San Antonio Water System

August 3, 2009

Mark Wentzel
Texas Water Development Board
P.O. Box 13231
Austin Texas 78711-3231

Re: Comments – draft Study Design, Instream Flow study of the Lower San Antonio River and Lower Cibolo Creek report (June 2009) and the study, titled, Preliminary Instream Flow Assessment for the Lower San Antonio River (BIO-WEST, September 2008)

Dear Mr. Wentzel:

The staff of the San Antonio Water System (SAWS) would like to provide written comments to the draft Study Design report, titled, Instream Flow study of the Lower San Antonio River and Lower Cibolo Creek, June 2009, (Report). As a stakeholder of the Texas Instream Flow Program (TIFP) for the lower San Antonio River and lower Cibolo Creek, SAWS is pleased to provide comments on the Draft study design. The Texas Instream Flow Program and study partners developed the draft study design based on the goal, objectives, and indicators developed for the basin during workgroup meetings conducted last year.

The TIFP was developed by the Texas Water Development Board (TWDB), the Texas Parks and Wildlife Department (TPWD), and the Texas Commission on Environmental Quality (TCEQ) in response to direction from the Texas legislature to "identify instream flow conditions that support a sound ecological environment." SAWS understands that the TIFP's development of a study design, stakeholder input, implementation, monitoring, adaptive management and the overall development of river flow needs will comply with the TWDB's 2008 report, titled, "Texas Instream Flow Studies: Technical Overview", (Report 369).

SAWS has a strong interest in the outcome of the instream flow identification process for the San Antonio River. This is an important topic to our community, and SAWS staff would like to offer the following comments. There are a number of thoughts we wish to provide.

In 2008 during the stakeholder involvement process, the San Antonio River Authority (SARA) sponsored a study, titled, "Preliminary Instream Flow Assessment for the Lower San Antonio River" (BIO-WEST, September 2008), probably best described by its subtitle: *Interim Subsistence and Base-Dry Instream Flow Guideline Development.* Since this report is referenced in the draft Study Design, Instream Flow study of the Lower San Antonio River and Lower Cibolo Creek report (June 2009), SAWS believes comments on this report are warranted.

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SAWS' primary concern with the report is that it prematurely makes instream flow recommendations, although qualified as preliminary and conservative, has published numeric flow values. Making flow recommendations should only be done when a sufficient level of scientific information is available to inform the decision and when the decision-making process follows prescribed protocols involving stakeholders, as discussed in the TIFP Technical Overview document. This is not to say that the identified instream flow guidelines are not good, but that appropriate steps that go into the flow recommendation process are essential. Additionally, the report does not use the entire extent of the stream nor its overall ecological system to forward preliminary flow guidelines.

The recent drought conditions in our region have produced some of the lowest San Antonio River flows on record. BIO-WEST and TPWD are collecting biological and general chemical water field data to evaluate the aquatic ecosystems under these low flow conditions. Will SAWS have a chance to review this data and will this data be incorporated into the Study Design if the need arises? Also, with the elimination of the Conquista Crossing sampling location and the potential to sampling site with Reach 1, how do these modifications impact the study design? SAWS did not have an opportunity to review the draft version of the Preliminary Instream Flow Assessment for the Lower San Antonio River. SAWS requests to have adequate opportunity to review all future documents pertaining to the San Antonio River TIFP. As an attachment to this document SAWS has included its comments pertaining to the Preliminary Instream Flow Assessment for the Lower San Antonio River.

Below are SAWS' comments pertaining to the contents of the draft Study Design report, titled, "Instream Flow Study of the Lower San Antonio River and Lower Cibolo Creek". (June 2009)

- The degree to which flows in the lower San Antonio River changed before and after 1970 is somewhat misleading by the data and information presented in the report. For example, the two curves plotted in Figure 2 and in Figure 3 do not represent an equal number of years of flow data (38 versus 30), with almost a third of the shorter pre-1970 period encompassing the 1950s drought of record. Based solely on these facts, it is not surprising that the pre-1970 flows are substantially lower than the post-1970 flows, particularly when the report clearly acknowledges with the bar chart in Figure 4 that there was significantly less rainfall during this earlier period than the latter period. What needs to be presented are the data that truly substantiate why there is more base flow in the lower San Antonio River now than in the past, that is, the historical wastewater return flow data. This would clearly make the point. If a river flow plot is to be used for this purpose, then it has to be based on historical flow data for periods of equal duration and very similar rainfall conditions; otherwise, the flow changes due to varying climatic conditions overshadow the effects of the increased wastewater return flows or whatever else (i.e., increased impervious cover in San Antonio) may have impacted historical flows along the lower San Antonio River.

