Statement of Work: Colorado River Flow Relationships to Aquatic Habitat and State Threatened Species: Blue Sucker
Task Order 2

Vendor: BIO-WEST, Inc.

1. Team Members

The following table presents key BIO-WEST Project Team Members for this activity:

TABLE 1. BIO-WEST PROJECT TEAM MEMBERS

Name	Position on Project
Edmund Oborny (Bio-West)	Project Manager
Dr. Paul Holden (Bio-West)	Principal
Dr. William Espey (Espey Consultants)	Principal
Dr. David Harkins (Espey Consultants)	Senior Expert - Engineer
Roy Frye (Hicks and Company)	Senior Expert - Scientist
Joe Trungale (TES)	Engineer
Dr. Chris Bunt (Biotactic)	Telemetry Expert
Darren Olsen (Bio-West)	Fluvial Geomorphologist
Cynthia Gorham-Test (Bio-West)	Biologist III

2. Statement of Work

Task 1: Project Management / Meetings

Subtask 1.10 – Contract / Project Management
Subtask 1.20 – Task Coordination
Subtask 1.30 – Meetings (CH2M Hill and LCRA/SAWS)

Description of Work: Project management, contracting, task coordination, and internal and external communication are included in this category. Communication of progress with LCRA/SAWS and the CH2M Hill Project Management Team is extremely important. Four meetings are proposed for March, June, September, and December 2005. In addition to these face-to-face meetings, the BIO-WEST project team anticipates frequent communication via phone or email with the CH2M Hill Project Management Team.

Communication with the other study groups will also be a vital component in the success of the LSWP. The BIO-WEST project team will prepare for and participate in bi-monthly

conference calls sponsored by the CH2M Hill project team that involve all study leads. In addition, BIO-WEST will maintain frequent communication via phone/email or meetings with the other project teams to facilitate the proper coordination and integration of studies. The original Detailed Study Plans provide a good description of the interdependencies of the LSWP studies and highlight the critical path communications that the BIO-WEST project team will maintain during the project.

Key Assumptions:

- *Four face-to-face meetings with CH2M Hill/LCRA/SAWS.*
- *Bi-monthly conference calls including all study leads.*

Deliverables: Monthly Progress Letter Reports with invoices
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Dr. Paul Holden

Task 2 – Intensive Site – Topography Data Collection

Subtask 2.10 – Field Activities

Description of Work: At each of the ten intensive sites, complete channel and near channel floodplain Digital Terrain Models (DTMs) will be created using a combination of survey-grade GPS equipment, conventional surveying equipment, autotracking GPS system coupled with hydroacoustic depth/velocity sounding data and aerial photogrammetry (subtask 2.20). Survey data will be reviewed for completeness (missing data, holes in the topography, etc.) on a daily basis using ArcView software, and supplementary topographic surveying will be conducted to ensure complete coverage of each intensive site. A final editing of the topography will be accomplished using OrthoMax 3D visualization software (or equivalent software). Terrain points will be added interactively to ensure that the terrain interpolation algorithm (triangular irregular network [TIN] with break lines) accurately represents the channel topography.

Where water depths at low base flows preclude either photogrammetric or conventional surveying of channel topography, a coupled survey grade GPS Total Station GPS (real time kinematic) and scientific grade echo sounder will be used to collect channel bottom topography. These data will be collected at a relatively high flow to maximize the amount of topography that can be generated with the sonar system. The data will be merged with other topographic data from photogrammtry and conventional surveying to create a DTM of the channel. The GPS will have centimeter level accuracy and the depth accuracy of the sonar is approximately 7 cm.

Key Assumptions:

- *Weather conditions will permit all topography data collection prior to scheduled irrigation releases in Spring 2005.*
- This Statement of Work is based upon GIS, surveying, and database management standards established by LCRA before November 1, 2004. In the event that standards

are changed, the Project Manager will evaluate potential schedule and budget impacts to the proposed project and notify the Technical Studies Coordinator of any potential impacts within 5 business days of the new standards release. Wherever possible, teams will identify potential impacts during the drafting of new standards.

