

Memorandum

To: Environmental Flows Advisory Group (EFAG)
From: Texas Environmental Flows Science Advisory Committee (SAC)
Date: May 3, 2011
**Re: Review comments on Colorado and Lavaca Rivers and Matagorda and
Lavaca Bays Basin and Bay Expert Science Team (BBEST) Environmental
Flow Regime Recommendations Report dated March 1, 2011**

Introduction

The Colorado and Lavaca Rivers and Matagorda and Lavaca 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 1 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.

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 well done. The presentation of detailed summaries (Section 2.0) for each individual site with photographs and available data was exceptional. The BBEST directly used the extensive information available for the lower Colorado River and Matagorda Bay that was generated from site-specific studies. Information collected as part of a special study on the main stem of the Colorado River near San Saba was also directly used in the BBEST assessment. Additionally, both TWDB and TPWD directly 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 well documented with a considerable amount of that information presented in the detailed summaries. The methods for most data analyses were also adequately documented. One exception is the Comparative Cross-section Methodology (CCM) discussion. A thorough description of the development of the scope of work and assumptions behind that exercise would have added context to this key component of the instream analysis. Throughout the BBEST process, this methodology was repeatedly referred to as the means for developing ecological linkages that would help guide instream flow recommendations, yet it appeared to fail to produce those results. Comparisons of the CCM back to existing River-2D or MesoHABSIM results at specific locations (lower Colorado River or Colorado River at San Saba) early on in the process may have provided insight to the applicability and adequacy of the method.

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 a role in the scientific issues addressed or in the methodologies. A preliminary evaluation of environmental flow regime recommendations with WAMs was conducted and presented in Section 5.0. However, this was presented only as an example of how the proposed flow recommendations might be interpreted to assist the BBASC with their charge.

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?

Section 1.2 presents a good overview, definition, and discussion of nuances regarding a sound ecological environment. Importantly, the BBEST acknowledges that the streams and estuaries in the Colorado, Lavaca and Navidad river basins have changed in a variety of ways over the past century and that these changes have been both natural and influenced by humans. The BBEST thoroughly reviews the information gathered and presented in the report and concludes that the existing riverine and estuarine environments are ecologically sound. In this context, they describe an "acceptably sound ecological environment" as one that "has flow regimes that support existing biological communities in rivers, riparian, bay and estuary habitats."

For sites with specific studies, including Matagorda Bay, that information was used to assess both riverine and estuarine systems. For sites without specific

studies, instream flows are based on the "natural flow paradigm" while flows to the Lavaca Bay system are based on salinity versus inflow relations, together with literature results for salinity preference for focal species. The Lavaca Bay assessment focuses on oysters with confirmatory evaluations of juvenile shellfish and finfish species.

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. The BBEST considered information like existence of upstream reservoirs, historic changes in flow, and ability to represent different ecological and flow conditions at each site to represent the significant water courses, ecoregions, and basin management divisions. Additionally, the BBEST evaluated and considered sites that were specifically suggested by their stakeholders.

Environmental flow regime recommendations were presented for the final list of 22 sites which reasonably represents the geographic extent of the entire study area. No specific procedure was presented for how a flow regime at other locations could be estimated.

In the Lavaca Bay system, flow determination was linked to salinity zones and habitats in which oysters are most commonly found. This procedure and the addition of other focal species can be translated into other locations in the system.

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?

For site-specific studies, the recommended flow periods in those assessments were used as described on page 3-23. For all other locations, the BBEST determined that the period of record (1940 – 2009) best reflected the entire range of hydrologic conditions across the basin and provided a consistent period of analysis between sites. This determination was made following a careful examination of any pre- and post-impact time periods, the entire period of record for each respective gauge, and the 1970-2009 period. Selection of the 1940-2009 time period required data gaps to be filled at some locations, which was completed by drainage area ratios and later supported with additional correlation techniques.

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?

In Section 1.2, the BBEST report states, "the BBEST has reviewed data for these water bodies and believes they have acceptably sound ecological environments in

terms of flow regimes.” It is importantly acknowledged that all of these sites have experienced change over time.

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?

Detailed studies previously were conducted for the lower Colorado River and Matagorda Bay through the LCRA-SAWS Water Project (LSWP). During those studies, examinations of factors relating flow regimes to ecological health were evaluated and used to make recommendations. The BBEST elected to adopt those recommendations for those locations.