- With regard to San Antonio Bay, it should be noted that the freshwater inflow recommendations from the studies conducted by the TPWD and the TWDB utilizing the state methodology have not been adopted by the TCEQ for water rights permitting or any other purpose. Furthermore, it is important to recognize that the Texas Environmental Flows Science Advisory Committee in its draft Freshwater Inflow Regime report has not fully endorsed the TPWD/TWDB freshwater inflow studies or the inflow recommendations for any of the Texas bays and estuaries because of technical and scientific concerns regarding the procedures employed. Requirements for freshwater inflows to San Antonio Bay will not become official until completion of the TCEQ rulemaking process for the San Antonio/Guadalupe Basin and the Guadalupe Estuary system as required under Senate Bill 3.

- The discussion of the geomorphology of the lower San Antonio River sub-basin in Section 1.1.3 notes that "flashy" streams such as those in central Texas behave differently with regard to their geomorphic processes and characteristics, but it is not clear that the San Antonio River, which lies generally below the base of the Hill Country and generally flows across the relatively flat Coastal Plain, exhibits these unique hydrologic or geomorphic traits. Indeed, the meandering nature of the lower San Antonio River is mentioned in Section 1.2.3, and the decrease in the "flashiness" of the river from its upper to lower portions is noted in Section 1.3. Further explanation would be helpful.

- The number of water rights located on and authorized to withdraw water from the San Antonio River is closer to 100 than 211 as noted on page 18 of the report. The 41 water rights noted on Cibolo Creek also may be questionable.

- With regard to surface water/groundwater interactions, it is not clear how the study being conducted by the U. S. Geological Survey for the lower San Antonio River will utilize the Hydrological Simulation Program to provide meaningful estimates of groundwater recharge to the Carrizo and Gulf Coast aquifers unless data are available to quantify these flow quantities to start with. If such data are available, then it is not clear as to why it needs to be modeled to assess surface water gains and losses. It is likely that the results from the synoptic gain/loss field surveys, the extensive base flow measurements, and the water chemistry analyses will provide the most useful information.

- It is not clear as to exactly what the Conceptual Model described in Section 1.3 and depicted in Figure 10 is supposed to represent. Is it the riverine ecosystem? The diagram seems to be missing some important elements, such as wastewater return flows that are discharged into the San Antonio River under Inputs, a water quality function linked to other components of the ecosystem, and riparian habitat and connectivity with the stream channel. It is

not clear how this representation "incorporates much of the basic understanding of the system at the point of study initiation" or "represents a beginning point from which to develop flow/ecology relationships and direct studies to further refine understanding".

- Do we really know that the magnitude and frequency of high flow pulses may have increased as a result of increased development in the basin? This statement is made, but it is likely based only on conjecture.

- In Section 2.2.1, obvious questions arise with regard to which portions of gage records will be considered to represent "natural variability" and the role of water losses and gains in the overall process of establishing appropriate flow regime components. The definition of the natural variability gage period again involves issues dealing with the length of the records used (the pre-1970 30-year period versus post-1970 38-year period) and the influence of the drought of record during the 1950s. How these periods are selected can make a lot of difference in the results. With regard to indicators for water losses and gains, the question is how will these quantities be determined. Normal practice is to perform a water balance for a stream segment using synoptic measured upstream and downstream river or tributary flows at gages, measured river flow diversions, measured wastewater discharges, and an estimate of surface evaporation losses during relatively dry periods to arrive at an estimate of the loss/gain amount. The problem is that the resultant loss/gain amount does not necessarily represent only the interaction or exchange between surface water and groundwater. It also includes unreported and illegal diversions, diversions for domestic and livestock use, evapotranspiration uptake, and any ungaged surface runoff. It is not clear as to the utility of such an uncertain and indefinite estimate of losses and gains in the context of developing recommendations for environmental flow requirements. These issues regarding estimates of water losses and gains also applies to the discussion of Connectivity in Section 2.2.5 in which it is suggested that the loss/gain values would be representative of indicators for surface water/groundwater interaction.