Internal Deliverable: Topography necessary for development of DTM (Task 7).
Task Leader: Joe Trungale
Quality Control/Quality Assurance Leader : Edmund Oborny

Subtask 2.20 – Aerial Photogrammetry

Description of Work: Once the intensive sites are established, low-altitude (1,200 ft above ground level), high-resolution color aerial photogrammetry will be flown at each of the ten intensive sites at relatively low flows (at low flows to increase the amount of channel topography that can be generated from the photos). Where riparian vegetation precludes the use of photogrammetry, conventional surveying and GPS will be used to generate topography (subtask 2.10). The photogrammetry derived DTM will have an expected RMSE accuracy in the x, y, and z directions of approximately 1/10,000 of the flying elevation (1,200 feet) or accuracy in the range of 0.12 ft. Imagine Orthomax softcopy photogrammetry software (or an equivalent) will be used to process the photogrammetry. The density of the DTM will depend on the complexity of the terrain and location in the channel. Near channel floodplains will be digitized at a slightly coarser resolution than the active channel. The aerial photogrammetry will be used to fill in any gaps and increase the accuracy of the topography necessary for constructing the DTM.

Internal Deliverable: Topography necessary for development of DTM (Task 7).
Task Leader: Joe Trungale
Quality Control/Quality Assurance Leader : David Harkins

Subtask 2.30 –Advisory Group (AG) / Science Review Panel (SRP) Conference Call

Description of Work: Two conference calls with the SRP and AG (or subset of the AG - instream group) will be conducted following subtasks 2.10 and 2.20. These calls will include verbal presentations of the findings of the topographic data collected. The AG and SRP will be asked to provide input to ensure that the topographic data collected will be used most efficiently with the proposed modeling approaches.

Deliverable: Within one week of the call, the BIO-WEST project team will submit to LCRA/SAWS a letter report summarizing the AG/SRP conference call and comments provided.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Joe Trungale

Task 3 – Intensive Site – Physical Data Collection

Subtask 3.10 – Hydrodynamic Model Calibration

Description of Work: Calibration and verification are defined as the process whereby a model is calibrated (i.e., input parameters are tuned to maximize measures of model performance) against some of the data and the model is then verified against the remaining data by holding these tuned parameters at the calibrated values. Calibration data for hydrodynamics modeling consists of generating stage discharge relationships at the top and bottom of each intensive site and measuring water surface elevations throughout the site at three different discharges. Detailed water surface elevations will be measured with the survey grade GPS (centimeter accuracy) or conventional surveying equipment at 3 flows--high, medium, and low flow. Water surface elevations (WSE) will be surveyed in enough detail to completely describe the edge of water and water surface elevations throughout the intensive site. During data collection, a temporary staff gauge will be installed at the downstream end of the study site to document any changes in stage. Velocity data to validate the accuracy of the two-dimensional hydrodynamics model results will consist of measuring the length and width of any large recirculation zones and collection of acoustic doppler profiler data or conventional mean column velocity and direction measurements at high, low, and medium flow. Close coordination with the Surface Water Availability group will be maintained through this data collection task.

Key Assumptions:

- *Moderate- and high-flow data will be obtainable in 2005 to provide the range of flows necessary for hydrodynamic model calibration. It is assumed that the higher flows will need to be sampled following natural events and/or irrigation releases that would occur within the context of the current LCRA water management plan. It is also acknowledged that differences between high-flow (natural versus irrigation release) events do occur and must be considered.*

Internal Deliverable: WSE and velocity calibration data for development of hydrodynamic model (Task 7).
Task Leader: Joe Trungale
Quality Control/Quality Assurance Leader : Ed Oborny

Subtask 3.20 – Substrate and Riparian Mapping

Description of Work: Substrate and riparian vegetation classifications throughout the intensive sites will be delineated in the field on prints of the intensive site digital aerial imagery (subtask 2.20) or in areas of complexity, surveyed in with conventional surveying equipment. Mapping will be completed at low flow when the entire channel is visible, and mapping for all intensive sites will be completed by the same individual to ensure consistency. Substrate will be delineated into visibly homogeneous substrate types based on dominant and subdominant particle sizes. In areas too deep for visual characterization, sampling with a pole ekman dredge (or equivalent sediment sampler) or sounding will be used to characterize the substrate. Classification will be based on a modified Wentworth scale presented below.