For sites without specific studies, an attempt to establish functional relationships for fish species relative to aquatic habitat amount and flow was conducted via the habitat suitability criteria development and CCM application. An excellent discussion is presented in Section 3.7 on the fisheries in the basin, selection of focal species, use of existing studies, development of habitat suitability criteria for fish guilds, and the linkage of that information to the cross-sections collected by TWDB and TPWD. Although the low base, moderate base, and high base flow recommendations are overlaid on the Percent of Maximum Habitat figures presented on pages 3-58 through 3-77, there is no discussion in the report on how this information was used to set or influence instream flow recommendations. It does state on page 7-1, “Using fishes and their associated habitats as surrogates for all aquatic fauna and flora—We are confident that aquatic fauna, flora, and habitats are protected by the instream flow recommendations based on the fish habitat guild approach”. However, it is not clearly articulated in the report how this conclusion was derived. At the BBEST presentation to the SAC on April 13th, it was communicated that although cross-sectional data was collected at each location and presented in the report, too few cross-sections were taken to confidently describe an ecological linkage to flow. This resulted in the aquatic habitat information being used more as a professional judgment overlay. The SAC concurs that data limitations associated with this methodology rendered it insufficient for use other than via professional judgment. The report would have benefited from this discussion at the conclusion of this section.

It should be noted that Section 3.7.13 on page 3-81 is inaccurate. It states that, “To provide some insights, the site-specific habitat guild suitability criteria developed as part of the LSWP studies on the lower Colorado and basin-wide habitat guild suitability criteria developed by the Guadalupe-San Antonio BBEST were used to generate habitat versus flow relationships at two river sites in that basin where calibrated habitat models were available (BIO-WEST, Inc.2008a).” However, the “LSWP” results are not presented in the subsequent figures. Additionally, the “basin-wide habitat guild suitability criteria developed by the Guadalupe-San Antonio BBEST” are really state-wide generic curves generated

from multiple basins across the state (Sabine, Brazos, Colorado, San Antonio, etc.).

It was also communicated at the April 13th SAC meeting that although not specifically documented in the report, the Riparian overlay consisted of considerable work and discussions regarding environmental flow needs and recommendations prior to receiving any HEFR default pulses. The various riparian communities were documented and pulse requirements to maintain these communities were discussed during BBEST meetings. When the HEFR default pulses were generated, they were similar to what the riparian subcommittee was already discussing and thus, no alterations were made. The report would have benefitted by presenting more detailed descriptions of this analysis in Section 3.8.4 and then discussing the incorporation of that work into the HEFR default pulses.

Although the methodology was well documented, the SAC has concerns regarding the formulation and subsequent use of the Subsistence Flow formula presented in Section 3.3.2. Using HEFR, the BBEST was confronted with the complexity that the natural variability in Hill Country and western streams frequently results in periods of extremely low flow or zero flow. The BBEST chose to use the following formula in their selection of subsistence flows for these locations.

Subsistence flow = Maximum (1.0 cfs, TCEQ Critical Low Flow or Seasonal 95% Exceedence Flow)

By using this formula, a minimum of 1.0 cfs is the lowest possible flow that could be selected at any site. The BBEST recognized that naturally occurring no-flow periods do occur and are permissible, but placed this minimum recommendation to prevent the removal of extremely low flow during dry or drought conditions. In the formula, the 1.0 cfs and the Seasonal 95% Exceedence Flow seem appropriate for streams that experience periods of zero flow. However, the SAC questions the applicability of using the TCEQ Critical Low Flow values, which in this application is most often the 7Q2 value, in the subsistence formula as presented by the BBEST. The BBEST states, "The TCEQ Critical Low Flow values were taken directly from the June 2010 publication of Procedures to Implement the Texas Surface Water Quality Standards (TCEQ 2010). The TCEQ Critical Low Flow is computed as the maximum of either 0.10 cfs, the 95% exceedence flow for the period of record used by TCEQ for the analysis, or the 7Q2 flow." Two issues immediately arise. The first is that the TCEQ period of record (typically, the most recent 30 years of available flow data) at each site does not necessarily correspond with the BBEST period of record (1940-2009). The second is that the purpose of the TCEQ Critical Low Flow values is to define the flow conditions under which water quality standards do not apply to a given water body. In particular, 7Q2 is not a flow statistic intended to set minimum environmental flow regime requirements.

The above described subsistence flow recommendation formula was not used where more detailed studies were available and adopted by the BBEST as their recommendation. However, it appears to have been applied at all other sites, without supporting analysis such as identification of a specific water quality concern which suggested an increase in the subsistence flow was warranted. This across the board application is disconcerting. For example, using HEFR for the Lavaca River near Edna, USGS Gage 08164000 site (page 2-157) produces a subsistence flow recommendation of 8.5cfs (Winter), 10cfs (Spring), 1.3cfs (Summer), and 1.2cfs (Fall). The BBEST acknowledges that this location did experience about 0.5% days of zero flow over the period of record used. The application of the subsistence formula was then used which resulted in the selection of 16cfs (TCEQ critical low flow value) for all seasons. Considering the Seasonal 95% Exceedence Flows were nearly identical to the HEFR generated values and the underlying principle of the BBEST's report is the "natural flow paradigm", this adjustment at this location is not considered appropriate.