- In Table 7, the title suggests that the "importance" of the Hydrology study indicators is provided under the Explanation column, but it would seem more appropriate to label this information as the "Function" of the various indicators. Also, for the Base Habitat Flows and the Subsistence Flows, the "frequency, timing, duration, and rate of change" would seem to be relatively unimportant compared to "magnitude". Are these just carry-overs from the indicator descriptions for the Overbank and High Pulse Flows? Again, in this table, the indicator for Losses/Gains is described as the "Difference in the amount of water entering and leaving a specific section of the river channel." As noted above, this may not be representative of indicators for surface water/groundwater interaction, if that is the intention.

- From a layman's point of view with regard to biology, it seems unlikely that typical stakeholders would select the five species listed on page 33 as the important key species for consideration in a study to establish environmental flow recommendations. Maybe more explanation as to exactly how these species were selected would be helpful and would make the selections seem more credible. From a practical standpoint, it would seem that using at least some more common fish species that most people are familiar with would help in this regard.

- Why are High Pulse Flows not listed in Table 9 as an Indicator Category considering their important role with respect to connectivity and riparian habitat areas? Is it because Habitat Features are addressed in Table 11 with respect to connectivity? It seems like High Flow Pulse might be considered in both tables.

- Looking at the maps of regional geology in Figure 11 and ecoregions in Figure 12, it appears that only the regional geology was considered when delineating the Tier 1 study segments, even though at the bottom of page 38 both are indicated to have been examined.

- In Section 3.2.1, the same comments are offered here as presented above with regard to the significant influence that flows during the drought of the 1950s have on defining "natural variability" flow statistics.

- Also in Section 3.2.1, it would be meaningful to know what level of resolution in terms of grid size or element length expressed in feet will likely be used to construct the 2-D hydraulic model. Also, it is not clear as to whether this will be a steady-state model or a dynamic model. If dynamic, some discussion of periods to be simulated would be helpful. Has a modeling platform been selected? If so, it should be noted and generally described.

- With regard to the substrate and instream cover mapping, is it possible that these features could change with flow conditions in the river over the range of flow levels being considered for the hydraulic and habitat modeling and analyses? Does this present problems with using the substrate and instream cover mapping to characterize conditions in the river segments for the proposed studies? This should be explained further in the report.

- On page 47, with regard to calibration/validation of the 2-D hydraulic model, what does using "half" of the velocity and depth data mean? Half of the sampling periods or half of the actual measurements or what? Can the parameter used to describe substrate roughness in the model be related to some common bottom roughness coefficient such as Mannings "n" or a "C" factor? The final distribution of substrate roughness parameters at a given site

should be examined for reasonableness with regard to the actual distribution of substrate types. What action will be taken if the 2-D hydraulic models cannot be adequately calibrated using normally accepted values of the model input parameters?

- The importance of performing model sensitivity analyses cannot be overstated. Results from these analyses will either provide confidence in the overall modeling process or identify modeling deficiencies that must be addressed. The sensitivity procedures and results need to be fully documented in the Study report.

- With regard to the high flow pulse and overbank flow assessment using HEC-RAS models, is there LIDAR topographic data already available or are these data going to be acquired during and as part of the Study? Some indication of the resolution to be incorporated into the HEC-RAS modeling in terms of the distance spacing between model sections would be helpful in understanding the modeling application.

- No discussion is provided either at the end of Section 3.0 or in Section 4.0 regarding the procedures and process by which instream flow recommendations for the different Study reaches and sites will be established. This is the crux of the Study output and is a substantial omission from the Study Design. The concept of data integration is mentioned in Section 4.0 and shown on the diagram in Figure 14 dealing with stakeholder participation, but nowhere is there an in-depth description of how these recommended environmental flow regimes are to be developed.

- The importance of stakeholder participation, input and buy-in cannot be overemphasized. It is not clear from the discussion in Section 4.0 or the diagram in Figure 14 how this is to be accomplished for the Study. Annual presentations seem too infrequent to allow for useful input from the stakeholders.

- Finally, and again to reemphasize, on page 61 the statement is made that the descriptions of the flow recommendations "will" include four flow components of the hydrologic regime: subsistence flows, base flows, high flow pulses and overbank flows, but it would be more appropriate to say they "may" include four such flow components depending on local or regional site-specific conditions.

- Page 2: The document indicates that the study results will provide a means to assess "social impacts/benefits" of various flow regimes. From what SAWS has read in the Study Plan, the results are only focused on ecological values.