Size Classes Used for Substrate Mapping

Size Class (mm)	Description
<2	sand/silt
2-8	fine gravel
8-32	medium gravel
32-64	large gravel
64-96	small cobble
96-192	medium cobble
192-256	large cobble
256-512	small boulder
512-1024	medium boulder
>1024	large boulder

Disturbed or rip-rapped areas will be placed into the size class that most closely corresponded to the size of the rip-rap or disturbed soil. Instream cover will also be mapped and include aquatic macrophytes and woody debris. Riparian vegetation will be delineated into the following broad categories established to distinguish vegetation types based on hydraulic roughness characteristics: grass/herbaceous, scrub-shrub, and mature tree. Substrate and riparian maps will be digitized into a GIS layer using ArcView software. The results will be integrated with the DTM results (or computational mesh) for several purposes (i.e., to assign roughness, substrate, and cover attributes to each computational mesh point).

Internal Deliverable: Data inputs for the development of hydrodynamic model (Task 7) and riparian corridor model/analysis (2006).
Task Leader: Melissa Stamp
Quality Control/Quality Assurance Leader : Darren Olsen

Subtask 3.30 – Sediment Transport

Description of Work: For this study, sediment transport is broken into two categories: bedload and suspended load. Bedload mostly consists of particles larger than fine sand (>0.25 mm) whereas the suspended load consists of particles in the sand, silt and clay size ranges (0.005mm to 2mm). Both types of sediment transport will be modeled to evaluate how alternative flow regimes may affect riparian and aquatic habitat. Field data collected to develop bedload rating curves will include surveyed channel cross sections, water surface slope, and streambed particle size distributions within each of the intensive sites.

Bedload Sampling

Field samples of bedload will be collected to determine model inputs such as the sizes of bed material actually in transport during high flow. Bedload will be sampled at all intensive sites. In general, bedload will be sampled from a bridge located nearest each intensive site. Bedload will be sampled during low, moderate, and high flows using a modified Helley Smith type bedload sampler. To sample bedload, the sampler will be lowered into the flow by hand or cable/winch and held firmly to the stream bed. This will be done at different locations incrementally across the channel. The sampler will be held longest at the location where the most active bedload movement occurs. Determining this location comes with experience as one can feel when material is in transport because it bumps against the sides of the orifice. Total sample time will be dependent on the material moved but will be approximately 20 minutes.

Bedload Sieving

Each field-collected bedload sample will be dried and sorted into the following size categories using standardized sieves: 16 millimeters (mm), 8mm, 4mm, 2mm, 1mm and <1mm. After sieving each size category will be individually weighed using a digital scale accurate to 1 gram. When practical, organic matter present in the sample will be removed before weighing. The organic material will also be individually weighed. Additionally, before sorting, digital photographs will be taken of each sample using a penny for scale. These photographs will be used to compare sample characteristics for the different intensive sites and collection dates. The largest particle collected in each sample will be measured and its size recorded. The largest particles sampled are measured and recorded to provide a reality check for the bedload modeling results. By using actual field data, this measurement allows for the ability to back calculate a critical shear stress value at that cross section associated with a certain flow level.

Suspended Load

Flow and Total Suspended Solids (TSS) data will be obtained from the LCRA database for selected long-term monitoring stations within the study area. A close evaluation of the LCRA TSS database will be conducted and any bias for sampling methodology (single-point sample verses a cross-section, flow-weighted TSS concentration) considered. TSS data has been collected in the study area by LCRA as presented below:

Station	Period of Record
Below Longhorn Dam	Feb 1984 – Present
Del Valle	Oct 1982 – Present
Webberville	Feb 1989 – Present
Bastrop	Oct 1982 – Present
Smithville	Oct 1982 – Present
LaGrange	Oct 1982 – Present
Columbus	Oct 1982 – Present
Garwood	Oct 1982 – Present
Bay City	Feb 1984 – Present

Key Assumptions:

- *Moderate- and high-flow data will be obtainable in 2005 to provide the range of flows necessary to evaluate sediment transport capability and function. It is assumed that the higher flows will need to be sampled following natural events and/or irrigation releases that would occur within the context of the current LCRA water management plan. It is also acknowledged that differences between high-flow (natural versus irrigation release) events do occur and must be considered.*

Internal Deliverable: Data inputs for the sediment transport model/analysis (2006).
Task Leader: Darren Olsen
Quality Control/Quality Assurance Leader : Edmund Oborny

