Review of Instream Flow Study of the Middle and Lower Brazos River, Draft Study Design

Reviewer 2

Overall this is an impressive, attempt to deal with a broad mandate. There are some key shortcomings, however. The objectives are not defined clearly enough to determine whether they are being met. The central feature of the project is a generic 2D hydraulic model that is not sufficiently linked to specific biological issues, and will not extend to high enough flows to be relevant for riparian vegetation or flood-plain spawning fish. The proposed sampling strategy for riparian vegetation will not make it possible to relate the occurrence of riparian species or communities to flow.

General Comments

Page 35, section 2.2.2, The biological objectives are vague. At what level do we want to maintain these features? Do we want them to function at current levels, pre-industrial levels, or at some other benchmark? The following sections, Physical Processes and Water Quality, have the same problem. Is the goal to maintain current channel dimensions within a certain range? Is the goal to allow all processes to occur naturally? Indicators are supposed to help determine whether goals are being met, but these goals are too vague to work in that way. The other goals have the same problem.

P. 36, Study Indicators. In order to focus the biological analysis, a subset of fish were selected as indicators for more intensive study. Why were no mussels selected as indicators? No indicator riparian species are identified, and no distinction is made between native and invasive riparian species. Is maintaining overall diversity and richness really the only concern with respect to riparian plants? How about the total area or linear thickness of the riparian zone?

P. 48. The justification for reach selection is unconvincing. The primary reason for selection of particular reaches for intensive study appears to be the existence of past studies.

P. 61. One of the goals for overbank flows is to maintain riparian vegetation. In order to quantify the needed overbank flows it will be necessary to know the hydraulic position occupied by the desirable riparian species, but it does not appear that this will be possible using the data collected. The 2D hydraulic model will not extend up to the flood plain. A 1D hydraulic model will be available, but it is unclear whether the resolution will be sufficient to determine the inundating discharge of a surface occupied by a given plant. Two sets of plant data will be collected. Extent and distribution of riparian communities will be assessed using the TPWD/NatureServe Vegetation Classification System database. This database will not provide information about the locations of individual plants, and it is unclear whether the mapped plant-community polygons will be small enough to relate to local hydraulic position as determined from the 1D hydraulic model. The 50-m transects perpendicular to the channel will provide information about individual species, but will be much too large to have a uniform inundation frequency. Thus it may not be possible to relate riparian vegetation to hydraulic position. If more precise positional information were desired about vegetation, this could be acquired by subdividing the 50-m plots into 5-m subplots (these would need to be very wide) and measuring elevation of each subplot relative to some hydraulic reference (e.g. Auble et al. 2005). It is unclear, though, whether the 1D hydraulic model would provide precise enough hydraulic information to relate to such data. In particular, will a 1-D hydraulic model be sufficient to determine what parts of the flood plain are inundated by a given discharge? How will you deal with levees and complex flow paths? Photographs showing inundation during high flows can be used to verify such predictions. Do you plan to use this approach? If hydraulic data are available for the floodplain at a scale useful for vegetation analysis, they will need to be related to the vegetation in a meaningful way. For example, if the flood-plain has been cut off from flooding, bottomland forest may have been replaced by upland forest. Assessments of tree size, species richness, density and canopy cover will not directly address this. How about taking the Wetland Indicator Status for each species from the USDA Plants Database and calculating an average Wetland Indicator Status (weighted by species importance) for each plot (Auble et al. 2005). This would allow you to relate species composition to hydroperiod or duration of inundation in a straightforward way. Alternatively, you could use species composition to assign plots to bottomland hardwood forest zones (Clark and Benforado 1981). Finally, an important aspect of the present condition of the riparian ecosystem is the percentage of original flood-plain area that continues to be flooded. Will you be collecting the information necessary to calculate this? Will you be determining locations of levees that could be removed to increase riparian habitat and increase connectivity with the river? Such actions would change the hydrology of the system and might be more productive and less expensive than restoring flow.

The proposed study is limited by lack of information on the threats to the target species. More specifically, the proposed fish and mussel habitat studies are generic in that they are not guided by knowledge or hypotheses about processes or life stages that are most important to prevent decline. The fish surveys will tell us where some of the different life stages are, but they will not necessarily tell us which of those life stages is most vulnerable or why. Brief biological descriptions of a few species are provided, but information about important threats is not used to focus the study. Such information should be assembled before the modeling exercise begins (e.g. Bovee et al. 2008). The planned habitat modeling effort may miss the most important factors controlling abundance of some species. For example, some Texas fish spend a critical part of their life cycle on the flood plain (e.g. alligator gar). The proposed modeling effort will not be able to address this vulnerability because the 2-D model does not extend up to the flood plain. Threats to unionid mussels include overharvesting, excessive siltation, channel dredging, and decline of the fish species serving as glochidial hosts. Can the data collection effort be tailored to address any of these issues? Some fish spawn in gravels, and therefore eggs may be especially susceptible to siltation. Can we include assessment of spawning gravels and flushing flows necessary to keep them clean?

