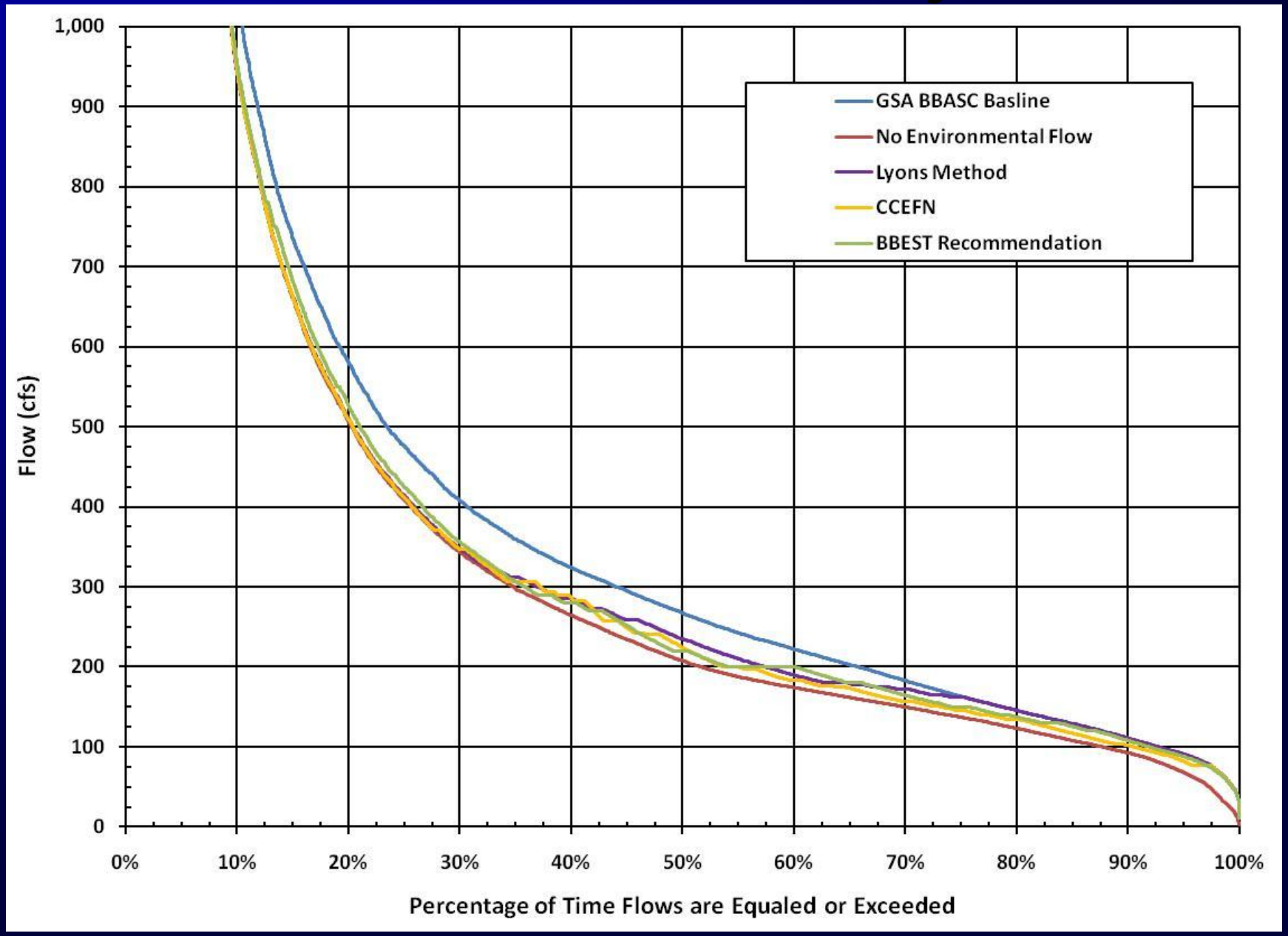
22,925 acft/yr

22,925 acft/yr

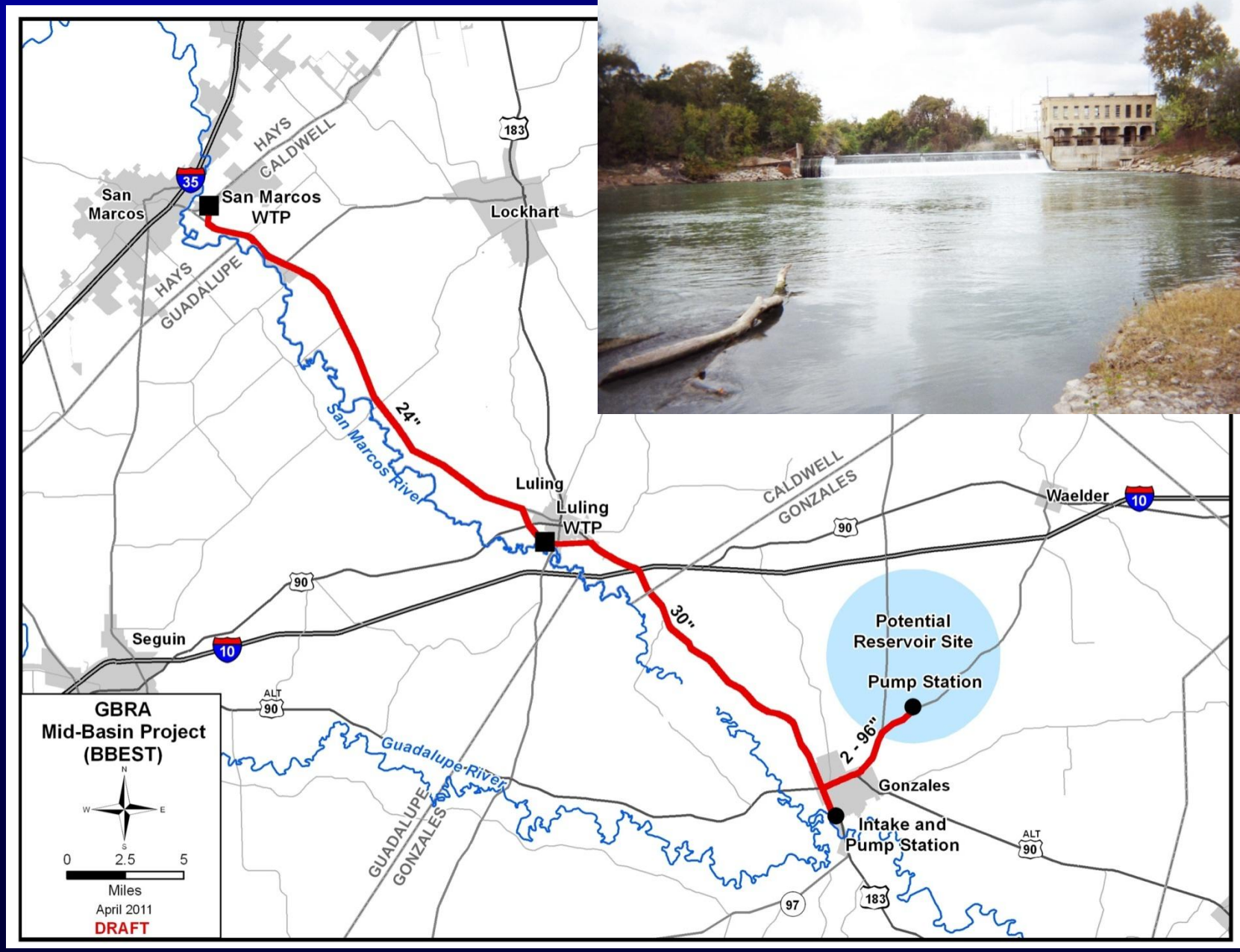
San Antonio River Project



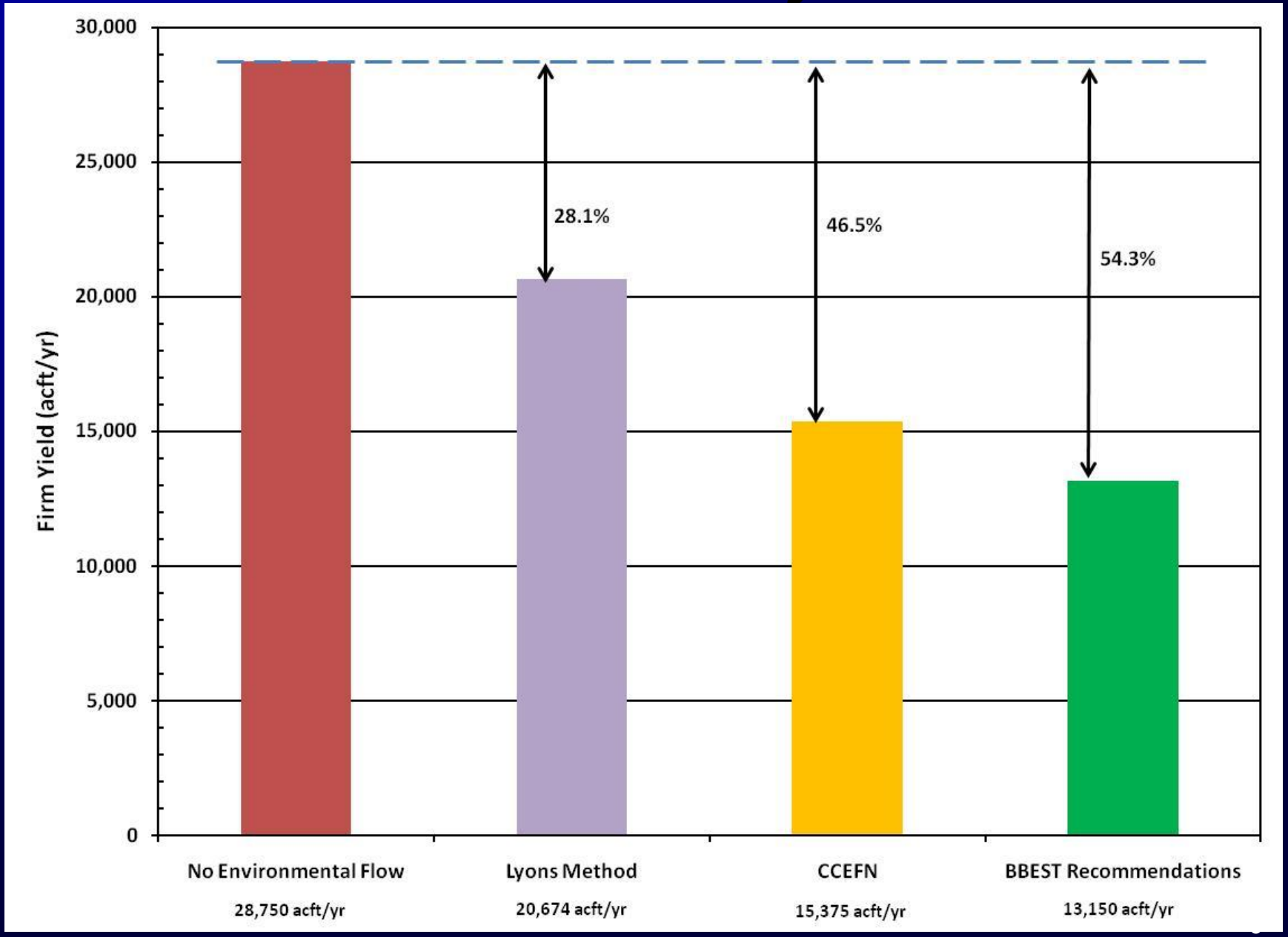
San Antonio River Project



Mid-Basin Project



Mid-Basin Project



Mid-Basin Project

	No Environmental Flow	Lyons Method	CCEFN	BBEST Recommendation
Available Project Yield (acft/yr)	28,750	20,674	15,375	13,150
Raw Water at Reservoir				
Total Project Cost	$253,801,000	$253,801,000	$253,801,000	$253,801,000
Total Annual Cost	$22,908,000	$22,854,000	$22,636,000	$22,563,000
Annual Cost of Raw Water ($ per acft)	$797	$1,105	$1,472	$1,716
Annual Cost of Raw Water ($ per 1,000 gallons)	$2.45	$3.39	$4.52	$5.27
Treated Water Delivered				
Total Project Cost	$475,090,000	$413,942,000	$384,892,000	$369,922,000
Total Annual Cost	$49,713,000	$42,891,000	$38,912,000	$37,123,000
Annual Cost of Water ($ per acft)	$1,729	$2,075	$2,531	$2,823
Annual Cost of Water ($ per 1,000 gallons)	$5.31	$6.37	$7.77	$8.66

Note: Costs corrected since May 4 Meeting

Mid-Basin Project

- How Big Does the Reservoir Need to Be to Get the Same Firm Yield of Lyons? And What's the Cost?

	105,500 acft Lyons Method	191,500 acft BBEST Recommendation*
Available Project Yield (acft/yr)	20,674	20,674
Raw Water at Reservoir		
Total Project Cost	$253,801,000	$279,391,000
Total Annual Cost	$22,854,000	$24,828,000
Annual Cost of Raw Water ($ per acft)	$1,105	$1,201
Annual Cost of Raw Water ($ per 1,000 gallons)	$3.39	$3.68
Treated Water Delivered		
Total Project Cost	$413,942,000	$441,845,071
Total Annual Cost	$42,891,000	$44,865,622
Annual Cost of Water ($ per acft)	$2,075	$2,170
Annual Cost of Water ($ per 1,000 gallons)	$6.37	$6.66

*Note: *Reservoir size increased to 191,500 acft to achieve same firm yield of Lyons Method*

Mid-Basin Project

Full BBEST Recommendation = 13,150 acft/yr

Overbank Flows	Qp: 36,700 cfs with Average Frequency 1 per 5 years Regressed Volume is [illegible] Duration Bound is 70											
	Qp: 24,400 cfs with Average Frequency 1 per 2 years Regressed Volume is 306,000 Duration Bound is 57											
	Qp: 14,300 cfs with Average Frequency 1 per year Regressed Volume is 165,000 Duration Bound is 43											
High Flow Pulses	Qp: 4,140 cfs with Average Frequency 1 per season Regressed Volume is 48,300 Duration Bound is 29			Qp: 6,590 cfs with Average Frequency 1 per season Regressed Volume is 58,400 Duration Bound is 24			Qp: 1,760 cfs with Average Frequency 1 per season Regressed Volume is 14,800 Duration Bound is 14			Qp: 4,330 cfs with Average Frequency 1 per season Regressed Volume is 41,200 Duration Bound is 23		
	Qp: 1,150 cfs with Average Frequency 1 per season Regressed Volume is 9,640 Duration Bound is 13			Qp: 3,250 cfs with Average Frequency 1 per season Regressed Volume is 26,900 Duration Bound is 17			Qp: 950 cfs with Average Frequency 1 per season Regressed Volume is 7,060 Duration Bound is 10			Qp: 1,410 cfs with Average Frequency 1 per season Regressed Volume is 11,400 Duration Bound is 13		
Base Flows (cfs)	[illegible]			[illegible]			[illegible]			[illegible]		
Subsistence Flows (cfs)	[illegible]			[illegible]			[illegible]			[illegible]		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