- Page 2: The document indicates that the goal of the study is to develop a "comprehensive tool" to "provide predictive capabilities" to "evaluate ecological significance." Ecological significance is a vague and value-laden term. It is also unclear what "tool" will allow this to be assessed. The studies outlined in the Study Plan are scientific and, as such, the results can only be used to inform the decision process for recommending instream flows, not to "evaluate ecological significance."

- Page 5. In Section 1.1.1 Hydrology: the text describes the changes in flow that have occurred in the San Antonio River since 1970. Sources of the change are noted as wastewater discharges (+), changes in precipitation (+), storm water (+ and - seasonal), and various withdrawals (-). Increased urbanization in San Antonio and adjacent communities which corresponds with the increase in impervious cover, may also be a contributing factor. Figure 2 indicates about a 60% increase in median flow over this period. Figure 4 indicates an increase in average precipitation of about 18%. It would be useful to have a better understanding of how much each of these factors has contributed to the total flow change. When trying to comply with minimum flow requirements or looking for flow-related opportunities to enhance ecological values in the stream, it would be important to have a better quantitative understanding of the sources of flow gains and losses. The Study Plan (p 29) notes a hydrology objective of "evaluating water losses and gains" but it is not clear whether it is intended to separately quantify each source (or category) of change. It is suggested that each source of flow change should be separately quantified.

- Page 29 Goals and Objectives (Section. 2.2): The stated goal is to have a "sustainable ecosystem that supports a **balance** of ecological and **economic**, recreational, and educational uses." Yet the Study Plan focuses entirely on ecological values. The flow chart (Fig 14 on page 60) includes a step entitled "Data Integration to Generate Flow Recommendations." The box above that states "Multidisciplinary Data" input. Does this mean that non-ecological values, many of which may conflict with ecological values, will be considered or "balanced" in the final recommendations? This approach is not apparent from what is stated many times elsewhere in the Study Plan. If the goal of the Study is to exclusively recommend flows for ecological values then it should be clearly stated so as to not disillusion some stakeholders who may believe, by virtue of their involvement in the study plan, that the final flow recommendations will involve tradeoffs and balancing of instream and out-of-stream water-use values.

- Page 29 (Hydrology): Based on typical scopes for these studies, it is expected that the objective of the Hydrology studies would be to "identify flow regimes that sustain ecological processes", not to "develop" them. Developing an ecological flow regime involves the integration of results of multiple studies, as is stated elsewhere.

- Page 33 (Key Species): Doing an instream flow study, especially one that quantifies fish habitat versus flow, in a stream that supports many species of fish, each with multiple life stages, is a major challenge. Habitat for each species and life stage responds differently to flow. The common approach to this situation is to group the species into habitat guilds (ranging from slow-shallow to fast-deep) and/or to focus only on "key" species. This study plan proposes both. It is also useful if the key species reasonably represent the range of guilds (and are "key" for other reasons too). However, the key fish species chosen for this study, except for burrhead chub, are those that prefer "moderate-to-swift' or "moderate-to-strong" current. If the results of the habitat-flow models for these species are to be used in a major way for recommending instream flows, then it must be acknowledged that the flows will be biased toward the high end.

- Page 38 (Study Site Selection): This section does an excellent job of describing the importance of study site selection and presents a logical approach. The authors need to be clear and consistent on the use of terminology. On page 38, the distinction is made between stream segment (long), reach (mid-length), and site (small). Elsewhere in the Study Plan, the terms (and others) are used interchangeably.

- Page 42 (The Study Plan): The Plan indicates that the study sites will be representative of the study reach. This is a critical requirement of an instream flow study and one that is often violated. It is usually very difficult or impossible to find a truly "representative" site. Therefore, it has become common practice in instream flow studies to do what is called "habitat mapping." This involves quantifying meso-habitat ratios in the larger study reach and then applying those ratios as "weighting factors" to similarly-defined sub-areas of the study site. This is simple to apply with one-dimensional (1-D) models (containing individual transects) but is challenging with two-dimensional (2-D) models. On page 49, it is stated that habitat mapping will be used to determine if the study sites are representative, but does not indicate what might be done if the sites are not found to be representative. Several options are available to address this potential concern, and the Study Plan should not overlook this need.