Attention must be paid to integrating the different study components. For example, shade from riparian trees decreases light, reducing unwanted algal growth. Woody debris is important habitat for some fish. The project will be studying fish habitat, riparian vegetation, and woody debris, but it is not clear whether these studies will be carried out at appropriate scales to be integrated effectively. Measurements of local riparian vegetation and woody debris must be integrated into fish microhabitat assessment, and must be related to the broader-scale studies of riparian vegetation and woody debris.

Detailed Comments

Page 9, There should be a map showing these locations to accompany Table 2. Otherwise the Table is of little value.

Page 9, 2nd paragraph and Figs. 2 and 3. The most important hydrologic change for the Brazos River at Waco appears to be a major reduction in spring peak flows. This is not addressed in the paragraph, and the extent of the peak flow reduction cannot be assessed by analysis of median flows or flow duration curves. A third graph showing the historic series of peak instantaneous annual discharges should be added.

Page 10, first paragraph. Delete both occurrences of the word "slightly". Such changes always appear small when presented on a flow duration curve, but they are important.

Page 10, second paragraph. Reservoir operations alone could never produce this pattern (an increase in discharge of all frequencies). Replace "The type of change shown in Figure 5 is typical for a basin experiencing increased runoff due to factors such as increased precipitation or increased impervious cover within the basin. The changes may also be a result of reservoir operation for hydropower generation, flood control, or water supply." With "The type of change shown in Figure 5 is typical for a basin experiencing increased runoff due to factors such as increased precipitation or increased impervious cover within the basin combined with the moderating effects of reservoir operation for hydropower generation, flood control, or water supply."

Page 14, second paragraph. Replace "withdrawls" with "withdrawals".

Page 15, first paragraph. Delete the unnecessary "and are based upon scientific studies".

Figure 7. The river names on this figure are not legible.

P. 15, second paragraph states that the fish community includes flood-plain spawners, but Table 5 does not indicate which are the flood-plain spawners. Which are they? This is important in the hydraulic modeling.

P. 22, third full paragraph. After "400 river miles" insert "(slope = 0.00017)".

P. 23, second to last line. Replace "impairmentsA" with "impairments. A"

P. 29 first paragraph. Were these oxbow lakes formed under the modern flow regime? How old are they?

P. 30, Section 1.2.1, 9th line. Replace “affects” with “effects”.

P. 30, Section 1.2.1, 13th line. Insert “s” after “remain”.

P. 31, line 10, delete “of them”.

P. 31, line 20, replace “underlying” with “understory”

P. 32, Section 1.3, 13th line, replace “vary” with “varies”.

P. 32, 4th line from bottom, replace “process” with “processes”.

P. 38, Table 11. Under the Category “Instream Biological Communities” is an indicator labeled “Benthic invertebrates”, which includes bullets labeled “mussels”, “riparian plants” and “other vertebrates”. Riparian plants and vertebrates are not benthic invertebrates.

P. 39, Table 11. Under Vegetation, a bullet labeled “area” should be added. Given that most of the riparian ecosystem has already been eliminated, the area of remaining riparian vegetation is especially important. In addition to the benefits listed under “explanation” you could add that the riparian ecosystem is important fish habitat during high flows (e.g. for floodplain spawners) serves as the source of large woody debris for channel habitat, and filters nutrients from agricultural runoff.

P. 40, line 14, replace “is” with “are”.

P. 40, line 19, replace “is” with “are”.

P. 40, line 21, delete “that”

P. 41, 4th line from bottom, insert “were” at beginning on line.

P. 51, 4th line from bottom, replace “human’s” with “humans”.

P. 53, line 17. These photos are to be used to develop topographic information. Will they be flown in stereo? (Otherwise little topographic information will be derivable from them).

P. 55, 4th and 5th lines from bottom. What are these “riparian vegetation categories”?

P. 57, 5th line under Mussel surveys, replace “equidistance” with “equidistant”.

P. 58, 2nd line from bottom, replace "shiver" with "shiner".

P. 61,. Riparian habitat - baseline surveys and evaluation. The ninth line of the first paragraph states that age-class distributions of riparian vegetation will be assessed. Age classes are, indeed, important for linking riparian vegetation to flow, but the detailed methods make it clear that no age measurements will be made. Therefore, replace "age class" with "size class".

P. 64, line 11. Please specify which sediment transport model will be used, and how it will be accurate given that the hydrologic input will be only one-dimensional.

P. 65. The inclusion of detailed models of dissolved oxygen concentrations is an excellent idea.

P. 67, line 27, replace "describe" with "described".

Throughout. Both "overbank" and "overbanking" are used. "Overbank" is usually preferred.

References

Auble, G.T., M.L. Scott, and J.M. Friedman. 2005. Use of individualistic streamflow-vegetation relations along the Fremont River, Utah, USA to assess impacts of flow alteration on wetland riparian areas. Wetlands 25:143-154.

Bovee, K.D., Waddle, T.J., Talbert, C. Hatten, J.R., and Batt, T.R., 2008, Development and Application of a Decision Support System for Water Management Investigations in the Upper Yakima River, Washington: U.S. Geological Survey Open-File Report 2008-1251, 289 p.

Clark, J.R. and J. Benforado (Editors). 1981. Wetlands of bottomland hardwood forests : Developments in Agricultural and Managed-Forest Ecology, Vol. 11. Elsevier Scientific Publishing Company, Amsterdam, Oxford, New York, pp. xvii + 401.