13,150 acft/yr

13,150 acft/yr

13,910 acft/yr

15,375 acft/yr

16,790 acft/yr

16,790 acft/yr

25,410 acft/yr

26,600 acft/yr

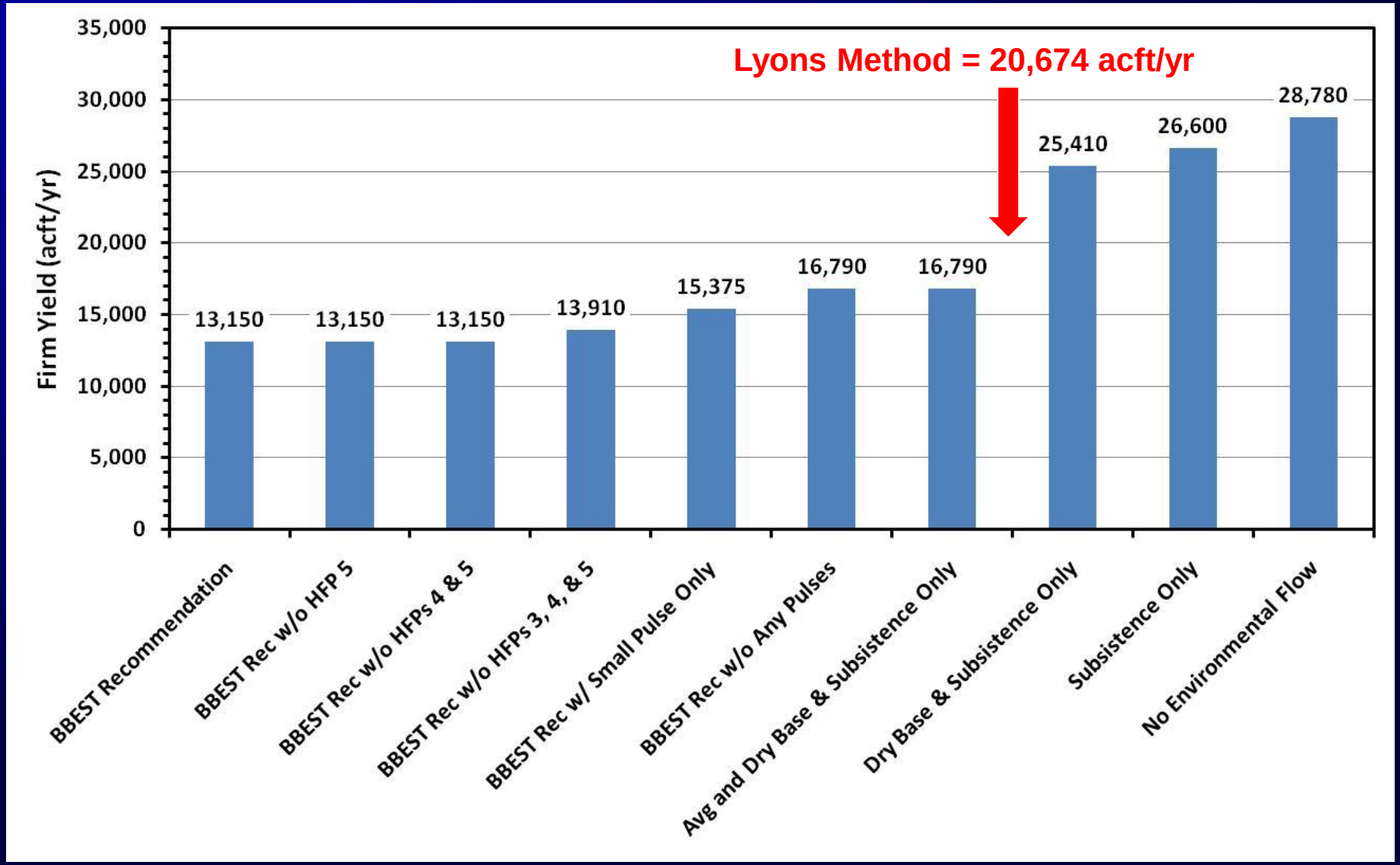
28,750 acft/yr

Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)
	Subsistence

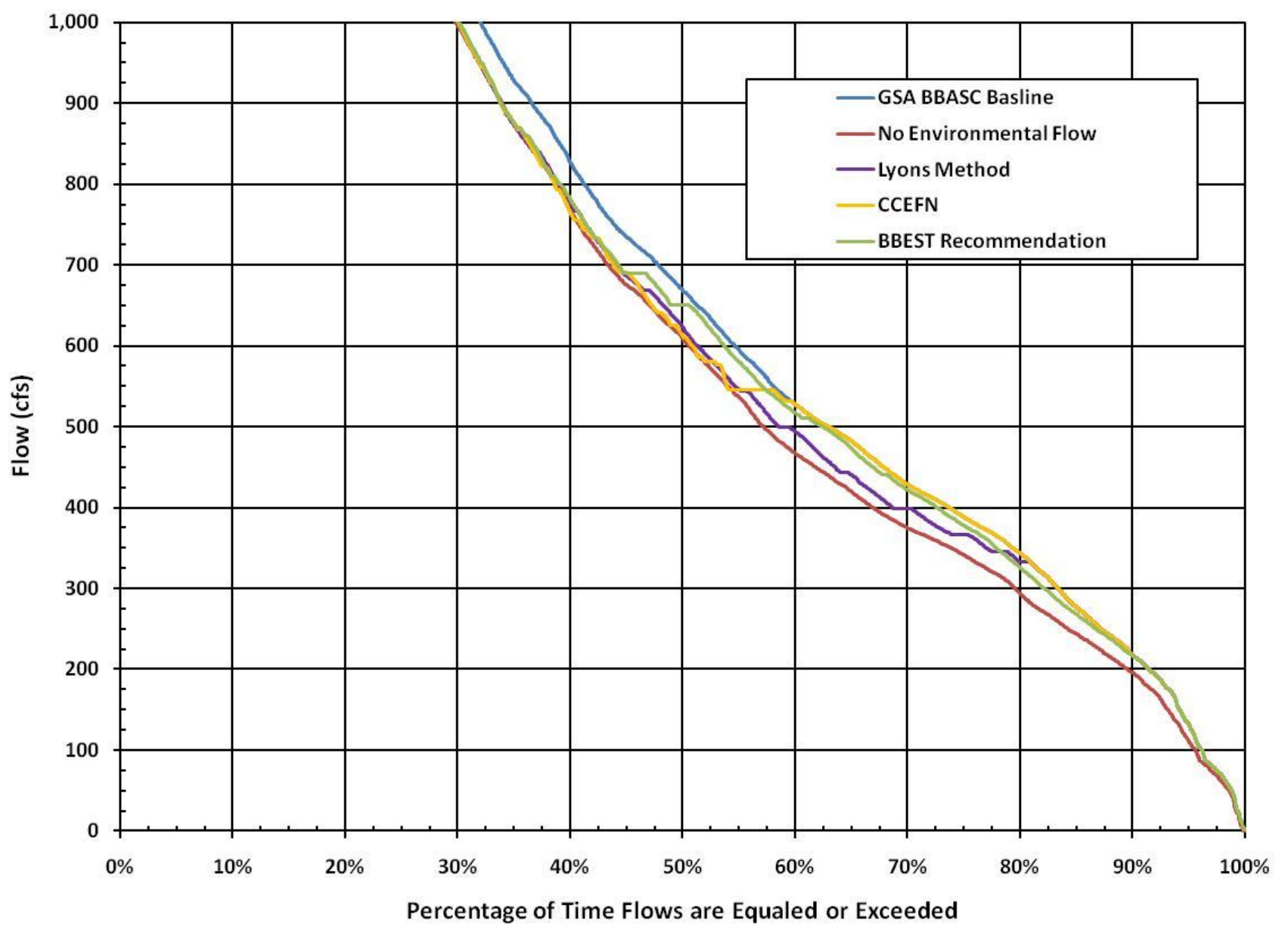
Notes:

1. Period of Record used : 1/1/1940 to 12/31/2009.
2. Volumes are in acre-feet and durations are in days.

Mid-Basin Project



Mid-Basin Project



Questions, Comments, & Discussion

Guadalupe, San Antonio, Mission, & Aransas Rivers and Mission, Copano, Aransas, & San Antonio Bays Basin and Bay Area Stakeholder Committee (GSA BBASC)

Technical Analyses of GSA BBEST Recommendations: Options for Hydrologic Conditions on Pulses

Sam Vaugh, PE

May 19, 2011

Developing Balance – Options

Weighted Too Heavy Toward Human Needs

1) Increase Subsistence Flows
2) Eliminate Diversions Below Baseflows
3) Increase Average or Wet Baseflows
4) Add More Pulses / Increase Pulses
5) Shift Period of Record for Flow Standard Recommendation

Weighted Too Heavy Toward Environmental Needs

1) Eliminate the 50% Requirement between Subsistence & Dry Base
2) Eliminate Wet and/or Average Baseflows
3) Eliminate Some/All Pulses
   - Annual / Multi-Year
   - Seasonal
4) Place Hydrologic Conditions on Pulses
5) Shift Period of Record for Flow Standard Recommendation

Consider TCEQ Adopted Environmental Flow Standards?

Structure of Adopted TCEQ Environmental Flow Standards*

Overbank Flows	Qp: 36,700 cfs with Average Frequency 1 per 5 years Duration Bound is 70											
	Qp: 24,400 cfs with Average Frequency 1 per 2 years Duration Bound is 57											
	Qp: 14,300 cfs with Average Frequency 1 per year Duration Bound is 43											
High Flow Pulses	Qp: 4,140 cfs with Average Frequency 1 per season Regressed Volume is 48,300 Duration Bound is 29			Qp: 6,590 cfs with Average Frequency 1 per season Regressed Volume is 58,400 Duration Bound is 24			Qp: 1,760 cfs with Average Frequency 1 per season Regressed Volume is 14,800 Duration Bound is 14			Qp: 4,330 cfs with Average Frequency 1 per season Regressed Volume is 41,200 Duration Bound is 23		
	Qp: 1,150 cfs with Average Frequency 2 per season Regressed Volume is 9,640 Duration Bound is 13			Qp: 3,250 cfs with Average Frequency 2 per season Regressed Volume is 26,900 Duration Bound is 17			Qp: 950 cfs with Average Frequency 2 per season Regressed Volume is 7,060 Duration Bound is 10			Qp: 1,410 cfs with Average Frequency 2 per season Regressed Volume is 11,400 Duration Bound is 13		
Base Flows (cfs)	540			440			440			510		
Subsistence Flows (cfs)	210			210			210			180		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)
	Subsistence

*Sabine & Neches Rivers and Sabine Lake Bay

Structure of Adopted TCEQ Environmental Flow Standards*

	x1	x2	x1	x2
Pulses	Qp: 1,150 cfs with Average Frequency 2 per season Regressed Volume is 9,640 Duration Bound is 13	Qp: 3,250 cfs with Average Frequency 2 per season Regressed Volume is 26,900 Duration Bound is 17	Qp: 950 cfs with Average Frequency 2 per season Regressed Volume is 7,060 Duration Bound is 10	Qp: 1,410 cfs with Average Frequency 2 per season Regressed Volume is 11,400 Duration Bound is 13
Base Flows (cfs)	540	440	440	510
Subsistence Flows (cfs)	210	210	210	180
	Jan, Feb, Mar	Apr, May, Jun	Jul, Aug, Sep	Oct, Nov, Dec
	Winter	Spring	Summer	Fall

+10%

*Sabine & Neches Rivers and Sabine Lake Bay

Option 1

❑ Wet: HFPs 1, 2, & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
High Flow Pulses	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19	x1
	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x2

❑ Average: HFPs 2 & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
High Flow	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19	x1

❑ Dry: HFPs 1 & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
Pulses	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x2

Option 2

❑ Wet: HFPs 1, 2, & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