- Page 45 (Hydraulic Models): Is the 2-D hydraulic model that is discussed the same as a 2-D hydrodynamic model, such as River 2-D? Either term is acceptable but it should be noted if these are one and the same or not. Also, has the use of 1-D models been excluded? Often the 1-D- and 2-D models provide similar results, but the 2-D is much more expensive to implement. The advantages of 2-D include an ability to better model eddies and side channels and to generate more informative graphs. If funds are limited or

could be applied to other studies, the option of a 1-D model should not be ruled out in the Study Plan.

- Page 51: This section indicates that a meso-habitat-flow relationship will be developed. However, meso-habitats are defined primarily by physical features such as slope, hydraulic controls, and substrate, and not by flow (although high flows help create these features). Also, a decision as to when a certain meso-habitat (e.g. pool) might turn into another type (e.g. run) is highly subjective. Most habitat surveys are done at low-to-moderate flow so that the habitat distinctions and defining physical features can readily be observed. There is little value in attempting to develop a meso-habitat-flow relationship.

- Since it is stated that water quality has improved and quantity has increased, the focus has been on including historical and natural conditions which are echoed in the Statewide and Basin Goals, these include:

  - *"natural processes"*
  - *"comparable to that of the natural habitat"*
  - *"naturally functioning"*
  - *And most importantly," supports a balance of ecological benefits and economic, recreational, and educational uses"*

  Have historical data been the centerpoint for evaluating these factors? A more definitive comparison of aquatic ecosystems, species and abundance should reflect what historical flows have been and not focusing on modifications of base flows (see page 6, Figure 2).

- 1.2.4, Water Quality: the Report should have a detailed description of the current Total Maximum Daily Loads (TMDL) activities within the basin. There are currently three TMDL development projects in the San Antonio River Basin. The project titles are:
  - Salado Creek (Dissolved Oxygen),
  - San Antonio River Basin and Leon River (Bacteria), and
  - South Central Texas (Bacteria and Dissolved Oxygen).

  Also, reference should be provided on the existence of the draft Best Management Practices (BMP) Assessment Report, dated February 17, 2009. This report's objective is to identify and assess potential sources of bacteria, and to evaluate Best Management Practices (BMPs) that can be used to control those sources.

- There needs to be some reference to the significant value of precipitation and the contribution of rain events to overall flow and especially high pulse flows. Also, any flow values for spring discharges which include the Edwards Aquifer, could be drastically reduced or even to no flow if another significant drought occurs.

- The Pugnose minnow is now being proposed as a potential target species. SAWS believe that any inclusion of a target species needs to be evaluated by the stakeholders as to the river life cycle and preferred aquatic habitat requirements of this particular species.

- The Report proposes new water quality indicators:

  - Nutrients - Organic and total Nitrogen indicator omitted and the explanation changed to TCEQ definitions.
  - Filterable reactive and total phosphorus indicator changed to total phosphorus and orthophosphate. Explanation changed to TCEQ definitions.
  - Dissolved Oxygen - Explanation changed to TCEQ definitions.
  - Temperature - Explanation changed to TCEQ definitions.
  - Bacteria - Bacteria indicator as a function of contact recreation. Explanation changed to TCEQ definitions.

  Any modification such as water quality indicators should comply with the decisions we accomplished together as stakeholders during the study design workgroup meetings. These include but are not limited to:

  - Determine natural, historic, and current parameters of water quality of the river system.

  - Maintain flow in order to sustain water quality to support:
    - Biodiversity, Economic uses, and Recreational uses

  - The workgroup also noted the following as possible water quality indicators:
    - Dissolved oxygen levels, Purity, Sensitive or intolerant species, Contact recreation, Low bacterial count, Edible fish, Salinity

  Will there be a "matrix" or benchmarking table that will weigh these factors to aid in prioritizing them?

SAWS requests that our comments be recorded and evaluated whether any revisions that are described in this letter be incorporated into the Report prior to finalization. SAWS also requests the opportunity to review any Report modifications as a result of other comments that may be included in the final report.

SAWS appreciates the opportunity to participate in this important project. Please call me at (210) 233-3774 with any questions that you may have.