Task 4 – Intensive Site – Biological Data Collection

Subtask 4.10 – Fish Collection to supplement fish habitat guild development

Description of Work: During the data review phase of Task Order 1, it was determined that the majority of the Mosier and Ray (1992) functional habitat groups would be suitable for the aquatic habitat modeling effort. However, one important habitat category that was not covered in sufficient detail was backwater/tributary/side channel habitat. Therefore, the study team spent one week sampling this type of habitat in November 2004 (Fall) and will conduct two additional sampling efforts (Spring and Summer 2005) to characterize the annual usage of this habitat type by fish in the lower Colorado River. Sampling will be performed by seining, backpack electrofishing, boat/barge electrofishing, or some combination of the three. Direct observations of fish with positive identification but not collected will also be noted. During the biological sampling, several habitat parameters will also be measured per individual sampled cell. At a minimum, these will include velocity, depth, substrate, and cover (aquatic macrophytes and woody debris).

Key Assumptions:

- *The 10 functional habitat groups defined in Mosier and Ray (1992) provides a solid biological representation of the lower Colorado River, excepting the one additional habitat type described above.*

- *The LCRA electrofishing boat/barge will be available for use and 1 LCRA fisheries biologist will assist in this field effort.*

Internal Deliverable: Internal Use for refinement of Habitat Suitability information.
Task Leader: Michael Robertson
Quality Control/Quality Assurance Leader : Edmund Oborny

Subtask 4.20 – Fish Sampling – Biological Model Verification

Description of Work: For the purpose of updating the existing database and to validate the habitat model for each intensive site, biological sampling will be conducted at all ten intensive sites during low-flow conditions. To maximize cost efficiency, this will take place concurrently with the collection of detailed topography information for each intensive site.

To further validate the habitat modeling (2006), fish will be sampled at five of the intensive sites at the other two measured flows (medium and high) where feasible. Locations of all fish samples will be registered accurately (+/- 0.5 meters) onto the intensive sites using a combination of surveying and/or marking on large aerial prints.

Key Assumptions:

- *Moderate- and high-flow biological data will be obtainable in 2005 to provide the validation set for the habitat model. It is assumed that the higher flows will need to be sampled following natural events and/or irrigation releases that would occur within the context of the current LCRA water management plan. It is also acknowledged that differences between high-flow (natural versus irrigation release) events do occur and must be considered.*
- *The LCRA electrofishing boat will be available for use and 1 LCRA fisheries biologist will assist in this field effort.*

Internal Deliverable: Internal Use for habitat model verification.
Task Leader: Michael Robertson
Quality Control/Quality Assurance Leader : Edmund Oborny

Task 5 – Blue Sucker Life History Assessment

Subtask 5.10 – Spawning Survey

Description of Work: Spawning season surveys will be conducted in the early spring (March, April, and May) for three years (2005-2007). These surveys will be conducted at five sites along the lower Colorado River. These sites will include:

Site 1 Boulder field – Bastrop #1

Site 2 Meander cobble - Smithville # 1

Site 3 Bedrock outcrop - Smithville # 2

Site 4 Bedrock outcrop - Columbus #1

Site 5 Bedrock outcrop - Altair #1

Specific locations of these sites are not presented in this Scope to avoid human disturbance at these sites during the spawning period. The survey will involve a pair of fisheries biologists traveling to the above sites and conducting visual observations each week during the aforementioned months (up to ten visits). During each site visit, measurements of potential triggering mechanisms (such as water temperature, flow, and available habitat [i.e. depth, velocity, substrate, and cover]) will be documented for each individual blue sucker that is observed spawning. The information gathered on individual spawning blue suckers over the study period will be compiled and analyzed to create specific habitat suitability criteria for this life stage. Digital photographs of the sites will also be taken during each site visit. In addition, thermistors will be placed at each of these sites to record continuous temperature data for each respective site. The thermistors will be installed in January 2005, take measurements every 15 minutes, and will be left in place for the duration of the study. It is anticipated that data will be downloaded every time a site is visited in the spring and every 1-2 months during the remainder of the year. When feasible, underwater video

equipment will be used to locate and survey specific spawning habitat. Additionally, the placement of a permanent underwater camera and video recorder may be used at the Smithville #1 site for continuous monitoring of spawning activity.