High Flow Pulses	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19	x1
	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x1

❑ Average: HFPs 2 & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
High Flow	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19	x1

❑ Dry: HFPs 1 & 3 Only

	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38				x1
Pulses	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x1

Option 3

- Wet: HFPs 1 & 2 Only

High Flow Pulses	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19	x1
	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x2

- Average: HFP 1 Only

Pulses	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x2

- Dry: HFP 1 Only

Pulses	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11	x1

Option 4

- Wet: HFP 2 Only

High Flow	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19	Qp: 3,540 cfs with Average Frequency 1 per season Regressed Volume is 30,000 Duration Bound is 24	Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16	Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19

x1

- Average: HFP 1 Only

High Flow Pulses	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11	Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,070 Duration Bound is 11

x2

- Dry: HFP 1 Only; Spring and Summer Only

High Flow Pulses		Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,300 Duration Bound is 16	Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,450 Duration Bound is 10	

x1

Questions, Comments, & Discussion

AGENDA ITEM X

Discussion Regarding Work Plan Development

a. List of Work Plan Elements
b. Discussion Regarding Creation of a Work Plan Workgroup

5/4/2011 DRAFT

Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin and Bay Area Stakeholders Committee (BBASC)

Work Plan for Adaptive Management

Table of Contents

1 Preamble

1.1 Charge of the Basin and Bay Area Stakeholders Committee
1.2 Science Advisory Committee Guidance
1.3 Introduction

2 Adaptive Management

2.1 Studies Required to Establish Linkages Between Flow and Ecology
2.2 Funding and Resources for Studies
2.3 Mechanisms for Changes in Standards or Strategies

3 Existing Programs and Potential Resources

3.1 Texas Commission on Environmental Quality
3.2 Texas Water Development Board
3.3 Texas Parks & Wildlife Department
3.4 Texas Instream Flows Program
3.5 Additional Programs and Resources

4 Instream Flows – Rivers, Streams, and Tributaries

4.1 Subsistence Flows - Needed Studies, Surveys, and Monitoring Programs
4.2 Base Flows - Needed Studies, Surveys, and Monitoring Programs
4.3 Pulse & Overbank Flows - Needed Studies, Surveys, and Monitoring Programs
4.4 Hydrology – Needed Studies, Surveys, and Monitoring Programs

5 Bays and Estuaries

5.1 Flora and Fauna - Needed Studies, Surveys, and Monitoring Programs
5.2 Sediment Input - Needed Studies, Surveys, and Monitoring Programs
5.3 Nutrient Input - Needed Studies, Surveys, and Monitoring Programs
5.4 Freshwater Inflow - Needed Studies, Surveys, and Monitoring Programs

6 Prioritization and Schedule

Appendices

Section 11.02362 (p) In recognition of the importance of adaptive management, after submitting its recommendations regarding environmental flow standards and strategies to meet the environmental flow standards to the commission, each basin and bay area stakeholders committee, with the assistance of the pertinent basin and bay expert science team, shall prepare and submit for approval by the advisory group a work plan. The work plan must:

1) Establish a periodic review of the basin and bay environmental flow analyses and environmental flow regime recommendations, environmental flow standards, and strategies, to occur at least once every 10 years;

2) Prescribe specific monitoring, studies, and activities; and

3) Establish a schedule for continuing the validation or refinement of the basin and bay environmental flow analyses and environmental flow regime recommendations, the environmental flow standards adopted by the commission, and the strategies to achieve those standards.