Sincerely,

Steve Clouse, Senior VP
Chief Operating Officer

CC: Dr. Calvin Finch, SAWS
Ken Diehl, SAWS
Gregg Eckhardt, SAWS
Gary Guy, SAWS
Scott R. Halty, SAWS
John Reynolds, SAWS

Enclosed: Attachment A

Attachment A

The report first discusses the four main components of the hydrologic regime that are important to the stream's ecological well being, and then explains that the objective of this report is only to focus on the low-flow components (subsistence and base flow). Despite this objective, the report repeatedly addresses the full-component environmental flow topic. This is inconsistent with the study's stated objective. Instream flow study protocols stipulate that the major stakeholders affected by the ultimate instream flow decision be involved in most major decision-making steps during the study. Most studies carefully document this collaboration. Further, this collaboration should at a minimum include concurrence on the methodology and study site selection. This report does not indicate that this important study implementation requirement was satisfied. If consultation meetings were held and consensus agreements made, then these should be referenced or acknowledged in the report.

The mesohabitat study conducted by BIO-WEST does not appear to be consistent with the TIFP guidelines, at least as a primary tool, and might not be an appropriate method for addressing the study's stated objectives of the study (see additional comments below on mesoHABSIM). The report does not indicate that the methodology used for this study was approved by SARA or by a collaborative work group.

Specific Comments on the Use of MesoHABSIM: This method seems to be best applied to streams where channel restoration is planned. It focuses on mesohabitats (for example, pool, riffle, and run), which are defined more by a stream's morphology than by base flow. Thus, the methodology is not well-suited for establishing base-flow targets (guidelines) except in the broader sense. The TIFP Technical Overview recognizes mesohabitat assessments as being useful in helping to inform the flow guideline development process, but it does not replace the need for a more detailed incremental microhabitat assessment.

The mesoHABSIM methodology requires that the entire river reach in question be habitat-mapped. With that information, detailed information on fish and hydraulic conditions is to be obtained at representative sites. For the BIO-WEST study, there is no indication that the total reach was mapped or that the specific study sites represent their respective reaches. In fact, the report (page 23) states that the two study sites were selected because they were determined to be more impacted by low flows, which is an acknowledgement that the sites were biased. Both sites contain side channels (predominant in one), and a review of aerial photographs reveals that side channels are very rare in these two reaches of the river.

Habitat criteria are a critical component of any instream flow study because they strongly influence the results. For this study, the manner in which the criteria were developed and used is not well defined. Sampling of fish to obtain habitat data—including depth,

velocity, substrate, and cover—is very prone to a number of sampling biases, and a study must be designed to address these potential biases. Robust sampling and large sample sizes are often required to overcome the bias concern. Because of this inherent problem, most instream flow studies, even those like this that involve fish habitat guilds, rely on criteria developed from numerous other studies (with perhaps some limited on-site verification).

There are 72 fish species in the San Antonio River, each with multiple life stages; this makes the process of defining habitat criteria challenging. To overcome this challenge, analysts often use habitat guilds, which are what this study used. However, the development of the criteria using mathematical means (canonical correspondence analysis [CCA], binary logistical regression [BLR], receiver operating characteristic curve [ROCC]) is difficult to follow and understand, making it difficult to accept the results.

Page 4 defines base-dry guidelines as those flows that would be achieved at a high percentage (80 to 90 percent) of the time. Although this might be a suitable definition, there needs to be clarification as to whether this is the official State definition or one developed by the report authors. The TIFP defines base flow and subsistence flow more broadly, without numeric values.

Page 68 of the report states that the TIFP does not provide specific guidance on developing recommendations. The report goes on to explain that a level of professional judgment is interwoven into the interpretation of results and the decision-making process. While this might be accurate, we believe it was premature for the authors to make flow recommendations on their own without collaborating with others.

Providing numerically-defined flow recommendations, although highly qualified and preliminary, begs the question of how these or other flow values are going to be implemented in the regulatory process. What defines a base-flow situation? What conditions trigger a subsistence-flow situation? Does a "natural flow if less" (consistent with the natural flow paradigm) ever come into play? The TIFP provides a solid discussion of implementation issues and specifically identifies the need to establish stakeholder committees.

The report graphically compares their preliminary flow guidelines to the 95 and 80 percent monthly flow exceedance values of the pre- and post-development hydrology; not surprisingly, these preliminary guidelines fall between the pre- and post-development flows. In the final analysis we would expect that the flow guidelines would be closer to the pre-development (prior to 1972 as defined in the report) flows based on two factors identified in the BIO-WEST report: (1) the preliminary guidelines have a level of conservatism built into them to account for the limited investigations to date (page 90), and (2) a reduction in base flow from existing conditions to a more natural condition would likely create greater diversity of habitat conditions (page 81).