In conjunction with the migration study described in subtask 5.30, radio telemetry equipment will be used to locate individually tagged fish during these months. Upon observation/confirmation of spawning, specific information documenting the timing, location, specific habitat requirements, water quality, and spawning activities (i.e. behavior) will be collected. A GPS unit will be used to document the location each observed individual blue sucker. Standard water quality parameters (water temperature, conductivity, pH, and dissolved oxygen) will be measured along with a detailed habitat characterization including depth, velocity, substrate, and instream cover in the area of and adjacent to the observed spawning. The habitat characterization will be conducted in a manner amenable for use in habitat suitability criteria development. This will involve collecting the above mentioned parameters on individual spawning individuals over the course of the study (2005 and 2006). Each parameter will then be analyzed to identify preferences (suitability) of that parameter and curves generated based on that analysis. The individual suitability curves that demonstrate preferences will be used in the habitat model to evaluate available spawning habitat as per the developed criteria.

Key Assumptions:

- *The tagging of thirty individual blue suckers and subsequent survival will provide a representative sample of the blue sucker population in the lower Colorado River and will allow interpretation of spawning characteristics when coupled with the specific spawning survey data collection eff*ort. *In the event that survival rates indicate that additional tagging is necessary; the Project Team will notify the Technical Studies Coordinator.*

- *The biological data collected for the blue sucker over a 2 ½ year time period will be sufficient to describe the habitat suitability requirements of the species/lifestage for habitat modeling purposes.*

Internal Deliverable: Data inputs for blue sucker adult habitat and spawning habitat suitability criteria development.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Mike Robertson

Subtask 5.20 – Larval/Juvenile Sampling and Habitat Assessment

Description of Work: Larval and juvenile sampling will be conducted in areas downstream of the five likely spawning areas (noted above) as well as up to five additional sites that might be determined to be located below spawning areas during previous biological sampling efforts (subtasks 4.10 and 4.20). These sites will be sampled from April to June (one time per month) in both 2005 and 2006 and subsequently in August and November of each year to track year class development and recruitment success. The sample areas in August and November will include the same areas sampled in the spring but also include habitat amenable to blue sucker juveniles. It is anticipated that a combination of seining, light traps, and dip netting associated with lights will be used for larval sampling. Backpack electrofishing with block nets and hoop nets will likely be employed as an additional collection method for juveniles.

Once larval or juvenile blue suckers are collected, detailed habitat information including depth, velocity, substrate, and instream cover in the area of and adjacent to the observations will be performed. As described above, the habitat characterization will be conducted in a manner amenable for use in habitat suitability criteria development. A GPS unit will be used to document the location where the larval and/or juvenile blue suckers are collected. Additionally, standard water quality parameters (water temperature, conductivity, pH, and dissolved oxygen) will be measured. The primary focus of this evaluation is to document the existence of larval/juvenile blue suckers in the lower Colorado River and define the associated habitat requirements. Detailed sampling to establish population estimates is not proposed.

Key Assumptions:

- *The biological data collected for the blue sucker over a 2 ½ year time period will be sufficient to describe the habitat suitability requirements of the species/lifestage for habitat modeling purposes.*
- *The primary focus of this evaluation is to document the existence of larval/juvenile blue suckers in the lower Colorado River and define the associated habitat requirements. Detailed sampling to establish population estimates is not proposed for this Task Order.*

Internal Deliverable: Data inputs for larval/juvenile blue sucker habitat suitability criteria development (2005/2006) and for assessment of placement of potential intake structures (2006).
Task Leader: Mike Robertson
Quality Control/Quality Assurance Leader : Edmund Oborny

Subtask 5.30 – Migration Assessment

Description of Work: In 2005, the telemetry study will expand upon the effort initiated in Fall 2004. Thirty blue suckers of various sizes were collected and tagged in Fall 2004. Additionally, a fixed telemetry station was established at the LCRA Lakeside Irrigation District River Facility. In 2005, manual tracking of the blue sucker will be conducted via airplane followed by boat confirmation during March, April, and May (coordinated with spawning surveys), and August and November. Manual tracking will involve locating the individual and recording the coordinates using high precision GIS. During one of the spring tracking efforts and during both the August and November tracking efforts, specific habitat information will be collected for the individual fish being tracked. This information will include depth, velocity, substrate, and instream cover in the area of and adjacent to located fish as well as measurement of standard water quality parameters. This will allow for the collection of actual habitat use data for different age classes three different times per year over a two-year period. High precision GPS will be used to document the locations of each sampling station.