Guadalupe, San Antonio, Mission, & Aransas Rivers and Mission, Copano, Aransas, & San Antonio Bays Basin & Bay Area Stakeholders Committee (BBASC)

Work Plan for Adaptive Management

Instream Flows - Rivers, Streams, and Tributaries

		Flow Regime Component				
ID#	**Subject**	**Subsistence**	**Base**	**Pulse**	**Hydrology**	**Source(s)**
1	Impacts of Groundwater Use on Upper Basin Streamflows				X	BBASC
2	Exempt Uses of Surface Water				X	BBASC
3	Riparian Diversions for Domestic & Livestock (D&L) Uses				X	BBASC
4	Effects of Conservation & Drought Management				X	BBASC
5	Predictability in Surface Water Permitting				X	BBASC
6	Intensity & Duration of Floods Affecting Logjams & Habitat			X		BBASC
7	Impacts of Invasive Species			X	X	BBASC
8	Impacts of Groundwater Withdrawn from Alluvial Gravels	X	X		X	BBASC
9	Instream & Riparian Sediment Deposition			X	X	BBASC
10	USGS Streamflow Gaging & Water Quality Monitoring	X	X	X	X	BBEST
11	TCEQ Clean Rivers Program Water Quality Monitoring	X	X	X		BBEST
12	Real Time Monitoring System	X	X	X		BBEST
13	Biological Sampling & Monitoring	X	X	X		BBEST
14	Texas Instream Flows Program	X	X	X	X	BBEST
15	Edwards Aquifer Recovery Implementation Program	X	X		X	BBASC/BBEST
16	Environmental Flow Collaboration Forum	X	X	X	X	BBEST
17	Geomorphic Studies & Monitoring			X	X	BBEST
18	Riparian Vegetation Mapping & Monitoring			X		BBEST
19	Groundwater Monitoring in the Riparian Corridor	X	X	X	X	BBEST
20	Fish Community Use of Floodplain Environments			X		BBEST

Guadalupe, San Antonio, Mission, & Aransas Rivers and Mission, Copano, Aransas, & San Antonio Bays Basin & Bay Area Stakeholders Committee (BBASC)

Work Plan for Adaptive Management

Bays & Estuaries

ID#	Subject	Flora/Fauna	Sediment	Nutrients	Inflow	Source(s)
1	Scouring of Passes & Impacts on Estuarine Ecology	X				BBASC
2	Marine Wetland Effects on Commercial & Recreational Fishing	X				BBASC
3	Impacts of Levees		X		X	BBASC
4	Impacts of Saltwater Barrier		X		X	BBASC
5	Sediment Transport Affecting Guadalupe Delta		X		X	BBASC/BBEST
6	Sea Level Rise Associated with Climate Change				X	BBASC
7	Hydrodynamic & Salinity Modeling Improvements				X	BBEST
8	Bay & Marsh Salinity & Water Level Data Collection & Monitoring				X	BBEST
9	Diversion & Return Flow Data for Freshwater Inflow Estimates				X	BBEST
10	Rangia Clam & Eastern Oyster Investigations	X				BBEST
11	Delta Inundation & Salinity Modeling				X	BBEST
12	Life Cycle Habitat & Salinity Studies for Key Faunal Species	X				BBEST
13	Salinity Sensitive Plant Monitoring	X				BBEST
14	Habitat Suitability Models for Oysters, Blue Crabs, & White Shrimp	X				BBEST
15	Nutrient Load & Concentration Monitoring			X		BBEST

AGENDA ITEM XI

Discussion Regarding West Warren's Resignation from BBASC

May 6th, 2011

Ms. Susan Scott
Chair, BBASC

Dear Susan,

With this letter I am tendering my resignation as a member of the Guadalupe/San Antonio Bay and Basin Area Stakeholders Committee.

My reasons are straightforward and twofold.

- When I accepted the appointment it was with the understanding that this committee would meet bi-monthly. That time commitment has increased now to the point that I cannot sustain continued participation and proper attention to my business at the same time.
- When I accepted the appointment, it was with some expectation that I could contribute meaningfully to the dialogue of the group and ultimately to its mission. It has become increasingly apparent to me that I cannot. I lack any background in scientific or engineering disciplines that are presently pushing the dialogue forward and I am completely uncomfortable weighing in on behalf of Recreational Water Users from a position of ignorance.

I believe the concept of the BBASC is solid however I think it is incumbent upon the TCEQ or possibly the Committee Chair to better qualify the stakeholder representatives, and particularly those representing the Recreational users. With stakeholder representatives from such interests as water districts, river authorities, municipalities, agriculture, and manufacturing, there is a reasonable expectation that the representative, either from vocation or employment, has some background and exposure to the science, technology, modeling, engineering, hydrology etc which I believe is prerequisite to meaningful participation on this committee. Recreational users necessarily have none of these qualifications. Though I cannot substantiate this, I believe many of the representatives on the BBASC are "on the clock". They are participating while at the same time being compensated normally for their time. Again, the same cannot be assumed for Recreational users. Unless these circumstances are addressed, both will lead to inadequate representation for Recreational users. The solution is a more detailed qualification process for the BBASC representatives, one that fully discloses the time commitment and requires at least a working knowledge of the prerequisites.

In parting, I'll say that my concern as I joined the committee remains the same as I when exit. The health of the bays and estuaries in our basin is vitally important and fresh water inflow necessary to sustain a sound ecological environment must not be compromised by competing interests. All of us are in the same boat. To borrow from the dialogue at our last meeting, it is my opinion that "human needs" and "environmental needs" are one and the same. We all share the same resource and an equitable and sustainable balance must be achieved. Thanks to you and all of the committee members for your diligent efforts in pursuing that goal.

Sincerely,

West Warren

CC Robby Byers, Exec Director CCA Texas

AGENDA ITEM XII

Set Next Meeting Date, Time and Location (June 1, 2011)

ADDITIONAL INFORMATION

Instream Flows Assessment

May 4, 2011

Instream Assessment

- Evaluate the magnitude, frequencies, and durations of flows at the selected locations.
- Consider quantitative ecological ramifications in the forms of relative differences in species abundance, suitable habitat area, and/or other factors.

Instream Flow Components (TIFP)

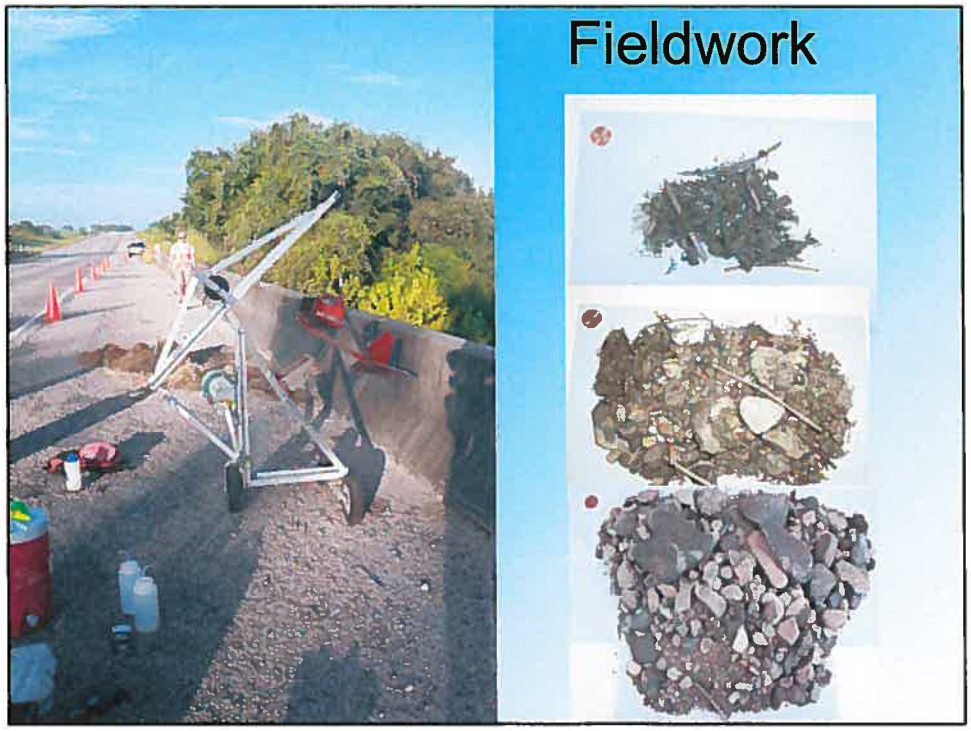
Subsistence flows	
Definition:	Infrequent, seasonal periods of low flow
Objectives:	Maintain water quality criteria
Base flows	
Definition:	Normal flow conditions between storm events
Objectives:	Ensure adequate habitat conditions, including variability, to support the natural biological community
High flow pulses	
Definition:	Short-duration, in-channel, high flow events following storm events
Objectives:	Maintain important physical habitat features
	Provide longitudinal connectivity along the river channel
Overbank flows	
Definition:	Infrequent, high flow events that exceed the normal channel
Objectives:	Maintain riparian areas
	Provide lateral connectivity between the river channel and active floodplain