The flow statistics presented in the report have been verified and independently validated using historical mean daily flow records obtained from the U. S. Geological Survey web site for the Falls City and Goliad gages (Figures 6.14 and 6.16).

It is not readily apparent from the graph of 1925-2007 historical mean daily flows in the San Antonio River at the Falls City gage presented in Figure 3.2 or from the 7Q2 values for these gages (Table 3.2), that the end of calendar year 1971 is a definite and hydrologically-meaningful breakpoint between the pre-1972 "early historical period" and the post-1971 "current period". While it may not make any significant difference considering the preliminary and indefinite nature of the low-flow guidelines presented in the report, the major variations in flow exhibited on the graph and identified in the report text as being relevant are likely merely reflections of differing precipitation amounts and patterns that occurred during these two periods.

The application of the IHA analysis and the discussion of pulse and flood flows in Section 5.1, Hydrology and Hydraulics, (and Table 5.1) seem unnecessary and irrelevant to the evaluation of low-flow conditions, the primary subject of the report. Furthermore, the observations noted regarding changes in the frequency and duration of the high-flow events over time probably has less to do with changing flow conditions for the before and after 1971 time periods and is more likely the result of differing precipitation amounts and patterns during these periods. The same can be said with regard to the discussion of observed increases in high flows in Section 5.3, Geomorphology.

The suggestion that elevated base flow conditions have caused a large portion of the streambed in the lower San Antonio River now to be in constant motion may be true, but this conclusion cannot be based solely on visual observations during the current field studies. Are there similar observations or data substantiating that such movement of the streambed did not occur during earlier periods, i.e., before 1971? As is the case with this sediment transport issue, most of the conclusions regarding geomorphology in Section 5.3 also appear to more intuitive rather than based on actual data or observations, and that may be satisfactory for this preliminary assessment, but it should be acknowledged.

Both of the study sites selected for detailed analyses of low-flow requirements include islands within the channel of the river. It would be informative to provide discussion in the report as to whether such conditions are typical of the entire lower San Antonio River. Otherwise, it would seem that the derived low-flow guidelines may only apply to somewhat unique and localized conditions that are atypical of normal river conditions.

While the physical habitat breakpoints derived relative to flow at the two study sites can be somewhat rationalized based on the graphs in Figure 6.3 (Falls City) and Figure 6.6 (Goliad), there appears to be substantial latitude for alternative interpretations of these data, notwithstanding the potential errors inherent in the measurements themselves (see Section 6.1.1). It might be appropriate to acknowledge this and simply reiterate that these are preliminary observations that are subject to further refinement during subsequent more comprehensive studies that are to be undertaken by SARA. The same

also can be said with regard to the discussion of fish habitat breakpoints derived from the fish habitat availability modeling (Section 6.1.2).

The time period definitions used in Section 6.1.3, Hydrologic Time Period Analysis (#3), appear to be somewhat arbitrary and may not be meaningful with regard to the stated observations pertaining to hydrologic characteristics and features, but again, these definitions may not be that important considering the preliminary and indefinite nature of the low-flow results from the analyses.

In Section 6.1.3, Hydrologic Time Period Analysis (#3), the selection of the "through 1971" time period as being representative of "natural" hydrologic conditions for purposes of establishing the preliminary subsistence and base-dry flow guidelines may be appropriate for the lower San Antonio River, but in the context of developing environmental flow prescriptions to support a sound ecological environment, it is the natural variations in flows that may be the most important consideration and not necessarily the natural flow magnitudes.

In Section 6.1.3, Hydrologic Time Period Analysis (#3), it is apparent that the establishment of the "final" values of the preliminary subsistence low-flow guidelines at the two study sites involves considerable subjectiveness and interpretation regarding the monthly flow statistics, with seemingly no definitive or prescribed procedure for arriving at these flow quantities. This is somewhat troubling, but, again, may be appropriate for determining the preliminary values presented in the report.

In Section 6.1.3, Hydrologic Time Period Analysis (#3), no explanation is provided as to why the base-dry flow recommendation is taken as twice the preliminary subsistence flow. Again, this seems arbitrary with little or no scientific basis or justification.

In Section 7.3, Application, it is not clear why the base-dry flow guidelines, which according to the report incorporate some level of conservatism (presumably conservatively high), should be achieved 80 to 90 percent of the time if they are based on historical flows that have been exceeded only 50 to 55 percent of the time. Further explanation would be helpful.