Key Assumptions:

- *The tagging of thirty individual blue suckers and subsequent survival will provide a representative sample of the blue sucker population in the lower Colorado River and will allow interpretation of spawning and migration characteristics. It is likely that some of the fish will die and others will shed their tags, but the majority of the fish should remain for subsequent tracking. If mortality or tag shedding of greater than 50% of the individuals occur, then this method will be*

deemed unsuitable for collection of this type of data. Therefore, re-tagging is not proposed under these circumstances. However, in the event that telemetry is deemed unsuitable, the contingency plan will be to document the situation and use the remaining funding associated with subsequent telemetry tasks for physical observations of fish movement and spawning via conventional sampling techniques.

- *The biological data collected for the blue sucker over a 2 ½ year time period will be sufficient to describe the habitat suitability requirements of the species for habitat modeling purposes.*

Internal Deliverable: Data inputs to define habitat suitability curves for life-stages of the blue sucker to be used in the habitat model.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Mike Robertson

Task 6 – Aquatic Resource Characterization

Subtask 6.10 – Species of Concern Evaluation

Description of Work: A second component of the aquatic resource evaluation will be to look at potential impacts to not only the state-listed blue sucker, but also those species of concern that may be listed before the permit process is complete. For the aquatic species, this evaluation will involve the use of a spatial niche approach in the evaluation of aquatic habitat. The product will be an evaluation of a wide group of species (guild) as opposed to individual species and/or life stages. For the terrestrial component, a cursory review of potentially affected species of concern using riparian habitat directly adjacent to the river channel will be conducted.

Key Assumptions:

- *The facility siting team will provide the potential location(s), configuration/size of potential instream structures and intake facilities prior to November 2005.*

Deliverable: Stand-alone section in the 2005 activities letter report that can be used for the Section 404 permit assessment.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Michael Robertson

Subtask 6.20 – Connectivity Assessment

Description of Work: A major issue to be addressed is the "connectivity" of riverine habitat and/or potential "fragmentation" of riparian habitat. The placement of instream structures has the potential to influence both the aquatic and terrestrial resources. A qualitative evaluation of benefits/impacts to the aquatic and riparian resources will be conducted using existing information. This will consist of an aquatic resource evaluation involving migration and habitat "connectivity" and a riparian resource evaluation involving the identification of habitat fragmentation via changing vegetative communities. Along with the assessment of connectivity for aquatic life, a recreational assessment concerning connectivity and safety of instream structures to recreation will be qualitatively addressed. Professional judgment of resource professionals from state agencies most familiar with the river will also be employed to assist in the qualitative assessment of connectivity and recreational safety.

- **Key Assumptions:** *Team will provide the potential location(s), configuration/size of potential instream structures and intake facilities prior to November 2005.*

Deliverable: Stand-alone section in the 2005 activities letter report that can be used for the Section 404 permit assessment.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Michael Robertson

Subtask 6.30 – Entrainment Assessment

Description of Work: An additional issue to be addressed is the potential for entrainment of larval/juvenile fish in the intake structures design to fill the off-channel reservoirs. Based on the biological sample collections throughout the entire main stem of the lower Colorado River for this project, an inventory of potential species present within these intake areas will be conducted from existing data. Additionally, the habitat present in these areas will be evaluated and an assessment of what species are using what habitat in relation to the intake structures will be conducted. There is an inherent feed-back loop here with the Facility Siting Team where if the intake site is found to be unacceptable by this analysis, a new site may need to be selected. Therefore, close coordination with the Facility Siting team will be maintained during this assessment.

Key Assumptions:

- *The Facility Siting Team will provide the potential location(s), configuration/size of potential instream structures and intake facilities prior to November 2005.*

Deliverable: Stand-alone section in the 2005 activities letter report that can be used for the Section 404 permit assessment.

Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Michael Robertson

Task 7 – Intensive Site – Model Development

Subtask 7.10 – Digital Terrain Model

Description of Work: The complete channel and floodplain DTM will be generated at each intensive site by combining the sonar, survey, and photogrammetry data (Task 2). The final DTM will be viewed and edited in the 3D photogrammetry software with contour lines to ensure that the DTM accurately follows the terrain.