Lower San Antonio River - Goliad Project

Fieldwork

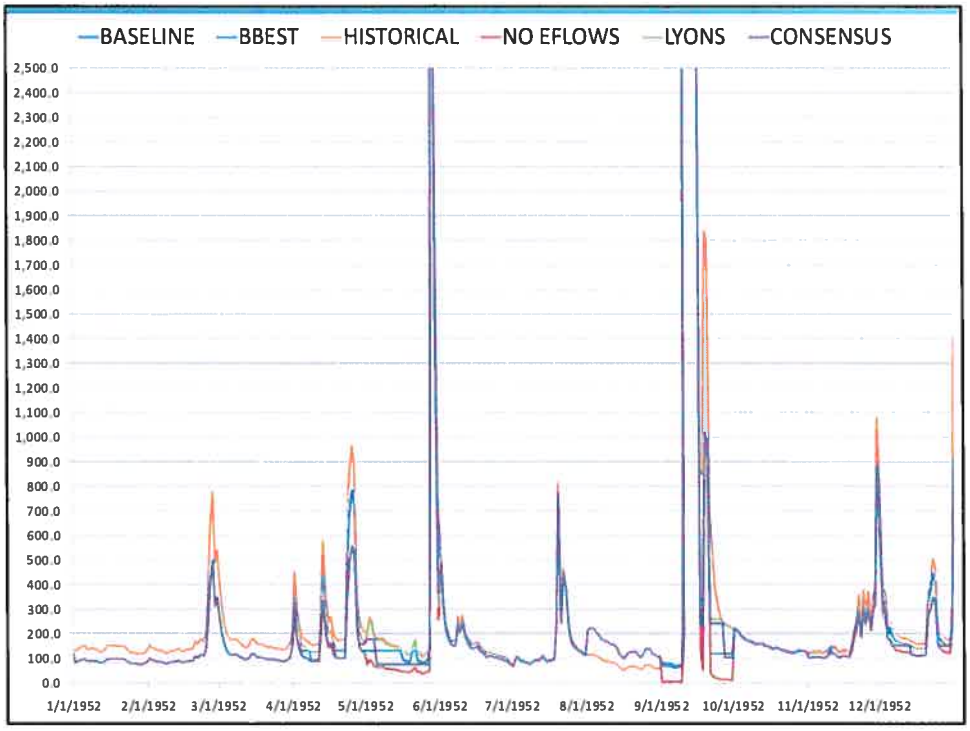
Fieldwork
Photo: Clint Robertson (TPWD)

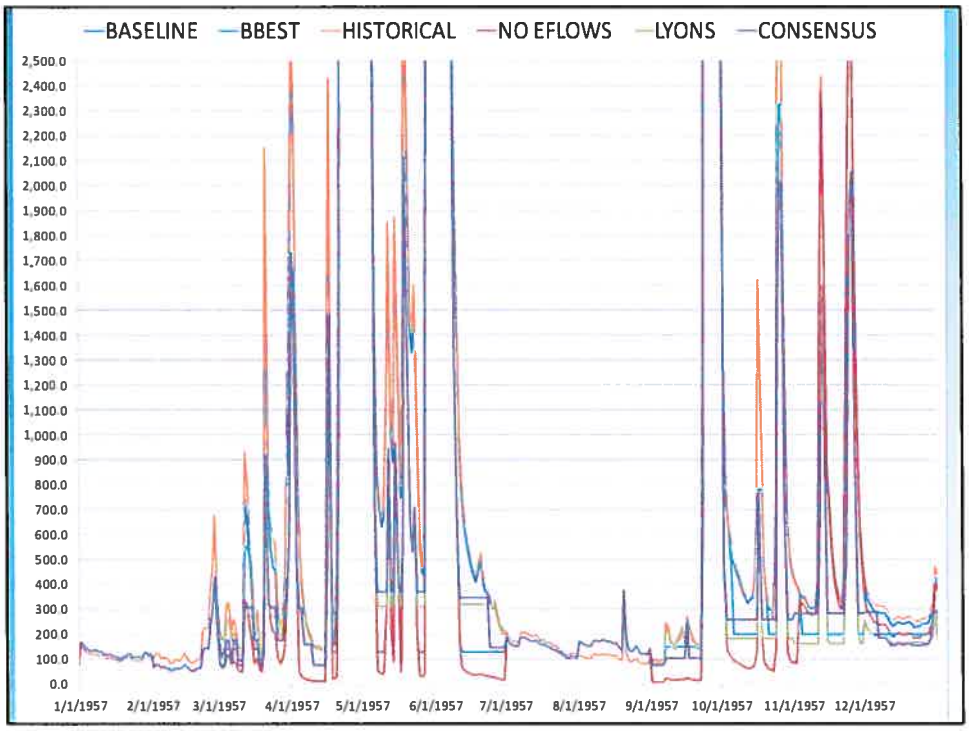
Fieldwork


Fieldwork

Goliad Evaluation

- Water Quality
  - Subsistence flow – focus on dissolved oxygen and temperature
- Habitat Availability
  - Subsistence and base flows – fish habitat
- Flow Pulses
  - Riparian communities
- Total Annual Volume
  - Riparian growth and sediment transport




BASELINE
BBEST
HISTORICAL
NO EFLOWS
LYONS
CONSENSUS
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2,400.0
2,300.0
2,200.0
2,100.0
2,000.0
1,900.0
1,800.0
1,700.0
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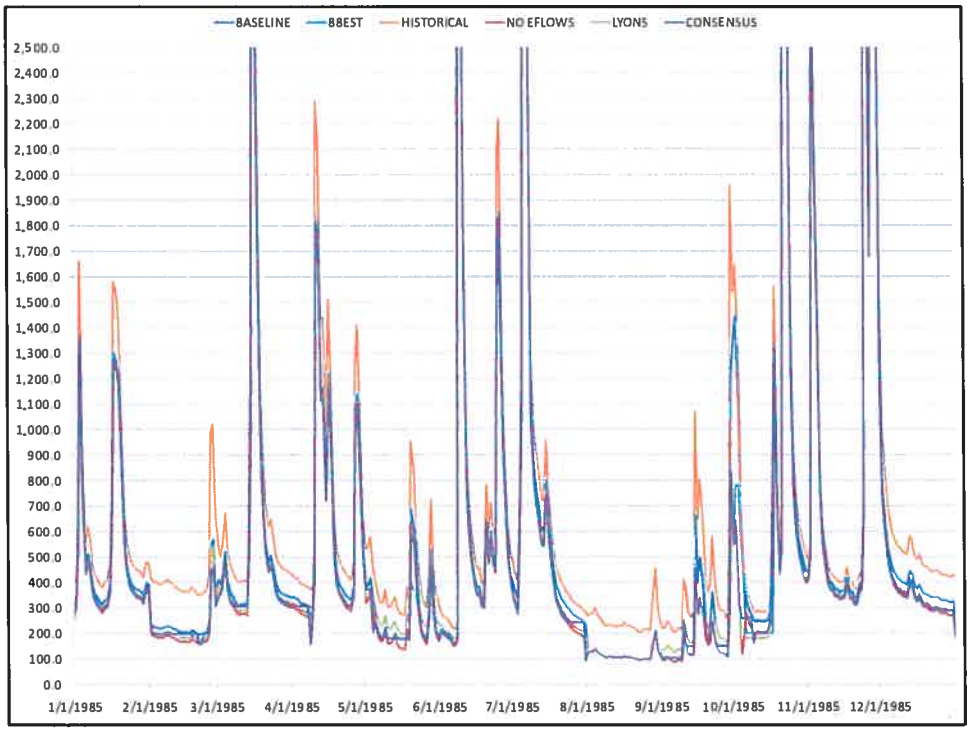
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11/1/1985
12/1/1985

Table 6.1-15. – Environmental Flow Regime Recommendation, San Antonio River at Goliad

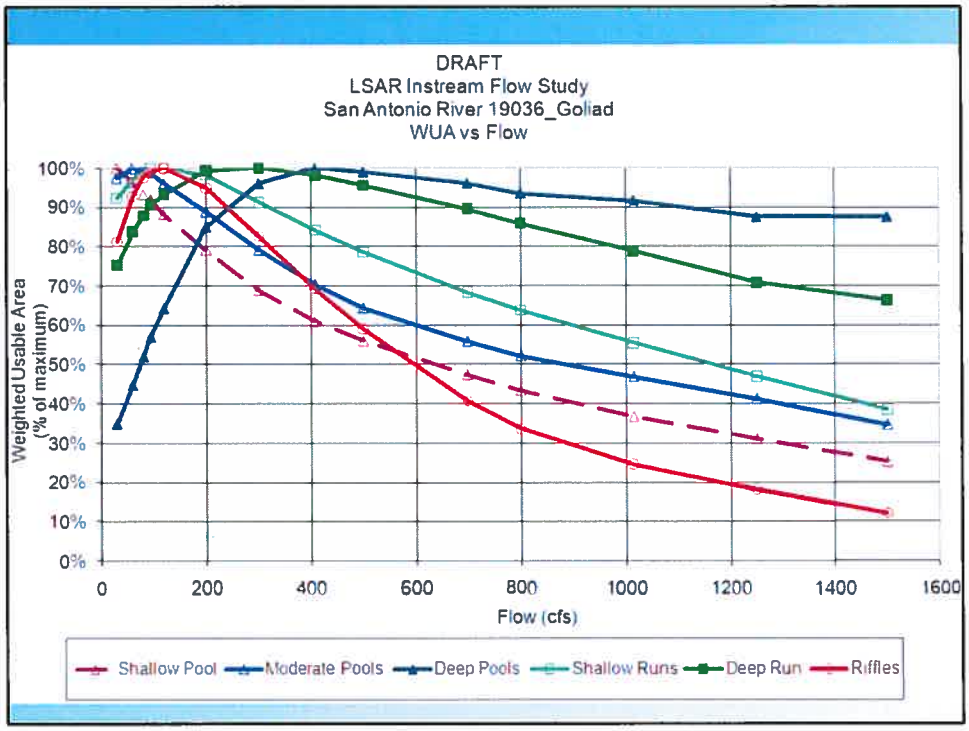
Overbank Flows	Qp: 23,600 cfs with Average Frequency 1 per 5 years Regressed Volume is 273,000 Duration Bound is 69											
	Qp: 10,600 cfs with Average Frequency 1 per 2 years Regressed Volume is 107,000 Duration Bound is 45											
	Qp: 7,680 cfs with Average Frequency 1 per year Regressed Volume is 73,500 Duration Bound is 38											
High Flow Pulses	Qp: 1,520 cfs with Average Frequency 1 per season Regressed Volume is 12,800 Duration Bound is 19			Qp: 3,640 cfs with Average Frequency 1 per season Regressed Volume is 30,600 Duration Bound is 24			Qp: 1,640 cfs with Average Frequency 1 per season Regressed Volume is 11,200 Duration Bound is 16			Qp: 2,320 cfs with Average Frequency 1 per season Regressed Volume is 17,600 Duration Bound is 19		
	Qp: 550 cfs with Average Frequency 2 per season Regressed Volume is 3,940 Duration Bound is 11			Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 11,200 Duration Bound is 16			Qp: 750 cfs with Average Frequency 2 per season Regressed Volume is 4,430 Duration Bound is 16			Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 5,870 Duration Bound is 11		
Base Flows (cfs)	290			280			220			270		
	200			160			150			200		
	140			130			120			130		
Subsistence Flows (cfs)	76			60			54			66		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)
	Subsistence

Notes:
1. Period of Record used: 1/1/1940 to 12/31/1969.
2. Volumes are in acre-feet and durations are in days.