The sediment transport overlay provides a wealth of information and is well presented. However, the analysis is focused only on sediment bed load and does not discuss the adaptive processes that take place in stream geomorphology and habitat. Two of the three examples employed are downstream of major main stem reservoir projects that have very likely produced large reductions in sediment yield and associated changes in habitat. Yet today we work with these stations as representative of the sound ecological environment that we seek to maintain. The BBEST concludes that the existing channels at the three sites examined during this effort all appear to be stable, but that the HEFR Regime flow values for subsistence, base and pulse flows alone will not provide the variability and magnitude of flows needed to maintain the current channel shape. With that said, it is also noted that there is a high probability that in the future the channel would continue to receive considerable flow in excess of the HEFR flow regime. The conclusions of the geomorphology analysis did not affect the BBEST flow recommendations or application, but rather was cited for additional study.

For the Lavaca Bay system, an analysis was carried out for occurrence of salinity preference of focal species. The focal organism was oyster which primarily defined the regime, though other shellfish and juvenile finfish were used as overlays. As is the case for the MBHE recommendations adopted for Matagorda Bay, these recommendations are not amenable to direct operational use, but would be employed in long term simulations to determine the effect of a proposed diversion or impoundment.

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

The BBEST attempted to address this question in Section 6 with the discussion of "interpretation" versus "implementation" while trying not to step over the line into BBASC territory. There is no discussion on "interpretation" of the existing

study recommendations (lower Colorado River and Matagorda Bay) that were adopted by consensus. This will need to be addressed by the BBASC as the lower Colorado River recommendations were not developed with the same “interpretation” scheme as presented in Section 6. It is also important to point out that the “base” terminology (Base Low, Base Medium, and Base High) employed for the Lavaca Bay recommendations carries a different meaning from the “base” instream flows with the same names prescribed by HEFR.

For all other instream sites, there is no definitive answer because of the unknown regarding future flows above and beyond just HEFR based flow values. One might conclude that since the systems were determined to be presently healthy, and the recommendation was to revert to historical-data-based flows (HEFR), by default they would meet the definition of sound ecological environment, even though strict adherence to the HEFR based flows and associated attainment frequencies does not preserve the historical statistics of all flows. Moreover, one can easily argue that reverting back to historically derived flow data simply describes what the system has seen, but this argument fails to address what the system truly needs as being adequate to support 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. An example is on page 7-2 when the BBEST states, “The geomorphic overlay relied on the principal [*sic*] of maintaining the annual sediment yield and effective discharge within 10% of the historical values based on the preponderance of evidence within the published scientific literature. We recognize however, that these types of estimates have an inherent degree of uncertainty due to scatter in the data and even choice of the sediment transport equation utilized.” 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

The BBEST is to be commended for all the hard work conducted in the short time-frame allowed and for advancing the understanding of ecological conditions throughout the basin. Although an excellent report overall, there are a few notable shortcomings highlighted below:

- While an impressive body of technical work on focal fish species and suitability criteria of important guilds was developed, the CCM methodology as it was applied proved insufficient to support environmental flow regime development. This limited the use of the habitat guild availability analysis presented in Section 3.7 to a professional judgment overlay. Although not clearly articulated in the

BBEST report, that assessment apparently did not support modification of any HEFR values, which culminated in default HEFR recommendations for every site for which site-specific studies were not available. For these instream locations, it is disappointing that the BBEST was unable to make any quantifiable recommendation or modifications to the HEFR results founded upon a connection between levels of flow and metrics of ecosystem health.

- The use of the TCEQ critical low flow value in the subsistence formula, absent a specific identification of a water quality concern, is not warranted for the reasons described above.
- The BBEST adopted site-specific flow recommendations based on special studies, but failed to discuss implementation for those specific recommendations.

These shortcomings of the BBEST report are, in part, 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. Although the pace of the SB3 process coupled with limited available information geographically across the basin can be exasperating, several notable achievements were accomplished as follows:

- The BBEST had and used the best available science regarding the completed studies for the lower Colorado River and Matagorda Bay.
- The report presents a wealth of baseline condition assessments and data analysis which will enhance future understanding and studies within the basin.
- Chapters 5 and 6 provide an excellent starting point for the BBASC regarding interpretation of the BBEST recommendations as they embark on their charge.
- Chapter 7 (Research and Adaptive Management) provides a well-thought out summary of limitations and data needs for consideration in the development of the upcoming work plan.