Key Assumptions:

- *Weather conditions will permit, all topography data collection prior to scheduled irrigation releases in Spring 2005.*

Internal Deliverable: DTM for each intensive site to be used in the development on the hydrodynamic model and subsequent habitat model.
Task Leader: Joe Trungale
Quality Control/Quality Assurance Leader : David Harkins

Subtask 7.20 – Hydrodynamic Model

Description of Work: In conjunction with the National Academy of Science (NAS) review and Texas Instream Flow program, a two-dimensional hydrodynamic model will be developed for each intensive site. The two-dimensional model(s) will be calibrated to the three measured water surfaces (high, medium, and low flow) by adjusting substrate roughness. The substrate maps at each intensive site will include an estimated hydraulic roughness height based on the size of the largest particle sizes in each substrate category. During the calibration phase of the hydrodynamics modeling, the roughness heights across all substrate types will be increased or decreased by a constant percentage until the modeled water surface matches the measured water surface. This will first be done at the high calibration flow. A check that the calibrated roughness performs accurately at the medium and low calibration flows will be performed. If necessary an equivalent roughness height modifier regression will be used to scale roughness height over the range of modeled flows. When a roughness height adjustment is obtained throughout the intensive site that generates accurate modeled water surface elevations for all three measured water surface elevations the hydrodynamics model will be assumed to be calibrated. All subsequent hydrodynamics modeling of the various flows for habitat modeling will be done with the same calibrated channel roughness heights. Fifteen to 30 flows ranging from 10 to 3,000 cfs will likely be modeled at each intensive site. This flow range covers the majority of median monthly flows in the historical range excluding temporary high rainfall and runoff events. This range builds on the 50 – 2,000 cfs range modeled by Mosier and Ray (1992).

Perform Sensitivity Analysis

Uncertainty in environmental models lies within characterizing the system. A riverine model attempts to take all of the physical characteristics and form generalized parameters to accurately simulate the system. These generalized parameters have uncertainty bounds associated with them, which leads to model uncertainty. Proper calibration of a hydrodynamic model aids in reducing, but not totally eliminating, model uncertainty. Calibration of a model occurs when model parameters are adjusted within their uncertainty ranges to ensure that simulation results adequately match data records as discussed above. Once calibrated, the project team will investigate the sensitivity of the hydrodynamic model results to changes in parameters. If the model is found to be highly sensitive to a parameter, efforts can be made to reduce the parameter uncertainty through further data analysis and/or additional verification data acquisition.

Key Assumptions:

- *The National Academy of Science will complete their assessment of the Texas Instream Flow Draft Technical Overview and provide recommendations for the State of Texas by Summer 2005.*

Internal Deliverable: Hydrodynamic model development for each intensive site (initiated in 2005, completed in 2006).
Task Leader: Joe Trungale
Quality Control/Quality Assurance Leader : Edmund Oborny

Subtask 7.30 –Advisory Group (AG) / Science Review Panel (SRP) Meeting

Description of Work: Two meetings with the SRP and AG (or subset of the AG - instream group) will be conducted during the initial stages of Task 7. These meetings will include verbal presentations of the proposed hydrodynamic model and methodology rational. The AG and SRP will be asked to provide input so that the proposed modeling approach is appropriate for the specific questions on the lower Colorado River, while also being consistent with the NAS review and Texas Instream Flow Program directives.

Key Assumptions:

- *The National Academy of Science will complete their assessment of the Texas Instream Flow Draft Technical Overview and provide recommendations for the State of Texas by Summer 2005.*

Deliverable: Within one week of the meeting, the BIO-WEST project team will submit to LCRA/SAWS a letter report summarizing the AG/SRP conference call and comments provided.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Joe Trungale

Task 8 – Data Reduction and Analysis

Subtask 8.10 – Blue Sucker

Description of Work: The BIO-WEST project team will reduce and analyze blue sucker data collected and review activities conducted during the second task order.

Internal Deliverable: Analysis necessary to evaluate data inputs for habitat suitability criteria development/refinement and for preparation of the 2005 Activities Letter Report.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Chris Bunt

Subtask 8.20 – Instream Flow

Description of Work: The BIO-WEST project team will reduce and analyze instream flow data collected and review activities conducted during the second task order.

Internal Deliverable: Analysis necessary to evaluate data inputs for 1) habitat suitability criteria development/refinement, 2) hydrodynamic model development, and 3) preparation of the 2005 Activities Letter Report.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Joe Trungale

Subtask 8.30 – 2005 Activities Letter Report

Description of Work: The BIO-WEST project team will submit a final progress letter report in mid-December summarizing activities conducted during the Second Task Order and highlighting any potential fatal flaws identified during those activities.

Deliverable: Second Task Order Activities Letter Report

Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader : Dr. Paul Holden, Dr. William Espey