Goliad Tools for Evaluation

- Water Quality
  - Existing Data
  - Water quality model for the lower San Antonio River – Texas Instream Flow Program (TIFP) / SARA
- Aquatic Habitat
  - TIFP/SARA 2D hydraulic and habitat models
- Pulses and Total Annual Volume
  - Hydrology

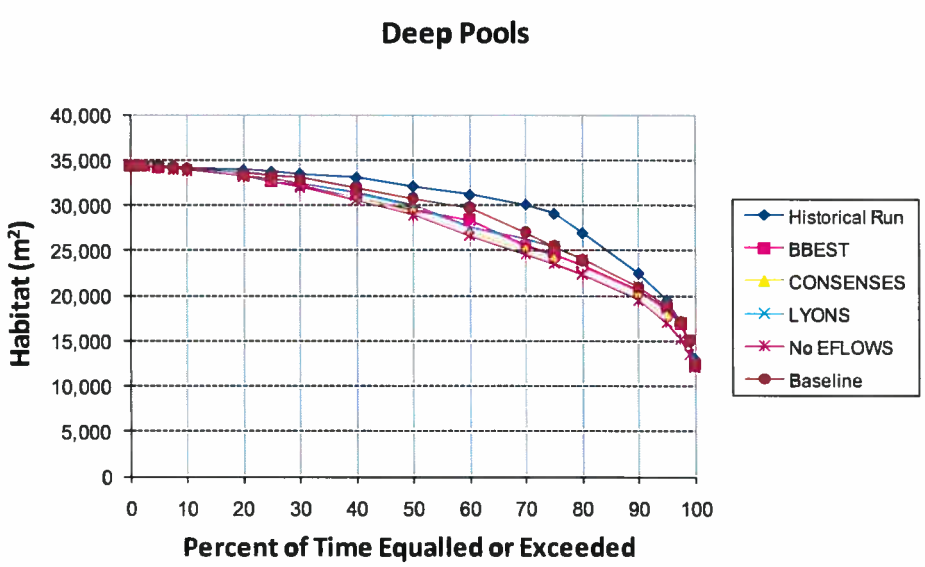

DRAFT
LSAR Instream Flow Study
San Antonio River 19036_Goliad
WUA vs Flow
Weighted Usable Area (% of maximum)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
200
400
600
800
1000
1200
1400
1600
Flow (cfs)
Shallow Pool
Moderate Pools
Deep Pools
Shallow Runs
Deep Run
Riffles

Max suitability 131 cfs
N
Riffle
Shallow Run
Deep Run
Shallow Pool
Moderate Pool
Deep Pool
0
75
150
300
450
600
Feet

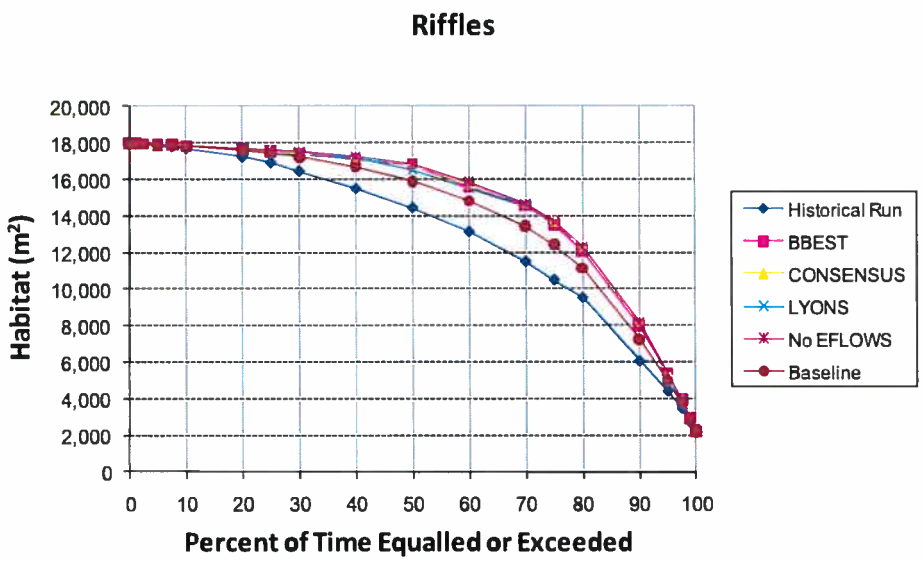
Habitat Time Series - BBEST

	Percent of Maximum Available Habitat					
Percent Exceedance Level	Moderate Pools	Deep Pools	Deep Run	Shallow Pool	Shallow Runs	Riffles
0.01	100%	100%	100%	100%	100%	100%
0.1	100%	100%	100%	100%	100%	100%
1	100%	100%	100%	97%	100%	100%
2.5	99%	100%	100%	95%	100%	100%
5	99%	99%	100%	93%	100%	100%
7.5	99%	99%	100%	92%	100%	99%
10	98%	98%	100%	91%	100%	99%
20	95%	97%	100%	87%	99%	98%
25	94%	95%	99%	85%	99%	98%
30	93%	94%	99%	84%	99%	97%
40	90%	90%	98%	81%	98%	95%
50	88%	86%	97%	79%	97%	93%
60	83%	82%	95%	73%	94%	87%
70	78%	74%	94%	68%	91%	81%
75	74%	71%	93%	65%	87%	75%
80	69%	68%	91%	60%	83%	67%
90	58%	60%	87%	49%	70%	44%
95	50%	54%	81%	41%	60%	30%
97.5	45%	49%	76%	35%	52%	22%
99	39%	44%	70%	30%	45%	16%
99.9	35%	37%	67%	26%	39%	13%
99.99	35%	36%	66%	25%	39%	12%

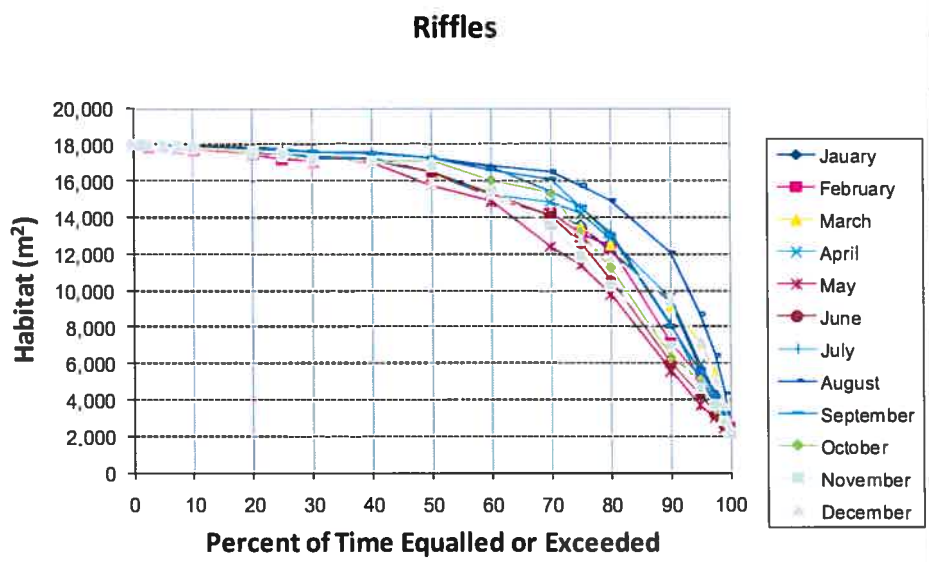
Habitat Duration Curves



Habitat Duration Curves



Habitat Duration Curves – BBEST Monthly



Flow Pulses

- BBEST Recommendations
  - HEFR default values
- TIFP Recommendations
  - Indicator species – ecological linkage to flow
    - Black willow (April – June)
    - Buttonbush (September – October)
    - Boxelder (August – October; recruit through the following spring)
    - Cottonwood (May – July)
    - Green ash (September – October; recruit for several years)
    - Sycamore (February – May; good seed crops only every 1 or 2 years)
    - Hardwood forest communities' growing season (February – October)

Total Annual Volume (acre-feet)

- Riparian growth (TIFP)
- Sediment Transport (BBEST)

		Goliad	
	Baseline	**BBEST**	**Historical**
min	95,114	93,387	88,990
25th	212,162	180,914	269,041
median	364,144	329,577	411,304
75th	694,860	612,661	764,220
max	1,448,998	1,423,088	1,636,074
		Difference	
	BASE/His	**BBEST/Base**	**BBEST/His**
min	-7%	2%	-5%
25th	21%	15%	33%
median	11%	9%	20%
75th	9%	12%	20%
max	11%	2%	13%

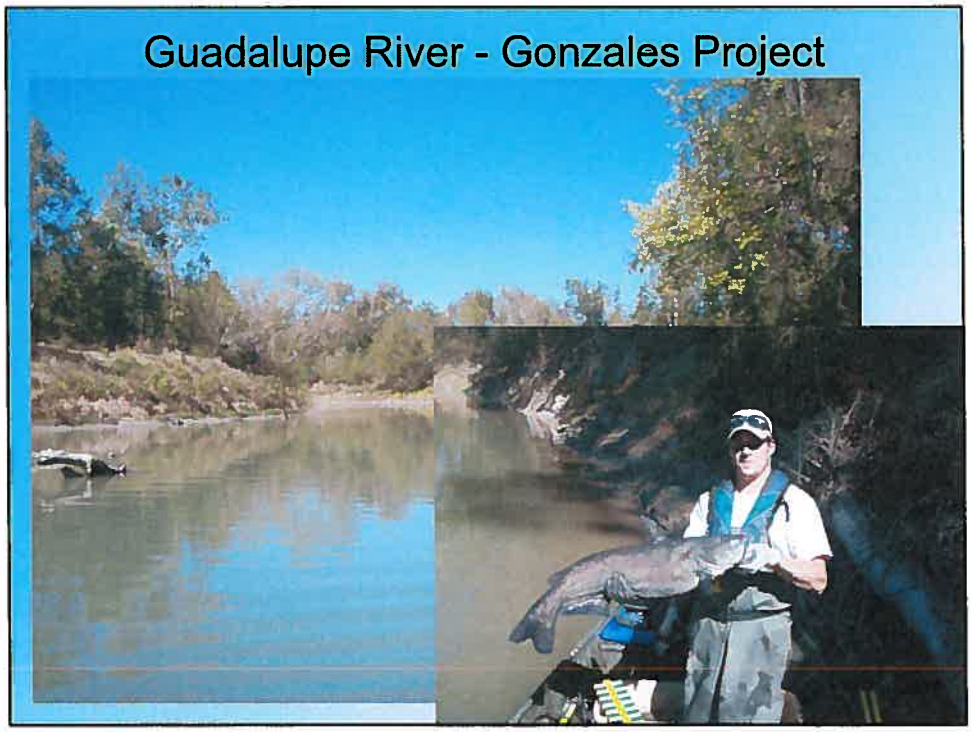
Goliad Preliminary Conclusions of BBEST recommendations

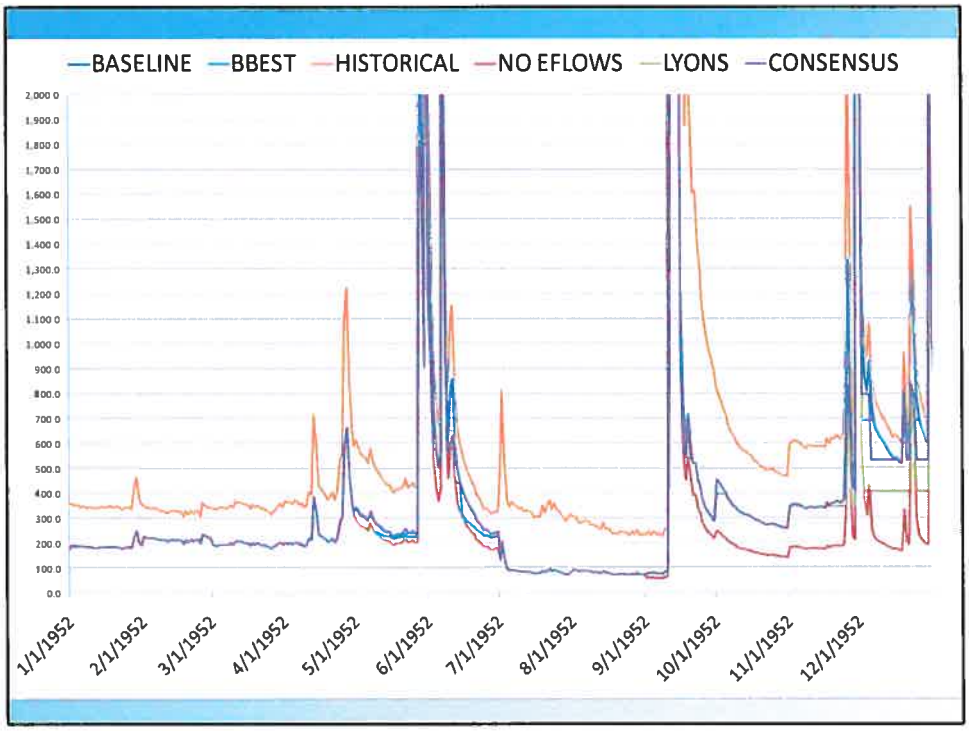
- **Water Quality**
  - Existing water quality data supportive
  - Modeling of water temperature shows stress at subsistence flows during extreme summertime conditions
- **Aquatic Habitat**
  - Supported by BBEST recommendations
  - Continued base flow evaluation for balancing possible.

Goliad Preliminary Conclusions of BBEST recommendations

- **Pulses and Total Annual Volume**
  - Riparian (TIFP) supported
  - Sediment transport may not be supported if 10% change in annual sediment yield is considered part of the BBEST recommendation. Not a TIFP concern for the lower San Antonio River

Questions
TX 5550 KM


Guadalupe River - Gonzales Project


BASELINE
BBEST
HISTORICAL
NO EFLOWS
LYONS
CONSENSUS
2,000.0
1,900.0
1,800.0
1,700.0
1,600.0
1,500.0
1,400.0
1,300.0
1,200.0
1,100.0
1,000.0
900.0
800.0
700.0
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400.0
300.0
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0.0
1/1/1952
2/1/1952
3/1/1952
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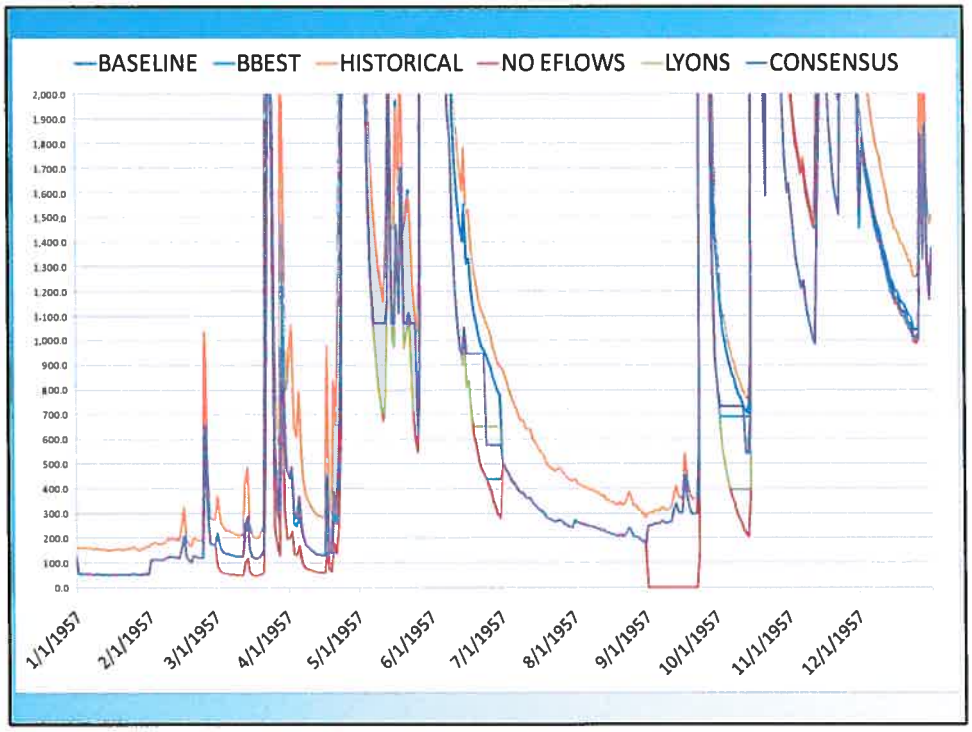
BASELINE
BBEST
HISTORICAL
NO EFLOWS
LYONS
CONSENSUS
2,000.0
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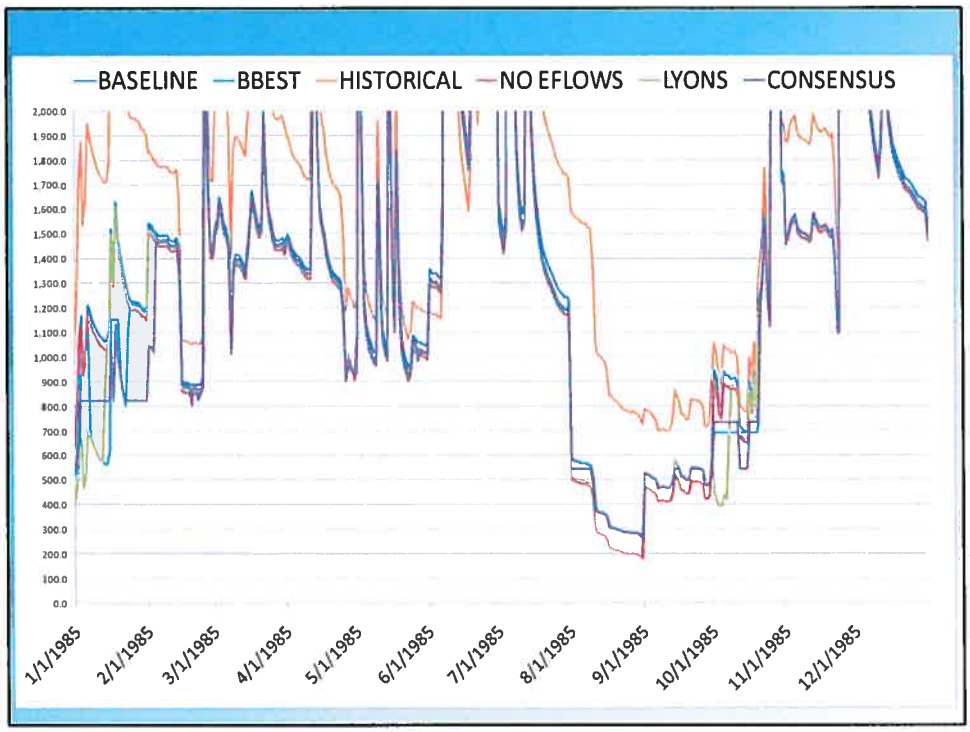


Table 6.1-6. – Environmental Flow Regime Recommendation, Guadalupe River at Gonzales

Overbank Flows	Qp: 36,700 cfs with Average Frequency 1 per 5 years Regressed Volume is 492,000 Duration Bound is 70											
	Qp: 24,400 cfs with Average Frequency 1 per 2 years Regressed Volume is 306,000 Duration Bound is 57											
	Qp: 14,300 cfs with Average Frequency 1 per year Regressed Volume is 165,000 Duration Bound is 43											
High Flow Pulses	Qp: 4,140 cfs with Average Frequency 1 per season Regressed Volume is 40,300 Duration Bound is 29			Qp: 6,590 cfs with Average Frequency 1 per season Regressed Volume is 58,400 Duration Bound is 24			Qp: 1,760 cfs with Average Frequency 1 per season Regressed Volume is 14,800 Duration Bound is 14			Qp: 4,330 cfs with Average Frequency 1 per season Regressed Volume is 41,200 Duration Bound is 23		
	Qp: 1,150 cfs with Average Frequency 2 per season Regressed Volume is 9,835 Duration Bound is 13			Qp: 3,550 cfs with Average Frequency 2 per season Regressed Volume is 26,000 Duration Bound is 17			Qp: 850 cfs with Average Frequency 2 per season Regressed Volume is 7,885 Duration Bound is 10			Qp: 1,410 cfs with Average Frequency 2 per season Regressed Volume is 11,400 Duration Bound is 13		
Base Flows (cfs)	860			870			880			810		
	690			650			650			690		
	540			440			440			510		
Subsistence Flows (cfs)	210			210			210			180		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

Flow Levels	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)
	Subsistence

Notes
1. Period of Record used: 1/1/1940 to 12/31/2007
2. Volumes are in acre-feet and durations are in days.

Gonzales Tools for Evaluation

- Water Quality
  - Existing Data
- Aquatic Habitat
  - TIFP PHABSIM analysis (hydraulic and habitat models)
- Pulses and Total Annual Volume
  - Hydrology

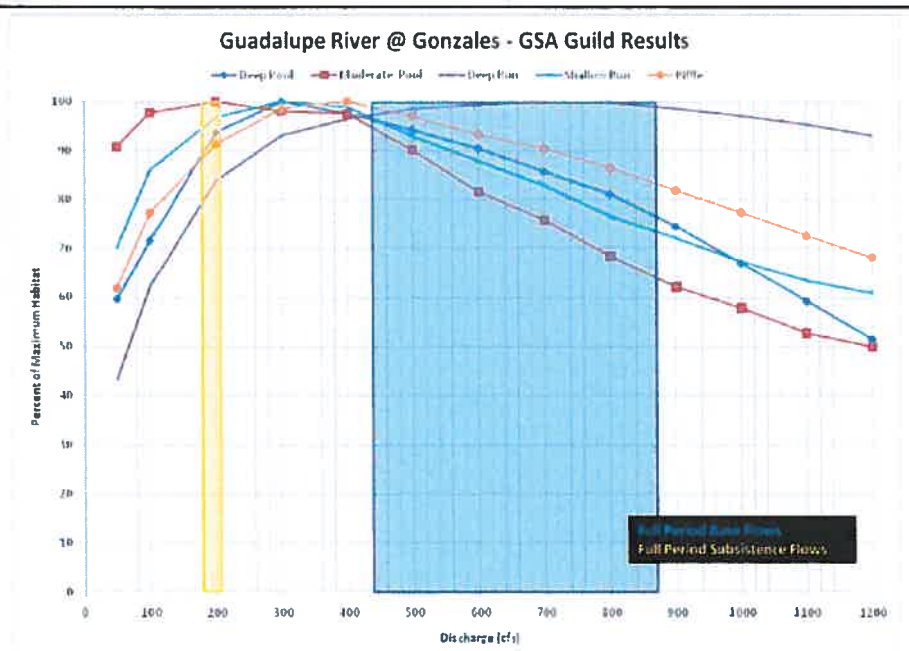
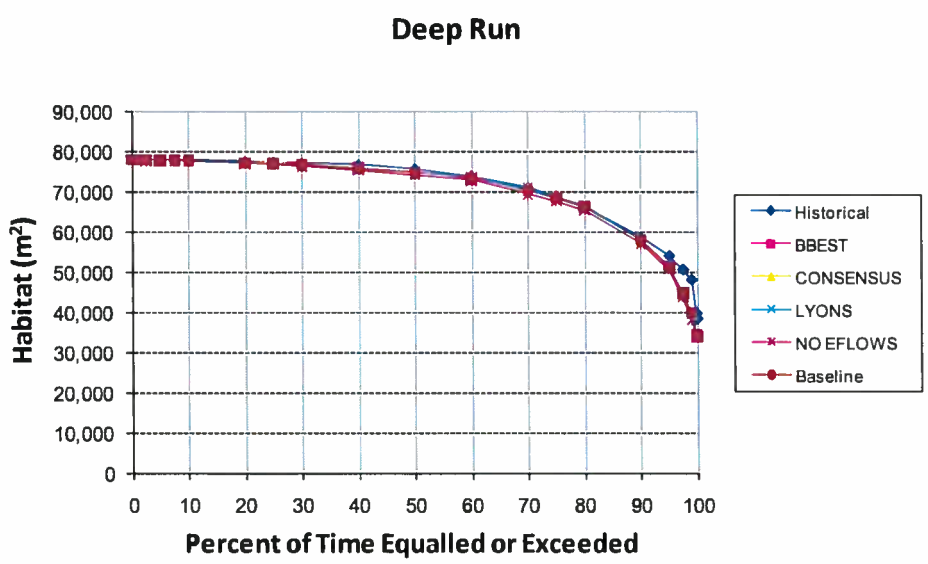


Figure 3.3-15. Percent of maximum habitat versus discharge for habitat guilds at Guadalupe River at Gonzales.

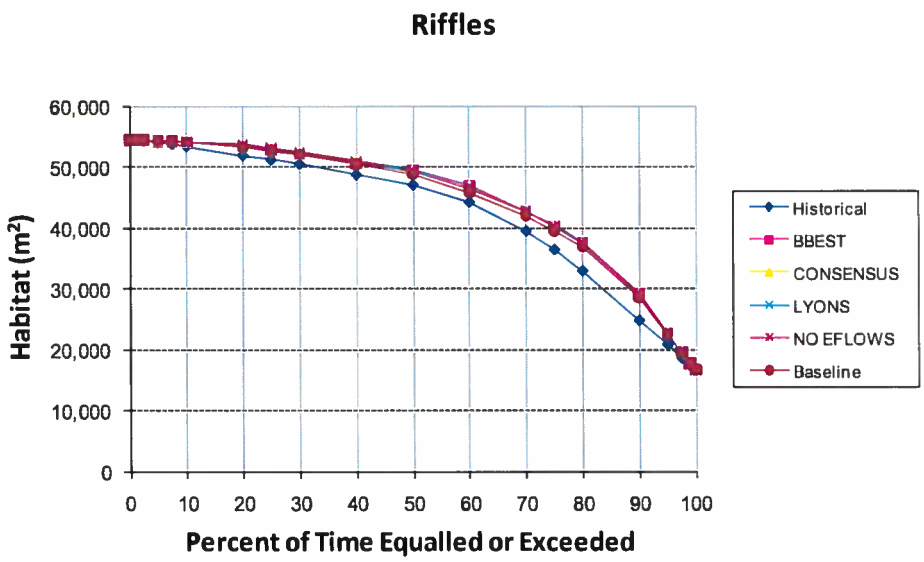
Habitat Time Series - BBEST

Percent of Maximum Available Habitat					
Percent Exceedance Level	Deep Pool	Deep Run	Shallow Pool	Shallow Runs	Riffles
0.01	100%	100%	100%	100%	100%
0.1	100%	100%	100%	100%	100%
1	100%	100%	100%	100%	100%
2.5	100%	100%	100%	100%	100%
5	99%	100%	99%	100%	100%
7.5	99%	100%	99%	99%	99%
10	98%	100%	99%	99%	99%
20	96%	99%	98%	98%	98%
25	95%	99%	98%	97%	97%
30	94%	99%	95%	95%	96%
40	91%	97%	90%	91%	93%
50	87%	96%	80%	85%	91%
60	81%	94%	74%	80%	86%
70	70%	90%	62%	72%	78%
75	64%	88%	57%	67%	74%
80	55%	85%	51%	62%	69%
90	28%	74%	41%	50%	53%
95	18%	66%	37%	41%	42%
97.5	16%	57%	31%	35%	36%
99	16%	51%	28%	32%	33%
99.9	15%	44%	28%	30%	31%
99.99	15%	43%	28%	30%	30%

Habitat Duration Curves



Habitat Duration Curves



Total Annual Volume (acre-feet)

- Sediment Transport (BBEST)

Gonzales T1		
Baseline	**BBEST**	**Historical**
42,854	42,835	108,723
398,558	386,293	545,396
765,604	743,999	923,220
1,140,478	1,116,898	1,269,547
2,282,683	2,265,432	2,529,590
Difference		
BASE/His	**BBEST/Base**	**BBEST/His**
61%	0%	61%
27%	3%	29%
17%	3%	19%
10%	2%	12%
10%	1%	10%

Gonzales Preliminary Conclusions of BBEST recommendations

- **Water Quality**
  - Existing water quality data supportive
- **Aquatic Habitat**
  - Supported by BBEST recommendations
  - Considerable room for further evaluation at base flows.
- **Pulses and Total Annual Volume**
  - BBEST HEFR default pulses met
  - Sediment transport may not be supported if 10% change in annual sediment yield is considered part of the BBEST recommendation.